

# VOLUSON® 530D MT

## USER'S MANUAL



*ultrasound*





## KRETZTECHNIK AG

TIEFENBACH 15  
A-4871 ZIPF  
AUSTRIA

Telefon: +43 7682 / 3800 – 0  
Fax: +43 7682 / 3800 – 47  
E-Mail: [info@kretztechnik.com](mailto:info@kretztechnik.com)  
Internet: <http://www.kretztechnik.com>

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User's Manual

**VOLUSON® 530D MT**

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## 1 SAFETY

The VOLUSON® 530D/MT scanner system has been designed for utmost safety for patient and user. Read the following chapters thoroughly before you start working with the machine! The manufacturer guarantees safety and reliability of the system only when all the following cautions and warnings are observed.

**CAUTION:** **The manual refers to probes that can be connected to the device. It might be possible that some probes are NOT available in some countries!!**

### 1.1 IMPORTANT INSTRUCTIONS FOR SAFETY

**WARNING !** This equipment must not be used in the presence of inflammable gases => explosion hazard!

**WARNING !** The system must only be connected to a fully intact mains cable with a grounded guard wire via an appropriate mains cable. The ground wire must never be removed or disconnected.

**WARNING !** No covers or panels must be removed from the system (high-tension risk). Service and repairs must only be performed by Kretztechnik-authorized personal. Attempting do-it-yourself repairs invalidate warranty and are an infringement to regulations and are inadmissible acc. to IEC 601-1.

**WARNING !** Only accessories explicitly recommended by the system manufacturer may be used in connection with the system.

**WARNING !** Footswitch must not be used in operating rooms!

### 1.2 ELECTRIC INSTALLATION

The system must be exclusively installed in medically used rooms. The equipment conforms with regulations for electrical safety (EN60.601-1/1990 resp. ÖVE-MG/EN60.601-1/1991 and IEC 601) and safety class I, Type BF. Local safety regulations may require an additional connection between the potential equilibrium bolt and the building's grounding system.

**CAUTION !** Before first switch-on the local mains voltage and frequency are to be checked against the values indicated on the VOLUSON® 530D/MT nameplate on the rear panel. Any change to the system must only be performed by authorized personnel.

The minimum required house installation must have 16A.

### **1.3 SYMBOLS USED**

Some symbols used with electrical medical equipment have been accepted as standard by IEC. They serve for marking of connection, accessories, and as warnings.

**I**Mains switch ON

**0** Mains switch OFF



**CAUTION!** See user's manual for proper operation!  
(improper use may cause damage).

Insulated patient application part acc. to EN60.601-1(Type BF)

Insulated patient application part acc. to EN60.601-1 (Type CF)

**IPX7** Dripwater-tight part  
Safe with wet hands

Potential equilibrium connection (rear panel)



Dangerous electric tension  
Pull the mains plug before opening the unit!

### **1.4 REMARKS FOR SAFE USE**

- \* Get acquainted with the transducers and the ultrasound system: read the user's manuals thoroughly!
- \* Follow these safety instructions as well as the clinically adopted precautions and measures for hygiene!
- \* The manufacturer is not liable for damage caused by improper or inexpert use of the device!
- \* Any ultrasound transducers - irrespective of system and design - are sensitive to shock and shall be treated with care. Pay attention to cracks which may allow conductive fluids to leak in.
- \* Any type of repair shall only be performed by authorized personnel. Never attempt to open a transducer or transducer connector. This leads to a loss of guarantee!
- \* Avoid kinking, bending or twisting of probe cables and take care to guard them against mechanical stress (e.g. wheels or heels)!

- \* The probes must not be exposed to mechanical shock (e.g. by dropping). Any damage caused that way invalidates warranty.
- \* Have the scanner system and the transducers regularly checked (for faulty cables, housing, etc.) by authorized personnel!
- \* Injuries to transducer or cable may lead to a safety hazard, therefore have them repaired immediately!
- \* Before you plug in or unplug a transducer, activate the "FREEZE"-Mode!
- \* Installation and first switch-on and check-up of the system shall be performed by a specialist being acquainted with the handling and the use of the system.
- \* The user must have read and understood the user's manual. The system must only be operated by trained and qualified persons.
- \* For safety reasons, avoid handling fluids in the vicinity of the system. Fluids leaking into the floppy disk drive can damage the drive. Never remove the stowage tray above the probe connections, it helps to protect the unit from fluids.
- \* Do not grasp under the rear rim of the control console when moving it: Danger of injuries!
- \* Trolley: never move the unit with blocked wheels, but block the wheels in the proximity of stairs and ramps.
- \* The user's manual must always be with the scanner system. It is the user's duty to ensure this!
- \* Only probes conforming to type BF or CF requirements may be used with the VOLUSON 530D/MT. See the probe's label, in case of doubt, ask authorized service personnel.
- \* After activating scan mode a transducer should be brought in scanning contact within 2 minutes time in order to avoid unwanted energy and temperature emission.

## 1.5 ENVIRONMENTAL CONDITIONS FOR OPERATION

Temperature: 15°C to 30°C (59°F to 86°F)  
Humidity: 35% to 90%

**CAUTION !** Do not operate the system in the vicinity of a source of heat, of strong electric or magnetic fields (close to a transformer), or near instruments generating high-frequency signals. These can affect the ultrasound images adversely.

**CAUTION !** In case the equipment has been brought from cold environment (stock room, airfreight) into a warm room, first switch-on shall take place after some hours in order to allow for temperature balance and passing of condensation humidity.

## **1.6 BIOPSY LINES**

To achieve best possible accuracy of the display of the needle way, the biopsy lines have to be programmed for each transducer.

**WARNING !** Before starting a biopsy, make sure that the displayed biopsy line corresponds to the needle way (check in a vessel filled with warm water!). Repeat this test when changing transducers or biopsy needle guides!

**WARNING !** The biopsy line memory is also stored on the disk when a backup is made. When reprogramming biopsy lines erase old backup and make new backup.

## **1.7 CLEANING AND MAINTENANCE**

Daily cleaning of the scanner, the probes and the probe holders from coupling gel, mineral oil etc. is recommended, wet cloth and soap are allowed.

**CAUTION !** Before cleaning the scanner switch it off. Do not use disinfection spray nor gas disinfection. Electric parts must be protected from dripwater. Keep the touchpanel screen and especially the infra-red frame clean. Dust and parts on the frame can cause irregular function! Check mains cable, transducer cable, plugs and sockets regularly.

Have the system checked and serviced in regular intervals (once per year) by authorized service personnel.

In case of total failure first check if mains voltage is present. Mentioning any observations or failure symptoms to the service engineers is helpful.

## 1.8 TEMPERATURE SENSORS

In the VOLUSON<sup>R</sup> 530D/MT unit two temperature sensors are continuously sensing the internal temperature. In case the actual temperature exceeds the normal working temperature the display shows: "**WARNING: EXCESS TEMPERATURE**" and every 20 seconds a beeping sound is heard.

**CAUTION!** **Continuing to work despite temperature warning can lead to severe damages of the system. Call the service!**

## 1.9 SAFETY TESTS

Time limits: corresponding to the regulations for safety tests acc. to §11 Abs.1 MedGV in the certificate acc. to §§22 Abs.1, 22 Abs.2 or acc. to the model license acc. to §5 MedGV, or acc. to respective national regulations, acc. to the manufacturer recommendations for the medical-technical unit.

- Range:
- a) Visual inspection:  
Housing, connection, operating elements, display facilities, labels, accessories, user's manual.
  - b) Functional test:  
Checking of functions (acc. to user's manual), check also modular combinations and common operability of system and accessories.
  - c) Electric test:  
Checking of electric safety of system combinations acc. to VDE 0751 or respective national regulations.

Avoid handling fluids in the vicinity of the system for safety reasons.

## 1.10 MANUFACTURER RESPONSIBILITY

The manufacturer, assembler, importer or installer considers himself responsible regarding safety, reliability and performance of the instrument under the following conditions:

- when assembling, additions, new settings and modifications or repairs were performed by personnel authorized by him,
- when the electric installation on the location complies to the national regulations,
- when the equipment is only used according to the User's Manual.

## 1.11 SERVICE DOCUMENTS

If required, the supplier supplies block diagrams, lists of spare parts, descriptions, adjustment instructions or similar information which help adequately qualified technical personnel in repairing those parts of the instrument which have been defined repairable by the manufacturer.

## 1.12 ACOUSTIC OUTPUT: BIOPHYSICS, BIOEFFECTS

"Diagnostic ultrasound has been in use since the late 1950s. Given its known benefits and recognized efficacy for medical diagnosis, including use during human pregnancy, the American Institute of Ultrasound in Medicine herein addresses the clinical safety of such use: No confirmed biological effects on patients or instrument operators caused by exposure at intensities typical of present diagnostic ultrasound instruments have ever been reported. Although they indicate that the benefits to patients of the prudent use of diagnostic ultrasound outweigh the risks, if any, that may be present."

**Reference:** Bioeffects considerations for the safety of Diagnostic Ultrasound - Journal of Ultrasound in Medicine, Vol.7, Number 9 (supplement) - American Institute of Ultrasound in Medicine, Bioeffects Committee.

**Please note:** Prudent use means that the ultrasound machine is to be used by the operator in accordance with the ALARA principle, i.e. keep the power levels and the exposure time **AS LOW AS REASONABLY ACHIEVABLE**.

## 1.13 DISPOSAL

When disposing of the instrument national regulations must be observed!  
The instrument does not pose any unusual threat when disposing of it.



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## 2 Description of the System

### 2.1 SYSTEM SURVEY

#### 2.1.1 Product description

The VOLUSON® 530D/MT is a professional, innovative, most versatile real-time scanning system. It opens new sonographic possibilities with 3D-VOLUME scanning technique. The vast program of probes makes it suitable for many applications. The modular concept of the system enables customer-specific equipment.

#### **The system offers the following diagnostic possibilities:**

- \* B-Mode
- \* M-Mode
- \* Spectral Doppler (pulsed and continuous wave)
- \* CFM-Mode (Velocity, power, tissue imaging, angio mode)
- \* Volume-Mode (3d-sectional image analysis and interactive 3D rendering)

#### **Medical application fields:**

- \* Examination of abdominal organs
- \* Examination of thyroid and lymphatic nodes
- \* Transvaginal examination
- \* Transrectal examination
- \* Examination of breast, scrotum
- \* Fetal examinations
- \* Examination of peripheral vessels
- \* Examination of neonates

#### **Operable probes:**

- \* Mechanical probes (single element and annular arrays)
- \* Multi-element probes (linear and curved and phased arrays)
- \* Volume probes

The operation is designed for the specific clinical requirements and ensures simple and efficient handling. A vast range of measuring and evaluation programs, as well as many special functions enable comfortable working. An SCSI-interface with interface software provides quick digital archiving of image and/or volume data sets on mass storage medium. An network interface (ethernet) provides documentation in DICOM-norm.

In case of regular maintenance by authorized service staff the life expectancy is about 10 years from the manufacturing date.

### **2.1.2 Biological safety**

The biological effects of diagnostic ultrasound on humans have not been entirely investigated yet. So far no damages by ultrasound diagnosis are known, still the instrument should only be used by a medical doctor or under his supervision.

The ultrasound examination should last as shortly as possible and with the lowest transmit power enabling diagnostically available results (ALARA-principle, As Low As Reasonably Achievable).

The VOLUSON 530D/MT permanently controls the emitted power and limits it acc. to the maximum values set by the manufacturer (sound field limiting vector). The occurring sound intensities are depending on the respective probes. The declaration of sound field parameters acc. to IEC 1157 can be obtained from the manufacturer on request.

### **2.1.3 Bioeffects, possible hazards**

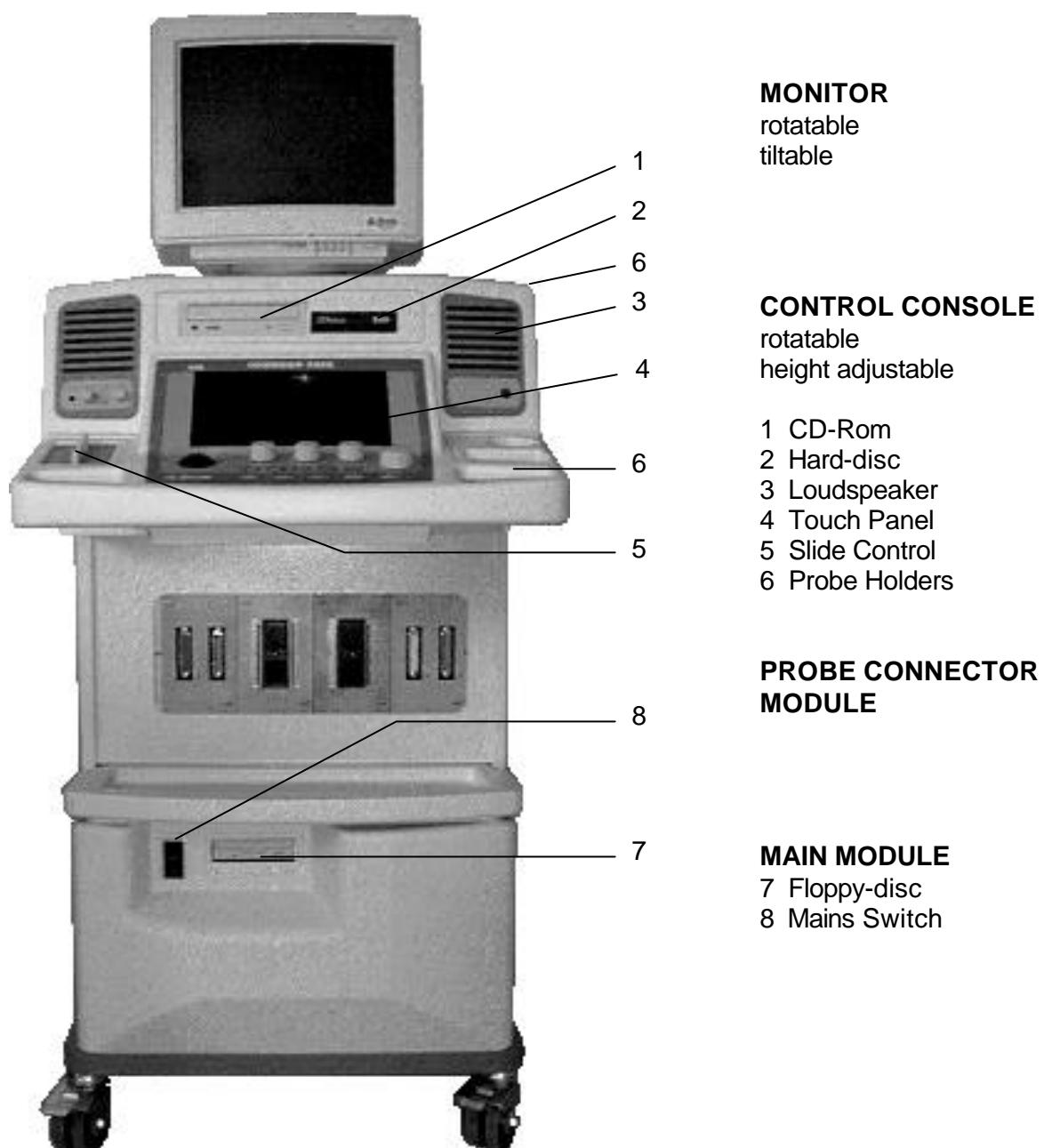
One distinguishes between two acting mechanisms for the development of Bioeffects when exposing humans to ultrasound waves: heat generation and cavitation.

Heat generation: the ultrasound energy is absorbed and warms the tissue. The heat generation depends on the absorbed power and duration of exposure. A part of the heat is dissipated into the blood stream.

Cavitation: due to a strong negative pressure gas bubbles appear. The permanent change between gas and liquid phase constitute strong mechanical stress locally in the tissue. For the cavitation the gas content and the superficial tension of the tissue resp. of body fluid is essential.

## 2.2 MECHANICAL DESIGN

### 2.2.1 Schematic illustration of the system



## 2.2.2 Mechanical adjustment of the control console

The control console can be rotated 90° to the right.

### TRANSPORT LOCK

There is a locking knob for locking and unlocking the control console, mounted at the rear of the control console. In case of a transport, even from ward to ward the lock shall be engaged in order to secure the console from uncontrolled rotation. The knob set to the locking position, the lock catches in when the console is rotated to its center 0° position.

Grafikname:  
Erstellt in:  
Erstellt am:

### ROTATION OF THE CONTROL CONSOLE

When rotating the control console grasp it only at the front grips. The built-in brake provides setting between light and heavy force. Setting the braking force:

1. Pull out the brake spindle knob
2. Rotate the console to wanted position
3. Push in the brake spindle knob.

**WARNING:** Do not grasp under the rear rim of the control console when moving it:  
danger of injuries!

### 2.2.3 Height adjustment of the control console

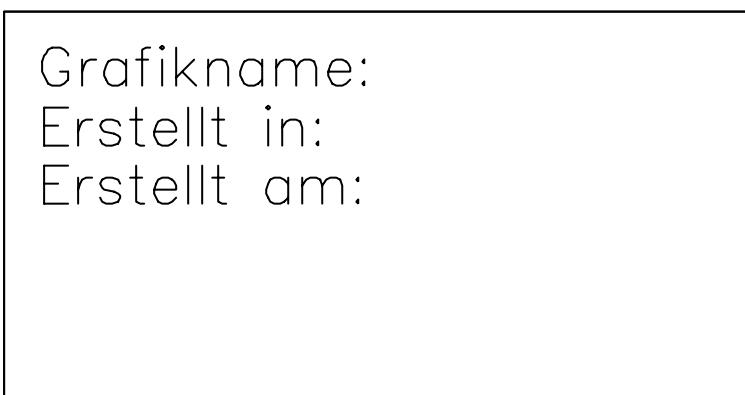
The control console height can be adjusted in 3 positions spaced 3 cm each. The changing of the height is to be done by 2 persons!

How to adjust the console:

- a) remove the cover (fig.1)
- b) remove the 4 fastening screws (hex key 6 mm) (fig.2)
- c) hold the console firm at the grips at the front
- d) loosen the securing screw (fig.2)
- e) lift (or lower, resp.) the console to the intended height
- f) fix the securing screw again, observe the correct screw position
- g) fit and fasten the 4 fastening screws again
- h) mount the cover in place again

Fig. 1

Fig. 2



Grafikname:

Erstellt in:

Erstellt am:

securing screw

fastening screws

Remove cover: loosen the screws and push to the middle

## 2.3 SYSTEM - ASSEMBLY

### 2.3.1 Basic system: contains the following modules:

*Main electronic module:*

This module houses the entire electronics with all connections except the probe connectors. Position of the module, see figure of the system, page 2-4.

*Probe connector module:*

This module houses up to 4 probe connectors and the beamformer module (Transmit and receive electronics).

*Control console:*

The control console contains the touchpanel, hard keys, digipots and trackball, loudspeakers, SCSI-drives, modular probe holders.

*Color monitor*

*Trolley:*

All modules mentioned above are arranged within the trolley. There are 4 wheels, the front wheels being equipped with blocking brakes. Underneath the control console there is space for auxiliary equipment.

### 2.3.2 Optional modules

*Doppler module contains:*

Spectral Doppler module:

This module enables the evaluation of blood flow ratios with pulsed and continuous wave and is built into the main electronic module.

Color Doppler module

This module enables color-coded evaluation of blood flow conditions and is built into the main electronic module.

### 2.3.3 Optional peripheral equipment

Video - printer (black/white)

RGB - printer (color)

Video tape recorder(S-VHS)

ECG - Module

Footswitch

Actual type see pricelist of VOLUSON 530D/MT unit

**WARNING !** The leakage current of the entire system including any/all auxiliary equipment must not exceed the limit values as per EN60.601-1:1990 (IEC 601-1) resp. other valid national or international standards.

**Remark:** Optional devices (Printer, VTR, etc.) according to the pricelist of the VOLUSON 530D/MT unit fulfill the electrical safety requirements.

Connection of optional auxiliary equipment, see chapter13.

### 2.3.4 Optional software functions

Interactive volume rendering	(PSX 2)
VOCAL	(PSX 3)
DICOM	(PSX 4)
Tissue Doppler	(PSX 5)
Volume acquisition	(PSX 6)
Live3D	(PSX 7)
Magic Cut	(PSX 8)
Sonoview	(PSX 9)
Harmonic Imaging	(PSX 10)

### 2.3.5 Transducers

For all available probes with operation modes and applications see chapter 16.

Remark: The detailed description, technical data and accessories of each transducer can be found in the respective user's manual of the transducer.

#### **CAUTION:**

**The manual refers to probes that can be connected to the device. It might be possible that some probes are NOT available in some countries!!**

## 2.4 CONCEPT OF OPERATION

The outstanding control center is the touchpanel (with control monitor) with the digipot controls and the trackball arranged below it. An additional 10 hardkeys are provided. They are controlling frequently used functions, e.g. Freeze/Run.

### TOUCHPANEL

The touchpanel consists of the flat control monitor and the infrared frame. When touching a key on the control monitor the x, y coordinates of that key are determined by interruption of an IR beam.

**CAUTION:** The touchpanel could be blocked by direct sunlight - avoid full sunlight.  
The touchpanel will be blocked by any foreign body lying on it, or e.g. by remainder of coupling gel - clean the touchpanel regularly (with a wetted soft cloth).

The touchpanel enables a comfortable control of menus.

Only those touch keys are provided which are necessary for the activated menu. The touchpanel eases working in dark rooms.

### DIGIPOT CONTROLS, TRACKBALL

More/less functions are comfortably controlled by these controls. They deliver digital pulses when rotated and hence can be selected by program call-up. They are displayed on the touchpanel screen by their location, their function, and their actual value of setting. A dual function is marked by a brighter bar within their half-circle symbol, touching the symbol causes switching to the second function.

## 2.5 LAYOUT OF MENUS

### 2.5.1 Survey

Grafikname:  
Erstellt in:  
Erstellt am:

Mainly two menu levels are used for operating the system, they are the main-menu level and sub-menu level. From the main menu the most important sub-menus, e.g. measurement menu, P.ID. menu are directly accessible. Via the function menu the other sub-menus can be activated. Some hard keys activate a specific sub-menu on the touchpanel, e.g. the disk key. Normally changing from one sub-menu to another is made via the main menu, direct call-up from one to another sub-menu is possible in some rare cases.

## 2.5.2 Layout of B-Mode main menu

All system operations are started from this menu. It contains 4 main groups of operating functions:

Main group 1: Sub-menu keys for: Probe/Program menu  
NEW PAT. Menu  
CAL/TAB (Measuring) menu  
Function menu

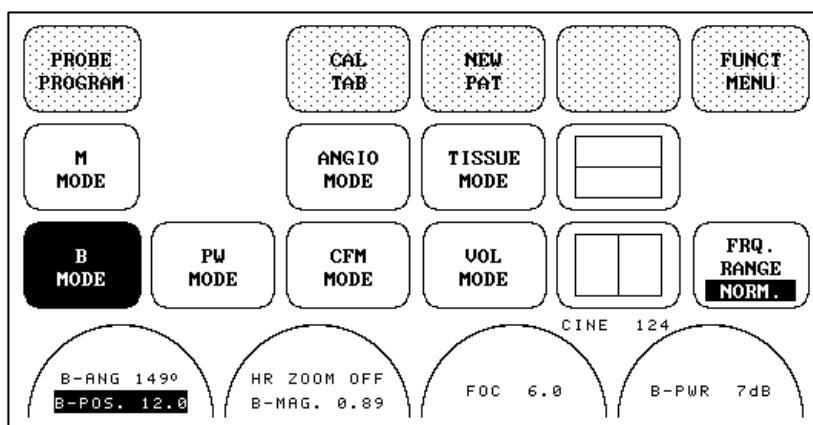
Main group 2: Mode keys for: B-Mode  
M-Mode  
PW-Mode  
CW-Mode  
CFM-Mode  
ANGIO-Mode  
TISSUE-Mode  
Vol-Mode  
depth and magnifying  
Selection of focus  
Selection of element (probes with several crystals)  
B-angle, B-Gain, B-output, HR-Zoom

Main group 3: Exchange of Write-only functions with Read-only functions when changing Read/Write (Freeze/Run):

### Remarks:

The different mode-keys only appear on the touchpanel, if the selected probe is able to work in this mode. After selecting a new mode a new main menu with the essential operating functions of this mode is built-up. The keys for the functions Focus, Element, B-angle only appear on the touchpanel if the selected probe is able to work in this function.

Example: Transducer S-VDW5-8 ( Write-Mode)



Remark: \* The half-circles indicate the functions of the trackball and the digipots. The large digipot (transmit power) is not displayed on the touchpanel.

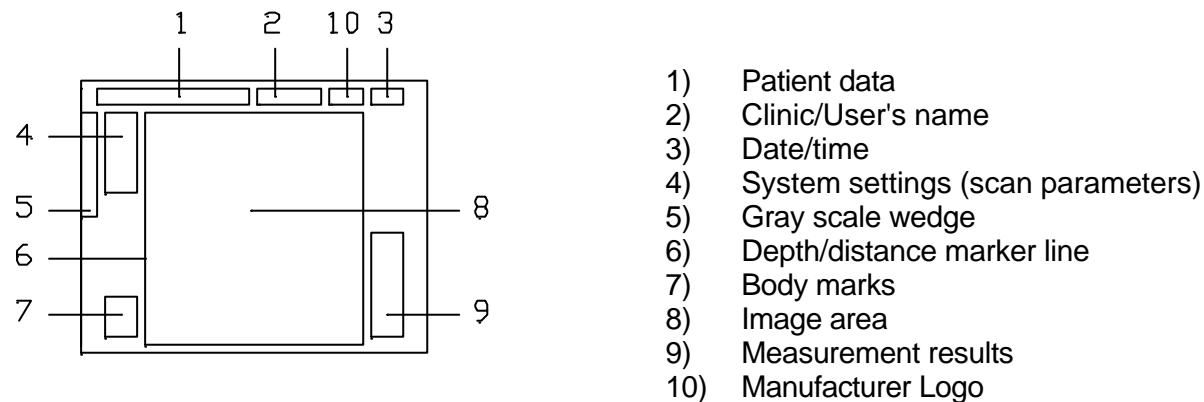
### 2.5.3 Change of menu

Each menu has an own menu key with a "typical" name. By touching the menu key the menu is changed and built up at once. The key "MAIN MENU" is available in all sub-menus in the top right corner of the touchpanel. The keys for the different sub-menus can be found in different positions on the touchpanel. The function menu key is available in all main menus in the top right corner of the touchpanel.

Remark:

If no probe is selected, no main menu can be built up. In this case the „PROBE/PROGRAM“ menu or the FUNCTION menu is displayed. In the FUNCTION menu the "PROBE/PROGRAM" key also is available to enable selecting a probe.

## 2.6 POSITION OF DISPLAY ANNOTATIONS



### SCAN PARAMETERS: B-Mode, M-Mode

7.0-5.0 receiver frequency range (B-image)

01	3.5	probe code, probe nom. frequency
BG	58	B-gain
FR	26	frame rate
PWR	18	B-power(output)
RJ	16	reject
GM	A-2	gray map
ENH	L	enhance
F/L	M/L	frame filter/line filter
DR	70	dynamic range

**SCAN PARAMETERS: D-Mode**

7.0-5.0 receiver frequency range (B-image)

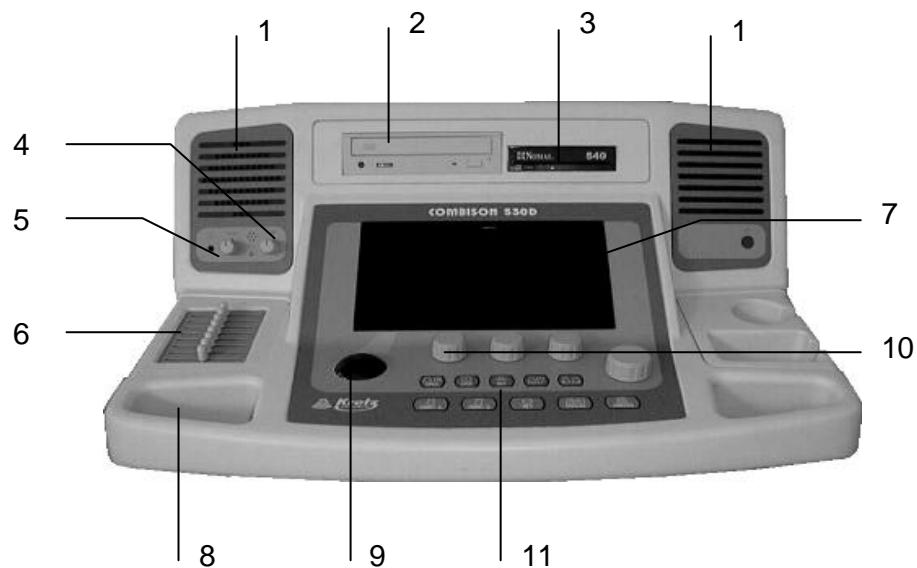
P	6.9MHz	Doppler nominal frequency
ANG	0°	D-angle (degrees)
WMF	30	wall motion filter
D-PWR	-3	power (transmit power)
LG	-14	D-Gain
HFG	45	HF-Gain
RJ	0	reject (threshold)
PRF	6.2K	pulse repetition frequency
SV	1.0	sample volume (mm)

**SCAN PARAMETERS: CFM-Mode**

7.0-5.0 receiver frequency range (B-image)

8C	6.5	probe code/probe nominal frequency
C-PWR	18	color output power
DISP	V	display mode
FR	11.3	frame rate
PRF	3.5	pulse repetition frequency
WMF	211	wall motion filter
CG	40	color gain

## 2.7 CONTROL PANEL



- 1 Loudspeaker positions
- 2 CD-Rom
- 3 Hard-disc
- 4 loudness
- 5 balance
- 6 TGC Slide control
- 7 Touchpanel screen (infrared soft-key control)
- 8 Grips for moving the unit and rotating the control console
- 9 Trackball
- 10 Digipot controls

## 2.8 HARDKEYS

### READ/WRITE KEY (FREEZE/RUN KEY)

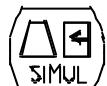


when dark: image is frozen (Read-Mode)  
when bright: real-time scan (Write-Mode)

- B-Mode: B-scan start/stop  
M-Mode: M-Mode scroll/stop  
D-Mode: Doppler scroll/stop  
VOLUME: one volume scan with VOLUSON probes



- B/B-Mode: freezing of the real-time image and switching to the other position in dual mode.
- B/M-Mode: Quick change between 2D and M-Mode image in non simultaneous display mode
- B/D-Mode: Quick change between B and Doppler image with the non-simultaneous display mode.



- SIMULTANEOUS ON/OFF**  
function possible in display format: B/D-Mode  
B/CFM/D-Mode (triplex)  
with linear, curved and phased array probes only.



- Printer trigger key A  
Remote key for B/W-Printer, Dicom Printer, Dicom server  
Key setup see chapter 12  
operation see chapter 11



- Printer trigger key B  
Remote key for Color-Printer, Dicom Printer, Dicom server  
Key setup see chapter 12  
operation see chapter 11



### DISK ACTIVE KEY

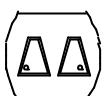
- Call-up of the disk menu for controlling the Floppy ,SCSI-, and CDROM drive functions.  
operation see chapter 11



**VCR REMOTE CONTROL MENU**  
operation see chapter 11



**NET ACTIVE KEY**  
Call-up of the net menu to send data via net (DICOM)  
operation see supplement to user's manual



**IMAGE ORIENTATION LEFT/RIGHT**  
operation see chapter 5



**IMAGE ORIENTATION UP/DOWN**  
operation see chapter 5

## 2.9 SOFTKEYS

All the menus and keys on the touchpanel see chapters 5 to 12

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Entering of date, clock, clinics name, operators name see chapter 12

## 3 STARTING THE SYSTEM

### 3.1 GENERAL REMARKS

Installation and first switch-on and check-up of the system must only be performed by authorized service staff.

The system VOLUSON<sup>R</sup> 530D/MT is delivered with recommended basic settings. These offer suitable conditions for a large number of applications. Depending on the user's experience these factory-set settings can be changed and stored as new User Programs. Storing these programs or quick loading of new programs of a second user is done with the help of back-ups from floppy disks.

### 3.2 SAFETY WARNINGS

**CAUTION!** In case the equipment has been brought from cold environment (stock room, airfreight) into a warm room, first switch-on should take place after some hours in order to allow for temperature balance and passing of condensation humidity (risk of leakage current).

**CAUTION!** The system is equipped with mains outlets separated by an isolation transformer for peripheral equipment (printer, VCR). To ensure electrical safety, these instruments must never be connected to a wall socket.

### 3.3 TO TURN ON POWER TO THE SYSTEM

Switch the mains switch on (for position, see page 3).

When switching on the system it is completely reset. The unit-Logo will appear on the touchpanel for approx. 4 seconds, then the B-Mode main menu of last selected transducer is displayed. If the earlier selected probe has been disconnected the menu "PROBE/PROGRAM" appears for the selection of a new probe.

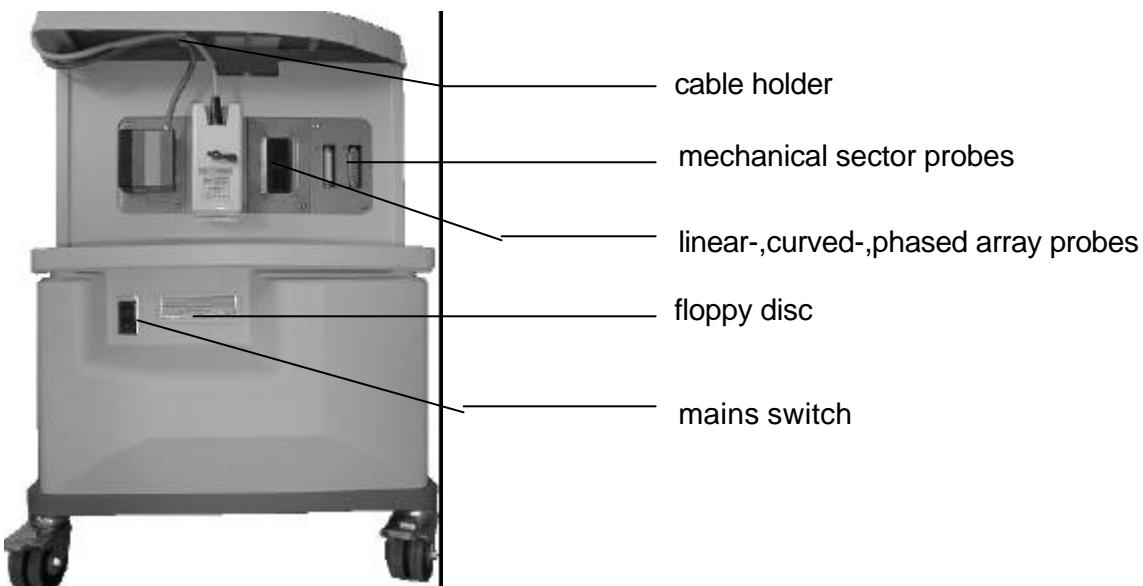
#### Remarks:

- \* The mains outlets of the system for peripheral auxiliary equipment are co-switched with the mains switch, so the auxiliary equipment need not be switched on/off separately. But some auxiliary equipment can switch to stand-by mode when mains power is on (e.g. Color video printer Mitsubishi CP 50) and must therefore be switched on separately.
- \* The color monitor of the system has own mains switch, which is normally always switched on. If necessary, switch on monitor.

### 3.4 TRANSDUCER CONNECTION

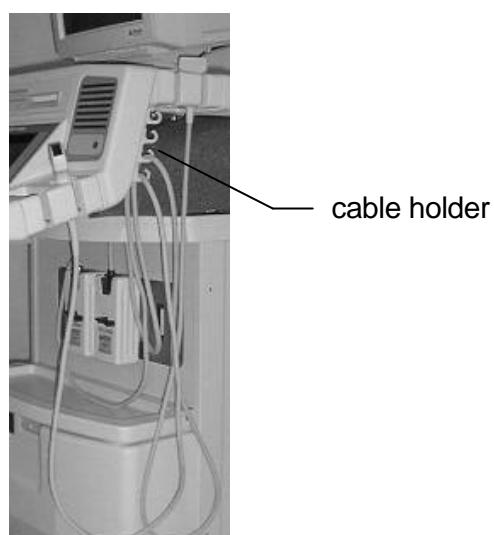
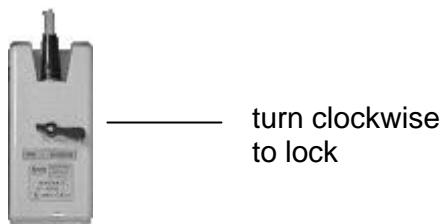
**CAUTION!** Prior to connecting or disconnecting a probe freeze the image (activate Read-Mode - transducer stops).  
It is not necessary to switch off the unit.  
If a probe is disconnected while running (Write-Mode) a software error can occur. In this case switch the unit OFF/ON (perform a reset).

A Maximum of 4 different probes can be stay connected.



Plug the probe connector into a free socket. Do not apply much force. Lay the cable in the intended cable holders. A wrong plugging in of connectors is excluded by their design. The connectors of the electronic probes have a mechanical lock which has to be locked. The electronic probes will not work with unlocked connector.

Connector of an electronic probe:



## Transducer holders:

Always store the probes in the intended probe holders. The probe holders are of modular design and can be exchanged according to personal requirements.

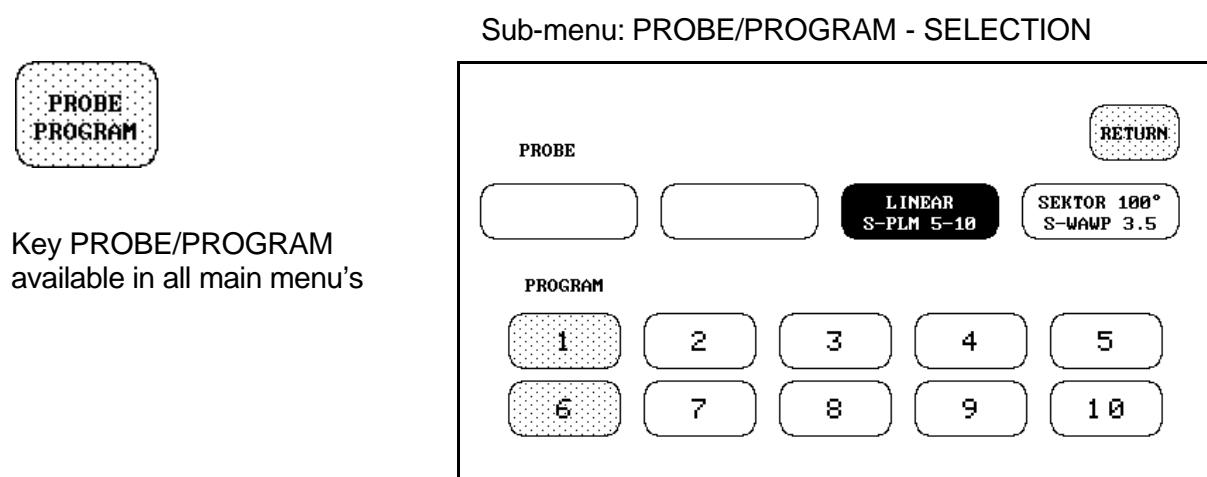
## 3.5 PROBE/PROGRAM - SELECTION

This menu informs about the connected probes. The name of every connected transducer appears in the corresponding key. Probe selection is done by touching the corresponding key. The key with the selected probe is illuminated. At the same time available programs of the selected probe are displayed in the program field (keys 1 to 10) with a raster in the keys. The survey of stored programs also appears on the screen. Program selection is done by touching the corresponding key.

For each probe 10 programs can be stored (max. 40 for all probes).

The program selection function enables the quick adjustment of the instrument for different fields of application.

To store a user preset under a program key see chapter 12.



### Remark:

- \* If the B-Mode main menu is active on the touchpanel, the menu "PROBE/PROGRAM" automatically appears if a probe is connected and selected.  
If no probe is connected or selected, the "PROBE/PROGRAM" menu appears after touching the "FREEZE/RUN"-key.

### 3.5.1. Selection of a probe

Touch the corresponding key of the probe.

Each connected probe is shown with its name inside a touch key. The selected probe is indicated by its lit key. At the same time programmed User presets for the selected probe are marked on the 10 program keys by a raster and the menu of the program names is displayed on the monitor.

### 3.5.2 Starting the system



touch a program key

By touching a program key the program preset is loaded and the touch screen displays the message: Please wait a moment loading program parameters.

The probe is started, the main menu (B-Mode) appears on the touchpanel and the ultrasound image appears on the monitor in Write-Mode (real-time display).



By touching the "FREEZE" key after a probe select the initial preset of the probe is loaded and the touch screen displays the message: Please wait a moment loading scanhead parameters.

If no User Program is programmed, the system is started with the initial settings.



Return to B-mode menu

When starting the probe with FREEZE or program key the B-mode menu appears automatically.

### 3.5.3 To freeze a image



Freeze/Run-key (hardkey)

Storing of the image by touching the Read/Write-key:

Dark key: Read-Mode (image is stored, probe stops)

Bright key: Write-Mode (real-time is on, probe running)

#### Remark:

- For detailed operation of the different system function (e.g. image size, Mode selection, TGC, measurements, etc.) and procedures see chapters 5 to 12.

## 3.6 PATIENT DATA ENTRY

### 3.6.1 Standard entries

Patient Data can be entered by using a Patient data form. These information will be used in calculations, patient reports, DICOM settings and are displayed on the screen to identify images. All entries into the data fields are stored to the internal data base.



Touch this key for patient data entry. On the touch screen the message NEW PATIENT ? appears . Press the keys YES or NO.

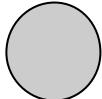
**YES:** Enter new patient data

Current patient data, measurements and the reports will be cleared.

**NO:** Actual patient data can be modified without erasing measurements and reports.

The following window appears on the monitor:

Patient Data		Patient List
Patient ID: 1998-10-14-0001		
Patient name: Patient name		
Date of Birth: 10.02.1960	Age: 38	Sex: <input type="radio"/> male <input checked="" type="radio"/> female <input type="radio"/> others
Height: 180 cm	Weight: 65 kg	BSA: 1.830 m <sup>2</sup> Units
Sonographer: Dr. Sono      Referring MD: Dr. Medicus		
Application: <input checked="" type="radio"/> General <input type="radio"/> Obstetrics <input type="radio"/> Gynecology		<input type="button" value="Cancel"/> <input type="button" value="OK"/>



Use the trackball to move the Cursor to any field on the form, select the field by pressing the SIMUL-key (write cursor appears) and then use the keyboard on the touch screen for entering the patient data.



Touch the ENTER-key (touch screen) to store the entered text and/or move the cursor from one data entry field to the next.

**Entering of Patient Data**

Data Field	Input									
• Patient ID:	Enter digits or letters for the patient ID (max. 16 characters), Monitor display: at the beginning of second P.ID line. ID:123456..... If no Patient ID is entered the system automatically assigns a patient ID based on the date of entry after touching the ENTER-key.									
• Patient name:	Enter patient name (max. 51 characters) Monitor display: first P.ID line									
• Date of birth:	Enter the date of birth using the selected format:: (see chapter 12.1) dd.mm.yy or mm/dd/yy. If two digits are entered the separate character (point or slash) is automatically inserted. Monitor display: in the middle of the second P.ID. line									
• Age: entering	no entries are possible, the age is calculated automatically after the date of birth.									
• Sex:	Click on the corresponding circle icon. Monitor display: at the end of second P.ID line: SEX: male, female or others									
• Height:	Enter the height of the patient using the selected unit (cm or inch)									
• Weight:	Enter the weight of the patient using the selected unit (kg, pounds or ounces)									
• BSA	no entries are possible, the 'Body Surface Area' is calculated automatically after entering the patient's height and weight according to the following equation:									
	$\text{BSA} = \text{WT}^{0,425} \times \text{HT}^{0,725} \times 10^{-4}$ <table style="margin-left: auto; margin-right: 0;"> <tr> <td>WT</td> <td>Weight</td> <td>[kg]</td> </tr> <tr> <td>HT</td> <td>Height</td> <td>[cm]</td> </tr> <tr> <td>BSA</td> <td colspan="2">Body surface area [m<sup>2</sup>]</td> </tr> </table>	WT	Weight	[kg]	HT	Height	[cm]	BSA	Body surface area [m <sup>2</sup> ]	
WT	Weight	[kg]								
HT	Height	[cm]								
BSA	Body surface area [m <sup>2</sup> ]									
• Sonographer:	Enter the name of the Sonographer (max. 32 characters)									
• Referring MD:	Enter the name of the Referring Doctor (max. 32 characters)									

**OK**

With this button the entered patient data are saved and the patient data window is closed. The key MAIN MENU has the same function.

**Cancel**

With this button the entered patient data are **not saved** and the patient data window is closed.

**Units**

With this button the units for the weight and the height can be selected. A small window is opened. Select the units by clicking on the corresponding circle icon.

**Patient list**

With this button the patient can be selected from the internal data base. A small window with a patient list is opened. Select the patient by

clicking

on the corresponding patient's ID (direct selection with double click).

### Patient List, Internal Data Base

All entries into the data fields are stored to the internal data base after closing the patient data form with the OK-button or by touching the key MAIN MENU on the touch screen.  
Searching for patient data can be done by using the patient list window.

Patient list

Click on this button by using the trackball and the SIMUL-key.  
This is only possible if 'new patient data entry' has been selected:  
**NEW PATIENT ? --> YES**

The following window appears on the monitor additionally

Patient List		
		X
<input type="text"/>		Search ID
<input type="text"/>		Search Name
Patient ID	Patient Name	Date
1998-10-14-0003	Mayer	14.10.1998
1998-10-14-0004	aigner	14.10.1998
1998-10-14-0005	Wiku	14.10.1998
1998-10-14-0006	meir	14.10.1998
1998-10-14-0007	heiter	14.10.1998
1998-10-14-0008	krankl	14.10.1998
1998-10-14-0009	unwohl	14.10.1998
1998-10-14-0010	schwanger	14.10.1998
1998-10-14-0011	hoch	14.10.1998
1998-10-14-0012	burger	14.10.1998
1998-10-14-0013	kuech	14.10.1998
1998-10-14-0014	schoen	14.10.1998
1998-10-14-0015	koester	14.10.1998
1998-10-14-0016	wiesau	14.10.1998
1998-10-14-0017	krebs	14.10.1998
1998-10-14-0018	hypochondrer	14.10.1998
1998-10-14-0019	hustl	14.10.1998

Select     Delete    Disk Free Space: 636.781 MB     Close

Search Name

Enter patient's name (or a part of the beginning) by using the keyboard,  
click on this button for searching the patient's ID.

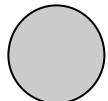
Matching patient name(s) are listed.

or

Search ID

Enter patient's ID (or a part of the beginning) by using the keyboard and  
click on this button for searching the patient's ID.

Matching patient ID's are listed.



Use the trackball and the SIMUL-key to preselect the patient ID  
Click on the patient ID: -> a bar indicates the preselection

Note: a double click directly selects the patient ID and  
the Patient List window is closed.

Select

Click on this button to select the patient's ID.  
the patient list window is closed.

Delete

Click on this button to delete all data of the preselected patient's ID  
from the internal data base, the patient list window is closed.

Close

Click on this button to close the patient list window  
without selection.

Patient ID

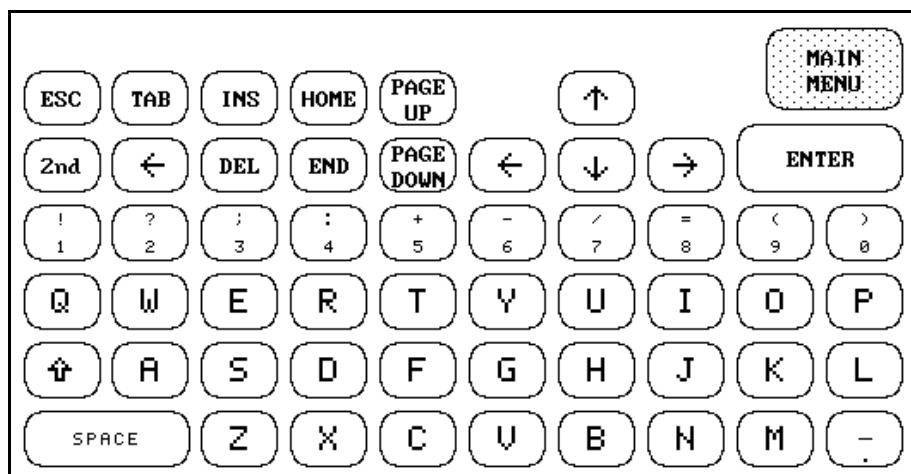
Click on this button to sort the patient IDs ascending.  
A second click sorts the list descending (toggle).

Patient Name

Click on this button to sort the patient names ascending.  
A second click sorts the list descending (toggle).

Date

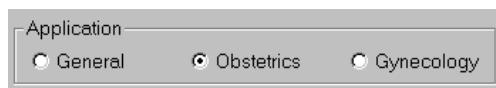
Click on this button to sort the date ascending.  
A second click sorts the list descending (toggle).

**Keyboard functions:**

- Arrow keys:** the write cursor ‘|’ is moved within the data entry field to the left, right, up or down. Moving up and down is only possible if the data field has more than one line
- SPACE** Space: a blank is written
- DEL** of Delete: the character right from the write cursor resp. the marked text a data field (performed with double click) is deleted
- ←** Backspace: the character left from the write cursor is deleted
- TAB** Tabulator: the write cursor is moved to the next data entry field.
- HOME** Home: the write cursor is moved to the beginning of the text within the data field.
- END** field. End: the write cursor is moved to the end of the text within the data field.
- ↑** Shift lock: if active (key bright lit) capital letters are written.
- 2nd** 2nd Function: if active (key bright lit) additional characters are available.
- ENTER** The entered text within a data field is stored and the write cursor is moved to the next data entry field.
- MAIN MENU** The entered patient data are saved and the patient data entry window is closed.

### 3.6.2 Entries for Obstetrics

For Obstetrics additional data fields are available in the patient data form.



Call up the patient data and select the obstetrics application by using the trackball and the SIMULT-key. Click on the circle icon for obstetrics

Additional data fields appear in the patient data form.

#### Entering of additional Patient Data

Data Field	Input
• LMP	Enter the date of the last menstrual period using the selected format. DD.MM.YY or MM/DD/YY. (see chapter 12.1) <b>Note:</b> the <u>first day</u> of the <u>last period</u> must be entered. If two digits are entered the separate character (point or slash) is automatically inserted.
• GA(LMP)	Enter the gestational age (weeks and days), LMP and EDC is calculated automatically after entering the gestational age.
• EDC (LMP)	Enter the estimated date of confinement, LMP and GA is calculated automatically after entering the date of confinement.
• Display LMP	Click on this icon, if LMP, GA and EDC should only be displayed in the report (no monitor display at standard format).
• Gravida:	Enter patient's history of pregnancies by using the number keys
• Para:	Enter patient's history of pregnancies by using the number keys
• AB:	Enter patient's history of pregnancies by using the number keys
• Indication:	Enter text of indication (max. 80 characters)

All these information above appear in the Obstetrics Report.

### 3.6.3. Entries for Gynecology

For Gynecology additional data fields are available in the patient data form.



Call up the patient data form (see chapter 3.6.1 Standard entries) and select the gynecology application by using the trackball and the SIMULT-key. Click on the circle icon for gynecology

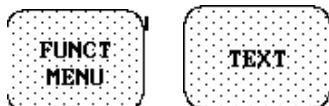
Additional data fields appear in the patient data form.

#### Entering of additional Patient Data

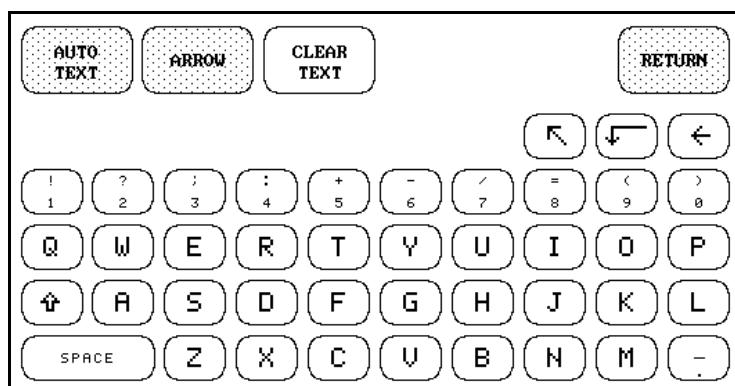
Data Field	Input
• LMP	Enter the date of the last menstrual period using the selected format. DD.MM.YY or MM/DD/YY. <b>Note:</b> the <u>first day</u> of the <u>last period</u> must be entered. If two digits are entered the separate character (point or slash) is automatically inserted.
• Display LMP	Click on this icon, if LMP, GA and EDC should only be displayed in the report (no monitor display at standard format).
• Gravida:	Enter patient's history of pregnancies by using the number keys
• Para:	Enter patient's history of pregnancies by using the number keys
• AB:	Enter patient's history of pregnancies by using the number keys
• Day of cycle:	Enter the number of days of the menstrual period by using the number keys.
• Expect. ovulation:	Enter the number of days when the ovulation is expected.
• Exam:	Enter the number of the examination.
• Indication:	Enter text of indication (max. 160 characters)
• Medication:	Enter text of medication (max. 80 characters)

All these information above appear in the gynecology report.

### 3.7. IMAGE INSCRIPTION



Sub-menu: ENTER TEXT

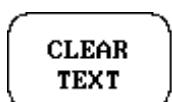


#### 3.7.1 Enter text

- By this function text can be written onto the ultrasound image, in Read-Mode or in Write-Mode (automatic FREEZE).
- The inscription will be erased with selection of a probe or a program.
- Inscription is not possible outside the measuring marker lines.

Operation:

1. Activate the text mode (touch key "TEXT")
2. Position the write cursor with the trackball.
3. Enter the text.



Erasure of the entire text



Write cursor returns to start



Write cursor set to start of next line



Write cursor goes back to previous line



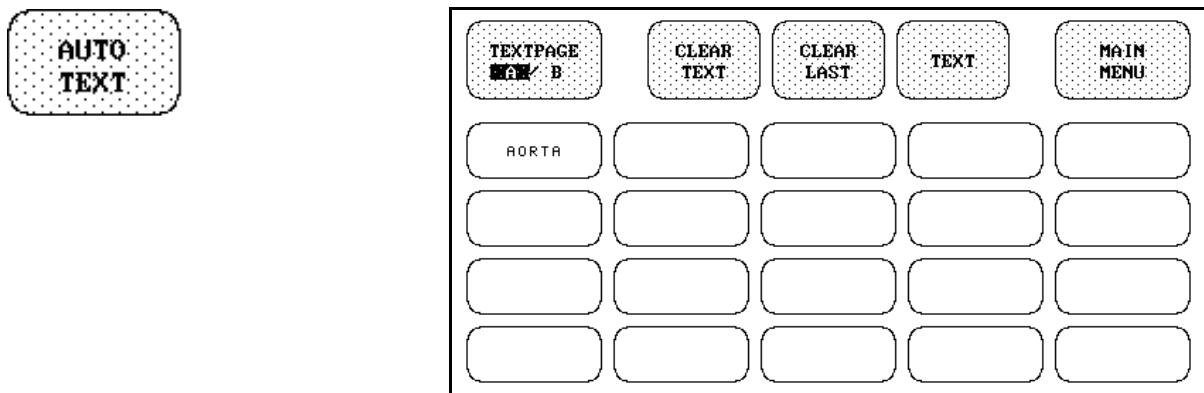
Sub-menu key "TEXT AUTO" (see page 14)



Sub-menu key "ARROW" (see page 15)

### 3.7.2 Auto Text

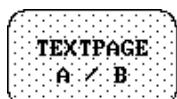
Sub-menu: AUTO TEXT



This function is provided for fast image inscription.  
40 words, each with 10 characters are user-programmable.  
Programming of the AUTO TEXT function see chapter 12.

#### Operation:

1. Touch menu key "TEXT AUTO" in function menu resp. text menu
2. Position the write cursor with the trackball
3. Touch the word key, the first character appears at the cursor position.



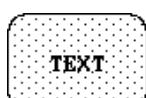
Select the text page A or B  
(each page contains 20 terms)



Erase the entire text

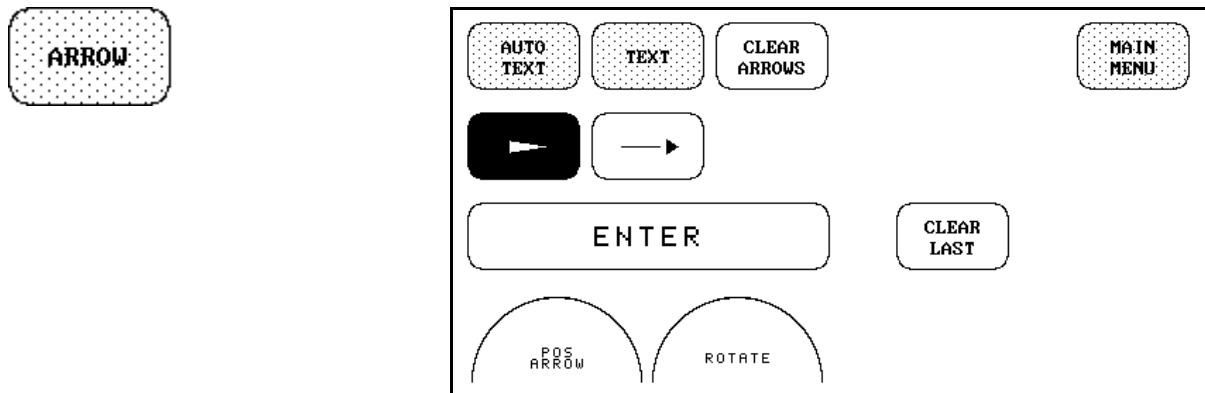


Erase the last entered term



Switch to the standard inscription (by "keyboard")

### 3.7.3 Arrow marks



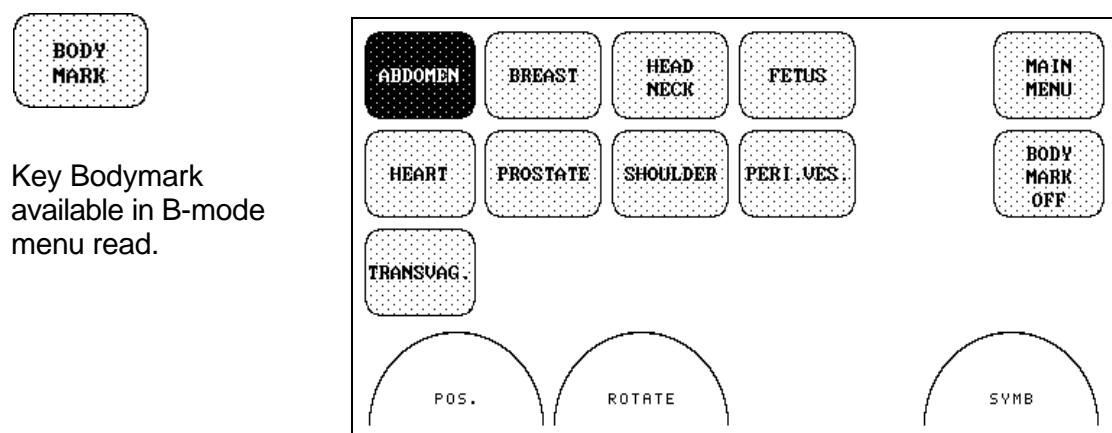
With this function up to 10 arrow marks can be displayed in the image. The arrow to be positioned twinkles on the screen.

#### Operation:

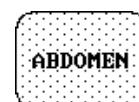
- |  |  |
|--|--|
|  | 108Switch on arrow function (Key in "TEXT" menu) |
|  | Select which kind of arrow.                      |
|  |  |
|  | Position the arrow with the trackball.           |
|  | Adjust direction of arrow (digipot)              |
|  | Store arrow                                      |
| To set a new arrow repeat procedure. When the trackball is moved the next arrow appears. |  |
|  | Erasure of last set arrow                        |
|  | All arrows are erased                            |
|  | Menu "TEXT" (see page 13)                        |
|  | Menu "AUTO TEXT" (see page 14)                   |

### 3.7.4 Pictogram Display (Body Marks)

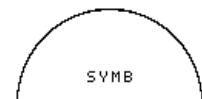
For the documentation of the scan position on the patient a selection of graphic body symbols (body marks) is available. The scan position is indicated by a short lit line. This line can be positioned freely on the body symbol.



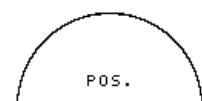
#### Operation:



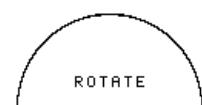
Select wanted scan region, e.g. abdomen  
The body mark of this region is displayed on the screen.



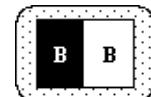
Select body mark, if several are available. By turning the knob one after the other is displayed on the screen.



Position the scan position with the trackball.



Adjust scan direction with turning knob "ROTAT."



Selection of image position with half-image display. The body mark is displayed in the half-image lit in the key.



Body mark menu OFF (pictograms will be erased)

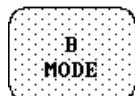
Remark: With D-Mode and M-Mode body mark display is not possible.

---

<b>5</b>	<b>B-MODE .....</b>	<b>5-2</b>
5.1	Main menu "B-MODE" .....	5-2
5.2	B-Mode Depth .....	5-5
5.3	B-Mode Image Angle/Width .....	5-5
5.4	Image Magnifying - Zoom .....	5-6
5.5	Image Magnifying using the Zoom-Box .....	5-6
5.6	Image orientation (Left/Right, Up/Down) .....	5-7
5.7	B-Mode GAIN and TGC slide controls.....	5-8
5.8	B-Mode OUTPUT (Transmit power).....	5-9
5.9	Receiver Frequency Range.....	5-9
5.10	B-Mode FOCUS.....	5-10
5.11	Switching of Elements.....	5-11
5.12	Switching/Positioning of Scan Plane (S-VRW77AK only).....	5-11
5.13	Dual Image Display.....	5-13
5.14	B-Cine Function .....	5-14
5.15	Signal Processing .....	5-17
5.16	2D gray/chroma mapping.....	5-23
5.17	Display of biopsy guideline.....	5-26
5.18	Slope Delay.....	5-30
5.19	ECG-Display .....	5-31
5.20	Histogram .....	5-33
5.21	Function Menu .....	5-35
5.22	Switching between Linear- and Vectormode .....	5-37
5.23	Tissue Harmonic Imaging .....	5-38

## 5 B-MODE

### 5.1 Main menu "B-MODE"

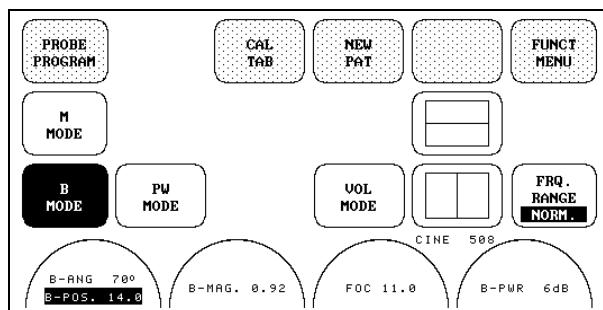


Key "B-MODE" active

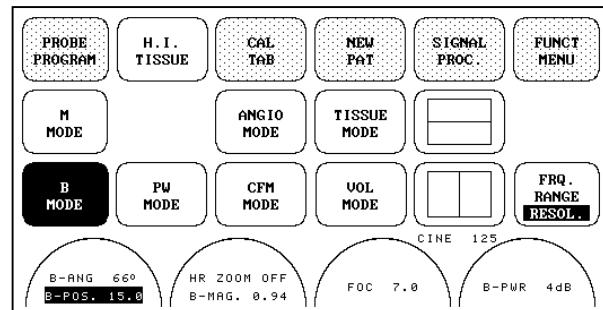
#### Remark:

- \* With multi-image display (i.e. B+M, B+D, B+CFM, B+D+CFM) the modes concerned are signalized by a rastered key. Touching such a mode-key will refer the operation to this mode, the corresponding main menu for this mode appears on the touchpanel and the mode-key will be brightly lit. Touching such a bright mode-key will switch off the corresponding mode (M, D, CFM). Touch the back-lit B-Mode key to return to standard B-Mode.

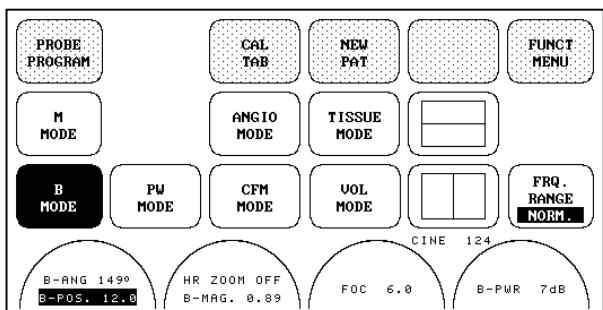
Main menu "B-Mode" of the scanheads: write mode



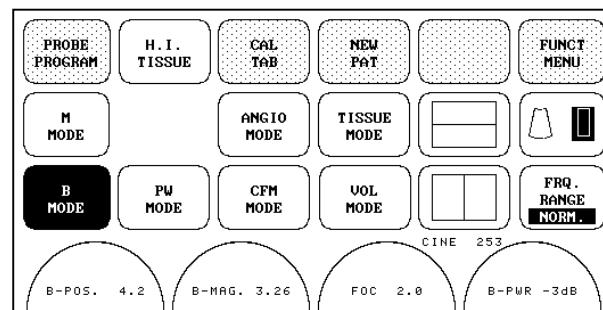
S-VSW3-5



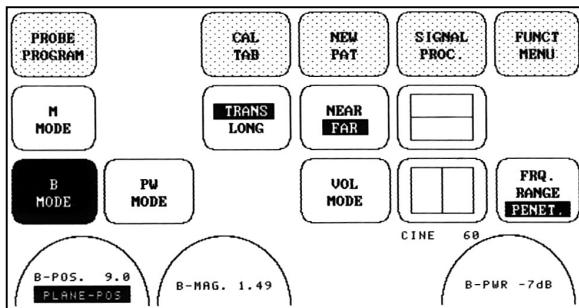
S-VAW3-5  
S-VAW4-7  
S-ACA4-7  
S-ACP4-7  
S-AB2-5  
S-AB4-8



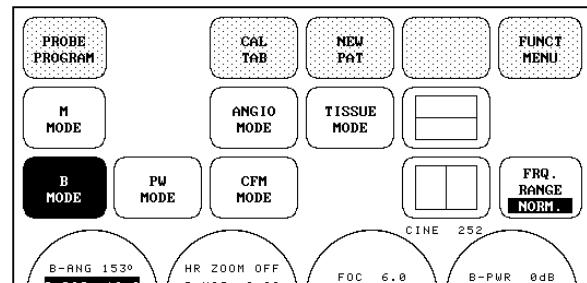
S-VDW5-8(B)  
S-VNA5-8(B)  
S-ACM3-5  
S-ACM5-8  
S-ACP3-5  
S-NLM5-10



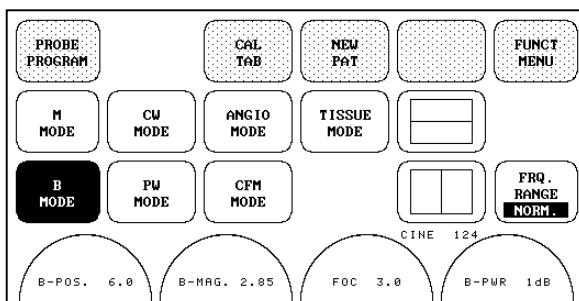
S-NLP5-10  
S-NLP6-12  
S-VNW5-10  
S-VNW6-12



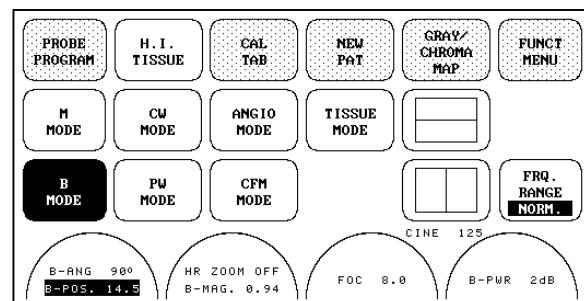
S-VRW 77AK  
S-VRW 7-10



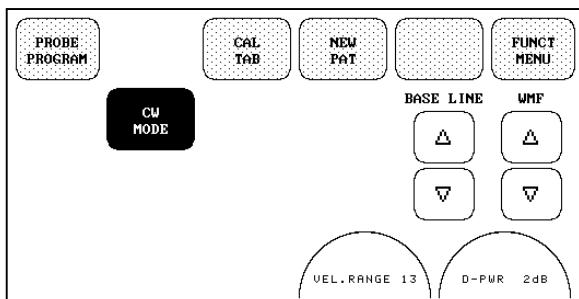
S-ICA5-8  
S-PLM5-10  
S-IOL5-9  
S-IOC4-8  
S-LAP5-8



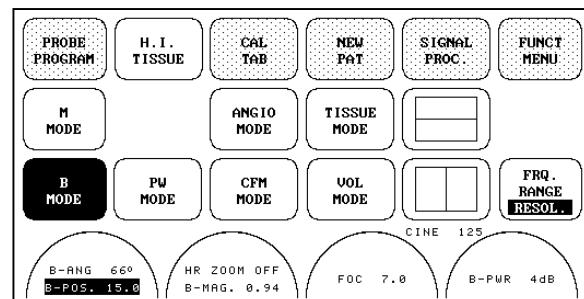
S-NLV4-8  
S-TEE4-6  
S-PPA3-5



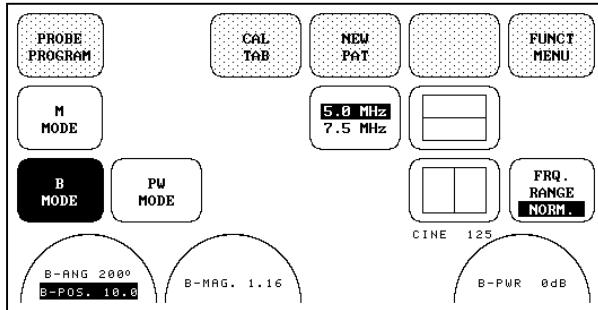
S-PPA2-4  
S-PPA4-6  
S-PPA6-8  
S-PPB2-4



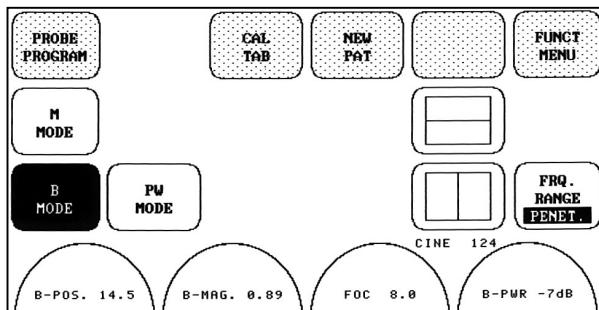
S-PEN4  
S-PEN9  
S-SUP2



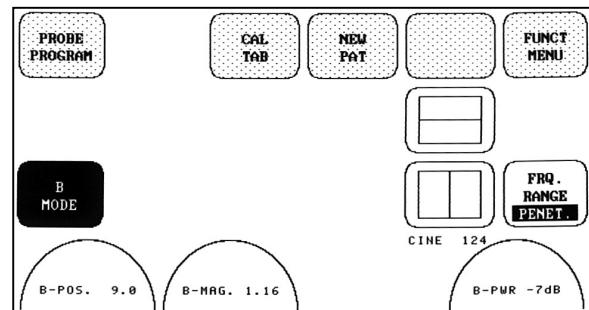
S-ICA5-8P  
S-IC5-9



S-EW5/7K

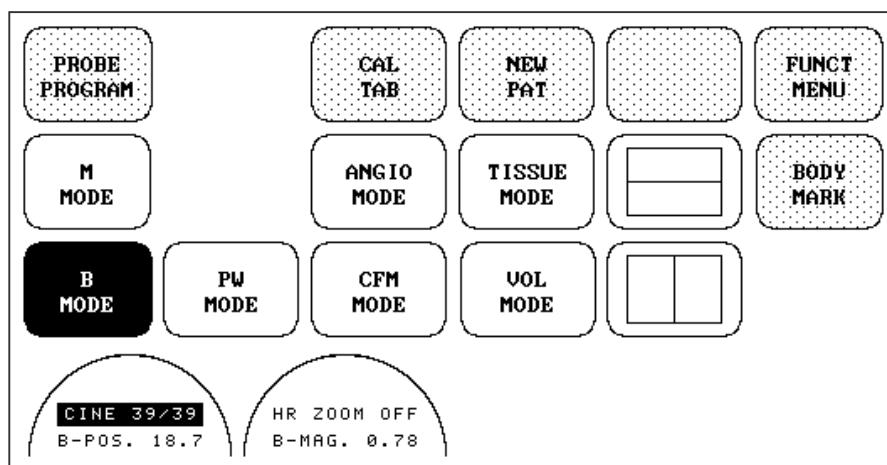


S-WAWP3.5



S-IR11AK

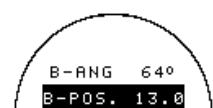
Main menu "B-Mode": read mode



## 5.2 B-Mode Depth

With this function the necessary depth of the ultrasound image for the region of interest is adjusted. The number of image lines and the frame rate are automatically optimized. Changing of the depth is only possible in real-time (Write-Mode - key "FREEZE" illuminated).

### Operation:



#### Trackball

In B-Mode the trackball has two functions: depth range and angle selection. Touch the half-circle to switch between functions (the active one is illuminated).

Trackball rotation:

- ↑ increase of display depth (image is shifted upwards)
- ↓ decrease of display depth (image is shifted downwards)
- image is shifted to the right
- ← image is shifted to the left

### Remarks:

- \* Maximal depth depends on the selected probe.  
The actual depth in [cm] is displayed in the trackball display.
- \* Minimal depth depends on the actual magnification. Min. depth is reached, when the adjusted depth is one third of the display size.
- \* Read-Mode:  
The displayed B-image is positioned again on the monitor without change in the depth range.

## 5.3 B-Mode Image Angle/Width

Use the angle control to select a portion of the 2D image. The advantage of the decreased field of view is an increased 2D frame rate over the smaller sector width.

### Operation:



#### Trackball

In B-Mode the trackball has two functions: depth and width selection. Touch the half-circle to switch between functions (the active one is illuminated).

- increase of image width
- ← decrease of image width

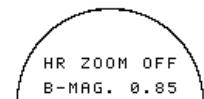
### Remarks:

- \* If the selected probe has the possibility to adjust the 2D angle/width the control selectively appears on the trackball display.
- \* trackball display:  
curved array probe: angle [degree]  
linear array probe: width [mm]

## 5.4 Image Magnifying - Zoom

The 2D-image can be magnified gradually in Read- and Write-Mode. The magnification takes place around the center of the image format. Image frame rate, line number and depth are automatically optimized in Write-Mode. The image magnification can also be performed with a superposed Zoom-Box (see next chapter).

### Operation:



By rotating this control the B-image is magnified (turn to the right) or scaled down (turn to the left).

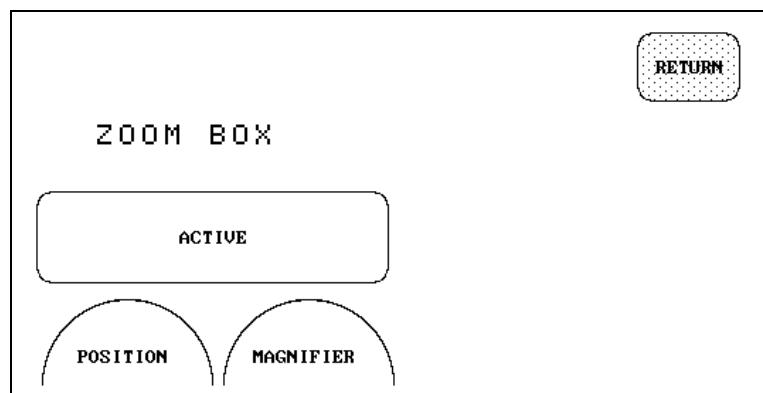
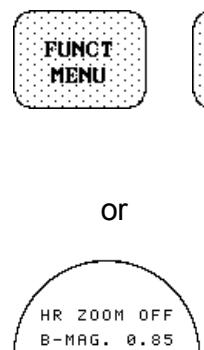
By pressing the "Half Circle" the image size is adjusted 1:1 (100%) in relation to the monitor.

### Remarks:

- \* The selected magnification in relation to the monitor is visible in the control display.
- \* Maximum magnification depends on the selected transducer's line density
- \* Read mode: After magnification in Read-Mode, a newly inscribed image appears in original size, before the Read-magnification

## 5.5 Image Magnifying using the Zoom-Box

This function is identical with the direct magnification, except that a Zoom-Box is displayed as an intermediate step.



### Operation:

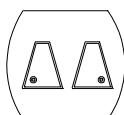
1. Adjust Zoom-Box size with the control "MAGNIFIER"
2. Position Zoom-Box with trackball "POSITION"
3. Activate magnification

Remark: At all Curved-probes a sector zoombox is displayed.  
With this probes touch the "Half Circle" to switch the zoom function on/off quickly.

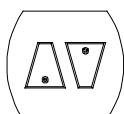
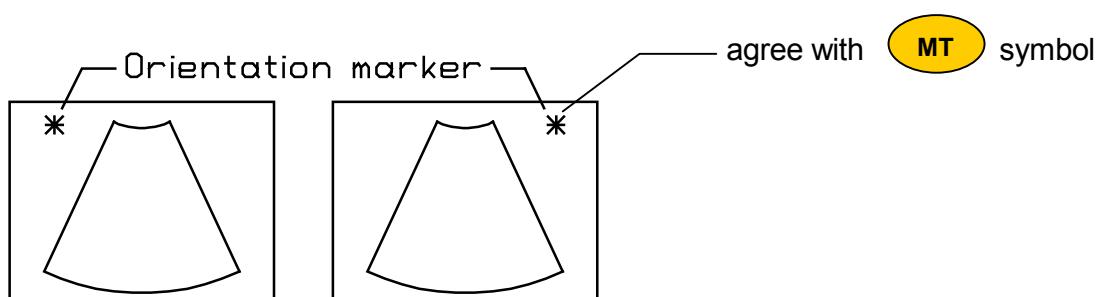
## 5.6 Image orientation (Left/Right, Up/Down)

With this function the image orientation on the screen is alternated between left and right image orientation without rotating the scanhead. The orientation marker shows the actual orientation. For the relationship between marker and design of the scanhead see user's manual of the scanhead.

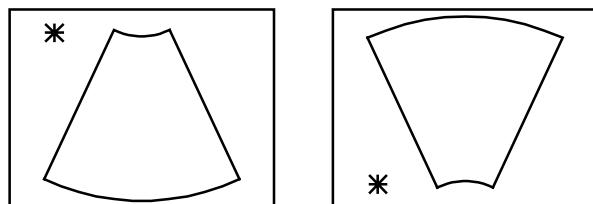
### Operation:



Press the control to alternate between left and right image orientation.



Press the control to alternate between up and down image orientation

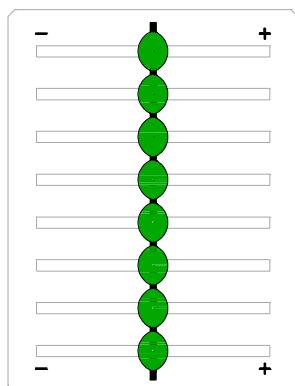


## 5.7 B-Mode GAIN and TGC slide controls

With the gain control the overall brightness of the B-image is adjusted. The adjustment of gain control determines the amount of amplification applied to the received echoes. All incoming echoes are amplified with same gain value regardless of depth. The TGC slide controls apply gain in certain depths of the B-image to allow exact compensation for the attenuation of the echoes over time.

### Operation

large rotary control      rotate the B-gain control to adjust the amount of gain.



Sliding a slide control to the left decreases the amount of gain applied to the corresponding specific 2D-depth.

Sliding a slide control to the right increases the amount of gain applied to the corresponding specific 2D-depth.

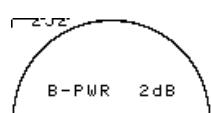
### Remarks:

- \* The large rotary control is not contained in the touchpanel designation. The actual gain value is displayed on the screen [GN ... ] )
- \* The large rotary control is switched to B-gain only, if the key "B-mode" is illuminated.  
Key "CFM MODE" active: control is switched to COLOR gain  
Key "PW MODE" active: control is switched to DOPPLER gain
- \* The standard adjustment of the sliders is the middle position because of the preset time gain compensation for every scanhead.
- \* The setting of the sliders is not stored in a users program because of the absolute position of the sliders.

## 5.8 B-Mode OUTPUT (Transmit power)

The control "Transmit Power" directs the acoustic output of the scanhead and shall be set to the minimum value which still allows well evaluable information. Always keep the power levels and the exposure time **AS LOW AS REASONABLY ACHIEVABLE**.

### Operation:



rotate the PWR control to adjust the amount of acoustic output.

### Remarks:

- \* The transmit power is adjustable in 1db steps.
- \* The maximum possible transmit power can be reduced by the intensity control function if certain values of mechanical and thermal indices are exceeded.
- \* The adjustment of B-Mode output don't change the actual output adjustment of spectral and color Doppler imaging.

## 5.9 Receiver Frequency Range

The frequency range function allows the fast adjustment of high resolution/lower penetration - mid resolution/mid penetration -lower resolution/high penetration of the B-Image. From the scanhead's broad band signal a certain start frequency and start bandwidth is selected and continuously changed over depth. Every scanhead has a set of three fixed receive settings which are easily controlled by touching the "FREQUENCY RANGE" key.

### Operation: Touch the FRQ. RANGE control consecutively



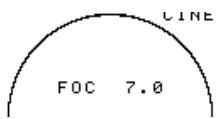
- \* The selected frq. range is illuminated.
- \* The frq. range is displayed in first line of B-Mode settings:  
e.g.: 5.5 - 3.2      5.5 ..... start frequency  
                          3.2 ..... end frequency

## 5.10 B-Mode FOCUS

The selected focal zone determines the depth range at which the sharpness of the ultrasound beam is at optimum. Each scanhead with the capability to select different focal zones has a set of fixed transmit focal zones. The focus control is displayed selectively for probes which are able to change focal zones.

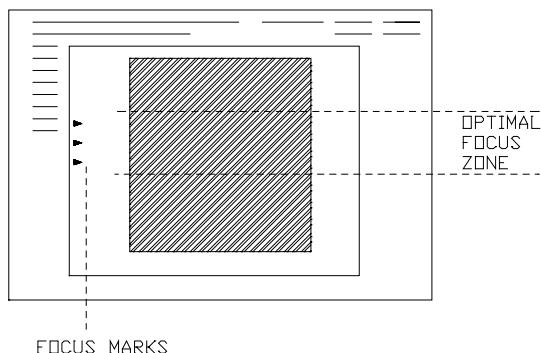
### Operation:

Condition: B-Mode main menu active (key B-MODE backlit)



Rotation of the control allows selection of the focal zones provided. The selected focal range is displayed by arrows at the left edge of the B-image.

### Monitor:



### Remark:

- \* By selecting focal zones the maximum possible transmit power can be reduced by the intensity control function.
- \* The selected focus depth in [cm] is indicated in the focus control display.

## 5.11 Switching of Elements

With this function the different single elements (crystals) of a scanhead are selected. The element control key is displayed selectively for scanheads which have more than one single element inbuilt.

Switching of elements is possible in B-Mode only, not in mixed modes!

### 5.11.1 Transrectal volume scanhead S-VRW77AK

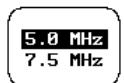
Operation:



By touching the key the back-lit element is selected.  
NEAR: 7.5MHz near focused element  
FAR: 7.5MHz far focused element

### 5.11.2 Transvaginal scanhead S-EW5/7K

Operation:



By touching the key the back-lit element is selected.  
5.0MHz 5.0MHz far focused element  
7.5MHz 7.5MHz near focused element

## 5.12 Switching/Positioning of Scan Plane (S-VRW77AK only)

The transrectal volume probe makes it possible to switch directly between transversal and longitudinal scan plane without moving the scanhead. The plane cursor inserted in the transverse scan marks the intersection between the longitudinal and transverse scan. Both 2D sectors have the same starting center. The scan direction control key and the plane pos control are displayed selectively for the scanhead S-VRW77AK.

Switching of scan direction is possible in B-Mode only, not in mixed modes!

### 5.12.1 Switching between trans. and long. scan plane

Operation:



By touching the key the back-lit scan plane is selected.



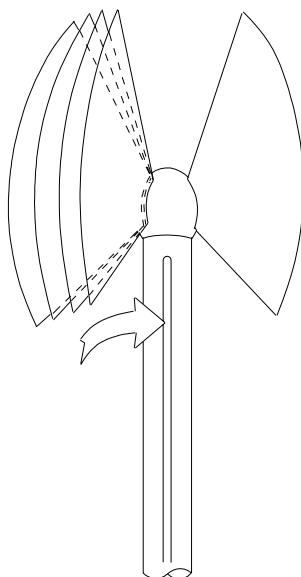
the "FREEZE SPEC." key also switches between the scan planes.

### 5.12.2 Positioning of the longitudinal scan plane

Operation:

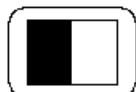


Transversal scan plane active:  
use the trackball to move the plane cursor to the desired location on the transversal scan plane and then switch to longitudinal scan plane.



Longitudinal scan plane active:  
use the trackball to move the longitudinal scan plane in real time without moving the scanhead.

### 5.12.3 Simultaneous display of longit. and transv. scan plane



1. select dual image display



2. press "SPEC. FREEZE"  
The actual image is frozen, the second display position is selected and the scan plane is switched from trans. to longit. direction or vice versa.  
Storing of the last image is done with "Freeze/Run" in order to prevent partial image positioning.

Remarks:

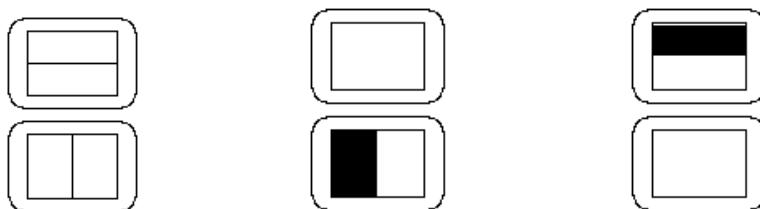
- \* For displaying two longit. or transv. scan planes use the key "DUAL IMAGE" to select the second display position instead of key "SPEC. FREEZE" to avoid automatic switching of scan plane direction.
- \* The switching of scan plane and positioning of the longit. scan plane is possible at any time.

## 5.13 Dual Image Display

The dual controls (vertical and horizontal partition) allows you to display two B-Mode images side by side. With the key "SPEC. FREEZE" you can toggle between the two images.

Key presentation in B-Menu:

active display: active display: active display:  
full size image      dual image vertical    dual image horizontal



Remark:

- \* To switch from dual image vertical to horizontal you have to select full size image between.
- \* The wanted display mode is selected by touching the corresponding key.

### Selection of one partial image:

The actual position of a partial image is determined by the lighting of the key.  
Selection of a partial image is possible in two ways:

#### 1. Touch the active image selection key



The active image format is illuminated.



The active image format is illuminated.

#### 2. Touch key "SPEC.FREEZE" in Write-Mode



The actual image is frozen, the format position is changed and the 2D image appears in the new position.

Storing of the last image is done with "Freeze/Run" in order to prevent partial image positioning.

**NOTE:** Following functions are only possible in the last stored image:

- image positioning
- image magnifying
- Cine-Mode
- Left/Right-, Up/Down reversal

## 5.14 B-Cine Function

When freezing a B-image a certain number of frames (B-images of last examination sequence) is stored in the B-Cine memory. The sequence can be played back to simulate real time motion or it can be reviewed frame by frame.

### 5.14.1 Cine-Function



Use the trackball to display the B-images of the stored sequence.

Display: /72 ..... number of stored B-images  
72/ ..... number of displayed B-image

#### Remarks:

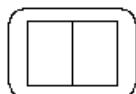
- \* The number of stored images depends on the number of scan lines, scan depth and magnification. In Write-Mode menu the length of the sequence is indicated on the touch screen. (Display: CINE ..)
- \* Operating the "CINE" control erases measuring marks and measuring displays.
- \* In dual image display-mode B-Cine function is only possible on display half last represented in real-time mode.
- \* The Cine-Function (operation and Cine-length) is identical in B/Color-Mode.
- \* In B/M- or B/D-Mode only a reduced Cine-Mode is possible.

### 5.14.2 Cine-Split-Function

After recording a B-image sequence two different images of the sequence can be displayed parallel on the screen by selecting dual image display (hor. or ver. image format).

#### Operation:

1. Store B-image sequence (Dual display mode off).
2. Select dual display mode



3. Select desired B-image



Adjust the desired B-image of the sequence by rotating the control.

4. Select the second display position  
Touching the key toggles the display position



The last actual B-image of the sequence is always displayed on the lighting position of the key.

5. Select second desired B-image (pt. 3)

Remark:

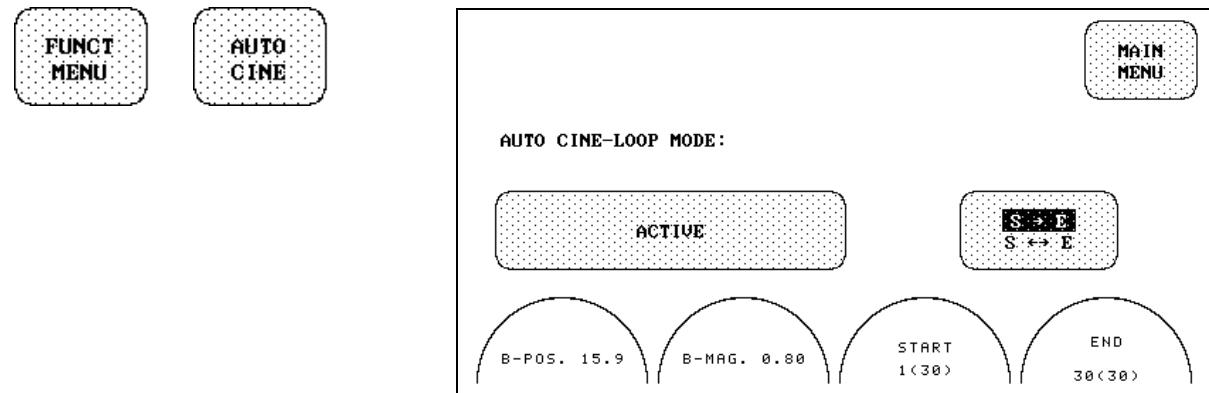
- \* When the ECG-line is on, a superimposed marker allows the comfortable selection of a time fraction within the heart cycle and the corresponding cardiac Cine-image.  
Also see chapter 5.19

### 5.14.3 Auto-Cine-Function

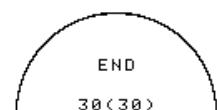
The images of a sequence from a start image to an end image are displayed on the screen at an adjustable speed.

Operation:

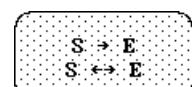
Switch on Auto-Cine-function (Menu key "AUTO CINE" in funct. menu).



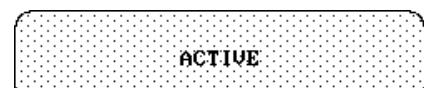
Set starting image of the sequence



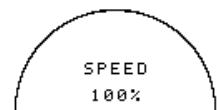
Set final image of the sequence



SE/SE: image running only from start to end.  
SE/ES: image running from start to end and back.

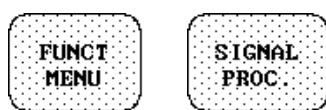


With this key the sequence display is started (key illuminated) and stopped.



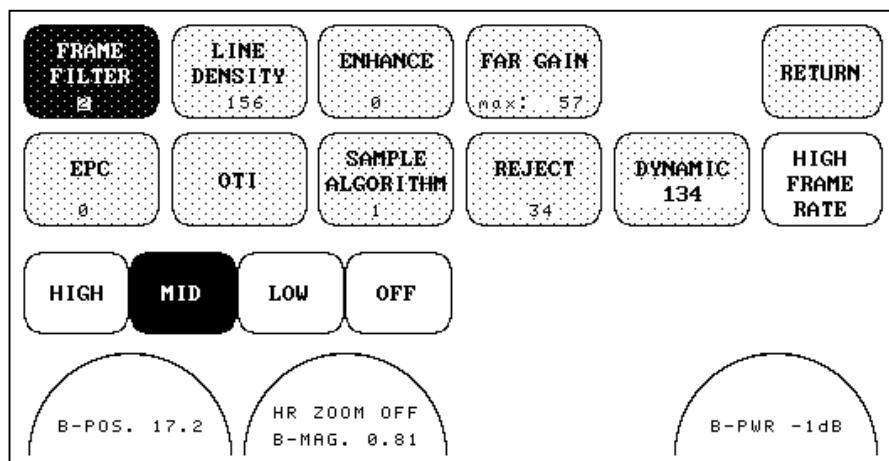
Set speed  
100% corresponds to real-time speed

## 5.15 Signal Processing



B-Menu active:  
Touch the key "FUNCT MENU" and then "SIGNAL PROC."  
The signal proc. menu appears.

Sub-menu: SIGNAL PROCESSING



Select the wanted function and then adjust the function with inserted control keys.

**Note:** If the unit is programmed to 'Predefined Operation' (see chapter 12.15), only the following functions are available:  
Frame Filter, B-Mode Dynamic Range, B-Mode Reject, reduced number of gray map curves .

### 5.15.1 Frame Filter (Frame Averaging)

By filtering several B-scan images a reduction of artifacts and noise is achieved which "smoothens" the real-time display. When studying quick movements switch the frame filter to "LOW" or "OFF".



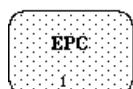
Frame filter ON (key illuminated)



- |       |                                      |
|-------|--------------------------------------|
| High: | filtering of three images (25:50:25) |
| Mid:  | filtering of two images (50:50)      |
| Low:  | filtering of two images (75:25)      |
| Off:  | no filtering                         |

### 5.15.2 EPC (Enhanced Pulse Correlation)

Especially the lateral resolution could be optimized with this innovative correlation algorithm. With the new process, the signals of the neighboring pulses are less weighted for the display of the actual pulse which considerably improves the detail resolution and signal to noise ratio.



Adjustment EPC on (key illuminated)



adjust the weight of neighboring pulses

### 5.15.3 B-Mode DYNAMIC RANGE

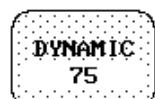
The dynamic range function determines the ratio between the smallest and the biggest echo in the 2D image.

High dynamic: all echoes are displayed in the image

--> "soft gray" image

Low dynamic: reduction of dyn. range at the expense of the higher echoes

--> "hard gray" image



DYNAMIC ON (key illuminated)  
the adjusted dyn. range is displayed in the control.



1. generation | 2. generation

max. dyn. range: 100db

min. dyn. range: 40db

step with: 5db

100dB

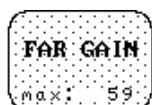
40dB

#### Remark:

- \* The appearance of the gray values depends also of the selected gray map.  
To select a 2D gray map see chapter 5-16.

#### 5.15.4 Far-Gain-Max - control

With this control the total amplification of the system is adjusted. Normally the control is set to 60 (only slight background noise at the end of B-Mode image). By increasing the total amplification more depth range can be achieved, but the noise increases.

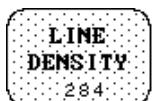


FAR-GAIN-MAX function ON  
the adjusted value is displayed in the control.



#### 5.15.5 Line Density

With this function the line density is adjusted in a certain range. The 2D image frame rate will be increased/decreased if a low/high line density is adjusted.

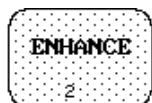


#### Remarks:

- \* The higher the line density, the larger the possible Read-magnification of a stored image.
- \* The line density setting only has an effect on the 2D-image, not on the volume image.
- \* If the line density is low the line filter adjustment should be reduced.
- \* The line density can only be adjusted in Write-Mode.

### 5.15.6 Enhance

The echo information is digitally processed such that certain existing information becomes easier visible for the eye (e.g. adjacent media layers). Due to the Enhance function a finer, sharper impression of the image is produced.



Enhance ON (key illuminated)

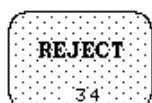


#### Remark:

- \* The enhance function can only be adjusted in Write-Mode.

### 5.15.7 Reject (B-Scan)

This function determines the amplitude-level below which echoes are suppressed (rejected).



Reject function ON (key illuminated)



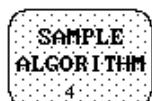
#### Remarks:

- \* The reject function can only be set in Write-Mode.
- \* A reject set too high leads to bad tissue display.
- \* A separate reject control is available for M-Mode images.

### 5.15.8 Sample Algorithm

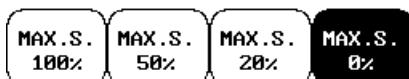
The high sampling rate of an ultrasound line offers more information (pixels) than the TV-norm (TV-memory pixel) can resolve. The Sample Algorithm is the function selecting the information for one TV-pixel out of several samples.

This function depends on the magnification of the 2D image: the smaller the magnification of the image, the stronger the effect of the Sample Algorithm. With magnification more than 3.95 the effect is zero.



Sample Algorithm ON (key illuminated)

Select Sample Algorithm:



1. MAXIMUM SAMPLE 100%

The highest sample value occurring is shown.

2. MAXIMUM SAMPLE 50%

The maximum sampling is effective up to an echo amplitude of 50% only. Higher echo amplitudes are shown in LAST-Sample-Mode.

3. MAXIMUM SAMPLE 20%

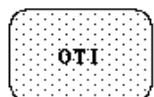
The maximum sampling is effective up to an echo amplitude of 20% only. Higher echo amplitudes are shown in the mode "MAXIMUM SAMPLE 0%"

4. MAXIMUM SAMPLE 0%

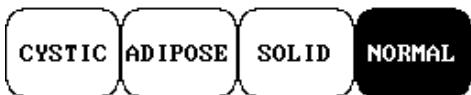
The last sample value independent of the others is displayed.

### 5.15.9 OTI (Optimized Tissue Imaging)

The function OTI™ allows the examiner to “fine tune” the system for scanning different kinds of tissue, for instance more adipose, solid cystic or normal tissue . Setting the relevant parameter improves image quality.



Adjustment of OTI on (key illuminated)



Select the resp. tissue for fine tuning

### 5.15.10 High frame rate

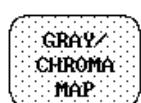
This function raise the frame rate. The lateral resolution in B-mode is reduced.  
(Only available with special probes.)



High frame rate on (key illuminated)

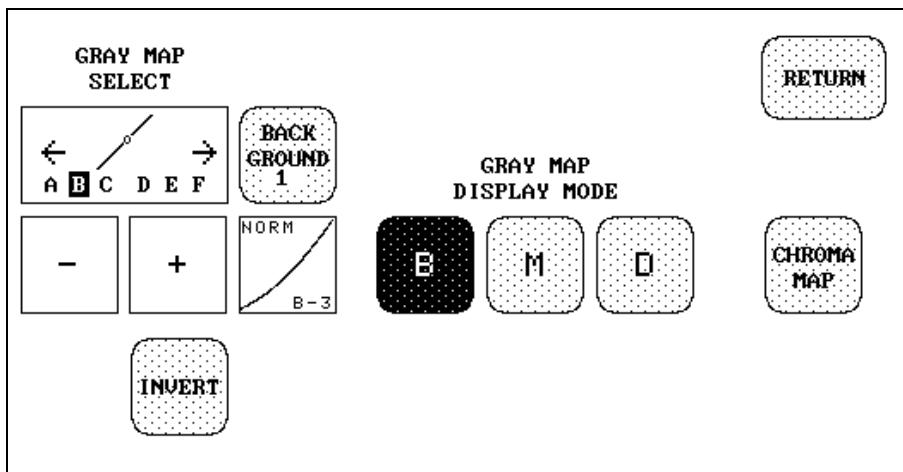
## 5.16 2D gray/chroma mapping

A gray map determines the displayed brightness of a echo in relationship to its amplitude. A chroma map determines the displayed color of a echo in relationship to its amplitude. Depending on individual requirements a "harder" or "softer" image can be obtained with this function and can be adjusted in Read- and in Write-Mode (postprocessing). The displayed gray wedge corresponds to the adjusted gray map curve. Different gray map curves can be related to a B-image, M-image and D-image.

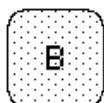


B-Menu active:  
Touch the key "FUNCT MENU" and then the key  
"GRAY/CHROMA MAP"  
The menu gray/chroma map appears

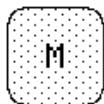
Sub-menu: GRAY/CHROMA MAPPING



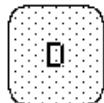
### 5.16.1 To select gray map display mode



The adjusted gray map curve only refers to the B-Mode display.

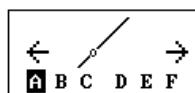


The adjusted gray map curve only refers to the M-Mode display.



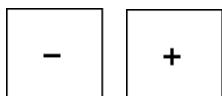
The adjusted gray map curve only refers to the D-Mode display.

### 5.16.2 To select 2D gray maps

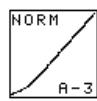


Select gray map type:

- Map of type A: influence of small echo amplitudes
- Map of type B: influence of medium echo amplitudes
- Map of type C: influence of high echo amplitudes
- Map of type D,E,F: Different "S"-curves



Select different maps of chosen type.  
Settings from -8 to +8



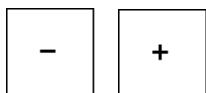
By touching this key the A0 curve is selected.  
The selected curve is displayed graphically inside the key.

### 5.16.3 Background select of screen brightness

With this function the contrast between screen background and B-image is set. This function is only of significance in B-scan, when a part of the screen background is visible.



BGS function ON (key illuminated)  
The set value is displayed inside the key (-4 to +4)



adjust contrast:

- 0: neutral
- 1 to 4: Screen background brighter than sector background  
(increase of contrast)
- 1 to -4: Screen background darker than sector background.

### 5.16.4 Inverted display of the gray levels

- Standard display: echoes (from gray to white) are displayed on a dark background
- Inverted display: echoes (from white to gray) are displayed on a light background

Every display mode (B-, M- or D-image) can be inverted separately.



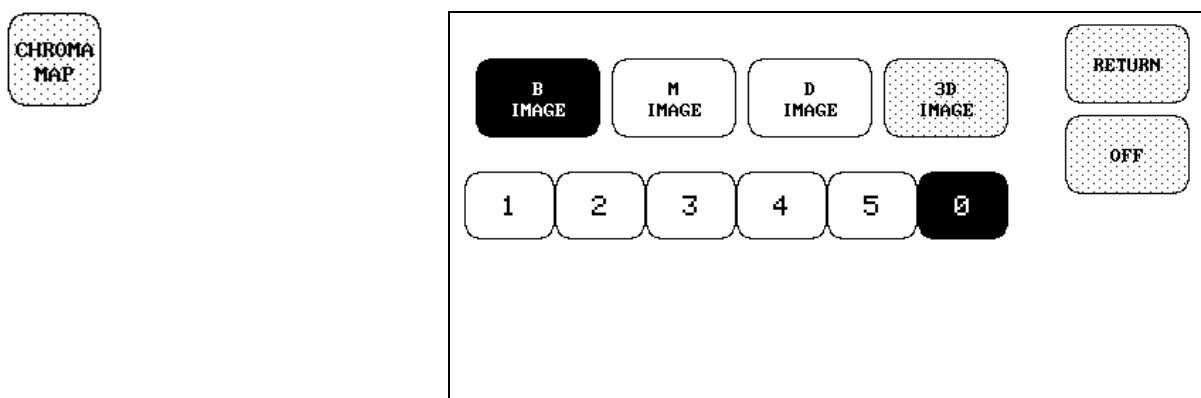
The selected gray map display mode (B, M or D-image) is displayed inverted by pressing this key.  
Inverted condition: key is illuminated

### 5.16.5 Chroma Mapping

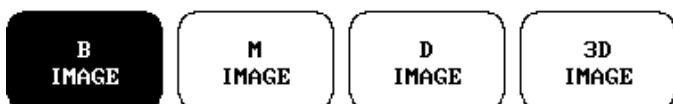
Five chroma maps are available. To each Mode (B, M, D, 3D) a certain chroma map can be independently assigned. In B+CFM Mode the chroma map function of the B-image automatically is switched off.

Setting can be performed in Read- or Write-Mode (post-processing).

Operation: 1. Switch on chroma Mapping Menu



2. Select Mode to be colored:



Key bright: Chroma map selection assigned to this mode.

Key with raster: A chroma curve is assigned to this mode, but not operable.

Key without raster: Gray map display.

3. Selection of a chroma wedge



Chroma wedge 1: candle light

Chroma wedge 2: sepia

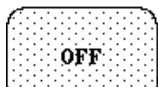
Chroma wedge 3: green

Chroma wedge 4: blue

Chroma wedge 5: magenta

Chroma wedge 0: chroma off (gray display)

Remark: The input for the chroma map are the values given by the actual gray map. Therefor the chroma wedge can be modified by altering the gray map.



Switch off chroma mapping



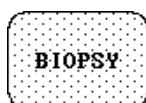
Exit to main menu

## 5.17 Display of biopsy guideline

### **WARNING!**

- The biopsy lines must be programmed once by the service personnel or by the user. The procedure must be repeated if probes and/or biopsy guides are exchanged!
- The biopsy guideline positions are part of the saved settings on a BACK-UP disk. When loading a back-up into another unit the biopsy guidelines must be checked and reprogrammed if necessary.
- Before performing a biopsy make sure that the displayed biopsy line coincides with the needle track (e.g. check in a water-filled bowl).
- The call-up of biopsy lines is only possible in full-size image format.
- Please read the "Instructions for Safe Use" in the User's Manuals of the different probes!

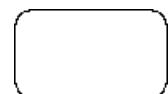
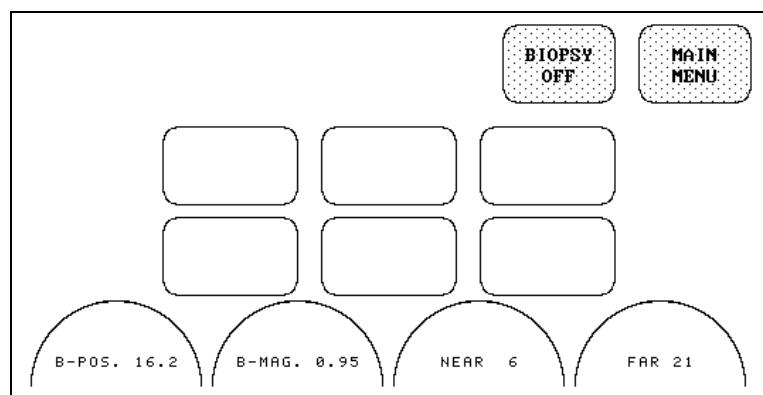
### Operation:



B-Menu active:

Touch the key "FUNCT MENU" and then the key "BIOPSY".

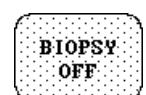
The submenu BIOPSY appears (all scanheads without S-VRW77AK).



Selection of the appropriate biopsy line.

A raster and the annotation of the line inside the key indicate that a biopsy guideline is programmed.

The keys being ON/OFF switches, allow the display of several biopsy lines in the same image f.e. to mark a certain range of the needle's way.



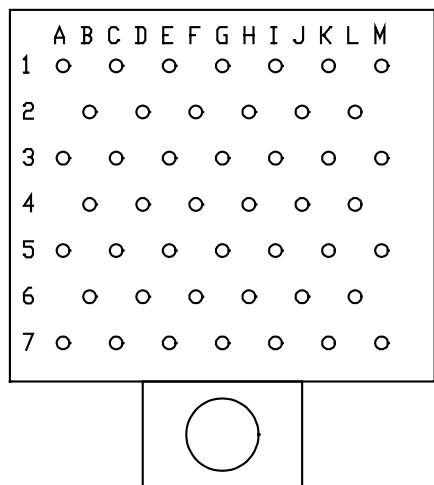
Biopsy lines OFF

### Remarks:

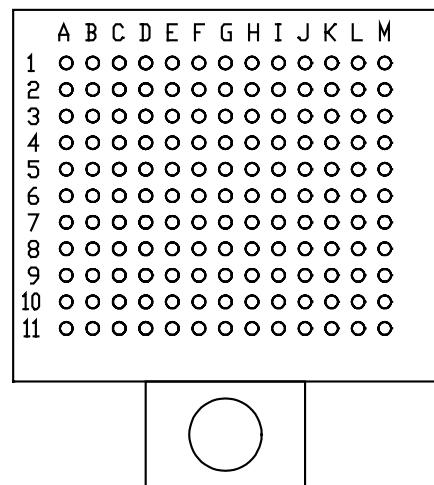
- For handling (sterilization etc. ) and operation of the biopsy guides see the User's Manual of the respective probes.
- In the biopsy line memory a maximum of 15 different lines can be stored. Programming and erasing of biopsy lines see chapter 12.

### 5.17.1 Rastered puncture device PEC 34, PEC 15 for scanhead S-VRW 77AK

PEC 15      Raster: 10 mm

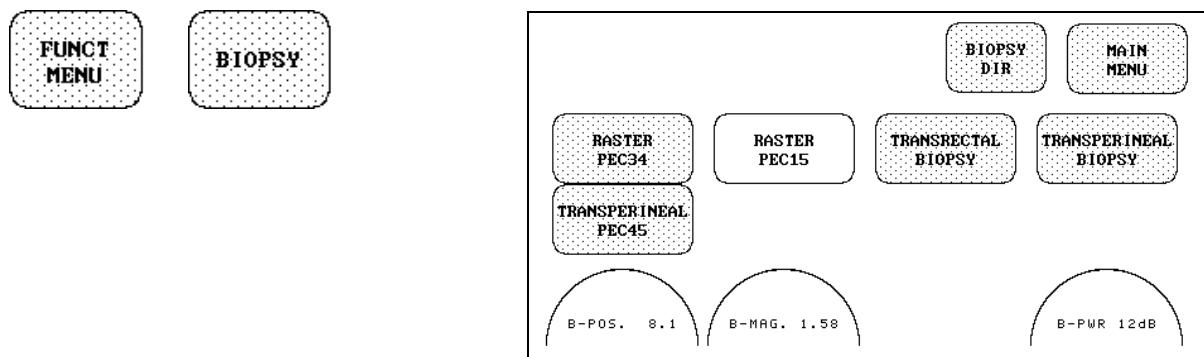


PEC 34      Raster: 5 mm



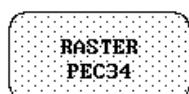
Operation: Condition: S-VRW 77AK active

#### 1. Activate Biopsy

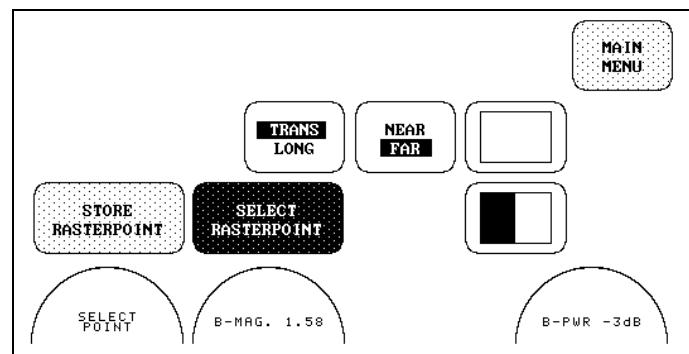


This menu informs about the possible biopsy guides for the probe S-VRW77AK. A rastered key shows that this biopsy guide is programmed.

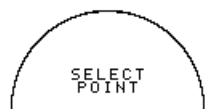
#### 2. Select the puncture mode e.g. PEC 34



The PEC 34 raster sub-menu for puncturing or seed implantation appears.



**3. Select the first raster point position by trackball**



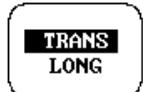
Trackball: the position within the raster is marked by a small bright circle.

**4. Store the raster point**



The plane cursor (position for the longitudinal section) is automatically set to the raster point.

**5. Switch to longitudinal section**

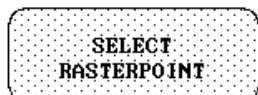


or



The longitudinal section scan starts in the right-hand half sized image and the puncture line is displayed according to the transverse image. One may now perform the first needle insertion.

**6. Select the next raster point position**



The transverse scan can be observed to position the next point by trackball.  
Repeat step 3. through 6. for all seed implantation points.  
The stored raster dots are marked as bright circles.

Remarks:

- During the puncture procedure it is possible to switch either the near or the far focus of the 7.5 MHz elements with the element key "NEAR/FAR".
- In case the needle is not well displayed, the longitudinal section may be slightly angled by the trackball "PLANE POS" function to optimize the needle image.

### 5.17.2 Programming of the raster puncture device

Preparative measures:

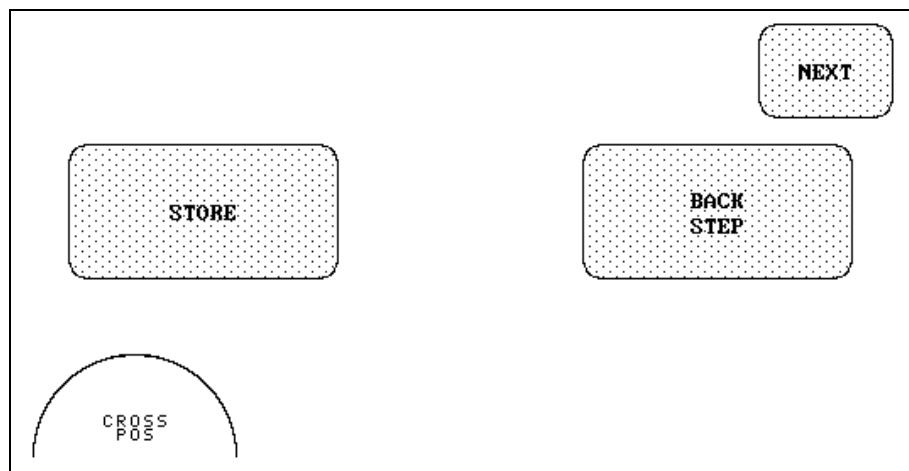
Submerge the transducer with the mounted puncture device in a waterfilled vessel (temperature 45°C/110°F). Insert 4 needles in the corner holes (A1, M1, A11, M11), so that they are well visible in the transverse scan. Adjust the power and TGC (near, far) so that only echo dots are visible.

Operation:

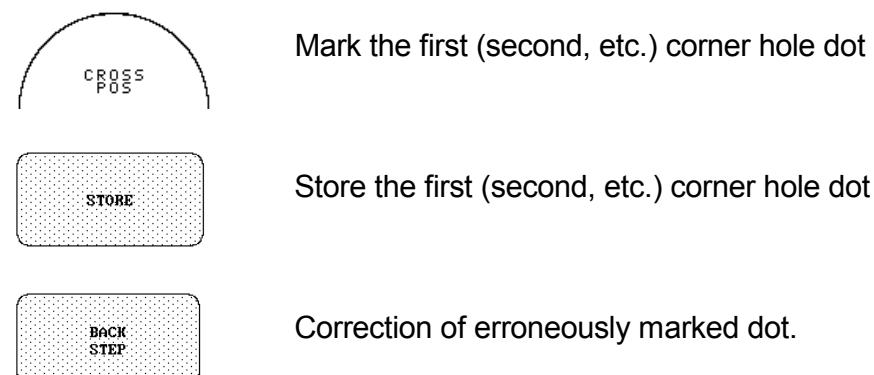
1. Activate the programming of biopsy lines

Key sequence: "FUNCT MENU", "LEARN MODE", "BIOPSY GUIDE LINE", "RASTER PEC 34"

The touchpanel shows the sub-menu, the screen displays a marker cross..



2. Mark and store the dots A1, M1, A11 and M11. Strictly follow this order!

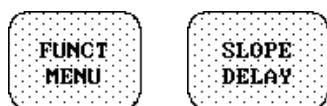


3. Store the program  
Touch key "NEXT" and then "LINE MEMORY" in the sub-menu.

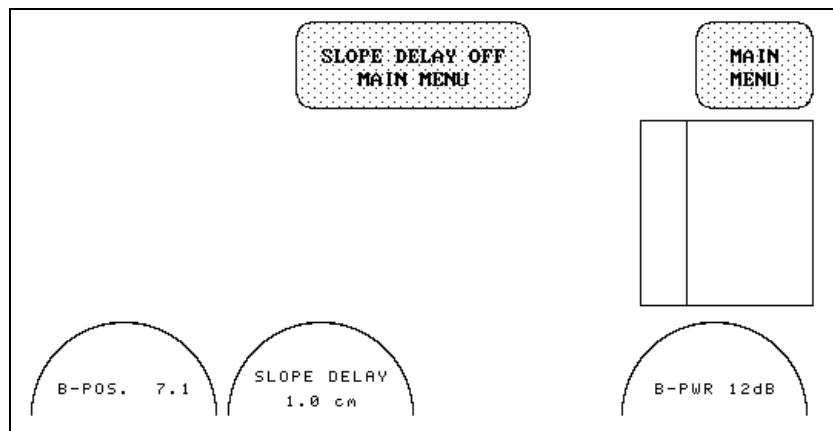
## 5.18 Slope Delay

When using a stand-off with low damping material the slope start can be delayed according to the thickness of the stand-off material. The slope delay is adjustable in steps of 0.5 cm in write mode only. The ultrasound image is displayed from the start of the slope.

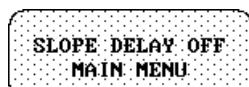
### Operation:



B-Menu active:  
Touch the key "FUNCT MENU" and then "SLOPE DELAY".  
The slope delay menu appears.



adjust the slope delay by rotating the control.  
The slope delay value in cm is shown inside the rotary control display.



Slope delay OFF, back to main menu



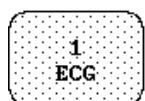
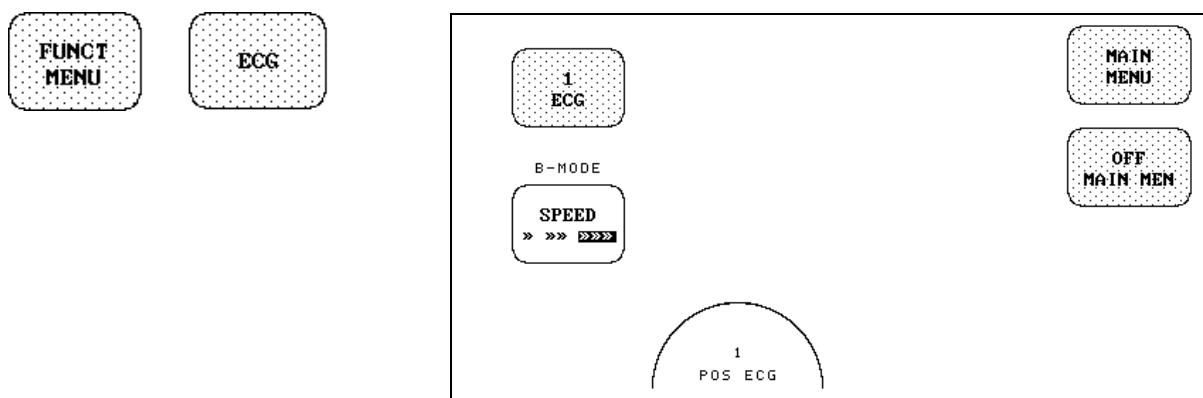
Return to main menu  
The slope delay set remains.

## 5.19 ECG-Display

This function inserts an ECG-line in the display of the B-image.

Condition: ECG-module (ECG preamplifier) is connected to the unit.

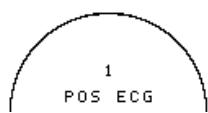
### Operation:



1. ECG on (on/off switch)  
On the screen the ECG-curve starts running from left to right if B-Write Mode is active.



2. Adjust ECG-velocity (slow, mid, fast). Touch key repeatedly.



3. Set vertical position on the monitor



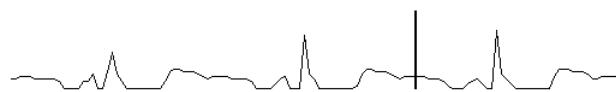
4. Return to main menu  
ECG-function remains active



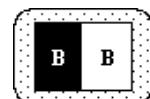
5. Store B-Mode image  
ECG-line is stored. The most recent information is always on the right edge of the image.



When rotating the B-Cine control a indicator (small vertical line) is inserted on the ECG curve and indicates the temporal position of the B-image in relation to the recorded ECG line. This way e.g. diastolic or systolic phase of the B-Mode image can be set (without ECG-trigger).

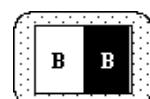


### Cine Split Mode



Touch dual image key

The present B-Mode image is displayed in the indicated position.  
Adjust the first trigger image with the B-Cine control.



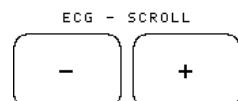
Switch the image position (touch key again) and adjust the second trigger image with the B-Cine control.



The arrow tips indicate to which image the trigger mark is related. Arrow to the left (left image).

### ECG-scroll function:

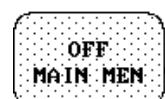
In the ECG-memory a longer period than the one displayed on the monitor is stored. With the help of the Scroll-key the previous ECG-curve can be scrolled back.



Scroll of the ECG-curve

The keys are displayed in the ECG-menu when the image is frozen.

Switching off the ECG-function:



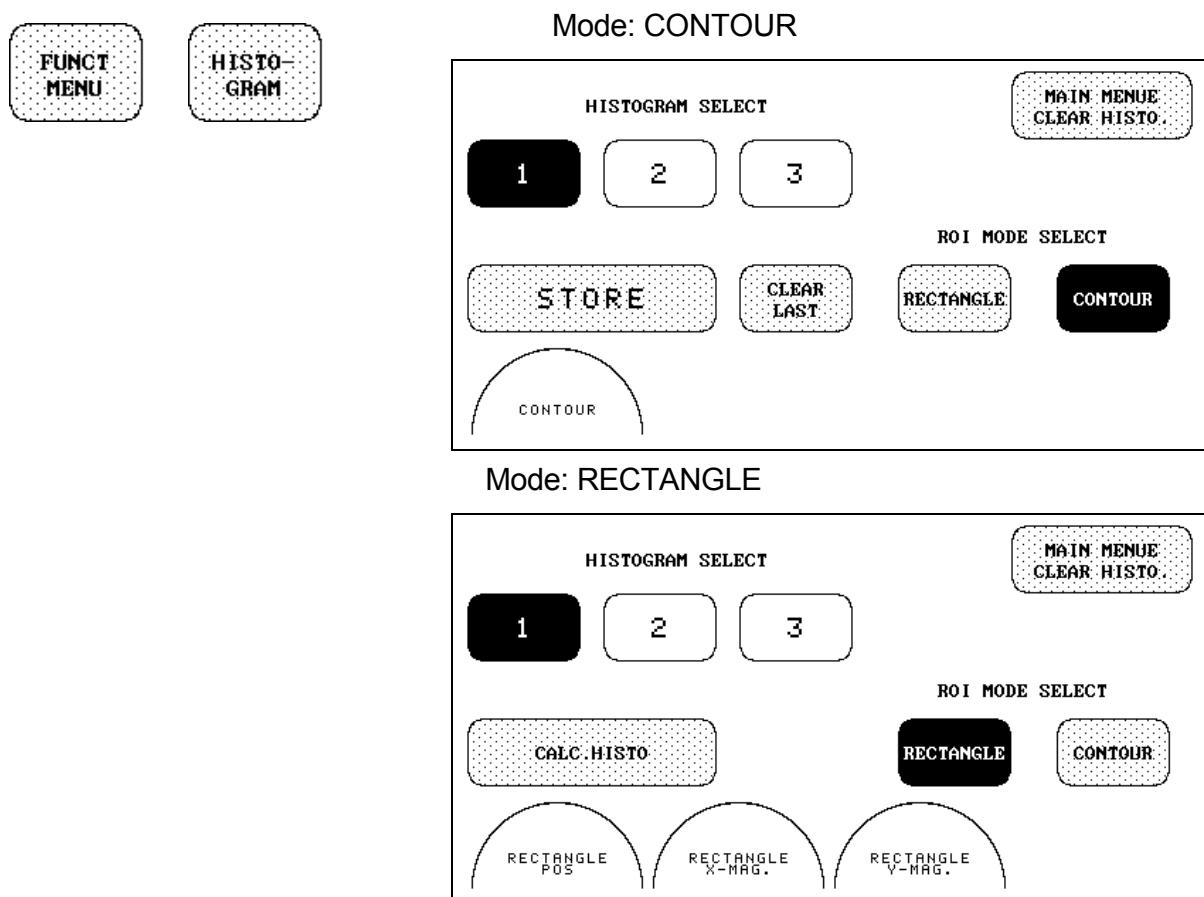
ECG-function is switched off and the main menu appears.  
Key in ECG-menu.

## 5.20 Histogram

With this function the gray scale or color distribution within a marked Region of Interest (ROI) will be graphically displayed. Three histograms may be shown on the screen simultaneously.

### Operation:

1. store a B-mode or a CFM-mode image
2. switch on HISTOGRAM



2. Select the number of the histogram: 1, 2 or 3
3. Select the ROI mode: rectangle or contour
  - Rectangle: the ROI is a rectangle
  - Contour: the ROI is any shape (not possible in Color-mode)
4. Marking of the ROI
  - Rectangle: position the ROI rectangle, adjust its size in X and Y direction with the digipots and its position with the trackball.
  - Contour:
    - \* position and store the start dot
    - \* round the area
    - \* store the end dot
    - \* store a dot within the area

5. Touch key "CALC.HISTO"

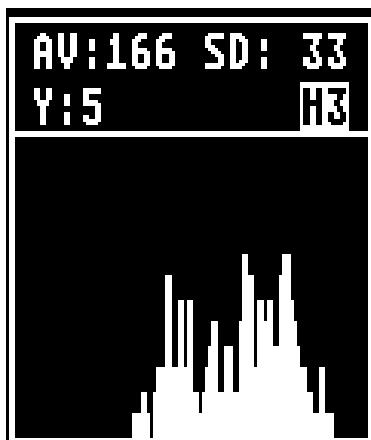
The histogram will be calculated and displayed. During calculation following remark is displayed:

**"Please wait, calculating"**

Remark:

- \* Erase incorrectly entered dots with key "CLEAR LAST" during enter procedure.
- \* Measuring, inscription, body marks entering as well as all post-processing settings are not possible in Histogram Mode.

Display of a gray scale HISTOGRAM



X-axis: grayscale values from 0 to 255  
Y-axis: presence of incidence in %:  
the max. incidence is displayed normalized  
in 5% raster.

Y:5 inscription of y-axis:  
the max. incidence is below 5%, therefore  
the Y-scale is calibrated to 5%

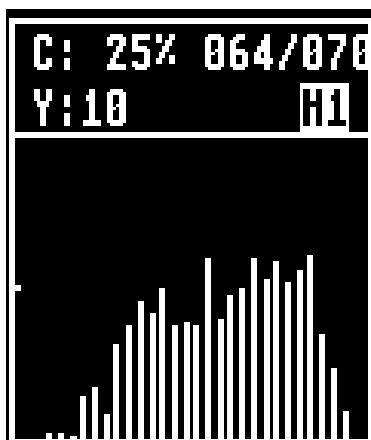
H1: Order number of the histogram (H1,H2 or  
H3)

AV: Average value

$$\text{AV} = \frac{\text{Sum of [values * presence]}}{\text{number of values in ROI}}$$

SD: Standard deviation

Display of a color HISTOGRAM



X-axis: color values acc. to color bar  
Y-axis: presence of incidence in %:  
the max. incidence is displayed normalized  
in 5% raster.

H1: Order number of the histogram (H1,H2 or  
H3)

C:25% 064/070 25% of the evaluated box area are color  
values

064: 064: box size hor. [pixel]  
070: 070: box size ver. [pixel]

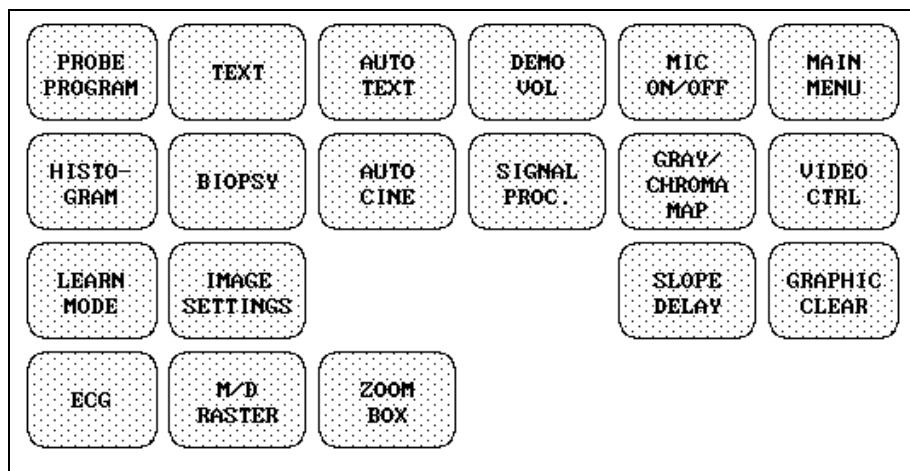
## 5.21 Function Menu

In this menu the menu keys for those sub-menus can be found which cannot be reached from the main menu and some function keys.



Menu key "FUNCTION MENU"

Key in main menu



Sub-menu keys:

chapter:

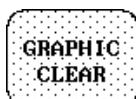
Probe/Program	3
Text	3
Text Auto	3
Histogram	5
Biopsy	5
Signal Processing	5
2D gray/chroma mapping	5
Slope Delay	5
ECG	5
Zoom Box	5
Auto cine	5
Learn Mode	12



Image settings display on/off

By this function the display of the image settings (scan parameters) can be switched off in order to avoid too many data on the screen with dual image mode. With mixed modes the display of the settings is reduced.

Bright key: data on  
Dark key: data are deleted

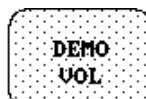


Touching this key erases all the graphic annotations. After erasure the marker lines and the image cursor reappear.



Switch on the microphone to record comments for video recordings.

When the microphone is switched on the green LED between the two knobs for volume and balance (at the left loudspeaker) is lit. Start the video recording and record the comments.



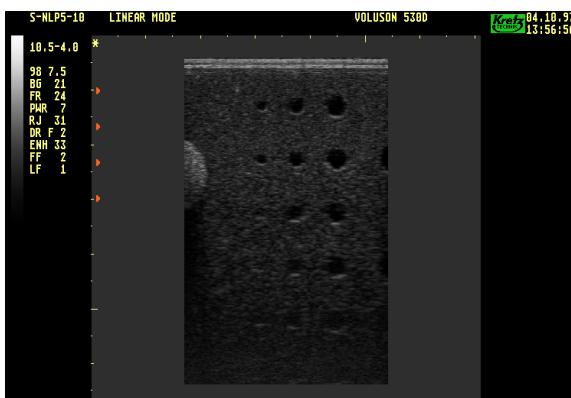
Not meant for the user!

With this function a cube or an ellipsoid are inscribed into the volume memory for testing or demonstration.

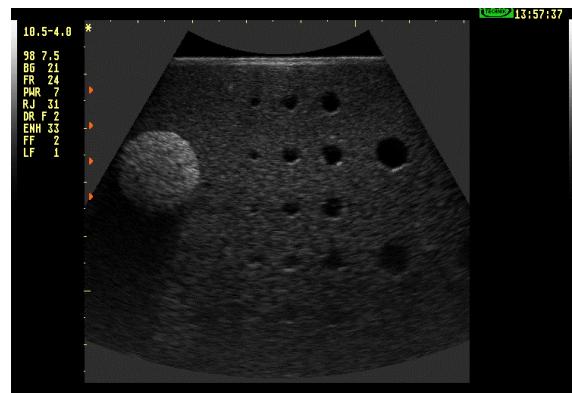
## 5.22 Switching between Linear- and Vectormode

Advantage of the vector mode display, also called trapezium mode:  
the scan area is very increased in relation to the linear display by steering the ultrasound lines on the border of the probe.

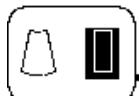
Linear display:



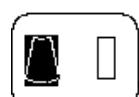
Vectormode display (trapezium):



Operation:



Selection of Linear display



Selection of Vector mode (trapezium mode) display

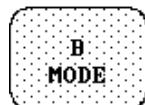
Remarks:

This key appears in the B-Mode menu automatically, if the selected probe is capable of trapezium mode (e.g. S-NLP5-10).

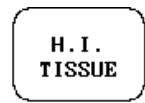
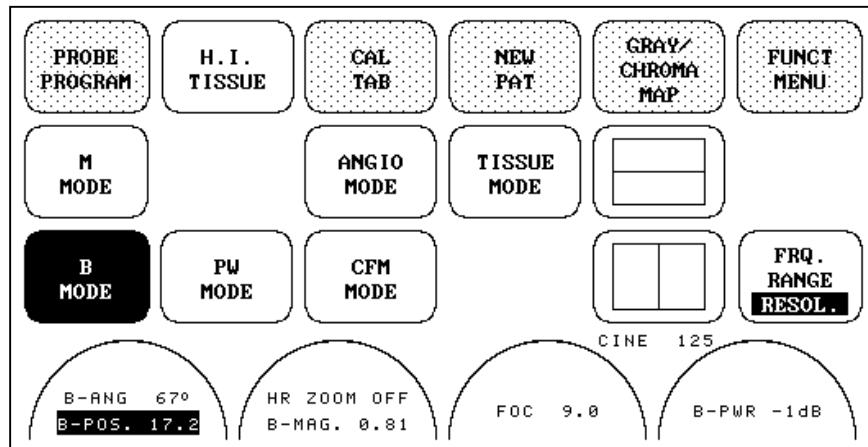
Trapezium mode is possible in Doppler- and Color mode without restrictions.

## 5.23 Tissue Harmonic Imaging

This function is a software option which is not available for every probe.  
Tissue harmonic imaging is not released in every country.



Activate B-Mode  
by touching this key in the B-Main menu.



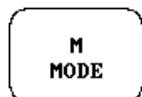
Switch on Tissue Harmonic Imaging  
by touching this key in the B-Main menu.

All functions of the B-Mode are also available for Tissue Harmonic Imaging. See chapter 5.

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## 6 M-MODE

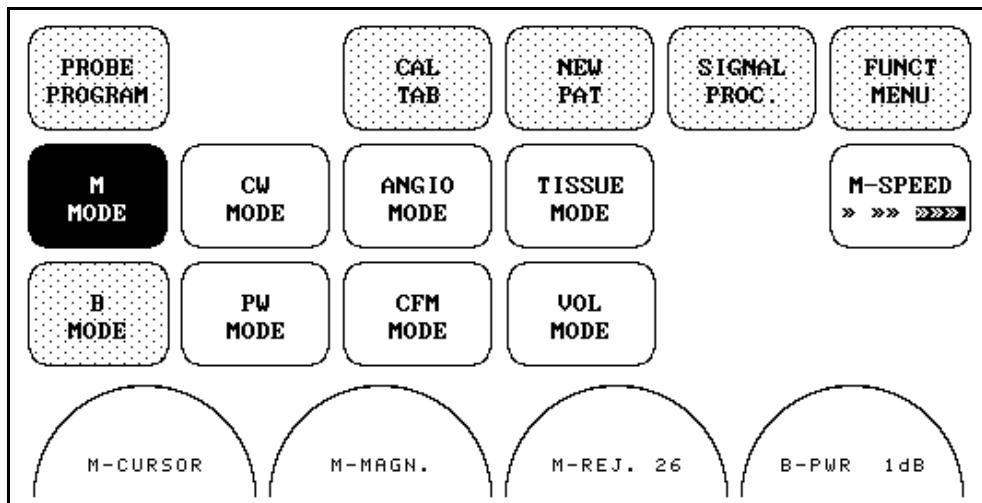
### 6.1 MAIN MENU "M-MODE"



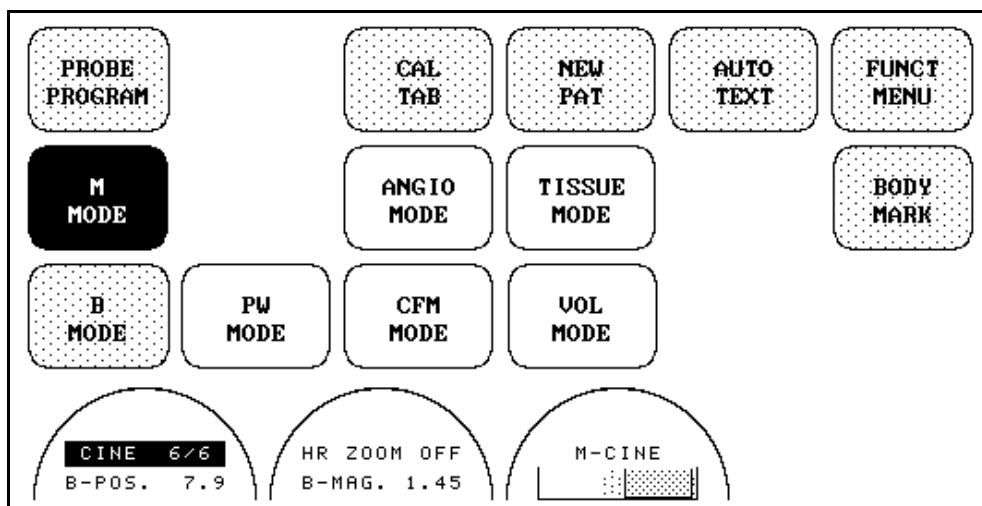
M-Mode key

When switching on Mmode the main menu "M-Mode" appears. Key available in all main menus.

Main menu: M-MODE (Write)



Main menu: M-MODE (Read)



## 6.2 PRINCIPLE

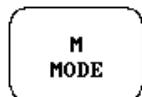
The M-Mode display is derived from a B-image display. When switching on the M-Mode the M-cursor is inserted into the B-image. It defines the position of the M-image. Two marks on the M-cursor mark the M-Mode depth range shown on the screen. The M-image is started and frozen with the "FREEZE" key.

### Simultaneous Mode:

With electronic probes B- and M-image are displayed simultaneously. The running M-image is displayed in Scroll-Mode (the most recent information is always shown on the right border of the M-image).

## 6.3 OPERATION

### 1. Activation of M-MODE



Touching this key the screen is divided unsymmetrically. In the smaller image on the left B-scan image appears. In the larger image on the right the M-Mode image starts running. The touch panel shows the M-Mode main control menu, the "M-Mode" key is backlit.

#### Remarks:

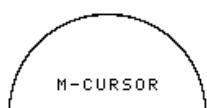
- \* M-Mode can be switched on if only B-Mode (no mixed mode) is active.
- \* In B+M-Mode one can switch between B-image control and M-Mode control by touching the corresponding key.

Mode key backlit: Control corresponds to this mode  
Mode key rastered: Mode is active, but control does not correspond to this mode.

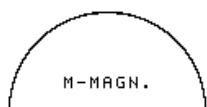
Switch off M-Mode: Touch the backlit M-Mode key.  
When you touch the backlit B-Mode key all modes are switched off and the standard B-Mode is active.

### 2. Setting of M-cursor position and M-Mode depth range

The adjusted M-Mode depth range is shown by two marks on the M-cursor lines.



↔ M-cursor position (trackball)  
⇓ M-Mode depth range position (trackball)



adjust M-Mode magnification by rotating the control.  
max. magnification is reached if a range of 4cm is displayed over the vertical length of the monitor.

### 3. M-Mode image START and STOP



The control "FREEZE" starts and stops the M-image.

### 4. M-Mode sweep speed



By repeated touch three speeds are selected. This function is only adjustable in Write-Mode.

>	13 mm/s (50 Hz)	20 mm/s (60 Hz)
>>	33 mm/s (50 Hz)	40 mm/s (60 Hz)
>>>	66 mm/s (50 Hz)	80 mm/s (60 Hz)

These values are only valid on the system's video monitor.

### 5. To adjust gain and reject

The TGC-setting with the slide controls, B-Mode gain and the B-Mode transmit power are also valid for a M-Mode image. The functions M-Gain and M-Reject influence a M-image only.

large rotary control      rotate the M-gain control to adjust the amount of gain.  
The M-Mode gain range is -10 to +10db and is added to the actual B-Mode gain.

Remark: The large rotary control is not contained in the touchpanel designation.



#### M-REJECT

This function determines the amplitude threshold above which the ultrasound echoes are displayed on the screen (suppression of smaller echoes). Display 0 to 50.

The gain settings are only possible in Write-Mode.

## 6. Switching between B-image and M-image (simultan mode off only)

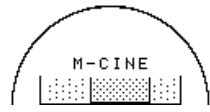


This key switches from B-image to M-image and vice versa. This function is necessary specially for non-simultaneous B/M-display with mechanical probes.

In simultan mode this control has the same function like "FREEZE".

## 7. M-Cine-Mode (M-image stored, Read-Mode)

The M-Mode memory has the double length of the M-Mode image displayable on the screen. With the M-Cine controls this invisible information can be "re-called" when the memory has been filled.



On the display the small rectangle corresponds to the screen, the big rectangle is the stored M-Mode length.

By rotating the turning knob the small rectangle is shifted and the M-image is scrolled on the screen.

### Remarks:

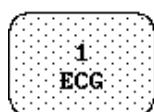
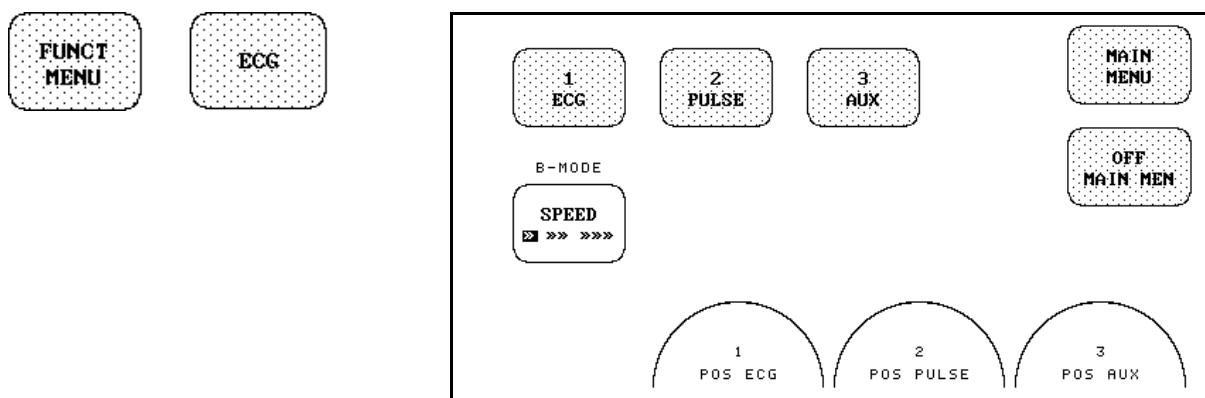
- \* By separate setting of 2D gray maps for M- and B-image the M-Mode display can be optimized.
- \* The M-Mode image can be displayed inverted, independently from the B-scan image (see menu video control).

## 6.4 ECG-DISPLAY

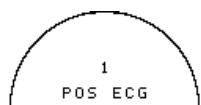
This function inserts an ECG-line in the display of the M-image.  
The ECG-curve is shown by a bright white line that is directly written into the M-Mode image.

Condition:    M-Mode is active  
                  ECG-module (ECG preamplifier) is connected to the unit.

Operation:



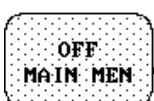
1. ECG on (on/off switch)



2. Adjust ECG-position  
Function only possible in M-Write-Mode

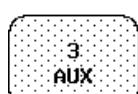


3. Return to main menu  
ECG-function remains active.



Switching off the ECG-function:  
ECG-function is switched off and the main menu appears  
(key in ECG-menu)

Note:



Function in preparation



No function in this mode.

---

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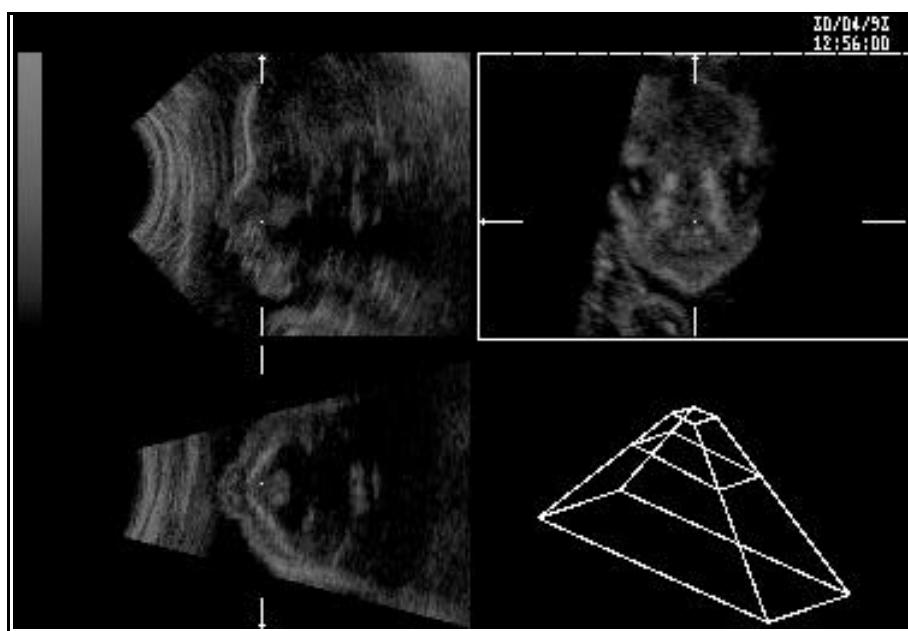
## 7 VOLUME MODE

### GENERAL DESCRIPTION

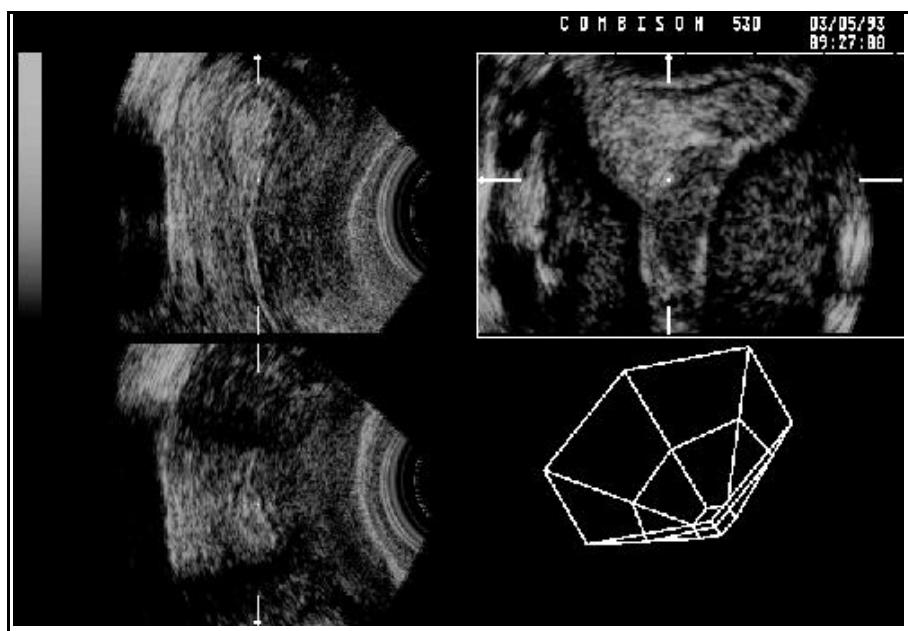
The Volume Mode allows for scanning a tissue volume and subsequent analysis of sections of the volume in 3 dimensions. The liberal selection of sections within the volume and the simultaneous real-time display of three orthogonal planes represents a new dimension for e.g. the diagnosis of fetal abnormalities. The volume mode provides access to sections unachievable by the 2D-scan technique.

A parallel interface provides the possibility to memorize volume data a hard disk drive for repeated analysis anytime.

Example of fetal "facing" by liberal selections of sections:



Case example: Endometrial polyp



The volume data sets may be processed by means of software option "interactiv volume rendering" for surface or transparent mode images.

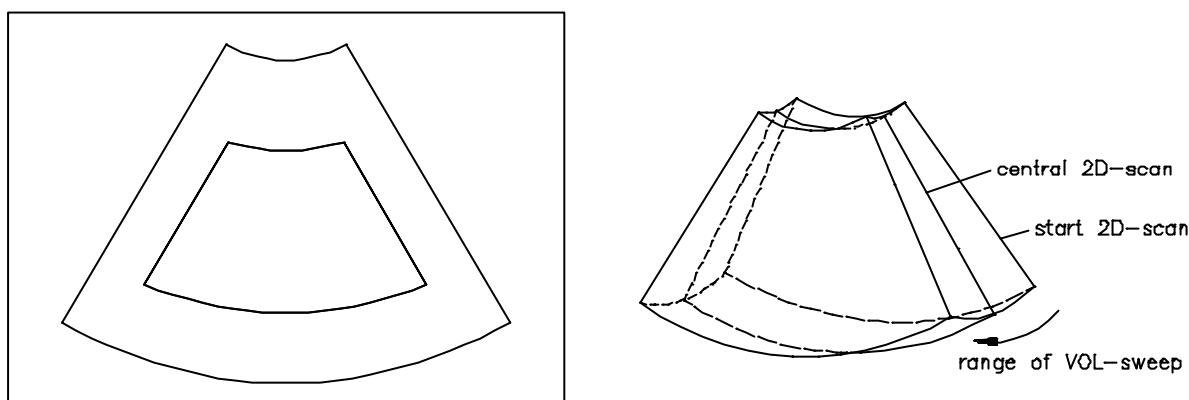


## 7.1 VOLUME ACQUISITION WITH VOLUME PROBES

### 7.1.1 Principle

The acquisition of volume data sets is performed by sweeping 2D-scans with special transducers designed for the 2D-scans and the 3D-sweep. Survey of volume probes, see chapter 2.

The Volume acquisition is started using a 2D-image with superimposed VOL-BOX or using a B+Color image. In case of a B+Color image the Color-Box is at the same time the VOL-BOX. The start 2D image represents the central 2D scan of the volume. The volume scan itself sweeps from one margin to the other margin of the volume to be acquired.



The VOL-BOX frames the Region of Interest (ROI) which will be stored during the volume sweep. The display shows the actual 2D scan. The range of the volume sweep is indicated by the Sweep-Box, which is displayed at the bottom right of the screen. The moving indicator informs about the position of the B-image during the volume scan.

The sweep time varies between 2 and 10 seconds and depends on the VOL-BOX size (depth range, angle) and the line density (3 positions). The probe must be held steady in place during the volume scan. The real-time display of the swept B-frames allows continual observation of the scan quality (check for movements, shadowing, etc.). Movements within the scanned volume may cause usefulness of the volume scan and necessitate a repeated the volume scan.

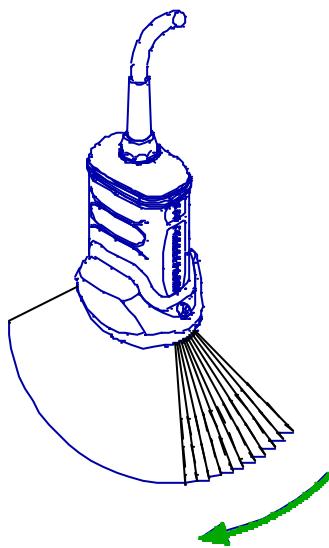
### 7.1.2 Principal Scanning Modes

Transducer type:

Grafikname:  
Erstellt in:  
Erstellt am:

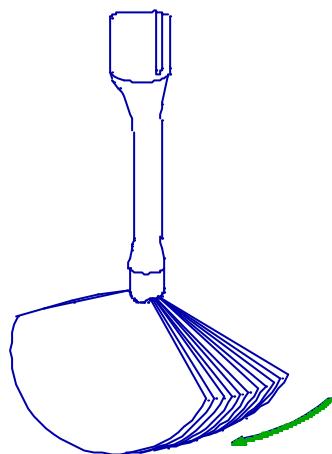
S-VRW 77 AK (Transrectal)

The volume scan is automatically performed by a slow rotational movement of the 2D-scan mechanics. The scanned volume is similar to a section of a torus.  
B-Mode image angle: 100°  
Sweep angle: 180°, 140°, 115° or 90° switchable



S-VSW3-5

The volume scan is automatically performed by a slow tilt movement of the 2D-scan mechanics. The scanned volume is similar to a section of a torus.  
B-Mode image angle: 70°, 60°, 50°, 40°  
Sweep angle: 60°, 45°, 30°



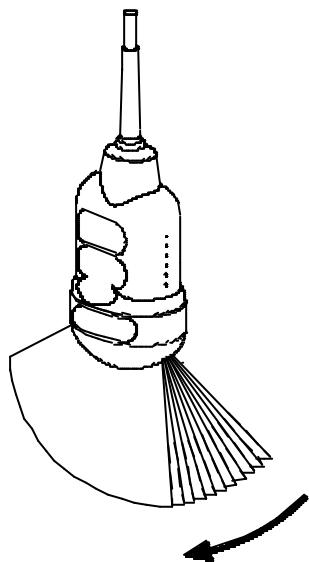
S-VDW

The volume scan is automatically performed by a slow tilt movement of the 2D-scan mechanics.

The scanned volume is similar to a section of a torus.

B-Mode image angle: 130°, 110°, 90°, 70°, 50°, 40°

Sweep angle: 95°, 75°, 55°, 40°, 30°, 20°



S-VAW3-5

The volume scan is automatically performed by a slow tilt movement of the 2D-scan mechanics.

The scanned volume is similar to a section of a torus.

B-Mode image angle: 70°, 50°, 40°

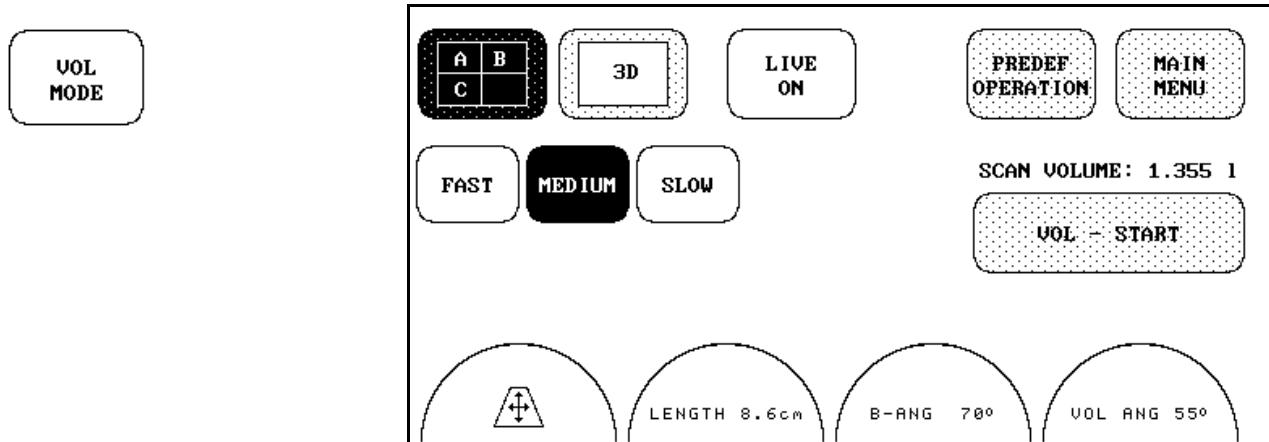
Sweep angle: 75°, 55°, 40°, 30°, 20°, 10°

### 7.1.3 B-Mode Volume acquisition

Condition: Volume-acquisition option is installed.  
 VOLUSON probe is connected selected.  
 adjust an optimum 2D-image before VOL-Mode is activate.

Operation:

1. activate VOL-Mode



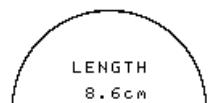
The VOL-Mode key is present in each B-mode main menu if a volume transducer is connected and selected.  
 The VOL-WRITE Menu appears at the touchpanel and the VOL-BOX is superimposed to the 2D image.

B-Mode image

VOL-BOX

Grafikname:  
 Erstellt in:  
 Erstellt am:

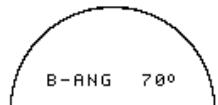
2. Select the VOL-BOX size and position



rotate the control to adjust the box length

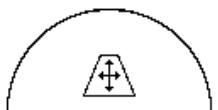
Remark: Each length is sampled by 512. Therefore select the least possible length in order to have highest resolution in axial direction.

## VOLUME MODE



touch the control to adjust the box angle (box with)

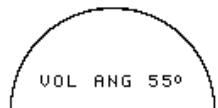
Remark: If feasible select a small angle in order to have a small volume, short sweep time.



adjust wanted position with trackball

Remark: The BOX position determines the depth range.  
This parameter determines the scan density within the volume:  
the smaller the depth range the lesser the necessary scan density leading to a shorter volume scan time and lesser amount of data to be processed.

### **3. VOL-angle (sweep angle)**



#### **VOL-ANGLE**

Sweep angle of the VOL scan orthogonal to the VOL-BOX.  
The selected VOL-angle is also displayed in the Sweep-Box at the bottom right of the screen.

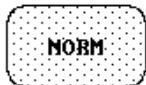
Remark:

- \* The VOL-angle may be adjusted only with certain probes (e.g. VSW 3-5). The "VOL-ANGLE" keys are only displayed on the touchpanel when the probe is designed for sweep selection.

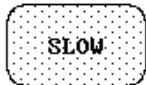
#### 4. Selection of scan time (scan density)



Fast VOL scan / low scan density  
This mode is selected only in case of expected movement artifacts.  
A loss of volume resolution will result.



Standard VOL scan / medium scan density



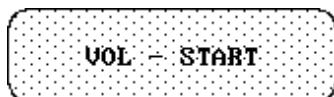
Slow VOL scan / high scan density  
This mode reveals the highest volume resolution. It is recommended to scan structures with (nearly) no movement.

Please note: The volume memory has 32 MByte capacity. If the capacity would be succeeded by certain settings, the scan density will be automatically reduced.

The scan acquisition time of a volume is displayed below the "FAST", "NORM", "SLOW" keys on the touchpanel.

**ACQUISITION TIME: 3.1 s**

#### 5. To start the volume scan



or



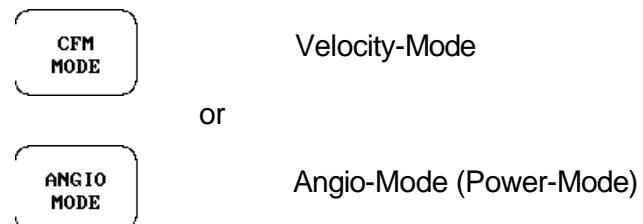
During the scan hold the transducer still. Upon completion of the volume scan the 3 orthogonal center planes are displayed, the transducer stops. The moving indicator in the Sweep-Box informs about the position of the B-image during the VOL-recording.

**IMPORTANT:** Observe the scan images in order to recognize movements or shadows, respectively. Only good 2D-images lead to good volume scan images.

#### 7.1.4 Color-Mode Volume acquisition

Condition: Volume-acquisition option is installed.  
Color+VOL capable probe is connected and selected  
(e.g. S-VDW5-8B)  
B-Mode active (Read or Write)

##### 1. Color-Mode activation



##### 2. Adjust optimum Color-Doppler image

For operation of Color-Doppler, please see Chapter 9.  
The Color-Box is at the same time the VOL-Box and surrounds the ROI which is recorded.

###### Remarks:

The Color-Frame Rate and the setting of the Persistence Filter strongly influence the duration of the volume acquisition.

The Color-Frame Rate depends on:

- Color Box: Therefor select a small box size, especially in lateral direction
- Color Density: As low as necessary for a good color image
- Color Quality: As low as necessary for a good color image
- CFM-PRF: As high as possible in order to just enable the display of the wanted flow velocity

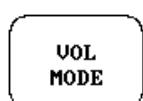
###### Persistence Filter:

- RISE: Filtering of Rise velocity leads to noise suppression and filtering (smoothing) of strong pulsating flows → even flow display in a rendered 3D-display.
- FALL: Leads to "Persistence" of the displayed flow and also to smoothing of the Color signal.

In order to avoid the transfer of color information from one B-image to the neighboring B-image in a volume display, the sweep velocity is reduced in accordance with the set filter time:

High Filter time: even flow display in a rendered 3D-display, but at the same time longer acquisition time.

### 3. Color-Volume Mode activation

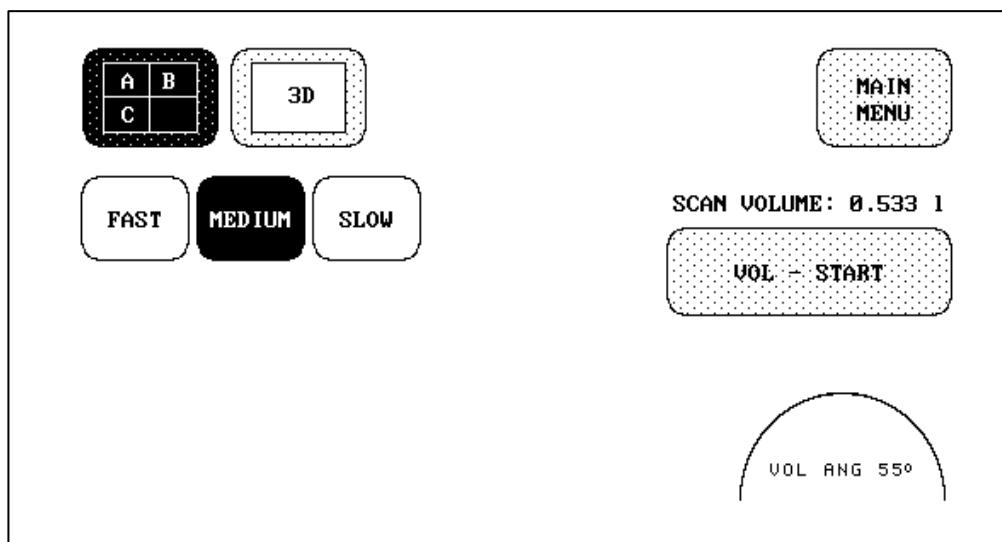


Touch key "VOL-MODE"

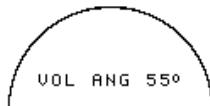
When activating VOL-MODE, the COL-VOL Write-Menu appears.

In CFM-Mode several blood flow codings are possible (see chapter 9.10.1. In a COL-VOL image only the Velocity display is possible.

When activating the VOL-Mode the Velocity display is automatically selected, if not already active.



### 4. Adjust VOL-ANGLE



#### VOL-ANGLE

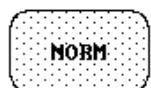
Sweep angle of the VOL scan orthogonal to the VOL-BOX. The image present on the screen is the center image of the sweep area.

Remark: The size of the selected angle is directly proportional to the acquisition time. Therefor, select small sweep angles.

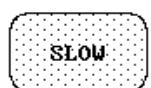
### 5. Selection of scan time



Fast VOL scan / low scan density  
A loss of volume resolution will result.



Standard VOL scan / medium scan density



Slow VOL scan / high scan density  
This mode reveals the highest volume resolution.

## VOLUME MODE

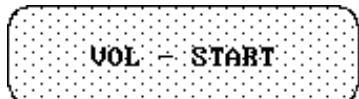
The scan acquisition time of a volume is displayed below the "FAST", "NORM", "SLOW" keys on the touchpanel.

**ACQUISITION TIME: 3.1 s**

This time is the active inscription time of the volume acquisition.

The acquisition time depends on the Color-Frame Rate, Persistence Filter, Sweep area and selected scan time.

### **6. To start the Color-Volume scan**



or



During the scan hold the transducer still. Upon completion of the volume scan the 3 orthogonal center planes are displayed, the transducer stops. The moving indicator in the Sweep-Box informs about the position of the B-image during the VOL-recording.

**IMPORTANT:** Observe the scan images in order to recognize movements or shadows, respectively. Only good 2D-images and good color quality lead to good volume scan images.

## 7.2 VOLUME ACQUISITION MANUAL (Freehand)

### 7.2.1 Principle

The acquisition is done by a steady movement of the probe over the region of interest. The B-images of the acquisition sequence are stored and put together to a volume data set. The acquisition geometry (position of the B-images within the data set) is pretended by the system. Due to the given geometry it is pretended how far and how long the probe has to be moved. The more exact the acquisition follows the given geometry the smaller are the distortions in the visualized sectional planes. The visualization of 2D and 3D images take place in the same way like after a acquisition with special volume probes.

Advantage of freehand acquisition:

- no special volume probe required
- no special measuring system for probe position required

Disadvantage of freehand acquisition:

- Only qualitative utilization of volume data sets possible because of possible distortions of the B-image positions. Therefor the measuring function is blocked.

**Important:**

After a acquisition the three orthogonal sectional planes A, B, C are displayed on screen. The position of the planes to each other calculated from the volume is predefined through the system (see diagram)

Sectional planes A, B, C

Display of A, B, C

Grafikname:  
Erstellt in:  
Erstellt am:

**Warning:**

**The freehand acquisition enables a movement of the probe in one or in the opposite direction. This fact produces when changing the movement direction that the orientation of B-plane is rotated by 180° round the vertical axis and C-plane is rotated by 180° round the horizontal axis.**

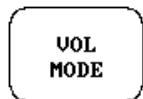
**It is within the province of the user to take care for the orientation!**

**Always use the same acquisition direction related to the probe's housing to have the always same orientation of screen display.**

### 7.2.2 B-Mode Volume acquisition

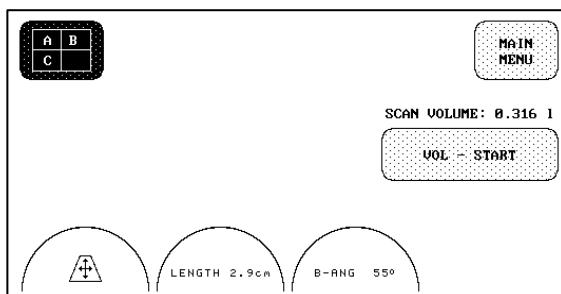
Operating:

#### 1. activate VOL-Mode

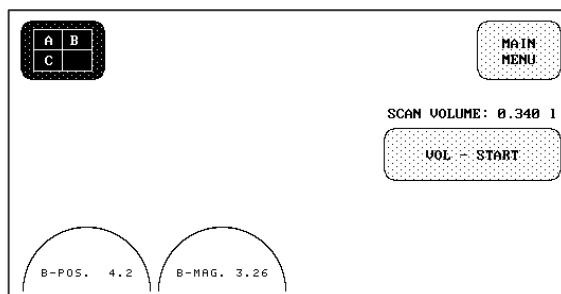


touch key "VOL MODE"  
the VOL-aquier menu appears

acquire menu: curved array probes



acquire menu: linear array probes



B-Mode image

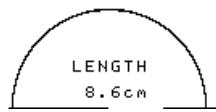
VOL-BOX

Grafikname:  
Erstellt in:  
Erstellt am:

Remark:

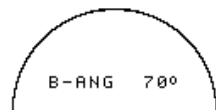
- The VOL-Mode key is present in each B-mode main menu if a volume transducer is connected and selected.
- Curved array probes: the VOL-BOX is superimposed to the 2D image. The box determines that part of image, that is stored during acquisition.
- Linear array probes: no VOL-BOX is superimposed. The whole image will be stored. Acquisition is only possible in Linear-Mode not in Vector-Mode (Trapezium-Mode).
- On right side on screen a pictogram of the volume scan geometry is superimposed with notification of acquisition time in sec and length in cm.

## 2. Select the VOL-BOX size and position

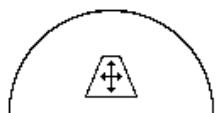


rotate the control to adjust the box length

remark: Each length is sampled by 512. Therefore select the least possible length in order to have highest resolution in axial direction.

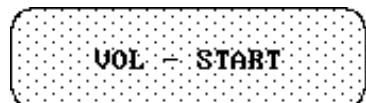


touch the control to adjust the box angle (box width)



adjust wanted position with trackball

## 3. To start the volume acquisition



or

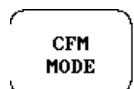


A short peep marks the start of acquisition. The moving indicator in the pictogram of the volume scan geometry informs about the position of the B-image during VOL-recording. Upon completion of the volume scan the 3 orthogonal center planes are displayed, the transducer stops

### 7.2.3 Color-Mode Volume acquisition

Condition:      Volume-acquisition option is installed.  
                    Color+VOL capable probe is connected and selected  
                    (e.g. S-ACP3-5, S-NLP5-10)

#### 1. Color-Mode activation



Velocity-Mode

or



Angio-Mode (Power-Mode)

#### 2. Adjust optimum Color-Doppler image

For operation of Color-Doppler, please see Chapter 9.

Curved array probes: The Color-Box is at the same time the VOL-Box and surrounds the ROI which is recorded.

Linear array probes: The whole B-Image will be recorded.

#### Remarks:

The Color-Frame Rate and the setting of the Persistence Filter strongly influence the duration of the volume acquisition.

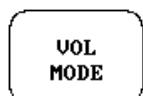
The Color-Frame Rate depends on:

- Color Box:      Therefor select a small box size, especially in lateral direction
- Color Density:   As low as necessary for a good color image
- Color Quality:   As low as necessary for a good color image
- CFM-PRF:          As high as possible in order to just enable the display of the wanted flow velocity
  
- Persistence Filter:
- RISE:              Filtering of Rise velocity leads to noise suppression and filtering (smoothing) of strong pulsating flows → even flow display in a rendered 3D-display.
  
- FALL:              Leads to "Persistence" of the displayed flow and also to smoothing of the color signal.

In order to avoid the transfer of color information from one B-image to the neighboring B-image in a volume display, the sweep velocity is reduced in accordance with the set filter time:

- High Filter time:   even flow display in a rendered 3D-display, but at the same time longer acquisition time.

### 3. Color-Volume Mode activation

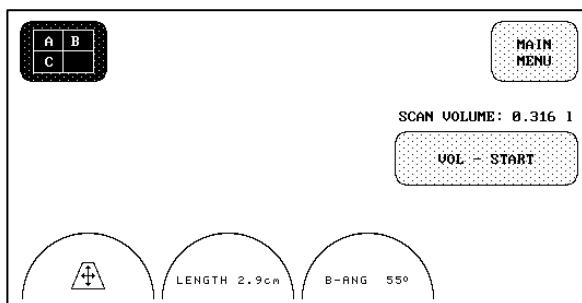


Touch key "VOL-MODE"

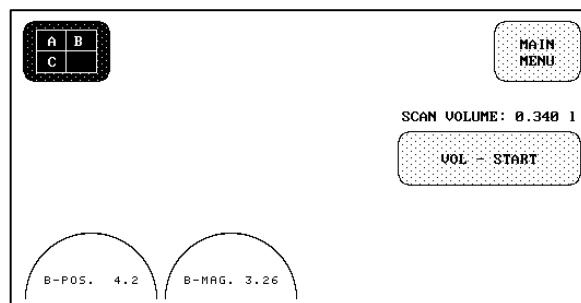
When activating VOL-MODE, the COL-VOL Write-Menu appears.

In CFM-Mode several blood flow coding are possible. In a COL-VOL image only the Velocity display is possible. When activating the VOL-Mode the Velocity display is automatically selected, if not already active.

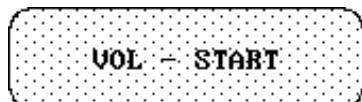
Acquire menu: curved array probes



Acquire menu: linear array probes



### 4. To start the volume acquisition



or



A short peep marks the start of acquisition. The moving indicator in the pictogram of the volume scan geometry informs about the position of the B-image during VOL-recording. Upon completion of the volume scan the 3 orthogonal center planes are displayed, the transducer stops

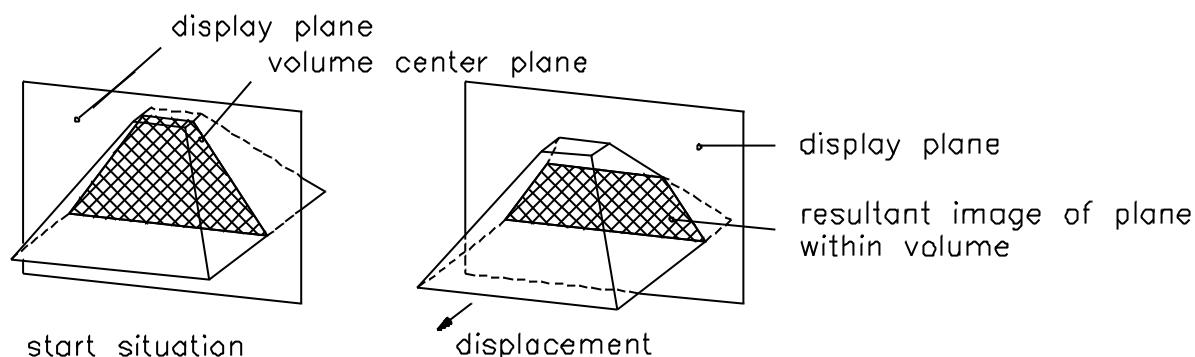
## 7.3 VOLUME DISPLAY - IMAGE ANALYSIS

### 7.3.1 Principle

The display-screen related system

The display screen shows that sectional plane located within the volume which has been selected by rotating and shifting of the volume body relative to the display plane.

Displacement of the volume body relative to the display plane:



Rotation of the volume body relative to the display plane:

The rotation can be about the X-axis or the Y-axis of the display plane, or the Z-axis which is normal to the display plane.

Start situation

Rotation (about X-axis)

Grafikname:  
Erstellt in:  
Erstellt am:

The position of the volume body relative to the display plane is determined by a relative coordinate system. This is made up of three orthogonal axes which common intersection is the 3-axial center of rotation. These axes are displayed within the display plane - exactly in the X-, Y- and Z-directions and colored. Rotation about any of these axes and displacement of the center of rotation along any of these axes make any imaginable plane within the volume body displayable. The INIT position of the volume body relative to the display plane is resettable; it is the start situation after completion of a volume scan.

The standard representation: 3 section mode

The 3 orthogonal sectional planes are simultaneously displayed on the quartered screen field of the monitor. Each quarter field displays a sectional view through the volume body as shown below.

Sectional planes A, B, C

Display of A, B, C

Grafikname:  
Erstellt in:  
Erstellt am:

The intersection lines between are displayed in colors:

AB = blue      AC = red      BC = yellow

Orientation of intersection lines on the screen:

Section/field	A	B	C
Intersection line AB	V	V	N
Intersection line AC	H	N	H
Intersection line BC	N	H	V

V = Vertical

H = Horizontal

N = Normal

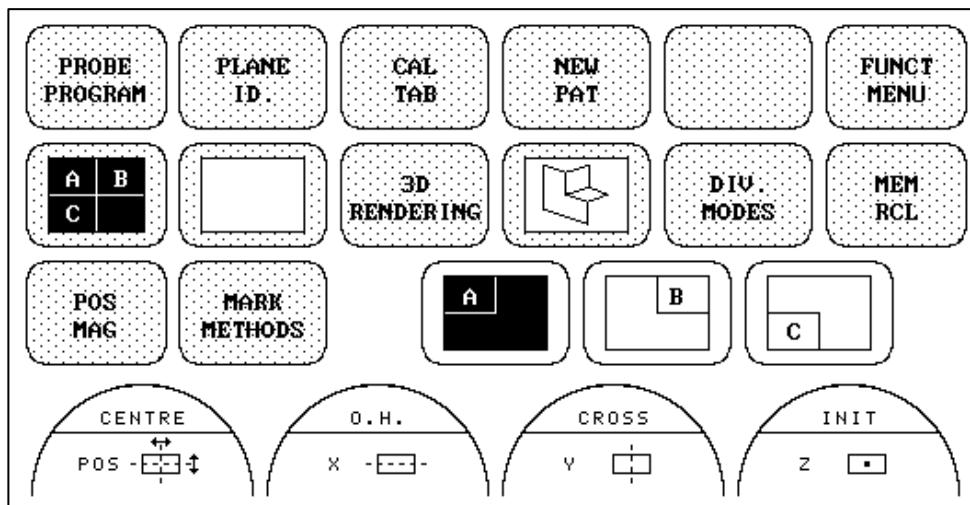
By this definition the position relation of the 3 images A, B, C is also defined (as made clear by the direction of arrows).

The presentation of 3 orthogonal sectional planes may lead to non-conformance with the conventional orientation to the patient as used in 2D-sonography. An identification system - the automatic display of the direction of section - will support clearness.

Please note: Whenever a usual longitudinal section (of the patient) is selected for display field A, the usual orientation for longitudinal and transverse sections is valid.

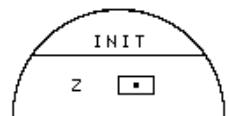
### 7.3.2 VOL-READ MENU

This menu appears after a volume scan is performed. It provides all control functions for the scan plane analysis.



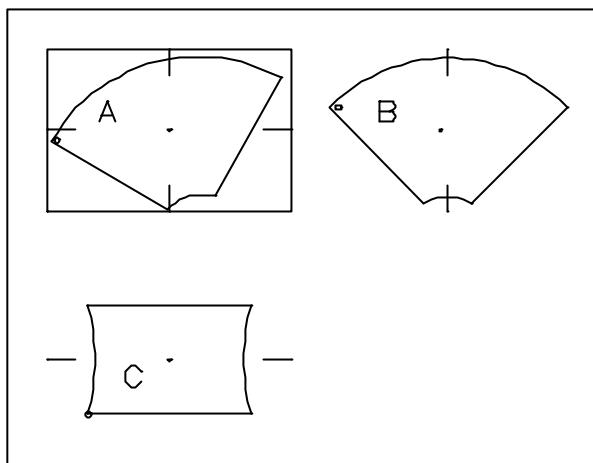
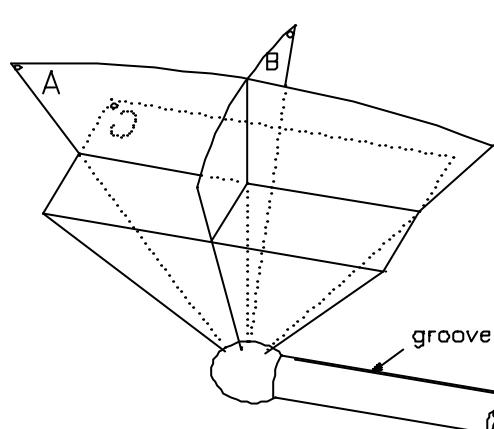
The description and operation of the keys is explained in chapters 7.3.3 through 7.3.13.

### 7.3.3 INIT-condition



Touching the INIT-key (semi-circle) resets the rotations and translations of a volume section to the initial (start) position, which automatically appears after a volume acquisition. The center of rotations lies in the middle of the central ultrasound line (in the middle of the scanned volume body respectively).

### 7.3.3.1 INIT-condition of transrectal probe S-VRW 77AK

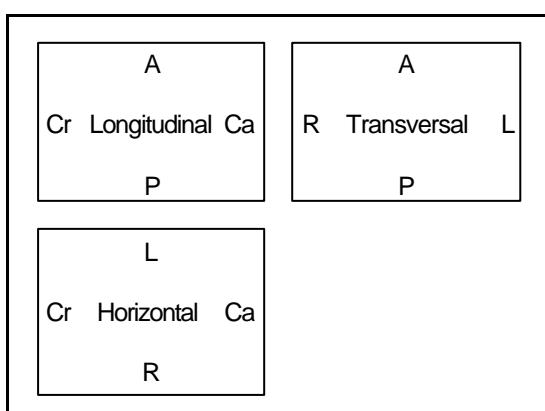


The sectional image B represents that 2D image, from which the volume acquisition was started. The volume acquisition is performed by sweeping the A-sections. The central axis of the probe shaft is perpendicular to the B-image.

Remark: The symmetrical axis of image A is inclined 15° to the sectional plane of image B. During the volume scan these sections are represented symmetrically on the screen.

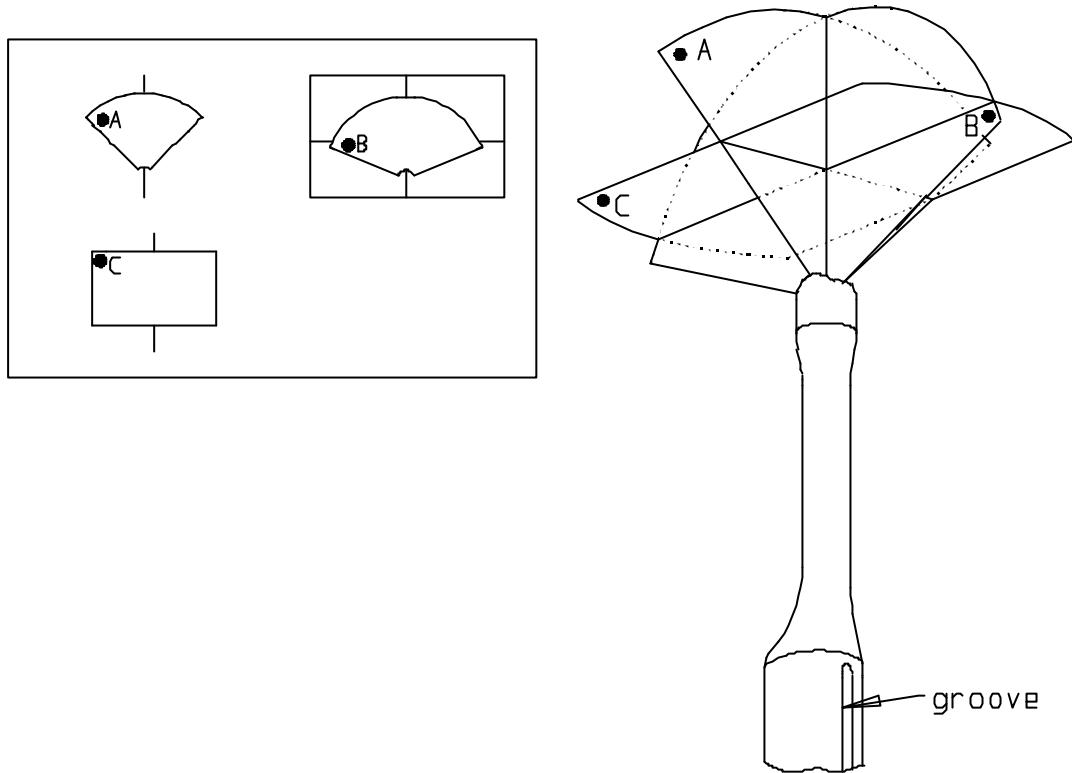
Grafikname:  
Erstellt in:  
Erstellt am:

If the VOL-start image is a transverse section of the prostate (right side of the patient is left side on the screen), the following INIT-positions are obtained:



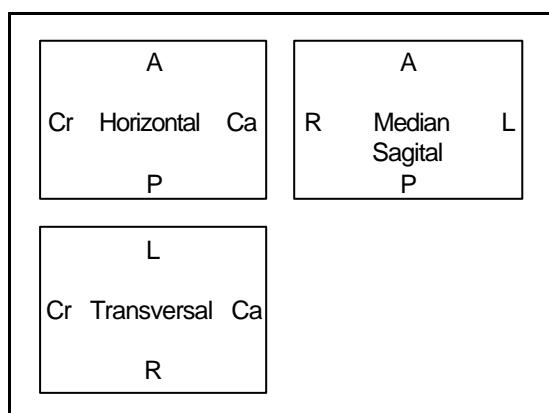
A ..... anterior (ventral)  
P ..... posterior (dorsal)  
Cr ..... cranial  
Ca ..... caudal  
R ..... right  
L ..... left

### 7.3.3.2 INIT-condition of probe S-VDWxxx



The sectional image B represents that 2D image, from which the volume acquisition was started.

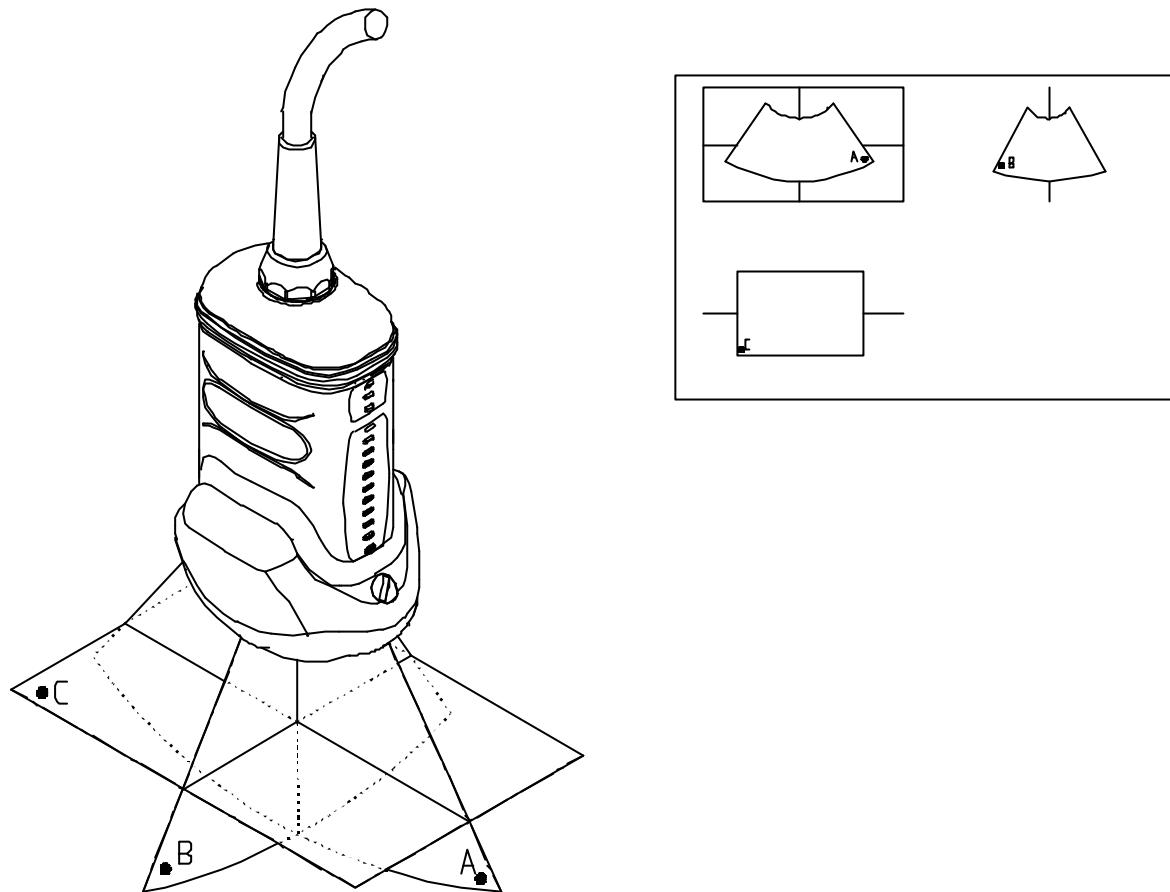
If the VOL-start image is a median-sagittal section (left side of the screen is anterior), the following INIT-positions are obtained:



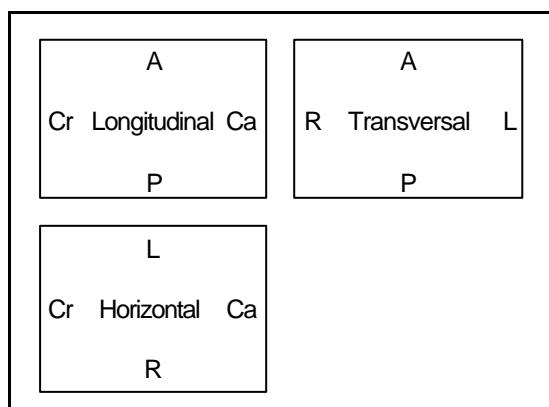
A .....	anterior (ventral)
P .....	posterior (dorsal)
Cr .....	cranial
Ca .....	caudal
R .....	right
L .....	left

Remark: The position of the B-image plane in relation to the probe is determined by the central axis and the groove in the shaft.

### 7.3.3.3 INIT-condition for probe type S-VSWxxx and VAWxxx

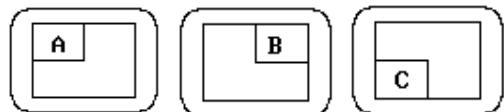


The sectional image A is at the same time the starting image for the volume recording.  
 If the VOL-start image is a longitudinal section (Cr on the left of the screen), the following INIT-positions are obtained:



A ..... anterior (ventral)  
 P ..... posterior (dorsal)  
 Cr ..... cranial  
 Ca ..... caudal  
 R ..... right  
 L ..... left

### 7.3.4 Choosing a reference image

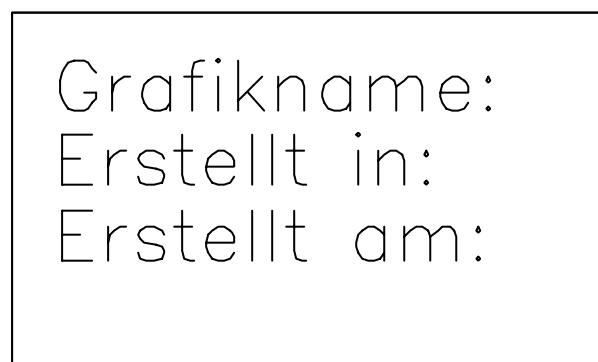


Section A, B or C is the reference image

Choosing a reference image automatically determines the control functions of the rotary controls and the trackball for the liberal adjustment of a sectional plane. With simultaneous displays of the sectional planes A, B and C (3-section mode) the one chosen for reference is marked by a green frame. If a single sectional plane A, B or C is displayed (full-screen mode, arbitrary plane mode), this is the reference image. The reference image may be changed.

### 7.3.5 Selecting a sectional plane

For the adjustment of an arbitrary sectional plane 6 independent control functions are necessary, i.e. for 3 rotations and 3 rectilinear movements.



The large rotary control is not contained in the touchpanel designations.

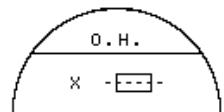
- |                     |   |
|---------------------|---|
| 1 : rotary control: | Rotation about X-axis of the reference image        |
| 2 : rotary control: | Rotation about Y-axis of the reference image        |
| 3 : rotary control: | Rotation about Z-axis of the reference image        |
| 4 : rotary control: | Movement along Z-axis of the reference image        |
| 5 : trackball:      | Movement along X- and Y-axis of the reference image |

Rule: The control elements are always corresponding with the reference image and effective in the way described.

### 7.3.5.1 Rotations

While turning a rotary control the corresponding axis is inserted into the reference image as a line (X- or Y-axis) or as a cross (Z-axis).

Rotations about any one of the axes X, Y and Z can be performed liberally.

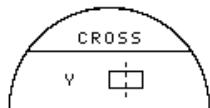


Rotation about X-axis of reference image (e.g. A)

Clockwise turn of rotary control 1:

Grafikname:  
Erstellt in:  
Erstellt am:

By the clockwise turn of the volume body relative to the screen plane (as shown) the new sectional planes are calculated in real time and displayed on screen.

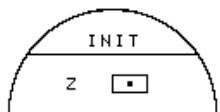


Rotation about Y-axis of reference image (e.g. A)

Clockwise turn of rotary control 2:

Grafikname:  
Erstellt in:  
Erstellt am:

By the clockwise turn of the volume body relative to the screen plane (as shown) the new sectional planes are calculated in real time and displayed on screen.



Rotation about Z-axis of reference image (e.g. A)

Clockwise turn of rotary control 3:

Grafikname:  
Erstellt in:  
Erstellt am:

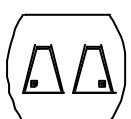
By the clockwise turn of the volume body relative to the screen plane (as shown) the new sectional planes are calculated in real time and displayed on screen.

Important notes for the user:

- Rotation should be performed slowly to keep the orientation.
- Do not rotate by large angles except the orientation left/right or up/down is to be changed. At 90° rotation about an axis the sections A, B, C will change:
- Reference image e.g. A:
  - X-axis: A ↔ C
  - Y-axis: A ↔ B
  - Z-axis: B ↔ C
- Before performing a rotation position the center of rotation at that part of the image, which you don't want to loose.

The image orientation keys:

These two keys have still their function, despite of the possibility to achieve any intended orientation by use of the rotary controls.



Orientation left/right  
Activating this key changes the left/right orientation of the reference image or in other words, it rotates about the Y-axis by 180°.



Orientation up/down  
Activating this key changes the up/down orientation of the reference image or in other words, it rotates about the X-axis by 180°.

### 7.3.5.2 Rectilinear movements

The rectilinear movements allow a displacement of the center of rotation along the intersection lines of the sectional planes A, B and C.

The displacement of the center of rotation leads to the display of parallel sectional images.

## VOLUME MODE

To perform parallel slicing of images rotate the rotary control 4 (large rotary control).

Clockwise turn of rotary control 4:

Grafikname:  
Erstellt in:  
Erstellt am:

Reference image: A

The sectional plane migrates from the front to the rear through the volume body

Grafikname:  
Erstellt in:  
Erstellt am:

Reference image: B

The sectional plane migrates from the left to the right through the volume body.

Grafikname:  
Erstellt in:  
Erstellt am:

Reference image: C

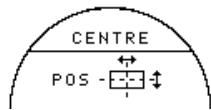
The sectional plane migrates from the top to the bottom through the volume body

### Important note:

The terms "front, left, top" etc. are not orientated to the patient, but serve for explanation. Of course the "patient" can be rotated to achieve the position described.

By parallel movement of the reference image the new intersection lines will be displayed with the non-reference images. The sectional planes of the non-reference images are not altered.

Positioning of the center of rotation in the reference image:



The center of rotation can be X/Y-positioned by the trackball. This causes also a parallel displacement of those planes presented by the non-reference images. The intersection line of the non-reference images with the reference image will undergo a parallel X or Y shift accordingly.

- IMPORTANT:**
- Positioning the center of rotation in the reference image marks that point which will not get lost during the rotation.
  - It is recommended to use the rotary control 4 (large knob) together with the reference selection for the performance of parallel sections. In this mode only one image is concerned by changes, leading to a higher image transfer rate.
  - Performing parallel sections is simple and easy to understand and therefore should be preferred for a detail exploration of an object.

System feature:

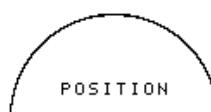
The center of rotation cannot leave the display field A, B or C. In case an intersection line reaches the field border, the line will stay there and the image (with further shift) will continue to move in the shift direction. This is especially helpful when due to magnification the display field is small compared with the area of the plane to be observed.

### 7.3.6 Image position, magnifier

By this function the position and the aspect ratio of a reference image A, B or C relative to the display field is determined.



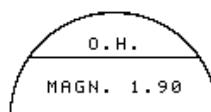
Activation of position and magnifier.  
The key is brightened and the rotary controls determined.



display field.

By means of the trackball the reference image is shifted and positioned in X- and Y-direction, respectively. The center of rotation is naturally also shifted. When an intersection line reaches the border of the display field it will stay there and the image further shifted.

Thus the center of rotation will always stay on the

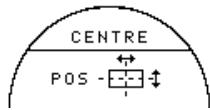


By means of rotary control 1 all sectional images A, B and C will be magnified from the center of rotation.



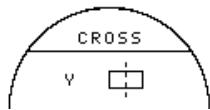
After the image is positioned and/or magnified, touch key POS/MAG again in order to relate again the rotary controls to rotations and rectilinear movements.

### 7.3.7 Centering function



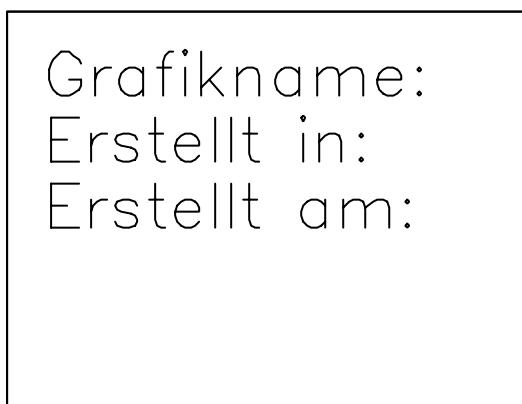
Touching the semi-circle leads to positioning /centering of the center of rotation of the reference image into the center of the display field.

### 7.3.8 Cross-line function

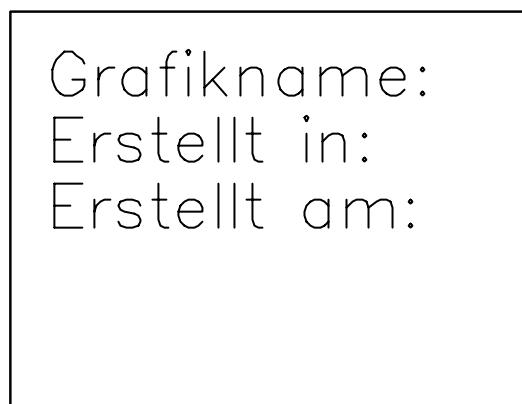


By touching this semi-circle (acts as toggle-switch) one can select between 2 different display modes of the intersection lines.

Mode 1



Mode 2



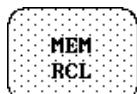
The intersection lines are only marked and the center of rotation shown as a dot. In the non-reference images only the intersection line with the reference image is marked.

Benefit: the ultrasound image is barely distorted by graphics. The center of rotation dot allows for exact positioning to interesting areas in the reference image.

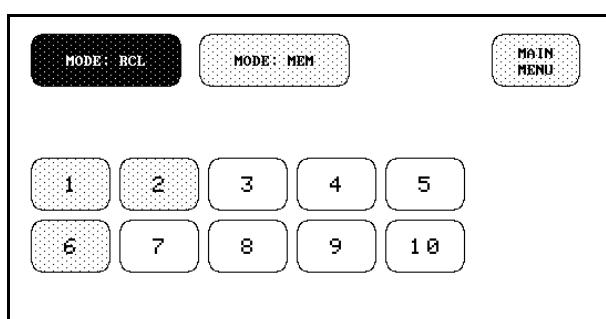
The intersection lines are displayed as interrupted lines in the 3 sectional images.

Benefit: ease of positioning the line cross onto the intended center of rotation

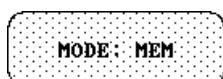
### 7.3.9 MEM/RCL Function



This function provides storage in the memory of up to 10 different sets of information i.e. geometric data and display data which describe a sectional plane. The sectional plane images are then automatically displayed when recalled. Upon touching the key the submenu appears (the rastered keys indicate occupied memory sections):



Memory:

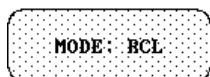


1. Touch key for activation
  
2. Touch a key (1 to 10) without raster. The actual images are stored and the main menu VOL READ appears. A rastered key indicates an occupied memory section (data stored).

Note:

If a rastered key is touched the display shows the question if the stored data may be erased. If "YES" is keyed the new data will substitute the stored ones. If "NO" is keyed new data will not be stored.

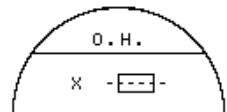
Recall:



1. Touch key for activation
  
2. Touch a key (1 to 10) with raster. The sectional plane images will be displayed with their original settings.
  
3. For another plane touch another rastered key, or back to VOL main menu with

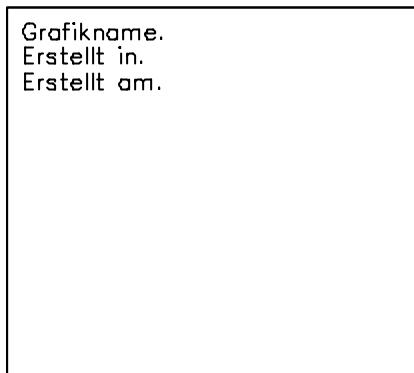


### 7.3.10 Orientation help image (O.H.)



The orientation help image is only displayed in the lower right quadrant in 3-section mode.

The volume body is shown in a somewhat simplified way (arcs substituted by straight lines). The help image figure shows the intersections of a plane with the volume body by green lines.



Intersections → green lines

Simplified volume body

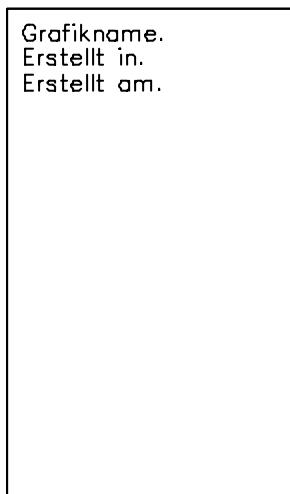
Touching the O.H. semi-circle activates/deactivates the orientation help image. Please note that the cone of the transvaginal 3D-volume transducer looks hexagonal. When the O.H. image is deactivated, the transfer time from the memory is a little shorter.

The orientation of the O.H. image on the screen: probe type

S- VWxxx

S-VRWxxx

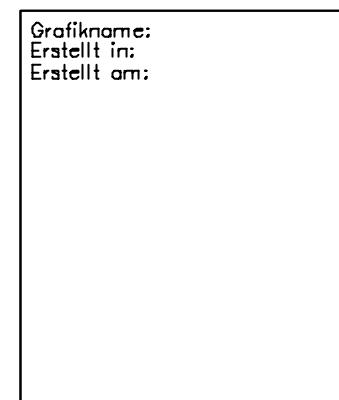
S-VDWxxx



Reference image A



Reference image B



Reference image B

Note: The orientation help image shows only the position of the actual reference image plane within the volume body without direct relation to the patient.  
For patient-related orientation, please see next page.

### 7.3.11 Identification of sectional planes

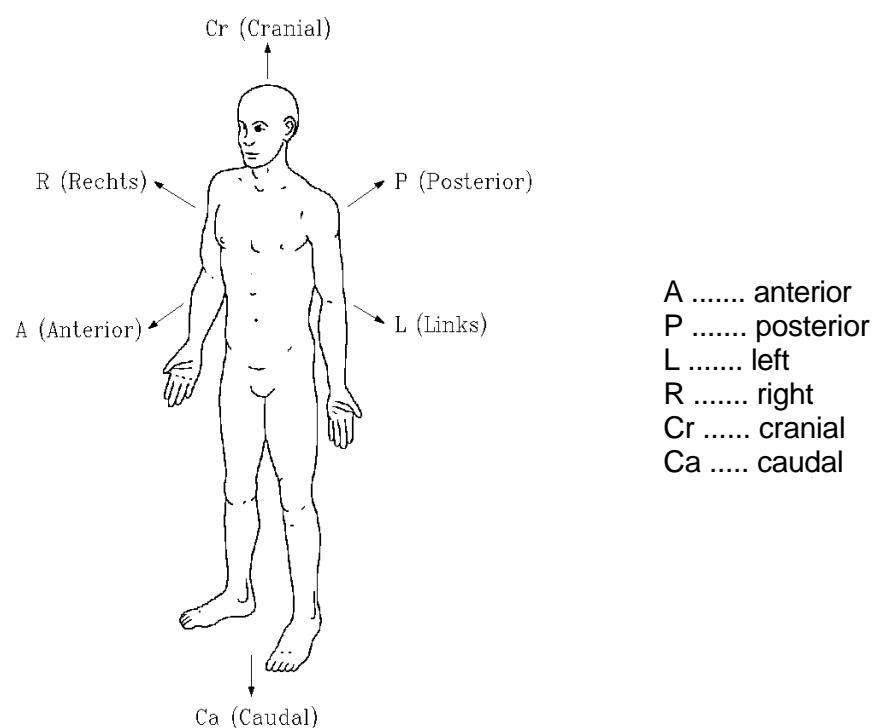
#### 7.3.11.1 Principle

With this function it is possible to insert patient-oriented shortcuts to the sectional planes, which indicate the direction of the axis. The entry of the position data of the probe relative to the patient should be done after a volume scan. After entry is completed, the sectional images will be automatically marked.

Grafikname:  
Erstellt in:  
Erstellt am:

The superposition of positional marks is made by defined characters at the image edge.  
This display defines the direction of the axes of the relative coordinate system in relation to the patient.

Definition of directions:



In addition to the six main directions also intermediate positions between two (three) main directions will be displayed. The display takes place by combination of the two (three) characters of the main directions:

e.g. A Cr (Anterior-Cranial)  
A R Cr (Anterior-Right-Cranial)

Direction of the probe

The direction of a probe in relation to the patient is defined as follows:

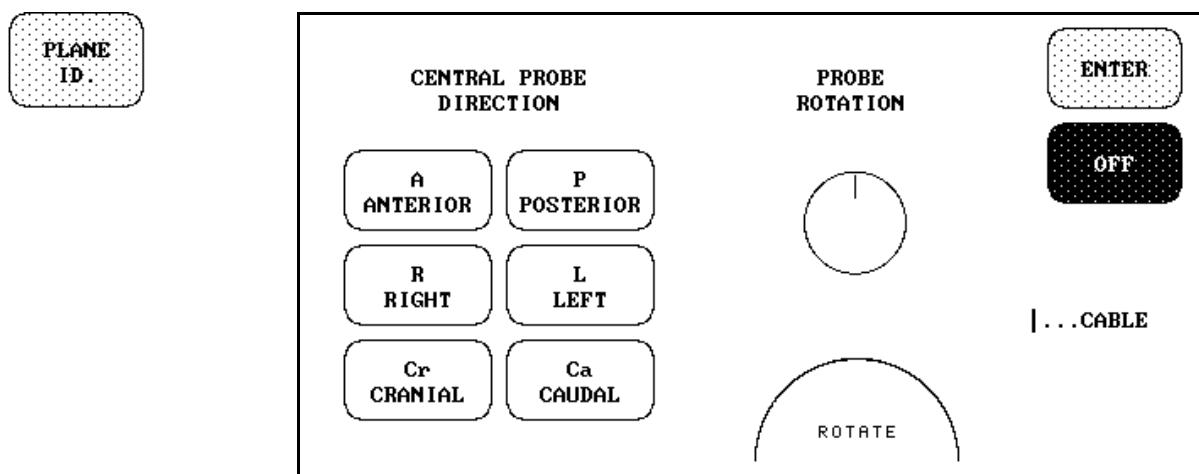
1. by the denomination of the probe's central directions.
2. by rotation of the probe about the central direction.

After the entry the software calculates the direction of the sectional images in relation to the patient and superimposes the short denominations at the images.

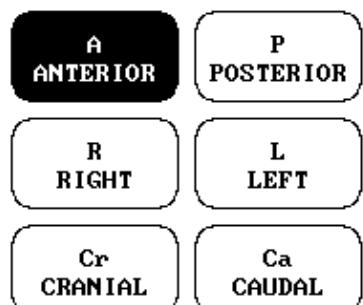
**7.3.11.2 Operation**

Condition: volume acquisition completed,  
VOL-Read menu present on the touchpanel.

1. Activate the identification of sections



2. Enter the central probe direction of the volume scan



Each key represents a main direction of the patient. Each key can be switched on resp. off, allowing for entry of intermediate positions

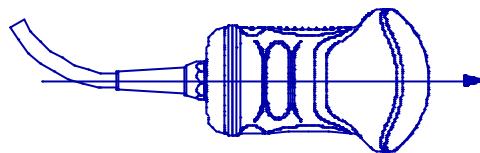
**Rule:** One must enter the entrance direction of the center direction into the body!

**Example:** With the S-VAW probe applied anterior and not tilted, the center direction of the probe is anterior towards posterior. The entrance direction is anterior. Entering by key on. All the other keys must be off!

Definition of the center directions of probes:

Model:

S-VSWxxx, S-VAWxxx



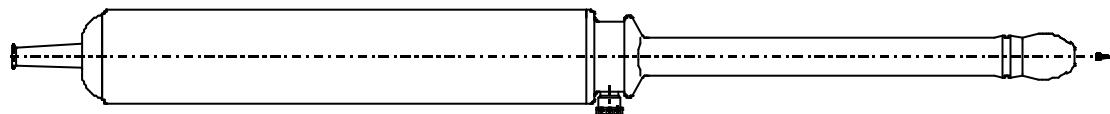
The center direction is also the center ultrasound line of the volume scan.

Model: S- VDWxxx, S-VNAxxx

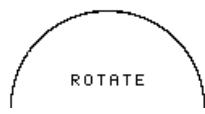


The center direction is also the center ultrasound line of the volume scan.

Model: S-VRWxxx

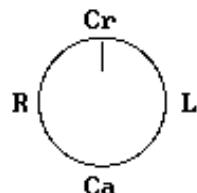


### 3. Enter the probe rotation about the center direction



Rotating the control sets a small dash marker within the "clock symbol" in 5-minute steps. The marker corresponds either to the groove in the shaft (models: VRW, VDW) or the filling screw (model VSW, VAW).

PROBE  
ROTATION



The clock symbol refers to a section of the body to which the center direction of the probe stands normal. The marker is to be set to a position where the cable or the groove of the probe shaft or the filling screw is located during the volume acquisition.

## VOLUME MODE

### 4. Confirm the entry



Upon touching the "ENTER" key the screen will display the direction definitions of the A, B and C sections. The touchpanel shows the VOL-Read Menu.

Further:



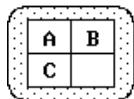
Upon touching the "OFF" (delete) key, the direction definitions disappear, the probe position however is held. Touching the "ENTER" key again will restore the direction definitions in the image.

The identification data of sectional planes are part of a volume data set and therefore they will be saved on disk and also reloaded together with the volume data.

Important: It should become routine to enter the identification of sections immediately after a volume scan. The display of section identification takes place only in 3-section mode and full-size image mode, not in oblique aspect mode.

### 7.3.12 Modes of image display

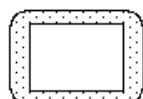
#### 7.3.12.1 3-sections mode (standard display mode)



This display mode is automatically active after a volume scan, or upon touch of the 3-sections key ("ON"-switch). The 3 sectional planes A, B and C are standing normal on each other.

The intersecting lines of the planes are the axes of the relative coordinate system and they are displayed in colors in the different images planes. This display mode is basic for the other display modes.

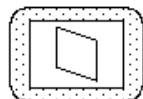
#### 7.3.12.2 Full-size image mode



Touching the full-size image key will magnify x2 and display the reference image A, B or C.

For the free plane selection the same rules as for 3-sections mode apply. The graphic display of the orientation help is not possible.

#### 7.3.12.3 Spatial Aspect Mode



By touching the Spatial Aspect key the reference image A, B or C is magnified x2 and displayed in full-size on the monitor.



If this key is not available in the main menu, touch key and select key in the appearing sub-menu. This display mode is especially apt for quick orientation (rear/front, right/left) by selecting the reference image and adjustment of parallel sections. The location of the A, B and C-section in relation to each other is especially clear in this mode. For a liberal selection of sections the same rules as for the 3-sections mode apply.

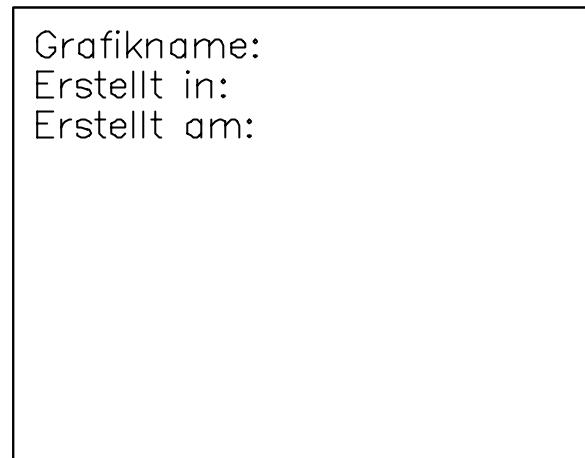
Grafikname:
Erstellt in:
Erstellt am:

The following functions are excluded with this mode: measuring, identification of sections and orientation help image.

### 7.3.12.4 Niche display mode

Principle:

Parts of the orthogonal sections A, B and C are compiled to a 3D-section aspect. The name niche has been selected because the aspect shows quasi a spatial cut into the reference image.

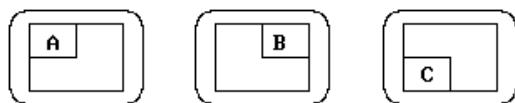


The following kinds of niche display are possible:

Reference image: A, B		Reference image: C	
1st quadrant	2nd quadrant	1st quadrant	2nd quadrant
<p>Grafikname Erstellt in Erstellt am</p>	<p>Grafikname Erstellt in Erstellt am</p>	<p>Grafikname: Erstellt in: Erstellt am:</p>	<p>Grafikname: Erstellt in: Erstellt am:</p>
3rd quadrant	4th quadrant	3rd quadrant	4th quadrant
<p>Grafikname Erstellt in Erstellt am</p>	<p>Grafikname: Erstellt in: Erstellt am:</p>	<p>Grafikname: Erstellt in: Erstellt am:</p>	<p>Grafikname: Erstellt in: Erstellt am:</p>

**Operation:**

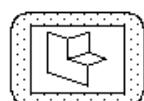
1. Select the reference image



2. Position the niche section in the reference image.

Adjustment is done by positioning the sectional axes with the trackball in the reference image.

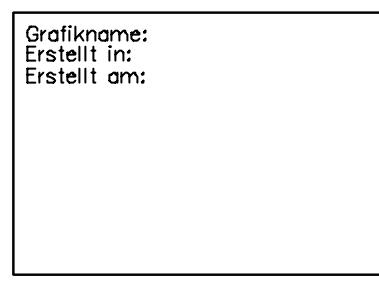
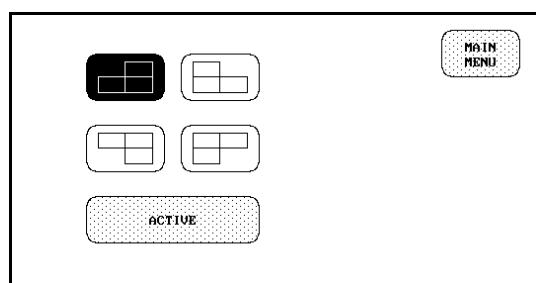
3. Activate the niche display mode



The niche enable mode is active and the touchpanel displays the sub-menu for the quadrant selection of the reference image.

Touchpanel

Screen: e.g. reference image A selected



In the sectional images A, B and C those image parts are framed green which will be compiled to form the niche display. The position of the sections is determined by the location of the coordinate axes.

4. Select the location of the niche



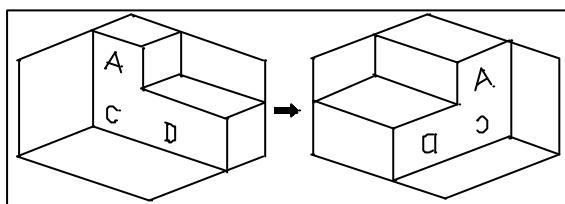
5. Touch key "ACTIVE".

The niche display appears on the monitor and the VOL main menu appears on the touchpanel.

6. By real-time modification of the coordinate system by rotation and translation the niche position can be altered. The same rules as with the 3-sections mode apply.

Remark: The reference image plane separates the volume block into two parts.

One can determine by the left/right position selection into which half the niche cuts in. 

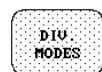
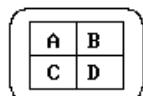


Once the view from one side, on the other hand the view from the other side to the volume block results.

The following functions are excluded with this mode:

- measurements
- identification of sections
- display of orientation help

#### 7.3.12.5 4-sections mode



If this key is not available in the main menu, touch key and select key in the appearing sub-menu.

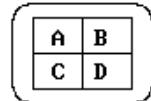
This display mode is nearly identical to the 3-sections mode. instead of the orientation help image a fourth sectional image is shown. This sectional image is a 2D-image of the volume scan. The position of the 2D-image is determined by the center of rotation (=intersection of the 3 rotation axes).

##### Usefulness:

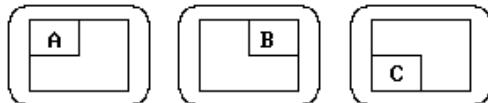
Shadowing (e.g. shadow of a concrement) or enhancing (e.g. due to a fluid-filled cyst) result in difficult interpretation of C-sections (which are normal to the direction of insonation). By placing the center of rotation in a shadow or enhancement zone the corresponding 2D-image of the volume acquisition will be presented in the D-image of the 4-sections mode. This allows for interpretation of the shadow respectively the enhancement as the "sound history" beginning from the probe's surface is visible on image D.

## Operation:

1. Activate the 4-sections mode:



2. Select the reference image:



3. Position the center of rotation in the reference image by means of the trackball. During the positioning the 2D-scan images are displayed on the screen.

Note:

The intersection line of the 2D-image with the reference image is displayed by a dotted green line. The angle of the 2 sectional planes to each other is not displayed.

Grafikname:	
Erstellt in:	
Erstellt am:	

Example:  
Reference image is the C-image

dotted green line

Magnification (diminution) as well as positioning of the D-image is not possible. The size is such that the entire depth range of the 2D-image is displayed.

Measurements in the D-image are not possible.

The rest of the control procedures is identical to the 3-sections mode.

### 7.3.13 Marking methods

Principle:

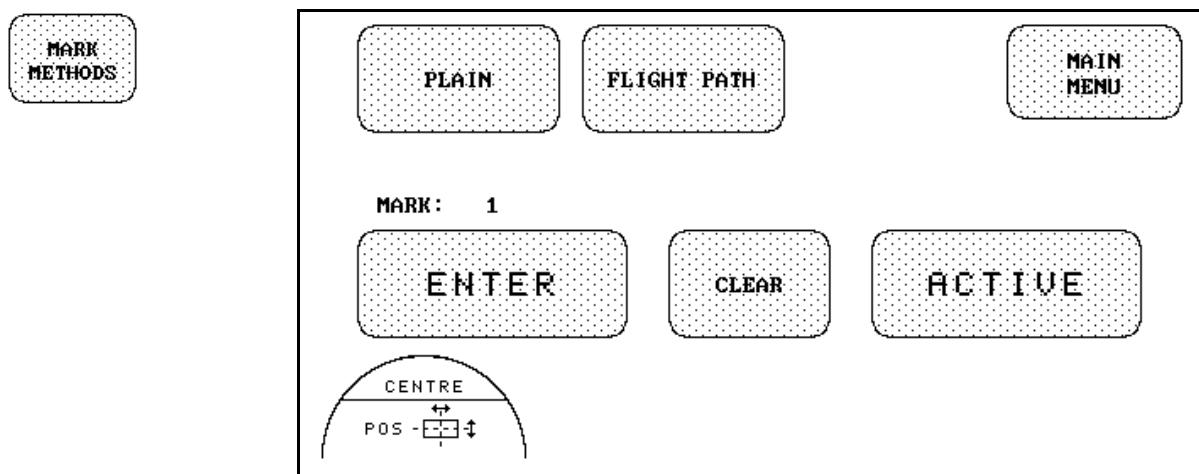
Here the term "marking methods" means the liberal selection of sections by setting markers in the volume block. At present, two possibilities of producing sections are provided:

- Plane: Determination of a plane by setting 3 dots.
- Flight path: Determination of a line in space by setting of 3 to max. 20 dots. Flying along the line will produce sectional images which stand normal to the line. The line leads through the center of rotation of the sectional images. The orientation of the sectional images about the Z-axis is performed by rotary control 3.

#### 7.3.13.1 Plane (3-dots method)

1. Activate marking methods

The sub-menu for marking methods appears on the touchpanel..



2. Touch the "PLANE" key, if not already active.
3. Produce parallel sections of the reference image by means of rotary control 4 (large knob). Adjust that sectional image within which the first dot is to be set.
4. Position the center of rotation to the place for the first dot.
5. Touch key "ENTER".
6. Adjust and enter the 2nd and 3rd dot the same way.
7. Upon entering the 3rd dot, touch the "ACTIVE" key.

The new sectional image appears on the screen, its location defined as described:

Grafikname:  
Erstellt in:  
Erstellt am:

Dots 1, 2 and 3 describe a triangle. The center of the triangle is the new center of rotation. The side 1...2 is displayed parallel to the X-axis of the screen.

The main menu "VOL-READ" appears.

Additional function:    - The "CLEAR" key deletes the last entered dot.  
                             - Key "MAIN MENU": provides exit from the plane entry, the dots are deleted.

Remark: The marking methods are only possible in 3-sections mode resp. in full-size mode. In case another mode is active, an automated switching to the 3-sections mode will happen. After selection of a section by the 3-dots method the "VOL-READ" menu with the standard operations will appear.

### 7.3.13.2 Flight path

1. Touch the "MARK METHODS" key, the sub-menu for the entering of the flight path dots appears.
2. Touch the "FLIGHT PATH" key, if not already active.
3. Use rotor control 4 (large knob) to produce parallel sections of the reference image - select a plane to enter the first dot.
4. Enter the 1st dot by positioning the center of rotation to the appropriate place, and touch "ENTER".
5. Repeat the procedures under 3. and 4. until the last dot of the flight path is marked.
6. Touch the "ACTIVE" key.  
 The first section through the start point of the flight path appears in the reference image. The green line at the right bottom of the screen corresponds to the length of the flight path. The little yellow line represents the position of the reference image relative to the flight path.  
 The "VOL-READ" main menu appears.  
 Instead of key "MARK METHODS" the key "FLIGHT PATH" appears and is activated (backlit).
7. The large rotary control 4 serves to call up the sectional images along the flight path.

8. The position of rotation about the Z-axis may be corrected anytime (rotary control 3).
9. Switch off function "FLIGHT PATH".  
Tough key "FLIGHT PATH" in the main menu. Instead of this key the "MARK METHODS" key appears.

Additional functions:

- The "CLEAR" key serves for deletion of the last entered dot.
- The "MAIN MENU" provides exit from the line entry, the dots are deleted.

The following functions are inoperative in the flight path mode:

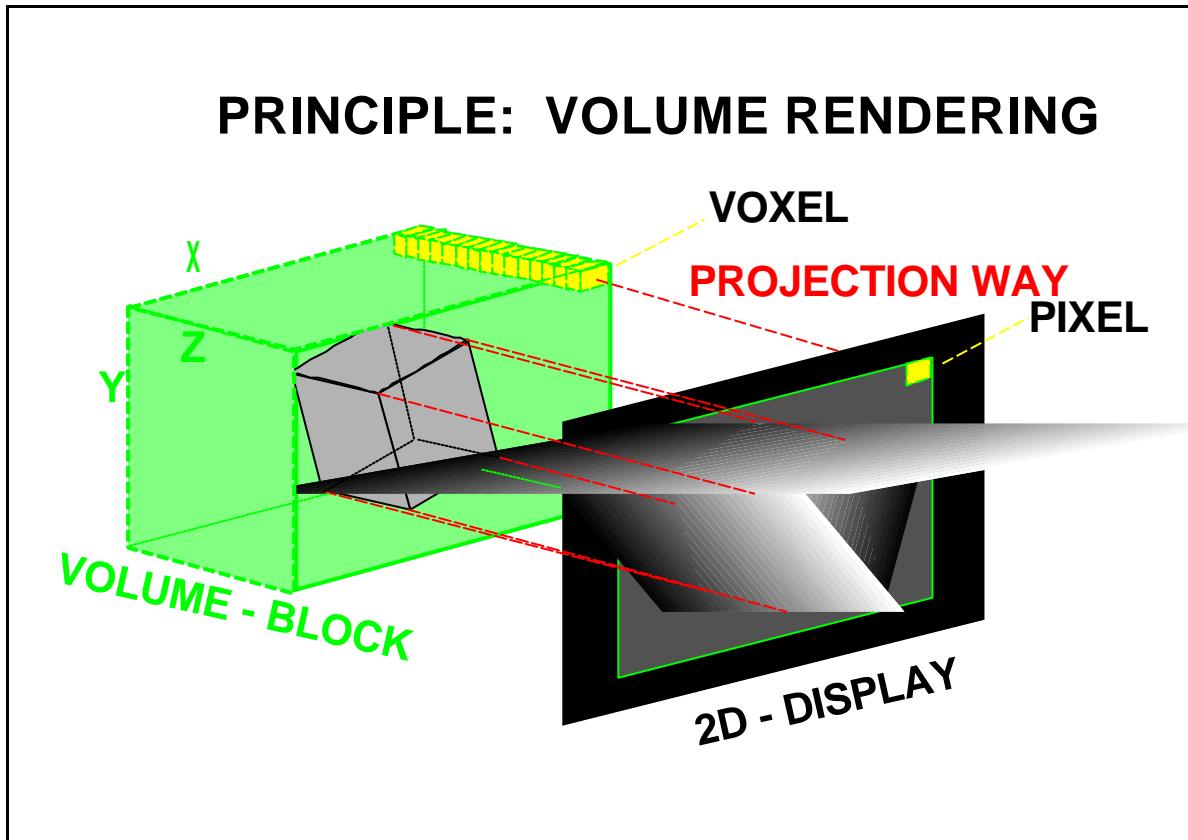
- Magnification/diminution and image position.  
The image size set before activating flight path remains. The image position is determined by the dot for the flight path displayed in the center of the image.
- Rotation about X-axis resp. Y-axis of the reference image.  
The rotations are calculated so that the sections always stand normal to the flight path. The Z-direction is alterable.

## 7.4 INTERACTIVE VOLUME RENDERING

### 7.4.1 Principle explanations

#### 7.4.1.1 What is VOLUME RENDERING?

The VOLUME RENDERING is a calculation process to visualize certain 3D-structures of a scanned volume with help of a 2D-image. The gray value for each pixel of the 2D-image is calculated from the voxels along the corresponding projection way (analyzing beam) through the volume. The render(calculation) algorithm -surface or transparent mode- decide which 3D-structures are visualized.



#### 7.4.1.2 What is "INTERACTIVE"

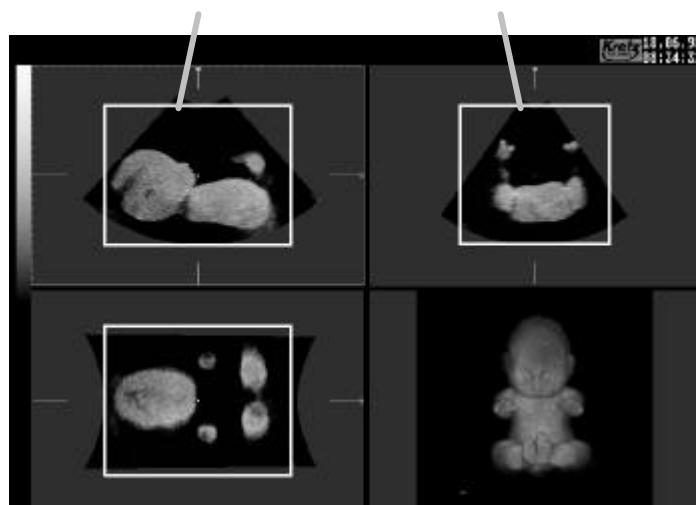
Interactive means, that every operation/adjustment concerning the result of the rendering process can be followed in realtime. The fast hardware and intelligent software enables calculation of 2 to 10 rendered pictures per sec. dependent of the size of the render box. After an operation step the result is rendered with a lower resolution for speeding up the interactive feedback and when no operation take place the result is rendered in high resolution.

#### 7.4.1.3 The "RENDER BOX"

For a good 3D-picture following three points are very important (similar to a photography):

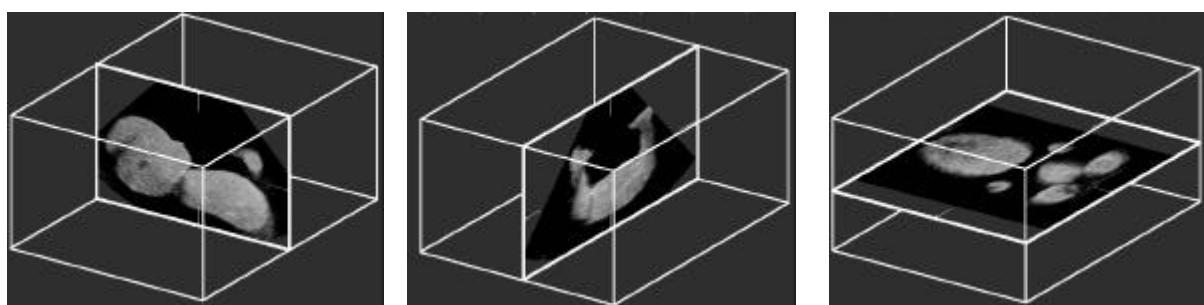
- the direction of view
- the part/size of view
- free sight to the object (surface mode)

This has to be adjusted with the render box. The render box determines the size of volume to be rendered. Therefore objects which are not inside the box will not be included in the render process and cut out (important for the surface mode to cut off objects, which interfere with a free sight). The positioning of the box inside the scanned volume is done with help of the orthogonal sectional planes A,B and C, which cut through the box in the middle each. Look at the following diagram to understand how the render box determines the direction of the view. The green line marks the render start area.

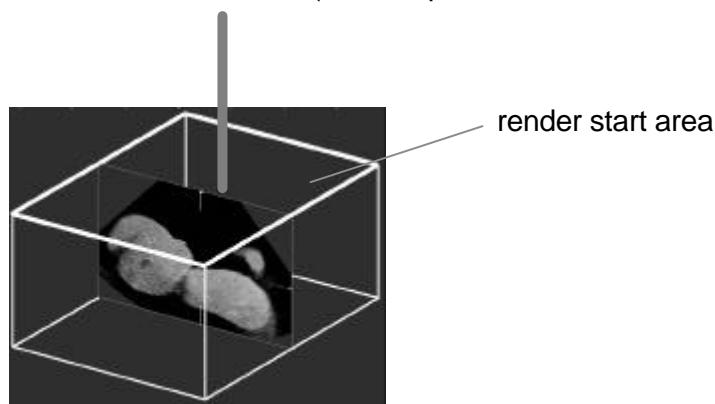


Presentation of the render box on screen

The displayed graphic boxes represent the intersection area between the render box and the corresponding sectional planes.



**View direction:** view direction is the same like scan direction during acquisition.  
(Volume probe looks onto the object of interest like a camera)

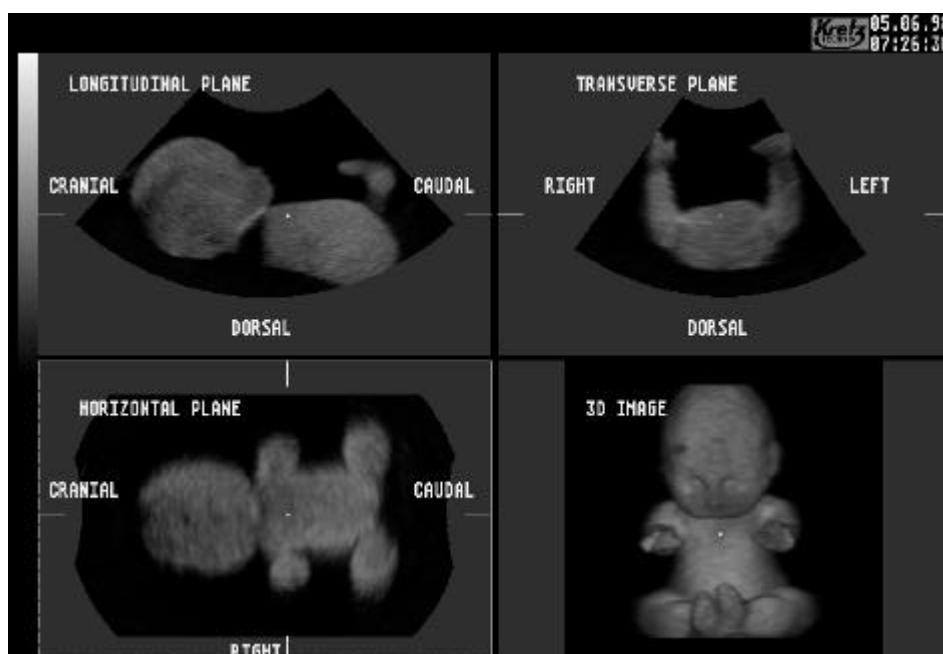
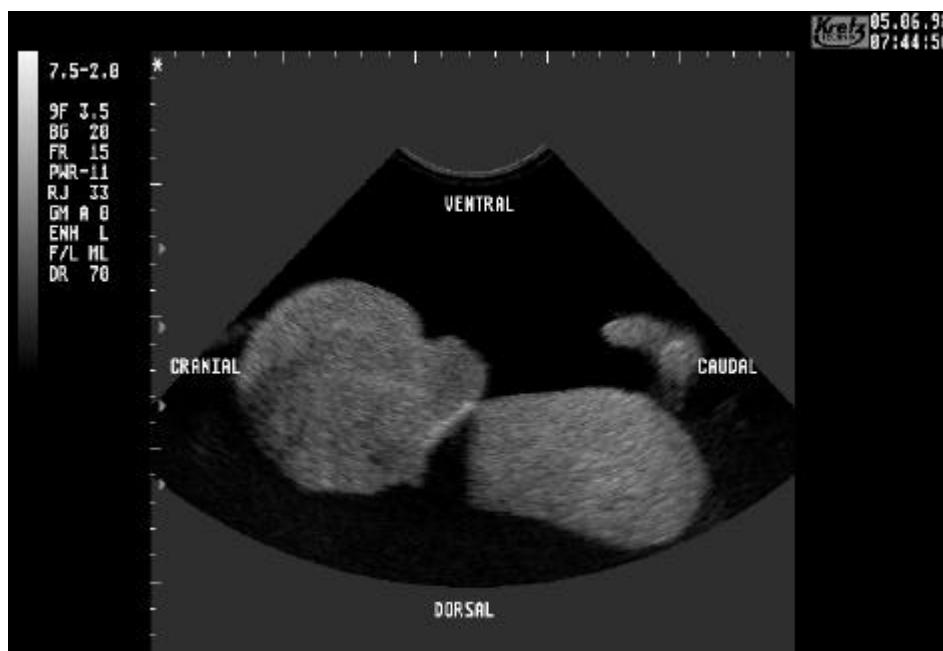


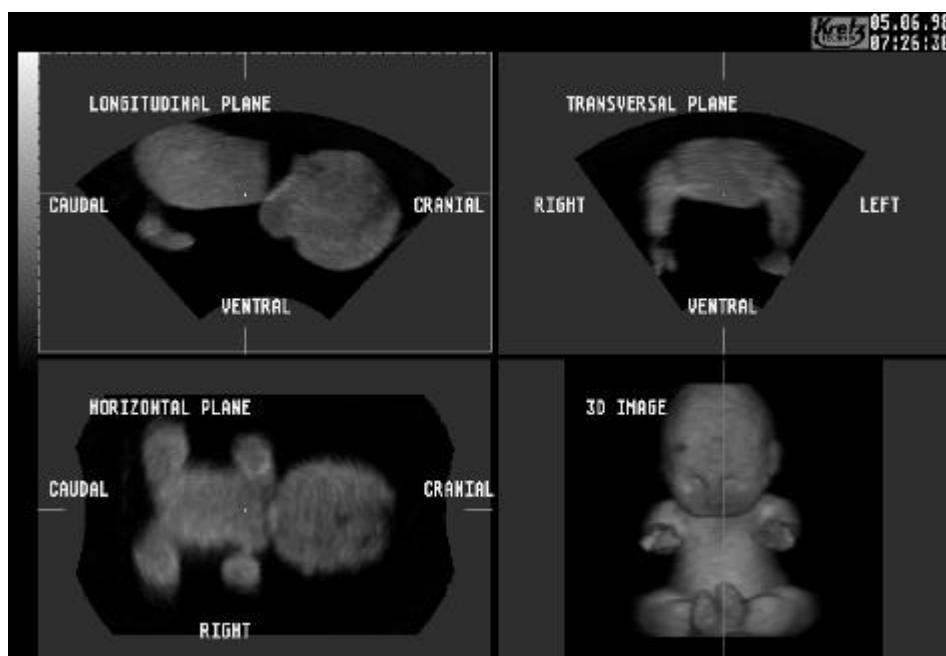
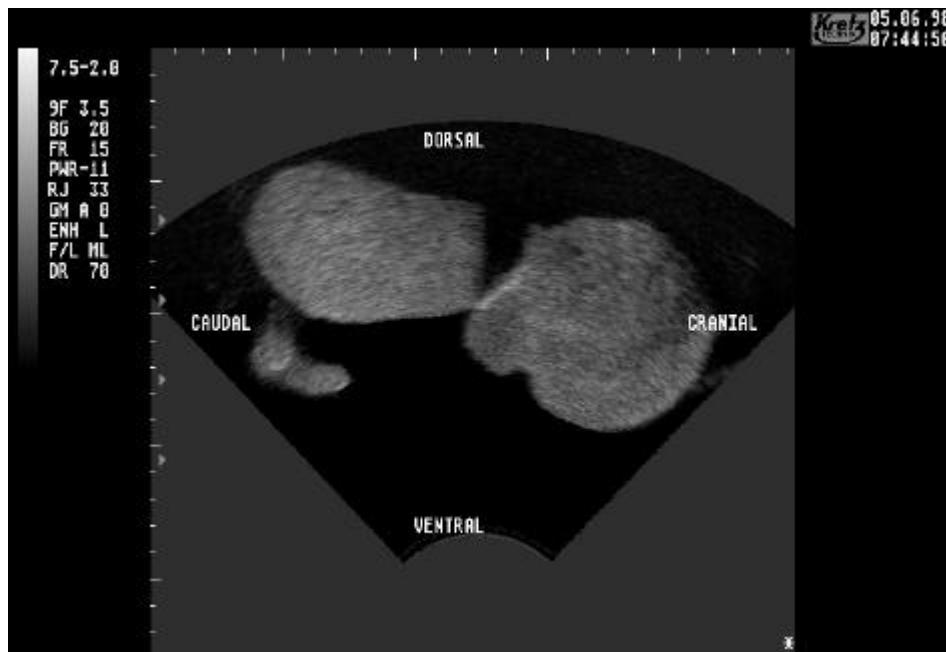
#### 7.4.1.4 Image orientation (all acquisition modes)

Live 3D probe types: VAWxxx, VDWxxx, VNAXxx

Note: Image orientation of probe type VDWxxx has changed.  
old orientation see main user's manual chapter 7.3.3

Start condition: B- image: adjust a longitudinal scan of wanted object, switch on VOL-Mode and start volume acquisition





#### 7.4.1.5 Render algorithm

##### a.) Surface modes:

###### SURFACE (texture)

The surface will be displayed in "texture"-mode.

Texture: the gray values of the surface are identical with the gray values of the original scan.

###### Light-Mode:

A surface will be displayed in "light"-mode.

Light: structures near to viewer are displayed bright, structures far from the viewer are darker.

*For a good 3D-surface image please note the following application hints:*

Adjust the render box in that way, to have free sight from the render-start-area to the surface to be displayed. Surface imaging requires hypoechoic structures (e.g. liquids) between render-start-area and the surface to be displayed. With the control "LOW THRESHOLD" echo structures adjacent to the surface can be "cut off" if their gray values are much lower than the gray values of the surface structures. Always cut out signal noise with the control "LOW THRESHOLD".

##### b.) Transparent modes:

###### Maximum-Mode:

The maximum gray values of the render box are displayed.

Application: Representation of bony structures.

###### Minimum-Mode:

The minimum gray values of the render box are displayed.

Application: Representation of vessels and hollow structures.

note that the interesting objects (vessels, cysts) should be surrounded by hyperechoic structures. Avoid dark areas (shadows caused by attenuation, dark tissue presentation) within the ROI, otherwise big parts of 3D-images will be displayed dark.

###### X-Ray Mode:

Representation of all gray values (mean value) of the render box.

Application: Tissue block with tumor or similar.

Note: For a good 3D impression transparent-mode-images need a certain number of different views, which are shown in a rotating cine sequence. The increment/step angle should be about 5 degree. The 3D impression results of the different movement diverse structures.

**c.) General advises to obtain good rendered 3D images****B-MODE**

- \* Poor quality of the volume scan will lead to a poor quality 3D-image.
- \* For a good 3D-image quality adjust high contrast in B-Mode of the interesting structures before starting the volume scan.
- \* Only the ultrasound data within the ROI (render box) will be calculated and displayed.
- \* The correct placement of the ROI is essential for a good result, because the ROI determines the view onto the interesting object.
- \* Surface-Mode: note that the surface of interest has to be surrounded by hypoechoic structures because otherwise the system is unable to define the surface: with the function "THRESHOLD" echo structures adjacent to the surface can be "cut off" if their gray values are much lower than the gray values of the surface structures.
- \* Minimum-Mode: note that the interesting objects (vessels, cysts) should be surrounded by hyperechoic structures. Avoid dark areas (shadows caused by attenuation, dark tissue presentation) within the ROI, otherwise big parts of 3D-images will be displayed dark.
- \* Maximum-Mode: avoid bright artifact echoes within the ROI, otherwise these artifacts are displayed in the 3D-images.
- \* X-Ray-like Mode: note that all gray values within the ROI are displayed. Therefore, in order to enlarge the contrast of the structures within the ROI, the depth of the ROI should be adjusted as low as allowable.

**COLOR MODE:**

- \* Poor quality of the Color image in 2D-Mode will lead to poor image quality in 3D-color image.
- \* In Angio-Mode (key "ANGIO") a pure flow display without directional coding is given.  
In Velocity-Mode (key "CFM) a flow display with directional coding is given:  
Flow towards probe → red  
Flow away from probe → blue
- \* Use small VOL-BOX and small sweep angle to reduce acquisition time.
- \* High Persistence Filter (Rise and Fall in 2D-image) leads to smoother flow and a good color-3D-display of vessels (e.g. filtering of high pulsing vessels).  
Disadvantage: The higher the filter setting, the longer the acquisition time.
- \* Surface-Mode: Finds vessel surfaces independent of gray values lying in front (color has priority)

## VOLUME MODE

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- \* Maximum-Mode:
  - Power-Mode: The highest intensity values along the viewing direction are displayed.
  - Velocity-Mode: Maximum-Mode only possible in connection with Surface-Mode. The Surface-Mode dominates over the Maximum-Mode as follows: depending on the red or blue surface found, the highest red or blue intensity values are displayed to enable mixing of Surface- and Maximum-Mode.
- \* X-Ray Mode:
  - Calculation of mean value along the viewing direction.  
In Velocity-Mode only possible in connection with Surface-Mode. Depending on the red or blue surface found, the corresponding mean values are calculated to avoid an averaging between red and blue vessel displays and to enable mixing of Surface- and mean value display.
- \* In case of combined display of gray value and color, the color has priority. In the presence of color values along the viewing direction no gray values are displayed.
- \* For Gray Rendering only one mode (Maximum or X-Ray) can be calculated.

**d.) Examples of rendered images**

Surface Mode: gray rendering

Fetal hand

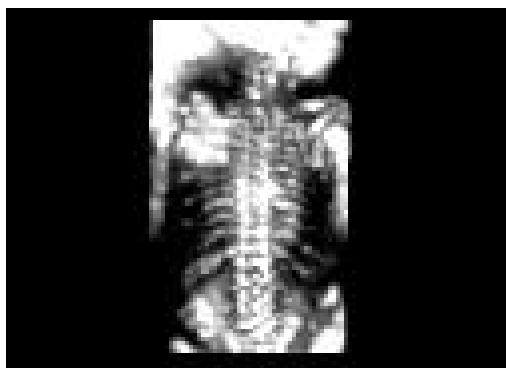


Fetal hands over head



Transparent Mode: gray rendering

maximum mode: fetal skeleton



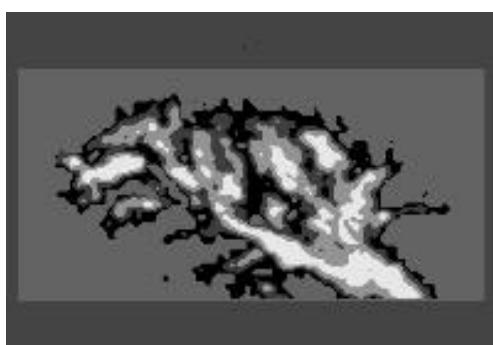
minimum mode: liver vessels



Transparent Mode:

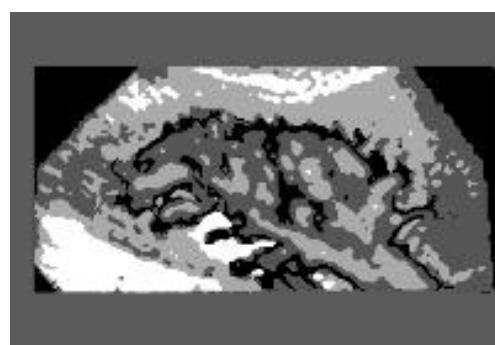
Color rendering

maximum mode: kidney vessels



Color + gray rendering

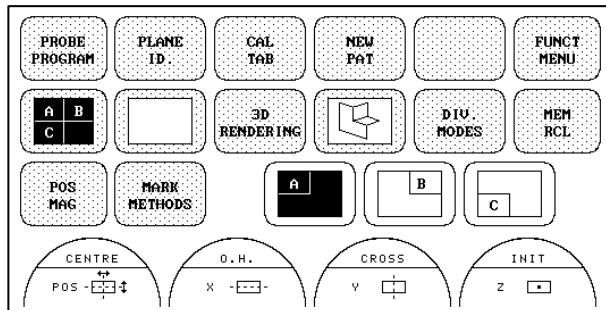
maximum mode: kidney vessels



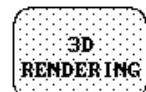
## 7.4.2 Interactive Volume Rendering - Operation

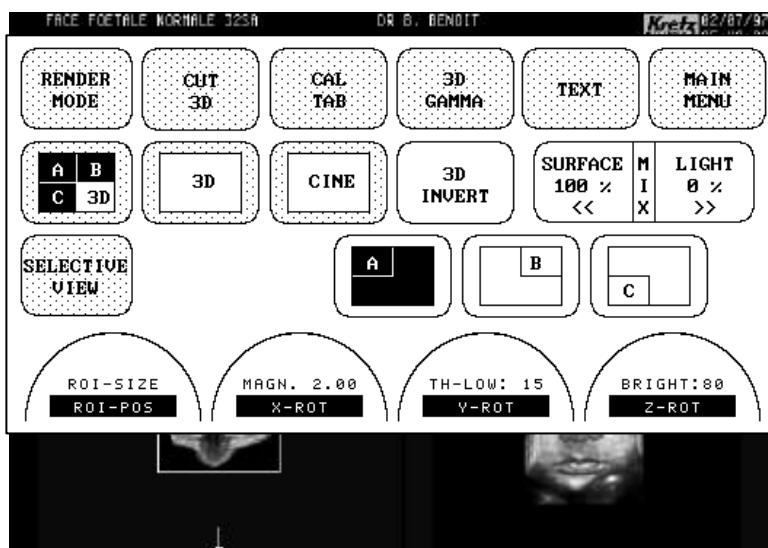
### 7.4.2.1 To activate Interactive Volume Rendering

Condition: volume scan is performed and menu "VOL READ" is selected:



Operation:

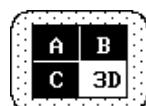
 Touch this key for starting the RENDERING-function.  
On touchscreen the render main menu appears.



On the monitor the Render Box  
is displayed in the orthogonal planes A,B,C and the rendered 3D-image is calculated  
immediately and appears in the lower right quadrant.

### 7.4.2.2 To select Render Display Mode

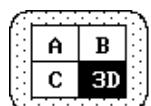
- **3D-ROI Mode:**



This is the mode for the adjustment of the volume render box. The volume rendering box determines the ROI for the 3D calculation and is inserted in the orthogonal planes A,B,C.

Adjustment of the render box see chapter 7.4.2.3

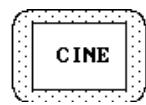
- **3D-Pictogram Mode:**



In this mode the rendered 3D-image is used as a pictogram for the adjustment of the two dimensional planes A,B and C.

Adjustment of the pictogram mode see chapter 7.4.2.5

- **3D-Cine Sequence Mode:**

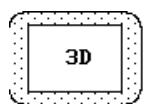


To get an overall 3D impression of the rendered object a certain number of calculated views are displayed image per image in a fast sequence. The rendered object so to speak is rotating for the observer.

Transparent mode: Only constant rotation of the object enables a 3D impression due to the different movement of the structures.

Adjustment of the cine sequence mode see chapter 7.4.2.6

- **3D-Full Size Display:**



on: key is illuminated

The rendered 3D image is magnified and displayed in a full size image format without the sectional planes A,B, and C.

### 7.4.2.3 To position the Render Box

The 3D render box determines the ROI (region of interest) for the 3D-calculation and determines the direction of the view through the volume block. The adjustment of the render box is done with help of the 3 orthogonal planes A,B and C, each dividing the box in the middle.

The direction of the view is as defined below:

(also see chapter 1.3 "principle explanation")

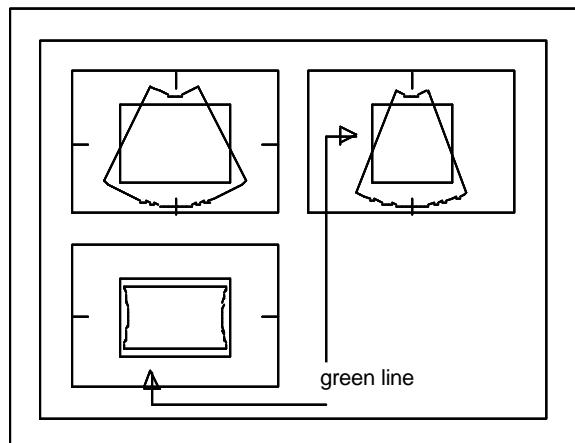
Plane A: the viewing direction is normal on plane A

Plane B: the viewing direction is from left to right in plane B

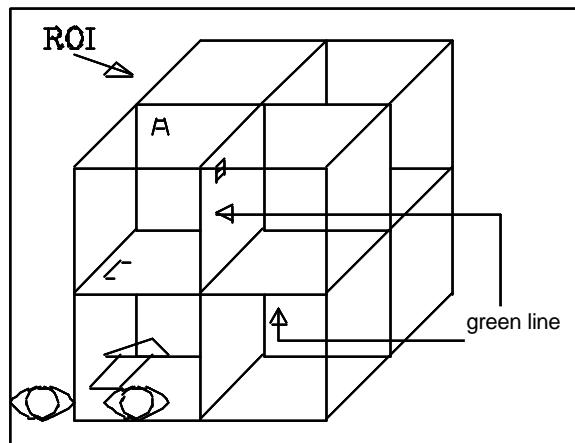
Plane C: the viewing direction is from the bottom to top in plane C.

The green line of the rendering box in B- and C-plane symbolizes the direction of the view and the border for starting the analysis.

Display on the monitor:

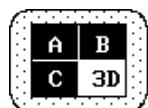


Position of sectional images relative to ROI



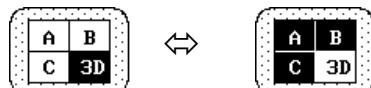
## Operation:

- Select the 3D-ROI-Mode (if not active)



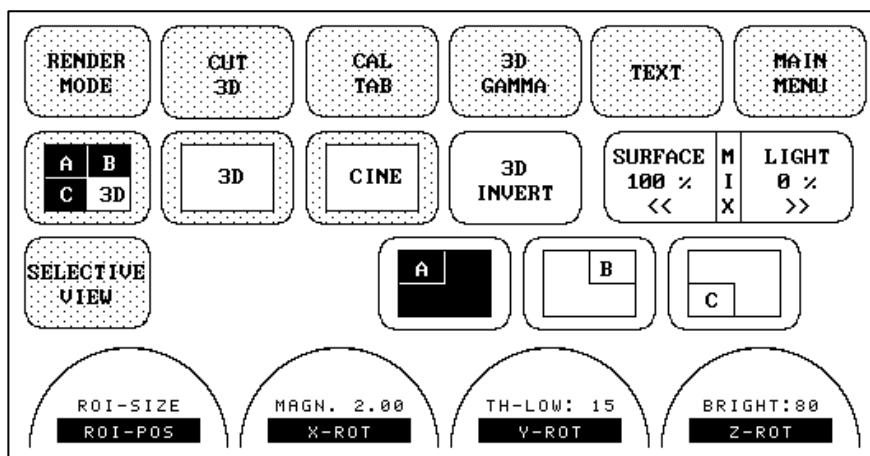
Key in Render main menu:

With this key one can toggle between 3D-Pictogram-Mode and 3D-ROI-Mode:



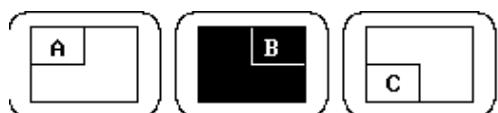
The volume rendering box for the 3D calculation is inserted in the orthogonal planes A,B,C and the rendering result is displayed in the lower right quadrant. This mode is automatic active when switching on 3D-Rendering.

Render main menu:



- Adjust size of the render box

- Select reference image A,B or C



The rotary controls and the trackball are assigned to the reference image for the adjustment of the render box functions.

- Adjust size (= 3D resolution) of the render box:



The horizontal resp. vertical dimension of the box may be varied by the trackball controls.

ROI-POS } Note: Benefit of a bigger box: higher resolution  
calculation time Benefit of a smaller box: faster

- **Adjust content of the render box**

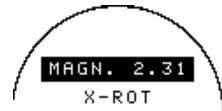
Place the information to be rendered into the render box:



The selected image A,B or C is positioned relative to the render box with the trackball.

**Important:**

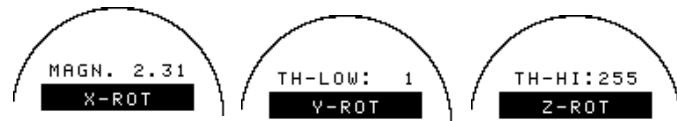
Structures which obstruct the free sight to the object can be shifted out of the box.



The magnifier control varies the size of box contents within image A, B, C relative to the render box.

**Note:**

The magnification of the whole 3D-image without changing the box's contents is only possible in Pictogram Mode (see next chapter).



The Rotation controls rotate the box contents relative to the render box.

**Important:**

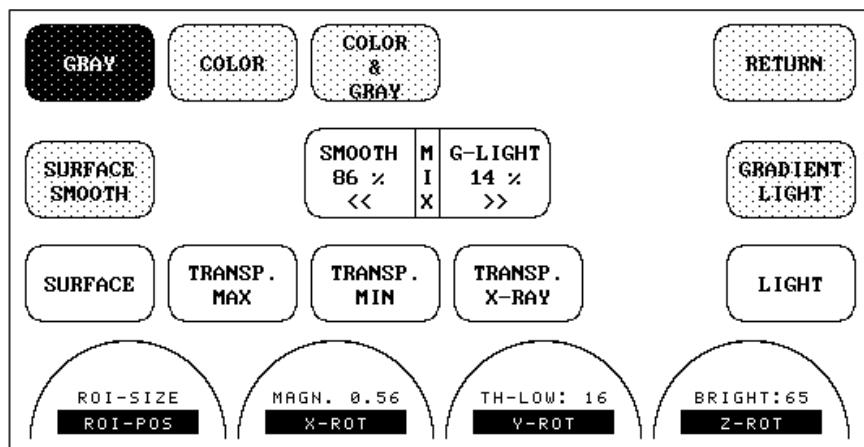
With the rotation controls the direction of view of the 3D image is selected.

#### 7.4.2.4 To select Render Mode (Image Type and Render Algorithm)

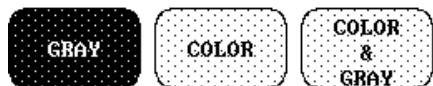
1.) Call the 3D Render Mode menu:



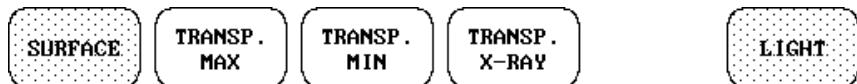
Key in Render main menu



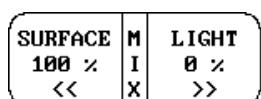
2.) Select Image Type



3.) Select Render Algorithm



4.) To mix between two render modes

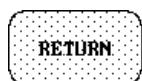


#### MIX-function

The mixing can be done in 8 steps by touching the corresponding key.  
The mix-ratio is displayed in %.

Application: for example: to produce a better smoothed surface by mixing surface and light mode.

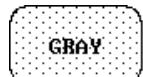
5.) Return to the Render Main Menu



Return to the 3D Render main menu

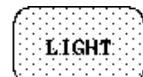
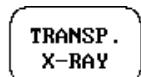
**a.) Gray Render Mode**

In Gray Rendering Mode only the gray information of the data set is used, even if a Color Volume image is displayed. In case of a data set without color information, this mode is automatically activated.



Activate Gray Rendering Mode (if not active)

Select wanted render algorithm



Surface-Mode:

A surface will be displayed in "texture"-mode.

Texture: the gray values of the surface are identical with the gray values of the original scan.

Light-Mode:

A surface will be displayed in "light"-mode.

Light: structures near to viewer are displayed bright, structures far from the viewer are darker.

Application: The surface to be displayed has to be surrounded by hypoechoic structures (e.g. liquids).

Surface smoothed:

The surface is displayed in a smoothed "texture"-mode

Texture: the gray values of the surface are identical with the gray values of the original scan.

Gradient light: The surface will be displayed as illuminated from a spot light source.

Application: The surface to be displayed has to be surrounded by hypoechoic structures (e.g. liquids).

Maximum-Mode:

The maximum gray values of the ROI are displayed.

Application: Representation of bony structures.

Minimum-Mode:

The minimum gray values of the ROI are displayed.

Application: Representation of vessels and hollow structures.

X-Ray Mode:

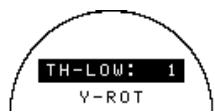
Representation of all gray values within the ROI.

Application: Tissue block with tumor or similar.

The software module allows selection of 2 modes which are simultaneously calculated. Always the actual selected mode is displayed with 100%. With the MIX-keys one can mix between the chosen modes. Selection itself is liberal, except the Light-Mode, which only goes with Surface-Display. Always select 2 modes!

Function of the threshold values (Surface Mode only)

In case Surface-Modes is selected, it will normally be necessary to adjust the low and the high threshold for the border recognition of the surface. These threshold values do not apply for the Transparent Modes!

**Threshold LOW (Reject):**

normally this threshold always has to be adjusted for a good appearance of the 3D-surface image.

By changing the threshold all echo's below the level are enhanced in pink color for a certain interval.

Application: With this function small echo's or noise are removed, to have a "clear sight" from the start boarder of the render box to the wanted surface.

**Threshold HIGH**

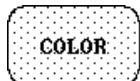
normally this threshold has not to be adjusted and should be set to the max. value 255.

By changing the threshold all echo's above this level are enhanced in green color for a certain interval.

Application: If the surface render algorithms reaches a gray value higher as the threshold value, then this gray value marks the surface boarder. Therefore its possible to mark the surface boarder manual with the threshold-high-function.

**b.) Color Rendering**

In Color Rendering only the color information of the Color Doppler signal (Velocity-Mode or Power-Mode) is used for the 3D-display. In the presence of a data set with color information, this mode is automatically activated.



Activate Color Rendering Mode (if not active)

Select wanted render algorithm:



**SURFACE MODES:**

- Surface-Mode: Surface-display of color information of blood flows
- Light-Mode: A surface will be displayed in "light"-mode.  
Light: structures near to viewer are displayed bright, structures far from the viewer are darker.

**TRANSPARENT MODES:**

- Maximum-Mode: The maximum color values of the ROI are displayed.  
Application: Representation of all vessels in the ROI, 3D-impression due to rotation of the display.
- X-Ray Mode: All color values in the ROI are used for the calculation and are averaged (impression of an X-Ray image)

The software module allows selection from 2 modes which are simultaneously calculated. Selection itself is liberal, except with the Light-Mode which only goes with Surface-Display. **Always select 2 modes!**

The following Rendering combinations are possible:

Acquisition in Power-Mode	Acquisition in Velocity-Mode
Surface + Light	Surface + Light
Surface + Maximum	Surface + Maximum
Surface + X-Ray	Surface + X-Ray
Maximum + X-Ray	

In case Surface-Modes is selected, it will normally be necessary to adjust the low and the high threshold for the border recognition o the surface. These threshold values do not apply for the Transparent Modes!

Function of the threshold values:



#### Threshold LOW (Reject):

normally this threshold always has to be adjusted for a good appearance of the 3D-surface image. By changing the threshold all echo's below the level are enhanced in pink color for a certain interval.

All the color values below this level (pink in the B-Scan) will be disregarded for the calculation of the surface.



#### Threshold HIGH

normally this threshold has not to be adjusted and should be set to the max. value 63.

By changing the threshold all echo's above this level are enhanced in green color for a certain interval.

Application:

If the surface render algorithm reaches a color value higher as the threshold value, than this color value marks the surface boarder. Therefore its possible to mark the surface boarder manual with the threshold-high-function.

### c.) Color + Gray Rendering

In Color+Gray Rendering Mode the color and the gray information are processed into a common 3D-image.

Note: The color display has priority.

If gray values are present along the viewing direction in front of a color information, the gray values are not displayed.

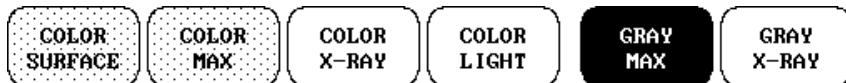


Activate Color+Gray Mode (if not active)

## VOLUME MODE

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Select wanted render algorithm



The module allows the setting of two Color Modes and one Gray Mode. **Always select 2 Color Modes and 1 Gray Mode!**

The following Rendering combinations are possible:

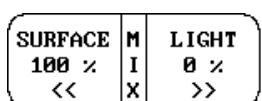
Color acquisition in Power-Mode	
Color	Gray
Surface + Light	Maximum or X-Ray
Surface + Maximum	Maximum or X-Ray
Surface + X-Ray	Maximum or X-Ray
Maximum + X-Ray	Maximum or X-Ray

Color acquisition in Velocity-Mode	
Color	Gray
Surface + Light	Maximum or X-Ray
Surface + Maximum	Maximum or X-Ray
Surface + X-Ray	Maximum or X-Ray

In case Surface-Mode is selected, it will normally be necessary to adjust the low and the high threshold for the border recognition of the surface. These threshold values do not apply for the Transparent Modes!

Adjustment of the threshold see color rendering (same function, the thresholds only influence the color values).

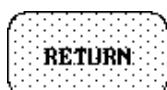
### d.) To mix between two render modes



#### MIX-function

The mixing can be done in 8 steps by touching the corresponding key. The mix-ratio is displayed in %.

Application: for example: to produce a better smoothed surface by mixing surface and light mode.



Return to the render main menu

### e.) ***Image Orientation of the 3D-Image***

With this function the image orientation of the 3D-image (up/down) can be changed.  
The image orientation of the sectional planes is unaffected from this.

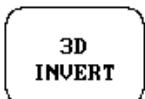


Image orientation of the 3D-image: up/down  
The 3D-image orientation can be inverted in read or write mode and is stored in the user program.

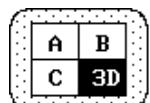
#### 7.4.2.5 3D-Pictogram Mode

In this mode the rendered 3D-image is used as a pictogram for the adjustment of the 2D-sectional planes A,B and C. A inserted green graphic line on the 3D-image marks the position of image B or C in relation to the rendered 3D-image.

Condition: a for a pictogram useful 3D-image has to be displayed on screen, otherwise adjust a useful 3D-image before.

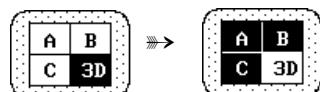
Operation:

##### Switch on 3D-Pictogram-Mode



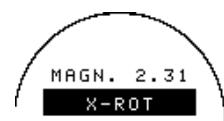
Key in Render main menu.

With this key one can toggle between 3D-Pictogram-Mode and 3D-ROI-Mode:

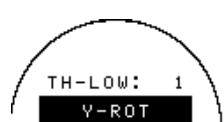
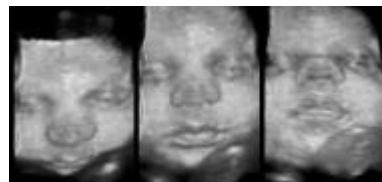


Because of the interactive render system the next operation steps may be performed in free order.

##### Change view of the rendered 3D-image



Rotation about X-axis



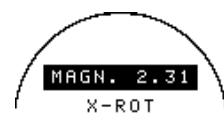
Rotation about Y-axis



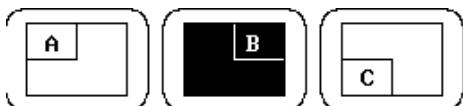
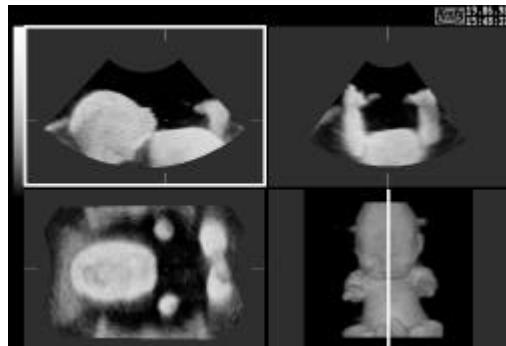
Rotation about Z-axis



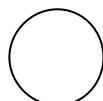
##### Adjust magnification of the rendered 3D-image



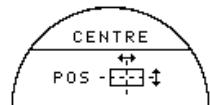
The 3D-image as well as the sectional image can be varied by their aspect ratio .

**Select reference image A,B or C:**Selected reference image is sectional plain A:

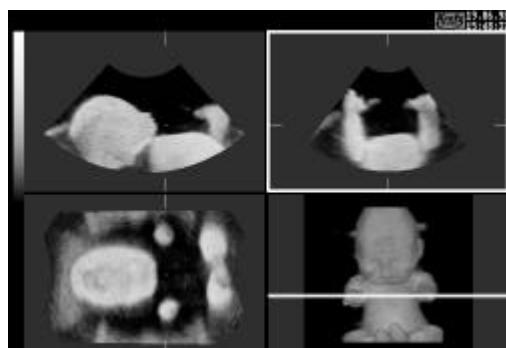
The spatial position of plain A in relationship to the displayed 3D-image is always vertical and also normal to the 3D-image display. Therefor the trace of image A is indicated with help of a vertical green line within the 3D-image.

**Adjust the position of the green line within the 3D-image:**

Rotary control No. 4 (big rotary control, no annotation on touchpanel) enables a parallel shifting (left/right) of the green line and the corresponding parallel plains of image A will be displaced automatically.

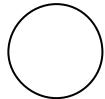
**Adjust the position of image B and C with trackball:**

The position of image B and C in relationship to the reference image A is determinate through the Y-axis (= intersection line for image B ) and through the X-axis (= intersection line for image C). By positioning this two axis in the reference image the corresponding parallel plains of B- and C-images are displaced automatically.

Selected reference image is sectional plain B

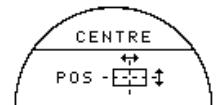
The spatial position of plain B in relationship to the displayed 3D-image is always horizontal and also normal to the 3D-image display. Therefor the trace of image B is indicated with help of a horizontal green line within the 3D-image.

**Adjust the position of the green line within the 3D-image:**



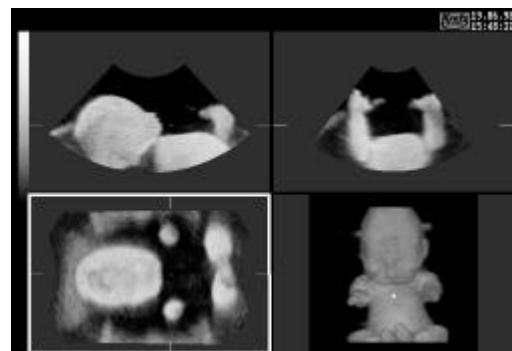
Rotary control No. 4 (big rotary control, no annotation on touchpanel) enables a parallel shifting (up/down) of the green line and the corresponding parallel plains of image B will be displaced automatically.

**Adjust the position of image A and C with trackball:**



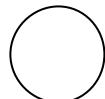
The position of image A and C in relationship to the reference image B is determinate through the Y-axis (= intersection line for image A ) and through the X-axis (= intersection line for image C). By positioning this two axis in the reference image B the corresponding parallel plains of A and C-images are displaced automatically.

*Selected reference image is sectional plain C:*



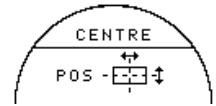
The spatial position of plain C in relationship to the displayed 3D-image is always a parallel plain with a rotation of 90°. Therefor its not possible to indicate the trace of image C with help of a intersectional line within the 3D-image.

**Adjust the depth-position of plain C:**



Rotary control No. 4 (big rotary control, no annotation on touchpanel) enables a parallel shifting (forward/backward) of plain A. The depth position of the image C in relationship to the Z-direction (normal to the display) of the 3D-image is indicated by the X-axis in image B.

**Adjust the position of image A and B with trackball:**



The position of image A and B in relationship to the reference image C is determinate through the Y-axis (= intersection line for image A ) and through the X-axis (= intersection line for image B). By positioning this two axis in the reference image C the corresponding parallel plains of A and B-images are displaced automatically.

#### 7.4.2.6 3D Cine Sequence Mode

To get an overall 3D impression of the rendered object a certain number of calculated views are displayed image per image in a fast sequence. The rendered object so to speak is rotating for the observer.

**Transparent mode:** Only rotation of the object enables a 3D impression due to the different movement of the structures.

#### 7.4.2.7 To calculate a 3D cine sequence

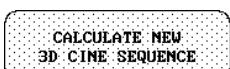
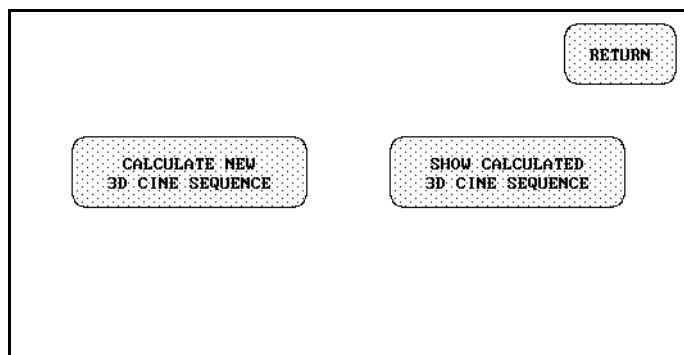
Operation:

**Activate the 3D Cine Display Mode:**

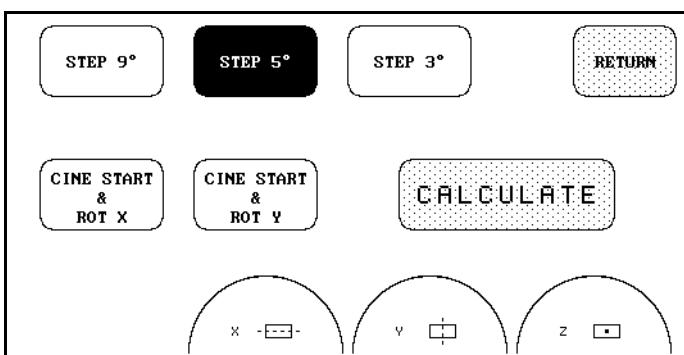


Key in Render main menu

If a cine sequence is in the cine memory the following menu appears:



Touch this key to start a new calculation.  
The cine sequence already calculated will be lost!

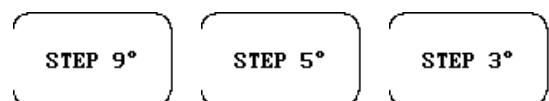


## VOLUME MODE

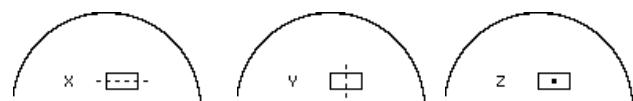
---

### Select step raster

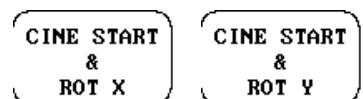
The step raster defines the size of rotation between adjoining 3D-images.



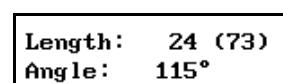
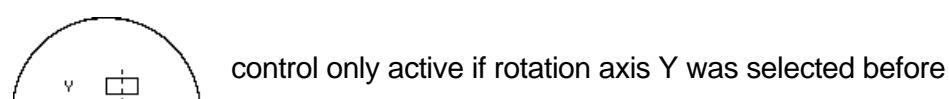
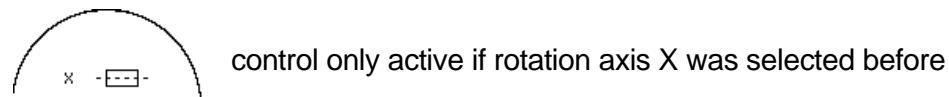
### Adjust start view of 3D image



### Select rotation axis



### Adjust end view of 3D image



On touch panel the length (numbers of images) and rotating angel of the sequence are displayed.

(73)...is the possible maximum length

**Start calculation of the cine sequence**

During the calculation process this menu is displayed:

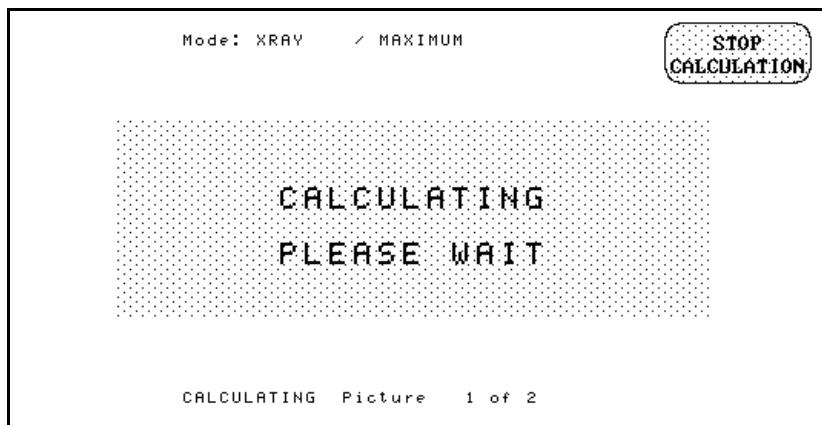
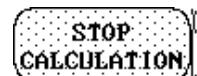


Image after image of the sequence is calculated and stored in the cine memory. After the calculating process the cine sequence is displayed on the screen.



Activation of this key stops the actual calculation. But, if at this moment no image calculation is finished, an automatic return to the 3D-ROI menu will happen.

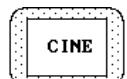
If however at least 1 image calculation is finished (status line CALCULATING IMAGE shows a number > 1), the calculation will be quit, the calculated cine sequence (till to the interruption) is displayed and the cine menu appears on touch panel.

Possible operation of a displayed cine sequence see next chapter.

#### 7.4.2.8 To display a 3D cine sequence:

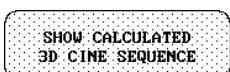
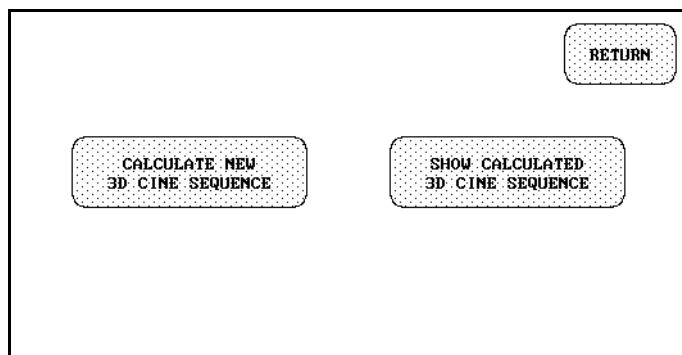
Condition: a cine sequence is calculated

##### Activate the 3D Cine Display Mode:

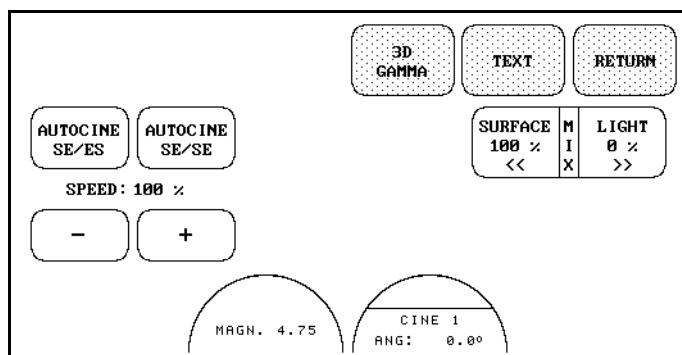


Key in Render main menu

If a cine sequence is in the cine memory the following menu appears:



Touch this key to show the 3D cine sequence. On screen the cine sequence starts rotating and the cine menu appears..



##### AUTOCINE Mode:

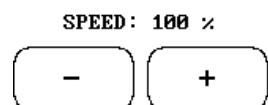
If several 3D-images have been calculated, they can automatically be displayed in a sequence. Images in Transparent-Mode will only render the 3D-effect by this way.



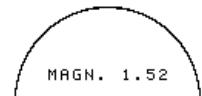
Scan in both directions through the image block:  
First image...last image, last image...first image, etc.



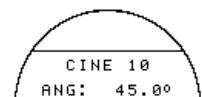
Scan in one direction through the image block:  
First image...last image, first image...last image, etc.

**Select rotating speed**

Scan speed: the speed of sequencing through the number of images can be varied between 2:1 and 0.5:1

**Select aspect ratio:**

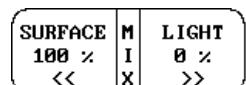
The 3D image magnification can be varied by its aspect ratio.

**Selection of single images:**

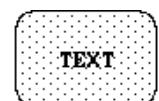
When rotating this control the auto cine mode stops and one can select each single image step by step.

The displayed number indicate:

CINE 10: image number of the sequence  
ANG: 45.0° corresponding angle

**Mix the calculate modes:**

adjust the mix ratio between the two calculated modes

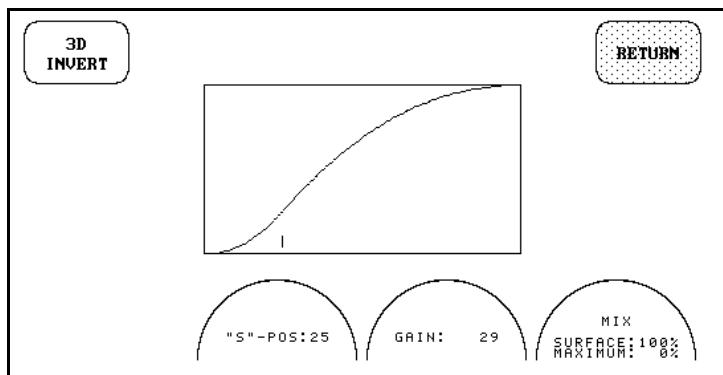
**Enter text:**

Allows image inscription.  
(Operation see main manual chapter 3).

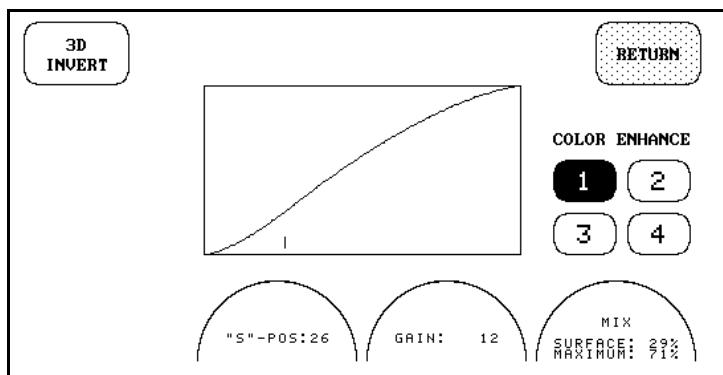
#### 7.4.2.9 To adjust 3D Gamma



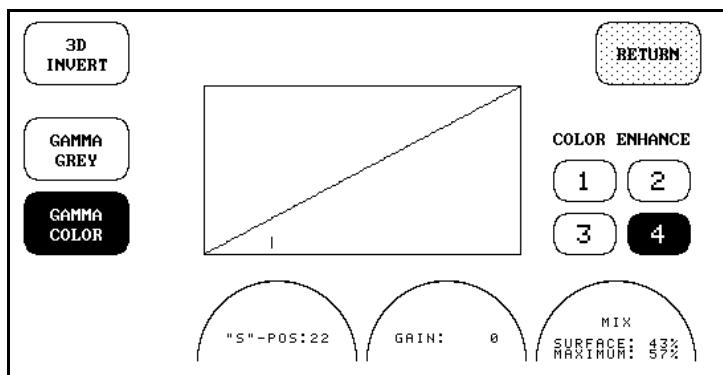
Key in Render main menu



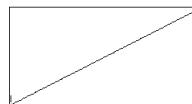
Sub-menu, if Gray Rendering is active



Sub-menu, if Color Rendering is active

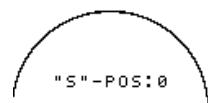


Sub-menu, if Color+Gray Rendering is active

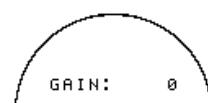
**Gamma curve correction 3D-image:**

This is provided only for the 3D-image. Touching the display field resets the gray scale to INIT that is the linear distribution of gray values.

Horizontal axis: gray values from 0 to 255  
 Vertical axis: brightness from black to white

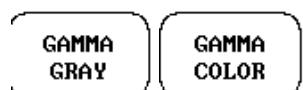


Set the start point of the gamma curve bending

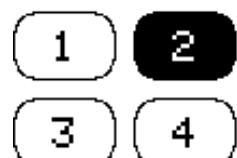


Set the gain resp. amplitude of the bending

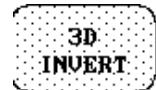
Note: these settings require an alert observation of the influence on the 3D-image!



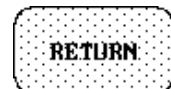
The gamma adjustment can be done separately for the gray and color values in a color+gray rendered image.  
 The active key is illuminated.

**COLOR ENHANCE**

Selection of different color palettes.

**Invert the gray values of the 3D-image, i.e. b-w/w-b display**

In order to maintain an adequate impression of the monitor brightness the inversion is not linear but includes a correction (observe the gamma curve display!).

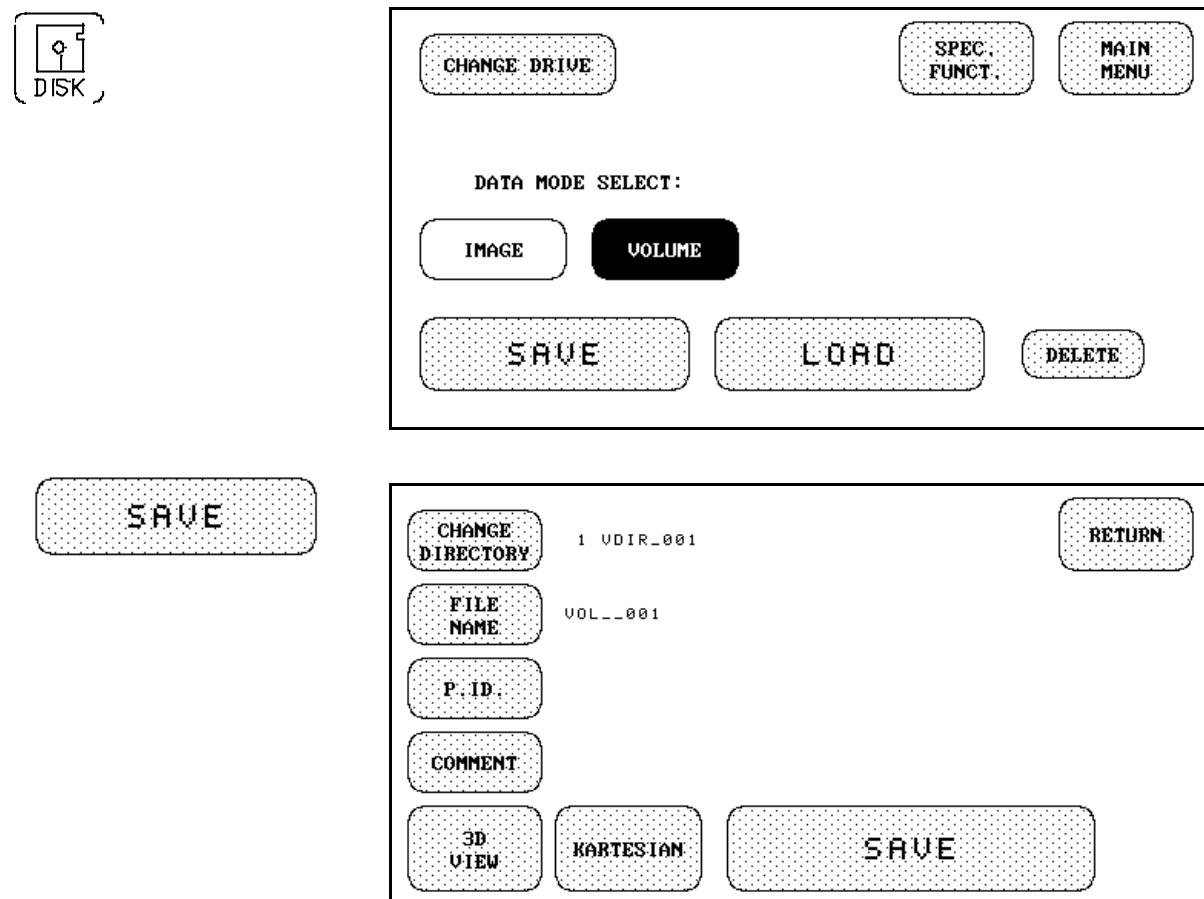
**Exit from this sub-menu:**

Upon touching this key the instrument returns into the previously active menu.

#### 7.4.2.10 Storage and loading of calculated 3D-images

When 3D-calculations are done, the calculated 3D-images can be stored either when in VOLUME RENDERING MODE or when in VOL-READ menu, respectively. One has to keep in mind however, that the calculated 3D-images together with the complete volume can be stored (not the 3D-image alone).

You must touch the key "3D-VIEW" in order to save both the volume and the calculated 3D-cine sequence, otherwise only the volume will be saved!



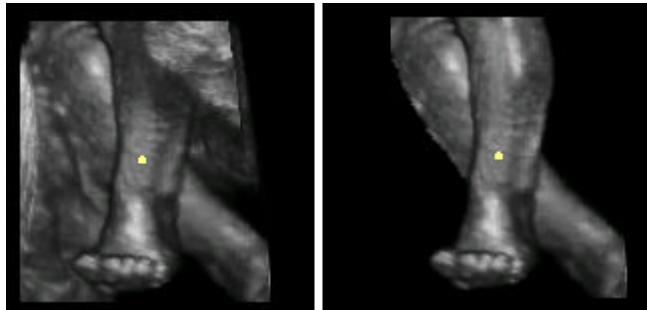
- 3D VIEW** Touch the key  
 Key appears only if a 3D-calculation has been performed. If it is not activated, the volume data set is stored without the 3D-calculation. The 3D-calculation alone cannot be stored.
- SAVE** Touch the key to start the "SAVE" process.

**For operating the storage/loading procedure see chapter 11.**

## 7.5 CUT-3D - Electronic Scalpel

### 7.5.1 Principle

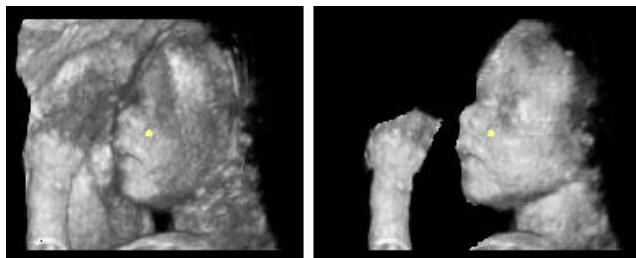
This software has the ability to electronically manipulate the images, and makes it possible to cut away "3D artifacts".



The left image displayed above is rendered without cutting whereas the right image has had cutting techniques applied to give a clearer view of the object of interest.

The cutting function makes available six methods for cutting. These different methods can be used in different cases so that there is an unobstructed view to the object of interest.

The following image shows a 3D rendered image before 3D cutting, and after. The cutting was performed by rotating the image to give the best view and utilizing the 'contour inside' method.

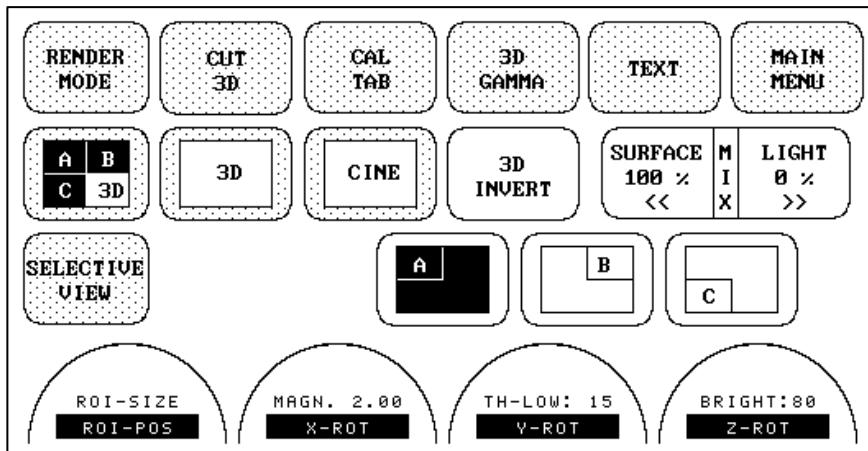


**Note:**

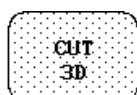
**The cutting function is only available on a 3D rendered image. In a combined display mode (Pictogram mode: 3D-image + 2D sectional planes) the cut information still remain in the 2D planes.**

### 7.5.2 Operation

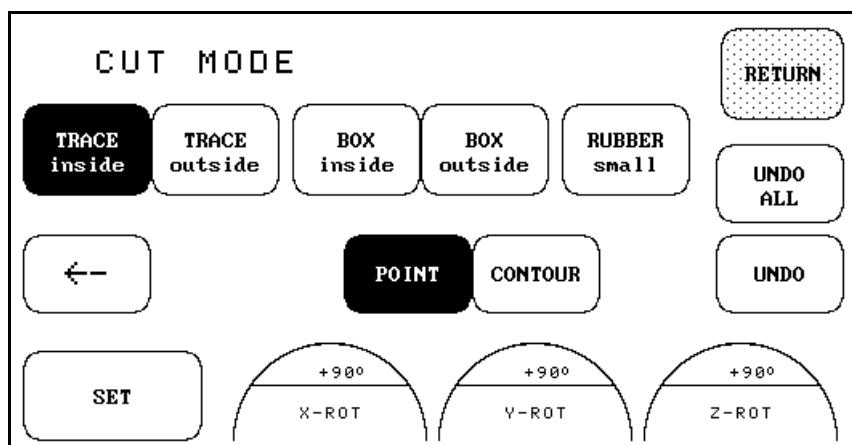
Condition: 3D-Render mode is on and a 3D rendered image to cut is displayed on screen. The touchpanel shows the render main menu.



#### 1. Switch on CUT 3D mode



Touch key "CUT 3D"  
The CUT 3D menu appears.

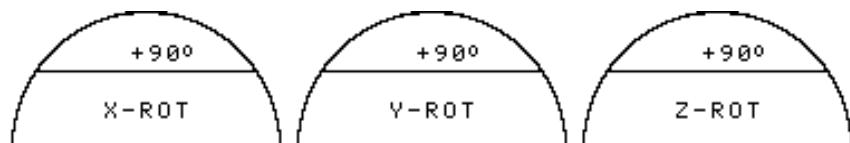


#### Remark:

- The system switches to "3D pictogram mode" if not active for fixing the render box.
- Full size 3D-image display is activated if not active

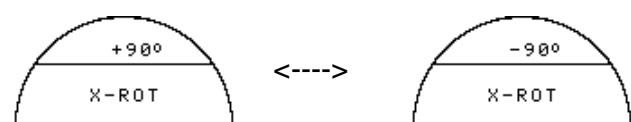
**2. Rotate 3D rendered image in a position, where you can cut the 3D artifact or unwanted information.**

**2.1 Use the digipots to rotate the 3D-image**

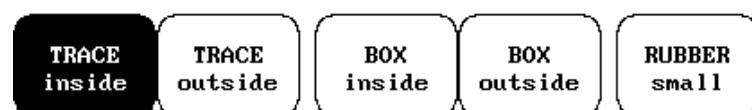


**2.1 Fast rotating +/- 90°**

Touch the half circle to rotate +90° and touch again to rotate -90° (toggle switch)



**3. Select method of cutting.**



**TRACE inside:** The image within the contour (drawn freehand) will be discarded. If a contour is left open, the program will automatically close the contour with a line directly from the end point to the start point.

**TRACE outside:** The image that lies outside of the contour (drawn freehand) will be discarded. If a contour is left open, the program will automatically close the contour with a line directly from the end point to the start point.

**BOX inside:** All information inside the box will be cut.

**BOX outside:** All information outside the box will be cut.

**RUBBER:** All information underneath the rubber trace will be cut.

**4. Set region of interest to be cut**

**4.1 Trace Mode inside, outside**



Select trace mode "POINT" or "CONTOUR"

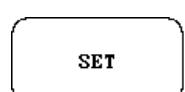
• **Point**



Position first point, second point and so on with trackball and enter each point with key "SET". A red trace line is drawn automatically from one point to the next.

To finish: Press "SET" again without positioning the next point.  
The region inside/outside the trace will be cut from the 3D rendered image.

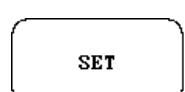
• **Contour**



Position first point, enter it with key "SET" and move the reference cross along wanted trace. Red points marking the trace are set automatically

To finish: Press "SET" again  
The region inside/outside the trace will be cut from the 3D rendered image.

**4.2 BOX inside, BOX outside**



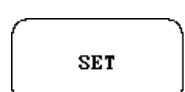
Position left upper point with the trackball and enter it with key "SET".  
Position right lower point with trackball in a diagonal fashion to create a box.  
The red trace of the box is displayed immediately.

To finish: Press "SET" again  
The region inside/outside the box will be cut from the 3D rendered image.

**4.3 Rubber**



select small or big (toggle switch)



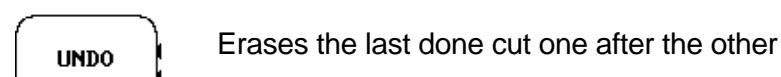
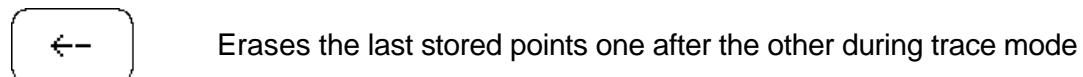
Position first point, enter it with key "SET" and move the rubber over the part of image to be erased.

To finish: Press "SET" again  
The region underneath the rubber trace will be cut from the 3D rendered image.

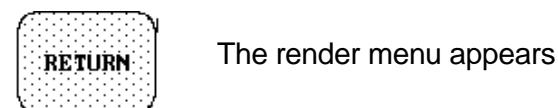
## 5. Perform next cut

Rotate rendered image to another position  
Continue with point 2. to 4 again

## 6. Erase functions

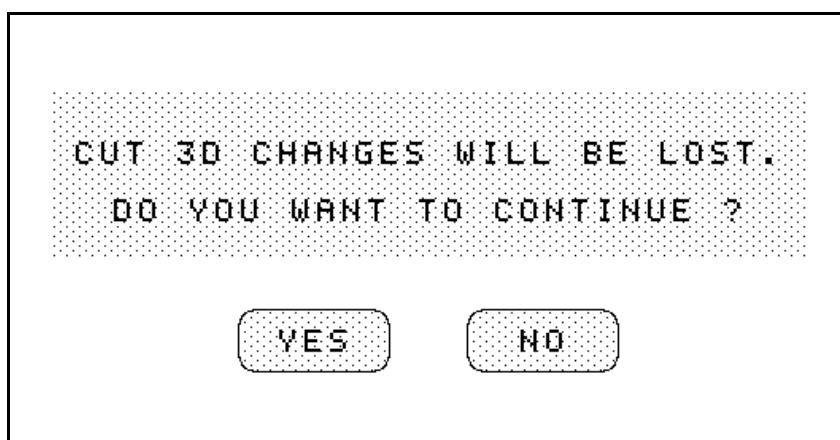


## 7. To switch off CUT-Mode



### Note:

If a cut 3D-image is displayed and one switches to 3D-ROI-Mode for changing the render box a warning is displayed on touch screen:



## 7.6 Live 3D: Predefined Operation (Easy to Use Mode)

### 7.6.1 Principle

Live 3D mode is obtained through continuous volume acquisition and parallel calculation of 3D rendered images. In Live 3D mode the volume acquisition box is at the same time the render box. All information in the volume box is used for the render process. Therefor size and position of the volume box is important for a good render result. The size of a calculated 3D image is set automatically in that way, that the content of the render box fits to the chosen display mode area (quarter size or full size). After freezing 3D image size can be adjusted manually, if wanted. This algorithm makes it sure, that independent from size of the volume box always whole 3D image will be displayed in a proper way.

#### Condition for Live 3D:

Software option "LIVE 3D" is installed

Live 3D probe is connected and selected

Possible probe types for Live 3D: VAWxxx, VDWxxx, VNAXxx, S-VNWxxx

#### Display modes:

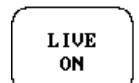
Live on (continuos photo mode):

full size 3D image + small B-acquisition-image (center image through volume block) during acquisition and after freeze full size 3D image.

Live off (single photo mode):

full size 3D image

#### Operation:



Touch "LIVE ON" in acquisition menu

Detailed operation see chapter 7.7.

#### *Predefined operation (Easy to Use Mode)*

Target of this operation mode:

to produce good 3D images with a minimum of operation steps and without having a lot of experience in 3D scanning.

Depending on a setup switch always predefined or extended operation is activated when switching on Volume Mode. In predefined operation certain functions are removed from touch panel and replaced through predefined values. The predefined values can be modified in setup menu.

Following functions are predefined:

init size of volume box (length, B-angle, Vol-angle), acquisition speed (fast, medium, slow), smooth filter on/off, Live on/off, render mode (surface, transparent max, min ...etc.), 3D gamma (gamma curve, chroma map, mix value), 3D brightness, threshold auto on/off, auto render start on/off.

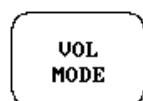
From the predef. operation one can switch to extended operation (expert mode), where all functions are available. By starting a new acquisition predefined mode will appear again with all the predefined settings.

Setup operation see chapter 12.15.

Condition: Volume-acquisition and Live 3D option are installed.  
predefined operation setup switch is on.  
Voluson probe is connected and selected.  
adjust an optimum 2D-image before activating VOL-Mode.

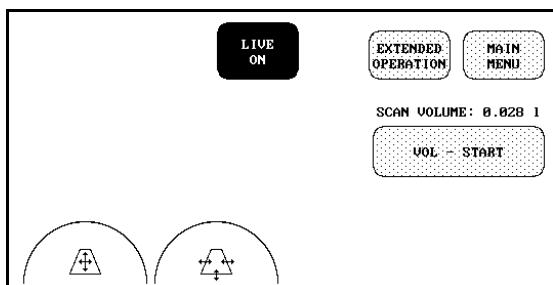
## 7.6.2 Write Mode (volume acquisition) adjustment

### 7.6.2.1 activate VOL-Mode



The VOL-Acquisition menu appears on touchpanel and the Volume box is superimposed to the 2D image.

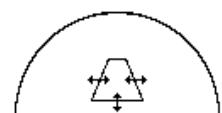
Touch screen



2D image with Vol-Box



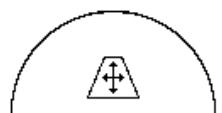
### 7.6.2.2 adjust Volume box size and position



rotate the control to adjust the box size

Note:

box size changes in all direction (depth, B-angle, Vol-angle) with same proportion. In extended operation every direction can be adjusted independent.



adjust wanted position with trackball

remark:

the Volume box frames the Region of Interest (ROI), which will be stored during a volume sweep and from which a rendered 3D image is calculated.

If feasible select a small volume box in order to have a small volume and therefore a short sweep time (higher frame rate in LIVE 3D).

### 7.6.2.3 activate LIVE ON, if wanted



LIVE ON active (button illuminated):  
real time display of 3D rendered images (continuous volume acquisition)

LIVE ON not active:  
display of one 3D rendered image (single volume acquisition).  
After acquisition freeze mode is activated.

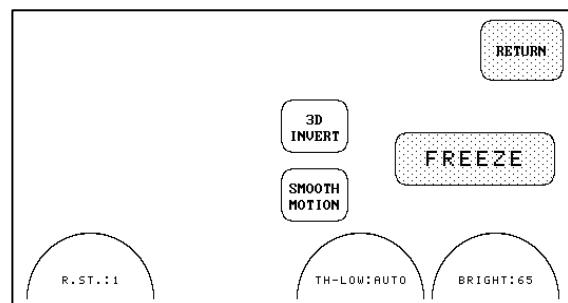
activate volume write mode (acquisition start)



if LIVE ON is active:

LIVE ON acquisition menu appears on touch panel and on monitor the rendered 3D images are displayed.

Touch screen



Monitor display



### 7.6.2.4 Possible adjustment during LIVE 3D

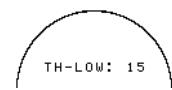


adjust Render Start:

manual: position start line with trackball

automat.: touch half circle: the render start will be calculated automatically. (control display: R.ST.: AUTO)

All information before the red render start line is cutted from the rendered 3D image. Red render start line is displayed in the center B-image of the volume scan (left beside 3D image).

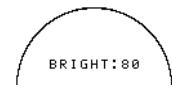


adjust Threshold Low:

manual: adjust TH-LOW with digi potentiometer

automat.: touch half circle: TH-LOW value will be calculated automatically

All information beyond TH-LOW value is cutted from the rendered 3D image.



adjust brightness of 3D image

**SMOOTH MOTION**

Smooth Motion filter ON/OFF

ON: increase of display frame rate (with help of the smooth filter additionally calculated 3D images are displayed).

OFF: always last calculated 3D image is displayed.

**3D INVERT**

Image orientation of the 3D-image: up/down

The 3D-image orientation can be inverted in read or write mode and is stored in the user program.

**RETURN**

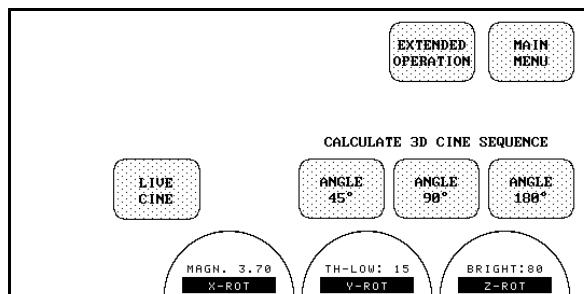
back to previous acquisition menu

**FREEZE**

freeze Live 3D

### 7.6.3 Read Mode (Frozen 3D image)

Touch screen

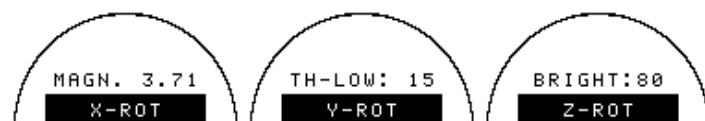


Monitor display



#### 7.6.3.1 Rotation (X, Y, Z)

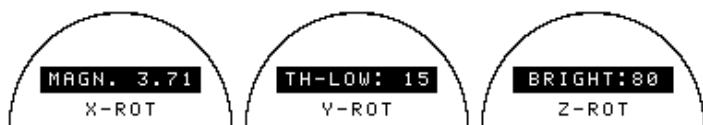
Touch half circle to select rotation, if not active (illuminated)



Rotate 3D image around x-, y-, z-axis with corresponding digipot.

#### 7.6.3.2 Magnification, Threshold Low, Bright

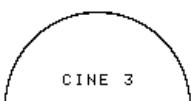
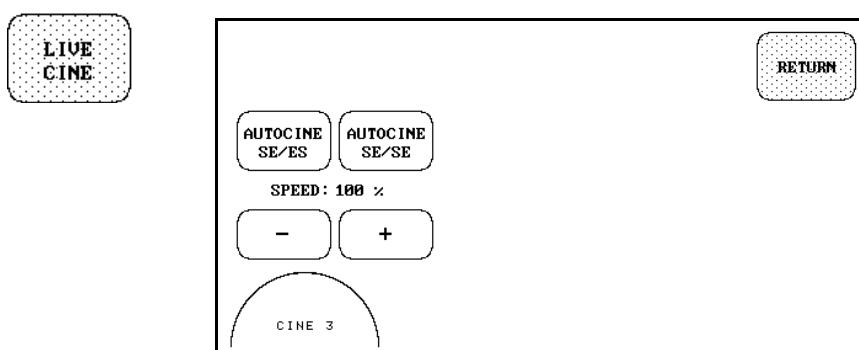
Touch half circle to select above functions, if not active (illuminated)



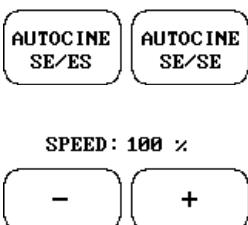
Adjust function with corresponding digipot

### 7.6.3.3 Live Cine Mode

The last 20 images of a Live 3D sequence can be displayed image after image. Switching on Live Cine Mode the Live Cine Menu appears.

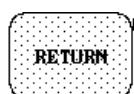


Select image after image with trackball



automatic cine of all stored images  
 SE/ES: start -> end, end -> start  
 SE/SE: start -> end, start -> end

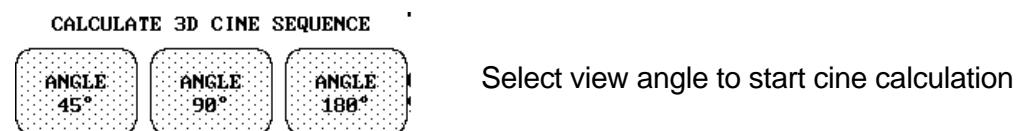
SPEED: 100 x  
 - + select cine speed



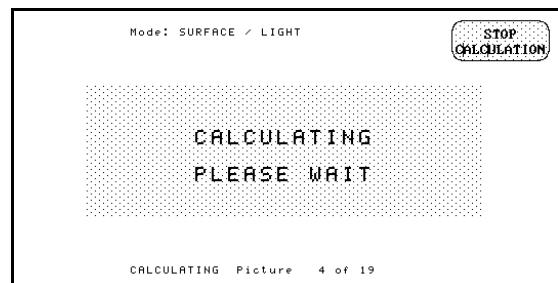
Return to previous menu:  
 3D image of last stored volume sweep appears.

### 7.6.3.4 3D Cine Sequence

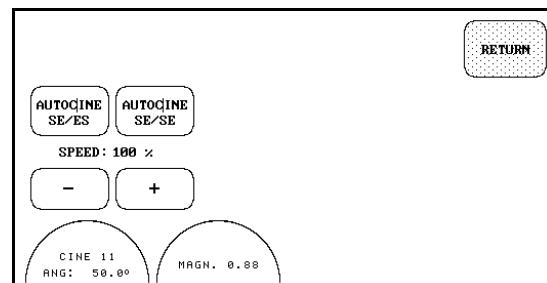
For each step of 5° a new rendered view is calculated and then shown in a cine sequence.



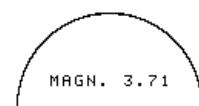
Menu during cine calculation:



Menu after calculation



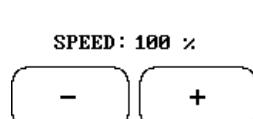
Select image after image with trackball



adjust magnification, if wanted



automatic cine of all calculated images  
 SE/ES: start -> end, end -> start  
 SE/SE: start -> end, start -> end

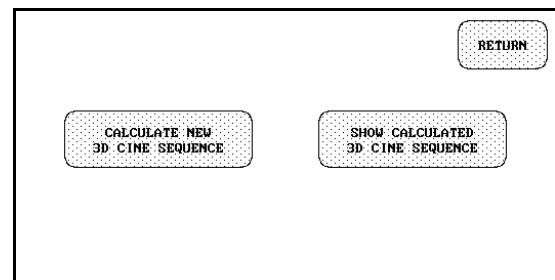


select cine speed



Return to previous menu:

Menu, if a cine sequence is already calculated:



Touch "CALCULATE NEW 3D CINE SEQUENCE" to start a new calculation.  
 The cine sequence already calculated will be lost!

## 7.7 Live 3D: Extended operation (Expert Mode)

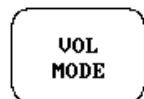
Depending on a setup switch always predefined or extended operation is activated when switching on Volume Mode.

For the Setup operation see chapter 12.15.

Condition: Volume-acquisition and Live 3D option are installed  
extended operation setup switch is on.  
Voluson probe is connected and selected.  
adjust an optimum 2D-image before activating VOL-Mode.

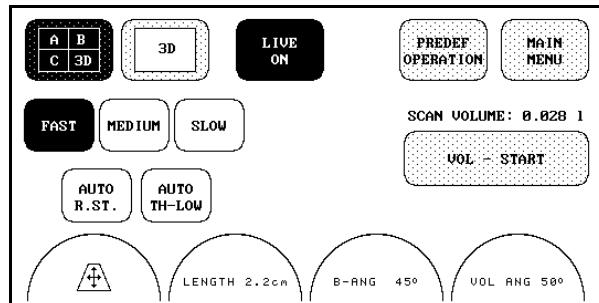
### 7.7.1 Write Mode (volume acquisition)

#### 7.7.1.1 activate VOL-Mode



The VOL-Acquisition menu appears on touchpanel and the Volume box is superimposed to the 2D image.

Touch screen



2D image with Vol-Box

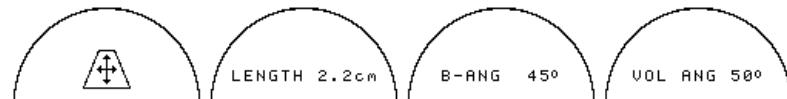


### 7.7.1.2 Possible adjustment before starting acquisition

- select acquisition mode

			acquisition: result:	single volume sweep multiplanar plane display without 3D image
			acquisition: result:	single volume sweep (Photo Mode) full size display of a rendered 3D image
			acquisition: result:	continuos volume sweep (Live 3D) quarter size display of a rendered 3D image + multiplanar planes.
			acquisition: result:	continuos volume sweep (Live 3D) full size display of a rendered 3D image

- adjust volume box size and position



remark:

the Volume box frames the Region of Interest (ROI), which will be stored during a volume sweep and from which a rendered 3D image is calculated.

If feasible select a small volume box in order to have a small volume and therefore a short sweep time (higher frame rate in LIVE 3D).

- select acquisition speed



remark:

due to the selected speed the volume line density will change.

Fast: fast speed/lower line density (lower image quality)

Medium: medium speed/medium line density (medium image quality)

Slow: slow speed/high line density (high image quality)

- If "LIVE 3D" is on:



Auto Render Start ON/OFF:

automatic calculation of render start plane to cut out information, which prevent free sight to rendered surface. For good performance the calculation algorithm needs liquid before rendered surface.



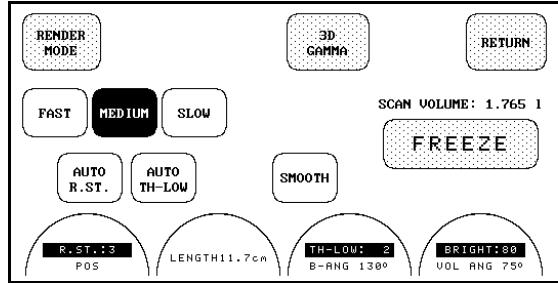
Auto Threshold Low ON/OFF:

automatic calculation of TH-LOW value to suppress small echoes or noise to have a "clear sight" to rendered surface.

### 7.7.1.3 activate volume write mode (acquisition start)

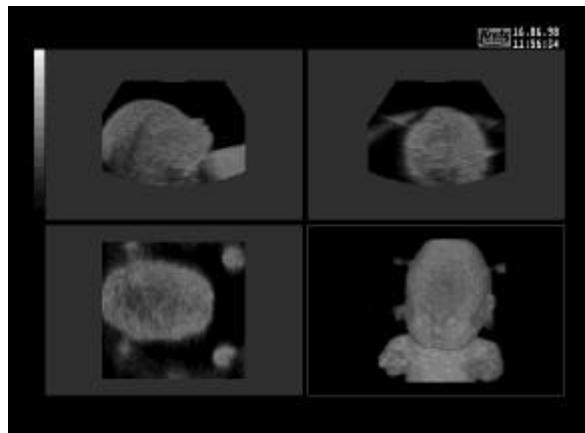
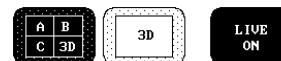


if LIVE ON is active: LIVE ON acquisition menu appears on touch panel.



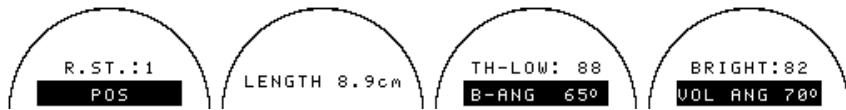
Monitor display (Live 3D):

Acquisition mode:



#### 7.7.1.4 Possible adjustment during LIVE 3D

- adjust volume box size/position



Remark:

changes always are visible in the next recorded volume frame. Update speed depends on actual live 3D frame rate.

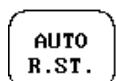
- select acquisition speed



- adjust Render Start

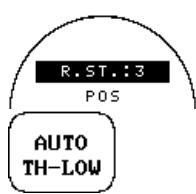


manual: position start line with trackball  
All information before the red render start line is cutted from the rendered 3D image. Red render start line is displayed in the center B-image (left upper quadrant of display).



Auto Render Start ON:  
render start will be calculated automatically. (display: R.ST.: AUTO)

- adjust Threshold Low:



manual: adjust TH-LOW with digipot  
All information beyond TH-LOW value is cutted from the rendered 3D image.

Auto Threshold ON:  
TH-LOW value will be calculated automatically  
(display: TH-LOW: AUTO)

- 3D image brightness



adjust brightness of 3D image

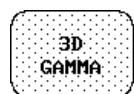
- Smooth filter



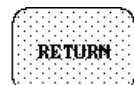
Smooth filter ON/OFF

ON: increase of display frame rate (with help of the smooth filter additionally filtered 3D images are displayed).

OFF: always last calculated 3D image is displayed.



see main user's manual chapter 7.4.2.9



back to previous acquisition menu

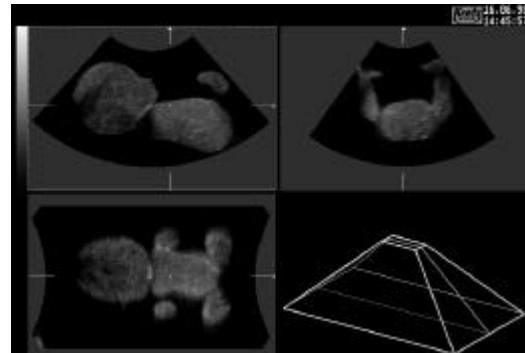
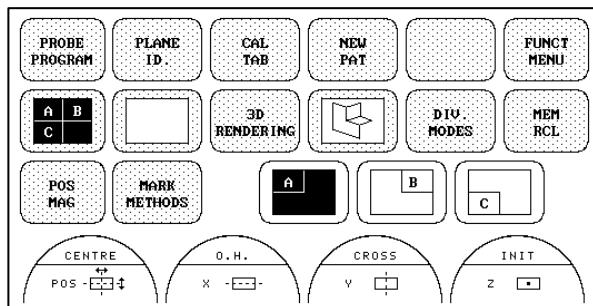
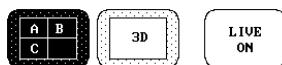


freeze Live 3D

### 7.7.2 Read Mode - operation on a frozen volume scan

Touch panel menu and monitor image after freeze:

- Acquisition mode:

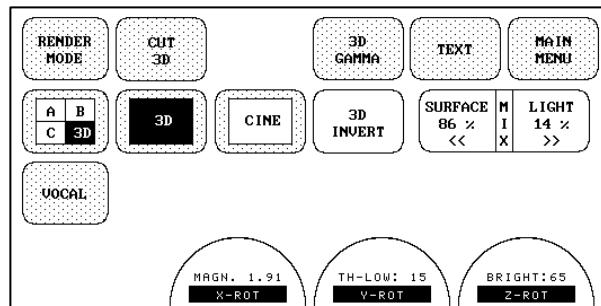
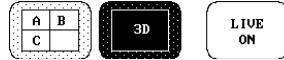


Vol-read menu

No change in operation:

see main USER'S MANUAL chapter 7.3 Volume display - Image analysis

- Acquisition mode:



Render main menu

Operation see main USER'S MANUAL:

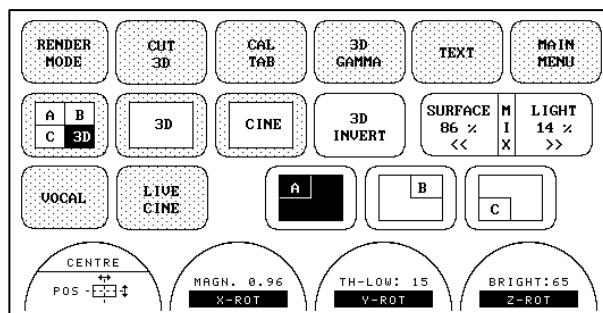
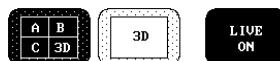
**chapter 7.4 Interactive Volume Rendering**

new function: Live Cine see 7.7.2.1  
VOCAL see 7.8

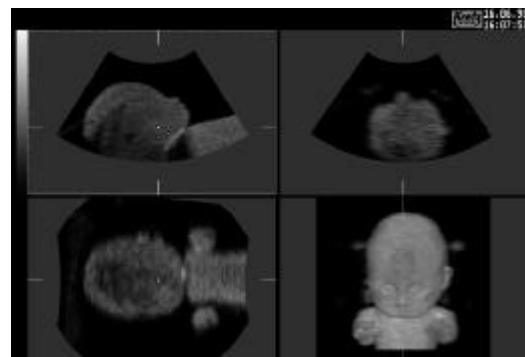
## VOLUME MODE

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- Acquisition mode:



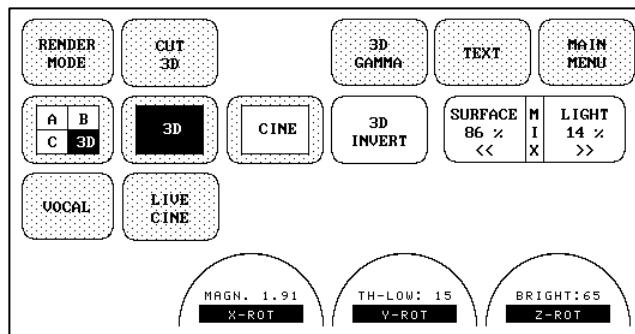
Render main menu



Operation see main USER'S MANUAL:  
**chapter 7.4 Interactive Volume Rendering**

new function: Live Cine see 7.7.2.1  
VOCAL see 7.8

- Acquisition mode:



Render main menu

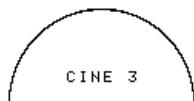
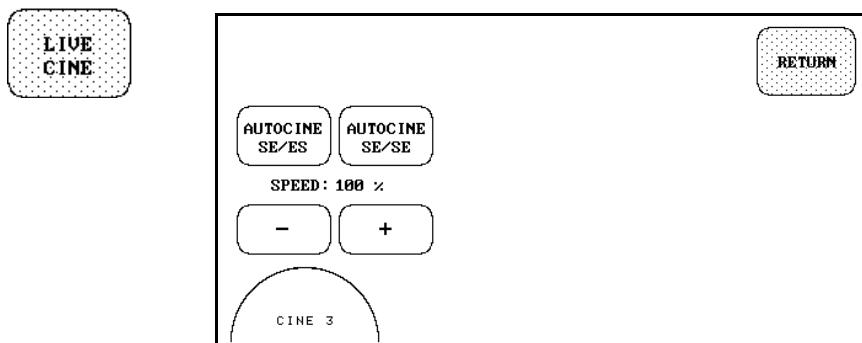


Operation see main USER'S MANUAL:  
**chapter 7.4 Interactive Volume Rendering**

new function: Live Cine see 7.7.2.1  
VOCAL see 7.8

### 7.7.2.1 Live Cine Mode

The last 20 images of a Live 3D sequence can be displayed image after image. Switching on Live Cine Mode the Live Cine Menu appears.



Select image after image with trackball



automatic cine of all stored images  
 SE/ES: start -> end, end -> start  
 SE/SE: start -> end, start -> end



select cine speed



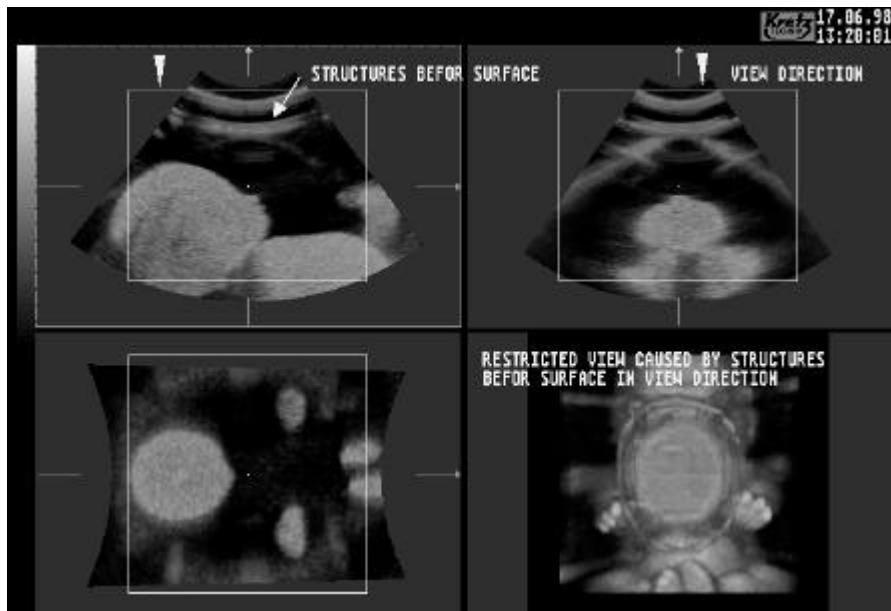
Return to previous menu:  
 3D image of last stored volume sweep appears.

### 7.7.2.2 Selective View

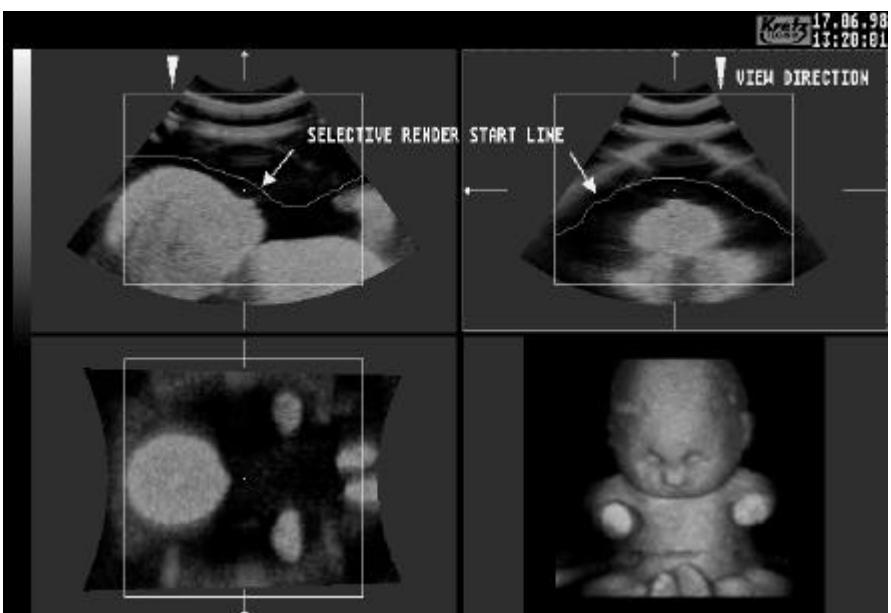
With this render tool structures which obstruct free sight to the surface can be selectively removed by entering a selective (polygon) render start line between surface and structures, which should be removed from render calculation.

for example:

bad 3D image before using selective view tool

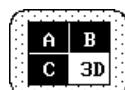


good 3D image after removing unwanted structures using selective view tool



Operation:

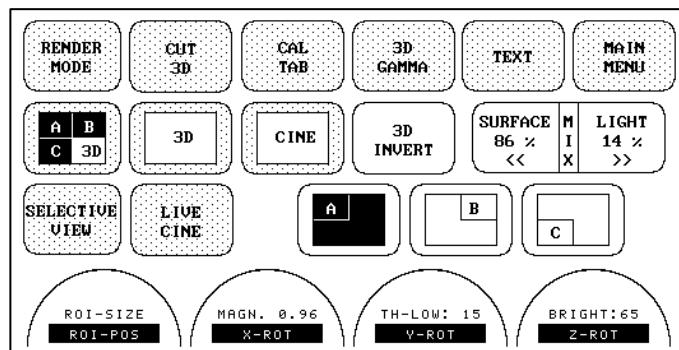
- Select the 3D-ROI-Mode (if not active)



Key in Render main menu:

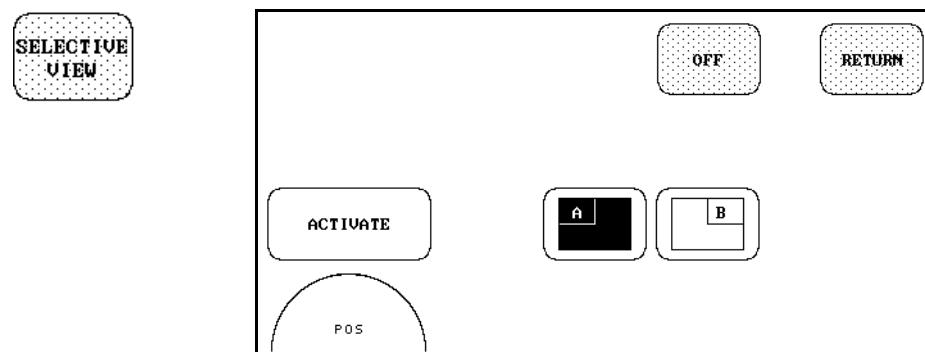
With this key one can toggle between 3D-Pictogram-Mode and 3D-ROI-Mode.

Render main menu:

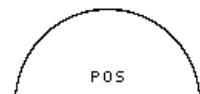


The volume rendering box for the 3D calculation is inserted in the orthogonal planes A,B,C and the rendering result is displayed in the lower right quadrant. This mode is automatic active when switching on 3D-Rendering. If 3D rendering is on during acquisition 3D-Pictogram-Mode is active after freeze.

- Switch on Selective View

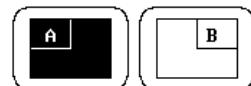


- enter selective render start line with trackball

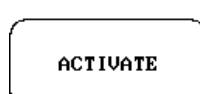


Enter the red render line between wanted surface and other structures, which should be removed from calculation process.

- select image B and enter selective start line as well

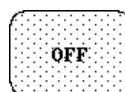


- activate render calculation



3D image with new render start line is calculated.

Note: only in 3D image information above render line is removed. In A, B, C-plane information remains.



switch off selective view



return to render main menu  
adjusted selective render start line remains active

## 7.8 VOCAL

### 7.8.1 General Information

The VOCAL™ - Imaging program (Virtual Organ Computer-aided AnaLysis) is integrated in Kretztechnik's Voluson™ 530 D/MT sonography system. It opens up completely new possibilities in cancer diagnosis, therapy planning and follow-up therapy control. VOCAL™ offers different functions:

- Automatic contour detection of structures (such as tumor lesion, cyst, prostate etc.) and subsequent volume calculation. The accuracy of the process can be visually controlled by the examiner in multi-planar display.
- Construction of a virtual shell around the contour of the lesion. The thickness of the shell can be defined. The shell can be imagined as a layer of tissue around the lesion, where the tumor-vascularization takes place.
- Automatic calculation of the vascularization within the shell by 3D color histogram by comparing the number of color voxels to the number of gray-scale voxels.

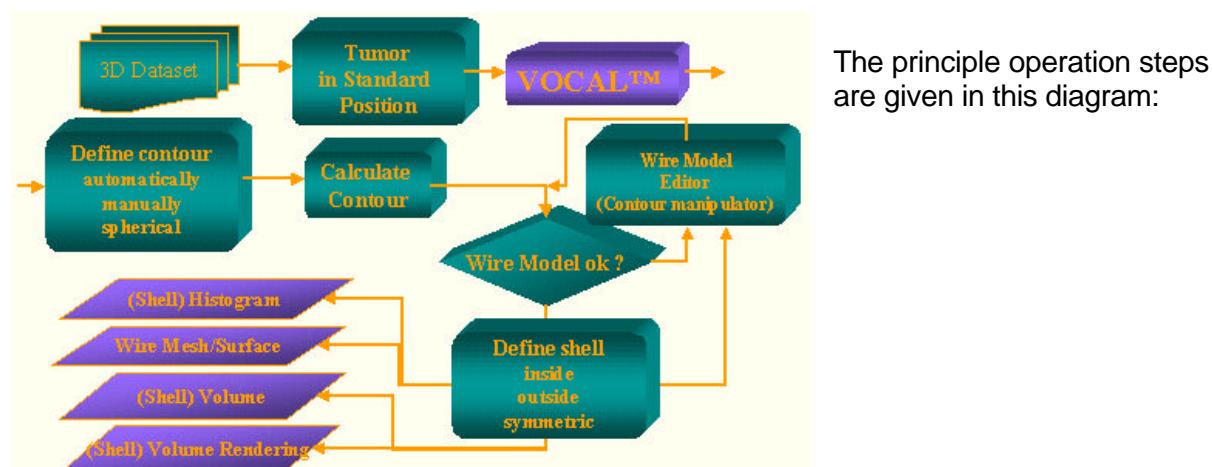
**The follow-up control of tumor volume and vascularization deliver information on the proper dose of medication or radiation and is therefore a measure for the success of treatment.**

After definition of a contour in 3D space a wide range of functionality is given:

- definition of a shell contour
- visualization of a (shell) contour as a surface or wire mesh
- volume calculation of a (shell) contour
- histogram calculation of ultrasound tissue inside a (shell) contour
- visualization of ultrasound tissue inside a (shell) contour as a rendered image
- niche presentation of contour and slices
- shell map presentation of ultrasound tissue inside a (shell) contour

The basic idea behind VOCAL™ is the combination of 3D ultrasound tissue (presented as VOXEL's) and the geometric information of surfaces in a 3D dataset.

The main interest of VOCAL™ is the surface characterization (definition) of tumors or lesions.



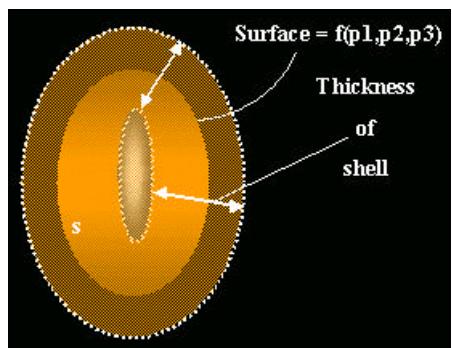
## Definition of the Surface Geometry

The *Surface Geometry* is defined by rotation of an image plane round a fixed axis (main contour axis) and the definition of 2D contours in each plane. The 2D contours can be defined automatically (for prostate or breast lesions) or manually or by a sphere. The rotation step for each contour plane is selectable in the range from 6 to 30 degrees (30 - 6 contour planes).

The *Surface Geometry* is defined by 3D triangularization of the 2D contours, meaning each point of the 2D contour in plane N is connected via a triangle mesh to corresponding points in plane N-1 and plane N+1.

## Definition of a Shell Contour (Geometry)

The basic idea of a *Shell Contour* is, to define a 'thickness' of the 'reference' surface geometry.

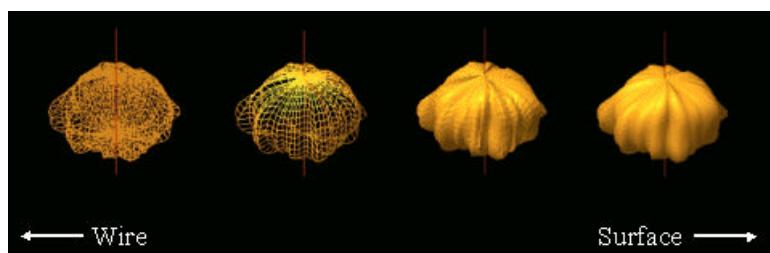


The 'parallel' contours shown in the image define the 'parallel' surface geometry (describing the shell). The 'parallel' contours are either defined symmetrically to the reference contour or limited to one direction, inside or outside. The *Shell Geometry* consists of one outside and one inside surface and therefore it is possible to distinguish between points enclosed by the shell geometry and points outside. A *Shell Contour* represents all points enclosed by the inner and outer surface geometry. If no *Shell Contour* is defined explicitly, the

*Shell Geometry* consists of the reference surface (outside surface) and an inner point (inside surface is degenerated).

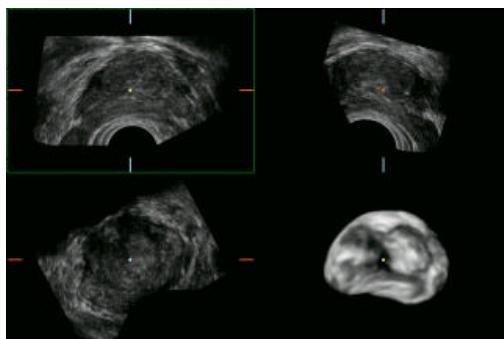
## Display of a Shell Geometry (contour rendering)

The shell geometry can be visualized as a surface or a wiremesh.



The image shows the different visualization techniques. VOCAL shows a surface mesh.

### Volume Rendered display of a Shell Contour



The shell contour is used to define which VOXEL's in the 3D ultrasound dataset are part of the shell geometry and which are outside. VOXEL's outside the shell contour are not displayed in the Volume Rendered image.

### (Shell) Volume Calculation

The (shell) volume is defined as the difference between the volume defined by the outer surface (of the shell geometry) and the volume defined by the inner surface (of the shell geometry).

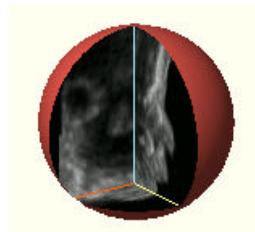
### (Shell) Histogram

The histogram calculation of all points inside the shell contour.

### (Shell) Niche presentation

The niche presentation allows the visualization of slices and the shell contour in one image.

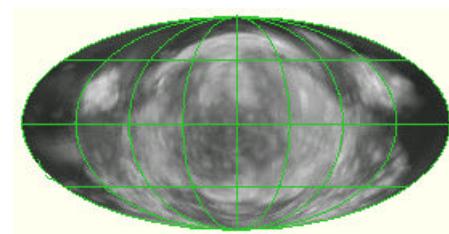
The presentation gives a 3D overview about the orientation of the slices and the shell contour.



### Shell Map presentation (Homographic Equal-Area Projection)

The shell map image represents an overview mode of all data of a shell contour in degree of latitude and longitude, comparable with the presentation of the earth. The shape of the surface is deformed. The area of surface objects remain unchanged.

The maximum value of all VOXEL's with same angles (degree of latitude and longitude) is projected to screen.



### Summarized Definitions

*Surface Geometry:* a closed triangle mesh of 3D contour points.

*Shell Geometry* a defined inner and outer surface geometry.

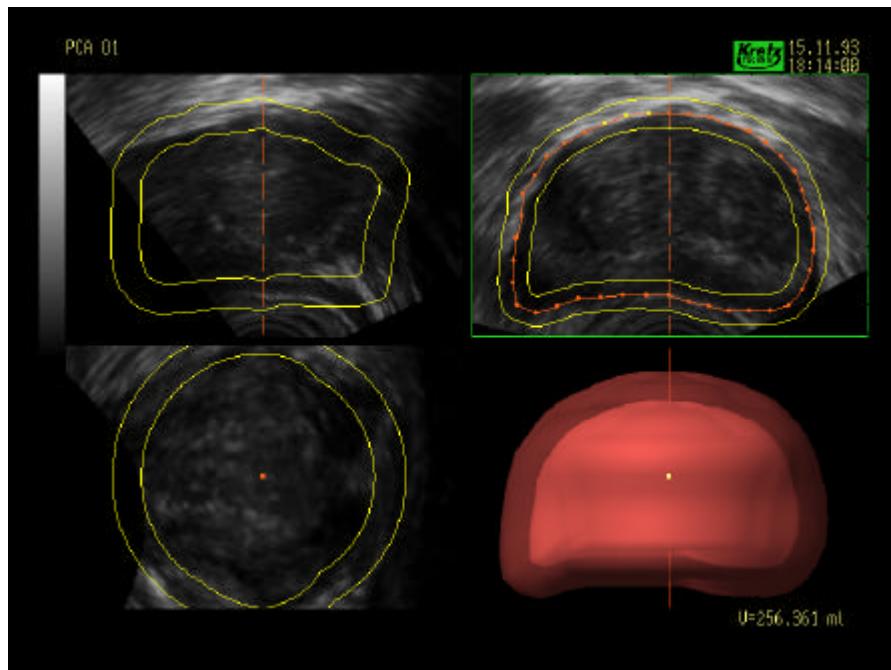
*Shell Contour:* Points inside the inner and outer surface of the shell geometry.

*Shell:* Generic term of shell contour and shell geometry.

### 7.8.2 VOCAL - Define Contour

For these adjustments two menus are available:

- the VOCAL-Define Contour menu, where the contours of an object, lesion, tumor ... are generated
- the VOCAL-Edit menu, where the contours can be manipulated and a shell contour is generated

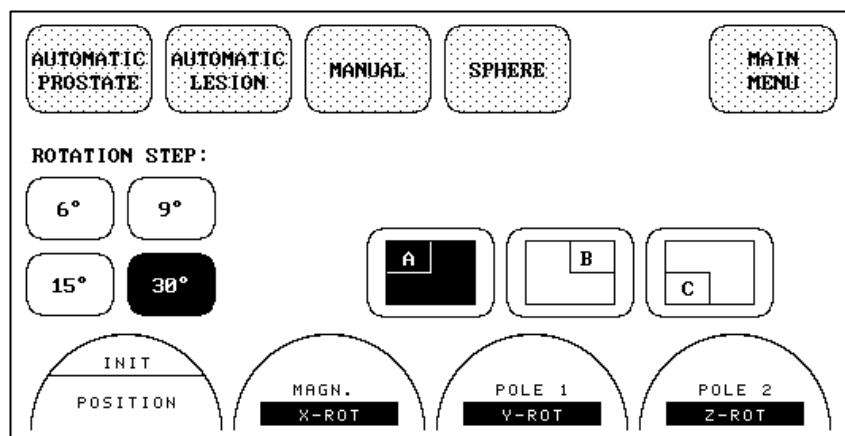


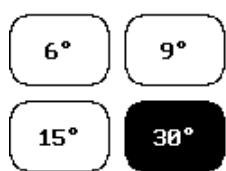
(Screenshot of a shell contour)

Operation:



Touch the VOCAL-key for starting VOCAL. If this key is not present in the VOL-READ menu, touch the key DIV.MODES before. Then this key is copied to the VOL-READ menu.  
The VOCAL - Define Contour menu appears on the touch screen:



**Principle steps to generate a (shell) contour****a.) Selection of a Rotation Step****ROTATION STEP:**

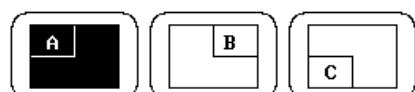
The rotation step defines the number of available contour planes. (How many contours must be generated.)

Number of contour planes =  $180^\circ / \text{rotation step}$

e.g. for a rotation step of  $15^\circ$ , 12 contour planes are available  
 $(= 180 / 15)$

**b.) Selection of the reference image**

The selection of the reference image defines the image plane(s) to generate the contours.



Touch the respective key to select the reference image

To generate the contours the reference image is rotated via the

- vertical axis (for reference image A or B)
- horizontal axis (for reference image C)

in the center of the image. (red dotted line)

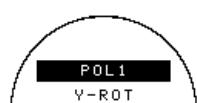
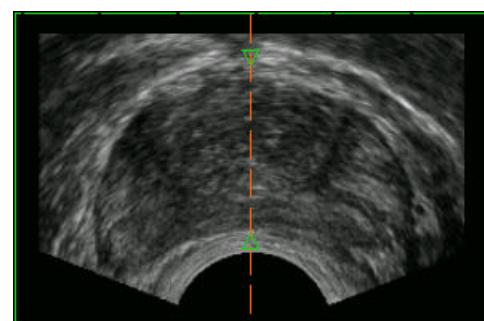
The rotation angle of the reference image is defined with the rotation step.

**c.) Selection of two contour points on the rotation axis. (main contour axis)**

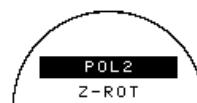
For automatic contour modes

- Automatic Prostate
- Automatic Lesion
- Sphere

two contour points are marked in the image plane(s) along the main contour axis to define the poles of the (shell) contour. (All generated contours in the image planes cross the main contour axis in these two points.)



Adjust the upper contour point (characterized by a green arrow) by using this knob



Adjust the lower contour point (characterized by a green arrow) by using this knob

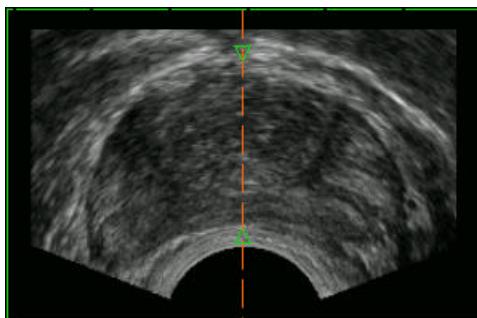
For the manual contour mode the positions of the two contour points are irrelevant and not essential!

**d) Selection of a contour generation mode**

The main contour axis should lie in the center of the 3D lesion. (The 3D object should be centered with respect to the rotation axis.)

All defined contours (in different planes) cross the main contour axis at the position of the green arrows. If not, change the position of by using the trackball.

### Computer assisted contour modes (Automatic)



#### **Automatic Prostate**

This function is only useful if you want to outline the surface of a prostate. Using this function an automatic detection of the prostate contour in every image plane is running. The reference image is rotated automatically via the rotation axis and contours in each image plane are generated. The number of generated contours depends on the selected rotation step. This function will not find the prostate contours in every case, but helps to have a first result for later manipulations of the contours in the VOCAL Edit menu.

#### **Automatic Lesion**

This function is only useful if you want to outline the surface of a breast lesion. Using this function an automatic detection for breast lesions in every image plane is running. The reference image is rotated automatically via the rotation axis and contours in each image plane are generated. The number of generated contours depends on the selected rotation step. This function will not find the prostate contours in every case, but helps to have a first result for later manipulations of the contours in the VOCAL Edit menu.

#### **Sphere**

This function is only useful if you want to outline the surface of a sphere. Using this function a sphere round the main contour axis is generated within the two green arrows. The number of generated contours depends on the selected rotation step.

#### Operation:



Touch one of these keys to select the desired Automatic contour mode.

The contour of the 3D data set is calculated automatically. The VOCAL-Edit menu is displayed on the touch screen. Edit the contour if necessary (See chapter 7.8.3).

To accept the Computer assisted Contour press the key



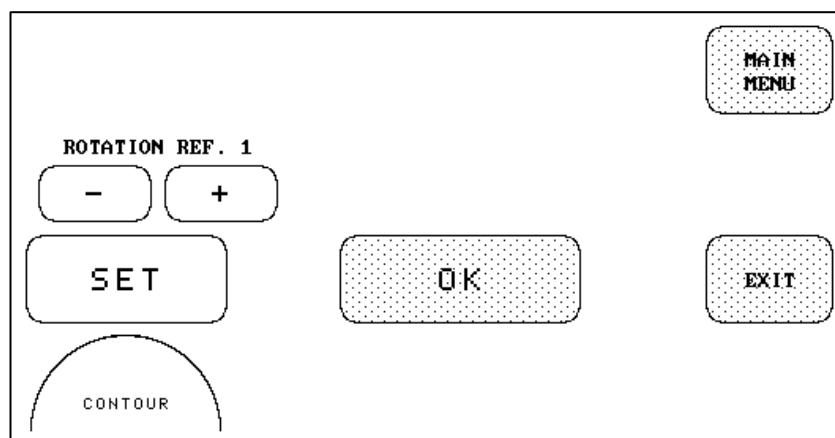
**Manual contour mode**

This function allows you to outline any connected lesion. The number of manual generated contours depends on the selected rotation step.

Operation:

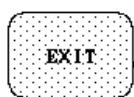


Select the manual contour mode by touching this key.  
The following menu appears on the touch screen:  
VOCAL-manual menu



- Use the trackball and the SET-key to outline the first contour.  
Position the cursor for starting the contour and touch the SET-key.  
Draw the contour line and enter this line by touching the SET-key again.  
The two green arrows are automatically positioned on the main contour axis.  
The outlined contour is only valid, if the rotation axis is crossed exactly twice
- Select the next image plane by using the keys + / - of the function ROTATION REF.  
The contour is automatically copied to the next image plane and can be redefined by  
drawing a new contour. Every time you start to outline a contour, the old contour in this  
image plane is replaced by the new one.
- After you have defined the contours in all image planes touch the OK-key.  
The result is displayed on the monitor and the VOCAL-Edit menu appears on the touch  
screen (See chapter 7.8.3).

Additional functions:



Return to the 'VOCAL-Define Contour'-menu



Return to the 'Main' - menu.

### 7.8.3 VOCAL - Edit

You will enter this menu

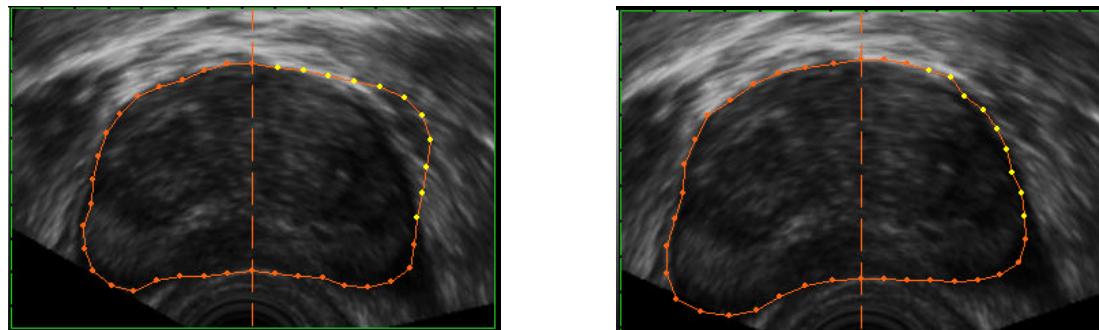
- from the VOCAL - Define Contour menu - if a (shell) contour is defined
- from the VOCAL – Manual menu - if a (shell) contour is already generated

In the VOCAL Edit menu the generated contours can be manipulated.

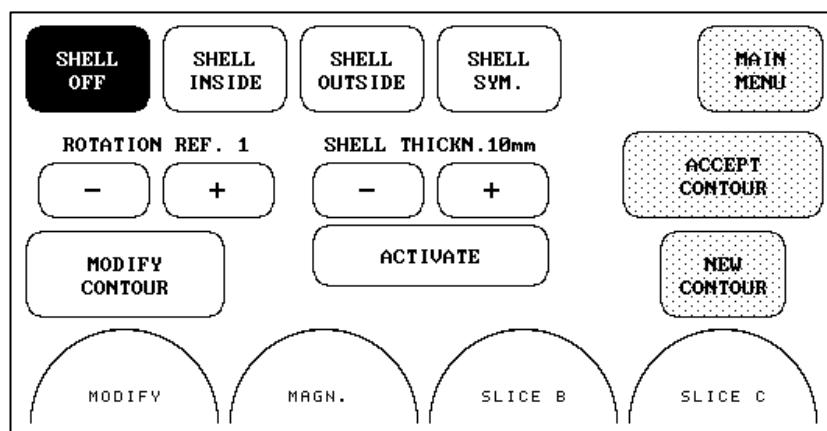
#### ***The VOCAL™ contour Editor***

When entering this menu the screen appears as follows:

- The reference image shows the first generated contour, outlined with red and yellow dots.
- In the orthogonal slices the intersection curves between the shell geometry and the different image planes are outlined as a yellow contour.
- The shell geometry is visualized in the lower right quadrant.



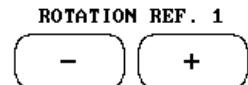
The following window appears on the touch screen: VOCAL-Edit menu



**a.) Modifying the Contour:**

When moving the trackball the yellow dots change with respect to the position of the cursor. If the cursor is positioned close to the contour line only one dot is yellow. By increasing the distance, more dots become yellow.

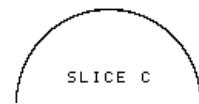
- Touch the key MODIFY CONTOUR and move the yellow dots by using the trackball. Press the MODIFY CONTOUR –key again to store the modified contour. Repeat these steps if necessary. All relevant results (shell contour, volume etc.) are updated automatically.
- Select the next image plane by using the keys + / - of the function ROTATION REF. and modify the contour for this plane.
- After you have modified the contours in selected image planes touch the key ACCEPT CONTOUR. The result is displayed on the monitor and the VOCAL-Display menu appears on the touch screen.

**b.) To analyze the contours (shell geometry)**

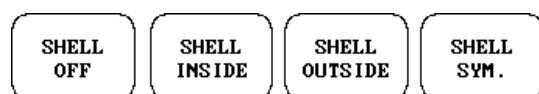
With these keys a new reference contour can be selected. The number indicates the selected image plane.



With this knob the B image can be moved forward and backward (parallel slices). This allows you to see the changes of the intersection curves with parallel movement.

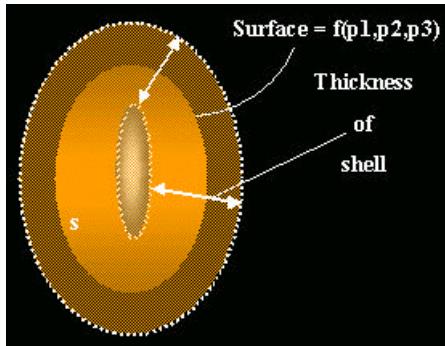


With this knob the C image can be moved forward and backward (parallel slices). This allows you to see the changes of the intersection curves with parallel movement.

**c.) Defining a shell contour (shell geometry)****Shell off**

- the outside surface is equal to the generated contours (reference surface geometry)
- the inside surface is represented by an inner point (inside surface is degenerated)

Selection of other *Shell* states mean:



#### **Shell inside**

- the outside surface is equal to the reference surface geometry
- the inside surface is the surface geometry of the inner 'parallel' contours with *distance Shell Thickness* in mm

If one of the inside contours is not valid, the inside surface is represented by an inner point (inside surface is degenerated). (A contour is only valid if the rotation axis is crossed exactly twice.)

#### **Shell outside**

- the outside surface is the surface geometry of the outer 'parallel' contours with *distance Shell Thickness* in mm
- the inside surface is equal to the reference surface geometry

#### **Shell symmetric**

- the outside surface is the surface geometry of the outer 'parallel' contours with *half distance Shell Thickness* in mm
- the inside surface is the surface geometry of the inner 'parallel' contours with *half distance Shell Thickness* in mm.

If one of the inside contours is not valid, the inside surface is represented by an inner point (inside surface is degenerated). (A contour is only valid if the rotation axis is crossed exactly twice.)

SHELL THICKN. 10mm

-	+
ACTIVATE	

The thickness of the shell can be adjusted by using this +/- keys  
To activate the selected shell thickness touch the ACTIVATE-key.  
Then the new shell thickness is calculated.



The shell contour is not accepted and you return to the VOCAL-Define Contour-menu, where you can define a new contour.



The shell contour is accepted and stored.  
The VOCAL-Display menu appears on the touch screen:

Of course only valid reference contours generate a valid shell contour.

#### d.) Display of the (Shell) Volume

The (shell) volume is defined as the difference between the volume defined by the outer surface (of the shell geometry) and the volume defined by the inner surface (of the shell geometry). A degenerated surface is symbolized in the display with \*\*\*\*\*.

The Volume is displayed on the monitor in the lower right quadrant: V=xxx.xx ml

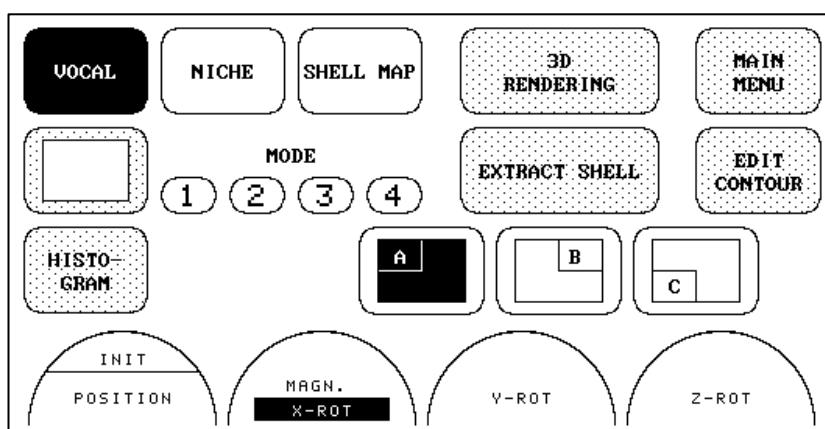
If the reference surface geometry is not valid, all volumes are invalid and displayed with \*\*\*\*\*.

#### 7.8.4 VOCAL - Display

In the VOCAL-Display menu several display modes can be selected.  
You will enter this menu after accepting a contour.



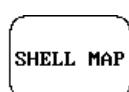
Touch this key in the VOCAL-Edit menu.  
The defined (shell) contour is accepted and stored.  
The following menu appears on the touch screen:



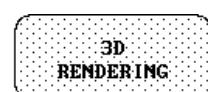
The surface of the (shell) contour is displayed in the lower right quadrant.



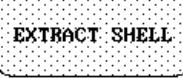
The surface of the (shell) contour is cut up.  
The slices of the 3D image and the surface of the (shell) contour is displayed in one image. With the MODE-keys '1, 2, 3, 4' the position of the niche can be changed.



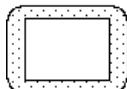
The shell map image represents all data of a shell contour in degree of latitude and longitude, comparable with the presentation of the earth. With the MODE-keys '1, 2, 3, 4' several display modes of the shell map can be selected changed.



The rendered Volume image within the shell contour is displayed.  
VOXEL's outside the shell contour are not displayed but the volume data set is left unchanged.



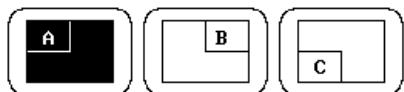
The rendered Volume image within the shell contour is displayed. VOXEL's outside the shell contour are deleted and the volume data set is reduced.



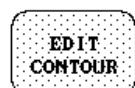
The image format is switched to full size format.



A histogram is calculated of all points inside the shell contour. An additional window is displayed on the monitor.



The rotary knobs and the trackball are assigned to the selected reference image for adjusting the position, magnification and rotation of the shell image.



Return to the VOCAL-Define Contour-menu, where you can define a new contour.



Return to the 'Main' - menu.



<b>8 DOPPLER MODE .....</b>	<b>8-2</b>
8.1 PW-Mode (Pulsed Doppler).....	8-2
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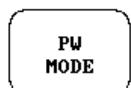
## 8 DOPPLER MODE

### 8.1 PW-Mode (Pulsed Doppler)

After switching on PW-Mode (pulsed mode) a D-cursor with a sample volume (gate) is displayed in the image.

The D-image (Doppler spectrum) is started and frozen with the "FREEZE"-key. The D-image is displayed in Scroll-Mode (most recent information is always on the right edge of the screen).

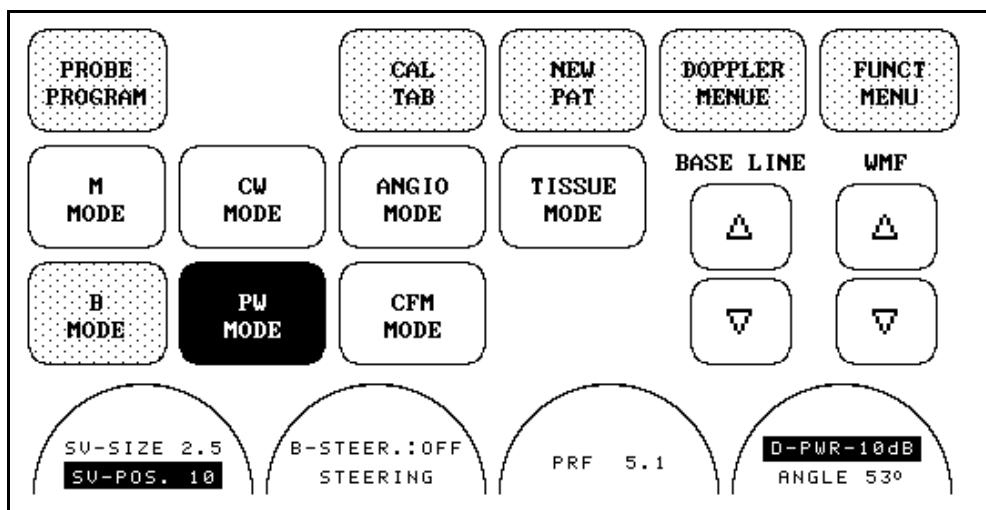
The simultaneous B/D-Mode display (simultaneous running of B- and D-Mode image) is only possible with electronic transducers.



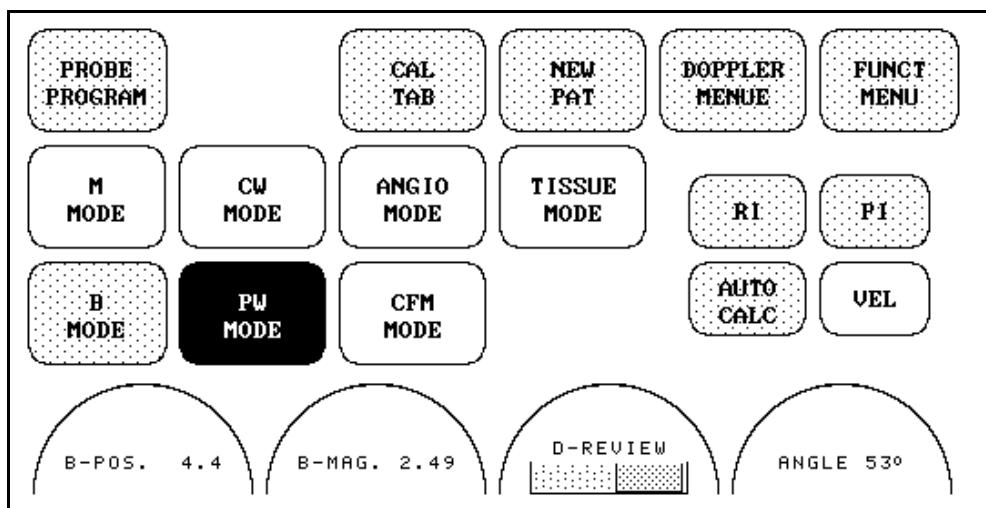
PW-Mode key

When switching on PW-Mode the main menu 'PW-Mode' appears.

Main Menu: PW-MODE (Write)

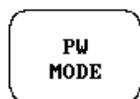


Main Menu: PW-MODE (Read)



Operation:

## 1. Switching on PW-MODE



By touching this key the B/D-display is switched on.  
The screen is sectioned horizontal or vertical (depending on the selected image format) and the D-cursor appears within the B- image.  
Change of format see point 14.  
This key only appears when the connected transducer is capable of Doppler.

## 2. Setting the D-Cursor and the Doppler sample volume



↔ D-Cursor position (trackball)  
↑↓ Depth of sample volume (trackball)



↑↓ Length of sample volume (trackball)  
5 steps: 1, 2.5, 6, 10, 15 mm



Steering angle of D-Cursor (digipot)  
This function is only available with steerable linear transducers.  
(e.g. S-NLM5-10)  
Touching the half circle (toggle switch):  
B-STEER.: OFF: B-image is not steered  
B-STEER.: ON: B-image and Doppler is steered

## 3. Starting and stopping the D-image



The D-image starts scrolling.  
Touching this key again stops the running D-image.

## 4. Switching between B- and D-Mode



This key switches from B- to D-Mode and vice versa.  
This function is necessary specially for non-simultaneous B/D- display with mechanical transducers. Simultaneous B/D-Mode is stopped and B-image with D-Cursor is started.

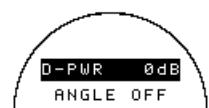
## 5. Simultaneous Doppler-Mode

Simultaneous B/D-display (B-image and D-image running simultaneously) is only possible with electronic transducers. For physical reasons the max. Doppler-PRF in this mode is limited depending on the penetration depth of the B-image.  
By reducing the B-image penetration the max. Doppler-PRF can be increased (see depth range, image positioning).



With this key the simultaneous B/D-display is switched on or off. If the Doppler is running already (Write) the simultaneous mode is activated at once.  
With a frozen Doppler spectrum the function is only prepared. After the start of the D-image simultaneous mode is switched on at once.

### 6. Setting the Doppler transmit power



Doppler transmit power

The Doppler transmit power can be set in max. 32 steps

Display: D-PWR -20...+12dB

The Doppler transmit power can only be set in Doppler Write- Mode.

When reaching MIN- or MAX-settings a short beep sound will be heard.

The maximum possible transmit power can be reduced by the intensity control depending on certain settings (e.g. PRF, transmitter frequency, etc.).

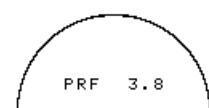
### 7. LF-GAIN (low frequency gain)

After starting the D-image the Doppler LF-GAIN is related to the right (large) digipot.

The LF-GAIN can only be set in Doppler Write-Mode (20 steps). The following display appears on the monitor.

Display: LFG -20...0dB

### 8. Setting the pulse repetition frequency



PRF (pulse repetition frequency)

The PRF can be set in max. 22 steps from 1 kHz to 31 kHz.

Depending on the depth of the sample volume the max. permissible PRF is indicated with a short beep sound.

Exceeding this maximum by further increasing the PRF the HPRF-Mode is automatically switched on.

#### HPRF-Mode

The max. clearly measurable flow velocity (Nyquist-Limit) is determined by the measuring depth of the sample volume and the related running time of the ultrasound. By a further increase of the Doppler-PRF (High PRF-Mode, HPRF) the Nyquist-Limit can be increased. Thus in addition to the main sample volume one or more sample volumes appear in lesser depth. During examinations make sure that these additional sample volumes (virtual gates) do not lie in echo-rich areas, as these lead to overswings and interferences in the Doppler signal.

Further it has to be noted that blood flows recorded by these virtual gates are overlaying the actual Doppler signal of the main sample volume.

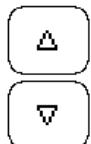
#### Operation:

Set the PRF (Pulse Repetition Frequency) to maximum.  
A beep tone can be heard.

When the maximum is exceeded the HPRF-Mode is automatically switched on.  
Virtual gates are being displayed and the message "HIGH PRF" appears on the monitor.

## 9. Base line shift

BASE LINE



By touching the upper key the zero line can be shifted up in 7 steps or shifted down in 7 steps.

This function can only be set in Write-Mode.

The displayed velocities resp. frequencies on the upper and lower edge of the screen (white borderline) mark the max. values (max. measuring range).

## 10. Wall motion filter

WMF



By touching the upper key the cut off frequency of the filter is shifted upward, with the lower key it is shifted downward.

The cut off frequency of the filter can be set from 30Hz and 2kHz.

The maximum cut off frequency of the filter depends on the PRF (with low PRFs: PRF/4).

Display: WMF 0....2000

## 11. Inversion of D-image (Doppler spectrum)



By pressing this key the display of the Doppler spectrum above and below the zero-line is inverted.

normal: Forward flow above the zero-line  
Reverse flow below the zero-line

inverted: Reverse flow above the zero-line  
Forward flow below the zero-line

Forward flow means: Blood flow toward transducer  
Backward flow means: Blood flow away from transducer

This function can only be set in Write-Mode.

## 12. D-Review Mode (Read-Mode)

The D-Mode memory has the double length of the D-image displayable on the screen. This invisible information can be called back with the D-Review rotary knob if the memory is full.



The small rectangle on the display corresponds to the screen, the large rectangle corresponds to the stored D-length.

## DOPPLER MODE

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### 13. Angle correction (only in Read-Mode)

The blood flow velocity calculation based on the incident angle of the ultrasound onto the axis of the vessel can be determined this way.

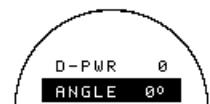
The vessel must be displayed in longitudinal section and the angle cursor must be positioned parallel to the vessel axis (in the area of the measuring volume).

Angle correction is only necessary for velocity display (cm/s, m/s) acc. to the Doppler equation.



#### Read-Mode:

The angle cursor can be turned in both directions without stop. By touching the half-circle the angle correction is switched off (ANGLE OFF, i.e. Angle off the cursor = 0°). No request to set the angle will appear in measuring programs.



#### Write-Mode:

Touching the half-circle switches from D-Power to angle correction (the bright bar shows the actual state).

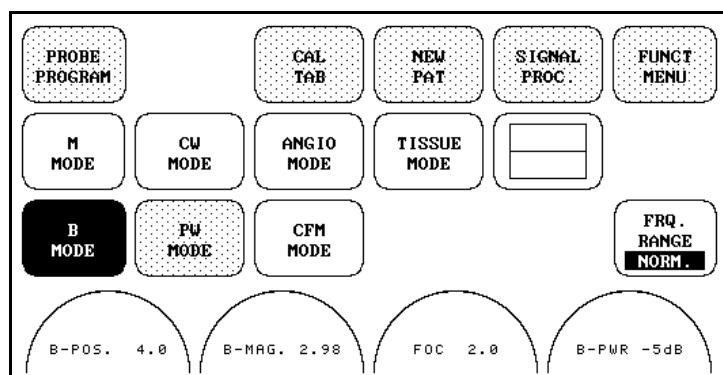
#### Generally:

If the trackball or digipots have two functions touch the half-circle to switch between these functions. The active one is brightly lit.

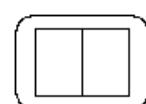
### 14. B/D Display Format

Two Formats are possible: horizontal partition (B-image upper half, D-image lower half)  
vertical partition (B-image left half, D-image right half)

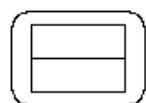
#### 1. select B-Menu in B/D-Mode ( key B-menu is illuminated )



#### 2. change display format



vertical partition  
key is available, if horizontal partition is active

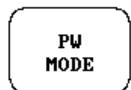


horizontal partition  
key is available, if vertical partition is active

## 8.2 CW-Mode (Continuous Wave Doppler)

After switching on CW-Mode the CW-Cursor is displayed in the B-image. The D-image (Doppler spectrum) is started and frozen with the "FREEZE"-key. The D-image is displayed in Scroll-Mode (most recent information is always on the right edge of the screen).

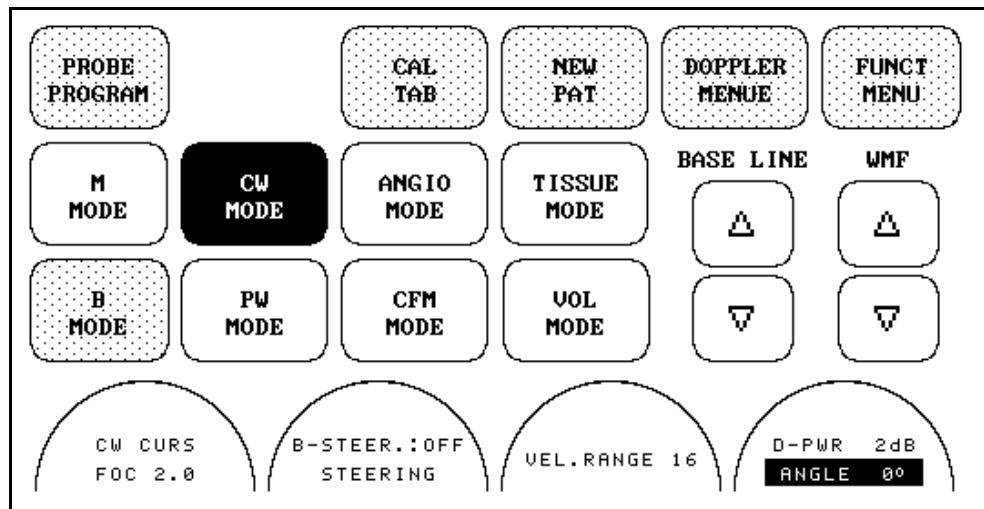
The key "CW MODE" appears in the main menu, if the selected probe enables CW-Mode.



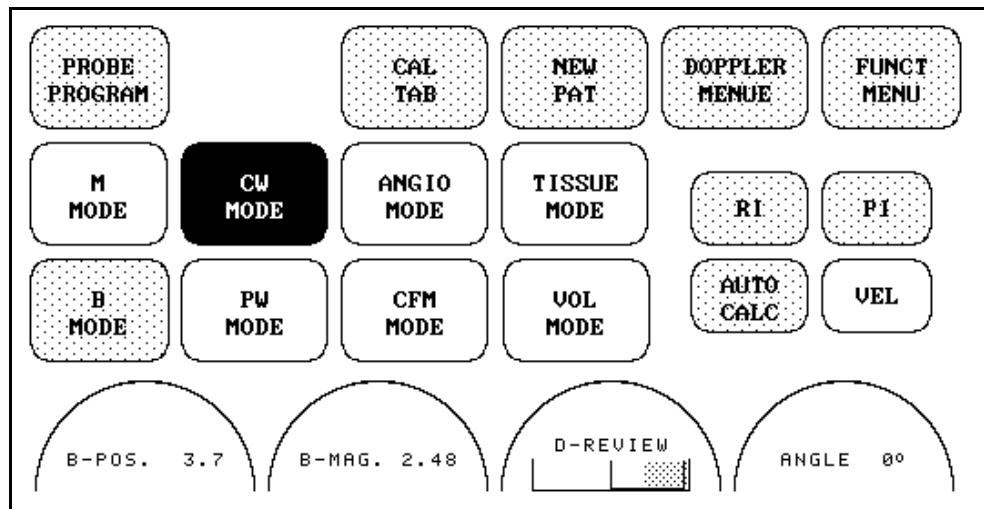
CW-Mode key

When switching on CW-Mode the main menu 'CW-Mode' appears.

Main Menu: CW-MODE (Write)



Main Menu: CW-MODE (Read)

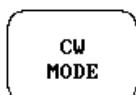


## DOPPLER MODE

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### Operation:

#### 1. Switching on CW-MODE



By touching this key the B/D-display is switched on.  
The screen is sectioned horizontal or vertical (depending on the selected image format) and the D-cursor appears within the B- image.  
Change of format see point 13.  
This key only appears when the connected transducer is capable of CW-Doppler.

#### 2. Setting the CW-Cursor and the CW-Focus



↔ CW-Cursor position (trackball)



Steering angle of CW-Cursor (digipot)

This function is only available with steerable linear transducers.  
(e.g. S-NLM5-10)

Touching the half circle (toggle switch):

B-STEER.: OFF: only PW-Doppler is steered

B-STEER.: ON: B-image and Doppler is steered

#### 3. Starting and stopping the D-image



The D-image starts scrolling in the right image field.

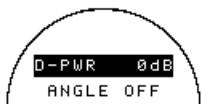
Touching this key again stops the running D-image.

#### 4. Switching between B- and D-Mode



This key switches from B- to D-Mode and vice versa.

#### 5. Setting the Doppler transmit power



Doppler transmit power

The Doppler transmit power can be set in max. 32 steps  
Display: D-PWR -20...+12dB

The Doppler transmit power can only be set in Doppler Write- Mode.

When reaching MIN- or MAX-settings a short beep sound will be heard.

The maximum possible transmit power can be reduced by the intensity control depending on certain settings (e.g. transmitter frequency, focus etc.).

## 6. LF-GAIN (low frequency gain)

After starting the D-image the Doppler LF-GAIN is related to the right (large) digipot. The LF-GAIN can only be set in Doppler Write-Mode (20 steps). The following display appears on the monitor.

Display: LFG -20...0dB

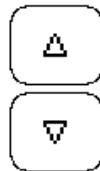
## 7. Setting the velocity range



The velocity range can be set in max. 22 steps from 1 to 22. This function changes the velocity scale of the Doppler display.

## 8. Base line shift

### BASE LINE



By touching the upper key the baseline can be shifted up in 7 steps or shifted down in 7 steps. This function can only be set in Write-Mode. The displayed velocities resp. frequencies on the upper and lower edge of the screen (white borderline) mark the max. values (max. measuring range).

## 9. Wall motion filter



By touching the upper key the cut off frequency of the filter is shifted upward, with the lower key it is shifted downward. The cut off frequency of the filter can be set from 30Hz and 2kHz.

Display: WMF 0....2000

## 10. Inversion of D-image (Doppler spectrum)



By pressing this key the display of the Doppler spectrum above and below the zero-line is inverted.

normal: Forward flow above the zero-line  
Reverse flow below the zero-line

inverted: Reverse flow above the zero-line  
Forward flow below the zero-line

Forward flow means: Blood flow toward transducer  
Backward flow means: Blood flow away from transducer

This function can only be set in Write-Mode.

### 11. D-Review Mode (Read-Mode)

The D-Mode memory has the double length of the D-image displayable on the screen. This invisible information can be called back with the D-Review rotary knob if the memory is full.



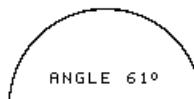
The small rectangle on the display corresponds to the screen, the large rectangle corresponds to the stored D-length.

### 12. Angle correction (only in Read-Mode)

The blood flow velocity calculation based on the incident angle of the ultrasound onto the axis of the vessel can be determined this way.

The vessel must be displayed in longitudinal section and the angle cursor must be positioned parallel to the vessel axis (in the area of the measuring volume).

Angle correction is only necessary for velocity display (cm/s, m/s) acc. to the Doppler equation.



Read-Mode:

The angle cursor can be turned in both directions without stop. By touching the half-circle the angle correction is switched off (ANGLE OFF, i.e. Angle off the cursor = 0°). No request to set the angle will appear in measuring programs.



Write-Mode:

Touching the half-circle switches from D-Power to angle correction (the bright bar shows the actual state).

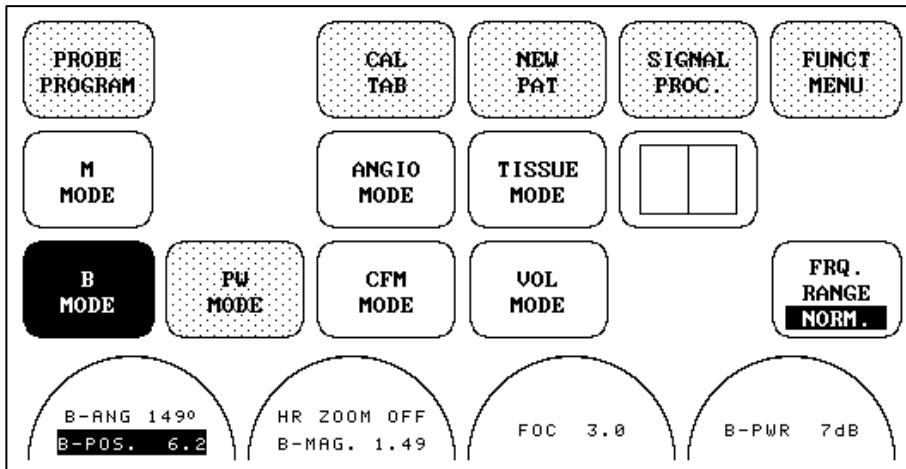
#### Generally:

If the trackball or digipots have two functions touch the half-circle to switch between these functions. The active one is brightly lit.

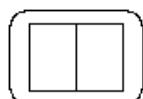
### 13. B/D Display Format

Two Formats are possible: horizontal partition (B-image upper half, D-image lower half)  
 vertical partition (B-image left half, D-image right half)

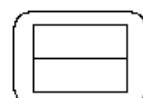
- select B-Menu in B/D-Mode ( key B-menu is illuminated )



- change display format

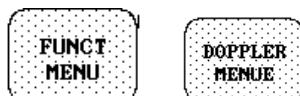


vertical partition  
 key is available, if horizontal partition is active



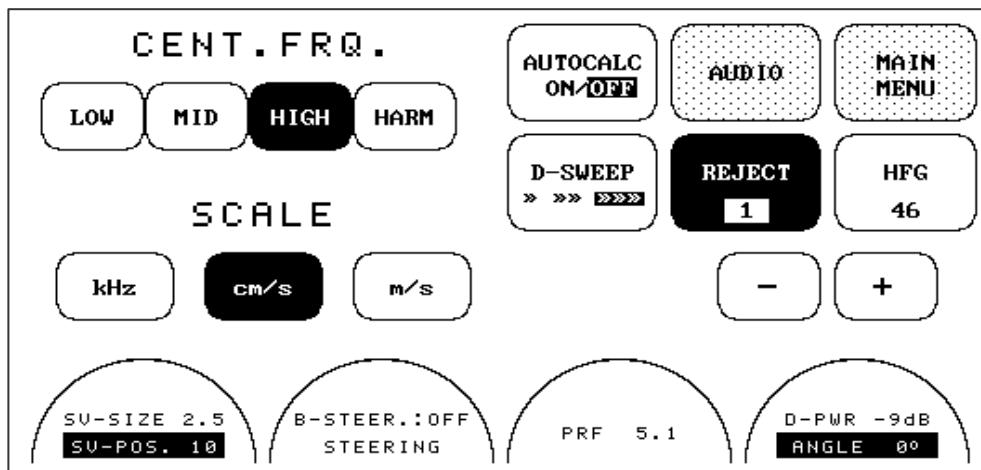
horizontal partition  
 key is available, if vertical partition is active

### 8.3 Doppler Menu



Menu key "DOPPLER MENU"

Doppler menu (Write)



#### Operation:

##### 1. Center Frequency / Contrast Harmonic

Normally one works with the transmit frequency corresponding to the ultrasound element (CENT.FRQ. MID).

With a higher transmit frequency (CENT.FRQ. HIGH) the amplitude of the Doppler spectrum is displayed larger (advantage: better display of lower flow velocities), but the penetration depth is reduced.

With a lower transmit frequency (CENT.FRQ. LOW) the amplitude of the Doppler spectrum is displayed smaller (advantage: display of higher flow velocities), but the penetration depth is increased (higher sensitivity).



Selection of transmit frequency by touching one of the three keys (selected key brightly lit).

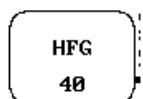


Switch on Contrast Harmonic Imaging for PW-Doppler by touching this key in the Doppler menu.

All functions of the PW-Doppler mode are also available for Contrast Harmonic Imaging. See chapter 8.

Remark: Contrast Harmonic Imaging is not released in some countries.

## 2. HFG (High Frequency Gain)



The key must be brightly lit for setting the HFG.  
This function is connected to the keys Ä/+ below.

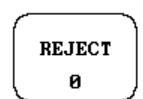


Key Ä : decrease gain  
Key + : increase gain

If distortions by over-modulations appear in lesser measuring depths the HFG can be reduced.

## 3. D-REJECT, threshold for Doppler spectrum (D-Write)

This function determines the amplitude level, at which a Doppler spectrum is displayed on the screen (suppression of small amplitude values of the Doppler spectrum).



The key must be brightly lit for REJECT settings.  
This function is connected to the keys Ä/+ below.



Key Ä : threshold is shifted downward  
Key + : threshold is shifted upward

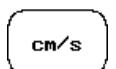
Display: RJ 0....5 (6 steps)

Higher threshold: less noise, coarser spectrum display  
Lower threshold: more noise, finer spectrum display

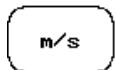
## 4. Scale (kHz, cm/s, m/s)



kHz: Doppler shift frequency



cm/s: Flow velocity



m/s: Flow velocity

Display: On the upper and lower screen edges the maximum values (in relation to the zero-line) and the selected measuring unit are displayed.  
e.g.: 97 cm/s (max. displayable velocity)  
20/DIV (distance between 2 points 20 cm/s)

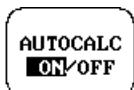
### 4. D-sweep speed



By repeated touching 3 different sweep speeds can be selected. This function can only be set in Write-Mode.

- |     |                 |                 |
|-----|-----------------|-----------------|
| >   | 16 mm/s (50 Hz) | 20 mm/s (60 Hz) |
| >>  | 33 mm/s (50 Hz) | 40 mm/s (60 Hz) |
| >>> | 66 mm/s (50 Hz) | 80 mm/s (60 Hz) |
- (in relation to the system's monitor)

### 5. AUTOCALC on/off



AUTOCALC on:

Upon freeze of the D-spectrum automatically the spectral envelope curve and the corresponding evaluation are displayed. Function AUTO CALC description and operation, see chapter 10.15.1.

AUTOCALC off:

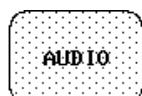
Though the spectral envelope curve is evaluated, it is not displayed.

However, upon switching on the AUTOCALC function in the measuring menu the envelope curve appears.

#### Remark:

- Ø In Simultaneous Mode the Doppler spectrum envelope is calculated after freeze of the D-spectrum.

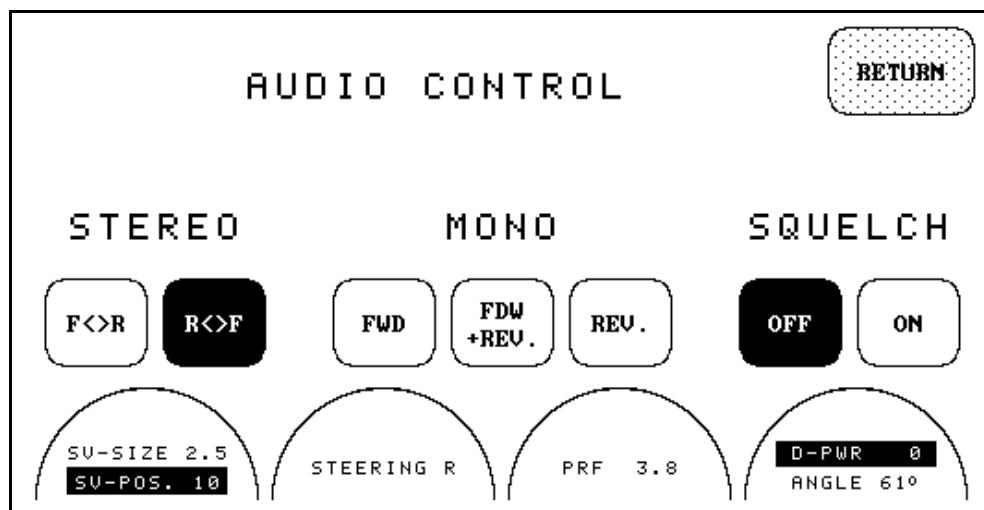
## 8.4 Audio Control



Menu key "AUDIO CONTROL"

Key in Doppler menu

Sub-menu: AUDIO CONTROL



### 1. Stereo mode



Forward flow on the left loudspeaker  
Backward flow on the right loudspeaker



Backward flow on the left loudspeaker  
Forward flow on the right loudspeaker

### 2. Mono mode



Forward flow on both loudspeakers



Forward and backward flow on both loudspeakers



Backward flow on both loudspeakers

- Ø Forward flow means: blood flow toward the transducer  
Backward flow means: blood flow away from the transducer
- Ø The spectrum display remains the same (no image reversal up/down)

## DOPPLER MODE

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### 3. Squelch:

Squelch is a function for noise suppression in the audio module:



When Squelch is on, the loudspeakers are automatically switched off when there is no Doppler signal.



Squelch switched off, loudspeaker not switched off.

### 4. Loudspeakers

There are 2 rotary knobs below the left loudspeaker which are used to set the volume and balance of the Audio signal.



Setting the volume (right hand knob)

- both loudspeakers louder
- ← both loudspeakers lower



Setting the balance (left hand knob)

- right loudspeaker louder, left loudspeaker lower
- ← right loudspeaker lower, left loudspeaker louder

### 5. Headphones

On the jack plug socket (on the left of the balance rotary knob) stereo headphones can be connected. The loudspeakers (external or internal) are then automatically switched off. (Setting of volume and balance as with internal loudspeakers).

### 6. Microphone

A microphone is built-in between the two knobs for volume and balance (only with b/w Doppler option). This way comments to video recordings can be made.

While Doppler is running the microphone cannot be used because of feedback and is therefore switched off automatically.

A green LED underneath the microphone indicates the working condition of the microphone.

#### Operation:



Microphone on

Key is in function menu.

When the microphone is switched on the green LED between the two knobs for volume and balance is lit.

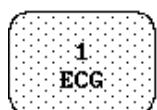
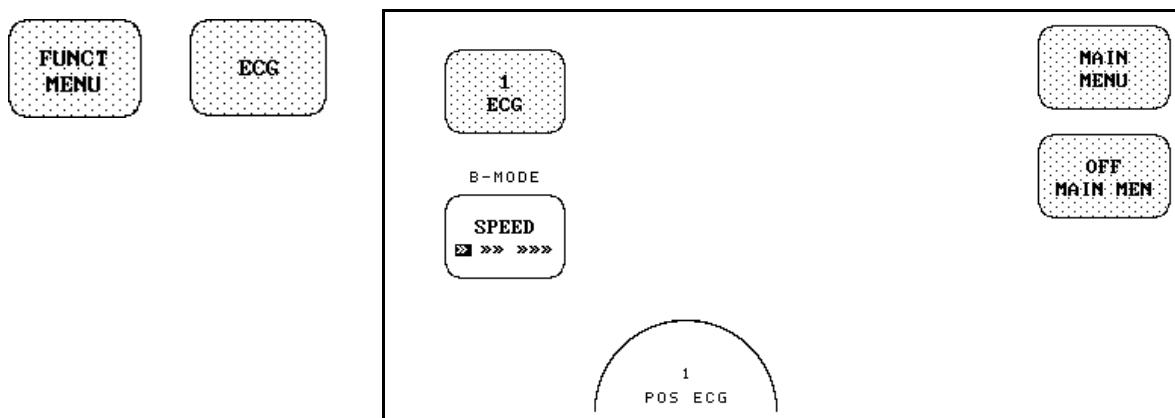
Start the video recording and record the comments.

## 8.5 ECG-Display

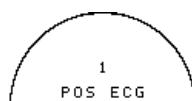
This function inserts an ECG-line in the display of the D-image.  
The ECG-curve is shown by a bright white line that is directly written into the M-Mode image.

Condition: D-Mode is active  
ECG-module (ECG preamplifier) is connected to the unit.

Operation:



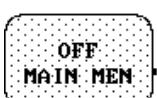
ECG on (on/off switch)



Adjust ECG-position  
Function only possible in M-Write-Mode



Return to main menu  
ECG-function remains active.



Switching off the ECG-function:  
ECG-function is switched off and the main menu appears

Note:

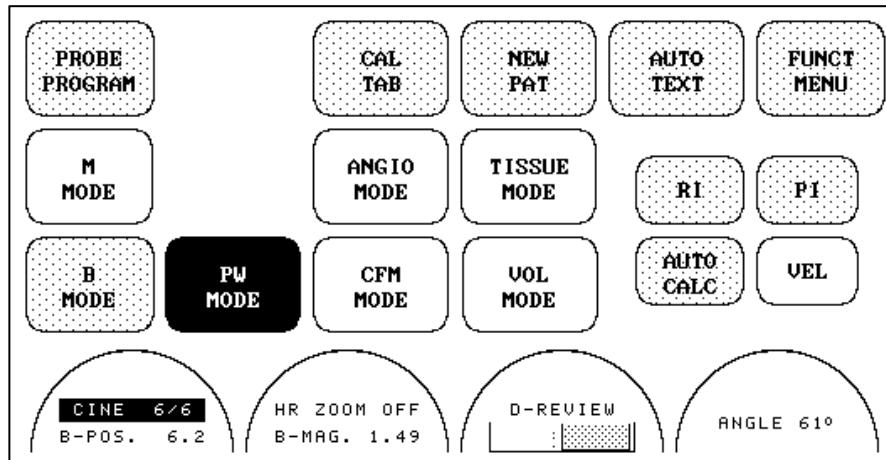


No function in this mode.

## 8.6 Standard Measuring Programs

VEL	velocity measurement
RI	Resistance Index
PI	Pulsatility Index
AutoCalc	Automatic envelope curve calculation

Doppler measuring programs can only be called up after a doppler spectrum has been recorded.



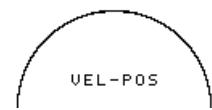
### 8.6.1 VEL-Measurement

Condition: Doppler spectrum on screen, frozen.



VEL-Measurement on/off

ON: A horizontal blue line appears in the spectrum display, with velocity value above the right end of the line.



When the line is vertically shifted over the spectrum by means of the trackball, the velocity display changes on-line accordingly.

Remark:

- The velocity display takes place in kHz, cm/s, m/s depending on the scale chosen. Switching of velocity scale, see page 8-13.

**IMPORTANT:** The velocity can only be calculated correctly if the angle cursor has been set correctly in relation to the axis of the vessel.

### **8.6.2 Pulsatility Index**

See chapter 10 'Measurements/Calculations' Cardiology D-Mode

### **8.6.3 Resistance Index**

See chapter 10 'Measurements/Calculations' Cardiology D-Mode

### **8.6.4 AutoCalc**

See chapter 10 'Measurements/Calculations' Cardiology D-Mode



**9 COLOR MODE.....9-2**

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9.3	Color Sub-Program .....	9-15
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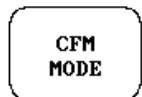
## 9 COLOR MODE

Color flow mapping generates a Color image by using the Doppler principles. This Color image is overlayed onto the B-image. The Color flow image provides information about blood flow direction and velocity.

Color flow mapping can be combined with spectral doppler and M-Mode.

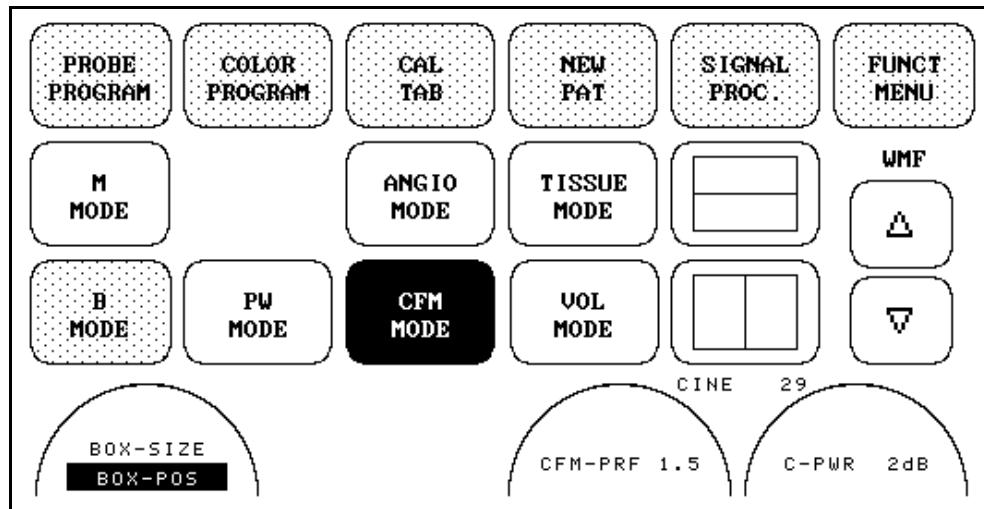
Color flow mapping is only possible with electronic transducers.

### 9.1 Main Menu "CFM"

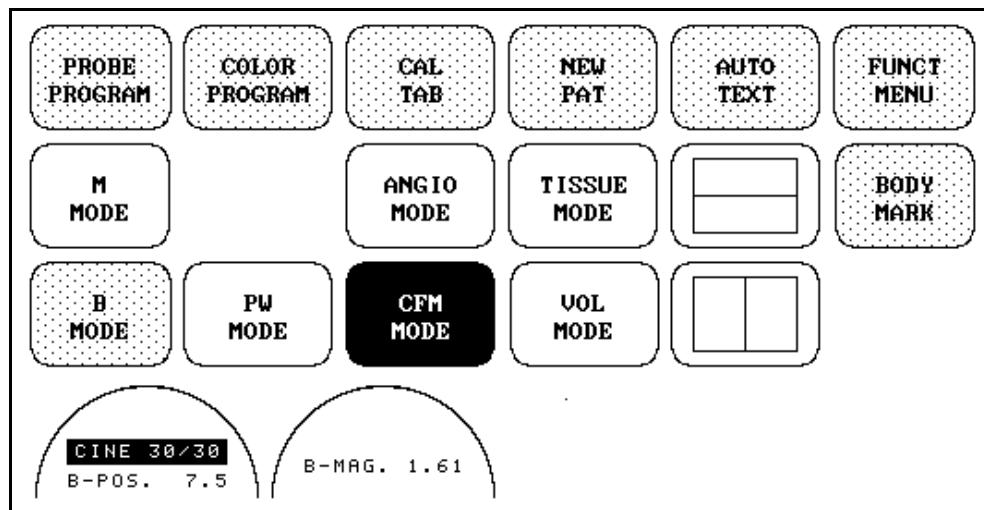


When switching on Color-Mode the main menu 'Color-Mode' appears.

Main Menu: COLOR-MODE (Write)

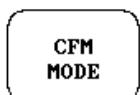


Main Menu: COLOR-MODE (Read)



Operation:

## 1. Switching on COLOR-MODE



By touching this key a Color box is overlaid onto the B-image

This key only appears if the selected transducer is capable of Color Doppler

## 2. Adjusting the Color Box Position and Size



↔ Color Box Position horizontal (trackball)  
 ⇩ Color Box Position vertical (trackball)  
 adjustable within the B-image

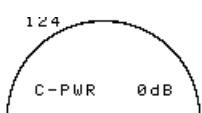


The left/right starting point of the Color Box is fixed  
 ↔ Color Box Width (trackball)  
 ⇩ Color Box Length (trackball)



Steering angle of Color Box (digipot): -15°, 0°, +15°  
 This function is only available with steerable linear transducers (e.g. S-NLM7.5).

## 3. CFM- power (CFM transmit power)



CFM-Power lower/higher

The CFM transmit power can be adjusted in max. 32 steps

Display: C-PWR -20...+12dB

The CFM transmit power can only be set in Write-Mode.

When reaching MIN- or MAX-settings a short beep sound will be heard.

The maximum possible transmit power can be reduced by the intensity control depending on certain settings (e.g. CFM-PRF, transmitter frequency, etc.)

## 4. CFM-Gain

After starting the Color-Mode the CFM-Gain is related to the right (large) digipot.

The CFM-Gain can only be set in Write-Mode.

If the Gain is set too high color noise will appear within the color box.

The following display appears on the monitor.

Display: CG 0.0 ... 80.0

## COLOR MODE

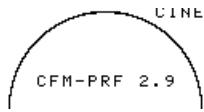
---

### 5. Setting the CFM velocity range (Color-PRF)

The Color-PRF is adjusted similar to the Spectral Doppler. For recording higher/lower flows the Color-PRF must be set higher/lower.

Note: the Color-PRF is proportional to the Color frame rate.

Color-PRF high/low --> Color frame rate high/low.



Color-PRF lower/higher (digipot)

The Color-PRF can be adjusted in 16 steps (1...13kHz)  
Depending on the Box depth the possible PRF will be automatically reduced resp. limited.

Display: CFM-PRF 1.0 ...13.0 (kHz)

### 6. CFM-Invert

This function provides inversion of the color display in relation to the direction of flow.  
The colors of the color bar are inverted relative to the zeroline.



Key prelit:	Normal	Flow toward transducer RED Flow away from transducer BLUE
Key bright:	Inverted:	Flow toward transducer BLUE Flow away from transducer RED

## 7. Color Wall Motion Filter (Color-WMF)

The Color wall motion filter suppresses unwanted signals generated from wall motions. Those low-frequent signals are suppressed by a "MOVING TARGET" filter, leaving the blood flow signals clearer for color display.

Selection of the filter:



Raising the filter frequency

Lowering the filter frequency

- |            |   |
|------------|---|
| 400 Hz:    | Heart with average ultrasound characteristics. This filter setting offers better color filling for left ventricle, especially in the auricles and the right ventricle, but leads to increased wall motion artefacts.  |
| 600 Hz:    | Not only wall motion artefacts are reduced, but also facilitates the identification of mitral and tricuspid regurgitation, due to less visible diastolic pre-flow, so that only the signals of fast regurgitation flow remain.  |
| 800 Hz:    | Together with the increase of the priority threshold (Balance CFM/2D) useful with most patients to make visible mitral and tricuspid regurgitation without normal diastolic flow and to eliminate a high noise level in the ventricles caused by clutter with patients difficult to scan. |
| 30-200 Hz: | With abdominal examinations lower settings of the color wall filter are useful to achieve adequate filling of the vessels with color information. The velocities and scan angles existing here require low PRF values and a lower setting of the color wall filter.                       |

### Remark:

WMF is displayed on the monitor (image settings).

The WMF-filter is automatically calculated and adjusted when the PRF is changed.

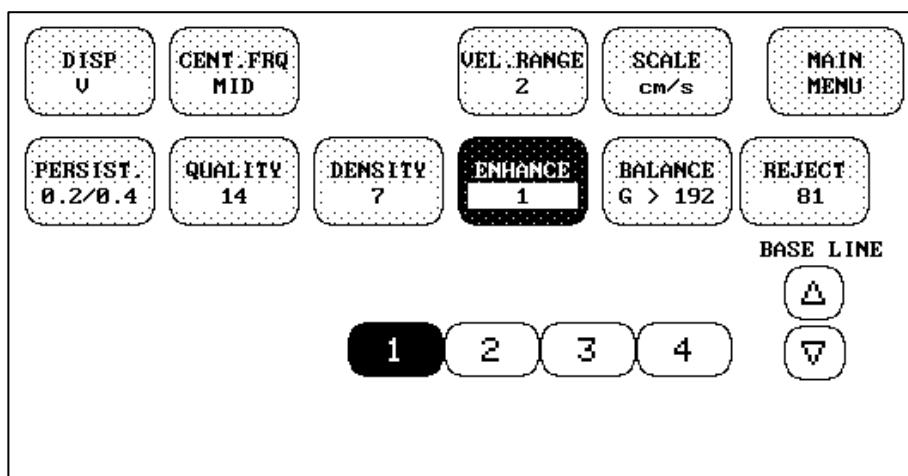
## 9.2 Color Sub-Menu

**Note:** If the unit is programmed to 'Predefined Operation' (see chapter 12.15) the Color Submenu is not available.



Menu key 'COLOR MENU'

Color Sub-Menu



### Operation:

#### 1. Color Display Modes

The following color display modes can be selected:

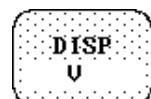
Velocity, Power, Turbulence (also Variance) and their combinations  
Velocity and Turbulence, Velocity and Power, Power and Turbulence.

Velocity display allows to see speed and direction of the blood flow.

Power display allows to see the amplitude of the blood flow (useful for low velocities).

Turbulence display allows to see the variation of the blood flow (turbulent flows).

The default Color display mode is 'velocity'.



Touch key 'DISP' and select the Color display mode



Color coding of the Color display modes / Enhance:

Forward flow: blood flow toward the transducer  
 Reverse flow: blood flow away from the transducer

Color coding is influenced by the 'Enhance'-function. Up to four Enhance curves are available for some Color display modes.

- Velocity (V):

	low flow <- - -> high flow
Enhance 1	
Forward flow:	dark red - light red - yellow
Reverse flow:	dark blue - light blue - cyan
Enhance 2	
Forward flow:	dark red - light red - yellow
Reverse flow:	dark blue - light blue - green
Enhance 3	
Forward flow:	dark red - light red - white
Reverse flow:	dark blue - light blue - green
Enhance 4	
Forward flow:	dark red - light red - yellow
Reverse flow:	dark blue - light blue - green

- Velocity and turbulence (V-T):

Enhance 1	
Forward flow:	dark red - light red - yellow
- turbulence:	green
Reverse flow:	dark blue - light blue - cyan
- turbulence:	green
Enhance 2	
Forward flow:	dark red - light red
- turbulence:	green
Reverse flow:	dark blue - light blue
- turbulence:	green
Enhance 3	
Forward flow:	dark red - light red
- turbulence:	white
Reverse flow:	dark blue - light blue
- turbulence:	cyan
Enhance 4	
Forward flow:	dark red - light red - violet
- turbulence:	yellow
Reverse flow:	dark blue - light blue - green
- turbulence:	yellow

- Velocity and Power (V-P):

Forward flow:	dark red - light red
- Power:	violet
Reverse flow:	dark blue - light blue
- power:	violet

## COLOR MODE

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### - Power (P):

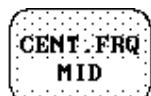
Enhance 1	dark blue - light blue - yellow
Enhance 2	dark red - light red - yellow
Enhance 3	dark rusty - light rusty - yellow
Enhance 4	dark red - light red - yellow

### - Power and Turbulence:

Power: dark violet - light violet  
- turbulence: green

- Turbulence (T): dark green - light green

## 2. Center Frequency / Contrast Harmonic Imaging



Touch the "CENT.FRQ" key, then select "LOW, MID, HIGH"



LOW: Transmitter frequency is lower than the nominal frequency, i.e. lower resolution, better depth penetration, higher flow display

MID: Transmitter frequency corresponds to nominal frequency of the ultrasound crystal.

HIGH: Transmitter frequency is higher than the nominal frequency, i.e. better resolution, better display of low flows

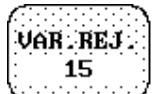
HARM: Contrast Harmonic Imaging is switched on.

All functions of the Color-Mode are also available for Contrast Harmonic Imaging

Remark: Contrast Harmonic Imaging is not available for all probes and is not released in some countries.

### 3. Variance Reject

With this function high turbulences of the flow display can be suppressed.  
Variance Reject only appears with turbulence color display modes (V-T, P-T, T).



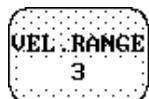
Touch key "VARIANCE"



Variance Reject less/more

Under certain circumstances laminar flow can change to turbulent flow with vortices transversely oriented to the vessel axis. This will cause increase of loss in flow energy and flattening of the flow profile.

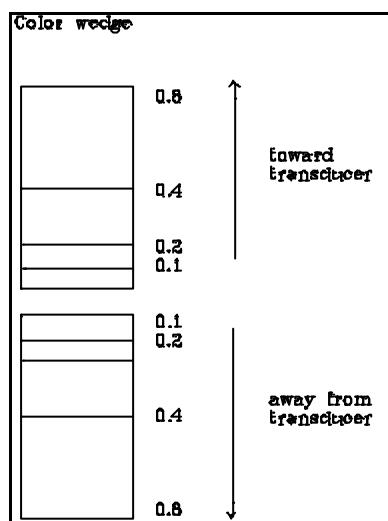
4. Velocity Range Compress



Touch "VEL RANGE" and select wanted range by touching keys 1 to 4.



With Color Doppler imaging the flow velocity is displayed in colors. As an aid the color wedges are displayed by which the velocity and the direction can be checked.



In relation to the max. detectable blood flow (Nyquist limit) the display of lower velocities can be expanded to the whole color wedge.

With this function low blood flows can be displayed in brighter colors with a higher CFM-PRF resp.  
Color frame rate

VEL.RANGE 1: The maximum velocity is displayed at the end of the color bar (e.g. 0.8 m/sec)

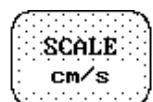
VEL.RANGE 2: Half of the max. velocity is displayed at the end of the color bar (e.g. 0.4 m/sec)

VEL.RANGE 3: One quarter of the max. velocity is displayed at the end of the color bar (e.g. 0.2 m/sec)

VEL.RANGE 4: One eighth of the max. velocity is displayed at the end of the color bar (e.g. 0.1 m/sec)

Remark: With high flow velocities range "1" or "2" should be selected, with low flow velocities range "3" or "4" should be selected.

## 5. Scale (kHz, cm/s, m/s)



Touch key 'SCALE' an select velocity or frequency scale by touching the corresponding key.

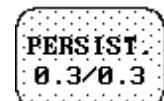


kHz: Doppler shift frequency  
cm/s: Flow velocity  
m/s: Flow velocity

On the upper/lower edge of the color wedge the maximum values (in relation to the zero line) and the selected measuring unit are displayed. This are qualitative values (no absolute values), because in color mode no angle correction is calculated.

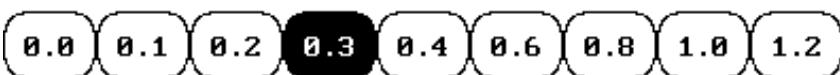
## 6. Persistance Filter

A temporal average is determined from several color images, so that different filter periodes can be selected for rise velocity an d falling velocity.



Touch key "PERSIST" and select the wanted filter setting RISE or FALL

RISE



FALL

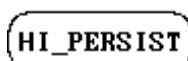


RISE: Filtering of the rise velocity leads to noise suppression.

To be used with small laminar flows. Avoid quick movements of the probe, because the flow is "built up" slowly. When displaying pulses the Rise-Filter must be set low (0.0 to 0.2).

FALL: This filter leads to "prolongation" of the displayed flow.

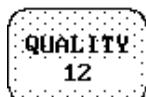
To be used with quick pulses (short "color flashes") to prolongate them for better evaluation on the monitor.



With this function the range of the filter-parameter (Persistance) can be reduced to the half. So you can get finer steps.

**7. CFM Quality**

This function controls the number of pulses per color Doppler line in the display. Since several pulses are to be evaluated for display of a result, the color display quality increases with the number of evaluated pulses.



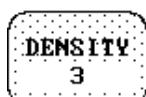
Touch this key  
Display: number of pulses per Color line: CQxx



Number of pulses per Color line -/+  
With increasing CFM Quality the frame rate decreases!

**8. CFM Density**

This function determines the color line density of the color window. The lower the line density, the larger the line distance and the size of the color pixel.



Touch this key and adjust the wanted line density.  
Display: Line density of Color box CD xx



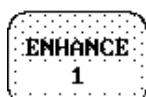
Line density lower/higher

**9. Enhance**

This function provides select ability of the color coding for an optimization of the display of blood flow (similar to the post-processing curves with grey scale B-scans). It is useful especially with low flow rates. it may be altered in real-time or FREEZE mode, respectively.

For velocity display (CFM-Disp V) and velocity-turbulence display (CFM-Disp V-T) in each mode 4 different color patterns are provided for selection.

Selection of a CFM-Enhance curve:

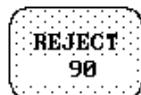


Touch this key and select the wanted enhance curve by touching key 1 to 4.

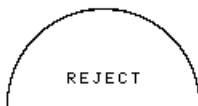


For the displayed color maps see chapter 9.3 page 9-10 'Color display modes' .

## 10. CFM-Reject (Threshold)



Touch this key for adjusting the CFM-Reject by digipot



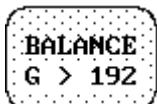
Color threshold higher/lower

The threshold should be set to the lowest value (approx. 80) at which no color noise appears in case of low CFM-Gain. Color noise can be tuned out in case of high CFM-Gain.

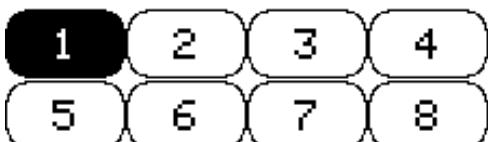
NOTE:      Display 0:    maximum threshold  
                     Display 98:   minimum threshold

## 11. CFM Balance

This function allows the intentional settings which concern the display of brightness (of B-information) and tint of Color Doppler information.



Touch this key and select wanted balance position by touching key 1 to 4.



- |                 |   |
|-----------------|---|
| CFM Balance 1 : | G > 44<br>If the grey value is higher than 44 while a color value is present, the grey value will be displayed.   |
| CFM Balance 2 : | G > 96<br>If the grey value is higher than 96 while a color value is present, the grey value will be displayed.   |
| CFM Balance 3 : | G > 144<br>If the grey value is higher than 144 while a color value is present, the grey value will be displayed. |
| CFM Balance 4 : | G > 192<br>If the grey value is higher than 192 while a color value is present, the grey value will be displayed. |

## 12. CFM Zero Line (CFM-baseline)

The Color baseline shift can be used to prevent aliasing in on flow direction similar to the Doppler baseline shift. Shifting the Color baseline enlarges the velocity range in one direction. The zero line of the color bar is also shifted.

**BASE LINE**



Adjust zero line up/down

only possible in real-time mode.

The maximum value resp. minimum value of flow velocity are displayed at the upper resp. lower edge of the color wedge.

### 9.3 Color Sub-Program

With the color sub-programs the user can quickly and easily load programmed color settings in B+Color Mode (e.g. fetal heart, umbilical cord, v. femoralis, v. cava, etc.)

Per probe a maximum of 9 color programs can be programmed. The designation of the programs is possible with max. 13 letters or digits on the program key.

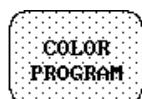
The following parameters are contained in a color sub-program:

PRF	Gain	Density	Invert
Disp.Mode	R.Frequency	Quality	Vel.Range Comp.
Persistance F.	WMF		Enhance
Balance	BOX size		

B-image parameters:

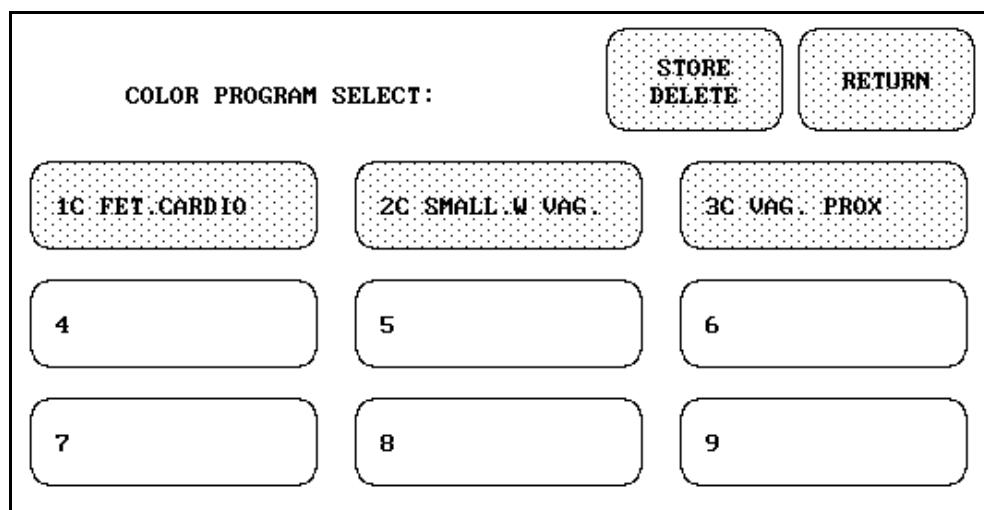
Frame Filter      B-angle

Condition: CFM-Mode active, key "CFM-MODE" bright.



Touch Color program key

The color program menu appears.



Operation:

Touch the wanted 'Color program key'  
Program settings are loaded and the Color main menu appears

### 9.3.1 Programming of Color programs

#### Operation:

1. Adjust the color settings for the wanted application.
2. Touch color program key (Color program menu appears).
3. Touch key "STORE/DELETE".
4. Select wanted program key (1...9) and touch key "NEXT".  
The keyboard for entering a program name appears.
5. Enter program designation (max. 13 letters or digits) and touch key "NEXT".
6. Store program: touch key ""PROGRAM → MEMORY".  
Color program is being stored and the main menu appears.

Key "MAIN MENU":

Exit without programming a program.

Key "DELETE PROGRAM":

Program under this number is erased.  
The main menu appears.

## 9.4 ANGIO-Mode

### General

Sonographic diagnostics can be greatly extended by Color-Doppler sonography. Still, Color-Doppler sonography has deficits, especially in displaying very slow flow velocities - such as neo-vascularization to be found in malign tumors. The Angio-Mode intends to erase this deficit by displaying such slow flow velocities. In gynecologic and obstetric applications the advantages can be clearly seen in the display of placenta blood circulation. With eutrophic fetus the blood flow can be seen over the total width of the placenta. In the radiologic field too, advantages with slow flows can be seen (e.g. kidney, liver, prostate, etc.). This new technique is not intended to replace hitherto established sonographic techniques, but to complete them specially in the above mentioned fields.

Advantages compared to Color-Doppler:

- less independent of angle
- no aliasing
- less independent of direction
- interesting, wherever slow flows occur  
(e.g. blood circulation, veins, etc.)

Functional description:

In contrast to Color-Doppler, a basically different physical parameter from the reflected ultrasound beam is used for color coding, so that the regularities of coloring too are different. The ultrasound angiography analyzes the amplitude, the Color-Doppler the frequency shift of the reflection. The amplitude is determined by the amount resp. density of the blood cell aggregates being collected by the measuring volume of the ultrasound beam, and is thus independent from the angle between blood flow direction and the incident ultrasound beam, while the frequency shift is determined by the velocity of the reflectors.

### Angio-Imaging

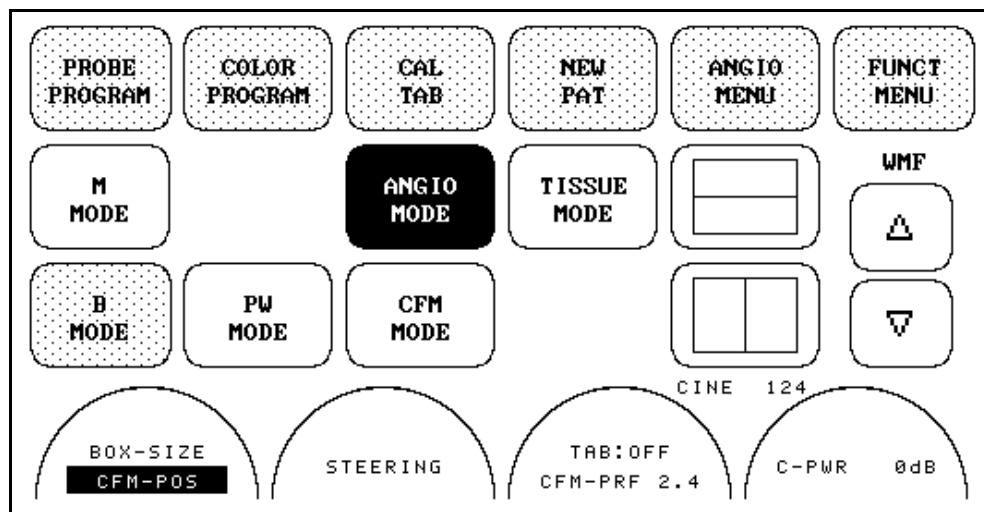
Angio imaging generates a Color image by using the Doppler principles. This Color image is overlaid onto the B-image. The Angio image provides information about the energy (Power) of the blood cell motion.

From the Color Doppler signal the amplitudes are evaluated and displayed with special color coding. All velocity-determined functions (Velocity Range Compress, Zero Line, Scale, Display Mode, etc.) are not available in Angio-Mode.

Angio-Mode can be combined with spectral Doppler.

Angio-Mode is only possible with electronic transducers.

Switch on Angio-Mode (on: key is bright)  
A Color window is displayed in the B-image and the Angio- parameters are being loaded.



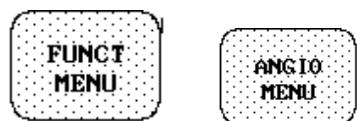
### Operation:

1. Set size and position of the color window.  
The smaller the width of the color window, the higher the frame rate.
2. Select PRF: the lower the PRF, the slower the displayable flows, with the frame rate getting lower.
3. Set Angio-Gain and Angio-transmit power.

The other functions of the Angio-Mode can be set in the sub-menu "ANGIO-MENU".

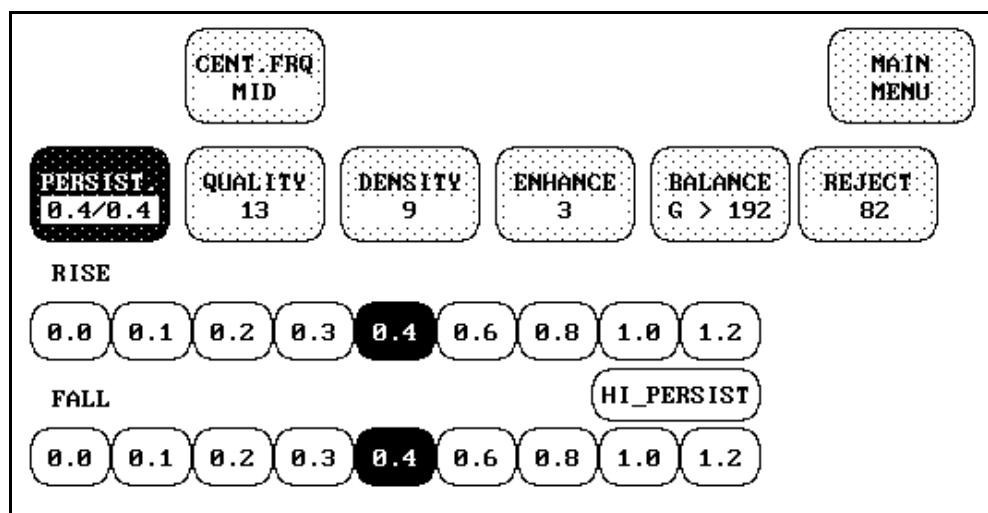
**Angio Sub-menu:**

**Note:** If the unit is programmed to 'Predefined Operation' (see chapter 12.15) the Angio Submenu is not available.



Menu key 'ANGIO MENU'

Angio Sub-Menu



For the description of the functions, see chapter 9.2:

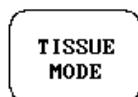
## 9.5 TISSUE-Mode

Tissue imaging generates a Color image by using the Doppler principles. This Color image is overlaid onto the B-image. The Tissue image provides information about tissue motion direction and velocity.

The Tissue Doppler captures low flow but high amplitude signals associated with Wall motion and creates a colorcoded tissue image.

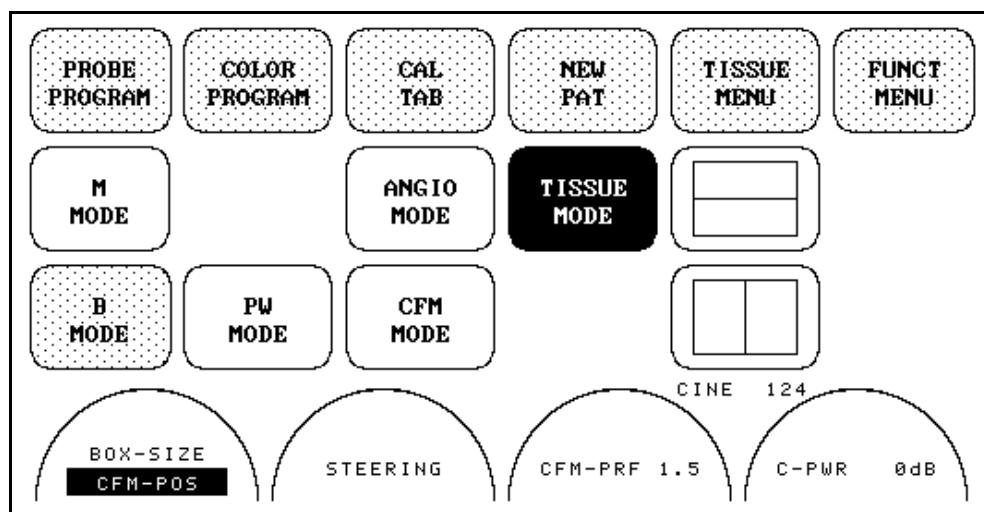
Tissue-Mode can be combined with spectral Doppler and M-Mode (Tissue color M-Mode).

Tissue-Mode is only possible with electronic transducers.



Switch on Tissue-Mode (on: key is bright)

A Color window is displayed in the B-image and the Tissue-parameters are being loaded.



### Operation:

1. Set size and position of the color window.  
The smaller the width of the color window, the higher the frame rate.
2. Select PRF: the lower the PRF, the slower the displayable tissue motion, with the frame rate getting lower.
3. Set Tissue-Gain and Tissue-transmit power.

The other functions of the Tissue-Mode can be set in the sub-menu "TISSUE-MENU".

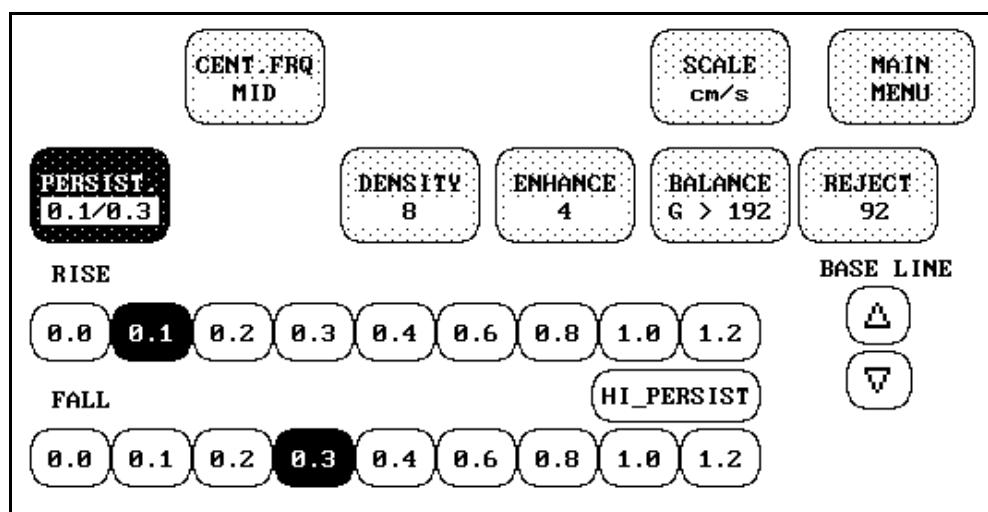
**Tissue Sub-menu:**

**Note:** If the unit is programmed to 'Predefined Operation' (see chapter 12.15) the Tissue Submenu is not available.



Menu key 'TISSUE MENU'

Tissue Sub-Menu



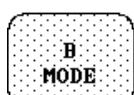
For the description of the functions, see chapter 9.2:

## 9.6 Combined Display Modes

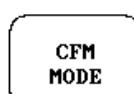
### 9.6.1 Triplex-Mode

Triplex Mode is the simultaneous real-time display of B-Mode, Pulsed Doppler and Color Doppler (CFM-Mode, Angio-Mode).

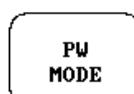
#### Operation:



Adjust and record B-image



Switch on CFM-Doppler  
Adjust good color display



Switch on pulsed Doppler  
Adjust Sample Volume and Doppler settings



Triplex-Mode on/off (on: Key lit bright)  
Start the Triplex-Mode  
B-image, PW-Doppler and Color Doppler are displayed simultaneously.

If the Spectral Doppler is running already (Write) Triplex-Mode is switched on or off.



Stop/Start the Triplex-Mode



This key switches from Triplex-Mode to the Color-B-image with D-Cursor.  
Triplex-Mode is switched off.

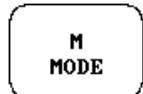
#### Remarks:

Triplex-Mode is also possible with the Angio-Mode.  
Press the corresponding key 'ANGIO MODE' instead of the 'CFM MODE'-key.

### 9.6.2 Color M-Mode

Color M-Mode provides Color information additional to the normal M-Mode image. M-Mode signal and Color flow information is derived from the displayed M-Cursor.

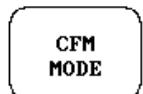
#### Operation:



Switch on M-Mode  
Adjust and record M-image



Start M-Mode (Key 'SPECIAL' or 'FREEZE')



Switch on CFM  
B-image and Color M-image are displayed simultaneously.  
Adjust good color display

## COLOR MODE

## 10. Measurements/Calculations ..... 3

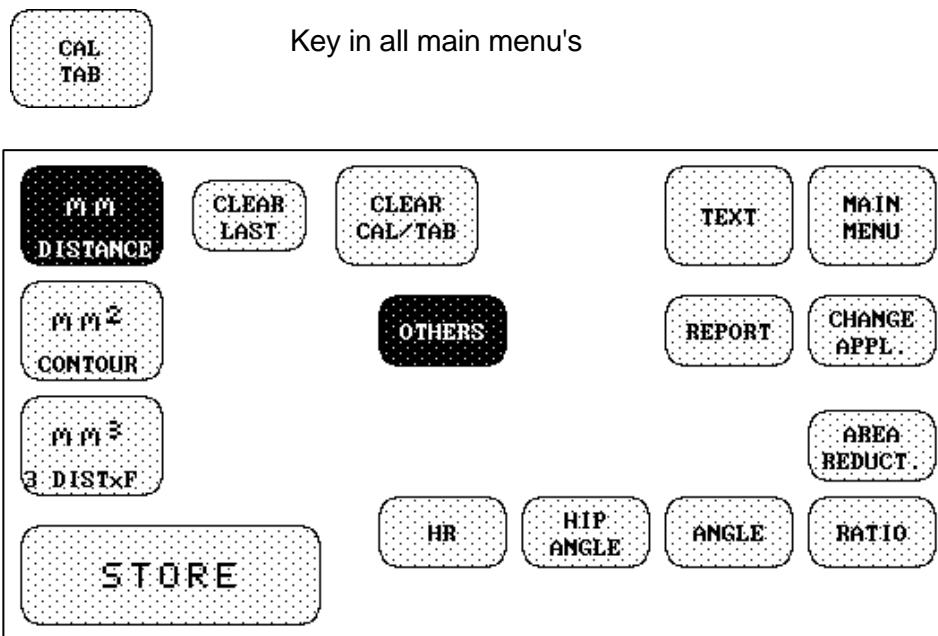
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## Measurements/Calculations

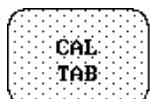
## 10.1. Menu "CALC/TAB"

General:

- Measurements are possible in Read-Mode or Write-Mode
- When starting a new scan previously set measuring marks are erased.
- Moving the trackball after completion of a measurement activates the next measurement.
- When the result display field is full the message "OVERFLOW" appears. Then a measurement is only possible after erasure of the measurements (touch the key "CLEAR CAL/TAB").
- Positioning of measuring marks is done with the trackball.
- Entering and storage of measuring marks is done with the "STORE" key.
- When a measurement is not possible or rational the error message "INCORR.MEAS." appears, e.g. in case of attempted M-Mode measurement in a 2D-image.

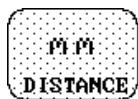
## 10.2. Measurement Procedure

- Call-up the measurement menu



The measuring cross appears on the screen.  
The last measurement is selected.

- Select measuring mode (if necessary)



The measurement mode (displayed in the key) can be modified by activating a sub-menu (touch the bright key).

- Perform the measurement

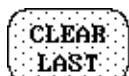
TRACKBALL

Position the measuring cross with the trackball.

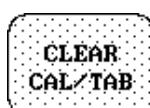


Fix the measuring marks with the "STORE" key.

- Help-functions



The last entered dot is erased (correction)



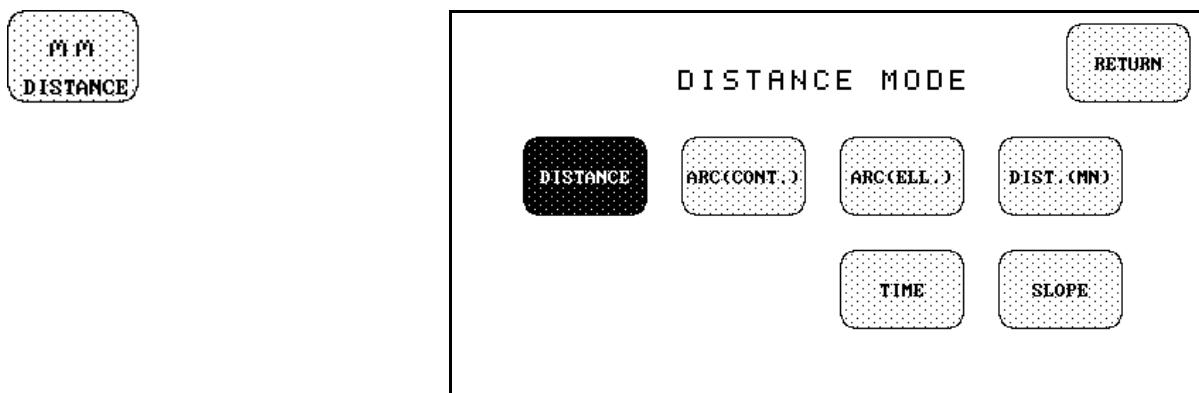
Erasure key:  
All measurement results and displays are erased.



Store key for measurement results  
When writing a new image only the measuring marks will be erased but not the results

### 10.3. Distance Measurements (mm)

Sub-menu key "mm" (Touch the bright key)



**NOTE:** The key "mm" shows the last selected function in the sub-menu. Only when changing a measurement the sub-menu is called up (touch the lit key "mm"). When operating the trackball or when touching the "RETURN" key the "CALC/TAB" menu appears and the selected measurement is displayed in the key "mm".

#### 10.3.1. Distance



1. Position and store the first measuring dot.
2. Position and store the second measuring dot.

The dots are substituted by two arrows pointing at each other, and the measuring number is displayed.

Result display: D. = .... mm

#### 10.3.2. ARC Length



1. Position and store the start dot
2. Move the measuring cross along the arc and store the end dot.

Dots are automatically set and stored during the move.

Result display: Cx = .... mm

### 10.3.3. Circumference (Ellipse)

ARC(ELL.)

1. Position and store the first dot of the long diameter
2. Position and store the second dot of the long diameter, the ellipse is shown.
3. Adjust the size and shape of the ellipse (trackball)
4. If necessary, correct the first or second dot of the long diameter:

Touch key

CORR

Adjust new position of the first or second dot with the help of the trackball.

When the correction is completed touch key "STORE".

If necessary, adjust again the size and shape of the ellipse with the trackball (see point 3).

5. Touch key "STORE".  
The circumference of the ellipse is calculated and displayed.

Result display: C. = .... mm

### 10.3.4. Mean Value (of distances)

DIST. (MN)

If this mode is active, the mean value of the measured distance will be displayed. Writing a new image causes erasure of the measurement marks but not of the results. The distances of a mean value calculation will be marked by an arrow.

Result display: MN = .... mm  
 D3 = .... mm ←  
 D2 = .... mm ←  
 D1 = .... mm ←

### 10.3.5. Time Interval

TIME

Condition: M-Mode image or ECG in 2D-image  
 Proceed as for distance measurements

Result display: T. = .... s

### 10.3.6. Slope

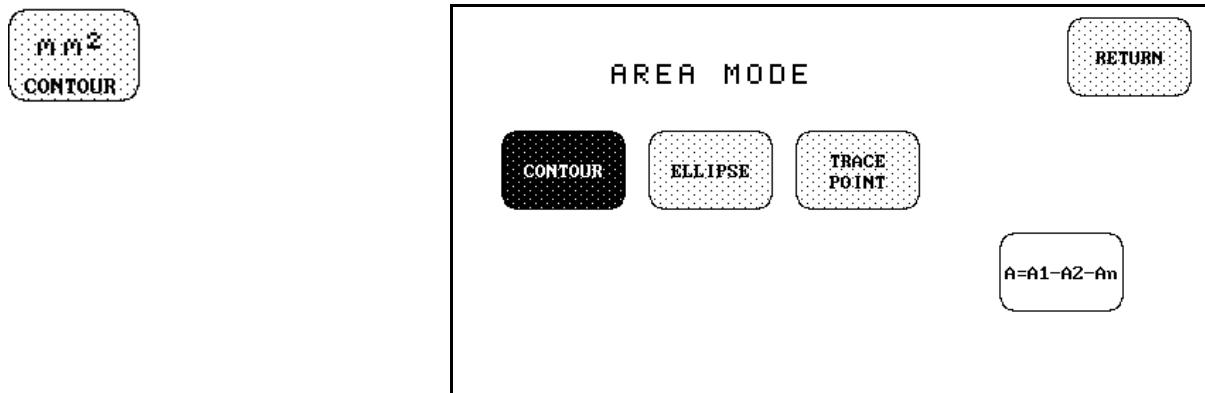
SLOPE

Condition: M-Mode image  
 Proceed as for distance measurement

Result display: S. = .... mm/s

## 10.4. Area measurements "mm<sup>2</sup>"

Sub-menu key "mm<sup>2</sup>" (Touch the bright key)



**NOTE:** The key "mm<sup>2</sup>" shows the last selected function in the sub-menu. Only when changing a measurement the sub-menu is called up (touch the lit key "mm<sup>2</sup>"). When operating the trackball or when touching the "RETURN" key the "CALC/TAB" menu appears and the selected measurement is displayed in the key "mm<sup>2</sup>".

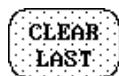
### 10.4.1. Contour



1. Position and store the start dot
2. Round the area (follow the contour), dots are being automatically set.
3. Touch key "STORE".  
The area is calculated and displayed.

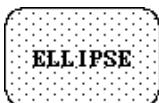
Result display:      A. = ...,.. cm<sup>2</sup>

**NOTE:** When the contour is stored, the start dot and end dot of the surrounded area are connected by a straight line.



The last entered dot is erased (correction)

### 10.4.2. Ellipse

 ELLIPSE

1. Position and store the first dot of the long diameter
2. Position and store the second dot of the long diameter, the ellipse is shown.
3. Adjust the size and shape of the ellipse (trackball)
4. If necessary, correct the first or second dot of the long diameter:

Touch key

 CORR

The measuring cross jumps to the second dot of the long diameter, if the key is touched again it jumps to the first dot (toggle-function between first and second dot).

Adjust new position of the first or second dot with the help of the trackball.

When the correction is completed touch key "STORE".

If necessary, adjust again the size and shape of the ellipse with the trackball (see point 3).

5. Touch key "STORE".

The area of the ellipse is calculated and displayed.

Result display: A. = ...,.. mm<sup>2</sup>

### 10.4.3. Trace Point

 TRACE  
POINT

1. Position and store the start dot
2. Use the trackball and the 'STORE'-key to round the area.  
After moving the trackball a cross appears, dots are set with the 'STORE'-key .
3. Finish the measurement by touching the "STORE"-key before moving the trackball.  
The area is calculated and displayed.

Result display: A. = ...,.. cm<sup>2</sup>

 CLEAR  
LAST

The last entered dot is erased (correction)

#### 10.4.4. Calculation: $A = A_1 - A_2 - A_n$

Measurement required: More than one area measurement

Formula used:  $A = A_1 - A_2 - A_n$

$A$  ..... calculated area

$A_1$  .... first measured area

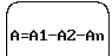
$A_2$  .... second measured area

$A_n$  .... n measured area

##### Operation:

1. Perform first, second until n area measurements.

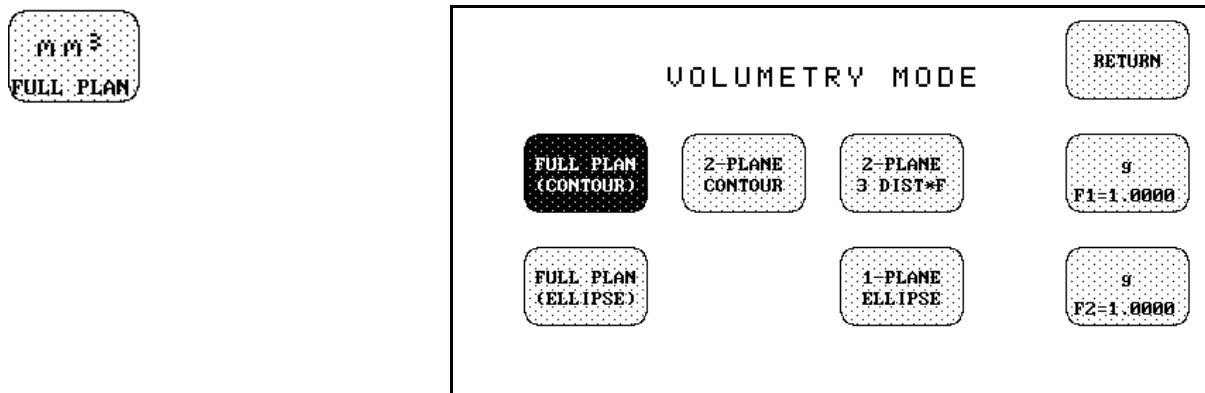
2. Touch the key  to insert the area menu

3. Touch the key  to start the calculation

The result is displayed above the last measured area on the monitor.

## 10.5. Volume measurements „mm<sup>3</sup>“

Sub-menu key "mm<sup>3</sup>" (Touch the bright key)



**NOTE:** The key "mm<sup>3</sup>" shows the last selected function in the sub-menu. Only when changing a measurement the sub-menu has to be called up (touch the lit key "mm<sup>3</sup>"). After moving the trackball or touching the "RETURN" key the "CALC/TAB" menu appears and the selected measurement is displayed in the key "mm<sup>3</sup>".

### 10.5.1. Planimetric Volume Measurement

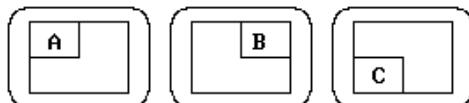
This measuring program allows the volume determination of any organ which was stored by a volume scan. Several parallel planes are laid through the organ, the areas of these planes are determined. A measuring program calculates the volume from the measured areas and the distance between the areas. The larger the number of areas, the more exact the volume calculation result will be.

Used formula:  $V = \sum_{j=2}^n (A_j + A_{j-1}) \times (d_j - d_{j-1})$  (Trapezoid formula)

Condition: a stored volume scan.

#### Operation:

1. Select the reference image in which the measurement should be performed.



2. Activate the planimetric volume measurement.



The area measurement can either be performed in Contour-mode or in Ellipsoid-Mode. To change the mode call the sub-menu "VOLUME".

Touch  and select wanted mode:

3. Select the first section through the body by rotating the large digipot (make parallel sections through the reference image). The first section should be set at the edge of the measured object.
4. Measure the area (proceed as for area measurement)  
Position the start dot of the area to be surrounded with the trackball and store it. Surround the area with the trackball, then touch key "STORE". The area is calculated and displayed.  
The area may even be "zero" (dot at the edge). Touch key "STORE" twice!
5. Select the next parallel section with the large digipot.
6. Measure the area.
7. Repeat 5. and 6. until the edge of the measured object is reached.  
Result display:  
V. = . . . . ml  
A. = . . . . cm<sup>2</sup> (last measured area)

Remarks:

- The contour of the measured area is not erased if a new section is adjusted. From the deviation in the new section it is possible to decide whether a new area should be marked. With new marking the old contour is erased.
- The different sections can be chosen liberally, it is not necessary to follow a certain order.
- The volume measurement is only possible in 3D-Mode or full-image mode (not in aspect mode).

### 10.5.2. 2-Plane, (Contour)

This measuring program allows the volume determination of a approximately rotation-symmetric organ (e.g. kidney) which was stored by a volume scan. The organ has to be rotated in this way, that the long axis of the organ is displayed in the reference image A and reference image B. After measuring the two areas (method contour) the volume of the organ is calculated according to the following formula:

Used formula:

$$V = \sum_{j=1}^n \frac{d_{A_j} \cdot d_{B_j}}{4} \cdot p$$

Condition: a stored volume scan.

#### Operation:

1. Rotate and shift the displayed organ in this way, that the long axis of the organ is displayed into the intersection line of the two planes (blue vertical line) in both reference images (A and B).
2. Activate the volume measurement '2-Planes (Contour)'.



Touch the 'mm<sup>3</sup>' -key and move the trackball.

If an other volume measurement is assigned to this key, first call up the sub-menu "VOLUME" by touching this key once more and select the measurement '2-Planes (contour)'.

3. Measure the first area in reference image A.  
(For operation see 'area measurement contour')  
The points of intersection (contour line with vertical blue line) are fixed in the reference image B.  
After finishing this measurement the measurement cross is positioned to the reference image B.
4. Measure the second area in reference image B  
The contour line is started at the first point of intersection is automatically lead through the second point of intersection if the blue line (of intersection) is crossed.  
After finishing this measurement the volume is calculated and displayed.

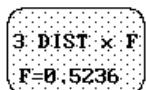
Result display:

$V = \dots, . \text{ ml}$   
 $A_2 = \dots, . \text{ cm}^2$   
 $A_1 = \dots, . \text{ cm}^2$

#### Remarks:

- The volume measurement is only possible in 3D-Mode or full-image mode (not in aspect mode).

### 10.5.3. 2-Planes, 3 Distances x Factor



$$V[\text{ml}] = \text{Width} \times \text{Length} \times \text{Height} \times \text{Factor}$$

Condition: Transverse section and a longitudinal section in dual image mode are stored.

#### Operation:

1. Measure the first and the second distance in the first section (proceed as for distance measurement).
2. Measure the third distance in the second section

Result display:  $V. = \dots, \text{ ml}$   
 $D. = \dots, \text{ mm}$

#### Remark:

- The volume factor is programmable, the normal factor being  $\frac{\pi}{6} = 0.5236$ .  
 (see „programming the volume factor“, chapter 12).

### 10.5.4. 1-Plane, Ellipse



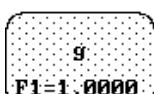
Volume determination from one 2D-scan. The object to be measured has to be of rotation-symmetric shape to achieve an acceptable accuracy.

#### Procedure:

1. Select the measurement
2. Position the first dot of the long axis, store it.
3. Position the second dot of the long axis, store it. The axes and the ellipse will be displayed.
4. Adjust the size to fit the measurement object with the trackball.
5. Store the ellipse.

Result display:  $V. = \dots, \text{ ml}$

### 10.5.5. Weight Estimation



A volume measurement in [ml] will be multiplied with the weight factor F1 (F2) and displayed in [g].  
 (Programming of the weight factor, see chapter 12).

## 10.6. OB measurement

The OB measurement package includes B-Mode exams (Fetal biometry, Fetal weight estimation, ratio calculation, etc..) and D-Mode exams (Uterine-, Cord-, Placental artery). All the OB exams are included in the OB Report. Each OB exam supports multiple gestation studies (up to six fetus), providing separate measurement information for each fetus. Growth Analyses Graphs can display exam results from a single exam, or results acquired over a series of exams.

- **Gestational Age Tables**

<b>Label</b>	<b>Description</b>	<b>Measurement Method</b>
AAP	Abdominal Anter. Poster. Diameter	Distance
AC	Abdominal Circumference	Ellipse, Trace
BPD	Biparietal Diameter	Distance
CRL	Crown Rump Length	Distance
FL	Femur Length	Distance
FTA	Fetal Trunk Area	Ellipse, Trace
GS	Gestational Sack (mean diameter)	Distance
HC	Head Circumference	Ellipse, Trace
OFD	Occipital Frontal Diameter	Distance
RL	Radius Length	Distance
TAD	Transverse Abdominal Diameter	Distance
TTD	Thorax Transverse Diameter	Distance
HL	Humerus Length	Distance
UL	Ulna Length	Distance
TL	Tibia Length	Distance
FL	Fibula Length	Distance

- **Calculations:**

<b>Label</b>	<b>Description</b>	<b>Required Measurements</b>
HC/AC	Ratio: Head to Abdominal Circumference	HC, AC
FL/AC	Ratio: Femur Length to Abdominal Circumference	FL, AC
FL/BPD	Ratio: Femur Length to Biparietal Diameter	FL, BPD
CI	Cephalic Index (HC/BPD)	HC, BPD
FW	Estimated Fetal Weight	depending on FW method used
AFI	Amniotic Fluid Index	4 Distances (Q1 to Q4)
HR	Heart Rate	M-Mode time interval
MAD	Middle Abdominal Diameter	TAD, AAP

- Measurements with Label (no table evaluation):

<b>Label</b>	<b>Description</b>	<b>Measurement Method</b>
AD	Abdominal Diameter	Distance
APTD	Anter. Post. Thoracic Diameter	Distance
TTD	Thorax Transverse Diameter	Distance
FTA	Fetal Trunk Area	Area measurement derived from AC measurement

### 10.6.1. Fetal Biometry (GA look up tables)

With the GA tables the gestational age can be determined.

In the OB measure menu ten GA keys are available for selecting a biometrics table. Which key holds which table can be assigned by the user out of a stock of tables (Biometry tables setup). The stock contains a certain number of fixed programmed tables and tables, which are programmed by the user.

Biometry table setup:	see chapter 12.4.1
To program a user table:	see chapter 12.4.2 (learn Biometry tables)
Listing of tables:	see main user manual chapter 15 additional tables see supplement

Displayed values of a GA table exam on screen:

EDC:MM/DD/YYYY	(Estimated Date of Confinement)
GA:XXwXd (i)	(Gestational Age)
D1=XXX.Xmm	(measured Distance)
BPD(Author)	(Kind of table (Author))

(i): index number:

up to five measurements of same table type are stored in Report's data base. If a sixth measurement is performed the index will show number one again and the old stored value one will be overwritten.

Table range

If the measured value is too small or too high for the table range, the age result is marked with asterisk characters.

EDC:*****
GA:***** (i)
D1=XXX.Xmm
BPD(Author)

Necessary operation steps:

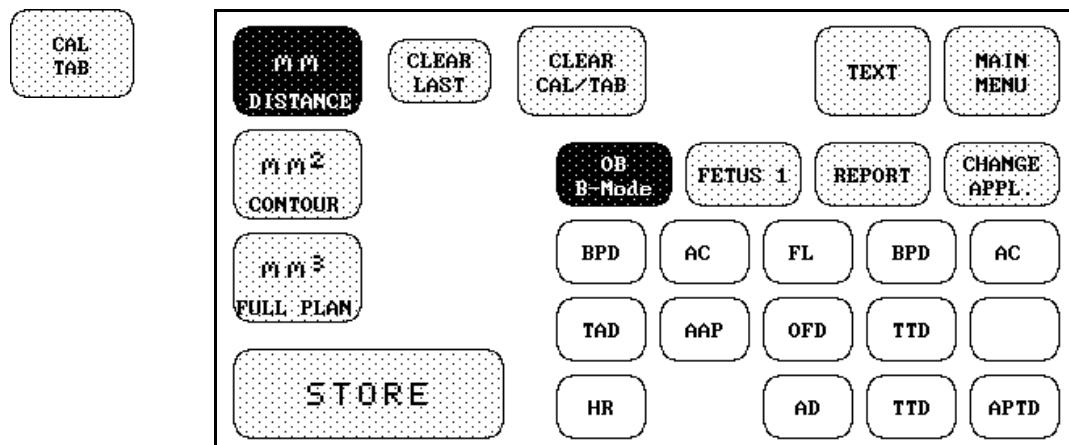
Condition: B-Mode image on screen (running or frozen)

- Call the OB Measure menu
- Select fetus number (at multiple gestation studies only)
- Select biometrics table
- Perform measurement

Note:

**The result of a table evaluation will be send and stored automatically in the OB Report data base. Accidentally wrong entered data's can be erased in the work page(s) of the OB Report.**

### 10.6.1.1 OB Measure menu (B-Mode)

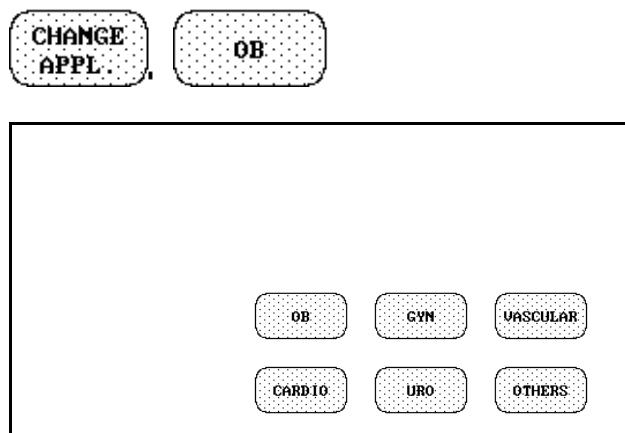


Note:

Different measure application windows can be displayed in the measurement menu. Switching on the measurement menu the last used window will appear.

### 10.6.1.2 Change of a measurement application

If a different measurement window then OB is active press button "Change Application" and select OB measurement in the appearing sub-menu.

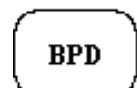


Application sub menu:

### 10.6.1.3 Direct evaluation of a measured value

The evaluation by a table is performed by activating a table key before a measurement.

Operation:

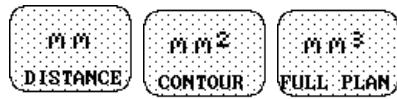


1. Select a table (e.g. "BPD")  
Table key is illuminated and type of measurement is selected automatically.
2. Use the trackball and the STORE'-key to set the first dot. After moving the trackball the measured value and the fetal age is displayed on the monitor simultaneously.
3. Finish the measurement by touching the 'STORE'-key or start a new measurement.

### 10.6.1.4 Subsequent evaluation of a measured value:

The evaluation by a table is performed by activating a table key after a measurement.

Operation:



1. Perform the selected measurement
2. Select wanted table (e.g. "BPD")

If the measurement does not match to the selected table a direct evaluation is started. In case of an area measurement with circumference calculation, the circumference measurement will be used for the table evaluation.

### 10.6.1.5 Measurement with Label (no GA estimation)

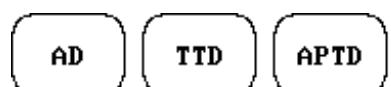
To following three distance measurements a label can be assigned:

AD: Abdominal Diameter

TTD: Thorax Transverse Diameter

APTD: Anterior Posterior Thorax Diameter

Operation:



Select wanted label and perform measurement (distance measurement is selected, if not active)

or

perform standard distance measurement and assign wanted label after measurement

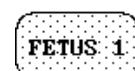
### 10.6.2. Multiple Gestations

Each OB exam supports multiple gestation studies (up to six fetus), providing separate measurement information for each fetus.

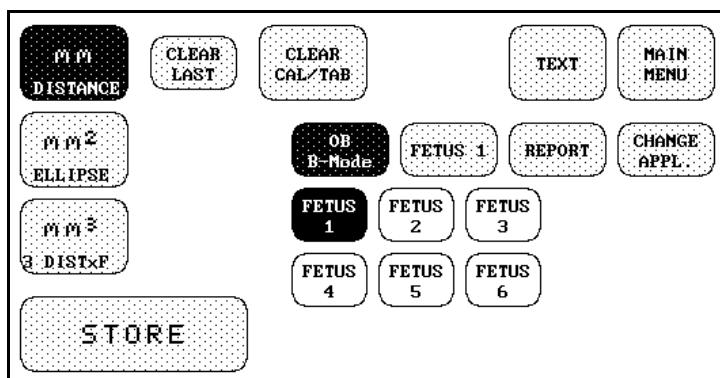
**Note:**

**For multiple gestation examinations the corresponding fetus number must be selected before measurements are performed.**

**Operation:**



touch the FETUS-key on OB measurement window  
the submenu to select a fetus number appears



select wanted fetus number

### 10.6.3. FW (Fetal Weight)

Operation: No operation required.

The FW value automatically will be calculated, stored in Report and displayed on screen (beside measurement block), if the last of the required measurements is performed.

Note:

If more than one value of each required measurement exists in the Report data base, the EFW result is calculated from their mean values.

Display of FW on screen:

**EFW: xxx.x g** (grams, ponds or ounces, selectable in setup)  
(Author)

Possible FW calculation methods:

For FW calculation one of following methods has to be selected once in biometry tables setup menu before starting a fetal weight estimation.

AUTHOR	Required Measurement(s)	AUTHOR	Required Measurement(s)
Merz	BPD, AC	Tokyo 1	BPD, TTD, AAP
Hansmann	BPD, TTD	Tokyo 2	BPD, TTD, AAP, FEL
Campbell	AC	Osaka	BPD, FTA, FEL
Shepard	BPD, AC	Tohamy	AC, HC
Hadlock	BPD, AC	Eik-Nes	BPD, TAD
Hadlock	AC, FEL		

Used Formulas see Annex chapter 15 .

#### 10.6.4. Ratios (FL/BPD, FL/AC, HC/AC, CI)

Operation: No operation required.

The Ratios are calculated and displayed automatically in the OB Report page(s), if required measurements are done.

<b>Ratio</b>	<b>Validity range(MA)</b>	<b>Normal Range</b>
FL/BPD	23 weeks - Term	71 - 87%
FL/AC	21 weeks - Term	20 - 24%
HC/AC	12 weeks - Term	varies with GA
CI	14 weeks - Term	70 - 86%

Note:

If more than one value of each required measurement in the Report data base exists, the Ratio is calculated from their mean values.

The Ratios are displayed in OB Report only.

#### 10.6.5. Amniotic Fluid Index (AFI)

The Amniotic fluid index is derived from four distance measurements of the largest amniotic fluid pocket in the four quadrants of the maternal abdomen. The AFI is the sum of these four measurements.

Equation: AFI = Q1 + Q2 + Q3 + Q4

Operation:

1. Call up the measuring program by touching the 'AFI'-key.
2. Use the trackball and the 'STORE'-key to measure the four distances.  
(After scanning and freezing a new B-Image the measure menu appears again until Q4 measurement is done.)
3. After the fourth distance the amniotic fluid index calculated and stored in OB Report.

Monitor display:      AFI=    xxx.x  
                        Q4 = xxx.xmm  
                        Q3 = xxx.xmm  
                        Q2 = xxx.xmm  
                        Q1 = xxx.xmm  
                        AFI (Author)

The amniotic fluid index can be assigned to one of the ten keys in the OB measurement menu like a normal Biometry table.

To assign tables see chapter 12.4.1 (Biometry table setup).

### 10.6.6. Routine Measurements

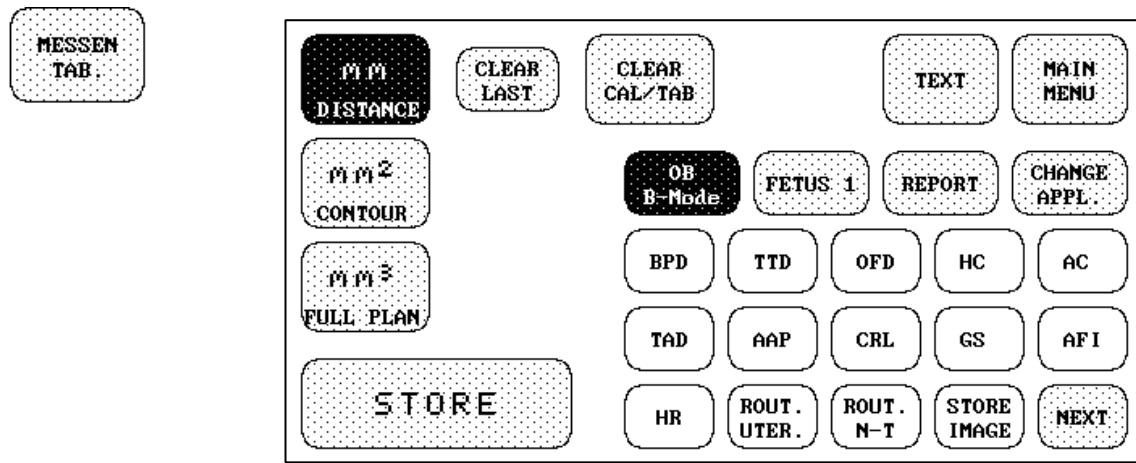
The following Routine measurements are supported:

- Uterus measurements
- Nuchal Translucency measurement of the fetus
- Examination of the fetal anatomy.

All results are stored with images to the patient report.

At patient data entry performed routine measurements are indicated, results are displayed and images can be loaded.

Call up the routine measurements in the OB main menu (B-Mode)



#### Annotation:

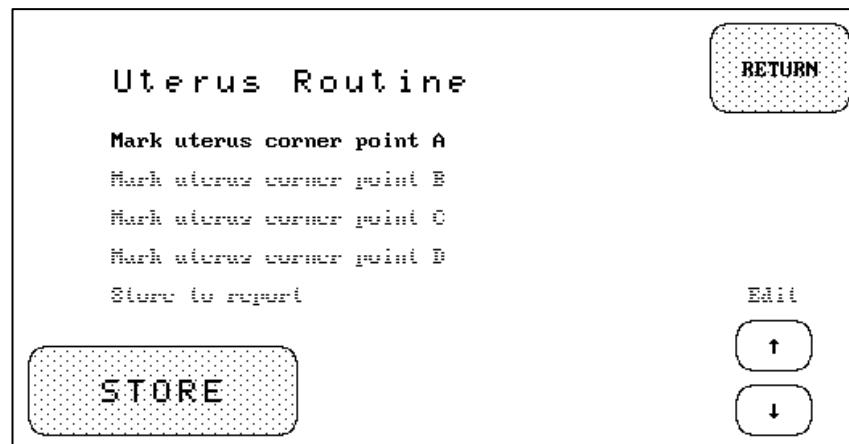
- In the measurement menu other application menus can be displayed.  
Always the application menu used at last is displayed.
- The OB application can be selected with the key ,CHANGE APPL. ‘.

With the key ,NEXT‘ you can switch between ,Routine-Measurements‘ and the measurement labels, AD, TTD, APTD‘.

### 10.6.6.1. Uterus-Measurement

**ROUT.  
UTER.**

Call up the measuring program by touching this key,  
the following window appears on the touch screen.



#### Operation:

1. Obtain a B-image of the uterus.
2. Call up the measuring program by touching the key ,ROUT. UTER.'. A horizontal line with a measuring cross is displayed.
3. Mark point A and B of the uterus corner by using the trackball and the ,STORE'-key. After entering point B a vertical line with a measuring cross is displayed.
4. Mark point C and D of the uterus corner by using the trackball and the ,STORE'-key. The points A to D are connected with lines and the corresponding distances are displayed on the monitor.

Monitor display:    a =xxx.xmm  
                       b =xxx.xmm  
                       c =xxx.xmm  
                       d =xxx.xmm  
                       RM-Uterus

5. Edit function:  
 With the arrow keys the points A to D can be selected once more for corrections.  
 The corresponding line is lighted up on the touch screen.  
 Use the trackball and the 'STORE'-key to correct the position of the selected point.
6. Store the results and the B-Image to the report with the ,STORE'-key.  
 The line ,Store to the report' must be lit.

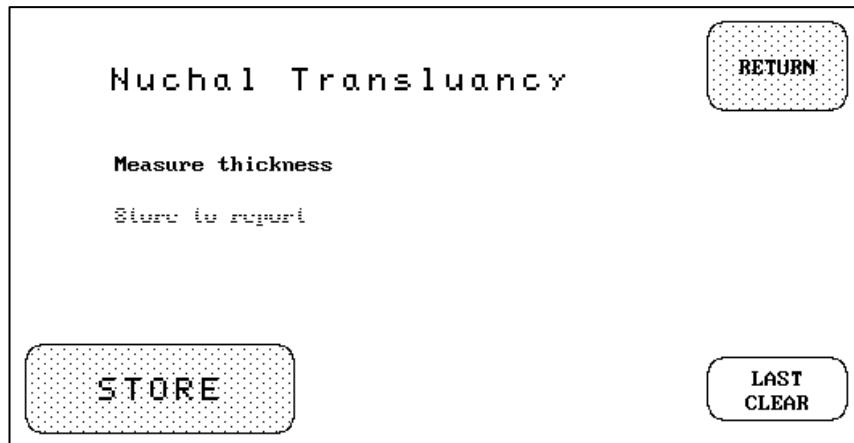
#### Annotation:

- With the ,RETURN'-key you can exit from the measuring program at any time but then no measurement values and no B-image are stored to the report.

### 10.6.6.2 N-T-Measurement (Nuchal Translucency)

**ROUT.  
N-T**

Call up the measuring program by touching this key,  
the following window appears on the touch screen.



#### Operation:

1. Obtain the nuchal translucency of the fetus.
2. Select the fetus number at multiple birth by using the key ,FÖTUS n' in the measuring main menu.
3. Call up the measuring program by touching the key ,ROUT. N-T'. A measuring cross appears.
4. Measure the thickness of the nuchal translucency by using the trackball and the ,STORE'-key. The distance is displayed on the monitor.

Monitor display: D =xxx.xmm  
RM-N-F

5. Edit function:  
Correct the measured distance by using the key ,CLEAR LAST'.
6. Store the distance and the B-Image to the report with the ,STORE'-key.  
The line ,Store to the report' must be lit.

#### Annotation:

- With the ,RETURN'-key you can exit from the measuring program at any time but then no measurement value and no B-image are stored to the report.

### 10.6.6.3 Fetal Anatomy

For assessment of the fetal anatomy an actual B-image can be stored to the database.

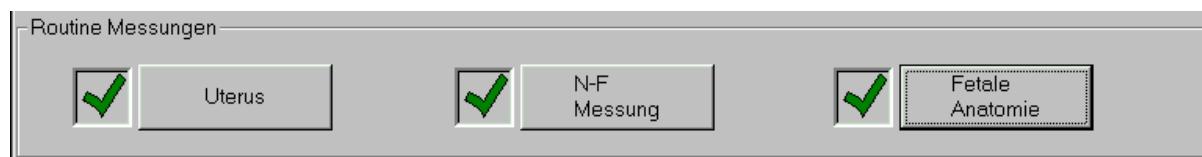
This images can be reviewed at patient data entry and in the patient reports.

**STORE  
IMAGE**

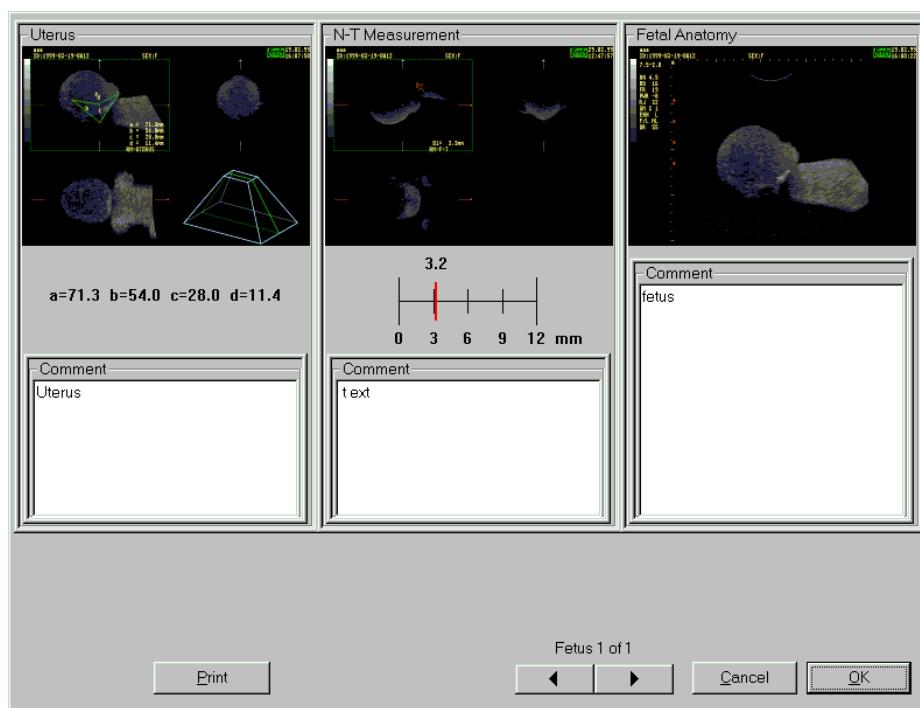
Store the actual image into the database by touching this key.  
At multiple birth: select the correct fetus number before storing images by touching the key ,FÖTUS n' in the measuring main menu.

#### 10.6.6.4 Registrations in the patient data form

After calling up the patient data form for obstetrics the following window appears:



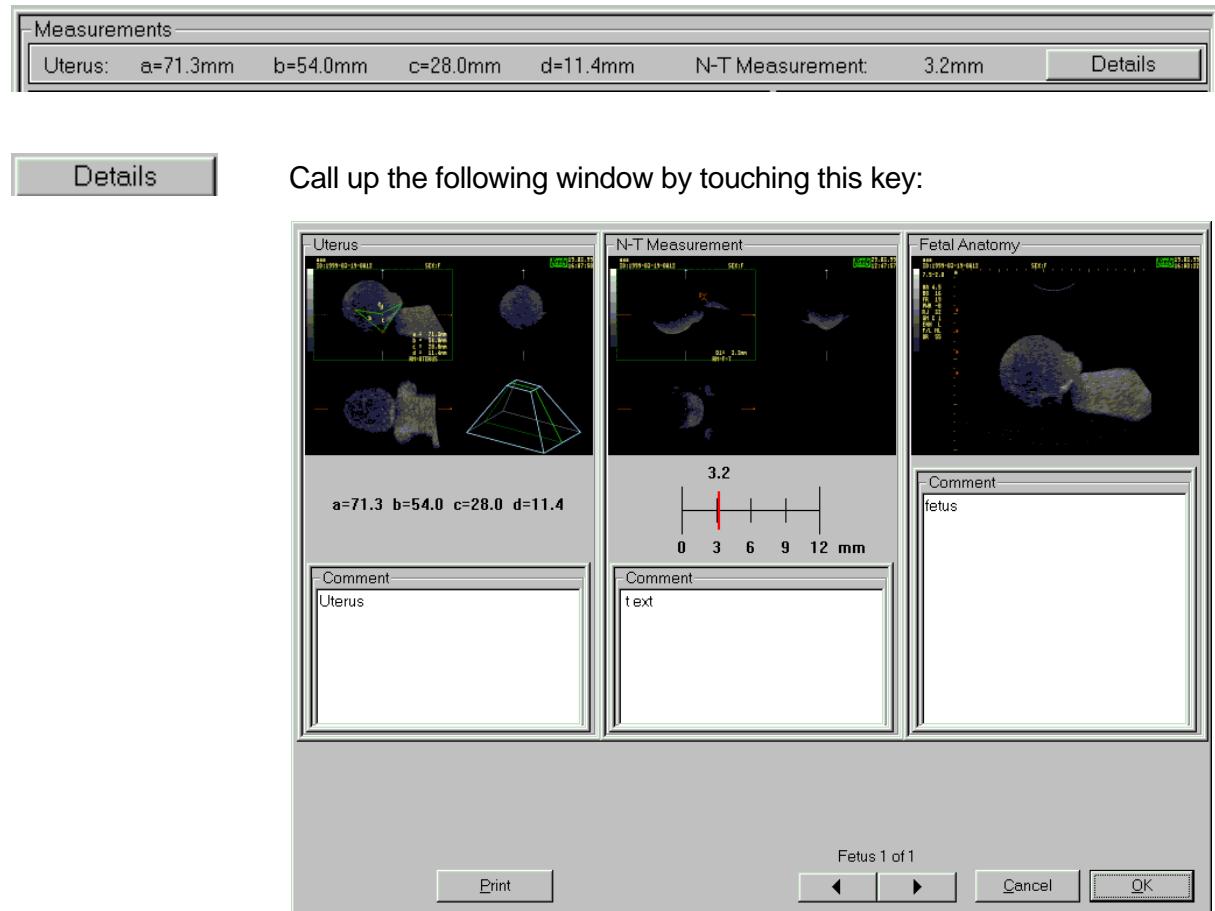
- The marks ,→ left from the corresponding button indicate that routine measurements have been performed or images are stored.
- Click on one of the 3 buttons above, the following window appears::



- Click on the images for magnification, click on a magnified image for reduction.
- Click on the icons ,◀ 'and '▶' to step through the pages at multiple birth.
- Click on the corresponding input field for comments. A write cursor appears and the text can be entered.
- Click on the [ OK ] – button to store the entered text. The window is closed. Using the [ CANCEL ] – button the window is closed but the text is not stored..
- Click on the [ Print ] – button for printing the actual image on the monitor to a line printer.

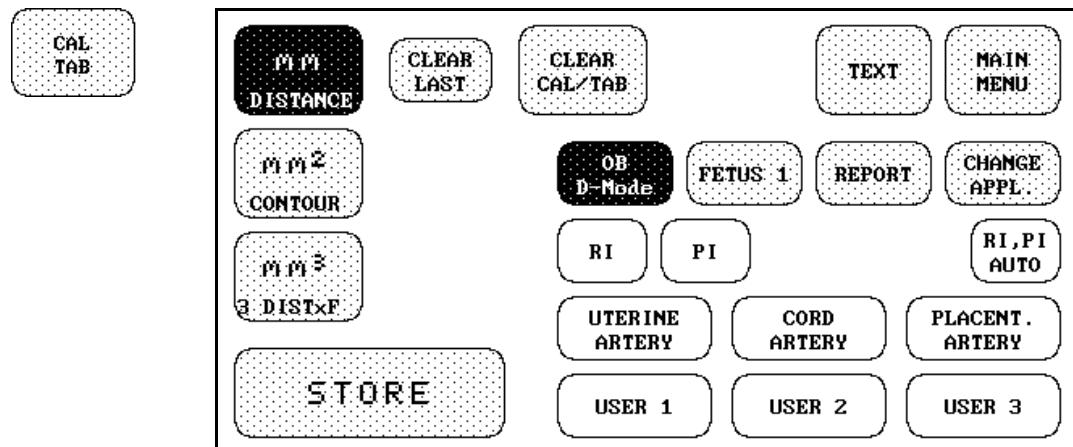
#### 10.6.6.5 Registrations in the Report

The routine measurements are registered in the report as below:



### 10.6.7. OB Doppler measurements and calculations

#### 10.6.7.1 OB Measure menu (D-Mode)

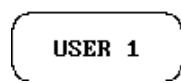


Note:

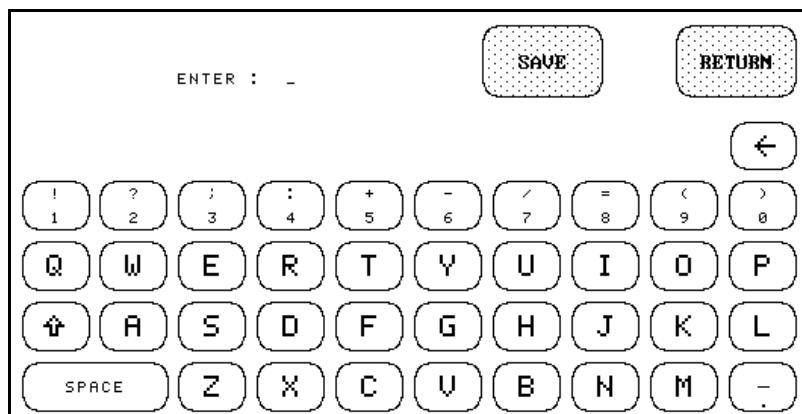
The OB Doppler window appears automatically, when a B/D-image is frozen and when measurement application is set to OB.

To change measurement application see chapter 10.6.1.2

#### 10.6.7.2 To Change a User Label



1. Touch key USER 1 (2 or 3)  
Key have to be illuminated (active)
2. Touch the key two times quickly  
The submenu to enter or change a new label appears
3. Enter new label with keyboard



4. Touch SAVE to store the Label

### 10.6.7.3 RI (Resistance Index)

Required measurements: PS (Peak Systole, measure peak velocity)  
ED (End Diastole, measure minimum vertical deflection)

Calculation:  $RI = (PS - ED)/PS$

Result display:  
RI = xx.xx  
PS = xxxx cm/s  
ED = xxxx cm/s  
Meas. Label

Measurement Labels: Uterine artery, cord artery, placental artery,  
three user defined labels

#### Operation:

1.  Select wanted label of the vessel to be measured before starting the RI measurement.  
It is also possible to enter a label once after the RI measurement is done.
2.  Switch on RI measurement. Touch key RI (the RI-submenu appears on touch screen)
3. Mark the peak systole (PS) with trackball and press ENTER
4. Mark end diastole (ED) with trackball and press ENTER to calculate and display

#### Note:

If no measurement Label is selected, the RI measurement will not be stored in the OB Report.

#### 10.6.7.4 PI (Pulsitility Index)

Required measurements: PS (Peak Systole)  
MDD (Maximum Diastolic Deflection)  
TAPV (Time Average Peak Velocity, evaluated from entered trace)

Calculation:  $PI = (PS - MDD)/TAPV$

Result display:  
PI = xx.xx  
TAPV= xxxx cm/s  
MDD = xxxx cm/s  
PS = xxxx cm/s  
Meas. Label

Measurement Labels: Uterine artery, cord artery, placental artery,  
three user defined labels

#### Operation:

UTERINE  
ARTERY

1. Select wanted label of the vessel to be measured before starting the PI measurement.  
It is also possible to enter a label once after the PI measurement is done.
2. Switch on PI measurement. Touch key PI (the PI-submenu appears on touch screen)
3. Mark the envelope curve with trackball (one can select between point and trace mode before)
4. to start PI calculation press ENTER.

#### Note:

If no measurement Label is selected, the RI measurement will not be stored in the OB Report.

### 10.6.7.5 RI/PI AUTO

The required measurements to calculate RI and PI are derived from the automatic tracing of the Doppler spectrum.

Result display:

```
PI = xx.xx
RI = xx.xx
PS = xxxx cm/s
MDD = xxxx cm/s
TAPV= xxxx cm/s
ED = xxxx cm/s
Meas. Label
```

#### Operation:

**UTERINE  
ARTERY**

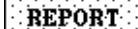
1. Select wanted label of the vessel to be measured before starting the RI/PI AUTO measurement.  
It is also possible to enter a label once after the measurement is done.
2. Switch on RI/PI AUTO measurement  
(the autocalc-submenu appears on touch screen)
3. Position angle cursor (if necessary)
4. Select channel (upper, both, lower if necessary)
5. Select the periode(s) to be evaluated with cursor 1 and 2
6. press ENTER to start RI/PI calculation.

Note:

If no measurement Label is selected, the RI measurement will not be stored in the OB Report.

### 10.6.8. OB Patient Report

#### 10.6.7.6 To display the Report


**REPORT**

touch the REPORT key in measurement menu

To move through the Report use the Page Select controls at the bottom of the Report pages:

1. Move the cursor to the Page Select control (< or >)
2. Press the SIMUL (Enter) key to select next or previous page



To exit the Report touch the key MAIN MENU on the touch screen.

#### 10.6.7.7 Report layout

The OB exam has a four-page Patient Report. For twins or multiple gestations (up to six) each fetus has it's own report pages.

Obstetric Report- Summary page:

Obstetric Report - Summary Page					
Hospital Name: KRETZTECHNIK C530 3D ULTRASOUND			Date: 10/12/1998		
Patient Name:	Patient Name	ID: 123456789abc	Referring MD:	Dr. Meier	AGE: 22
Sonographer:	Dr. Huber				
Indication:					
LMP	04/25/98	GA (LMP)	24w 2d	EDC (LMP)	01/30/99
LMP (Avg.US)	04/15/98	GA (Avg.US)	25w 5d	EDC (Avg.US)	01/20/99
				Gravida 3	AB
				Para 2	
Measurements					
Fetal Bio		Avg.	G.A.	Dev.	EDC
BPD (Hadlock)	61.2 mm	24w 6d	±16d	01/26/99	FL/BPD 80 % (71 - 87 %)
FL (Hadlock)	48.7 mm	26w 0d	±22d	01/18/99	FL/AC 23 % (20 - 24 %)
HC (Hadlock)	244.1 mm	26w 3d	±16d	01/15/99	HC/AC 1.16
AC (Hadlock-2)	210.3 mm	25w 3d	±15d	01/22/99	CI 71 % (70 - 86 %)
FTA	30.7 cm <sup>2</sup>				EFW (Hadlock) 812.4 g
AFI (Moore)	173.2 mm				HR 146 BPM
OFD (Merz)	86.6 mm	26w 6d		01/12/99	Doppler S/D PI RI
TTD	69.9 mm				Uterine Artery 4.1 0.8
					Cord Artery
					Placental Artery
					User Defined 1
					User Defined 2
					User Defined 3
<b>Backup</b>	<b>Print</b>	<b>Graph</b>	Fetus 1 of 1	Page 1 of 4	

LMP display:

Clinical: GA(LMP) and EDC(LMP) are calculated from the entered LMP date in relationship to the actual date of the US-System.  
EDC calculation: pregnancy days: 280

Avg.US: GA(Avg.US) and EDC(Avg.US) are calculated from the values of the measured GA-tables. If more values for a GA-table are measured, then the average value is taken.

**Note: For the GA(Avg.US) and EDC(Avg.US) calculation only the BPD, HC, AC, and FL measurement are used.**

Ratio and EFW display:

Calculation is automatically done, if required measurements exist.

D-Mode measurements:

If more than one measurement exists, the peak measurement is displayed.

Note:

In the summary page no editing of values is possible.

**Obstetric Report-Work page 2:**

This page includes Observation, Biophysical Profile and Comment. With the EDIT function scores and observations can be filled in.

Obstetric Report - Workpage																							
Hospital Name: KRETZTECHNIK C530 3D ULTRASOUND	Date: 10/12/1998																						
Patient Name: Patient Name	ID: 123456789abc	AGE: 22																					
<b>Observations</b> <table border="0"> <tr> <td>Fetal Heart: Motion Seen</td> <td>Amn. Fluid Vol:</td> <td>Spine - Lumbar: Seen</td> </tr> <tr> <td>Fetal Position: Transverse</td> <td>Placenta Grade: I</td> <td>Diaphragm: Seen</td> </tr> <tr> <td>3-V Cord:</td> <td>Placenta Loc.: Posterior</td> <td>Abdominal Wall:</td> </tr> <tr> <td>4 CH Heart:</td> <td>Previa:</td> <td>Stomach - left:</td> </tr> <tr> <td>Aortic Arch:</td> <td>Face: Seen</td> <td>Bowel Pattern:</td> </tr> <tr> <td>Great Vessels: Seen</td> <td>Spine - Cervical: Previously Seen</td> <td>Bladder: Seen</td> </tr> <tr> <td>4 Extremities: Seen</td> <td>Spine - Thoracic: Seen</td> <td>Genitalia:</td> </tr> </table>			Fetal Heart: Motion Seen	Amn. Fluid Vol:	Spine - Lumbar: Seen	Fetal Position: Transverse	Placenta Grade: I	Diaphragm: Seen	3-V Cord:	Placenta Loc.: Posterior	Abdominal Wall:	4 CH Heart:	Previa:	Stomach - left:	Aortic Arch:	Face: Seen	Bowel Pattern:	Great Vessels: Seen	Spine - Cervical: Previously Seen	Bladder: Seen	4 Extremities: Seen	Spine - Thoracic: Seen	Genitalia:
Fetal Heart: Motion Seen	Amn. Fluid Vol:	Spine - Lumbar: Seen																					
Fetal Position: Transverse	Placenta Grade: I	Diaphragm: Seen																					
3-V Cord:	Placenta Loc.: Posterior	Abdominal Wall:																					
4 CH Heart:	Previa:	Stomach - left:																					
Aortic Arch:	Face: Seen	Bowel Pattern:																					
Great Vessels: Seen	Spine - Cervical: Previously Seen	Bladder: Seen																					
4 Extremities: Seen	Spine - Thoracic: Seen	Genitalia:																					
<b>Biophysical Profile</b> <table border="0"> <tr> <td>Reactive Nonstress Test</td> <td>1</td> </tr> <tr> <td>Fetal Body Movements</td> <td>2</td> </tr> <tr> <td>Fetal Breathing Movements</td> <td>2</td> </tr> <tr> <td>Fetal Tone</td> <td>1</td> </tr> <tr> <td>Amniotic Fluid Volume</td> <td>2</td> </tr> <tr> <td>Total Score</td> <td>8</td> </tr> </table>		Reactive Nonstress Test	1	Fetal Body Movements	2	Fetal Breathing Movements	2	Fetal Tone	1	Amniotic Fluid Volume	2	Total Score	8	<b>Comment</b> Enter your comment!									
Reactive Nonstress Test	1																						
Fetal Body Movements	2																						
Fetal Breathing Movements	2																						
Fetal Tone	1																						
Amniotic Fluid Volume	2																						
Total Score	8																						
Edit      Print      Graph      Fetus 1 of 1      Page 2 of 4																							

## Measurements/Calculations

**Obstetric Report-Work page 3:**  
This page includes all done B-mode measurements.

Obstetric Report - Workpage									
Hospital Name: KRETZTECHNIK C530 3D ULTRASOUND				Date: 10/12/1998					
Patient Name: Patient Name				ID: 123456789abc AGE: 22					
LMP	04/25/98	GA (LMP)	24w 2d	EDC (LMP)	01/30/99	Gravida	3 AB		
LMP (Avg.US)	04/15/98	GA (Avg.US)	25w 5d	EDC (Avg.US)	01/20/99	Para	2		
FL / BPD	80 % (71 - 87 %)	HC / AC	1.16			EFW	812.4 g		
FL / AC	23 % (20 - 24 %)	CI	71 % (70 - 86 %)			HR	146 BPM		
<b>Measurements</b>									
Fetal Bio	1	2	3	4	5	Avg.	G.A.	Dev.	EDC
BPD (Hadlock)	61.7	60.7	61.3			61.2 mm	24w 6d	±16d	01/26/99
FL (Hadlock)	49.1	48.4				48.7 mm	26w 0d	±22d	01/18/99
HC (Hadlock)	239.5	248.7				244.1 mm	26w 3d	±16d	01/15/99
AC (Hadlock-2)	221.5	199.2				210.3 mm	25w 3d	±15d	01/22/99
FTA						30.7 cm <sup>2</sup>			
AFI (Moore)	34.8	54.7	62.6	21.0	sum:	173.2 mm			
OFD (Merz)	86.6					86.6 mm	26w 6d		01/12/99
TTD	69.9					69.9 mm			

     Fetus 1 of 1      Page 3 of 4

**Obstetric Report-Work page 4:**  
This page includes all done D-mode measurements.

Obstetric Report - Workpage							
Hospital Name: KRETZTECHNIK C530 3D ULTRASOUND				Date: 10/12/1998			
Patient Name: Patient Name				ID: 123456789abc AGE: 22			
<b>Doppler Measurements</b>							
Uterine Artery				Peak	User Defined 1	Peak	
PS	45.0	45.0 cm/s		PS			
ED	11.0	11.0 cm/s		ED			
S/D	4.1	4.1		S/D			
PI				PI			
RI	0.8	0.8		RI			
Cord Artery				User Defined 2			
PS				PS			
ED				ED			
S/D				S/D			
PI				PI			
RI				RI			
Placental Artery				User Defined 3			
PS				PS			
ED				ED			
S/D				S/D			
PI				PI			
RI				RI			

     Fetus 1 of 1      Page 4 of 4

### 10.6.7.8 To edit the Report

#### EDIT operation elements:

Trackball: cursor position (function like mouse positioning)



Enter button (function like right mouse button)

Key board.: alphanumeric text entry

#### Operation:

1. Display the Report (if not active)
2. Select wanted work page to edit
3. Switch on EDIT (move the cursor to the EDIT key and press SIMUL)
  - Work page 2: all entry fields light up, which can be edited
  - Work page 3,4: all measurements and entries (LMP, Gravida etc.) are framed which can be edited.
4. Move the cursor to the entry field, that you want to edit and press the SIMUL key to select the entry field (the edit window appears)
5. Clear or enter the new value or text

#### To delete a whole measurement line:

1. select workpage 3  
(EDIT function has to be off)
2. select f.e. label BPD with the cursor and press SIMUL  
a window with the question: Delete table measurements? appears
3. quit with YES for deleting

#### Details on Work page 2

- **Observation field:**

Move the cursor to ▼ symbol of wanted entry, press SIMUL (a pull down window with predefined observations appears), select wanted observation and press SIMUL to enter.

For entering a not predefined observation, select entry field direct and enter observation with keyboard.

- **Comment field:**

Select comment entry field and enter the comment with keyboard.

- **Biophysical Profile field**

Position cursor to wanted entry field and press SIMUL repeatedly to enter the score value 0, 1, or 2 .

**Criteria for Scoring Biophysical Profiles:**

Score	0	1	2
Reactive Nonstress Test	1 or fewer accelerations in a 20 minute period	least 15 beats per minute in amplitude and at least 15 seconds duration associated with fetal movements in 20 minute period	acceleration 15 beats per minute in amplitude and at least 15 seconds duration associated with fetal movements in 20 minute period
Fetal Body Movements	Absence of fetal movements within 30 minutes	1 or 2 fetal movements within 30 minutes	3 or more discrete body/limb movements within 30 minutes. Simultaneous limb and trunk movements were counted as a single movement
Fetal Breathing Movements	Absence of fetal breathing lasting less 30 seconds within 30 minutes	At least 1 episode of fetal breathing lasting 30 to 60 seconds within 30 minutes	At least 1 episode of fetal breathing of at least 60 seconds duration within a 30 minute observation period
Fetal Tone	Extremities in extension. Fetal movements not followed by return to flexion. Open hand	At least 1 episode of extension with return to position of flexion or 1 episode of extension of spine with return to flexion	Extension of extremities with return to position of flexion and also 1 episode of extension of spine with return to position of flexion
Amniotic Fluid Volume	Crowding of fetal small parts, largest pocket less than 1cm in diameter	a pocket that measures less than 2 and more than 1cm in diameter	Fluid evident throughout the uterine cavity; a pocket that measures 2cm or more in diameter

**Scoring Interpretation:**

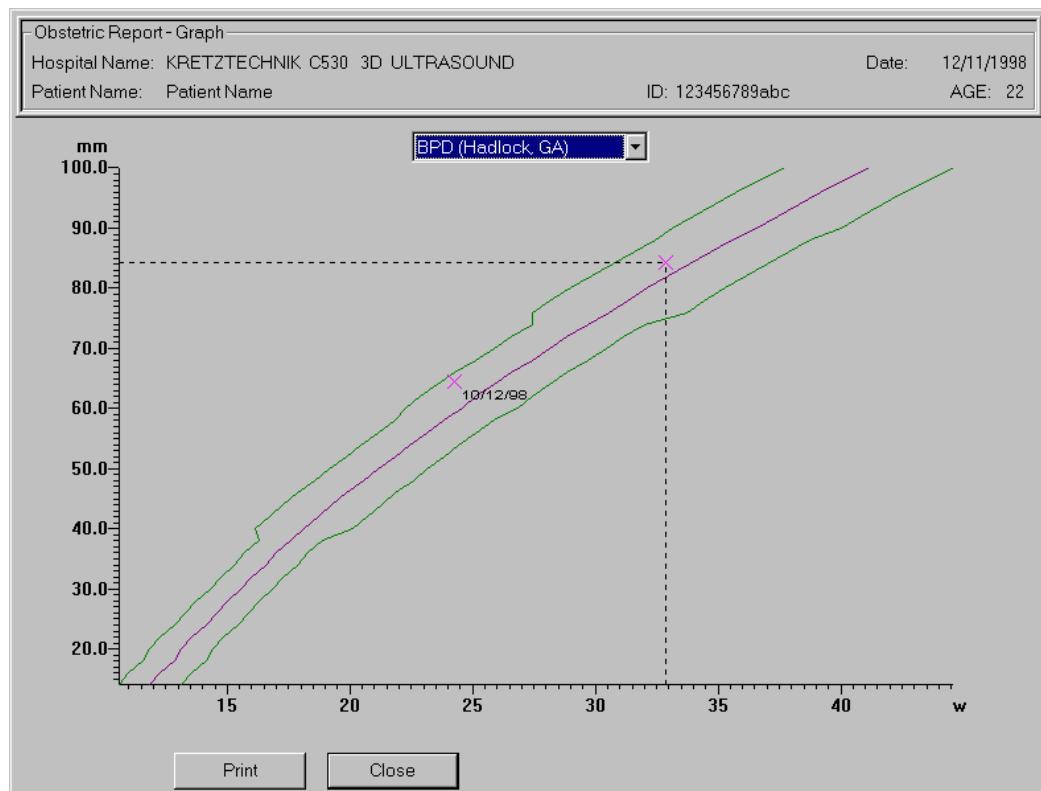
- Total Score = 8:      Normal infant; low risk for chronic asphyxia  
 Total Score = 6:      Suspect chronic asphyxia  
 Total Score = 4:      Suspect chronic asphyxia  
 Total Score = 2:      Strong suspicion of chronic asphyxia

### 10.6.9. Growth Analysis Graphs

A Growth Analysis Graph displays curves that indicate predicted fetal growth patterns according to the selected reference for a measurement. The system plots the mean, 10th and 90th percentile curves of a selected growth table or mean, upper and lower limit of a selected GA-table and measured results on the graph.

#### Trend Analysis:

Measured results stored in different studies with same patient identification will be plotted automatically on the graph in relationship to entered clinical LMP date.



Horizontal axis: gestational age  
 Vertical axis: measure result

The current exam is framed with a dotted horizontal line(measure result) and with a dotted vertical line (GA, calculated from clinical LMP). Previous measures are emphasized by the exam date.

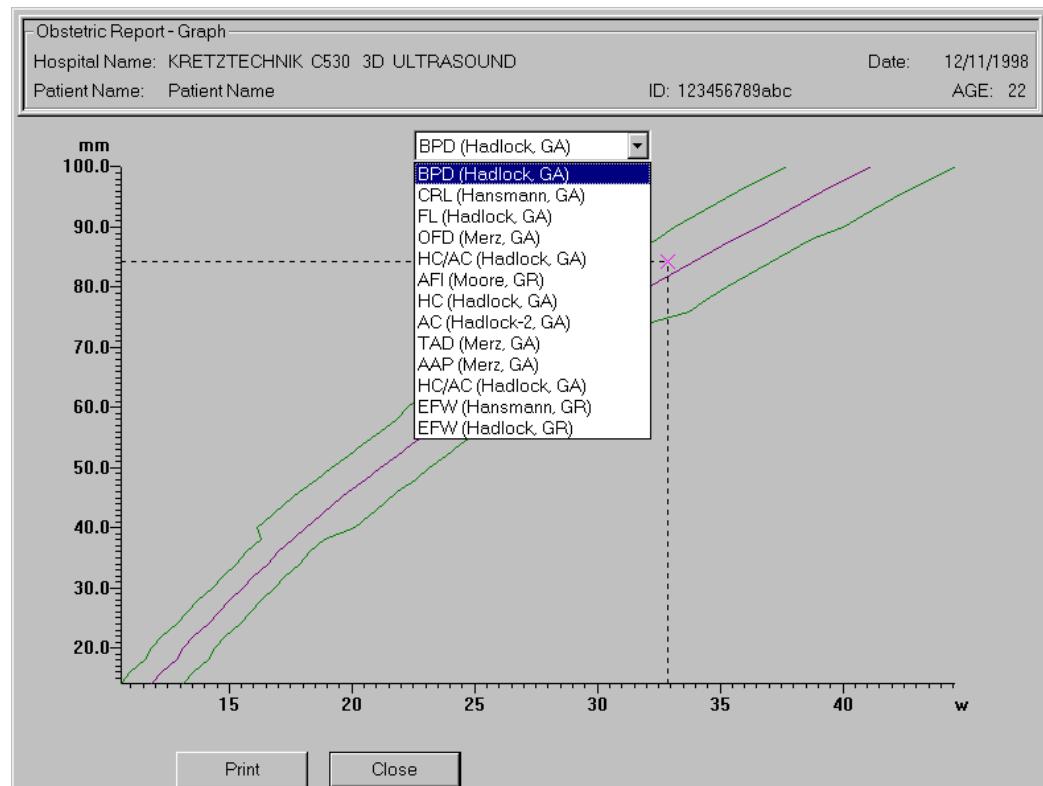
Graph reference: BPD: Hadlock (GA)

BPD.....kind of table  
 Hadlock....Author  
 GA.....Type of table (GA = gest. age or GR = growth)

**Note:** If no clinical LMP date is entered, the graph without measured results is plotted.  
 If no growth table is available, the gestation age table is plotted.

### To display a graph - possibility 1

1. Display the Report (if not active)
2. Switch on GRAPH (move the cursor to the GRAPH key and press SIMUL)  
Graph reference of the first measured table appears
3. Move the cursor to ▼ symbol of Graphs reference and press SIMUL  
Survey of all possible Graphs appears (pull down window)
4. Select wanted Graph reference with Trackball and press SIMUL  
pull down window closes and selected graph will be displayed



### To display a graph - possibility 2

1. Display the Report (if not active)
2. Position the cursor to wanted table (summary page)
3. press SIMUL twice

## 10.7. GYN measurements

### 10.7.1. Survey

#### Patient ID/History information

The following Patient ID/History information can be entered during patient data entry:  
ID number, Name, Day of Birth, LMP, Day of menstrual cycle, Gravida, Para, Indication, Medication, Comment, Sonographer, Referring MD.

#### GYN measurement package

The GYN measurement package includes following exams:

B-Mode: length, width, height measurements of the uterus  
Endometrial thickness  
Cervix length  
length, width, height of left and right renal  
length, width, height and volume of ovaries and follicles  
early gestation OB tables: GS, CRL

D-Mode: RI and PI calculation with label of measured vessel.

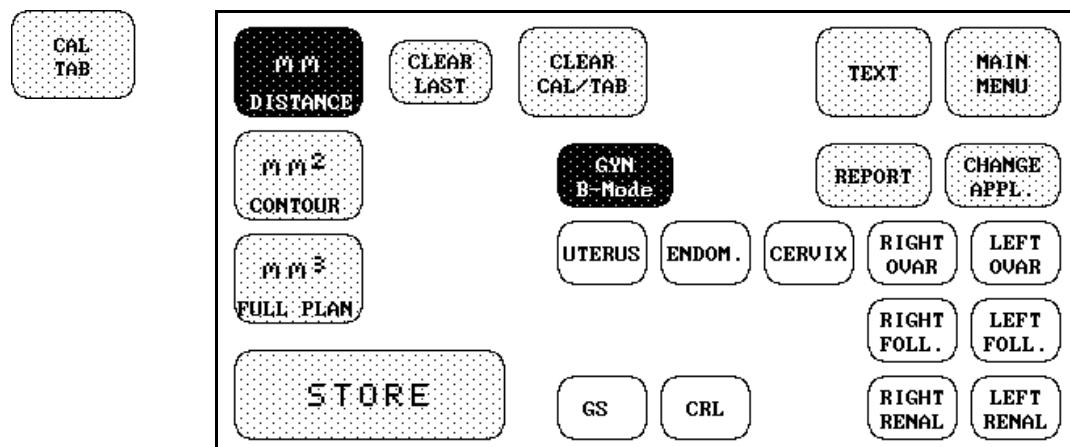
#### GYN Report

All the exams are included in the GYN Report. For fertility studies two separate report pages support up to 12 follicle measurements for each ovary.

Note:

**The result of an exam will be send and stored automatically in the data base of the GYN Report. Accidentally wrong measured data's can be erased in the report page(s) itself.**

### 10.7.2. GYN Measurements - B-Mode

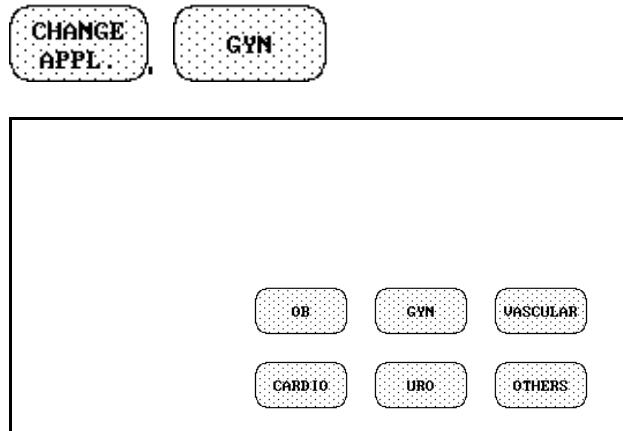


Note:

Different measure application windows can be displayed in the measurement menu. Switching on the measurement menu the last used application window will appear

### 10.7.2.1. Change of a measurement application

If a different measurement window then GYN is active press button "Change Application" and select GYN measurement in the appearing sub-menu.



### 10.7.2.2. Uterus

possible measurements: three linear distance measurement (height, weight and length)

measurement display:  $D_3=311.5\text{mm (W)}$   
 $D_2=311.5\text{mm (H)}$   
 $D_1=311.5\text{mm (L)}$   
 Uterus

#### Operation:

1. switch on UTERUS measurement  
a subwindow with the keys length, with, height appears
2. select wanted label, if not active and perform distance measurement  
3. select next wanted label and perform distance measurement  
4. switch off UTERUS measurement  
main GYN measurement window appears again

**note:** it is possible to do a new B-scan between measurements

### 10.7.2.3. Right (left) Renal

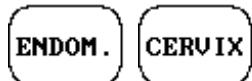
same possible measurements and operation than UTERUS measurement.

#### 10.7.2.4. Endometrium thickness, Cervix length

required measurement: one linear distance measurement

measurement display: D1= xxx.x mm or D1= xxx.x mm  
Endomet.thickn. Cervix length

Operation:



switch on ENDOM. or CERVIX Measurement and perform a distance measurement

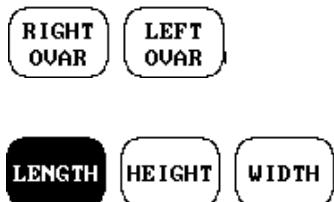
#### 10.7.2.5. Right Ovar (Left Ovar)

required measurements: three linear distance measurement (height, weight and length)

Calculation: Volume [ml] = L x H x W x factor  
(normally factor is 0.5236, can be changed in setup)

measurement display: VOL= xxx.x ml  
D3= xxx.x mm(W)  
D2= xxx.x mm(H)  
D1= xxx.x mm(L)  
Right Ovar

Operation:



1. switch on RIGHT (LEFT) OVAR measurement  
a subwindow with the keys length, width, height appears
2. select wanted label, if not active and perform distance measurement
3. select next wanted label and perform distance measurement  
after the third measurement the volume will be calculated and displayed.
4. switch off RIGHT (LEFT) OVAR  
main GYN measurement window appears again

**Note:** It is possible to do a new B-scan between the measurements

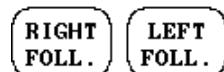
#### 10.7.2.6. Right Follicle (Left Follicle)

required measurements: three linear distance measurement (height, weight and length)

Calculation: Volume [ml] = L x H x W x factor  
(normally factor is 0.5236, can be changed in setup)

measurement display: VOL= xxx.x ml  
D3=xxx.x mm(W)  
D2=xxx.x mm(H)  
D1=xxx.x mm(L)  
Right Foll. (x) x...Follicle number

##### Operation:

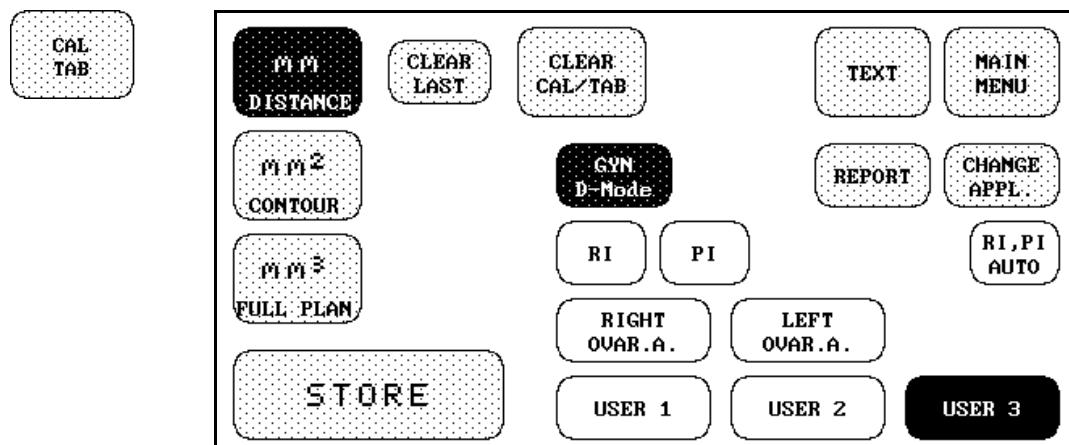


1. switch on RIGHT (LEFT) FOLL. measurement  
a subwindow with the keys length, width, height appears
2. select wanted label, if not active and perform distance measurement
3. select next wanted label and perform distance measurement  
after the third measurement the volume will be calculated and displayed.
4. select NEXT FOLL.  
Follicle number increments by one
5. repeat point 2, 3, and 4 for all follicles to be measured
6. switch off RIGHT (LEFT) FOLL.  
main measurement window appears again to select another measurement

measurements

**Note:** It is possible to do a new B-scan between the

### 10.7.3. GYN Measurements - D-Mode

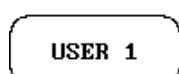


Note:

The GYN Doppler window appears automatically, when a B/D-image is frozen and when measurement application is set to GYN.

To change measurement application see chapter 10.6.1.2

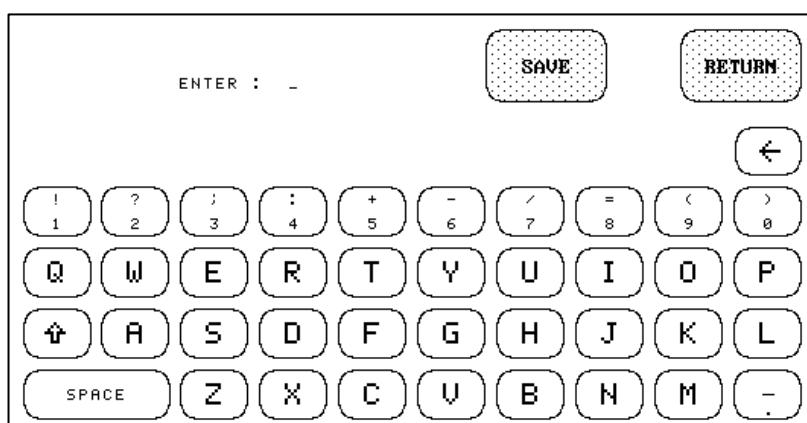
#### 10.7.3.1. To Change a User Label



1. Touch key USER 1 (2 or 3)  
Key have to be illuminated (active)



2. Touch the key two times quickly  
The submenu to enter or change a new label appears



3. Enter new label with keyboard
4. Touch SAVE to store the Label

### 10.7.3.2. RI (Resistance Index)

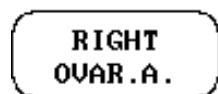
Required measurements: PS (Peak Systole, measure peak velocity)  
ED (End Diastole, measure minimum vertical deflection)

Calculation:  $RI = (PS - ED)/PS$

Result display:  
RI = xx.xx  
PS = xxxx cm/s  
ED = xxxx cm/s  
Meas. Label

Measurement Labels: Right (Left) ovar artery,  
three user defined labels

#### Operation:



1. Select wanted label of the vessel to be measured before starting the RI measurement.  
It is also possible to enter a label once after the RI measurement is done.



2. Switch on RI measurement. Touch key RI (the RI-submenu appears on touch screen)
3. Mark the peak systole (PS) with trackball and press ENTER
4. Mark end diastole (ED) with trackball and press ENTER

#### Note:

If no measurement Label is selected, the RI measurement will not be stored in the OB Report.

### 10.7.3.3. PI (Pulsatility Index)

Required measurements: PS (Peak Systole)  
 MDD (Maximum Diastolic Deflection)  
 TAPV (Time Average Peak Velocity, evaluated from entered trace)

Calculation:  $PI = (PS - MDD)/TAPV$

Result display:  
 $PI = xx.xx$   
 TAPV= xxxx cm/s  
 MDD = xxxx cm/s  
 PS = xxxx cm/s  
 Meas. Label

Measurement Labels: Right (Left) ovar artery,  
 three user defined labels

#### Operation:

RIGHT  
OVAR.A.

1. Select wanted label of the vessel to be measured before starting the PI measurement.  
 It is also possible to enter a label once after the PI measurement is done.
2. Switch on PI measurement. Touch key PI (the PI-submenu appears on touch screen)
3. Mark the envelope curve with trackball (one can select between point and trace mode before)
4. to start PI calculation press ENTER.

#### Note:

If no measurement Label is selected, the RI measurement will not be stored in the OB Report.

#### 10.7.3.4. RI/PI AUTO

The required measurements to calculate RI and PI are derived from the automatic tracing of the Doppler spectrum.

Result display:

PI = xx.xx  
RI = xx.xx  
PS = xxxx cm/s  
MDD = xxxx cm/s  
TAPV= xxxx cm/s  
ED = xxxx cm/s  
Meas. Label

Operation:

RIGHT  
OVAR.A.

1. Select wanted label of the vessel to be measured before starting the RI/PI AUTO measurement.  
It is also possible to enter a label once after the measurement is done.
  

RI , PI  
AUTO

2. Switch on RI/PI AUTO measurement  
(the autocalc-submenu appears on touch screen)
3. Position angle cursor (if necessary)
4. Select channel (upper, both, lower if necessary))
5. Select the periods to be evaluated with cursor 1 and 2
6. press ENTER to start RI/PI calculation.

Note:

If no measurement Label is selected, the RI measurement will not be stored in the OB Report.

## 10.7.4. GYN Patient Report

### 10.7.4.1 To display the Report



touch the REPORT key in measurement menu

The GYN exam has a three-page Patient Report.

First page: Gynecology report

Second/third page: Fertility Report

To move through the Report use the Page Select controls at the bottom of the Report pages:

1. Move the cursor to the Page Select control (< or >)
2. Press the SIMUL (Enter) key to select next or previous page



To exit the Report touch the key MAIN MENU on the touch screen.

### 10.7.4.2 Report layout

Gynecology Report:

Gynecology Report					Date: 10/14/1998
Hospital Name: KRETZTECHNIK C530 3D ULTRASOUND	Patient Name: Patient Name	ID: 1998-10-14-0002	Age:		
Sonographer:	Referring MD:				
LMP:	Gravida:	Para:	AB:		
Indication:					
B-Mode      L [mm]    H [mm]    W [mm]    VOL [cc]			D-Mode      PS    ED    RI    PI		
Uterus	Right Ovar A.				
Endomet. thickn.	Left Ovar A.				
Cervix length	User 1				
Right Ovarian	User 2				
Left Ovarian	User 3				
Right Renal					
Left Renal					
Early Gestation      1    2    3    4    5    Avg.    G.A.    Dev.    EDC					
Observations      Uterus: Cul de sac:			Comment		
Right Adnexa: Left Adnexa:					
Right Ovary: Left Ovary:					
<input type="button" value="Edit"/>		<input type="button" value="Print"/>	<input type="button" value="Backup"/>		
Page 1 of 3					

## Fertility Report (right ovary page 2, left ovary page 3):

Fertility Report				Date: 10/14/1998
Hospital Name: KRETZTECHNIK C530 3D ULTRASOUND		ID: 1998-10-14-0002	AGE:	
Patient Name:	Patient Name	Referring MD:		
Sonographer:				
LMP:	Gravida:	Para:	AB:	
Day of Cycle:	Expect. ovulation:			
Prev. Surgery:				
Medication:				
Follicles right ovary				
	L [mm]	H [mm]	W [mm]	VOL [cc]
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
Ovary				
Maximum				

Page 2 of 3

[Edit](#) [Print](#) [◀](#) [▶](#)

**10.7.4.3 To edit the Report**Operation:

1. Display the GYN Report (if not active)
2. Select wanted page to edit
3. Switch on EDIT (move the cursor to the EDIT key and press SIMUL) alphanumeric entry fields, which can be edited, light up measurements and entries (LMP, Gravida etc.) which can be edited are framed.
4. Move the cursor to the entry field, that you want to edit and press the SIMUL key to select the entry field (the edit window appears)
5. Clear or enter a new value or text

Observation field:

Move the cursor to ▼ symbol of wanted entry, press SIMUL (a pull down window with predefined observations appears), select wanted observation and press SIMUL to enter. For entering a not predefined observation, select entry field direct and enter observation with keyboard.

## 10.8. To print OB-, GYN Reports and Graphs

### 10.8.1. Echo Printer (Black/White)

Condition: The video printer is connected to the remote control socket at the rear panel and The key "PRINT A" is assigned to B/W-Printer.  
see Printer remote setup chapter 12 in main user manual

Operation:



#### PRINTER TRIGGER KEY A

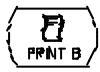
Select wanted report page or graph display

By pressing the PRINT A key the actual screen display will be printed.

### 10.8.2. Echo Printer (Color)

Condition: The video printer is connected to the remote control socket at the rear panel and the key "PRINT B" is assigned to the Printer.  
see Printer remote setup in main user manual chapter 12.

Operation:



#### PRINTER TRIGGER KEY B

Select wanted report page or graph display

By pressing the PRINT B key the actual screen display will be printed.

### 10.8.3. Line Printer

Condition: Line printer is connected to the Printer connector (LPT1) at the rear panel and type of Line Printer was selected once in setup (see next chapter "Line Printer setup").

Connecting a Line Printer (Auxiliary Equipment):

Note following cautions!

**CAUTION !** The leakage current of entire system including any / all auxiliary equipment must not exceed the limit values as per EN60 601-1-1:1990 (IEC 601-1-1) res. other valid national or international standards. All equipment's must comply with UL, CSA and IEC requirements.

**CAUTION !** Auxiliary equipment must only be connected to the main console with the special mains outlet provided for the electrical safety of the system.

**CAUTION !** Auxiliary equipment with direct mains connection requires galvanic separation of the signal and / or control leads.

**ATTENTION !** The load capacity of the main console with the special mains outlet provided for the electrical safety of the system for all auxiliary equipment's is max. 150 VA.

**Layout of the OB Report:**

Grafikname:  
Erstellt in:  
Erstellt am:

**Layout of OB Graph:**

Grafikname:  
Erstellt in:  
Erstellt am:

**Layout of the GYN Report:**

Grafikname:  
Erstellt in:  
Erstellt am:

**Layout of Fertility Report:**

Grafikname:  
Erstellt in:  
Erstellt am:

Operation:

• **OB Report:**

1. Display the OB Report (if not active)
2. Select the PRINT key (move the cursor to the PRINT key and press SIMUL)  
one common OB Report will be printed (all four Report pages on screen are summarized to one line printer page).

Note: For every measured fetus automatically a report page will be printed.

• **GYN Report (standard page):**

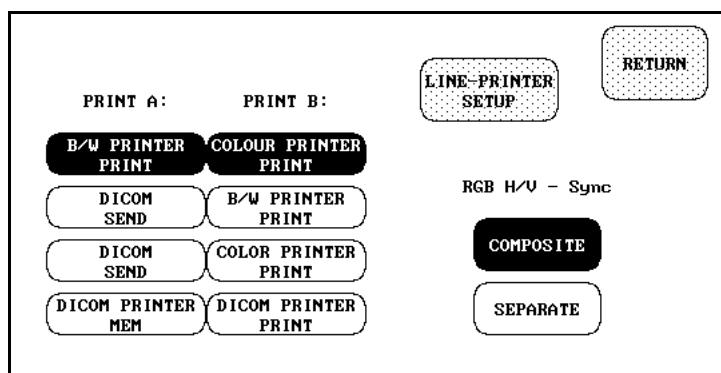
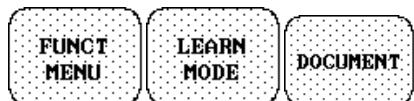
1. Display the GYN Report (if not active)
2. Select the PRINT key (move the cursor to the PRINT key and press SIMUL)  
Standard Gyn Report will be printed

• **GYN Report (FERT. page):**

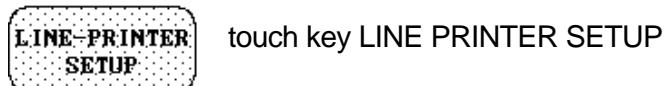
1. Display the GYN Report (if not active)
2. Select page two or three of the GYN Report (Fertility report pages)
3. Select the PRINT key (move the cursor to the PRINT key and press SIMUL)  
Fertility Report will be printed

### 10.8.3.1. Line Printer Setup

1. Call the document setup menu



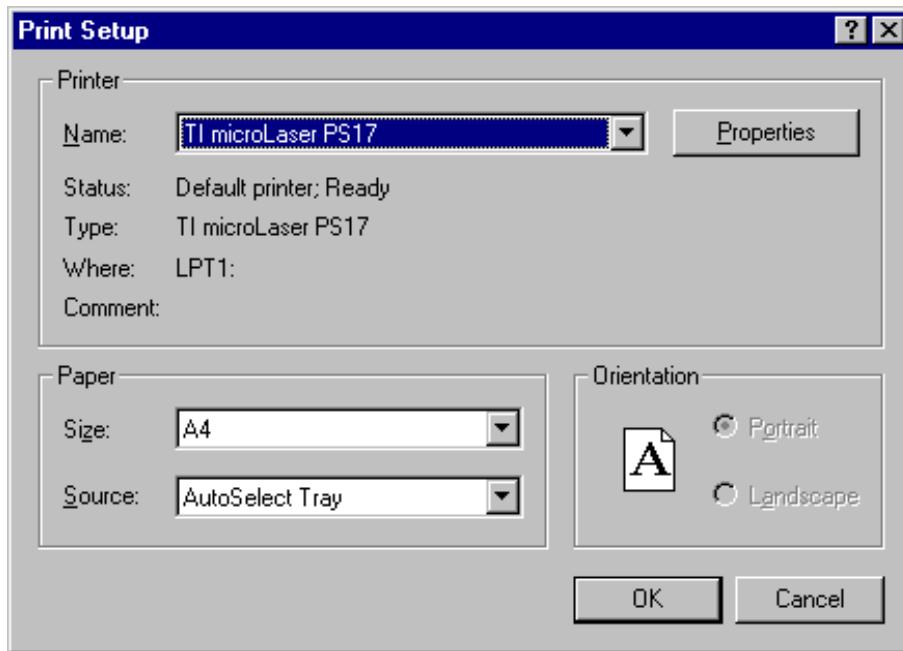
2. call the Line Printer Setup Menu



windows operating system: German language



windows operating system: English language



3. Move the cursor to ▼ symbol of printer name and press SIMUL  
Survey of the installed Printers are listed in the appearing pull down window
4. Select wanted Printer  
Move cursor to wanted Printer and press SIMUL
5. Quit the selection with OK  
Move cursor to OK and press SIMUL

Note:

If a Line Printer is connected the first time, the set up procedure has to be done once.

The Report pages are designed for the paper format A4 or Letter. Therefor don't select different paper formats than A4 or Letter, otherwise the print result may be not satisfying.

#### 10.8.3.2. Line Printer Installation

The following two Line Printers are already installed:

TI microLaser PS17 (post script)  
HP LaserJet Series II

To install a different type please call your local dealer!

## 10.9. Internal data base

All PID entries and measurement results for the Reports are stored in the internal data base (internal Hard disk). The optional image management system "SonoView" and the data base share the free space on hard disk. The remaining space is displayed in the exam list of SonoView and also in the patient list (PID entry). To obtain free space (if no space is left) delete old data's. If you don't want to loose these data's perform a backup.

### 10.9.1. Backup of internal data base

With the Backup function the data base can be saved to a changeable cartridge of the inbuilt MOD or MCD-drive.

It is recommended to do a backup every day, if the data's should be not lost in case of a breakdown of the harddisk!

#### Operation:

1. Display the Report (if not active)
2. Switch on BACKUP (move the cursor to the BACKUP key and press SIMUL)
3. Follow the instruction on screen

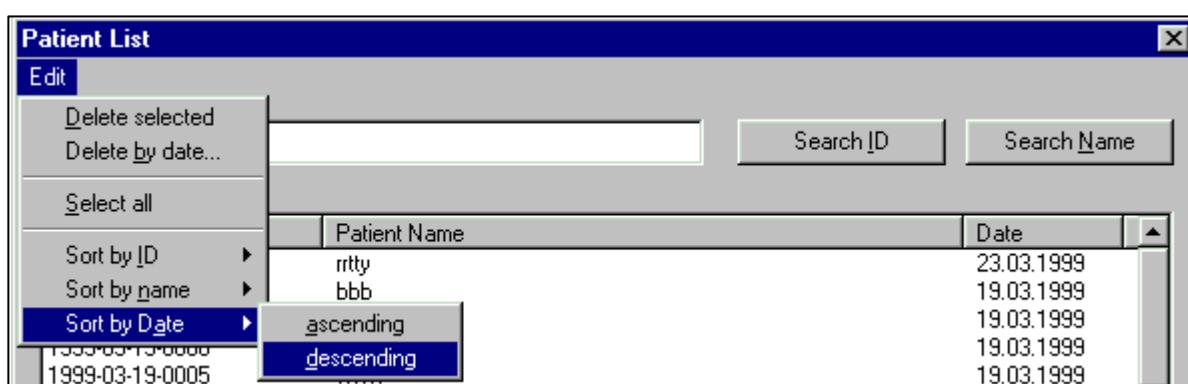
#### Note:

An old backup on inserted cartridge will be overwritten!

### 10.9.2. Deleting Patient data

All PID entries and measurement results for the reports are stored into the internal database (internal harddisk). To obtain free disk space old patient data can be deleted in different ways.

Call up the patient list and open the pull down menu. So you can perform the following operations. The following window appears:



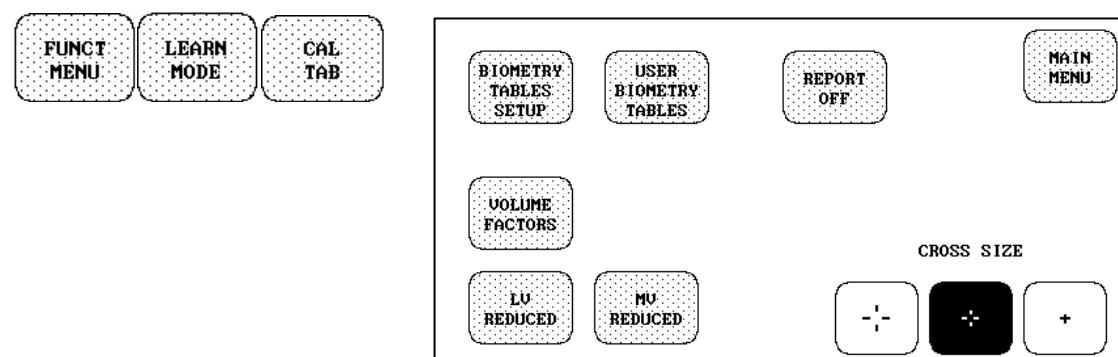
- Click on the icon [Edit] to open the „pull down“-menu and select the respective function by using the trackball and the „SIMUL“-key.

**a) Delete selected patient names /-data:**Procedure:

1. Call up the patient list and sort it if necessary.
2. Select the patient names to be deleted:  
click on the patient names by using the trackball and the 'SIMUL'-key or  
select the complete patient list using the pull down menu (line 'select all')  
The selected patient names are indicated with a blue bar.  
To cancel a selection click on a selected patient name once more.
3. Delete selected patient names:  
Click on the line 'Delete selected' of the pull down menu using the trackball and the 'SIMUL'-key.  
Annotation: all exams stored under the patient name resp. Patient ID are deleted.

**b) Delete all patient names /-data till a selected date:**Procedure:

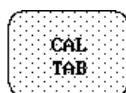
1. Call up the patient list.
2. Open the pull down menu using the trackbal and the ,SIMUL‘-key and  
click on the line ,Delete by date’.  
A sub-window with the list of all dates sorted ascending appears.
3. Search for the desired date using the buttons ,▲ ‘ and ,▼ ‘ and  
click on this date to select it. A blue bar appears.
4. Delete all old patient names / -data till this selected date:  
click on the button [ ok ] by using the trackball and the 'SIMUL'-key.

**10.9.3. To disable the data base**

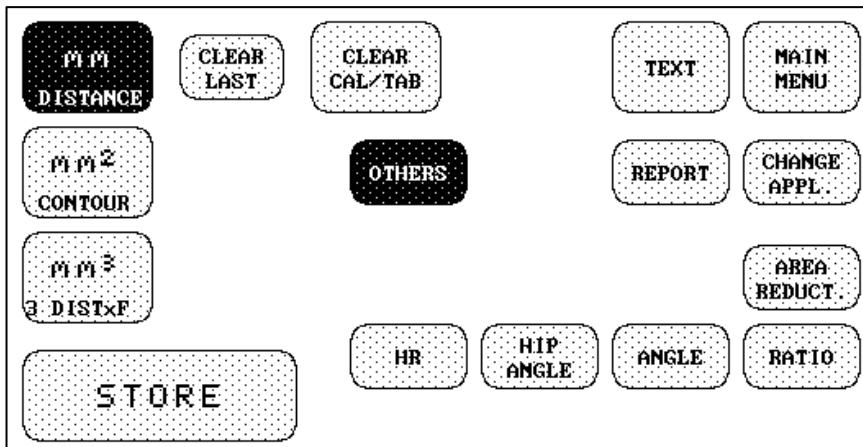
Touch the REPORT OFF key in the setup menu CAL/TAB

**Note: No PID entries and measurements are stored in the data base and therefore no OB graphs can be plotted!**

## 10.10. Other Measurements



Select the CAL/TAB window (if not active) and the measure window OTHERS.



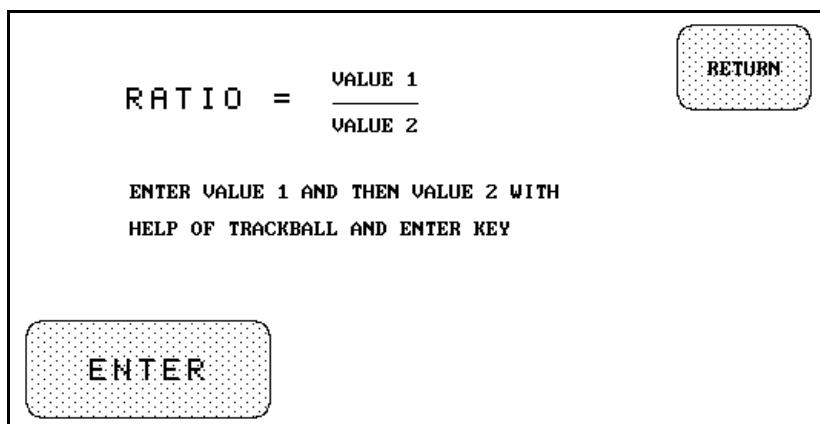
### 10.10.1. Ratio

Condition: At least 2 measurements displayed on the monitor.

Operation:



Switch on Ratio measurement  
sub-menu "RATIO" is displayed.



1. Declare result no. 1 by using the trackball for marking.
2. Touch key "ENTER".
3. Declare result no. 2 by using the trackball for marking.
4. Touch key "ENTER".

The ratio will be calculated and displayed.

Result display: R 1:2 = .....

R ..... Ratio

### 10.10.2. Hip joint measurement

Necessary measurements: Entering of the lines 1 to 3 acc. to sketch. The direction of the arrows must be followed.

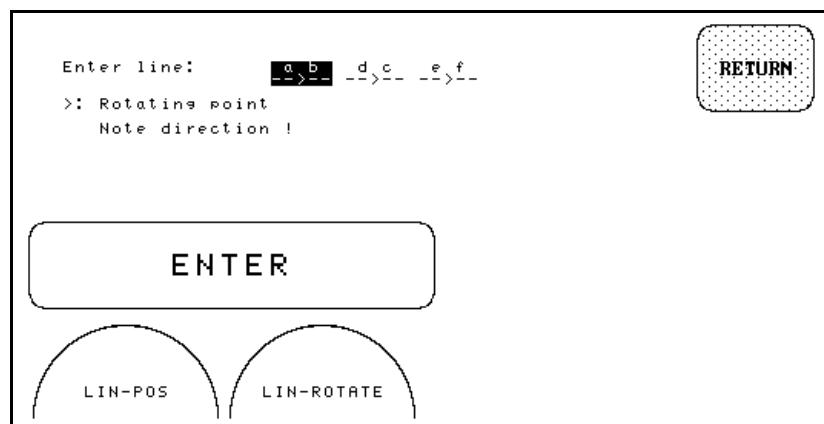
Sketch: a-b (line 1) c-d (line 2) e-f (line 3)

Grafikname:
Erstellt in:
Erstellt am:

Operation:



1. Switch on hip joint measurement.  
Sub-menu: HIP JOINT ANGLE



2. Enter line 1 (a-b), 2 (c-d), 3 (e-f) consecutively.  
Trackball: Position of the lines (arrow tips)  
Digipot: Rotation of the lines around the arrow tips  
Key "ENTER": Storing of lines
3. After storing the 3rd line the evaluation appears on the screen.

$\alpha = ..^\circ$   
 $\beta = ..^\circ$   
TYPE: ..

The Type of the hip joint is evaluated according to the following table:

TYPE	$\alpha$	$\beta$
Ia	$\geq 60^\circ$	$< 55^\circ$
Ib	$\geq 60^\circ$	$\geq 55^\circ$
IIa/b	$50^\circ - 59^\circ$	—
IIc	$43^\circ - 49^\circ$	$\leq 77^\circ$
D	$43^\circ - 49^\circ$	$> 77^\circ$
III/IV	$< 43^\circ$	--

### 10.10.3. Heart rate

Measurement required::

T (time)

Input required:

P (heart periods)

Formula used:

$$HR = P/T \times 60 \text{ (1/min)}$$

#### Operation:



Switch on HR-measurement.  
the following Submenu appears

SELECT NUMBER OF PERIODS  
THEN MOVE CROSS BY TRACKBALL

1	2	3	4	5
6	7	8	9	10

1. Select the number of periods (if necessary)
2. Perform time measurement  
When the trackball is moved the "CALC/TAB" menu appears.  
Position the first measuring dot with the trackball and touch "STORE", repeat for the second dot.

Upon completion of the time measurement the heart rate is displayed.

Result display:

HR (2P): 60

HR .... Heart rate

T1 = 2.0 s

P ..... Periods

T..... Time measurement

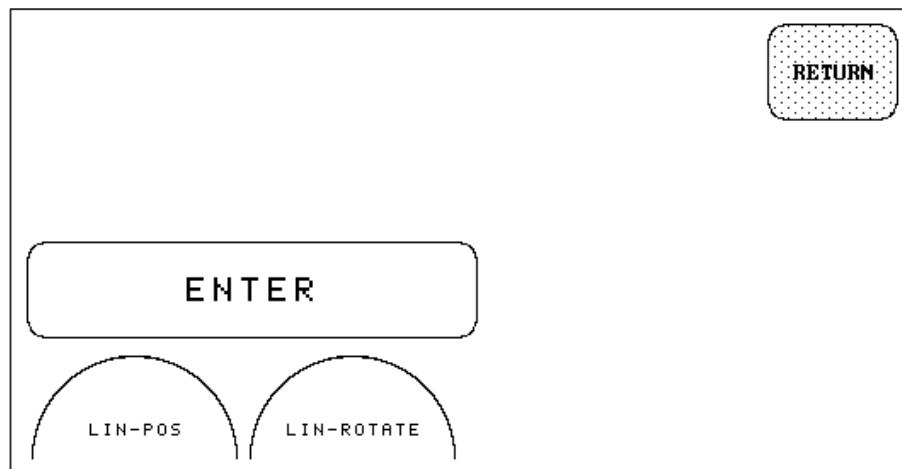
#### 10.10.4. Angle Measurement

Necessary measurements: Entering of 2 lines

Operation:



Switch on angle measurement.  
Sub-menu: ANGLE



1. Enter line 1 and 2 by using the trackball and the digipot.  
Trackball: Position of the lines (arrow tips)  
Digipot: Rotation of the lines around the arrow tips  
Key "ENTER": For storing the lines
2. After moving line 2 the angle is displayed on the screen.

$$\alpha = \dots^\circ$$

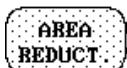
### 10.10.5. Area Reduction

The area reduction of a vessel (stenoses) can be calculated.

The system calculates the percent of area reduction and displays the maximum area, the minimum area, and the percent of area reduction in the results.

Necessary measurements: Obtain the cross-sectional plane of the vessel and measure the original and reduced area.

Operation:

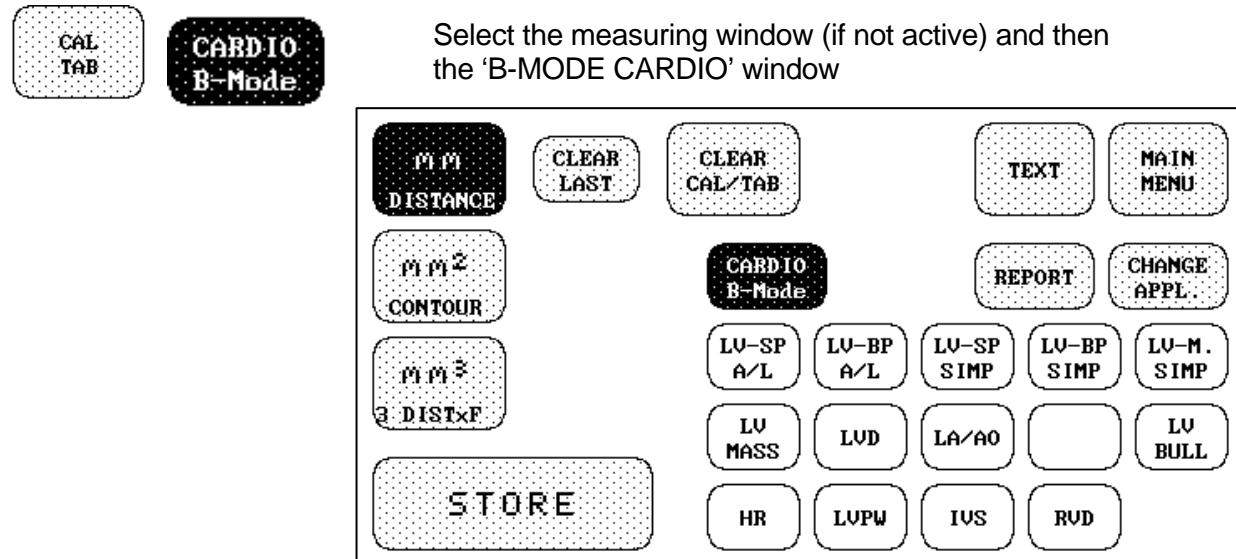
1. Measure the first area. (unreduced)
2. Measure the second area. (reduced)
3. Press key  to start calculation.

Note: Only the last two measured areas are used for calculation.

Monitor display: AR = xx.x %  
A2 = xx.x cm<sup>2</sup>  
C2 = xx.x mm  
A1 = xx.x cm<sup>2</sup>  
C1 = xx.x mm

## 10.11. Cardiology - B-Mode

The following measuring programs are available in B-Mode. Calculations from these B-Mode measurements are automatically performed and included into the report.



### 10.11.1. LV-Single Plane (Area/Length)

#### Required Measurements:

LVLD	left ventricle long-axis diastole	[cm]
LVALD	left ventricle area long-axis diastole	[cm <sup>2</sup> ]
LVLS	left ventricle long-axis systole	[cm]
LVALS	left ventricle area long-axis systole	[cm <sup>2</sup> ]
HR	heart rate	[bpm]
BSA	body surface area	[m <sup>2</sup> ]

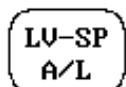
#### Results:

EDV	enddiastolic volume	[ml]
ESV	endsystolic volume	[ml]
SV	stroke volume	[ml]
EF	ejection fraction	[%]
CO	cardiac output	[l/min]
SI	stroke volume index	[--]
CI	cardiac output index	[--]

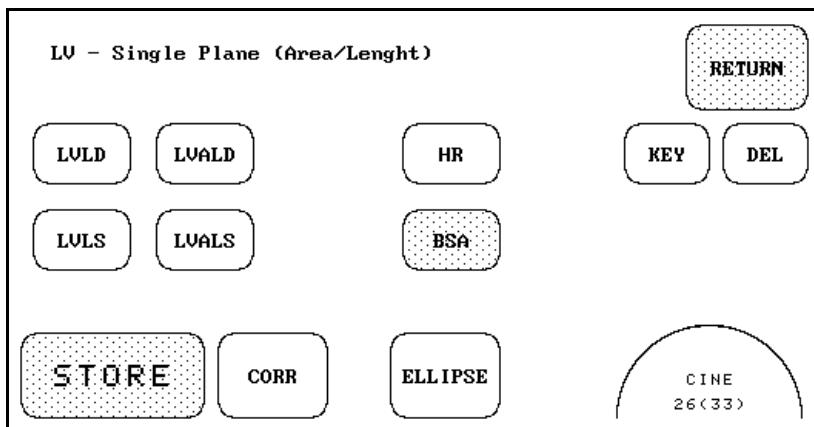
#### Equations:

$$\text{EDV} = \frac{8}{3\pi} \times \frac{\text{LVALD}^2}{\text{LVLD}} \quad \text{ESV} = \frac{8}{3\pi} \times \frac{\text{LVALS}^2}{\text{LVLS}} \quad \text{SV} = \text{EDV} - \text{ESV} \quad \text{CO} = \frac{\text{SV} \times \text{HR}}{1000}$$

$$\text{EF} = \frac{\text{EDV} - \text{ESV}}{\text{EDV}} \cdot 100 \quad \text{HR}(n) = \frac{n_{\text{beats}}}{\text{time}} \times 60 \quad \text{SI} = \frac{\text{SV}}{\text{BSA}} \quad \text{CI} = \frac{\text{CO}}{\text{BSA}}$$

Menu of this Measuring program:

Select the measuring program by touching this key,  
the following window appears on the touchscreen.

Operation:

1. Obtain an apical 4-chamber or 2-chamber view of the left ventricle  
Only one plane is necessary (Single plane).
2. Call up the measuring program by touching the key 'LV-SP A/L'
3. Perform the required measurements at systole and diastole:  
Touch the corresponding key to select the measurement (key bright lit),  
use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

Monitor display:

LVALID	=	xxx.xcm <sup>2</sup>
LVLD	=	xxx.xmm
LVALS	=	xxx.xcm <sup>2</sup>
LVLS	=	xxx.xmm
EDV	=	xxx.xml
ESV	=	xxx.xml
SV	=	xxx.xml
EF	=	xxx.x%
HR	=	xxx bpm
CO	=	x.xxl/min
SI	=	xxx.x
CI	=	xxx.x

Additional Functions:

Select the type of area measurements by touching this key once more for switching to 'ellipse' (e.g.), 'trace continuous' or 'trace points'

-  CORR The last dot entered is cleared
-  DEL All values of the selected measurement are cleared in the report.
-  KEY A keyboard appears on the touch screen:  
additional values can be entered for the selected measurement by using  
the keyboard. These values are also stored into the report (maximal 5  
values per measurement).
-  RETURN Return to the previous touchscreen window

### 10.11.2. LV-Biplane (Area/Length)

#### Required Measurements:

LVALD	left ventricle area long-axis diastole	[cm <sup>2</sup> ]
LVAMD	left ventricle area at the level of the mitral valve diastole (short axis)	[cm <sup>2</sup> ]
LVIDD	left ventricle internal diameter diastole (short axis)	[cm]
LVALS	left ventricle area long-axis systole	[cm <sup>2</sup> ]
LVAMS	left ventricle area at the level of the mitral valve systole (short axis)	[cm <sup>2</sup> ]
LVIDS	left ventricle internal diameter systole (short axis)	[cm]

#### Results:

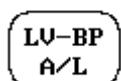
EDV	enddiastolic volume	[ml]
ESV	endsystolic volume	[ml]
SV	stroke volume	[ml]
EF	ejection fraction	[%]
CO	cardiac output	[l/min]
SI	stroke volume index	[--]
CI	cardiac output index	[--]

#### Equations:

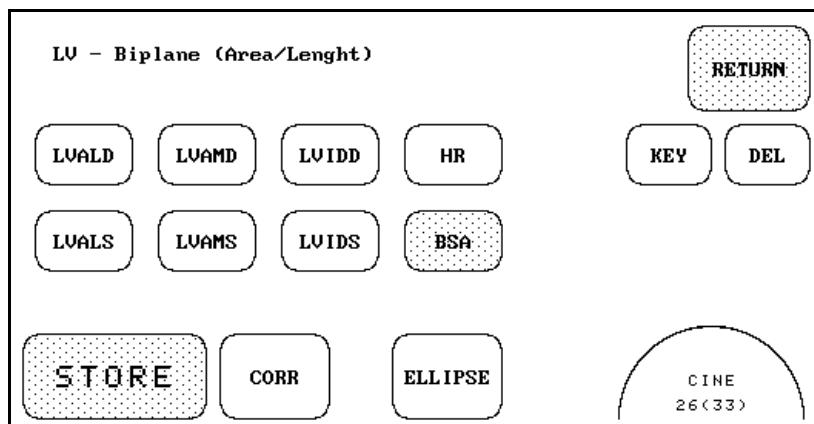
$$\text{EDV} = \frac{8}{3\pi} \times \frac{\text{LVALD} \times \text{LVAMD}}{\text{LVIDD}}$$

$$\text{ESV} = \frac{8}{3\pi} \times \frac{\text{LVALS} \times \text{LVAMS}}{\text{LVIDS}}$$

For the remaining equations see chapter 10.11.1, page 61.

Menu of this Measuring program:

Select the measuring program by touching this key,  
the following window appears on the touchscreen:

Operation:

1. Obtain the long axis view of the left ventricle
2. Call up the measuring program by touching the key 'LV-BP A/L'
3. Perform the required measurements at systole and diastole :  
Touch the corresponding key to select the measurement (key bright lit), use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

4. Obtain a short axis view of the left ventricle at the level of the mitral valve.
5. Perform the required measurements at systole and diastole :  
Touch the corresponding key to select the measurement (key bright lit), use the trackball and the 'STORE'-key to perform the measurement

Monitor display:

LVIDD =	xxx.xmm
LVAMD =	xxx.xcm <sup>2</sup>
LVALID =	xxx.xcm <sup>2</sup>
LVIDS =	xxx.xmm
LVAMS =	xxx.xcm <sup>2</sup>
LVALS =	xxx.xcm <sup>2</sup>

EDV =	xxx.xml
ESV =	xxx.xml

SV =	xxx.xml
EF =	xxx.x%
HR =	xxx bpm
CO =	x.xxl/min

SI =	xxx.x
CI =	xxx.x

Additional Functions: See page 63

### 10.11.3. LV-Single Plane (Simpson)

#### Required Measurements:

LVLD	left ventricle long-axis diastole	[cm]
LVLS	left ventricle long-axis systole	[cm]

#### Results:

EDV	enddiastolic volume	[ml]
ESV	endsystolic volume	[ml]
SV	stroke volume	[ml]
EF	ejection fraction	[%]
CO	cardiac output	[l/min]
SI	stroke volume index	[--]
CI	cardiac output index	[--]

#### Equations:

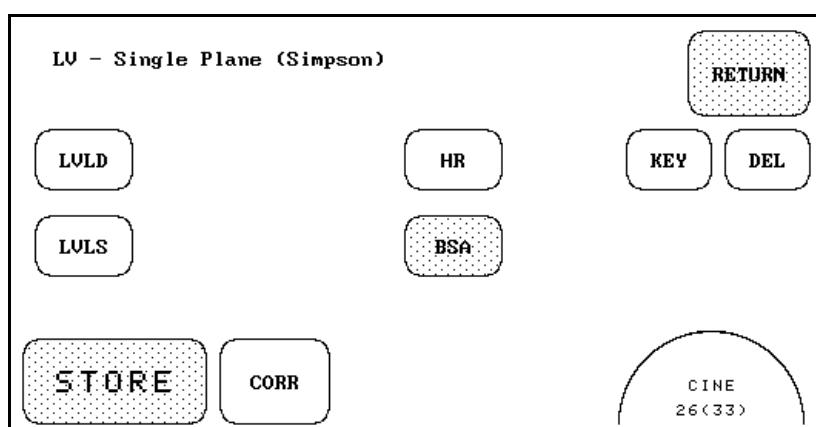
$$\text{EDV} = \pi \times \frac{\text{LVLD}}{20} \times \sum_{i=1}^{20} r_i^2 \quad \text{ESV} = \pi \times \frac{\text{LVLS}}{20} \times \sum_{i=1}^{20} r_i^2$$

For the remaining equations see chapter 10.11.1, page 61.

#### Menu of this Measuring program:

**LV-SP  
SIMP**

Select the measuring program by touching this key,  
the following window appears on the touchscreen:



Operation:

1. Obtain an apical 4-chamber or 2-chamber view of the left ventricle.  
Only one plane is necessary (Single plane).
2. Call up the measuring program by touching the key 'LV-SP SIMP'
3. Perform the required measurements at systole and diastole:  
Touch the corresponding key to select the measurement (key bright lit),  
use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

Monitor display:

LVLD =	xxx.xmm
LVLS =	xxx.xmm
EDV =	xxx.xml
ESV =	xxx.xml
SV =	xxx.xml
EF =	xxx.x%
HR =	xxx bpm
CO =	x.xx l/min
SI =	xxx.x
CI =	xxx.x

Additional Functions: See page 63

#### 10.11.4. LV-Biplane (Simpson)

##### Required Measurements:

LVLD4	left ventricle long-axis diastole (4 chamber view)	[cm]
LVLS4	left ventricle long-axis systole (4 chamber view)	[cm]
LVLD2	left ventricle long-axis diastole (2 chamber view)	[cm]
LVLS2	left ventricle long-axis systole (2 chamber view)	[cm]

##### Results:

EDV	enddiastolic volume	[ml]
ESV	endsystolic volume	[ml]
SV	stroke volume	[ml]
EF	ejection fraction	[%]
CO	cardiac output	[l/min]
SI	stroke volume index	[--]
CI	cardiac output index	[--]

##### Equations:

$$EDV = \pi \times \frac{LVLD}{20} \times \sum_{i=1}^{20} r_{2i_b} \times r_{4i_b} \quad LVLD \text{ longer axis}$$

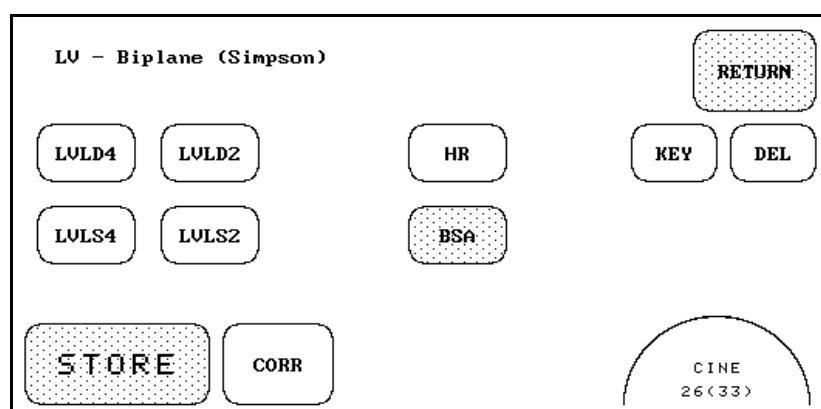
$$ESV = \pi \times \frac{LVLS}{20} \times \sum_{i=1}^{20} r_{2i_s} \times r_{4i_s} \quad LVLS \text{ longer axis}$$

For the remaining equations see chapter 10.11.1, page 61.

##### Menu of this Measuring program:

**LV-BP  
SIMP**

Select the measuring program by touching this key,  
the following window appears on the touchscreen:



Operation:

1. Obtain a 4-chamber view of the left ventricle
2. Call up the measuring program by touching the key 'LV-BP SIMP'
3. Perform the required measurements at systole and diastole :  
Touch the corresponding key to select the measurement (key bright lit),  
use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

4. Obtain a 2-chamber view of the left ventricle.
5. Perform the required measurements at systole and diastole :  
Touch the corresponding key to select the measurement (key bright lit),  
use the trackball and the 'STORE'-key to perform the measurement

Monitor display:

LVLD4 = xxx.xmm
LVLS4 = xxx.xmm
LVLD2 = xxx.xmm
LVLS2 = xxx.xmm
EDV = xxx.xml
ESV = xxx.xml
SV = xxx.xml
EF = xxx.x%
HR = xxx bpm
CO = x.xx l/min
SI = xxx.x
CI = xxx.x

Additional Functions: See page 63

### 10.11.5. LV-modified Simpson

#### Required Measurements:

LVLD	left ventricle long-axis diastole	[cm]
LVAMD	left ventricle area at the level of the mitral valve diastole (short axis)	[cm <sup>2</sup> ]
LVAPD	left ventricle area at the level of the papillary muscles diastole (short axis)	[cm <sup>2</sup> ]
LVLS	left ventricle long-axis systole	[cm]
LVAMS	left ventricle area at the level of the mitral valve systole (short axis)	[cm <sup>2</sup> ]
LVAPS	left ventricle area at the level of the papillary muscles systole (short axis)	[cm <sup>2</sup> ]

#### Results:

EDV	enddiastolic volume	[ml]
ESV	endsystolic volume	[ml]
SV	stroke volume	[ml]
EF	ejection fraction	[%]
CO	cardiac output	[l/min]
SI	stroke volume index	[--]
CI	cardiac output index	[--]

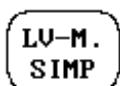
#### Equations:

$$\text{EDV} = \frac{\text{LVLD}}{9} \times (4 \times \text{LVAMD} + 2 \times \text{LVAPD} + \sqrt{\text{LVAMD} \times \text{LVAPD}})$$

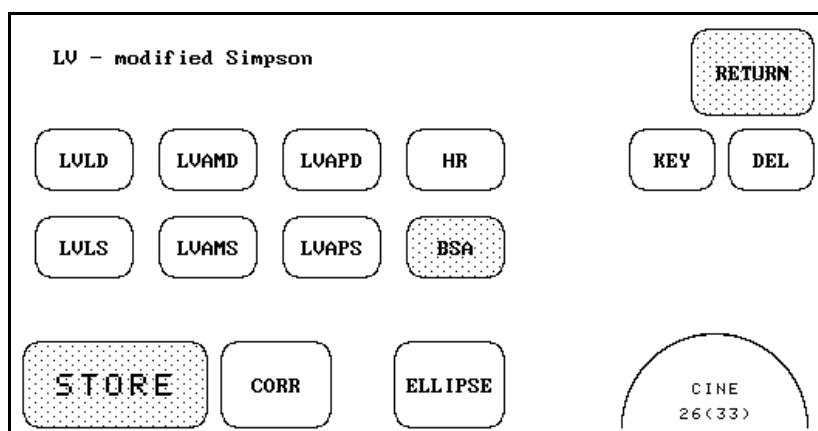
$$\text{ESV} = \frac{\text{LVLS}}{9} \times (4 \times \text{LVAMS} + 2 \times \text{LVAPS} + \sqrt{\text{LVAMS} \times \text{LVAPS}})$$

For the remaining equations see chapter 10.11.1, page 61.

#### Menu of this Measuring program:



Select the measuring program by touching this key,  
the following window appears on the touchscreen:



Operation:

1. Obtain the long axis view of the left ventricle
2. Call up the measuring program by touching the key 'LV-M SIMP'
3. Perform the required measurements at systole and diastole :  
Touch the corresponding key to select the measurement (key bright lit), use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

4. Obtain the short axis view of the left ventricle at the level of the mitral valve.
5. Perform the required measurements at systole and diastole :  
Touch the corresponding key to select the measurement (key bright lit), use the trackball and the 'STORE'-key to perform the measurement
6. Obtain the short axis view of the left ventricle at the level of the papillary muscles.
7. Perform the required measurements at systole and diastole :  
Touch the corresponding key to select the measurement (key bright lit), use the trackball and the 'STORE'-key to perform the measurement

Monitor display:

LVAPD =	xx.xcm <sup>2</sup>
LVAMD =	xx.xcm <sup>2</sup>
LVLD =	xxx.xmm
LVAPS =	xx.xcm <sup>2</sup>
LVAMS =	xx.xcm <sup>2</sup>
LVLS =	xxx.xmm
EDV =	xxx.xml
ESV =	xxx.xml
SV =	xxx.xml
EF =	xxx.x%
HR =	xxx bpm
CO =	x.xxl/min
SI =	xxx.x
CI =	xxx.x

Additional Functions: See page 63

### 10.11.6. LV-Bullet

#### Required Measurements:

LVLD	left ventricle long-axis diastole	[cm]
LVAMD	left ventricle area at the level of the mitral valve diastole (short axis)	[cm <sup>2</sup> ]
LVLS	left ventricle long-axis systole	[cm]
LVAMS	left ventricle area at the level of the mitral valve systole (short axis)	[cm <sup>2</sup> ]

#### Results:

EDV	enddiastolic volume	[ml]
ESV	endsystolic volume	[ml]
SV	stroke volume	[ml]
EF	ejection fraction	[%]
CO	cardiac output	[l/min]
SI	stroke volume index	[--]
CI	cardiac output index	[--]

#### Equations:

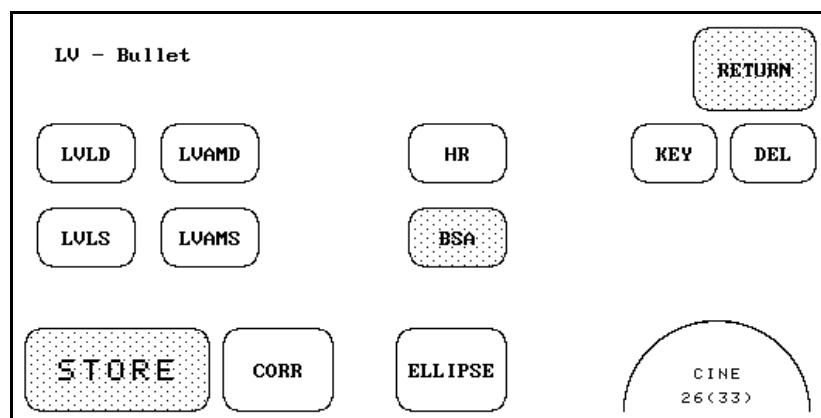
$$\text{EDV} = \frac{5}{6} \times \text{LVLD} \times \text{LVAMD} \quad \text{EDS} = \frac{5}{6} \times \text{LVLS} \times \text{LVAMS}$$

For the remaining equations see chapter 10.11.1, page 61.

#### Menu of this Measuring program:



Select the measuring program by touching this key,  
the following window appears on the touchscreen:



Operation:

1. Obtain the long axis view of the left ventricle
2. Call up the measuring program by touching the key 'LV-BULL'
3. Perform the required measurements at systole and diastole :  
Touch the corresponding key to select the measurement (key bright lit),  
use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

4. Obtain the short axis view of the left ventricle at the level of the mitral valve.
5. Perform the required measurements at systole and diastole :  
Touch the corresponding key to select the measurement (key bright lit),  
use the trackball and the 'STORE'-key to perform the measurement

Monitor display:

LVAMD = xx.xcm <sup>2</sup>
LVLD = xxx.xmm
LVAMS = xx.xcm <sup>2</sup>
LVLS = xxx.xmm
EDV = xxx.xml
ESV = xxx.xml
SV = xxx.xml
EF = xxx.x%
HR = xxx bpm
CO = x.xxl/min
SI = xxx.x
CI = xxx.x

Additional Functions: See page 63

### 10.11.7. Left Ventricular Mass

#### Required Measurements:

LVLD	left ventricle long-axis diastole, endocardium	[cm]
LVAPD-epi	left ventricle area at the papillary muscles diastole, epicardium (short axis)	[cm <sup>2</sup> ]
LVAPD-endo	left ventricle area at the papillary muscles diastole, endocardium ( - " - )	[cm <sup>2</sup> ]

#### Results:

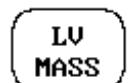
MWT	mean wall thickness	[cm]
LVmass	left ventricle mass	[g]

#### Equations:

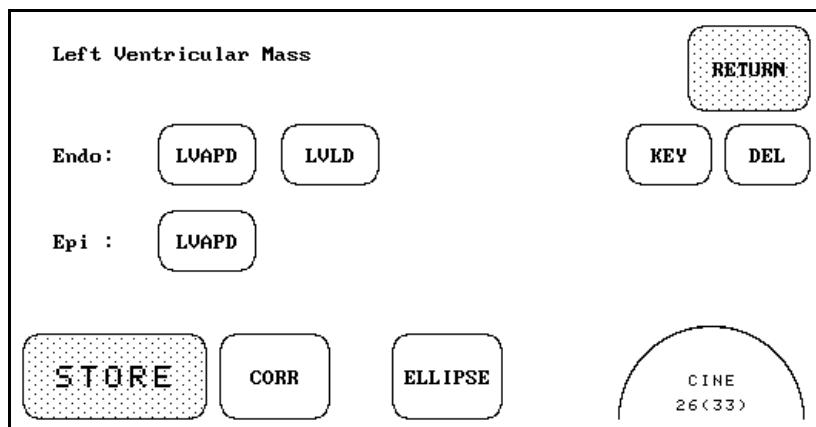
$$MWT = \sqrt{\frac{LVAPDepi}{\pi}} - \sqrt{\frac{LVAPDendo}{\pi}}$$

$$LVmass = 1.05 \times \left[ \frac{5}{6} \times LVAPDepi \times (LVLD + MWT) \right] - \left[ \frac{5}{6} \times LVAPDendo \times LVLD \right]$$

#### Menu of this Measuring program:



Select the measuring program by touching this key,  
the following window appears on the touchscreen.



Operation:

1. Obtain the short axis view of the left ventricle at the level of the papillary muscles showing the epicardial and endocardial perimeters of the heart.
2. Call up the measuring program by touching the key 'LV-MASS'
3. Perform the required measurements:  
Touch the corresponding key to select the measurement (key bright lit), use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

4. Obtain the short axis view of the left ventricle
5. Perform the required measurement:  
Touch the corresponding key to select the measurement (key bright lit), use the trackball and the 'STORE'-key to perform the measurement.

Monitor display:      LVLD     = xxx.xmm  
                          APDepi = xx.xcm<sup>2</sup>  
                          APDend = xx.xcm<sup>2</sup>

                          MWT = xxx.xmm  
                          LVmass= xxxxg

Additional Functions:      See page 63

### 10.11.8. LV-Diameter

Required Measurements:

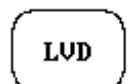
LVDD left ventricle diameter diastole (left side of septum to posterior endocardium) [mm]  
 LVDS left ventricle diameter systole (left side of septum to posterior endocardium) [mm]

Result:

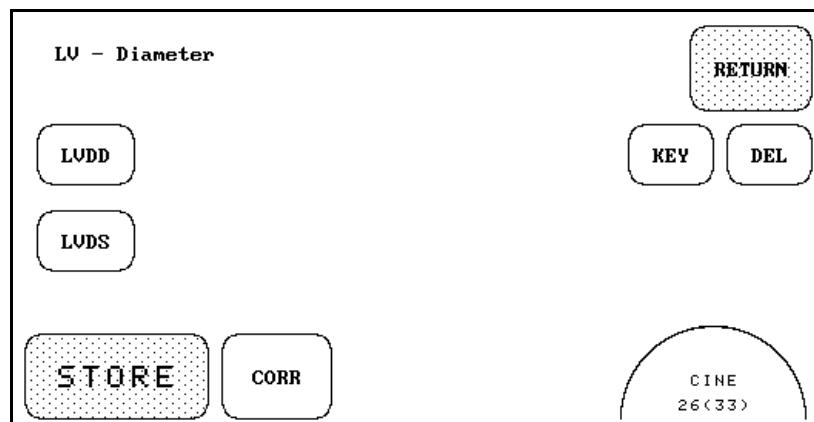
LVFS left ventricular fractional shortening [%]

Equation: 
$$\text{LVFS} = \frac{\text{LVDD} - \text{LVDS}}{\text{LVDD}} \times 100$$

Menu of this Measuring program:



Select the measuring program by touching this key,  
 the following window appears on the touchscreen.



Operation:

- 1 Obtain an apical 4-chamber or 2-chamber view of the left ventricle
- 2 Call up the measuring program by touching the key 'LVD'
3. Perform the required measurements at systole and diastole:  
 Touch the corresponding key to select the measurement (key bright lit),  
 use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

Monitor display:      LVDD = xxx.xmm  
 LVDS = xxx.xmm

                        LVFS = xxx.x%

Additional Functions:      See page 63

### 10.11.9. LA/AO-Ratio

#### Required Measurements:

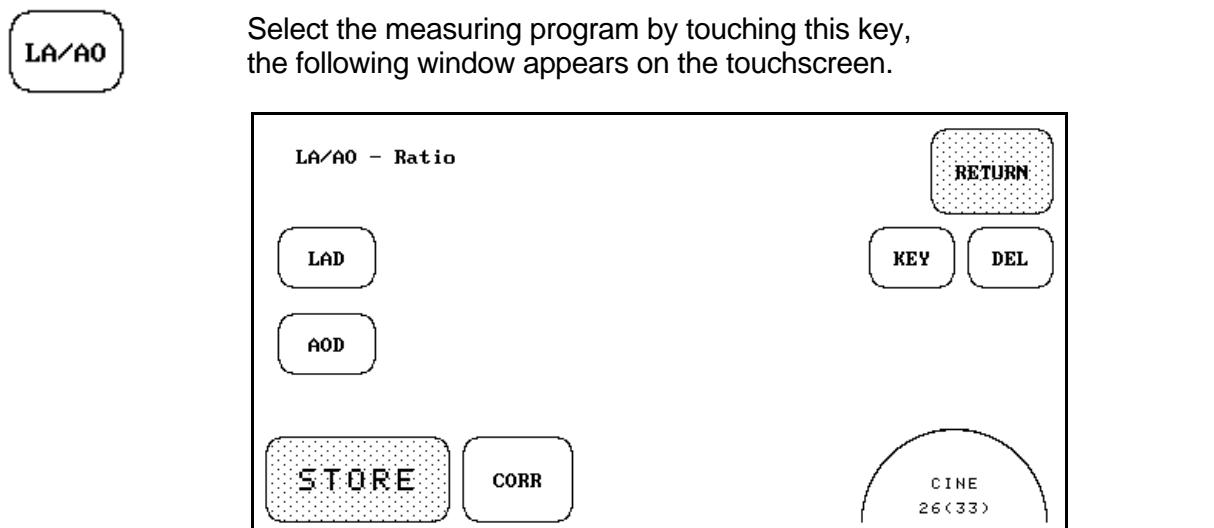
LAD	left atrial diameter	[mm]
AOD	aortic diameter (root)	[mm]

#### Result:

LA/AO	LA/AO-Ratio	[--]
-------	-------------	------

Equation: 
$$\text{LA / AO} = \frac{\text{LAD}}{\text{AOD}}$$

#### Menu of this Measuring program:



#### Operation:

- 1 Obtain a scan from the left atrium and the aorta.
- 2 Call up the measuring program by touching the key 'LA/AO'
3. Perform the required measurements:  
Touch the corresponding key to select the measurement (key bright lit), use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

Monitor display:      LAD = xxx.xmm  
                          AOD = xxx.xmm

LA/AO = x.xxx

Additional Functions:      See page 63

### 10.11.10.LV-Posterior Wall Thickening Fraction

#### Required Measurements:

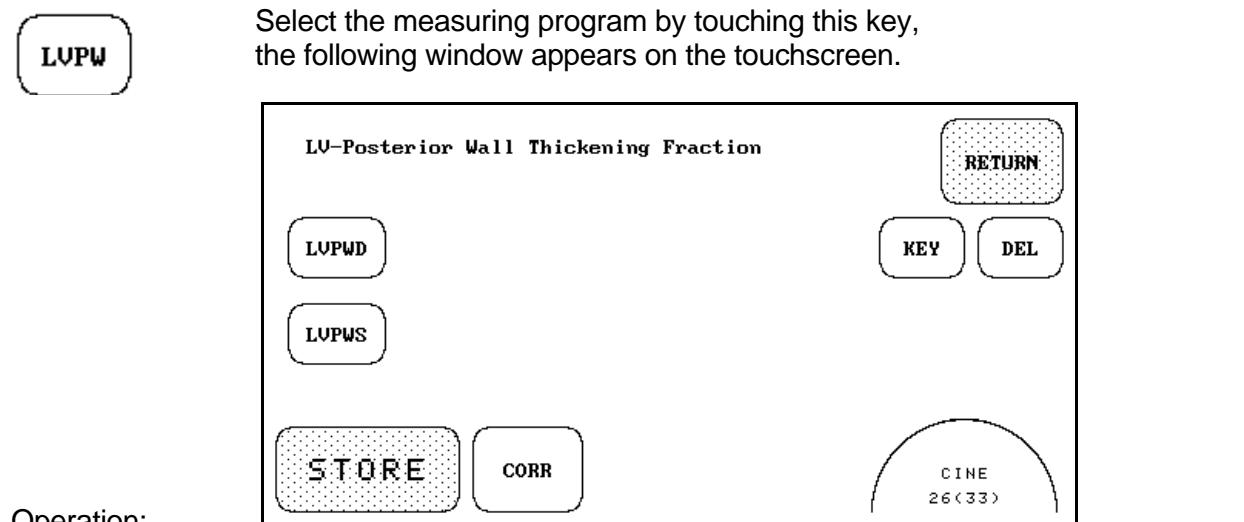
LVPWD      left ventricular posterior wall thickness diastole      [mm]  
 LVPWS      left ventricular posterior wall thickness systole      [mm]

#### Results:

LVPWTF      left ventricular posterior wall thickening fraction      [%]

Equation:      
$$\text{LVPWTF} = \frac{\text{LVPWS} - \text{LVPWD}}{\text{LVPWD}} \times 100$$

#### Menu of this Measuring program:



#### Operation:

1. Obtain a scan of the left ventricle showing the left ventricular endocardium and epicardium of the posterior wall.
2. Call up the measuring program by touching the key 'LVPW'.
3. Perform the required measurements at systole and diastole:  
Touch the corresponding key to select the measurement (key bright lit), use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

Monitor display:      LVPWD = xxx.xmm  
                           LVPWS = xxx.xmm

                          LVPWTF = xxx.x%

Additional Functions:      See page 63

### 10.11.11.IVS-Thickening Fraction

#### Required Measurements:

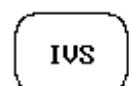
IVSD	interventricular septum thickness diastole	[mm]
IVSS	interventricular septum thickness systole	[mm]

#### Results:

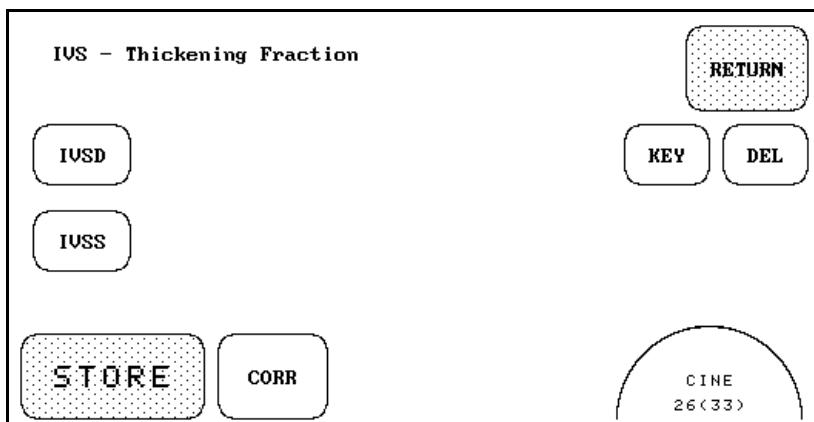
IVSTF	interventricular septum thickening fraction	[%]
-------	---	-----

Equation: 
$$\text{IVSTF} = \frac{\text{IVSS} - \text{IVSD}}{\text{IVSD}} \times 100$$

#### Menu of this Measuring program:



Select the measuring program by touching this key,  
the following window appears on the touchscreen.



#### Operation:

- 1 Obtain a scan of the interventricular septum wall.
- 2 Call up the measuring program by touching the key 'IVS'.
3. Perform the required measurements at systole and diastole:  
Touch the corresponding key to select the measurement (key bright lit),  
use the trackball and the 'STORE'-key to perform the measurement.

The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

Monitor display:      IVSD = xxx.xmm  
                          IVSS = xxx.xmm

                          IVSTF = xxx.x%

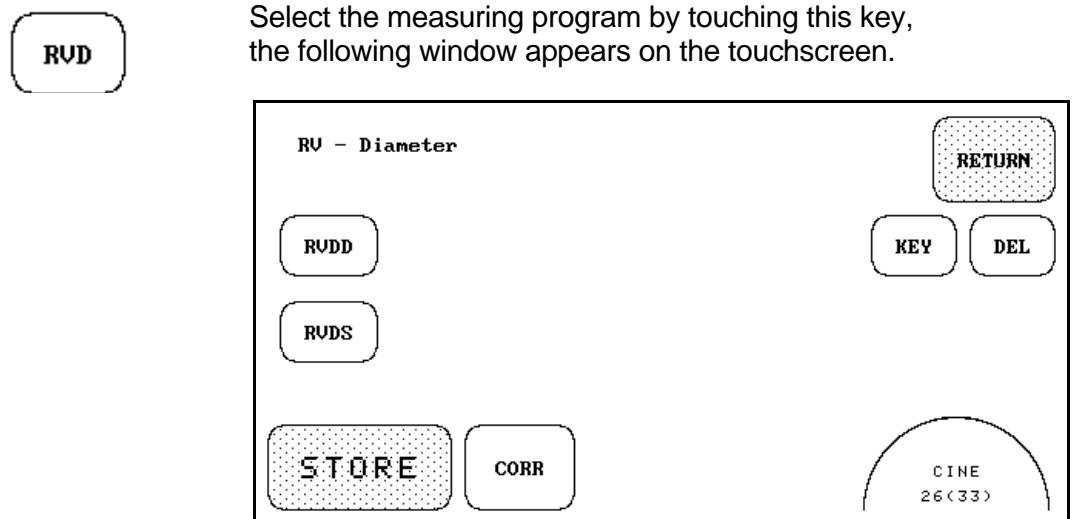
Additional Functions:      See page 63

### 10.11.12.RV-Diameter

#### Required Measurements:

RVDD      right ventricular diameter diastole      [mm]  
RVDS      right ventricular diameter systole      [mm]

#### Menu of this Measuring program:



#### Operation:

- 1      Obtain a scan of the right ventricle.
- 2      Call up the measuring program by touching the key 'RVD'.
3.      Perform the required measurements at systole and diastole:  
Touch the corresponding key to select the measurement (key bright lit),  
use the trackball and the 'STORE'-key to perform the measurement.

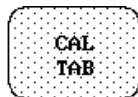
The measured values and available results are directly displayed on the Monitor and stored automatically into the report (maximal 5 values per measurement).

Monitor display:      RVDD = xxx.xmm  
                          RVDS = xxx.xmm

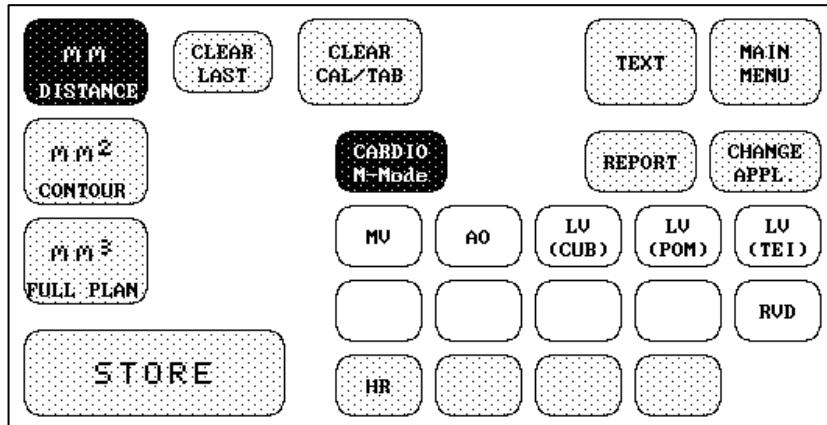
Additional Functions:      See page 63

## 10.12. Cardiology - M-Mode

The following measuring programs are available in M-Mode. Calculations from these M-Mode measurements are automatically performed and included into the report.



Select the measuring window (if not active) and then the 'B-MODE CARDIO' window



### 10.12.1. Mitral valve (M-Mode)

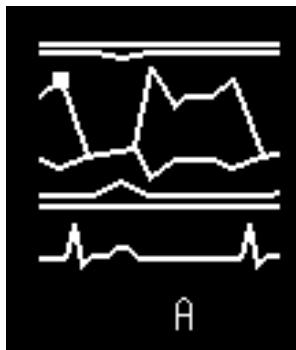
Necessary measurements:

C - E	amplitude	[mm]
D - E	amplitude	[mm]
C - A	amplitude	[mm]
E - E'	amplitude	[mm]
D - E	slope	[mm/s]
E - F	slope	[mm/s]



Select the measuring program by touching this key,  
The MV guide pictogram appears on the monitor.

MV Guide pictogram



Enter the measuring dots **A - C - D - E - F - E'** acc. the guide pictogram.  
After entering dot A the next point to measure ( **C** ) is displayed in the pictogram.

Operation:

1. Perform a M-Mode record of the anterior and posterior mitral leaflets.
2. Call up the measuring program by touching the key 'MV'
3. Enter the measuring dots **A - C - D - E - F - E'** acc. the guide pictogram by using the trackball and the 'STORE'-key.  
After entering dot A the next point to measure ( **C** ) is displayed in the pictogram.

If the last point is entered the results are displayed instead of the pictogram.

Results: CA/CE =xxxxx  
CA = xxxx mm  
CE = xxxx mm  
DE = xxxx mm  
EE' = xxxx mm  
DE = xxxmm/s  
EF = xxxmm/s

Additional functions:



skip the next dot  
The evaluation concerning the skipped dot will be missing

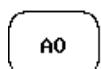


The last entered dot is erased (correction)

### 10.12.2. Aortic valve (M-Mode)

#### Necessary measurements:

AOD: aortic diameter  
 LAD: left atrial dimension  
 AVD: aortic valve dimension  
 RVD: right ventricular dimension  
 ET: ejection time  
 PEP: pre-ejection period



Select the measuring program by touching this key,  
The MV guide pictogram appears on the monitor.

AO Guide pictogram



Enter the measuring dots acc. the guide pictogram.  
After entering a dot the next point to measure is displayed in the pictogram.

#### Operation:

1. Perform a M-Mode record of the aortic valve.
2. Call up the measuring program by touching the key 'AO'
3. Enter the measuring dots acc. the guide pictogram by using the trackball and the 'STORE'-key. After entering one dot the next point to measure is displayed in the pictogram.

If the last point is entered the results are displayed instead of the pictogram.

Results: LA/AO = xxxx  
 ET = xx.xxs  
 PEP = xx.xxs  
 RVD = xx.xmm  
 AVD = xx.xmm  
 LAD = xx.xmm  
 AOD = xx.xmm

Additional functions: same as at the measuring program 'Mitral valve' (MV).

### 10.12.3. Left ventricle (M-Mode)

#### Necessary measurements:

IVSTD: interventricular septum thickness - diastolic  
LVIDD: left ventricle internal diameter - diastolic  
PWTd: posterior wall thickness - diastolic  
IVSTS: interventricular septum thickness - systolic  
LVIDS: left ventricle internal diameter - systolic  
PWTS: posterior wall thickness - systolic  
HR: Heart Rate

#### Formula used:

$$FS\{\%\} = \frac{D - S}{D} \cdot 100$$

#### Method:

CUBED

POMBO

TEICHHOLZ

$$EDV = D^3 \text{ ml}$$

$$ESV = S^3 \text{ ml}$$

$$EDV = 1.047 \times D^3 \text{ ml}$$

$$ESV = 1.047 \times S^3 \text{ ml}$$

$$EDV = D^3 * 7/(2.4 + D)$$

$$ESV = S^3 * 7/(2.4 + S)$$

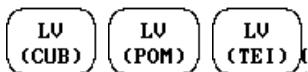
$$SV\{\text{ml}\} = EDV - ESV$$

$$EF\{\%\} = \frac{SV}{EDV} \times 100$$

$$CO\{\text{l / min}\} = \frac{SV \times HR}{1000}$$

#### Abbreviations:

LVIDD = D, LVIDS = S  
FS: fractional shortening  
EDV: end-diastolic volume  
ESV: end-systolic volume  
SV: stroke volume  
EF: ejection fraction  
CO: cardiac output



Select the measuring program by touching this key,  
The LV guide pictogram appears on the monitor.

LV Guide pictogram



Enter the measuring dots acc. to guide pictogram.  
After entering a dot the next point to measure is  
displayed in the pictogram.

#### Operation:

1. Perform a M-Mode record of left ventricle.
2. Call up the measuring program by touching the respective key 'AO'
3. Enter the measuring dots acc. the guide pictogram by using the trackball and the 'STORE'-key. After entering one dot the next point to measure is displayed in the pictogram.

If the last point is entered the results are displayed instead of the pictogram.

Results:	CO:	[ l/min ]
	HR:	[ B/min ]
	SV:	[ ml ]
	EF:	[ % ]
	ESV:	[ ml ]
	EDV:	[ ml ]
	FS:	[ % ]
	PWTS	[ mm ]
	LVIDS	[ mm ]
	IVSTS	[ mm ]
	PWTD	[ mm ]
	LVIDD	[ mm ]
	IVSTD	[ mm ]

Additional functions: same as at the measuring program 'Mitral valve' (MV).

**Reduced LV measurement:**

Depending on a setup switch the standard (full) or reduced measurement program is preselected. To change the setup switch (full or reduced) see chapter 12.9.

Necessary measurements: Evaluation results:

LVIDD	CO: [ l/min ]
LVIDD	HR: [ B/min ]
HR	SV: [ ml ]
	EF: [ % ]
	ESV: [ ml ]
	EDV: [ ml ]
	FS: [ % ]
	LVIDS: [ mm ]
	LVIDD: [ mm ]

**Operation:**

This is the same operation as at the standard LV evaluation.

**10.12.4. RV-Diameter (M-Mode)****Required Measurements:**

RVD right ventricular diameter [mm]



Select the measuring program by touching this key,  
a measuring cross is displayed on M-mode window.

**Operation:**

1. Obtain the right ventricle with M-Mode.
2. Call up the measuring program by touching the key 'RVD' and measure the distance in the M-Mode window by using the trackball and the 'STORE'-key.

Monitor display: RVD = xxx.x mm

**10.12.5. BSA (Body Surface Area)**

Values to be entered: weight WT [kg]  
height HT [cm]

Formula used (DUBOIS):

$$\text{BSA} = \text{WT}^{0.425} \times \text{HT}^{0.725} \times 71,84 \times 10^{-4} \quad \text{BSA} \quad [\text{m}^2]$$

Operation: See Chapter 3, patient data entry

### 10.12.6. Heart rate

Required measurement: T (time)  
Required inputs: P (heart periods)  
Formula used:  $HR = P/T \times 60$  (1/min)



Select the heart rate measurement by touching this key, the following window appears on the touchscreen.

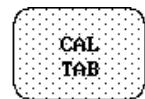
SELECT NUMBER OF PERIODS  
THEN MOVE CROSS BY TRACKBALL

### Operation:

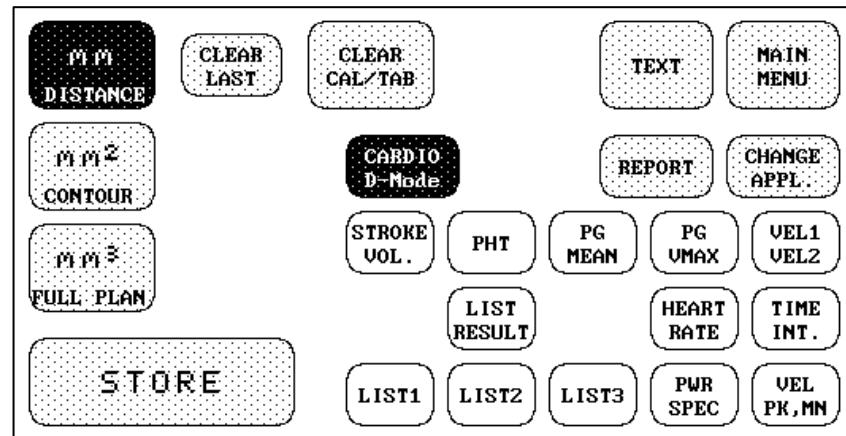
1. Perform a M-Mode record
  2. Select the measuring program by using the key 'HR' and enter number of periods (if not assigned).
  3. Perform the time measurement by using the trackball and the 'STORE'-key Time and pulse frequency is calculated and displayed.

### 10.13. Cardiology D-Mode

The following measuring programs are available in D-Mode. Calculations from these D-Mode measurements are automatically performed and included into the report.



Select the measuring window (if not active) and then the 'D-MODE CARDIO' window



#### 10.13.1. Stroke Volume, Cardiac Output

##### Necessary measurements:

Heart Rate and fixing time Interval of the Doppler spectrum.

The Aortic Valve Area (AOVA) is calculated from a distance measurement acc. to the following formula:

$$\text{AOVA} = \frac{d^2 \times \pi}{4}$$

d = DIAM..... Diameter [cm]  
AOVA..... Aortic Valve Area [cm<sup>2</sup>]

$$\text{SV} = v_{\text{mean}} \times (\text{AOVA} \times t)$$

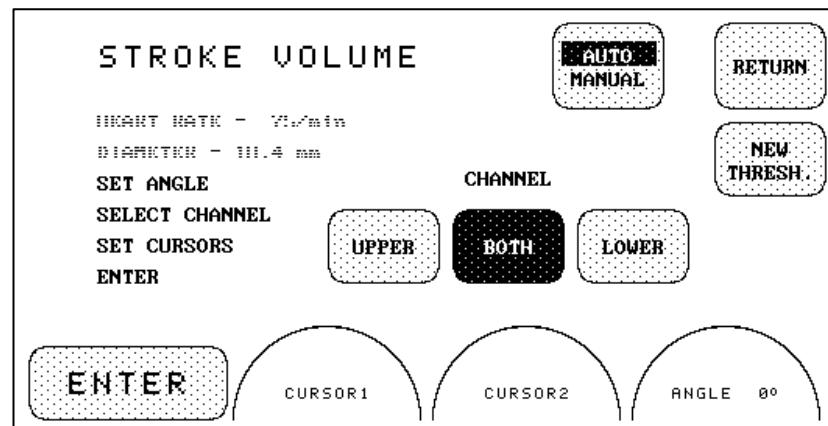
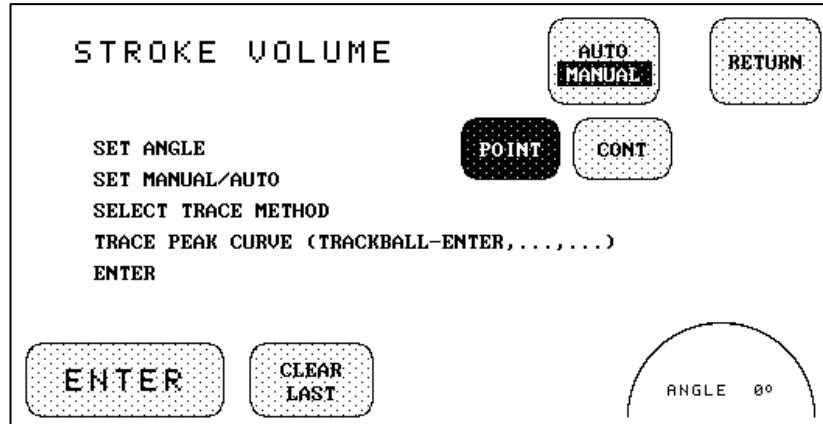
v<sub>mean</sub> = MN mean velocity of the mean velocity curve between Cursor 1 and 2 [cm/s]  
SV ..... Stroke Volume [ml]  
t ..... Time between Cursor 1 and 2 [s]

$$\text{CO} = \frac{\text{SV} \times \text{HR}}{1000}$$

HR .... Heart Rate [min<sup>-1</sup>]  
CO .... Cardiac Output [l/min]



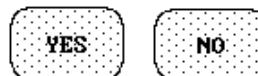
Select the measuring program by touching this key,  
The following menu appears on the monitor.



#### Operation:

1. Switch on measuring program "STROKE VOLUME" (key "STROKE VOL.")
2. Measure the Hear Rate (turning knobs CURSOR 1 and 2),  
If the Heart Rate has already been measured, following message appears on the touchpanel:

HEART RATE = xxx/min  
IS THIS CORRECT?



If YES: Touch key "YES", measuring program is continued (point 3)  
If NO: Touch key "NO" and measure the Heart Rate (as in point 2)

Measurement is allowed over one period only.

3. Determine and enter the Aortic Valve Area. A point already set can be erased with key "CLEAR LAST".
4. Position the angle cursor parallel to the vessel direction (digipot "ANGLE").
5. Select the Doppler channel (keys "UPPER", "BOTH", "LOWER"). This determines whether the envelope curve calculation takes into account only one flow direction (upper or lower) or both flow directions (both).

6. Limit the time interval (digipots CURSOR 1 and CURSOR 2).  
The limitation can take place over one or several cardiac cycles. Complete cycles must be set between Cursor 1 and 2.
7. Touch key "ENTER".  
The velocity curve between the two cursor lines and the following results are displayed:

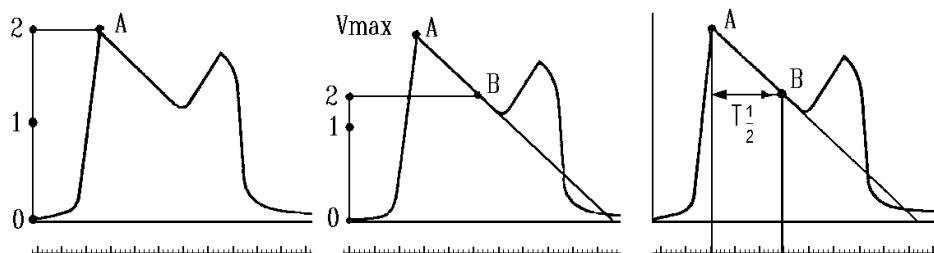
Results:      DIAM = xx.x mm  
                   AOVA = x.x cm<sup>2</sup>  
                   HR = xxx/min  
                   MN = x cm/s  
                   SV = xx ml  
                   CO = x.x l/min

### 10.13.2. Pressure Half Time

Calculation:

$$MVA = \frac{200}{T_{\frac{1}{2}}} \quad \begin{array}{l} MVA \dots \text{Mitral Valve Area} \\ T_{\frac{1}{2}} \dots \text{Pressure Half Time} \\ 200 \dots \text{Empirical constant} \end{array}$$

$$V_{p\frac{1}{2}} = \frac{V_{max}}{\sqrt{2}} \quad \begin{array}{l} V_{p\frac{1}{2}} \dots \text{Flow velocity, at which the Pressure} \\ \text{Gradient has fallen to the half of its} \\ \text{value } V_{max}. \end{array}$$



Procedure:

1. Determine the maximum velocity ( $V_{mean}$ )
2.  $V_{p\frac{1}{2}}$  (horizontal line) is displayed automatically.
3. Determine the velocity  $V_{p\frac{1}{2}}$  in the Doppler spectrum (vertical line), the horizontal distance between the peak of  $V_{max}$  and the intersection  $V_{p\frac{1}{2}}$  is the Pressure Half Time (PHT).



Operation:

1. Switch on measuring program PRESSURE HALF TIME (key PHT).
2. Position the angle cursor parallel to the vessel direction (digipot "ANGLE"), then store the angle with key "ENTER".
3. Mark the systolic peak (trackball, key "ENTER").  
A horizontal auxiliary line appears on  $V_{p\frac{1}{2}}$  ( $V_{p\frac{1}{2}} = V_{max}/\sqrt{2}$ ).
4. Mark the velocity value B (intersection between horizontal line and spectrum curve) (trackball).
5. Touch key "ENTER".  
Pressure Half Time and Mitral Valve Area are calculated.

Results:      PHT    = xxx ms  
                  MVA   = x.xx cm<sup>2</sup>

Remark:

- When the scale is switched to kHz or if the angle cursor is switched off ("ANGLE OFF"), the setting for angle correction is left out in the measuring procedure. The angle is calculated with 0°.

### 10.13.3. Mean Pressure Gradient

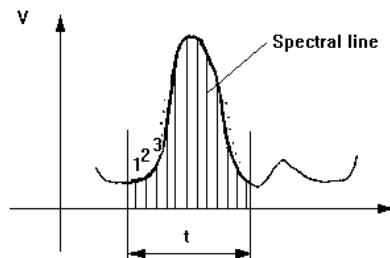
Calculation:

$$\text{MPG} = \frac{\text{PG}_1 + \text{PG}_2 + \dots + \text{PG}_n}{n} \quad \text{MPG ..} \quad \text{Mean Pressure Gradient from PG}_1 \text{ to PG}_n \quad [\text{mmHg}]$$

$$\text{PG}_n = 4 \times v_{\max}^2 \quad \text{calculated} \quad \text{PG}_n \dots \quad \text{Pressure} \quad \text{Gradient}$$

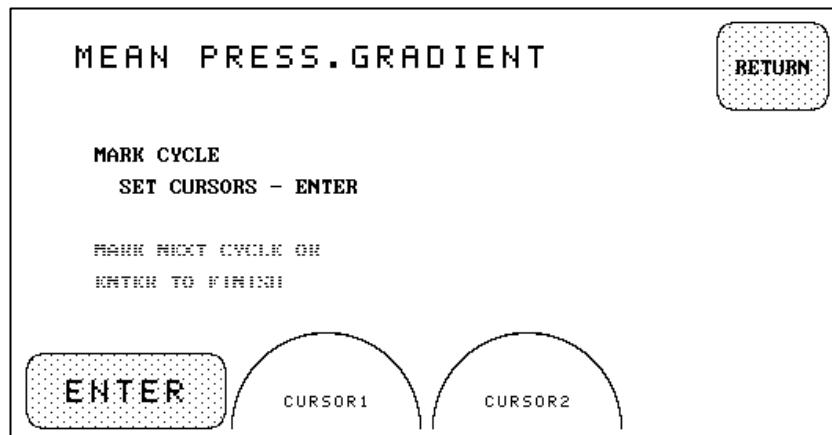
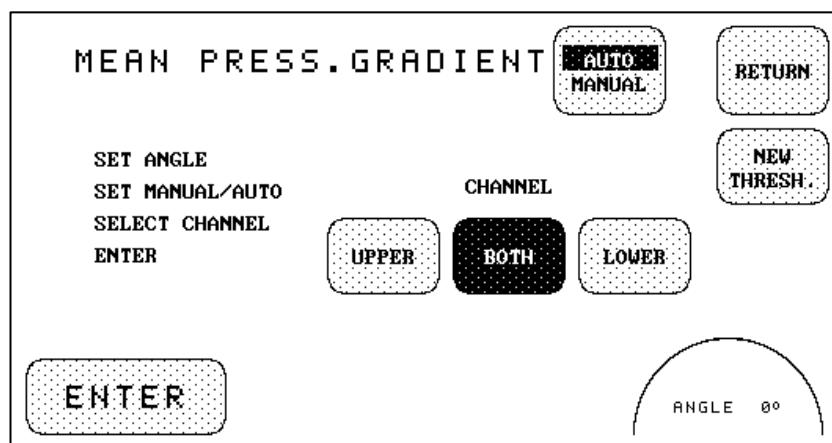
from one spectral line

The mean Pressure Gradient is calculated within a preselected time period.



**PG  
MEAN**

Select the measuring program by touching this key,  
The following menus appear on the monitor.



Operation:

1. Switch on measuring program "MEAN PRESSURE GRADIENT" (key "PG MEAN"). The automatically calculated envelope curve is displayed.
2. If necessary, set a new threshold manually.
3. If necessary, switch the envelope curve calculation to "manual" (key "AUTO/MANUAL"). The envelope curve can be calculated manually in 2 ways:
  - a) Point method: touch key "POINT"
  - b) Continuous method: touch key "CONT"

Operation same as with Pulsatility Index (see page 109).

When the automatically calculated envelope curve is used (if necessary, touch key "AUTO/MANUAL").

Select Doppler channel (keys "UPPER", "LOWER", "BOTH").

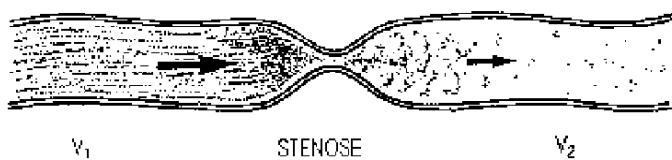
4. Position the angle cursor parallel to the vessel direction.
5. Enter the envelope curve (key "ENTER").
6. Mark the first cycle (turning knobs Cursor 1 and Cursor 2) and touch key "ENTER". The two vertical cursor lines are transformed into dotted lines.
7. Mark the next cycle (a) or finish the measuring program (b).
  - a) when turning one of the two digipots two more cursor lines appear. Continue the operation at point 6.
  - b) Touch key "ENTER".

Results: ANG = xx°  
CYCLES x  
MPG = xx mmHg

#### 10.13.4. Pressure Gradient, Maximal Velocity

The following conditions must be met:

- Grade of stenosis > 50%
- Vessel diameter > 3.5 mm
- Velocity before the stenosis very small compared to the velocity inside the stenosis
- No turbulent flows
- Drop in pressure > 70 mmHg



The Sample Volume (Gate) must be positioned exactly on the stenosis and the highest value of the systole must be measured.

##### Equation:

Simplified Law of Bernoulli:

$$PG = 4 \times (V_{max}^2)$$

PG .... Pressure Gradient [mmHg]  
V<sub>max</sub> ... Maximum velocity [m/s]

$$PG = P_1 - P_2$$

P<sub>1</sub> ..... Pressure before stenosis (high)  
P<sub>2</sub> ..... Pressure inside stenosis (low)

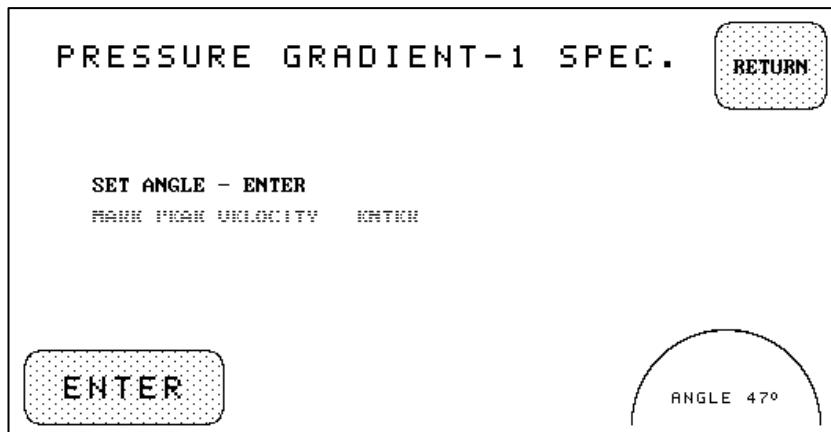
##### Literature:

Clinical Application of Doppler Ultrasound Ed. Kenneth J.W. Taylor, Peter N. Burns, Peter N.T. Wells, Raven Press, p.71 (1988)

Doppler Assessment of Aortic Stenosis: Bernoulli Revisited, H. Rijsterborgh, J. Roelandt  
Ultrasound in Medicine and Biology V 13/p.241...248 (1987)



Select the measuring program by touching this key,  
The following menu appears on the monitor.



#### Operation:

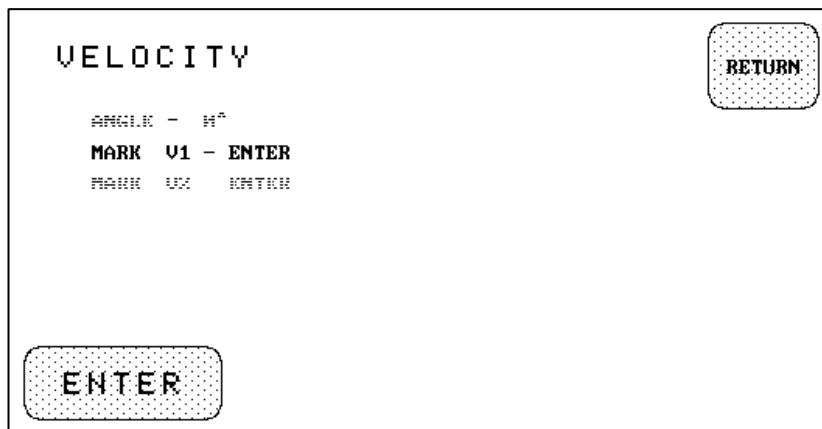
1. Switch on measuring program "PRESSURE GRADIENT" (key "PG")
2. Position the angle cursor parallel to the vessel direction (digipot "ANGLE"), then store the angle with key ENTER".
3. Mark the systolic peak (trackball, key "ENTER").  
The Pressure Gradient is calculated.

Results:      MAX = xxxx cm/s  
                   PG1 = x mmHg

### 10.13.5. Velocity 1, Velocity 2

VEL1  
VEL2

Select the measuring program by touching this key,  
The following menu appears on the monitor.



#### Operation:

1. Position the angle cursor parallel to the vessel direction (digipot "ANGLE"), then store the angle with key ENTER".
2. Switch on measuring program "VEL1, VEL 2" (key "VEL1, VEL2")
3. Mark the first velocity by using the trackball and the 'ENTER'-key
4. Mark the second velocity by using the trackball and the 'ENTER'-key  
The following results are displayed:

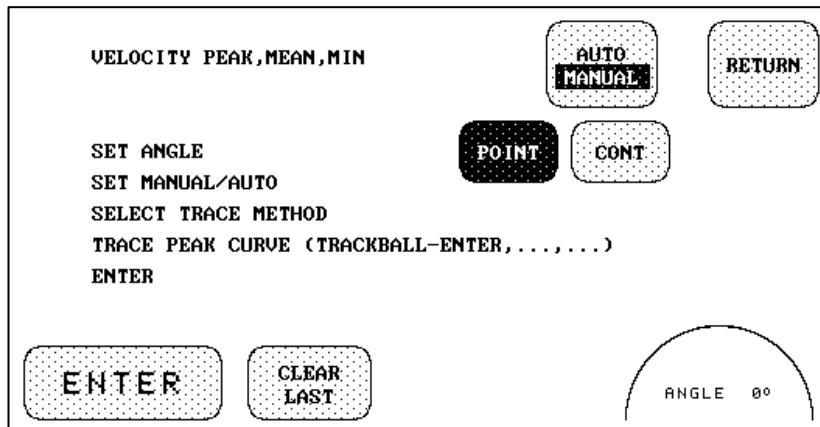
Results: VEL1 = xxxx cm/s  
VEL2 = xxxx cm/s  
V1/V2 = x.xxxx

### 10.13.6. Peak-, Mean-, Minimum Velocity

Peak-, Mean and Minimum Velocity can be calculated automatically or by entering the envelope velocity curve manually.



Select the measuring program by touching this key,  
The following menu appears on the monitor.



#### Operation:

1. Switch on measuring program (key "VEL PK, MEAN")
2. Position the angle cursor parallel to the vessel direction (digipot "ANGLE").
3. Enter the envelope curve calculation by using the key 'AUTO / MANU and calculate the envelope curve. See Entering the envelope curve.

After entering the envelope curve the following results are displayed:

Results:      PEAK = xxxx cm/s  
                   MEAN = xxxx cm/s  
                   MIN = xxxx cm/s

***Entering the envelope curve:***

1. Entering manually:

Two methods are available:

a) Point method:

Enter dots from left to right by using the trackball and the 'ENTER'-key, these dots are connected with lines. After storing one dot the measuring cross disappears and appears again after moving the trackball.

With the key 'CLEAR LAST' the last line will be deleted.

To finish the inputs touch the 'ENTER'-key before moving the trackball again.

b) Continuous method:

Enter the start point of the envelope curve by using the trackball and the 'ENTER'-key and draw the envelope curve with the trackball. When moving back the measuring cross the curve is deleted.

To finish the inputs touch the 'ENTER'-key.

2. Automatic calculation:

Select the Doppler channel (key "UPPER", "BOTH", "LOWER"). This determines whether the envelope curve calculation takes into account only one flow direction (upper or lower) or both flow directions (both).

Limit the time interval by turning knobs CURSOR 1 and CURSOR 2. The limitation can take place over one or several cardiac cycles. Complete cycles must be set between Cursor 1 and 2.

Touch key "ENTER"-key. The envelope curve between the two cursor lines and the following results are displayed:

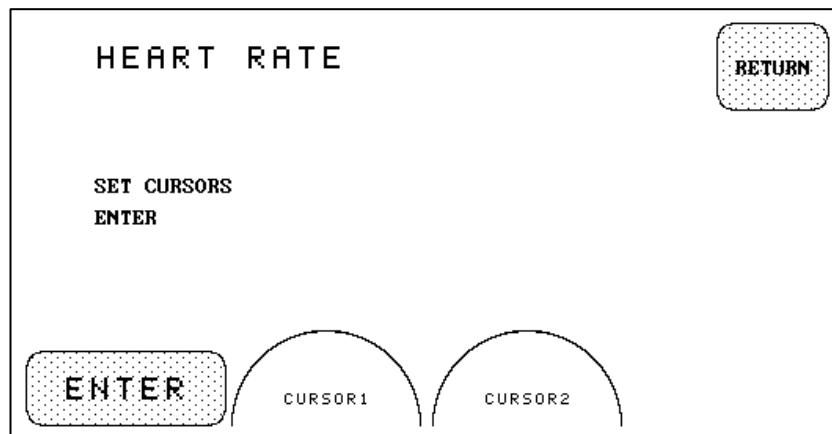
### 10.13.7. Heart Rate

After entering the time (T) of one heart cycle the heart rate is calculated.

Formula used:  $HR = 1/T \times 60$  [1/min]



Select the measuring program by touching this key,  
The following menu appears on the monitor



#### Operation:

1. Switch on measuring program "HEART RATE" (key "HEART RATE")
2. Set Cursor 1 and 2.  
It is only allowed to measure over one heart cycle. The time between Cursor 1 and 2 is essential for the calculation (Cursor 1 may be on the right of Cursor 2).
3. Calculate the heart rate (key "ENTER").

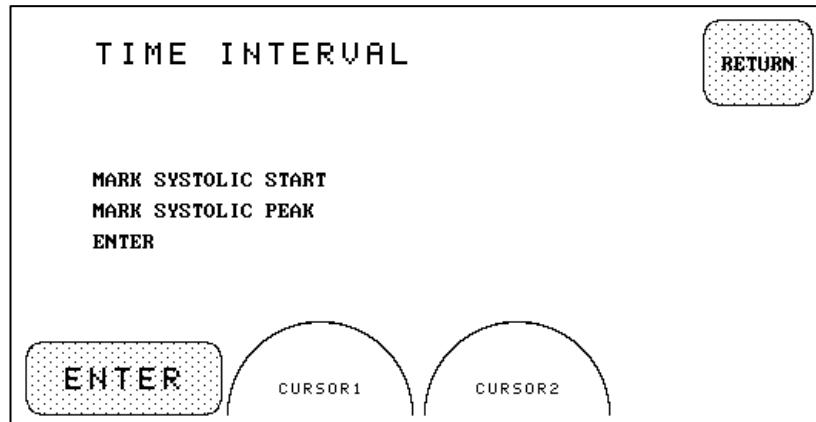
Result:      HR    = xx/min

### 10.13.8. Time Interval

For measuring the time at the Doppler spectrum



Select the measuring program by touching this key,  
The following menu appears on the monitor



#### Operation:

1. Switch on measuring program "TIME INTERVAL" (key "TIME INT.")
2. Position Cursor 1 and 2.  
The time between Cursor 1 and 2 is essential for the calculation (Cursor 1 may be positioned on the right of Cursor 2).
3. Touch key "ENTER".

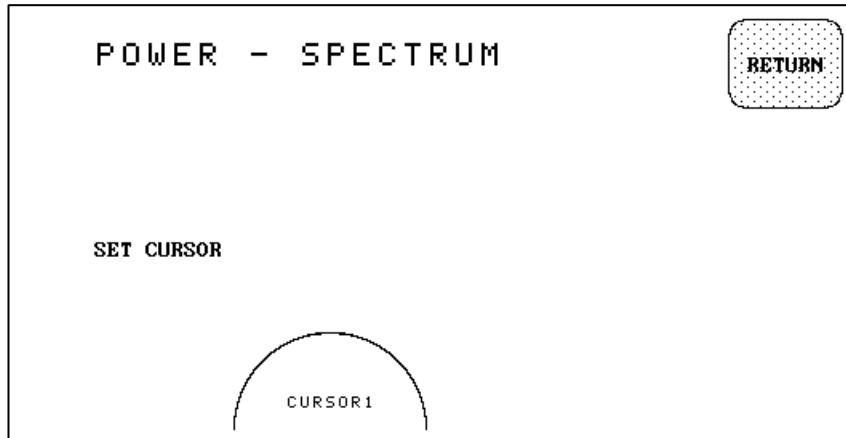
Result:      TI      =    xxx ms

### 10.13.9. Power Spectrum (Doppler histogram)

The frequency spectrum of a certain spectral line is displayed (frequency horizontal, amplitudes vertical).

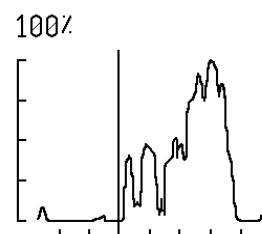


Select the measuring program by touching this key,  
The following menu appears on the monitor

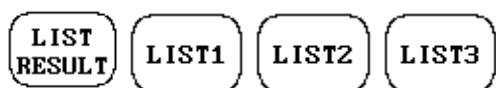


#### Operation:

1. Switch on measuring program (key "PWR SPEC").
2. Position the cursor (digipot "CURSOR").  
After the cursor stands still the power spectrum is displayed.



### 10.13.10.Lists of Results



Touch the respective key  
Following results are displayed:

LIST RESULT:	LIST 1:	LIST 2	LIST 3
HR = xx/min	PG2S = x mmHg	MPG = x mmHg	PHT = xxx ms
TI = xxx ms	F1 = x.x kHz	CYCLES x	MVA = x.xx cm <sup>2</sup>
PG = x mmHg	F2 = x.x kHz	ANG = xx°	SV = xx ml
PG2S = x mmHg	V1 = xx cm/s	AOVA = x.x cm <sup>2</sup>	CO = xx l/min
MPG = x mmHg	V2 = xx cm/s	AO.A = x.x cm <sup>2</sup>	HR = xx /min
AOVA = x.x cm <sup>2</sup>	PG = x mmHg	V1 = xx cm/s	AOVA = x.x cm <sup>2</sup>
PHT = xx ms	F = x.x kHz	V2 = xx cm/s	MN = xx cm/s
SV = xx ml	V = xx cm/s	DIAM = x.x cm	ANG = xx°
CO = x.x l/min	ANG = xx°		DIAM = x.x cm

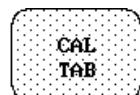
### 10.14. Cardiology Report:

All cardiological measurements and calculations are automatically stored to the data memory and can be displayed via report. The actual report is cleared if the P.ID is cleared by touching the keys 'NEW PAT' and 'YES'.

For each measuring parameter up to five values are stored and the arithmetical mean value is calculated from existing values for the final report (at most from the last five values).

The values for each measuring parameter can be entered via measurement or by using the keyboard (edit function for corrections).

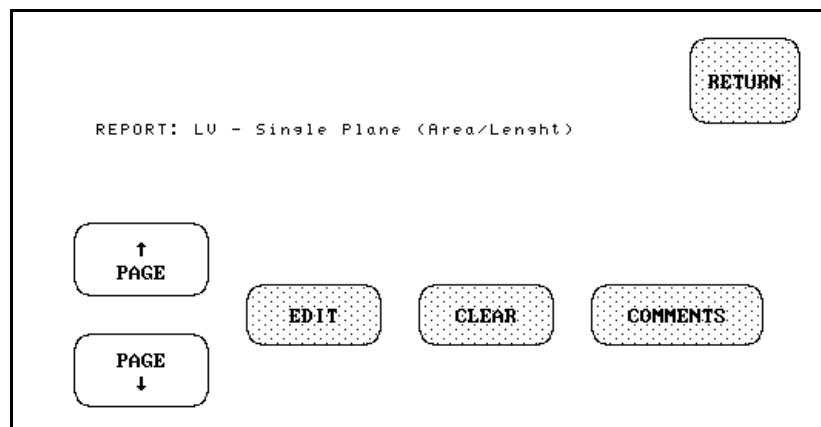
#### Menu of the cardiology report:



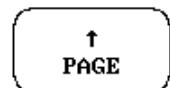
Select the measuring window and then the 'B-MODE CARDIO' window (if not active)



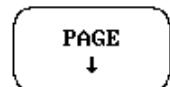
Call up the cardiology report by touching this key, the following window appears on the touchscreen.



#### Report functions:



Select previous page of the report



Select next page of the report



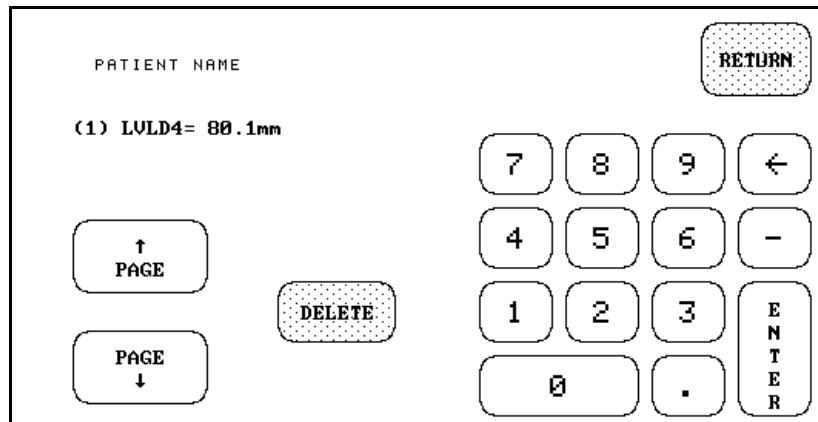
a keyboard appears on the touchscreen for entering a text



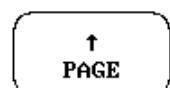
Use the trackball to select the measuring program (white bar) and clear its memory data by pressing this key.

**EDIT**

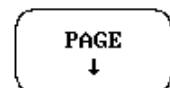
Call up the edit menu of the report,  
the following window appears on the touchscreen.  
Note: Input parameters of M-Mode can't be edited or corrected.

Operation:

1. Use the PAGE ↑ - and PAGE ↓ -keys to select the memory page of the measuring program to be corrected.
2. Use the trackball to select the input parameter (white bar) and correct it by using the keyboard.
3. Press the ENTER-key to store the corrected value.  
A new calculation is started automatically.

Edit functions of the report:

Select previous page of the edit report,  
one page per measuring program



Select next page of the edit report  
one page per measuring program



Use the trackball to select the input parameter (white bar) and clear it by pressing this key. A new calculation is started automatically.



Return to the previous touchscreen window

Remark:

- Values entered by the keyboard and all calculated values affected by these entries are marked with a dot •.

Monitor display of the Cardiology Report:

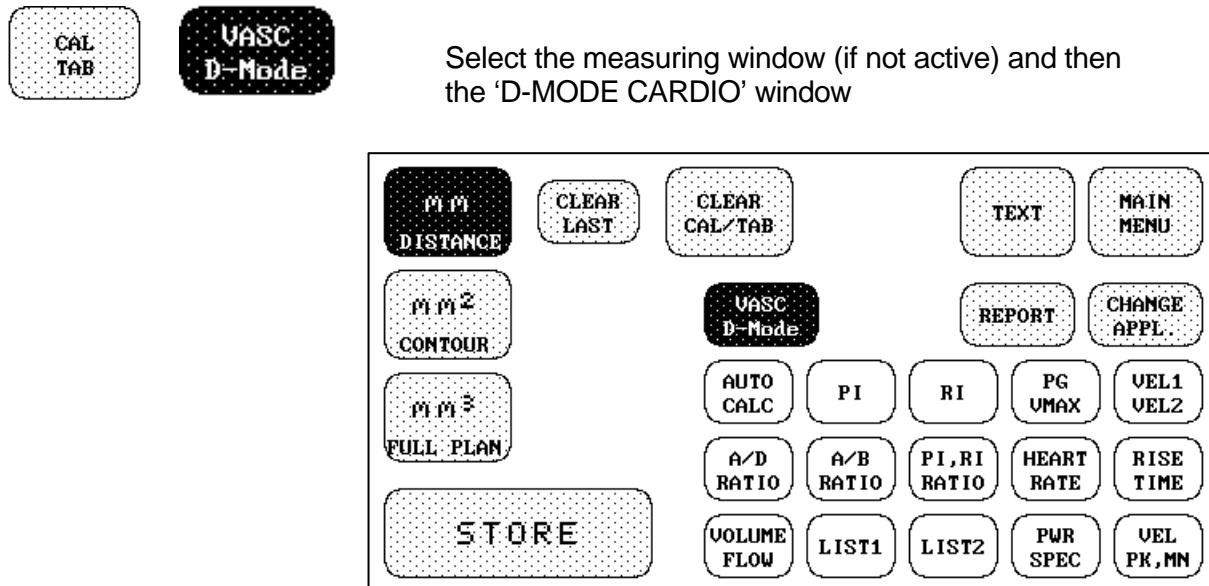
PATIENT NAME	CLINIC NAME	02/18/98 02:24 PM	
REPORT (1/2)		WT: 80kg HT:180cm BSA = 1.996m <sup>2</sup>	
LV - Single Plane (Area/Lenght)	LV - Biplane (Area/Lenght)	LV - Biplane (Simpson)	Left Ventricular Mass
LVALD= 6.8cm <sup>2</sup> LVLD = 52.4mm LVALS= 1.7cm <sup>2</sup> LVLS = 35.0mm  EDV = 7.5ml ESV = 0.7ml  SV = 6.8ml EF = 90.7% •HR = 65 bpm •CO = 0.441/min  •SI = 3.4 •CI = 0.2	LVIDD= 48.3mm LVAMD= 4.7cm <sup>2</sup> LVALD= 5.7cm <sup>2</sup> LVDS= 37.3mm LVAMS= 0.5cm <sup>2</sup> LVALS= 3.4cm <sup>2</sup>  EDV= 4.7ml ESV= 0.4ml  SV = 4.3ml EF = 91.3% •HR = 65 bpm •CO = 0.281/min  •SI = 2.2 •CI = 0.1	LVLD4= 50.1mm LVLS4= 34.0mm LVLD2= 47.6mm LVLS2= 31.6mm  EDV= 32.9ml ESV= 10.0ml  SV = 22.9ml EF = 69.5% •HR = 60 bpm •CO = 1.371/min  •SI = 11.5 •CI = 0.7	LVLD = 47.9mm APDepi=14.0cm <sup>2</sup> APDend= 9.3cm <sup>2</sup>  MWT = 3.89mm LVmass= 26g  LA/AO - Ratio  LAD = 33.8mm AOA = 24.2mm  LA/AO = 1.395

Monitor display of the Edit Report:

PATIENT NAME	CLINIC NAME	02/18/98 02:24 PM
REPORT-EDIT (1/6)		WT: 80kg HT:180cm BSA = 1.996m <sup>2</sup>
LV - Single Plane (Area/Lenght)	No.1      No.2      No.3      No.4      No.5	
LVALD= 6.8cm <sup>2</sup> LVLD = 52.4mm LVALS= 1.7cm <sup>2</sup> LVLS = 35.0mm  EDV = 7.5ml ESV = 0.7ml  SV = 6.8ml EF = 90.7% •HR = 65 bpm •CO = 0.441/min  •SI = 3.4 •CI = 0.2	6.4      5.9      8.1 56.4      50.7      50.0 1.0      2.4 35.4      37.6      31.9  • 70      • 60	

## 10.15. Vascular D-Mode

The following measuring programs are available in D-Mode. Calculations from these D-Mode measurements are automatically performed and included into the report.



### 10.15.1. Auto Calc

#### Important note:

The determination of the Doppler spectrum envelope curve at its best requires a clean, crisp, low-noise record of the Doppler spectrum!

The automatic evaluation of the envelope curve over the entire length of the displayed spectrum resp. of the cursor-marked part of it provides a fast and comfortable determination of the most important parameters as:

Pulsatility Index, Resistance Index, A/B Ratio, A/D Ratio, Max. Velocity, Min. Velocity, Mean Velocity, end-diastolic Velocity, Pressure Gradient, Rise Time, Heart Rate.

#### *Manual evaluation:*

With difficult cases of Doppler signal recordings the eye can better discriminate clean Doppler signals from distorted ones, therefore the manual determination of the envelope curve and its evaluation will help in such situations.

#### *Automated determination of the envelope curve:*

The calculation of the envelope curve employs an algorithm with automatic threshold level regulation. However, the function "NEW THRESHOLD" allows for manual adjustment of the threshold level for a new evaluation of the envelope curve. With the next recording of a new Doppler spectrum automatic threshold takes place again.

In standard D-Mode (frozen B-scan, running D-spectrum) the envelope trace is determined on-line.

In B/D simultaneous mode the envelope curve is determined after spectrum freeze.

During the calculation the screen shows "CALCULATING".

Remark:

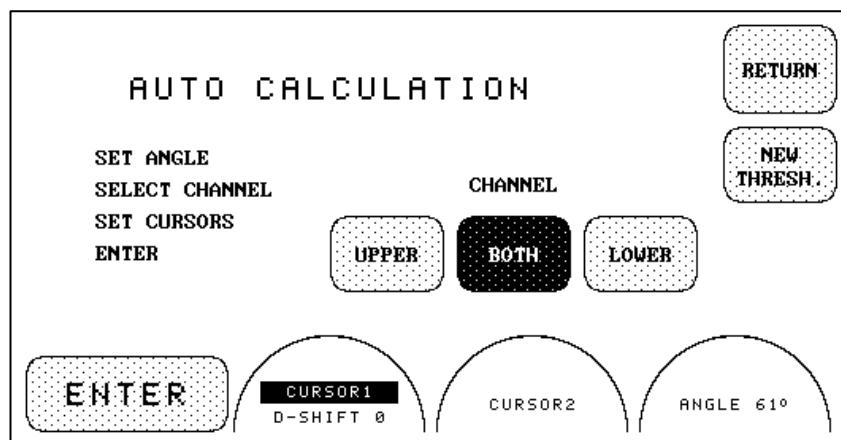
- Depending on the preselect state of the key 'AUTOCALC ON/OFF' in the Doppler menu (see chapter 10 Measurements/ Calculations) the operation is:

AUTO CALC on: After freeze of the Doppler spectrum the spectral envelope curve with evaluation appears. For corrections (e.g. evaluation of exceptionally well displayed heart cycles) the measuring function is  to be activated

AUTO CALC off: Standard operation procedure.



Select the measuring program by touching this key,  
The following menu appears on the monitor. AUTO CALC on

Operation:

- Switch on measuring program "Auto Calc" (Key "AUTO CALC")
- Turn the angle cursor parallel to the direction of the vessel (digipot "ANGLE")
- Select the Doppler channel (keys "UPPER", "BOTH", "LOWER"). This determines whether the envelope curve evaluation should take into consideration one (upper, lower) or both flow directions.
- Limit the time zone (digipots CURSOR 1 and CURSOR 2). The limitation may cover one or several cardiac cycles, but only complete cycles must be between Cursor 1 and 2. The left cursor must always be positioned before the systolic start and the right cursor after the end-diastole, so that the starting and final points can be registered correctly by the automatic.
- Press ENTER-key.  
The envelope curve with velocity marks (A, B, D) between Cursor 1 and 2 and the results are displayed.

Results:	PI = xx.xx	MEAN = xx cm/s
	RI = xx.xx	B = xx cm/s
	A/B = xx.xx	D = xx cm/s
	A/D = xx.xx	PG = xx mmHg
	MAX = xx cm/s	RT = xx ms
	MIN = xx cm/s	HR (x) = xxx/min

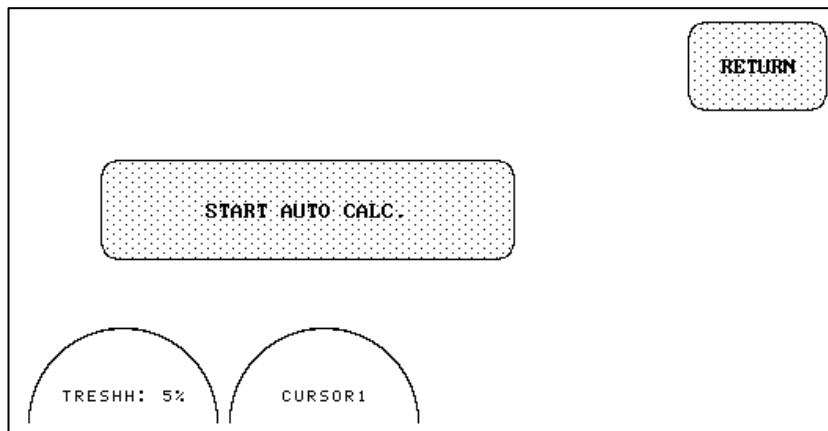
**Manual setting of threshold:**

Condition: Doppler spectrum stored, AUTO CALC activated.



NEW THRESHOLD  
Key in "AUTO CALC" menu

Sub-menu "SET THRESHOLD" appears.



A vertical line appears in the Doppler spectrum, the power spectrum of the so marked Doppler instant being displayed in the lower right corner of the screen.

Power spectrum: X-axis: Frequency  
Y-axis: Amplitude

In the power spectrum a dotted horizontal line is provided which marks the actual threshold level.

**Operation:**

1. Switch on the function 'New Threshold'
2. Set the threshold: Vertical rotation of trackball  
The threshold (marked by the horizontal line) is to be set on the peak noise in the power spectrum.
3. Check amplitudes of the Doppler spectrum with the power spectrum  
(digipot cursor 1)  
The position in the Doppler spectrum is marked by a vertical line.  
The lowest amplitudes of the power spectrum must be higher than the threshold marked by the horizontal line to be evaluated.
4. Start Auto Calc (key START AUTO CALC)  
The calculation will reveal the envelope after 1 to 4 seconds.

### 10.15.2. Pulsatility Index

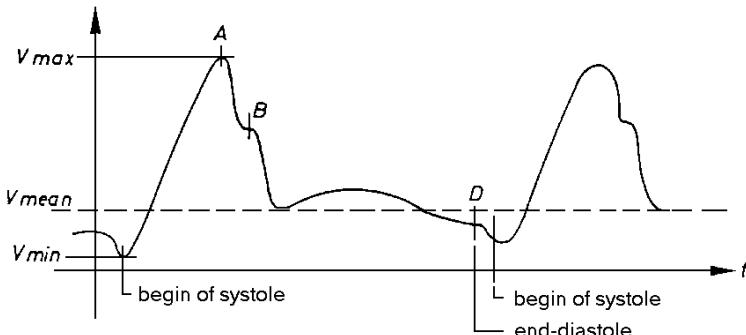
acc. Golsing and King, 1975

The PI describes the ratio between peripheral resistance and mean blood flow velocity resp. volume flow (with constant vessel diameter the volume flow is proportional to  $v_{mean}$ , the temporal mean value).

The Pulsatility Index is calculated according to the following formula:

$$PI = \frac{V_{max} - V_{min}}{V_{mean}}$$

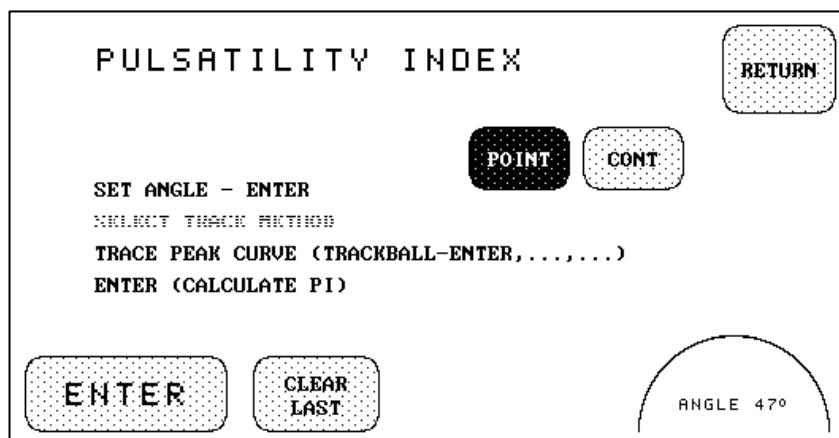
V<sub>max</sub> ... Maximum velocity [cm/s]  
 V<sub>min</sub> .... Minimum velocity of envelope curve [cm/s]  
 V<sub>mean</sub> .. Velocity averaged over time  
 (between Cursor 1, 2) [cm/s]

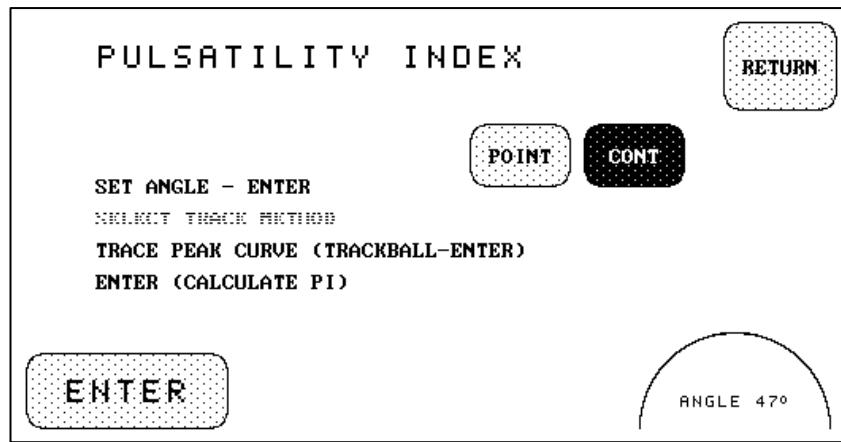


The measurement can be performed over one or more cardiac cycles

**PI**

Select the measuring program by touching this key,  
The following menu appears on the monitor.



Operation:

1. Switch on the measuring program "PULSATILITY INDEX" (key "PI")
2. Position the angle cursor parallel to the vessel axis (digipot "ANGLE"), then confirm the adjusted angle with key "ENTER".
3. Drawing the envelope curve:  
Two possibilities:
  - a) Point method: Touch key "POINT".  
Position dots from left to right (trackball, key "ENTER"), connecting lines will appear automatically. After storing a dot the measuring cross disappears, when the trackball is moved the measuring cross reappears.  
With key "CLEAR LAST" the last connecting line is erased.
  - b) Continuous method: Touch key "CONT".  
Position the starting dot and draw the envelope curve from left to right with the trackball. When moving the measuring cross in the opposite direction (right to left) the inscribed curve is erased.
4. Storing the envelope curve and calculation of the Pulsatility Index (touch key "ENTER").

Results: PI = xx.xx  
 MAX = xx cm/s  
 MIN = xx cm/s  
 MEAN = xx cm/s

Remark:

- When the scale is switched to kHz or if the angle cursor is switched off ("ANGLE OFF") the setting for angle correction is left out in the measuring procedure. Then the angle is calculated with  $0^\circ$  ( $\cos\alpha = 1$ ).

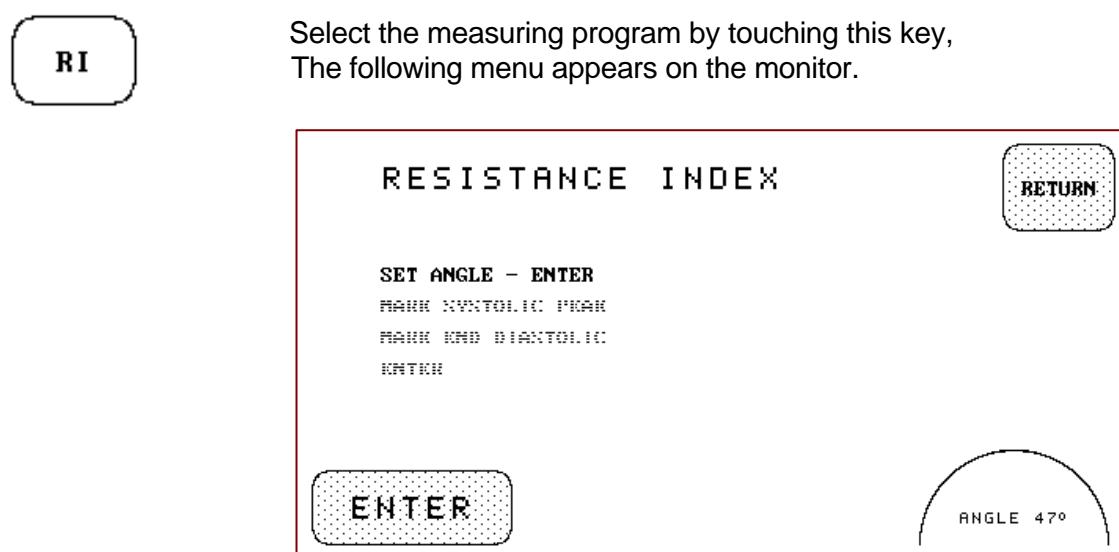
### 10.15.3. Resistance Index

Acc. Pourcelot, 1974)

Calculation:

$$RI = (A-D)/A$$

A ..... maximum velocity (systole, value A)  
D ..... end-diastolic velocity (value D)



#### Operation:

1. Switch on measuring program "RESISTANCE INDEX" (key "RI").
2. Position the angle cursor parallel to the vessel axis (digipot "ANGLE"), then store the angle with key "ENTER".
3. Mark the systolic peak (trackball, key "ENTER").
4. Mark the end-diastole (trackball, key "ENTER").  
The Resistance Index is calculated.

Results:      RI      = xx.xx  
                   A      = xxxx cm/s  
                   D      = xxxx cm/s

#### Remarks:

- When the scale is switched to kHz or if the angle cursor is switched off ("ANGLE OFF"), the setting for angle correction is left out in the measuring procedure. The angle is calculated with 0°.
- The vertical position of the cursor line is decisive for entering the velocity. The horizontally adjustable measuring cross is for marking only.

#### 10.15.4. Pressure Gradient, Maximal Velocity

See chapter Cardiology D-Mode

#### 10.15.5. Velocity 1, 2

See chapter Cardiology D-Mode

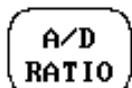
#### 10.15.6. A/D Ratio

The ratio of systolic to end-diastolic maximum is determined. In literature often the end-diastolic velocity is defined with the letter "B" instead of "D".

Calculation: (acc. to Stuart)

$$R_{A/D} = \frac{v_A}{v_D}$$

$v_A$  ... Ratio A/D  
 $v_A$  ..... Maximum velocity  
 (systole, value A) [cm/s]  
 $v_D$  ..... End-diastolic velocity [cm/s]



Select the measuring program by touching this key,  
The following menu appears on the monitor.



##### Operation:

1. Switch on measuring program "A/D RATIO" (key "A/D RATIO")
2. Position the angle cursor parallel to the vessel direction (digipot "ANGLE"), then store the angle with key "ENTER".
3. Mark the systolic peak (trackball, key "ENTER").
4. Mark the end-diastole (trackball, key "ENTER"). A/D Ratio is calculated.

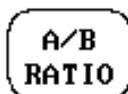
Results:  
 $A/D = xx.xx$   
 $A = xxxx \text{ cm/s}$   
 $D = xxxx \text{ cm/s}$

### 10.15.7. A/B Ratio

Calculation:

$$R_{A/B} = \frac{v_A}{v_B}$$

R<sub>A/B</sub> ... Ratio A/B  
 v<sub>A</sub> ..... Maximum velocity  
 (systole, value A) [cm/s]  
 v<sub>B</sub> ..... Velocity, value B [cm/s]



Select the measuring program by touching this key,  
The following menu appears on the monitor.



Operation:

1. Switch on measuring program "A/B RATIO" (key "A/B RATIO")
2. Position the angle cursor parallel to the vessel direction (turning knob "ANGLE"), then store the angle with key "ENTER".
3. Mark the systolic peak (trackball, key "ENTER").
4. Mark the end-diastole (trackball, key "ENTER").  
A/B Ratio is calculated.

Results:      A/B    = xx.xx  
                   A     = xxxx cm/s  
                   B     = xxxx cm/s

### 10.15.8. PI-, RI-RATIO

With this measuring program the ratio of two Pulsatility Indexes resp. two Resistance Indexes is determined.

Calculation:

$$\text{PI } 1/2 = \text{PI } 1/\text{PI } 2 \quad \begin{array}{l} \text{PI 2 ..... last measured PI} \\ \text{PI 1 ..... PI measured before PI 2} \end{array}$$

$$\text{RI } 1/2 = \text{RI } 1/\text{RI } 2 \quad \begin{array}{l} \text{RI 2 ..... last measured RI} \\ \text{RI 1 ..... RI measured before RI 2} \end{array}$$

Operation:

1. Measure PI 1 resp. RI 1
2. Record new Doppler spectrum
3. Measure PI 2 resp. RI 2
4. Calculate PI-Ratio resp. RI-Ratio (touch key "PI,RI-RATIO")

Results:      PI 2    = x.xxx  
                  PI 1    = x.xxx  
                  RI 2    = x.xxx  
                  RI 1    = x.xxx  
                  PI 1/2 = x.xxx  
                  RI 1/2 = x.xxx

Remark:

- After the introduction of a new P.ID. all PI- and RI-data are erased.

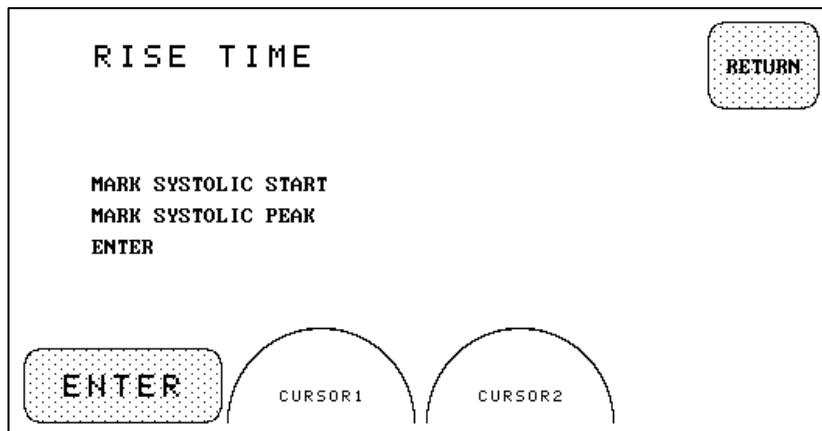
### 10.15.9. Heart Rate

See chapter Cardiology D-Mode

### 10.15.10.Rise Time



Select the measuring program by touching this key,  
The following menu appears on the monitor.



#### Operation:

1. Switch on measuring program "RISE TIME" (key "RISE TIME")
2. Mark the systolic start (digipot)
3. Mark the systolic peak (digipot).  
For the calculation the time between Cursor 1 and Cursor 2 is essential  
(Cursor 1 may be on the right of Cursor 2).
4. Calculate the Rise Time (touch key "ENTER")

Result:      RT      =    xxx ms

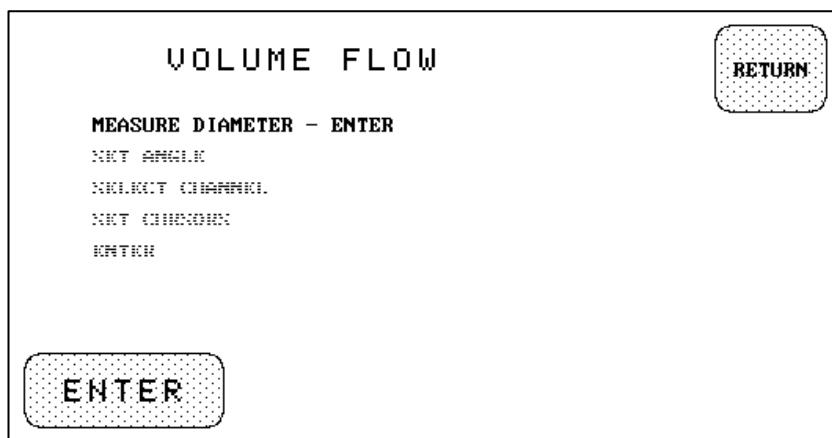
### 10.15.11. Volume Flow

First the circular area is calculated from a diameter (distance) measurement, then the temporal mean value of the mean velocity curve ( $V_{mean}$ ) between Cursor 1 and Cursor 2 is determined, then the volume flow is calculated according to the following formula:

A = $(d^2 \times \pi)/4$	d = DIAM	measured diameter
FLOW = A x $V_{mean} \times 60$	A = AREA	[cm]
	$V_{mean} \dots\dots\dots$	calculated surface
		[cm <sup>2</sup> ]
		temporal mean value of the mean
		velocity curve between
		Cursor 1 and 2
	FLOW .....	[cm/s]
		Volume Flow [ml/min]



Select the measuring program by touching this key,  
The following menu appears on the monitor.



#### Operation:

1. Switch on the measuring program "VOLUME FLOW" (key "VOLUME FLOW")
2. Determine and enter the vessel diameter in the measuring volume area. An already positioned dot can be erased with key "CLEAR LAST".
3. Position the angle cursor parallel to the vessel direction (digipot "ANGLE").
4. Select the Doppler channel (keys "UPPER", "BOTH", "LOWER"). This determines whether the envelope curve calculations takes into account only one flow direction (upper or lower) or both flow directions (both).
5. Limit the time interval (digipots CURSOR 1 and CURSOR 2).  
The limitation can take place over one or several cardiac cycles. Complete cycles must be set between Cursor 1 and 2.
6. Touch key "ENTER".  
The mean velocity curve between the two cursor lines and the following results are displayed:

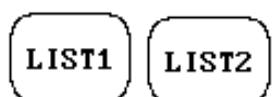
Results:      DIAM = xx.x mm  
                   AREA = x.x cm<sup>2</sup>  
                   MEAN = x cm/s  
                   FLOW = xxx ml/min

**10.15.12.Power Spectrum**

See chapter Cardiology D-Mode

**10.15.13.Maximal-, Mean-, Minimum Velocity**

See chapter Cardiology D-Mode

**10.15.14.Lists of results**

Touch the respective key,  
the following lists are displayed:

LIST 1:	LIST 2:
PI = x.xx	PI = x.xx
RI = x.xx	MAX = xx cm/s
A/B = x.xx	MIN = xx cm/s
A/D = x.xx	MEAN = xx cm/s
PI 1/2 = x.xxxxx	CYCLES x
RI 1/2 = x.xxxxx	RI = x.xx
MAX = xx cm/s	A/D = x.xx
PG = x mmHg	A = xx cm/s
PG2S = x mmHg	D = xx cm/s
RT = xxx ms	A/B = x.xx
HR(1) = xxx/min	A = xx cm/s
FLOW = xxx ml/min	B = xx cm/s



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## 11 DATA RECORDING/PRINTING

### 11.1 SCSI-Drive with removable harddisk cartridges

The SCSI-drive uses exchangeable cartridges. Type and capacity see manufacturer's instruction manual.

Position of drive: see illustration of control panel (chapter 2)

**CAUTION:** **Avoid stronger blows, shocks and vibrations to the control panel while a cartridge is inserted in the drive, otherwise the cartridge or drive may be destroyed.**

**Always remove a cartridge before transporting the system!**

#### Important instructions

- \* Please see the manufacturer's instruction manual for the correct use of the SCSI drive! The drive comes readily mounted.
- \* **A new cartridge always has to be formatted on the C 530D first even if the cartridge is already formatted.**  
**The quick formatting procedure is sufficient (see page 11-10)**

#### General remarks:

The following data sets can be stored:

- |                   |   |
|-------------------|---|
| Volume data sets: | Ultrasonic scan data of a volume + actual settings. |
| Image data sets:  | Displayed image(s) on screen + actual settings.     |
| TIFF data sets:   | Displayed image(s) on screen in TIFF format         |
- actual settings:  
All values (e.g. image size, depth range, signal processing, etc.)  
including patient data, clinic resp. MD's name, date and time

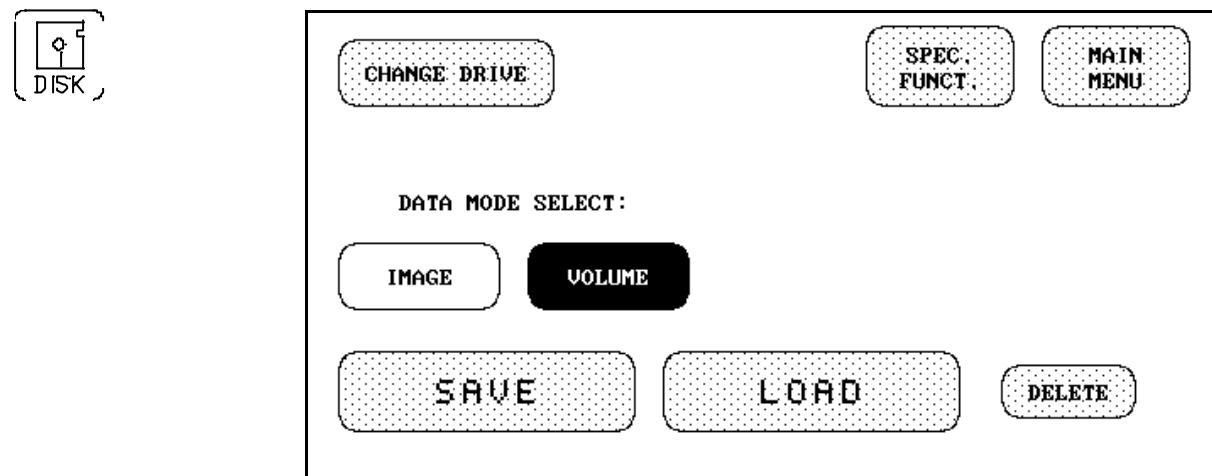
Any stored data can be replayed to the scanner console without any losses. It is advantageous e.g. that this method provides arbitrary reviews of a stored volume despite the patient's absence. Since all the working settings are reprogrammed, the original conditions are restored in case a comparative examination of a patient would be necessary. The exchangeable cartridges allow transfer of data to other memories (e.g. of a workstation) for 3D-processing.

To import and display 2D images on a PC requires 2D data sets, which are converted to a standard graphics norm. The TIFF-conversion program converts the actual display of the screen including all graphics (text, measuring data, etc.) from TV-format into a graphics file with TIFF extension while saving it disk. Reloading of a TIFF-file into the C 530D unit is impossible.

#### Note:

- |                  |  |
|------------------|--|
| Image data sets: | Following graphics data will <u>not</u> be <u>stored</u> :<br>Image text, measuring markers and measuring results, histogram,<br>ECG trace in B-image. |
| TIFF data sets:  | Images in Tiff-format can not be replayed to the scanner console.  |

### 11.1.1 SCSI-drive main menu

**IMAGE****VOLUME**

Selection of the set of data to be stored:  
Image data set or volume data set.  
In case none of these keys is activated, the "SAVE" resp. "LOAD" menu cannot be called up.

**SAVE**

Call-up of the "SAVE" -menu (chapter 11.1.2)

**LOAD**

Call-up the "LOAD" -menu (chapter 11.1.3)

**DELETE**

Call-up of the "DELETE" -menu (chapter 11.1.4)

**CHANGE DRIVE**

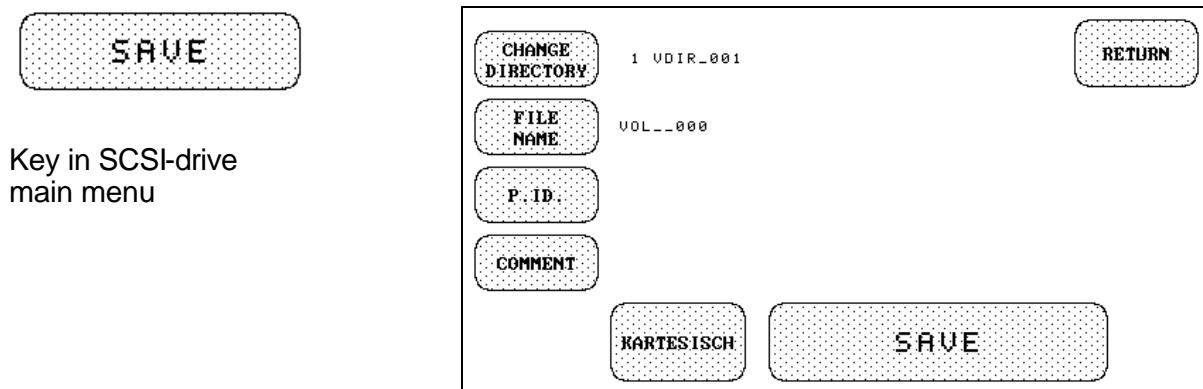
Call-up of the "DISK DRIVE" -menu (chapter 11.1.5)

**SPEC.  
FUNCT.**

Call-up of the "SPEC.FUNCT" menu (chapter 11.1.6)

Always the last actual drive menu (SCSI drive menu or floppy menu) appear.  
With "CHANGE DRIVE" in the FDD main menu and upon selecting a SCSI-drive the SCSI-drive main menu will appear.

### 11.1.2 SAVE-menu

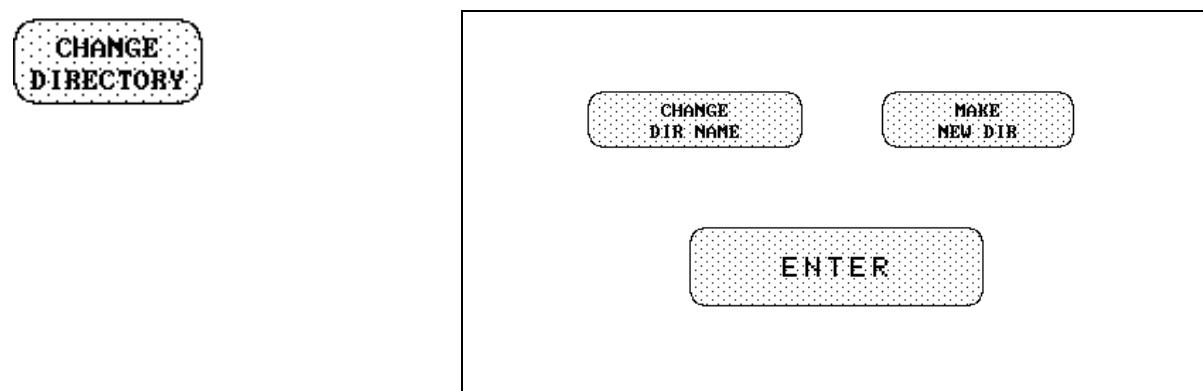


#### 11.1.2.1 To save a volume data set

Condition: key "VOLUME" in SCSI-drive main menu active

##### 1. Change directory, if wanted

Modification of the actual DIR where the data set is to be stored.



DIR sub-menu:

The 16 provided directories are displayed ("NEW" stands for unused directory space). Select a space by positioning the bright bar in the intended directory field and touch "ENTER". The SAV-menu will appear.

##### 2. Make a new directory

Position the bright bar to a "NEW" marked position and touch "MAKE NEW DIRECTORY". The system automatically provides the new directory name:

Volume data set: VDIR\_\_XX    XX : number 1 to 16 of possible DIRs  
 Image data set: IDIR\_\_XX    XX : number 1 to 16 of possible DIRs

### 3. Change directory name, if wanted

- \* Position the bright bar on the directory name to be modified.
- \* Touch the "CHANGE DIRECTORY NAME" key: the alphanumeric keys appear.
- \* Enter the new name (max. 8 characters)
- \* Touch "RETURN" to complete procedure.

### 4. Enter file name, if wanted



Filename key for entering a new filename:

Upon touch the alphanumeric keyboard appears. The filename consists of max. 8 characters (letters and/or digits, no special characters!)

After entering touch the "RETURN" key. The "SAVE" sub-menu appears. In case no filename is entered the data set will be named automatically:

data set:	Volume	Image
	VOL_001	IMAGE001
	VOL_002	IMAGE002
	VOL_003	IMAGE003
.	.	.
.	.	.
etc.		etc.

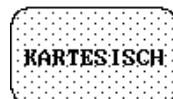
### 5. Enter a comment, if wanted



Comment key:

When touched, the alphanumeric keys for entering a comment (max. 30 characters) appear. The comment is shown beside the comment key. For completion touch the "RETUNR" key.

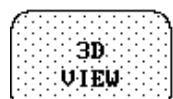
### 6. Storage of the data set in Cartesian coordinates, if wanted.



Touch the key "CARTESIAN"

Description of the function, see chapter 11.1.8

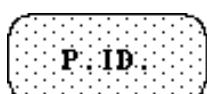
### 7. Additional storage of a 3D-VIEW calculation, if wanted



Touch the key

Key appears only if a 3D-calculation has been performed. If it is not activated, the volume data set is stored without the 3D-calculation. The 3D-calculation alone cannot be stored.

8. Enter resp. correct P.ID., if wanted



Touch the key if you want to enter resp. to correct P.ID. data. Only the first line of the 2-line P.ID. is displayed and stored. After entering, touch the "RETURN" key.

9. Store a data set



Touch the key to start the "SAVE" process.

During the SAVE process no operation of the equipment is possible. A running number informs about the progress. At zero the process is finished and the VOL-READ main menu appears on the touchpanel.

Before starting the SAVE process it is recommended to check P.ID., comments, file name, DIR and eventually make corrections. In case of insufficient space on the disk, the touchpanel will display "DISK FULL".

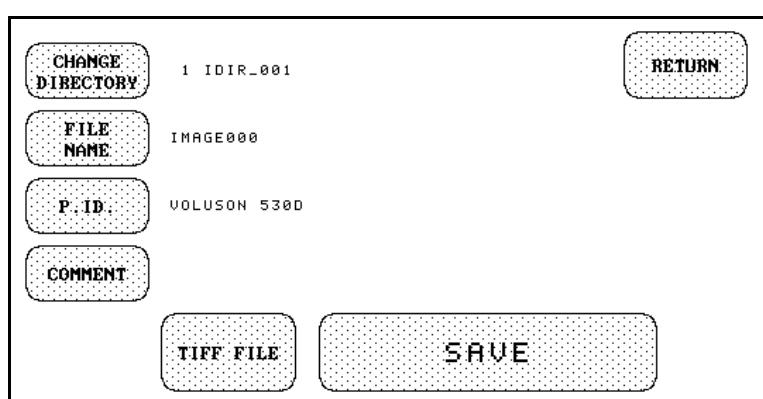
Remarks:

- \* The SAVE-menu cannot be called up (touch of the "SAVE" key causes beeping) if neither the "IMAGE" nor the "VOLUME" key is active.
- \* Data sets in Cartesian coordinates are marked with an "\*" in the file directory of the "LOAD" menu.
- \* Volume data sets stored with their 3D-calculation are marked with an "#" in the file directory of the "LOAD" menu.

### 11.1.2.2 To save a 2D image data set

Condition: key "IMAGE" in SCSI-drive main menu active

Key in SCSI-drive  
main menu



Operation:

It is identical to the VOL data set storage. The image as displayed on the monitor is stored upon touching the key. The following graphic data will not be stored: image inscription, measuring marks, measuring results, histograms and ECG trace in the B-scan image.

### 11.1.2.3 To save a 2D image in TIFF format

The conversion program converts the image as displayed on the monitor including all graphics (text, measuring data, etc.) from TV-format into a graphics file with TIFF extension. Reloading of a TIFF-file into the VOLUSON 530D unit is impossible.

Condition: key "IMAGE" in SCSI-drive main menu active

1. Touch the "TIFF FILE" key.



The keys for the file name entry appears.

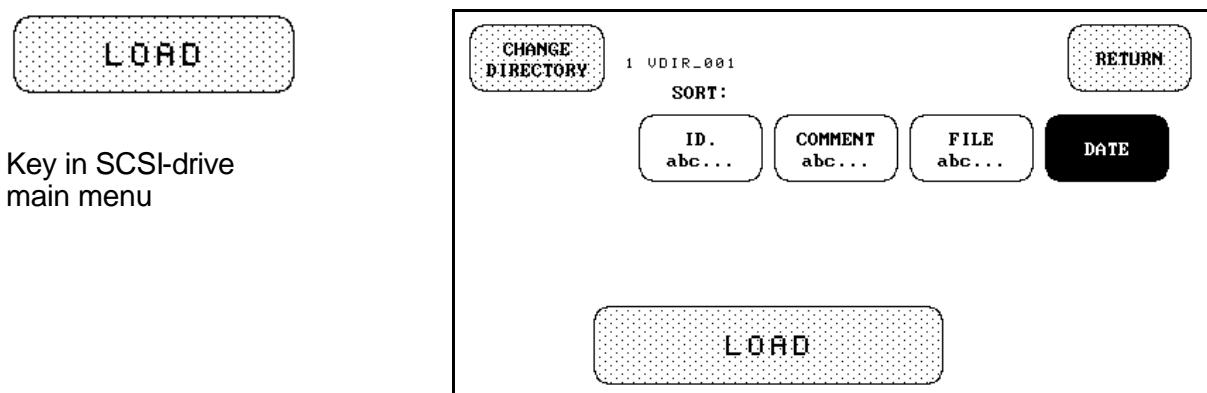
2. Enter the file name (max. 8 characters)

3. Touch the "SAVE" key.

The image is converted and stored on the cartridge under the automatically established "TIF" directory.

### 11.1.3 LOAD-menu

Before touching the load key select "IMAGE" or "VOLUME" data set before.



The display shows the file list of the actual directory. The 1st file is marked with the bright bar.

#### 11.1.3.1 Loading a data set

1. Select the file to be loaded: position bright bar by trackball:

Note: To select a file from the next display page just continue to move the bar down.

2. Touch the "LOAD" key:

Note: During loading system operation is impossible. A running number informs about the process with volume data sets. With zero, loading is completed and either the VOL-READ menu or the image menu appears depending on the data set.

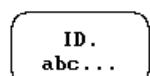
### 11.1.3.2 Support functions



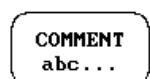
Change directory.

The provided directories appear. Position the bar on the wanted DIR and touch "ENTER". The display will show the file list of the DIR and the "LOAD" sub-menu appears on the touchpanel.

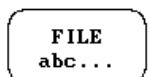
### 11.1.3.3 File sorting



Alphabetic sorting of the file list by P.ID.



Alphabetic sorting of the file list by comments.



Alphabetic sorting of the file list by filenames.

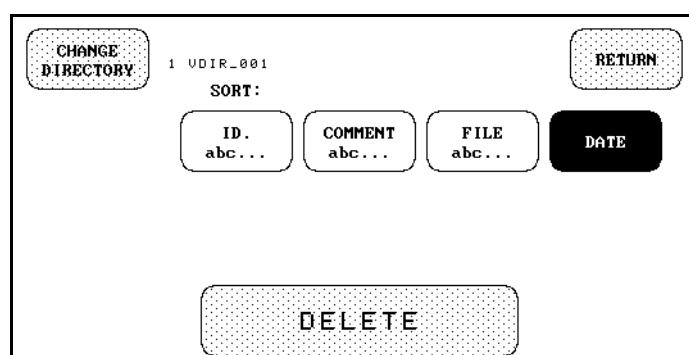


Alphabetic sorting of the file list by date

### 11.1.4 DELETE-menu



Key in SCSI-drive main menu

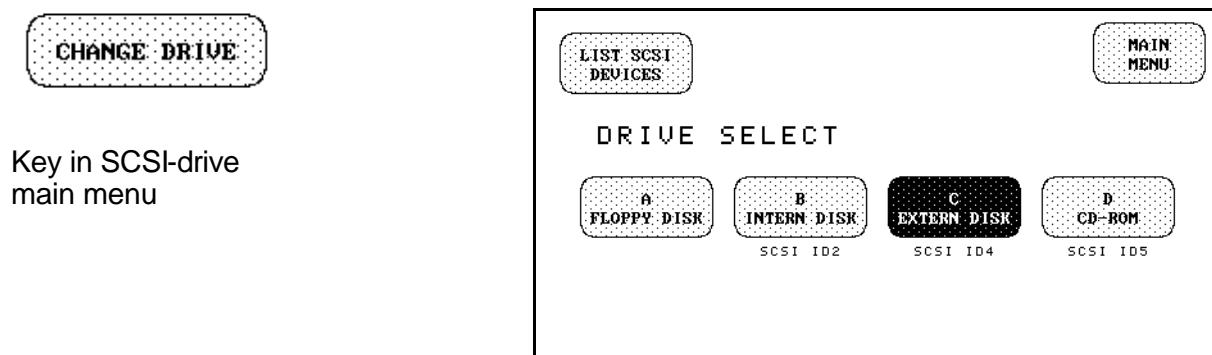


The display shows the file list of the actual directory.

Erasure of a file:

1. Select the file to be erased: position the bar by the trackball.
2. Touch the "DELETE" key.  
The touchpanel shows "**Delete file?**" Yes / No
3. Key "YES": File will be deleted.  
Key "NO": File will not be deleted.
4. Key "RETURN": return to the SCSI-drive main menu.

### 11.1.5 DRIVE-menu



- Select the FDD  
The Floppy Disk main menu appears.
- Select the internal SCSI-drive (ID 2)  
The SCSI-drive main menu appears.
- Select SCSI-drive (ID4)  
The SCSI-drive main menu appears.  
Note: only possible, if an external SCSI-Drive is connected.  
The ID-number has to be 4!
- Select CD-ROM drive (ID5)  
The SCSI-drive main menu appears.
- All the SCSI-devices connected will be displayed on the touchpanel.

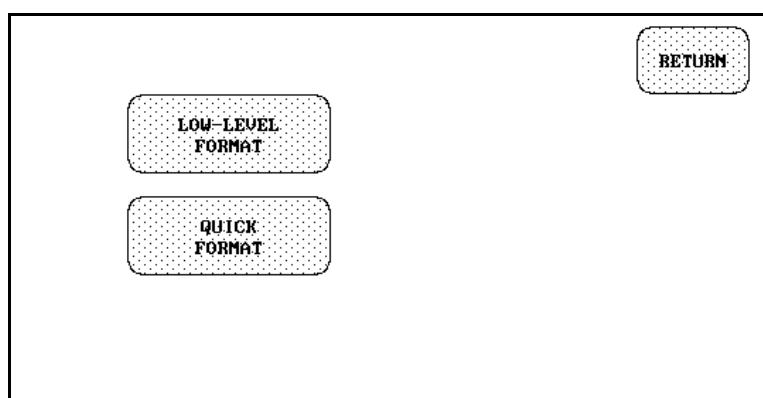
Remark: As long as there is no drive connected, or the actual drive is below operational rpm, the message "**NO DISK IN DRIVE**" will be displayed.

### 11.1.6 SPEC.FUNCT.-menu



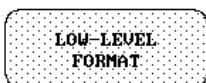
Key in SCSI-drive main menu

In this menu the keys for formatting of cartridges are provided.



Key for quick formatting

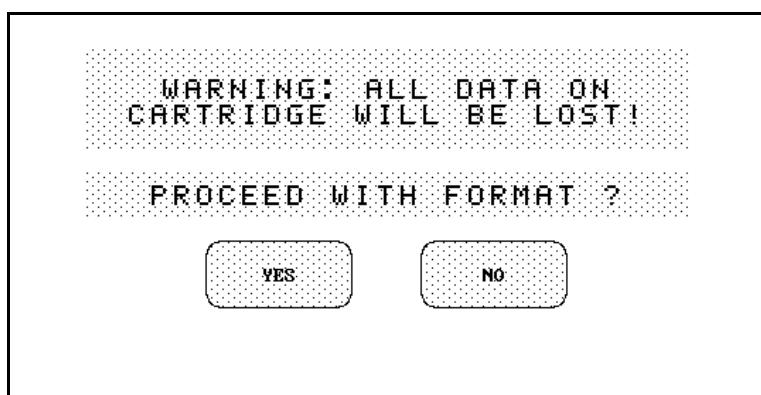
The FAT (FAT = File Allocation Table) will be (re-)formatted. Normally this type of formatting is sufficient.



Key for low-level formatting

This is for complete (new) formatting. In case of Disk Read/Write error messages, eventually use this type of formatting to repair a fault.

Upon touching either one of these keys the following alert message is displayed:



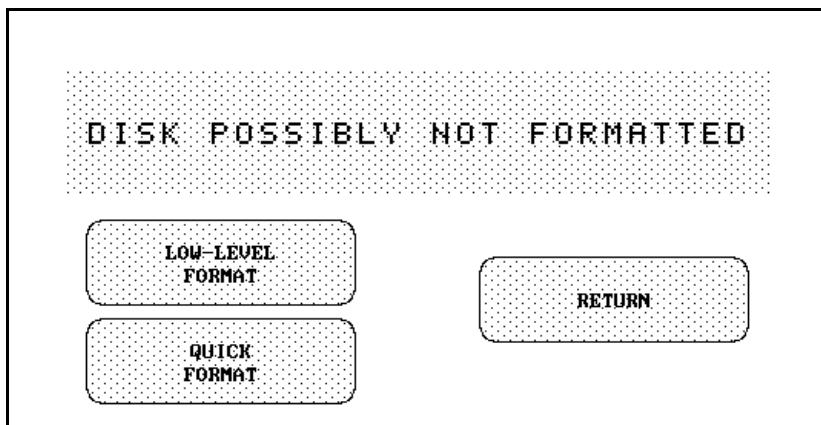
Key "YES":  
Formatting starts

Key "NO":  
Back to main menu

During the formatting process the following message is displayed:  
**"PLEASE WAIT, FORMATTING IN PROGRESS"**

and the system cannot be operated. After completion of formatting the current main menu reappears.

A new cartridge or one already used with e.g. a personal computer must be re-formatted, when the following message is displayed:



Touch key "QUICK FORMATTING".

Remark: If a cartridge is not formatted at all it is necessary to perform a low level formatting.

### 11.1.7 Error messages on the Touchpanel

#### NO DEVICE PRESENT

Drive not connected  
Drive not switched on  
No cartridge in drive  
The cartridge is not in due rpm.

#### "DISK READ/WRITE ERROR":

Defective disk or defective disk drive  
Transfer error - repeat read/write procedure  
If the error remains, re-format the disk.

#### 11.1.7.1 State of operation messages on the touchpanel

"PLEASE WAIT, DRIVE INITIALIZED"  
"PLEASE WAIT, DIRECTORY IS MADE"  
"PLEASE WAIT, FILE IS DELETED"  
"PLEASE WAIT, COUNTDOWN TO 0, TRANSFER RUNNING"  
"PLEASE WAIT, DISK.FORMATTING RUNNING"

During these messages operating the system is impossible!

### 11.1.8 Cartesian volume data set

Two ways of storing a VOL data set onto mass medium (e.g. MCD-harddisk cartridge) are possible:

1. Storage of the data in polar coordinates:

The primary information (each ultrasound line of the volume scan) is stored: The coordinates of each vector are stored in the equipment-specific data section - after reloading of a data set into the unit the volume is exactly reproduced. Working with such a data set in a 3D-workstation is difficult, because calculating of a VOXEL (X, Y, Z) in space would require all the knowledge about the scangeometry of the volume acquisition.

2. Storage of the data in Cartesian coordinates:

The conversion program converts the data set in Cartesian format. The VOXELS have now equal X, Y, Z edge lengths. The transfer and processing of the data set is easy as the position of each VOXEL in space is defined.

By proper use of the ROI also parts only of the volume may be converted, with the advantage of data reduction.

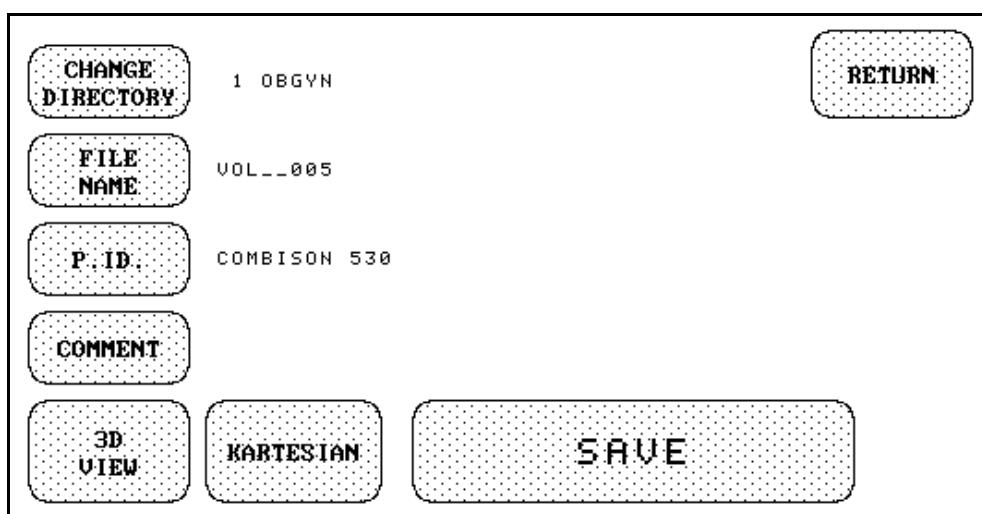
**IMPORTANT:** The 3D-Rendering program uses also the volume memory for the 3D Rendering images. If by the volume data acquisition of a large volume (high density of ultrasound lines) the memory is full with primary information, then the calculation of the 3D-Cine sequence is limited. Conversion of the data set in Cartesian format (reduction to max. 16 MByte) and loading of a data set an additional 16 MByte space for a sequence of 128 3D Rendered images is available.

Operation:

Condition: Volume stored resp. volume data set (in polar coordinates!) loaded.

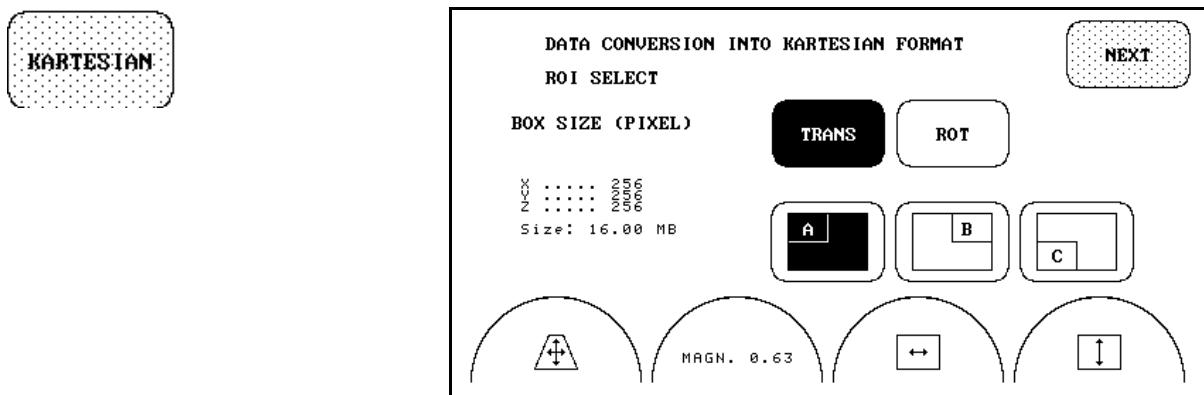
1. Select the "SAVE" menu.

The operation is identical with the storage of a volume scan, see page 11-4.



### 2. Touch key "CARTESIAN"

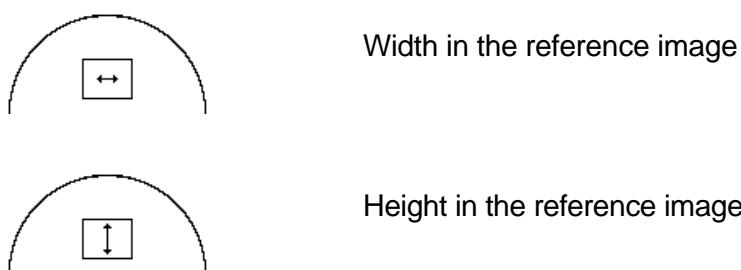
The sub-menu for the setting of this mode appears.



A yellow ROI-BOX is displayed in the A, B and C sectional images. The information within the ROI-BOX will be converted in Cartesian format.

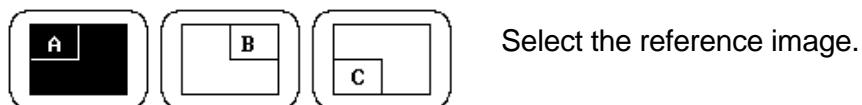
The operation steps below may be performed in free order.

### 3. Adjust the VOL-BOX (ROI-BOX)



#### Remark:

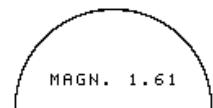
- \* By selecting the reference image the BOX can be adjusted in each A, B, C image.



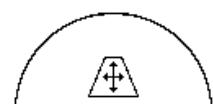
## 4. Adjust the size and position of the image relative to the BOX size



Activate "TRANS" key (illuminated)



Adjust the image size



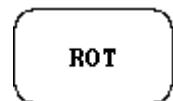
Trackball: Adjust position of the image relative to the ROI-BOX

The BOX-position is centered in the A, B, C sections and cannot be altered.

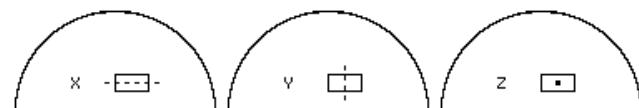
Remark:

- \* With the large digipot the ultrasound information can be checked by parallel sections showing within the ROI-BOX. The rotary controls are always referred to the reference image.

## 5. Rotate the image content in the ROI-BOX, if necessary.



Activate the "ROT" key.



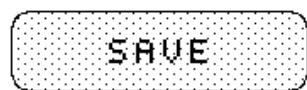
With the digipots rotate the data sets about the axes. The axes are automatically in the center of the BOX.

The digipots are always referred to the reference image.

## 6. Touch the "NEXT" key: the "SAVE" sub-menu appears.

Check the file names, the comment, the directory and correct, if necessary.

## 7.52 Touch the key SAVE:



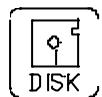
The data set is converted and transferred to the disk. During the data transfer following message appears on the touchpanel:

**"PLEASE WAIT,COUNTDOWN TO 0,TRANSFER RUNNING".**

## 8. Loading a data set in Cartesian format is performed the same way as a "normal" data set (see chapter 11.1.3).

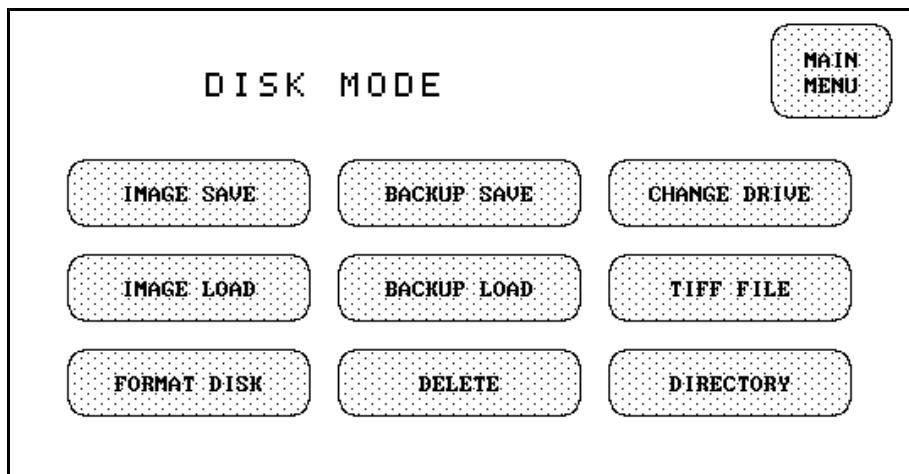
## 11.2 FLOPPY-DISK DRIVE (FDD)

### 11.2.1 Menu "DISK MODE" (Floppy disk main menu)



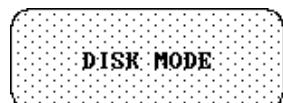
Menu key "DISK" (hard key)

Menu: DISK MODE



Based on this survey the different diskette modes are to be selected. Touching a key starts the sub-menu concerned.

This key switches the disk drive function for FDD resp. HDD on. The control menu of the last active mode appears. Change of disk drive, please see next page.

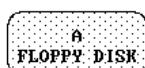
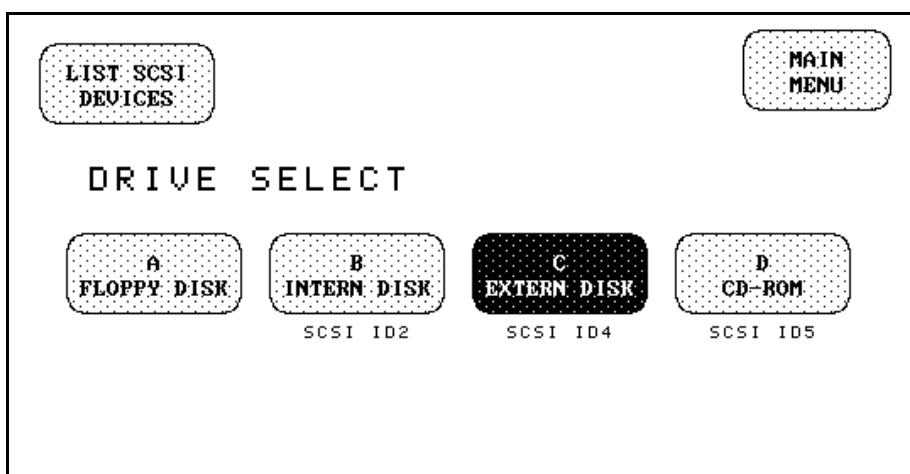


Call-up of the "DISK MODE" menu from an FDD sub-menu.  
Key available in all FDD sub-menus.

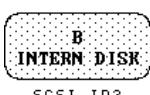
### 11.2.2 Change drive



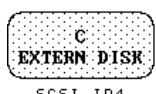
Call-up of the "DRIVE" sub-menu.  
Key in "DISK MODE" menu and in SyQuest main menu  
(see page 11-2)



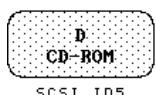
Select the FDD  
The Floppy Disk main menu appears.



Select the internal SCSI-drive (ID 2)  
The SCSI-drive main menu appears.



Select SCSI-drive (ID4)  
The SCSI-drive main menu appears.  
Note: only possible, if an external SCSI-Drive is connected.  
The ID-number has to be 4!



Select CD-ROM drive (ID5)  
The SCSI-drive main menu appears.



All the SCSI-devices connected will be displayed on the touchpanel.

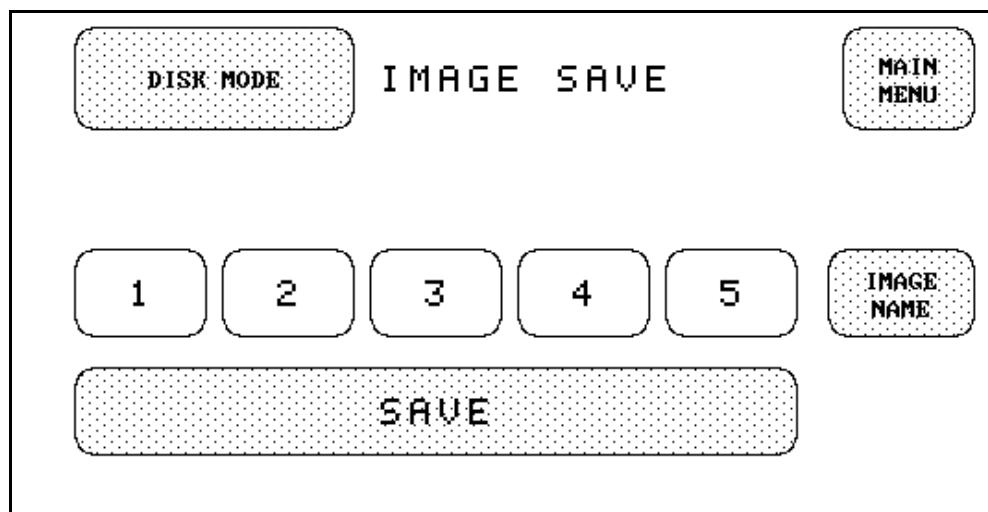
Remark: As long as there is no drive connected, or the actual drive is below operational rpm, the message "**NO DISK IN DRIVE**" will be displayed.

### 11.2.3 Image save



Menu key "IMAGE SAVE"

Key in menu "DISKETTE"



#### Operation:

1. Touch an image key (1 to 5)  
An enlightened raster means an image in this position is memorized.
2. Touch key "IMAGE NAME" for entry of a short denomination. The alphanumerically keys appear. Enter the name, touch key "RETURN". There is no must to enter a name.
3. Touch key "SAVE"  
The display shows:  
**"PLEASE WAIT A MOMENT,STORING IMAGE ON DISK"**

#### Remarks:

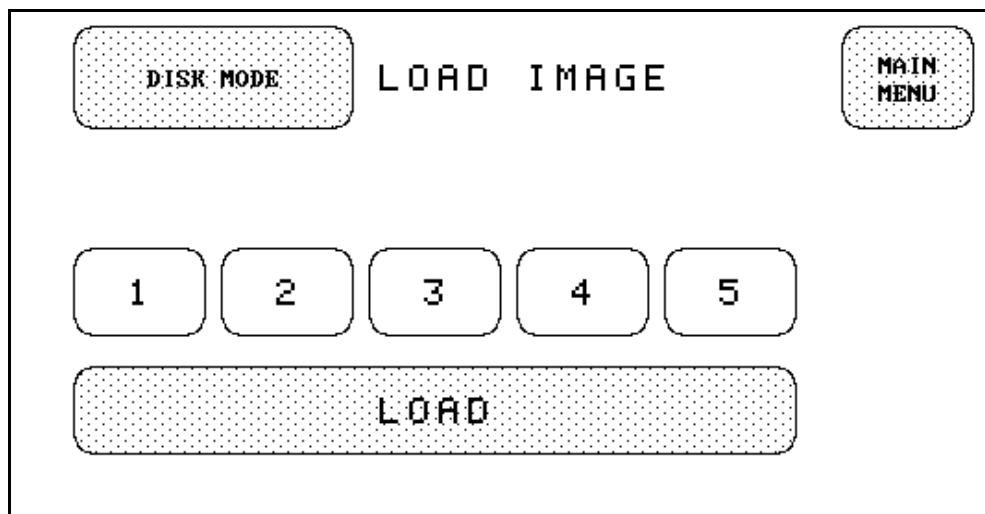
- \* The following data will be saved: the displayed ultrasound image, the patient I.D., date, time, all the scanner settings (but no text, no measurement results).
- \* In case the memory space gets too small "**DISK FULL**" will be displayed.
- \* During the save procedure the scanner accepts no control operation.

### 11.2.4 Image load



Menu key "IMAGE LOAD"

Key in menu "DISK MODE"



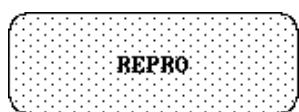
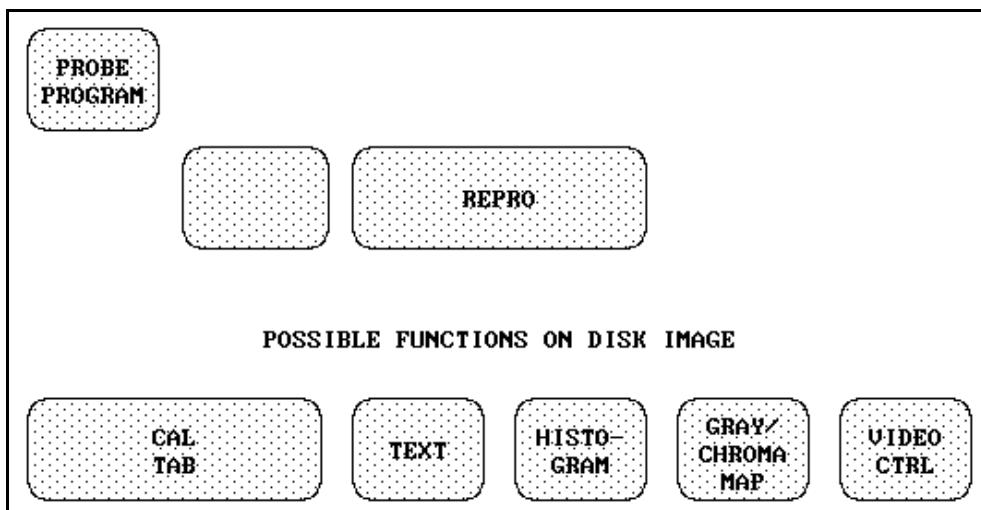
The monitor screen displays the list of stored images 1 through 5 with their names, provided names have been entered before storage of image(s).

#### Operation:

1. Touch an image key (1 to 5)  
An enlightened raster means an image in this position is memorized.
2. Touch key "LOAD"  
The display shows:  
**"PLEASE WAIT A MOMENT,LOADING IMAGE FROM DISK"**  
After the loading procedure the disk mode is off and the disk image control menu containing keys to eventually modify the image will appear.

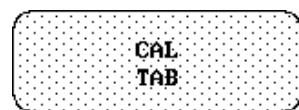
After the transfer (load) process the disk mode is switched off and the disk image menu appears. In this menu the keys for later image processing are contained, see next page.

MENU DISK IMAGE (after loading)

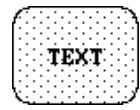


REPRO function

Upon touching this key the complete probe settings with the reproduced image will be loaded. With this function subsequent examinations with same settings are possible.



Key "CALC/TAB" (see chapter 10)



Key "TEXT" (see chapter 3)



Key "HISTOGRAM" (see chapter 5)



Key "GRAY/CROMA MAPPING" (see chapter 5)



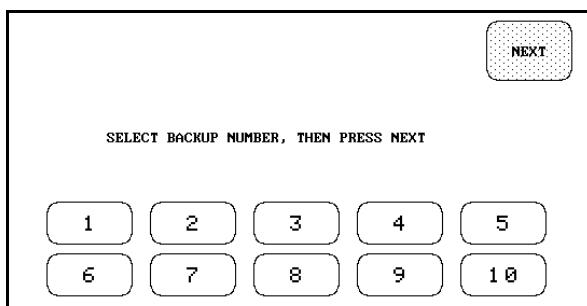
Key "VIDEO CONTROL" (see chapter 11)

### 11.2.5 Backup save

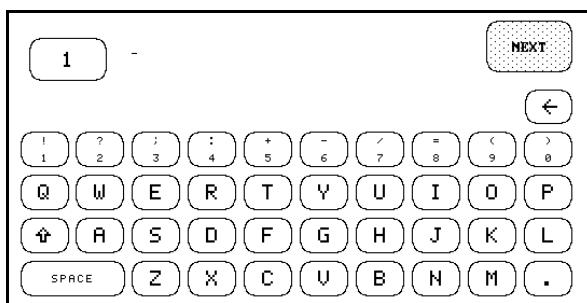


Menu key "BACKUP SAVE"

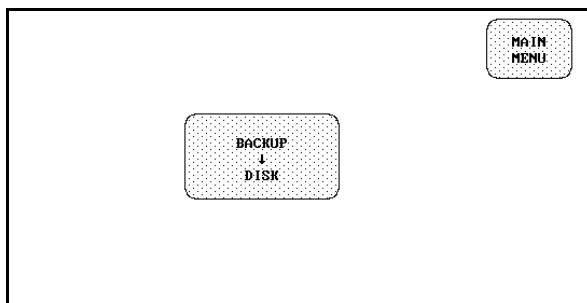
Key in menu "DISK MODE"



Select the backup number, then touch "NEXT"



Enter name for the backup, then touch "NEXT"



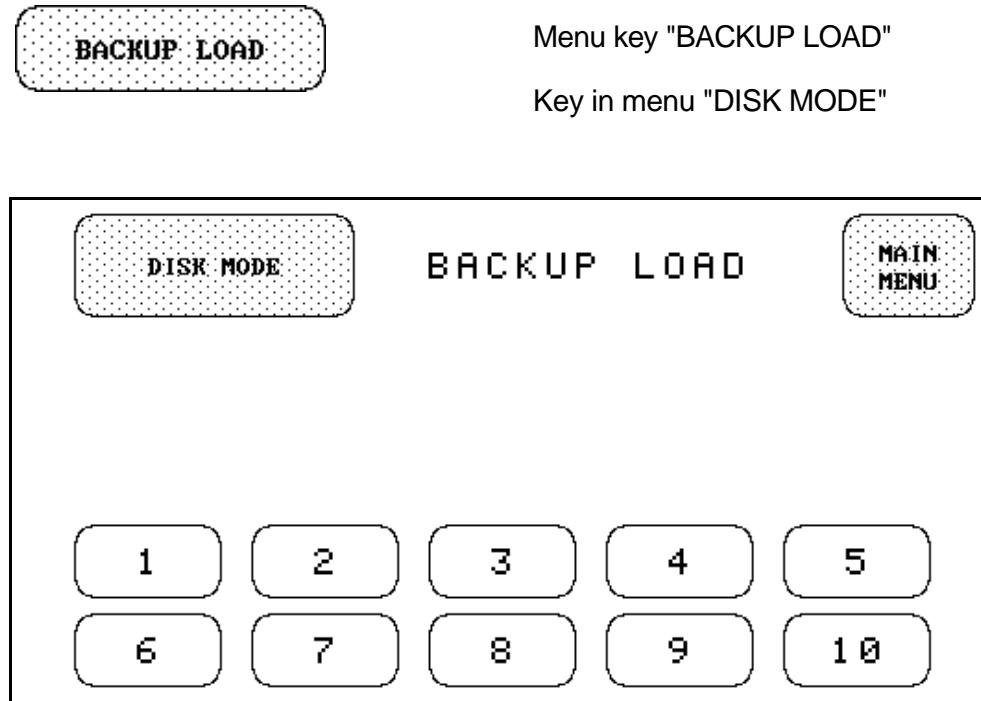
Touch key "BACKUP → DISK", the backup is saved on the disk.

If key "MAIN MENU" is touched, the backup will not be saved.

#### Remarks:

- \* The backup will save the following programmed scanner data: program memory, biometric tables, biopsy lines, text auto memory, clinic name.
- \* The backup allows rapid change of scanner settings from different users when loaded into the scanner's control memory.

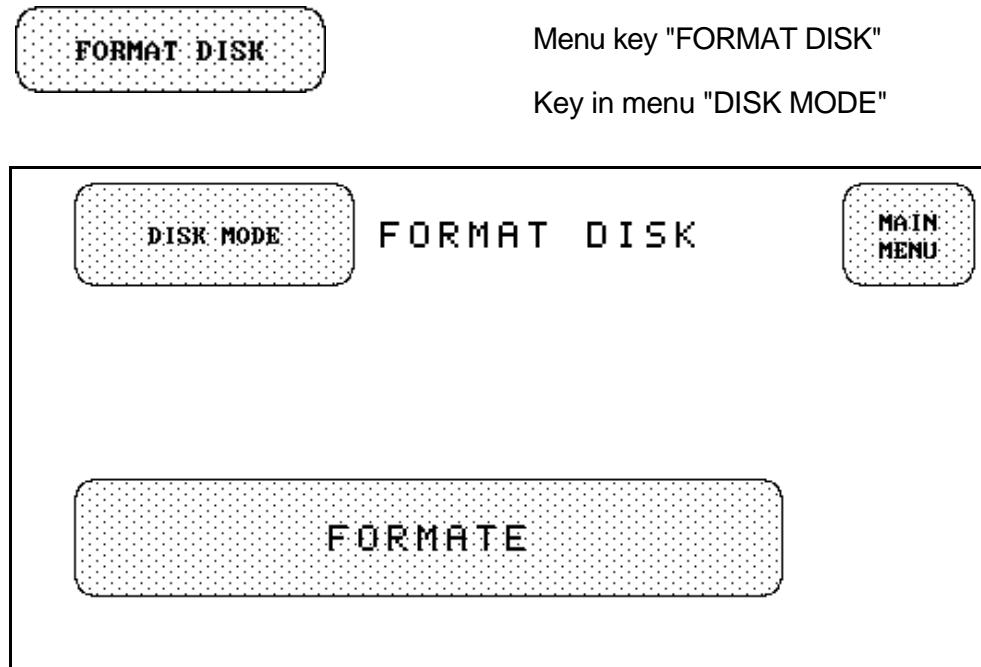
### 11.2.6 Backup load



When this sub-menu is selected, the denominations of the backup on the disk will be displayed on the screen.

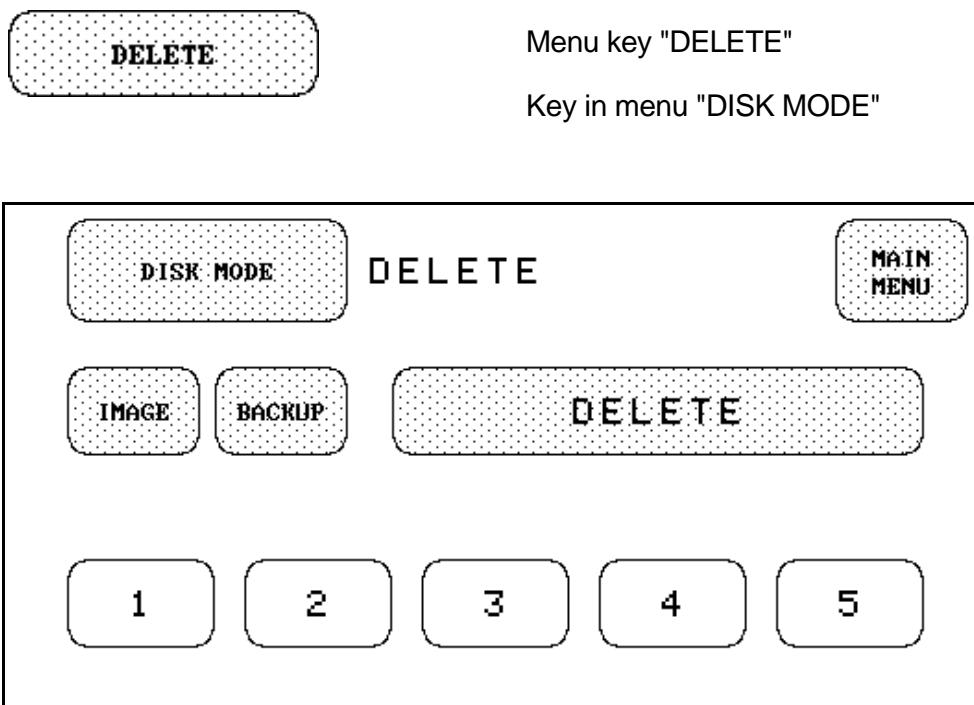
Loading of a backup is activated by touching the appropriate key (1 to 10).

### 11.2.7 Formatting a diskette



Formatting of a disk is activated by touching key "FORMATE". The touchpanel displays "**PLEASE WAIT, DISK FORMATTING ON**"

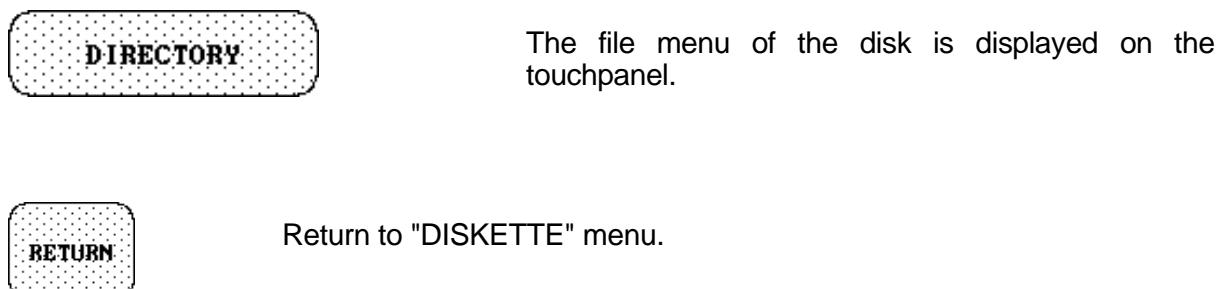
### 11.2.8 Delete file



In this menu only those files on the disk can be erased which were stored from the scanner onto the disk.

1. Touch key "IMAGE" or "BACKUP"  
A survey of the stored images or backups appears.
2. Touch the number key of the file to be deleted.
3. Touch "DELETE"

### 11.2.9 Directory



### 11.2.10 Diskette

Type: 3.5" DS, HD  
Double side  
High Density  
2.0 MB

Possible error messages on the touchpanel:

- \* Disk is write protected
- \* No disk in drive
- \* Disk is full
- \* Disk read/write error (disk defective)

Touch the "TOUCH HERE" key to restart after error message.

### 11.2.11 TIFF-File

General:

By this software the monitor image (also color image) including all graphic features (text, measuring data, etc.) are converted from TV-format into a graphics file with TIFF extension and is stored on the disk.

Reloading of a TIFF-file into the basic unit is impossible. A TIFF-file may be stored on a diskette as well as on an SCSI-drive.

Practical use:

- \* Making slides by transfer of a image in TIFF-format on a diskette into a documentation apparatus.
- \* Processing of an image in a PC with special software.

Operation:

1. Touch key "TIFF FILE" in the "DISKETTE" menu  
The keys for entering the file name appear.
2. Enter the file name (max. 8 characters).
3. Touch key "SAVE".  
The image on the monitor is converted and transferred to the floppy disk. It is possible to transfer/store max. 3 TIFF-images on a diskette.

### 11.3 CD-ROM DRIVE

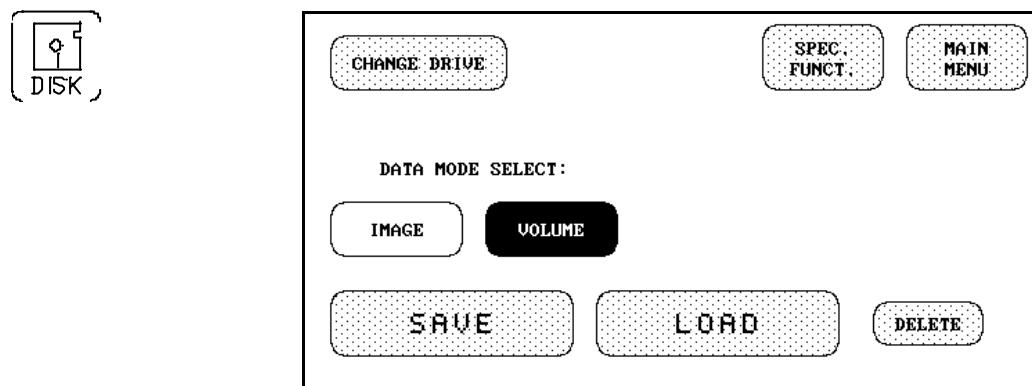
#### General:

Volume- or image data sets of a CD-ROM can be loaded again to the system. To create a CD-ROM is not supported by the system VOLUSON 530D. The creation is done for example by copying datasets from the hard disk cartridges to a CD-ROM with help of a CD-ROM-writer on a PC.

Operating the CD-ROM drive is identical as the SCSI-hard disk drive.

Because of the read-only-memory medium only the load functions are available.

1. Switch on the disk function



Always the last actual drive menu (SCSI drive menu or floppy menu) appear. With "CHANGE DRIVE" in the FDD main menu and upon selecting the CD-ROM-drive the SCSI-drive main menu will appear.

2. Selection of the set of data to be loaded:



Image data set or volume data set.  
In case none of these keys is activated, "LOAD" menu cannot be called up.

3. Select the load menu - touch the key "LOAD"
4. Change DIR if wanted - touch the "CHANGE DIR" key
5. Select data set with the trackball
6. Load data set - touch the key "LOAD"

Operating the CD-ROM drive is identical as to operate the SCSI-hard disk drive. Therefore for more details see chapter 11.1.3 (Load menu )

## 11.4 PRINTING

### 11.4.1 Black/white printer

The black and white printer comes already installed with the system.  
Connection scheme (e.g. Mitsubishi P90E) see chapter 13

Condition: The video printer is connected to the remote control socket at the rear panel.  
The key "PRINT A" is assigned to B/W-Printer, see Printer remote setup  
chapter 12

#### Operation:



PRINTER TRIGGER KEY A

By pressing the key the actual screen display will be printed.  
For detailed adjustment see original user's manual of the printer.  
If the remote cable is not connected, use the controls of the printer.

### 11.4.2 Color printer

The color printer comes already installed with the system.  
Connection scheme (e.g. Sony UP-2800P or Mitsubishi CP700E) see chapter 13  
Use the Printer-Remote cable: Type: KUK1 PNO: 194906

Condition: The video printer is connected to the remote control socket at the rear panel  
and the key "PRINT B" is assigned to the Printer, see Printer remote setup  
chapter 12. The printer itself has to be set to MEM&PRINT.

#### Operation:



PRINTER TRIGGER KEY B

By pressing the key the actual screen display will be printed.  
For detailed adjustment see original user's manual of the printer  
If the remote cable is not connected, use the controls of the printer.

### 11.4.3 DICOM Printer

The printer comes already installed with the system.

Condition: The printer is connected to the net connector at the rear panel and the key  
"PRINT A" and "PRINT B" are assigned to the Printer, see Printer remote  
setup chapter 12.

#### Operation:

Operation see DICOM supplement to user's manual

## 11.5 S-VHS Video recorder

### 11.5.1 Remote control by the system (Touchpanel)

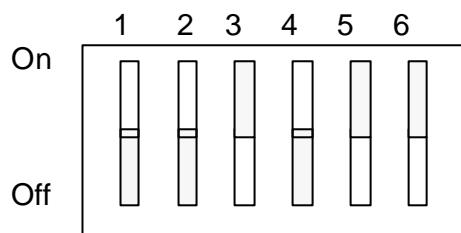
#### 11.5.1.1 Condition/Setup:

- VCR-Type: Sony SV09500MDP with RS-232C Interface Board SVBK-120  
Connection scheme see chapter 13

Use the supplied S-VHS cable: Type: KUV1 PNO: 154072  
(due to the special S-VHS connector of the system!)

Use the VCR-Remote cable: Type: KUG1 PNO: 194905

- Set DIP Switches on RS 232C interface board as shown:



Switch 1: OFF - Audio is muted during fast playback - (play\_ff).

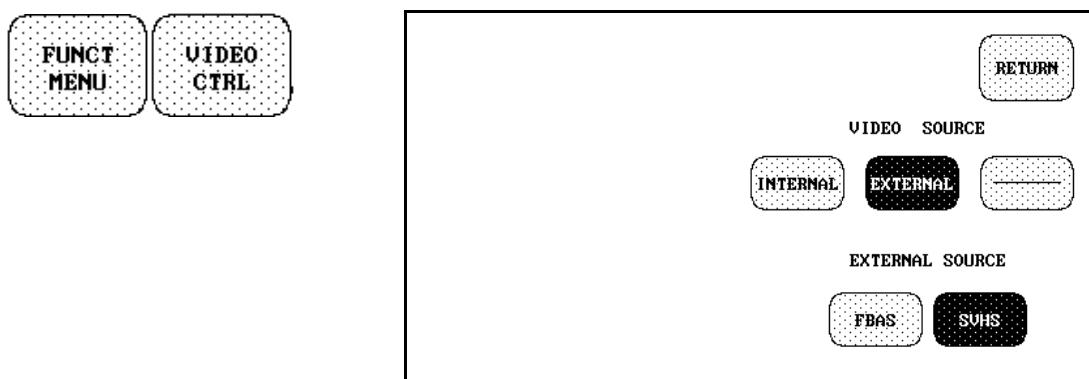
Switch 2: OFF - FF/REW mode is used during searches.

Switch 3: ON - VCR counter is reset upon cassette ejection.

Switch 4: OFF - The VCR can be controlled by the VOLUSON 530D/MT

Switch 5 and 6: ON ON - The Baud rate is set to 19200 bit/sec (must be the same as VOLUSON 530D/MT)

- Select external video source S-VHS on ultrasound system:



- touch the key "EXTERNAL", if not active

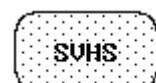


An externally connected video signal (e.g. VCR) is displayed on the monitor.  
Connections of external Video source see rear panel chapter 13  
FBAS: coax socket No. 9  
SVHS: SVHS socket No. 12

- select external video source



Selection of video source FBAS



Selection of video source SVHS

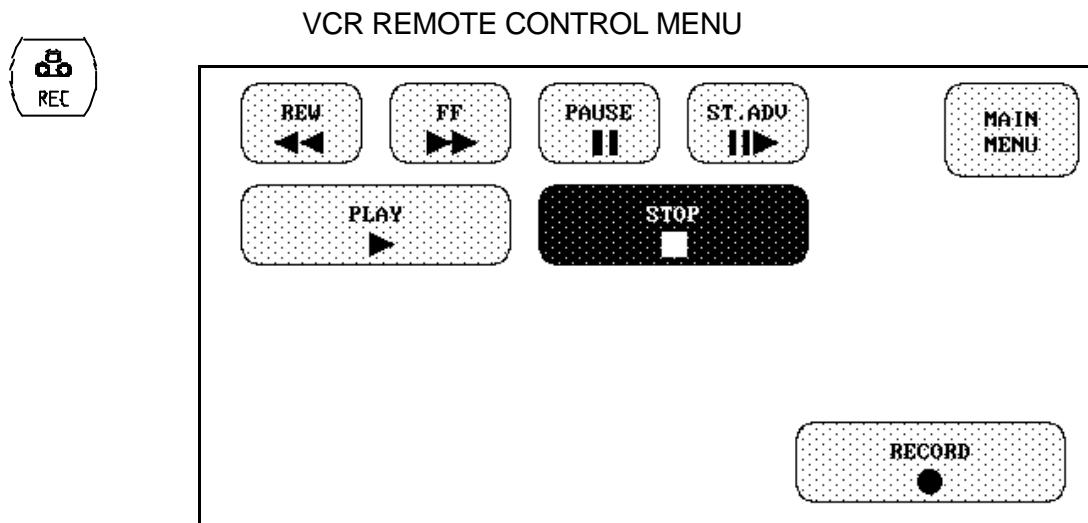
Note:

Always due to quality the S-VHS source should be used.

The setting of external video source is stored in the system. By touching the key "PLAY" on touchpanel the system switches automatically to the predefined external video source.

#### 11.5.1.2 Operation:

- *Standard operation*



FF:	touch STOP, if not active and then FF
REV:	touch STOP, if not active and then REV
PLAY_FF:	touch PLAY and then FF
PLAY_REW:	touch PLAY and then REW
PAUSE:	touch PLAY, if not active and then PAUSE
ST.ADV:	touch PLAY and PAUSE and then ST.ADV.
RECORD:	touch RECORD
if PLAY active:	recording starts
if STOP active:	recording starts
if FF active:	record + pause is activated
if REV active:	record + pause is activated
if PAUSE active:	record + pause is activated

- **Fast recording**



double push starts recording  
double push stops recording

The recording starts immediately and in the left upper corner of the screen the red flashing "REC" sign informs about the record status. The VCR-Menu will not appear to be able to control the ultrasound system.

additional hints:

When entering the VCR menu, the control of the VCR is given to the touch screen only. No manual operation of the VCR possible. When leaving this menu, the control is given back to the VCR. Manual operation of the VCR possible.

When there is no cassette in the drive, an error message is displayed on the monitor.

When recording, the cassette is checked for write protection.

If communication with the VCR is incorrect, an error message is displayed on the monitor.

The C530D polls the VCR every 2 seconds to check the status, and update the VCR main menu. If there is an error checking the status, a message is displayed.

Error Messages:

Initial check - \*\* VCR NOT PROPERLY CONNECTED OR TURNED OFF \*\*

No response from the VCR - \*\* VCR TIMEOUT ERROR \*\*

VCR didn't acknowledge the command sent - \*\* VCR COMMUNICATION ERROR \*\*

Cassette not in drive when entering menu - \*\* NO CASSETTE IN DRIVE \*\*

Cannot record to cassette in drive - \*\* WRITE PROTECTED CASSETTE!! \*\*

### 11.5.2 VCR operation without remote connection to the system

#### 11.5.2.1 Condition:

- VCR-Type: Sony SV09500MDP

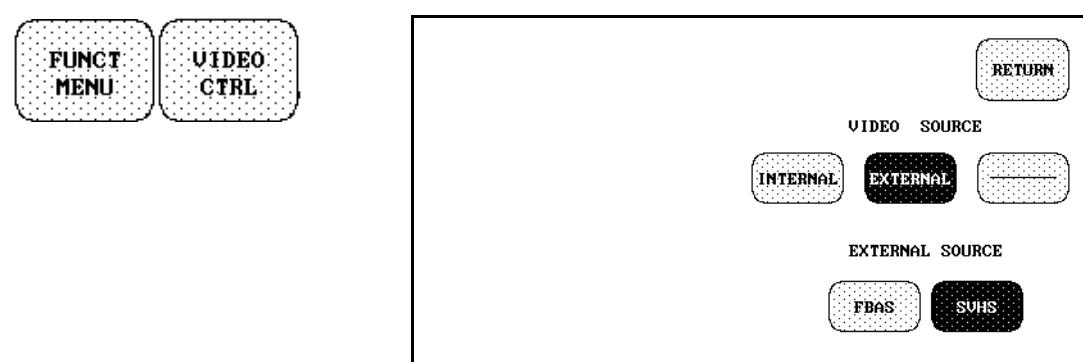
Connection scheme see chapter 13

Use the supplied S-VHS cable: Type: KUV1 PNO: 154072 due to the special S-VHS connector of the system!

#### 11.5.2.2 Operation:

- **Playback**

1. Select external video source on the ultrasound system:



touch the key "EXTERNAL"



An externally connected video signal (e.g. VCR) is displayed on the monitor.  
Connections of external Video source see rear panel chapter 13  
FBAS: coax socket No. 9  
SVHS: SVHS socket No. 12



Selection of video source FBAS



Selection of video source SVHS

2. Switch the recorder to PLAY-mode.

Use the control keys or the remote control of the recorder.  
Operation see original user's manual of the recorder.

3. To switch back to system's video press the key "INTERNAL"

- **Recording and all other functions of VCR**

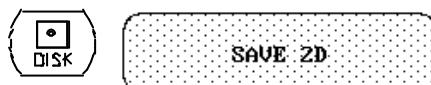
Use the control keys or the remote control of the recorder.  
Operation see original user's manual of the recorder.

## 11.6 SonoView

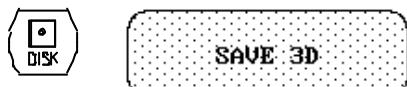
SonoView is an image management system for ultrasound images. It provides fast and easy image management capabilities. It allows the user to store, view, report, and transfer images. In addition, SonoView also allows the user to send DICOM images via DICOM network. The user can manage image data effectively via database.

### 11.6.1 Saving Images

The scanned images can be stored as 2D images, Volume data sets can be stored in polar- or cartesian coordinates.



Press these keys for saving the image(s) as a 2D image to SonoView. If an other drive is selected touch the SONOVIEW-key at first.  
After storing the data the main menu appears again.



Press these keys for saving the image(s) as 3D images in polar coordinates to SonoView.  
After storing the data the main menu appears again



Press these keys for saving the image(s) as 3D images in cartesian coordinates to SonoView.  
After storing the data the main menu appears again

**Precaution:** The images are stored according to the patient's ID. If no ID is present on the system, you have to input an ID for proper storing.

### 11.6.2 Exam Selection

This chapter describes how to select, load, remove and backup exams. It also describes how to select exams from backup media and transfer exams to other systems via DICOM network.

#### Using the Exam List



Click on this button by using the trackball and the SIMUL-key.  
The following window appears on the monitor.  
A list of all exams stored on the internal hard disk (window LOCAL) or removable media (window BACKUP) is provided.



- Select the Exam(s):**

Use the trackball and the SIMULT-key to select the exam.

Click the same line again to cancel the selection. You can select several exams.

The approximate amount of image space left on the disk (number of images), number of selected exams and images are shown at the bottom of the exams list.

Note: a double click directly selects the exam.

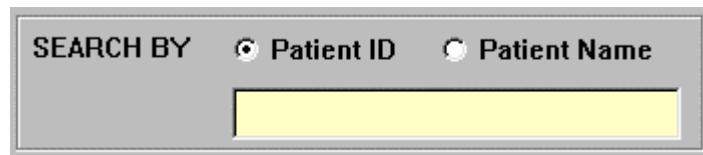
- Sort the Exam list:**

Click on the corresponding icon to sort the exam list by patient ID or Date of study.



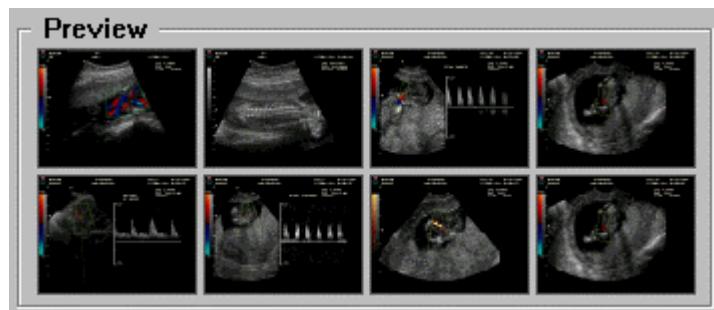
- Search Exams:**

Click on the corresponding icon to search for patient IDs or patient names. Enter patient's ID resp. patient's name into the data field. The system will automatically find the closest expression.



- Preview Images:**

If an exam is selected up to eight images appear in the 'Preview' field to find the exam resp. images.



### 11.6.3 Loading Exams

You can load exams in the following ways:

- Select the desired exam(s) in the exams list and then click on the VIEW-button. All the selected exams will be loaded into the system.
- Click on the line in the exam list with a double click. Same function as above.

### 11.6.4 Removing Exams

- Select the exam in the exam list you want to delete and then
- Click on the DELETE-button to remove all images of this exam. The images are deleted permanently and cannot be recovered.

### 11.6.5 Transferring Exams via DICOM Network (Optional)

You can use the SonoView to transfer exams between DICOM 3.0 compliant systems on the network.

- Select the exams in the list that you want to transfer.
- Click on the SEND-button: a small window is opened.
- Click on the drop-down list beside Destination entry field and select the destination or add a new destination by clicking on the ADD-button and enter the required information, then click the OK-button.
- Click on the INFO-button to see or modify the data of the destination.
- Finally, click the SEND-button. The system transfers the selected exams to the destination.

### 11.6.6 Backup of Exams

For saving the data of the exams you can generate a backup to a removable media (e.g. PD cartridge).

- Select the exams in the exam list by using the trackball and the SIMILT-key
- Click on the BACKUP-button.  
A message box 'Please reinsert the disk' appears on the monitor
- Remove and insert the disk/cartridge again and click on the OK-button  
A message box 'Do you want to delete the selected exams ....' appears on the monitor:
- Click on YES or NO to delete or not delete the exams after backup procedure.  
Backup procedure is started.

### 11.6.7 Retrieving Exams from the Backup Media

To retrieve the exams stored in backup media:

- Insert the cartridge into the drive and wait till the drive is ready.
- Select the Backup page by using the trackball and the SIMULT-key  
Click on BACKUP at the bottom of the window, the exams list stored on the cartridge is displayed on the monitor



After selecting the exams, you can view, delete and transfer the exams.

- Click on the RESTORE-button to load the exams from the cartridge to the internal hard disk.

## 11.6.8 Image Review

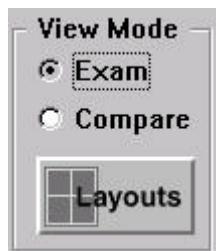
This chapter describes how to review images and use all of the tools available on the system.

### 11.6.8.1 View Mode

SonoView adapted the tab controls for easy and quick navigation between exams or images. For example, if you load five exams, five thumbnail image tabs will appear at the bottom of your screen. You can activate the desired exam just by clicking the thumbnail image tab you want.

#### Exam Mode

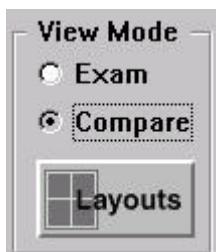
Exam mode provides a quick and easy method of paging through the images of an exam.



- The page tab can be used to page through the images in an activated exam.
- If you click on the image of interest from the thumbnail image tab, the panel of images including that image will be displayed in the main display window automatically.
- The currently displayed images are shown in a yellow box at the thumbnail images.

#### Compare Mode

You can place images of your choice for comparing.



- When you click the desired image from thumbnail images, the border line of the image flickers.
- After selecting the thumbnail image, click the main display window where you want to place the image. Dragging the image is not allowed.

#### Layout

To specify the desired image layout.

- Click on the Layout-button and select one of the pre-defined layouts

#### Full Screen View

The selected image is displayed in Full Screen View on a black background.

- Click on the image in the main display window by using the trackball and the SIMULT-key.

To return to the main display window by pressing the DISK-key.

### 3D View

If 3D images have been saved in polar or cartesian coordinates a 3D button is visible right down in the image.

- Click on this 3D-button to load the volume data set again into the system.

### 11.6.8.2 Tools

#### Export

Allows you to export images in BMP or JPEG format. For some countries file compression is not available.



Click on this button to activate the export function.  
the mouse cursor appears as a floppy disk.

- Move the mouse cursor to the desired image, and then click on the image.
- Select the disk drive for the floppy disk, internal or external disk and the file format (BMP or JPEG). In some countries file compression is not allowed and therefore not available.
- Enter the file name and then click on the **OK** button to save image to the selected disk.  
Note: on the internal harddisk the files are stored automatically to the following  
location: S:\images\.....

#### Magnify

Provides a magnifying glass for magnifying an area of interest of an image.



Click on this button to activate the magnifying glass.  
the mouse cursor appears as a magnifying glass.

- Move the mouse cursor to the desired image, and then click on the image with the SIMULT-key to activate the magnifying glass.
- Move the magnifying glass over the image to view the area of interest.
- Cancel the magnification by clicking on the image once more.

## Print

Images and a brief report can be printed on a line printer (A4)



Click on this button by using the trackball and the SIMULT-key  
a small window appears

- Click on the LAYOUT-button to select the layout for printing  
Full image, double image, quad image formats are available.
- Click on the desired image from the image display window and click on a blank (black) field in the print menu.  
Repeat these steps to fill all blank fields
- For entering information to the report click on the REPORT-button  
This report can be saved to the internal data base.
- Click on the PRINT-button to start printing.

## Settings

These settings define the default View mode, layout, line printer and AE title for DICOM.



click on this button by using the trackball and the SIMULT-key  
a Settings window appear for default setup

## Report

A Report can be written for the current selected exams. This report is the same as the report in the print menu (same contents).



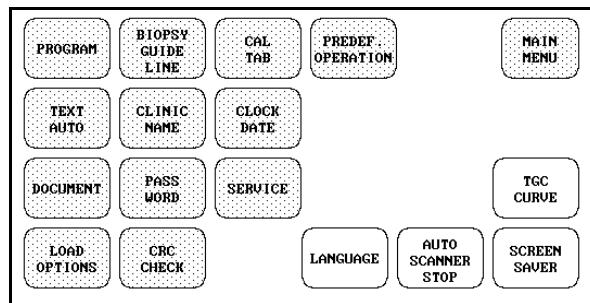
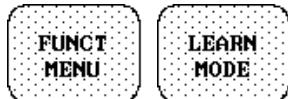
Click on this button by using the trackball and the SIMULT-key  
a Report window is opened for typing the report.

- Click on the SAVE-button to store the report to the data base. With the CLOSE-button the report is closed without saving.

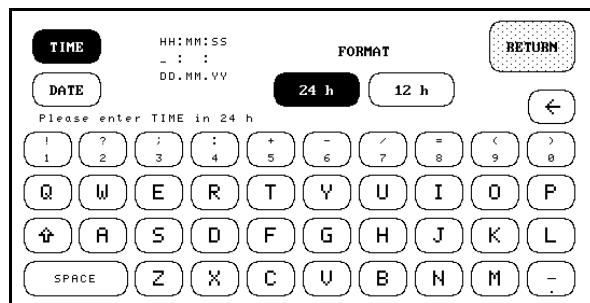
<b>12 LEARN MODE (SETUP).....</b>	<b>12-2</b>
12.1 Entering of DATE and TIME.....	12-2
12.2 Clinic Name, Doctor's Name.....	12-3
12.3 Entering of programs.....	12-4
12.4 Obstetrics Setup.....	12-6
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## **12 LEARN MODE (SETUP)**

### **12.1 Entering of DATE and TIME**

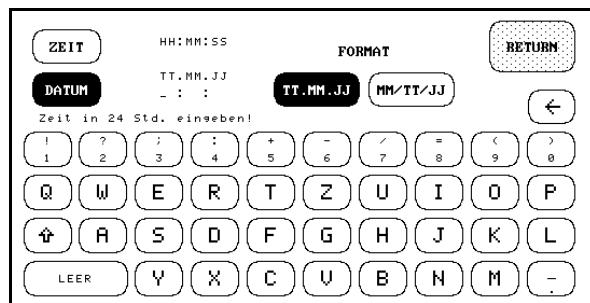


Touch key "CLOCK/DATE"



Touch key "TIME" and enter hours, minutes and seconds, and / or select format for 24 or 12 hours by touching the corresponding key.

Touch key 'RETURN':  
New time is programmed and the Main Menu appears.

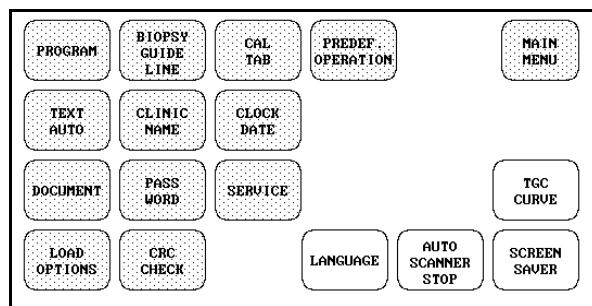
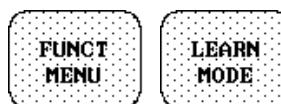


Touch key "DATE" and enter day, month and year, and / or select display format by touching the corresponding key.

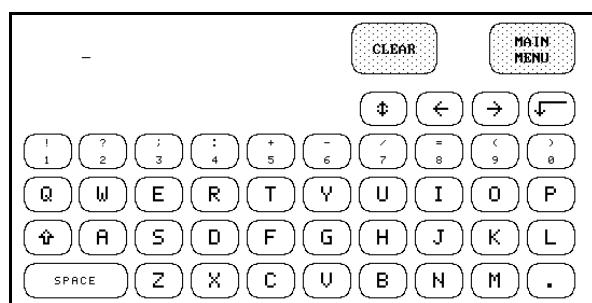
Touch key 'RETURN':  
New date is programmed and the Main Menu appears

## 12.2 Clinic Name, Doctor's Name

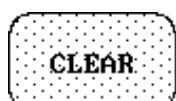
For this entry two lines with 22/18 characters (50/60Hz Version) each are available. The data entry is kept when the instrument is switched off.



Touch key "CLINIC NAME"



Enter Clinic Name and MD's name



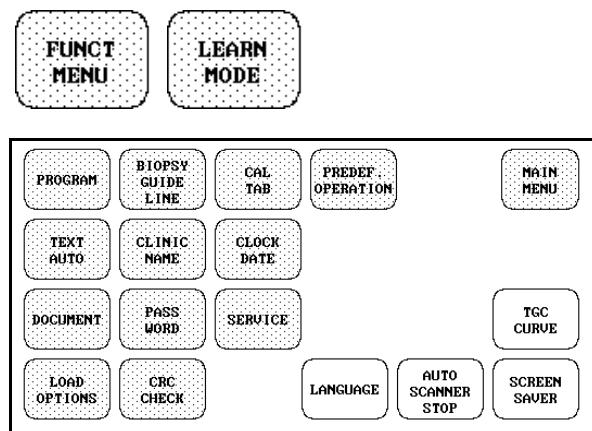
Erase Clinic Name



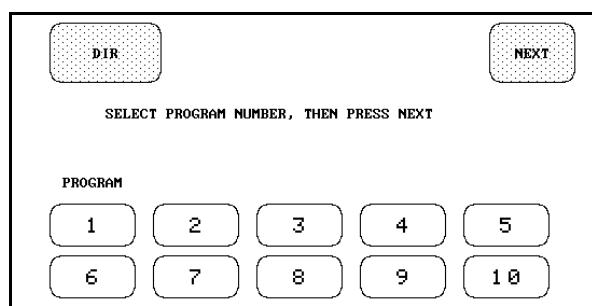
Clinic Name is stored and the Main Menu appears.

### **12.3 Entering of programs**

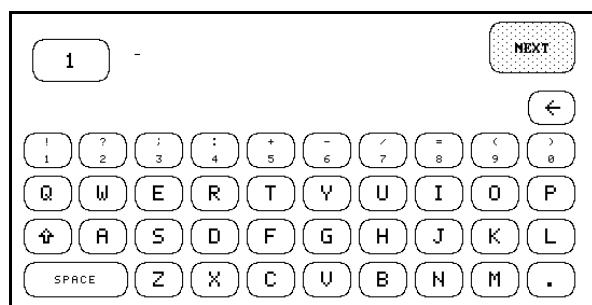
The actual unit setting is stored under a program key. 10 different programs per probe are possible (max. 40 in total). The unit setting comprises the settings of all menus/controls.



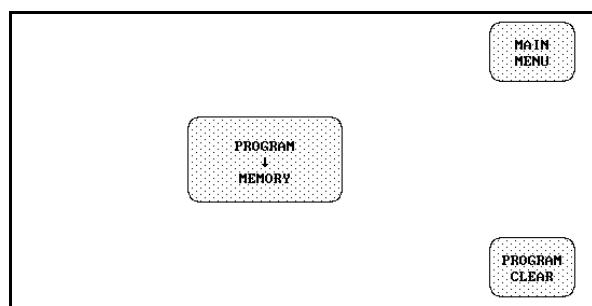
Touch key "PROGRAM"



Select program number, then touch key "NEXT".  
"DIR" key see next page.



Enter names, then touch key "NEXT".



Touch key "MEMORY"  
The program is stored and the Main Menu appears.



Return to Main Menu without storing the unit settings.



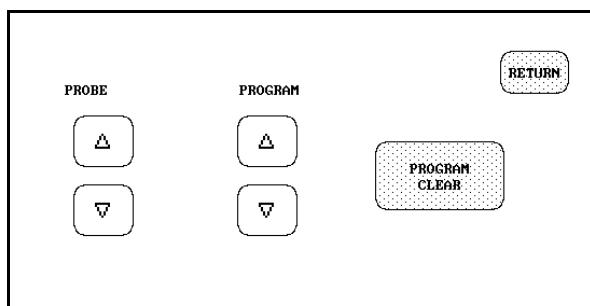
Previous program under the selected program number is erased.

### DIR-Function

With this function the survey of all stored programs is displayed on the screen. Programs can also be erased with this function.



The survey of the stored programs of the different probes appears on the screen.



### Erasure of programs:

1. Select probe by positioning the probe mark with the key "PROBE".
2. Select program by positioning the probe mark with the key "PROGRAM".
3. Touch key "CLEAR".

### Remark:

If not all probes can be displayed on the screen, the next page is selected when the screen border is reached by the probe mark.

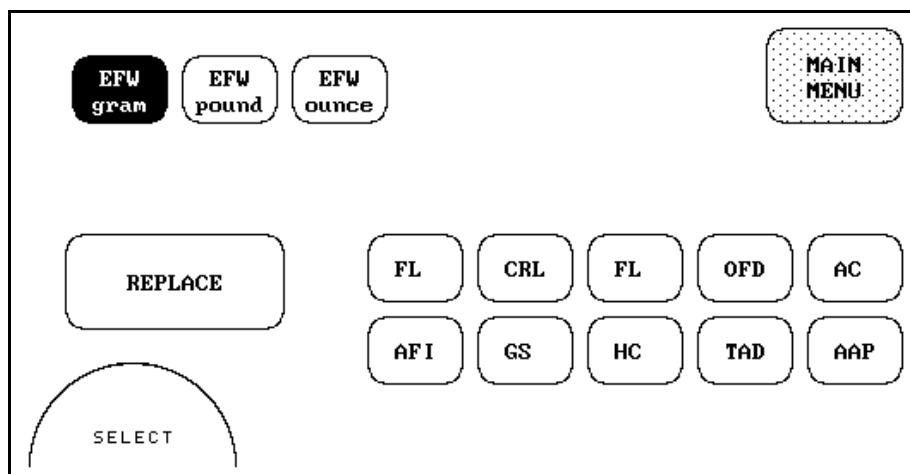
## 12.4 Obstetrics Setup

### 12.4.1 Biometry Tables

Biometry tables from several investigators can be assigned to the table key's. These Biometry tables are fix programmed.



Call up the Biometry setup page  
the following menu appears on the touch screen.



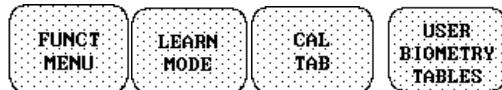
On the monitor the contents of the Table library is listed in alphabetic order. The first two boxes from the left contain the Biometry tables.

- Select one of the 10 table-keys to be replaced with the new Biometry table.
- Select the new table from the table-library by using the trackball ( $\uparrow\downarrow\leftarrow\rightarrow$ )  
The selected line is marked with a white bar.
- Confirm the selection with the REPLACE-key

Note: Already selected Biometry tables are marked with a '\*' - Character

### 12.4.2 Entering new tables

With this learn function own Biometry tables can be created.



Call up the Learn mode for Biometry tables  
the following menu appears on the touch screen.

- Select a free key for the new table or touch the corresponding key of the table to be modified.

With the key 'CLEAR OLD ENTRIES' all table values of the selected table are cleared.

- Enter the class of the table by touching the corresponding key (e.g. BPD)
- or**
- Enter a new class for the table by touching the key 'USER LABEL'.  
A new menu appears on the touch screen, then enter the name of the new class (max. 5 characters). See annotation.

- Enter the name of the author by using the touch screen (max. 12 characters) and then
- Touch the NEXT-key

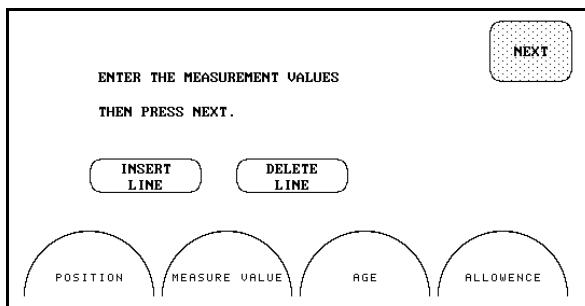
- Select the type of measurement by touching the corresponding key (e.g. distance) and then
- Touch the NEXT-key

## LEARN MODE (SETUP)

Annotation: The labels of the table class are used for calculating the fetal weight or ratios (e.g. BPD and AC for calculating EFW acc. Merz). If a new label with a new table class is created (key USER LABEL) these calculations are not possible.

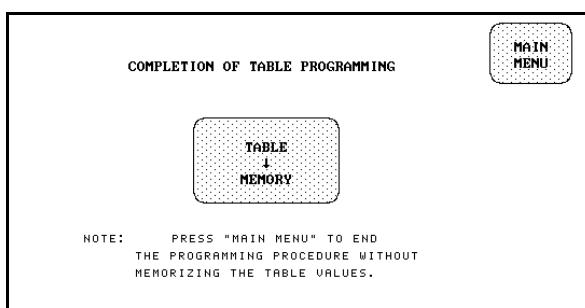
A list of the table appears on the monitor.

1. Select the (new) line of the table by using the trackball (marked with a white bar) and
2. enter the measurement values, age and allowance with the digipots.  
Repeat step 1 and 2 to enter further values.  
To delete or insert a line use the keys INSERT LINE resp. DELETE LINE.
3. Touch the NEXT-key if all inputs are complete.



Note: if the measurement values don't increase continuously or equal age values are assigned an error message with a beep will occur. Programming can only be continued after correcting such errors.

- Touch the key TABLE → MEMORY  
The table is stored and the main menu appears again.



### Annotation:

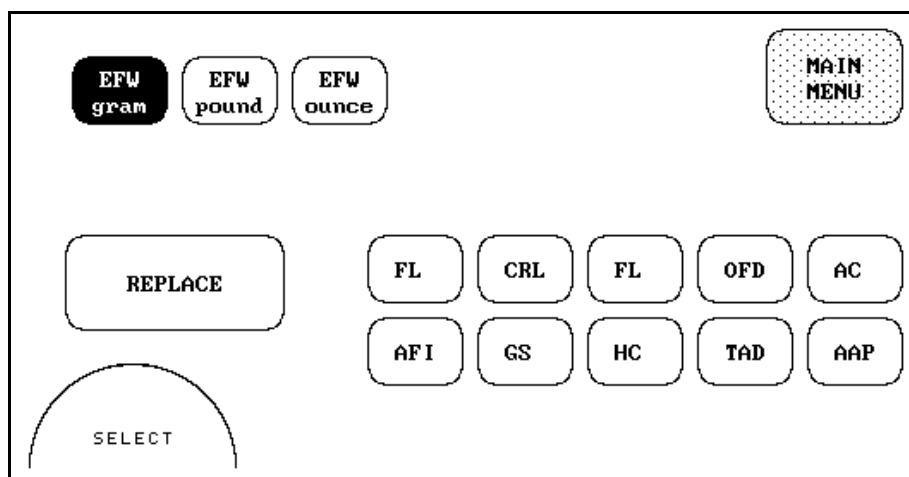
All the created Biometry tables are listed in the table library.  
For using this created tables you have to assign them to one of the 10 Biometry keys.  
See chapter 12.4.1.

### 12.4.3 Fetal weight setup

Fetal weight calculation from several investigators can be selected from a table. These equations are fix programmed.



Call up the Biometry setup page  
the following menu appears on the touch screen.

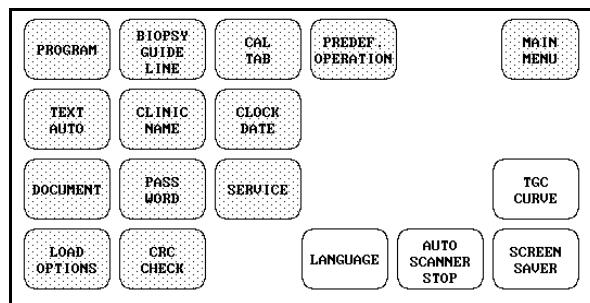
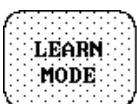


On the monitor the contents of the Table library is listed. The third box from the left contains the fetal weight calculations.

- Select the fetal weight calculation from the table-library by using the trackball ( $\uparrow\downarrow \leftarrow\rightarrow$ )  
The selected line is marked with a white bar.
- Confirm the selection with the REPLACE-key
- Select the unit for the fetal weight to be displayed (gram, pounds, ounces) by touching the corresponding key on the touch screen.

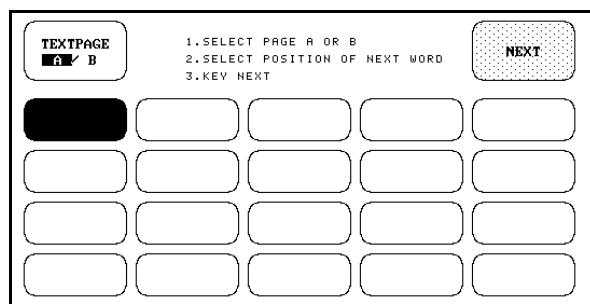
Note: The selected Fetal weight calculation is marked with a '\*' - Character

## 12.5 Auto text setup

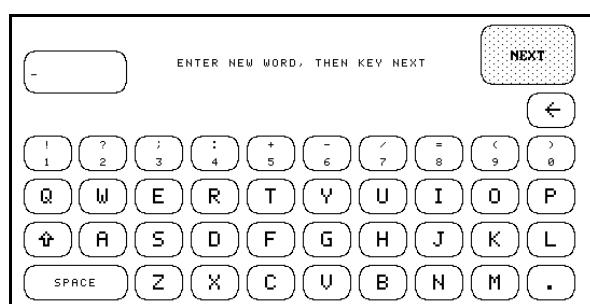


Menu "LEARN MODE"

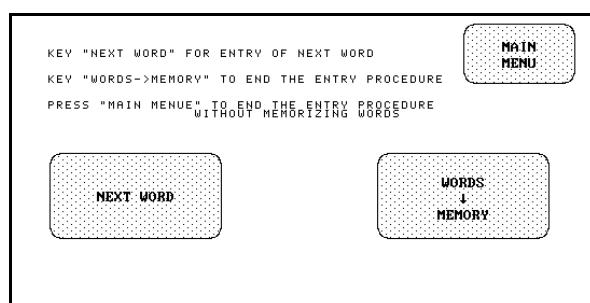
Touch key "TEXT AUTO"



Operation displayed in menu



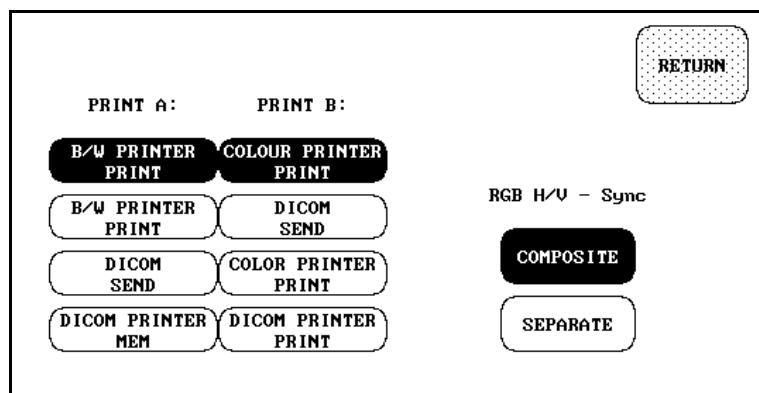
Operation displayed in menu



Operation displayed in menu

## 12.6 Document (printer remote setup)

### Setup for PRINT A, PRINT B



Select wanted function for PRINT A and PRINT B

### Setup: Configuration of RGB-Sync-signal



#### Composite

horizontal and vertical sync-signal on connector 'RGB' pin 4  
No vertical sync on pin 5



#### Separate:

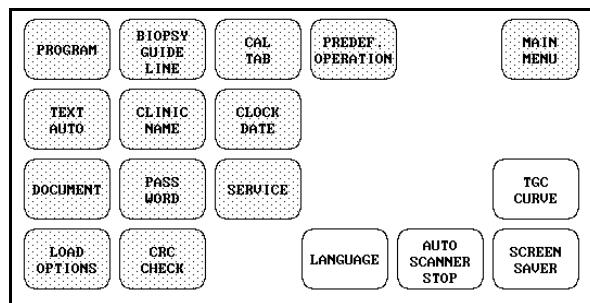
separated horizontal and vertical signal.  
Output of the horizontal sync on connector 'RGB' pin 4  
Output of the vertical sync on connector 'RGB' pin 5

## **12.7 Entering Biopsy lines**

By adjusting the biopsy lines in water the best possible accuracy is achieved.

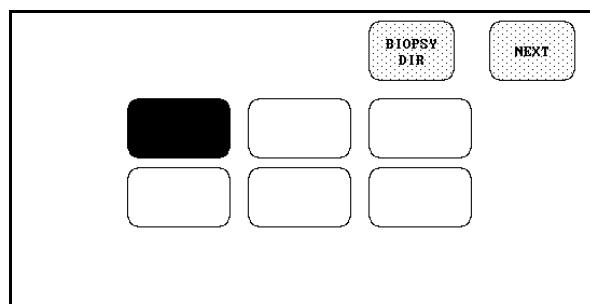
### Procedure:

The puncture needle guide with needle is mounted on the probe and held in a vessel filled with warm water (approx. 40°C, 104°F). The transducer is started and the image with the needle information is stored. The biopsy line is positioned exactly over the needle information and stored.

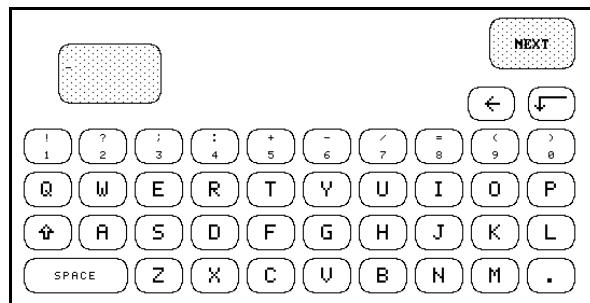


Menu "LEARN MODE"

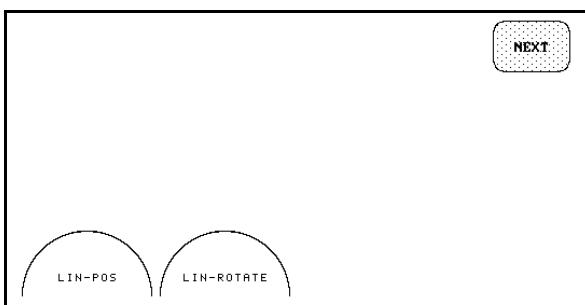
Touch "BIOPSY GUIDE LINE"



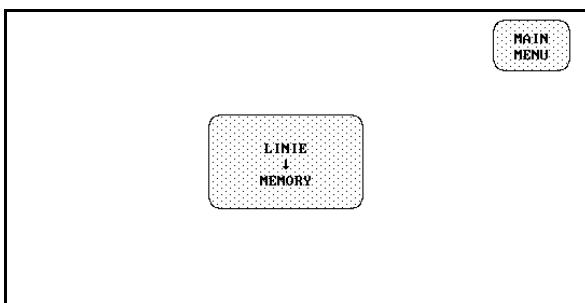
1. Touch the key under which the biopsy line is stored, then
  2. touch "NEXT"
- "DIR" see next page



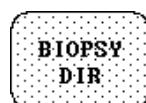
1. Enter name of the biopsy line (2 lines with 10 characters each)
2. Touch "NEXT"



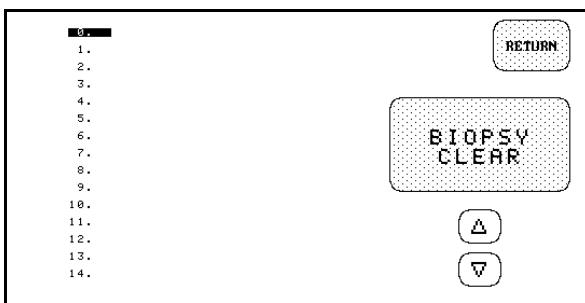
1. Placing the lines over the needle echoes by positioning and rotating the line.
2. Touch "NEXT"



Touch "STORE" key  
Line is stored and the main menu appears.



Survey of all programmed biopsy lines.



Erasure of biopsy lines:

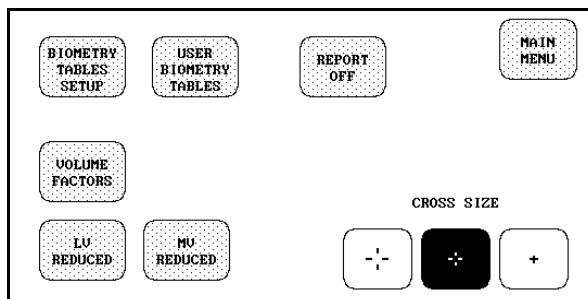


Select the biopsy line by positioning the illuminated field.

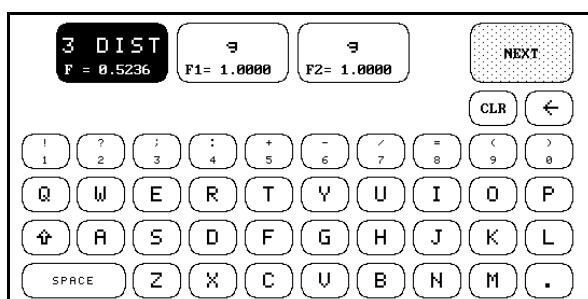


Touch the clearance key  
Biopsy line is erased.

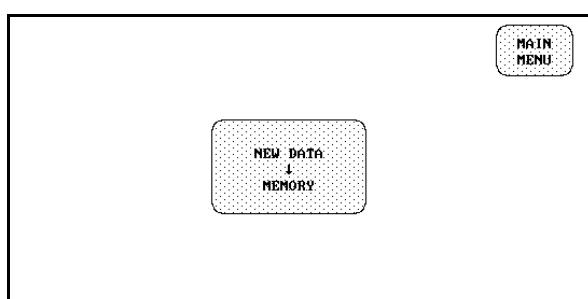
## 12.8 Volume factor



Touch key "VOLUME FACTORS"



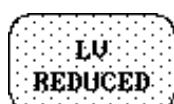
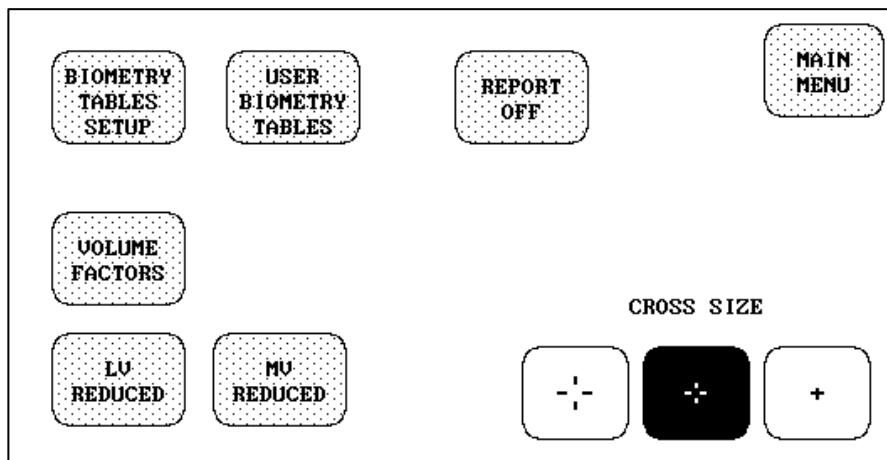
1. Select Factor key \*
2. Enter Factor
3. Touch "NEXT"



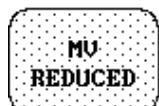
Touch Store key

The new factor is stored and the main menu appears.

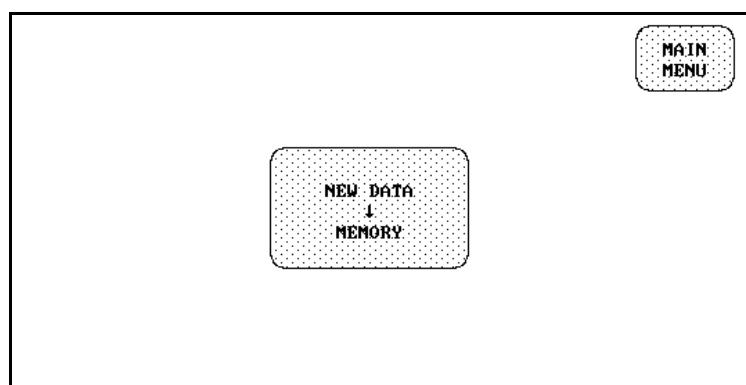
## 12.9 Data memory mode



Reduced cardiologic measuring program LV (left ventricle)



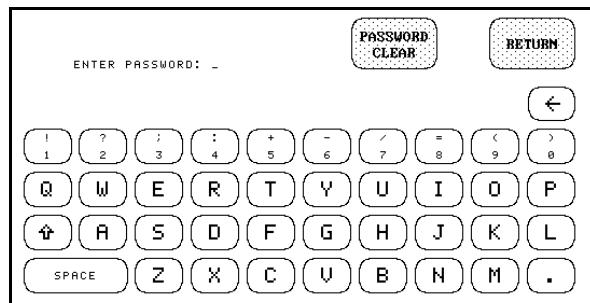
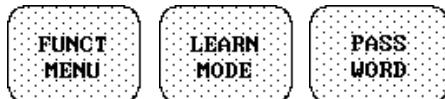
Reduced cardiologic measuring program MV (mitral valve)



Touch "RETURN" and store key.

## 12.10 Password

By fixing a password the unit program is protected.



1. Enter password (max. 5 characters)
2. Touch "RETURN" key  
Password is stored

### Erasure of password:

1. Activate password entry
2. Enter old password
3. Touch key "RETURN"
4. Touch key "CLEAR"
5. Touch key "RETURN"

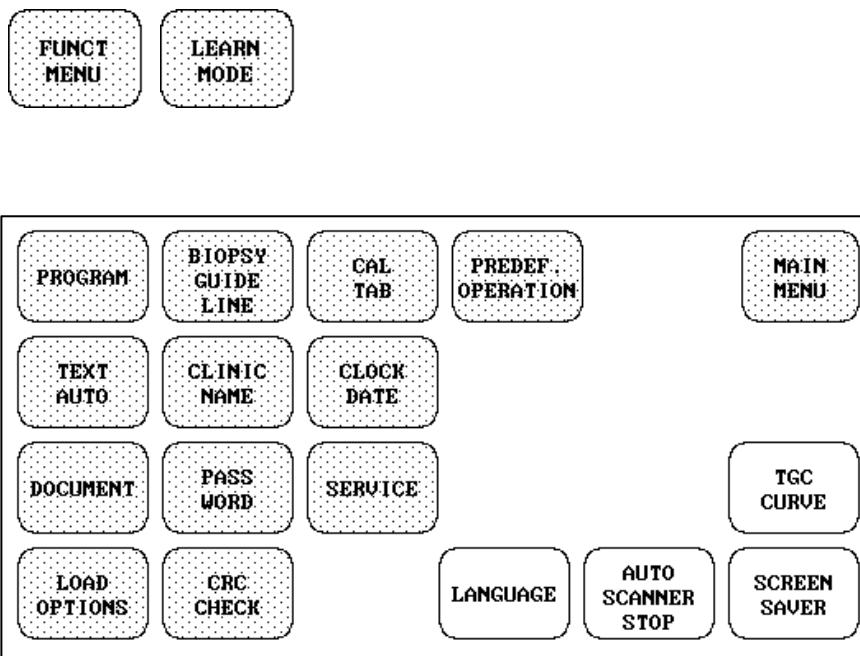
### Remarks:

- \* If a password has been fixed and a key is touched in "Learn Mode" menu, the request: "INSERT PASSWORD" appears on the touchpanel. After entering the password and after touching key "RETURN" programming of the unit can be continued.
- \* **IMPORTANT:** **If you forget your password, only our service personnel can help you !**
- \* Date and time are not protected by the password.

## 12.11 Language

Four languages can be selected:

1. English
2. German
3. French
4. Spanish



By repeated touching of key "LANGUAGE" the languages are selected in the following order:

Language:	English
Sprache:	German
Langage:	French
Lenguaje:	Spanish

### Remark:

Programmable text entries are not influenced by the switching of languages.

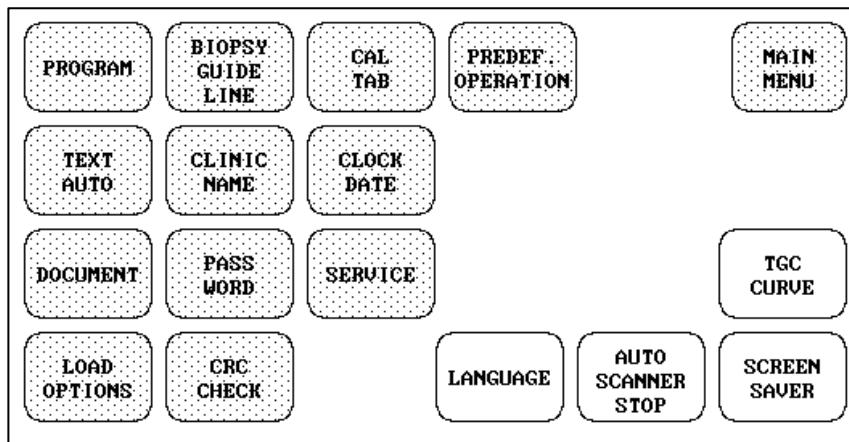
## 12.12 Screen saver

After 5 minutes of no operation activity the touchpanel screen and the monitor screen are blanked and the monitor screen shows a randomly positioned KRETZ-logo.

Touching the touchpanel at any position switches back to the standard control menu.

The screen saver function can be activated resp. de-activated in LEARN-MODE.

Operation:



Screen saver on/off

on: key illuminated

## 12.13 Automatic Scanner Stop

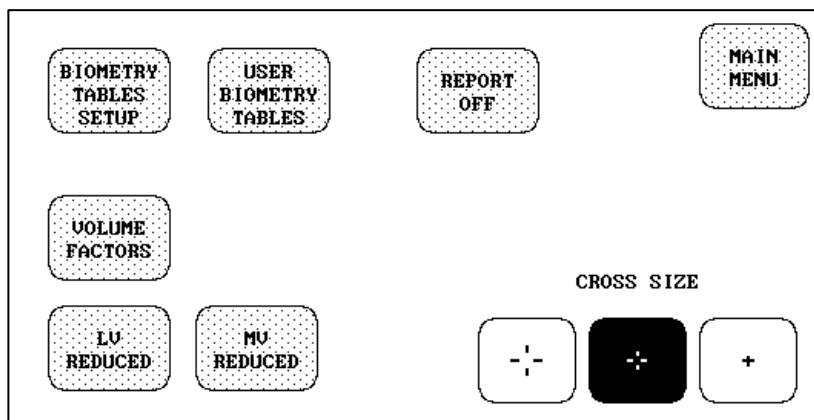
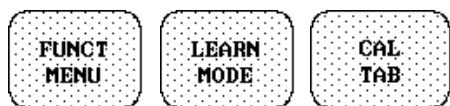
After 5 minutes of no operation activity, the unit automatically switches to "FREEZE MODE" and the probe stops.

The "AUTO SCANNER STOP" can be activated resp. de-activated in LEARN-MODE. Activating of the LEARN MENU, see previous point.



Auto Scanner Stop on/off

on: key illuminated

**12.14 Measure cross size**

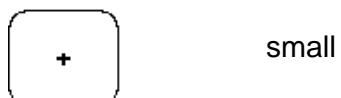
Select the size of the measure cross:



big



middle



small

## 12.15 Live 3D - Predefined/Extended Operation

### 12.15.1 Setup switch PREDEFINED/EXTENDED

Depending on this switch the predefined or extended operation is activated in Volume-Mode, B-Mode and Color-Mode.

If the unit is programmed to 'Predefined Operation' there are only the B-Mode functions Frame- Filter, B-Mode Dynamic Range, B-Mode Reject and a reduced number of gray map curves available. At Color-Modes the respective Submenus cannot be activated.

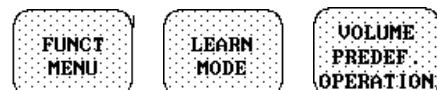
### 12.15.2 Change of predefined parameters

The actual settings of following functions will be stored in preset memory:

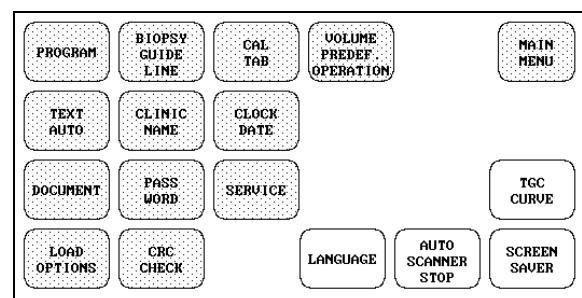
**Note:** Before you invoke setup menu adjust these functions in extended operation first!  
Each probe has its own preset structure.

Operation:

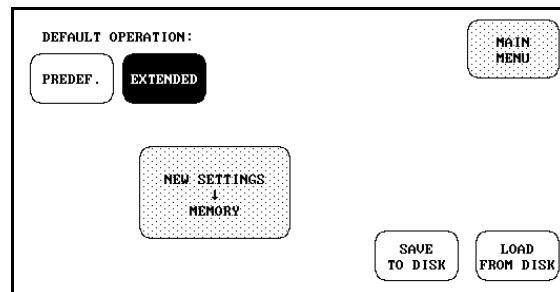
1. call main menu "Learn Mode" and then submenu "Volume Predef. Operation"



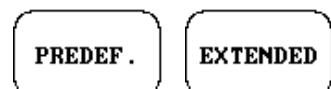
menu "Learn Mode"



menu "Volume Predef. Operation"



2. change operation mode



select wanted operation mode and touch return, if predefined settings should not be changed.

3. save predefined settings



actual setting are saved into preset memory

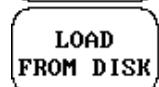
Note:

this button only appears, if a rendered 3D image was adjusted in extended operation mode before invoking setup!

4. Disk operation



contents of preset memory is copied to disk



preset settings are copied into preset memory

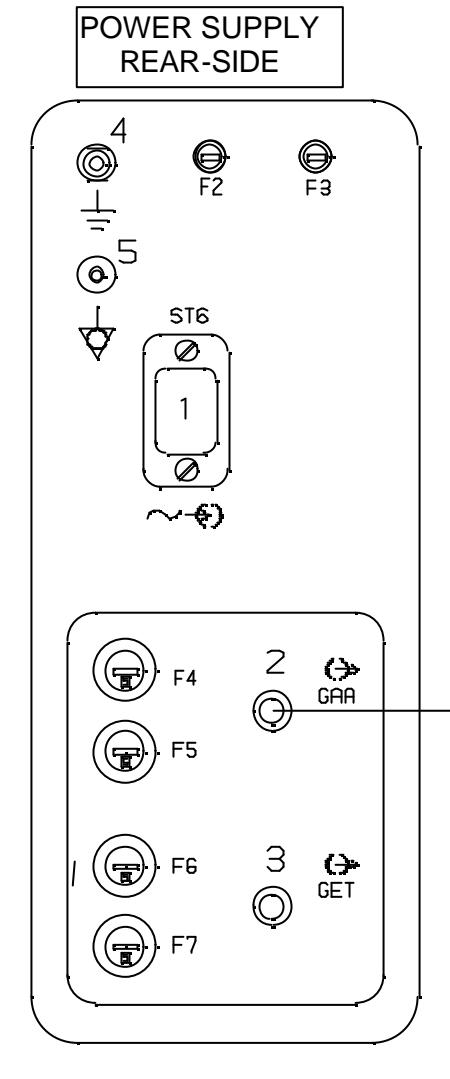
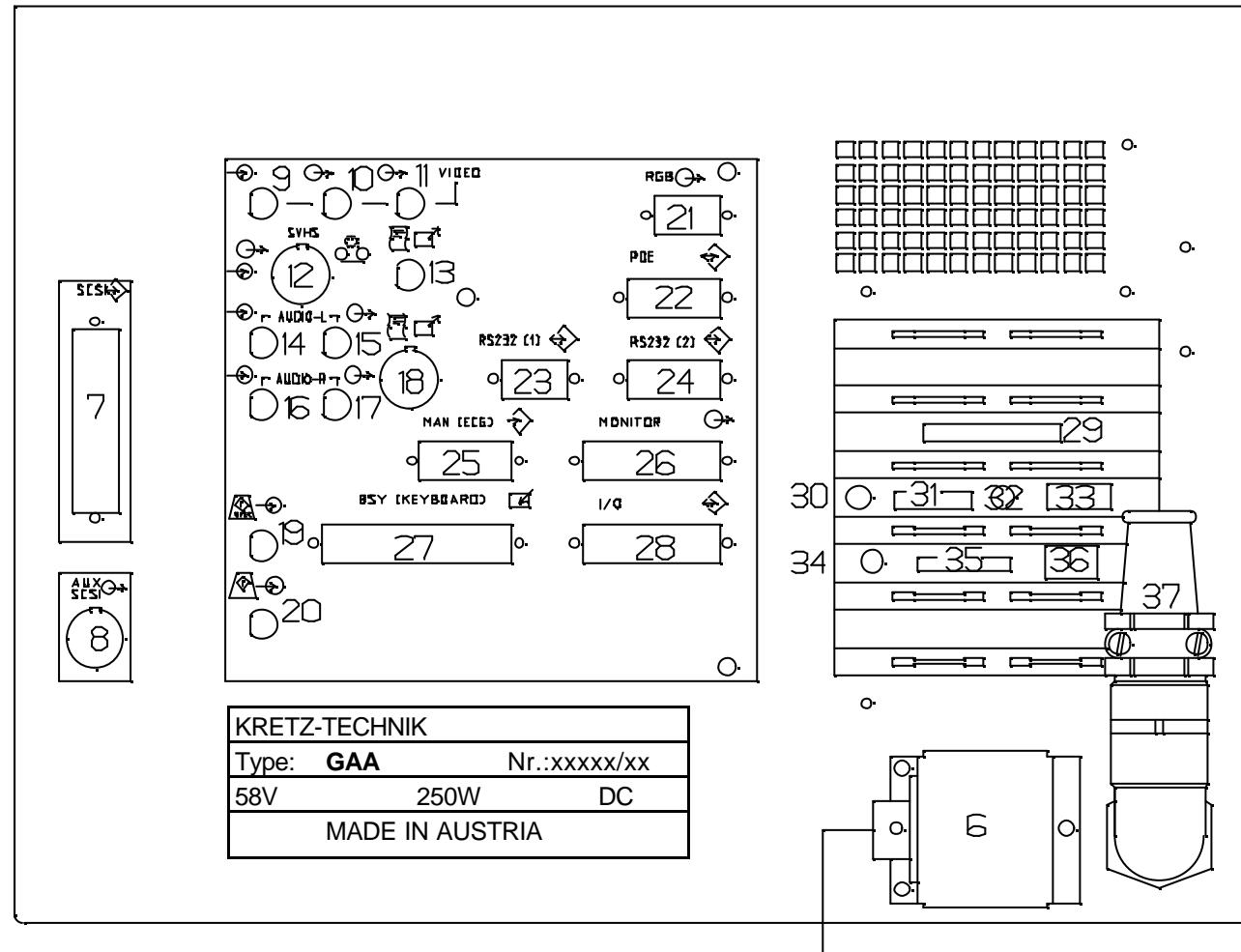


**13 CONNECTIONS.....13-2**

13.1	Module .....	13-2
13.2	Power Supply (top side).....	13-5
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13.10	Important Notes: Connecting Auxiliary Equipment .....	13-13

## 13 CONNECTIONS

### 13.1 Main Module



- 1 Mains IN**  
Mains voltage according to type plate  
Modification of voltage setting only by authorized service person!  
Possible mains voltages: 110V, 130V, 230V, 240V, AC only
- 2 Supply OUT for GAA (Main Module)**
- 3 Supply OUT for GET (Probe Connector Module)**
- 4 Ground socket**
- 5 Potential equilibrium wire connection**
- 6 Supply IN for GAA**
- 7 SCSI-connector for Modul GAF30**
- 8 Mains OUT for Modul GAF30**
- 9 Video in:** 1V<sub>ss</sub> @ 75 Ohm, PAL / CCIR (Softwareversion 50Hz)  
1V<sub>ss</sub> @ 75 Ohm, NTSC / FCC (Softwareversion 60Hz)
- 10 Video out:** 1V<sub>ss</sub> @ 75 Ohm, PAL (Softwareversion 50Hz)  
1V<sub>ss</sub> @ 75 OHm, NTSC (Softwareversion 60Hz)
- 11 Video out:** 1V<sub>ss</sub> @ 75 Ohm, CCIR (Softwareversion 50Hz)  
1V<sub>ss</sub> @ 75 OHm, FCC (Softwareversion 60Hz)
- 12 SVHS IN/OUT**
- |   |                                      |
|---|--------------------------------------|
| Pin    1 : Chroma in<br>3 : Luminance in<br>5 : Chroma out<br>7 : Luminance out | Pin    2 : GND<br>4 : GND<br>6 : GND |
|---|--------------------------------------|
- 13 Remote control "Print A" for video printer (e.g. Mitsubishi P90)**
- 14 Audio IN L :** from Audio Out/L of VCR
- 15 Audio OUT L :** from Audio IN/L of VCR
- 16 Audio IN R :** from Audio Out/R of VCR
- 17 Audio OUT R :** from Audio IN/R of VCR
- 18 Remote control "Print B"**
- 19 Connector for footswitch:** Freeze special
- 20 Connector for footswitch:** Freeze (Read/Write)
- 21 R, G, B, H, V outputs for color video printer  
(e.g. SONY UP-1800EPM)**
- |   |
|---|
| Pin    1 : Red<br>2 : Green<br>3 : Blue<br>4 : Composite Sync<br>5 : V-Sync |
|---|

22 **Connector for PDE** (Doppler loudspeaker units)

23 **RS232 (1) interface**

Pin	1 :	RXD	Pin	9 :	+5V
	3 :	TXD		1, 4, 5, 6:	GND
	7 :	RTS			
	9 :	CTS			

24 **RS232 (2) interface TGC Slide Control**

25 **Connector for MAN** (ECG-preamplifier)

26 **Connector for color video monitor**

27 **Connector for BSY** (control panel)

28 **not connected**

29 **auxiliary SCSI**

30 **auxiliary Keyboard**

31 **USB Port**

32 **auxiliary PS/2 Mouse connector**

33 **auxiliary RS232**

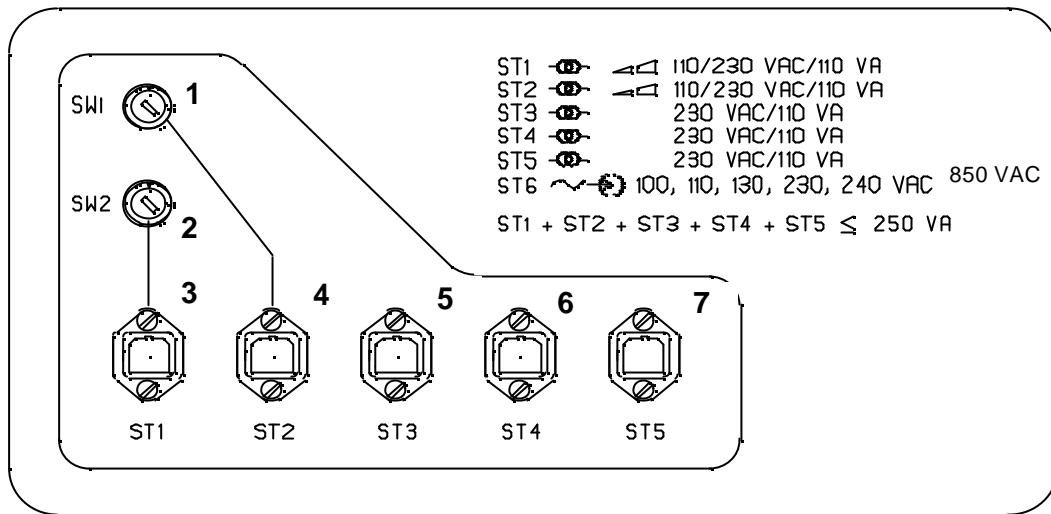
34 **BNC thin wire connector ETHERNET** (e.g. for DICOM)

35 **AUI connector ETHERNET** (e.g. for DICOM)

36 **Twisted pair connector ETHERNET** (e.g. for DICOM)

37 **HF-, DIV-, MOT- and CLK-wire to GET (Probe Connector Module)**

### 13.2 Power Supply (top side)



#### 1, 2      Voltage selectors for outlets ST1 and ST2

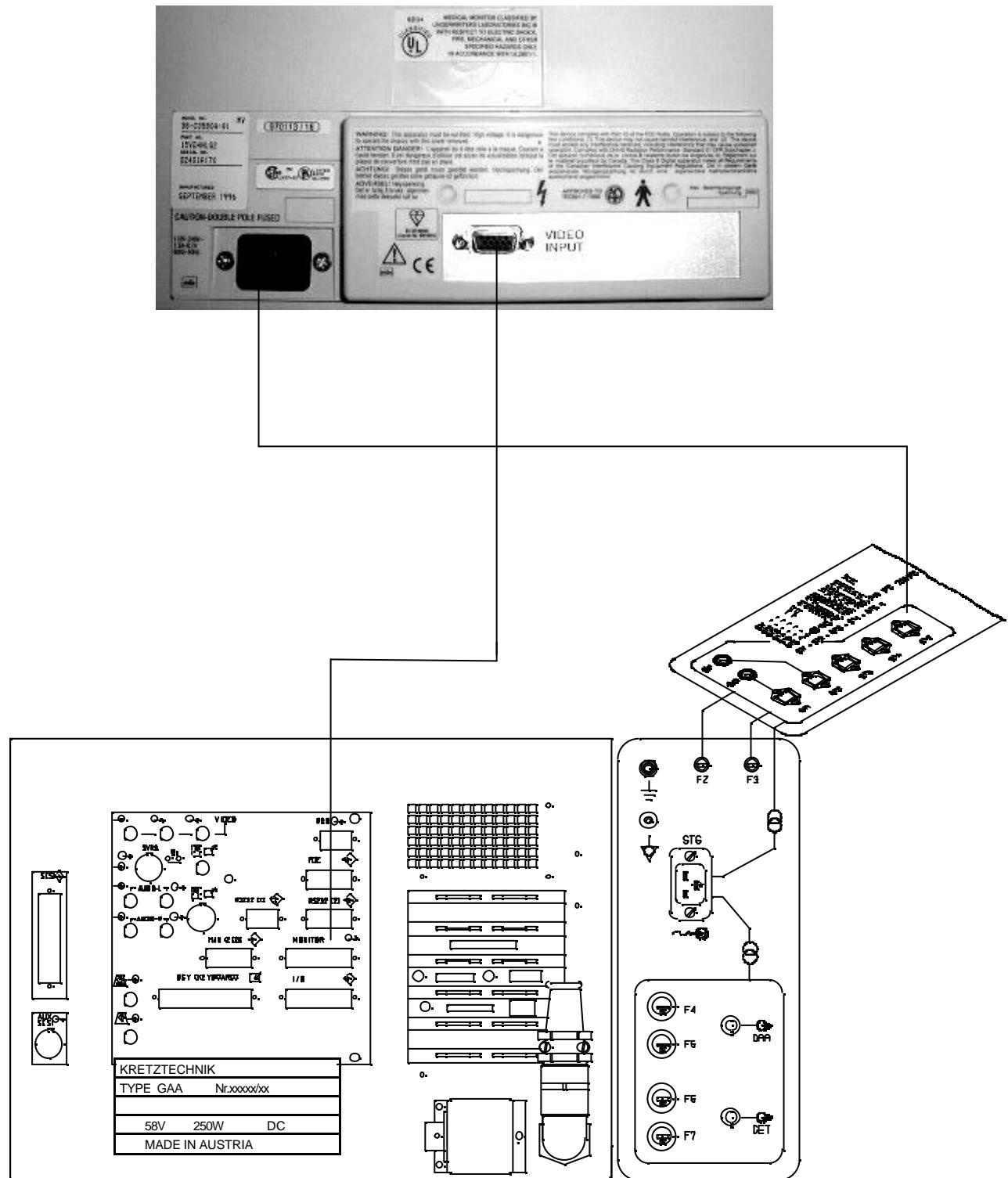
#### 3, 4, 5, 6, 7    Mains OUT for auxiliary equipment

These outlets are feed from an isolation transformer which is co-switched with the main switch of the console. These outlet-voltage is not depending on mains voltage.

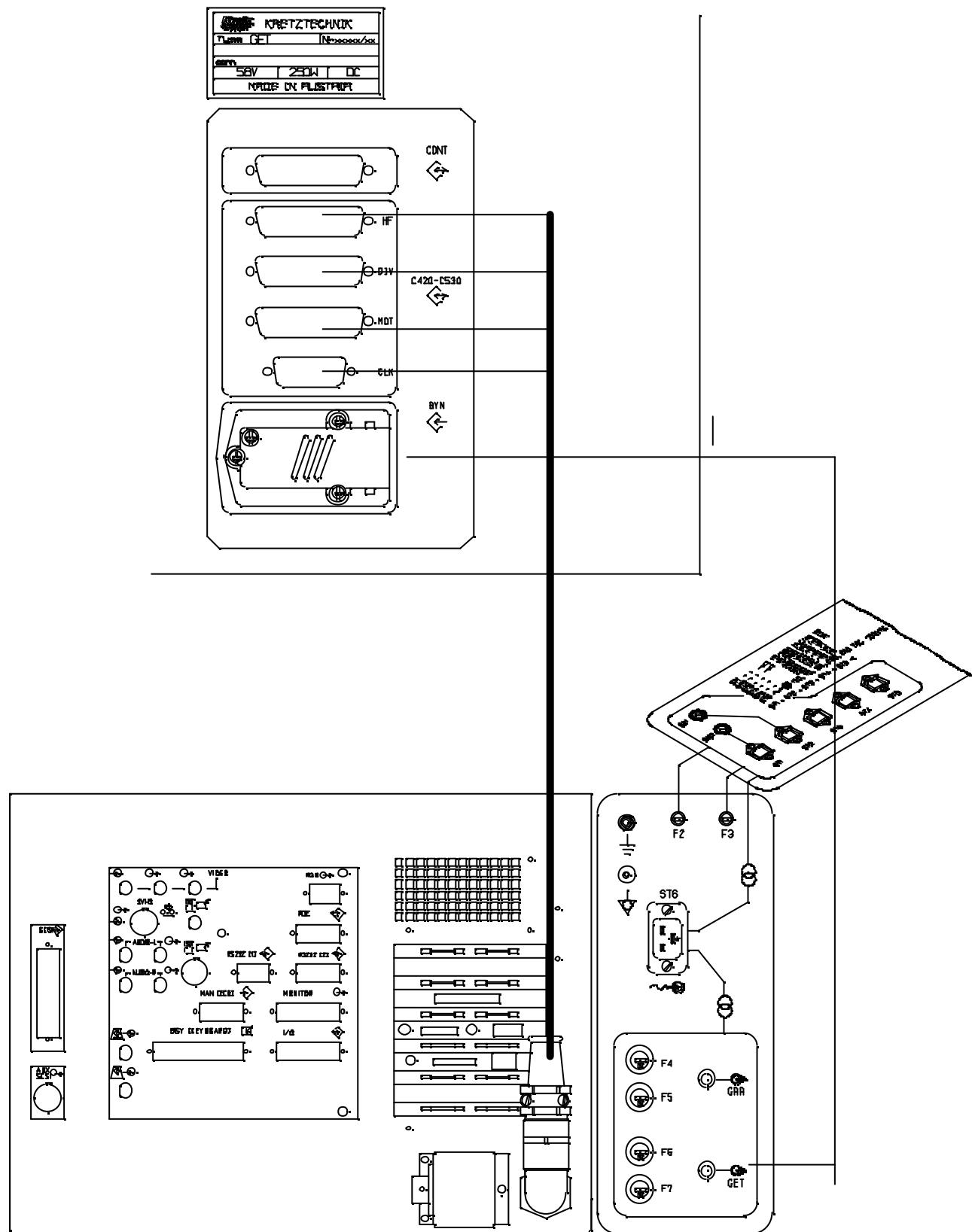
**CAUTION!** The sum of the power consumption of equipment connected to these outlets must not exceed 250 VA! (incl. the color video monitor)  
 The voltage outlet ST3, ST4 and ST5 is always 230V!  
 The outlets ST1 and ST2 each may be set to 230V or 110V with the voltage selectors SW1 and SW2.

**Remark:** Outlet ST3 is solely for the color video monitor (100 VA consumption), leaving 150 VA capability for auxiliary equipment.

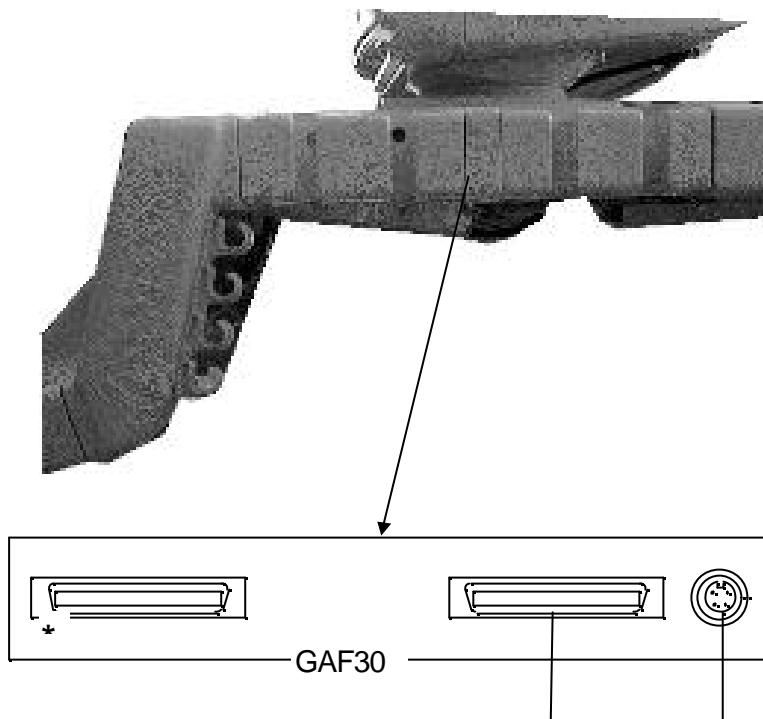
### 13.3 Color Video Monitor Connection



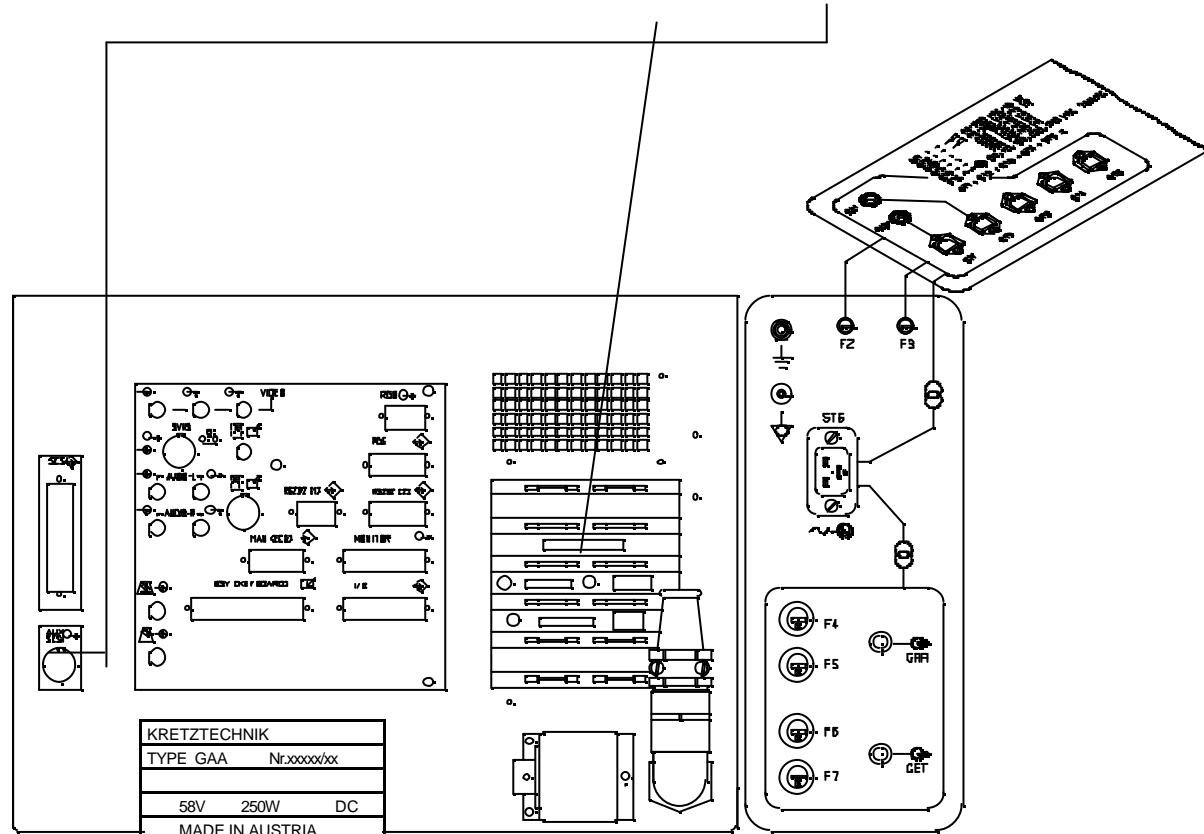
### 13.4 GET / GAA Connection Scheme



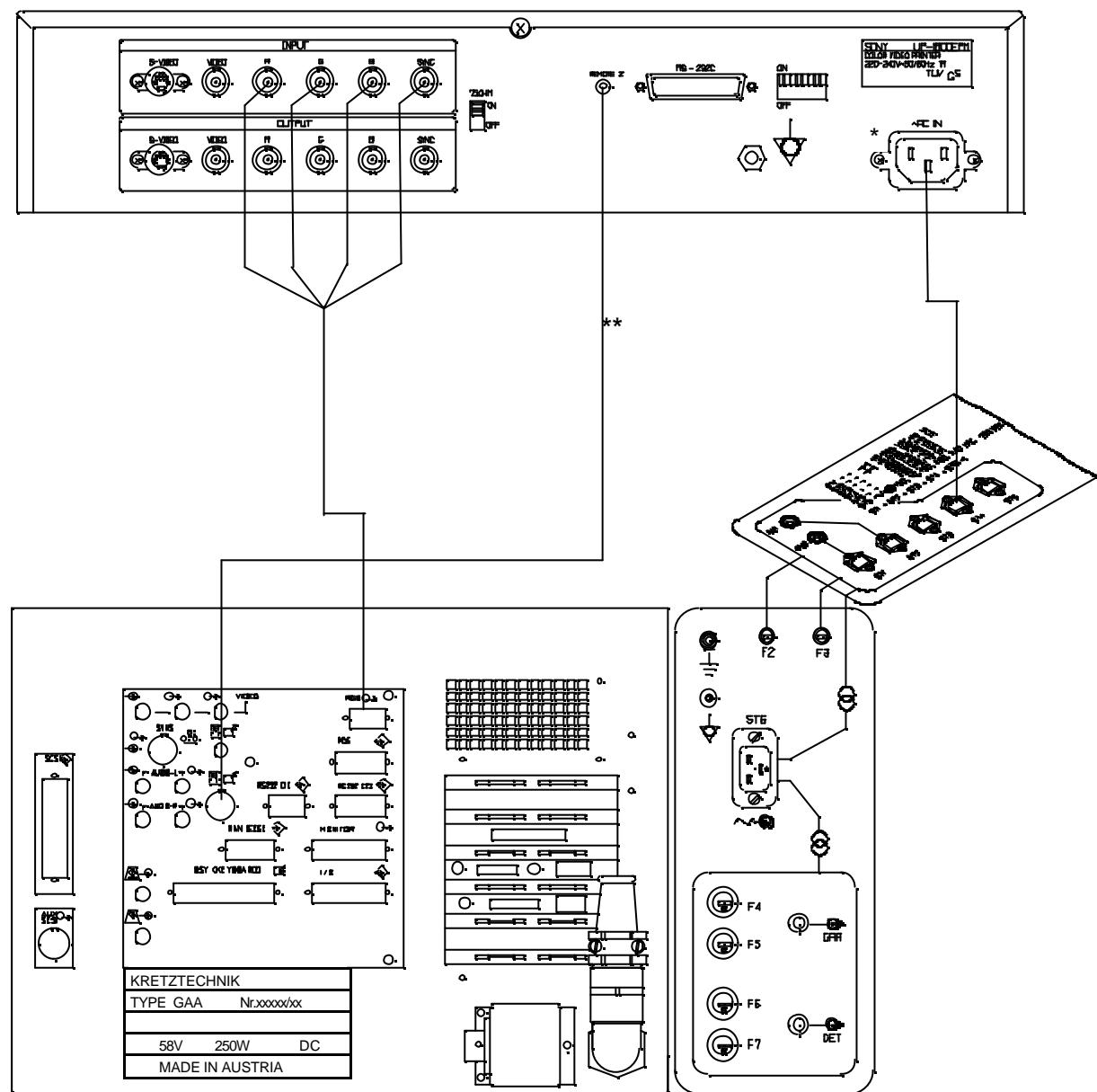
### 13.5 GAF30 (SCSI-Drive) Connection Scheme



**\* Remark:** It is possible to connect a additionally SCSI-Drive  
(Hard-disc drive or MOD-drive). If there is no SCSI-Drive  
connected a terminator must be installed!



### 13.6 Color Video Printer Connection Scheme (e.g. SONY UP-2800P)

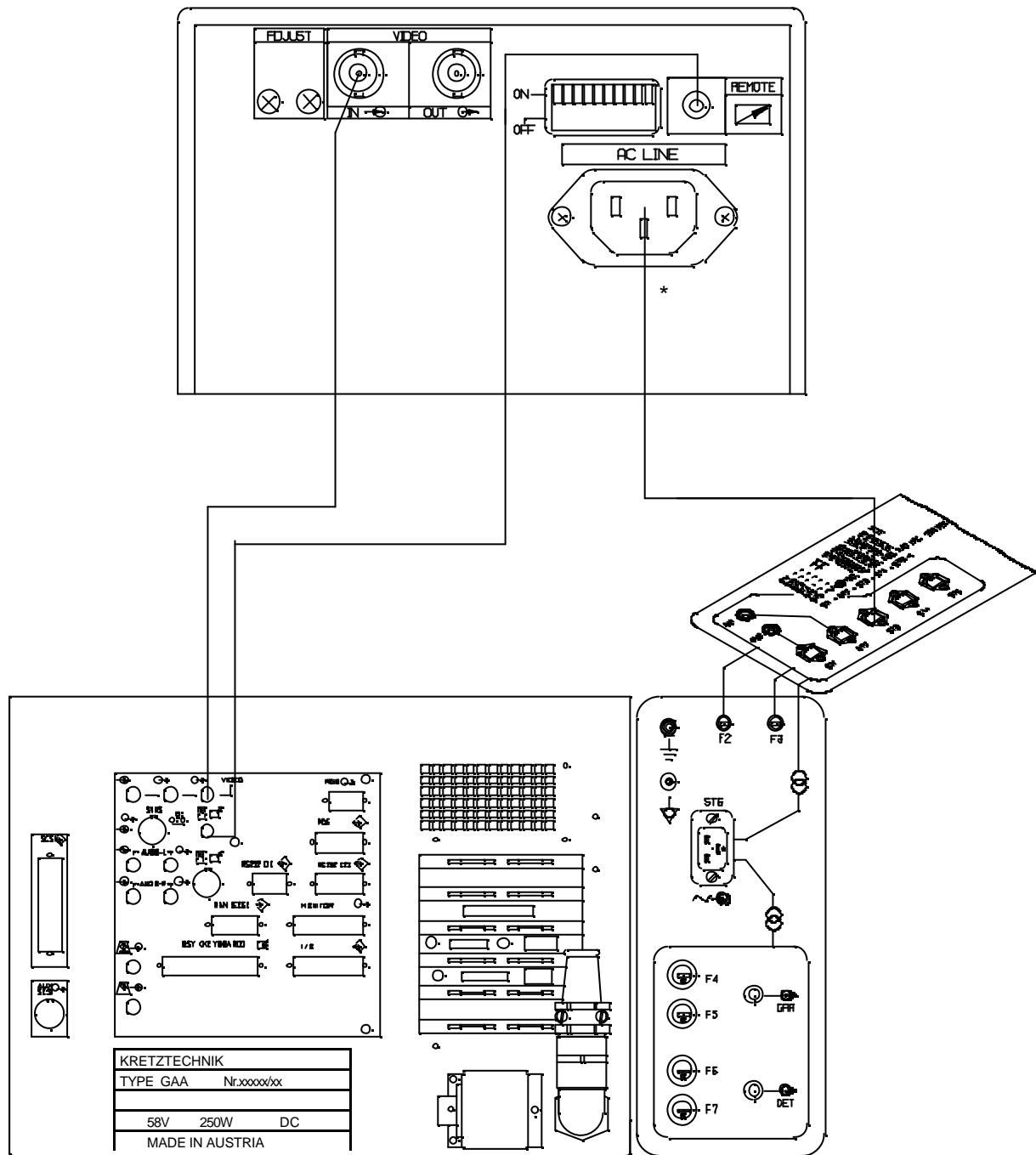


**\*CAUTION:** Printer with power supply 220-240V could be connected on each outlet (Voltage selectors SW1 and SW2 must be set to 230V).

Printer with power supply 100-110V must be connected on outlet ST1 or ST2 (Voltage selectors SW1 or SW2 must be set to 110V).

**\*\*REMARK:** Remote Control Cable KUK1, PartNr.: 194906

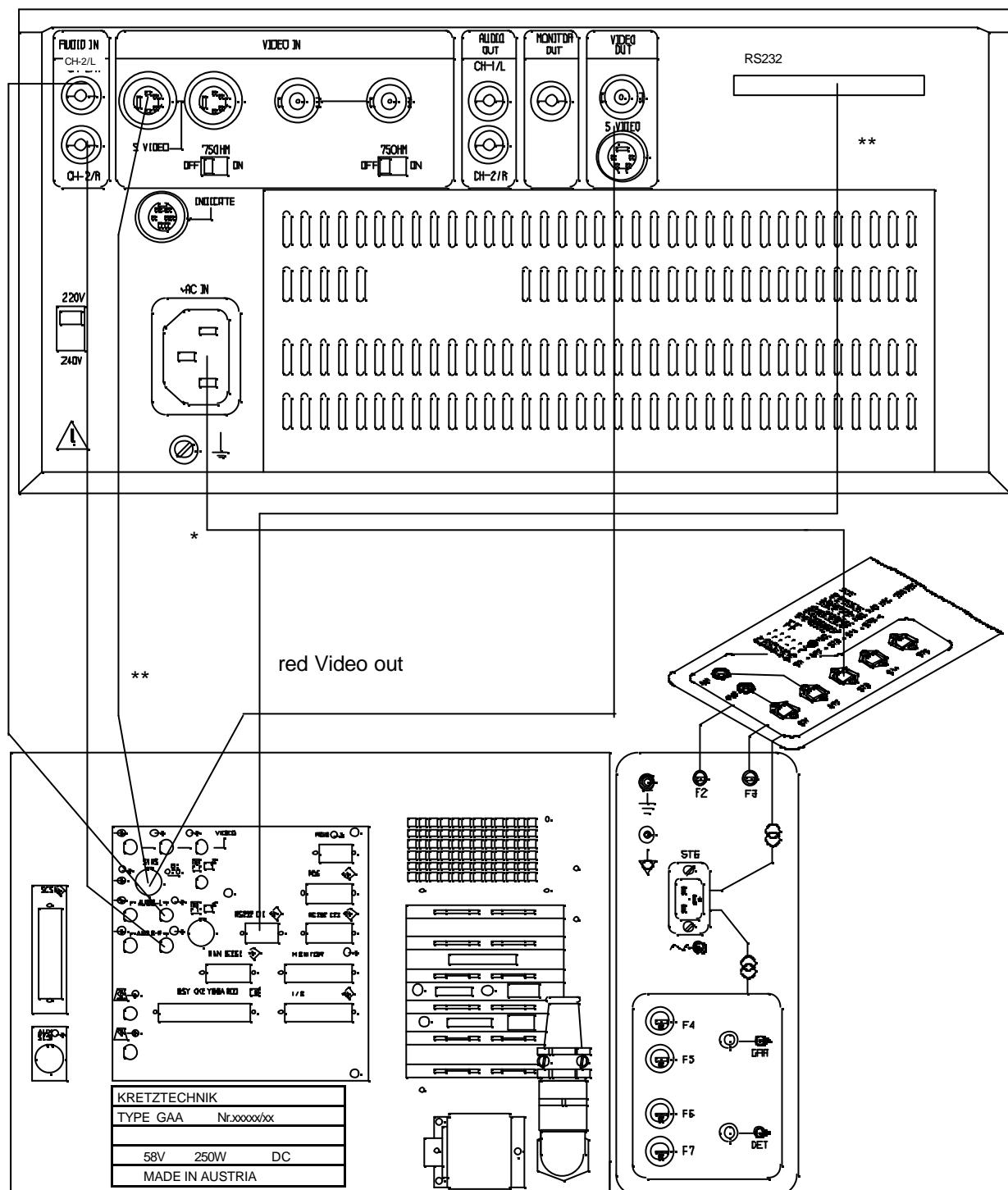
### 13.7 B/W Video Printer Connection Scheme (e.g. Mitsubishi P90E)



**\*CAUTION:** Printer with power supply 220-240V could be connected on each outlet (Voltage selectors SW1 and SW2 must be set to 230V).

Printer with power supply 100-110V must be connected on outlet ST1 or ST2 (Voltage selectors SW1 or SW2 must be set to 110V).

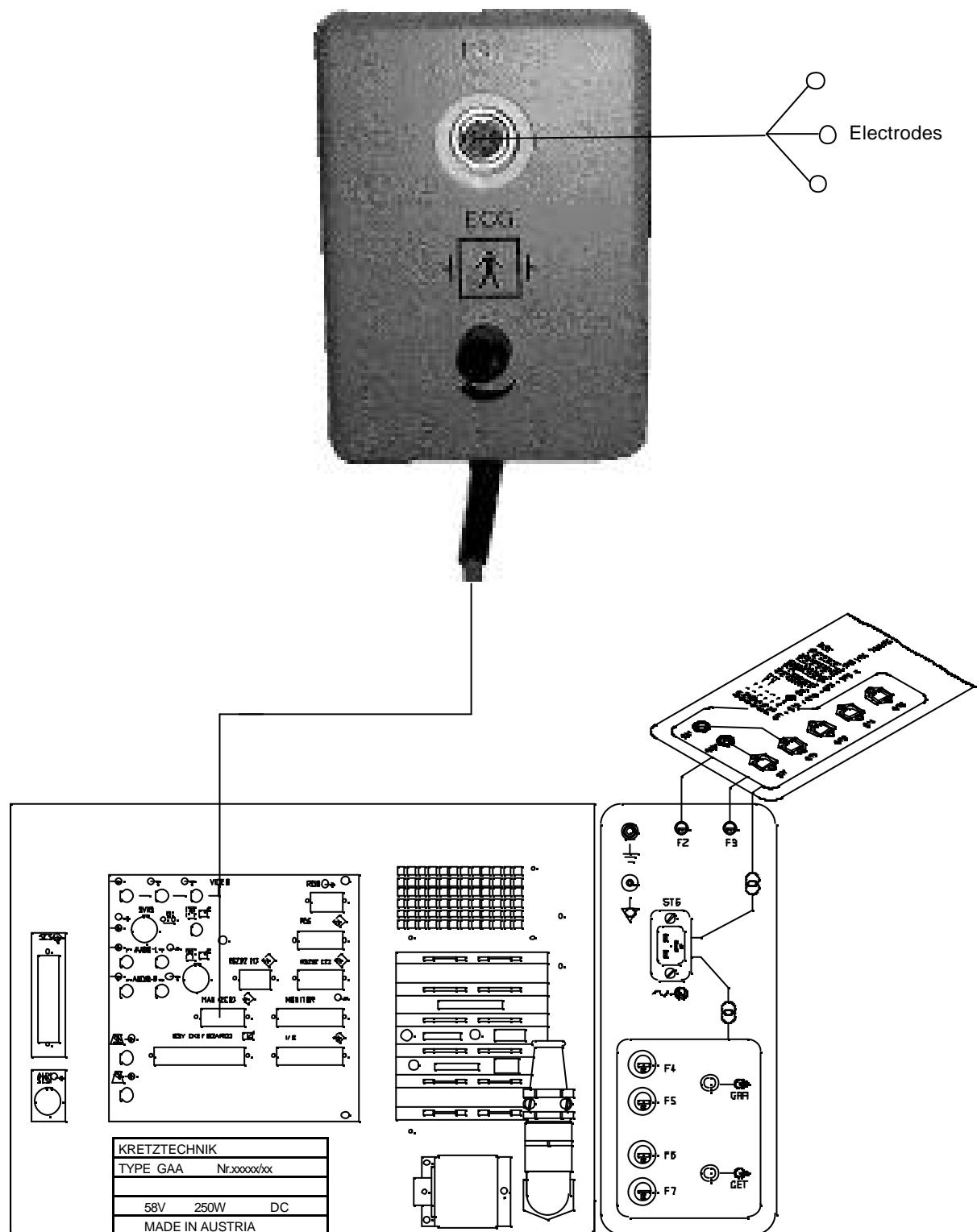
### 13.8 S-VHS-Video Recorder Connection Scheme (e.g. SONY SVO9500MDP)



**\*CAUTION:** Videorecorder with power supply 220-240V could be connected on each outlet.  
 (Voltage selectors SW1 and SW2 must be set to 230V).  
 Videorecorder with power supply 100-110V must be connected on outlet ST1 or ST2.  
 (Voltage selectors SW1 or SW2 must be set to 110V).

**\*\*REMARK:** Use only:  
 S-VHS cable: KUV1 PNO. 193822  
 Remote cable: KUG1 PNO. 194905

### 13.9 ECG-Module MAN Connection Scheme



### 13.10 Important Notes: Connecting Auxiliary Equipment

- CAUTION !** The leakage current of entire system including any / all auxiliary equipment must not exceed the limit values as per EN60 601-1-1:1990 (IEC 601-1-1) res. other valid national or international standards. All equipment's must comply with UL, CSA and IEC requirements.
- CAUTION !** Auxiliary equipment must only be connected to the main console with the special mains outlet provided for the electrical safety of the system.
- CAUTION !** Auxiliary equipment with direct mains connection requires galvanic separation of the signal and / or control leads.
- ATTENTION !** With the color video monitor connected to its isolated mains outlet, the remaining load capacity for auxiliary equipment is max. 150 VA.



**14 TECHNICAL DATA.....14-2**

## 14 TECHNICAL DATA

TYPE: COMBISON530D  
 MODEL: VOLUSON 530D  
 SPECIAL-MODEL: VOLUSON 530D MT

### SERIAL NUMBER

Position: Rear panel, top left  
 Identification for tracing

### POWER SUPPLY

Power requirements: 230V AC  
 110V, 130V, 240V AC  
 50 Hz, 60 Hz ( $\pm 2\%$ )

Power consumption: nominal 4A at 230V/50 Hz  
 including all options

Mains outlets: Mains socket ST1,ST2,ST3,ST4,ST5 for accessories  
 All mains outlets are co-switched with unit mains switch via built-in isolation transformer.  
 Output voltage: ST3, ST4, ST5: 230V (fix)  
 ST1: 230/110V (voltage selector)  
 ST2: 230/110V (voltage selector)  
 Output power: 250VA per mains outlet, max. power of all connected accessories must not exceed 250VA.

EMC (electro-magnetic compatibility): EN 60601-1-2:1994

Emission:	EN55011	Group 1,Class B	Electronical Probes
		Group 1 Class A	Mechanical Probes
Immunity:	EN61000-3-2	Power line harmonics	
	EN61000-4-2 (IEC1000-4-2):	8kV air discharge, 2,4,6kV contact discharge	
	EN61000-4-3 (IEC1000-4-3):	26- 1000 MHz 3V/m	
	EN61000-4-3 (IEC1000-4-3)	800-1000 MHz 10V/m	
	EN61000-4-4 (IEC1000-4-4):	2kV burst on power lines	
	EN61000-4-5 (IEC1000-4-5):	2kV differential mode 1kV common mode	
	EN61000-4-6 (IEC1000-4-6):	150 kHz-80 MHz, 3V (80% AM, 1kHz) except area of effective frequency (1-15 MHz)	
	EN61000-4-8 (IEC1000-4-8):	low frequency magnetic field (10 A/m,50 Hz)	
	EN61000-4-11	Voltage dips and interruptions 100% 5s,60%-100ms,30%-10m s	
Electric safety:	EN60601-1 (IEC601-1)		
Mechanical safety:	EN60601-1 (IEC601-1)		
Thermal safety:	EN60601-1 (IEC601-1)		
Electro-magnetic influence:	In the working frequency range of the ultrasound system from 1 to 14 MHz an influence on the ultrasound image can be visible in the range from 200...500mV/m depending on the probe connected.		

Duty cycle:	100% on
Surge current limiter:	built-in
Safety classification:	Class I, applied parts type BF acc. to EN60601-1/1990 (IEC 601-1/1990)
Ambient temperature:	10°C to 40°C resp. 50°F to 104°F (working temp.of instrument)
	working temp. of probes see attached probe user's manual
	-10°C to 40°C resp. 104°F (stock temp.)
Barometric pressure:	700 to 1060 hPa (working condition)
	700 to 1060 hPa (transport condition)
Overtemperature protection:	yes, provided by dual fans and alert display
Humidity:	30 to. 80% RH no condensation (working condition)
	0 to. 90% RH no condensation (transport condition)
Humidity protection:	covered, no humidity protection
Dimensions:	600 x 1000 x 1414 - 1530 mm [width x depth x height] 23.6 x 39.4 x 55.7 - 60.2 in.
Weight:	basic unit (without accessories) approx. 150 kg

**Transmitter:**

Frequency range:	Wide band system 1 to 14 MHz, automated adaptation to the probe used.
Control acoustic output:	Range: 32dB, adjustable in 1dB steps
Focusing:	selectable transmit focal length and focal depth
Transmit-channels:	per shot max. 64 channels
Transmit-apodization:	yes
Sound field parameters:	the declaration of the sound field parameters acc. to IEC1157 can be furnished by the manufacturer on request. Sound field limiting parameters on request.

**Receiver:**

Frequency range:	Wide band system 1 to 14 MHz, automated adaptation to the probe used.
Focusing (with annular and multi-element):	
	Sub-pixel based digital dynamic focusing system:
	Accuracy of focus: +/- 3ns
	Sample-rate: 27.5 MHz
Receive-channels:	High resolution mode: 128 channels
Receive-apodization:	yes
TGC:	manual, 100 dB control range by gain knob and slider-pot
Dynamic range:	100dB.....150dB (Scan converter 2. generation) 40dB.....100dB (Scan converter 1. generation)

**SCAN-CONVERTER:**

Video memory size:	720 x 512 x 8 bit
Image memory:	2 MB
Gray scale values:	256 (8 bit)
Depth range:	depends on used probe
Image lines:	max. 1024
Scan angle:	max. 360°
Aspect ratio:	min. 0.25:1 to max. 8:1 (Write 4:1, Read 2:1), incremental magnification, no loss of resolution.
M-Mode:	M-Mode search line positionable at each scan line
M-Mode depth range:	4 to 24 cm incremental
M-Mode aspect ratio:	max. 4:1
M-Mode full screen scroll time:	14/7/3.5 sec. (50 Hz) 10/5/2.5 sec. (60 Hz) in relation to monitor width
2D/M-Mode simultaneous:	yes (multi-element probes)

**CINE LOOP MEMORY:**

Capacity:	32 MB max. 1024 2D-images typ. 128 to 256 2D-images
Call-up of sequence:	manual image by image automated: 50 to 100% of real-time rate, liberal selection of start- and end image
Sequence display:	1 or 2 images from a sequence synchronously on screen, ECG-synchronous sequence display with time marker on the ECG-line.

**DISPLAY MODES:**

2D-scan:	single, dual
M-Mode:	2D/M
Doppler-Mode:	2D/D hor. and 2D/D vertical partition
Color Doppler Mode:	2D/CFM (single, dual), 2D+M/CFM, 2D/CFM+D
Image orientation:	left/right and up/down selectable
Video pos/neg:	separately selectable for 2D-, M- and D-images

**SIGNAL PROCESSING:**

Frame filter:	4 steps (post)
Line filter:	4 steps (pre)
Enhance:	4 steps (pre)
Reject:	50 steps (pre)
Gray scale dynamic:	6 basic curves each with $\pm 8$ variations (pre, post)
Gray scale contrast:	8 variations: (background/image contrast) (post)
Echo sample algorithm:	4 variations (pre)
Dynamic:	40 to 100dB (100 to 150dB) adjustable in steps of 5dB (pre)

**MEASUREMENT AND EVALUATION PROGRAMS**

Measurements:	Distance, mean of distances, arc length, circumference (contour, ellipse mode), area (contour, ellipse mode), volume (3 dist x factor), volume (ellipsoid), planimetric volume, time and slope, Heart rate, hip joint evaluation.
Obstetric biometry tables:	Library of fetal biometry tables, fetal weight estimation, data memory for all measurement values.
Cardiology measuring program:	B-Mode LV-Single Plane (Area/Length), LV-Biplane (Area/Length), LV-Single Plane (Simpson), LV-Biplane (Simpson), LV-modified Simpson, LV-Bullet, Left Ventricular Mass, LV-Diameter, LA/AO-Ratio, LV-Posterior Wall Thickening Fraction, IVS-Thickening Fraction, RV-Diameter M-Mode Mitral Valve, Aortic Valve, LV (Cubed), LV (Pombo), LV (Teichholz),

**Doppler measuring programs:**

Velocity, Pulsatility Index, Resistance Index  
 Pulsatility Index, Resistance, Index, A/D Ratio, A/B Ratio, PI/PI ratio, RI/RI ratio, Mean Pressure Gradient, Pressure Half Time, Automatic envelope determination and PI, RI, A/B, A/D max. velocity, Pressure Gradient, Rise Time, Heart Rate;, Stroke Volume, Cardiac output.

**DATA ENTRY**

Patient data: 2 lines with 51 characters each  
 Clinic/Doctor's name: 2 lines with 24 characters each  
 Image text: 29 lines with 86 characters each  
 Auto Text memory: 40 user-programmable terms with 10 characters each.

**USER PROGRAM MEMORY**

Program presets: 40 (programmable), max. 10 per probe

**FLOPPY DISK DRIVE**

Size: 3.5"  
 Diskette: HD, 2 MB  
 Image storage: max. 5 full sized images  
 Backup-storage: max. 10 backups

**INTERFACES**

Video out	BNC-socket video norm: PAL/NTSC FBAS-signal: $1V_{ss}/75\Omega$
Video out	BNC-socket video norm: black/white video (whiteout color carrier) CCIR-signal: $1V_{ss}/75\Omega$
Video in:	BNC-socket video norm: PAL/NTSC FBAS-signal: $1V_{ss}/75\Omega$
S-Video in/out:	60°-socket, 7-pole: S-VIDEO (separated video) video norm: PAL/NTSC Chrominance: in: $0.3V_{ss}/75\Omega$ , pin 1 Luminance: in: $1.0V_{ss}/75\Omega$ , pin 3 Mass: in: GND pin 2, 4 Chrominance: out: $0.3V_{ss}/75\Omega$ , pin 5 Luminance: out: $1.0V_{ss}/75\Omega$ , pin 7 Mass: out: GND pin 6
RGB out:	Sub-D-socket, 9-pole: RGB Red: $1.0V_{ss}/75\Omega$ , pin 1 Green: $1.0V_{ss}/75\Omega$ , pin 2 Blue: $1.0V_{ss}/75\Omega$ , pin 3 H-Sync: TTL-CMOS, active low, pin 4 V-Sync: TTL-CMOS, active low, pin 5 Mass: GND pin 6, 7, 8, 9
Audio in L:	BNC, NF-signal $1.2V_{ss}$
Audio in R:	BNC, NF-signal $1.2V_{ss}$
Audio out L:	BNC, NF-signal $1.2V_{ss}$
Audio out R:	BNC, NF-signal $1.2V_{ss}$

## TECHNICAL DATA

Footswitch in:	BNC-socket: FREEZE/RUN Freeze/Run in: TTL-CMOS, active low
Footswitch in:	BNC-socket: FREEZE SPECIAL Freeze Spec. in: TTL-CMOS, active low
Remote control out:	BNC-socket: PRINT A DIN-socket: PRINT B Remote signal: TTL-CMOS, active low, I <sub>max</sub> = 25 mA RS232: VTR remote control
Net connection:	Ethernet, IEC802-2, IEC802-3 Software: DICOM 3.0 standard

## VOLUME SCAN MODULE

Size of memory:	32 MB (RAM)
Vol scan requires:	1 to 32 MB (max. 65536 scan lines each with 512 samples). The required memory space depends on scan parameters (VOL-box size and scan speed (FAST, NORM, SLOW)). typ.: 4-10 MB (S-VSW3-5)
Lines/2D-image:	max. 1024 (typ. 80 to 350)
2D-images/volume:	max. 1024 (typ. 50 to 250)
Scan time/volume:	2 to 15 sec. (typ. 4-6 sec.) 3 modes selectable: FAST (low line density) NORM (med. line density) SLOW (high line density) The depth also influences the volume scan time.
Display of sectional plane images:	synchronous with control setting, arbitrary movement in volume, monitored position in volume.
Rotation:	360°, 0.5° increments (X-, Y- and Z-axis)
Rectilinear movement:	the incremental distance between parallel sections depends on the aspect ratio min: 0.05 mm (16:1) typ.: 0.5 mm (1:1) max: 2 mm (0.25:1)
Aspect ratio:	depends on VOL-BOX depth range min                  max                  BOX 0.5:1              16:1              4 cm 0.12:1            4:1              17 cm Sizes related to display monitor.

3D-Rendering:	Calculation and display of rendered gray scale images: * surface mode, maximum mode, minimum mode; calculation time depends on rendering box size (typ. 0.3 sec)
Calculation and display of rendered color-images:	* 3D color angio mode: surface mode, max. intensity mode * 3D CFM-mode: display of flow direction or max. flowspeed in surface calculated images
Display modes:	<ul style="list-style-type: none"> <li>- 3-section mode A triplet of 3 sectional planes normal to each other is displayed.</li> <li>- Full-sized image Display of 1 single full-screen image.</li> <li>- Aspect model Display of the selected plane within the (graphics) cube.</li> <li>- Niche image Display of the sectional plane triplets within the (graphics) cube.</li> <li>- 4-section mode Display of the sectional plane triplets plus (control) 2D-scan images.</li> <li>- Display of sectional images + calculated 3D images</li> </ul>
MEM/RCL-function:	10 settings from sections of a VOL scan may be stored (and recalled thereafter).
Marking modes:	<ul style="list-style-type: none"> <li>- Plane Selection of a sectional plane in space by setting 3 markers.</li> <li>- Winding Marking of a winding line in space in order to display sections normal to that line.</li> </ul>
Display graphics:	<ul style="list-style-type: none"> <li>- Orientation help: Display of the volume body with sectional plane.</li> <li>- Color display of the center of rotation and the axes.</li> <li>- Framing of the reference image</li> <li>- Automated indexing of image orientation.</li> </ul>
Data interface: (Option)	SCSI, transfer rate: max. 4 MB/sec. Bi-directional transfer of volume, image data sets between console and mass storage medium.
Data transferred:	<ul style="list-style-type: none"> <li>volume, image data</li> <li>date, time</li> <li>clinic's name / doctor's name</li> <li>patient data</li> <li>control settings</li> <li>No measurements and text data!</li> </ul>

**DOPPLER MODULE****Spectral Doppler:**

WORKING MODES:	Pulsed Wave Doppler (Single Gate), PW Continuous Wave Doppler, CW
TRANSMIT FREQUENCIES:	PW-Doppler: 3.5, 4.0, 4.5, 5.5, 7.0, 9.0 MHz CW-Doppler: 2.25, 4.5, 9.0 MHz
PULSE REPETITION FREQUENCY (PRF):	1...31kHz in 22 steps
SAMPLE VOLUME (DOPPLER GATE):	Length: 1, 2.5, 6, 10, 15 mm Position: 5...180 mm Angle correction: 0°...89°
POWER CONTROL:	- 30dB
LFG (low frequency gain):	0...-20dB
HFG (high frequency gain):	0...-12dB
WMF (wall motion filter):	30...2000Hz
Zero line shift:	± PRF/2, ± 7 steps
SPECTRUM ANALYZER:	FFT (Fast Fourier Transformation) Max. 512 channels, 255 amplitude levels
DISPLAY SCROLL SPEEDS:	50, 100, 200 SL/s (SL..spectral lines/sec.)
REVIEW (MEMORY TIMES):	20, 10, 5 s
MEASURABLE FLOW VELOCITIES:	
Pulsed wave:	1cm/s.....3m/s ( $\alpha = 0^\circ$ , 3.5 MHz, max. zero shift) 1cm/s.....6m/s ( $\alpha = 60^\circ$ , 3.5 MHz, max. zero shift)
Continuous wave:	1cm/s...10m/s ( $\alpha = 0^\circ$ , 2.25MHz, max. zero shift) 1cm/s...20m/s ( $\alpha = 60^\circ$ , 2.25MHz, max. zero shift)
SIGNAL PROCESSING:	Reject, 6 steps
MEASURING VALUES DISPLAY:	kHz, cm/s, m/s
IMAGE FORMATS:	D, B+D, B+D simultaneous
SIMULTANEOUS MODE:	With electronic probes and Duplex probe only
REFRESH-MODE:	With electronic and mechanical probes.
AUDIO-MODES:	Stereo (both directions separately in both channels) Mono (either direction in both channels, or both together)
AUDIO VOLUME, BALANCE:	Adjustable, control knobs
HEADSET SOCKET:	4...600Ω (stereo coax plug, $\phi$ 6.3mm)

**Color Doppler:****CFM-Mode:**

Color flow imaging is possible with Curved Array and Linear Array probes.

Display modes:	2D/CFM (single, dual) Simultaneous: 2D+M/CFM Simultaneous triplex mode 2D/CFM+/D 3D/CFM
Color coding steps:	192 color steps
Depth range:	axial: 0 to 17 cm lateral: 0 to B-scan-range
Zero line shift:	16 steps (independent from spectral Doppler)
Velocity range compress:	4 steps (100%, 50%, 25%, 12.5%, depending on PRF set)
Inversion of color direction:	yes
Wall Motion Filter:	6 steps (independent of selected PRF)
Persistance Filter:	6 steps rising time 6 steps falling time
Gain control (HF-Gain):	0 to 99, incremental
Reject:	0 to 99, incremental
Density (color line density):	10 steps
Quality (color shots per line):	4 to 63
Pulse repetition frequency:	18 steps (0.5 kHz to 13 kHz)
Enhance:	4 steps, user programmable
Frequency range:	1 to 10 MHz depending on the probe, adjustable in 3 steps (low, mid, high)
Balance:	8 steps
Turbulence Reject:	15 steps
Max. meas. velocity:	4.5 m/sec.
Min. meas. velocity:	less than 1 cm/sec.
Display Modes:	V-T (velocity + turbulence) V (velocity) V-P (velocity + power) T (turbulence) P (power) P-T (power + turbulence)
Scale:	kHz, cm/s, m/s
Automatic moving tissue suppression:	yes

**Tissue Mode:**

Tissue flow imaging is possible with Curved Array and Linear Array probes.

Display modes:	2D/CFM (single, dual) Simultaneous: 2D+M/CFM Simultaneous triplex mode 2D/CFM+/D 3D/CFM
Color coding steps:	64 color steps
Depth range:	axial: 0 to 17 cm lateral: 0 to B-scan-range
Zero line shift:	16 steps (independent from spectral Doppler)
Inversion of color direction:	yes
Persistance Filter:	6 steps rising time 6 steps falling time
Gain control (HF-Gain):	0 to 99, incremental
Reject:	0 to 99, incremental
Density (color line density):	10 steps

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## TECHNICAL DATA

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Quality (color shots per line): 4 to 63  
Pulse repetition frequency: 18 steps (3 kHz to 13 kHz)  
Enhance: 4 steps  
Frequency range: 1 to 10 MHz  
depending on the probe, adjustable in 3 steps (low, mid, high)  
Balance: 8 steps  
Turbulence Reject: 15 steps  
Max. meas. velocity: 4.5 m/sec.  
Min. meas. velocity: less than 1 mm/sec.  
Display Modes: V (tissue relative velocity)  
Scale: kHz, cm/s, m/s

### **Color Angio Mode:**

Angio imaging is possible with Curved Array and Linear probes.  
Display modes: 2D/Angio, Angio (single, dual)  
Simultaneous: 2D/Angio+D  
Angio coding steps: 64 colors steps  
Angio window size: lateral: maximum to minimum B-mode scan angle  
axial: 0 to 17cm  
Reject: 15 steps  
Wall motion filter: 6 steps (automatically adjusted with PRF-range)  
Smoothing filter: rising edge: 8 steps each step 0.1 sec  
falling edge: 8 steps each step 0.1 sec.  
Gain control (HF-gain): 0 to 99, incremental  
Angio display quality: 32 steps  
Angio display density : 10 steps  
Pulse repetition frequency: 16 steps (1kHz to 13kHz)  
Enhance: 4 different color codes for each probe  
Frequency range: 1 to 10 MHz  
Image sequence memory: max. 128 images, 1024 images optional  
Balance: 8 steps  
Frequency: 3 steps (LO,MID,HI)

### **COLOR VIDEO MONITOR:**

Nominal current: 0.5A  
Mains socket: acc. to CEE 22 (Norm sheet VI, XIV), mains filter  
Safety classification: Class I, Type B  
Standards: EN60950 (IEC950)+EN60601-1-1 (IEC601-1-1)  
UL listed or classified  
Mains switch: 2-pole  
Picture tube: 15" self-safe cathode ray tube acc. to annex III German X-Ray Regulation

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## 15 Annex

### 15.1 Biparietal Diameter

#### 15.1.1 Hadlock BPD

- Reference: Hadlock FP, Deter RL, Harrist RB, Park SK, *Journal of Ultrasound in Medicine*, 97 - 104, 1997.

BPD mm	GA week + day	SD ±days	BPD mm	GA week + day	SD ±days
14	11+6	9	58	23+6	14
16	12+2	9	60	24+4	16
18	12+6	9	62	25+1	16
20	13+1	9	64	25+6	16
22	13+4	9	66	26+4	16
24	14+1	9	68	27+3	16
26	14+4	9	70	28+1	16
28	15+0	9	72	28+6	16
30	15+4	9	74	29+5	16
32	16+0	9	76	30+4	22
34	16+4	9	78	31+2	22
36	17+0	9	80	32+1	22
38	17+4	9	82	33+0	22
40	18+1	14	84	33+6	22
42	18+5	14	86	34+5	22
44	19+2	14	88	35+4	22
46	19+6	14	90	36+4	24
48	20+4	14	92	37+3	24
50	21+1	14	94	38+2	24
52	21+6	14	96	39+1	24
54	22+3	14	98	40+1	24
56	23+1	14	100	41+1	24

### 15.1.2 Hansmann BPD

- Reference: M. Hansmann, B.-J. Hackelöer, A. Staudach, "Ultraschalldiagnostik in Geburtshilfe und Gynäkologie", *Lehrbuch und Atlas*, Springer Verlag, 413-443, 1985

BPD	GA (week + day)			BPD	GA (week + day)		
mm	5%	50%	95%	mm	5%	50%	95%
29	12+2	13+3	14+3	68	24+3	25+6	27+2
30	12+5	13+5	14+5	69	24+6	26+1	27+4
31	12+6	14+0	15+1	70	25+0	26+3	27+6
32	13+2	14+2	15+3	71	25+2	26+5	28+3
33	13+3	14+4	15+6	72	25+4	27+1	28+4
34	13+5	15+0	16+2	73	26+0	27+3	29+2
35	14+1	15+2	16+3	74	26+1	27+6	29+4
36	14+3	15+4	16+6	75	26+3	28+1	29+6
37	14+6	16+0	17+1	76	26+5	28+4	30+2
38	15+0	16+2	17+4	77	27+1	28+6	30+5
39	15+3	16+4	17+6	78	27+2	29+2	31+3
40	15+5	17+0	18+1	79	27+3	29+5	32+0
41	16+0	17+2	18+4	80	27+6	30+0	32+1
42	16+3	17+4	18+6	81	28+2	30+3	32+4
43	16+4	17+6	19+1	82	28+6	31+0	33+1
44	16+6	18+1	19+3	83	29+0	31+2	33+5
45	17+2	18+4	19+6	84	29+3	31+6	34+2
46	17+4	18+6	20+1	85	29+6	32+2	34+4
47	17+6	19+1	20+4	86	30+1	32+5	35+1
48	18+0	19+3	20+6	87	30+2	33+2	36+1
49	18+1	19+5	21+2	88	31+0	32+5	36+3
50	18+4	20+0	21+1	89	31+4	34+2	37+0
51	19+0	20+3	21+6	90	32+0	34+5	37+3
52	19+2	20+5	22+1	91	32+1	35+1	38+5
53	19+3	21+0	22+4	92	33+2	35+6	39+2
54	20+0	21+3	22+6	93	33+5	36+5	39+5
55	20+2	21+5	23+0	94	34+5	37+3	40+1
56	20+5	22+0	23+2	95	35+2	38+3	41+0
57	21+0	22+2	23+4	96	35+2	38+6	41+3
58	21+3	22+5	23+6	97	35+6	39+0	42+0
59	21+4	23+0	24+3	98	36+3	39+2	42+0
60	21+6	23+2	24+4	99	36+4	39+3	42+4
61	22+1	23+4	25+0	100	36+5	39+4	42+2
62	22+4	24+0	25+3	101	37+1	39+5	42+4
63	22+6	24+2	25+4	102	37+1	39+6	42+2
64	23+1	24+4	26+0	103	37+2	40+0	42+2
65	23+4	24+6	26+2	104	37+3	40+1	42+2
66	23+6	25+1	26+5	105	37+6	40+2	42+2
67	24+1	25+3	27+1				

### 15.1.3 Jeanty BPD

- Reference: Jeanty, Philippe, *Obstetrical Ultrasound*, McGraw Hill, p 58, 1983.

Benson, Carol B., Doubilet, Peter M., "Sonographic Prediction of Gestational Age": Accuracy of Second and Third Trimester Fetal Measurements," *AJR*, 157: 1275-1277, December 1991.

BPD	GA	SD	BPD	GA	SD	BPD	GA	SD
mm	week+day	±days	mm	week+day	±days	mm	week+day	±days
28	14+0	17	46	19+0	19	64	24+6	18
29	14+1	18	47	19+2	19	65	25+2	18
30	14+3	18	48	19+3	18	66	25+3	18
31	14+6	18	49	19+6	18	67	26+0	18
32	15+1	18	50	20+2	18	68	26+3	18
33	15+2	18	51	20+3	18	69	26+5	18
34	15+3	19	52	20+6	18	70	27+1	18
35	15+6	19	53	21+1	18	71	27+3	18
36	16+1	19	54	21+3	18	72	27+6	18
37	16+3	19	55	21+6	18	73	28+2	18
38	16+5	19	56	22+1	18	74	28+5	18
39	17+0	19	57	22+3	18	75	29+1	18
40	17+2	19	58	22+6	18	76	29+3	18
41	17+3	19	59	23+1	18	77	29+6	18
42	17+6	19	60	23+3	18	78	30+2	19
43	18+1	19	61	23+6	18	79	30+5	19
44	18+3	19	62	24+1	18			
45	18+5	19	63	24+3	18			

### 15.1.4 Merz BPD

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" *Textbook and Atlas*, Georg Thieme Verlag, 308-338, 1991.

BPD	GA (week + day)			BPD	GA (week + day)		
mm	5%	50%	95%	mm	5%	50%	95%
21	10+5	12+1	13+5	62	22+1	24+1	26+1
22	10+6	12+3	13+6	63	22+4	24+4	26+4
23	11+1	12+5	14+1	64	22+6	24+6	26+6
24	11+4	13+0	14+4	65	23+1	25+1	27+1
25	11+5	13+1	14+5	66	23+4	25+4	27+4
26	12+0	13+4	15+0	67	23+6	25+6	27+6
27	12+1	13+6	15+3	68	24+1	26+1	28+2
28	12+4	14+1	15+5	69	24+3	26+4	28+4
29	12+5	14+2	15+6	70	24+5	26+6	28+6
30	13+0	14+4	16+1	71	25+1	27+1	29+2
31	13+2	14+6	16+4	72	25+4	27+4	29+5
32	13+4	15+1	16+6	73	25+6	27+6	30+0
33	13+6	15+3	17+0	74	26+1	28+2	30+3
34	14+0	15+5	17+3	75	26+4	28+4	30+5
35	14+2	16+0	17+5	76	26+6	29+0	31+1
36	14+4	16+2	18+0	77	27+1	29+3	31+4
37	14+6	16+4	18+1	78	27+4	29+6	32+0
38	15+1	16+6	18+4	79	27+6	30+1	32+2
39	15+3	17+1	18+6	80	28+2	30+4	32+5
40	15+5	17+3	19+1	81	28+5	30+6	33+1
41	15+6	17+5	19+4	82	29+1	31+2	33+4
42	16+1	18+0	19+6	83	29+4	31+5	33+6
43	16+4	18+2	20+1	84	29+6	32+1	34+2
44	16+6	18+4	20+3	85	30+2	32+4	34+5
45	17+1	18+6	20+5	86	30+6	32+6	35+1
46	17+3	19+1	21+0	87	31+0	33+2	35+4
47	17+4	19+3	21+1	88	31+4	33+6	36+1
48	17+6	19+5	21+4	89	31+6	34+1	36+4
49	18+1	20+0	21+6	90	32+2	34+4	36+6
50	18+4	20+3	22+1	91	32+6	35+1	37+3
51	18+6	20+5	22+4	92	33+1	35+4	37+6
52	19+1	21+0	22+6	93	33+4	35+6	38+1
53	19+3	21+2	23+1	94	34+0	36+3	38+6
54	19+5	21+4	23+4	95	34+4	36+6	39+2
55	20+0	21+6	23+6	96	34+6	37+2	39+5
56	20+2	22+1	24+1	97	35+3	37+6	40+1
57	20+4	22+4	24+3	98	36+6	38+2	40+5
58	20+6	22+6	24+5	99	36+3	38+6	41+1
59	21+1	23+1	25+1	100	36+6	39+2	41+6
60	21+4	23+4	25+4	101	37+2	39+6	42+2
61	21+6	23+6	25+6	102	37+6	40+2	42+6

### 15.1.5 Rempen BPD

- Reference: A. Rempen, UFK Würzburg, 'Biometrie in der Frühgravidität (I. Trimenon)' *Der Frauenarzt*, 32, 1991.

BPD	GA (week + day)			BPD	GA (week + day)		
mm	5%	50%	95%	mm	5%	50%	95%
3	5+6	6+6	8+0	16	9+3	10+4	11+5
4	6+0	7+1	8+2	17	9+4	10+6	12+1
5	6+2	7+3	8+4	18	10+0	11+1	12+2
6	6+4	7+5	8+6	90	10+2	11+3	12+4
7	6+6	8+0	9+1	20	10+4	11+5	12+6
8	7+1	8+2	9+3	21	10+6	12+0	13+1
9	7+3	8+4	9+5	22	11+1	12+2	13+3
10	7+5	8+6	10+0	23	11+3	12+4	13+5
11	8+0	9+1	10+2	24	11+5	12+6	14+0
12	8+2	9+3	10+4	25	12+0	13+1	14+2
13	8+4	9+5	10+6	26	12+2	13+3	14+4
14	8+6	10+0	11+1	27	12+4	13+5	14+6
15	9+1	10+2	11+3				

### 15.1.6 Osaka University BPD

- Reference: Osaka University Method 3 by Univ. of Osaka, 1989.

BPD	G.A.	BPD	G.A.
mm	weeks	mm	weeks
13	10	67	26
17	11	70	27
21	12	72	28
25	13	75	29
28	14	77	30
32	15	80	31
35	16	82	32
39	17	84	33
42	18	86	34
45	19	88	35
49	20	90	36
52	21	91	37
55	22	92	38
58	23	93	39
61	24	94	40
64	25		

### 15.1.7 Seoul National University BPD

- Reference: Seoul National University, Park, Yong Kyun. 'Sonographic standard mean values for each body of Korean normal fetuses based on number of weeks of gestation', *Journal of Korean Association of Sonography*, Vol.14, No.2, 1995.

BPD mm	GA week + day	SD ±days	BPD mm	GA week + day	SD ±days
24	12 + 0	12	71	27 + 0	12
25	13 + 0	12	74	28 + 0	12
29	14 + 0	12	76	29 + 0	12
33	15 + 0	12	78	30 + 0	12
37	16 + 0	12	81	31 + 0	12
40	17 + 0	12	83	32 + 0	12
44	18 + 0	12	85	33 + 0	12
47	19 + 0	12	87	34 + 0	12
51	20 + 0	12	89	35 + 0	12
54	21 + 0	12	90	36 + 0	12
57	22 + 0	12	92	37 + 0	12
60	23 + 0	12	94	38 + 0	12
63	24 + 0	12	95	39 + 0	12
66	25 + 0	12	96	40 + 0	12
68	26 + 0	12			

### 15.1.8 Tokyo University BPD

- Reference: Tokyo University Method 6 by Univ. of Tokyo, 1986.

BPD mm	GA week + day	SD $\pm$ days	BPD mm	GA week + day	SD $\pm$ days
16	11+3	7	56	23+0	11
18	11+6	7	58	23+5	11
20	12+0	7	60	24+2	12
22	12+4	7	62	25+0	12
24	13+0	7	64	25+6	12
26	13+6	7	66	26+3	13
28	14+2	7	68	27+3	13
30	14+6	7	70	28+0	13
32	15+2	7	72	29+0	14
34	16+0	8	74	29+5	14
36	16+3	8	76	30+1	15
38	17+0	8	78	31+1	16
40	17+5	8	80	32+1	16
42	18+2	9	82	33+0	18
44	19+0	9	84	34+0	20
46	19+5	10	86	35+5	25
48	20+2	10	88	37+0	25
50	21+0	10	90	39+0	25
52	21+4	10	92	42+0	25
54	22+2	10	92	42+0	25

## 15.2 Femur Length

### 15.2.1 Hadlock FEL

- Reference: Hadlock FP, Deter RL, Harrist RB, Park SK, *American Journal of Radiology*, 138:875 - 878, 1982.

FEL	GA	SD	FEL	GA	SD
mm	week + day	±days	mm	week + day	±days
10	12+6	10	45	24+4	22
11	13+1	10	46	24+6	22
12	13+3	10	47	25+2	22
13	13+4	10	48	25+5	22
14	13+6	10	49	26+1	22
15	14+1	10	50	26+4	22
16	14+4	10	51	27+0	22
17	14+6	10	52	27+3	22
18	15+1	10	53	27+6	22
19	15+3	10	54	28+1	22
20	15+5	10	55	28+5	22
21	16+0	10	56	29+1	22
22	16+2	10	57	29+4	22
23	16+4	10	58	30+0	22
24	16+6	10	59	30+4	22
25	17+1	10	60	30+6	22
26	17+4	10	61	31+3	22
27	17+6	10	62	31+6	22
28	18+1	10	63	32+2	22
29	18+4	10	64	32+6	22
30	18+6	10	65	33+2	22
31	19+1	10	66	33+6	22
32	19+4	10	67	34+1	22
33	19+6	10	68	34+5	22
34	20+2	10	69	35+1	22
35	20+5	10	70	35+5	22
36	21+0	10	71	36+1	22
37	21+3	10	72	36+5	22
38	21+6	10	73	37+1	22
39	22+1	10	74	37+5	22
40	22+4	10	75	38+2	22
41	22+6	10	76	38+6	22
42	23+2	22	77	39+2	22
43	23+5	22	78	39+6	22
44	24+1	22	79	40+3	22

### 15.2.2 Merz FEL

- Reference: E. Merz, W. Goldhofer, E. Timor-Tritsch, 'Ultrasound in Gynecology and Obstetrics', *Textbook and Atlas*, Georg Thieme Verlag, 308-338, 1991.

FEL	GA (week + day)			FEL	GA (week + day)		
mm	5%	50%	95%	mm	5%	50%	95%
10	11+1	12+2	13+4	46	23+4	25+3	27+1
11	11+4	12+5	13+6	47	24+0	25+6	27+4
12	11+6	13+0	14+1	48	24+3	26+1	28+0
13	12+1	13+2	14+4	49	24+5	26+4	28+2
14	12+3	13+5	15+0	50	25+1	26+6	28+5
15	12+5	14+0	15+2	51	25+4	27+2	29+1
16	13+1	14+3	15+5	52	25+6	27+5	29+4
17	13+3	14+5	16+0	53	26+1	28+1	30+0
18	13+6	15+1	16+3	54	26+4	28+4	30+4
19	14+1	15+3	16+5	55	27+0	29+0	31+0
20	14+4	15+6	17+1	56	27+3	29+3	31+3
21	14+6	16+1	17+3	57	27+6	29+6	31+6
22	15+1	16+4	17+6	58	28+1	30+1	32+1
23	15+3	16+6	18+1	59	28+4	30+4	32+4
24	15+6	17+1	18+4	60	29+0	31+0	33+0
25	16+1	17+4	19+1	61	29+4	31+4	33+4
26	16+3	17+6	19+3	62	29+6	31+6	33+6
27	16+6	18+2	19+6	63	30+2	32+2	34+2
28	17+1	18+4	20+1	64	30+6	32+6	34+6
29	17+4	19+0	20+4	65	31+1	33+1	35+1
30	17+6	19+3	20+6	66	31+4	33+4	35+4
31	18+1	19+5	21+1	67	32+0	34+1	36+1
32	18+4	20+1	21+4	68	32+3	34+4	36+4
33	18+6	20+4	22+1	69	32+6	35+0	37+1
34	19+1	20+6	22+3	70	33+2	35+3	37+4
35	19+4	21+1	22+6	71	33+6	35+6	38+0
36	20+0	21+4	23+1	72	34+1	36+2	38+3
37	20+2	21+6	23+4	73	34+4	36+6	39+0
38	20+5	22+2	23+6	74	35+1	37+2	39+4
39	21+0	22+5	24+3	75	35+4	37+5	39+6
40	21+3	23+1	24+6	76	36+0	38+1	40+3
41	21+5	23+3	25+1	77	36+4	38+5	40+6
42	22+1	23+6	25+4	78	37+0	39+1	41+3
43	22+4	24+1	25+6	79	37+3	39+4	41+6
44	22+6	24+4	26+3	80	37+6	40+1	42+2
45	23+1	25+0	26+6				

### 15.2.3 Osaka University FEL

- Reference: Osaka University Method 3 by Univ. of Osaka, 1989.

FEL mm	GA weeks	FEL mm	GA weeks	FEL mm	GA weeks
9	13	38	23	60	33
13	14	41	24	62	34
16	15	43	25	64	35
19	16	46	26	65	36
22	17	47	27	67	37
25	18	50	28	68	38
28	19	52	29	70	39
30	20	54	30	71	40
33	21	56	31		
36	22	58	32		

### 15.2.4 Seoul National University FEL

- Reference: Seoul National University, Park, Yong Kyun. 'Sonographic standard mean values for each body of Korean normal fetuses based on number of weeks of gestation', *Journal of Korean Association of Sonography*, Vol.14, No.2, 1995.

FEL mm	GA week + day	SD ±days	FEL mm	GA week + day	SD ±days
7	12 + 0	13	49	27 + 0	13
10	13 + 0	13	52	28 + 0	13
13	14 + 0	13	54	29 + 0	13
16	15 + 0	13	56	30 + 0	13
20	16 + 0	13	58	31 + 0	13
23	17 + 0	13	60	32 + 0	13
26	18 + 0	13	62	33 + 0	13
29	19 + 0	13	64	34 + 0	13
31	20 + 0	13	66	35 + 0	13
34	21 + 0	13	67	36 + 0	13
37	22 + 0	13	69	37 + 0	13
39	23 + 0	13	70	38 + 0	13
42	24 + 0	13	72	39 + 0	13
45	25 + 0	13	73	40 + 0	13
47	26 + 0	13			

### 15.2.5 Tokyo University FEL

- Reference: Tokyo University Method 6 by Univ. of Tokyo, 1986.

FEL mm	GA week + day	SD $\pm$ days	FEL mm	GA week + day	SD $\pm$ days
8	12+3	10	42	24+5	24
10	13+0	10	44	25+2	25
12	13+4	10	46	26+0	25
14	14+1	10	48	27+0	25
16	14+5	10	50	28+0	25
18	15+2	10	52	29+0	30
20	16+0	10	54	29+5	30
22	16+4	10	56	30+2	30
24	17+1	10	58	31+3	32
26	17+6	10	60	33+0	38
28	18+4	14	62	34+0	42
30	19+2	17	64	35+0	46
32	20+5	17	66	36+5	50
34	21+5	18	68	38+0	57
36	22+3	19	70	40+0	64
38	23+0	21	72	40+2	64
40	24+0	22			

## 15.3 Head Circumference

### 15.3.1 Hadlock HC

- Reference: Hadlock FP, Deter RL, Harrist RB, Park SK, 'Estimating Fetal Age: Computer - Assisted Analysis of Multiple Fetal Growth Parameters', *Radiology*, 152: 497 - 501, 1984.

HC mm	GA week + day	SD ±days	HC mm	GA week + day	SD ±days
55	12+0	9	209	23+0	11
62	12+2	9	216	23+4	11
69	12+6	9	223	24+2	16
76	13+1	9	230	25+0	16
83	13+4	9	237	25+5	16
90	14+0	9	244	26+3	16
97	14+3	9	251	27+2	16
104	15+0	9	258	28+0	16
111	15+2	9	265	28+6	16
118	15+6	9	272	29+4	16
125	16+2	9	279	30+4	19
132	16+5	9	286	31+3	19
139	17+2	9	293	32+2	19
146	17+5	9	300	33+2	19
153	18+2	11	307	34+1	19
160	18+6	11	314	35+1	19
167	19+2	11	321	36+1	24
174	20+0	11	328	37+2	24
181	20+3	11	335	38+2	24
188	21+1	11	342	39+3	24
195	21+6	11	349	40+4	24
202	22+2	11	356	41+5	24

### 15.3.2 Merz HC

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" Textbook and Atlas, Georg Thieme Verlag, 308-338, 1991.

HC	GA (week + day)			HC	GA (week + day)			HC	GA (week + day)		
mm	5%	50%	95%	mm	5%	50%	95%	mm	5%	50%	95%
72	11+0	12+1	13+1	170	17+4	19+1	20+4	268	26+0	27+6	29+4
74	11+1	12+2	13+4	172	17+6	19+2	20+6	270	26+1	28+1	30+0
76	11+1	12+3	13+4	174	17+6	19+3	20+6	272	26+3	28+2	30+1
78	11+2	12+4	13+5	176	18+0	19+4	21+1	274	26+4	28+4	30+3
80	11+4	12+5	13+6	178	18+1	19+6	21+3	276	26+6	28+5	30+4
82	11+4	12+6	14+0	180	18+2	19+6	21+4	278	27+0	28+6	30+6
84	11+5	12+6	14+1	182	18+4	20+1	21+5	280	27+1	29+1	31+0
86	11+6	13+1	14+2	184	18+4	20+1	21+6	282	27+3	29+2	31+1
88	12+0	13+1	14+3	186	18+6	20+3	22+0	284	27+5	29+4	31+4
90	12+1	13+2	14+4	188	19+0	20+4	22+1	286	27+6	29+6	31+5
92	12+2	13+4	14+5	190	19+1	20+5	22+2	288	28+1	30+0	31+6
94	12+3	13+4	14+6	192	19+2	20+6	22+4	290	28+2	30+1	32+1
96	12+4	13+5	14+6	194	19+4	21+1	22+5	292	28+4	30+4	32+3
98	12+5	13+6	15+1	196	19+4	21+1	22+6	294	28+6	30+5	32+4
100	12+6	14+0	15+1	198	19+5	21+3	23+0	296	29+0	30+6	32+6
102	12+6	14+1	15+4	200	19+6	21+4	23+2	298	29+1	31+1	33+0
104	13+0	14+2	15+4	202	20+0	21+5	23+3	300	29+3	31+3	33+3
106	13+1	14+3	15+5	204	20+1	21+6	23+4	302	29+4	31+4	33+4
108	13+2	14+4	15+6	206	20+3	22+1	23+6	304	29+6	31+6	33+6
110	13+3	14+5	16+0	208	20+4	22+1	23+6	306	30+1	32+1	34+1
112	13+4	14+6	16+1	210	20+5	22+3	24+1	308	30+2	32+2	34+2
114	13+5	15+0	16+2	212	20+6	22+4	24+2	310	30+4	32+4	34+4
116	13+6	15+1	16+3	214	21+0	22+5	24+3	312	30+6	32+6	34+6
118	14+0	15+2	16+4	216	21+1	22+6	24+4	314	31+1	33+1	35+1
120	14+1	15+3	16+5	218	21+3	23+1	24+6	316	31+3	33+3	35+3
122	14+1	15+4	17+0	220	21+4	23+2	25+0	318	31+4	33+4	35+4
124	14+2	15+5	17+1	222	21+6	23+4	25+1	320	31+6	33+6	36+0
126	14+3	15+6	17+1	224	21+6	23+4	25+2	322	32+0	34+1	36+1
128	14+4	16+0	17+3	226	22+1	23+6	25+4	324	32+2	34+3	36+4
130	14+5	16+1	17+4	228	22+1	24+0	25+6	326	32+4	34+5	36+6
132	14+6	16+2	17+5	230	22+3	24+1	26+0	328	32+6	34+6	37+0
134	15+0	16+3	17+6	232	22+4	24+3	26+1	330	33+1	35+1	37+2
136	15+1	16+4	18+0	234	22+5	24+4	26+2	332	33+2	35+4	37+5
138	15+2	16+5	18+1	236	22+6	24+5	26+4	334	33+4	35+6	38+0
140	15+4	16+6	18+2	238	23+1	24+6	26+5	336	33+6	36+1	38+2
142	15+4	17+0	18+3	240	23+2	25+1	26+6	338	34+1	36+3	38+4
144	15+6	17+1	18+4	242	23+4	25+2	27+1	340	34+3	36+4	38+6
146	15+6	17+2	18+5	244	23+5	25+4	27+2	342	34+5	36+6	39+1
148	16+0	17+4	19+0	246	23+6	25+5	27+4	344	35+0	37+1	39+3
150	16+1	17+4	19+1	248	24+1	25+6	27+5	346	35+2	37+4	39+5
152	16+2	17+6	19+2	250	24+1	26+0	27+6	348	35+4	37+6	40+1
154	16+3	17+6	19+3	252	24+3	26+1	28+0	350	35+6	38+1	40+4
156	16+4	18+1	19+4	254	24+4	26+3	28+1	352	36+1	38+4	40+6
158	16+5	18+1	19+5	256	24+6	26+4	28+3	354	36+4	38+6	41+4
160	16+6	18+3	19+6	258	25+0	26+6	28+4	356	36+6	39+1	41+3
162	17+0	18+4	20+0	260	25+1	27+0	28+6	358	37+1	39+4	41+6
164	17+1	18+5	20+1	262	25+3	27+1	29+0	360	37+4	39+6	42+1
166	17+2	18+6	20+2	264	25+4	27+3	29+1	362	37+6	40+1	42+3

### 15.3.3 Seoul National University HC

- Reference: Seoul National University, Park, Yong Kyun. 'Sonographic standard mean values for each body of Korean normal fetuses based on number of weeks of gestation', *Journal of Korean Association of Sonography*, Vol.14, No.2, 1995.

HC	GA	SD	HC	GA	SD
mm	week + day	±days	mm	week + day	±days
74	12 + 0	5	246	27 + 0	5
87	13 + 0	5	256	28 + 0	5
100	14 + 0	5	265	29 + 0	5
113	15 + 0	5	274	30 + 0	5
125	16 + 0	5	283	31 + 0	5
137	17 + 0	5	292	32 + 0	5
149	18 + 0	5	301	33 + 0	5
161	19 + 0	5	309	34 + 0	5
172	20 + 0	5	317	35 + 0	5
183	21 + 0	5	325	36 + 0	5
194	22 + 0	5	333	37 + 0	5
205	23 + 0	5	340	38 + 0	5
216	24 + 0	5	347	39 + 0	5
226	25 + 0	5	354	40 + 0	5
236	26 + 0	5			

### 15.3.4 Hansmann HC

- Reference: Hansmann, M. Ultrasound Diagnosis in Obstetrics and Gynecology. New York: Springer Verlag, 1985.

HC	GA	SD	HC	GA	SD	HC	GA	SD
mm	week+day	±days	mm	week+day	±days	mm	week+day	±days
106	14+0	0	215	23+0	0	311	32+0	0
115	15+0	0	226	24+0	0	318	33+0	0
127	16+0	0	240	25+0	0	325	34+0	0
140	17+0	0	251	26+0	0	332	35+0	0
152	18+0	0	263	27+0	0	337	36+0	0
164	19+0	0	274	28+0	0	340	37+0	0
176	20+0	0	284	29+0	0	344	38+0	0
190	21+0	0	293	30+0	0	347	39+0	0
203	22+0	0	303	31+0	0	349	40+0	0

## 15.4 Crown Rump Length

### 15.4.1 Hadlock CRL

- Reference: Hadlock FP, Shah YP, Kanon DJ, Linsey JV: Fetal crown-rump length: Reevaluation of relation to menstrual age (5-18 weeks) with high resolution realtime. *US. Radiology* 182:501-503, 1992.

CRL	GA	SD	CRL	GA	SD	CRL	GA	SD
mm	week+day	±days	mm	week+day	±days	mm	week+day	±days
2	5+5	3	42	11+1	5	82	14+1	6
3	5+6	3	43	11+1	5	83	14+1	6
4	6+1	3	44	11+1	5	84	14+2	6
5	6+2	3	45	11+2	5	85	14+3	6
6	6+3	3	46	11+3	5	86	14+3	6
7	6+4	3	47	11+3	6	87	14+4	7
8	6+5	3	48	11+4	6	88	14+5	7
9	6+6	3	49	11+5	6	89	14+6	7
10	7+1	3	50	11+5	6	90	14+6	7
11	7+2	3	51	11+6	6	91	15+0	7
12	7+3	3	52	11+6	6	92	15+1	7
13	7+4	3	53	12+0	6	93	15+1	7
14	7+5	3	54	12+0	6	94	15+2	7
15	7+6	3	55	12+1	6	95	15+2	7
16	8+0	3	56	12+1	6	96	15+3	7
17	8+1	3	57	12+2	6	97	15+3	7
18	8+2	3	58	12+2	6	98	15+4	7
19	8+3	3	59	12+3	6	99	15+5	7
20	8+4	4	60	12+3	6	100	15+6	7
21	8+5	4	61	12+4	6	101	16+0	7
22	8+6	4	62	12+4	6	102	16+1	8
23	9+0	4	63	12+5	6	103	16+1	8
24	9+1	4	64	12+6	6	104	16+2	8
25	9+2	4	65	12+6	6	105	16+3	8
26	9+3	4	66	12+6	6	106	16+3	8
27	9+4	4	67	13+0	6	107	16+4	8
28	9+4	4	68	13+1	6	108	16+5	8
29	9+5	4	69	13+1	6	109	16+6	8
30	9+6	4	70	13+1	6	110	16+6	8
31	10+0	5	71	13+2	6	111	17+0	8
32	10+1	5	72	13+3	6	112	17+1	8
33	10+1	5	73	13+3	6	113	17+1	8
34	10+2	5	74	13+3	6	114	17+2	8
35	10+3	5	75	13+4	6	115	17+3	8
36	10+4	5	76	13+5	6	116	17+3	8
37	10+4	5	77	13+6	6	117	17+4	8
38	10+5	5	78	13+6	6	118	17+5	8
39	10+6	5	79	13+6	6	119	17+6	8
40	10+6	5	80	14+0	6	120	17+6	8
41	11+0	5	81	14+1	6	121	18+0	8

### 15.4.2 Hansmann CRL

- Hansmann, B.-J. Hackelöer, A. Staudach 'Ultraschalldiagnostik in Geburtshilfe und Gynäkologie', *Lehrbuch und Atlas*, Springer Verlag, 413-443, 1985.

CRL	GA (week + day)			CRL	GA (week + day)		
mm	5%	50%	95%	mm	5%	50%	95%
6	5+1	6+1	6+7	52	10+7	12+2	13+4
7	5+3	6+2	7+2	54	10+7	12+3	13+5
8	5+4	6+4	7+3	56	11+1	12+4	13+6
9	5+6	6+6	7+6	58	11+1	12+5	13+7
10	6+1	6+7	7+7	60	11+3	12+6	14+1
11	6+2	7+2	8+1	63	11+4	12+7	14+3
12	6+3	7+3	8+3	66	11+5	13+2	14+5
13	6+5	7+4	8+4	70	11+7	13+3	14+7
14	6+6	7+6	8+6	73	12+1	13+5	15+1
15	6+7	7+7	8+7	76	12+2	13+6	15+3
16	7+2	8+2	9+1	80	12+4	14+1	15+5
17	7+3	8+3	9+2	83	12+5	14+2	15+7
18	7+4	8+4	9+4	86	12+6	14+4	16+2
19	7+5	8+5	9+5	90	13+1	14+6	16+4
20	7+6	8+6	9+6	93	13+3	15+1	16+6
21	7+7	8+7	9+7	96	13+4	15+3	17+1
22	8+1	9+1	10+1	100	13+6	15+5	17+3
23	8+2	9+2	10+2	103	14+1	15+7	17+6
24	8+3	9+3	10+3	106	14+3	16+2	18+1
26	8+5	9+5	10+5	110	14+5	16+4	18+4
28	8+6	9+7	11+1	113	14+7	16+7	18+7
30	9+1	10+2	11+2	116	15+2	17+2	19+2
32	9+2	10+3	11+4	120	15+4	17+4	19+4
34	9+4	10+5	11+5	123	15+7	17+7	19+7
36	9+5	10+6	11+7	126	16+2	18+2	20+3
38	9+6	11+1	12+2	130	16+5	18+6	20+6
40	10+1	11+2	12+3	133	16+7	19+1	21+2
42	10+2	11+3	12+4	136	17+3	19+4	21+6
44	10+3	11+4	12+6	140	17+6	19+7	22+2
46	10+5	11+6	12+7	143	18+1	20+3	22+5
48	10+6	11+7	13+2	146	18+4	20+6	23+1
50	10+6	12+1	13+3	150	18+7	21+3	23+5

### 15.4.3 Osaka University CRL

- Reference: Osaka University Method 3 by Univ. of Osaka, 1989.

CRL	GA
mm	week
9	7
13	8
20	9
30	10
41	11
53	12
65	13

#### 15.4.4 Rempen CRL

- Reference: Rempen, UFK Würzburg, 'Biometrie in der Frühgravidität (I. Trimenon) 'Der Frauenarzt, 32, 1991.

CRL	GA (week + day)			CRL	GA (week + day)		
mm	5%	50%	95%	mm	5%	50%	95%
2	5+1	6+0	6+6	41	9+6	10+5	11+4
3	5+2	6+1	7+0	42	10+0	10+6	11+5
4	5+3	6+2	7+1	43	10+1	11+0	11+6
5	5+4	6+3	7+2	44	10+1	11+0	11+6
6	5+5	6+4	7+3	45	10+2	11+1	12+0
7	5+6	6+5	7+4	46	10+3	11+2	12+1
8	6+0	6+6	7+5	47	10+3	11+2	12+1
9	6+1	7+0	7+6	48	10+4	11+3	12+2
10	6+2	7+1	8+0	49	10+5	11+4	12+3
11	6+3	7+2	8+1	50	10+5	11+4	12+3
12	6+4	7+3	8+2	51	10+6	11+5	12+4
13	6+5	7+4	8+3	52	10+6	11+5	12+4
14	6+6	7+5	8+4	53	11+0	11+6	12+5
15	7+0	7+6	8+5	54	11+1	12+0	12+6
16	7+0	7+6	8+5	55	11+1	12+0	12+6
17	7+1	8+0	8+6	56	11+2	12+1	13+0
18	7+2	8+1	9+0	57	11+2	12+1	13+0
19	7+3	8+2	9+1	58	11+3	12+2	13+1
20	7+4	8+3	9+2	59	11+4	12+3	13+2
21	7+5	8+4	9+3	60	11+4	12+3	13+2
22	7+6	8+5	9+4	61	11+5	12+4	13+3
23	7+6	8+5	9+4	62	11+5	12+4	13+3
24	8+0	8+6	9+5	63	11+6	12+5	13+4
25	8+1	9+0	9+6	64	11+6	12+5	13+4
26	8+2	9+1	10+0	65	12+0	12+6	13+5
27	8+3	9+2	10+1	66	12+0	12+6	13+5
28	8+4	9+3	10+2	67	12+1	13+0	13+6
29	8+4	9+3	10+2	68	12+1	13+0	13+6
30	8+5	9+4	10+3	69	12+2	13+1	14+0
31	8+6	9+5	10+4	70	12+2	13+1	14+0
32	9+0	9+6	10+5	71	12+3	13+2	14+1
33	9+0	9+6	10+5	72	12+3	13+2	14+1
34	9+1	10+0	10+6	73	12+4	13+3	14+2
35	9+2	10+1	11+0	74	12+4	13+3	14+2
36	9+3	10+2	11+1	75	12+5	13+4	14+3
37	9+3	10+2	11+1	76	12+5	13+4	14+3
38	9+4	10+3	11+2	77	12+5	13+4	14+3
39	9+5	10+4	11+3	78	12+6	13+5	14+4
40	9+6	10+5	11+4				

### 15.4.5 Robinson & Flemming CRL

- Reference: Robinson HP and Flemming JEE."A critical evaluation of sonar 'crown-rump lenght' measurements".*Br. J. Obstet. Gynaecol.* 82: 702-710 1975.

CRL	GA	SD	CRL	GA	SD	CRL	GA	SD
mm	week+day	±days	mm	week+day	±days	mm	week+day	±days
5.5	6+2	5	21.9	9+0	5	48.3	11+5	5
6.1	6+3	5	23.1	9+1	5	50.0	11+6	5
6.8	6+4	5	24.2	9+2	5	51.7	12+0	5
7.5	6+5	5	25.4	9+3	5	53.4	12+1	5
8.1	6+6	5	26.7	9+4	5	55.2	12+2	5
8.9	7+0	5	27.9	9+5	5	57.0	12+3	5
9.6	7+1	5	29.2	9+6	5	58.8	12+4	5
10.4	7+2	5	30.5	10+0	5	60.6	12+5	5
11.2	7+3	5	31.8	10+1	5	62.5	12+6	5
12.0	7+4	5	33.2	10+2	5	64.3	13+0	5
12.9	7+5	5	34.6	10+3	5	66.3	13+1	5
13.8	7+6	5	36.0	10+4	5	68.2	13+2	5
14.7	8+0	5	37.4	10+5	5	70.2	13+3	5
15.7	8+1	5	38.9	10+6	5	72.2	13+4	5
16.6	8+2	5	40.4	11+0	5	74.2	13+5	5
17.6	8+3	5	41.9	11+1	5	76.3	13+6	5
18.7	8+4	5	43.5	11+2	5	78.3	14+0	5
19.7	8+5	5	45.1	11+3	5			
20.8	8+6	5	46.7	11+4	5			

### 15.4.6 Seoul National University CRL

- Reference: Seoul National University, Park, Yong Kyun. 'Sonographic standard mean values for each body of Korean normal fetuses based on number of weeks of gestation', *Journal of Korean Association of Sonography*, Vol. 14, No. 2, 1995.

CRL	GA	SD
mm	week + day	±days
10	7 + 0	
15	8 + 0	
23	9 + 0	
33	10 + 0	
42	11 + 0	

### 15.4.7 Tokyo University CRL

- Reference: Tokyo University Method 6 by Univ. of Tokyo, 1986.

CRL	GA	SD	CRL	GA	SD
mm	week + day	±days	mm	week + day	±days
6	6+3	7	54	12+4	7
8	6+6	7	56	12+5	7
10	7+1	7	58	13+0	7
12	7+4	7	60	13+1	7
14	7+6	7	62	13+2	7
16	8+1	7	64	13+3	7
18	8+4	7	66	13+4	7
20	9+1	7	68	13+5	7
22	9+2	7	70	13+6	7
24	9+4	7	72	14+0	8
26	9+6	7	74	14+1	8
28	10+2	7	76	14+2	8
30	10+3	7	78	14+3	8
32	10+4	7	80	14+4	8
34	10+6	7	82	14+5	8
36	11+0	7	84	14+6	8
38	11+1	7	86	15+0	8
40	11+3	7	88	15+1	14
42	11+4	7	90	15+2	14
44	11+6	7	92	15+3	14
46	12+0	7	94	15+4	14
48	12+1	7	96	15+5	14
50	12+2	7	98	15+6	14
52	12+3	7	100	16+0	14

## 15.5 Abdominal Circumference

### 15.5.1 Hadlock AC (1)

- Reference: Hadlock FP, Deter RL, Harrist RB, Park SK, *American Journal of Radiology*, 139:367-370, 1982.

AC	GA	SD	AC	GA	SD
mm	week + day	±days	mm	week + day	±days
100	15+4	13	235	27+5	15
105	16+1	13	240	28+2	15
110	16+4	13	245	28+5	15
115	16+6	13	250	29+1	15
120	17+2	13	255	29+5	15
125	17+6	13	260	30+1	18
130	18+1	14	265	30+4	21
135	18+4	14	270	31+1	21
140	19+1	14	275	31+4	21
145	19+4	14	280	32+1	21
150	20+0	14	285	32+4	21
155	20+3	14	290	33+1	21
160	20+6	14	295	33+4	21
165	21+2	14	300	34+1	21
170	21+5	14	305	34+4	21
175	22+1	14	310	35+1	21
180	22+4	14	315	35+4	21
185	23+1	14	320	36+1	18
190	23+4	14	325	36+4	18
195	24+0	15	330	37+1	18
200	24+4	15	335	37+4	18
205	24+6	15	340	38+1	18
210	25+3	15	345	38+5	18
215	25+6	15	350	39+1	18
220	26+2	15	355	39+5	18
225	26+6	15	360	40+1	18
230	27+2	15	365	40+6	18

### 15.5.2 Hadlock AC (2)

- Reference: Hadlock FP, Deter RL, Harrist RB, *et al.* "Estimating fetal age: Computer-assisted analysis of multiple fetal growth parameters". *Radiology* 152 (2): 497-501: 1984.

Deter RL, Hadlock FP and Harrist RB. "Evaluation of fetal growth and the detection of intrauterine growth retardation". In Callen PW (ed.), *Ultrasonography in Obstetrics and Gynecology*. W.B. Saunders Co., Philadelphia, pp. 113-140, 1983.

AC mm	GA week+day	SD ±days	AC mm	GA week+day	SD ±days	AC mm	GA week+day	SD ±days
51	12+1	12	160	21+1	15	270	31+1	21
60	12+6	12	170	22+0	15	280	32+0	21
70	13+4	12	180	22+6	15	290	33+0	21
80	14+3	12	190	23+5	15	300	34+0	21
90	15+1	12	200	24+4	15	310	34+6	21
100	16+0	12	210	25+3	15	320	35+6	21
110	16+6	12	220	26+3	15	330	36+6	21
120	17+5	12	230	27+3	15	340	37+6	21
130	18+3	15	240	28+2	15	350	38+6	21
140	19+3	15	250	29+1	15	360	39+6	21
150	20+1	15	260	30+1	21	370	40+6	21

### 15.5.3 Merz AC

- Reference: E. Merz, W. Goldhofer, E. Timor-Tritsch, 'Ultrasound in Gynecology and Obstetrics', *Textbook and Atlas*, Georg Thieme Verlag, 308-338, 1991.

AC	GA (week + day)			AC	GA (week + day)			AC	GA (week + day)		
mm	5%	50%	95%	mm	5%	50%	95%	mm	5%	50%	95%
56	10+6	12+1	13+2	154	19+6	21+3	23+0	252	28+6	30+6	32+5
58	11+1	12+2	13+4	156	20+1	21+4	23+1	254	29+0	30+6	32+6
60	11+2	12+4	13+5	158	20+1	21+6	23+3	256	29+1	31+1	33+1
62	11+4	12+5	13+6	160	23+3	22+0	23+4	258	29+3	31+2	33+2
64	11+5	12+6	14+1	162	20+4	22+1	23+6	260	29+4	31+4	33+4
66	11+6	13+1	14+2	164	20+6	22+3	24+0	262	29+5	31+5	33+5
68	12+0	13+2	14+4	166	21+0	22+4	24+1	264	29+6	31+6	33+6
70	12+1	13+4	14+5	168	21+1	22+6	24+3	266	30+1	32+1	34+1
72	12+3	13+4	14+6	170	21+2	23+0	24+4	268	30+2	32+2	34+2
74	12+4	13+6	15+1	172	21+4	23+1	24+6	270	30+4	32+4	34+4
76	12+6	14+0	15+2	174	21+5	23+2	25+0	272	30+4	32+5	34+5
78	12+6	14+1	15+4	176	21+6	23+4	25+1	274	30+6	32+6	34+6
80	13+1	14+3	15+5	178	22+1	23+5	25+3	276	31+0	33+0	35+1
82	13+2	14+4	15+6	180	22+1	23+6	25+4	278	31+1	33+1	35+2
84	13+4	14+6	16+1	182	22+3	24+1	25+6	280	31+3	33+3	35+4
86	13+5	15+0	16+2	184	22+4	24+2	26+0	282	31+4	33+4	35+5
88	13+6	15+1	16+4	186	22+6	24+4	26+1	284	31+5	33+6	35+6
90	14+0	15+3	16+5	188	23+0	24+5	26+3	286	31+6	34+0	36+1
92	14+1	15+4	16+6	190	23+1	24+6	26+4	288	32+1	34+1	36+2
94	14+3	15+5	17+1	192	23+2	25+0	26+6	290	32+2	34+3	36+4
96	14+4	15+6	17+2	194	23+4	25+1	27+0	292	32+4	34+4	36+5
98	14+6	16+1	17+4	196	23+5	25+3	27+1	294	32+4	34+5	36+6
100	14+6	16+2	17+5	198	23+6	24+4	27+3	296	32+6	34+6	37+1
102	15+1	16+4	17+6	200	24+1	25+6	27+4	298	33+0	35+1	37+1
104	15+2	16+5	18+1	202	24+2	26+0	27+6	300	33+1	35+2	37+3
106	15+4	16+6	18+2	204	24+3	26+1	27+6	302	33+3	35+4	37+4
108	15+5	17+1	18+3	206	24+4	26+3	28+1	304	33+4	35+5	37+6
110	15+6	17+2	18+4	208	24+6	26+4	28+2	306	33+5	35+6	38+0
112	16+0	17+3	18+6	210	25+0	26+6	28+4	308	33+6	36+1	38+1
114	16+1	17+4	19+0	212	25+1	27+0	28+5	310	34+1	36+2	38+3
116	16+3	17+6	19+1	214	25+2	27+1	28+6	312	34+2	36+4	38+4
118	16+4	18+0	19+3	216	25+4	27+2	29+1	314	34+4	36+4	38+6
120	16+6	18+1	19+4	218	25+5	27+4	29+2	316	34+4	36+6	39+0
122	17+0	18+3	19+6	220	25+6	27+5	29+4	318	34+6	37+0	39+1
124	17+1	18+4	20+0	222	26+1	27+6	29+5	320	35+0	37+1	39+3
126	17+2	18+6	20+1	224	26+2	28+1	29+6	322	35+1	37+3	39+4
128	17+4	19+0	20+3	226	26+3	28+2	30+1	324	35+3	37+4	39+6
130	17+5	19+1	20+4	228	26+4	28+4	30+2	326	35+4	37+6	40+0
132	17+6	19+2	20+6	230	26+6	28+5	30+4	328	35+5	38+0	40+1
134	18+0	19+4	21+0	232	27+0	28+6	30+5	330	35+6	38+1	40+3
136	18+1	19+5	21+1	234	27+1	29+0	30+6	332	36+1	38+3	40+4
138	18+3	19+6	21+3	236	27+3	29+1	31+1	334	36+2	38+4	40+6
140	18+4	20+1	21+4	238	27+4	29+3	31+2	336	36+4	38+5	41+0
142	18+6	20+2	21+6	240	27+5	29+4	31+4	338	36+5	38+6	41+1
144	19+0	20+4	22+0	242	27+6	29+6	31+5	340	36+6	39+1	41+3
146	19+1	20+5	22+1	244	28+1	30+0	31+6	342	37+0	39+2	41+4
148	19+2	20+6	22+3	246	28+2	30+1	32+1	344	37+1	39+4	41+6
150	19+4	21+1	22+4	248	28+3	30+3	32+2	346	37+3	39+5	42+0
152	19+5	21+1	22+6	250	28+4	30+4	32+4	348	37+4	39+6	42+1

## 15.6 Gestational Sack

### 15.6.1 Holländer GS

- Reference: nach Holländer, E. Merz, W. Goldhofer, E. Timor-Tritsch 'Ultrasound in Gynecology and Obstetrics', *Textbook and Atlas*, Georg Thieme Verlag, 309, 1991:

GS	GA	GS	GA	GS	GA
mm	week + day	mm	week + day	mm	week + day
8	5+4	20	7+2	32	8+6
9	5+5	21	7+3	33	9+0
10	5+6	22	7+3	34	9+1
11	6+0	23	7+4	35	9+2
12	6+1	24	7+5	36	9+3
13	6+2	25	7+6	37	9+4
14	6+3	26	8+0	38	9+5
15	6+4	27	8+1	39	9+6
16	6+5	28	8+2	40	10+0
17	6+6	29	8+3	41	10+1
18	7+0	30	8+4	42	10+2
19	7+1	31	8+5		

### 15.6.2 Seoul National University GS

- Reference: Seoul National University, Park, Yong Kyun. 'Sonographic standard mean values for each body of Korean normal fetuses based on number of weeks of gestation', *Journal of Korean Association of Sonography*, Vol.14, No.2, 1995.

GS	GA	SD	GS	GA	SD
mm	week + day	±days	mm	week + day	±days
3	4 + 0		141	23 + 0	
10	5 + 0		148	24 + 0	
18	6 + 0		155	25 + 0	
25	7 + 0		163	26 + 0	
32	8 + 0		170	27 + 0	
39	9 + 0		177	28 + 0	
47	10 + 0		184	29 + 0	
54	11 + 0		192	30 + 0	
61	12 + 0		199	31 + 0	
68	13 + 0		206	32 + 0	
76	14 + 0		213	33 + 0	
83	15 + 0		221	34 + 0	
90	16 + 0		228	35 + 0	
97	17 + 0		235	36 + 0	
105	18 + 0		242	37 + 0	
112	19 + 0		250	38 + 0	
119	20 + 0		257	39 + 0	
126	21 + 0		264	40 + 0	
134	22 + 0				

### 15.6.3 Tokyo University GS

- Reference: Tokyo University Method 6 by Univ. of Tokyo, 1986.

GS	GA	SD	GS	GA	SD
mm	week + day	±days	mm	week + day	±days
10	4+0	7	40	8+6	13
12	4+1	7	42	9+1	14
14	4+4	7	44	9+3	14
16	5+0	8	46	9+4	14
18	5+1	8	48	10+0	15
20	5+4	8	50	10+1	15
22	6+0	11	52	10+3	15
24	6+1	11	54	10+4	15
26	6+6	12	56	10+6	15
28	7+1	12	58	11+1	16
30	7+3	12	60	11+3	16
32	7+4	12	62	11+4	16
34	8+0	13	64	11+6	16
36	8+1	13	66	11+8	16
38	8+3	13	68	12+1	17

### 15.6.4 Hansmann GS

GS	GA	SD
mm	week+day	±days
6	5+0	0
10	6+0	0
16	7+0	0
24	8+0	0
34	9+0	0
44	10+0	0
50	11+0	0
58	12+0	0
64	13+0	0

### 15.6.5 Hellman GS

- Reference: Hellman LM, Kobayashi M, Fillisti L, Lanenhar M. 'Growth and development of the human fetus prior to the twentieth week of gestation'. American Journal of Obstetrics and Gynecology 103:769, 1969.

GS mm	GA week+day	SD ±days	GS mm	GA week+day	SD ±days	GS mm	GA week+day	SD ±days
4	4+1	7	23	6+6	11	42	9+4	14
5	4+2	7	24	7+0	11	43	9+5	14
6	4+3	7	25	7+1	11	44	9+6	14
7	4+4	7	26	7+2	11	45	10+0	14
8	4+5	7	27	7+3	12	46	10+1	14
9	4+6	7	28	7+4	12	47	10+2	14
10	5+0	7	29	7+5	12	48	10+3	14
11	5+1	7	30	7+6	12	49	10+4	0
12	5+2	7	31	8+0	12	50	10+5	0
13	5+3	7	32	8+1	12	51	11+0	0
14	5+4	7	33	8+2	13	52	11+1	0
15	5+5	8	34	8+3	13	53	11+2	0
16	5+6	8	35	8+4	13	54	11+3	0
17	6+0	8	36	8+5	13	55	11+4	0
18	6+1	8	37	8+6	13	56	11+5	0
19	6+2	8	38	9+0	13	57	11+6	0
20	6+3	8	39	9+1	13	58	11+6	0
21	6+4	11	40	9+2	13	59	12+0	0
22	6+5	11	41	9+3	14	60	12+1	0

### 15.7 Tibia Length

#### 15.7.1 Merz TL

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" Textbook and Atlas, Georg Thieme Verlag, 1991.

GA week	TL / mm			GA week	TL / mm			GA week	TL / mm		
	5%	50%	95%		5%	50%	95%		5%	50%	95%
12	4	7	10	22	29	33	37	32	50	54	58
13	6	10	13	23	32	36	40	33	51	56	60
14	9	12	16	24	34	38	42	34	53	57	62
15	12	15	19	25	36	40	44	35	54	59	63
16	14	18	21	26	38	42	46	36	56	60	65
17	17	21	24	27	40	45	49	37	57	62	66
18	20	23	27	28	42	47	51	38	59	63	68
19	22	26	30	29	44	49	53	39	60	64	69
20	25	28	32	30	46	50	55	40	61	66	70
21	27	31	35	31	48	52	57				

## 15.8 Humerus Length

### 15.8.1 Merz HL

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" *Textbook and Atlas*, Georg Thieme Verlag, 1991.

GA	HL / mm			GA	HL / mm			GA	HL / mm		
week	5%	50%	95%	week	5%	50%	95%	week	5%	50%	95%
12	4	8	11	22	31	35	39	32	51	55	60
13	7	11	14	23	33	37	41	33	53	57	62
14	10	14	17	24	36	40	44	34	54	59	63
15	13	16	20	25	38	42	46	35	55	60	65
16	16	19	23	26	40	44	48	36	57	61	66
17	18	22	26	27	42	46	50	37	58	63	67
18	21	25	28	28	44	48	52	38	59	64	69
19	24	27	31	29	46	50	54	39	60	65	70
20	26	30	34	30	48	52	56	40	62	66	71
21	29	32	36	31	49	54	58				

### 15.8.2 Osaka University HL

- Reference: Osaka University Method 3 by Univ. of Osaka, 1989.

HL	GA	HL	GA
mm	weeks	mm	weeks
10	13	44	27
13	14	46	28
16	15	48	29
19	16	49	30
22	17	51	31
24	18	53	32
27	19	54	33
29	20	55	34
32	21	57	35
34	22	58	36
36	23	59	37
38	24	60	38
40	25	61	39
42	26	62	40

## 15.9 Ulna Length

### 15.9.1 Merz UL

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" *Textbook and Atlas*, Georg Thieme Verlag, 1991.

GA	UL / mm			GA	UL / mm			GA	UL / mm		
week	5%	50%	95%	week	5%	50%	95%	week	5%	50%	95%
12	3	6	9	22	29	33	36	32	47	51	55
13	5	9	12	23	31	35	39	33	49	53	57
14	8	12	15	24	33	37	41	34	50	54	58
15	11	14	18	25	35	39	43	35	51	55	60
16	14	17	21	26	37	41	45	36	52	56	61
17	17	20	23	27	39	43	47	37	53	57	62
18	19	23	26	28	41	45	49	38	54	58	63
19	22	25	29	29	43	47	51	39	55	59	64
20	24	28	31	30	44	48	52	40	56	60	65
21	27	30	34	31	46	50	54				

## 15.10 Fibula Length

### 15.10.1 Merz FL

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" *Textbook and Atlas*, Georg Thieme Verlag, 1991.

GA	FL / mm			GA	FL / mm			GA	FL / mm		
week	5%	50%	95%	week	5%	50%	95%	week	5%	50%	95%
12	2	5	8	22	29	32	35	32	48	52	56
13	5	8	11	23	31	35	38	33	50	54	58
14	8	11	14	24	33	37	40	34	51	55	59
15	11	14	17	25	36	39	42	35	53	57	60
16	14	17	20	26	38	41	45	36	54	58	62
17	16	19	22	27	40	43	47	37	55	59	63
18	19	22	25	28	42	45	49	38	56	60	64
19	21	25	28	29	43	47	51	39	57	61	66
20	24	27	30	30	45	49	52	40	59	63	67
21	26	30	33	31	47	51	54				

## 15.11 Radius Length

### 15.11.1 Merz RL

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" *Textbook and Atlas*, Georg Thieme Verlag, 1991

GA	RL / mm			GA	RL / mm			GA	RL / mm		
week	5%	50%	95%	week	5%	50%	95%	week	5%	50%	95%
12	1	5	8	22	25	29	33	32	41	45	50
13	4	7	11	23	27	31	35	33	42	47	51
14	7	10	14	24	29	33	37	34	43	48	52
15	9	13	16	25	31	35	39	35	44	49	53
16	12	15	19	26	32	37	41	36	45	50	54
17	14	18	21	27	34	38	43	37	46	51	55
18	16	20	24	28	36	40	44	38	47	51	56
19	19	22	26	29	37	41	46	39	47	52	57
20	21	25	29	30	38	43	47	40	48	53	58
21	23	27	31	31	40	44	49				

## 15.12 Abdomen Anterior Posterior

### 15.12.1 Merz AAP

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" *Textbook and Atlas*, Georg Thieme Verlag, 1991.

GA	AAP / mm			GA	AAP / mm			GA	AAP / mm		
week	5%	50%	95%	week	5%	50%	95%	week	5%	50%	95%
12	12	18	24	22	43	50	58	32	74	83	92
13	15	21	27	23	46	54	61	33	78	86	95
14	18	24	30	24	49	57	65	34	81	90	98
15	21	28	34	25	53	60	68	35	84	93	102
16	24	31	37	26	56	64	71	36	87	96	105
17	28	34	41	27	59	67	75	37	90	99	109
18	31	37	44	28	62	70	78	38	93	103	112
19	34	41	48	29	65	73	82	39	97	106	115
20	37	44	51	30	68	77	85	40	100	109	119
21	40	47	54	31	71	80	88				

## 15.13 Transverse Abdominal Diameter

### 15.13.1 Merz TAD

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" *Textbook and Atlas*, Georg Thieme Verlag, 1991

GA	TAD / mm			GA	TAD / mm			GA	TAD / mm		
week	5%	50%	95%	week	5%	50%	95%	week	5%	50%	95%
12	13	19	25	22	45	52	59	32	76	85	93
13	17	23	28	23	48	55	63	33	79	88	97
14	20	26	32	24	51	58	66	34	82	91	100
15	23	29	35	25	54	62	70	35	85	94	104
16	26	32	39	26	57	65	73	36	88	98	107
17	29	36	42	27	60	68	76	37	92	101	110
18	32	39	46	28	63	72	80	38	95	104	114
19	35	42	49	29	66	75	83	39	98	108	117
20	38	45	53	30	70	78	87	40	101	111	120
21	41	49	56	31	73	81	90				

## 15.14 Occipito Frontal Diameter

### 15.14.1 Merz OFD

- Reference: Merz, W. Goldhofer, E. Timor-Tritsch. "Ultrasound in Gynecology and Obstetrics" *Textbook and Atlas*, Georg Thieme Verlag, 1991

GA	OFD / mm			GA	OFD / mm			GA	OFD / mm		
week	5%	50%	95%	week	5%	50%	95%	week	5%	50%	95%
12	18	23	28	22	63	69	75	32	95	101	108
13	23	28	33	23	67	73	79	33	97	104	110
14	28	33	38	24	71	77	83	34	99	106	113
15	33	38	43	25	74	80	86	35	102	108	115
16	38	43	48	26	78	84	90	36	104	110	117
17	42	48	53	27	81	87	93	37	105	112	119
18	47	52	58	28	84	90	96	38	107	114	121
19	51	57	62	29	87	93	99	39	109	116	123
20	55	61	67	30	90	96	102	40	110	117	124
21	59	65	71	31	92	99	105				

## 15.15 Thorax Transverse Diameter

### 15.15.1 Hansmann TTD

- Reference: M. Hansmann, B.-J. Hackelöer, A. Staudach, "Ultraschalldiagnostik in Geburtshilfe und Gynäkologie", *Lehrbuch und Atlas*, Springer Verlag, 413-443, 1985

TTD	GA (week + day)			TTD	GA (week + day)			TTD	GA (week + day)		
mm	5%	50%	95%	mm	5%	50%	95%	mm	5%	50%	95%
20	10+6	12+0	13+2	52	19+6	22+0	24+1	82	28+4	32+0	35+4
22	11+5	13+0	14+3	55	20+6	23+0	25+2	85	29+3	33+0	36+5
26	12+5	14+0	15+3	58	21+5	24+0	26+3	88	30+2	34+0	37+6
29	13+5	15+0	16+3	61	22+4	25+0	27+4	90	31+4	35+0	38+3
32	14+5	16+0	17+3	64	23+3	26+0	28+5	93	32+6	36+0	39+2
36	15+4	17+0	18+4	67	24+2	27+0	29+6	96	33+6	37+0	40+2
39	16+3	18+0	19+5	70	25+0	28+0	31+0	98	34+5	38+0	41+3
42	17+3	19+0	20+5	73	26+0	29+0	32+1	101	35+3	39+0	42+5
46	18+2	20+0	21+6	76	26+6	30+0	33+2	103	36+6	40+0	43+1
49	19+0	21+0	23+0	79	27+5	31+0	34+3	105	38+2	41+0	43+5

## 15.16 Fetal Trunk Area

### 15.16.1 Osaka University FTA

- Reference: Osaka University Method 3 by Univ. of Osaka, 1989.

FTA	GA	FTA	GA
cm <sup>2</sup>	weeks	cm <sup>2</sup>	weeks
5.6	14	43.4	28
7.3	15	47.1	29
9.2	16	50.8	30
11.3	17	54.5	31
13.5	18	58.3	32
15.8	19	62.1	33
18.4	20	65.8	34
21.0	21	69.5	35
23.8	22	73.2	36
26.8	23	76.8	37
29.9	24	80.2	38
33.1	25	83.5	39
36.5	26	86.6	40
39.9	27		

## 15.17 Middle Abdominal Diameter

### 15.17.1 Eik-Nes, Grottum MAD

- Literatur: Eik-Nes SH, Jorgensen NP, Grottum P, Lokvik B. Normal range curves for the intrauterine growth of the fetal abdominal diameters. Submitted JCU.

Campbell S, Thomas A. Ultrasound measurement of the fetal head to abdomen circumference relation in the assessment of growth retardation. Br J Obstet Gynecol 1977; 84:165-174.

MAD mm	GA week+day	SD ±days	MAD mm	GA week+days	SD ±days	MAD mm	GA week+days	SD ±days
36	16+0		61	24+5		86	31+5	
37	16+3		62	25+0		87	32+0	
38	16+6		63	25+2		88	32+2	
39	17+3		64	25+4		89	32+4	
40	17+6		65	25+6		90	32+6	
41	18+2		66	26+1		91	33+1	
42	18+4		67	26+3		92	33+4	
43	19+0		68	26+5		93	33+6	
44	19+3		69	27+0		94	34+1	
45	19+5		70	27+2		95	34+3	
46	20+1		71	27+3		96	34+6	
47	20+3		72	27+5		97	35+1	
48	20+5		73	28+0		98	35+3	
49	21+1		74	28+2		99	35+6	
50	21+3		75	28+4		100	36+1	
51	21+5		76	28+6		101	36+4	
52	22+0		77	29+1		102	37+0	
53	22+2		78	29+3		103	37+3	
54	22+5		79	29+5		104	37+6	
55	23+0		80	30+0		105	38+2	
56	23+2		81	30+2		106	38+5	
57	23+4		82	30+4		107	39+1	
58	23+6		83	30+6		108	39+5	
59	24+1		84	31+1				
60	24+3		85	31+3				

#### Annotation:

For this biometry table two distance measurements must be performed. If both measurements are available the MAD is calculated (formula below) and evaluated acc. the table.

TAD ... Transverse Abdominal Diameter

AAP ... Abdomen Anterior Posterior

$$\text{MAD} = \frac{\text{TAD} + \text{AAP}}{2}$$

## 15.18 Head circumference to Abdominal circumference - Ratio

### 15.18.1 Hadlock HC/AC Ratio

- Reference: Deter RL, Hadlock FP and Harrist RB. "Evaluation of fetal growth and the detection of intrauterine growth retardation". In Callen PW (ed.), *Ultrasonography in Obstetrics and Gynecology*. W.B. Saunders Co., Philadelphia, 1983, pp. 113-140.

Hadlock FP, et al. *Perinatol. Neonatal* 7(9): 21 1983.

Hadlock FP. "Evaluation of fetal dating studies". In Deter RL, et al. (eds.) *Quantitative Obstetrical Ultrasonography*. John Wiley & Sons, New York, 1982, 33-45.

HC/AC	GA	SD	HC/AC	GA	SD	HC/AC	GA	SD
mm	week+day	±days	mm	week+day	±days	mm	week+day	±days
1.22	12	8	1.14	21	10	1.05	32	19
1.21	13	8	1.13	22	10	1.04	33	19
1.20	14	8	1.12	23	10	1.03	34	19
1.19	15	8	1.10	26	14	1.02	35	19
1.18	16	8	1.09	27	14	1.01	37	18
1.17	18	8	1.08	28	14	1.00	38	18
1.16	19	10	1.07	29	14	0.99	39	18
1.15	20	10	1.06	31	19	0.98	40	18

## 15.19 Amniotic Fluid Index

### 15.19.1 Moore AFI

- Reference: Moore TR and Cayle JF. *Am. J. Obstet. Gynecol.* 162: 1168-1173, 1990

GA weeks	AFI			GA weeks	AFI			GA weeks	AFI		
	Percentile (mm)				Percentile (mm)				Percentile (mm)		
	10th	50th	90th		10th	50th	90th		10th	50th	90th
16	79	121	185	25	97	147	221	34	81	142	248
17	83	127	194	26	97	147	223	35	79	140	249
18	87	133	202	27	95	146	226	36	77	138	249
19	90	137	207	28	94	146	226	37	75	135	244
20	93	141	212	29	92	145	231	38	73	132	239
21	95	143	214	30	90	145	234	39	72	127	226
22	97	145	216	31	88	144	238	40	71	123	214
23	98	146	218	32	86	144	242	41	70	116	194
24	98	147	219	33	83	143	245	42	69	110	175

**15.19.2 Korean AFI**

AFI	GA	SD	AFI	GA	SD	AFI	GA	SD
mm	week+day	±days	mm	week+day	±days	mm	week+day	±days
78	12+0	8	118	22+0	11	141	32+0	21
83	13+0	8	121	23+0	11	142	33+0	21
87	14+0	8	124	24+0	15	142	34+0	21
92	15+0	8	127	25+0	15	138	35+0	19
96	16+0	8	129	26+0	15	134	36+0	19
100	17+0	8	132	27+0	15	131	37+0	19
104	18+0	11	134	28+0	15	129	38+0	19
108	19+0	11	136	29+0	15	128	39+0	19
111	20+0	11	138	30+0	21	127	40+0	19
115	21+0	11	139	31+0	21			

## 15.20 Fetal Weight

### 15.20.1 Campbell FW

Input: AC Abdominal circumference [cm]

Result: FW Fetal weight [g]

Equation:  $\text{Log}_e \text{FW} = (-4.564 + 0.282 \times \text{AC} - 0.00331 \times \text{AC}^2) \times 1000$

### 15.20.2 Hadlock FW (1)

Inputs: BPD biparietal diameter [cm]  
AC Abdominal circumference [cm]

Result: FW Fetal weight [g]

Equation:  $\text{Log}_{10} \text{FW} = 1.11 + 0.05845 \times \text{AC} - 0.000604 \times \text{AC}^2 - 0.007365 \times \text{BPD}^2 + 0.000595 \times \text{BPD} \times \text{AC} + 0.1694 \times \text{BPD}$

### 15.20.3 Hadlock FW (2)

Inputs: FEL Femur length [cm]  
AC Abdominal circumference [cm]

Result: FW Fetal weight [g]

Equation:  $\text{Log}_{10} \text{FW} = 1.3598 + 0.051 \times \text{AC} + 0.1844 \times \text{FEL} - 0.0037 \times \text{AC} \times \text{FEL}$

### 15.20.4 Hansmann FW

Inputs: BPD biparietal diameter [cm]  
TTD Thorax transverse diameter [cm]

Result: FW Fetal weight [g]

Equation:

$\text{FW} = (-1.05775 \times \text{BPD} + 0.649145 \times \text{TTD} + 0.0930707 \times \text{BPD}^2 - 0.020562 \times \text{TTD}^2 + 0.515263) \times 1000$

### 15.20.5 Merz FW

Inputs:      BPD    biparietal diameter                [cm]  
                  AC      Abdominal circumference        [cm]

Result:        FW      Fetal weight                [g]

Equation:       $FW = -3200,40479 + 157.07186 \times AC + 15.90391 \times BPD^2$

### 15.20.6 Osaka FW

Inputs:      BPD    biparietal diameter                [cm]  
                  FEL    Femur length                        [cm]  
                  FTA    Fetal trunk area                  [cm<sup>2</sup>]

Result:        FW      Fetal weight                [g]

Equation:       $FW = 1.25647 \times BPD^3 + 3.50665 \times FTA \times FEL + 6.3$

### 15.20.7 Shepard FW

Inputs:      BPD    biparietal diameter                [cm]  
                  AC      Abdominal circumference        [cm]

Result:        FW      Fetal weight                [g]

Equation:       $\log_{10} FW = (-1.7492 + 0.166 \times BPD + 0.046 \times AC - 2.646 \times AC \times BPD) \times 1000$

### 15.20.8 Tokyo FW (1)

Inputs:      BPD    biparietal diameter                [mm]  
                  TTD    Thorax transverse diameter    [mm]  
                  AAP    Abdomen anterior posterior   [mm]

Result:        FW      Fetal weight                [g]

Equation:       $FW = 0.00173 \times BPD^3 + 0.238 \times AAP \times TTD - 217$

### 15.20.9 Tokyo FW (2)

Inputs:      BPD    biparietal diameter                         [cm]  
                   TTD    Thorax transverse diameter                [cm]  
                   AAP    Abdomen anterior posterior                [cm]  
                   FEL    Femur length                                [cm]

Result:      FW    Fetal weight                                [g]

Equation:       $FW = 1.07 \times BPD^3 + 3.42 \times AAP \times TTD \times FEL$

### 15.20.10 Tohamy FW

Input:      AC    Abdomen circumference                        [cm]  
                   HC    Head circumference                            [cm]

Output:      FW    Fetal weight                                [g]

Equation:

$$FW = -95.2960 + \frac{94.3548 \times HC}{AC} + 0.0082 \times HC \times AC + 100 + 1.92547 \cdot 10^{-7} \times (HC \times AC \times 100)^2$$

### 15.20.11 Eik-Nes, Grottum FW

- Reference: Eik-Nes SH, Grottum P. Estimation of fetal weight by ultrasound measurement I. Development of a new formula. Acta Obstet er Gynecol Scand. 61:299-305. 1982.

Eik-Nes SH, Grottum P., Andersson NJ. Estimation of fetal weight by ultrasound measurement II. Clinical application of a new formula. Acta Obstet er Gynecol Scand. 61:307-312. 1982.

Input:      BPD    biparietal Diameter                            [mm]  
                   TAD    Transverse Abdominal Diameter            [mm]

Result:      FW    Fetal weight                                [g]

Equation:

$$FW = 1.43149 \cdot 10^{-3} \times BPD^{1.85628} \times TAD^{1.34008}$$

## 15.21 Fetal Weight Growth

### 15.21.1 Hansmann FW growth

- Reference: Hansmann, Hackeloer, Staudach, Wittman, 'Ultrasound Diagnosis in Obstetrics and Gynecology', Springer-Verlag New York, p.186, 1986.

GA	FW (g)			GA	FW (g)			GA	FW (g)		
weeks	-2SD	Mean	+2SD	weeks	-2SD	Mean	+2SD	weeks	-2SD	Mean	+2SD
9	44	45	46	20	246	377	508	31	1113	1798	2483
10	45	48	51	21	294	456	618	32	1226	1984	2742
11	48	54	60	22	348	545	742	33	1342	2176	3010
12	54	63	72	23	409	644	879	34	1460	2369	3278
13	63	77	91	24	475	753	1031	35	1575	2557	3539
14	74	96	118	25	547	871	1195	36	1682	2734	3786
15	90	122	154	26	626	1000	1374	37	1776	2890	4004
16	111	155	199	27	711	1139	1567	38	1849	3016	4183
17	136	197	258	28	802	1288	1774	39	1888	3099	4310
18	166	247	328	29	899	1448	1997	40	1887	3131	4375
19	203	307	411	30	1003	1618	2233				

### 15.21.2 Hadlock FW Growth

- Reference: Hadlock, F., Harrist, R.B., Martinez-Poyer, J. "In-utero Analysis of Fetal Growth: A Sonographic Standard" *Radiology*, 1991, 181: 129-133.

GA	FW (g) / percentiles			GA	FW (g) / percentiles			GA	FW (g) / percentiles		
weeks	10th	50th	90th	weeks	10th	50th	90th	weeks	10th	50th	90th
10	29	35	41	21	331	399	467	32	1621	1953	2285
11	37	45	53	22	398	478	559	33	1794	2162	2530
12	48	58	68	23	471	568	665	34	1973	2377	2781
13	61	73	85	24	556	670	784	35	2154	2595	3036
14	77	93	109	25	652	785	918	36	2335	2813	2391
15	97	117	137	26	758	913	1068	37	2513	3028	3543
16	121	146	171	27	876	1055	1234	38	2686	3236	3786
17	150	181	212	28	1004	1210	1416	39	2851	3435	4019
18	185	223	261	29	1145	1379	1613	40	3004	3619	4234
19	227	273	319	30	1294	1559	1824				
20	275	331	387	31	1453	1751	2049				

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## 16 PROBES

### 16.1 S-VSW3-5

#### Diagnostic Ultrasound Indications for Use Form

Voluson 530D/MT Ultrasound System with Probe: **S-VSW3-5**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X						X
Abdominal		X	X	X						x
Intra-Operative										
Intraoperative										
Neurological										
Pediatric		X	X	X						X
Small Parts		X	X	X						X
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparoscopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

## 16.2 S-VAW3-5

### Diagnostic Ultrasound Indications for Use Form

Voluson 530D/MT Ultrasound System with Probe: **S-VAW3-5**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X			X
Abdominal		X	X	X		X	X			X
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.3 S-VAW4-7****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-VAW4-7**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X			X
Abdominal		X	X	X		X	X			X
Intra-Operative										
Intraoperative										
Neurological										
Pediatric		X	X	X		X	X			X
Small Parts		X	X	X		X	X			X
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional		X	X	X		X	X			X
Muscular-Skeletal Superficial										
Others										

Additional Comments:

## 16.4 S-SUP2

### Diagnostic Ultrasound Indications for Use Form

Voluson 530D/MT Ultrasound System with Probe: **S-SUP2**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac					X					
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.5 S-VRW 77AK****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-VRW 77AK**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal	X	X	X							X
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparoscopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.6 S-VRW 7-10****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-VRW 7-10**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal	X	X	X							X
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.7 S-VDW5-8(B)****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-VDW5-8(B)**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X			X
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal		X	X	X		X	X			X
Transvaginal		X	X	X		X	X			X
Transurethral										
Intravascular										
Peripheral Vascular										
Laparoscopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

## 16.8 S-ICA5-8(P)

### Diagnostic Ultrasound Indications for Use Form

Voluson 530D/MT Ultrasound System with Probe: **S-ICA5-8(P)**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X			
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal		X	X	X		X	X			
Transvaginal		X	X	X		X	X			
Transurethral										
Intravascular										
Peripheral Vascular										
Laparoscopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.9 S-EW5/7K****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **SEW5/7K**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X						
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal		X	X	X						
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.10 S-IC5-9****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-IC5-9**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X			
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal		X	X	X		X	X			
Transvaginal		X	X	X		X	X			
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.11 S-VNA5-8(B)****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-VNA5-8(B)**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X			X	X			X
Small Parts	X	X	X			X	X			X
Neonatal Cephalic	X	X	X			X	X			X
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			X
Laparascopic										
Muscular-Skeletal Conventional	X	X	X			X	X			X
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.12 S-PLM5-10****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-PLM5-10**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X			X	X			
Small Parts	X	X	X			X	X			
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			
Laparoscopic										
Muscular-Skeletal Conventional	X	X	X			X	X			
Muscular-Skeletal Superficial	X	X	X			X	X			
Others										

Additional Comments:

**16.13 S-NLM5-10****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-NLM5-10**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X			X	X			
Small Parts	X	X	X			X	X			
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			
Laparascopic										
Muscular-Skeletal Conventional	X	X	X			X	X			
Muscular-Skeletal Superficial	X	X	X			X	X			
Others										

Additional Comments:

**16.14 S-NLP5-10****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-NLP5-10**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X			X	X			
Small Parts	X	X	X			X	X			
Neonatal Cephalic	X	X	X			X	X			
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			
Laparascopic										
Muscular-Skeletal Conventional	X	X	X			X	X			
Muscular-Skeletal Superficial	X	X	X			X	X			
Others										

Additional Comments:

**16.15 S-NLP6-12****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-NLP6-12**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X			X	X			
Small Parts	X	X	X			X	X			
Neonatal Cephalic	X	X	X			X	X			
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			
Laparascopic										
Muscular-Skeletal Conventional	X	X	X			X	X			
Muscular-Skeletal Superficial	X	X	X			X	X			
Others										

Additional Comments:

**16.16 S-NLV4-8****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-NLV4-8**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X	X	X	X				
Small Parts	X	X	X	X	X	X				
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X	X	X	X				
Laparascopic										
Muscular-Skeletal Conventional	X	X	X	X	X	X				
Muscular-Skeletal Superficial	X	X	X	X	X	X	X			
Others										

Additional Comments:

**16.17 S-VNW5-10****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-VNW5-10**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X			X	X			X
Small Parts	X	X	X			X	X			X
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			X
Laparascopic										
Muscular-Skeletal Conventional	X	X	X			X	X			X
Muscular-Skeletal Superficial	X	X	X			X	X			X
Others										

Additional Comments:

**16.18 S-VNW6-12****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-VNW6-12**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X			X	X			X
Small Parts	X	X	X			X	X			X
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			X
Laparascopic										
Muscular-Skeletal Conventional	X	X	X			X	X			X
Muscular-Skeletal Superficial	X	X	X			X	X			X
Others										

Additional Comments:

**16.19 S-ACA4-7****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-ACA4-7**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X			
Abdominal		X	X	X		X	X			
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular		X	X	X		X	X			
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.20 S-ACP3-5****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-ACP3-5**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X			
Abdominal		X	X	X		X	X			
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.21 S-ACP4-7****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-ACP4-7**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X			
Abdominal		X	X	X		X	X			
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular		X	X	X		X	X			
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.22 S-ACM3-5****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-ACM3-5**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X			
Abdominal		X	X	X		X	X			
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.23 S-ACM5-8****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-ACM5-8**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X			X	X			
Small Parts	X	X	X			X	X			
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			
Laparascopic										
Muscular-Skeletal Conventional	X	X	X			X	X			
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.24 S-AB2-5****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-AB2-5**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X		X	
Abdominal		X	X	X		X	X		X	
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.25 S-AB4-8****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-AB4-8**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X		X	X		X	
Abdominal		X	X	X		X	X		X	
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.26 S-WAWP3.5****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-WAWP3.5**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal		X	X	X						
Abdominal		X	X	X						
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.27 S-PPA3-5****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-PPA3-5**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal	X	X	X	X	X	X				
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic	X	X	X	X	X	X				
Adult Cephalic	X	X	X	X	X	X				
Cardiac	X	X	X	X	X	X				
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.28 S-PPA2-4****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-PPA2-4**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal	X	X	X	X	X	X				
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic	X	X	X	X	X	X				
Cardiac	X	X	X	X	X	X				
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.29 S-PPA4-6****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-PPA4-6**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal	X	X	X	X	X	X				
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic	X	X	X	X	X	X				
Adult Cephalic										
Cardiac	X	X	X	X	X	X				
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.30 S-PPA6-8****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-PPA6-8**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric	X	X	X	X	X	X				
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac	X	X	X	X	X	X				
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.31 S-PPB2-4****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-PPB2-4**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal	X	X	X	X	X	X				
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic	X	X	X	X	X	X				
Cardiac	X	X	X	X	X	X				
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparoscopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.32 S-TEE4-6****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-TEE4-6**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac	X	X	X	X	X	X				
Transesophageal	X	X	X	X	X	X				
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.33 S-IOC4-8****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-IOC4-8**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative	X	X	X			X	X			
Intraoperative										
Neurological										
Pediatric										
Small Parts	X	X	X			X	X			
Neonatal Cephalic	X	X	X			X	X			
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.34 S-IOL5-9****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-IOL5-9**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative	X	X	X			X	X			
Intraoperative										
Neurological										
Pediatric										
Small Parts	X	X	X			X	X			
Neonatal Cephalic	X	X	X			X	X			
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular	X	X	X			X	X			
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.35 S-IR11AK****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-IR11AK**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal	X	X	X							
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparoscopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others Anorectal Sphincter	X	X	X							

Additional Comments:

**16.36 S-LAP5-8****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-LAP5-8**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular										
Laparascopic	X	X	X			X	X			
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.37 S-PEN4****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-PEN4**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular					X					
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

**16.38 S-PEN9****Diagnostic Ultrasound Indications for Use Form**Voluson 530D/MT Ultrasound System with Probe: **S-PEN9**

Intended Use: Diagnostic ultrasound imaging or blood flow analysis of the human body as follows:

Clinical Application	Mode of Operation (* includes simultaneous B-mode)									
	A	B	M*	PWD*	CWD*	Color Doppler*	Power (Amplitude) Doppler*	Color Velocity Imaging	Combined (specify)	3D Volume Imaging
Ophthalmic										
Fetal										
Abdominal										
Intra-Operative										
Intraoperative										
Neurological										
Pediatric										
Small Parts										
Neonatal Cephalic										
Adult Cephalic										
Cardiac										
Transesophageal										
Transrectal										
Transvaginal										
Transurethral										
Intravascular										
Peripheral Vascular					X					
Laparascopic										
Muscular-Skeletal Conventional										
Muscular-Skeletal Superficial										
Others										

Additional Comments:

