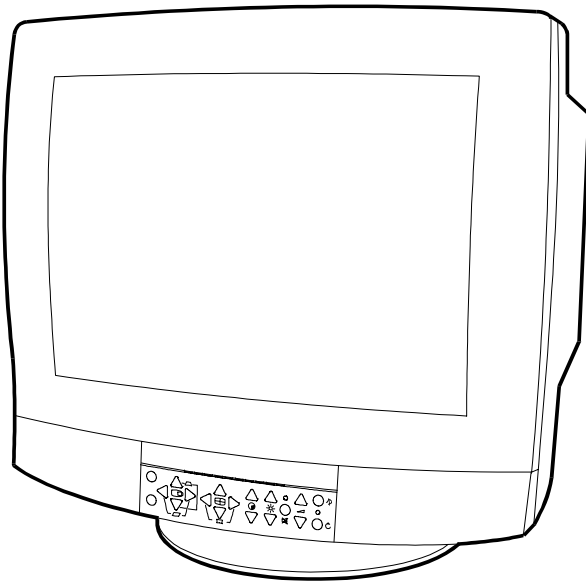


# Service Manual

Nokia Display Products Oy  
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FIN-24101 Salo, Finland

## Chassis 447Z

### 17" High Resolution Color Monitor



### Contents

- Service
- Circuit Description
- Monitor Dismantling
- Part List
- PCB Part List
- PCB Layout pictures

#### Level

1

Main Board module . . . . . SMA198D  
CRT module . . . . . SMH143D



# Service

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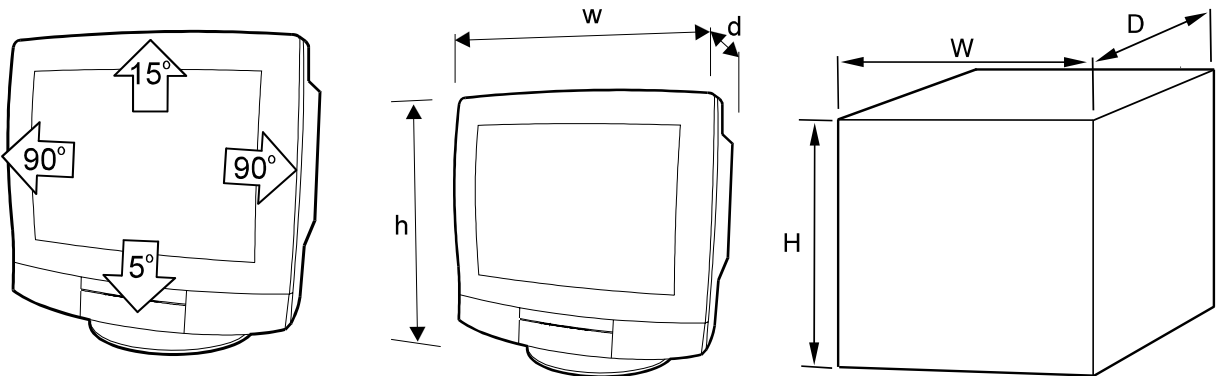
# 1. Product Overview

447Z is a 17 inch monitor. The maximum resolution of 1280 x 1024 makes the monitor suitable for PC applications using graphical user interfaces. The monitor has an own power supply with input voltage requirements from 90V to 264V.

## 1.1. Technical Specifications

Cathode Ray Tube	17" in diagonal, 90° deflection angle Dark, antiglare, spin coating Short persistence (P22) Dot pitch 0.27 mm
Picture Size	300 mm x 225 mm with specified geometric distortion
Maximum Picture Size	328 mm x 242 mm, diagonally 406 mm (16")
Power Input Requirements	Voltage 90–127/195–264 V, 60/50 Hz Autosense Current 2.0 A/110 V, 1.0 A/240 V Inrush current max. <40 A (peak)
Power Dissipation	< 100 W Normal Operation ~ 70 W Stand-by < 30 W Suspend < 5 W Active off
Memory Locations	15 for factory preset timings (9 in use 6 free) 5 for user adjusted timings
Geometric Distortion	The distance between bezel and active screen edge shall not vary more than 3 mm in both vertical and horizontal dimensions
Luminance	Min. 100 cdm <sup>-2</sup> at center, with full white field
Video Input	Input Signal: RGB, analog, positive, max 0.7 V/75 Ω Horizontal addressability: 1280 dots maximum Vertical addressability: 1024 dots maximum
Synchronization Range	Horizontal: 31 kHz to 72 kHz automatic Vertical: 50 Hz to 120 Hz automatic
Synchronization Signal	Separate TTL, positive/negative Composite TTL, positive/negative
Max. Dot Frequency Capability	100 MHz
Temperature	Operating: +10°C to +40°C Packed: -20°C to +60°C
Humidity	Operating: 15% to 85 % Packed: 5% to 95 %
Weight	18 kg net 21 kg gross

### Size, Tilt and Swivel



### Dimensions

Monitor	h	430 mm
	w	422 mm
	d	427 mm
Package	H	567 mm
	W	540 mm
	D	596 mm

## Audio

### *Audio Output power*

Amplifier RMS power . . . . . 2\*3 W  
Input level . . . . . 0,7 Vrms  
Line level input at clipping . . . . 2,8 Vpp  
Headphone impedance . . . . . 16–600 ohm

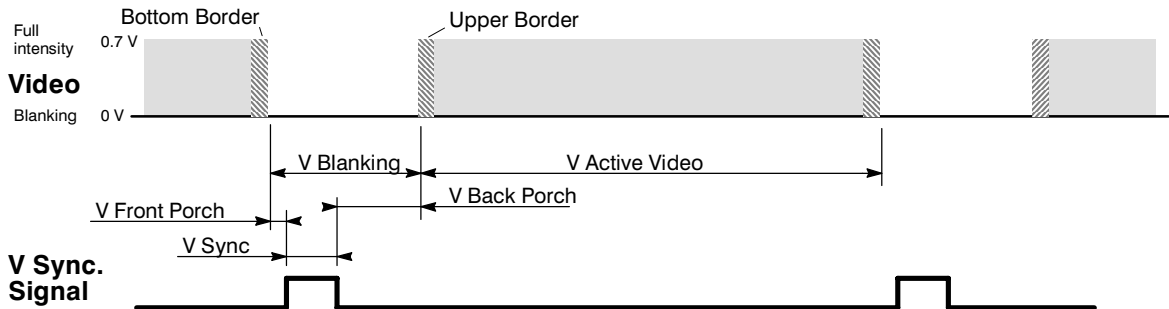
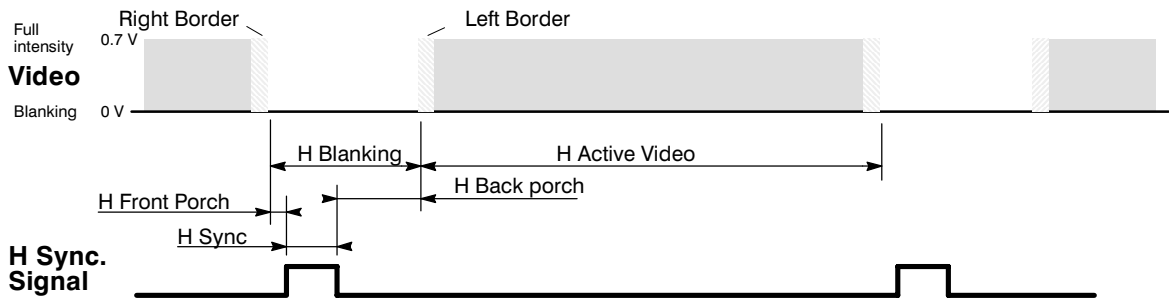
### *Microphone*

Mic amplifier gain . . . . . 40dB  
Mic output level . . . . . adjustable 0–2 Vpp  
External Mic input type . . . . . dynamic, capacitive

### *Speaker*

Nominal power . . . . . 5 W  
Nominal Impedance . . . . . 8 ohm  
Frequency range, useable area 200 Hz – 18 kHz  
Number of elements . . . . . two pcs  
Type of element . . . . . Fullrange  
Enclosure(s) type . . . . . Backdamped free air box

## 1.2. Preset Display Modes



Display Mode Memory location ->	0	1	2	3	4	5	6	7	8
Display Mode Name	NCE506	NCE513	NCE011	NCE561	NCE406	NCE402	NCE300	NCE010	NCE602
H Frequency/ kHz	60.023	68.677	68.861	61.101	46.875	48.077	31.472	49.718	63.953
H Period/ $\mu$ s	16.660	14.561	14.560	16.366	21.333	20.800	31.774	20.113	15.636
H Active Vid- eo/ $\mu$ s	13.003	10.836	11.520	11.903	16.162	16.000	25.420	14.527	11.636
H Resolution	1024	1024	1152	1024	800	800	640	832	1280
H Sync/ $\mu$ s	1.219	1.016	1.28	3.72	1.02	2.40	3.81	1.12	1.02
H Back Porch/ $\mu$ s	2.235	2.201	1.44	0.66	3.23	1.28	1.91	3.91	2.26
V Frequency/Hz	75.0	85.0	75.1	75.8	75.0	72.2	59.9	74.5	59.9
V Period/Lines	800	808	915	806	625	666	525	667	1067
V Resolution	768	768	870	768	600	600	480	624	1024
V Sync/Lines	3	3	3	8	3	6	2	3	5
V Back Porch/ Lines	28	36	39	30	21	23	33	39	37
H sync Polarity	+	+	-	+	+	+	-	-	-
V sync Polarity	+	+	-	+	+	+	-	-	-
H Front Porch/ $\mu$ s	0.20	0.51	0.32	0.08	0.32	1.12	0.64	0.56	0.72
V Front Porch/ Lines	1	1	3	1	1	37	10	1	1
Dot Frequency/ MHz	78.750	94.500	100.000	86.030	49.500	50.000	25.177	57.275	110.000
Interlacing	no	no	no	no	no	no	no	no	no

### 1.3. Monitor Connection

**Make sure that the monitor is disconnected from mains and the power switches of the computer and all attached devices are turned off before connecting the monitor.**

1. Connect the signal cable plug to the videocontroller connector at the back of the computer.
2. Tighten the screws on the plug by hand.
3. Connect the power cord first to the monitor and then to a grounded power outlet.

**If your monitor is DDC compatible (PC)**

- Do not use any adapter when connecting signal cable to your computer.
- Do not extend the signal cable with extension lead. The DDC signals will not accept extended cable.

**If there is no DDC in your computer (PC)**

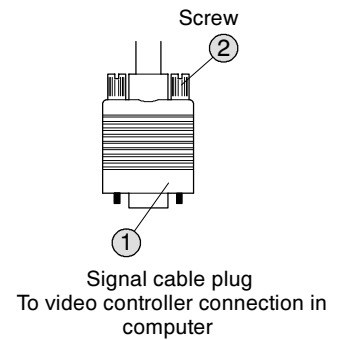
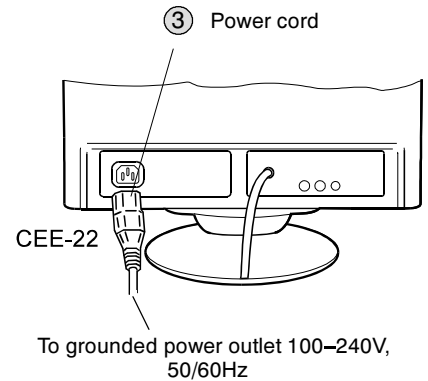
- Normally there is no need for adaptor when connecting signal cable to your computer.

**Display Data Channel (DDC)  
Plug'n'Play (PnP)**

The data channel is intended to simplify monitor installation. The monitor sends to the computer details of its capabilities. Using this information, the computer may configure its display driver to make best use of the monitor's features.

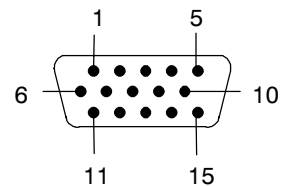
**Note**

Your monitor operates according to the VESA DDC level 2AB. Only computers that support the same guidelines and operate at the same or a higher level can make use of this feature. If your computer does not support the relevant guidelines, you can still use your monitor and computer. You may need to specify manually the appropriate resolution in the computer.



**Signal connector**

Pin	Signal	
1	RV	Red video
2	GV	Green video
3	BV	Blue video
4	GND	Ground
5	Sgnd	Ground return for serial data in/out
6	Rgnd	Red video ground return
7	Ggnd	Green video ground return
8	Bgnd	Blue video ground return
9		No Connection
10	Syncgnd	Sync return
11	GND	Ground
12	SDA	DDC data I/O
13	Hsync	Horizontal sync.
14	Vs	Vertical sync .
15	SCL	DDC clock input





## 1.4. Audio Features

Monitor has built-in basic audio features. The sound system is capable of producing stereo sound via R and L loudspeakers.



**If the audio signal input level exceeds the specified range, the acoustic waves may cause disturbances in the picture with high VOLUME setting. The picture returns to normal by reducing the sound volume.**

### 1.4.1. Audio

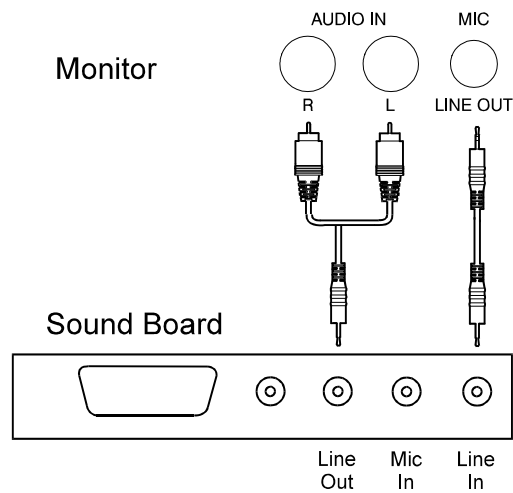
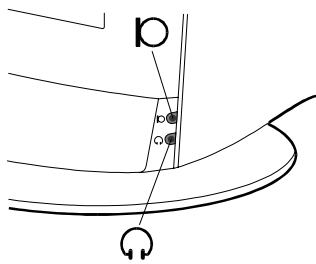
- There are two RCA connectors for line level AUDIO IN in rear of the monitor.

### 1.4.2. Headphones

- There is 3.5 mm HEADPHONE OUT socket for audio out for  $\geq 16 \Omega$  headphone connection in front side of corner, usage will switch off internal speakers.

### 1.4.3. Microphone

- There is 3.5 mm EXTERNAL MICROPHONE IN connection in front side of corner, usage will switch off internal microphone. There is 3.5 mm MICROPHONE OUT socket in rear of the monitor.



# 1.5. User Controls

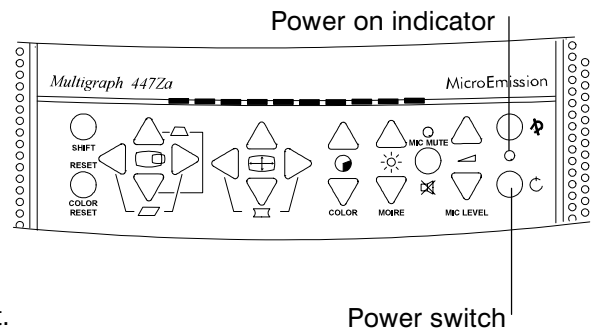
## 1.5.1. Power Switch

### Turning the Monitor ON and OFF

Push the **power switch** to turn the monitor on or off

When the power is turned on, the **power-on indicator** will light.

- Green . . . . . The monitor is in normal operation
- Blinking . . . . . The monitor is in Power off state
- Not illuminated . . The monitor is turned off with power switch or disconnected from mains outlet.

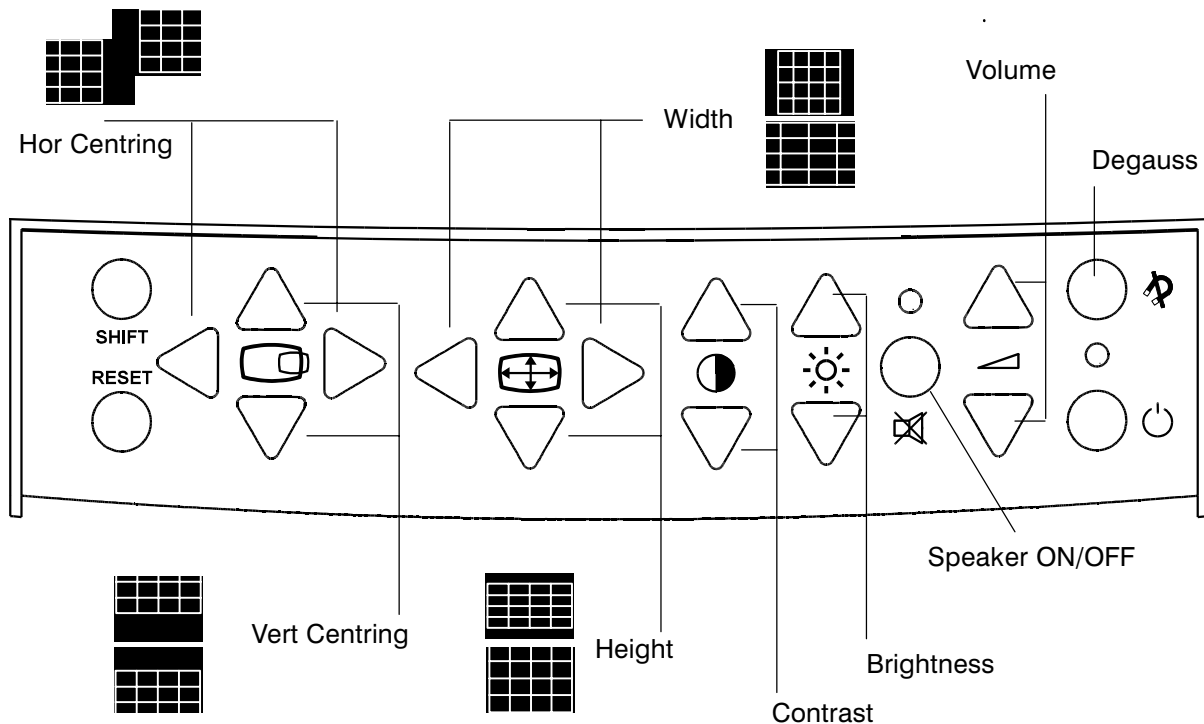


If the power management function works properly in your computer, you do not need to switch the monitor on or off. It happens automatically.



**The power switch does not disconnect the monitor from mains. In order to make the monitor completely powerless, unplug the power cord from power outlet.**

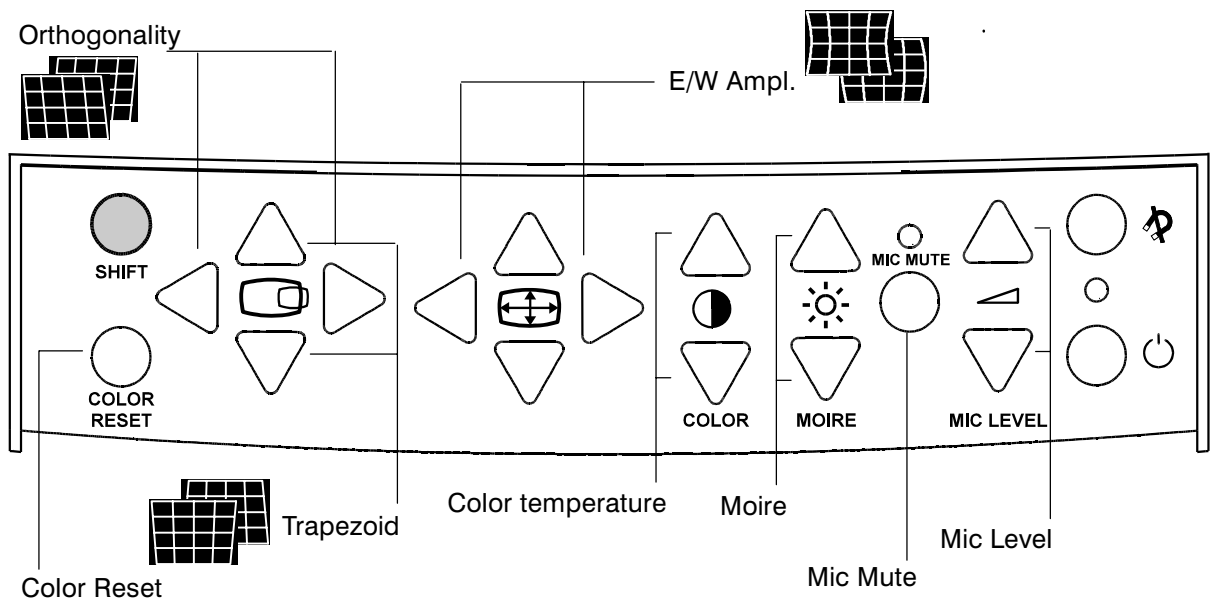
## 1.5.2. Normal Operations



Push RESET –button down to return to the factory settings.

### 1.5.3. Shift Operations

First push the shift button and hold it down during adjustment of shift operations.



Push RESET –button down to return to the factory settings.

## 2. Site Preparation

### 2.1. Location

This Monitor is designed for normal office conditions. It is equipped with own power supply. It is not to be serviced or repaired on site

### 2.2. Troubleshooting

Local service facilities should perform simple maintenance such as trimming. More advanced maintenance and repair that requires replacement of components which in turn requires testing and re-trimming should be carried out in a central workshop.

Symptom		Measures
Picture screen is blank	The indicator on the front panel is not illuminated	Check that the power cord is correctly connected to the monitor and to the power outlet. If the monitor is powered through the computer, check that the computer is switched on with the mains switch. Use a desk light, for example, to verify that current is connected to a power outlet. If no electricity is connected to the outlet, call an electrician Unplug the monitor from power outlet for about one minute.
	The indicator on the front panel is illuminated	The monitor might be in stand-by position. Push one of the keyboard buttons or move the mouse. Check that the keyboard's connection to the computer is OK. Check that the signal cable connector is connected. If the connector is loose, tighten the connector's screws. Unplug the monitor from power outlet for about one minute. Switch off the monitor and the computer. Remove the signal cable from the computer. Switch on the monitor using the power switch. If a gray, slightly blinking frame (background) appears on the screen, it is evident that the monitor functions correctly and the problem is caused by an error in other parts of the system. Check the signal cable's connection pins. If the pins are slightly distorted, use nose pliers to straighten them. The computer may use a timing values which are out of the monitor's synchronization range.
Picture has colour defects		Demagnetize the monitor If colour defect is repeated without the monitor having been moved, it is possible that the monitor is influenced by a strong magnetic interference field (near to a high power cable, for example). Try to find a better location for the monitor or the interference source. Note that another monitor placed too near (less than 30 cm.) may also generate interference in the picture.
		Your computer may use a timing for which the corresponding picture characteristic adjustments have not been set at the factory. Adjust the picture characteristics
Picture is stable but distorted		Make sure your computer and video card are properly configured for your monitor Check the proximity of other electrical devices that generate magnetic fields, such as speakers, other monitors, electric fans and fluorescent light fixtures.
Picture is unstable		Check that the signal cable's connector is completely inserted. Switch off the computer and restart.
Picture is black and white		

### 2.3. Checking the Operation of PowerSaver

The proper operation of the function requires a computer with VESA DPMS power management capabilities. Note that the power saving feature must be activated in the computer when checking the operation.

State	Colour of the power-on indicator	5V	6V	12V	High Voltage	Video
Normal Operation	Green	Yes	Yes	Yes	Yes	Yes
Stand-by	Green	Yes	Yes	Yes	Yes	No
Suspend	Green	Yes	Yes	Yes	No	No
Active Off	Blinking	Yes	No	No	No	No

DPMS (Display Power Management Signaling) is a trade mark of Video Electronics Standard Association (VESA)

### 3. Controlling the Memory for Picture Adjustments

The picture adjustment values are stored in non-volatile memory. The memory has separated areas for User Adjustments and for Factory Adjustments.

#### 3.1. Memory for User Adjustments

##### 3.1.1. Adjustment

- 1 If there are values available in the memory for user adjustments, corresponding to the present timing signals, they are always used.
- 2 New user made adjustments are stored to the memory for user adjustments.

##### 3.1.2. Resetting the User made settings for geometry or image

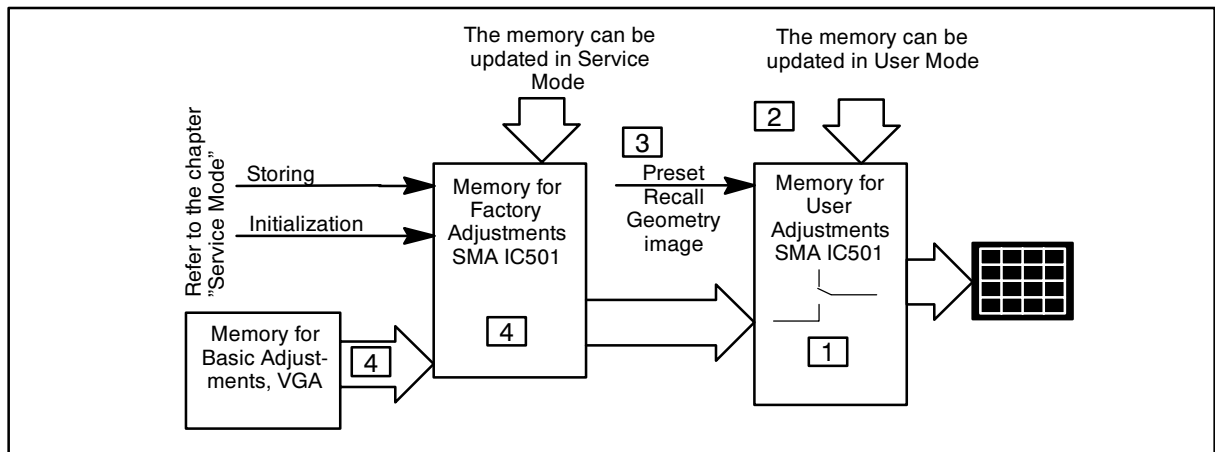
- 3 User memory can be emptied from user made settings. **Resetting affects only the timing which is currently active.** The reset function is inhibited if no corresponding factory preset display mode exists. Please refer to chapter "User controls".

After resetting all picture properties are coming from memory for factory adjustments.

#### 3.2. Memory for Factory Adjustments

##### 3.2.1. Adjustment

- 4 Factory adjustments can be updated in service mode. If there is no location in factory adjustment memory for timings currently in use, the adjustment affects the memory for user adjustments.
  - If the memory location mentioned in case 1 is empty, the picture adjustment values are read from memory for factory adjustments. Factory adjustments, corresponding to the current timings, are transferred to user memory if any picture property is adjusted. After that the operation is as in case 1.



## 4. Service Mode

Service Mode is needed for updating of the factory adjustments for timings listed in the chapter Pre-set Display Modes. If there is no location in factory adjustment memory for display mode currently in use, the adjustment affects the memory for user adjustments.

Activate Service Mode **ALWAYS** in **60 kHz/75 Hz (NCE506) –mode**.

After initializing also adjust the mode 60 kHz/75 Hz (NCE506) first. After that mode can be changed in certain order, which is found in page 5.

If the certain mode is want to adjusted, the order in page 5 must be followed.

(For Example before Memory Location 4 can be adjust you must go through Locations 1,2 and 3)

### 4.1. Grouping of the Adjustments

There are two groups of software adjustments in service mode:

- geometry adjustment set
- video adjustment set

The following table shows how the adjustments act in relation to the display modes.

Adjustment	Common for all Display modes	Separate for each Display mode	Available in User Mode	Available in Service Mode
Contrast	X		X (Common memory for both modes)	
Brightness	X		X (Common memory for both modes)	
Horizontal centring		X	X	X
Vertical centring		X	X	X
Height		X	X	X
Width		X	X	X
Pincushion		X	X	X
Trapezium		X	X	X
Orthogonality		X	X	X
Pincushion balance		X		X
Moire		X	X	
Horizontal raster centring	X			X
G2	X			X
Max/Min contrast	X			X
R Gain	X			X
B Gain	X			X

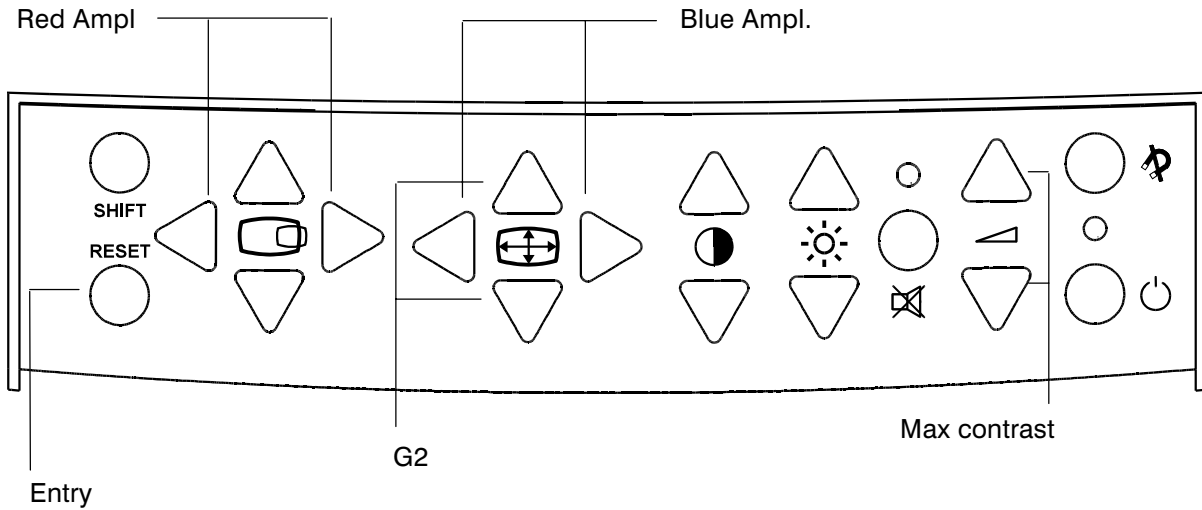
Common adjustments need to be adjusted only once. Separate adjustment must be performed for every display mode to be stored.



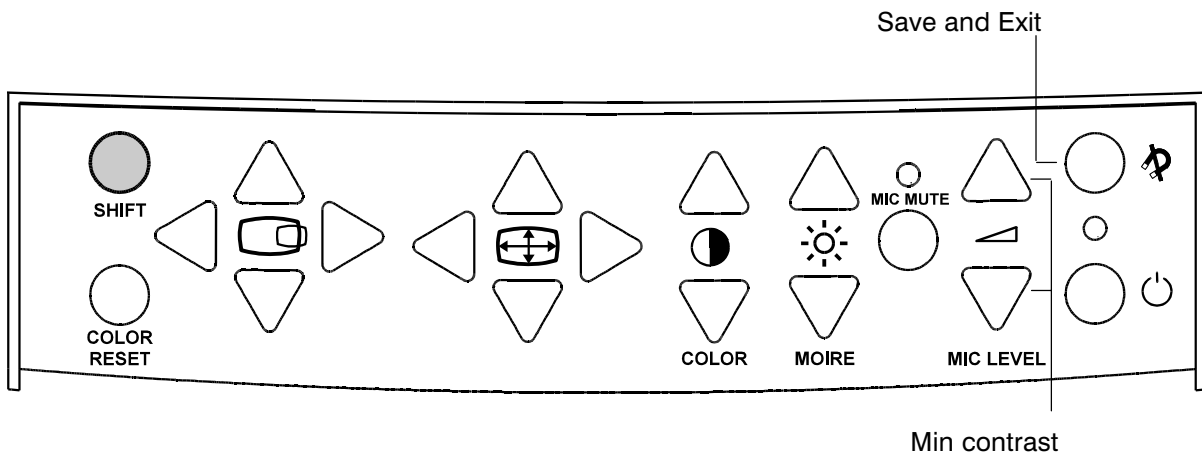
### 4.2.2. Access to Service Mode Video

First switch OFF the monitor with power switch.

- 1) Push RESET down
- 2) While keeping RESET down, switch ON the monitor
- 3) Release RESET **after monitor has been started.**



### Service Mode Shift Video





### *4.2.3. Initializing the Replacement IC501 on SMA board*

If the memory for factory adjustments is replaced, it must be initialized. During initializing all memory locations are written with approximate values. They must be updated in service mode as explained in the chapter 'Adjustment Procedure'.

- Activate service mode Geometry as explained before.
- Press INITIALIZING button.
- Wait min. 2 seconds.
- Switch OFF the monitor

#### **Caution**

**Initializing of a programmed memory IC deletes all user and factory made adjustments.**


### *4.2.4. Storing and Returning to the User Mode*

The geometry adjustments are stored in two seconds after each adjustment. Video adjustments are stored at the moment when you leave Service Mode. Display modes can be changed without leaving Service Mode when making display mode related adjustments. Exit from Service Mode Video by pushing Save and EXIT button.

When you exit from Service Mode, the monitor turns to normal user mode. If you want to leave the service mode without memorizing Video adjustments, switch off the monitor in service mode.

# 5. Workshop Maintenance

## 5.1. Important Safety Notice

The components, which are important for safety, are marked with special mark  on the circuit diagram. It is essential that these critical parts should be replaced with manufacture's specified parts to prevent X-radiation, shock, fire or other hazards.

**For your own safety, use always safety isolating transformer when repairing the monitor.**

### 5.1.1. Discharging the CRT

High voltage circuitry includes bleeder resistor which normally discharges the tube in about 5 seconds after the power is switched off. If you – for safety reasons – want to be sure about the discharging, do as follows:

**Wear safety goggles. A cracked CRT may implode when discharged.**

**The signal cable must be disconnected from the computer.**

To discharge the CRT, a flat-head screwdriver with grounding cable is required.

- Disconnect the power cable.
- Connect the metal chassis of the monitor to reliable earth.
- Connect the grounding wire to the screwdriver.
- Connect the other end of the grounding wire to the chassis (earth).
- Insert the screwdriver under the rubber cap of the EHT connector to discharge the tube.

## 5.2. ESD-Sensitive Parts

To prevent damage, when working with electrostatic discharge (ESD) sensitive parts, observe the following instructions:

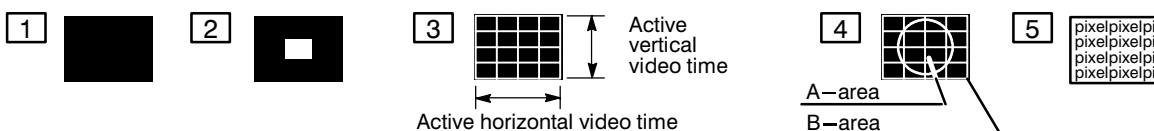
- Keep the ESD-sensitive part in its original shipping container until you are ready to install the part into the component card.
- Just before touching the ESD-sensitive part, discharge to the monitor any static electricity in your body; do this by touching the metal frame or cover of the machine. If possible, keep one hand on the frame when inserting or removing a logic card, for example.
- Hold the ESD-sensitive part by its edge; do not touch its pins.

## 5.3. Test Equipment

The following test equipment are required to adjustment procedure.

- Safety isolating transformer
- Digital multimeter: Fluke 87 or equivalent true RMS multimeter
- High voltage probe: e.g. Fluke 80-40k
- Signal generator: VTG220 + PC or programmable video generator
- Colour analyzer: e.g. Minolta TV Colour Analyzer CA100
- Convergence Gauge (CM7AR or equivalent)
- Oscilloscope 40-100 MHz band width
- Hi-Pot tester (Flash tester with insulation measurement / Leakage current / Break down voltage)
- ESD protection necessary

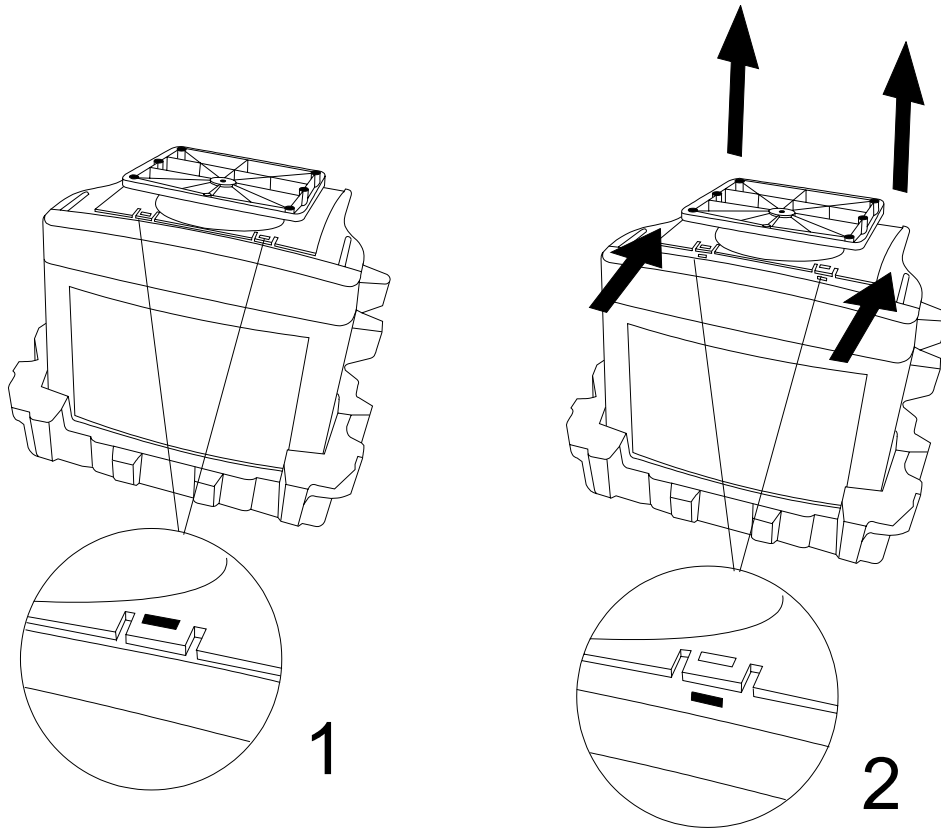
## 5.4. Test Patterns



- 1** Black Picture
  - Signal level = 0 V at each RGB input
- 2** Highlight grey scale tracking
  - Signal level = 700 mV in the window at each RGB input
- 3** Crosshatch Picture
  - Squares e.g. 20 mm x 20 mm
  - Outmost lines correspond the active vertical/horizontal video time
- 4** Convergence test pattern
- 5** Focus test pattern

## 5.5. Disassembly

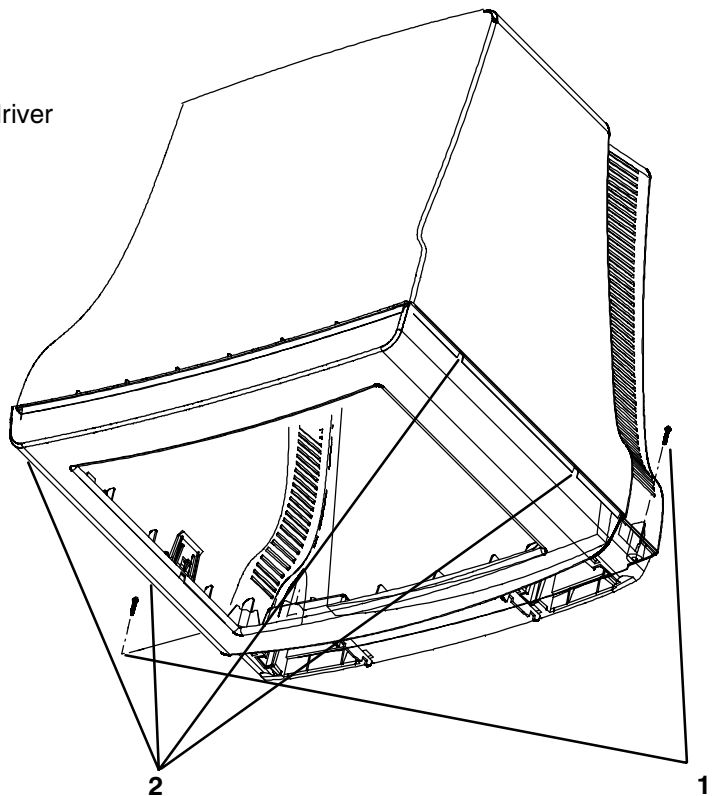
### 5.5.1. Stand assembly



### 5.5.2. Cabinet

Set the monitor on cushion picture tube facing down.

- 1 Loosen and remove two screws
- 2 Open the plastic pawl with screwdriver (maximum width 5 mm)

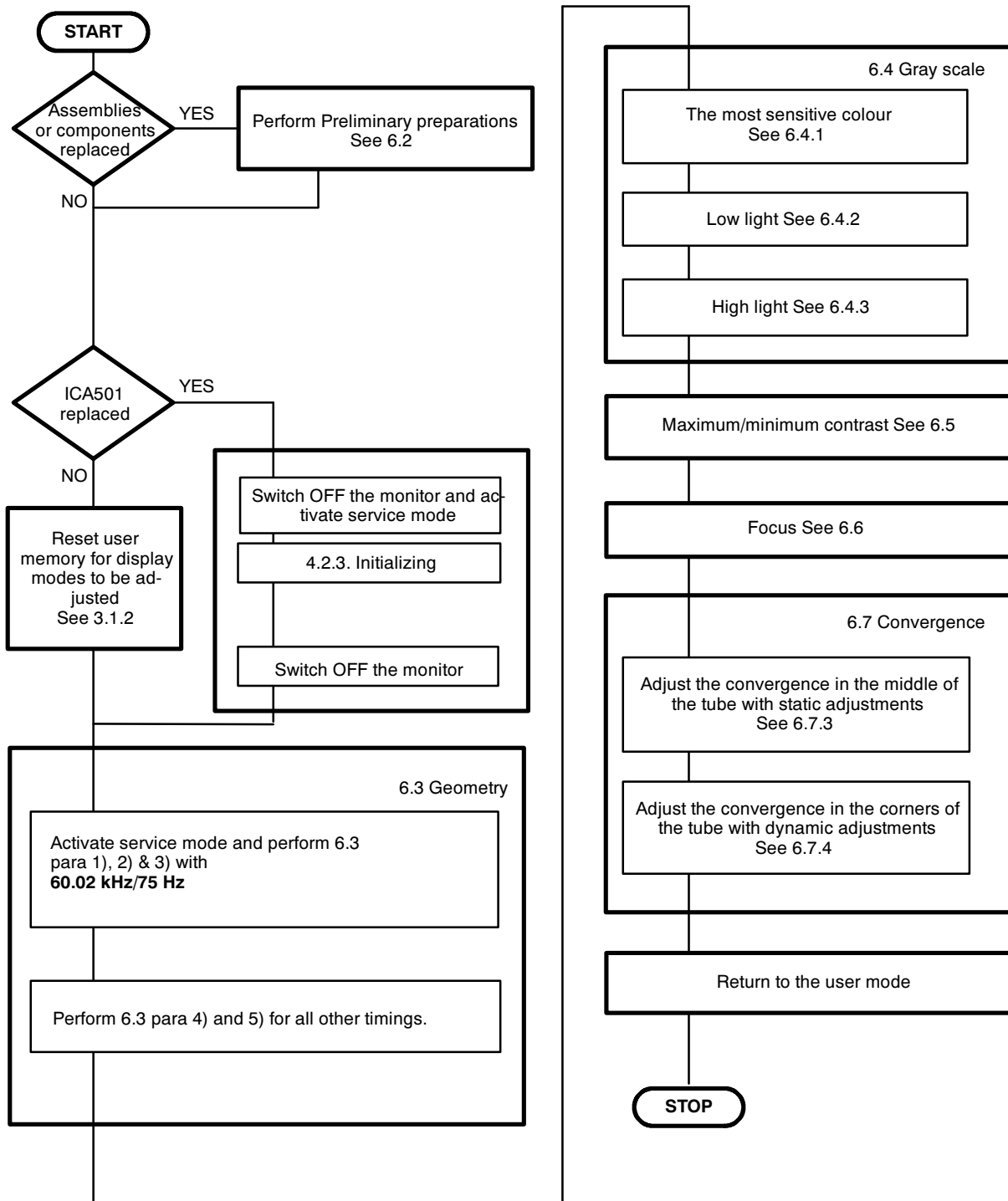


## 6. Adjustment Procedure

The following procedure must be carried out in case of large service operations e.g. when a circuit board or nonvolatile memory ICA501 has been replaced by a new one.

The order of adjustments explained here has been found to produce the desired result with the minimum of effort. Adjustments can also be made in another order or completely separately.

### 6.1. Adjustment Flow Diagram



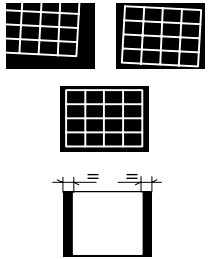
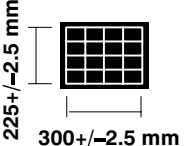
After initializing adjust ALWAYS first **60.0 kHz/ 75 Hz** –mode (NCE506). After that you can change mode in certain order (see page 4) without leaving service mode.

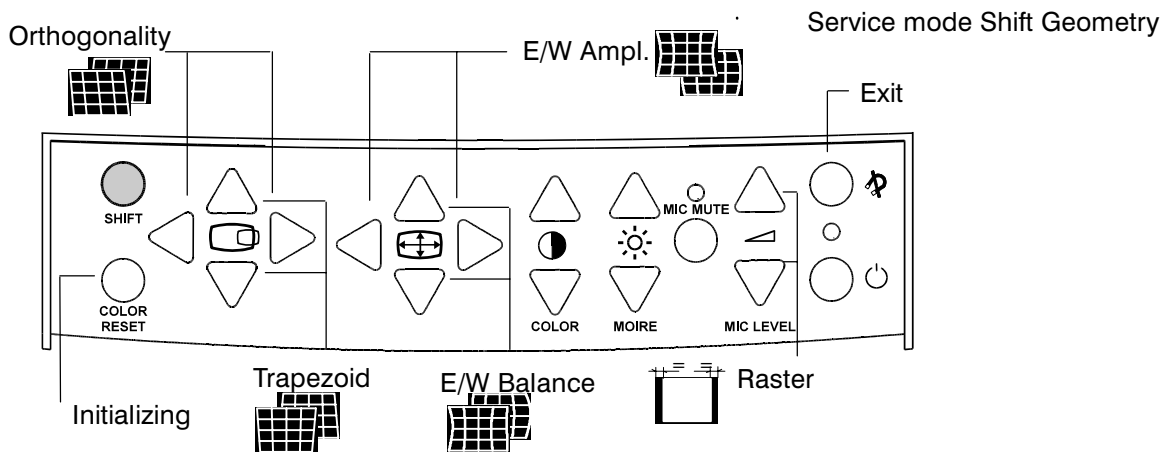
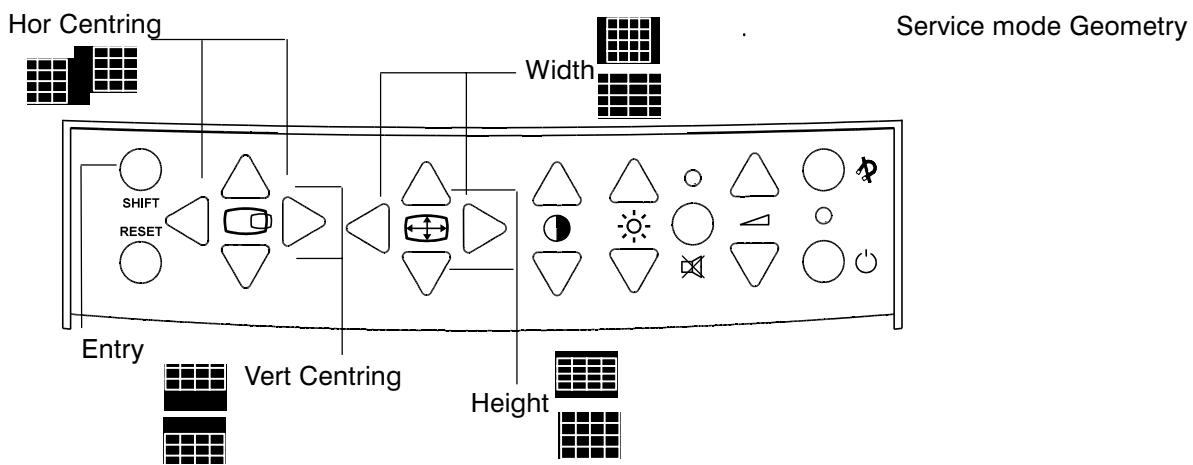


### 6.3. Geometry

Activate Service Mode in **60.0 kHz/75 Hz** –mode (NCE506).

Degaussing must be carried out before the picture adjustments. Degaussing shall be repeated if the monitor is moved.

<ol style="list-style-type: none"> <li>1) Select <b>60.02 kHz/75 Hz</b> (NCE506) crosshatch test pattern. Set ● to maximum and adjust ✱ until the background is faintly visible. Reduce width until both vertical edges of the <b>background</b> are visible.</li> <li>2) Centre the background. This adjustment is common for all display modes.</li> </ol>	
<ol style="list-style-type: none"> <li>3) Adjust size, position and shape of the picture equal to the mask aperture Adjust first the properties with largest deviation from the correct value.</li> <li>4) Select <b>60.02 kHz/75 Hz</b> (NCE506) crosshatch pattern Adjust final width and height.</li> </ol>	
<ol style="list-style-type: none"> <li>5) Repeat steps 2) 3) and 4) for every display mode to be stored. Note that the display mode can be changed in certain order (see page 5) without leaving the service mode.</li> </ol>	



## 6.4. Grey Scale

The grey scale is adjusted for 9300K colour temperature.

Activate Service Mode Video in 60 kHz/75 Hz (NCE506) –mode

### 6.4.1. The Most Sensitive Colour

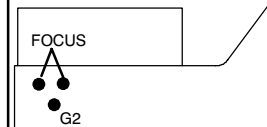
The most sensitive colour has been marked in a label on the deflection yoke. It may not be correct if tube or SMH card has been changed. In that case judge the most sensitive colour from the tone of the picture after you have made the following adjustments.

- 1) Select **60.02 kHz/75 Hz** (NCE506) black test pattern.
- 2) Set \* and ● to maximum.
- 3) Set **RED/GREEN/BLUE Black Level** trimmer adjustments maximum – 3V (RTH120, RTH220, RTH320)
- 4) Set **G2** adjustment to center
- 5) Place the probe of the colour analyzer in the middle of the screen and adjust with **G2 trimmer** until the picture brightness to  $6 \pm 1$  nit.



### 6.4.2. Low Light

- 1) Select **60.02 kHz/75 Hz** (NCE506) black test pattern.
- 2) Adjust picture brightness to  $5 \pm 1$  nits with **G2** adjustment.
- 3) Adjust with \* adjustment the brightness to  $1 \pm 0.5$  nits.
- 4) Adjust the colour coordinates to (9300K)  
 $x = 0.281 \pm 0.010$   
 $y = 0.311 \pm 0.010$   
 with **RED/GREEN/BLUE Black Level** adjustments.  
**Do not adjust the most sensitive colour.**
- 5) Set \* and ● to the maximum and check that the brightness is still  $6 \pm 1$  nits. If not, repeat steps 2),3) and 4).



Left side view of the chassis

### 6.4.3. High Light

- 1) Select **60.02 kHz/75 Hz** (NCE506) black test pattern.
- 2) Adjust with \* the picture brightness to  $1 \pm 0.5$  nits.
- 3) Select 60.02 kHz/75 Hz (NCE506) window test pattern.
- 4) Adjust with ● the picture brightness in the window to  $100 \pm 5$  nits.
- 5) Adjust with **RED/BLUE ampl** the colour coordinates in the window to  
 $x = 0.281 \pm 0.010$   
 $y = 0.311 \pm 0.010$   
 Check after adjustment that the brightness reading is in limits.
- 6) Check 6.4.2 para 3) and 4). Readjust color temperature if out of tolerance.



## 6.5. Maximum/Minimum Contrast

- 1) Set ● to the maximum.
- 2) Adjust with \* the picture brightness outside window to  $1 \pm 0.2$  nits.
- 3) Adjust brightness in the window to  $150 \pm 2$  nits with **MAX CONTR.**
- 4) Set ● to minimum.
- 5) Adjust brightness to  $8 \pm 2$  nits with **MIN CONTR.**
- 6) Exit service mode



## 6.6. Focus

- 1) Select **60.02 kHz/75 Hz** (NCE506) crosshatch test pattern
- 2) Set ● to the maximum and adjust \* until the background is faintly visible
- 3) Adjust the sharpness with **FOCUS trimmers** to optimum
- 4) Adjust \* until the background is invisible
- 5) Select focus test pattern. Check that all letters are clearly visible



## 6.7. Convergence

Reduce first the convergence error in the middle of the screen to minimum using static adjustments. After the convergence is faultless in the middle of the tube, use dynamic adjustments to eliminate the error in the edges of the tube.

Static adjustments affects the whole picture area:

- magnet ring set on the tube neck (horizontal + vertical)

Dynamic adjustments affects a part of the picture area:

- deflection yoke trimmers.

### 6.7.1. Measuring Conditions

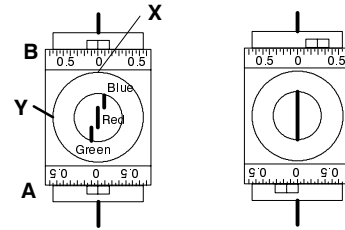
- Adjust convergence with 60.02 kHz (NCE506) line frequency
- Make sure that focus is correctly set at the mid-point between the screen center and the edge of the picture.
- Use white crosshatch test pattern with circle.
- Adjust ● to near the maximum and reduce ✱ until the background disappears.

### 6.7.2. Convergence Measuring Gauge CM7AR

The use of the Klein CM7AR Convergence Gauge has been explained here but other types of gauges can be used as well.

Check that the adjusting knobs (A & B) are set to zero.

- Place the gauge on the line with marking **Y up** upwards when measuring horizontal line.
- Place the gauge on the line with marking **X up** upwards when measuring vertical line.
- If the line has convergence error, the line in the window seems to be broken.
- Use knobs A and B to adjust the line continuous.
- If the readings are on the opposite side of zero, the convergence error is A+B (e.g. 0.2 + 0.1 = 0.3).
- If the readings are on the same side of zero, the convergence error is equal to A if A > B or B if B > A



### 6.7.3. Static Convergence

The magnet rings has been set to the optimum in the factory. Readjustment is necessary only in case the adjusting magnets have been accidentally moved.

- 1 Adjust G vertically in the middle between R and B with 6 pole magnet rings.
- 2 Adjust G horizontally in the middle between R and B with 6 pole magnet rings.
- 3 Adjust R and B vertically to the same position with G line with 4 pole magnet rings
- 4 Adjust R and B horizontally to the same position with G line with 4 pole magnet rings

Lock the rings with paint

