Service Manual

Chassis 445P

07.96

21" High Resolution color Monitor
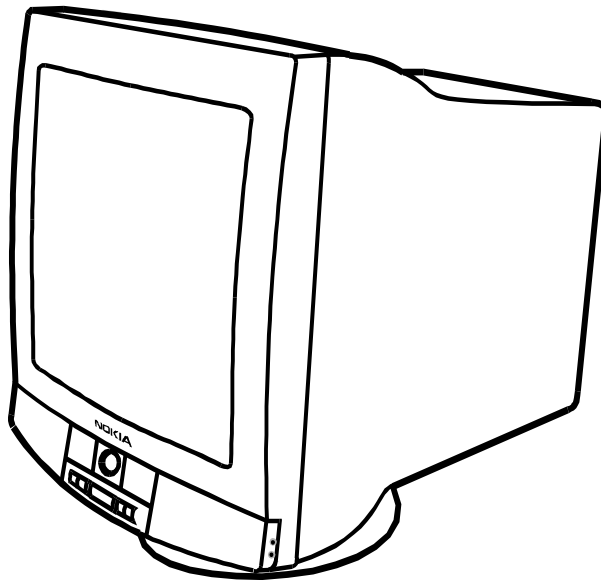
Contents

Service

Monitor Dismantling

Part List

PCB Part List

PCB Layout pictures

Level ▼ 1

Main Board module SMA172
CRT module SMH132
Video amplifier module . . . SMY031
Control module SMZ040

When re−ordering manuals, please quote the model name and part number.

ZB1557
07.96

Service

Contents

1. Product Overview

445P is a 21 inch monitor with optional videocamera and sound reproducing feature. The maximum resolution of 1600 x 1280 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 . . . . 21" in diagonal, 90° deflection angle
Dark, non−glare, antistatic coating
Short persistence (P22)
Dot pitch 0.28 mm

Picture Size . . . . 387 mm x 290 mm with specified geometric distortion

Maximum Picture Size . . . . 400 mm x 300 mm, diagonally 500 mm (19.7")

Power Input Requirements . . . Voltage 90−264 V, 50/60 Hz Autosense
Current 2.0 A/110 V, 1.0 A/240 V

Power Dissipation . . . . < 160 W Normal Operation
~70 W Stand−by
< 30 W Suspend
< 5 W Auto power off

Memory Locations . . . . 14 for factory preset timings
18 for user adjusted timings

Geometric Distortion . . . . The distance between bezel and active screen edge shall not vary more than 2 mm in both vertical and horizontal dimensions

Luminance . . . . Min. 70 cdm^{-2} at center, with full white field

Video Input . . . . Input Signal: RGB, analog, positive, max 0.7 V/75 Ω
Horizontal addressability: 1600 dots maximum
Vertical addressability: 1280 dots maximum

Synchronization Range . . . . . . Horizontal: 30 kHz to 102 kHz automatic
Vertical: 50 Hz to 150 Hz automatic

Synchronization Signal . . . . Separate TTL, positive/negative
Composite TTL, positive/negative
Composite, on green 0.3 Vpp negative

Max. Dot Frequency Capability >200 MHz

Temperature . . . . Operating: +10°C to +40°C
Packed: −20°C to +60°C

Humidity . . . . Operating: 15% to 85 %
Packed: 5% to 95 %

Weight . . . . 31 kg net
36 kg gross

Size, Tilt and Swivel
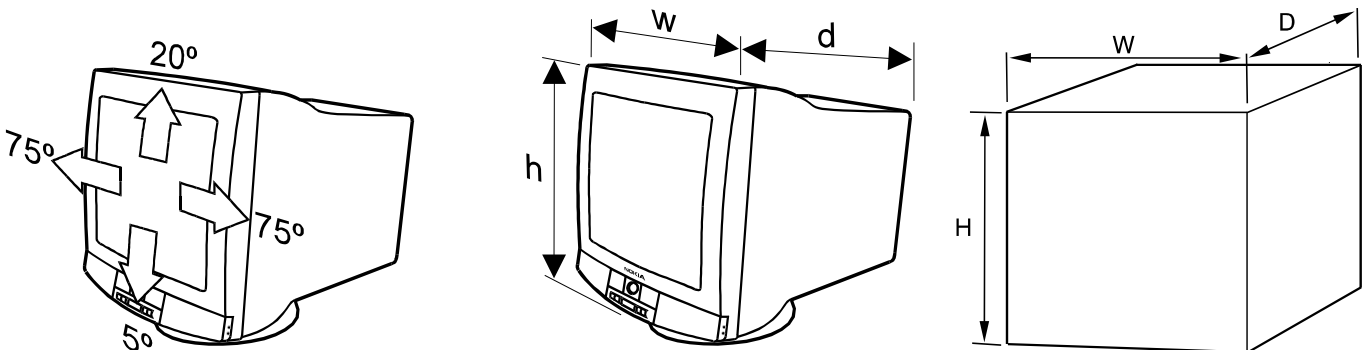
Dimensions

Monitor . . . . h . . . . 518 mm
w . . . . 530 mm
d . . . . 555 mm

Package . . . . H . . . . 670 mm
W . . . . 670 mm
D . . . . 740 mm

1.2. Preset Display Modes
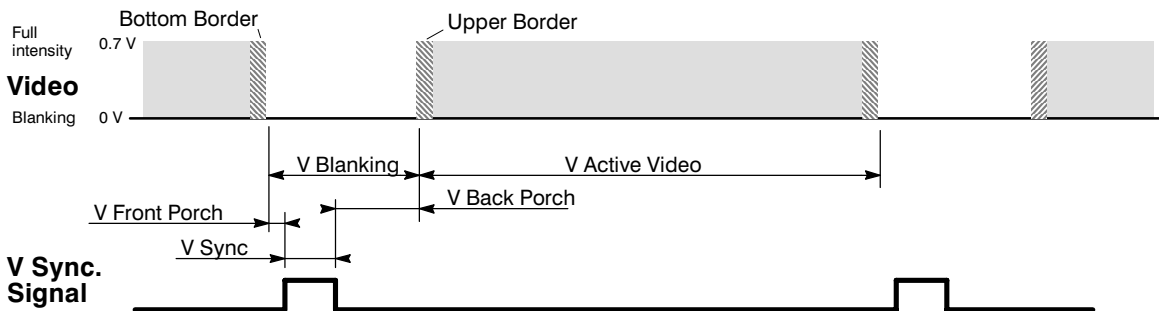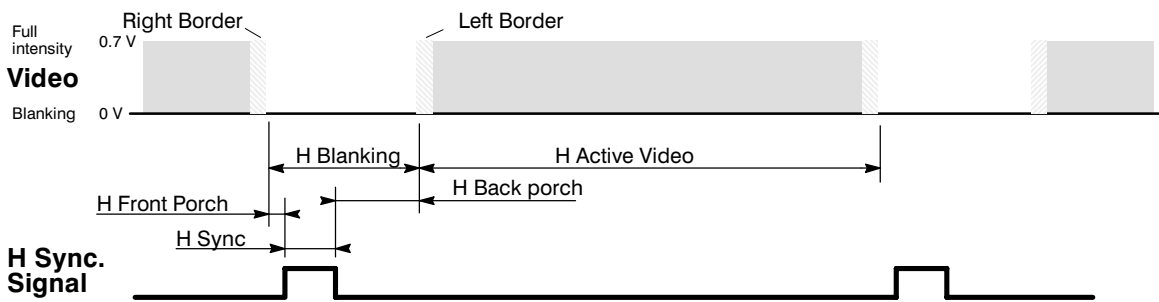
Display Mode =>	1	2	3	4	5	6	7
Display Mode Name	NCE605	NCE200D	NCE201D	NCE300	NCE306	NCE307	NCE406
H Frequency/kHz	79.976	31.467	44.544	31.472	37.500	53.966	46.875
H Period/µs	12.504	31.780	22.450	31.774	26.667	18.530	21.333
H Active Video/µs	9.481	31.780	16.036	25.420	20.317	14.254	16.162
H Resolution	1280	720	720	640	640	640	800
H Sync/µs	1.062	3.814	2.405	3.81	2.032	1.425	1.616
H Back Porch/µs	1.043	1.907	2.405	1.91	3.810	2.138	3.232
V Period/Lines	1066	449	513	525	500	539	625
V Resolution	1024	400	400	480	480	480	600
V Sync/Lines	3	2	12	2	3	4	3
V Back Porch/ Lines	38	34	61	33	16	38	21
H sync Polarity	+	–	–	–	–	–	+
V sync Polarity	+	+	+	–	–	–	+
H Front Porch/µs	0.12	0.64	1.60	0.64	0.51	0.71	0.32
V Front Porch/ Lines	1	13	40	10	1	17	1
Dot Frequency/ MHz	135.640	56.640	89.800	25.177	31.500	44.900	49.500
Interlacing	no	no	no	no	no	no	no

Full intensity 0.7 V

Right Border

Left Border

Video

Blanking 0 V

H Blanking

H Active Video

H Front Porch

H Back porch

H Sync

H Sync. Signal

Full intensity 0.7 V

Bottom Border

Upper Border

Video

Blanking 0 V

V Blanking

V Active Video

V Front Porch

V Back Porch

V Sync

V Sync. Signal
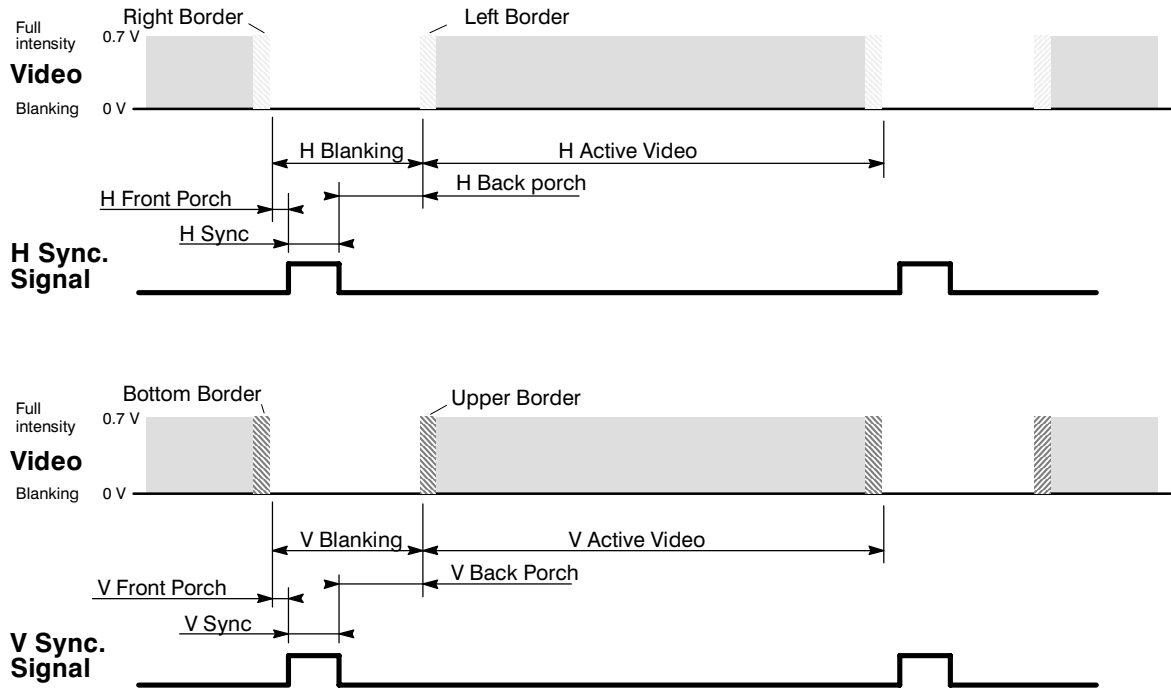
Display Mode –>	8	9	10	11	12	13	14
Display Mode Name	NCE409	NCE506	NCE510	NCE60Y	NCE60X	NCE700	NCE70X
H Frequency/kHz	66.603	60.023	63.812	91.146	96.846	74.995	93.755
H Period/μs	15.014	16.660	15.671	10.971	10.326	13.334	10.666
H Active Video/μs	11.461	13.003	11.082	8.127	7.793	9.877	7.901
H Resolution	800	1024	1024	1280	1280	1600	1600
H Sync/μs	1.146	1.22	1.126	1.016	1.072	1.185	0.948
H Back Porch/μs	1.719	2.23	2.165	1.422	1.272	1.883	1.501
V Period/Lines	666	800	886	1072	1076	1250	1250
V Resolution	600	768	768	1024	1024	1200	1200
V Sync/Lines	4	3	4	3	3	3	3
V Back Porch/ Lines	43	28	64	44	48	46	46
H sync Polarity	+	+	+	+	+	+	+
V sync Polarity	+	+	+	+	+	+	+
H Front Porch/μs	0.69	0.20	1.30	0.41	0.19	0.39	0.32
V Front Porch/ Lines	19	1	50	1	1	1	1
Dot Frequency/ MHz	69.800	78.750	92.400	157.500	164.250	161.990	202.510
Interlacing	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.

– Use a XGA−2 adaptor in the signal cable if you are going to use XGA−2 display mode (1024 x 768, 75 Hz)

– Use MAC adaptor in signal cable when connecting the monitor to an Apple Macintosh computer.
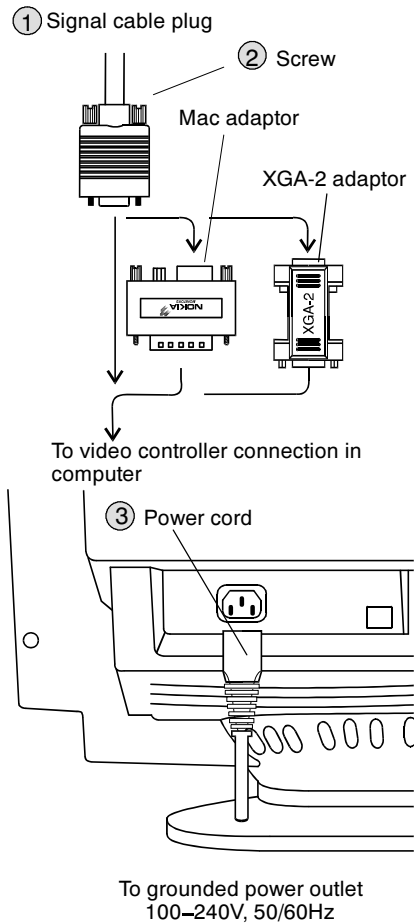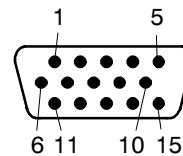
ACCESS.bus connector

The monitor has been equipped with ACCESS.bus connector in the connector panel. You may plug other DDC level 2AB compatible equipments (e.g. mouse) there.

① Signal cable plug

② Screw

Mac adaptor

XGA-2 adaptor

To video controller connection in computer

③ Power cord

To grounded power outlet
100−240V, 50/60Hz

Signal connector

Pin		Signal	
1	−>	RV	Red video
2	−>	GV	Green video
3	−>	BV	Blue video
4	<−	ID2	ID2 (tied to LG with 332 ohms inside monitor)
5		ST	DDC GND
6		RG	Red ground
7		GG	Green ground
8		BG	Blue ground
9	−>		+ 5V
10		LG	Logic ground
11	<−	ID0	ID0 (tied to LG with 332 ohms inside monitor)
12	<−	SDA	DDC SDA
13	−>	Hs	Hor. sync., Comp. sync.
14	−>	Vs	Vert. sync.
15	<−	SCL	DDC SCL

ACCESS.bus connector
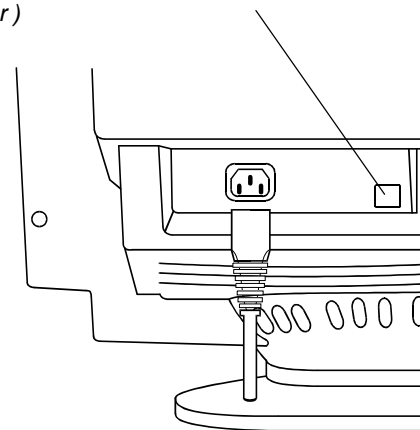
ACCESS.bus

Pin	Signal
1	Ground
2	DDC SDA (I^2 C signal)
3	+ 5V
4	DDC SCL (I^2 C signal)

1.4. Audio Features Option

The Monitor has built−in basic audio features. In business and multimedia systems this is an advantage because external speakers, microphone and connection do not clutter your desktop.

Before making any connections, switch off the computer and monitor with the power switch.

As an example the illustration shows connection to a computer sound board (Sound Blaster, Creative Labs, Inc.) Note that other types of sound boards may use different names for connectors.
The monitor can be connected to any other sound system if the signal levels and impedances are taken into account.

Incoming sound

The incoming sound system is capable to procedure stereo sound via loudspeaker L and R.
In the right hand side of the monitor there is a jack for headphones. Inserting of the headphones plug silences the loudspeakers.
Connect the audio inputs Audio IN L/R of the monitor to the audio output (Line Out) in the computer.
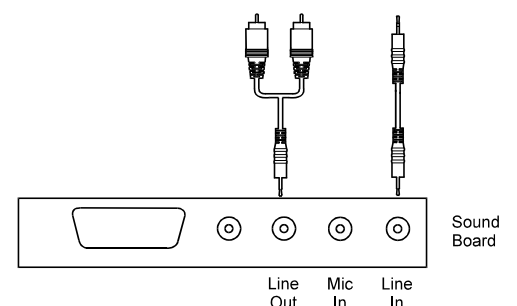
Outgoing sound

The monitor has built−in microphone.
If you use external microphone (electret condenser mic), plug it into the jack on the right hand side of the monitor. Inserting of the microphone plug switches off the internal microphone.

Connect the microphone output Microphone OUT of the monitor to the line level sound input (Line IN) in the computer. If the Line In jack is occupied, try microphone input jack (Mic in).

Note

Sound Board, headphones, external microphone and-connection cables are not part of monitor delivery even in case the monitor includes audio features.

Internal Microphone

Loudspeaker L   Loudspeaker R

External Microphone

Headphones

AUDIO IN   VIDEO   MIC   ACCESS
R   L   OUT   LINE   bus
OUT

Line Out   Mic In   Line In

Sound Board
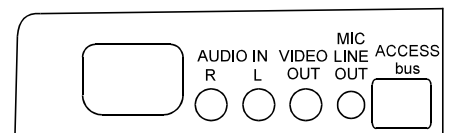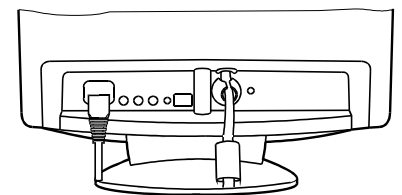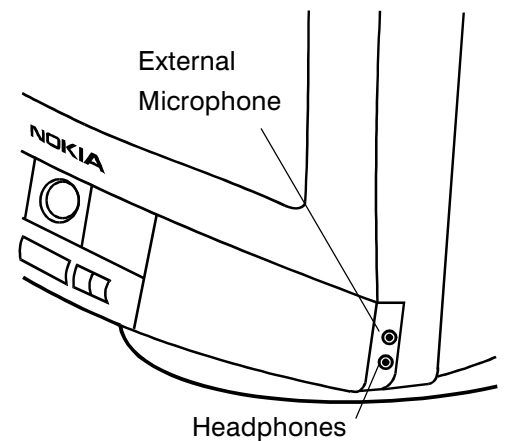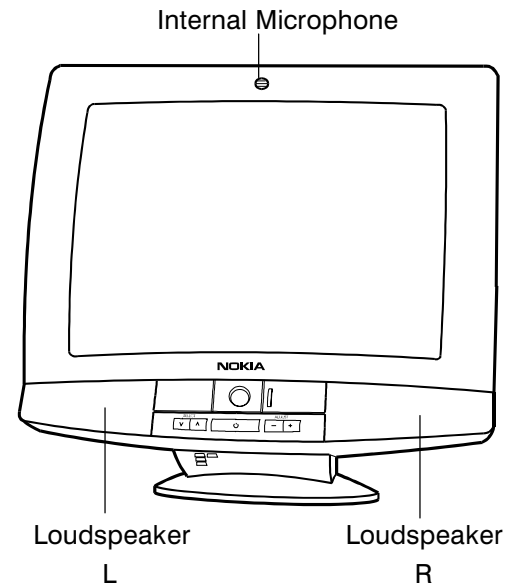
1.5. Video Camera Option

Video camera offers PAL composite signal which can be used e.g. for

- – Video conference together with audio features.
- – Video recording with ordinary video recorder.
- – Signal source for computer video capture card in case the card accepts composite signal.

The camera objective can be closed with lever operated lid. The lid is intended to operate as a shield for objective when the camera is not in use. When closed it gives a possibility for the user to be absolute privacy without danger of somebody watching you.

The camera can be angled towards the object horizontally by swivelling the monitor in its base and vertically by a lever under the bezel.

1.5.1. Connections

Adjust focus with help of a TV−set equipment with a SCART connector

Nokia Parts cable set P/N 81V029 can be used for connection to the TV−set but if not available, build your own cable.

1. Attach the SCART connector to the TV−set.
2. Attach the Video IN RCA connector to the Monitor Camera VIDEO OUT
3. Adjust focus.

1.5.2. Focusing Camera

The camera can be focused to the target by turning the focusing ring (black) with fingertip.

- – Turning the ring clockwise gives a sharp picture from targets which are farther.
- – Turning the ring counterclockwise focuses the camera to the targets which are near.

If you can not find a position with good focus, turn the focus ring clockwise to the limit. Turn the ring 4 turns backwards.

Video Camera lens

Focusing ring
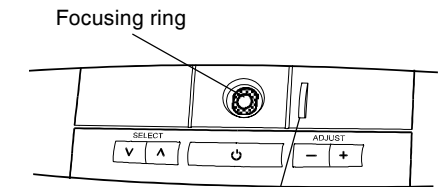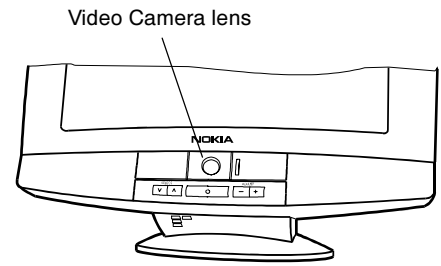
Vertical angling of camera
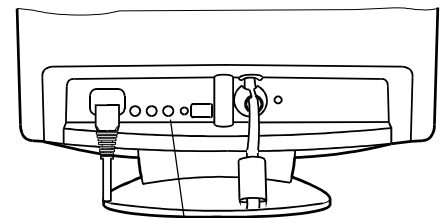
RCA-connector for
Camera VIDEO OUT

1

GND

SCART−connector

Video IN

2

RCA − connector

3

Focusing Ring
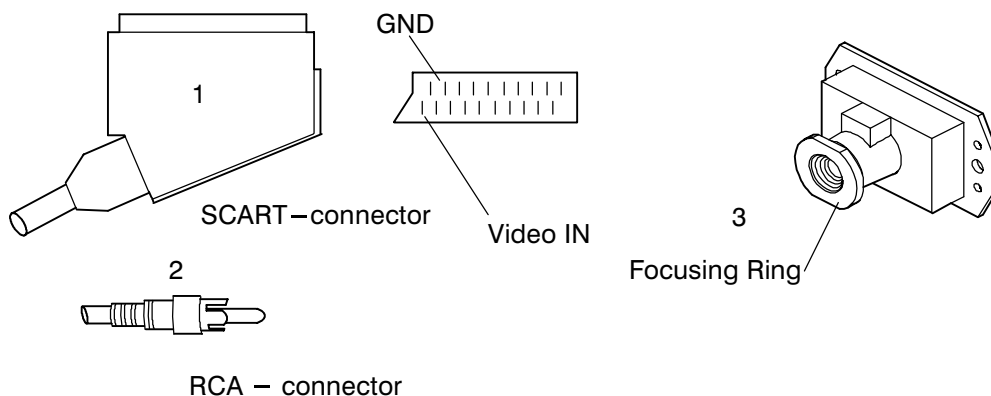
1.6. User Controls

1.6.1. 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.
The colour of the the power−on light indicates the operating state of the monitor.

Green . . . . The monitor is in normal operation

Orange . . . . The monitor is in automatic power off state

Not illuminated . . The monitor is turned off with power switch or disconnected from mains outlet.
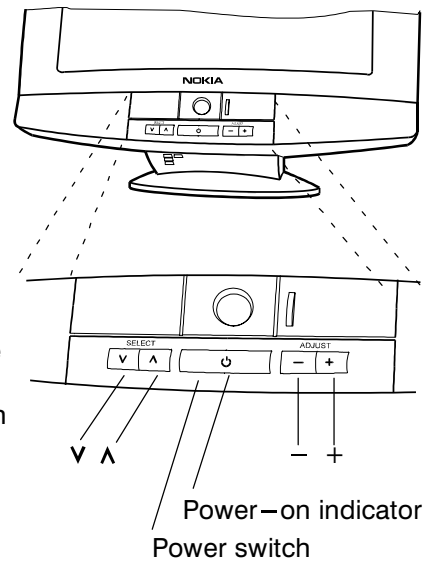
If the power management function working properly in your computer, you do not need to switch the monitor on or off. It happens automatically.

Power−on indicator
Power switch

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

1.6.2. Main Menu

The adjustments and settings of the monitor are carried out using menu display. The menu is called on the screen by pushing \/ or /\ button.

Each line in the MAIN MENU contains a header of another menu. Footer line contains information about the display mode currently in use. Nothing can be adjusted directly in this menu.

MAIN MENU
LANGUAGE
BASIC ADJUSTMENTS
GEOMETRY
IMAGE
1024 x 768 75 Hz
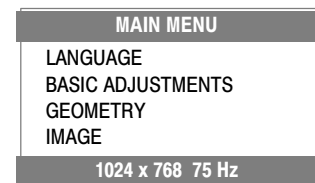
1.7.Menu

Basic Adjustments

The BASIC ADJUSTMENTS menu contains the most useful adjustments.

① The menu is called to the screen by pushing the ⓥ or ⓐ button.

② Select the property you want to adjust with ⓥ or ⓐ (e.g. WIDTH). The selected item in the menu is indicated with triangles " and A.

③ Adjust the selected property (WIDTH) with **+** or **−**. The menu disappears and a scale shows the position of the adjustment. The **+** button increases and **−** button decreases the property.

After adjusting, the new setting will be stored automatically.

Some of the menu items consist of selection alternatives. **+** scans the alternatives upwards and **−** downwards. If there are only two alternatives, **+** button switches the property ON and **−** button OFF.

All menu displays disappear automatically in a few seconds or at once by pushing ⓥ and ⓐ simultaneously.

Default Item

The menu selection is in force 20 seconds after the menu has disappeared. During that time the latest item can be called to the screen simply by pushing **+** or **−** . After the time has expired the menu selection returns to the default item.

Main Menu

④ If you want to adjust other properties in the main menu, push ⓥ or ⓐ and select EXIT TO MAIN MENU. Returning takes place when you push **+**.

Select with ⓥ or ⓐ the header which contains the adjustment you are looking for.

Open the selected submenu with **+** button.
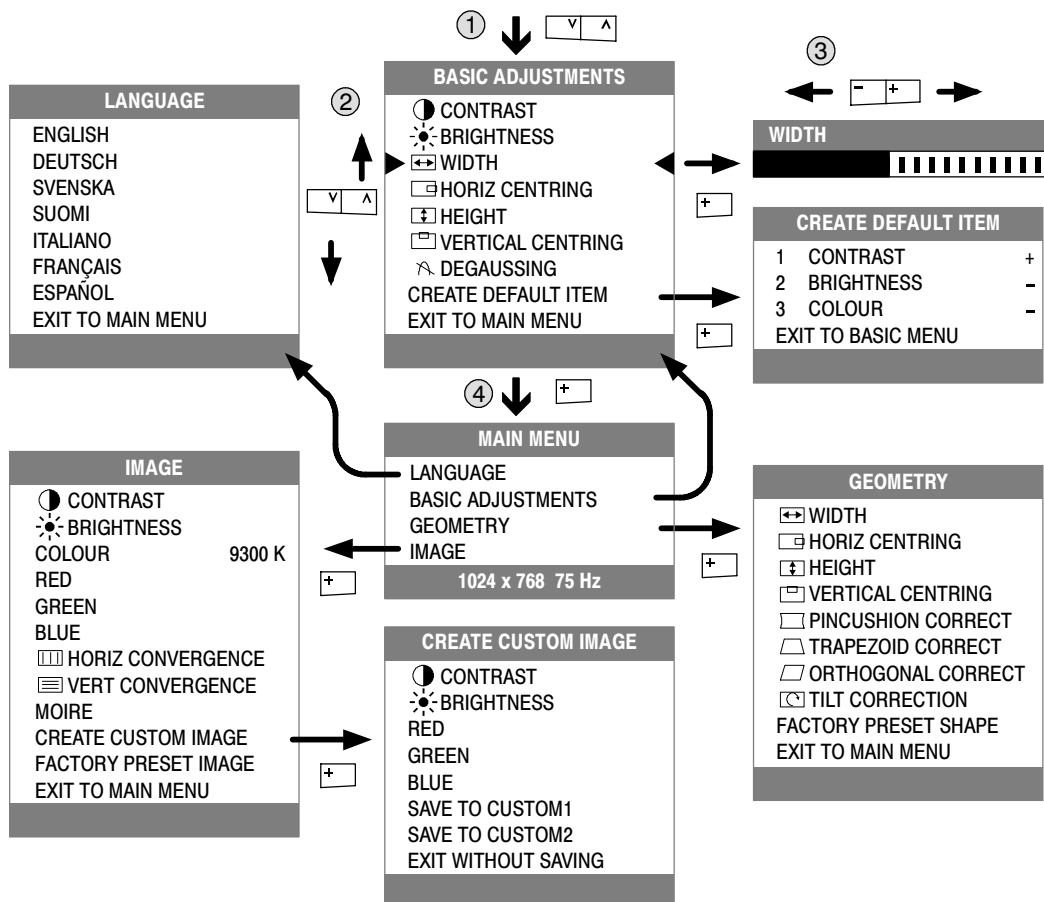
1.8. Audio Menu

Volume and Balance

VOLUME adjusts the sound intensity of the loudspeakers and headphones.

BALANCE adjusts the relation of sound volume in the right speaker to that in the left speaker.

Bass and Treble

Low and high frequencies can be boosted or atteunated separately by 10 decibels.

Mono/Stereo/Pseudo stereo/Spatial stereo

This menu item has four alternatives.

MONO forces the sound reproduction to mono whether the incoming signal is mono or stereo.

STEREO allows for stereo reproduction.

PSEUDO STEREO makes a mono signal sound like stereo.

SPATIAL STEREO emphasises the differences in information between R and L channels. This makes the stereo sound wider.

Speaker on/off

SPEAKER OFF silences the loudspeakers and headphones. Sound can be restored by switching SPEAKER ON or increasing VOLUME.

Microphone on/off

MICROPHONE OFF switches the outgoing sound signal (Microphone LINE OUT) off. MICROPHONE ON restores the signal.

Mic Output Level

MIC OUTPUT LEVEL adjusts the level of the outgoing (Microphone LINE OUT) sound signal.

Mic Level Select internal/external

If you continuously use the internal or external microphone only, you do not need to make any MIC LEVEL SELECT settings.

If you use internal and external microphones alternately and they have different sensitivities you may need this feature.

– Select first MIC LEVEL SELECT INT

– Adjust the level of the outgoing sound with MIC OUTPUT LEVEL.

– Install the external microphone or headset.

– Select MIC LEVEL SELECT EXT

– Adjust the level of the outgoing sound with MIC OUTPUT LEVEL equal to that with internal microphone.

Now if you change back to the internal microphone, you get the correct output level by setting MIC LEVEL SELECT from EXT to INT and vice versa.
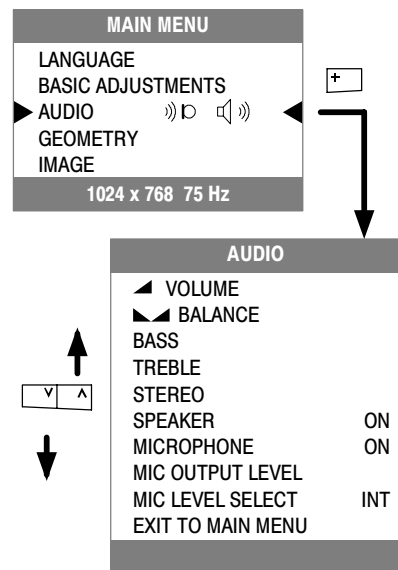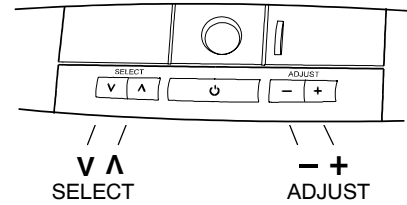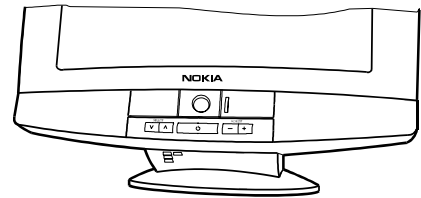
2. Site Preparation

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 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.
Picture is stable but distorted		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 unstable		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 black and white		Check that the signal cable's connector is completely inserted. Switch off the computer and restart.

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	7V	12V	Video
Normal Operation	Green	Yes	Yes	Yes	Yes
Stand−by	Green	Yes	Yes	Yes	No
Suspend	Green	Yes	Yes	No	No
Power Off	Orange	Yes	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 with service menu 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.
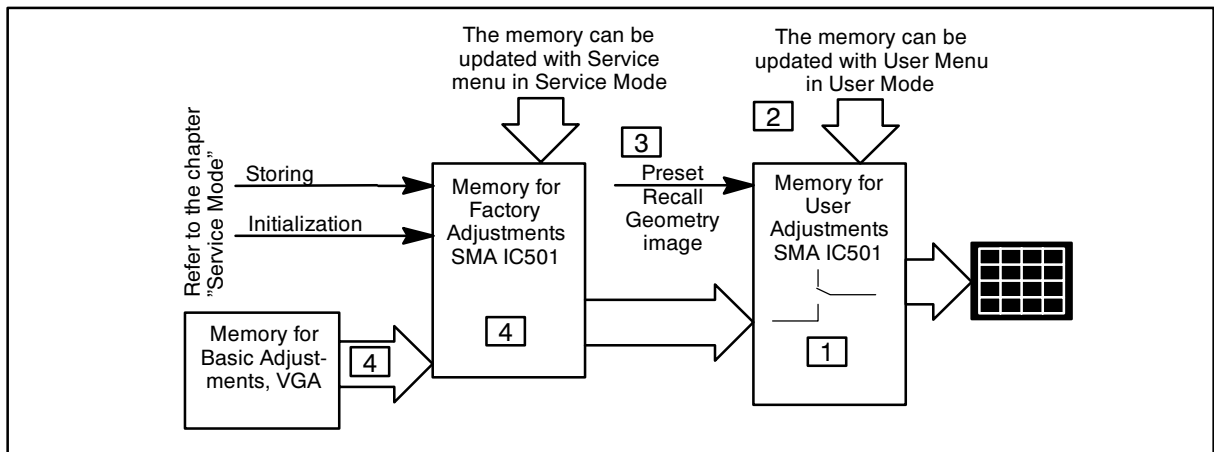
4. Service Mode

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.

4.1. Grouping of the Adjustments

There are three groups of software adjustments in service mode:
- geometry adjustment set
- grey scale adjustment set
- convergence 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
Horizontal convergence	X		X	X
Vertical convergence	X		X	X
Moire	X		X	
Pincushion balance		X		X
Horizontal raster centring	X			X
Tilt	X		X	X
G2	X			X
Max/Min contrast	X			X
R Blacklevel	X			X
G Blacklevel	X			X
B Blacklevel	X			X
R Gain	X			X
G 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.

```
SELECT          SELECT
┌──┬──┐ ┌───────┐ ┌──┬──┐
│ ∧│ ∨│ │   ⏻   │ │ ∧│ ∨│
└──┴──┘ └───────┘ └──┴──┘
   ▲       ▲        ▲
   1)      2)       3)

      SERVICE MODE

   ┌─────────────────┐
   │ GEOMETRY        │ ◄
   │ GREY SCALE      │      ◄
                          ▲ SELECT
     CONVERGENCE
     INITIALIZING ─┐      ▶
         EXIT      │
                   ▼
ADJUST+              ADJUST+


SELECT
   ┌─────────────────┐
   │ HEIGHT          │
     VERT CENTRING
     WIDTH
     HOR CENTRING
     PINCUSHION         ◄
     TRAPEZOID        ▲ SELECT
     ORTHOGONALITY
     PINCUSHION BAL     ▶
     TILT
     N/S TRAPEZOID
     RASTER


   ┌─────────────────┐
   │ BRIGHTNESS      │
     CONTRAST
     G2
     RED coarse        ◄
     GREEN coarse    ▲ SELECT
     BLUE coarse
     RED ampl          ▶
     GREEN ampl
     BLUE ampl
     MAX/MIN CONTR


   ┌─────────────────┐
   │ S HOR CONVERGENCE│ ◄
     S VER CONVERGENCE
     D HOR CONVERGENCE ▲ SELECT
     D VER CONVERGENCE ▶
   └─────────────────┘
```

4.2. Service Menu

4.2.1. Access to Service Mode

First switch OFF the monitor with power switch.
1) Push Ⓥ down
2) While keeping Ⓥ down, switch ON the monitor
3) Release Ⓥ **after service menu has appeared** to the screen.

Versions up to 1.13

First switch OFF the monitor with power switch.
1) Push Ⓥ down
2) While keeping Ⓥ down, switch ON the monitor
3) During 0,5 s release Ⓥ and push Ⓐ down.
4) Release Ⓐ **after service menu has appeared** to the screen.

Select the items in the menu with button. Push **+** to open Geometry or Grey Scale Submenu or to Initialize the memory IC. Adjust each property with **+ −** .

4.2.2. Geometry

Geometry submenu contains placement, size and shape adjustments.

4.2.3. Grey Scale

This monitor has six preset tints. With tint numbers smaller than 4 the picture becomes reddish and with tint numbers greater than 4 the picture turns blue.

Tint no	1	2	3	4	5	6	7
Colour Temperature	5000K	6000K	6500K	7000K	8000K	9300K	10000K

The grey scale adjustment affects directly tint number 6 (9300K) only. Other tints are derived automatically from 9300K colour temperature.

4.2.4. 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 as explained before.
− Select INITIALIZING in the service mode menu.
− Initialize of the memory by pushing **+**.
− Switch OFF the monitor

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

4.2.5. Monitor Type setting

− After initializing the monitor continue with the setting of the monitor version of the memory.
− Switch the monitor off.

Audio
− Push + down
− While keeping + down switch ON the monitor
− During 0,5 s release + and push − down
− Release − after service menu has appeared to the screen

Non Audio
− Push − down
− While keeping − down switch ON the monitor
− During 0,5 s release − and push + down
− Release + after service menu has appeared to the screen

4.2.6. Storing the mode related adjustments

1. Return to the SERVICE MODE menu

2. Wait for five seconds and select a new display mode.

Caution

Make all adjustments at a time. If you return afterwards to the display mode, which you have already done, you have to adjust it totally again.

4.2.7. Exit from service mode

1. Return to the SERVICE MODE menu

2. Wait for five seconds and select a new display mode.

3. Switch off the monitor

4. Wait for one minute before switching on the monitor.

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.
- Disconnect the power cable.

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
- Color analyzer: e.g. Minolta TV Color 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
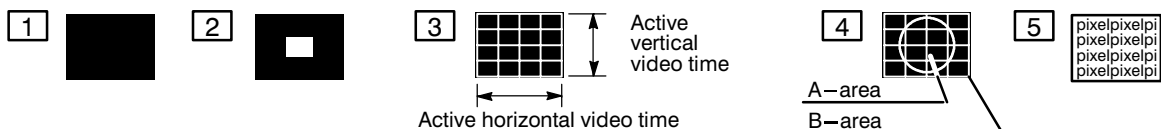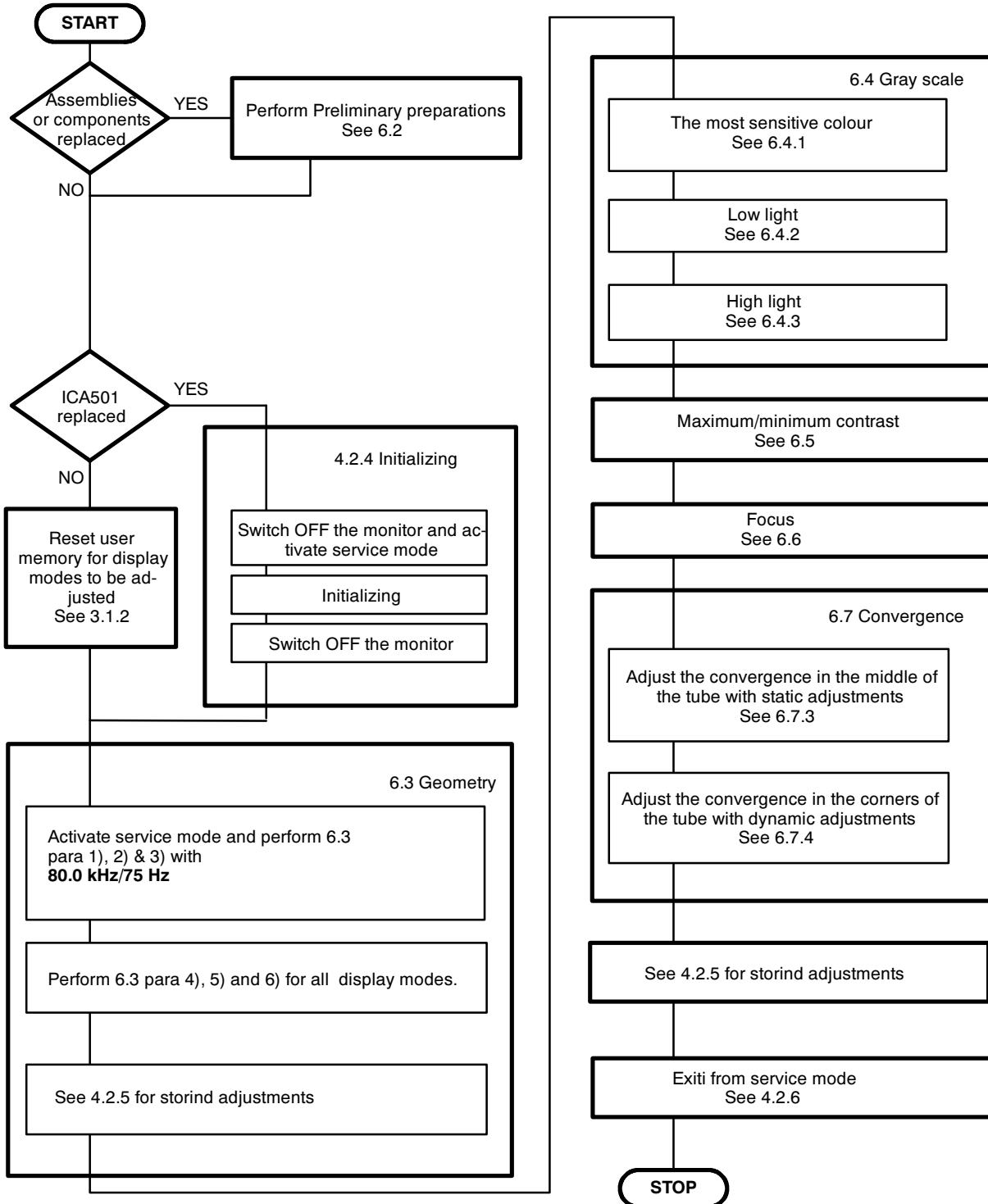

1 Black Picture
- Signal level = 0 V at each RGB input
2 Highlight grey scale tracking
- Signal level = 700 mV in the window at each RGB input
3 Crosshatch Picture
- Squares e.g. 20 mm x 20 mm
- Outmost lines correspond the active vertical/horizontal video time
4 Convergence test pattern
5 Focus test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

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

```
                START

         Assemblies          YES     Perform Preliminary preparations
         or components  ───────────▶  See 6.2
         replaced

             NO

                                     6.4 Gray scale
         ICA501         YES
         replaced  ──────────┐        The most sensitive colour
                             │        See 6.4.1
             NO              │
                             │        Low light
                   4.2.4 Initializing   See 6.4.2
      Reset user
      memory for       Switch OFF the monitor and ac-    High light
      display          tivate service mode               See 6.4.3
      modes to be ad-
      justed           Initializing
      See 3.1.2                                   Maximum/minimum contrast
                       Switch OFF the monitor      See 6.5

                                                  Focus
                                                  See 6.6

                6.3 Geometry                      6.7 Convergence

      Activate service mode and perform 6.3       Adjust the convergence in the middle of
      para 1), 2) & 3) with                       the tube with static adjustments
      80.0 kHz/75 Hz                              See 6.7.3

                                                  Adjust the convergence in the corners of
      Perform 6.3 para 4), 5) and 6) for all      the tube with dynamic adjustments
      display modes.                              See 6.7.4

      See 4.2.5 for storind adjustments           See 4.2.5 for storind adjustments

                                                  Exiti from service mode
                                                  See 4.2.6

                                                       STOP
```
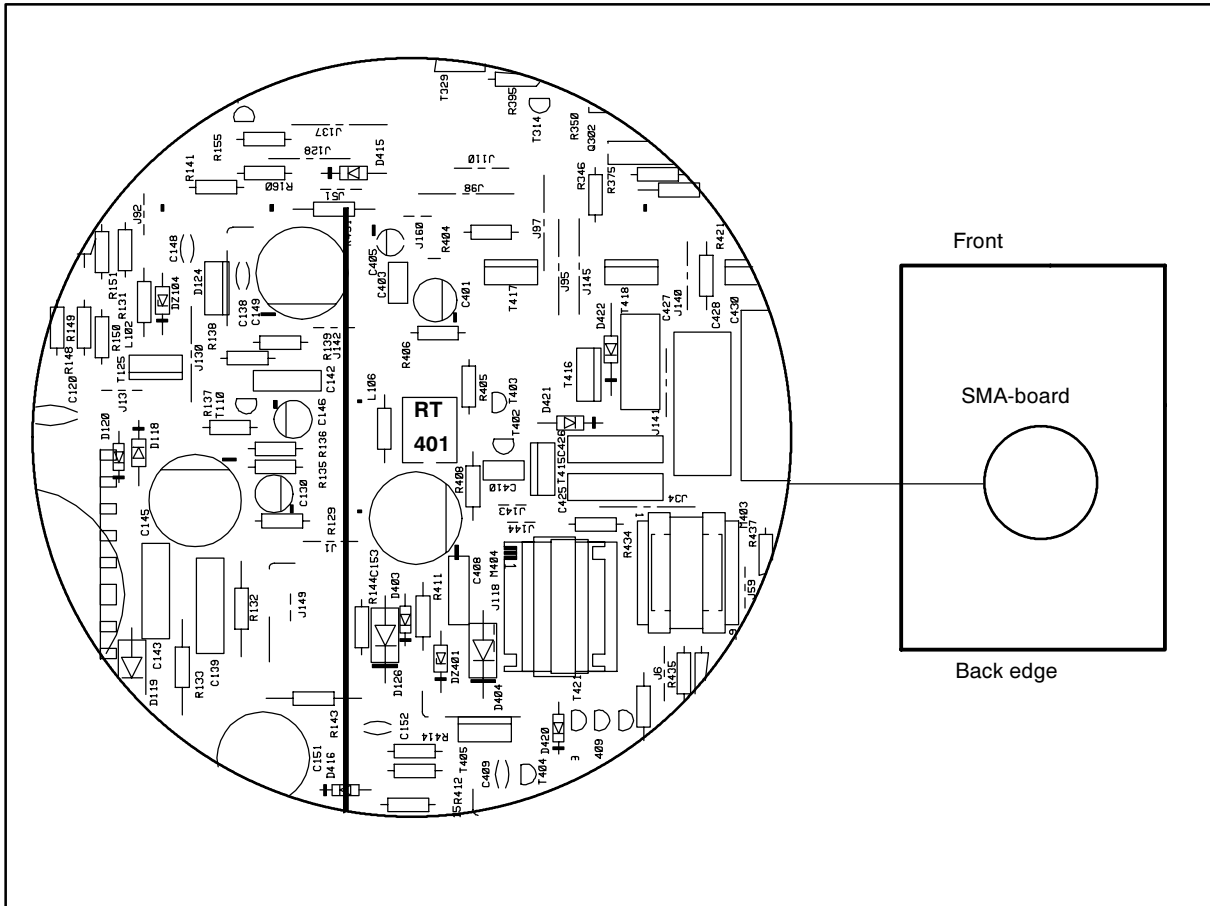
6.2. Preliminary Preparations

Connect the signal cable to the PC. Switch on the monitor and the PC. Let the monitor warm up for 20 minutes before starting the adjustments.
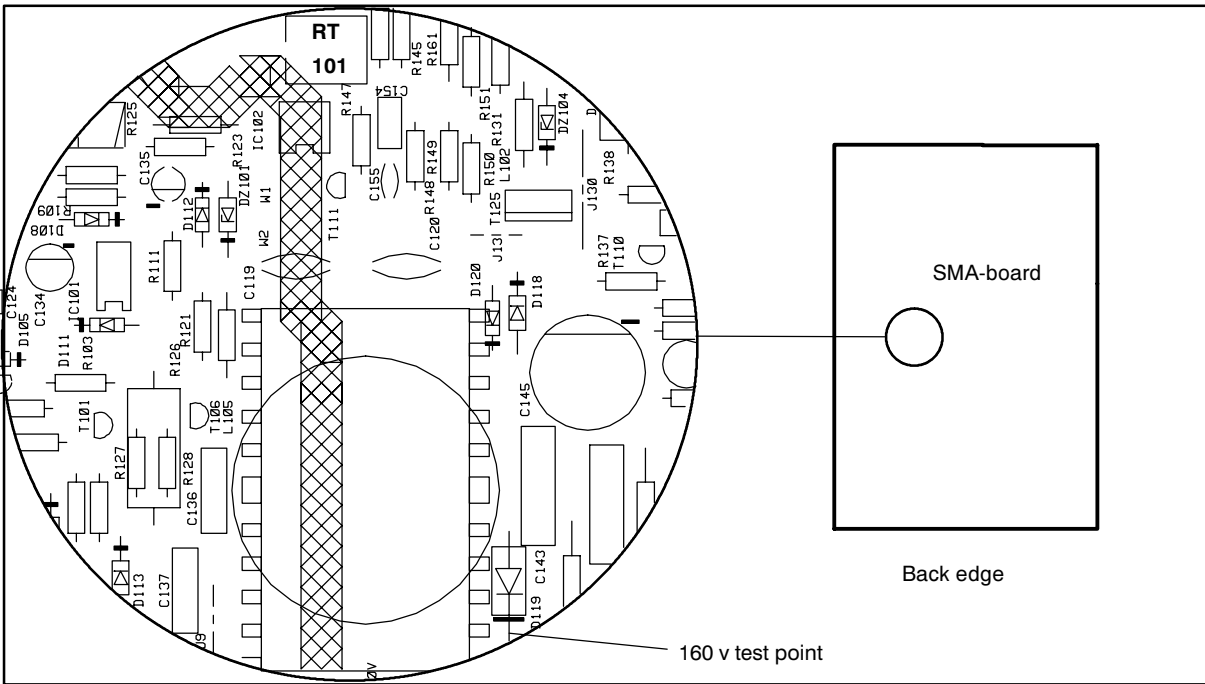
6.2.1. Coarse width

- Select 80 kHz/75 Hz crosshatch test pattern
- Set width to the maximum with menu adjustment
- Set width approximately 387 mm with coarse adjustment **RT401**

6.2.2. Operating voltage

Connect the DVM to 160 v test point. Adjust trimmer **RT101** on SMA −board for a voltage of **160 ± 0.5 V.**

RT 101

SMA-board

Back edge

160 v test point

6.2.3. High Voltage

−   Select 31.47kHz/60Hz crosshatch test pattern.
−   Connect the high voltage meter to the anode of the picture tube.
−   Adjust the high voltage to **27.0 ±0.3 kV** with **RT301** on SMA−board.

SMA-board

Back edge

RT 301
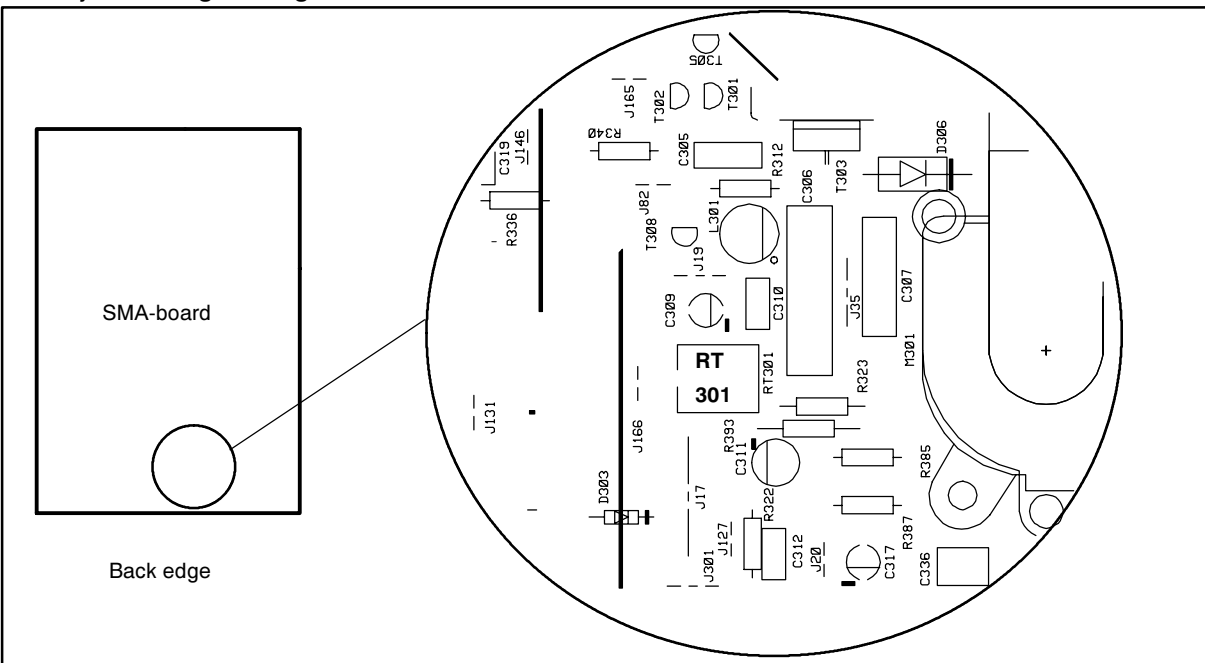
6.2.4. Preliminary Picture Adjustments

1)   Select 80.0 kHz/75 Hz crosshatch test pattern.
2)   Set ◑ to maximum and adjust ✳ until the background is faintly visible.
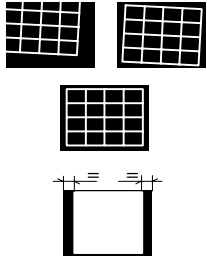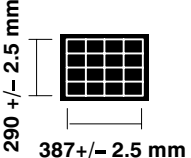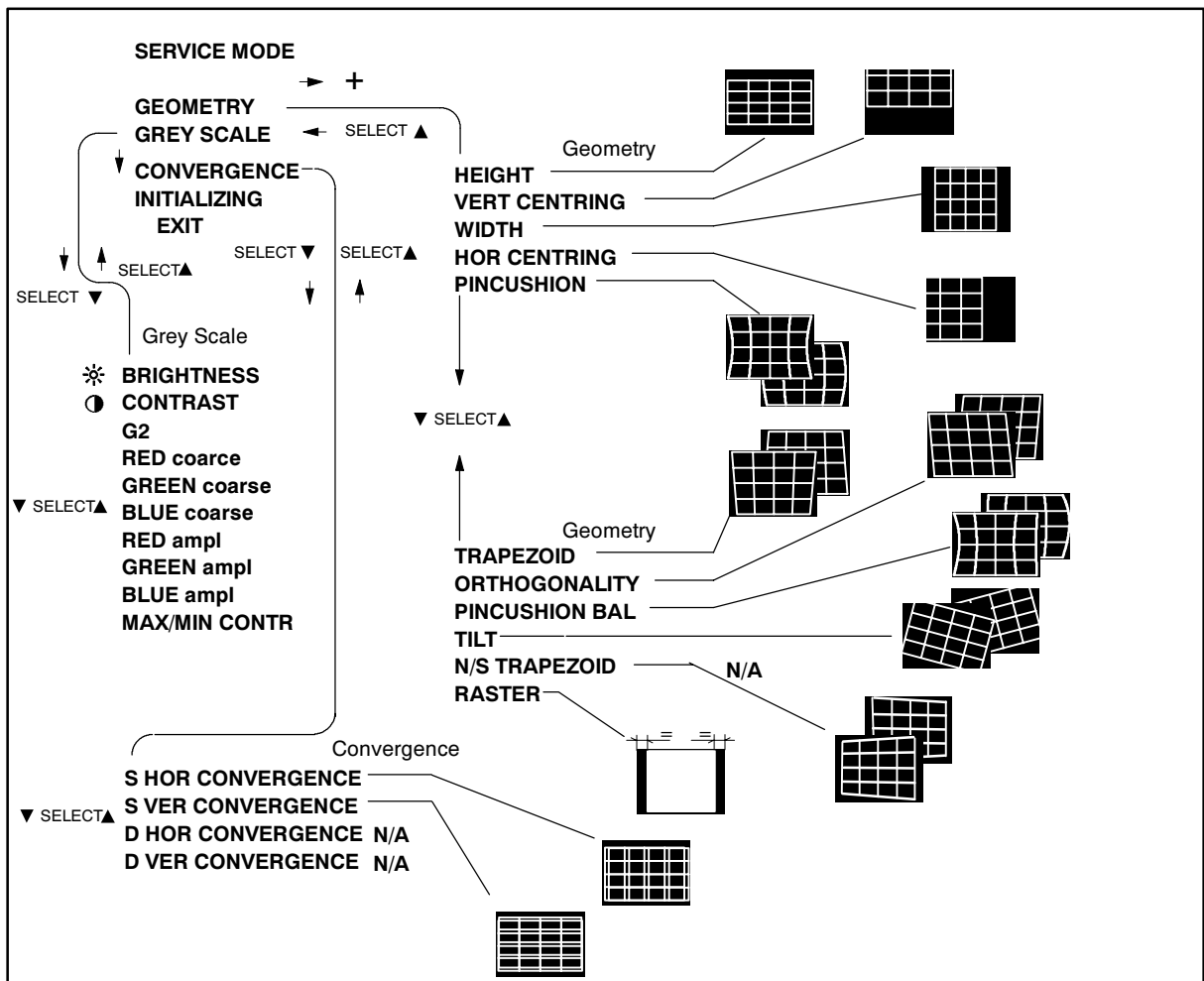3)   Adjust focus if poor.

Remember

−   Do not adjust **G2**−voltage with potentiometer or keypanel if you have reason to belive that there is no need to adjust gray scale.

6.3. Geometry

Activate Service Mode.

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

1) Select **80 kHz/75 Hz** crosshatch test pattern. Set ◐ to maximum and adjust ❋ until the background is faintly visible. Reduce width until both vertical edges of the **background** are visible. 2) Straighten the picture if tilted. This adjustment is common for all display modes. 3) Centre the background. This adjustment is common for all display modes.	
4) Adjust size, position and shape of the picture equal to the mask aperture Adjust first the properties with largest deviation from the correct value. 5) Adjust final width and height.	290 +/− 2.5 mm 387+/− 2.5 mm
6) Return to the main menu and wait for five seconds.	
7) Repeat steps 4) , 5) and 6) for every display mode to be stored. Note that the display mode can be changed without leaving the service mode.	

SERVICE MODE

GEOMETRY
GREY SCALE ← SELECT ▲
CONVERGENCE
INITIALIZING
EXIT

SELECT ▼   SELECT ▲

SELECT ▼   SELECT ▲

SELECT ▼

Grey Scale

❋ **BRIGHTNESS**
◐ **CONTRAST**
  G2
  RED coarce
  GREEN coarse
▼ SELECT ▲ **BLUE coarse**
  RED ampl
  GREEN ampl
  BLUE ampl
  MAX/MIN CONTR

Geometry

HEIGHT
VERT CENTRING
WIDTH
HOR CENTRING
PINCUSHION

▼ SELECT ▲

Geometry

TRAPEZOID
ORTHOGONALITY
PINCUSHION BAL
TILT
N/S TRAPEZOID   **N/A**
RASTER

Convergence

S HOR CONVERGENCE
▼ SELECT ▲ **S VER CONVERGENCE**
D HOR CONVERGENCE **N/A**
D VER CONVERGENCE **N/A**

6.4. Grey Scale

The grey scale is adjusted for 9300K colour temperature. Memorizing of G2 and Max/Min Contrast takes place in five seconds when you return to the main menu from submenu.

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 **80 kHz**/**75 Hz** black test pattern.
2) Set ☀ and ◑ to maximum.
3) Set blacklevel adjustment **RED**/**GREEN**/**BLUE coarse** to minimum (for darkest picture)
4) Set **RED**/**GREEN**/**BLUE ampl** menu adjustments to center
5) Set **G2 menu** adjustment to center
6) Place the probe of the colour analyzer in the middle of the screen and adjust with **G2 trimmer** until the picture brightness to 5±1 nit.

6.4.2. Low Light

1) Select **80 kHz**/**75 Hz** black test pattern.
2) Adjust picture brightness to 5±0.8 nits with **G2 menu** adjustment.
3) Adjust with ☀ adjustment the brightness to 2±0.5 nits.
4) Adjust the colour coordinates to (9300K)
   x = 0.281±0.020
   y = 0.311±0.020
   with **RED**/**GREEN**/**BLUE coarse** adjustments.
   Do not adjust the most sensitive colour.
5) Set ☀ and ◑ to the maximum and check that the brightness is still 8±0.8 nits. If not, repeat steps 3) and 4).

○ FOCUS V
○ FOCUS H
○
G2
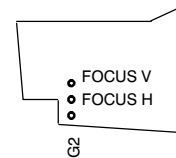
Left side view
of the chassis

6.4.3. High Light

1) Select **80 kHz**/**75 Hz** black test pattern.
2) Adjust with ☀ the picture brightness to 2±0.5 nits.
3) Select 80 kHz/75 Hz window test pattern.
4) Adjust with ◑ the picture brightness in the window to 70±5 nits.
5) Adjust with **RED**/**GREEN**/**BLUE ampl** the colour coordinates in the window to
   x = 0.281±0.020
   y = 0.311±0.020
   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 2±0.5 nits.
3) Adjust brightness in the window to 150±3 nits with **MAX**/**MIN CONTR**.
4) Set ◑ to minimum.
5) Adjust brightness to 16±1 nits with **MAX**/**MIN CONTR**.
6) Return to the main menu and wait for five secods.
7) Exit from service mode.

6.6. Focus

1) Select **80 kHz**/**75 Hz** crosshatch test pattern
2) Set ◑ to the maximum and adjust ☀ until the background is faintly visible
3) Adjust the sharpness with **FOCUS H** and **FOCUS V** to optimum
4) Adjust ☀ until the background is invisible
5) Select focus test pattern. Check that all letters are clearly visible

pixelpixelpi
pixelpixelpi
pixelpixelpi
pixelpixelpi

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 80.0 kHz 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
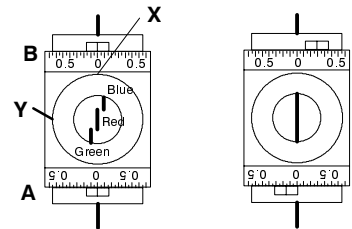

6.7.3. Static Convergence

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
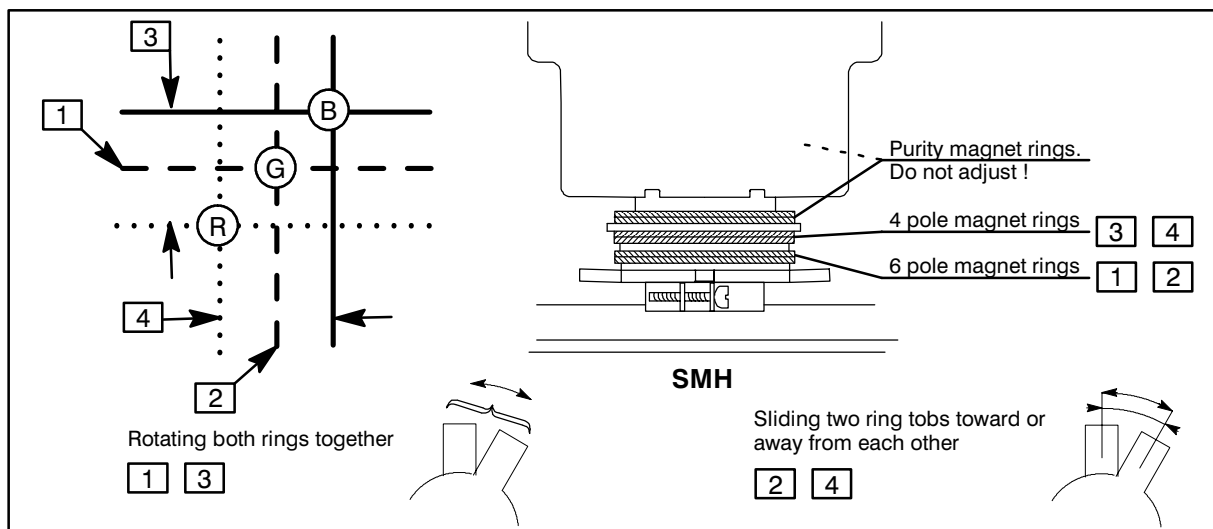
6.7.4 Dynamic Convergence

Purity magnet rings.
Do not adjust !

A—area

B—area
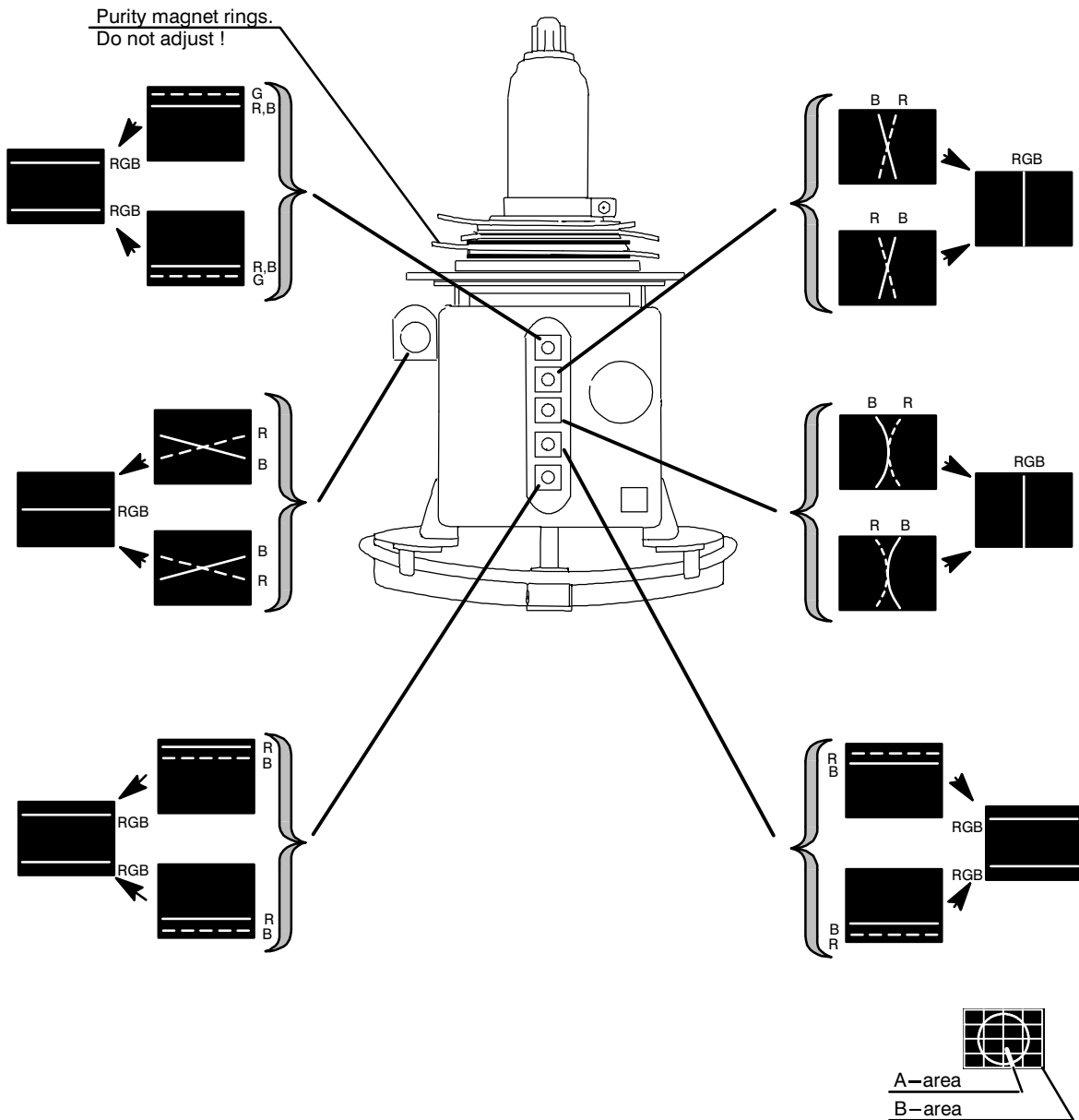
6.7.5 Allowed Error Levels for Convergence

For horizontal sync frequencies above 58 kHz

Area A: ≤ 0.3 mm

Area B: ≤ 0.4 mm

For horizontal sync frequencies below 58 kHz

Area A: ≤ 0.4 mm

Area B: ≤ 0.5 mm

6.8. Colour Purity

Do not move purity magnet rings. If the purity magnet rings are found to have moved during transportation or handling, set them just in the original position by tracing the locking paint put on purity magnet rings and holder of beam bender and then readjust the static convergence.