Service

Contents

Revision History

Rev	Date	Prepared by	Comments
09.99	24.09.99		
02.00	14.02.00	J. Paukku	SMA241H added

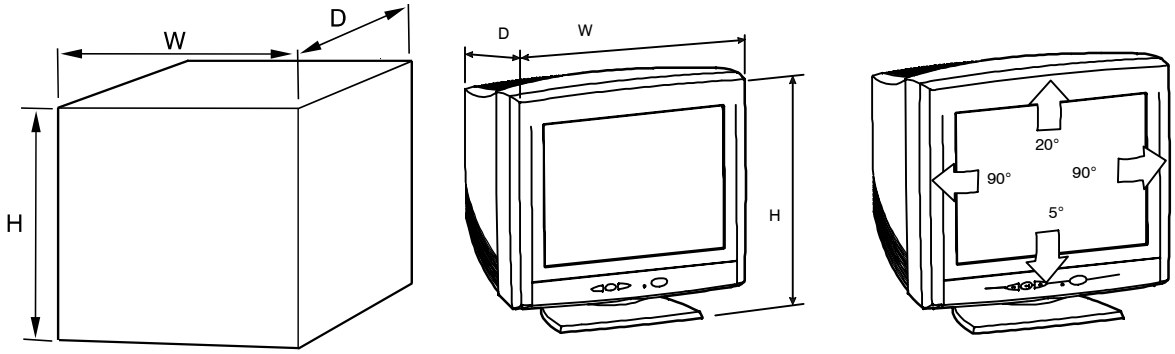
1. Product Overview

446F is a 19 inch monitor. The maximum resolution of 1600 x 1200 makes the monitor suitable for PC, Macintosh and workstation applications in normally heated, ventialed and controlled office/home environment. The monitor has an own power supply with nominal input voltage requirements from 90 V to 264 V.

1.1. Technical Specifications

Cathode Ray Tube	19” in diagonal 86˚ deflection angle Antistatic, antireflex Phosohor P22 medium short, Dot pitch 0.24 mm
Picture Size	354 mm x 265 mm with specified geometric distortion
Maximum Picture Size	366 mm x 275 mm
Power Input Requirements	Voltage 90-264 V, 50/60 Hz Current 1.8 A/100 V, 0.8 A/240 V
Power Dissipation	< 130 W Normal Operation < 95 W Stand-by < 8 W Suspend < 3 W Power off
Memory Locations	3 for factory preset display mode 18 for user adjusted display mode
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. 100 cd/m^2 (Nits) at center, with full white field
Video Input	Input Signal: RGB, analog, max 0.7 V/ 75 Ω Horizontal addressability: 1600 dots maximum Vertical addressability: 1200 dots maximum
Synchronization Range	Horizontal: 30 kHz to 107 kHz automatic Vertical: 50 Hz to 150 Hz automatic
Synchronization Signal	Separate TTL , positive/negative Composite TTL , positive/negative
Max. Dot Frequency	230 MHz
Temperature	Operating: +10˚C to +35˚C Packed: -30˚C to +60˚C
Humidity	Operating: 20% to 80 % Packed: 5% to 90 %
Weight	25.3 kg net 29.6 kg gross

Size, Tilt and Swivel



Dimensions

Monitor	H	471 mm
	W	470 mm
	D	464 mm
Package	H	596 mm
	W	600 mm
	D	571 mm

1.2. Certifications

The monitor has following agency approvals

1.2.1. Safety

FIMKO, DEMKO
NEMKO, SEMKO
UL / USA
CSA / Canada
TÜV – GS / Germany
IAA / Korea
PSB / Singapore
CCIB / China

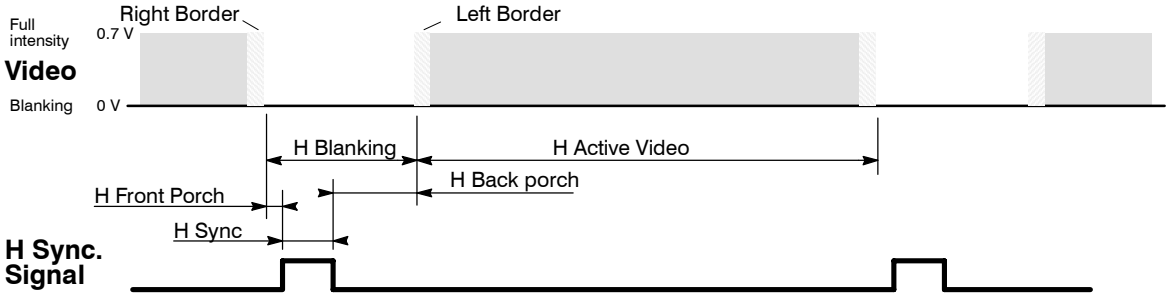
1.2.2. EMC

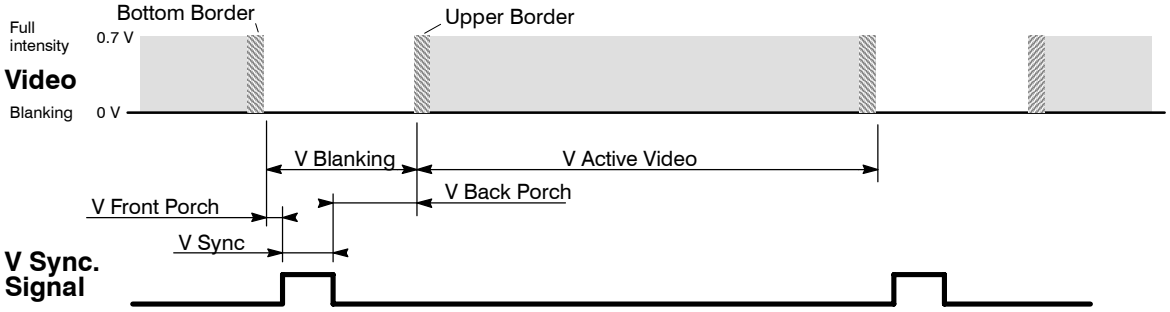
FCC – D.O.C.
VCCI / Japan
CE / Europe
RRL EMI / Korea
BSMI / Taiwan

1.2.3. X – ray, emissions, environmental, ergonomics

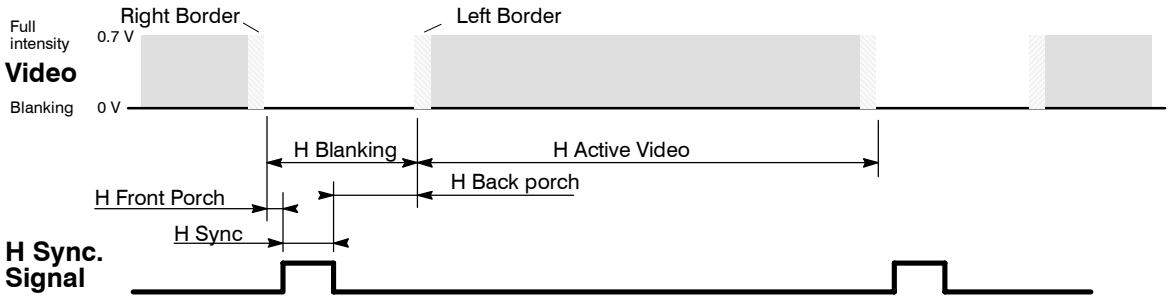
TÜV – ERGO / Germany
DHHS / USA
TCO 99 / Sweden
Blue Angel / Germany

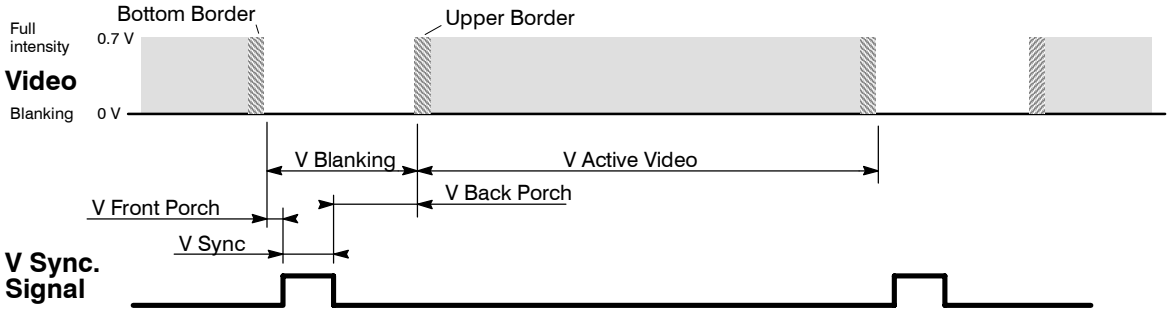
1.3. Preset Display Modes





Display Mode no	00	01	02	03	04	05	06	07	08
NCE	GTF642	NCE642	NCE791	NCE513	NCE501	NCE506	NCE401	NCE406	NCE40A
V Frequency/Hz	85.0	85.0	85.0	85.0	60.0	75.0	60.3	75.0	85.06
H Frequency/kHz	91.376	91.146	106.25	68.677	48.363	60.023	37.879	46.875	53.674
H Period/us	10.944	10.971	9.41	14.561	20.677	16.660	26.400	21.333	18.631
Active Video/us	8.032	8.127	6.97	10.836	15.754	13.003	20.000	16.162	14.222
H Resolution	1200	1280	1600	1024	1024	1024	800	800	800
H Sync/us	0.803	1.016	0.83	1.02	2.092	1.219	3.200	1.616	1.14
H Back Porch/us	1.456	1.422	1.32	2.20	2.6462	2.235	2.200	3.232	2.70
V Period/lines	1075	1072	1250	808	806	800	628	625	631
V Resolution	1024	1024	1200	768	768	768	600	600	600
V Sync/lines	3	3	3	3	6	3	4	3	3
V Back Porch/lines	47	44	46	36	29	28	23	21	27
H Sync Polarity	–	+	+	+	–	+	+	+	+
V Sync Polarity	+	+	+	+	–	+	+	+	+
H Front Porch/us	0.65	0.41	0.27	0.51	0.37	0.20	1.00	0.32	0.57
V Front Porch/lines	1	1	1	1	3	1	1	1	1
Dot Frequency/MHz	159.360	157.500	229.490	94.500	65.000	78.750	40.000	49.500	56.250
Interlacing	no	no	no	no	no	no	no	no	no





Display Mode no	09	10	11	12	13	14	15	16	17	18
NCE	NCE300	NCE306	NCE30A	NCE200D	NCE012	NCE011	NCE603	NCE605	NCE700	NCE70X
V Frequency/Hz	59.9	75.0	85.0	70.1	75.0	75.1	60.0	75.0	60.0	75.0
H Frequency/kHz	31.472	37.500	43.269	31.467	67.500	68.681	63.981	79.976	74.995	93.755
H Period/us	31.774	26.667	23.111	31.780	14.815	14.560	15.630	12.504	13.334	10.666
Active Video/us	25.420	20.317	17.778	25.423	10.667	11.520	11.852	9.481	9.877	7.901
H Resolution	640	640	640	1440	1152	1152	1280	1286	1600	1600
H Sync/us	3.81	2.032	1.56	3.814	1.185	1.280	1.037	1.06	1.185	0.948
H Back Porch/us	1.91	3.810	2.22	1.907	2.370	1.440	2.296	1.84	1.883	1.501
V Period/lines	525	500	509	449	900	915	1066	1066	1250	1250
V Resolution	480	480	480	400	864	870	1024	1024	1200	1200
V Sync/lines	2	3	3	2	3	3	3	3	3	3
V Back Porch/lines	33	16	25	34	32	39	38	38	46	46
H Sync Polarity	–	–	–	–	+	–	+	+	+	+
V Sync Polarity	–	–	–	+	+	–	+	+	+	+
H Front Porch/us	0.64	0.51	1.56	0.64	0.59	0.32	0.44	0.12	0.39	0.32
V Front Porch/lines	10	1	1	13	1	3	1	1	1	1
Dot Frequency/MHz	25.177	31.500	36.000	56.640	108.000	100.000	108.000	135.640	161.990	202.510
Interlacing	no	no	no	no	no	no	no	no	no	no

1.4. S-Capacitor table

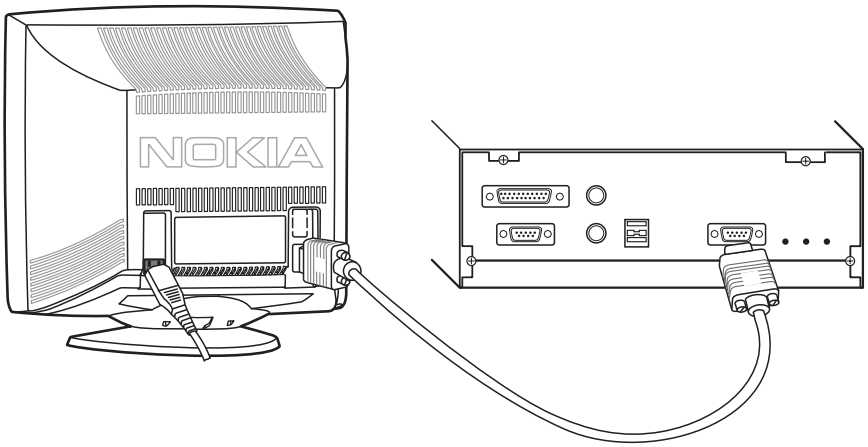
f/kHz	S5	S4	S3	S2	S1	S0
27.6						
	x	x	x	x	x	x
28.4						
	x	x	x	x	x	x
29.2						
	x	x	x	x	x	x
30.4						
	x	x	x	x	x	x
30.8						
	x	x	x	x	x	x
31.8						
	x	x	x		x	
32.8						
	x	x		x		x
33.7						
	x	x			x	x
34.7						
	x		x	x	x	x
36.0						
	x		x		x	x
37.2						
	x			x	x	x
38.3						
	x			x		x
39.4						
		x	x	x	x	x
40.4						
		x	x	x		
41.4						
		x	x		x	x
42.7						
		x	x			
44.2						
		x		x	x	x
45.8						
		x		x		x
47.7						
		x			x	x
49.4						
		x				x
51.6						
			x	x	x	x
53.5						
			x	x	x	
54.6						
			x	x	x	
55.8						
			x	x		
57.3						
			x		x	x
59.0						
			x		x	x
60.5						
			x		x	
62.2						
			x		x	
65.3						

65.3						
			x			
68.8						
				x	x	x
71.3						
				x		x
74.1						
				x		x
78.2						
				x		x
82.8						
					x	x
87.4						
					x	
94.0						
						x
100.0						
108.0						

1.5. 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.

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

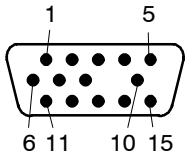


If your computer is DDC compatible (PC)

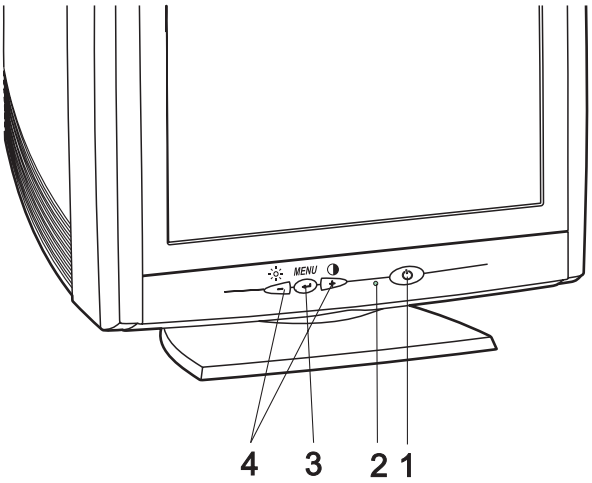
- Do not use any adapter when connecting signal cable to your computer.
- Do not extend the signal cable with extension lead. The DDC signals will not accept extended cable.
- Display controller must be compatible for External +5 V

Signal connector

Pin		*Signal*	
1	*->*	*RV*	*Red video*
2	*->*	*GV*	*Green video*
3	*->*	*BV*	*Blue video*
4	*<-*	*N.C*	
5			*Plugged / unplugged test*
6		*RG*	*Red ground*
7		*GG*	*Green ground*
8		*BG*	*Blue ground*
9	*->*		*DDC +5V (optional)*
10		*LG*	*Logic Gnd*
11	*<-*	*ID0*	*ID0 (tied to LG)*
12	*<-*		*DDC SDA*
13	*->*	*Hs*	*Horizontal synchronization, composite sync*
14	*->*	*Vs*	*Vertical synchronization*
15	*<-*		*DDC SCL*



1.6. User Controls



1. Power switch
2. Power on indicator
3. Menu button
4. Select and adjustment buttons

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, Stand–by or Suspend operation.
- Blinking Green: The monitor is in Automatic Power off state.
- Not illuminated: The monitor is turned off with power switch or disconnected from mains outlet.

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.

1.7.Menu

1.7.1. Moving in the menu

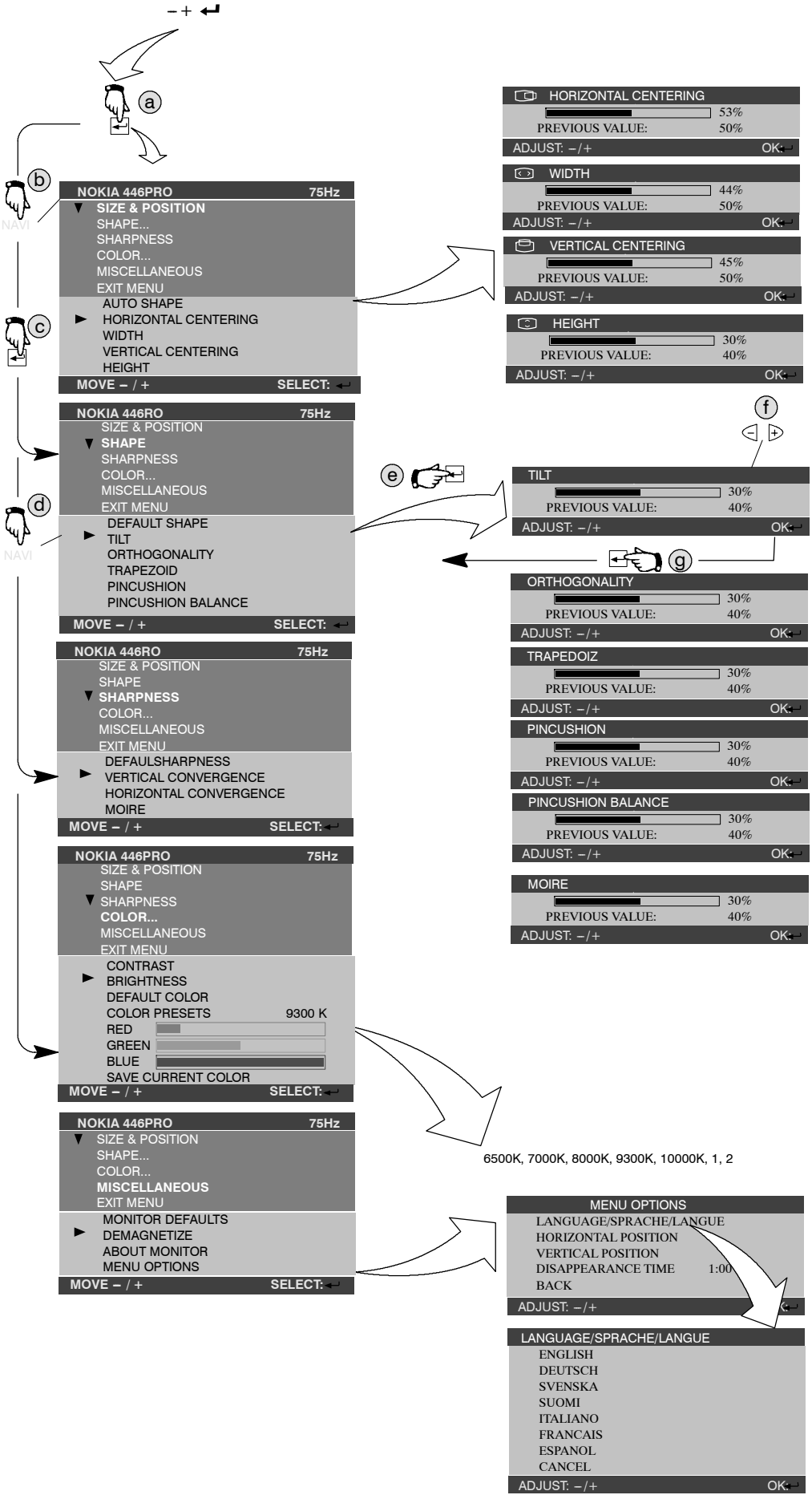
Menu operations are controlled with ↵ button and −/+ buttons.
ⓐ Call the menu to the screen by pushing ↵ button.
ⓑ Select the header with −/+ buttons.
ⓒ Push ↵ to confirm the selection.

Adjustment and settings corresponding the header appear below the header field.
ⓓ Select the adjustment with −/+ buttons.
ⓔ Push ↵ to confirm the selection.

Menu disappears and a scale shows the position of the adjsutment. In addition to the bar, position of the adjustment is shown as a percenage of the maximum value. The upper number shows the current value and the lower one shows the value where the adjustent started.
ⓕ Adjust with −/+ buttons.
ⓖ When ready, push ↵ button.

1.7.2. Exit Menu

Select **EXIT MENU** and pushing ↵ button.or push + and − buttons together


– + ↵
a
b
NAVI
c
d
NAVI
NOKIA 446PRO 75Hz
▼ SIZE & POSITION
SHAPE...
SHARPNESS
COLOR...
MISCELLANEOUS
EXIT MENU
AUTO SHAPE
► HORIZONTAL CENTERING
WIDTH
VERTICAL CENTERING
HEIGHT
MOVE – / + SELECT: ↵
NOKIA 446RO 75Hz
SIZE & POSITION
▼ SHAPE
SHARPNESS
COLOR...
MISCELLANEOUS
EXIT MENU
DEFAULT SHAPE
► TILT
ORTHOGONALITY
TRAPEZOID
PINCUSHION
PINCUSHION BALANCE
MOVE – / + SELECT: ↵
NOKIA 446RO 75Hz
SIZE & POSITION
SHAPE
▼ SHARPNESS
COLOR...
MISCELLANEOUS
EXIT MENU
DEFAULSHARPNESS
► VERTICAL CONVERGENCE
HORIZONTAL CONVERGENCE
MOIRE
MOVE – / + SELECT: ↵
NOKIA 446PRO 75Hz
SIZE & POSITION
SHAPE
▼ SHARPNESS
COLOR...
MISCELLANEOUS
EXIT MENU
CONTRAST
► BRIGHTNESS
DEFAULT COLOR
COLOR PRESETS 9300 K
RED
GREEN
BLUE
SAVE CURRENT COLOR
MOVE – / + SELECT: ↵
NOKIA 446PRO 75Hz
▼ SIZE & POSITION
SHAPE...
COLOR...
MISCELLANEOUS
EXIT MENU
MONITOR DEFAULTS
► DEMAGNETIZE
ABOUT MONITOR
MENU OPTIONS
MOVE – / + SELECT: ↵
HORIZONTAL CENTERING
53%
PREVIOUS VALUE: 50%
ADJUST: –/+ OK: ↵
WIDTH
44%
PREVIOUS VALUE: 50%
ADJUST: –/+ OK: ↵
VERTICAL CENTERING
45%
PREVIOUS VALUE: 50%
ADJUST: –/+ OK: ↵
HEIGHT
30%
PREVIOUS VALUE: 40%
ADJUST: –/+ OK: ↵
e
f
TILT
30%
PREVIOUS VALUE: 40%
ADJUST: –/+ OK: ↵
g
ORTHOGONALITY
30%
PREVIOUS VALUE: 40%
ADJUST: –/+ OK: ↵
TRAPEDOIZ
30%
PREVIOUS VALUE: 40%
ADJUST: –/+ OK: ↵
PINCUSHION
30%
PREVIOUS VALUE: 40%
ADJUST: –/+ OK: ↵
PINCUSHION BALANCE
30%
PREVIOUS VALUE: 40%
ADJUST: –/+ OK: ↵
MOIRE
30%
PREVIOUS VALUE: 40%
ADJUST: –/+ OK: ↵
6500K, 7000K, 8000K, 9300K, 10000K, 1, 2
MENU OPTIONS
LANGUAGE/SPRACHE/LANGUE
HORIZONTAL POSITION
VERTICAL POSITION
DISAPPEARANCE TIME 1:00
BACK
ADJUST: –/+ OK: ↵
LANGUAGE/SPRACHE/LANGUE
ENGLISH
DEUTSCH
SVENSKA
SUOMI
ITALIANO
FRANCAIS
ESPANOL
CANCEL
ADJUST: –/+ OK: ↵

2. Site Preparation

2.1. Location

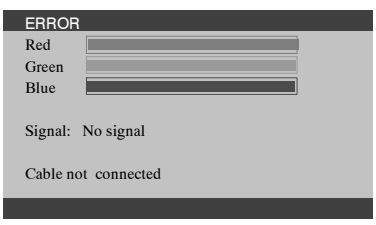
This Monitor is designed for normal office conditions. It is equipped with own power supply. It is not to be serviced or repaired on site

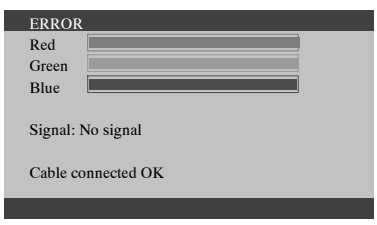
2.2. Troubleshooting

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	Check that the signal cable connector is connected. If the connector is loose tighten the connector's screws.
		The Monitor might be in stand-by position. Push one of the buttons or move the mouse.
		Unplug the monitor from 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 the Selftest error menu 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 has strong colour defect,		Switch off the monitor and the computer. Remove the signal cable from the computer. Switch on the monitor using the power switch.Check the colour of the Red, Green and Blue bars. If they have pure colours, the fault is not in the monitor. Check signal cable connectors and the computer. If the menu itself and the colour bars are discoloured, the monitor is obviously damaged.
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		Check the proximity of other electrical devices that generate magnetic fields, such as speakers, other monitors, electric fans and fluorescent light fixtures. Make sure your computer and video card are properly configured for your monitor.

The automatical appearance of the Error menu on the screen means that the signal is faulty or missing.





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	Heater	12V	Video
Normal Operation	Green	Yes	Yes	Yes	Yes
Stand-by	Green	Yes	Yes	Yes	No
Suspend	Red	Yes	Yes	No	No
Power Off	Red	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

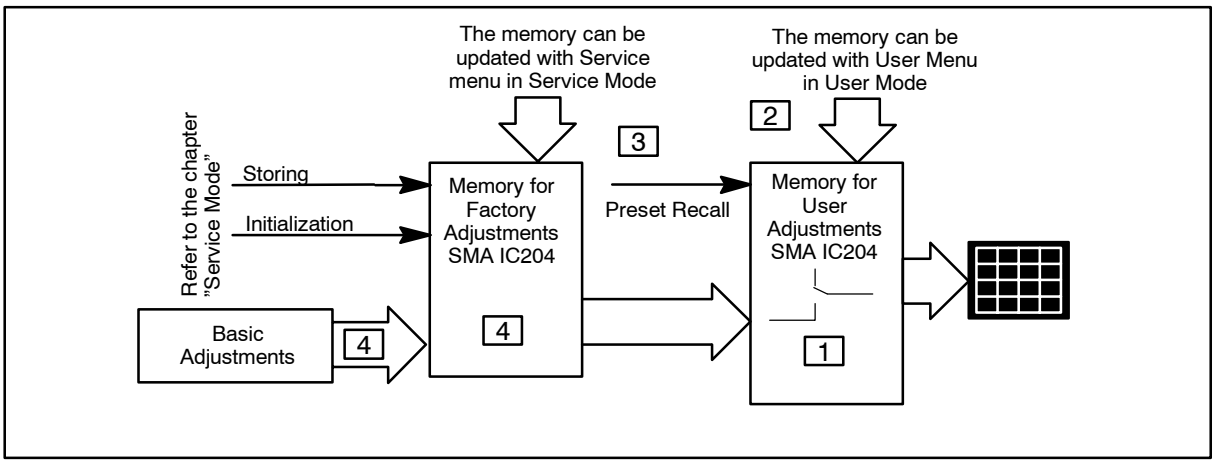
3 User memory can be emptied from user made settings. **Resetting affects only the timing which is currently active**. The reset function is inhibited if no corresponding factory preset display mode exists.

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 display mode 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 display mode, 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 display mode listed in the chapter Preset 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 set
- Grey scale 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
Horizontal centering		X	X	X
Vertical centering		X	X	X
Height		X	X	X
Width		X	X	X
Pincushion		X	X	X
Pincushion balance		X	X	X
Trapezoid		X	X	X
Orthogonality		X	X	X
S-correction	X			X
C-correction	X			X
E/W corner	X			X
Tilt	X		X	X
Moire	X		X	X
Raster	X			X
G2	X			X
Min contrast	X			X
Max contrast	X			X
R Black level	X			X
G Black level	X			X
B Black level	X			X
R Ampl	X		X	X
G Ampl	X		X	X
B Ampl	X		X	X
BCL adjust	X			X
Vertical conv	X		X	X
Horizontal conv	X		X	X
Init burn in test *				X

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

* Init burn in test only for manufacturing purposes

4.2. Service Menu

4.2.1. Access to Service Mode

Activate 9300K color temperature before you go to the service menu.

Activate the service mode always in 91.376 kHz/85 Hz (GTF642).

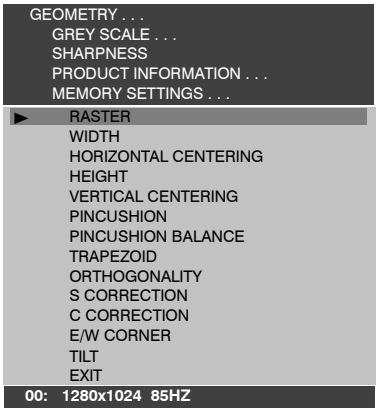
First switch OFF the monitor with power switch.

1) Push ↵ button down.
2) While keeping ↵ button down, switch ON the monitor.
3) Release ↵ button **when the power–on indicator is illuminated.**
4) Press ↵ button.
5) Monitor ask password. Type the password (7711) with the −/+ buttons.
6) Press ↵ button.

Select the items in the Menu with the − or + buttons. Push the ↵ button to open Geometry, Grey Scale, Product Information or Memory Settings. Adjust each property with the − or + buttons.

4.2.2. Sharpness

Geometry submenu contains placement, size and shape adjustments.

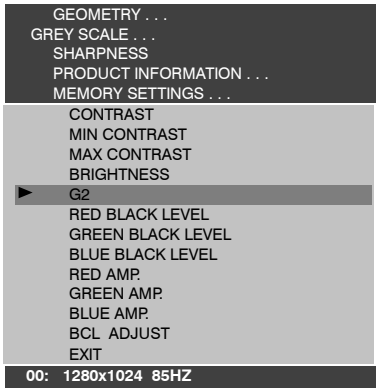


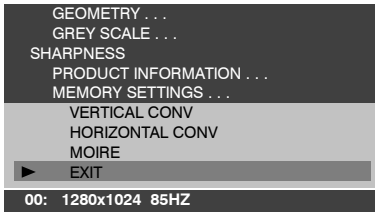
4.2.3. Grey Scale

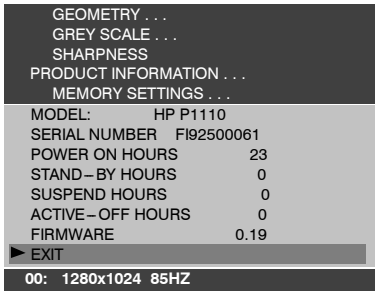
This monitor has six preset tints. With tint numbers smaller than 3 the picture becomes reddish and with tint numbers greater than 3 the picture turns blue.

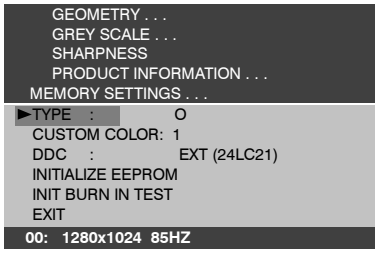
Tint no	1	2	3	4	5	6	7
Colour Temperature	5000K	6000K	6500K	7000K	8000K	9300K	10000K

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









4.2.4. Memory settings and Initializing the Replacement IC204 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'.

- INTIALIZE EEPROM always with using display mode no 00! (91.376 kHz/85 Hz (GTF642))
- After initializing switch OFF the monitor.
- Activate service mode as explained before.
- Select Memory settings – menu.
- Select Monitor type O, custom color 1 and DDC (EXT (24LC21)

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

4.2.5. Storing the Adjustments

When the adjustment is ready, return to the menu by pushing the ↵ button. Adjustement will be stored automatically.

4.2.6. Exit from Service Mode

Switch off the monitor.

4.2.7. Uninstalled EEPROM

If you have uninstalled EEPROM. You can not adjust in user menu. You have to go first in service menu and select Memory settings – Initialize EEPROM.

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 signal 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:

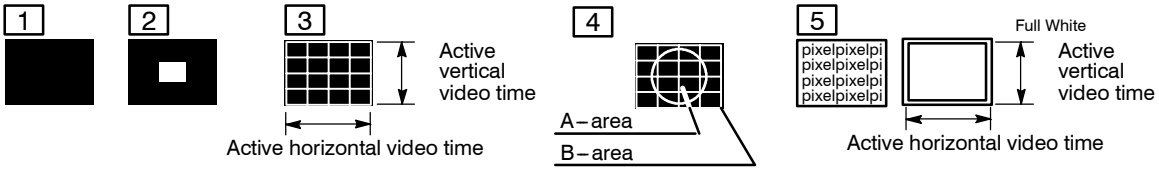
- Keep the ESD-sensitive part in its original shipping container until you are ready to install the part into the component card.
- Just before touching the ESD-sensitive part, discharge to the monitor any static electricity in your body; do this by touching the metal frame or cover of the machine. If 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

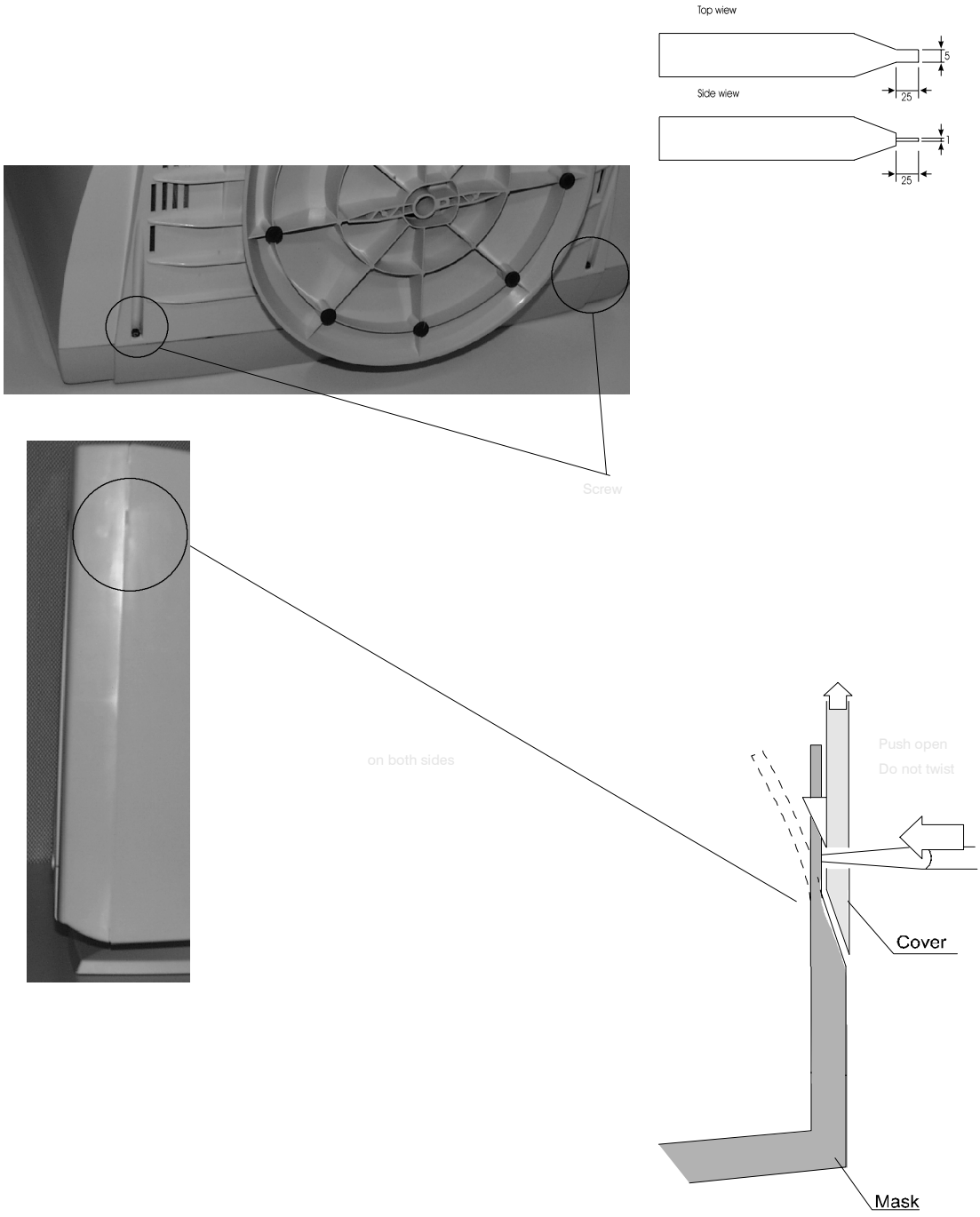
5 Focus test pattern

5.5. Disassembly

5.5.1. Cabinet

Set the monitor on cushion picture tube facing down

1. Loosen and remove two screws.
2. Open the plastic pawls with a screwdriver or special tool (for instance 860006)



6. Image performance

Measurement to verify this specification shall be made with equipment that measures the displayed image as if it were projected forward onto a flat plane tangent to the center of the CRT faceplate surface and perpendicular to the Z−axis of the CRT.

Image performance specifications are applicable over specified input power conditions, specified environmental operating conditions and after being subjected to the specified non−operating environmental conditions. Before performance measurements the monitor must have been in room temperature (20+/− 5 degrees C) for at least 2 hours. After that the monitor must have been warmed up with power on at least 60 minutes.

The monitor shall be positioned to a magnetic field, which is specified as 0 G horizontal field and 0.45 G vertical field (Northern Hemisphere) when ever the image performance is measured.

If there is no standardised magnetic field available, the monitor should be positioned face to east.
All image performance specifications will be met in diffuse ambient 500 lux.

All the performance specifications are met when using factory adjusted timing modes within line frequencies 48 kHz − 107 kHz.

The timings below 48 kHz line frequency are usable, but not specified.
Performance is optimised for 1280 x 1024, 85 Hz (VESA) resolution.

6.1. Image stabilising time

The image shall begin to be visible in a 500 lux environment within 15 seconds of application of power and input signals.

The image shall be stabilised within 30 seconds of application of power and input signals. ”Stabilised” means that no significant changes shall occur in the image quality specifications, such as image brightness, size, linearity and so on.

The image shall reach performance stability within 20 minutes of the application of power and input signals. ”Performance Stability” means that the display monitor shall meet all of its image quality specifications.

6.2. Colour temperature and tracking

The default colour temperature is 9300 ˚K
Measurement conditions:
− test pattern 50*50 mm white field at the screen centre
− brightness control adjusted for a background raster luminance level of 1 nit
− input signals R, G, B with maximum amplitude

When contrast−control is adjusted for 100 nit’s luminance level, the factory adjusted colour coordinates measured at the screen centre will be:
x = 0.283 +/− 0.015 = x ref
y = 0.297 +/− 0.015 = y ref

When contrast−control is adjusted from a luminance level of 100 cd/m2 to
35 cd/m2 or its adjust stop, the colour coordinates measured at the screen centre will be:
x = x ref +/− 0.015
y = y ref +/− 0.015

6.3. White Uniformity

Measurement conditions:
– Full screen picture size, Brightness in middle 100 nit
– Magnetic field horizontal 0 Gauss
vertical 0.45 Gauss
– Warming up time 1 hour
Maximum variation between colour coordinates between any measurement points shall not vary more than d(x),d(y) below.
Colour coordinates from corner to center:

d(x) = ± 0.015
d(y) = ± 0.015

6.4. Colour Purity

There should not be visual discoloration with each of the red, green and blue beams after the tube is moved to any directions.
Measurement conditions: same as spec. 8.3

6.5. Luminance

– Definition:
The following methodology and definition of luminance shall be applicable throughout this specification.
Luminance shall be measured on 1280 x 1024 85 Hz pixel format at five areas, using two different pictures:

1. In the center of the screen white field 50*50 mm.
2. Full white field.

The five areas are defined as:

L0 Center of the screen L1 L2
L1 Upper left of the screen
L2 Upper right of the screen L0
L3 Lower left of the screen
L4 Lower right of the screen L3 L4

– Requirements
Maximum contrast luminance:

With the brightness control set so that background brightness is 1 nit and the contrast control set to maximum.

L0 = 140 +/– 20 nits (41 Ft–L) 50*50 mm white field
L0 = 110 +/– 10 nits (32 Ft–L) Full white field

Minimum luminance
Using full white picture, with the brightness and contrast controls in minimum, the foreground full white field (L0) < 5 nits.

Background luminance:
The luminance of the background, measured at center of the screen without active video and in the absence of significant ambient illumination, brightness at maximum must be:
1 nit.=< L0 =< 7 nits

The background shall be extinguished before brightness control reaches its end.

– Luminance uniformity:

With the brightness control set so that the background raster is just extinguished the contrast control set for L0 = 100 nits, (29 Ft–L), luminance on areas L1, L2, L3 and L4 shall be greater than (75 %) of L0.(75 nits)

6.6. Image size

Display size is defined as the width and height of the display using the active raster, not including the border.

Measurement:
Full white field brightness set to 100 nits (29 Ft–L). Cross–hatch test pattern.
The width and the height are measured at the center of the screen.

Requirements:

Tolerance Nominal size:	Adjusted mode	Pre load or GTF based timings :
Width = 354 mm	± 4	± 6 mm
Height = 265 mm	± 3	± 5 mm

Over the full range of operating temperature, the size shall not change more than one percent.

6.7. Linearity

Cross–hatch test pattern (16 x 12 cells). Brightness control set so that the background raster is just extinguished and the contrast control is set to maximum.

The limits for vertical or horizontal non–linearities are 4 % for adjacent cells and 8 % for overall linearity. The method of calculating linearity is: [(max–min)/max]*100 < 8 %
The measurements are done along the vertical and horizontal center lines of the screen.
Frequency range <48kHz non–linearities are 8% for adjacent cells and 12% for overall linearity.

6.8. Geometrical distortion

The distance between bezel and active screen edge shall not vary more than 1.5mm for adjusted mode and 4.0mm for the preloaded mode.

6.9. Jitter

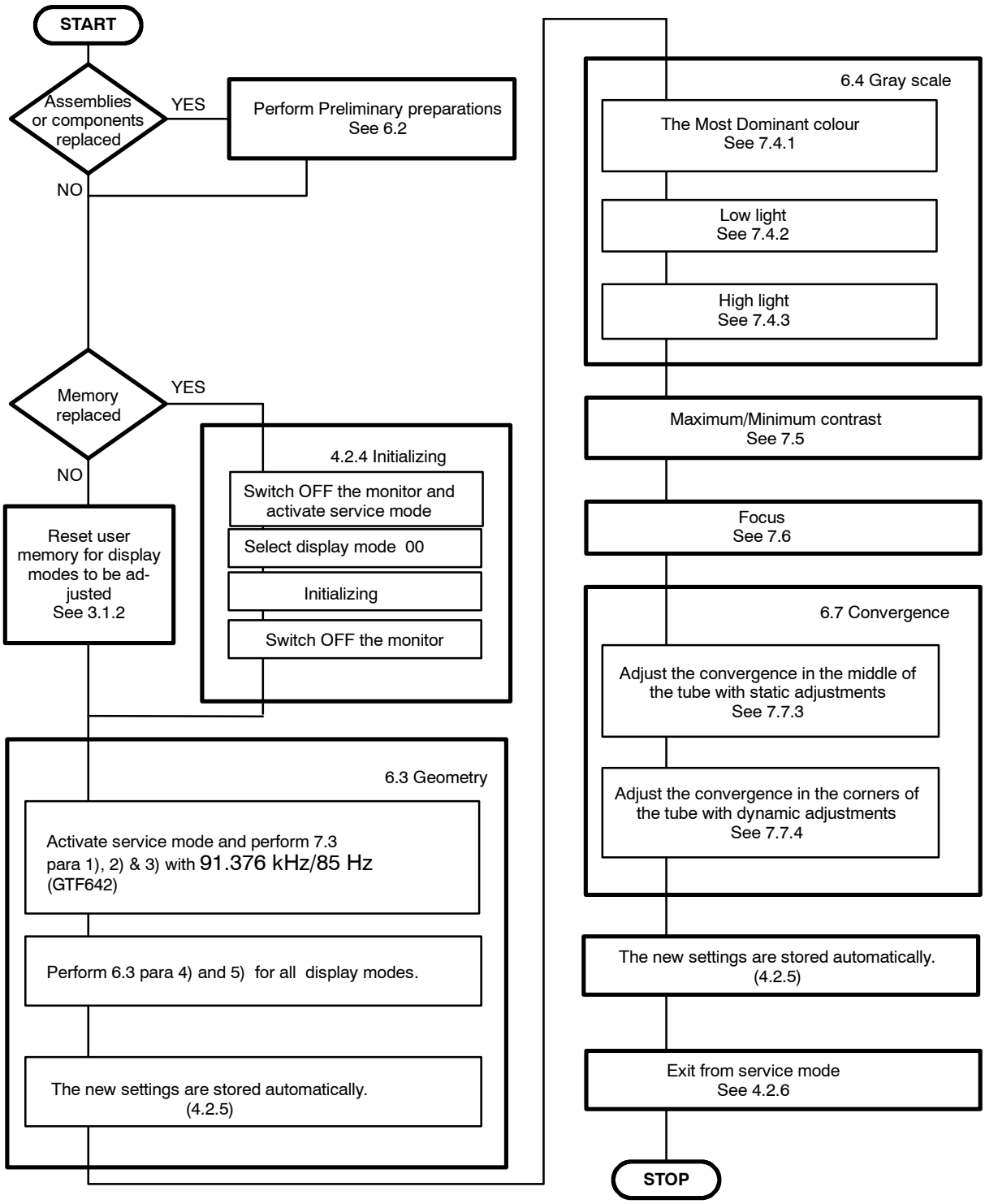
Image motion in terms of dynamic pixel displacement shall be defined as jitter.
(MPR 1990:10, 1.07)
The horizontal and vertical displacement of any pixel using the ”convergence” dot and cross hatch pattern measured using microscope with appropriate magnification.
The maximum displacements in both the horizontal and vertical directions must be less than 0.1 mm.

7. Adjustment Procedure

The following procedure must be carried out in case of large service operations e.g. when a circuit board or nonvolatile memory ICA 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.

7.1. Adjustment Flow Diagram

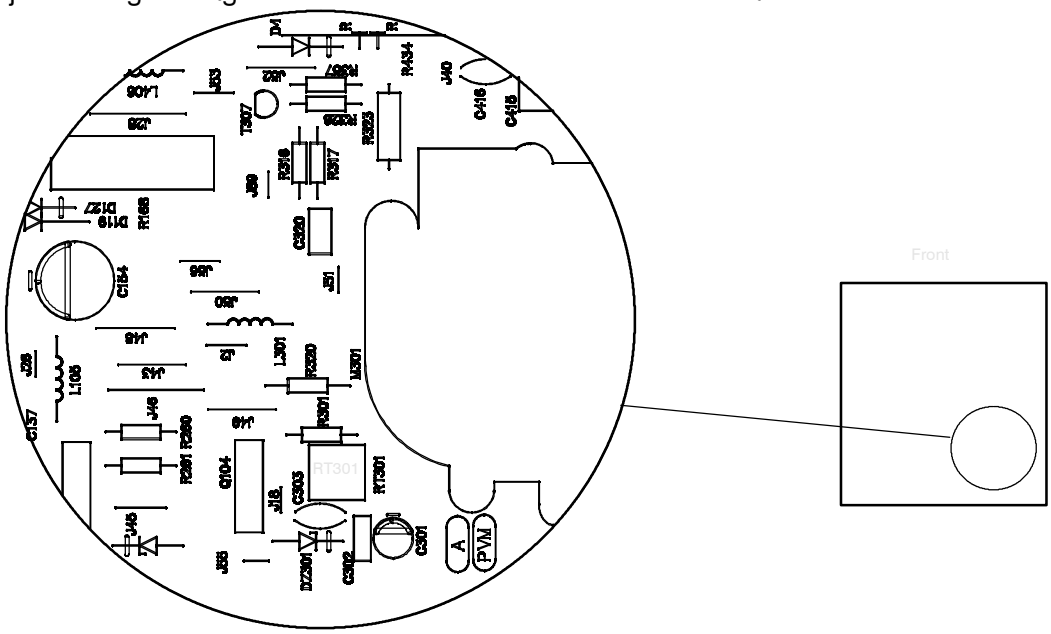


7.2. Preliminary Preparations

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.

7.2.1. High Voltage

- Select 91.376 kHz/85 Hz (GTF642) crosshatch test pattern.
- Connect the high voltage meter to the anode of the picture tube.
- Adjust the high voltage to **27.0 ±0.2 kV** with **RT301** on SMA-board.



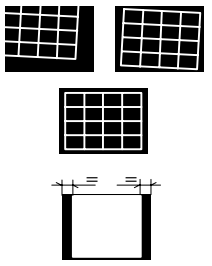
7.3. Geometry

Magnetic fields for following adjustments: vertical 0.45G and horizontal 0.0G.

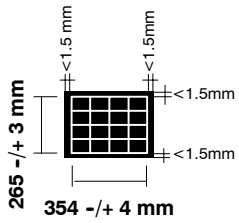
Activate Service Mode in 91.376 kHz/85 Hz (GTF642).

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

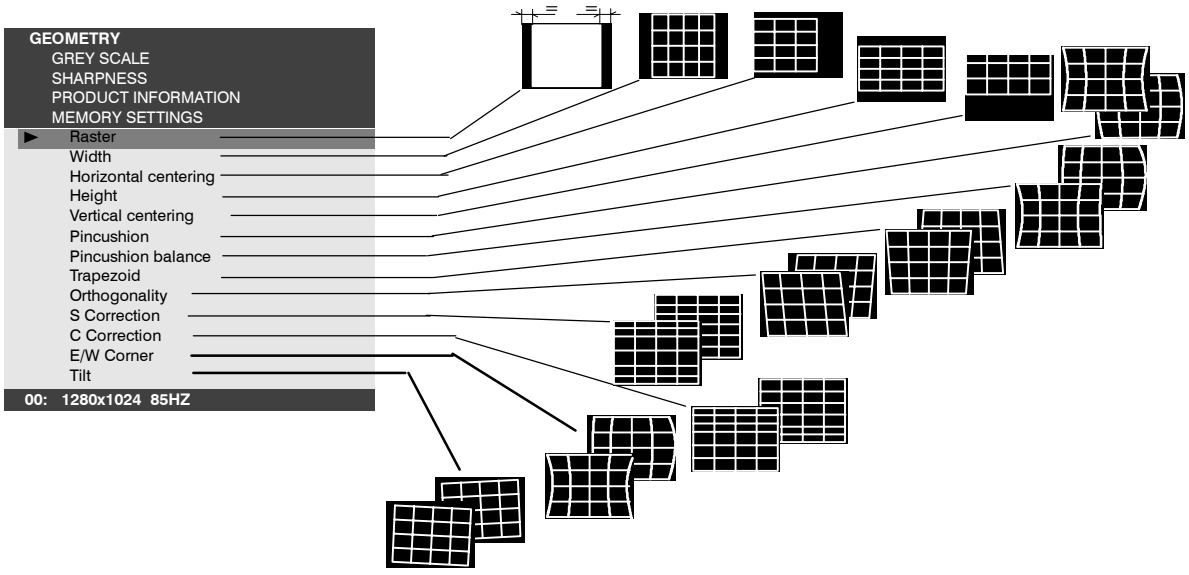
1) Select **91.376 kHz/85 Hz** (GTF642) crosshatch test pattern.
   Set ◑ to maximum and adjust ☼ until the background is faintly visible.
   Reduce width until both vertical edges of the **background** are visible.
2) Straighten the picture if tilted.
   This adjustment is common for all display modes.
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.
6) The distance between bezel and active screen edge shall not vary more than 2.0 mm in vertical and horizontal direction.



7) Repeat steps 4) and 5) for every display mode to be stored. Note that the display mode can be changed without leaving the service mode.



7.4. Grey Scale

The grey scale is adjusted for 9300K colour temperature.
Activate Service Mode in 91.376 kHz/85 Hz (GTF642).

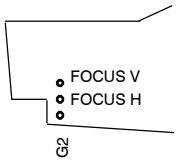
7.4.1. The Most Dominant Colour

The most dominant 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 dominant colour from the tone of the picture after you have made the following adjustments.

1) Select **91.376**/**85** (GTF642) black test pattern.
2) Set ☼ to maximum and ◑ to minimum.
3) Set Blacklevel adjustment **RED**/**GREEN**/**BLUE Black Level** to (step 33)
4) Set **RED**/**GREEN**/**BLUE Amp** (step 33) menu and **G2 menu** adjustments to center (step130).
5) Place the probe of the colour analyzer in the middle of the screen and adjust with **G2 trimmer** until the picture illuminance is 3±1.0 cdm^2 (Nits)

7.4.2. Low Light

1) Select 91.376/85 (GTF642) black test pattern.
2) Adjust picture illuminance to 1.0 cdm^{-2} (Nits)with ☼ in servicemenu.
3) Adjust the ◑ in servicemenu to the minimum.
4) Adjust the colour coordinates to (9300K)
   x = 0.283±0.010
   y = 0.297±0.010
   with **RED**/**GREEN**/**BLUE Black Level** adjustments.
   Do not adjust the most dominant colour.
   During the adjustment check if brightness is chancing over tolerance, when needed adjust it back. If Y− and X−values are getting too far from ideal values, you have chosen wrong MOST DOMINANT COLOUR. Check the dominant colour again according to the instructions.
5) Set ☼ to the maximum and check that the illuminance is still 3±1.0 cdm^2. If not, adjust with G2 in service menu.
6) Adjust picture illuminance to 1.0 cdm^2 (Nits)with ☼ in servicemenu and check the colour coordinates.



Left side view of the chassis

7.4.3. High Light

1) Select **91.376**/**85** (GTF642) black test pattern.
2) Adjust with ☼ the picture illuminance to 1±0.1 cdm^2 (Nits).
3) Select **91.376**/**85** (GTF642) window test pattern.
4) Adjust with ◑ the picture illuminance in the window to 100±5 cdm^2 (Nits)
5) Adjust with **RED**/**BLUE Amp** the colour coordinates in the window to
   x = 0.283±0.003
   y = 0.297±0.003
   Check after adjustment that the illuminance reading is in limits.
6) Back to low light step 4) and check colour coordinates.

7.5. Maximum/Minimum Contrast

1) Set ◑ to the maximum.
2) Adjust with ☼ the picture illuminance outside window to 1.0 cdm^{-2} (Nits).
3) Adjust illuminance in the window to 140±5 cdm^{-2} (Nits) with **MAX CONTRAST**.
4) Set ◑ to the minimum.
5) Adjust the minimum illuminance in the window to 5 ± 1 cdm^{-2} (Nits) with **MIN CONTRAST**.
6) Exit from service mode.

7.6. Focus

1) Select **91.376**/**85** (GTF642) crosshatch test pattern
2) Set ◑ to the maximum and adjust ☼ to 70 % (background 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.

7.7. 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.

7.7.1. Measuring Conditions

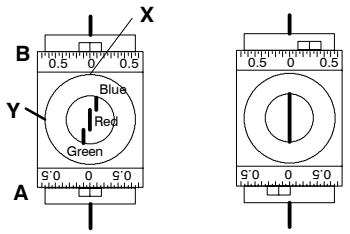
- Adjust convergence with **91.376**/**85** (GTF642) line frequency.
- Make sure that focus is correctly set at the mid-point between the screen center and the edge of the picture.
- Use white crosshatch test pattern with circle.
- Adjust ◑ to near the maximum and reduce ☼ until the background disappears.

7.7.2. 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

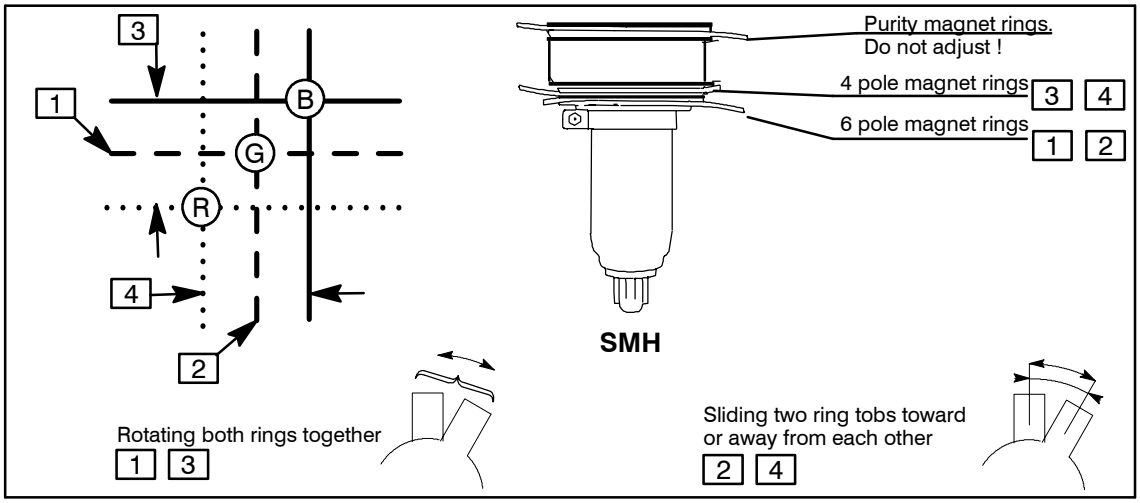


7.7.3. Static Convergence

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.

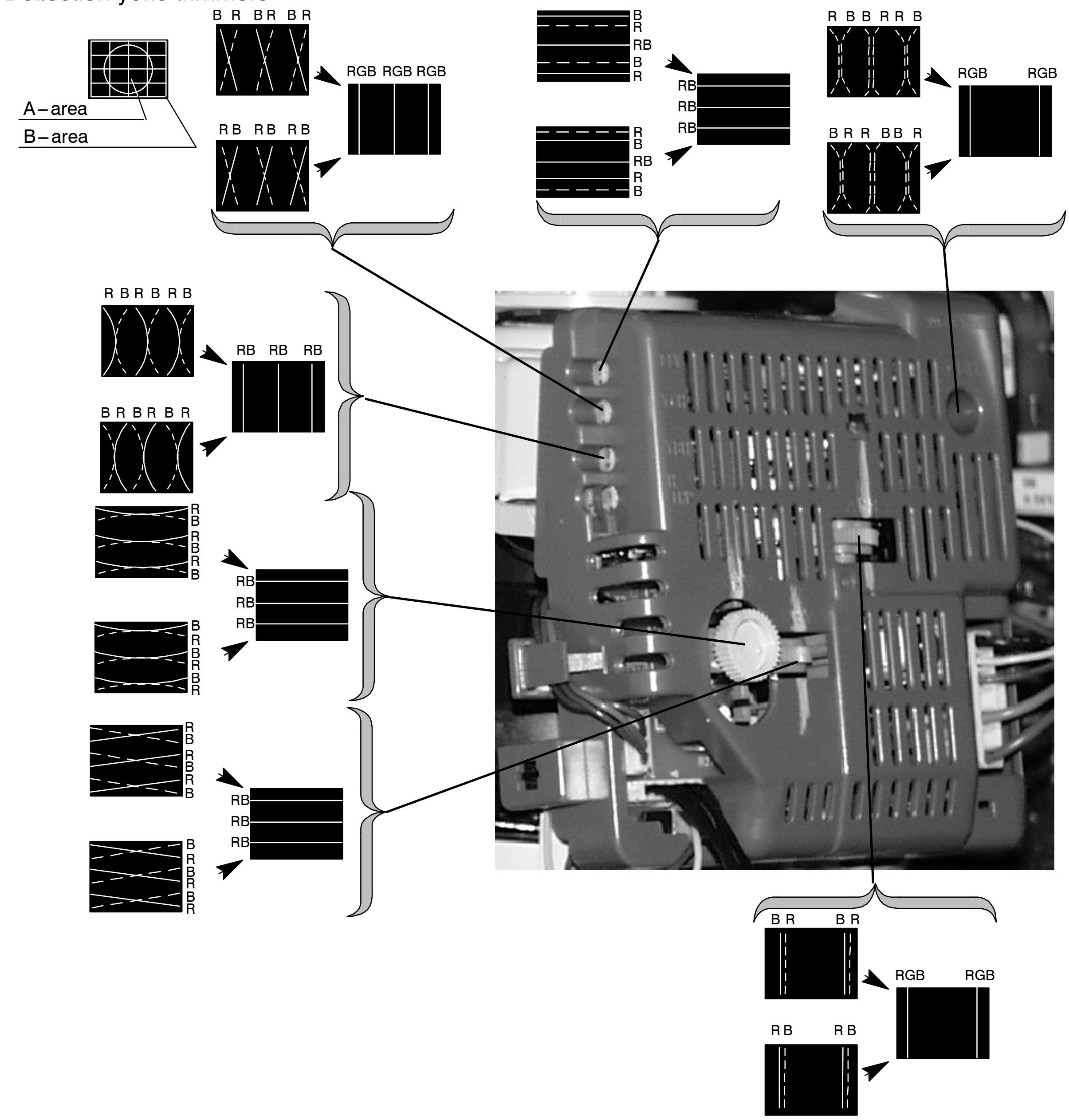
1 Adjust G vertically in the middle between R and B with 6 pole magnet rings.
2 Adjust G horizontally in the middle between R and B with 6 pole magnet rings.
3 Adjust R and B vertically to the same position with G line with 4 pole magnet rings.
4 Adjust R and B horizontally to the same position with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

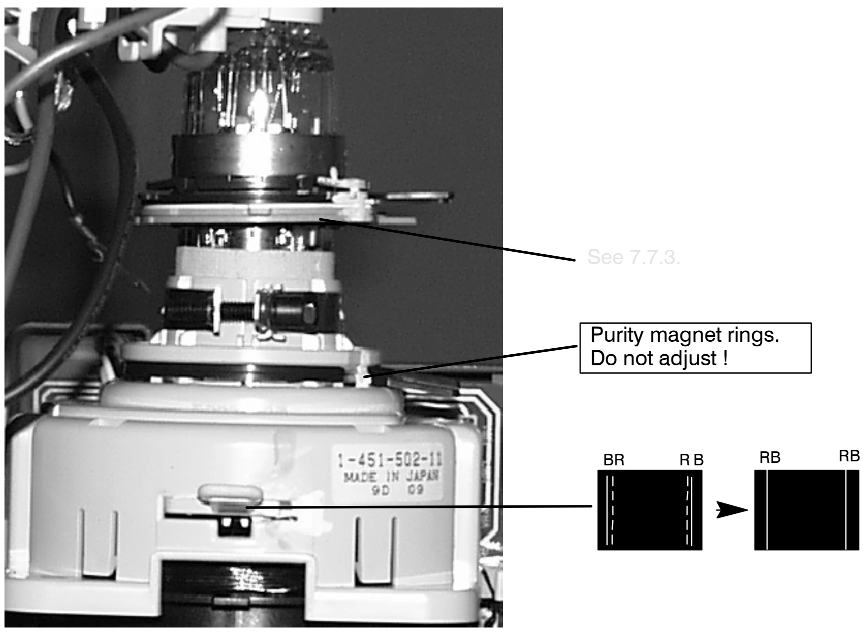
Lock the rings with paint.



7.7.4. Dynamic Convergence

Deflection yoke trimmers





7.7.5. Allowed Error Levels for Convergence

Area A $\leq$ 0.25 mm

Area B $\leq$ 0.35 mm

7.8. 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. Beamlanding adjustment handle to purity.