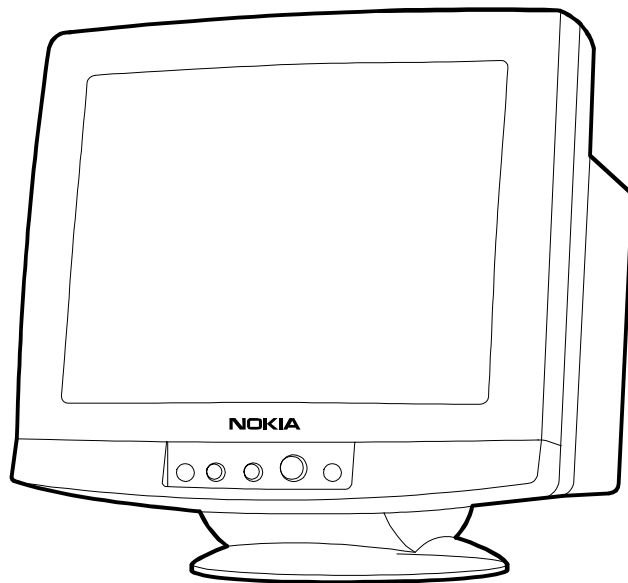


Service Manual

Nokia Display Products Oy
P.O.Box 14
FIN-24101 Salo, Finland

Chassis 445T

21" High Resolution color Monitor



Contents

Service
Monitor Dismantling
Part List
PCB Part List
PCB Layout pictures

Level

1

Main Board module SMA193E
CRT module SMH144G
Video amplifier module ... SMY039E

Service

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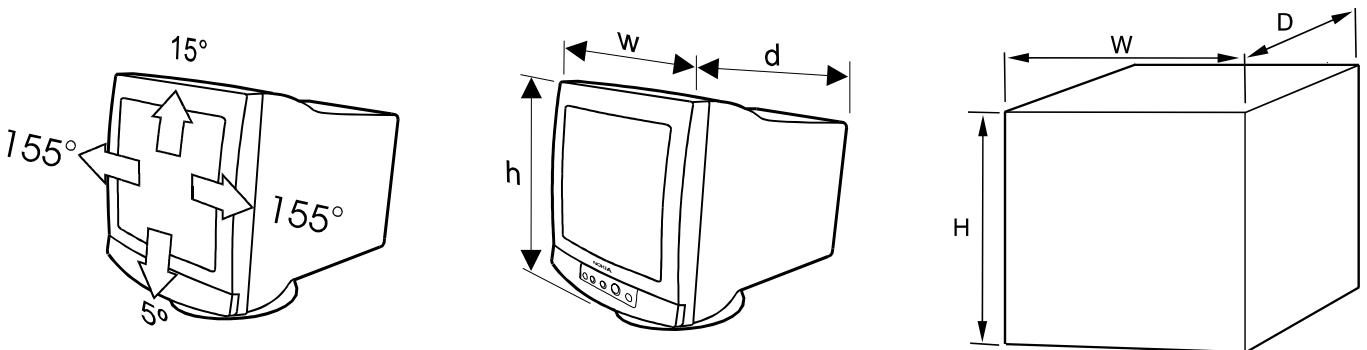
1. Product Overview

445T is a 21 inch monitor. The maximum resolution of 1800 x 1440 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 0.26 mm
Picture Size	387 mm x 290 mm with specified geometric distortion
Maximum Picture Size	400 mm x 300 mm, diagonally 498 mm (19.69")
Power Input Requirements	Voltage 90–264 V, 50/60 Hz Autosense Current 2.3 A/110 V, 1.1 A/240 V
Power Dissipation	< 160 W Normal Operation ~70 W Stand-by < 30 W Suspend < 5 W Auto power off
Memory Locations	15 for factory preset timings 6 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: 1800 dots maximum Vertical addressability: 1440 dots maximum
Synchronization Range	Horizontal: 30 kHz to 121 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	230 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

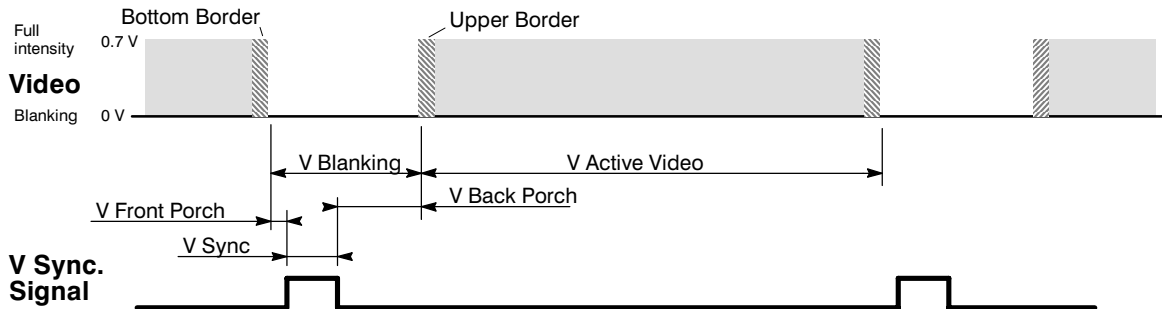
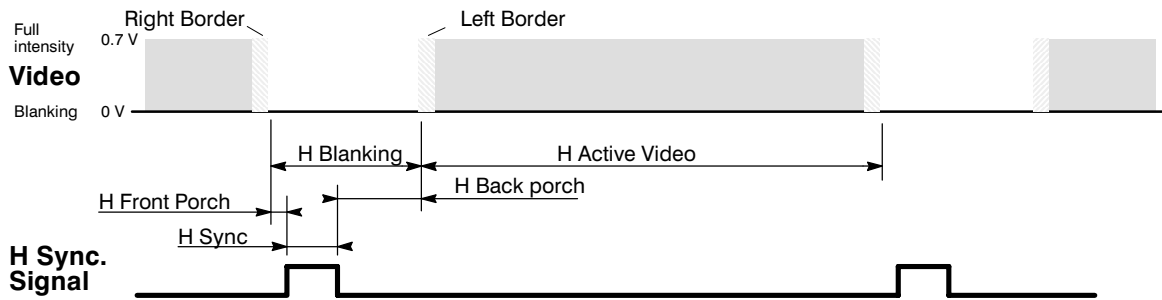
Size, Tilt and Swivel



Dimensions

Monitor	h	490 mm
	w	515 mm
	d	544 mm
Package	H	670 mm
	W	670 mm
	D	740 mm

1.2. Preset Display Modes



Memory location→	0	1	2	3	4	5	6	7	8	9
Display Mode Name	GTF790	NCE300	NCE406	NCE321G	NCE513	NCE3612	NCE013	NCE605	GTF890	NCE70X
H Frequency/kHz	107.101	31.472	46.875	35.000	68.677	91.146	79.494	79.976	120.438	93.755
H Period/ μ s	9.337	31.774	21.333	28.571	14.561	10.971	12.904	12.504	8.303	10.666
H Active Video/ μ s	6.815	25.420	16.162	21.164	10.836	8.127	9.481	9.481	6.007	7.901
H Resolution	1600	640	800	640	1024	1280	1.52	1280	1800	1600
H Sync/ μ s	0.750	3.81	1.616	2.12	1.02	1.02	1.05	1.062	0.647	0.948
H Back Porch/ μ s	1.261	1.91	3.232	3.17	2.20	1.52	1.84	1.043	1.145	1.501
V Frequency/Hz	85.0	59.9	75	66.7	85.0	85.0	85.1	75	85.0	75.0
V Period/Lines	1260	525	625	525	808	1072	911	1066	1417	1250
V Resolution	1200	480	600	480	768	1024	864	1024	1350	1200
V Sync/Lines	3	2	3	3	3	3	3	3	3	3
V Back Porch/Lines	56	33	21	39	36	44	43	38	63	46
H sync Polarity	+	-	+	N/A	+	+	+	+	+	+
V sync Polarity	-	-	+	N/A	+	+	+	+	-	+
H Front Porch/ μ s	0.51	0.64	0.32	2.12	0.51	0.31	0.53	0.12	0.50	0.32
V Front Porch/Lines	1	10	1	3	1	1	1	1	1	1
Dot Frequency/MHz	234.776	25.177	49.500	30.240	94.500	157.500	121.510	135.640	299.650	202.510
Interlacing	no	no	no	no	no	no	no	no	no	no

1.3. S–Capacitor table

F/kHz	PA6	PA5	PA4	PA3	PA2	PA1	PA0	C1 Lin	C2 Lin
	0	0	0	0	0	0	0	0	0
118.3									
	0	0	0	0	0	0	1	0	0
112.8									
	0	0	0	0	0	1	0	1	0
108.0									
	0	0	0	0	0	1	1	1	0
103.5									
	0	0	0	0	1	0	0	1	0
99.5									
	0	0	0	0	1	0	1	1	0
96.2									
	0	0	0	0	1	1	0	1	0
93.1									
	0	0	0	0	1	1	1	1	0
89.2									
	0	0	0	1	0	0	0	1	0
85.6									
	0	0	0	1	0	0	1	1	0
83.5									
	0	0	0	1	0	1	0	1	0
81.5									
	0	0	0	1	0	1	1	1	0
79.5									
	0	0	0	1	1	0	0	0	1
77.7									
	0	0	0	1	1	0	1	0	1
76.1									
	0	0	0	1	1	1	0	0	1
71.4									
	0	0	1	0	0	0	0	0	1
67.4									
	0	0	1	0	0	1	1	0	1
64.8									
	0	0	1	0	1	0	1	0	1
62.9									
	0	0	1	0	1	1	1	0	1
60.8									
	0	0	1	1	0	0	1	0	1
59.0									
	0	0	1	1	0	1	1	0	1
57.5									
	0	0	1	1	1	0	1	0	1
56.2									
	0	0	1	1	1	1	1	0	1
53.9									

F/kHz	PA6	PA5	PA4	PA3	PA2	PA1	PA0	C1 Lin	C2 Lin
53.9									
	0	1	0	0	0	0	1	0	1
50.9									
	0	1	0	0	1	1	1	0	1
48.5									
	0	1	0	1	0	1	1	0	1
46.8									
	0	1	0	1	1	1	1	1	1
45.0									
	0	1	1	0	0	1	1	1	1
43.3									
	0	1	1	0	1	1	1	1	1
42.1									
	0	1	1	1	0	1	1	1	1
41.0									
	0	1	1	1	1	1	1	1	1
39.3									
	1	0	0	1	1	1	1	1	1
37.5									
	1	0	1	0	0	1	1	1	1
36.5									
	1	0	1	0	1	1	1	1	1
35.5									
	1	0	1	1	1	1	1	1	1
34.0									
	1	1	0	0	1	1	1	1	1
32.6									
	1	1	0	1	1	1	1	1	1
32.0									
	1	1	1	1	1	1	1	1	1
30.5									
	1	1	1	1	1	1	1	1	1

1.4. 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.

This monitor can be connects to the computer via D–SUB or BNC connectors. They allowed connection of the monitor to two signal sources at the same time.

The displayed signal can be selected by pushing the button in font panel.

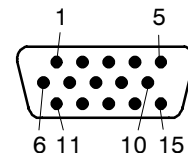
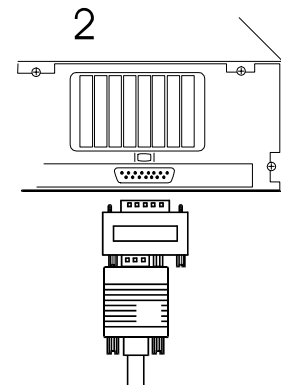
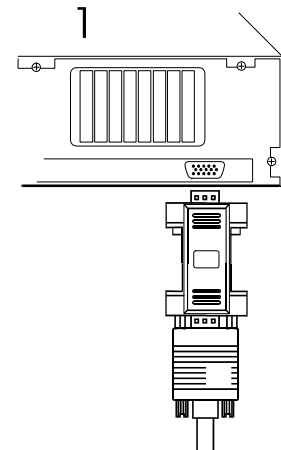
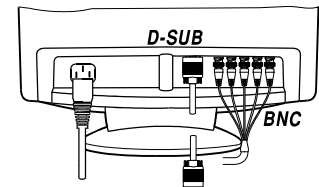
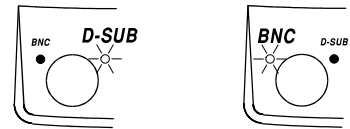
- Connect the signal cable plug to the videocontroller connector at the back of the computer.
- Tighten the screws on the plug by hand.
- Connect the power cord first to the monitor and then to a grounded power outlet.

If your monitor is DDC compatible (PC)

- Do not use any adaptor 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.
1. Use a XGA–2 adaptor (QK1511) in the signal cable if you are going to use XGA–2 display mode (1024 x 768, 75 Hz)
 2. Use MAC adaptor (QK1518) in signal cable when connecting the monitor to an Apple Macintosh computer.
- If the computer is equipped with separate display adapter card. It may have a standard D–SUB connector. In that case Mac adaptor is not needed.



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	->	Not connected
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

1.5. User Controls

1.5.1. Power Switch

Turning the Monitor ON and OFF

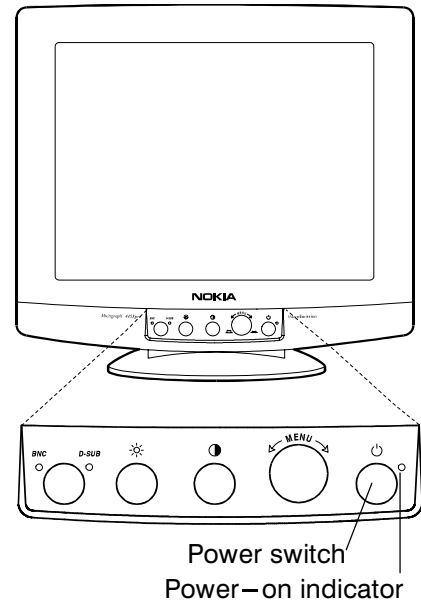
Push the **power switch** to turn the monitor on or off.

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

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

- Green The monitor is in normal operation.
- Red 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.



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.

1.6.Menu

Basic Adjustments

The PICTURE SHAPE menu contains the most useful adjustments.

- ① The menu is called to the screen by pushing the Menu wheel.
- ② Select the property you want to adjust with the Menu wheel (e.g. WIDTH). The selected item in the menu is illuminated with white color.
- ③ Adjust the selected property (WIDTH) with the Menu wheel. The menu disappears and a scale shows the position of the adjustment. Turning the Menu wheel to the right increases the property and turning the Menu wheel to the left decreases the property.

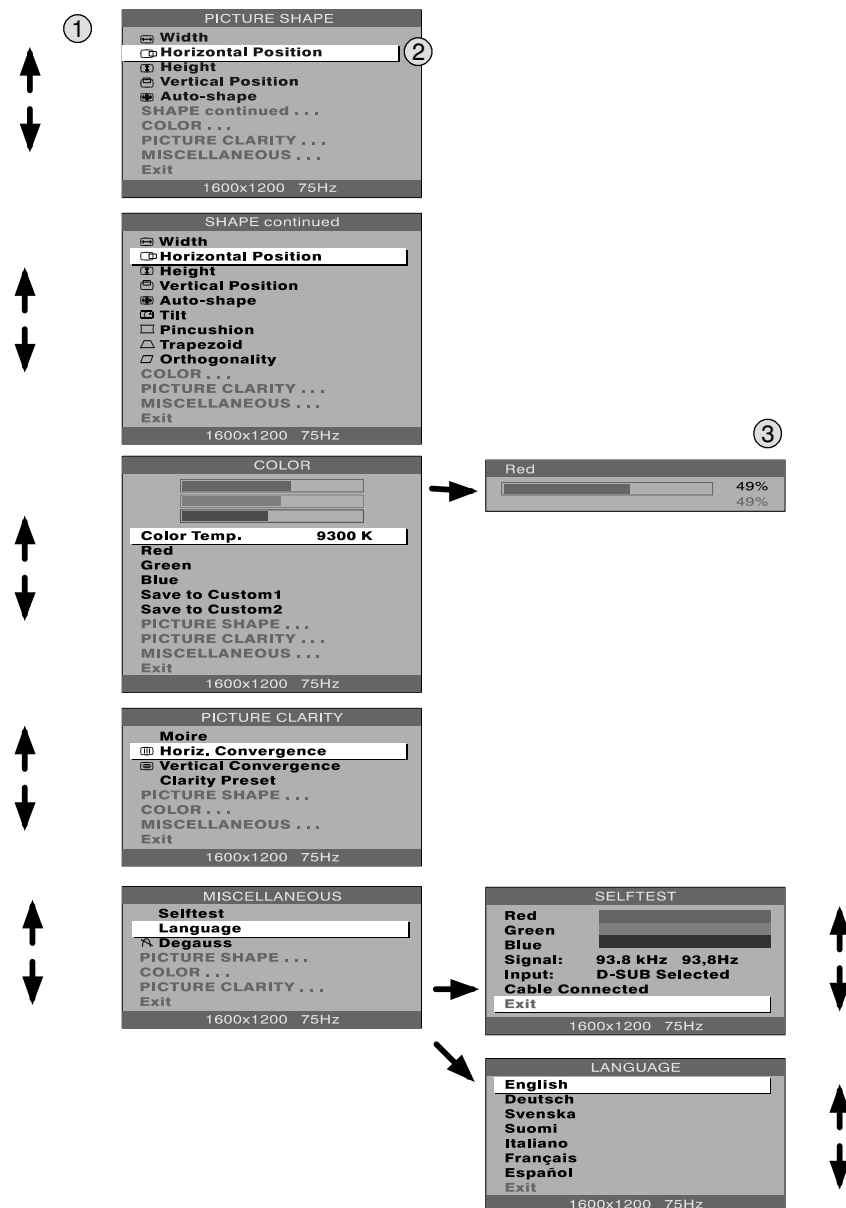
After adjusting, the new setting will be stored automatically.

All menu displays disappear automatically in a few seconds or at once by pushing exit.

The latest item can be called to the screen simply by pushing the Menu wheel.

If you want to adjust other properties select with the menu wheel the header which contains the adjustment you are looking for.

Open the selected submenu by pushing the menu wheel.



2. Site Preparation

2.1. Location

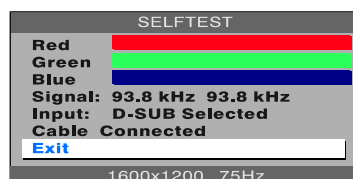
This Monitor is designed for normal office conditions. It is equipped with own power supply. It is not to be serviced or repaired on site

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 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 Selftest menu appears. 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 color defect,		Open the Miscellaneous/Selftest menu. Check the color of the Red, Green and Blue bars. If they have pure colors, the fault is not in the monitor. Check signal cable connectors and the computer. If the menu itself and the color bars are discolored, 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 fluMake sure your computer and video card are properly configured for your monitororescent light fixtures.

The automatic appearance of the Selftest 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	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	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

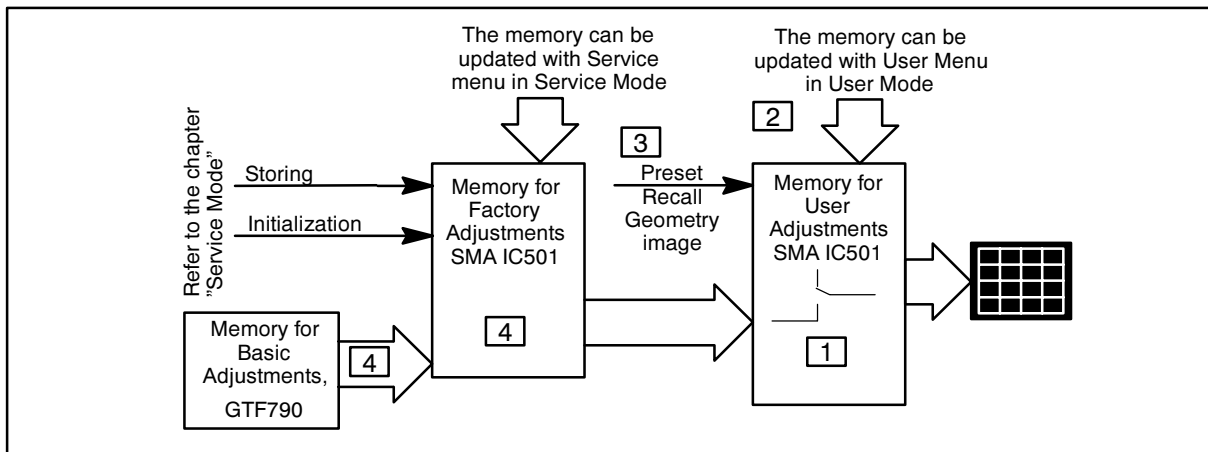
- 3 User memory can be emptied from user made settings. **Resetting affects only the timing which is currently active.** The reset function is inhibited if no corresponding factory preset display mode exists.

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 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 Basic set
- Geometry Advanced 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
Brightness	X			X
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 contrast	X			X
R Blacklevel	X			X
G Blacklevel	X			X
B Blacklevel	X			X
R Amp	X			X
G Amp	X			X
B Amp	X			X
Raster	X			X

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



4.2. Service Menu

4.2.1. Access to Service Mode

Active the service mode always in 107.1 kHz/85 Hz (GTF790).

First switch OFF the monitor with power switch.

- 1) Push the Menu wheel down.
- 2) While keeping the Menu wheel down, switch ON the monitor.
- 3) Release the Menu wheel **when the picture has appeared**.
- 4) Press the Menu wheel.
- 5) Insert the password 7711 and select OK with the Menu wheel.

Select the items in the Menu with by turning the Menu wheel. Push the Menu wheel to open Geometry Advanced , Grey Scale or Product Information Submenu or to Initialize the memory IC. Adjust each property with the Menu wheel.

4.2.2. Geometry Basic and Advanced

Geometry submenus contain 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 Geometry Basic menu.
- Confirm Initialization by selecting Start Initializing and pushing the Menu wheel.
- Switch OFF the monitor.

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 Menu wheel. The new setting is stored automatically.

4.2.6. Exit from service mode

1. Select exit from the Geometry Basic / Geometry Advanced or Grey Scale menu
2. Switch off 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:

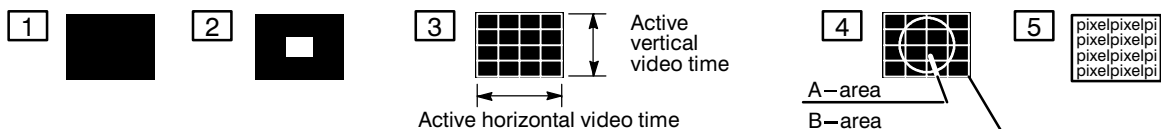
- Keep the ESD-sensitive part in its original shipping container until you are ready to install the part into the component card.
- Just before touching the ESD-sensitive part, discharge to the monitor any static electricity in your body; do this by touching the metal frame or cover of the machine. If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

5.5. Disassembly

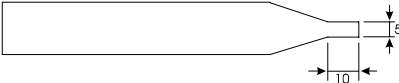
5.5.1. Cabinet

Set the monitor on cushion picture tube facing down

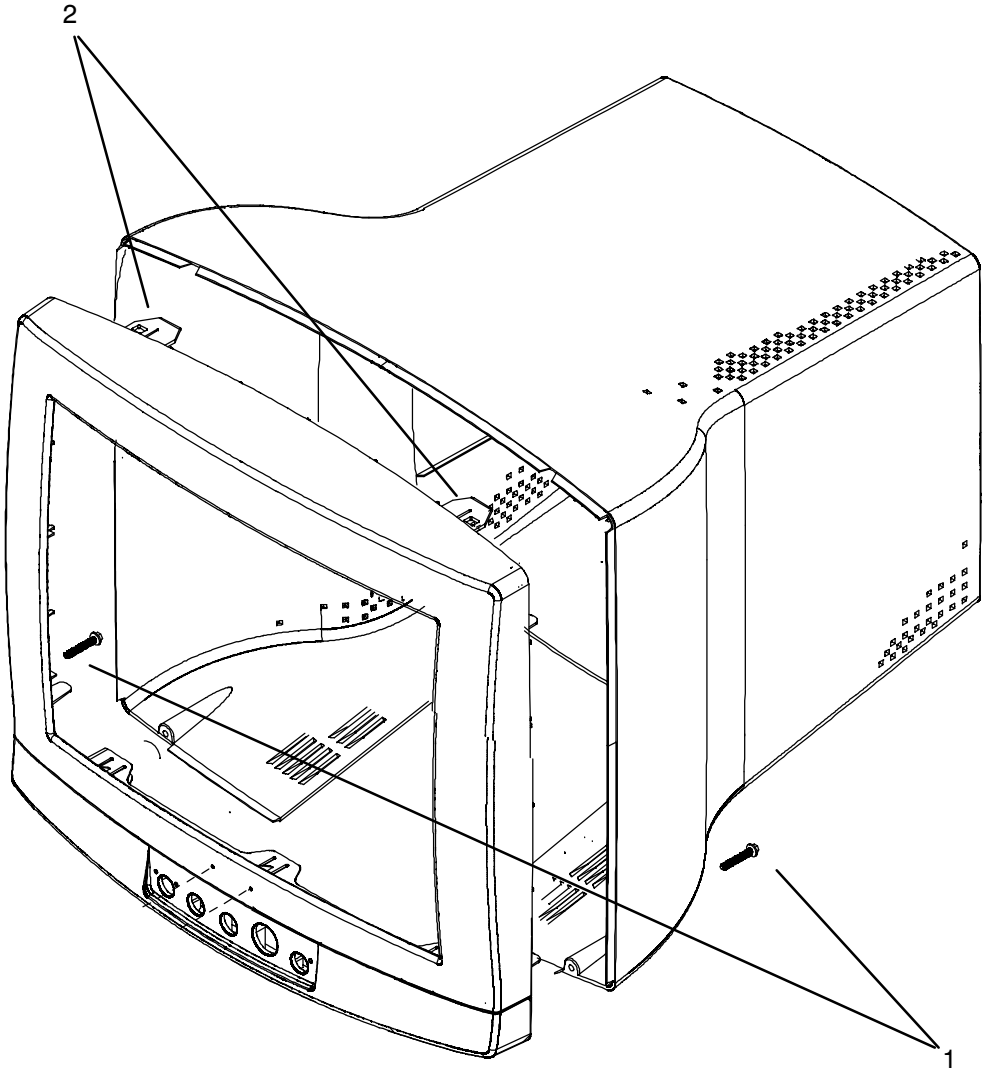
- 1. Loosen and remove two screws.
- 2. Open the plastic pawl with a screwdriver or the special tool (for instance 860006)

860006

Top view



Side view

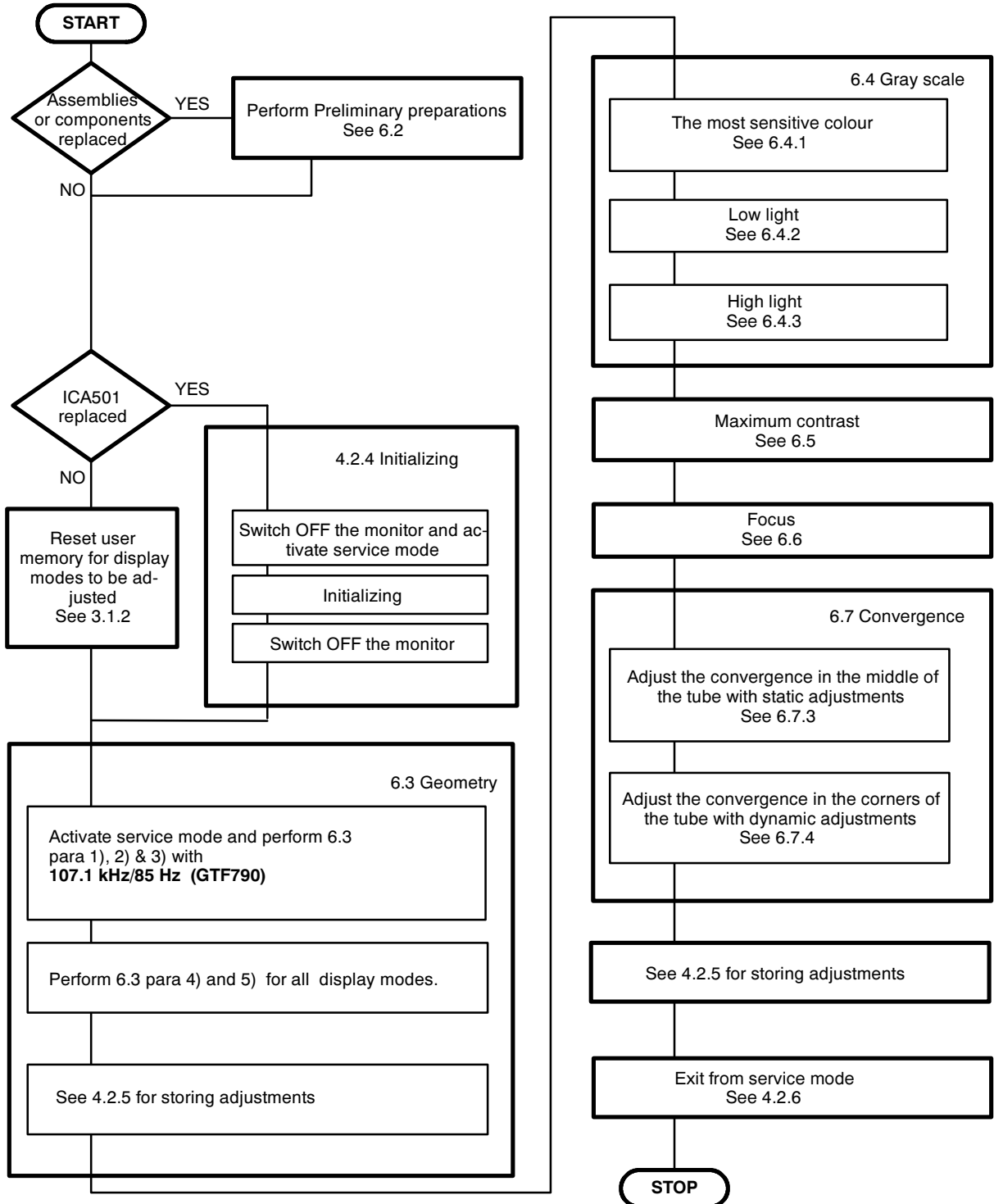


6. Adjustment Procedure

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

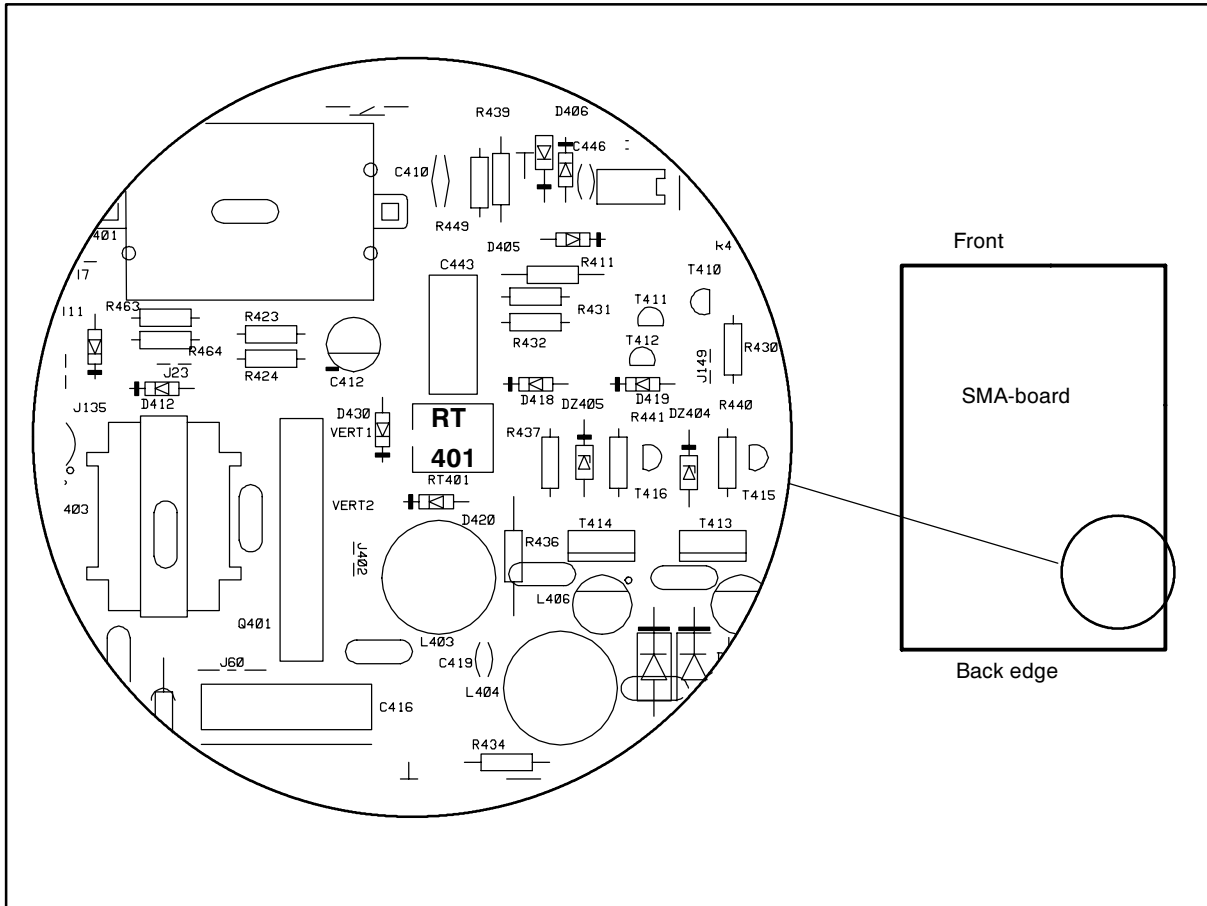


6.2. Preliminary Preparations

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.

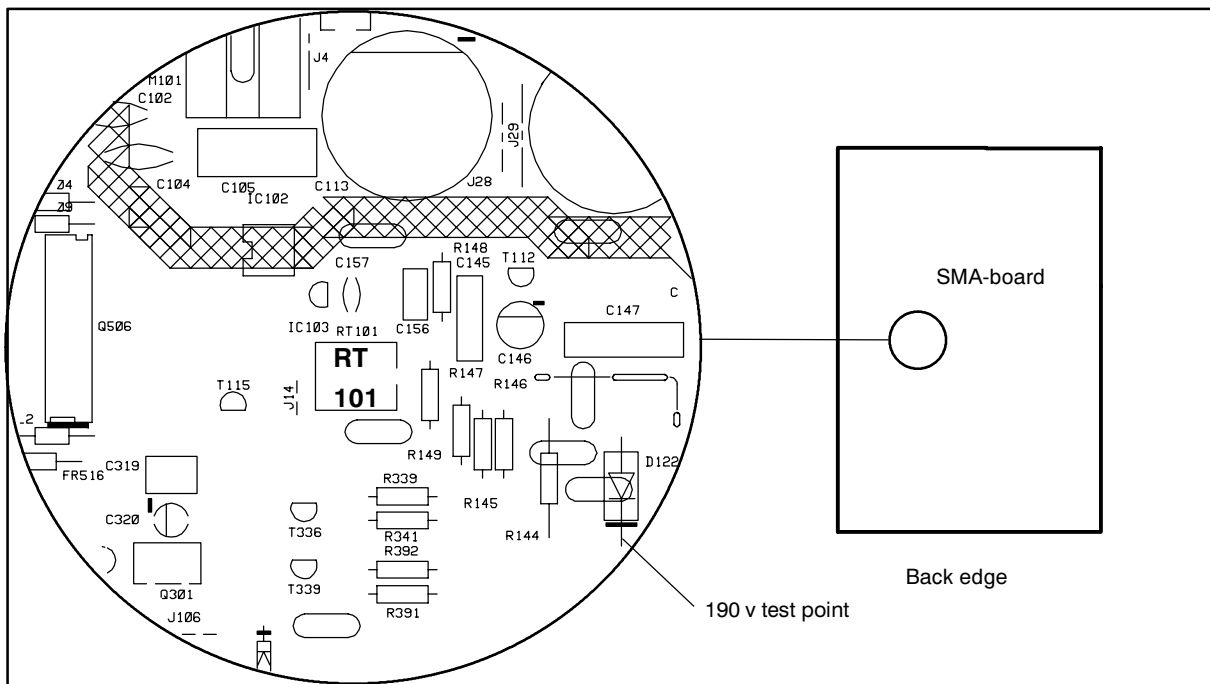
6.2.1. Coarse width

- Select 107.1 kHz/85 Hz (GTF790) crosshatch test pattern
- Set width to the 65% of the maximum with menu adjustment
- Set width equal to the mask aperture (400 mm) with coarse adjustment **RT401**



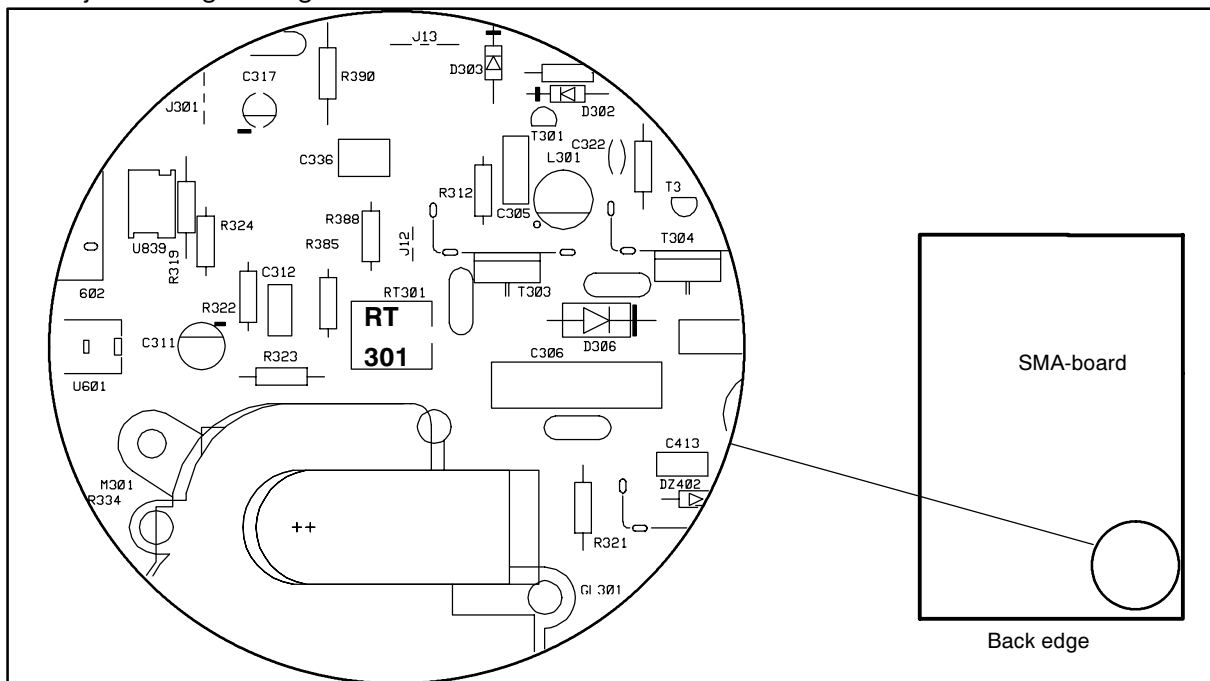
6.2.2. Operating voltage

Connect the DVM to 190 v test point. Adjust trimmer **RT101** on SMA –board for a voltage of **190 ± 0.5 V**.



6.2.3. High Voltage

- Select 31.47kHz/60Hz (NCE300) 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.



6.2.4. Preliminary Picture Adjustments

- 1) Select 107.1 kHz/85 Hz (GTF790) crosshatch test pattern.
- 2) Set \odot to maximum and adjust \ast until the background is faintly visible.
- 3) Adjust focus if poor.

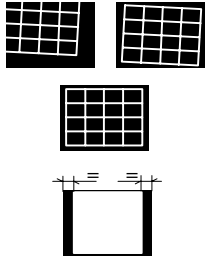
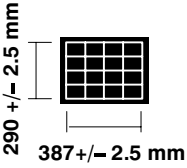
Remember

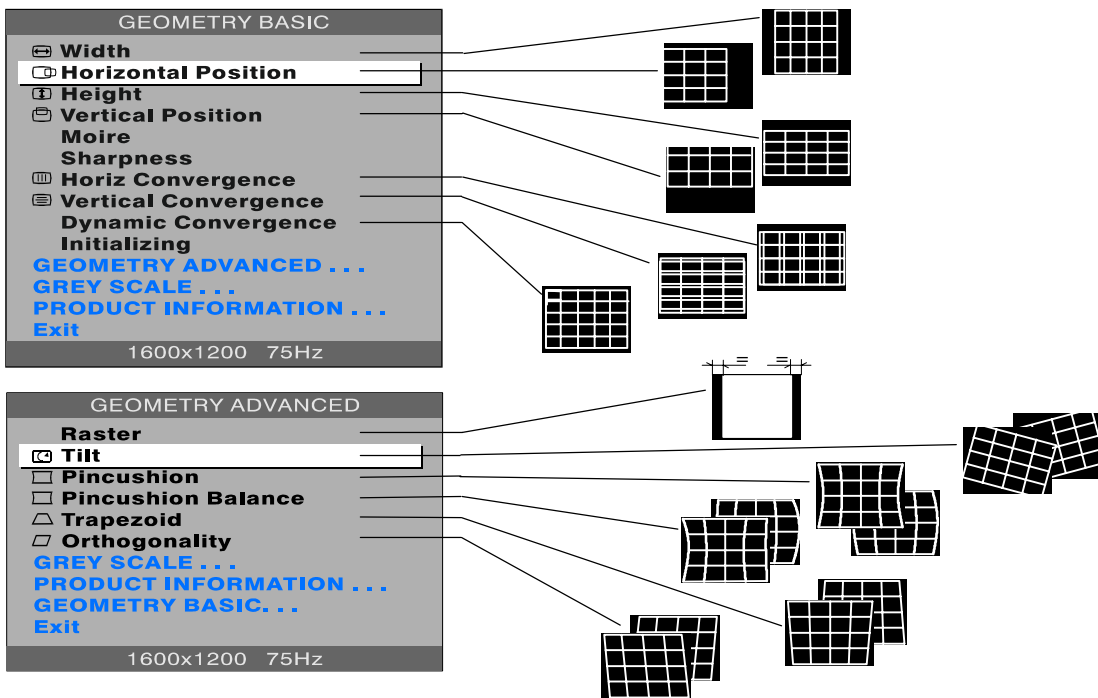
- Do not adjust **G2**–voltage with potentiometer or keypanel if you have reason to believe that there is no need to adjust gray scale.

6.3. Geometry

Activate Service Mode in 107.101kHz/85Hz (GTF790).

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

<ol style="list-style-type: none"> 1) Select 107.1 kHz/85 Hz (GTF790) 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. 	
<ol style="list-style-type: none"> 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. 	
<ol style="list-style-type: none"> 6) 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. 	



6.4. Grey Scale

The grey scale is adjusted for 9300K colour temperature.

6.4.1. The Most Sensitive Colour

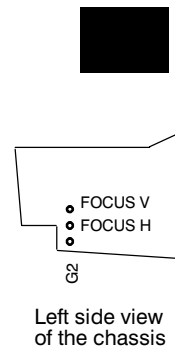
The most sensitive colour has been marked in a label on the deflection yoke. It may not be correct if tube or SMH card has been changed. In that case judge the most sensitive colour from the tone of the picture after you have made the following adjustments.

- 1) Select **107.1 kHz/85 Hz** (GTF790) black test pattern.
- 2) Set * to maximum and ● to minimum.
- 3) Set Blacklevel adjustment **RED/GREEN/BLUE Black Level** to 12% of the maximum.
- 4) Set **RED/GREEN/BLUE Amp** menu adjustments to center (50%).
- 5) Set **G2 menu** adjustment to center (50%).
- 6) Place the probe of the colour analyzer in the middle of the screen and adjust with **G2 trimmer** until the picture brightness is 3 ± 0.5 nit.



6.4.2. Low Light

- 1) Select **107.1 kHz/85 Hz** (GTF790) black test pattern.
- 2) Adjust picture brightness to 1.0 nits with * potentiometer.
- 3) Adjust the ● with potentiometer to the minimum.
- 4) Adjust the colour coordinates to (9300K)
 - $x = 0.283 \pm 0.020$
 - $y = 0.298 \pm 0.020$
 with **RED/GREEN/BLUE Black Level** adjustments.
Do not adjust the most sensitive colour.
- 5) Set * to the maximum and check that the brightness is still 3 ± 0.5 nits. If not, repeat 6.4.1. steps 5) and 6).
- 6) Adjust picture brightness to 1.0 nits with * potentiometer and check the colour coordinates.



6.4.3. High Light

- 1) Select **107.1 kHz/85 Hz** (GTF790) black test pattern.
- 2) Adjust with * the picture brightness to 1 ± 0.5 nits.
- 3) Select 107.1 kHz/85 Hz window test pattern.
- 4) Adjust with ● the picture brightness in the window to 70 ± 5 nits.
- 5) Adjust with **RED/BLUE Amp** the colour coordinates in the window to
 - $x = 0.283 \pm 0.020$
 - $y = 0.298 \pm 0.020$
 Check after adjustment that the brightness reading is in limits.



6.5. Maximum/Minimum Contrast

- 1) Set ● to the maximum.
- 2) Adjust with * potentiometer the picture brightness outside window to 0.5 nits or its maximum position.
- 3) Adjust brightness in the window to 145 ± 5 nits with **MAX CONTRAST**.
- 4) Set ● to the minimum.
- 5) Check that the minimum brightness is between 10 and 25 nits.
- 6) Exit from service mode.



6.6. Focus

- 1) Select **107.1 kHz/85 Hz** (GTF790) 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



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:

- Service mode Convergence menu adjustments (horizontal + vertical).
- Magnet ring set on the tube neck (horizontal + vertical)

Dynamic adjustments affects a part of the picture area:

- Service mode Dynamic Convergence menu adjustments.
- Deflection yoke trimmers.

6.7.1. Measuring Conditions

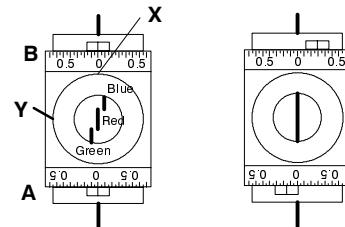
- Adjust convergence with 107.1 kHz (GTF790) line frequency
- Make sure that focus is correctly set at the mid-point between the screen center and the edge of the picture.
- Use white crosshatch test pattern with circle.
- Adjust **Y** to near the maximum and reduce **X** until the background disappears.

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

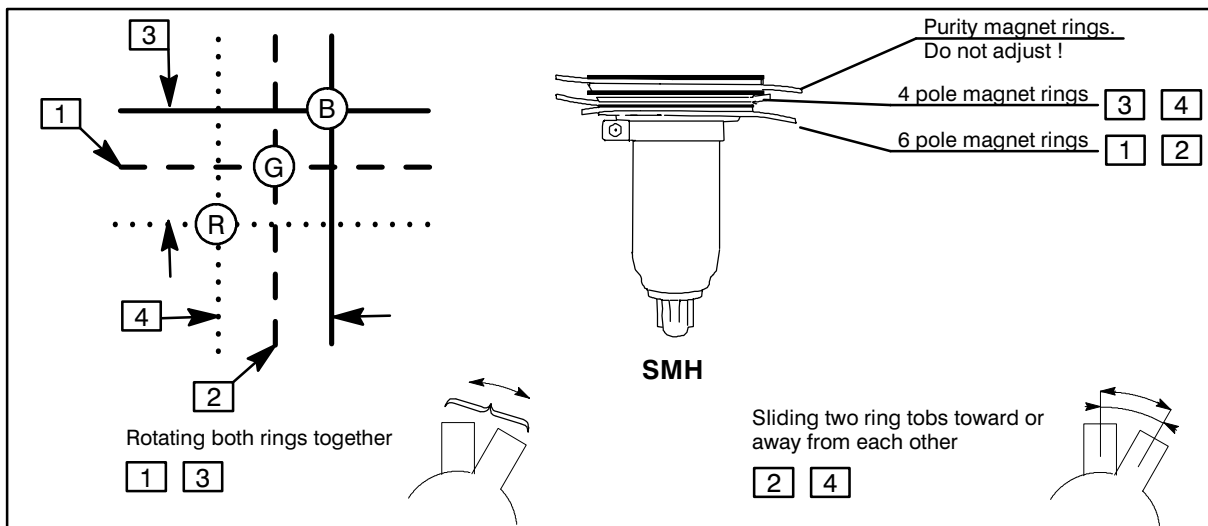


6.7.3. Static Convergence

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.

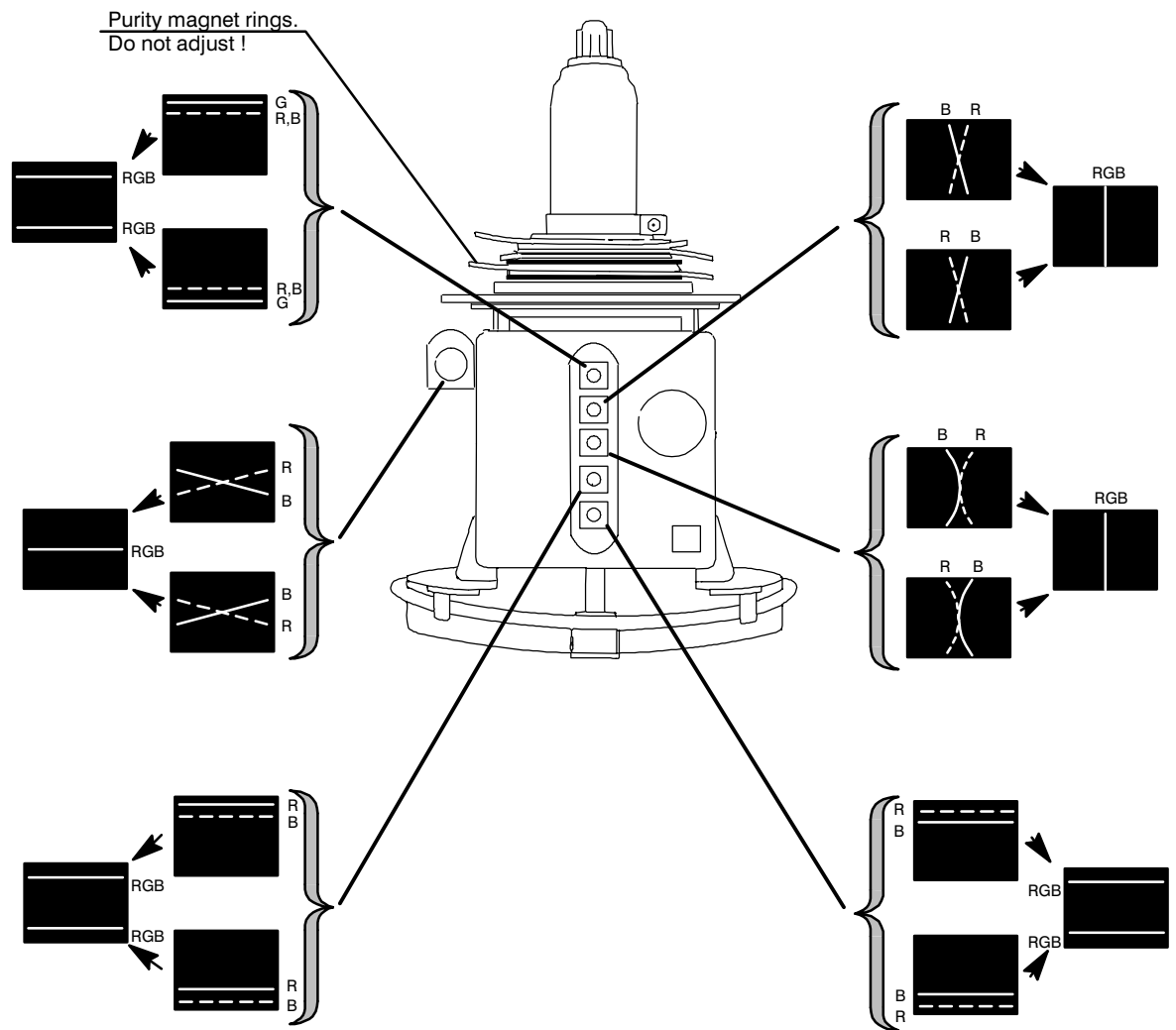
- 1 Adjust G vertically in the middle between R and B with 6 pole magnet rings.
- 2 Adjust G horizontally in the middle between R and B with 6 pole magnet rings.
- 3 Adjust R and B vertically to the same position with G line with 4 pole magnet rings
- 4 Adjust R and B horizontally to the same position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

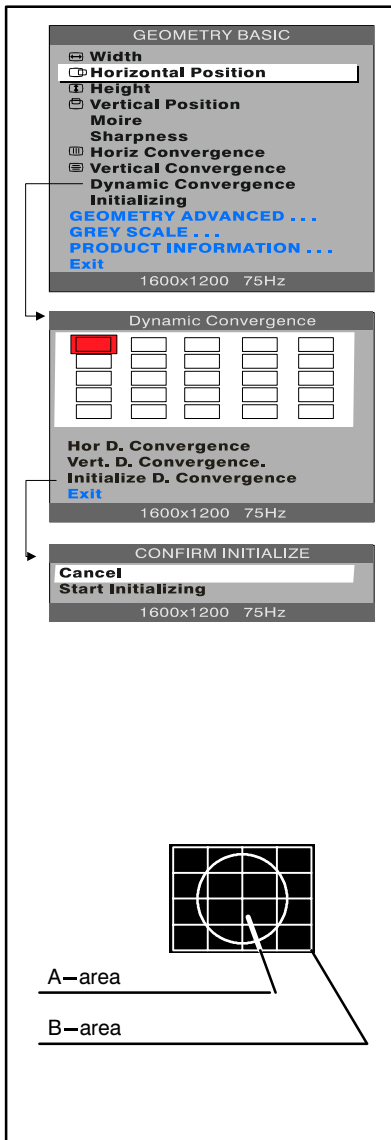
Lock the rings with paint



6.7.4 Dynamic Convergence

Deflection yoke trimmers





Dynamic Convergence Menu adjustments

Active the service mode as explain in 4.2.1.

- 1) Select Dynamic Convergence in Geometry Basic Submenu with the Menu wheel.
- 2) Select the position which you want to adjust with the Menu wheel.
- 3) Push the Menu wheel.
- 4) Select direction with the Menu wheel.
- 5) Push the Menu wheel.
- 6) Adjust Dynamic Convergence.

Dynamic Convergence adjustments affect only to the selected location of the 5 x 5 crosshatch picture.

Initializing the Dynamic Convergence sets all the Dynamic Convergence adjustments to the centre position.

6.7.5 Allowed Error Levels for Convergence

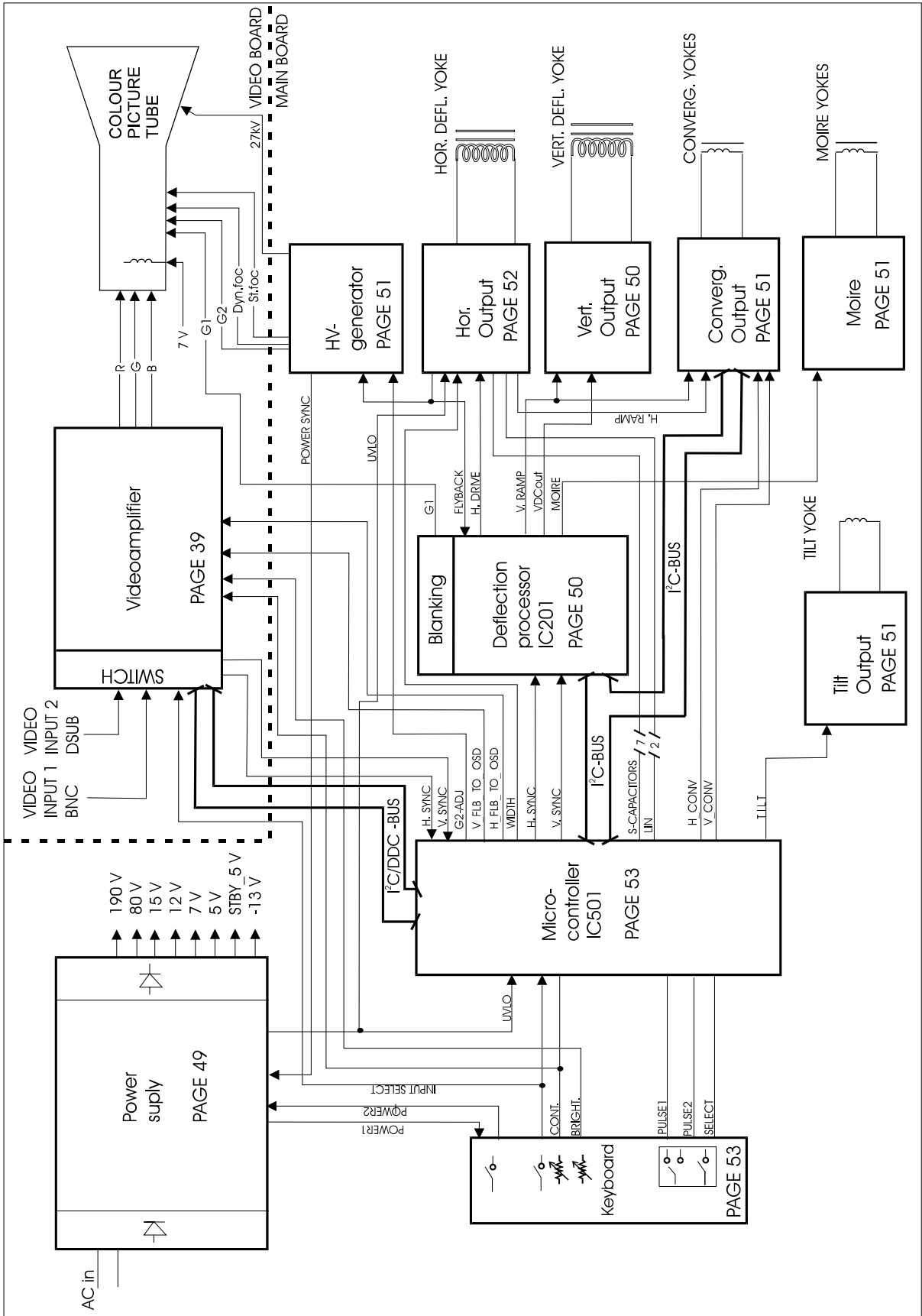
Area A: $\leq 0.2 \text{ mm}$

Area B: $\leq 0.3 \text{ mm}$

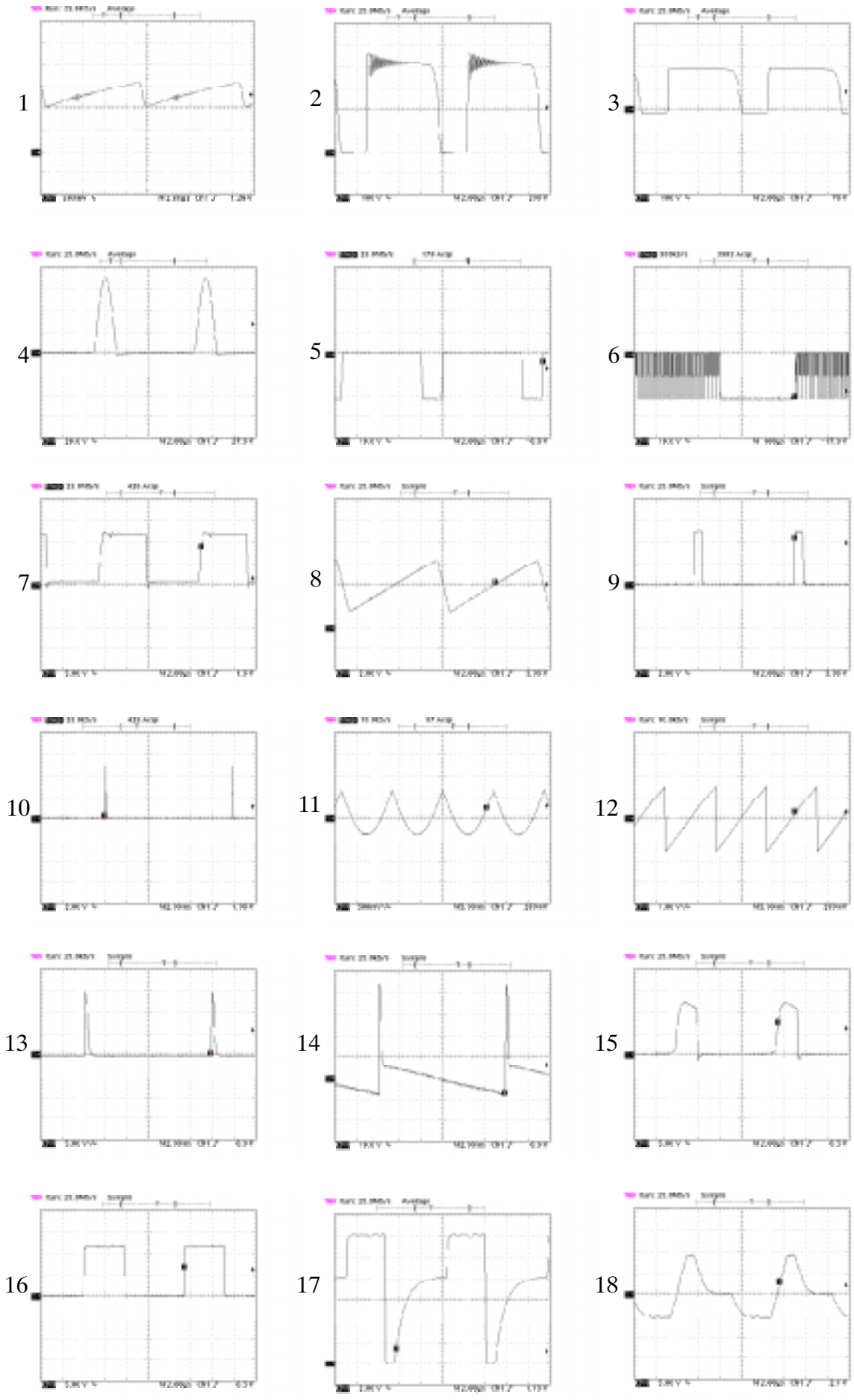
6.8. Colour Purity

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.

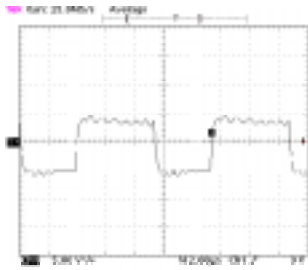
BLOCK DIAGRAM



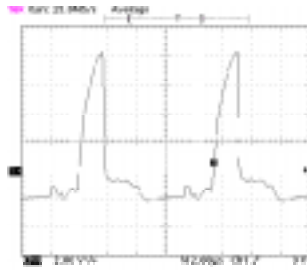
Page numbers references the page numbers of the schematic diagrams.



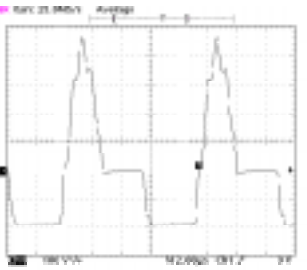
19



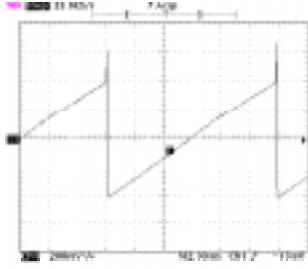
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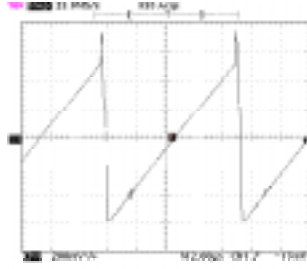
21



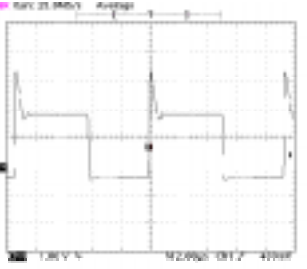
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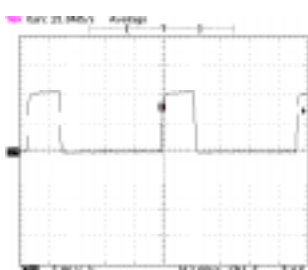
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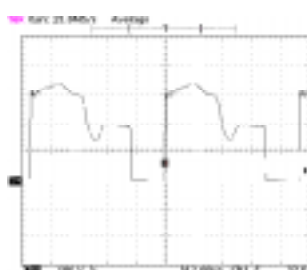
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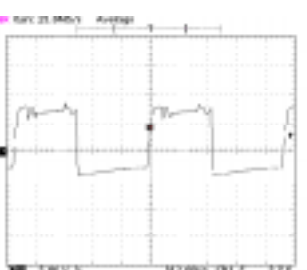
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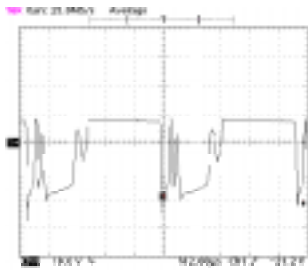
26



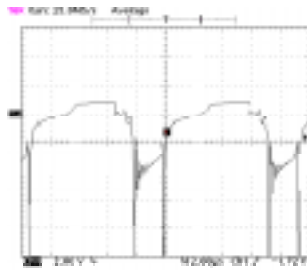
27



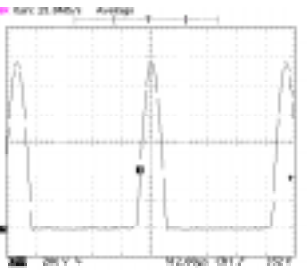
28



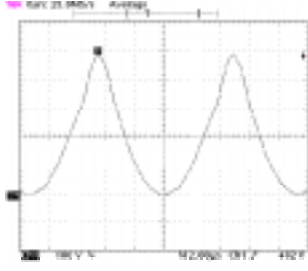
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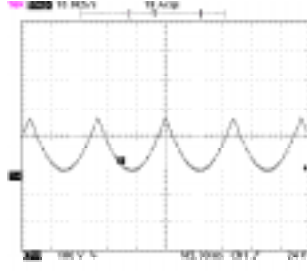
30



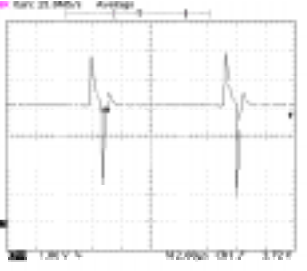
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32*

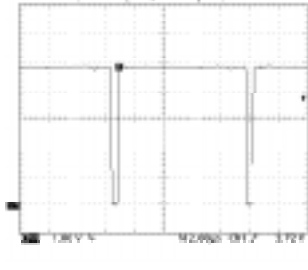


33

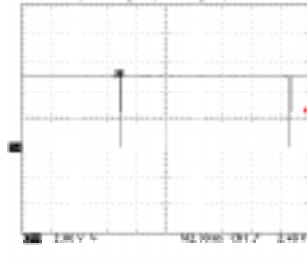


*100 x probe

34



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