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Color Monitor Service Manual
MODEL: MTG – 1902MM



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1. SAFETY PRECAUTIONS

WARNING: Service should not be attempted by anyone unfamiliar with the necessary precautions on this unit. The following precautions are necessary during servicing.

1-1. Some parts in this unit, such as the picture tube, have special safety-related characteristics for X-RAY RADIATION protection. For continued safety, parts replacement should be undertaken by referring to articles (1-2 ~ 1-5).

1-2. Many electrical/mechanical parts in this unit have special safety-related characteristics for protection against electrical shock and other potential hazards. These characteristics often go unnoticed by a visual inspection and the protection afforded by them cannot necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. Replacement parts, which have these special characteristics, are identified in the manual and highlighted on the schematic diagram and parts list. Before replacing these components read the parts list carefully.

1-3. When replacing chassis in the cabinet, always be certain that all the protective devices are installed properly, such as insulating covers, strain relief, etc.

1-4. Before replacing the back cover of the set, thoroughly inspect inside the cabinet to see that no stray parts or tools have been left inside.

1-5 Before returning the set to the customer always perform an ac current leakage check on the exposed metallic parts of the cabinet, such as terminal, screw heads, metal overlays, control shafts, etc. To be sure the set is safe to operate without danger of electrical shock, plug the AC power cable directly into a 115V AC outlet. (do not use a line isolation transformer during this check). Use an AC volt- meter with 5000 or more ohms per volt in the following manner. You cannot use a 1500 ohm, 10watt resistor, paralleled by a 0.15(uF) capacitor. Reverse the AC plug, the AC outlet and repeat the AC voltage measurements for each exposed metallic part. Voltage measured must not exceed 0.3V RMS. This corresponds to 0.2mA AC. Any value exceeding this limit constitutes a potential shock hazard and must be corrected immediately.

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2. SPECIFICATIONS

2-1. Picture Tube

- Size : 19"
- Dot Pitch : 0.26mm

2-2. Signal Input

- Video Input : Analog, Positive Signal(0.7Vp-p)
- Horizontal Sync : TTL Level, Positive or Negative pulse.
- Scanning : 28Khz ~ 70KHz
- Vertical Input : TTL Level, Positive or Negative pulse.
- Scanning : 40~ 160Hz

2-3. Power Supply

- Power Input : AC100~ 240V, 50/60Hz
- Fuse Rating : 250V, 50T 3.15A
- Power Consumption
 - Normal : less than 85W
 - DPMS : less than 20W

2-4. External Control :

Refer to page 7.

2-5. Operating Temperature : 0°C~ 55°C

2-6. Operating Humidity : 10%~ 90%(Non-condensing)

2-7. Net weight : 17kg

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3. TECHNICAL FEATURES

3-1. U-com(MCU) control with OSD.

U-com recognizes the computer signal and signal output from control board connected with wire. So the circuit is simplified.

3-2. Universal AC input voltage.

Power supply operates on AC100~ 265volt 50/60Hz for use all over the world.

3-3. Protection Circuit for over-current.

When over-current occurs in the circuit, the protection circuit operates in order to prevent the components from electrical shock or other risks.

3-4. Override function

The override function is designed for the normal display when the monitor is powered on without connection from the source (No signal message).

3-5. Control panel

If you are not satisfied with the factory mode size, position, color settings, use the control panel to program what you prefer in each resolution mode.

These adjusted settings are kept in memory even if you change resolution mode or turn off the monitor.

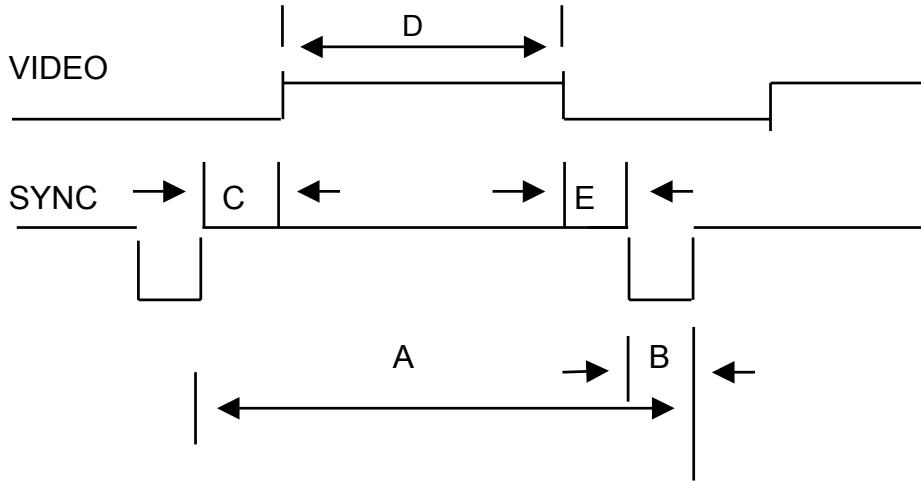
3-6. I²C BUS control

It is designed by I²C BUS control for simplifying circuit.

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4. TIMING CHART

Factory Pre-Set Timing Modes:



DESCRIPTION		MODE 1 VGA 720*400	MODE 2 VGA 640*480	MODE 3 8514/A 1024*768	MODE 4 S-VGA 680*400
H	FH	31.469KHz	31.469KHz	35.552KHz	37.500KHz
	A	31.778μs	31.778μs	28.251μs	26.667μs
	B			3.920μs	2.032μs
	C	1.907μs		1.247μs	3.810μs
	D	25.422μs	25.422μs	22.806μs	20.317μs
	E	0.636μs	0.318μs	0.170μs	0.508μs
	POL.			POSITIVE	
V	FH	70.087Hz	59.940Hz	86.960KHz	75.000Hz
	A	14.268ms		11.500ms	13.333ms
	B	0.064ms		0.113ms	0.080ms
	C	1.112ms	0.794ms	0.563ms	0.427ms
	D	12.711ms	15.253ms	10.810ms	12.800ms
	E	0.381ms	0.064ms	0.014ms	0.027ms
	POL.	POSITIVE	NEGATIVE	POSITIVE	NEGATIVE
VIDEO	ANALOG	ANALOG	ANALOG	ANALOG	

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DESCRIPTION		MODE5 S-VGA VESA 800*600	MODE6 VGA 800*600	MODE 7 VGA VESA 800*600	MODE 8 VESA 1024*768
H	FH	37.879KHz	46.875KHz	48.077KHz	48.363KHz
	A	26.400μs	21.333μs	20.800μs	20.677μs
	B	3.200μs	1.616μs	2.400μs	2.231μs
	C	2.200μs	3.232μs	1.280μs	1.615μs
	D	20.000μs	16.162μs	16.000μs	15.754μs
	E	1.000μs	0.323μs	1.119μs	0.998μs
	POL.	POSITIVE	POSITIVE	POSITIVE	NEGATIVE
V	FV	60.317Hz	75.000Hz	72.188Hz	60.004Hz
	A	16.579ms	13.333ms	13.853ms	16.666ms
	B	0.106ms	0.064ms	0.125ms	0.124ms
	C	0.607ms	0.448ms	0.478ms	0.600ms
	D	15.840ms	12.800ms	12.480ms	15.880ms
	E	0.026ms	0.021ms	0.772ms	0.062ms
	POL.	POSITIVE	POSITIVE	POSITIVE	NEGATIVE
VIDEO	ANALOG	ANALOG	ANALOG	ANALOG	

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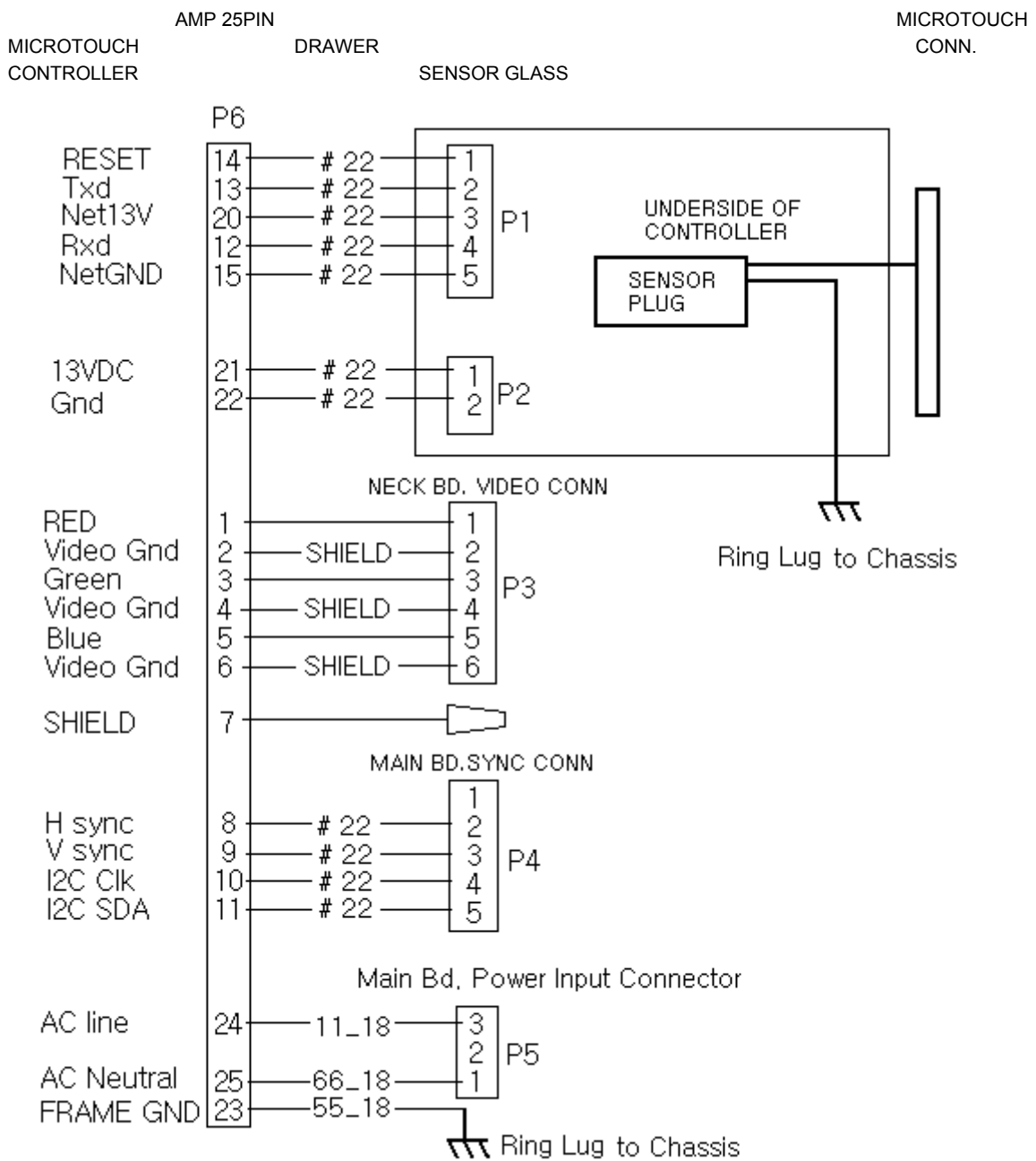
DESCRIPTION		MODE 9 VESA 800*600	MODE 10 VESA 1024*768	MODE 11 VESA 1024*768	MODE 12 VESA 1280*1024	MODE 13 VESA 1024*768
H	FH	53.674KHz	56.476KHz	60.023KHz	63.981KHz	68.677KHz
	A	18.631μs	17.707μs	16.660μs	15.698μs	14.561μs
	B	1.138μs	1.813μs	1.219μs	1.037μs	1.016μs
	C	2.702μs	1.920μs	2.235μs	2.296μs	2.201μs
	D	14.222μs	13.653μs	13.003μs	11.852μs	10.836μs
	E	0.569μs	0.321μs	0.203μs	0.360μs	0.508μs
	POL.	POSITIVE	NEGATIVE	POSITIVE	POSITIVE	POSITIVE
V	FV	85.062Hz	70.069Hz	75.029Hz	60.020Hz	84.997Hz
	A	11.756ms	14.272ms	13.328ms	16.638ms	11.765ms
	B	0.056ms	0.106ms	0.050ms	0.047ms	0.044ms
	C	0.503ms	0.513ms	0.466ms	0.594ms	0.524ms
	D	11.179ms	13.599ms	12.795ms	16.005ms	11.183ms
	E	0.019ms	0.054ms	0.017ms	0.016ms	0.015ms
	POL.	POSITIVE	NEGATIVE	POSITIVE	POSITIVE	POSITIVE
VIDEO	ANALOG	ANALOG	ANALOG	ANALOG	ANALOG	

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5. SET UP

5-1. Start Up

Your monitor starts up automatically when you insert the power plug to power source.



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6. CONTROLS AND ADJUSTMENTS

There are four switches on the control panel.
Adjustable controls allow the best display status for individual preferences.

6-1. Key Function

① MODE

MODE - Call the Main-Menu OSD.

② SEL/DEGAUSS

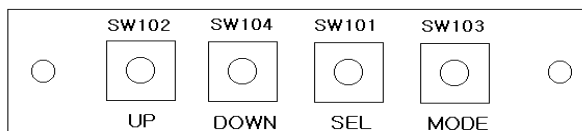
SEL – Select the function (sub-Menu OSD) on the Main- Menu OSD.

DEGAUSS – Do degaussing if the OSD isn't displayed.

③ DOWN/UP

-When the Main-Menu is displayed, you can search each function using these keys.

-When the Sub-Menu is displayed(after select the function), can change each state of the screen using these keys.



O.S.D Control
Sub-P.C.B

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6.2. O.S.D CONTROL METHOD

1) Control items.

Location	Adjustment Method	Function
SUB PCB	OSD Control	Brightness Contrast Horizontal Position Horizontal-Size Vertical Position Vertical-Size Side Pincushion Trapezoid Pin Balance Parallelogram
MAIN PCB	VR control VR301 VR501 VR502 VR503 FBT	H-MIN SIZE H.V Adjustment ABL Adjustment Sub-Bright Focus and Screen

6-3. OSD Controls

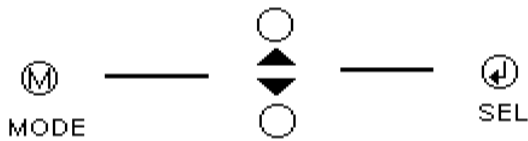
- User's control.

A. BRIGHTNESS ADJUSTMENT.

- 1) Press the "MODE" key then Main-Menu OSD come out as below Figure.
- 2) Search "BRIGHTNESS" sub-menu by using the "UP/DOWN" key on the Main-Menu OSD.
- 3) Select the "BRIGHTNESS" by pressing the "SEL" key. Then the "BRIGHTNESS" OSD color changes from yellow to red.
- 4) Search the "BRIGHTNESS" sub-menu using the "UP/DOWN" key on the Main-Menu OSD.

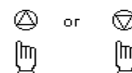
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- 5) Select the "BRIGHTNESS" by pressing the "SEL" key. Then the "BRIGHTNESS" OSD color changes from yellow to red.
 - 6) Adjust the Brightness as much as you want using the "UP/DOWN" key.
 - 7) After finishing the Brightness adjust, Press the "MODE" key then the "BRIGHTNESS" OSD color changes from red to yellow and be saved automatically.
 - 6) If you want to adjust other functions, search your sub-menu. For example, if you want to adjust the "CONTRAST" use the "UP/DOWN" keys and then adjust the same way as item 3),4) and 5).
- To finish the adjustment press the "MODE" key then the OSD will disappear.



	BRIGHTNESS	████████	50
	CONTRAST	██████████	Max
	H.POSITION	████████	50
	H.SIZE	████████	50
	V.POSITION	████████	50
	V.SIZE	████████	50
	ROTATION	████████	50
	PINCUSHION	████████	50
	TRAPEZOID	████████	50
	PARALLELG	████████	50
	PIN BALANCE	████████	50
	K COLOR		
	RECALL		
640x480 60Hz / 31.4KHz			

	BRIGHTNESS	████████	50
	CONTRAST	██████████	Max
	H.POSITION	████████	50
	H.SIZE	████████	50
	V.POSITION	████████	50
	V.SIZE	████████	50
	ROTATION	████████	50
	PINCUSHION	████████	50
	TRAPEZOID	████████	50
	PARALLELG	████████	50
	PIN BALANCE	████████	50
	K COLOR		
	RECALL		
640x480 60Hz / 31.4KHz			

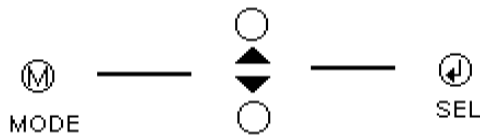


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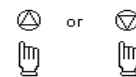
- B. CONTRAST ADJUST SAME WAY AS ABOVE
- C. H. POSITION ADJUST SAME WAY AS ABOVE
- D. H. SIZE ADJUST SAME WAY AS ABOVE
- E. V. POSITION ADJUST SAME WAY AS ABOVE
- F. V. SIZE ADJUST SAME WAY AS ABOVE
- G. PINCUSHION ADJUST SAME WAY AS ABOVE
- H. TRAPEZOID ADJUST SAME WAY AS ABOVE
- I. PARALLELOG ADJUST SAME WAY AS ABOVE
- J. PIN BALANCE ADJUST SAME WAY AS ABOVE

K. COLOR ADJUSTMENT.

1) Press the "MODE" key then the Main-Menu OSD come out as left below figure.



	BRIGHTNESS		50
	CONTRAST		Max
	H.POSITION		50
	H.SIZE		50
	V.POSITION		50
	V.SIZE		50
	ROTATION		50
	PINCUSHION		50
	TRAPEZOID		50
	PARALLELG		50
	PIN BALANCE		50
	K COLOR		
	RECALL		
640x480 60Hz / 31.4KHz			



min->1-99->max

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- 2) Press the "SELECT" key to adjust the "RED","GREEN" and "BLUE"
The "RED","GREEN" and "BLUE" is selected by pressing the "SELECT" key and selected item change the OSD color from white to it's own color as character (ex: "RED" goes to red color)
- 3) Adjust the "RED","GREEN" or "BLUE" by using the "UP/DOWN" key.
- 4) Press the "MODE" key to finish the color adjustment then the OSD goes back to Main-Menu.
- 5) Press the "MODE" key again to finish the adjustment then the OSD disappears.

L. RECALL.

When you press the "RECALL" key, all user's adjustment values are erased and covered by factory adjustment value.

At first stage without any user adjustments, The monitor is set up by the factory adjustment value.

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7. Adjustment Specifications

7-1. Adjustment Sequence.

You should allow 15 minutes for the unit to warm up before adjusting.

7-2. Adjustment Sequence.

FBT High Voltage → G2 Voltage → Raster. Center → Hor. Size → Hor. Position → Ver. Size → Ver. position → Side-pin → Trapezoid → Focus → White balance → Convergence

7-3. Adjustment Procedure.

How to enter the Factory Mode : Press SEL and UP key simultaneously.

7-3.1. H/V voltage adjustment.

- 1) Input the cross-hatch pattern with the 31KHz 640*480 mode.
- 2) After connecting a HIGH voltage meter to the ANODE, adjust the VR 501 to 27kv.

7-3.2. G2 Voltage adjustment.

- 1) Input the cross-hatch pattern with 31KHz 640*480 mode
- 2) After connecting a DC high voltage meter to the G2 of the CRT socket, adjust G2 voltage to 560V ± 10V by changing SCREEN VR of FBT.

7-3.3 G/D Adjustment.

Refer to controls and adjustment.(Article 6)

7-3.4 Focus adjustment.

- 1) Input the "H" character pattern with 60KHz 1024*768 .
- 2) Adjust the focus for the best balance at each point of A, B, C, D, E as shown below by rotating the focus VR of FBT.



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7-3.5. White balance Adjustment.

Pre-adjustment

- 1) This should be carried out at least 15 minutes.
- 2) Input the window pattern with 53KHz 800*600 mode.
- 3) Degauss the screen with Manual degaussing coil.

White Balance adjustment(Back Raster)

- 1) Remove the video signal
- 2) Adjust the sub-brightness of back raster to be 0.35 ± 0.05 FT/L with R,G,B BIAS
- 3) And, adjust the color temperature to be $X=0.281 \pm 0.02$ and $Y=0.311 \pm 0.02$ by R.G.B bias control function on OSD menu.
- 4) Adjust BRIGHTNESS to be 0.35 FL ± 0.05 F/L.

White Balance adjustment(Video)

- 1) Input the 20% window pattern with 53KHz 800*600 mode.
- 2) Adjust the color temperature to be $X=0.281 \pm 0.015$ and $Y=0.311 \pm 0.02$ by R.B gain on OSD menu.
- 3) Adjust CONTRAST to be 66 FL ± 5 F/L.

7-3.6. Purity and Convergence Adjustment.

1) Purity Adjustment.

- ① Demagnetize the picture tube and cabinet using a degaussing coil.
- ② Turn the CONTRAST and BRIGHTNESS controls to maximum.
- ③ Adjust RED and BLUE bias controls to provide only a green raster
- ④ Loosen the clamp screw holding the yoke, and slide the yoke, backward to provide vertical green belt(zone) in the picture screen.
- ⑤ Remove the Rubber wedges.
- ⑥ Rotate and spread the tabs of the purity magnet see figure 1 around the neck of the picture tube until the green belt is in the center of the screen. At the same time, center the raster vertically.
- ⑦ Move the yoke forward slowly until a uniform green screen is obtained. Tighten the clamp screw of the yoke temporarily.

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- ⑧ Check the purity of the red and blue raster by adjusting the bias controls.
- ⑨ Obtain a white raster, referring to CRT GRAY SCALE ADJUSTMENT
- ⑩ Proceed with convergence adjustment.

2) Convergence adjustment.

- ①. Receive crosshatch pattern with a color bar signal generator.
- ②. Adjust the BRIGHTNESS and CONTRAST controls for a well defined pattern.
- ③. Adjust two tabs of the 4-Pole Magnets to change the angle between them (See figure 1) and superimpose the red and blue vertical lines in the center area of the picture screen.
- ④. Turn both tabs at the same time keeping their angles constant to superimpose the red and blue horizontal lines at the center of the screen. (See figure 2.)
- ⑤. Adjust two tabs of 6-Pole Magnets to superimpose red/blue line with green one. Adjusting the angle affects the vertical lines and rotating both magnets affects the horizontal lines
- ⑥. Repeat adjustment ③, ④ and ⑤. Keeping in mind red, green and blue movement, because 4-Pole Magnets and 6-Pole Magnets are interacted and make dot movement complex.

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8. DESCRIPTION OF CIRCUIT OPERATION

8-1. Mode control

8-1.1. H-Sync is inputted to pin 31 of IC601, V-Sync to pin 30 of IC601 for each mode, and pin 28, 29 of IC601 output always positive polarity sync.

8-1.2. The outputs from IC601 are as below (See Table 1)

No.	Frequency		Resolution	Range of Frequency		OUT PUT (MCU PIN)			
	Hf kHz	Vf Hz		Hf (kHz)	Vf (Hz)	CS2 39	CS1 40	CS0 41	SUS- 4
1	31	70	720x400	28~ 32.9	68~ 72	L	L	L	H
2	31	60	640x480	"	58~ 62	L	L	L	H
3	35	86	1024x768	33~ 35.9	84~ 88	H	L	L	H
4	38	75	640x480	36~ 40.9	73~ 77	L	H	L	H
5	38	60	800x600	36~ 40.9	58~ 62	L	H	L	H
6	47	75	800x600	41~ 51.9	73~ 77	H	L	H	H
7	48	72	800x600	"	70~ 74	H	L	H	H
8	48	60	1024x768	"	58~ 62	H	L	H	H
9	53	85	800x600	52~ 61.9	83~ 87	L	H	H	H
10	56	70	1024x768	"	68~ 72	L	H	H	H
11	60	75	1024x768	"	73~ 77	L	H	H	H
12	64	60	1280x1024	62~ 70	58~ 62	H	H	H	H
13	69	85	1024x768	62~ 70	83~ 87	H	H	H	H
14	-	-	-	$H \leq 10$	NORMAL	X	X	X	L
15	-	-	-	NORMAL	$V \leq 40$	X	X	X	L
16	-	-	-	$H \leq 10$	$V \leq 40$	X	X	X	L

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8-2. Deflection Processor (IC301)

8-2.1. Horizontal section

1) Horizontal oscillation

R314 and C347 set horizontal free frequency.

Auto-sync processing can be done from 30KHz to 70KHz by mean of IC301 without any adjustment.

2) Phase shift

Horizontal phase shift is controlled by IC601 using I²C BUS control.

3) Horizontal driver output

The output pulse, which has the duty-cycle of 47%, is available at pin 26 of IC301.

This output is used for horizontal drive circuit.

4) B+ control driver output

The output pulse is available at pin 28 of IC301 and it is used for H-scan voltage control driver.

5) X-ray protection

When the fly-back voltage rises up to unacceptable level X-ray protection is activated X-ray input pin 36 of ic601 is above 3.2v

This result is that complete line drive stage stops working.

The reset of this protection is obtained by Main power off.

8-2.2. Vertical section

1) Vertical oscillation

The free running frequency of the vertical oscillator is determined by the capacitor C342 at pin VCAP (pin22) of IC301.

2) Vertical amplitude

Vertical amplitude is controlled by IC601 using I²C.

3) Vertical position

Vertical position is controlled by IC601 using I²C.

4) East-west parabola

A parabola waveform is available on pin 24 of IC301 for driving the pincushion correction stage. Amplitude of parabola waveform is controlled by IC601 using I²C.

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8-2.3. B+ Regulator

B+ PWM regulator output is available on pin 28 of IC301 for driving the B+ control stage.

8-3. Vertical Deflection (IC201)

IC201 (KA2142) is used for direct driving of vertical deflection yoke.

8-4. Horizontal scan voltage control stage

The step-up converter is used in this stage.

The output pulse at pin 28 of the IC301 is synchronized on horizontal frequency. And this pulse is operated via buffer stage Q353,Q354

This output is rectified through D308,C328.

8-5. Horizontal deflection output stage

8-5.1. Line driver stage

As a driver device, small TR Q305(C3502E) is used.

The driver transformer T302 is equipped with a snubber circuit (R327/C309) at the primary side to damp excessive ringing.

8-5.2. Horizontal power output stage

The horizontal power output stage is used boost-up circuit.

As a deflection transistor, the Q308(J6825) is used.

To compensate the horizontal linearity, T301 is connected in a series with the horizontal DY. It is controlled by DC collector voltage of Q304, which the base voltage of Q304 is integrated from output at pin 24 of IC601.

8-5.3. S-correction capacitor switches

Q316 is off when horizontal frequency is 35KHz.

Q317 is off when horizontal frequency is 37KHz.

Q316,Q318 is off when horizontal frequency is 44KHz~52KHz.

Q317,318 is off when horizontal frequency is 53KHz~ 61KHz.

Q316,Q317,Q318 is off when horizontal frequency is 62KHz~ 70KHz.

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8-6. FBT(Fly-back Transformer)

As a driver device, IC302(KA7500) is used.

The high voltage for CRT anode ,focus, G2 voltage for CRT and 800V for FOCUS VOLTAGE are generated by the FBT.

Also, -130V for G1 voltage, 26V for X-RAY detect voltage are extracted from the FBT.

In this way, the supply voltage to the fly-back transformer can be proportional to the horizontal line frequency.

8-7. . ABL(Automatic Beam Limiting)

The voltage of the FBT pin10 is affected by the anode current of the FBT.

When the voltage at pin 10 is decreased, the anode current is increased accordingly. When the anode current is increased, contrast is set at the certain limited level (28FL in white pattern) that is set by inner voltage of IC401.

8-8. Video amplification section.

8-8.1. Video pre-amplifier (IC401)

Input video signals are amplified by means of IC401, and the amplified signals drive the video output stage(IC402).

Video gain is adjusted by DC voltage at pin 12 for ABL control.

8-8.2. Video output stage (IC402)

The video output signal from IC401 is amplified again by IC402, and IC402 apply video signal to each cathode of CRT.

Q405, Q406 and Q407, which is operated by I2C BUS control through u-com, adjust cutoff voltages.

8-8.3. OSD(On Screen Display : IC403)

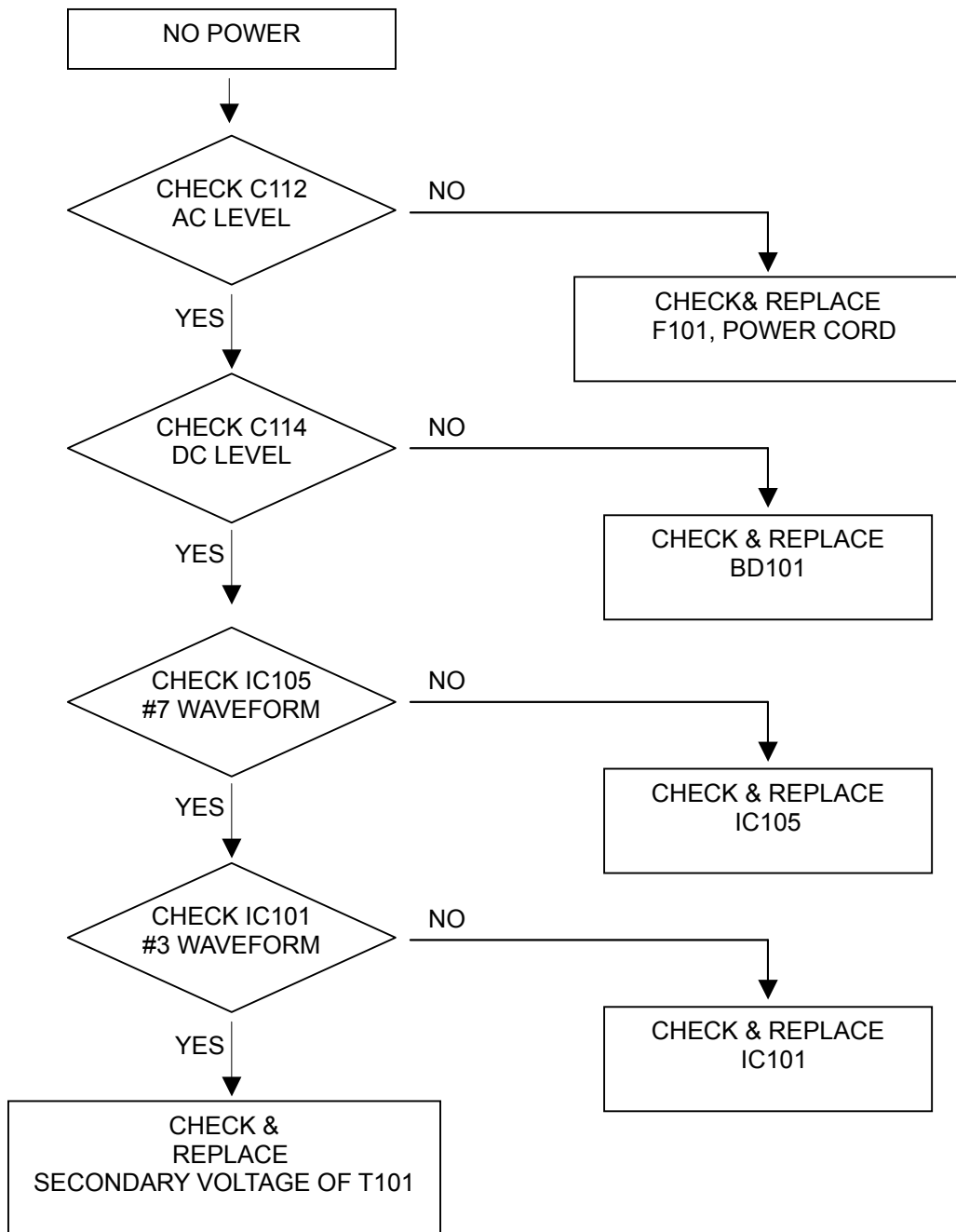
The OSD signal is applied from IC403 to IC402.

It is controlled by I²C BUS control line.

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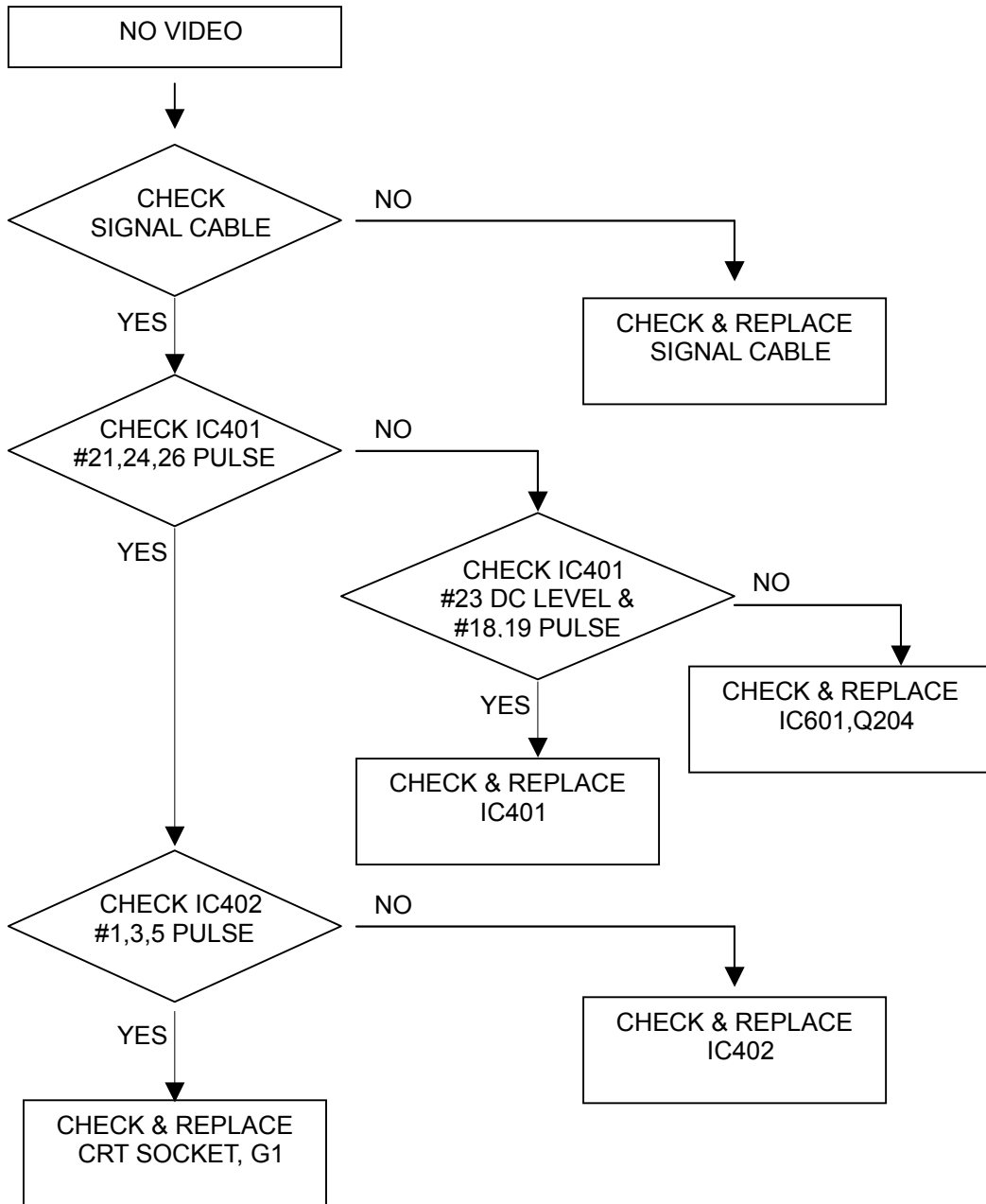
9. TROUBLE SHOOTING

9-1. NO POWER



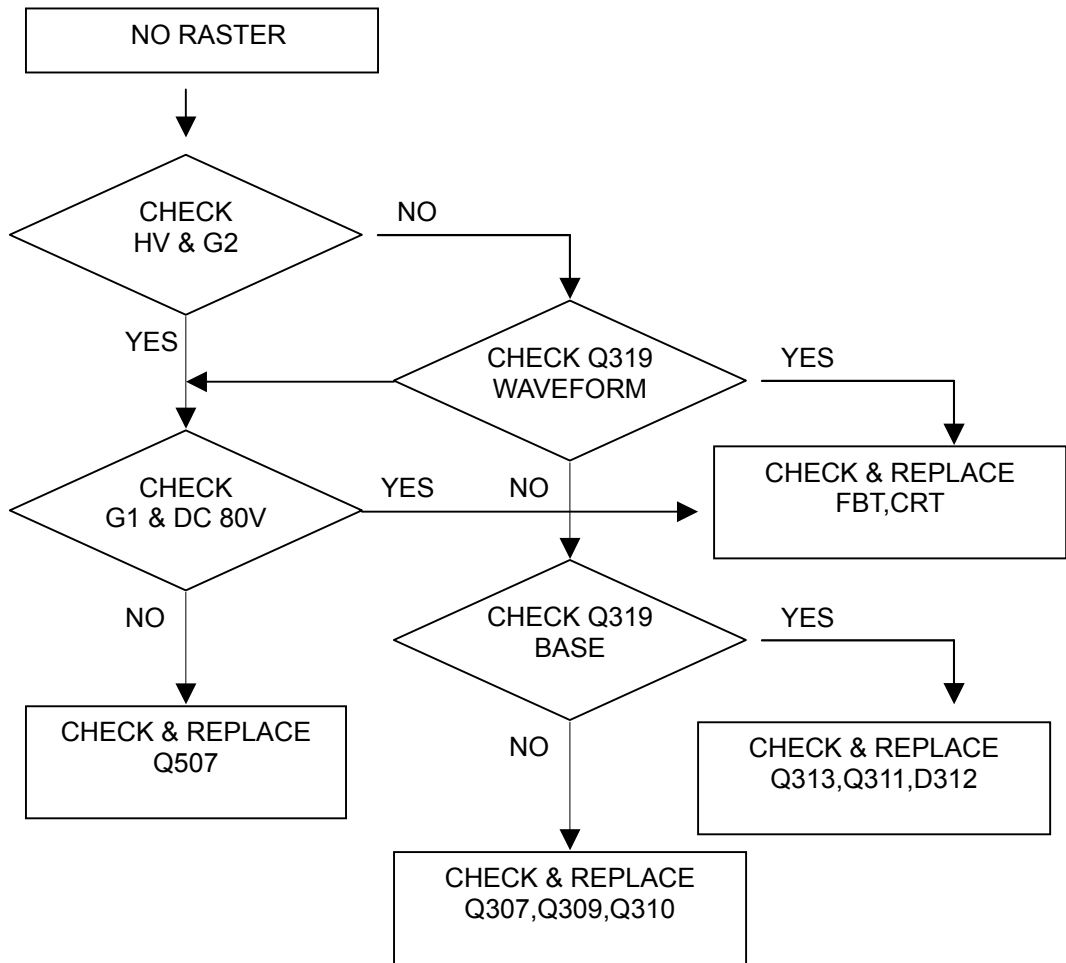
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9-2. NO VIDEO



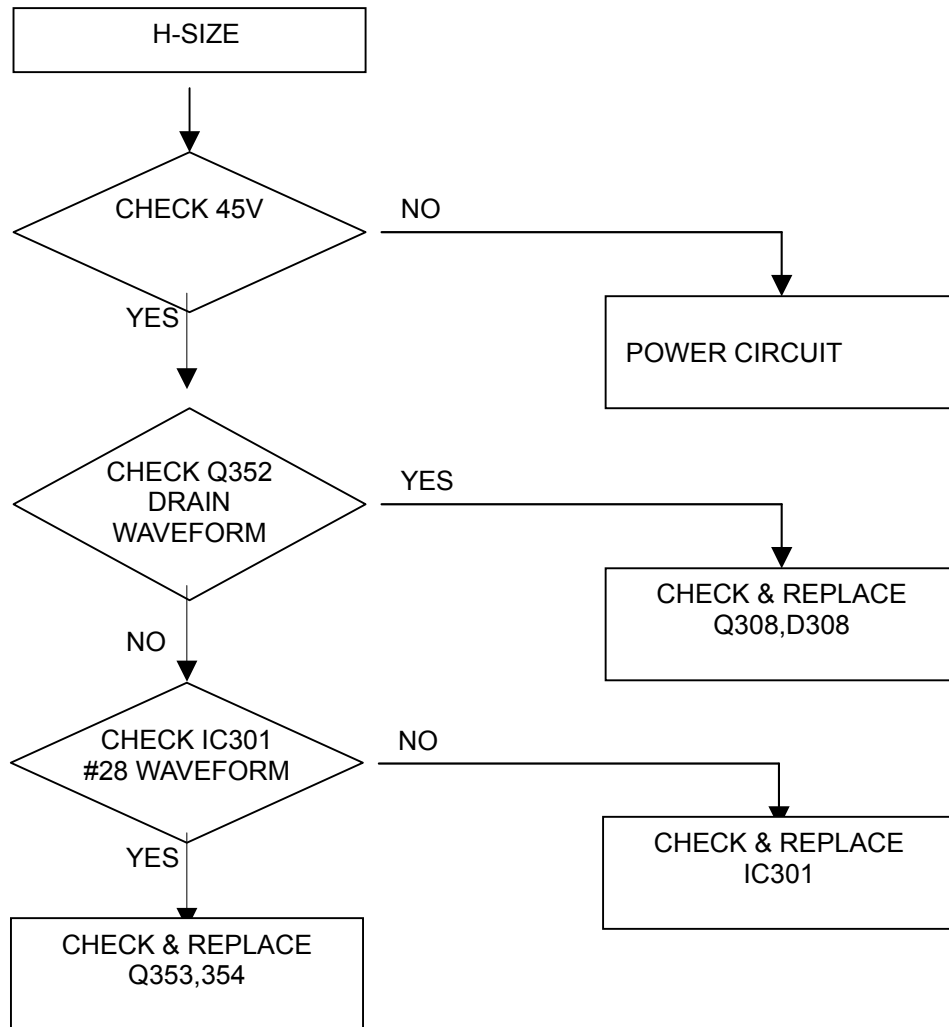
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9-3. NO RASTER



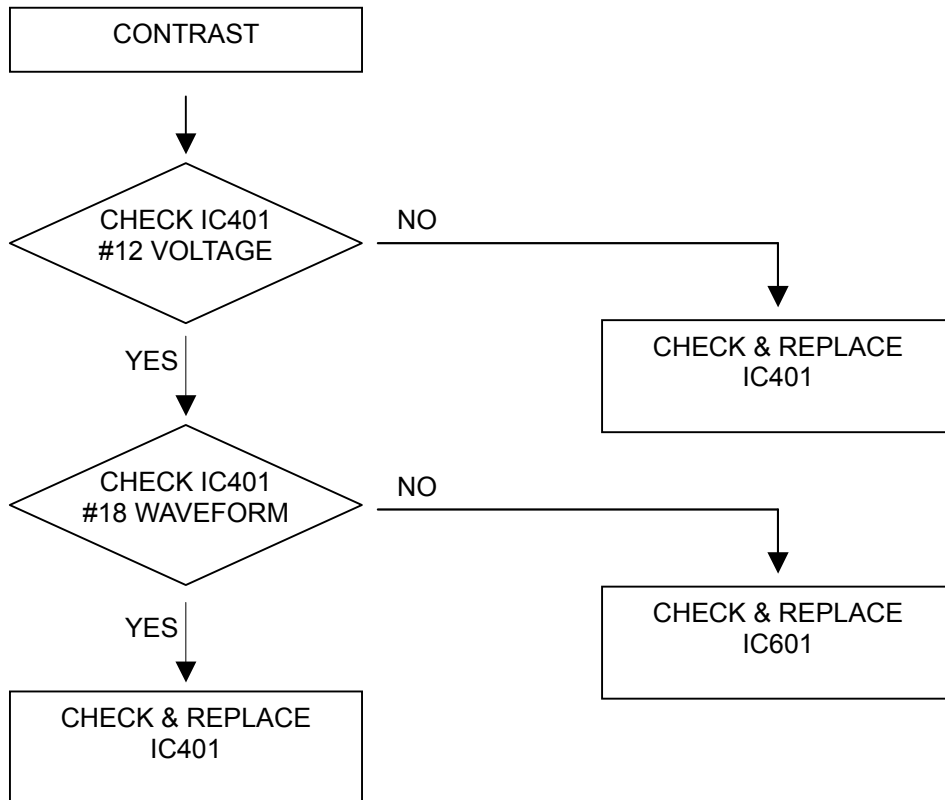
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9-4. TROUBLE IN HORIZONTAL SIZE



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9-5. TROUBLE IN CONTRAST



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9-6. TROUBLE IN BRIGHTNESS

