VGA Colour Monitor

2401 Series

Type Z Chassis

SERVICE INFORMATION

79-1497-0-001

CONTENTS

ILLUSTRATIONS

SECTION 1. SPECIFICATION

1.1 Power

Input: 220-240VAC, 48-63Hz or 110-120/220-240VAC, 48-63Hz (switchable).
Power Consumption: <85W

1.2 Sync Input

TTL Levels:

Mode	H-Sync	V-Sync	H-Freq/kHz	V-Freq/Hz
1	+	-	31.5	70
2	-	+	31.5	70
3	-	-	31.5	60

1.3 Signal Cable: 15-way Sub-miniature 'D' type.

1.4 Cathode Ray Tube: 14" (13V) Diagonal, landscape mode. Dot pitch 0.39mm, polished

1.5 Operating Ranges: Temperature - 10-35^{o}C
Humidity - 20-85% (non-condensing)

1.6 Weight: 11.5Kg

1.7 Video Input: RGB Analogue video signal, 0.71V positive

1.8 User Controls: Power On/Off, Contrast, Brightness

1.9 Display Colours: Infinite array

1.10 Display Area: 240mm wide x 180mm high

1.11 Dimensions: Width 351mm, Height 327mm, Depth 384mm

SECTION 2. PRECAUTIONS AND SAFETY

2.1 Observe all cautionary and safety related notes located on the chassis, cabinet and display tube.

2.2 Operation of the display with the back cover removed presents a potential shock hazard. Only personnel familiar with the precautions necessary for safe working on high voltage equipment should attempt to carry out servicing.

2.3 Always wear safety approved shatter-proof goggles when removing, installing or generally handling the picture tube. People not so equipped should be kept at a safe distance when any such handling is being undertaken. Do not handle the picture tube by the neck or deflection coil. Do not carry the picture tube resting against the body.

2.4 The picture tube is designed and constructed to limit X-Radiation to a safe level during normal operation. To maintain the required level of protection and safe operation, replacement tubes must be correctly adjusted and any protective circuits **must not be defeated.**

2.5 A.C. Current Leakage Test

After servicing and before returning the display to the customer, perform a thorough safety test to ensure there is no potential shock hazard to the operator. The safety check should be in the form of a high voltage test between live and neutral (joined together) to earth, at 1.5 kilovolts, 50Hz for one minute, an earth continuity test at 25 amps between the primary safety earth point (marked with a ⏚ symbol, located near the mains inlet) and the earth terminal of the mains plug and, if possible, an AC current leakage test on the exposed metallic parts of the cabinet, e.g. signal cable shell and screw heads. Using the test circuit shown in Fig.1, connect the monitor power lead, via an isolating transformer, to the mains supply and switch on.

Measure the AC leakage current between any exposed metallic parts of the cabinet and each pole of the isolated supply line in turn. The earth leakage current must not exceed 0.5mA rms.

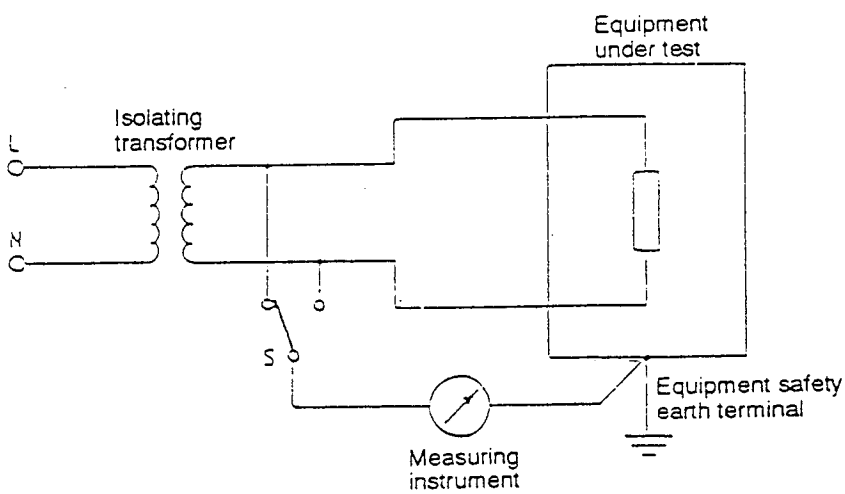


Fig.1. Measurement of AC Leakage Current.

2.6 Cabinet Back Removal

a). Place the monitor on its front, protecting the screen and cabinet with some suitable material, and remove the tilt/swivel base (if fitted) by pulling back its retaining clip at the rear of the swivel ball and, at the same time, sliding the swivel base towards the rear of the cabinet to release the bayonet catches.

b). Remove the retaining screw just above and to the left of the power inlet socket.

c). Remove the two retaining screws at the top left- and top right- hand corners of the cabinet back.

d). Remove the two retaining screws at the bottom left- and bottom right-hand corners of the cabinet back.

e). Carefully replace the cabinet on its base. Insert a screwdriver blade into the slot above each screw (item c). Press downward and forward to release the retaining tabs whilst easing the cabinet back away from the cabinet front.

f). The back can now be removed, threading the signal cable through its access opening.

Replace the cabinet back by reversing the procedure in steps a to f omitting item e. *Note: When re-assembling the cabinet, the retaining tabs mentioned in item e can be locked by pressing the cabinet back and front firmly together.*

2.7 Critical Safety Components

A number of electrical components in this monitor contribute to operating safety, and the protection afforded by them cannot necessarily be maintained by using replacement components rated for higher voltage, wattage, etc. They are identified by the ⚠ symbol which indicates that only manufacturer's approved replacements are to be used.

2.8 Servicing notes

2.8.1 Soldered Connections

Always wrap the lead wires around terminals before soldering.

2.8.2 Wire Replacement

Run connecting wires along their original routes in order to :-

Avoid introducing unwanted interference.
Avoid them being too close to high voltage or temperature.
Maintain safety approval standards.

SECTION 3. OPERATING INSTRUCTIONS

3.1 Connections

The monitor should be connected to a computer incorporating a VDE approved VGA graphics display card which supplies analogue RGB video signals. Connect the captive signal cable to the 15 pin output on the card and secure it in place with the locking screws. Connect the monitor and computer to the mains supply.

3.2 Controls

3.2.1 Power On/Off

The On/Off switch is located on the right by the Power On LED which should illuminate after approximately 3 seconds. The display should become visible within approximately 30 seconds of switching on. IMPORTANT. Repeatedly switching On and Off should be avoided. This action may activate the Safety Protection shut-down circuits. Should this occur or the supply be accidentally interrupted, allow 30 seconds for the circuits to reset before switching on again.

3.2.2 Contrast

This control varies the difference in intensity between black and coloured areas of the screen. After setting the brightness control as described below, set the contrast for the most comfortable display.

3.2.3 Brightness

This sets the average intensity of the whole display. Normally this control will be set at the centre detent position.

3.2.4 Plinth

The plinth can be rotated or tilted to improve the viewing angle.

SECTION 4. CIRCUIT DESCRIPTION

4.1 Power Supply

The power supply is of the flyback switch mode design based around the UC3842 current mode control IC.

European models are designed for 220/240V operation. In these models diodes D814-D817 form a full wave bridge rectifier and CE804 provides smoothing.

North American models are designed for 110-120V or 220-240V operation selectable by switch S802. With S802 open (220-240V operation), diodes D814-D817 form a full wave bridge rectifier and capacitors CE804 and CE805 in series provide smoothing. When S802 is closed (110-120V operation), diodes D814-D817 and capacitors CE804 and CE805 form a voltage doubler so that the rectified voltage at the transformer T801 primary is the same as for 220-240V operation.

Immediately after switch-on, current derived from the rectified mains input flows through R828/829 and D806, charging CE809 to approximately 17V. At this point IC805 makes a start attempt relying on stored charge in CE809 to supply current until the power supply starts. Operating current is then derived from a winding on the transformer via D807 at approximately 12V. The circuit operates as follows: TR804 is switched on, causing a linear rise in current in the primary winding (pins 11-12 of T801). After a period determined by the voltage drop across the current limit resistor R825, TR804 is then switched off and the energy stored in the flux of T801 is now transferred to the secondary circuits. Diodes D812 and D813 conduct until the transformer is demagnetized at which point, after a short delay, TR804 is switched on again as before.

The two secondary transformer windings produce 87V and 18V d.c. when rectified by D812 and D813 respectively. The energy stored in the leakage flux of T801 must be safely dissipated to avoid destruction of TR804.

The dv/dt is limited on TR804 drain by D804 which charges C807. In addition, D803 clamps the peak voltage to about 500V to prevent damage to TR804. Regulation is acheived by sensing the voltage developed on the feedback winding (pins 8-10 of T801) and the control signal is fed back to the error amplifier in IC805 via RV815 which is used to set the 87V rail to the correct level. This forms the voltage feedback loop. A current feedback loop is also employed on the primary side to sense the drain current in TR804. The linear ramp voltage across R825 (1V max) is fed into pin 3 of IC805. This is low pass filtered to remove transient spikes. The current feedback circuit actively limits the peak transformer flux during each cycle and is used to provide feed-forward compensation to improve regulation. The operating frequency is synchronized to the line output stage using a double-insulated single turn of wire around the flyback transformer core. This sync pulse is fed into IC805 via TR803.

4.2 Synchronisation

The incoming horizontal and vertical sync. pulses are fed to IC201 (74LS86) which has the function of providing positive sync pulses to the line and field oscillators. IC201 also provides automatic height adjustment for each mode.

4.5 Vertical Deflection

The incoming sync. signal locks the vertical oscillator to provide a steady, synchronized display. The series combination C305/306 charge from a current out of IC301 pin 9, mirrored at pin 7 into R340, RV315 and R304 to establish the correct height, producing a field rate ramp voltage on pin 9. The output current from pin 1 flows through the deflection coil, CE309, and R312. Feedback from R312 into pin 12 is compared with this internally generated ramp to produce a linear scan.

Vertical shift is achieved by providing positive or negative offset current into the DY using R317/318, with RV338 providing user adjustment to centre the display.

4.6 Horizontal Deflection

The incoming negative sync signal at pin 3 of IC401 causes the phase locked loop to bring the horizontal oscillator into lock. The oscillator frequency for the VGA modes is controlled by RV405, R404 and C402. The IC output from pin 1 drives TR402 which is connected to the line drive transformer T401. This provides the high base current and controlled turn-off characteristics required by the line output transistor TR403 which generates a sawtooth current waveform in the horizontal deflection coil. The line output section also includes a beam current limit circuit connected to the contrast control (RV589) so that the screen light output is automatically limited in the event of excessive brightness. The voltage on the wiper is pulled low by TR593 if the beam current exceeds 0.5mA. The diode split transformer T403 is used to generate the EHT and Focus voltages, CRT heater current (pin 7), line scan and A1 voltages (pin 10) and a -60V supply to the user brightness control

(RV585). A seperate single turn winding around the bobbin of T403 is used to synchronize the switched mode power supply to the video signal. The line scan waveform is rectified and smoothed by D406 and C424 to provide the A1 supply. R451, RV448 and R449 control the A1 voltage to set the correct brightness.

4.7 Pincushion Correction and Width.

The pincushion correction circuit is based around transistors TR302 and TR303 and their associated components. The vertical scan waveform from IC301 (pin 1) is integrated by C314, R327, R328, and C316 to produce the correct parabolic waveform. This signal is amplified by TR302 and TR303 to drive the control winding of the saturable reactor T402. The width of the horizontal scan is thus modulated by modulating the current in the secondary winding of T402. The scan width is set by the width coil L402 which is adjustable to achieve the correct display size. The horizontal centre of the display may be set by adjusting RV415 which adds an offset current to the deflection coils.

4.8 Blanking

IC301 produces a 1.5V field blanking pulse from pin 13. This is mixed with line flyback pulses from T402 pin 10, via C418, C419, C452 and R456. Output buffering is provided by TR591 to give composite blanking pulses. The blanking pulses are used to clamp the R,G, and B output signals from IC501 during blanking.

4.9 Video Circuits

The Z Series monitor can only accept RGB signals of 0.71V amplitude into 75 ohms. The incoming signals are capacitor coupled into the inputs of IC501. The function of IC501 is to provide gain control, cut-off control and clamping (d.c. restoration). The latter ensures that the outputs at pins 21, 25, and 29 of IC501 are directly able to drive their respective cascode amplifiers (e.g. TR901 and TR902 for the red channel), and the tube. The cascode amplifiers provide the CRT cathodes with a maximum of 40V drive from a 93V nominal black level (adjustable to 75V for cut-off adjustment).

4.10 Protection Circuits

4.10.1 Power Supply

The mains input fuse FS801 is of the IEC time-delay T2A type. Replacements must be of the same type and rating. Immediately after the power supply has started D802 is triggered into an 'on' state disabling the start-up circuit so that, in the event of a fault, the power supply is prevented from attempting to re-start. The power supply will shut down if any output is shorted after a single start attempt. R808 (fusible) will fail, going open circuit should TR804 become short circuited and R812 (fusible) will go open-circuit if CE810 goes short-circuit. Diodes D818, D819 ensure that if TR804 goes short-circuit and/or R825 fails open-circuit, the voltage at the feedback input of IC805 (pin 3) is limited to 1.5V to prevent damage to IC805.

4.10.2 Line Drive

R439 (fusible) protects against the possible (short-circuit) failure of C430. Similarly R446 (fusible) protects against the heater supply being short-circuited.

4.10.3 Line Scan

The EHT is protected from exceeding a safe limit by monitoring the flyback pulse amplitude at T403 pin 7. If it exceeds 35V the thyristor D424 triggers and 'crowbars' the +9V line oscillator supply to ground shutting down the line scan. The trigger typically operates at an EHT of about 27kV. The maximum beam current is automatically limited by TR593 during normal monitor operation.

SECTION 5. ADJUSTMENTS

5.1 Introduction

The Z Series incorporates a number of adjustments which are listed below. The monitor will have been correctly aligned before leaving the factory and adjustments should be made only if necessary.

5.1.1 Main pcb:

87V Adjust	RV815	*(N.B. This adjustment is notated '90V' on the P.W.B. This is a printing error).*
Horizonal (Line) Frequency	RV405	
Pincushion Amplitude	RV327	
H-Centre	RV415	
H-Phase	RV411	
Width	L402	
V-Size 480 line mode (Master)	RV315	
V-Size 400 line mode	RV208	(if fitted)
V-Size 350 line mode	RV211	(if fitted)
V-centre	RV338	
V-Linearity	RV316	
A1/Screen Voltage	RV448	
FBT Focus	FBT	

5.1.2 Video pcb

Red Gain	RV562	
Green Gain	RV502	
Blue Gain	RV532	
Red Cut-off	RV509	
Green Cut-off	RV569	(if fitted)
Blue Cut-off	RV539	

5.2 Adjustments

5.2.1 87V Adjustment

a) Apply a VGA signal with a blank pattern to monitor.
b) Set CONTRAST to MINIMUM and BRIGHTNESS to DETENT.
c) Check voltage at pin 1 of PL401 and adjust RV815 (87V ADJ) for a voltage of +87V ±1V.

5.2.2 Horizontal Frequency Adjustment

a) Apply a VGA signal with a full white pattern to monitor.
b) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
c) Disconnect horizontal sync(H+) from pin 3 of PL405.
d) Adjust RV405(H.FREQ) for stable display or, if a frequency counter is available, measure the frequency at pin 1, IC401, and set to 31.5kHz.

5.2.3 Focus Adjustment

a) Apply a VGA signal with a cross hatch pattern to monitor.
b) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
c) Adjust focus control until display has best overall focus.

5.2.4 Horizontal Phase Adjustment.

a) Apply a VGA signal with a full white pattern to monitor.
b) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
c) Adjust RV411(H.PHASE) to centre the display raster within the bezel.

5.2.5 Vertical Linearity Adjustment

a) Apply a VGA signal with a cross hatch pattern to monitor.
b) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
c) Adjust RV316(V.LIN) until the difference between the smallest and the largest is less than 5%.

5.2.6 Horizontal Width Adjustment

a) Apply a VGA signal with a cross hatch pattern to monitor.
b) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
c) Adjust L402(WIDTH) until display width is 240mm ±2mm.

5.2.7 Vertical Size Adjustment

a) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
b) Apply a VGA signal mode 3 with a cross hatch pattern to monitor.
c) Adjust RV315(HEIGHT 480) to give a display height of 180mm ±2mm.
d) Apply a VGA signal mode 2 with a cross hatch pattern to monitor.
e) Adjust RV208(HEIGHT 400) to give a display height of 180mm ±5mm.
f) Apply a VGA signal mode 1 with a cross hatch pattern to monitor.
g) Adjust RV211(HEIGHT 350) to give a display height of 180mm ±5mm.

5.2.8 Vertical Centre Adjustment

a) Apply a VGA signal with a cross hatch pattern to monitor.
b) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
c) Adjust RV338(V.CENTRE) to centralize raster.

5.2.9 Pincushion Adjustment

a) Apply a VGA signal with a cross hatch pattern to monitor.
b) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
c) Adjust RV327(PINCUSHION) for straight vertical edges and no stepped changes.
d) Ensure no barrel distortion occurs because of this adjustment.

5.2.10 White Balance Adjustment

a) Apply a VGA signal with a blank pattern to the monitor.
b) Set CONTRAST to MINIMUM and BRIGHTNESS to MAXIMUM.
c) Set video cut-off pots. RV509, RV539 and RV569 fully anti-clockwise.
d) Using a light meter, adjust RV448(A1) until a light output of (Y) 3 ±0.5cd/m^2 is obtained.
e) Observe the readings of (x) and (y) and adjust ONLY TWO CUT-OFF pots. either RV509(RED) or RV569(GREEN) or RV539(BLUE)to obtain (y) = 0.311 ±0.005 (x) = 0.281 ±0.005
f) Check (Y) is still 3 ±0.5 cd/m^2, adjust RV448(A1) if necessary.
g) Apply a VGA signal with a 50mm X 50mm white block pattern to monitor.
h) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
i) Adjust RV502(GREEN gain) to give a (Y) reading of 76 ±1cd/m^2.
j) Adjust RV562(RED gain) to give a yellow display.
k) Adjust RV532(BLUE gain) to give a white display.
l) Using a light meter,
Adjust RV532(BLUE gain) to give a (y) = 0.311 ±0.005
Adjust RV562(RED gain) to give an (x) = 0.281 ±0.005
o) Check (Y) reading is 100 +15 -10 cd/m^2.
p) Adjust CONTRAST control to give a (Y) reading of 17 cd/m^2. Check the (x) and (y) readings are within ±0.015 of those in l). If out of spec. adjust RV509(RED) and RV539(BLUE) accordingly.

5.2.11 Static Convergence Adjustment

a) Apply a VGA signal with a cross hatch pattern to monitor.
b) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
c) Check that the convergence error in the centre of the display tube is less than 0.3mm, outside this less than 0.5mm. If errors are outside these limits, then the convergence rings on the neck of the display tube are to be adjusted.

5.2.12 Purity

a) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
b) Apply a VGA signal with a full Red pattern.
c) Check for any discolouration of the Red raster.
d) Apply a VGA signal with a full Green pattern.
e) Check for any discolouration of the Green raster.
f) Apply a VGA signal with a full Blue pattern.
g) Check for any discolouration of the Blue raster.

5.2.13 Dual Voltage Version (240/110V)

Note: This section applies to dual voltage models only. For 220/240V models, disregard this section.

a) Disconnect 220/240V mains supply.
b) Switch to 110V operation.
c) Connect 110V mains supply.
d) Switch on mains supply.
e) Set CONTRAST to MAXIMUM and BRIGHTNESS to DETENT.
f) Apply a VGA signal with a full white pattern.
g) Check that display is normal.
h) Disconnect the 110V mains supply.
i) Switch to 220/240V operation.
j) Connect 220/240V mains supply.
k) Switch on mains supply.
l) Check that display is normal.

5.2.14 SAFETY TEST (POWER DISCONNECTED, SWITCH ON S801)⚠

*Note: SAFETY TEST MUST BE CARRIED OUT ON ALL MONITORS. A CHASSIS FAILING ANY PART OF 5.2.14 **MUST BE REJECTED***

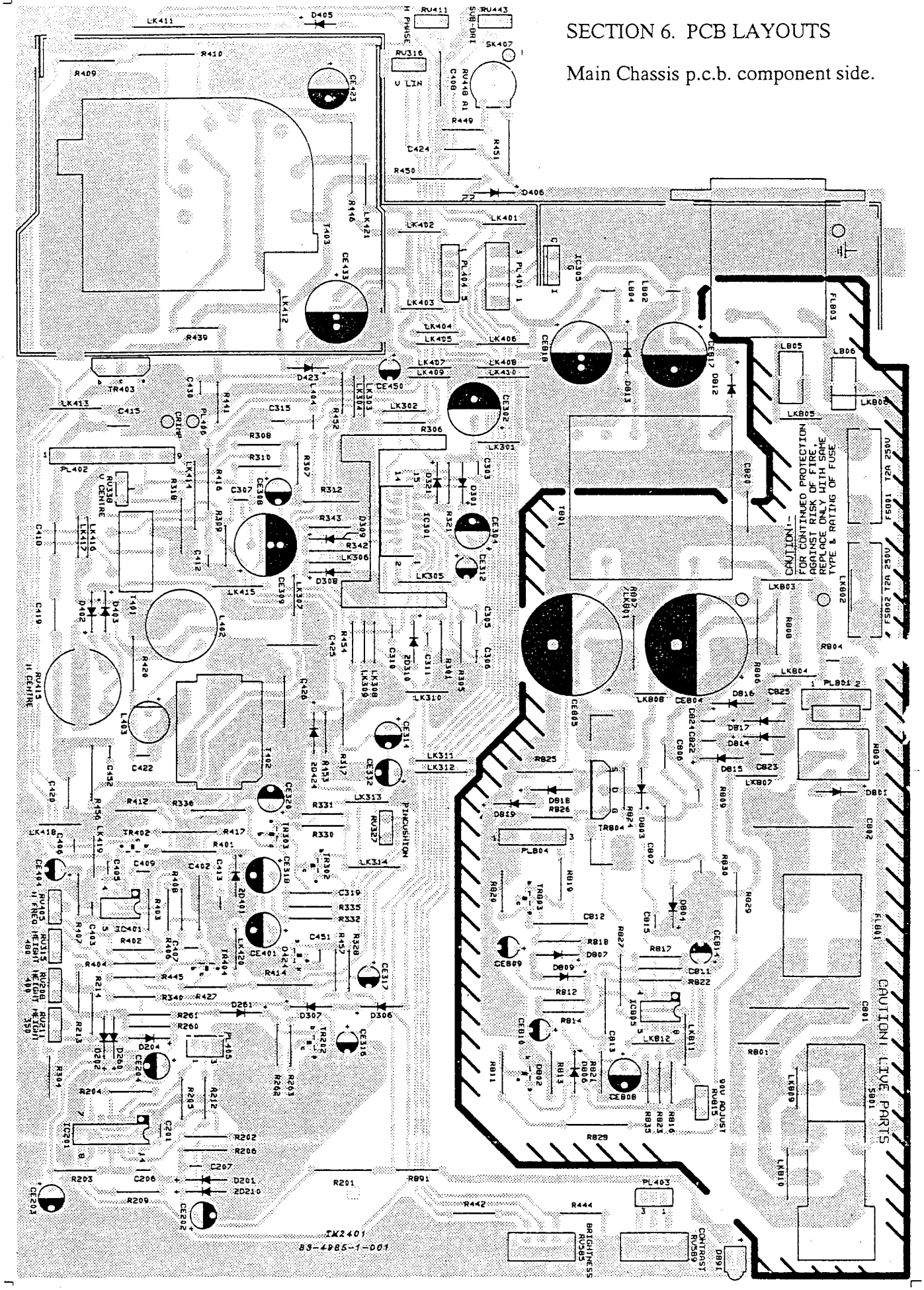
a) CHECK LEAKAGE FROM LIVE AND NEUTRAL TO THE PROTECTIVE EARTH. LEAKAGE CURRENT SHOULD NOT EXCEED 3.5mA. (EN 60950 Paragraph 5.2.3 reference to appendix C) TYPICAL READING 0.5mA.

b) THE RESISTANCE OF THE SIGNAL CABLE SHELL TO THE PROTECTIVE EARTH MUST NOT EXCEED 0.1 Ohms.

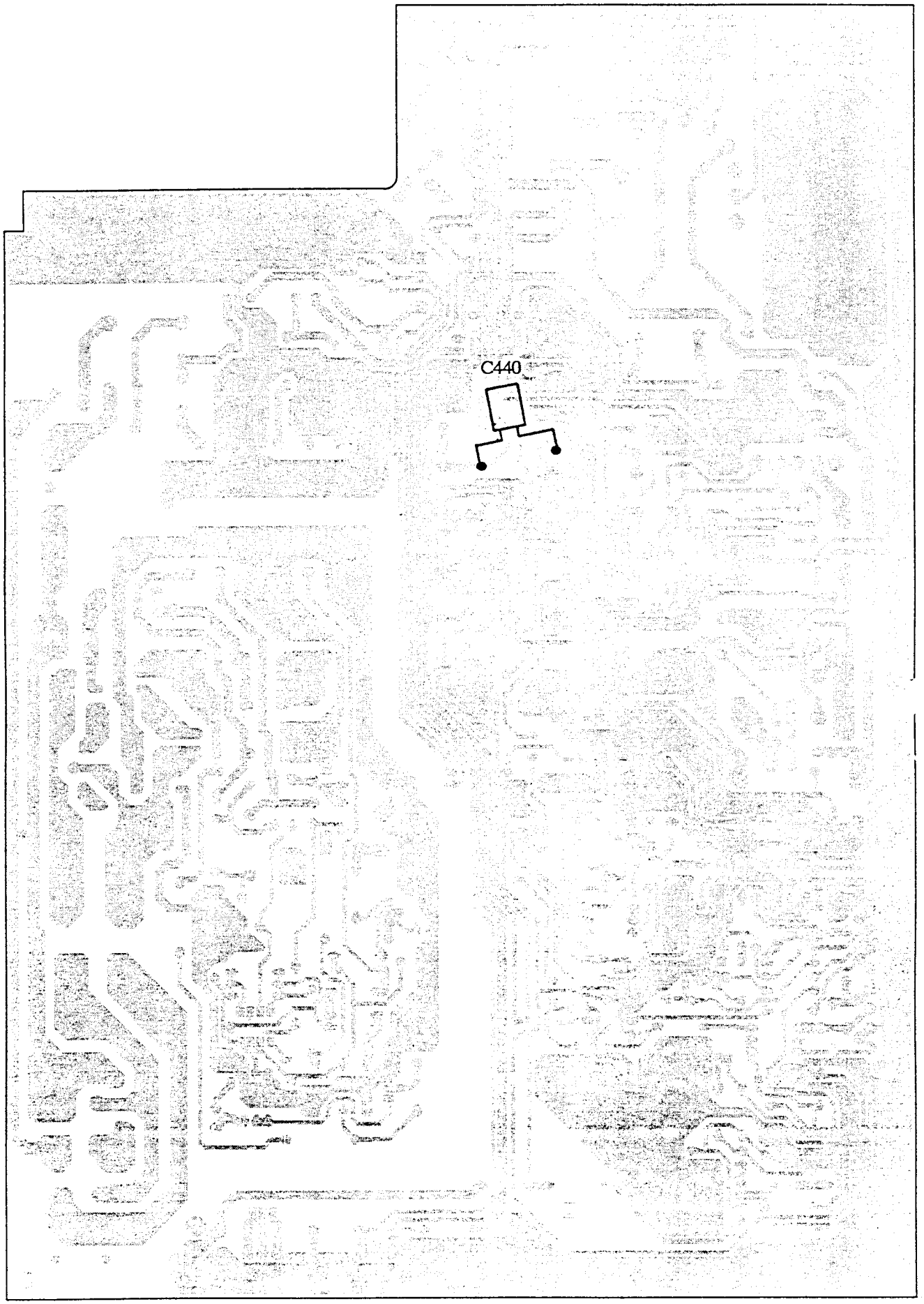
c) HAVING CONNECTED LIVE AND NEUTRAL TOGETHER, A BREAKDOWN TEST OF 2120V D.C. APPLIED BETWEEN LIVE/NEUTRAL AND EARTH MUST NOT RESULT IN AN INSULATION FAILURE OR BREAKDOWN.

SECTION 6. PCB LAYOUTS

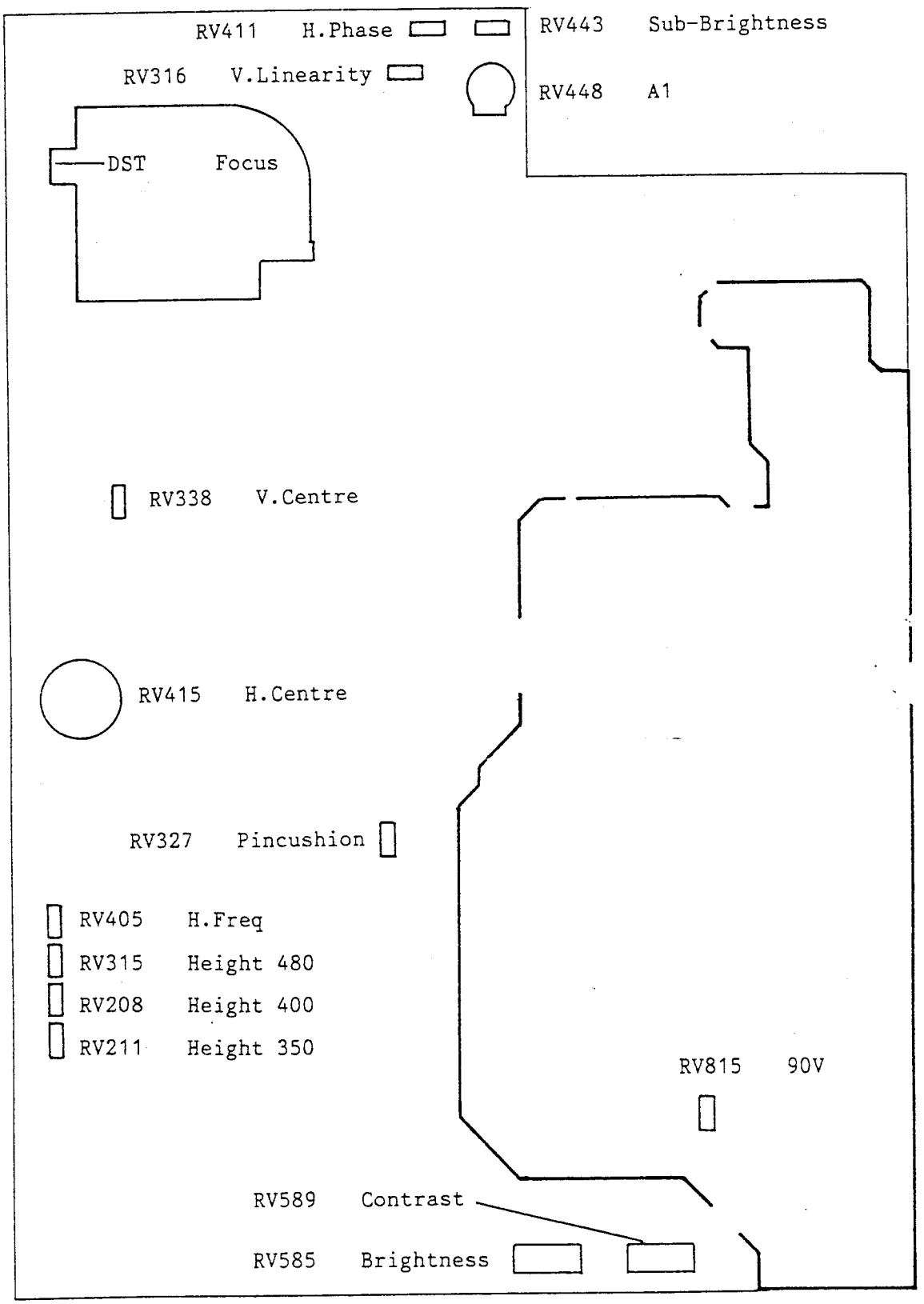
Main Chassis p.c.b. component side.



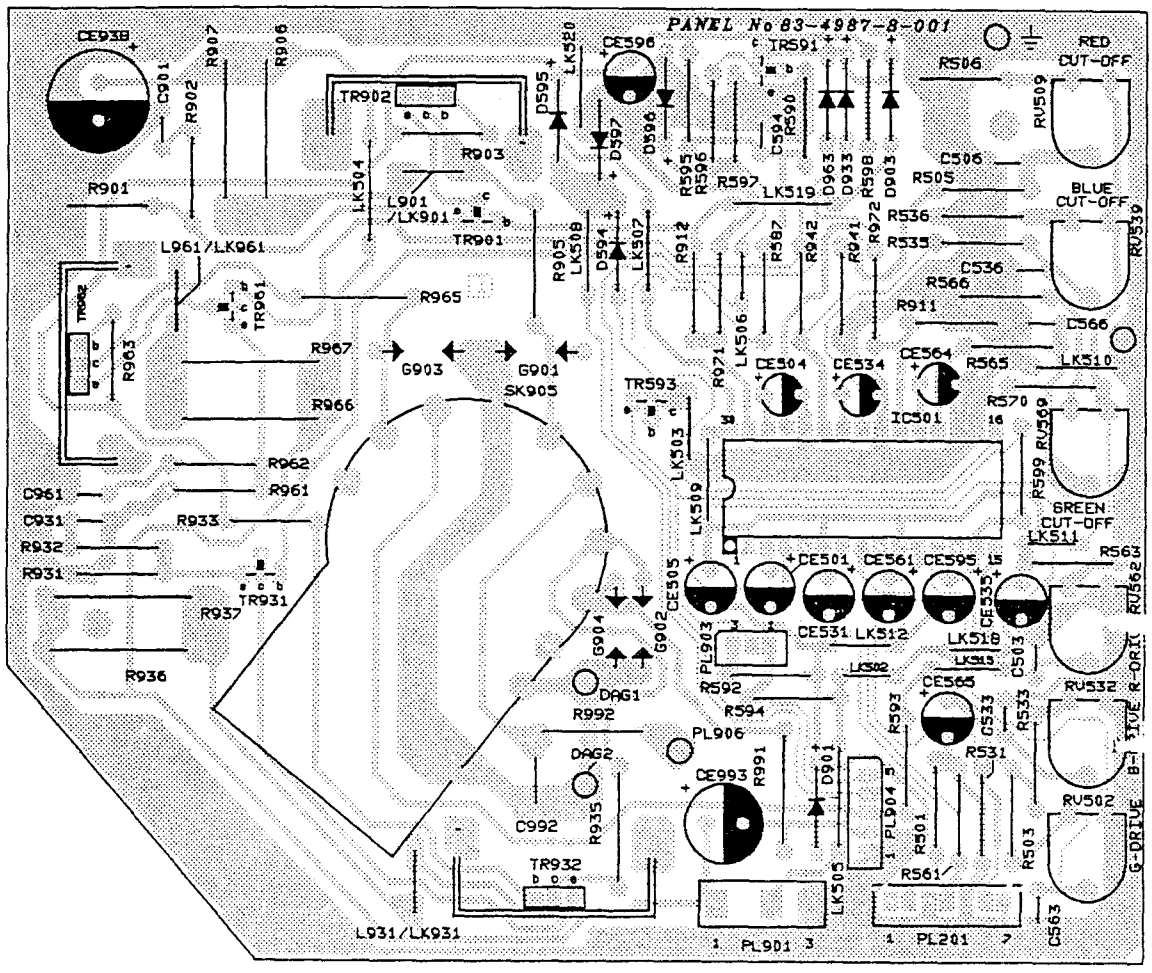
Main Chassis p.c.b. trackside components.



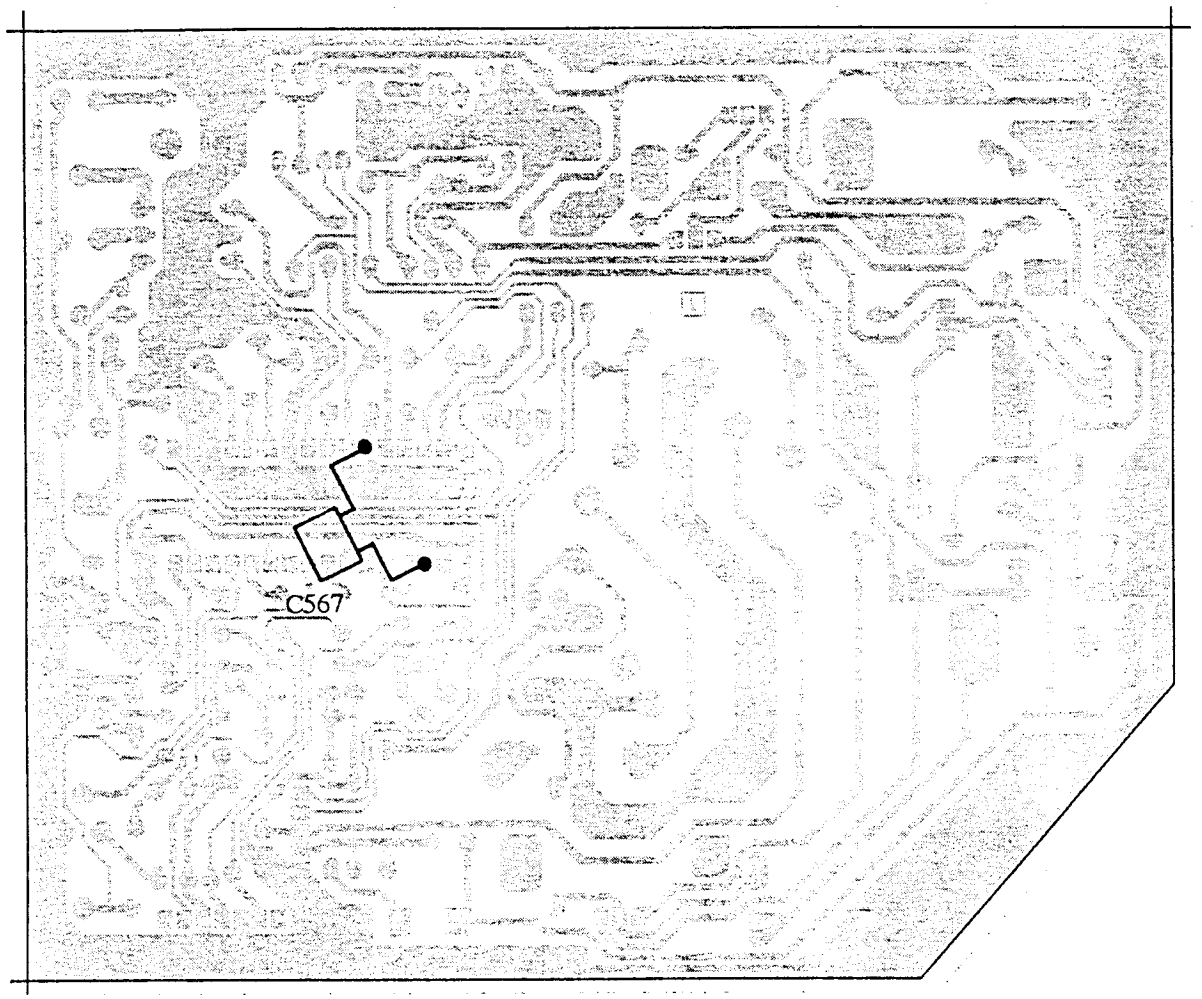
Main Chassis adjustment locations.



Video p.c.b. component side.



Video p.c.b. trackside components.



SECTION 7. COMPONENTS LIST

To obtain spare parts, contact the Service Division at TATUNG (UK) Ltd., P.O.Box 230, Telford, Shropshire, TF2 6SP

Components marked ⚠ are safety critical approved types and **must** be replaced with components supplied by the Service Division. All other parts should be replaced with components of the same type and rating as those originally fitted.

7.1 Resistors

The majority of resistors are carbon film types (0.125W, 0.25W, 0.4W, 0.5W), and are not listed. Refer to the circuit diagram for values. Replacements should always be of a power rating equal to the originals. This is particularly important for those resistors `stood off' the printed circuit board.

Legend: All components marked thus # are used on switchable mains input models.

Circuit Ref	Val	Tol%	Watts	Type	Code Number	
R201	470R	5	1	M-Film	11-5556-3	
⚠R312	1R	5	0.5	M-Film	11-4268-2	
R317	300R	5	1	M-Film	11-5557-1	
R318,414	120R	5	1	M-Film	11-5560-1	
⚠R416	5K6	5	2	M-Film	11-5547-4	
R420	820R	5	1	M-Film	11-5562-8	
R427	43K	1	0.25	M-Film	11-5482-6	
⚠R439	1K	5	0.5	M-Film Fus	11-4292-5	
⚠R446	1R5	5	1	W/W Fus	11-5647-0	
R449	1M2	5	0.6	M-Film	11-5565-2	
R450	47K	5	1	C-Film	11-4293-3	
R456	18K	5	1	M-Film	11-5563-6	
⚠R801	820K	5	0.25	C-Film	11-3358-6	
⚠R803	18R	--	--	Thermistor	11-5531-8	#
⚠R803		--	--	Thermister	11-3569-4	
⚠R804	10R	--	--	Thermistor	11-5529-6	
R806,807	150K	5	1	M-Oxide	11-5315-3	#
⚠R808	0R5	5	1	W/W	11-5578-4	
R809	18K	5	5	W/W	11-5576-8	
R811	360R	2	0.4	M-Film	11-5336-6	
⚠R812	6R8	5	0.25	M-Film	11-5579-2	
R814	10K7	1	0.25	M-Film	11-5555-5	
R825	0R39	10	1	M-Oxide	11-5574-1	
R828,829	39K	5	2	M-Film	11-5548-2	
R830	2K5	5	7	W/W	11-5580-6	
R905,935,965	470R	5	0.6	M-Film	11-5567-9	
R906,936,966	3K0	5	3	M-Film	11-5627-6	
R991	1K	10	0.5	C-Comp	11-2621-0	
R992	330K	5	0.6	M-Film	11-5566-0	
RV208	1M	25	--	Pot Lin	12-4577-5	
RV211,315,316	100K	25	--	Pot Lin	12-3202-9	
RV327,405,411	4K7	25	--	Pot Lin	12-3204-5	
RV338	5K	20	0.5	Pot Lin	12-4578-3	
RV415	500R	20	5	Pot Lin	12-3209-6	
RV443	100K	25	--	Pot Lin	12-3202-9	
RV448	2M2	--	0.5	Pot Lin	12-4579-1	
RV502,532,562	22K	25	--	Pot Lin	12-3180-4	
RV509,539,569	10K	25	--	Pot Lin	12-3179-0	
RV585	50K	20	--	Pot Lin	12-4575-9	
RV589	5K	20	--	Pot Lin	12-4576-7	
RV815	470R	25	--	Pot Lin	12-3211-8	

7.2 Capacitors

The majority of capacitors used are standard off-the-shelf items. Refer to the circuit diagram for values. Replacements must be of the same tolerance and rating as the originals.

Key to Type Codes:

Metalized Polyester - MP, Polypropylene - PP, Polyester - P, Metalized Polypropylene - MPP, Ceramic Plate - C, Polystyrene - PS, Electrolytic - E, Ceramic Disc - CD, Metalized Polystyrene - MPS.

Circuit Ref	Val	Tol%	Volts	Type	Code Number
C201	10n	-20+80	63	C	14-6892-8
C207	22n	10	250	MP	14-6877-4
CE314	10µ	20	100	E	14-7043-4
C402	3n3	1	160	PS	14-4849-8
C406	10n	5	400	MP	14-6842-1
C407	1n	10	100	C	14-6934-7
C412	22n	10	250	MP	14-6877-4
C413	1n	20	400	CD	14-4320-8
C415	470p	10	1K5V	PP	14-6985-1
C418,419,420	15n	5	630	PP	14-7173-2
C422	1n	20	400	CD	14-4320-8
CE423	10µ	20	160	E	14-7044-2
C424	4n7	10	2kV	C	14-7172-4
C425,426	330n	5	250	MP	14-7177-5
CE433	47µ	20	160	E	14-7120-1
C452	18p	5	500	CD	14-7171-6
C503,506,533, C536,563,566	10n	-20+80	63	C	14-6892-8
⚠C801,802,	470n	20	250	AC Mains	14-7029-9
CE804	100µ	20	400	E	14-7079-5
CE804,805	220µ	20	200	E	14-7142-2 #
C806	10n	-20+50	2kV	CD	14-6954-1
C807	1n	5	1k6V	PP	14-7174-0
C812	3n3	1	160	PS	14-4849-8
C815	1n	10	100	C	14-6934-7
CE817	100µ	20	160	E	14-7144-9
⚠C820	2n2	20	400	AC	14-7033-7
⚠C992	470p	10	2kV	CD	14-2804-7
CE938	22µ	20	160	E	14-7193-7
CE993	3µ3	20	160	E	14-7167-8

7.3 Integrated Circuits

Circuit Ref	Description	Code Number
IC201	74LS86	19-8008-4
IC301	TDA1675A SGS Thomson	19-8480-2
IC305	Regulator +12V, 0.5A T0220	19-8398-9
IC401	LM1391N Nat Semi	19-8317-2
IC501	M51387P	19-8434-9
IC805	UC3842AN	19-8696-1

CONTENTS

ILLUSTRATIONS

7.4 Transistors

Circuit Ref	Description	Code Number
TR202,302, TR404,803	2SC1815Y Toshiba	19-8590-6
TR303	BC327	19-8147-1
TR402	2SD667AC Hitachi	19-8533-7
TR403	2SD2125 Toshiba	19-8701-1
TR591	PH2369	19-8324-5
TR593	BC557B Philips	19-8228-1
TR804	2SK538 Toshiba	19-8616-3
TR901,931,961	2SD468C Hitachi	19-8546-9
TR902,932,962	2SD1610C Hitachi	19-8613-9

7.5 Diodes

Circuit Ref	Description	Code Number
D201,202,204,260, D261,306-309,321, D594-597,903,933, D963	1N4148	19-3992-0
D301	GP15D GI	19-8617-1
D402,403,818,819	1N4003	19-8346-6
D405	RGP10D GI	19-8603-1
D406	RGP02-20 GI	19-8498-5
⚠D423	TVR1B-TPA3 Toshiba	19-8619-8
D424,802	TICP106D Texas	19-8544-2
D803,804	BYD33M	19-8393-8
D806	1N4002	19-8345-8
D807,809	RGP10D GI	19-8603-1
D812	RG3J	19-8614-7
D813	RGP15J GI	19-8609-0
D814,815, D816,817	BY133GP	19-8144-7
D891	LED Green 90°	19-8505-1
D901	RGP10D GI	19-8603-1
ZD210	C5V1 5% 345mW	19-6295-7
ZD310	C2V7 5% 345mW	19-8012-2
ZD401	C9V1 5% 345mW	19-4033-3
⚠ZD424	C6V2 5% 350mW	19-8033-5

7.6 Inductors

Circuit Ref	Description	Code Number
⚠FL801	Filter TLF-011	15-7688-7
⚠FL803	Filter Line	87-0138-5
⚠FL803	Filter Line	15-7783-2 #
L402	Coil Width TWH-142	15-7795-6
L403	Coil Lin. L5302	15-7683-6
L404	Choke 700µH	15-7679-8
L802	TSH-170	15-7796-4
L804	Choke TLN-2026	15-7797-2
L805,806	Choke 100µH 10%	15-7799-9
⚠L901	Degaussing Coil 14"	85-9965-3

7.7 Transformers

Circuit Ref	Description	Code Number
T401	TLN-129A	15-7684-4
T402	TPC0022	15-7811-1
⚠T403	Transformer Flyback	15-7810-3
⚠T801	Transformer SM PSU (TPW466)	15-7808-1

7.8 Connectors

Circuit Ref	Description	Code Number
PL201	7 Way Plug B7B-XH-A JST	22-8261-7
PL401	3 Way Plug 5287 Molex	22-8369-7
PL402	Base & Pin 6P HBR-206C	22-8255-0
PL403	W/Harness contrast	83-5002-7-001
PL404	5 Way Plug 5267-05	22-8364-6
PL405	3 Way Plug B3B-XH-A JST	22-8187-2
PL406, G2	PCB Pin 2.36mm Molex	22-8421-9
PL801	2 Way Plug SE20/4451	42-0211-2
PL804	3 Way Plug RTB-1.5-3 JST	22-8279-8
PL901	W/Harness video power	83-5169-4-001
PL904	W/Harness video signal	83-5170-8-001
PL903	3 Way Header straight	22-8372-7
SK407	Wiring Harness A1	83-5171-6-001
⚠SK905	CRT Base Std Neck	25-2066-4

7.9 CRT

Circuit Ref	Description	Code Number
-	⚠14" CDT E2971B22TC47ET(Y) CPT 0.39mm dot pitch tube	18-1039-1

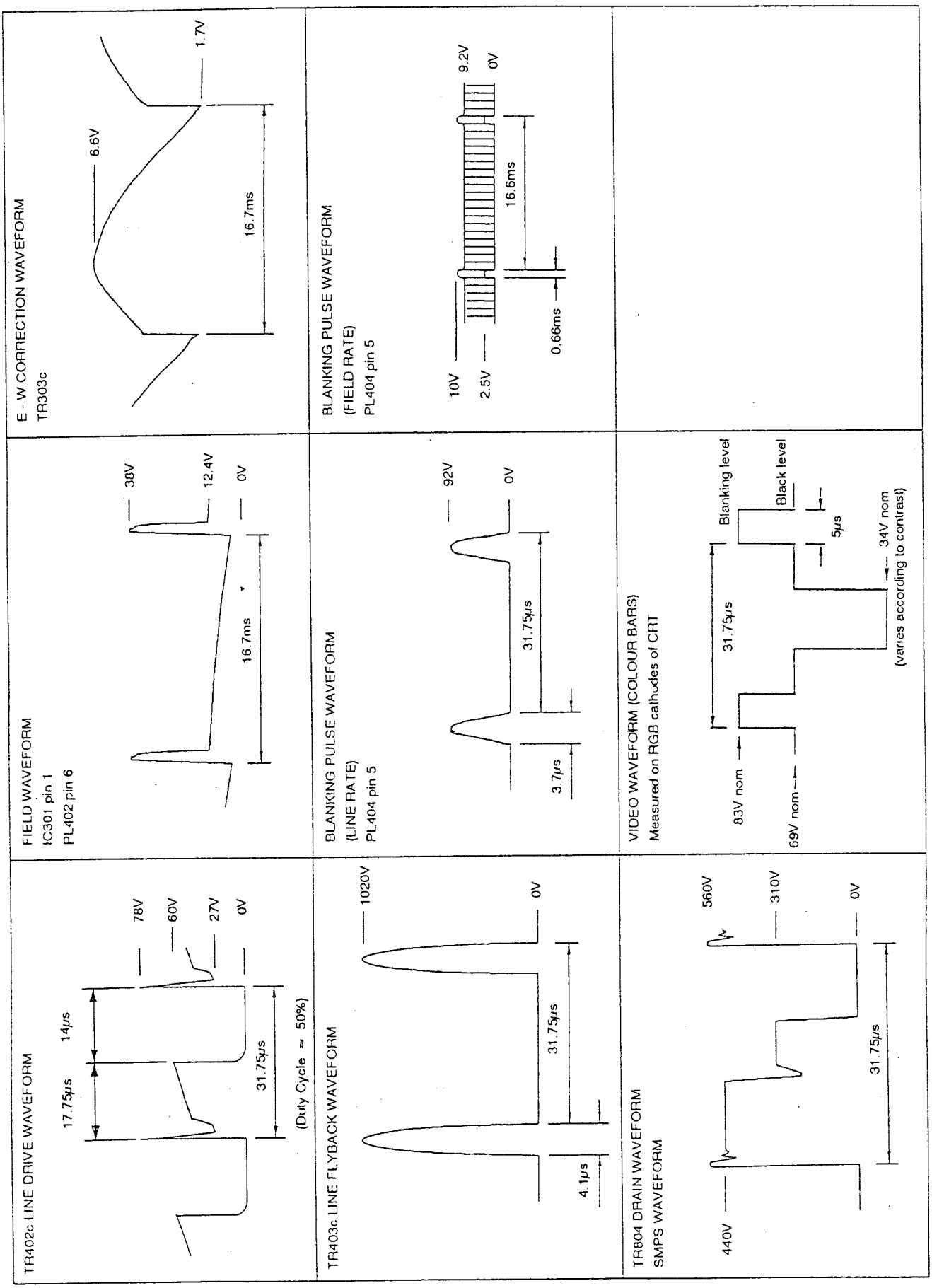
7.10 Miscellaneous

Circuit Ref	Description	Code Number	
⚠FS801	Fuse Timelag 2A	21-3685-6	
⚠FS801A	Fuse Holder DE611/01 Philips	21-3712-7	
⚠S801	Switch 2 Pol Mains DPST	20-4091-3	
⚠S802	Switch Slide SPDT	20-4090-5	#
⚠G901-904	Spark Gap DSP-201M-A11F Mitsubishi	21-3727-5	
	Earthing Braid Assembly	83-5313-1-002	
	⚠Mains Cordset IEC320 10A, 1 Metre	22-8366-2	
	⚠Power Cordset UL	22-8355-7	#
	⚠Back Cover MX2	83-4002-1	
	⚠Back Cover	83-4002-1-102	#
	⚠Chassis Rail LH	83-4004-8-003	
	⚠Chassis Rail RH	83-4005-6-003	
	⚠Knob On/Off Long	83-5261-5-001	
	⚠Knob On/Off Long	83-4919-3-101	#
	⚠Knob V/R	83-4008-0-002	
	Swivel Base	83-5527-4-001	or
	Swivel Base	83-4056-0-002	
	Swivel Base MX2/MX3	83-5024-8-001	#
	Swivel Top	83-5528-2-003	
	Swivel Top MX2/MX3	83-4057-9-002	
	Swivel Washer	83-4148-6-003	
	Lead E2	83-5168-6-001	
	Lead Dag Earth	83-4098-6-001	
	Lead Video Earth	83-5248-8-001	
	⚠Lead P-Band Earth	83-5249-6-003	
	Prism	83-4315-2	
	⚠Front Cover MX2	83-4327-6	
	⚠Front Cover MX2A	83-5060-4-002	#

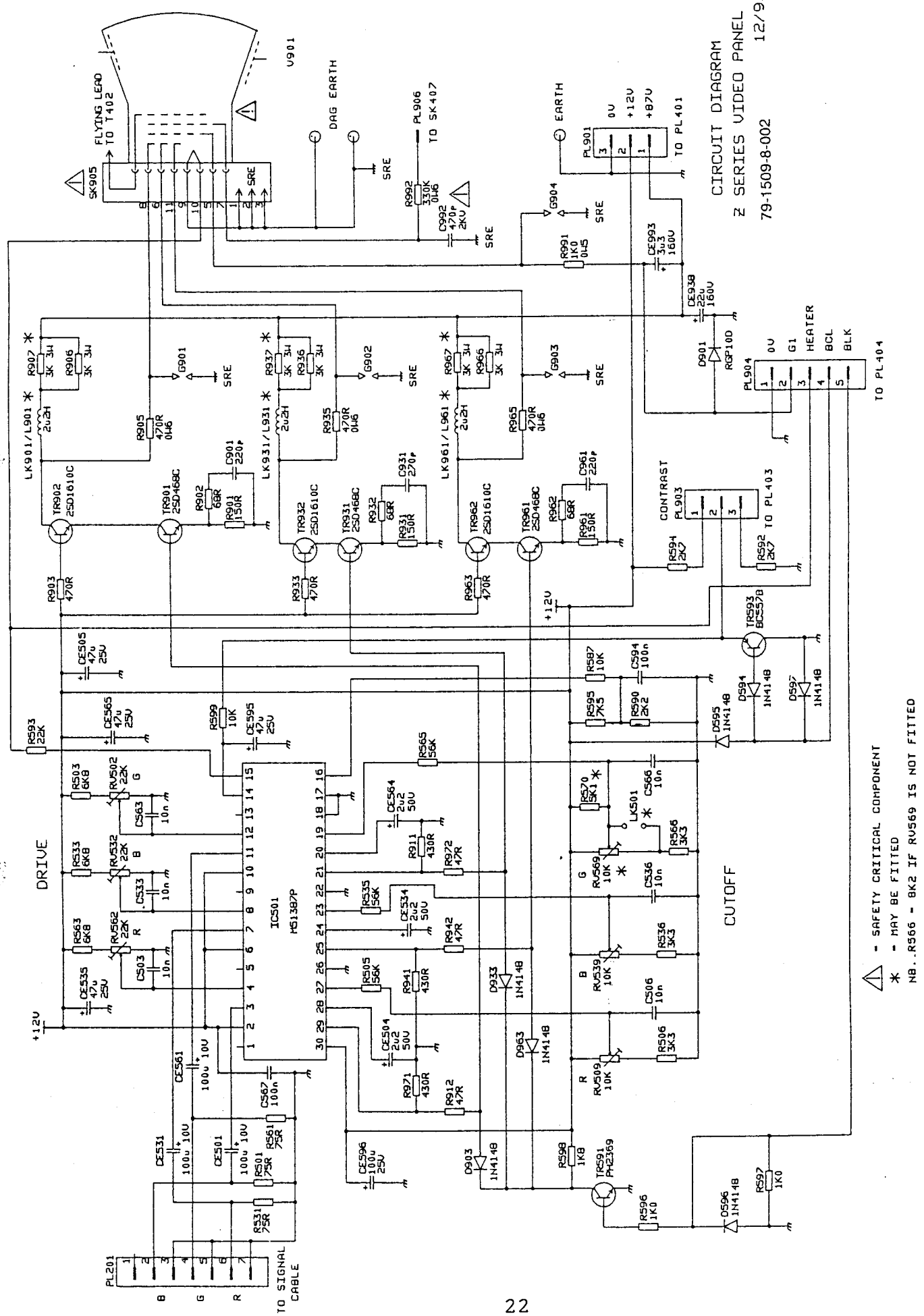
	⚠Lead Primary Earth	83-5273-9-001
	Lead Video Screen Earth	83-5276-3-001
	Lead Signal Cable	83-5280-1-002
	Foot Rubber (White)	83-5020-5-002
	Mains Filter Support Rail	83-5234-8-003
	Bracket Hook Locating	83-5073-6-001
	Op Instructions Z Series 110/220V	79-1464-4-002
	Op Instructions Z Series 220/240V	79-1463-6-002
PCB Assemblies	Mian chassis	01-0523-6
	Video panel	01-0516-3

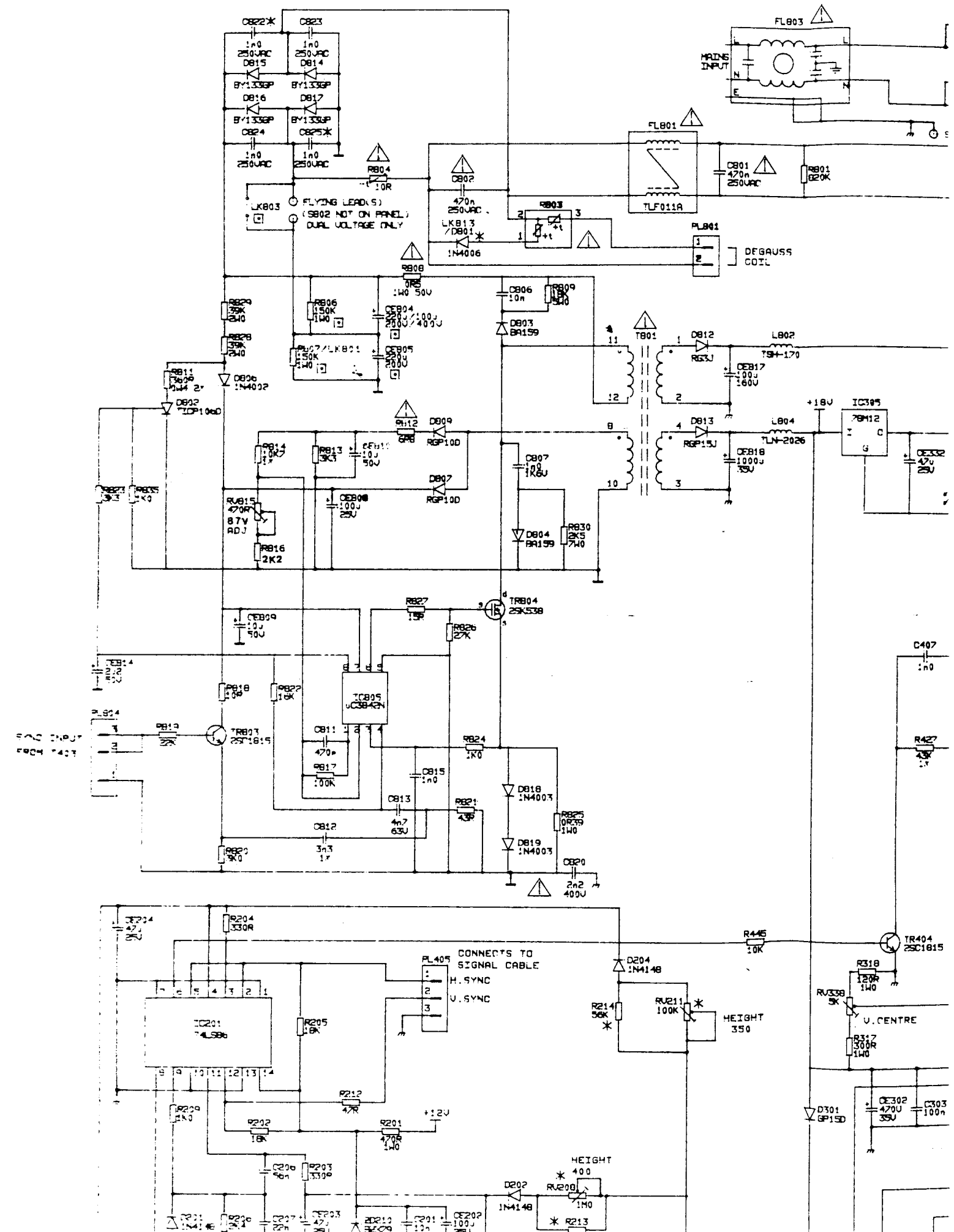
SECTION 8. WAVEFORMS and CIRCUIT DIAGRAMS

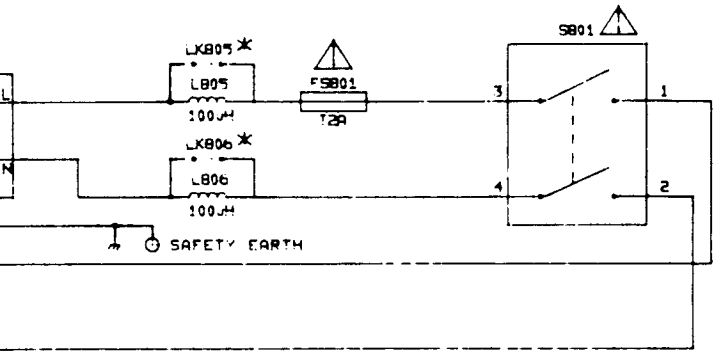
8.1 Waveforms

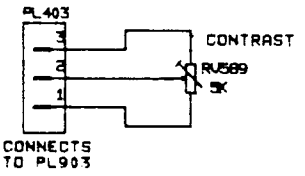


8.2 Video Panel Circuit Diagram




C822*
C823
1n0 250VAC
D815 BY133GP
D814 BY133GP
D816 BY133GP
D817 BY133GP
C824
C825*
R804 10R
LK803
FLYING LEAD(S)
(S802 NOT ON PANEL)
DUAL VOLTAGE ONLY
C802 470n 250VAC
LK813 /D801
1N4006
R803
FL803
MAINS INPUT
FL801
TLF011A
C801 470n 250VAC
R801 820K
PL801
DEGAUSS COIL
R808 0R5 1W0 5%
R829 39K 2W0
R828 39K 2W0
R806 150K 1W0
RV807/LK801 150K 1W0
CE804 220U/100U 200V/400V
CE805 220U 200V
D806 1N4002
R811 360R 1W4 2%
D802 TDP10D0
C806 10n
R809 1K5 5W0
D803 BA159
TB01
D812 RS3J
L802 TSH-170
CE817 100U 160V
D813 RGP15J
L804 TLN-2026
CE818 1000U 35V
+18V
IC305 78M12
CE332 47U 25V
R812 68R
D809 RGP10D
R814 10K 1%
R813 3K3
CE810 10U 50V
D807 RGP10D
C807 1n0 1K6V
D804 BA159
R830 2K5 7W0
RV815 470R 87V ADJ
R816 2K2
CE808 100U 25V
R827 15R
TR804 2SK538
R826 27K
CE809 10U 50V
CE814 2u2 50V
R818 10R
R822 10K
IC805 uC3842N
PL804
R819 22K
TR803 2SK1815
C811 470p
R817 100K
R824 1K0
C815 1n0
C813 4n7 63V
R821 43R
D818 1N4003
D819 1N4003
R825 0R39 1W0
C812 3n3 1%
R820 3K0
C820 2n2 400V
C407 1n0
R427 43R 1%
CE214 47U 25V
R204 330R
PL405 CONNECTS TO SIGNAL CABLE
H.SYNC
V.SYNC
IC201 74LS86
R205 10K
R212 47R
R209 1K0
R202 10K
R201 470R 1W0
+12V
R445 10K
D204 1N4148
R214 56K
RV211 100K
HEIGHT 350
TR404 2SC1815
R318 120R 1W0
RV338 5K
V.CENTRE
R317 300R 1W0
D301 GP15D
CE302 470U 35V
C303 100n
HEIGHT 400
D202 1N4148
RV200 1M0
R213
C206 56n
R203 330R
CE203 47U
CE202 100U





SAFETY AND ISOLATION

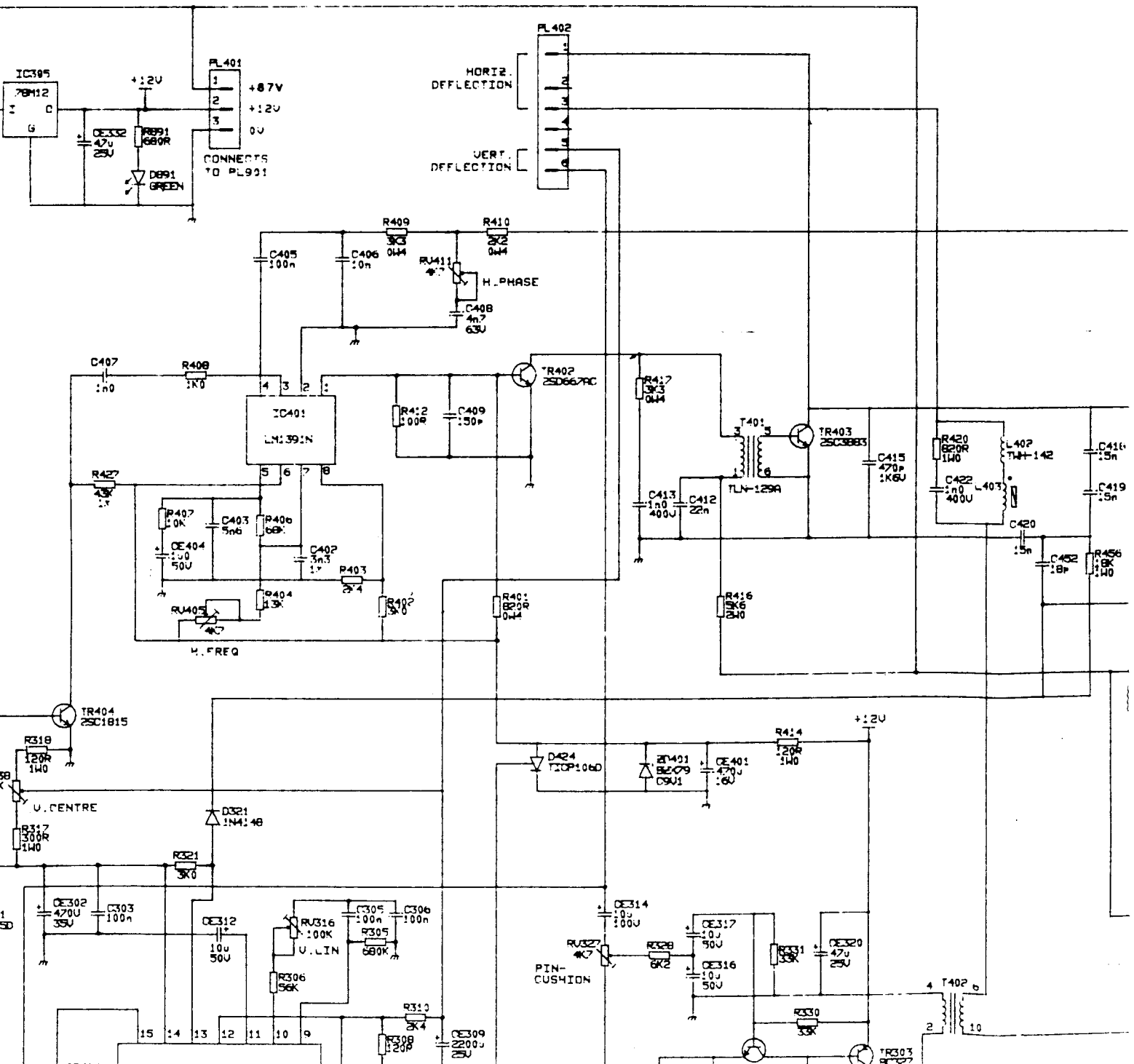
THE POWER SUPPLY IS ALWAYS LIV
POLARITY. THEREFORE, FOR SERVI
THROUGH A MAINS ISOLATION TRAN

THE POWER SUPPLY REMAINS CHA
SWITCHING OFF; AVOID TOUCHING

MOST OF THE MONITOR, OTHER THA
MAINS BY T801, C823 AND AN AIR GA
ENSURE THAT AFTER REPAIR THE A
WIRES etc.

COMPONENTS MARKED ⚠ IN THE
SAFETY APPROVED TYPES AND SHO
SUPPLIED OR APPROVED BY OUR SE
THAT OTHER REPLACED PARTS SHO
PARTICULARLY RESISTORS STOOD

FAILURE TO OBSERVE T
CHASSIS AND EXTERNA
CAUSE OTHER HAZARDS



SAFETY AND ISOLATION

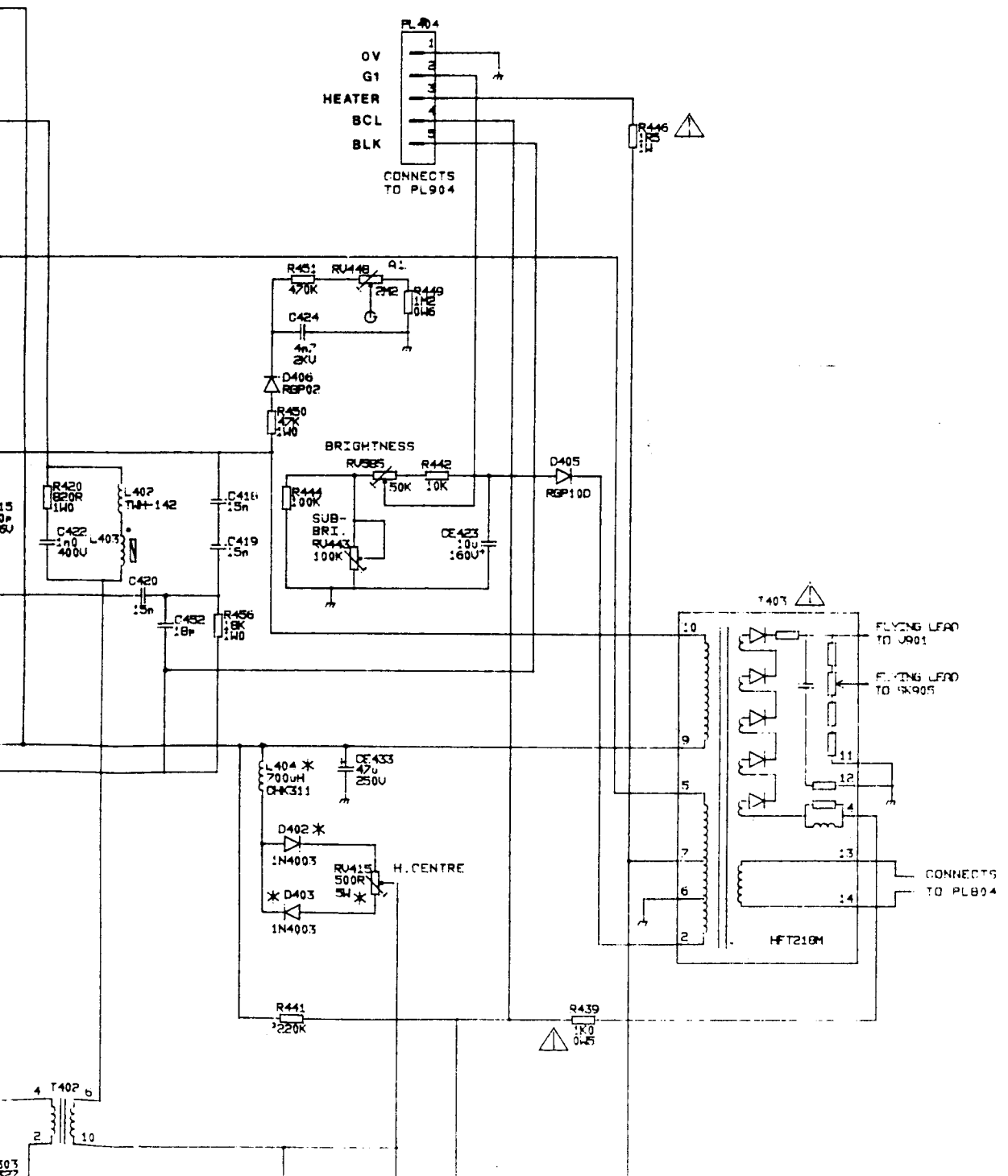
THE POWER SUPPLY IS ALWAYS LIVE REGARDLESS OF THE MAINS SUPPLY POLARITY. THEREFORE, FOR SERVICING, THE MONITOR SHOULD BE SUPPLIED THROUGH A MAINS ISOLATION TRANSFORMER.

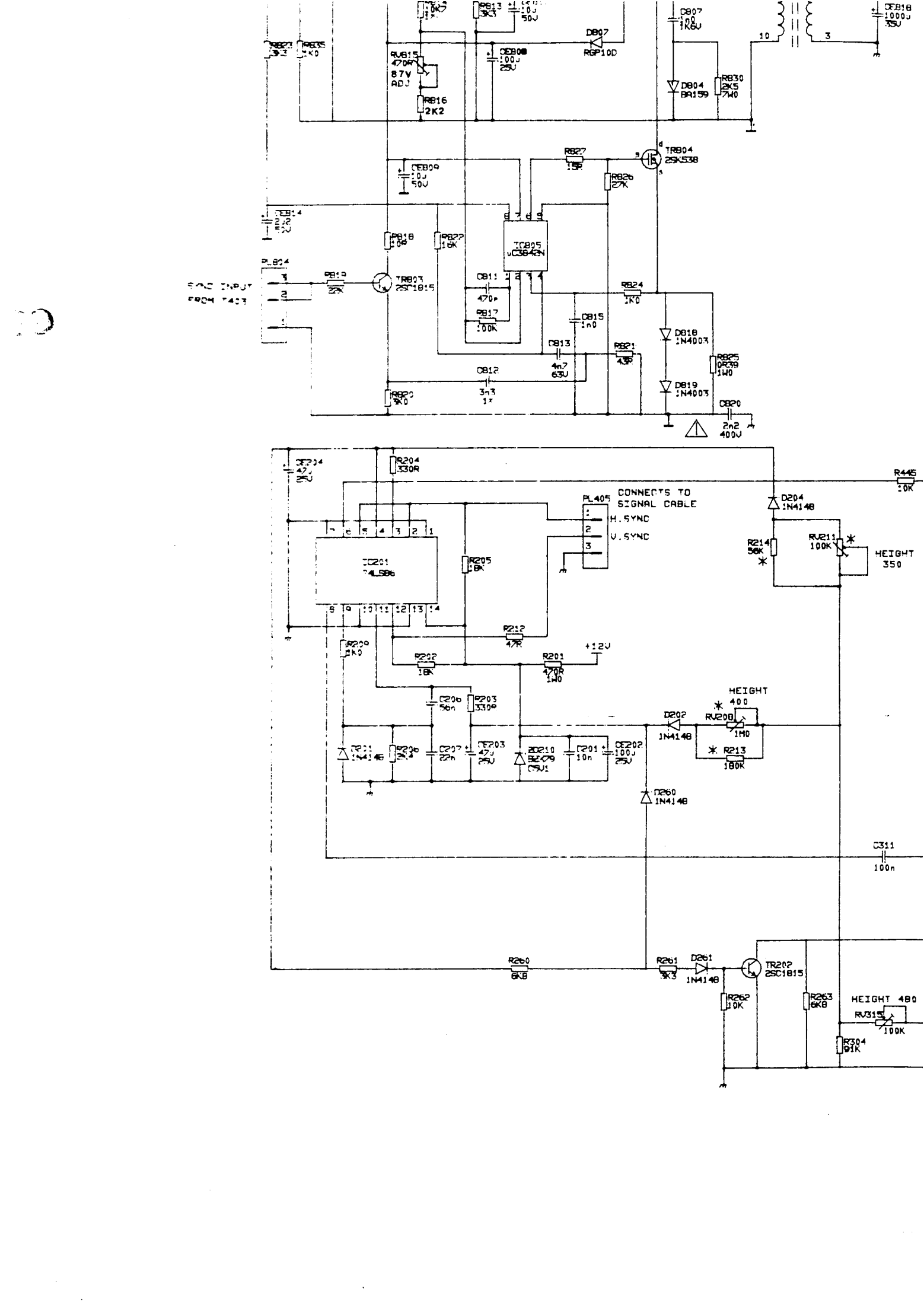
THE POWER SUPPLY REMAINS CHARGED FOR APPROXIMATELY 30 SECONDS AFTER SWITCHING OFF; AVOID TOUCHING THIS AREA DURING THIS TIME.

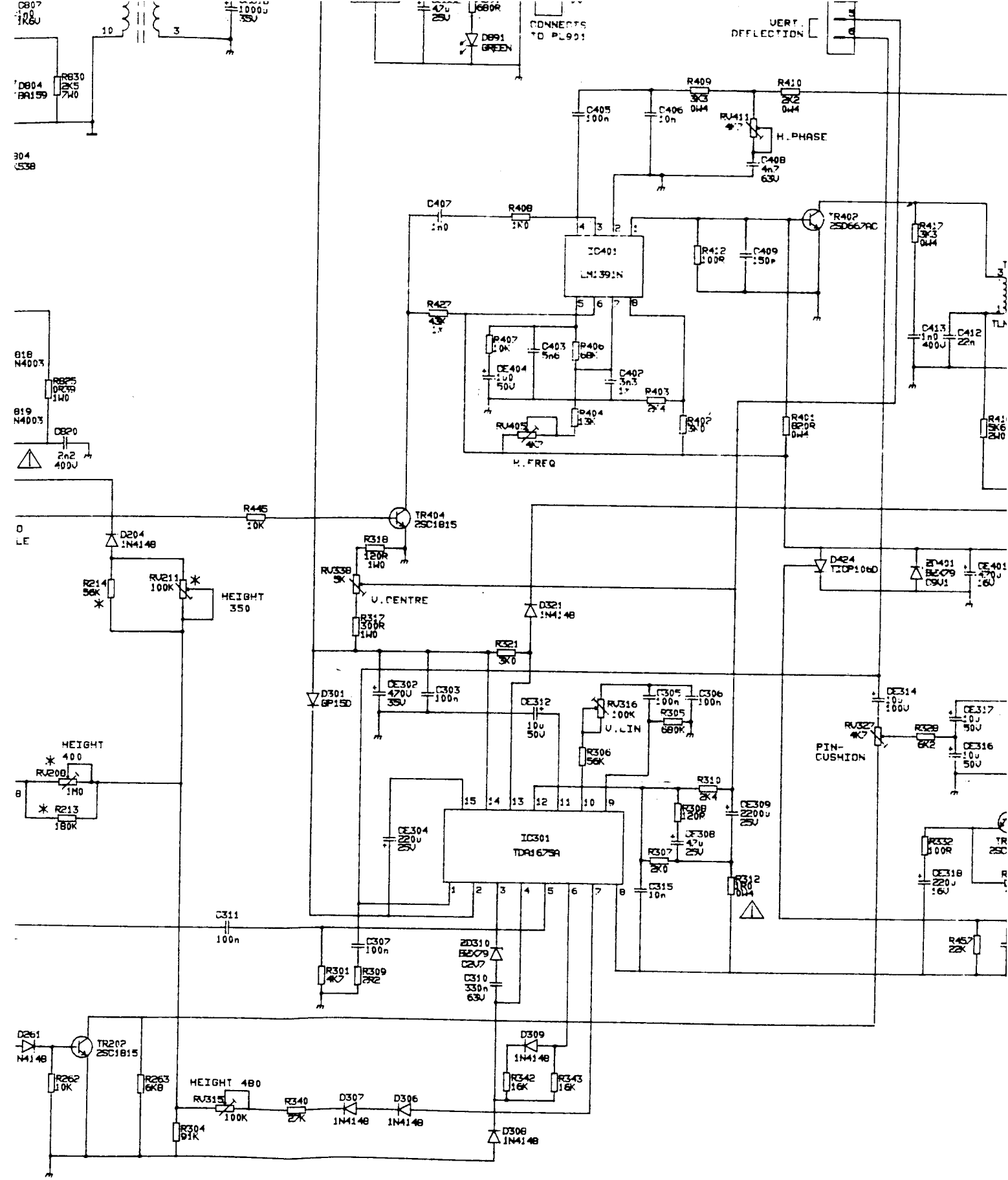
MOST OF THE MONITOR, OTHER THAN THE POWER SUPPLY, IS ISOLATED FROM THE MAINS BY T801, C823 AND AN AIR GAP OF 6mm OR MORE. TO MAINTAIN SAFETY, ENSURE THAT AFTER REPAIR THE AIR GAPS ARE NOT REDUCED BY PROTRUDING WIRES etc.

COMPONENTS MARKED ⚠ IN THE PARTS LIST OR ON THE CIRCUIT DIAGRAM ARE SAFETY APPROVED TYPES AND SHOULD ONLY BE REPLACED BY COMPONENTS SUPPLIED OR APPROVED BY OUR SERVICE DEPARTMENT. IT IS RECOMMENDED THAT OTHER REPLACED PARTS SHOULD BE OF THE TYPE ORIGINALLY FITTED, PARTICULARLY RESISTORS STOOD OFF THE PRINTED CIRCUIT BOARD.

FAILURE TO OBSERVE THE ABOVE MAY RENDER THE CHASSIS AND EXTERNAL ACCESSIBLE PARTS LIVE, OR CAUSE OTHER HAZARDS.




RV815
470R
87V
ADJ
R816
2K2
D807
RGP10D
CE808
100U
25V
D807
1K6V
D804
BA159
R830
2K5
7W0
CE818
1000U
35V
10
3
TR804
2SK538
R827
15R
R826
27K
CE809
10U
50V
CE814
2U2
IC805
UC3842N
R818
10K
R822
16K
PL804
R819
22K
TR803
2SC1815
C811
470P
R817
100K
C815
1N0
R824
1K0
D818
1N4003
C813
4N7
63V
R821
43R
R825
0R39
1W0
C812
3N3
1%
R820
3K0
D819
1N4003
C820
2N2
400V
CONNECTS TO
SIGNAL CABLE
PL405
H.SYNC
V.SYNC
R204
330R
R445
10K
D204
1N4148
IC201
74LS86
R205
1K
RV211
100K
HEIGHT
350
R214
56K
R212
47R
R209
1K0
R202
1K
R201
470R
1W0
+12V
HEIGHT
400
RV208
1M0
R213
180K
D202
1N4148
C206
56N
R203
330R
D211
1N4148
R206
2K2
C207
22N
CE203
47U
25V
ZD210
BZX79
C5V1
C201
10N
CE202
100U
25V
D260
1N4148
C311
100N
R260
6K8
R261
3K3
D261
1N4148
TR202
2SC1815
R262
10K
R263
6K8
HEIGHT 480
RV315
100K
R304
91K


CONNECTS TO PL901
VERT. DEFLECTION
R409 3K3 0W4
R410 2K2 0W4
C405 100n
C406 10n
RV411 4K7
H.PHASE
C408 4n7 63V
C407 1n0
R408 1K0
IC401 LM1391N
TR402 2SD667RC
R412 100R
C409 150p
R417 3K3 0W4
R427 43K
R407 10K
C403 5n6
R406 68K
C404 1u0 50V
C402 3n3
R403 2K4
R404 13K
RV405 4K7
R402 5K0
R401 8R2R 0W4
H.FREQ
C413 1n0 400V
C412 22n
R445 10K
TR404 2SC1815
D204 1N4148
R214 56K
RV211 100K
HEIGHT 350
R318 120R 1W0
RV338 5K
V.CENTRE
R317 300R 1W0
D321 1N4148
R321 3K0
D424 T20P10D
DE401 10u 160V
D301 GP15D
DE302 470U 35V
C303 100n
DE312 10u 50V
RV316 100K
V.LIN
C305 100n
C306 100n
R305 680K
R306 56K
DE314 10u 100V
RV327 4K7
R328 6K2
PIN-CUSHION
DE317 10u 50V
DE316 10u 50V
HEIGHT 400
RV200 1M0
R213 180K
R310 2K4
R308 120R
DE309 2200u 25V
DE304 2200u 25V
IC301 TDA1675A
DE308 47u 25V
R307 2K0
R312 1R0 0W4
C315 10n
R332 100R
DE318 220u 16V
R457 22K
C311 100n
C307 100n
R301 4K7
R309 2R2
D310 BZX79 C2V7
C310 330n 63V
D261 N4148
TR202 2SC1815
R262 10K
R263 6K8
HEIGHT 480
RV315 100K
R340 27K
D307 1N4148
D306 1N4148
R304 91K
D309 1N4148
R342 16K
R343 16K
D308 1N4148

SECTION 1. SPECIFICATION

1.1 Power

Input: 220-240VAC, 48-63Hz or 110-120/220-240VAC, 48-63Hz (switchable).
Power Consumption: <85W

1.2 Sync Input

TTL Levels:

Mode	H-Sync	V-Sync	H-Freq/kHz	V-Freq/Hz
1	+	-	31.5	70
2	-	+	31.5	70
3	-	-	31.5	60

1.3 Signal Cable: 15-way Sub-miniature 'D' type.

1.4 Cathode Ray Tube: 14" (13V) Diagonal, landscape mode. Dot pitch 0.39mm, polished

1.5 Operating Ranges: Temperature - 10-35^{o}C
Humidity - 20-85% (non-condensing)

1.6 Weight: 11.5Kg

1.7 Video Input: RGB Analogue video signal, 0.71V positive

1.8 User Controls: Power On/Off, Contrast, Brightness

1.9 Display Colours: Infinite array

1.10 Display Area: 240mm wide x 180mm high

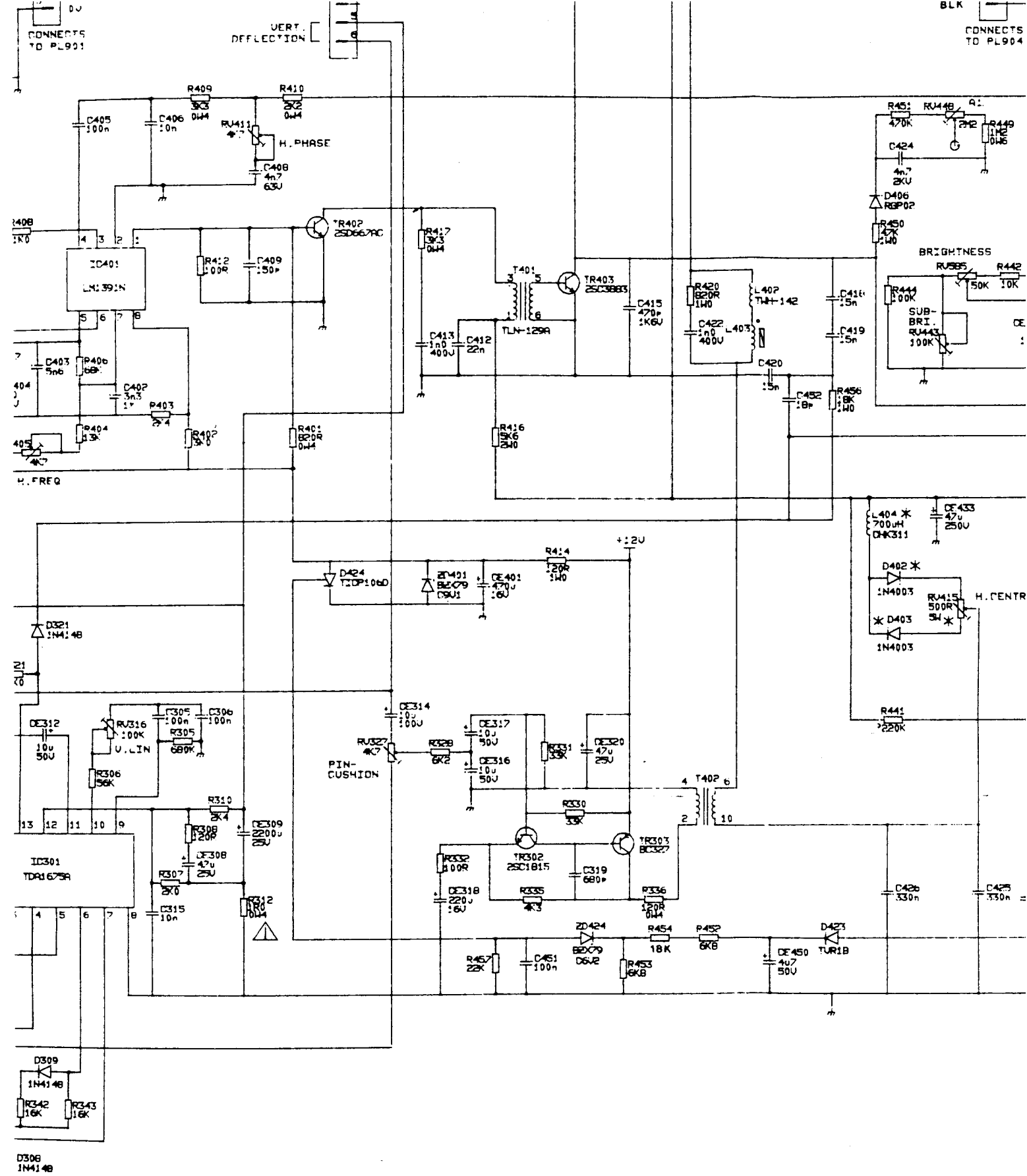
1.11 Dimensions: Width 351mm, Height 327mm, Depth 384mm

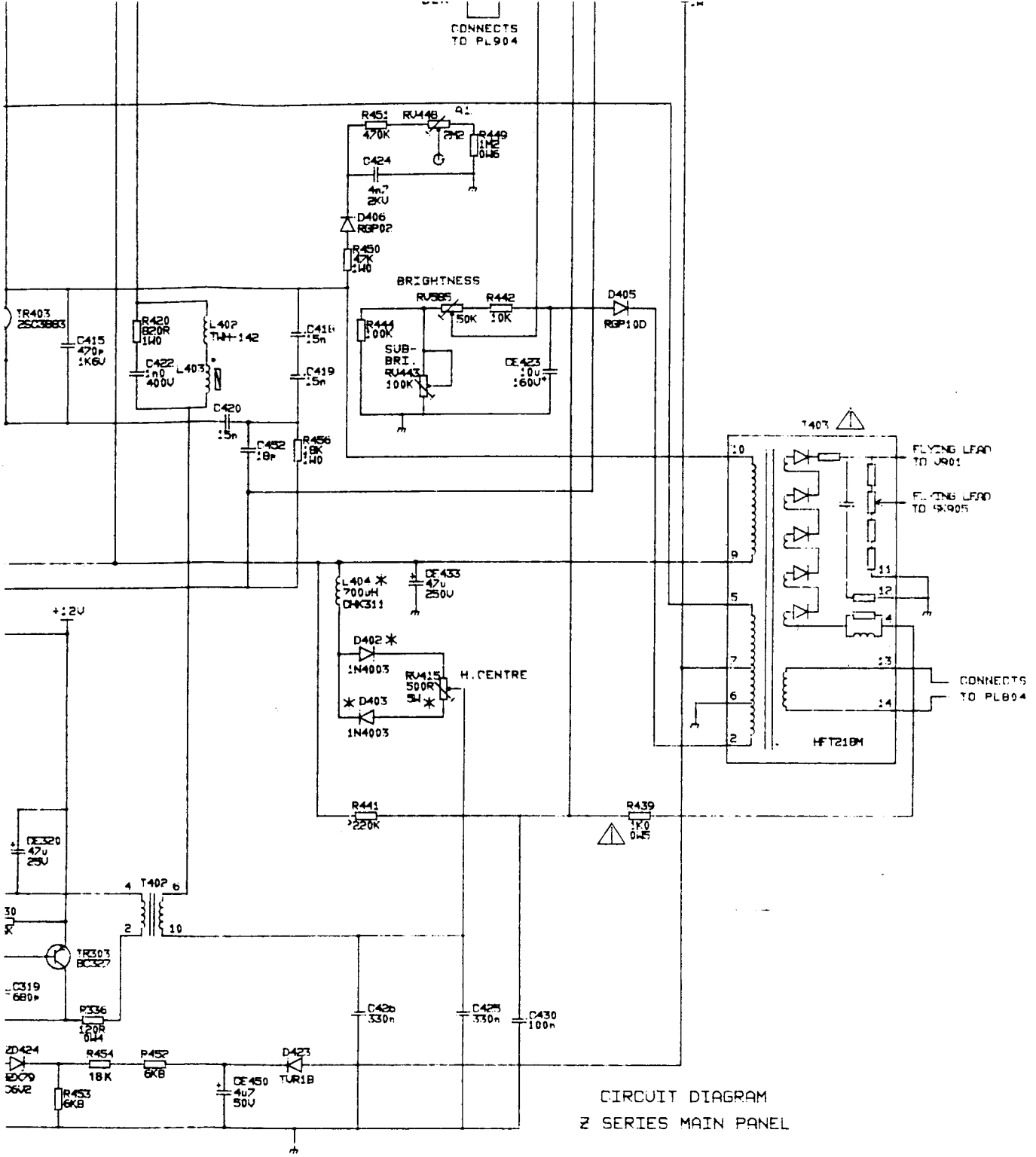
SECTION 2. PRECAUTIONS AND SAFETY

2.1 Observe all cautionary and safety related notes located on the chassis, cabinet and display tube.

2.2 Operation of the display with the back cover removed presents a potential shock hazard. Only personnel familiar with the precautions necessary for safe working on high voltage equipment should attempt to carry out servicing.

2.3 Always wear safety approved shatter-proof goggles when removing, installing or generally handling the picture tube. People not so equipped should be kept at a safe distance when any such handling is being undertaken. Do not handle the picture tube by the neck or deflection coil. Do not carry the picture tube resting against the body.


CONNECTS TO PL901
VERT. DEFLECTION
CONNECTS TO PL904
R409
R410
C405 100n
C406 10n
RV411
H.PHASE
C408 4n7 63V
IC401 LM1391N
TR402 2SD667AC
R412 100R
C409 150p
R417
T401
TR403 2SC3883
TLN-129A
C415 470p 1K6V
C413 1n0 400V
C412 22n
R420 820R 1W0
L402 TWH-142
C422 1n0 400V
L403
C420 15n
C452 18p
R456 18K 1W0
C403 5n6
P406
C402 3n3
P403
R404 13K
R402 5K0
R401 820R 0W4
R416 5K6 2W0
H.FREQ
R451 470K
RV448
R449 1K2 0W6
C424 4n7 2KV
D406 RGP02
R450 47K 1W0
BRIGHTNESS
RV585
R442 10K
R444 100K
SUB-BRI. RV443 100K
50K
L404 700uH CHK311
DE433 47u 250V
D402 1N4003
RV415 500R 5W
D403 1N4003
H.CENTR
R441 220K
+12V
R414 120R 1W0
D424 TIDP106D
ZD401 BZX79 C9V1
DE401 470u 16V
D321 1N4148
DE312 10u 50V
RV316 100K V.LIN
C305 100n
C306 100n
R305 680K
R306 56K
R310 2K4
R308 120R
DE309 2200u 25V
DE308 47u 25V
R307 2K0
C315 10n
R312 1R0 0W4
IC301 TDA1675A
DE314 10u 100V
RV327 4K7
R328 6K2
DE317 10u 50V
DE316 10u 50V
R331 33K
DE320 47u 25V
PIN-CUSHION
T402
R330 33K
TR302 2SC1815
TR303 BC327
R332 100R
C319 680p
DE318 220u 16V
R335 4K3
R336 120R 0W4
C426 330n
C425 330n
ZD424 BZX79 C6V2
R454 18K
R452 6K8
D423 TVR1B
R457 22K
C451 100n
R453 6K8
DE450 4u7 50V
D309 1N4148
R342 16K
R343 16K
D308 1N4148



CIRCUIT DIAGRAM

Z SERIES MAIN PANEL

⚠ - SAFETY CRITICAL COMPONENT

⊡ - USED ON 110V ONLY

✳ - MAY BE FITTED

79-1507-1-001