TATUNG

XGA Colour Monitors

Series X2 Chassis

14"/15" 50kHz Models

SERVICE INFORMATION

X2N128, X2AN128, X2QN128,
X2AN1M, X2QN1M
X2AN1D, X2QN1D, X2AN1MD, X2QN1MD chassis.

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SECTION 1 BRIEF SPECIFICATION

1.1 Power Supply

Input:: 220-240VAC or 110-125VAC or 110-125/220-240VAC at 48-63Hz. auto or manual selection indicated on the label at the rear of the cabinet.
Internal fuse protection, T3, 15A.
Power Consumption: Less than 80W average in normal operation
Less than 50W in standby operation (no H-sync)
Less than 30W in suspend operation (no V-sync)
Less than 5W with full power saving (no syncs) VESA OFF mode.
Power connector: IEC320, 3 pin male.

1.2 C.R.T.

14"(13V) or 15"(14V)
Dot pitch 0.28mm or 0.39mm according to model.
V models only are VLMF (very low magnetic field emissions) screen.
VA models only have VLMF and Anti-static Screen.

1.3 Audio ('Mult-media' versions).

Models with M in model number are fitted with mult-media option.
Input: Phono sockets, 2x150mV max. RMS into 22k Ohms.
Output: 2x3W max. Music Output Power with digitally controlled volume.
3.5mm headphone socket.

1.4 Operating Conditions:

Temperature: 10° to 35°C.
Humidity: 20% to 85% non-condensing.

1.5 Plug & Play (where fitted)

Models with D in the model number meet DDC1/2B compatibility requirements

1.6 Input Signals:

Sync. inputs, TTL level as specified below
Mode detection windows : H ± 1kHz. V ±1Hz.
Video inputs, analogue RGB. Level 0.71V positive going, into 75 Ohms.

1.6.1 Sync Inputs

Mode		Resolution	Sync Polarity		Sync Frequency		
			H	V	H/kHz	V/Hz	
0	IBM VGA	640 x 480	-	-	31.5	60	
1		640 x 400	-	+	31.5	70	
		720 x 400	-	+	31.5	70	
2		640 x 350	+	-	31.5	70	
3	SVGA	800 x 600	-	-	35.1	56	
4	8514/A	1024 x 768	+	+	35.5	87	Interlaced
5	VESA VGA	640 x 480	-	-	37.8	72	
8		800 x 600	+	+	48.0	72	
9		800 x 600	+	+	37.8	60	
10		1024 x 768	-	-	48.3	60	
11	VESA 75Hz	640 x 480	-	-	37.5	75	
12		800 x 600	+	+	46.9	75	

Table 1

1.6.2 Signal Cable:

Lead captive in monitor, to 15 pin compact male D-type connector. Minimum length 1 metre.

1.6.3 Signal Cable pin assignment.

Pin	Function	Pin	Function
1	Red video signal	8	Blue video screen
2	Green video signal	9	No connection
3	Blue video signal	10	Sync ground
4	Linked to pin 10	11	Linked to pin10
5	Must be grounded in PC for correct operation	12	DDC Data*
		13	Hor sync or composite sync
6	Red video screen	14	Vertical sync
7	Green video screen	15	DDC1 Clock*

Table 2

* Models without DDC1/2B compatibility - No connection

1.7 Display Size: (Factory preset. Can be increased to edge to edge or overscan by user).

	Width:	Height
14"	260mm	190mm
15"	270mm	202mm

1.8 User Digital Controls

Brightness, Contrast, Hor. Centre, Vert. Centre, Width, Height, Volume (multi-media models only).

1.9 Colour Point

x = 0.281 ±0.015, y = 0.311 ±0.015 (9300K). Measured at 90 Cd/m² light output.

SECTION 2 PRECAUTIONS AND SAFETY

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

Operation of the monitor 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.

Always wear 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.

The picture tube is designed and constructed to limit X-radiation to a safe limit during 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.***

IMPORTANT - Safety Tests.

After servicing, and before returning the monitor to the user, a thorough safety test must be carried out to ensure there is no potential shock hazard to any operator(s) using the monitor.

All the following tests must be performed. A monitor failing any of these tests must be rejected and have the problem rectified.

2.1 A.C. Leakage Test

Remove the power source. Connect the monitor to the circuit as in Fig.1. below. Switch the monitor on/off switch to 'on'. A reading of less than 3.5mA should be obtained (ref EN60950).

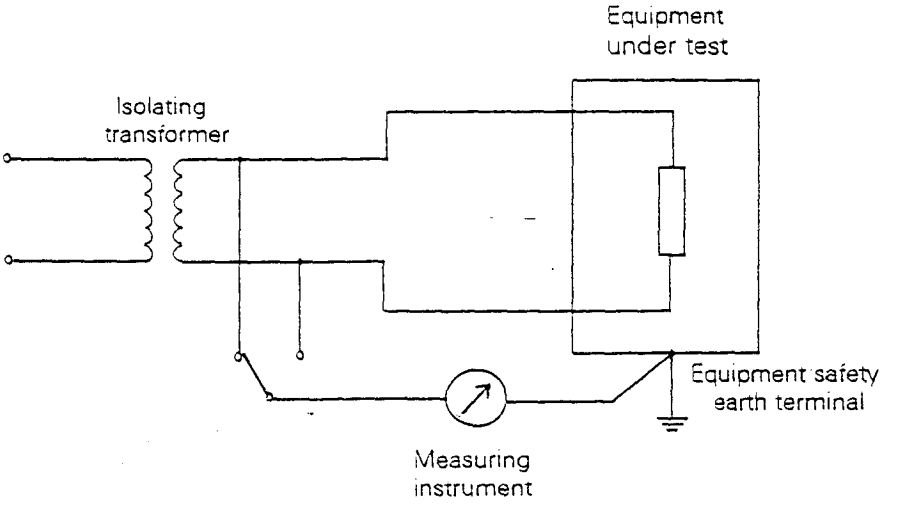


Fig.1. Measurement of AC Leakage Current

2.2 Voltage Breakdown Test

Connect the live and neutral connections together. Switch the monitor on/off switch to 'on'. Apply 1500Vac rms at 50Hz or 2250Vdc, for one minute between live and neutral shorted together and earth. Ensure no voltage breakdown occurs.

2.3 Earth Resistance/Continuity Test

Measure the resistance between the signal cable metal shell and the earth pin in the A.C. socket. At a current of 25 Amperes the resistance should be less than 100 MOhms.

Note: A portable appliance tester (PAT) is a suitable instrument to use for the above safety tests.

SECTION 3 INTRODUCTION

The X2 chassis is for VGA/SVGA compatible landscape monitors with horizontal refresh of 31.5 to 50kHz and 50 to 100Hz vertical. This encompasses the common 48kHz graphics modes at up to 1024 x 768 dot resolution.

The chassis has variants to drive both 14" and 15" CRT's. The 'multi-media variant has a stereo audio amplifier and twin speakers fitted. Supply voltage options are 240V and 110V manually switched and auto-switched. A composite sync decoding circuit may be fitted for use with Apple computers.

All controls are digital offering width, height , vertical centre, horizontal centre, contrast, brightness and, where applicable, volume. An internal microprocessor and memory offers storage and display settings for each mode (refresh rate), minimizing display shift when changing frequencies.

The monitor automatically adapts to the horizontal and vertical frequencies for the given modes. However, with non standard display adapter cards there may be differences in display sizes or centring when changing modes. The front user controls allow fine adjustment for these, which can also be stored in memory.

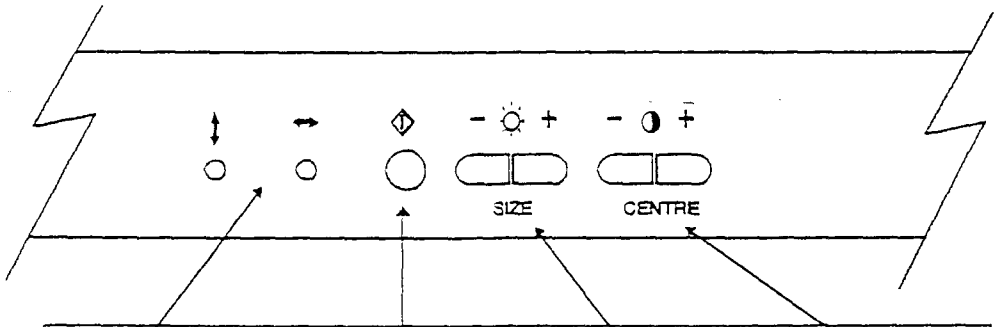
The monitor fully supports power saving modes; when H, V or both syncs. are removed the monitor enters standby, suspend or 'VESA OFF' modes respectively, with 'VESA OFF' consuming less than 5W.

Note: A .mode (graphics mode) refers to a unique combination of a number of pixels on screen and horizontal and vertical scan frequencies. See appendices.

3.1 User Controls

The front facia panel has an 'on/off' push switch and a power on indicator LED. At the rear of the monitor (where applicable) is a recessed slide switch for supply voltage selection. Power input is via a 3-pin IEC inlet socket and is normally supplied with an auxiliary power lead (IEC M to F) for connection to the computer.

The front fascia panel also houses the digital control buttons and indicators. Digital control is achieved using a select button, two of up/down controls and two LED's (designated V and H), as illustrated below:



Selection Indicators	Select Button	− +	− +
● ●		Brightness	Contrast
● ○	First Press	Width	H Centre
○ ●	Second Press	Height	V Centre
○ ○	Third Press *	Unused	Volume

Fig. 2 User Controls ○ On ● Off

* Available on multi-media models only.

The default state is brightness/contrast (both LED's off), to which the monitor will time out after 30 seconds, or after a mode change. An adjustment will be stored if the select button is pressed, or after a five second delay. If the computer changes mode prior to the five seconds elapsing the adjustment will not be stored.

3.2 Factory Default Settings

If both the - and + buttons for a particular adjustment are pressed simultaneously and held for one second, that PWM will be set to its mid-point. If the select button is held for five seconds, all the geometry parameters will be reset to the nearest factory settings for that mode.

Geometry parameters are stored against each mode so that when scan frequencies change, the display, once initially adjusted will remain the same size and in the same position. Contrast, brightness and volume are global adjustments.

3.3 Power Management

Power saving operates automatically. Standby and suspend are indicated only by a blank screen, whilst VESA OFF is indicated by the power LED flashing. Power saving comes into effect five seconds after the loss of sync 's.

SECTION 4 MODE STORAGE

The graphics mode is determined by the horizontal and vertical sync. pulse frequencies, and where defined (i.e. 31.5kHz modes), from the polarity; active high or low. The microprocessor measures the horizontal frequency to an accuracy of ±1kHz and vertically to ±1Hz.

The monitor stores geometry parameters for individual modes. There are initially eleven factory preset parameters stored. Additional stored parameters are called 'user ' modes.

The incoming mode is matched with the nearest horizontal frequency stored, checking against user modes first then factory modes. If a precise match is made with a user mode (H and V frequency), any adjustments made are stored against that mode. If the match is not precisely a user mode, even if it is a precise match to a factory mode (which is not user adjustable), then any adjustments create a new user mode. If no memory is left for a new user mode, the mode and the nearest matching user mode are made one and the same.
Note: No new mode is created until a parameter is adjusted.

For a new (previously unknown) mode, since the nearest match is made to horizontal, not vertical frequency, the processor does not adopt the stored vertical parameters. Height is calculated from the frequency to give the specified nominal picture height, and vertical position is set to mid-point.

The parameters stored for each mode are horizontal and vertical sync., frequency and polarity, width and height, vertical centre and horizontal centre. The others (brightness, contrast and volume) are stored globally (common).

If the monitor apparently becomes unable to recall the geometry settings for new modes, it may be that the memory is full. The memory can be cleared as detailed in section 4.3.

4.1 Service Adjustments

The monitor has a service state for changing factory preset mode parameters, global adjustments and for setting limits.

All power saving modes are disabled when in the service state.

4.2 Entering Service State.

Service state is entered by depressing the two end buttons (Select , contrast +).during power up of the monitor. This is indicated by the V LED flashing and the H LED off.

Note: Switching off does not clear the service state, see section 4.4.

4.3 Memory Reset

Alternatively, a complete reset, clearing all user modes from ROM and resetting factory presets, can be achieved by connecting processor pin 28 to ground during power up. A full reset will be performed automatically if the memory is not programmed or faulty. The V LED will be on and the H LED flashing (when pin 28 is released). Press one of the contrast -/+ buttons to enter service state.

4.4 Service State Select

The contrast -/+ buttons are used to cycle through the three service state selections:

Function	V LED	H LED
Global set-up	flash	off
Factory modes optimize	off	flash
Set user limits	Both LED's flashing in sync.	

Table 3

For each of the above, the select button is used (as for user operations), to select the parameter to adjust

Press select	LED on	Global Set-up	Optimize Factory Modes	Set User Limits
First	none	global con' & brilliance	as normal	- , max vol
Second	H	width, H.Centre	width, H.Centre	min, max width
Third	V	- , V.Centre	height, V.Centre	min, max height
Fourth	both*	global volume as norm	global volume as norm	not accessible

Table 4

* 'Both on' state applies only to multi-media models.

The pair of adjustments in a column indicate the action of the brightness/size and contrast/centre button pairs respectively.

A subsequent press of the select button returns you to the service state select option. Note that adjustments are only stored in memory when the select button is pressed, there are no time-outs of any kind.

4.5 Global Set-up

Adjustments to width, horizontal centre and vertical centre are common to all modes (factory and user). This allows adjustments to compensate for component tolerance variations after a repair without the need to set all modes individually. Global height is not adjustable.

4.5.1 Factory modes Optimize

This adjusts the factory mode sizes and positions. If when selected, both LED's flash alternately, it indicates the computer is not set to one of the factory modes (see ?), so there is nothing to adjust. This cannot override the ROM settings; a reset (see ?) will return the factory mode parameters to their preset values.

4.6 User Limits

The maximum range of each adjustment accessible to the user may be limited. This is useful if the monitor display degrades at extremes of range which the user is unlikely to use. The minimum width is limited at factory set-up.

The first press of a pair of -/+ buttons will change the display to the relevant maximum or minimum in a single step, which can then be adjusted in the normal way. When moving to the other pair of buttons, the first press will set the display to the current nominal setting, the second press will set it to the min/max as applicable.

4.7 Clearing the Service Data

The monitor can be returned to normal operation with the user limits either disabled or enabled. As user limits are employed in factory set-up, it is recommended that they are always enabled.

4.7.1 User Limits Enabled

Switch off the monitor. Press and hold the 'select' and 'brightness -' buttons simultaneously and switch on the monitor. Release the buttons when the monitor is fully powered up. The service state will be cleared (no LED flashing) and the user limits enabled.

4.7.2 User Limits Disabled

This is the same procedure as in 4.7.1 except the 'brightness +' button is pressed simultaneously with the 'select' button during switch on.

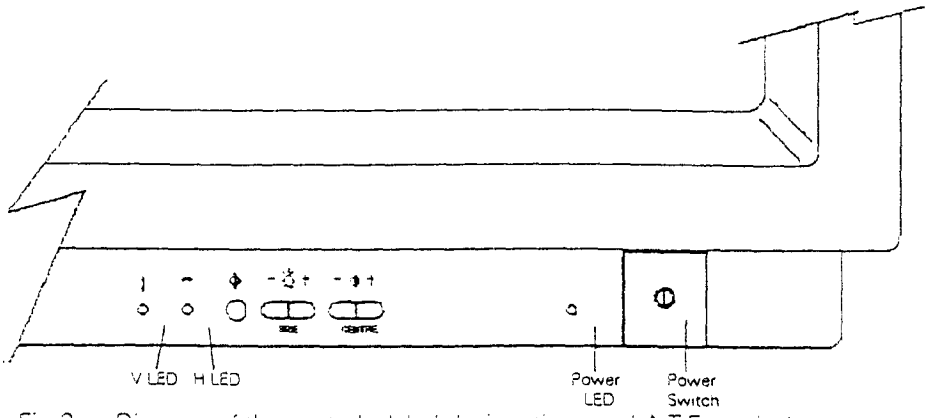


Fig.3 Diagram of the controls, label designations and A.T.E. equivalents.

A.T.E. Equivalents

H LED	Lit if pin 28 of IC701 is at 0V, off if pin 28 is 5V.	
V LED	Lit if pin 27 of IC701 is at 0V, off if pin 27 is 5V.	
MENU	Connect pin 32 of IC701 to 0V to simulate press	Select.
X-	Connect pin 33 of IC701 to 0V to simulate press	Brightness -
X+	Connect pin 34 of IC701 to 0V to simulate press	Brightness +
Y-	Connect pin 35 of IC701 to 0V to simulate press	Contrast -
Y+	Connect pin 36 of IC701 to 0V to simulate press	Contrast +

4.8 NVRAM Reset (To ensure the chassis has initialized the memory)

See above for designation of control names 'SELECT', X-, X+, Y-, Y+ and LED references H LED and V LED.

4.8.1 Connect pin 28 of IC701 to ground

4.8.2 Switch on the power and allow delay for chassis start up

4.8.3 Remove the ground connected in 4.8.1

4.8.4 Check the V LED is on and the H LED is flashing

4.8.5 Allow 2 seconds from switch on for the NVRAM reset to complete

4.8.6 Switch off power

4.8.7 Press and hold SELECT and X- keys (see A.T.E. Connections above)

4.8.8 Switch on power and allow delay for chassis start up

4.8.9 Release the SELECT and X- keys

4.8.10 Check both the H LED and V LED are off. If V LED is flashing, NVRAM reset failed

SECTION 5 CIRCUIT DESCRIPTION

Note: In the following sections figures in square brackets [ ] are applicable to the 15" version, e.g. [130V].

5.1 Power Supply (component idents from 800)

The power supply is a single ended flyback switched mode converter type designed around IC801 (UC3842AN) which directly drives output switching FET Q801. The switching frequency is synchronized to the horizontal output stage. Supply line and load regulation being achieved by duty cycle control of the switching wave form from feedback provided by a winding on T801.

On models designed for 220V - 240V operation, full wave rectification is provided by D801 - D804 and smoothing by CE805 and CE806 in series. Models for 110V - 125V/220V - 240V mains operation have a switch to select operating range. With the switch open, 220V - 240V range is selected and the mains supply is rectified and smoothed as described above. With the switch closed, D801 - D804 and CE805 and CE806 form a voltage doubler, ensuring the rectified DC voltage on transformer T801 primary is approximately the same as for 220V - 240V operation. Automatic mains switching is fitted on some models. The automatic switch, IC806, (STR8-3145A) allows the monitor to be operated on 110V - 125V or 220V - 240V without adjustment by the user. Pins 2 and 3 of IC806 are connected across the mains voltage range selection switch connections. At switch on pin 5 detects the peak voltage of the mains supply If the supply is 220V - 240V then pins 2 and 3 of IC806 remain open circuit and operation is as described for 220V- 240V mains. If the peak voltage indicates 110V - 125V input pins 2 and 3 of IC806 become short circuit, switching in the doubler.

At switch on current flows from the DC supply at CE805 through R810 and R811 into CE817. The voltage across CE817 rises until it reaches the starting threshold of IC801, which is approximately 16V. IC801 begins delivering a switching waveform via R816 to the gate of Q801.The power supply can now start supplying operating current to IC801 from the IC supply winding on transformer T801, via R830 and D814, at a nominal 15 volts.

IC801 turns on Q801 causing a linear rise in current in the primary winding of T801. After a period of time limited by the voltage sensed across R819, Q801 is switched off. Energy is now stored in T801 magnetised flux and transferred to the secondary circuits by flyback action induced in the primary. Diodes D831, D832, D833, D847, D836, D837 and D829 conduct until the transformer is de-magnetised. After a short delay Q801 is switched on again as before.

Voltage regulation is achieved as a result of feedback from IC801 supply winding on T801, the voltage being fed back to pin 2 of IC801 through R831, D815, CE819, R833, R832, C813, RV822 and R821. IC801 controls the power through-put of T801 accordingly by varying the duty cycle of the switching waveform applied to the gate of Q801, whose drain-source current is actively limited by the voltage developed across R819. Transient spikes are removed from this voltage by the filter formed by R818 and C811 which is then fed to pin 3 of IC801. This pin causes Q801 gate drive pulse to be terminated if the voltage applied to it exceeds 1 volt. This current feedback actively limits peak transformer flux during each cycle and is used to provide feed forward compensation helping to improve line regulation.

Should the feedback loop be broken and output regulation fail, resistor R816 is used to provide over voltage protection. This is triggered when the voltage across zener diode ZD817 exceeds approximately 18 volts. This short circuits IC801's supply, preventing its operation and causing the power supply to shut down.

IC801's internal oscillator generating the switching frequency is synchronized to the horizontal scan frequency. A stepped down horizontal output pulse is indirectly fed to the LED in opto-isolator IC803. This pulse is detected by the photo-transistor and fed via TR815 to TR801 and then TR803 where it is amplified and fed to R823 via C815. This pulse adds to the ramping voltage on IC801's oscillator timing capacitor C814, instantly taking it above the discharge threshold causing IC801 to discharge it and begin a new timing cycle.

The dv/dt on Q801 drain is limited by C808 charging via D807 when Q801 switches off. In addition, D805, C809 R812 and R832 clamp the peak drain voltage to <700 volts to prevent damage to Q801. A protective clamp is incorporated on the 180 volts winding formed by D830, C830, R860 and R861 to prevent damage to D831 under certain circumstances

5.1.1 Power Management System

The micro-controller will automatically enter power management mode as signalled by the combination of sync. signals available at any instant. Power management is disabled when the monitor is in 'factory test' mode.
In the following table, horizontal sync. frequencies of ≤20kHz signify no horizontal syncs., and vertical sync. frequencies of ≤30Hz signify no vertical syncs.

Power Management Sequence

	Horizontal sync.	Vertical sync.	Power LED indication	Power consumption
Signal Cable pin	13	14		
Normal Operation	yes	yes	Continuous	Normal 80W
VESA Standby	no	yes	Continuous	Less than 50W
VESA Suspend	yes	no	Continuous	Less than 30W
VESA OFF	no	no	Flashing	Less than 5W
Factory Test Mode	X	V	Continuous	Normal

Table 5.

Note: X indicates sync may or may not be present.

5.1.2 Power Management Operation

When both sync. signals are removed from the monitor it will enter VESA OFF mode. In this mode the monitor supply will be shut down and the monitor will enter low power operation. If only one of the sync. signals is removed, then the monitor will enter either VESA Standby or VESA Suspend mode and the scan circuits will be disabled to reduce power consumption. See table 5.

The overall time delay between loss of signals and actually entering one of the power management modes will be approximately six seconds, but , the PC will determine under what conditions, and after what overall period of inactivity these modes will be used.

Recovery from VESA Standby/Suspend mode to normal operation will take approximately 3 seconds after syncs.are restored.

Recovery from VESA OFF mode to normal operation will take the same time as power switch on to normal operation.

To achieve the Standby mode, under which conditions the power requirement must be <50W, the line drive to the CRT is removed. This is effected by TR508 being switched on which removes the B+ supply to the FBT (T403) by switching off the B+ regulator and so removing the scanning current.

To achieve the Suspend mode, under which conditions the power requirement must be <30W, the 26V and 12V supplies are removed in addition to the B+. The 12V supply is removed by TR814 being switched on. Removing the 12V supply causes TR817 and TR816 to switch off, removing the 26V supply.

The final state of power down, Off mode, is achieved by allowing the power supply to be turned off. The micro-controller detects the lack of syncs on its relevant sync. input pins and removes the drive to the opto-isolator, IC803, by forcing pin 37 low. This causes the comparator, IC802, output on pin 1 to be pulled high, switching on TR804 which in turn forces pin 1, IC801, to 0V. The monitor in the power down mode is typically <5W.

5.2 Protection Circuits

The power input supply fuse FS801 is of the 3.15 amp time delay type. Replacements must be of the same type and rating.

In order to prevent minor faults causing localized over-heating or further damage several fusible or flame retardent resistors are incorporated in the design. R850 is included to prevent high currents damaging T801 primary winding, rectifier diodes D801 - D804, diode D806, thermister R803 and other components in the event of Q801 failure. R830 and R831 are present to prevent localized over heating in the event of a component failure or short circuit in the circuitry surrounding IC801. Resistors R875 - R878 are included in the secondary circuit to prevent localized over heating in the event of a fault occurring in one of the low voltage secondary circuits.

To maintain compliance with EN 60 950 (IEC950), it is essential that all such resistors are replaced with the same type and rating.

5.3 The B+ Regulator

The horizontal scan coil has to be driven with a constant amplitude sawtooth current waveform at all possible scan frequencies. As the scan coil's impedance increases with frequency, the voltage applied across it must also be increased to maintain a constant current. This is achieved by controlling the B+ voltage applied to the scan coil: the purpose of the B+ regulator. This linear, discrete component regulator receives its feedback from the

-80 volt winding on the flyback transformer. Essentially it can be thought of as regulating the EHT voltage.

At switch on current flows into the base of TR502 from the 12 volt rail via R517 and R507 switching on TR502 and TR501. TR501 draws current from the base of TR505 which in turn supplies current to the base of TR504. TR504 then supplies current to the B+ rail through R514 and R508. The -80 volt winding of the flyback transformer draws current through D501 and R501 taking C502 negative. When this voltage reaches -80 volts, the voltage divider formed by RV503, R504, R507 and R517 ensures the voltage on the base of TR502 begins to fall. TR502 starts to switch off, ultimately reducing the current entering the base of TR504 which in turn reduces the current supplied to the B+ regulator, thereby reducing its voltage and maintaining it at a steady value.

The B+ regulator can be switched off under command from IC701 via transistors TR507 and TR508, which when switched on remove base drive from TR502.

A safety feature of the B+ regulator is the over current trip out centered around TR503 and TR506 . The base and emitter of TR503 are connected across R508 in such a way that if excssive current flows through R508 into the B+ rail, the voltage generated across it switches on TR503, allowing current to flow into the base of TR506 which, in turn, draws current from the base of TR503 and the two transistors 'latch' and sustain each others conduction. TR506 pulls the cathode of D502 close to the input rail preventing any current being drawn from the base of TR505. TR505 switches off, and in so doing, switches off TR504. The B+ regulator can only be re-activated by removing and re-applying the supply.

5.4 B+ Rail Switching

The purpose of the B+ rail switch is to switch between the 180V [175V], 140V [130V] and 116V [106V] rails and apply each one as necessary to the input of the B+ regulator. Diode D834 applies the 116V [105V] rail. TR812 applies the 140V [130V] rail via D835 and TR810 applies the 180V [175V] rail. These transistors are activated by IC701 via TR811 and TR813.

5.5 Vertical Processing and Deflection

IC401 contains the vertical processing circuitry required within the monitor to provide sync. capture amplitude adjustment and linearity correction to the scanning waveform.

The capacitor, C416, at pin 13 of IC401is charged towards a high threshold from a current set by R419, R475 and R486. If this threshold is reached before a normalized sync. pulse is received via pin 14 of IC401, C416 is internally discharged and the charging cycle started again. These two components control the free running vertical frequency. Should sync. pulses be detected, they are used to discharge C416 and provide a ramp in sync. with the vertical sync input.

The pull-in frequency of the vertical stage is controlled by switching in one of three current control resistors. R419 is always present. R475 is switched in for frequencies above 65Hz and R486 is present for frequencies above 80Hz.

Vertical linearity is controlled by R418 and the voltage on pin 17 of IC401. This controls the amount of S correction applied to the vertical ramp on pin 15.

The amplitude of the ramp is controlled by the voltage on pin 16 of IC401. This voltage controls a variable amplifier within the IC. The adjustment range is ±20% around the nominal value of the ramp when the voltage is varied from 0.5V to 4.5V.

The ramp produced by IC401 is the input to the vertical deflection amplifier which contains the necessary drive stages for providing the output scanning ramp and the retrace currents required for the vertical scan coils.

The scan current required by the coils is approximately 1.5A p-p for full screen scan. The retrace time is approximately 260µS.

The input ramp is applied to the -ve input on pin 1 of IC401, with the +ve input, pin 7, having a reference voltage of 4V applied. This ramp is amplified internally, controlled by R414 to produce the current ramp output on pin 5.for input to the scan coils. A voltage representing the scan current is produced across R415 and R467 and used for feed back.

Linearity is controlled by R412, R413, R409 and CE412 providing a C correction to the scanning waveform.

Vertical shift is attained by providing a variable current sink from the vertical scan coils via TR418.

5.6 Horizontal Processing and Deflection

IC401 contains the horizontal processing circuitry required within the monitor to provide sync. capture, phase adjustment and deflection drive.

The normalized H sync. input is used to charge capacitor C453 on pin 5 of IC401, which is internally discharged when a 6V threshold is reached. This waveform is a constant amplitude pulse which is buffered and integrated to provide a voltage proportional to the input frequency at CE461. The voltage is converted to a current by TR415,R472,RV487 and R423 and is used to bias the PLL operating point at 3.5V on pin 1 of IC401 to the centre operating frequency. The oscillation frequency is maintained by C417 and the current at pin 1. The input PLL maintains the oscillator locked by injecting current from pin 3 to pin 1 via R421 correcting any difference between the input frequency and the PLL frequency. The dynamic capture range is thus controlled by R421.

When no sync. signals are present, TR415 will not conduct. At this time the current sunk at pin 1 of IC401 will be determined by R422, R472 and RV487. This corresponds to the free running horizontal frequency.

Phase adjustment is accomplished by applying a DC voltage level of between 0.5V and 4.5V to pin 10 of IC401., allowing a phase adjustment of ±45° between the sync. and the flyback pulse. The circuit recovers dynamically the deflection delay of the line output transistor, TR404, from the flyback pulse reference applied to pin 8 of IC401.

The resultant horizontal drive pulse is output on pin 7. This is an open collector output. The duty cycle will vary from 41.59 (TDA9102C) to 48.52 (TDA9102F) depending on IC401.

The horizontal output pulses from IC401 are buffered and delivered via T401 to the horizontal output transistor TR404. T401 acts as an impedance converter to provide a low impedance, high current drive for the output transistor.

The horizontal scan coils require aproximately 6A p-p full screen scan current. The flyback time is 4.3µS (M34 CRT) or 4.0µS (M36 CRT). and is controlled by C462 in conjunction with the scan coil inductance.

The output stage is configured as a diode modulator, enabling the dynamic width control to provide the correction. This correction is applied to D419 in the form of a parabola. A DC level applied to the parabola enables a width control to be realized.

S correction is provided by C430 enabling the scan velocity modulation of the scan current to provide correction. C431 is a switchable S correction capacitor which is in circuit for horizontal frequencies of less than 39kHz. It is switched in by Q401 and TR701.

5.6.1 Pincushion, Keystone and Width control.

These functions are controlled by IC403, TR406 and TR423 which control the diode modulator. IC403 generates a parabola waveform with keystone from the vertical current ramp fed to pin 2. This is internally compared with a horizontal raw sawtooth generated at pin 8. The output appears as a pulse width modulated voltage at pin 5, filtered by R477 and C455.It is mixed with a DC control voltage from TR406 and TR423 and the resultant waveform drives the base of TR408 which controls the diode modulator voltage.

5.7 Video Amplifiers.

The monitor accepts RGB signals of 0.71V amplitude into 75 Ohms. The input signals are coupled into IC201, a video pre-amplifier. IC201 controls the gain and clamping of the signals. The gain is controlled by a DC level applied to pin 12, contrast input. Clamping occurs when a valid clamp pulse is received on pin 14. The outputs on pins 16, 20 and 25 are fed into fixed gain transistor amplifiers whose gain is approximately 10, with a rise time of 11nS giving a maximum cathode drive of 40V. R229, RV230 and RV231 control the cut-off voltage set to 75V.

5.7.1 Brightness and Blanking.

Brightness and blanking are both applied to the G1 of the CRT. The blanking is supplied from TR410. Its base drive supplies both the horizontal and vertical retrace pulses which combine to provide a composite blanking signal at its collector. This signal is combined with the brightness voltage to provide a blanking signal.

The brightness control is obtained from a PWM waveform applied to TR412. This creates an 85V p-p waveform on its collector. The signal is filtered and smoothed to provide a brightness control on the emitter of TR411. The brightness control range is approximately -15V to -30V (M34 CRT) or -43V to -59V (M36 CRT).

5.8 Audio Amplifier.

Audio amplification is provided by IC601. The stereo input signals of 150mV rms are fed onto pins 6 and 7 from the sockets SK604 and SK605 at the rear of the monitor. These are amplified by 39dB internally to IC601 and fed out on pins 1 and 3 to 16 Ohm speakers. The amplitude of the signal and hence volume control is adjusted by a FET control using IC602

5.9 DDC1/2B.

IC202 is a DDC1/2B compatible EEPROM which contains the data display channel (DDC) information relating to the monitor. The data is accessed by use of either DDC1 or DDC2B compatible hardware via the monitor signal lead. The information being used for identification and configuration purposes.

The supply voltage for IC202 is from either the CRT heater supply voltage or via pin 9 of the signal cable. This facilitates access of the DDC data even when the monitor is powered down. DDC1 data is serially read from the EEPROM, IC202 using pins 7 and 5 as clock and data lines. DDC2B (a bi-directional serial interface) uses pins 6 and 5 respectively.

5.10 Microprocessor Control

The microprocessor (IC701) controls all analogue and switching lines on the chassis, provides user interface, measures the incoming sync. frequencies and uses the non-volatile memory for storage.

Default or safe conditions (low B+) are designed to be with the pins high, as this is the default 'power on' condition of the processor. The I.C's internal pull-ups are weak, so most pins have external pull-up resistors fitted.

5.10.1 Pulse Width modulated analogue controls

Pins 1 to 8 are PWM outputs providing the analogue control for the chassis. These operate in a slightly non-standard way; instead of the mark space ratio changing directly, pulses are inserted or removed from a sequence

Pins 1 and 2 are only active when LK701 (multi-media option) is not fitted. Pin 1 then becomes the volume control, stepped to a 12 volts range by TR713 and providing a smoothed DC control to the audio panet via PL606. Pin 2 is not used.

5.10.2 Miscellaneous Switching

Horizontal reset, pin 10, is used to inhibit the B+ supply with TR508 providing scan shut down in the 'suspend' power save condition.

The 12 volts supply is switched off by pin 14 for both 'standby' and 'suspend' power save conditions.

Pins 11 and 12 are used for switching in S-correction capacitors at certain frequencies. Currently only pin 12 is used for switching in C431 with Q401. *Both are connected together.*

Pins 16 and 17 switch on TR416 and TR420 at 65Hz and 80Hz field respectively, changing the range of the vertical section of IC401 to suit.

Pin 39 switches in the middle B+ supply line (140 [130] volts) at >= 34kHz, and pin 38 switches in the top B+ line (180 [175] volts) at 40.5kHz.

Pins 38 and 39 switch on the L.E.D's (active low).

Pin 23 provides a brief pulse during mode change which switches down the B+ supply, vital for the protection of the horizontal output transistor.TR404

5.10.3 Sync. Detection and Normalisation

The processor is supplied with sync. polarity signals at pins 21 and 22, and normalised sync. pulses at pins 13 and 15.

The signals are generated by IC703, the 74LS86 quad exclusive OR gate. The incoming H. and V. sync. pulses are inverted by the gates on pins 1,2,3 and 4,5,6 respectively. These are integrated by R715/CE713 and R716/CE714 to give DC levels of 1 for a positive going original sync. and 0 for negative going. They are exclusive OR'd with the original syncs. by the gate on pins 13, 12, 11 for H. and 10, 9, 8 for V. to give normalized sync. outputs to the processor which are always negative going.

5.10.4 EEPROM and I²C Bus

Pins 24 and 25 of IC701 are the serial clock and data lines for the I²C bus communication protocol with non-volatile memory, IC702 This is a type 24C02 EEPROM (or NVRAM) with 256 x 8 bit structure. It is used to store all information needing preserving at switch-off: for each mode — sync. frequencies and polarities, height, width, horizontal centre, vertical centre and the spare parameter (pin 2 PWM), and for all modes — the global value of volume, contrast, brightness and user limits. Internal items such as the service state and memory reset status are also stored.

5.10.5 Oscillator

The processor runs at 12MHz driving crystal XL701. As precision measurement of sync. frequencies is required, this should not be replaced with a ceramic resonator or other value crystal.

5.10.6 Reset Circuit

Pin 37 goes low to switch off the power supply for full power-save condition. In this condition the processor is powered down.

5.11 Composite Sync. Circuit

Some Apple computers have a composite sync. signal. A lead adaptor feeds this to the monitor on the H sync. pin. On models with a composite sync. decoder fitted, the normalized H sync. (i.e. composite) is fed to TR711 and through the integrator network R747 - R749, C730 and C727. This passes the low frequency field component to TR712 which is fed to the V sync. line.

5.12 DDC1 Chip (IC202).

The DDC1 option is the monitor contribution to the "Plug 'n' Play" philosophy. The core of the IC is an EEPROM. It is pre-programmed with data in a standardised form, representing the monitor's capabilities. This data stream is continuously fed to IC202 on a previously unused wire in the signal lead, clocked by the field sync. A suitable graphics card in the PC can collect the data, and thus determine its best operating modes for the monitor without user intervention. NOTE: This is not connected in any way to the monitor's processor.

5.13 Push Buttons.

The push buttons are wired to ground pins 32 - 36 in a non-matrix configuration as indicated on the circuit diagram.

SECTION 6 SERVICE TEST PROCEDURES

6.1 General

This section details the tests, voltage measurements and adjustments which can be performed to ensure correct operation of the various circuits.

Final set-up procedures are given in section 7.

6.2 Equipment Required

- Signal source or suitable graphics card and P.C. to provide signals as defined in section 1.6.
- 100Mhz dual beam oscilloscope.
- Digital multi-meter (1000V @ 10 MOhm)
- 30kV E.H.T. meter.
- Low distortion audio source with 0-700mV rms @ 600 Ohms output impedance.
- Headphones (32 Ohms) having a 3.5mm stereo 'jack' connector

6.3. Drain Waveform

- Connect a x100 oscilloscope probe to Q801 drain with earth to P.S.U. zero volt reference.

WARNING: CONNECTING THE OSCILLOSCOPE PROBE TO POWER SUPPLY REFERENCE MUST NOT BE ATTEMPTED WITHOUT THE USE OF AN ISOLATION TRANSFORMER.

- Select mode 8 (48kHz)
- Where a supply voltage switch is fitted, ensure this is set to the local supply voltage.
- Switch on and check that the drain waveform is as in appendix A.
- Check the power L.E.D. is continuously lit.

6.4 Power Supply Synchronisation

- Connect Y1, x10 oscilloscope probe to pin 11 of SK403 (horizontal sync. input).
- Connect Y2, x100 oscilloscope probe to D818 anode.
- Select mode 0.
- Ensure the power supply is synchronised and at the same frequency as the sync. pulses
- If not adjust RV487

6.5 Output Voltages. (N.B. Figures in [ ] brackets relate to 15" models).

- Measure supply at CE853. (Adjust RV822 if necessary)
  90Vdc [91Vdc] (±1V for 230V, and ±2V for 115V)
- Measure supply at CE831 185V ÷20V [179.5V ÷20V]
- Measure supply at CE832 140V ÷10V [130V ÷10V]
- Measure supply at CE833 116V ± 2V [106V ±2V]
- Measure supply at CE407 26V ± 2V [31.2V ±2V]
- Measure 12Vdc supply at CE838 12V ±0.5V
- Measure 5Vdc supply at CE842 5V ±0.25V
- Measure heater supply at pin 10, SK901 6.3V ±0.2V [6.1V ±0.2V]

6.6 Line Oscillator set-up and B+ switching check.

- Connect a x10 probe to pin 3, IC401.
- Monitor the B+ rail at the +ve terminal of CE438
- Monitor the P.S.U. waveform as in section 6.4
- Monitor the line drive waveform at pin 7 of IC401
- Ensure H. Phase is centred by repeatedly pressing the MENU key until only the H LED is illuminated. Press both Y+ and Y- and hold for two seconds (centre H. Phase). Adjust RV487 until the voltage at pin 3, IC401 is 3.5V ±0.1V.

- Check:
- The B+ rail is between 130V and 185V.
- The P.S.U. waveform is synchronised to the line.
- The line drive is synchronised to the line.

6.6.1 Select mode 4

- Check:
- The B+ rail is between 106V and 140V.
- The P.S.U. waveform is synchronised to the line.
- The line drive is synchronised to the line.

6.6.2 Select mode 0

- Check:
- The B+ rail is between 70V and 116V.
- The P.S.U. waveform is synchronised to the line.
- The line drive is synchronised to the line.
- Remove scope probe and D.V.M. connections.

6.7 *SAFETY TEST* - Over Current Protection

- With the power removed from the chassis connect a 10 Ohm, 15W resistor with a 5 amp protection fuse across CE831.
- Connect a x100 scope probe to CE831
- Connect power
- Check the power supply cycles and D820 is flashing.
- With power connected remove 10 Ohm load and ensure voltage across CE831 rises to 185V [179.4V] ±5V.
- Remove power.

6.8 *SAFETY TEST* - Over Voltage Protection

- Connect a x100 scope probe to CE821
- Re-connect to the local supply voltage.
- Measure the voltage across CE821: 195V ±5V.

- Connect a 470 Ohm resistor from IC803 control gate to 0 volts.
- Ensure the power supply is disabled and the voltage across CE821 falls to <1 volt.

- Remove the 470 Ohm resistor and ensure the voltage across CE821 is <1 volt.
- Remove the local supply voltage.
- Discharge CE820 using a 1k Ohm, 5W resistor.
- Reconnect the supply voltage.
- Check the voltage across CE821 is 195V ±5V

6.9 **Power Line Regulation**

- Remove the 230V input supply
- Connect a 185Vac supply
- Measure the 90Vdc supply rail and set to 90V ±2V [91V ±2V].

- Remove the 185Vac supply.
- Connect a 265Vac supply.
- Measure the 90Vdc supply rail and set to 90V ±2V [91 ±2V].

- Remove the 265Vac supply.

6.10 115Vac Operation

Note: This section applies to dual voltage versions only.

- Remove the input supply voltage from the chassis.
- Manual versions only: Switch voltage selector switch to 115Vac operation.

- Connect a 115Vac input supply to the chassis.
- Check the voltage across CE853 is 90V ±2V.

- Reduce the 115Vac input supply to 90V
- Check the voltage across CE853 is 90V ±2V.

- Increase the 115Vac input supply to 137V.
- Check the voltage across CE853 is 90V ±2V.

- Remove the input supply voltage.
- Switch the voltage selector to 230Vac operation.

6.11 NVRAM Reset - To ensure the chassis has initialised the memory.

- See Appendix B for designation of control names MENU, X-, X+, Y-, Y+ and LED references H LED and V LED.

- Connect pin 28, IC701 to ground.
- Switch on the power and allow delay for chassis start up.
- Remove the ground connection from pin 28, IC701.
- Check the H LED is flashing and the V LED is on.
- Allow two seconds from switch on for the NVRAM reset to complete.
- Switch off power.

6.12 Video Cut-offs - Check the black levels (highest step of the colour bars).

- Use the oscilloscope with a x100 probe to monitor R, G, and B drives as specified
- Use the D.V.M. to monitor the voltage across CE721.

- Select Mode 10, pattern colour bars.
- Ensure A1 is at minimum (fully anti-clockwise).
- Hold 'Y-' key until the voltage across CE721 stops decreasing (minimum contrast).
- Adjust RV219 fully clockwise.

- Hold both the Brightness+/- keys for two seconds (centre brightness).
- Monitor the red drive at pin 8, SK901.
- Adjust RV231 for minimum black level, check it is ≤ 50V.
- Adjust RV231 to 75V ±1V.

- Monitor the green drive at pin 6, SK901.
- Adjust RV230 for minimum black level, check it is ≤ 50V.
- Adjust RV230 to 75V. ±1V.

- Monitor the blue drive at pin 11, SK901
- Adjust RV229 for minimum black level, check it is ≤ 50V.
- Adjust RV229 to 75V. ±1V.

6.13 Video Gains - Set the drive range from the white (bottom) to black (top) step of the colour bars.

- Hold Y+ key until voltage across CE721 stops increasing (maximum contrast).
- Monitor the green drive at pin 6, SK901.
- Adjust RV219 for white to black of 30V ±1V

- Monitor the red drive at pin 8, SK901.
- Adjust RV214 for white to black of 30V ±1V

- Monitor the blue drive at pin 11, SK901.
- Adjust RV224 for white to black of 30V ±1V

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6.14 **Minimum gains** - Check the lowest gain setting.

- Hold the Y- key until the voltage across CE721 stops decreasing (minimum contrast).

- Monitor the red drive at pin 8, SK901.
- Check white to black is less than 4V.

- Monitor the green drive at pin 6, SK901.
- Check white to black is less than 4V.

- Monitor the blue drive at pin 11, SK901.
- Check white to black is less than 4V.

- Hold both Y- and Y+ keys until the voltage across CE721 jumps to approximately mid-point (central contrast).

6.15 **Set A1 and B+ regulator** - Adjust for nominal picture at correct B+/EHT.

- Use the E.H.T. meter to monitor the voltage at the anode cap.

- Select Mode 1.
- Adjust RV503 to give 25.0kV ±0.2kV. EHT

- Select Mode 10
- Increase the A1 setting until the raster is visible at normal viewing level.

6.16 **Focus** - Approximate focus adjustment to check control range.

- Select the focus test pattern.
- Adjust focus for clearest lines and spaces.
- Select white screen pattern.

6.17 **Beam Current Limit** - To check the B.C.L. circuit is working.

- Use the oscilloscope with x100 probe and the EHT meter.

- Monitor the red drive at pin 8, SK901 with the oscilloscope.
- Increase the A1 slowly until the beam current limit is seen as follows:
- Check the black to white voltage decreases before the screen brightness becomes excessive.
- Check the E.H.T does not vary by more than ±0.3kV.
- Reduce the A1 for nominal viewing brightness.
- Disconnect the oscilloscope and EHT meter..

6.18 **Power Saving** - Testing the three power saving modes.

- Use a x10 oscilloscope probe, a D.V.M. and the signal lead sync. switches.
- Monitor the line waveform with the oscilloscope at the junction of R428 and R424.
- Monitor the 26Vdc rail across CE407 with the D.V.M.

6.18.1 **Standby mode.**

- Disconnect the horizontal sync and ground the input.
- Check that after five seconds the EHT drops below 10kV, but 26V remains.
- Reconnect the horizontal sync. and check normal operation is restored.

6.18.2 **Suspend mode.**

- Disconnect the vertical sync. and ground the input.
- Check that after five seconds the line drive stops and the 26V rail falls to <3V
- Reconnect the vertical sync. and check normal operation is restored.

6.18.3 Off mode.

- Disconnect both sync's and ground the inputs.
- Check that after five seconds the chassis enters full power saving, with the power L.E.D. flashing.
- Reinstate the syncs and check the chassis switches on again (the C.R.T. will need to warm up).
- Disconnect the oscilloscope and D.V.M.

6.19 Audio (where fitted) - To test the operation of the amplifier and volume P.W.M.

- Equipment.
- Audio generator, 1kHz sinewave, 150mV RMS high impedance to two phono plugs in parallel.
- Two speakers or dummy loads, 2W, 16 Ohm.
- Stereo headphones, 32 Ohm nominal impedance with 3.5mm stereo jack plug.
- Distortion meter.

- Initial conditions.
- Connect the generator to the phono sockets on the chassis.
- Connect the speaker/loads to SK601 and SK602.
- Switch on the chassis.

6.19.1 Volume level set and check.

- Use a x10 oscilloscope probe.

- Monitor the output signal at pin 1, SK601.
- Repeatedly press and release the MENU key until both L.E.D's are illuminated.
- Press the Y+ (volume up) key until the output signal stops increasing (it may be clipping).
- Adjust RV619 until the waveform starts to clip (if necessary).
- Adjust RV619 back until the clipping just stops.
- Monitor the output signal at pin 1, SK602.
- If the signal is clipping, adjust RV619 until clipping just stops.

6.19.2 Distortion.

- Check the output sinewave is 8V ±1V p-p.
- Check distortion is less than 20%.

6.19.3 Volume range.

- If necessary, repeatedly press and release the MENU key until both L.E.D's are illuminated.
- Press the Y- (volume down) key until the output signal stops decreasing.
- Check the output signal is less than 300mV p-p.

6.19.4 Headphones

- Connect the headphones load.
- If necessary, repeatedly press and release the MENU key until both L.E.D's are illuminated
- Press the Y+ (volume up) key until the output signal stops increasing.
- Check there is no signal at pin 1 of SK601 or SK602.
- Check for the signal at R608 (either end) of 1.6V ±0.3V p-p.
- Check for the signal at R609 (either end) of 1.6V ±0.3V p-p.

TEST COMPLETE

SECTION 7 FINAL SET-UP PROCEDURES

7.1 General

Prior to final set-up, a 30 minute minimum warm up period ***must*** be allowed.

All light intensity measurements should be made at the centre of the screen unless otherwise stated.

All the following checks must be made. Adjustments may not be necessary.

7.2 Equipment required

- Signal source or suitable graphics card and suitable P.C. to provide signals as defined in section 1.6. For accurate colour alignments you require a signal source capable of generating 0.707V. p - p. (A Chroma 2000 or 2250 or equivalent is recommended.).

- EHT meter to 30kV.
- D.V.M. 1kV.
- Minolta 2150 Colour analyser or equivalent.
- Variable isolated mains supply set to match the factory default supply setting for the model.

7.3 Initial Conditions.

- Connect the supply source generator to the monitor, set to Mode 5, (37.8kHz) green focus pattern.
- Ensure (where fitted) the voltage selector switch is correctly set for the local supply voltage.
- Connect the mains supply to the monitor.
- Switch on the monitor.
- Check the 'V' L.E.D. is flashing. If so proceed to section 7.4.

7.3.1 Depress and hold the two outermost control keys on the monitor (Select and Contrast +).
- Switch on the monitor.
- When the monitor has fully powered up (two seconds maximum), release the keys. The vertical (leftmost) LED should flash; if not, switch off and repeat this section.

7.4 Focus Setting

- Select brightness and contrast to mid position (see Appendix A)..
- Adjust focus for most clearly defined vertical lines.

7.5 Geometry and Global adjustment

Select 4 x 4 grid pattern.

7.5.1 Press the select button. The V LED should be off and the H LED on (not flashing).
- Adjust horizontal phase (Contrast-/+ keys) to centre the image on the screen.
- Adjust RV443 (pincushion) and RV449 (keystone) for straight parallel and vertical lines at the edges of the pattern.
- Adjust width (Brightness-/+ keys) for a raster width of 260mm (14" C.R.T) or 270mm (15" C.R.T).
- Repeat this section as required for best results.

7.5.2 Press the Select key. The V LED should be on (not flashing) and the H LED should be off.
- Adjust the vertical position (Contrast -/+ keys) to centre the picture. Do not attempt to adjust height.
- Adjust vertical linearity with RV404 for equally spaced vertical intervals.
- Press the Select key. The V LED should be flashing and the H LED off.
- Repeat this section as required for best results.

7.6 Geometry and global adjustment/Factory mode optimise.

- Select 4 x 4 grid pattern
- Set contrast to maximum
- Check display tilt (with C.R.T. facing EAST) is within the limits of Appendix B1.
- Check horizontal linearity is within the limits of Appendix B2.
- Check vertical linearity is within the limits of Appendix B2 and adjust RV404 if necessary.

- Select Modes 1, 8 and 12 in turn. Check for each that the display is centred and 260x190mm (14") or 270x203mm (15") in size. If a Mode requires adjustment, perform the following:
- Select factory mode optimise.

- Press the select key until the H and/or V LED's are flashing.
- If both LED's are flashing press the Contrast - key. If only the V LED is flashing press the Contrast +. The H LED should now be flashing and the V LED off.

- Press the select key twice so that the H LED is on and the V LED is off.
- Use the Brightness -/+ key to adjust width and the Contrast -/+ key to adjust horizontal phase.

- Press the select key again so that the V LED is on and the H LED is off.
- Use the Brightness -/+ key to adjust height and the Contrast -/+ key to adjust vertical position.
- After adjustment press the select key again to store the settings..

7.7 White Balance.

- Select Mode 8, black screen.
- Press the select key until no LED's are lit.
- Set brightness to maximum, contrast to minimum.

- Using the Minolta light meter, adjust the A1 for luminance of 3.0 ±0.5Cd/m².
- Adjust the two non-predominant colours for co-ordinates: x=0.281 ±0.015 and y=0.311 ±0.015.
- Check that luminance remains at 3.0 ±0.5Cd/m².
- If not repeat the three previous items

- Set contrast to maximum, brightness to nominal.
- Select small green block pattern on the generator.
- Adjust green drive (RV219) for luminance of 100 ±5Cd/m².
- Select small white block pattern.

- Adjust red (RV214) and blue (RV224) drives as follows:
- Adjust blue for y=0.311 ±0.005
- Adjust red for x=0.281 ±0.005
- Repeat this section until x=0.281 ±0.005 and y=0.311 ±0.005.

- Check the luminance is 130 ±10Cd/m².
- Reduce user contrast for a luminance of 20 ±3Cd/m².
- Check that x=0.281 ±0.010 and y=0.311 ±0.010. If this is not correct, repeat from section 7.8.5, but continue to adjust the original two non-predominant colours - not the current ones.

- Select full white screen pattern.
- Set brightness and contrast to maximum.
- Check the luminance reading is 120 ±15Cd/m².

7.8 Static Convergence.

- Select Mode 8, 4x4 grid pattern.
- Set brightness to mid-position, contrast to maximum.
- With reference to appendix A, B3, check the convergence error at :

- Centre <0.15mm.
- Zone A <0.30mm
- Zone B <0.40mm

- Slight adjustment of the static convergence magnets on the C.R.T. may be necessary to achieve this.

7.9 Purity.

- Select red raster pattern and check there is no discoloration.
- Select blue raster pattern and check there is no discoloration.
- Select green raster pattern and check there is no discoloration.

7.10 **Set and Enable User Limits.**

- Check the 'V' L.E.D. is flashing and the 'H' L.E.D. is off
- Press the 'Contrast +' (rightmost) key twice. Both the 'H' and 'V' L.E.D's should be flashing.
- Press the 'Select' key twice, so that the 'V' L.E.D. is off and the 'H' L.E.D. is illuminated.
- Press the 'Brightness -' key and observe the minimum width.
- Use the 'Brightness+' key to increase the minimum width to full screen width -020mm each side.

- Press the 'Select' key twice so that both 'V' and 'H' L.E.D's are flashing again.
- Switch off the monitor.
- Press and hold the 'Select' and 'Brightness-' keys simultaneously and switch on the monitor. Release both keys when the monitor has fully powered up.
- Observe that both the 'H' and 'V' L.E.D's are off (not flashing). If either or both flash, repeat from section

7.11 **Final Picture Quality Check.** (If necessary, repeat any previous sections).

- Set brightness and contrast to mid-position.
- Select Mode 8, (48kHz), white block.
- Set contrast for Y=90 ±5Cd/m².
- Select text pattern.

7.11.1 Check text is clearly legible.

- Check there is no smearing or streaking between characters.
- Select Mode 1 and repeat section 7.11.1
- Select Mode 5 and repeat section 7.11.1

7.12 **Dual Voltage** (where applicable).

- Switch off the monitor.
- (If fitted), change the voltage selector switch to its alternative position.
- Adjust the mains supply to the other setting as above: 240V if it was 110V and vice versa.

- Switch on the monitor.
- Check the display is not degraded from final check in section 7.11.1.
- Check the picture size is not unduly reduced or increased.
- *Note:* A slight reduction may result from the brief switch off.

- Switch off the monitor.
- (If fitted), return the voltage selector switch to its original position.
- Adjust the input supply voltage to its former level.

7.13 **DDC1 Communications Verification**

- Connect the monitor to a suitable computer with DDC1/2B software and hardware.
- Ensure the software automatically recognises the monitor type

7.14 **Safety Testing.**

- THE FOLLOWING TESTS ARE NECESSARY FOR COMPLIANCE WITH INTERNATIONAL SAFETY STANDARDS AND MUST BE PERFORMED ON ALL MONITORS. ANY MONITOR FAILING ANY TEST MUST BE REJECTED.

- PERFORM EARTH LEAKAGE TEST PRESCRIBED IN EN 60 950, PARA. 5.2.3. EARTH LEAKAGE FROM EITHER LIVE OR NEUTRAL MUST NOT EXCEED 3.5mA. THIS TEST SHOULD BE PERFORMED WITH BOTH THE INPUT VOLTAGE AND VOLTAGE SELECTOR SWITCH (if fitted) IN BOTH CLOSED AND OPEN POSITIONS.

- CHECK THE RESISTANCE BETWEEN THE SIGNAL CABLE SHELL AND MAINS EARTH IS NOT MORE THAN 0.1Ω.

- CONNECT LIVE AND NEUTRAL TOGETHER, APPLY 2120Vdc. BETWEEN THEM AND EARTH. CHECK NO BREAKDOWN OCCURS.

FINAL ALIGNMENT COMPLETE

Notes for Appendix A

Setting Brightness and Contrast.

Brightness control voltage can be monitored at pin 4 of SK403/SK202 or equivalent point.

Contrast control voltage can be monitored at pin 8 of SK403/SK202 or equivalent point.

Before adjusting brightness and contrast controls, neither the 'H' or 'V' L.E.D. should be illuminated.

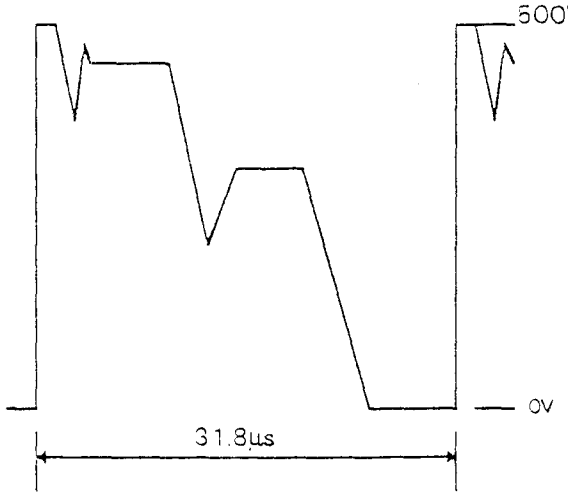
1 To set nominal position for either brightness or contrast, press and hold both the up and down keys for a maximum of two seconds, or until a change is seen on the screen, or until the control voltage changes.

2 To set maximum or minimum for either brightness or contrast, press and hold the relevant up or down key for:

2.1 Maximum of six seconds from nominal to maximum/minimum, or until screen stops changing, or until control voltage stops changing

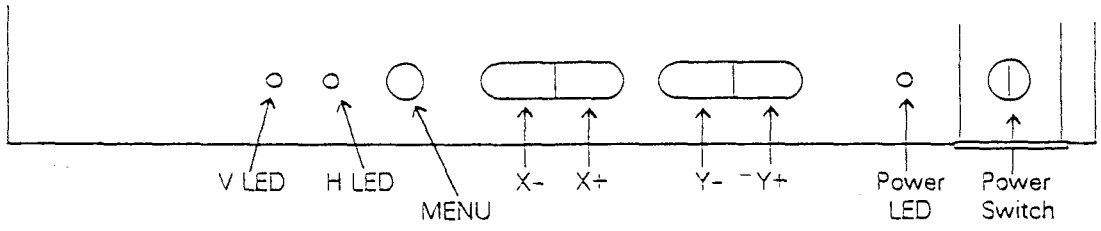
2.2 Maximum of eleven seconds from maximum to minimum, or minimum to maximum, or until screen stops changing, or until control voltage stops changing.

APPENDIX A

PARAMETER	APPENDIX A. X2 SERIES WAVEFORMS	NOTES
A1 Q801 drain wave form SMPS waveform Q801d		Measurement must be made using an isolated supply with S.M.P.S primary ground as reference. See section 6.2

A2

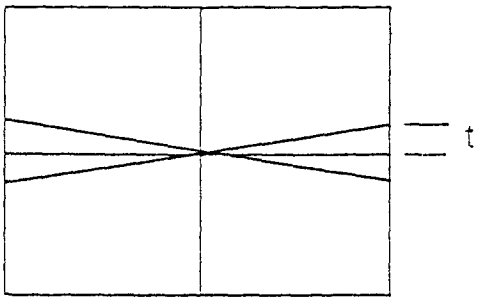
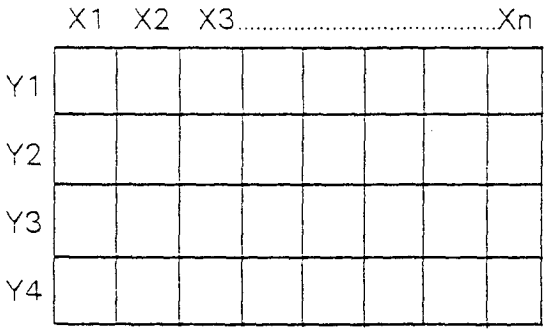
Diagram of the controls, label designations and A.T.E. equivalents.



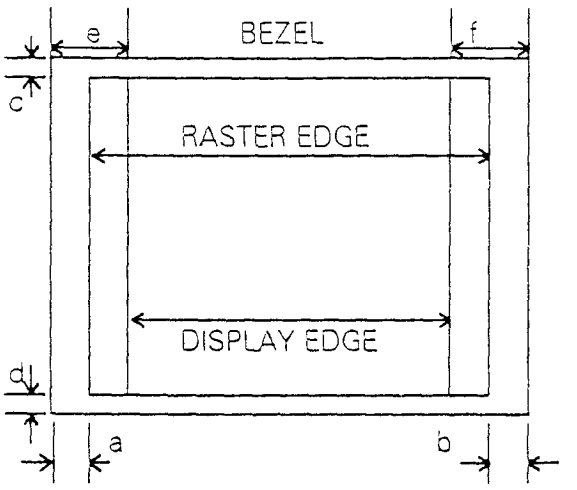
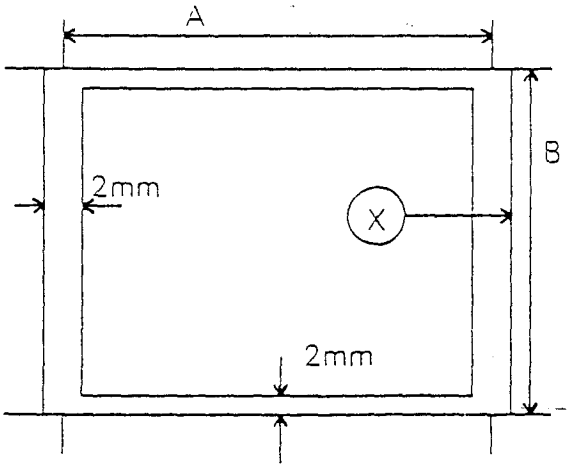
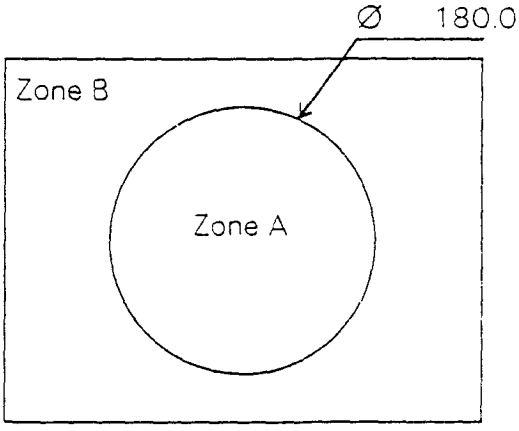
A.T.E equivalents:

H LED:	Lit if pin 28, IC701 is at 0V, off if pin 28 is at 5V.
V LED:	Lit if pin 27, IC701 is at 0V, off if pin 27 is at 5V.
MENU:	Connect pin 32, IC701 to 0V to simulate press
X- :	Connect pin 33, IC701 to 0V to simulate press.
X+ :	Connect pin 34, IC701 to 0V to simulate press.
Y- :	Connect pin 35, IC701 to 0V to simulate press.
Y+ :	Connect pin 36, IC701 to 0V to simulate press.

APPENDIX A

PARAMETER	APPENDIX A X2 SERIES LINEARITY/TILT	TEST CONDITIONS
B1 TILT	 t ≤ 1.0mm	TILT CONTRAST = Maximum BRIGHTNESS = Detent Pattern = 4 x 4 Grid
B2 LINEARITY	 $Average X = \frac{\sum X_1 \ldots X_n}{n} = X$ $Average Y = \frac{\sum Y_1 \ldots Y_4}{4} = Y$ $\frac{\overline{X} - X_i}{\overline{X}} \le 0.05$ $i = 1 \ldots n$ $\frac{\overline{Y} - Y_i}{\overline{Y}} \le 0.05$ $i = 1 \ldots 4$ NOTE: NO STEP CHANGES ALLOWED	CONTRAST = Maximum BRIGHTNESS = Detent Pattern = 4 x 4 Grid

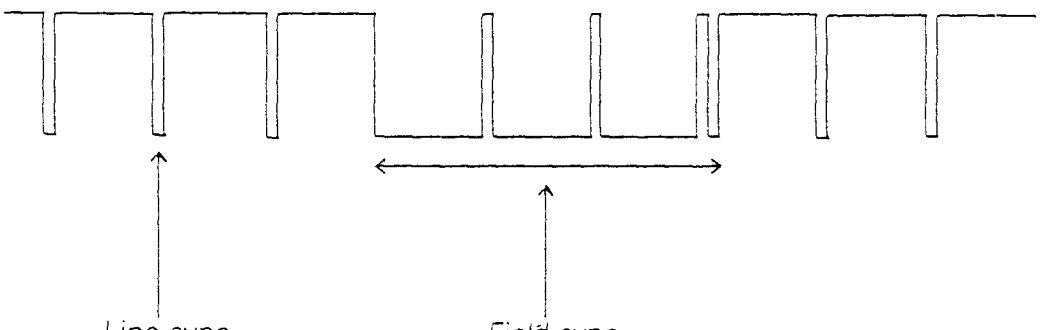
APPENDIX A

PARAMETERS	APPENDIX A: X2 SERIES SPEC. LIMITS	TEST CONDITIONS
C1 Raster + Display Centring	 [a-b]≤4.0mm, [c-d]≤4.0mm, [e-f]≤4.0mm	CONTRAST = Central BRIGHTNESS = Maximum PATTERN = White Raster
C2 Geometric Distortion	 A (width) & B (height) are ±2mm Allowing for height and width setting tolerances, total display distortion must be within area X	Geometric Distortion CONTRAST = Maximum BRIGHTNESS = Detent Pattern = Cross Hatch Width = 270mm [15"] = 260mm [14"] Height = 203mm [15"] = 190mm [14"]
C3 Convergence	 Centre <0.15mm Zone A <0.30mm Zone B <0.40mm	Static Convergence CONTRAST = Maximum BRIGHTNESS = Detent Pattern = Cross Hatch

APPENDIX B

Composite Sync. Signal

Composite sync. can be generated by gating vertical and horizontal syncs with 'EX-OR' gate or similar.



Note extra line sync. pulse at end of field sync.

SECTION 1 BRIEF SPECIFICATION

1.1 Power Supply

Input:: 220-240VAC or 110-125VAC or 110-125/220-240VAC at 48-63Hz. auto or manual selection indicated on the label at the rear of the cabinet.
Internal fuse protection, T3, 15A.
Power Consumption: Less than 80W average in normal operation
Less than 50W in standby operation (no H-sync)
Less than 30W in suspend operation (no V-sync)
Less than 5W with full power saving (no syncs) VESA OFF mode.
Power connector: IEC320, 3 pin male.

1.2 C.R.T.

14"(13V) or 15"(14V)
Dot pitch 0.28mm or 0.39mm according to model.
V models only are VLMF (very low magnetic field emissions) screen.
VA models only have VLMF and Anti-static Screen.

1.3 Audio ('Mult-media' versions).

Models with M in model number are fitted with mult-media option.
Input: Phono sockets, 2x150mV max. RMS into 22k Ohms.
Output: 2x3W max. Music Output Power with digitally controlled volume.
3.5mm headphone socket.

1.4 Operating Conditions:

Temperature: 10° to 35°C.
Humidity: 20% to 85% non-condensing.

1.5 Plug & Play (where fitted)

Models with D in the model number meet DDC1/2B compatibility requirements

1.6 Input Signals:

Sync. inputs, TTL level as specified below
Mode detection windows : H ± 1kHz. V ±1Hz.
Video inputs, analogue RGB. Level 0.71V positive going, into 75 Ohms.

1.6.1 Sync Inputs

Mode		Resolution	Sync Polarity		Sync Frequency		
			H	V	H/kHz	V/Hz	
0	IBM VGA	640 x 480	-	-	31.5	60	
1		640 x 400	-	+	31.5	70	
		720 x 400	-	+	31.5	70	
2		640 x 350	+	-	31.5	70	
3	SVGA	800 x 600	-	-	35.1	56	
4	8514/A	1024 x 768	+	+	35.5	87	Interlaced
5	VESA VGA	640 x 480	-	-	37.8	72	
8		800 x 600	+	+	48.0	72	
9		800 x 600	+	+	37.8	60	
10		1024 x 768	-	-	48.3	60	
11	VESA 75Hz	640 x 480	-	-	37.5	75	
12		800 x 600	+	+	46.9	75	

Table 1

SECTION 8 P.W.B COMPONENT LOCATIONS and CIRCUIT DIAGRAMS

8.1 Audio P.W.B (component side) and Circuit Diagram.

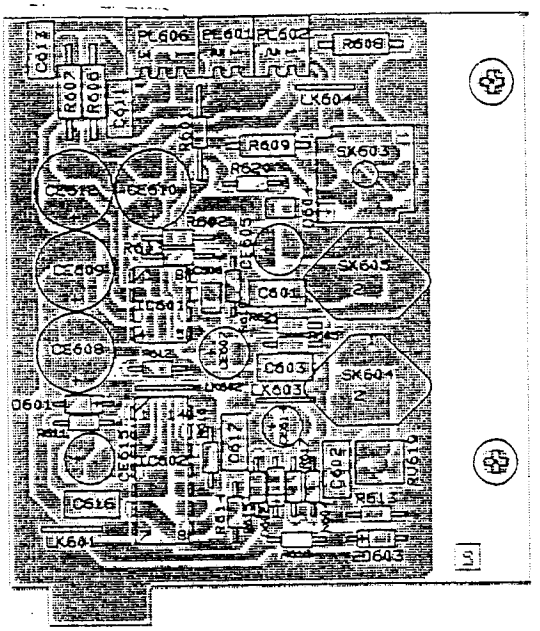


Fig. 4 Audio P.W.B.

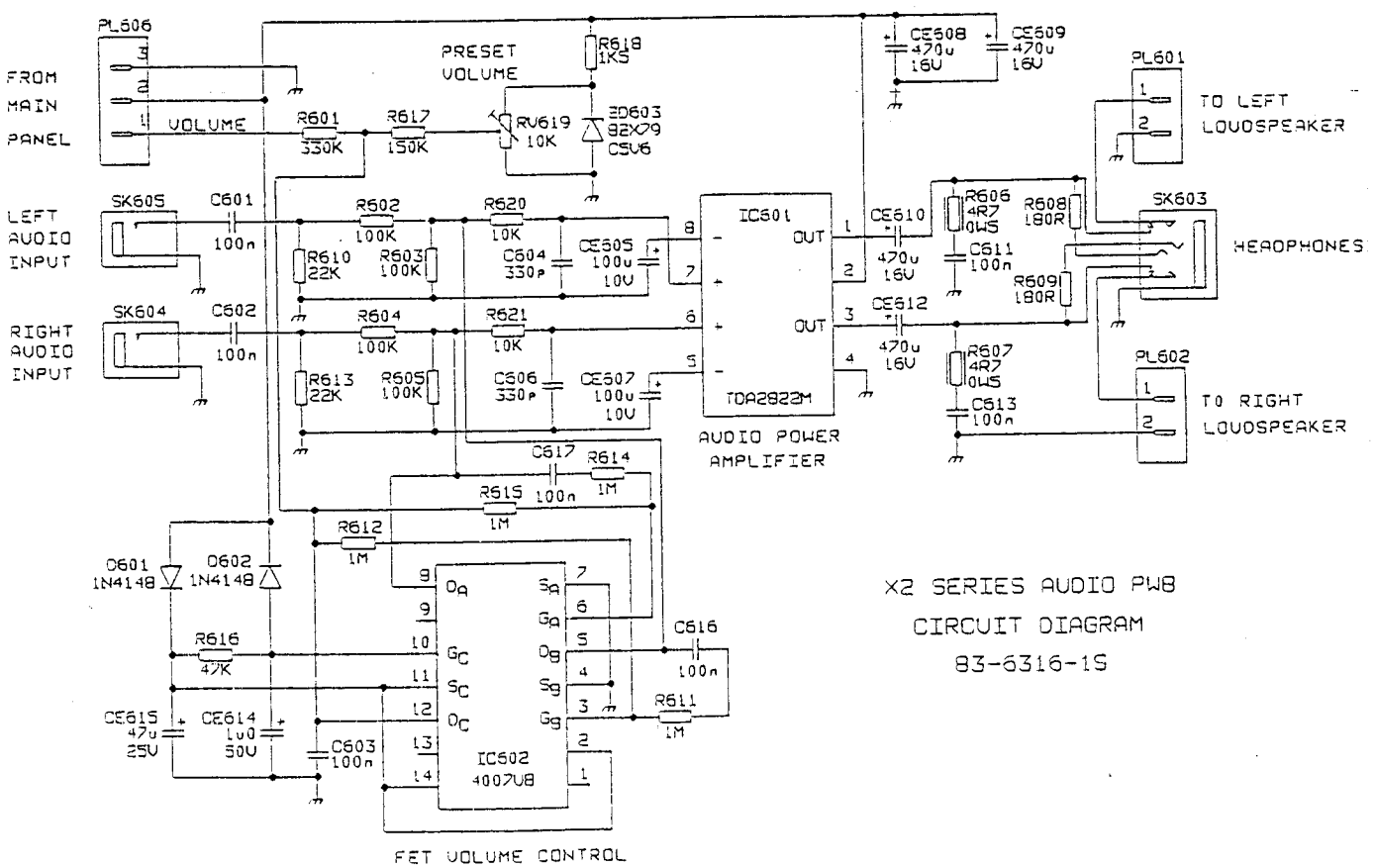


Fig. 5 Audio Circuit Diagram

8.2 Video P.W.B. (component side)

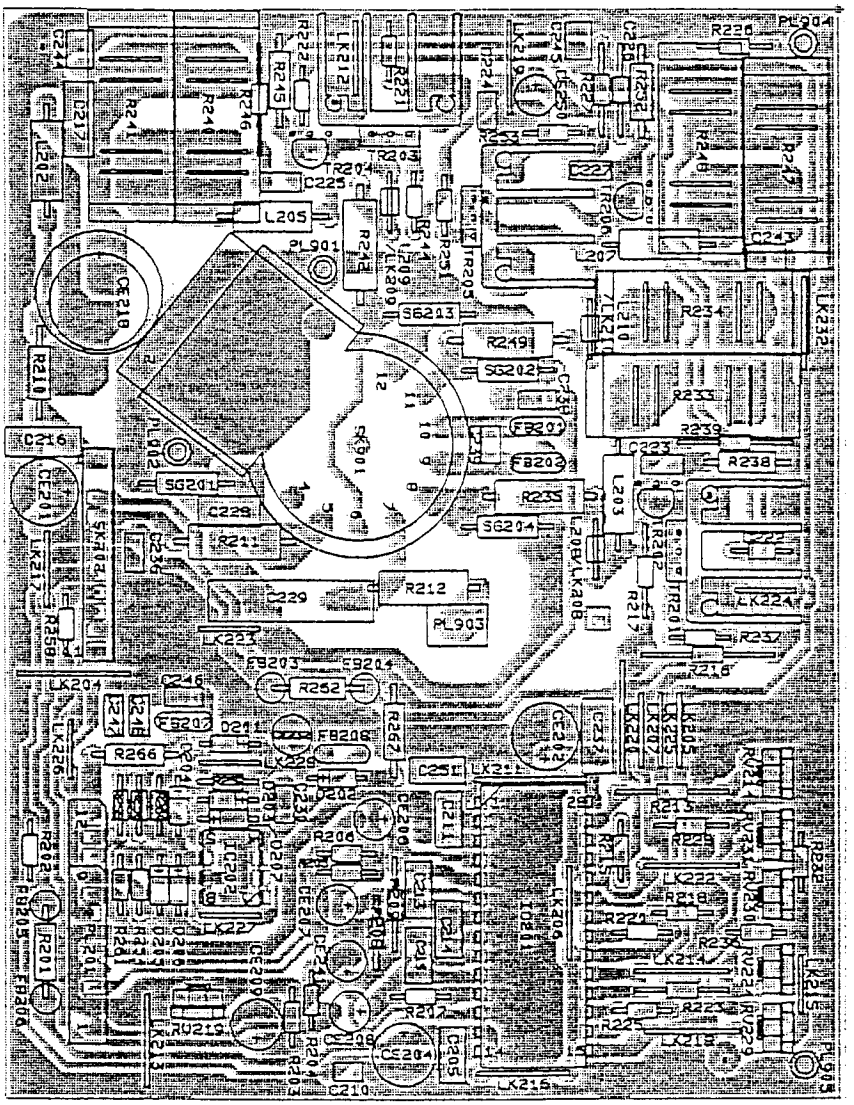


Fig. 6 Video P.W.B.

8.2.1 Video Base Circuit Diagram

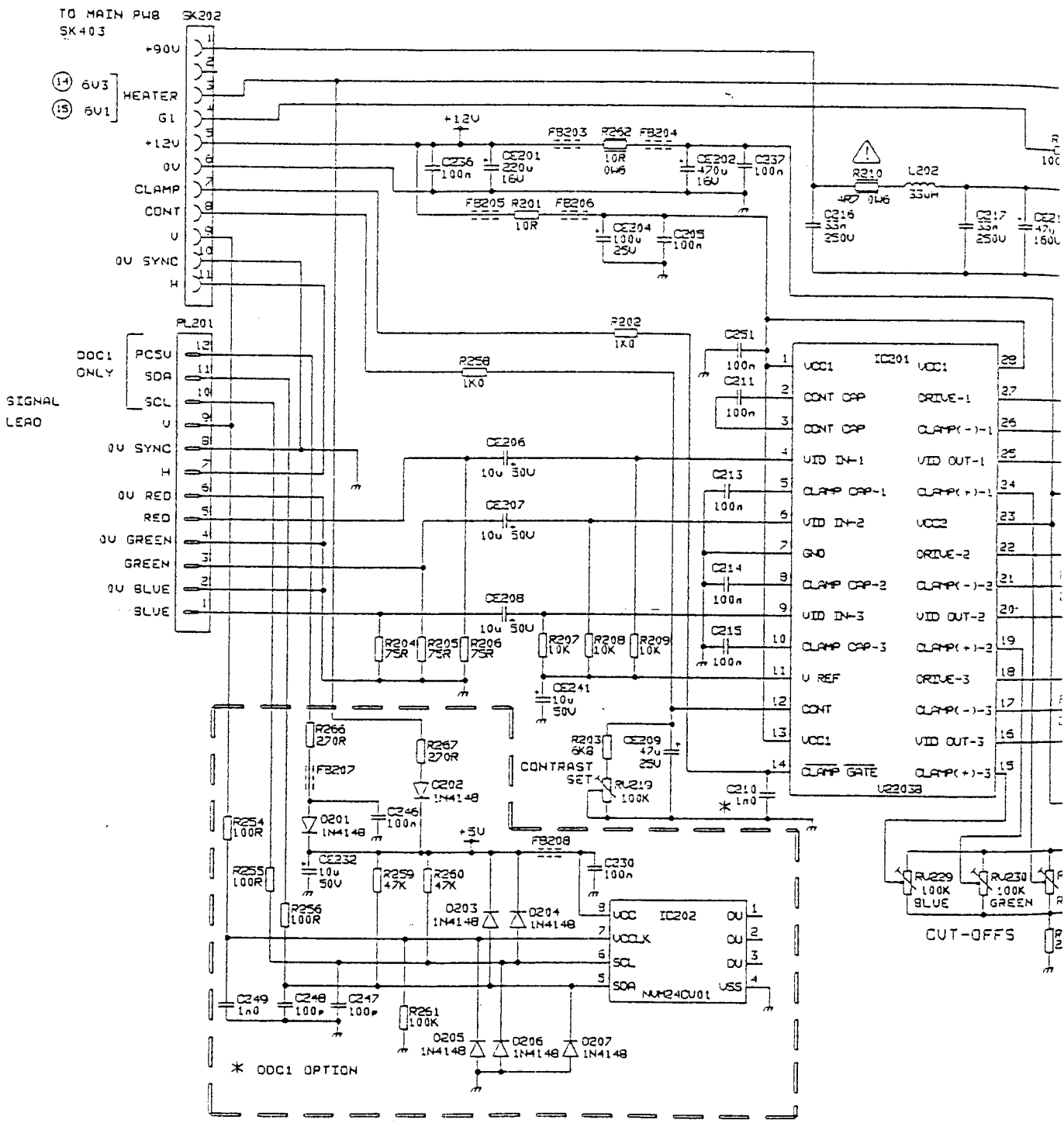
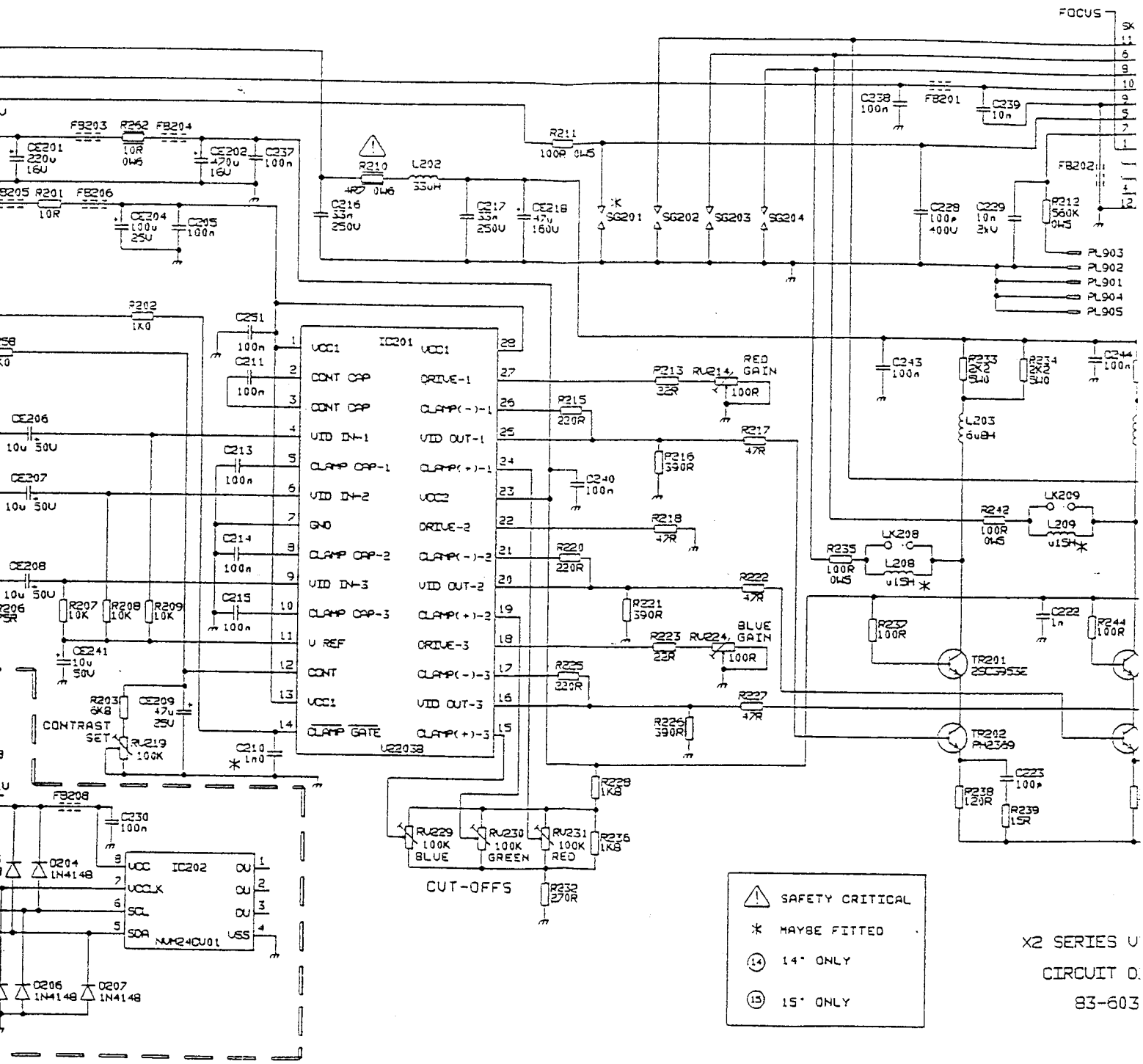
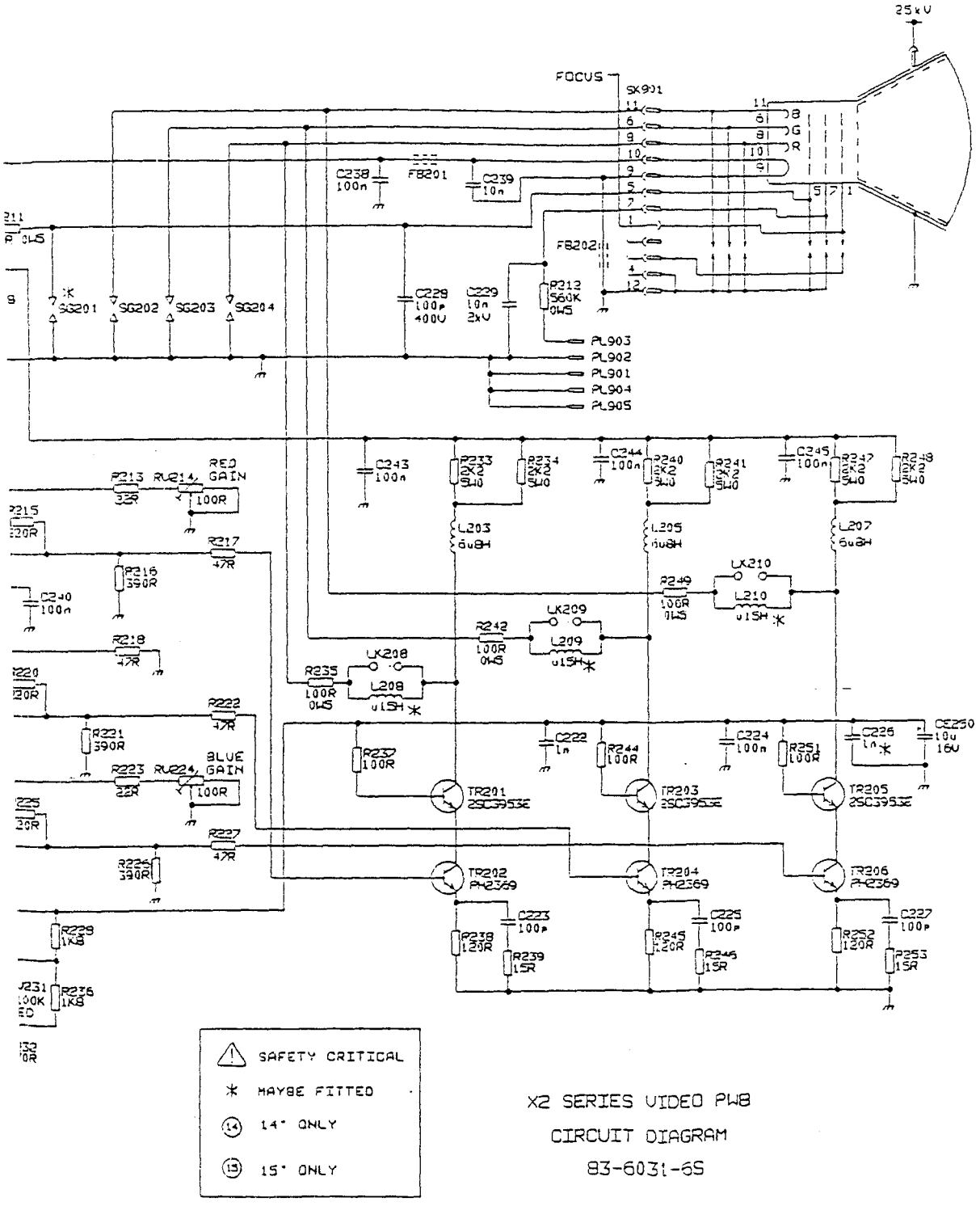


Fig. 7 Video Circuit Diagram

t Diagram


FOCUS
IC201
U22038
VCC1
CONT CAP
CONT CAP
VID IN-1
CLAMP CAP-1
VID IN-2
GND
CLAMP CAP-2
VID IN-3
CLAMP CAP-3
V REF
CONT
VCC1
CLAMP GATE
DRIVE-1
CLAMP(-)-1
VID OUT-1
CLAMP(+)-1
VCC2
DRIVE-2
CLAMP(-)-2
VID OUT-2
CLAMP(+)-2
DRIVE-3
CLAMP(-)-3
VID OUT-3
CLAMP(+)-3
RED GAIN
BLUE GAIN
CONTRAST SET
CUT-OFFS
BLUE
GREEN
RED
IC202
NJM24CU01
VCC
VCCLK
SCL
SDA
OU
VSS
TR201
2SC3953E
TR202
PA2369
L202
L203
L208
L209
SG201
SG202
SG203
SG204
PL903
PL902
PL901
PL904
PL905
SAFETY CRITICAL
MAYBE FITTED
14" ONLY
15" ONLY
X2 SERIES
CIRCUIT D
83-603



⚠ SAFETY CRITICAL

* MAYBE FITTED

(14) 14° ONLY

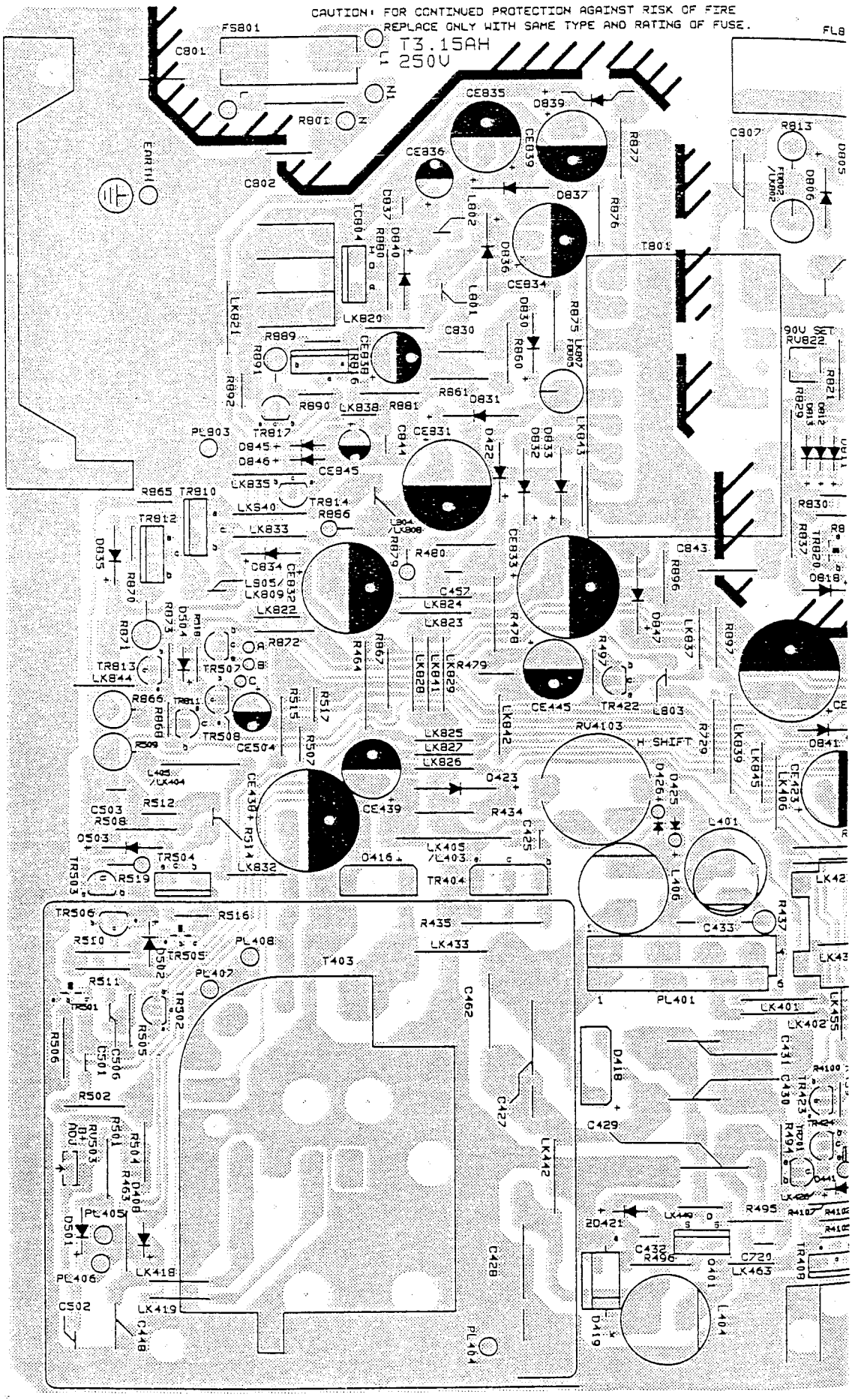
(15) 15° ONLY

X2 SERIES VIDEO PWB

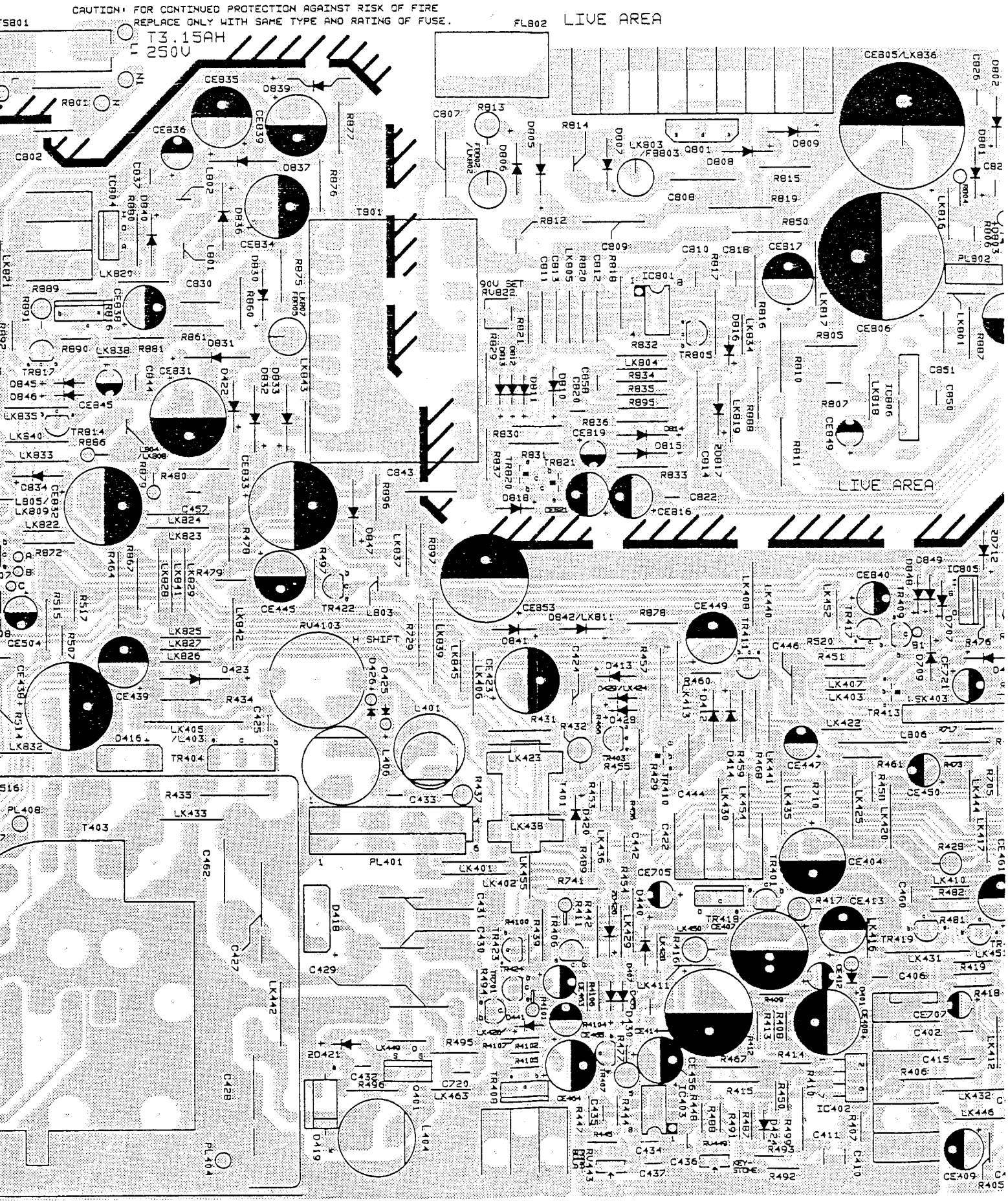
CIRCUIT DIAGRAM

83-6031-6S

8.3 Main Chassis P.W.B (component side)



P.W.B (component side)



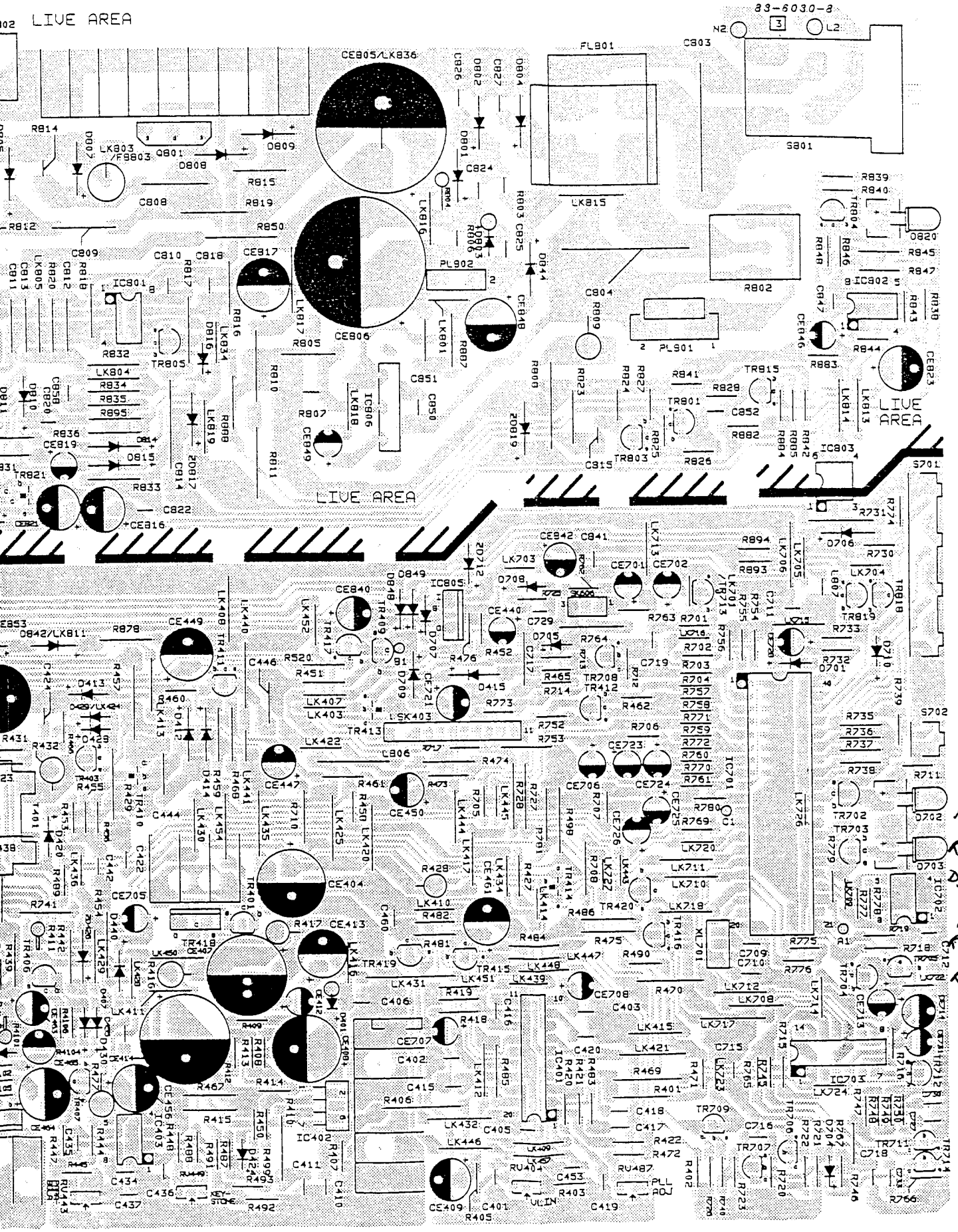


Fig. 8 Main Chassis P.W.B.

8.3.1 Main Chassis Circuit Diagram

Fig. 9 Main Chassis Circuit Diagram

The Main Chassis circuit diagram 83-6030-8S can be found as a loose leaf insert at the rear of this manual.

SECTION 9 ADJUSTMENT LOCATIONS (Physical)

9.1 Audio P.W.B. Adjustment

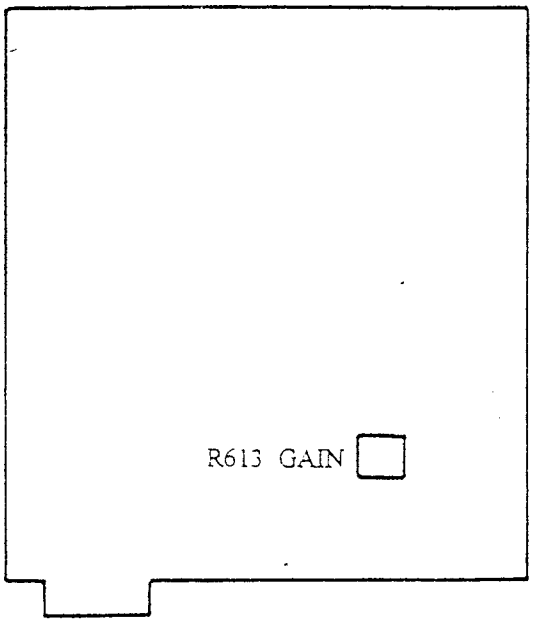


Fig. 10 Audio Adjustment location

9.2 Video P.W.B. Adjustments

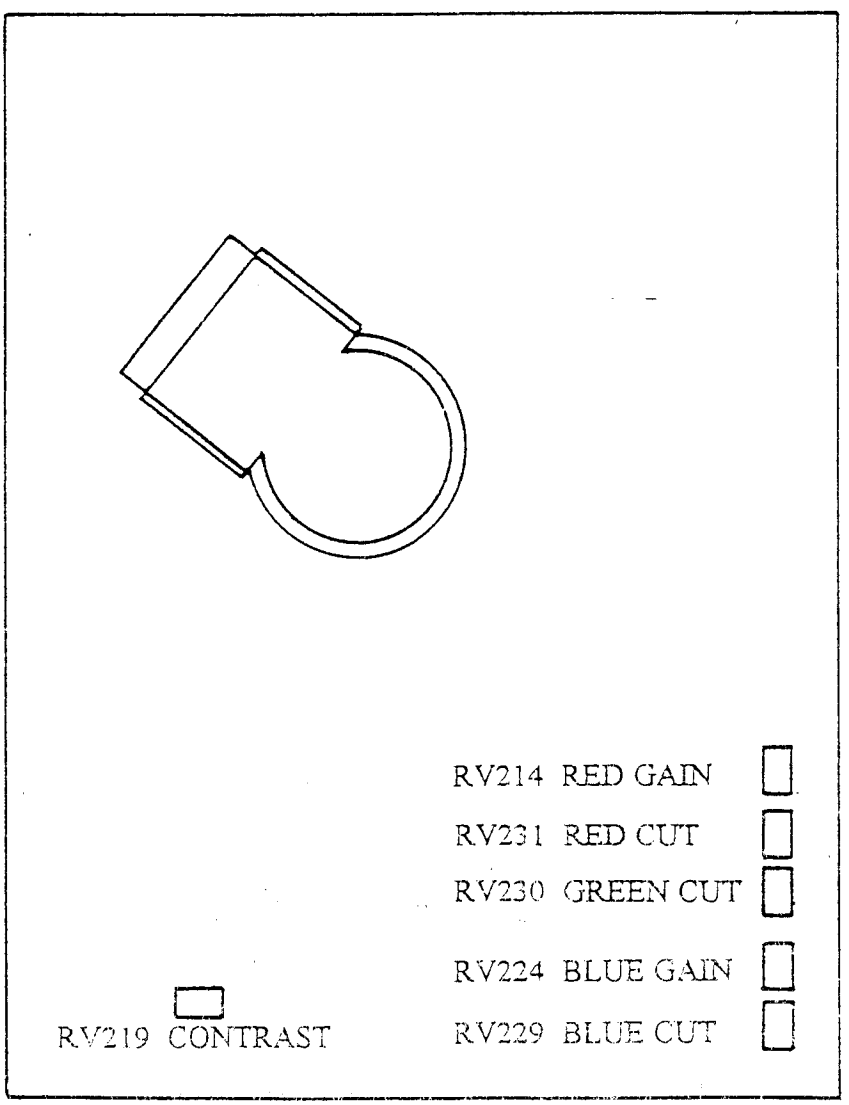


Fig. 11 Video Adjustment locations

1.6.2 Signal Cable:

Lead captive in monitor, to 15 pin compact male D-type connector. Minimum length 1 metre.

1.6.3 Signal Cable pin assignment.

Pin	Function	Pin	Function
1	Red video signal	8	Blue video screen
2	Green video signal	9	No connection
3	Blue video signal	10	Sync ground
4	Linked to pin 10	11	Linked to pin10
5	Must be grounded in PC for correct operation	12	DDC Data*
		13	Hor sync or composite sync
6	Red video screen	14	Vertical sync
7	Green video screen	15	DDC1 Clock*

Table 2

* Models without DDC1/2B compatibility - No connection

1.7 Display Size: (Factory preset. Can be increased to edge to edge or overscan by user).

	Width:	Height
14"	260mm	190mm
15"	270mm	202mm

1.8 User Digital Controls

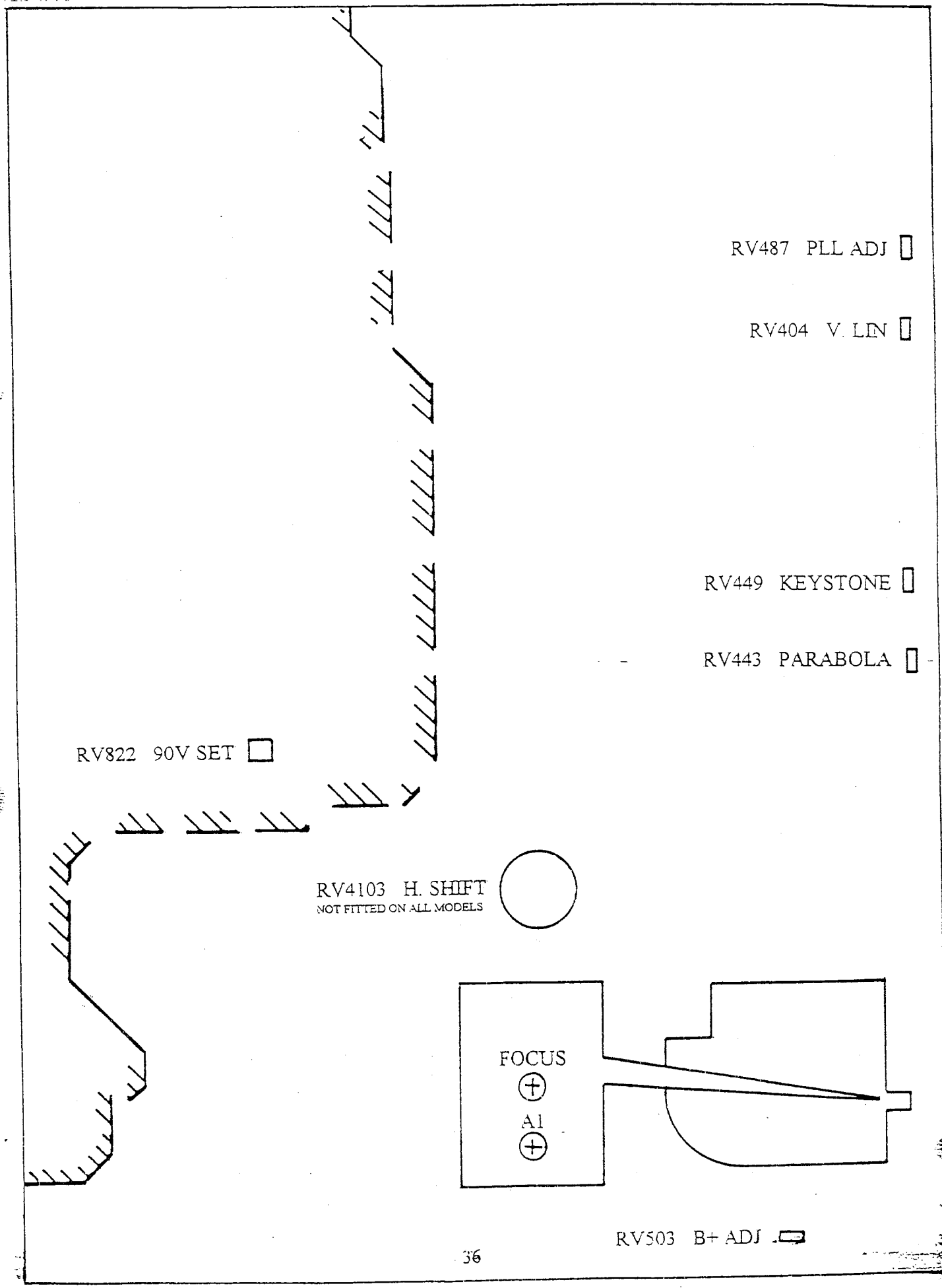
Brightness, Contrast, Hor. Centre, Vert. Centre, Width, Height, Volume (multi-media models only).

1.9 Colour Point

x = 0.281 ±0.015, y = 0.311 ±0.015 (9300K). Measured at 90 Cd/m² light output.

9.3 Main Chassis P.W.B Adjustments

Fig.12 Main Chassis Adjustment locations



SECTION 10 PARTS LIST

This section lists most of the parts common to all the chassis identified on the front cover of this manual and which should be changed with replacement parts supplied by the manufacturer's parts and service division. It also lists all parts not common to all chassis. Those parts not listed can be purchased at most electronic component stockists. See enclosed circuit diagrams for individual values and tolerances.

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

N.B. The tables (where applicable) following each category of components lists all those components not common to all chassis covered by this manual. See main chassis circuit diagram for individual values.

10.1 Resistors

The majority of resistors are carbon film types of less than 0.6W obtainable from most electronic component stockits and are therefore not listed; refer to the circuit diagram for values. All other parts should be replaced with components supplied by the manufacturer. 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.

The following list of resistors is common to all chassis covered by this Service Manual

Cct Ref	Value	Tol.	Watts	Description	Part number
R210	4R7	1%	0.6W	M/Film Flame Retardant	11-5758-2
R233,234,240,241,					
R247,248	2k2	5%	5W	M/Oxide	11-5942-9
R262	10R	1%	0.6W	M/Film Flame Retardant	11-5759-0
R410	1R8	5%	0.5W	M/Film Fusible	11-5717-5
R416	220R	5%	2W	M/Oxide	11-5800-7
R421	12k	1%	0.125W	M/Film	11-5537-7
R422	5k1	1%	0.125W	M/Film	11-5809-0
R428	120R	5%	1W	M/Oxide	11-5704-3
R431	22R	5%	0.5W	M/Film Fusible	11-5724-8
R432	470R	5%	2W	M/Oxide	11-5802-3
R451	240k	1%	0.125W	M/Film T.26	11-5952-6
R452	10k	1%	0.125W	M/Film T 26	11-5953-4
R457	150R	5%	2W	M/Oxide	11-5819-8
R472	1k	1%	0.125W	M/Film	11-5750-7
R477	100R	5%	2W	M/Oxide	11-5813-9
R478	27k	5%	2W	M/Oxide	11-5316-1
R480,494	100k	2%	0.6W	M/Film	11-5266-1
R501	220R	1%	0.6W	M/Film Flame Retardant	11-5787-6
R505	33k	2%	0.6W	M/Film	11-5207-6
R508	1R	1%	0.6W	M/Film Flame Retardant	11-5756-6
R509	10k	5%	3W	M/Oxide	11-5762-0
R514	47R	10%	6W	W/Wound 308-3 VTM	11-5445-10
R801	560k	5%	0.5W	M/Glaze	11-5333-1
R802	18R	Thermistor dual PTC			11-5531-8
R803	10R	Thermistor NTC			11-5529-6
R806,807		Varistor VL140LA2			11-5643-8
R808,809	10k	5%	2W	M/Oxide	11-5808-2
R810,811	39k	5%	2W	M/Oxide	11-5588-1
R812	18k	5%	5W	W/Wound	11-5576-8
R813	1k	5%	1W	M/Oxide	11-5612-8
R814	2k5	5%	7W	W/Wound	11-5580-6
R817	15k	1%	0.4W	M/Film	11.5045-6
R819	0R39	5%	1W	M/Oxide	11-5616-0
R831	6R8	1%	0.6W	M/Film Flame Retardant	11-5749-3
R832	8k2	1%	0.25W	M/Film	11-5599-7
R850	0R33	5%	0.6W	M/Film Flame Retardant	11-5782-5
R866	33k	5%	3W	M/Oxide	11-5661-6
R871	18k	5%	2W	M/Oxide	11-5587-3
R875	1R	5%	1W	M/Oxide	11-5822-8
R876	0R68	5%	0.6W	M/Film Flame Retardant	11-5784-1
R877	0R39	5%	0.6W	M/Film Flame Retardant	11-5783-3
R880	270R	1%	0.25W	M/Film	11-5217-3
R881	2k37	1%	0.25W	M/Film	11-5218-1
RV214,224	100R	30%		6mm Linear Pot	12-4603-8

Cct Ref	Value	Tol.	Watts	Description	Part number
RV219,229,230,231					
RV443	100k	30%		6mm Linear Pot	12-4621-6
RV404,503	47k	30%		6mm Linear Pot	12-4618-6
RV449	2k	30%		6mm Linear Pot	12-4609-7
RV487	5k	30%		6mm Linear Pot	12-6413-5
RV822	470R	30%		6mm Linear Pot	12-4629-1

Cct Ref	X2N128	X2AN128	X2QN128	X2AN1M	X2QN1M
R414	11-5254-8	11-5254-8	11-5273-4	11-5254-8	11-5273-4
R434	11-5948-8	11-5948-8	11-5949-6	11-5948-8	11-5949-6
R460	11-5221-1	11-5221-1	11-5233-5	11-5221-1	11-5233-5
R468	11-3355-1	11-3355-1	11-5431-1	11-3355-1	11-5431-1
R601				11-5489-3	11-5489-3
R602-605				11-5221-1	11-5221-1
R606,607				11-5291-2	11-5291-2
R608,609				11-2737-3	11-2737-3
R610,613				11-5230-0	11-5230-0
R611,612				11-5216-5	11-5216-5
R614,615				11-5216-5	11-5216-5
R616				11-5233-5	11-5233-5
R617				11-5380-3	11-5380-3
R618				11-5248-3	11-5248-3
R620,621				11-5232-7	11-5232-7
R701			11-5213-0		11-5213-0
R754				11-5285-8	11-5285-8
R762				11-5232-7	11-5232-7
R763				11-5221-1	11-5221-1
R764				11-5720-5	11-5720-5
R878	11-5692-6	11-5692-6	11-5817-1	11-5692-6	11-5817-1
RV619				12-4639-9	12-4639-9

Table 6 Resistors

10.2 Capacitors

The following list of capacitors is common to all chassis covered by this Service Manual

Cct Ref	Value	Tol.	Volts	Type	Part number
C205,224,236-238	100n	20%	50V	RPE132	14-7093-0
C216,217	33n	20%	250V	Metal Polyester	14-6840-5
C223,225,227	100p	2%	50V	Ceramic Plate N150	14-6884-7
C228	100p	10%	400V	Ceramic Disc	14-4257-0
C229	10n	-20+50%	2kV	Ceramic Disc	14-6954-1
C239	10n	20%	50V	RPE132	14-7105-8
C243-245	100n	5%	100V	Ceramic Plate	14-7221-6
C251,722,240	100n	20%	50V	RPE132	14-7093-0
C401-403,424	15n	20%	400v	Metal Polyester	14-6933-9
C417	1n5	5%	50V	NPO	14-7320-4
C418	2n2	10%	100V	Ceramic Plate	14-6893-6
C420	22n	10%	250V	Metal Polyester	14-6877-4
C433,425	4n7	10%	100V	Ceramic Plate	14-6894-4
C429	1µ	5%	250V	Polypropylene	14-7238-0
C727	1n	10%	100V	Ceramic Plate	14-6934-7
C434,460	1n5	10%	100V	Ceramic Plate	14-6945-2
C437,730	10n	-20+50%	100V	Ceramic Plate	14-6903-7
C444,446,448	100n	20%	250V	Metal Polyester	14-4386-0
C453,716	68p	2%	50V	Ceramic-Plate NPO	14-7012-4
C457,810,815,818	10n	20%	400V	Metal Polyester	14-6838-3
C463	100n	10%	100V	Metal polyester	14-7213-5
C501	1n	20%	250V	Metal Polyester	14-7313-1
C502	10n	10%	400V	Metal Polyester	14-6994-0
C604,606	330p	2%	50V	Ceramic Plate N750	14-7030-2
C709,710	22p	5%	50V	Ceramic Plate N150	14-6885-5
C720	1n	20%	400V	Ceramic Disc	14-4320-8
C729	270p	2%	50V	Ceramic Plate N750	14-6944-4
C732	56p	5%	50V	COH S.M.0805	72-0016-4

Cct Ref	Value	Tol.	Volts	Type	Part number
C733	47p	5%	50V	Ceramic Plate NPO	14-6902-9
C734-741	100p	5%	50V	COH S.M.0805	72-0014-5
C742	22n	20%	50V	Y5R S.M.C805	72-0007-2
C801,802	4n7	20%	250VAC	Class Y	14-7209-7
C803	1µ	20%	250V	AC Mains	14-6919-3
C804	470n	10%	250V	Metal Polyester X2	14-7290-9
C807	100n	20%	400V	Metal Polyester	14-5003-4
C808	680p	5%	1k6V	Polypropylene	14-7077-9
C809	33n	10%	1kV	Polpropylene	14-6991-6
C811	100p	5%	50V	Tubular Ceramic	14-6814-6
C814	4n7	1%	160V	Polystyrene	14-7051-5
C824-827	1n	20%	250VAC	Ceramic Plate	14-6937-1
C830	22n	20%	400V	Metal Polyester	14-6981-9
C843	3n3	20%	400VAC	R12.5 CLS Y	14-6977-0
CE218	47µ	20%	160V	105°C Electrolytic	14-7330-1
CE250	10µ	20%	16V	105°C Electrolytic	14-7332-8
CE438	100µ	20%	250V	105°C Electrolytic	14-7257-7
CE439	10µ	20%	160V	Electrolytic	14-7044-2
CE445	10µ	20%	250V	Electrolytic	14-7261-5
CE447,450	1µ	20%	160V	Electrolytic	14-7212-7
CE449	0u47	20%	160V	Electrolytic	14-7333-6
CE465	10µ	20%	100V	Electrolytic	14-7043-4
CE464	47µ	20%	100V	105°C Electrolytic	14-7201-1
CE805,806	220µ	20%	200V	105°C Electrolytic	14-7142-2
CE831,832	470µ	20%	100V	105°C Electrolytic	14-7297-6
CE833,853	220µ	20%	160V	Electrolytic	14-7081-7
CE834	1000µ	20%	35V	105°C Electrolytic	14-7265-8
CE835,839	1000µ	20%	25V	105°C Electrolytic	14-7210-0

Cct Ref	X2N128	X2AN128	X2QN128	X2AN1M	X2QN1M
C430	14-4397-6	14-4397-6	14-4619-3	14-4397-6	14-4619-3
C431	14-5833-7	14-5833-7	14-4619-3	14-5833-7	14-4619-3
C601-603				14-6836-7	14-6836-7
C611,613				14-6836-7	14-6836-7
C616,617				14-6836-7	14-6836-7
C614				14-6844-8	14-6844-8
C701				14-6846-4	14-6846-4
C615				14-6853-7	14-6853-7
C605,607				14-6854-5	14-6854-5
C719				14-6869-3	14-6869-3
C604,606				14-7030-2	14-7030-2
CE608-610				14-7263-1	14-7263-1
CE612				14-7263-1	14-7263-1
C427	14-7317-4	14-7324-7	14-7324-7	14-7324-7	14-7324-7
C428	14-7277-1	14-7277-1	14-7324-7	14-7277-1	14-7324-7

Table 7 Capacitors

10.3 Chokes, Crystals and Filters

The following list of chokes, crystals and filters is common to all chassis covered by this Service Manual

Cct Ref	Description	Part Number
FL801	Filter Line	15-7881-2
FL802	Mains Lead filtered (internal)	83-6443-5-001
L202	Choke 33µH 10%	15-7557-0
L203,205,207	Choke 6.8µH 10%	15-7610-0
L401	Coil Line linearity	87-0311-6-001
L404	Choke 330µH 2A RMS	15-7902-9
L801-805	Choke TLN-2026	15-7797-2
L806	Choke 10µH 10%	15-7528-7
L807	Choke 10µH T.D.K.	15-7801-4
XL701	Xtal 12.00mhz (20pF) PR	16-1940-3

10.4 Diodes

The following list of diodes is common to all chassis covered by this Service Manual

Cct Ref	Description	Part Number
D401,841,842	1N4003	19-8346-6
D407,420,441,502,430,440	1N4148	19-3992-0
D408	BYD33G	19-8388-1
D412-414,707,814	RGP10D 1A 200V 150ns	19-8603-1
D415,503,808,809	1N4003 Plastic encapsulated	19-8346-6
D418	1600V 5A 5THZ52	19-8650-3
D419	Ultrafast 8A 800V	19-8803-4
D422,830	RGP10M	19-5135-1
D423	RGP30K	19-6417-8
D501	RGP10G	19-8708-9
D504,701,818,845	1N4148	19-3992-0
D702,703,820	LED green	19-8810-7A
D704-706,708-710	Schottky switch BAT85	19-8163-3
D801-804	BY133GP	19-8144-7
D805-807	RGP15M	19-8340-7
D815	RGP10D	19-8603-1
D816,848,849	Schottky switch BAT85	19-8163-3
D831,832	2NU41 1000V 2A	19-8634-1
D833,847	3JU41 600V 3A	19-8636-8
D834,835840,	1N4003 Plastic encapsulated	19-8346-6
D836,837,839	3GU41 400V 3A	19-8637-6
D846	1N4148	19-3992-0
ZD421,819	C12V 5% 350mW Voltage Regulator	19-5070-3
ZD426	C9V1 5% 345mW Voltage Regulator	19-4033-3
ZD712	C5V1 5% 345mW Voltage Regulator	19-6295-7
ZD817	C16V 5% 345mW Voltage Regulator	19-4517-3

Cct Ref	X2N128	X2AN128	X2QN128	X2AN1M	X2QN1M
D601,602				19-3992-0	19-3992-0
ZD603				19-4952-7	19-4952-7

Table 8 Diodes

10.5 Transistors

The following list of transistors is common to all chassis covered by this Service Manual

Cct Ref	Description	Part Number
Q401	FET 2SK526	19-8705-4
Q801	FET 2SK1461 5A 900V	19-8691-0
TR201,203,205	2SC3953E	19-8624-4
TR202,206,706,711,714	PH2369	19-8324-5
TR204,707-709	PH2369	19-8324-5
TR401,409,502,506	2SC1815GR	19-8665-1
TR403	2SD667C 1A NPN	19-8601-5
TR404	2SC3884A	19-8467-5
TR406,417,423,701,811	BF422	19-8150-1
TR407,415,419,712	2SC1815-BL NPN	19-8646-5
TR408	2SB595Y 100V 5A PNP	19-8818-2
TR410,414	2N4401	19-8743-7A
TR411,412,424	BF423	19-8293-1
TR413,505	MPSA93	19-8534-5
TR416,507,508,704,705	RN1203	19-8557-4
TR418,504	NPN 400V 4A	19-8834-4
TR420,713,814,818,819	RN1203	19-8557-4
TR422,813,817	High voltage switch	19-8639-2
TR501	MPSA43	19-8532-9
TR503,801	General purpose PNP	19-8591-4
TR702,703	RN2203	19-8552-3
TR803-805,815,821	2SC1815GR	19-8665-1

TR810	PNP 200V 2A	19-8813-1
Cct Ref	Description	Part Number
TR812,816	2SB1375 PNP 3A 60V	19-8638-4
TR820	2SA1015GR	19-8664-3

Cct Ref	X2N128	X2AN128	X2QN128	X2AN1M	X2QN1M
TR404	19-8812-3				
TR713				19-8557-4	19-8557-4

Table 9 Transistors

10.6 Integrated Circuits

The following list of integrated circuits is common to all chassis covered by this Service Manual

Cct Ref	Description	Part Number
IC201	U2203B	19-8789-5
IC401 Prime part	TDA9102C	19-8855-7 *
IC401 Alternative part	TDA9102F	19-8796-8 *
IC402	TDA8172	19-8794-1
IC701	80C51 CMOS 8 bit microprocessor	19-8797-6
IC702	NMOS EEPROM 256 byte	19-8447-0
IC703	74LS86	19-8008-4
IC801	UC3842AN	19-8696-1
IC802	LM393N	19-8162-5
IC803	Opto-isolator TLP731GB(D4)-LF2	19-8790-9
IC804	LM317T	19-8264-8
IC805	Regulator +5V 0.5A TO220	19-8333-4

* There are different value components associated with the functioning of IC401 when prime or alternative I/C's are used and they are not interchangeable.

When Prime component IC401, TDA9102C, 19-8855-7 is used the following components and their respective values will be fitted:

C417	1n8	5%	50V	NP0 Ceramic plate	14-7356-5
C453	82p	5%	50V	NP0 Ceramic plate	14-6953-3
R472	1k2	1%	0.125W	Metal film	11-5955-0
R421	10k	1%	0.125w	T26	11-5953-4
D421				RGP1010D	19-8603-1

Note: D421 is fitted in parallel with R429.(+ve to C422)

When Alternative component IC401, TDA9102F, 19-8796-8 is used the following components and their respective values will be fitted:

C417	1n5	5%	50V	NP0 Ceramic plate	14-7320-4
C453	68p	2%	50V	NP0 Ceramic plate	14-7012-4
R472	1k0	1%	0.125W	Metal film	11-5750-7
R421	12k	1%	0.125W	Metal film	11-5537-7

Note D421 in not fitted

Cct Ref	X2N128	X2AN128	X2QN128	X2AN1M	X2QN1M
IC403	19-8660-0	19-8660-0	19-8698-8	19-8660-0	19-8698-8
IC601			19-8401-2		19-8401-2
IC602				19-8771-2	19-8771-2

Table 10 Integrated Circuits

10.7 Transformers

The following list of transformers is common to all chassis covered by this Service Manual.

Cct Ref	Description	Part Number
~~T8~~ ~~T~~401	Line drive	87-0151-2-005

Cct Ref	X2N128	X2AN128	X2QN128	X2AN1M	X2QN1M
T403	87-0295-0-002	87-0308-6-001	87-0308-6-001	87-0308-6-001	87-0308-6-001
T801	87-0296-9-003	87-0296-9-003	87-0309-5-001	87-0296-9-003	87-0309-4-001

Table 11 Transformers

10.9 Ferrite Beads

The following list of ferrite beads is common to all chassis covered by this Service Manual

Cct Ref	Description	Part Number
FB201,202	FBR07VA121NB	15-7887-1
FB203-206	CP22 53R @ 100mhz	15-7886-3
FB802,803,805	4S2 8 x 1.5 x 10mm	15-7578-3
FB804	BRH 17.5 x 28.5 x 9.5mm	15-7844-8

10.10 Plugs and Sockets

The following list of plugs and sockets is common to all chassis covered by this Service Manual

Cct Ref	Description	Part Number
PL201	Connector 9 way header straight	22-8377-8
PL202	Wiring harness 10 way	83-5972-5-002
Cct Ref	Description	Part Number
PL405	Lead field cancellation 610mm	83-6376-5-002
PL406	Lead field cancellation 910mm	83-6375-7-002
PL801	Connector 2 way plug SE20/4451	42-0211-2
PL901,902,904	PWB pin 2.36mm	22-8421-9
PL903	Connector 1 way B1P-LV-TN	22-8280-1
SK901	CRT base socket narrow neck	25-2079-6

Cct Ref	X2N128	X2AN128	X2QN128	X2AN1M	X2QN1M
PL401	22-8255-0	22-8255-0	22-8433-2	22-8255-0	22-8433-2
PL601,602				22-8382-4	22-8382-4
PL606				22-8383-2	22-8383-2
SK603				22-8441-3	22-8441-3
SK604,605				22-8337-9	22-8337-9
SK606				22-8440-5	22-8440-5

Table 12 Plugs and sockets

10.11 Miscellaneous

Cct Ref	Description	Part Number

The following list of miscellaneous parts is common to all chassis covered by this Service Manual

FS801	Fuse time lag 3.15A ceramic	21-3743-7
FS801A	Fuse holder DE611/01	21-3712-7
G202-204	Spark gap DSP-201M-A11F	21-3727-5-26
S701	Switch 4 gang	20-4080-8
S702	Switch 1 way single pole push	20-4102-2
S801	Switch 2 pole push-push power	20-4091-3
-	Foot rubber (white)	83-5020-5-002
-	Mains socket support moulding	83-5643-2-004C
-	Screen Video	83-6306-4-003
-	Earth braid	83-6367-6-001
-	Filter Line 3 amp	83-6425-7-001
-	Cordset plg/skt IEC320 1.5M	83-6442-7-001
-	W/harness 320mm A-A1	83-6483-4-001
-	W/harness 210mm B-B1	83-6484-2-001
-	W/harness 290mm C-C1	83-6485-0-001
-	W/harness FBT/cancellation D-D1	83-6574-1-001
-	Coil degaussing filtered	87-0310-8-001

10.12 CABINET PARTS 14" Models Plugs and sockets

Description	TM4422V-N128Z Chassis X2AN128	TM4422VA-N128Z ChassisX2AN128	TM4422-N139Z Chassis X2AN128	TM4424VA-N128 ChassisX2AN128	TM4424VAM-N128 ChassisX2AN1M
14" CDT M34AFA63X18 CPT	18-1078-2				
14" CDT M34AFA83X18-CPT		18-1079-0		18-1079-0	18-1079-0
14" CDT M34AGC63X03-CPT			18-1082-0		
Actuator	83-5953-9-101C	83-5953-9-102C	83-5953-9-101C		
Back cover	83-5822-2-002C	83-5822-2-002C	83-5822-2-002C	83-5656-4-003C	83-5656-4-102C
Carton	83-5599-1-004	83-5599-1-004	83-5599-1-004		
Chassis rail L/H	83-5948-2-001C	83-5948-2-002C	83-5948-2-001C		
Chassis rail R/H	83-5949-0-001C	83-5949-0-002C	83-5949-0-001C		
Control activator				83-5953-9-002C	83-5953-9-002C
Earthing braid assembly	83-6227-0-002	83-6227-0-002	83-6227-0-002	83-6227-0-002	83-6227-0-002
EPS bottom	83-5494-6-001	83-5494-6-001	83-5494-6-001		
EPS front 14"/15"				83-5892-3-004	83-5892-3-004
EPS rear				83-5893-1-003	83-5893-1-003
EPS top	83-5493-6-001	83-5493-6-001	83-5493-6-001		
Front moulding	83-5952-0-001C	83-5952-0-002C	83-5952-0-001C	83-5964-4-001C	83-5964-4-001C
Knob On/Off	83-5946-6-001C	83-5946-6-002C	83-5946-6-001C	83-5699-8-002C	83-5699-8-002C
Lead P band earth 200mm				83-6307-2-001	
Loud speaker 3" round, 16R, 2W					21-3711-9
Loud speaker L/H					83-5761-7-001
Prism	83-5947-4-001C	83-5947-4-001C	83-5947-4-001C	83-4315-2-003	83-4315-2-003
Prism	83-6048-0-001C	83-6048-0-001C	83-6048-0-001C		
Screen audio					83-5874-5-005
Signal lead 1.5M	83-5967-9-003	83-5967-9-003	83-5967-9-003	83-5967-9-003	83-5967-9-003
Speaker support bracket R/H					83-5658-0-001
Speaker support bracket L/H					83-5844-3-001
Swivel base	83-6254-8-001C	83-6254-8-001C	83-6254-8-001C	83-5527-4-003C	83-5527-4-003C
Swivel spring	83-5704-8-001	83-5704-8-001	83-5704-8-001		
Swivel top	83-4057-9-004C	83-4057-9-004C	83-4057-9-004C	83-5528-2-004C	83-5528-2-004C
Swivel washer	83-4148-6-003	83-4148-6-003	83-4148-6-003	83-4148-6-003	83-4148-6-003
Swivel washer metal	83-5706-4-001	83-5706-4-001	83-5706-4-001		

Table 13 Cabinet parts 14"

10.13 CABINET PARTS 15" Models

Description	TM4524VA-N128 Chassis X2QN128	TM4523VAM-N128Z Chassis X2QN1M	TM4524VAM-N128 Chassis X2QN1M
15" CDT M36EDR320X360/2F01 Philips	18-1083-9	18-1083-9	18-1083-9
Actuator		83-5953-9-102C	
Back cover	83-5656-4-003C	83-5980-6-101C	83-5656-4-102C
Chassis rail L/H		83-4004-8-001C	
Chassis rail R/H		83-4005-6-001C	
Control activator	83-5953-9-002C		83-5953-9-002C
Earthing braid assembly	83-6488-5-001	83-6488-5-001	83-6488-5-001
EPS front	83-5892-3-004	83-6243-2-001	83-5892-3-004
EPS rear	83-5893-1-003	83-6244-0-001	83-5893-1-003
Front cover	83-6047-2-001C	83-5962-8-001C	83-6047-2-001C
Knob On/Off	83-5699-8-002C	83-5966-0-002C	83-5699-8-002C
Lead P band earth 200mm	83-6307-2-001		
Lead signal 1.5M	83-5967-9-003	83-5967-9-003	83-5967-9-003
Loud speaker 3" round, 16R, 2W		21-3711-9	21-3711-9
Loud speaker L/H		83-5761-7-001	83-5761-7-001
Moulding speaker		83-6157-6-001C	
Prism		83-5947-4-001C	
Screen audio		83-5874-5-005	83-5874-5-005
Speaker bracket support R/H			83-5658-0-001
Speaker support bracket L/H			83-5844-3-001
Swivel base	83-5527-4-003C	83-6254-8-001C	83-5527-4-003C
Swivel spring		83-5704-8-001	
Swivel top	83-5528-2-004C	83-4057-9-004C	83-5528-2-004C
Swivel washer	83-4148-6-003	83-4148-6-003	83-4148-6-003
Swivel washer metal		83-5706-4-001	

Table 14 Cabinet parts 15"

Description	Chassis type				
	X2N128	X2AN128	X2QN128	X2AN1M	X2QN1M
Main chassis PWB assembly	01-1108-2	01-1205-4	01-1199-6	01-1219-4	01-1220-8
Sound PWB assembly				01-1219-46	01-1219-46
Video PWB assembly	01-1108-22/H	01-1108-22/H	01-1108-22/H	01-1108-22/H	01-1108-22/H

Table 15 Complete assemblies

SECTION 2 PRECAUTIONS AND SAFETY

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

Operation of the monitor 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.

Always wear 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.

The picture tube is designed and constructed to limit X-radiation to a safe limit during 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.***

IMPORTANT - Safety Tests.

After servicing, and before returning the monitor to the user, a thorough safety test must be carried out to ensure there is no potential shock hazard to any operator(s) using the monitor.

All the following tests must be performed. A monitor failing any of these tests must be rejected and have the problem rectified.

2.1 A.C. Leakage Test

Remove the power source. Connect the monitor to the circuit as in Fig.1. below. Switch the monitor on/off switch to 'on'. A reading of less than 3.5mA should be obtained (ref EN60950).

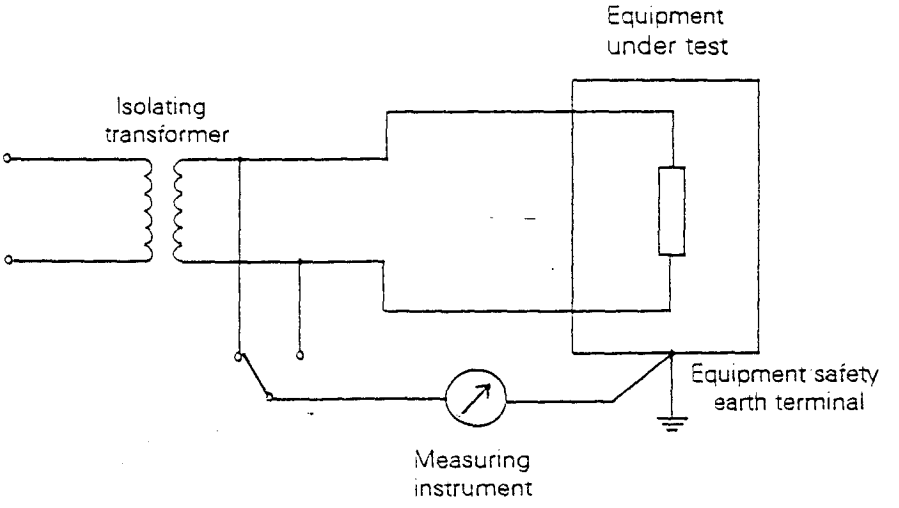


Fig.1. Measurement of AC Leakage Current

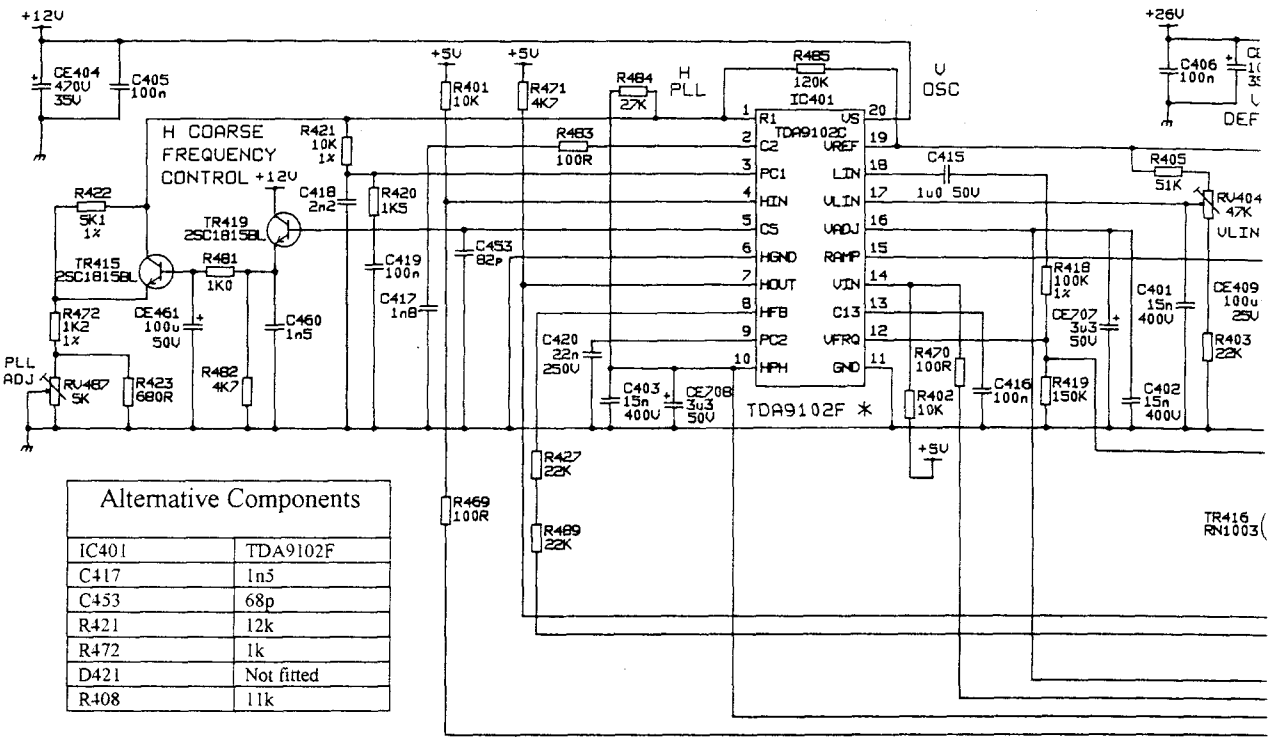
2.2 Voltage Breakdown Test

Connect the live and neutral connections together. Switch the monitor on/off switch to 'on'. Apply 1500Vac rms at 50Hz or 2250Vdc, for one minute between live and neutral shorted together and earth. Ensure no voltage breakdown occurs.

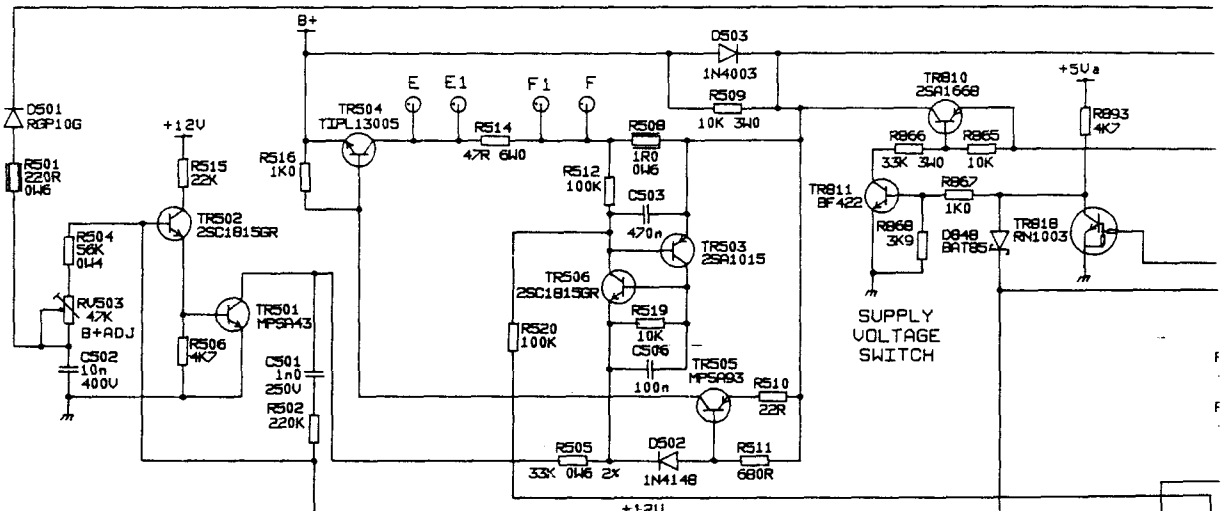
2.3 Earth Resistance/Continuity Test

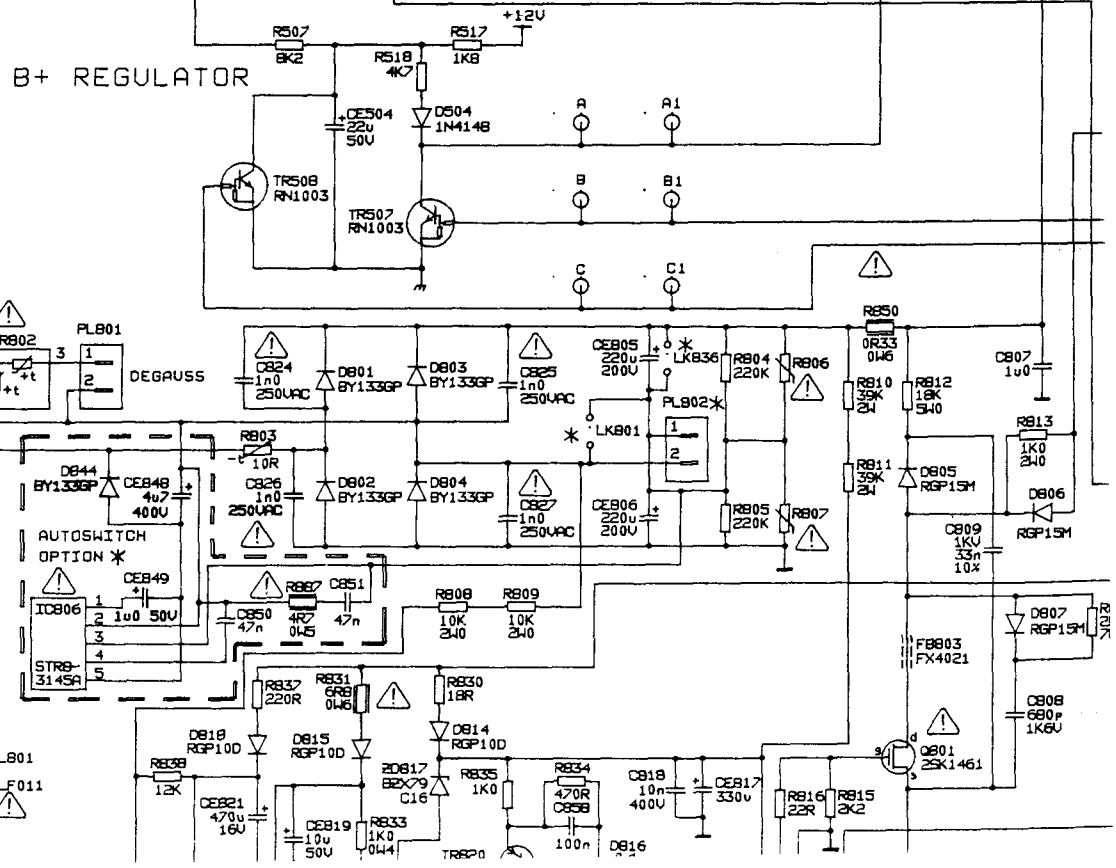
Measure the resistance between the signal cable metal shell and the earth pin in the A.C. socket. At a current of 25 Amperes the resistance should be less than 100 MOhms.

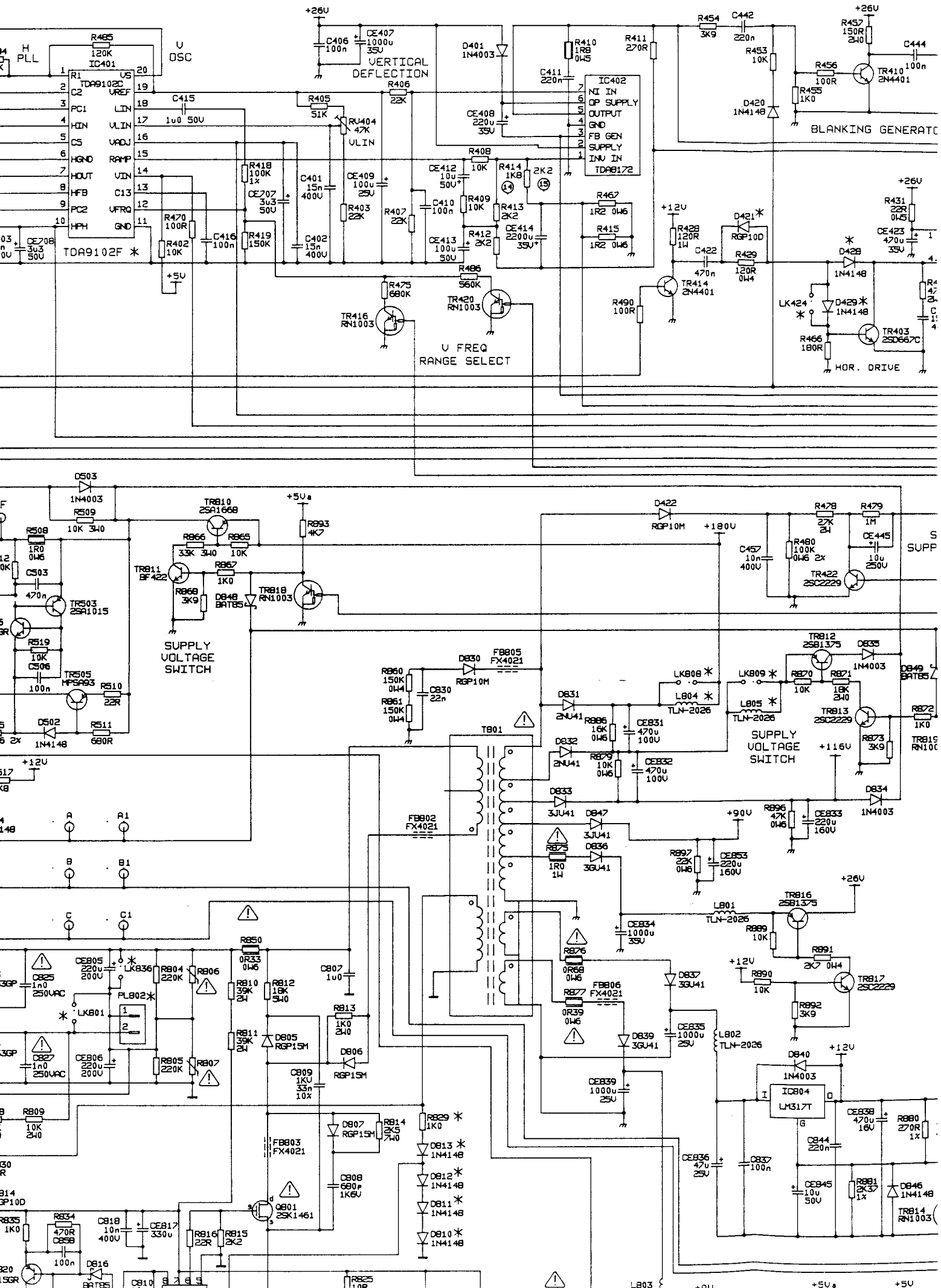
Note: A portable appliance tester (PAT) is a suitable instrument to use for the above safety tests.

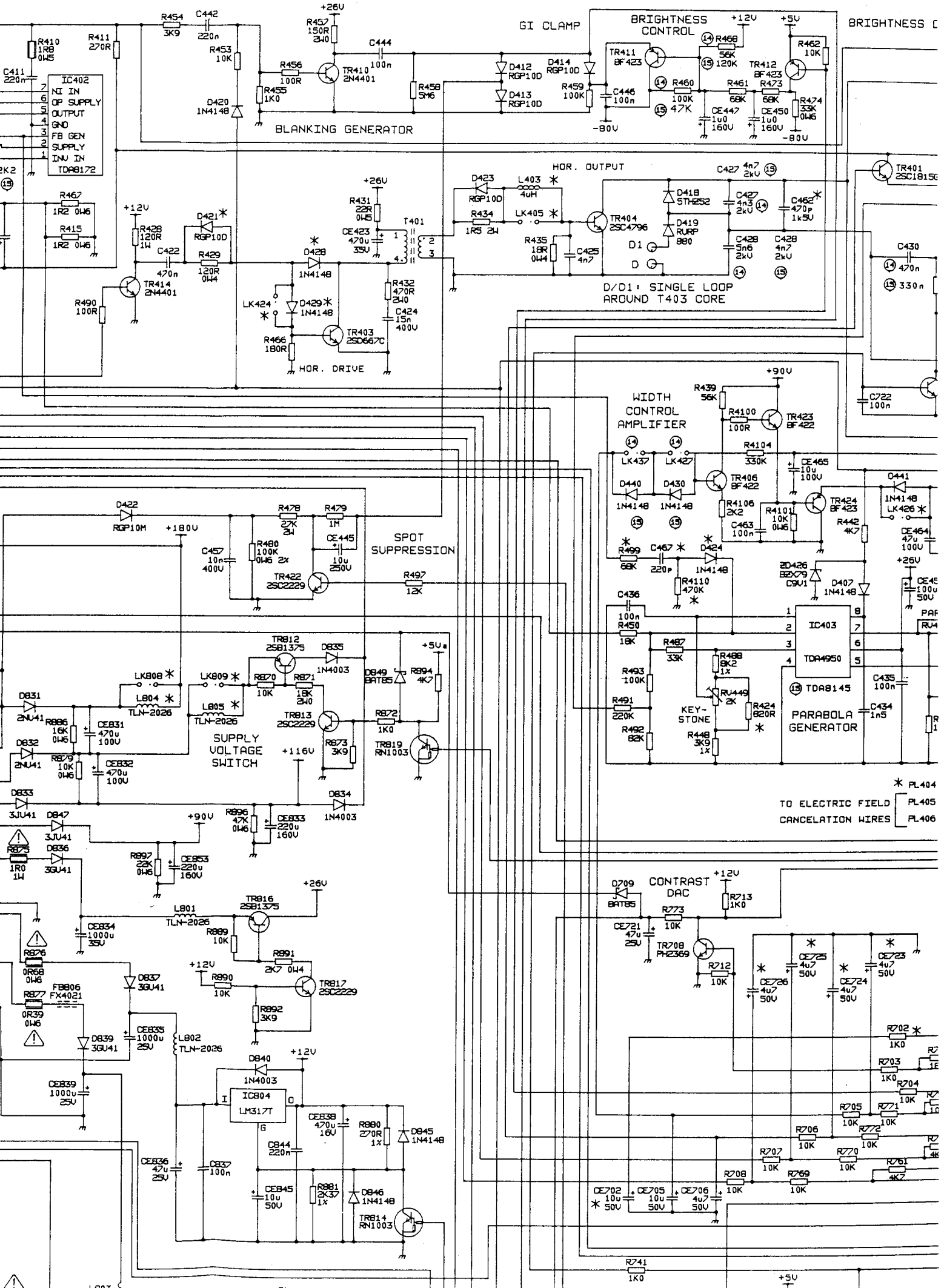


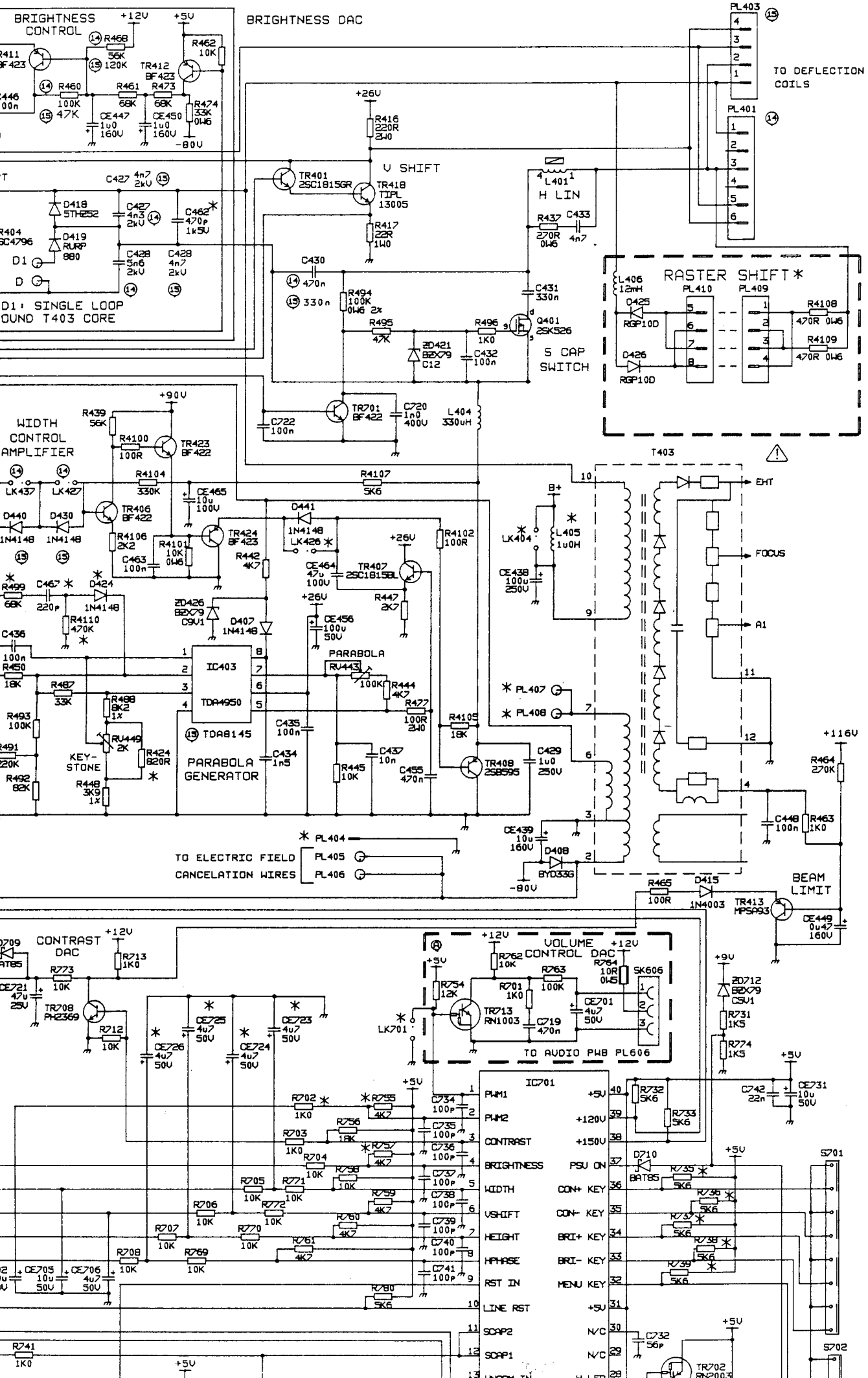
Alternative Components	
IC401	TDA9102F
C417	1n5
C453	68p
R421	12k
R472	1k
D421	Not fitted
R408	11k

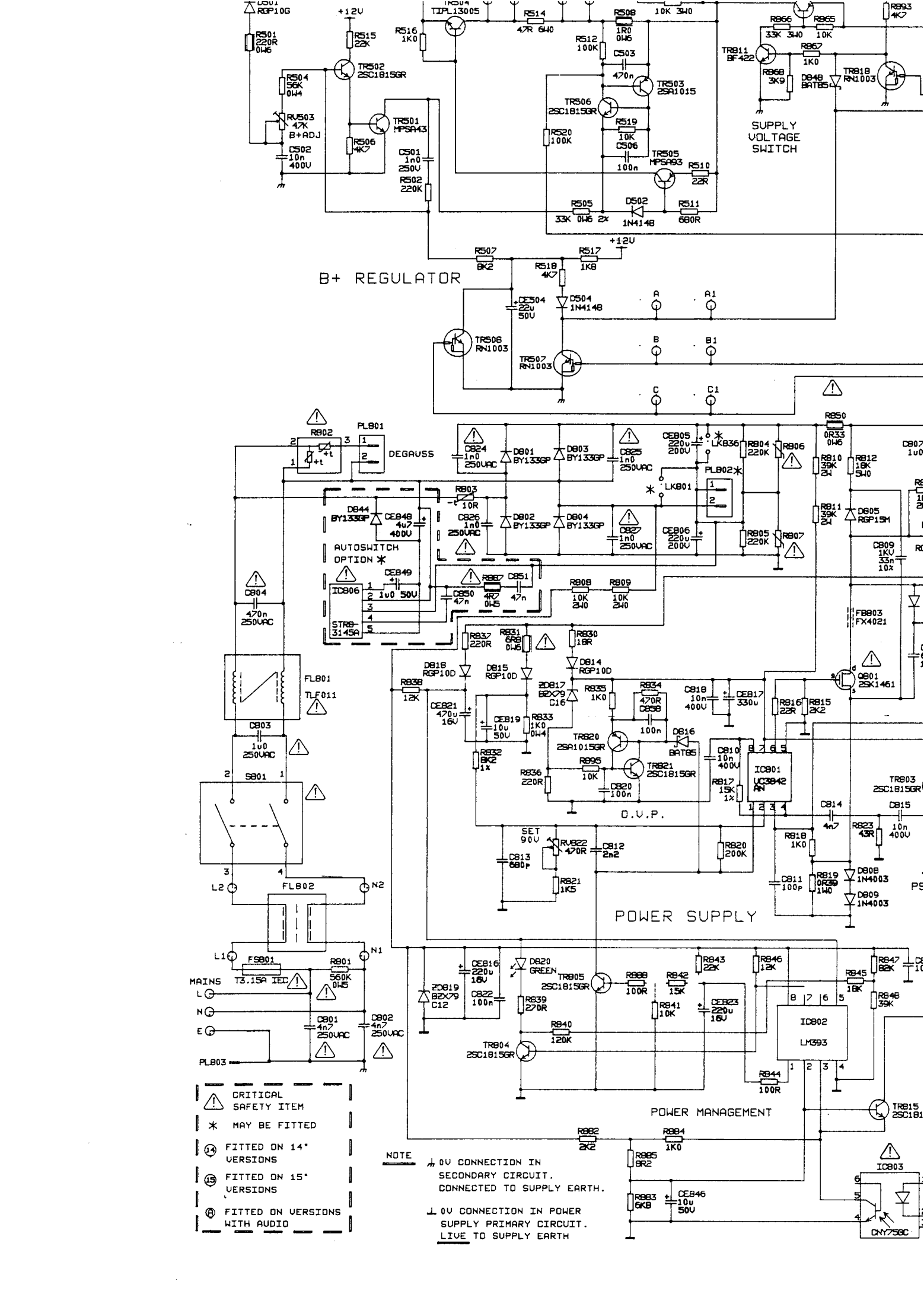


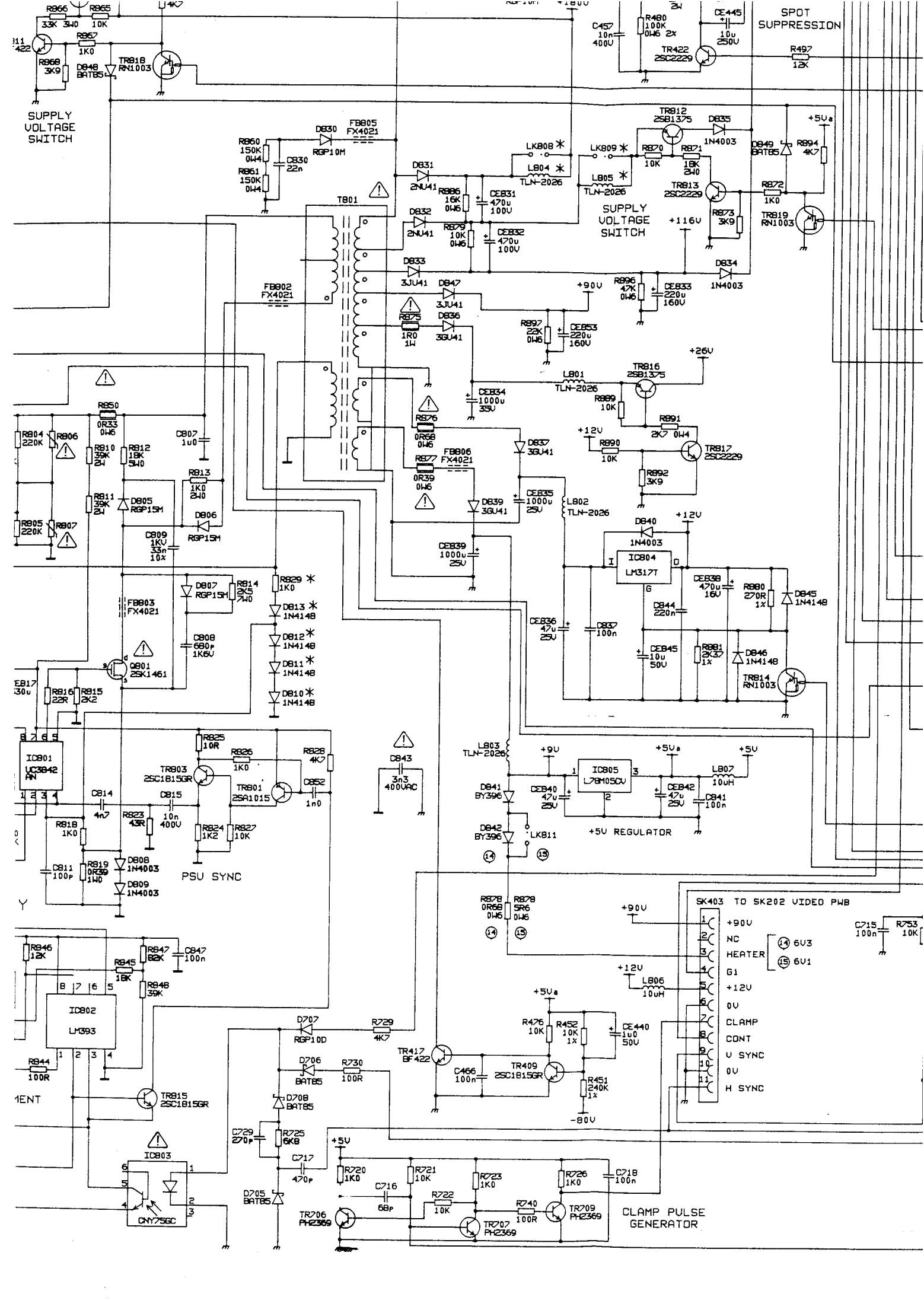


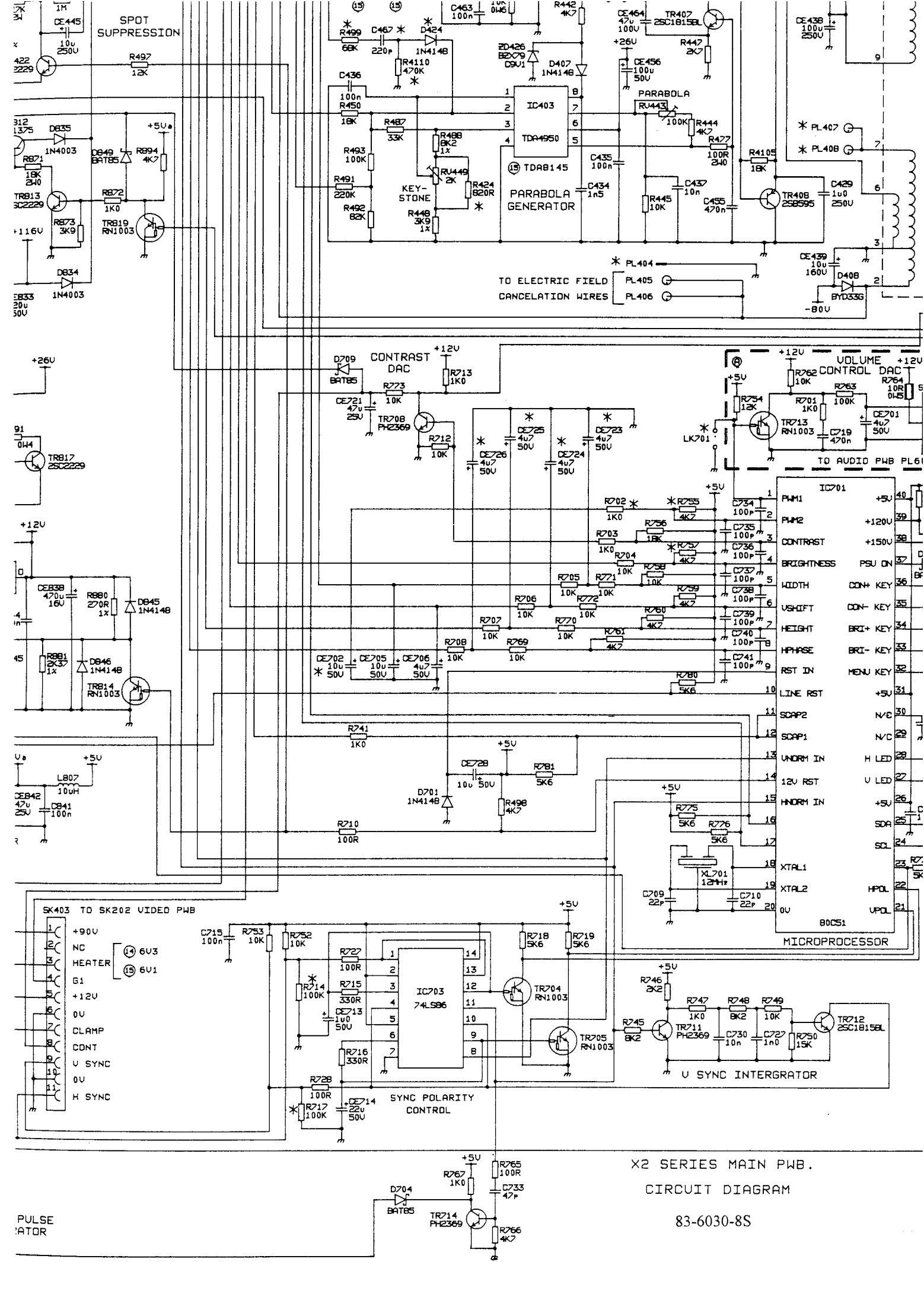

H PLL
V OSC
IC401
TDA9102C
TDA9102F *
VERTICAL DEFLECTION
IC402
TDA8172
BLANKING GENERATO
V FREQ RANGE SELECT
HOR. DRIVE
SUPPLY VOLTAGE SWITCH
SUPPLY VOLTAGE SWITCH
SUPPLY
+26V
+12V
+5V
+5Va
+180V
+116V
+90V
TR810 2SA1668
TR811 BF422
TR818 RN1003
TR503 2SA1015
TR505 MPSA93
TR414 2N4401
TR420 RN1003
TR416 RN1003
TR422 2SC2229
TR812 2SB1375
TR813 2SC2229
TR816 2SB1375
TR817 2SC2229
Q801 2SK1461
IC804 LM317T
TBO1
FB802 FX4021
FB803 FX4021
FB805 FX4021
FB806 FX4021
PL802*
LK801
LK808
LK809
LK424
L801 TLN-2026
L802 TLN-2026
L803
L804 TLN-2026
L805 TLN-2026
D503 1N4003
D502 1N4148
D401 1N4003
D420 1N4148
D421 RGP10D
D422 RGP10M
D428 1N4148
D429 1N4148
D830 RGP10M
D831 2NU41
D832 2NU41
D833 3JU41
D847 3JU41
D836 3GU41
D837 3GU41
D839 3GU41
D840 1N4003
D805 RGP15M
D806 RGP15M
D807 RGP15M
D813 1N4148
D812 1N4148
D811 1N4148
D810 1N4148
D816 BAT85
D848 BAT85
D849 BAT85
D834 1N4003
D835 1N4003
R485 120K
R508 1R0 0W6
R509 10K 3W
R866 33K 3W
R865 10K
R867 1K0
R868 3K9
R893 4K7
R519 10K
R510 22R
R511 680R
R860 150K 0W4
R861 150K 0W4
R886 16K 0W6
R879 10K 0W6
R875 1R0 1W
R876 0R68 0W6
R877 0R39 0W6
R850 0R33 0W6
R804 220K
R806 220K
R805 220K
R807 220K
R810 39K 2W
R811 39K 2W
R812 18K 5W0
R813 1K0 2W0
R809 10K 2W0
R829 * 1K0
R814 2K5 7W0
R834 470R
R835 1K0
R816 22R
R815 2K2
R825 10R
R454 3K9
R457 150R 2W0
R453 10K
R456 100R
R455 1K0
R410 1R8 0W5
R411 270R
R467 1R2 0W6
R415 1R2 0W6
R428 120R 1W
R429 120R 0W4
R431 22R 0W5
R466 180R
R490 100R
R475 680K
R486 560K
R405 51K
R406 22K
R407 22K
R408 10K
R409 10K
R403 22K
R418 100K 1%
R419 150K
R470 100R
R402 10K
R414 1K8
R413 2K2
R412 2K2
R478 27K 2W
R479 1M
R480 100K 0W6 2%
R457 C457 10n 400V
R870 10K
R871 18K 2W0
R872 1K0
R873 3K9
R896 47K 0W6
R897 22K 0W6
R889 10K
R891 2K7 0W4
R890 10K
R892 3K9
R880 270R 1%
R881 2K37 1%
C406 100n
C407 1000u 35V
C408 220u 35V
C411 220n
C415 1u0 50V
C401 15n 400V
C402 15n 400V
C409 100u 25V
C410 100n
C412 10u 50V
C413 100u 50V
C414 2200u 35V
C416 100n
C422 470n
C423 470u 35V
C442 220n
C444 100n
C445 10u 250V
C503 470n
C506 100n
C830 22n
C807 1u0
C809 1KV 33n 10%
C818 10n 400V
C858 100n
C844 220n
C837 100n
CE708 3u3 50V
CE707 3u3 50V
CE817 330u
CE805 220u 200V
CE806 220u 200V
CE831 470u 100V
CE832 470u 100V
CE833 220u 160V
CE853 220u 160V
CE834 1000u 35V
CE835 1000u 25V
CE839 1000u 25V
CE836 47u 25V
CE838 470u 16V
CE845 10u 50V
D825 1n0 250VAC
D827 1n0 250VAC
TR410 2N4401
TR403 2SD667C
TR414 2N4401
TR420 RN1003
TR416 RN1003
TR422 2SC2229
TR812 2SB1375
TR813 2SC2229
TR816 2SB1375
TR817 2SC2229
TR818 RN1003
TR814 RN1003
TR819 RN100
TR503 2SA1015
TR505 MPSA93
TR810 2SA1668
TR811 BF422
Q801 2SK1461
IC804 LM317T
IC402 NI IN OP SUPPLY OUTPUT GND FB GEN SUPPLY INV IN TDA8172
IC401 TDA9102C
R1 VS C2 VREF PC1 LIN HIN VLIN CS VADJ HGND RAMP HOUT VIN HFB C13 PC2 VFRQ HPH GND
A A1 B B1 C C1


GI CLAMP
BRIGHTNESS CONTROL
BRIGHTNESS C
BLANKING GENERATOR
HOR. OUTPUT
D/D1 : SINGLE LOOP AROUND T403 CORE
HOR. DRIVE
WIDTH CONTROL AMPLIFIER
SPOT SUPPRESSION
SUPPLY VOLTAGE SWITCH
PARABOLA GENERATOR
KEY-STONE
CONTRAST DAC
TO ELECTRIC FIELD CANCELATION WIRES
PL404
PL405
PL406
IC402
TDA8172
IC403
TDA4950
TDA8145
IC804
LM317T


BRIGHTNESS CONTROL
BRIGHTNESS DAC
TO DEFLECTION COILS
V SHIFT
H LIN
S CAP SWITCH
RASTER SHIFT*
WIDTH CONTROL AMPLIFIER
T403
EHT
FOCUS
A1
PARABOLA GENERATOR
IC403
TDA4950
TDA8145
KEY-STONE
PARABOLA
TO ELECTRIC FIELD CANCELATION WIRES
PL404
PL405
PL406
BEAM LIMIT
CONTRAST DAC
VOLUME CONTROL DAC
TO AUDIO PWB PL606
IC701
PWM1
PWM2
CONTRAST
BRIGHTNESS
WIDTH
VSHIFT
HEIGHT
HPHASE
RST IN
LINE RST
SCAP2
SCAP1
+5V
+120V
+150V
PSU ON
CON+ KEY
CON- KEY
BRI+ KEY
BRI- KEY
MENU KEY
N/C
S701
S702
D1 : SINGLE LOOP
OUND T403 CORE


B+ REGULATOR
SUPPLY VOLTAGE SWITCH
DEGAUSS
AUTOSWITCH OPTION *
D.V.P.
SET 90V
POWER SUPPLY
POWER MANAGEMENT
FL801 TLF011
FL802
FS801 T3.15A IEC
MAINS
L
N
E
PL803
IC801 UC3842 AN
IC802 LM393
IC803 CNY75GC
STR8-3145A
TR803 2SC1815GR
TR804 2SC1815GR
TR805 2SC1815GR
TR820 2SA1015GR
TR821 2SC1815GR
TR501 MPSA43
TR502 2SC1815GR
TR503 2SA1015
TR505 MPSA93
TR506 2SC1815GR
TR507 RN1003
TR508 RN1003
TR811 BF422
TR818 RN1003
D501 RGP10G
D502 1N4148
D504 1N4148
D801 BY133GP
D802 BY133GP
D803 BY133GP
D804 BY133GP
D805 RGP15M
D808 1N4003
D809 1N4003
D814 RGP10D
D815 RGP10D
D816 BAT85
D818 RGP10D
D844 BY133GP
D848 BAT85
ZD817 BZX79 C16
ZD819 BZX79 C12
D820 GREEN
RV503 47K B+ADJ
RV822 470R
LK801
LK836
PL802
Q801 2SK1461
FB803 FX4021
NOTE
0V CONNECTION IN SECONDARY CIRCUIT. CONNECTED TO SUPPLY EARTH.
0V CONNECTION IN POWER SUPPLY PRIMARY CIRCUIT. LIVE TO SUPPLY EARTH
CRITICAL SAFETY ITEM
* MAY BE FITTED
(14) FITTED ON 14" VERSIONS
(15) FITTED ON 15" VERSIONS
(A) FITTED ON VERSIONS WITH AUDIO

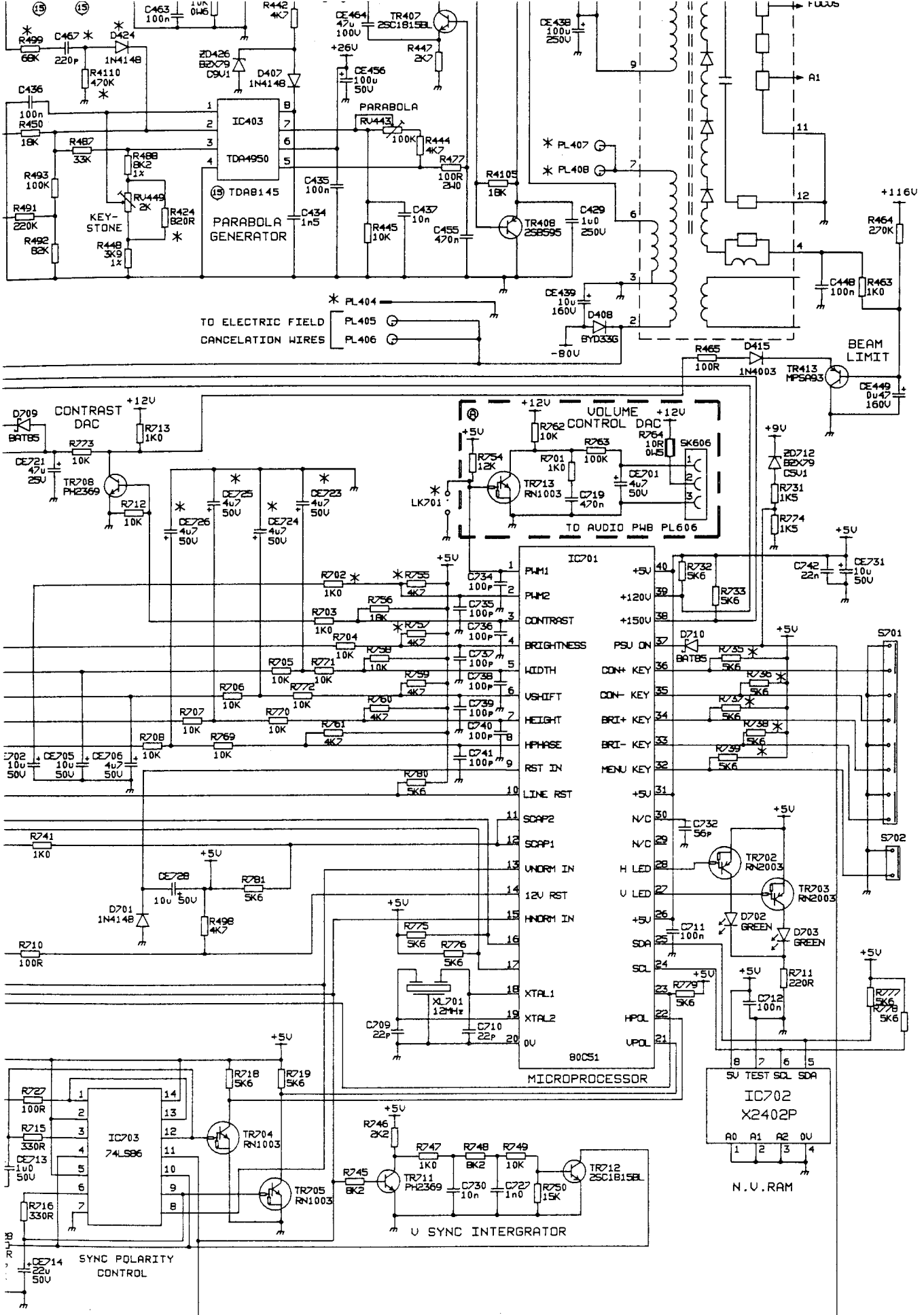

SUPPLY VOLTAGE SWITCH
SPOT SUPPRESSION
SUPPLY VOLTAGE SWITCH
+116V
T801
FB802 FX4021
FB803 FX4021
FB805 FX4021
FB806 FX4021
+90V
+26V
+12V
+5Va
+5V
IC801 UC3842 AN
IC802 LM393
IC803 CNY75GC
IC804 LM317T
IC805 L78M05CV
+5V REGULATOR
PSU SYNC
SK403 TO SK202 VIDEO PWB
+90V
NC
HEATER
G1
+12V
0V
CLAMP
CONT
V SYNC
0V
H SYNC
6V3
6V1
-80V
CLAMP PULSE GENERATOR



X2 SERIES MAIN PWB.

CIRCUIT DIAGRAM

83-6030-8S



X2 SERIES MAIN PWB.

CIRCUIT DIAGRAM

83-6030-8S