

CERONIX

Monitor Models:

1493

1793

1993

2093

2793

3693

Safety Isolating Transformer Models:

ISO XFR-75W

ISO XFR-100W

2 YEAR LIMITED WARRANTY

This product is warranted by CERONIX to be free of defects in material and workmanship for a period of two years from the date of purchase. All parts and labor are free of charge during the warranty period. This warranty does not cover mechanical breakage due to physical abuse. It is the customer's responsibility for shipping the defective unit to and from CERONIX or one of the authorized service centers for repair. Please attach a note describing the problem.

CERONIX Inc.
13350 New Airport Road
Auburn, CA. 95602-7419
Phone: (530) 886-6400
FAX: (530) 888-1065
WEB: www.ceronix.com

CERONIX shall not be liable for any consequential damages, including without limitation damages resulting from loss of use.

Ceronix will repair XX93 monitors after the 2 year warranty, for a minimal charge, plus shipping to and from Ceronix.



Recognized under the Component Program of Underwriters Laboratories Inc., the Canadian Standards Association, and **TÜV** Product Service.

Compliance to the following Standards:

IEC 60950, CAN/CSA-C22.2 No. 60950-00, ANSI/UL 60950, CAN/CSA-C22.2 No. 1-98, IEC 65:85 + A1:87 + A2:89 + A3:92.

ISO 9001:1994 Certified through **TÜV** Management Service.

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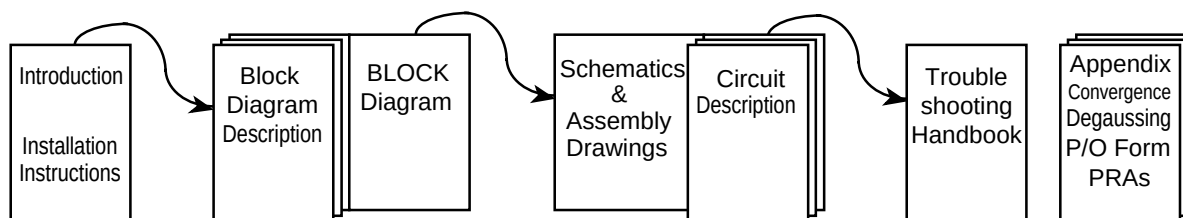


ABOUT THIS MANUAL

This manual is specifically written to aid the service technician, repairing CERONIX Models 1493, 1793, 1993, 2093, 2793, and 3693 color monitors.

There are three main sections:

1. General Description.
2. Circuit Description.
3. Repair Setup and Appendix.



To understand how the Monitor works, it is best to know what each circuit does and how each circuit relates to the other circuits. The Block Diagram is presented in a simplified view and a comprehensive view to accomplish the goal of understanding the whole unit. Once the general picture is clear, the complexity of each circuit will be easier to understand.

The Circuit Description is also written in two views, a simplified view and a detailed view to help give the reader a clear understanding of what each component does. This understanding is most helpful for the more complex problems or multiple problems that sometimes occur.

The power supply trouble shooting section describes methods used to power up various monitor circuits, when there is a fault in the monitor, which disables the power supply.

The appendix includes; filament voltage test, convergence procedure, replacement parts purchase order form, degaussing coil attachment specification, high pot test, wire routing drawing, production assembly drawings (PADs), C, I, J, & K film resistor arrays and a parts list addendum. The parts list addendum is used to add new information describing part changes. Tables, suitable for pasting on these pages, will be published as new variations of the XX93 monitors are produced.

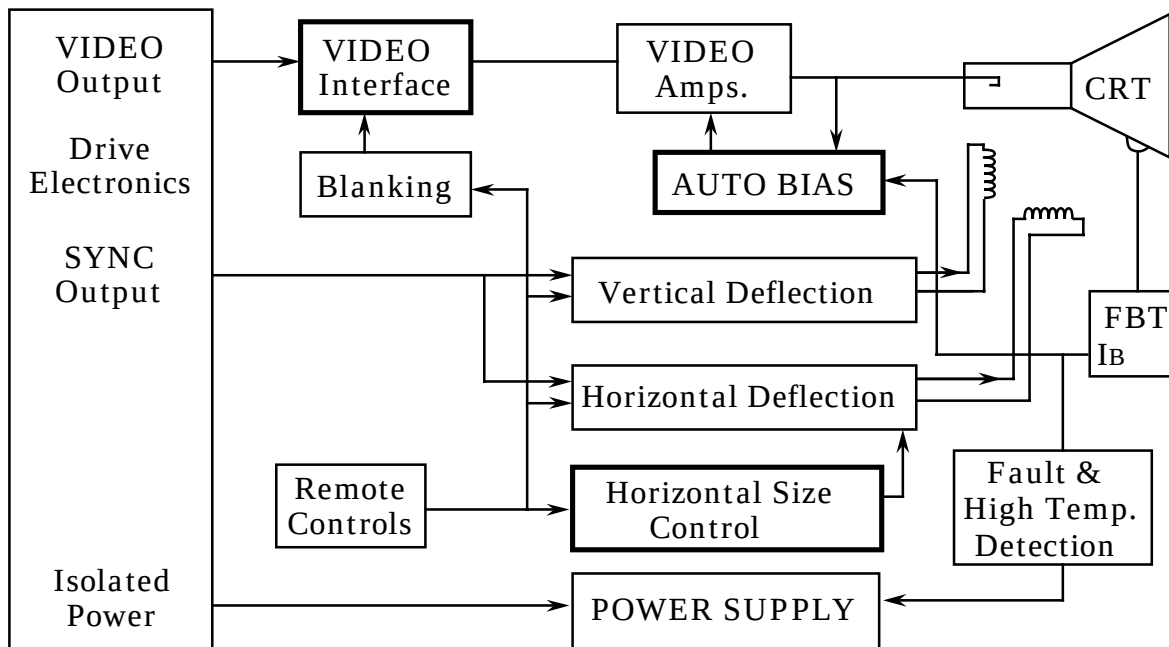
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Monitor Simplified Block Diagram.



This block diagram gives a broad view of the circuit organization of the 1493, 1793, 1993, 2093, 2793, and 3693 monitors. The blocks with the bold outline represent circuits which provide these monitors with a wide range of operating conditions without the need for adjustment.

The video interface circuit can be programmed to accept; +Analog AC or DC coupled, -Analog, and 4 line TTL. The M. GAIN or contrast control is located on the remote control board.

The auto bias circuit eliminates the need for the color setup procedure. This circuit is designed to actively compensate for picture tube drift which normally causes unbalanced color. The auto bias circuit also adjusts the CRT gain to compensate for gain loss with age.

The horizontal size control circuit permits the horizontal size to be adjusted from a remote control board. This circuit is also used to compensate for pincushion distortion and blooming. Anti-blooming is accomplished by correcting horizontal size variations which are caused by the additional load on the flyback transformer under high beam current conditions.

Careful reading of all the information presented in this manual is a good way to learn how to repair the CERONIX monitor.

Installation Instructions For The XX93 Monitors.

1. A 3 amp slow blow fuse (for the degaussing current) and a 75 VA isolation transformer are the minimum requirements for using our monitor in a product.
2. Unpack the monitor.
3. Install the monitor in the enclosure. Refer to the installation instructions supplied by the system manufacturer for details of mounting the monitor in the enclosure.
4. Connect the green/yellow ground wire to the earth ground connection on the enclosure. This wire is connected to the ground screw, located on the monitor chassis behind the serial number label.



WARNING! Failure to connect this ground wire before applying power is not allowed, since this condition can produce a shock hazard. The chassis to mains connector resistance shall not exceed 100mΩ.

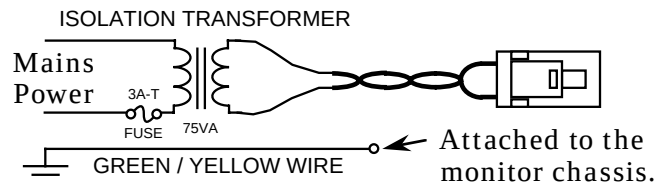
5. Check that the following wires are properly connected;
 - A. Green wire from the CRT aquadag braid to the video board.
 - B. 12 conductor flat cable from the video board to the main board.
 - C. Red high voltage wire from the flyback transformer to the picture tube anode cap.
 - D. Yoke cable from the yoke to the main board.
 - E. Remote cable from the remote control board to the main board.

Note; Be sure these wires are secured such that they do not touch any metal parts.

6. Plug in the seven conductor video connector.

Pin	Signal	Color			
0	+12V from monitor.	White	3	Signal ground.	Gray
1	Horizontal sync.	Yellow	4	Red video.	Red
2	Vertical sync.	Purple	5	Green video.	Green
			6	Blue video.	Blue

7. Plug in the power connector from the isolation transformer.



8. Apply power to the monitor and the drive electronics.
9. Check the focus and, if necessary, adjust the top control on the flyback transformer.
10. Adjust the controls on the remote control board for proper;
 - Horizontal Raster Size.
 - Vertical Raster Size.
 - Vertical Raster Position.
 - Horizontal Picture Position.
 - Video Gain.
11. For convergence instructions, see page 100 & 101.

Instructions d'installation des écrans XX93.

1. Un fusible à fusion lente de 3 amp (pour le courant du champ magnétique d'ajustement) et un transformateur d'isolation de 75 VA sont le minimum requis pour utiliser nos écrans dans un produit.
2. Déballer l'écran.
3. Installer l'écran dans son carter. Se référer aux instructions d'installation fournies par le fabricant du système pour les détails de montage de l'écran dans le carter.
4. Relier le fil de terre vert/jaune à la prise de terre sur le carter. Ce câble est relié à la vis de terre située sur le chassis de l'écran derrière l'étiquette portant le numéro de série.



ATTENTION! Il n'est pas permis de ne pas relier ce fil de terre avant de mettre le courant, car cette situation pourrait provoquer un choc électrique dangereux.
La résistance du chassis aux principales connections ne doit pas dépasser 100mΩ.

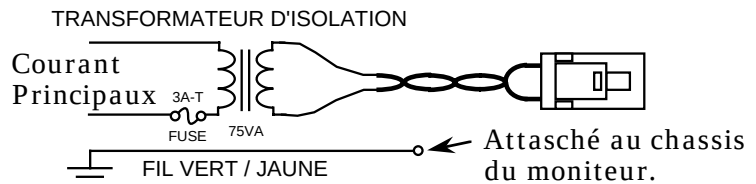
5. Vérifier que les fils suivants sont correctement reliés:
 - A. Le fil vert de la tresse du tube cathodique aquadag à la carte video.
 - B. Le câble plat à 12 conducteurs de la carte vidéo à la carte principale.
 - C. Le câble rouge haut voltage du retour du transformateur au capuchon de l'anode du tube cathodique.
 - D. Le fit de bobinage du bobinage à la carte principale.
 - E. Le fil de télécommande de la carte de la télécommande à la carte principale.

Note: Soyez sûr que ces fils sont connectés en toute sécurité de sorte qu'ils ne touchent aucune partie métallique.

6. Brancher les sept fils de la connection vidéo:

Broche	Signal	Couleur			
0	+ 12V de l'écran	Blanc	3	Signal de terre	Gris
1	Synchro Horizontale	Jaune	4	Rouge vidéo	Rouge
2	Synchro Verticale	Violet	5	Vert vidéo	Vert
			6	Bleu vidéo	Bleu

7. Brancher les fils de courant depuis le transformateur d'isolation:



8. Amener le courant à l'écran et au disque électronique.
9. Vérifier le foyer, et si nécessaire, régler le contrôle sur le retour du transformateur.
10. Effectuer les réglages sur la carte de la commande à distance pour:
 - La taille du balayage horizontal.
 - La taille du balayage vertical.
 - La position du balayage vertical.
 - La position horizontale de l'image.
 - L'acquisition vidéo.

11. Pour les instructions de convergence, voir page 100 & 101.

Installationsanweisungen für die XX93 Monitore.

1. Ein 3 Ampère-T sicherung (für die degaussing-Strömung) und ein 75 VA Isoliertransformator ist die Minimum-Forderung für benutzen unseren Monitoren in einem Produkt.
2. Packen Sie den Monitor aus.
3. Schließen Sie den Monitor im Gehäuse an. Für Details, Folgen Sie den Installation-Anweisungen, Vom Lieferanten der Antriebelektronik.
4. Verbinden Sie den Grüne/Gelben Schutzleiter zum Erdung anschluß auf dem Gehäuse. Dieser Draht ist verbunden zur der Erdung-Schraube auf dem Monitor-Chassis, und wird hinter der Serien-Nummer-Aufschrift gefunden.



WARNUNG!

Unterlassen dieser Verbindung dieses Erdung-Drahts ist gesetzte widrig. Der Widerstand von diesem anschluß biz zum netzstecker darf 100mΩ nicht überschreiten.

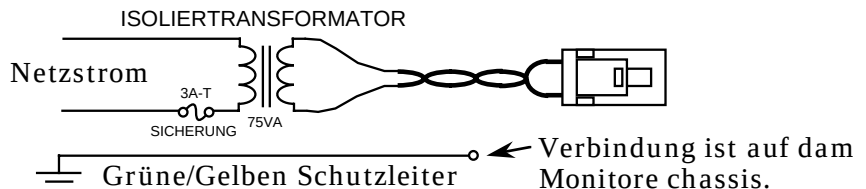
5. Prüfe daß die folgenden Drähte ordentlich verbunden sind;
 - A. Grüne Draht vom CRT aquadag zum Video Schaltpult.
 - B. 12 Leiter-Flachkabel vom Videoschaltpult zum Hauptschaltpult.
 - C. Rote hochspannungs Draht vom Flybacktransformator zur der Bildröhrenanode.
 - D. Jochkabel vom Joch zum Hauptschaltpult.
 - E. Fernsteuerung Kabel vom Fernsteuerungschaltpult zum Hauptschaltpult.

Notiz; Seien Sie sicher diese Drähte sind so befestigt daß sie kein Metallteil berühren.

6. Stecken Sie den 7 Leiter-Video-Verbindungsstecker ein.

Leiter	Signal	Farbe			
0	+12V Von Monitor.	Weiß	3	Signal-Erdung.	Grau
1	Horizontal sync.	Gelb	4	Rotes Video.	Rot
2	Vertical sync.	Purpur	5	Grünes Video.	Grün
			6	Blaues Video.	Blau

7. Stecken Sie den Stecker vom Isoliertransformator ein.

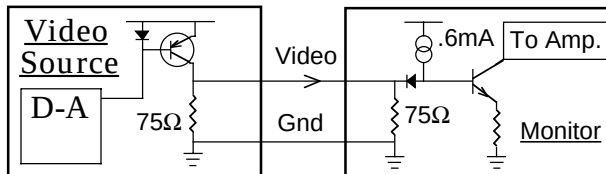


8. Schalten Sie den Monitor und die Steuerung an.
9. Prüfe Sie den Fokus und, wenn notwend, stell en Sie die obere Kontrolle ein auf dem Flybacktransformator.
10. Stellen Sie die Kontrollen des Fernsteuerungsschaltung ein für richtige
 - Horizontal Raster Größe.
 - Vertical Raster Größe.
 - Vertical Raster Position.
 - Horizontal Bild Position.
 - Video Kontrast.
11. Für Konvergenz-Anweisungen, auf seite 100 & 101.

INPUTS

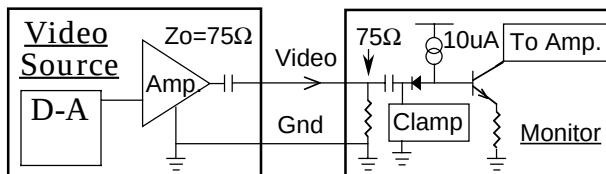
1. Standard Video Configurations, available, are:

A. Positive Analog, DC Coupled.



		Min.	Typ.	Max
.75V	Black level	0.00V	0.02V	0.04V
Video	Saturated color	0.75V	0.77V	0.79V
1.0V	Black level	0.00V	0.02V	0.04V
Video	Saturated color	1.00V	1.02V	1.04V

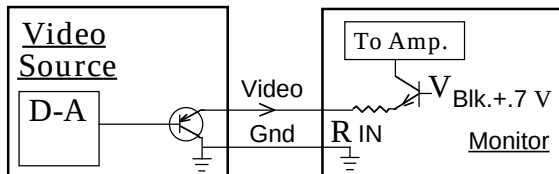
B. Positive Analog, AC Coupled.



.75V	Black level	Blk-.02V	Blank	Blk+.02V
Video	Saturated color	Blk+.73V	Blk+.75V	Blk+.77V
1.0V	Black level	Blk-.02V	Blk+0.00V	Blk+.02V
Video	Saturated color	Blk+.98V	Blk+1.00V	Blk+1.02V

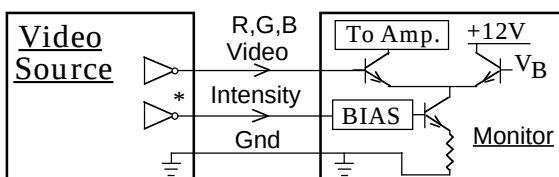
AC voltages are referenced to the R, G, & B video input voltage during horizontal sync (Hs). Blank is the black level voltage during Hs.

C. Negative Analog.



Red & Green	Black level	5.4V	5.6V	5.8V
Blue	Black level	4.85V	5.05V	5.25V
	Saturated color	.7V	.9V	1.1V

D. 4 Line TTL also available.

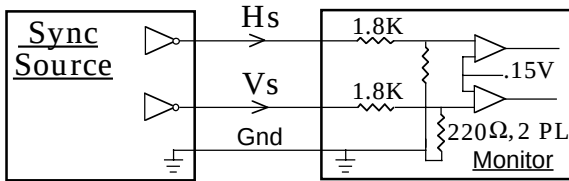


Black level	0V	.2V	.5V
Color on	2.7V	3.5V	6.0V
Low intensity	0V	.2V	.4V
Full intensity	4.5V	4.6V	4.8V

* No pullup resistor on intensity line.

Note: RS170 and other voltage combinations optional for analog video.

2. The Sync signals may be of either polarity and separate or composite.



For composite sync, vertical and horizontal sync lines are connected together.

Custom horizontal frequencies from 15KHz to 39KHz are available upon request.

Model	Min.	Typ.	Max
High input voltage	2.2V	3.5V	20V
Low input voltage	-2.7V	.30V	.80V
Horizontal sync pulse	1.5uS	4.0uS	12uS
Vertical sync pulse	65uS	.5mS	1.5mS
Horizontal frequencies:	15.5KHz	15.7KHz	15.9KHz
	29.3KHz	29.6KHz	29.9KHz
	31.2KHz	31.5KHz	31.8KHz
	34.9KHz	35.2KHz	35.6KHz
	37.5KHz	37.9KHz	38.3KHz
Vertical frequencies:	45Hz	50Hz	55Hz
	51Hz	56Hz	61Hz
	55Hz	60Hz	65Hz
	65Hz	70Hz	75Hz

3. The Power to the monitor is to be supplied by a secondary winding of an isolation transformer.

	Model 1493		Model 1793		Model 1993	
	Min.	Max.	Min.	Max.	Min.	Max.
120VAC 50Hz or 60Hz	90VAC	145VAC	90VAC	145VAC	90VAC	145VAC
230VAC 50Hz or 60Hz	180VAC	290VAC	180VAC	290VAC	180VAC	290VAC
Power	35W	60W	40W	70W	45W	75W

	Model 2093		Model 2793		Model 3693	
	Min.	Max.	Min.	Max.	Min.	Max.
120VAC 50Hz or 60Hz	90VAC	145VAC	90VAC	145VAC	90VAC	145VAC
230VAC 50Hz or 60Hz	180VAC	290VAC	180VAC	290VAC	180VAC	290VAC
Power	45W	75W	50W	100W	50W	100W

4. Five Controls are located on a separate PCB for easy access.

H SIZE-----Horizontal raster size

V SIZE-----Vertical raster size

V RAS. POS.-----Vertical raster position

H POS-----Horizontal picture position

M GAIN-----Master gain

Model 1493		Model 1793		Model 1993	
Min.	Max.	Min.	Max.	Min.	Max.
10.1"	11.1"	11.9"	12.9"	13.4"	14.4"
7.3"	8.3"	8.6"	9.6"	9.8"	10.8"
0"	.50"	0"	.50"	0"	.50"
1" Right	1" Left	1" Right	1" Left	1" Right	1" Left
0mA	.75mA	0mA	.75mA	0mA	.75mA

Model 2093		Model 2793		Model 3693	
Min.	Max.	Min.	Max.	Min.	Max.
14.9"	15.9"	20.4"	21.4"	27.4"	28.4"
10.9"	11.9"	15.1"	16.1"	20.3"	21.3"
0"	.60"	0"	1.0"	0"	1.0"
1" Right	1" Left	1" Right	1" Left	1" Right	1" Left
0mA	.75mA	0mA	1.5mA	0mA	1.5mA

The board Controls are located on the main PCB:

Focus and G2 on the FBT.

Optional board Controls are: pincushion, video black level, and horizontal hold control.

5. Image

	1493		17/19/2093		2793		3693	
	9300°K		9300°K		9300°K		9300°K	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Color Temperature								
Horizontal linearity	-2%	+2%	-5%	+5%	-8%	+8%	-10%	+10%
Vertical linearity	-2%	+2%	-5%	+5%	-8%	+8%	-10%	+10%
Pincushion	-2%	+2%	-3%	+3%	-5%	+5%	-8%	+8%

6. Environmental

Operating temperature

Storage temperature

Operating humidity

Storage humidity

0° C	70° C
-20° C	85° C
20%	80%
10%	95%

7. <u>Picture tube</u>	1493-CGA/VGA/SVGA		1793-VGA/SVGA		1793-SVGA		1993-VGA/SVGA		
	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
	Useful diagonal	13.2	335	16	407	16.1	409	18	457
	Useful horizontal	11.1	281	12.9	328	12.9	328	14.4	366
	Useful vertical	8.3	211	9.7	246	9.6	245	10.8	274
	Useful area	92.1 in ²	593 cm ²	125 in ²	807 cm ²	124 in ²	804 cm ²	165 in ²	1,003 cm ²
	Spacing of dot/line trios	.0110"	.28mm	.0106"	.27mm	.0098"	.25mm	.0102"	.26mm
	Phosphor Trio Type	Dot		Dot		Dot		Dot	
	Deflection angle	90°		90°		90°		100°	
	Light transmission	Approximately 57%		Approximately 53%		Approximately 50%		Approximately 45%	
	CRT surface	Polished/Curved		Polished/Curved		AR / Flat		AR / Curved	
	Phosphor	P22		P22		P22		P22	
	2093-CGA		2093-VGA		2793-CGA		2793-VGA		
	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
	Useful diagonal	18.9	480	18.9	480	26.8	679	26.8	679
	Useful horizontal	15.9	404	15.9	404	21.4	544	21.4	544
	Useful vertical	11.9	303	11.9	303	16.1	408	16.1	408
	Useful area	189 in ²	1,224 cm ²	189 in ²	1,224 cm ²	345 in ²	2,220 cm ²	345 in ²	2,220 cm ²
	Spacing of dot/line trios	.0331"	.84mm	.0307"	.78mm	.0326"	.83mm	.0326"	.83mm
	Phosphor Trio Type	Line		Line		Line		Line	
	Deflection angle	90°		90°		110°		110°	
	Light transmission	Approximately 40%		Approximately 40%		Approximately 38%		Approximately 38%	
	CRT surface	Polished/Curved		Polished/Curved		Polished/Curved		Polished/Curved	
	Phosphor	P22		P22		P22		P22	
	2793-VGA		3693-CGA						
	Inch	mm	Inch	mm					
	Useful diagonal	26.6	676	35.5					902
	Useful horizontal	21.3	541	28.4					721
	Useful vertical	16.0	406	21.3					541
	Useful area	341 in ²	2,196 cm ²	605 in ²					3,901 cm ²
	Spacing of dot/line trios	.0299"	.76mm	.0394"					1mm
	Phosphor Trio Type	Line / Variable		Line					
	Deflection angle	110°		111°					
	Light transmission	Approximately 81%		Approximately 32%					
CRT surface	Polished/Flat		Polished/Curved						
Phosphor	P22		P22						



Refer to the block diagram on page 15 (foldout) when reading this description.

A

The Video Interface is designed around a custom IC and will accept DC or AC coupled positive analog video signals. It can also be used with negative analog and 4 line TTL. This IC has a built in multiplier circuit for the master gain control and blanking functions. Resistors are used to protect the IC and to set the gain. The programmed gain is dependent on the input signal amplitude except with the TTL mode. Solder jumpers and component substations are used to program the Video Interface for the type of input signal to be received. The output of the IC drives the video amplifiers. This drive is a current where 0 mA is black and 10 mA is a saturated color.

B

The Video Amplifiers are of the push pull type. They are built partly on thick films and partly on the video PCB. Spreading out the amplifier reduces the component heat and improves the life of the unit. The bandwidth is 25 MHz with 40Vp-p output. The rise and fall times are 20nS.

C

The Beam Current Feedback circuit directs most of the beam current of each amplifier to the beam current buffer. The only time this current is measured, by the auto bias circuit, is during the time of the three faint lines at the top of the screen and three lines thereafter. The CRT auto bias circuit is designed to adjust the video amplifier bias voltage such that the beam current of each of the three guns is set to a specific programmed value.

D

The Beam Current Buffer converts the, high impedance low current, beam current signal into a low impedance voltage. This voltage is applied to the auto bias IC through a 200 ohm resistor. After the three lines of beam current are measured, the program pulse from the auto bias IC, produces a voltage drop across this 200 ohm resistor that equals the amplitude of the beam current voltage.

E

The CRT Auto Bias IC is a combination of digital and analog circuitry. The digital part is a counter and control logic which steps the analog circuits through a sequence of sample and hold conditions. The analog part uses a transconductance amplifier to control the voltage on a 10uF capacitor (one per gun). This voltage is buffered and sent to the video amplifiers as the bias voltage. In monitors without CRT auto bias, this voltage is adjusted manually using a setup procedure to set the color balance. With CRT auto bias, the color balance is set during the end of each vertical blanking time.

The control sequence is:

1. The cycle starts with a sync pulse from the vertical oscillator (15KHz) or from the vertical sync delay. 15H later the grid pulse starts.
2. The grid pulse on G1 causes cathode current which can be seen as the three faint white lines at the top of the screen. This cathode current is transmitted by the beam current feedback to the beam current buffer where it is converted to a voltage and applied to the CRT auto bias input pin. At this time the CRT auto bias IC outputs a reference voltage at its input pin which sets the voltage across the coupling capacitor. This coupling capacitor voltage is directly dependent on beam current.
3. After the grid pulse is over, the program pulse matches the voltage from the beam current buffer. If the voltage from the beam current buffer, during the grid pulse, is the same as the voltage from the program pulse, the bias is correct and no bias adjustment is made for that vertical cycle.

F

The timing of the auto bias IC is synchronized to the vertical oscillator and the flyback pulses. For horizontal frequencies higher than 15.7KHz a Vertical Sync Delay may be needed to position the grid pulse, generated 3 gray lines, at the top of the screen. The need for the delay circuit is dependent on the particular CRT vertical retrace time.

G

The aging of the picture tube (CRT) not only affects the balance of the cathode cutoff voltage, which is corrected by the auto bias circuit, but it also affects the gain of the CRT. The Auto Bright circuit actively corrects for CRT gain changes by sensing any common bias voltage change, from the auto bias circuit, and adjusts the screen voltage to hold the average bias voltage constant. The lower adjustment on the flyback transformer which is the screen voltage, is used to set the auto bright voltage to the center of its range. Therefore, the auto bright circuit sets up a second control feedback loop to reduce picture variation due to CRT aging. The auto bright circuit is also used to turn off the beam current when the monitor power is turned off.

H

The CRT for the 1493, 1793 and 2093 monitors have a 90° deflection angle. The 1993 incorporates 100° while the 2793 CRT has 110° and the 3693 has 111° deflection angles. These picture tubes have integral implosion protection and a EHT of 25KV.

H1

The Vertical Dynamic Focus amplifies the parabolic waveform across the vertical coupling capacitor from about 3Vp-p to about 200Vp-p, depending on CRT requirements. This waveform sharpens the top and bottom portion of the raster on dual focus CRT's.

H2

The Horizontal Dynamic Focus amplifies the parabolic waveform across the horizontal coupling capacitor, using a transformer to produce 300Vp-p output from an input that is about 33Vp-p. This waveform is added to the vertical dynamic waveform and sharpens the right and left sides of the raster.

I

Blanking is accomplished by setting the gain of the interface IC to zero during blank time. The Horizontal Blanking pulse is generated by amplifying the flyback pulse. The Vertical Blanking pulse is started by the vertical oscillator one shot and ended by the counter in the auto bias IC via the "bias out" pulse. The Master Gain control, located on the remote PCB, sets the gain of the video signal when blanking is not active. The Beam Current Limiter circuit, which is designed to keep the FBT from overloading, will reduce the video gain if the maximum average beam current is exceeded. Also, the beam current is reduced if the FBT approaches maximum operating temperature.

J

The Sync Interface can accept separate or composite sync. Two comparators are used to receive sync, one for vertical sync and the other for horizontal sync. Resistor dividers are used to protect the comparator IC from over voltage damage. For customers who do not require interlace, an additional vertical sync stabilization circuit is included. This circuit synchronizes the vertical sync to the horizontal cycle.

K

The Vertical Oscillator generates the vertical free running frequency when no vertical sync is present. When sync is applied, the vertical oscillator synchronizes to the leading edge of the sync pulse.

L

The Vertical Control & Output circuit consists of:

1. One shot.
2. Ramp generator.
3. Vertical drive.
4. Vertical output.

The sync pulse from the LA7851 triggers a one shot in the LA7838 which clamps the vertical ramp generation capacitor to 5V during the first half of vertical retrace. The ramp generation capacitor then charges via a constant current set by an external resistor. This resistor is connected to the V SIZE pot, located on the remote control board, for the vertical size adjustment. The vertical drive is a differential amplifier which compares the ramp voltage to the yoke return feedback current. The yoke feedback current and voltage circuits are used to set the vertical linearity. The vertical Output is a power driver, with thermal protection, which drives the vertical deflection yoke. It also has a special pump up circuit which doubles the output voltage during vertical retrace. This voltage doubler also increases the efficiency of the circuit since the high retrace voltage is not present across the power driver during the trace time.

M

The Horizontal Control incorporates a variable sync delay and a phase locked loop to generate the horizontal timing. The H POS. adjustment, on the remote control board, sets the sync delay time which controls the picture position. The phase locked loop uses the flyback pulse to generate a sawtooth wave which is gated with the delayed sync pulse to control the horizontal oscillator.

N

The Horizontal Driver supplies the high base current necessary to drive the horizontal output transistor which has a beta as low as three. A transformer is used to step up the current from the driver circuit and also protects the horizontal output transistor from a continuous turned on state. A special clamp circuit is connected to the transformer which reduces the turnoff time of the horizontal output transistor for reduced power dissipation.

O

The Horizontal Output transistor is mounted to the rear frame which acts as a heat sink. The collector conducts the 900 volt primary flyback pulses which should not be measured unless the equipment is specifically designed to withstand this type of stress. A linear ramp current is produced in the horizontal yoke by the conduction of the horizontal output transistor (trace time). A fast current reversal (retrace time) is achieved by the high voltage pulse that follows the turn off of the horizontal output transistor. This pulse is due to the inductive action of the yoke and flyback transformer.

P

The main function of the Flyback Transformer (FBT) is to generate a 25,000 volt (EHT) potential for the anode of the picture tube. This voltage times the beam current is the power that lights up the phosphor on the face of the picture tube. At 1.5mA beam current, for the 2793 monitor, the FBT is producing almost 38 watts of high voltage power. The FBT also sources the focus voltage, screen grid voltage, filament power, and has two more secondaries which are used for control functions. The FBT has a built in high voltage load resistor which stabilizes the EHT, for the low beam current condition. This resistor also discharges the EHT, when the monitor is turned off, which improves the safety of handling the monitor.

Q

The Remote Control PCB houses the:

CONTROL	DESCRIPTION	CIRCUIT
1. H SIZE -----	Horizontal raster size -----	Diode modulator
2. V SIZE -----	Vertical raster size -----	Vertical control
3. V RAS. POS. ---	Vertical raster position -----	DC current to V. yoke
4. H POS -----	Horizontal picture position --	H. sync delay
5. M GAIN -----	Master gain -----	Video interface

R

The Horizontal Size Control circuit has four inputs:

#	SIGNAL	FUNCTION
1.	Horizontal size -----	Horizontal size control
2.	Beam current -----	Blooming control
3.	Vertical linear ramp -----	} (#4)-(#3)=Vertical parabolic (Pincushion)
4.	Vertical parabolic + V. linear ramp ---	

The horizontal size control circuit sums the four signals at one node plus the feedback from the diode modulator to drive a switching mode power driver. The output of the power driver is then connected to the diode modulator through an inductor to complete the control loop.

S

The Diode Modulator is a series element of the horizontal tuned circuit. It forms a node between GND and the normal yoke return circuit. If this node is shorted to GND, the result is maximum horizontal size. Forward current in the diode modulator, at the start of retrace, keeps the node voltage clamped to ground until enough current flows from the horizontal tuned circuit to exceed this forward current. The horizontal size, therefore, is controlled by controlling the current to this diode via the horizontal size control circuit.

T

A Voltage Doubler is used in the power supply for two reasons:

1. To improve the efficiency of the power supply.
2. To permit 120 volt and 230 volt operation. For the 230 volt operation the voltage doubler is replaced with a bridge rectifier.

U

The Switching Regulator is synchronized to the horizontal pulse and drives a power MOSFET. Unlike most regulators that have a common GND, this power supply has a common V+ and current is supplied from V- to GND. The MOSFET is connected to V- and signal ground (GND) through a transformer which is used as an inductor for series switch mode regulation. An operational amplifier, voltage reference, comparator, and oscillator in the power supply controller IC are used to accomplished regulation by means of pulse width modulation.

The transformer has two taps on the main winding which are used to generate the +16 volt and +24 volt supplies. It also has a secondary which is referenced to V- and supplies the power supply. Since the power supply is generating its own power, a special start up circuit is built into the power supply controller IC that delays start up until the capacitor which supplies the IC is charged up enough to furnish the current to start the power supply. This capacitor is charged with current through a high value resistor from the raw dc supply. This self sustaining action is why the power supply chirps when an overload or underload occurs. Additional secondaries to drive the horizontal raster shift circuit and the video amplifiers are also included in the power transformer.

V

The Load consists primarily of the horizontal flyback circuit. The power supply will not operate without the load since the voltage that sustains the power supply comes from a secondary in the power transformer and depends on some primary current to generate secondary current.

W

A +12V regulator is used to supply current, to all the control circuits in the monitor, with the exception of the power supply. Many of the control circuits are decoupled from the +12 volt line with a resistor or diode to minimize noise from common current loops.

X

The Over Voltage Protect circuit is built into the power supply and monitors the flyback transformer peak pulse voltage. This circuit will turn off the power supply and hold it off if the EHT exceeds its maximum rated value. Since excessive X-ray output occurs with excessive EHT, this circuit provides X-ray protection.

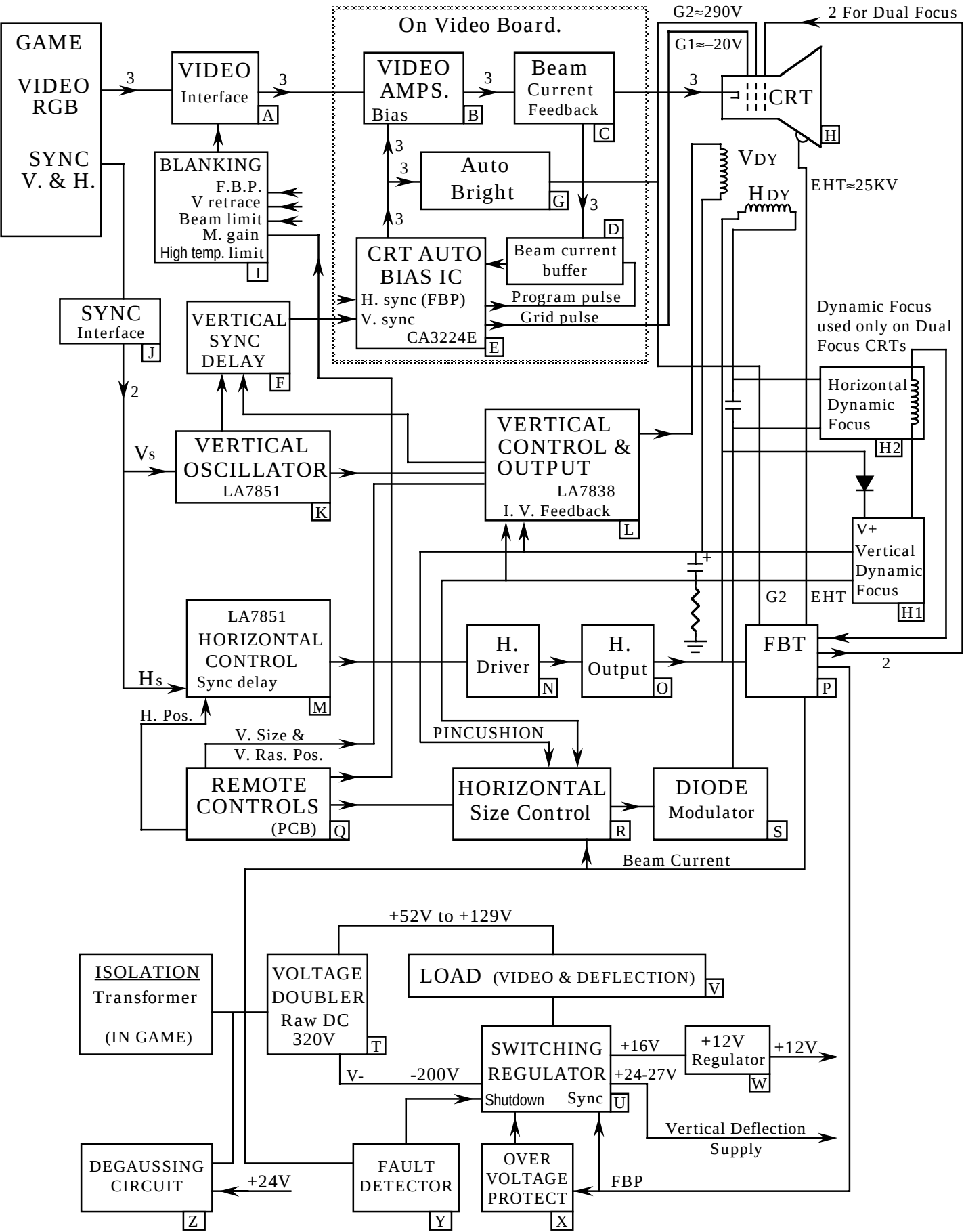
Y

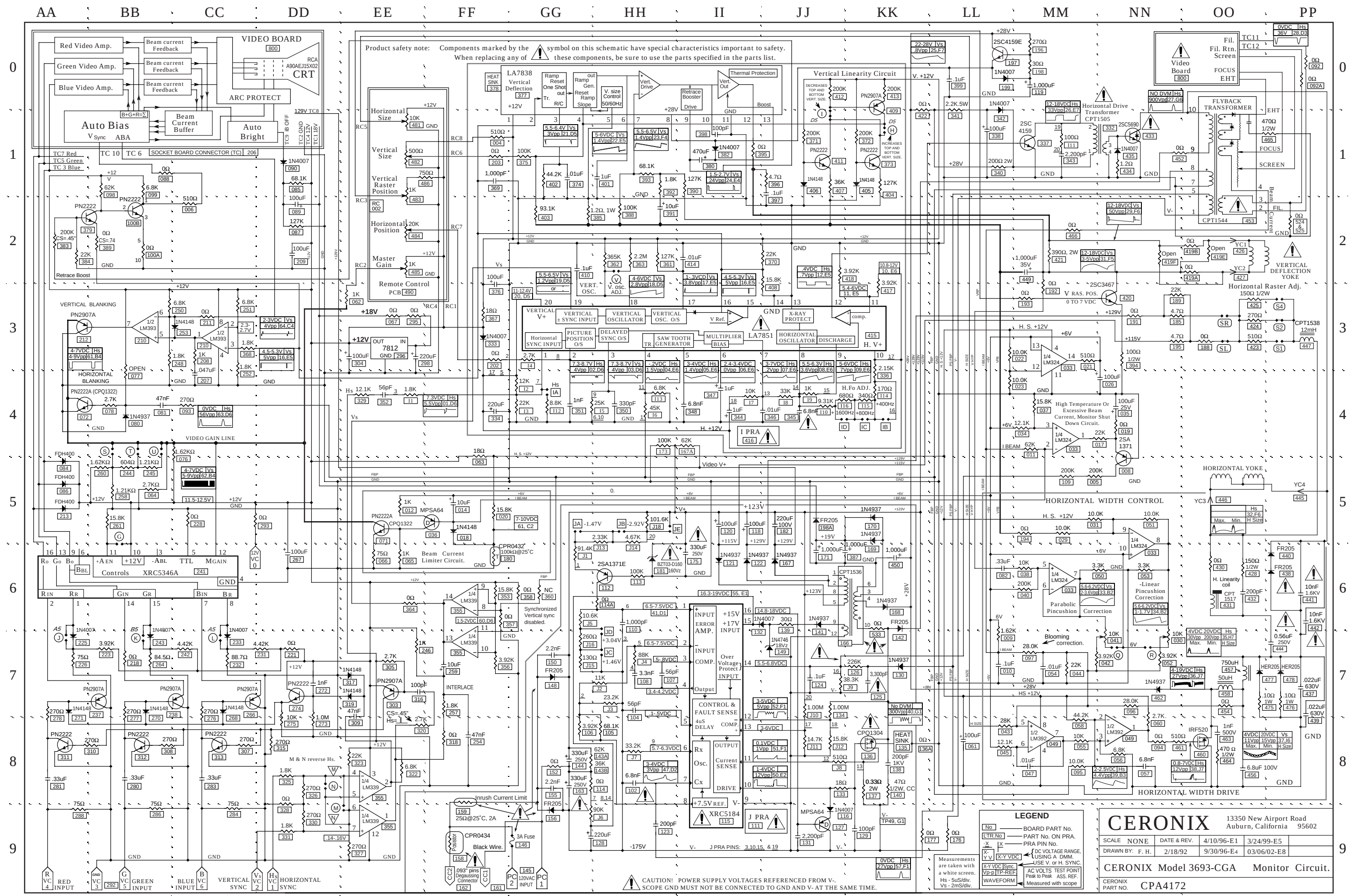
The Fault Detector senses beam current and temperature. This circuit will activate the power supply shutdown circuit if either the maximum temperature is sensed or if the beam current becomes large enough to threaten the FBT.

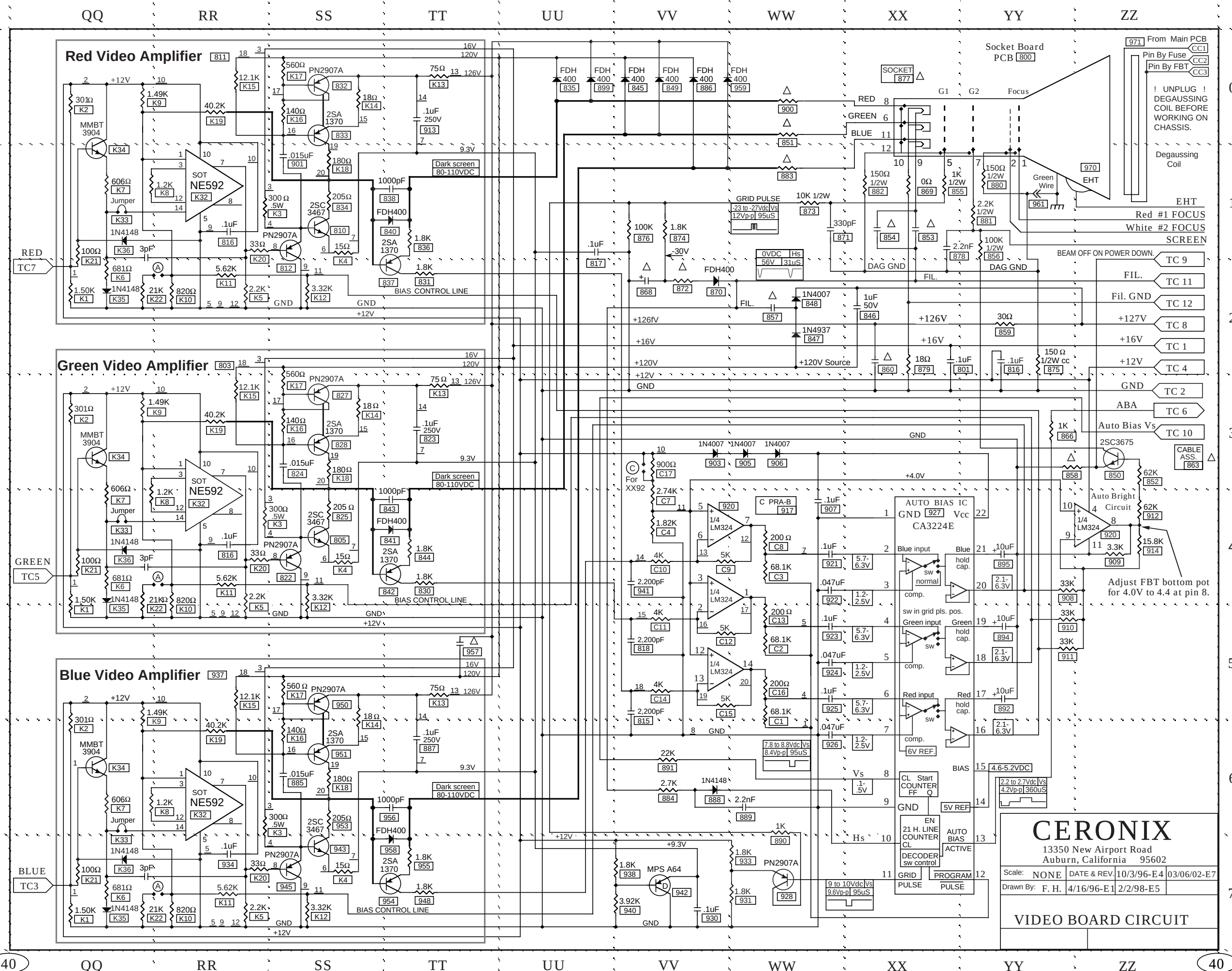
Z

The Degaussing circuit is connected across the isolated AC line. A posistor is used to allow a large current to flow, in the degaussing coil, on power up. This current is then gradually reduced by the increased temperature of the positive temperature coefficient thermistor in the posistor. A relay is used to short the degaussing coil after the degaussing operation. This greatly reduces posistor residual current in the degaussing coil. When repairing a monitor, the degaussing coil should be unplugged, to avoid possible damage to the degaussing coil shorting relay.

XX93 Monitor Block Diagram.







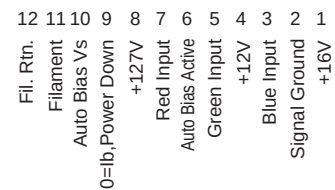
CERONIX

13350 New Airport Road
Auburn, California 95602

Scale: NONE	DATE & REV: 10/3/96-E4 03/06/02-E7
Drawn By: F. H.	4/16/96-E1 2/2/98-E5

VIDEO BOARD CIRCUIT

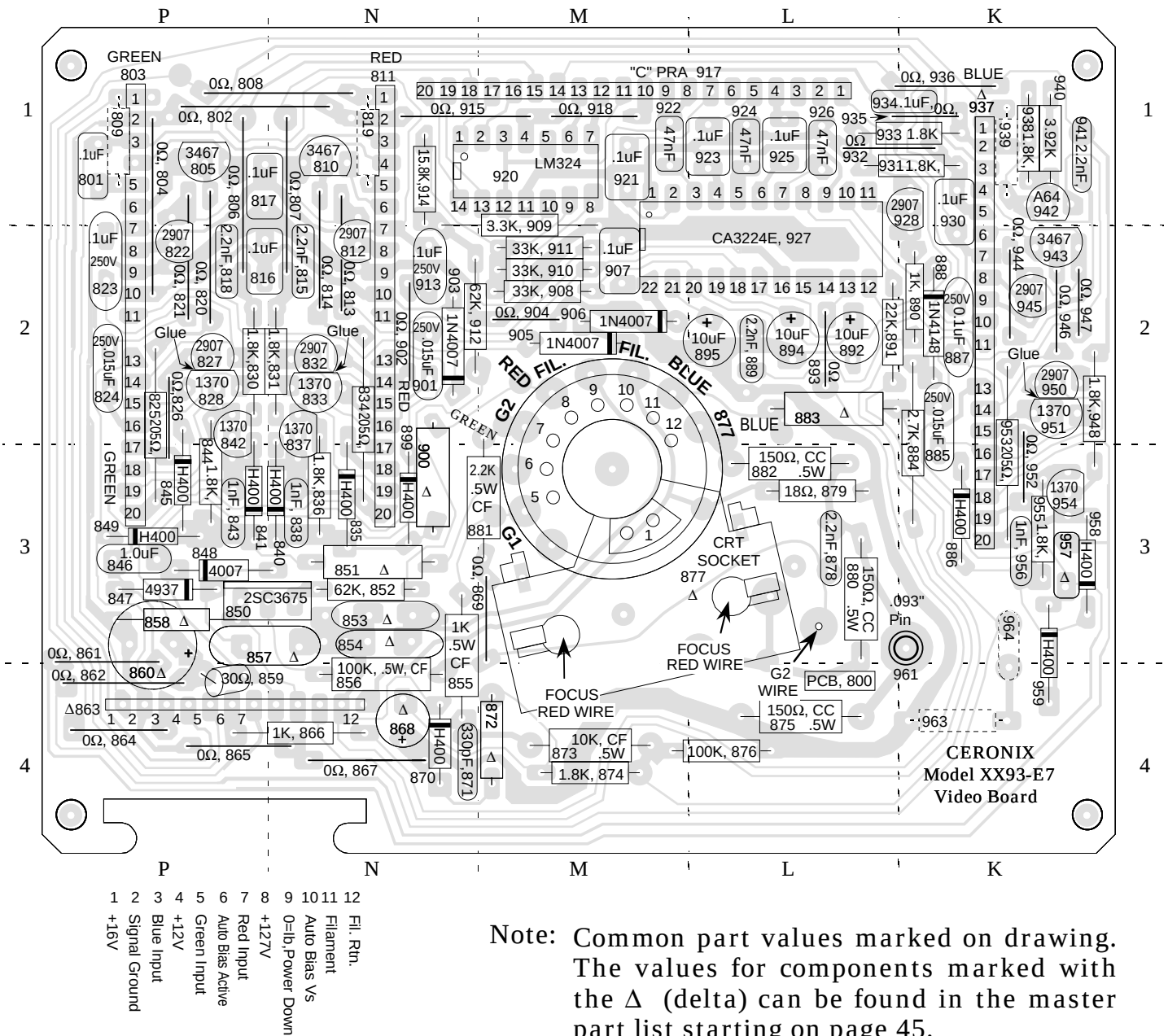
View is from component side.



41

XX93 Video Board, Technician's Assembly Drawing.

View is from conductor side.





PRODUCT SAFETY NOTE:

Components marked by the symbol ! have special characteristics important to safety. When replacing any of these components, be sure to use the parts specified in the parts list.

An example of how the critical components are marked in the Master Part List is shown below. See the Master Part List for specifying critical components.

Δ Bd.#	Part No.	Bd.	Sch. Ref.	Description	
!	102	CPC1027	D2	HH8	6,800pF ±5%, 100V, Film

CAUTION:

CERONIX XX93 Monitors MUST USE AN APPROVED ISOLATION TRANSFORMER.

The monitor chassis must be connected to earth ground via a common connection in the system which contains the monitor.

X-RAY NOTE:

X-radiation is produced by electrons colliding with the phosphor and shadow mask at the front of the picture tube. The X-radiation emanating from the front of the picture tube is highly reduced due to the shielding affect of the leaded glass face. It is also produced at the anode bulb contact. The X-radiation emanating from the anode bulb contact is much higher than from the face due to less shielding.

X-radiation is directly proportional to beam current. It doubles for each 1.3KV increase of the EHT voltage at the face and also doubles for each 3KV increase of the EHT at the anode bulb contact.

From this information, it should be noted that when servicing monitor electronics, where the back of the picture tube is facing the service person, that the beam current should be turned down to avoid excessive exposure.

Due to the increase in X-Radiation emission with increase of EHT voltage, it is important that the EHT voltage is checked.

To measure the EHT voltage: Connect the (-) lead of a volt meter to the monitor chassis so that a reliable connection is made. Connect a high voltage probe to the (+) input of the meter and at the anode contact of the picture tube.

The EHT should not exceed 26KV at 0 beam current.



PRODUKTSICHERHEIT ANMERKUNG:

Bestandteile gekennzeichnet durch das Symbol ! haben Sie die speziellen Eigenschaften, die zur Sicherheit wichtig sind. Wenn Sie irgendwelche dieser Bestandteile ersetzen, seien Sie sicher, die Teile zu benutzen, die in der Stückliste spezifiziert werden. Ein Beispiel von, wie die kritischen Bestandteile in der Vorlagenstückliste gekennzeichnet werden, wird unten gezeigt. Sehen Sie die Vorlagenstückliste für das Spezifizieren der kritischen Bestandteile.

Δ Bd. #	TeilNr.	Bd.	Sch.	Ref.	Beschreibung
!	102	CPC1027	D2	HH8	6,800pF ±5%, 100V, Film

VORSICHT:

MONITOREN CERONIX XX93 MÜSSEN EINEN ANERKANNTEN LOKALISIERUNG TRANSFORMATOR BENUTZEN.

Das Monitorchassis muß an die Masse angeschlossen werden, die über einen allgemeinen Anschluß im System gerieben wird, das den Monitor enthält.

RÖNTGENSTRAHLANMERKUNG:

X-Strahlung wird durch die Elektronen produziert, die mit der Phosphor- und Schattenschablone an der Frontseite des Abbildung Gefäßes zusammenstoßen. Die X-Strahlung, die von der Frontseite des Abbildung Gefäßes ausströmt, liegt in hohem Grade an der Abschirmung beeinflussen vom verbleiten Glasgesicht verringertes. Sie wird auch am Anode Birne Kontakt produziert. Die X-Strahlung, die vom Anode Birne Kontakt ausströmt, ist viel höher als vom Gesicht, das zu weniger abschirmen passend ist. X-Strahlung ist direkt zum Lichtstrahlstrom proportional. Sie verdoppelt für jede Zunahme 1.3KV der EHT-Spannung am Gesicht und verdoppelt auch für jede Zunahme 3KV des EHT am Anode Birne Kontakt.

Von diesen Informationen sollte es beachtet werden daß, wenn man Monitorelektronik instandhält, in der die Rückseite des Abbildung Gefäßes die Service-Person gegenüberstellt, daß der Lichtstrahlstrom unten gedreht werden sollte, um übermäßige Berührung zu vermeiden.

Wegen der Zunahme der X-Radiationemission mit Zunahme der EHT-Spannung, ist es wichtig, daß die EHT-Spannung überprüft wird.

Die EHT-Spannung messen: Schließen Sie die (-) Leitung eines Voltmeßinstruments an das Monitorchassis an, damit eine zuverlässige Beziehung hergestellt wird. Schließen Sie eine Hochspannungsprüfspitze an den (+) Input des Meßinstruments und am Anode Kontakt des Abbildung Gefäßes an.

Das EHT sollte nicht 26KV bei 0 Lichtstrahlstrom übersteigen.

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A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

[illegible]

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A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
	043	CPR0016	A3	LL8	33KΩ ±5%, 1/4W, CF						E	F	G	H										R	S						c	0.01
	043	CPR0017	A3	LL8	36KΩ ±5%, 1/4W, CF			C																							c	0.01
	043	CPR0018	A3	LL8	62KΩ ±5%, 1/4W, CF																					T					c	0.01
	043	CPR0145	A3	LL8	15.8KΩ ±1%, 1/4W, MF															M	N	O									c	0.01
	043	CPR0153	A3	LL8	20.0KΩ ±1%, 1/4W, MF																										c	0.01
	043	CPR0154	A3	LL8	44.2KΩ ±1%, 1/4W, MF	A	B										K														c	0.01
	043	CPR0163	A3	LL8	28.0KΩ ±1%, 1/4W, MF				D						I	J		L									U				c	0.01
	044	CPR0015	A3	MM7	22KΩ ±5%, 1/4W, CF			C																R			U				c	0.01
	044	CPR0016	A3	MM7	33KΩ ±5%, 1/4W, CF																		Q								c	0.01
	044	CPR0017	A3	MM7	36KΩ ±5%, 1/4W, CF																O				S						c	0.01
	044	CPR0018	A3	MM7	62KΩ ±5%, 1/4W, CF					E	F	G	H	I	J												T				c	0.01
	044	CPR0029	A3	MM7	200KΩ ±5%, 1/4W, CF	A	B																								c	0.01
	044	CPR0148	A3	MM7	24.3KΩ ±1%, 1/4W, MF														M	N											c	0.01
	044	CPR0154	A3	MM7	44.2KΩ ±1%, 1/4W, MF				D									L													c	0.01
	044	CPR0163	A3	MM7	28.0K ±1%, 1/4W, MF																		P								c	0.01
	045	CPR0144	A3	LL8	12.1KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01
	047	CPC1032	B3	MM8	.01uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.03
	048	CPR0050	A3	J	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01
	049	CPI1414	B3	MM8	OP Amp / Comp. IC, LM392	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.57
	050	CPR0024	B3	NN6	3.3KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01
	051	CPR0143	B2	NN5	10.0KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01
	052	CPR0024	B2	NN7	3.3KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H					M														

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
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F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
	081	CPC1032	B3	BB4		.01uF ±5%, 50V, Film			C	D								L			O	P	Q		S	T					c	0.03
	081	CPC1036	B3	BB4		.047uF ±5%, 50V, Film													M	N				R			U				c	0.04
	081	CPC1040	B3	BB4		.015uF ±10%, 250V, Film				E	F		H	I	J	K															c	0.06
	081	CPC1054	B3	BB4		.039uF ±5%, 100V, Film	A	B																							c	0.06
	082	CPC1041	B3	LL6		.33uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.08
	083	CPR0050	C3	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	084	CPD1250	C3	AA5		100mA, 200V Diode, FDH400	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
	085	CPR0155	C3	DD1		68.1KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	086	CPD1250	C3	AA5		100mA, 200V Diode, FDH400	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
	087	CPR0157	C3	DD2		127KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	088	CPR0050	C3	BB1		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N				R	S		U				c	0.01
	088	CPR0100	C3	BB1		2.2KΩ ±5%, 1/4W, CC															O	P	Q			T				c	0.04	
	089	CPC1102	C3	DD2		100uF, 25V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.04
	090	CPD1252	C3	DD1		1A, 1KV Diode, 1N4007	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	092	CPR0050	C3	PP0		0Ω Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L					Q				U				c	0.01
	092	CPR0375	C3	PP0		.68Ω ±5%, 1W, MO												M	N	O	P		R	S	T					c	0.02	
	092A	CPR0050	C3	PP0		0Ω Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	093	CPR0004	C3	CC4		270Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	094	CPR0050	C3	NN8		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	095	CPR0143	C3	MM8		10.0KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	096	CPR0163	C3	NN7		28.0KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	097	CPR0016	C3	MM7		33KΩ ±5%, 1/4W, CF													M	N										c	0.01	
	097	CPR0018	C3	MM7		62KΩ ±5%, 1/4W, CF				D																				c	0.01	
	097	CPR0146	C3	MM7		169KΩ ±1%, 1/4W, MF			C																					c	0.01	
	097	CPR0155	C3	MM7		68.1KΩ ±1%, 1/4W, MF	A	B			E	F	G	H									Q							c	0.01	
	097	CPR0158	C3	MM7		84.5KΩ ±1%, 1/4W, MF									I	J	K	L												c	0.01	
	097	CPR0163	C3	MM7		28.0KΩ ±1%, 1/4W, MF														O	P		R	S	T	U				c	0.01	
	098	CPR0018	D2	BB1		62KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	099	CPR0013	D2	BB1		6.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N				R	S		U				c	0.01
	099	CPR0018	D2	BB1		62KΩ ±5%, 1/4W, CF														O	P	Q			T					c	0.01	
	100	CPI1416	D2	CC2		7 Bit Counter, CD4024B														O	P	Q			T					c	0.32	
	100A	CPR0050	D2	BB2		0Ω Jumper, pins 5 to 10.	A	B	C	D	E	F	G	H	I	J	K	L	M	N				R	S		U				c	0.01
	100B	CPQ1303	D3	BB2		30V, .6A, NPN, PN2222A	A	B	C	D	E	F	G	H	I	J	K	L	M	N				R	S		U				c	0.04
	101	CPC1058	D2	BB2		.1uF ±5%, 50V, Film														O	P	Q			T					c	0.05	
!	102	CPC1027	D2	HH8		6,800pF ±5%, 100V, Film	A	B										M	N				R			U				c	0.07	
!	102	CPC1035	D2	HH8		3,300pF ±5%, 100V, Film			C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T					c	0.08
	104	CPC1000	D2	HH7		56pF ±5%, 100V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	105	CPR0017	D2	HH8		36KΩ ±5%, 1/4W, CF																		S						c	0.01	
	105	CPR0018	D2	GG8		62KΩ ±5%, 1/4W, CF															P									c	0.01	
	105	CPR0029	D2	HH8		200KΩ ±5%, 1/4W, CF											K													c	0.01	
	105	CPR0142	D1	GG8		7.15KΩ ±1%, 1/4W, MF																	R							c	0.01	
	105	CPR0143	D2	HH8		10.0KΩ ±1%, 1/4W, MF																			T					c	0.01	
	105	CPR0153	D2	HH8		20.0KΩ ±1%, 1/4W, MF								H																c	0.01	
	105	CPR0155	D1	GG8		68.1KΩ ±1%, 1/4W, MF																				U				c	0.01	
	105	CPR0163	D2	HH8		28.0KΩ ±1%, 1/4W, MF									I	J														c	0.01	
	105	CPR0168	D1	GG8		8.06KΩ ±1%, 1/4W, MF												M	N											c	0.01	
	105	CPR0172	D1	GG8		140KΩ ±1%, 1/4W, MF			C													Q								c	0.01	
	106	CPR0138	D2	GG8		2.15KΩ ±1%, 1/4W, MF											L								T					c	0.01	
	106	CPR0140	D2	GG8		3.92KΩ ±1%, 1/4W, MF							G					M	N				R			U				c	0.01	
	106	CPR0142	D2	GG8		7.15KΩ ±1%, 1/4W, MF	A		C						H		K				O	P	Q		S					c	0.01	
	106	CPR0168	D2	GG8		8.06KΩ ±1%, 1/4W, MF		B		D	E	F			I	J					O	P	Q								c	0.01
	107	CPC1000	D2	HH7		56pF ±5%, 100V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	108	CPC1035	D2	HH7		3,300pF ±5%, 100V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.08
	109	CPR0029	E2	MM5		200KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	110	CPC1005	D1	HH6		1,000pF ±10%, 500V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
!	111	CPR0501	E1	JJ9		"J" PRA Power Supply	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.79
	112	CPQ1310	D1	HH6		.1A, 300V, PNP, 2SA1371AE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.23

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
	113	CPR0019	D1	HH6		100KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	114	CPR0050	E1	HH8		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	114A	CPR0050	D1	HH6		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
!	115	CPI1403	E2	II7		PS Control IC, XRC5184	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	3.33
	116	CPD1252	E2	JJ9		1A, 1N4007	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	117	CPR0050	E3	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	118	CPC1102	E2	II5		100uF, 25V, Electrolytic	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.04
	119	CPC1104	E3	MM0		1,000uF, 35V, Electrolytic																	R			U				c	0.22	
	120	CPC1102	E2	II5		100uF, 25V, Electrolytic	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.04
	121	CPD1253	F2	II6		1A, 600V, Fast D., 1N4937	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
	122	CPD1253	F2	II6		1A, 600V, Fast D., 1N4937	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
	123	CPC1002	F2	HH9		330pF ±10%, 500V, Ceramic	A	B			E	F	G	H																c	0.01	
	123	CPC1006	F2	HH9		200pF ±10%, 1KV, Ceramic			C	D					I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.01	
	124	CPC1058	E2	JJ7		.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.05
!	125	CPC1035	F2	KK7		3,300pF ±5%, 100V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.08
!	126	CPR0156	E2	KK7		93.1KΩ ±1%, 1/4W, MF					E	F	G	H																c	0.01	
!	126	CPR0157	E2	KK7		127KΩ ±1%, 1/4W, MF			C	D											O	P	Q							c	0.01	
!	126	CPR0171	E2	KK7		365KΩ ±1%, 1/4W, MF																				T				c	0.01	
!	126	CPR0172	E2	KK7		140KΩ ±1%, 1/4W, MF																			S					c	0.01	
!	126	CPR0174	E2	KK7		210KΩ ±1%, 1/4W, MF									I	J														c	0.04	
!	126	CPR0176	E2	KK7		226K ±1%, 1/4W, MF																				U				c	0.01	
!	126	CPR0146	E2	KK7		169KΩ ±1%, 1/4W, MF																		R						c	0.01	
!	126	CPR0169	E2	KK7		191KΩ ±1%, 1/4W, MF	A	B									K	L	M	N										c	0.01	
	127	CPQ1302	E2	JJ9		30V, .3A, PNP, D, MPSA64	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.06
	128	CPC1103	E2	HH9		220uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.14
	129	CPC1009	G1	KK9		100pF ±10%, 500V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	130	CPD1251	F2	KK7		10mA, 75V Diode, 1N4148	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T		U			c	0.01
	130	CPD1253	F2	KK7		1A, 600V, Fast D., 1N4937																					U			c	0.02	
	131	CPC1003	E1	JJ9		2,200pF ±20%, 1KV, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
	132	CPD1252	F1	JJ6		1A, 1KV Diode, 1N4007												M	N		P		R			U				c	0.01	
	132	CPR0050	F1	JJ6		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L				O		Q		S	T				c	0.01
	133	CPR0002	E1	JJ8		18Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	134	CPR0147	F1	JJ7		1.00MΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	135	CPM2037	F2	KK8		Heat Sink For P.S. FET.																	Q	R			U			c	0.12	
	135	CPM2123	F2	KK8		Heat Sink For P.S. FET.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P			S	T				c	0.16	
!	136	CPQ1304	F2	KK8		4.5A, 450V, Mos Fet, 2SK1446LS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	1.19
	136A	CPR0050	F2	KK8		22 Gage Buss Wire under P/S	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	137	CPR0389	F1	KK8		.33Ω ±5%, 2W, MO	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.03
	138	CPC1006	G1	KK8		200pF ±10%, 1KV, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	139	CPR0033	G1	JJ6		30Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	140	CPR0350	F1	KK8		47Ω ±10%, 1/2W, CC	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.06
	141	CPD1253	G1	JJ6		1A, 600V, Fast D., 1N4937	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
!	142	CPD1264	H1	KK6		2A, 600V Fast D., FR205-F	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.03
	143A	CPR0018	H1	HH8		62KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	143B	CPR0017	H1	HH8		36KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
!	144	CPC1107	I1	GG8		330uF, 250V, Electrolytic																			R	S	T	U		c	1.35	
!	144	CPC1111	I1	GG8		220uF, 2=0V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q								c	0.97
	145	CPS1753	J1	GG9		2 Cond. Right Angle Header	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.13
	145A	CPM2003	J1			Cable Tie, 4"	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
!	146	CPR0425	J2	GG9		3 Amp Slow Blo	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.32
!	148	CPD1264	J2	GG7		2A, 600V Fast D., FR205-F	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.03
	149	CPD1255	F1	JJ7		18V, 1W Zener D., 1N4746A													M	N				R		U				c	0.05	
	150	CPC1003	J2	GG7		2,200pF ±20%, 1KV, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
!	151	CPD1264	J2	GG7		2A, 600V Fast D., FR205-F			C	D						I	J	K	L				Q		S	T				c	0.03	
	152	CPC1003	I2	GG7		2,200pF ±20%, 1KV, Ceramic			C	D						I	J	K	L				Q		S	T				c	0.02	
	152	CPR0050	I2	GG8		0Ω Jumper, CS=.40"	A	B			E	F	G	H					M	N	O	P		R			U			c	0.01	
	153	CPC1003	I2	GG7		2,200pF ±20%, 1KV, Ceramic			C	D						I	J	K	L				Q		S	T				c	0.02	

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A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch. Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
197	CPQ1307	E3	LL0	1.5A, 180V, NPN, 2SC4159E																			R		U				c	0.46	
197	CPR0050	E3	LL0	0Ω Jumper, 0.600" Long.					E	F	G	H	I	J	K	L								S	T				c	0.01	
198	CPR0033	D3	MM0	30Ω ±5%, 1/4W, CF																			R		U				c	0.01	
198A	CPD1264	D3	JJ5	2A, 600V Fast D., FR205-F																			R		U				c	0.03	
198A	CPR0050	D3	JJ5	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q			S	T				c	0.01	
199	CPD1252	D3	LL0	1A, 1KV Diode, 1N4007																			R		U				c	0.01	
200	CPR0050	D3	J	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
201	CPR0029	D3	BB2	200KΩ ±5%, 1/4W, CF																	O	P	Q		T			c	0.01		
202	CPR0050	D3	FF3	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
203	CPR0050	D3	FF1	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
204	CPR0050	D3	J	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
206	CPS1757	C4	CC1	12 Cond. Straight Header	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.25	
207	CPC1036	D4	CC4	.047uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.04	
208	CPR0009	D4	CC3	1KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
209	CPC1102	C4	DD2	100uF, 25V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.04	
210	CP11410	C4	CC3	Dual Comp. IC, LM393N	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.17	
211	CPR0050	C4	CC3	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
212	CPQ1301	C4	AA3	60V, .6A, PNP, PN2907A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.04	
213	CPD1250	B4	AA5	100mA, 200V Diode, FDH400	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.02	
214	CPR0050	C4	J	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
215	CPR0050	B4	J	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
216	CPR0050	B4	J	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
217	CPR0050	B4	J	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
218	CPR0050	B4	BB7	0Ω, Jumper Wire	A	C	D	E	F	G	H	I	J	K	L		N	O	P	Q		R	S	T	U			c	0.01		
218	CPR0129	B4	BB7	340Ω ±1%, 1/4W, MF		B											M											c	0.01		
221	CPR0050	A4	DD7	0Ω, Jumper Wire	A		C	D	E	F	G	H						N	O	P	Q		R	S	T	U			c	0.01	
222	CPR0050	A4	J	0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
223	CPR0140	A4	BB7	3.92KΩ ±1%, 1/4W, MF																			R		U			c	0.01		
223	CPR0144	A4	BB7	12.1KΩ ±1%, 1/4W, MF														N										c	0.01		
223	CPR0145	A4	BB7	15.8KΩ ±1%, 1/4W, MF			C	D											O	P	Q		S	T				c	0.01		
223	CPR0153	A4	BB7	20.0KΩ ±1%, 1/4W, MF	A				E	F	G	H																c	0.01		
225	CPD1252	A5	AA7	1A, 1KV Diode, 1N4007																			R		U			c	0.01		
225	CPR0000	A5	AA7	2.2Ω ±5%, 1/4W, CF					E	F			H	I	J	K	L											c	0.01		
225	CPR0003	A5	AA7	4.7Ω ±5%, 1/4W, CF							G																	c	0.01		
225	CPR0050	A5	AA7	0Ω, Jumper Wire	A		C	D												O	P	Q		S	T			c	0.01		
225	CPR0129	A5	AA7	340Ω ±1%, 1/4W, MF														N										c	0.01		
226	CPR0124	A5	AA7	75.0Ω ±1%, 1/4W, MF			C	D	E	F	G	H								O	P	Q			U			c	0.01		
226	CPR0125	A5	AA7	88.7Ω ±1%, 1/4W, MF	A																	R						c	0.01		
226	CPR0127	A5	AA7	205Ω ±1%, 1/4W, MF														N										c	0.01		
226	CPR0173	A5	AA7	64.9Ω ±1%, 1/4W, MF									I	J	K	L							S	T				c	0.01		
227	CPR0018	A5	BB5	62KΩ ±5%, 1/4W, CF		B																						c	0.01		
228	CPR0050	A5	CC5	0Ω, Jumper Wire, CS=.30"	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		R	S	T	U			c	0.01	
231	CPR0141	A5	DD7	4.42KΩ ±1%, 1/4W, MF																			R		U			c	0.01		
231	CPR0144	A5	DD7	12.1KΩ ±1%, 1/4W, MF														N										c	0.01		
231	CPR0145	A5	DD7	15.8KΩ ±1%, 1/4W, MF			C	D												O	P	Q		S	T			c	0.01		
231	CPR0153	A5	DD7	20.0KΩ ±1%, 1/4W, MF	A				E	F	G	H																c	0.01		
232	CPR0121	A5	CC7	57.6Ω ±1%, 1/4W, MF										I	J	K	L							T				c	0.01		
232	CPR0122	A5	CC7	105Ω ±1%, 1/4W, MF																		R						c	0.01		
232	CPR0124	A5	CC7	75.0Ω ±1%, 1/4W, MF	A			D																				c	0.01		
232	CPR0125	A5	CC7	88.7Ω ±1%, 1/4W, MF			C																		U			c	0.01		
232	CPR0127	A5	CC7	205Ω ±1%, 1/4W, MF														N										c	0.01		
232	CPR0173	A5	CC7	64.9Ω ±1%, 1/4W, MF					E	F	G	H							O	P	Q							c	0.01		
232	CPR0175	A5	CC7	69.8Ω ±1%, 1/4W, MF																								c	0.01		
232	CPR0182	A5	CC7	54.9Ω ±1%, 1/4W, MF																			S					c	0.01		
233	CPD1252	A5	CC7	1A, 1KV Diode, 1N4007																		R		U				c	0.01		
233	CPR0000	A5	CC7	2.2Ω ±5%, 1/4W, CF					E	F	G	H	I	J	K	L												c	0.01		
233	CPR0003	A5	CC7	4.7Ω ±5%, 1/4W, CF	A			D																				c	0.01		

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE	
233	CPR0050	A5	CC7	0Ω		Jumper Wire			C													O	P	Q		S	T				c	0.01	
233	CPR0129	A5	CC7	340Ω ±1%, 1/4W, MF																N												c	0.01
235	CPR0050	A5	BB7	0Ω		Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		S	T						c	0.01
236	CPR0050	A5	AA7	0Ω		Jumper Wire	A		C	D	E	F	G	H	I	J	K	L		N	O	P	Q		S	T						c	0.01
236	CPR0129	A6	AA7	340Ω ±1%, 1/4W, MF				B											M													c	0.01
237	CPQ1301	A6	BB7	60V, .6A, PNP, PN2907A																					R		U					c	0.04
238	CPQ1301	B5	CC7	60V, .6A, PNP, PN2907A																					R		U					c	0.04
239	CPR0010	B5	AA5	4.7KΩ ±5%, 1/4W, CF															M													c	0.01
239	CPR0013	B5	AA5	6.8KΩ ±5%, 1/4W, CF				B																								c	0.01
240	CPR0050	B5	J	0Ω		Jumper Wire																			R		U					c	0.01
241	CPI1409	B5	BB6	Video Input IC, XRC5346A			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	2.47
242	CPR0141	B4	CC6	4.42KΩ ±1%, 1/4W, MF																					R		U					c	0.01
242	CPR0144	B4	CC7	12.1KΩ ±1%, 1/4W, MF																N												c	0.01
242	CPR0145	B4	CC7	15.8KΩ ±1%, 1/4W, MF					C	D												O	P	Q		S	T					c	0.01
242	CPR0153	B4	CC7	20.0KΩ ±1%, 1/4W, MF			A				E	F	G	H																		c	0.01
243	CPD1252	B5	BB7	1A, 1KV Diode, 1N4007																					R		U					c	0.01
243	CPR0000	B5	BB7	2.2Ω ±5%, 1/4W, MF									G														T					c	0.01
243	CPR0003	B5	BB7	4.7Ω ±5%, 1/4W, CF						E	F		H	I	J	K	L															c	0.01
243	CPR0050	B5	BB7	0Ω		Jumper Wire	A		C	D												O	P	Q		S						c	0.01
243	CPR0129	B5	BB7	340Ω ±1%, 1/4W, MF																N												c	0.01
244	CPR0122	B5	BB5	105Ω ±1%, 1/4W, MF			A	B			E	F	G	H	I	J	K	L			O	P			S	T						c	0.01
244	CPR0132	B5	BB5	604Ω ±1%, 1/4W, MF				C	D									M	N			Q	R			U						c	0.01
245	CPR0132	C5	BB5	604Ω ±1%, 1/4W, MF			A	B			E	F	G	H	I	J	K	L			O	P			S	T						c	0.01
245	CPR0134	C5	BB5	1.21KΩ ±1%, 1/4W, MF				C	D									M	N			Q	R			U						c	0.01
246	CPR0009	C5	EE7	1KΩ ±5%, 1/4W, CF														M	N				R			U						c	0.01
246	CPR0029	C5	FF7	200KΩ ±5%, 1/4W, CF			A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T						c	0.01
247	CPR0016	C5	FF8	33KΩ ±5%, 1/4W, CF			A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T						c	0.01
248	CPR0011	C5	CC3	1.8KΩ ±5%, 1/4W, CF			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01
250	CPR0013	C5	CC3	6.8KΩ ±5%, 1/4W, CF			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01
251	CPR0013	C5	CC3	6.8KΩ ±5%, 1/4W, CF			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01
252	CPR0011	C5	CC4	1.8KΩ ±5%, 1/4W, CF			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01
253	CPD1251	D5	CC3	10mA, 75V Diode, 1N4148			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01
254	CPC1036	C5	FF8	.047uF ±5%, 50V, Film														M	N					R			U					c	0.04
254	CPQ1303	C5	FF8	30V, .6A, NPN, PN2222A			A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T						c	0.04
255	CPQ1303	C5	FF7	30V, .6A, NPN, PN2222A			A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T						c	0.04
256	CPR0029	C5	FF8	200KΩ ±5%, 1/4W, CF			A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T						c	0.01
257	CPR0019	C5	FF8	100KΩ ±5%, 1/4W, CF			A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T						c	0.01
257	CPR0011	C5	FF7	1.8KΩ ±5%, 1/4W, CF														M	N					R			U					c	0.01
258	CPR0131	C5	BB5	464Ω ±1%, 1/4W, MF			A	B			E	F	G	H	I	J	K	L			O	P			S	T						c	0.01
258	CPR0134	C5	BB5	1.21KΩ ±1%, 1/4W, MF				C	D									M	N			Q	R			U						c	0.01
259	CPC1101	C6	FF7	10uF, 50V, Electrolytic														M	N					R			U					c	0.03
260	CPR0130	C5	BB5	412Ω ±1%, 1/4W, MF			A	B			E	F	G	H	I	J	K	L			O	P			S	T						c	0.01
260	CPR0136	C5	BB5	1.62KΩ ±1%, 1/4W, MF				C	D									M	N			Q	R			U						c	0.01
261	CPR0050	B5	BB5	0Ω		Jumper Wire, 0.30" long.		B											M													c	0.01
261	CPR0145	B5	BB5	15.8KΩ ±1%, 1/4W, MF			A		C	D	E	F	G	H	I	J	K	L		N	O	P	Q	R	S	T	U					c	0.01
264	CPR0120	B5	BB7	100 Ω ±1%, 1/4W, MF			A																		R							c	0.01
264	CPR0124	B5	BB7	75.0Ω ±1%, 1/4W, MF																			Q		S							c	0.01
264	CPR0127	B5	BB7	205Ω ±1%, 1/4W, MF															N													c	0.01
264	CPR0152	B5	BB7	84.5Ω ±1%, 1/4W, MF				C	D	E	F	G	H								O	P					U					c	0.01
264	CPR0175	B5	BB7	69.8Ω ±1%, 1/4W, MF											I	J	K	L									T					c	0.01
266	CPQ1301	B5	CC7	60V, .6A, PNP, PN2907A																					R		U					c	0.04
266	CPR0050	B6	CC7	0Ω		Jumper Wire	A		C	D	E	F	G	H	I	J	K	L		N	O	P	Q		S	T						c	0.01
266	CPR0128	B5	CC7	301Ω ±1%, 1/4W, MF				B											M													c	0.01
267	CPC1102	B5	DD6	100uF, 25V, Electrolytic			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.04
268	CPD1251	B6	CC7	10mA, 75V Diode, 1N4148			A		C	D	E	F	G	H	I	J	K	L		N	O	P	Q	R	S	T	U					c	0.01
268	CPD1251	B6	CC7	1N4148 Diode, Reverse Polarity.				B											M													c	0.01
270	CPD1251	B6	BB7	10mA, 75V Diode, 1N4148			A		C	D	E	F	G	H	I	J	K	L		N	O	P	Q	R	S	T	U					c	0.01

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A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

[illegible]

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
	317	CPD1251	C7	EE7		10mA, 75V Diode, 1N4148																		R		U				c	0.01	
	318	CPC1036	C6	FF8		.047uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q	R	S	T	U				c	0.04
	318	CPR0050	C6	FF8		0Ω, Jumper Wire													M	N				R		U				c	0.01	
	319	CPD1251	C6	EE7		10mA, 75V Diode, 1N4148																		R		U				c	0.01	
	320	CPR0012	C7	FF7		2.7KΩ ±5%, 1/4W, CF																		R		U				c	0.01	
	321	CPR0013	C7	EE8		6.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q	R	S	T	U				c	0.01
	322	CPR0013	C7	EE8		6.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	323	CPR0015	C7	EE8		22KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	324	CPR0050	C7	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	325	CPR0011	C7	DD8		1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	326	CPR0004	D7	DD8		270Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	327	CPR0004	D7	EE9		270Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	328	CPR0050	D7	DD9		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	329	CPR0144	D6	EE4		12.1KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	330	CPR0004	D7	DD9		270Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	331	CPR0011	D7	DD9		1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
!	332	CPT1505	E7	NN1		Horizontal Drive Transformer	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.72
	333	CPD1252	D6	FF3		1A, 1KV Diode, 1N4007	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	334	CPC1103	E6	FF4		220uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.14
	336	CPR0012	E6	KK4		2.7KΩ ±5%, 1/4W, CF			C		E	F			I	J						P	Q		S	T				c	0.01	
	336	CPR0024	E6	KK4		3.3KΩ ±5%, 1/4W, CF															O									c	0.01	
	336	CPR0050	E6	KK4		0Ω Jumper Wire							G																	c	0.01	
	336	CPR0134	E6	KK4		1.21KΩ ±1%, 1/4W, MF				D					H		K	L												c	0.01	
	336	CPR0138	E6	KK4		2.15KΩ ±1%, 1/4W, MF	A	B										M	N					R		U				c	0.01	
	337	CPQ1307	E7	MM1		1.5A, 180V, NPN, 2SC4159E	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.46
	338	CPC1102	E7	LL1		100uF, 25V, Electrolytic	A	B	C	D	E	F	G	H				M	N	O	P	Q	R			U				c	0.04	
	338	CPC1103	E7	LL1		220uF, 50V, Electrolytic									I	J	K	L							S	T				c	0.14	
	340	CPR0390	F7	LL1		47Ω ±5%, 2W, MO									I	J	K	L												c	0.04	
	340	CPR0391	F7	LL1		200Ω ±5%, 2W, MO	A	B	C	D	E	F	G	H				M	N	O	P	Q	R			U				c	0.03	
	340	CPR0398	F7	LL1		100Ω ±5%, 2W, MO																			S	T				c	0.04	
	341	CPR0365	F7	LL0		470KΩ ±5%, 1/2W, CF									I	J	K	L												c	0.01	
	341	CPR0368	F7	LL1		2.2KΩ ±5%, 1/2W, CF	A	B	C	D								M	N	O	P	Q	R			U				c	0.01	
	341	CPR0371	F7	LL0		1KΩ ±5%, 1/2W, CF				E	F	G	H												S	T				c	0.01	
	342	CPD1252	F6	LL1		1A, 1KV Diode, 1N4007	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	343	CPC1003	F6	MM1		2,200pF ±20%, 1KV, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
	344	CPC1100	E6	II4		1uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.04
!	345	CPC1027	E6	JJ4		6,800pF ±5%, 100V, Film	A	B										M	N					R		U				c	0.07	
!	345	CPC1035	E6	JJ4		3,300pF ±5%, 100V, Film			C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T				c	0.08	
	346	CPC1032	E6	JJ4		.01uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.03
	347	CPC1100	E6	II4		1uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.04
	348	CPC1035	E6	II4		3,300pF ±5%, 100V, Film			C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T				c	0.08	
	348	CPC1027	E6	II4		6,800pF ±5%, 100V, Film	A	B										M	N					R		U				c	0.07	
	350	CPC1025	D6	HH4		330pF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.06
	351	CPC1025	D6	GG4		330pF ±5%, 50V, Film			C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T				c	0.06	
	351	CPC1026	D6	GG4		1,000pF ±5%, 100V, Film	A	B										M	N					R		U				c	0.07	
	352	CPC1000	D6	EE4		56pF ±5%, 100V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	353	CPR0145	D6	FF6		15.8KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	354	CPR0155	D6	GG6		68.1KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T				c	0.01	
	355	CPI1406	C6	FF7		Quad Comparator IC, LM339	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.18
	356	CPR0012	C6	FF7		2.7KΩ ±5%, 1/4W, CF				D	E	F	G	H	I	J														c	0.01	
	356	CPR0140	C6	FF7		3.92KΩ ±1%, 1/4W, MF	A	B	C								K	L	M	N	O	P	Q	R	S	T	U			c	0.01	
	357	CPR0009	C6	GG6		1KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T				c	0.01	
	357	CPR0050	C6	FF6		0Ω, Jumper Wire, CS=.30"												M	N					R		U			c	0.01		
	358	CPC1035	C6	GG7		3,300pF ±5%, 100V, Film	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T				c	0.08	
	358	CPR0050	C6	GG6		0Ω, Jumper Wire, CS=.40"												M	N					R		U			c	0.01		
	360	CPR0144	C6	GG6		12.1KΩ ±1%, 1/4W, MF																			S	T			c	0.01		
	360	CPR0145	C6	GG6		15.8KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J					O	P	Q							c	0.01	

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE		
	360	CPR0153	C6	GG6		20.0KΩ ±1%, 1/4W, MF											K	L													c	0.01		
	361	CPR0157	D6	HH2		127KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					c	0.01	
	362	CPR0171	D6	HH2		365KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H		J	K	L	M	N	O		Q	R	S	T	U					c	0.01	
	362	CPR0180	D6	HH2		309KΩ ±1%, 1/4W, MF									I							P									c	0.01		
	363	CPR0034	D5	HH2		2.2MΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H				M	N	O	P	Q	R	S	T	U						c	0.01	
	364	CPR0050	D5	EE6		0Ω, Jumper Wire												M	N				R			U						c	0.01	
	364	CPR0142	D5	EE6		7.15KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T						c	0.01	
	365	CPR0050	C5	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	366	CPR0142	D5	EE6		7.15KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T							c	0.01
	367	CPR0002	D5	FF3		18Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	368	CPR0011	D5	CC3		1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	369	CPC1005	E4	FF1		1,000pF ±10%, 500V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	370	CPR0015	D5	JJ2		22KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	371	CPR0029	D5	JJ1		200KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	372	CPR0029	D5	KK1		200KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	373	CPQ1303	D5	KK1		30V, .6A, NPN, PN2222A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.04
	374	CPC1032	D5	GG1		.01uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.03
	375	CPR0018	D5	GG1		62KΩ ±5%, 1/4W, CF										I	J	K	L			O	P									c	0.01	
	375	CPR0019	D5	GG1		100KΩ ±5%, 1/4W, CF																		R			U					c	0.01	
	375	CPR0157	D5	GG1		127KΩ ±1%, 1/4W, MF												M	N			Q										c	0.01	
	375	CPR0156	D5	GG1		93.1KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H											S	T							c	0.01
	376	CPC1102	D4	FF3		100uF, 25V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.04
!	377	CPA4265	E4	GG0		V. Deflection Boost																		S	T							c		
!	377	CPI1415	E4	GG0		V. Deflection IC, LA7838	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R			U						c	1.31
	378	CPM2028	F4	FF0		LA7838 Heat Sink.	A	B	C	D								M	N	O	P	Q											c	0.28
	378	CPM2028	F4	FF0		LA7838 Heat Sink.																	R			U						c	0.28	
	378	CPM2037	F4	FF0		LA7838 Heat Sink.																	R			U						c	0.12	
	378	CPM2121	F4	FF0		LA7838 Heat Sink.					E	F	G	H																		c	0.28	
	378	CPM2122	F4	FF0		LA7838 Heat Sink.					E	F	G	H																		c	0.30	
	378	CPM2141	F4	FF0		LA7838 Heat Sink.									I	J	K	L						S	T							c	0.68	
	379	CPQ1303	E4	BB2		30V, .6A, NPN, PN2222A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.04
	380	CPC1109	E4	II1		470uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.34
	381A	CPC1035	D4	HH1		3,300pF ±5%, 100V, Film				E	F	G	H	I	J	K	L							S									c	0.08
	382	CPD1252	E4	II1		1A, 1KV Diode, 1N4007	A	B	C	D								M	N	O	P	Q	R		T	U							c	0.01
	382	CPR0019	E4	HH1		100KΩ ±5%, 1/4W, CF				E	F	G	H	I	J	K	L																c	0.01
	382	CPR0158	E4	HH1		84.5KΩ ±1%, 1/4W, MF																		S									c	0.01
	383	CPR0029	E4	AA2		200KΩ ±5%, 1/4W, CF (CS=.45)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	384	CPR0015	E4	AA2		22KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	385	CPR0375	E4	HH2		.68Ω ±5%, 1W, MO																		S	T							c	0.02	
	385	CPR0376	E4	HH2		1.2Ω ±5%, 1W, MO	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R		U							c	0.02
	387	CPC1104	F3	KK6		1,000uF, 35V, Electrolytic																	R		U							c	0.22	
	388	CPR0019	F4	HH2		100KΩ ±5%, 1/4W, CF																	R		U							c	0.01	
	388	CPR0029	F4	HH2		200KΩ ±1%, 1/4W, CF															O	P										c	0.01	
	388	CPR0157	F4	HH2		127KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N			Q		S	T							c	0.01
	389	CPR0050	E4	BB2		0Ω, Jumper Wire, CS=.74"	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						c	0.01
	390	CPR0019	F4	II1		100KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		S	T							c	0.01
	390	CPR0157	F4	II1		127KΩ ±1%, 1/4W, MF																	R		U							c	0.01	
	391	CPC1043	F5	HH2		1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		S	T							c	0.16
	391	CPC1101	F5	HH2		10uF, 50V, Electrolytic																	R		U							c	0.03	
	392	CPR0011	F5	HH1		1.8KΩ ±5%, 1/4W, CF																	R		U							c	0.01	
	392	CPR0012	F5	HH1		2.7KΩ ±5%, 1/4W, CF	A	B			E	F	G	H	I	J	K	L			O	P	Q										c	0.01
	392	CPR0138	F5	II1		2.15KΩ ±1%, 1/4W, MF			C	D														S	T							c	0.01	
	392	CPR0141	F5	HH1		4.42KΩ ±1%, 1/4W, MF												M	N													c	0.01	
	393	CPR0050	E5	HH1		0Ω, Jumper Wire															O	P		S	T							c	0.01	
	393	CPR0155	E5	HH1		68.1KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H				M	N			Q	R		U							c	0.01	
	393	CPR0158	E5	HH1		84.5KΩ ±1%, 1/4W, MF									I	J	K	L														c	0.01	
	394	CPR0364	E5	NN3		100Ω ±5%, 1/2W, CF	A	B	C	D		F	G	H	I		K	L	M	N	O	P	Q	R	S	T	U					c	0.01	

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE		
394	CPR0390	E5	NN3			47Ω ±5%, 2W, MO					E																				C	0.04		
394	CPR0397	E5	NN3			33Ω ±5%, 2W, MO										J															C	0.03		
395	CPR0050	E5	II1			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					C	0.01	
396	CPR0003	E5	JJ1			4.7Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					C	0.01	
397	CPC1037	E5	JJ1			.1uF ±5%, 250V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					C	0.07	
398	CPC1009	E4	II1			100pF ±10%, 500V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					C	0.01	
399	CPC1058	D4	LL0			.1uF ±5%, 50V, Film																		R			U				C	0.05		
400	CPR0050	E4	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					C	0.01	
401	CPC1043	E5	HH1			1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					C	0.16	
402	CPR0017	E5	GG1			36K ±5%, 1/4W, MF																					T				C	0.01		
402	CPR0163	E5	GG1			28.0KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L							S							C	0.01	
402	CPR0154	E5	GG1			44.2KΩ ±1%, 1/4W, MF												M	N	O	P	Q	R			U					C	0.01		
403	CPR0019	E5	GG2			100KΩ ±5%, 1/4W, CF	A	B									L															C	0.01	
403	CPR0155	E5	GG2			68.1KΩ ±1%, 1/4W, MF									I	J	K				O	P				T					C	0.01		
403	CPR0156	E5	GG2			93.1KΩ ±1%, 1/4W, MF			C	D	E	F	G	H										R	S		U					C	0.01	
403	CPR0157	E5	GG2			127KΩ ±1%, 1/4W, MF												M	N			Q										C	0.01	
404	CPR0019	E5	KK1			100KΩ ±5%, 1/4W, CF			C	D					I	J																C	0.01	
404	CPR0146	E5	KK1			169KΩ ±1%, 1/4W, MF	A	B						H		K																C	0.01	
404	CPR0158	E5	KK1			36KΩ ±5%, 1/4W, CF																					T					C	0.01	
404	CPR0156	E5	KK1			93.1KΩ ±1%, 1/4W, MF											L							S								C	0.01	
404	CPR0157	E5	KK1			127KΩ ±1%, 1/4W, MF																		R			U					C	0.01	
405	CPD1251	E5	KK1			10mA, 75V Diode, 1N4148	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					C	0.01	
406	CPD1251	E5	JJ1			10mA, 75V Diode, 1N4148	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U					C	0.01	
407	CPR0019	E5	JJ1			100KΩ ±5%, 1/4W, CF								H		K	L			O	P											C	0.01	
407	CPR0146	E5	JJ1			169KΩ ±1%, 1/4W, MF																	Q									C	0.01	
407	CPR0157	E5	JJ1			127KΩ ±1%, 1/4W, MF			C	D																							C	0.01
407	CPR0158	E5	JJ1			84.5K ±1%, 1/4W, MF	A	B																									C	0.01
407	CPR0017	E5	JJ1			36KΩ ±5%, 1/4W, CF																		R		T	U					C	0.01	
407	CPR0155	E5	JJ1			68.1KΩ ±1%, 1/4W, MF									I	J																C	0.01	
407	CPR0018	E5	JJ1			62KΩ ±5%, 1/4W, CF																			S							C	0.01	
407	CPR0154	E5	JJ1			44.2KΩ ±1%, 1/4W, MF												M	N													C	0.01	
408	CPR0145	E5	JJ3			15.8KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.01
409	CPQ1301	D5	KK0			60V, .6A, PNP, PN2907A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.04
410	CPC1058	E5	GG2			.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.05
411	CPQ1303	D5	JJ1			30V, .6A, NPN, PN2222A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.04
412	CPR0029	D5	JJ0			200KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.01
413	CPR0029	D5	KK0			200KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.01
414	CPC1032	D6	II2			.01uF ±5%, 50V, Film	A	B										M	N	O	P	Q	R		T	U						C	0.03	
414	CPC1035	D6	II2			3,300pF ±5%, 100V, Film			C	D	E	F	G	H	I	J	K	L							S								C	0.08
! 415	CPI1400	E6	KK3			H. Control IC, LA7851	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	1.59
! 416	CPR0502	E6	II4			"I" PRA Horizontal Control	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.79
417	CPR0140	E5	KK3			3.92KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.01
418	CPR0140	E5	KK2			3.92KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.01
419A	CPR0050	F5	OO2			0Ω, Jumper, Normal Vertical.	A	B	C	D		F				J			M	N	O	P	Q	R	S	T	U						C	0.01
419B	CPR0050	F6	OO2			0Ω, Jumper, Normal Vertical.	A	B	C	D		F				J			M	N	O	P	Q	R	S	T	U						C	0.01
419E	CPR0050	F5	OO2			0Ω, Jumper, Reverse Vertical.					E		G	H	I		K	L															C	0.01
419F	CPR0050	F5	NN2			0Ω, Jumper, Reverse Vertical.					E		G	H	I		K	L															C	0.01
420	CPQ1307	E5	NN3			1.5A, 180V, NPN, 2SC4159E					E					J																	C	0.46
420	CPQ1308	E5	NN3			.1A, 200V, NPN, 2SC3467AE	A	B	C	D		F	G	H	I		K	L	M	N	O	P	Q	R	S	T	U						C	0.18
421	CPR0393	F6	MM2			390Ω ±5%, 2W, MO	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.03
422	CPR0050	F5	KK1			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.01
423	CPR0006	F5	OO3			510Ω ±5%, 1/4W, CF	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.01
424	CPR0004	F5	OO3			270Ω ±5%, 1/4W, CF	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.01
425	CPR0367	F5	OO3			150Ω ±5%, 1/2W, CF	A		C	D	E	F	G	H	I	J	K		M	N	O	P	Q	R	S	T	U						C	0.01
425	CPR0379	F5	OO3			68Ω ±5%, 1W, MO												L														C	0.03	
426	CPS1758	F5	OO2			.093" Dia. Bead Pin, YC1					E	F	G	H	I	J	K	L							S	T							C	0.02
426	CPS1759	F5	OO2			.062" Dia. Bead Pin, YC1	A	B	C	D									M	N	O	P	Q	R			U						C	0.01

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
	427	CPS1758	F5	002		.093" Dia. Bead Pin, YC2					E	F	G	H	I	J	K	L							S	T					c	0.02
	427	CPS1759	F5	002		.062" Dia. Bead Pin, YC2	A	B	C	D									M	N	O	P	Q	R			U				c	0.01
	428	CPR0365	F6	006		470Ω ±5%, 1/2W, CF	A	B	C	D			G					L				O	P								c	0.01
	428	CPR0367	F6	006		150Ω ±5%, 1/2W, CF					E	F		H	I	J	K							Q	R	S	T	U			c	0.01
	428	CPR0371	F6	006		1KΩ ±5%, 1/2W, CF													M	N											c	0.01
	430	CPR0050	F6	006		0Ω, Jumper Wire		B			D	E	F	G	H		K							Q	R	S		U			c	0.01
	430	CPT1506	F6	005		H. Linearity Inductor													M	N											c	0.74
	430	CPT1539	F6	006		H. Linearity Inductor	A																								c	0.61
	430	CPT1546	F6	005		27uH Inductor			C																						c	0.76
	430	CPT1557	F6	006		H. Linearity Inductor																O	P								c	0.77
	430	CPT1557	F6	005		H. Linearity Inductor (-3T)																				T					c	0.77
	430	CPT1566	F6	006		H. Linearity Inductor									I	J															c	0.63
	430	CPT1569	F6	005		H. Linearity Inductor												L													c	
	431	CPT1506	F6	006		H. Linearity Inductor													M	N											c	0.74
	431	CPT1517	F6	006		H. Linearity Inductor		B			D														R			U			c	0.77
	431	CPT1539	F6	006		H. Linearity Inductor	A		C														Q								c	0.61
	431	CPT1557	F6	006		H. Linearity Inductor																				T					c	0.77
	431	CPT1557	F6	006		H. Linearity Inductor					E	F		H							O	P			S						c	0.77
	431	CPT1565	F6	006		H. Linearity Inductor							G																		c	0.60
	431	CPT1566	F6	006		H. Linearity Inductor									I	J	K														c	0.63
	431	CPT1569	F6	006		H. Linearity Inductor												L													c	
	432	CPC1002	G6	006		330pF ±10%, 500V, Ceramic																			S						c	0.01
	432	CPC1006	F6	006		200pF ±10%, 1KV, Ceramic			C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R			T					

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
!	443	CPC1050	H6	PP7		.47uF ±5%, 250V, Film				D	E	F		H				L				P								c	0.31	
!	443	CPC1056	H6	PP7		.39uF ±5%, 250V, Film							G																	c	0.45	
!	443	CPC1059	H6	PP7		.33uF ±5%, 250V, Film													M	N										c	0.37	
!	443	CPC1062	H6	PP7		.56uF ±5%, 250V, Film															O		Q							c	0.50	
!	443	CPC1069	H6	PP7		1.5uF ±5%, 400V, Film	A	B																						c	0.79	
!	443	CPC1078	H6	PP7		1.6uF ±5%, 250V, Film									I	J														c	0.68	
!	444	CPC1042	H6	OO7		.68uF ±5%, 250V, Film	A										K	L												c	0.55	
!	444	CPC1050	H6	PP7		.47uF ±5%, 250V, Film																		R						c	0.31	
!	444	CPC1050	H6	OO7		.47uF ±5%, 250V, Film					E	F	G	H																c	0.31	
!	444	CPC1059	H6	PP7		.33uF ±5%, 250V, Film																			T					c	0.37	
!	444	CPC1062	H6	PP7		.56uF ±5%, 250V, Film																		S		U				c	0.50	
!	444	CPC1069	H6	OO7		1.5uF ±5%, 400V, Film		B																						c	0.79	
	445	CPS1758	G5	PP5		.093" Dia. Bead Pin, YC4					E	F	G	H	I	J	K	L							S	T				c	0.02	
	445	CPS1759	G5	PP5		.062" Dia. Bead Pin, YC4	A	B	C	D									M	N	O	P	Q	R			U			c	0.01	
	446	CPS1758	G5	OO5		.093" Dia. Bead Pin, YC3					E	F	G	H	I	J	K	L							S	T				c	0.02	
	446	CPS1759	G5	OO5		.062" Dia. Bead Pin, YC3	A	B	C	D									M	N	O	P	Q	R			U			c	0.01	
	447	CPT1538	G5	PP3		12 mH, H. Raster Shift Inductor	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.74	
	448	CPC1104	F4	MM2		1,000uF, 35V, Electrolytic															O	P		S						c	0.22	
	449	CPC1104	F4	MM2		1,000uF, 35V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S		U			c	0.22	
	449	CPC1113	F4	MM2		2,200uF, 25V, Electrolytic																			T					c		
	450	CPC1104	G4	KK6		1,000uF, 35V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.22	
	451	CPR0050	G4	NN1		0Ω, Jumper Wire			C	D											O	Q		S						c	0.01	
	452	CPR0050	G4	NN1		0Ω, Jumper Wire	A	B			E	F	G	H	I	J	K	L	M	N		P		R		T	U			c	0.01	
!	453	CPT1516	H5	OO2		31KHz, .75mA, FBT Meritron T-8090B			C	D											O	P	Q		S					c	12.78	
!	453	CPT1544	H5	OO2		15KHz, 1.5mA, FBT Meritron CT-8227													M	N				R			U			c	14.18	
!	453	CPT1555	H5	OO2		31KHz, .45mA, FBT Meritron CT-8819					E	F	G	H																c	13.13	
!	453	CPT1558	H5	OO2		15KHz, FBT Hitachi BW02651	A	B																						c	12.78	
!	453	CPT1561	H5	OO2		31KHz, FBT Meritron CT-8943									I	J	K	L												c	13.13	
!	453	CPT1568	H5	OO2		31KHz, FBT Meritron																			T					c	13.13	
	454	CPR0050	I6	OO7		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.01	
	456	CPC1044	I6	OO8		2.7uF ±10%, 100V, Film			C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q		S	T				c	0.37	
	456	CPC1064	I6	OO8		6.8uF ±5%, 100V, Film	A	B																	R		U			c	1.16	
	457	CPT1504	I7	OO7		750uH Horz. Width Inductor													M	N				R			U			c	0.76	
	457	CPT1528	I7	OO7		150uH Horz. Width Inductor	A	B	C	D											O	P	Q							c	0.74	
	457	CPT1560	I7	OO7		100uH Horz. Width Inductor					E	F		H											S	T				c	0.75	
	457	CPT1564	I7	OO7		70uH Horz. Width Inductor							G		I	J	K	L												c	0.58	
	458	CPT1511	J7	OO7		50uH Control Inductor	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.70	
	460	CPQ1315	J6	OO8		8A, 100V, Mos Fet, IRF520	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.41	
	461	CPR0006	J6	NN8		510Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.01	
	462	CPD1253	J6	NN7		1A, 600V, Fast D., 1N4937	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.02	
	463	CPC1005	J6	OO8		1,000pF ±10%, 500V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.01	
	464	CPR0365	J6	OO8		470Ω ±5%, 1/2W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.01	
	465	CPR0050	I6	PP1		0Ω Jumper Wire					E	F	G	H	I	J	K	L												c	0.01	
	465	CPR0352	I6	PP1		470Ω ±10%, 1/2W, CC	A	B	C	D									M	N	O	P	Q	R	S	T	U			c	0.06	
	466	CPR0050	I6	MM2		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.01	
	468	CPR0433	J5	EE9		24V coil, 200V @ .5A Relay	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T				c	0.83	
	470	CPR0352	J6	EE9		470Ω ±10%, 1/2W, CC	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T				c	0.06	
	473	CPR0050	G6	J		0Ω, Jumper Wire					E	F	G	H	I	J	K	L							T					c	0.01	
	475	CPR0374	H7	PP7		.10Ω ±5%, 1W, MO	A	B	C	D	E	F	G	H					M	N	O	P	Q	R			U			c		
	476	CPR0374	H7	PP7		.10Ω ±5%, 1W, MO	A	B	C	D	E	F	G	H					M	N	O	P	Q	R			U			c		
	477	CPD1266	H7	PP7		2A, 400V, Fast D., HER205	A	B	C	D	E	F	G	H					M	N	O	P	Q	R			U			c	0.07	
	478	CPD1266	H7	PP7		2A, 400V, Fast D., HER205	A	B	C	D	E	F	G	H					M	N	O	P	Q	R			U			c	0.07	
	480	CPR0050	G7	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			c	0.01	
	500	CPC1041	F4	NN4		.33uF ±5%, 50V, Film					E	F	G	H	I	J	K	L							T				c	0.08		
	501	CPR0009	G4	NN4		1KΩ ±5%, 1/4W, CF					E	F	G	H	I	J	K	L							T				c	0.01		
	502	CPR0050	G4	NN5		0Ω, Jumper Wire					E	F	G	H	I	J	K	L							T				c	0.01		
	503	CPR0017	G4	OO4		36K ±5%, 1/4W, MF																			T				c	0.01		

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A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE		
	503	CPR0151	G4	004		73.2KΩ ±1%, 1/4W, MF								H																	C	0.01		
	503	CPR0158	G4	004		84.5KΩ ±1%, 1/4W, MF					E	F	G		I	J	K	L														C	0.01	
	504	CPR0147	G4	004		1.00MΩ ±1%, 1/4W, MF					E	F	G	H	I	J	K	L								T						C	0.01	
	505	CPR0017	G4	004		36KΩ ±5%, 1/4W, MF					E	F	G	H																		C	0.01	
	505	CPR0018	G4	004		62KΩ ±5%, 1/4W, CF									I	J	K	L														C	0.01	
	505	CPR0145	G4	004		15.8KΩ ±1%, 1/4W, MF																			T							C	0.01	
	507	CPC1003	G4	PP3		2,200pF ±20%, 1KV, Ceramic					E	F	G	H	I	J	K	L							T							C	0.02	
	507	CPC1057	G4	PP3		1,000pF ±3%, 1.6KV, Film																			T							C	0.24	
	508	CPR0050	G5	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U						C	0.01
	509	CPQ1308	G4	004		.1A, 200V, NPN, 2SC3467AE					E	F	G	H	I	J	K	L							T							C	0.18	
	510	CPR0034	G5	004		2.2MΩ ±5%, 1/4W, CF					E	F	G	H	I	J	K	L							T							C	0.01	
	511	CPR0034	G5	004		2.2MΩ ±5%, 1/4W, CF					E	F	G	H	I	J	K	L							T							C	0.01	
	512	CPD1252	G5	PP4		1A, 1KV Diode, 1N4007					E	F	G	H	I	J	K	L														C	0.01	
	512	CPD12XX	G5	PP4		6A, 1,200V, BYD33U Diode																			T							C		
	514	CPR0029	G5	004		200KΩ ±5%, 1/4W, CF					E	F	G	H	I	J	K	L							T							C	0.01	
	515	CPC1002	H5	PP4		330pF ±10%, 500V, Ceramic					E	F	G	H	I	J	K	L							T							C	0.01	
	515	CPC1005	H5	PP4		1,000pF ±10%, 500V, Ceramic																			T							C	0.01	
	516	CPR0004	H6	006		270Ω ±5%, 1/4W, CF					E	F	G	H	I	J	K	L							T							C	0.01	
	517	CPC1037	H6	005		.1uF ±5%, 250V, Film					E	F	G	H	I	J	K	L															C	0.07
	517	CPC1068	H6	005		.01uF ±5%, 400V, Film																			T							C	0.07	
	518	CPT1556	I6	PP4		Dynamic Focus Transformer					E	F	G	H	I	J	K	L							T							C	0.86	
	520	CPR0352	J5	PP1		470Ω ±10																												

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A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

Δ	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
	811	CPR0510	N1	RR0		“K” PRA Video Amplifier	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	1.02
	812	CPQ1301	N2	SS2		60V, .6A, PNP, PN2907A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.04
	813	CPR0050	N2	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.01
	814	CPR0050	N2	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.01
	815	CPC1003	N2	VV5		2,200pF ±20%, 1KV, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.02
	816	CPC1058	N2	YY2		.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.05
	817	CPC1058	N1	UU2		.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.05
	818	CPC1003	P2	VV5		2,200pF ±20%, 1KV, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.02
	820	CPR0050	P2	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.01
	821	CPR0050	P2	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.01
	822	CPQ1301	P2	SS4		60V, .6A, PNP, PN2907A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.04
	823	CPC1037	P2	TT3		.1uF ±5%, 250V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.07
	824	CPC1040	P2	SS3		.015uF ±10%, 250V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.06
	825	CPR0127	P2	SS4		205Ω ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.01
	826	CPR0050	P2	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.01
	827	CPQ1301	P2	SS3		60V, .6A, PNP, PN2907A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.04
	828	CPQ1309	P2	SS3		.1A, 200V, PNP, 2SA1370AE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.23
	830	CPR0011	P2	TT4		1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.01
	831	CPR0011	N2	TT2		1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.01
	832	CPQ1301	N2	SS0		60V, .6A, PNP, PN2907A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				V	0.04
	833	CPQ1309	N2	SS0																												

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
!	854	CPC1076	N3	XX1		0.1uF ±5%, 200V, Film	A	B																						v.	0.28	
	855	CPR0371	N4	XX1		1KΩ ±5%, 1/2W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	856	CPR0366	N4	YY1		100KΩ ±5%, 1/2W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
!	857	CPC1034	N3	WW2		.022uF ±3%, 630V, Film									I	J	K	L													v.	0.08
!	857	CPC1037	N3	WW2		.1uF ±5%, 250V, Film																		R							v.	0.07
!	857	CPC1040	N3	WW2		.015uF ±10%, 250V, Film																			S	T					v.	0.06
!	857	CPC1046	N3	WW2		.047uF ±5%, 200V, Film	A	B																							v.	0.32
!	857	CPC1052	N3	WW2		.018uF ±5%, 200V, Film			C	D	E	F	G	H							O	P	Q								v.	0.07
!	857	CPC1074	N3	WW2		.068uF ±5%, 200V, Film													M	N							U				v.	0.14
	858	CPR0019	P3	YY3		100KΩ ±5%, 1/4W, CF																					U				v.	0.01
	858	CPR0146	P3	YY3		169KΩ ±1%, 1/4W, MF	A	B	C	D									M	N	O	P	Q	R	S	T					v.	0.01
	858	CPR0170	P3	YY3		294KΩ ±1%, 1/4W, MF					E	F	G	H	I	J	K	L													v.	0.01
	859	CPR0032	P4	YY2		30Ω ±5%, 1/4W, CF, Hairpin.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	860	CPC1106	P3	XX2		10uF, 200V, Electrolytic													M	N			R			U					v.	0.24
	861	CPR0050	P3	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	862	CPR0050	P4	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	863	CPS1772	P4	ZZ3		12 Cond. Video Cable, 12"	A	B	C	D	E	F	G	H						M	N	O	P	Q	R	S	T				v.	1.24
	863	CPS1849	P4	ZZ3		12 Cond. Video Cable, 17"									I	J	K	L									U				v.	1.40
	864	CPR0050	P4	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	865	CPR0050	P4	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	866	CPR0009	N4	YY3		1KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	867	CPR0050	N4	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	868	CPC1101	N4	VV2		10uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L					Q								v.	0.03
	868	CPC1110	N4	VV2		100uF, 50V, Electrolytic													M	N	O	P		R	S	T	U				v.	0.14
	869	CPR0050	M3	XX1		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	870	CPD1250	N4	VV2		100mA, 200V Diode, FDH400	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.02
	871	CPC1002	N4	WW1		330pF ±10%, 500V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	872	CPR0004	M4	VV2		270Ω ±5%, 1/4W, CF													M	N				R		U				v.	0.01	
	872	CPR0011	M4	VV2		1.8KΩ ±5%, 1/4W, CF					E	F	G	H	I	J	K	L												v.	0.01	
	872	CPR0024	M4	VV2		3.3KΩ ±5%, 1/4W, CF	A	B																						v.	0.01	
	872	CPR0141	M4	VV2		4.42KΩ ±1%, 1/4W, MF															O	P			S	T				v.	0.01	
	872	CPR0143	M4	VV2		10.0KΩ ±1%, 1/4W, MF			C	D													Q							v.	0.01	
	873	CPR0370	M4	WW1		10KΩ ±5%, 1/2W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	874	CPR0011	M4	VV1		1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	875	CPR0351	L4	YY2		150Ω ±10%, 1/2W, CC	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.06
	876	CPR0019	L4	VV1		100KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
!	877	CPS1850	L3	XX0		Dual Focus CRT Socket				E	F	G	H	I	J	K	L													v.	1.31	
!	877	CPS1852	L3	XX0		Single Focus CRT Socket	A	B	C	D									M	N	O	P	Q	R	S	T	U				v.	0.95
	878	CPC1003	L3	XX1		2,200pF ±20%, 1KV, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.02
	879	CPR0002	L3	XX2		18Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	880	CPR0351	L3	YY1		150Ω ±10%, 1/2W, CC	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.06
	881	CPR0368	M3	YY1		2.2KΩ ±5%, 1/2W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	882	CPR0351	L3	XX1		150Ω ±10%, 1/2W, CC	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.06
	883	CPR0365	L2	WW1		470Ω ±5%, 1/2W, CF	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T				v.	0.01	
	883	CPR0371	L2	WW1		1KΩ ±5%, 1/2W, CF													M	N			R			U				v.	0.01	
	884	CPR0012	K2	VV6		2.7KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	885	CPC1040	K3	SS6		.015uF ±10%, 250V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.06
	886	CPD1250	K3	VV0		100mA, 200V Diode, FDH400	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.02
	887	CPC1037	K2	TT6		.1uF ±5%, 250V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.07
	888	CPD1251	K2	VV6		10mA, 75V Diode, 1N4148	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	889	CPC1003	L2	WW6		2,200pF ±20%, 1KV, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.02
	890	CPR0009	K2	WW7		1KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	891	CPR0015	K2	VV6		22KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	892	CPC1101	L2	YY5		10uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.03
	893	CPR0050	L2	J		0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.01
	894	CPC1101	L2	YY5		10uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.03
	895	CPC1101	L2	YY4		10uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v.	0.03

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

A	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
899	CPD1250	N3	UU0			100mA, 200V Diode, FDH400	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.02
900	CPR0365	N3	WW0			470Ω ±5%, 1/2W, CF	A	B	C	D	E	F	G	H	I	J	K	L				O	P	Q	R	S	T				v	0.01
900	CPR0371	N3	WW0			1KΩ ±5%, 1/2W, CF													M	N				R		U				v	0.01	
901	CPC1040	N2	SS1			.015uF ±10%, 250V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.06
902	CPR0050	N2	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
903	CPD1252	N2	VV3			1A, 1KV Diode, 1N4007	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
904	CPR0050	M2	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
905	CPD1252	M2	WW3			1A, 1KV Diode, 1N4007	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
906	CPD1252	M2	WW3			1A, 1KV Diode, 1N4007	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
907	CPC1058	M2	WW4			.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.05
908	CPR0016	M2	YY4			33KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
909	CPR0024	M1	ZZ4			3.3KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
910	CPR0016	M2	YY5			33KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
911	CPR0016	M2	YY5			33KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
912	CPR0018	M2	ZZ4			62KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
913	CPC1037	N2	TT0			.1uF ±5%, 250V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.07
914	CPR0145	N1	ZZ4			15.8KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
915	CPR0050	N1	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
917	CPR0506	M1	WW4			"C" PRA, CRT Auto Bias	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.79
918	CPR0050	M1	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
920	CPI1405	M1	WW4			Quad OP Amp IC, LM324	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.24
921	CPC1058	M1	WW4			.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.05
922	CPC1036	M1	WW4			.047uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.04
923	CPC1058	L1	WW5			.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.05
924	CPC1036	L1	WW5			.047uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.04
925	CPC1058	L1	WW5			.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.05
926	CPC1036	L1	WW6			.047uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.04
927	CPI1402	L2	XX4			CRT Bias IC, CA3224E	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	3.47
928	CPQ1301	K1	WW7			60V, .6A, PNP, PN2907A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.04
930	CPC1058	K1	VV7			.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.05
931	CPR0011	K1	WW7			1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
932	CPR0050	L1	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
933	CPR0011	K1	WW7			1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
934	CPC1058	K1	RR7			.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.05
935	CPR0050	L1	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
936	CPR0050	K1	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
937	CPR0510	K1	RR5			"K" PRA Video Amplifier		B	C	D									M	N				R		U				v	1.02	
937	CPR0511	K1	RR5			"Blue" PRA Video Amplifier	A				E	F	G	H	I	J	K	L				O	P	Q	S	T				v	1.02	
938	CPR0011	K1	VV7			1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
940	CPR0140	K1	VV7			3.92KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
941	CPC1003	K1	VV4			2,200pF ±20%, 1KV, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.02
942	CPQ1302	K1	VV7			30V, .3A, PNP, D, MPSA64	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.06
943	CPQ1308	K2	SS7			.1A, 200V, NPN, 2SC3467AE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.18
944	CPR0050	K2	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
945	CPQ1301	K2	SS7			60V, .6A, PNP, PN2907A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.04
946	CPR0050	K2	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
947	CPR0050	K2	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
948	CPR0011	K2	TT7			1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
950	CPQ1301	K2	SS5			60V, .6A, PNP, PN2907A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.04
951	CPQ1309	K2	SS6			.1A, 200V, PNP, 2SA1370AE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.23
952	CPR0050	K2	J			0Ω, Jumper Wire	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
953	CPR0127	K2	SS6			205Ω ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
954	CPQ1309	K3	TT7			.1A, 200V, PNP, 2SA1370AE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.23
955	CPR0011	K3	TT7			1.8KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
956	CPC1005	K3	TT6			1,000pF ±10%, 500V, Ceramic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.01
957	CPC1043	K3	TT5			1uF ±5%, 50V, Film													M	N				R		U				v	0.16	
957	CPC1058	K3	TT5			.1uF ±5%, 50V, Film	A	B	C	D	E	F	G	H	I	J	K	L				O	P	Q	S	T				v	0.05	

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Δ Bd.#	Part No.	Bd. Sch. Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
958	CPD1250	K3	TT7	100mA, 200V Diode, FDH400	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			V	0.02
959	CPD1250	K4	WW0	100mA, 200V Diode, FDH400	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			V	0.02
961	CPS1758	K4	YY1	.093" Bead Pin, Dag. GND	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			V	0.02
	CPM2003	K4		Cable Tie, 4"	A	B	C	D					I	J		L	M	N	O	P	Q	R	S		U		V.	0.01	
	CPM2043			Video Board Cover	A	B	C	D		F	G		I	J	K	L	M	N	O	P	Q	R	S	T	U		V.	0.61	
	CPM2051			Video Board Insulating Sheet					E			H															V.	0.18	
! 971	CPS1766		ZZ0	1493, Degaussing Coil	A	B	C	D									M	N	O	P	Q						C	1.70	
! 971	CPS1771		ZZ0	2093, Degaussing Coil													M	N	O	P	Q						C	3.15	
! 971	CPS1786		ZZ0	2793, Degaussing Coil																		R	S	T			C	14.82	
! 971	CPS1828		ZZ0	1793, Degaussing Coil					E		G	H															C	2.42	
! 971	CPS1856		ZZ0	3693, Degaussing Coil																					U		C	15.14	
! 971	CPS1860		ZZ0	1993, Degaussing Coil									I	J	K	L											C	9.80	
	CPS1775			14" Grounding Strap	A	B	C																				C	0.33	
	CPS1791			20" Grounding Strap									I	J	K	L	M	N	O	P	Q						C	0.33	
	CPS1792			27" Grounding Strap																		R	S	T			C	0.77	
A	Solder Conn.	A6	AA9	Red Video, Input Line Filter.																							S		
B	Solder Conn.	B6	BB9	Green Video, Input Line Filter.																							S		
C	Solder Conn.	B6	BB9	Blue Video, Input Line Filter.																							S		
! CRT			17"	Chunghwa M41AJR53X46																							C		
! CRT			17"	Orion M41KXU100XX01																							C		
! CRT	CPP1703		20"	RCA A48AAB37X01 CRT. c												M	N										C	122.50	
! CRT	CPP1707		27"	RCA A68AEG25X07 CRT.																			S				C	300.30	
! CRT	CPP1708		27"	RCA A68AEG25X05 CRT. c																		R					C	288.75	
! CRT	CPP1711		14"	Chunghwa M34AFA13X07 CRT.cv	A	B	C	D													Q						C	87.50	
! CRT	CPP1717		20"	RCA A48AAB37X03 CRT.																							C	105.00	
! CRT	CPP1721		36"	RCA A90AEJ15X02 CRT. c																				U			C	918.75	
! CRT	CPP1724		20"	Chunghwa A48AGY13X87 CRT. v														O	P								C	101.50	
! CRT	CPP1725		19"	Samsung M46QCY261X112 CRT.								I	J	K	L												C	245.00	
! CRT	CPP1726		17"	Chunghwa M41AGE13X47R CRT.					E	F		H															C	140.00	
! CRT	CPP1727		17"	Samsung M41QCJ761X172 CRT.						G																	C	218.75	
! CRT	CPP1728		27"	Samsung M68QCP891X002 CRT.																			T				C		
	CPS1831			17" Grounding Strap					E	F	G	H															C	0.33	
	CPS1846			36" Grounding Strap																					U		C	0.79	
CS	Solder Conn.	A6	DD9	CSync Pin 1&2 of Conn.292																	R			U			S		
G	Solder Conn.	B5	BB5	Video, -Analog, Selection.																							S		
H	Solder Conn.	D5	KK1	Vertical linearity Adjustment.	A	B	C	D				H				M	N			Q		S					S		
I	Solder Conn.	D5	JJ1	Vertical linearity Adjustment.								I	J	K	L				O	P		R		T	U		S		
IA	Solder Conn.	D6	GG4	Reverse Horizontal Sync.	A	B	C	D	E			H	I	J	K	M			O	P	Q		S	T			S		
IC	Solder Conn.	E6	KK4	Horizontal Frequency Adj.						G												R					S		
ID	Solder Conn.	E6	KK4	Horizontal Frequency Adj.	A	B	C	D	E	F		H	I	J	K	L	M	N	O	P	Q		S	T	U		S		
J	Solder Conn.	A5	AA7	Video, +Analog, Red Gain.																P							S		
JC	Solder conn	D1	GG5	Power Supply V+ Adj.																P		R			U		S		
JD	Solder Conn.	D1	HH7	Power Supply V+ Adj.	A				E		G														U		S		
JE	Solder Conn.	E1	HH5	Power Supply V+ Adj.		B																					S		
K	Solder Conn.	B5	BB7	Video, +Analog, Green Gain.																							S		
L	Solder Conn.	A5	CC7	Video, +Analog, Blue Gain.																							S		
M	CPM2024			Front Support Bracket	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U		C	1.87	
M	CPM2025			Rear Support Bracket	A	B	C	D								M						R		T	U		C	0.18	
M	CPM2026			Right Support Bracket	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U		C	0.42	
M	CPM2029			Left Support Bracket	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U		C	0.42	
M	CPM2060			Rear Support Bracket					E	F	G	H	I	J	K	L		N	O	P	Q		S				C	0.26	
M	CPM2113	G6		H. Transistor Support	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U		C		
M	CPM2550	G6		H. Transistor Support Screw	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U		C		
M	CPM2551	G6		H. Transistor Support Screw	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U		C	0.03	
M	Solder Conn.	C6	DD9	Reverse Hs, AC Video Clamp.																							S		
N	Solder Conn.	C7	DD8	Reverse Hs, AC Video Clamp.																							S		
P	Solder Conn.	A5	AA5	Video, -Analog, Blue Offset.		B										M											S		

A	CPA4233, 1493-CGA	G	CPA4247, 1793-SVGA	M	CPA4112, 2093-CGA	S	CPA4231, 2793-VGA
B	CPA4235, 1493-CGA	H	CPA4250, 1793-SVGA	N	CPA4166, 2093-CGA	T	CPA4254, 2793-VGA
C	CPA4200, 1493-VGA	I	CPA4221, 1993-VGA	O	CPA4224, 2093-VGA	U	CPA4172, 3693-CGA
D	CPA4252, 1493-SVGA	J	CPA4255, 1993-VGA	P	CPA4227, 2093-VGA	V	ISO XFR-75W
E	CPA4243, 1793-VGA	K	CPA4249, 1993-SVGA	Q	CPA4108, 2093-VGA	W	ISO XFR-100W
F	CPA4244, 1793-VGA	L	CPA4256, 1993-SVGA	R	CPA4104, 2793-CGA	X	Vertical Deflection Booster

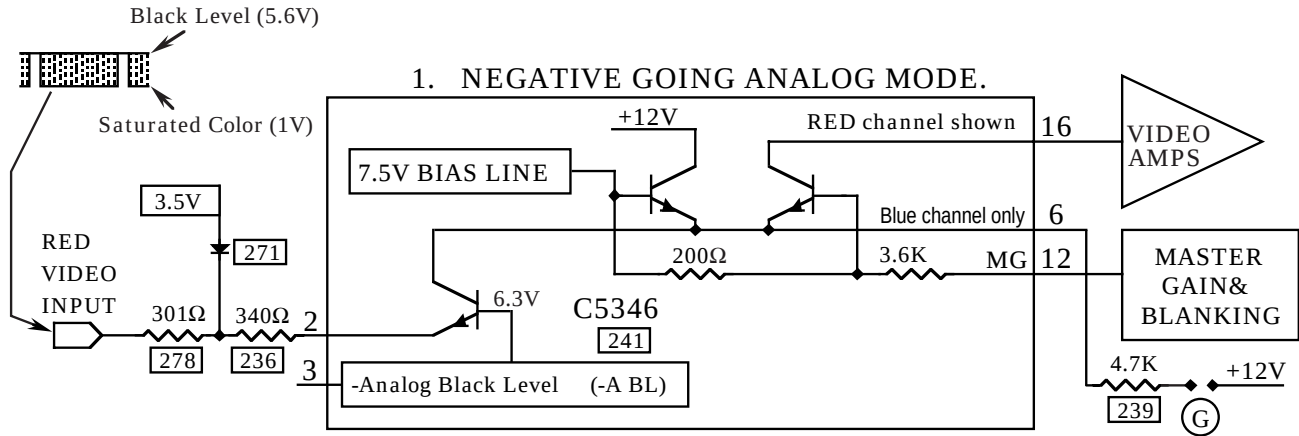
Δ	Bd.#	Part No.	Bd.	Sch.	Ref.	Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
Q		Solder Conn.	A2	NN7		Verrable Parabolic Pincushion Range.																									S	
R		Solder Conn.	C2	NN7		Verrable -Linear Pincushion Range.																									S	
S1		Solder Conn.	F5	PP3		Raster Shift, One Unit.											K						Q								S	
S2		Solder Conn.	F5	PP3		Raster Shift, Two Units.	A			D	E	F		H	I	J		L				P		R	S	T	U				S	
S4		Solder Conn.	F5	PP3		Raster Shift, Four Units.							G		I	J		L													S	
SL		Solder Conn.	G5	OO3		Raster Shift Left.							G		I	J	K	L				P		R	S	T	U				S	
SR		Solder Conn.	G5	OO3		Raster Shift Right.	A			D	E	F		H									Q								S	
S		Solder Conn.	C5	BB4		M. Gain Limit Adjustment.			C	D																					S	
T		Solder Conn.	C5	BB4		M. Gain Limit Adjustment.																									S	
TR		Solder Conn.	G2	JJ6		Cut pin1 of 166, solder pad 1&2.																					U				S	
U		Solder Conn.	C5	BB4		M. Gain Limit Adjustment.		B					G							N		Q									S	
V		Solder Conn.	D6	HH2		Vertical Frequency Adj.															O										S	
W		Solder Conn.	C3			Touch Screen -V Set.																									S	
V+	107					106V to 108V			C	D											O	Q									c	
V+	111					110V to 112V																P									c	
V+	114					113V to 115V																			S						c	
V+	124					123V to 125V																					U				c	
V+	127					126V to 128V													M	N				R		T					c	
V+	52.0					51.3V to 52.7V		B																							c	
V+	54.0					53.3V to 54.7V	A																								c	
V+	54.5					54V to 55V											K														c	
V+	55.5					55V to 56V										I	J														c	
V+	64.5					64V to 65V												L													c	
V+	70.0					69.5V to 70.5V					E	F																			c	
V+	72.5					72V to 73V							G																		c	
V+	77.5					77V to 78V								H																	c	
T500	CPB1606					ISO XFR PCB. .062", CEM-1.																					V	W			t	0.40
T501	CPR0050					0Ω, Jumper Wire																					V	W			t	0.01
T502	CPD1252					1A, 1KV Diode, 1N4007																					V	W			t	0.01
T503	CPD1267					TZL200B 200V ±5% .5W, Z.D.																					V	W			t	0.12
T504	CPR0016					33KΩ ±5%, 1/4W, CF																					V	W			t	0.01
T505	CPR0171					365K ±1%, 1/4W, MF																					V	W			t	0.01
! T506	CPR0425					3 Amp Slow Blow Fuse.																					V	W			t	0.32
T507	CPR0431					250VAC, 6Ω, 0.145A R. Fuse.																					V	W			t	0.55
T508	CPC1037					.1uF ±10%, 250V, Film																					V	W			t	0.07
T509	CPR0157					127K ±1%, 1/4W, MF																					V	W			t	0.01
T510	CPD1252					1A, 1KV Diode, 1N4007																					V	W			t	0.01
T511	CPD1252					1A, 1KV Diode, 1N4007																					V	W			t	0.01
T512	CPC1069					1.5uF ±5%, 400V, Film																					V	W			t	0.79
T513	CPC1110					100uF ±20%, 50V Electrolytic																					V	W			t	0.14
T514	CPQ1315					IRF520 100V, 8A Mos Fet.																					V	W			t	0.41
T515	CPD1257					1N4742A 12V ±5%, 1W,																					V	W			t	0.04
T516	CPD1269					P6KE27A 27V 600W, TVS																					V	W			t	0.23
! T517	CPC1011					2,200pF ±20%, 250VAC																					V	W			t	0.09
! T518	CPR0436					Relay; 8A, 250VAC, Coil; 24VDC																					V	W			t	1.30
! T518	CPR0437					10A, DPDT Voltage Select																					V	W			t	2.68
T519	CPR0050					0Ω, Jumper Wire																					V	W			t	0.01
T519	CPR0360					2.7Ω ±10%, 1W, CC Resistor.																					V	W			t	0.61
! T520	CPC1011					2,200pF ±20%, 250VAC																					V	W			t	0.09
TX	CPM2047					ISO XFR 75W Housing																					V				t	3.47
TX	CPM2146					ISO XFR 100W Housing																						W			t	
! TX	CPT1507					75W Isolation Transformer.																					V				t	14.88
! TX	CPT1553					100W Isolation Transformer																							W		t	28.44
! TX	CPS1830					Input Power Cable																					V	W			t	0.60
! TX	CPS1762					Output Power Cable																					V	W			t	0.51
TX	CPM2517					Vinyl Grommet																					V	W			t	0.08

VIDEO INTERFACE CIRCUIT, FUNCTION, DESCRIPTION (+ & - Analog).

The video interface circuit is a general purpose RGB type input circuit. This circuit connects the external video signal to the video amplifiers. It can accept, DC or AC coupled positive going analog, negative going analog, and 4 line TTL.

The particular mode of operation is selected by inserting jumpers, different value components, and solder bridges. The Production Assembly Drawings (PADs) are given in the appendix which describe the component differences.

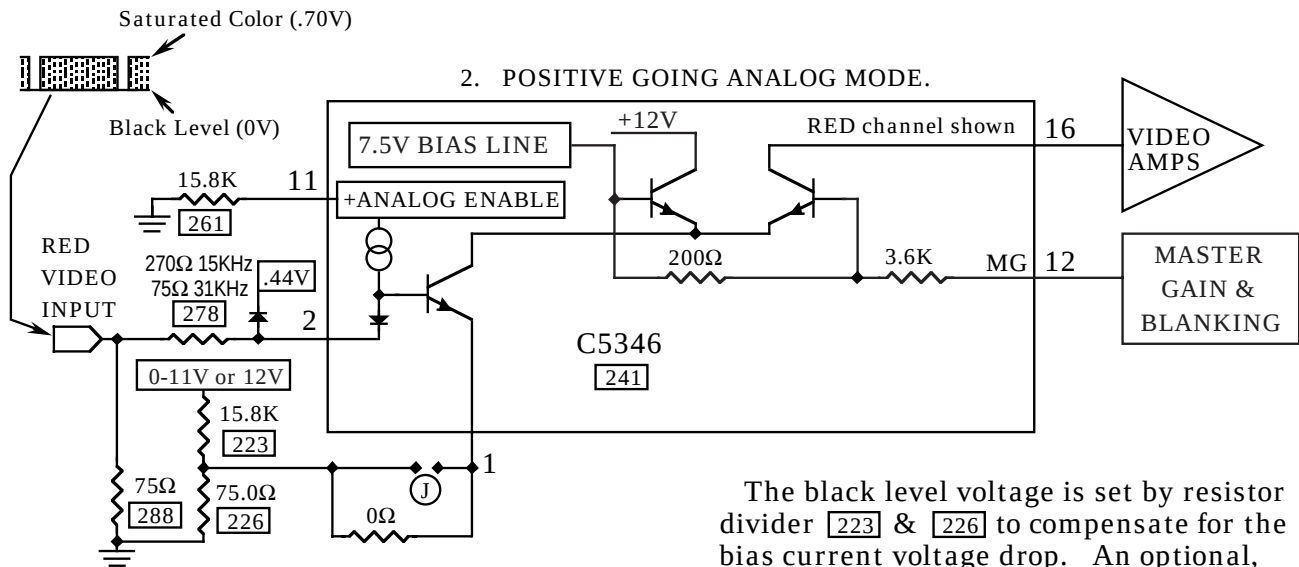
SIMPLIFIED VIDEO INTERFACE CIRCUIT:



In the negative analog mode, the video signal has a black level (5.6V) which is the -A BL voltage. The saturated color is the lowest input voltage (.9V-1.1V). The current amplitude to the video amplifiers is defined by resistors [278] & [236] and the master gain voltage.

For the blue channel only, 15% of the output current is subtracted by resistor [239]. Signal sources with 8 bit drivers, that use 2 bits for the blue channel use this 15% offset.

To prevent input line ringing from exceeding the saturated color voltage limit, a clamp diode [271] has been added.

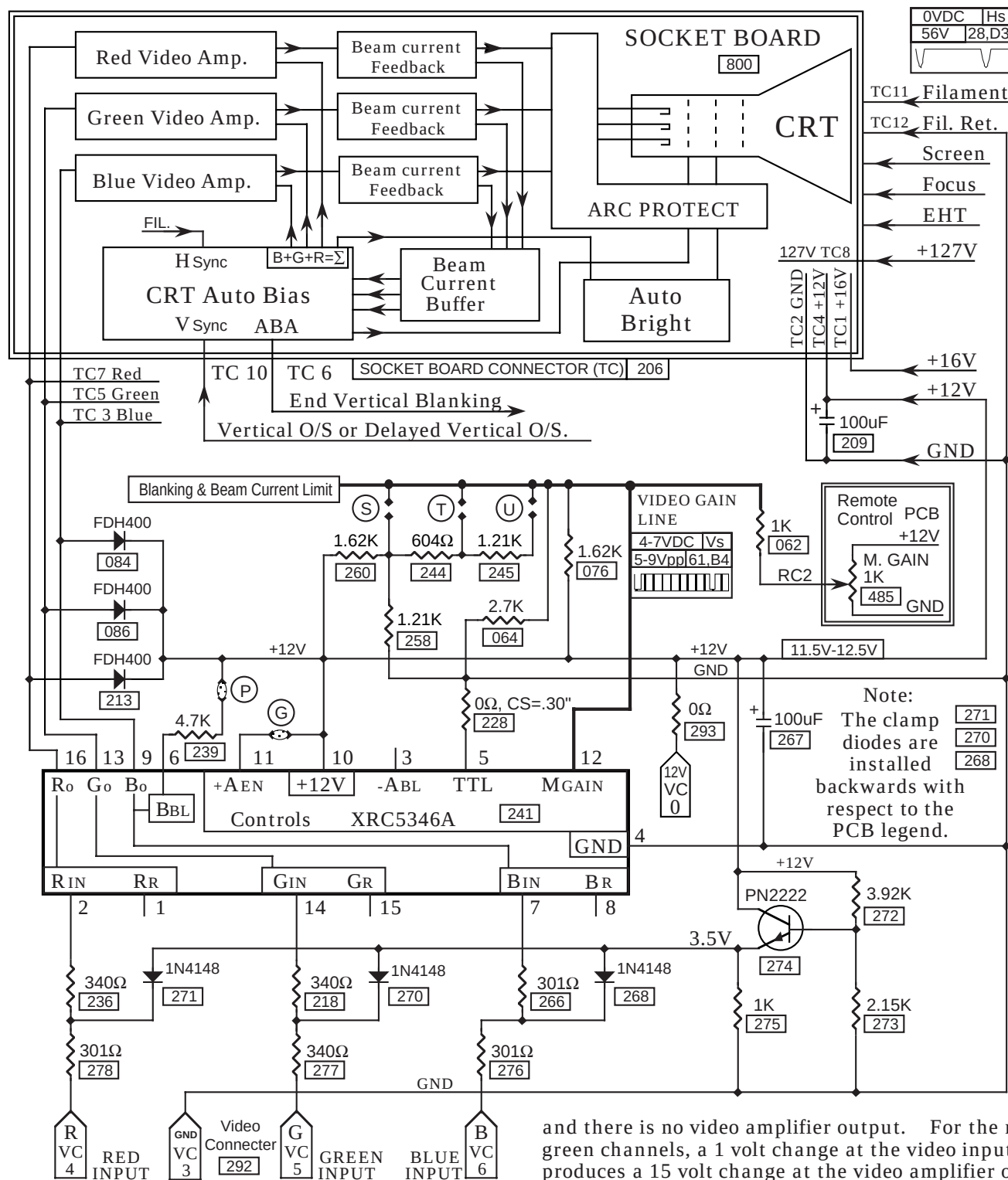


In the positive analog mode, a bias current of .6mA flows to the input pin 2. This current is set by resistor [261] at the +Analog Enable input pin 11. The .6mA produces a voltage, across the parallel resistance of the game and [288] plus resistor [278], at pin 2. If the external source resistance is 75 ohms, the black level voltage at pin 2 is .18V for 15KHz and .07V for the 31KHz.

The black level voltage is set by resistor divider [223] & [226] to compensate for the bias current voltage drop. An optional, variable black level, is accomplished with the black level adjustment pot.

The input termination resistor [288] reduces video line ringing and produces a dark screen when the video input connector is disconnected.

The normal saturated color is set at .70 volts. Higher saturated color levels can be accommodated with resistor or gain changes.



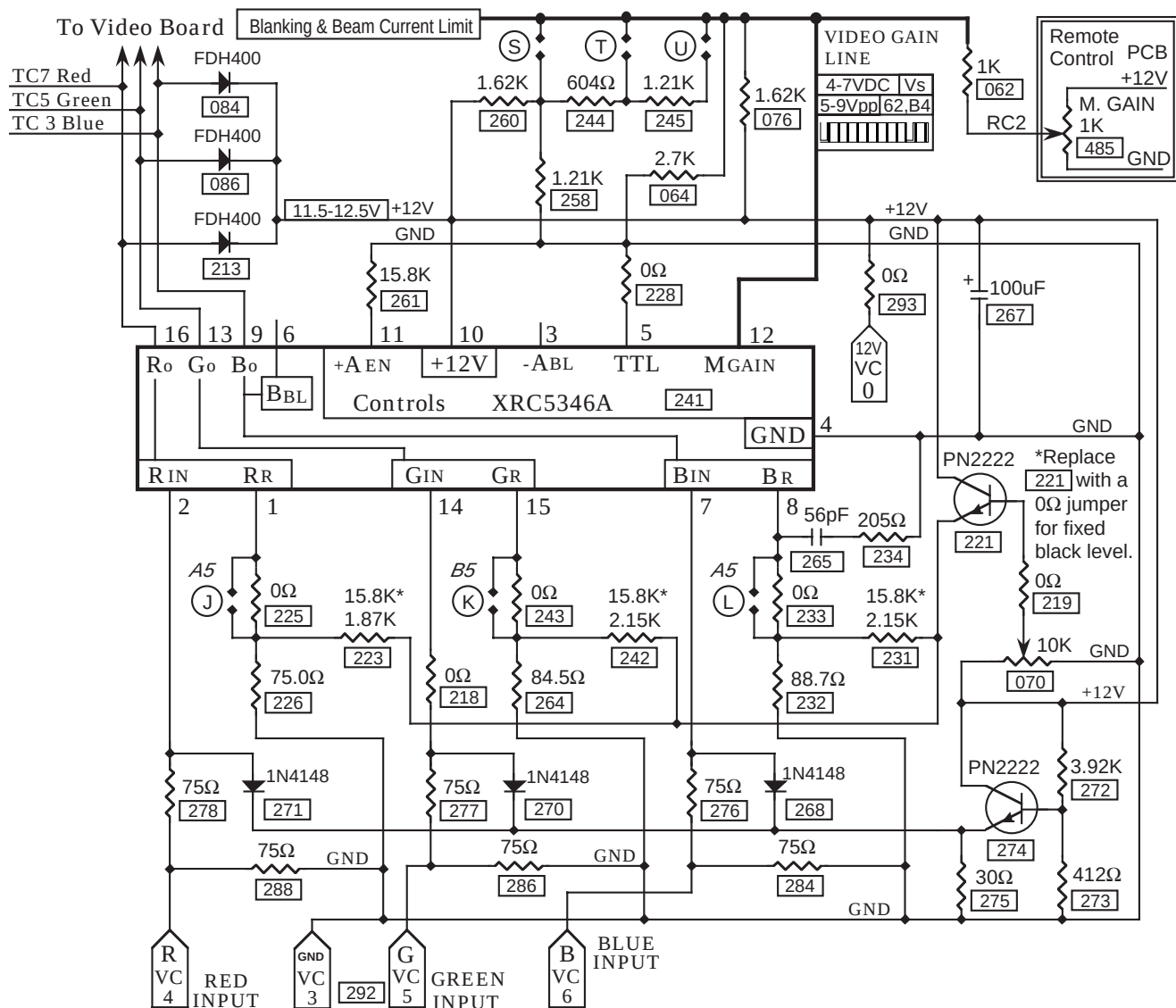
In each of the video interface circuit configurations, current from the interface circuit is converted to a voltage at the CRT cathodes. The simplest current path is accomplished by the negative analog video interface configuration.

The voltage drop across the input resistors [278] and [236], for the red channel, is the current which drives the video amplifiers when the video gain line is at 8.2 volts. For a lower gain line voltage, part of the current is directed to the +12 volt line. During blanking all the input current flows to the +12 volt line.

and there is no video amplifier output. For the red and green channels, a 1 volt change at the video input produces a 15 volt change at the video amplifier output. For the blue channel this change is 18 volts but resistor [265] subtracts the equivalence of .6 volts from the input which results in the same saturated color as the red and green channels.

The clamp diodes [271], [270], & [268] limit the maximum current to the video amplifiers. This avoids over driving the video amplifiers when undershoots at the input cables are present. The clamp reference voltage is set by resistors [272], [273], and buffer transistor [274]. Load resistor [275] stabilizes this buffered clamp voltage.

0V to .7V, POSITIVE ANALOG, DC COUPLED, VIDEO INTERFACE CIRCUIT DESCRIPTION.



For DC coupled positive analog video signals, the signal source black level is 0 volts. The standard saturated color voltages are .7 volt and 1 volt.

The RGB video signals and sync are connected to the monitor through the video input connector [292]. Resistors [288], [286], & [284] terminate the video lines and load the input such that, when no signal source is connected, the screen is dark.

Resistors [278], [277], & [276] protect the video interface IC [241] from transients. They also act as load resistors for the clamp diodes. The clamp diodes [271], [270], & [268] limit the peak amplitude of the video, to prevent overdrive of the video amplifiers. These diodes are connected to transistor [274] and load resistor [275]. The base to emitter voltage of the transistor [274] balances the clamp diode's forward voltage for temperature compensation. Resistors [272] and [273] set the clamp voltage.

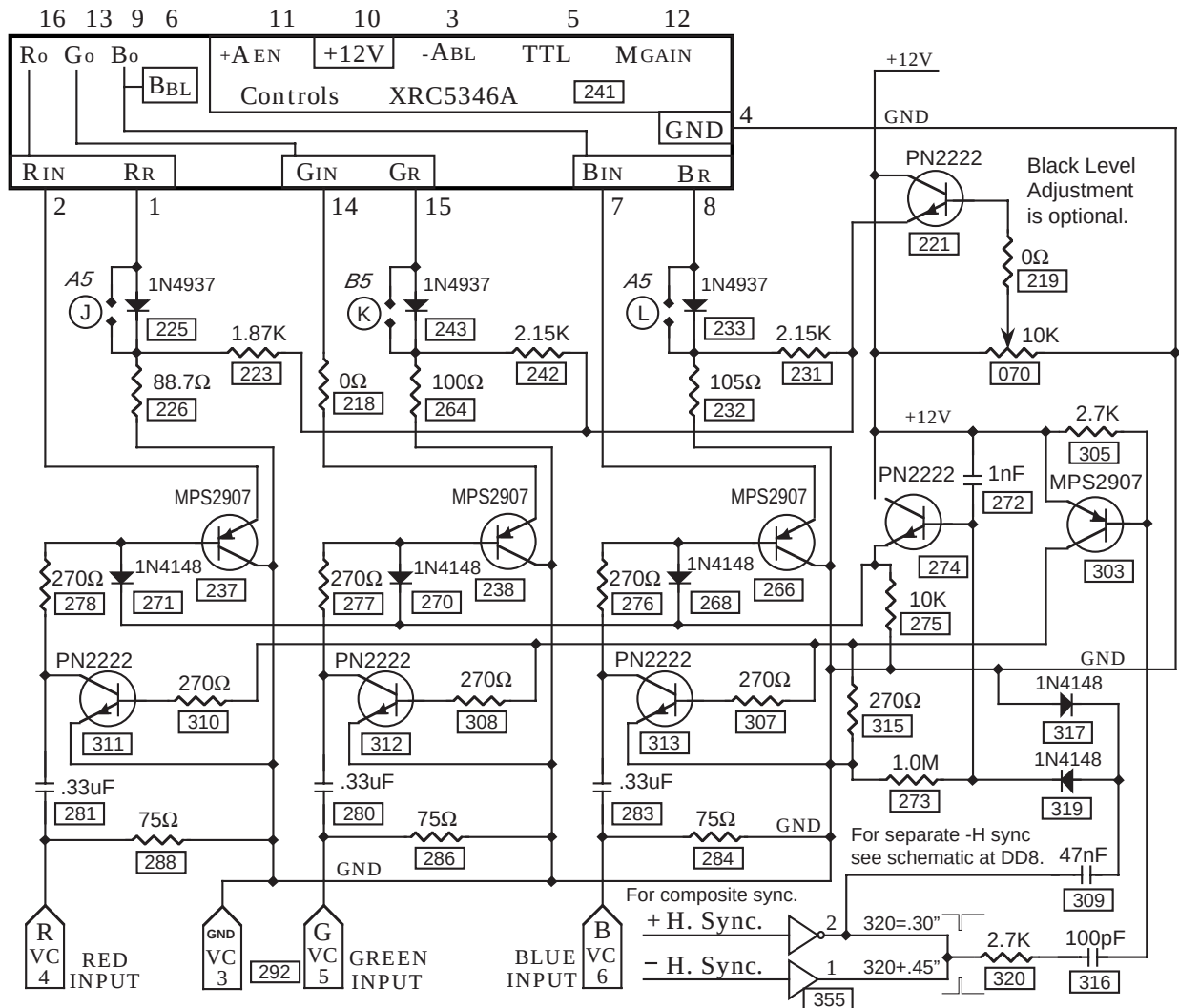
The gain of the input circuit is set by resistors [226], [264], & [232].

Resistors [223], [242], & [231] produce a voltage drop across the gain resistors to offset the voltage drop caused by the .6mA bias current across the input and protection resistors. +12 volts to these resistors produces a fixed black level. An optional black level adjustment may replace the +12V with a range of 0 volts to 11.3 volts. Potentiometer [070] is buffered by transistor [221] and resistor [219] which provide the adjustment voltage.

The master gain line is connected to the video interface IC [241] at pin 12. It multiplies the gain set by the gain resistors [225], [226], etc. by 0 to 1. Vertical and horizontal blanking set the gain to 0 during retrace. The gain is adjusted by the master gain control [485] through load resistor [062]. The maximum gain may also be limited by making solder connections (S), (T), & (U).

Diodes [084], [086], & [213] clamp the video lines connected to the video board to prevent damage to the video interface IC from arc related voltage spikes.

1Vp-p, POSITIVE ANALOG, AC COUPLED, VIDEO INTERFACE CIRCUIT DESCRIPTION.



In the + analog AC coupled mode, the video black level is set by a clamp circuit which is active during the first part of horizontal sync. For this circuit to work properly, the incoming video must be at the black level voltage when horizontal sync starts and remain blanked for at least 4.5uS.

The clamp circuit is dependent on the polarity of incoming horizontal sync. For separate horizontal sync, the sync polarity should be positive. For composite sync, and positive going horizontal sync pulses, resistor [320] (.30" long) is connected to the inverting horizontal sync comparator which is the same as separate, positive, horizontal sync. For composite sync, with negative going horizontal sync pulses, resistor [320] (.45" long) makes the connection to the noninverting vertical sync comparator. This connection is valid since the horizontal and vertical sync lines are connected together for composite sync.

The clamping function is accomplished by turning on transistor [303] at the start of horizontal sync through the differentiating action of capacitor [316] and resistors [305] & [320]. The collector of this transistor is connected to clamp transistors [311], [312], & [313] through resistors [310], [308], & [307] with pull down resistor [315]. The coupling capacitors [281], [280], & [283] at the video input are set to the black level voltage by the video source.

If the coupling capacitor voltage, on the clamped side, is high at clamp time, the clamp transistor shorts the capacitor to GND by normal transistor action. If the coupling capacitor voltage is low at clamp time the clamp transistors act as dual diodes to raise the capacitor voltage to GND, which is the black level reference for the video input circuit.

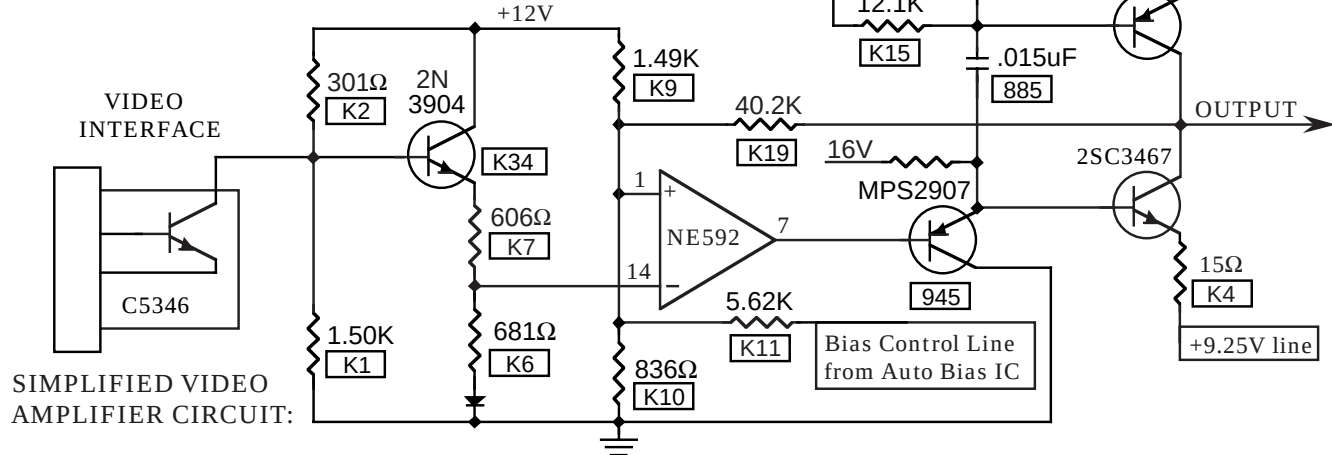
The ground referenced video signal is then buffered by transistors [237], [238], & [266] through protection resistors [278], [277], & [276]. The buffer transistors are needed to reduce the .6mA bias current, from the video interface IC, to under 10uA which limits the coupling capacitor voltage buildup to 2mV during one horizontal cycle.

Resistor [275] and clamp diodes [271], [270], & [268] are connected to the coupling capacitors to limit the voltage buildup when no sync is present. If this limit did not exist, the monitor would show excessive brightness without sync. When sync pulses are present, capacitor [309] with rectifier diodes [317] & [319] and filter capacitor [272] apply a voltage to the base of transistor [274] which raises the voltage on the clamp diodes to avoid interference with the video signal.

Diodes [225], [243], & [233] balance the base to emitter voltage of the buffer transistors. The rest of the video interface functions the same as the DC coupled video interface circuit.

VIDEO AMPLIFIER CIRCUIT, FUNCTION, DESCRIPTION.

The video amplifier, is a high speed push pull amplifier, which can swing as much as 90 volts. The maximum dynamic output swing is limited to 60 volts. The rest of the output voltage range is reserved for bias adjustment.



The video amplifier drive circuit is built on a ceramic substrate which is a good heat sink. The printed resistors and conductors are small and have precise geometries which output a faithful reproduction of the input signal with good high frequency response and low overshoot.

The NE592 is a 120MHz emitter coupled differential amplifier which is connected to a push pull output stage. This output stage has a low bias current of 3mA and a bandwidth of 25MHz. Although at 25MHz, the output stage current increases to 15mA.

VIDEO AMPLIFIER CIRCUIT DESCRIPTION

The video amplifier's output voltage, with no input signal, is the black level which is the picture tube cut off voltage. This voltage is set, for each of the three video amplifiers, by the auto bias circuit via the bias control line. This black level voltage has a range of 80V to 110V.

The voltage swing at the output is 60 volts for a 10 mA current signal from the C5346. For this same 10 mA current signal, the voltage swing at the video amplifier input is 1.5 volts and the input voltage swing at the NE592 is .80 volts. The reason for using the voltage divider [K6] and [K7] is that the C5346 minimum output voltage is 7.7 volts, and the bias voltage at the NE592 input is 5.3 volts.

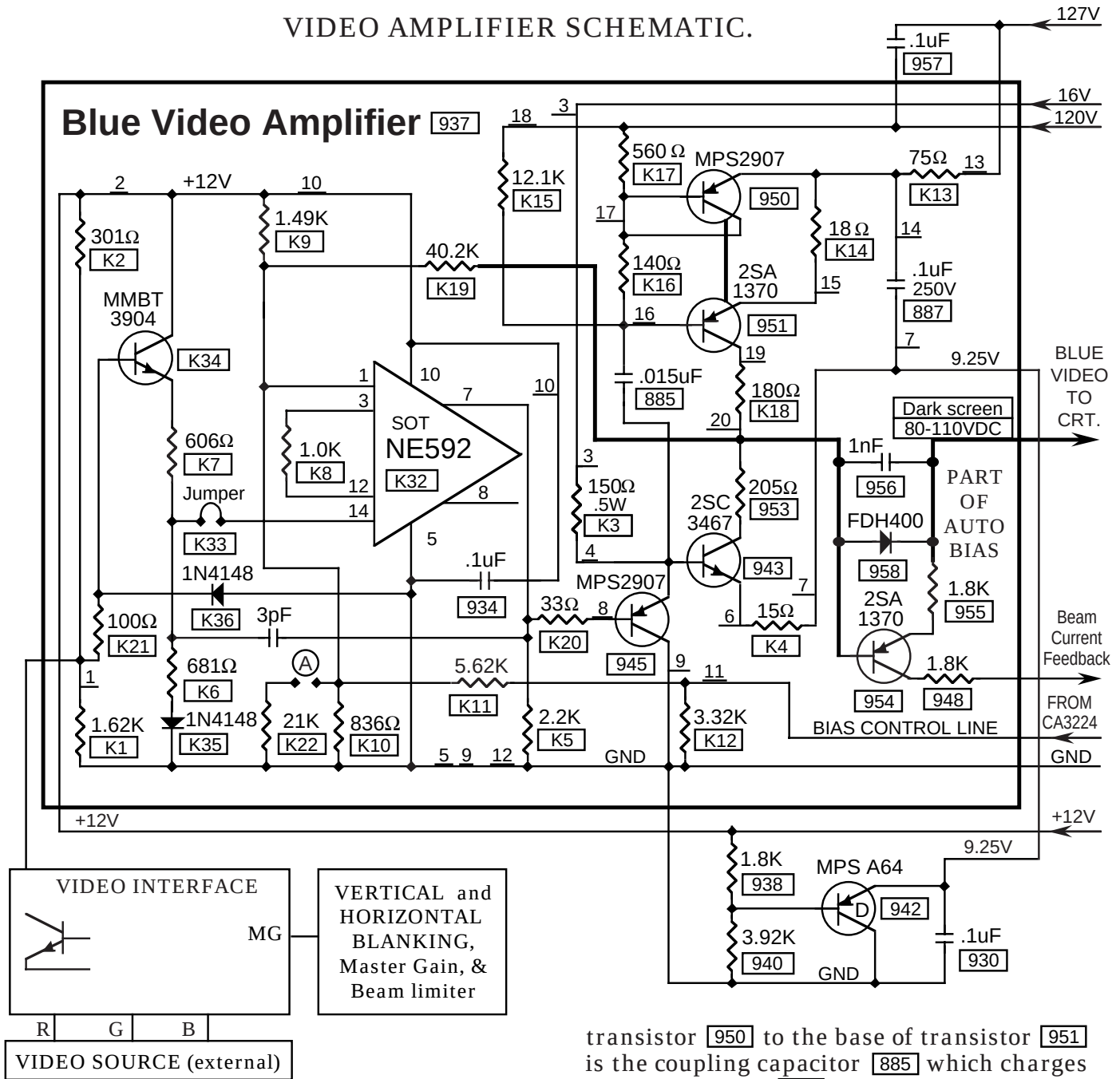
The input signal is buffered by a NPN transistor [K34] for low input capacitance. Resistors [K1] and [K2] set the black level input voltage at 10 volts. Resistor [K21] (see schematic next page) and diode [K36] protect the input against arc related transients. Resistors [K6] and [K7] are used to set the input bias voltage for the NE592. Diode [K35] acts as a temperature compensator to match the emitter to base diode in the buffer transistor.

The negative feedback circuit consists of bias resistors [K9], [K10] and output feedback resistor [K19]. The geometry of the feedback circuit defines the AC negative feedback path. The autobias output, which adjusts the black level voltage, is also connected to this node through resistor [K11]. Solder connection (A) connects resistor [K22], which raises the video amp. output voltage by 10V, for some CRTs.

The voltage gain of the differential amplifier [K32] is set by resistor [K8]. The output of the amplifier has a load resistor [K5] for faster low going transitions and is buffered by a PNP transistor [945] with base matching resistor [K20]. The load resistor for this buffer amplifier is [K3] which is connected to the 16 volt line.

The buffered output of the differential amplifier is DC coupled to the NPN transistor [943] and AC coupled, by capacitor [885], to the PNP transistor [951] of the push-pull output stage. Resistors [K18] and [953] protect the push-pull transistors from current spikes caused by voltage transients when CRT arcing occurs.

VIDEO AMPLIFIER SCHEMATIC.

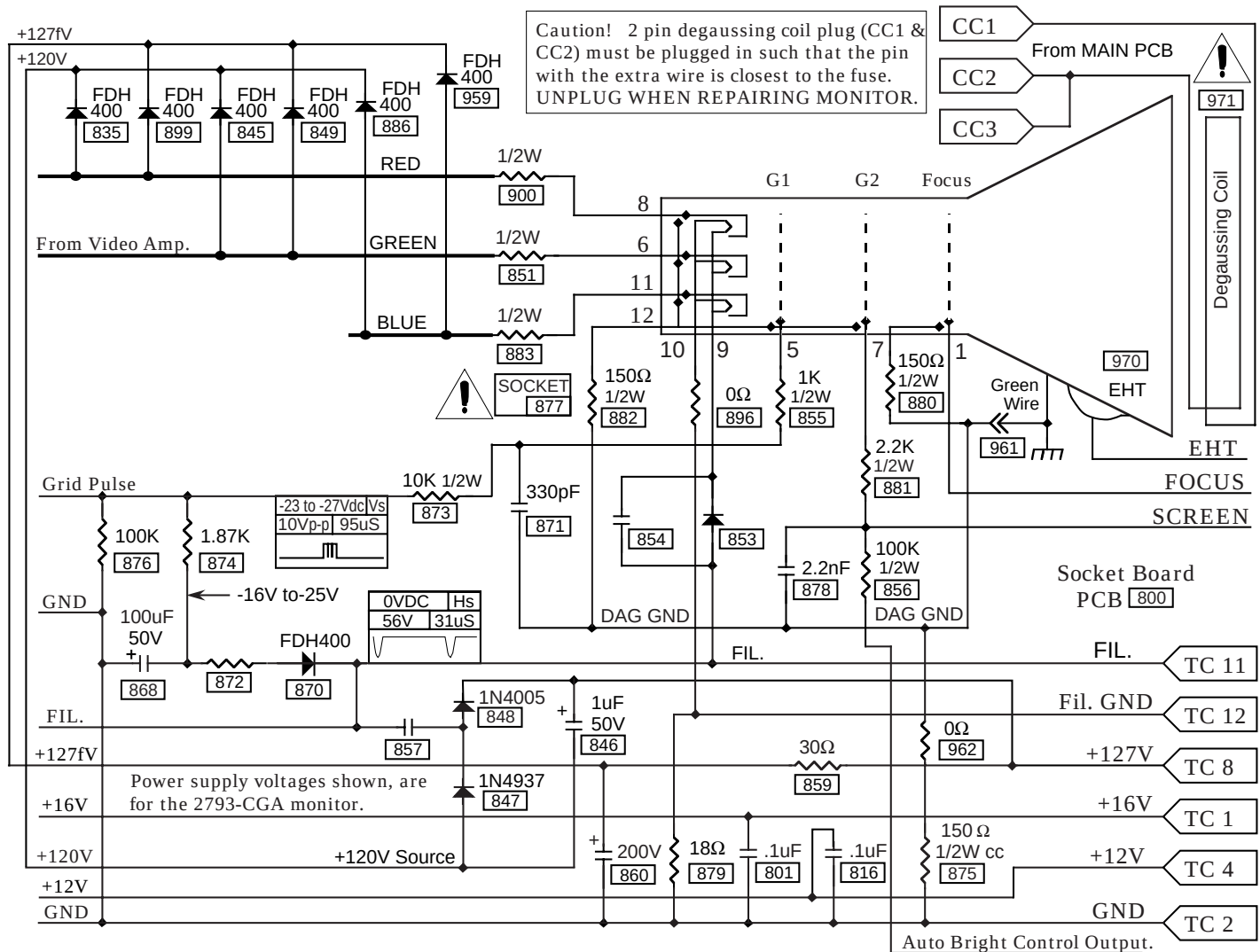


The bias current of the push-pull output stage is set by resistors [K14], [K15], [K16], [K17], and diode connected transistor [950]. Transistor [950] is thermally connected to transistor [951] to maintain the same base to emitter voltage drop. Note that resistor [K17] adds 11mA to the diode connected transistor [950]. This current is available to drive the base of transistor [951] during periods of high frequency amplification. This high base current is needed because, the beta of transistor [951] is low for high current pulses and when high frequency is amplified many high current pulses occur. The mechanism for transferring the current from

transistor [950] to the base of transistor [951] is the coupling capacitor [885] which charges through resistor [K16] on the positive part of the signal and discharges through the base of transistor [951] on the negative part of the drive signal. Therefore the output stage, bias current, is frequency dependent and has a range of 3mA to 15mA.

Resistor [K13] and capacitor [887], which are connected to the 9.25 volt line, decouples the video amplifier current pulses from the 127V line. The 9.25 volt line is connected to the emitter of the NPN push-pull transistor by resistor [K4]. This voltage establishes the output voltage of the NE592 in the middle of it's ± 2 volt drive range. The 9.25 volt line is regulated by darlington transistor [942] with voltage divider resistors [938] & [940].

VIDEO BOARD POWER SUPPLY AND ARC PROTECT SCHEMATIC.



The high voltage in the CRT, through an arc, can be conducted to any tube socket connection on the video board. To reduce the danger of these arcs causing component failure, a number of arc current paths are provided. The tube socket has integral spark gaps which conduct arc current to the tube ground (aquadag), through dissipation resistor [882]. The clamping voltage of the spark gaps to the cathodes and G1 is about 1.5KV.

The peak arc current to the video amplifier outputs is limited by resistors [900], [851], & [883]. Each amplifier output is connected to two clamp diodes [835], [899], [845], [849], [886], & [859] to provide a current return to ground via the power supply filter capacitors [175] & [860]. The grid pulse drive to G1 is protected by a low pass filter made up of elements [855], [871], & [873]. Resistors [881], [856] and capacitor [878] also form a low pass filter for the G2 to auto bright control output connection.

A dissipation resistor [880] is connected to the focus spark gap to match the impedance of the aquadag connection. This reduces reflections and helps dissipate the arc energy. Resistor [879] supplies an additional ground path for arc energy.

G1 is connected to a negative voltage to increase the cutoff voltage which reduces the dot size and produces a sharper picture. This negative voltage is generated by rectifying the negative peaks of the filament flyback pulse with diode [870], filter capacitor [868], and resistor [872]. Resistor [872] is used to adjust the negative G1 voltage for different FBTs. Resistor [876] provides a fixed load to stabilize the -G1 voltage. The grid pulse is developed across load resistor [874] by a PNP transistor.

The 120 volt line, which is also generated by the filament voltage, is used to supply the video amplifier output bias current. Capacitor [857] translates the GND referenced filament flyback pulse to the 127 volt line. Rectifier diodes [847] & [848] and filter capacitor [846] generate the V+ minus 7 volt supply. Capacitor [857] is also used to adjust this voltage for different FBTs.

The filament voltage is adjusted by capacitor [854] and diode (or resistor) [853].

Resistor [859] and capacitor [860] decouples the video amplifiers from the 127 volt line. This filter is needed, in some models, to eliminate video amplifier distortion caused by ripple current on the V+ line. This ripple current is caused by the, V+ minus 7 volt line, power supply.

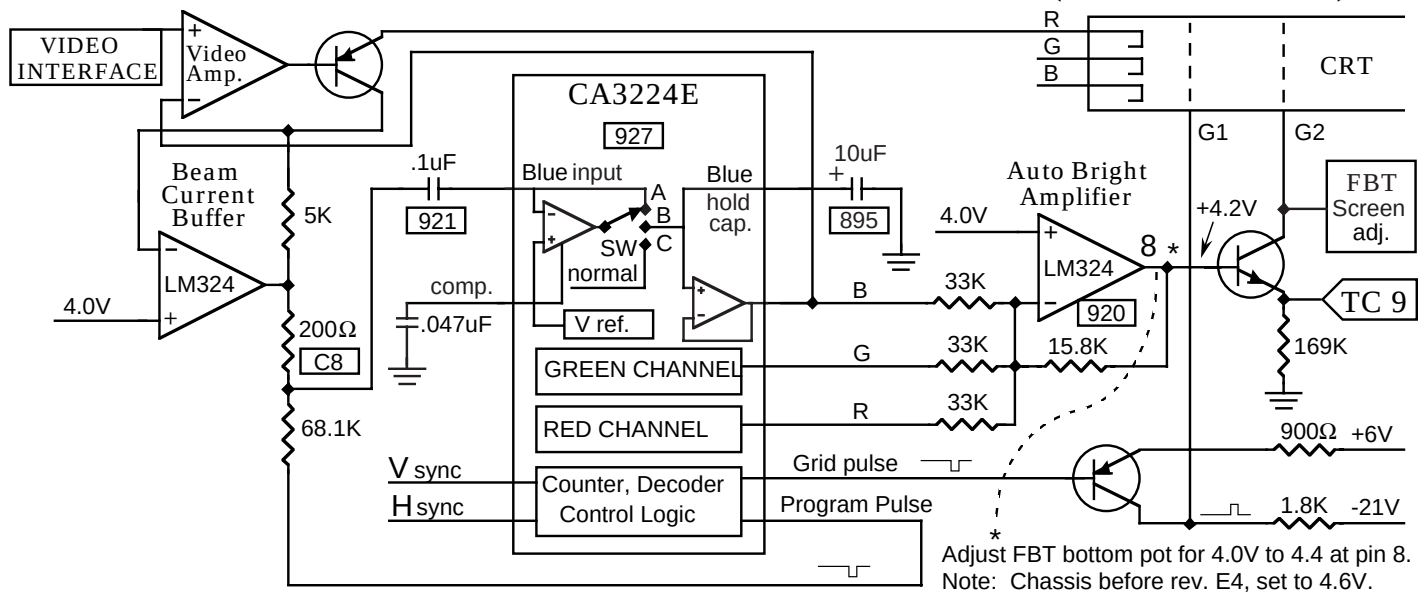
CRT AUTO BIAS AND AUTO BRIGHT CIRCUIT, FUNCTION, DESCRIPTION.

The auto bias circuit is a control system that forms a closed loop for controlling the CRT bias voltage. It generates a set of conditions where the current near the cutoff voltage of each gun is measured, and then adjusts the bias voltage of the video amplifiers, to set the correct black level voltage for each gun. This color balance adjustment is necessary, since each gun in the color picture tube can have a different cutoff voltage, which also, will change as the CRT ages.

If the picture tube gain changes, the auto

bias circuit would adjust all three guns in the same direction to maintain constant black level. This effect reduces the auto bias voltage range which is needed for the cathode differential voltage adjustment. To prevent this occurrence a second control loop is added to the system. This second control loop is called the auto bright circuit and corrects for CRT gain changes. The auto bright circuit senses any common bias voltage change and controls the screen grid (G2) to hold the common bias voltage constant.

SIMPLIFIED PICTURE TUBE VIDEO BIAS CONTROL CIRCUIT: (One channel shown)



The auto bias circuit performs all of its sensing and bias corrections during the sixteenth to the twenty first horizontal cycle, after the vertical sync pulse. Before the sixteenth cycle, the SW in the auto bias IC is open (SW in "C" position).

During the 16,17, and 18 horizontal cycle, the CRT is brought out of cutoff by the grid pulse. The resulting beam current produces a voltage at the beam current buffer output. This voltage is applied to the coupling capacitor [921]. At the other side of the coupling capacitor is the channel input, which is clamped to V ref. (SW in "A" position). The voltage amplitude of the amplifier output with the cathode current information is then stored in the coupling capacitor [921] during this time.

During the next three horizontal cycles (19, 20, and 21), the SW is switched to pass current to capacitor [895] which is the bias voltage storage capacitor. At the same time a program pulse is applied to resistor [C8]

which, if the bias was correct during the previous cycle, exactly balances the voltage stored in the coupling capacitor and no difference is sensed at the channel input. The channel amplifier, in this case, does not output current and the voltage of capacitor [895] stays unchanged.

If the CRT cathode is too far into cutoff, less beam current flows at the grid pulse time. This causes the beam current buffer to output a smaller negative pulse and less voltage is stored in the coupling capacitor. The program pulse amplitude (which is constant) is now larger than the stored (beam current) voltage and the channel amplifier will add current to the, bias voltage, storage capacitor [895] thus correcting the low bias voltage which caused the cathode to be too far into cutoff. After the program pulse is over, the SW is switched to the open position again and the next time the bias voltage can be adjusted is during the next vertical blank time.

CRT AUTO BIAS AND AUTO BRIGHT CIRCUIT DESCRIPTION.

The beam current feedback circuit uses a PNP video transistor [954] to direct most of the beam current to the auto bias circuit while passing the voltage waveform, from the video amplifiers to the CRT cathodes. Diode [958] and capacitor [956] insure that no video waveform distortion occurs. An additional benefit of this circuit is that it protects the video amplifiers from the destructive arc energy. Resistors [948] and [955] divide energy due to CRT arcing, between the video amplifier transistors and the beam current feedback transistor [954]. The beam current is filtered by capacitor [941] and resistor [C10] and is buffered by an operational amplifier, which translates the beam current into a low impedance voltage. This voltage is applied to a coupling capacitor [921] through a 200 ohm resistor [C8].

The 200 ohm and the 68.1K resistor [C3] forms the program value which sets the black level voltage via the action of the program pulse.

Capacitor [922] is used to stabilize the transconductance amplifier which is used at the channel input of the auto bias IC [927]. The auto bias IC stores the bias voltage of this channel in capacitor [895] at pin 21. This voltage is buffered by an internal amplifier, with output at pin 20, which is connected to the Blue video amplifier bias control input.

Resistor [908], [910], and [911] are part of the auto bright circuit. They are used to sum the bias voltage of each of the three channels via a voltage node at the auto bright amplifier, [920] pin 9. The resulting output voltage then controls the screen grid via transistor [850]. Resistor [881] protects the CRT grid from excessive current during arcing. Capacitor [878] supplies a low AC impedance to GND to insure that the CRT gain is constant during each horizontal line. Resistor [858] and [914] defines the current gain of, and stabilizes, the auto bright control loop.

Load resistor [909] eliminates crossover distortion from the OP Amp. [920]. Resistor [852] and [856] protects the transistor and OP Amp. from damage due to CRT arcing.

PNP transistor [928] is used as a voltage translator to direct the grid pulse from the auto bias IC to G1. The voltage on G1 is normally -15 to -27 volts depending on which CRT is used. When the grid pulse at pin 11 is low, the current from resistor [933] is conducted to resistor [874] and produces a 10 volt pulse on the minus G1 line. Capacitor [871] and resistors [855] & [873] protect transistor [928] from CRT arcing.

The auto bias IC (CA3224E) is designed for a supply voltage of +10V and since the video amplifier requires +12V, three diodes [903], [905], and [906] are used to supply this IC. Resistors [C4] and [C7] form a voltage divider which supplies the, auto bright, bias voltage to the LM324 [920]. The green and blue channel circuits are identical to the red channel and are controlled by the timing logic in the same way.

Refer to the waveforms at the bottom left of page 34 for the timing relationship. The vertical retrace boost pulse, from the LA7838, (15KHz models) or the delayed vertical sync pulse from the sync delay circuit (25 & 31KHz models) starts the 21 count auto bias state counter. This pulse is applied to the auto bias IC through resistor [891]. The negative going flyback pulse which is used to heat the filament also supplies the horizontal sync to the auto bias IC via diode [884] and resistor [888]. The grid pulse becomes active between the 15 and 18 horizontal cycle and the program pulse is active between the 18 and 21 horizontal cycle. These two pulses in conjunction with the internal control of the transconductance amplifier output switch are what establish the timing for the measurement and setting of the video bias.

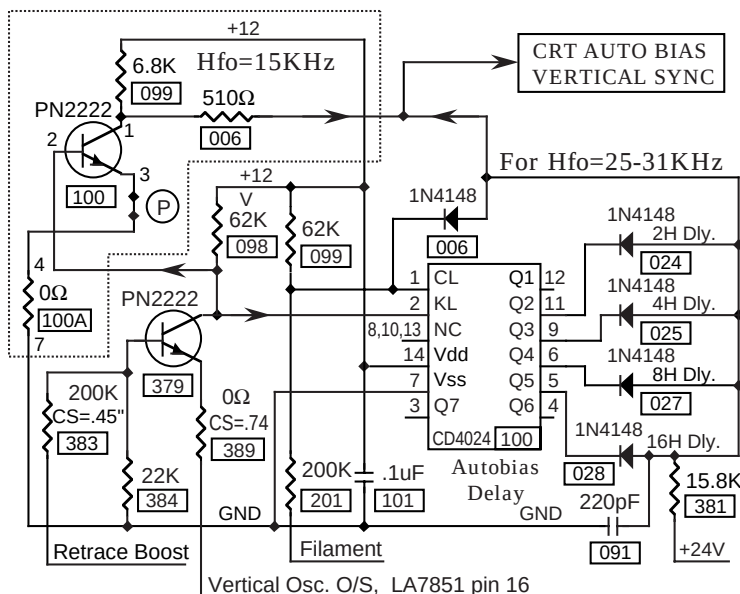
CRT AUTO BIAS, VERTICAL SYNC CIRCUIT DESCRIPTION.

The auto bias vertical sync comes from a buffer circuit for 15KHz operation. For 31KHz operation this signal is generated by a delay counter. For both cases, the vertical boost pulse is "and" connected with the Vertical Osc. O/S to provide flicker free operation and laser beam protection. In the case of vertical deflection failure, the loss of the boost signal causes the auto bias vertical sync to stop, which stops the auto bias function, and blanks the screen via the vertical blanking circuit, thus providing for laser beam protection.

The vertical oscillator one shot (LA7851 pin 16) supplies the start timing for the auto bias vertical sync. This signal is conducted to the emitter of [379] by jumper [089]. The base of [379] is connected to the retrace boost pulse by resistor divider [383] and [384]. Combining these signals in this way produces a collector waveform which has the vertical oscillator one shot timing and is dependent on the retrace boost pulse.

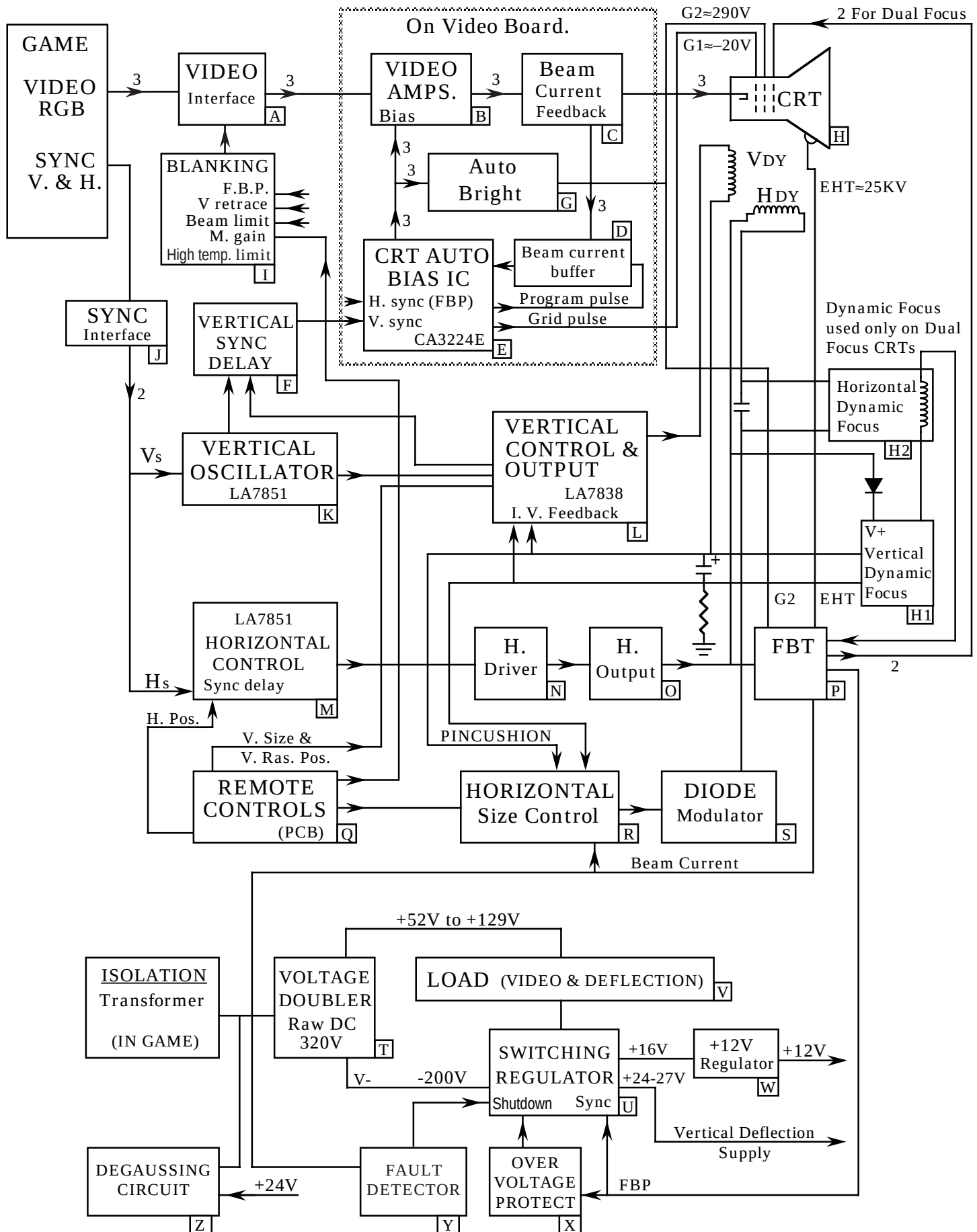
For the 15KHz case, transistor [100] inverts the vertical oscillator one shot signal to produce the CRT auto bias vertical sync signal. Resistor [099] is the pullup and resistor [006] reduces the chance of arc damage to the transistor.

For the 31KHz case, the vertical oscillator one shot signal is directed to the clear of the 7 bit counter [100]. This O/S time out must occur after the autobias delay time out and come before the bias active pulse from the CA3224E. When the clear is low, the counter counts horizontal pulses, by the clock connected voltage divider [099] and [201]. When the counter outputs ones at each diode connected output, further counts are inhibited by diode [006] and pullup [381]. This diode "or" signal is also used for the CRT auto bias vertical sync. The delay is set to locate the grid pulse generated 3 faint lines at the top of the screen with full vertical deflection. Capacitor [091] produces a delay to avoid a race condition between the counter clock and the auto bias horizontal sync.



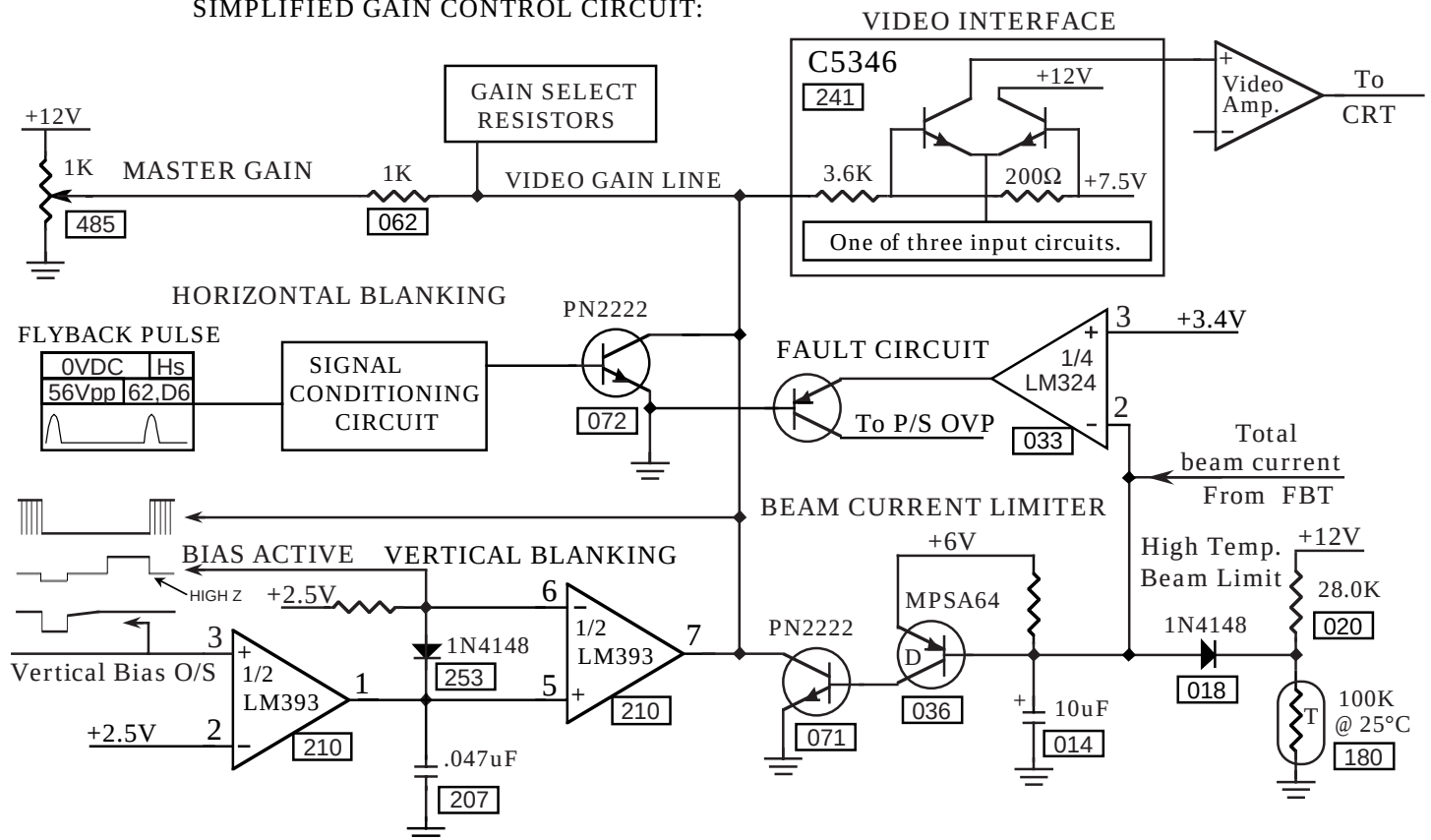


Monitor, Block Diagram Review.



BLANKING, MASTER GAIN, AND FAULT CIRCUIT, FUNCTION, DESCRIPTION.

SIMPLIFIED GAIN CONTROL CIRCUIT:



Blanking in this monitor is accomplished by reducing the video gain to zero during the vertical and horizontal blank time. During video time, the gain is set by the master gain control which is located on the remote control PCB. If the overall beam current exceeds .75mA or 1.5mA (depending on model) for more than ten frames, the beam current limiter circuit will reduce the video gain to protect the FBT. A high temperature sensor, close to the FBT, will also reduce the beam current if the high temperature limit (70°C) is exceeded.

The fault circuit senses the temperature or beam current line and will turn off the monitor if either of these signals exceeds the beam current shut off value. If an abnormal condition exists in the monitor or the cooling system of the enclosure fails, the high temperature sensor will activate the fault circuit at 80°C. The fault circuit is also turned on when the beam current becomes large enough to damage the FBT. This condition will happen if the video bias supply (V+ -9V) on the video board fails. An OP Amp. is used to sense the fault condition and a transistor is used to transmit the fault signal down to the power supply.

The video P-P voltage amplitude at the cathodes, is the video input signal amplitude times the master gain control setting times the video amplifier gain. The gain select resistors set the maximum video gain via the master gain line. For a greater range of brightness, (highlighting) the video system is allowed to supply high peak video currents which could damage the FBT if sustained. The beam current limiter circuit insures that the long term maximum beam current is not exceeded.

Horizontal blanking is achieved by amplifying the flyback pulse (FBP) with transistor [072]. Vertical blanking starts as soon as the LA7851 starts the vertical retrace sequence and is terminated by the auto bias, bias active signal. A comparator is used to sense the vertical bias O/S, at pin 16 of the LA7851, which goes low when vertical retrace starts. Capacitor [207] holds the vertical blanking active, between the vertical bias O/S pulse, and the bias active pulse. When the bias active line goes high, the capacitor [207] is reset and vertical blanking ends, after the bias active line returns to it's high impedance state.

The master gain control [485] is connected to the video gain line through a 1K resistor [062]. The voltage range of the video gain line is programmable via resistors [064], [076] and solder bridges at (S), (T), & (U). The solder bridges may connect resistors [244], [245], [258], and [260] to the video gain line. This arrangement permits a variety of input signals and picture tubes to be used with the same monitor PCB.

Horizontal blanking (H_B) is added to the gain line by transistors [072]. This transistor pulls down on the gain line when the flyback pulse is high. Capacitor [081] is charged by diode [080] and resistor [093] such that, as soon as the flyback pulse starts going positive the NPN transistor [072] turns on and horizontal blanking starts. The time constant of capacitor [081] and resistors [078] and [093] is chosen such that the capacitor will lead the FBP on the downward slope and turn the horizontal blanking transistor off just at the end of the FBP. This advanced timing compensates for the turn off delay of transistor [072].

Vertical blank time is started when a low going pulse from the LA7851 pin 16 causes the output, pin 1, of the dual comparator [210] to go low. Capacitor [207] is discharged through resistor [208] at this time. After the end of the LA7851 pulse, the capacitor [207] holds the output, pin 7 of the comparator, low until the bias active pulse recharges the capacitor [207] through diode [253]. During the high time of the bias active pulse, the comparator output pin 7 is still low, because of the voltage drop across the diode [253]. The end of vertical blank time occurs when the bias active line returns to its high impedance state. The capacitor [207] holds the charge from the bias active pulse until the next vertical blank time. The advantage of this type of vertical blanking circuit is that, if the CRT auto bias IC fails to produce a bias active pulse, the screen stays blanked. This action protects the CRT when the vertical deflection system fails since the output of the LA7838 boost pulse is needed for the CRT auto bias vertical sync (CA3224E pin 8).

The video gain line will source up to 32mA during blank time, which is the reason for buffering the vertical blank comparator with a PNP transistor [212].

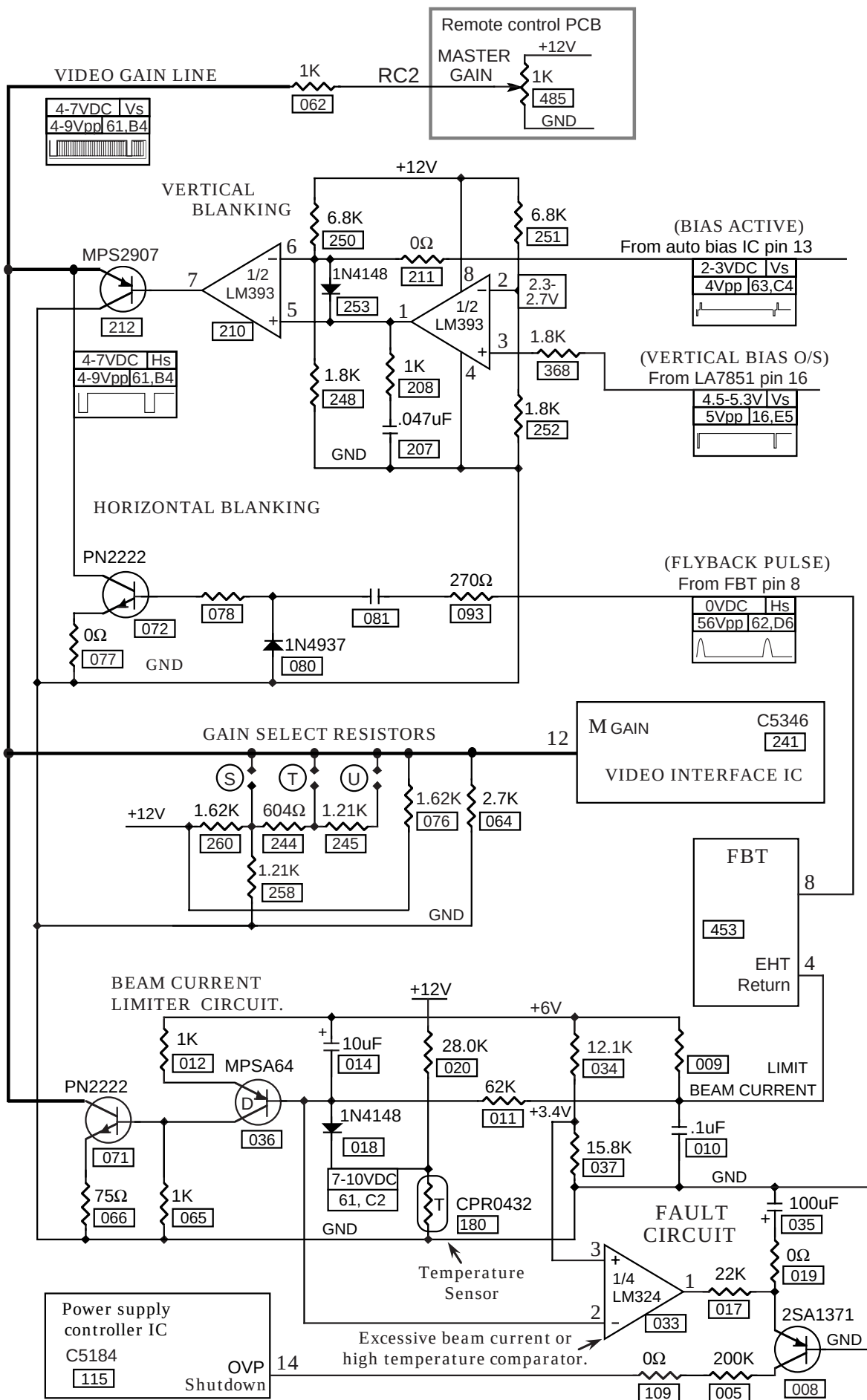
Resistors [251] and [252] supply a voltage that is midrange relative to the LA7851 pulse for maximum noise immunity.

Resistors [248] and [250] also supply another midrange voltage for the bias active pulse and the, vertical blanking, hold capacitor [207] to work against. Resistors [211] and [368] are used as jumpers.

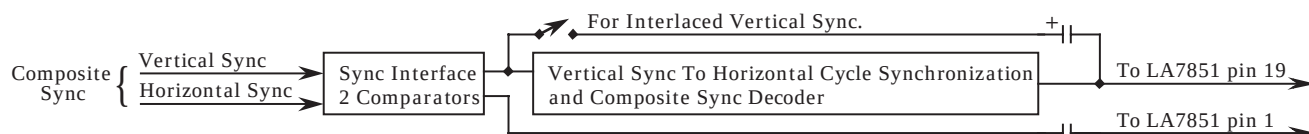
The beam current limiter circuit uses the base to emitter voltage of a darlington transistor [036] to set the maximum beam current. To sense the beam current, capacitor [010] integrates the current pulses produced by rectifying the high voltage flyback pulses. The beam current is converted to a voltage across resistor [009]. This voltage is applied to a long time constant RC circuit, resistor [011] and capacitor [014], before it is sensed by the darlington transistor. The sharpness of the limiting response is set by resistors [012], [065] and [066]. Transistor [071] then, reduces the video gain by pulling down on the master gain line upon excessive beam current. The beam current is also reduced if the FBT temperature sensor exceeds 74°C. Resistor [020] sets the temperature at which this circuit becomes active. The resistance of thermistor [180] decreases with increasing temperature until the voltage at the cathode of diode [018] is low enough to turn on transistor [036] which turns on transistor [071] and darkens the screen.

The fault circuit senses the temperature or beam current line with a, comparator connected, OP Amp. [033] at pin 2 (– input). The + input of the OP Amp. is biased to 3 volts by a voltage divider, resistors [034] and [037]. The output of the, OP Amp. is connected to a low pass filter, resistor [017] and capacitor [035] to insure that the fault circuit does not become active on power up. Transistor [008] conducts the fault signal to the over voltage protect input of the power supply IC. Resistor [005] protects the voltage translator transistor [008] and the power supply controller IC.

BLANKING, MASTER GAIN, BEAM LIMITER, AND FAULT CIRCUITS SCHEMATIC.

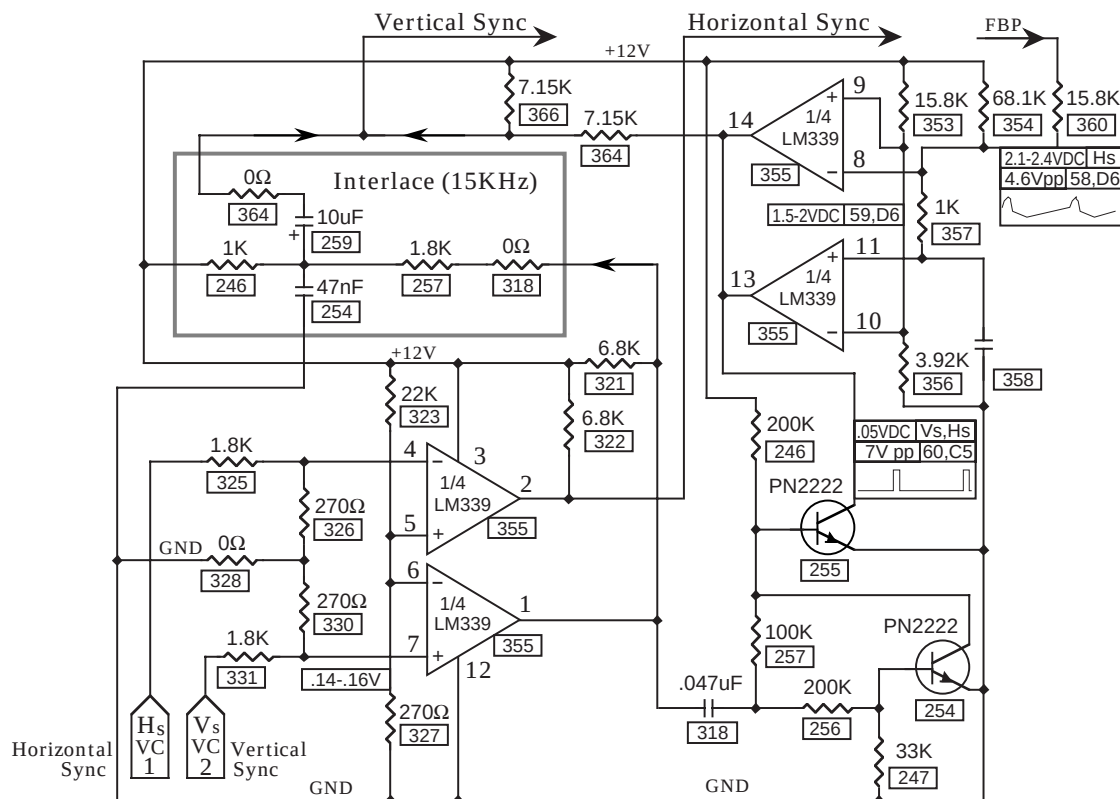


VERTICAL AND HORIZONTAL SYNC CIRCUIT DESCRIPTION.



Composite sync or separate vertical and horizontal sync are buffered by two comparators in the sync interface circuit. A vertical sync synchronization circuit is used to insure a stable raster and functions as a sync separator.

The synchronization circuit is bypassed, for interlaced vertical sync, because this circuit rejects the half horizontal line time variation used to generate the interlaced vertical raster.



The sync interface comparators are biased to .15 volts, by resistors [323] & [327], to permit receiving low level sync signals such as RS170. For low level composite sync, the vertical and horizontal lines are tied together and jumper [328] is left off. For normal amplitude sync, (greater than 2.3 volts) resistors [325] & [326] form an attenuator to protect the sync interface comparators and normalize the sync amplitude. This combination also reduces noise sensitivity since the sync voltage amplitude is low at the comparator input which slows the comparator response and acts as a low pass filter.

For the interlaced sync case, the pullup resistor [321] is left off and the voltage divider resistors [246] and [257] act as the pullup. Also the vertical sync synchronization comparators are disabled by changing the input resistors to bias the comparators in the high output state and resistor [366] is left off. Capacitor [254] acts as a sync separator for composite interlaced sync. Capacitor [259] and jumper [364] are used to couple the composite sync to the LA7851 vertical sync input pin 19.

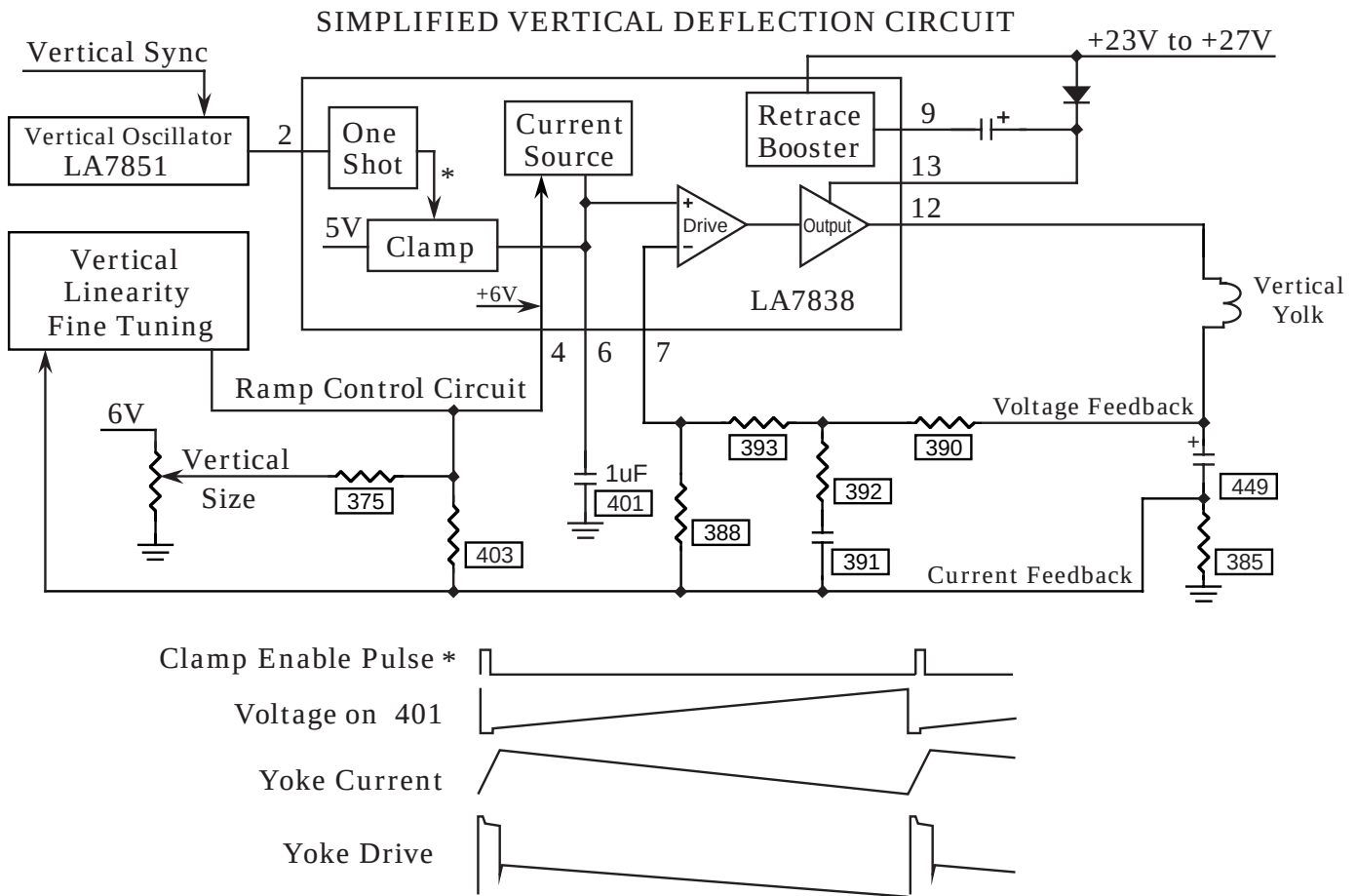
The vertical sync synchronization window comparator generates a pulse, a little after the midpoint of each horizontal cycle. This pulse is shorted to GND by transistors [255] except when vertical sync is active. The two transistor circuit permits using either positive or negative pulses for vertical sync.

Capacitor [318] couples the vertical sync pulses to transistors [254] & [255]. When no sync pulse is present, transistor [255] is turned on by resistor [246]. For a negative vertical sync pulse, transistor [255] is turned off by the negative pulse applied to resistor [257] and the window comparator pulse is allowed to be the vertical sync pulse. For positive vertical sync pulse, transistor [254] is turned on by resistor [247] & [256], which shorts the base of transistor [255] to GND also allowing the window comparator pulse to act as the sync pulse.

A sawtooth waveform is produced on integrating capacitor [358] by applying the flyback pulse to resistors [360] & [357]. This sawtooth waveform is connected to two comparators which are biased by resistors [353], [356], [354], & [360] such that both comparator outputs are high between 1.8 volts to 2.3 volts. This circuit would produce a pulse on both the positive and negative slope parts of the sawtooth waveform. Resistor [357] eliminates the output pulse on the negative slope by introducing part of the flyback pulse to pin 8 which keeps the comparator from going high at this time. Resistors [364] & [366] act as a pullup for the window comparator and apply a 6 volt bias to the vertical sync input, LA7851 pin 19. At 6 volts, the vertical sync input is inactive. It becomes active only when the window comparator output and the $\pm$ sync transistors are all high.

VERTICAL DEFLECTION CIRCUIT, FUNCTION, DESCRIPTION.

The LA7851 IC is used for the vertical oscillator. The LA7838 is a vertical deflection control and high efficiency vertical yoke driver IC. Together they form a compact and efficient vertical deflection system.



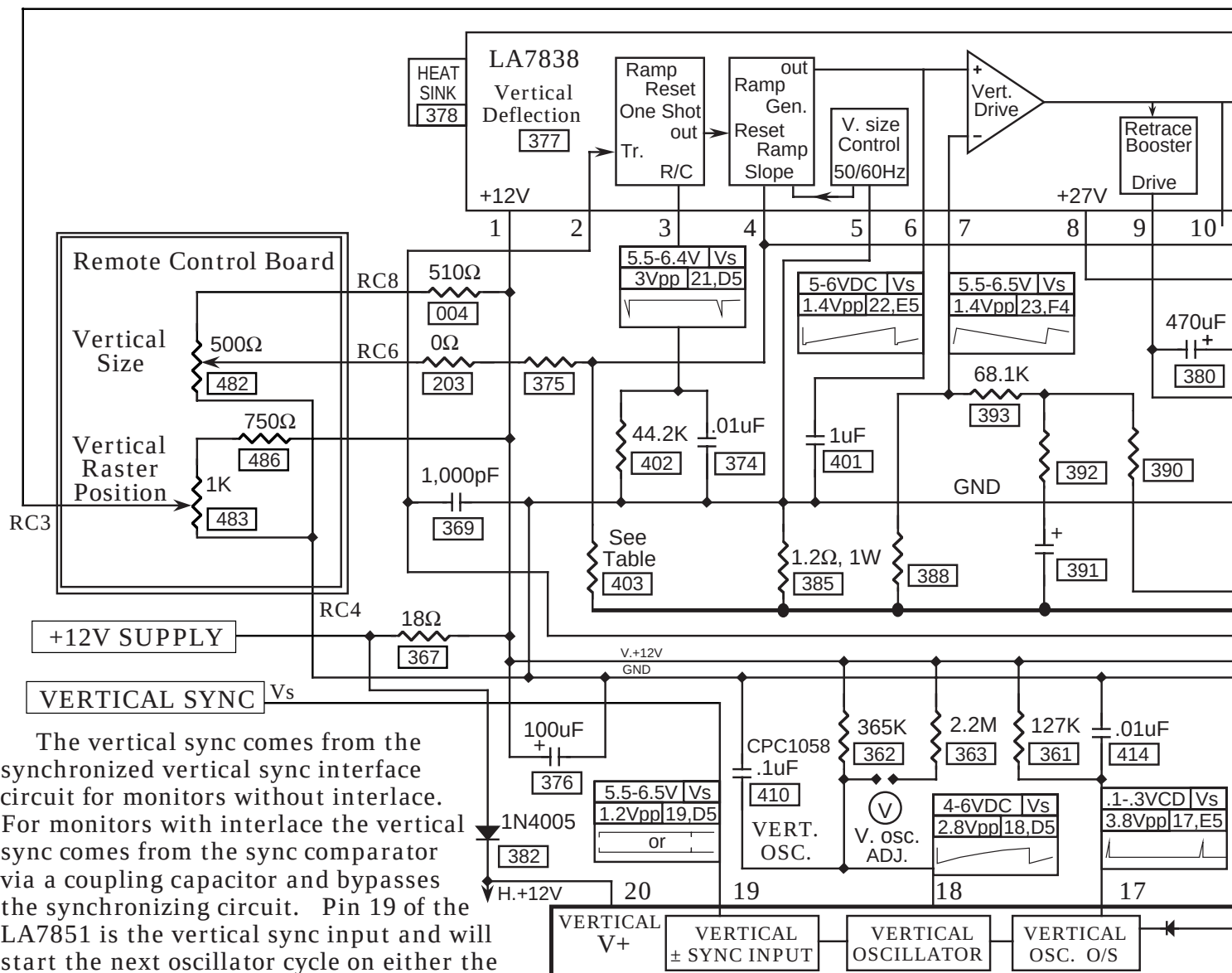
The vertical oscillator in the LA7851 supplies timing to the vertical deflection IC to maintain a raster with no sync present. Vertical sync supplies the timing when sync is present.

The one shot in the LA7838 clamps the ramp forming capacitor [401] to 5V during the first half of vertical retrace. The ramp forming capacitor is supplied with current by a current source at pin 6. The current source has a fixed 6 volt input voltage at pin 4. A linear ramp is generated if a fixed resistor is connected from pin 4 to GND. Feedback from the yoke current, via resistor [403], is used to modify the linear ramp which helps correct for nonlinearity introduced by the voltage feedback circuit connected to pin 7. The vertical size control is connected to the current source input since adjusting the slope of the ramp adjusts the vertical size. This ramp with the clamp, as the discharge, produces a sawtooth waveform which is connected to the + input of the vertical control differential amplifier at pin 6.

The combination, voltage and current, feedback circuit senses the parabolic waveform on the yoke coupling capacitor [449] and is connected to the yoke current sense resistor [385]. This circuit is then connected to the other input of the differential amplifier at pin 7. A capacitor [391] smoothes the parabolic waveform and a voltage divider is used to set the output bias voltage. The time constant, of the capacitor [391] and resistor [392], is set to produce good vertical linearity. An additional linearity correction circuit is added to fine tune vertical linearity. This circuit can be set to add or subtract deflection from the upper and lower portions of the raster.

The differential amplifier controls the power output stage which drives the vertical deflection yoke. The retrace booster is turned on when the ramp voltage is set to the clamp voltage and is reset when the yoke feedback voltage balances the ramp voltage.

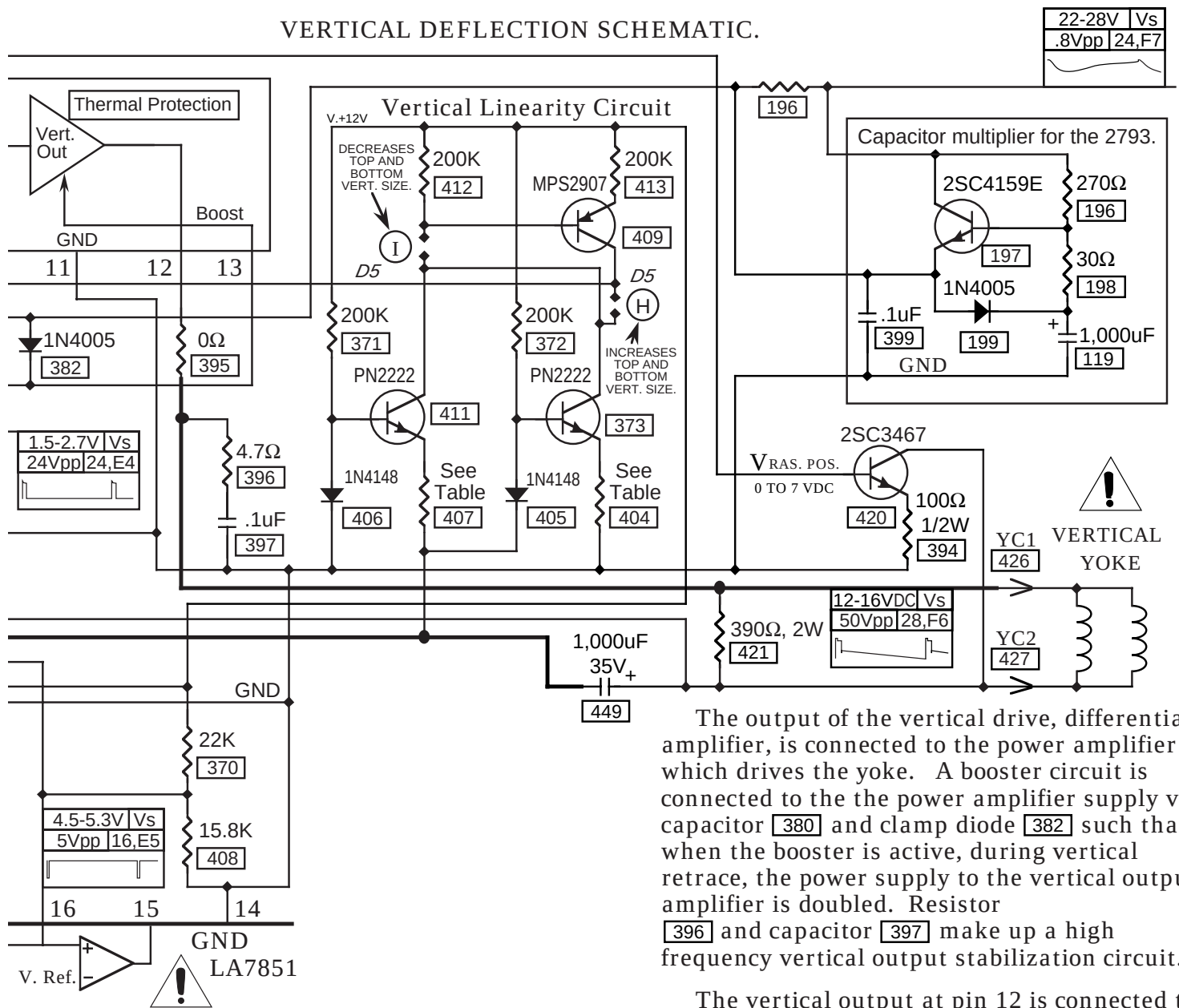
VERTICAL DEFLECTION CIRCUIT DESCRIPTION.



The one shot in the LA7838 clamps the ramp forming capacitor [401] to 5 volts for about half of the vertical retrace time. Capacitor [384] and resistor [402] form the RC circuit for the ramp reset one shot.

The ramp capacitor [401] is charged by current from a current generator with a 6 volt input node at pin 4. The vertical size is adjusted by the vertical size control [482] which is connected to pin 4 via resistors [003] & [375]. The adjustment range is set by resistor [375] and the maximum deflection is set by resistor [403]. A third input to pin 4 comes from the vertical linearity circuit. This circuit uses the above and below GND parts of the vertical current waveform separately. Transistor [411] conducts when the vertical current waveform is below GND. This transistor's emitter is referenced to GND by diode [406] and resistor [371]. The emitter is connected to the vertical current waveform through resistor [407] which is adjusted for each tube and yoke combination.

VERTICAL DEFLECTION SCHEMATIC.



In similar manner, the positive half of the vertical current waveform is conducted by transistor [373] diode [405], and resistors [372] and [404]. Both transistors [373] and [411] may be connected to pin 4 via solder connection (H) or they may be connected to inverting transistor [409] and resistors [412] and [413]. The inverting transistor is connected with solder connection (I) and decreases the vertical size at the top and bottom of the screen.

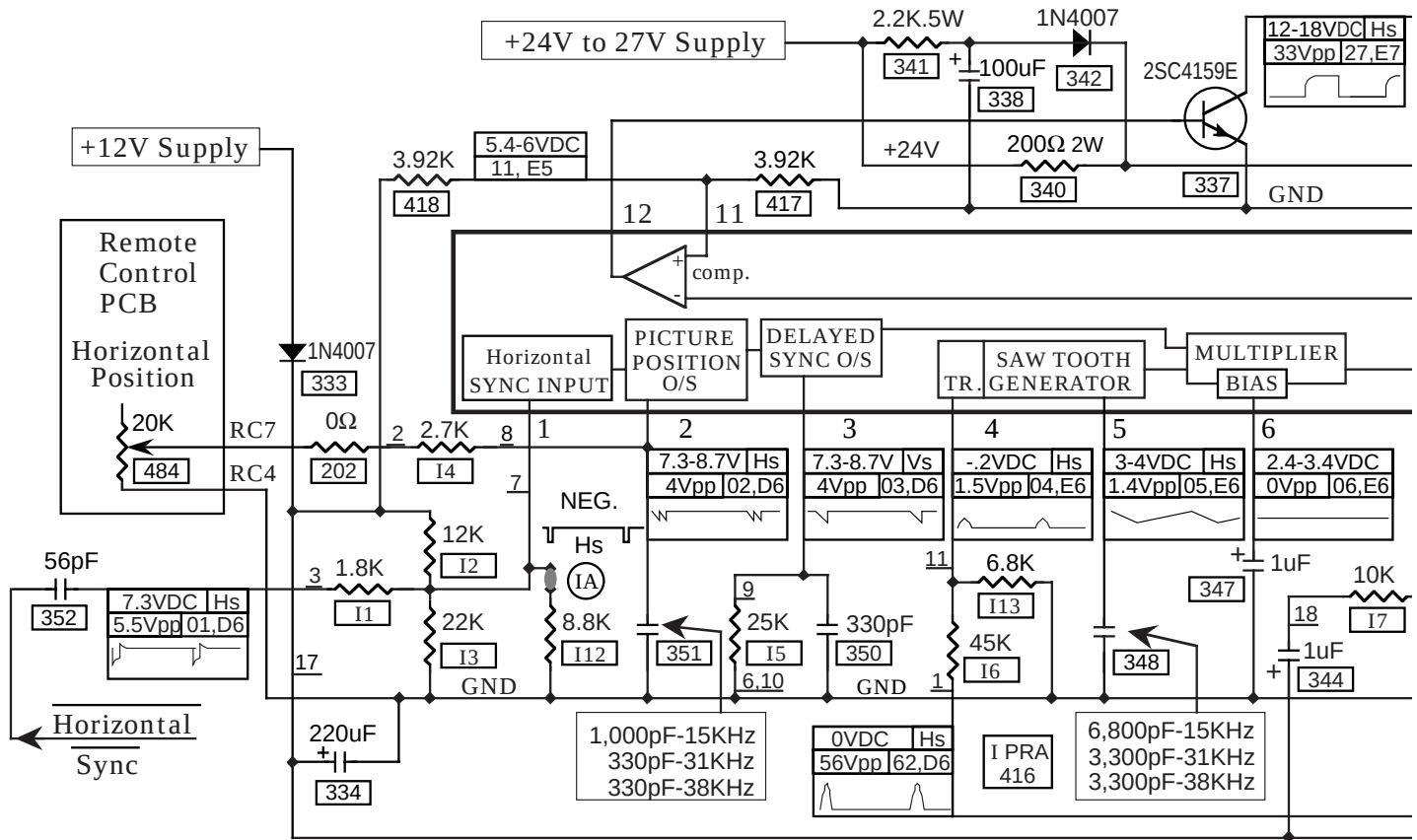
The ramp capacitor [401] is connected to a differential amplifier at pin 6 and the negative feedback from the yoke return line is connected to pin 7. This negative feedback, which senses the DC component of the vertical output voltage, is also the current feedback for the LA7838. It is made up of voltage divider resistors [388] and [390] + [393] and a wave shaping integrator. The wave shaping integrator, capacitor [391] and resistor [392], is used as the primary vertical linearity adjustment.

The output of the vertical drive, differential amplifier, is connected to the power amplifier which drives the yoke. A booster circuit is connected to the the power amplifier supply via capacitor [380] and clamp diode [382] such that when the booster is active, during vertical retrace, the power supply to the vertical output amplifier is doubled. Resistor [396] and capacitor [397] make up a high frequency vertical output stabilization circuit.

The vertical output at pin 12 is connected to the vertical yoke. Resistor [421] is a load resistor across the yoke which stabilizes the vertical deflection feedback loop. The yoke return is decoupled by capacitor [449] and the vertical current is sensed by resistor [385]. The vertical raster position is adjusted by injecting current in the vertical yoke return. This is accomplished by transistor [420], with emitter resistor [394], and the V. RAS. POS. control [483].

A capacitive multiplier circuit is connected in series with the 27 volt line, in the 27" monitor, to reduce the ripple voltage due to beam current variations. Transistor [197] conducts current from the 27 volt line to the LA7838 deflection supply input pin 8. Capacitor [119] and resistors [196] and [198] form a low pass filter which is connected to the base of this transistor. Diode [199] conducts the inductive current from the vertical yoke during the first part of retrace. A jumper at [196] replaces the capacitive multiplier circuit in the chassis with smaller CRTs.

HORIZONTAL DEFLECTION CIRCUIT DESCRIPTION.



The functions of the horizontal control circuits are:

1. To provide the horizontal output circuit with a stable frequency with or without incoming horizontal sync.
2. To be able to adjust the picture position, horizontally, with respect to the raster.
3. To operate stability through periods of missing horizontal sync pulses.
4. To keep the picture from drifting within the operating temperature range.

All of these functions except for the picture position adjustment are accomplished by the phase locked loop. Delaying the horizontal sync with an adjustable timer produces the picture position adjustment.

The horizontal sync input circuit (pin 1) will trigger the picture position one-shot (O/S) on either the rising edge, or the falling edge, of the horizontal sync pulse. To accomplish the edge triggering, the sync pulse is differentiated by capacitor [352] into two short pulses, one for the rising edge and one for the falling edge of the sync pulse. Which edge is the trigger depends on the bias voltage at pin 1. For positive edge triggering, the bias voltage is set to 7.8 volts by resistors [I2] and [I3]. For negative edge triggering, the bias voltage is set to 4.1V by connecting [I12] via the solder connection (IA).

The picture position O/S clamps timing capacitor [351] to 8.2 volts until horizontal sync triggers this O/S. The voltage on the timing capacitor drops at a rate set by the horizontal position control [484] and resistor [I4]. When the voltage, at pin 2, drops below 4 volts the delayed sync O/S is triggered and capacitor [351] is reset to its clamped voltage. The delayed sync O/S functions the same as the picture position O/S with the exception that it is not adjustable.

The flyback pulse, connected to pin 4 through resistor [I6], starts the negative slope of the sawtooth generator. When the sawtooth wave, which is produced by a current to capacitor [348], drops to 3 volts, the sawtooth generator switches back to the positive slope part of the wave till the next FBP.

During the active part of the delayed sync pulse, the multiplier gates current to capacitor [346] which is dependent on the sawtooth voltage at the delayed sync pulse time. Capacitor [347] sets the "0" voltage for the multiplier which is the average value of the sawtooth waveform.

If the delayed sync pulse occurs when the sawtooth is at a low voltage part of its cycle, capacitor [346] discharges and the oscillator frequency lowers. If the delayed sync pulse occurs at the top part of the sawtooth wave no current flows to capacitor [346]. This action, phase locks the horizontal oscillator to the incoming sync pulses.

The schematic diagram illustrates the internal circuitry of a color television set, focusing on the horizontal drive, vertical drive, and flyback transformer sections. The horizontal drive section (top left) features a transformer with a 100Ω resistor and a 2.2nF capacitor. The vertical drive section (top right) includes a 2SC5690 transistor, a 1N4007 diode, and a 1.2Ω resistor. The flyback transformer section (bottom right) shows a transformer with a 1K resistor and a 170Ω resistor. The diagram also depicts the connections to the video board, TC11, TC12, and the EHT (Electron Gun Heater Transformer). The horizontal drive section is labeled 'Horizontal Drive Transformer' and includes a 'HORIZONTAL OSCILLATOR' and 'DISCHARGE' section. The vertical drive section is labeled 'H. V+' and includes a 'H. Fo ADJ.' section. The flyback transformer section is labeled 'FLYBACK TRANSFORMER' and includes a 'To Yoke' connection. The diagram also shows the connections to the video board, TC11, TC12, and the EHT (Electron Gun Heater Transformer). The horizontal drive section is labeled 'Horizontal Drive Transformer' and includes a 'HORIZONTAL OSCILLATOR' and 'DISCHARGE' section. The vertical drive section is labeled 'H. V+' and includes a 'H. Fo ADJ.' section. The flyback transformer section is labeled 'FLYBACK TRANSFORMER' and includes a 'To Yoke' connection. The diagram also shows the connections to the video board, TC11, TC12, and the EHT (Electron Gun Heater Transformer).

The duty cycle of the horizontal drive transistor is generated by comparing the oscillator waveform against a fixed voltage. This fixed voltage is set by resistors [417] and [418].

The flyback transformer's main function is to supply EHT to the CRT. It also supplies the focus and screen grid voltages which are taps on the EHT supply. There are three low voltage secondaries. One supplies the filament current, negative G1 voltage, and timing on the video board. Another supplies sync and EHT information to the power supply. The third secondary drives the horizontal blanking circuit and supplies sync for the horizontal PLL, the horizontal width control, & the vertical sync synchronizing circuits.

The purpose of the horizontal width control is to:

1. Provide a convenient means for adjusting the horizontal raster size.
2. Correct pincushion distortion in the vertical axis.
3. Correct horizontal raster distortion caused by periods of high beam current.

The horizontal width control circuit is comprised of two main parts; The control circuit and the diode modulator (DM). The control circuit combines four signals in the monitor to produce the width control circuit. These signals are:

1. Horizontal size - - - - - H. Size Pot.
2. Vertical current (Iv) - - V. current feedback resistor
3. Vertical parabolic + Iv Vertical yoke return.
4. Beam current - - - - - EHT return on the FBT

The diode modulator controls the horizontal yoke current which affects the horizontal size. This is accomplished by the diode forward current. In effect, the diode shorts out the horizontal width coil to the extent of the diode forward current during the previous horizontal trace time. The current used to control the diode forward current comes from the diode modulator and is controlled by the control circuit and the switching mode driver.

The horizontal size voltage from the remote control PCB [490] is applied directly to the current node (LM392 Pin 5) of the control amplifier by resistor [043].

For pincushion correction, two separate signals are used. The inverted vertical current waveform (TP 34) and the yoke return waveform (TP 33). The yoke return waveform includes a parabolic and linear component. The inverse of the linear component is added to the yoke return waveform to correct the pincushion. The vertical current waveform (Iv) is inverted by an Op Amp and resistors [029] and [051]. Resistor [031] level shifts the inverted Iv to + 6V. The (vertical parabolic + Iv) is AC coupled by capacitor [082] and resistor [038] and [040]. It is then amplified by an Op Amp connected as a voltage follower. Resistor [038] protects the Op Amp against arc related voltage spikes. Load resistors [050] and [053] prevent cross over distortion of the Op Amps by using only the current source transistors. The inverted Iv and (parabolic voltage + Iv) are added to the current node of the control amplifier by resistors [041], [042], [030], & [052] which then makes up the pincushion correction signal.

The beam current from the FBT is converted to a voltage by resistors [009] and is filtered by capacitor [010]. Resistor [097] then connects the signal to the current node of the control amplifier, which accomplishes the blooming correction function.

These circuits are designed around a virtual ground, the +6 volt line. This line is generated by buffering a voltage divider [022] and [023] with an OP Amp. Resistor [021] and capacitor [026] form the output filter.

The power output stage of the horizontal width control circuit is a high efficiency switching mode driver. The FBT pulse is integrated by capacitor [057] through resistor [095] and level shifted by resistor [058] to produce a saw tooth waveform. See waveform block TP 39. By connecting one input of the comparator, in the LM392 [049], to this sawtooth signal and the other input to the control amplifier a switched signal with a duty cycle dependent on the control voltage is produced at the output. Resistors [055] and [056] form a voltage divider which limits the control voltage amplitude to be within the sawtooth waveform. Resistor [060] acts as a pullup for the comparator output. Resistor [461] couples the power MOSFET [460] to the comparator. Capacitor [463] and resistor [464] are connected as a snubber circuit to reduce noise due to rapid drain transitions.

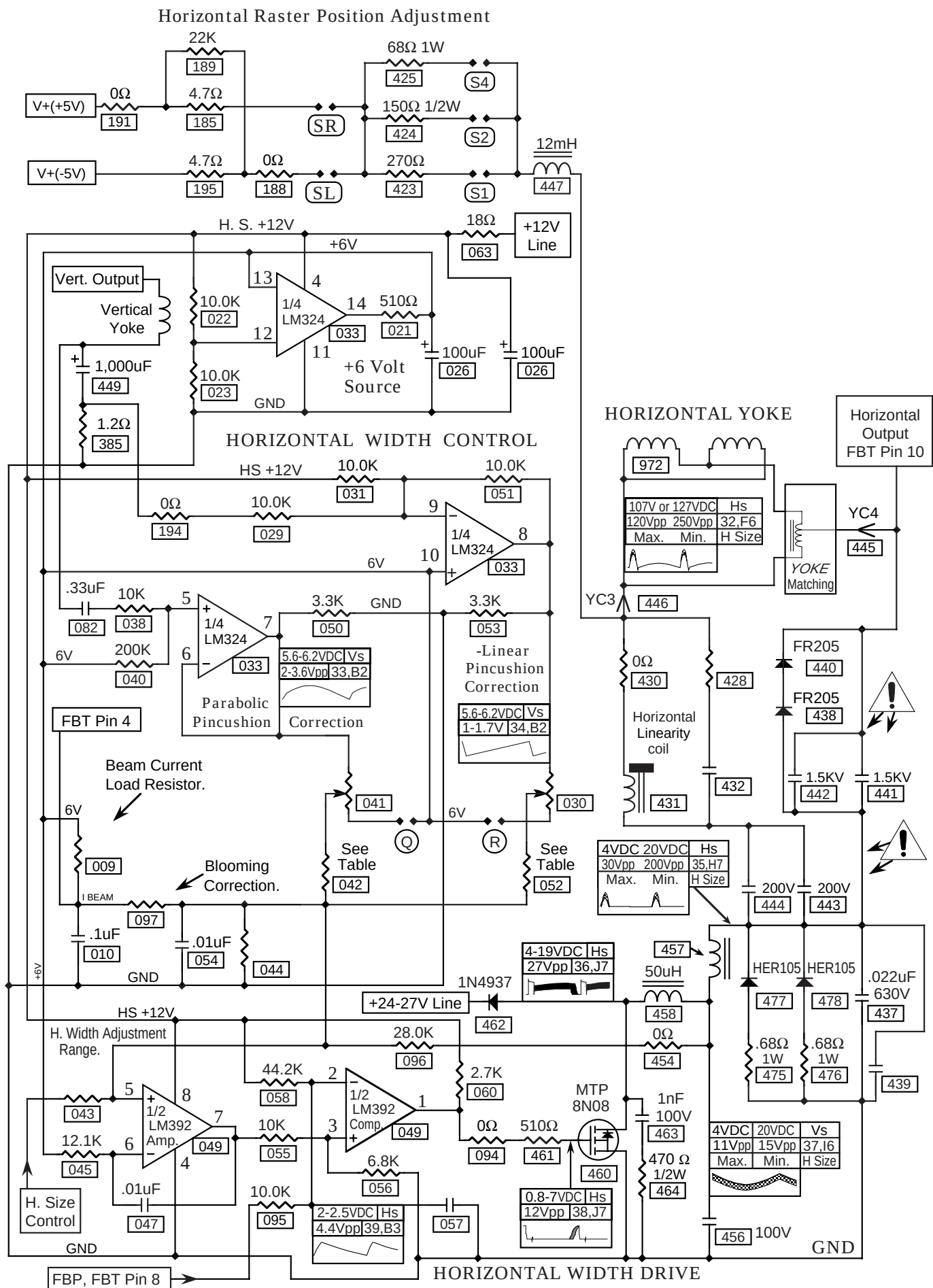
When the MOSFET is on (gate voltage high) current increases in inductor [458] and when the MOSFET is turned off the current is dumped in to the 24-27V line through diode [462]. The magnitude of this current, from the diode modulator, is determined by the duty cycle of the MOSFET which is a function of the control voltage.

Diodes [477] and [478] with current equalizing resistors [475] and [476] rectify the flyback waveform present on the GND referenced node of the horizontal tuned circuit. This current is conducted through inductor [457] and integrated by capacitor [456] and then is controlled by the driver circuit. Diodes [477] and [478] are the diode modulator diodes and the forward current which the drive circuit controls is the current which determines the turn on delay of the GND referenced node of the horizontal tuned circuit. An increase in the current of diodes [477] and [478] produces a greater delay in the GND referenced node, and reduces the amplitude of the flyback pulse at this node, which results in an increased horizontal size.

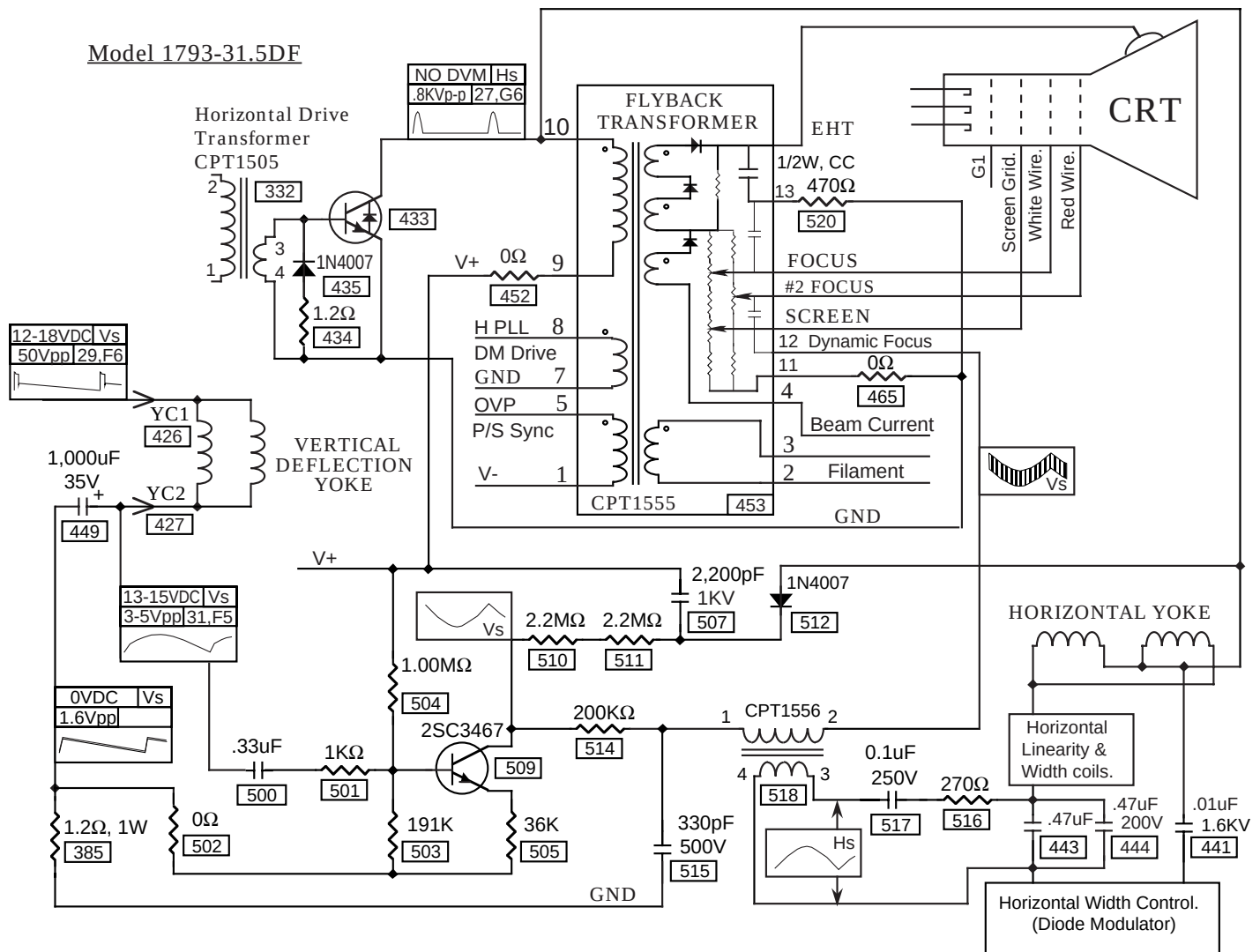
Capacitors [441] and [442] are the primary horizontal tuning capacitors and must be the specified value for a given chassis horizontal frequency and yoke combination for proper operation of the monitor. Capacitors [437] and [439] are the diode modulator horizontal tuning capacitors. Diodes [440] and [438] clamp the GND referenced node voltage to GND. Horizontal linearity coil [431] stores energy from the flyback pulse and injects it into the horizontal yoke in the reverse direction of the yoke current to decrease deflection at the start of trace to balance the decreased deflection at the end of the horizontal trace due to I²R losses in the yoke during trace time. Capacitor [432] and resistor [428] keeps the linearity coil from ringing after retrace.

The raster may be shifted by making solder connections: left (SL) or right (SR). The amount of the shift is set by solder connections (S1), (S2), & (S4). Inductor [447] permits only the DC current to pass to the yoke return. Resistors [423], [424], & [425] define the size of the shift together with the V+ plus 5V and V+ minus 5V supplies. Resistor [189] supplies a load on the V+ ±5V lines to avoid over-voltage of the filter capacitors. Resistors [185], [195] act as fuses to protect the PCB in the case where both (SL) and (SR) connections are made.

HORIZONTAL RASTER WIDTH AND POSITION CONTROL SCHEMATIC.



DYNAMIC FOCUS CIRCUIT FUNCTION AND CIRCUIT DESCRIPTION.



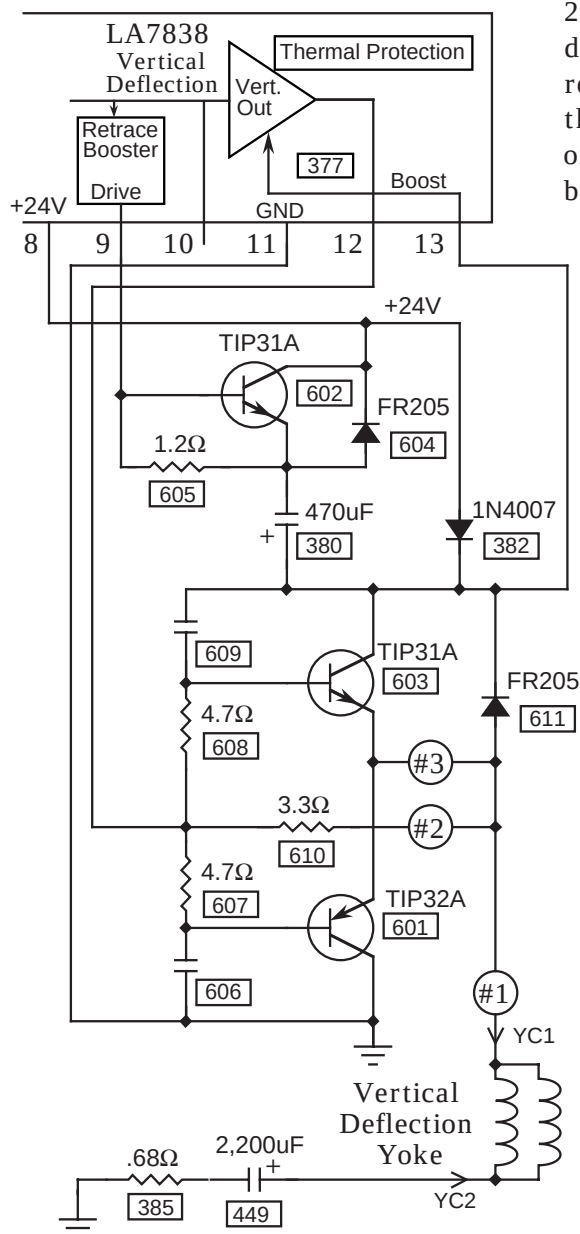
The dual focus CRTs require a waveform on the #2 focus grid. This voltage waveform is dependent on the position of the beam on the CRT. The lowest voltage part of the waveform is in the center of the screen and the highest voltage part of the waveform is at the corners of the screen.

The dynamic focus circuit produces a composite waveform which consists of the horizontal parabolic waveform and the vertical parabolic waveform. This composite waveform is applied to the dynamic focus input, of the flyback transformer, and produces a sharp picture on the dual focus picture tubes. Typically dual focus picture tubes produces a sharper picture than the single focus picture tubes.

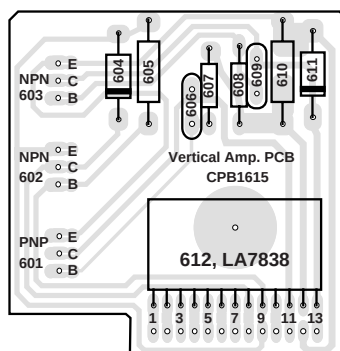
Dynamic Focus Circuit Operation: The vertical component of the dynamic focus circuit is derived by amplifying the voltage waveform across the vertical yoke coupling capacitor. The horizontal component of the dynamic to focus circuit is produced by applying the voltage waveform across the horizontal yoke coupling capacitor to the dynamic focus transformer primary. This transformer steps up the horizontal parabolic voltage from about 33V to about 300V to produce the horizontal component of the dynamic focus circuit.

Circuit Description: Transistor [509] amplifies the vertical parabolic waveform which exists across capacitor [449]. This waveform is coupled to the transistor base via capacitor [500] and resistor [501]. The bias for this transistor is generated by resistors [503] and [504]. The gain of this amplifier is defined by resistor and [505]. Note; Resistor [505] is connected to the vertical feed back line and not to ground. The supply voltage for the collector is produced by diode [512] which rectifies the primary flyback pulse and is integrated by capacitor [507]. The load resistors for this transistor are resistors [510] and [511]. The waveform on the collector, which is the vertical parabolic waveform, is conducted through resistor [514] and through transformer [518] to the dynamic focus input of the flyback transformer. Resistors [514] and [501] provides arc protection for transistor [509]. The horizontal component of the dynamic focus waveform is produced by coupling the primary of the dynamic focus transformer at [518] to the horizontal yoke coupling capacitors at [443] and [444]. Capacitor [515] provides a low impedance pass to ground for the horizontal parabolic waveform which is developed across the dynamic focus transformer secondary at [518]. Capacitor [517] insures that there is no D. C. component across the transformer primary. Resistor [516] protects the dynamic focus transformer primary from overload. The flyback transformer [453] couples the dynamic focus waveform to the #2 focus grid via an internal capacitor.

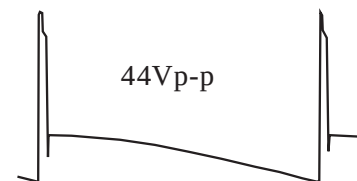
Vertical Booster Amplifier Circuit, Circuit And Function Description.



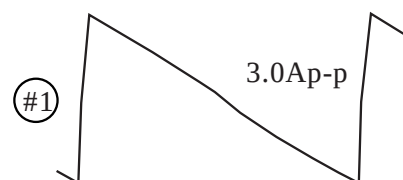
Monitors with vertical deflection current which exceeds 2.2 Ap-p cannot be driven directly by the LA7838 vertical deflection IC. The vertical booster amplifier circuit reduces the output current of the LA7838 by amplifying the vertical deflection current. The LA7838 is mounted on the vertical booster amplifier circuit board to allow the boosters circuit to be inserted at the output of the LA7838.



PCB View;
Foil Side.



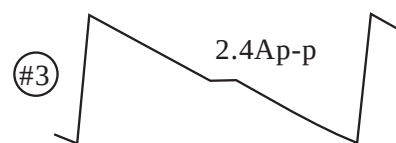
Vertical yoke drive, voltage waveform.



Vertical yoke drive, current waveform.



LA7838 output, current waveform.



Vertical booster, current waveform.

Vertical Booster Circuit, Operation. The following waveforms are taken from the 2793-VGA monitor. See waveform #1 for the vertical deflection current. Waveform #2 shows the LA7838 output current. Waveform #3 shows the current supplied by the vertical booster amplifier circuit. These current waveforms describe how the vertical booster circuit reduces the LA7838 output current to a current which is well within the specification of the IC.

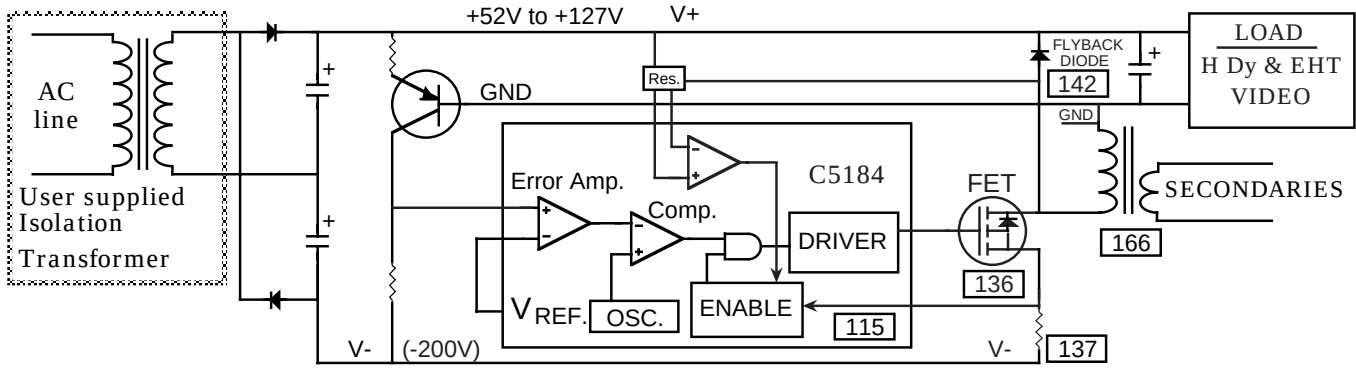
The output of the LA7838 is connected to the yoke by a 3.3Ω resistor at [610]. It also drives the bases of transistors [601] and [603] through 4.7Ω stabilization resistors. When the voltage drop across resistor [610] reaches ±.7V the respective transistor (601 for -.7V & 603 for +.7V) takes over most of the additional vertical yoke drive current.

The retrace booster pulse, from the LA7838 pin 9, is connected to the retrace booster capacitor at [380] and is also buffered by an NPN transistor at [602]. The output of the retrace boost is connected to the LA7838 at pin 13 and to the vertical booster NPN transistor at [603].

Diodes [604] and [611] conduct current, right at the start of retrace. This current is produced by the energy in the yoke, from the end of the last trace. Diode [382] supplies the deflection current to both the LA7838 and the booster amplifier circuits during trace time.

Stabilization capacitors [606] and [609] are not used at present, but may be needed with other output transistors.

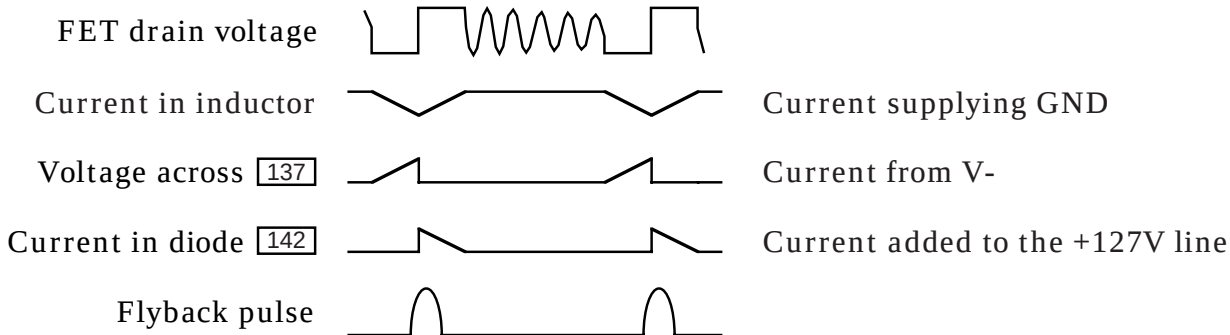
SIMPLIFIED POWER SUPPLY CIRCUIT, FUNCTION, DESCRIPTION.



The switching regulator includes the power FET [136] which passes current from V- to GND through the inductor [166]. During the time the FET is on, the current in the inductor is increasing and the inductor is storing energy. $\longrightarrow$

When the FET is turned off, the stored energy in the inductor continues supplying current to GND. But in this case, the current path is from V+ to GND, instead of V-to GND. During this part of the cycle, the current in the inductor is decreasing.

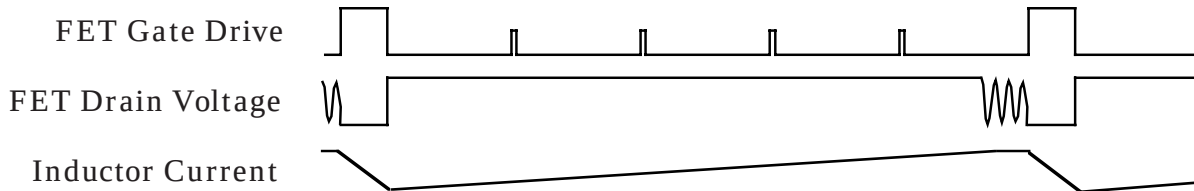
Under normal conditions, the current will decrease to zero and the voltage will ring.



As can be seen from the waveforms, the largest number of changes occur when the FET is turned off. Also, the FET drain voltage switches fast due to the high inductor current. To minimize video interference from the power supply, the power supply is synchronized to the horizontal oscillator such that horizontal blanking is coincident with the FET turn off time.

The C5184 [115] is the series regulator IC. All of the control circuits that are built into this IC work together to produce one output signal, which is the FET drive signal. This signal can take on many shapes depending on the load conditions of the power supply. The waveforms for normal operation are shown above.

For the shorted +127V to GND condition, which also occur right on power up,
the waveforms are:



The first FET pulse is a full on pulse which causes current to flow in the inductor. After the FET is turned off the current in the inductor drops much more slowly than normal since the inductor is discharging into a much lower than normal voltage. If the FET were turned on for full power in the

next cycle with current still flowing in the flyback diode, a current spike of 6A would occur, which is a power spike of 2,000W. The reason for this is that the diode stores charge when current flows which turns into reverse current for a short time when the voltage is reversed across the diode.

The FET drive circuit avoids this problem by sensing flyback diode conduction. If the flyback diode conduction is sensed, the low current start mode is selected. This mode turns the FET on, to a current of .1A, for not more than 4 μ S. If before or during the low current FET on time, the flyback diode breaks free, and the FET drain voltage goes down, the flyback diode voltage comparator will signal the regulator to permit the FET to be turned on for a full power cycle. The cycle after the last low power cycle in the waveform, on the previous page, is an example of this condition. The flyback diode voltage comparator inputs are located at pins 12 & 13 of the C5184. The two resistor dividers (see next page) [J10], [J11] and [J12], [J13] connect the comparator across the flyback diode [J14]. The comparator enables the FET drive only after a 10% voltage drop is measured across this diode.

Another fault condition exists when the FET exceeds 5A drain current. This condition can occur if the oscillator frequency is too low, the FET drain is shorted to GND or V+, the transformer has a shorted secondary, or the core is broken. In these cases the voltage across the FET source resistor [J17] exceeds 1.6V which is sensed by the over current comparator at pin 11. If pin 11 exceeds 1.6V, the FET drive is set to 0V for the rest of the cycle. In some cases, this condition can produce an output waveform which looks normal, but the voltage across the load (+127V to GND) would be low or unstable. A quick check for this condition is to check the peak voltage across the FET source resistor. CAUTION; Whenever connecting a scope ground to V-, be sure that the other scope probe or common grounded devices are not connected to the monitor GND.

Most of the power supply fault conditions cause the power supply to chirp because the source of +17V for the C5184 is generated by the power supply. A special circuit is built into the C5184, which permits charging the +17V line filter capacitor with only a very low load from the C5184. This circuit turns the rest of the C5184 on only after the voltage at pin 15 reaches 17V. If the transformer does not supply at least 12V to this line before the filter capacitor discharges to 12V, the C5184 turns off. The reason for the audible chirp, is that, the power supply is not full on for each cycle which produces a frequency low enough to hear. See the bottom waveform on the previous page.

A 0-30 volt @ 1A, DC, isolated power supply is a tool necessary for trouble shooting CERONIX monitors. When trouble shooting the power supply, it can be connected to V- and the +17V line to keep the power supply running while checking the voltages and waveforms to find the fault. Caution, do not exceed 20 volts on the 17 volt line. It can also be used to supply the GND to +16V line for checking the horizontal circuit. If the horizontal circuit does not work, the power supply will chirp. Without the horizontal circuit working, there is not enough load on the power supply for transformer action to keep the regulator IC +17V line up to the minimum of +12V. A quick check for this condition is to clip a 2-4K @ 10W power resistor from GND to V+. If the chirping stops, the horizontal is probably not working.

The heart of the power supply is the oscillator which supplies the basic timing. The FET drive is always low during the negative slope of the oscillator or, when synchronized, after the start of the sync pulse. The low to high transition of the FET drive, pin 10, is determined by the voltage at the output of the error amplifier. If V+ goes up in voltage, the error amplifier voltage goes up, which then intersects the oscillator waveform at a higher voltage and causes the FET on time to start later and be shorter. This negative feedback accomplishes the control loop of the power supply.

The regulator IC has a built in reference voltage which is used by the error amplifier to set and hold the V+ constant. Solder connections on the J PRA are used to adjust V+ in steps of $\pm 1.5V$.

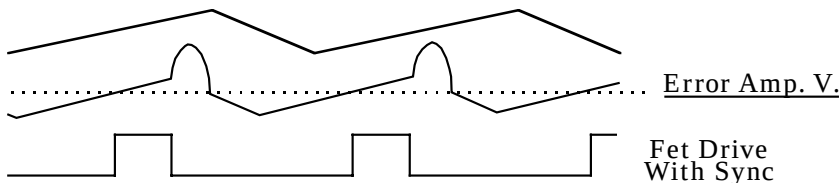
The over voltage protect (OVP) circuit, when activated, turns off the regulator IC until power is disconnected. This circuit is connected to the rectified flyback pulse, which outputs a voltage that is proportional to the EHT. The circuit's main purpose is to protect the user against excessive x-ray which is caused by excessive EHT. The OVP circuit is also activated if the monitor temperature goes too high or if too much beam current is demanded from the FBT. The purpose of the last two functions is to protect the FBT and the CRT from component failure on the main or video boards.

SWITCH MODE POWER SUPPLY CIRCUIT DESCRIPTION.

Oscillator waveform without sync:

Oscillator waveform with sync:

FET drive, C5184 pin 10:



The series regulator IC [115], controls current to the monitor GND by pulse width modulation. A PNP transistor [112], has an emitter current, that is directly proportional to the 127V line voltage due to resistor [J1] and adjustment resistors [J13] & [J14]. This current is transmitted to the power supply V-line, and is applied to a resistor [J5], [J15], & [J16]. The voltage across these resistors is compared to a reference voltage by the error amplifier. If the +127V line goes up the output of the error amplifier voltage goes up. The pulse width modulation, which controls the +127V line voltage, is accomplished by turning the FET drive on at some particular voltage along the rising slope of the oscillator waveform. This particular voltage is the error amplifier output voltage. See waveforms above.

The FET drive is always off during the negative slope of the oscillator, or just after the sync pulse. Since the FET drive pulse is started by the error amplifier voltage and terminated by the end of the oscillator cycle, a control system via pulse width modulation has been established. The oscillator waveform is produced by charging capacitor [102] with a constant current set by resistor [J7] to a voltage of 5V and then discharging the capacitor with double the charging current to 2.5V. Adding the flyback pulse, via capacitor [123] to this waveform synchronizes the oscillator, since the oscillator frequency is set below the horizontal frequency. Resistors [J2], [J4] and capacitor [108] limit the error amplifier's AC gain, to hold the control loop stable. Capacitor [107] holds the error amplifier stable. Capacitor [110] reduces power supply noise, but, if too large, will cause the power supply to be unstable. The 127V line is adjusted by making solder connections on the J PRA (refer to page 65 for the layout). Solder connections [JC] and [JD] are used to raise the 127V line up to 4.5 volts in steps of 1.5 volts. Connections [JA] and [JB] lower the 127V line as much as 4.5V.

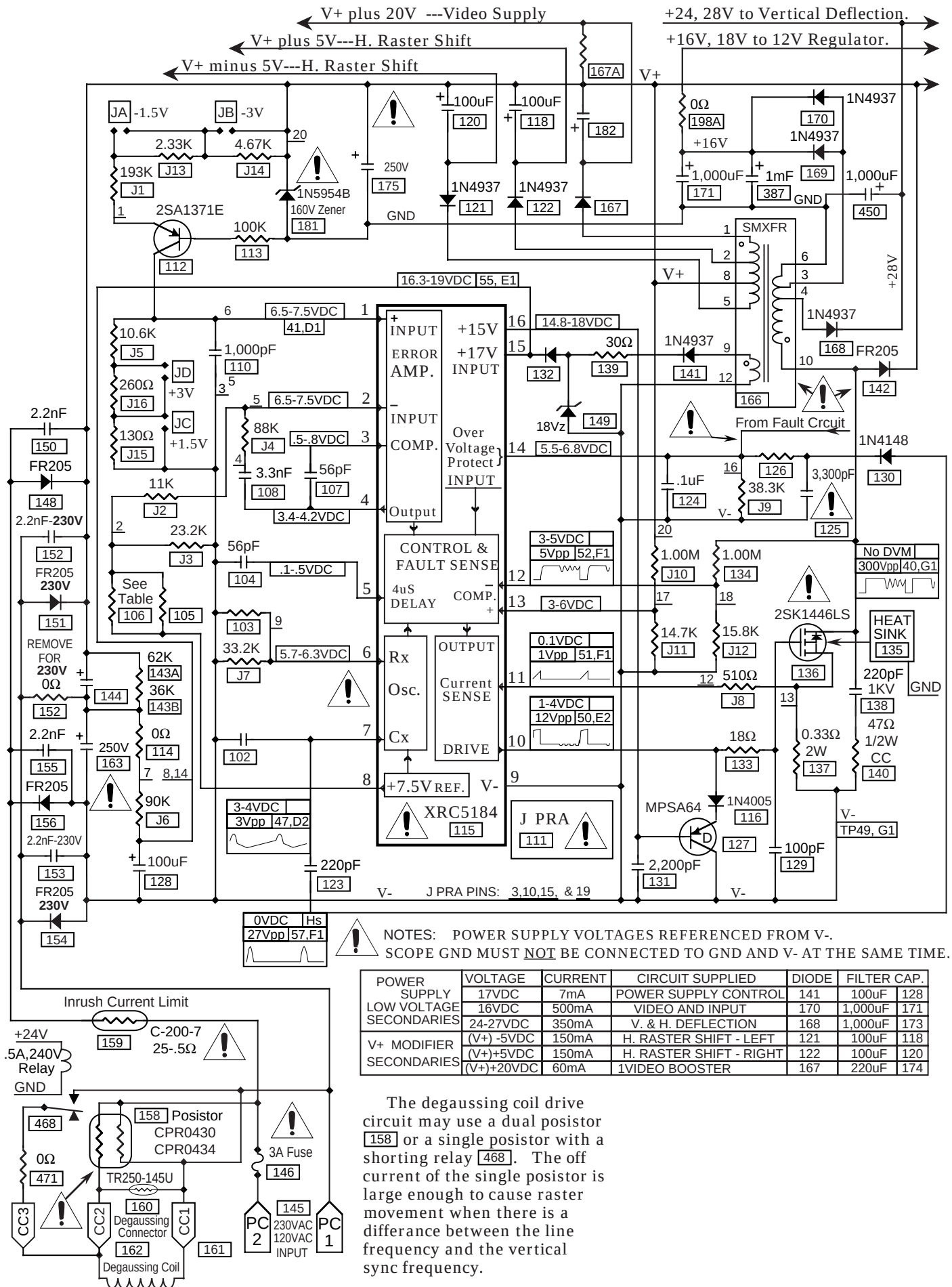
The FET [136] works together with the transformer [166] to provide a low resistance current path from V- to GND. This low resistance coupled with no large voltage times current products is what makes the power supply efficient. Resistor [137] provides a means for sensing the FET current. In the low current mode, it is used to set the 300mA current and in the full on mode it is used to

sense the max. current. Resistors [140], [133] and capacitor [138] reduce power supply electrical noise. Transistor [127] and diode [116] short the FET drive to V- when the monitor is turned off to protect the FET from conducting current with a still large drain voltage. Resistors [J10], [J11], [J12] and [134] provide a means for checking flyback diode [142] conduction via a comparator. If the comparator measures low flyback diode voltage the FET is turned on to the .3A low current mode. This mode is necessary for power up, since initially the +127V line is 0V and no reverse diode voltage exists. The over voltage protect circuit, at pin 14, has a trip voltage of 8V and when it is activated, it shuts down the power supply. The EHT is measured by rectifying the flyback pulse, with diode [130], from a secondary winding of the FBT. Capacitors [125], [124] and resistors [126], [J9] are connected as a low pass filter to smooth out the simulated EHT voltage which is then applied to the C5184 at pin 14. Resistor [J8] protects the IC current sense input from voltage spikes and resistor [113] protects the PNP transistor from momentary overvoltage damage due to line spikes. Zener diode [181] protects the horizontal and video circuits from overvoltage due to power supply failure. If the +127V line exceeds 160V, the zener diode [181] shorts to GND the +127V line.

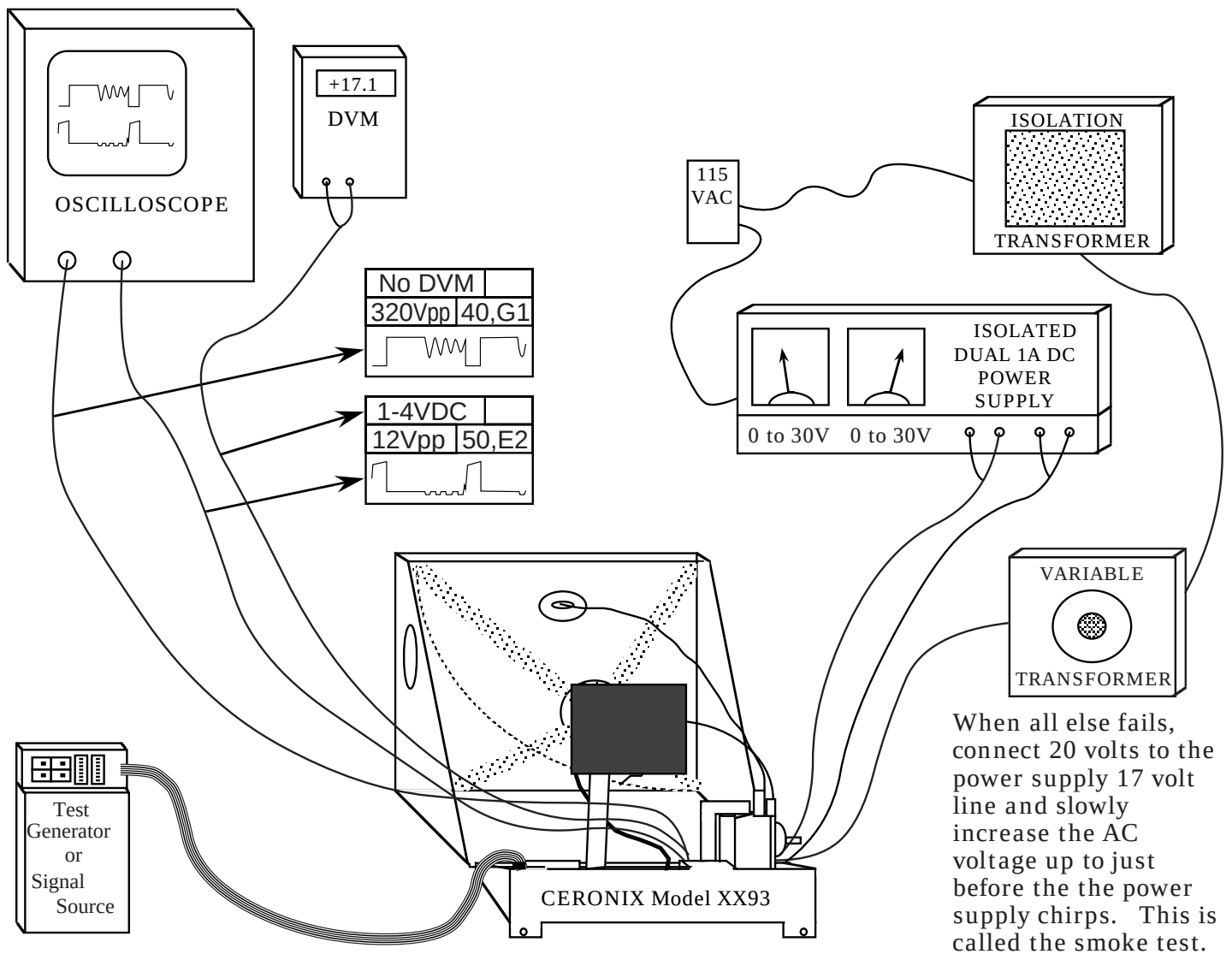
At the input to the power supply is a voltage doubler which outputs between 240 to 425VDC depending on the AC line voltage. It has a three amp fuse [146] to protect the PCB traces, an inrush current limiter [159] to protect the rectifier diodes [148] & [156]. Capacitors [150] and [155] are used to reduce diode noise from the monitor to the AC input. For 220VAC operation the voltage doubler is replaced by a full wave rectifier by adding diodes [151], [154], capacitors [152], [153] and removing the jumper at [152]. [144] & [163] are the raw DC filter capacitors. Resistor [J6] supplies the power supply start current and resistors [143A] and [143B] balances the series connected filter capacitors for 220VAC operation.

Caution! When working on a monitor with a degaussing relay, [468] unplug the degaussing coil to avoid causing the residual current relay to close on a cold posistor. This can happen if the 24V line is energized by a external power supply.

SWITCH MODE POWER SUPPLY SCHEMATIC.



Equipment Setup For Repairing The Model XX93 Monitor.



Legend Description

No. ← { Represents the XX93 board part number. The parts list gives the CERONIX PART NUMBER which is indexed to the board part number.

LTR.No. ← Part numbers of the resistors on the PRA indicated by LTR.

X | **X** ← { PRA pin number. To determine which PRA the pin number belongs to, look for the nearest PRA part number on that line.

X-Y | **V** ← DC voltages are measured to GND except in the power supply where V- is the reference. Use a DVM for DC measurements.

X-Y VDC | **Sync.** ← Test Point, board cross REference location.

Vp-p | **TP-REF** ← { The waveform is normally checked with a oscilloscope. It has a P-P voltage amplitude of **Vp-p**.

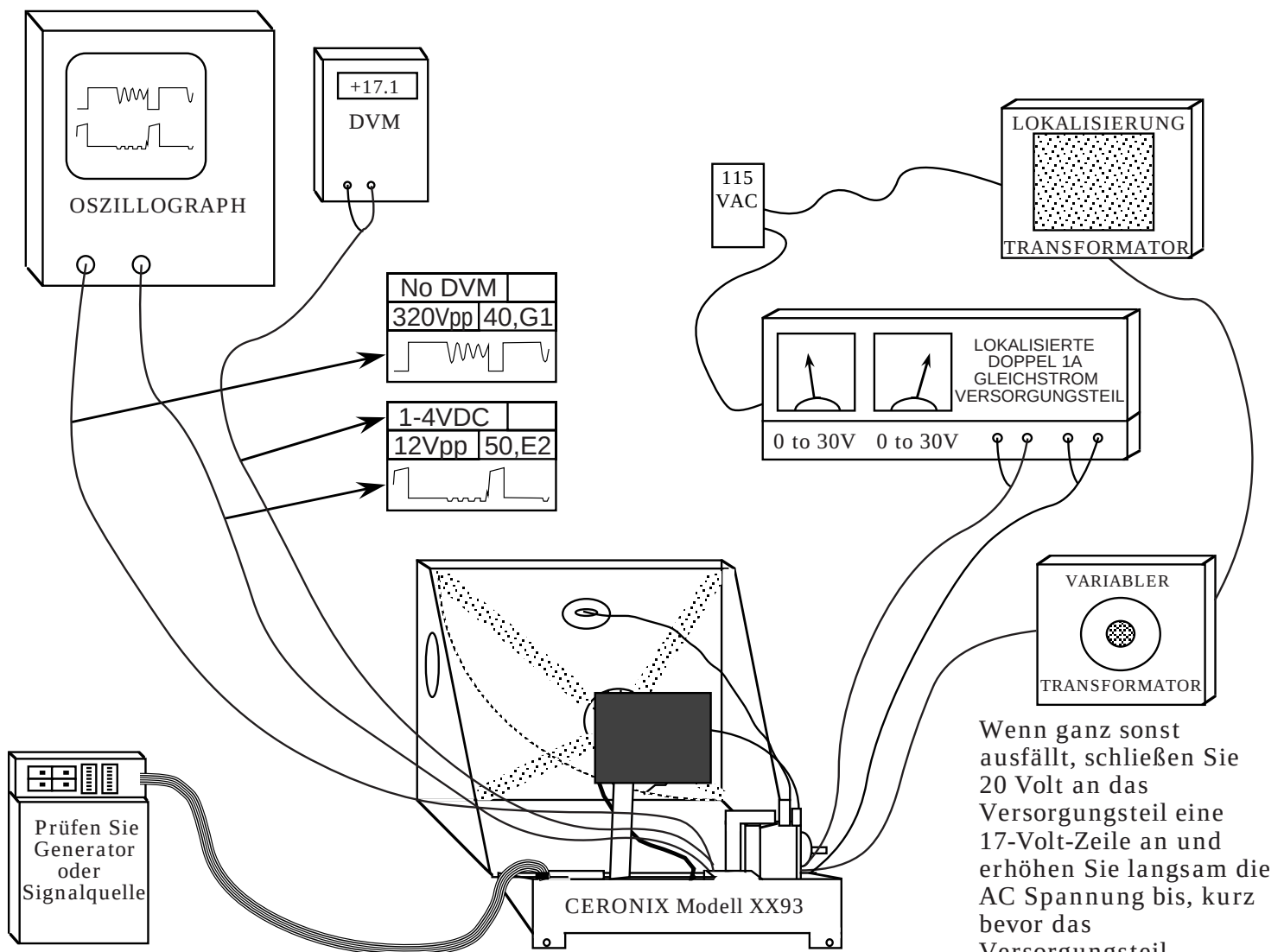
CAUTION: When making measurements on the power supply be sure that the other scope probe is not connected to GND.

Measurements are taken with a white screen.
Hs - 5uS/div.
Vs - 2mS/div.

LEGEND

No.	←	BOARD PART No.
LTR.No.	←	PART No. ON PRA.
X X	←	PRA PIN No.
X-Y V	←	DC VOLTAGE RANGE, USING A DMM. USE V. or H. SYNC.
X-Y VDC Sync.	←	AC VOLTS
Vp-p TP-REF	←	Peak to Peak
WAVEFORM	←	TEST POINT ASS. REF.
	←	Measured with scope

Ausrüstung Gegründet Für Die Reparatur Des Monitors Des Modells XX93.



Legende Beschreibung

- No.** ← Dieses stellt die Teilnummer des Brettes XX93 dar. Die Stückliste gibt die CERONIX-Teilnummer, die zur Brettteilnummer registriert wird.
- LTR.No.** ← Teilnummern der Widerstände auf dem PRA angezeigt von LTR.
- X** | **X** ← { PRA Anschlußstiftzahl. Gehört, um festzustellen welchem PRA die Anschlußstiftzahl, suchen Sie nach der nächsten PRA Teilnummer auf dieser Zeile.
- X-Y V** ← Gleichstromspannungen werden gemessen, um ausgenommen in das Versorgungsteil zu reiben, in dem V- die Referenz ist. Verwenden Sie ein DVM für Gleichstrommessen.
- X-Y VDC**

- X-Y VDC | Sync.** ← Prüfpunkt, Brettquerverweisstandort.
- Vp-p | TP-REF** ← Die Wellenform wird normalerweise mit einem Oszillograph überprüft. Sie hat einen P-P Spannung Umfang **Vp-p**.
- WAVEFORM**

VORSICHT: Wenn Sie Messen auf dem Versorgungsteil bilden, seien Sie sicher, daß die andere Bereichprüfspitze nicht an Erden angeschlossen wird.

Messen werden mit einem weißen Bildschirm genommen.

Hs - 5uS/div.
Vs - 2mS/div.

LEGENDE

- No** ← BRETTEIL-Nr.
- LTR.No** ← TEIL-Nr. AUF PRA.
- X** | **X** ← PRA Anschlußstift-Nr.
- X-Y V** ← **X-Y VDC** ← { GLEICHSTROM Spannung STRECKE MIT A DMM VERWENDEN Sie V.- oder H.-Synchronisierung.
- X-Y VDC | Sync.** ← Volt Wechselstrompaek PRÜFPUNKT ASS. REF. zur Spitze. Gemessen mit oszillograph.
- Vp-p | TP-REF** ← Wellenform

POWER SUPPLY, TROUBLE SHOOTING TIPS.

SAFETY FIRST; Use only one hand when working on a powered up monitor to avoid electrical shock.

Always wear safety glasses.

Many of the failures that cause burnt components and boards are eliminated by the load sensitive switching mode power supply in the CERONIX monitor. This feature can cause problems with servicing the monitor if the proper trouble shooting approach is not used. The equipment setup, shown here, is necessary for efficient trouble shooting of the CERONIX monitors.

Problems that cause the power supply to chirp are:

1. Insufficient V+ line load.
2. Overloaded V+, +24V, or +16V lines.
3. Shorted V+, +24V, or +16V lines.
4. Power supply component failure.
5. Raw DC (V+ to V-) voltage too low.

1. A quick check for the insufficient V+ load is to connect a 2K to 4K ohm 10 watt power resistor from GND to the V+ (cathode of diode [181]). If the chirping stops, proceed to check the horizontal deflection circuit. First disconnect the board from the AC supply. Then connect 16 volts to the 16V line at the cathode of [169]. Also connect 24 volts to the 24V line at the cathode of diode [168] and to V+ at the cathode of diode [181] on the monitor. Now the complete horizontal and vertical circuits can be checked with the oscilloscope and DVM. The flyback waveform will be about 170Vp-p instead of 900Vp-p which permits checking even the H. output transistor, collector, waveform.

2. For the overloaded supply line problems, the monitor power supply can be made to run continuously by connecting the external power supply to the 17V line. To accomplish this, connect the external supply 0V clip lead to V- (resistor [137] lead by the power transformer) and +20V clip lead to the monitor power supply +17V line (cathode of diode [141]). Sometimes the monitor will operate normally in this mode, in which case, watch for smoke and after a few minutes of operation disconnect the power connections and carefully feel around the conductor side of the board for hot spots. Overload conditions will not harm the power supply unless there is a problem in the power supply. If the power supply is suspect, read the POWER SUPPLY TEST section on this page. Next check the DC voltage of each of the power supply outputs. The overloaded line will have a lower than normal voltage reading. The defective component can be located by measuring the voltage drop along the trace of this line.

3. If the V+ crowbar zener [181] is shorted, a fault exists in the power supply which permitted the V+ line to exceed +160V. First replace the zener. Never operate the monitor without the crowbar zener installed. Then read the POWER SUPPLY TEST section on this page. Shorts on the V+, 24V, and 16V lines other than the crowbar zener are not likely to be connected to the power supply even though the power supply chirps. By operating the power supply with the +20V external power supply many of these problems can be found using the same procedure as are used in trouble shooting monitors with linear power supplies.

4. The power supply may chirp if:

The transformer core is broken or a winding is shorted.

The .33 ohm current sensing resistor value is too high.

The +17V line is open. (goes away when external. PS is used)

5. There is a line voltage range of about 60% to 70% AC line voltage where a correctly operating monitor will chirp.

POWER SUPPLY TEST

To verify that the power supply is working correctly, connect the 17V line, as indicated in section 2 on this page. Also connect the oscilloscope GND to V- and the oscilloscope probe to the FET drive (anode of diode [116]). There should be a waveform at this point. If there is no FET drive waveform, check the voltages and waveforms on the C5184 pins and compare them to the voltages and waveforms on the schematic. Connect the AC power cord with the AC voltage, from the variable transformer turned down to 0 volts. TAKE CARE NOT TO TOUCH THE OSCILLOSCOPE AND MONITOR CHASSIS DURING THIS TEST, SINCE THE VOLTAGE DIFFERENCE CAN BE AS HIGH AS 400 VOLTS. Connect the DVM to GND and V+. Slowly increase the AC line voltage and observe the power supply response. Do not exceed +145V on V+. If the monitor runs normally, a fault may still exist in the power supply +17V line circuit. Note; if the crowbar zener is shorted and the FET is internally shorted, the C5184 IC [115] should also be replaced.

Trouble Shooting Handbook

The information that is written in this handbook is to help repair XX93 Monitors.

Here is a guideline in which this handbook will follow:

1. Color problems.
2. No video with power.
3. No V-H sync.
4. Retrace lines.
5. No power.



Always wear safety glasses.

Caution; Use only one hand when working on a powered up monitor to avoid electrical shock.

Color Problems.

A helpful hint when working with color problems is by identifying the color of the three grid lines at the top of the screen.

When there is a missing color and the lines are white the problem lies in the video interface section. This means it can be found between the customers game and pin 8 of the Video Amplifier (K-Film). If the lines are not white it would be a output problem, which is anything after pin 8 to the picture tube.

If the problem is excessive blue, green, or red background color, tap on related K-film to see if it is defective.

If blue is the problem, check for damaged traces around the outside of the video board, since most of these traces go to the blue K-film.

If monitor shuts down due to excessive color, disconnect the filament for voltage tests. (Desolder CRT socket pin 9.)

Note: All voltage measurements are: DC with -lead to GND unless other wise noted.

<u>Problem</u>	<u>Tests</u>	<u>Probable Solution</u>
Missing Color. Refer to the schematic for the specific pin numbers of each color. Pins, listed in table, are in order of Red, Green, and Blue. Tests should preformed in order to reduce chance of replacing wrong component.	1. Check voltage on 75Ω input resistors [288], [286], & [284].	If 0V to .05V, check video connector and drive electronics.
	2. If voltage, IC [241] pins 16, 13, or 9 less than 7V & K-Films pin 1>8V.	Check for open between IC and associated K-Film.
	3. If voltage, K-Film pin 1 is 10V and IC 241 Pins 1,15, & 8 are .3 to.7V.	Ohm gain resistors at pins, if OK replace video interface IC [241].
	4. If voltage, K-Film pin 1 over 10.6V Desolder pin 1. Make open to trace. Color may be tested by connecting a clip lead to GND and a 1.62KΩ resistor. Contact the resistor to K-Film pin 1.	If pin 1 over 10.6V, replace K-Film. If pin 1 is 10V, replace the diode of missing color [213], [086], & [084]. If still missing color, replace IC [241].
	5. If voltage, K-Film pin 20, different than voltage at CRT socket pin.	Resistance between these two points should not exceed 1.1KΩ.
	6. If voltage, K-Film pin 20 is over 115V. Arc suppression diodes: Red [835] [899] Green [845] [849] Blue [886] [959]	First replace, for shorted arc suppression, diodes of affected color. Then try replacing the K-Film. If not solution, change the transistors in the amplifier.

<u>Problem</u>	<u>Tests</u>	<u>Probable Solution</u>
Excessive color. Turn down G2 (bottom pot of FBT) if excessive color is too bright. Refer to the schematic for the specific pin numbers of each color. Tests should preformed in order to reduce chance of replacing wrong component.	1. Turn down M. Gain. Measure voltage of K-Film pin 1 for each color. If affected color has a .3V difference then others Desolder pin 1. Make open to trace.	If pin 1 still different replace K-Film. If pin 1 voltage same as others, replace IC [241] .
	2. Measure voltage across cap. [846] .	If this voltage is less than 5V, check filament pulse. If OK replace capacitor [857] .
	3. Turn up M. Gain. Measure voltage, of affected color, base to emitter: Red [837] Green [842] Blue [954]	If the voltage is greater than .7V or 0V , Replace the transistor.
	4. Ohm check, CRT socket. pin of effected color to pin 12. Red, pin 8 Green, pin 6 Blue, pin 11	If resistance is below 2K, replace the CRT socket.
	5. Measure voltage, of affected color, K-Film pin 4.	If voltage is 3-8V replace the 2SC3467 & the PNP transistor pair. If voltage is less than 2V replace PNP transistor connected to pin.

<u>Problem</u>	<u>Tests</u>	<u>Probable Solution</u>
No Picture. Check that the master gain pot is turned up.	1. Note; Blanking should be > 5V. Measure blanking voltage on jumper [215] . If .6V to 1V check vertical output for waveform.	The vertical booster pulse supplies part of vertical sync to the auto bias IC [927] . With no sync to pin 8 of [927] , vertical blanking is not reset.
	2. Check light from filament. If no light check FBP before and after capacitor [854] .	If FBT waveform is the same on both sides of the filament adjustment cap. [854] , ohm out the filament circuit.
	3. Measure voltage on Blue K-Film pin 7. This voltage should be 9.3V.	If this voltage is over 10V, replace transistor [942] .
	4. Measure G2 voltage on CRT socket [877] pin 7.	If this voltage is under 100V, check that the FBT bottom pot is turned up. Replace CRT Socket if GND to G2 is less than 100KΩ.
	5. Measure voltage on LM324 [920] pin 8.	If this voltage is 9-11V, replace the C-Film [917] and or LM324 [920] .

<u>Problem</u>	<u>Tests</u>	<u>Probable Solution</u>
No Sync. Tests should preformed in order to reduce chance of replacing wrong component.	1. Vertical osc. frequency adjustment;	Add or remove V solder connection. p30
	2. Check H. free running freq. (Hfo)	If out ±500Hz of sync, adj. Hfo. p75
	3. Check sync waveforms at input of LA7851. Hs=pin 1, Vs=pin 19.	If input sync to the LA7851 is OK and picture roles replace IC [415] .
	4. Check voltage, LM339, [355] pin 14. Normal range is 5V to 7V.	Also should check other voltages in this circuit. If outside range replace IC [355] .

<u>Problem</u>	<u>Tests</u>	<u>Probable Solution</u>
Retrace Lines .	1. Turn down M. Gain to minimum. Measure voltage, auto bias IC [927] pins 2, 4, & 6 for 5.5V to 6.5V. Also measure voltage, pins 3, 5, & 7 for 1.1V to 2.7V	If any of the voltages are not in the listed voltage range, replace IC [927].
	2. Measure voltage, LM324 [920] pin 5. Should be less than 4.5V.	If old style C-Film (no solder connection) & pin 5 voltage is 4.8V add a 7.15K resistor pins 8 to 11. Otherwise replace C-Film.
	3. Check video gain line (J [215]) scope sync on Vs [215], .2mS/cm, and verify V. & H. blanking.	If either V. or H. blanking is missing, go to that circuit for further tests.

<u>Problem</u>	<u>Tests</u>	<u>Probable Solution</u>
Monitor Shuts Down.	1. If screen turns bright & shutdown.	Check voltage across cap. [846] 5-10V
	2. If shutdown right after power up.	Check V+, Hfo, & EHT at power up.
	3. Disable fault; clip [019] to GND.	If solution, check fault circuit.
	4. Disable shutdown; clip V- to [109].	Measure EHT, should be less than 27KV.

<u>Problem</u>	<u>Tests</u>	<u>Probable Solution</u>
No Power.	1. With power applied, check voltage ground to (V-) anode of diode [156].	If 0V to 100V, ohm out fuse [146] & inrush current limiter [159] 25Ω to .5Ω.
	2. Measure voltage, V+ line is 0V & PS chirps	Ohm out crowbar zener diode [181]. Also ohm out H. output Xsr [433].
	3. If fuse is blown. Ohm out 160V crowbar zener [181].	If the zener is shorted and the fuse is blown, replace fuse [146], zener [181], power FET [136], and the C5184 IC [115].
	4. If the power supply chirps and high voltage can be heard.	Ohm out the 17V line; V- to anode of [141], [141], [149], [139], [132], J-Film pins 8-14 & IC [115] pin 15.
	5. If the power supply chirps, check for shorted secondary voltages by; Disconnect power to chassis. Apply external DC PS to 16V line at cathode of diode [169]. Apply second DC voltage to 24V line at cathode of [168]. FBT Check at low voltage;	First, ohm out diodes; [142], [168], [169], [181]. If PS current less than .5A and 12V line=11.5V to 12.5V, go to next test. If PS current less than .3A, line OK. Check base of H. output [433] for drive waveform. If OK connect 24V line to V+ line and check flyback waveform at collector of [433]. (Without H. deflection load, PS chirps) If large and small pulses observed, replace the FBT.

Filament Voltage Test.

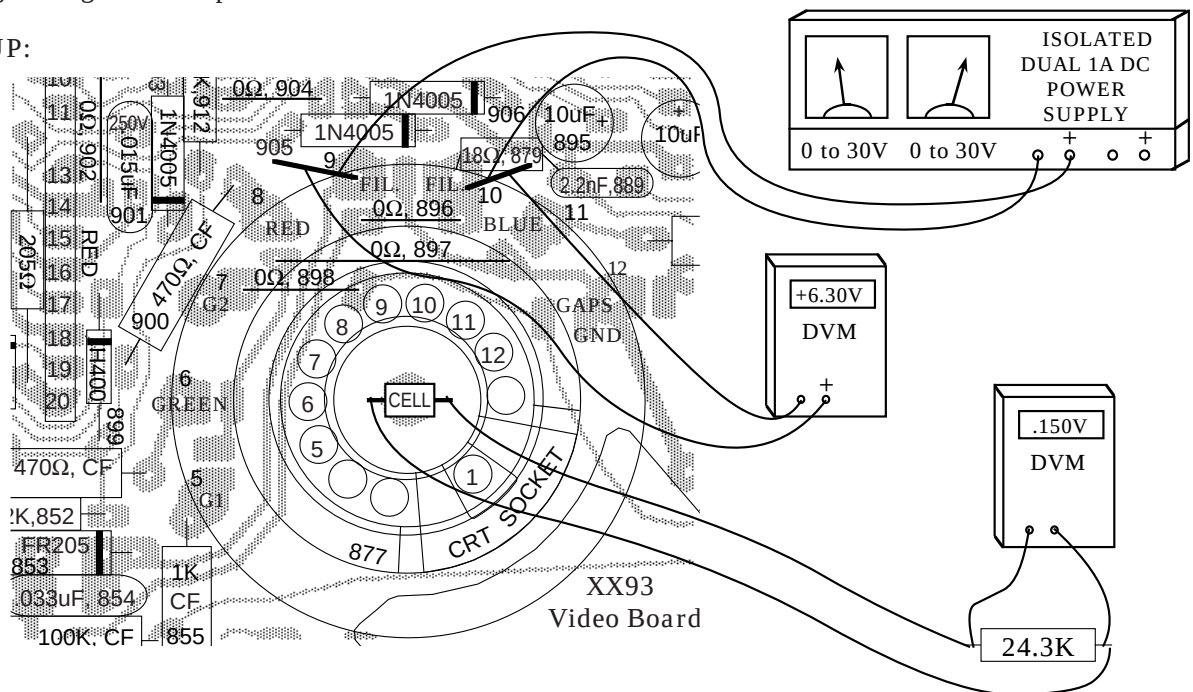
When replacing either the flyback transformer or the video board, the filament voltage may not be correct.

Measuring the filament voltage is not accurate using a true RMS voltage meter, because of the high frequency components, which make up the filament voltage. An oscilloscope, with RMS capability, may be used to measure the filament voltage.

Although a visual check of the filament color is a indicator of the filament voltage, it is a good practice to check the filament voltage if there is any doubt about this important monitor parameter.

The following filament voltage test is an accurate method of finding the true RMS voltage to the filament. This is accomplished by comparing the light output of the filament when it is driven by the monitor to the light output of the filament with an applied DC voltage using a loaded photocell.

SETUP:



To find the filament voltage;

1. Solder two short buss wires to the filament pins to clip on.
2. Use black tape to secure the photocell over the hole in the plastic CRT socket connector. Caution: Be sure not to move the photocell between the two tests.
3. Record the DC voltage output from the photocell with the monitor running normally. The monitor should be powered up for 10 minutes before making this measurement.
4. Turn off the monitor.
5. Connect the variable voltage, 1 amp, DC power supply to the filament. The negative lead to the filament ground at the CRT socket pin 10.
6. Adjust the power supply voltage for the photocell reading, recorded in step 3.
7. The equivalent filament RMS voltage is now recorded by measuring the DC voltage at the CRT socket pins 9 and 10.

HeizfadenSpannung Test.

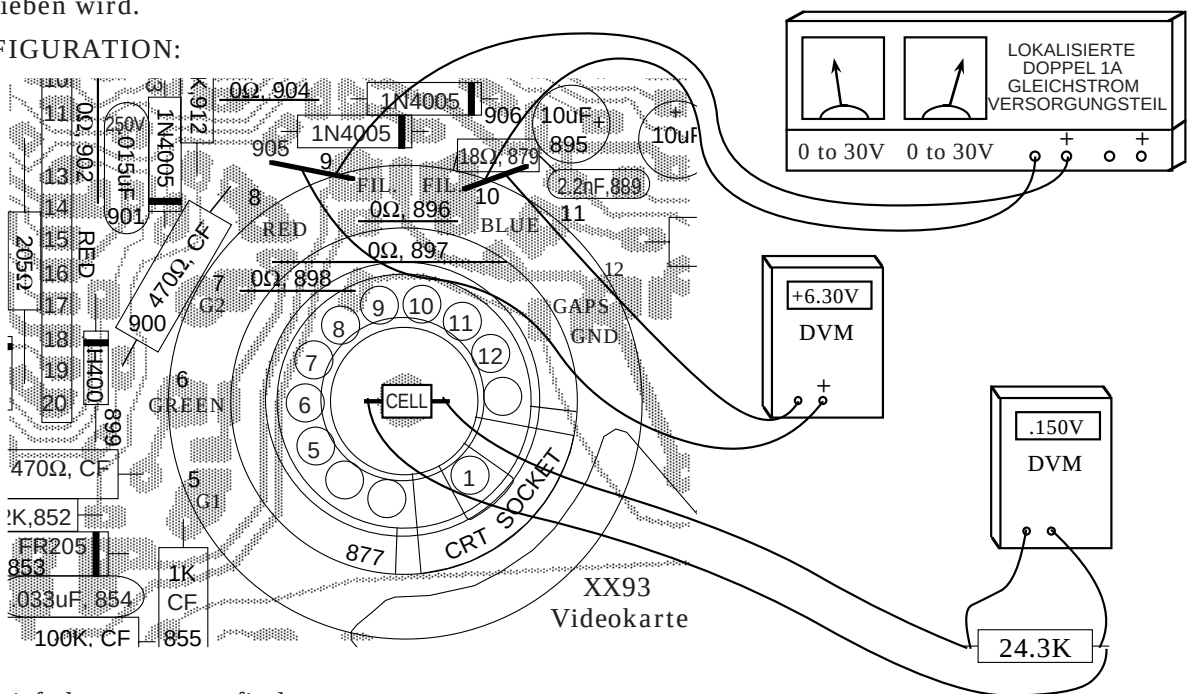
Wenn der EHT-Transformator oder die Videokarte geändert wird, kann die Heizfadenspannung falsch sein.

Die Heizfadenspannung besteht aus Hochfrequenzbestandteilen. Genaues Messen der Heizfadenspannung kann nicht mit einem Effektivwertmeßinstrument erhalten werden. Ein Oszillograph mit Effektivwertmessen-Fähigkeit kann benutzt werden, um die Heizfadenspannung zu messen.

Obgleich ein Sichtprüfen der Heizfadenfarbe eine Anzeige der Heizfadenspannung ist, ist es gutes üblich, die Heizfadenspannung zu überprüfen, wenn es irgendeinen Zweifel ,ber diesen wichtigen Monitorparameter gibt.

Der folgende Heizfadenspannung Test ist eine genaue Methode des Findens der zutreffenden Effektivwertspannung zum Heizfaden. Dieses wird vollendet, indem man die helle Ausgabe des Heizfadens vergleicht, wenn es durch den Monitor zur hellen Ausgabe des Heizfadens mit einer angewandten Gleichstromspannung mit einer einprogrammiert Fotozelle angetrieben wird.

KONFIGURATION:



Die Heizfadenspannung finden;

1. Löten Sie zwei kurze bussleitungen zu den Heizfadenanschlußstiften weich.
2. Benutzen Sie schwarzes Band, um die Fotozelle über der Bohrung im Plastik-CRT-Einfaßung Stecker zu sichern.
Vorsicht: Seien Sie sicher, die Fotozelle nicht zwischen die zwei Tests zu verschieben.
3. Speichern Sie die Gleichstromspannung, die von der Fotozelle mit dem Monitor ausgegeben wird, der normalerweise läuft. Der Monitor Muß laufen damit 10 Minuten die Heizfadenspannung messen.
4. Drehen Sie weg den Monitor Ab.
5. Schließen Sie die variable Spannung, 1 Ampere, Gleichstrom-Versorgung zum Heizfaden an. Das Negativ führen zu den Heizfaden, der am CRT-Einfaßung Anschlußstift 10 gerieben wird.
6. Stellen Sie die Versorgungsteilspannung auf das Fotozelle Messen ein, gespeichert in Jobstep 3.
7. Die gleichwertige Heizfadeneffektivwertspannung wird jetzt gespeichert, indem man die Gleichstromspannung an den CRT-Einfaßung Anschlußstiften 9 und 10 mißt.

SETUP AND CONVERGENCE PROCEDURE

1. Use a knife to brake free the magnetic rings on the yoke, which are usually locked with red varnish. Bring the adjustment tabs on each pair of magnetic rings in line for the starting point.
2. Loosen the yoke clamp. Remove the yoke wedges and the tape from the CRT.
3. Connect a test generator to the video input.
4. Turn the monitor on. Switch the test generator to red field. Adjust the horizontal and vertical raster size, on the remote control board, for under scan. Let the monitor run for at least half an hour.
5. Check the auto bright control voltage with a DVM. Connect the DMM to GND and pin 8 of the LM324 920 on the video board. The voltage range is 4.0V to 4.4V. If out of range, adjust this voltage to 4.2V by using pliers to rotate the bottom knob on the FBT.
6. Degauss the picture tube and front part of the frame.
7. Adjust the yoke position, on the CRT neck, to the center of purity. One way to locate this yoke position is to make a felt pen mark on the CRT neck at the rear extreme of purity and another mark at the front extreme of purity. Make a third mark between the two marks and set the yoke to this position. Rotate the yoke to line up, the raster top line, with the top of the picture tube. Tighten the yoke clamp. Tilt the yoke side to side and up and down while watching the red field to verify that purity is good.
8. If the yoke position adjustment does not produce good purity, adjust the purity magnets. Tabs closest to the yoke winding.
9. Switch the generator to the red/blue grid. Adjust the 4 pole magnets (center pair) for convergence of the red and blue guns in the center of the screen.
10. Tilt the yoke up and down for the best convergence around the edge of the grid. Insert the top yoke wedge. Tilt the yoke side to side for the best convergence around the edge of the grid and insert the rest of the yoke wedges. Secure the wedges with tape.
11. Switch the generator to the white grid. Adjust the 6 pole magnets (Pair closest to the video board) for convergence of the green gun. Step #10 and this step may have to be repeated for optimum convergence.
12. If the corner convergence is still not acceptable, shunts may be used to correct this problem.
Shunts are available from CERONIX.
Shunt order number is CPM2011.

CAUTION: To avoid electrical shock, take care not to touch the yoke conductors or push against the anode cap.

Always keep one hand free to avoid making a complete electrical circuit.

SETUP UND KONVERGENZ PROZEDUR

1. Benutzen Sie eine scharfes Messer, um die magnetischen Ringe auf dem Joch frei zu bremsen, die normalerweise mit rotem Lack gesperret werden. Holen Sie die Justagetabulatoren auf jedem Paar magnetischen Ringen in der Zeile für den Ausgangspunkt.
2. Lösen Sie den Klemmring des Jochs.
Löschen Sie die Jochkeile von der CRT.
Löschen Sie das Band von der CRT.
3. Schließen Sie einen Testgenerator an den videoinput an.
4. Schalten Sie den Monitor ein. Schalten Sie den Testgenerator zum roten Feld. Justieren Sie die horizontale und vertikale Rastergröße, mit dem Fernbedienungsbrett, für Unterscan. Lassen Sie den Monitorlauf für mindestens halbe Stunde.
5. Überprüfen Sie die helle Steuerselbstspannung mit einem DVM. Schließen Sie das DMM an erden und Anschlußstift 8 des LM324 920 auf der Videokarte an. Die Spannung Strecke ist 4.0V zu 4.4V. Wenn aus Strecke heraus, justieren Sie diese Spannung auf 4.2V, indem Sie Zangen verwenden, um den unteren Drehknopf auf dem FBT zu drehen.
6. Degauss die CRT und das Vorderteil des Monitorchassis.

VORSICHT: Um elektrischen Schlag zu vermeiden, berühren Sie nicht sich zu den Jochleitern oder -presse gegen die Anode Schutzkappe.

Halten Sie immer eine Hand frei beim Arbeiten auf Elektronik.
7. Justieren Sie das Joch auf die CRT, um Mitte der Reinheit zu erreichen.
Ein Weg, diese Joch Position zu finden, soll eine Kugelschreiber Markierung auf dem DATENSICHTGERÄT Hals an der Hinterseite und den vorderen Extremen der Reinheit machen.
Machen Sie eine dritte Markierung zwischen den zwei Markierungen und Satz das Joch zu dieser Position.
Drehen Sie das Joch auszurichten, die raster oberste Linie, mit dem Oberteil Rohr des Bilds.
Ziehen Sie die Joch Klammer fest. Kippen Sie die Joch Seite zu Seite und auf und ab während Zuschauen des roten Felds zu beglaubigen, daß jene Reinheit gut ist.
8. Wenn die Joch Position Regelung gute Reinheit nicht herstellt, stellen Sie den Reinheit Magneten ein. Diese sind die magnetischen Ringe der nächst Joch Winden.
9. Schalten Sie den Generator zum rot/blauem Raster. Stellen Sie den 4 Stange Magneten (Mitte Paar) für Zusammenlaufen vom roten und blauen in der Mitte des Schirms ein.
10. Kippen Sie das Joch auf und ab für das beste Zusammenlaufen um die Kante des Rasters. Fügen Sie den obersten Joch Keil ein. Kippen Sie die Joch Seite zu Seite für das beste Zusammenlaufen um die Kante des Rasters und fügen Sie den restlichen Joch Keile ein. Befestigen Sie die Keile.
11. Schalten Sie den Generator zum weißen Raster. Stellen den 6 Stange Magneten (Paaren nahst zum Videoausschuß) für Zusammenlaufen vom grünen. Schritt #10 und dieser Schritt können für das günstigste Zusammenlaufen wiederholt werden müssen.
12. Wenn die Eckkonvergenz noch nicht annehmbar ist, können Shunts benutzt werden, um dieses Problem zu beheben.

Shunts sind von CERONIX vorhanden. Shuntauftragsnummer ist CPM2011.



CERONIX, INC.
13350 New Airport Road
Auburn, California 95602-7419

Tel. (530) 886 - 6400
Fax. (530) 888 - 1065
WEB. www.ceronix.com

REPLACEMENT PARTS PURCHASE ORDER FORM

Date _____

Purchase Order No. _____ Requisition No. _____

Name _____

BILL TO			SHIP TO		
STREET & NO.			STREET & NO.		
CITY	STATE	ZIP	CITY	STATE	ZIP

Phone No. _____ Fax No. _____

Shipping Information _____

Comments _____

	CERONIX Part No.	Description	Quantity	Price
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Please copy form and fill in, parts order, on copy.

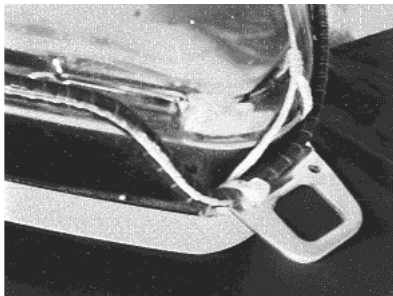
DEGAUSSING COIL ATTACHMENT SPECIFICATION.

For The Model 1493 Video Monitor.
Use degaussing coil part number CPS1766.

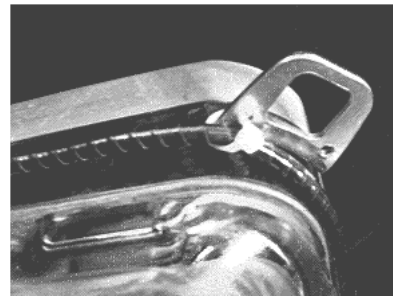
ATTACH THE
GROUNDING
STRAP FIRST.



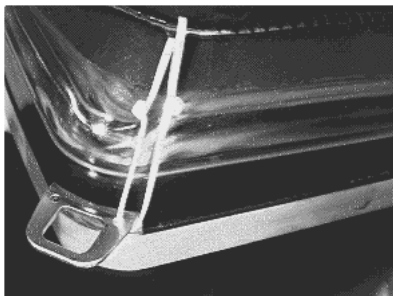
With the degaussing coil leads centered on the bottom of the CRT, FORM THE COIL to avoid the remote control board.



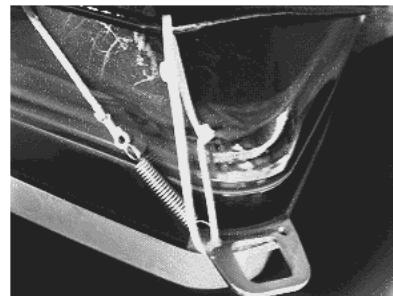
INSTALL A WIRE TIE through
the top hole in the left CRT ear.



INSTALL A WIRE TIE through
the top hole in the right CRT ear.



INSTALL WIRE TIES through
the bottom hole in the left CRT ear.



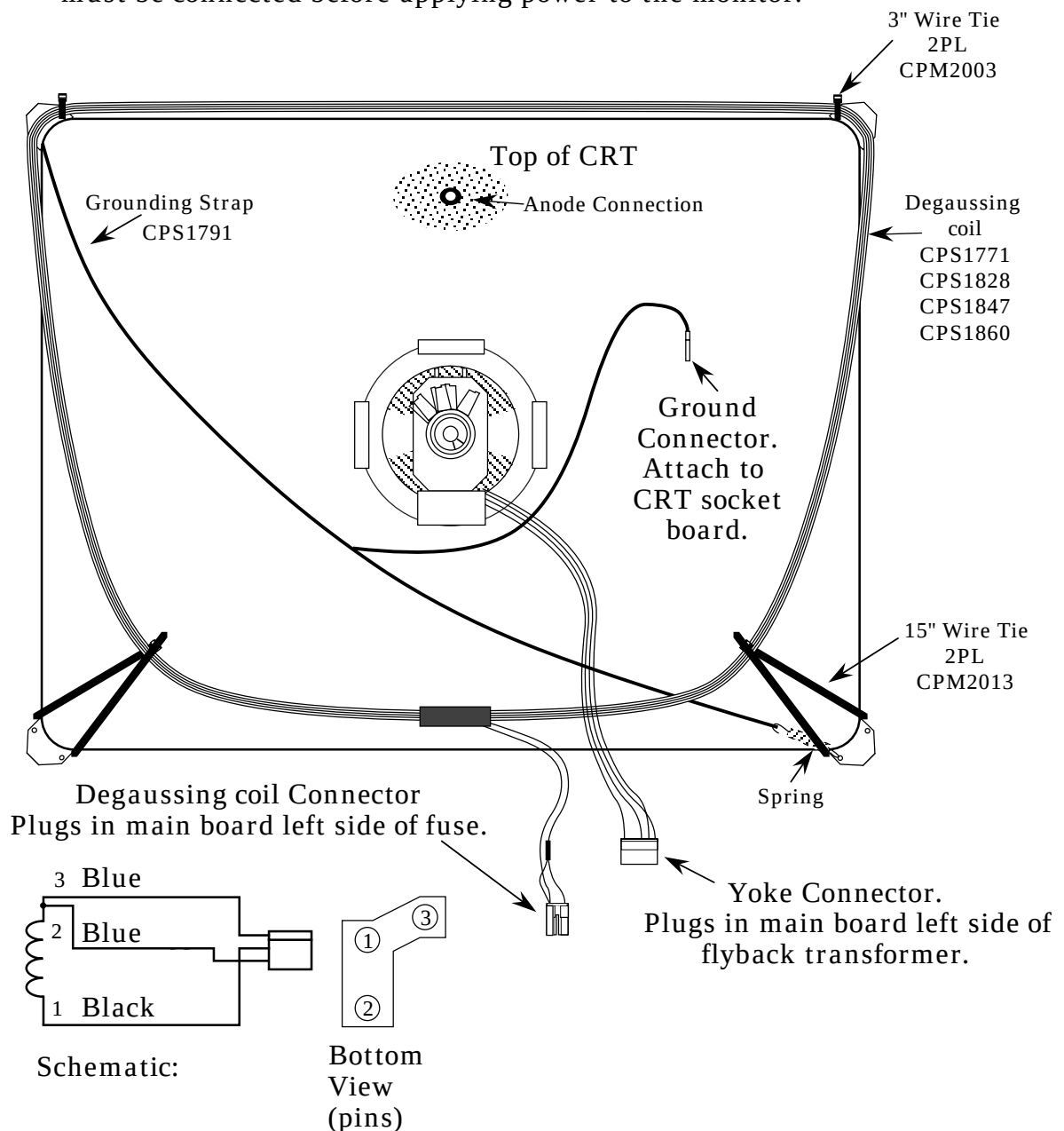
INSTALL WIRE TIES through
the bottom hole, with the
grounding strap spring, in the
right CRT ear.

Degaussing Coil & Grounding Strap Attachment Specification.

For The Model 1793, 1993, 2093 Video Monitor.

1. The first item to attach to the picture tube is the grounding strap. Lay the tube face down on a soft surface. Slide the folded over end of the braided wire over the top left CRT mounting ear (The braided wire is oriented to the left). Attach the spring at the other end to the left hole of the right bottom mounting ear.
2. Next attach the degaussing coil. Locate the connector wires at the bottom center of the CRT. Form the degaussing coil to the contour of the tube at the top two corners. Attach and tighten two 3" wire ties on the inside hole of the top two corners. Loosely attach two 15" wire ties around the degaussing coil and around the bottom ears. Tighten the wire ties.

CAUTION: The ground cable from the enclosure to the monitor chassis must be connected before applying power to the monitor.

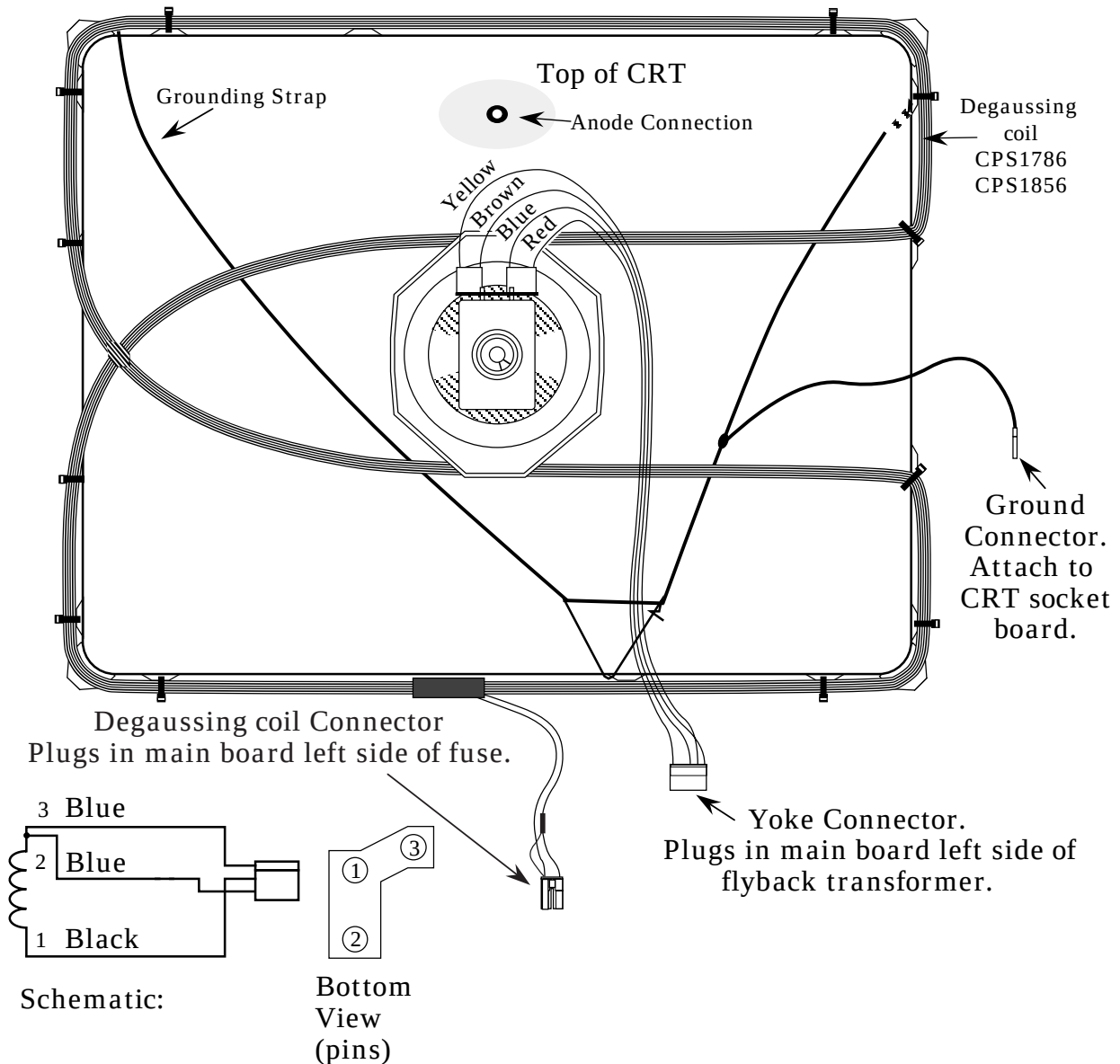


Degaussing Coil & Grounding Strap Attachment Specification.

For The Model 2793 and 3693 Video Monitor.

1. The first item to attach to the picture tube is the grounding strap. Lay the tube face down on a soft surface. Slide the folded over end of the braid over the left top CRT mounting ear. Attach the spring at the other end to the, right side top, slot in the rimband. Pull the bare wire through the bottom slot in the rimband (tension the spring) and back around the braid. The coils of the spring should measure about 1.25".
2. Next attach the degaussing coil. Locate the connector wires at the bottom center of the CRT. Loosely attach the degaussing coil with 5" wire ties as shown below. Adjust the coil for an equal size top and bottom coil half. Tighten the wire ties.
3. Plug the yoke connectors on the yoke as shown below.

CAUTION: The ground cable from the enclosure to the monitor chassis must be connected before applying power to the monitor.

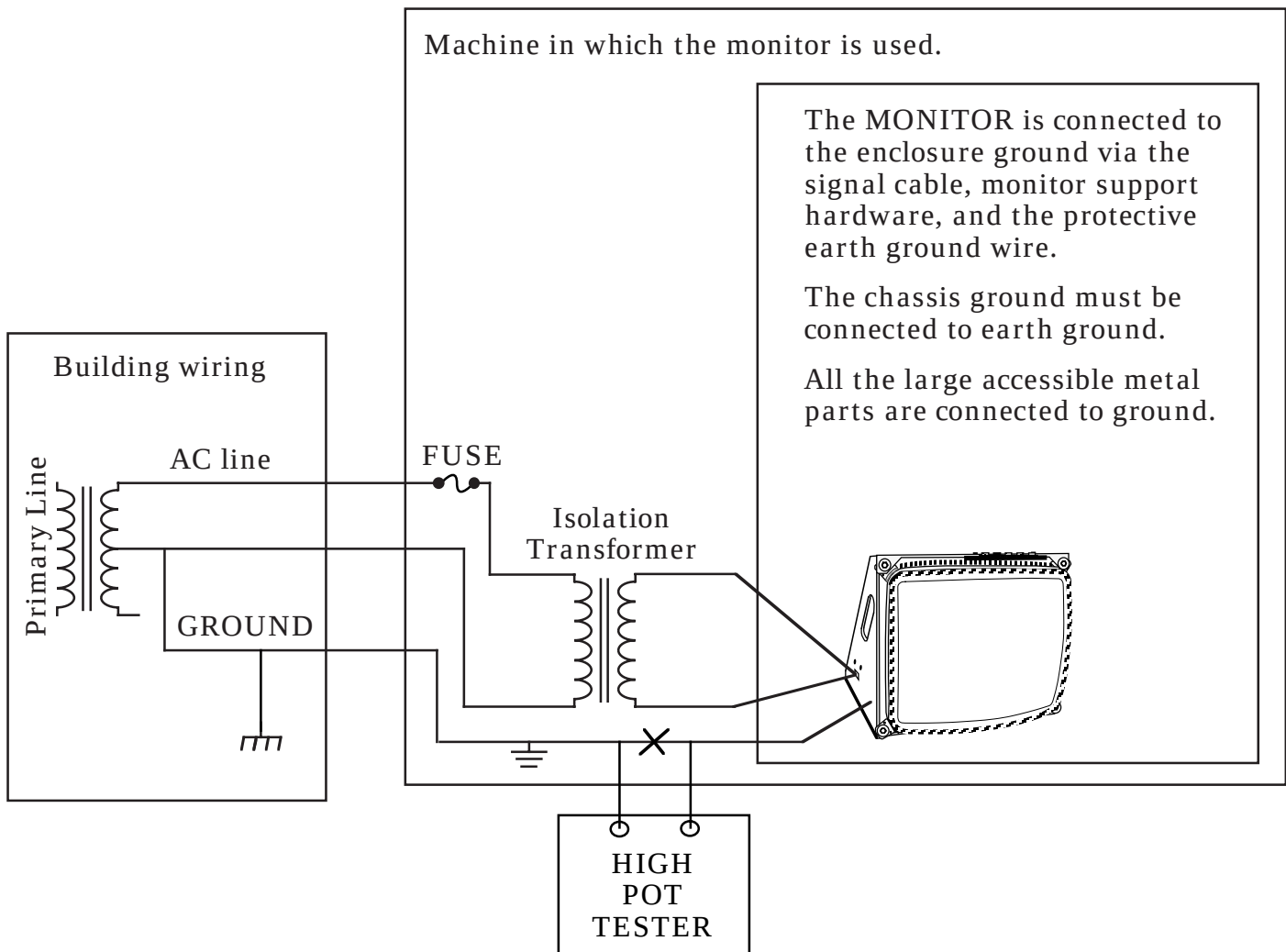


Highpot, For Shock Hazards, Circuit Description.

For the models 1493,1793, 1993, 2093, 2793, and 3693 video monitors.

It is the responsibility of the company which uses the Ceronix monitor in there system to make sure that no shock hazards exist. Below is a description of the highpot test to verify that the monitor is properly connected to an isolation transformer.

Once the monitor is installed in the enclosure, the protective earth ground connection must be connected. The connection point is located on the inside of the main board metal frame behind the serial number label.

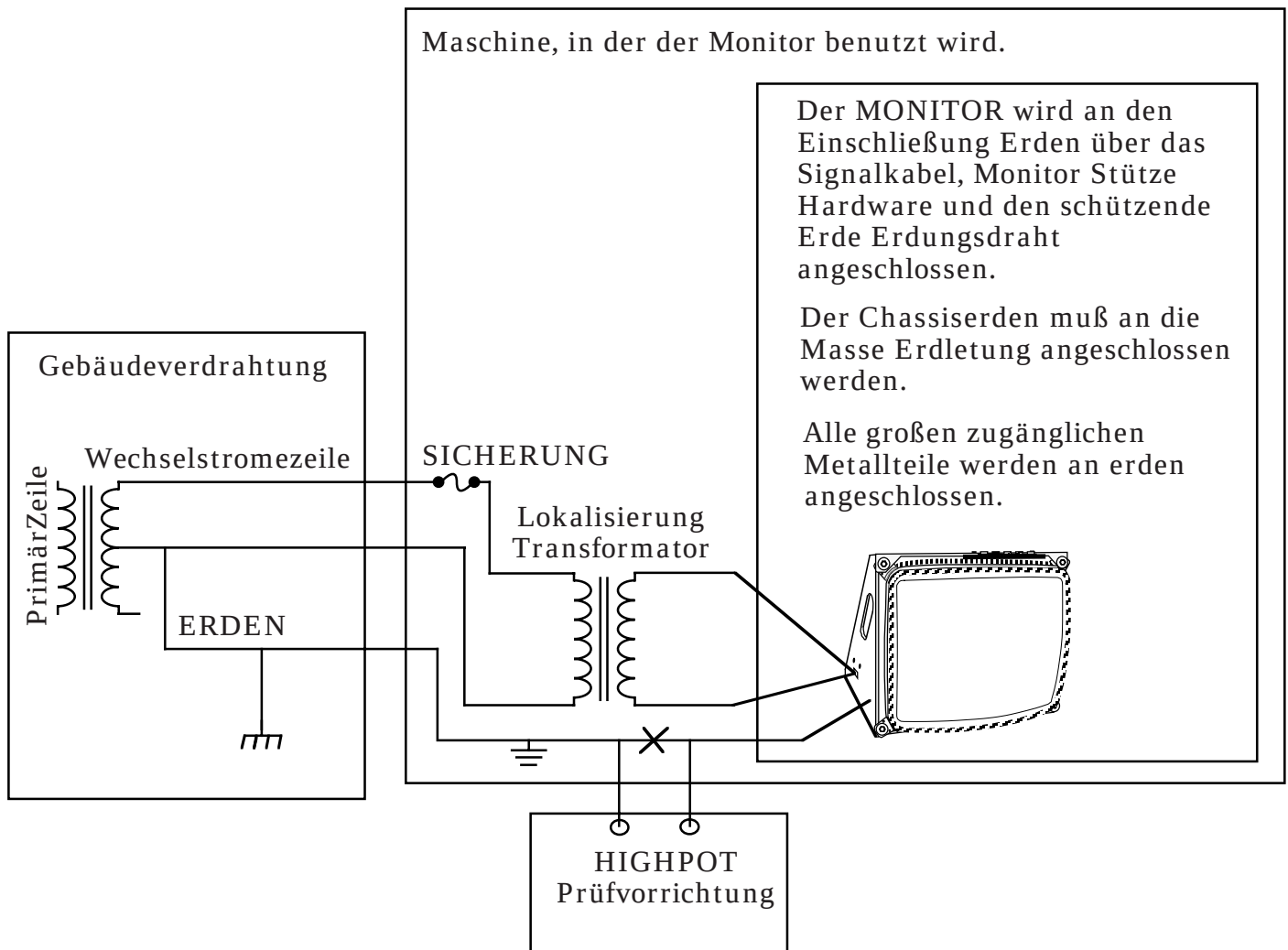


Highpot, Für Schock Gefahren, StromkreisBeschreibung.

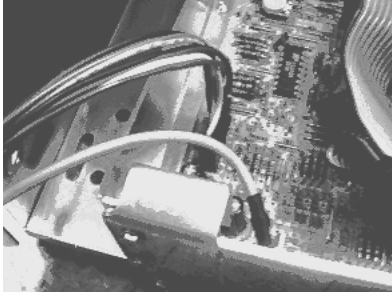
Für die Modelle 1493,1793,1993,2093,2793, und 3693 videomonitoren.

Es ist die Verantwortung der Firma, die den Ceronix Monitor in dort system benutzt, sich zu vergewissern, daß kein Schock Gefahren existieren. Unten ist eine Beschreibung Prüfung des highpot zu beglaubigen, daß der Monitor ordentlich an einen Isolierung Umformer angeschlossen wird.

Nachdem der Monitor in der Einschließung installiert wird, muß der schützende Erde Erdanschluß verbunden werden. Der Anschluß Punkt wird sich auf dem innerhalb des Hauptausschusses Metalls Rahmens hinter dem Seriennummer Etikett befunden.



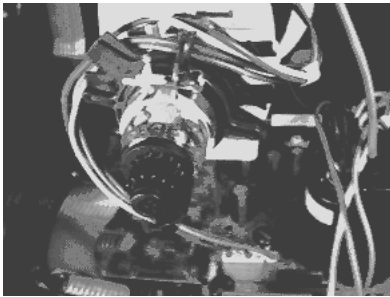
Wire Routing Instructions.



Attach the protective earth, green / yellow, ground wire.



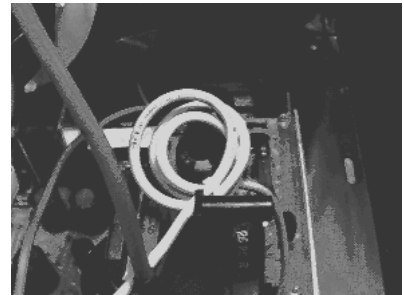
Fold remote cable to clear CRT and add wire tie.



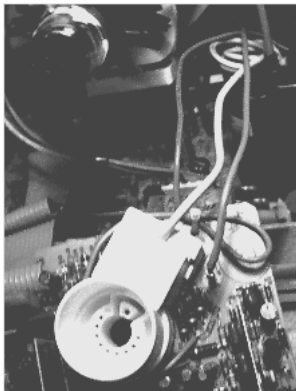
Route yoke wires over CRT neck.



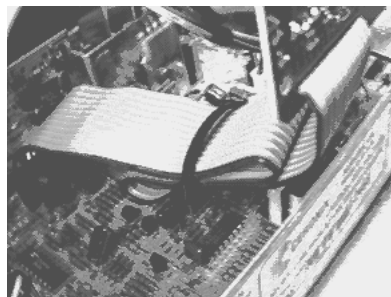
Shorten EHT wire and add wire tie.



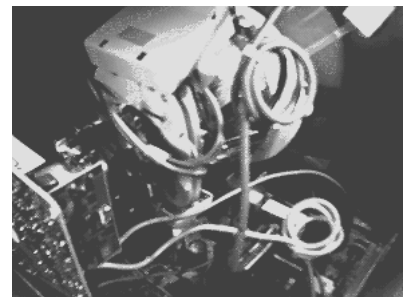
Shorten focus wire and add wire tie.



Route G2 wire around CRT socket, shorten with loop, and add wire tie.



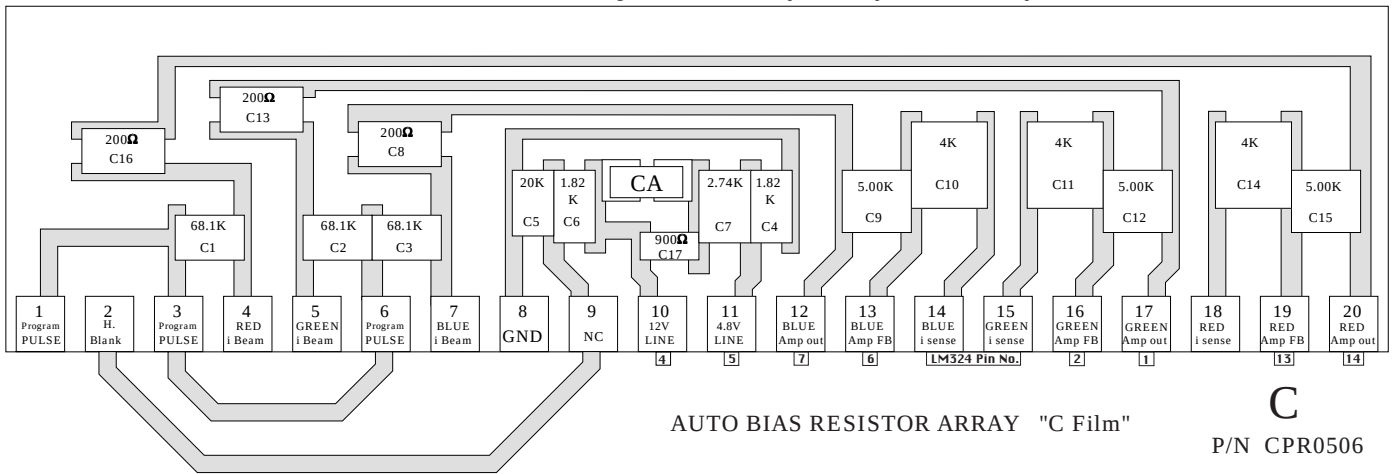
Plug in video board. Fold video flat cable to avoid contacting the metal frame. Secure fold with a wire tie.



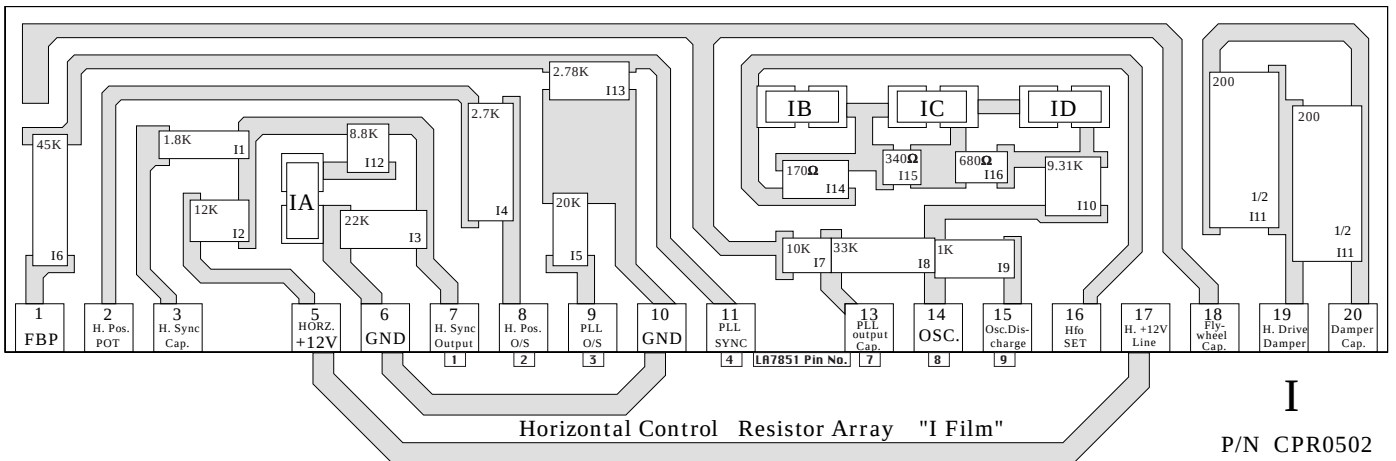
Finished assembly with the different voltage type wires not touching each other.

Precision Resistor Arrays (PRAs).

Make solder connection CA when using these C PRAs for replacement parts on the XX92 product line.



IA - Inverts Horizontal Sync. IB, IC, & ID Adjust the Horizontal Oscillator Frequency. For 31.5KHz Operation; IB=Hfo +400 Hz, IC=Hfo +800Hz, & ID=Hfo +1,600Hz.

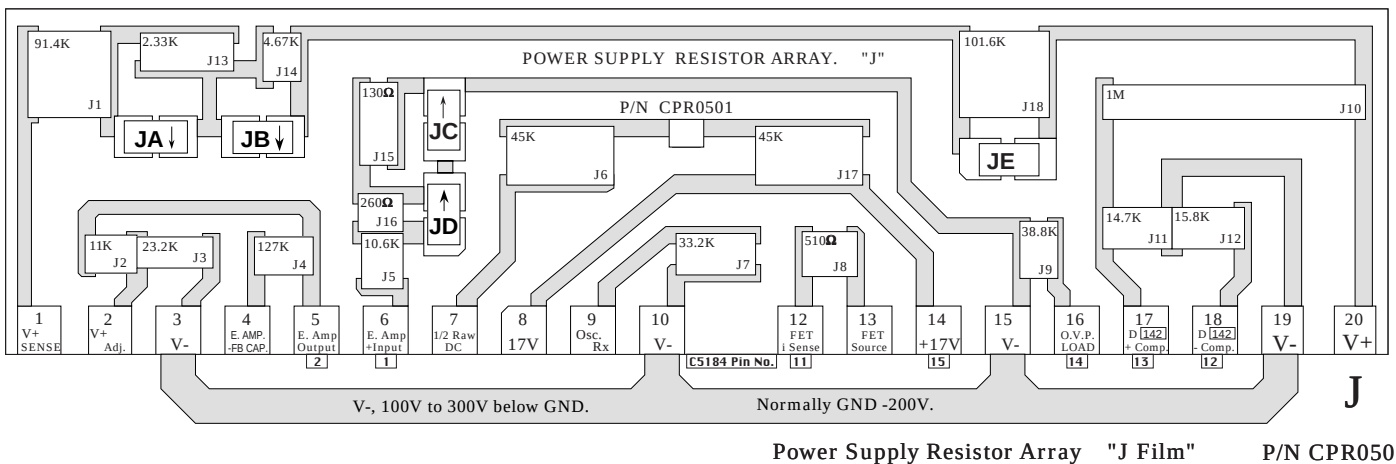


JA - Decreases V+ line by 1.5V

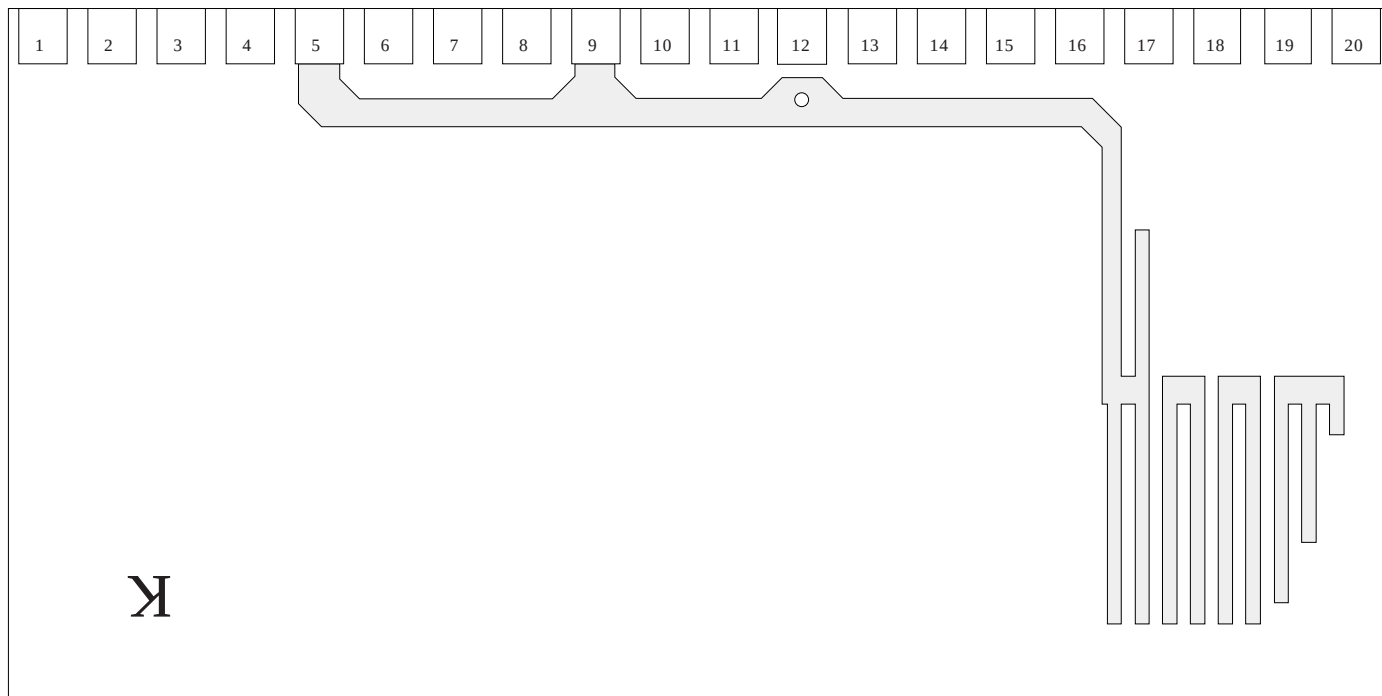
JC - Increases V+ line by 1.5V

JB - Decreases V+ line by 3V

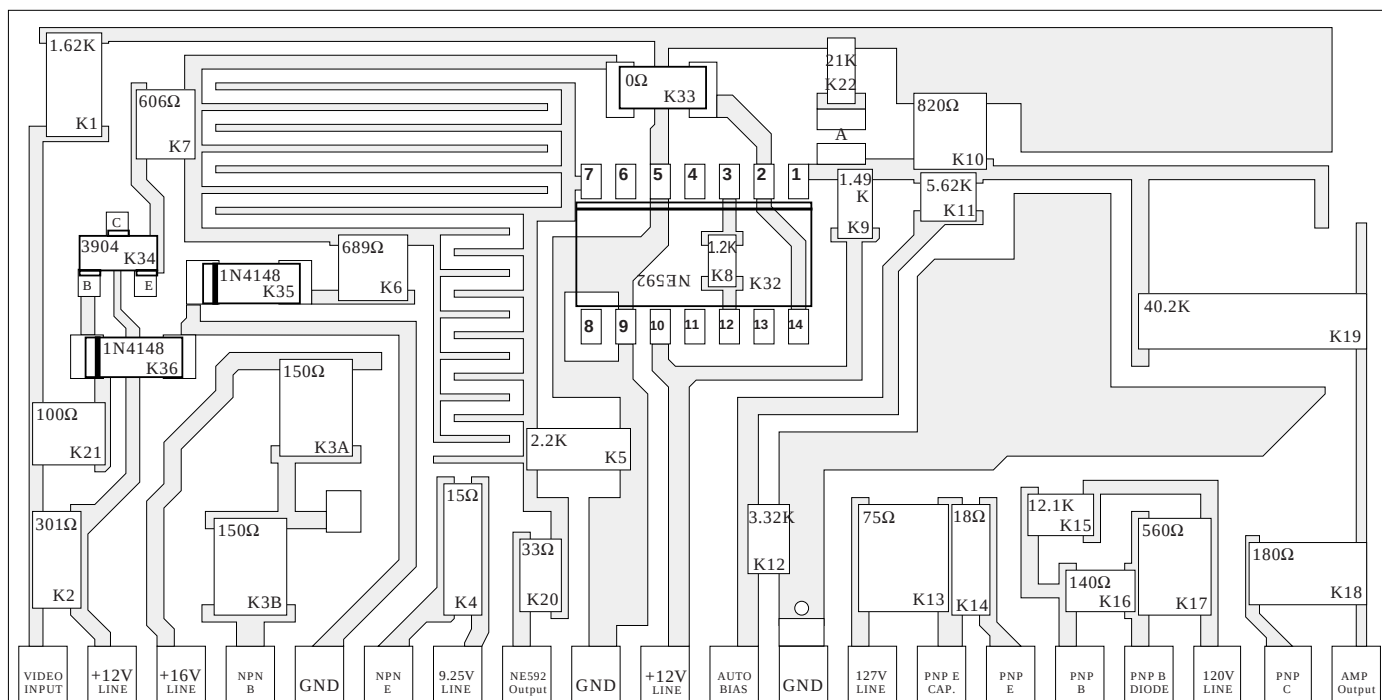
JD - Increases V+ line by 3V



Precision Resistor Arrays (PRAs).

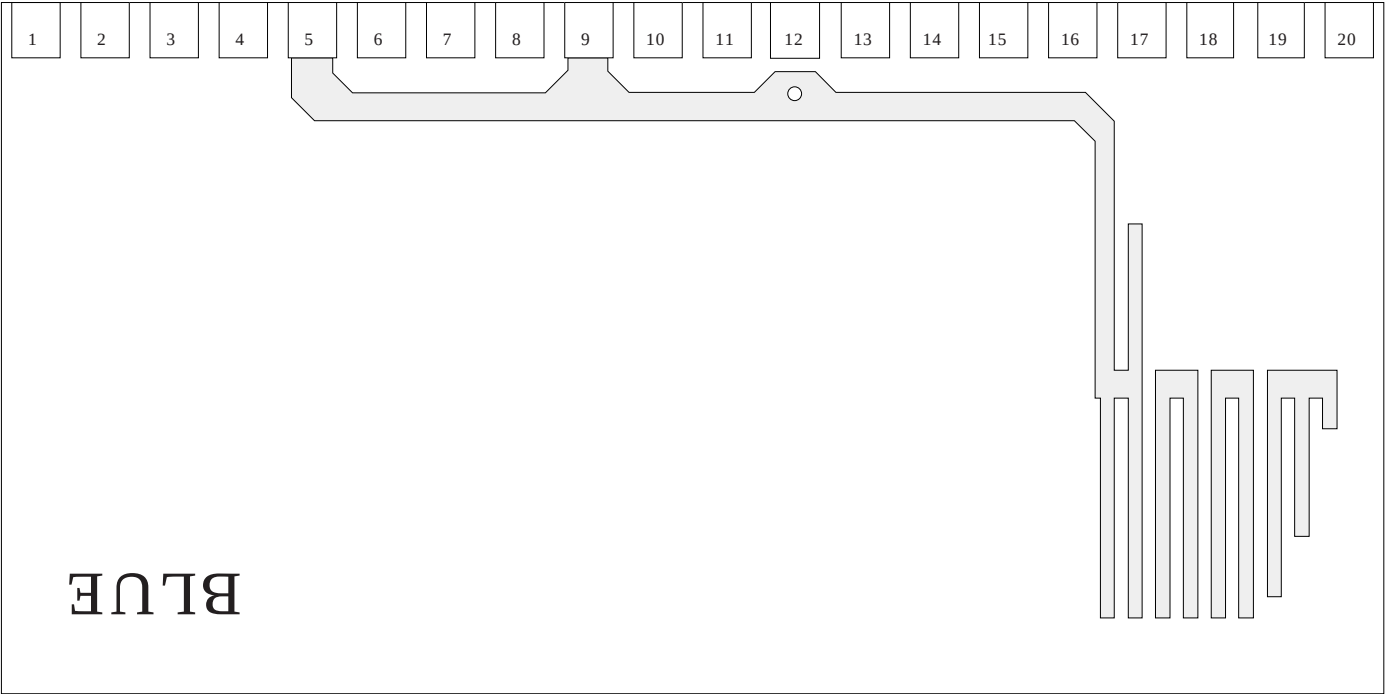


A - Increases Output Voltage by 10V

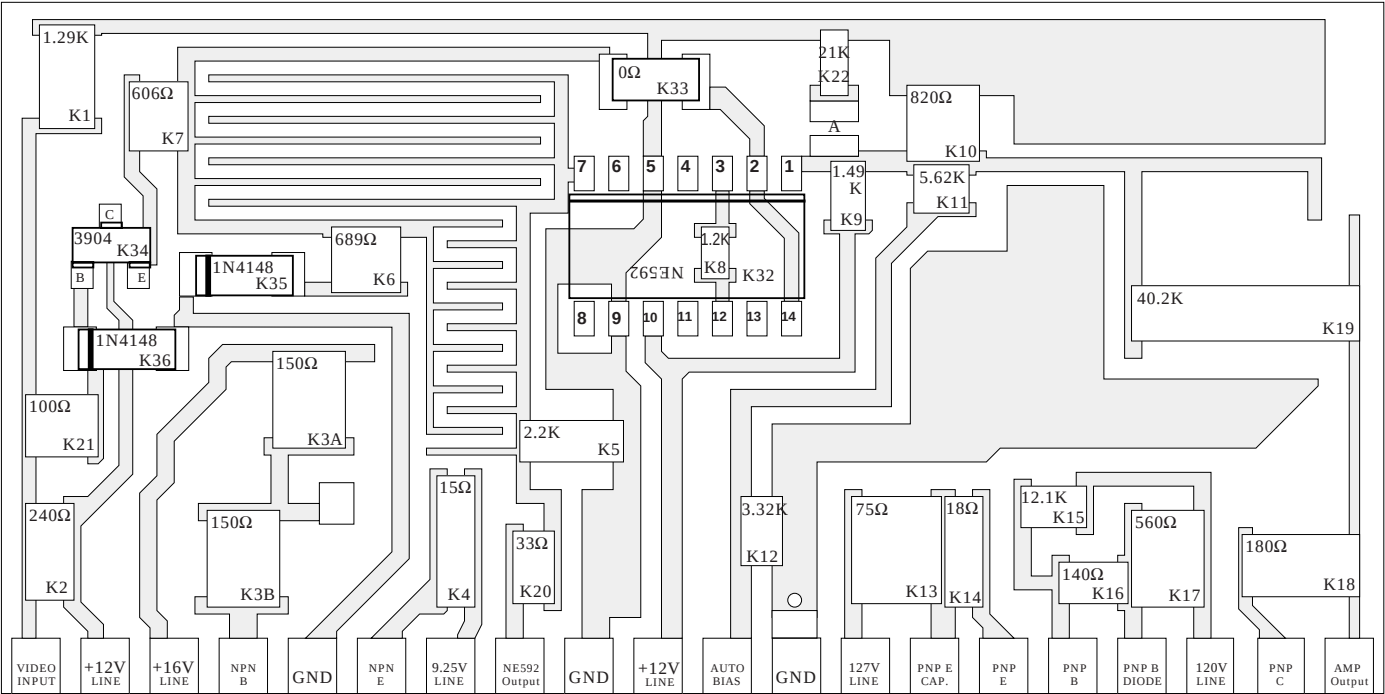


Video Amplifier Resistor Array "K Film" **K**
P/N CPR0510

Precision Resistor Arrays (PRAs).

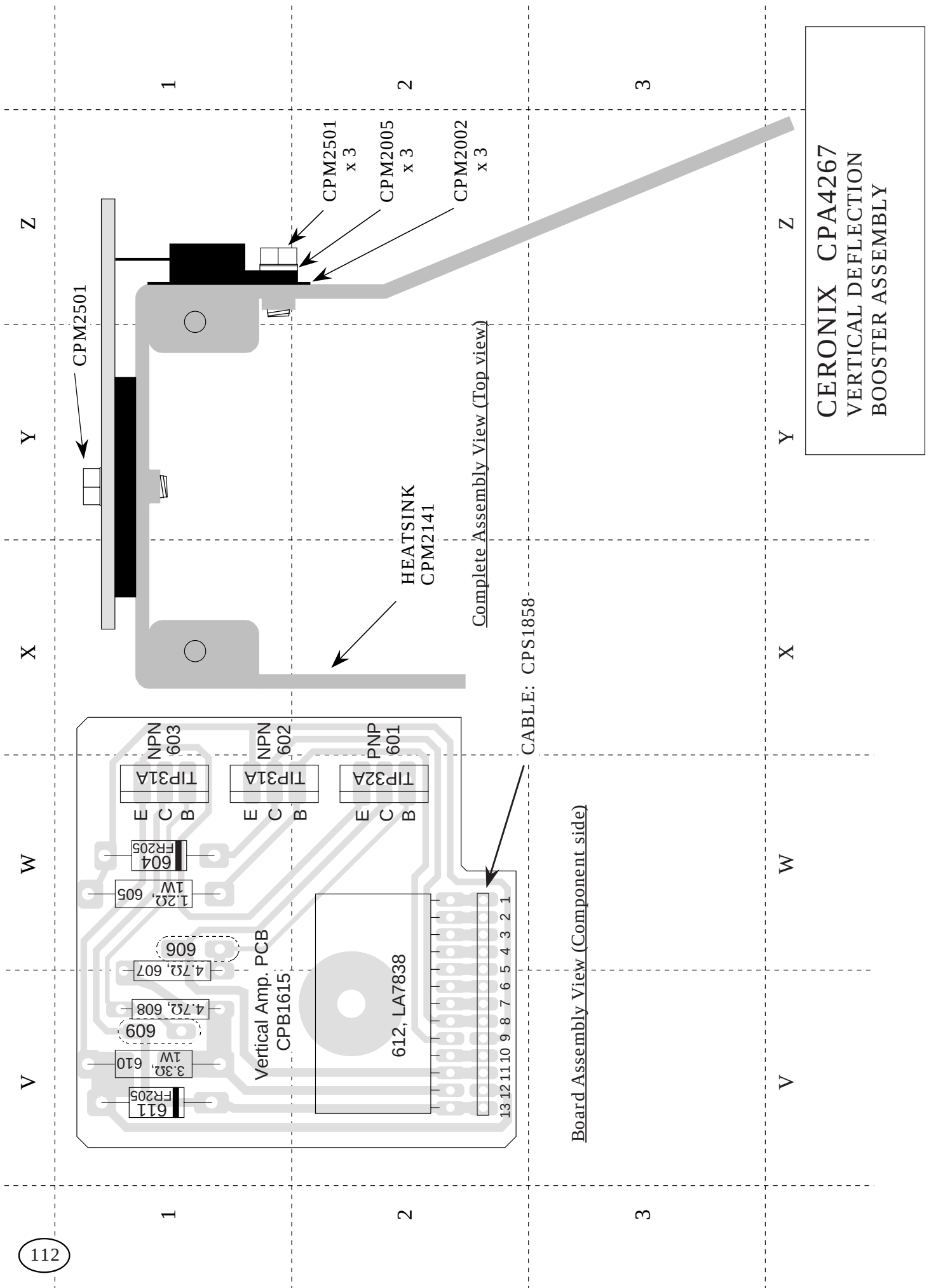


A - Increases Output Voltage by 10V



BLUE

Video Amplifier Resistor Array "BLUE Film" P/N CPR0511



CERONIX CPA4267
VERTICAL DEFLECTION
BOOSTER ASSEMBLY

The "Drive Signals To The Monitor Input" form is included here for those people who have problems interfacing their drive electronics with the Ceronix Monitor.

DRIVE SIGNALS to the MONITOR INPUT voltage and waveforms, work sheet.

CERONIX
13350 New Airport Road
Auburn, CA, USA 95602-7419
Fax (530) 888-1065

Company name: _____
Date: _____

For CERONIX Monitor
Model number: _____

VIDEO: For the following measurements use an oscilloscope.

With no load, the black level voltage of the video drive signal is:

With no load, the saturated color voltage is:

RED	GREEN	BLUE

To simulate the monitor input resistance.

With 75 Ω load on the video drive signal
or other _____ Ω load.

the black level voltage is:

the saturated color voltage is:

RED	GREEN	BLUE

If available, sketch the video drive circuit on the back of a copy of this form.

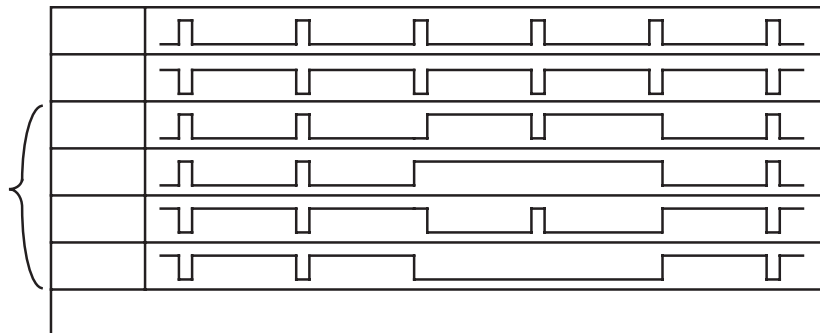
Horizontal or composite sync:

Horizontal frequency: _____ KHz "High" voltage: _____ V
Horizontal sync pulse time: _____ μ S "Low" voltage: _____ V

Compare your sync to
this table and check
the best fit.

For composite sync.

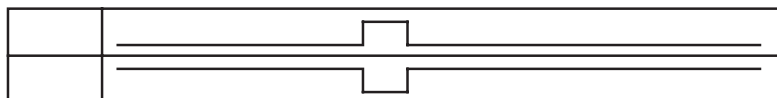
Sketch if different.



Vertical sync:

Vertical frequency: _____ Hz "High" voltage: _____ V
Vertical sync pulse time: _____ μ S "Low" voltage: _____ V

Check correct polarity.



If there are any questions,
call (530) 886-6400.

Complete form and send to:
or FAX us (530) 888-1065

CERONIX, INC.
13350 New Airport Road
Auburn, CA. 95602-7419

DECLARATION OF CONFORMITY

Manufacturer: C. CERONIX

13350 New Airport Road
Auburn, California 95602
USA

Equipment: Component Color Monitor.

Models: 1493-CGA, 1493-VGA, 1493-SVGA.
1793-VGA, 1793-SVGA.
1993-VGA, 1993-SVGA.
2093-CGA, 2093-VGA.
2793-CGA, 2793-VGA.
3693-CGA.

Component Isolation Transformer Assembly.
Models: ISOXFR-75W, ISOXFR-100W.

Standards: IEC 60950, 3rd Edition

'National Differences: AT, AU, CA, DE, ES, FR, GB, HU, RU, US, ZA.'

CAS/CAN 60950-00

UL 60950, 3rd Edition

IEC 65:85 + A1:87 + A2:89 + A3:92, 5th Edition

'National Differences: KR.'

I hereby declare that the equipment named above has been tested and found to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the standards. The declaration is issued under the sole responsibility of the manufacturer.

Authorized

Signatory: Don Whitaker



Title: President

Date: February 26, 2002





Models: ISO XFR-75W
ISO XFR-100W

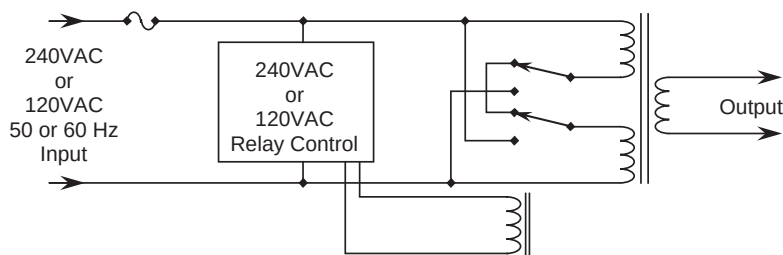
SAFETY ISOLATING TRANSFORMER

Circuit Function Description.

The basic function of the ISO XFR-75W and ISO XFR-100W is to isolate the line power for monitors requiring an isolation transformer.

The transformer is designed to have a low leakage flux value which allows it to be mounted close to the CRT. To accomplish the low leakage flux, the transformer has two sets of primary and secondary coils mounted on a modified toroid type core. The ideal transformer would be a toroid but this type transformer is expensive because it is difficult to wind.

A relay is used to connect the two primary coils in series or parallel to accommodate 240VAC or 120VAC line voltages. Before power is applied, the relay connects the transformer primary windings in series to avoid excessive primary current for the 240VAC case. The control circuit energizes the relay when the line voltage is 120VAC.



Circuit Description.

The fuse **T506** protects the mains wires and the control PCB.

The power transformer has two internal 2 amp temperature sensitive fuses.

Each primary half has one, built in, series connected fuse.

A resettable fuse **T507** is connected to the relay driver power supply.

This fuse protects the relay control circuit from square wave input which would occur if an inverter is used as the power source. Capacitor **T512** supplies current from the line to capacitor **T513** through diode **T510** which forms the, relay control, power supply. Diode **T511** charges capacitor **T512** during the negative going part of the line wave. Transient Voltage Suppressor **T516** regulates the 24V power supply and protects the relay coil from over heating.

The Mos Fet **T514** shorts out the 24 volt power supply when the input line voltage is 240VAC.

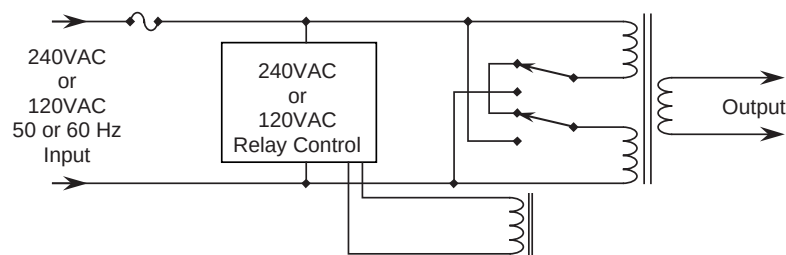
The input line voltage, at which the Mos Fet turns on, is set by the Mos Fet turn on voltage (about 4V), the voltage drops across resistors **T509**, **T505**, **T504**, and the zener diode **T503**. 154VAC is the approximate line voltage at which the relay **T518** switches. Capacitor **T508** and diode **T502** keep the Mos Fet turned on for the complete AC cycle to eliminate ripple current in the capacitor **T513**.

Resistor **T504** limits the peak current to capacitor **T508** to avoid relay switching due to line transients. The zener diode **T515** which is connected from the Mos Fet source to gate protects the Mos Fet gate against over voltage. Resistor **T519** is needed to limit the mains current when the relay arcs across both sets of contacts. Capacitors **T517** and **T520** reduce the relay **T518** contact noise which may be generated when switching.

Stromkreisfunktion Beschreibung

Die grundlegende Funktion des XFR75W und des XFR100W ist, die Zeile Energie für die benötigten Monitore und Lokalisierung Transformator zu lokalisieren. Der Transformator wird entworfen, um einen niedrigen Durchsickernflusswert zu haben, der erlaubt, daß er nah an der CRT eingehangen wird. T vollenden den niedrigen Durchsickernfluß, hat der Transformator zwei Sets der Primär- und Sekundärspulen, die an einem geänderten Ringkörperartkern eingehangen werden. Der ideale Transformator würde ein Ringkörper sein, aber diese Art des Transformators ist kostspieliges becuase zu wickeln, das ist schwierig.

Ein Relais wird benutzt, um die zwei Primärspulen in den Serien oder in der ähnlichkeit anzuschließen, um Spannungen der Zeile anzupassen 240VAC oder 120VAC. Bevor Energie angewendet wird, schließt das Relais die Transformatorprimärwicklungen in den Serien an, um übermäßigen Primärstrom für den Fall 240VAC zu vermeiden. Der Steuerstromkreis versorgt das Relais mit Energie, wenn die Zeile Spannung 120VAC ist.



Stromkreis Beschreibung

Die Sicherung [T506] schützt die Hauptleitungen Leitungen und das Steuer-cPwb. Der Leistungstranformator hat zwei interne 2-Ampere-temperaturempfindliche Sicherungen. Jede Primärhälfte hat ein, das in der angeschlossenen Serie aufgebaut wird, fixieren. Eine rückstellbare Sicherung [T507] wird an das Relaisreiber. Versorgungsteil angeschlossen. Diese Sicherung schützt den Relaissteuerstromkreis vor quadratischem Welle Input, der auftreten würde, wenn ein Inverter als Energiequelle benutzt wird. Kondensator [T512] gibt Strom von der Zeile an Kondensator [T513] durch Diode [T510] an, die das Relaissteuer. Versorgungsteil bildet. Kondensator [T512] Ladungen der Diode [T511] während des negativen gehenden Teils der Zeile Welle. Vorübergehender Spannung Entstörer [T516] regelt das 24V Versorgungsteil und schützt die Relaispule vor der überhitzung. Das MosFet [T514] schließt aus dem 24 Volts. Versorgungsteil kurz, wenn die Inputzeile Spannung 240VAC ist.

Die Inputzeile Spannung, an der das MosFet einschält, wird durch das MosFet einschalten Spannung eingestellt (über 4v). Die Spannung fällt über Widerstände [T509], [T505], [T504] und die zenerdiode [T503]. 154 VAC ist die ungefähre Zeile Spannung, an der das Relais [T518] schält. Kondensator [T508] und Diode [T502] halten das MosFet eingeschalten, damit die komplette Wechselstromschleife den Kräuselungstrom in den Begrenzungen Kondensator [T513]. Resistor [T504] der Spitzenstrom zum Kondensator [T508] beseitigt, um das Relaischalten wegen der Zeile Ausgleichströme zu vermeiden. Die zenerdiode [T515], die von der MosFet-Quelle an Gatter angeschlossen wird, schützt das MosFet-Gatter gegen überspannung. Widerstand [T519] ist erforderlich, den Hauptleitungen Strom zu begrenzen, wenn das Relais über beiden Sets Kontakten einen Bogen bildet. Kondensatoren [T517] und [T520] verringern die Kontaktgeräusche des Relais [T518], die beim Schalten festgelegt werden kann.

WARNING! Grounding of the monitor is to be evaluated in the end user application.

Installation Instructions.

1. Mount the unit on a, grounded, flat metal surface using at least two screws.
Note; The mounting surface should not have holes larger than 0.2" diameter under the enclosure.
2. Connect the mains cable to the Molex plug mounted on the enclosure.
3. Connect the output cable from the unit to the monitor power input connector.

AVERTISSEMENT. La mise à la terre de l'écran doit être évaluée dans le produit fini.

Instructions d'installation

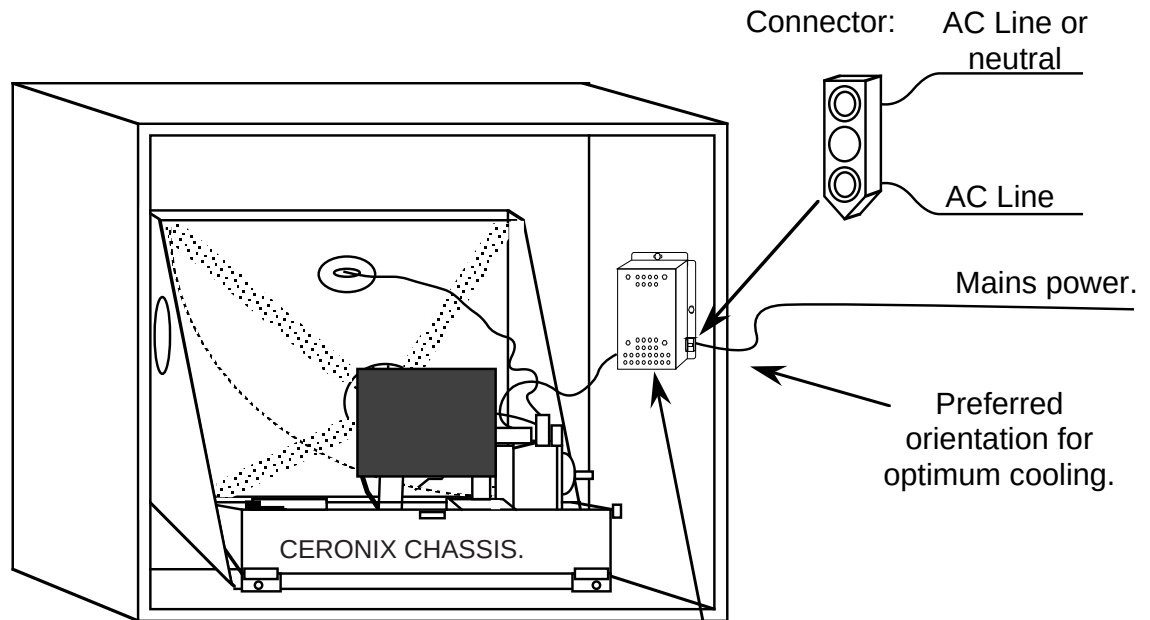
1. Fixer l'appareil à une surface métallique plane et mise à la terre par au moins deux vis. Note. La surface de montage ne doit pas présenter de trous de plus de 5.1mm (0.2 po) sous le boîtier.
2. Raccorder le câble du secteur à la prise molex sur le boîtier.
3. Raccorder le câble de sortie de l'appareil au connecteur d'entrée de l'écran.

WARNING! Die Erdung des Monitors soll in die Endbenutzeranwendung ausgewertet werden.

Installationsanweisungen

1. Stellen Sie die Einheit auf einer geerdeten, flachen Metalloberfläche Gebrauch wenigstens zwei Schrauben auf.
Anmerkung: Die Oberfläche soll Löcher größer als 0.2" in Durchmesser nicht haben.
2. Verbinden Sie das haupt ac Spannung Kabel zum Molex Verbinder auf der Transformator.
3. Verbinden Sie das Ausgangskabel vom Transformator zur Kraft Verbinder des Monitors.

INSTALLATION of the ISO XFR-75W, ISO XFR-100W ISOLATION TRANSFORMERS.



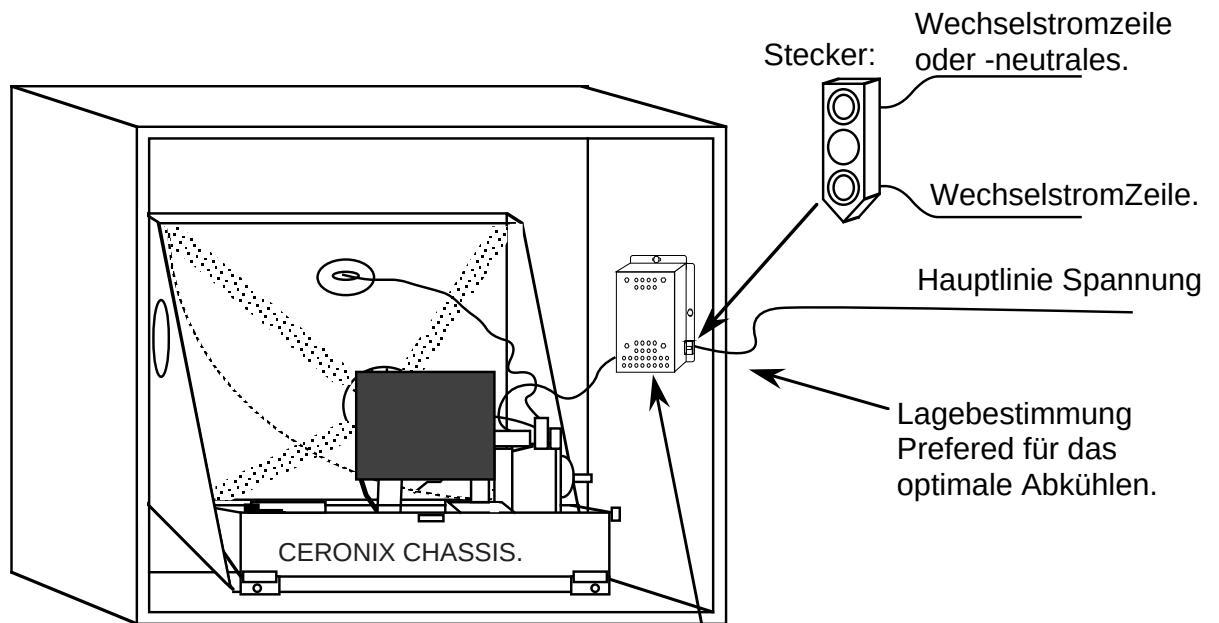
The ISO XFR-75W/-100W MUST be grounded by mounting on a grounded, conductive surface via at least two screws.

WARNING: Mains power and ground connections must be made before power is applied to the ISO XFR-75W or the ISO XFR-100W Isolation Transformers.

WARNING: FOR CONTINUED SAFETY, REPLACE SAFETY CRITICAL COMPONENTS ONLY WITH MANUFACTURER'S RECOMMENDED PARTS (REFER TO SERVICE LITERATURE).

AVIS: POUR MAINTENIR LE DEGRE DE SECURITE DE L'APPAREIL NE REMPLACER LES COMPOSANTS DONT LE FONCTIONNEMENT EST CRITIQUE POUR LA SECURITE QUE PAR DES PIECES RECOMMANDEES PAR LA FABRICANT (CONSULTER LE GUIDE DE DEPANNAGE).

INSTALLATION Isolierung Transformator des XFR75W und des XFR100W.



Das XFR75W und das XFR100W müssen geerdet werden, indem man an einer geerdeten, leitenden Oberfläche mit mindestens zwei Schrauben einhängt.

WARNING: Haupt ac Kraft und Erdanschlüsse müssen gemacht werden, bevor Spannung für DEN XFR75W oder Den XFR100W Isolierung transformator gegolten wird

WARNING: Zu anhaltender Sicherheit ersetzen Sie Sicherheit kritische Bestandteile nur durch empfohlene Teile des Herstellers (Siehe Service-Literatur).

Model ISO XFR-75W Specifications.

Electrical:

Rating;	Input	Output	Notes:
Volts; 120VAC	108VAC to 132VAC	108VAC to 146VAC	} Output wired for 120VAC.
Volts; 240VAC	216VAC to 264VAC	108VAC to 146VAC	
Volts; 120VAC	108VAC to 132VAC	216VAC to 292VAC	} Output wired for 240VAC.
Volts; 240VAC	216VAC to 264VAC	216VAC to 292VAC	
Frequency	50Hz to 60Hz	50Hz to 60Hz	Input = output.
Power	.84 Watts Maximum	0VA	No Load.
Power	100VA	75VA	Full Load.
Capacitance	250pF input to output.		
Highpot Voltage	3,000VAC input to output.		

Environmental:	Operating temperature range is -20°C to +60°C.
	Storage temperature range is -25°C to +70°C.
	Operating humidity; 20% to 80% (Noncondensing).

Mechanical:

Unit weight: 4.2Lb 1.91Kg

Enclosure dimensions:

0.20" DIA. holes on a 0.40" grid.

0.20" DIA. X .375" DIA. 4 PL.

0.092"

0.328"

0.50"

2.10"

1.83"

0.25"

2.94"

6.38"

2.94"

0.25"

0.25"

3.66"

4.25"

4.75"

5.26"

0.56" 4 PL.

0.56" 4 PL.

2.10"

0.933"

0.45"

0.32"

0.375"

MATERIAL: .052" THICK 18AWG MILD STEEL.
FINISH: CLEAR ZINC COATING
TOLERANCE: ±0.015" Except where noted.
DIMENSIONS IN INCHES.

Model ISO XFR-100W Specifications.

Electrical:

Rating;	Input	Output
Volts; 120VAC	108VAC to 132VAC	108VAC to 146VAC
Volts; 240VAC	216VAC to 264VAC	108VAC to 146VAC
Volts; 120VAC	108VAC to 132VAC	216VAC to 292VAC
Volts; 240VAC	216VAC to 264VAC	216VAC to 292VAC
Frequency	50Hz to 60Hz	50Hz to 60Hz
Power	1.24 Watts Maximum	0VA
Power	125VA	100VA
Capacitance	275pF input to output.	
Highpot Voltage	3,000VAC input to output.	

Notes:

} Output wired for 120VAC.

} Output wired for 240VAC.

Input = output.

No Load.

Full Load.

Environmental:

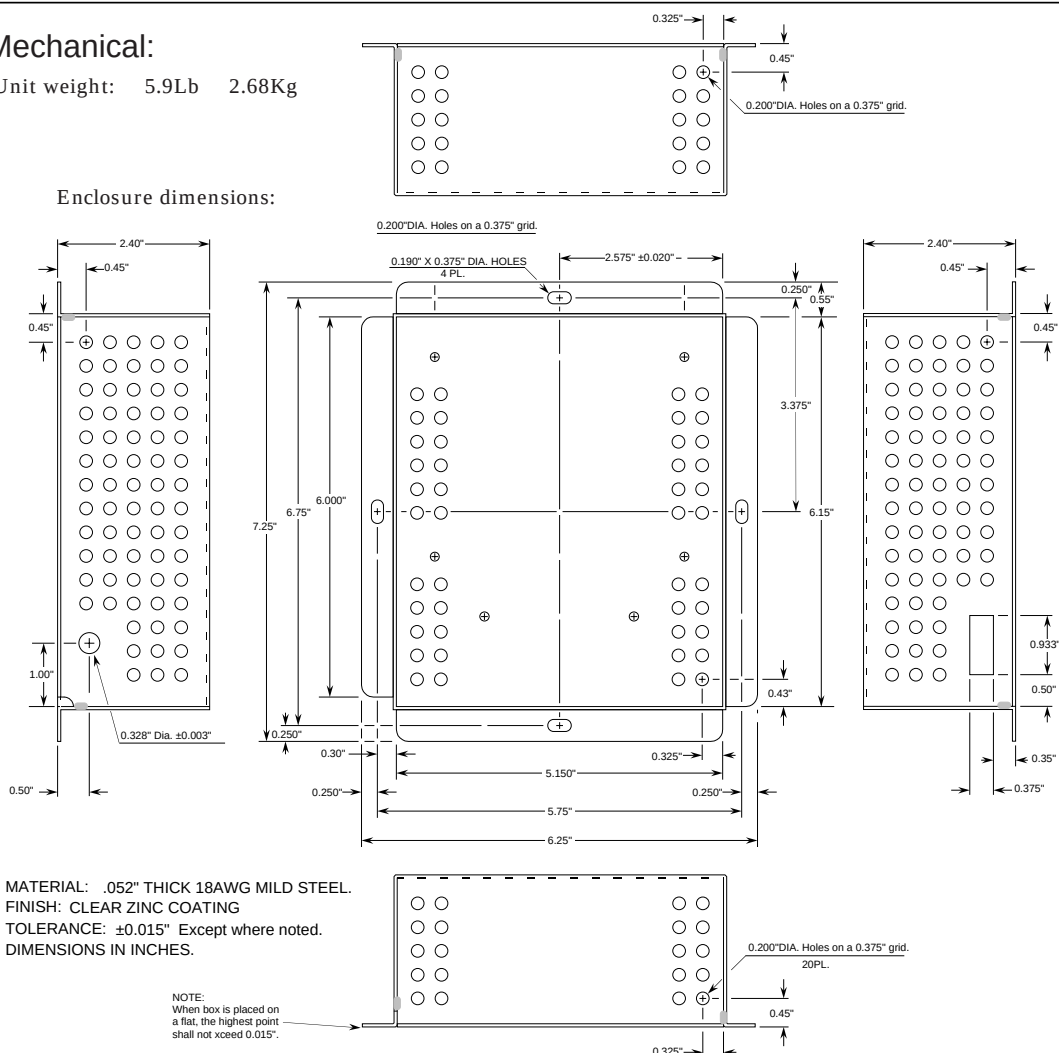
Operating temperature range is -20°C to +60°C.

Storage temperature range is -25°C to +70°C.

Operating humidity; 20% to 80% (Noncondensing).

Mechanical:

Unit weight: 5.9Lb 2.68Kg

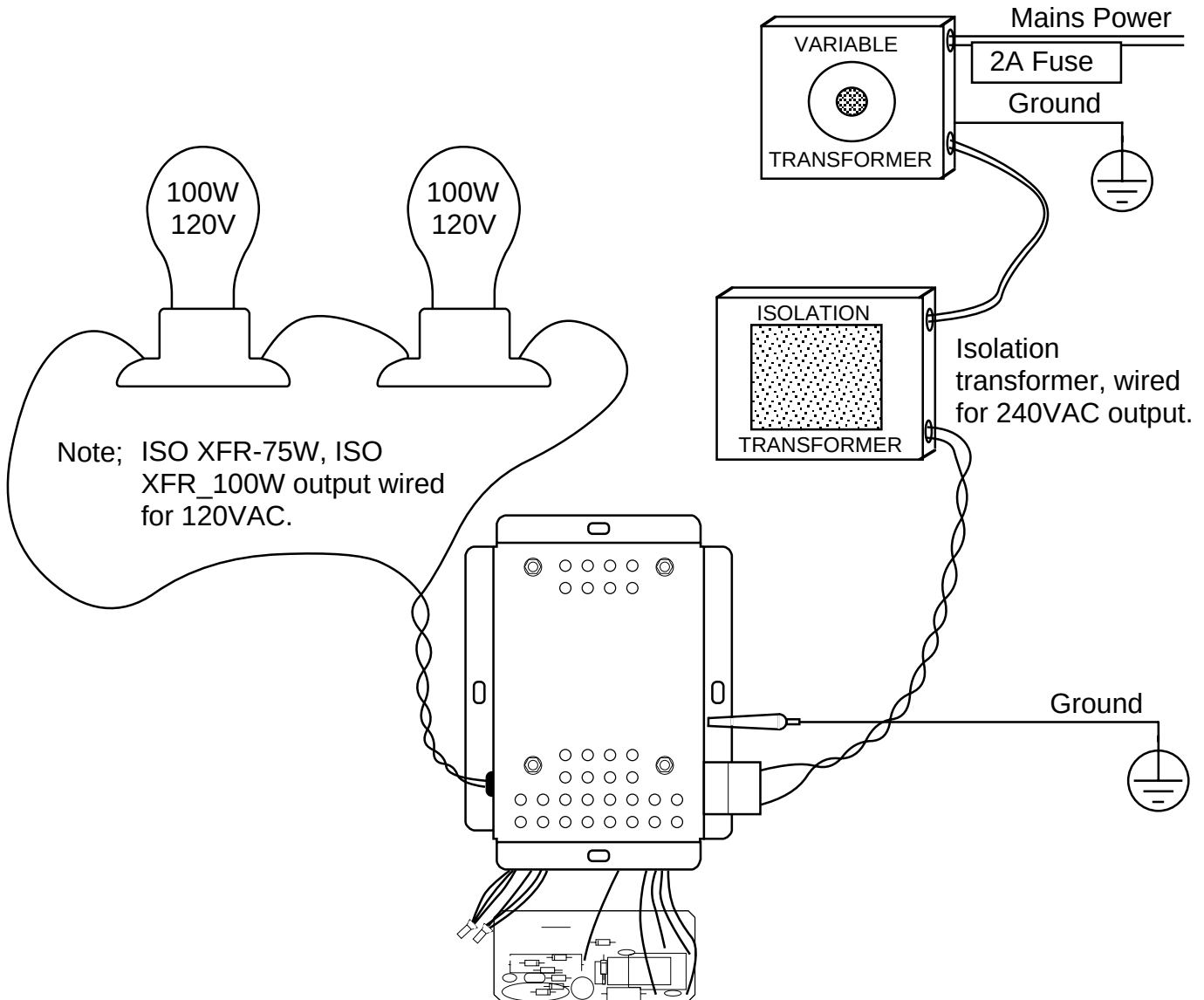


Equipment setup for trouble shooting the ISO XFR-75W, ISO XFR-100W Isolation Transformers.

SAFETY FIRST;

Use only one hand when working on a powered up ISO XFR-75W, ISO XFR-100W to avoid electrical shock.

Always wear safety glasses when working on powered up electronic equipment.

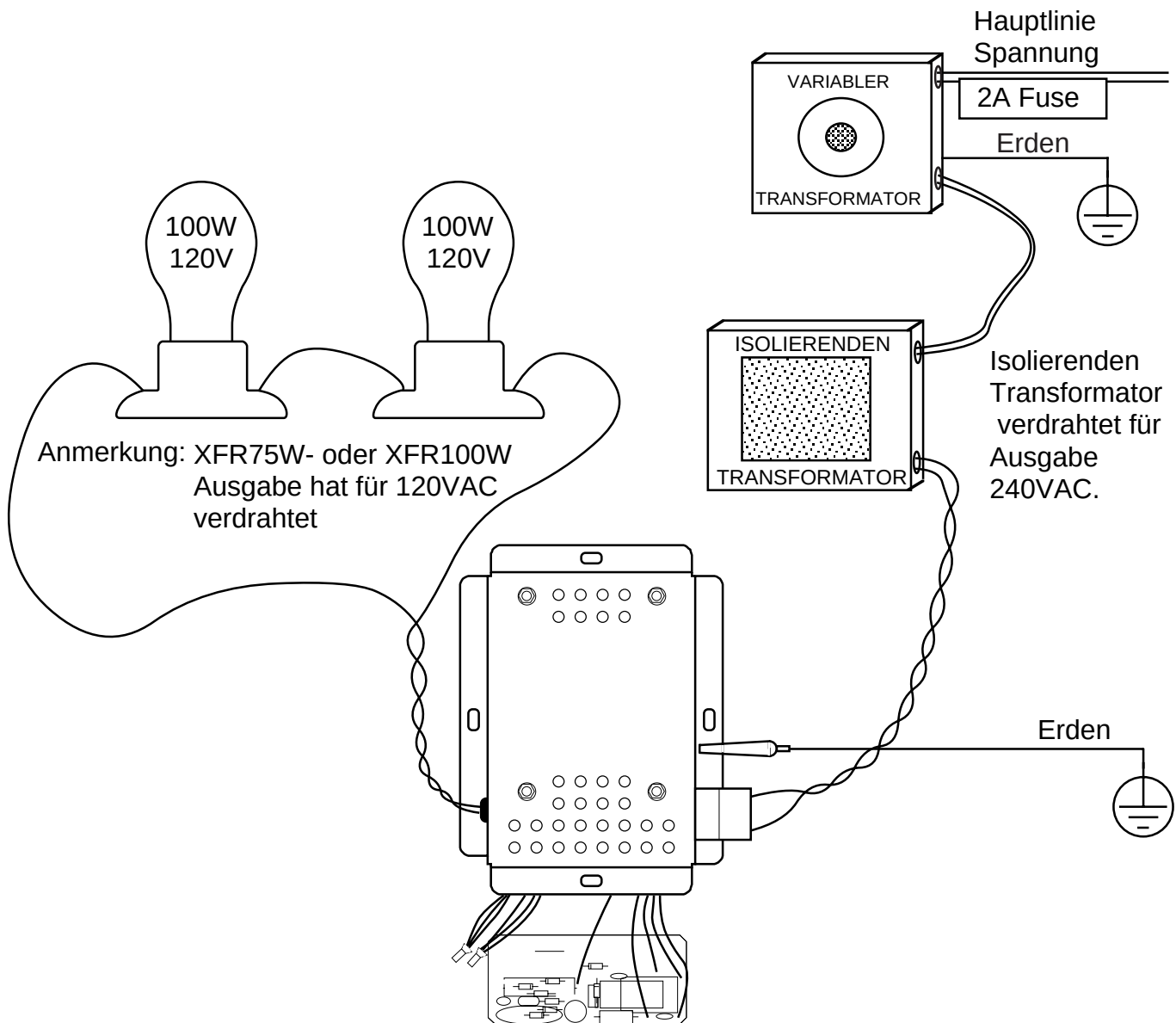


Note: When using this isolation supply for working on monitors, it is important to have some resistance (10M Ω or less) to ground. An insulated monitor connected to a insulated power supply may attain a high static voltage. When this voltage discharges through the ISO XFR-75W, ISO XFR-100W control circuit, the FET in the control circuit may be damaged.

Vorrichtungen haben zum Lösen von Problemen mit dem 75W und dem 100W Isolierung Transformatoren benutzt.

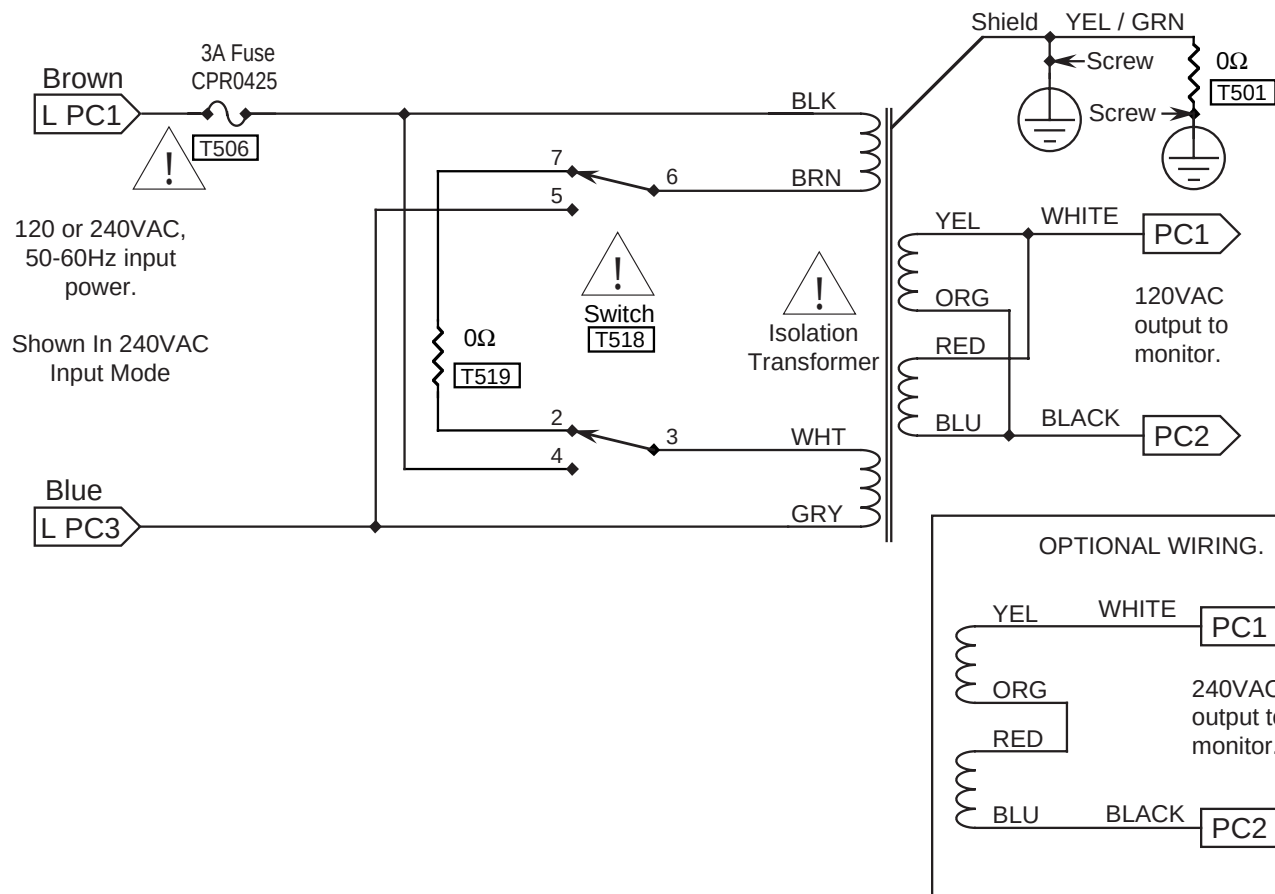
SICHERHEIT ZUERST: Um elektrischen Shock zu vermeiden, benutzen Sie nur eine Hand beim Arbeiten auf einem angeschalteten Transformator 75W oder 100W.

Tragen Sie immer Sicherheitsgläser beim Arbeiten auf angeschaltener elektronischer Ausrüstung.

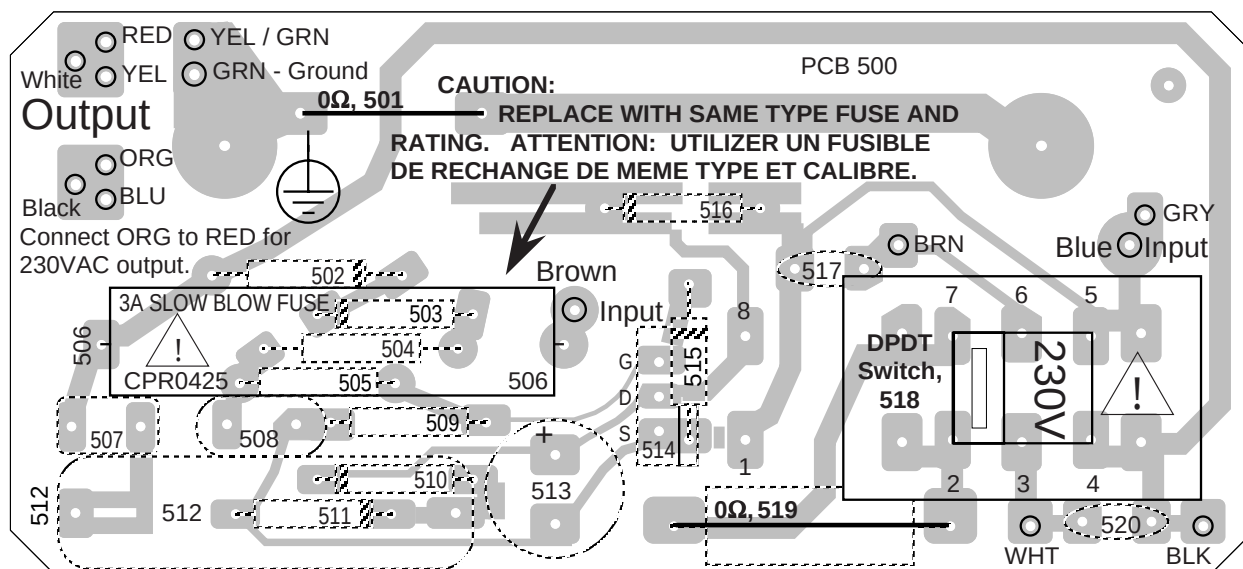


Anmerkung: Beim Benutzen dieser Isolierung Versorgung von Monitoren dem Bearbeiten zu, ist es wichtig, irgendeinen Widerstand zu haben, (10 Meg. Ω oder kleiner) zu erden. Ein Isoliermonitor, der an eine Isolierenergie kann angeschlossen wird eine hohe statische Spannung supply, erreichen. Wenn diese Spannung Entladungen durch das XFR75W oder den XFR100W Steuerstromkreis, der FET im Steuerstromkreis beschädigt werden können.

ISO XFR-75W, ISO XFR-100W Schematic (Manual Voltage Select).



ISO XFR-75W, ISO XFR-100W Assembly Drawing.



Note: The "T" in front of the board numbers refers to this PCB.

