CERONIX

SERVICE MANUAL

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.

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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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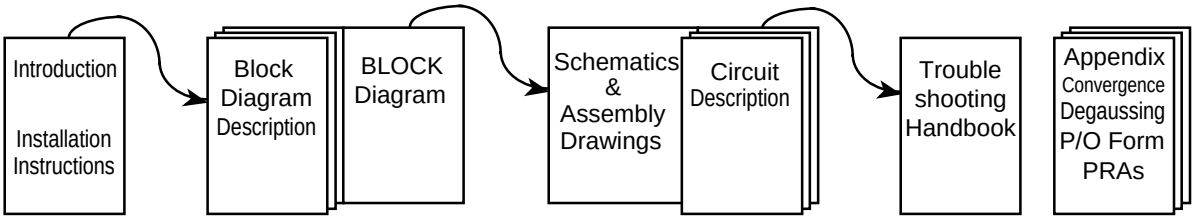
The information contained in this manual is subject to change without prior notice.

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.

TABLE OF CONTENTS

About This Manual.....i
Table of Contents.....ii-iii
CERONIX Monitor Simplified Block Diagram..... 1
Installation Instructions; English, French, and German.....2-4
CERONIX Monitor Electrical Specification.....5-8

1493, 1793, 1993, 2093, 2793, and 3693 General Operation Description.
Video Interface, Amps & Beam Current Sense..... Blocks A-D..... 9
Auto Bias, Bias Sync Delay, & Auto Bright..... Blocks E-G..... 10
CRT, Blanking, Sync, & Vertical deflection..... Blocks H-L..... 11
Horizontal Deflection & Remote..... Blocks M-P..... 12
Horizontal Size & Power Supply..... Blocks Q-T..... 13
P/S, Safety Shutdown Circuits, Degaussing..... Blocks U-Z..... 14
Monitor BLOCK DIAGRAM.....15

Monitor Schematics and Assembly Drawings
1493-CGA Main Board Schematic..(4233/4235)..... 16
1493-CGA Main Board Technician Assembly Drawing..... 17
1493-VGA/SVGA Main Board Schematic..(4200/4252)..... 18
1493-VGA/SVGA Main Board Technician Assembly Drawing..... 19
1793-VGA Main Board Schematic..(4243/4244)..... 20
1793-VGA Main Board Technician Assembly Drawing..... 21
1793-SVGA Main Board Schematic ..(4247/4250)..... 22
1793-SVGA Main Board Technician Assembly Drawing..... 23
1993-VGA Main Board Schematic..(4221/4255)..... 24
1993-VGA Main Board Technician Assembly Drawing..... 25
1993-SVGA Main Board Schematic..(4249/4256)..... 26
1993-SVGA Main Board Technician Assembly Drawing..... 27
2093-CGA Main Board Schematic..(4112/4166)..... 28
2093-CGA Main Board Technician Assembly Drawing..... 29
2093-VGA Main Board Schematic..(4224/4227/4108)..... 30
2093-VGA Main Board Technician Assembly Drawing..... 31
2793-CGA Main Board Schematic..(4104)..... 32
2793-CGA Main Board Technician Assembly Drawing..... 33
2793-VGA Main Board Schematic..(4231)..... 34
2793-VGA Main Board Technician Assembly Drawing..... 35
2793-VGA Main Board Schematic..(4254)..... 36
2793-VGA Main Board Technician Assembly Drawing..... 37
3693-CGA Main Board Schematic..(4172)..... 38
3693-CGA Main Board Technician Assembly Drawing..... 39
Video Board Schematic..... 40
Video Board Technician Assembly Drawing..(Component Side)..... 41
Video Board Technician Assembly Drawing..(Conductor Side)..... 42
Safety Critical Components for XX93 Monitors..(English)..... 43
Safety Critical Components for XX93 Monitors..(German).....44
Replacement Part List..... 45-63

Detailed Circuit Description

Video Interface Circuit, Function, Description (+ & - Analog)..... 64
5.6V to 1.1V, -Analog, DC, Video Interface Circuit Description..... 65
0V to .7V, +Analog, DC Video Interface Circuit Description..... 66
1Vp-p, +Analog, AC Video Interface Circuit Description.....67

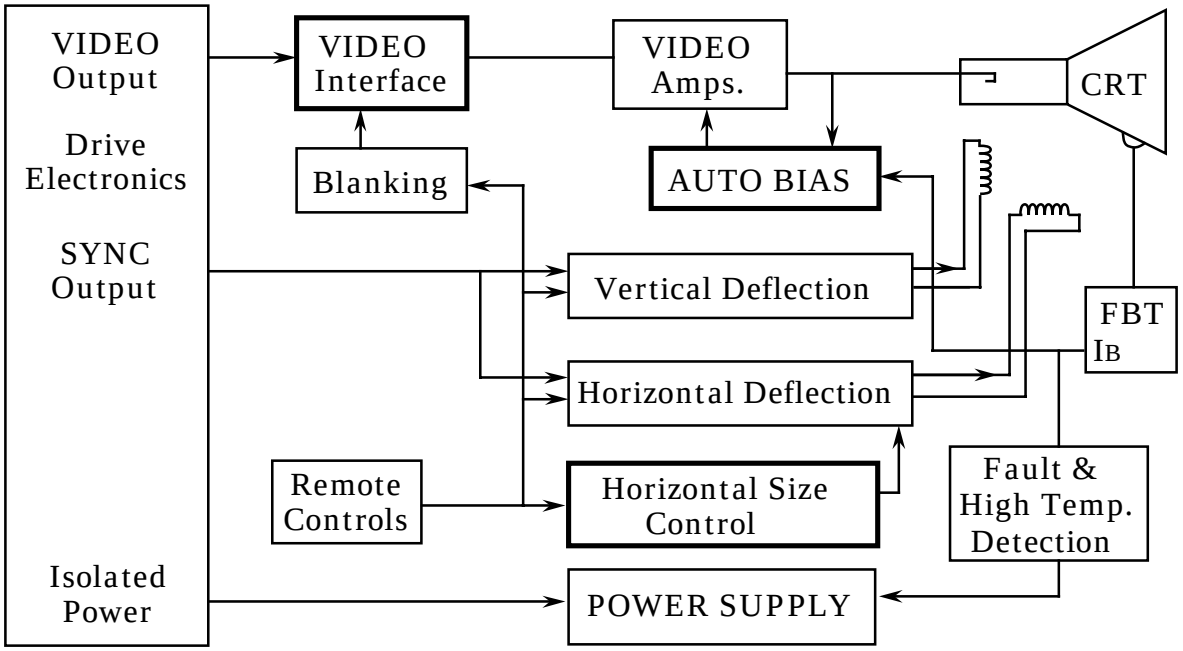
TABLE OF CONTENTS

Video Amplifier Circuit, Function, Description....68
Video Amplifier Circuit Description and Schematic....68-69
Video Board Power Supply and Arc Protect Schematic....70
CRT Auto Bias and Auto Bright Circuit, Function, Description....71
CRT Auto Bias, Auto Bright, and Vertical Sync Delay Circuit Description....72
CRT Auto Bias and Auto Bright Schematic....73
Monitor, Block Diagram Review....74
Blanking, Master Gain, and Fault Circuit, Function, Description....75
Blanking, Master Gain, and Fault Circuit Description....76
Blanking, Master Gain, Beam Limiter, and Fault Schematic....77
Vertical and Horizontal Sync Circuit Description....78
Vertical Deflection Circuit Description and Schematic....79-81
Horizontal Deflection Circuit Description and Schematic....82-83
Horizontal Raster Width Control Circuit Description....84
Horizontal Raster Width and Position Control Schematic....85
Dynamic Focus Circuit Function and Description....86
Vertical Booster Amplifier Circuit and Description....87
Simplified Power Supply Circuit, Function, Description....88-89
Switch Mode Power Supply Circuit Description and Schematic....90-91

Trouble Shooting and Repair
Equipment Setup for repairing the Model XX93 Monitor..(English)....92
Equipment Setup for repairing the Model XX93 Monitor..(German)....93
Power Supply Trouble Shooting Tips....94
Trouble Shooting Handbook....95-97
Filament Voltage Test..(English)....98
Filament Voltage Test..(German)....99
Setup and Convergence Procedure..(English)....100
Setup and Convergence Procedure..(German)....101
Replacement Parts, Purchase Order Form....102
1493 Degaussing Coil Attachment Specification....103
1793, 1993, 2093 Degaussing Coil Attachment Specification....104
2793, 3693 Degaussing Coil Attachment Specification....105
HighPot, for Shock Hazards, Circuit Description..(English)....106
HighPot, for Shock Hazards, Circuit Description..(German)....107
Wire Routing Instructions....108
Precision Resistor Arrays..(C, I, J)....109
Precision Resistor Array..(K)....110
Precision Resistor Array..(Blue)....111
Vertical Deflection Amplifier-Booster Technician Assembly Drawing....112
Monitor Input Drive Signal Worksheet....113
Declaration of Conformity....114

ISO XFR-75W and ISO XFR-100W Safety Isolating Transformer....115
Circuit Description..(English)....116
Auto Voltage Select Schematic and Assembly Drawing....117
Circuit Description..(German)....118
Installation Instructions....119-121
Specifications....122-123
Isolation Transformer Trouble shooting..(English)....124
Isolation Transformer Troubleshooting..(German)....125
Manual Voltage Select Schematic and Assembly Drawing....126
Part List Addendum....127-130

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.

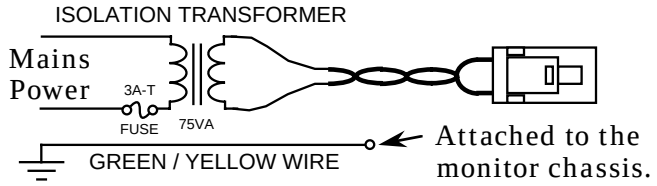
   E. Remote cable from the remote control board to the main board.

   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
1	Horizontal sync.	Yellow
2	Vertical sync.	Purple
3	Signal ground.	Gray
4	Red video.	Red
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 á fusion lente de 3 amp (pour le courant du champ magnétique d´adjustement) 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 foumies par le fabriquant du systéme pour les détails de montage de l´écran dans le carter.

4. Relier le fil de terre vert/jaune á la prise de terre sur le carter. Ce cable est relié á la vis de terre située sur le chassis de l´écran derriére 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 pricipales connections ne doit pas depasser 100mΩ.

5. Vérifier que les fils suivants sont correctement reliés:

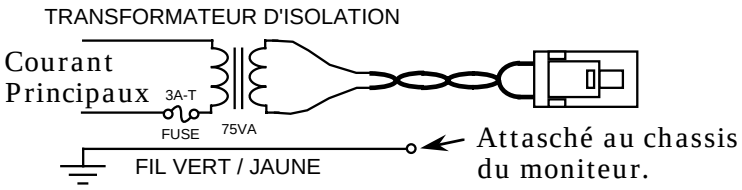
   A. Le fil vert de la tresse du tube cathodique aquadag á la carte video.
   B. Le cable plat á 12 conducteurs de la carte vidéo á la carte principale.
   C. Le cable rouge haut voltage du retout du transformateur au capuchon de l´anode du tube cathodique.
   D. Le fit de bobinage du bobinage á la carte principale.
   E. Le fil de télécommande de la carte de la télécommande á la carte principale.

   Note: Soyez sur 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
1	Synchro Horizontale	Jaune
2	Synchro Verticale	Violet
3	Signal de terre	Gris
4	Rouge vidéo	Rouge
5	Vert vidéo	Vert
6	Bleu vidéo	Bleu

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



8. Amener le courant á l´écran et au disque électronique.

9. Vérifier le foyer, et si nécessaire, régler le contróle sur le retour du transformateur.

10. Effectuer les réglages sur la carte de la commande á distance pour:

    La taille du balayage horizontal.

    La taille du balayage vertical.
    La position du balayage fertical.
    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 Gehause an.

   Für Details, Folgen Sie den Installation-Anweisungen, Vom Lieferanten der Antriebelektronik.

4. Verbinden Sie den Grüne/Gelben Schutzleiter zum Erdung anschluß auf dem Gehause. 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 gesetze widrig. Der Widerßtand 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.

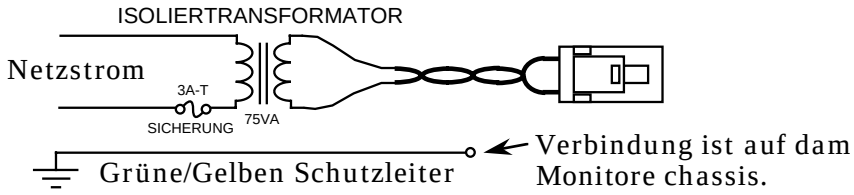
   E. Fernsteuerung Kabel vom Fernsteuerungschaltpult zum Hauptschaltpult.

   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
1	Horizontal sync.	Gelb
2	Vertical sync.	Purpur
3	Signal-Erdung.	Grau
4	Rotes Video.	Rot
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.

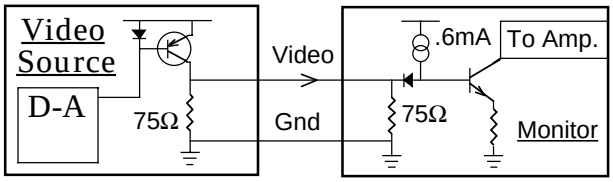
10. Stellen Sie die Kontrollen des Fernsteuerungsschaltung ein für richtige
    - Horizontal Raster Größe.
    - Vertical Raster Größe.
    - Vertical Raster Position.
    - Horizontal Bild Position.
    - Video Kontrast.

11. Für Konvergenz-Anweisungen, auf seite 100 & 101.

INPUTS

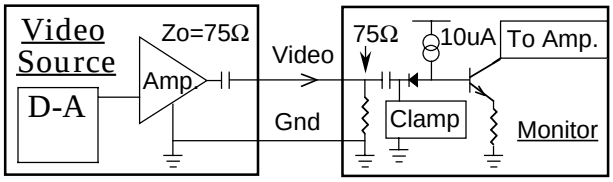
1. Standard Video Configurations, available, are:

A. Positive Analog, DC Coupled.



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

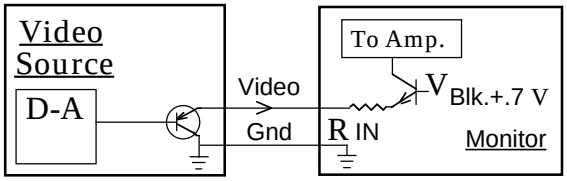
B. Positive Analog, AC Coupled.



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

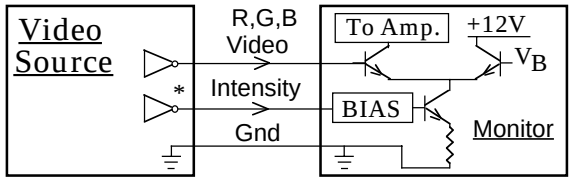
AC voltages are referenced to the R, G, & B video input voltage during horizontal sync (Hs). Blank is the black level voltage during Hs.

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.

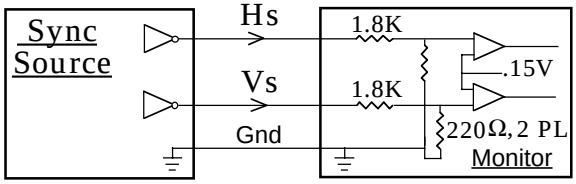


Black level	0V	.2V	.5V
Color on	2.7V	3.5V	6.0V
Low intensity	0V	.2V	.4V
Full intensity	4.5V	4.6V	4.8V

* 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.

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

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

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	
Min.	Max.
10.1"	11.1"
7.3"	8.3"
0"	.50"
1" Right	1" Left
0mA	.75mA

Model 1793	
Min.	Max.
11.9"	12.9"
8.6"	9.6"
0"	.50"
1" Right	1" Left
0mA	.75mA

Model 1993	
Min.	Max.
13.4"	14.4"
9.8"	10.8"
0"	.50"
1" Right	1" Left
0mA	.75mA

Model 2093	
Min.	Max.
14.9"	15.9"
10.9"	11.9"
0"	.60"
1" Right	1" Left
0mA	.75mA

Model 2793	
Min.	Max.
20.4"	21.4"
15.1"	16.1"
0"	1.0"
1" Right	1" Left
0mA	1.5mA

Model 3693	
Min.	Max.
27.4"	28.4"
20.3"	21.3"
0"	1.0"
1" Right	1" Left
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	
Color Temperature	9300°K		9300°K		9300°K		9300°K	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
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	0° C	70° C
Storage temperature	-20° C	85° C
Operating humidity	20%	80%
Storage humidity	10%	95%

7. Picture tube

	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
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 circuits 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.

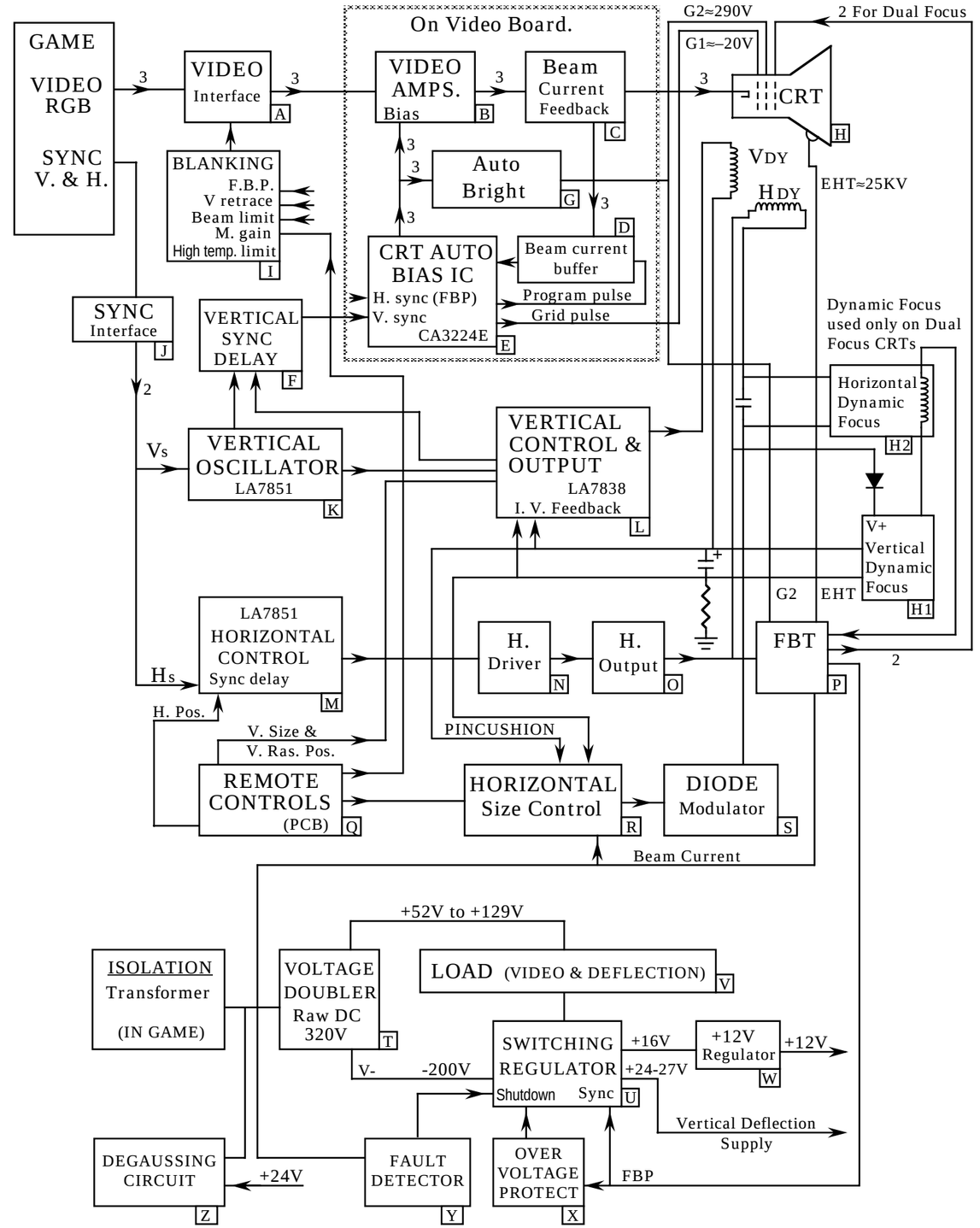
Y

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.



AA BB CC DD EE FF GG HH II JJ KK LL MM NN OO PP

Product safety note: Components marked by the ⚠ symbol on this schematic have special characteristics important to safety. When replacing any of these components, be sure to use the parts specified in the parts list.

VIDEO BOARD 800 — Samsung M46CY261X112 CRT

Red Video Amp. / Green Video Amp. / Blue Video Amp. — Beam current Feedback

ARC PROTECT

Auto Bias — V_{Sync} ABA

Beam Current Buffer

Auto Bright

127V TC8 — TC3 B GFF — TC2 GND — TC4 12V — TC1 16V

TC2 Red. TC5 Green TC 3 Blue — TC 10 — TC 6 — SOCKET BOARD CONNECTOR (TC) 206

Retrace Boost

VERTICAL BLANKING — PN2907A — HORIZONTAL BLANKING — PN2222A (CPQ1322)

VIDEO GAIN LINE

Controls XRC5346A 241 — R IN, R R, G IN, G R, B IN, B R — +AEN, +12V, -ABL, TTL, MGAIN — B BL

RED INPUT — GREEN INPUT — BLUE INPUT — VERTICAL SYNC — HORIZONTAL SYNC

Horizontal Size — Vertical Size — Vertical Raster Position — Horizontal Position — Master Gain — Remote Control PCB 490

LA7838 Vertical Deflection 377 — Ramp Reset One Shot — Ramp Gen. — V. size Control 50/60Hz — Vert. Drive — Retrace Booster Drive — Vert. Out — Thermal Protection — HEAT SINK 378

Vertical Linearity Circuit — DECREASES TOP AND BOTTOM VERT. SIZE. — INCREASES TOP AND BOTTOM VERT. SIZE.

LA7851 — VERTICAL V+ — ± SYNC INPUT — VERTICAL OSCILLATOR — VERTICAL OSC. O/S — V Ref. — X-RAY PROTECT — Horizontal SYNC INPUT — PICTURE POSITION O/S — DELAYED SYNC O/S — SAW TOOTH GENERATOR — MULTIPLIER BIAS — HORIZONTAL OSCILLATOR DISCHARGE — H. V+

XRC5184 — INPUT ERROR AMP. — +15V +17V INPUT — Over Voltage Protect INPUT — CONTROL & FAULT SENSE — 4uS DELAY COMP. — OUTPUT — Current SENSE — DRIVE — Rx Osc. Cx — +7.5V REF. — V-

I PRA 416 — J PRA 111 — J PRA PINS: 3,10,15, & 19

Video V+ — +55V — +24V — +15V — +6V — +61V — +44V — +127V — -244V — H. +12V — H. S. +12V

Horizontal Drive Transformer CPT1505 — FLYBACK TRANSFORMER — CPT1561 — EHT — FOCUS — #2 FOCUS — SCREEN — Dynamic Focus — Beam Current — FIL.

VERTICAL DEFLECTION YOKE — Horizontal Raster Adj. 150Ω 1/2W — CPT1538 12mH

V RAS. POS. 0 TO 7 VDC

High Temperature Or Excessive Beam Current, Monitor Shut Down Circuit.

HORIZONTAL YOKE — CPT1566 — CPT1556 — CPT1564

HORIZONTAL WIDTH CONTROL — Parabolic Pincushion Correction — -Linear Pincushion Correction — Blooming correction.

HORIZONTAL WIDTH DRIVE — IRF520 — HER605

CAUTION! POWER SUPPLY VOLTAGES REFERENCED FROM V-. SCOPE GND MUST NOT BE CONNECTED TO GND AND V- AT THE SAME TIME.

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

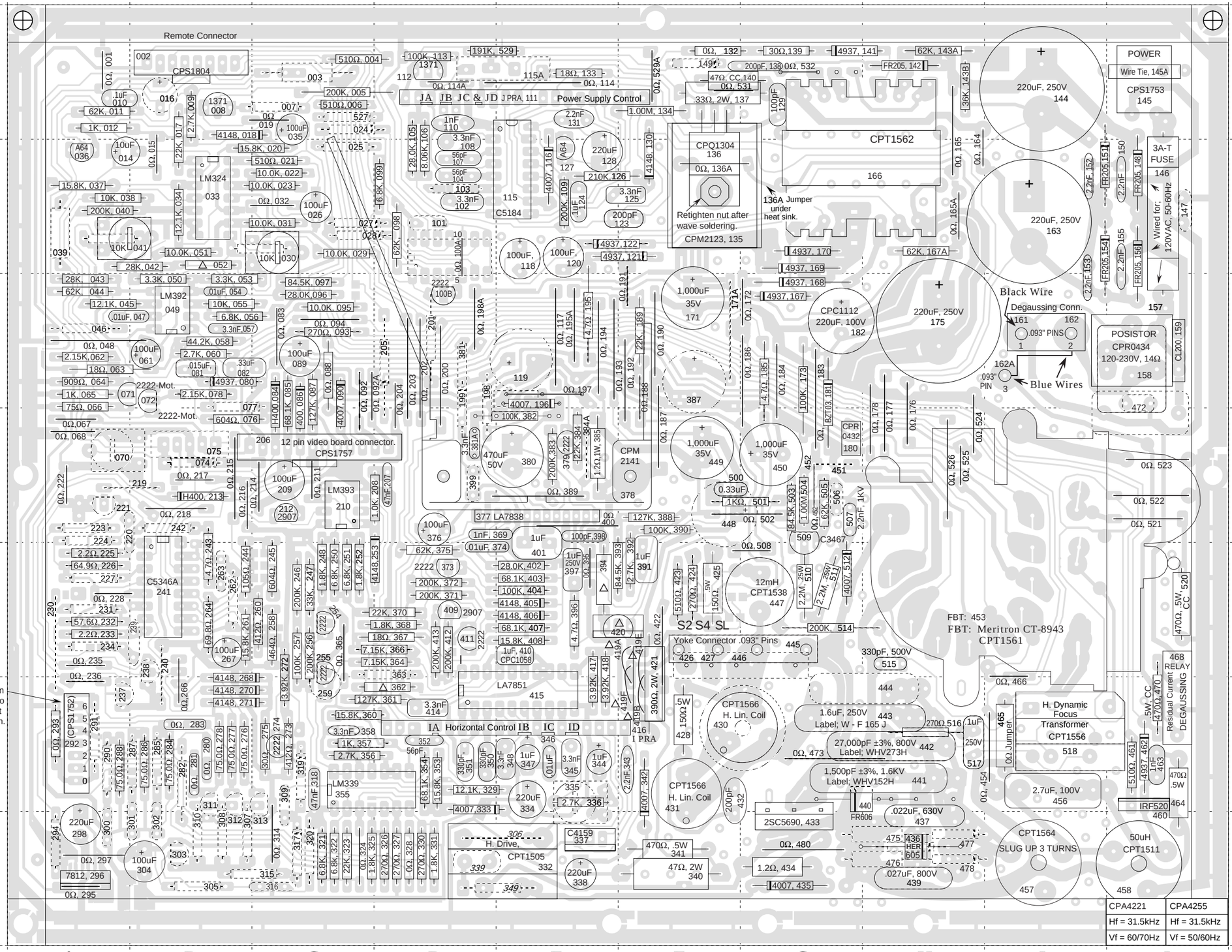
LEGEND — No — BOARD PART No. — LTR.No — PART No. ON PRA. — X — PRA PIN No. — X-Y VDC — DC VOLTAGE RANGE, USING A DMM. USE V. or H. SYNC. — X-Y VDC Sync. Vp-p TP-REF. WAVEFORM — AC VOLTS TEST POINT Peak to Peak ASS. REF. Measured with scope

CERONIX — 13350 New Airport Road, Auburn, California 95602

SCALE	NONE	DATE & REV.	4/10/96-E1	3/24/99-E5
DRAWN BY:	F. H.	2/18/92	9/30/96-E4	03/06/02-E8

CERONIX Model 1993-VGA Monitor Circuit.

CERONIX PART NO. CPA4221, CPA4255

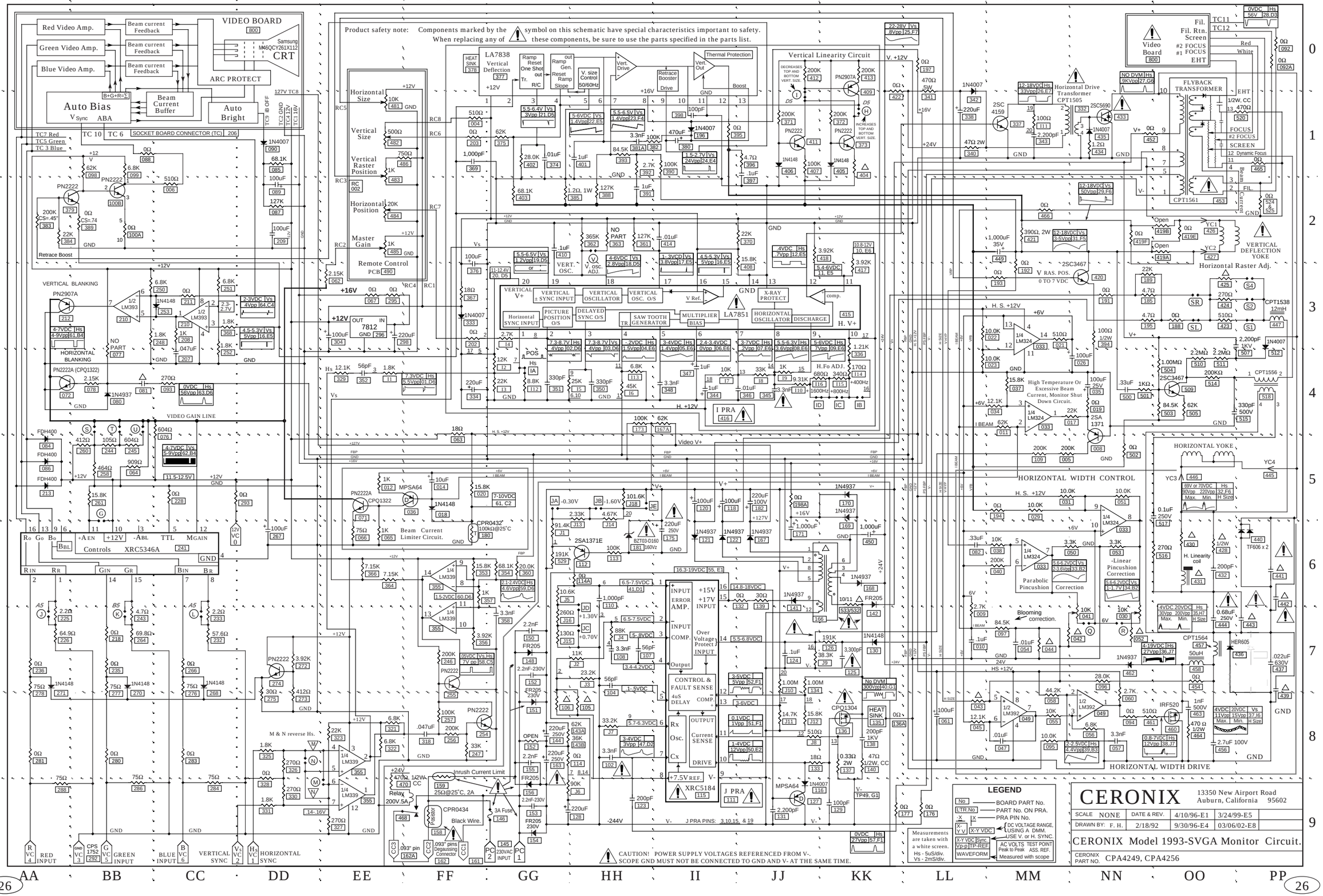


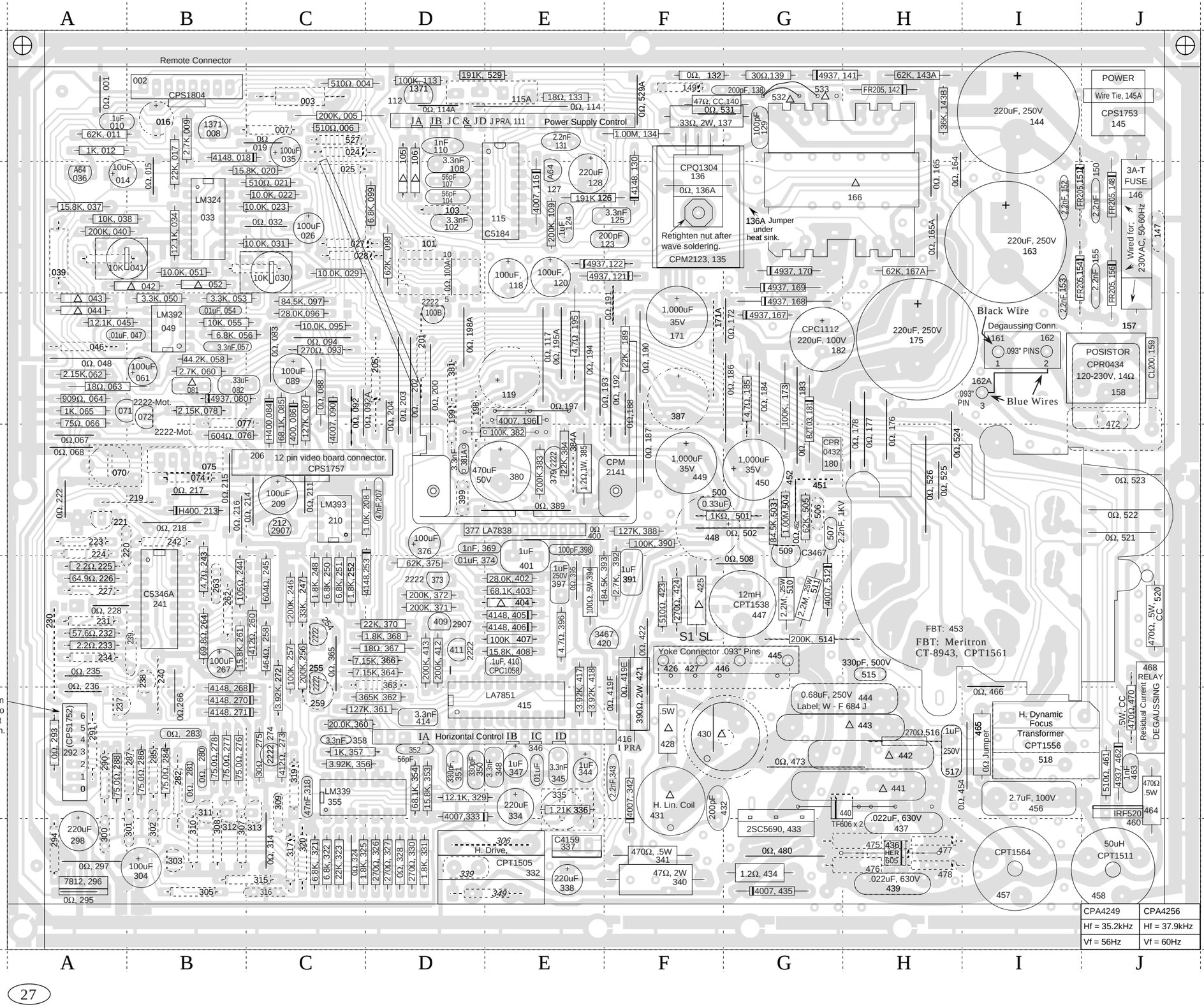
NOTES

△	VALUE	PART No.	BD	SCH	CPA4221	CPA4255
052	24.3K 1%,1/4W	CPR0148	B2	NN7	I	
052	20.0K 1%,1/4W	CPR0153	B2	NN7		J
362	365K 1%,1/4W	CPR0171	D6	HH2		J
362	309K 1%,1/4W	CPR0180	D6	HH2	I	
394	100Ω 5%,1/4W	CPR0364	E5	NN3	I	
394	33Ω 5%,2W	CPR0397	E5	NN3		J
419A	0Ω JUMPER	CPR0500	F5	OO2		J
419B	0Ω JUMPER	CPR0500	F6	OO2		J
419E	0Ω JUMPER	CPR0500	F5	OO2	I	
419F	0Ω JUMPER	CPR0500	F5	NN2	I	
420	2SC4159E	CPQ1307	E5	NN3		J
420	2SC3467AE	CPQ1308	E5	NN3	I	
CRT	M46QCY261X112	CPP1725			I	J
V+	55-56V DC.	55.5V DC.			I	J
Hf	31.5kHz				I	J
Vf	60/70Hz				I	
Vf	50/60Hz					J
	Video Board	CPA4230			I	J
Video	Positive Analog	0.00-0.70V			I	J
	Power: 220VAC				I	J

Model 1993-VGA

25


Product safety note: Components marked by the ⚠ symbol on this schematic have special characteristics important to safety. When replacing any of these components, be sure to use the parts specified in the parts list.
VIDEO BOARD
Red Video Amp.
Green Video Amp.
Blue Video Amp.
Beam current Feedback
Samsung M46CY261X112 CRT
ARC PROTECT
Auto Bias
Beam Current Buffer
Auto Bright
LA7838 Vertical Deflection
Vertical Linearity Circuit
FLYBACK TRANSFORMER
Horizontal Drive Transformer CPT1505
CPT1561
Horizontal Raster Adj.
VERTICAL DEFLECTION YOKE
HORIZONTAL YOKE
HORIZONTAL WIDTH CONTROL
HORIZONTAL WIDTH DRIVE
Horizontal Size
Vertical Size
Vertical Raster Position
Horizontal Position
Master Gain
Remote Control PCB
Controls XRC5346A
LA7851
XRC5184
VERTICAL BLANKING
HORIZONTAL BLANKING
VIDEO GAIN LINE
Beam Current Limiter Circuit.
Inrush Current Limit
Relay 200V.5A
Degaussing Connector
Black Wire.
3A Fuse
High Temperature Or Excessive Beam Current, Monitor Shut Down Circuit.
Parabolic Pincushion Correction
-Linear Pincushion Correction
Blooming correction.
H. Linearity coil
TF606 x 2
RED INPUT
GREEN INPUT
BLUE INPUT
VERTICAL SYNC
HORIZONTAL SYNC
CAUTION! POWER SUPPLY VOLTAGES REFERENCED FROM V-. SCOPE GND MUST NOT BE CONNECTED TO GND AND V- AT THE SAME TIME.
LEGEND
CERONIX
13350 New Airport Road
Auburn, California 95602
CERONIX Model 1993-SVGA Monitor Circuit.
CERONIX PART NO. CPA4249, CPA4256



NOTES

△	VALUE	PART No.	BD	SCH	CPA4249	CPA4256
042	24.3K 1%,1/4W	CPR0148	B2	NN7		L
042	28.0K 1%,1/4W	CPR0163	B2	NN7	K	
043	44.2K 1%,1/4W	CPR0154	A3	LL8	K	
043	28.0K 1%,1/4W	CPR0163	A3	LL8		L
044	44.2K 1%,1/4W	CPR0154	A3	MM7		L
052	24.3K 1%,1/4W	CPR0148	B2	NN7	K	
052	20.0K 1%,1/4W	CPR0153	B2	NN7		L
081	.01uF, 50V	CPC1032	B3	BB4		L
081	.015uF, 250V	CPC1040	B4	BB4	K	
105	200K 5%,1/4W	CPR0029	D2	HH8	K	
106	2.15K 1%,1/4W	CPR0138	D2	GG8		L
106	7.15K 1%,1/4W	CPR0142	D2	GG8	K	
166	S.M. INDUCTOR	CPT1562	H2	KK6	K	
166	S.M. INDUCTOR	CPT1563	H2	KK6		L
404	169K 1%,1/4W	CPR0146	E5	KK1	K	
404	93.1K 1%,1/4W	CPR0156	E5	KK1		L
425	150Ω 5%,1/2W	CPR0367	F5	OO3	K	
425	68Ω 5%,1/2W	CPR0379	F5	OO3		L
428	470Ω 5%,1/2W	CPR0365	F6	OO6		L
428	150Ω 5%,1/2W	CPR0367	F6	OO6	K	
430	0Ω JUMPER	CPR0050	F6	OO6	K	
430	LIN. INDUCTOR	CPT1569	F6	OO5		L
431	LIN. INDUCTOR	CPT1566	F6	OO6	K	
431	LIN. INDUCTOR	CPT1569	F6	OO6		L
441	.012uF, 1.6KV	CPC1051	H6	PP6	K	
442	.027uF, 800V	CPC1047	H6	PP6		L
442	12nF, 1.6KV	CPC1051	H6	PP6	K	
443	.68uF, 250V	CPC1042	H6	PP7	K	
443	.47uF, 250V	CPC1050	H6	PP7		L
532	0Ω JUMPER	CPR0050	H6	PP7	K	
533	0Ω JUMPER	CPR0050	H6	PP7		L
CRT	M46QCY261X112	CPP1725			K	L
V+	54-55V DC.	54.5V DC.			K	
V+	64-65V DC.	64.5V DC.				L
Hf	35.2kHz				K	
Hf	37.9kHz					L
Vf	56Hz				K	
Vf	60Hz					L
	Video Board	CPA4262			K	
	Video Board	CPA4257				L
Video	Positive Analog	0.00-0.70V			K	L
	Power: 220VAC				K	L

CPA4249	CPA4256
Hf = 35.2kHz	Hf = 37.9kHz
Vf = 56Hz	Vf = 60Hz

27

Red Video Amplifier 811

Green Video Amplifier 803

Blue Video Amplifier 937

RED TC7 — GREEN TC5 — BLUE TC3

SOT NE592 K32 — Jumper K33 — MMBT 3904 K34 — 1N4148 K35 — 1N4148 K36

301Ω K2 — 1.50K K1 — 606Ω K7 — 681Ω K6 — 100Ω K21 — 820Ω K10 — 1.49K K9 — 1.2K K8 — 21K K22 — 40.2K K19 — 12.1K K15 — 5.62K K11 — 2.2K K5 — 3.32K K12 — 3pF — .1uF 816 — .015uF 901 — 300Ω .5W K3 — 33Ω K20 — 140Ω K16 — 560Ω K17 — 18Ω K14 — 180Ω K18 — 205Ω 834 — 15Ω K4 — 75Ω K13 — .1uF 250V 913 — 1000pF 838 — FDH400 840 — 1.8K 836 — 1.8K 831 — 9.3V — 16V 120V 126V — Dark screen 80-110VDC — BIAS CONTROL LINE — GND — +12V

PN2907A 832 — 2SA 1370 833 — 2SC 3467 810 — PN2907A 812 — 2SA 1370 837

Socket Board PCB 800

SOCKET 877 — RED 8 — GREEN 6 — BLUE 11 — 12 — G1 — G2 — Focus

971 From Main PCB — CC1 — Pin By Fuse CC2 — Pin By FBT CC3

! UNPLUG ! DEGAUSSING COIL BEFORE WORKING ON CHASSIS.

Degaussing Coil — 970 EHT — Green Wire 961

EHT — Red #1 FOCUS — White #2 FOCUS — SCREEN

BEAM OFF ON POWER DOWN.

FDH 400 835 — FDH 400 899 — FDH 400 845 — FDH 400 849 — FDH 400 886 — FDH 400 959

900 — 851 — 883

150Ω 1/2W 882 — 0Ω 869 — 1K 1/2W 855 — 150Ω 1/2W 880 — 2.2K 1/2W 881 — 100K 1/2W 856 — 2.2nF 878 — 330pF 871 — 10K 1/2W 873 — GRID PULSE -23 to -27Vdc Vs 12Vp-p 95uS — 0VDC Hs 56V 31uS — DAG GND — FIL.

100K 876 — 1.8K 874 — -30V — .1uF 817 — FDH400 870 — 868 — 872 — FIL. 857

1N4007 848 — 1N4937 847 — 1uF 50V 846 — +120V Source — +126V — +16V — +120V — +12V — GND — +126fV

30Ω 859 — 18Ω 879 — .1uF 801 — .1uF 816 — 150 Ω 1/2W cc 875 — 1K 866 — 858 — 2SC3675 850 — 62K 852 — 62K 912 — 15.8K 914 — Auto Bright Circuit — 1/4 LM324 920 — 3.3K 909 — Adjust FBT bottom pot for 4.0V to 4.4 at pin 8.

33K 908 — 33K 910 — 33K 911

FIL. — Fil. GND — +127V — +16V — +12V — GND — ABA — Auto Bias Vs — TC 9 — TC 11 — TC 12 — TC 8 — TC 1 — TC 4 — TC 2 — TC 6 — TC 10

CABLE ASS. 863

GND — +4.0V

C For XX92 — 900Ω C17 — 2.74K C7 — 1.82K C4 — 4K C10 — 2,200pF 941 — 4K C11 — 2,200pF 818 — 4K C14 — 2,200pF 815 — 5K C9 — 5K C12 — 5K C15 — 200Ω C8 — 68.1K C3 — 200Ω C13 — 68.1K C2 — 200Ω C16 — 68.1K C1 — 1/4 LM324 920

C PRA-B 917

1N4007 903 — 1N4007 905 — 1N4007 906

AUTO BIAS IC GND 927 Vcc CA3224E

Blue input — Green input — Red input — sw — normal — comp. — sw in grid pls. pos. — 6V REF. — hold cap. — 2.1-6.3V — .1uF 907 — .047uF 922 — .1uF 923 — .047uF 924 — .1uF 925 — .047uF 926 — 5.7-6.3V — 1.2-2.5V — 10uF 895 — 10uF 894 — 10uF 892

7.8 to 8.8Vdc Vs 8.4Vp-p 95uS — 22K 891 — 2.7K 884 — 1N4148 888 — 2.2nF 889 — 1K 890 — 1.8K 933 — 1.8K 931 — PN2907A 928 — 1.8K 938 — MPS A64 942 — 3.92K 940 — .1uF 930 — +9.3V — +12V

Vs .1-.5V — Hs — 9 to 10Vdc Vs 9.6Vp-p 95uS — CL Start COUNTER FF Q — GND — EN 21 H. LINE COUNTER CL — DECODER sw control — GRID PULSE — PROGRAM PULSE — 5V REF — AUTO BIAS ACTIVE — BIAS — 4.6-5.2VDC — 2.2 to 2.7Vdc Vs 4.2Vp-p 360uS

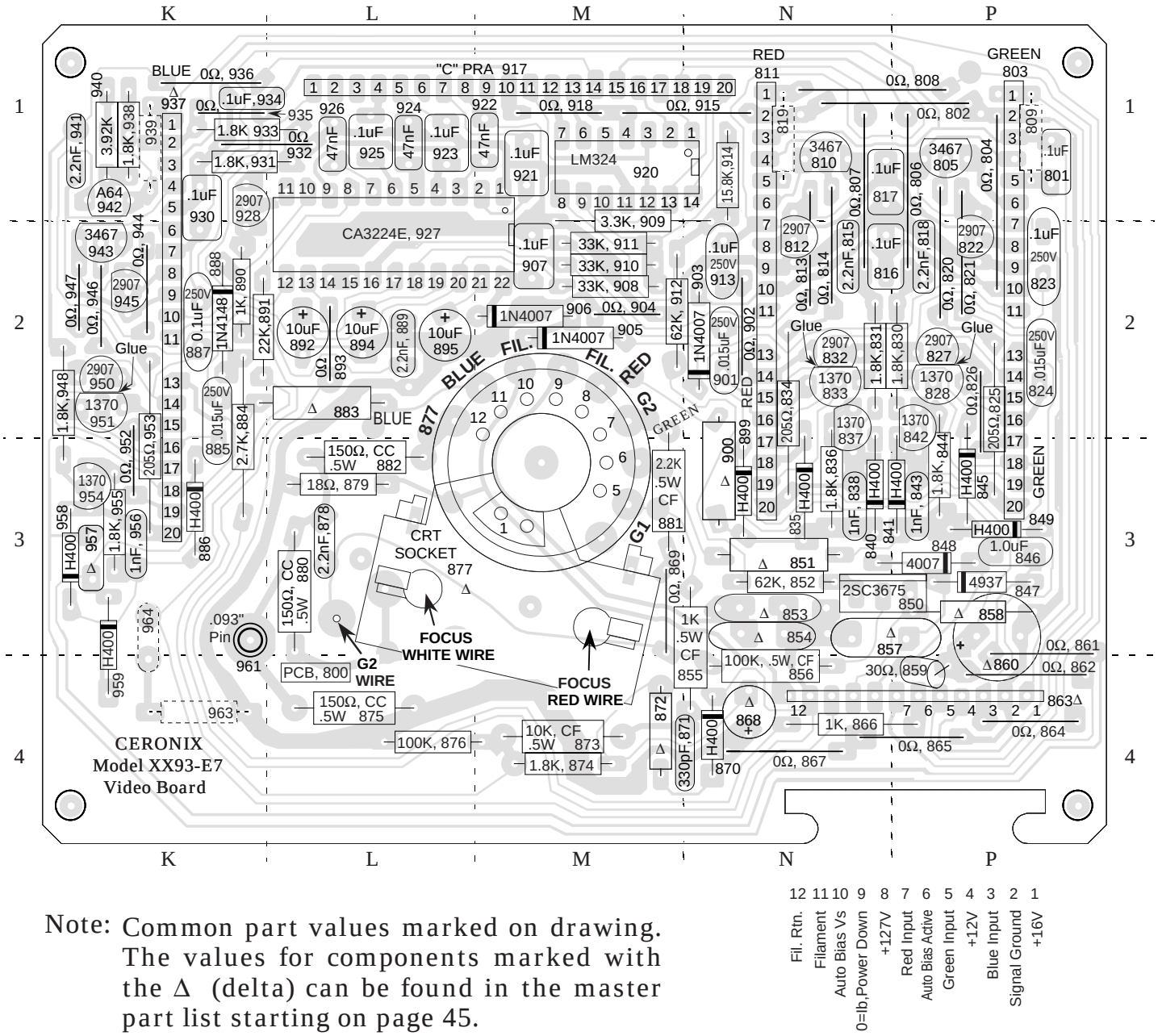
CERONIX

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

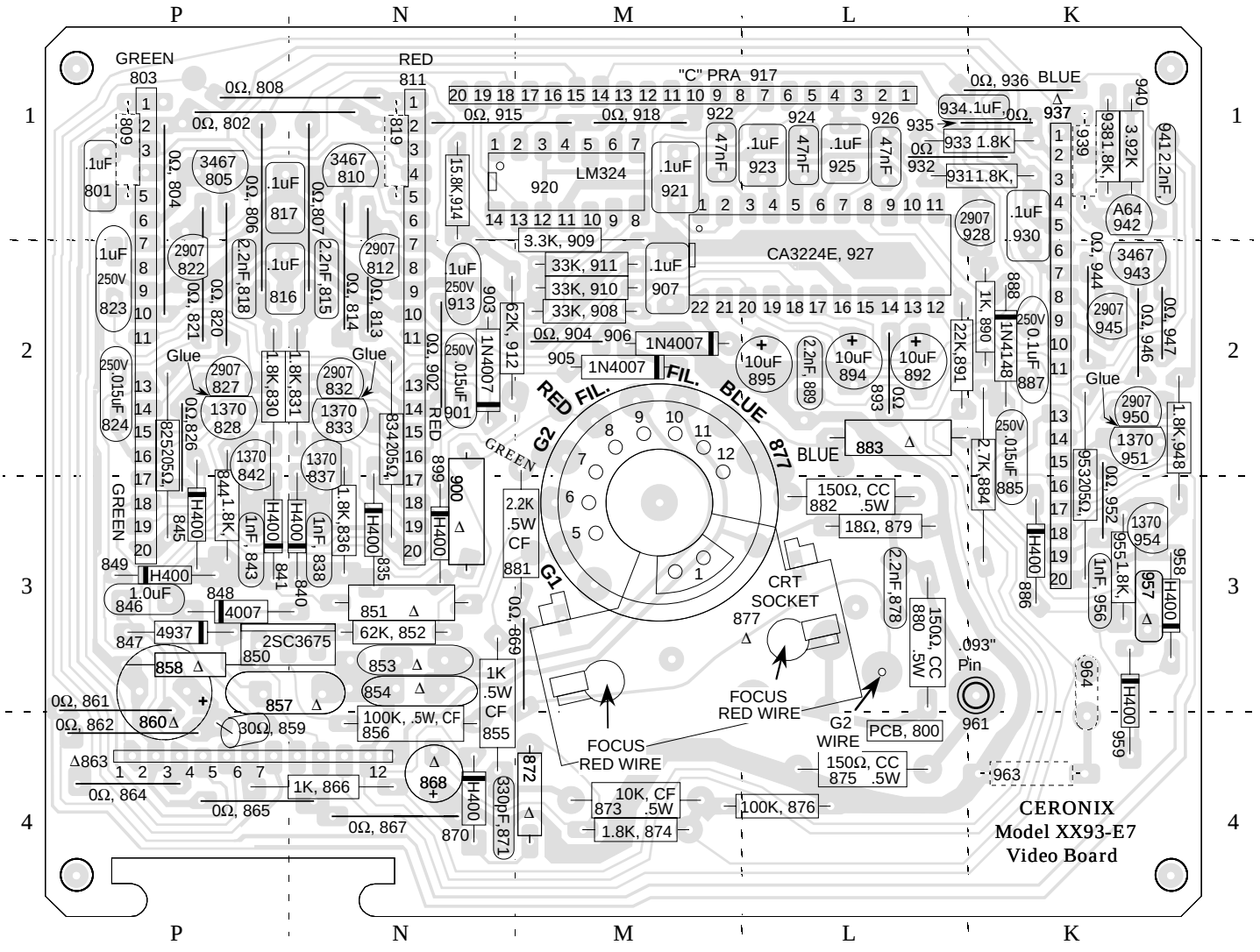
XX93 Video Board, Technician's Assembly Drawing.
View is from component side.



Note: Common part values marked on drawing. The values for components marked with the Δ (delta) can be found in the master part list starting on page 45.

XX93 Video Board, Technician's Assembly Drawing.

View is from conductor side.



Note: Common part values marked on drawing. The values for components marked with the Δ (delta) can be found in the master part list starting on page 45.

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.

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
		CPB1614			Main PCB "93" REV. E8	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	3.15
	001	CPR0050	A1	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
	002	CPS1804	B1	EE2	8 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	0.19
	004	CPR0006	C1	FF1	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
	005	CPR0029	C1	NN5	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
	006	CPD1251	C1	CC1	10mA, 75V Diode, 1N4148															O	P	Q			T					c	0.01
	006	CPR0006	C1	CC2	510Ω ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L	M	N				R	S		U				c	0.01
	008	CPQ1310	B1	NN5	.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
	009	CPR0012	B1	LL7	2.7KΩ ±5%, 1/4W, CF									I	J	K	L			O	P	Q								c	0.01
	009	CPR0134	B1	LL7	1.21KΩ ±1%, 1/4W, MF																		R	S						c	0.01
	009	CPR0136	B1	LL7	1.62KΩ ±1%, 1/4W, MF																				T	U				c	0.01
	009	CPR0138	B1	LL7	2.15KΩ ±1%, 1/4W, MF													M	N											c	0.01
	009	CPR0140	B1	LL7	3.92KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H																	c	0.01
	010	CPC1058	A1	LL7	.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
	011	CPR0018	A1	MM4	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
	012	CPR0009	A1	EE5	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
	014	CPC1101	A2	FF5	10uF, 50V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.03
	015	CPR0050	B2	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
	017	CPR0015	B1	NN4	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
	018	CPD1251	B1	FF5	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
	019	CPR0050	C1	NN4	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
	020	CPR0145	C2	FF5	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
	021	CPR0006	C2	MM3	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
	022	CPR0143	C2	MM3	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
	023	CPR0143	C2	MM4	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
	026	CPC1102	C2	NN4	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
	027	CPR0006	C2	CC2	510Ω ±5%, 1/4W, CF															O	P	Q			T					c	0.01
	029	CPR0143	C2	MM5	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
	030	CPR0142	C2	NN7	7.15KΩ ±1%, 1/4W, MF																			S						c	0.01
	030	CPR0144	C2	NN7	12.1KΩ ±1%, 1/4W, MF					E	F		H					M	N											c	0.01
	030	CPR0145	C2	NN7	15.8KΩ ±1%, 1/4W, MF	A	B	C	D													Q								c	0.01
	030	CPR0153	C2	NN7	20.0KΩ ±1%, 1/4W, MF							G																		c	0.01
	030	CPR0163	C2	NN7	28.0KΩ ±1%, 1/4W, MF															O	P									c	0.01
	030	CPR0411	C2	NN7	10K ±20%, 1/5W, White Pot									I	J	K	L						R		T	U				c	0.33
	031	CPR0143	C2	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
	032	CPR0050	C2	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
	033	CPI1405	B2	MM6	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				c	0.24
	034	CPR0144	B2	MM4	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
	035	CPC1102	C1	NN4	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
	036	CPQ1302	A2	FF5	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
	037	CPR0145	A2	MM4	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
	038	CPR0143	A2	MM6	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
	040	CPR0029	A2	MM6	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
	041	CPR0141	A2	NN7	4.42KΩ ±1%, 1/4W, MF																			S						c	0.01
	041	CPR0144	A2	NN7	12.1KΩ ±1%, 1/4W, MF				D																					c	0.01
	041	CPR0145	A2	NN7	15.8KΩ ±1%, 1/4W, MF			C		E	F		H					M	N											c	0.01
	041	CPR0153	A2	NN7	20.0KΩ ±1%, 1/4W, MF							G								O	P									c	0.01
	041	CPR0154	A2	NN7	44.2KΩ ±1%, 1/4W, MF																	Q								c	0.01
	041	CPR0163	A2	NN7	28.0KΩ ±1%, 1/4W, MF	A	B																							c	0.01
	041	CPR0411	A2	NN7	10K ±20%, 1/5W, White Pot									I	J	K	L						R		T	U				c	0.33
	042	CPR0013	B2	NN7	6.8KΩ ±5%, 1/4W, CF							G																		c	0.01
	042	CPR0024	B2	NN7	3.3KΩ ±5%, 1/4W, CF	A	B	C	D	E	F		H							O	P	Q			T					c	0.01
	042	CPR0138	B2	NN7	2.15KΩ ±1%, 1/4W, MF													M	N											c	0.01
	042	CPR0140	B2	NN7	3.92KΩ ±1%, 1/4W, MF																		R	S		U				c	0.01
	042	CPR0148	B2	NN7	24.3KΩ ±1%, 1/4W, MF												L													c	0.01
	042	CPR0163	B2	NN7	28.0KΩ ±1%, 1/4W, MF									I	J	K														c	0.01
	043	CPR0015	A3	LL8	22KΩ ±5%, 1/4W, CF																	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

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
	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																P									c	0.01
	043	CPR0153	A3	LL8	20.0KΩ ±1%, 1/4W, MF													M	N	O										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	N	O	P	Q			T					c	0.01
	052	CPR0138	B2	NN7	2.15KΩ ±1%, 1/4W, MF																			S						c	0.01
	052	CPR0140	B2	NN7	3.92KΩ ±1%, 1/4W, MF																		R			U				c	0.01
	052	CPR0148	B2	NN7	24.3KΩ ±1%, 1/4W, MF									I		K														c	0.01
	052	CPR0153	B2	NN7	20.0KΩ ±1%, 1/4W, MF										J		L													c	0.01
	053	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
	054	CPC1032	B3	MM7	.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
	055	CPR0143	B3	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
	056	CPR0013	B3	NN8	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
	057	CPC1027	B3	NN8	6,800pF ±5%, 100V, Film	A	B											M	N				R			U				c	0.07
	057	CPC1035	B3	NN8	3,300pF ±5%, 100V, Film			C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T					c	0.08
	058	CPR0154	B3	MM8	44.2KΩ ±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
	060	CPR0012	B3	NN8	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				c	0.01
	061	CPC1102	B3	LL8	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
	062	CPR0009	A3	EE3	1KΩ ±5%, 1/4W, CF			C	D									M	N			Q	R			U				c	0.01
	062	CPR0138	A3	EE3	2.15KΩ ±1%, 1/4W, MF	A	B			E	F	G	H	I	J	K	L			O	P			S	T					c	0.01
	063	CPR0002	A3	FF5	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
	064	CPR0012	A3	BB5	2.7KΩ ±5%, 1/4W, CF			C	D									M				Q	R			U				c	0.01
	064	CPR0024	A3	BB5	3.3KΩ ±5%, 1/4W, CF														N											c	0.01
	064	CPR0126	A3	BB5	909Ω ±1%, 1/4W, MF	A	B			E	F	G	H	I	J	K	L			O	P			S	T					c	0.01
	065	CPR0009	A3	EE6	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
	066	CPR0124	A3	EE6	75.0Ω ±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
	067	CPR0050	A4	EE3	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
	068	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
	071	CPQ1322	B3	EE5	30V, .6A, NPN, PN2222A, Motorola.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.05
	072	CPQ1322	B3	AA4	30V, .6A, NPN, PN2222A, Motorola.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.05
	076	CPR0132	B4	CC5	604Ω ±1%, 1/4W, MF	A	B			E	F	G	H	I	J	K	L			O	P			S	T					c	0.01
	076	CPR0136	B4	CC5	1.62KΩ ±1%, 1/4W, MF			C	D									M	N			Q	R			U				c	0.01
	077	CPR0163	B3	BB4	28.0KΩ ±1%, 1/4W, MF			C	D																					c	0.01
	077	CPR0016	B3	BB4	33KΩ ±5%, 1/4W, CF															O	P			S						c	0.01
	078	CPR0011	B3	BB4	1.8KΩ ±5%, 1/4W, CF			C	D																					c	0.01
	078	CPR0012	B3	BB4	2.7KΩ ±5%, 1/4W, CF																		R			U				c	0.01
	078	CPR0136	B3	BB4	1.62KΩ ±1%, 1/4W, MF																	Q								c	0.01
	078	CPR0138	B3	BB4	2.15KΩ ±1%, 1/4W, MF	A	B			E	F	G	H	I	J	K	L	M	N	O	P			S	T					c	0.01
	080	CPD1253	B3	BB4	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
	081	CPC1027	B3	BB4	6800pf ±5%, 100V, Film							G																		c	0.07

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
	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															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

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
	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					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

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
!	154	CPD1264	J2	GG7	2A, 600V Fast D., FR205-F			C	D				I	J	K	L					Q		S	T					c	0.03
	155	CPC1003	J2	GG8	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
!	156	CPD1264	J2	GG9	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
	157	CPR0434	J3	FF9	Posistor 230V, 14Ω																		R							c	0.51
	158	CPR0434	J3	FF9	Posistor 230V, 14Ω	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.51
!	159	CPR0426	J3	FF9	Inrush Current Limit	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.20
	161	CPS1758	I3	FF9	.093" Dia. Bead Pin, CC1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
	162	CPS1758	I3	FF9	.093" Dia. Bead Pin, CC2	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
	162A	CPS1758	I3	EE9	.093" Dia. Bead Pin, CC3	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T					c	0.02
!	163	CPC1107	I2	GG8	330uF, 250V, Electrolytic																		R	S	T	U				c	1.35
!	163	CPC1111	I2	GG8	220uF, 250V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q								c	0.97
	164	CPR0050	H2	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
	165	CPR0050	H2	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
	165A	CPR0050	H2	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
!	166	CPT1536	H2	KK7	XX93 S. M. Power Inductor			C	D									M	N	O	P	Q	R	S	T	U				c	3.66
!	166	CPT1552	H2	KK6	XX93 S. M. Power Inductor		B																							c	3.99
!	166	CPT1559	H2	KK6	1793 S. M. Power Inductor					E	F	G																		c	3.15
!	166	CPT1562	H2	KK6	14/1993 S. M. Power Inductor	A								I	J	K														c	2.89
!	166	CPT1563	H2	KK6	XX93 S. M. Power Inductor												L													c	
!	166	CPT1567	H2	KK6	XX93 S. M. Power Inductor								H																	c	2.89
	167	CPD1253	G3	JJ6	1A, 600V, Fast D., 1N4937	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S		U				c	0.02
	167A	CPR0018	H2	II4	62KΩ ±5%, 1/4W, CF	A	B	C	D	E	F	G	H	I	J	K	L			O	P	Q		S		U				c	0.01
	167A	CPR0050	H2	II4	0Ω, Jumper Wire													M	N				R		T					c	0.01
	168	CPD1253	G3	KK6	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
	169	CPD1253	G2	KK5	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
	170	CPD1253	G2	KK5	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
	171	CPC1104	F3	JJ6	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
	171A	CPR0050	F3	J	0Ω, Jumper Wire																		R			U				c	0.01
	172	CPR0050	G3	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
	173	CPR0019	G3	HH4	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
!	175	CPC1107	H3	II6	330uF, 250V, Electrolytic																		R	S	T	U				c	1.35
!	175	CPC1111	H3	II6	220uF, 250V, Electrolytic	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q								c	0.97
	176	CPR0050	H4	LL9	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
	177	CPR0050	H4	LL9	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
	178	CPR0050	H4	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
	180	CPR0432	G4	GG6	100KΩ @25°C Thermistor	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.18
	181	CPD1256	G3	HH6	3W, 160V Zener, BZT03-D160	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.22
	182	CPC1103	G3	JJ5	220uF, 50V, Electrolytic			C	D											O	P	Q		S		U				c	0.14
	182	CPC1112	G3	JJ5	220uF, 100V, Electrolytic	A	B			E	F	G	H	I	J	K	L													c	0.33
	183	CPR0050	G3	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
	184	CPR0050	G3	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
	185	CPR0003	G3	NN3	4.7Ω ±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
	186	CPR0050	G3	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
	187	CPR0050	F4	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
	188	CPR0050	F3	OO3	0Ω, Jumper Wire	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	189	CPR0015	F3	NN3	22KΩ ±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
	190	CPR0050	F3	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
	191	CPR0050	F3	NN3	0Ω, Jumper Wire	A		C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.01
	192	CPR0050	F3	MM3	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
	193	CPR0050	E3	MM3	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
	194	CPR0050	E3	MM5	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
	195	CPR0003	E3	NN3	4.7Ω ±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
	195A	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
	196	CPD1252	E3	II1	1A, 1KV Diode, 1N4007					E	F	G	H	I	J	K	L							S						c	0.01
	196	CPR0004	E3	MM0	270Ω ±5%, 1/4W, CS=0.40"																		R			U				c	0.01
	196	CPR0050	E3	LL0	0Ω, Jumper Wire, CS=0.78"	A	B	C	D									M	N			Q			T					c	0.01
	196B	CPR0050	E3	LL0	0Ω, Jumper Wire															O	P									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

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
	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	CPI1410	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

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
	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

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
	270	CPD1251	B6	BB7	1N4148 Diode, Reverse Polarity.		B										M												c	0.01
	271	CPD1251	B6	AA7	1N4148 Diode, Reverse Polarity.		B										M												c	0.01
	271	CPD1251	B6	AA7	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
	272	CPC1026	C6	DD7	1,000pF ±5%, 100V, Film																		R			U				c	0.07
	272	CPR0138	C5	DD7	2.15KΩ ±1%, 1/4W, MF														N											c	0.01
	272	CPR0140	C5	DD7	3.92KΩ ±1%, 1/4W, MF	A	B	C	D	E	F	G	H	I	J	K	L	M		O	P	Q		S	T					c	0.01
	273	CPR0130	C6	DD8	412Ω ±1%, 1/4W, MF	A		C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T					c	0.01
	273	CPR0136	C6	DD8	1.62KΩ ±1%, 1/4W, MF														N											c	0.01
	273	CPR0147	C6	DD8	1.00MΩ ±1%, 1/4W, MF																		R			U				c	0.01
	273	CPR0138	C6	DD8	2.15KΩ ±1%, 1/4W, MF		B										M												c	0.01
	274	CPQ1303	C6	DD7	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
	275	CPR0009	C6	DD8	1KΩ ±5%, 1/4W, CF		B										M												c	0.01
	275	CPR0033	C6	DD8	30Ω ±5%, 1/4W, CF	A		C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T					c	0.01
	275	CPR0122	C6	DD8	105Ω ±1%, 1/4W, MF														N											c	0.01
	275	CPR0143	C6	DD8	10.0KΩ ±1%, 1/4W, MF																		R			U				c	0.01
	276	CPR0004	B6	CC7	270Ω ±5%, 1/4W, CF																		R			U				c	0.01
	276	CPR0124	B6	CC7	75.0Ω ±1%, 1/4W, MF	A		C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T					c	0.01
	276	CPR0128	B6	CC7	301Ω ±1%, 1/4W, MF		B										M	N												c	0.01
	277	CPR0004	B6	BB7	270Ω ±5%, 1/4W, CF																		R			U				c	0.01
	277	CPR0124	B6	BB7	75.0Ω ±1%, 1/4W, MF	A		C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T					c	0.01
	277	CPR0128	B6	BB7	301Ω ±1%, 1/4W, MF														N											c	0.01
	277	CPR0129	B6	BB7	340Ω ±1%, 1/4W, MF		B										M													c	0.01
	278	CPR0004	B6	AA7	270Ω ±5%, 1/4W, CF																		R			U				c	0.01
	278	CPR0124	B6	AA7	75.0Ω ±1%, 1/4W, MF	A		C	D	E	F	G	H	I	J	K	L			O	P	Q		S	T					c	0.01
	278	CPR0128	B6	AA7	301Ω ±1%, 1/4W, MF		B										M	N												c	0.01
	280	CPC1041	B6	BB8	.33uF ±5%, 50V, Film																		R			U				c	0.08
	280	CPR0050	B6	BB8	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
	281	CPC1041	B6	AA8	.33uF ±5%, 50V, Film																		R			U				c	0.08
	281	CPR0050	B6	AA8	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
	283	CPC1041	B6	CC8	.33uF ±5%, 50V, Film																		R			U				c	0.08
	283	CPR0050	B6	CC8	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
	284	CPR0124	B6	CC9	75.0Ω ±1%, 1/4W, MF	A		C	D	E	F	G	H	I	J	K	L			O	P	Q	R	S	T	U				c	0.01
	284	CPR0128	B6	CC9	301Ω ±1%, 1/4W, MF														N											c	0.01
	286	CPR0124	B6	BB9	75.0Ω ±1%, 1/4W, MF	A		C	D	E	F	G	H	I	J	K	L			O	P	Q	R	S	T	U				c	0.01
	286	CPR0128	B6	BB9	301Ω ±1%, 1/4W, MF														N											c	0.01
	288	CPR0124	A6	AA9	75.0Ω ±1%, 1/4W, MF	A		C	D	E	F	G	H	I	J	K	L			O	P	Q	R	S	T	U				c	0.01
	288	CPR0128	A6	AA9	301Ω ±1%, 1/4W, MF														N											c	0.01
	292	CPS1752	A6	BB9	7 Cond. Straight Header	A		C	D	E	F	G	H	I	J	K	L			O	P	Q	R	S	T	U				c	0.18
	292	CPS1781	A6	BB9	6 Cond. Straight Header		B										M	N												c	0.16
	293	CPR0050	A6	DD5	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
	295	CPR0050	A7	EE3	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
	296	CPI1407	A7	EE3	12V, 1A, Regulator, 7812	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.25
	297	CPR0050	A7	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
	298	CPC1103	A7	FF3	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
	303	CPQ1301	B7	EE7	60V, .6A, PNP, PN2907A																		R			U				c	0.04
	304	CPC1102	B7	EE3	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
	305	CPR0012	B7	EE7	2.7KΩ ±5%, 1/4W, CF																		R			U				c	0.01
	307	CPR0004	B7	CC8	270Ω ±5%, 1/4W, CF																		R			U				c	0.01
	308	CPR0004	B7	BB8	270Ω ±5%, 1/4W, CF																		R			U				c	0.01
	309	CPC1036	C6	EE8	.047uF ±5%, 50V, Film																		R			U				c	0.04
	310	CPR0004	B7	BB8	270Ω ±5%, 1/4W, CF																		R			U				c	0.01
	311	CPQ1303	B6	AA8	30V, .6A, NPN, PN2222A																		R			U				c	0.04
	312	CPQ1303	B6	BB8	30V, .6A, NPN, PN2222A																		R			U				c	0.04
	313	CPQ1303	C6	CC8	30V, .6A, NPN, PN2222A																		R			U				c	0.04
	314	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
	315	CPR0004	C7	DD8	270Ω ±5%, 1/4W, CF																		R			U				c	0.01
	316	CPC1009	C7	EE7	100pF ±10%, 500V, Ceramic																		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

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
	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		S	T					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		S	T					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	470Ω ±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

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
	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

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
	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

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
	427	CPS1758	F5	OO2	.093" Dia. Bead Pin, YC2					E	F	G	H	I	J	K	L							S	T					c	0.02
	427	CPS1759	F5	OO2	.062" Dia. Bead Pin, YC2	A	B	C	D									M	N	O	P	Q	R			U				c	0.01
	428	CPR0365	F6	OO6	470Ω ±5%, 1/2W, CF	A	B	C	D			G					L			O	P									c	0.01
	428	CPR0367	F6	OO6	150Ω ±5%, 1/2W, CF					E	F		H	I	J	K						Q	R	S	T	U				c	0.01
	428	CPR0371	F6	OO6	1KΩ ±5%, 1/2W, CF													M	N											c	0.01
	430	CPR0050	F6	OO6	0Ω, Jumper Wire		B		D	E	F	G	H			K						Q	R	S		U				c	0.01
	430	CPT1506	F6	OO5	H. Linearity Inductor													M	N											c	0.74
	430	CPT1539	F6	OO6	H. Linearity Inductor	A																								c	0.61
	430	CPT1546	F6	OO5	27uH Inductor			C																						c	0.76
	430	CPT1557	F6	OO6	H. Linearity Inductor															O	P									c	0.77
	430	CPT1557	F6	OO5	H. Linearity Inductor (-3T)																				T					c	0.77
	430	CPT1566	F6	OO6	H. Linearity Inductor									I	J															c	0.63
	430	CPT1569	F6	OO5	H. Linearity Inductor												L													c	
	431	CPT1506	F6	OO6	H. Linearity Inductor													M	N											c	0.74
	431	CPT1517	F6	OO6	H. Linearity Inductor		B		D														R			U				c	0.77
	431	CPT1539	F6	OO6	H. Linearity Inductor	A		C														Q								c	0.61
	431	CPT1557	F6	OO6	H. Linearity Inductor																				T					c	0.77
	431	CPT1557	F6	OO6	H. Linearity Inductor					E	F		H							O	P			S						c	0.77
	431	CPT1565	F6	OO6	H. Linearity Inductor							G																		c	0.60
	431	CPT1566	F6	OO6	H. Linearity Inductor									I	J	K														c	0.63
	431	CPT1569	F6	OO6	H. Linearity Inductor												L													c	
	432	CPC1002	G6	OO6	330pF ±10%, 500V, Ceramic																			S						c	0.01
	432	CPC1006	F6	OO6	200pF ±10%, 1KV, Ceramic			C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R		T	U				c	0.01
	432	CPC1026	G6	OO6	1,000pF ±5%, 100V, Film	A	B																							c	0.07
!	433	CPQ1305	G7	NN1	5A,1.5KV, NPN, 2SD1651	A	B																							c	1.40
!	433	CPQ1318	G7	NN1	12A,1.5KV, NPN, 2SC5690			C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	3.45
	434	CPR0376	G7	NN1	1.2Ω ±5%, 1W, MO	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				c	0.02
	435	CPD1252	G7	NN1	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
	436	CPD1272	H7	PP7	6A, 1KV, Fast D., HER605									I	J	K	L							S	T					c	
!	437	CPC1034	H7	PP7	.022uF ±3%, 630V, Film			C	D	E	F		H	I	J	K	L	M	N		P	Q	R			U				c	0.08
!	437	CPC1047	H7	PP7	.027uF ±3%, 800V, Film															O										c	0.46
!	437	CPC1076	H7	PP7	0.1uF ±5%, 200V, Film	A	B																							c	0.28
	438	CPD1264	H6	PP6	2A, 600V Fast D., FR205-F	A	B	C	D									M	N	O	P	Q	R			U				c	0.03
!	439	CPC1034	H7	PP7	.022uF ±5%, 630V, Film							G				K	L	M	N				R		T	U				c	0.08
!	439	CPC1047	H7	PP7	.027uF ±3%, 800V, Film									I	J									S						c	0.46
	440	CPD1259	H6	PP6	3A, 1KV Fast Diode, TF307					E	F		H																	c	0.12
	440	CPD1264	G6	PP6	2A, 600V Fast D., FR205-F	A	B	C	D									M	N	O	P	Q	R			U				c	0.03
	440	CPD1270	H6	PP6	6A, 800V Fast Diode, TF606									I	J	K	L								T					c	0.39
	440	CPD1270	H6	PP6	6A, 800V Fast Diode, TF606																				T					c	0.39
	440	CPD1271	H6	PP6	6A, 1KV Fast Diode, TF607							G												S						c	0.39
	440	CPD1271	H6	PP6	6A, 1KV Fast Diode, TF607																			S						c	0.39
!	441	CPC1030	H6	PP6	.01uF ±3%, 1.6KV, Film					E	F															U				c	0.24
!	441	CPC1051	H6	PP6	.012uF ±3%, 1.6KV, Film											K							R							c	0.32
!	441	CPC1055	H6	PP6	8,200pF ±3%, 1.6KV, Film								H							O										c	0.39
	441	CPC1057	H6	PP6	1,000pF ±3%, 1.6KV, Film							G						M	N											c	0.24
!	441	CPC1061	H6	PP6	7,500pF ±3%, 1.6KV, Film			C														Q								c	0.31
!	441	CPC1063	H6	PP6	5,600pF ±3%, 1.6KV, Film				D																					c	0.35
!	441	CPC1065	H6	PP6	6,800pF ±5%, 1.6KV, Film																P									c	0.33
!	441	CPC1075	H6	PP6	.033uF ±3%, 800V, Film	A	B																							c	0.46
!	441	CPC1077	H6	PP6	1,500pF ±3%, 1.6KV, Film									I	J										T					c	0.30
!	442	CPC1030	H6	PP6	.01uF ±3%, 1.6KV, Film																		R			U				c	0.24
!	442	CPC1047	H6	PP6	.027uF ±3%, 800V, Film									I	J		L													c	0.46
!	442	CPC1051	H6	PP6	12,000pF ±3%, 1.6KV, Film											K		M	N					S						c	0.32
!	442	CPC1055	H6	PP6	8,200pF ±3%, 1.6KV, Film							G																		c	0.39
!	442	CPC1057	H6	PP6	1,000pF ±3%, 1.6KV, Film								H																	c	0.24
!	442	CPC1061	H6	PP6	7,500pF ±3%, 1.6KV, Film																				T					c	0.31
!	443	CPC1042	H6	PP7	.68uF ±5%, 250V, Film			C								K														c	0.55

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
!	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

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
	503	CPR0151	G4	OO4	73.2KΩ ±1%, 1/4W, MF							H																	c	0.01
	503	CPR0158	G4	OO4	84.5KΩ ±1%, 1/4W, MF				E	F	G		I	J	K	L													c	0.01
	504	CPR0147	G4	OO4	1.00MΩ ±1%, 1/4W, MF				E	F	G	H	I	J	K	L								T					c	0.01
	505	CPR0017	G4	OO4	36KΩ ±5%, 1/4W, MF				E	F	G	H																	c	0.01
	505	CPR0018	G4	OO4	62KΩ ±5%, 1/4W, CF								I	J	K	L													c	0.01
	505	CPR0145	G4	OO4	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	OO4	.1A, 200V, NPN, 2SC3467AE					E	F	G	H	I	J	K	L								T					c	0.18
	510	CPR0034	G5	OO4	2.2MΩ ±5%, 1/4W, CF					E	F	G	H	I	J	K	L								T					c	0.01
	511	CPR0034	G5	OO4	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	OO4	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	OO6	270Ω ±5%, 1/4W, CF					E	F	G	H	I	J	K	L								T					c	0.01
	517	CPC1037	H6	OO5	.1uF ±5%, 250V, Film					E	F	G	H	I	J	K	L													c	0.07
	517	CPC1068	H6	OO5	.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%, 1/2W, CC					E	F	G	H	I	J	K	L								T					c	0.06
	521	CPR0050	J4	J	0Ω, Jumper Wire					E	F	G	H	I	J	K	L								T					c	0.01
	522	CPR0050	J4	J	0Ω, Jumper Wire					E	F	G	H	I	J	K	L								T					c	0.01
	523	CPR0050	J4	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
	524	CPR0050	H4	PP2	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
	525	CPR0050	H4	PP2	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
	526	CPR0050	H4	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
	529	CPR0169	E1	GG6	191KΩ ±1%, 1/4W, MF	A								I	J	K	L													c	0.01
	529	CPR0170	E1	GG6	294KΩ ±1%, 1/4W, MF							G																		c	0.01
	529	CPR0179	E1	GG6	392K ±1%, 1/4W, MF.					E	F		H																	c	0.01
	529A	CPR0050	F1	J	0Ω, Jumper Wire	A				E	F	G	H	I	J	K	L													c	0.01
	531	CPR0050	F1	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
	532	CPR0050	G1	KK7	0Ω, Jumper Wire	A							H	I	J	K														c	0.01
	533	CPR0050	G1	KK7	0Ω, Jumper Wire, CS=.450"		B	C	D	E	F	G					L	M	N	O	P	Q	R	S	T	U				c	0.01
	600	CPB1615			Vertical Amplifier PCB																								X	x	
	601	CPQ1314	W2		TIP32A Transistor																								X	x	0.14
	602	CPQ1313	W1		TIP31A Transistor																								X	x	0.14
	603	CPQ1313	W1		TIP31A Transistor																								X	x	0.14
	604	CPD1264	W1		2A, 600V Fast D., FR205-F																								X	x	0.03
	605	CPR0376	W1		1.2Ω ±5%, 1W, MO																								X	x	0.02
	607	CPR0003	V1		4.7Ω ±5%, 1/4W, CF																								X	x	0.01
	608	CPR0003	V1		4.7Ω ±5%, 1/4W, CF																								X	x	0.01
	610	CPR0377	V1		3.3Ω ±5%, 1W, MO																								X	x	0.02
	611	CPD1264	V1		2A, 600V Fast D., FR205-F																								X	x	0.03
	612	CPI1415	V2		V. Deflection IC, LA7838																								X	x	1.31
	613	CPS1858	V2		Vertical Amp Wiring Cable																								X	x	
	800	CPB1613	L4	YY0	Video Board PCB E7	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.89
	801	CPC1058	P1	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
	802	CPR0050	P1	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
	803	CPR0510	P1	RR2	"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
	804	CPR0050	P1	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
	805	CPQ1308	P1	SS4	.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
	806	CPR0050	P1	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
	807	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
	808	CPR0050	P1	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
	810	CPQ1308	N1	SS1	.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

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	.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
	834	CPR0127	N2	SS1	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
	835	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
	836	CPR0011	N3	TT1	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
	837	CPQ1309	N2	TT2	.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
	838	CPC1005	N3	TT1	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
	840	CPD1250	N3	TT1	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
	841	CPD1250	P3	TT4	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
	842	CPQ1309	P2	TT4	.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
	843	CPC1005	P3	TT4	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
	844	CPR0011	P3	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
	845	CPD1250	P3	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
	846	CPC1043	P3	XX2	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	0.16
	847	CPD1253	P3	WW2	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				v	0.02
	848	CPD1252	P3	WW2	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
	849	CPD1250	P3	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
	850	CPQ1306	P3	ZZ3	.1A, 1.5KV, NPN, 2SC3675	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U				v	0.88
	851	CPR0365	N3	WW0	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
	851	CPR0371	N3	WW0	1KΩ ±5%, 1/2W, CF													M	N				R			U				v.	0.01
	852	CPR0018	N3	ZZ3	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
	853	CPC1034	N3	XX1	.022uF ±3%, 630V, Film									I	J															v	0.08
	853	CPC1035	N3	XX1	3,300pF ±5%, 100V, Film							G	H																	v	0.08
	853	CPC1038	N3	XX1	.068uF ±5%, 100V, Film															O	P	Q								v.	0.08
	853	CPC1040	N3	XX1	.015uF ±10%, 250V, Film												L								T					v	0.06
	853	CPC1047	N3	XX1	.027uF ±3%, 800V, Film	A	B																							v	0.46
	853	CPC1058	N3	XX1	.1uF ±5%, 50V, Film																					U				v	0.05
	853	CPC1068	N3	XX1	.01uF ±5%, 400V, Film				D							K														v.	0.07
!	854	CPC1026	N3	XX1	1,000pF ±5%, 100V, Film															O										v.	0.07
!	854	CPC1027	N3	XX1	6,800pF ±5%, 100V, Film																	Q								v.	0.07
!	854	CPC1035	N3	XX1	3,300pF ±5%, 100V, Film																P									v.	0.08
!	854	CPC1038	N3	XX1	.068uF ±5%, 100V, Film																			S	T					v.	0.08
!	854	CPC1041	N3	XX1	0.33uF ±5%, 50V, Film																					U				v.	0.08
!	854	CPC1046	N3	XX1	.047uF ±5%, 200V, Film					E	F					K														v.	0.32
!	854	CPC1052	N3	XX1	.018uF ±5%, 200V, Film				D																					v.	0.07
!	854	CPC1054	N3	XX1	.039uF ±5%, 100V, Film								H	I	J		L													v.	0.06
!	854	CPC1067	N3	XX1	.56uF ±5%, 100V, Film													M	N				R							v.	0.18
!	854	CPC1073	N3	XX1	0.033uF ±5%, 200V, Film			C				G																		v.	0.21

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
!	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

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
	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		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

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
	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																					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																					c	87.50
!	CRT	CPP1717		20"	RCA A48AAB37X03 CRT.																	Q								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

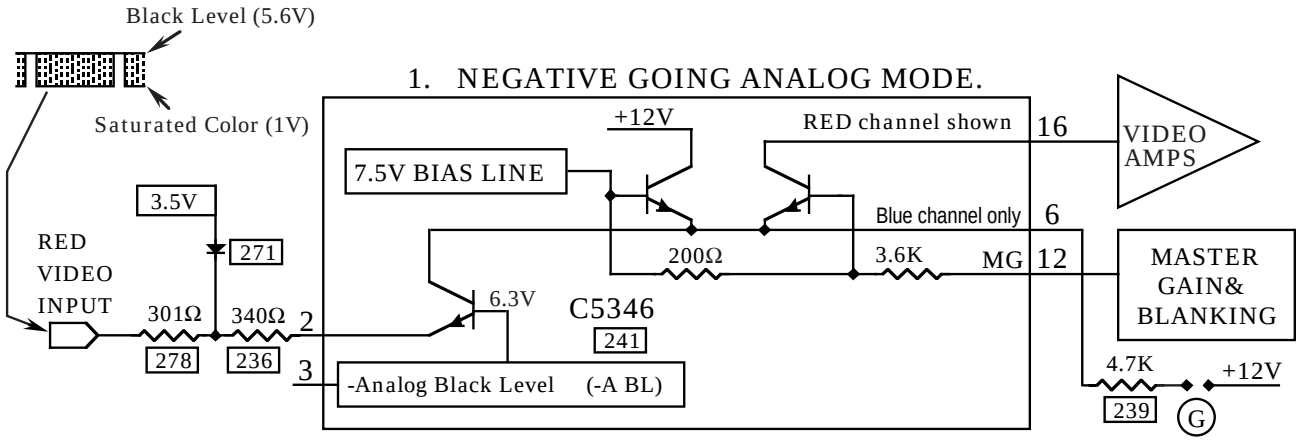
Δ	Bd.#	Part No.	Bd. Sch. Ref.		Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Com.	PRICE
	Q	Solder Conn.	A2	NN7	Verrable Parabolic Pincushion Range.																										s	
	R	Solder Conn.	C2	NN7	Verrable -Linear Pincushion Range.																										s	
	S1	Solder Conn.	F5	PP3	Raster 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.

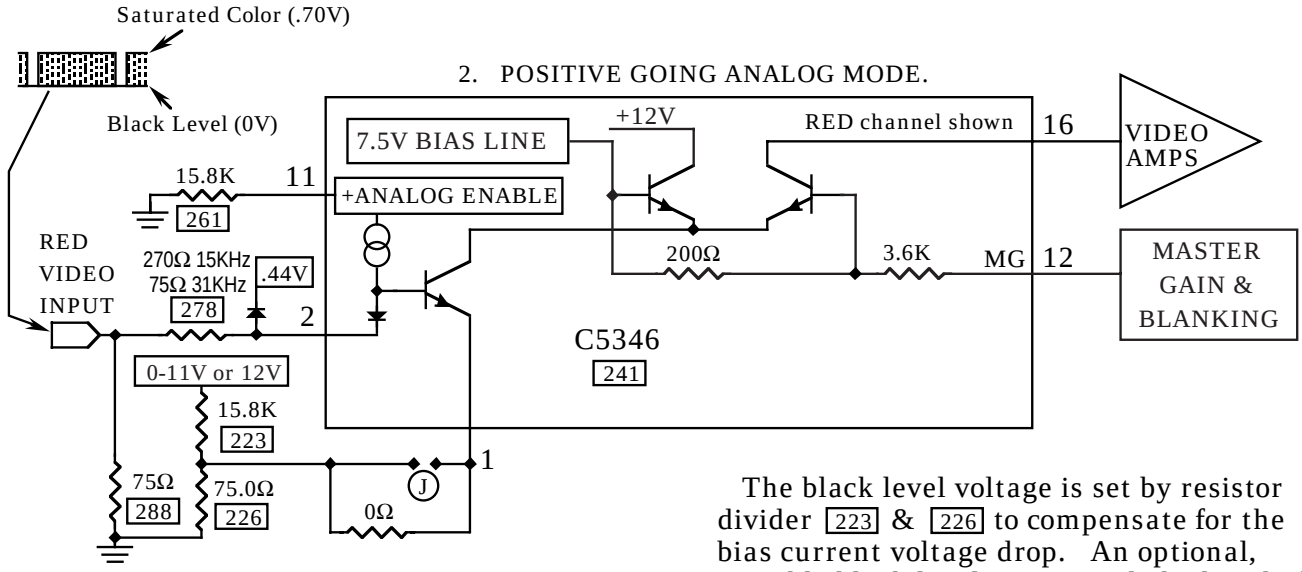
SIMPLIFIED VIDEO INTERFACE CIRCUIT:



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.

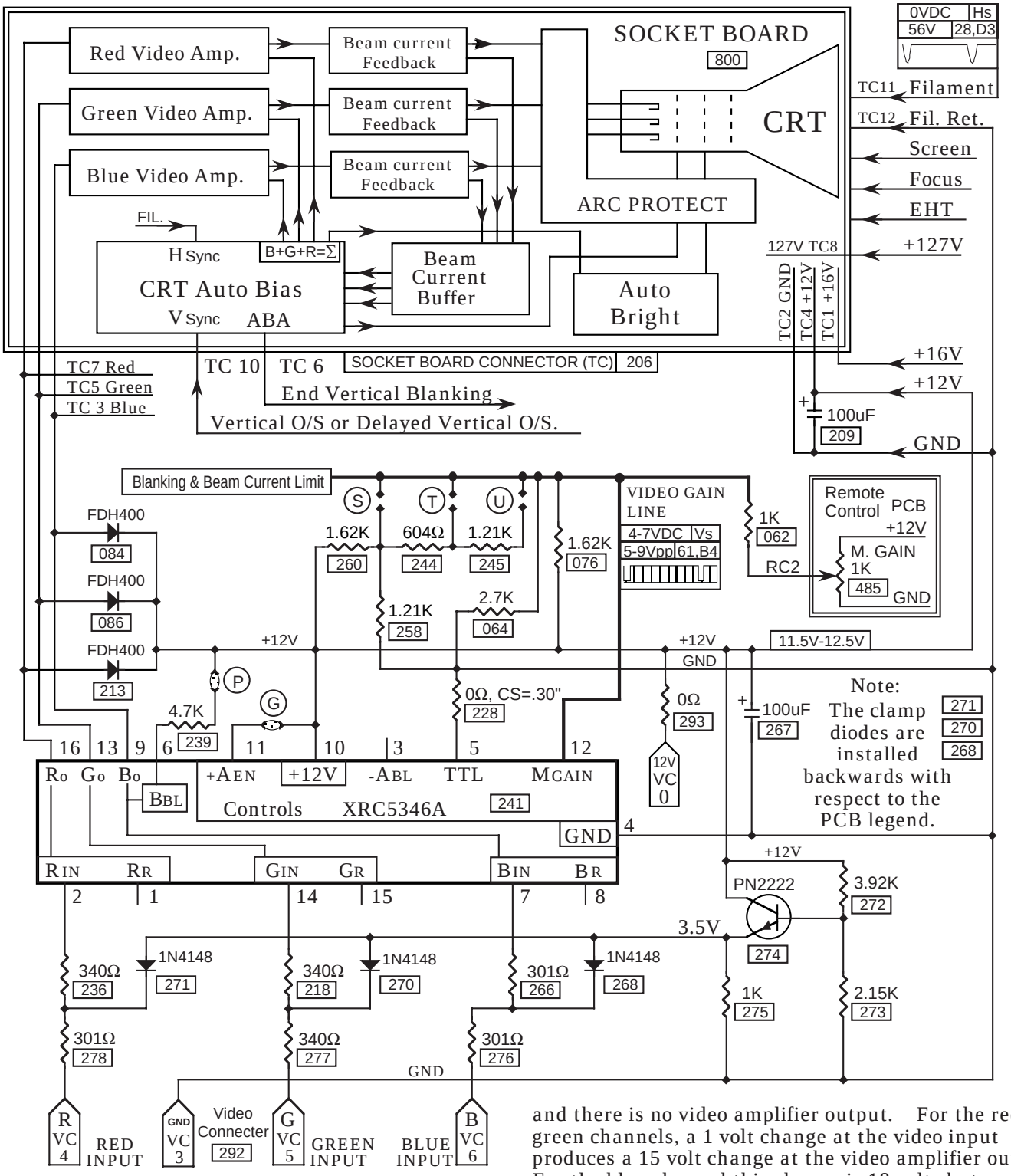


In the positive analog mode, a bias current of .6mA flows to the input pin 2. This current is set by resistor [261] at the +Analog Enable input pin 11. The .6mA produces a voltage, across the parallel resistance of the game and [288] plus resistor [278], at pin 2. If the external source resistance is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

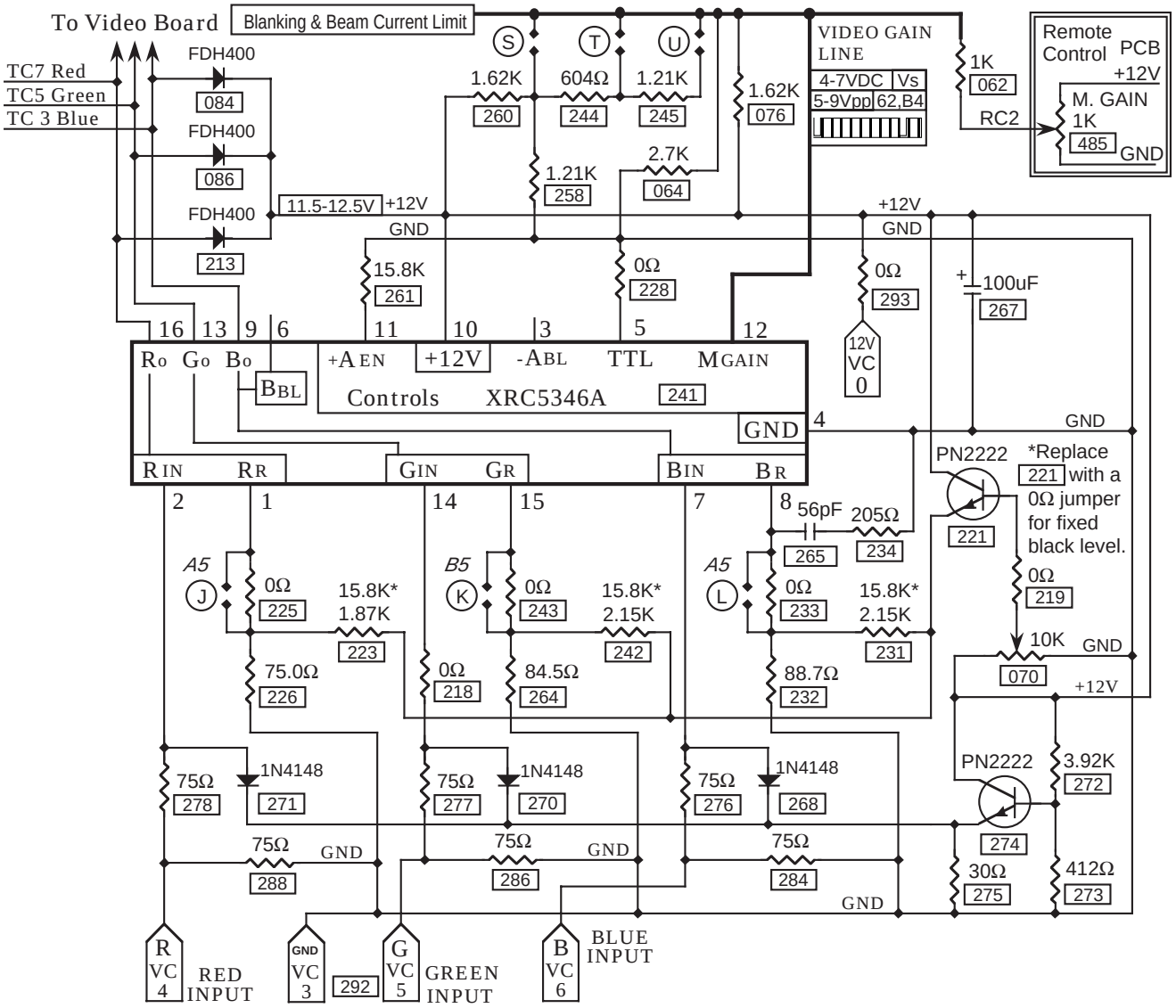


In each of the video interface circuit configurations, current from the interface circuit is converted to a voltage at the CRT cathodes. The simplest current path is accomplished by the negative analog video interface configuration.

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.

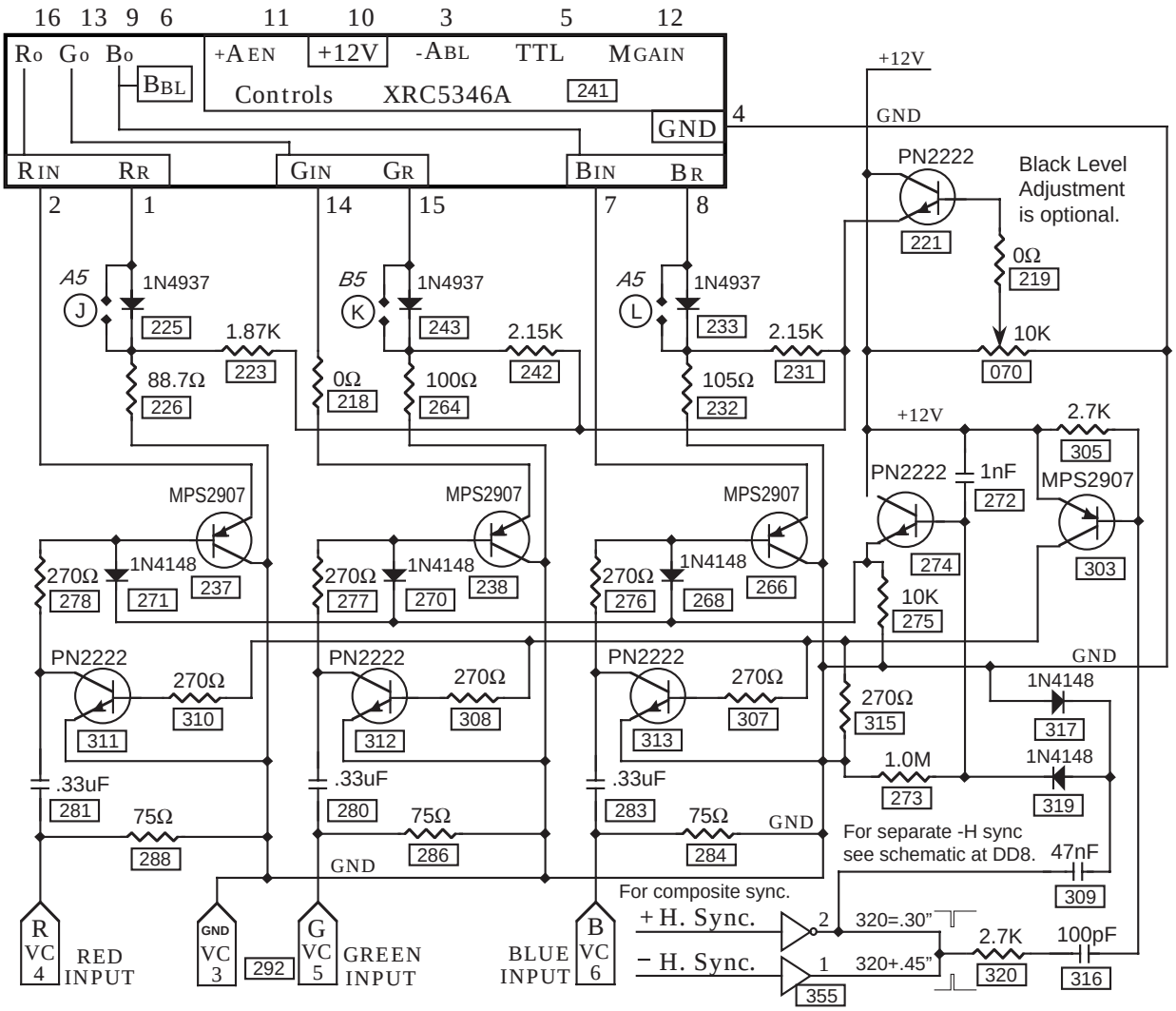
The gain of the input circuit is set by resistors 226, 264, & 232.

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.

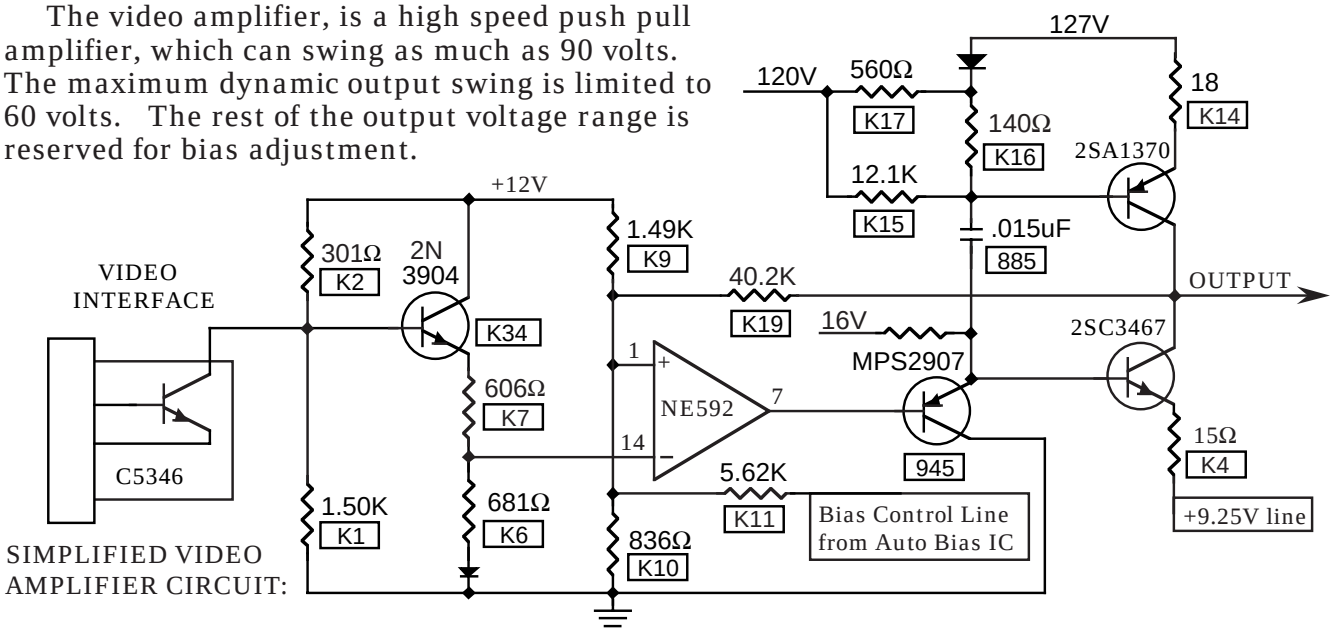
The ground referenced video signal is then buffered by transistors [237], [238], & [266] through protection resistors [278], [277], & [276]. The buffer transistors are needed to reduce the .6mA bias current, from the video interface IC, to under 10uA which limits the coupling capacitor voltage buildup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

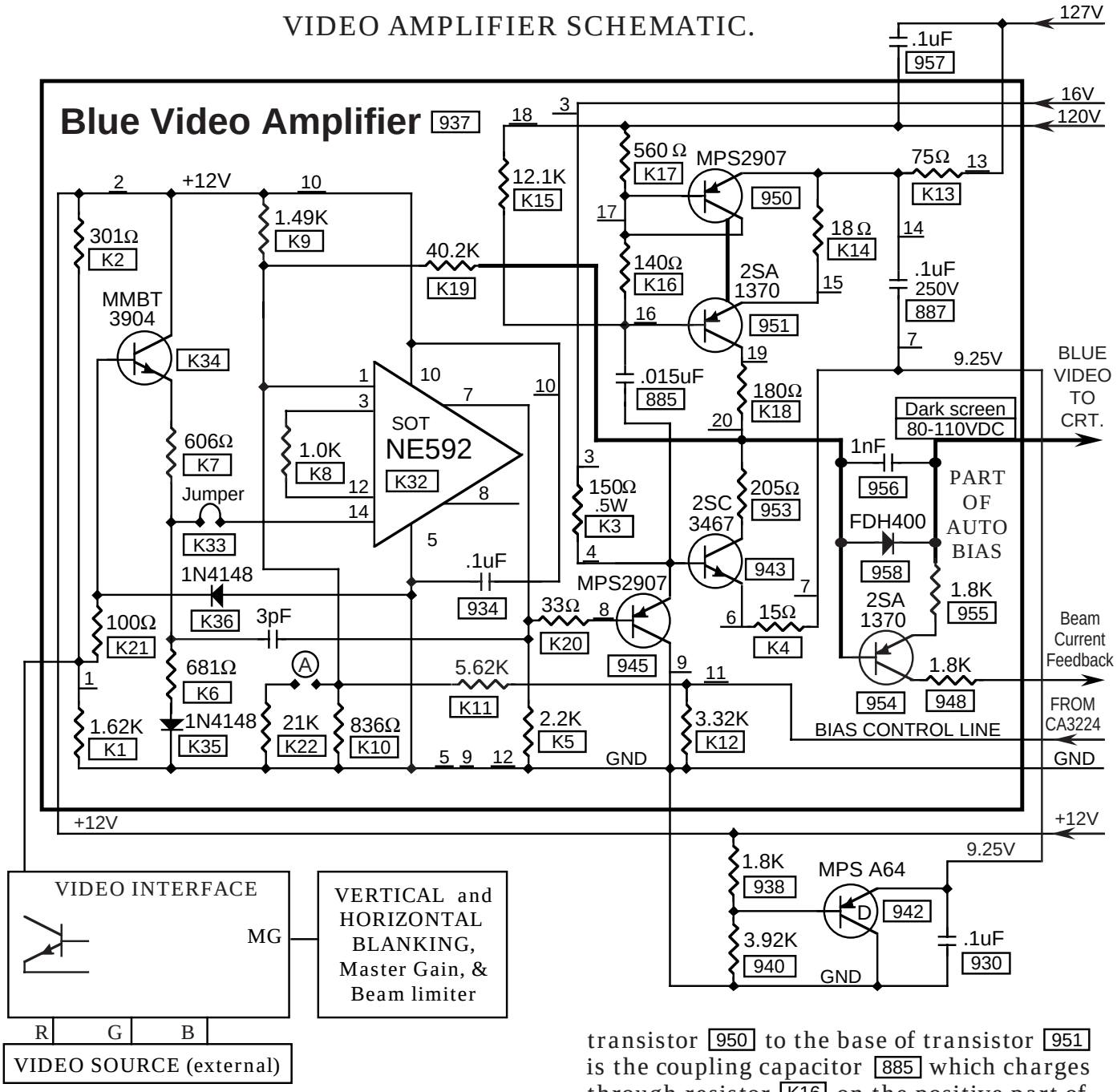
The input signal is buffered by a NPN transistor K34 for low input capacitance. Resistors K1 and K2 set the black level input voltage at 10 volts. Resistor K21 (see schematic next page) and diode K36 protect the input against arc related transients. Resistors K6 and K7 are used to set the input bias 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.

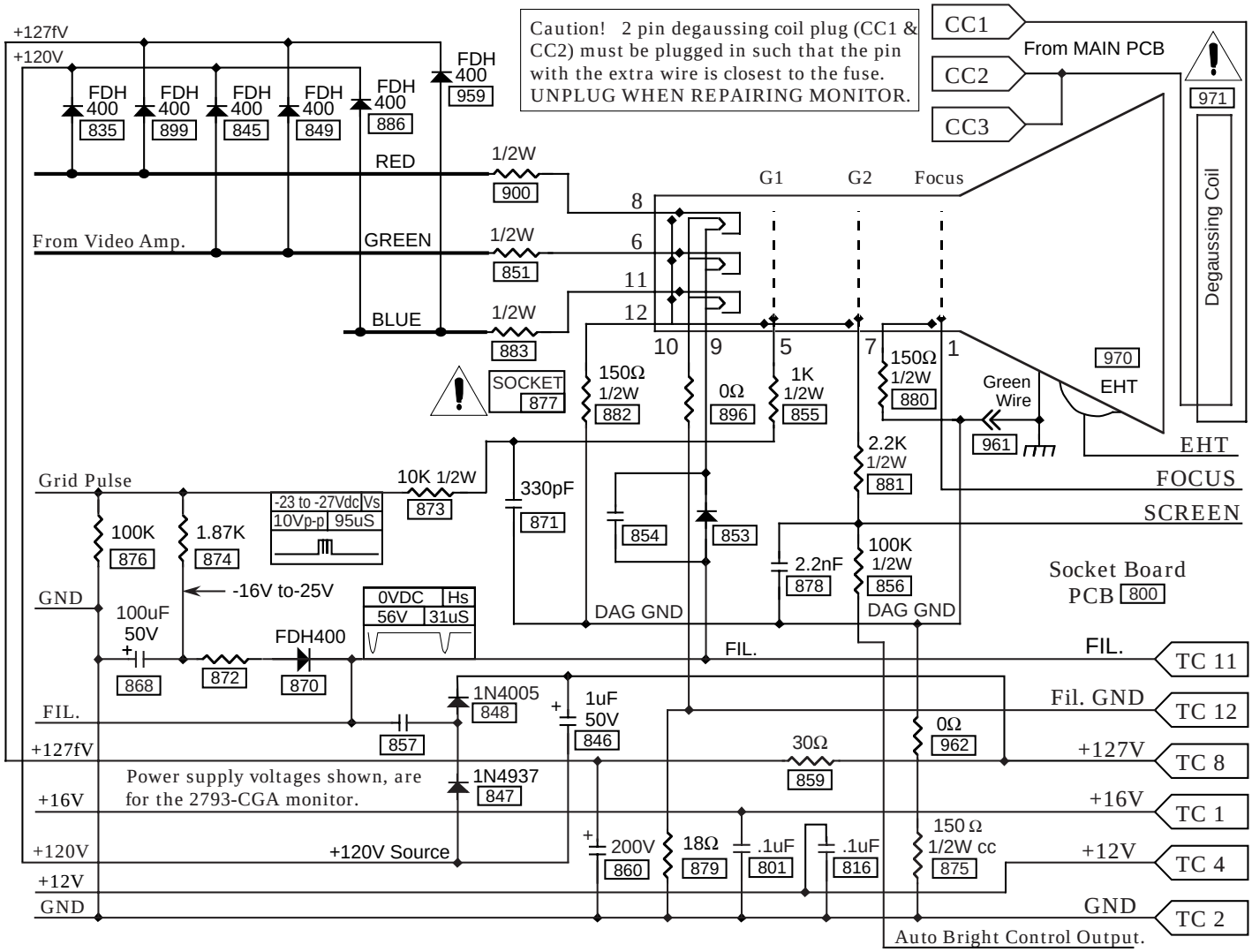
VIDEO AMPLIFIER SCHEMATIC.



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].

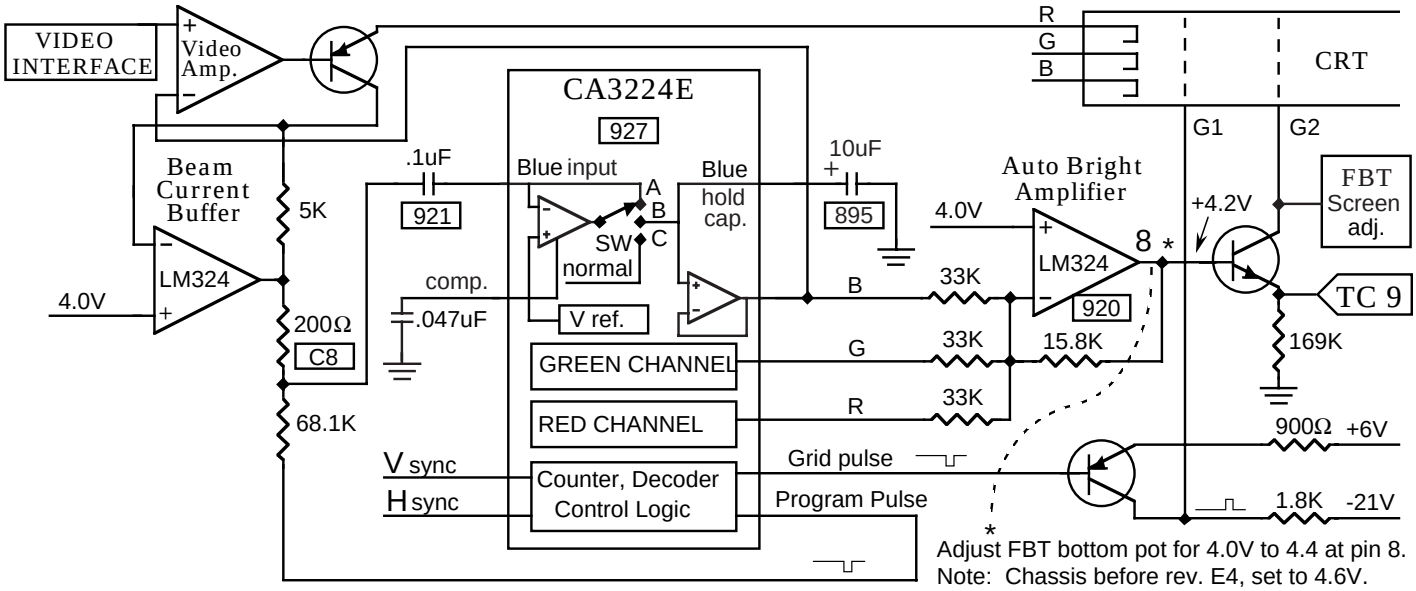
Resistor [859] and capacitor [860] decouples the video amplifiers from the 127 volt line. This filter is needed, in some models, to eliminate video amplifier distortion caused by ripple current on the V+ line. This ripple current is caused by the, V+ minus 7 volt line, power supply.

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.

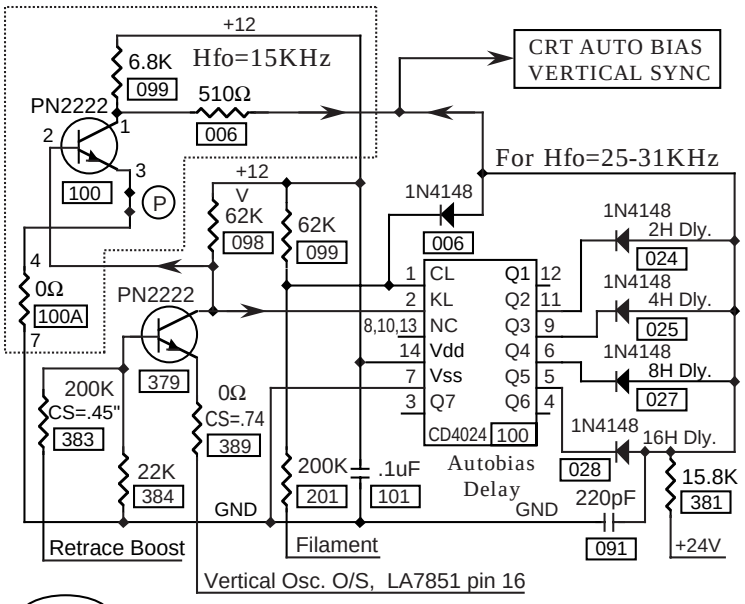
PNP transistor [928] is used as a voltage translator to direct the grid pulse from the auto bias IC to G1. The voltage on G1 is normally -15 to -27 volts depending on which CRT is used. When the grid pulse at pin 11 is low, the current from resistor [933] is conducted to resistor [874] and produces a 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 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.

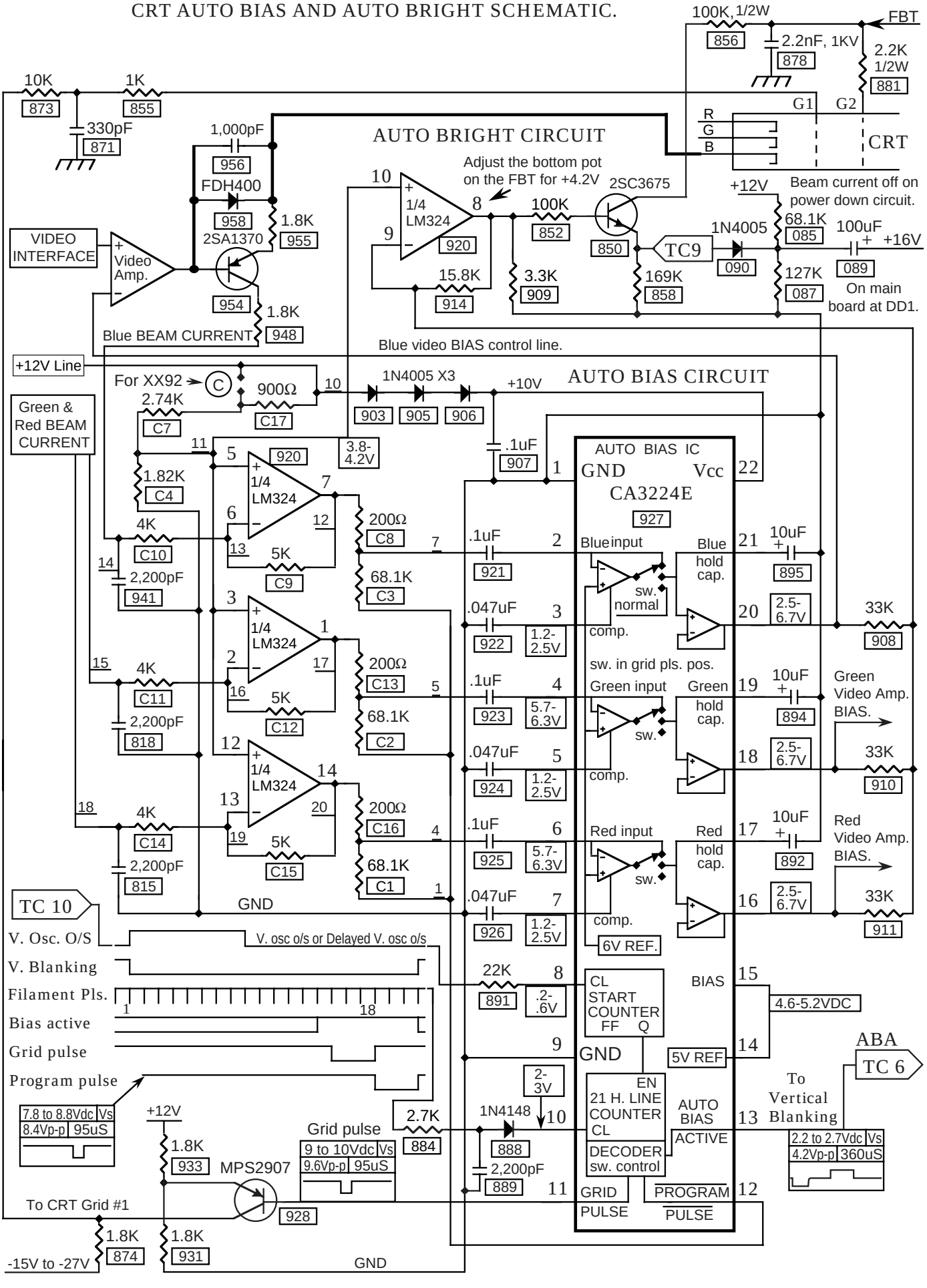


The vertical oscillator one shot (LA7851 pin 16) supplies the start timing for the auto bias vertical sync. This signal is conducted to the emitter of [379] by jumper [089] . The base of [379] is connected to the retrace boost pulse by resistor divider [383] and [384] . Combining these signals in this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

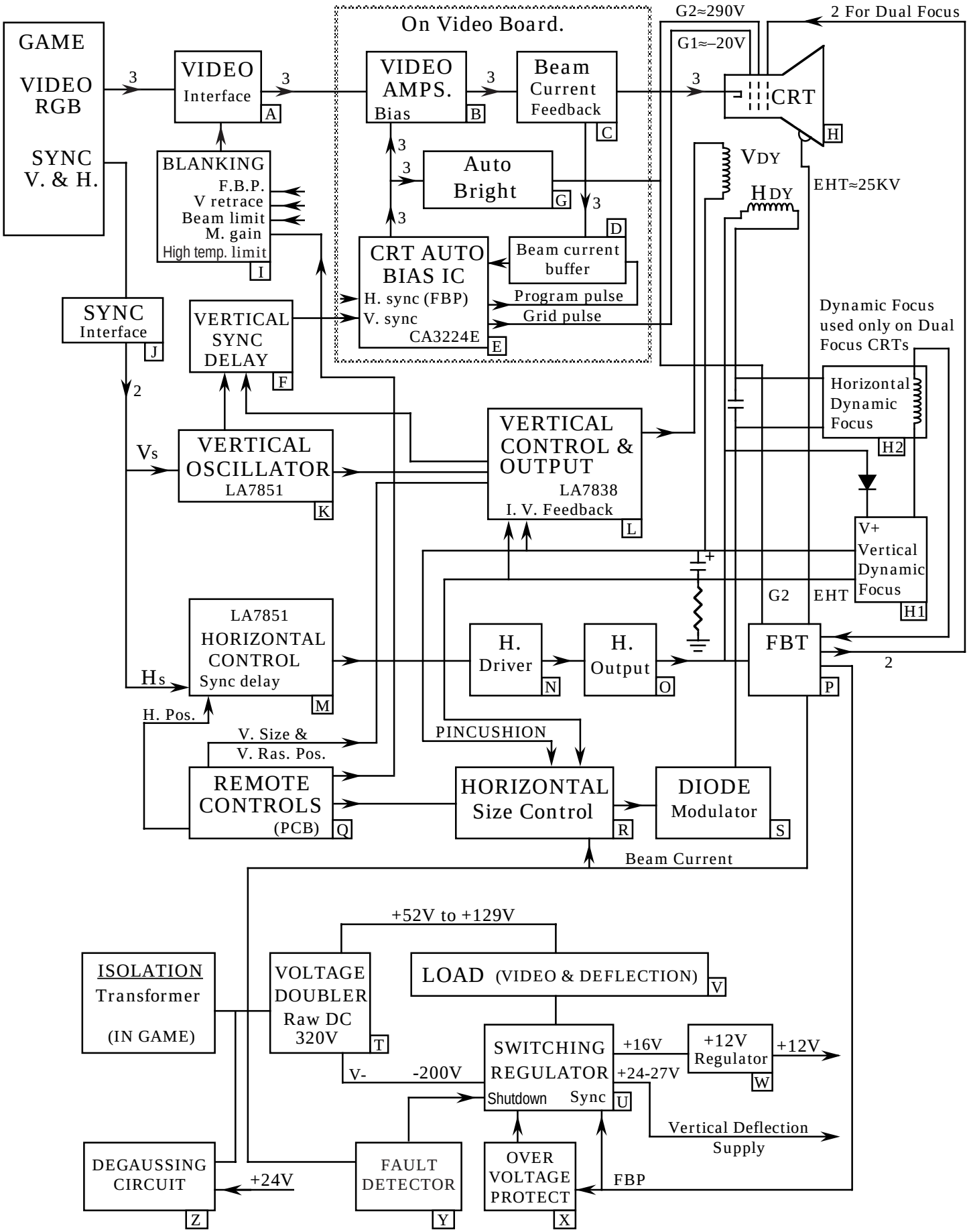
For the 15KHz case, transistor [100] inverts the vertical oscillator one shot signal to produce the CRT auto bias vertical sync signal. Resistor [099] is the pullup and resistor [006] reduces the chance of arc damage to the transistor.

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.

CRT AUTO BIAS AND AUTO BRIGHT SCHEMATIC.

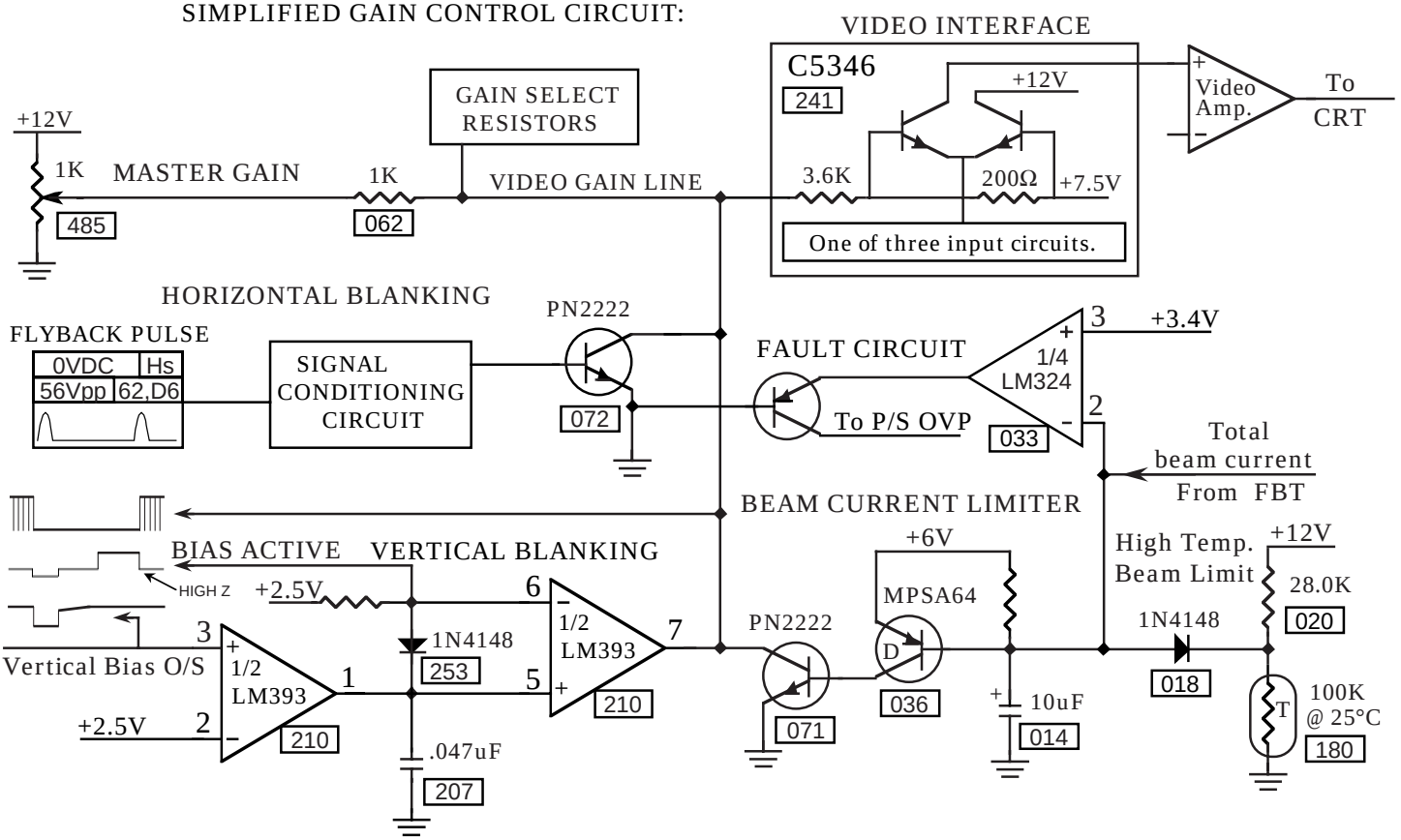


Monitor, Block Diagram Review.



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 then 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].

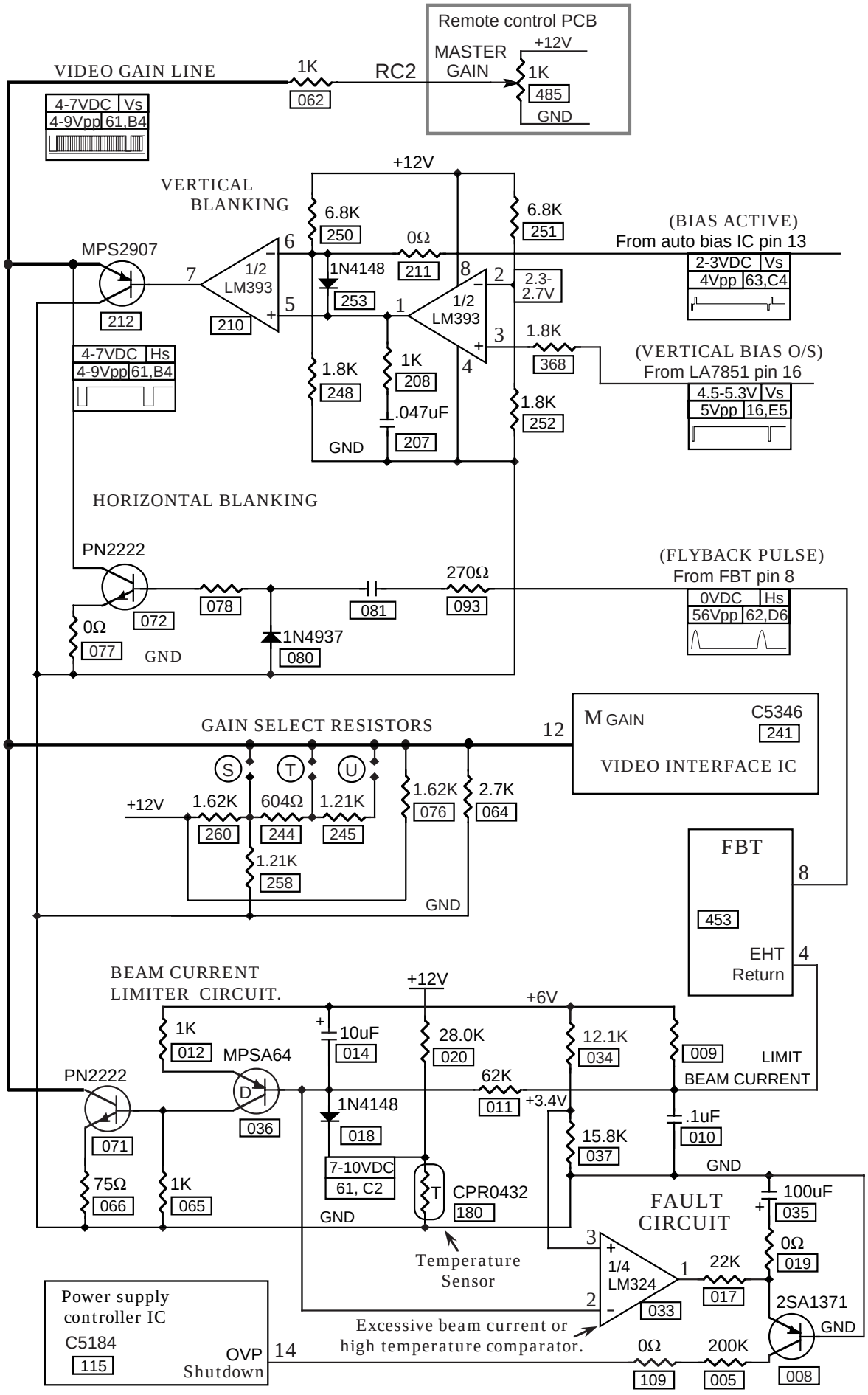
Vertical blank time is started when a low going pulse from the LA7851 pin 16 causes the output, pin 1, of the dual comparator [210] to go low. Capacitor [207] is discharged through resistor [208] at this time. After the end of the LA7851 pulse, the capacitor [207] holds the output, pin 7 of the comparator, 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 it's 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.

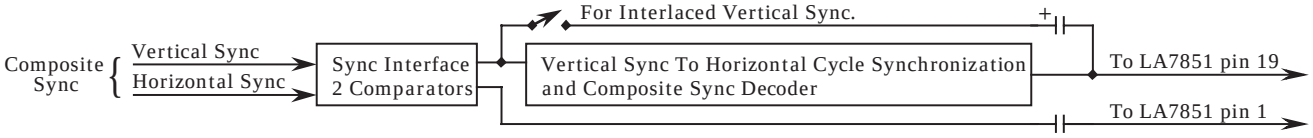
The beam current limiter circuit uses the base to emitter voltage of a darlington transistor [036] to set the maximum beam current. To sense the beam current, capacitor [010] integrates the current pulses produced by rectifying the high voltage flyback pulses. The beam current is converted to a voltage 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.

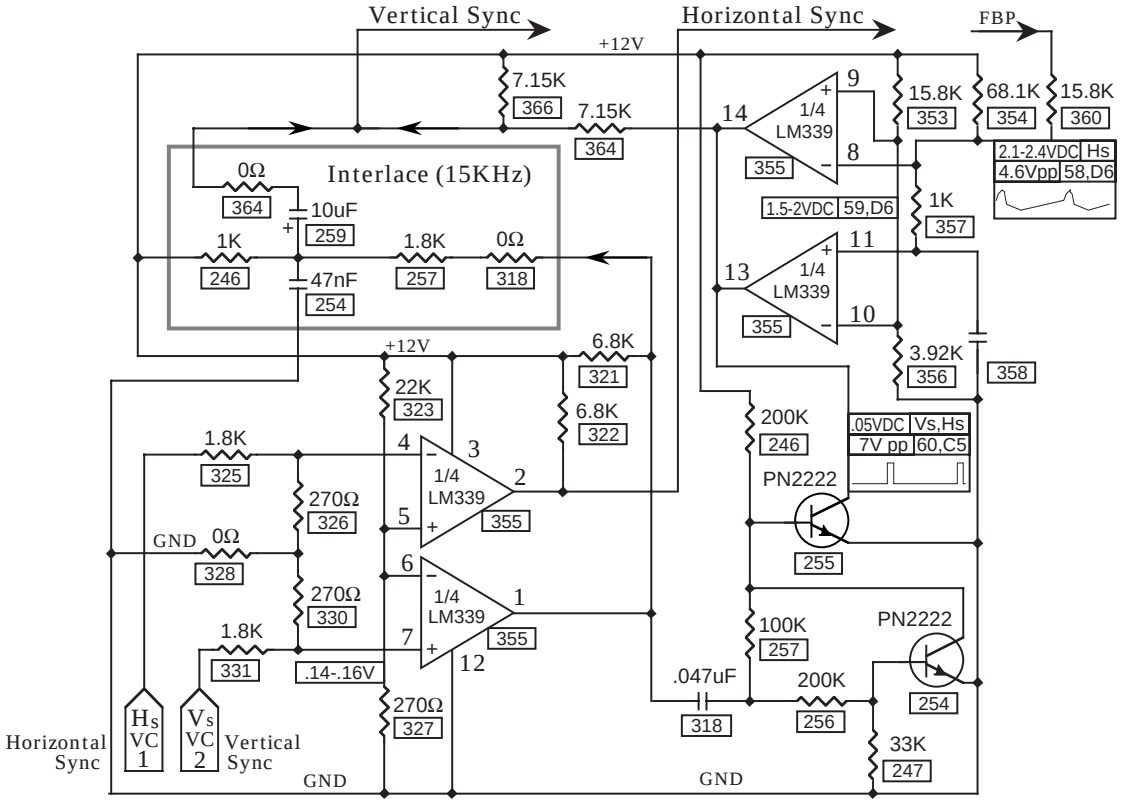


VERTICAL AND HORIZONTAL SYNC CIRCUIT DESCRIPTION.



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.

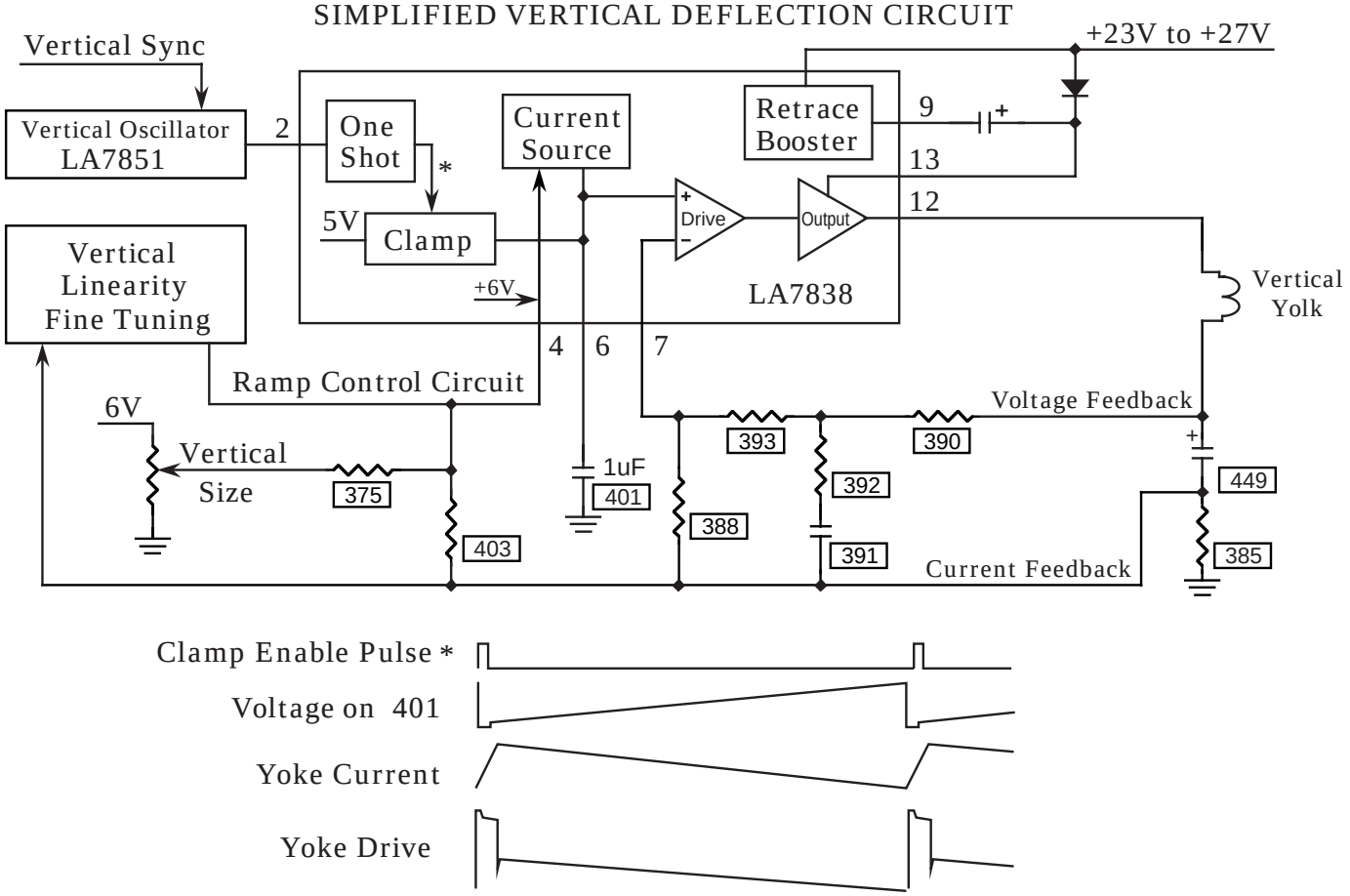
Capacitor [318] couples the vertical sync pulses to transistors [254] & [255]. When no sync pulse is present, transistor [255] is turned on by resistor [246]. For a negative vertical sync pulse, transistor [255] is turned off by the negative pulse applied to resistor [257] and the window comparator pulse 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 ± 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.

SIMPLIFIED VERTICAL DEFLECTION CIRCUIT



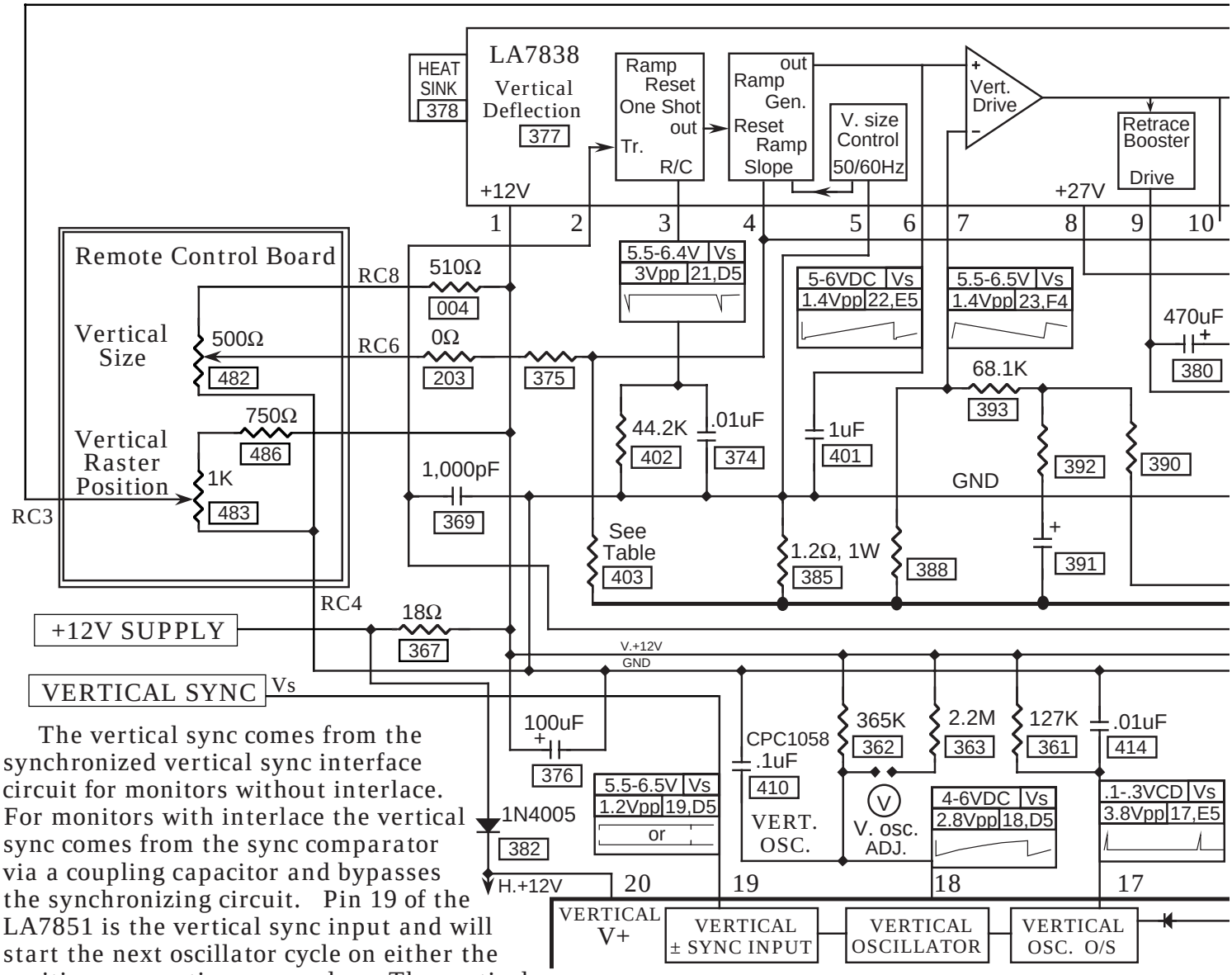
The vertical oscillator in the LA7851 supplies timing to the vertical deflection IC to maintain a raster with no sync present. Vertical sync supplies the timing when sync is present.

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.



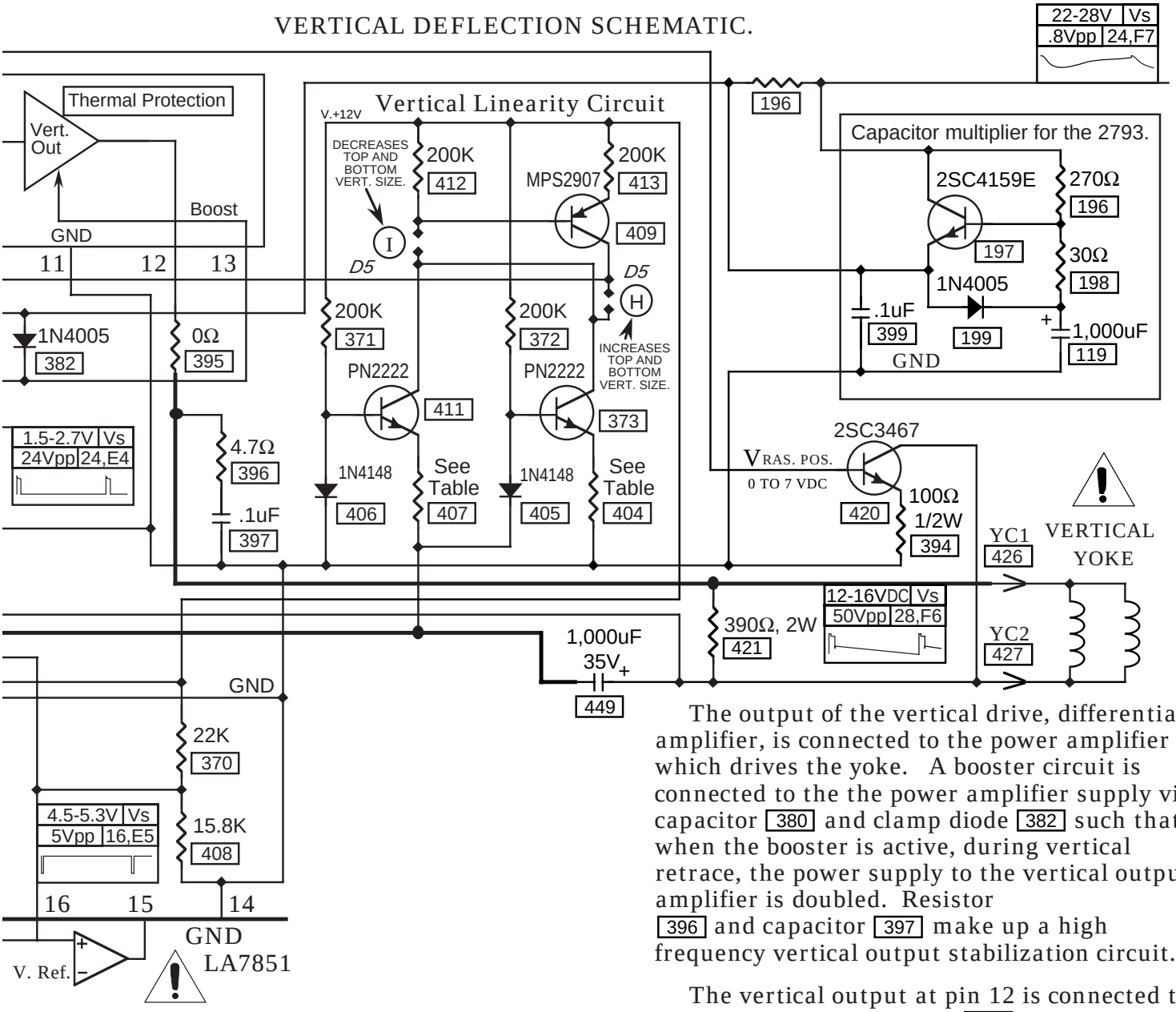
The vertical sync comes from the synchronized vertical sync interface circuit for monitors without interlace. For monitors with interlace the vertical sync comes from the sync comparator via a coupling capacitor and bypasses the synchronizing circuit. Pin 19 of the LA7851 is the vertical sync input and will start the next oscillator cycle on either the positive or negative sync pulse. The vertical oscillator capacitor [410] discharges to 4 volts on the leading edge of the vertical sync by the action of an internal transistor and resistor. Capacitor [410] is then charged by resistor [362] until the next sync pulse or to 8 volts, which ever comes first. The V. osc. frequency is set low such that the adjustment resistor [363] can be used to act as a vertical hold adjustment. Solder connection (V) is used to make this adjustment.

The vertical oscillator triggers the vertical oscillator one shot, which outputs a pulse to trigger the vertical sync input, pin 2, of the LA7838. This one shot is also used to synchronize the CRT auto bias IC. Resistor [361] & capacitor [414] set the timeout which must be longer than the CRT auto bias Vs delay and shorter than the vertical blanking. Resistors [370] & [408] supply the pullup for this one shot.

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.



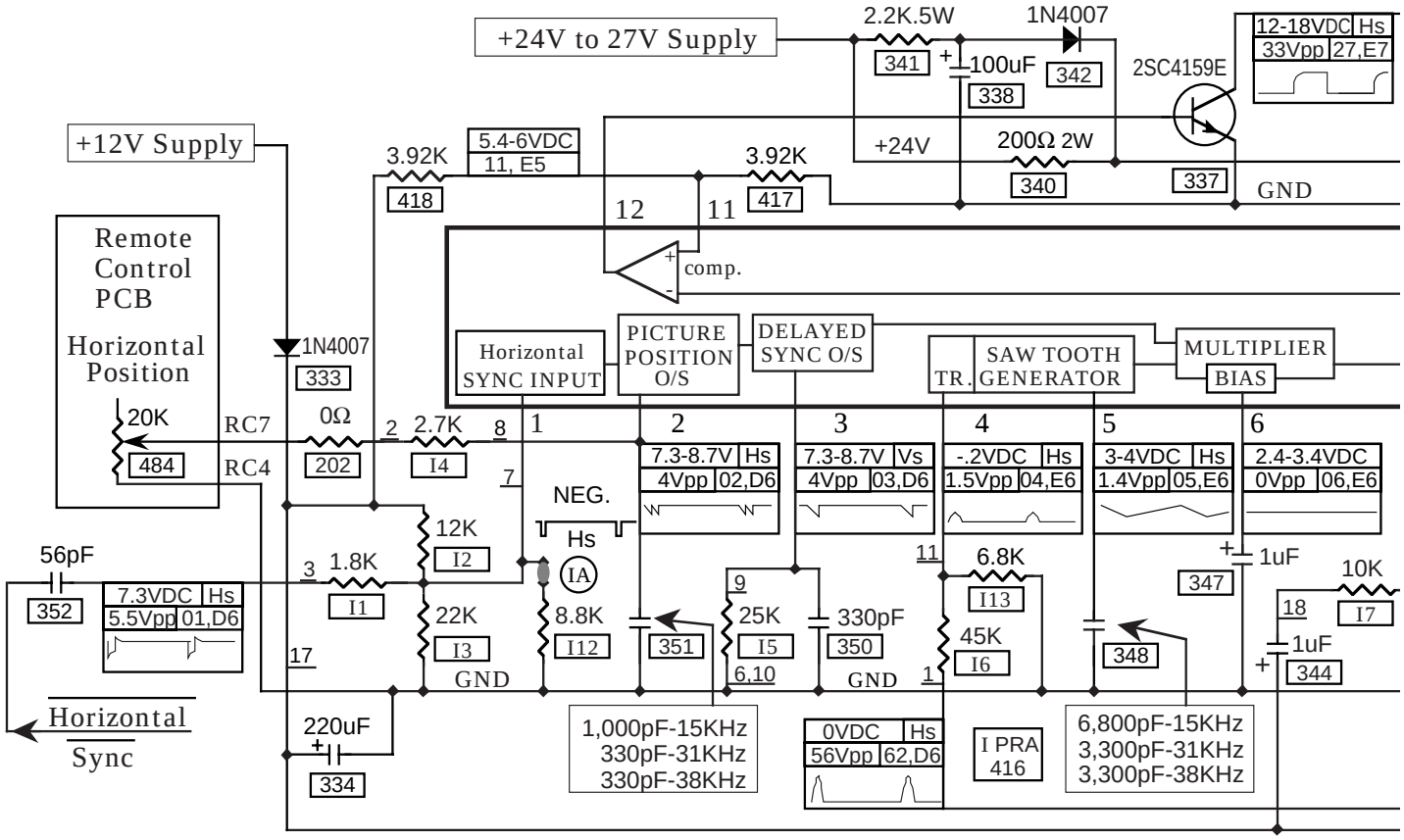
In similar manner, the positive half of the vertical current waveform is conducted by transistor [373] diode [405], and resistors [372] and [404]. Both transistors [373] and [411] may be connected to pin 4 via solder connection (H) or they may be connected to inverting transistor [409] and resistors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



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).

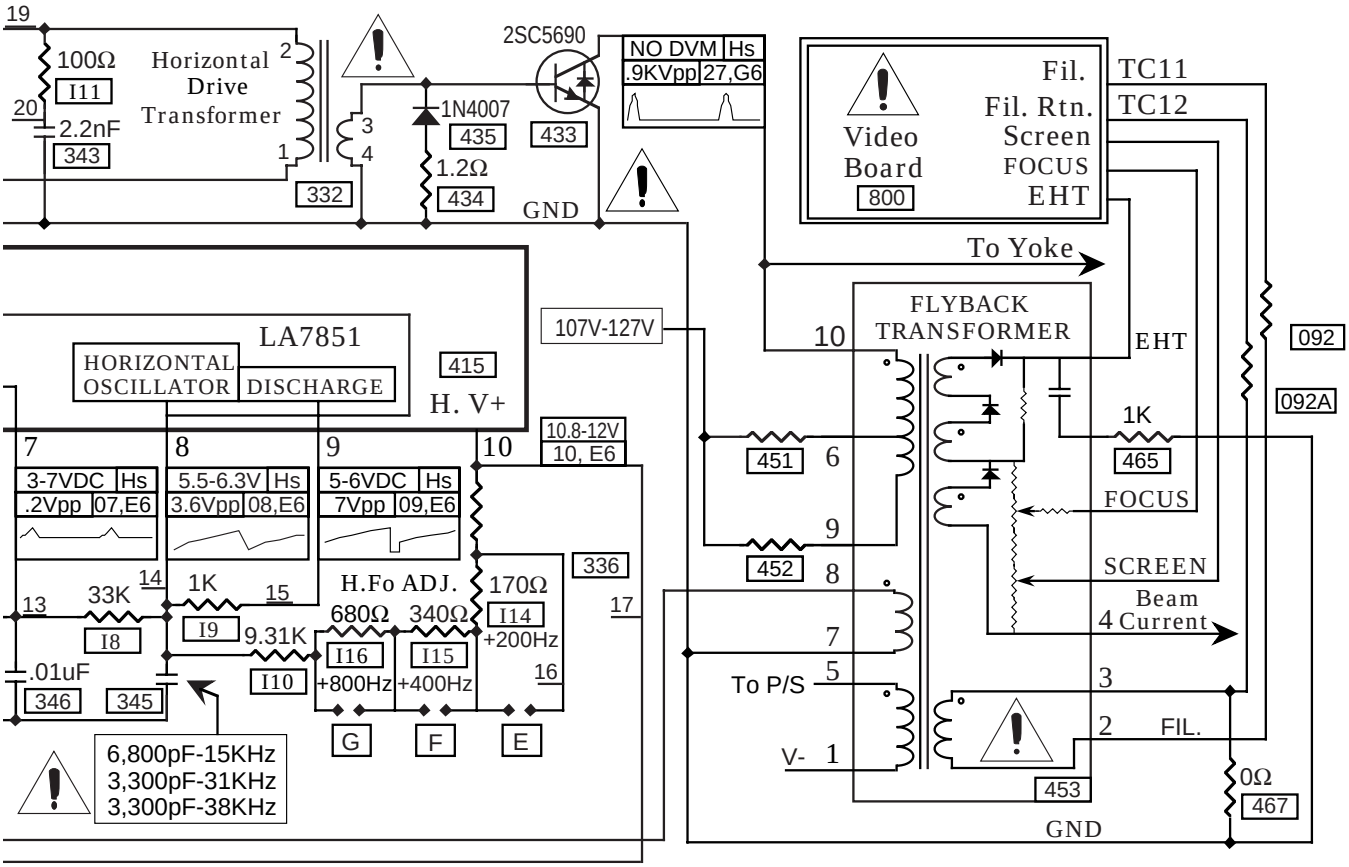
The picture position O/S clamps timing capacitor [351] to 8.2 volts until horizontal sync triggers this O/S. The voltage on the timing capacitor drops at a rate set by the horizontal position control [484] and resistor [I4]. When the voltage, at pin 2, drops below 4 volts the delayed sync O/S is triggered 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 saw tooth 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.

HORIZONTAL DEFLECTION SCHEMATIC.



The voltage on capacitor 346 controls the horizontal oscillator frequency via I8. In the case of missing horizontal sync pulses, the multiplier does not sink current and flywheel capacitor 344 holds the horizontal frequency constant. Resistor I7 permits small rapid changes of the control voltage at pin 7 for locking of the oscillator to horizontal sync.

The horizontal oscillator capacitor 345 charges to its upper voltage limit through resistors I10, I16, I15, I14, and 336. This capacitor is then discharged to the lower voltage limit through the action of discharge pin 9 and resistor I9. The free running frequency (Hfo) may be adjusted by making solder connections on the I PRA. (see page 65 for the I PRA layout). In some cases where there are many missing horizontal sync pulses, it is necessary to adjust the Hfo closer than ±200 Hz. For fine tuning the Hfo, resistor 336 is replaced with a pot.

The horizontal phase locked loop then consists of an oscillator which sets the flyback timing. The flyback pulse is then compared to the incoming sync pulse and the difference voltage holds the oscillator at the sync frequency.

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 horizontal output transistor 433 conducts about three amps of horizontal flyback transformer primary current and deflection yoke current. This transistor has a beta as low as three. To supply the high base current, a horizontal output transistor drive transformer is used. The drive transformer 332 builds up energy during the on time of the drive transistor, 337 which is the off time of the horizontal output transistor 433. Capacitor 343 and resistor I11 damps the drive transformer primary waveform. To reduce power dissipated by the horizontal output transistor during turnoff, a clamp circuit is connected to the drive transformer primary. This clamp consists of resistor 341, capacitor 338, and diode 342.

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.

HORIZONTAL RASTER WIDTH CONTROL CIRCUIT DESCRIPTION.

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.

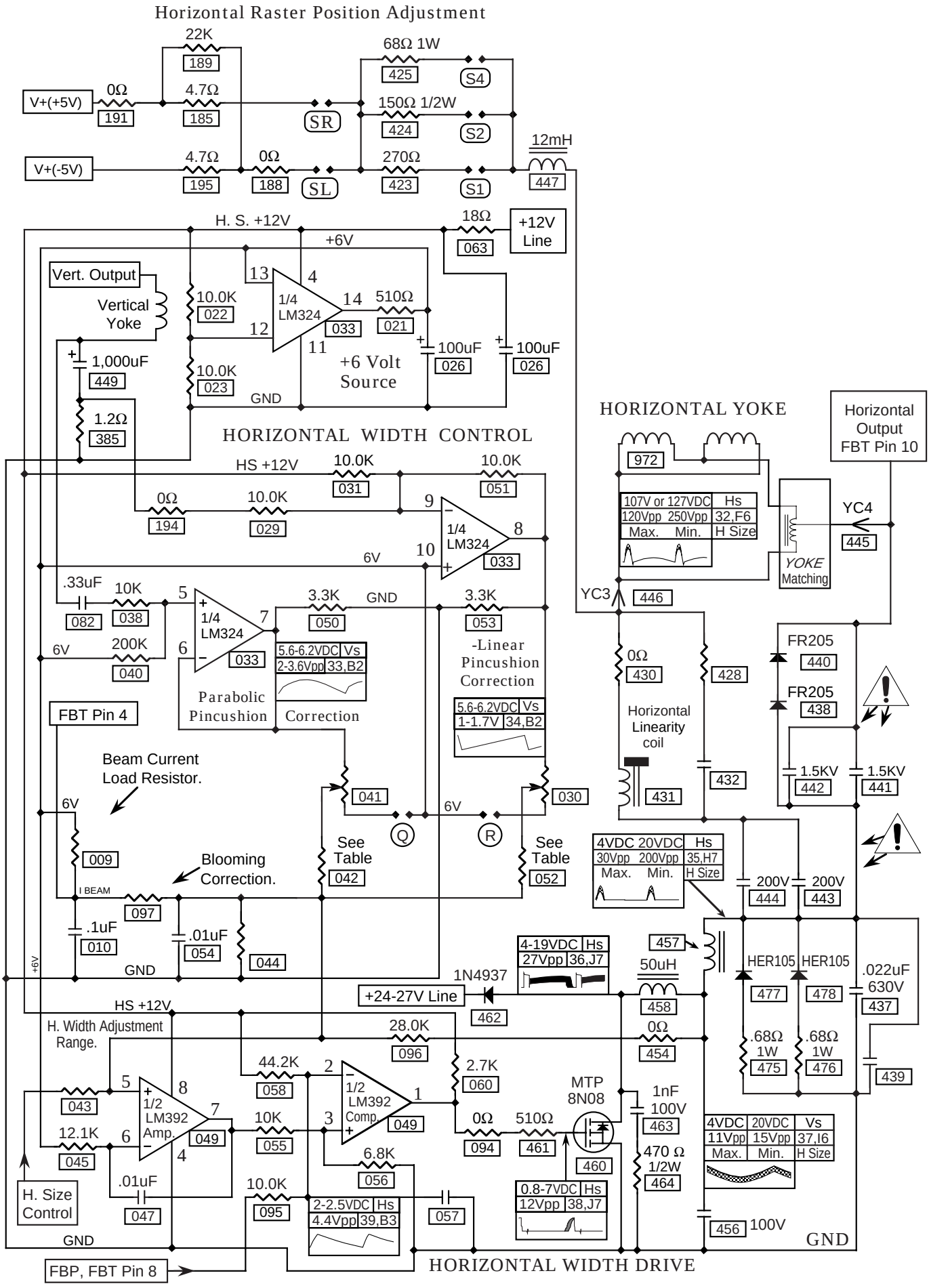
The power output stage of the horizontal width control circuit is a high efficiency switching mode driver. The FBT pulse is integrated by capacitor [057] through resistor [095] and level shifted by resistor [058] to produce a saw tooth waveform. See waveform block TP 39. By connecting one input of the 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 reduces noise due to rapid drain transitions.

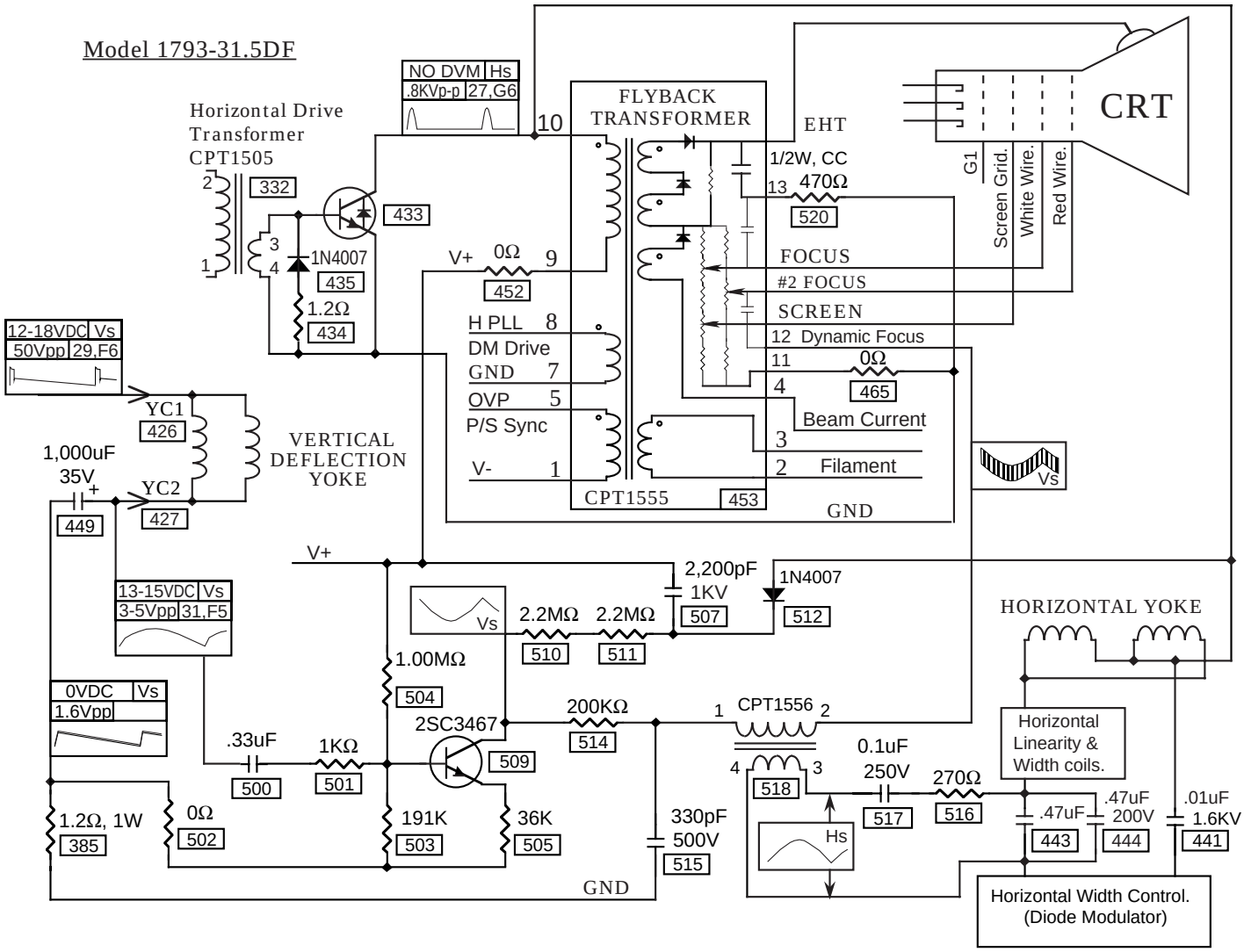
When the MOSFET is on (gate voltage high) current increases in inductor [458] and when the MOSFET is turned off the current is dumped in to the 24-27V line through diode [462]. The magnitude of this current, from the diode modulator, is determined by the duty cycle of the MOSFET which is a function of 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 I^2R 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 Position Adjustment
22K
189
68Ω 1W
425
S4
V+(+5V)
0Ω
191
4.7Ω
185
SR
150Ω 1/2W
424
S2
12mH
V+(-5V)
4.7Ω
195
0Ω
188
SL
270Ω
423
S1
447
H. S. +12V
18Ω
063
+12V Line
+6V
Vert. Output
Vertical Yoke
10.0K
022
13
4
1/4 LM324
033
14
510Ω
021
12
11
+6 Volt Source
100uF
026
100uF
026
1,000uF
449
10.0K
023
GND
1.2Ω
385
HORIZONTAL WIDTH CONTROL
HS +12V
10.0K
031
10.0K
051
0Ω
194
10.0K
029
9
8
10
6V
.33uF
082
10K
038
5
7
6
3.3K
050
GND
3.3K
053
200K
040
Parabolic Pincushion Correction
5.6-6.2VDC Vs
2-3.6Vpp 33,B2
-Linear Pincushion Correction
5.6-6.2VDC Vs
1-1.7V 34,B2
FBT Pin 4
Beam Current Load Resistor.
041
030
Q
R
See Table
042
See Table
052
009
Blooming Correction.
I BEAM
097
.1uF
010
.01uF
054
044
GND
+6V
HORIZONTAL YOKE
Horizontal Output FBT Pin 10
972
107V or 127VDC Hs
120Vpp 250Vpp 32,F6
Max. Min. H Size
YC4
445
YOKE Matching
YC3
446
0Ω
430
428
Horizontal Linearity coil
431
432
FR205
440
FR205
438
1.5KV
442
1.5KV
441
4VDC 20VDC Hs
30Vpp 200Vpp 35,H7
Max. Min. H Size
200V
444
200V
443
4-19VDC Hs
27Vpp 36,J7
457
50uH
458
1N4937
462
+24-27V Line
HER105
477
HER105
478
.022uF
630V
437
.68Ω 1W
475
.68Ω 1W
476
439
HS +12V
H. Width Adjustment Range.
28.0K
096
0Ω
454
44.2K
058
2
1
2.7K
060
MTP 8N08
1nF
100V
463
043
5
8
1/2 LM392 Amp.
7
4
1/2 LM392 Comp.
049
10K
055
3
0Ω
094
510Ω
461
460
470 Ω
1/2W
464
12.1K
045
6
6.8K
056
4VDC 20VDC Vs
11Vpp 15Vpp 37,I6
Max. Min. H Size
H. Size Control
.01uF
047
10.0K
095
2-2.5VDC Hs
4.4Vpp 39,B3
057
0.8-7VDC Hs
12Vpp 38,J7
456
100V
GND
GND
FBP, FBT Pin 8
HORIZONTAL WIDTH DRIVE



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.

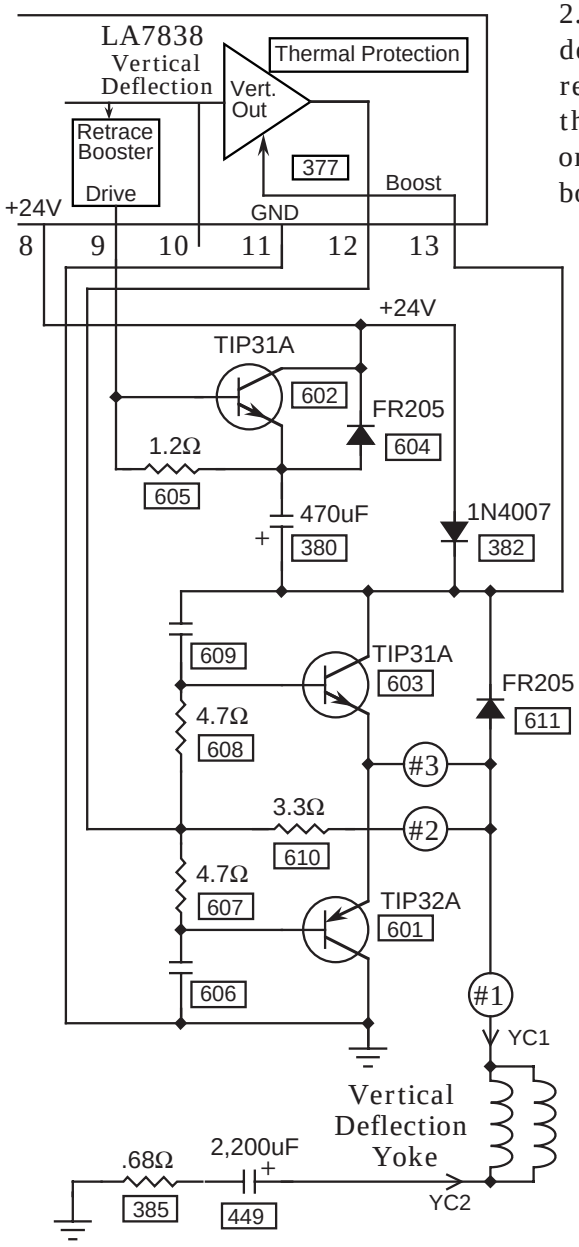
The dynamic focus circuit produces a composite waveform which consists of the horizontal parabolic waveform and the vertical parabolic waveform. This composite waveform is applied to the dynamic focus input, of the flyback transformer, and produces a sharp picture on the dual focus picture tubes. Typically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

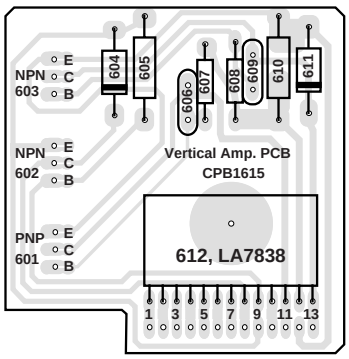
Dynamic Focus Circuit Operation: The vertical component of the dynamic focus circuit is derived by amplifying the voltage waveform across the vertical yoke coupling capacitor. The horizontal component of the dynamic to focus circuit is produced by applying the voltage waveform across the horizontal yoke 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 resister [501]. The bias for this transistor is generated by resistors [503] and [504]. The gain of this amplifier is defined by resister and [505]. Note; Resister [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 rectifiers the primary flyback pulse and is integrated by capacitor [507]. The load resisters for this transistor are resistors [510] and [511]. The waveform on the collector, which is the vertical parabolic waveform, is conducted through resister [514] and through transformer [518] to the dynamic focus input of the flyback transformer. Resisters [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. Resister [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.

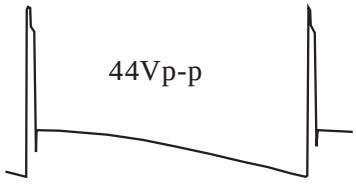
Vertical Booster Amplifier Circuit, Circuit And Function Description.

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.



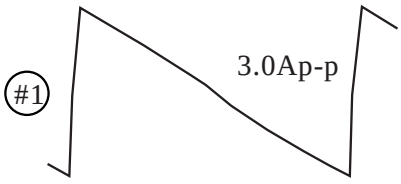


PCB View;
Foil Side.



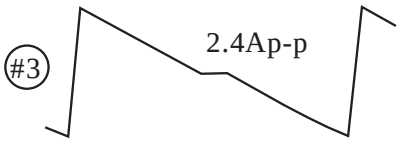
Vertical yoke drive, voltage waveform.

Vertical 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.



Vertical yoke drive, current waveform.

LA7838 output, current waveform.



Vertical booster, current waveform.

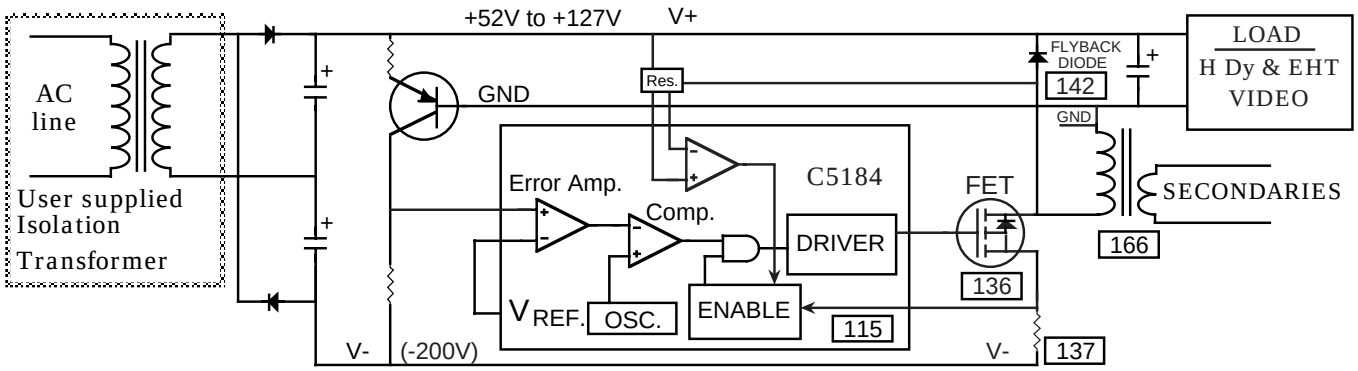
The output of the LA7838 is connected to the yoke by a 3.3Ω resister at [610]. It also drives the bases of transistors [601] and [603] through 4.7Ω stabilization resistors. When the voltage drop across resistor [610] reaches ±.7V the respective transistor (601 for -.7V & 603 for +.7V) takes over most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

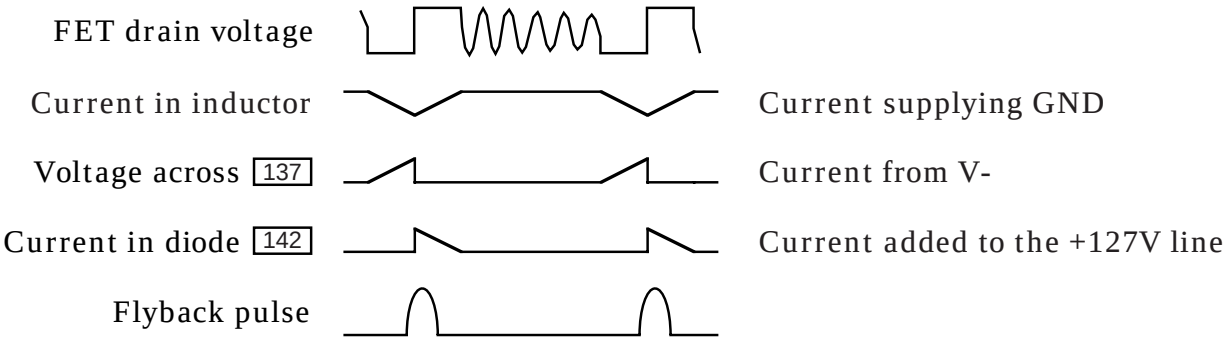
SIMPLIFIED POWER SUPPLY CIRCUIT, FUNCTION, DESCRIPTION.



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. →

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.

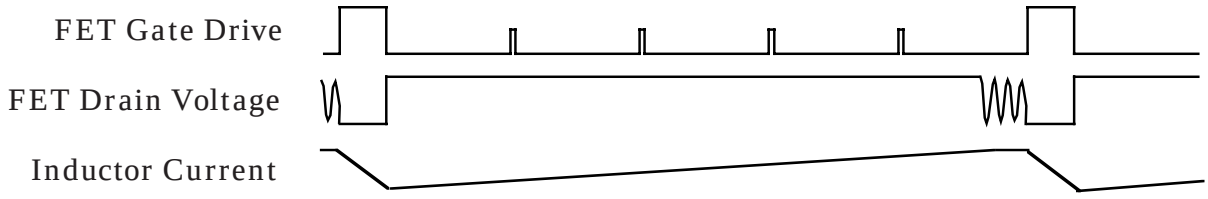
Under normal conditions, the current will decrease to zero and the voltage will ring.



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 4uS. 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, 134 connect the comparator across the flyback diode 142. 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 137 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.

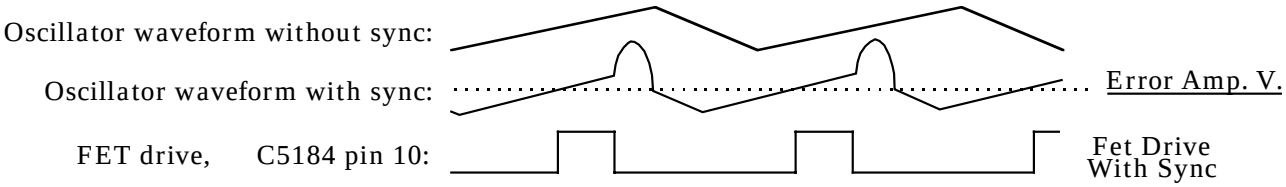
A 0-30 volt @ 1A, DC, isolated power supply is a tool necessary for trouble shooting CERONIX monitors. When trouble shooting the power supply, it can be connected to V- and the +17V line to keep the power supply running while checking the voltages and waveforms to find the fault. Caution, do not exceed 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 ±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.



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.

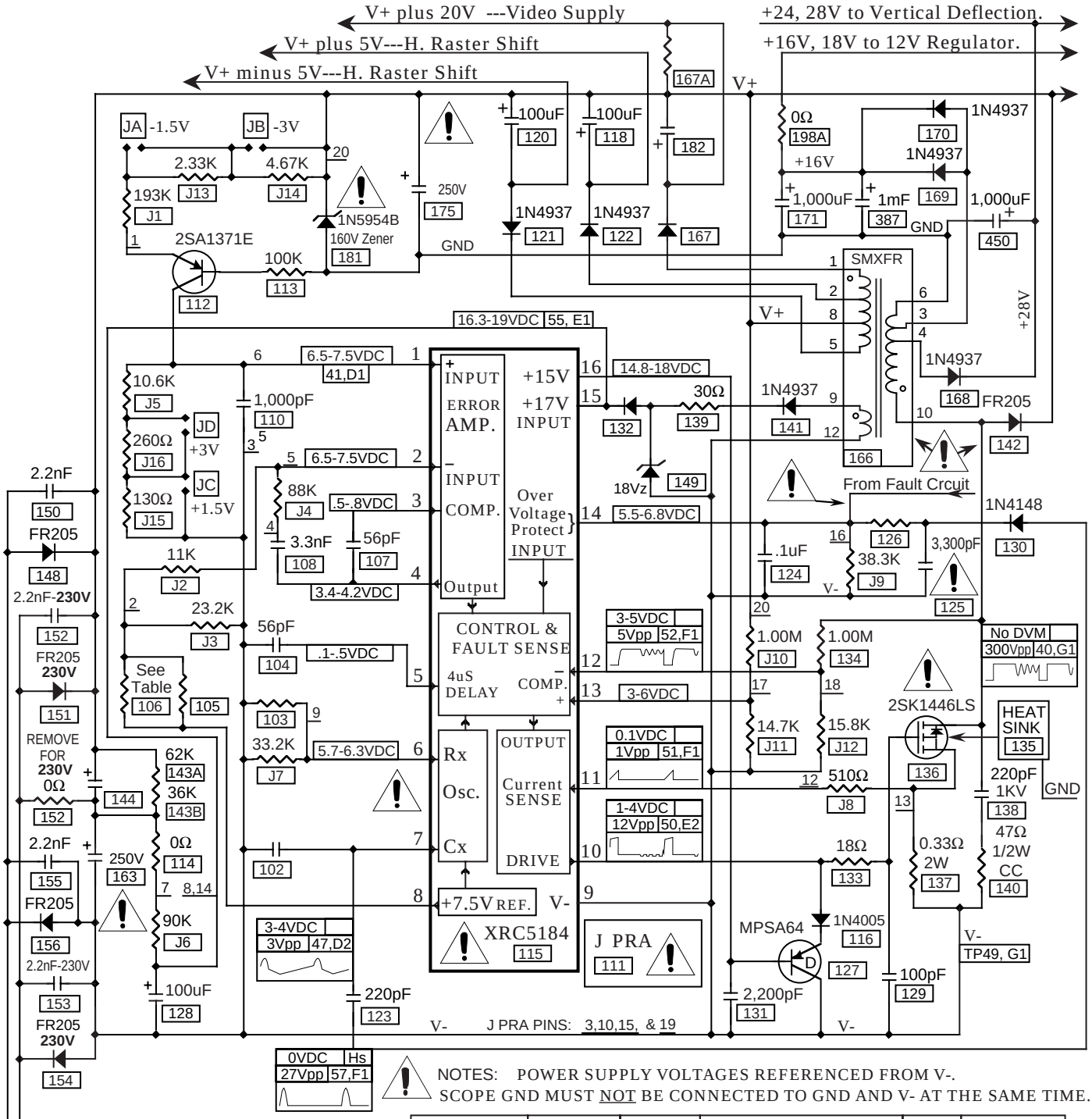
The FET drive is always off during the negative slope of the oscillator, or just after the sync pulse. Since the FET drive pulse is started by the error amplifier voltage and terminated by the end of the oscillator cycle, a control system via pulse width modulation has been established. The oscillator 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.

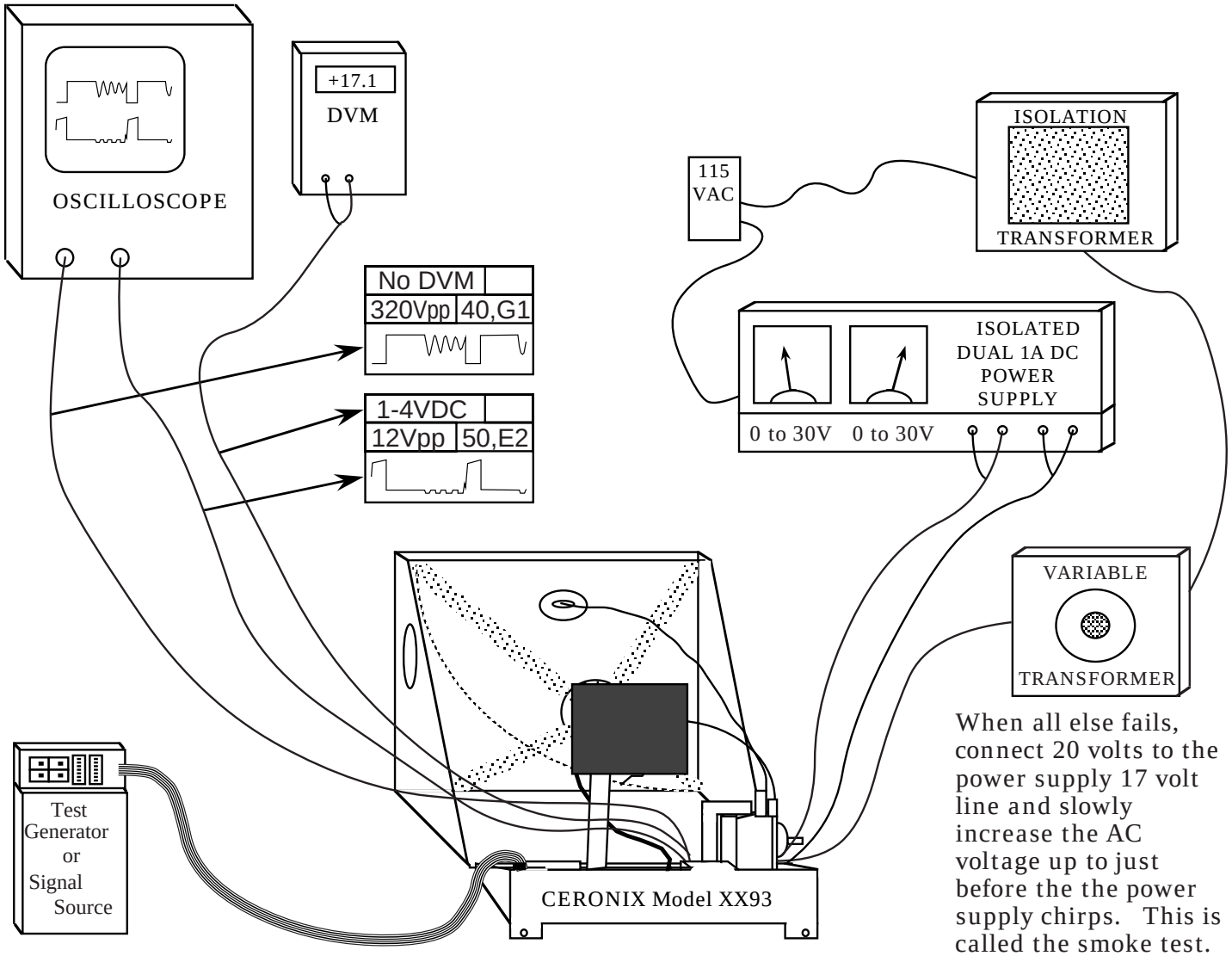
SWITCH MODE POWER SUPPLY SCHEMATIC.



POWER SUPPLY	VOLTAGE	CURRENT	CIRCUIT SUPPLIED	DIODE	FILTER CAP.	
LOW VOLTAGE SECONDARIES	17VDC	7mA	POWER SUPPLY CONTROL	141	100uF	128
	16VDC	500mA	VIDEO AND INPUT	170	1,000uF	171
	24-27VDC	350mA	V. & H. DEFLECTION	168	1,000uF	173
V+ MODIFIER SECONDARIES	(V+) -5VDC	150mA	H. RASTER SHIFT - LEFT	121	100uF	118
	(V+)+5VDC	150mA	H. RASTER SHIFT - RIGHT	122	100uF	120
	(V+)+20VDC	60mA	1VIDEO BOOSTER	167	220uF	174

The degaussing coil drive circuit may use a dual posistor [158] or a single posistor with a shorting relay [468]. The off current of the single posistor is large enough to cause raster movement when there is a differance between the line frequency and the vertical sync frequency.

Equipment Setup For Repairing The Model XX93 Monitor.



When all else fails, connect 20 volts to the power supply 17 volt line and slowly increase the AC voltage up to just before the the power supply chirps. This is called the smoke test.

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 / X-Y VDC ← 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. / Vp-p | TP-REF / WAVEFORM ← { Test Point, board cross REFerence location. The waveform is normally checked with a oscilloscope. It has a P-P voltage amplitude of Vp-p.

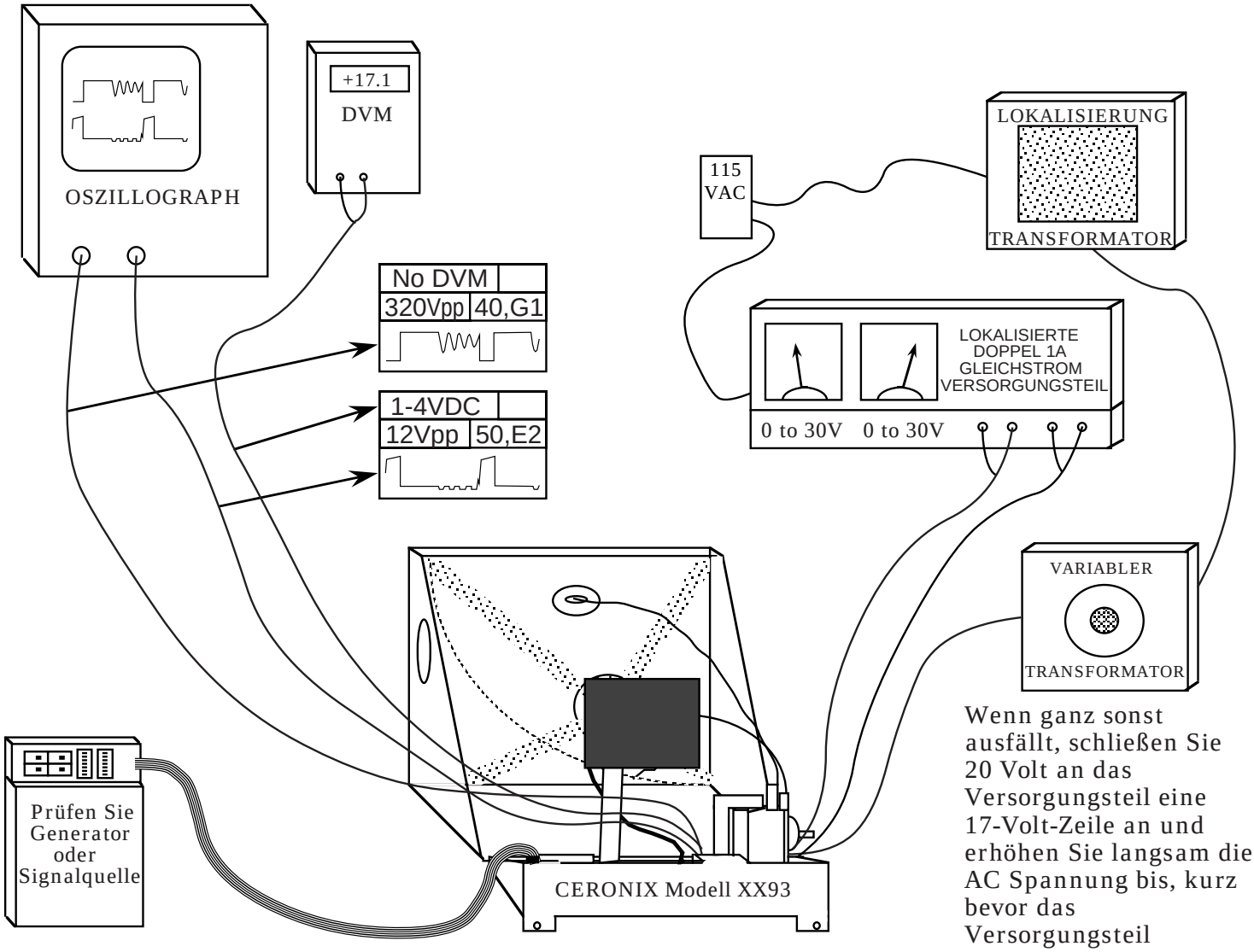
CAUTION: When making measurements on the power supply be sure that the other scope probe is not connected to GND.

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 / X-Y VDC ← { DC VOLTAGE RANGE, USING A DMM.
- X-Y VDC | Sync. ← USE V. or H. SYNC.
- Vp-p | TP-REF / WAVEFORM ← AC VOLTS Peak to Peak | TEST POINT ASS. REF.
- Measured with scope

Ausrüstung Gegründet Für Die Reparatur Des Monitors Des Modells XX93.



Wenn ganz sonst ausfällt, schließen Sie 20 Volt an das Versorgungsteil eine 17-Volt-Zeile an und erhöhen Sie langsam die AC Spannung bis, kurz bevor das Versorgungsteil zwitschert. Dieses wird die Feuerprobe genannt.

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

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

Messen werden mit einem weiflen Bildschirm genommen.

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

LEGENDE

No ← BRETTTEIL-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.
Vp-p | TP-REF
Wellenform
Volt Wechselstrompaek zur Spitze. | PRüFPUNKT ASS. REF.
Gemessen mit oszillograph.

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.

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.

Problem		Tests	Probable Solution
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.

Problem		Tests	Probable Solution
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.

Problem		Tests	Probable Solution
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] .

Problem		Tests	Probable Solution
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] .

Problem		Tests	Probable Solution
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.

Problem		Tests	Probable Solution
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.

Problem		Tests	Probable Solution
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.

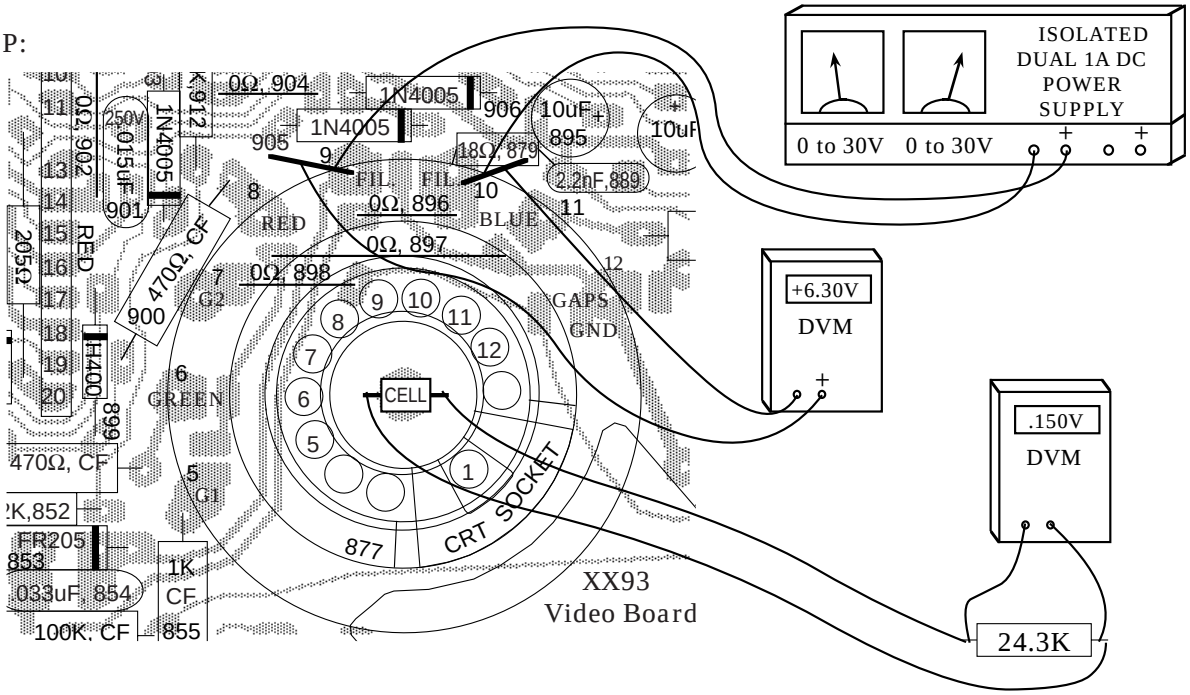
When replacing either the flyback transformer or the video board, the filament voltage may not be correct.

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.

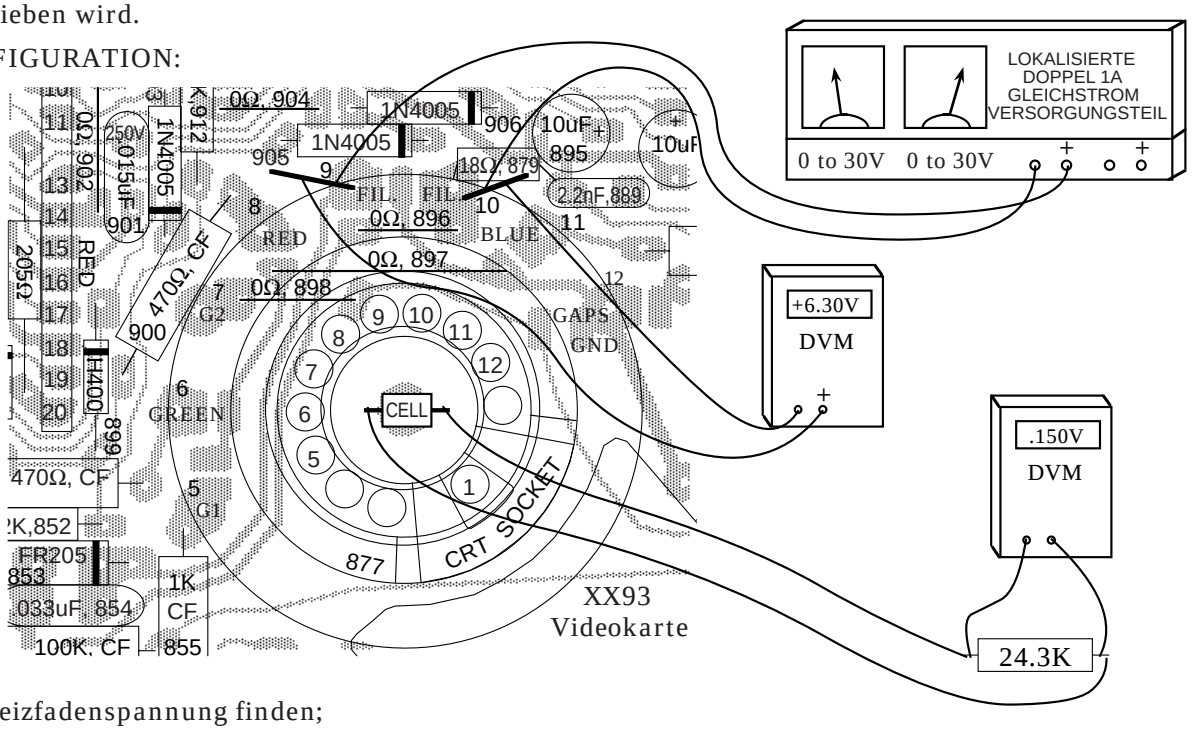
Wenn der EHT-Transformator oder die Videokarte geändert wird, kann die Heizfadenspannung falsch sein.

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.

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.

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.

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 gesperrt 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 Fernbedienungbrett, 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.

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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 & N0.	STREET & N0.
CITY STATE ZIP	CITY STATE ZIP

Phone No. _____ Fax No. _____

Shipping Information _____

Comments _____

	CERONIX Part No.	Description	Quantity	Price
1				
2				
3				
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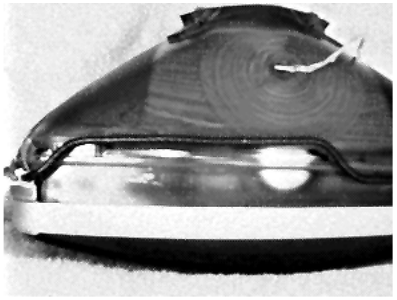
12				

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

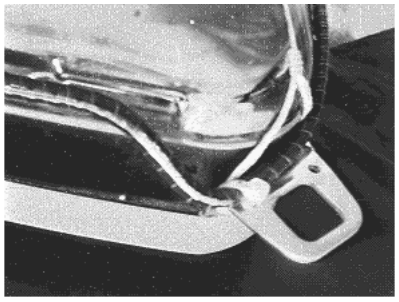
DEGAUSSING COIL ATTACHMENT SPECIFICATION.

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

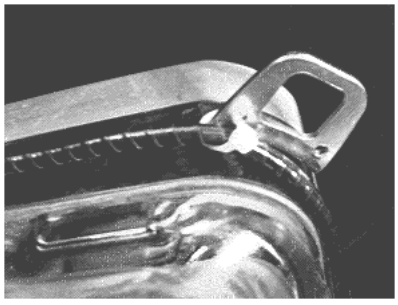
ATTACH THE GROUNDING STRAP FIRST.



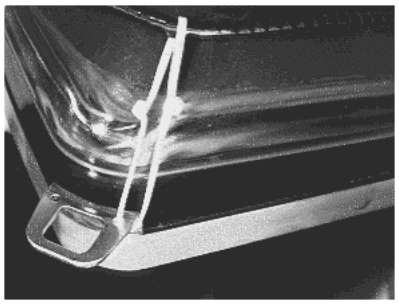
With the degaussing coil leads centered on the bottom of the CRT, FORM THE COIL to avoid the remote control board.



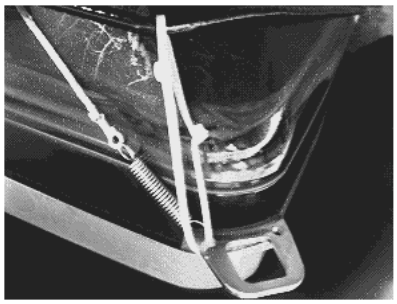
INSTALL A WIRE TIE through the top hole in the left CRT ear.



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.

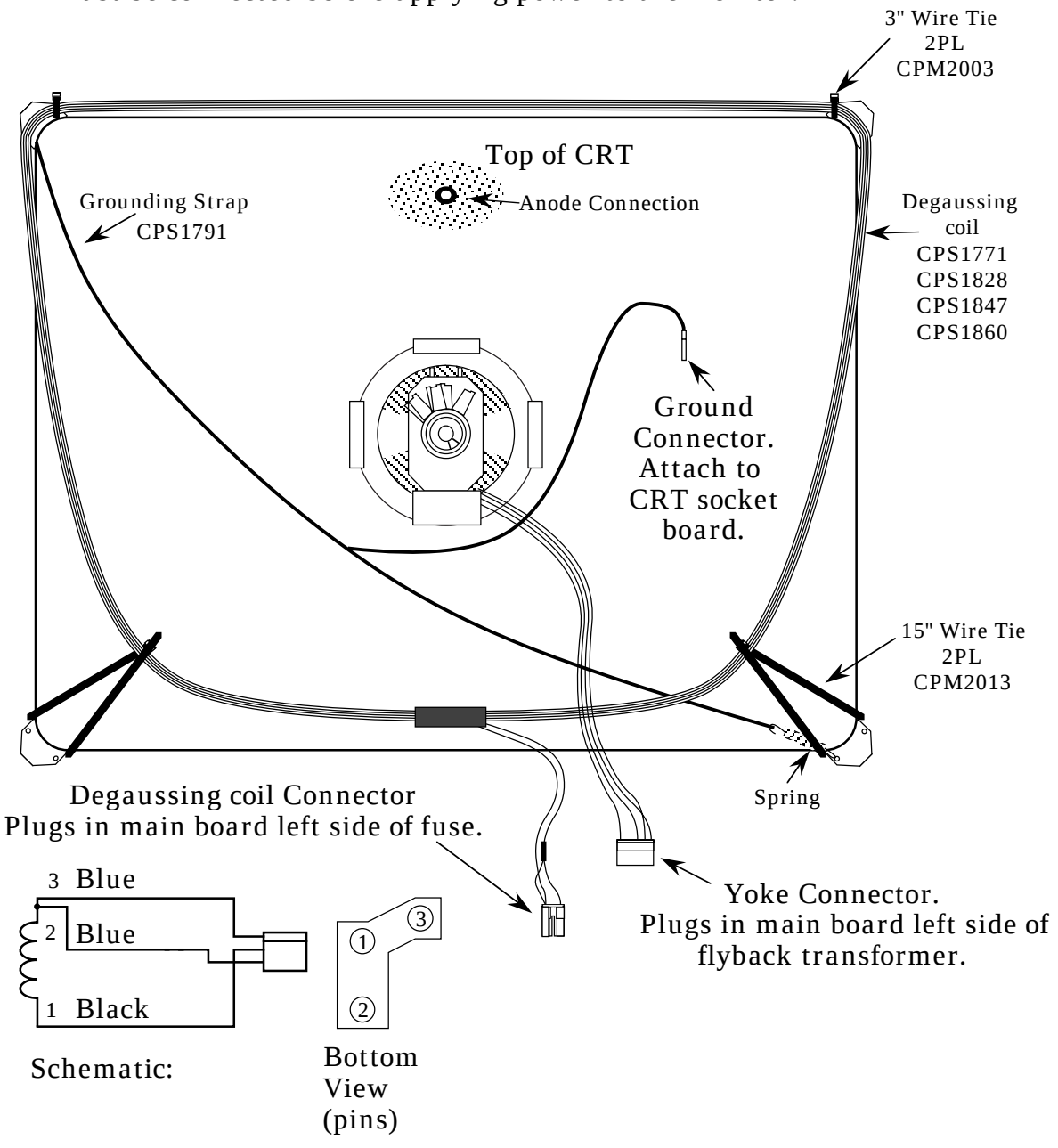
Degaussing Coil & Grounding Strap Attachment Specification.

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.

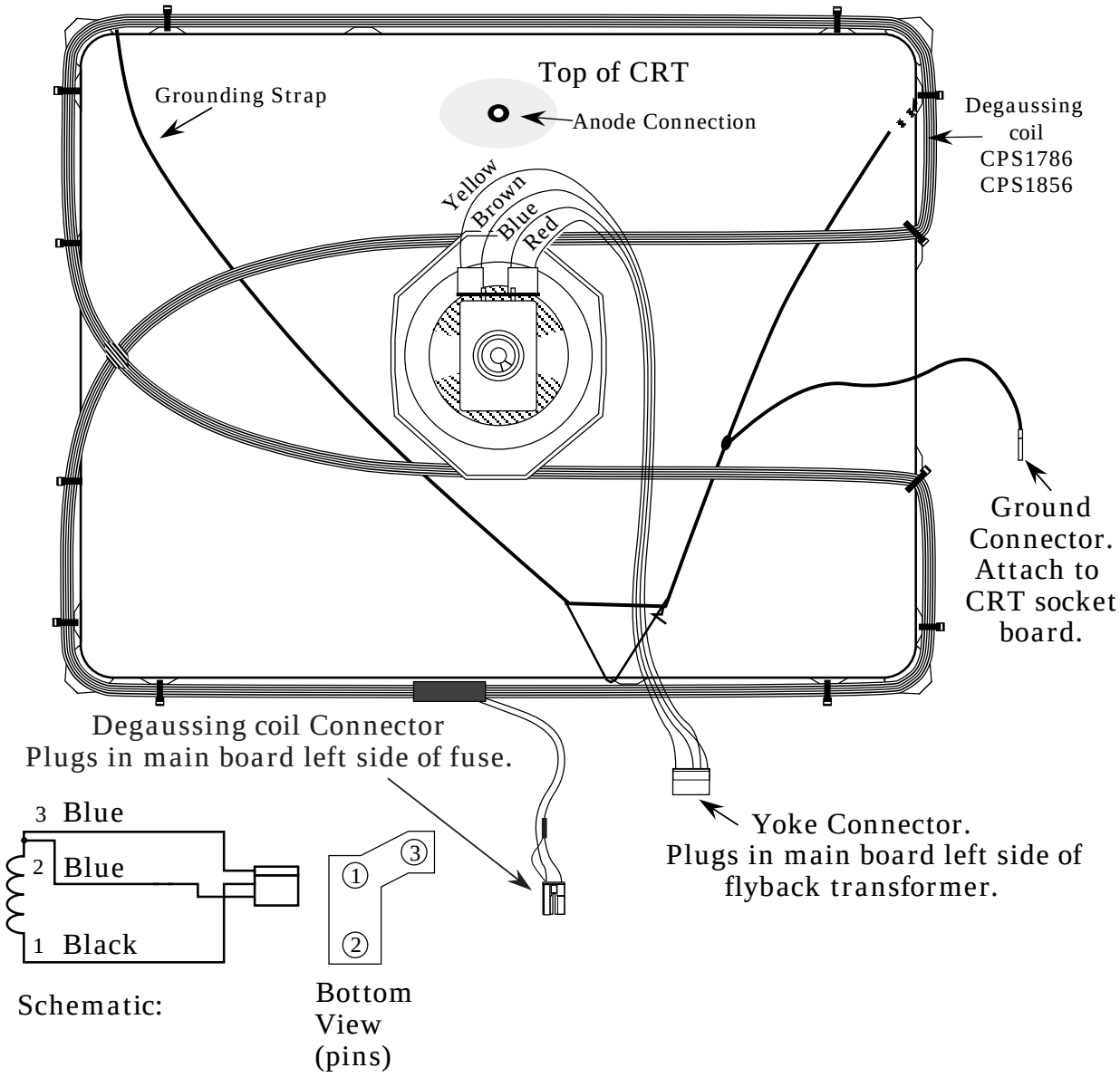
For The Model 2793 and 3693 Video Monitor.

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.

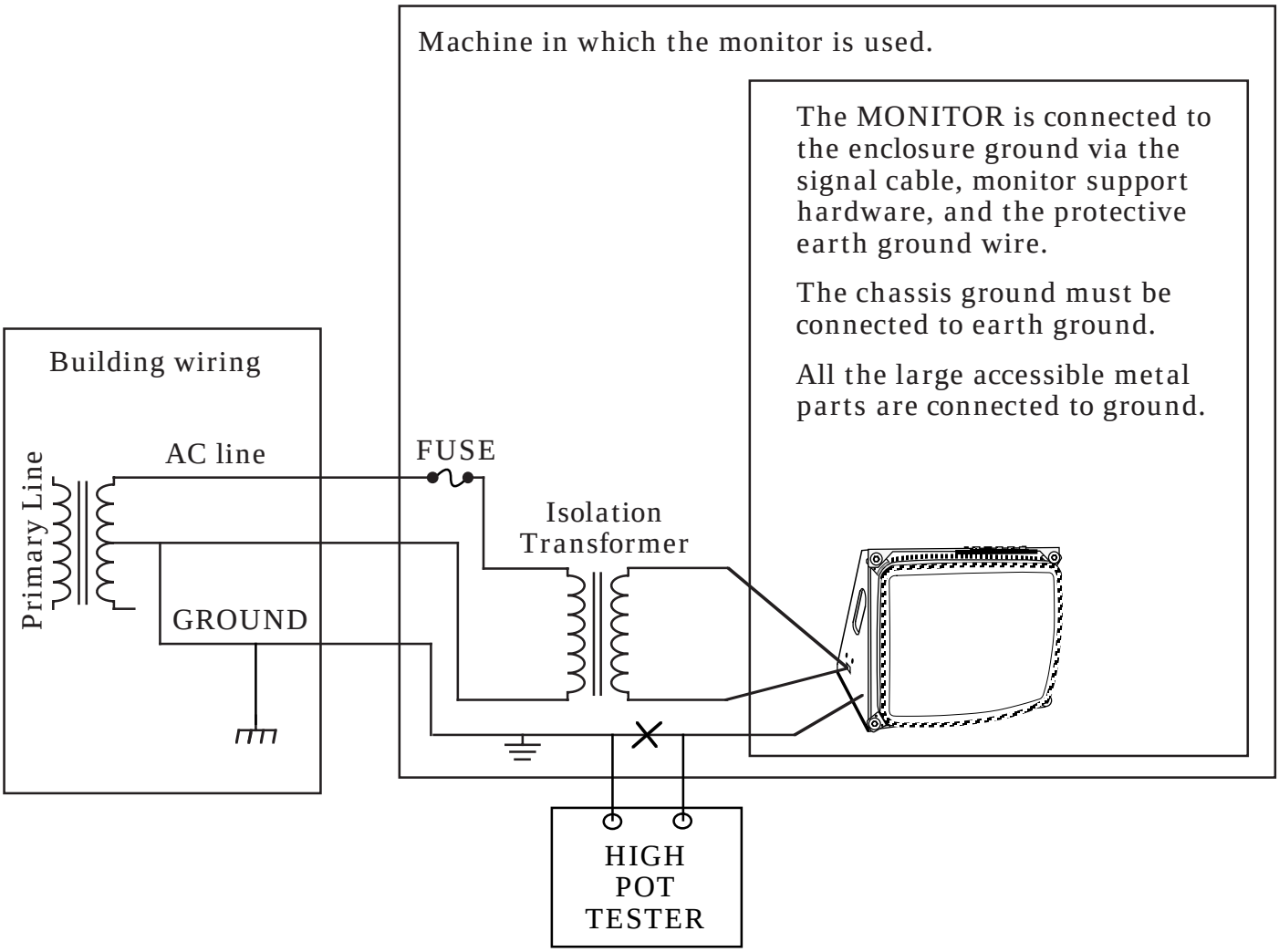


Highpot, For Shock Hazards, Circuit Description.

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.

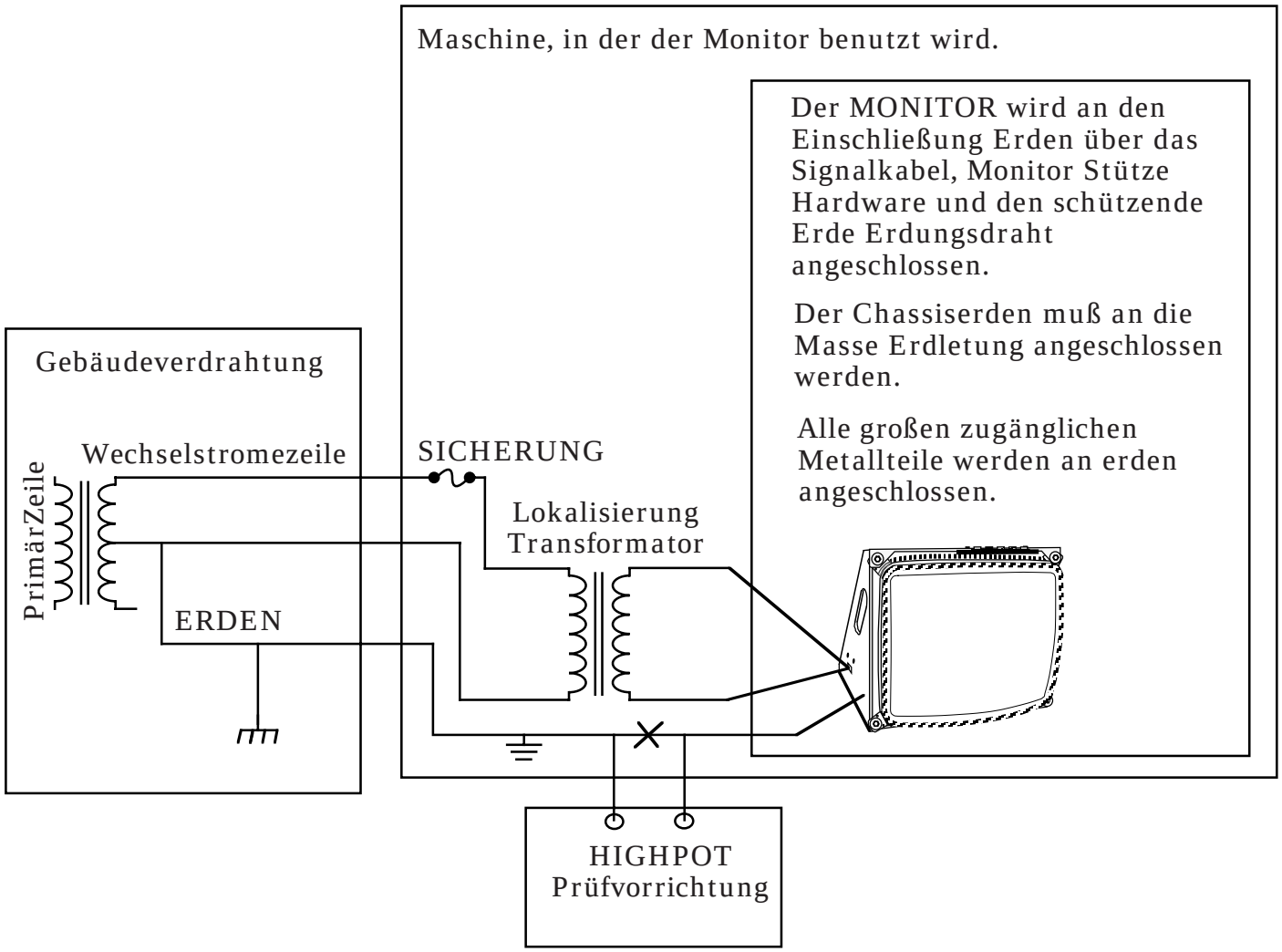


Highpot, Für Schock Gefahren, StromkreisBeschreibung.

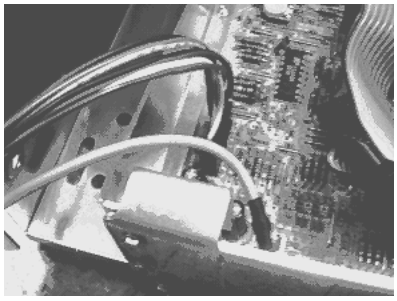
Für die Modelle 1493,1793,1993,2093,2793, und 3693 videomonitoren.

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.

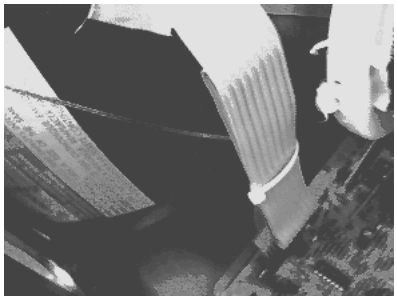
Nachdem der Monitor in der Einschlieflung installiert wird, muß der schützende Erde Erdanschluß verbunden werden. Der Anschluß Punkt wird sich auf dem innerhalb des Hauptausschusses Metalls Rahmens hinter dem Seriennummer Etikett befunden.



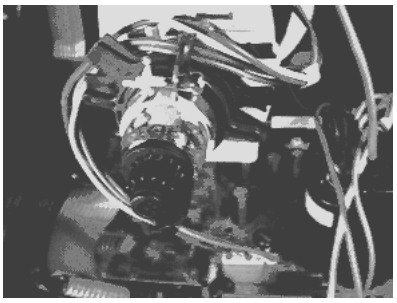
Wire Routing Instructions.



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

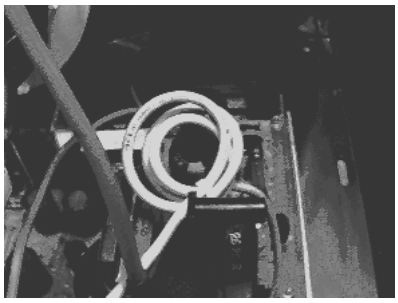


Fold remote cable to clear CRT and add wire tie.

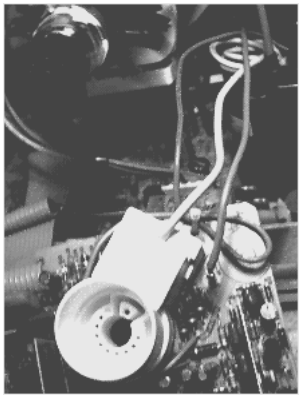


Rout yoke wires over CRT neck.

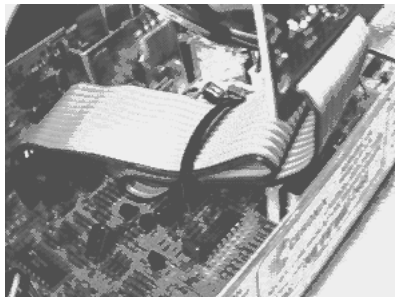
Shorten EHT wire and add wire tie.



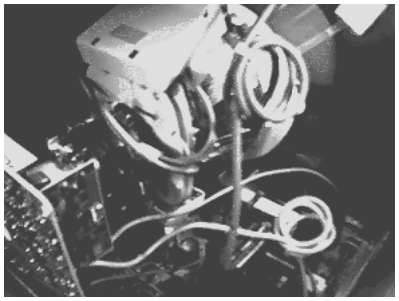
Shorten focus wire and add wire tie.



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



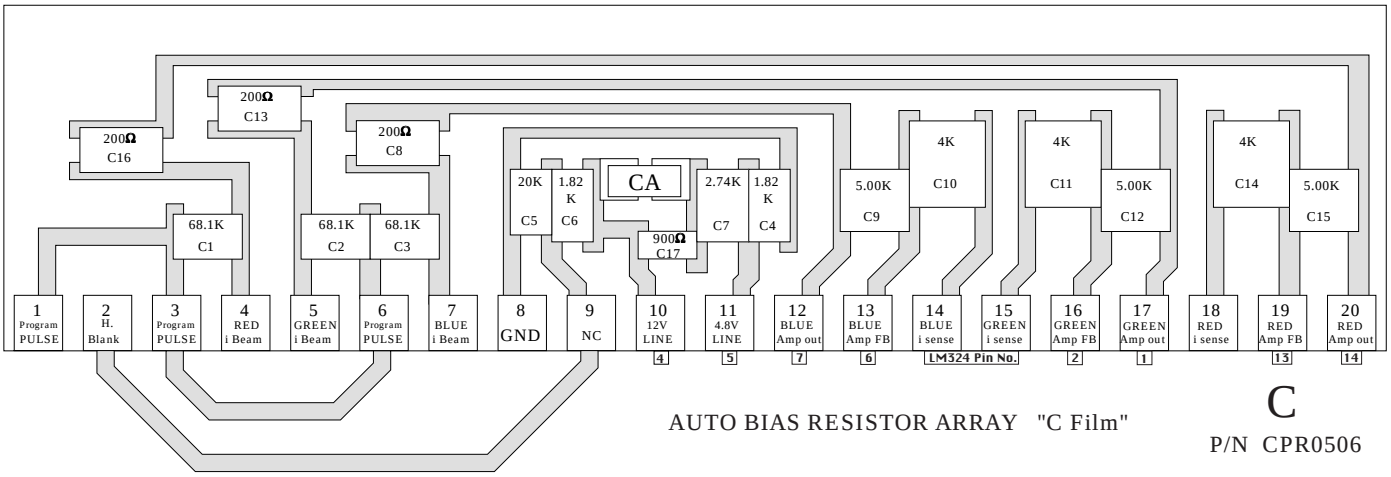
Plug in video board. Fold video flat cable to avoid contacting the metal frame. Secure fold with a wire tie.



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.

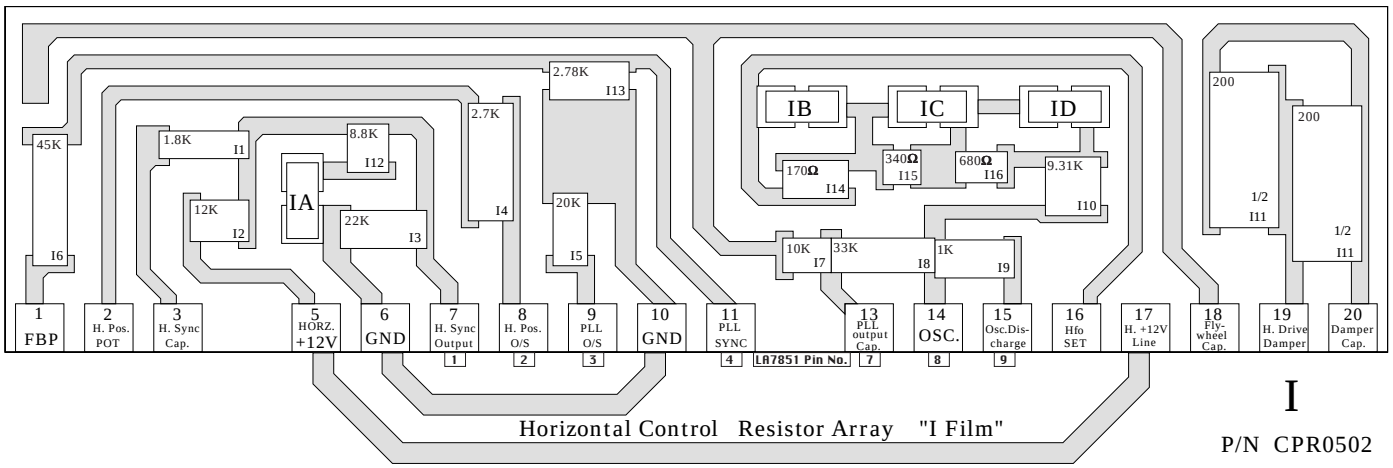


AUTO BIAS RESISTOR ARRAY "C Film"

C

P/N CPR0506

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.



Horizontal Control Resistor Array "I Film"

I

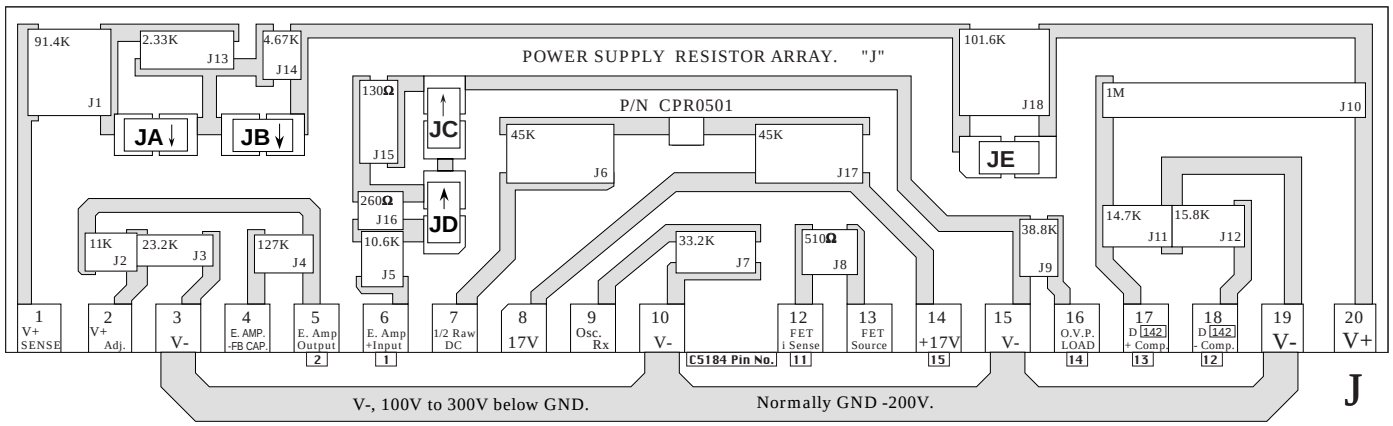
P/N CPR0502

JA - Decreases V+ line by 1.5V

JB - Decreases V+ line by 3V

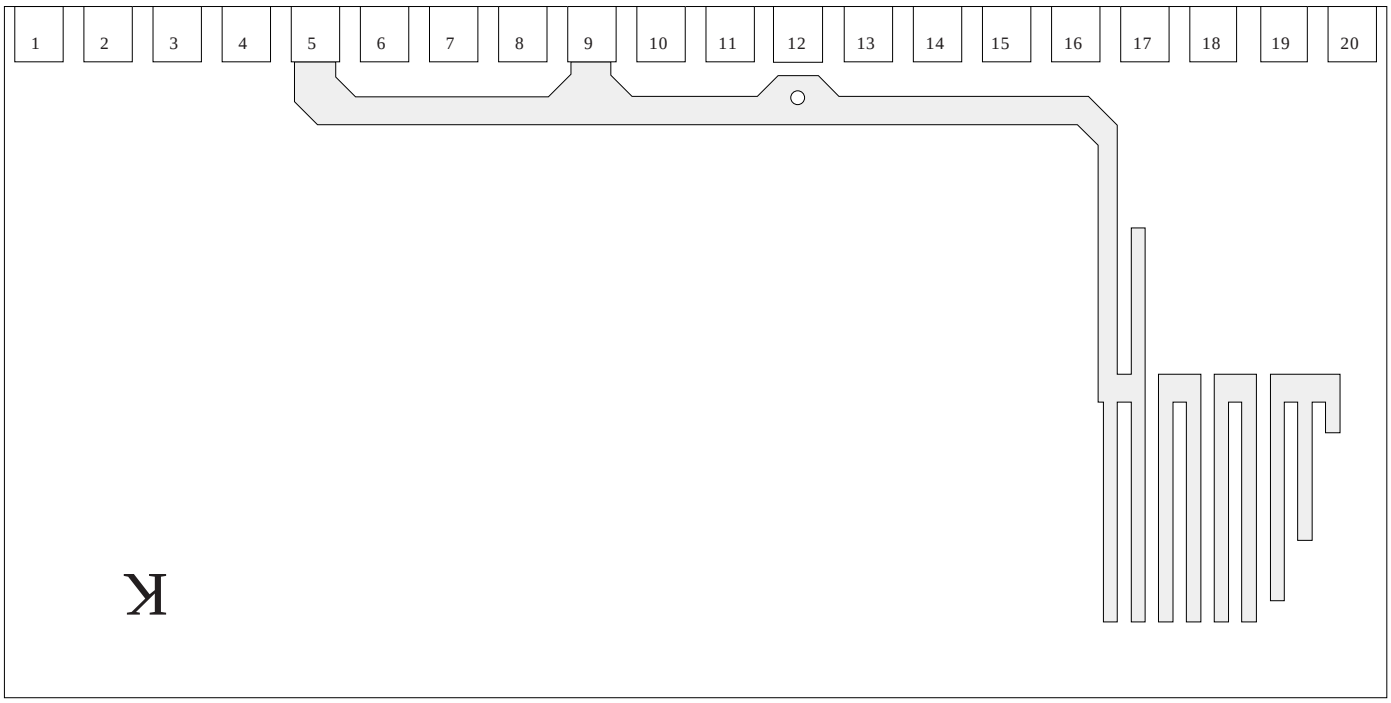
JC - Increases V+ line by 1.5V

JD - Increases V+ line by 3V

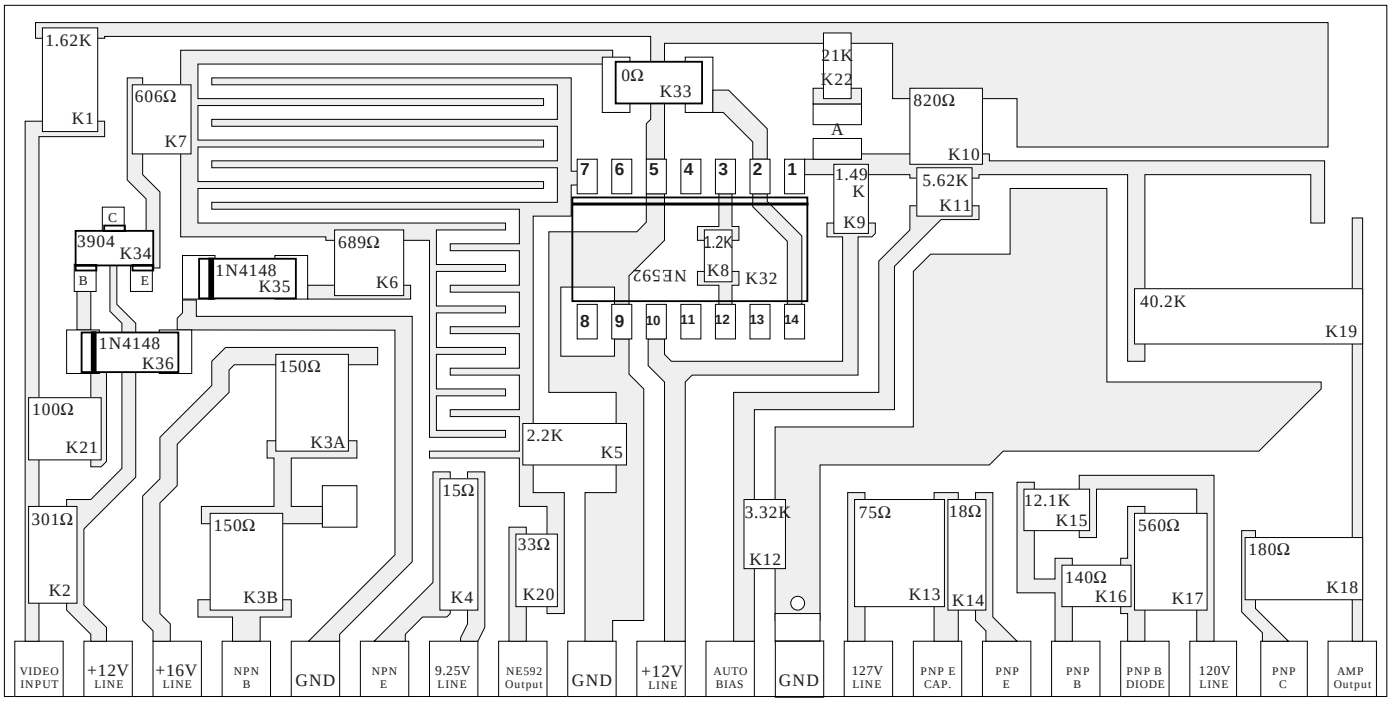


J

Power Supply Resistor Array "J Film" P/N CPR0501



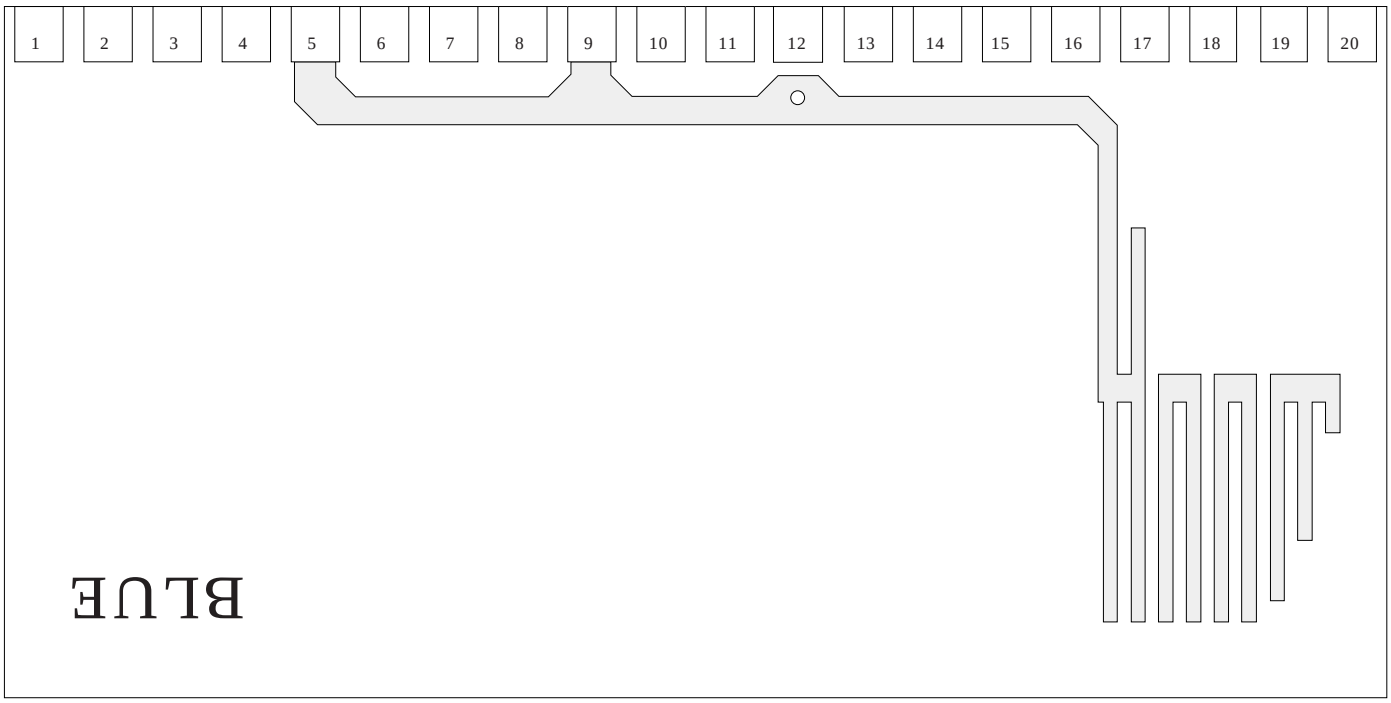
A - Increases Output Voltage by 10V



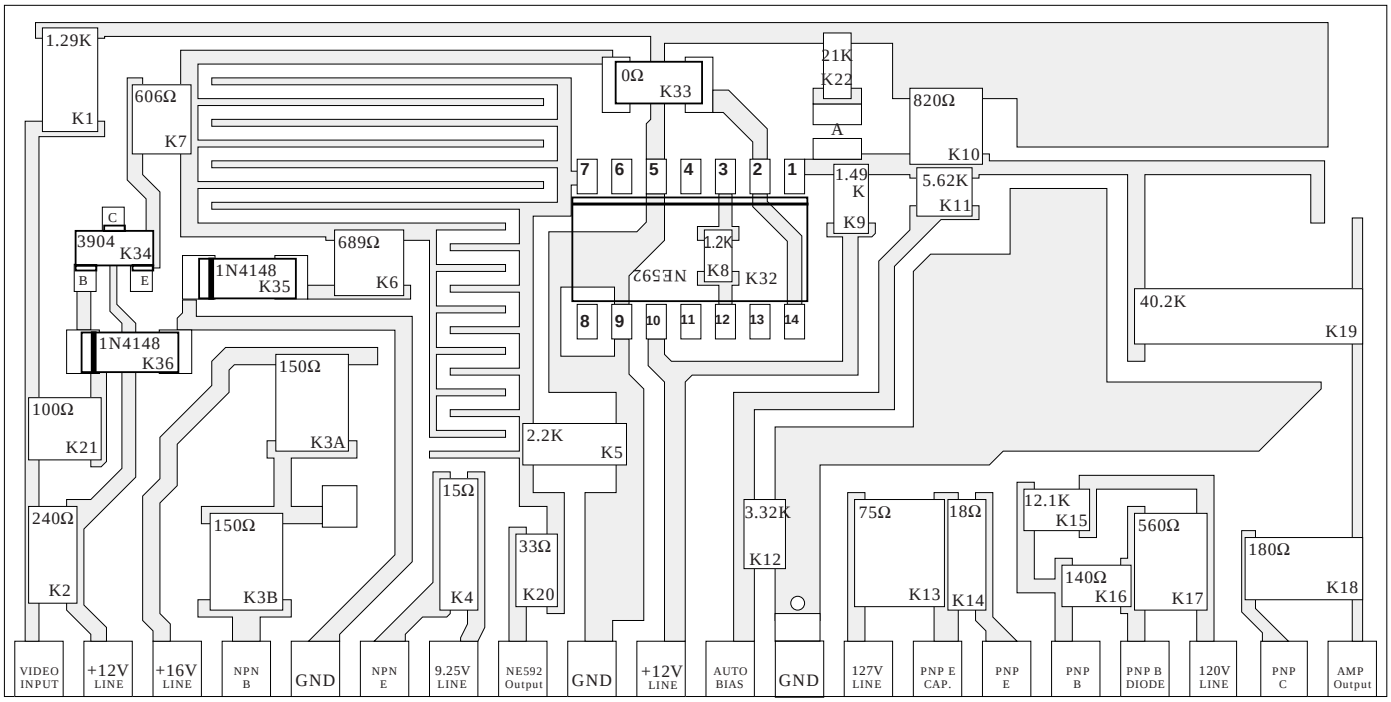
Video Amplifier Resistor Array "K Film"

K

P/N CPR0510

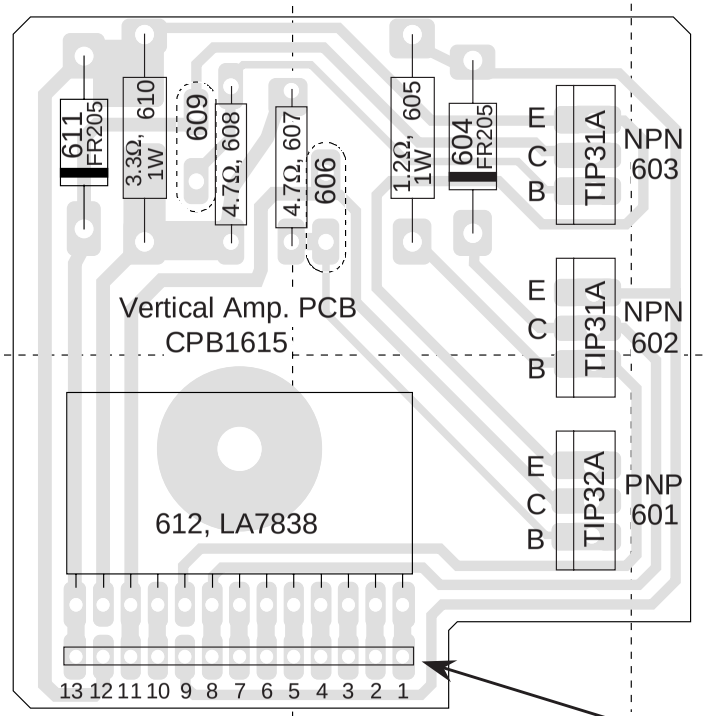


A - Increases Output Voltage by 10V

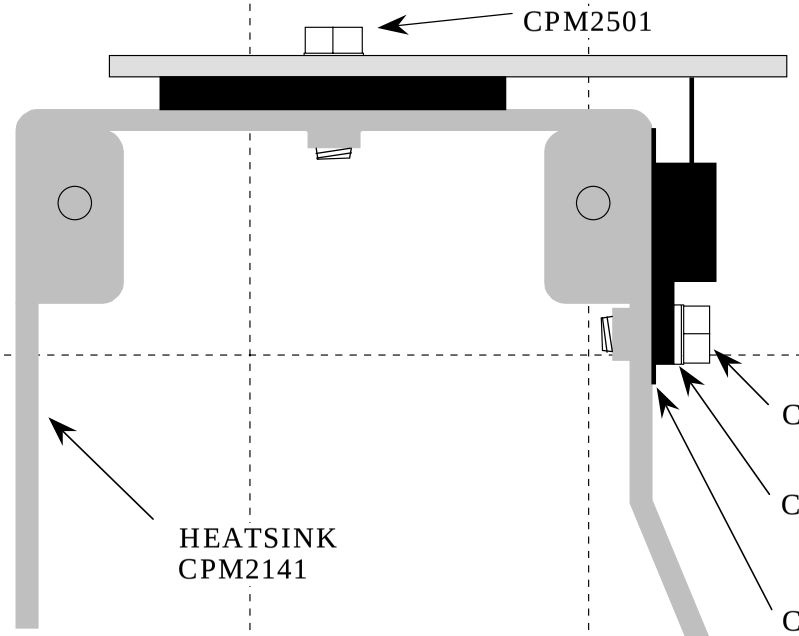


BLUE

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



Board Assembly View (Component side)



Complete Assembly View (Top view)

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.

	RED	GREEN	BLUE
With no load, the black level voltage of the video drive signal is:			
With no load, the saturated color voltage is:			

To simulate the monitor input resistance.

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

	RED	GREEN	BLUE
the black level voltage is:			
the saturated color voltage is:			

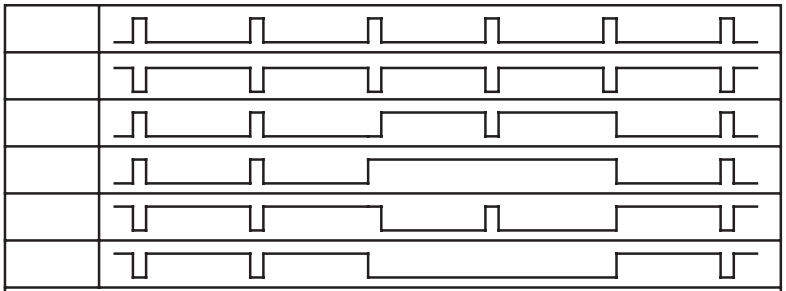
If available, sketch the video drive circuit on the back of a copy of this form.

Horizontal or composite sync:

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

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

For composite sync.

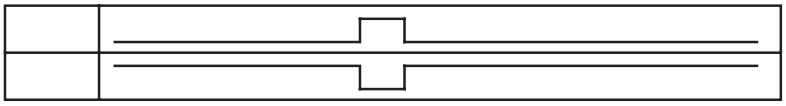


Sketch if different.

Vertical sync:

Vertical frequency: _____ Hz "High" voltage: _____ V
Vertical sync pulse time: _____ uS "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

CE 02

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

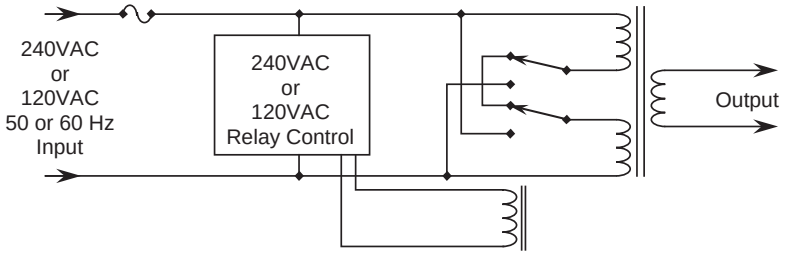
SAFETY ISOLATING TRANSFORMER

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.

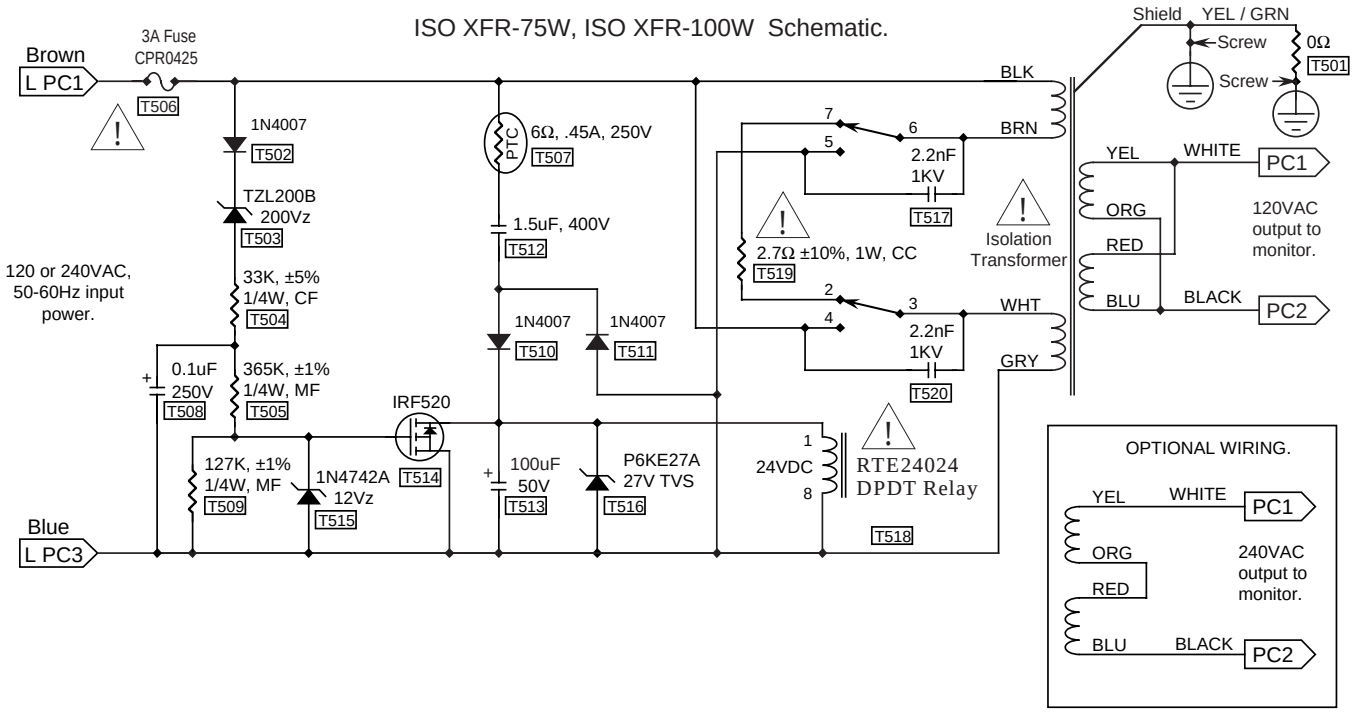
A relay is used to connect the two primary coils in series or parallel to accommodate 240VAC or 120VAC line voltages. Before power is applied, the relay connects the transformer primary windings in series to avoid excessive primary current for the 240VAC case. The control circuit energizes the relay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



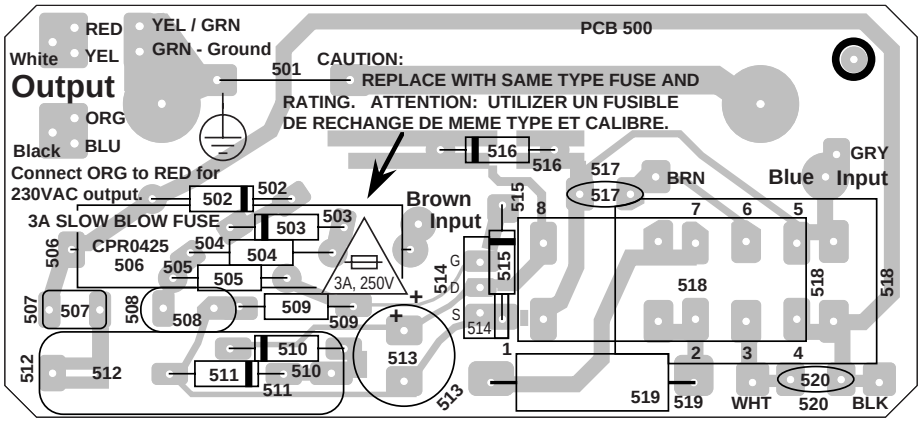
Circuit Description.

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.

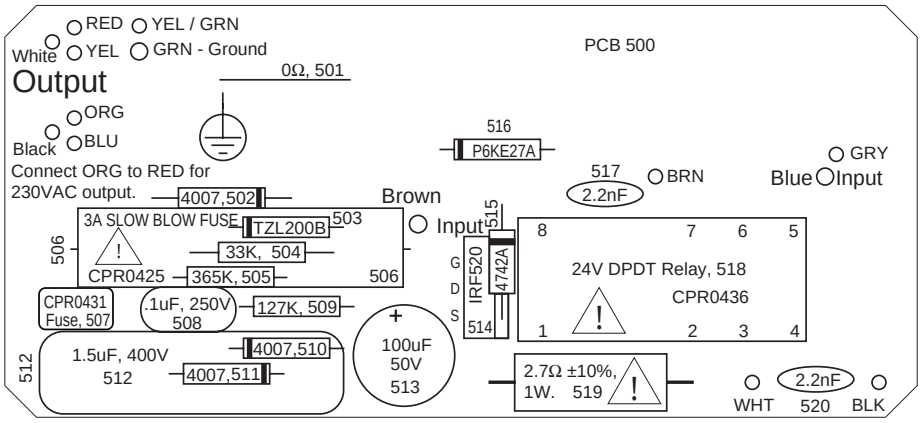
ISO XFR-75W, ISO XFR-100W Schematic.



ISO XFR-75W, ISO XFR-100W PCB.



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

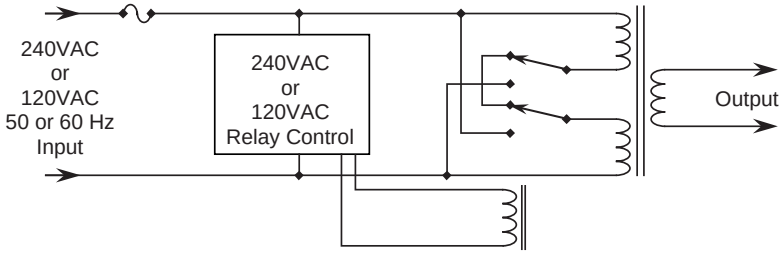


ISO XFR-75W, ISO XFR-100W Assembly Drawing.

Stromkreisfunktion Beschreibung

Die grundlegende Funktion des XFR75W und des XFR100W ist, die Zeile Energie für die benötigenden Monitoren 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 Relaistreiber. 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 Relaisspule 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 Kondensatort T513. Resistor T504 der Spitzenstrom zum Kondensator T508 beseitigt, um das Relaisschalten 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 connecter.

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

Instructions d'installation

1. Fixer l'appareil á une surface métallique plane et mise á 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 á la prise molex sur le boîtier.

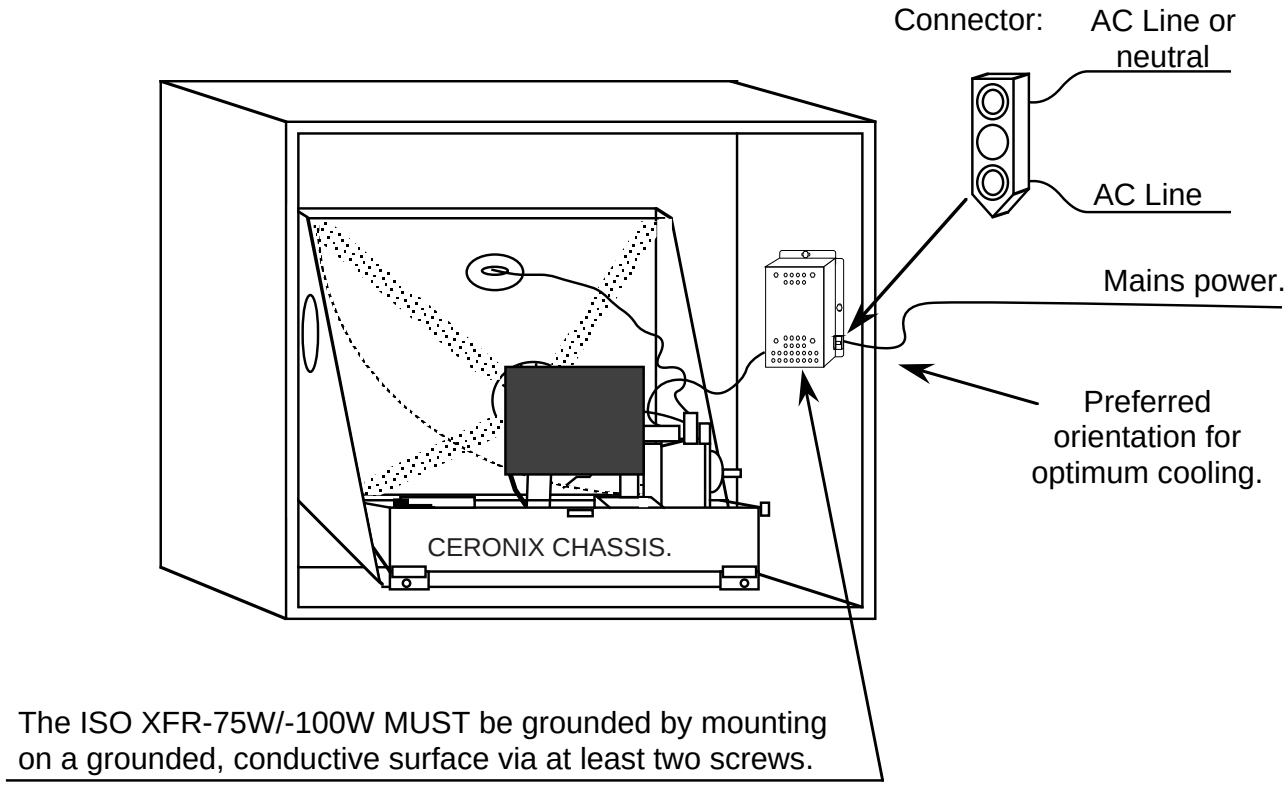
3. Raccorder le câble de sortie de l'appareil au connecteur d'entrée de l'écran.

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.

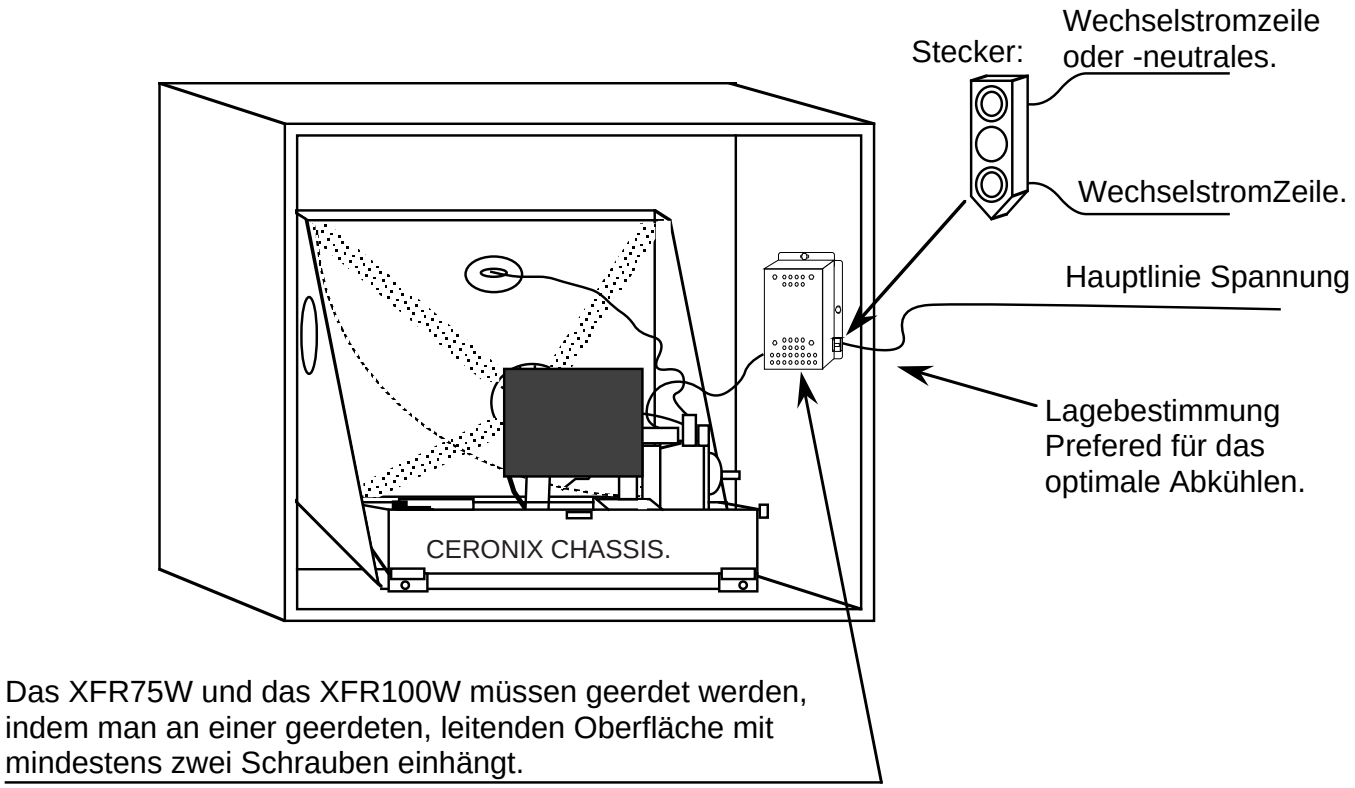


WARNING: Mains power and ground connections must be made before power is applied to the ISO XFR-75W or the ISO XFR-100W Isolation Transformers.

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 †ransformator 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.		

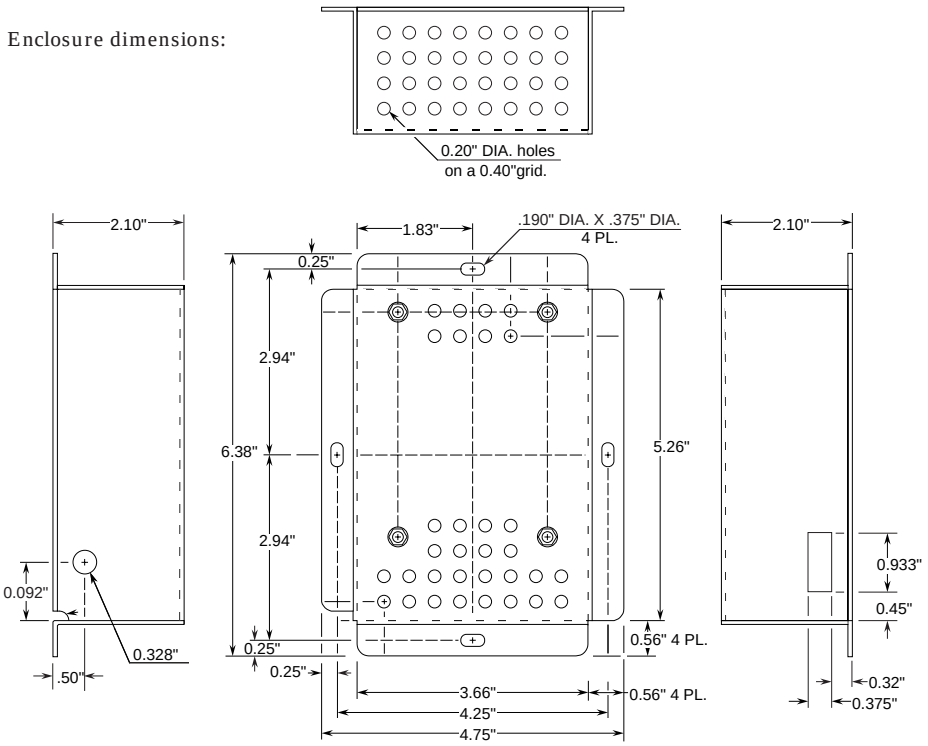
Environmental:

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:



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	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	1.24 Watts Maximum	0VA	No Load.
Power	125VA	100VA	Full Load.
Capacitance	275pF input to output.		
Highpot Voltage	3,000VAC input to output.		

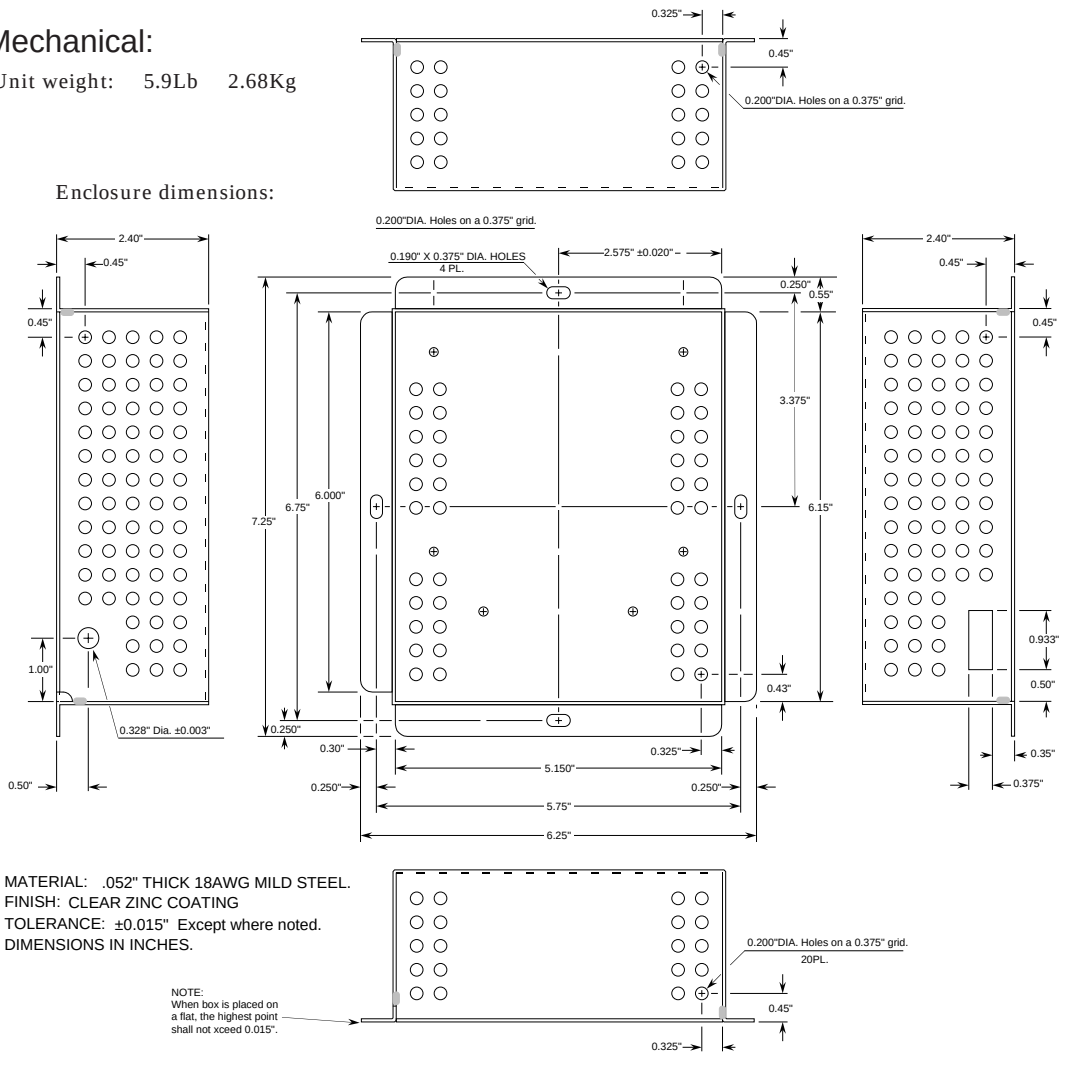
Environmental:

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: 5.9Lb 2.68Kg

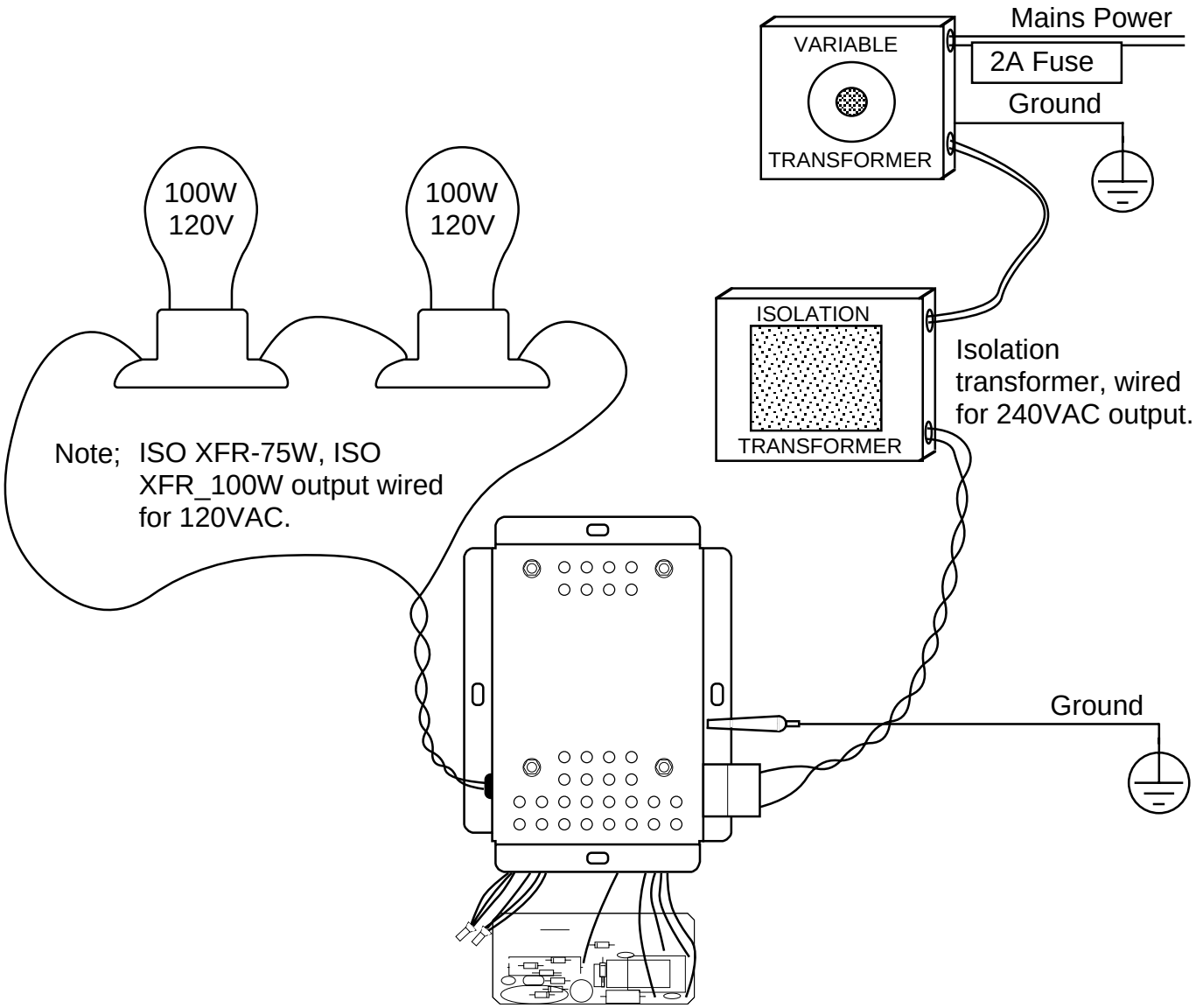
Enclosure dimensions:



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.

<u>Always wear safety glasses when working on powered up electronic equipment.</u>

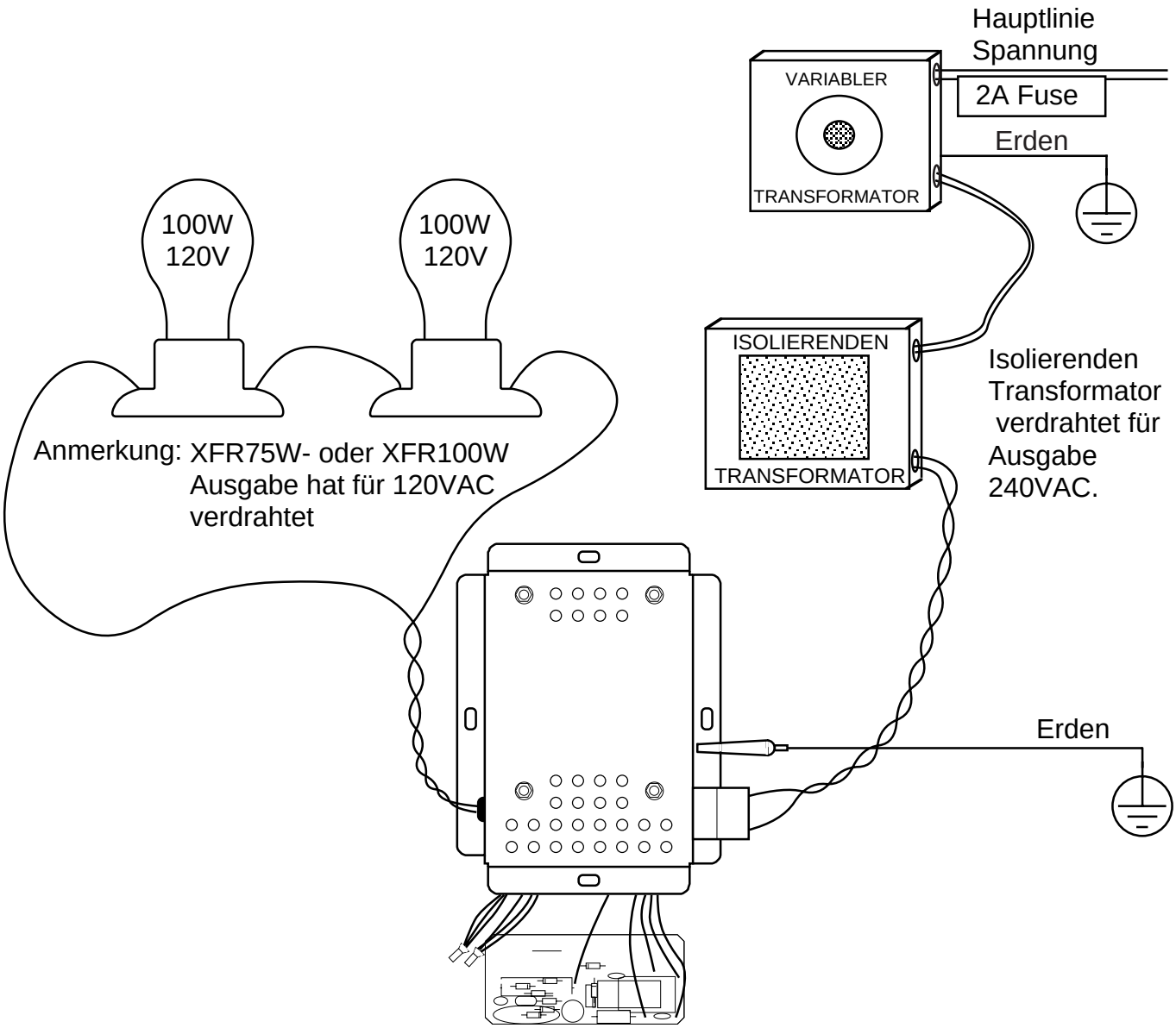


Note: When using this isolation supply for working on monitors, it is important to have some resistance (10MΩ or less) to ground. An insulated monitor connected to a insulated power supply may attain a high static voltage. When this voltage discharges through the ISO XFR-75W, ISO XFR-100W control circuit,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

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

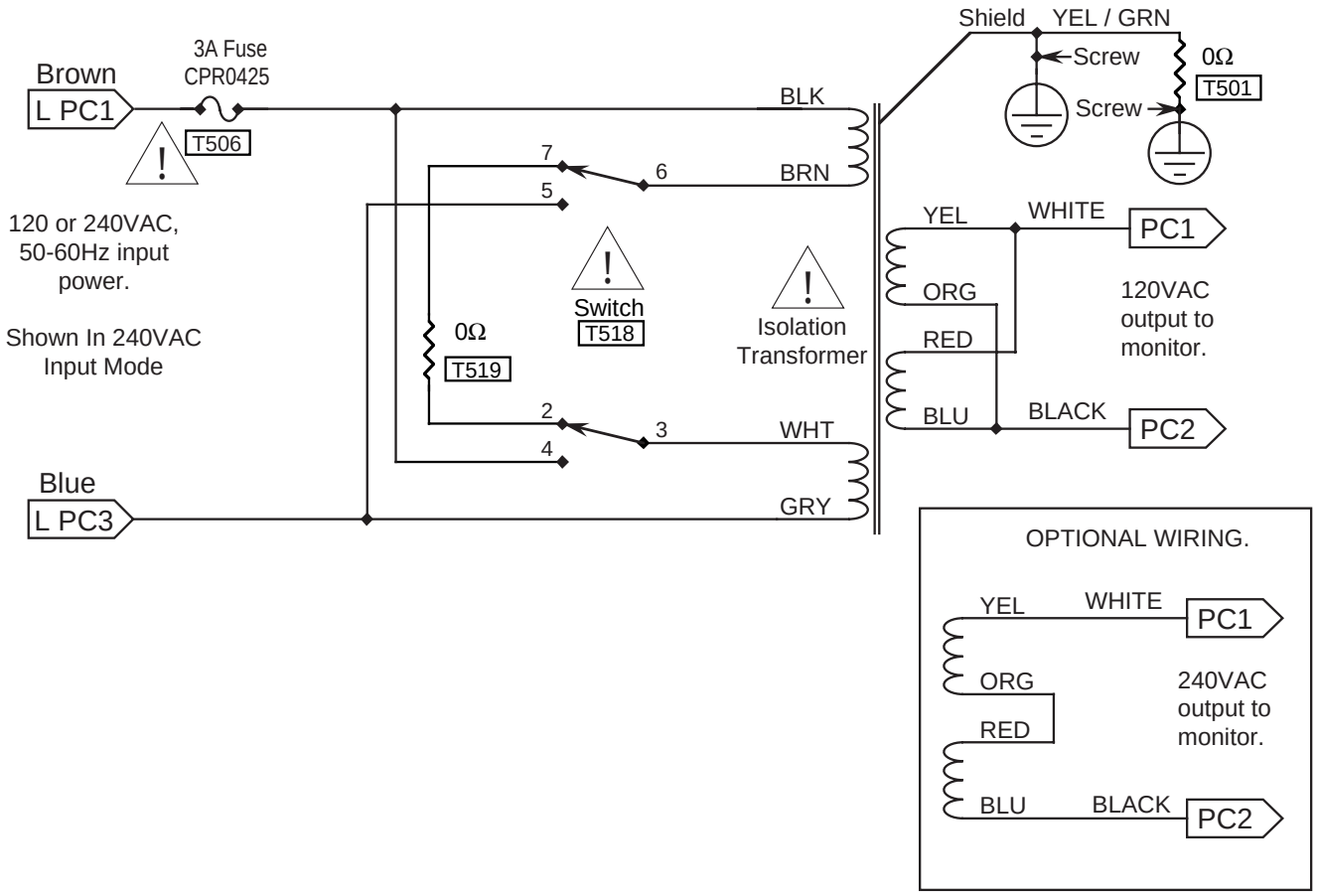
SICHERHEIT ZUERST: Um elektrischen Shock zu vermeiden, benutzen Sie nur eine Hand beim Arbeiten auf einem angeschaltenen Transformator 75W oder 100W.

Tragen Sie immer Sicherheitsgläser beim Arbeiten auf angeschaltener elektronischer Ausrüstung.

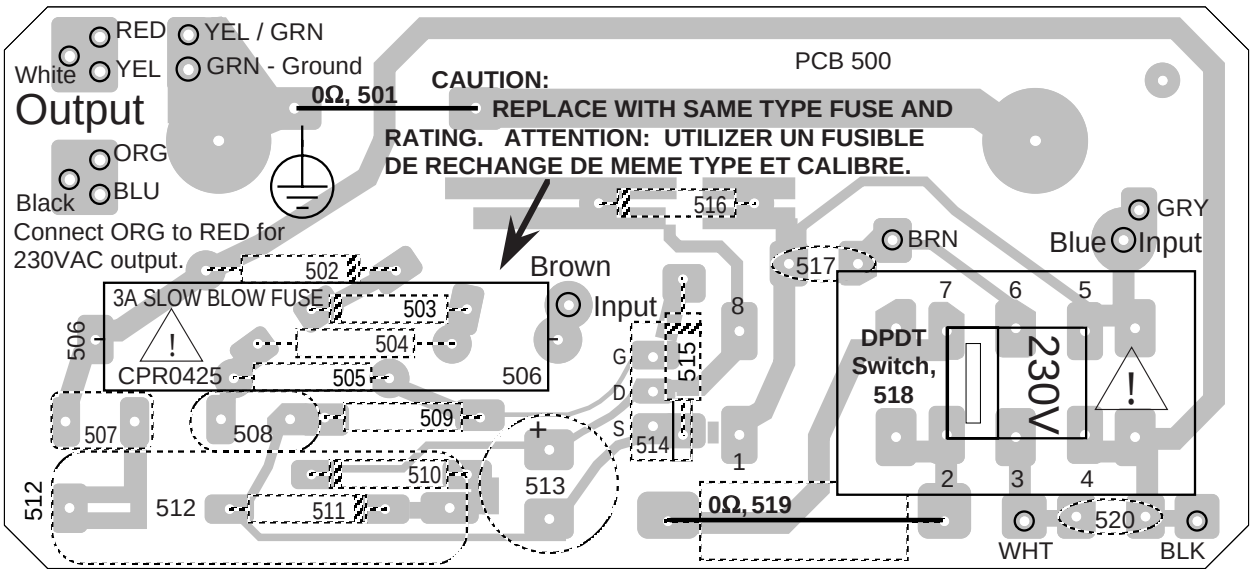


Anmerkung: Beim Benutzen dieser Isolierung Versorgung von Monitoren dem Bearbeiten zu, ist es wichtig, irgendeinen Widerstand zu haben, (10 Meg.Ω oder kleiner) zu erden. Ein Isoliermonitor, der an eine Isolierenergie kann angleschlossen wird eine hohe statische Spannung supply, erreichen. Wenn diese 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.

Parts List Addendum.

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