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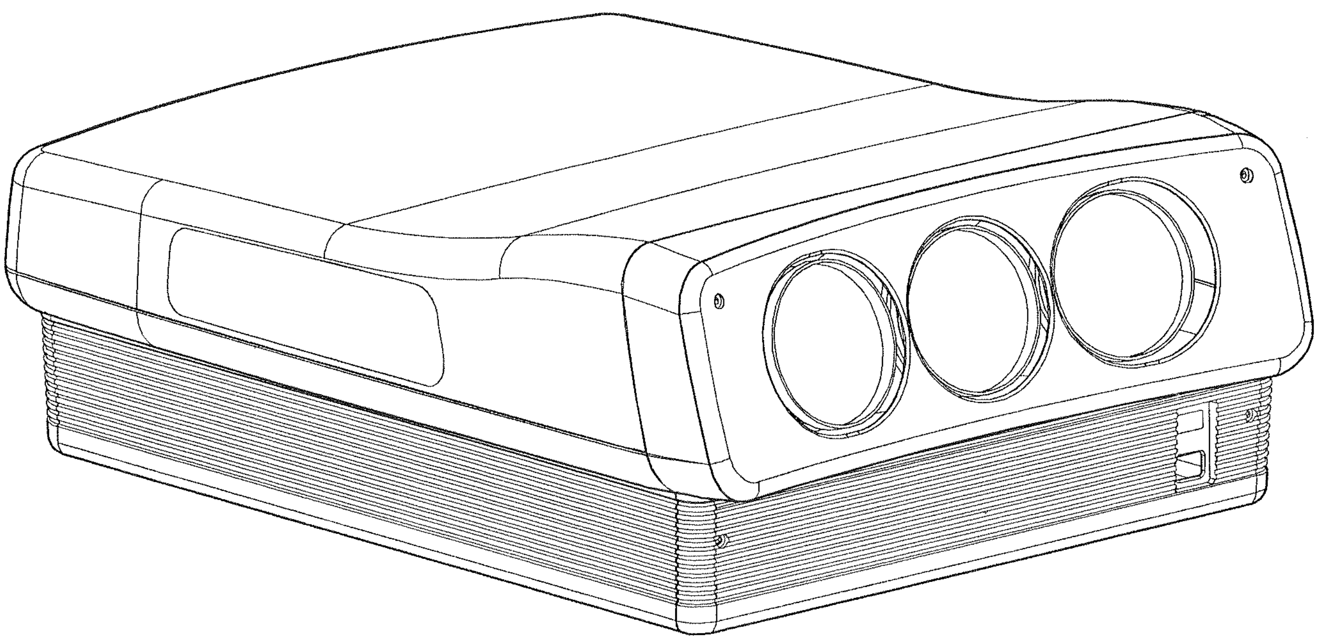
Service Quality Partners

Technical Training Manual



PRO 900X Technical Training Manual

Product Overview
Installation
Convergence
Circuit Descriptions
Module Replacement Instructions

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ZENITH ELECTRONICS CORPORATION zenith
201JAMES RECORD ROAD HUNTSVILLE, AL. 35824

PRODUCT SAFETY SERVICING GUIDELINES FOR AUDIO-VIDEO PRODUCTS

IMPORTANT SAFETY NOTICE

This manual was prepared for use only by properly trained audio-visual service technicians.

When servicing this product, under no circumstances should the original design be modified or altered without permission from Zenith Electronics Corporation. All components should be replaced only with types identical to those in the original circuit and their physical location, wiring and lead dress must conform to original layout upon completion of repairs.

Special components are also used to prevent x-radiation, shock and fire hazard. These components are indicated by the letter "x" included in their component designators and are required to maintain safe performance. No deviations are allowed without prior approval by Zenith Electronics Corporation.

Circuit diagrams may occasionally differ from the actual circuit used. This way, implementation of the latest safety and performance improvement changes into the set is not delayed until the new service literature is printed.

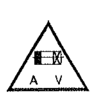
CAUTION: Do not attempt to modify this product in any way. Never perform customized installations without manufacturer's approval. Unauthorized modifications will not only void the warranty, but may lead to property damage or user injury.

Service work should be performed only after you are thoroughly familiar with these safety checks and servicing guidelines.

GRAPHIC SYMBOLS

The exclamation point within an equilateral triangle is intended to alert the service personnel to important safety information in the service literature.

The lightning flash with arrowhead symbol within an equilateral triangle is intended to alert the service personnel to the presence of noninsulated "dangerous voltage" that may be of sufficient magnitude to constitute a risk of electric shock.



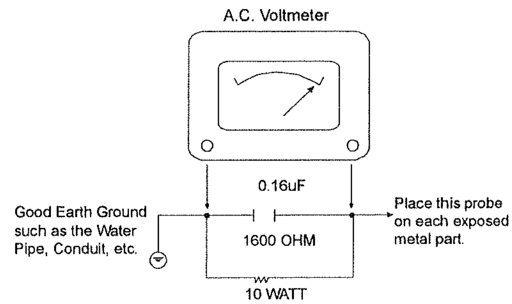
The pictorial representation of a fuse and its rating within an equilateral triangle is intended to convey to the service personnel the following fuse replacement caution notice:
CAUTION: FOR CONTINUED PROTECTION AGAINST RISK OF FIRE, REPLACE ALL FUSES WITH THE SAME TYPE AND RATING AS MARKED NEAR EACH FUSE.

SERVICE INFORMATION

While servicing, use an isolation transformer for protection from AC line shock. After the original service problem has been corrected, make a check of the following:

FIRE AND SHOCK HAZARD

1. Be sure that all components are positioned to avoid a possibility of adjacent component shorts. This is especially important on items transported to and from the repair shop.
2. Verify that all protective devices such as insulators, barriers, covers, shields, strain reliefs, power supply cords, and other hardware have been reinstalled per the original design. Be sure that the safety purpose of the polarized line plug has not been defeated.
3. Soldering must be inspected to discover possible cold solder joints, solder splashes, or sharp solder points. Be certain to remove all loose foreign particles.
4. Check for physical evidence of damage or deterioration to parts and components, for frayed leads or damaged insulation (including the AC cord), and replace if necessary.
5. No lead or component should touch a receiving tube or a resistor rated at 1 watt or more. Lead tension around protruding metal surfaces must be avoided.
6. After reassembly of the set, always perform an AC leakage test on all exposed metallic parts of the cabinet (the channel selector knobs, antenna terminals, handle and screws) to be sure that set is safe to operate without danger of electrical shock. DO NOT USE A LINE ISOLATION TRANSFORMER DURING THIS TEST. Use an AC voltmeter having 5000 ohms per volt or more sensitivity in the following manner: Connect a 1500 ohm, 10 watt resistor, paralleled by a .15 mfd 150V AC type capacitor between a known good earth ground water pipe, conduit, etc.) and the exposed metallic parts, one at a time. Measure the AC voltage across the combination of 1500 ohm resistor and .15 mfd capacitor. Reverse the AC plug by using a non-polarized adaptor and repeat AC voltage measurements for each exposed metallic part. Voltage measured must not exceed 0.75 volts RMS. This corresponds to 0.5 milliamp AC. Any value exceeding this limit constitutes a potential shock hazard and must be corrected immediately.



X-RADIATION

1. Be sure procedures and instructions to all service personnel cover the subject of x-radiation. The only potential source of x-rays in current TV receivers is the picture tube. However, this tube does not emit x-rays when the HV is at the factory-specified level. The proper value is given in the applicable schematic. Operation at higher voltages may cause a failure of the picture tube or high-voltage supply and, under certain circumstances may produce radiation in excess of desirable levels.
2. Only factory-specified CRT anode connectors must be used.
3. It is essential that the service personnel have available an accurate and reliable high-voltage meter.
4. When the high-voltage circuitry is operating properly, there is no possibility of an x-radiation problem. Every time a color chassis is serviced, the brightness should be run up and down while monitoring the high voltage with a meter, to be certain that the high voltage does not exceed the specified value and that it is regulating correctly.
5. When troubleshooting and making test measurements in a product with a problem of excessively high voltage, avoid being unnecessarily close to the picture tube and the high voltage power supply. Do not operate the product longer than necessary to locate the cause of excessive voltage.
6. Refer to HV, B+, and shutdown adjustment procedures described in the appropriate schematics and diagrams (where used).

IMPLOSION

1. All direct view picture tubes are equipped with an integral implosion protection system; take care to avoid damage during installation.
2. Use only the recommended factory replacement tubes.

TIPS ON PROPER INSTALLATION

1. Never install any receiver in a closed-in recess, cubbyhole, or closely fitting shelf space over, or close to, a heat duct, or in the path of heated air flow.
2. Avoid conditions of high humidity such as: outdoor patio installations where dew is a factor, near steam radiators where steam leakage is a factor, etc.
3. Avoid placement where draperies may obstruct venting. The customer should also avoid the use of decorative scarves or other coverings that might obstruct ventilation.
4. Wall- and shelf-mounted installations using a commercial mounting kit must follow the factory-approved mounting instructions. A product mounted to a shelf or platform must retain its original feet (or the equivalent thickness in spacers) to provide adequate air flow across the bottom. Bolts or screws used for fasteners must not touch any parts or wiring. Perform leakage tests on customized installations.
5. Caution customers against mounting a product on a sloping shelf or in a tilted position, unless the receiver is properly secured.
6. A product on a roll-about cart should be stable in its mounting to the cart. Caution the customer on the hazards of trying to roll a cart with small casters across thresholds or deep pile carpets.
7. Caution customers against using a cart or stand that has not been listed by Underwriters Laboratories, Inc. for use with its specific model of television receiver or generically approved for use with TVs of the same or larger screen size.
8. Caution customers against using extension cords. Explain that a forest of extensions, sprouting from a single outlet, can lead to disastrous consequences to home and family.

SECTION ONE

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Pro900/900X Multi-Format Projector Monitor

General Overview

The Pro900/900X projection system is a high resolution multiple signal format display monitor. It uses 7" high performance liquid cooled CRTs. Each CRT has a 5" active phosphor area and a 90 degree deflection angle. The CRTs use high resolution color corrected multi-layered hybrid lens assemblies.

Horizontal scan frequency is from 15 to 50 KHz. Vertical scan frequency is from 40 to 100 Hz. Video system signal bandwidth is 35 MHz. The projected display diagonal size (4:3 aspect ratio) is adjustable from 60" to 240". Supported signal formats include NTSC (3.58 and 4.43), PAL (M,N,B, and G), VGA, SVGS, Mac II, and Grand Alliance HDTV. Signal input options include 5 BNC connectors (R,G,B,V,H), composite video, S-Video (Y-C), and an RS232 serial data port. The IR control format is addressable (0 - 99) for use with multiple unit installations. Each Pro900/900X comes with a Z-Mouse (track ball) remote control and a service/alignment 5 function MBR3470 remote control.

From the factory the Pro900/900X comes aligned for a 80" wide display. The preset projection distance is 95 7/16" and configured for a ceiling mount. You may customize the setup to be floor or ceiling mounted and rear or front projected. Refer to the setup section before attempting an instalation.

The convergence system is a digital controlled analog system with 10 signal format preset and 5 customer option memory locations. The preset format memory locations can not be altered in the field. Each preset format has a custom memory location to store customized setup data. Each customized setup has a separated memory location for each aspect ratio (4X3,letter box, compressed, and 16X9). You must setup and converge the system for each aspect ratio that will be used. The five customer memory locations are for signal formats that do not match the ten factory preset signal formats. There is also the option to copy the stored format data from one memory location to another. This allows faster setup when several similar formats are used. Internally generated signal patterns also aid with setup of convergence. The internal pattern generator may sync from the internally preset signal formats or it will sync from an external signal source. This is helpful for on site full convergence or just a touch up. You must use the customer signal source to perform blanking and phase adjustments.

Standard Signal Format Modes

Mode Name	Freq.	Signal Type
1.** Factory 1	15.73Khz	Video - NTSC
2. Factory 2	15.62khz	Video - PAL
3. VGA 400	31.46khz	RGB
4.* VGA480	31.46khz	RGB
5. VGA350	31.46khz	RGB
6. HDTV 33	31.75khz	RGB
7. MAC II 35	35.0khz	RGB
8.*#HDTV 45	45.0khz	RGB
9.* SVGA48	48.36khz	RGB
10. Factory 10	15.7Khz	Video - SVHS

11. Return To Normal Viewing

* = 4:3 factory setup
** = 4:3,16:9 factory setup
*# = 16:9 factory setup

The Pro900/900X cabinet is comprised of three pieces. Removal of the case allows full maintenance access to the systems electronic and mechanical assemblies. Front and rear mounted IR detector assemblies allow almost no interference to IR control. There are adjustable (and removable) feet on the bottom of the case.

Be sure to read and understand the setup section before you attempt to install a Pro900/900X system. You will find tables and examples of the required installation data, for a successful installation, in the setup section. Also read the

Figure 1

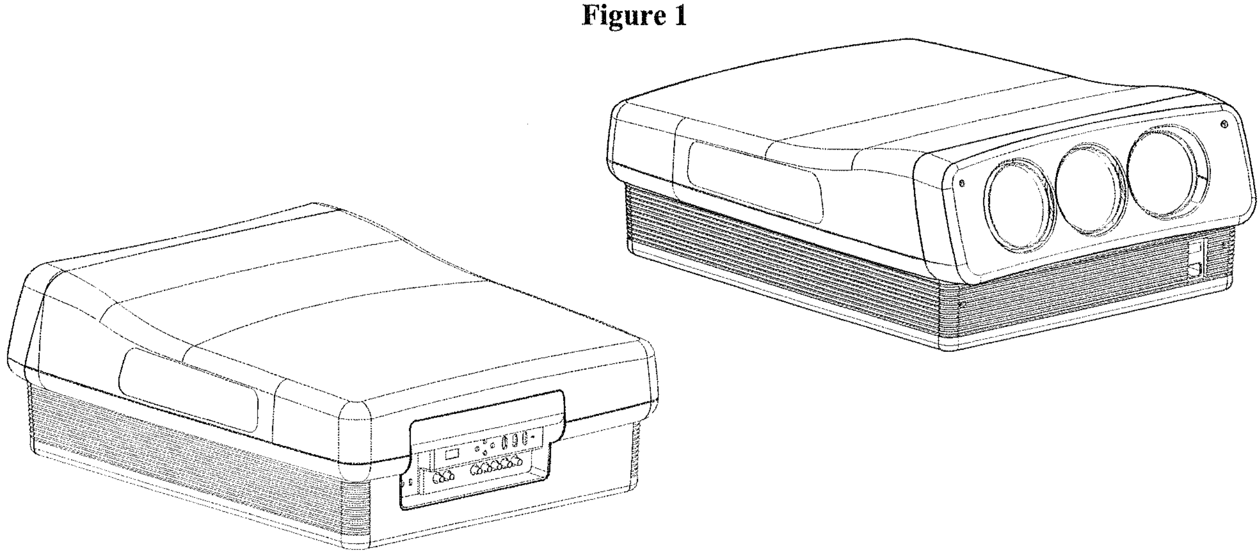
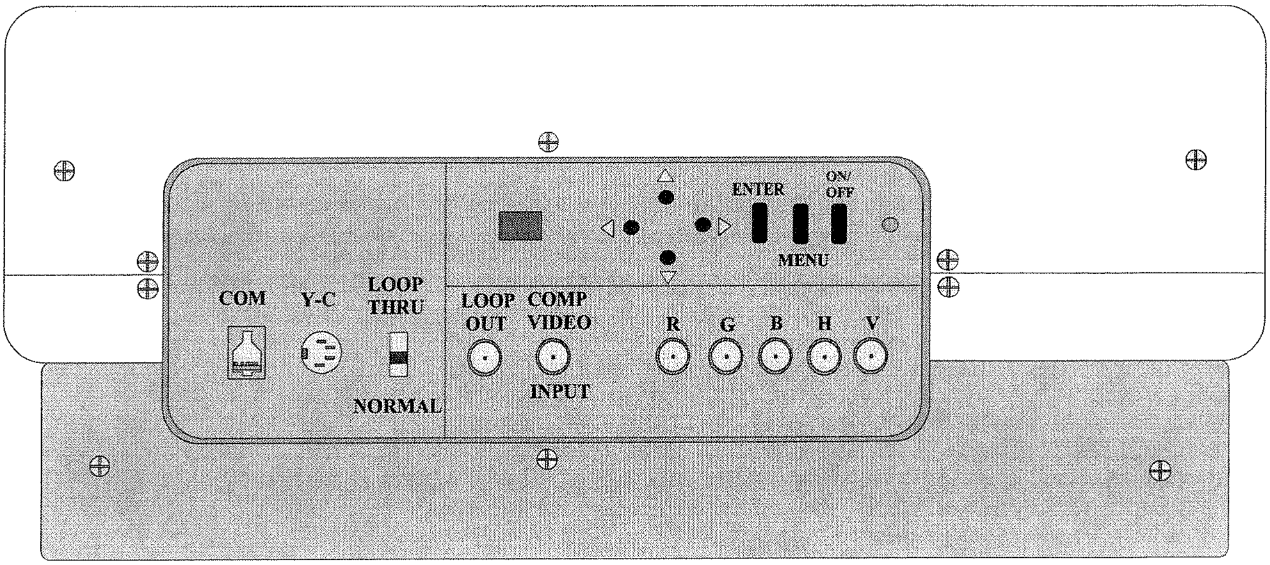


Figure 2



Status LEDs

- Standby - 5VDC is present in the 9-1515 module.
- Horizontal Active - horizontal deflection yoke drive is present in the 9-1505 module.
- Vetical Active - vertical deflection yoke drive is present in the 9-1515 module.
- Video Enable - all conditions are ready for high voltage to turn on via the 9-1504 module.

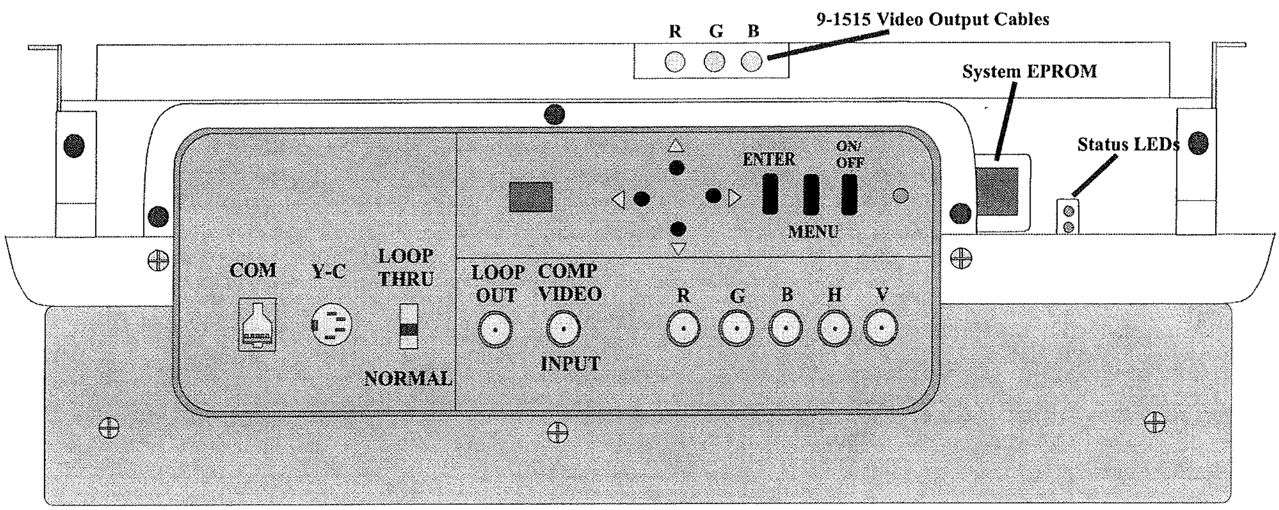


Figure 3

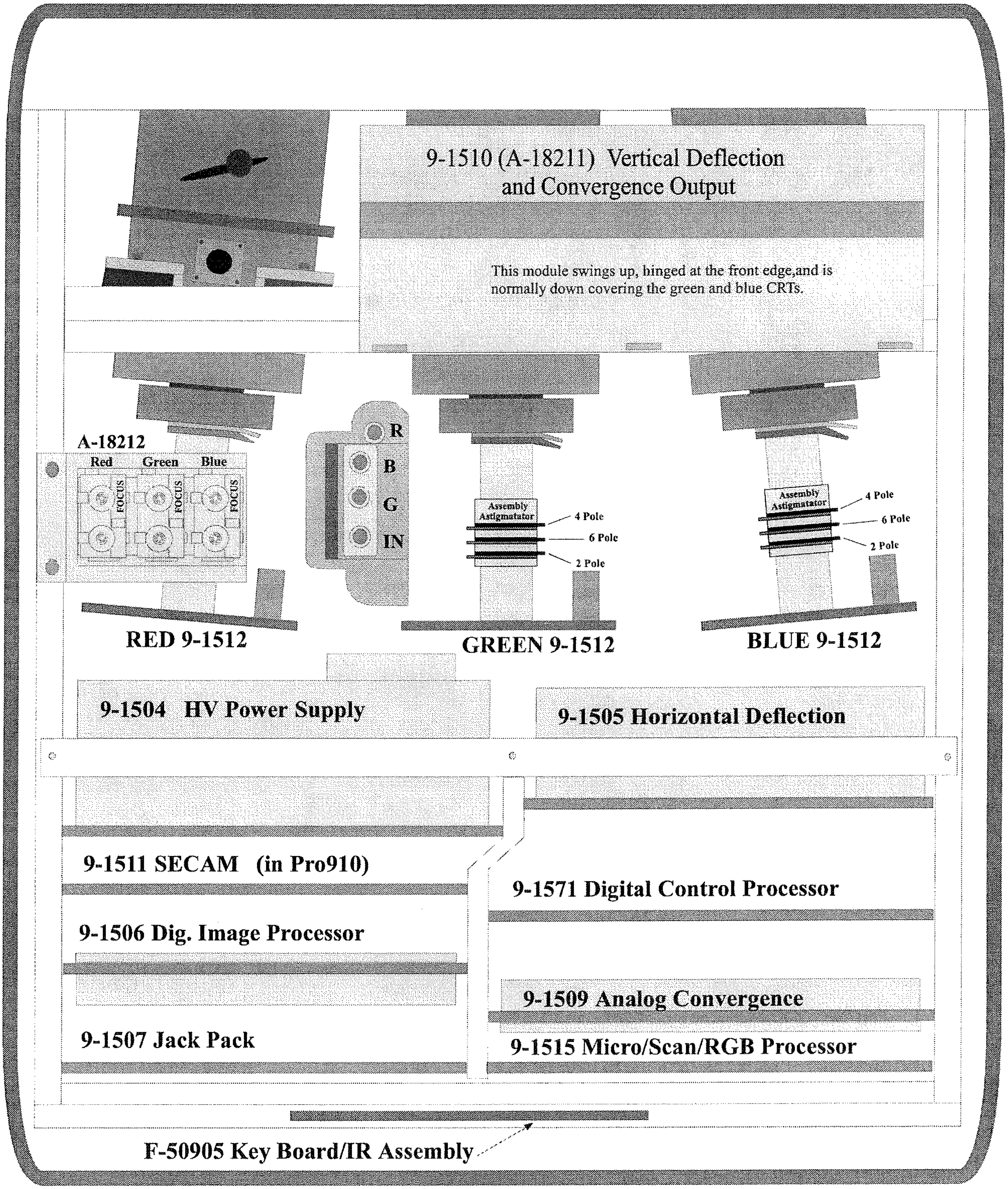

9-1510 (A-18211) Vertical Deflection and Convergence Output
This module swings up, hinged at the front edge,and is normally down covering the green and blue CRTs.
A-18212
Red
Green
Blue
FOCUS
FOCUS
FOCUS
R
B
G
IN
Assembly Astigmatator
4 Pole
6 Pole
2 Pole
Assembly Astigmatator
4 Pole
6 Pole
2 Pole
RED 9-1512
GREEN 9-1512
BLUE 9-1512
9-1504 HV Power Supply
9-1505 Horizontal Deflection
9-1511 SECAM (in Pro910)
9-1571 Digital Control Processor
9-1506 Dig. Image Processor
9-1509 Analog Convergence
9-1507 Jack Pack
9-1515 Micro/Scan/RGB Processor
F-50905 Key Board/IR Assembly

Figure 4

user menu section to understand the features and functions for normal system operation. The service menu has been included as a reference and trouble shooting aid. There are no field required adjustments to the service menu.

Pro900/900X Setup Remote Control

The Pro900/900X will be supplied with the MBR3467 and a Z-Trak (track ball) remote controls. For most servicing situations the MBR3467 is required. The MBR3467 has the special functions needed for geometry/convergence adjustments and system setup functions which the Z-Trak remote can not perform.

When using the MBR3460 or MBR3467 keep in mind these are five mode remote controls. The mode functions at the top, CABLE, VCR, AUX, and TV are standard MBR programmable functions. The SETUP mode is only for Pro900/900X setup/convergence use. To use the normal "user menu" (Source, Setup, or Video) the system must be out of the convergence setup mode. The user menus will indicate the current setting by highlighted text or a bar/number

Pro900 Setup Remote Control

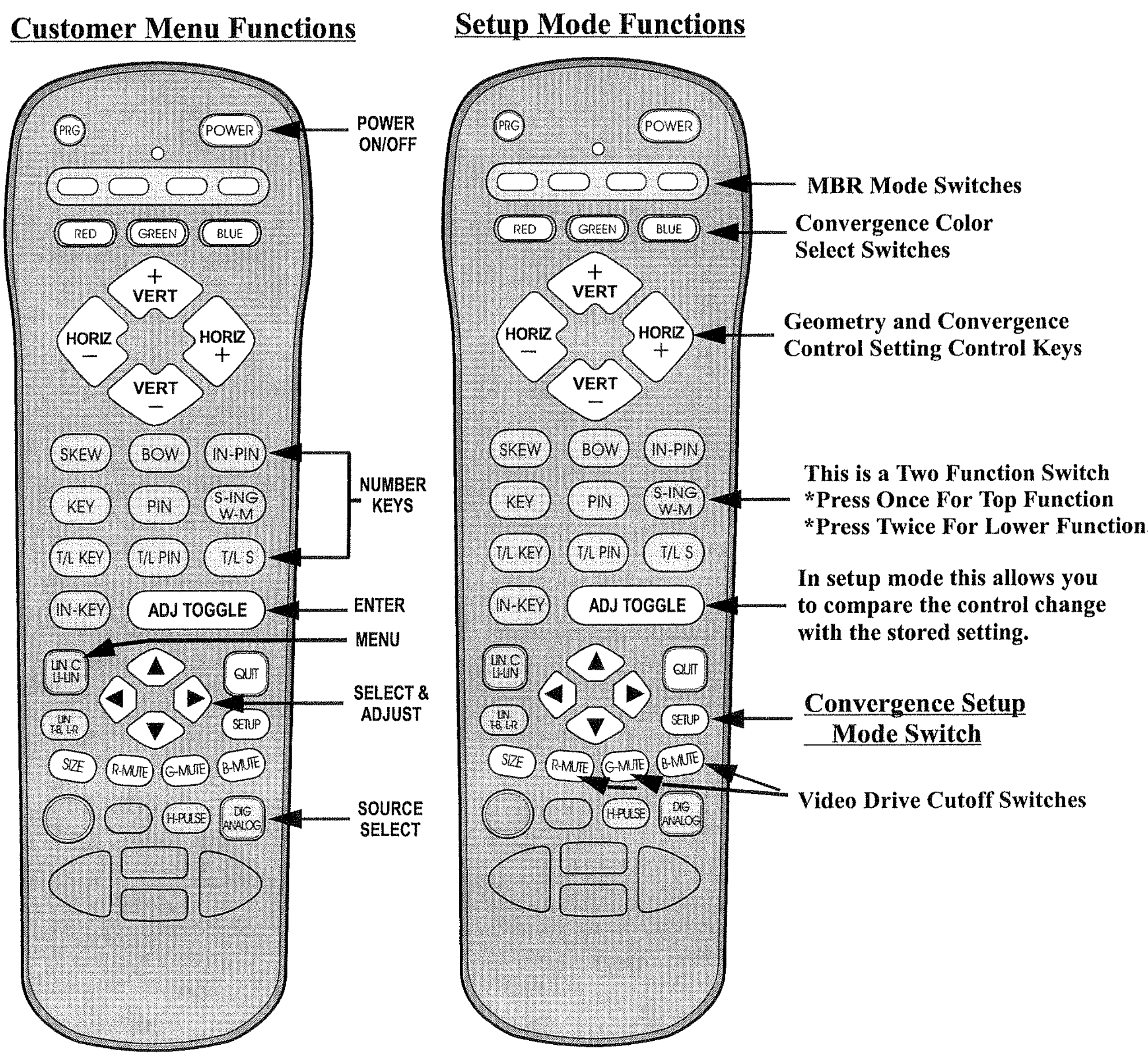


Figure 5

indication in the dialog box at the bottom of the screen. The exception is the Source menu which has the three choices with the current selected source being highlighted and control instructions in the dialog box.

Setup Mode Notes and Cautions

1. When you enter the setup mode the system is in the **"Geometry Mode"** (the shape controls adjust all three colors at the same time). To adjust an individual color (i.e. Red to adjust SKEW) you must press the "Red Select" button. This will put the system into the **"Convergence Mode"** (the shape controls adjust one color at a time).. To return to the Geometry Mode you must press the "Red Select" button a second time.

2. When you are adjusting all colors **("geometry mode")** the **little arrow keys** at the bottom are for **video phase adjust** only. When they are pressed the remote will switch the geometry control to phase. If the arrow keys have not been touched for a few seconds the remote will automatically switch back to the geometry control you were last using before using the small arrows.

3. When you are adjusting an individual color **("convergence mode")** the **little arrow keys** at the bottom are for **DC Centering** only. When they are pressed the remote will switch the convergence control to DC Centering. If the arrow keys have not been touched for a few seconds the remote will automatically switch back to the convergence control you were last using before using the small arrows.

4. The setup controls, in the on screen display, are usually labeled with Horz/Vert, T/L (top/left), or B/R (bottom/right) and a number value indicating the current setting.

5. If you want to see what effect the **"new setting"** compared to the **"stored setting"** has on the display press the **"ADJ TOGGLE"** key on the remote. Adjust toggle will allow you to switch between the two settings before committing to a change.

6.After making your changes and adjustments be sure you SAVE THE NEW SETTINGS. If a major change has been made, new module, new CRT, or a change in the physical setup, you must readjust and store the geometry/setup for each of the formats and aspect ratios being used.

7. To escape, from the **setup mode**, with out saving and changes press the **"Quit"** button **twice**.

8. Caution - shut all the Pro900/900X timers off and signal source power conserve features before starting convergence. If the video signal is lost you will quit convergence mode with no chance to save your work.

9. To see the **Forced Mode Menu** press **"SETUP"** and **"GREEN SELECT"**.

10. To see the current **sync and video format** being used press **"GREEN MUTE"**.

11. To see the **elapsed time** display press and **hold "LIN C/LI-LIN"**, until the **regular menu disappears**, and then press **"TIMER" or "H-Pulse" key**.

12. To set the **unit IR Code** (for use when multiple units are in the area) press and **hold "LIN C/LI-LIN"**, until the regular **menu disappears**, and then press **"9", "9", "9", "9", and "ADJ TOGGLE"**.

13. See the "MENU" chapter for "COPY FORMAT" procedure information - refer to page 34 section 5.6.

14. To Aid with the alignment procedure it is recommended to mark the center of the screen and the center of all four sides with masking tape. Use drafting type tape that will not leave any marks. This will give you calibration points for convergence and CRT alignments.

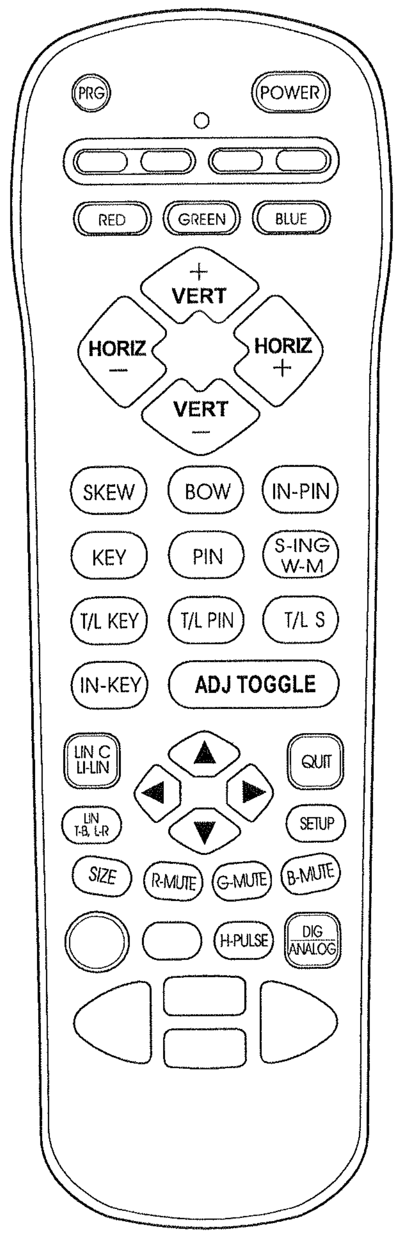


Figure 6

Specification for Pro900/900X RGB Sync Inputs

Version 2.1 December 21, 1995

I. Sync Inputs
There are three Sync signal inputs for use with RGB sources:
a) SYNC-ON-GREEN(SOG)...this is through the Green video input BNC jack, terminated 75 ohms.
b) HORIZONTAL/COMPOSITE (H / Comp)...through a BNC jack on the 9-1515 Combo module, software switched termination 2K/75 ohms.
c) VERTICAL (V)...through a BNC jack on the 9-1515 Combo module, software switched termination 2K/75 ohms.

II. Compatibility
a) SYNC-ON-GREEN...negative-going sync on Green video input, either EIA or SMPTE (HD) spec compatible.
b) HORIZONTAL/COMPOSITE
1) Analog/TTL Mode...TTL-level computer syncs (VGA, SVGA, Macintosh) , NTSC/PAL/SECAM studio/commercial horizontal/composite analog sync.
2) Special composite Mode... NTSC/PAL/SECAM or SMPTE HD studio/commercial negative composite or tri-level analog sync (Black Video).
c) VERTICAL... TTL-level computer syncs (VGA, SVGA, Macintosh) , NTSC/PAL/SECAM studio/commercial negative vertical analog sync.

III. Frequency Range
a) SYNC-ON-GREEN...Horizontal component: 15kHz to 50kHz
Vertical component: 50 to 100 Hz
b) HORIZONTAL/COMPOSITE... Horizontal component: 15kHz to 50kHz
Vertical component: 50 to 100 Hz
c) VERTICAL...50 to 100 Hz

IV. Amplitude
a) SYNC-ON-GREEN...Sync portion: 300mV, +/- 150mV
b) HORIZONTAL/COMPOSITE
1) Analog/TTL Mode...0.7Vp-p to 5Vp-p
2) Special composite Mode... 300mV, +/- 150mV
c) VERTICAL... 0.7Vp-p to 5Vp-p

V. Polarity
a) SYNC-ON-GREEN...negative
b) HORIZONTAL/COMPOSITE
1) Analog/TTL Mode...positive or negative
2) Special composite Mode...negative
c) VERTICAL...positive or negative

VI. Pulse Width or Duty Cycle
a) SYNC-ON-GREEN...Minimum sync pulse width = 400nS
b) HORIZONTAL/COMPOSITE...
1) Analog/TTL Mode...Max duty cycle of sync pulse (Vsync in = 0.7Vp-p) = 15%
Max duty cycle of sync pulse (Vsync in 1.4Vp-p) = 30%
2) Special composite Mode... Minimum sync pulse width = 400nS
c) VERTICAL...Max duty cycle of sync pulse (Vsync in = 0.7Vp-p) = 15%
Max duty cycle of sync pulse (Vsync in 1.4Vp-p) = 30%

				1	2	3	4	5	6	7	8	9
Parameter	Units	Symbol	Formula	NTSC M	PAL BG	VGA400	VGA480	VGA350	SMPTE33	MACII35	SMPTE45	SVGA48
H Frequency	KHz	HF	Given	15.734	15.625	31.468	31.469	31.469	33.750	35.000	45.000	48.363
V Frequency (Field)	Hz	VF	Given	59.940	50.000	70.085	59.940	70.086	60.000	66.667	60.000	6.004
H Resolution	Pixels	HR	Given	720	720	720	640	640	1920	640	1280	1024
V Resolution	Lines	VR	Given	487	575	400	480	350	1080	480	720	768
Aspect Ratio	-	AR	Given	4:3	4:3	4:3	4:3	4:3	16:9	4:3	16:9	4:3
Interlace	Y/N	Int	Given	Y	Y	N	N	N	Y	N	N	N
H Sync Polarity	-	HP	Given	NOTE 1	NOTE 1	N	N	P	NOTE 2	Ncomp/SOG	NOTE 2	N
V Sync Polarity	-	VP	Given			P	N	N		n/a		N
Pixel Frequency	MHz	PF	Given	13.500	13.500	28.321	25.175	25.175	74.250	30.240	74.250	65.000
Pixel Time	nS	PT	1/PF*1000	74.074	74.074	35.309	39.722	39.722	13.468	33.069	13.468	15.385
Total Pixels/line	Pixels	P/L	Given	858	864	900	800	800	2200	864	1650	1344
Line Time	uS	LT	PT*HT/1000	63.557	64.000	31.778	31.778	31.778	29.630	28.571		20.67722.222
Total Lines/Frame	lines	L/Frame	Given	525	625	449	525	449	1125	525	750	806
Total Lines/Field	lines	L/Fld	(L/Frame)/2	262.5	312.5	449.0	525.0	449.0	562.5	525.0	750.0	806.0
Frame Time	mS	Tframe	LT*(L/Frame)/1000	33.367	40.000	14.268	16.683	14.268	33.333	15.000	16.667	16.666
Field Time	mS	Tfld	LT*(L/Fld)/1000	16.684	20.000	14.268	16.683	14.268	16.667	15.000	16.667	16.666
Horiz. Active	uS	Hactive	PT*HR/1000	52.557	52.000	25.423	25.422	25.422	25.859	21.164	17.239	15.754
Horiz. front-porch	Pixels	Hfp	Given	24	21	9	8	8	44	64	70	24
Horiz. front-porch	uS	Hfp(T)	Pt*Hfp/1000	1.778	1.556	0.318	0.318	0.318	0.593	2.116	0.943	0.369
H Sync width	Pixels	HSw	Given	64	64	108	96	96	88	64	80	136
H Sync width	uS	HSw(T)	Pt*HSw/1000	4.741	4.741	3.813	3.813	3.813	1.185	2.116	1.077	2.092
Horiz. back-porch	Pixels	Hbp	LT-HR-Hfp-HSw	50	59	63	56	56	148	96	220	160
Horiz. back-porch	uS	Hbp(T)	Pt*Hbp/1000	4.481	5.704	2.224	2.224	2.224	1.993	3.175	2.963	2.462
Horiz. Blank	Pixels	Hblank	LT-Hactive	138	144	180	160	160	280	224	370	320
Horiz. Blank	uS	Hblank(T)	Pt*Hblank/1000	11.000	12.000	6.356	6.356	6.356	3.771	7.407	4.983	4.923
H Blank %	%	HB%	(P/L-HR)/P/L *100	20.000	20.000	20.000	20.000	20.000	12.727	25.926	22.424	23.810
Vert. Active/Field	lines	Vactive	VR (/2 for int.)	243.5	287.5	400	480	350	540	480	720	768
Vert. Active/Field	mS	Vactive(T)	LT*VR/1000 (/2)int	15.48	18.40	12.711	15.253	11.122	16.000	13.714	16.000	15.880
Vert. front-porch	lines	Vfp	Given	3	2.5	6	3	32	2	3	5	3
Vert. front-porch	uS	Vfp(T)	LT*Vfp	190.67	160.00	190.67	95.33	1016.88	59.26	85.71	111.11	62.00
V Sync width	lines	VSw	Given	3	2.5	2	2	2	5	3	5	6
V Sync width	uS	VSw(T)	LT*VSw	190.67	160.00	63.56	63.56	63.56	148.15	85.71	111.11	124.00
Vert. back-porch	lines	Vbp	L/Fld-VR-Vfp-VSw	13	20	41	40	65	15.5	39	20	29
Vert. back-porch	uS	Vbp(T)	LT*Vbp	826.24	1280.00	1302.91	1271.10	2065.54	459.26	1114.29	444.44	600.00
Vertical Blank	lines	Vblank	L/Fld-Vactive	19	25	49	45	99	23	45	30	38
Vertical Blank	uS	Vblank(T)	LT*Vblank	1207.58	1600.00	1557.14	1429.99	3145.98	666.67	1285.71	666.67	785.72
V Blank %	%	VB%	(L/Fld-VR)/L/Fld*100	7.238	8.000	10.913	8.571	22.049	4.000	8.571	4.000	4.715
Vertical Retrace	uS	Tr(V)	Vblank(T) - Vfp(T)	1016.91	1440.00	1366.47	1334.66	2129.10	607.41	1200.00	555.56	723.72
Format source				FCC	CCIR	VESA	VESA	VESA	SMPTE	APPLE	SMPTE	VESA

NOTE 1: NTSC, PAL and SECAM syncs are specified as sync-on-luma or sync-on-composite video. RGB implementations do exist as standards (CGA, Macintosh), but the numbers given here assume the CCIR recommended standard timing with any type of sync input as a possibility. Identifying the television standard timing formats in RGB mode cannot therefore rely on sync type or polarity, but should be adaptive to any sync type. The back-porch video clamp position should always be used for the NTSC & PAL RGB formats. NOTE 2: The draft SMPTE specs only describe a tri-level sync-on-green as the sync inputs for the HD formats. However, HD video equipment or set-top boxes could use either separate or composite TTL syncs of indeterminate polarity. Identifying the HD formats should always be used for the HD formats.

Screen Size Selection

Courtesy of Draper Shade & Screen

One of the most important decisions in screen selection is to determine the correct size of screen based upon-
1. The dimensions of the audience area.
2. The projection format, or formats, to be used.

In some situations, these two questions yield the same answer; in others they do not and compromises must be made. Here are the key considerations-

Audience Area-In determining the correct size of screen in relation to the audience area, the goal is to make the size large enough so those in the rear of the audience area can see the subject matter easily, but not so large that those in the front of the audience area have difficulty seeing the full width the projected image.

Width-The generally accepted guideline in determining the screen width is the Two and Six Rule:
A. Screen width should equal the distance from the screen to the first row of seats, divided by two.
B. Screen width should equal the distance from the screen to the last row of seats, divided by six.
In case of a difference between these two guidelines, the one yielding the larger size should prevail.

Height-As a rule of thumb, the screen height should equal or exceeding the distance from the screen to the last row of seats, divided by eight. Ceiling height and projection format considerations may modify this standard.

Ceiling Height-The bottom of the screen should be approximately 48" above the floor to allow all members of the audience to see the bottom of the projected image.

Projection Format-Once you have determined the correct size of the screen based upon the audience area, that size may be based upon the type, or types, of projection equipment to be used. If the screen will only be used with one type of projector of (overhead projector, CRT video projector, etc.), it is easy to determine the exact screen dimensions based upon the projection format of that projector. Projection formats are expressed in terms of aspect ratio, which is the relationship of the height of the projected image to its width. Aspect ratios of common projection formats are listed below.

If it is necessary to modify the screen dimensions based upon the formats of projectors to be used, it is preferable to hold the screen height constant and increase the screen width as necessary, rather than to hold the width constant and decrease the height.

Aspect Ratios of Common Projection Formats

H:W		**H-W**	
1.00:1.00	Overhead and opaque projection,	1.00:1.78 or 9:16	High Definition Television (HDTV)
1.00:1.33 or 3:4	LCD and CRT video and data-graphics projection	1.00:1.85	Wide Screen (also known as Letterbox)
		1.00:2.35	CinemaScope
1.00:1.48 or 2:3	2x2 standard slides (35mm DF)		

Note.- Vertical presentation of a slide reverses its aspect ratio. To allow this, use a 1.00: 1.00 aspect ratio for any type slide.

Projection Formats

Most models of DRAPER screens are offered in both audio visual and 3:4 video formats. Certain models are also offered in HDTV and WideScreen formats. The differences between these formats are stated below.

We are glad to provide any DRAPER screen in the size and projection format of your choice. We can provide any size up to and including the largest published size. If you do not find the size and format you need listed, please call or fax your requirement to us, and we will be delighted to quote.

Audiovisual (or AV) format screens are intended for general use. They accommodate a variety of projector types and range from square to wide horizontal in aspect ratio.

AV format screens are described in terms of height x width, and are standardly furnished without black borders, although borders are optionally available.

Video format screens, on the other hand, are specifically designed for use with video projectors. Their format is strictly defined as a 3:4 rectangle, and the size is usually described in terms of a nominal diagonal. Conventional models of video format screens are standardly furnished with black borders to frame the image on all four sides, allowing for video projector overscan. Tab Tensioned electric screens are routinely furnished with black borders at the sides and bottom, although black masking at the top is optionally available.

HDTV format (9 high by 16 wide) is also available for high-definition television projection, and WideScreen format (1: 1.85) is offered for letterboxed video images.

How to Calculate a Custom Size

Draper also manufactures custom size screens to meet your specification. Virtually any size within the maximum shown for a given model is available. Please call for pricing on special sizes. If you need to calculate a custom size, these formulas may be useful (D = exact diagonal; H viewing area height; W = viewing area width):

3:4 Video:	**9:16 HDTV:**	**1:1.85 wind screen:** (also called Letterbox)
H = D x.6	H = D x.49	H = D x.4762
W = D x.8	W = D x.87146	W = D x.881
D = H x 1.667	D = H x 2.04	D = H x 2.1
D = W x 1.25	D = W x 1.1475	D = W x 1.135

Pro900/900X Setup and Alignment Procedure

Procedure Overview

There are several situations to consider when performing the setup procedure for the Pro900/900X System. The setup procedure will vary depending on the required physical and signal configuration.

The simplest setup is of a "factory configured" projector which will use the preset conditions. Factory configured means it has been aligned for ceiling/front projection and a 80"wide display at a projected distance of 95 7/16". In this case, using the customer's signal source, only minor blanking, phase, and convergence touch up is required.

If the display size is changed, to other than 80" width or the unit is to be floor mounted, completion of the full setup procedure is required.

Setup, after a hardware repair, is the other condition. Replacement of a CRT usually require minor alignment steps (yoke, astigmatator, focus, and re-convergence only for that color). Replacement of modules, in the vertical, horizontal deflection, or convergence systems, usually requires that most all alignment steps to be performed.

I. Installation Prerequisites

1. Mounting Configuration - Floor or Ceiling.
2. Projection Configuration - Front or Rear.
3. Determine Display Size and Aspect Ratio (Shape).
4. List All Signal Source(s) and Format(s).
5. Check Projection Installation Area - Before Installation.
6. Survey Installation Area For Power and Signal Source Requirements.
7. Test Pro900/900X system before modifying its configuration. 8. Modify, Instal,l and setup the Pro900/900X system.

II. System Check and Physical Setup

1. Pro900/900X Check Out Before Changes to Configuration

IMPORTANT

Do Not Connect Power until you verify correct setup of the 120/220 VAC jumper on the 9-1500 power supply. Refer to the figure in the next column.

a. Connect all the customer's RGB and Composite Video Source(s) to the Pro900/900X jack pack.

b. Turn on the Pro900/900X and the Signal Source(s).

c. Verify that the Pro900/900X recognizes all the source signals. **d.** Verify that the Pro900/900X operates correctly.

e. Turn the Pro900/900X off and disconnect the AC power.

2. Set Floor/Ceiling and Front/Rear Configuration

Refer the figures on page 10.

a. Remove the Pro900/900X top cover.

b. 9-1510 Module set vertical deflection and horizontal/vertical convergence connectors.

c. 9-1505 module set horizontal deflection connectors.

d. 9-1509 module set dynamic focus switch SW7001.

3. Set Red and Blue CRT Point Angles

a. Remove the nylon rod shipping spacers (or shipping wedges).

b. Set Red CRT point angle according to the display width.

c. Set Blue CRT point angle according to the display width. Refer to figures on page 11.

Note: The Pro900/900X unit is shipped with spacer shims between the CRT and lens assemblies these must be removed to setup the CRT mechanical focus. Refer to figure on page 14 lens focus procedure.

4. Mount the projector system.

Mount the Pro900/900X system according to the prearranged plans of the customer. Verify the mounting point, hardware, signal connections, and power connections.

Note: It is recommended that preliminary setup be done on the floor before hanging a ceiling configured system.

5. Projector/Display Surface Physical Setup

a. Set the projector to screen distance according to display width. Refer the figures on pages 11 and 12.

b. Set projector height according to display size. Refer the figures on pages 11 and 12.

c. Adjust the projector's position for no horizontal skew to the display screen.

d. Verify that the Green CRT center is centered (+/-1/8") to the screen horizontal center.

e. Stabilize the projector and screen mounting hardware.

f. Verify that the setup of steps "a" through "d" has not changed.

6. Setup Signal Sources

a. Connect the RGB and/or Video Source(s) to the Pro900/900X jack pack.

9-1500
Stanby Switch Mode Power Supply

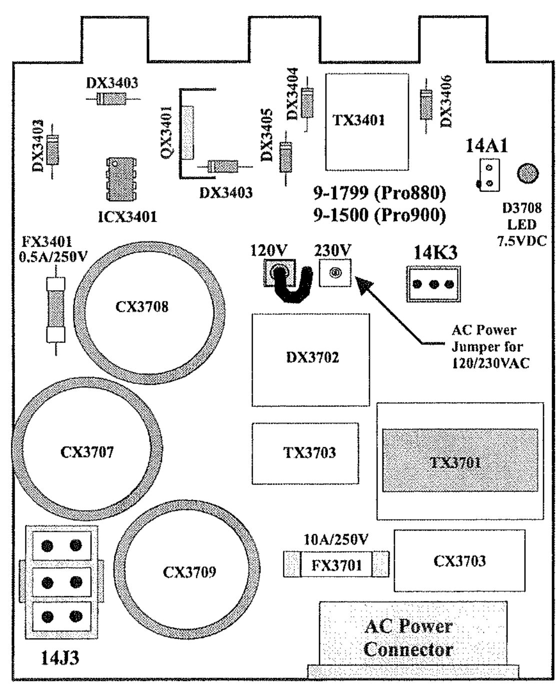


Figure 7

b. Reconnect the AC power.
c. Turn on the Pro900/900X and the Signal Source(s).
d. Verify that the Pro900/900X recognizes all the source signals.
e. Set the "Ceiling/Floor" setup menu option.

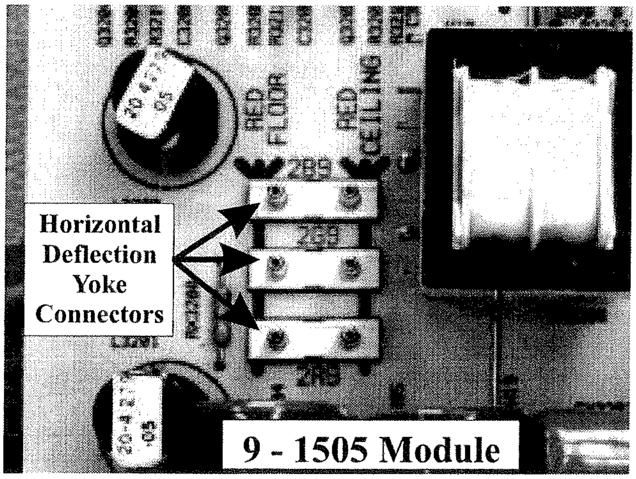


Figure 8

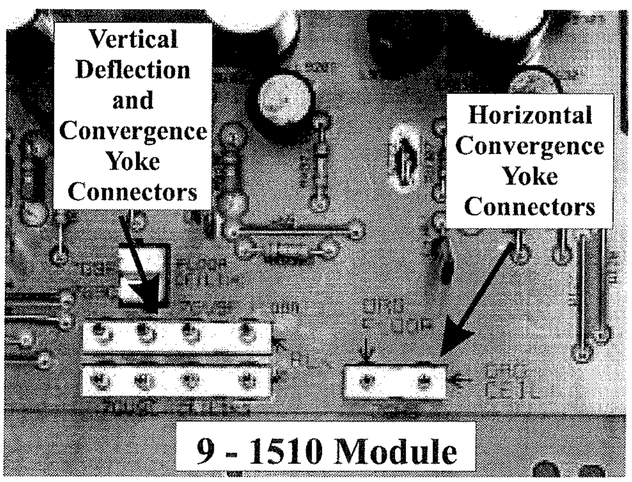


Figure 9

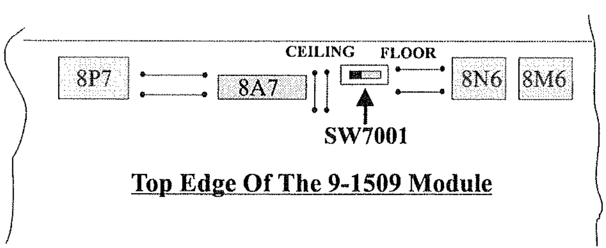
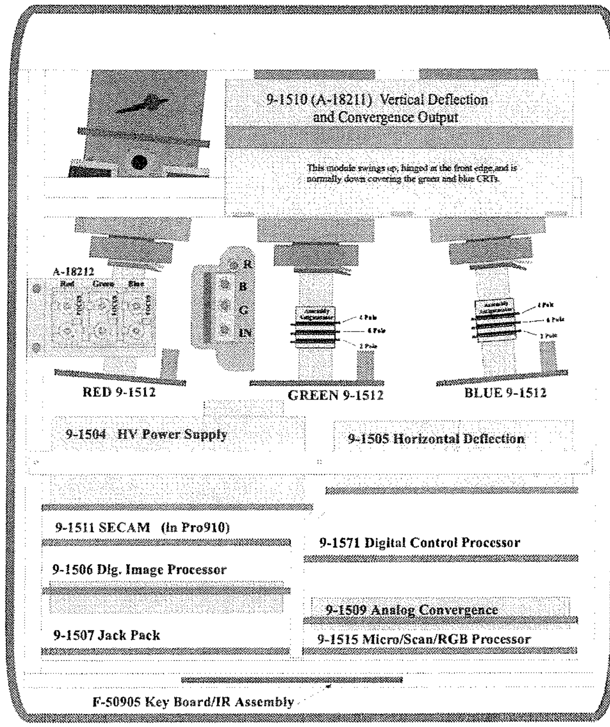


Figure 10



Pro900/900X Module Locations
Figure 11

SETUP is used to adjust geometry and convergence settings.

Press RED to continue SETUP.
Press GREEN to force formats.
Press BLUE to set floor / ceiling.
Press any other key to exit.

Pro900/900X Setup Menu Screen
Figure 12

SETUP Position = Floor.
Press ←→ To change selection.

Pro900/900X Floor/Ceiling Setup Menu
Figure 13

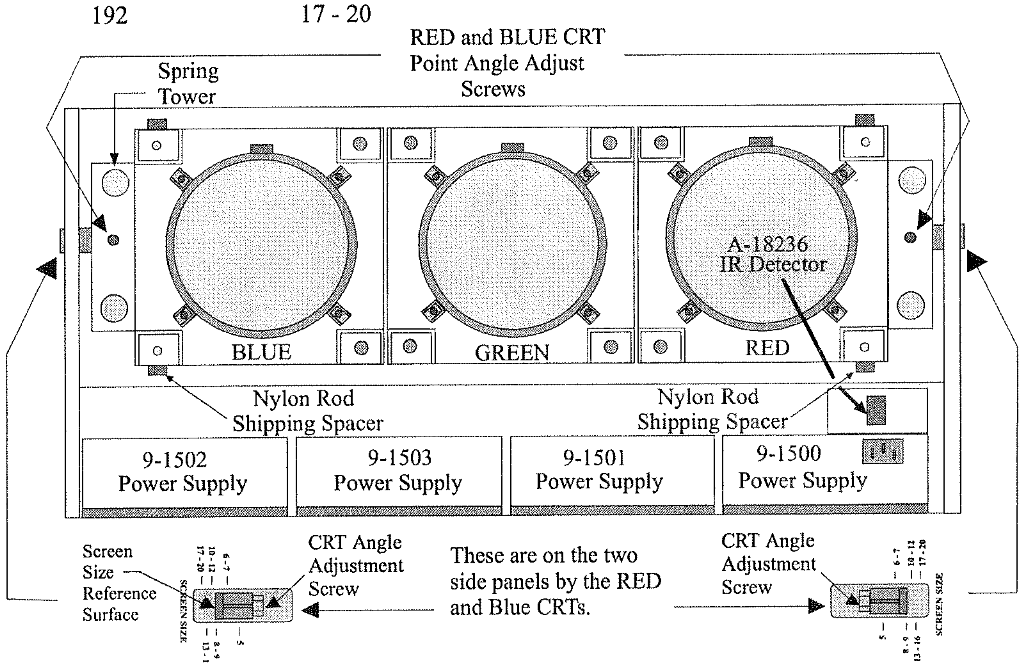
Examples Of Display Setup Distances And Center Points

Screen Width	"A"* Projection Distance	"B" Display Center	"Peerless" Mount Center
48"	58 5/8"	26 3/8"	11"
60"	72 7/8"	30 3/4"	11"
80"	96 3/8"	38"	11"
96"	115 1/4"	43 5/8"	11"
120"	143 1/2"	52 3/8"	11"
144"	171 7/8"	61"	11"
160"	190 5/8"	66 3/4"	11"
200"	237 7/8"	81 1/8"	11"

PHYSICAL SETUP TO THE SCREEN (for all aspect ratios)

1. Set distance "A" according to the selected display width (* or calculate the distance in inches "A" = 1.179 x width)+2.063
Note: Distance "A" is measured from the cabinet panel front directly below the green CRT lens.
2. Calculate the Display Center "B" from a reference line projected from the bottom of the cabinet. Display Center "B" = A x 0.3057)+8.44 .
3. Set the projector's height using measurement "B". This references the bottom of the cabinet to the display center. When doing a ceiling mount be sure to allow for the dimensions of the mounting bracket hardware.
4. Adjust for no horizontal twist and verify that the green CRT is at the display horizontal center by making measurements "C" and "D" equal. **Note:** the light path start is straight out from the bottom of the green CRT lens opening.
5. Verify that distance "A" has not changed.
6. The Peerless ceiling mount center is 11" from the "A" distance reference point on the Pro900/900X front.
7. Set Red and Blue CRT point angle for the selected screen size.

Screen Width (min) inches	Screen Width (max) inches	Red and Blue Screen Size Setting
48	55	5 - 6
55	72	6 - 7
72	91	8 - 9
91	120	10 - 12
120	158	13 - 16
158	192	17 - 20



This projection system comes set up for Ceiling Mount and a display width of 80". To change the display width, two shipping spacer rods for the RED and BLUE CRTs, must be removed. This allows the RED and BLUE CRT point angles to be set for the new display width.

Figure 14

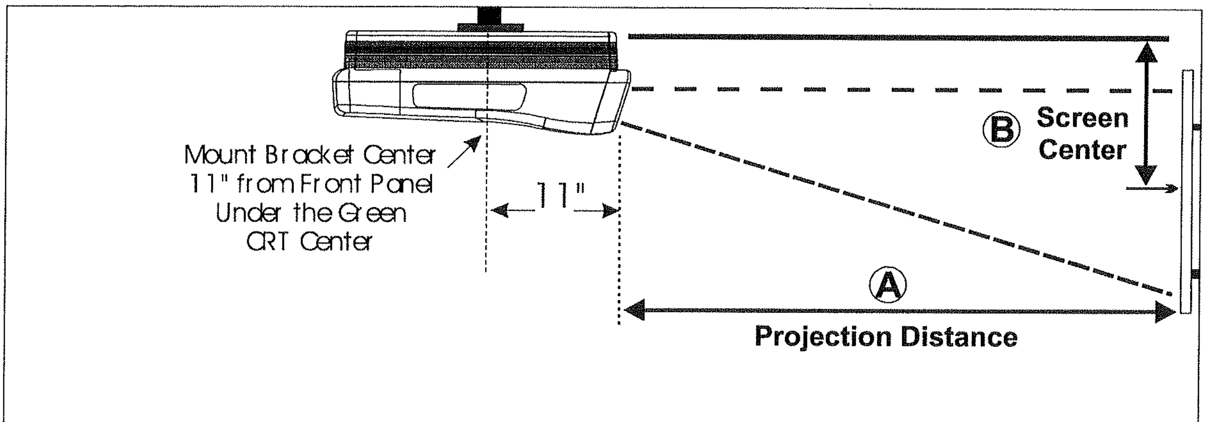
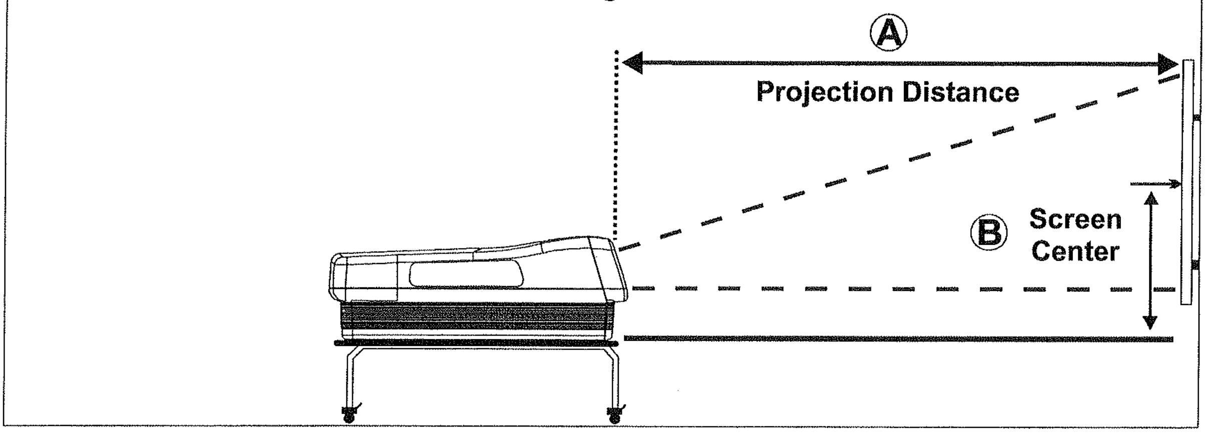


Figure 15

Figure 16



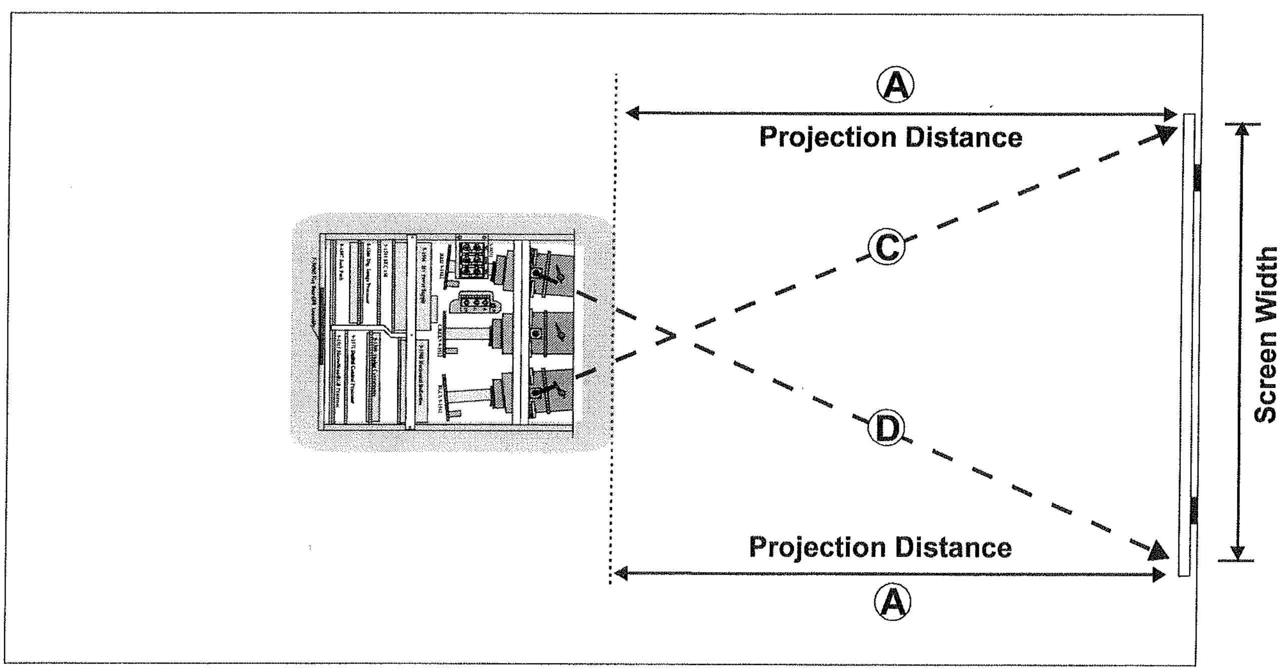


Figure 17

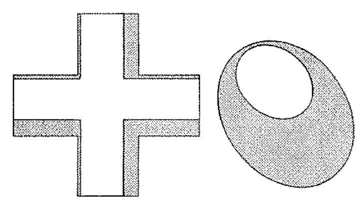
III. Preliminary Alignment Setup
The following procedures are intended for complete "Geometry/Convergence" setup. Use the customer's signal for doing DC centering, phase, and size adjustments. You can use the internal patterns for shape and convergence if the customer signal sources do not have a cross hatch pattern. If you are realigning a single CRT, due to replacement, or doing alignment touch up perform the following steps, as needed.

1. Yoke Tilt Alignment
Use a cross hair or cross hatch pattern. Monitor only the center most horizontal line of the pattern to check yoke tilt. Do Not Use SW9501,on the 9-1510 module, to disable convergence. The vertical circuit is not disabled. Only the horizontal is disabled.
a. Set Horizontal DC centering to "0"(red, green, blue).
b. Set Vertical DC centering:
Floor: Red = -30; Green = -20; Blue = -30.
Ceiling : Red = 30; Green = 20; Blue = 30.
c. In Geometry Mode set Green, Red, and Blue "SKEW" H = 0 and "SKEW" V = 0 .
d. Adjust the Red, Green, and Blue yokes for no horizontal tilt or twist.

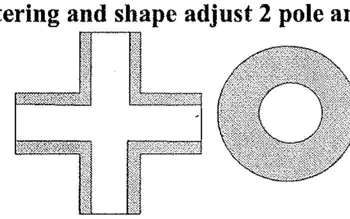
2. Rough Geometry/Convergence Setup of Green
When aligning green some controls are enabled in Geometry only. This is why the alignment starts by using green in the geometry mode of setup.
a. Using the setup remote control press "SETUP" and "RED". This will put the system into the "GEOMETRY MODE".
b. Using the setup remote control press "RED MUTE" and "BLUE MUTE". You should see only the green video.
c. Roughly setup the shape of the green display using the appropriate Skew, Bow, Key, etc. controls. Adjust linearity, size, or phase using the customer's video signal. Refer to pages 16, 17, and 18 for the convergence remote control and procedure notes.

3. Rough Geometry/Convergence of Red and Blue
a. Using the remote control return to the SETUP Mode and select the internal cross hatch pattern.
b. Press "RED" and mute the green and blue video.
c. Roughly setup the shape of the red display using the appropriate Skew, Bow, Key, etc. controls. Adjust linearity, size, or phase using the customer's video signal. Refer to pages 16, 17, and 18.
d. Press green mute to display green and red video at the same time.
e. Using "Point Angle" adjustment screws align the vertical center line of the red pattern to the vertical center line of the green pattern.
f. Using DC vertical center align the horizontal center line of the red pattern to the horizontal center line of the green pattern.
g. Adjust red "Size" and "Lin T/B - L/R " to roughly match the green pattern size. Refer to pages 16, 17, and 18.
h. Press "BLUE" and mute the green and red video.
i. Roughly setup the shape of the blue display using the appropriate Skew, Bow, Key, etc. controls. Adjust linearity, size, or phase using the customer's video signal. Refer to pages 16, 17, and 18.
j. Press green mute to display green and blue video together.
k. Using "Point Angle" adjustment screws align the vertical center line of the blue pattern to the vertical center line of the green pattern.
l. Using DC vertical center align the horizontal center line of the blue pattern to the horizontal center line of the green pattern.
m. Adjust blue "Size" and "Lin T/B - L/R " to roughly match the green pattern size. Refer to pages 16, 17, and 18.
n. Press "QUIT" and "ADJ TOGGLE" to store the adjustments.

4. Yoke Ring Magnet and Astigmatator Alignment Verify Only - This is not a normal field adjustment.
The astigmatator assembly should be mounted 62.5 mm from the video output module (from the front edge of the video output module to the six pole rings). Refer to the figure on the bottom of page 15.
Astigmatator Alignment Verification Test
Adjust for the best electrical and mechanical focus.
Verify spot alignment by rotating Green electrical focus slightly CW to CCW. The Dot shape should not tail or flair. The bright area should remain in the center of the haloed area. Refer to the figure below .
If this test shows a need for astimatator alignment perform steps "a" to "n" below.



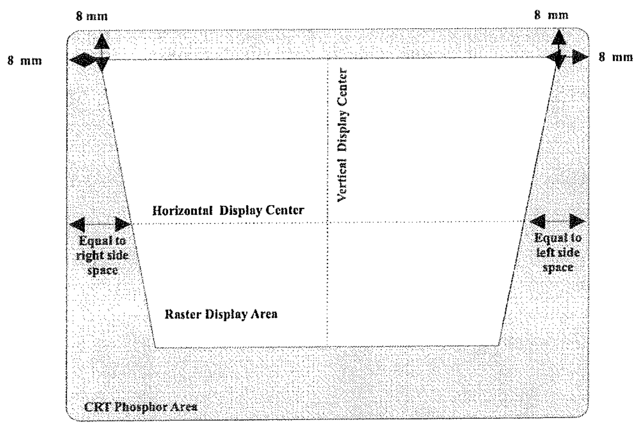
Bad Centering and shape adjust 2 pole and 4 pole



Good Shape and Centering
Figure 18

Astigmatator Alignment Procedure
a. Set the display/sync mode to Forced Mode 6 (HDTV33) and select a cross hatch or dot pattern.
b. Cut off Red and Blue video or cover the CRT lens assemblies.
c. Set the astigmatator 2,4,and 6 pole magnets to the zero position (ring tabs together and pointed straight up).
d. Set Green electrical focus slightly CCW. This is to make a near display center dot dimmly haloed with a bright center. The haloed effect will also be visable with the cross hatch lines.
e. Use the astigmatator 2 pole magnet (refer to the figure on page 13) to center the bright spot within the halo. You may also use an intersection, of the cross hatch, to center the bright area within the haloed area.

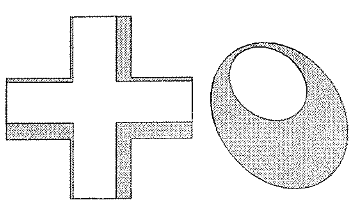
f. Use the astigmatator 4 pole magnet to shape the halo and bright spot as round as possible.
g. Use the astigmatator 6 pole magnet, if needed, to help shape the halo and spot round.
h. Use the main yoke magnets to position the signal source video pattern center to the CRT face center. Refer to the figure19.



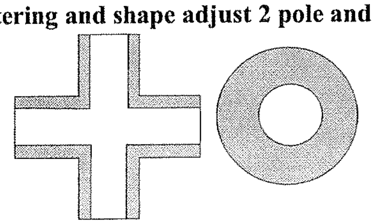
The center of the video pattern display should be in the center of the CRT phosphor ares. Video pattern display is vertically compressed below the horizontal center of the display..

Figure 19

i. Repeat steps e thru h as needed to obtain the smallest and best round Green center dot.
j. Verify spot alignment by rotating Green electrical focus slightly CW to CCW. The Dot shape should not tail or flair. The bright area should remain in the center of the haloed area.
k. Repeat steps e thru j as needed to obtain the smallest and best round Green center dot with no shape flairing.
l. Adjust for the best electrical and mechanical focus.
m. Repeat steps d thru m for the Red and Blue displays.
n. Exit forced mode 6 and return to normal video. Set Brightness and Contrast to 50.



Bad Centering and shape adjust 2 pole and 4 pole



Good Shape and Centering

Figure 20

Note: The yoke adjustments should not be touched during the remaining setup steps.
5. Ceiling/Front Projection Lens Angle Focus Alignment If this Pro900/900X system is equipped with the "lens assembly foucus" spring the following procedure must be completed. This procedure must be completed as part of the system mechanical foucus procedure. See the figure below.
a. Turn on the projector, project a crosshatch pattern on the screen. Cover up both blue and red lenses. Work only on the green lens.
b. Adjust the mechanical and electrical focus to get the best image possible in the center of the picture.
c. Tighten all 4 lens mounting screws.
d. Loosen all 4 lens mounting screws 3 full turns.
e. Loosen lens focus adjustment knob, fully extend lens barrel. Adjust mechanical focus while observing the vertical center line. If the upper portion of the image comes to focus before the lower portion of the image , tighten or loosen the lower left screw until both upper and lower portions of the image come to focus simultaneously. It's recommended to tighten the screws 1/8 - 1/4 turn each time for adjustment
f. Adjust mechanical focus while observing the horizontal center line. If right portion of the image comes to focus before the left, tighten or loosen the lower left screw until both right and left portions of the image come to focus simultaneously. It's recommended to tighten the screws 1/8 - 1/4 turn each time for adjustment
g. Adjust the focus mechanically and electrically to get the best overall image.
h. Cover green lens and uncover red lens.
i. Repeat step "b - g for red.
j. Cover red lens and uncover blue lens.
k. Repeat step "b -g for blue.
l. Re-install Pro900/900X top cover.
m. Turn off the sync forced mode 9 and return to normal video viewing or sync forced mode 11.

IV Final Detailed Geometry/Convergence Setup

Use the video patterns generated by the customer's signal source for final alignment. If this is not possible use the internal cross hatch pattern only to do the geometry and convergence. The customer's signal for must be used blanking, size, centering and phase.

1. Green Geometry Setup
a. Return to the geometry and convergence modes and setup the green display with precision. Each step should be done by measuring the display and not guess work.
b. Now store the green setup.

2. Red to Green Convergence Setup
a. Return to the convergence mode and setup the red display with precision. Convergence the red display to the green display using all necessary controls.
b. Now store the red setup.

3. Blue to Green Convergence Setup
a. Return to the convergence mode and setup the blue display with precision. Convergence the red display to the green display using all necessary controls.
b. Now store the blue setup.

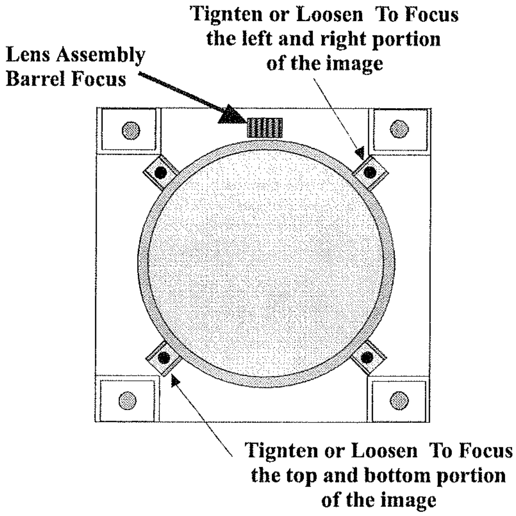


Figure 21

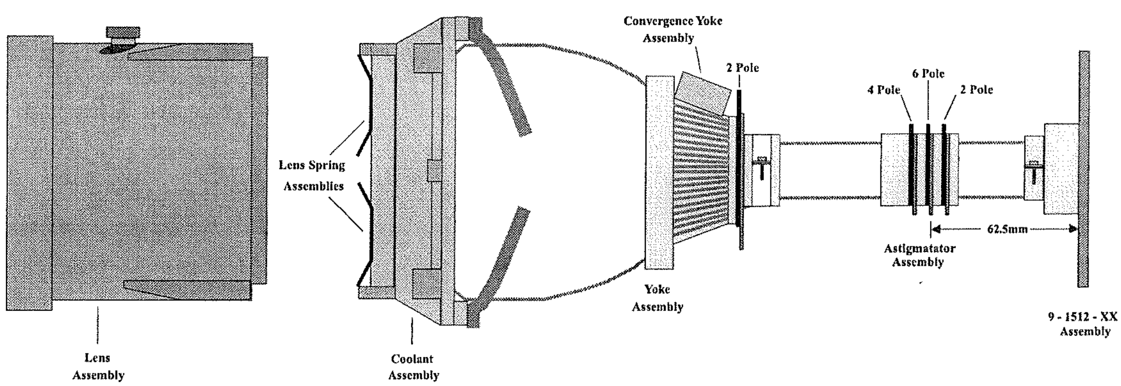
4. Red to Green to Blue Convergence Setup
a. Return to the convergence mode and setup the red and blue display with precision. Convergence the red display to the green display using all necessary controls.
b. Now store the completed setup.

5. Video Blanking Setup Using the Customer's Signal
a. Access the Blanking/Phase feature of the setup menu.
b. Select the TOP/LEFT BLANKING feature.
c. Using the small arrows adjust the top and left edges (increasing the setting number) until the edge begins to crop or frame the video. Decease the number until the cropping just stops. Now decease the number value two more.
d. Select the BOTTOM/RIGHT BLANKING feature and repeat step c.
e. Press ADJ TOGGLE and save the settings.

V. Geometry/Convergence of Other Aspect Ratios
1. Geometry/Convergence setup must be accomplished for each required aspect ratio of each signal format used (Video, S-Video, RGB VGA400, VGA480, SVGA, ect.).
2. Each of the ten standard signal format memory "custom" locations also has a "custom" location for each of associated aspect ratios.
3. The five "customer" format memory locations also store the aspect ratio information separately.
4. RGB sources use the 4x3, letter box, or 16x9 aspect ratios.
5. Video and S-Video sources use the 4x3, letter box, Compressed, and 16x9 aspect ratios.

Figure 22

Installed Pro900/900X CRT Assembly



Replacement CRT Assembly

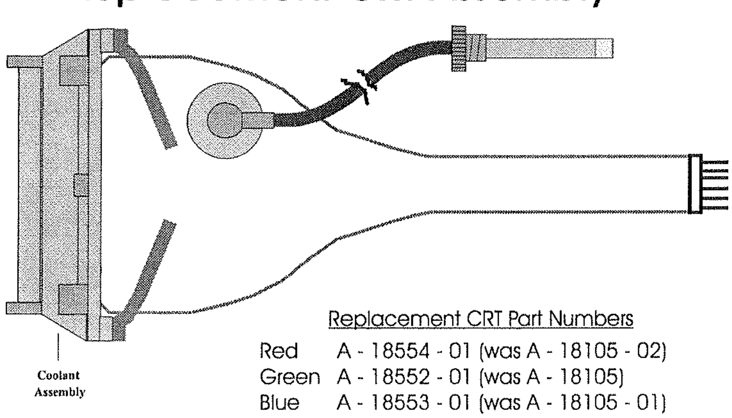


Figure 23

Transfered Assemblies

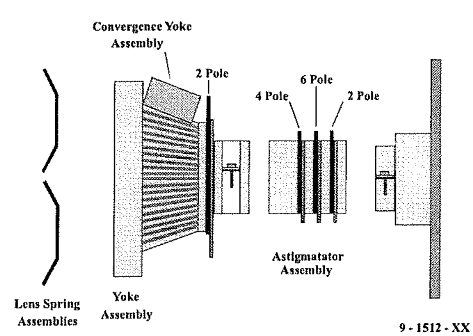


Figure 24

DIGITAL DISPLAY SETUP PROCEDURE
GEOMETRY CONVERGENCE

Geometry controls all three colors at the same time.

Button	Adjustment	Goal
1. SIZE	H. Size	Set to fill screen at C and D. (Use external source **not** internal test pattern)
2. SIZE	V. Size	Set to fill Screen at A and B. (Use external source **not** internal test pattern.)
3. SMALL ARROWS	H&V Video Phase	Set the position of the external source to be centered on the screen.
4. SKEW	V. Skew	Level line C-D.
5. BOW	Bow V.	Straighten line C-D (note that some screen frames are curved).
6. SKEW	H. Skew	Line A-B edges equal distance to screen edge.
7. BOW	H. Bow	Straighten Line A-B
8. LIN TB LR	H. Lin L-R	Set equal widths CZ=ZD
9. LIN TB LR	V. Lin T-B	Set equal height AZ=ZB
10. LIN C	H. Lin C	Set box width at center equal to average of left and right box widths and size.
11. LIN C	V. Lin C	Set box heights at center equal to average of top and bottom box widths and size.
12. KEY	V. Key	Set bottom edge G-H straight with respect to screen border.
13. PIN	V. Pin	Set for straight bottom edge, line G-H (corners G & H move, center B is stable.)
14. S-ING	V. 'S'	Set for straight bottom edge, line G-H (middle areas K & M move in opposite direction, center B; and ends G & H are stable).
15. W-M	V. W-M	Adjust for straightest line G-H (middle areas K & M move in same direction, center B and ends G & H are stationary).
16. KEY	H. Key	Set right edge F-H straight with respect to screen border (top and bottom move in opposite directions; center D is stable.)
17. PIN	H. Pin	Set for straight right edge, line F-H (corner F&H move, center D is stable.)
18. S-ING	H. 'S'	Set for straight right edge, line F-H (middle areas O & Q move opposite and center D and ends F & H are stable.)
19. T/L KEY	V. Top Key	Set top edge E-F straight with respect to screen border.
20. T/L PIN	V. Top Pin	Set for straight top edge, line E-F.
21. T/L S	V. Left S	Set for straight edge, line E-F (middle areas J & L move opposite; center A and ends E & F are stable).
22.T/L KEY	H. Left Key	Set left edge E-G straight with respect to screen border top and bottom move in opposite directions, center C is stable).
23. T/L PIN	H. Left Pin	Set for straight left edge, line E-G (corners E &G move, center C is stable).
24.T/L S	H. Left S	Set for straight left edge, line E-G (middle areas N & P move opposite; center C and ends E & G are stable).
25. IN-KEY	H. In Key	Set J-K and L-M straight with respect to line E-G, A-B, and F-H (adjust for minimal internal keystone; top bottom move in opposite directions; centers 3 and 4 are stable).
26. HV PIN	H. In Pin	Set J-K and L-M straight (adjust for minimal internal pincushion).
27. W-MV	W-M	Average error for straightest lines G-H and E-F (middle areas K & M, and J & L move in same direction; center B, A and ends G & H, are stationary).
28.Touch up all controls		Due to the interaction of IN-XXX controls, key controls, and pin controls for best overall convergence, it may be necessary to 'tweak' the other controls.

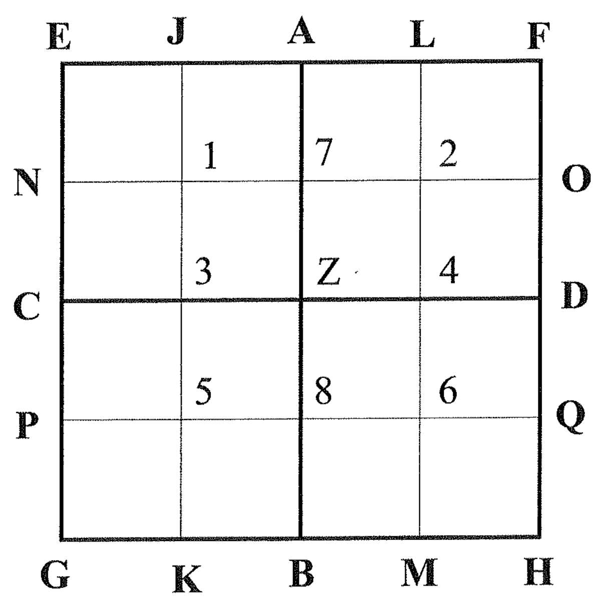


Figure 25

Pro900 Convergence Setup Controls

→ = Area to focus your attention

#1 - #28 are figure references and not the adjustment order.

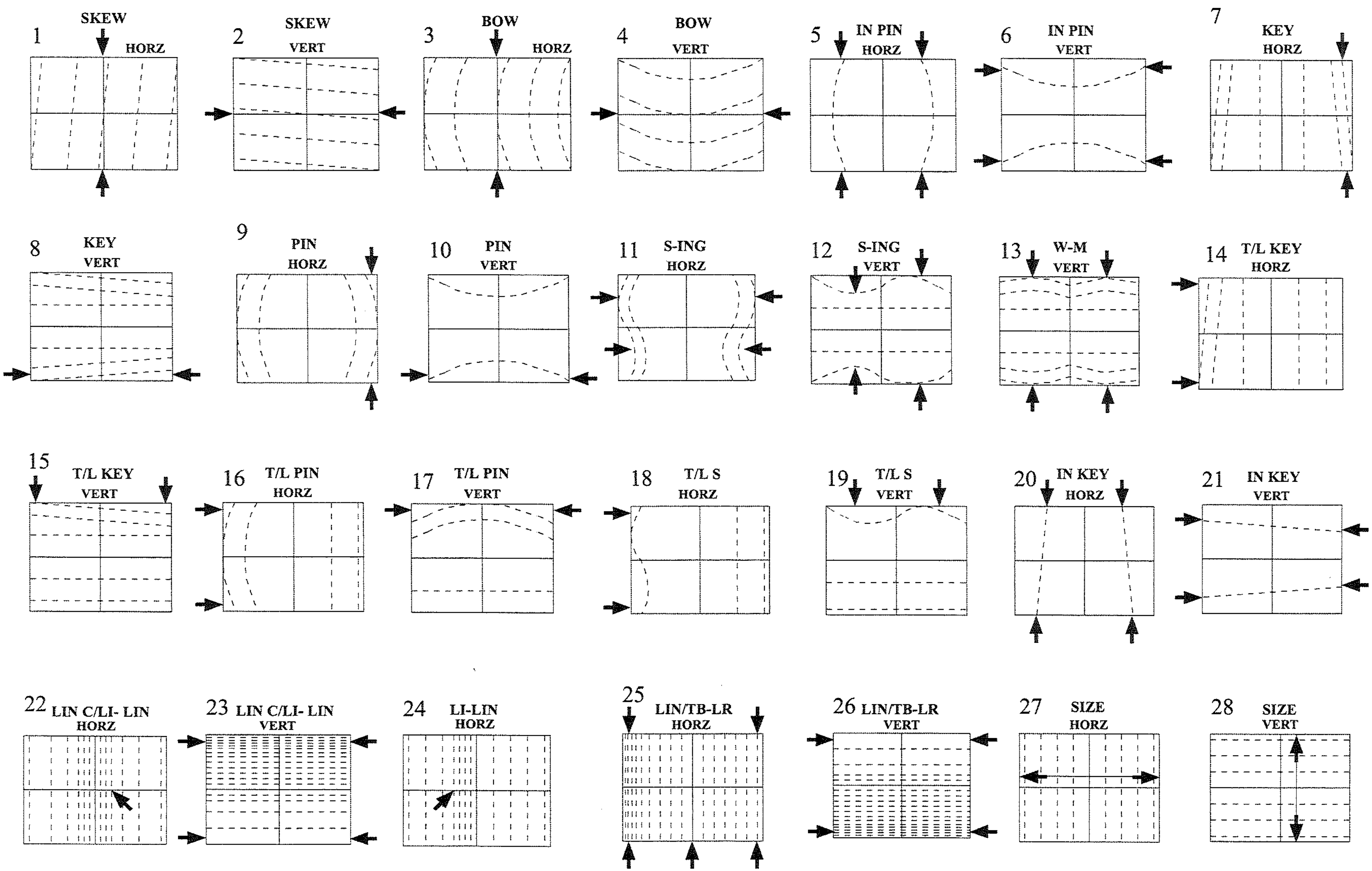


Figure 26

DIGITAL DISPLAY SETUP PROCEDURE
CONVERGENCE OF RED AND BLUE ONTO GREEN

It is desirable to Mute color you are not adjusting. Select the color you want to adjust by pressing the RED or BLUE button.

Button	Adjustment	Goal
1. SMALL ARROWS	H. & V. Statics	Set center of video for best overlap with Green (this may have to be 'tweaked' during this alignment procedure.)
2. SIZE	H. Size	Set to match Green at C and D.
3. SIZE	V. Size	Set to match Green at A and B.
4. SKEW	V. Skew	Match Green at C and D.
5. BOW	V. Bow	Match Green at C and D.
6. SKEW	H. Skew	Match Green at A and B.
7. BOW	H. Bow	Match Green at A and B.
8.LIN T-B L-R	H. Lin L-R	Match Green at C and D; Iterate with H.Size if necessary.
9. LIN T,B L-R	V. Lin T-B	Match Green at A and B iterate with V. Size if necessary.
10. LIN C and H. SIZE	Lin C and SIZE	Match Green at 4, center line vert axis, midway between Z and D.
11. LI-LIN	H. LI LIN	Match Green at 3, center line vert axis, mid between C & Z and LI-LIN (Press button twice to get the second function.) Caution: H. LIN C also affects this; adjust in correct order above.)
12. LIN C	V. Lin C	Match Green at 7 and 8.
13. KEY	V. Key	Balance error with Green at bottom edge G-H (left and right edges move in opposite directions; center is stable).
14. PIN	V. Pin	Match Green at right edge corners G & H (comers G & H move in same direction; center B is stable).
15. S-ING	V. 'S'	Balance error at bottom edge in areas K & M (middle areas K & M move in opposite directions; center B and ends G & H are stationary).
16. W-M	V. W-M	Balance error at bottom edge in areas K & M (middle areas K & M move in same direction, center B and ends G & H are stationary).
17. KEY	H. key	Balance error with Green at right edge corners F & H (top and bottom move in opposite directions; center D is stable).
18. PIN	H. Pin	Match Green at F & H (corners F & H move in same direction; center D is stable).
19. S-ING	H. 'S'	Balance error at right edge in areas & Q (middle areas O & Q move in opposite direction; center D and ends F & H are stationary).

Button	Adjustment	Goal
20. T/L KEY	V. Top Key	Balance error with Green at top corners E & F straight with respect to screen border (left and right move in opposite directions; center A is stable).
21. T/L KEY	V. Top Pin	Match Green at top edge comers E & F (comers E & F move in same direction; center A is stable).
22. T/L S-ING	V. 'S'	Balance error at bottom edge in areas J & L (middle areas J & L move in opposite directions; center A and ends E & F are stationary).
23. T/L KEY	H. Left Key	Balance error with Green at left corners E & G (top and bottom move in opposite directions; center C is stable).
24. T/L PIN	H. Left Pin	Match Green at left edge comers E & G (comers E & G move in same direction, center C is stable).
25. T/L S-ING	H. 'S'	Balance error at left edge in areas N & P (middle areas N & P move in opposite directions; center C and ends E & G are stationary).
26. IN KEY	H. In Key	Average error with Green in middle areas J, K, and L, M (ends move in opposite direction centers 3 & 4 are stable, may require iteration with H. Skew, H. Key).
27. IN PIN	H. In Pin	Match Green in middle areas J, K, and L, M (ends move in same direction: center is stable; may require iteration with H. Bow, H. Pin).
28. IN KEY	V. In Key	Average error with Green in middle areas N, O, and P, Q (ends move in opposite direction centers 7 & 8 are stable, may require iteration with V. Skew, V. Key).
29. IN-PIN	V. In Pin	Match Green in middle areas N, O and P, Q (may require iteration with V. Bow, V. Pin)
30. Touch up all controls		Due to the interaction of IN-Controls, Key Controls and Pin controls for best overall convergence, it may be necessary to tweak the other controls. This should only require minor adjustments of each control. It may be necessary to perform this procedure twice to get optimal performance.

C-9 Chassis Menu

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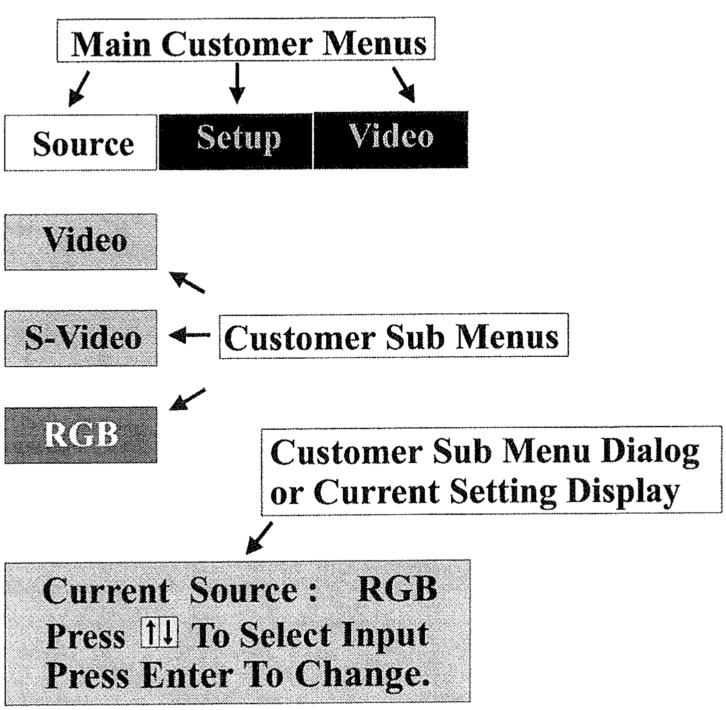


Figure 27

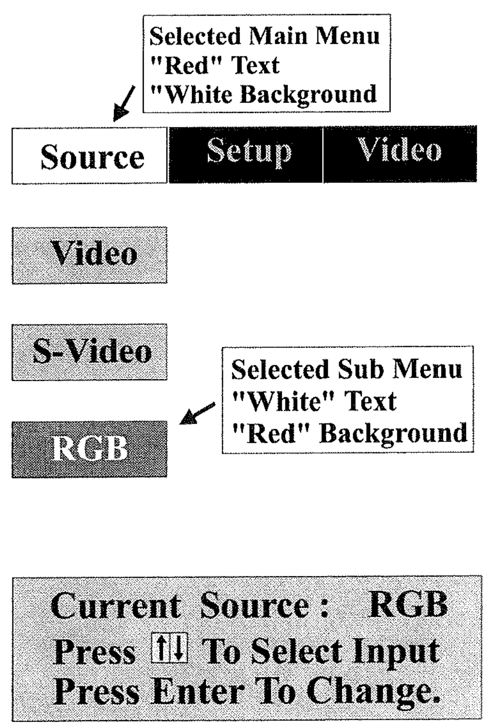


Figure 28

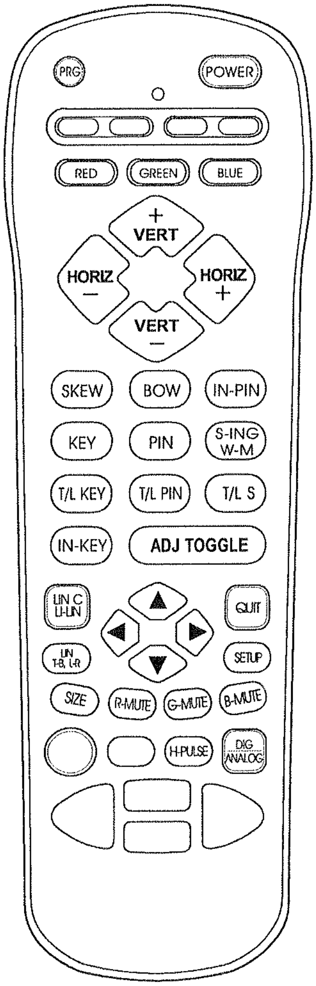


Figure 29

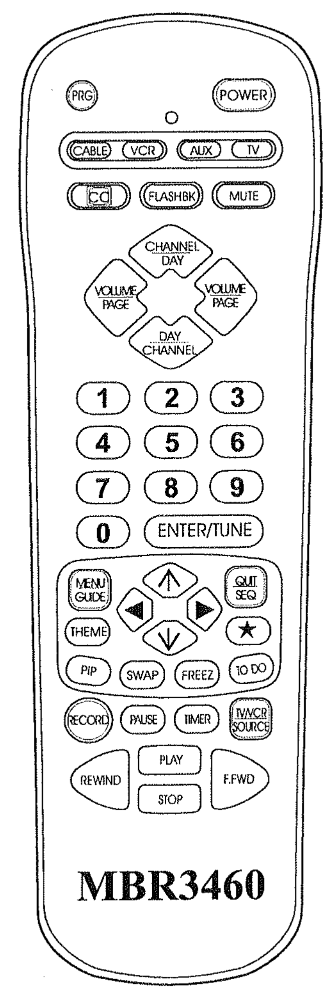


Figure 30

C9 Remote Control and Menu Use

The Pro900/900X will be supplied with the MBR3467 and a Z-Trak (track ball) remote controls. For most servicing situations the MBR3467 is required. The MBR3467 has the special functions needed for convergence and system setup function which the Z-Trak remote can not perform. Even though it is not marked with the Pro900/900X functions the MBR3460 can be used in the STAR Mode for Pro900/900X setup. When using the MBR3460 or MBR3467 keep in mind these are five mode remote controls. The mode functions at the top, CABLE, VCR, AUX, and TV are standard MBR programmable functions. The SETUP or * mode is only for Pro900/900X setup/convergence use. Please note if you need to use the normal "user menus" (Source, Setup, or Video) the remote control must be in the TV Mode.

The user menus will indicate the current setting by highlighted text or a bar/number indication in the dialog box at the bottom of the screen. The exception is the Source menu which has the three choices with the current selected source being highlighted and control instructions in the dialog box.

When the remote is in the Setup Mode there are some things to keep in mind.

1. In the setup mode the Geometry Controls adjust all three colors at the same time for that control. To adjust an individual color, i.e. Red to adjust SKEW, you press the RED button, then press the SKEW button and make the adjustment using the large arrow keys.

2. When you are adjusting individual color geometry the little arrow keys at the bottom are for DC Centering only. When they are pressed the remote will switch the convergence control to DC Centering. If the arrow keys have not been touched for a few seconds the remote will automatically switch back to the convergence control you were last using before using the small arrows.

3. The setup controls are usually labeled with horz/vert, T/L (top/left), or B/R (bottom/right) and a number value indicating the current setting. If you want to see what effect the last setting Vs the new setting has on the display press the "ADJ TOGGLE" key on the remote. Adjust toggle will allow you to switch between the two settings before committing to a change.

4. After making your changes and adjustments be sure you SAVE THE NEW SETTINGS. If a major change has been made, new module, new CRT, or a change in the physical setup, you must readjust and store the geometry/setup for each of the formats being used.

C-9 Service Menu

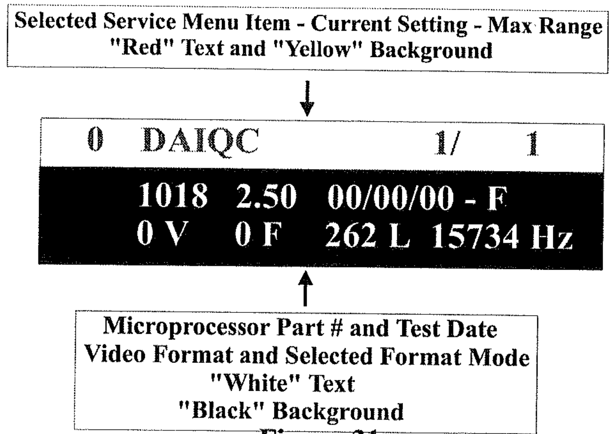


Figure 31

These settings are not to be changed unless directed.

Item	Control Name	Setting	Max.Range
0	DAIQC	1*	0-1
1	DAIQC Comp	1	0-1
2	PreFil	0	0-1
3	YDLY	0	0-7
4	CDLY	1	0-7
5	YDLY SECAM	2	0-7
6	CDLY SECAM	0	0-7
7	ACLW	0	0-3
8	HBLKLV	36	0-63
9	IQSPLV	0	0-15
10	QISPLV	0	0-15
11	YWST	97	0-2047
12	CWST	97	0-2047
13	MRST	10	0-2047
14	YRST POP	88	0-2047
15	YRST Normal	189	0-2047
16	CRST POP	86	0-2047
17	CRST Normal	186	0-2047
18	SPST POP	685	0-2047
19	SPST Normal	783	0-2047
20	SPEN POP	137	0-2047
21	SPEN Normal	242	0-2047
22	IHBLS	888	0-2047
23	IHBLE	136	0-2047
24	ACLS	4	0-2047
25	HDRS	4	0-2047
26	HBLS	889	0-2047
27	HBLE	151	0-2047
28	SPWS POP	686	0-2047
29	SPWS Comp	785	0-2047
30	SPWS Normal	889	0-2047
31	SPWE POP	148	0-2047
32	SPWE Comp	247	0-2047
33	SPWE Normal	150	0-2047
34	THRS	458	0-2047
35	THRE	275	0-2047
36	VBLS	517	0-2047
37	VBLE	39	0-2047
38	VDRS	0	0-2047
39	ER1F	30	0-255
40	EDG1F	12	0-15

*** = If set wrong will disable operation.**

Item	Control Name	Setting	Max.Range
41	FLT1F	3	0-15
42	SE1FS	0	0-1
43	SLPC1	0	0-1
44	ENF1F	0	0-3
45	LPFS	0	0-3
46	ER2F	30	0-255
47	F2OF	0	0-1
48	F1OF	0	0-1
49	MTADP	0	0-1
50	SDC	7	0-7
51	EDG2F	5	0-15
52	FLT2F	5	0-15
53	SE2FS	0	0-1
54	SLPC2	0	0-1
55	ENF2F	0	0-3
56	ARFOF	0	0-1
57	ARFRF	4	0-15
58	MDIPE	0	0-1
59	IPFC	0	0-1
60	STDOF	0	0-1
61	HSTU	90	0-255
62	HSTD	50	0-255
63	LMDSW	0	0-1
64	NT44	0	0-1
65	STFR	0	0-1
66	PLC	0	0-127
67	KLS	1	0-1
68	MDL	3	0-3
69	SVHS	0	0-1
70	FCOMDL	3	0-3
71	VNLR	6	0-31
72	VGR	3	0-7
73	VCR	3	0-7
74	VECLP	11	0-15
75	FILOFF	0	0-1
76	HDL	7	0-7
77	HON	0	0-1
78	EXSEL	3	0-3
79	HIFOFF	0	0-1
80	CORR	15	0-15
81	KAIS	1	0-1

Item #	Control Name	Setting	Max.Range
82	CREF2	10	0-63
83	CREF1	10	0-63
84	NT44C	0	0-1
85	CMSW	0	0-1
86	STFRC	0	0-1
87	FCC	1	0-1
88	CTION	1	0-1
89	IGAQ	1	0-3
90	IGAI	1	0-3
91	CORQ	0	0-15
92	CORI	0	0-15
93	ISC3	0	0-1
94	CDLY	5	0-7
95	CDLY 4.43	0	0-7
96	CLLR	0	0-127
97	KILBIT	1	0-1
98	LACSEL	1	0-1
99	PENTSC	16	0-63
100	PEPAL	16	0-63
101	AVREF	6	0-63
102	ACCORE	2	0-7
103	ACCITI	1	0-3
104	KILOFF	0	0-1
105	ACCON	0	0-1
106	HUPB	0	0-255
107	HUPR	0	0-255
108	HUNB	57	0-255
109	HUNR	57	0-255
110	FSKIL	13	0-15
111	FSSTM	5	0-15
112	KILLON	9	0-63
113	KILLOFF	12	0-63
114	NTSCON	5	0-63
115	NTSCOFF	9	0-63
116	IDTELE	55	0-63
117	IDSTAY	0	0-3
118	PNIT	2	0-3
119	PNMO	1	0-3
120	KILMO	1	0-3
121	STDIRG	3	0-63
122	STDON	2	0-63
123	STDIT	2	0-3
124	STDMO	0	0-3
125	NOCLMPE	27	0-63
126	POCLMPE	27	0-63
127	NOCLMPS	20	0-63
128	POCLMPS	18	0-63
129	POBMSKS Norm	52	0-63
130	POBMSKS Comp	36	0-63
131	POBMSKS POP	20	0-63
132	POBMSKE Norm	29	0-63
133	POBMSKE Comp	44	0-63
134	POBMSKE POP	29	0-63
135	NOBMSKS Norm	57	0-63
136	NOBMSKS Comp	43	0-63
137	NOBMSKS POP	30	0-63
138	NOBMSKE Norm	24	0-63
139	NOBMSKE Comp	37	0-63
140	NOBMSKE POP	25	0-63
141	HMSKWCON	1	0-1
142	SKEWCCON	0	0-1
143	SOCLMPE	3	0-63

Item #	Control Name	Setting	Max.Range
144	SOCLMPS	30	0-63
145	SOHBLKE	32	0-63
146	SOHBLKS	3	0-63
147	NCBFPS	34	0-127
148	PCBFPS	63	0-127
149	PCHBLKE	50	0-127
150	PCHBLKS	120	0-127
151	NCHBLKE	30	0-127
152	NCHBLKS	94	0-127
153	NYHBLKE	28	0-63
154	NYHBLKS	53	0-63
155	PHSEPE	115	0-127
156	PHSEPS	75	0-127
157	NHSEPE	92	0-127
158	NHSEPS	60	0-127
159	HSEPLPG	2	0-3
160	PIHMSKE	16	0-31
161	PIHMSKS	10	0-31
162	NIHMSKE	6	0-31
163	NIHMSKS	20	0-31
164	PICLMPE	17	0-31
165	PICLMPS	17	0-31
166	NICLMPE	15	0-31
167	NICLMPS	23	0-31
168	LPGC	0	0-7
169	NFVIS	7	0-7
170	PFVIS	0	0-7
171	BPMASKS	38	0-127
172	BPMASKE	52	0-127
173	PDLVL	8	0-63
174	Uni-color	87	0-127
175	TV Bright	127	0-255
176	Color Mute	0	0-1
177	RGB Bright	90	0-127
178	RGB Contrast	0	0-127
179	Y Gain - VM	0	0-3
180	ColLim Level	3	0-3
181	Sub-contrast	9	0-15
182	R Cutoff	110	0-255
183	G Cutoff	110	0-255
184	B Cutoff	110	0-255
185	G Drive	63	0-127
186	B Drive	63	0-127
187	R-Y Corr	1	0-1
188	RY Rel Phase	0	0-1
189	F Pull Range	1	0-1
190	Col Det Emph	0	0-3
191	HiBright Col	2	0-3
192	Sharp Track	2	0-3
193	Whit Pk Supp	1	0-1
194	Peak ACL	0	0-1
195	Blk Ex Gain	0	0-1
196	Monitor Out	0	0-3
197	HRDLY	68	0-1023
198	VRDLY	10	0-1023
199	MNACC	0	0-4095
200	PP9C	17	0-1023
201	PP1C	0	0-1023
202	MP9C	0	0-2047
203	MP1C	0	0-2047
204	HCNT Min	70	0-254

Item#	Control Name	Setting	Max.Range
205	HCNT Max	240	0-254
206	VCNT Min	50	0-254
207	VCNT Max	175	0-254
208	HB+ Fr1	48000*	0-59903
209	HB+ Fr0	15734*	0-59903
210	HB+ PWMMAX	255*	0-255
211	HB+ PWMMIN	0*	0-255
212	HFr Fr1	45000*	0-59903
213	HFr Fr0	15734*	0-59903
214	HFr PWMMAX	xxx*	0-255
215	HFr PWMMIN	xx*	0-255
216	HDC Fr1	48000	0-59903
217	HDC Fr0	15734	0-59903
218	HDC PWMMAX	255	0-255
219	HDC PWMMIN	1	0-255
220	Bell Filter	8	0-15
221	Rcap Freq	42000	0-59903
222	Scap Range 0	28000*	0-59903
223	Scap Range 1	42000*	0-59903
224	Scap Range 2	59903*	0-59903
225	Scap Range 3	59903*	0-59903
226	Scap Set 0	0*	0-7
227	Scap Set 1	4*	0-7
228	Scap Set 2	6*	0-7
229	Scap Set 3	6*	0-7
230	TV B AKB	127	0-254
231	TV G AKB	127	0-254
232	TV R AKB	127	0-254
233	RGB B AKB	127	0-254
234	RGB G AKB	127	0-254
235	RGB R AKB	127	0-254
236	Control 1	49	0-255
237	Control 2	0	0-255
238	Control 3	4	0-255
239	TV Pre Cont	50	0-100
240	TV Pre Brit	50	0-100
241	TV Pre Col	50	0-100
242	TV Pre Tint	50	0-100
243	TV Pre Shrp	50	0-100
244	TV Pre CTmp	0	0-3
245	TV Pre B Dr	50	0-100
246	TV Pre G Dr	50	0-100
247	TV Pre R Dr	50	0-100
248	TV Pre VFil	0	0-3
249	TV Pre AuFl	0	0-1
250	RGB Pre Cont	50	0-100
251	RGB Pre Brit	50	0-100
252	RGB Pre CTmp	0	0-3
253	RGB Pre B Dr	50	0-100
254	RGB Pre G Dr	50	0-100
255	RGB Pre R Dr	50	0-100
256	TV The Cont	50	0-100
257	TV The Brit	50	0-100
258	TV The Col	50	0-100
259	TV The Tint	50	0-100
260	TV The Shrp	50	0-100
261	TV The CTmp	0	0-3
262	TV The B Dr	50	0-100
263	TV The G Dr	50	0-100
264	TV The R Dr	50	0-100

Item#	Control Name	Setting	Max.Range
265	TV The VFil	0	0-3
266	TV The AuFl	0	0-1
267	RGB The Cont	50	0-100
268	RGB The Brit	50	0-100
269	RGB The CTmp	0	0-3
270	RGB The B Dr	50	0-100
271	RGB The G Dr	50	0-100
272	RGB The R Dr	50	0-100
273	DNRC Off Lev	6	0-127
274	DNRC Low Lev	18	0-127
275	DNRC Med Lev	30	0-127
276	DNRC Hi Lev	48	0-127
277	TV B Dr ST1	127	0-255
278	TV G Dr ST1	127	0-255
279	TV R Dr ST1	127	0-255
280	TV B Dr ST2	127	0-255
281	TV G Dr ST2	127	0-255
282	TV R Dr ST2	127	0-255
283	TV B Dr ST3	127	0-255
284	TV G Dr ST3	127	0-255
285	TV R Dr ST3	127	0-255
286	RGB B Dr ST1	127	0-255
287	RGB G Dr ST1	127	0-255
288	RGB R Dr ST1	127	0-255
289	RGB B Dr ST2	127	0-255
290	RGB G Dr ST2	127	0-255
291	RGB R Dr ST2	127	0-255
292	RGB B Dr ST3	127	0-255
293	RGB G Dr ST3	127	0-255
294	RGB R Dr ST3	127	0-255
295	Line Dur.	48	0-57
296	Horz Delay	63	0-254
297	Lock Phas TC	0	0-7
298	Lock Freq TC	1	0-7
299	Capt Phas TC	2	0-7
300	Capt Freq TC	4	0-7
301	SECAM Fsc St	0	0-2
302	Fact. Mode	0	0-1
303	Key Defeat	0	0-1
304	AC Power On	0	0-1
305	Acceleration	0	0-2
306	V Delay DAC	127	0-254
307	V Center DAC	127	0-254
308	Hfreq Delay	0	0-50
309	H Pulse Wdth	10	0-254
310	Cont Offset	27	0-55
311	Brite Offset	77	0-155
312	Color Offset	23	0-47
313	Tint Offset	37	0-75
314	Sharp Offset	15	0-27
315	Red Offset	77	0-155
316	Green Offset	77	0-155
317	Blue Offset	77	0-155
318	PAL Tint Off	37	0-75
319	VCR Mode	0	0-1
320	Hsync Mute	1	0-1
321	Noise Gate	1	0-1
322	Hsize 15klim	182	0-254
323	Hsize 48klim	242	0-254

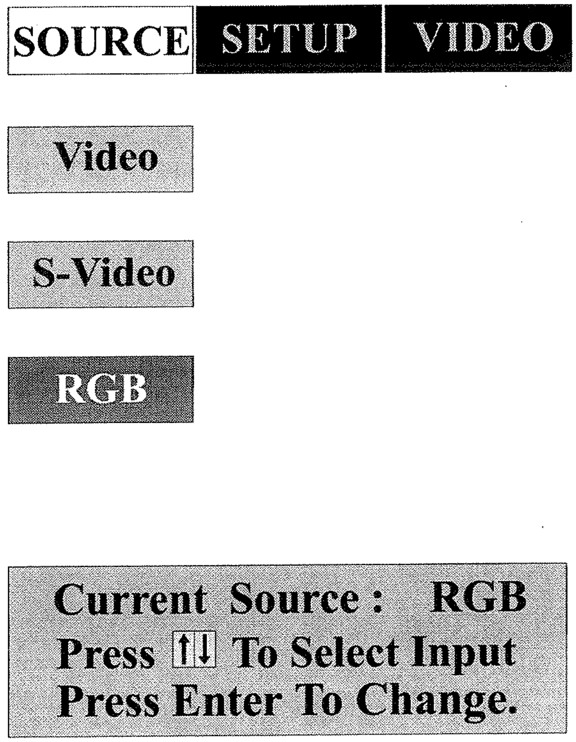


Figure 32

1. Source Menu

1.1 Video

1.2 S-Video

1.3 RGB

SetupMBR Key	ADJUST TOGGLE	= Enter
	LIN C/ LI LIN	= Menu
	DIG ANALOG	= Source Select

Control
This menu controls the source of the input currently being displayed.

Display
The option will read as follows if the trakball cursor is not present:

"Current Source: RGB "
"Press to select input"
"Press ENTER to change"
The option will read as follows if the trakball cursor is present:

"Current Source: RGB " (Current and highlighted source are the same)
or
"Press to Switch Input " (Current and highlighted source are different)

Limitations
This menu will always be displayed.

Setting by remote
Pressing the adjust left and right or select up and down keys will move the highlight bar between the three sources. The ENTER key must be pressed in order to change the source. If the highlighted bar is the same as the current source and the ENTER key is pressed, the Source/Time display will be brought up.

Setting by trakball
Pressing the trakball on the selected source bar will move the highlight bar between the three sources. In order to change the source, the trakball must be pressed a second time while on the highlight bar or on the bottom display bar. If the highlighted bar is the same as the current source and the source is entered, the Source/Time display will be brought up.

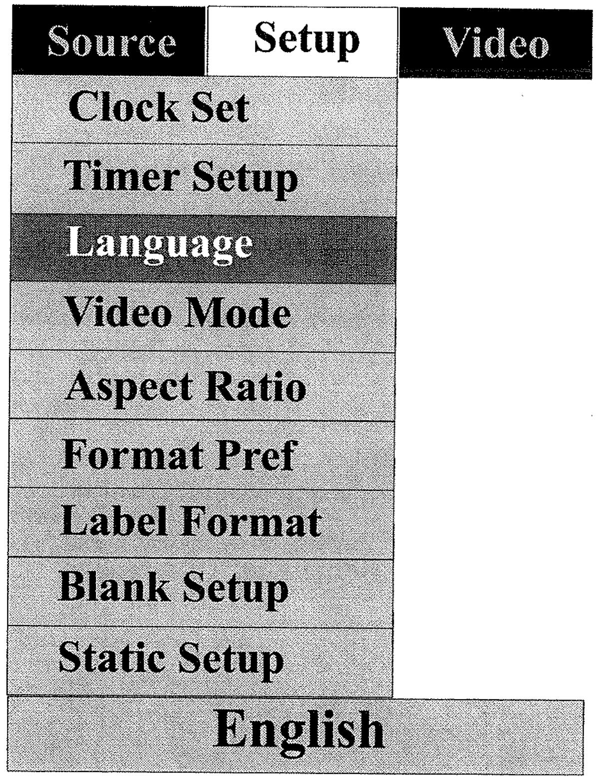


Figure 33

2. Setup Menu

2.1 Clock Set

Control
This option is used to set the 24 hour on-screen clock.
Display
"< 12:00 AM >" (Clock set) or "< —:— — >" (Clock not set)
Both left and right arrows appear on the "Clock Set" option line when the trakball cursor is present.
Limitations
This feature is always present on the menu.
Setting by remote
Pressing the Adjust keys will move the clock forward or reverse at two speeds. The first few changes will occur slowly, to allow for fine tuning, while keeping the key depressed will move it into the faster mode. Digits may also be directly entered into the display and will be entered either by allowing them to time-out (five seconds), or by pressing ENTER. In either case pressing the TIMER key will automatically toggle the AM/PM flag. Entering an illegal time with the digits clears the clock. If digits are entered and then the adjust key is pressed, the digits will be entered and the clock will be adjusted from the new time.
Setting by trakball
The trakball will act as either a left or right adjust key. If pressed on the left hand side of the "Clock Set" option line, or to the left of the clock display in the bottom adjustment bar, it will act as a left adjust. If pressed on the right hand side of the "Clock Set" option line, or to the right of the clock display on the bottom adjustment bar, it will act as a right adjust. If pressed on the two hour position digits, the clock will advance in hours while leaving minutes fixed. If pressed on the two minute position digits, the clock will advance in minutes while leaving the hours fixed. If pressed on the "AM" or "PM" characters, the AM/PM flag will toggle, leaving the time otherwise fixed. If no time had been previously set, then the first press on any portion of the "Clock Set" option line or bottom adjustment bar will set the time to 12:00 PM and continue normal operation from that point.

2.2 Timer Setup

Control
This option is used to allow access to the Timer Menu, where the on and off timers may be set.
Display"
"Press to Set Timers"
Only the right arrow appears on the "Timer Setup" option line when the trakball cursor is present.
Limitations
This display option will appear only when the on-screen clock has been set.
Setting by remote
Pressing the adjust keys will bring up the Timer Menu screen.
Setting by trakball
Pressing the trakball on the option line or the bottom highlight bar will bring up the timer Menu screen.

2.3 Language

Control
This control selects the language for the on screen displays: English, Spanish, French, or German.
Display“
“English”, “Espanol”, “Francais”, or “German”
Only the right arrow appears on the “Language” option line when the trakball cursor is present.
Limitations
This option is always present on the Setup Menu.
Setting by remote
Pressing the right adjust arrow adjusts the control in the order of English, Spanish, French, German... Pressing the left adjust arrow adjusts the control in the order of English, German, French, Spanish...
Setting by trakball
Pressing the trakball on the option line or on the bottom highlight bar will adjust control in the order of English, Spanish, French, German...

2.4 Video Mode

Control
This sets the type of broadcast standard that the incoming video will be decoded as. There are options for M-NTSC, M-PAL, N-PAL, BG-PAL, NTSC 4.43, and SECAM to be forced as well as automatic detection modes for NTSC/M-PAL/N-PAL and NTSC/BG-PAL/SECAM. When the SECAM module is not present in the system, the option for SECAM cannot be selected and the second automatic detection mode will become NTSC/BG-PAL only.
Display“
M-NTSC”, ”M-PAL”, “N-PAL”, “BG-PAL”, “NTSC 4.43”, “SECAM”, “Auto NTSC/M-PAL”, “Auto NTSC/BG-PAL/SECAM” (“Auto NTSC/BG-PAL”)
Only the right arrow appears on the “Video Mode” option line when the trakball cursor is present.
Limitations
This option will appear only if the source selection is Video or S-Video.
Setting by remote
Pressing the right adjust arrow adjusts the control in the order of M-NTSC, M-PAL, N-PAL... Pressing the left adjust arrow adjusts the control in the order of M-NTSC, Auto NTSC/BG-PAL/SECAM, Auto NTSC/M-PAL/N-PAL...
Setting by trakball
Pressing the trakball on the option line or on the bottom highlight bar will adjust control in the order of M-NTSC, M-PAL, N-PAL...

2.5 Aspect Ratio

Control
This sets the aspect ratio of the scan and video for the current image. The options are for 4x3, a standard 4x3 raster and video image, Letterbox, a 4x3 raster with top/bottom blanking expanded to reveal only a 16x9 video image, 16x9, a true 16x9 scan and full video image, and Compressed, a 16x9 scan with video compression turned on to create a 4x3 image in the center of the raster. The Compressed option is available only on Video or S-Video sources. This setting is unique to each format which is recognized.
Display“
4x3”, “Letterbox”, “16x9”, “Compressed”
Only the right arrow appears on the “Aspect Ratio” option line when the trakball cursor is present.
Limitations
This option will only appear on the menu if a stable signal is available and a format which is programmed into memory (Factory 1-10 or Customer 1-5) is recognized.
Setting by remote
Pressing the right adjust arrow adjusts the control in the order of 4x3, Letterbox, 16x9, Compressed.
Pressing the left adjust arrow adjusts the control in the order of 4x3, Compressed, 16x9, Letterbox.
Setting by trakball
Pressing the trakball on the option line or on the bottom highlight bar will adjust control in the order of 4x3, Letterbox, 16x9, Compressed.

2.6 Format Pref

Control
This option allows the customer to select between the convergence, blanking and chromatic numbers programmed at the factory and the numbers which the customer has defined. It can only affect the formats which were programmed at the factory.
Display“
Custom”, “Preset”
Only the right arrow appears on the “Format Pref” option line when the trakball cursor is present.
Limitations
This option will only be available if there is a valid signal present which is identified as being one of the ten factory preset formats.
Setting by remote
Pressing the right or left adjust keys will toggle between the Preset and Custom modes.
Setting by trakball
Pressing the trakball on the option line or on the bottom highlight bar will toggle between the Preset and Custom modes.

2.7 Label Format

Control
This option accesses to a sub menu which will allow the customer to set an eight character label for the currently identified format.
Display“
Press to Label Format”
Only the right arrow appears on the “Label Format” option line when the trakball cursor is present.
Limitations
This option will only appear on the menu if a stable signal is available and a format which is programmed into memory (Factory 1-10 or Customer 1-5) is recognized.
Setting by remote
Pressing the adjust keys will access the Format Label sub menu screen.
Setting by trakball
Pressing the trakball on the option line or on the bottom highlight bar will access the Format Label sub menu screen.

2.8 Blank Setup

Control
This option allows the customer access to a sub menu where the blanking and phase of the currently displayed image may be adjusted. These settings are unique to each format which is recognized, and vary depending on the aspect mode which is selected for the format.

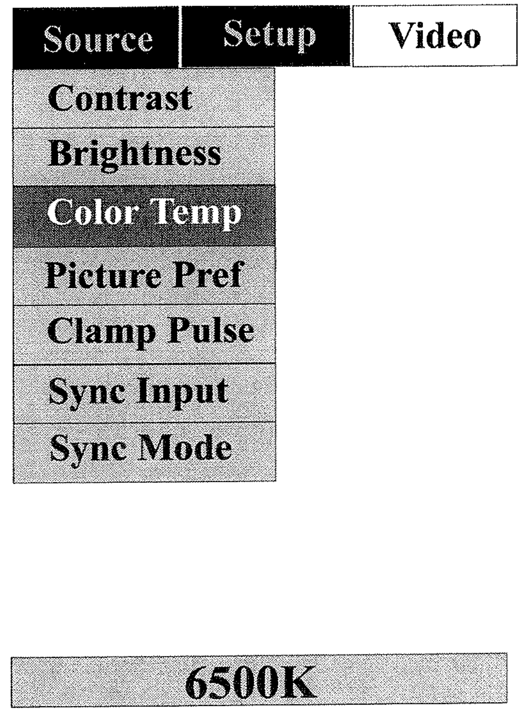
Display"
Press to Set Blanking"
Only the right arrow appears on the "Blank Setup" option line when the trakball cursor is present.
Limitations
This option will only appear if a stable input signal is available.
Setting by remote
Pressing the adjust keys will access the Blank Setup sub menu screen.
Setting by trakball
Pressing the trakball on the option line or on the bottom highlight bar will access the Blank Setup sub menu screen.

2.9 Static Setup

Control
This option allows the customer access to a sub menu where the red and blue static DC centering of the currently displayed image may be adjusted. These settings are unique to each format which is recognized.
Display"
Press to Set Statics"
Only the right arrow appears on the "Label Format" option line when the trakball cursor is present.
Limitations
This option will only appear if a stable input signal is available.
Setting by remote
Pressing the adjust keys will access the Static Setup sub menu screen.
Setting by trakball
Pressing the trakball on the option line or on the bottom highlight bar will access the Static Setup sub menu screen.

Video or S- Video Video Menu

Figure 34



RGB Video Menu

Figure 35

3. Video Menu

3.1 Contrast

Control

This control adjusts the level of contrast on the currently displayed picture. The true contrast level is a combination of this number and a factory aligned offset:

(2 * contrast) + contrast offset , where contrast = 0-100, contrast offset = 0-55

Display"

||||||||||||||||||| 100"

Both left and right arrows appear on the "Contrast" option line when the trakball cursor is present.

Limitations

This option will always appear on the video menu.

Setting by remote

The left adjust key will reduce the level of contrast, while the right adjust key increases it. The control will continue to change as long as the key is pressed and the control is within range. The range of the control is 0-100.

Setting by trakball

Pressing the trakball on the left side of the option line will reduce the contrast level, while pressing on the right side of the option line will increase it. The control will continue to change as long as the key is pressed and the control is within range. Pressing the trakball on the bar area of the bottom highlight bar will set the contrast to the level at which the trakball is pressed. There are twenty spaces on the bar (0-19), so at any one of the positions the contrast is set to Position * 100 / 19. Pressing the trakball on the area of the highlight bar where the numbers are displayed will have no effect.

3.2 Brightness

Control

This control adjusts the level of brightness on the currently displayed picture. The true brightness level is a combination of this number and a factory aligned offset:

brightness + brightness offset , where brightness = 0-100, brightness offset = 0-155

Display"

||||||||||||||||||| 100"

Both left and right arrows appear on the "Brightness" option line when the trakball cursor is present.

Limitations

This option will always appear on the video menu.

Setting by remote

The left adjust key will reduce the level of brightness, while the right adjust key increases it. The control will continue to change as long as the key is pressed and the control is within range. The range of the control is 0-100.

Setting by trakball

Pressing the trakball on the left side of the option line will reduce the brightness level, while pressing on the right side of the option line will increase it. The control will continue to change as long as the key is pressed and the control is within range. Pressing the trakball on the bar area of the bottom highlight bar will set the brightness to the level at which the trakball is pressed. There are twenty spaces on the bar (0-19), so at any one of the positions the brightness is set to Position * 100 / 19. Pressing the trakball on the area of the highlight bar where the numbers are displayed will have no effect.

3.3 Color

Control
This control adjusts the level of color on the currently displayed picture. The true color level is a combination of this number and a factory aligned offset:

color + color offset - 10, where color = 0-100, color offset = 0-47, and the total is limited to 0-127

Display"
|||||||||||||||||||| 100"
Both left and right arrows appear on the "Color" option line when the trakball cursor is present.

Limitations
This option will only appear on the video menu if a Video or S-Video source is selected.

Setting by remote
The left adjust key will reduce the level of color, while the right adjust key increases it. The control will continue to change as long as the key is pressed and the control is within range. The range of the control is 0-100.

Setting by trakball
Pressing the trakball on the left side of the option line will reduce the color level, while pressing on the right side of the option line will increase it. The control will continue to change as long as the key is pressed and the control is within range. Pressing the trakball on the bar area of the bottom highlight bar will set the color to the level at which the trakball is pressed. There are twenty spaces on the bar (0-19), so at any one of the positions the color is set to Position * 100 / 19. Pressing the trakball on the area of the highlight bar where the numbers are displayed will have no effect.

3.4 Tint

Control
This control adjusts the level of tint on the currently displayed picture. The true tint level is a combination of this number and a factory aligned offset:

(2 * tint) + tint offset - 10, where tint = 0-100, tint offset = 0-75, and the total is limited to 0-255

When any PAL or SECAM is the video mode, the level sent to the tint register is equal to:

100 + pal tint offset - 10, where pal tint offset = 0-75

Display"
|||||||||||||||||||| 100"
Both left and right arrows appear on the "Tint" option line when the trakball cursor is present.

Limitations
This option will only appear on the video menu if a Video or S-Video source is selected and the video standard is M-NTSC or NTSC 4.43.

Setting by remote
The left adjust key will reduce the level of tint, while the right adjust key increases it. The control will continue to change as long as the key is pressed and the control is within range. The range of the control is 0-100.

Setting by trakball
Pressing the trakball on the left side of the option line will reduce the tint level, while pressing on the right side of the option line will increase it. The control will continue to change as long as the key is pressed and the control is within range. Pressing the trakball on the bar area of the bottom highlight bar will set the tint to the level at which the trakball is pressed. There are twenty spaces on the bar (0-19), so at any one of the positions the tint is set to Position * 100 / 19. Pressing the trakball on the area of the highlight bar where the numbers are displayed will have no effect.

3.5 Sharpness

Control
This control adjusts the level of sharpness on the currently displayed picture. The true sharpness level is a combination of this number and a factory aligned offset:

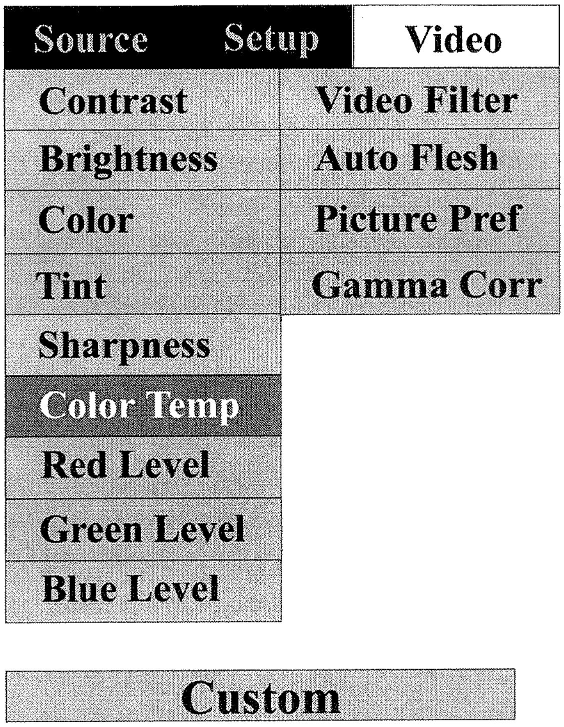
sharpness + sharpness offset, where sharpness = 0-100, sharpness offset = 0-27

Display"
|||||||||||||||||||| 100"
Both left and right arrows appear on the "Sharpness" option line when the trakball cursor is present.

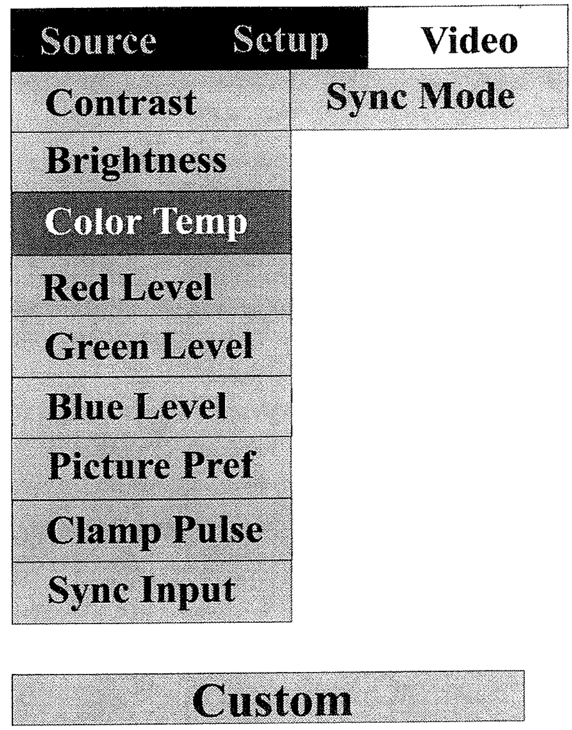
Limitations
This option will only appear on the video menu if a Video or S-Video source is selected.

Setting by remote
The left adjust key will reduce the level of sharpness, while the right adjust key increases it. The control will continue to change as long as the key is pressed and the control is within range. The range of the control is 0-100.

Setting by trakball
Pressing the trakball on the left side of the option line will reduce the sharpness level, while pressing on the right side of the option line will increase it. The control will continue to change as long as the key is pressed and the control is within range. Pressing the trakball on the bar area of the bottom highlight bar will set the sharpness to the level at which the trakball is pressed. There are twenty spaces on the bar (0-19), so at any one of the positions the sharpness is set to Position * 100 / 19. Pressing the trakball on the area of the highlight bar where the numbers are displayed will have no effect.



Video or S- Video Video Menu
Figure 36



RGB Video Menu
Figure 37

3.6 Color Temp

Control
This control selects the color temperature settings for the currently displayed picture. The selections are made from three different preset modes and a customer defined setting. When a preset mode is selected, the red, green, and blue drive levels are set by factory aligned values for the selected color temperature. When the custom mode is selected, each of the red, green, and blue drive levels will be a combination of a customer defined level plus a factory aligned offset:
red level + red offset, where red level = 0-100, red offset = 0-155
green level + green offset, where green level = 0-100, green offset = 0-155
blue level + blue offset, where blue level = 0-100, blue offset = 0-155
Display"
6500 K", "9300 K", "3200 K", "Custom"
Only the right arrow appears on the "Color Temp" option line when the trakball cursor is present.
Limitations
This option will always appear on the video menu.
Setting by remote
The right adjust key will change the color temperature setting in the order of 6500 K, 9300 K, 3200 K, Custom.
The left adjust key will change the color temperature setting in the order 6500 K, Custom, 3200 K, 9300 K.
Setting by trakball
Pressing the trakball on either the option line or the bottom highlighted bar will change the color temperature setting in the order of 6500 K, 9300 K, 3200 K, Custom.

3.7 Red Level

Control
This option allows the customer to change the red drive level for the custom setting of the color temperature option.
Display"
|||||||||||||||||| 100"
Both left and right arrows appear on the "Red Level" option line when the trakball cursor is present.
The option line for "Red Level" appears on the right hand side of the display, next to the "Brightness" line for RGB sources and the "Sharpness" line for Video or S-Video sources. It will appear only when the color temperature is in custom mode and either "Color Temp", "Red Level", "Green Level" or "Blue Level" is the highlighted option.
Limitations
This option will only be available when the color temperature is set to the custom setting.
Setting by remote
The left adjust key will reduce the level of red drive, while the right adjust key increases it. The control will continue to change as long as the key is pressed and the control is within range. The range of the control is 0-100.
Setting by trakball
Pressing the trakball on the left side of the option line will reduce the red drive level, while pressing on the right side of the option line will increase it. The control will continue to change as long as the key is pressed and the control is within range. Pressing the trakball on the bar area of the bottom highlight bar will set the red drive to the level at which the trakball is pressed. There are twenty spaces on the bar (0-19), so at any one of the positions the red level is set to Position *

100 / 19. Pressing the trakball on the area of the highlight bar where the numbers are displayed will have no effect.

3.8 Green Level

Control
This option allows the customer to change the green drive level for the custom setting of the color temperature option.
Display"
|||||||||||||||||| 100"
Both left and right arrows appear on the "Green Level" option line when the trakball cursor is present.
The option line for "Green Level" appears on the right hand side of the display, next to the "Color Temp" line. It will appear only when the color temperature is in custom mode and either "Color Temp", "Red Level", "Green Level" or "Blue Level" is the highlighted option.
Limitations
This option will only be available when the color temperature is set to the custom setting.
Setting by remote
The left adjust key will reduce the level of green drive, while the right adjust key increases it. The control will continue to change as long as the key is pressed and the control is within range. The range of the control is 0-100.
Setting by trakball
Pressing the trakball on the left side of the option line will reduce the green drive level, while pressing on the right side of the option line will increase it. The control will continue to change as long as the key is pressed and the control is within range. Pressing the trakball on the bar area of the bottom highlight bar will set the green drive to the level at which the trakball is pressed. There are twenty spaces on the bar (0-19), so at any one of the positions the green level is set to Position * 100 / 19. Pressing the trakball on the area of the highlight bar where the numbers are displayed will have no effect.

3.9 Blue Level

Control
This option allows the customer to change the blue drive level for the custom setting of the color temperature option.
Display"
|||||||||||||||||| 100"
Both left and right arrows appear on the "Blue Level" option line when the trakball cursor is present.
The option line for "Blue Level" appears on the right hand side of the display, next to the "Picture Pref" line for RGB sources and the "Video Filter" line for Video or S-Video sources. It will appear only when the color temperature is in custom mode and either "Color Temp", "Red Level", "Green Level" or "Blue Level" is the highlighted option.
Limitations
This option will only be available when the color temperature is set to the custom setting.
Setting by remote
The left adjust key will reduce the level of blue drive, while the right adjust key increases it. The control will continue to change as long as the key is pressed and the control is within range. The range of the control is 0-100.
Setting by trakball
Pressing the trakball on the left side of the option line will reduce the blue drive level, while pressing on the right side of the option line will increase it. The control will continue to change as long as the key is pressed and the control is within range. Pressing the trakball on the bar area of the bottom highlight bar will set the blue drive to the level at which the trakball is pressed. There are twenty spaces on the bar (0-19), so at any one of the positions the blue level is set to Position * 100 / 19. Pressing the trakball on the area of the highlight bar where the numbers are displayed will have no effect.

3.10 Video Filter

Control
This option allows the user to select the level of noise reduction for the currently displayed picture. The four predefined levels are factory aligned.
Display"
Off", "Low", "Medium", "High"
Only the right arrow appears on the "Video Filter" option line when the trakball cursor is present.

Limitations
This option will only be available when a Video or S-Video source is selected.
Setting by remote
The right adjust key will change the video filter setting in the order of Off, Low, Medium, High.
The left adjust key will change the video filter setting in the order of Off, High, Medium, Low.
Setting by trakball
Pressing the trakball on either the option line or the bottom highlighted bar will change the video filter setting in the order of Off, Low, Medium, High.

3.11 Auto Flesh

Control
This option allows the customer to enable or disable and automatic flesh tone compensation mode for the video processing.
Display"
Enabled", Disabled"
Only the right arrow appears on the "Auto Flesh" option line when the trakball cursor is present.
Limitations
This option will only be available when a Video or S-Video source is selected.
Setting by remote
Pressing the right or left adjust keys will toggle the auto flesh tone feature activation.
Setting by trakball
Pressing the trakball on either the option line or the bottom highlighted bar will toggle the auto flesh tone feature activation.

3.12 Picture Pref

Control
This option allows the customer to select a set of chromatic numbers for the currently displayed picture. There are options for two predefined setting groups and a customer defined group of settings. The settings which are changed by the Picture Pref option are: contrast, brightness, color, tint,

sharpness, color temperature, red level, green level, blue level, video filter, and auto flesh tone compensation. Any change made to one of these settings while the picture preference is in one of its preset modes will copy the current preset settings into the customer defined group and set the picture preference to "Custom" mode before making the change to the other control. Of the two predefined settings, the "Preset" mode represents the optimal factory settings for normal ambient light conditions. The "Theater" setting represents the optimal settings for a dim light environment.
All chromatic numbers are unique to each format which is recognized.

Display"
Custom", "Preset", "Theater"
Only the right arrow appears on the "Picture Pref" option line when the trakball cursor is present.

Limitations
This option will always be available on the video menu.

Setting by remote
The right adjust key will change the picture preference setting in the order of Custom, Preset, Theater.
The left adjust key will change the picture preference setting in the order of Custom, Theater, Preset.

Setting by trakball
Pressing the trakball on either the option line or the bottom highlighted bar will change the picture preference setting in the order of Custom, Preset, Theater.

3.13 Clamp Pulse

Control
This option allows the customer to set the position of the video clamping pulse. There are options to fix it to the sync tip level, back porch level, and to automatically select what would appear to be appropriate, based on the type of input signal. This setting is unique to each format that is recognized.

Display"
Auto Select", "Back Porch", "Sync Tip"
Only the right arrow appears on the "Clamp Pulse" option line when the trakball cursor is present.

Limitations
This option will only be available when an RGB source is selected.

Setting by remote
The right adjust key will change the clamp pulse setting in the order of Auto Select, Back Porch, Sync Tip.
The left adjust key will change the clamp pulse setting in the order of Auto Select, Sync Tip, Back Porch.

Setting by trakball
Pressing the trakball on either the option line or the bottom highlighted bar will change the clamp pulse setting in the order of Auto Select, Back Porch, Sync Tip.

3.14 Sync Inputs

Control
This option allows the user to terminate the RGB inputs with 75 Ohms if desired.

Display"
Terminated", "Not Terminated"
Only the right arrow appears on the "Sync Inputs" option line when the trakball cursor is present.

Limitations
This option will only be available when an RGB source is selected.

Setting by remote
The left and right adjust keys will toggle the termination of the sync inputs on and off.

Setting by trakball
Pressing the trakball on either the option line or the bottom highlighted bar will toggle the termination of the sync inputs on and off.

3.15 Sync Mode

Control
This control allows the user to select the type of sync signal that the system will look for on the RGB inputs. In the Normal Analog/TTL mode, the system will look for standard level signals of either the separate horizontal and vertical, composite horizontal and vertical, or sync on green modes. In the Special Composite mode, the system will look only for a low amplitude sync on black video type of input on the composite sync input (Horizontal), treating it internally as if it were a sync on green type. In this mode, normal sync processing will not be consistent. It is designed for special types of studio inputs.

Display"
Normal Analog/TTL", "Special Composite"
Only the right arrow appears on the "Sync Mode" option line when the trakball cursor is present.

Limitations
This option will only be available when an RGB source is selected.

Setting by remote
The left and right adjust keys will toggle the sync mode between the Normal Analog/TTL and Special Composite modes.

Setting by trakball
Pressing the trakball on either the option line or the bottom highlighted bar will toggle the sync mode between the Normal Analog/TTL and Special Composite modes.

4. Timer Menu

4.1 On Time 1-4

Control
These four items allow the user to program in a time at which the set will turn on (in the event that it was turned off prior to that time). The clock must be set to access the timer menu.

Display"
12:00 AM " (On time set)or " —:—— " (On time not set)
Both left and right arrows appear on the "On Time" 1-4 option lines when the trakball cursor is present.

Limitations
This feature is always present on the timer menu.

Setting by remote
Pressing the Adjust keys will move the on time forward or reverse at two speeds. The first few changes will occur slowly, to allow for fine tuning, while keeping the key depressed will move it into the faster mode. Digits may also be directly entered into the display and will be entered either by allowing them to time-out (five seconds), or by pressing ENTER. In

either case pressing the TIMER key will automatically toggle the AM/PM flag. Entering an illegal time with the digits clears the on time. If digits are entered and then the adjust key is pressed, the digits will be entered and the on time will be adjusted from the new time.

Setting by trakball

The trakball will act as either a left or right adjust key. If pressed on the left hand side of the "On Time" 1-4 option lines, or to the left of the clock display in the bottom adjustment bar, it will act as a left adjust. If pressed on the right hand side of the "On Time" 1-4 option lines, or to the right of the clock display on the bottom adjustment bar, it will act as a right adjust. If pressed on the two hour position digits, the on time will advance in hours while leaving minutes fixed. If pressed on the two minute position digits, the on time will advance in minutes while leaving the hours fixed. If pressed on the "AM" or "PM" characters, the AM/PM flag will toggle, leaving the on time otherwise fixed. If no on time had been previously set, then the first press on any portion of the "On Time" 1-4 option lines or bottom adjustment bar will set the on time to 12:00 PM and continue normal operation from that point.

4.2 Off Time 1-4

Control

These four items allow the user to program in a time at which the set will turn off (in the event that it was turned on prior to that time). The clock must be set to access the timer menu.

Display"

12:00 AM " (Off time set)or " —:—— " (Off time not set)

Both left and right arrows appear on the "Off Time" 1-4 option lines when the trakball cursor is present.

Limitations

This feature is always present on the timer menu.

Setting by remote

Pressing the Adjust keys will move the off time forward or reverse at two speeds. The first few changes will occur slowly, to allow for fine tuning, while keeping the key depressed will move it into the faster mode. Digits may also be directly entered into the display and will be entered either by allowing them to time-out (five seconds), or by pressing ENTER. In either case pressing the TIMER key will automatically toggle the AM/PM flag. Entering an illegal time with the digits clears the off time. If digits are entered and then the adjust key is pressed, the digits will be entered and the off time will be adjusted from the new time.

Setting by trakball

The trakball will act as either a left or right adjust key. If pressed on the left hand side of the "Off Time" 1-4 option lines, or to the left of the clock display in the bottom adjustment bar, it will act as a left adjust. If pressed on the right hand side of the "Off Time" 1-4 option lines, or to the right of the clock display on the bottom adjustment bar, it will act as a right adjust. If pressed on the two hour position digits, the off time will advance in hours while leaving minutes fixed. If pressed on the two minute position digits, the off time will advance in minutes while leaving the hours fixed. If pressed on the "AM" or "PM" characters, the AM/PM flag will toggle, leaving the off time otherwise fixed. If no off time had been previously set, then the first press on any portion of the "Off Time" 1-4 option lines or bottom adjustment bar will set the off time to 12:00 PM and continue normal operation from that point.

4.3 On/Off Timer

Control

This option turns enables the use of the previously set On Time and Off Time features. When enabled, the set will turn on and off as specified. When disabled, the feature is inactive.

Display"

Enabled", "Disabled"

Only the right arrow appears on the "On/Off Timer" option line when the trakball cursor is present.

Limitations

This feature will only be available if at least one On Time or Off Time has been set and the clock has also been set.

Setting by remote

The right and left adjust keys will toggle the feature between "Enabled" and "Disabled" states.

Setting by trakball

Pressing the trakball on either the option line or the bottom highlight bar will toggle the feature between "Enabled" and "Disabled" states.

5. Sub Menus

5.1 Label Format

Control

This is the sub menu for programming a label for the currently recognized format. It is accessed from the "Format Label" option on the Setup Menu.

Display

Customer Format 1	Customer Format 1
- - - - - - - -	- - - - - - - -
Press for next character Press /\\/ to change character	Press on selected character and hold to change.
	-Exit-
(Trakball cursor inactive)	(Trakball cursor active)

Limitations

This menu can only be accessed if a valid signal is input and the format is recognized as one which exists in memory.

Setting by remote

Pressing the left or right adjust keys moves the active character one place to the left or right, wrapping around. The select up and down keys change the active character. A"-" signifies a blank space. The alphanumeric keys "A" - "Z" and "0" - "9" are available for the label. The select up key progresses "-", "A", "B",... ; the select down key progresses "-", "9", "8",... The select keys will repeat if held down; the adjust keys will not. Any other key press that would exit the menu will return the user to the Setup Menu screen.

Setting by trakball

Pressing the trakball on a character position makes that character active. If the trakball is held down, the character selected will change as if a select up key were pressed ("-", "A", "B", ...). Pressing the trakball at any time on the current active character will begin to change that character. In order to exit the screen and return to the Setup Menu, the trakball must be pressed on the "Exit" space in the lower right hand corner, or on any portion of the screen where the underlying video is shown.

5.2 Blank Setup

Control
This option allows the customer to set up the blanking on the top, bottom , left, and right, as well as the vertical and horizontal phase (position of the picture within the raster). The top and bottom blanking range from 0 to 1/4 the total number of horizontal lines; the left and right blanking range from 0 to 63. The vertical phase ranges from 0 to (2 * # of horizontal lines) - 3; the horizontal phase ranges from 0 to 254.
Display
Trakball cursor inactive:

Adjusting :

Top/Left Blanking
Bottom/Right Blanking
Vert./Horz. Phase

Press MENU for next adjustment.
Press ^v to change setting.

Top = 0Left = 0

Trakball cursor active:

Exit

Adjusting :

Top/Left Blanking
Bottom/Right Blanking
Vert./Horz. Phase

Up Down Left Right

Top = 0Left = 0
Limitations
This option can only be accessed if a valid signal is present.
Setting by remote
While this screen is active, the MENU key is used to select between the three modes: the Top/Left Blanking, Bottom/Right Blanking, and Vert./Horz. Phase modes. In the Top/Left mode, the select up and down keys will move the top edge of blanking up (decrease) and down (increase), and the adjust up and down keys will move the left edge of blanking left (decrease) or right (increase). In the Bottom/Right mode, the select up and down keys will move the bottom edge of blanking up (increase) and down (decrease), and the adjust up and down keys will move the right edge of blanking left (increase) or right (decrease). In the Vert./Horz. Phase mode, the adjust left and right keys will move the horizontal phase left (increase) or right (decrease), and the select up and down keys will move the vertical phase up (increase) and down (decrease). The vertical phase will wrap around from 0, while the other controls will not. The QUIT key (or other key which would change the state) will exit this screen and go to the "Would you like to store your changes?" screen.

Setting by trakball
While this screen is active, pressing the trakball on the areas labeled "Top/Left Blanking", "Bottom/Right Blanking", and "Vert./Horz. Phase" will change to the selected mode. In the Top/Left mode, pressing the trakball on the "Up" and "Down" active areas will move the top edge of blanking up (decrease) and down (increase), and pressing the trakball on the "Left" or "Right" active areas will move the left edge of blanking left (decrease) or right (increase). In the Bottom/Right mode, the pressing on the same "Up" or "Down" active areas will move the bottom edge of blanking up (increase) and down (decrease), and pressing on the "Left" or "Right" active areas will move the right edge of blanking left (increase) or right (decrease). In the Vert./Horz. Phase mode, the pressing on the "Up" or "Down" active areas will move the horizontal phase left (increase) or right (decrease), and pressing on the "Left" or "Right" active areas will move the vertical phase up (increase) and down (decrease). The vertical phase will wrap around from 0, while the other controls will not. In order to exit this screen and go to the "Would you like to store your changes?" screen, the trakball must be pressed on the "Exit" active area in the upper right corner.

5.3 Storing Changes:

As soon as any of the Blank Setup, Static Setup, or Convergence Setup screens are exited, the system will prompt the user with a screen which reads:

Would you like to store
your changes?

Yes
No

Press ENTER to Confirm Selection

If the trakball cursor is active, the last line will read:

Press HERE to Confirm Selection

The user may use the select up and down keys, or the adjust right and left keys, to switch between the yes or no options. This selection may also be made with the trakball by pressing on the "Yes" or "No" active areas. Any other illegal key will have the effect of changing the option to "No". The selection will not take effect until the user presses ENTER or presses the trakball on the "Press HERE..." active area at the bottom of the screen.

By selecting the "Yes" option, the user indicates that the changes which have been made should be stored.

By selecting the "No" option, by pressing the QUIT key, or by allowing the display to simply time out, the changes which have been made are ignored and the previous settings which were loaded for the format in question are read out of memory. At this time, a display will appear which reads :

Changes have not been stored.
Previous settings restored.

If the user has indicated that the changes are to be stored, one of two paths are then taken. If the current format is recognized as being one of the previously set Factory (1-10) or Customer (1-5) formats, then the changes are automatically stored to the location in memory allocated for that format and the status message appears, along with a heading which reads:"

Format update has been stored."

If the current format is not recognized as being one already in memory, then the user will be prompted to ask which customer format the data should be stored as:

Which format should this be
stored as?

1. Customer 1 —
2. Customer 2 —
3. VGA 480 31.4 KHz RGB
4. Customer 4 —
5. Customer 5 35.0 KHz RGB
6. Exit Without Store

Press ENTER to Confirm Selection

If the trakball cursor is active, the last line will read:

Press HERE to Confirm Selection

If the customer format number does not currently have a format stored to it, a series of dashes will appear next to the format number. If a format is stored in that location, then the horizontal frequency and the source of that input is displayed to the right of the format number. If a label had previously been loaded for the format, then the label will appear in the place of the "Customer #" portion of the line. The last option line indicates that the user may abandon the format store without making any changes to permanent memory.

The user may enter a digit, "1" - "6", or select the option by using the select up and down or adjust left and right keys. They may also press the trakball on one of the six option lines. If another key is pressed, the option will automatically move to the "Exit Without Store" line. The selection will not take effect until the user presses ENTER or presses the trakball on the "Press HERE..." active area at the bottom of the screen.

If the "Exit Without Store" option is selected, the QUIT key is pressed, or if the display is simply allowed to time out, the format changes are not stored to permanent memory. They will, however, remain with the current format until the input is changed, the source is changed, or the set is turned off.

If a format number is selected, it is then checked to determine whether a format is already present in that location. If no format is currently present, then the data is stored to the new format number and the "Format update has been stored." screen appears. If another format currently resides there, the user will be prompted to make certain that this is correct, understanding that the data presently in that location would then be lost:

This format setup will be lost:

35.0 KHz H 60 Hz V RGB
Pos. Hsync Neg. Vsync Separate

Is it still OK to Store?

Yes
No

Press ENTER to Confirm Selection

If the trakball cursor is active, the last line will read:

Press HERE to Confirm Selection

The user may use the select up and down keys, or the adjust right and left keys, to switch between the yes or no options. This selection may also be made with the trakball by pressing on the "Yes" or "No" active areas. Any other illegal key will have the effect of changing the option to "No". The selection will not take effect until the user presses ENTER or presses the trakball on the "Press HERE..." active area at the bottom of the screen.

By selecting the "Yes" option, the user indicates that the previous format may be overwritten, and the data is stored to the new format number. The "Format update has been stored." screen would then appear.

By selecting the "No" option, by pressing the QUIT key, or by allowing the display to simply time out, the current format is not overwritten and the data is not stored into memory. It will be retained as long as the current format is active (until the input is changed, the source is changed, or the set is turned off).

5.4 Static Setup

Control
This sub menu allows the user to adjust the static DC centering of the Red and Blue colors with respect to the Green. This is used as a touch up procedure for the convergence setup to account for drift over time or changes in orientation of the unit. Each of these controls, red horizontal, red vertical, blue horizontal, and blue vertical, has a range of 0-254.

Display

Trakball cursor not present:	Trakball cursor present:
Use Arrows to Converge Blue	Up Down Left Right
(Cross hatch pattern)	(Cross hatch pattern)
Press MENU to Switch to Red	Adjusting Red Exit

Limitations
This option can only be accessed if a valid signal is present.

Setting by remote
While this display is active, the MENU key is used to select the color, red or blue, which is active. The adjust left and right keys are used to move the centering of the selected color left or right. The select up and down keys are used to move the centering of the selected color up or down. These keys will automatically repeat when held down, until the limit of the

control range is met. The procedure should be repeated until the colors overlap to form a white color on the cross hatch pattern portion of the display. The QUIT key (or other key which would change the state) will exit this screen and go to the "Would you like to store your changes?" screen.

Setting by trakball

When this display is active, the active area labeled "Adjusting Red" or "Adjusting Blue" must be pressed on to switch the active color between red and blue. The active areas will appear as Red on white and white on red when red is the active color, and will appear as blue on white and blue on yellow when blue is the active color. The active areas labeled "Up", "Down", "Left", and "Right" will move the centering of the selected color up, down, left, or right. This action will automatically repeat as long as the trakball is pressed on this active area, until the limit of the control range is met. In order to exit this screen and go to the "Would you like to store your changes?" screen, the trakball must be pressed on the "Exit" active area in the lower right corner.

5.5 Trakball Screen

Control

This screen appears when the trakball is pressed from a no display condition or from another inactive display. It is what allows the trakball user access to all functions which can be accessed from that remote.

Display

Source Setup Video RGB
12:00

Status
Copy
Sleep
Z-Trak
Store

Limitations

The option labeled "Store" can be accessed only if a valid signal is present and the format recognized is not currently store in memory.

Setting by remote

This is a trakball only option. It cannot be accessed by conventional remote.

Setting by trakball

By rolling the trakball cursor into the upper left corner, the portion of the screen with the active areas for "Source", "Setup", and "Video" is displayed. Pressing the trakball on any of these three active areas will call up the Source, Setup, and Video menus, respectively. When any of those three menus are displayed and the trakball is pressed on one of those active areas, the same function will be performed.

By rolling the trakball to the left hand side of the screen, a series of five options will be listed. Details regarding these controls, "Status", "Copy", "Sleep", "Z-Trak", and "Store", will appear on the bottom of the screen as the cursor is placed over the particular active area. Pressing the trakball while the cursor is positioned in one of these active areas will have effects detailed in the sections to follow.

By rolling the trakball to the right hand side of the screen, the Source/Time status display will appear. Pressing the trakball while this is displayed will cause the display and the trakball cursor to disappear.

5.6 Format Copy

Control

This option allows the user to copy the setup information (convergence, blanking, phase, chromatics, aspect ratio) from one defined format to another defined format. The identification information is not copied, only the setup data associated with it. This may be used to quickly set up a new format if it is similar to one already in memory. The data may be copied from any of the factory format custom or preset setups or customer format setups to any factory format custom setup or customer format setups. The factory format presets may not be overwritten.

Display

Copy From: Factory 3 Custom Copy From: Factory 3 Custom
48.0 KHz H 60 Hz V RGB 48.0 Hz H 60 Hz V RGB
Neg. Hsync Pos. Vsync Composite Neg. Hsync Pos. Vsync Composite

Copy To: Customer 1 Copy To: Customer 1
48.4 KHz H 60 Hz V RGB 48.4 KHz H 60 Hz V RGB
Neg. Hsync Neg. Vsync Separate Neg. Hsync Neg. Vsync Separate

Press to change selection Copy Format Data
Press /\V to select copy window
Press ENTER to copy formats -Exit-

(Trakball cursor not present) (Trakball cursor present)

Limitations

This screen may be accessed at any time.

Setting by remote

The screen is accessed by pressing the RED MUTE key.

The select up and down keys are used to change the active window between the "Copy From" and "Copy To" states. The active window is highlighted. The adjust left and right keys are used to change the format in the active window. In the "Copy From" window, the adjust right key will change the format in the following order: Factory 1 Custom, Factory 1 Preset, Factory 2 Custom,..., Factory 10 Preset, Customer 1,..., Customer 5. The adjust left key will change the format as follows: Factory 1 Custom, Customer 5,..., Customer 1, Factory 10 Preset, Factory 10 Custom,..., Factory 2 Custom, Factory 1 Preset. In the "Copy To" window, the adjust right key will change the format in the following order: Factory 1 Custom, Factory 2 Custom,..., Factory 10 Custom, Customer 1,..., Customer 5. The adjust left key will change the format as follows: Factory 1 Custom, Customer 5,..., Customer 1, Factory 10 Custom,..., Factory 2 Custom. The ENTER key is used to initiate a copy of the setup data from the format indicated in the "Copy From" window to the format indicated in the "Copy To" window. If the formats are identical, no action is taken. If not, the display will move to the Copy Verify screen. The QUIT key (or any other key which would change

the display state) will exit this screen without performing a copy.
Setting by trakball
The screen may be accessed by pressing on the "Copy" active area on the left hand side of the main trakball screen.
Pressing the trakball on one of the "Copy From" and "Copy To" windows will cause it to become the active window. The active window is highlighted. All subsequent presses of the trakball on the active window will change the format selected in that window. In the "Copy From" window, the following order is used: Factory 1 Custom, Factory 1 Preset, Factory 2 Custom,..., Factory 10 Preset, Customer 1,..., Customer 5. In the "Copy To" window, the following order is used: Factory 1 Custom, Factory 2 Custom,..., Factory 10 Custom, Customer 1,..., Customer 5. Pressing the trakball on the "Copy Format Data" active area will initiate a copy of the setup data from the format indicated in the "Copy From" window to the format indicated in the "Copy To" window. If the formats are identical, no action is taken. If not, the display will move to the Copy Verify screen. Pressing the trakball on the "Exit" active area at the bottom of the screen will exit without performing a copy.

5.7 Copy Verify

Once a format copy is inititiated, the user is prompted to make certain that the copy should take place, understanding that the data presently in that location would then be lost:

This format data will be lost:

35.0 KHz H 60 Hz V RGB
Pos. Hsync Neg. Vsync Separate

Is it still OK to Copy?

Yes
No

Press ENTER to Confirm Selection

If the trakball cursor is active, the last line will read:

Press HERE to Confirm Selection

The user may use the select up and down keys, or the adjust right and left keys, to switch between the yes or no options. This selection may also be made with the trakball by pressing on the "Yes" or "No" active areas. Any other illegal key will have the effect of changing the option to "No". The selection will not take effect until the user presses ENTER or presses the trakball on the "Press HERE..." active area at the bottom of the screen.
By selecting the "Yes" option, the user indicates that the data for the format may be overwritten, and the setup information is copied. A display stating that the "Format has been copied." would then appear. If the format to be copied into is the same as the current format, the new data would be loaded into current memory as well, updating all affected devices.
By selecting the "No" option, by pressing the QUIT key, or by allowing the display to simply time out, the copy function is aborted and no data is changed.

5.8 Format Store

Control
This option allows the user to store the current format into memory as a customer format (1-5) if it is not recognized as one of the currently held factory or customer formats. The screen will appear automatically whenever a new format is recognized that does not match one which is in memory.
Display
This format is not recognized.
35.0 KHz H 70 Hz V RGB
Pos. Hsync Neg. Vsync Composite

Would you like to store it?

Yes
No

Press ENTER to Confirm Selection

If the trakball cursor is active, the last line will read:
Press HERE to Confirm Selection

Limitations
This sub menu will only appear if a valid signal is present and the format recognized does not match any currently held in memory.
Setting by remote
The user may use the select up and down keys, or the adjust right and left keys, to switch between the yes or no options. Any other illegal key will have the effect of changing the option to "No". The selection will not take effect until the user presses ENTER.
By selecting "Yes", the user indicates that the format should be stored. The display will then change to the "Which format should this be stored as?" screen (See "Storing Changes:" section) and will proceed from that point. Selecting "No", pressing QUIT, or allowing the display to time out will exit the display without performing a store.
Setting by trakball
The selection with the trakball is made by pressing on the "Yes" or "No" active areas. The selection will not take effect until the user presses the trakball on the "Press HERE..." active area at the bottom of the screen.
By selecting "Yes", the user indicates that the format should be stored. The display will then change to the "Which format should this be stored as?" screen (See "Storing Changes:" section) and will proceed from that point. Selecting "No" or allowing the display to time out will exit the display without performing a store.
This screen may be accessed at any time by pressing the trakball on the "Store" active area on the left side of the main trakball screen. The option will only appear if a valid signal is present and the format recognized does not match any currently held in memory.

5.9 Sleep Timer

Control
This option allows the user to program a fixed amount of time after which the set will turn off. In the event that the set is turned off before the set amount of time has elapsed, the fea-

ture will be reset to the off state. One minute before the sleep timer is to turn the set off, a "Good Night" display will appear, counting off the last seconds before the set turns off. The set shut off may be delayed by resetting the sleep timer. The contrast and brightness will slowly ramp down over this last minute, reaching minimum as the set turns off. This will continue, even if the "Good Night" display is removed from the screen.

Display

Sleep Timer 0:15   Sleep Timer Off

Good Night
0:59

Limitations

This option is always available.

Setting by remote

The sleep timer screen may be accessed by pressing the TIMER button on the remote. Each subsequent press of the TIMER key will advance the sleep timer to the next interval in the following order: Off, 0:15, 0:30, 1:00, 1:30, 2:00, 2:30, 3:00, 3:30, 4:00. If the timer has run down to a time between one of the fixed intervals, a press of the TIMER key will advance the time to the next highest fixed interval. While the sleep timer display is active, the left and right adjust or select up and down keys may be used to adjust the sleep timer duration as well. The adjust right and select down keys will advance it in the following order: Off, 0:15, 0:30, 1:00, 1:30, 2:00, 2:30, 3:00, 3:30, 4:00. The adjust left and select up keys will advance it in the following order: Off, 4:00, 3:30, 3:00, 2:30, 2:00, 1:30, 1:00, 0:30, 0:15.

Setting by trakball

The sleep timer may be accessed by positioning the trakball on the "Sleep" active area on the left side of the main trakball screen. Each press of the trakball when in this active area will advance the sleep timer to the next interval in the following order: Off, 0:15, 0:30, 1:00, 1:30, 2:00, 2:30, 3:00, 3:30, 4:00. If the timer has run down to a time between one of the fixed intervals, a press of the trakball will advance the time to the next highest fixed interval.

5.10 Trakball Speed

Control

This option allows the user to select the relative speed with which the trakball cursor moves in response to the remote commands. This will have no effect on the cursor if in Microsoft mouse emulation mode, as it only relates to the OSD cursor.

Display"

Slow", "Medium", "Fast"

Limitations

This option is always available.

Setting by remote

This control is trakball only. It cannot be accessed by conventional remote commands.

Setting by trakball

The trakball speed option may be accessed by positioning the trakball on the "Z-Trak" active area on the left side of the main trakball screen. Each press of the trakball when in this active area will advance the speed setting in the following order: Slow, Medium, Fast.

5.11 Z-Trak Mouse

Control

This option allows the user to have the system transmit commands from the trakball remote out the data port in a mode which will emulate a Microsoft mouse when connected to the serial port of a computer. In this mode, the unit will take no action from trakball remote commands except to pass them to the data port. The on screen display will not respond, and the data port will be in output mode only, unable to communicate with test equipment of the data port interface. In this mode, the trakball press will act as the left mouse button, the key marked "drag" (channel up or play) will toggle the left and right buttons between drag and normal modes, and the "left" (volume down or rewind) and "right" (volume up or fast forward) keys will act as the mouse left and right buttons.

Display"

Enabled", "Disabled"

Limitations

This option is always available.

Setting by remote

This control is trakball only. It cannot be accessed by conventional remote commands.

Setting by trakball

The option for Z-Trak Mouse mode may be accessed by pressing the key marked "mouse" (channel down or stop) on the trakball remote. The first press of this key will call up the display sub menu; any subsequent presses will toggle the mode between the "Enabled" and "Disabled" states. Any press of this key will automatically turn off the on screen trakball cursor if it is displayed. The display must be allowed to time out, as there is no other command from the trakball remote which would remove it.

6. Status Displays

6.1 Status

Control

This is merely an information display, showing the horizontal frequency, vertical frequency, source, video standard (if a Video or S- Video source), horizontal sync polarity, vertical sync polarity, and sync type for the current format. No adjustments are made.

Display

Factory Format 1

Horizontal Frequency: 31.4 KHz
Vertical Frequency: 60 Hz
Input Source: RGB
(Video Format: M-NTSC)
Horizontal Sync: Positive
Vertical Sync: Negative
Composite

Limitations

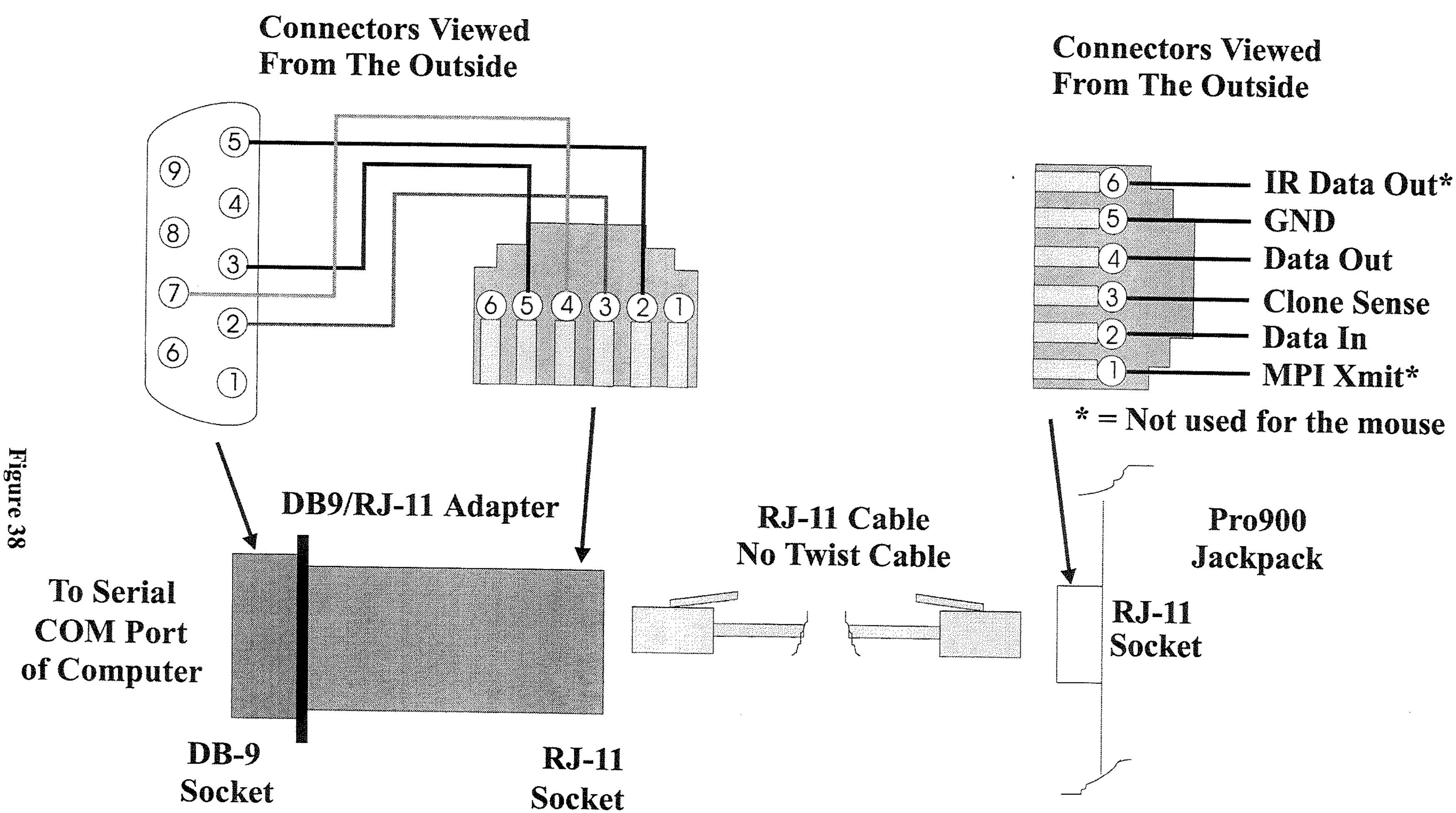
This screen can only be accessed if a valid signal is present.

Setting by remote

The screen is accessed by pressing the FREEZE key. Pressing any other key once it is displayed will exit.

Setting by trakball

The screen may be accessed by pressing on the "Status" active area on the left hand side of the main trakball screen.



1. This connection is to a serial "COM Port" of a computer.
2. The data format is 1200 baud, no parity, 8 bit, and 1 stop bit.
3. The serial COM Port used must be setup for the correct data configuration.
4. If a PS-2 mouse is used, by the computer, it must be disconnected when using Z-Mouse.

Figure 38

Once it is displayed, pressing the trakball at any point on the screen will exit.

6.2 Source/Time

Control
This is an information display, showing the current source, video standard (if a Video or S- Video source), time (if set), current format label (if set), no signal condition warning (if set), unit IR address (if set), and broadcast IR address (if set). No adjustments are made.
Display

Video
(M-NTSC)
(12:00)
(VCR 1)

(No signal on current source)
(Current Unit Address = ##)
(Selected IR Address = ##)
Limitation
This option is always available.
Setting by remote
The Source/Time display can be recalled by using the "ENTER" key. Pressing the "ENTER" key while the Source/Time display is active will remove the display.
Setting by trakball
The Source/Time display may be brought up by rolling the trakball to the right on the main trakball screen. It may also be brought up in response to an action on another screen (e.g. trying to copy a format to itself in the "Copy Format" screen).

7. Special Function Displays

7.1 Convergence Setup

Control
This option allows the user to gain access to the convergence setup screen, where various geometry and convergence waveforms may be manipulated under remote command. It will also provide access to the forced format mode.
Display
SETUP is used to adjust geometry and convergence settings.

Press RED to continue SETUP.
Press GREEN to force formats.
Press BLUE to set floor/ceiling.
Press any other key to exit.
Limitations
This option is always available.
Setting by remote
This option is called up by pressing the button labeled SETUP (the * key) on the setup transmitter. Once this sub menu is displayed, the key labeled RED (the CAPTIONS key) on the setup transmitter must be pressed to access the convergence setup screen. If no valid signal is detected and the RED key is pressed, the display will disappear without bringing up the convergence setup screen. If the key labeled GREEN (the FLASHBACK key) is pressed, the forced format mode screen will be accessed. If the key labeled BLUE (the MUTE key) is pressed, the floor/ceiling mode setup screen will be accessed. If any other key is pressed, the display will disappear without accessing the convergence setup screen.
Setting by trakball
This mode cannot be accessed or controlled by the trakball. It may only be used with the standard setup remote.

7.2 Setting up convergence:

The SETUP option is intended for use by the installer, and gives the user full control over all geometry and convergence settings. The keys on the setup remote define a specific function to be controlled using the VERT +/- (Channel up and down) and HORZ +/- keys (volume up and down).
If an option is not present for a chosen function, an "N/A" will appear next to that function rather than a current setting number.
In Geometry mode, all three colors are controlled simultaneously; in Convergence mode, only the single selected color is controlled. Convergence mode is selected by pressing one of the keys labeled RED (captions), GREEN (flashback), or BLUE (mute). Pressing any of these keys twice sets the unit back into Geometry mode.
The following IR Codes are mapped on the setup remote to call up the following functions:
IR CodeFunctionSKEW (Digit 1)SkewBOW (Digit 2)BowIN-PIN (Digit 3)Inner PincushionKEY (Digit 4)KeystonePIN (Digit 5)PincushionS-ING/W-M (Digit 6) - 1st press"S" functionS-ING/W-M (Digit 6) - 2nd pressW-MT/L KEY (Digit 7)Top and Left KeystoneT/L PIN (Digit 8)Top and Left PincushionT/L S (Digit 9)Top and Left "S" functionIN-KEY (Digit 0)Inner KeystoneLIN C/LI-LIN (Menu) - 1st pressCenter linearity LIN C/LI-LIN (Menu) - 2nd pressLeft inner linearityLIN T-B,L-/R (Theme)Top/Bottom, Left/Right linearitySIZE (PIP)SizeH-PULSE (Timer)Horizontal pulse position
Codes which have two functions call up the first function when pressed, and the second function after a second press. The first press of the code (after any other function has been selected) will always call up the first function.

Once adjustment of a particular function begins, the ADJ TOGGLE (enter) key may be used to swap between the state of the function prior to the adjustment and its current state after adjustment. If an adjustment is made after swapping back to the prior setting, this will become the new "current" setting.
The R-MUTE (swap), G-MUTE (freeze), and B-MUTE (to do) keys are used to selectively turn off the individual color outputs. These are toggle functions, as the first press mutes the color and the second press restores the color.

Pressing the SETUP (the * key) key while in setup mode will call up a sequence of integrated test patterns to aid in the setup process. These patterns are as follows:

1.Clear (background video shows through)
2.Cross hatch
3.Fine pitch cross hatch
4.Convergence color pattern
5.Black/White horizontal split
6.Dot pattern
7. "H" repeated

8.White window on black field
9.Full white field

The key labeled DIG/ANALOG (source) is provisional for future systems to allow a switch between analog convergence setup and digital convergence setup. This key has no function at this time.

The QUIT button is used to exit setup mode and bring the user to the "Would you like to store your changes?" screen. The process for storing the changes made continues from that point (see "Storing Changes:" section).

7.3 Factory Menu

Control
This allows the user access to over 300 factory aligned parameters which can be field adjusted by a properly trained technician. Care must be taken when adjusting any of the options presented. In addition to offering the option to change these parameters, the technician can review the settings as well as read certain information about the current format. A list of these options will be published separately.

Display
0 DAIQC 0/ 1
1018-1.00 12/25/95-B
0 V 20 F 451 L 44944 Hz

The first line gives the number of the current option, the name of the option, its current setting, and its limit.

The second line shows the part number of the microprocessor, the software version number, the date the unit was aligned, and a byte to signify that it has passed test equipment.

The third line gives the current video format (if Video or S-Video source), the current format number (0-9 = Factory Custom 1-10, 10-19 = Factory Preset 1-10, 20-24 = Customer 1-5), The number of lines in the current format, and the current horizontal frequency.

Limitations
This option is always available.

Setting by remote
In order to get into the factory menu, the MENU key must be pressed for roughly five seconds, until the Source/Time status display appears. Press the "9", "8", "7", "6", and "ENTER" keys, in that sequence, to activate the factory menu.

Once the factory menu is displayed, the adjust left and right keys will change the value of the currently highlighted parameter. All controls will wrap around the limit and the adjust keys will repeat if held down. The select up and down keys will change the selected highlight, wrapping around when the last item in the list is reached, and will also repeat if held down. Entering a series of digits followed by the ENTER key will set value of the currently highlighted parameter to the number which was entered, providing it is within the limit. If it is not within the limit, the digit buffer will be cleared and the parameter will not change. Entering a series of digits followed by the MENU key will change the selected highlight to the option number corresponding to the number which was entered, providing it is legal. If it is not a legal number, then the digit buffer will be cleared and the selected highlight will not change. The QUIT key may be used to exit the factory menu.

Setting by trakball
This option cannot be accessed by the trakball. A conventional remote must be used.

7.4 Unit life time

Control
This allows the user to call up a display showing how long the unit has been operating (i.e. turned on). There are two timers, one which can be reset, and another which cannot. This information may be useful for service situations or in certain rental environments.

Display
Total Life Time
1 years
25 days
13 hours
46 minutes
Current Life Time
0 years
156 days
2 hours
14 minutes

The Total Life Time refers to the counter which cannot be reset.
The Current Life Time refers to the counter which can be reset.

Limitations
This option is always available.

Setting by remote
In order to bring up the life time display, the MENU key must be pressed for roughly five seconds, until the Source/Time status display appears. Press the "TIMER" key to activate the life time display. Any key may be used to exit the display.

In order to reset the Current Life Time counter, enter the factory menu (see the "Factory Menu" section) and press the TIMER key. No on screen feedback will be given, but the timer will be reset. Bring up the life time display in order to confirm.

Setting by trakball
This option cannot be accessed by the trakball. A conventional remote must be used.

7.5 Temperature Fail

Control
This display will come up automatically if the temperature in the unit is read consistently to be too high for a period of two minutes. When it appears, all remote activity will be prohibited, save the use of the "POWER" key to shut the set off. The display will count down from 59 seconds to 0, at which point the set will shut off automatically. The set may be turned on again without delay, though if the temperature does not improve, the warning message will reappear in two minutes.

Display
The system temperature is too
high. The set will shut down
in 0:59.

Limitations
This option can only be brought up automatically in the case of excessive system temperature.

Setting by remote
There is no control available via the remote. Only the "POWER" key may be used to turn the set off.
Setting by trakball
There is no control available via the trakball. Only the "POWER" key may be used to turn the set off.

7.6 No Signal Present

Control
This message will appear if no valid signal is detected and no other on screen display is requested. It is brought up to inform the user that the set is still turned on, but that no signal is active on the selected source. It is first brought up on the first line of the display, and will move one line down (until it wraps back around to the top) for each minute it remains active, in order to protect against burning the image into the CRTs. Any other display which is brought up will cause the message to start again at the top when it becomes active again. The display will remain until another display is called for or a valid signal is input on the currently selected source. If on an RGB source and the "Special Composite" sync mode is selected, the message will read "No signal in this Sync Mode" as a flag to the user that this may be the reason that no signal is being found on the current source.
Display"
No signal on current source" or "No signal in this Sync Mode"

Limitations
This display will appear automatically only if no valid signal is input on the current source and no other display is called for.
Setting by remote
There is no control for this display. Any key will exit this display to call up another.
Setting by trakball
There is no control for this display. A trakball press will exit this display to call up the main trakball screen.

7.7 Unit IR Address

Control
An option exists which allows multiple units to be used side by side without the remote commands directed for one unit affecting any other unit. This is accomplished by setting a unique IR address for each unit. Once this has been done, a single message giving the address for which the IR commands to follow are intended is sent to all units, which will then ignore the IR unless it matches the unit's address. It will continue to disregard the IR until a new message comes in which matches its address. The default condition is to set the unit IR address to "0", which means that no IR address is set and that the unit should listen to all incoming IR, regardless of the address. The range for the unit address is 0-99. When a broadcast message comes in specifying that the IR to follow is intended for address "0", this is interpreted as meaning that all units should listen to the IR, regardless of their unit's address. While the unit's IR address is being programmed, all IR commands will be listened to.

Display

Unit Address	Unit Address
No IR Address Required	IR Address = 23

Limitations
This option is always available.
Setting by remote
In order to get into the unit IR address sub menu, the MENU key must be pressed for roughly five seconds, until the Source/Time status display appears. Press the "9", "9", "9", and "ENTER" keys, in that sequence, to activate the unit IR address sub menu.

When the Unit Address display is active, the adjust left and right keys will change the address setting down or up, respectively. These keys will repeat if held down. In addition, digits may be entered and followed by the "ENTER" key in order to directly program the address. Only the last two digits entered will be considered, although if only one digit is entered, a leading "0" will be assumed. Once a non zero address has been entered, a line on the Source/Time status display will read "Current Unit Address = ##".
Setting by trakball
This option cannot be accessed by the trakball. A conventional remote must be used.

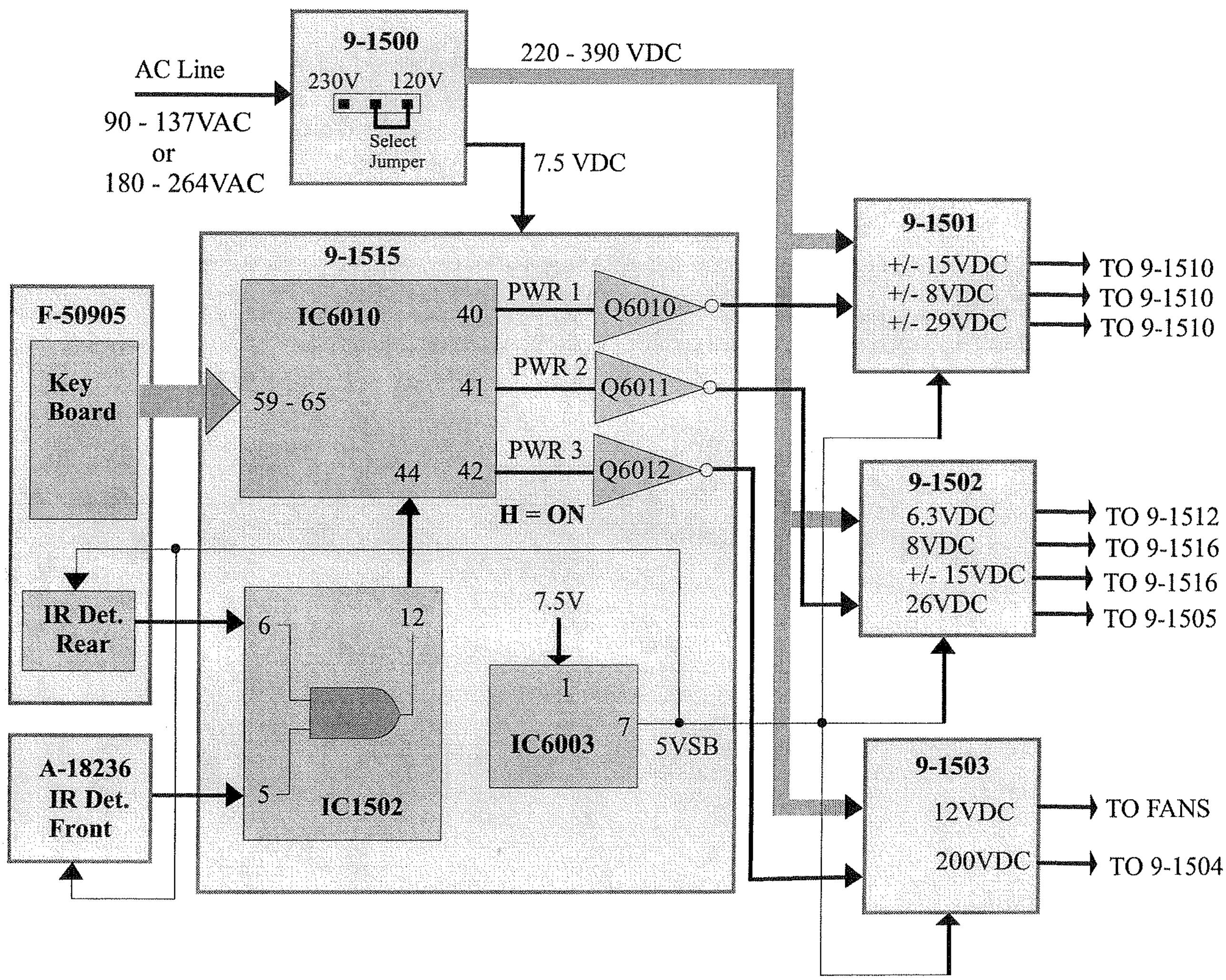
7.8 Broadcast IR Address

Control
An option exists which allows multiple units to be used side by side without the remote commands directed for one unit affecting any other unit (see "Unit Address" section). A single message giving the address for which the IR commands to follow are intended is sent to all units, which will then ignore the IR unless it matches the unit's address. The default condition is to set the broadcast IR address to "0", which means that no IR address is set and that all units should listen to all incoming IR. The range for the broadcast address is 0-99. While the broadcast IR address is being programmed, all IR commands will be listened to.
Display
Enter Selected IR Address: —
Limitations
This option is always available.
Setting by remote
In order to get into the broadcast IR address sub menu, the MENU key must be pressed for roughly five seconds, until the Source/Time status display appears. Press the "SETUP" (the * key) key to activate the broadcast IR address sub menu.

Once the display is active, exactly two digit keys must be pressed to specify the address. Any other key or a single digit key will not affect the broadcast address setting. The new broadcast address is entered after the receipt of the second digit key. Use of the "ENTER" key is not required. Once a non zero address has been entered, a line on the Source/Time status display will read "Selected IR Address = ##".
Setting by trakball
This option cannot be accessed by the trakball. A conventional remote must be used.

7.9 Signal Generation Mode

PRO900/900X Power Control Block Diagram



PRO900 Serial Bus Block Diagram

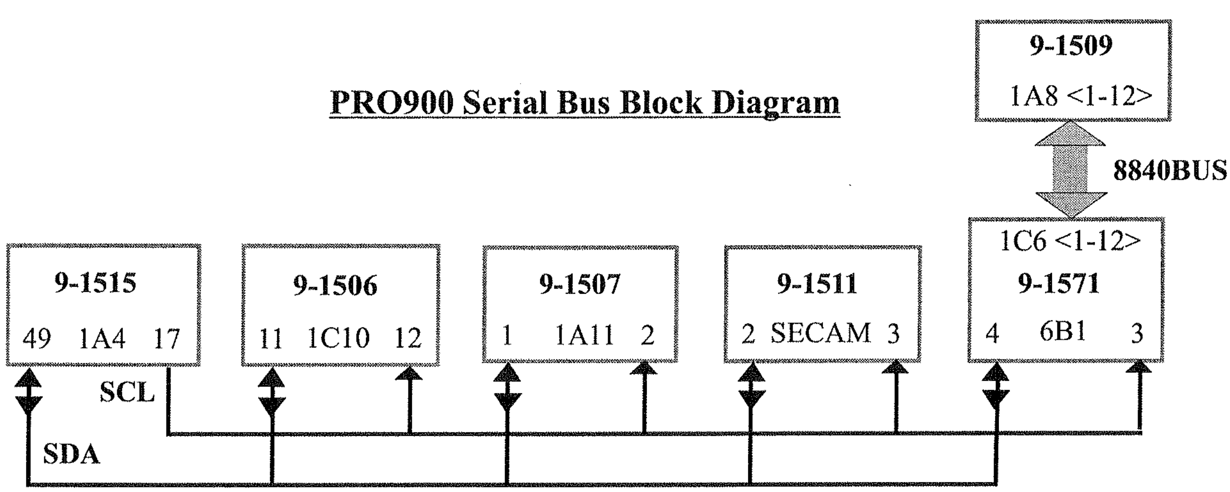


Figure 40

pacitors CX3705 and CX3706 and common mode choke TX3703. RX3701 is the bleeder resister
9-1500 AC to DC Converter
AC to DC converter located on 9-1500 and consists of bridge rectifier DX3702, voltage selector switch "120V-230V' and two stage filter CX3707-CX3708 and CX3709. Resistor RX3703 is for limiting in rush current on the line until stand-by power supply starts and +12V output activates the relay KX3701 and shorts out resistor RX3703.
Depending on the position of the voltage selector switch, the AC to DC converter operates as a voltage doubler at "120V" or in bridge configuration at "230V".
RX3704 and RX3705 are bleeders to discharge CX3707 and CX3708 when set is unplugged.
Output from AC to DC converter is "B+" from 210VDC to 390VDC depending on the line and load conditions taken through the fuse FX3401 to stand-by power supply and through connector 14J3 to the other three DC to DC converters.

9-1500 Stand-By Power Supply

Stand-by power supply is a DC to DC fixed frequency flyback built with current mode controller PWM. The input for the stand-by power supply is "B+" from AC to DC converter. Stand-by output is taken from connector 14A1 and it should be +7.5V±0.5V @ 200mA load. Second output is taken from connector 14K3 and it should be +12V±1V @ 48mA load.
When power is initially applied to the circuit, capacitor CX3401 charges through RX3404. When the voltage across CX3401 reaches a level of 16V the output of ICX3401 is enabled, turning ON QX3401. During the ON time of QX3401, energy is stored in the air gap of transformer TX3401. At this time the polarity of the output windings is such that all output rectifiers are reverse biased and no energy is transferred. Current through QX3401 is sensed by a resistor RX3412 and compared to a fixed 1V reference inside ICX3401. When the 1V level is reached, QX3401 is turned OFF and the polarity of all transformer windings reverses, forward biasing the output rectifiers. All the energy stored is now transferred to the output capacitors. The voltage across the capacitor CX3411 reaches approximately 13V used to support Vcc and is fed through a voltage divider RX3401 and RX3402 to the error amplifier (ICX3401 pin 2) and compared to an internal 2.5V reference.
Snubber network DX3404, RX3410 and CX3410 is for reducing voltage spike on the drain of QX3401 when QX3401 turns OFF. Additional turn OFF snubber CX3419 and RX3413 damps out any ringing which helps EMI. Diode DX3401 isolates Vcc power supply during start-up from CX3401. CX3404, RX3403 and CX3405 are the loop response compensation network. CX3406 and RX3406 are timing components setting up the running frequency at 56khz. C3415, L3401 and C3418 reduce the ripple on the +7.5V output. D3408 is an LED that indicates that power is ON. R3417 is the current limiting resistor and at the same time a pre-load for the stand-by output. CX3413 and CX3414 between chassis GND and primary GND are part of the EMI filter.

9-1501 Power Supply

The 9-1501/139W power supply is a DC to DC, self oscillating, variable frequency, current mode flyback converter with multiple outputs. All the outputs are taken from connector 3A7. The ±15V @ 0.9A are used by vertical deflection circuit, ±29V @ 1.5A and ±15V @ 0.6A are used by analog convergence circuit and +8V @ 0.2A and -8V @ 0.6A are used by digital convergence circuit. The input for the power supply is "B+" from AC to DC converter and +12V from the stand-by power supply. All the input voltages located on connector 3J14.
The ON-OFF signal for the power supply comes from the micro through connector 3H1. The ON-OFF circuit consist of opto-coupler ICX3702 for the primary to secondary isolation with the current limiting resistor R3716, QX3702, QX3701 and resistors RX3701 to RX3703 and RX3705. If the ON-OFF signal is OFF-no signal from the micro appears at 3H1 and transistor QX3701 is ON disabling the base of the output transistor located inside the hybrid ICX3701. When power is initially applied to the circuit, "B+" and +12V start coming up. Current flowing through RX3708 tries to bias the output transistor inside the hybrid ICX3701, but because ON-OFF signal is OFF, and transistor QX3701 is ON start-up operation is disabled. When the ON signal appears at 3H1, the output transistor inside opto-coupler ICX3702 turns ON. Emitter follower QX3702 amplifies the signal and turns QX3701 OFF. This means that the base of the output transistor inside the ICX3701 is ready to be biased from +12V through starter resistor RX3708. Collector current of the output transistor inside ICX3701 starts to rise, and the base drive voltage increases on the base drive winding of TX3701. During the ON time of QX3401, energy is stored in the air gap of transformer TX3701. At this time the polarity of the output windings is such that all output rectifiers are reverse biased and no energy is transferred. When the peak collector current is reached, the voltage across the base drive winding change polarity and negative base drive current turns the output transistor inside the ICX3701 OFF and the polarity of all transformer windings reverses, forward biasing the output rectifiers. All the energy stored is now transferred to the output capacitors. Every output has a C-L-C filter to reduce the ripple, and a pre-load resistor to operate with open load and a fusible resistor for short circuit protection. D3412 is an LED that indicates that power is ON.
CX3733 and CX3734 between chassis GND and primary GND are part of the EMI filter. The sense voltage is rectified by DX3705 and filtered by CX3705. The resultant voltage is used by the error amplifier inside the ICX3701 to set the ON time of the switching transistor. The ON time is proportional to the load and line voltage. QX3703 is part of the over-current protection circuit. Current through the switching transistor is sensed by RX3706.

9-1502 Power Supply

The 9-1502/125W power supply is a DC to DC, self oscillating, variable frequency, current mode flyback converter with multiple outputs. All the outputs are taken from connector 3C1 and 3B2. The +26V @ 3.25A and ±15V @ 0.2A are used by horizontal deflection circuit, +15V @ 0.775A, +8V @ 2.65A and -15V @ 0.09A are used by the low level logic circuit and +6.3V @ 0.63A used by filaments. The input for the power supply is "B+" from AC to DC converter and +12V from the stand-by power supply. All the input voltages located on connector 3J14.

The ON-OFF signal for the power supply comes from the micro through connector 3J1. The ON-OFF circuit consist of opto-coupler ICX3702 for the primary to secondary isolation with the current limiting resistor R3716, QX3702, QX3701 and resistors RX3701 to RX3703 and RX3705. If the ON-OFF signal is OFF-no signal from the micro appears at 3J1 and transistor QX3701 is ON disabling the base of the output transistor located inside the hybrid ICX3701. When power is initially applied to the circuit, "B+" and +12V start coming up. Current flowing through RX3708 tries to bias the output transistor inside the hybrid ICX3701, but because ON-OFF signal is OFF, and transistor QX3701 is ON start-up operation is disabled. When the ON signal appears at 3J1, the output transistor inside opto-coupler ICX3702 turns ON. Emitter follower QX3702 amplifies the signal and turns QX3701 OFF. This means that the base of the output transistor inside the ICX3701 is ready to be biased from +12V through starter resistor RX3708. Collector current of the output transistor inside ICX3701 starts to rise, and the base drive voltage increases on the base drive winding of TX3701. During the ON time of QX3401, energy is stored in the air gap of transformer TX3701. At this time the polarity of the output windings is such that all output rectifiers are reverse biased and no energy is transferred. When the peak collector current is reached, the voltage across the base drive winding change polarity and negative base drive current turns the output transistor inside the ICX3701 OFF and the polarity of all transformer windings reverses, forward biasing the output rectifiers. All the energy stored is now transferred to the output capacitors. Every output has a C-L-C filter to reduce the ripple, and a pre-load resistor to operate with open load and a fusible resistor for short circuit protection. The +26V and +8V outputs have re-settlable fuses RX3725 and RX3729. The +6.3V output is regulated with a three terminal regulator IC3703. D3711 is an LED that indicates that power is ON. CX3733 and CX3734 between chassis GND and primary GND are part of the EMI FIltER. The sense voltage is rectified by DX3705 and filtered by CX3705. The resultant voltage is used by the error amplifier inside the ICX3701 to set the ON time of the switching transistor. The ON time is proportional to the load and line voltage. QX3703 is part of the over-current protection circuit. Current through the switching transistor is sensed by RX3706.

9-1503 Power Supply

The 9-1503/188W power supply is a DC to DC, self oscillating, variable frequency, current mode flyback converter with multiple outputs. All the outputs are taken from connector 3A1. The +200V @ 0.85A is used by the high voltage circuit and +12V @ 1A is used by the DC fans. The input for the power supply is "B+" from AC to DC converter and +12V from the stand-by power supply. All the input voltages located on connector 3J14.

The ON-OFF signal for the power supply comes from the micro through connector 3K1. The ON-OFF circuit consist of opto-coupler ICX3702 for the primary to secondary isolation with the current limiting resistor R3716, QX3702, QX3701 and resistors RX3701 to RX3703 and RX3705. If the ON-OFF signal is OFF-no signal from the micro appears at 3K1 and transistor QX3701 is ON disabling the base of the output transistor located inside the hybrid ICX3701. When power is initially applied to the circuit, "B+" and +12V start coming up. Current flowing through RX3708 tries to bias the output transistor inside the hybrid ICX3701, but because ON-OFF signal is OFF, and transistor QX3701 is ON start-up operation is disabled. When the ON signal appears at 3K1, the output transistor inside opto-coupler ICX3702 turns ON. Emitter follower QX3702 amplifies the signal and turns QX3701 OFF. This means that the base of the output transistor inside the ICX3701 is ready to be biased from +12V through starter resistor RX3708. Collector current of the output transistor inside ICX3701 starts to rise, and the base drive voltage increases on the base drive winding of TX3701. During the ON time of QX3401, energy is stored in the air gap of transformer TX3701. At this time the polarity of the output windings is such that all output rectifiers are reverse biased and no energy is transferred. When the peak collector current is reached, the voltage across the base drive winding change polarity and negative base drive current turns the output transistor inside the ICX3701 OFF and the polarity of all transformer windings reverses, forward biasing the output rectifiers. All the energy stored is now transferred to the output capacitors. The +200V output has a C-L-C filter to reduce the ripple and a pre-load resistor to operate with open load and a fusible resistor for short circuit protection. The +12V output has a capacitive filter to reduce the ripple and a pre-load resistor to operate with open load and a fusible resistor for short circuit protection. D3412 is an LED that indicates that power is ON. If one of the outputs disabled LED will be OFF. CX3733 and CX3734 between chassis GND and primary GND are part of the EMI filter. The sense voltage is rectified by DX3705 and filtered by CX3705. The resultant voltage is used by the error amplifier inside the ICX3701 to set the ON time of the switching transistor. The ON time is proportional to the load and line voltage. QX3703 is part of the over-current protection circuit. Current through the switching transistor is sensed by RX3706.

9-1505 Horizontal Deflection Module

General Description

The function of the 9-1505-xx module is to supply horizontal deflection current to the three deflection yoke coils. The operating frequency range is from 15.7 kHz to 48 kHz. This module is dependent on other circuits in the chassis to provide: drive signal, DC control voltages, correction waveform, and TTL logic levels. The module can be divided into 6 functional blocks:

a) Horizontal Deflection
b) Scan Boost Converter
c) E/W Correction Gain Control
d) Base Drive
f) S-Capacitor Switching
g) Fault protection.

Connector Descriptions

Following are names and brief descriptions of all input/output connections to the 9-1505 Module. The names can be found on the module as legends next to the respective connector.

NAME DESCRIPTION

9-1505 Horizontal Deflection Module

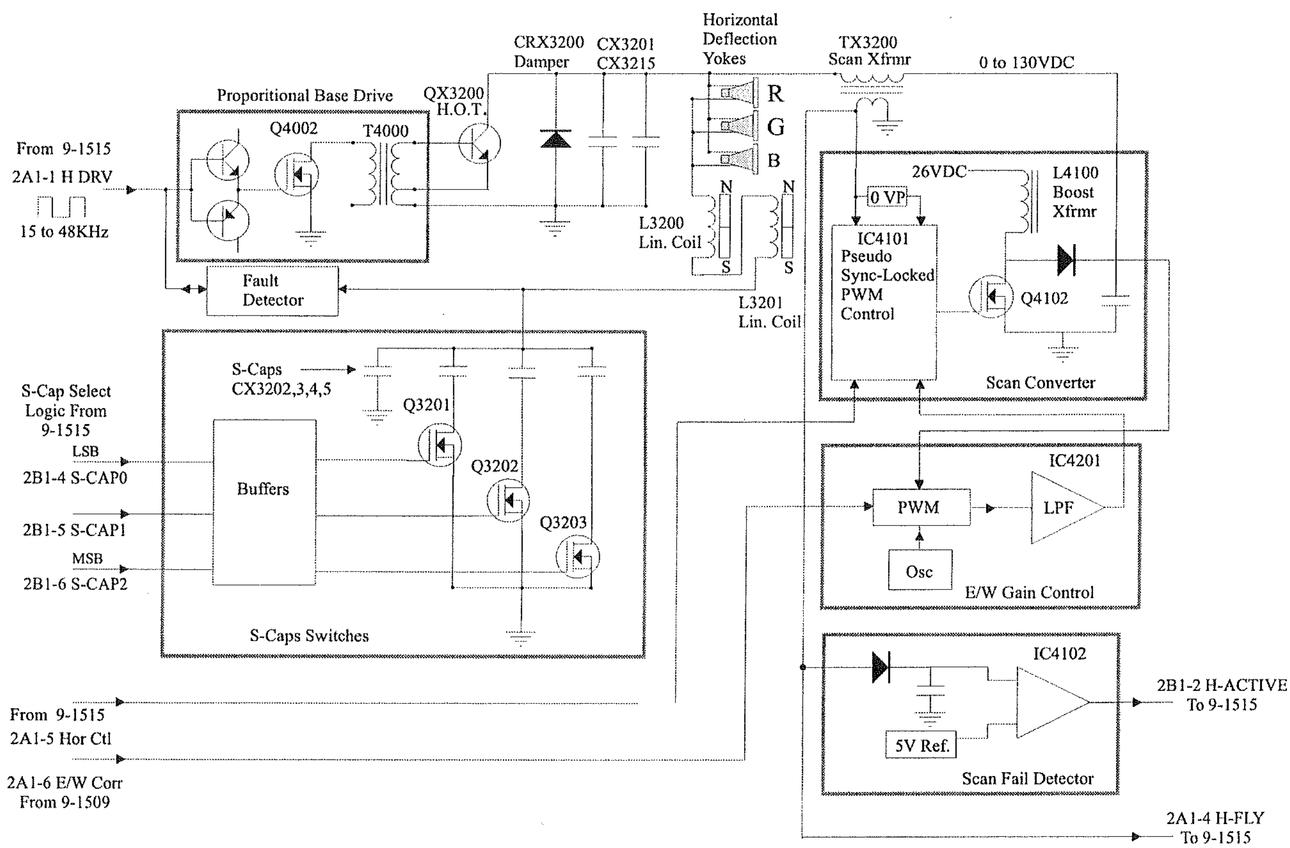


Figure 41

2A1-1 H-DRIVE Horizontal Drive input.
2A1-2 HDRGND Ground for Horizontal Drive.
2A1-3 HDRGND Ground for Horizontal Drive.
2A1-4 H-FLY Flyback Pulse output.
2A1-5 HOR-CNTL 0-5 VDC used to adjust boost supply voltage.
2A1-6 EW-PINCOR E/W Raster Correction Signal.
2B1-1 HOR-CENT Not Used.
2B1-2 H-ACTIVE Output Logic Level sent to other circuits to report circuit is functioning.
2B1-3 R-CAP Not Used.
2B1-4S-CAP0Input TTL Level for S-Cap switching. (Least Significant Bit)
2B1-5S-CAP1Input TTL Level for S-Cap switching.
2B1-6S-CAP2Input TTL Level for S-Cap switching. (Most Significant Bit)
2A3-1+26VDCSupply voltage, up to 3.0 amps.
2A3-2GROUNDSupply Ground.
2A3-3GROUNDSupply Ground
2A3-4-15VDCSupply voltage, less than 0.3 amps.
2A4-5+15VDCSupply voltage, less than 0.3 amps.
2/B/G/R/9 YOKESHorizontal Deflection Yokes
Scan Boost Converter (4100 Series)

Because the Horizontal Scan Frequency is not constant, a variable voltage source is required to supply the main deflection circuit. This is accomplished by the Scan Boost Converter circuit. The +26VDC Power Supply (from the main switched mode power supply in the chassis) is boosted to the voltage required for a given operating frequency, and becomes the B++ voltage to supply the main deflection circuit. The scan converter is a pseudo-synchronized, PWM, discontinuous, flyback type.

Pulse Width Modulation control is achieved by IC4101. It's function is to modulate the pulse width output at pin 8, based on the error voltage resulting from comparing the reference voltage at pin 2 with that at pin 1.

Scan converter free-run operating frequency is controlled by R4126 and C4111. It is necessary to synchronize this frequency with the incoming Horizontal Scanning frequency. Q4100 provides injection locking of the oscillator by discharging C4111 during the horizontal retrace interval, after which the oscillator is allowed to free-run only during the remaining scanning period. The effect is a pseudo-sync-locked oscillator. This provides improved noise and response performance, while reliably operating in the "discontinuous" mode over the entire horizontal operating frequency range.

The output at pin 8, drives the gate of the switching transistor Q4102. The "on" interval determines the amount of stored energy in L4100. The longer Q4102 is "on", the more energy is stored, resulting in a higher rectified output voltage at B++ after Q4102 is turned "off". Q4101 provides a fast turn-off of Q4102.

One half of the operational amplifier (pins 5,6, & 8 of IC4100) provides the error voltage needed to regulated the B++ output voltage to a specified level. This voltage is dependent on the horizontal scanning frequency, and is determined by the microprocessor (off-module), and a corresponding 0 to 5VDC level is sent to pin 5 of connector 2A1, "HOR-CNTL". At low scanning frequencies this voltage approaches 0.5 volts. At the highest frequency this voltage approaches 5.0 volts. This corresponds to an approximate B+ range of 35 to 120 Volts DC.

Over-voltage protection is provided by sampling the rectified flyback pulse from the deflection circuit and comparing to the reference voltage at pin 2.

This circuit also receives a pincushion correction signal to modulate this voltage to provide keystone and pincushion geometric correction.

Base Drive (4000 SERIES)

The Base Drive circuit provides high forward and reverse current to drive the base of the Horizontal Output Transistor, QX3200, from a low level input (H-DRIVE) at pin 1 of connector 2A1. This signal is approximately 12 volts peak to peak at the operating scanning frequency and has a duty cycle of about 45% high, 55% low.

Current from H-DRIVE is amplified by transistors Q4000 and Q4001, providing a low impedance to rapidly drive the gate of the driver transistor, Q4002. This action results in alternating current flow in the primary of Driver Transformer, T4000. During Q4002 'on' time, energy is stored in T4000 and rapid turn-off of QX3200 is initiated. During Q4002 'off' time, the energy previously stored in T4000 is used to drive the base of QX3200. A winding in T4000 from the Emitter of QX3200 to ground provides pulse shaping to optimize the base drive and improve efficiency.

Horizontal Deflection

The Horizontal Deflection circuitry is a common flyback type used in many television and monitor applications. QX3200 is the Horizontal Output Transistor. When QX3200 is initially turned 'on', current is allowed to flow from the B+ supply, through TX3200 and QX3200. This allows energy to be stored in TX3200. When QX3200 is turned 'off', some of this energy is returned to charge the S-Capacitor(s), CX3202,3,4, &5. After several cycles (repeating at the scanning frequency), sufficient voltage appears across the S-capacitors, providing an additional path producing current flow through the deflection yoke coils (connectors 2R9, 2G9, & 2B9). The negative current path is provided by Damper Diode DX3200. The result is a positive and negative sawtooth current through the deflection coils (approximately 16 to 18 amps peak to peak). When QX3200 is turned 'off', about 1200 volts peak of 'flyback' voltage is produced, resulting from the stored energy in the deflection coils and TX3200. The flyback (or retrace) period is about 3.0 uS.

A secondary winding on TX3200 (pin 12) provides a low voltage flyback pulse used for synchronization, phase comparison, etc. This pulse is sent externally via pin 4 of connector 2A1 (H-FLY).

Linearity Coils, L3200 & L3201, are saturating inductors skewed by a permanent magnet bonded to the coil. They produce a non-linear inductance curve Vs current. This characteristic cancels non-linearity in the deflection current caused by deflection yoke coil resistance.

S-Capacitor Switching

The 'S' shaping capacitors, CX3202, 3, 4, & 5 provide the proper deflection current shaping for optimum raster linearity with various frequencies. As horizontal scanning frequency increases, less capacity is needed. CX3202 is always connected in circuit. The remaining capacitors are switched by Q3201, 2, & 3. The switching points are determined by the microprocessor (off-board) via pins 4, 5, & 6 of connector 2B1. These logic level inputs are switched in a binary arrangement for eight (8) possible combinations. A low level switches the corresponding capacitor 'in'. These signals are buffered by transistors Q3204, 5, & 6. At the lowest frequency (15.7 kHz) all capacitors are switched 'in'.

East / West Correction (Pincushion) Gain Control (4201 Series)

The E/W Correction input signal, via pin 6 of connector 2A1(EW-PINCOR), is a vertical deflection rate parabola + sawtooth waveform of approximately 14 volts peak to peak. It is used to modulate the Scan Boost Converter to provide correction on the left and right sides of the raster.

In order to maintain a constant percentage of raster correction as scanning frequency is changed, it is necessary to alter the amplitude of the signal as a function of B+ voltage (which is also a function of frequency).

IC4201 is a quad voltage comparator configured as a self oscillating, voltage controlled pulse width modulator. Current source Q4200, together with C4206, produce a linear ramp at the oscillator frequency of approximately 200 kHz. With no signal input on EW-PINCOR, a square wave of about 50% duty cycle appears on pin 1 of IC4201. An input signal on EW-PINCOR will cause the square wave to be duty cycle modulated. The original waveshape is reproduced on C4203 after integration by R4202 and C4203. By varying the applied voltage through R4203, the peak to peak amplitude of the square wave will be altered. This results in an increased amplitude of signal appearing on C4203. In this way, the correction signal amplitude can be voltage controlled. Transistor Q4202 and resistors reduces and buffers the B++ voltage and applies it to pin 1 of IC4201, resulting in tracking of signal amplitude Vs B++ voltage.

To improve signal to noise ratio, one half of IC4100 is configured as a low-pass filter. This further attenuates the oscillator frequency (and other noise) from the signal. The un-filtered E/W correction signal enters on pin 3 and the filtered output appears on pin 1, where it is applied to the Scan Boost Converter error amplifier via C4104.

Fault Protection

Fault protection is provided to prevent failure of the 9-1505 Module when an otherwise destructive input condition is applied to the module. Protections provided are:

a) Excessively Low Frequency
b) Improper Drive Duty Cycle
c) Excessive HOR-CNTL input voltage for given input Frequency.
d) No H-DRIVE
e) S-Cap Value too Low for given Frequency.

IC3200 is configured to provide the fault protection. It's operation is such that, when a fault condition is detected, H-DRIVE is killed by forcing the signal low by Q3221. In all cases except one, restart is attempted within 2-3 seconds. If the fault still exists, the circuit will cycle repeatedly in this fashion until the fault is corrected. The exception is if the HOR-CNTL voltage is too high for the given input frequency, there is no re-start attempt. The module will then remain shutdown until this fault is corrected.

Pins 4 and 5 are inputs to one of the comparators of IC3200. These inputs compare the B++ voltage to the voltage developed across the S-Capacitors. This detects a operating frequency too low for the selected capacitor values.

Pins 6 and 7 are inputs to one of the comparators. Under normal operation, a ramp (at scanning rate) is produced at pin 7 by repeatedly charging and discharging C3222. Q3222 is turned 'on' by the high portion of the H-DRIVE square wave. This discharges C3222. The charge time is a function of B++ (through R3251) and the frequency of H-DRIVE. If the peak voltage of the ramp on C3222 goes above the reference on pin 6 (2.5 volts), a shutdown cycle is initiated.

9-1504-01 High Voltage System

The 9-1504-01 module contains the following functional blocks:

1. A variable frequency regulated H.V. Supply.
2. H.V. Shutdown circuitry and ABL interface.
3. CRT gun supplies.
4. H.V./video enabling and status circuits.
5. A dynamic focus amplifier.

References to fig.1 and fig. 2 refer to the H.V. block diagrams. References to specific legend numbers refer to the actual schematics.

The largest portion of the 9-1504-01 module is the variable frequency regulated HV. supply. it supplies the regulated 32KV. For the C.R.T. at average beam currents of 2.5MA and peak beam currents up to 15ma. In order to obtain good picture dynamics the HV. supply operates at several

Times the horizontal scanning rate (approximately 120KHz) and varies its frequency in response to load and /or line variations.

Referring to figure 1, the circuit begins with the voltage-controlled oscillator which is an RC. oscillator in which one resistor (R4919) sets the free-run and the lowest frequency of operation(approximately 70khz) and the other resistor(R4918) sets the maximum frequency of operation(approximately 170 KHz). With a positive increase in voltage to the input , the frequency increases till it reaches this limit. The output of the oscillator is connected to a one-shot which converts the waveform to a square wave with an off-time basically set by the time constant (R4914, C4912).

This time is set to always be longer than the time required for the HV. output to ring through zero voltage. This time is also modulated by a comparator which compares the sampled signal waveform from the output against an internal 0.5 volt reference thus creating a zero voltage crossing detector . This results in the output only being switched on at a zero voltage crossing which reduces power dissipation and noise in the switching circuits.

The one-shot is buffered through dual FET drivers and fed to the gate of Q4903 which with Q4902 forms a emitter-switched main output switch. This configuration is used for its higher speed and greater safe -operating area. The base of Q4902 is fed from a current limited fixed DC supply. When Q4903 is on ,the emitter of Q4902 is effectively grounded and Q4902 turns on. When Q4903 is turned off, the emitter of Q4902 is effectively opened and current flows out of the base through D4920 back to the bias supply, rapidly turning Q4902 off. The diodes in the base/collector of Q4902 form a

9-1504 High Voltage Module

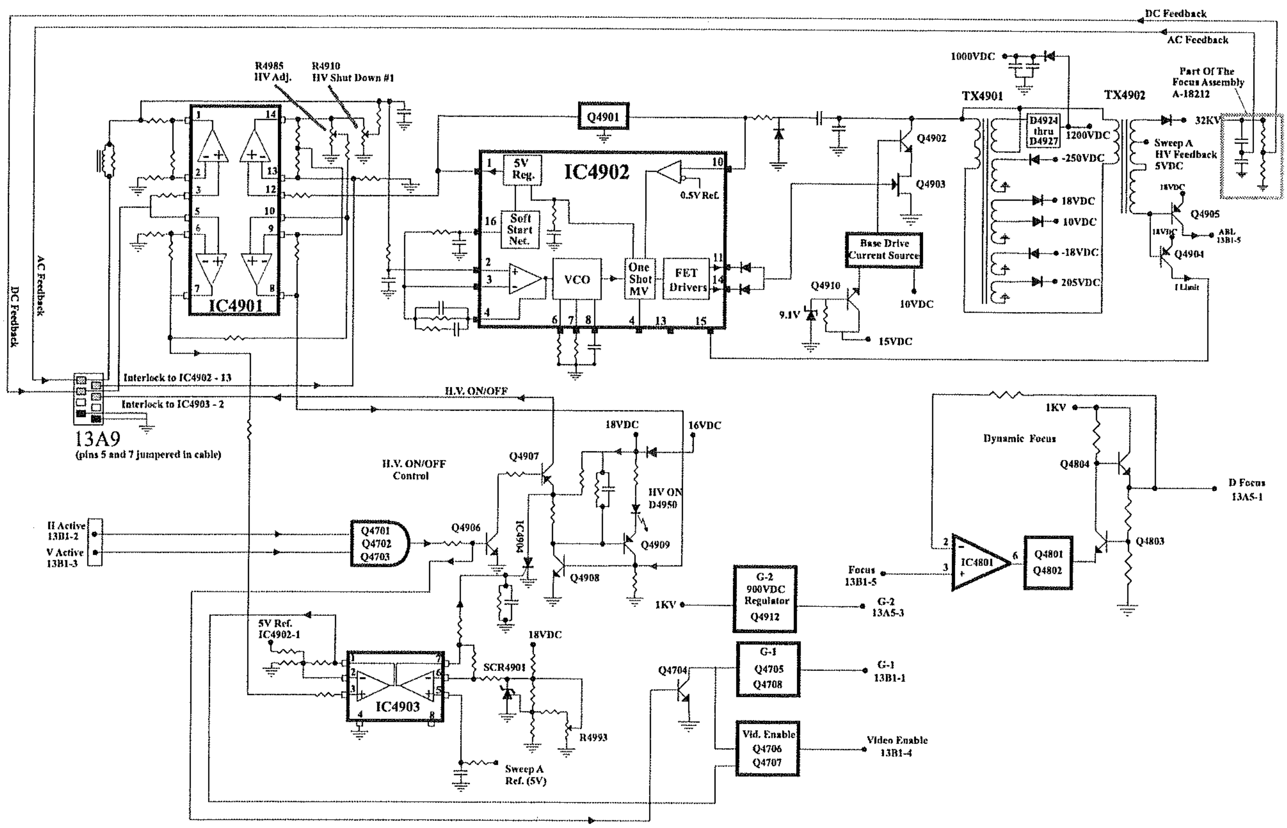


Figure 42

circuit known as a baker clamp or anti-saturation clamp . This improves speed and consistency with beta variations of the output device. The output is basically a switched resonant flyback topology. The L.C. resonant tank is made up of the primaries of TX4901 and TX4902. The resonating capacity is made up of C4914 through C4920 in parallel. The output produces a half sine wave during flyback time which varies in amplitude with changes in oscillator frequency (increasing with decreasing frequency and vice versa). Diodes D4922 and D4923 clip negative excursions of the sine wave. A part of the output waveform is AC coupled and clamped, divided down and fed back to the zero-crossing detector. A peak voltage limiter keeps this voltage from overloading the input to the zero-crossing detector. The main part of the output is fed through HV. transformer TX4902 where it is stepped up to 32KV. There it is rectified and fed to external block a-18212 where it is filtered by a high voltage capacitor and 10 mH. Inductor and distributed to the CRTs. Also in this block a capacitive AC voltage divider is formed from the HV. capacitor and used to provide AC feedback. A resistive divider provides DC feedback from the block. Because of the high impedance of the divider a buffer amplifier is provided to convert the signal to low impedance before it is recombined with the L.C., low pass filtered AC feedback signal and connected to the non-inverting input of the controller op-amp. The other input is connected to a stable soft-start controlled 5V. Reference. Any difference between the two inputs results in a highly amplified error signal which is fed back to the voltage controlled oscillator moving the frequency till the HV. Is back to the preset value. The combination of AC feedback with DC feedback results in not only good DC HV regulation but superior dynamic regulation on quick scene changes. Provide a stable adjustment of high voltage ,the 5 volt reference is fed through a voltage doubler and then to a potentiometer which can adjust the DC. bias input slightly on the input to the controller. Nominal HV. Is produced with the potentiometer approximately centered.

The next area of interest is the HV. shut down circuitry. The first circuit is an over-current shutdown. Referring to figure 1, the bottom of TX4902, there is a beam current sample circuit which consists of Q4904, Q4905 and the associated circuitry. This converts the HV. beam current into a voltage at a rate of 1 volt per 1 ma of beam current. One output is sent to the video circuitry for automatic brightness limiting(ABL). The other output is sent to a fault detector in the controller IC if the average beam current exceeds 3MA. For a sustained period of time the fault circuit will shutdown HV. for several seconds before attempting to restart the HV. This will repeat until the fault is cleared. The other two shutdowns are HV. over voltage circuits and are deliberately redundant and independent to provide reliable compliance to x-ray standards.

The first HV. shutdown appears in figure 1 and basically starts at the DC feedback from the HV. It also is buffered by a high to low impedance amplifier, the output of which is sent into a high gain comparator . The other input of the comparator is taken from a precision divider off the reference voltage doubler. If HV. exceeds the preset level the output goes high turning on the first latch (see figure 2) which shunts the voltage to the controller IC. to ground and shuts down the high voltage. The second HV. shutdown is similar in function to the first except it takes its HV. sample from a separate HV. divider in TX4902 and has its own separate independent reference (see figure 2). Both latches are hard latches and require complete shutdown of power to reset them if there is a trip. A red LED on the HV. module will light if either latch trips.

The next major area is the CRT gun supplies. These are derived from the secondary of TX4901. The low voltage supplies for this module during normal operation are also created here. The supply voltages between plus and minus 18 are derived off the flat conduction periods of the output waveform. All the higher voltages are derived from the flyback conduction time . The circuits are all capacitive input half wave rectifiers. The voltages are provided to there respective circuits directly with the exceptions of G2 and video B-plus. The G2 voltage is first filtered by a HV. shunt regulator with active filtering made up of Q4912 and its associated circuitry . The video B-plus is actually mixed with the input B-plus to the module to provide a more stable supply with load and guarantee CRT cathode voltage is up before HV. comes on which might cause a zero bias beam current condition under some start-up conditions.

The next major circuit group is the HV/video enabling and status circuits. These control the conditions under which the high voltage and video will be enabled. Referring to figure 2, a gate made up of Q4701, Q4702 and Q4703 looks for the presence of horizontal and vertical sync. Only if both are present will the gate toggle on the G1 and high voltage electronic switches and send a signal to the video enable gate. The video enable gate(Q4704, Q4706 and Q4707) looks at this information and the HV. status comparator to make sure HV. is also up before sending a signal to the video outputs and microcontroller to allow the video to be turned on.

The final major circuit function on this module is the dynamic focus amplifier. A low voltage horizontal and vertical scan rate parabola is AC. coupled into operational amplifier IC 4801. The output is coupled through push-pull emitter followers into the emitter of common base amplifier Q4803. The load for this transistor is the active boot-strapped transistor Q4804 which provides improved slew rate for the dynamic focus waveforms. Some of the output is sampled and fed back to the inverting input of the amplifier for improved linearity.

9-1571 Digital Controller - Convergence

Functional Description

The 9-1571 module consists of an 8032 Microcomputer (the Convergence Controller), a Gate Array (the IO Processor), and a 512fhPLL.

The 8032 Microcomputer provides the control function for the module along with an RS232 UART. The Gate Array contains the logic to generate the signals described below, along with an IIC bus interface, and the phase detector and counters for the 512fhPLL.

The 512fhPLL provides the clock for the programmable horizontal waveforms.

The 9-1571 module provides the following signals in the C9 chassis:

Programmable Horizontal Blanking

Programmable Vertical Blanking

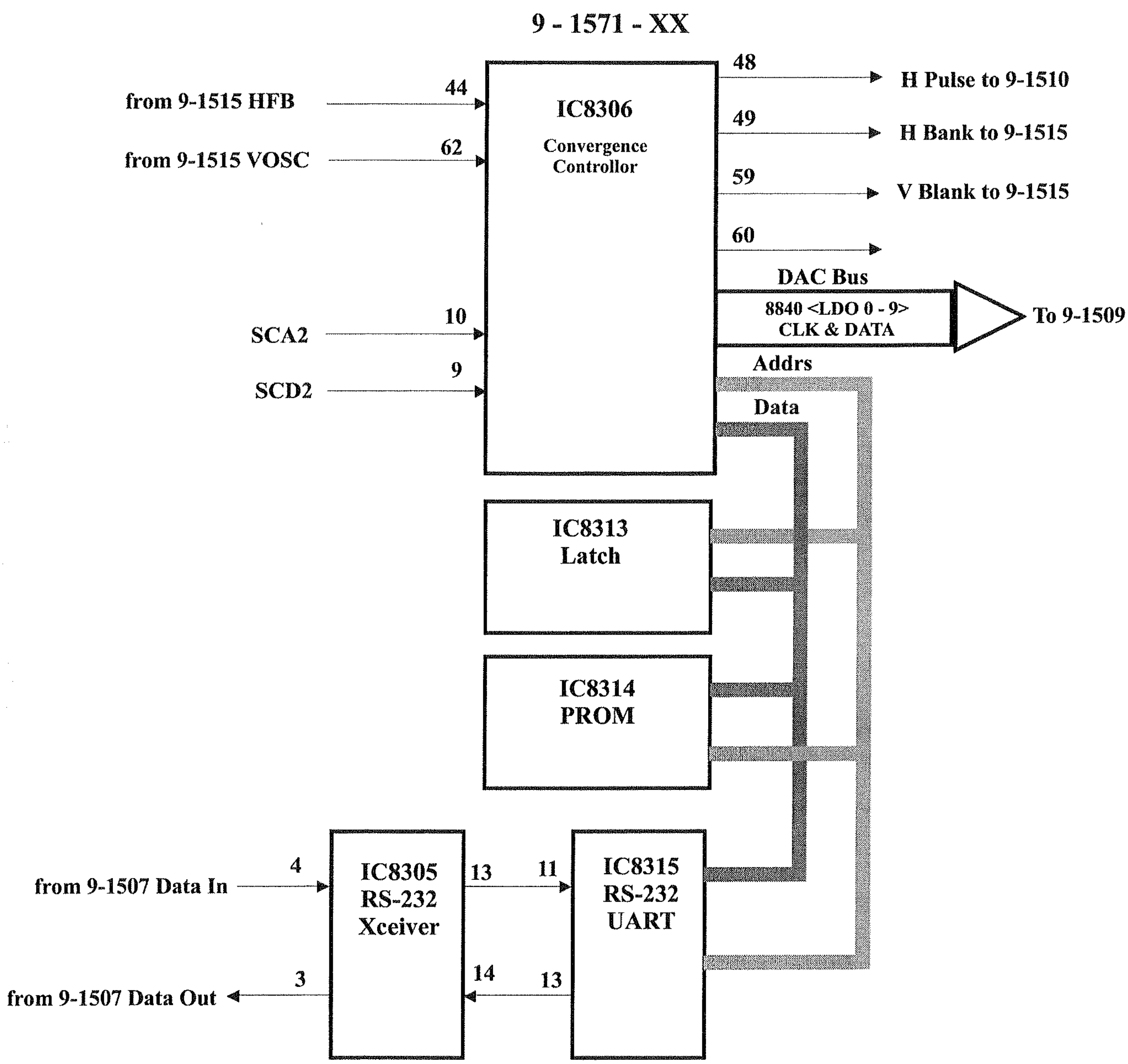

9 - 1571 - XX
IC8306
Convergence
Controllor
from 9-1515 HFB
44
from 9-1515 VOSC
62
SCA2
10
SCD2
9
48
H Pulse to 9-1510
49
H Bank to 9-1515
59
V Blank to 9-1515
60
DAC Bus
8840 <LDO 0 - 9>
CLK & DATA
To 9-1509
Addrs
Data
IC8313
Latch
IC8314
PROM
IC8305
RS-232
Xceiver
IC8315
RS-232
UART
from 9-1507 Data In
4
from 9-1507 Data Out
3
13
11
14
13

Figure 43

Delayed Vertical Output
Programmable Horizontal Pulse Out
Analog Convergence Control
Detailed descriptions of these signals are provided below.
The 9-1571 module also provides the RS232 link used to set up the system in the factory. By way of this link all parts of the C9 hardware system, controlled by either the System Controller, or the Convergence Controller microcomputers, are accessible via a PC running the appropriate software.

I/O Signal Descriptions

Signal	**Connector**
+16v @ 100mA	P1 6B1
-16v @ 100mA	P6 6B1
+8v @ 150mA	P7 6B1
IIC Bus Clock	P3 6B1
IIC Bus Data	P4 6B1
IIC RTS	P8 6B1
Horizontal Flyback	P2 6A1
Vertical Retrace	P8 6A1
Serial Data In (RS232)	P11 6A1
Vertical Sync	P9 6A1
Reset	P12 6A1

IIC Bus Clock - Standard IIC Bus Clock - 100kHz, 5v CMOS.

IIC Bus Data - Standard IIC Bus Data: 5v CMOS.
Horizontal Flyback - Combo board flyback output: 5v CMOS Positive Pulse, 15kHz - 50kHz.
Vertical Retrace - Combo board Vertical Retrace output : 5v CMOS Positive Pulse.
Serial Data In (RS232) - Standard RS232 levels at 19.2k baud and TTL levels for MPI input at 1200 baud.
Vertical Sync - Combo board Vertical Sync output: 5v CMOS Positive Pulse.
Reset - Active high, 5v CMOS, 100mS.

OUTPUTS: 5v CMOS

Signal	**Connector**
Horizontal Blanking	P1 6A1
Delayed Vertical Output	P3 6A1
Vertical Blanking	P6 6A1
MPI XMIT	P7 6A1
RS232 Data Out	P10 6A1
Horizontal Pulse Out	P12 6B1
8840 Data	P1 6C1
8840 Clock	P2 6C1
8840 Load 9	P3 6C1
8840 Load 8	P4 6C1
8840 Load 7	P5 6C1
8840 Load 6	P6 6C1
8840 Load 5	P7 6C1
8840 Load 4	P8 6C1
8840 Load 3	P9 6C1
8840 Load 2	P10 6C1
8840 Load 1	P11 6C1
8840 Load 0	P12 6C1

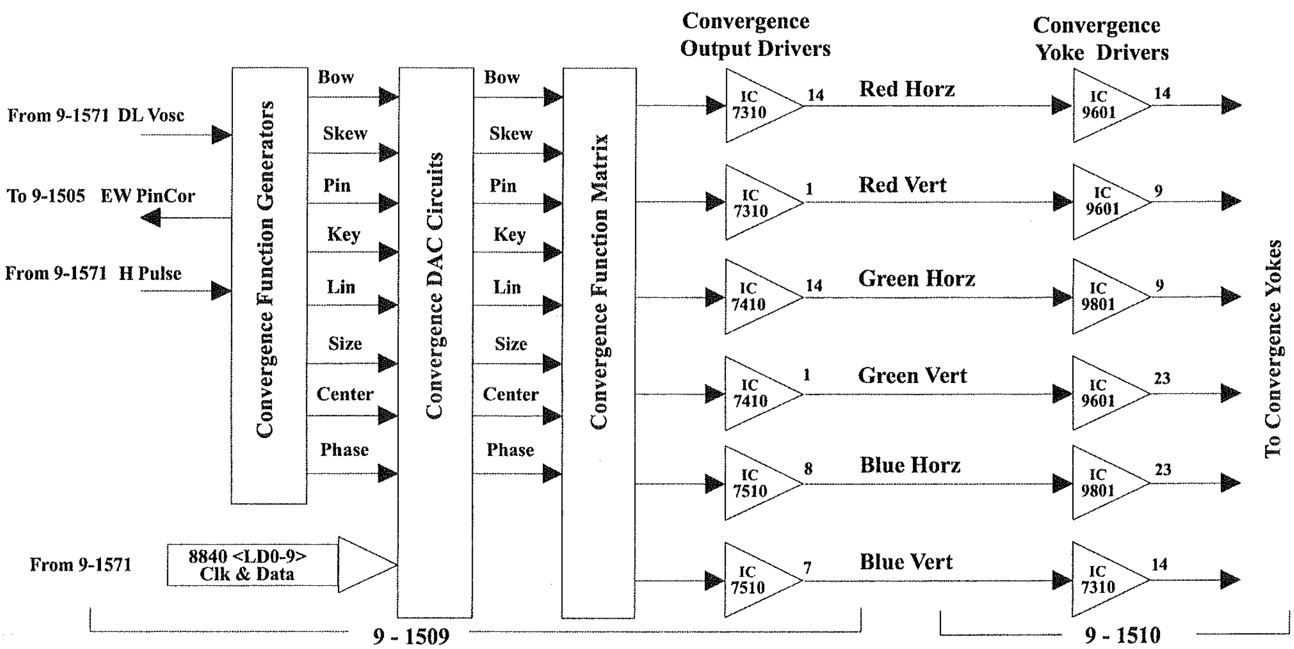
Horizontal Blanking - Programmable horizontal blanking output, synchronous with flyback. Start and Stop both clocked by 256fH. Control inputs range from 0 to 254.
Delayed Vertical Output - Programmable Vertical video phase, synchronous with vertical retrace, clocked with 2fH. Control input range (varies with the number of lines per field) from 0 to 2*lines per field - 1. Width programmable, clocked with 16fh. 8 bit control input range.
Vertical Blanking - Programmable Vertical Blanking, , synchronous with vertical retrace, clocked with fH. Control input range (varies with the number of lines per field) from 0 to 2*lines per field - 1.
MPI XMIT - TTL level serial data out @ 1200 baud for MPI.
RS232 Data Out - Standard RS232 Level output at 19.2k baud.
Horizontal Pulse Out: 5v CMOS Positive Pulse - Programmable Horizontal timing pulse out for analog convergence power amps. Start and Stop both clocked by 256fH. Control inputs range from 0 to 254.
8840 Data: 5v CMOS Positive Pulse - Serial Data for analog convergence control.
8840 Clock: 5v CMOS Positive Pulse - Clock for 8840 data. Rate = 32fH.
8840 Load 0 - 9: 5v CMOS Positive Pulse - Active high load strobes for analog convergence DAC's. 1 cycle of 32fH wide.

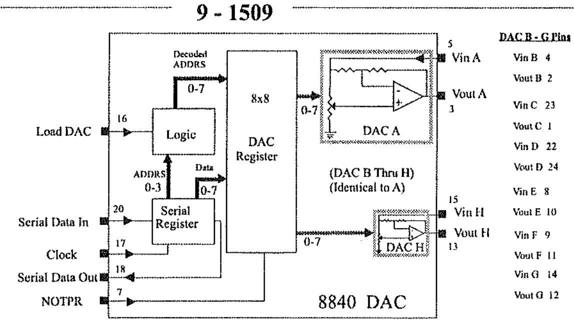
9-1509 ANALOG WAVFORM MODULE

OVERVIEW

This module is responsible for generation of 21 waveforms, contents and amplitude control of the 21 waveforms for 11 different drive waveforms. This module receives synchronization signals and digital control signals from the Convergence Controller Module 9-1571. It also receives DC offsets and a control signal from the Combo board, 9-1515.
The output from this module are;
1. The three separated vertical drives, green, red, and blue; (3)
2. Green, Red, Blue Vertical and Horizontal Convergence drives; (6)
3. E/W Correction with floor / ceiling compensation; for main deflection; (1)
4. Dual axis Dynamic Focus, with floor / ceiling compensation; (1)
Lets start in the vertical section, then we will go onto the horizontal section, and finally to the DACs and summation circuits for Vertical Drives and Convergence Outputs. Lastly will be the special outputs like the East West Correction and Dynamic focus.
Vertical Freerun Oscillator
(schematic sheet 7, area G2)
IC 7006, pins 1,2,3 and associated circuitry form an oscillator that only oscillates when no sync is received, or if the frequency of the sync is low. R7048M, R7049M, and R7050M form a divider that establish the thresholds for the oscillation conditions. C7038 and R7051M control the freerun frequency (about 35 Hz) by setting the discharge time and R7052M sets the charge time (about 200 usec) of the oscillator. When sync is present, C7038 is recharged by the positive pulses. The sync is passed to the Vertical saw generator IC7001, pin 5 by the diode D7002. When sync is not present, or to low of frequency, the voltage on C7038 discharges below the bias point on pin 3 (about 1.2 VDC). The output goes high, C7038 is charged through R7052M and D7006 until pin 2 goes above pin 3 then the output goes low. This output

9 - 1509/1510 Convergence System





NOTPR = active low reset - this resets the DAC to mid-range decimal 128/ output to 0.

Figure 44

pulse is passed to IC7001, pin 5 by D7007, supplying Vertical Deflection drive when sync has been lost.

WAVEFORM GENERATORS

MAIN WAVEFORM GENERATORS (IC7001 root source)
VS (Vertical Saw)
(schematic sheet 7, area F4)
IC7001 is a waveform generator with many different functional outputs. To continue the Vertical chain, the Vertical sync pulse is feed into pin 5, V. Blnk, and the IC generates a vertical rate saw (linear ramp) at pin 9 across C7004. There is an internal amplitude gain control system that keeps the saw amplitude constant over the operating range. Pin 27 is a reference bias input pin for the vertical saw and should be setup (by VR7018) at +1.00 V. The automatic gain control uses C7003 on pin 7 to average the feedback sample. The saw is output in two polarities, scan time falling on pin 9 and scan time rising on pin 10. Both polarity Vertical saws should be +/- 1 Vpp. V. SAW(-), pin 10, is inverted and buffered by IC7104, pins 1, 2, 3. This buffer has a small voltage gain of 2 so the output waveform at pin 1 will be +/- 2Vpp. This buffered signal is feed to many other loads labeled "VS".
VP (Vertical Parabola) & VPN (Inverted Vertical Parabola)
(sheet 7, location F5 and E5)
There is a vertical rate parabola that is generated by multiplying the vertical rate saw by itself using a internal analog multiplier with its output (+2 Vp) at IC7001, pin 11. The center of the vertical parabola is clamped to ground level by a feed back loop inside the IC, that uses the cap C7005 on pin 14 of IC7001. The vertical parabola signal has an unwanted dip during vertical retrace time and this dip must be gated out. This process is handled by one section of IC7002, CMOS analog triple pole double throw (3PDT), switch and buffer IC7004, C. The vertical sync signal is a pulse whose width is set by the Convergence Controller Module, 9-1571 at 200 usec +/- 4 usec. This sync signal is feed to the CMOS switch gate control input, pin 11. During the retrace time, the parabola signal is substituted by a reference signal created by IC7006, pins 5, 6, 7, from the vertical saw reference voltage. The reference voltage was setup at 1.00 VDC in the module alignment process, so after the gain of IC7006, the output, pin 7, should be 2.00 VDC. The output waveform at IC7004, pin 8 is parabolic during scan time and the 2.0 volt bias level during vertical retrace time.

HS (Horizontal Saw)

(sheet 7, location F5 and G10)
The remainder of the signals generated are horizontal rate waveforms or the above vertical waveforms multiplied by horizontal rate waveforms so we will now look at the horizontal rate chain. The CMOS horizontal sync pulse comes into IC7001, pin 24. R7004, D7003 and, D7004 are for arc protection. The horizontal saw is formed much the same as the vertical saw except the saw forming cap is inside the IC. Pin 25 is horizontal bias input. The saw waveform amplitude (+/- 1.0 Vp) is compared to the reference and the error voltage is integrated by C7008 on pin 21. There are both polarities of horizontal saw available, pin 20 has the falling during scan time and pin 19 has rising during scan time. The horizontal saw is buffered and inverted by IC7102, pins 1, 2, 3. The output on pin 1 should be +/- 2 Vp (4 Vpp).

HP (Horizontal Parabola)

(sheet 7, location F5 and F10)
The horizontal parabola is created by multiplying the horizontal saw by itself. The undesirable dip during the horizontal retrace time period is substituted by internal circuitry on the IC but the +2 Vp output is available on pin 18. The center of the horizontal parabola is clamped to ground level by a loop that uses the cap (C7009) on pin 15. This signal is buffered and inverted by IC7102, pins 5, 6, 7. The output is - 2.36 Vp at pin 7.

VSHS (Vertical Saw*Horizontal Saw)

(sheet 7, location F4 and C10)
The multiplied signals start on pin 12, with horizontal saw multiplied by vertical saw (VSHS). The product is created by a four quadrant type multiplier internal to the IC. At the top of vertical period, the horizontal is rising during scan time, and has a fast falling retrace time. At the bottom of the vertical period, the horizontal saw is inverted so it is falling during scan time. The signal is buffered and inverted by IC7104, pin 8, 9, 10. The output at pin 8 should be +/- 2 Vp (4 Vpp).

VPHS (Vertical Parabola*Horizontal Saw)

(sheet 7, location F4 and C10)
Pin 13 has the horizontal saw multiplied by a vertical parabola (VPHS). Since the Vertical parabola is always one polarity, the Horizontal. Saw component is always the same polarity. This signal is buffered and inverted. The output should be +/-2 Vp (4 Vpp) and is available at IC7104, pin 14.

VPHP (Vertical Parabola*Horizontal Parabola)

(sheet 7, location F5)
The horizontal parabola multiplied by vertical parabola signal is available on IC7001 at pin 16. It is only used a few places so it is not buffered. The output level should be +2 Vp.

VSHP (Vertical Saw*Horizontal Parabola)

(sheet 7, location F5 and F10)
The last multiplied signal generated by IC7001 is horizontal parabola times the vertical saw and +/- 1 Vpp is available on pin 17. This signal is buffered and inverted by IC7102, pins 8, 9 and, 10. The buffered output (VSHP) is available on pin 8 and should be +/- 2 Vp (4 Vpp over the vertical period). During the top of vertical period the horizontal parabolas should be negative and during bottom period, the horizontal parabolas should be positive.
Secondary Product Waveforms
The following waveforms use the above primary waveforms and modify them in some way to generated secondary waveforms. If debugging a module with a problem regarding these secondary waveforms, make sure the source waveforms are correct or some very strange results might mislead the service personnel.

VSINE (Vertical Sine)

(Sheet 7, areas C2 and E7)
There are several other signals necessary for convergence however they are generated by other circuits. The first we will discuss is called the vertical sine created by IC7105, B and IC7003, A. IC7003 is a four section XY multiplier. The

vertical saw is multiplied by the vertical parabola to create the vertical rate cubic function. IC7105, B subtracts the vertical saw to create a waveform that is not effected by vertical frequency and is similar to a vertical sinewave. VR7134 controls the amount of vertical saw that gets subtracted from the cubic waveform and must be setup to make the voltage at the beginning and end of scan time to be equal. The output is available on pin 5 and should be about 1.95 Vpp about ground.

HSINE (Horizontal Sine)

(sheet 7, locations C2 and D7)
The horizontal sine is generated the same way as the vertical sine by IC7003, D and IC7105, A. VR7136 sets the amount of horizontal saw that is subtracted from the cubic function generated by IC7003, and must be setup for equal voltage before and after the retrace period. The output at IC7105, pin 1 should be about 1.95 Vpp about ground.

VSHSINE (Vertical Saw*Horizontal Sine)

(sheet 7, locations B2 and B7)
Now that we have all the basic waveforms, saw, parabola, and sinewave, in both Vertical and Horizontal rates we can make the remaining product waveforms required. IC7003, B creates the product of Vertical Saw * HSINE (VSHSINE), and the signal is amplified and buffered by inverter IC7105, D. The output at IC7105, p14 should be +/- 1.75 Vp (3.5 Vpp).

VPHSINE (Vertical Parabola*Horizontal Sine)

(sheet 7, locations B3 and C7)
IC7003, C creates the product of Vertical Parabola * HSINE (VPHSINE) and the signal is amplified and buffered by inverter IC7105, C. The output at IC7105, p8 should be +/- 1.75 Vp (3.5 Vpp).

VSINE/ (Absolute Value of Vertical Sine)

(Sheet 8, area G3)
Now we move on to the VSINE and /VSINE/ (absolute value of VSINE) products with HS and HP. These waveforms are used to create T-KEY, T-PIN and LS (Left "S"). Lets look first at the creation of /VSINE/, the absolute value of VSINE. The VSINE goes to the absolute value circuit IC7004, A and B. When VSINE is positive portion of the waveform, D7041 conducts and an inverted portion of the sinewave is appears at the junction of R7041M and D7041, anode. During the negative portion of the sinewave, D7040 conducts and provides the canceling current so that 0 VDC would appear at the above junction with the anode of D7041. IC7004, B is a summation amp and receives two currents, one through R7043 of the VSINE and an inverted half sine during the positive portion of VSINE. Resistors R7043 and R7042 in parallel with R7056 have a 2:1 ratio so that giving the resulting waveform at IC7004, pin 7 of two equal positive sinewave shaped humps of +1.0 V0-p amplitude. If the above resistors ratio is not matched well the humps will be of different amplitudes. The unequal condition causes T-KEY and T-PIN not to cancel properly during the bottom of the vertical period.

VSINEHS & VSINEHP (Vertical Sine*Horizontal Saw & Vertical Sine*Horizontal Parabola)

(sheet 8, location F2)
VSINE*HS and VSINE*HP are created by IC7005, sections A and B respectively by multiplying the respective signals.
VSINE/HS & /VSINE/HP [(Abs. Val. Vertical Sine)*Horizontal Saw & (Abs. Val. Vertical Sine)*Horizontal Parabola]
(sheet 8, location F3)
VSINE/*HS and /VSINE/*HP are created by IC7005, sections D and C respectively by multiplying the respective signals.

T-KEY (Top Keystone)

(sheet 8, location G6)
T-KEY is created by IC7101, A by summing (/VSINE/*HS), VPHS, and (-VSHS) (through R7104, R7101 and R7102)in the correct ratios to cancel the bottom portion of the waveform vertically. To understand this cancellation better, it is necessary to understand that the product waveforms are only varying amplitudes of horizontal saws. The horizontal saw add or subtract from each other depending on the polarity. The amplitudes and polarities change within the vertical period. (/VSINE/HS) and VPHS all have the same polarity horizontal saws. In the (-VSHS) signal, the horizontal saws are opposite polarities at the top and bottom of the vertical period. The total summation signal amplitude should be about 5.3 Vpp at the top or beginning of the vertical period and less than 250 mVp at anytime during the latter, bottom half. The cancellation is not perfect, thus the remnant during the bottom of the vertical period.

T-PIN (Top Pincushion)

(sheet 8, location F6)
T-PIN is created by IC7101, B by summing (/VSINE/*HP), (-VPHP), and (-VSHP) (through R7109, R7107, and R7108) in the correct ratios to cancel the bottom portion of the waveform vertically. To understand this cancellation better, it is necessary to understand that the product waveforms are only varying amplitudes of horizontal parabolas. The horizontal parabolas add or subtract from each other depending on the polarity. The amplitudes and polarities change within the vertical period. The total summation signal amplitude should be about -2.5 V0-p at the top or beginning of the vertical period and less than +/-150m V0-p at anytime during the bottom half. The cancellation is not perfect, thus the remnant during the bottom of the vertical period.

LS (Left S)

(sheet 8, location E5)
LS is generated by IC7103, A. VSINEHP is subtracted from VSINEHS to cancel most of the waveform at the second half of the Horizontal period. If the divider ratios are incorrect then the waveforms will have excess signal at the right side of Horizontal period. The output should be about 2.24 Vpp at the 1/4 points vertically and left edge of the horizontal period. The output at any part of the right half of horizontal period should be less than +/- 0.25 Vp.

L-PIN

(sheet 8, location D6)

LPIN is generated by IC7004, D and IC7103, D. The negative portion of the signal -VPHS (which stands for inverse polarity of Horizontal. Saw multiplied by Vertical Parabola) is half wave rectified and by IC7004, D. IC7103, D buffers and inverts the signal so that the output at pin 14 is in the same polarity as -VPHS but only half of the waveform is present. The output should be about 2.56 Vpp positive only. The negative portion should be no lower than 25 mVp at the right half of horizontal period, anywhere during the vertical period.

LILIN (Left Inner Linearity)

(sheet 8, location E8)
IC7101, B and D half wave rectify the HSINE waveform. This circuit is very similar to the Vertical Sine generator above. When the sinewave input is positive D7101 conducts and passes the input signal waveform inverted to the junction of R7114M and R7115M. During the negative portion of the sinewave waveform, D7102 conducts and there is no output at the above junction. IC7101, D inverts and buffers the half wave rectified horizontal rate sinewave. The output should be about 1.9 V0-p positive only. The negative second half of Horizontal period should be no less than -25 mVp.

WM (bottom W and top M correction) (a.k.a. Gull wing or Cupids bow)

(sheet 8, location C8)
IC7106 is a dual two input four quadrant multiplier. It multiplies HSINE and HS to get a waveform with two negative going humps (H4), similar to a full wave rectified Horizontal sine but with smoother mid-zone. The H4 waveform is output at pin 9 and should be about -1.0 V0-p. The control VR7110 adjusts the bias voltage on HS as it goes into the multiplier. As the bias is raised or lowered the humps on the H4 waveform become unequal. When VR7110 is properly setup the humps are equal in amplitude +/- 100 mV. This control is to provide cancellation of small bias shifts on the incoming signals and internal offsets in the multiplier.
The H4 signal is then multiplied by VS (Vertical Saw). The output signal is available on pin 6 and should be about 1.9 Vpp over the total vertical period. This signal is used to correct cupids bow on top and bottom of the raster.

GAIN CONTROL DACs

The above discussed signals must be summed together in appropriate amplitudes and polarities to correct the geometric distortions in the Green, Red and Blue rasters to match them up. This matching up of all three colors on to one another is commonly called convergence. The outputs of the DACs are summed together with some pre-biasing of the above signals to generate the correction waveforms needed for each color and domain (horizontal or vertical). Some of the DACs control the amount of Vertical Drive for Green, Red and Blue deflection. All the DACs are the same IC and differ only in the signal they control and their micro address.

DAC8840P 221-979: DAC IC Function

There are ten ICs and eight individual analog controls in each IC for a total of 80 DAC controls. There is one input for each output. The gain is controlled by a digital number sent to the DAC by the serial data inputs. There is a SDI (serial data input), a CLK (clock input) and a LD (load input) inputs and an SDO (serial data output) but the output is not used. The SDIs and CLKs are common between all the DACs. The LD load inputs are separate and are feed from the 9-1473 control module. There is an "NOTPR" input which is an active low reset, which resets all the DACs to midrange. There is an RC time constant on the reset line to force the outputs to all go to zero if there are no digital communication.
When the DACs are set to midrange, 128 decimal, the output is zero. When the control number is +127D, the output is equal to the input signal in amplitude and polarity. When the control number is -128D, the output is inverted but the same amplitude as the input. At numbers in between 0D and +127D the amplitude varies linearly over the range, i.e. +64D gives the same polarity signal out as is at the input but 50% amplitude. The range for 0 to -128D is the same linear steps but reverse in polarity with respect to the input signal. One note about the numbering scheme. The +127D is not really available because it is blocked by the micro. Un-programmed memory comes with all 1's and there is a common memory failure mode of going to all 1's so that value is trapped out and shows up as a Loss of memory failure in the system.
There is a DAC map that correlates the control function, DAC number and signal source that can help with the debugging of a non functional DACs. It is sorted in two forms to assist in quick location.

Output Summation for Convergence Drive

Most of this section is just repetition so lets go through the Red Vertical Convergence drive to get a overview.

Red Vertical Convergence Drive

(sheet 5, locations G6, E6 and G11)
The output from IC7200, section A, (Red Vertical SKEW) pin 3 controls the Horizontal Saw waveform, feeds R7301M and that signal is summed together by OPamp IC7310, A in the summing inverter configuration. The gain factors are set by R7311M over a particular inputs series resistor. IC7200, B (RV BOW) pin 2 controls the Horizontal Parabola amplitude and feeds R7302M. IC7200, C (RV KEY) pin 1 controls the product signal VS*HS and feeds R7303M. Section D (TKEY) pin 24 controls the TKEY complex waveform and feeds R7304M. However, R7304M goes to the inverting input on IC7310, section B. This is also an inverting summation circuit, but its output is feed to the first section which inverts the signal again, thus the inputs to section B are not inverted with respect to the output. IC7200, section E (RV PIN) pin 10 controls VSHP amplitude and feeds R7305M which also feeds the non inverting input of the output summation pair. VSHP is one of the pre-biased signals by R7330M into the non-inverting input. This pre-biasing helps center the RV PIN control range and reduce the DAC step size. IC7200, sect. F (TPIN) pin 11, controls the TPIN signal and feeds R7306M which goes to the inverting input. IC7200, sect. G (TS) pin 12, controls the Top S waveform and feeds R7308M which goes to the inverting input. IC7200, sect. H (S-ING) pin 13, controls the VSHSINE signal and feeds R7307M which feeds the inverting input. IC7201, section A (RV IN-KEY) pin 3, controls the VSINEHS waveform and feeds R7309M which feeds the inverting input. IC7201, sect. B, (RV IN-PIN) pin 2, controls VSINEHP and feeds R7312M

which feeds the inverting input. IC7201, sect C (RV WM) pin 1, controls WM signal and feeds R7314M which feeds inverting input of the output summation amps. The differential input signals Digital Convergence module 9-1508, come in on 8H6, pins 2 and 4. Pin 1 is the shield ground and pin 3 is the signal reference ground. R7333 and R7334 are the load resistors for the DACs differential output (open collector pull down current sources). Resistors R7335M and R7336M feed the differential signals to the differential inputs of the summation output driver stage.
The output from IC7310, A feeds R7313M and then to the output at 8RG7, pin 6. The back to back 12V zener diodes are for arc protection. A common arc failure showed up as shifting DC at the output that gets worse with further arcs. These diodes help bypass the arc energy away from the ICs. R7282 and R7283 provide arc protection by limiting the supply current after an arc.

Red Horizontal Convergence Drive

(sheet 5)
Red Horizontal channel is very similar in topology to the Red Vertical but just with different DACs driving the summation amps with different signals. The other difference is in the pre-biasing. Some of the Horizontal LR LIN signal is pre-biased from Green Horizontal channel, through R7374M, to help reduce the range required of Red Horizontal LR LIN DAC. There is some WM signal pre-biased through R7375M to help give a fixed level of differential IN KEY that is a resultant of the optical firing angle of red. The horizontal DC centering control comes from the Combo module 9-1515, through connector 8B1, pin 11 and is filtered through L7022, R7260M and C7301 then fed to the positive input by R7345M.

Green Vertical Convergence Drive

(sheet 5)
The Green Vertical channel is very similar in topology but just with different DACs driving the green vertical summation amps with similar signals. The pre-biasing is the same as the Red Vertical channel discussed above. There are fewer controls for Green because it is the reference color.

Green Horizontal Convergence Drive

(sheet 5)
The Green Horizontal channel is similar in topology to the other channels but it supplies the Horizontal LIN LR pre-biasing for Red and Blue Horizontal channels. The horizontal DC centering control comes from the Combo module 9-1515, through connector 8B1, pin 9 and is filtered through L7024, R7261M and C7401 then fed to the positive input by R7445M.

Blue Vertical Convergence Drive

(sheet 6, areas G6-E12 and sheet 5, area C2)
The Blue Vertical channel is very similar in topology but just with different DACs driving the blue vertical summation amps IC7510, A and B with similar signals. The pre-biasing is the same as the Red Vertical channel discussed above.

Blue Horizontal Convergence Drive

(sheet 6, areas E6-A12)
Blue Horizontal channel is very similar in topology to the Red Vertical but just with different DACs driving the blue summation amps with different signals. The other difference is in the pre-biasing. Some of the Horizontal LR LIN signal is pre-biased from Green Horizontal channel, through R7374M, to help reduce the range required of Blue Horizontal LR LIN DAC. There is some WM signal pre-biased through R7575M to help give a fixed level of Differential IN KEY that is a resultant of the optical firing angle of red. Notice that the pre-biasing is input to the reverse polarity summation amp. This is because the blue tube is firing from the reverse angle. The horizontal DC centering control comes from the Combo module 9-1515, through connector 8B1, pin 7 and is filtered through L7026, R7265M and C7501 then fed to the positive input by R7545M.

Vertical Deflection Drive

(Sheet 6 location E2)
The Vertical Drive composition is arranged in a special way to give better linearity tracking with vertical size variations. There is a main signal that is a composite (by IC7211, A) of fixed amount of VS (Vertical Saw through R7211M)an adjustable amount of VP (Vertical Parabola through R7212M) and VSINE (Vertical Sine through R7214M). The amplitude of the composite signal is set by R7215M. R7216M and R7220M were added for arc protection and to help compensate for input bias currents. This composited signal is fed to a second stage, IC7211, B through a constant path by R7217M and a variable gain path through IC7209, A and R7218M for summation. The gain of this stage is set by R7219M in ratio with the above resistors. This Master output is feed to all three, red, green and blue vertical drive stages. Capacitors C7219M and C7220M are for high frequency bypassing. C7273M, R7278, and R7279 are for arc protection. They limit the supply current in case of a high current latch up due to an arc.

Master (Green) Vertical Deflection Drive

(Sheet 6 location f3)
The Master drive signal is feed to the Vertical Green Driver by R7221M. R7223M sets the gain of this output stage. C72267M was added to reduce the high frequency noise passed by this system. The Green Vertical DC centering is injected into the positive input of IC7210,D by R7222M and R7262M, from connector 8B1, pin 10, labeled GVPWM. The dc centering input is generated by a pulse width modulator style DAC and is filtered at the source on the 9-1515 and again on this module by R7262M and C7221. Capacitors C7217M, C7218M are for high frequency decoupling. R7280, R7281 and C7227M are for arc protection and current limiting if an arc does cause latch up of the OPamp. Resistor R7225 and zener diodes D7221M, D7222M are also for arc protection. The output at IC7210 pin 14 is inverted from the red and blue vertical drives and is feed to the Green Vertical. Drive (-) “GVD(-)”, 8A7 pin 7. The output stages on the 9-1510 module is a differential input amp uses the GVD(+) as a ground reference to help reduce the noise caused by ground currents in the system.

Red Vertical Deflection Drive

(sheet 6, location D2)

The Master drive signal is feed to the Vertical Red Driver by R7230M. IC7211, C sums and inverts the master drive and Top-Bottom LINearity (VPN) through IC7209,F and R7231M and LIN Center (VSINE) through IC7209, G and R7232M. This summed signal is feed to the input of DAC IC7209, E and to the output driver by R7233M. The output from IC7209, E pin 10 is additive or subtractive depending on the DAC setting and is summed to the output driver through R7234M. The output driver stage is very similar to the Green except that the drive is inverted and is feed to RVD(+) 8A7 pin 3. The DAC range is limited to cover only the variations in the circuits and yoke sensitivities. The Vertical Drive output can not ever go to zero or be inverted no matter what the DAC settings. (assuming that the ratio of the summation resistor is correct.).

Blue Vertical Deflection Drive
(Sheet 6 location C4)
The Master drive signal is feed to the Vertical Blue Driver by R7240M. IC7211, B inverts and sums the master drive with Top-Bottom LINearity (VPN) through IC7209, D and R7241M and LIN Center (VSINE) through IC7208, G and R7242M. This summed signal is feed to the input of DAC IC7209, H and to the output driver by R7243M. The output from IC7209, H pin 13 is additive or subtractive depending on the DAC setting and is summed to the output driver through R7244M. The output driver stage is very similar to the Green except that the drive is inverted and is feed to BVD(+) 8A7 pin 6. The DAC range is limited to cover only the variations in the circuits and yoke sensitivities. The Vertical Drive output can not ever go to zero or be inverted no matter what the DAC settings. (assuming that the ratio of the summation resistor is correct.).

East West Pincushion Correction (Main Deflection)
(Sheet 7 location D4 and Sheet 6 location F5)
The East West Pincushion Correction drives the main horizontal deflection module with a Vertical rate Parabola and a vertical rate saw of variable polarity. The polarity of the saw function is reversed between floor and ceiling modes.

EWKEY Generation

(Sheet 7 loc. D4)
IC7002, is a CMOS analog switch in a triple pole double throw configuration. The EWKEY output is from the common of the "Z" switch. The VS(+) is input to Z1 input and VS(-) is input to Z0. The switch is controlled by input C Pin 9 and is fed from FV input from 8B1, pin 4 and originates at the Combo module, 9-1515. When the software switch "FLOOR/CEILING" is in the CEILING mode FV=0 and the VS(-) is passed to EWKEY output, IC7002, pin 4. VS(-) is a fast falling slew and a slow rising vertical rate saw waveform. Conversely, when the software switch is in the FLOOR mode, FV=1 and the switch passes VS(+). VS(+) is a fast rising and slow falling vertical rate saw waveform.

EWPINCOR Generation

(Sheet 6 location F5)
The EWPINCOR is created by adding Vertical rate Parabola (VPN) to the EWKEY signal (from above). EWKEY is summed by R7251M and VPN is summed by R7255M into IC7210, A. R7252M controls the gain of the output signal about 9.1 Vpp at pin 1. The output waveform is a vertical rate parabola, about 2 Vpp, with the tips down ir-reguardless of the EWKEY polarity. R7250M and C7249 are only provisions and not used at this time. The EWPINCOR signal is feed to the horizontal deflection module, 9-1505, through connector 8C1 pin 3. R7254, D7203M and D7204M are for arc protection.

Dynamic Focus

(Sheet 7, location G8)
The Dynamic Focus amp IC7102, D sums together several different waveforms. The signal is dual axis and thus has vertical rate waveforms, horizontal rate waveform as well as two product waveforms. The image on the CRT phosphor is compressed at the bottom and expanded at the top (as viewed on a floor unit) thus requiring some top to bottom differential Dynamic Focus. When used in a floor unit the top to bottom differential will be reversed from a ceiling unit. With so many waveforms added together, this can be confusing. To help clarify, the explanation will add one waveform to the sum and describe the effects as if the following signals were not added yet. The graphic of the Dynamic Focus output waveform may help when going through this explanation
Vertical Parabola, VPN is summed to the non-inverting input of IC7102, at pin 12 through R7192M. Horizontal Parabola, H.PARA is also summed into the same node through R7191M. The resultant at this point is a constant amplitude HP riding on a VP. The product waveform of VP*HP is summed through R7193M. This has the effect of increasing the amplitude of the Horizontal Parabola but only at the top and bottom of the vertical rate.
Now for the top to bottom differential components. The EWKEY signal is summed by R7194M. This latest waveform simply skews the vertical rate parabola so it is higher at top than the bottom, or the reverse, depending on the EWKEY polarity. Switch SW7001 at the top of the module by connector 8A7, switches different polarities of a product waveform VSHP or -(VSHP). Because the signals are different amplitudes the summation resistors must be different. VSHP is twice the amplitude of -(VSHP) thus R7195M is used for summation of -(VSHP) and R7196M is added when VSHP is the source. At this point, the composite waveform is skewed so the when the vertical saw pushes the horizontal waveform up higher, the VSHP product adds to the horizontal parabola. Conversely, where the saw pulls the horizontal parabola lower, the horizontal parabola waveform amplitude is lowered.
The output from IC7201, pin 14 goes to the High Voltage module 9-1504, through R7199 to connector 8C1, pin 2. The outputs amplitude at pin 14 is about 9.3 Vpp. R7199, D7201M and D7202M are for arc protection.

9-1510 CONVERGENCE and VERTICAL OUTPUT MODULE

Overview

The 9-1510 module is the central power distribution point for the waveform modules, Analog and Digital for better noise characteristics. A fan was added to lower temperatures on the hybrid devices for better reliability. There is a Convergence

Power Amp Enable / Disable switch to aid in system debugging but it cannot be used in yoke ring setup.
The 9-1510 module contains the power output stages for Red, Green and Blue convergence as well as Vertical Deflection. There are six (6) convergence power amps in two hybrid devices, three channels each. There are three separate Vertical deflection output ICs. The module also contains current monitors for the +/- 29 Volt supplies and a missing supply detector. These circuits disable the convergence power outputs if either excessive current is drawn from the output supplies or if the +/- 16 VDC or +/- 29 VDC supplies is missing.
The power for the Analog Waveform Module, 9-1509, and part of the Digital Convergence Module, 9-1508 is distributed from the power supply to the 9-1510-01 to the 9-1509 and then to the 9-1508. This was done for a lower noise system.
The C-9 projo is adaptable to several different mounting and projection positions; front projection Ceiling/Floor, and rear projection Floor/Ceiling. In practical operation, when setting up the unit under different situations, such as Floor / Ceiling, Rear / Front projection, the yokes leads must be properly oriented. The deflection and convergence yoke leads must be appropriately reversed. The Vertical Deflection and Vertical Convergence yoke connections must always be reversed together. In later versions of the yokes, these two sets of leads are put together into the same four pin connector housing. These four pin housings are keyed so an extra header had to be added for the reversed yoke conditions. We left provisions for the old yoke connectors in the layout with future plans to depopulate, thus the apparent excess of yoke connectors. The Horizontal Convergence yoke leads are on a reversible connector.
We will first examine the Convergence Outputs and the protection circuits for them, and then the Vertical Outputs and the shutdown circuits for failed deflection.

Convergence Power Amplifier

(sheet 5)
The six convergence channels are comprised of two hybrids of three channels each. The first hybrid IC9601, has Red Vertical, Red Horizontal, and Green Vertical convergence drive. The second hybrid, IC9801 has Green Horizontal, Blue Vertical and Blue Horizontal convergence drive. We will look in depth at the first channel of IC9601. The other channels and the second hybrid are identical except for the circuit designators.

Red Vertical Convergence

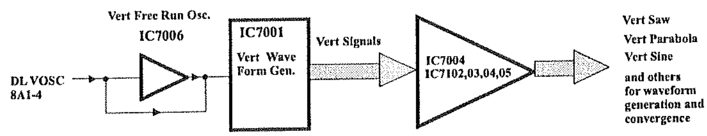
(sheet 5; locations G2 to B3)
The convergence amplifiers are configurated as voltage input and current output devices. The drive from the Analog Waveform Module 9-1509 is differentially connected (both inverting and non-inverting inputs). The Red Vertical channel's non-inverting input, IC9601, pin 5 is driven with the drive waveform through connector 7RG8 pin 6 and then goes to the input divider network R9601M, R9602M and C9601. The time constant of these components reduces the high frequency noise. The inverting input, pin 7, on this red channel is connected through R9603M to the GND_REF, ground reference, on 7RG8, pin 3 which goes to waveform modules local ground. This gives better noise rejection. C9603 limits the bandwidth of the power amp and helps keep the system properly damped.
The amplifier output, pin 9, goes to connector 8RV9F (Floor) pin 2 and 8RV7C (ceiling) pin 1. The output also goes to an output damping network R9606 and C9602. R9607 is the yoke current sampling resistor and feeds the feedback network R9604M, R9608M, C9604M and C9603M. Resistor R9605M was added for better open loop stability which helps keep the amp from oscillating when it recovers from saturation.
The hybrids require two sets of power supplies, a +/- 29 V for the driver stages and a +/- 29 V. The driver stages are powered by pins 3 and 4. These supplies are well filtered by L9573, L9574, C9576, C9577, C9578 and C9579. Each amp output stage has its own separate supply pin, +29V for pins 11, 12, 25 and -29V for pins 7, 16, 21. They are wired together for common filtering by L9571, L9572, C9570, CX9572, C9573 and CX9575. C9571 couples the negative driver supply with the output negative supply and was added to prevent high frequency oscillation.
Pin 1 is the ground reference for the hybrid's internal biasing. The reference current mirror input, pin 2, is used internal driver bias currents and we also use it for muting the driver stages of the amplifiers. R7563M supplies this reference current. The bottom of the current mirror input is referred to pin 3, the negative supply to the driver stage. When Q9537 is conducting it shunts the reference current around the input to the negative driver supply, thus disabling the driver stages. With the driver stages disabled the outputs go to a high impedance state. R9560 and R9561M are simply a voltage divider for the muting signal labeled "DISABLE". The source for the disable comes from the protection circuits on sheet 6.

Remaining 5 Convergence Channels

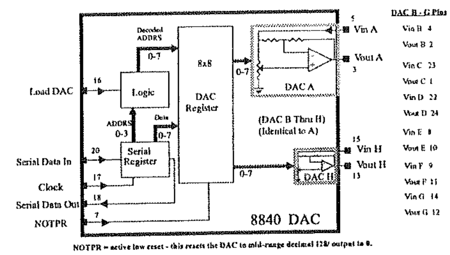
The above describes the complete Red Vertical Convergence channel. The other channels have the same topology so the same description can be used with the respective designators.

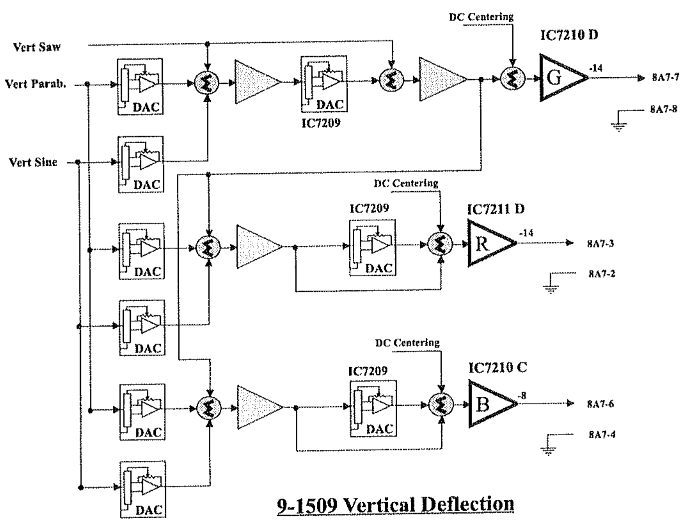
PROTECTION CIRCUITS

(sheet 6; location G8)
Connector 7S8 is for testing and debugging purposes. All supplies and protection circuit outputs are available on this header.
Supply Current Monitors
(sheet 6; locations D4 and E4)
There are two supply current monitors that monitor the current through the +29V and -29V supplies. Q9532, R9534M, and R9536M monitor the current through R9535, the -29 Volt current sampling resistor. C9532 provides a time constant to prevent false triggering from peak currents and momentary overloads. As the current through R9535 increases, the voltage drop across it rises until Q9532 turns on, somewhere between 2.5 and 4 amps DC. When Q9532 turns on it pulls down on the of Q9531, Base. When Q9531 conducts it pulls up on the DISABLE line, turning on Q9537 and Q9538, and mutes the power amplifiers. Q9531, in conjunction with R9531M, R9532 and R9533M is the +29V supply current monitor. C9531 provides a time constant to prevent false triggering from peak currents and momentary overloads.

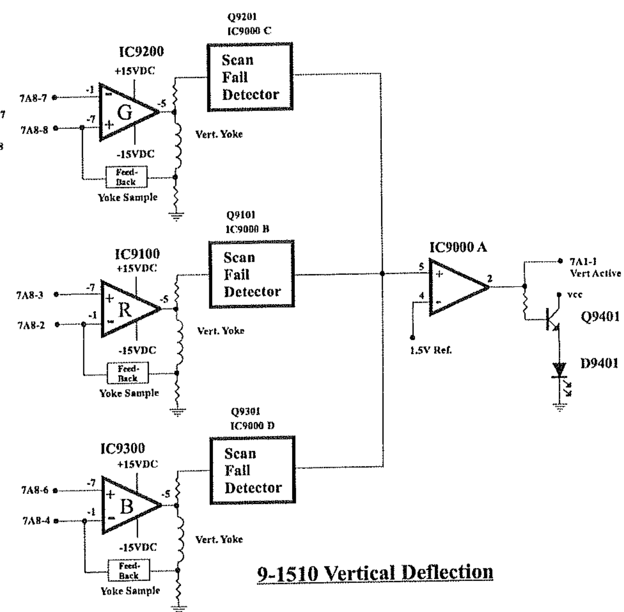


9-1509 Vertical Deflection Signal Generator





9-1509 Vertical Deflection



9-1510 Vertical Deflection

Figure 45

Voltage Monitors

(sheet 6; location E5)
Q9535 and Q9536 form an under-over supply detector. R9558, R9543, R9544, R9545M and R9546 form the divider for the supply monitors. Each supply provides current through its respective resistor. When all supplies are proper, the divider voltage at Q9535, Emitter and Q9536, Base is about 0, +/- 400 mV. If any single supply is missing, its counterpart will off bias the detectors node and one of the transistors conducts. When either of the transistors conducts it turns on Q9531, which disables the power amps. If the +15 V supply is low, the -15 V supply current offsets the detector node low and Q9535 turns on, thus muting the power amps. If both of the +/-29V supplies are missing the detector cannot mute because there is no current drive, thus no problem. If both of the +/-15V supplies are missing, then there can be no over drive condition.

Turn ON Delay

R9548 and C9533 mute the power amps for about 2 seconds, upon turn on. D9531 discharges C9533 for faster turn on / turn off transitions. SW9501 is a service switch for debugging purposes. When SW9501 and R9562 discharge C9533 and turns on Q9531, thus muting the power amps. When repairing a unit, if the convergence correction is jumping, use the switch to disable the power amps rather than repeatedly letting the power amp overload the power supply, possibly causing a secondary failure. This switch thus allows for safely testing system.

NOTE
SW9501 should not be used for Zeroing the DC centering component for yoke ring alignment. SW9501 does not disable the Vertical DC centering. That is done by the Vertical Deflection Outputs. Note that when the outputs go to a high impedance state the damping on the main Horizontal Deflection system changes and which will change Horizontal linearity. If Horizontal linearity changes, the position of the raster will shift and the yoke ring setup will no longer be valid.

Vertical Deflection

(sheet 4)
The Vertical deflection circuits deflect the CRT electron beam in the vertical direction, thus the name. The amplifiers are separated so that each amp can be driven differently. As such there are three separate drives, Red, Green and Blue. If any one of the vertical deflection systems fails, the CRTs can be damaged due to concentrated beam current burning the phosphor. There are three scan failure detectors to disable the HI Voltage system as soon as a failure condition is detected. These systems are redundant so only one will be discussed for each section, the Vertical Deflection and Vertical Scan failure.

Vertical Deflection

(sheet 4; location C3)
The Vertical Deflections composed of three separate Amplifiers for the Red, Green and Blue CRTs with internal retrace switches. This output amplifier circuit is DC coupled. The Vertical Drive signal is mostly Vertical rate saw tooth input that is about 6 Vp-p centered around zero volts. There is a slight amount of Vertical Parabola and Sinewave signals added for Vertical linearity of Top to Bottom and Center versus Edges. The deflection amplifier inputs are differentially connected to improve the noise rejection for the system. Compared to Red and Blue, Green is driven with a reverse polarity saw into its opposite input.
CX9103 is the pump-up cap used to create the extra supply for Vertical retrace period. D9101 charges CX9103 during scan time and is reversed biased when pin 6 is pulled high by the IC's internal circuitry. The top of the vertical yoke is coupled directly to the amplifier and the bottom of the yoke is coupled to ground with a small resistor, used for feedback to maintain constant size. Since the amplifiers are DC coupled, the vertical centering is also done in the Vertical deflection. R9107, C9107, and R9106 are the damping network across the deflection yoke. R9108 and C9106 help prevent high frequency oscillation. The yoke connectors have provisions for two different sets of yoke leads as well as options for reversing the yoke leads for floor versus ceiling mounted units.
The yoke current, in normal operation, is about 1.75 Amps p-p with an operating frequency of 47-120 Hz. It is powered from split supplies at +/- 15 Volts. The +15 Volt supply is filtered by L9101, C9101 and CX9102. The negative supply is filtered by L9102, C9104 and CX9105. RX9111 and RX9103 are fusible resistors and should open safely with any high current failure. The generic number for IC9100 is STV9379 from SGS or the Zenith number is 221-837.

4.2 Vertical Scan Failure System

(sheet 4; locations D6 to D8)
There are three scan detection circuits monitoring the three Vertical scan amplifiers. The outputs from these three detection circuits are OR'ed together and feed to anther comparitor, IC9000, section B which tells HI Voltage Supply that the Vertical scan is OK.
All three scan detectors are the same. We will only describe the Red detector. The scan detector looks for a Vertical retrace pulse at the deflection amplifiers outputs, at IC9100, pin 5. The pulse is level detected and inverted by Q9101. The input bias resistors R9113M and R9114M bias Q9101 so the output drive waveform pulse must go above the rail + 12 V supply rail or the signal will not pass. Then the pulse is clamped to ground by C9108, D9103. This signal is peak detected by D9104 and C9109 to nominally develop about 6 Volts DC. R9117 and R9118 give a discharge rate of about 2 vertical frames. R9119 provides positive feedback to help prevent oscillation when signal levels are around comparitor threshold. IC9000, section A is a comparitor, with a non-inverting reference input of about 1.5 VDC. This reference bias is set up by the +12 Volt regulator, IC9400 and bias network of R9408, R9409. R9413 and C9406 filter the reference supply. When the peak detected input is greater than 1.5, the output is high. If the peak detected signal is below the reference input the detectors output is low (about 0V). D9105 is part of the active low OR gate. If any scan should fail, the respective detector output will go low. If any output goes low, the VERT_ACTIVE output will go low disabling the HI-Voltage supply. R9401 is a pull up for this OR function. R9404 provides positive feedback to help prevent uncertainty in the signal to the HI Voltage supply. A low of any one of the

scan detectors sends a low signal to the HI Voltage power supply through connector 7A1, pin 1, turning it off. Q9401 is an LED driver. When scan is correct the LED, D9403 is lit. When any on of the scan fail detectors detects a failure the LED turns off.
Sensing the retrace pulse, as this circuit does, guarantees that the Vertical scan current is present. If the yoke lead is pulled, the output may go high but there will not be a retrace pulse so the detectors output will be low. If an output amplifier fails to a high a DC level, the signal will not pass the AC coupled input so the output of the detector will be low.

Description of 9-1507 Jack Pack Module

Jack Pack module inputs:
a. One Composite video BNC input with a loop through BNC output and switched 75 ohm termination.
1 V p-p. 75 ohm signal level.
NTSC, PAL (M, N, BGDI), SECAM
b. One Y-C (S VHS) input
Luminance (Y) input 1 V p-p. 75 ohm
Chrominance (C) input 0.68 V p-p. 75 ohm (75% Color Bars)

NTSC, PAL (M, N, BGDI), SECAM

c. One internal Y-C input pair for the SECAM to PAL transcoded signal from the 9-1511 SECAM module (Secam Y In , Secam C In).
Jack Pack module outputs:
a. Secam Y Out 2 V p-p. Luminance / Composite video signal to SECAM module.
b. Secam C Out 1.36 V p-p. Chrominance / Composite video signal to SECAM module.
c. Y/Vid Out 2 V p-p. Luminance / Composite video signal to 9-1506 DISP module.
d. C/Vid Out 1.36 V p-p. Chrominance / Composite video signal to 9-1506 DISP module.
The video switch is configured such that Secam Y Out and Secam C Out will have present any Y-C or Composite video signal that is connected to the input jacks with a 6 db. gain relative to the input. The active input is selected from the source menu on the on screen display (VIDEO or YC). In the case that Composite video is input and selected, Composite video will be applied to both Secam Y Out and Secam C Out. The Secam Y Out and Secam C Out signals are sent to the 9-1511 SECAM module.
The circuits on this module will analyze the signal to determine if it is receiving a valid SECAM signal.
If it is determined that a valid SECAM signal is present, a SECAM to PAL transcoded Y-C signal will appear at the Secam Y In and the Secam C In inputs to the Jack Pack module. The SECAM module will let the system micro know this (through IIC bus communication). The system micro will then send IIC commands to reconfigure the video switch so that the signals at Secam Y In and Secam C In are routed to Y/Vid Out and C/Vid Out.
If it is determined that a valid SECAM signal is not present, the video switch is configured by IIC to route the signals present at Secam Y Out and Secam C Out directly to Y/Vid Out and C/Vid Out.

In any case, Y/Vid Out and C/Vid Out serve as the final outputs of the Jack Pack module that are sent to the 9-1506 DISP module where the Y-C or Composite video input is decoded and processed to RGB.
The following chart denotes the switch positions for each type of input signal.

COMPOSITE VIDEO INPUT

	SW1	SW2	SW3	SW4	SW5
NTSC / PAL	A	B	B	A	A
SECAM	A	B	B	B	B

Y-C (S VHS) INPUT

	SW1	SW2	SW3	SW4	SW5
NTSC	D/C	A	A	A	A
PAL	B	B	A	A	A
SECAM	B	B	A	B	B

9-1515 Combo Module

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1.0 Overview

The 9-1515 module is part of the C9 wall projection chassis system containing the System controller, low-level sync/scan processing, and low-level RGB video processing functions. It is constructed using a double-sided plated-through hole PC board measuring 310mm wide by 298mm high. The 9-1515 interfaces to the rest of the C9 system through a 64-pin and a 12-pin edge connectors to the 9-1516 Carrier module. It mounts vertically in the chassis as part of a sub-assembly with the metal back plate and the 9-1507 Video Input module. R, G, B, H/Comp, and V sync BNC input jacks are located on the component side of the module, as are connectors for the processed R, G, and B video outputs, and a connector for the keyboard/IR module.

The Microprocessor Circuit Section includes a microprocessor, a PROM, an EAROM, and an OSD processor IC. Two separate I2C busses, one local to the 9-1515, and the other global, are used for control and communication. Port lines are also provided for specific control functions.

The Low-Level Sync/Scan Processing section includes two ASIC IC's, a Horizontal/Vertical Deflection Processor IC, and a handful of analog bipolar and digital CMOS SSI IC's. This portion of the 9-1515 module selects and processes incoming sync signals, provides information about those sync signals to the system microprocessor, provides Horizontal drive from a 1Fh PLL and Vertical Drive from an injection-locked Vertical oscillator, and also provides analog voltage control and digital on-off control to other circuits on the 9-1515 module, and throughout the C9 chassis.

The RGB Processing Section includes TV/EXT. RGB source switching, a Contrast Attenuator IC, individual R, G, and B processing IC's, as well as a handful of analog bipolar and digital CMOS SSI IC's for various control functions. Processing functions include Brightness, Contrast, R, G, and B gain and background controls, clamping, individual color muting, OSD insertion, ABL, and AKB insertion.

2.0 Power Supply

The +7.6V standby supply comes into the 9-1515 from pins 32 and 64 of connector 4A1. This, after filtering, provides the input to pin 1 of the regulator IC6003. The +5 standby supply used on the rest of the board derives from pin 7 of IC6003, and is separated by inductors L6036, L6035, and L6019, to form the +5SBA, +5SBB, and +5SBC supply voltages, respectively. A control output from the microprocessor is input to pin 3 of IC6003 to turn on (input = +5V) and off (input = 0V) the +5 switched supply, which derives from pin 6 of IC6003 and is separated by inductors L6025 and L6026 to form the +5B and +5C supply voltages, respectively. There is a RESET output from IC6003 pin 5 which will fall to a low (0V) level when the supply voltage on pin 1 falls below the threshold level. This output is connected to the RESET input of the microprocessor, and is to the convergence reset control line through diode D5217M in order to pull that control down whenever the RESET falls to a low level.

When the +5V standby supply is operating, current will flow through R6109M and LED6004, lighting the LED for status information.

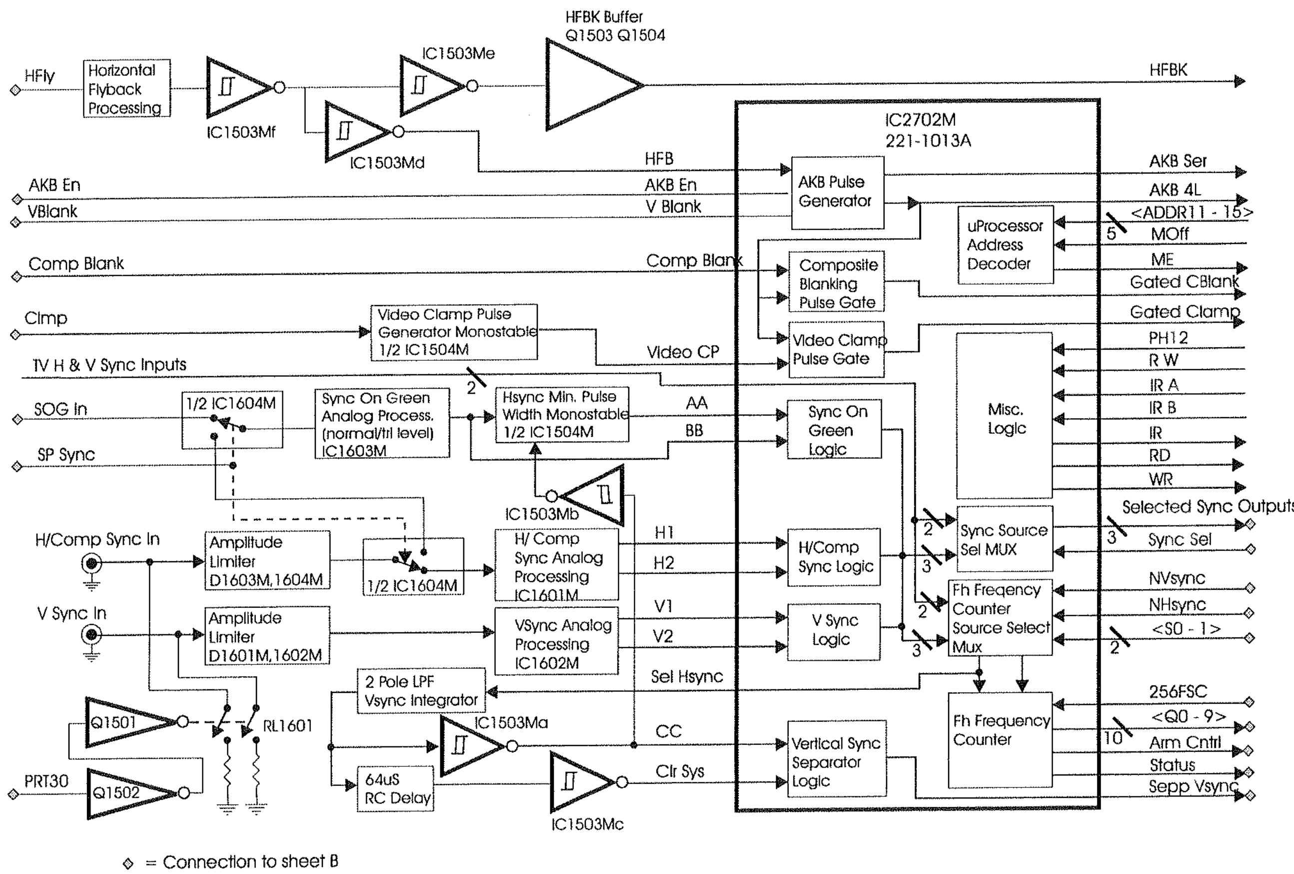
A 12 volt regulator IC6005 is supplied by the +15V input to the 9-1515 from pin 1 of connector 4B1. Its output is connected through inductors L6023 and L6022 to form the +12B and +12C supply voltages, respectively.

The -15V supply voltage derives from pin 8 of connector 4B1 and is separated out by inductors L6021 and L6020 to form the -15B and -15C supply voltages, respectively.

3.0 Microprocessor

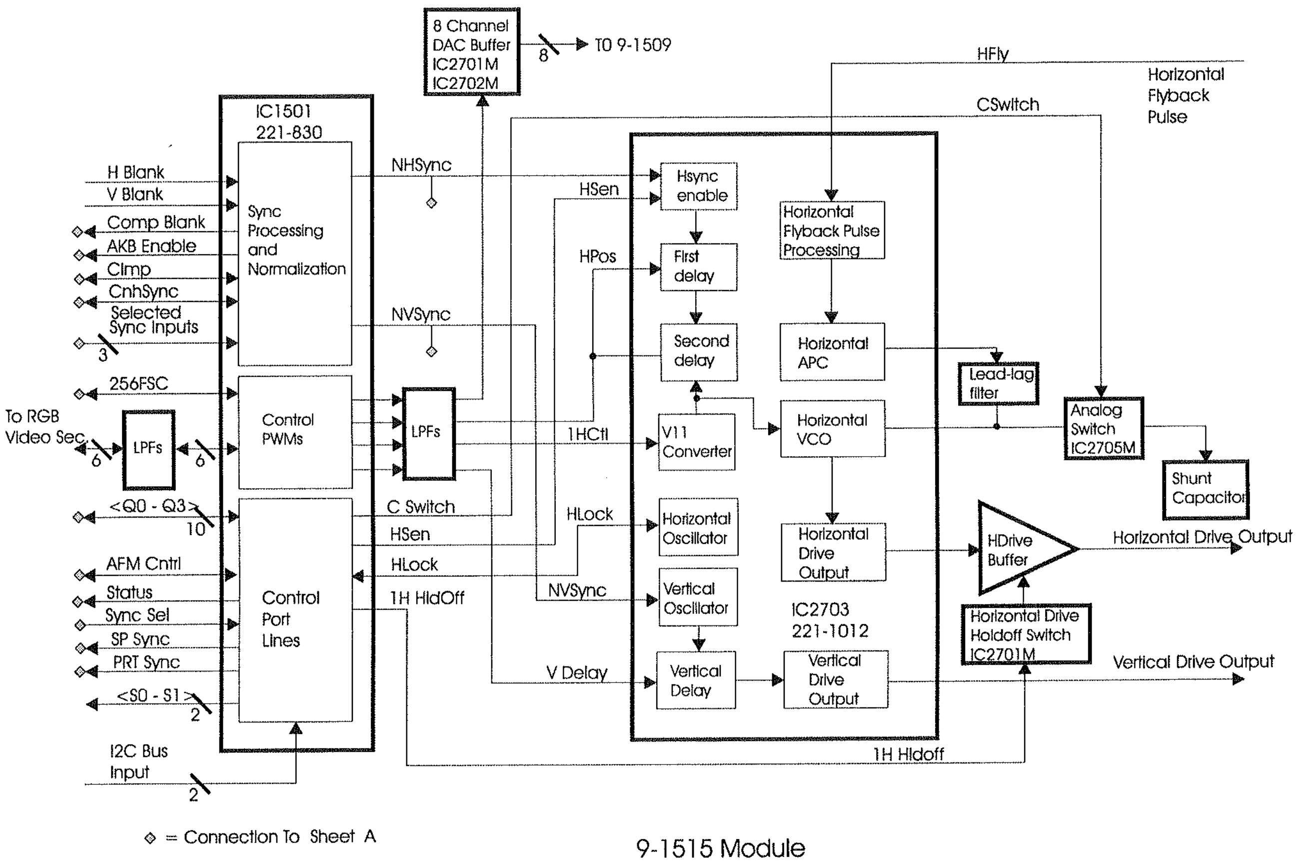
The main system microprocessor is IC6010 (221-1018), and ITT CCZE+ emulator packaged in an 80 pin QFP. It requires +5 supply voltages applied to pins 58 and 68, and its reset pin, which must be at a +5 level in order for the part to operate, is pin 78. It must be grounded at pins 77 and 47. Its clock source is a 12.083916 MHz crystal, CR6000, connected to pins 66 and 67. Certain signals used in emulation are tied to +5 through 10K pull-up resistors in order to allow proper operation: TEST (pin 27), EMU (pin 28), NMICPU/ (pin 32), and RESCPU/ (pin 33).

The microprocessor has 16 address lines (0-15 = pins 69, 70, 71, 72, 73, 74, 75, 76, 49, 50, 51, 52, 53, 54, 55, 56) and eight data lines (0-7 = pins 11, 12, 13, 14, 15, 16, 17, 18), which interface directly to the external PROM program memory IC6009 (221-27C512), a 28 pin DIP package (address 0-15 = pins 10, 9, 8, 7, 6, 5, 4, 3, 25, 24, 21, 23, 2, 26, 27, 1; data 0-7 = pins 11, 12, 13, 15, 16, 17, 18, 19). The address lines A15-A11 are connected to the ASIC IC1502M, along with the PHI2 (pin 31) and R/W (pin 29) clocking signals from the microprocessor, to create the Chip Enable and Read control lines for the PROM (pins 20 and 22). The ASIC performs an



9-1515 Module
Sheet A
Input Sync Processing and ASIC IC

Figure 46



9-1515 Module
Sheet B
Low Level Scan Circuit and UMFEP IC

Figure 47

address decode, as addresses less than 800 Hex are decoded internally within the microprocessor for RAM functions, and addresses greater than or equal to 800 Hex are intended to access the external PROM memory. All address, data, chip enable, and read lines are +5V/0V digital logic. The +5V supply pin for the PROM is pin 28; the ground pin is pin 14.
Provisional connectors CON1 (three pin), CON2 (three pin), and CON3 (six pin) are provided for use with a software emulator. They are not active when the PROM is being used for program memory.

3.1 Keyboard/IR Connections

The connector for the external keyboard is 4A9. Pins 5-11 of the connector are the input lines for the keyboard. A low level (0V) on any of these lines indicates that a key has been pressed (they will otherwise be pulled up to +5V with 100K resistors). If all 7 lines are at a low level simultaneously, the microprocessor will react by suspending all activity on the IIC bus. This is done to allow an external device to control the bus if a special "shorting plug" is connected to the keyboard input. The key functions are as follows:

4A9 connector pin	Function	IC6010 Port #	IC6010 Pin #
5	On/Off	3-6	64
6	Menu	3-5	63
7	Enter	3-4	62
8	Adjust Right	3-3	61
9	Select Up	3-2	60
10	Select Down	3-1	59
11	Adjust Left	3-0	57

Pin 4 of connector 4A9 will drive an LED located on the keyboard to indicate that the set is turned on. It is connected to the collector of Q6002M, whose base driver is connected to the +5 switched supply control line. Pin 1 of 4A9 is ground; Pin 3 is +5V standby.
The IR input from the keyboard (IR-A) comes in pin 2 of 4A9. This signal, which is active low, connects to the ASIC device, where it is logically ANDed with the IR-B signal from the front IR detector (also active low) which comes to the 9-1515 on pin 18 of connector 4A1. Both the keyboard and the front IR detector must be connected in order for the IR function to work. The resulting IR signal is connected to the microprocessor pin 44 (the IR input). This same signal also gets shaped and buffered (Q6007M, Q6008M) before it is sent off the board as an IR-OUT signal connected to pin 50 of 4A1. This signal is connected to the MPI output port.

3.2 IIC Bus

There are two IIC bus connections to the microprocessor. The first is the Standby Bus, which is pulled up to the standby +5V and may operate with the set turned on or off. The SDA line connects to pin 37 (port 1-4) of IC6010; the SCL line connects to pin 36 (port 1-3) of IC6010. The only devices connected to this bus are resident on the 9-1515 module: the EAROM (IC6001) and the UMFEP (IC1501M). A three pin connector CON5 is provided to look at the bus signals, with SDA on pin 1, SCL on pin 3, and ground on pin 2. This IIC bus operates at 100 Khz and is pulled up with 4.7 K resistors (R6056M, R6057M).
The second IIC bus is the Switched Bus, so named as it is pulled up to the +5V switched supply and cannot be operated unless the switched supply is turned on. The SDA line connects to pin 8 (port 0-7) of IC6010; the SCL line connects to pin 7 (port 0-6) of IC6010. It is connected directly to the OSD processor, IC6007, and then to a quad analog switch, IC6002M, a 14 pin SOIC package. This is used to selectively allow the IIC bus to pass to the rest of the system or to switch in two lines passively pulled up to +5V. This permits the IIC bus to run at 750 KHz when communicating with the OSD device (the passive +5 pull-ups connected the rest of the system, which cannot handle this speed) and at 100 KHz at all other times (the IIC bus passed through the switch). This bus is pulled up with 2.2 K resistors (R6047M, R6015M). The IIC bus is passed through when pin 80 of the microprocessor (port 0-1) is driven high and pin 1 (port 0-2) is driven low. The passive pull-ups are switched in when pin 80 is driven low and pin 1 is driven high. Pin 80 connects to pins 12 and 5 of IC6002M, to enable input 4 (SCL, pin 11) and input 2 (SDA, pin 4) to pass through. Pin 1 connects to pins 13 and 6 of IC6002M, to enable input 1 (+5V, pin 1) and input 3 (+5V, pin 8) to pass through. Outputs 3 and 4 (pins 10 and 9) are tied together and connected to the SCL2 IIC bus connection on pin 17 of 4A1. Outputs 1 and 2 (pins 2 and 3) are tied together and connected to the SDA2 IIC bus connection on pin 49 of 4A1. The supply pin for IC6002M is pin 14; its ground is on pin 7.

3.3 EAROM

The non volatile memory for the 9-1515 is IC6001, a 64 Kbit memory device in an 8 pin DIP package. It stores all setup and alignment information related to the use of controls excepting those resident on the DISP module, which has its own remote EAROM. It is read when the set is first plugged in to download most information and is accessed thereafter as necessary.
It is connected to the standby IIC bus, with the SDA line connected to pin 5 and the SCL line connected to pin 4. The +5V supply is connected through inductor L6013 to pin 8 and all other pins are grounded.

3.4 OSD Processor

The OSD processor is IC6007, an SGS STV9424 in a 16 pin DIP package. It is sent commands over the switched IIC bus, with the SDA connected to pin 10 and the SCL connected to pin 9. Its RESET line (pin 11) is connected to pin 79 of the microprocessor (port 0-0), which will drive it low to reset and high to enable normal operation. The +5V supply is connected to pin 4 and its ground is connected to pin 12. A test pin, pin 16, is also grounded. Its internal processor runs on a clock generated from the external 12.089316 MHz crystal CR6001, connected to pin 7 and 8. It expects a horizontal rate sync signal, derived from flyback (HFBK), to be connected to pin 3. The pulses should be active high. It will also expect a vertical rate sync signal, derived from the delayed vertical oscillator (DL-VOSC, pin 48 of 4A1), to be connected to pin 2. The pulses for this input should also be active high. The fast blank output signal from pin 1 is sent to the on screen display switching circuits directly (FASTBLANK) and to pin 54 of 4A1 (FBOUT) after the Q6001M buffer stage. Its outputs for R, G, and B, come from pins 13, 14, and 15, and are output to the on screen display switching circuitry after the Q6003M, Q6004M, and Q6005M buffer stages, respectively.

3.5 Port Control Signals

3.5.1 POWER1, POWER2, POWER3

These three control signals are active low, and connect to the power supply modules via the carrier board through pins 52, 20, and 51, respectively, of connector 4A1. These are open collector outputs from transistors Q6010M, Q6011M, and Q6012M. The active high base drivers for these transistors connect to the microprocessor (IC6010) pins 40 (port 2-1), 41, (port 2-2), and 42 (port 2-3).

3.5.2 UMFEP-RESET

The UMFEP reset control line connects directly from pin 48 (port 2-7) of the microprocessor, IC6010, to pin 52 of the UMFEP, IC1501M. It is driven to a high level to reset the UMFEP. When the set is turned on, the line should be held low for normal operation.

3.5.3 CONVRST

Pin 79 (port 0-0) of the microprocessor IC6010 provides the signal for resetting the convergence board. This signal also connects directly to pin 11 of IC6007 (the OSD processor) as its reset, and connects to pin 6 of the provisional connector CON3 for external software emulation. When this pin is low, a reset condition is set. It may be pulled low by diode D5217M if the reset line of the regulator IC6003 becomes low. The signal is inverted (reset = high) by transistor Q6006M and connected to pin 13 of connector 4A1. The reset condition is held when the set is turned off and released when the set is powered up. If the 9-1571 board fails to respond to polls of its address on the IIC bus for more than five seconds while the set is fully on, a short (20 mS) reset pulse will occur on this line in order to reset the convergence control module.

3.5.4 HFREE

This is a provisional control line intended for the DISP module. It connects to the carrier board on pin 22 of connector 4A1, and derives from the microprocessor IC6010 on pin 25 (port 1-0). It is not used at this time and should be low at all times.

3.5.5 HT, HT1

These signals are provisional control lines for the implementation of a half tone on screen display. These would be driven high much as a fast blank output in order to drive the video to half intensity. As the on-chip OSD processing in the microprocessor is not used, these control lines are inactive in the current design.

3.6 Input Status Signals

3.6.1 TEMP1, TEMP2

These two status lines enter the 9-1515 on pins 21 and 19, respectively, of connector 4A1. These lines will be driven high by the external (to the 9-1515) temperature sensors if the ambient temperature level becomes too high. If either line becomes high (there are two separate sensors provided for), the microprocessor will shut the unit off (if turned on) after three minutes. Pull down resistors R6038M and R6039M are provided for on the 9-1515 to insure that the signals come up at a harmless level, even if the external sensors are not attached.

3.6.2 H-ACTIVE

This status line enters the 9-1515 from pin 56 of connector 4A1. It will be at a high level when the horizontal scan is active. It is divided down by the resistor pair R6103/R6045M before entering the base of transistor Q6013M. When active, it will drive the collector to a low level, which is reported to the microprocessor IC6010 on pin 2 (port 0-3). The current will be drawn from +5V standby through R6100M and LED6001, which will be on when the H-ACTIVE signal is high. No action is taken by the microprocessor in response to the level of this signal.

3.6.3 V-ACTIVE

This status line enters the 9-1515 from pin 25 of connector 4A1. It will be at a high level when the vertical scan is active. It is divided down by the resistor pair R6104/R6049M before entering the base of transistor Q6014M. When active, it will drive the collector to a low level, which is reported to the microprocessor IC6010 on pin 5 (port 0-4). The current will be drawn from +5V standby through R6101M and LED6002, which will be on when the V-ACTIVE signal is high. No action is taken by the microprocessor in response to the level of this signal.

3.6.4 VIDENBL

This status line enters the 9-1515 from pin 5 of connector 4A1. It will be at a high level when the high voltage is active. It is divided down by the resistor pair R6105/R6048M before entering the base of transistor Q6015M. When active, it will drive the collector to a low level, which is reported to the microprocessor IC6010 on pin 6 (port 0-5). The current will be drawn from +5V standby through R6102M and LED6003, which will be on when the VIDENBL signal is high. When the microprocessor reads a high level on pin 6 (VIDENBL = low), it will disable the AKB pulse (controlled through the UMFEP) and set the contrast and brightness levels to minimum. These will not be restored to their normal states until the microprocessor reads a low level on pin 6.

3.7 Input Control Signals

3.7.1 Vsync

Vsync is a vertical rate sync signal, derived from the delayed vertical oscillator (DL-VOSC, pin 48 of 4A1), and is connected to pin 2 of IC6007 (the OSD processor) and pin 23 of IC6010 (the microprocessor). The pulses should be active high. The input to the microprocessor may be used for closed caption decoding and OSD generation, though these options are not exercised.

3.7.2 Hsync

Hsync is a horizontal rate sync signal, derived from flyback (HFBK), and is connected to pin 3 of IC6007 (the OSD processor) and pin 24 of IC6010 (the microprocessor). The pulses should be active high. The input to the microprocessor may be used for closed caption decoding and OSD generation, though these options are not exercised.

3.7.3 CAP-VID

This signal enters the 9-1515 from pin 16 of connector 4A1. It is coupled by capacitor C6017M and connected to the microprocessor IC6010 on pin 3. This signal is a 1.5 V peak to peak composite video signal derived from the DISP module. It was intended for use in decoding closed captions, though that capability is not exercised by the microprocessor software. This signal is not currently in use.

4.0 Sync Processing

4.1 RGB Sync Processing

The RGB Sync Processing function can be divided into two major blocks; the analog front-end processing, and the digital processing.

4.1.1 Analog Front-End

The H/Comp and V sync inputs from the BNC connectors located on the 9-1515 module are processed through nearly identical channels, so that the following description of the operation of the V sync input channel from connector 4G9 also applies to the H/Comp sync input channel at 4H9.

The input is AC-coupled and peak limited (C1601, R1601, D1601M, D1602M). This limiting stage optimizes the performance of the front-end sync processing over a wide range of sync amplitudes and duty cycles. After limiting, the sync signal is again AC-coupled and fed to both non-inverting inputs of a Dual High-Speed Comparator, IC1601M, pins 4 and 9. This point is biased through R1611M to the center tap of a resistor divider network (R1607M, R1608M, R1609M, R1610M). The inverting inputs of IC1601M, pins 10 and 5, are tapped approximately 0.5V above and below the center tap respectively. Using this arrangement, a positive (active high) sync pulse results in a positive pulse of 0 to +5V level at pin 7, and a steady +5V level at pin 12 of IC1601M. A negative (active low) sync pulse results in a negative pulse of +5V to 0V at pin 12, and a steady 0V level at pin 7. With no input, pin 7 will be at a steady 0V state, and pin 12 will be at a steady +5V state.

4.1.2 Digital Processing

Both comparator outputs go to inputs on ASIC IC1502M, in which logic circuits decode these states and output a single CMOS-level sync signal with the same polarity as the input sync signal. In RGB mode, this signal goes to the UMFEP, IC1501M (221-830) for further processing. A normalized version (always positive polarity) of the decoded sync signal also goes to the Horizontal Frequency Counter through a one-of-four MUX, all inside IC1502M.

4.1.3 Input Terminations

When relay RL1601 is energized through Q1601 and Q1602, the H\Comp and Vsync inputs are both terminated with 75 ohm resistors. The control line for this function comes from PRT 30 on the UMFEP IC1501M.

4.1.4 Special Composite Sync Mode Switch

When the Special Composite Sync mode is selected, the H/Comp sync input is switched to the Sync-on-Green processing circuit, which is described below. This is to allow for use of a sync signal consisting of only the sync portions of a composite video signal, either normal or HD. When the Special Composite Sync mode is selected, the system microprocessor does not use it's normal sync input search algorithm, and assumes that the sync input signal is consistent with a normal sync-on-green signal, minus the active video. The control line for this function comes from PRT 26 on the UMFEP IC1501M.

4.2 Sync-on-Green Processing

The Sync-on-Green processing function can process either Normal or Tri-Level syncs.

4.2.1 Sync Tip Clamp and Composite Sync Separator

The Green Video input is passed through emitter follower Q5216M, which also limits the signal's bandwidth to about 8Mhz. This signal is AC coupled to the inverting input of comparator IC1603M , where it is compared to a reference voltage on the non-inverting input at pin 4: When the pin 5 voltage dips below the pin 4 voltage, the comparator output at pin 12 goes high (+5V). This forward-biases diode D1605M, which increases the charge in capacitor C1618M. The C1618M voltage is used to provide a bias voltage through R1624M for the AC coupled input signal at pin 5, and once this bias voltage level exceeds the pin 4 reference level, the output at pin 12 goes low. As the description shows, the most negative portion of the incoming signal at pin 5 is therefore clamped to the level of the reference voltage at pin 4. In the case of Sync-on-Green video, this corresponds to the negative peak of the sync pulse.

The AC-coupled clamped input signal at IC1603M pin 5 is also applied to the inverting input of the comparator at pin 10. This signal is compared with a second reference voltage at the non-inverting input at pin 9. The pin 9 reference is approximately 100mV higher than the pin 4 reference; creating a "slice" level for the pin 10 signal, in that the portion of the signal that falls below this reference voltage appears as a high level (+5V) at the comparator's output at pin 7, and the portions where the voltage level exceeds the reference force the pin 7 output low. In this way, the pin 10 comparator functions as a sync separator on the incoming processed video, and the resulting separated composite sync signal is used in the stages that follow.

4.2.2 Hsync Pulse Minimum Width Logic

When separated from video by the circuitry in 4.2.1 above, the horizontal pulse width of a SMPTE-standard HDTV signal is typically .5uS, whereas all the other formats supported by the C9 chassis design are 1uS or longer (NTSC is 4.5uS). This fact suggests that the presence of an HDTV-type signal can be inferred by the width of the separated horizontal pulse. This inference becomes important for proper back-porch clamp circuit operation as described below.

The trailing edge of the separated HDTV horizontal pulse occurs while the positive portion of the tri-level sync is present on the green video at the input. If the back-porch clamp pulse were to be generated directly from this trailing edge (as is normally the case), the video would be clamped to the wrong level. If the start of the video clamp pulse can be delayed until the positive portion of the tri-level sync pulse ends, there is ample back-porch time available for video clamping.

The separated composite sync pulse is applied to the B trigger input at pin 10 of IC1504M. The rising edge of the input triggers a monostable multivibrator, which generates a positive-going pulse with a width of 1.1uS at the Q output at pin 5. This pulse is applied to one input of an OR gate inside ASIC IC1502M, which OR's the pin 5 pulse with the trigger pulse at pin 10, resulting in an output from the OR gate (pin 26 of IC1502M, SEL_HSYNC) with a minimum pulse width of 1.1uS (the output pulse from IC1504M pin 5). Any separated composite sync pulse with an pulse width greater than 1.1uS stays unchanged in width coming out of the OR gate.

With an HDTV input signal, a back-porch clamp pulse of 1.1uS triggered from the falling edge of the signal at pin 26 of IC1502M (SEL_HSYNC) will occur after the end of the positive tri-level sync pulse and during the video back-porch region. For the case of an RGB signal with NTSC timing, the same 1.1uS back-porch clamp pulse triggered from the falling edge of the SEL_HSYNC signal will occur immediately following the end of the 4.5uS sync pulse, and during the video back-porch region.

4.2.3 Vertical Sync Separator

The composite sync in from the Hsync Pulse Minimum Width Logic circuit is applied to the 2-pole low-pass filter (vertical sync integrator) R1512M, C1505M, R1513M, C1507M. The values of these components are selected to provide a delay of less than 1/2 line at 33kHz to the vertical sync pulse. A Schmitt-trigger input inverter gate, IC1503Ma, is used to square up the output of the low-pass filter, which is a slightly delayed version of the vertical sync portion of the composite input. The output of IC1503Ma at pin 2 is applied to the Data input of a D flip-flop inside ASIC IC1502M at pin 25. This input is clocked through the flip-flop by the rising edge of the SEL_HSYNC pulse connected internally to the flip-flop's Clock input. In the case of the 33kHz HDTV signal, the rising edges of the 2H horizontal equalizing pulses do the clocking. Since these equalizing pulses occur at a half-line rate, and the flip-flop's Data input is delayed by less than 1/2 line, the resulting clocked V_sync from the flip-flop's Q output always goes low CO-incident with the rising edge of the first equalizing pulse after the start of the vertical sync pulse. This result is consistent from field to field, and therefore the leading edge of the V_sync output pulse preserves accurate interlace timing.

The Vertical Sync Separator circuit operates in the same way for any composite sync input with a serrated Vertical sync pulse, whether it is progressive or interlaced. One special case of computer sync that has to be accommodated is that of OR'd composite sync, where the vertical sync pulse is not serrated by 1H or 2H horizontal pulses. When a non-serrated vertical sync pulse occurs, the 2-pole low-pass filter operates normally, producing an integrated output pulse at the Data input of the D flip-flop inside ASIC IC1502M at pin 25. However, with no edges available at the flip-flop's Clock input, this pulse cannot be clocked through the flip-flop, and the state of the Q output remains unchanged. To overcome this limitation, an extra RC delay of just over 1 line at 33kHz (R1515M, C1571M) is connected to the output of the 2-pole low-pass filter. This pulse is also squared-up through a Schmitt-trigger input inverter gate, IC1503Mc, and it's output at pin 6 is applied to the Clear input of the D flip-flop inside ASIC IC1502M at pin 32 (CLR_SVS). This second delayed pulse forces the output of the flip-flop to change states, if it has not already done so. The resulting V_sync pulse is adequate for progressive scan operation.

In all cases, the V_sync pulse is terminated by clocking the output of IC1503Ma at pin 2 through the D flip-flop inside ASIC IC1502M at pin 25 by the first horizontal pulse following the end of the second delayed pulse from IC1503Mc, pin 6. In the C9 application, the placement and consistency of this edge is relatively unimportant, as the vertical deflection circuits trigger off the leading edge of the V_sync pulse.

4.3 TV Mode Processing

Dual 1 of 2 MUX's inside IC1502M select between the processed RGB syncs and the TV_HSYNC and TV_VSYNC inputs from the 9-1506 DISP module. SYNC_SEL, a port line output from IC1501M, controls whether the TV syncs or the RGB syncs are selected. The outputs (HSYNC, VSYNC) are then routed to the UMFEP IC1501M for further processing.

4.4 IC1501M UMFEP Sync Processing

Pre-processed sync signals HSYNC, CSYNC, VSYNC, and SEP_VSYNC from IC1502M are input to IC1501M, which provides information about these incoming signals to the system microprocessor. This information includes sync polarities, sync presence, Vsync period, and out-of-range detection. Normalized Horizontal (N_HSYNC) and Vertical (N_VSYNC) sync pulses for use by the Horizontal APC and Vertical Oscillator are also provided by IC1501M.

4.5 Fh Frequency Counter

The Fh Frequency Counter inside the ASIC IC1502M counts the number of Hsync pulses during a precisely timed window of 8.01mS. This window is opened 1.1mS after the leading edge of Vsync, so that any disturbance in Hsync related to the vertical sync interval is avoided. The timing for these intervals derives from DAC 9 at pin 32 of the UMFEP IC1501M, which is fixed to 127 to provide a constant square wave output counted down from IC1501M's crystal reference oscillator. The source and arming of the Frequency Counter are under the control of the System microprocessor, which also reads the result through the UMFEP IC1501M.

Dual 1 of 4 MUX's inside IC1502M select between the three sync input channels based on which source (separate H and V, composite, Sync-on-Green) the system microprocessor selects. S0 and S1, port lines output from IC1501M, control which of the sync sources are selected. The outputs are then routed to the Fh Frequency Counter. The system microprocessor initiates a count cycle by taking the ARM_CNTRL line (PRT 22) of the UMFEP IC1501M at pin 52 high for at least 5uS, and releasing it. The STATUS line (IC1502M pin 76) immediately goes low. The next vertical sync pulse triggers the 1.1mS delay. At the end of the delay, the 8.01mS window is opened, and a counter counts horizontal sync pulses until the window closes. The counter's output, Tcount, is latched and output as a 10-bit word over bus Q0-Q9 to PRT 10 (LSB) through PRT 21 (MSB) of the UMFEP IC1501M (pins 4-13). At the same time, the STATUS line goes high, which also is a port input line on the UMFEP (pin 17), indicating to the system microprocessor that the count cycle is concluded, and a valid result can be read.

The Horizontal Sync frequency, Fh, can then be calculated by the following expression:

Fh = Tcount / Tgate

where **Tgate = (Tclock * 128) - (Tclock * 16) = 8.01mS**

and **Tclock = 256 / 3579545 = 71.517uS** (output of DAC 9)

If either the HSYNC or VSYNC inputs to the frequency counter is missing, the counter will return 00h (or some extremely low nonsense number). Missing HSYNC yields a result in the normal 9.2mS, and missing VSYNC activates a default counter which times out in approximately 55mS. If VSYNC is applied before the default counter times out, the normal measurement cycle takes over, beginning from that point.

4.6 Auto Sync Select and Pseudo-Sync

In RGB mode, the system microprocessor uses the Fh Frequency Counter and it's dual 1 of 4 MUX's to scan the sync inputs for a valid Hsync signal. When one is detected, the frequency, source type, and polarity information (as well as the equivalent information about the Vsync input) are then used by the system microprocessor to try to match up with a stored format. If a match is found, then the system microprocessor adjusts the video, deflection, and convergence circuits of the C9 unit for the recognized format using stored set-up data.

During this search, and in the case that no match is found, a unique feature of the UMFEP IC1501M is used. The system microprocessor can place the UMFEP in a mode where it will output Pseudo-Sync signals for N_HSYNC and N_VSYNC. These signals look like valid sync signals to the Horizontal APC and Vertical Oscillator, and provide a stable raster on which the OSD text can be displayed. The frequencies of the

Pseudo H- and Vsyncs are controlled by the system micro, and are either close to the last valid format, or global defaults. In TV mode, a vertical sync presence bit from the 9-1506 DISP module is used to by the system micro to detect a valid input. In the absence of a valid signal, Pseudo syncs are also used.

5.0 Clamping, Blanking, and Timing Pulse Generation

5.1 Video Clamp Pulse

Trigger pulses are generated by IC1501M for both the leading and trailing edges of incoming Hsync based on an internal comparison between the CNHSYNC signal and a slightly delayed version of the same signal through RC time constant R1590 and C1504M. The system microprocessor selects one of the triggers as the output at pin 61 of IC1501M. The selected trigger pulse triggers a 1.1uS pulse at monostable IC1504M pin 13, which is AC-coupled and clamped by C1574M, R1520M, and D1510M. The VIDEO_CP line goes to the RGB video processing section.

5.2 Horizontal Flyback

The Horizontal Flyback pulse from the 9-1505 Deflection Module is AC-coupled and clamped to ground by C1501 and D1501M. The signal is attenuated and clipped by R1501, D1503M, and D1504M. The positive peak clipping voltage comes from a +4.3V Zener-regulated supply consisting of R1502M, D1511, and C1508. Taken together with the forward-biased diode drop of the clipping diode D1503M, the resulting positive peak of the clipped flyback signal is +5V. The leading edge of the clipped signal is sped up by the differentiating network of C1503, R1503M, and D1502M. This clipped flyback pulse goes to pin 13 of IC1503Mf, which is a Schmitt-trigger input Hex inverter IC. IC1503Mf squares up the flyback pulse, and provides two outputs, both the result of two cascaded inversions. The output at pin 8 is used by both IC1501M and IC1502M for local processing on the 9-1515 Combo Module. The output at pin 10 is further buffered by totem-pole emitter followers Q1503 and Q1504, and then goes off the Combo Module for use as a timing reference by other modules in the C9 system (HFBK).

5.3 Composite Blanking

IC1501M creates a composite blanking signal from the logical OR of the PH_BLANK, PV_BLANK, and HFB (Horizontal flyback) pulses, which it outputs at pin 60. This signal drives the base of buffer transistor Q1502, which inverts and level-shifts it. Q1502 functions as an open-collector buffer, with the collector load resistor on the 9-1512 Video Output Modules, where the COMP_BLK signal is used by the high-level CRT blanking circuits. Diodes D1508M, D1509M, and resistor R1507M are provided to protect Q1502.

5.4 OUTPUT_CP

OUTPUT_CP is the logical NOR of the HFB and COMP_BLNK pulses, OR'ed with the inverse of the AKB_4L pulse. The logic to create this pulse is contained within the ASIC IC1502M, and is output from pin 69. The OUTPUT_CP pulse is used in the RGB video processing section, as described in 8.7 and 8.8 below.

5.5 VID_MUTE

VID_MUTE is the logical OR of the HFB, COMP_BLNK, and the inverse of the AKB_4L pulses. The logic to create this pulse is contained within the ASIC IC1502M, and is output from pin 67. The VID_MUTE pulse is used in the RGB video processing section, as described in 8.5 below.

5.6 AKB Pulse Generation

5.6.1 AKB_4L

Coincident with the falling (trailing) edge of the VBLNK pulse, the AKB_4L output at pin 66 goes high, and remains high for a period of 4 horizontal lines, after which it goes low again until the end of the next VBLNK pulse. This pulse, occurring once per field immediately following the vertical blanking pulse, is used by the RGB video processing section as described in 8.7 below.

5.6.2 AKB_SER

The AKB_SER pulse at pin 21 of IC1502M is the logical NOR of the COMP_BLNK and AKB_4L pulses. This signal is buffered and inverted by Q1505M, before going to the 9-1512 Video Output modules, where it is used by the high-level AKB circuits.

5.6.3 AKB_EN

PRT 23 of the UMFEP IC1501M (pin 15) is the AKB_EN control port line. The system microprocessor uses this line to disable the AKB pulse generation (both AKB_4L and AKB_ser pulses) during mode change. A low level on AKB_EN disables the AKB pulse, while a high level enables it.

6.0 Control Functions

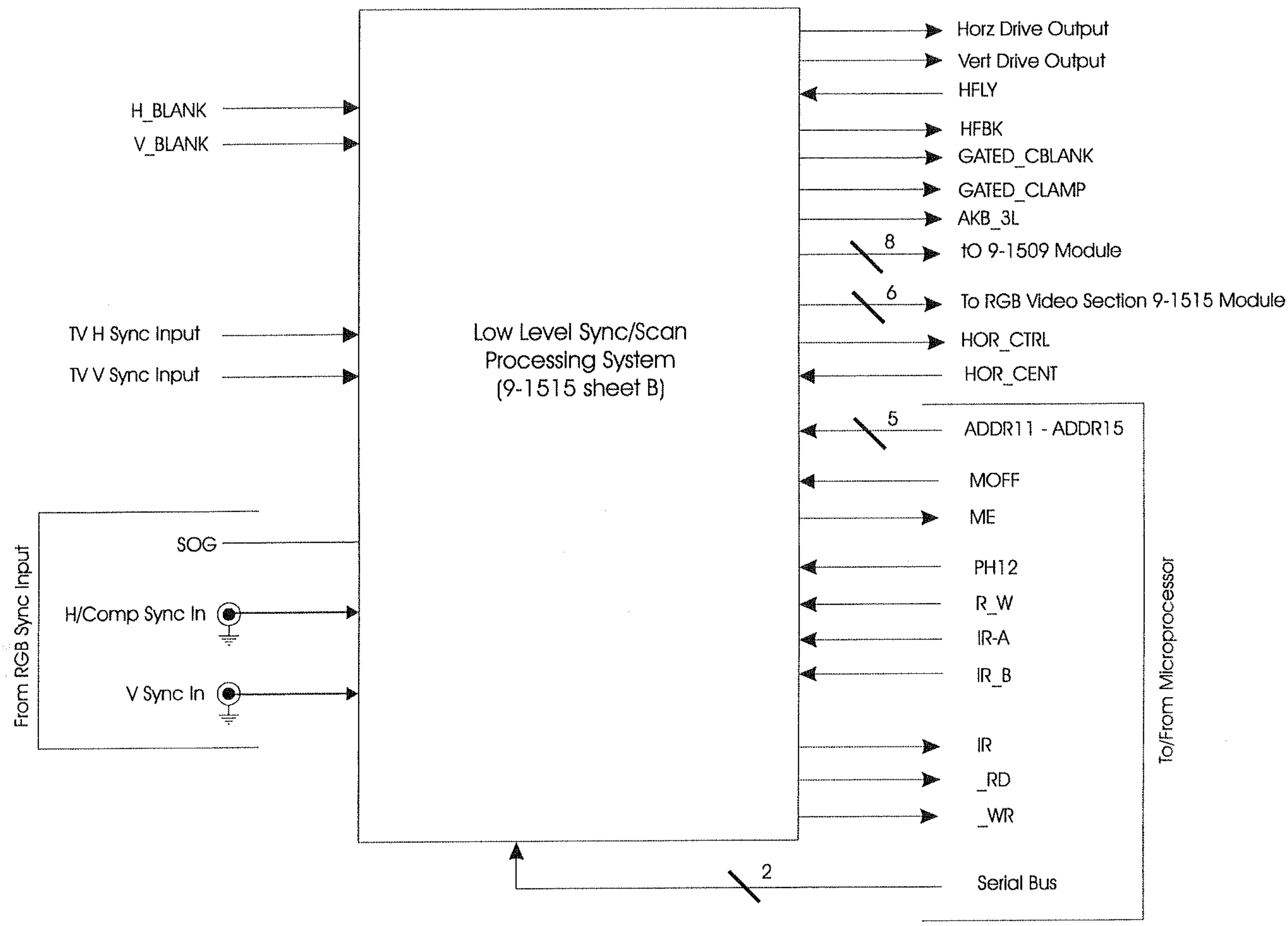
The following are generalized descriptions of the I/O Port lines and the PWM's of the UMFEP IC1501M, through which the system microprocessor controls many of the C9's functions, including the Horizontal scan frequency, horizontal B+ adjust, horizontal scan width, "S" capacitor selection, brightness, contrast, RGB tracking, RGB mutes, RGB/TV mode selection, etc. For the specific assignment of each Port line and PWM, refer to the attached UMFEP map document.

6.1 I/O Port Lines

Each of the 32 I/O Port lines (4x 8-bits) can be used as either a standard CMOS logic input or an open-drain output. These lines are read and/or written to by the system microprocessor through the local I2C bus.

6.2 PWM's

Each PWM is a symmetrical CMOS output that switches between Vdd (+5V) and Vss (Ground). The switching rate is 13.98kHz, and the pulse width is continuously variable from 0% to 100% in 256 steps. Most of the PWM outputs are connected through a series resistor (typically 4.7K) to a filter capacitor (typically 4.7MFD). In operation, the high output state sources current through the series resistor, partially charging the filter capacitor, and the low output state sinks current through the resistor, partially discharging the filter capacitor. The RC time constant of the filter network is chosen to average out these charge/dischage cycles, producing a DC voltage between 0V and +5V that is linearly proportional to the duty cycle of the PWM's output waveform. In other words, when the PWM is set to 0, the DC voltage at the RC filter's output is approximately 0V. For a PWM setting of 127, the filter's output voltage is approximately +2.5VDC, and for a PWM setting of 255, the filter's output voltage is approximately +5VDC. Some of these PWM control voltages are used directly where they control a circuit with a high input



9-1515 Module
Sheet C
Low Level Sync/Scan Processing Circuit

Figure 48

impedance, while others are buffered and/or level shifted, as described in section 6.3 below.
23 of the 30 available PWM's are used in the manner described above. DAC 9 is set to 127 and used directly (unfiltered) as a reference clock by the Fh Frequency counter block inside IC1502M, at pin 9. Six other PWM's are unused.
6.3 Buffered PWM's
The filtered PWM outputs designated D1 through D7 are each inverted, amplified, level-shifted, and buffered through sections of quad op-amps IC2701M and IC2702M. These buffered outputs are sent to the 9-1509 analog waveform generator module, where they are used to control front-of-screen geometric functions.
Except for component designators and IC pin numbers, the other six channels are identical to the one described as follows:
The output of DAC 22 at IC1501M pin 70 is filtered by R1567M, a 10k resistor, and C1570. This filtered line is designated D1. D1 is applied to the inverting input at pin 13 of quad op-amp IC2702M through R2782M, a 100K 1% metal film resistor. Feedback and further filtering are provided by R2783M, a 221k 1% metal film resistor, and C2720M. A fixed DC voltage of 1.67V is applied to the non-inverting input at pin 12. The op-amp's output at pin 14 goes through protection resistor R2784M to pin 11 of connector 4A1 as BHPWM.
The ratio of R1567M + R2782M to R2783M (10k+100k/221k) results in a voltage gain at the buffer output at pin 14 of -2 for the D1 input voltage, as well as a voltage gain of +3 for the DC offset voltage at pin 12. For a PWM setting of 0, the BHPWM output is +5VDC. With a PWM setting of 255, the BHPWM is -5VDC. An output of 0VDC corresponds to approximately 127.

7.0 Low-Level Scan Processing

7.1 Horizontal Phase
The N_HSYNC pulse from IC1501M is divided down by resistor divider R2701 and R2702M, and then AC coupled to the Hsync input at pin 1 of IC2703. Pin 2 is the Hsen input, which is a control line that enables or disables the sync input from pin 1. Even though pin 2 is connected to PRT 34 on the UMFEP, and thereby to the system microprocessor, this function is not used in normal operation. The Hsync input signal then goes to the first of two voltage-controlled monostable delay circuits, which are connected in series. The output of the second monostable goes directly to the Horizontal Phase comparator. The time constant for the first monostable consists of C2709 and R2708M at pin 4 of IC2703M. C2710 at pin 6 is the timing capacitor for the second monostable, which is a 2% NPO precision type, and can only be serviced with an EXACT replacement. A control voltage HPOS from DAC 16 of IC1501M is applied to both monostables through pins 3 & 5. Part of the control for the second monostable also derives from the current source for the horizontal oscillator. This allows part of the delay introduced by the second monostable to be proportional to the tuning of the horizontal oscillator itself. The total delay through both monostables is a function of the customer Horizontal Position control (HPOS), and the Horizontal Oscillator tuning voltage (1H_CTL).
7.2 Horizontal Flyback input and APC
The Horizontal Flyback pulse from the Horizontal Deflection module through pin 1 of Connector 4A1 is attenuated by R2720, and input to IC2703 at pin 18. The flyback pulse is first delayed through a monostable, the delay time of which is set by the time constant R2740M and C2760 at pin 20. This delay compensates for part of the Horizontal phase circuit delay, allowing the Horizontal Position control to have a differential (both left and right of nominal) control range. The now-delayed flyback pulse then drives a ramp generator. The ramp generator's output is compared in the APC circuit to the delayed output from the second Horizontal Phase delay monostable. Capacitor C2718 from pin 7 to ground is an AC bypass in the APC circuit. The output of the APC at pin 10 is applied to a filter network of C2713, C2714, R2718M, and C2715M, and also as a control input for the Horizontal VCO. Also connected to pin 10 is one side of analog switch IC2705M. The other side of the switch connects to C2738M, a capacitor to ground. The control line for IC2705M, C_SWITCH, comes from PRT 32 on the UMFEP IC1501M, through inverter transistor Q2705M. C_SWITCH is normally high, and is switched low by the system micro only when the Horizontal operating frequency is below 18kHz. This allows extra filtering, and a longer filter time constant, to improve APC operation in weak-signal and VCR modes.
7.3 Horizontal VCO
The Horizontal Oscillator tuning voltage (1H_CTL) is input to pin 8 of IC2703 through voltage divider network R2716M, R2717M, and C2711M. These two resistors, as well as R1522M in the primary filter of 1H_CTL, are precision 1% types, and can only be serviced with EXACT replacements. Pin 8 is the input of a voltage-to-current converter. Pin 9, also a precision 1% resistor, is the current reference. The output of the current-to-voltage converter goes to both the Horizontal VCO and the second Horizontal Phase delay monostable. As described above, this arrangement allows the Horizontal Phase control (HPOS) to be compensated for the horizontal operating frequency. The design of the oscillator allows it to cover a range of frequency of greater than 3:1, with a DAC setting of 0 corresponding to approximately 14 kHz, and 255 corresponding to approximately 53 kHz. C2717 at pin 11 is the Oscillator timing capacitor, which is a 2% NPO precision type, and can only be serviced with an EXACT replacement.
7.4 Low-Level Horizontal circuit operation
When a valid horizontal sync signal is processed by IC1501M and IC1502M, information about that sync signal, including a measurement of the incoming sync signal's frequency, is sent to the system microprocessor. Based on this information and the module's factory calibration, the micro extrapolates what the correct DAC number should be to properly tune the Horizontal VCO through control line 1H_CTL. Once the VCO has been pre-tuned by the micro, it should land well within the range needed by the APC for locking-in. The APC generates an error voltage proportional to the phase error between the delayed Horizontal sync and delayed horizontal flyback inputs. This error voltage fine-tunes the VCO, locking it on the incoming sync frequency.
For any given properly pre-tuned Horizontal frequency, the approximate pull-in range of the APC system is +/- 1 kHz to +/- 1.5 kHz.
7.5 Hvcc Regulator

The collector of regulator transistor Q2706 connects to the +15B supply line through dropping resistor R2715. The base of Q2706 connects to the +12B supply, which results in the voltage at the emitter of Q2706 being +12 - .7 = 11.3 VDC.
The supply voltage for the Horizontal processing half of IC2703 is input at pin 14. From pin 14 to ground (pin 12) internal to IC2703 is a 9 volt shunt regulator. This regulator requires a source current of approximately 60mA for proper operation. This current is supplied from the emitter of Q2706 through R2714 and L2701. C2721M and C2722 are the high- and low-frequency bypass capacitors on the 9V supply at pin 14.

7.6 Horizontal Drive output

The voltage divider network R2721M, R2722M, and C2756M sets the duty cycle of the Hdout pulse at pin 16 of IC2703. The values are chosen such that the duty cycle of the high portion of the buffered HDRV signal is 45%.
The open-collector output at pin 16 drives the base of transistor Q2702M, which inverts and amplifies the pulse. This amplified pulse at the collector of Q2702M is further buffered by emitter followers Q2703M and Q2704M, and output as HDRV to the Horizontal Deflection module through connector 4A1, pin 34. The collector of Horizontal drive hold-off switch transistor Q2701M also connects to the collector of Q2702M. When the 1H_HLDOF control line from PRT 31 on the UMFEP IC1501M is high (as during unit start-up), Q2701M is turned on, holding the common collector connection of Q2701M and Q2702M low, and inhibiting Horizontal Drive. Once 1H_HLDOF goes low, and the collector connection goes high, Q2702M can resume normal switching operation, and Horizontal Drive resumes operation.

7.7 Hlock

Although the parts at pin 19 are in-circuit to use this function, it is not presently used in normal operation.

7.8 Vertical Oscillator

The N_VSYNC pulse from IC1501M is divided down by resistor divider R2713 and R2734M, and then AC coupled to the Vsync input at pin 30 of IC2703 through C2744. The leading edge of the pulse at pin 30 is used to trigger the injection-locked oscillator, the timing components for which are C2743 at pin 29, and R2733M at pin 28. In the absence of a N_VSYNC pulse, the oscillator free-runs at approximately 38 Hz, but with a pulse present, will lock to any sync frequency between less than 50 Hz to over 100 Hz.

7.9 V_Delay

Although the parts at pin 26 and pin 27 are in-circuit to use this function, it is not presently used in normal operation.

7.10 Vertical Drive output

Pin 24 of IC2703 is the output of the vertical oscillator circuit, V_OSC. This output is pulled up to +5V through R2731M, and routed through protection resistor R2729M to pin 33 of connector 4A1.

8.0 RGB Processing

8.1 TV/EXT. RGB Switch

The function of this switch is to select between external RGB (input through 3 BNC connectors) and TV RGB (from 9-1506 DISP module). The external RGB is input at 0.71 Vpp. @ 75 ohms and the TV RGB is input at 2.4 Vpp. @ 3 kohms (0 to 100 IRE). The TV RGB is scaled down to 0.71 Vpp. before switching. An open drain port output from the UMFEP IC1501M (RGB/TV) is used as a switch control. When this control line is pulled low, external RGB is selected, and when let go high, TV RGB is selected.
Using the green channel as an example, the switching action is done in the following manner. When the RGB/TV line is pulled low, the collector of Q5203 goes to 12v, reverse biasing D5215M, thus allowing the external RGB to pass to buffer Q5209 and D5210M. At the same time, the 3v bias (supplied by Q5204M) applied to Q5212 through R5319M, is pulled down to a 0.7v bias. This reverse biases the b-e junction of Q5212 which prevents the passing of TV RGB through buffer Q5212 and D5211M When the RGB/TV line is let go high, the collector of Q5203 goes to ground. The external RGB signal is shunted to ground through D5215M, thus preventing it from passing through buffer Q5209 and D5210M. At the same time, a 3v bias (supplied by Q5204M) is applied to buffer Q5212 through R5319M. This makes Q5212 and 5211M conduct and pass through the TV RGB signal. The red and blue channels work in a similar fashion. On the green channel input, Q5216M acts as buffer to pick off the green video signal (SOG) and send it to the sync separator in the case of a sync on green input signal.

8.2 Contrast Attenuator

IC5205 functions as the contrast control attenuator. The RGB output of the switch is AC coupled and input to pins 2,6,10. and is output at pins 24,20,16. The typical gain control range is from +1db. to-8db.
The contrast control line (CONT) voltage is derived from a PWM DAC in the UMFEP IC1501M. Its range is from 3.3v at max. contrast and 1v at min. contrast. This voltage is buffered by Q5224M and Q5225M. It is sent to the individual contrast control inputs (pins 21,17,13) of IC5205 through a 33k resistor for each channel. The junction of each control input and its 33k resistor is connected to an open drain port output from the UMFEP IC (R_MUTE, G_MUTE, B_MUTE). During convergence-geometry setup in the factory or in the field, it is desirable to disable one or two of the colors from being displayed on the screen via the RS232 serial interface or from the IR remote control. If the red color is being commanded to turn off, for example, the R_MUTE output of the UMFEP IC1501M will pull down the red contrast control input (pin 21) to ground, thus reducing the amplitude of the red signal output of IC5205 to zero. When restoring the red output to its normal level, the open drain R_MUTE output of the UMFEP IC1501M will stop conducting and the red contrast control input will float up to the contrast control voltage level supplied by the emitter of buffer Q5225M.

8.3 ABL (auto beam limiter)

A sample of the total CRT average beam current is developed on the high voltage module and is supplied to the 9-1515 module as a current source via the ABL line. For an increasing beam current, the voltage developed by the beam current across R5262M (1k) will increase from zero. This voltage is applied to a unity gain inverting amplifier with a 1v offset (1/4 IC5207) Some integration is performed in the amplifier due to the capacitive negative feedback (C5269) around the amplifier to help smooth out the vertical rate ripple present. At zero beam current, the output of the amplifier (ABL_CTL) is at approximately 2v. This voltage is coupled through R5260M (1k) to the emitter of Q5211 and the anode of D5205M. The 2v level will cause D5205M to be forward biased, which also reverse biases the b-e junction of Q5211 causing it to not conduct any current. When the ABL_CTL voltage drops (as a result of increasing beam current) to about -0.5 to -0.6v (at 2.5 ma. avg. beam current), D5205M stops conducting and Q5211 begins conducting and pulling down the contrast control voltage on the CONT line. Any further increase in beam current causes the contrast level to be reduced further. A negative feedback loop is thus created to stabilize the maximum avg. beam current to 2.5 ma.

The ABL_CTL signal also feeds an amplifier/level shifter comprised of Q5217M and Q5218. The output is called BEAMSMPL and below about 2 ma. total avg. CRT current this line will sit at about 2.5v DC. As the CRT current increases above 2 ma.,(considered a very high avg. picture level content signal) the BEAMSMPL voltage will begin to drop. The voltage is fed to the 9-1506 DISP module where it drives a circuit that shifts the video signal slightly toward black in order to help improve the contrast between the high-lights and any low-light level signal present. This function works only in TV mode.

Another signal line called ST_ABL (single tube auto beam limiter) is connected to the CONT line. This signal originates at the three video output neck boards and is routed to the 9-1515 module through the carrier board. Its function is to provide a path to the CONT line from the video output neck boards to reduce the contrast level when a predetermined average beam current level is exceeded on either of the three CRT's. The circuitry for detecting the individual CRT beam current is located on each neck board.

8.4 Main RGB Signal Clamp

The RGB output signal from the contrast attenuator (IC5205) is AC coupled to an npn buffer. The output of the buffer is clamped to a voltage near 0v using a feedback clamp. It is mandatory to clamp the main RGB signal to a known reference level before applying it to the on-screen display (OSD) switch. Otherwise the black level of the OSD relative to the main RGB will vary dramatically in response to changing avg. picture level content of the main RGB signal.

Using the green channel as an example, the main RGB clamp works in the following manner. The video signal at emitter of buffer Q5231M is sampled by closing an analog switch (IC5206M) for a 1.1 microsecond time during the horizontal blanking time with gate pulse VIDEO_CP. If a sync on green signal is present, then VIDEO_CP switches automatically to sample during the back porch of the signal. Otherwise it samples during the horizontal sync time. This sampled level is fed to a high gain inverting op amp integrator (IC5207) where it is compared to a reference level at the + terminal of the op amp. The output of the op amp is the error signal and is fed back to the input of buffer Q5231M through R5383M (3.9k) to maintain the 0 IRE level of the RGB signal at the emitter of buffer Q5231M at the reference level set at the + terminal of the op amp. The red and blue channels work in a similar manner.

The reference level at the + terminal of the op amp is common to all three channels. Varying this level will DC offset all three channels by the same amount. This serves as the brightness control. The brightness control level comes from a PWM DAC on the UMFEP IC1501M (BRT). Its range is 0 to 5v DC from min. to max. brightness. This level is gain scaled and level shifted by one of the op amps of IC5211 to produce a level at the main RGB clamp reference terminals that will vary from -0.2v to +0.2v as the BRT level varies from 0 to +5v. Nominal brightness level is set at a BRT level of +2.5v DC. At this level the output at the emitter of buffers Q5230M, Q5231M, Q5232M will be clamped to zero volts DC. This is the condition when the Customer Brightness on the on-screen menu is 50.

8.5 OSD Switch

The output of the main RGB clamp is switched against the OSD signal (generated by the OSD IC6007) with DMOS switches IC5209M and IC5210M. The OSD RGB signal is input to the source terminals of IC5209M (pins 12,7 and 1 respectively) with an amplitude of 350 mv. pp. and a zero IRE level of 0 v DC. Likewise, the main RGB signal is input to the source terminals of IC5210M (pins 12,7 and 1 respectively) with a 0 to 100 IRE amplitude of 700 mv. pp. and a zero IRE level of 0 v DC (at a Customer Brightness setting of 50). The switches are configured to act as SPST switches. When the main RGB signal is selected, The switches in IC5210M are closed by applying 5v to pins 3, 6 and 12. At the same time, the switches in IC5209M (carrying the OSD RGB signal)are opened by applying 0v to pins 3, 6 and 12. When the OSD RGB signal is selected, the switches in IC5210M are opened (disabling the main RGB signal) and the switches in IC5209M are closed (enabling the OSD RGB signal). The complementary switch control signals thus required, are generated from the FASTBLNK signal by a pair of exclusive-OR gates at IC5204M. The non-inverted output at pin 8 is applied to IC5209M to gate the OSD RGB on/off. The inverted output at pin 11 is applied to IC5210M to gate the main RGB off/on. The complementary switch control signal generated by IC5204M are also gated with an extra DMOS switch at IC5209M and IC5210M (pins 8,9,10) by the VID_MUTE control signal. When VID_MUTE level is 0v, the complementary switch control signals pass through as normal to control the main RGB/OSD RGB switching. When the VID_MUTE level is 5v, the complementary switch control signals are over-ridden, forcing all switches to be open, and thus preventing any main RGB or OSD RGB from passing through to the switch output. The switch output will then settle to 0v DC. This is done during the horizontal blanking time, the vertical blanking time and the 4 line AKB pulse time because during these times we want to force the switch outputs to the nominal zero IRE level of the main RGB signal (which is 0v). You may also note that varying the BRT signal (brightness level) from 0 to 5v will cause the main RGB DC level to vary 200 mv. above and below 0v at the switch output.

8.6 RGB Preamp And Output Clamp

The RGB outputs of the OSD switches are buffered by JFET's Q5226, Q5227 and Q5228 and then AC coupled to IC's IC5200M, IC5201M, IC5202M (RGB preamp ICs) respectively. The purpose of these IC's is to provide a drive control function for color balance and to clamp the zero IRE level at their outputs to a fixed voltage (1.3v DC in this case). The drive control range is about 12db. The drive control voltages are derived from 3 PWM DAC's from the UMFEP IC1501M. At max. gain the PWM DAC's provide 3.3v DC and at min. gain they provide 0v DC. These control voltage levels are sent to IC5203 to gain scale and level shift the drive control voltages before applying them to the RGB preamp

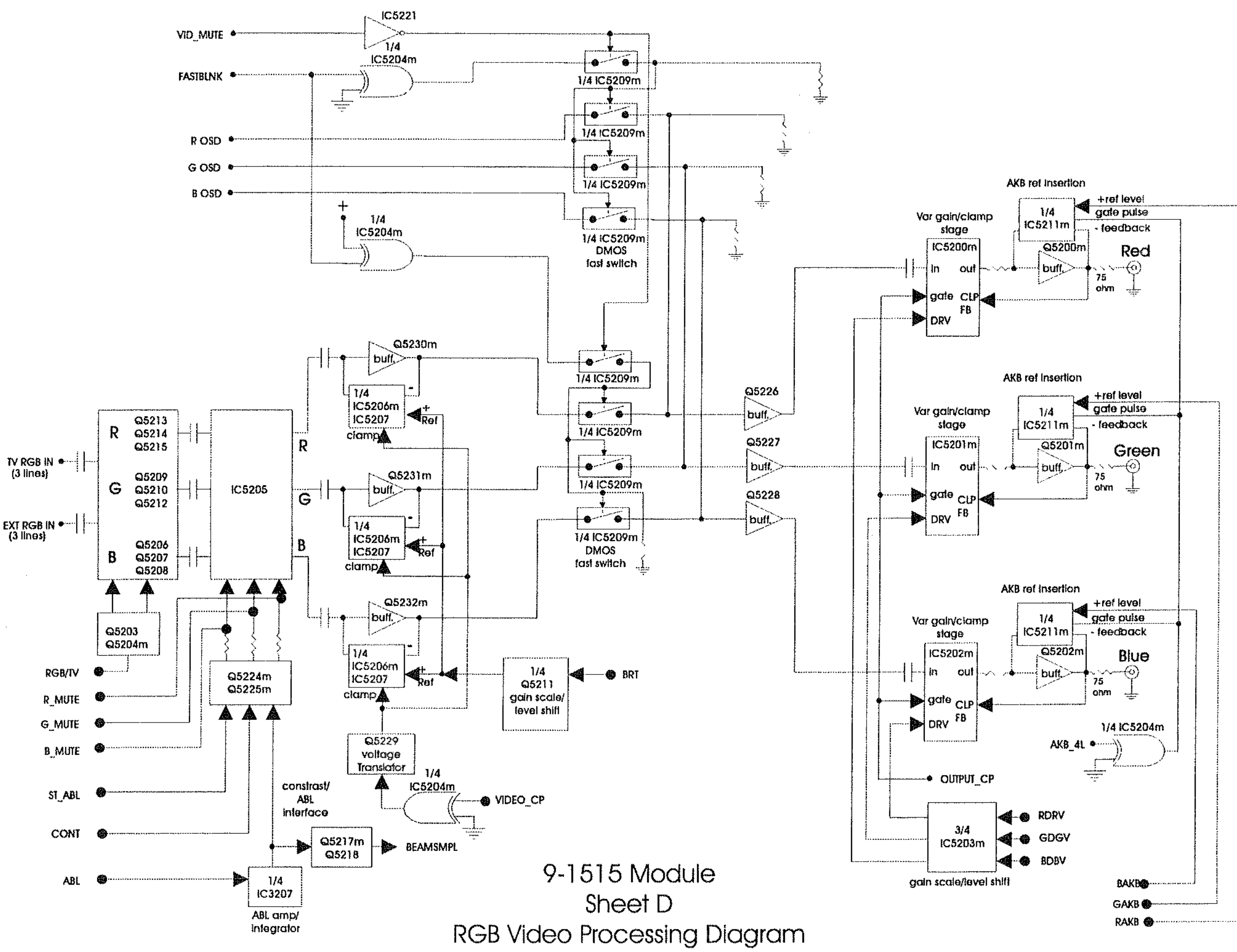

VID_MUTE
IC5221
1/4
IC5204m
FASTBLNK
1/4 IC5209m
R OSD
G OSD
B OSD
DMOS
fast switch
AKB ref insertion
+ref level
gate pulse
- feedback
Var gain/clamp stage
IC5200m
Q5200m
Red
75 ohm
buff.
in
out
gate
CLP FB
DRV
Q5230m
IC5206m
IC5207
clamp
Ref
Q5226
Q5227
Q5228
IC5201m
Q5201m
Green
TV RGB IN (3 lines)
EXT RGB IN (3 lines)
Q5213
Q5214
Q5215
Q5209
Q5210
Q5212
Q5206
Q5207
Q5208
IC5205
Q5231m
Q5232m
Q5203
Q5204m
RGB/TV
R_MUTE
G_MUTE
B_MUTE
Q5224m
Q5225m
Q5211
gain scale/ level shift
BRT
IC5202m
Q5202m
Blue
1/4 IC5204m
AKB_4L
OUTPUT_CP
Q5229
voltage Translator
VIDEO_CP
ST_ABL
CONT
ABL
constrast/ ABL interface
Q5217m
Q5218
BEAMSMPL
IC3207
ABL amp/ integrator
3/4
IC5203m
RDRV
GDGV
BDBV
gain scale/level shift
BAKB
GAKB
RAKB
9-1515 Module
Sheet D
RGB Video Processing Diagram

Figure 49

drive control pin (pin 4). At the drive control pin the range is 4.5v DC at min. gain and 10.2v DC at max. gain.
The RGB output from the preamp IC's are fed to a high speed buffer (Q5200M, Q5201M, Q5202M that drives a double terminated 75 ohm coaxial cable to the video output amplifier on the CRT neck board. The voltage at the emitter of the high speed buffer is sampled during the OUTPUT_CP clamp pulse time and compared to a reference voltage (1.3v DC) set by R5356M and R5357M. As a result of the comparison, a DC correction voltage is added to the RGB output signal inside the RGB preamp IC in order to regulate (clamp) the zero IRE level of the RGB output signal to the reference voltage mentioned above. Note also, that the OUTPUT_CP clamp pulse is active (0v) during the entire horizontal and vertical blanking time and is inactive during the 4 line AKB pulse time so as to not interfere with the AKB pulse insertion which will be discussed next.
8.7 AKB Pulse Insertion
The function of this circuit is to insert a variable reference pulse level, 4 horizontal lines long, into the RGB output of RGB preamp just before the signal is sent to the CRT neck board. The operation of the circuit will be explained on the green channel for simplicity. The other two channels work in a similar manner.
A DC reference voltage level is developed by a PWM DAC from the UMFEP IC1501M. This voltage is sent to the + terminal (pin 12) of an op amp in IC5211. Normally, when the AKB pulse is not being inserted, Q5239M is turned on by a +5v level on the AKB_4L signal and the + terminal is forced to ground. Under this condition, D5225M is conducting so that the output of the op amp is fixed at about -0.7v DC. The op amp output is connected to the anode of D5206M which is turned off, since the cathode of D5206M is always higher than -0.7v DC. So in this case, no AKB pulse is inserted.
When the AKB pulse is to be inserted, the AKB_4L signal will switch to ground. This will cause Q5239M to turn off, allowing the DC reference voltage from the PWM DAC to be applied to the + terminal (pin 12) of the op amp. This reference voltage will vary from about 1.4 to 2.4v DC. Under this condition, the output of the op amp will rise, causing D5225M to turn off and D5206M to turn on. When D5225M turns off, the op amp will turn into a very high gain comparator. This comparator samples the DC voltage at the emitter of high speed buffer Q5201M through R5236M (10k) to the - terminal of the op amp and compares it to the reference level at the + terminal of the op amp. The output of the opamp thus becomes the correction signal that is applied to the base of high speed buffer Q5201M through D5206M, which serves to force the emitter voltage of Q5201 to equal the reference voltage of the PWM DAC during the time that the AKB_4L signal is active (0v DC). Two things are important to note here. One, is that the OUTPUT_CP clamp pulse is forced to its inactive state (+5v) during the AKB pulse time. Otherwise the output clamp of the RGB preamp IC will interfere with the AKB pulse insertion. Secondly, all video (main RGB and OSD RGB) is prevented from passing through to the OSD switch output (and hence to the RGB preamp output) during AKB pulse insertion time so that the RGB signal will not interfere with the AKB pulse insertion.

9-1506 Digital Image Signal Processing (DISP) Module

System Description

General

The 9-1506 module as used in the C9 wall projector, decodes a 2 Vpp. composite video input or separate Y-C input signal into a 2.4 Vpp. RGB output signal that drives the 3 projector CRT's.
The color decoder, comb filter functions, sync processing, wide aspect correction and other video signal enhancement features are implemented digitally with an intermediate output converted to decoded luminance and color difference signals (Y,I,Q). The analog Y,I,Q signals are further processed by an analog processing IC which converts the Y,I,Q signals into RGB signals as well as providing color, tint and sharpness control functions.
In addition to the US NTSC standard, this module will also accept and decode the two South American standards (M/N PAL) and the two European standards (BGDI PAL and NTSC 4.43).
Secam is processed by transcoding the Secam signal into BG PAL and then applying it to the 9-1506 module as BG PAL.
One word about the comb filter processing. For the US NTSC standard, this module employs (thanks to the 5 mbit of on board frame store memory) a 3- dimensional motion adaptive Y-C separation system that enables a very high quality picture to be displayed. For the other standards mentioned above, a 3 line comb filter is used to perform Y-C separation.
System IC's
This module uses 4 digital LSI's, 3 DRAM LSI's to provide over 5 mbit storage capacity, and one analog signal processing IC to provide all the functions and signal processing capability necessary to realize this advanced digital video decoder. The IC's used are described below.
IC2700M - Digital Chroma and Sync Processing (VCDD)
IC2201M - Digital Luminance and 3-Line Comb Filter Processing (VCDV)
IC2203M - Digital 3-dimensional (Frame Comb) Comb Filter Processing (FCOMB)
IC2200M - Wide Aspect Ratio Processing (WAC)
IC2500M - Analog YIQ/ RGB Processing (RGB IC)
IC2204M - 2.5 mbit Frame Memory (MEM1)
IC2205M - 2.5 mbit Frame Memory (MEM2)
IC2206M - 2.5 mbit Frame Memory (MEM3)
For the sake of clarity and simplicity, the system description that follows will use the mnemonic name enclosed in parentheses when referring to the individual IC's.

Analog Input Video and Chroma Pre-Processing

Composite video or Luma (2V pp.) is input at pin 5 10B1 connector.. The Luma signal is fed to RGB IC at pin 53 where it has a DC level shift function acts on the signal. The output at pin 50 RGB IC is fed through a 10 Mhz anti-aliasing filter before being applied to the Luma A/D converter at pin 57 VCDV. After being digitized, the luma is output at pins 27-30 VCDV and sent to pins 75-78 VCDD for H and V sync separation from the luminance information. The Luma signal is also sampled during the horizontal sync tip level and compared to a reference level. The result of the comparison is a pulse width modulated control signal output at pin 61 VCDD (DC CLAMP) that is RC filtered to a DC voltage and sent back to pin 51 RGB IC to control the DC level of the Luma signal at pin 53 so that the sync tip level is fixed to 1.5 VDC at the Luma A/D converter input pin.

Composite video or Chroma is input at pin 3 10B1 connector. It is applied to a chroma bandpass filter before being input to the ACC amplifier input at pin 45 RGB IC. In the bandpass filter circuit, Q2304M acts a switch to connect C2317M to ground for NTSC, M PAL, and N PAL input signals. For BG PAL and 4.43 NTSC input signals, the switch is opened. This connects C2316M between C2317M and ground. This is done to change the center frequency of the chroma bandpass between the cases of a 3.58 and 4.43 Mhz. chroma subcarrier. The switch is IIC bus controlled through a port at pin 1 RGB IC.

The chroma at the output of the ACC amplifier (pin 48 RGB IC) is passed through a low pass filter before being applied to the Chroma A/D converter at pin 41 VCDD. Inside the VCDD LSI, the digitized Chroma is sent to the digital color demodulator where the Chroma is demodulated to it's baseband I (in-phase) and Q (quadrature) components before being output at pins 71-74. Before being output though, a sample of the demodulated color burst is compared to a reference level and a control voltage is derived, output at pin 28 VCDD and sent to pin 47 RGB IC to control the gain of the ACC amplifier to fix the amplitude of the color burst signal at the Chroma A/D converter to 480 mv. pp.

System Clock (N X fh) PLL

As mentioned earlier, the VCDD LSI separates the horizontal and vertical sync signal from the incoming digital video signal. Using the separated horizontal sync, the VCDD LSI generates a system clock that is synchronous with the horizontal sync (1820fh NTSC, 2270fh BG PAL) by using a PLL circuit. Within the PLL, this clock is derived by a numerical control oscillator (NCO) circuit which uses a 42 Mhz. crystal oscillator as a reference clock. The output of the NCO is converted to a sine wave using a ROM and fed to a D/A converter which is clocked by a 21 Mhz clock derived from the 42 Mhz. oscillator. The output of the D/A converter is output at pin 50 VCDD. This signal contains alias frequency components at the n x fh system clock frequency and also some lower frequency unwanted alias components. The unwanted components are removed by a discrete trap circuit and the desired n x fh frequency is amplified and bandpass filtered (L2709). The filtered system clock frequency is converted to a square wave with IC2703M and fed back into pin 13 VCDD where it undergoes a 1/n division before applying it to a phase comparator that compares the 1/n divided sytem clock with the separated H sync. The output of the phase comparator controls the NCO mentioned above ; to close the PLL loop.

The 1/n divided n x fh clock becomes the regenerated horizontal sync reference (HREF pin 62 VCDD) for the entire system. The positive going edge of HREF will line up with the leading edge of sync of the incoming video signal.

This system has a horizontal APC block, however it is not used. The horizontal drive signal that is generated (HD OUT pin 52 VCDD) is simply amplified, level shifted and fed back to the flyback pulse input (FBP-IN pin 46 VCDD).

A color sub-carrier (fsc) regeneration circuit is also provided in the VCDD LSI. The fsc is regenerated by another NCO whose reference clock is the n x fh system clock. However, when a non-standard signal is detected (fsc does not equal 455/2 x fh), the fsc is regenerated by direct phase lock to the incoming color burst signal. The regenerated fsc frequency is used by the chroma demodulator and the std./non std. signal detection circuit.

Line COMB Filter / Frame COMB Filter

In the NTSC standard, the phase of the color sub-carrier flips 180 degrees frame by frame (2 fields per frame). Three dimensional Y/C separation utilizes this characteristic. To obtain the Y signal, the present frame of the composite video signal is added to the previous frame (available through frame storage memory). The Y signal is doubled and the color subcarrier is cancelled. C separation is done by adding the present frame of the demodulated chroma (baseband IQ) signal to the previous frame. The interfering luminance components in the IQ signal flip 180 degrees frame by frame after passing through the color demodulator. Therefore, adding the present IQ frame to the previous IQ frame will cancel these interfering luminance components.

This temporal (time related) processing allows for complete separation for diagonal patterns, which is not possible with two-dimensional line comb filter processing. It should be noted, however, that the frame by frame processing is only effective for still pictures and that interfering components are caused if it is applied to moving pictures. To remedy this problem, a hardware algorithm for image motion detection is implemented in the FCOMB LSI. Frame by frame Y/C separation for still pictures (performed in the FCOMB LSI) is performed in parallel with the two-dimensional line comb filter processing for moving pictures(performed in the VCDV LSI). The motion detection algorithm enables the switching between two-dimensional processing in areas of the picture where there is motion and three-dimensional processing in areas of the picture where there is no motion.

The demodulated chroma output (DVSC) at pins 71-74 VCDD LSI is fed to pins 84-87 VCDV LSI where it undergoes two-dimensional comb filter processing (C extraction) and is output at pins 16-20 VCDV LSI as moving picture C output (MOVCO). The moving picture C signal is fed to pins 53-55, 57-58 FCOMB LSI. The demodulated chroma from the VCDD LSI is also fed to pins 76-79 FCOMB LSI where it undergoes 3 dimensional C separation processing. The output of the 3D C separation processing is called the still picture C.

Likewise, the composite video signal (DVSY) undergoes 2D comb filter processing in the VCDV LSI and is output at pins 27-30 as moving picture Y output (MOVYO). The moving picture Y signal is fed to pins 46, 48-51 FCOMB LSI. The composite video signal from the VCDV LSI at pins 27-30 is also fed to pins 72-75 FCOMB LSI where it undergoes 3D Y separation processing. The output of the 3D Y separation processing is called the still picture Y.

Inside the FCOMB LSI, motion detection is performed using a 1 frame delayed Y signal (1 frame motion detection) and a 2 frame delayed signal (2 frame motion detection). The higher of the two outputs is taken as the motion detection output. The motion detector output drives a pair of digital mixers (one for Y and one for C) which outputs a dynamically changing mixture of the still picture and moving picture signal depending on the amount of motion in the picture. The output of the Y mixer at pins 59-63 FCOMB LSI (MIXY) and the output of the C mixer at pins 64-68 FCOMB LSI are fed back to the VCDV IC at pins 10-14 (MIXYI) and pins 5-9 (MIXCI). The MIXY signal goes through vertical and horizontal peaking processing before being output at pins 60-69 (YOUT). The MIXC signal goes through a color transient improvement circuit before being output at pins 71-78 (IQOUT).

Std/Non-Std Detection

A requirement for 3D Y/C separation is that the video signal must be "standard". For this to happen, two conditions must be met. Namely, fsc = (455/2)fh and fh = (525/2)fv.
Where fsc = color sub carrier frequency 3.579545 Mhz.
fhb = horizontal line frequency 15.734 Khz.
fv = vertical field frequency 59.94 Hz.
Another way of stating this is that the fsc must alternate in phase line by line and frame by frame.
Standard / non-standard signal is detected by the VCDD LSI by acquiring 2 samples/line of regenerated fsc and examining whether the phase of the regenerated fsc is alternating every other line (every 2 lines in PAL mode). When the FCOMB LSI is connected in the system, regenerated fsc data with 2 samples/line is sent to the FCOMB LSI along with a flag giving the result of line by line standard detection (STDO). The FCOMB LSI uses this data to determine whether there is frame by frame phase alternation of the fsc. The FCOMB LSI reports back the result to the VCDD LSI via pin 47 FCOMB LSI (FCOMHGO). If line by line correlation is not detected, 2D or 3D comb filtering can not be done, and the system reverts to a chroma bandpass filter with a chroma trap in the luma channel. If line by line correlation is detected but frame by frame correlation is not detected, then the 3D comb filter is disabled and the 2D comb filter is enabled.
Wide Aspect Correction
The YOUT and IQOUT outputs of the VCDV LSI are input to the WAC LSI at pins 2-11 (YIN) and pins 92-99 (IQIN). This LSI basically compresses the horizontal width of the picture by 3/4 using interpolation/decimation DSP techniques. The reason for having this function is the following.
When the raster is set for a 16 by 9 scan and 4 by 3 aspect ratio picture is input, the picture will look like it is stretched in the horizontal direction. By horizontally compressing the picture by a factor of 3/4, the picture will be displayed in its proper aspect. In the unused area to the left and right of the picture, a gray "side panel" will be shown.
Other important signals that the WAC LSI provides are:
HDR (pin 22) - Horizontal sync pulse for the deflection system of the projector when in TV mode.
VDR (pin 23 - Vertical sync pulse for the deflection system of the projector when in TV mode.
HBL (pin 20) - Horizontal blanking pulse used to blank the RGB output of the RGB IC.
VBL (pin 21) Vertical blanking pulse used to blank the RGB output of the RGB IC.
The digital Y and IQ signal are converted to analog Y,I,Q signals inside the WAC LSI using D/A converters and are output at pin 32 (Y-OUT), pin 40 (I-OUT), pin 36 (Q-OUT). Assuming 75 % color bars are input, the output amplitudes of these signals are as follows:
Y-OUT - 720 mv. pp. (0-100 IRE)
I-OUT - 760 mv. pp.
Q-OUT - 690 mv. pp.

RGB Processing

The analog Y,I,Q signals are input to the RGB IC at pins 41, 33, 34 respectively. This IC supports the customer color, customer tint, customer sharpness control and auto-flesh functions. Since the customer brightness and contrast control functions are done in the RGB processing section of the 9-1515 module, the brightness control function of this IC is fixed. The contrast (uni-color) control is adjusted in the factory for 2.4 V pp. (0-100 IRE) at the RGB outputs. This IC also supports black level expansion on the luminance (Y) channel.
Inside the RGB IC, the I,Q signals get converted to U,V signals. If a PAL signal is inputted to the system, the IQ to UV conversion is disabled by IIC bus command, since the input will already be UV. After the U, V signals pass through the color and tint blocks, they get converted to color difference signals. The color difference signals along with the luminance (Y) signal are matrixed together to give RGB primary color signals which is output at pins 13,14,15.
The RGB outputs are passed to a CMOS analog switch (IC2503M). These outputs have horizontal and vertical blanking inserted by CBLANK signal that is applied to pin 8 of the RGB IC.
To have the black level expansion feature operate properly it is neccesary to have blanking inserted on the RGB outputs. This, however, is incompatible with the RGB processing on the 9-1515 module because it creates a very large offset between the video clamping time and the black level during active video time.
This problem is remedied by using the analog switch to prevent the video from passing to the switch output during the blanking time defined by the CBLANK signal. The switch timing is controlled by the OR'ed combination of the HBL and VBL signals. During the time that the HBL and VBL signals are active, the switch is opened and the output of the switch settles to a DC voltage (3.25v) defined by a resistor divider (10k and 27k) to 12 volts. When the switch is closed during active video time, the low impedance output of pins 13-15 will take over and the output of the switch will follow the video signal compliantly. It is very desirable to have the DC level during the horizontal and vertical blanking intervals be equal to the 0 IRE level of the video signal. This is done by using the IIC bus controlled RGB cutoff control function of the RGB IC to align the 0 IRE level of the RGB at the input of the analog switch to equal the DC voltage developed by the resistor divider at the output of the switch when the switch is open. This is a factory adjustment. Finally, the RGB signals exit the module at connector 10A1 pins3-5.
Signals Description

This section attempts to briefly describes each signal entering and exiting this module as well as some important signals internal to this module.
Beam Sample (10A1 pin 2) - A DC voltage proportional to the average beam current, used for dynamic ABL function. Dynamic ABL functions to reduce black level slightly at high (2 ma.)average beam current levels (i.e. high APL levels. Connects to pin 40 IC2500 (RGB IC) d_abl_in.
R, G, B (10A1 pins 3-5) - RGB output of 9-1506 module. It is routed to the 9-1515 combo module for further RGB processing. These outputs are aligned in the factory to 2.4 Vpp., 0 to 100 IRE.
HT (10A1 pin 7) - Halftone input to RGB IC. This function is not used at this time.
PIP FB, PIPR, PIPG, PIPB (10A1 pins 8-11) - Fastblank and RGB inputs for PIP (picture in picture). This function is not used at this time.
VMY OUT (10B1 pin 1) - Luminance (Y) output to scan velocity modulation circuit. This function is not used at this time.
C IN (10B1 pin 3) - Chroma input (SVHS input) from 9-1507 jackpack module. Color burst amplitude = 580 mv. p.p.
In case of composite video applied to jackpack module, a 2 Vp.p. composite video signal will be applied to this input. This input is routed to a chroma bandpass filter to remove the low frequency luminance components.
Y/VID IN (10B1 pin 5) - Luminance input (SVHS input) from 9-1507 jackpack module. Amplitude is 2 Vpp. In case of composite video applied to jackpack module, a 2 Vp.p. composite video signal will be applied to this input. This input is routed to a low pass filter before being applied to an A/D converter.
HFREE (10B1 pin 6) - Input signal from 9-1515 module. This signal is not being used at this time.
HBL and VBL (10B1 pin 7 and 8) - Horizontal and vertical blanking pulse outputs. At this point, these signals are used internally to this module only. They are generated by the WAC IC and are used remove the blanking pedestal generated inside the RGB IC by switching the RGB outputs (using IC2503M) of the RGB IC to a fixed DC level during the active (positive) time of these pulses.
HSYNC and VSYNC (10B1 pins 9 and 10) - Horizontal and vertical synch (positive) outputs to 9-1515 module low level scan processing section when projector is in TV display mode. These signals are genrated in the WAC IC.
MHD and MVD (10B1 pins 11 and 12) - Main picture horizontal and vertical synch outputs (for PIP applications). These signals are not used at this time.
4.43 (10C1 pin 1) - 4.43 Mhz. color sub carrier reference clock output for PAL modulator on the 9-1511 SECAM module. This signal is generated by using IC2701 (dual D flip-flop) to divide by 4 a 4fsc clock signal generated by the VCDD LSI at pin 6. Amplitude is about 2 Vpp.
16V (10C1 pin 2) - +16 volt DC input.
8V (10C1 pins 5 and 6) - +8 volt DC input.
H FLYB (10C1 pin 7) - Horizontal flyback pulse input. This input is not being used at this time.
SEC FB/HD (10C1 pin 8) - Horizontal HOT drive pulse output. This output is not being used at this time.
SEC BG (10C1 pin 9) - Auxiliary burst gate pulse output. This output is not being used at this time.
SDA and SCL (10C1 pins 11 and 12) - Data and clock line inputs for IIC bus communications.
The following signals are internal to the module.
DC CLAMP - DC control voltage feedback signal to the variable DC level shifter in the RGB IC. Used to fix the sync tip level at the composite video A/D converter input to 1.5 VDC by method of a gated negative feedback loop.
AC (or ACC) - DC control voltage feedback signal to the variable gain chroma ACC amplifier in the RGB IC.
Used in a gated negative feedback loop to control the color burst amplitude at the chroma A/D converter input to 480 mv. pp.
SCP - This is a two level "sandcastle" pulse, generated by the VCDD LSI at pin 60 and sent to the RGB IC Inside the RGB IC, the lower level is sliced at 1.5 VDC and the resultant pulse that is formed, is used to turn off the black peak detection circuit during the horizontal and vertical blanking intervals. The black level expansion circuit should be active only during active video time. The upper level is sliced at 3.5 VDC and the resultant pulse that is formed, is used as a clamp gate pulse for the Y, I, and Q input signals to the RGB IC.
CBLANK - Composite blanking pulse input to RGB IC. This signal is generated by the VCDD LSI at pin 65 as an auxiliary blanking pulse. This pulse is not required for blanking per se, however the RGB IC requires a composite blanking pulse to be applied for the black level expansion circuit to function properly. This pulse is removed by gating it out and replacing it with a fixed DC level during horizontal and vertical blanking intervals with analog switch IC2503M.

9-1512 C9 Video Output Module

Video Amplifier

The video signal is terminated in 75 ohms in series with a 0.39 uH inductor to improve the high frequency response. It is then buffered and limited to 3 V. by emitter follower Q5101M. Q5102 and Q51103 make up a cascade amplifier with R5104M and R5105M as the emitter resistors, and R5117 (on the heat sink) as the collector resistor. Q5103 is heat-sunk through a 6 mm thick aluminum oxide insulator to reduce the capacitive loading on the collector. Emitter peaking is provided by C5101M and R5106M. Collector peaking is provided by L5102M, L5103M, L5104M. The pulse-response of the amplifier is 8 ns black-to-white (10-90%) time with 20-25% overshoot, which is required to provide adequate drive for single pixels in the high-resolution modes (up to 75 MHz pixel rate). A "blue-boost" option consisting of D5102M and R5107M provides increased gain at higher drive levels to help compensate for the saturation of the blue phosphor. The emitter of Q5102M is biased up to 0.5 V. to keep the video amplifier from turning on until the input reaches 0.5 V.

Auto-Bias

The CRT cathode current is sampled by Q5104M, develops a voltage across R5134M, and is fed into the + input of the comparator in IC5101. One mA of cathode current corresponds to approximately 0.95 volt at this + input pin. An 8 uV reference is fed into the - input. This corresponds to approxi-

9-1512 Video Output Module

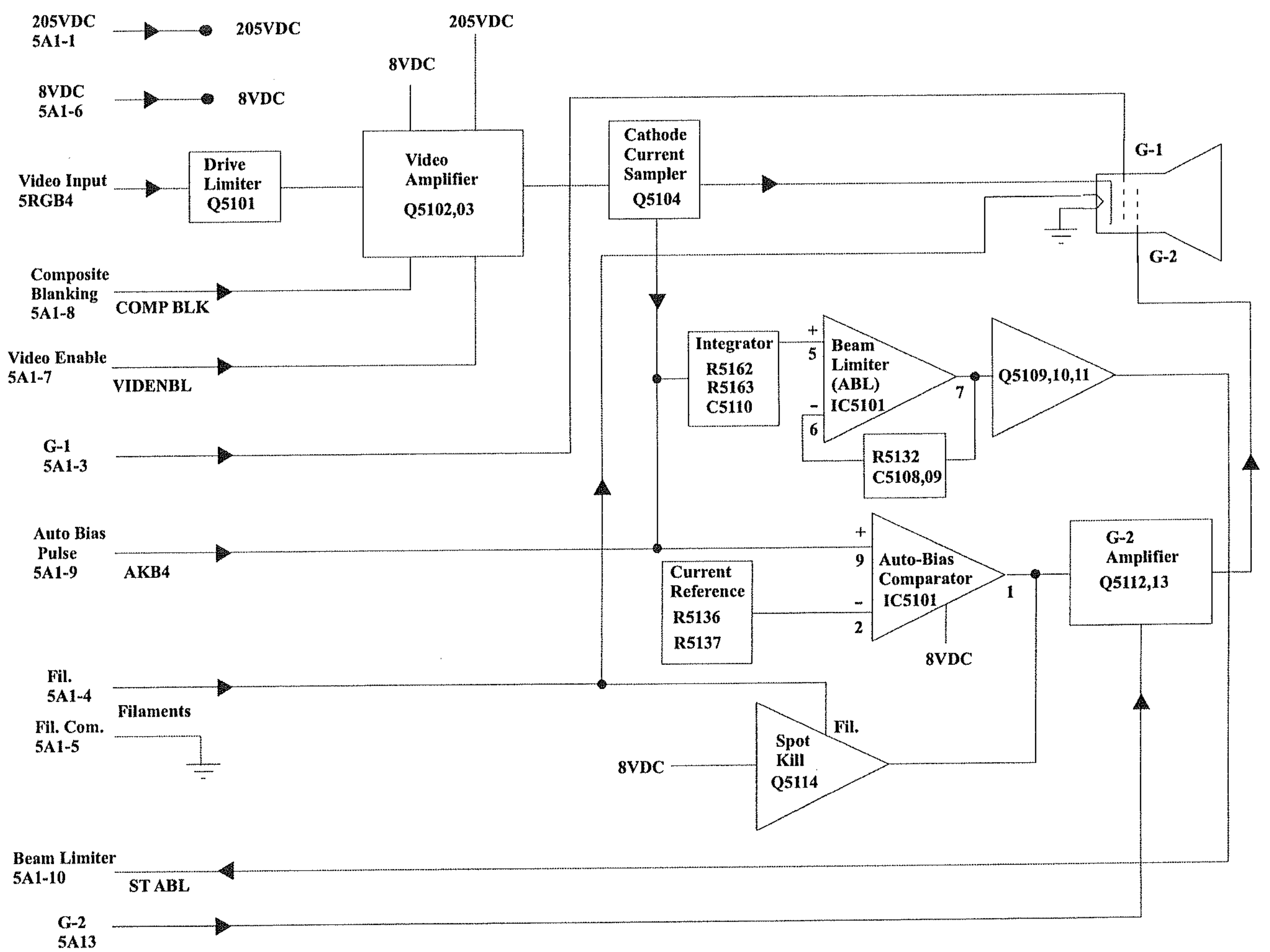


Figure 50

mately 8 uA of cathode current. The output of the comparator is filtered and fed to the base of Q5112, a common-emitter DC amplifier, which provides the bias voltage for G2. The collector resistor for Q5112 consists of 7 (1/10 W surface mount) resistors in series because of the high G2 voltage (up to 950 V.) and the low breakdown voltage of the resistors (150 V. each). During active video time the auto-bias (AKB4L) pulse is high, which forces the open-collector output of the comparator to be open. This gates off the comparator and prevents it from changing the voltage at its output. After vertical blanking , the auto-bias pulse is low (active) during the active (not blanked) time of the next 4 horizontal lines, which reverse-biases D5109M. During this interval a separate auto-bias pulse is switched into the input of each video amplifier and the resulting CRT cathode current is compared against the reference voltage, and the G2 bias voltage is adjusted as required to change the cathode current to 8 uA, thus closing the loop. The G2 voltage is maintained at this level through active video time by C5116 and C5119.

Beam Limiting

The cathode current sample voltage across R5134M is integrated by R5162M, R5163M, and C5110M and fed into the op-amp in IC5101. This integration is necessary because of the limited bandwidth of the op-amp. At higher frequencies, the gain of the op-amp is virtually 1 because of C5108M and C5109M between the output and - input, and at low frequencies the gain is 5.7 (the voltage divider consisting of R5129M and R5131M). Thus, the peak to average cathode current ratio is 5.7. The output of the op-amp is compared against a reference voltage by the differential amplifier made up of Q5110M and Q5111M. If the output of the op-amp goes above the reference voltage (the cathode current goes above the limit), Q5111M turns on, which turns on Q5109M, which then reduces the voltage on the contrast control, and closes the loop. The reference voltage, and thus beam current limit, is increased on the green CRT by the jumper plug on P2 and R5135M. The nominal CRT beam current limits are as follows:

CRTLimit (mA)
AveragePeak
Red0.95.1
Green1.26.8
Blue 0.95.1

Video Enable

If the VIDENBL (video enable) input is not high, Q5106M turns on, lowering the voltage on the base of Q5103 (video output). This virtually disables the video amplifier, and keeps it from operating when there is no high voltage present.

Blanking

An open-collector, active-low blanking signal feeds the base of Q5108M, which raises the emitter voltage of Q5102M, and thus blanks the video.

Spot Kill

If the +8 V. power supply goes below 4.9 V. (6.3 V. filament less the diode drop of D5111M and the VEB drop of 5114M) while the filament is still on, Q5114M turns on, causing the G2 voltage to go low to prevent CRT burning.

SECTION THREE

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CRT Replacement Instructions

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