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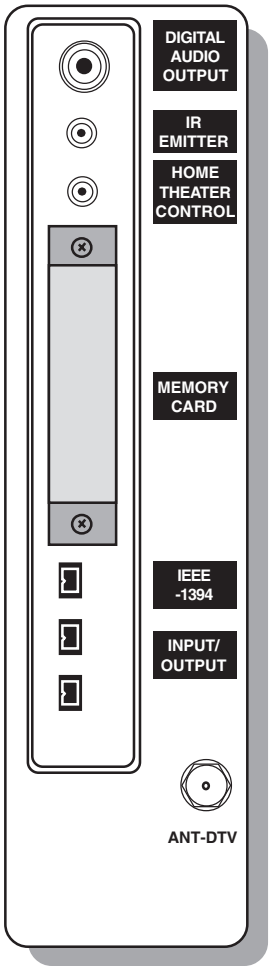
Digital

TECHNICAL TRAINING

2002

Projection Television Technical Training Manual



V19 CHASSIS	V21 CHASSIS	
WS-55859	WS-48511	WS-65511
WS-55909	WS-B55	WS-65611
WS-65909	WS-55511	WS-65711
WS-65869	WS-55711	WS-65712
WS-73909		WS-73711

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V19-V21 TRAINING MANUAL
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Chapter 1
Introduction

V19 CHASSIS	V21 CHASSIS	
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WS-55909	WS-B55	WS-65611
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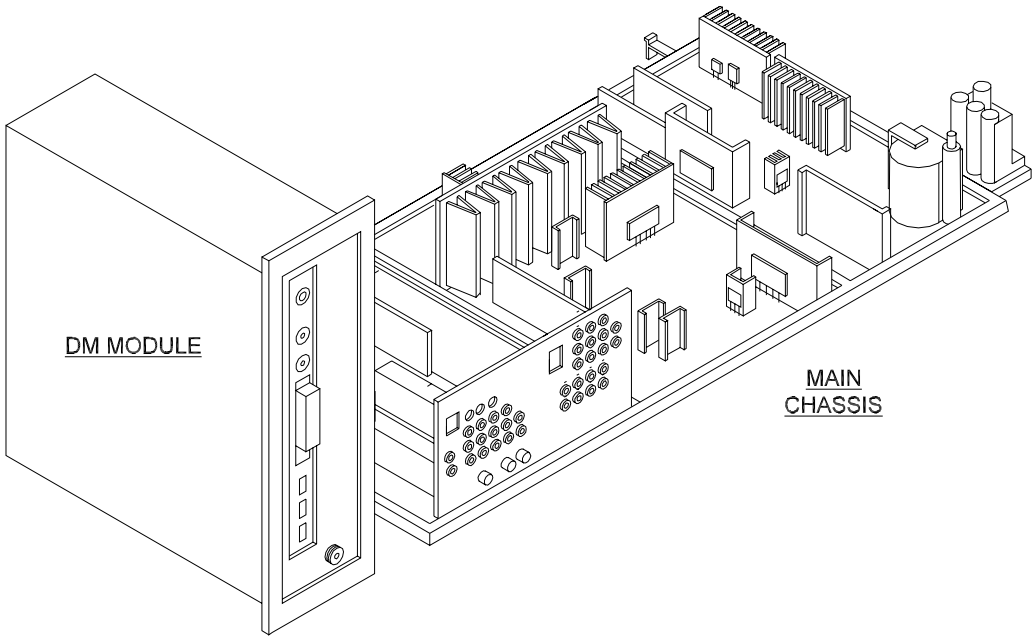
WS-65869	WS-55711	WS-65712
WS-73909		WS-73711



The V19 and V21 are Mitsubishi's high end Projection TV chassis for 2 years. Specific models for each chassis type are listed above. Both chassis types have features not available in previous models. These features include:

- Integrated ATV Tuner
- System 5 A/V Network
- NetCommand™ Home Theater Control
- IEEE 1394 Inputs/Outputs
- HAVi Compatibility
- 5C Copy Protection
- Record Timer for IEEE1394 D-VCR

Other features include:

- Five Picture Format modes
- Picture Format Memory by Input
- IR Repeater Outputs
- PIP-POP features (V19)
- PIP-POP and Multi PIP features (V21)
- Composite and S-Video Monitor Outputs
- Sub Picture Sound Outputs.
- Analog DTV, Component and VGA Inputs.

Differences between the V19 and V21 are software related:

- Streamlined NetCommand Setup Menus.
- Multiple PIP.
- Different Service Menu Access Codes.

In addition to cosmetic differences, the main difference between various models are optical improvements in the higher end models.

Terminology	Defitition
ATV	Advanced TV
AV	Audio Video
AV/C	1394 AV Control Format
DCM	Digital Control Module
FAV	Full Audio Video
HAVi	Home Audio Video Interoperability (Digital AV Devices, 1394 compliant)
IEEE-1394	Digital Transmission System using cables
IR	Infra-red
Legacy Devices	AV System 5 Compatible Components
QAM	Cable HDTV Signal
5C	Copy Protection (mainly used in Cable)

Table 1-1: Definititions

Due to the new added features, some terminology and abbreviations used are new. *Table 1-1* lists the definitions for some of the new terminology.

The Integrated ATV Tuner enables reception of HDTV signals without using an external Set Top Box. The ATV Tuner and its' associated circuitry is also capable of receiving Cable QAM digital signals, when not scrambled.

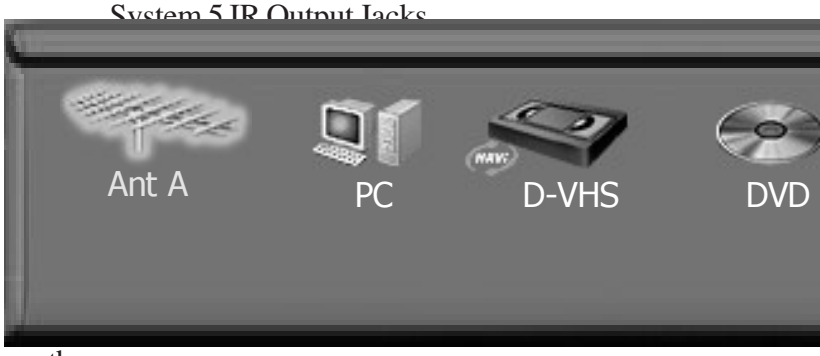
NetCommand™ simplifiies the control of Home Theater System devices. It controls compatible analog, digital and HAVi components using only the TV layer of the Remote Control.

When the Remote "Device" button is pressed an on-screen display shows all devices in that Home Theater System. An example of a Device Select Display is shown below.

The user selects the device using the "Direction" buttons, then presses "Enter". Compatible devices are activated and corresponding input selections are automatically performed. The initial NetCommand™ setup procedure is described in *Chapter 2*.

NetCommand™ controls Home Theater components by two methods:

1) Legacy Devices (System 5 compatible) are controlled through IR Blasters connected to the System 5 IR Output Jacks



other.

Device Select Display

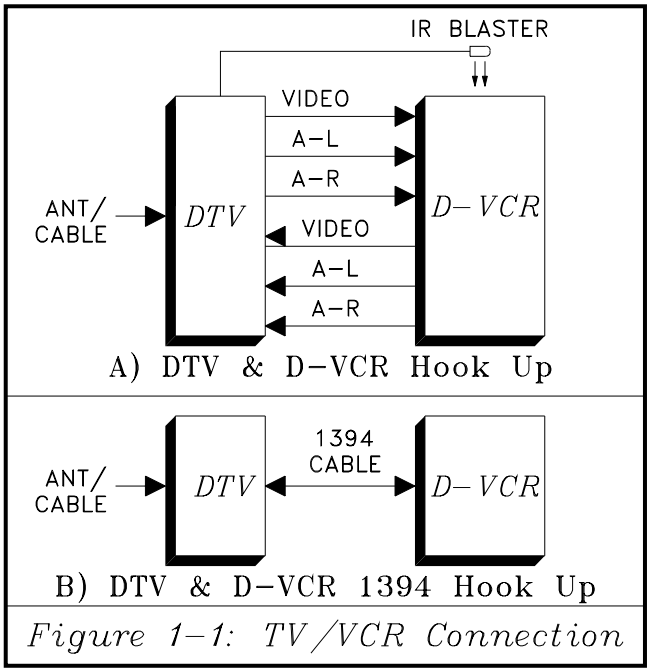


Figure 1–1: TV/VCR Connection

When used with consumer Audio Video products it transfers digital data streams for DTV and Digital Cable Boxes. This includes MPEG2 HDTV data streams.

When components are 1394 compatible, interconnection of the units is simplified. *Figure 1-1* illustrates how the 1394 system simplifies interconnection between the DTV and a D-VCR.

Figure 1-1A shows the connections between a DTV and D-VCR when components are not 1394 compatible. Six cables are required to transfer analog signals from one unit to the other. In addition, control of the VCR would be from an IR Blaster signal or directly from the D-VCR's Remote.

Figure 1-1B shows a single 1394 cable connection between a DTV and the D-VCR that are 1394 compliant. There are two types of 1394 Cables:

- 6 wire – two wires for data transfer, two wires for timing, and two wires for power.
- 4 wire – two for data transfer and two for timing.

Figure 1-2 shows an IEEE-1394 4 wire cable, used in consumer Audio Video. It consists of two pairs of twisted wires. Each pair is separately shielded, and then the entire cable is shielded. This minimizes any interaction between conductors. 1394 cables may be up to 40 feet in length.

Home Theater components that are not System 5 or 1394 compatible can usually be controlled through the TV by one of two methods.

1) Using the corresponding Mitsubishi remote layer, Cable, VCR, DBS or DVD.
2) Using that component's Remote Control and an IR Blaster connected to the IR Repeater Jacks.

5C Copy Protection

5C Copy Protection prevents copying restricted signals. There are three levels of 5C Copy Protection:

1) Unlimited Recording allowed.

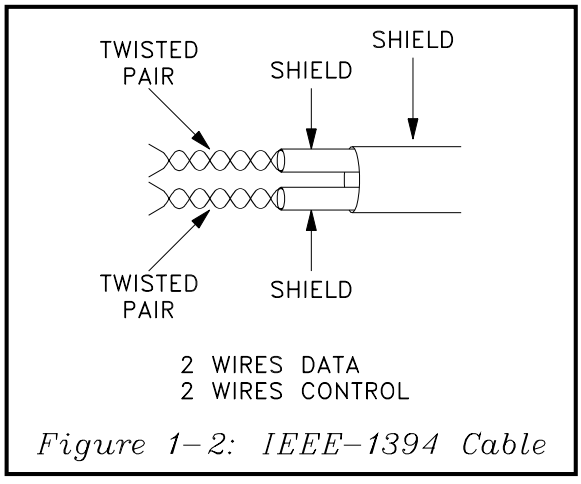


Figure 1–2: IEEE–1394 Cable

2) One Recording allowed.
3) No Recordings allowed.

At present, only QAM (Digital Cable Signals) are coded with 5C Copy Protection. When the V19 detects a Copy Protected signal, that signal is not output at the Monitor Outputs of the TV.

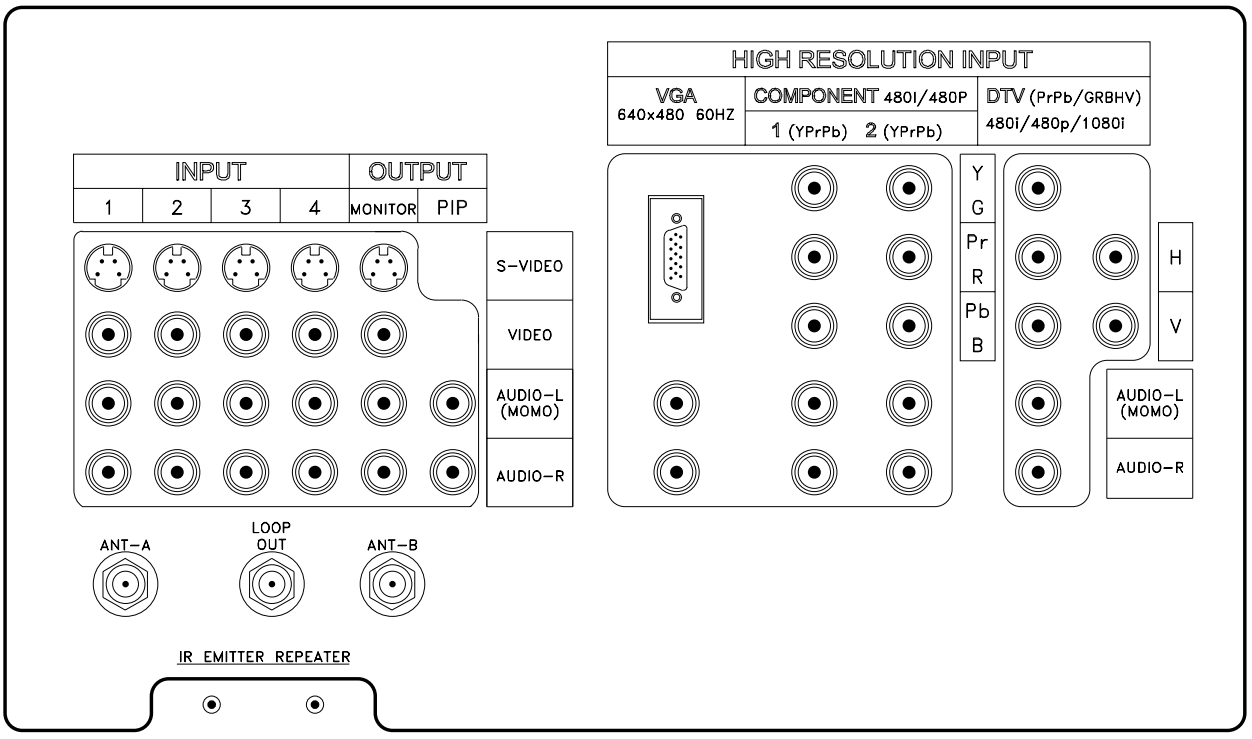
Monitor Output Sources
There are only two sources that output signals at the Monitor Outputs, NTSC signals and signals from the ATV Tuner (when not Copy Protected).

Timer Recording

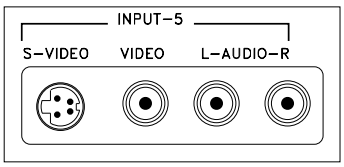
Mitsubishi's HS-HD2000U and HS-HD1100U, D-VCRs includes HDTV recording capability and HAVi. However it must be connected to an external ATV Receiver with a IEEE-1394 interface, such as in the V19 chassis. Time Shift Recording allows recording from the V19's ATV Tuner without turning the TV On, only the TV's signal circuits are activated. The Time Shift Recording time can be pre-programmed so the user does not have to be present to activate the recording.

External Inputs & Outputs

Analog External Inputs and Outputs are located both on the rear and front of the TV. *Figure 1-3* shows the External Analog Inputs and Outputs. The DTV Inputs



A) Rear Panel Analog Inputs/Outputs



B) Front Panel Analog Inputs/Outputs

Figure 1-3: Analog Inputs/Outputs

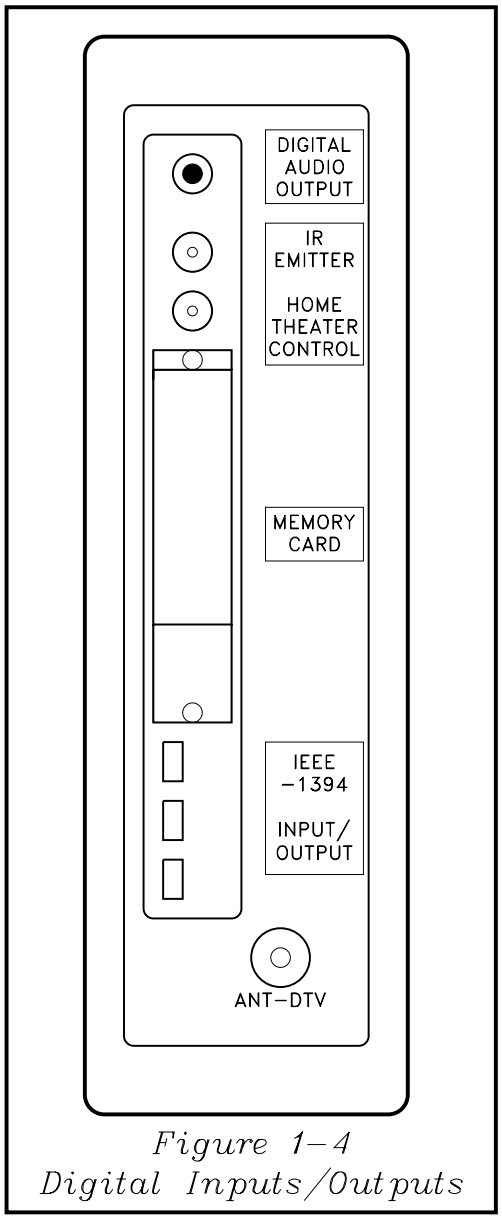


Figure 1-4
Digital Inputs/Outputs

are still available even though a Set Top Box is not needed to receive HD broadcasts. In the V19 these inputs are mainly used to connect a Digital Broadcast Satellite (DBS) to the TV.

The IR Emitter Repeater outputs are for connecting IR Blasters to control AV devices that are not System 5 or 1394 compatible. Signals from other manufacturer's remotes are amplified in the TV and output from the Repeater Jacks.

Digital Analog Inputs & Outputs are located on the rear of the TV and are shown in *Figure 1-4*. These include:

- ANT-DTV … Antenna or Cable Input (ATSC or QAM)
- Three 1394 Jacks … to connect external 1394 compatible devices
- Two System 5 IR Emitter Jacks … for IR Blasters controlling external System 5 devices.
- Digital Audio Output … AC-3® digital output for connection to an external device with an AC-3® Decoder.

Display Formats

Figure 1-5 illustrates the Display Formats possible in the V19. Pressing the "FORMAT" button on the Remote Control changes the Display Format. Note that

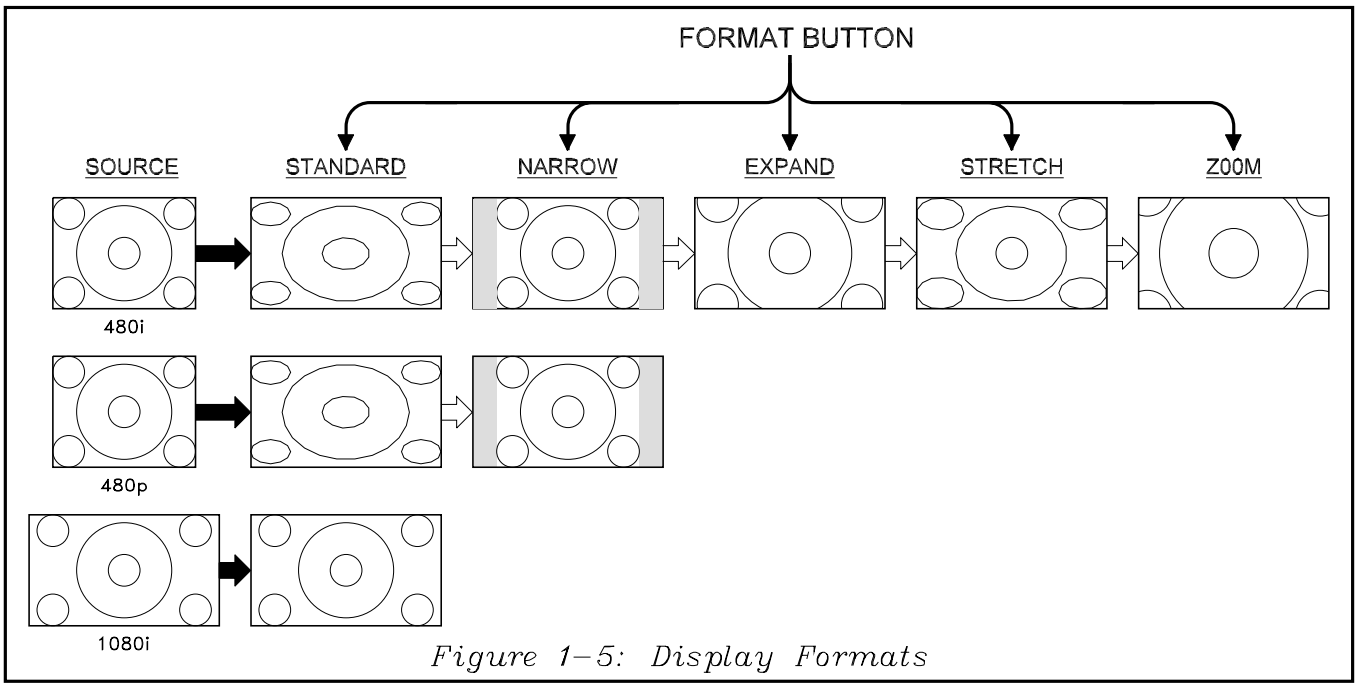


Figure 1–5: Display Formats

all five Display Formats can only be accessed when the signal source is 480i. When the source is 480p, only Standard and Narrow can be activated, and when the source is 1080i only Standard is available.

The Format memory is by input. When a Display Format is selected for an Input, that format will be activated when that input is selected again.

POP/PIP Features

POP/PIP features are illustrated in *Figure 1-6*. They are similar to those in previous models. In addition to PIP-POP V21 has multi-PIP capabilitys. **Only 480i format signals** can be selected for POP/PIP main and sub pictures. POP pictures can be viewed in either the "Standard" or "Expand" format.

In the Standard Format main POP pictures are symmetrical and there are dark areas at the top and bottom of the picture. In the Expand Format, the main picture is compressed horizontally and stretched vertically, removing the black areas.

Remote Control

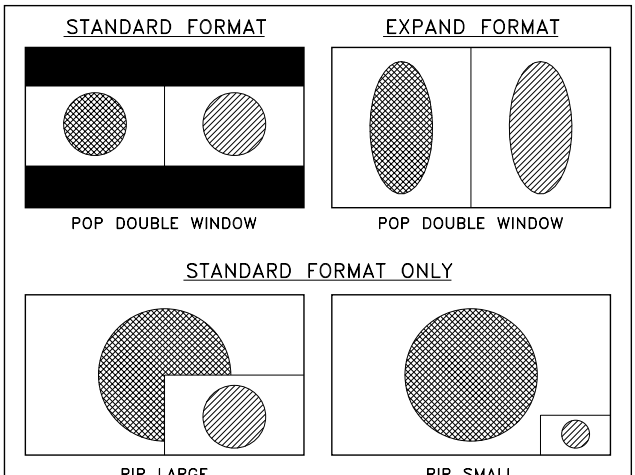


Figure 1–6: POP/PIP Displays (480i Only)

The Remote Hand Unit for the V19 appears the same as that in previous models, refer to *Figure 1-7*. However there are two differences.

- The "INPUT" button is changed to "DEVICE".
- There are two operational modes, Standard and NetCommand™.

The Remote for the V21 is physically larger but has the same basic functions. See *Figure 1-8*.

The Remote Hand Unit comes in the Standard Mode so the TV can be controlled in the normal fashion. To use NetCommand™, the Remote Hand Unit must be changed to the NetCommand™ mode. Changing the Remote operational mode is described in *Chapter 2*.

LED Diagnostics

The LED Diagnostic Mode, used in some previous models is carried over in the V19 and V21 with some additional features. This helps isolate the source of shutdown problems by counting how many times the front panel LED flashes. For details on this feature, refer to *Chaper 11*.

Figure 1-7: V19 Remote

Figure 1-8: V21 Remote

Chapter 2
NetCommand™

The NetCommand™ feature in the V19 and V21 is an enhanced user simplified Home Theater Control System. It provides graphic control of an entire Home Theater System through the TV. It controls existing analog devices along with New Digital Home Theater devices.

NetCommand™ uses System 5 to control Home Theater components with IR Blasters, and also controls HAVi capable devices over 1394 cables.

When a TV is first installed, the Setup Wizard automatically displays a series of Initial Setup Screens to configure System 5. It allows entry of all devices connected to the TV. When the Initial Setup is complete, NetCommand™ is automatically activated. For specfic instructions on setup and use, refer to the Owner's Guide and NetCommand Guide.

IEEE-1394 Devices

The TV automatically detects when an IEEE-1394 device is connected. The user will be asked to select a name for that device that will be displayed in the Device menu.

Remote Operational Mode

Before the NetCommand™ feature can be use, the Remote Hand Unit must be set to the NetCommand™ operational mode. To change to the NetCommand™ mode:

- Set the Remote to the TV Layer
- Point the Remote away from the TV
- While holding the "Power" button, press "9-3-5" in sequence.

Figure 2-12 illustrates how to change to the NetCommand™ mode, or to the Standard mode.

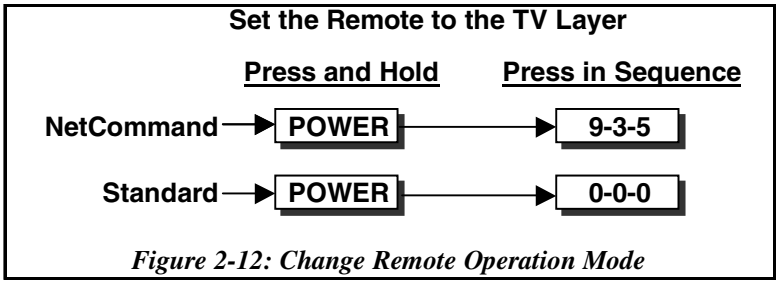


Figure 2-12: Change Remote Operation Mode

Chapter 3
Disassembly & PCB Locations

There are no radical changes in the disassembly of V19 models. *Figure 3-1* shows the cabinet rear disassembly for V19 models. The Light Box is still removable as a unit, as shown in *Figure 3-1*. Of course all front panel PCBs and the speakers must be disconnected before the Light Box can be removed.

Figure 3-1 shows one major change to the Light Box assembly, the addition of the Digital Module (DM) on the left side. The ability to remove the CRTs, main chassis and DM as a unit, facilitates servicing.

Only the Light Box is needed to troubleshoot most problems. So only the Light Box can to be taken to the shop, rather than the complete set.

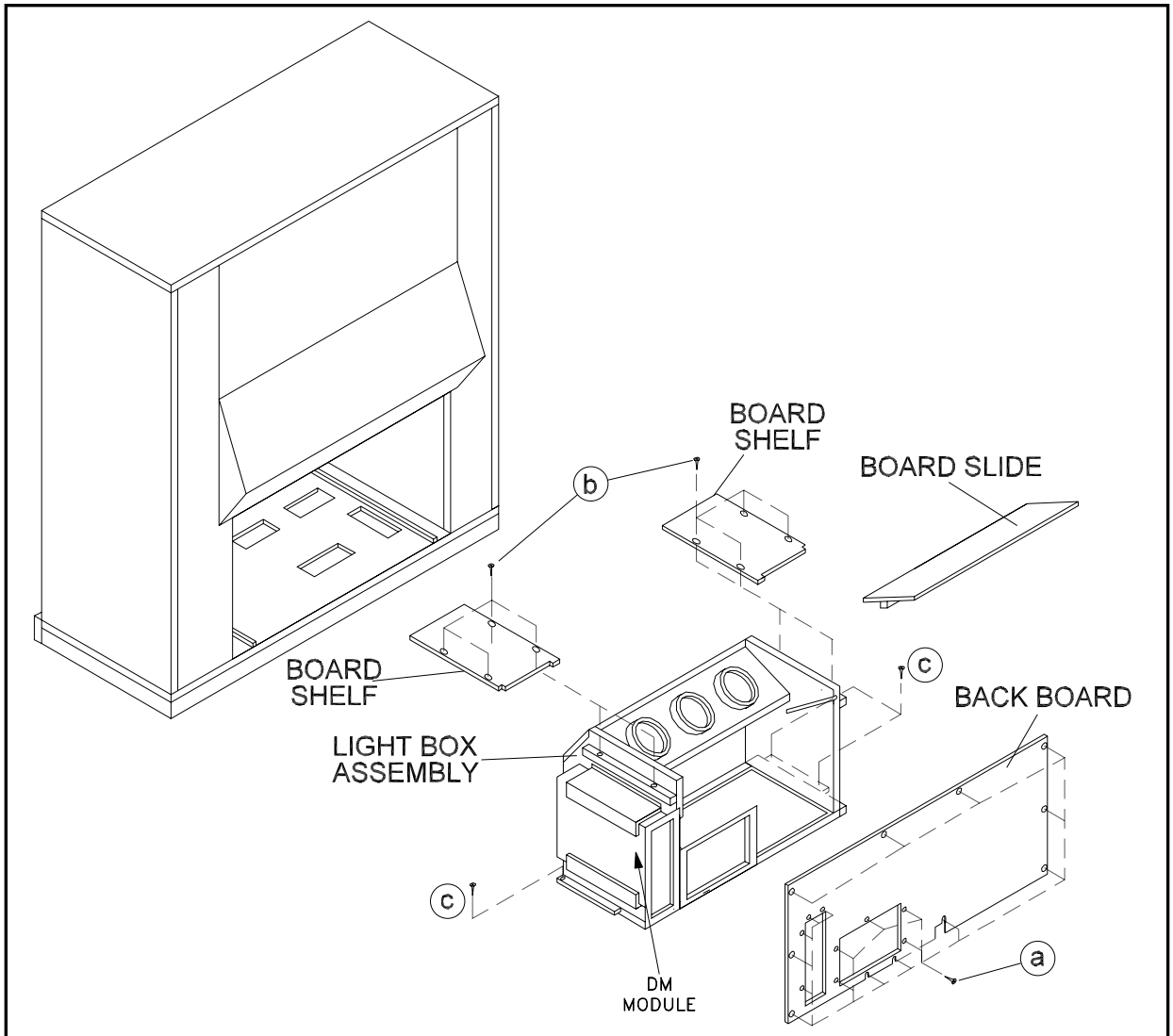


Figure 3–1: Light Box Removal

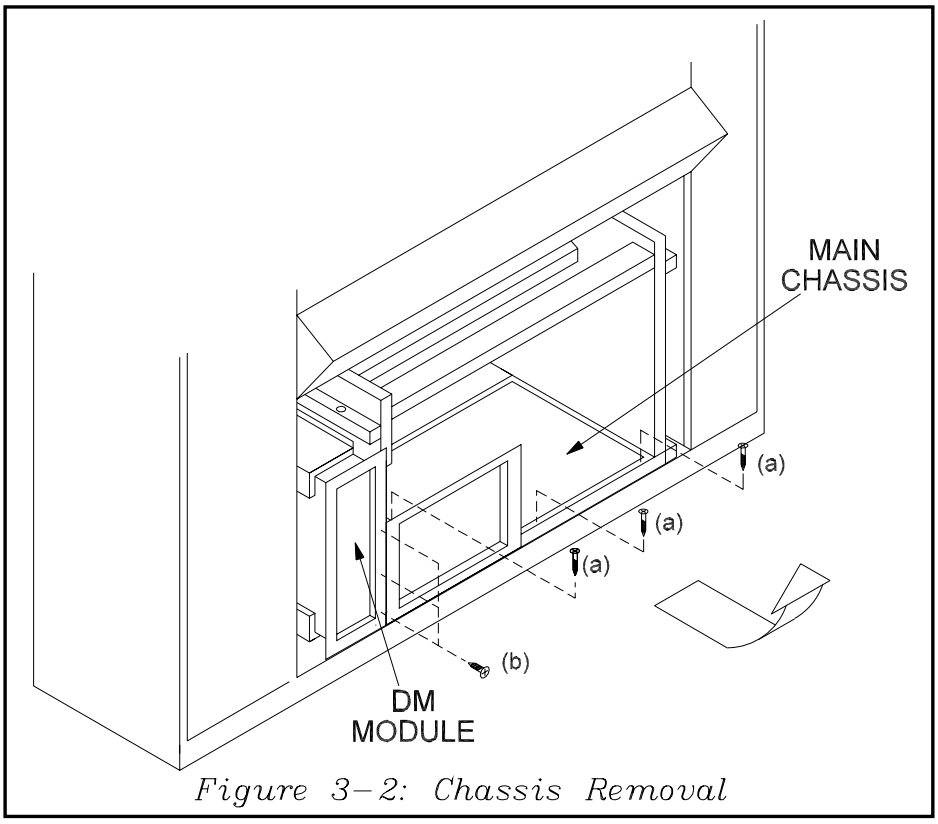


Figure 3–2: Chassis Removal

Accessing The Main Chassis

The Main Chassis can still be accessed as is in previous models.

1) Loosen wire ties on cables to the CRTs, front panel, speakers, etc.
2) Remove the three chassis mounting screws (a), shown in *Figure 3-2*.
3) Release the chassis locks on the front of the chassis, shown in *Figure 3-3*.
4) Slide the chassis out the rear of the cabinet. The DM Module is attached and will slide back with the chassis.
5) Tilt the chassis upward to access the bottom of the PCBs.

In some cases, Cable length will not allow the DM to slide back with the chassis. If this occurs:

1) Remove the three DM mounting screws (b), in *Figure 3-2*.
2) Slide the DM Module out the rear of the unit.
3) Then slide the chassis out the rear of the unit.

NOTE: The DM Module **must** be connected to the main chassis, or the TV will not switch On.

Main Chassis PCB Locations

Figure 3-3 shows the location of PCBs that comprise the main chassis. The following PCBs are plug in and are considered replaceable components:

- PCB-3DYC
- PCB-2HDW
- PCB-CONV-GENE
- PCB-JUNGLE
- PCB-DBF

PCBs SIGNAL, POWER and MAIN are not considered replaceable, an troubleshooting must be to component level.

Main Parts Location

For a reference, *Figure 3-4* shows the location of the major components in the main chassis. *Figure 3-5* displays the component layout inside the DM.

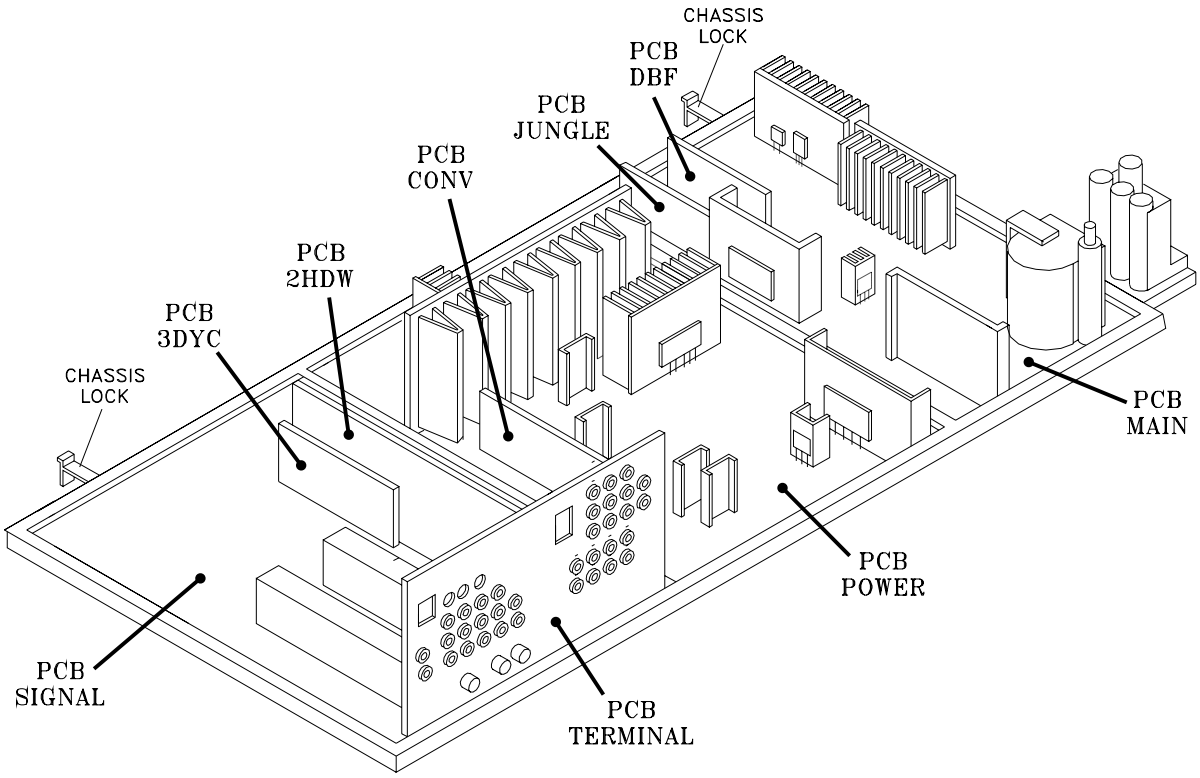


Figure 3–3: Main Chassis PCB Locations

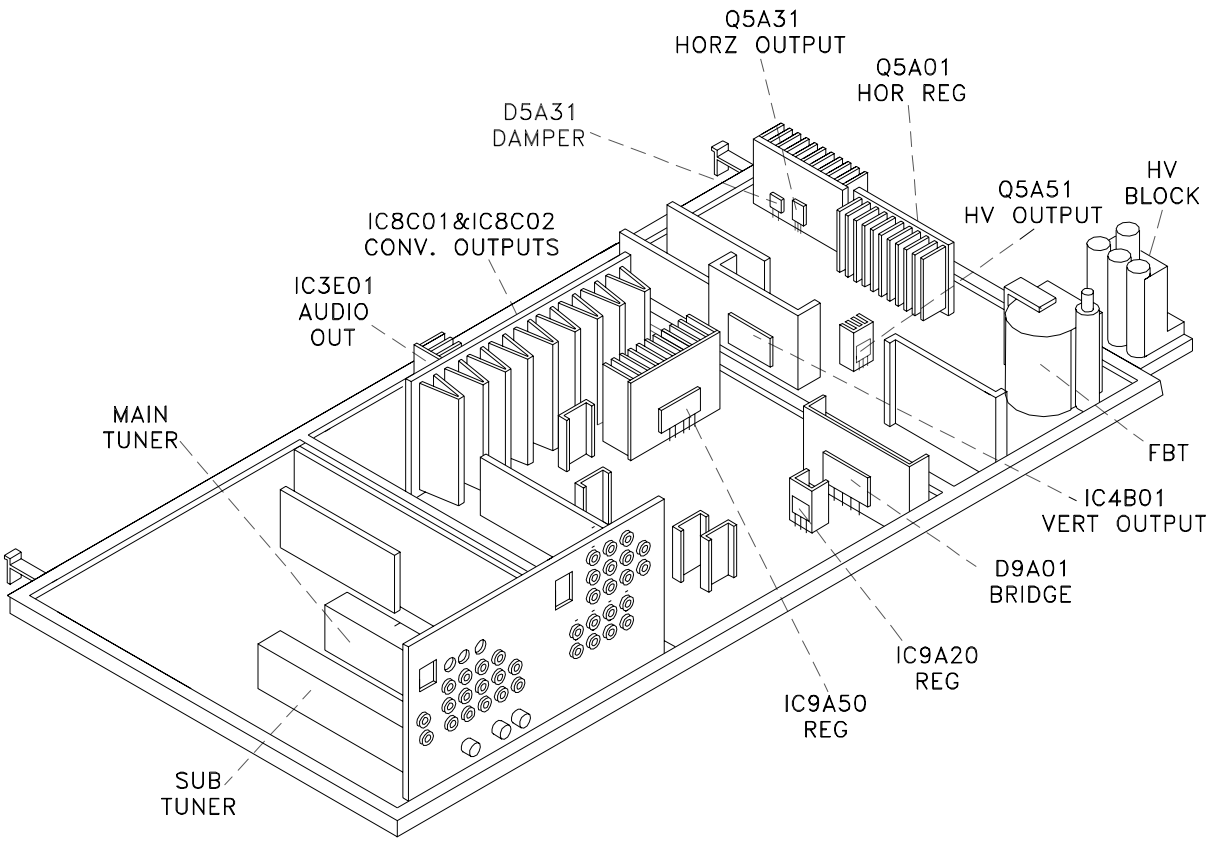


Figure 3–4: Main Parts Location

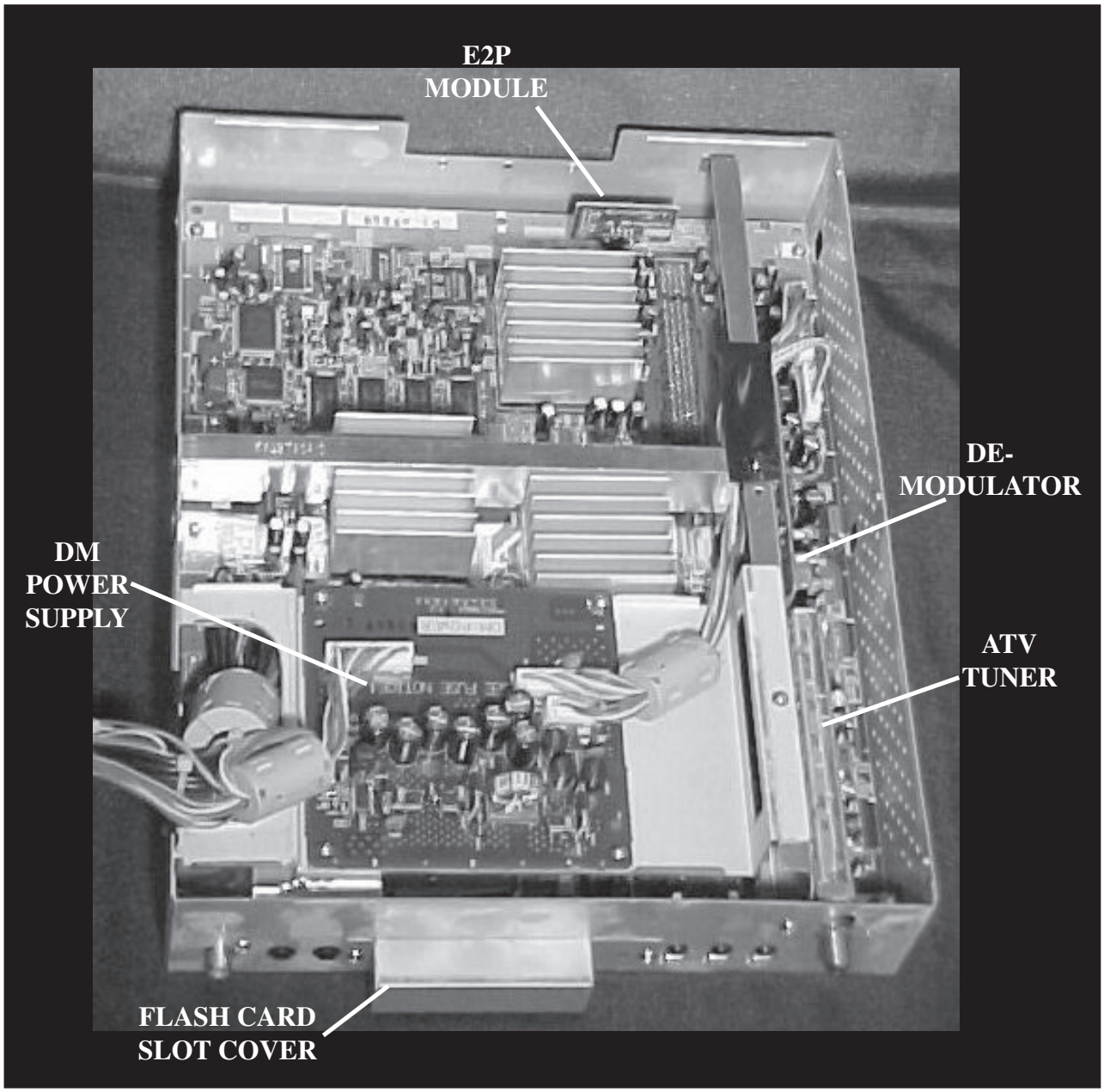


Figure 3-5: DM Module Main Components

Chapter 4
Adjustments

Chassis	Option Menu	Adjustment Mode	Convergence Mode	OSD Position
VZ5	1-3-7-0	2-3-5-7	2-3-5-9 <6><5><4>	Adjust Mode
VZ6	"	"	"	"
VZ7	1-2-7-0	1-2-5-7	1-2-5-9 <6><5><4>	"
VZ8	"	"	"	"
VZ9	0-1-7-0	0-1-5-7	0-1-5-9 <6><5><4>	"
V15	1-3-7-0	2-3-5-7	2-3-5-9 <6><5><4>	"
V16	1-2-7-0	1-2-5-7	1-2-5-9 <6><5><4>	"
V17	8-2-7-0	8-2-5-7	8-2-5-9 <6><5><4>	"
V18	0-1-7-0	0-1-5-7	0-1-5-9 <6><5><4>	"
V19	0-1-7-0	0-1-5-7	0-1-5-9 <6><5><4>	0-1-8-8
V20	2-2-7-0	2-2-5-7	2-2-5-9 <6><5><4>	Adjust Mode
VK20	2-2-7-0	2-2-5-7	2-2-5-9 <6><5><4>	Adjust Mode
V21	2-1-7-0	2-1-5-7	2-1-5-9 <6><5><4>	2-1-8-8

Table 4-1: Service Menu Access Codes

The individual Adjustment Procedures for the V19 and V21 are basically the same as in previous models, and are described in the Service Manual. Therefore, they don't require repeating here. There are some changes in the Adjustment Procedure process in the V19/V21 Chassis. The changes iclude:

- Change in the "Mode Activation Codes".
- Change in On-screen nomenclature of some "Adjustment Functions".
- New OSD Position Adjust Mode.
- Change in the procedure to activate the "Convergence HD Mode" with no signal.

The OSD Position Mode is new. In previous models, OSD position was set in the HR Function of the Adjustment Mode. The V19/V21 uses a separate mode, with its' own activation code to position the OSD.

Activation Codes

For a quick reference, *Table 4-1* lists the codes for the V21 and previous chassis types.

Adjustment Mode

Outside of the activation code, the procedure for the "Adjustment Mode" is the basically same as in previous models. *Figure 4-1* illustrates the "Adjustment Mode" procedure.

One of the changes in the "Adjustment Mode" is the on screen nomenclature used for some of the "Adjustment Functions. The changes are shown in *Table 4-2*

In the Adjustment Mode VC Function, pressing "3" toggles the signal mode between 480i, 480p, 1080i, DM and VGA. DM is an added signal format, but is only available for possible future use. When "3" is pressed, data changes are not automatically saved. Therefore, **press "ENTER" save data before pressing "3".**

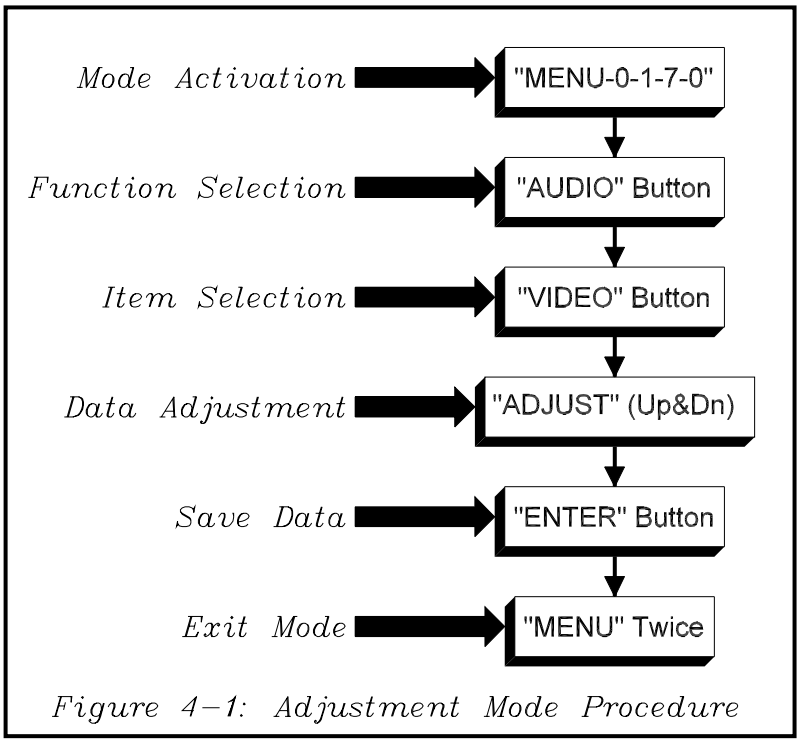


Figure 4-1: Adjustment Mode Procedure

OSD Position Mode

The horizontal position of the OSD is set in this mode. The OSD Position must be set in both the SD (Standard Definition), and HD formats. The procedure for setting OSD Position is given *Figure 4-2*.

Convergence Mode

Like the "Adjustment Mode" the only change in the "Convergence Mode" procedure is the activation code. *Figure 4-3* graphically shows the general "Convergence Mode" procedure.

Previous Models	V19/V21 Chassis
Video/Chroma	VC
Jungle	JNGL
Main Matrix	MNTS
Sub Matrix	SNTS
Audio	AUD

Table 4-2: Adjustment Function Changes

One additional change is the procedure on how to activate the HD Convergence Mode when no HD signal is available

SD OSD Horizontal Position Procedure

1) Select an NTSC signal (Ant-A or Ant-B).
2) Press "MENU-0-1-8-8" or "MENU-2-1-8-8"
3) Use the Adjust Buttons to adjust OSDSD data to center the On Screen Display.
4) Press "MENU" to save data and exit the mode.

HD OSD Horizontal Position Procedure

1) Select an HD signal (DTV Inputs).
2) Press "MENU-0-1-8-8" or "MENU-2-1-8-8"
3) Use the Adjust Buttons to adjust OSDHD data to center the On Screen Display.
4) Press "MENU" to save data and exit the mode.

Figure 4-2: OSD Position Adjustment Procedure

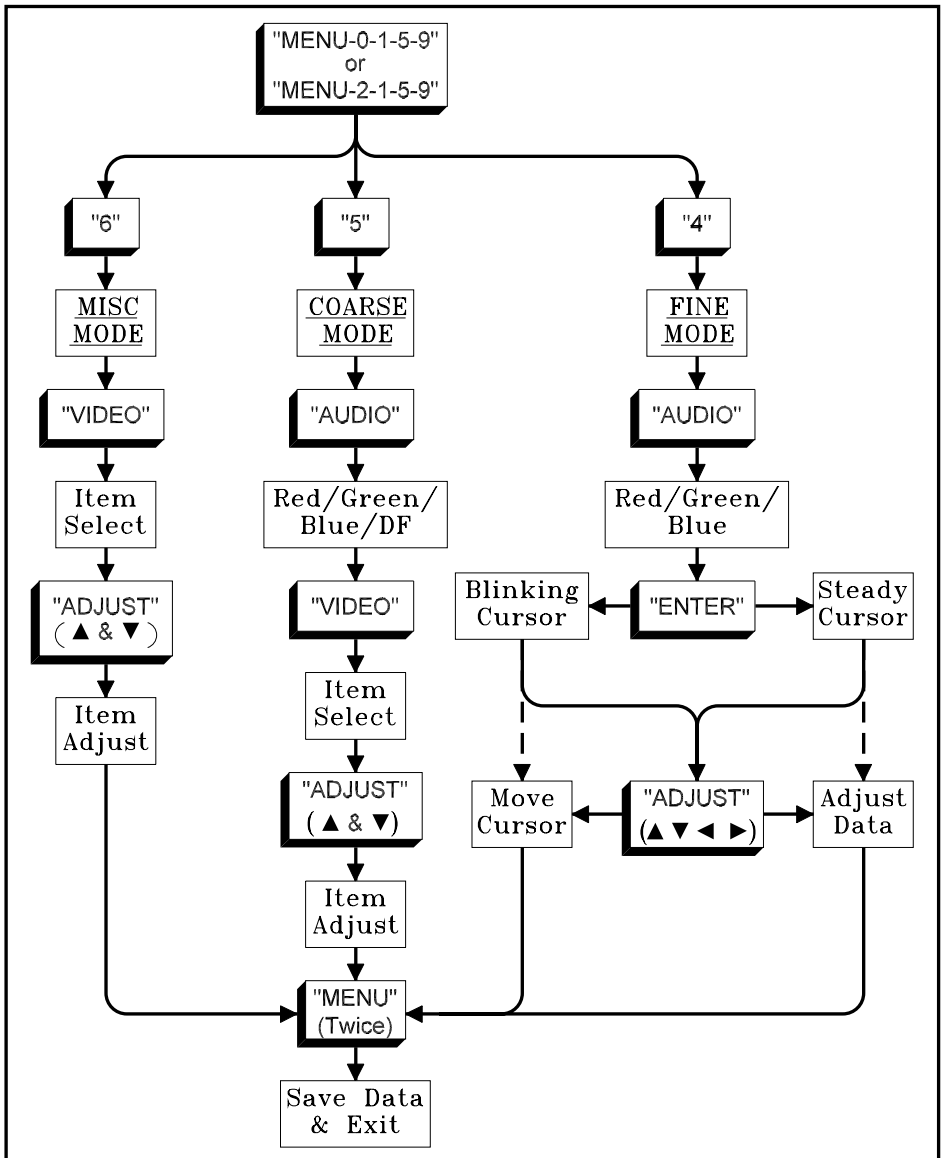


Figure 4–3: Convergence Mode Procedure

Note: In an Adjustment Mode, if the data changes too fast ... Change the Remote to the NetCommand™ mode. (Hold "Power" and press "9-3-5" in sequence).
Caution: When adjustments are complete, change back to the Standard Mode. (Hold "Power" and press "0-0-0" in sequence.

HD Convergence Mode With No Signal

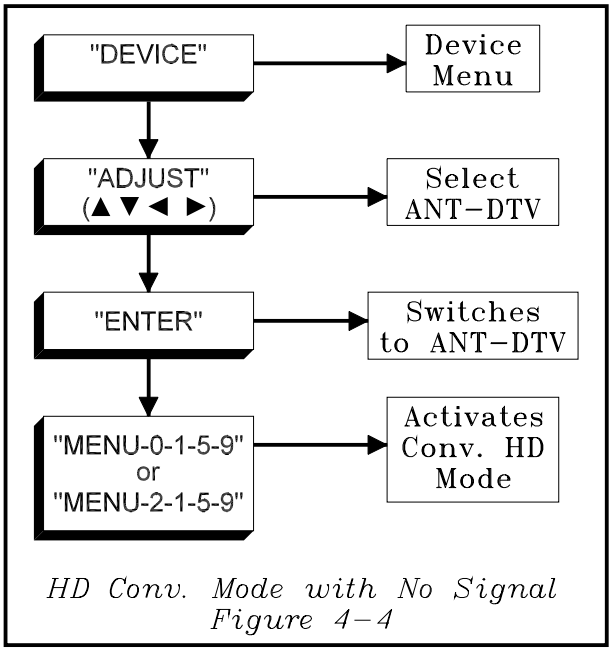
Although HD Test Patterns are required to perform Centering and Static Convergence, it is possible to perform Coarse and Fine Convergence Adjustments when no HD signal is available.

Note: To produce the internal crosshatch with a black background:

1) Turn off Video Mute.
2) Select a source with no signal.
3) Activate the Convergence Mode.

With Video Mute On, only a blue raster is produced.

The procedure for activating the HD Convergence Mode with no HD signal, is easier than that used in previous models. Merely select ANT-DTV as the signal source and then enter the Convergence Activation code. The Convergence Mode comes on in the HD mode. *Figure 4-4* graphically illustrates this procedure.

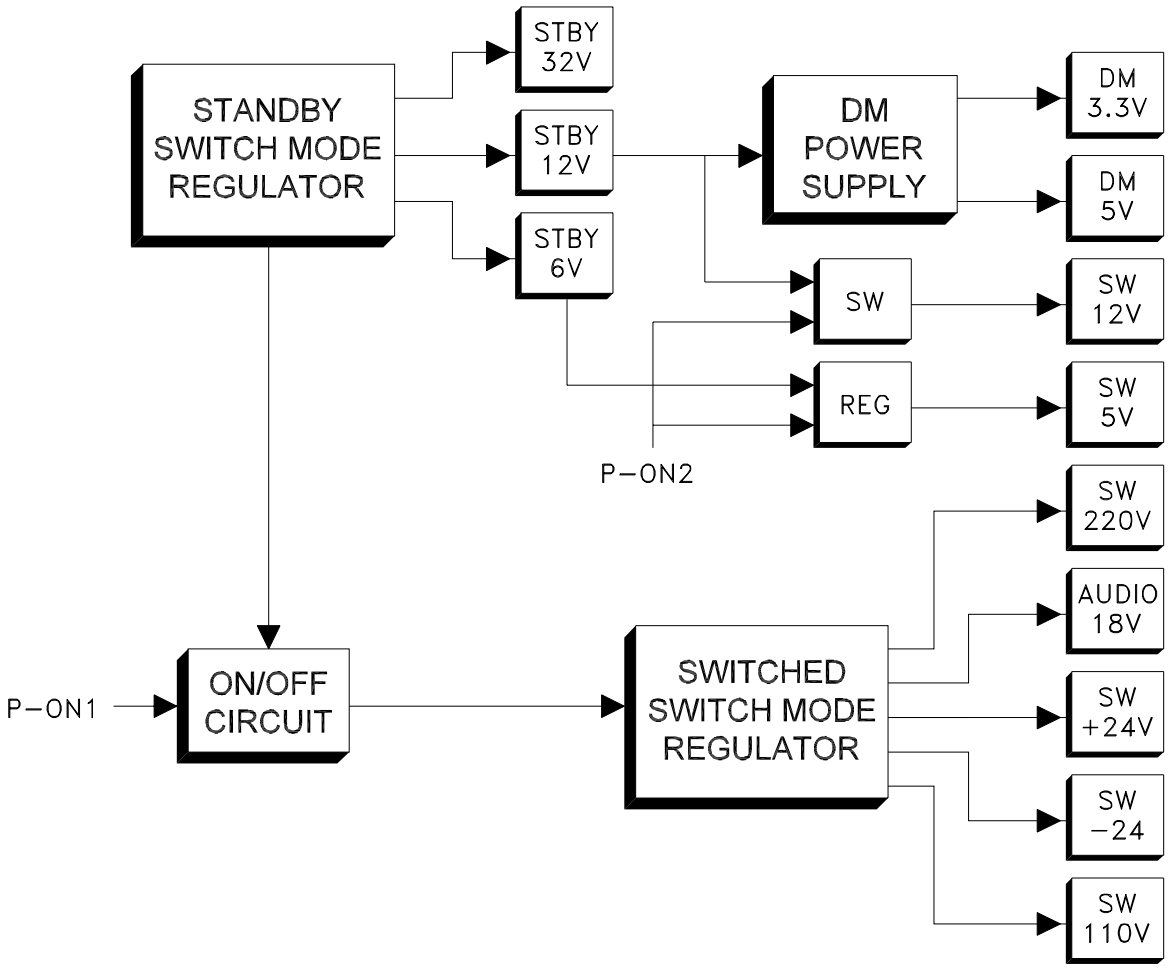


HD Conv. Mode with No Signal
Figure 4−4

Adjustments

Refer to the Service Manual for specific adjustment procedures.

Chapter 5
Power Supply



The above block diagram shows the main sections of the Power Supply circuitry. As in previous models, two types of DC supplies are generated, Standby and Switched. Standby supplies are generated as long as the TV is connected to an AC power source. Switched supplies are activated when the TV is switched On.

Switch Mode Regulators are the source for both types of supplies. An additional Standby source is used to supply power to the DM Module in the V19/V21 chassis. The DM Power Supply is internal to the DM Module. It receives power from the Standby 12V supply and generates DM 3.3V and DM 5V supplies. The two DM supplies fall into the Standby category and are present as long as the TV is plugged in.

The Standby and Switched supplies shown in the diagram are only those directly generated by the Switch Mode Regulators. Additional DC supplies are generated from those shown above.

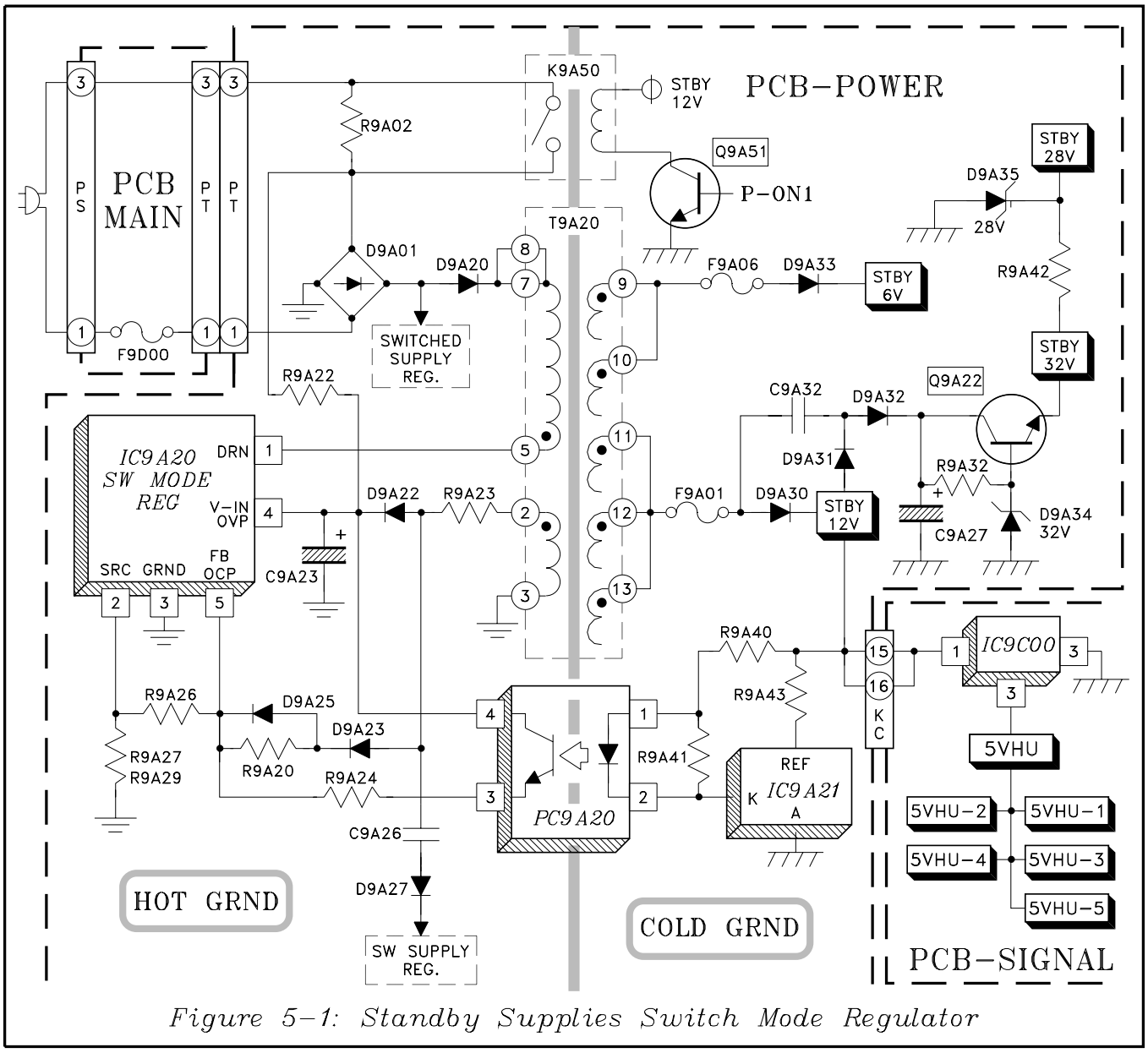


Figure 5–1: Standby Supplies Switch Mode Regulator

Standby Supplies Regulator

Figure 5-1 illustrates the Standby Switch Mode Regulator. Since its' operation is similar to that in previous models, a lengthy description is not required. Key points of operation are:

1) D9A01 supplies DC power to the regulator.
2) Start up voltage (16 volts) is supplied by R9A22 to pin 4 of IC9A20.
3) The signal at pin 2 of T9A20 is rectified by D9A22 and adds to the voltage at pin 4 of IC9A20. If the voltage drops below 11 volts the oscillator shuts Off.
4) Feedback for regulation is from the STBY 12V supply through IC9A21 and PC9A20 to pin 5 of the IC9A20.
5) Over Current Protection is provided by directing the voltage at the pin 2 (Source ground return) to pin 5 of the IC. A sudden increase in voltage will shut down the oscillator.
6) Pin 4 of the IC, the oscillator's DC supply input, also provides Over Voltage Protection. If the voltage at pin 4 exceeds 20.5 volts the oscillator shuts down.

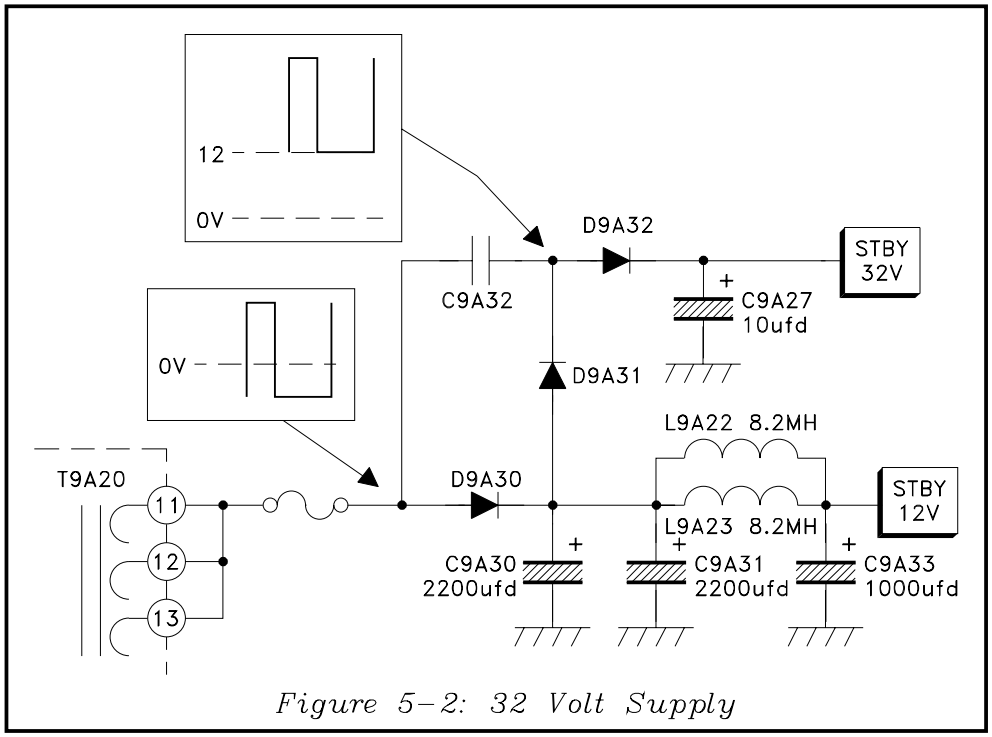


Figure 5-2: 32 Volt Supply

DC Standby supplies are generated in the secondary circuits of T9A20, these include STBY 6V, STBY 12V and STBY 32V. STBY 5V supplies are derived from the STBY 12V, and STBY 28V from the STBY 32V.

The STBY 12V and STBY 32V supplies are generated by rectifying the same secondary winding signal.

Figure 5-2 illustrates how this is accomplished. The positive part of the signal from the secondary winding is rectified by D9A30 to generate the STBY 12V supply. The same signal is directed through C9A32 to the anode of D9A32. The anode of D9A32 is clamped at 12 volts by D9A31 and the 12 volt supply. The combination of the clamping action and rectification of the signal from C9A32 generates the STBY 32V Supply.

CAUTION: The primary section of the regulator is referenced to a **Hot Ground. Use an Isolation Transformer** when working in the Primary circuitry.

Note in *Figure 5-1*, that voltage sources rectified by D9A01, and D9A27 are both directed to the Switch Mode Regulator for the Switched Supplies .

Switched Supplies Regulator

Figure 5-3 shows the Switched Supplies Switch Mode Regulator. Except for component nomenclature its' operation is the same as the Standby Regulator.:

1) Startup and the oscillators DC supply are input at pin 4 of IC9A50.
2) The SW 110V supply is monitored for regulation and is directed via IC9A51 and PC9A51 to pin 1 of IC9A50.
3) Switched supplies are generated by rectifying secondary winding signals.

On/Off Circuitry

Due to the V19/V21 Time r Recording feature, two On/Off commands are required. Time Shift Recording enables using the TV's Tuner as the signal source for a VCR pre-programmed recording, without switching the TV completely On.

The On/Off circuitry is also shown in *Figure 5-3*. There are two Power On commands, P-ON1 and P-ON2. P-ON1 activates the Standby Regulator, IC9A50. IC9A50 generates 220V, AUDIO (17V), +24V, -24V and 110V Switched Supplies. P-ON2 activates the 12V and 5V Switched Supplies, which supply power to the signal processing circuitry.

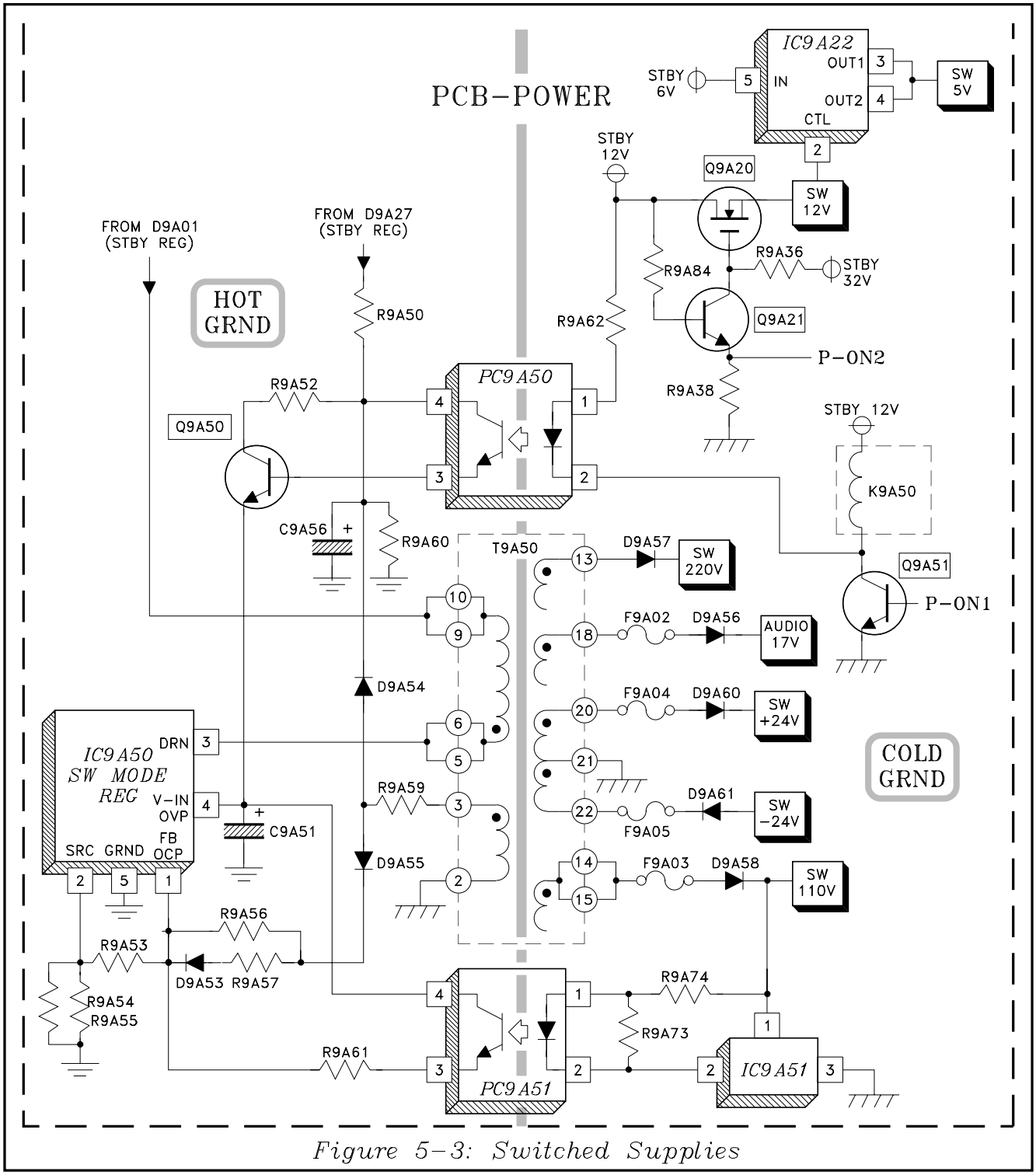


Figure 5–3: Switched Supplies

When the P-ON1 line goes High the turn On sequence is:

- Q9A51 conducts
- Relay K9A50 closes, removing current limiting resistor R9A02 (refer to *Figure 1*).
- The LED and Photo Transistor in PC9A50 conduct.
- Q9A50 conducts supplying rectified voltage from D9A27 in the Standby Regulator to pin 4 of IC9A50.
- Additional voltage is added to the Startup voltage by rectifying the signal at pin 3 of T9A50 and directing it to the collector of Q9A50.

When P-ON2 goes High, it turns Q9A21 Off:

- Allowing Q9A20 to conduct, generating the SW 12V supply.
- The SW 12V supply enables IC9A22, which outputs the SW 5V supply.

At a pre-programmed recording time, using the TV as the Signal source, only the P-ON2 line goes High. This activates only the signal processing circuits in the TV.

DM Power Supply

Figure 5-4 illustrates the DM Power Supply, which is located on a separate PCB in the DM Module. STBY 28V and STBY 12V from the Main Standby circuitry are input to the DM Power Supply. Both voltages are routed to the digital circuitry in the module. The STBY 12V also provides power for the Regulator circuitry in the DM Power Supply.

The DM Regulation circuitry generates two supplies DM 5V and DM 3.3V. The Regulator consists of four ICs, IC9B00, Q9B00, Q9B01 and Q9B02. IC9B00 is a Pulse Width Modulator (PWM), and Q9B00, Q9B01 and Q9B02 are comprised of MOSFET transistors. Multiple Drain and Source connections are used to increase current handling capability.

Q9B00 and Q9B01 are connected in a push-pull configuration. Gate drive is generated in IC9B00. UGATE drives Q9B00, and LGATE drives Q9B01. The output of the push-pull circuit is at the junction Q9B00 Source and Q9B01 Drain. The output is filtered to generated the DM 3.3V supply.

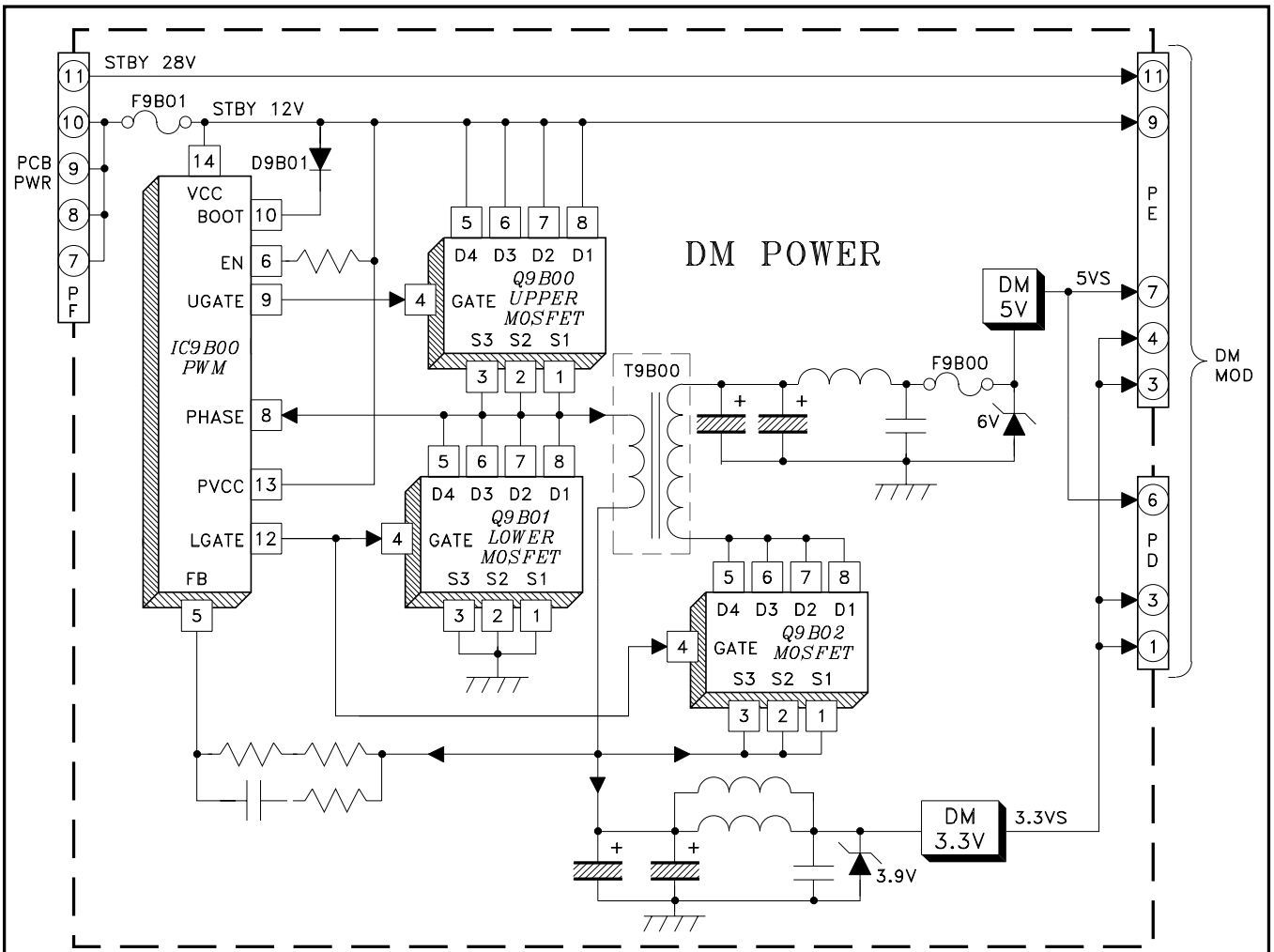


Figure 5-4: DM Module Power Supply

A sample of the 3.3V supply is fed back to pin 5 of IC9B00 for regulation. Regulation is achieved by controlling the PWM of the Gate drive signals.

The push-pull circuitry output is also used to generate the DM 5V supply. The signal, before filtering, is stepped up by T9B00, but is not large enough to generate 5 volts. To generate 5 volts the secondary winding is clamped at 3.3 volts by Q9B02.

The LGATE output of IC9B00 supplies Gate drive for Q9B02. When Q9B02 conducts it clamps the Drain outputs to 3.3 volts. The clamping at 3.3 volts and the stepped up signal from T9B00 are filtered to form the DM 5V supply.

All current rated in mA.

Name	3.3V[1]	3.3V[2]	3.3V[3]	3.3VS[1]	5V[1]	5V[2]	5V[3]	5VS[1]	5VS[2]	-9V	9V[1]	9V[2]	9V[3]
Voltage	3.3	3.3	3.3	3.3	5	5	5	5	5	-9	9	9	9
3DYC	200				25							105	
Ant. Relay													
Audio Amp													
Audio Process												85	
AV Switch												150	
Conv. Gen		120			50	50				50	50		
Conv. Out													
CRT (video)													180
DBF													
Digital Module	3500								600				
CRT													
HV													
H-Defl													
Jungle													
TV µPC								87				10	
V-Chip (Sub)					30								
Misc (main)													
Preamp								20					
Protect													
AMDP			600		270								111
Sub Decoder												75	
SVM													
Switch (signal)					130		100						
Tuner (DM)													
Tuner (signal)					30							280	
V-Defl.													
2H Enhance							200						60
Video Chroma													140

Table 5-1: V19 Power Distribution Estimate (3.3V to 9V Supplies)

DC Supply Source Locations

The DC supplies shown in *Figures 5-1 and 5-3* are located on the PCB-POWER. Additional supplies are generated from these supplies on other PCBs. In the Service Manual DC Supplies are designated with a "V" or "VS".

- "V" designates a Switched Supply (5V)
- "VS" designates a Standby Supply (5VS)

Table 5-1 shows the Power Distribution for the 3.3V through 9V supplies, and *Table 5-2* for the 9VS to 220V supplies. The tables indicate the estimated current, in Ma, supplied to the various circuits. When there is more than one supply of the same value, a superscript number is added to those supplies. For instance, $3.3V^1$ and $3.3V^2$ are different supplies.

All current rated in mA.

Name	$9VS^2$	$12V^1$	$12V^2$	12VS	17V	-24V	24V	28VS	32VS	110V	220V	Heater
Voltage	9	12	12	12	17	-24	24	28	32	110	220	6.3
3DYC												
Ant. Relay	200											
Audio Amp					2250							
Audio Process												
AV Switch												
Conv. Gen												
Conv. Out						700	700					
CRT (video)		150									50	
DBF			1							4		
Digital Module				310								
CRT												630
HV			17							400		
H-Defl				6						500		
Jungle												
TV µPC												
V-Chip (Sub)												
Misc (main)							70					
Preamp												
Protect							1					
AMDP												
Sub Decoder												
SVM		6								30		
Switch (signal)												
Tuner (DM)								1				
Tuner (signal)									4			
V-Defl.							300					
2H Enhance												
Video Chroma												

Table 5-2: Power Distribution Estimate (9VS to 220V Supplies)

Voltage supply derivation paths:

Supply	Path	Source
3.3V[1]	T9A20 -> 6VS -> IC9C50 -> 3.3V	Linear surface mount regulator on PCB-3DYC
3.3V[2]	T9A20 -> 6VS -> IC8E01 -> 3.3V	Linear surface mount regulator on PCB-CONV GEN
3.3V[3]	T9A20 -> 6VS -> IC9A22 -> 5V -> IC9C20 -> 3.3V	Linear regulator (heat sink required) on PCB-SIG [Video Chroma]
3.3VS[1]	T9A20 -> 12VS -> IC9B00 -> 3.3VS	Buck regulator on DM Power board
5V[1]	T9A20 -> 6VS -> IC9A22 -> 5V	Main 5V from PCB-PWR to PCB-SIG [Video Chroma]
5V[2]	T9A20 -> 12VS -> Q9A20 -> 12V -> IC8E02 -> 5V	Linear regulator on PCB-CONV GEN
5V[3]	T9A20 -> 6VS -> IC9C40 -> 5V	Linear regulator on PCB-SIG [Video Chroma]
5VS[1]	T9A20 -> 12VS ->IC9C00->5VS	Micro 5V Hold-up supply on PCB-SIG [Micro]
5VS[2]	T9A20 -> 12VS -> IC9B00 -> 5VS	Buck regulator on DM Power board
-9V	T9A50 -> -24V -> D8D04(zener) -> -9V	Zener diode on Power board to PCB-CONV GEN
9V[1]	T9A50 -> 24V -> D8D03(zener) -> 9V	Zener diode on Power board to PCB-CONV GEN
9V[2]	T9A20 -> 12VS -> Q9A20 -> 12V -> IC9C01 -> 9V	Linear regulator (9V-1) on PCB-SIG [AV I/O]
9V[3]	T9A20 -> 12VS -> Q9A20 -> 12V -> IC9C02 -> 9V	Linear regulator (9V-2) on PCB-SIG [Video Chroma]
9VS[1]	T9A20 -> 12VS -> IC4A02 -> 9VS	Linear regulator on PCB-JUNGLE
9VS[2]	T9A20 -> 12VS -> IC9C03 -> 9VS	Linear SMT regulator (9VS) on PCB-SIG [[AV I/O]
12V[1]	T9A20 -> 12VS -> Q9A20 -> 12V	Transistor on PCB-POWER
12V[2]	T9A50 -> 24V -> Q5A08 -> 12V	Transistor on PCB-MAIN
12VS	T9A20 -> 12VS	T9A20 transformer on PCB-POWER
17V	T9A50 -> 17V	T9A50 transformer on PCB-POWER
-24V	T9A50 -> -24V	T9A50 transformer on PCB-POWER
24V	T9A50 -> 24V	T9A50 transformer on PCB-POWER
28VS	T9A20 -> 12VS tripler ckt -> 32VS -> D9A35 -> 28VS	Tripler circuit and D9A35 on PCB-POWER
32VS	T9A20 -> 12VS tripler ckt -> 32VS	Tripler circuit on PCB-POWER
110V	T9A50 -> 110V	T9A20 transformer on PCB-POWER
220V	T9A50 -> 220V	T9A20 transformer on PCB-POWER
6.3VAC	T9A50 -> 110V -> T8A31 -> heater 6.3V(rms)	T8A31 on PCB-MAIN

Table 5-3: Voltage Supply Source Paths

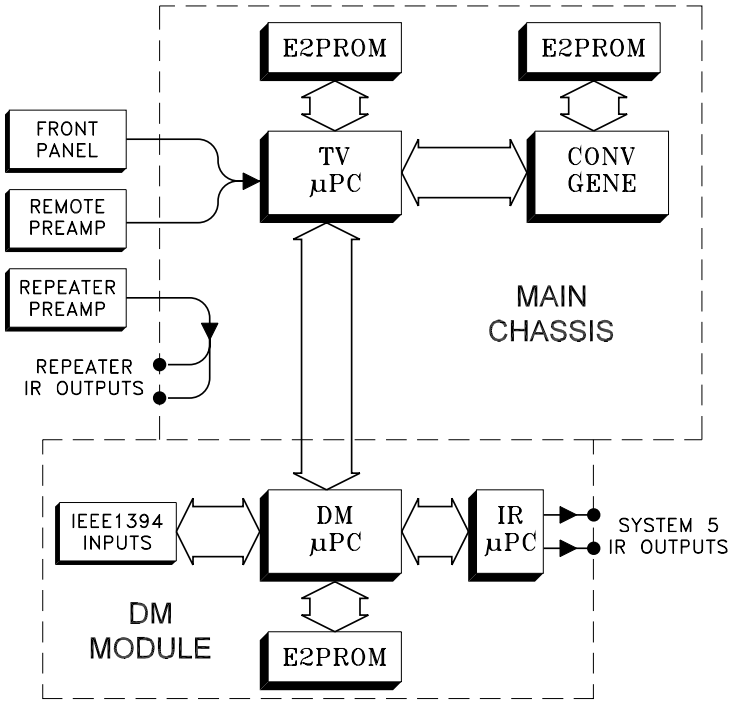
Locating the source of these supplies can be time consuming. *Table 5-3* indicates the PCB where each supply is located, and the path from that supply to its' source.

Supplies located on the PCB-SIGNAL can be on one of three shematics in the Service Manual.

- PCB-SIGNAL (Micro)
- PCB-SIGNAL (AV I/O)
- PCB-SIGNAL (Video/Chroma)

In *Table 5-3* the specific PCB-SIGNAL schematic is indicated in brackets [ ].

Chapter 6
Control Circuitry



The Control Circuitry in the V19/V21 chassis is similar to previous models, but is more complex. The addition of the DM Module, which houses the ATV Tuner, HDTV Decoding circuitry and IEEE 1394 circuitry adds to the Control Circuitry. A simplified Overall Block Diagram of the Control Circuitry is shown above.

There are now two Microprocessors, the TV µPC in the main chassis and the DM µPC in the DM Module. The DM µPC controls the TV. The TV µPC serves as an interface between the DM µPC and the circuitry in the TV.

Input commands, from the front panel or are input to the TV µPC. The commands are forwarded to the DM µPC over a bidirectional communication link. The DM µPC generates the required commands and directs them through the TV µPC to the appropriate circuitry.

There are three sets of E2PROM memory ICs, one for each µPC and one for the Convergence Waveform Generator. User programmed data and service adjustment data is stored mainly in the DM µPC E2PROM. The only data stored in the TV µPC E2PROM are the White Balance service adjustments. Convergence, Dynamic Focus and HV Adjustment data is stored in the Convergence E2PROM.

There are two sets of IR Output Jacks, Repeater and System 5. The Repeater Preamp is a wide band amplifier, capable of amplifying the signals from most manufactures Remote Controls. The signals are amplified and directed to the Repeater IR Output Jacks for controlling other brand Home Theater components.

The main Preamp amplifies signals from a Mitsubishi Remote. The signals are filtered and directed to an IR µPC in the DM Module. If the commands are specifi-

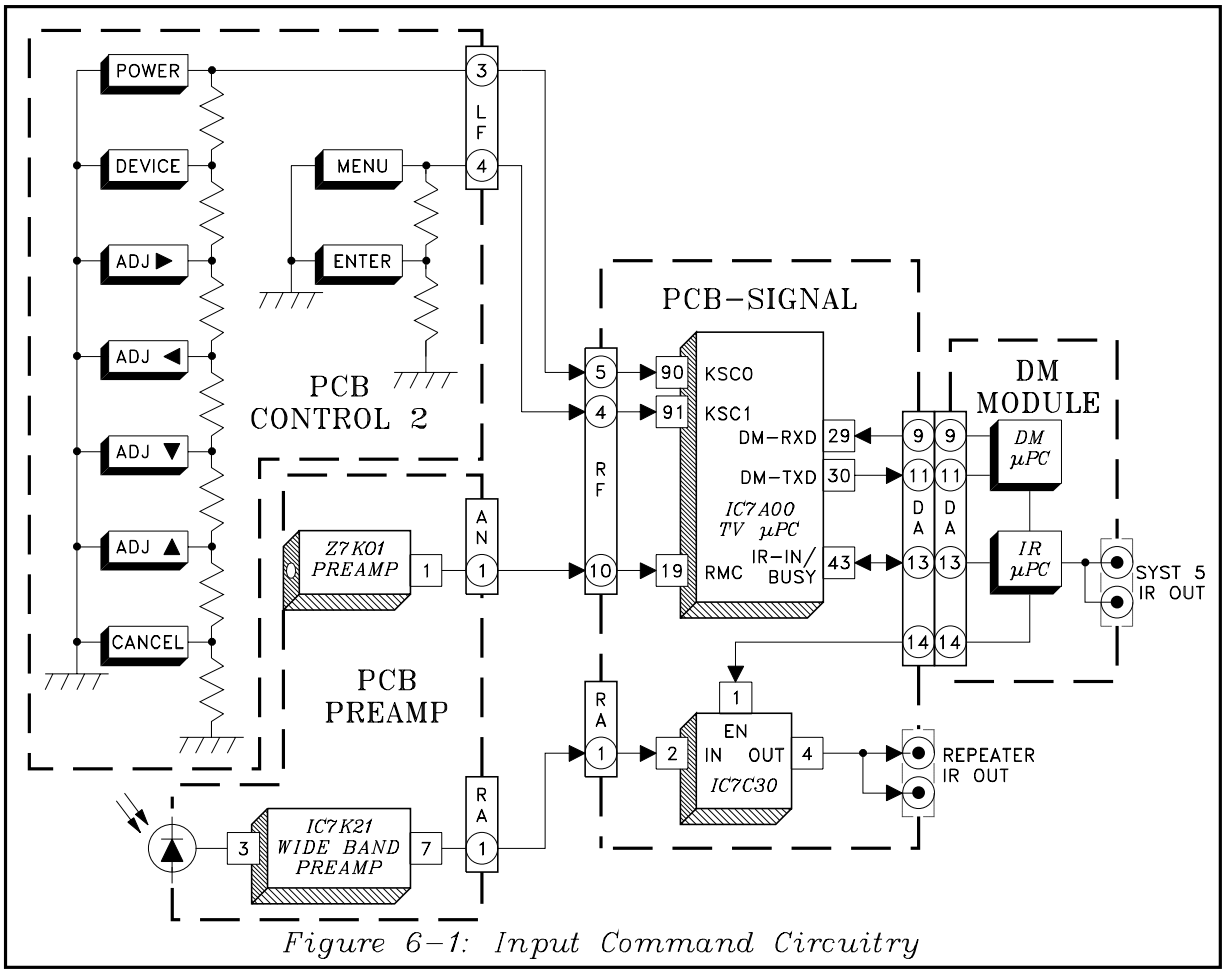


Figure 6−1: Input Command Circuitry

cally for the TV, they are processed by the DM µPC and sent back to the TV µPC.

If the signals are for System 5 compatible components, they are directed to the System 5 IR Output Jacks. System 5 enables Home Theater control using only the TV later of a Mitsubishi Remote.

Input Command Circuitry

Figure 6-1 illustrates the Input Command circuitry. Input commands can originate from the front panel buttons, or the Remote Control. As in previous models, the front panel buttons are connected in a two column resistive ladder array.

Each column connects to a Key Scan input on the TV µPC, either KSC0 or KSC1. When a button is pressed the analog voltage at that's columns input changes, denoting the command. The TV µPC converts the command to a serial data format and forwards it to the DM µPC over the DM-TXD line.

The DM µPC generates the appropriate control signals to perform the command, and sends them to the TV µPC over the DM-RXD line.

Remote commands from a Mitsubishi remote are amplified and directed to the RMC input of the TV µPC. The TV µPC rejects all signals not in a Mitsubishi format. After filtering, they are reformatted and directed to the DM µPC over the IPC Bus.

If the commands are for the TV, the appropriate signals are returned to the TV µPC over the DM-RXD line If they are System 5 commands, they are processed and directed to the System 5 IR Output Jacks.

Commands from other manufacturer Remotes are amplified in the Wide Band Preamplifier and, through IC7C30, are directed to the IR Output Jacks.

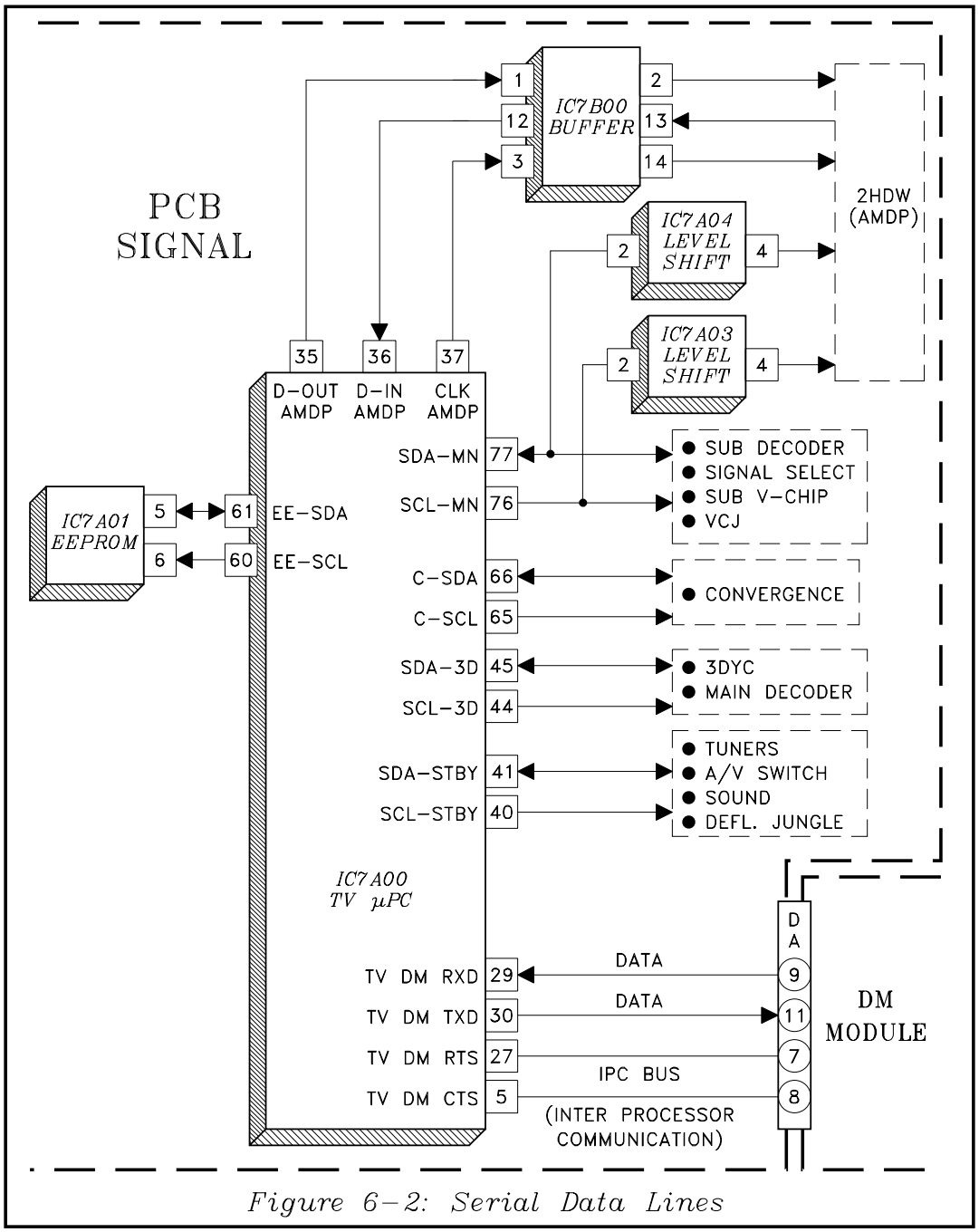


Figure 6-2: Serial Data Lines

Serial Data Lines

Figure 6-2 illustrates the Serial Data lines used in the Control Circuitry. There are five I²C bidirectional data lines used:

- EE-SDA … Transfers data to and from the TV µPC's E2PROM, IC7A01.
- SDA- MN …Controls the Sub Decoder, YCbCr Signal Selection, Sub V-Chip, VCJ and 2HDW circuitry.
- C-SDA … Controls the Convergence circuitry
- SDA-3D … Controls the 3DYC and Main Decoder circuitry.
- SDA-STBY … Controls the Tuners, A/V Switch, Sound and Deflection circuitry.

Of course, each I²C data line has an accompanying Clock line to time the transfer of data.

Note that the SDA-MN and SCL-MN signals to the 2HDW circuitry are routed through IC7A04 and IC7A03, respectively. Both of the ICs are level shift ICs, reducing the signal amplitude from the 5 volt range to 3.3 volts. This is necessary since the controlled circuitry on 2HDW uses a 3.3 volt DC supply and the TV µPC uses a 5 volt supply.

Additional control of the 2HDW circuitry is provided by conventional, one direction, D-OUT, D-IN and SCLK lines.

Single direction asynchronous data lines are used for communication between the TV µPC and the DM µPC.

- TV DM TXD … transfers data from the TV µPC to the DM µPC.
- TV DM RXD … transfers data from the DM to the TV µPC.
- TV DM RTS … Request to Transmit
- TV DM CTS … Clear to Transmit

If there is no communication between the TV µPC and the DM µPC, the TV will not switch On.

DC Supplies

Figure 6-3 shows the DC supplies for the TV µPC circuitry. The TV µPC requires a 5 volt DC supply. The STBY 12V supply is the source for the Control circuitry 5 volt supplies. IC9C00 regulates the 12 volts down to 5 volts, the 5VHU DC supply.

The 5VHU supplies power directly to IC5H00, the Flash Protect IC, and is the source for all the other Control circuitry 5 Volt supplies. Each of the supplies is isolated by Low Pass LC Filters.

- 5VHU-1 … Supplies IC7A00 5V STBY and Reset IC, IC7A02
- 5VHU-2 … Supplies IC7A00 AVCC
- 5VHU-3 … Supplies the Remote Preamps
- 5VHU-4 … IC7A00 5V STBY2 and E2PROM IC, IC7A01
- 5VHU-5 … Supplies Buffer IC, IC2B00

Reset Circuitry

Microprocessors must be reset to their nominal state when power is first applied, otherwise lockup occurs. *Figure 6-4* shows the Reset circuitry in the V19. The TV µPC's Reset Input is at pin 12. Reset

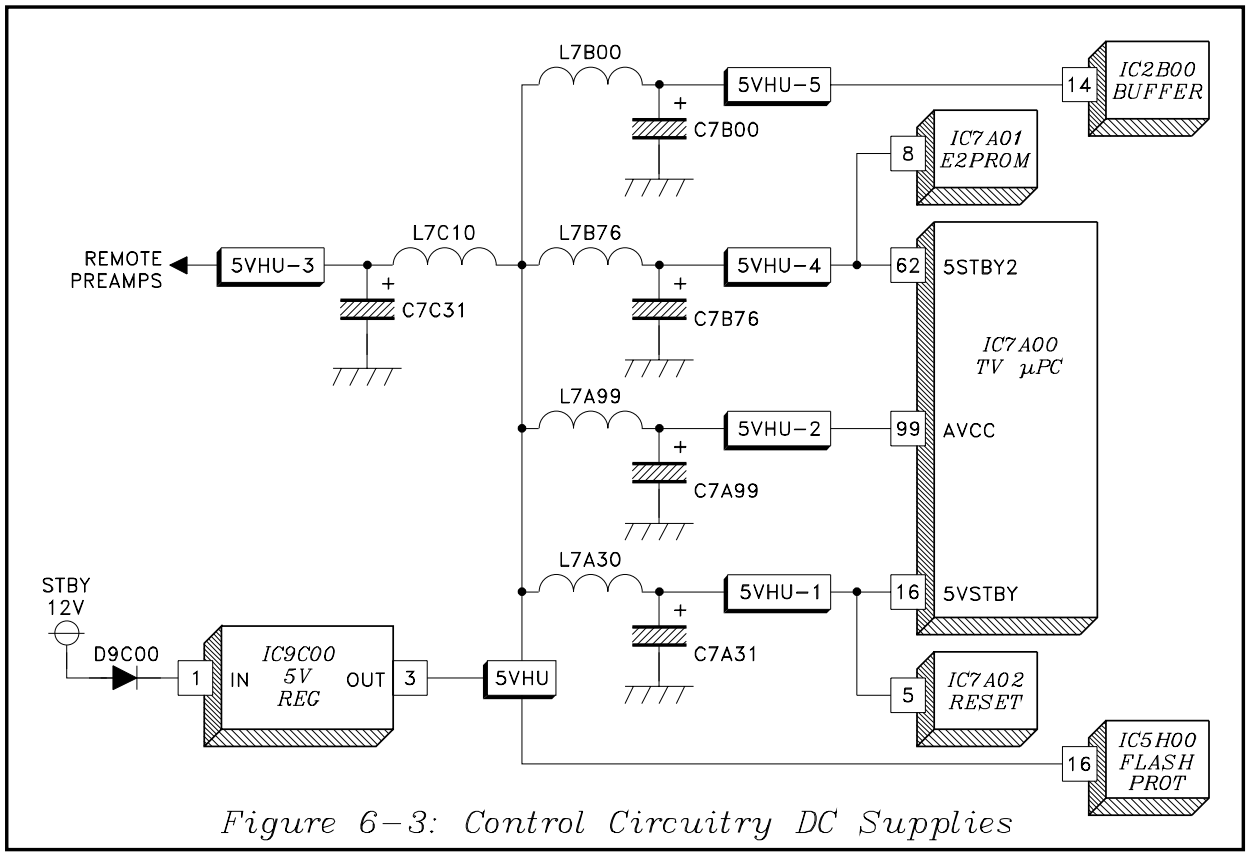


Figure 6–3: Control Circuitry DC Supplies

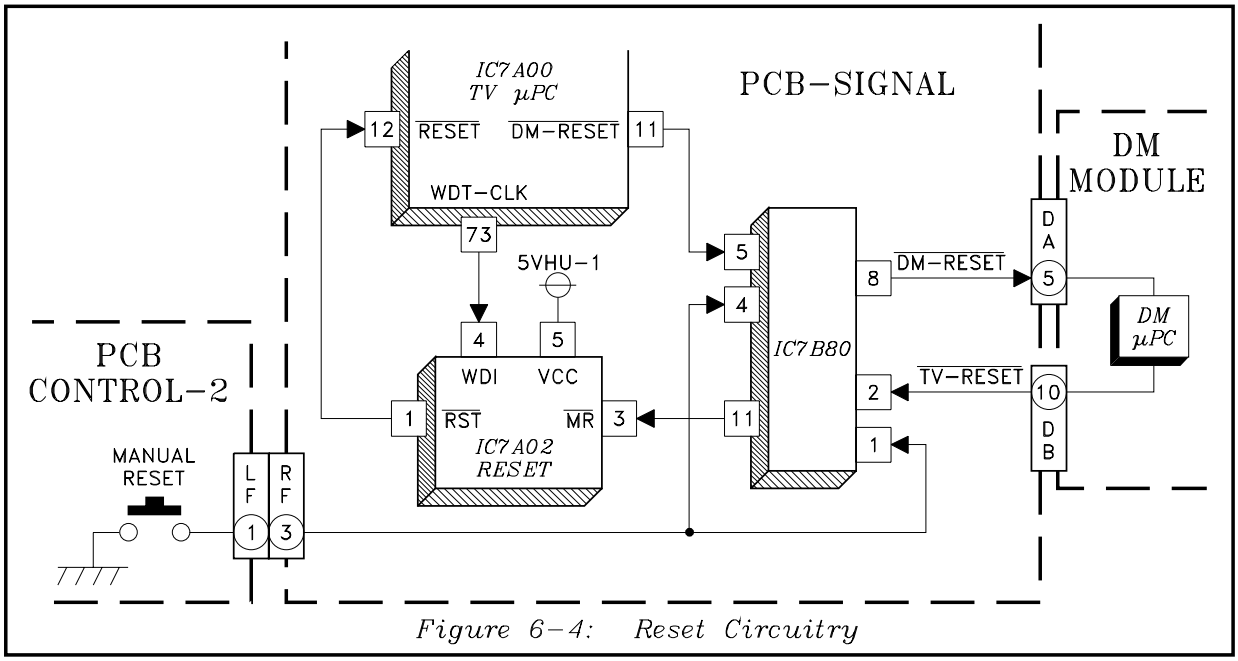


Figure 6–4: Reset Circuitry

IC, IC7A02, generates a delayed reset pulse when power is applied.

IC7A02 is a Reset Watchdog type of IC. When the µPC is functioning, pulses are output at pin 73 of IC7A00. The pulses constantly reset the counter in IC7A02 and no Reset pulse is generated.

If lock up occurs, no pulses are generated at pin 73. With no pulses from the TV µPC the counter in IC7A02 is not reset and a Reset pulse is generated. The same type of Reset action resets in the DM µPC circuit.

If communication is lost from either the TV µPC or from the DM µPC, the other µPC automatically generates a Reset pulse. A Low at pin 11 of IC7A00 resets the DM µPC, and a Low from pin 10 of the DB connector resets the TV µPC.

Both Reset commands are routed through IC7B80, that functions basically as an AND gate. This enables the front panel Manual Reset button to Reset both µPCs.

V-CHIP Blocking Circuitry

The V-Chip Blocking circuitry allows blocking of specific type of programming. Program rating information is located on line 21 of the TV signal. The circuit configurations is not new but is presented here as a reference.

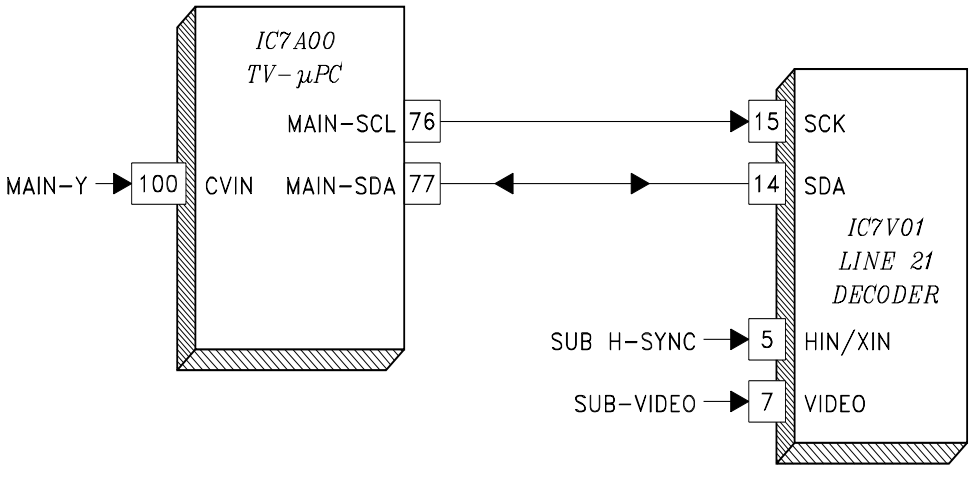


Figure 6–5: V–CHIP Blocking Circuitry

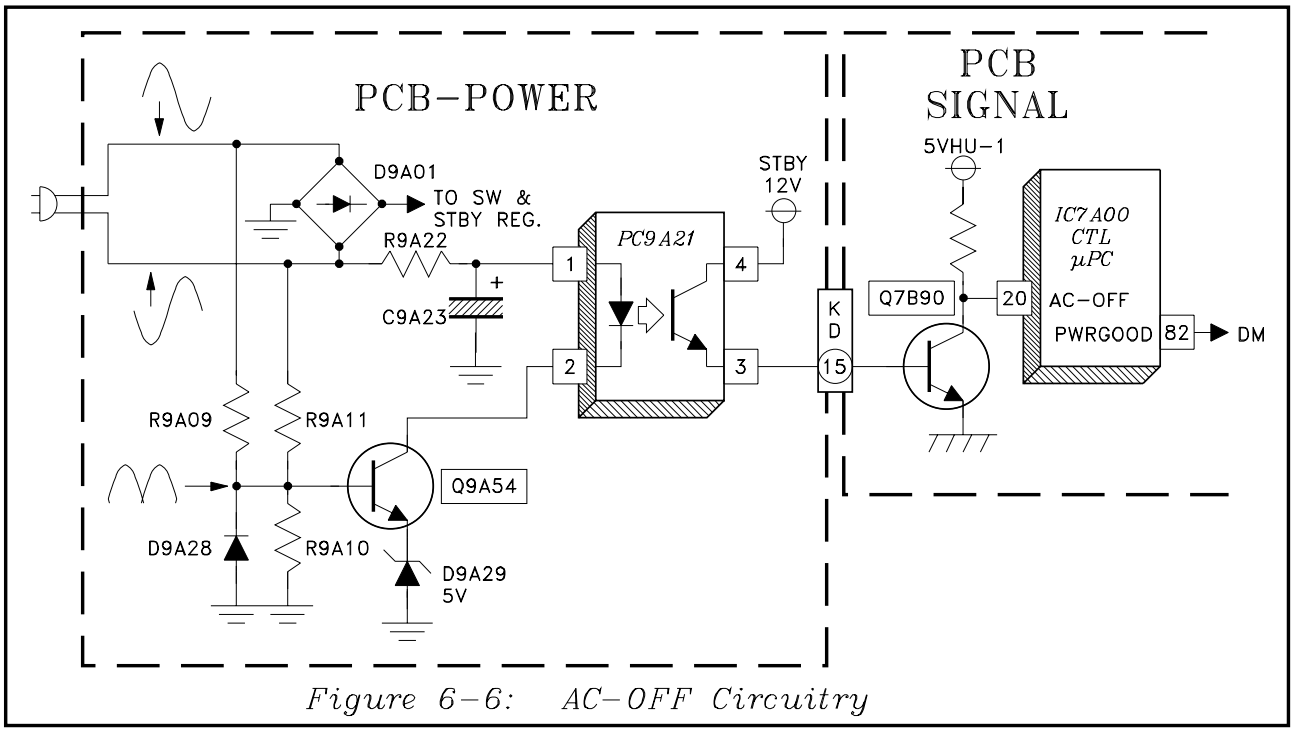


Figure 6–6: AC–OFF Circuitry

Figure 6-5 shows the V-Chip Blocking circuitry in the V19. Main picture V-Chip circuitry is in the TV µPC. Main picture Y signal is input to IC7A00 at pin 100. The current program rating is read and if necessary the µPC blocks the program.

IC7V01 is used to monitor the rating of the sub picture signal. Sub picture video is input to IC7V01 at pin 7. The internal circuitry reads the program rating data on line 21 and sends it to the TV µPC over the Program Block line. If that particular program rating has been blocked the µPC blocks the sub picture in the 2HDW circuitry. When the sub picture is blocked, the PIP/POP insert is black.

AC-OFF Circuit

The AC-OFF circuit is not new. When a logic change at the AC-OFF input of the TV µPC indicates an AC power loss, the Control circuitry rapidly stores all user programming and service adjustments in memory before the DC supplies drop to zero.

Although the purpose of the circuitry has not changed, the method of monitoring the AC source is different in the V19. *Figure 6-6* illustrates the AC-OFF monitoring circuit in the V19.

The AC signal applied to Bridge Rectifier D9A01 is monitored. D9A01 is the DC source for both Standby and Switched Regulators. The AC source is connected to the inputs of the Bridge Rectifier, and the circuit is reference to a Hot ground.

The signals at the rectifier inputs, in reference to the Hot ground, are AC sine waves 180 degrees out of phase. Both signals are resistive coupled to the base of Q9A54. Diode D9A28 removes the negative half of each signal. The resulting positive half cycles of each sine wave keep the transistor conducting.

With Q9A54 On, the LED and Photo Transistor in PC9A21 conduct, holding Q7B90 On. This holds the AC-OFF input of IC7A00 Low. If an AC power loss occurs, Q9A54, PC9A21 and Q7B90 stop conduction. This allows pin 20 of IC7A00 to go High, indicating AC power has been lost.

When this occurs, the TV µPC outputs a momentary High at pin 82, which is directed to the DM Module. This is the Power Good line, informing the DM Control circuitry of the power loss.

Name	Pin No.	Purpose
AFT1	92	Main Tuner Tuning
AFT2	93	Sub Tuner Tuning
AC-OFF	20	Loss of AC Power
H-SYNC	97	Horizontal Sync
DM-DET	26	DM connected
SD1	7	Main Tuner Signal Present
SD2	6	Sub Tuner Signal Present
SHORT	46	Power Supply Short
V-BLANK	94	Video is blanked
VSYNC	95	Vertical Sync
XRAY	47	Shuts the TV Off

Table 6-1: TV µPC Inputs

Name	Pin No.	Description
ANT-A	81	Select Ant-A or Ant-B
BLANK-CRT	2	Blanks CRT through CRT Protect Circuitry
DVD-SW	53	Selects DVD-1 or DVD-2
IR-IN-BUSY	43	IR Signal to DM for System 5
LED	4	Front Panel Led Control
M-FRUN	83	Main Picture Freerun
MN-SYNC-SW	24	Main Picture Sync Switch Control
MUTE-MON	86	Mutes sound from Monitor Outputs
MUTE-SPKR	80	Mutes sound from the set's speakers
MUTE-SUB	87	Mutes sound from the Sub Monitor Outputs
NT-SW	51	Selects NTSC Y signal source
PON-1	50	Power ON command
PON-2	49	Power On command (signal processing circuits)
POWER GOOD	82	High = AC Power Loss
S-FRUN	84	Sub Picture Freerun
SUB-CONTRAST	25	Reduces video amplitude during Sub Contrast Adjust.
SUB-SYNC-SW	23	Sub Picture Sync Switch Control

Table 6-2: TV uPC Outputs

Additional Inputs and Outputs

There of course specific purpose inputs and output on the TV µPC. Most of the inputs are status inputs and the outputs are specific commands. The specific purpose inputs are listed in *Table 6-1*, and the outputs in *Table 6-2*.

In the V19/V21 the Short input at pin 46 of the µPC only monitors the positive and negative 24 Volt supplies. The Power Good output at pin 82 is normally Low. If AC is lost, pin 82 goes High.

DM Module Control Circuitry

Since the DM Module is considered a replaceable component, an in depth circuit description is not required. Only a simplified overall view is needed.

Figure 6-7 shows a Simplified Overall Block Diagram of the Control Circuitry in the DM Module. The heart of the Control Circuitry is the DM µPC. The E2PROM, on the E2P Module, stores most of the user and service adjustment data.

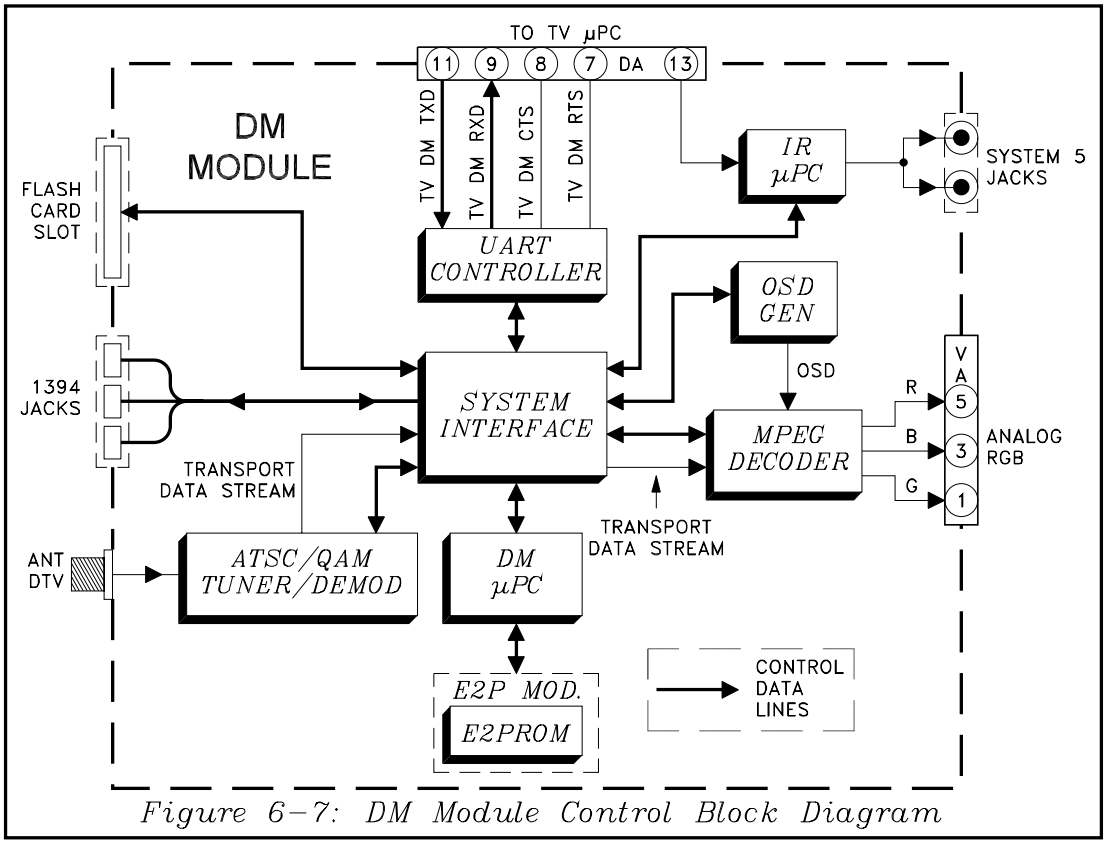


Figure 6-7: DM Module Control Block Diagram

The DM µPC communicates with the TV µPC through the System Interface and UART (Universal Asynchronous Receiver Transmitter) circuitry. Data from the TV µPC is received over the TV DM TXD line, and data is sent to the TV µPC over the TV DM RXD line. The TV DM CTS and TV DM RTS are Clear to Transmit and Request to Transmit, respectively. They are used to provide slow control on RXD and TXD lines.

The DM µPC, through the System Interface, controls the:

- ATSC/QAM Tuner/Demodulator
- MPEG Decoder
- OSD Generator
- IR µPC

The ATSC/QAM Tuner receives and processes Digital HD, SD and QAM (digital cable) Signals. The output is the Transport Data Stream, directed to the MPEG Decoder through the System Interface.

The MPEG Decoder processes the Transport Data Stream and outputs analog RGB signals.

All On Screen Display (OSD) signals, except Convergence OSD, are generated in the DM OSD circuit. When the main picture source is digital, from the ATV Tuner or 1394 Jacks, the OSD is inserted in the DM Module.

When the main picture source is analog, the OSD signals are output from the MPEG circuit and inserted in the main picture in the VCJ IC.

The IR µPC receives remote signals from the TV µPC over the IR IN/BUSY line. The signals are decoded and directed to the System 5 IR Outputs for controlling Home Theater components.

It was previously mentioned that the 1394 Jacks were the source of Digital Signals. When digital components in a Home Theater setup are IEEE 1394 compatible, a single four lead cable connection is all that is required.

Two of the IEEE 1394 cable leads are data lines, and two are control lines. The IEEE 1394 system en-

ables digital data stream transfer between 1394 units in the Home Theater setup.

There is one additional external connection shown in *Figure 6-7*, a Compact Flash Memory Card Slot. This enables soft ware updates in the field, if required.

Software Update

If and when software updates are required they can be performed by technicians in the field. Software updates will be on a plug in Compact Flash Card, available from the Parts Department.

Figure 6-8 shows the DM Module Rear Panel. To access the Flash Card slot, remove the Flash Card Cover by removing the mounting screws. This exposes the slot for the Flash Card and a Blue button. During the update, the Blue button must be depressed. After inserting the Flash Card, reinstalling the cover will hold the button depressed.

Figure 6-9 shows the basic Software Update Procedure in flow chart form. During the update, the front panel LED flashes. When the LED stops flashing, the update is complete.

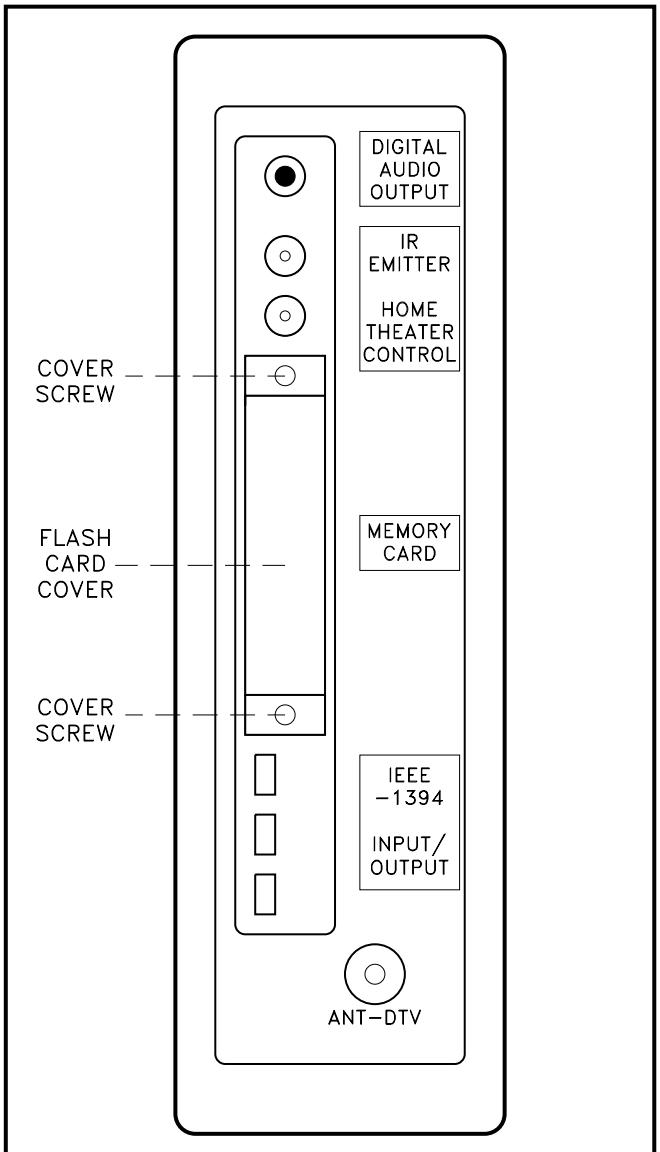


Figure 6-8: DM Module Rear Panel

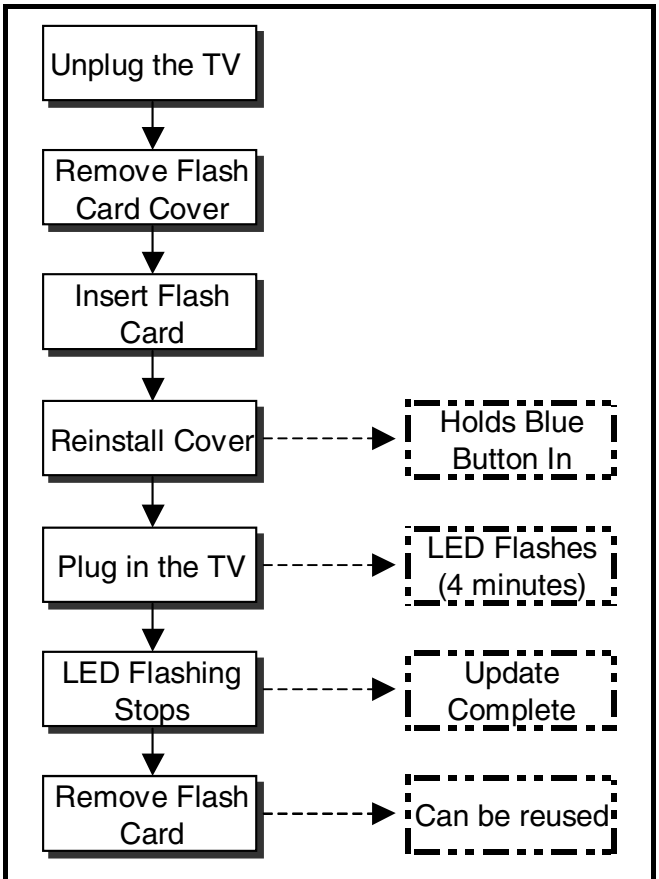


Figure 6-9: Software Update Procedure

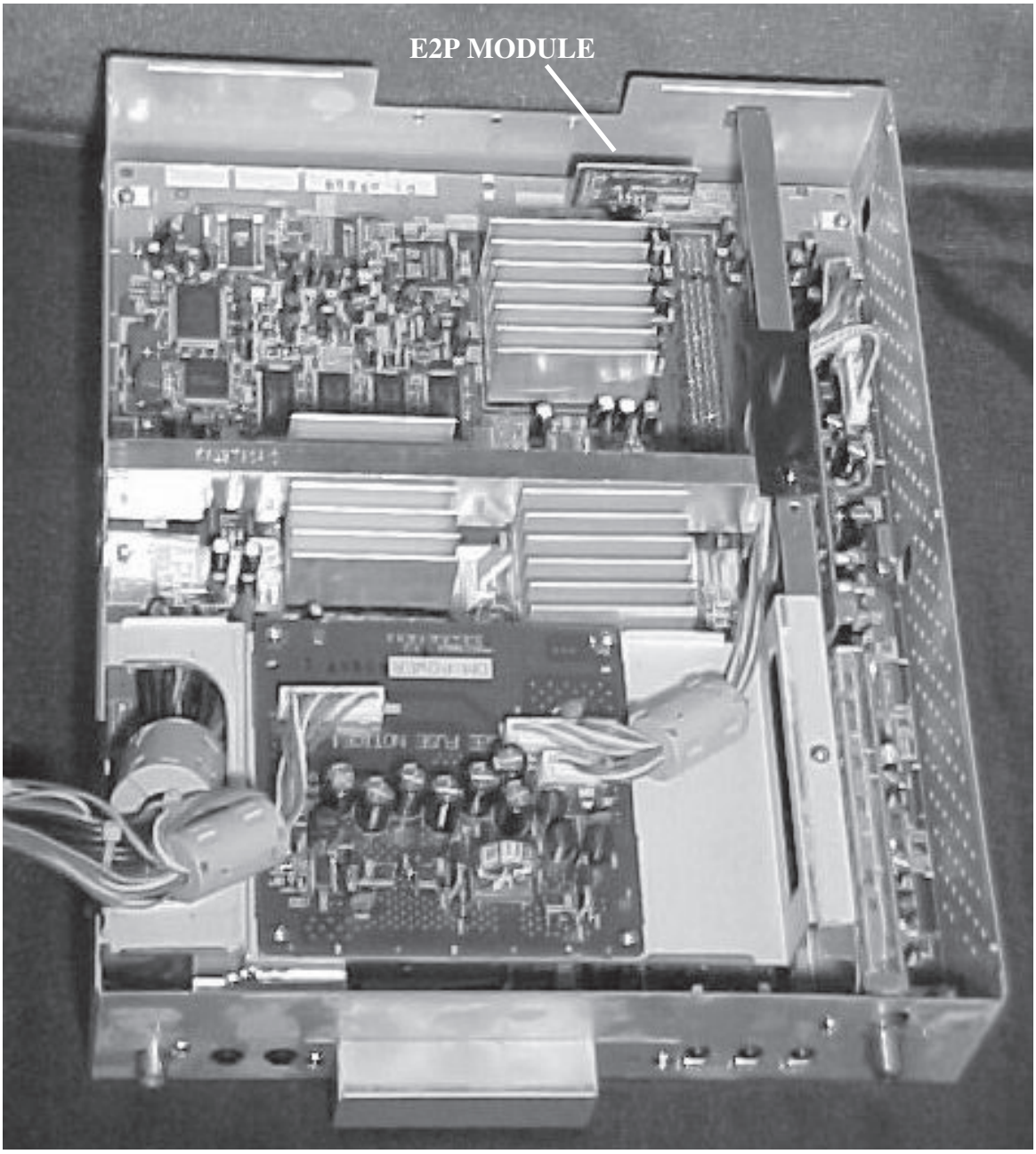


Figure 6-10: E2P Module Location

DM Module Replacement

Most user and service adjustment data is stored on the internal E2P Module. Before installing a replacement DM Module. Remove the cover on both the old and new modules.

Important: Unplug the E2P Module from both DM Modules. Insert the old E2P Module into the new replacement DM Module. Refer to *Figure 6-10* for the general location of the E2P Module *Figure 6-11* shows a close up of the E2P Module plugged in. *Figure 6-12* shows the E2P Module unplugged.

Installing the E2P Module in the new DM Module insures only minimal adjustment is required after installing the replacement DM Module.

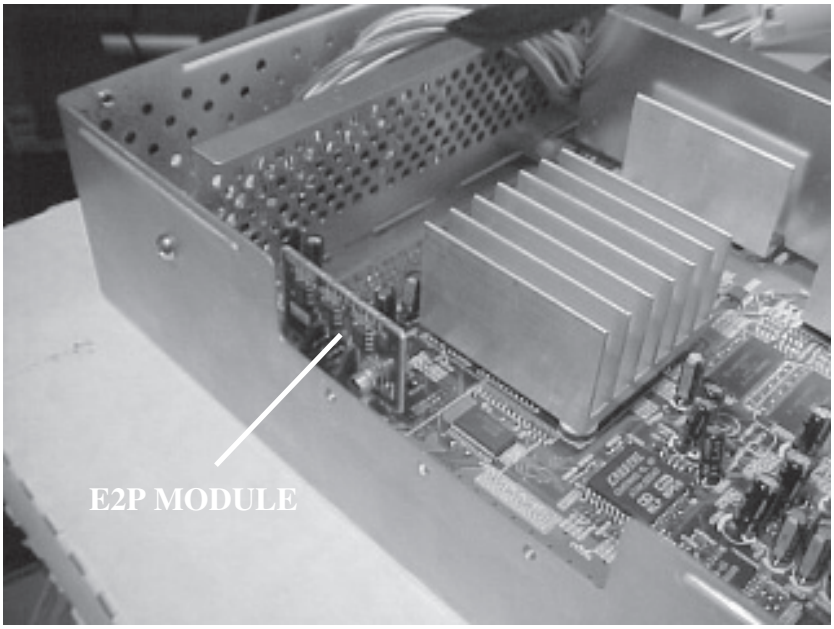


Figure 6-11: E2P Module Plugged In

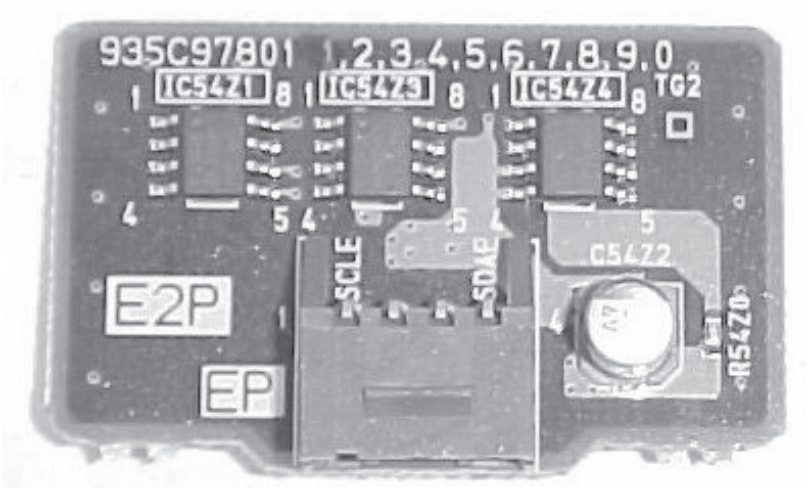
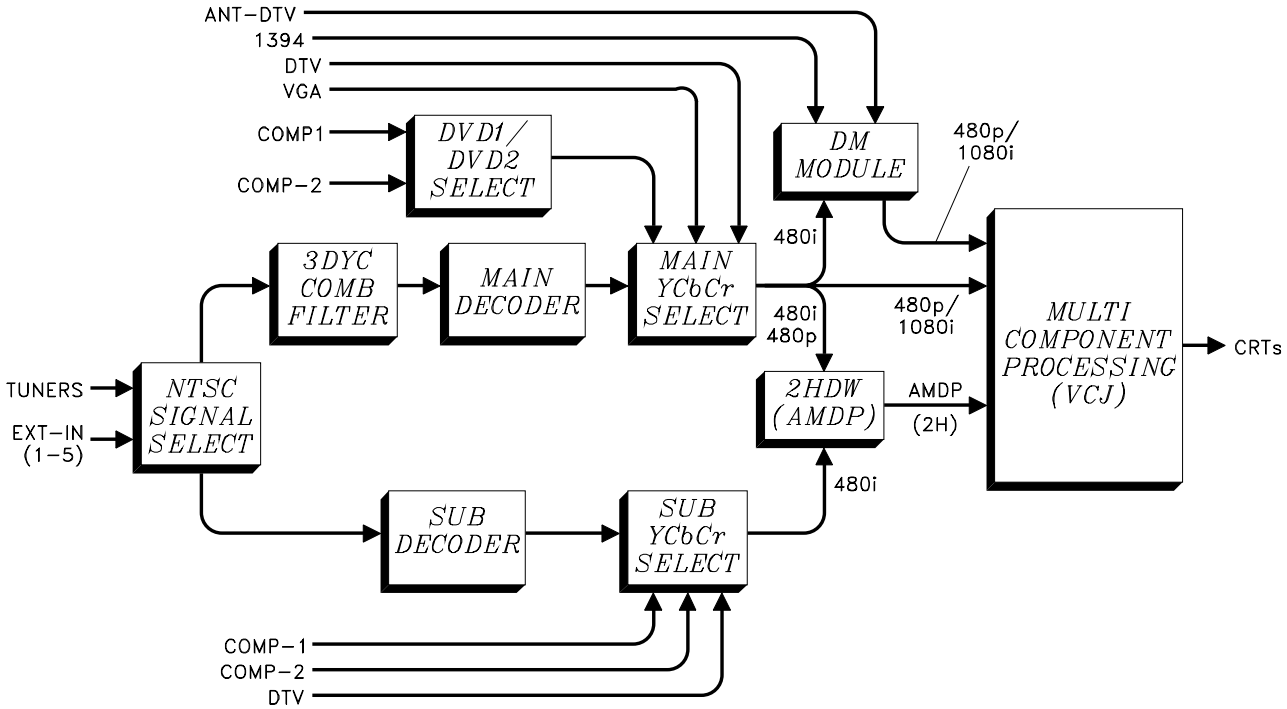


Figure 6-12: E2P Module Unplugged

Chapter 7
Video/Color Circuitry



The above Simplified Block Diagram represents the Video/Color circuitry in the V19/V21 chassis. The analog section of the circuitry is similar to that in the V17 and V18 chassis.

- NTSC Signal Select – Selects the Main and Sub Picture NTSC signal sources.
- 3DYC Comb Filter – Separates the luminance (Y) and chroma (C) signals when the main source is NTSC composite video.
- Main and Sub Decoders – convert their respective signals to the component format (YCbCr).
- YCbCr Select circuitry – selects the YCbCr main and sub picture signals.
- 2HDW (AMDP) circuitry – performs line doubling, PIP/POP and display format signal processing..
- Multi Component Processor (VCJ) – processes the YCbCr signals and converts them to the RGB format to drive the CRTs.

Only 480i signals are valid sources for PIP/POP signal processing in the 2HDW circuitry. Therefore the PIP/POP features are only possible when both the main and sub picture signals are 480i format. 480p signals are only processed in the 2HDW circuit when a display format change is selected.

Main picture 480p (with no display format change) and 1080i signals are applied directly to the VCJ, bypassing the 2HDW circuit.

The biggest change in the V19/V21 Video/Color circuitry is the addition of a DM Module. The circuitry in the DM Module consists of:

- ATV/QAM Tuner and Demodulator.
- HD MPEG2 Decoder
- IEEE-1394 Interface

This enables the V19/V21 to receive and decode High Definition broadcasts, and Digital Cable signals (when not scrambled), without using a Set Top Box. The IEEE-1394 interface enables single cable connection to 1394 compatible Digital Devices in a Home Theater System.

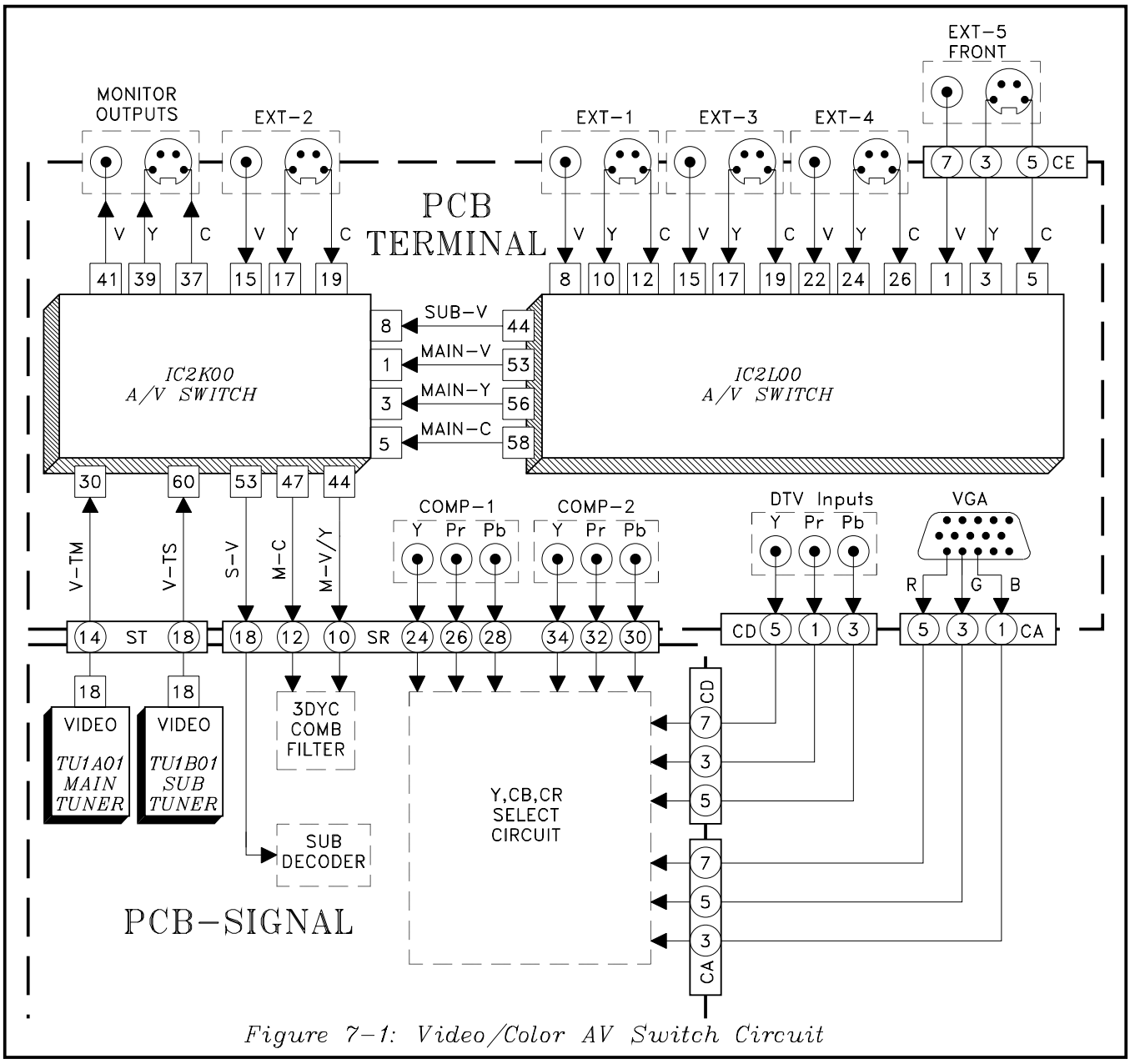


Figure 7-1: Video/Color AV Switch Circuit

NTSC Signal Selection

Figure 7-1 illustrates the NTSC Signal Selection circuitry. The circuitry is basically the same as in the V17 chassis. However, some pin numbers and nomenclature are different, due mainly to the addition of another NTSC External Input.

IC2L00 selects main and sub picture NTSC signal from the External 1, 3, 4 and 5 Inputs. External 5 inputs are the front panel inputs.

IC2K00 selects main and sub picture signals from IC2L00, or from the External 2 input, Main Tuner or Sub Tuner. The selected main picture signals are directed to 3DYC Comb Filter circuitry, and sub picture video is directed to the Sub Decoder.

The COMP-1, COMP-2, DTV and VGA inputs are directed to YCbCr Select circuitry on the PCB-SIGNAL. Since a Set Top Box is not required to receive HD broadcasts, the DTV inputs are mainly used for connection to a Digital Broadcast Satellite (DBS).

PCB-SIGNAL Video/Color Path

Main Picture Signal Path

Figure 7-2 shows the Overall Video/Color Signal Path on the PCB-SIGNAL. NTSC main picture signal from the A/V SW circuitry is routed through PCB-SIGNAL to PCB-3DYC.

The Comb Filter on the PCB-3DYC separates the Y and C signals, and the Main Decoder converts the Y and C signals to YCbCr. The signals are then directed to YCbCr Select circuitry on the PCB-SIGNAL.

The Main YCbCr Select circuit selects signals from the Main Decoder, or the Component, DTV or the VGA inputs. The selected signals can be:

- 480i – YCbCr are directed to PCB-2HDW and CbCr to the DM Module. The 480i Y signal, directly from PCB-3DYC, is routed to the DM Module.
- 480p – YCbCr are directed to the VCJ and 2HDW. 2HDW circuitry only processes 480p when there is a display format change.
- 1080i – YCbCr are directed to the VCJ

The 480i Y signal for both the DM Module and the Monitor Outputs must include sync signals. Since the Main Decoder strips sync from the Y signal, it must be directed to the DM and Monitor Outputs before Main Decoder processing.

The PCB-2HDW doubles the number of horizontal lines in 480i signals. The output signals from 2HDW, Y-

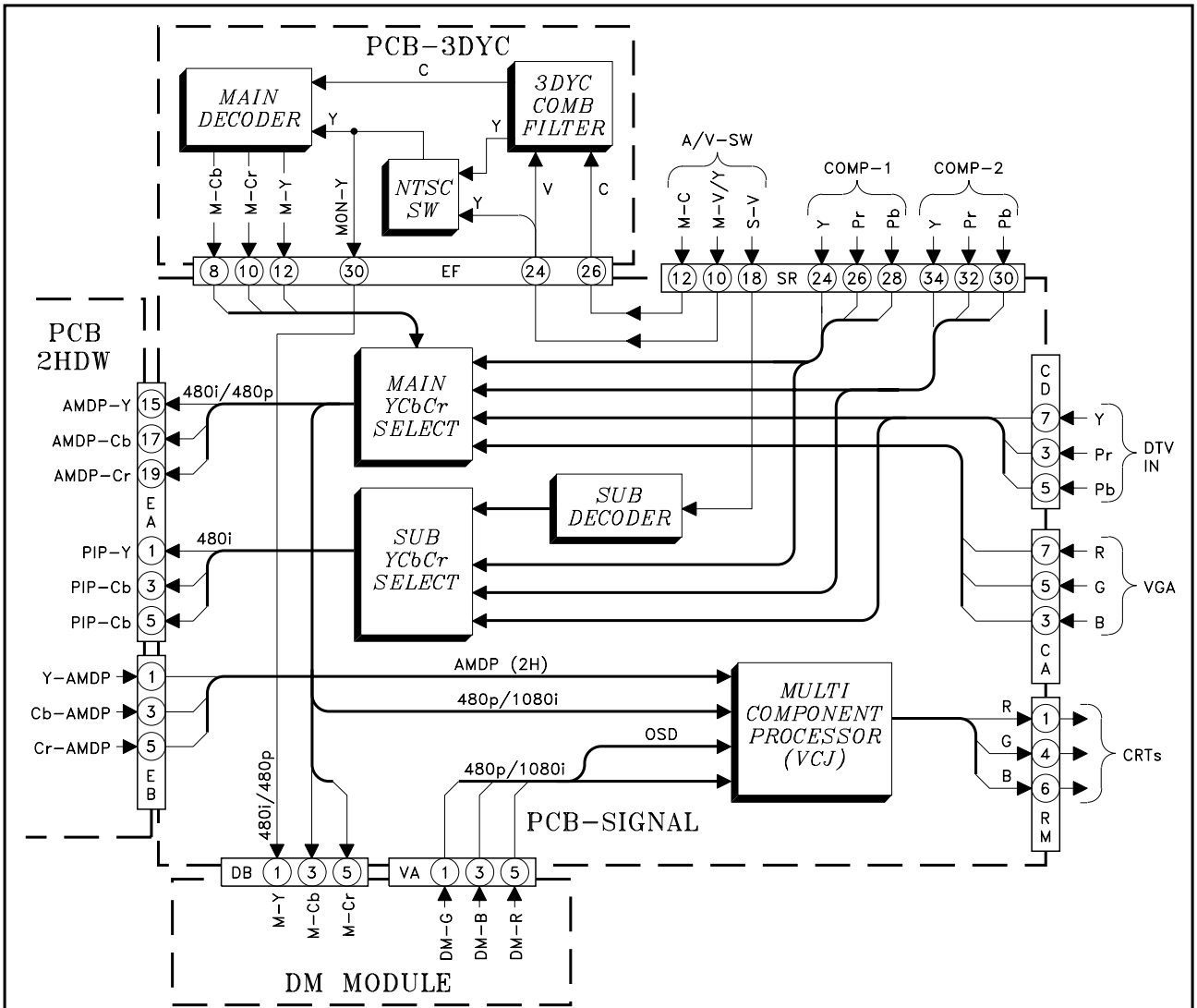


Figure 7–2: PCB–SIGNAL Overall Y/C Signal Path

AMDP, Cb-AMDP and Cr-AMDP are directed to the VCJ.

When the main picture source is a HD Broadcast or QAM cable signal, the circuitry in the DM Module processes the signals and outputs the resulting analog RGB signals. The DM RGB signals are applied to two sets of inputs on the VCJ:

1) DM Main Picture Input
2) OSD Insertion Input

All on screen (OSD) display signals are generated in the DM Module, except Convergence OSD. When the main picture source is digital, HD or QAM, OSD insertion occurs in the DM Module. When the main picture is an analog signal, RGB OSD signals from the DM Module are directed to the OSD insertion inputs on the VCJ and are inserted in the main picture in the VCJ.

The VCJ processes the selected signals, and converts them to the RGB format to drive the CRTs.

Sub Picture Signal Path

Sub picture NTSC signals, from the A/V Switch circuitry, are converted to YCbCr signals by the Sub Decoder. The output from the Sub Decoder is applied to the Sub YCbCr Select circuit. Signals from the COMP-1, COMP-2 and DTV inputs are also directed to the Sub YCbCr Select circuit.

The selected signals are directed to 2HDW circuitry for PIP/POP processing, and insertion into the main picture. The sub picture source must be 480i or it is not accepted by the 2HDW circuitry.

3DYC and Main Decoder Circuitry

Figure 7-3 illustrates the circuitry on the PCB-3DYC. This circuitry is also basically the same as in the V17 and V18 chassis. When the main picture source is NTSC composite video:

- The video signal is input to IC2C00 at pin 88 for Y and C signal separation.
- Y signal is output at pin 84 of IC2C00 and directed to the NTSC SW, IC2Y01.
- C signal is output at pin 83 and applied to the Main Decoder, IC2E00.

When the main signal is S-Y/C:

- The C signal still passes through IC2C00 for noise reduction.

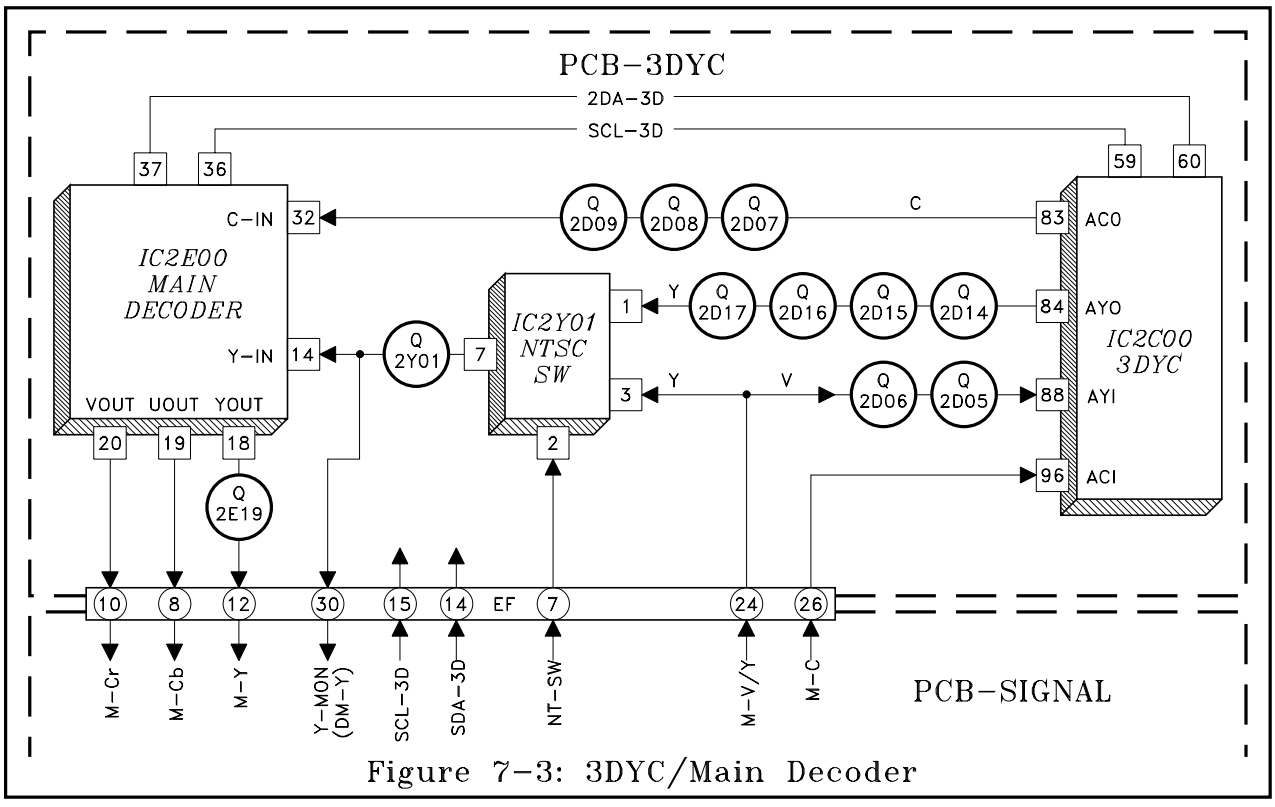


Figure 7−3: 3DYC/Main Decoder

- The Y signal is applied to the NTSC SW, IC2Y01.

The NTSC SW selects the S-Y signal, or the Y signal from IC2C00. The selected Y signal is applied to the Main Decoder.

The Main Decoder converts the Y and C signal to YCbCr and directs them to Main YCbCr Select circuitry on the PCB-SIGNAL.

Note that Y signal at the input to the Main Decoder is also directed to the DM Module and the Monitor Outputs.

YCbCr Select Circuitry

Figure 7-4 shows the **Main Picture YCbCr Select Circuitry.** Compared to that in the V17 and V18, the circuitry has been simplified. The DVD Select IC, IC2A60, selects either COMP-1 or COMP-2 signal.

IC2A00 is a new IC (Generic #CXA2151Q). It selects the main picture YCbCr signals from:

- The output of IC2A60
- The output of the Main Decoder
- The DTV Inputs
- The VGA Input

The path of the selected signals from IC2A00 depends on the signals format:

- 480i and 480p YCbCr signals are directed to 2HDW, and CbCr to the DM Module circuitry. Y signal for the DM comes directly from PCB-3DYC.
- 480p and 1080i YCbCr signals are directed to the Bypass Inputs on the VCJ.

The selected output from IC2A00 is always in the component format (YCbCr). If the selected signals are RGB, from the DTV or VGA inputs, they are converted to YCbCr in IC2A00.

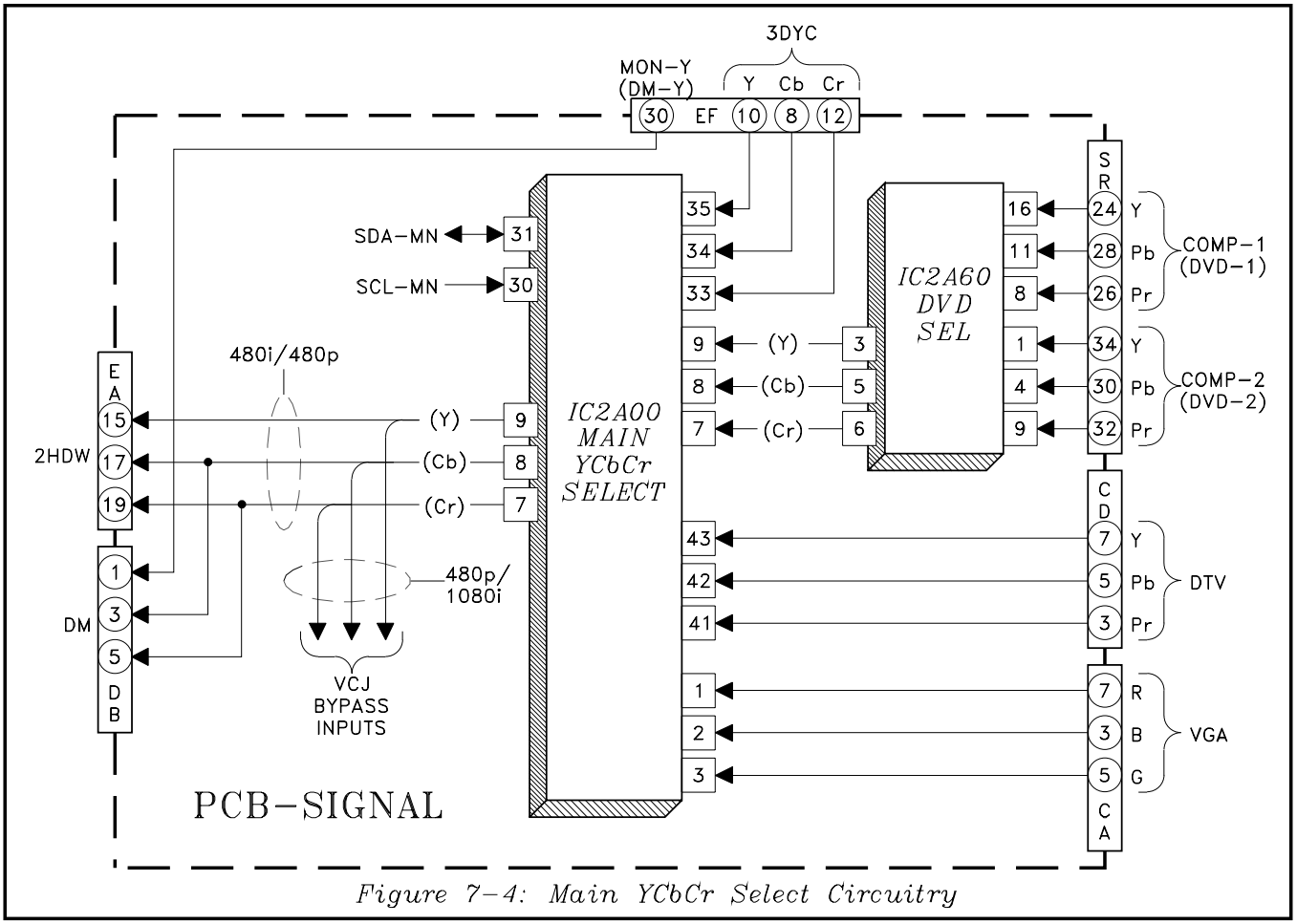


Figure 7–4: Main YCbCr Select Circuitry

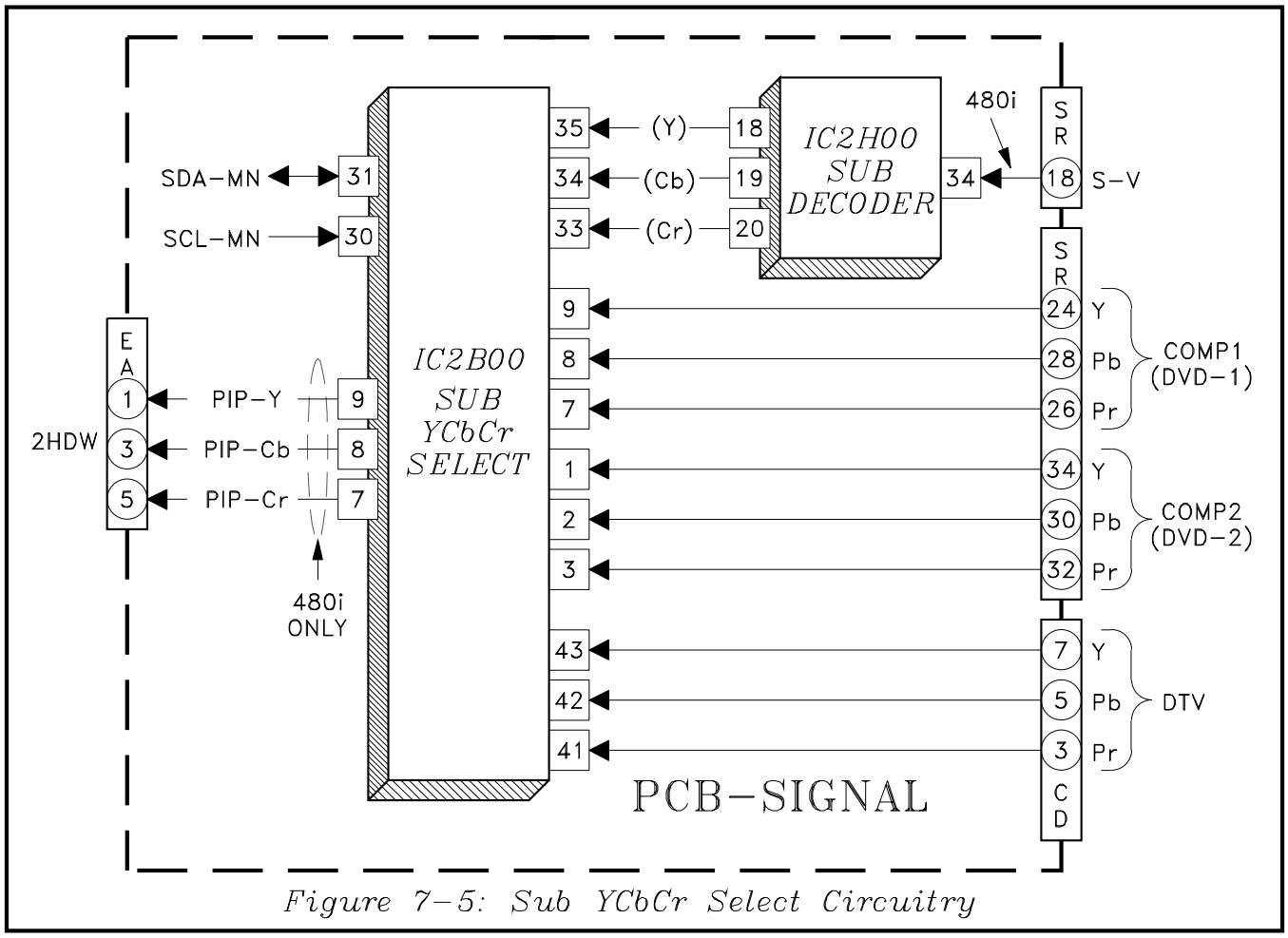


Figure 7-5: Sub YCbCr Select Circuitry

Figure 5 illustrates the **Sub Picture YCbCr Select Circuitry**. Sub picture NTSC signal is converted to the YCbCr format in the Sub Decoder, IC2H00. The output of IC2H00 is applied to IC2B00. Signals from the COMP-1, COMP-2 and DTV Inputs are also applied to IC2B00.

The outputs of IC2B00 are directed to the sub picture inputs of the 2HDW circuitry. If the format is not 480i that signal will not be accepted by the 2HDW circuitry.

YCbCr Select Control

Both the Main YCbCr Select (IC2A00) and Sub YCbCr Select (IC2B00) are Controlled by the SDA-MN data line. The SCL-MN clock line provides timing for data transfer. The internal circuitry of the ICs detects the format of the selected signals and informs the TV Control µPC of that format, via the SDA-MN I^2C Data line.

VCJ Video/Color Signal Path

Figure 7-6 shows the Video/Color Signal Path in the VCJ, IC2V00. Main picture signal inputs are:

- Pins 67-69 … 480i line doubled inputs.
- Pins 3-5 … 480p and 1080i analog inputs.
- Pins 15-17 … DM RGB inputs.

DM-RGB signals are converted to YCbCr in the VCJ. Internal Switch circuitry selects Analog 480p/1080i or DM YCbCr, and outputs the signals at pins 76-78. This signals are directed back to pins 73-75 of the VCJ.

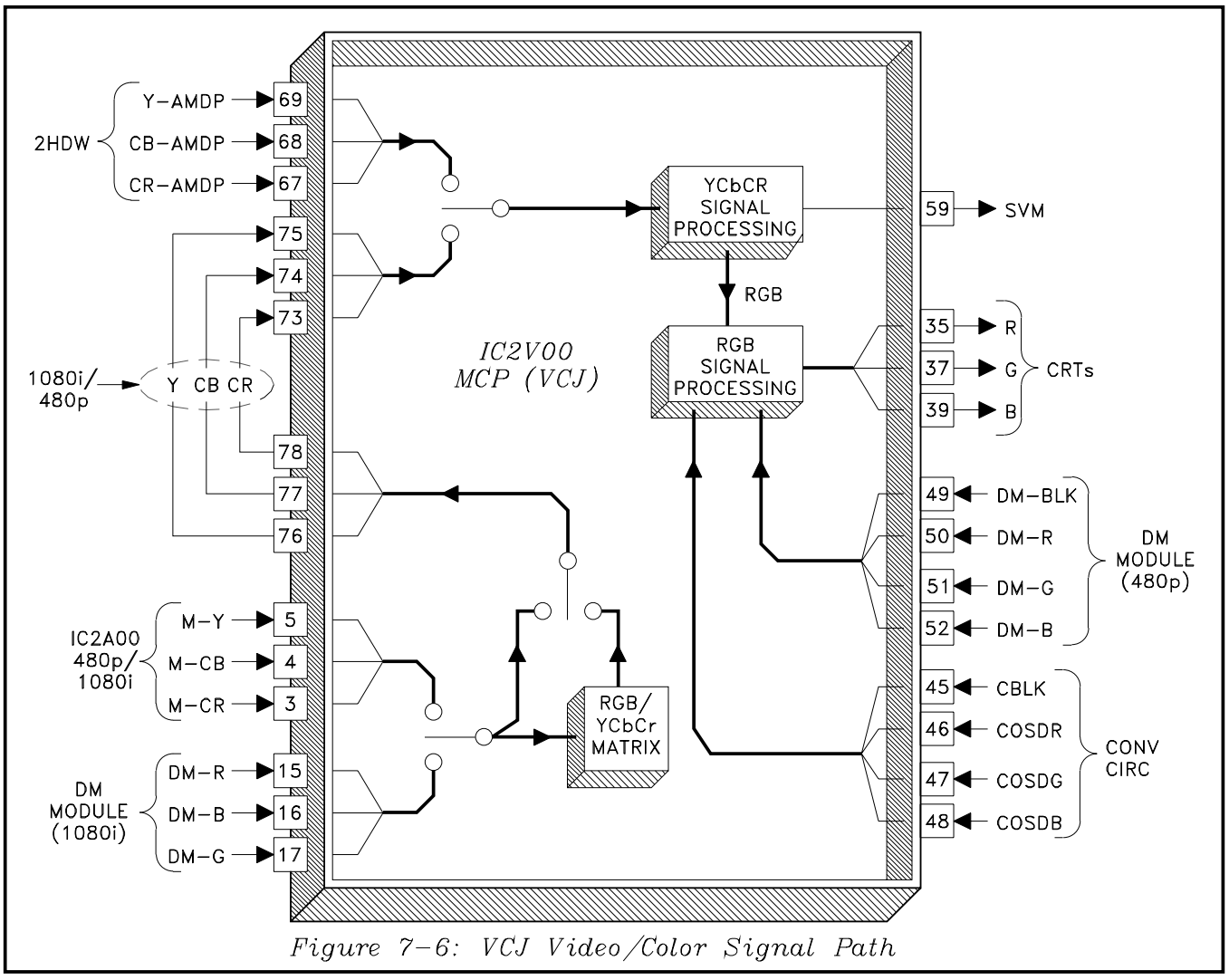


Figure 7–6: VCJ Video/Color Signal Path

Another internal switch in the VCJ selects the signals at pins 67-69 or pins 73-75 and directs the signals to the internal YCbCr Processing circuitry. The signals are converted to RGB and are directed to RGB Processing circuitry. The RGB signals are output at pins 35, 37 and 39, and directed to the CRT Drive circuitry.

DM-RGB conversion to YCbCr enables using the enhancements available in the YCbCr Signal Processing circuitry of the VCJ. For instance, the generation of a drive signal for the Scan Velocity Modulation (SVM) circuitry.

Note that the DM RGB signals are also input to the VCJ at pin 49-51. These inputs are used for OSD insertion when the main picture source is analog. The DM-BLK signal, from the DM Module, times the OSD insertion into the main picture.

When the main picture source is from the DM Module, the OSD is inserted in the main picture in the DM Module.

Pins 45-47 are also OSD Inputs. These inputs receive OSD signals from the Convergence circuitry, and the CBLK signal times the Convergence OSD insertion.

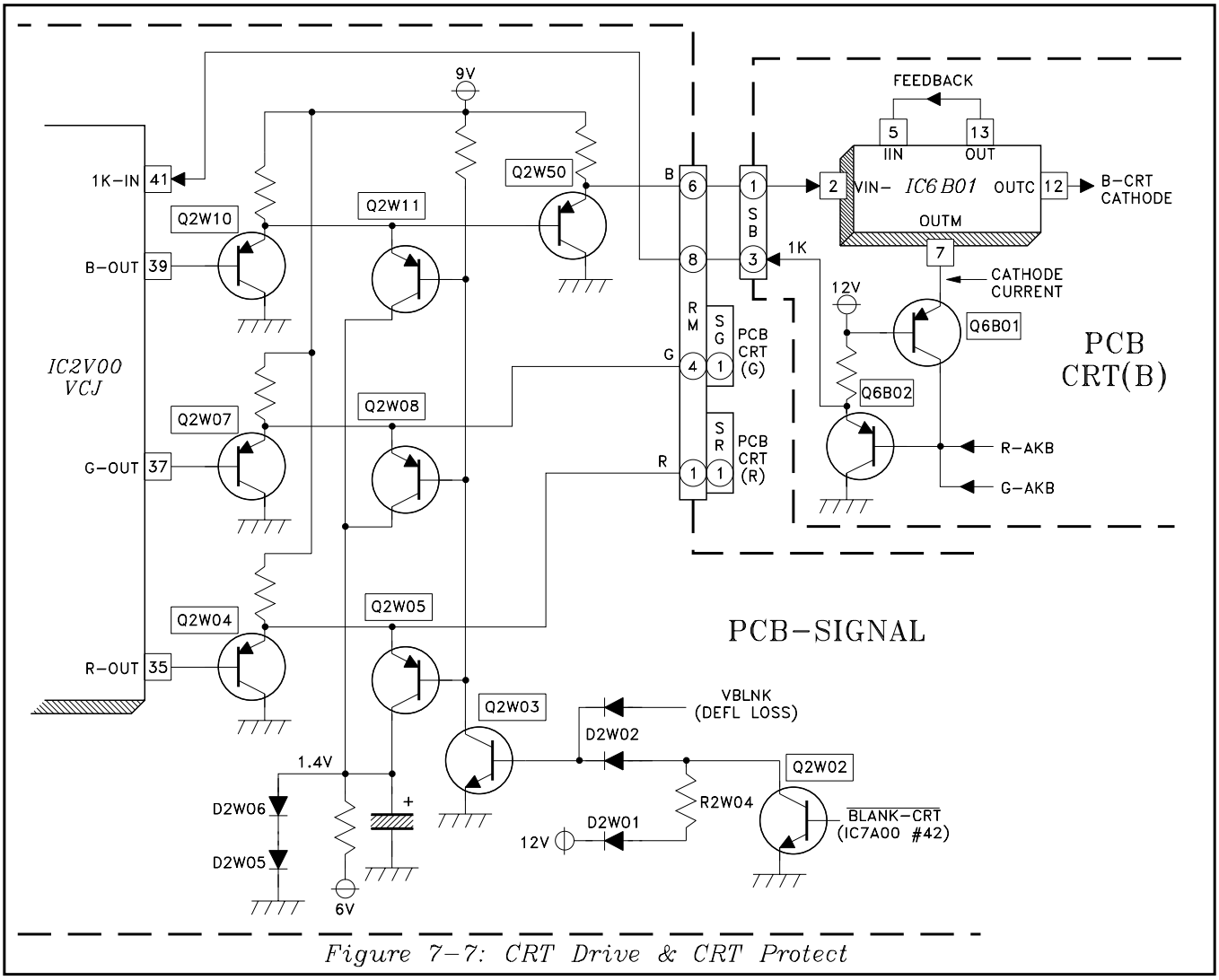


Figure 7-7: CRT Drive & CRT Protect

CRT Drive & Protect Circuitry

Figure 7-7 illustrates the CRT Drive and CRT Protect circuitry. The CRT Drive circuitry is the same as that in the V17, except that the three discrete component transistor amplifiers on each PCB-CRT are replaced with a single IC, IC6B01, IC6G01 or IC6R01. Only the PCB-CRT(B) is shown in *Figure 7-7*.

Transistors Q2W05, Q2W08 and Q2W11 are part of the CRT Protect circuitry. When these transistors conduct it removes the drive to the CRTs. Q2W03 controls the conduction of all three of CRT Protect transistors.

The conduction of Q2W03 is controlled by the VBLNK and BLANK CRT lines. The BLANK-CRT line momentarily goes Low during a channel or input change, momentarily blanking the CRTs.

The VBLNK line goes High if deflection is lost. The High turn Q2W03 On, blanking all three CRTs to prevent possible CRT phosphor damage.

In the V17 Spot Killer circuitry was also part of the CRT Protect circuitry. This circuit has been replaced by Flash Protect circuitry. The Flash Protect circuit and Deflection Detection Loss circuitry are described in *Chapter 8*.

Monitor Out Signal Path

The Video/Color Monitor Signal Path is shown in *Figure 7-8*. NTSC signal for the Monitor Outputs is derived from the C output of the 3DYC Comb Filter, and

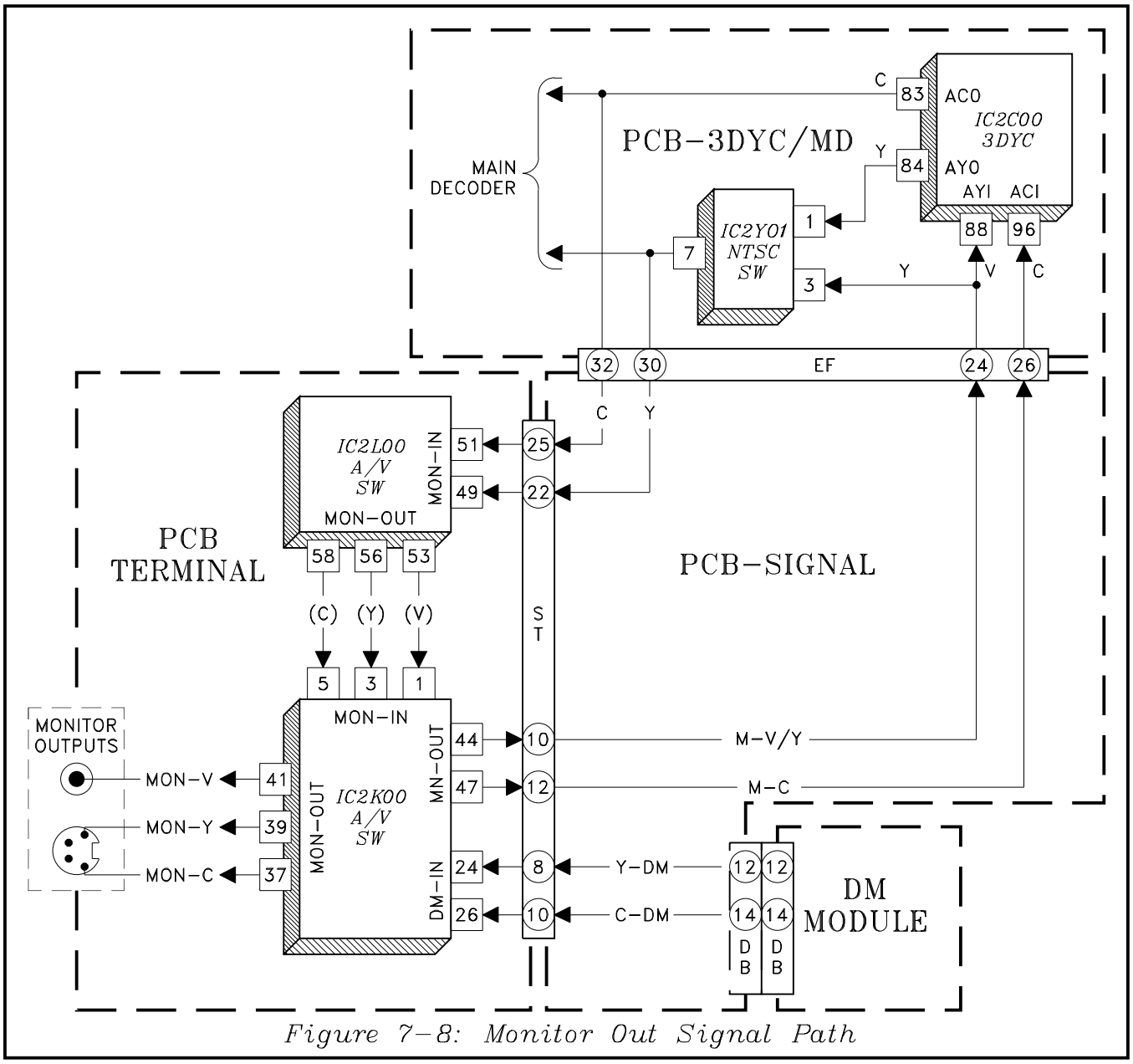


Figure 7-8: Monitor Out Signal Path

the Y output of the NTSC SW, IC2Y01. The two signals are applied to A/V-SW, IC2L00, and forwarded to the Main Inputs on IC2K00.

When the main signal source is composite video, there would be no Y and C signal input to IC2K00's main inputs. These signals are supplied by the Y and C signals from PCB-3DYC. The signals at pins 1, 3, and 5 of IC2K00 are output at pins 37, 39 and 41, and directed to the Monitor Output Jacks.

When the main signal source is HD or SD from the DM Module. The circuitry in the DM Module outputs analog Y-DM and C-DM signals which are directed to IC2K00. Internal to IC2K00 the Y and C signals are combined to form a Composite Video signal. All three signals V-DM, Y-DM and C-DM are directed to the Monitor Output Jacks.

If any other source, Component, DTV or VGA is the main picture source, no signal is available at the Monitor Outputs.

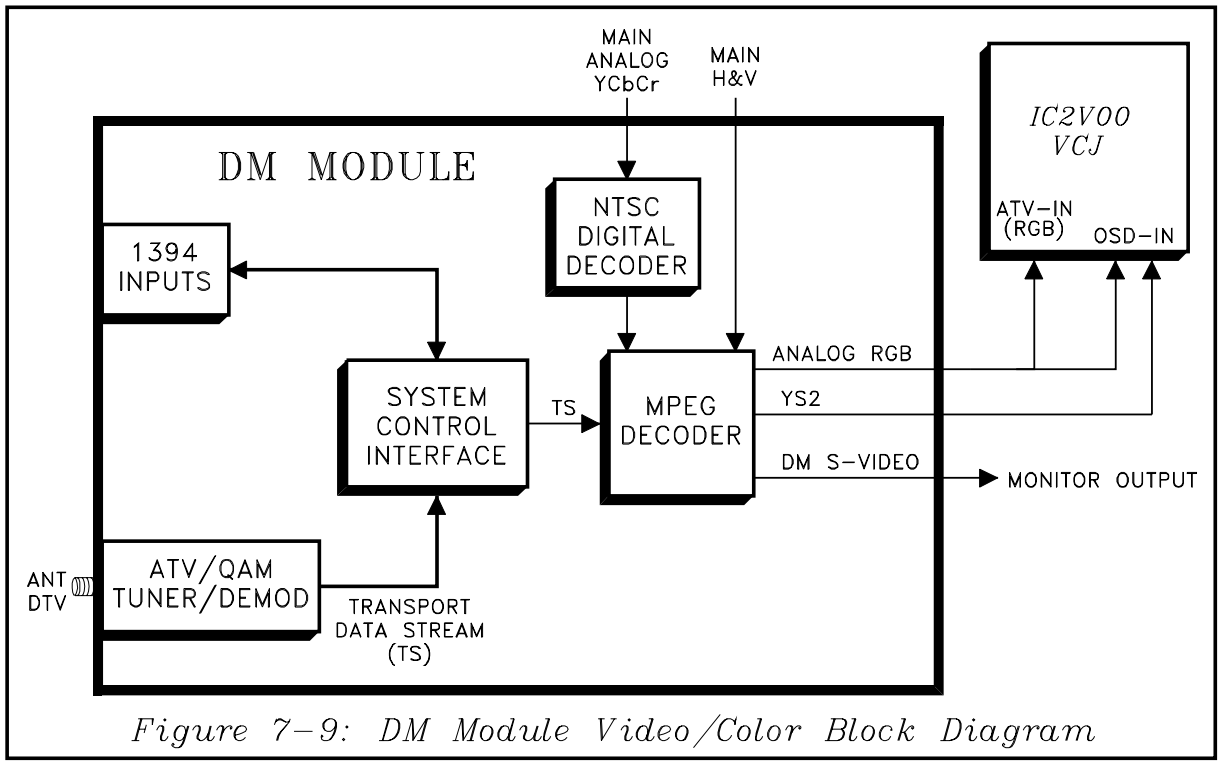


Figure 7–9: DM Module Video/Color Block Diagram

DM Basic Signal Block

Figure 7-9 shows a Basic Block Diagram of the Signal Processing circuitry in the DM Module. Only a simple Block Diagram is necessary since the DM Module is a replaceable component.

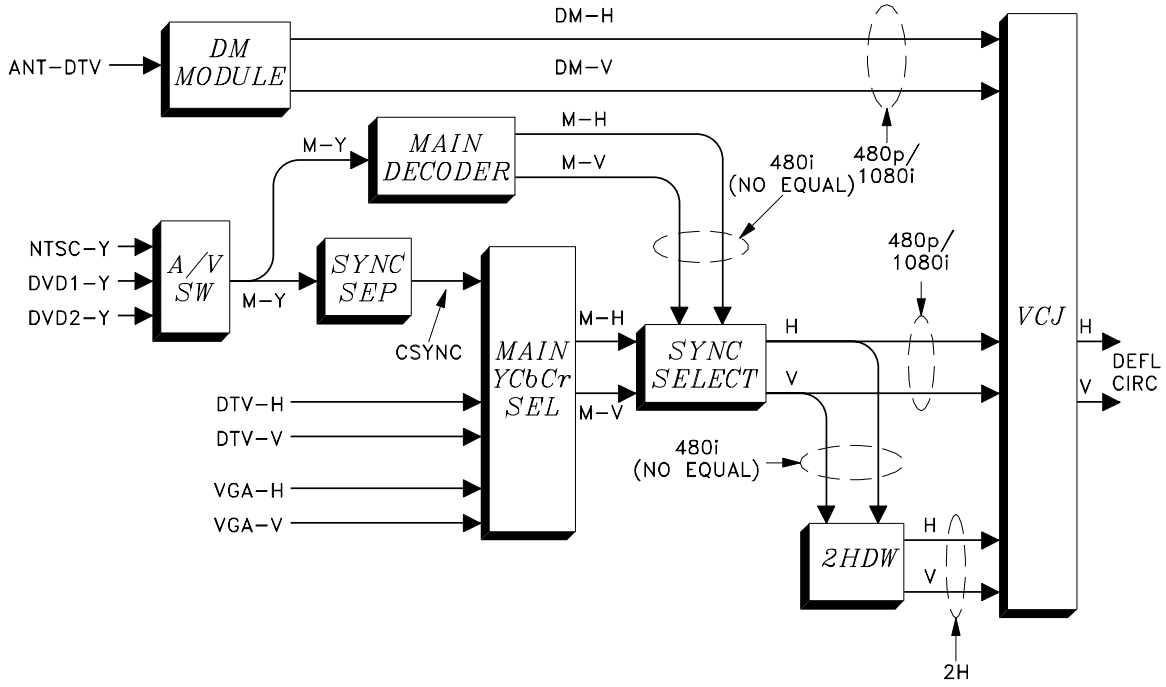
There are two main signal sources for the DM Module:

1) ANT-DTV Input
2) 1394 Jacks.

Signals from ANT-DTV input are processed by the ATV Tuner and Demodulation circuitry. The output of the Demodulator is the HD Transport Data Stream. It is directed through the System Interface circuitry to an MPEG Decoder. The Decoder outputs main picture analog RGB, and also Separate Y and C signals for the Monitor Output circuitry.

The other signal sources for the DM Module are the 1394 Jacks. The signal input to the 1394 Jack would be a compressed digital data stream from a 1394 Compatible Digital Device in a Home Theater System. This signal is routed through the System Interface circuitry to the MPEG Decoder. The output of the Decoder is main picture analog RGB.

Chapter 8
Deflection & HV Circuitry



Although some nomenclature differs, the Deflection circuitry is mostly the same as in previous models. The main changes are:

- The Sync Signal Path differs.
- An added Flash Protect circuit.

Sync Block Diagram

The above Block Diagram shows the Sync Signal path from the source to the VCJ, which generates drive for the Vertical and Horizontal Deflection circuitry.

The sync source for NTSC signals, and component format signals is in the Y or composite video (NTSC) signal. The A/V Switch circuitry selects the Y, or video signal of the desired source.

The output of the A/V Switch takes two paths:

1) To the Main Decoder
2) To a Sync Separator circuit.

The Main Decoder outputs separated Horizontal and Vertical Sync. The Sync Separator outputs composite sync (CSYNC), combined horizontal and vertical.

The CSYNC signal is applied, to the Main YCbCr Select circuitry. Horizontal and Vertical Sync from the DTV and VGA inputs are also directed to the YCbCr Select circuit.

The CSYNC signal is broken down to separate horizontal and vertical sync, and when selected as the signal source is output from the YCbCr Select circuit. Horizontal and vertical sync from the YCbCr Select circuit is applied to one set of inputs on a Sync Select IC.

The second set of inputs to the Sync Select IC receives sync from the Main Decoder. The difference in the two sets of sync signals is NTSC Sync from the YCbCr Select circuit contains equalizing pulses. The signals from the Main Decoder are generated by count down circuitry and have no equalizing pulses.

The 2HDW circuitry requires sync with no equalizing pulses. Therefore when the source signal is 480i, the sync from the Main Decoder is selected and directed to the 2HDW circuitry.

When the source signal is 480i the horizontal lines are doubled in the 2HDW circuitry and the resulting 2H signal is directed to the VCJ. When the source is 480p, the sync signals from the Sync Select IC are applied directly to the VCJ.

An additional sync source in the V19 is from DM Module. When receiving a digital broadcast or digital cable signal, the signal is decoded in the DM Module and DM horizontal and vertical sync are directed to the VCJ.

The VCJ selects 2H sync from 2HDW, analog 480p/1080i sync, or the 480p/1080i sync from the DM Module. The selected sync is processed, output from the VCJ and directed to the Deflection Generators on PCB-JUNGLE.

Figure 8-1 shows the Sync Signal path in more detail, showing ICs, pin numbers and connectors in the Sync Path.

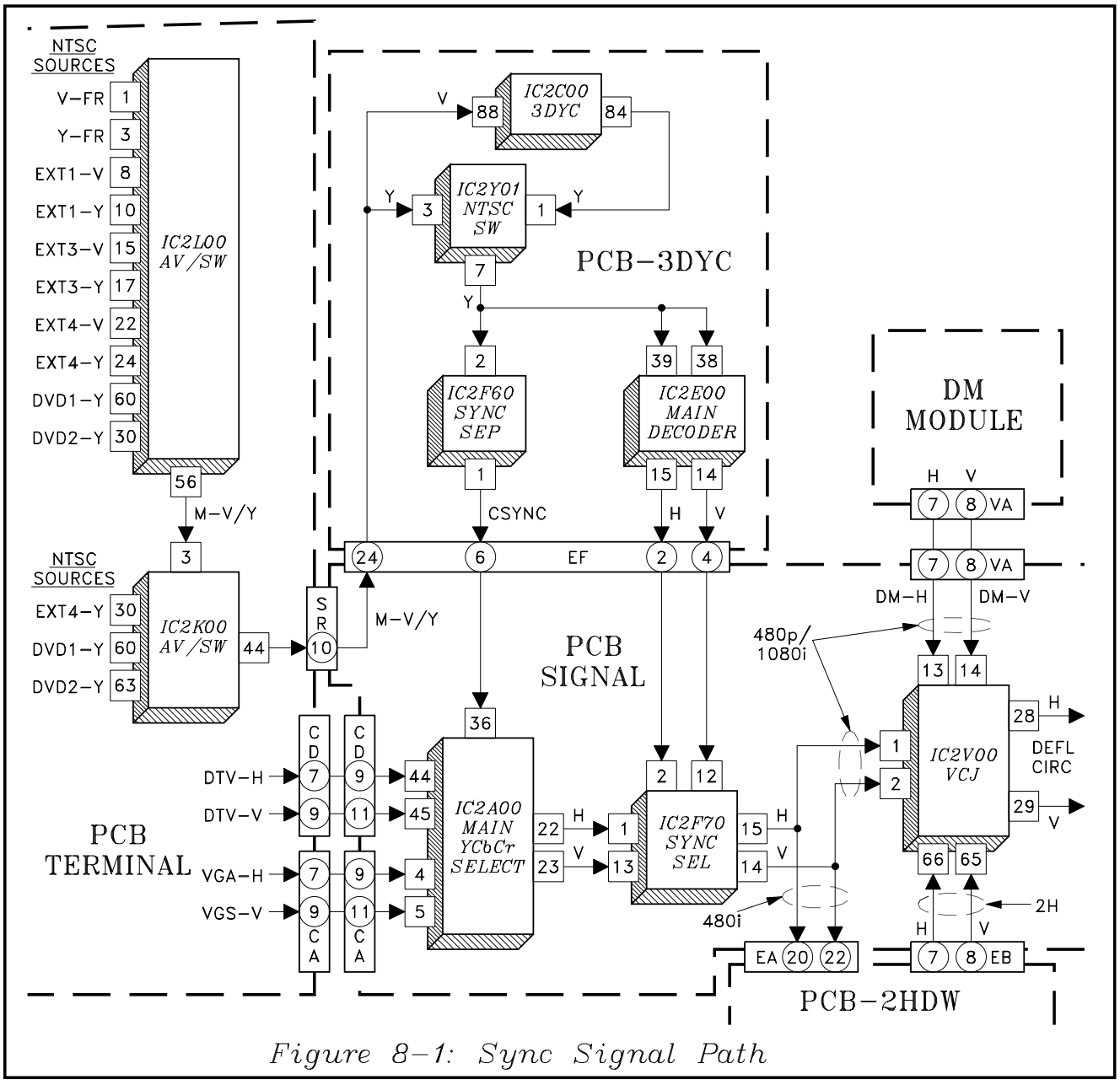


Figure 8–1: Sync Signal Path

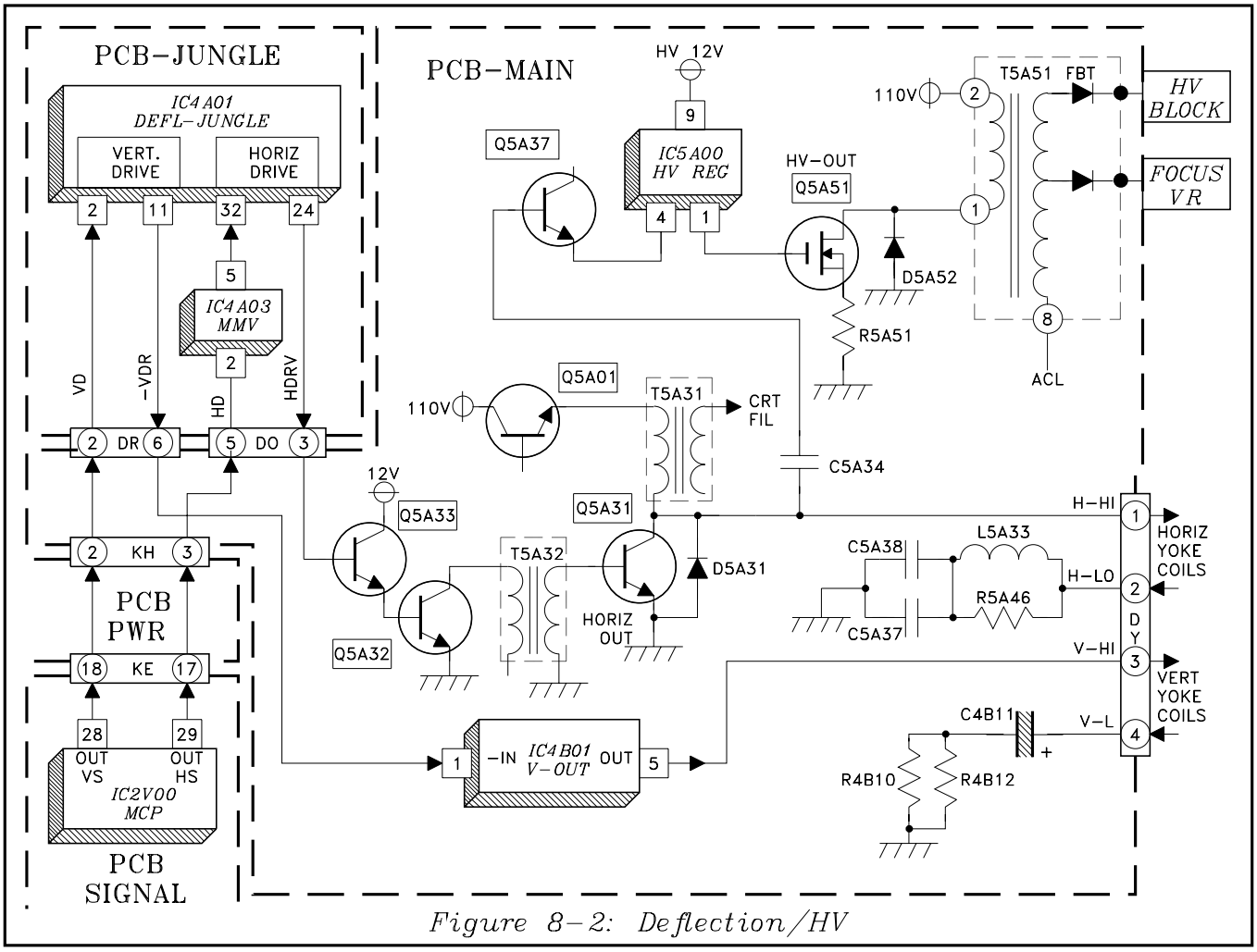


Figure 8–2: Deflection/HV

Deflection and HV Circuitry

Figure 8-2 illustrates the Deflection and High Voltage circuitry. Horizontal and Vertical Sync signals from the VCJ are routed from the PCB-SIGNAL, through PCB-POWER and PCB-MAIN to the Deflection Jungle IC on PCB-JUNGLE.

Vertical sync is applied directly to pin 2 of IC4A01. Horizontal sync triggers a MMV in IC4A03. The clean output pulse from the MMV is applied to pin 32 of IC4A01. The horizontal and vertical Deflection Drive signals from IC4A01 are directed to the Deflection circuitry on PCB-MAIN.

Vertical Drive is applied to IC4B01, the Vertical Output IC, amplified and directed to the Vertical Yoke Coils through the DY connector.

Horizontal Drive is amplified by Q5A33 and Q5A32 and applied to the base of Q5A31, the Horizontal Output transistor. The output of Q5A31 takes three paths.

1) To Horizontal Deflection Yoke coils.
2) Through T5A31 to generate the CRT filament supply.
3) Through C5A34 to the HV circuitry.

Q5A01 regulates the DC supply for Q5A31 and also is the source for horizontal pincushion correction.

The HV Drive passes through Q5A37, the HV Regulation IC (IC5A00), and Q5A51 to drive the Flyback Transformer. Note that the DC Supply for IC5A00 is denoted as HV 12V. This supply is generated specifically for the HV Drive circuitry.

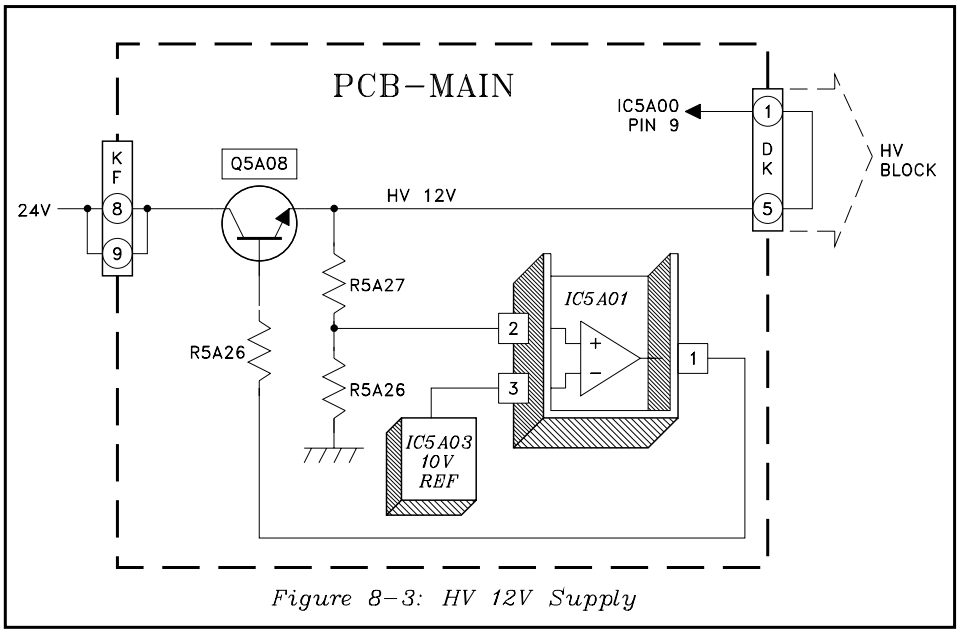


Figure 8−3: HV 12V Supply

HV 12 Volt Supply

Figure 8-3 shows the HV 12V supply circuitry. The source of the supply is the 24 Supply from the Main Power Supply, applied to the collector of Q5A08. A 10 volt reference, from IC5A03 is applied to the inverting input of an Op-amp in IC5A01. A sample of the voltage at the emitter of Q5A08 is applied to the non-inverting input.

The output of the Op-amp controls the conduction of Q5A08. Conduction increases if the voltage at the emitter drops below 12 volts, and decreases if the voltage exceeds 12 volts. The HV 12V supply is routed through a jumper in the DK connector to IC5A00.

The DK connector is connected to the ground returns of the HV Block. If the set is operational with the DK connector unplugged, excessive HV would be generated causing damage to the TV. The jumper in the DK connector insures that the HV is disabled when the connector is unplugged.

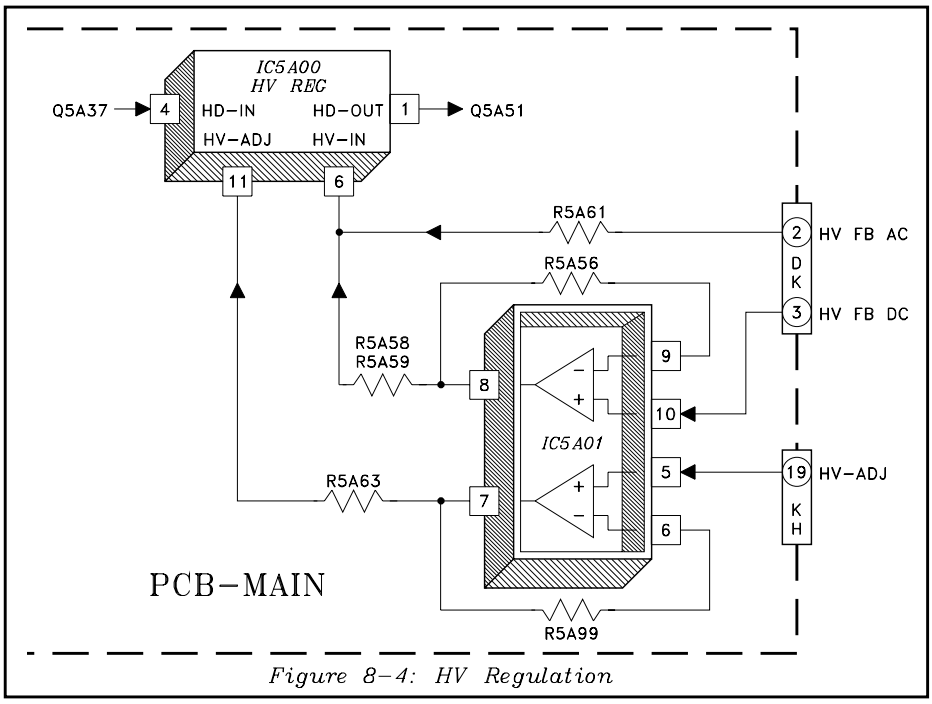


Figure 8−4: HV Regulation

HV Regulation

The HV Regulation circuitry is shown in *Figure 8-4*. Controlling the duty cycle of the drive applied to the HV Output transistor, Q5A51, regulates the HV. The amount of energy stored in the Flyback transformer is determined by how long Q5A51 conducts. Increasing conduction time increases HV, and decreasing conduction time reduces HV.

A sample of the HV is derived from the HV Block ground return circuitry. DC feedback (HV FB DC) is directed through an Op-amp in IC5A01 to the HV-IN input at pin 6 of IC5A00. AC feedback (HV FB AC) is applied directly to pin 6 to speed up the operation.

Caution: Do not measure HV FB DC at the DK connector. This will load down the circuit resulting in excessive HV. HV FB DC can safely be measured after buffering by the Op-amp in IC5A01.

The sample of the HV is compared to the HV-ADJ voltage from the Convergence circuitry, input at pin 11 of IC5A00. If the HV feedback voltage is higher than the HV-ADJ voltage, conduction time is decreased. Conversely, if the feedback voltage is lower, conduction time is increased.

X-Ray Protect

Figure 8-5 illustrates the X-Ray Protect circuitry. It is the same as in the V17 and V18 chassis. The X-Ray Protect circuitry shuts the TV down if High Voltage, Beam Current or arcing is excessive.

D5A57 provides a sample of the HV by rectifying the signal from pin 5 of the Flyback. Beam current is detected by monitoring the voltage at the ground return for the HV winding in the Flyback, pin 8 of T5A51.

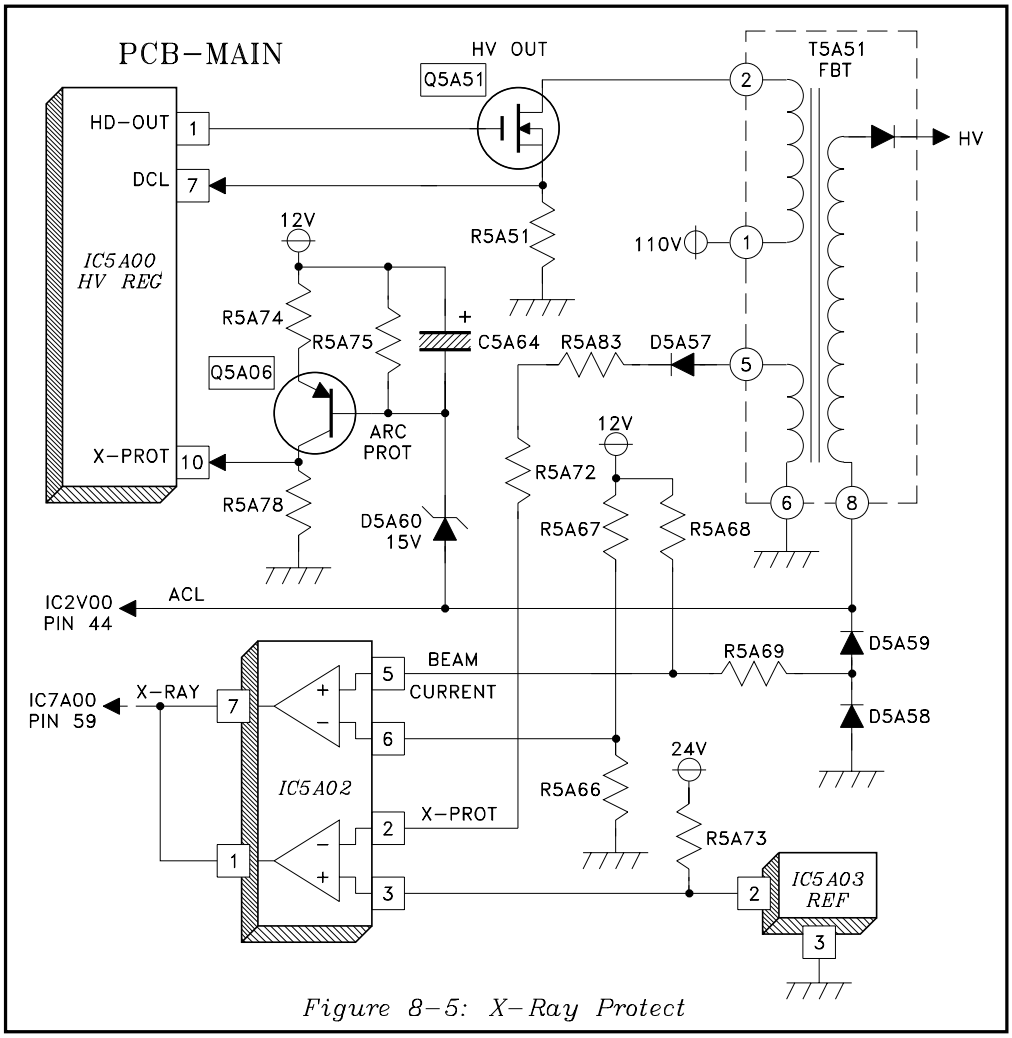


Figure 8−5: X−Ray Protect

The voltage from D5A57 is applied to the (-) input of an Op-amp in IC5A02. Reference IC5A03 hold the (+) input at 10 volts. If the voltage for D5A57 exceeds the 10 volt reference, the output of the Op-amp goes Low, pulling the X-Ray line Low. The TV µPC responds by turning the TV Off.

A similar Op-amp configuration monitors beam current. Pin 8 of the Flyback is connected through D5A59 to the (+) input (pin 5) of another OP-amp in IC5A02. The (-) input (pin 6) is a reference voltage derived from R5A66, R5A67 and the 12V supply.

As beam current increases, the voltage at pin 8 of the Flyback decreases. When the voltage at pin 5 of IC5A02 drops below the reference at pin 6, the output at pin 7 goes Low, shutting the set Off.

Other circuitry in IC5A00 provides additional protection. By monitoring the voltage across R5A51 at pin 7 of IC5A00, the HV Output transistor current is sensed. If the voltage becomes excessive, IC5A00 removes drive to Q5A51.

Pin 10 of IC5A00 is used to remove HV drive if a sudden arc occurs. Q5A06 normally does not conduct. If an arc occurs, the voltage at pin 8 of the Flyback drops suddenly:

- Exceeding the zener point of D5A60.
- Turning Q5A06 On
- The resulting High at pin 10 of IC5A00 removes HV drive.

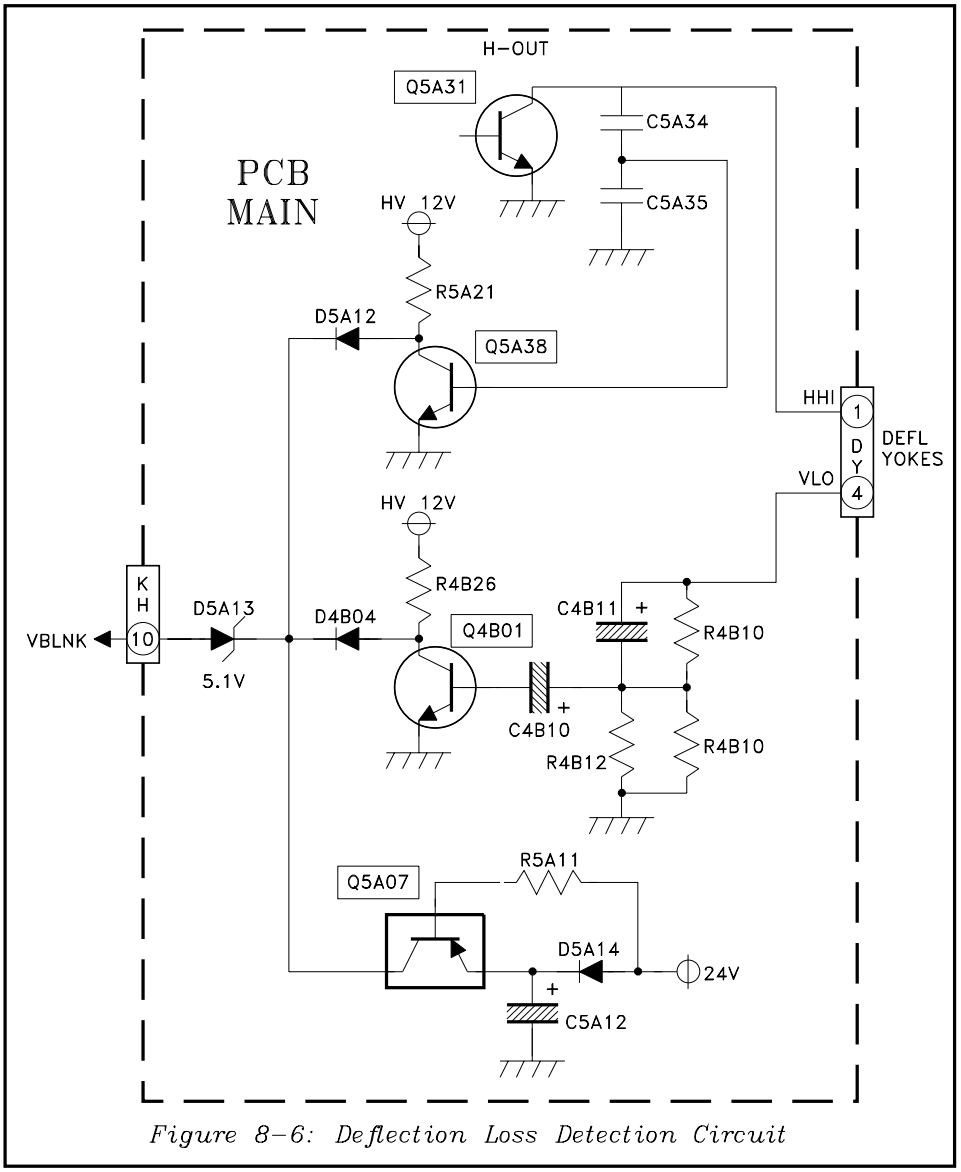


Figure 8-6: Deflection Loss Detection Circuit

Deflection Loss Detection

In the chapter on Video/Color, the CRT Protection Circuit was described. This circuit cuts off all three CRTs to prevent phosphor damage due to loss of deflection. *Figure 8-6* shows the Deflection Loss Detection circuitry.

Q5A38 monitors horizontal deflection. Pulses from the collector circuit of Q5A31 continually drives Q5A38 into conduction. The average collector voltage is below the turn on point of D5A12. If horizontal deflection is lost:

- Q5A38 shuts Off
- Q5A38 collector voltage rises.
- D5A12 is forward biased
- VBLNK goes High, activating CRT Protect.

Q4B01 monitors vertical deflection. The vertical sawtooth from the Vertical Yokes ground return drives Q4B01 into conduction. If vertical deflection is lost:

- Q4B01 stops conducting.
- Q4B01 collector voltage rises
- D5A13 is forward biased.
- VBLNK goes High.

Since the 24V supply is the source of the HV 12V supply, the 24V supply is monitored for further protection. Q5A07 does not normally conduct. If the 24V supply is lost:

- The emitter of Q5A07 momentarily remains High, due to the charge on C5A12.

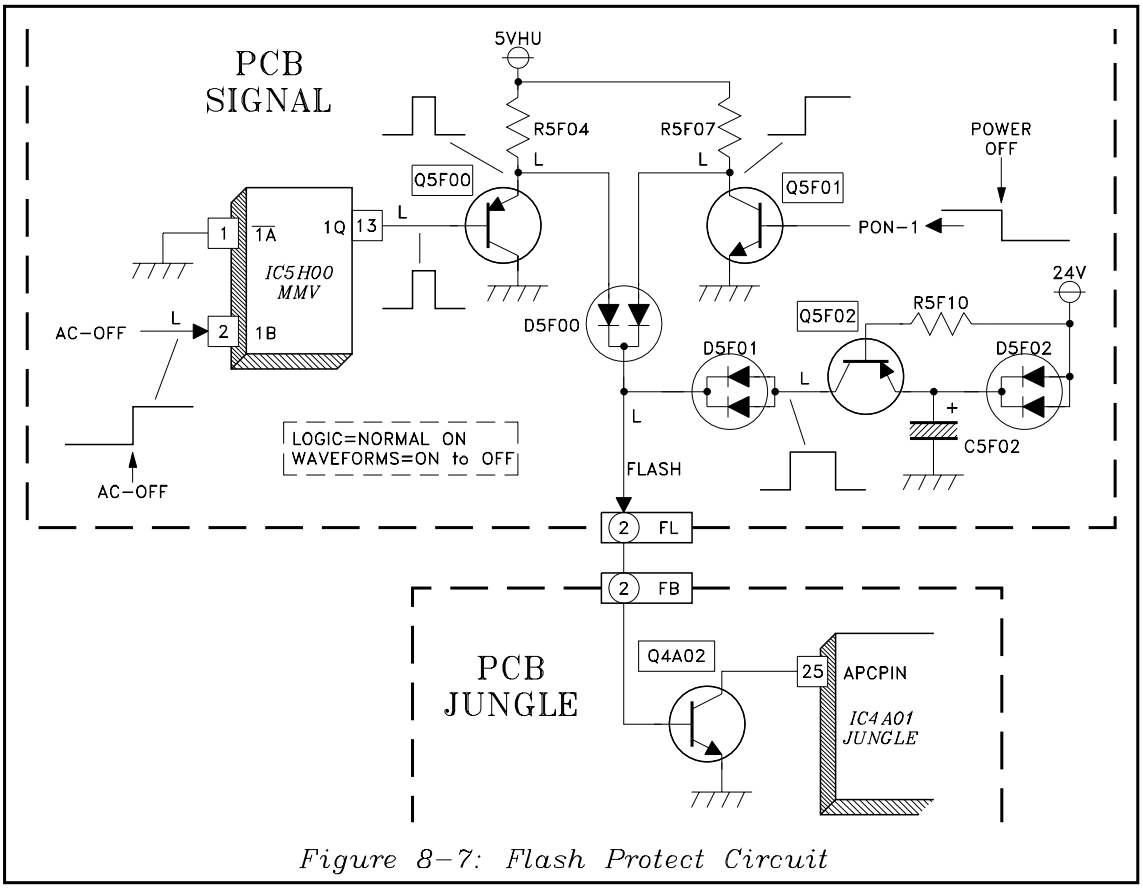


Figure 8–7: Flash Protect Circuit

- Q5A07 conducts
- VBLNK goes High, activating CRT Protect

Flash Protect Circuit

The Flash Protect circuit in *Figure 8-7* is new. It prevents the screen from flashing by removing HV:

- If AC Power is lost.
- When switching Power from On to Off
- If the 24V supply is lost.

IC5H00 is a one shot multivibrator and monitors the AC-OFF line. When power is lost:

- The AC-OFF line momentarily goes High.
- IC5H00 is triggered an outputs a positive pulse.
- Q4A02 conducts pulling pin 25 of the Jungle IC Low.
- HV is removed.

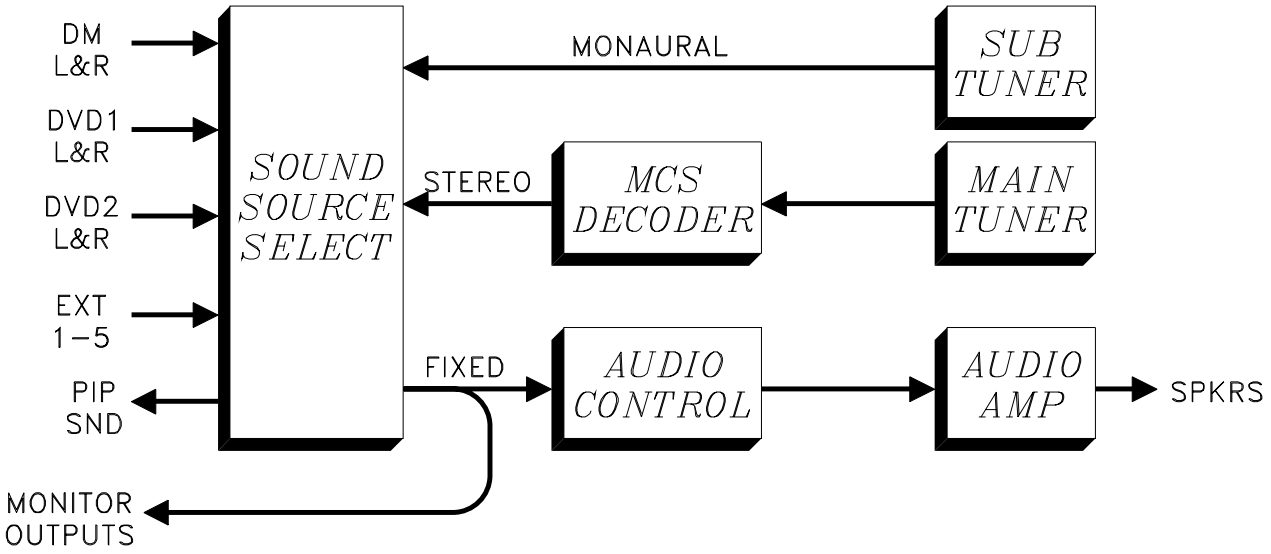
This same action occurs when Power is switched from On to Off.

- The P-ON1 line goes Low.
- Q5F01 stops conduction.
- Q5F01 collector voltage rises.
- Q4A02 conducts removing HV.

Loss of the 24V supply has the same effect.

- Q5F02 momentarily conducts due to the charge on C5F02.
- Q4A02 conducts.
- HV is removed.

Chapter 9
Sound Circuitry



Like most of the analog circuitry in the V19/V21, the Sound Circuitry is almost identical to previous models. This is apparent from the above Simplified Block Diagram.

The Sound Source Select circuitry selects the sound source for both the main and sub pictures. Most of the sources are conventional and have been available in the past:

- Main Tuner
- Sub Tuner (monaural only)
- Five External NTSC Inputs
- Two Component Inputs (DVD)

One additional sound source is added in the V19/V21 chassis, DM-R and DM-L. This is the sound signal from the DM Module. It is initially received in a digital format, from the ATSC/QAM Tuner or the IEEE 1394 inputs. The DM-R and DM-L signal are analog stereo signals that are directed to the Sound Source Select circuitry.

The remainder of the circuitry is the same as in many previous models:

- MCS Decoder circuitry decodes the Main Tuner sound signal, generating mono, stereo, or SAP signals when broadcast.
- Main picture sound from the Select circuitry takes two paths:
  1) To Audio Control circuitry
  2) To the Monitor Outputs
- The Audio Control circuitry performs adjustments to the Volume, Treble, Bass, etc. The outputs from Audio Control circuit are directed to the Audio Amplifier, and then to the set's speakers.
- Sub picture (PIP) sound, from the Source Select circuit is directed to the PIP Sound Output Jacks.

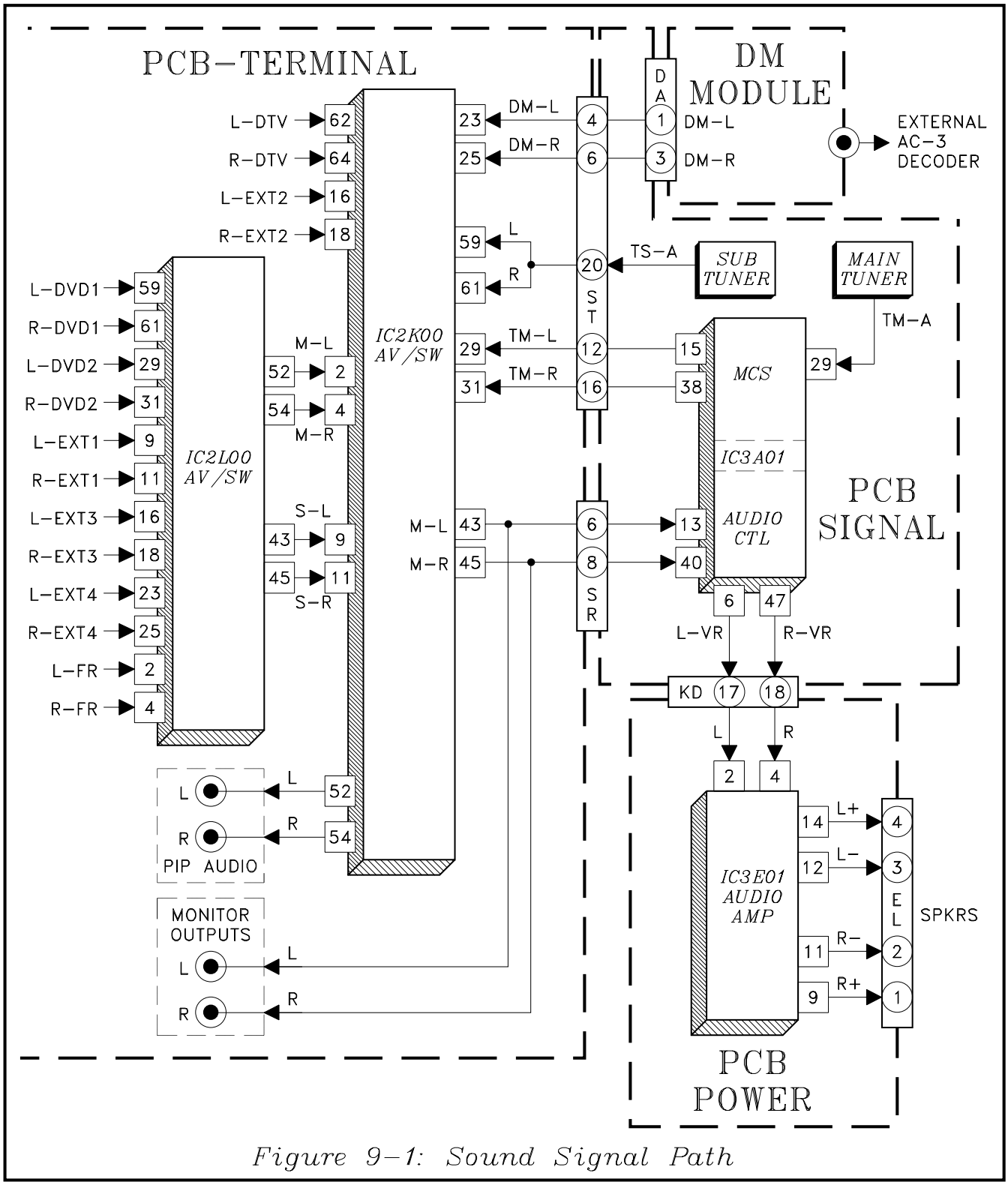


Figure 9–1: Sound Signal Path

Overall Sound Signal Path

Figure 9-1 illustrates the Overall Sound Signal Path. The AV/SW ICs, IC2L00 and IC2K00, used to select Main and Sub Picture Video/Color are used to the select the Sound sources.

IC2L00 selects Main and Sub sound sources from External NTSC Inputs 1, 3, 4, and 5, and from Component Inputs 1 and 2. The selected signals are directed to IC2K00.

IC2K00 selects the signals from IC2L00, or from the Main Tuner, Sub Tuner, NTSC External Input 2, DTV Inputs, or the DM Module. The Main Tuner sound signal is decoded by MCS circuitry in IC3A01 before being applied to IC2K00.

The Sub (PIP) sound signal is routed from IC2K00 to the PIP Sound Output Jacks. The selected main Sound signal is directed to Audio Control circuitry, also in IC3A01. The sound signal from IC3A01 is amplified in IC3E01 and directed to the set's speakers.

The input signals to IC3A01 are also directed to the Monitor Output Jacks. Only fixed level sound is available at the Monitor Output Jacks.

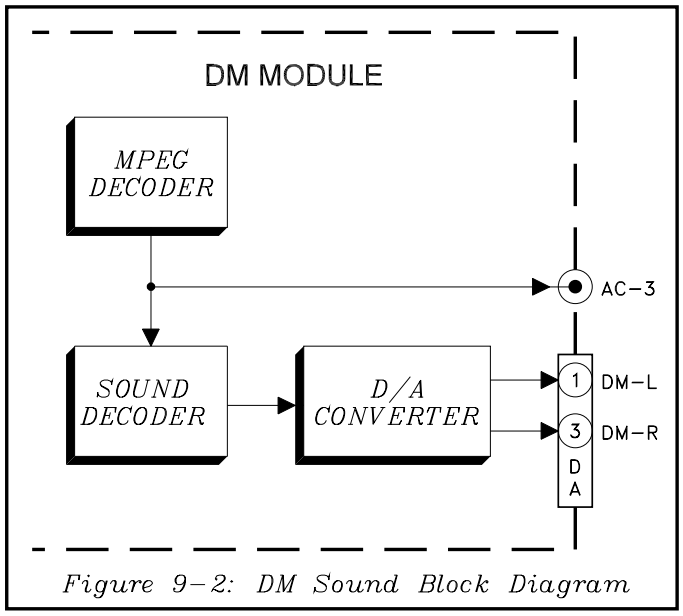


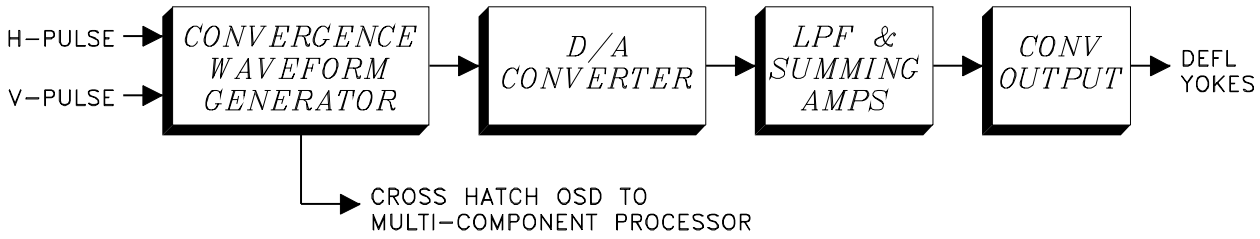
Figure 9-2: DM Sound Block Diagram

AC-3® Output

There is one additional sound output signal in the V19/V21 chassis, External AC-3® Decoder Output on the rear of DM Module. This is an AC-3® digital data stream (when available from a digital source). It allows connection to external components with an AC-3® Decoder AC-3® Decoder can produce 5.1 channel surround sound, 5 full audio channels (20 kHz) and one low frequency enhancement channel (120 Hz).

Figure 9-2 shows a Basic Block Diagram of the Sound circuitry in the DM Module.

Chapter 10
Convergence Circuitry



The Block Diagram above reveals the theory of operation of the Convergence Circuitry to be same as in previous models. Horizontal and vertical pulses are input to the Convergence Waveform Generator. The Convergence Generator outputs six digital convergence correction signals:

- Red Horizontal Correction
- Green Horizontal Correction
- Blue Horizontal Correction
- Red Vertical Correction
- Green Vertical Correction
- Blue Vertical Correction

The digital correction signals are directed D/A Conversion circuitry and are converted to analog signals.

The signals then pass through LPF circuitry, removing any remaining high frequency digital signals. Then the signals are amplified in Summing Amplifiers. Green correction is added to the red and blue signals at the inputs of the Summing Amplifiers.

The signals are then further amplified in Convergence Output circuitry and directed to the Sub Coils in their respective Deflection Yoke.

The Convergence Generator also develops the RGB signal for the cross hatch pattern used during convergence alignments

Closer examination of the Convergence Circuitry will show the main difference in the V19/V21 is fewer ICs are used.

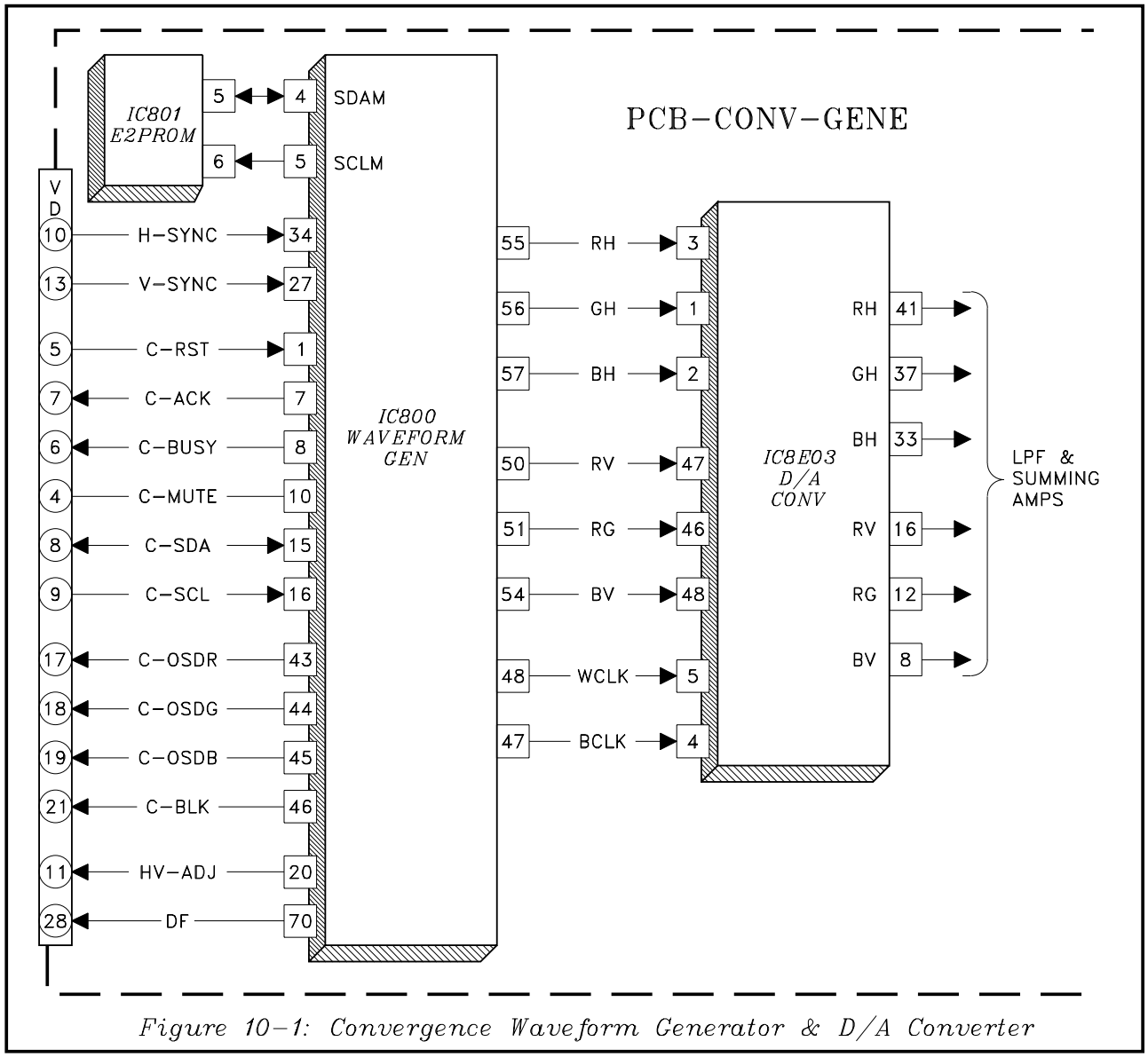


Figure 10−1: Convergence Waveform Generator & D/A Converter

Waveform Generator & A/D Converter.

Figure 10-1 illustrates the Convergence Waveform Generator and the A/D Converter. IC800 is the Waveform Generator. It operates from a 3.3 volt DC supply. No input buffers are needed for the horizontal and vertical pulses from the Deflection circuitry. Also the external PLL circuitry used in previous models is no longer required.

The same control signals from the Control circuitry are used:

- C-SDA … I^2C Data Line
- C-SCL …. I^2C Clock Line
- C-ACK … Command Acknowledgment line
- C-BUSY … Busy Line
- C-MUTE … Momentarily disables the Convergence Circuitry during Channel Change, Input Change and during On/Off.

The HV-ADJ PWM signal and the DF parabolic signal are still generated in the Waveform Generator.

Six A/D Converter ICs were used in previous models. In the V19/V21 there is only one A/D Converter IC,

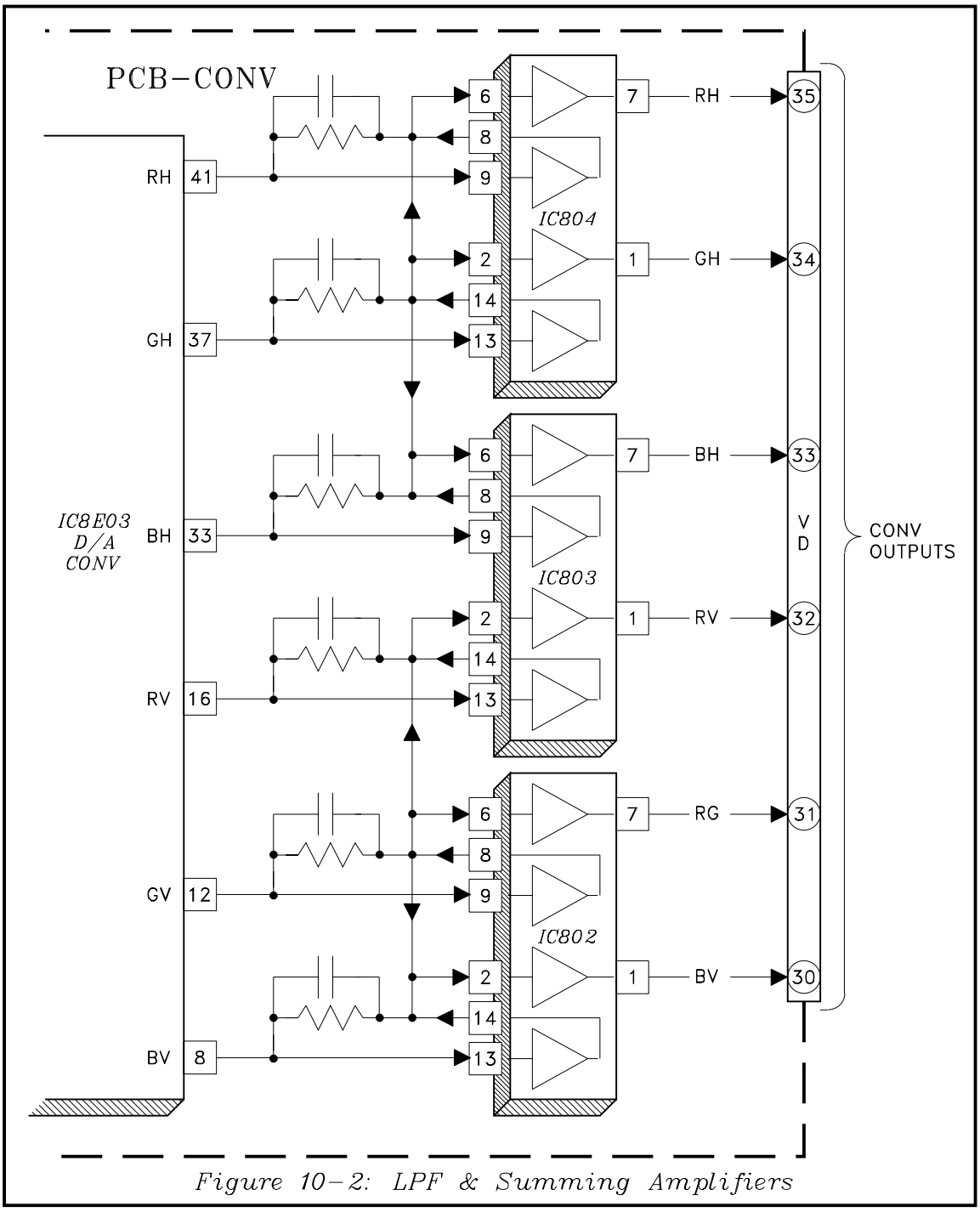


Figure 10–2: LPF & Summing Amplifiers

IC8E03. IC8E03 houses all the required A/D Converters.

LPF & Summing Amplifiers

The LPF and Summing Amplifier circuitry is shown in *Figure 10-2*. Three ICs are used in the LPF and Summing Amplifier circuitry.

- IC804 … RH and GH LPF and Summing Amplifier
- IC803 … BH and RV LPF and Summing Amplifier
- IC802 … GV and BV LPF and Summing Amplifier

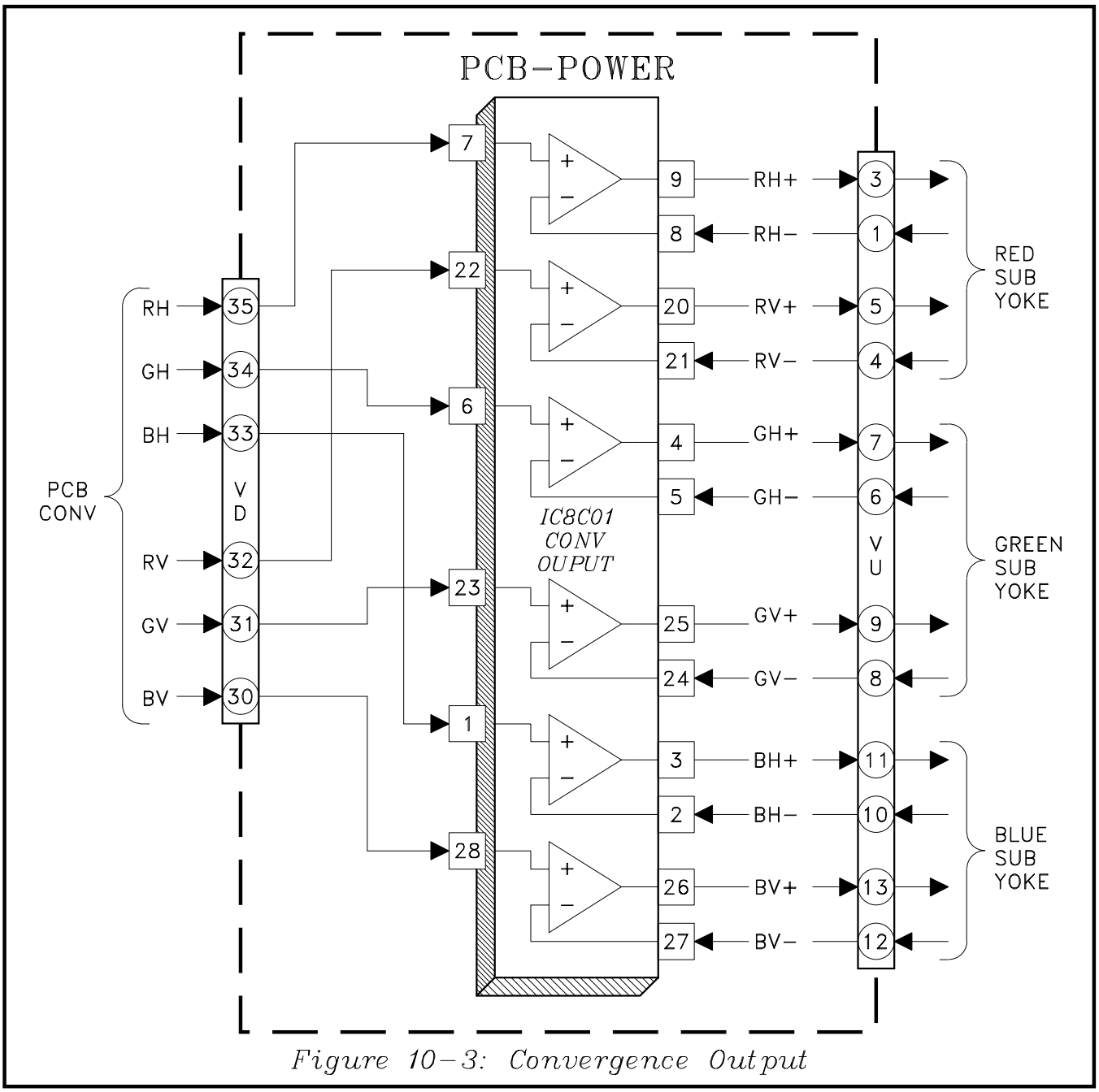


Figure 10–3: Convergence Output

Note that Green Horizontal is added to Red and Blue Horizontal second stage inputs, and Green Vertical is added to the Red and Blue Vertical second stage inputs.

The Green Correction voltage is used to correct green raster distortion, but does effect the red and blue raster. Therefore, green raster distortion must be adjusted first, before adjusting red and blue convergence.

Convergence Output Circuitry

Figure 10-3 illustrates the Convergence Ouput circuitry. In the V19, Convergence Output Circuitry is internal to a single IC, IC8C01, located on the PCB-POWER. It functions the same as in previous Output circuitry except only one IC is needed.

Chapter 11
Troubleshooting Tips

LED Indications	Conditions	Probable Cause
Off	After AC is applied	Standy Power Supply or TV µPC not running
Fast Blink for 70 sec.	After AC is applied	Normal - DM µPC is booting up
Fast Blink (doesn't stop)	After AC is applied	TV µPC is running, but DM failed to boot up
Slow Blink	Set is Off	Normal - Timer is set for Automatic Turn ON

Table 11-1: Front Panel LED Indications

Troubleshooting the analog circuitry in the V19/V21 is basically the same as in previous modes. Although the DM Module is a replaceable component, the service technician must determine that it is the cause of a problem. The following tips are useful in determining the source of a problem

Using The Front Panel LED

The Front Panel LED helps isolate the cause of the following problems.

- The TV will not turn On.
- The TV turns On, and then Shuts Off.

If the TV will not turn On, the LED response indicates the possible cause of the problem. *Table 11-1* lists the possible LED response when this problem occurs.

When the TV turn On and then shuts Off, the LED Diagnostic Error codes help isolate the problem. This is the same LED Diagnostic featured on some previous model TVs.

Figure 11-1 shows the LED Error Code Activation Procedure, an is describe in the following:

1) With the TV Off
2) Press and hold the front panel "MENU" and "DEVICE" buttons for 5 seconds.

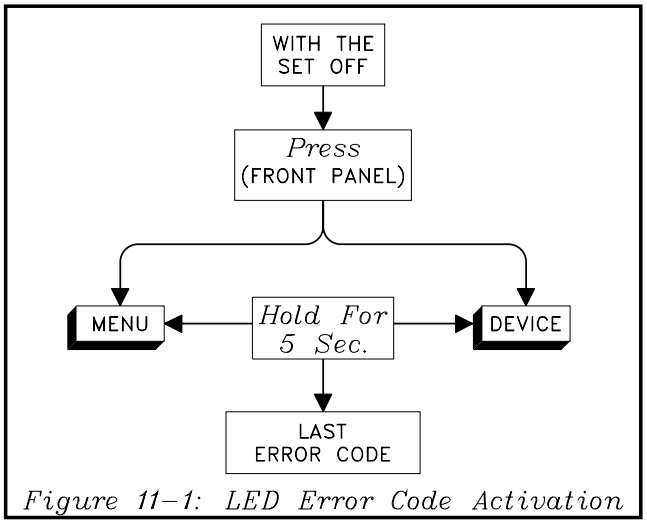


Figure 11–1: LED Error Code Activation

3) The LED will flash the Error Code indicating what caused the TV to shut Off.
4) The Error Code will be repeated 5 times.
5) When the LED stops flashing the mode is automatically terminated.

Reading the Error Codes

The Error Codes are two digit numbers. The LED:

- Flashes the value of the most significant digit (MSD).
- Then there is a pause.
- Flashes the value of the least significant digit (LSD).
- The Error Code is repeated 5 times.

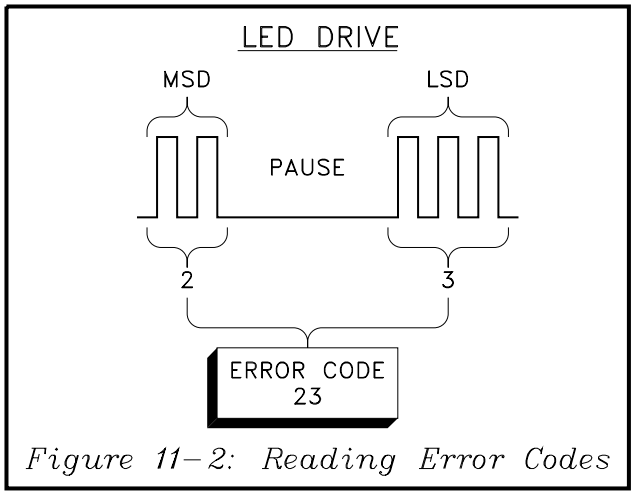


Figure 11-2: Reading Error Codes

As an example, *Figure 11-2* illustrates the LED drive for Error Code "23". *Table 11-2* lists the possible Error Codes and there cause.

DM Module Check

When the TV turns On, but a problem exists that may be caused by the DM Module, perform the following two checks:

1) Select the DTV Antenna as the source an select and HD Channel.
2) Select an analog 480i signal as the source and note if an On Screen Display (OSD) is present.

The ability to receive an HD channel indicates the DM Module is functioning properly.

Except for the convergence crosshatch, all OSD signals are generated in the DM Module. When there is no OSD using a 480i source, the DM Module may be the cause of the problem. However, before condemning the DM Module, make the following checks:

1) Check the VA connector, between the DM Module and PCB-SIGNAL. If the VA connector is disconnected, a 480i signal picture will be generated but there is no OSD.
2) Check for DSP-H and DSP-V signals at pins 10 and 11 of the VA connector.

Error Code	Probable Cause
12	Normal Operation - No Error Detected
21	X-Ray Protect
22	Short Protect
23	Loss of Horizontal Deflection
24	Loss of Vertical Deflection

Table 11-2: Error Codes

If DSP-H and DSP-V are missing, check the analog circuity. If they are present, the DM Module is probably at fault.

NetCommand™ Control Problems

If devices in a Home Theater System cannot be controlled properly with NetCommand™, the Remote Control may not be in the NetCommand™ Operational Mode. To put the Remote in the NetCommand™ Mode:

1) Set the Remote to the TV Layer.
2) Point the Remote away from the TV.
3) Press and Hold the "POWER" button and enter "9-3-5" in sequence.

CRT Phosphor Protection

Troubleshooting problems in the CRT Protect, Deflection Loss Detection and the Deflection circuits, sometimes involves disabling the CRT Protect circuitry and then Powering up the TV.

However, first disable the CRTs to prevent any possible phosphor damage.

1) Unplug the SP connector at the PCB-CRT(R). This removes the filament voltage to all three CRTs.
2) Remove zener diode D5A13 on PCB-MAIN. This disables the CRT Protect circuit.

The set then can be switched on for troubleshooting without damaging CRT phosphors.

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