SHARP

Technical Training

Colour Television
CS-Chassis

Contents

Diagrams

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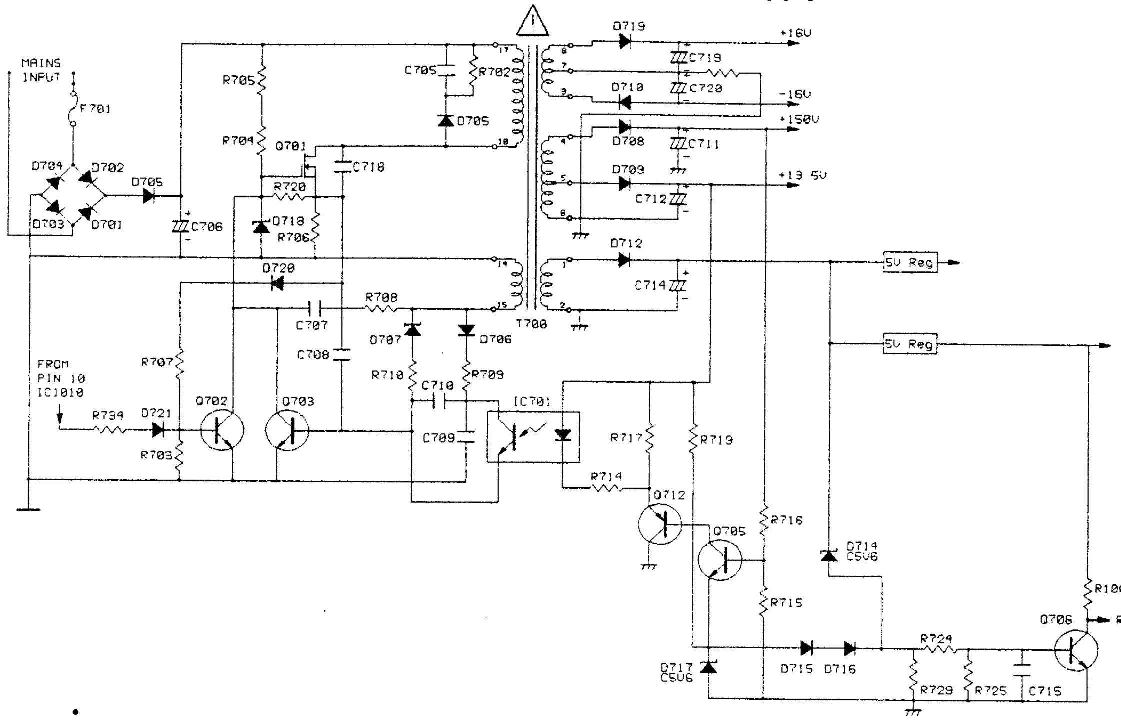
Power Supply.

This self running power supply is based on a single Field Effect Transistor, Q701. The PSU will generate the following D.C. supplies: +150V, for the line output stage. +16V and -16V, for the audio output stages. +13V for the line drive circuit. The +5V supplies and the reset voltage for IC1001.

Figure 3 - Switch Mode Power Supply



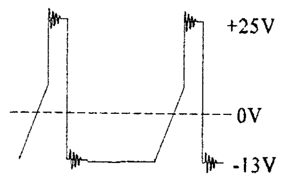
Start-up.

Current flows from the bridge rectifier via R704 and R705, turning on Q701. As Q701 begins to conduct, current will flow from the bridge rectifier, via the primary winding of T700, pins 12 and 17, through the FET and return to the bridge rectifier via R706. This current flow will course an electro magnetic field to build within T700 which in turn, produces an EMF (approximately +25V) on the secondary windings of T700. When the potential difference across zener diode D707 is greater than 5.6V, the zener will conduct, turning on Q703. Once Q703 turns on Q701 will turn off resulting in the electro magnetic field within the transformer collapsing. As the field collapses the EMF at pin 15 will be taken negative.
This results in the voltage at the junction of C707 & R708 to be approximately -13V, due to capacitor action this has the effect of holding Q701 off until the magnetic field has completely collapse then the cycle will be repeated.

Frequency.

It can be seen from the above, that this circuit oscillates, the frequency of oscillation will be dependant on load. The larger the load on the transformer, the longer Q701 will be turn on to enable larger transfer of energy. Therefore, the wavelength of the oscillator signal will increase, alternatively as the load decreases, less energy will be needed to be transferred across the transformer, therefore Q701 will turn off earlier shortening the wavelength of the oscillator signal.

Figure 4 - T700 Pin 15



Since frequency $= \frac{c}{\lambda}$ *"c = the speed of light and λ = wavelength"*

It can be seen that frequency will vary with load. Typically the frequency of this PSU is around 170kHz when the line stage is not operating, decrease to 80kHz for high brightness scenes, i.e. heavy load.

Regulation.

Due to the construction of the transformer, only one of the secondary supplies needs to be monitored to maintain a constant HT (150V). The 150V rail is fed to the base of Q705 via R716 (100kΩ), Q705 emitter is returned to the negative rail via D717 (6V2 zener) therefore to turn on Q705, the base will have to rise above 6.8V. Q705 turning on will remove the base bias from Q712, turning on Q712, which will allow current to flow through the LED section of the opto-coupler. The anode of the LED within the opto-coupler is connected to the 13.5V rail. This results in the transistor section of the opto-coupler turning on, increasing the voltage to the base of Q703, which inturn will turn on, turning of Q701, which will cause the 150V to fall.

Over-voltage Protection.

To prevent the 150V rail from increasing beyond safe limits under a fault conditions D707 (5V6 zener diode) is employed to monitor the EMF at T700 pin 15. If the voltage increases above the threshold, D707 will conduct, turning on Q703, which will turn off Q701 reducing the 150V rail.

Over-current Protection.

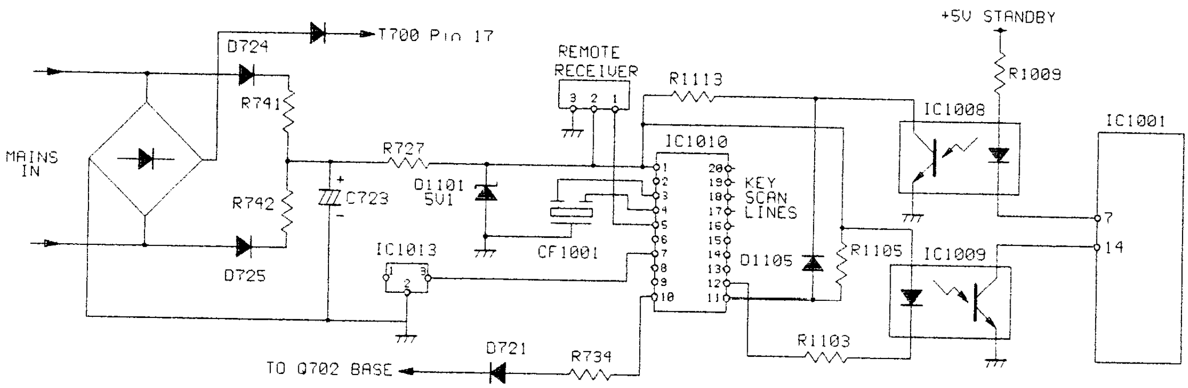
The current being drawn from the power supply is monitored by measuring the voltage drop across the FET source resistor R706. As the load on the power supply increases, the FET, Q701 will be turned on harder to stabilize the 150V rail. This inturn will increase the current flowing through the source resistor (R706), The junction of Q701/R706 is connected to the base of Q702 via D720 & R707. Once the voltage drop across R706 has increased sufficiently Q702 will turned on, turning off Q701, thus allowing the voltage drop across R706 to decrease. Once the voltage drop across R706 has fallen, Q702 will turn off allowing Q701 to turn on again. Q702 is also used to switch the power supply between standby & run.

Snubber Circuit.

During the time that the magnetic field is collapsing, the back EMF appearing in the primary winding will produce some very high positive voltage spikes. These spikes would be present on Q701 drain which would destroy it. To prevent this from happening, a snubber circuit consisting of D705, C705 and R702 is employed. This circuit will effectively short the primary winding of T700 when pin 3 becomes positive with respect to pin 8.

Power on Control.

Figure 5 - Standby Operation



The mains input is full wave rectified by D724 and D725 and smoothed by C723. This voltage feeds pin 1, VDD, of IC1010, the remote control receiver circuit, IC1013, which provides the reset pulse for IC1010 and the anode of the internal diode of the opto couple, IC1009.

The two opto couples: IC1008 and IC1009 are needed to provide isolation between primary and secondary circuits. Data from the power supply microprocessor to the main micro, IC1001, is output from pin 12 of IC1010 via IC1009 and is input into pin 14 of IC1001. This includes remote control and key scan data. The command for standby/on control is from Pin 7 of IC1001, via IC1008 to pin 11 of IC1010. The output for control of the power supply is pin 10 of IC1010. This pin is high in standby and is taken low to turn on the power supply.

Class D Output Stage.

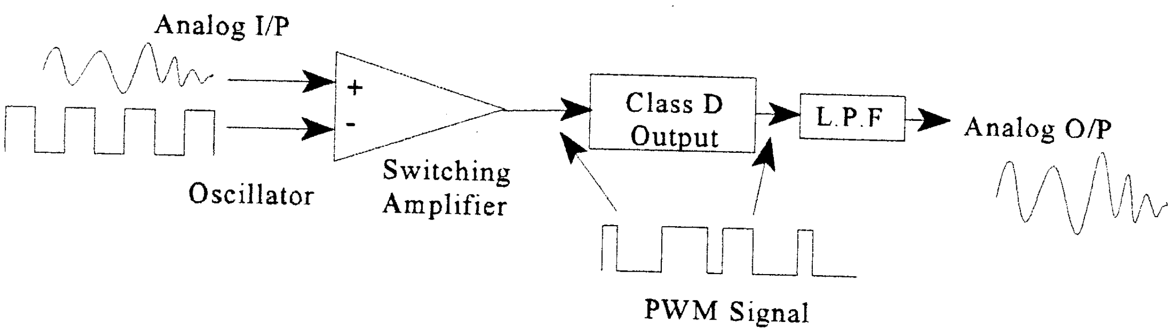
The Sound, Frame and East/West output stages in the CS chassis are operated in a class D bias configuration. That is the output transistors are acting as switches, and not amplifiers. The advantages of this type of biassing system are minimal power consumption with minimal distortion as shown in the table below.

Class	Distortion	Efficiency	Output
A	Low	Low	Output = Input
AB	Low input signal see class A High input signal see class B		
B	Crossover	High	Output is obtained from a single transistor from only half of its input signal
C	High	High	Output is obtained from less than half of the input signal
D	Low	High	Output = Input

However, this system has a fundamental disadvantage, you can not use a switch to amplify an analog signal. To overcome this problem the analog signal is first converted to a pulse width modulated (PWM) signal by a switching amplifier with a fixed frequency of 15.625kHz for the Frame & East/West stages and a varying frequency of between 120kHz to 140kHz for the Audio stage. The amplitude of the modulating frequency will cause the mark space ratio of the pulse to alter. After the Class D stage the PWM signal has to be converted back to an analog form before it can be used, this is achieved by a low pass filter.

Another disadvantage of this system is with two or more audio output stages, it is possible for an audible whistle to be produced from the separate oscillators beating with each other if they become out of faces the output transistors are in class D, ie used as a switch, it is essential that only one is turned on at anytime. If both transistors were to be turned on together then the current flow through the devices would be at a level that could cause the devices to fail. The zener diodes and capacitors in the base circuit of the output transistors ensures that only one transistor is switched on at anytime.

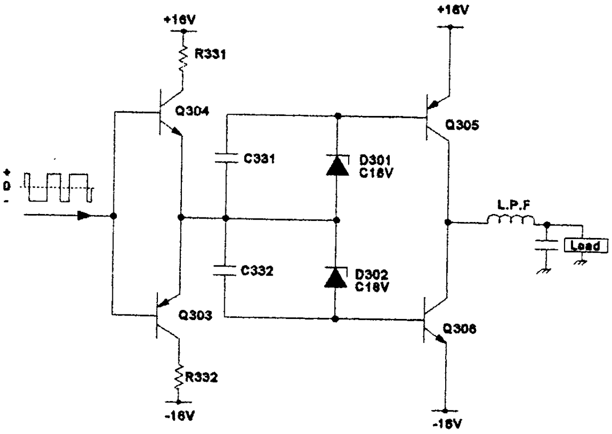
Figure 6 - Output Stage Block Diagram



When the output from the op-amp is negative, Q303 is on. Q305 will be turned on via D301, C331 will then be charged to the zener voltage of D301.

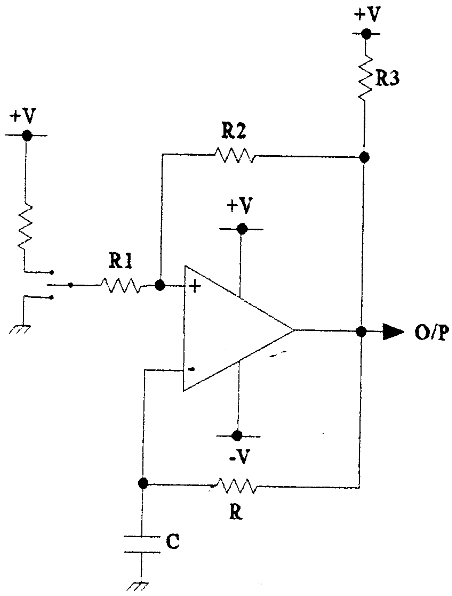
The top plate positively charged and the bottom plate negative. When the output from the op-amp goes positive, the negative charge on C331 will hold off Q396 until Q305 is turned off.
When Q305 is turned on and Q306 turned off, current will flow from the positive rail through Q305, L.P.F and the load to Zero rail (Ground). When Q305 is turned off and Q306 turned on, current will flow from Ground through the load, L.P.F and Q306 to the negative rail.

Figure 7 - Class D Push Pull Output



Switching Amplifier.

Figure 8 - Simple Switching Amp



$$\text{Gain} = \frac{R1}{R1 + R2}$$

$V+ > V- \Rightarrow V_{out} = +V$

$V+ < V- \Rightarrow V_{out} = -V$

The gain of the above circuit is set by the values of R1 and R2.

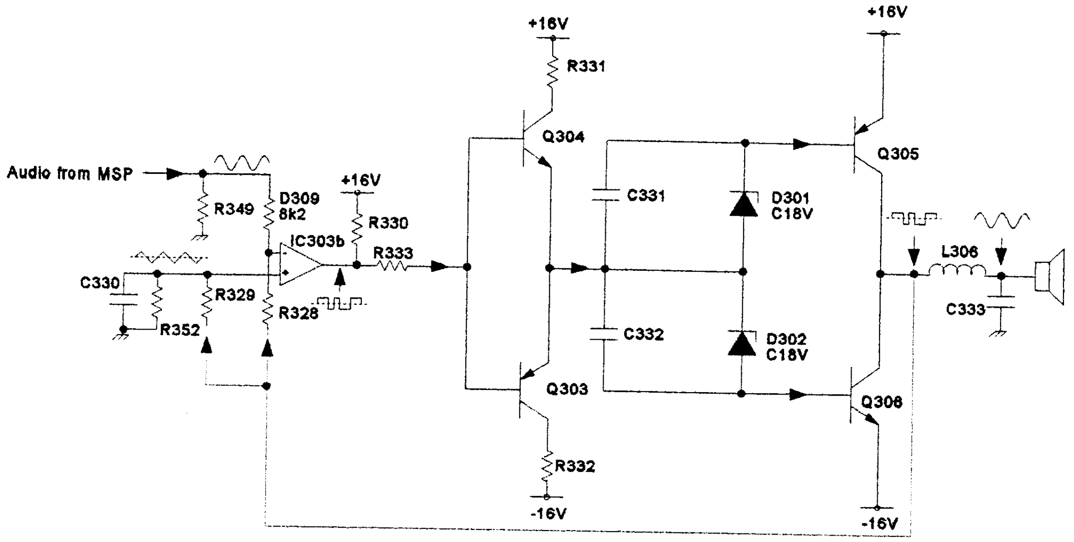
In the above circuit, the operational amplifier has an open collector output, which is taken high through R3. When the input switch is to ground the output will be high (+V), until C has charged enough to make the negative (Inverting) input higher than the positive (Non-Inverting) input. Then the output will go low (-V). The output will stay low until C discharges below the positive input, then the output will go high again. The circuit will oscillate at a frequency set by the values of R and C (f = RC).

If the positive input voltage is taken higher, by changing the position of the switch, then it will take longer for the charge on C to rise above input voltage. This will mean the output will stay high longer. Therefore we have changed the mark space ratio of the op-amp. output.

It can be seen then that by applying an alternating input to the above circuit , it would behave as a pulse width modulator. ie The output pulse width is changed dependant upon the changing input voltage. If the output signal is then passed through a low pass filter, the output from the filter would be the same as the input signal.

Audio Output Stage.

Figure 9 - Right Hand Channel



The above diagram shows the right channel audio output stage, the left channel is identical. IC303 is the switching amplifier, feedback for the oscillator is taken from the output, at the junction of the collectors of Q305 and Q306. This compensates for phase error caused by the output circuit. The frequency is set by the integrator circuit R329 and C330. The frequency of oscillation is between 120kHz and 140kHz.

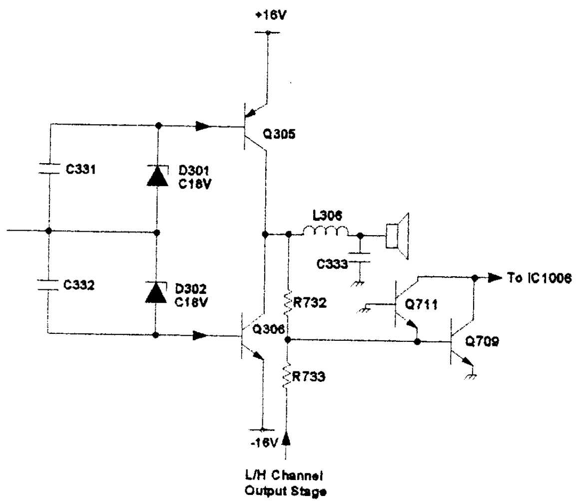
The audio signal is applied to the inverting input of the op-amp, whilst the feedback ramp from the integrator is applied to the non-inverting input. Therefore the PWM output is a result of both of these signals. When the PWM signal is passed through the low pass filter the signal consists of the original audio signal with the high frequency ramp superimposed over it. As this frequency is supersonic there is no need for additional filtering.

It is necessary to ensure that both put stages are synchronised to prevent them from causing a beat frequency, which could become audible. This is done by coupling the non-inverting amplifiers of both channels switching amplifiers, via C352 and R360 (not shown).

Audio Output Stage Protection.

The audio output stages are protected against short circuit, to prevent damage to the other parts of the circuit or damage to the PWB caused by overheating.

Figure 10 - Audio O/P Protection



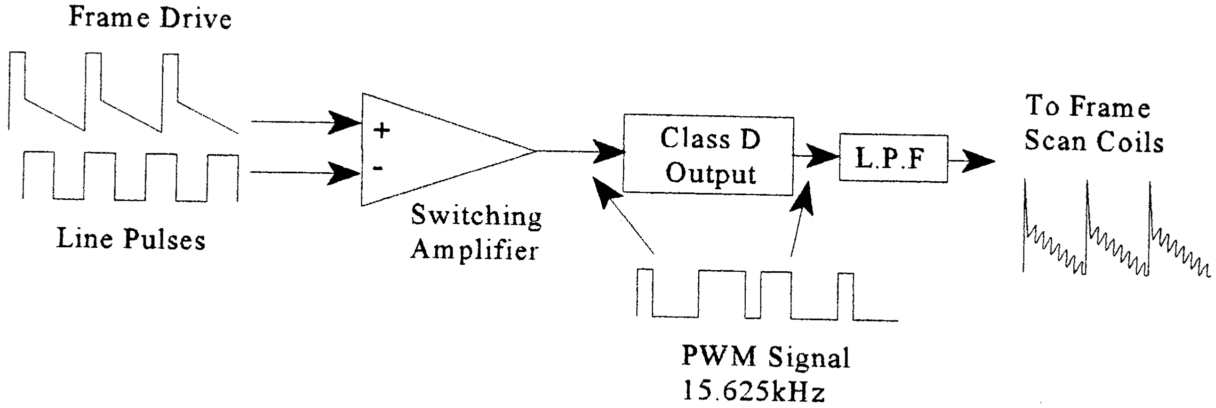
The mean voltage level at the junction of the output transistors will be zero volts. If a short circuit occurs in one of the output transistors, the mid point will be connected to either the +16V supply or the -16V supply. When both output stages are operating correctly the voltage at the junction will be zero. Q711 and Q709 will be off.

When a fault develops, the junction of R732 and R733 will be taken either to the +16V rail or the -16V rail depending on which transistor is short circuit. If the voltage at the junction of Q709 base & Q711 emitter went positive, Q709 will turned on. However, if the voltage at this junction went negative then Q711 will be turned on. Both of these conditions will give a low signal to the protection input of IC1006 (microprocessor input port expander). This will trigger the microprocessor to switch the set to standby.

Field Output Stage.

The field output stage is similar to the audio output stages. However, because the frame scan frequency is fixed, the switching amplifier oscillator frequency is fixed. Also the frame scan must be in phase with the line, therefore, instead an additional oscillator, line pulses are applied to the oscillator input of the switching amplifier.

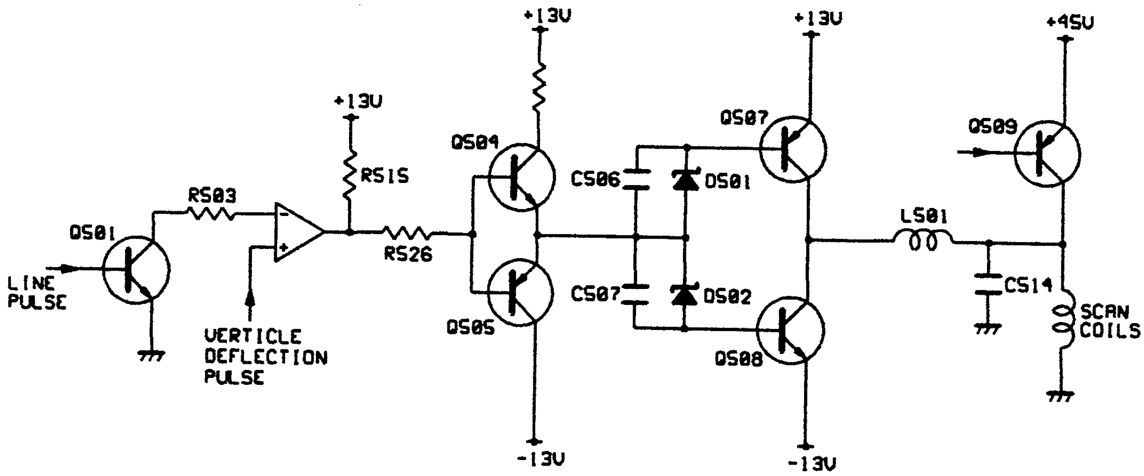
Figure 11 - Frame Output Stage Block Diagram



It therefore can be seen that output from the switching amplifier is the resultant of line pulses modulated by the frame drive signal. After passing through the low pass filter, the signal becomes a 50Hz ramp waveform with line pulses superimposed.

During flyback, when a larger pulse is required to move the spot quickly back to the top of the screen, Q509 is turned on by the flyback pulse and connects a line stage derived +45V D.C. to the scan coils for the duration of the flyback period.

Figure 12 - Basic Frame Output Circuit



Micro Processor Circuit

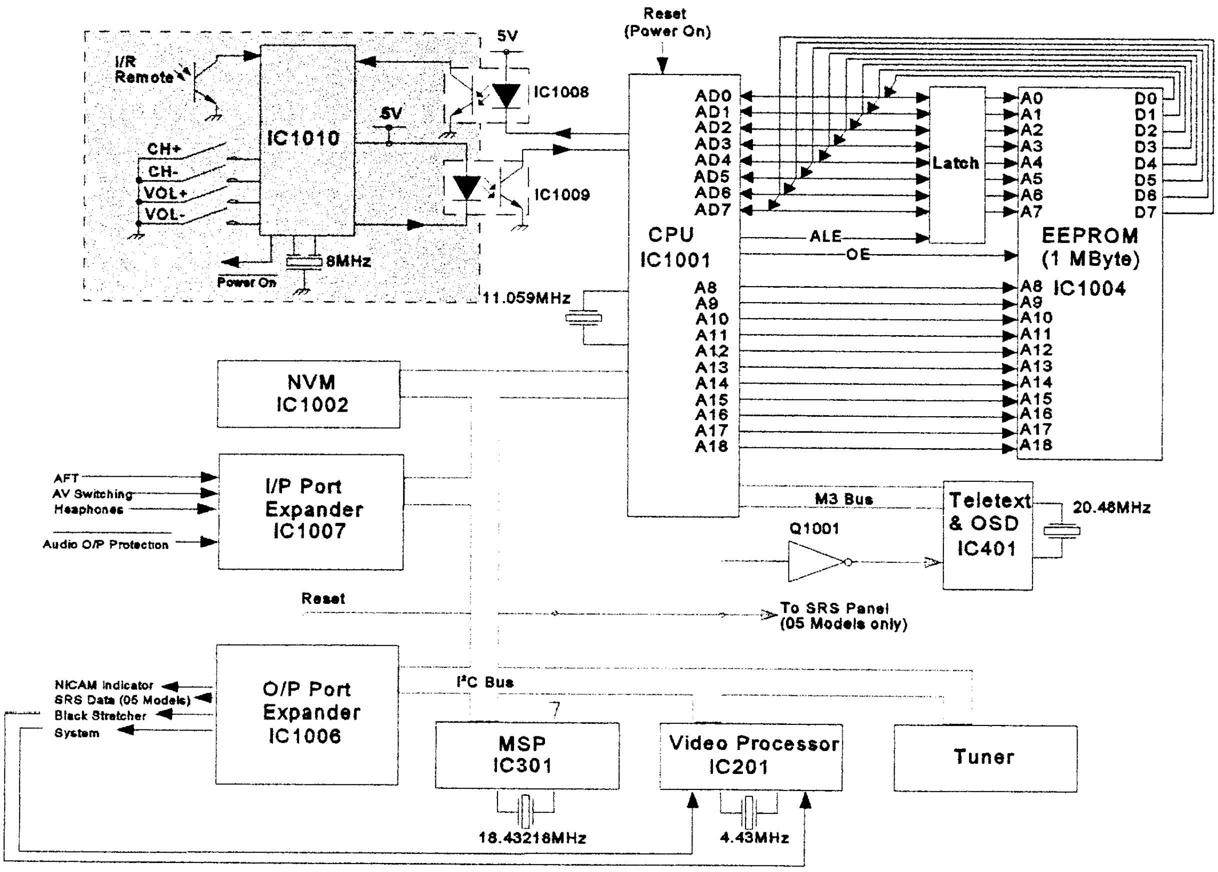
This part of the circuit is similar to that which has been used in previous Sharp Large Screen CTV. It consists basically of four IC's

IC1001	Central Processor	
IC1002	Non Volatile Memory	Unlike previous models, this device is supplied without programme data. The default values will be set by the EEPROM automatically on switch on.
IC1004	EEPROM	This contains the program to run the CTV. It is important that when replacing this IC it should be replace with the part specified by the part number for the particular model (Not IC type).
IC1006	Input port expander	
IC1007	Output port expander	

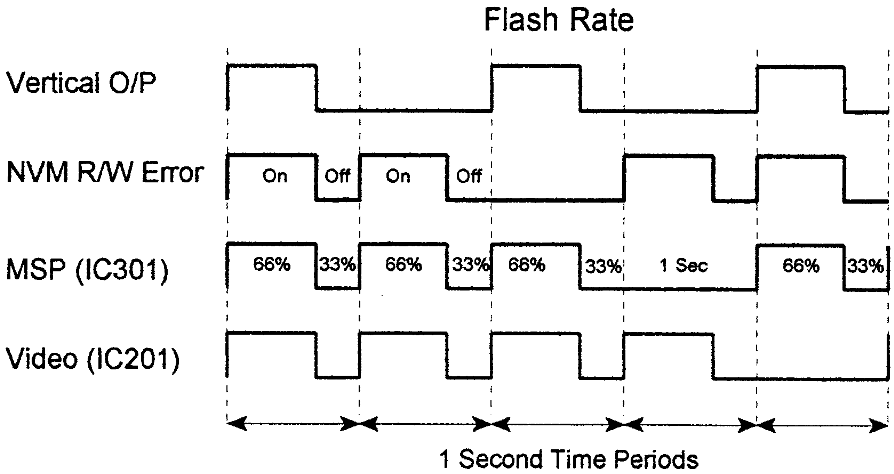
The CPU will communicate with the key IC via a data bus. Most of the commination is carried out via the I²C bus, except for the Megatext Chip (IC401) which employs the M3 bus system and the EEPROM which has a parallel address. Both the M3 and I²C buses are a two line serial bus system, one line is the clock (CK) to synchronise the data and the other line contains the data (D). This Data line contains two way communications.

Additionally the CS-Chassis employs an extra microprocessor, contained within the live side of the power supply (IC1010). This will control the switching of the set between standby & run, and supplies data to the CPU from the remote control, and the customer controls on the front of the cabinet. The CPU has two direct connections with IC1010 via opto-couplers IC1008 & IC1009 to maintain power supply isolation. CPU pin 14 excepts data from IC1010 and CPU pin 7 sends data to IC1010.

Figure 13 - Data Communications



Apart form tuning, Picture Geometry & Sound levels, this circuit is also monitoring key areas of the CTV for fault detection. If a fault is detectors then the CTV will either be switch to Standby Mode, or the line drive is remove which will give an outward appearances that the CTV is in Standby Mode, but the Power supply will still be operating. in either case the reason for the fault is not obvious. To assist with fault diagnostics the NICAM indicator will be switch on & off at different rates for different faults.



NVM Default Values

As already stated when replacing the NVM the default values are automatically downloaded from the CPU (IC1001). However it is possible to instruct the CPU to reset the NVM values at other times without altering the Tuner settings.

This is achieved by placing the CTV into service mode, Select NVM location '00', currently the data in this location should read '00'(reset default values off). Next adjust data to read '01'(reset default values on) and press the standby button to store this new data. Switch the CTV off and then back on again. The first thing you will notice is that the CTV appears to take longer to switch on this is because the NVM data is being reset before it allows the picture to appear. Once the picture has appeared, select service mode and make necessary adjustment that are needed. If you inspect NVM location '00' again you will notice that the data has also been reset to '00' automatically.

Adjustment Procedures

The adjustments for this chassis is carried out by accessing the service mode, then using the channel up& down buttons on the handset to select the function & the volume up & down buttons on the handset to carry out the adjustment. Once the adjustment has been made press the Power button on the handset to store the setting before moving on to the next function. **Do Not** adjust any of the data for the NVM function unless instructions has been issued by Sharp.

The complete adjustment procedure is contain in a separate service manual to the circuit diagram. These are available from Teega, however, the procedure for the adjustment of G2 & Grey Scale has been simplified as follows:

G2 Adjustment

1. Tune the CTV to a broadcast
2. Set the G" to maximum and then reduce it until the flyback lines disappear
3. Reduce Colour to minimum
4. Reduce Contrast to minimum
5. Reduce the brightness until the picture is just visible
6. Adjust G2 until 110V +/-3V is obtained on the Red Cathode of the CRT
7. Return Brightness, Contrast & Colour to Normal

Grey Scale Adjustment

1. Set Tint control to centre position
2. Place CTV into the Service Mode
3. Set Green reference to "2C"
4. Set Blue reference to "2C"
5. Set Red reference to "32"
6. •Adjust either Blue or Green reference to obtain correct grey scale. **Do Not** adjust the Red reference
7. Store the new settings

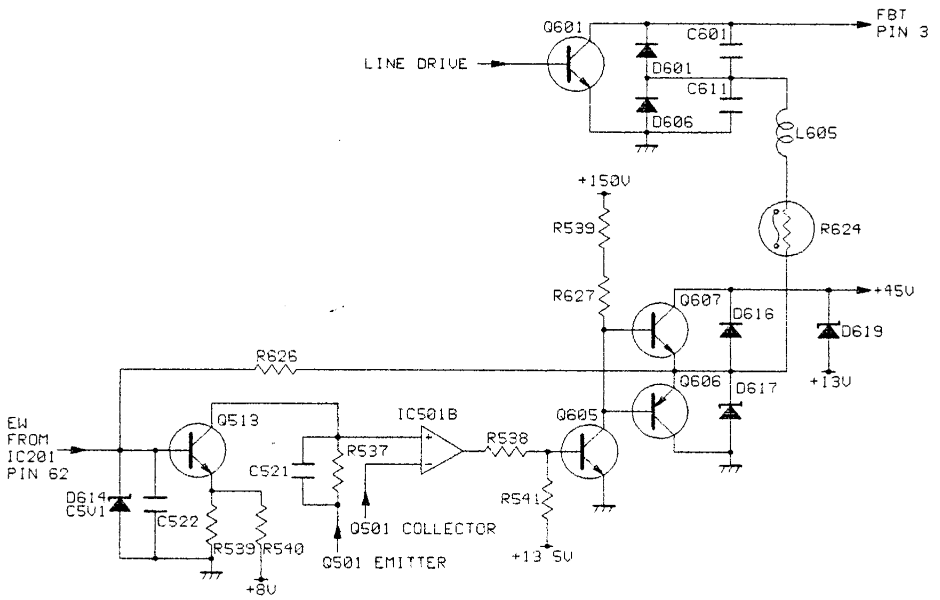
East-West correction circuit.

The CS chassis uses a conventional diode modulator circuit for East-West correction. However, the amplifier section is of the switching amplifier type.

The EW parabola from pin 62 of IC201, the video processor IC, is amplified by Q513 and fed into the non inverting input of the op. amp., IC501B. As in the field output stage the line pulse is used for switching. The output from the op-amp. is applied to the output switching circuit Q605, Q606 and Q607 and fed to the diode modulator circuit via R624 and L605. L605 is needed to filter out high voltage line flyback pulses to prevent them from damaging the switching circuit.

The parabola, when applied to the diode modulator is 1.4V peak to peak, this changes the conduction of the diodes, which effectively changes the value of C601 and C611. Changing the value of these capacitors, which are the flyback tuning capacitors, will cause a change in the EHT. The frame parabola

Figure 15 - 66C303H East West Circuit



will cause the EHT to increase at the top and bottom of the picture, causing the width to be reduced and will reduce the EHT at the centre of the screen, causing an increase in width.