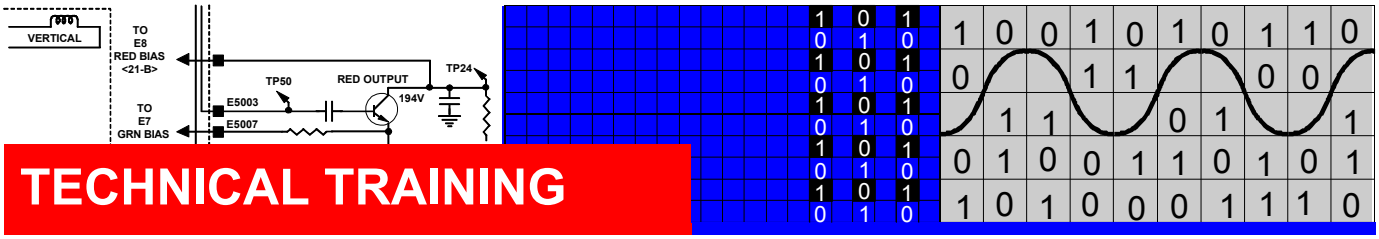

TECHNICAL TRAINING

ATC221 Technical Training Manual

SCENIUM

RCA

THOMSON MULTI MEDIA

FOREWORD

This publication is intended to aid the technician in servicing the ATC221 television chassis. It will explain the basic theory of operation. The manual covers the standby, main (run) and convergence power supplies, horizontal and vertical deflection, system control along with various shutdown circuits and practical troubleshooting tips and suggestions. It is designed to assist the technician in becoming familiar with chassis operation, increase confidence and improve overall efficiency in servicing the product.

Note: This publication is intended to be used only as a training aid. Never use training diagrams alone to troubleshoot. It is not meant to replace service data. TCE Electronic Service Information for this chassis contains specific information about parts, safety and alignment procedures and must be consulted before performing any service. The information in this manual is as accurate as possible at the time of publication. Circuit designs and drawings are subject to change without notice.

SAFETY INFORMATION CAUTION

Safety information is contained in the appropriate Thomson Consumer Electronics Service Data. All product safety requirements must be complied with prior to returning the instrument to the consumer. Servicers who defeat safety features or fail to perform safety checks may be liable for any resulting damages and may expose themselves and others to possible injury.

All integrated circuits, all surface mounted devices, and many other semiconductors are electrostatically sensitive and therefore require special handling techniques.

First Edition 0939 - First Printing

Printed in U.S.A.

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THOMSON MULTI MEDIA RCA

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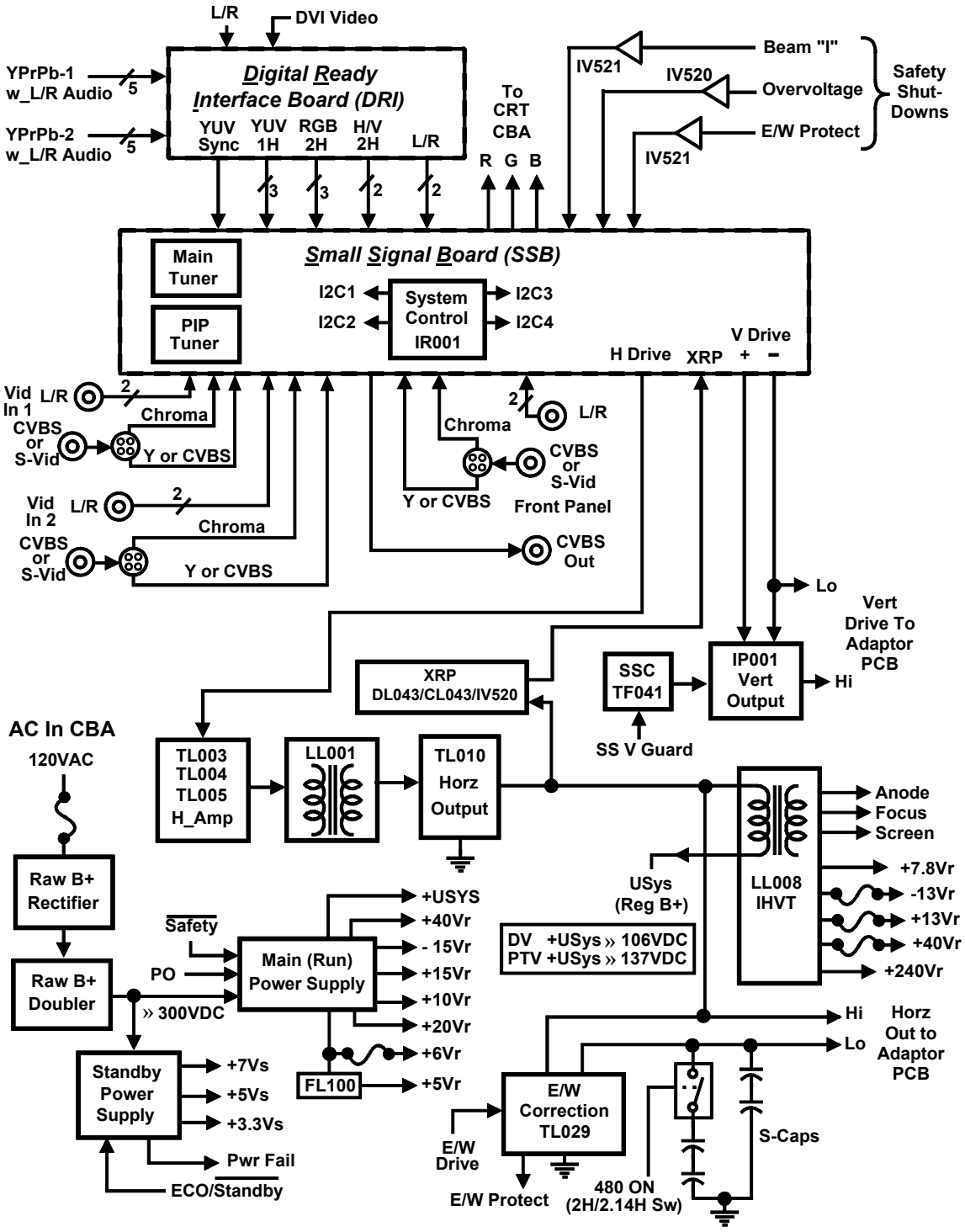
Introduction

The ATC221 chassis is a NTSC instrument that outputs only 2H and 2.14H. The chassis also accepts 1H inputs including YPrPb. It also accepts 2H and 2.14H YPrPb video signals. The display is a 16X9 that displays in five separate modes. These modes are standard 4X3, Zoom 14X9, Zoom 16X9, Zoom 16X9 adjust and Cinerama. The unit also accepts standard 1H composite inputs. The DVI (digital video interface) input is provided for digital video input such computer, HD receivers, digital DVD players, etc. Dolby audio is also incorporated in the chassis. A new feature of the ATC221 is the audio and video output. Any 1H source that is input to the chassis a composite output is generated. If 2H or 2.14H is input to the chassis there is no video output. This training manual applies to the direct view instrument as well as the projection set. The direct view instrument does not have the Adapter CBA, the Convergence Power Amp CBA or the Convergence Generator CBA.

Model D40W20



Electrical Overview Block Diagram

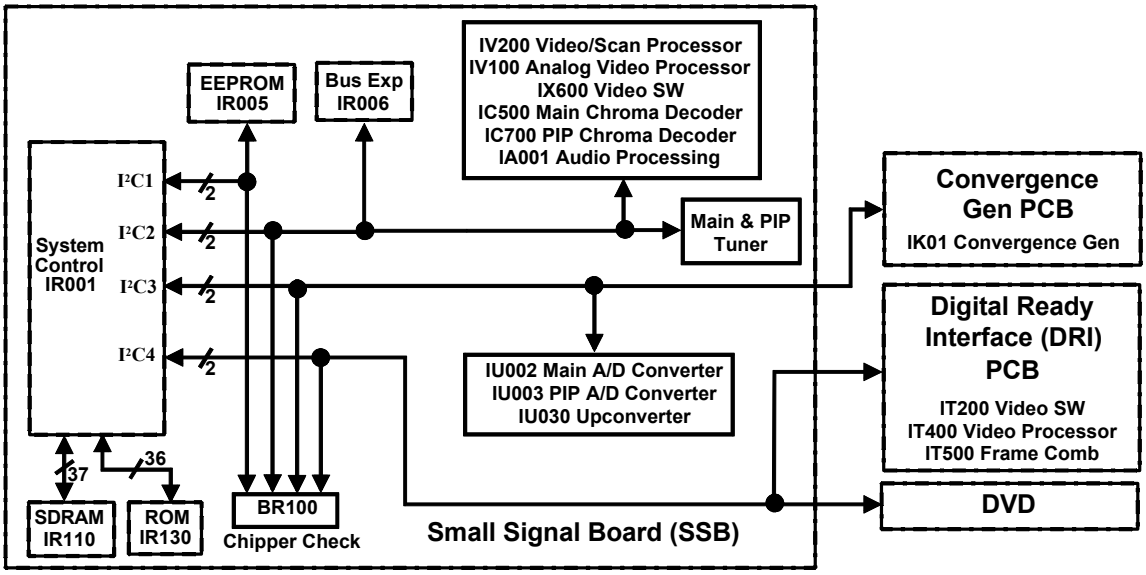
Electrical Overview

The ATC221 chassis is a 2H NTSC chassis with YPrPb inputs. This chassis also features a DVI or Digital Visual Interface. The direct view instrument has five (5) major circuit boards. These are the AC Input CBA, the DRI (Digital Ready Interface), SSB (Small Signal Board), the Power Supply/Deflection board and the Dynamic Focus circuit board. The projection instrument has three additional circuit boards. The Power Supply/Adapter CBA, Convergence Amplifier CBA and the Convergence Generator circuit board. The projection unit does not require the Dynamic Focus CBA.

The AC Input circuit board contains the Raw B+ rectifier and a voltage doubling circuit that provides approximately 300VDC (unregulated) for the Main (Run) and Standby power supply. The standby and main (run) power supplies are located on the Power Supply and Deflection circuit board. Both the main and standby power supplies are conventional switch mode power supplies (SMPS). The vertical and horizontal deflection circuits are also located on the power supply/deflection board. The configuration of the horizontal deflection is very conventional with the exception that it runs at 2H or 2.14H. Scan derived B+'s are also generated by the horizontal output.

The SSB circuit board contains the video signal and audio processing circuits. The Main and PIP tuners as well as the 1H video and audio inputs on the rear jack panel are input directly to the SSB. The video inputs accept both S-Video and Composite Video (CVBS). The video signals that are input directly to the SSB are 1H signals, however all 1H video is upconverted to 2H by the small signal board. The System Control microcomputer IR001 is also located on the SSB and has four (4) I^2C busses that monitor and control all chassis functions. The horizontal and vertical drive signals are also generated on the small signal board and applied to the power supply deflection circuit board.

The YPrPb (1H, 2H or 2.14H) signals along with their respective audio signals are input to the DRI circuit board for processing. They are then routed to the SSB for final processing. In the case of a 1H YPrPb, it is upconverted to 2H by the SSB. If a 2.14H YPrPb signal is input to the DRI module, the signal is routed to the SSB unchanged in frequency. However the frequency of the horizontal output is shifted to 2.14H by switching in additional S-Caps, thus changing the scan frequency slightly. The DVI video and audio signals are input to the DRI board for decoding and is then routed to the SSB for final processing.



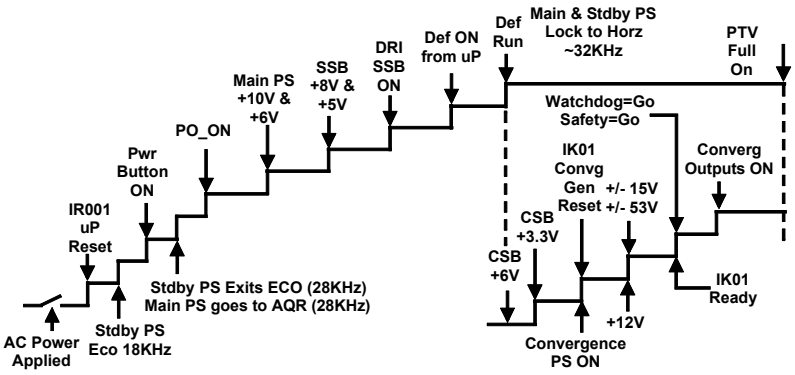
System Control Overview

System Control Overview

The system control microcomputer IR001 is located on the small signal board (SSB). IR001 controls and monitors all chassis functions via four (4) I²C buses. The SDRAM IR110 and the ROM has discrete data lines to the microcomputer. The primary function I²C1 is to read and write to the EEPROM IR005. I²C1 along with the other three I²C busses are routed to the Chipper Check connector PR100. I²C2 monitors and controls the video/scan processor, the analog video processor video switching, main and PIP chroma decoders and the audio processing IC's. I²C2 also controls the main and PIP tuners. I²C3 is responsible for the Man and PIP A/D (analog to digital) converter, the upconverter and the convergence generator IK01 on the convergence generator circuit board. I²C4 is responsible for the DVD (if installed) and video switching, the video processor and the frame comb on the digital ready interface (DRI) circuit board. The DRI circuit board processes all incoming YPrPb signals.

Off to On Startup Sequence

Understanding the startup sequence is important to understanding system control. When AC power is first applied, microcomputer is reset and the standby supply goes to the ECO (economy) mode. When the power button is pressed the standby and main supply are increased to 28KHz. After that the microcomputer outputs the power on command (PO_ON). Next, the main supply ouputs the +10V and +6V supplies. Then the +8V and +5V supplies on the small signal board come up. At this point both the DRI and SSB circuit boards are up and running. The microcomputer next turns on the deflection circuits. At this point the direct view unit is fully powered up. However, the projection unit must power up the convergence circuits. Once the deflection circuit is up, the +6V and +3.3V supplies on the convergence signal board (CSB) come up. After the supplies are up, the convergence generator is reset and the convergence power supply is turned on providing all



OFF to ON Timing Chart

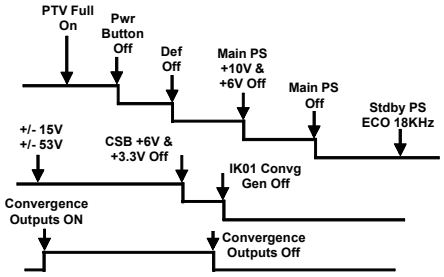
the supplies need by the convergence outputs. Before turning the outputs on, the watch dog and safety circuits are checked to make sure everything is OK. If all is OK, the outputs are turned on and the unit is fully up.

On to Off Sequence

When the power off button is pressed the deflection is turned off first. With deflection off, the convergence power supplies go off. Once the convergence power supplies are off, the outputs are off. Next the convergence generator is shut down. After the convergence circuits are completely off, the main power supply is turned off and the standby supply returns to the ECO mode.

Error Code Procedure

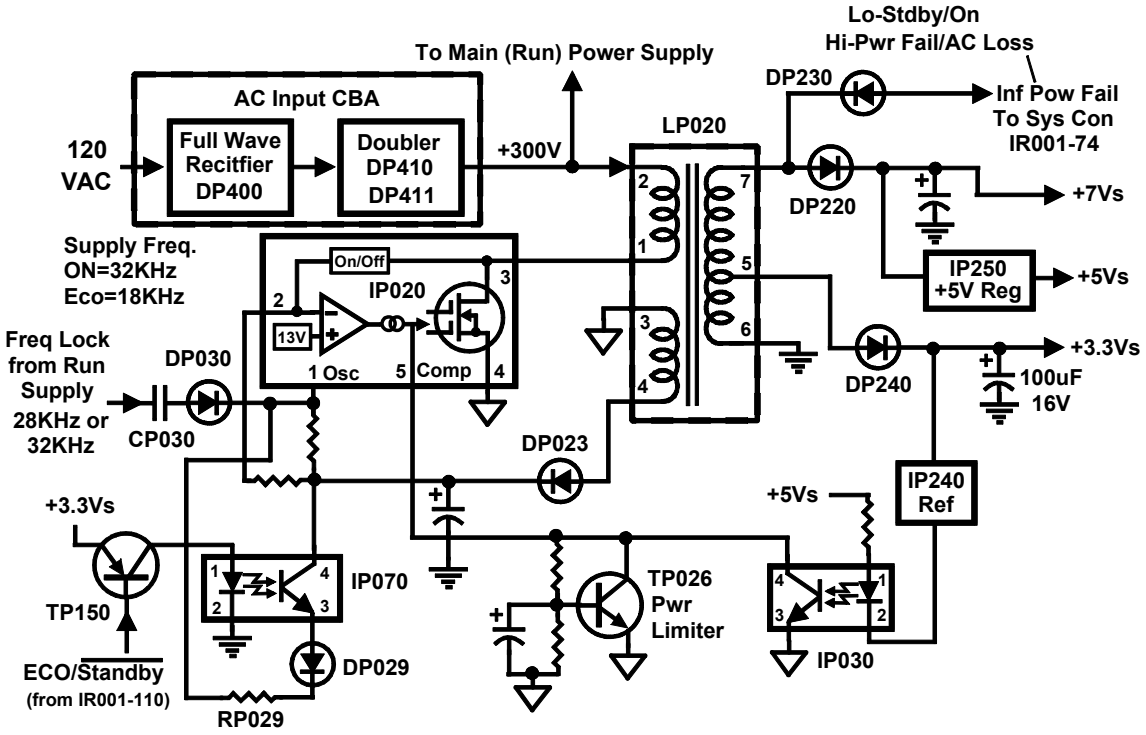
The error codes are flashed out using the power LED and are always a two digit number. When reading an error code there is a short pause between each digit and a long pause between each two digit number. For example, four quick flashes, a short pause and then four quick flashes and then a long pause would be a forty four (44). It's important to carefully count the flashes paying attention to the long pauses. The two digit number that is blinked out last is the correct error code. The flashing codes up to the last code out is unusable information. When dealing with a fatal error, the micro only repeats



ON to OFF Timing Chart

the flashing sequence if the micro is reset. A non-fatal error repeats simply by pressing the power button again. Certain failures such as the main (run) supply requires pressing the power button three (3) times before the error code is output. To reset the microcomputer, unplug the unit from AC power for at least 60 seconds. After the micro resets, apply AC power and watch for one short blink and one long blink. This indicates that the standby supply and system control are operational. If the LED does not blink twice (2) when AC is applied after being unplugged for 60 seconds, the standby supply or the small signal board has most likely failed. After the unit is repaired, reset the error code list in the service menu.

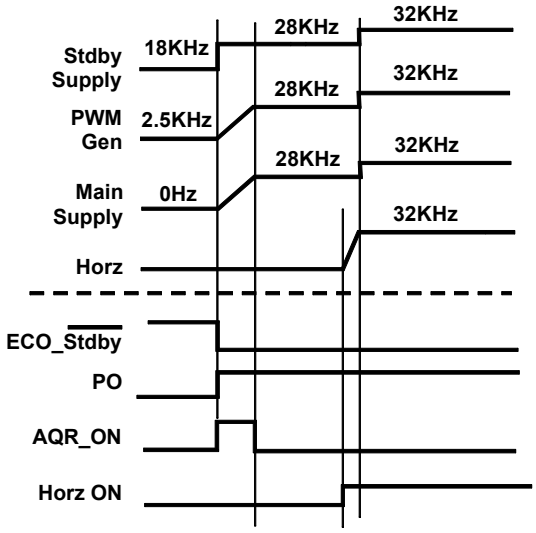
NOTE: Very early production PTV provides the flashing LED. Present production of the PTV does not have the flashing LED, however future production will incorporate the error code flashing LED. All production direct view (DV) has the flashing LED.



Standby Power Supply

Standby Power Supply Overview

The Standby Power Supply is a switch mode power supply and is always operational when the instrument is plugged into 120VAC. The full wave bridge rectifier (DP400) and the voltage doubler (DP410/411) provide the Raw B+ (~300VDC) to pin 2 of transformer LP020. IP020 serves as the output device driving the primary side of LP020. The first cycle of the power supply when AC is applied is accomplished by the On/Off control circuit within IP020. The raw B+ at pin 3 of IP020 is applied to the On/Off circuit. This causes the output device to turn on for the first time. After the output device in IP020 has turned off, the magnetic field across the primary



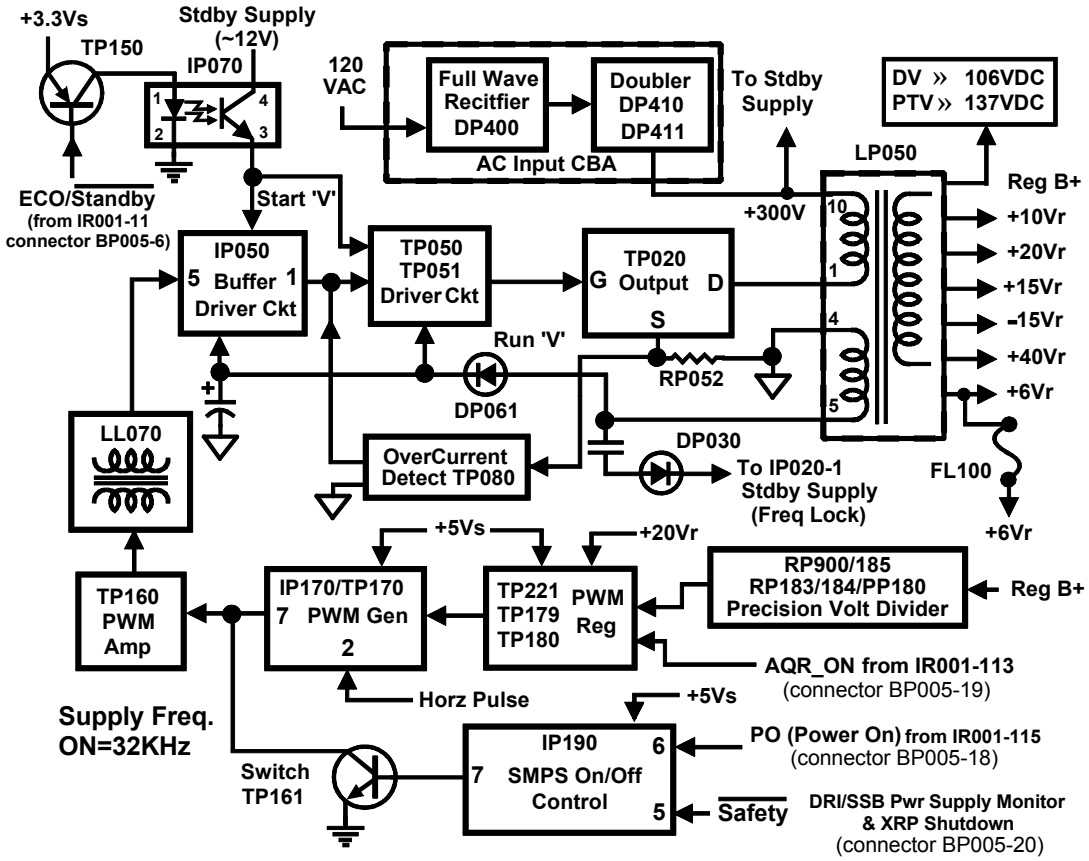
Power ON Sequence

(LP020-1/2) collapses and a voltage is developed by DP023 that is used as the B+ for the oscillator (IP020 pin 1). The frequency of the supply when the instrument is turned off but plugged into 120VAC is 18KHz (ECO mode). The standby supply runs at 32KHz whenever the instrument is turned on. The ECO/ Standby signal at the base of TP150 goes low when the instrument is turned on. This turns on TP150 and the opto isolator IP070. With IP070 on, the resistor RP029 is placed in parallel with the components at the oscillator input of IP020 (pin 1) increasing the frequency to approximately 28KHz.

With the instrument turned on, the main (run) supply has also been turned on and is also running at approximately 28KHz. The standby and main supplies are capacitively via CP030 and DP030. This is done to synchronize the main and standby supplies together. With the supplies now running at 28KHz, the horizontal is allowed to turn on. Once horizontal starts up and stabilizes, a horizontal pulse to the main supply cause the supply frequencies to increase to the horizontal scan frequency. The standby supply along with the main (run) supply and the horizontal output are all locked together. This is done to minimize noise and interference.

Regulation of the supply is performed by IP240 and IP030. If the voltage at the output of the supply (3.3Vs) falls, the output of the reference generator IP240 goes up. The cause the opto isolator to conduct less, letting the voltage on pin 5 of IP020 to rise. When this voltage rises, the output power of the supply goes up thus raising the voltages on the secondary. When the voltage tries to go up, the output voltage of IP240 goes down. This causes the opto coupler to conduct harder, pulling the voltage at pin 5 of IP020 down. The power output of the device goes down causing the voltage on the secondary to go down.

Diode DP230 (off pin 7 of LP020) provides a power fail signal to the system control microcomputer IR001 at pin 74. During normal operation pin 74 of IR001 is low. If AC power is lost, pin 74 is pulled high indicating to the microcomputer to do a shutdown routine. This would include such things as storing off last channel, mode settings, etc.



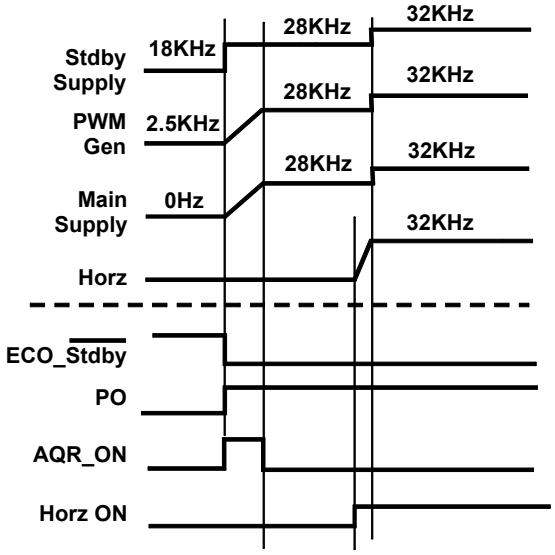
Main (Run) Power Supply

Main (Run) Power Supply Overview

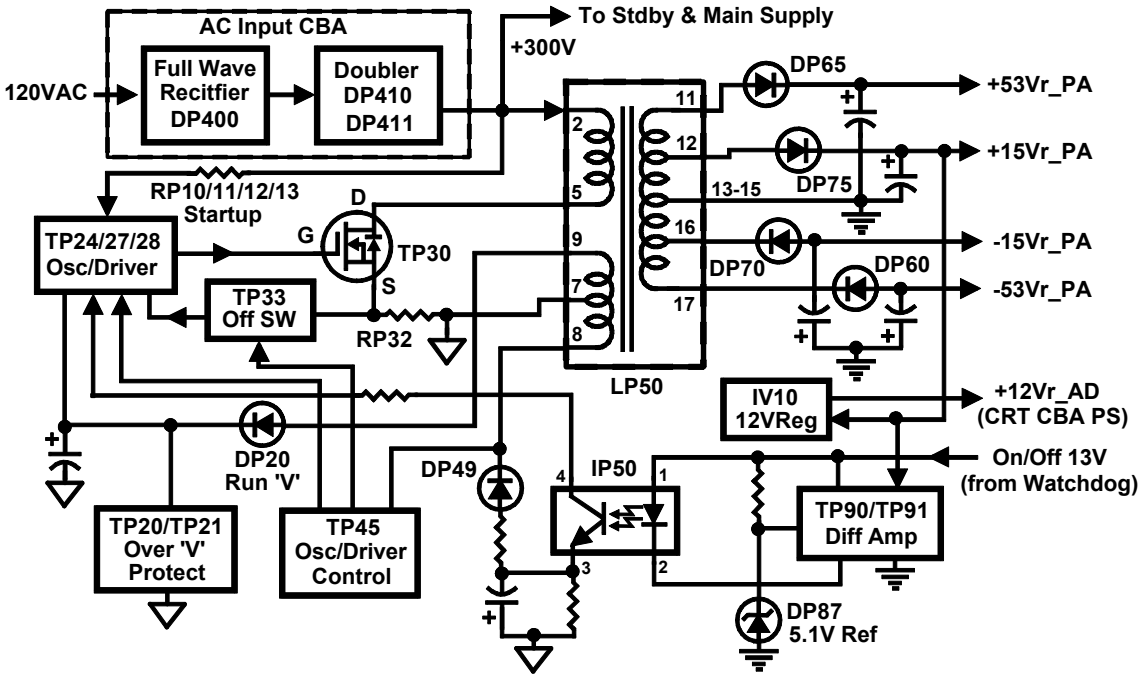
The main (run) power supply is a switched mode power supply (SMPS) that operates in the run mode at a frequency of 32KHz. The main supply produces the Reg B+, +10Vr, +20Vr, +40Vr, +6Vr and the +/-15Vr. The full wave bridge rectifier (DP400) and the voltage doubler (DP410/411) provide the Raw B+ (~300VDC) to pin 10 of transformer LP050. TP020 serves as the output device and is driven by IP050, TP050 and TP051. The main supply is PWM regulated. The PWM Generator (IP170 & TP170) provides the drive signal for the buffer/drivers. The opto coupler IP070 provides the startup voltage for the buffer/driver circuits. After the supply is up and running the run voltage is developed by diode DP061.

The power supply is turned on with two signals from the system control microcomputer IR001. The AQR_ON signal is first applied to the PWM Regulator (TP221/179/180) to preset the PWM generator. Next, the microcomputer outputs the PO (power on) command to pin 6 of IP190, the SMPS ON/OFF control. If the Safety signal at pin 5 of IP190 is high (OK) the main power supply turns on. The PWM generator circuits operate at 2.5KHz when ever the set is plugged into AC because of the +5Vs. The output at pin 7 of IP190 is applied to switch transistors TP161. These transistors mute the output of the PWM Generator, IP170 and TP170. When the power supply is turned on, these transistors turn off, un-muting the PWM Generator. The output

of the PWM generator is amplified by transistor TP160 and then transformer coupled to IP050 via LL070. If the Safety signal at pin 5 of IP190 goes low, switches TP161 are turned on muting the output of the PWM generator and shutting down the main supply. Once horizontal has started, a pulse is applied to the PWM Gen at pin 2 to synchronize the power supply with horizontal (32KHz). Overcurrent protection is provided by resistor RP052 and transistor TP080. If the current through RP052 goes too high, the voltage developed across it turns on transistor TP080 and grounds the output of the buffer/driver circuits. Regulation of the supply is accomplished by monitoring Usys. RP900, RP185, RP183, RP184 and adjustable resistor PP180 form a precision voltage divider. This voltage divider develops a representative voltage proportional to the USys. When current draw on the power supply increases, USys falls. When USys falls, the voltage from the divider network falls. This voltage is applied to the PWM regulator causing the on time of the PWM signal to increase. This increased on time keeps the output (TP020) on longer supplying more power out of the supply. The opposite happens if the USys goes to high, the on time of the PWM signal decreases. TP020 on time decreases allow the output voltage to go down.



Power ON Sequence



Convergence Power Supply

Convergence Power Supply Overview

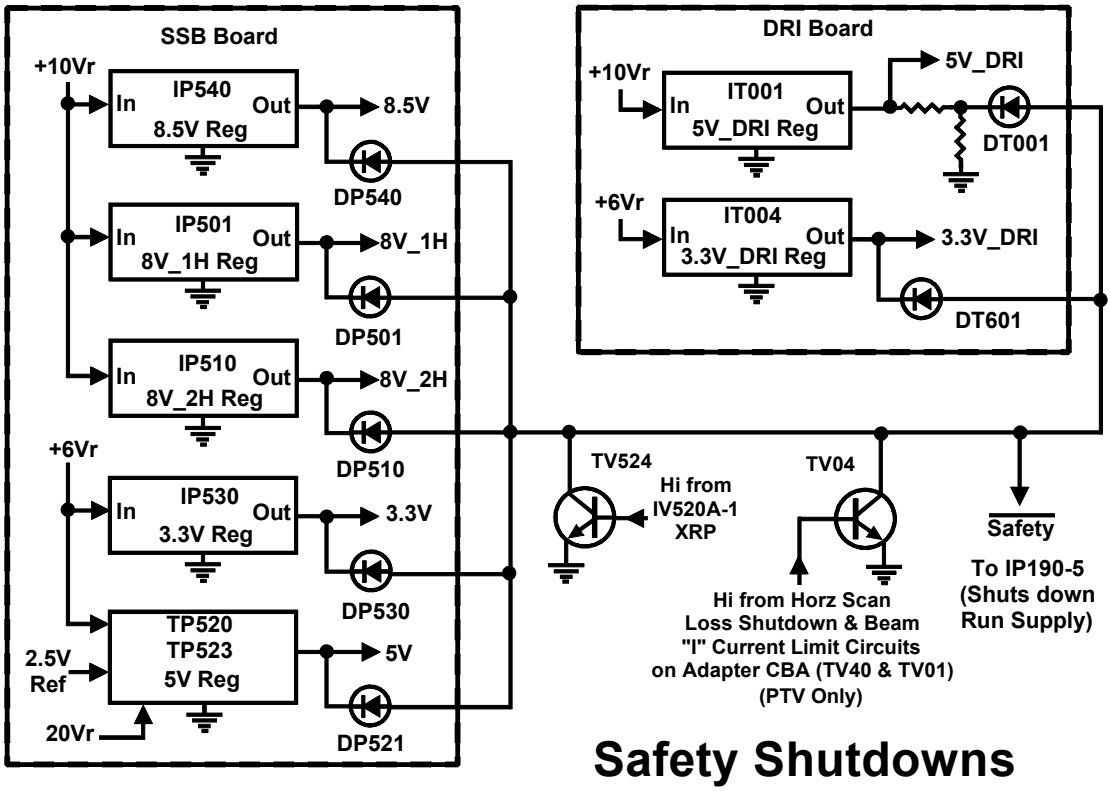
The convergence power supply is a switched mode power supply (SMPS) that operates in the run mode at a frequency of approximately 41KHz. The convergence power supply produces four primary voltages. These voltages are +/- 53V and +/-15V and are used by the convergence power amplifiers. It's important to note that the +12Vr voltage (via IV10) powers the CRT CBA and is developed off the +15Vr. If the convergence power supply does not run there is no power supply for the CRT circuit boards to operate. The power supply is not turned on until vertical is up and has stabilized. The on/off signal for the power supply is provided by the watchdog circuit and is the vertical B+ (+13V). The watchdog circuit is covered in another section. This vertical B+ is applied to opto-isolator IP50 and differential amplifiers TP90 and TP91.

The raw B+ (~300VDC) is applied to pin 2 of LP50. The hi-power FET TP30 serves as the output device. The resistor network RP10, 11, 12 and 13 provide the start voltage for the oscillator driver circuit (TP24/27/28). In the off mode the opto-isolator IP50 is turned off, removing the ground path from the oscillator driver circuit which keeps them turned off. When power supply is turned on, the opto-isolator turns on and the photo transistor in IP50 provides the ground path for TP24, TP27 and TP28 allowing them to turn on. With the oscillator driver on, TP30 is turned on. The first turn off is provided via excess current through RP32 in the source (s) of TP30. When the voltage across RP32 rises to a predetermined point, it

triggers the off switch TP33, turning off the oscillator driver circuit. This removes the drive pulse from the gate (G) of TP30. The run voltage for the oscillator driver circuit is developed off of pin 9 of transformer LP50 by diode DP20. The function of the oscillator driver control circuit (TP45) is to ensure that during the run mode, the oscillator and driver remain off until all the power has dissipated in the secondary. This is accomplished by monitoring pin 8 of LP50.

The opto-coupler IP50 and the differential amplifiers TP90 and TP91, monitors the +15Vr and provides the secondary voltage regulation. If the +15V goes up, the differential amplifier causes the current through the LED diode of the opto-coupler to go down. This causes the current through the photo transistor to go down. This in turn reduces the output of TP30 by reducing the on time of the oscillator driver circuit. When the +15V goes down the opposite occurs. Current in the opto-coupler goes up and this causes the on time of the output transistor to increase, thus increasing power output.

Transistor TP20 and TP21 provide over voltage protect by monitoring the run supply (DP20) of the oscillator driver. If this voltage rises too high, it is grounded by the TP20/21 and the oscillator and drivers are turned off which turns of the power supply. Along with first time turn off, RP32 also supplies the over current protect.

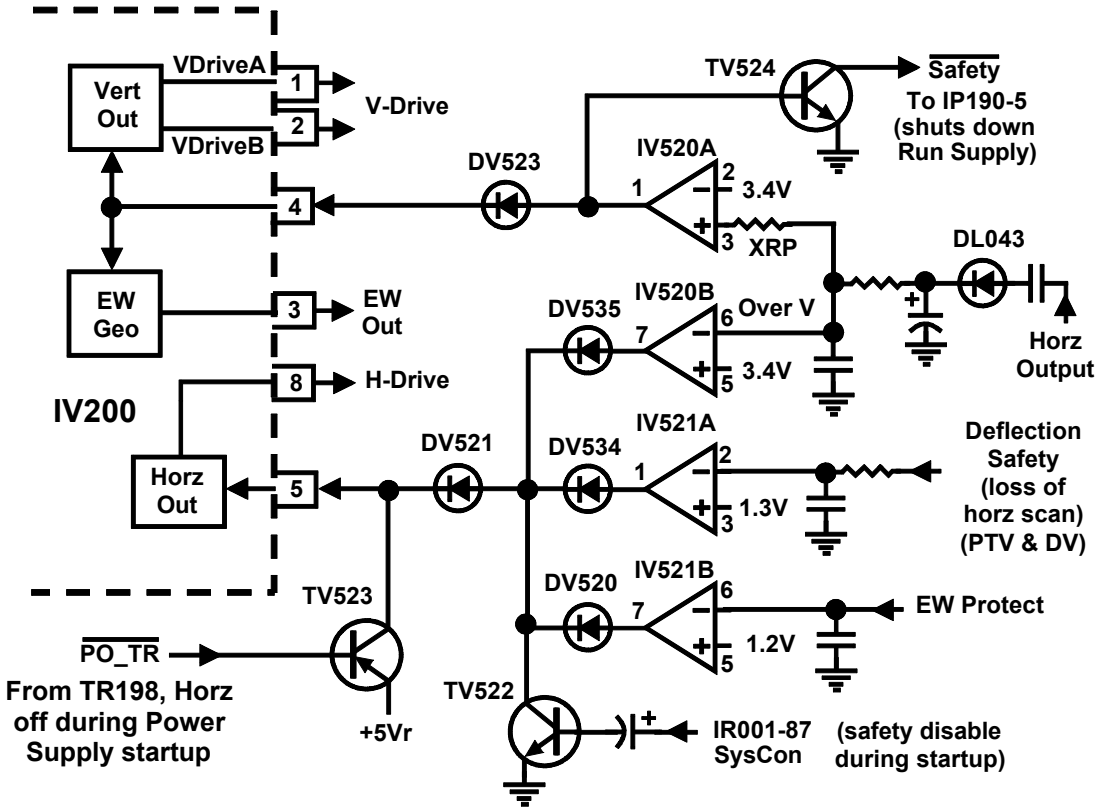


Safety Shutdowns

Safety Shutdown Overview

There are five (5) regulator IC's located on the SSB circuit board and two (2) on the DRI circuit board. The outputs of these seven (7) regulators are monitored with an "OR" gate configuration of diodes. The anodes of all the diodes are connected to form a single output. If the output of one of the regulators fail or one of the circuits they supply become shorted, the cathode of the respective diode is pulled low. This active low is the safety signal that is applied to IP190 at pin 5. When pin 5 of IP190 is pulled low by a loss of one of the regulators, the main (run) supply is turned off shutting down the instrument.

XRP shutdown is activated when Op-Amp IV520A pin 1 outputs a high which turns on TV524, generating the active low safety signal going to the main (run) supply. Also, loss of horizontal scan is also monitored for by TV04 and TV40 located on the adapter circuit board. If horizontal fails, transistor TV40 puts a high on the base of TV04, which turns on pulling the safety line low which turns off the main supply.



Deflection Shutdowns

Deflection Shutdowns

The deflection shutdowns include the XRP/Overvoltage, the Deflection Safety (loss of horizontal scan) and the EW Protect shutdown. The XRP and Overvoltage are developed from the same location but are applied to two separate pins of the Video/Deflection Processor IV200. The horizontal output pulse is rectified by diode DL043 and filtered, producing a DC voltage representive of regulated B+ (Usys). This voltage is applied to the non inverting unput of IV520A (XRP) and the inverting input of IV520B (Overvoltage). If the XRP voltage rises above a predetermined level set by the biasing network of the Op Amp IC, the outputs (pins 1 & 7) toggle high. These highs are then diode coupled into IV200 at pins 4 & 5. A high at pin 4 cause the vertical drive output and EW Geometry section of the IC to shutdown. The high at pin 5 causes the horizontal drive output to shutdown. The high on pin 1 of IV520A also turns on transistor TV524, which generates an active low Safety signal that shuts down the main (run) supply.

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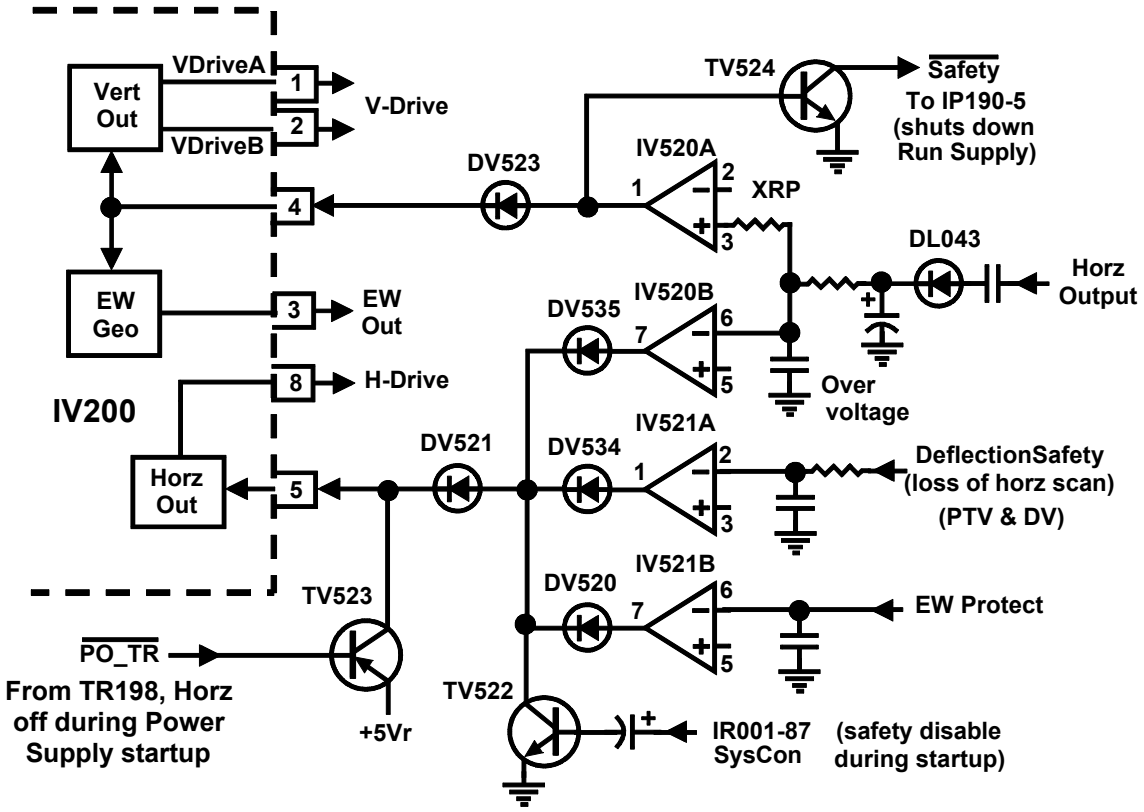
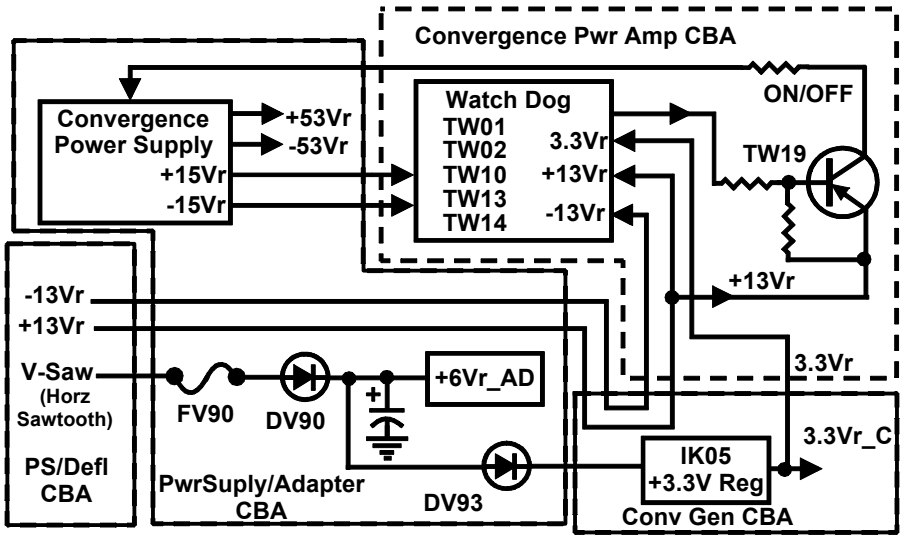


Deflection Shutdowns

When the deflection safety (beam current) rises to unsafe levels, the voltage at pin 2 of IV521A rises enough to cause the output (pin 1) to toggle high. This high is diode coupled (DV521 & DV534) to IV200-5, again shutting down horizontal. When horizontal goes down, the horizontal scan derived B+'s go away. The plus and minus (+/-) vertical output voltage are developed from the scan derived B+, thus shutting down vertical.

If the EW correction circuit fails, a EW Protect signal is output and applied to pin 6 of IV521B. This causes pin 7 to toggle high. The high is diode coupled into IV200 pin 5, shutting down horizontal and vertical in the same way excessive beam current.

Transistor TV522 and TV523 are deflection shutdowns overrides. The PO_TR is an active low signal that is developed from the power on (PO) signal from the microcomputer IR001 which starts the main supply. This low turns on TV523, applying a high to the horizontal shutdown. When all the supplies have started and stabilized this signal goes high turning off TV523, allowing horizontal to start. The safety disable transistor TV522 momentarily is turned on grounding the outputs of the deflection shutdowns during startup. The safety disable signal is generated by the system control microcomputer at pin 87. A high is capacitively coupled to the base of TV522 turning it on. When the capacitor is fully charged TV522 turns off, placing the deflection shutdown circuits back in operation.



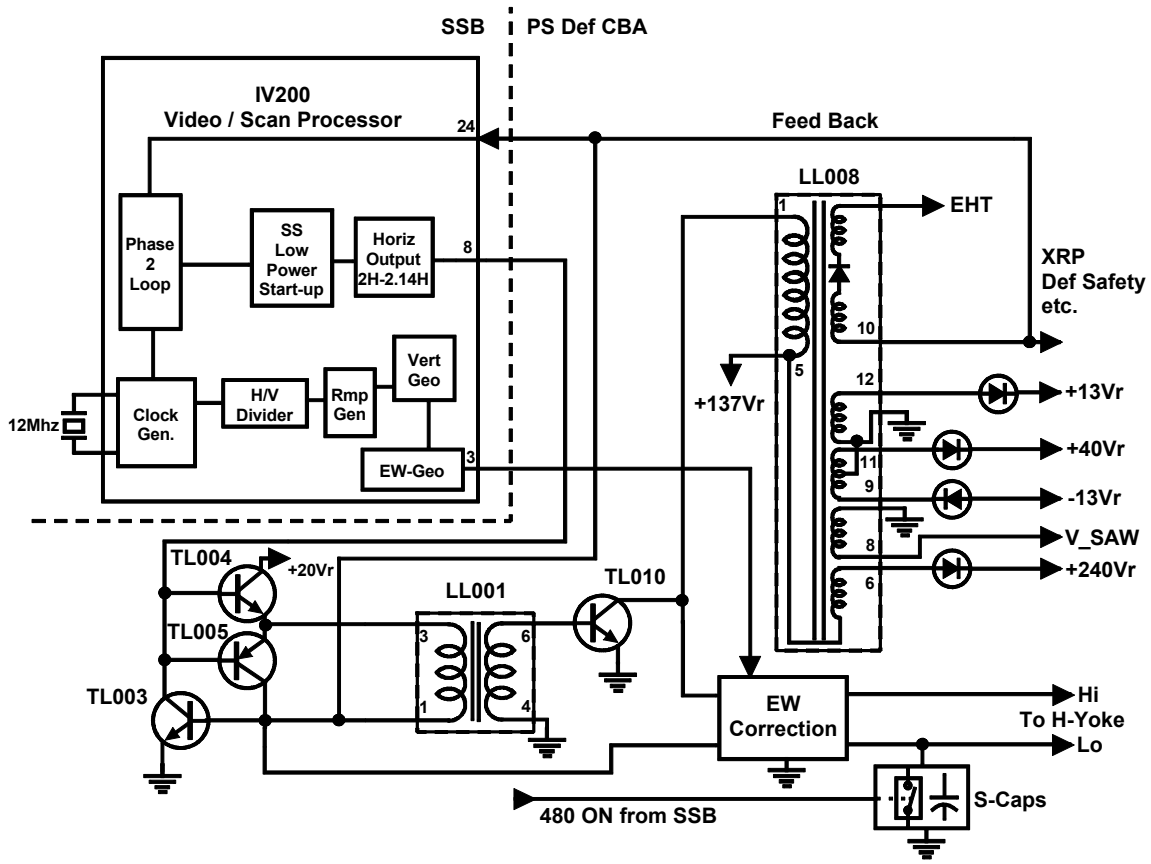
Convergence Power Supply Watch Dog

Convergence Power Supply ON/OFF Overview (Watch Dog)

The purpose of the convergence power supply on/off (or watch dog) circuitry is to turn on the power supply and also to shutdown the supply if something goes wrong with the other supplies in the instrument. The +/- 13V (vertical supply) from the power supply deflection circuit board is routed to the adapter CBA and then to the convergence generator board. The +/- 13V is then applied to the watch dog circuits consisting of TW01, 02, 10, 13 and TW14. A horizontal saw tooth (V-Saw) from the power/deflection circuit board is routed to the Adapter circuit board where it is rectified and filtered. The +6V is then diode coupled to the convergence generator board. There the +6V is applied to a +3.3V regulator (IK05). The +3.3V output operates convergence generator microcomputer and it is also sent to the watch dog circuitry on the convergence power amplifier board.

Once these three (3) voltages are present (+/-13V and +3.3V) the watch dog circuit outputs a low to the base of TW19. TW19 turns on and applies the +13V to the convergence power supply.

The convergence power supply starts generating the +/-53V and the +/-15V needed by the convergence power amplifiers. The +/-15V is also applied to the watch dog circuit. Once the +/-15V is present, the watch dog circuit then monitors all five voltages. If any one of the voltages disappears, the output of the watch dog circuit goes high and TW19 is switched off. The removes the +13V from the convergence supply thus shutting it down. This is done to prevent damage to the convergence power output devices. Notice also that the way the monitored voltages are routed through the circuit boards that if any of the circuit boards are unplugged while the set is running, the power supply shuts down. Also, if one of the boards is unplugged when the set is off, the convergence power supply and the generator board does not power up when the set is turned on. The chassis can operate without the convergence system but the 13V must be applied to the +12V Reg IV10 on the adapter CBA. Regulator IV10 provides the 12V for the CRT CBA's. Without the 12V the CRT's won't light up.



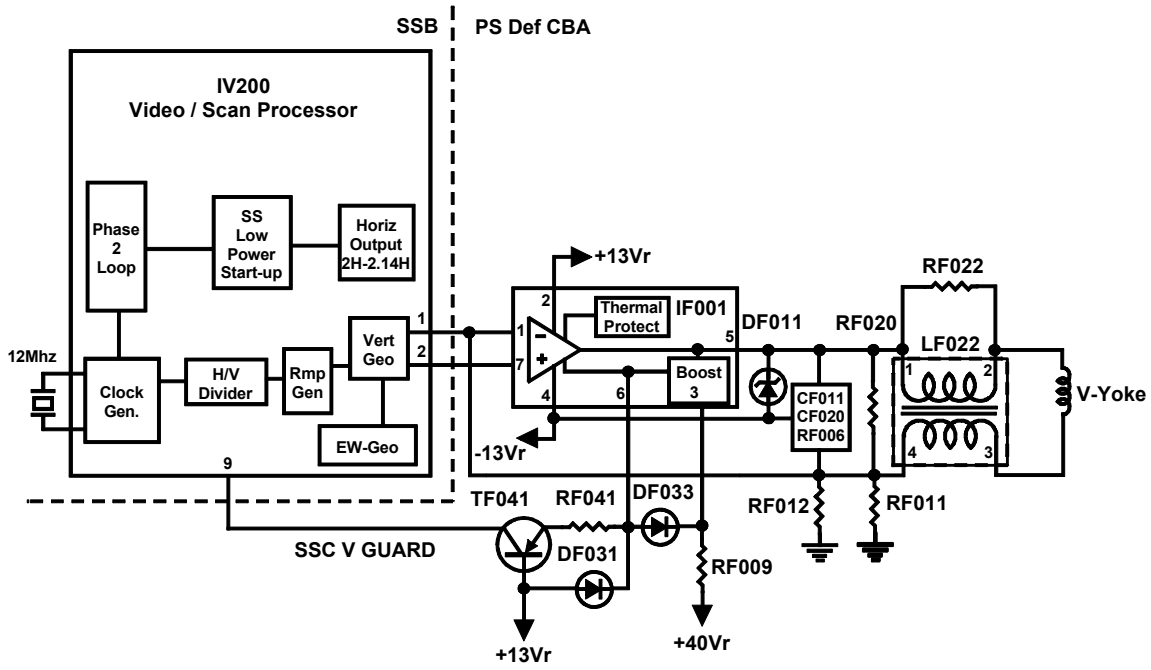
Horizontal Deflection

Horizontal Deflection Overview

Horizontal deflection starts with a drive signal from the HOUT of IV200, video / scan processor. This HOUT signal of 2H or 2.14H is amplified by TL004 and TL005 to drive LL001 driver transformer. TL003 is part of the feedback circuit.

The horizontal output transistor gets drive from LL001 secondary and amplifies the drive signal to drive IHVT (LL008). TL010 also drives the Horizontal yoke and EW correction. The return or Lo side of the yoke is controlled by EW correction and pincushion. The ATC221 operates at 2H and 2.14H so switching of the s-caps is required to keep the high voltage from LL008 in check. The s-cap switching is controlled by IR001 via 480 ON signal. A low on the 480 ON indicates 2.14H and a high is 2H.

LL001 generates scan derived voltages for the vertical and CRT(s). The vertical circuit uses the ±13Vr and +40Vr. V_SAW is used to generate the +6vr_AD used to drive the 3.3V regulator for the convergence generator. The +240Vr is the cathode bias for the CRT(s).



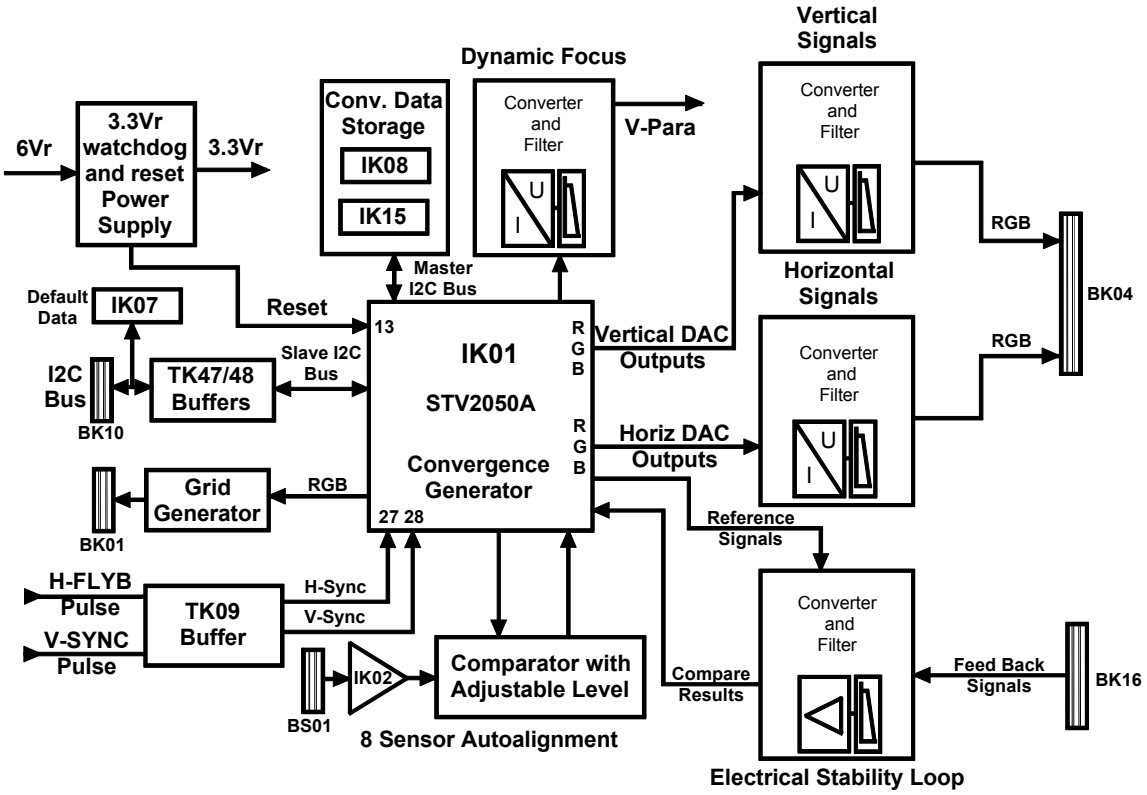
Vertical Deflection

Vertical Deflection Overview

Vertical deflection starts with IV200 video / scan processor generating the ± vertical drive signals. These vertical drive signals are sent to IF001 (vertical output) for further processing.

IF001 is the vertical output IC that drives the vertical yoke(s). The vertical deflection yoke is connected through sense resistors (RF011 and RF012) to ground and the inverting input of IF001. This provides IF001 feedback of the vertical current. DF011 and filter circuit of CF011, CF020 and RF006 also provide feedback. IF001 uses ±13Vr for normal trace (+13V for the top half of the picture and –13 for the lower half) and a +40Vr boost during retrace.

Transistor TF041 generates together with RF041 the vertical guard information, a small current that goes to the supper sandcastle pulse (SSC) pin of the video / scan processor during each vertical period of the SSC signal. If this information is missing the video / scan processor detects a vertical error and blanks the RGB outputs to avoid damaging the picture tube.



Convergence Signal Generator

Convergence Signal Generator Overview

The convergence generator IK01 is the main processor for digital convergence and auto-alignment in the ATC221. IK01 is I2C bus controlled and has a master and slave bus. The “master” bus is connected to the data storage EPROM’s IK08 and IK15.

The “slave” bus is connected to the main chassis CPU (via BK10) and IK07 factory alignment EEPROM. TK47 and TK48 are level converter / buffers and are needed during startup when IK01 is not active to prevent loading of the I2C bus.

Other signals from the main chassis are Horizontal and Vertical sync pulses and +6Vr. The +6Vr is used to feed the 3.3Vr regulator that provides Vcc and reset to IK01. The Horizontal and Vertical sync signals are level converted and provide IK01 timing information.

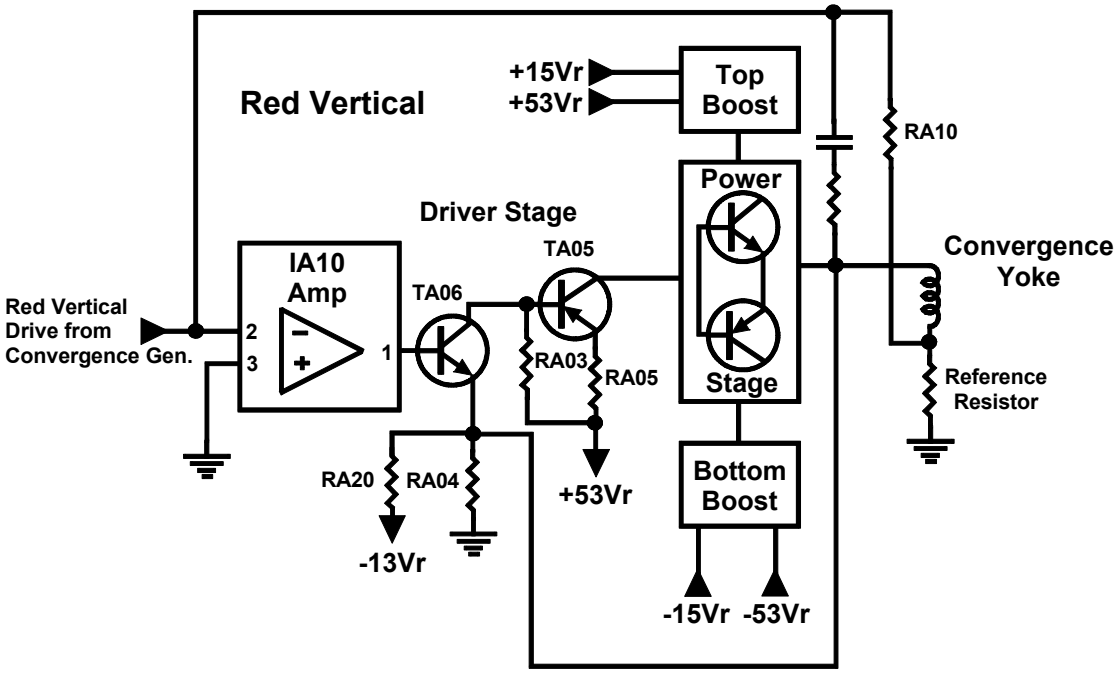
Eight photo sensors are used for auto-alignment. The eight sensors are attached to the screen frame just out of the viewing area, are parallel and connected to BS01. When auto-alignment is activated IK01 provides grid signals corresponding to the three

colors (RGB). These signals are used for the auto-alignment process one at a time to locate each of the eight photo sensors. With the information gained from the sensors, IK01 can calculate proper convergence alignment.

The IK01 produces a programmable vertical rate parabola signal for dynamic focus. The parabola signal is connected to BK02 to be used on the adapter board.

The convergence signal outputs are designed to provide a max swing of ±2.5V. A simple integrating filter with two capacitors at each input of the Opamp is used to smooth the output signal. IK01 has internal digital filters. The output signals are sent to the power amplifiers via BK04.

Feedback from the amplifiers via BK16, provide electrical stability loop information to IK01. This feedback is used to keep offset and gain of the convergence system stable over temperature change and aging. During one line of the vertical retrace a reference signal is produced by IK01. The feedback signals at BK16 are an image of this reference signal after passing the output Opamp on the CSB and the power stage on the CAB. The feedback signals are compared with target values that are also produced by IK01. The compared result is then read by IK01. The loop is working in a continuous sequential mode where first the offset is checked for the vertical channels. Then the offset for the horizontal channels is checked. Then the gain for vertical channels is checked and finally the gain for horizontal channels. The loop algorithm inside IK01 corrects the offsets until it is zero by adding or subtracting a value in the digital processing. The gain is corrected by changing a multiplication factor in the digital processing.



Conergence Power Amplifier

Convergence Power Amplifier (one channel)

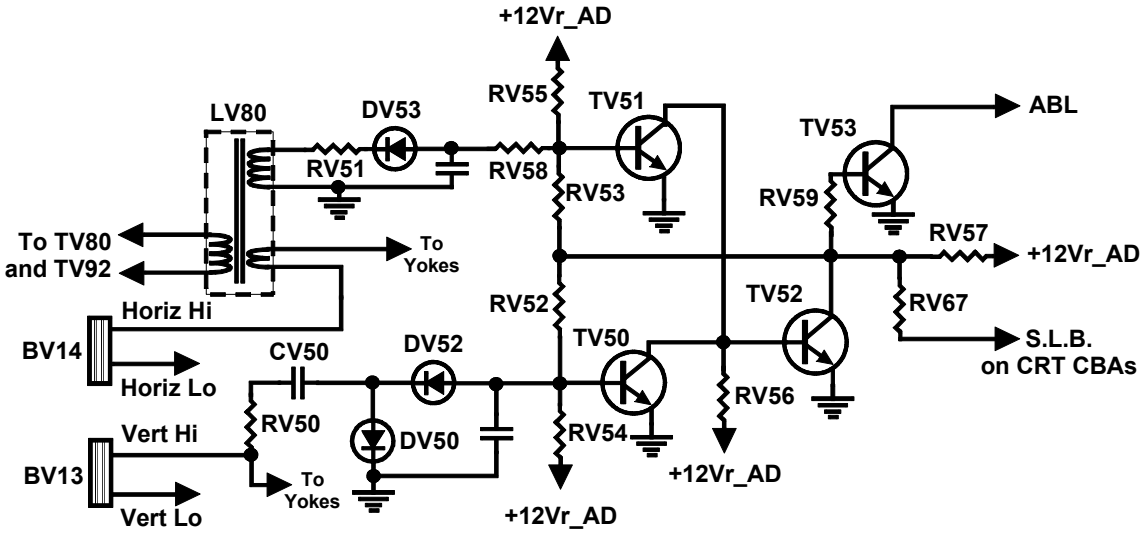
The convergence amplifier assembly contains six amplifiers and the watchdog circuit. There are three identical amplifiers for Vertical and two identical amplifiers for Horizontal. The sixth stage is for green horizontal, which doesn't have the bottom booster stage for negative signal peaks. This discussion will focus on the five stages that are identical. Horizontal and Vertical will not be addressed individually. Because the five stages are identical, generic descriptions for each component will be used when ever possible. When it is not possible to use generic descriptions, reference to the Red Vertical stage and the schematic will be used.

The convergence amplifier has three sections. The first section is the pre-amp, the second is the driver and the third is the power out. The pre-amp section consists of an integrated op-amp that is configured as a differential amp. This stage amplifies the signal from the convergence generator and sums it with two other signals (a image of the output current and output voltage). The summed signals are sent to the driver section.

The driver consists of an amp TA06 and a buffer TA05. This section takes the summed signals from the pre-amp and drives the power output.

The power output section provides the current for the convergence yokes, which are part of the deflection yokes. The low frequency components of each convergence signal are driven under resistive load conditions. The higher frequency components are driving the convergence current under inductive load conditions. With this, the power output stage has to work under both conditions. A high voltage swing is needed to generate fast changing current signals at the left and right borders of the picture while the current change during the visible part is very small.

To reduce total power dissipation, the amplifier is supplied with four voltages ±15 and ±53. During trace time, the output current is supplied from the lower voltages ±15V, but during retrace time, the output currents are fast changing and the ±53V are needed. The output stage consists of power transistors in Darlington configuration and has, for each polarity, two transistors in series. The boost transistors are working with ±15V supply during 80% of the time, when the picture is shown. Only at the borders and during retrace time the boost transistors are switching on the ±53V.



Scan Loss Blanking

Scan Loss Blanking Overview

Scan loss blanking (S.L.B.) is used to blank the CRT's if a loss of scan is detected. Both horizontal and vertical are monitored. If one or both are missing a fast switch of the video to black occurs to prevent the CRT's from burning.

Vertical Detection

The Vertical pulse is high impedance decoupled by RV50 and CV50. DV50 limits the positive voltage to 0.7V and DV52 rectifies the voltage to a negative value and given to the base of TV50. The base is also supplied by RV54 with a positive voltage. These two voltages are, during normal operation, in balance meaning TV50 is off. If vertical deflection fails RV54 will supply the base of TV50, which will immediately ground the base of TV52. The +12V coming from RV57 is able to activate the **S.L.B**. line and, through TV53, the **ABL (Automatic Beam Limiter)** line of the Video processor is pulled low.

Horizontal Detection

The horizontal pulse is taken from LV80 and DV53 rectifies the negative pulses supplied to the base of TV51. The base is also supplied by RV55 with a positive voltage. These two voltages are, during normal operation, in balance meaning TV51 is off. If horizontal deflection fails, RV55 will supply the base of TV51 with a positive voltage, which will immediately ground the base of TV52. The +12V coming from RV57 is able to activate the **S.L.B**. line and, through TV53, the **ABL** line of the Video processor is pulled low.

Abbrevations & Acronyms

480_on	**Switching signal for 480P & up-converted 480i mode**
ABL	**Average Beam Current Limiting**
ACQ	**Acquisition power mode**
ADB	**Adaptor Board, PTV**
APR_ON	**signal to switch between 6V & USYS regulation**
AQR_ON	**Signal from uP to switch from 6V regulation to USYS regulation**
BCL	**Beam Current Limiter**
BSVM	**Beam Scan Velocity Modulation**
CAB	**Convergence Amplifier Board**
CBA	**Circuit Board Assembly**
CCC	**Continuous Cathode Calibration**
CSB	**Convergence Signal Board**
CTI	**Color Transient Improvement**
CVBS	**Composite Video Baseband Signal**
DCR (R,G,B)	**Dark Current Signal (cathode cutoff)**
DCU	**Digital Convergence Unit**
DEGAUSS	**Signal from uP to turn degaussing circuit on & off**
DFB	**Dynamic Focus Board**
DP	**Deflection Part**
DRI	**Digital Ready Interface**
DST	**Diode Split Transformer (IHVT)**
DVI	**Digital Visual Interface**
ECO_Standby	**Signal from uP to switch stdby power supply modes**
EFC	**Earth Field Correction**
EW	**East West**
H_DRIVE	**Horizontal Drive Signal**
HIP	**Hi-Level Input Processor**
HOP	**Hi-Level Output Processor**
IHVT	**Integrated High Voltage Transformer**

Continued on next page.

INF_POW_FAIL	**Signal from standby SMPS indicating loss of mains (120VAC)**
LTI	**Luminance Transient Improvement**
MID	**Mains Input Doubler (doubles Raw B+)**
NVM	**Non Volatile Memory or EEPROM**
PA/SW	**Power Amp Sub Woofer**
PE	**Protective Earth**
PO	**Power On signal from uP to start main SMPS**
PP	**Power Supply Part**
PS_ON	**Signal derived from PO to start main SMPS, also controlled by safety circuits of the main SMPS**
PS-ADB	**PTV Power Supply/Adaptor Board (same as ADB)**
PSB	**Power and Scan Board**
PSI	**Picture Signal Improvement**
PWM	**Pulse Width Modulation**
RP	**Rear Projection**
SAFETY	**signal generated by safety circuit located on SPP CBA**
SMPS	**Switched Mode Power Supply**
SMT	**Switched Mode Transformer**
SPP	**Signal Power Part**
SSB	**Small Signal Board**
SSC	**Super Sandcastle Signal**
TFT	**True Flat Tube**
UP	**Micro-Processor**
USYS	**System voltage for the horz deflection or Reg B+**
XRP	**X-Ray Protect**

ATC221 Fuses

Fuse #	Rating	Circuit/Voltage	Type
FP400	6A/125V	AC Input	fuse
FV90 (PTV)	400mA/125V	Convergence PS	ICP
FL100	250mA	+6VAr	ICP
FP520	1.25A/125V	+5VarSI	ICP
FP521	1.25A/125V	+5V_VrSI	ICP
FL221	1.25A	-13Vr (vert)	ICP
FL251	1.25A	+13Vr (vert)	ICP
FL231	400mA	+40Vr	ICP
FP602	1A/125V	120VAC	fuse
FP360	3.15A/125V	+3.3V	ICP
FP361	1A/125V	-5V	ICP
FP362	3.15A/125V	+5Vs	ICP
FP390	2.5A/125V	+12Vs	ICP

Note: Fuse FP602 (DVD) is located on the AC Input CBA. Fuse's FP360/361/362/390 are DVD fuses and are located on the DVD Power Supply PCB.

NOTE: All measurements are referenced to cold ground.

Standby Power Supply	
DP220-C	3.7k Ohms
DP240-C	850 Ohms
Run Power Supply	
DP110-C	17k Ohms
DP120-C	3.9k Ohms
DP130-C	1.4k Ohms
DP135-A	5.5k Ohms
DP140-C	91k Ohms
DP150-C	6.8k Ohms
Deflection	
DL201-C	230k Ohms
DL221-A	630 Ohms
DL231-C	99k Ohms
DL251-C	12k Ohms
Convergence Power Supply	
DP60-A	3.1k Ohms
DP65-C	Greater than 20 meg Ohms
DP70-A	18k Ohms
DP75-C	2.3k Ohms

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

System Control Troubleshooting

1. Reset microcomputer by disconnecting AC power for 60 seconds.
2. Plug into AC power and read blinking error code.
3. If error code indicates component failure on small signal board (SSB), replace SSB.
4. If error code indicates failure elsewhere, troubleshoot circuit indicated by code.
5. Check standby supplies to SSB. If not OK, suspect standby supply.
6. If standby supplies are OK to SSB, disconnect front keyboard (PTV only) and try IR (remote) operation. If unit functions, suspect keyboard. If unit still inoperative, suspect SSB.
7. On direct view (DV) unit check connector BR001 pin 6 is 0 volts, Pin 3 is 4.9VDC and pin 2 is 1.7VDC. If voltages are correct suspect SSB.
8. If voltages not OK, unplug keyboard and recheck voltages on connector BR001 pins 2-3-6. If OK with keyboard disconnected suspect keyboard. If still not correct, suspect SSB.

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Standby Power Supply Troubleshooting

1. Check Raw B+ at IP020-3. If missing, check fuse FP400 and the AC Input CBA (full wave bridge rectifier & doubler).

2. If Raw B+ OK, check VDD at IP020-2. If anything other than approximately +10.75 volts, suspect IP020.

3. If IP020 is replaced, check all active components including DP023, TP026, IP030 and rectifier diodes and regulators on the secondary of LP020 before applying AC power.

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Main (Run) Supply Troubleshooting

1. Check for shorts to ground on the secondary of LP050 (cathodes of rectifier diodes). If any are shorted to ground, troubleshoot the circuit that is powered by that supply. If no shorts, go to step 2.
2. Press power button and check that Standby supply is exiting the ECO mode by going from 18KHz to 28KHz at IP020-3. If not, troubleshoot standby supply.
3. If standby supply is shifting to 28KHz, press power button and check for AQR_ON to run supply at TP221-b or connector BP005-19.
4. Using a scope, check for 2.5KHz at IP170-7. If 2.5KHz missing, troubleshoot PWM generator and PWM regulator (IP050/TP050/051). If 2.5KHz is present, the PWM generator and regulator are OK, go to step 5.
5. **Important:** Unsolder drain of TP020 before continuing to step 6.
6. Remove AC power and force on the driver circuit (IP050/TP050/051) by grounding pin 6 of connector BP005. Apply AC power and then short the base of transistor TP161 to ground.
7. Check for 2.5KHz drive at gate of TP020. If 2.5KHz is present driver circuits are OK. Suspect output circuit (TP020). If 2.5KHz is missing at gate of TP020, troubleshoot driver circuits.

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NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Convergence Power Supply Troubleshooting

1. Unplug convergence yokes.

2. Apply AC power and press power button, if convergence supply runs troubleshoot power amplifier CBA. If supply still does not run, go to step 3.

3. Press the power button and verify +3.3V at IK05-2 (regulator on conv gen PCB). If not present suspect regulator IK05 and/or rectifiers DV90/DV93. If OK, go to step 3.

4. Check +/-13Var_PA (vertical supplies - scan derived B+) at connector BW05-12/9. If not present, troubleshoot the +/-13V vertical power supplies. If OK go to step 4.

5. Remove AC power and disconnect connector BP60 on power supply adapter PCB, then reconnect AC power and go to step 6.

6. Connect approximately +9 to +12V external supply to pin 1 of opto-isolator IP50 and ground. Apply AC power.

NOTE: By changing the external supply in step 6 above, the regulation of the supply can also be verified.

7. If supply runs, troubleshoot the watch dog circuit. If supply does not run, check that transistor TP24 is turned on.

8. If TP24 is off, check TP24, IP50, RP50, DP49, RP49, RP44 and RP45.

9. If TP24 is turned on but supply does not run, check all active components in the gate and source of TP030, including RP32.

10. If the static checks in step 8 are OK, check secondary rectifier diodes.

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Safety Shutdown Troubleshooting

(Main Supply starts & then shuts down)

1. Eliminate the DRI CBA as the cause by bypassing it. Unplug all cables to DRI and then connect BP150 on power supply / deflection CBA to BT150 on small signal board (SSB). If run supply comes up, replace DRI circuit board.
2. If run supply does not come up, verify momentary presence of B+ at cathodes of shutdown diodes (DP540/501/510/521) on SSB CBA.
3. If missing a momentary B+ (one or more) at cathode of diodes (DP540/501/510/521), replace SSB. If all momentary B+ are present, go to step 4.
4. ***Remove CRT CBA's***.
5. Short B-E of XRP transistor TV524 at coordinates C8 on SSB CBA.
6. If run supply comes up, check horizontal due to excessive high voltage. If high voltage OK, go to step 7. If run supply does not come up, PTV go to step 8, DV go to step 9
7. If high voltage not excessive, suspect XRP detect circuit.
8. PTV Only: Short B-E of TV04 (adaptor CBA). If run supply comes up, troubleshoot horizontal circuits.
9. Troubleshoot run supply.

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the microprocessor needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Deflection Shutdown By-pass Procedure

Warning: Disabling the safety shutdowns and forcing deflection on in the following procedure may cause additional damage.

1. Eliminate DRI CBA as the cause by bypassing. Unplug all cables to DRI and then connect BP150 on power supply deflection CBA to BT150 on small signal board (SSB). If run supply comes up, replace DRI circuit board.
2. **IMPORTANT: Remove CRT socket(s)**
3. Locate TV522 on the top side of the small signal board (SSB) at board coordinates F7 and short the collector to emitter or to cold ground.
4. Locate TV524 on the top side of the SSB at board coordinates C8 and short base to emitter.

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Watch Dog Troubleshooting (PTV Only)

1. Apply AC power and press power button and check IK05-2 for 3.3VDC (regulator) on the convergence generator CBA. If 3.3V present go to step 2. If 3.3V not present, suspect +6V_C source (diode DV90/DV93).
2. Remove AC power and disconnect convergence yokes (BB01/BR01/BG01 on Convergence Power Amp CBA). Apply AC power and press the power button and check that convergence power supply is on.
3. If convergence power supply is on, troubleshoot the convergence power amplifier circuit board. If convergence power supply is not on, go to step 4.
4. Before forcing on the supply check that convergence yokes are disconnected. Force on the convergence power supply by jumping emitter-collector of TW19 (adapter CBA).
5. If convergence power supply starts, suspect a failure in the watch dog circuit. If the power supply does not start, troubleshoot the convergence power supply.

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Horizontal Troubleshooting (Horizontal not running)

1. Unsolder the collector of TL010.
2. Monitor the base of TL010 with a scope and push the power button. If there is drive to TL010, suspect a problem with TL010, LL008, EW correction, S-caps, or a problem with the scan derived supplies (±13Vr, +40Vr, +240Vr, etc.)

3. No base drive trace signal back to pin 8 of IV200 video processor at each active component along the way. The power button will have to be pushed each time as the drive signal will only be present for a few seconds while the set tries to start three times.

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Vertical Deflection Troubleshooting

1. Reset microcomputer by removing AC Power for 60 seconds.
2. If the unit is a PTV and a horizontal line is displayed momentarily the vertical +/- 13V is OK, go to step 5.
3. If a temporary horizontal line is not displayed or the unit is a direct view, check that the vertical +/- 13V (horizontal scan derived power supply) is trying to come up.
4. If the +/- 13V supplies are not trying to come up, troubleshoot horizontal scan derived supply.
5. If the +/- 13V supplies check OK, check the +40V supply.
6. If +40V supply missing, troubleshoot the scan derived power supply.
7. If +40V is coming up, check for vertical drive pulses at vertical IC IF001 pins 1 and 7.
8. If pulses present, suspect vertical IC IF001, vertical yoke or open in feedback circuit.
9. If vertical drive signals missing, suspect small signal board (SSB).

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Convergence Power Supply Troubleshooting

1. Unplug convergence yokes.

2. Apply AC power and press power button, if convergence supply runs troubleshoot power amplifier CBA. If supply still does not run, go to step 3.

3. Press the power button and verify +3.3V at IK05-2 (regulator on conv gen PCB). If not present suspect regulator IK05 and/or rectifiers DV90/DV93. If OK, go to step 3.

4. Check +/-13Var_PA (vertical supplies - scan derived B+) at connector BW05-12/9. If not present, troubleshoot the +/-13V vertical power supplies. If OK go to step 4.

5. Remove AC power and disconnect connector BP60 on power supply adapter PCB, then reconnect AC power and go to step 6.

6. Connect approximately +9 to +12V external supply to pin 1 of opto-isolator IP50 and ground. Apply AC power.

NOTE: By changing the external supply in step 6 above, the regulation of the supply can also be verified.

7. If supply runs, troubleshoot the watch dog circuit. If supply does not run, check that transistor TP24 is turned on.

8. If TP24 is off, check TP24, IP50, RP50, DP49, RP49, RP44 and RP45.

9. If TP24 is turned on but supply does not run, check all active components in the gate and source of TP030, including RP32.

10. If the static checks in step 8 are OK, check secondary rectifier diodes.

Read Me: Never use the training diagrams to troubleshoot. Always use the ESI schematics.

NOTE: When troubleshooting fatal error shutdowns the micro needs to be reset prior to each active check in the troubleshooting procedures. This is done by removing AC power for 60 seconds.

Dead Set Troubleshooting

1. Reset microcomputer by removing AC power for 60 seconds.
2. Apply AC power and turn instrument on. Check for power LED blinking error code (or use Chipper Check). If blinking error code, Standby Supply and System Control are operational, go to step 7. ***PTV only***: if power LED is on steady, go to step 8.
3. Power LED does not blink error code (LED off), go to step 4.
4. Check for Raw B+ (300VDC). If not present suspect AC Input CBA
5. If Raw B+ OK, check Standby Power Supply (+7Vs, +5Vs and +3.3Vs). If missing, troubleshoot standby supply.
6. If the standby supplies are OK, suspect system control on small signal board (SSB).
7. Check circuit area indicated by error code.
8. PTV Only: apply RF from generator with audio signal to RF input and direct access the generator channel with remote (IE; 03).
9. PTV Only: if no audio and no video, suspect a problem on small signal board.
10. PTV Only: if audio is present but no video, chassis power supplies (Standby & Main) are operational. Suspect scan loss blanking (TV52), convergence power supply, adapter CBA or convergence power amp circuit.

COMPONENT NUMBERING SYSTEM

The component numbering system in the TX809 family of chassis is slightly different than you may be familiar with. The component numbering for the "ATC " chassis indicates the component type and the general circuit area it is used.

COMPONENT DESIGNATION **X X XXX**

COMPONENT TYPE	CIRCUIT AREA	COMPONENT NUMBER
B - Connector	A - Audio	01 - 099 Main PCB (top)
C - Capacitor	C - Chroma	500 - 599 Main PCB (bottom)
D - Diode	D - DC-DC Convertor	101 - 199 E/W PCB
F - Fuse	F - Vertical	001 - 099 Sound Compressor
I - Integrated Circuit	G - Gemstar	401 - 599 Gemstar PCB
J - Jumper	H - Tuner	01 - 99 Kine PCB (top)
L - Transformer/Coil	I - IF	500 - 599 Kine PCB (bottom)
P - Adj. Resistor	J - Sync Separator	
Q - Filter/Crystal	K - Customer Control	
R - Resistor	L - Horizontal	
S - Switch	P - Power Supply	
T - Transistor	R - System Control	
V - Delay Line	U - Kine Drivers	
	V - Video	
	Z - XRP	

EXAMPLES:

TP20 - **T** = Transistor, **P** = Power Supply, 20 (number, top side of Main PCB)
RA543 - **R** = Resistor, **A** = Audio, 543 (number, bottom side of Main PCB)
CF07 - **C** = Capacitor, **F** =Vertical, 07 (number, top side of Main PCB)
IR501 - **I** = Integrated Circuit, **R** = System Control, 501 (number, bottom side of Main PCB)