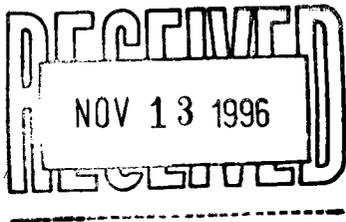


EXPANDER

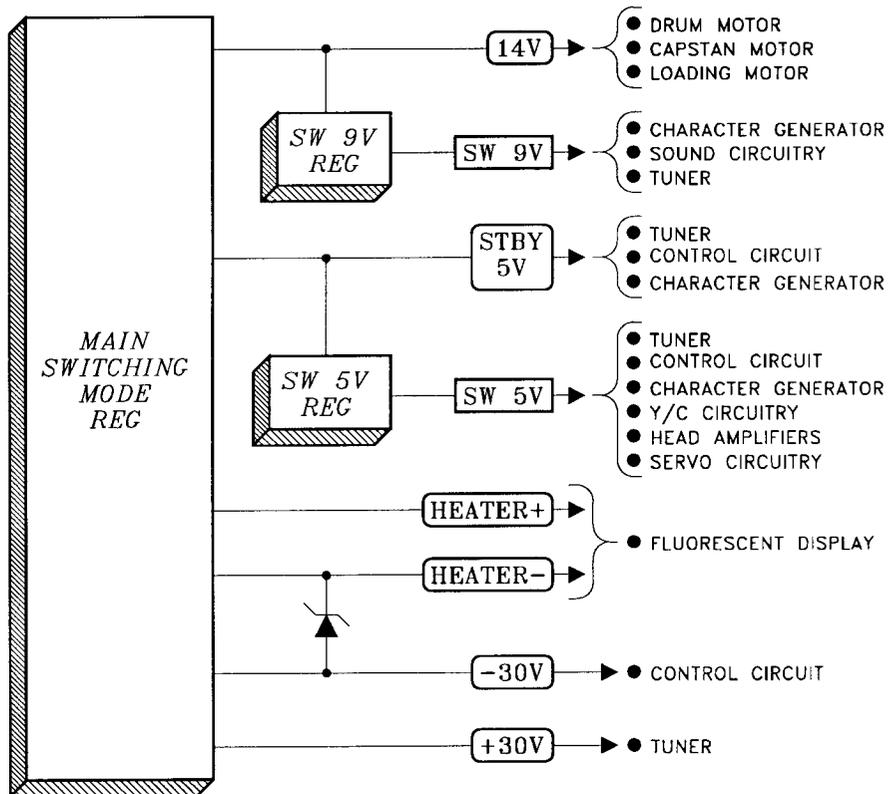
Mitsubishi Consumer Electronics America, Inc. -- Technical Publications Department

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1996 VCR Power Supply Circuitry



MODELS
 HS-U120
 HS-U270
 HS-U420
 HS-U520
 HS-U570



Power Distribution

The VCR Models listed above are part of the current Mitsubishi product line. Model specific features of the five VCRs are given in *Table 1*.

Although features vary, all five VCRs use the same Power Supply circuitry. The above drawing illustrates the Overall Power Distribution in the VCRs.

All supply voltages, standby and switched, are derived from the Main Switching Mode Regulator.

The Regulator is located on the PCB-MAIN, and is comprised mainly of discrete components. When servicing the circuitry, troubleshooting must be to the component level.

MODEL	MODEL SPECIFIC FEATURES					
	HI FI	AV DUB	PERF TAPE	CABLE BOX CTL	AV SYS2	REMOTE
HS-U120						(1)
HS-U270				X		(1)
HS-U420	X					(1)
HS-U520	X	X	X		X	(1)
HS-U570	X	X	X	X	X	(2)

(1) Multi-brand with 10 Button keypad

(2) Multi-brand with Jog Dial

Table 1: Model Specific Features

Switching Mode Regulator

The Switching Mode Regulator has two main cycles of operation:

- 1) **Start Up** -- starts the oscillator when power is applied.
- 2) **Regulation** -- maintains constant output voltages.

In addition, **Soft Start, Over Current, and Over Voltage features** protect circuit components if an abnormal condition occurs.

Figure 1 illustrates a simplified version of the Switching Mode Regulator circuitry. Only the components necessary to describe the circuit's operation are shown.

Start Up

Start Up occurs when the VCR is initially connected to the AC line. Once the Switching Regulator starts, operation continues whether the VCR is ON or OFF.

The following sequence describes the Start Up operation:

- 1) When power is applied, 150VDC from D901 is directed through T901 to the collector of Q901.
- 2) The initial output from D901 is also momentarily coupled to the base of Q901, through R903, R904 and C907.
- 3) The momentary voltage starts Q901 conducting, causing a drop in collector voltage.

- 4) Current through the primary winding (P) induces a positive voltage in the (Sc) secondary winding.
- 5) The positive voltage drives Q901 into heavier conduction.
- 6) The positive voltage also charges C913 through D905 and R907.
- 7) When the charge on C913 reaches 0.7 volts, Q903 conducts.
- 8) The conduction of Q903 turns Q902 ON, which switches Q901 OFF.
- 9) When Q901 turns OFF, the positive pulse in the primary winding induces a negative pulse in the Sc winding, holding Q901 OFF.
- 10) When the increasing current through the primary winding stops, the negative pulse at the Sc winding ends.
- 11) The collapse of the negative pulse in the Sc winding generates a positive pulse at pin 7 of T901.
- 12) The positive pulse turns Q901 ON and the cycle repeats.

The charging of C913 limits the ON time of Q901, providing **Soft Start Protection**.

Regulation

Controlling the ON time of Q901, also provides regulation once the oscillator starts. Feedback from a secondary supply determines the ON time of Q901.

During the OFF cycle of Q901, a positive pulse is generated across the secondary winding at pin 11 of

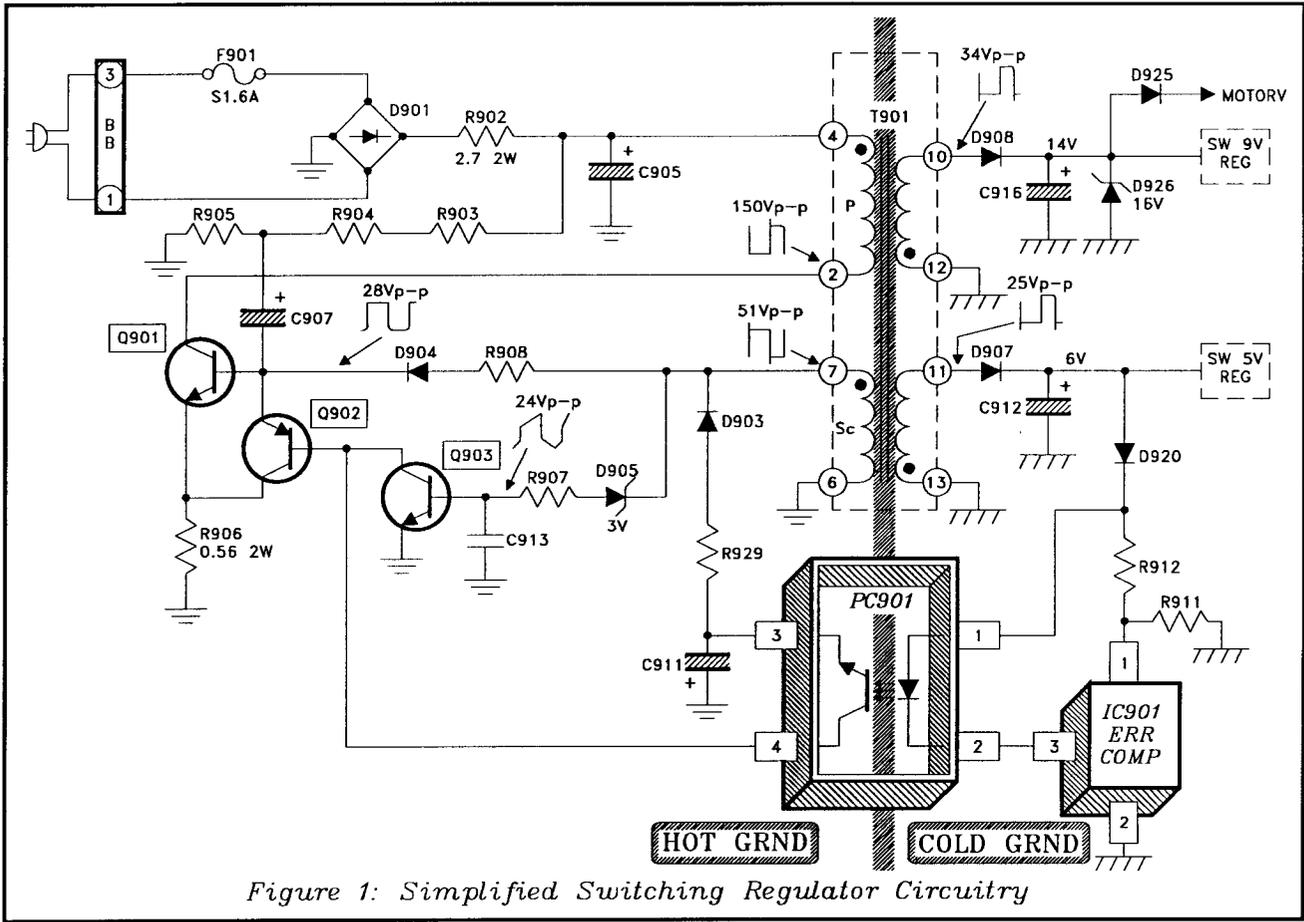


Figure 1: Simplified Switching Regulator Circuitry

T901. The pulse is rectified by D907 and produces approximately 6 VDC. A feedback circuit, through IC901, and PC901, provides a sample of the 6 VDC Supply to control the ON time of Q901.

PC901 is necessary to isolate the HOT and COLD grounds. The primary circuit of the Switching Regulator connects directly to the AC line. Therefore the primary winding circuitry of the Regulator is referenced a HOT ground.

**An ISOLATION TRANSFORMER
must be used when servicing the VCR.**

T901 provides isolation for the secondary circuitry, and PC901 provides isolation for the regulation feedback path.

The following describes regulation if the 6 VDC supply increases:

- 1) IC901 compares a sample of the 6 V supply to an internal reference.
- 2) If a difference exists, a correction voltage is generated at pin 3 of the IC.
- 3) When the 6 Volt supply increases, the correction voltage decreases.
- 4) The decrease in correction voltage increases the light emitted by the LED in PC901.
- 5) The light increases the conduction of the Photo Transistor.
- 6) Increasing Photo Transistor conduction, supplies additional current to the base of Q902, turning Q902 ON.
- 7) The earlier conduction of Q902, shortens the ON time Q901, which reduces the drive to the secondary rectifiers.

If the 6 Volt supply drops, due to an increased load, the ON time of Q901 is increased and the drive to the secondary rectifiers increases.

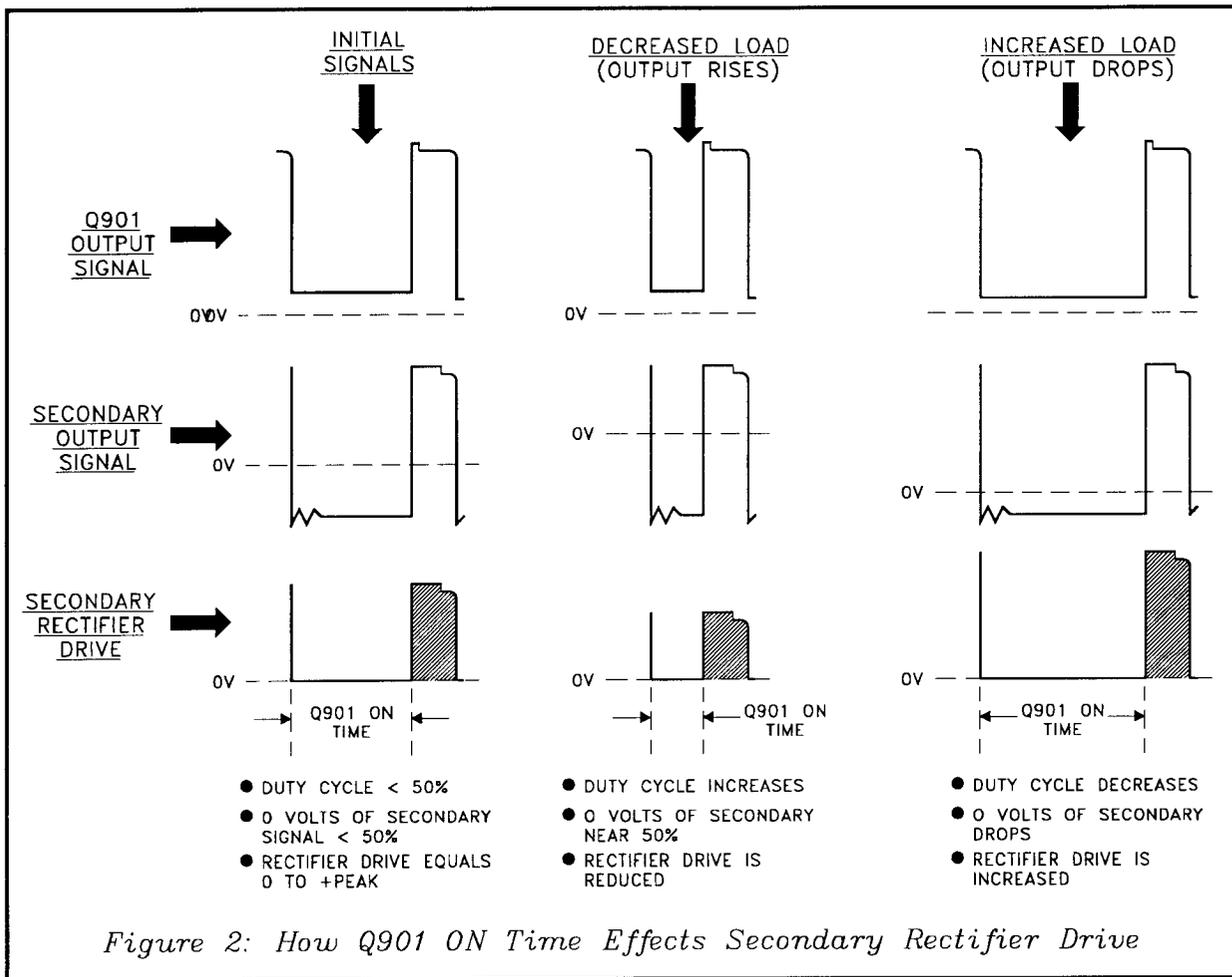


Figure 2 illustrates how varying the ON time of Q901 controls the drive to the secondary rectifiers. If the 6 Volt supply increases, the duty cycle of the oscillator becomes more positive. The change in duty cycle moves the average value of the signals from the secondary windings towards the positive peak. This reduces the amplitude of the positive signal driving the rectifiers.

If the 6 Volt supply decreases, the duty cycle becomes less positive. The average value of the secondary windings' signal drops. This increases the amplitude of the positive pulse driving the rectifiers.

Over Current Protection

Referring to Figure 1, the Soft Start components, C913, R907, and D905, also provide excessive load current protection.

Excessive load current causes a drop in all secondary voltages. The Regulator tries to compensate by increasing the ON time of Q901. However, the maximum ON time is limited by the charging of C913. The limitation reduces the signal from the secondary windings. When this occurs, the positive signal induced across the Sc winding is not large enough to turn Q901 ON and oscillation stops.

To restart the oscillator, the VCR must be disconnected from the AC line, and then reconnected. However, if the over current condition still exists, the oscillator will not start, or turns OFF immediately.

Over Voltage Protection

The Over Current Protection circuitry also protects circuit components if a defect causes excessive secondary voltage. D908, at pin 10 of T901, generates

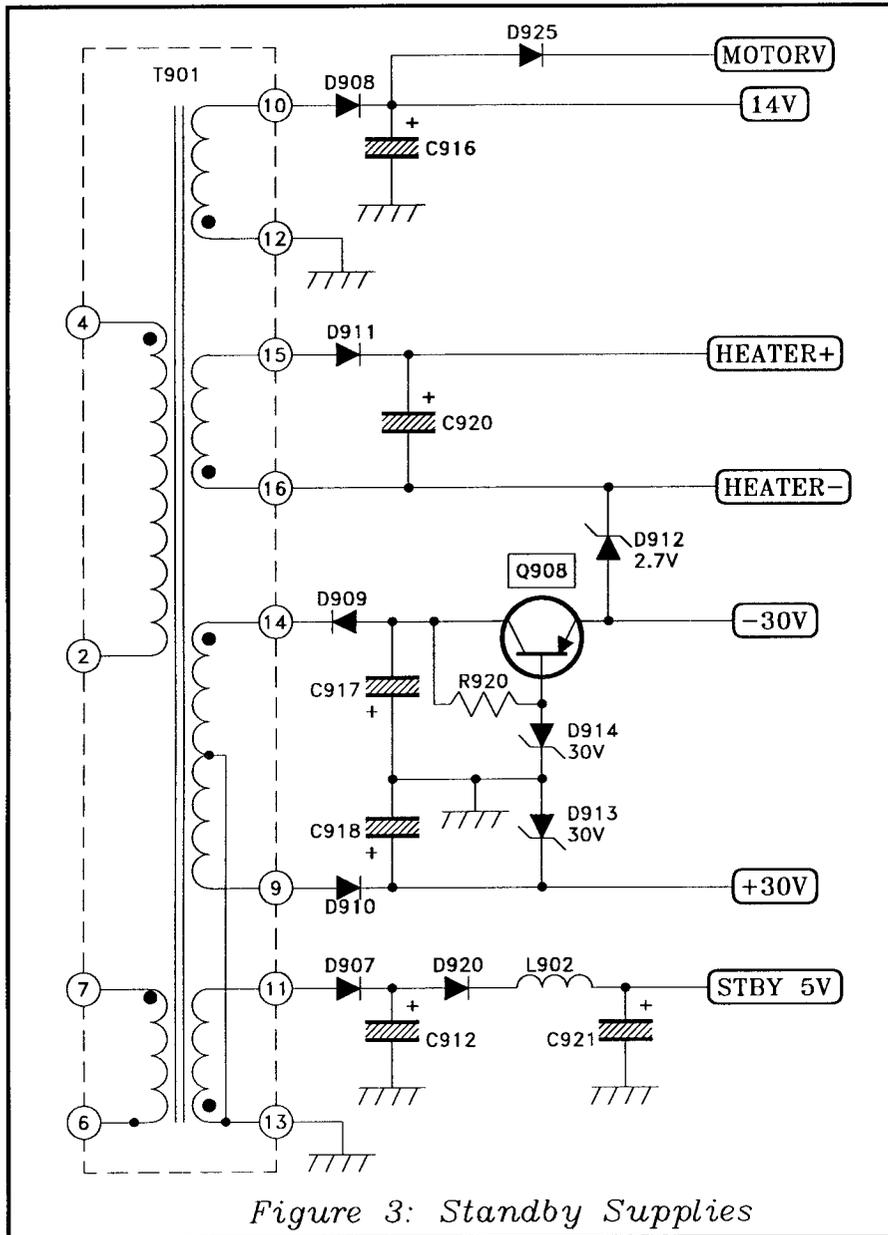


Figure 3: Standby Supplies

a 14 VDC supply. If the 14 Volt supply exceeds 16 volts, D926 conducts. The current through D926 causes an over current condition and the oscillator is switched OFF.

Standby Supplies

Standby Supplies are generated as long as the VCR is connected to the AC line. The Standby Supplies are generated in the secondary circuitry of T901, as shown in *Figure 3*. The Standby Supplies are:

- 14 Volts
- Positive and Negative Heater Voltage

- Positive and Negative 30 Volts
- 5 Volts

The circuits supplied by each of the Standby Supplies are listed in the Power Distribution Diagram on page 1.

Switched Supplies & ON/OFF Circuitry

The Switched DC Supplies are only activated when the VCR is switched ON. *Figure 4* illustrates the Switched Supplies, and the ON/OFF circuitry.

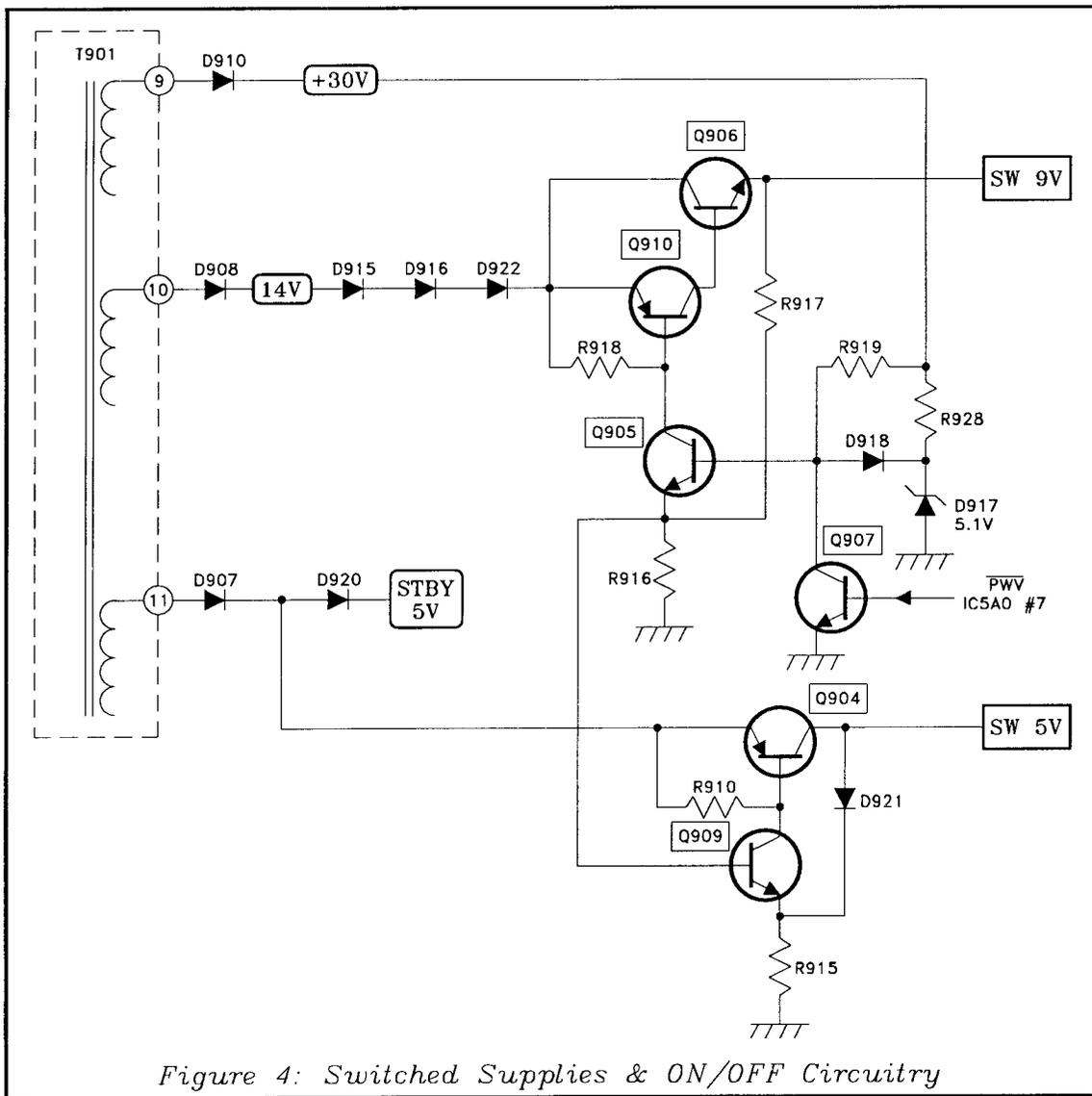


Figure 4: Switched Supplies & ON/OFF Circuitry

There are only two Switched Supplies generated:

- Switched 9 Volts -- derived from the Standby 14 Volt Supply
- Switched 5 Volts -- derived from the Standby 5 Volt Supply

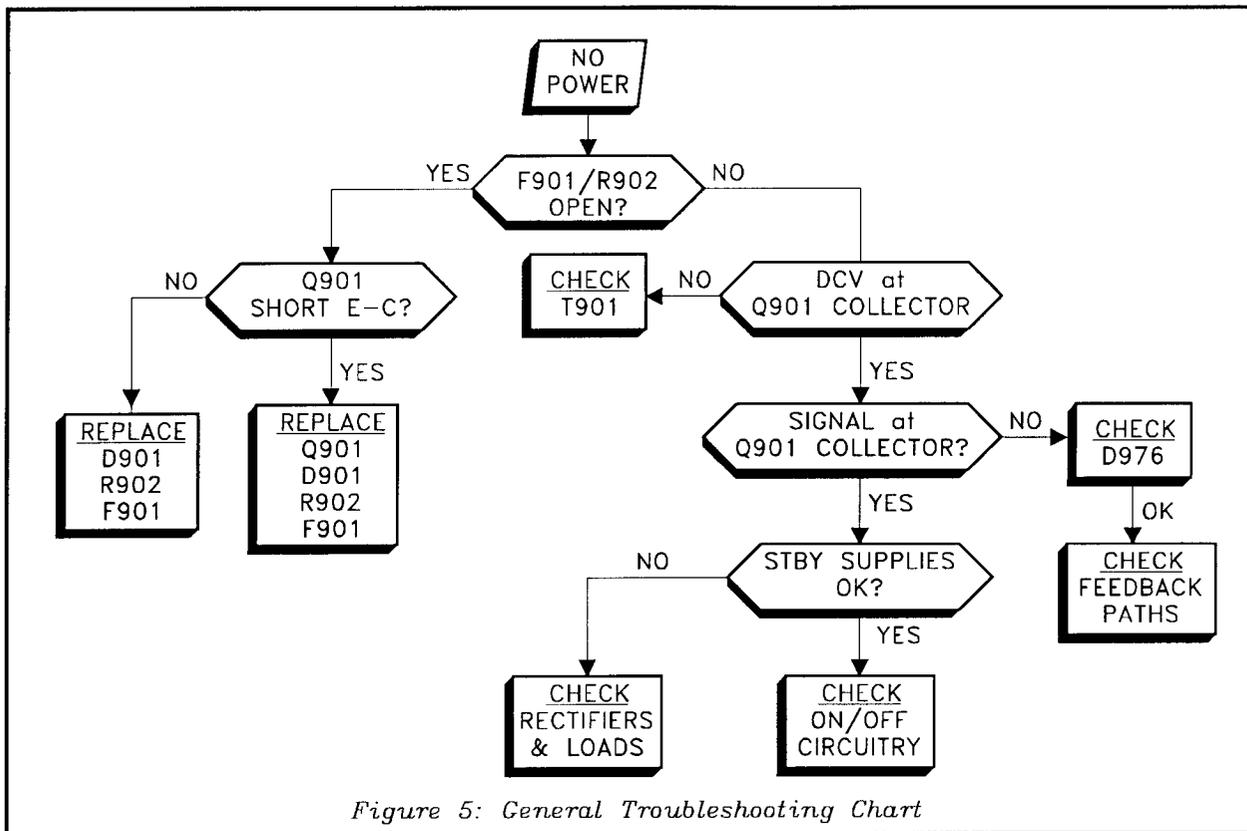
The following describes the Power ON sequence:

- 1) Power On button pressed -- logic on the PWV control line drops LOW.
- 2) The LOW turns Q907 OFF, which turns Q905 ON.
- 3) Q905 conduction activates the Switched 9 Volt and 5 Volt Regulators.
- 4) The drop in voltage at the collector of Q905 turns Q910 and Q906 ON.

- 5) The increase in voltage at the emitter of Q905 turns Q909, and Q904 ON.
- 6) Feedback from the 9 Volt line, through R917 to the emitter of Q905, regulates the 9 Volt supply.
- 7) D921 provides feedback to regulate the 5 Volt Regulator.

Troubleshooting

Probably the most common Switching Regulator problem is a dead set. *Figure 5* illustrates a general troubleshooting procedure for the Switching Regulator circuitry.



A short in the Regulator's primary winding circuit usually results in an open fuse (F901), and/or an open R902. The most common causes of a short, are the Bridge Rectifier (D901), and the oscillator transistor (Q901).

When F901 and R902 are OK, check for a waveform at the collector of Q901. If there is no waveform, and the collector of Q901 reads a constant 150 Volts:

- Q901 may be open, or
- Over Voltage Protect may be activated.

The most probable cause of Protection circuit activation is zener diode D926. If D926 checks OK,

incorrect feedback may be the problem. Check the components in the feedback paths to Q901.

If the signal at the collector of Q901 is approximately 150 Vp-p at 50KHZ, check the Standby Supplies. Check the rectifier, and load, of any Standby Supply that is incorrect.

If all the Standby Supplies are correct, it points to a problem in the ON/OFF circuitry, or in the Switched Supply Regulators.

The flow chart may not solve all your problems in the Switching Regulator circuitry, but it does point you in the right direction when a problem is encountered.