

Overdrive Recovery Explanation
 Overdrive occurs only when an input is driven negative enough to turn off either X31 or X32. The amplifier half with the more positive input always remains linear. If a negative signal causes X31 to give up all its current and turn off, the feedback path is shortened to X29, X9 lower emitter, and either X3 or X5 depending upon the gain selection. The now-closed loop generates no thermal errors.

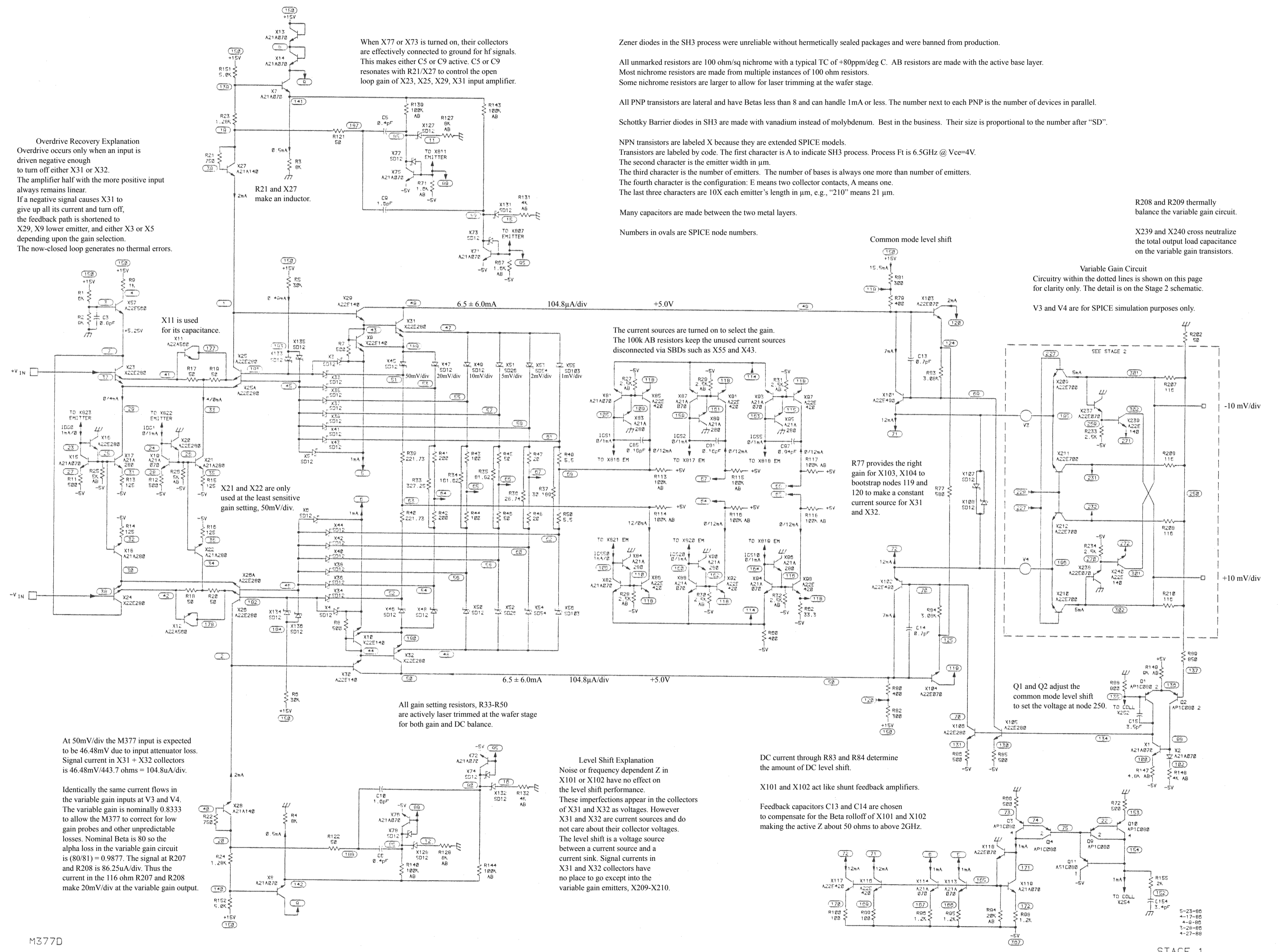
When X77 or X73 is turned on, their collectors are effectively connected to ground for hf signals. This makes either C5 or C9 active. C5 or C9 resonates with R21/X27 to control the open loop gain of X23, X25, X29, X31 input amplifier.

Zener diodes in the SH3 process were unreliable without hermetically sealed packages and were banned from production. All unmarked resistors are 100 ohm/sq nichrome with a typical TC of +80ppm/deg C. AB resistors are made with the active base layer. Most nichrome resistors are made from multiple instances of 100 ohm resistors. Some nichrome resistors are larger to allow for laser trimming at the wafer stage.

All PNP transistors are lateral and have Betas less than 8 and can handle 1mA or less. The number next to each PNP is the number of devices in parallel. Schottky Barrier diodes in SH3 are made with vanadium instead of molybdenum. Best in the business. Their size is proportional to the number after "SD". NPN transistors are labeled X because they are extended SPICE models. Transistors are labeled by code. The first character is A to indicate SH3 process. Process Ft is 6.5GHz @ Vce=4V. The second character is the emitter width in μm. The third character is the number of emitters. The number of bases is always one more than number of emitters. The fourth character is the configuration: E means two collector contacts, A means one. The last three characters are 10X each emitter's length in μm, e.g., "210" means 21 μm.

R208 and R209 thermally balance the variable gain circuit. X239 and X240 cross neutralize the total output load capacitance on the variable gain transistors.

Numbers in ovals are SPICE node numbers.



R21 and X27 make an inductor. X11 is used for its capacitance.

X21 and X22 are only used at the least sensitive gain setting, 50mV/div.

The current sources are turned on to select the gain. The 100k AB resistors keep the unused current sources disconnected via SBDs such as X55 and X43.

Common mode level shift

Variable Gain Circuit
 Circuitry within the dotted lines is shown on this page for clarity only. The detail is on the Stage 2 schematic.

V3 and V4 are for SPICE simulation purposes only.

At 50mV/div the M377 input is expected to be 46.48mV due to input attenuator loss. Signal current in X31 + X32 collectors is 46.48mV/443.7 ohms = 104.8uA/div.

Identically the same current flows in the variable gain inputs at V3 and V4. The variable gain is nominally 0.8333 to allow the M377 to correct for low gain probes and other unpredictable losses. Nominal Beta is 80 so the alpha loss in the variable gain circuit is (80/81) = 0.9877. The signal at R207 and R208 is 86.25uA/div. Thus the current in the 116 ohm R207 and R208 make 20mV/div at the variable gain output.

All gain setting resistors, R33-R50 are actively laser trimmed at the wafer stage for both gain and DC balance.

Level Shift Explanation
 Noise or frequency dependent Z in X101 or X102 have no effect on the level shift performance. These imperfections appear in the collectors of X31 and X32 as voltages. However X31 and X32 are current sources and do not care about their collector voltages. The level shift is a voltage source between a current source and a current sink. Signal currents in X31 and X32 collectors have no place to go except into the variable gain emitters, X209-X210.

DC current through R83 and R84 determine the amount of DC level shift.

X101 and X102 act like shunt feedback amplifiers.

Feedback capacitors C13 and C14 are chosen to compensate for the Beta rolloff of X101 and X102 making the active Z about 50 ohms to above 2GHz.