THAT Corporation Design Note 115

A Fully Adjustable Compressor / Limiter

The circuits within this application note feature THAT4301 Analog Engine® to provide the essential elements of voltage-controlled amplifier (VCA) and rms-level detector (RMS). Since writing this note, THAT has introduced several new models of Analog Engines, as well as new VCAs. With minor modifications, these newer ICs are generally applicable to the designs shown herein, and may offer advantages in performance, cost, power consumption, etc., depending on the design requirements. As well, a standalone RMS is available to complement our standalone VCAs. We encourage readers to consider the following alternatives in addition to the 4301:

- Low supply voltage and power consumption: 4320
- Low cost, supply voltage, and power consumption: 4315
- Low cost and power consumption: 4305
- High-performance (VCA only): 2180-series, 2181-series
- Dual (VCA only): 2162
- RMS (standalone): 2252

For more information about making these substitutions, please contact THAT Corporation's technical support group at apps_support@thatcorp.com.

THAT Corporation

45 Sumner St, Milford, MA 01757-1656 USA; www.thatcorp.com; info@thatcorp.com

Document 600148 Revision 05

This design demonstrates a full-blown compressor/limiter with some neat bells and whistles. With a THAT 4301 at its heart, excellent performance is coupled with reduced parts count and minimal cost.

A non-linear capacitor circuit is used to provide low distortion for slow moving signals, but fast action in the presence of rapidly changing signal levels.

D5, when placed inside OA1's feedback loop by SW2A, creates a conventional hard-knee threshold response. When SW2A is in its other position, D5 is outside the op amp feedback loop, and an offset generated by D1 is injected into the summing node of OA1 that compensates for the D5's forward drop. The resulting "soft knee" is a consequence of the turn-on characteristic of the diode.

The network comprising R25, R31, and either R16 or R28 combine with the variable source impedance of VR7 to yield a 4:1 compression ratio when VR7 is centered.

Two timing modes are available -- auto and manual. In auto mode, the output of VR7 is connected to R16 via SW3. Attack and release rates are linked, and depend on the design of the non-linear capacitor circuit (see Design Note DN114 for more design information on the non-linear capacitor circuit).

In manual mode, variable, independent adjustment of the attack and release dynamics are achieved by setting SW3 to steer the side-chain signal through the discrete transistor circuitry on the right side of the accompanying schematic. This circuit consist of a pair of adjustable current mirrors, a diode bridge to steer either the attack or the release current onto the storage capacitor C18, a FET to buffer the capacitor's voltage, and a feedback loop to maintain DC accuracy.

Q1 and Q3 are the mirror for the attack current. Q7 reduces bias current errors. R38, R73, R71, Q1, Q3, and Q7 give linear pot VR2 a logarithmic characteristic for setting the attack rate.

The release circuitry is a PNP-based, mirrored version of the attack circuitry.

To make a two-channel stereo compressor, one need only duplicate the circuitry shown and provide a means to link the two RMS detectors at their CT pins*. Such coupling results in true power summing and a more euphonic behavior. Note that, when linking detectors in this manner, means to adjust for the +/-3 dB tolerance on each detectors' 0 dB reference level must be provided.

*See THAT Design Note 116 for more information about true RMS power summing.

A Fully Adjustable Compressor / Limiter