Single Chip Automatic Gain Control

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.

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AGCs, as a rule, maintain a constant output signal level while the input signal level varies. This circuit is essentially a limiter operated most of the time above its threshold.

Gain control is accomplished by connecting the output of the RMS detector to the negative control port of the VCA. In a feed forward topology, the gain is then reduced by the same amount that the input level increases, keeping the output level constant. The RMS detector, which senses the level of the input signal, is set for a 0db reference level of -10dBu. This level is essentially arbitrary, and allows for convenient component values and signal levels. The timing current is determined by the equation:

$I_t = \frac{15V}{2M\Omega}$, and the 0dB input reference current is related to It by

$Iin_{0dB} = 1.13 \times I_t$.

If we set VinOdB = -10dBu as the reference input signal voltage, then we can calculate the input reference current as

$$Iin_{0dB} = 0.775 \times 10^{\frac{-10}{20}} \approx 0.245\ V_{rms}.$$

Using this result, the value of the RMS-Detector's input voltage-to-current resistor becomes

$$R1 = \frac{Vin_{0dB}}{Iin_{0dB}} = \frac{0.245}{8.5\mu A} \approx 28.8k\Omega$$

This setting will result in the RMS detector having zero volts out when the input signal level is -10dBu (corresponding to unity gain in the VCA).

The threshold amplifier has been modified to have an offset injected through R5 that sets the nominal threshold to -40 dBu, and VR2 allows this level to be adjusted by ±10dBu. The threshold amplifiers output, at the junction of D1, R2 and R6, is zero volts when the input signal is below the threshold level, but decreases so as to reduce the gain of the VCA to just compensate for the increase in the input signal the input signal once the input exceeds threshold.

VR4 allows the user to set the nominal gain. The remainder of the circuit functions essentially the same as the compressor/limiter mentioned in the THAT4301's datasheet. See the datasheet for details.

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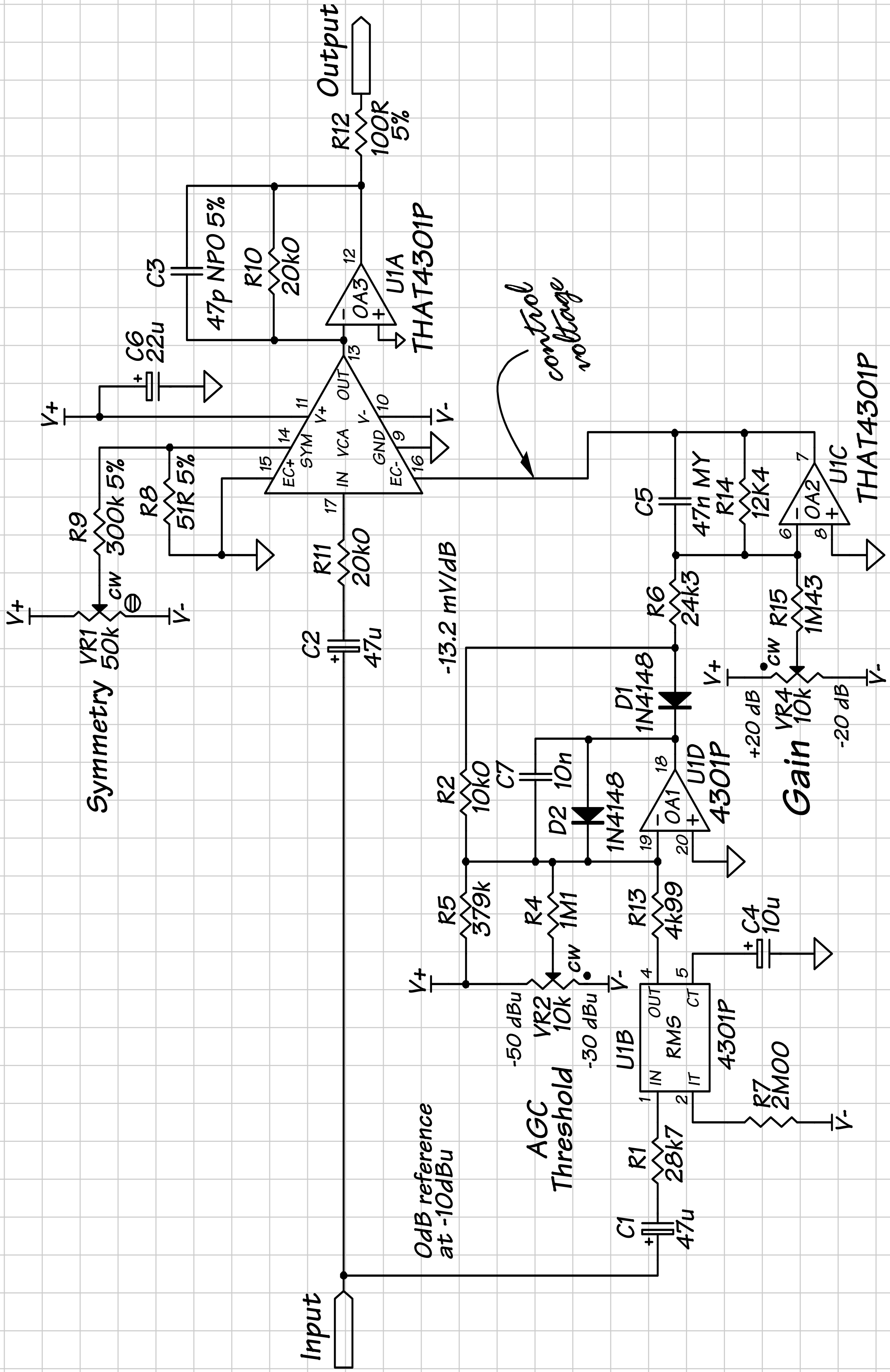

A simple AGC circuit using the THAT4301