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ADVANCED ANALOG

Model 590
RMS-to-DC Converter

DESCRIPTION

The Model 590 performs a true-RMS AC-to-DC conversion with excellent accuracy over a wide frequency range. The input voltage waveform can be any combination of both AC and DC up to peak values of ±10V. The output is a DC voltage level proportional to the true-RMS value of the input. Mid-band accuracy (500Hz—20kHz) is 0.2% and the crest factor rating is 10 to 1 with an input of 1V rms.

FEATURES

- **Excellent Accuracy**
  Maximum error of ±2mV plus 0.2% of reading, 0 to 7V rms
- **Wide Frequency Response**
  Rated accuracy of 0.2% from 500Hz to 10kHz
- **Bandwidth of 120kHz**

APPLICATIONS

The RMS value of a signal is proportional to the energy content. So RMS values are particularly important in noise measurements, such as:

- Audio Noise (Noise Pollution)
- Electrical Noise (Random or Periodic)
- Mechanical Noise (Vibration Instrumentation)

The energy content within various frequency bands is generally the most important information.

In addition, RMS-to-DC converters are used to measure audio distortion and to control audio levels. The wide dynamic range and excellent accuracy of the Model 590 make it ideal for use in high-quality audio instrumentation.

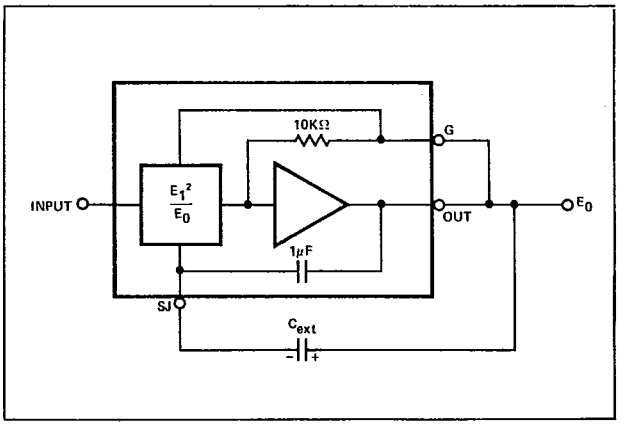
THEORY OF OPERATION

The input voltage is squared, then low-pass filtered to obtain the average value (see Figure 1). The square root is then extracted and the output voltage is:

$$E_0 = \sqrt{(E_1)^2}$$

The input voltage E_1 can contain both AC and DC terms; the only restriction is that the signal frequencies must be much higher than the cut-off frequency of the low-pass filter. The internal low-pass filter has a time constant of 10msec, and this can be increased by adding external capacitors (see LOW FREQUENCY OPERATION). Lowering the cut-off frequency extends the operation to lower frequencies, but will also increase the response time. The RMS-to-DC conversion is performed by solid-state operational circuitry, so the response time is very short compared with thermal techniques.

Accuracy varies with both signal amplitude and frequency, so the error is specified in terms of a constant value plus a percentage of reading. The combined error is then applied as a boundary over a specific frequency range.



SPECIFICATIONS

(Typical @ 25°C and with rated power supplies, unless otherwise noted)

Model	590
TRANSFER FUNCTION	DC output = RMS of input[1]
ACCURACY and STABILITY	
Input Range: 0 to 3.5V rms	Max Errors:
DC[1] to 20KHz	±2mV plus ±0.2% of Reading
Input Range: 3.5 to 7.0V rms	
DC[1] to 10KHz	±2mV plus ±0.2% of Reading
10KHz to 20KHz	±5mV plus ±0.5% of Reading
vs. Temperature	±100μV plus ±0.01% of Reading/°C
vs. Supply	±100μV plus ±0.01% of Reading/%ΔV_S
INPUT	
Input Voltage Range	
Peak Input Voltage	±10V peak
Crest Factor	10
Input Impedance	5KΩ
OUTPUT	
Rated Output — Voltage	0 to +10V
— Current	5mA
Output Impedance	1Ω
FREQUENCY RESPONSE	
Rated Accuracy	
Full Scale Input	10KHz
±1% Accuracy	20KHz
−3dB Bandwidth	120KHz
Internal Filter Time Constant	10msec
External Filter Time Constant	10msec/μF
TEMPERATURE RANGE	
Rated	0 to +70°C
Operating	−25 to +85°C
Storage	−55 to +100°C
POWER SUPPLY	
Rated	±15V
Operating	±14 to ±16V
Quiescent Drain	±7mA

NOTES:
1. Model 590 will operate on DC inputs. Low frequency input signals (below 500Hz) may require the addition of external capacitors to preserve accuracy. See LOW FREQUENCY OPERATION.
2. Over 0°C to +70°C: double for the −25°C to +85°C range.

EXTERNAL ADJUSTMENTS

OUTPUT OFFSET

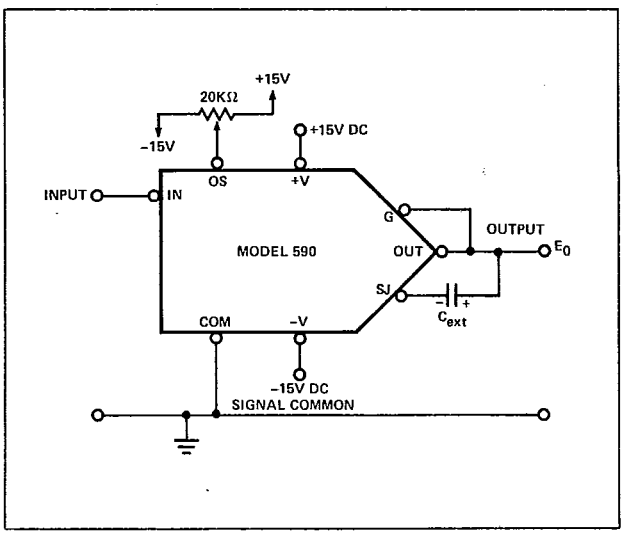
Connect the input to common and adjust the OUTPUT OFFSET pot shown in Figure 2 to make the output E_0 zero. The range of adjustment is ±30mV.

CREST FACTOR

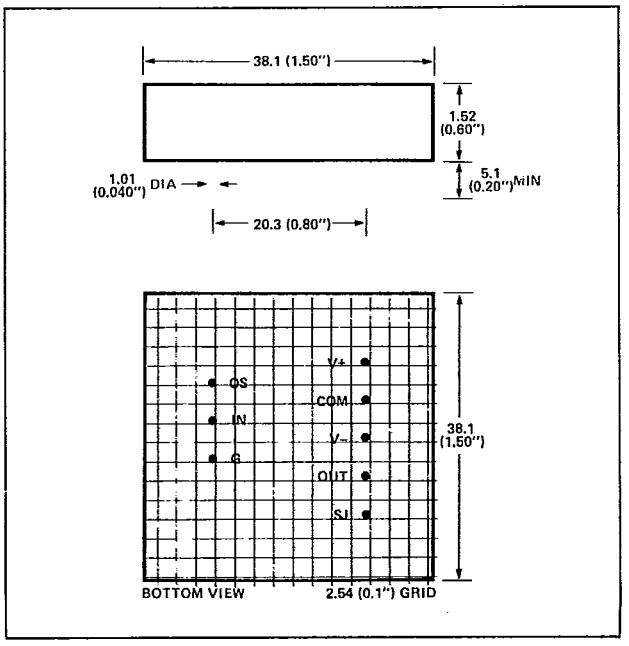
Crest factor of an input signal is the ratio of peak input to the RMS level. The peak input for the 590 is limited to ±10V, and the RMS level is limited to +10V by the output amplifier. Since the RMS level of a sine-wave is the peak value divided by $\sqrt{2}$, the crest factor for a sine-wave is $\sqrt{2}$. Low duty cycle pulse trains are an example of high crest factor waveforms. The crest factor of the 590 is 10 to 1 with inputs up to 1V rms.

LOW FREQUENCY OPERATION

The mid-band accuracy of the Model 590 is excellent; however, with low frequency signals (below 500Hz) applied, accuracy will suffer. This can be compensated by adding an external capacitor in the configuration shown in Figure 2 to increase the internal low-pass filter time constant. Since the output voltage is always positive, inexpensive electrolytic capacitors may be used. It should be noted that as capacitance is added externally to improve low frequency performance, response time is increased at the rate of 10ms/μF.



OUTLINE DIMENSIONS



Dimensions in millimeters (inches)

Case: Red epoxy
Pins: Gold flashed over silver plated, ½ hard brass
Weight: 1.5 oz.

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