TELEDYNE PHILBRICK

4370 ROOT MEAN SQUARE OPERATOR

Teledyne Philbrick Model 4370 converts the root-mean-square (rms) value of a signal to a proportional dc voltage, with an untrimmed accuracy of ±0.3% max. Optional trimming results in 0.15% accuracy. Virtually any waveform can be converted as long as the crest factor is 10 or below.

Applications for rms modules include measurement of audio distortion and rms power, or analysis of acoustic and seismic signals. In addition, the 4370 can be used to measure complex waveforms, such as SCR waveforms, power supply ripple, noise or vibration signals.

ACCURACY OF RMS MEASUREMENT

Sources of inaccuracy in rms measurement include input offset, gain error, nonlinearity, crest factor, and frequency. Offset and gain error can be trimmed for improved accuracy.

Crest factor is the ratio of the peak voltage to the rms value. In a perfect sinewave the crest factor is 1.414. As the crest factor increases, the error increases, as shown in Figure 2.

Accuracy at low frequencies can be improved by adding an external capacitor to increase the averaging time constant. The time constant should be at least as long as the period of the frequency being processed. The formula for determining the value of the capacitor is:

$$\text{Time Constant} = 20\ \text{msec} + [20\ \text{msec} \times \text{Ext. Cap}\ (\mu\text{F})]$$

Accuracy at high frequencies degrades, but is not affected by external capacitance. See Figure 3. Accuracy at high frequency is improved by having low level inputs (see specifications), and amplification in a following stage for required output level.

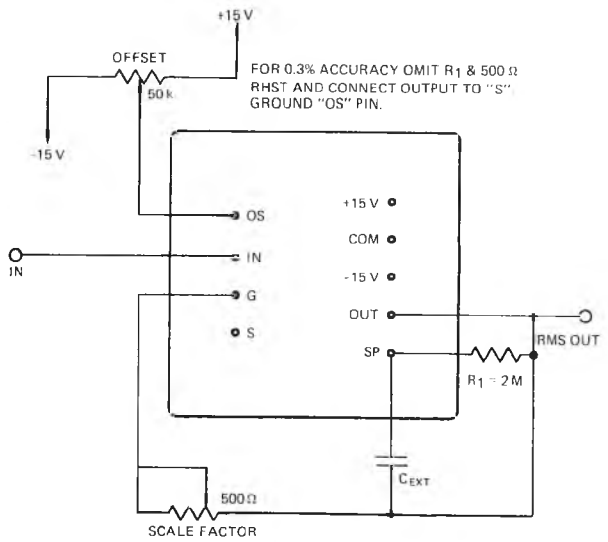


Figure 1. Connection Diagram

FEATURES

- 0.3% Error Untrimmed
- 0.15% Error Trimmed
- 500 kHz Bandwidth for 1% Accuracy
- Measures Signals With Crest Factors Up to 10

APPLICATIONS

- Noise Measurement
- Acoustic or Seismic Signal Analysis
- Measuring Complex Wave Forms
- Measuring RMS Power
- Measuring Audio Distortion

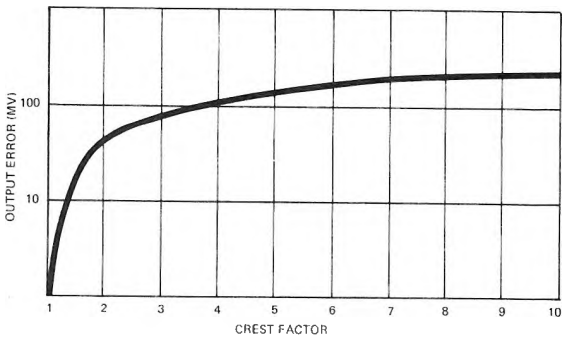


Figure 2. Output Error vs Crest Factor

SPECIFICATIONS Typical @ +25° C, ±15 V Supply, unless otherwise indicated

TRANSFER FUNCTION	E_O (VDC) = KE_{in} (VRMS)
Gain, K	1 VDC/VRMS
ACCURACY	
Max. Error (no ext. adj.)	10 mVDC + 0.2% of reading
Max. Error (with external offset & gain adj.)	5 mVDC + 0.1% of reading
Frequency for 1% Error	25 kHz (E_{in} = 7 VRMS)
Frequency for 1% Error	200 kHz (E_{in} = 0.7 VRMS)
Frequency for 1% Error	500 kHz (E_{in} = 0.07 VRMS)
Error vs. Crest Factor	See Figure 2
INPUT/OUTPUT	
Input Voltage Range	±10 V peak
Input Impedance	2 kΩ
Output Voltage Range	0 to +10 V
Output Current	5 mA
Output Filter Time Constant	20 msec (1 μf, 20 kΩ)
OUTPUT STABILITY	
Offset vs. Temperature	100 μV/°C
Scale Factor vs. Temperature	0.01%/°C
Supply Rejection	1 mV/%
POWER SUPPLY	
Rated	±14.7 to ±15.3 VDC
Operation	±12 to ±18 VDC
Recommended Philbrick Power Supply	2209 (P.C. mounting) or 2403 (chassis mounting)
TEMPERATURE	
Rated	0°C to +70°C
Storage	-55°C to +100°C

The input circuits of these units are protected to ±Vcc. Output circuits are short-circuit protected to ground.

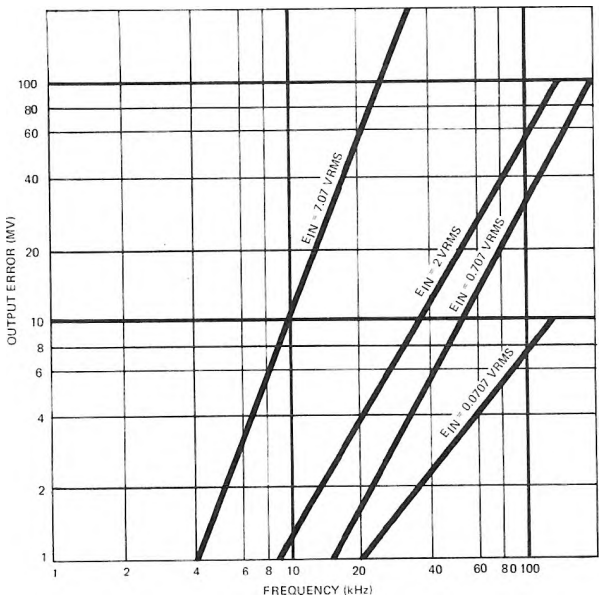
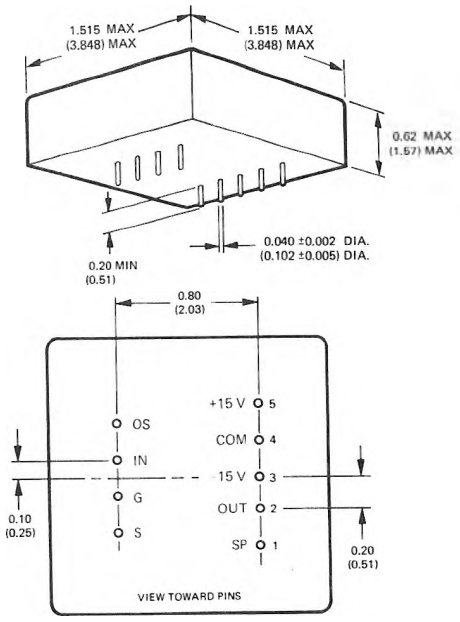
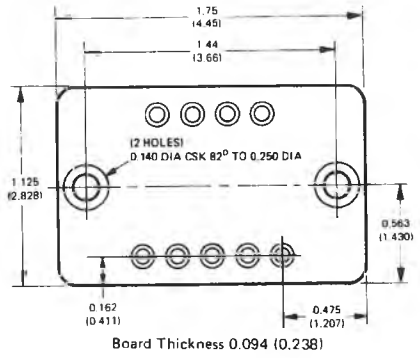


Figure 3. Output Error vs Frequency



±0.01 Non-cumulative tolerance between pins
±0.02 Tolerance from case edge to center of pins

Optional Socket: NSK-20



DIMENSIONS IN PARENTHESES ARE EXPRESSED IN CENTIMETERS

OPTIONAL GAIN & OFFSET TRIMMING
(See Figure 1).

Output Offset Trimming
Ground Input pin and adjust 50 kΩ potentiometer for zero volts output.

Gain Trimming
Apply +1.0 VDC to the Input pin, and adjust 500 Ω rheostat for an output that equals the input. Do the same for a -1.0 VDC input. Adjust for best compromise.

TELEDYNE PHILBRICK