Accurate, Wideband Multiplier, Divider, Square Rooter

Model 429

FEATURES:
1.0%10.5% Accuracy Without Trimming (429A/B)
Low Drift to 1.0mV/°C max
Wideband - 10MHz
0.2% Nonlinearity max (429B)
External Amplifiers Not Required
MTBF: 169, 268 Hours

APPLICATIONS:
Fast Divider
Modulation and Demodulation
Phase Detection
Instrumentation Calculations
Analog Computer Functions
Adaptive Process Control
Trigonometric Computations

GENERAL DESCRIPTION

The Model 429, an extremely fast multiplier/divider, should be considered if bandwidth, temperature coefficient, or accuracy are critical parameters. Based on the transconductance principle to achieve high speed, the model 429 offers a unique combination of features, those being ½% max error (429B) and 10MHz small signal bandwidth.

Both models 429A and 429B are internally trimmed achieving max errors of 1.0% and 0.5 % respectively. By fine trimming the offset and feedthrough with external trim potentiometers typical performance may be improved to 0.5% for the 429A and 0.2% for the 429B.In addition to high accuracy and high bandwidth, the model 429 offers exceptionally good stability for changes in ambient temperature. Model 429B is 100% temperature tested in order to guarantee an overall accuracy temperature coefficient of only 0.04%/"C max. Additionally, offset drift is held to only I mV/°C max. To satisfy OEM requirements of low cost, the 429 uses transconductance principles with the latest design techniques and components to achieve guaranteed performance at competitive prices.

MULTIPLICATION ACCURACY

Multiplication accuracy is generally specified as a percentage of full scale output. This implies that error is independent of signal level. However, for signal levels less than 2/3 of full scale, error tends to decrease roughly in proportion to the input signal. A good approximation of error behavior is:

$f(X, Y) \approx |X| \in_X, + |Y| \in_Y$, where $\in_X$ and $\in_Y$ are the fractional onlinearities specified for the X and Y inputs

EXAMPLE.- For Model 429A $\in_X = 0.5$ %, $\in_Y = 0.3$%. What maximum error can one expect for x = 5V, y = 1V, providing the offset is zeroed out? Can one get less by interchanging inputs?

1. Nominal output is XY/10 = (5)(1)/10 = 50mV
2. Expected error is (5) (0.5%) + (1) (0.3%)

   28mV, 5.6% of output (0.28% of F.S.)
3. Interchanging inputs (1) (0.5%) + (5) (0.3%) =

   20mV, 4.0% of output (0.20% of F.S.)

Compare this with the overly conservative error predicted by the overall 1% of full scale specification: 100mV, or 20% of output.

FREQUENCY RELATED SPECIFICATIONS

Accuracy, and its components, feedthrough, linearity, gain, (and phase shift) are frequency dependent. Feedthrough is constant up to 100kHz for the Y input, and up to 400kHz for the X input. Beyond these frequencies it rises at approximately a 6dB/octave rate due to distributed capacitive coupling. A plot of typical feedthrough vs. frequency is shown in Figure 1. For this measurement one input is driven with a 20V p-p sine wave while the other input is grounded and the feedthrough is measured at the output. This error will decrease roughly in proportion to the input signal, and will also vary with temperature (about 0.01%/°C of the nonzero input). Low frequency feedthrough error can be further reduced from the internally trimmed limits by the use of optional external potentiometers.

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