Low Cost Analog Multiplier

AD633

FEATURES

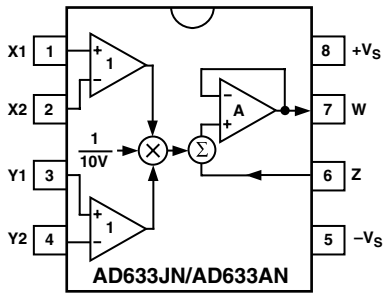
4-Quadrant Multiplication
Low Cost 8-Lead Package
Complete—No External Components Required
Laser-Trimmed Accuracy and Stability
Total Error within 2% of FS
Differential High Impedance X and Y Inputs
High Impedance Unity-Gain Summing Input
Laser-Trimmed 10 V Scaling Reference

APPLICATIONS

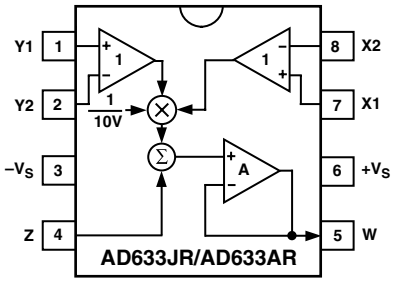
Multiplication, Division, Squaring
Modulation/Demodulation, Phase Detection
Voltage Controlled Amplifiers/Attenuators/Filters

CONNECTION DIAGRAMS

8-Lead Plastic DIP (N) Package



8-Lead Plastic SOIC (RN-8) Package



$$W = \frac{(X_1 - X_2)(Y_1 - Y_2)}{10V} + Z$$

PRODUCT DESCRIPTION

The AD633 is a functionally complete, four-quadrant, analog multiplier. It includes high impedance, differential X and Y inputs and a high impedance summing input (Z). The low impedance output voltage is a nominal 10 V full scale provided by a buried Zener. The AD633 is the first product to offer these features in modestly priced 8-lead plastic DIP and SOIC packages.

The AD633 is laser calibrated to a guaranteed total accuracy of 2% of full scale. Nonlinearity for the Y input is typically less than 0.1% and noise referred to the output is typically less than 100 µV rms in a 10 Hz to 10 kHz bandwidth. A 1 MHz bandwidth, 20 V/µs slew rate, and the ability to drive capacitive loads make the AD633 useful in a wide variety of applications where simplicity and cost are key concerns.

The AD633's versatility is not compromised by its simplicity. The Z-input provides access to the output buffer amplifier, enabling the user to sum the outputs of two or more multipliers, increase the multiplier gain, convert the output voltage to a current, and configure a variety of applications.

The AD633 is available in an 8-lead plastic DIP package (N) and 8-lead SOIC (R). It is specified to operate over the 0°C to 70°C commercial temperature range (J Grade) or the –40°C to +85°C industrial temperature range (A Grade).

PRODUCT HIGHLIGHTS

1. The AD633 is a complete four-quadrant multiplier offered in low cost 8-lead plastic packages. The result is a product that is cost effective and easy to apply.
2. No external components or expensive user calibration are required to apply the AD633.
3. Monolithic construction and laser calibration make the device stable and reliable.
4. High (10 MΩ) input resistances make signal source loading negligible.
5. Power supply voltages can range from ±8 V to ±18 V. The internal scaling voltage is generated by a stable Zener diode; multiplier accuracy is essentially supply insensitive.

REV. E

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AD633—SPECIFICATIONS (T_A = 25°C, V_S = ±15 V, $R_L \geq 2$ kΩ)

Model		AD633J, AD633A			
TRANSFER FUNCTION		$W = \frac{(X_1 - X_2)(Y_1 - Y_2)}{10\ V} + Z$			
Parameter	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
MULTIPLIER PERFORMANCE					
Total Error	–10 V ≤ X, Y ≤ +10 V		±1	**±2**	% Full Scale
T_{MIN} to T_{MAX}			±3		% Full Scale
Scale Voltage Error	SF = 10.00 V Nominal		±0.25%		% Full Scale
Supply Rejection	V_S = ±14 V to ±16 V		±0.01		% Full Scale
Nonlinearity, X	X = ±10 V, Y = +10 V		±0.4	**±1**	% Full Scale
Nonlinearity, Y	Y = ±10 V, X = +10 V		±0.1	**±0.4**	% Full Scale
X Feedthrough	Y Nulled, X = ±10 V		±0.3	**±1**	% Full Scale
Y Feedthrough	X Nulled, Y = ±10 V		±0.1	**±0.4**	% Full Scale
Output Offset Voltage			±5	**±50**	mV
DYNAMICS					
Small Signal BW	V_O = 0.1 V rms		1		MHz
Slew Rate	V_O = 20 V p-p		20		V/µs
Settling Time to 1%	Δ V_O = 20 V		2		µs
OUTPUT NOISE					
Spectral Density			0.8		µV/√Hz
Wideband Noise	f = 10 Hz to 5 MHz		1		mV rms
	f = 10 Hz to 10 kHz		90		µV rms
OUTPUT					
Output Voltage Swing		**±11**			V
Short Circuit Current	R_L = 0 Ω		30	**40**	mA
INPUT AMPLIFIERS					
Signal Voltage Range	Differential	**±10**			V
	Common Mode	**±10**			V
Offset Voltage X, Y			±5	**±30**	mV
CMRR X, Y	V_{CM} = ±10 V, f = 50 Hz	**60**	80		dB
Bias Current X, Y, Z			0.8	**2.0**	µA
Differential Resistance			10		MΩ
POWER SUPPLY					
Supply Voltage					
Rated Performance			±15		V
Operating Range		**±8**		**±18**	V
Supply Current	Quiescent		4	**6**	mA

Specifications shown in **boldface** are tested on all production units at electrical test. Results from those tests are used to calculate outgoing quality levels. All min and max specifications are guaranteed, although only those shown in **boldface** are tested on all production units.

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage . . . . . ±18 V
Internal Power Dissipation[2] . . . . . 500 mW
Input Voltages[3] . . . . . ±18 V
Output Short Circuit Duration . . . . . Indefinite
Storage Temperature Range . . . . . –65°C to +150°C
Operating Temperature Range
AD633J . . . . . 0°C to 70°C
AD633A . . . . . –40°C to +85°C
Lead Temperature Range (Soldering 60 sec) . . . . . 300°C
ESD Rating . . . . . 1000 V

NOTES

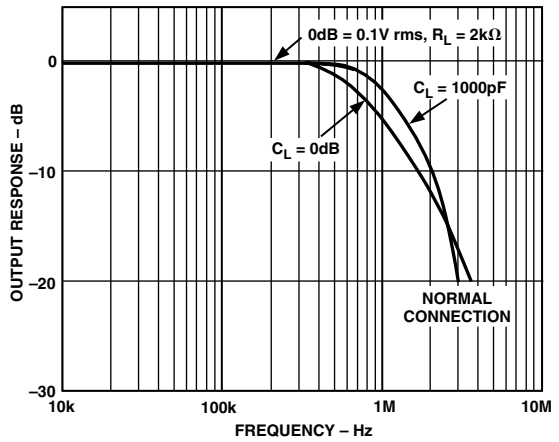
[1]Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied.

[2]8-Lead Plastic DIP Package: θ_{JA} = 90°C/W; 8-Lead Small Outline Package: θ_{JA} = 155°C/W.

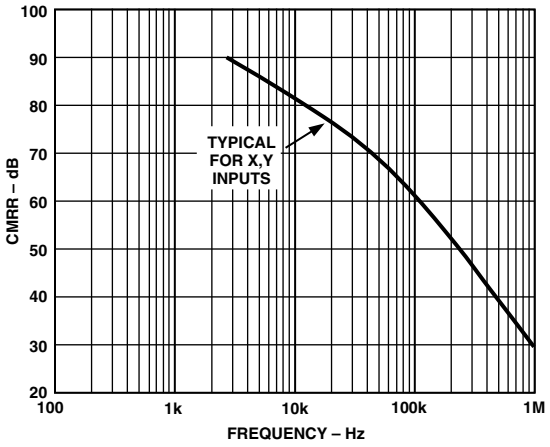
[3]For supply voltages less than ±18 V, the absolute maximum input voltage is equal to the supply voltage.

ORDERING GUIDE

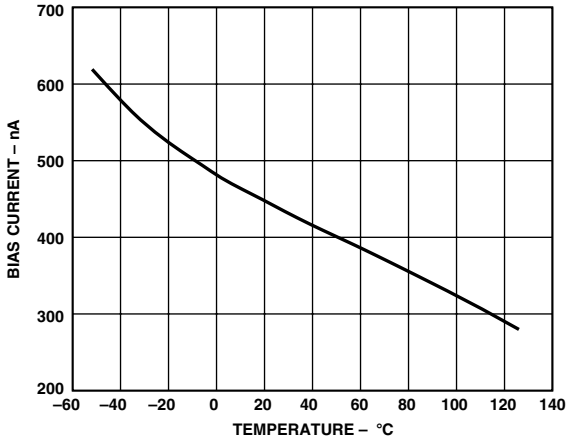
Model	Temperature Range	Package Description	Package Option
AD633AN	–40°C to +85°C	Plastic DIP	N-8
AD633AR	–40°C to +85°C	Plastic SOIC	RN-8
AD633AR-REEL	–40°C to +85°C	13" Tape and Reel	RN-8
AD633AR-REEL7	–40°C to +85°C	7" Tape and Reel	RN-8
AD633JN	0°C to 70°C	Plastic DIP	N-8
AD633JR	0°C to 70°C	Plastic SOIC	RN-8
AD633JR-REEL	0°C to 70°C	13" Tape and Reel	RN-8
AD633JR-REEL7	0°C to 70°C	7" Tape and Reel	RN-8



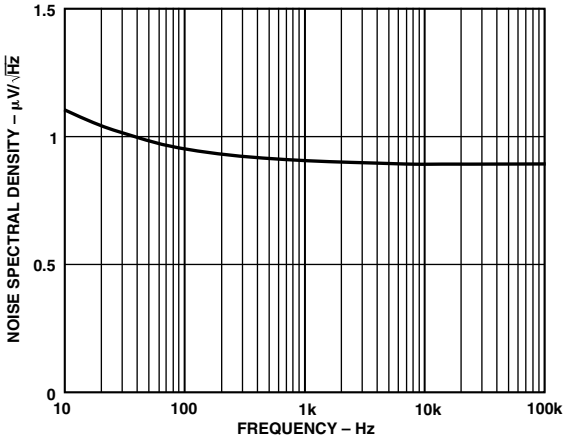
TPC 1. Frequency Response



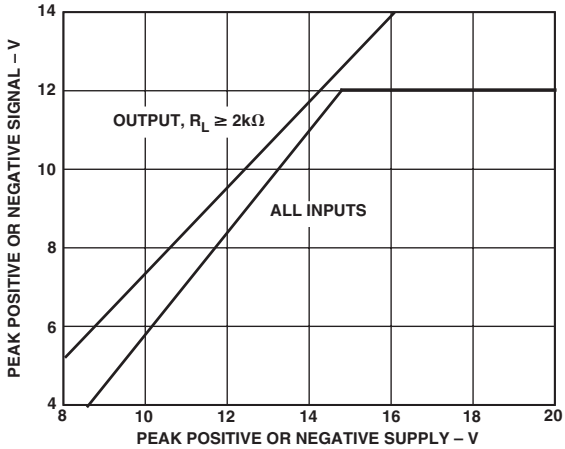
TPC 4. CMRR vs. Frequency



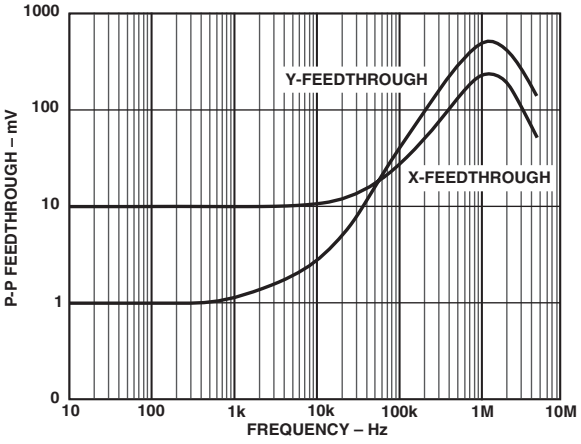
TPC 2. Input Bias Current vs. Temperature (X, Y, or Z Inputs)



TPC 5. Noise Spectral Density vs. Frequency



TPC 3. Input and Output Signal Ranges vs. Supply Voltages



TPC 6. AC Feedthrough vs. Frequency