Low Distortion Differential RF/IF Amplifier

Enhanced Product

AD8351-EP

FEATURES

−3 dB bandwidth of 2.2 GHz for A_V = 12 dB
Single-resistor programmable gain: 0 dB ≤ A_V ≤ 26 dB
Differential interface
Low noise input stage: 2.70 nV/√Hz at 70 MHz, A_V = 10 dB
Low harmonic distortion
- **−79 dBc second at 70 MHz**
- **−81 dBc third at 70 MHz**

Output third-order intercept (OIP3) of 31 dBm at 70 MHz
Single-supply operation: 3 V to 5.5 V
Low power dissipation: 28 mA at 5 V
Adjustable output common-mode voltage
Fast settling and overdrive recovery
Slew rate of 13,000 V/μs
Power-down capability

ENHANCED PRODUCT FEATURES

Supports defense and aerospace applications (AQEC standard)
Extended industrial temperature range: −55°C to +105°C
Controlled manufacturing baseline
1 assembly/test site
1 fabrication site
Product change notification
Qualification data available upon request

APPLICATIONS

Differential ADC drivers
Single-ended-to-differential conversion
IF sampling receivers
RF/IF gain blocks
Surface acoustic wave (SAW) filter interfacing

FUNCTIONAL BLOCK DIAGRAM

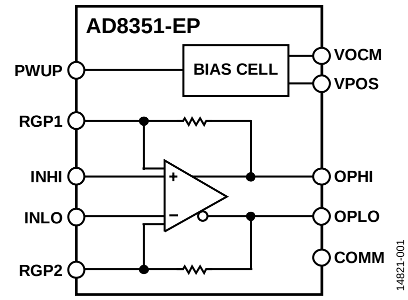

Figure 1.

GENERAL DESCRIPTION

The AD8351-EP is a low cost differential amplifier useful in RF and IF applications up to 2.2 GHz. The voltage gain can be set from unity to 26 dB using a single external gain resistor. The AD8351-EP provides a nominal 150 Ω differential output impedance. The excellent distortion performance and low noise characteristics of this device allow a wide range of applications.

The AD8351-EP is designed to satisfy the demanding performance requirements of communications transceiver applications. The device can be used as a general-purpose gain block, an ADC driver, and a high speed data interface driver, among other functions. The AD8351-EP can also be used as a single-ended-to-differential amplifier with similar distortion products as in the differential configuration. The exceptionally good distortion performance makes the AD8351-EP an ideal solution for 12-bit and 14-bit IF sampling receiver designs.

Fabricated in the Analog Devices, Inc., high speed XFCB process, the AD8351-EP has a high bandwidth that provides high frequency performance and low distortion. The quiescent current of the AD8351-EP is 28 mA typically. The AD8351-EP amplifier comes in a 16-lead LFCSP package, and operates over the temperature range of −55°C to +105°C.

Additional application and technical information can be found in the AD8351 datasheet.

Rev. A **Document Feedback**

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Technical Support **www.analog.com**

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REVISION HISTORY

9/2016—Rev. 0 to Rev. A

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7/2016—Revision 0: Initial Version

SPECIFICATIONS

V_S = 5 V, R_L = 150 Ω, R_G = 110 Ω (A_V = 10 dB), f = 70 MHz, T = 25°C, parameters specified differentially, unless otherwise noted. The gain (A_V) can be set to any value between 0 dB and 26 dB.

Table 1.

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
DYNAMIC PERFORMANCE					
−3 dB Bandwidth	A_V = 6 dB, V_{OUT} ≤ 1.0 V p-p		3000		MHz
	A_V = 12 dB, V_{OUT} ≤ 1.0 V p-p		2200		MHz
	A_V = 18 dB, V_{OUT} ≤ 1.0 V p-p		600		MHz
Bandwidth for 0.1 dB Flatness	0 dB ≤ A_V ≤ 20 dB, V_{OUT} ≤ 1.0 V p-p		200		MHz
Bandwidth for 0.2 dB Flatness	0 dB ≤ A_V ≤ 20 dB, V_{OUT} ≤ 1.0 V p-p		400		MHz
Gain Accuracy	Using 1% resistor for R_G, 0 dB ≤ A_V ≤ 20 dB		±1		dB
Gain Supply Sensitivity	V_S ± 5%		0.08		dB/V
Gain Temperature Sensitivity	−55°C to +105°C		3.9		mdB/°C
Slew Rate	R_L = 1 kΩ, V_{OUT} = 2 V step		13,000		V/μs
	R_L = 150 Ω, V_S = 2 V step		7500		V/μs
Settling Time	1 V step to 1%		<3		ns
Overdrive Recovery Time	V_{IN} = 4 V to 0 V step, V_{OUT} ≤ ±10 mV		<2		ns
Reverse Isolation (S12)			−67		dB
INPUT/OUTPUT CHARACTERISTICS					
Input Common-Mode Voltage Adjustment Range			1.2 to 3.8		V
Maximum Output Voltage Swing	1 dB compressed		4.75		V p-p
Output Common-Mode Offset			40		mV
Output Common-Mode Drift	−55°C to +105°C		0.24		mV/°C
Output Differential Offset Voltage			20		mV
Output Differential Offset Drift	−55°C to +105°C		0.13		mV/°C
Input Bias Current			±15		μA
Input Resistance[1]			5		kΩ
Input Capacitance[1]			0.8		pF
Common-Mode Rejection Ratio (CMRR)			43		dB
Output Resistance[1]			150		Ω
Output Capacitance[1]			0.8		pF
POWER INTERFACE					
Supply Voltage		3		5.5	V
PWUP Threshold			1.3		V
PWUP Input Bias Current	PWUP at 5 V		100		μA
	PWUP at 0 V		25		μA
Quiescent Current	−55°C to +105°C		28	35	mA
NOISE/DISTORTION					
10 MHz					
Second/Third Harmonic Distortion[2]	R_L = 1 kΩ, V_{OUT} = 2 V p-p		−95/−93		dBc
	R_L = 150 Ω, V_{OUT} = 2 V p-p		−80/−69		dBc
Third-Order Intermodulation Distortion (IMD)	R_L = 1 kΩ, f1 = 9.5 MHz, f2 = 10.5 MHz, V_{OUT} = 2 V p-p composite		−90		dBc
	R_L = 150 Ω, f1 = 9.5 MHz, f2 = 10.5 MHz, V_{OUT} = 2 V p-p composite		−70		dBc
Output Third-Order Intercept	f1 = 9.5 MHz, f2 = 10.5 MHz		33		dBm
Noise Spectral Density (Referred to Input (RTI))			2.65		nV/√Hz
1 dB Compression Point			13.5		dBm

Parameter	Test Conditions/Comments	Min	Typ	Max	Unit
70 MHz					
Second/Third Harmonic Distortion[2]	R_L = 1 kΩ, V_{OUT} = 2 V p-p		−79/−81		dBc
	R_L = 150 Ω, V_{OUT} = 2 V p-p		−65/−66		dBc
Third-Order IMD	R_L = 1 kΩ, f1 = 69.5 MHz, f2 = 70.5 MHz, V_{OUT} = 2 V p-p composite		−85		dBc
	R_L = 150 Ω, f1 = 69.5 MHz, f2 = 70.5 MHz, V_{OUT} = 2 V p-p composite		−69		dBc
Output Third-Order Intercept	f1 = 69.5 MHz, f2 = 70.5 MHz		31		dBm
Noise Spectral Density (RTI)			2.70		nV/√Hz
1 dB Compression Point			13.3		dBm
140 MHz					
Second/Third Harmonic Distortion[2]	R_L = 1 kΩ, V_{OUT} = 2 V p-p		−69/−69		dBc
	R_L = 150 Ω, V_{OUT} = 2 V p-p		−54/−53		dBc
Third-Order IMD	R_L = 1 kΩ, f1 = 139.5 MHz, f2 = 140.5 MHz, V_{OUT} = 2 V p-p composite		−79		dBc
	R_L = 150 Ω, f1 = 139.5 MHz, f2 = 140.5 MHz, V_{OUT} = 2 V p-p composite		−67		dBc
Output Third-Order Intercept	f1 = 139.5 MHz, f2 = 140.5 MHz		29		dBm
Noise Spectral Density (RTI)			2.75		nV/√Hz
1 dB Compression Point			13		dBm
240 MHz					
Second/Third Harmonic Distortion[2]	R_L = 1 kΩ, V_{OUT} = 2 V p-p		−60/−66		dBc
	R_L = 150 Ω, V_{OUT} = 2 V p-p		−46/−50		dBc
Third-Order IMD	R_L = 1 kΩ, f1 = 239.5 MHz, f2 = 240.5 MHz, V_{OUT} = 2 V p-p composite		−76		dBc
	R_L = 150 Ω, f1 = 239.5 MHz, f2 = 240.5 MHz, V_{OUT} = 2 V p-p composite		−62		dBc
Output Third-Order Intercept	f1 = 239.5 MHz, f2 = 240.5 MHz		27		dBm
Noise Spectral Density (RTI)			2.90		nV/√Hz
1 dB Compression Point			13		dBm

[1] Values are specified differentially.
[2] See the AD8351 data sheet for information about single-ended to differential operation.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Supply Voltage, VPOS	6 V
PWUP Voltage	VPOS
Internal Power Dissipation	320 mW
θ_{JA}	79.1°C/W
Maximum Junction Temperature	125°C
Operating Temperature Range	−55°C to +105°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature Range (Soldering, 60 sec)	300°C

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by this device is limited by the associated rise in junction temperature. Exceeding a junction temperature of 125°C for an extended period can result in device failure.

To ensure proper operation of the AD8351-EP, it is necessary to observe the maximum power derating curve (see Figure 2) to guarantee that the maximum junction temperature (125°C) is not exceeded under all conditions.

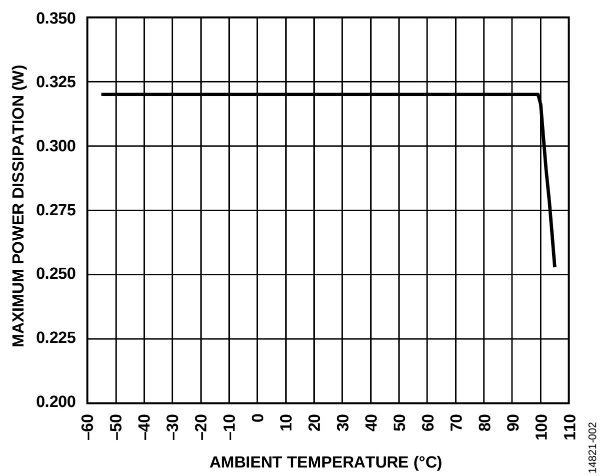
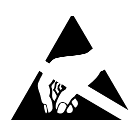


Figure 2. Maximum Power Dissipation vs. Temperature

ESD CAUTION



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

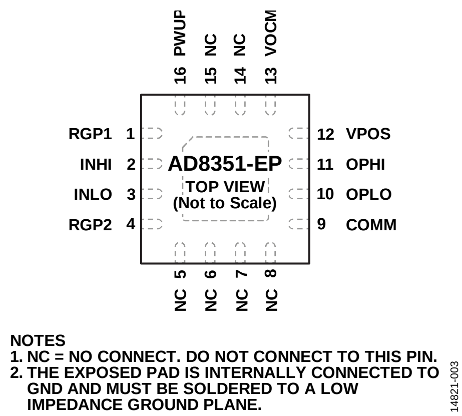


Figure 3. Pin Configuration

Table 3. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	RGP1	Gain Resistor Input 1.
2	INHI	Balanced Differential Input, High. Biased to midsupply, typically ac-coupled.
3	INLO	Balanced Differential Input, Low. Biased to midsupply, typically ac-coupled.
4	RGP2	Gain Resistor Input 2.
5, 6, 7, 8, 14, 15	NC	No Connect. Do not connect to this pin.
9	COMM	Device Common. Connect this pin to a low impedance ground.
10	OPLO	Balanced Differential Output, Low. Biased to VOCM, typically ac-coupled.
11	OPHI	Balanced Differential Output, High. Biased to VOCM, typically ac-coupled.
12	VPOS	Positive Supply Voltage. 3 V to 5.5 V.
13	VOCM	Input/Output Common-Mode Voltage. The voltage applied to this pin sets the common-mode voltage at both the input and output. This pin is typically decoupled to ground with a 0.1 μF capacitor.
16	PWUP	Apply a positive voltage (1.3 V ≤ V_{PWUP} ≤ VPOS) to activate the device.
	EPAD	Exposed Pad. The exposed pad is internally connected to GND and must be soldered to a low impedance ground plane.

TYPICAL PERFORMANCE CHARACTERISTICS

V_S = 5 V, T = 25°C, unless otherwise noted.

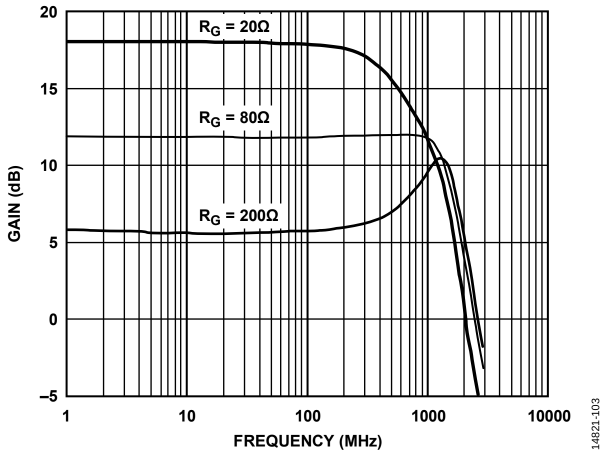


Figure 4. Gain vs. Frequency for a 150 Ω Differential Load (A_V = 6 dB, 12 dB, and 18 dB)

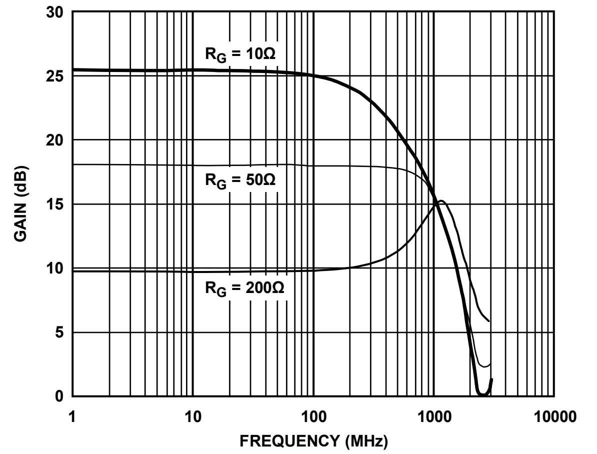


Figure 7. Gain vs. Frequency for a 1 kΩ Differential Load (A_V = 10 dB, 18 dB, and 26 dB)

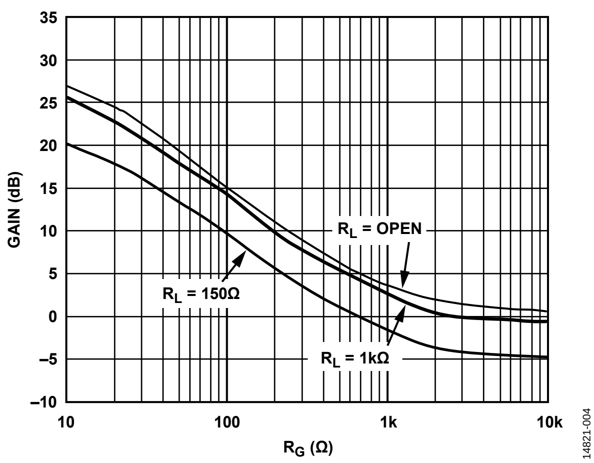


Figure 5. Gain vs. Gain Resistor, R_G (f = 100 MHz, R_L = 150 Ω, 1 kΩ, and Open)

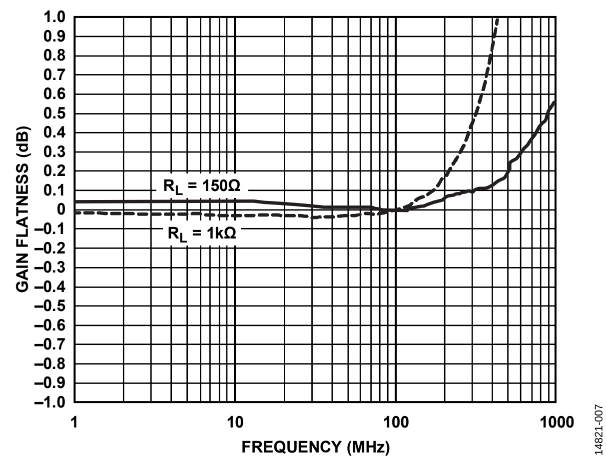


Figure 8. Gain Flatness vs. Frequency (R_L = 150 Ω and 1 kΩ, A_V = 10 dB)

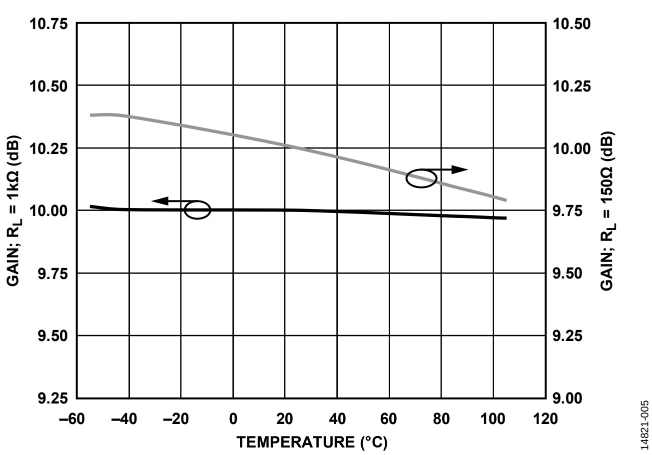


Figure 6. Gain vs. Temperature at 100 MHz (A_V = 10 dB)

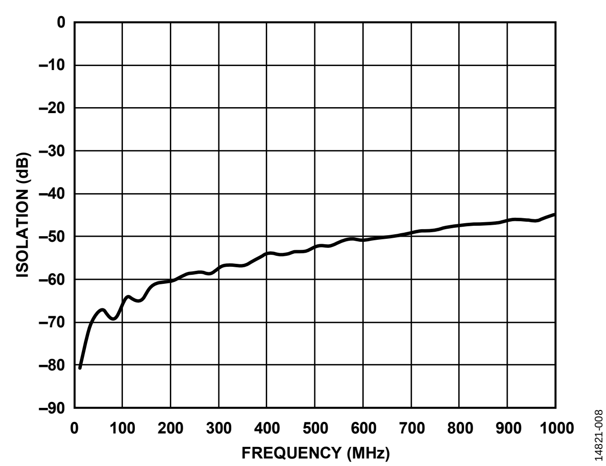


Figure 9. Isolation vs. Frequency (A_V = 10 dB)

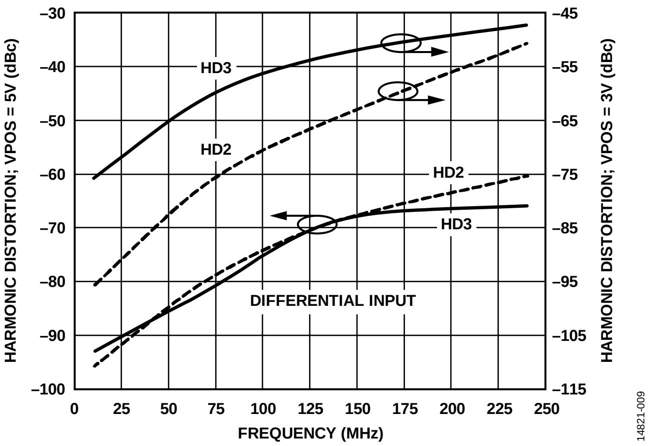


Figure 10. Harmonic Distortion vs. Frequency for 2 V p-p into R_L = 1 kΩ (A_V = 10 dB, at 3 V and 5 V Supplies)

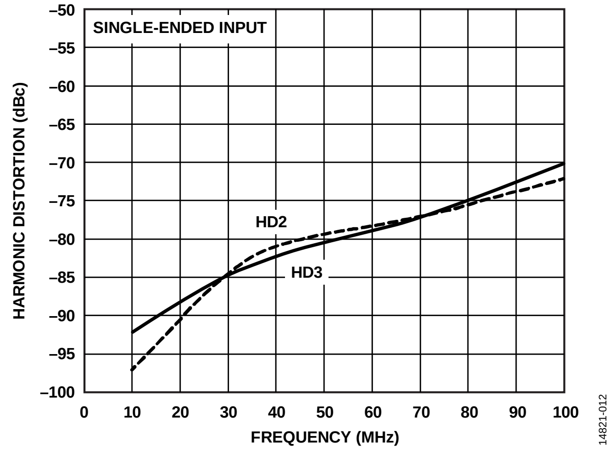


Figure 13. Harmonic Distortion vs. Frequency for 2 V p-p into R_L = 1 kΩ Using Single-Ended Input (A_V = 10 dB)

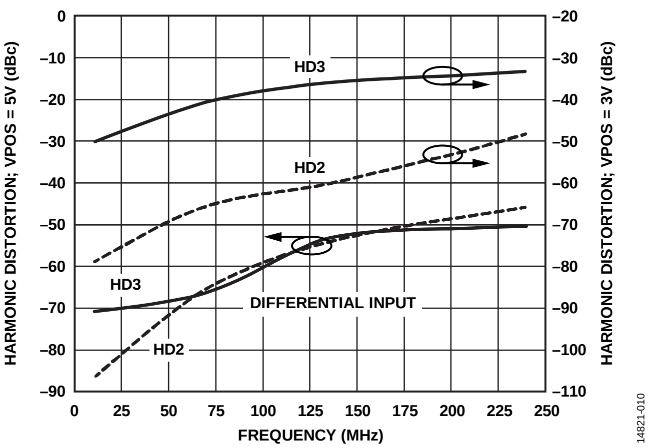


Figure 11. Harmonic Distortion vs. Frequency for 2 V p-p into R_L = 150 Ω (A_V = 10 dB)

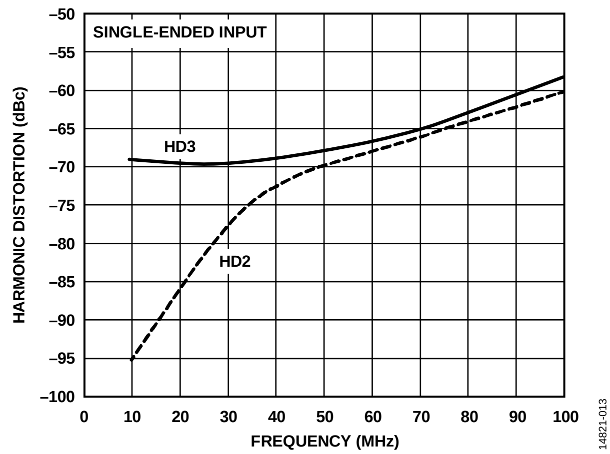


Figure 14. Harmonic Distortion vs. Frequency for 2 V p-p into R_L = 150 Ω Using Single-Ended Input (A_V = 10 dB)

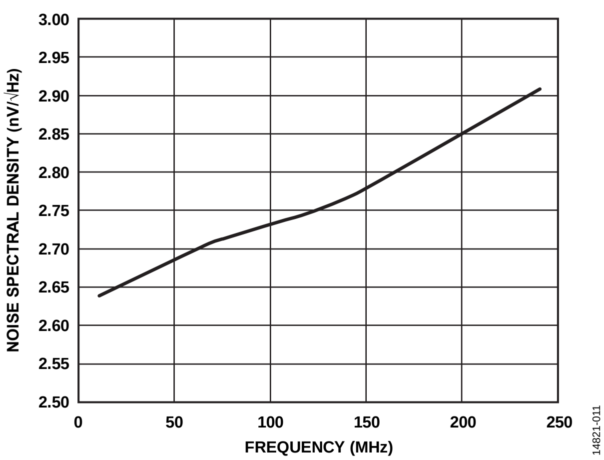


Figure 12. Noise Spectral Density (RTI) vs. Frequency (R_L = 150 Ω, 5 V Supply, A_V = 10 dB)

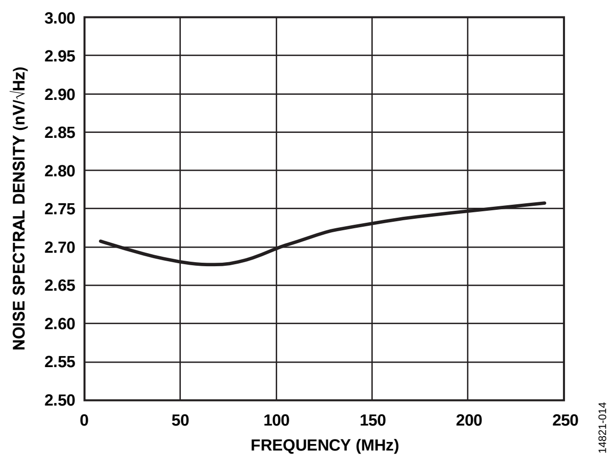


Figure 15. Noise Spectral Density (RTI) vs. Frequency (R_L = 150 Ω, 3 V Supply, A_V = 10 dB)

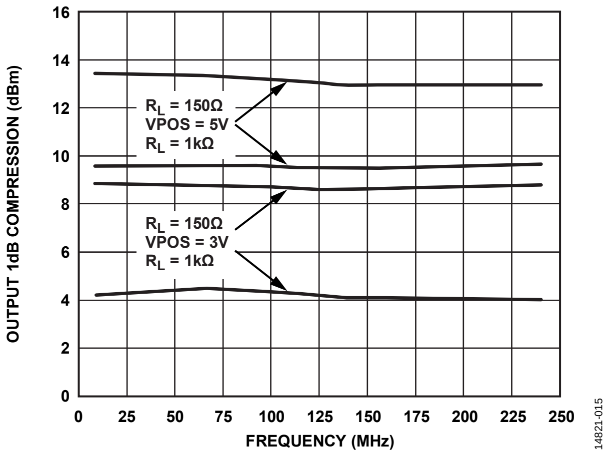


Figure 16. Output 1 dB Compression (P1dB) vs. Frequency (R_L = 150 Ω and 1 kΩ, A_V = 10 dB, at 3 V and 5 V Supplies)

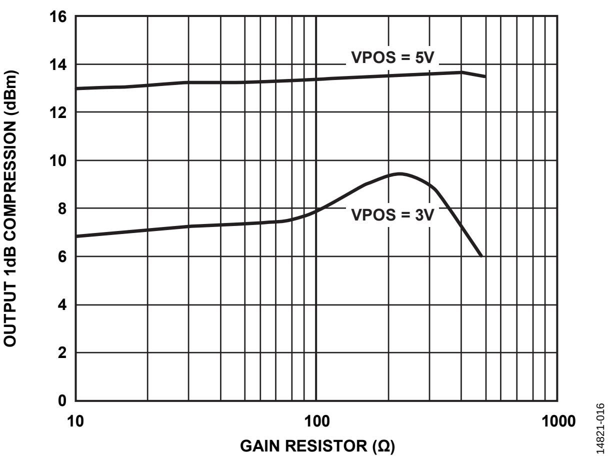


Figure 17. Output 1 dB Compression (P1dB) vs. Gain Resistor (R_G) (f =100, R_L = 150 Ω, A_V = 10 dB, at 3 V and 5 V Supplies)

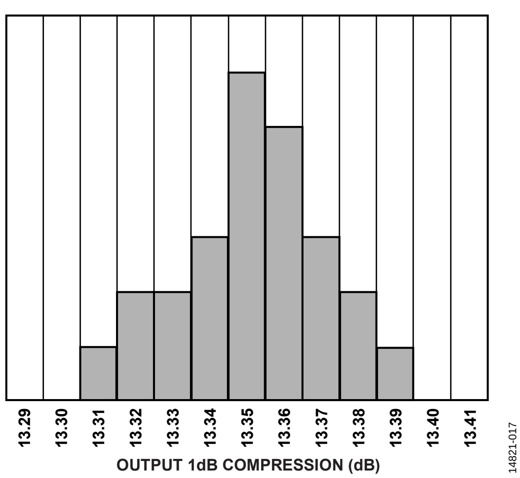


Figure 18. Output Compression Point Distribution (f = 70 MHz, R_L = 150 Ω, A_V = 10 dB)

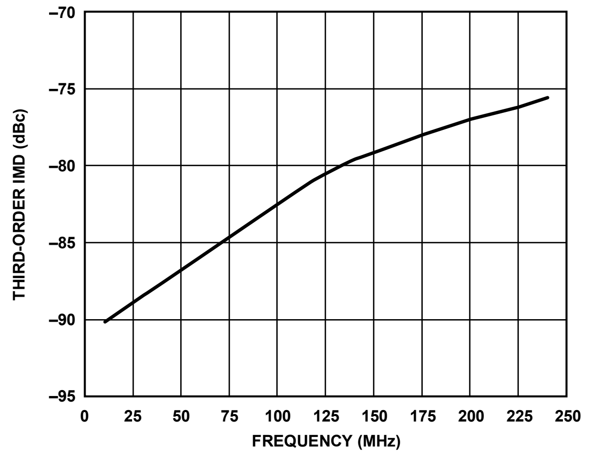


Figure 19. Third-Order Intermodulation Distortion (IMD) vs. Frequency for a 2 V p-p Composite Signal into R_L = 1 kΩ (A_V = 10 dB, at 5 V Supplies)

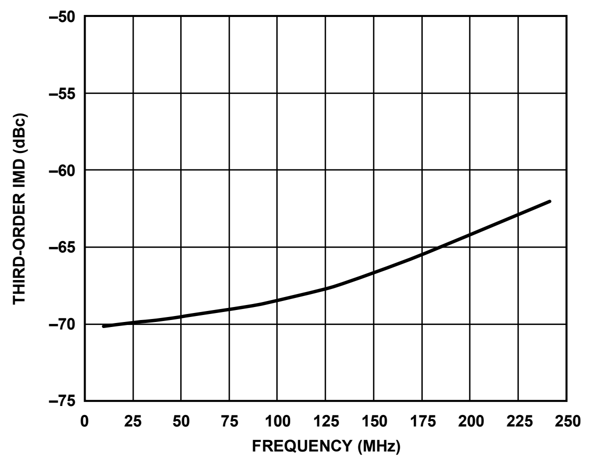


Figure 20. Third-Order Intermodulation Distortion vs. Frequency for a 2 V p-p Composite Signal into R_L = 150 Ω (A_V = 10 dB, at 5 V Supplies)

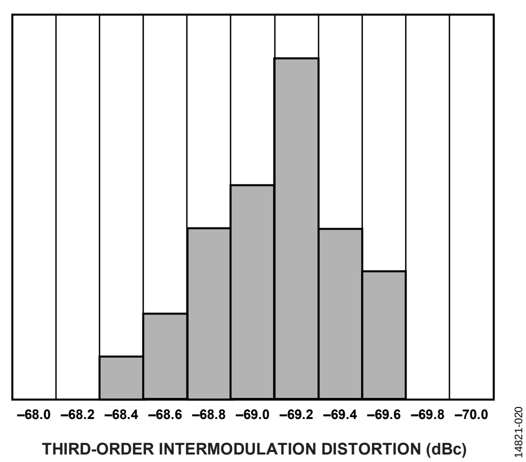


Figure 21. Third-Order Intermodulation Distortion Distribution (f = 70 MHz, R_L = 150 Ω, A_V = 10 dB)

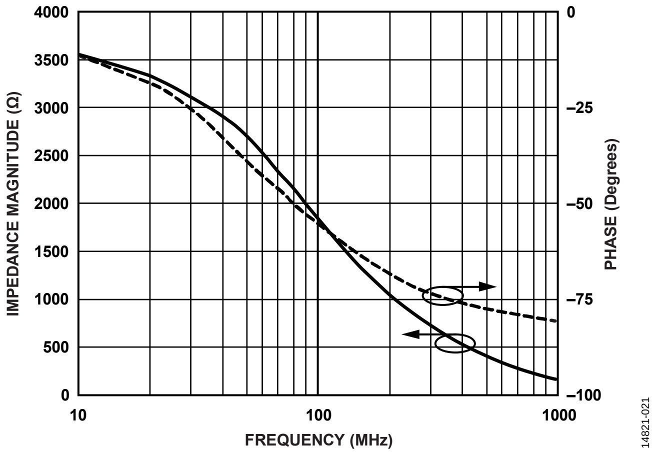


Figure 22. Input Impedance vs. Frequency

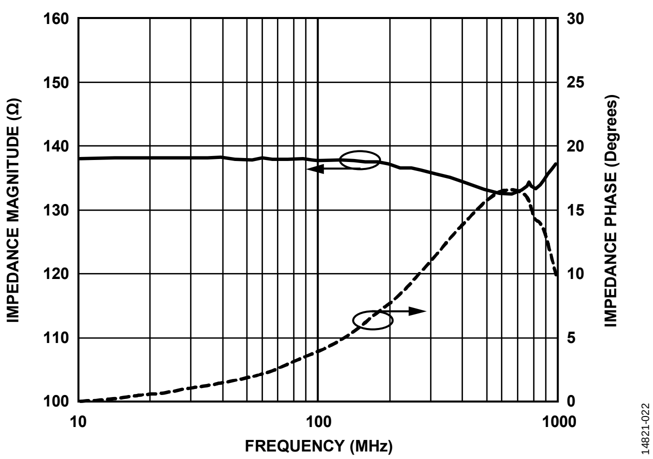


Figure 23. Output Impedance Magnitude and Phase vs. Frequency

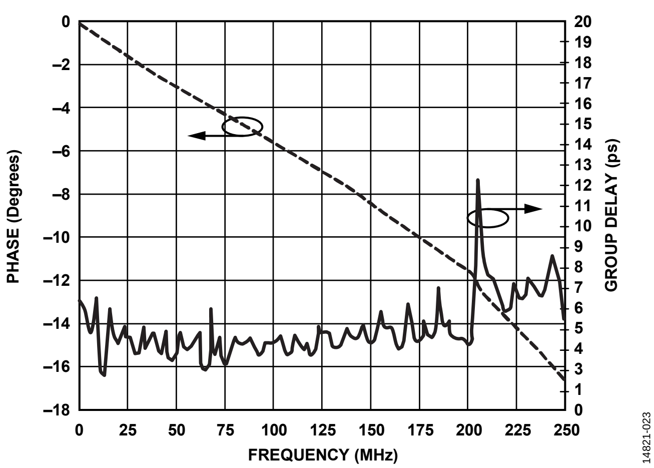


Figure 24. Phase and Group Delay (A_V = 10 dB, at 5 V Supplies)

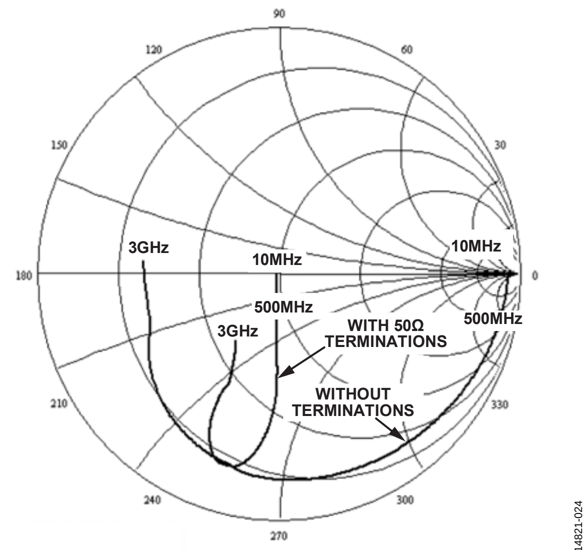


Figure 25. Input Reflection Coefficient vs. Frequency (R_S = R_L = 100 Ω With and Without 50 Ω Terminations)

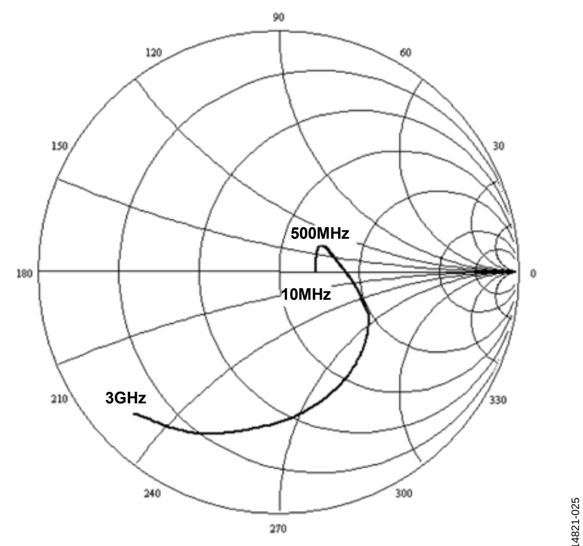


Figure 26. Output Reflection Coefficient vs. Frequency (R_S = R_L = 100 Ω)

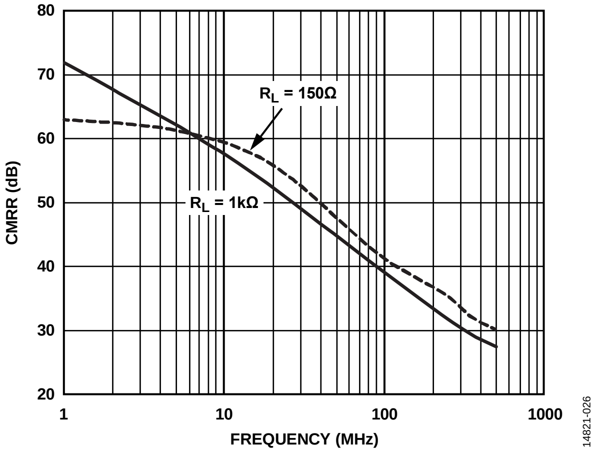


Figure 27. Common-Mode Rejection Ratio, CMRR (R_S = 100 Ω)

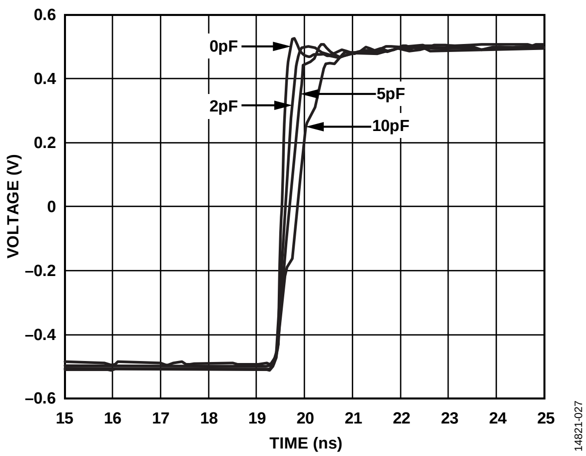


Figure 28. Transient Response Under Capacitive Loading (R_L = 150 Ω, C_L = 0 pF, 2 pF, 5 pF, 10 pF)

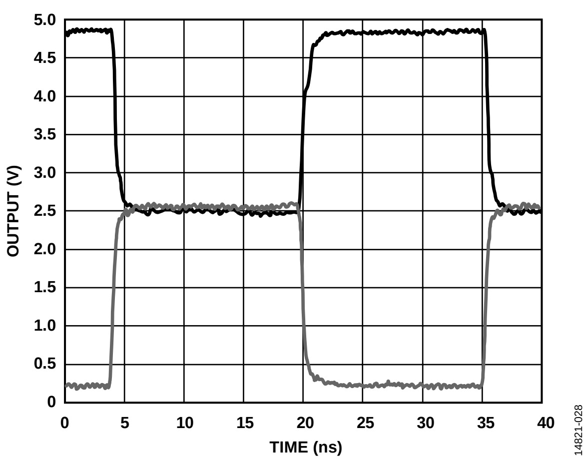


Figure 29. 2× Output Overdrive Recovery (R_L = 150 Ω, A_V = 10 dB)

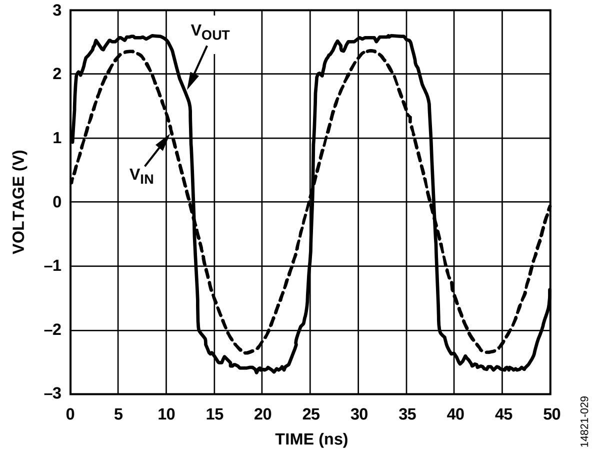


Figure 30. Overdrive Recovery Using Sinusoidal Input Waveform R_L = 150 Ω (A_V = 10 dB, at 5 V Supplies)

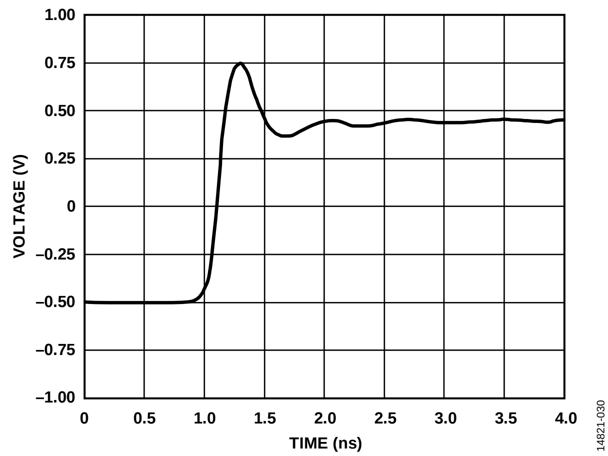


Figure 31. Large Signal Transient Response for a 1 V p-p Output Step (A_V = 10 dB, R_{IP} = 25 Ω)

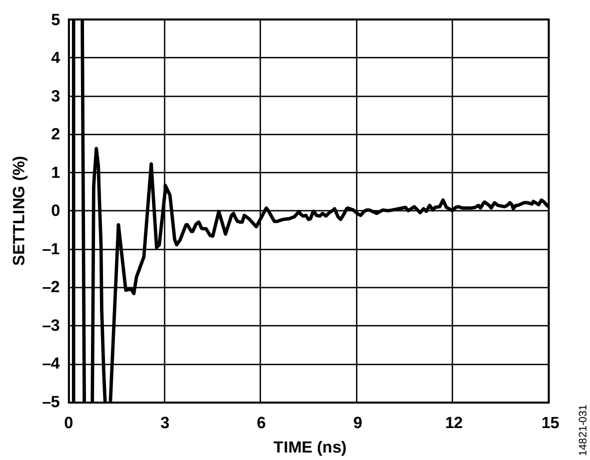


Figure 32. 1% Settling Time for a 2 V p-p Step (A_V = 10 dB, R_L = 150 Ω)

OUTLINE DIMENSIONS

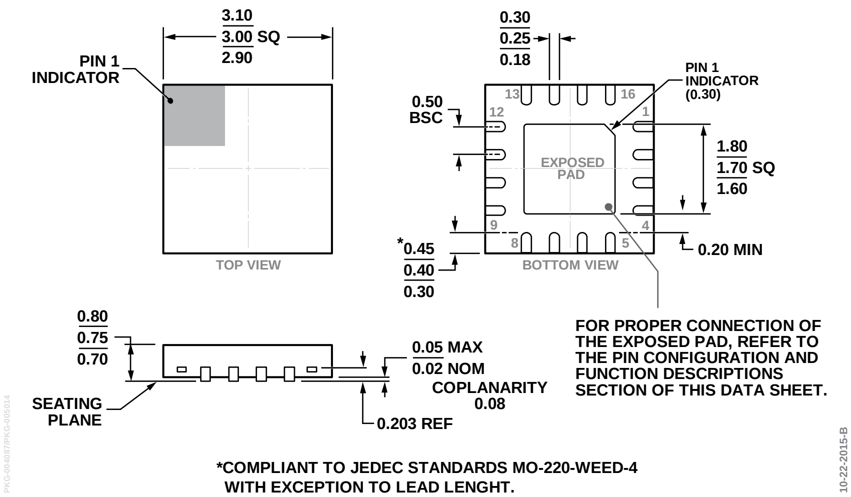


Figure 33. 16-Lead Lead Frame Chip Scale Package [LFCSP]
3 mm × 3 mm Body and 0.75 mm Package Height
(CP-16-33)
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Temperature Range	Package Description	Package Option	Branding
AD8351SCPZ-EP-R7	−55°C to +105°C	16-Lead Lead Frame Chip Scale Package [LFCSP]	CP-16-33	Q26

[1] Z = RoHS Compliant Part.

Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

Как с нами связаться

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