

FEATURES

Supports defense and aerospace applications (AQEC standard)

Military temperature range (-55°C to $+125^{\circ}\text{C}$)

Controlled manufacturing baseline

One assembly/test site

One fabrication site

Enhanced product change notification

Qualification data available on request

Low offset voltage: $1\ \mu\text{V}$

Input offset drift: $0.005\ \mu\text{V}/^{\circ}\text{C}$

Rail-to-rail input and output swing

5 V/2.7 V single-supply operation

High gain: 145 dB typical

CMRR: 140 dB typical

PSRR: 130 dB typical

Ultralow input bias current: $10\ \text{pA}$ typical

Low supply current: $750\ \mu\text{A}$ per op amp

Overload recovery time: $50\ \mu\text{s}$

No external capacitors required

APPLICATIONS

Temperature sensors

Pressure sensors

Precision current sensing

Strain gage amplifiers

GENERAL DESCRIPTION

This amplifier has ultralow offset, drift, and bias current. The AD8574-EP is a quad amplifier, featuring rail-to-rail input and output swings. It is guaranteed to operate from 2.7 V to 5 V single supply.

PIN CONFIGURATIONS

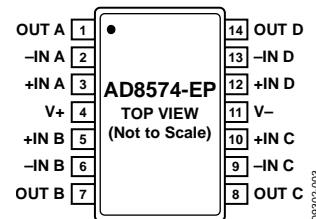


Figure 1. 14-Lead TSSOP (RU Suffix)

The AD8574-EP provides benefits previously found only in expensive auto-zeroing or chopper-stabilized amplifiers. Using a patented spread-spectrum, auto-zero technique, the AD8574 eliminates the intermodulation effects from interaction of the chopping function with the signal frequency in ac applications.

With an offset voltage of only $1\ \mu\text{V}$ and drift of $0.005\ \mu\text{V}/^{\circ}\text{C}$, the AD8574-EP is perfectly suited for applications where error sources must be minimized.

The AD8574-EP is specified for the military temperature range (-55°C to $+125^{\circ}\text{C}$). The AD8574-EP quad amplifier is available in a 14-lead TSSOP package.

Additional applications and technical information is available in the [AD8571/AD8572/AD8574](#) data sheets.

Rev. 0

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REVISION HISTORY

8/10—Revision 0: Initial Version

SPECIFICATIONS

5 V ELECTRICAL CHARACTERISTICS

$V_S = 5\text{ V}$, $V_{CM} = 2.5\text{ V}$, $V_O = 2.5\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 1.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		1	5	μV
					15	μV
Input Bias Current	I_B	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		10	50	pA
				1.0	1.5	nA
Input Offset Current	I_{OS}	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		20	70	pA
				150	200	pA
Input Voltage Range			0		5	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0\text{ V to } 5\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	120	140		dB
			115	130		dB
Large Signal Voltage Gain ¹	A_{VO}	$R_L = 10\text{ k}\Omega$, $V_O = 0.3\text{ V to } 4.7\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	125	145		dB
			120	135		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.005	0.04	$\mu\text{V}/^\circ\text{C}$
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	$R_L = 100\text{ k}\Omega$ to GND $R_L = 100\text{ k}\Omega$ to GND @ -55°C to $+125^\circ\text{C}$ $R_L = 10\text{ k}\Omega$ to GND $R_L = 10\text{ k}\Omega$ to GND @ -55°C to $+125^\circ\text{C}$	4.99	4.998		V
			4.99	4.997		V
			4.95	4.98		V
			4.95	4.975		V
Output Voltage Low	V_{OL}	$R_L = 100\text{ k}\Omega$ to V+ $R_L = 100\text{ k}\Omega$ to V+ @ -55°C to $+125^\circ\text{C}$		1	10	mV
				2	10	mV
				10	30	mV
				15	30	mV
Short-Circuit Limit	I_{SC}	$R_L = 10\text{ k}\Omega$ to V+ $R_L = 10\text{ k}\Omega$ to V+ @ -55°C to $+125^\circ\text{C}$	± 25	± 50		mA
				± 40		mA
Output Current	I_O	-55°C to $+125^\circ\text{C}$		± 30		mA
				± 15		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$V_S = 2.7\text{ V to } 5.5\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	120	130		dB
			115	130		dB
Supply Current per Amplifier	I_{SY}	$V_O = 0\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		850	975	μA
				1000	1075	μA
DYNAMIC PERFORMANCE						
Slew Rate	SR	$R_L = 10\text{ k}\Omega$		0.4		V/ μs
Overload Recovery Time				0.05	0.3	ms
Gain Bandwidth Product	GBP			1.5		MHz
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0 Hz to 10 Hz 0 Hz to 1 Hz		1.3		$\mu\text{V p-p}$
				0.41		$\mu\text{V p-p}$
Voltage Noise Density	e_n	$f = 1\text{ kHz}$		51		nV/ $\sqrt{\text{Hz}}$
Current Noise Density	i_n	$f = 10\text{ Hz}$		2		fA/ $\sqrt{\text{Hz}}$

¹ Gain testing is dependent upon test bandwidth.

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2.7 V ELECTRICAL CHARACTERISTICS

$V_S = 2.7\text{ V}$, $V_{CM} = 1.35\text{ V}$, $V_O = 1.35\text{ V}$, $T_A = 25^\circ\text{C}$, unless otherwise noted.

Table 2.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Offset Voltage	V_{OS}	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		1	5	μV
Input Bias Current	I_B	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		10	50	pA
Input Offset Current	I_{OS}	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		1.0	1.5	nA
Input Voltage Range			0		2.7	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0\text{ V to } 2.7\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	115	130		dB
Large Signal Voltage Gain ¹	A_{VO}	$R_L = 10\text{ k}\Omega$, $V_O = 0.3\text{ V to } 2.4\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	110	140		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		0.005	0.04	$\mu\text{V}/^\circ\text{C}$
OUTPUT CHARACTERISTICS						
Output Voltage High	V_{OH}	$R_L = 100\text{ k}\Omega$ to GND $R_L = 100\text{ k}\Omega$ to GND @ -55°C to $+125^\circ\text{C}$ $R_L = 10\text{ k}\Omega$ to GND $R_L = 10\text{ k}\Omega$ to GND @ -55°C to $+125^\circ\text{C}$	2.685 2.685 2.67 2.67	2.697 2.696 2.68 2.675		V V V V
Output Voltage Low	V_{OL}	$R_L = 100\text{ k}\Omega$ to $V+$ $R_L = 100\text{ k}\Omega$ to $V+$ @ -55°C to $+125^\circ\text{C}$ $R_L = 10\text{ k}\Omega$ to $V+$ $R_L = 10\text{ k}\Omega$ to $V+$ @ -55°C to $+125^\circ\text{C}$		1 2 10 15	10 10 20 20	mV mV mV mV
Short-Circuit Limit	I_{SC}	-55°C to $+125^\circ\text{C}$	± 10	± 15		mA
Output Current	I_O	-55°C to $+125^\circ\text{C}$		± 10		mA
POWER SUPPLY						
Power Supply Rejection Ratio	PSRR	$V_S = 2.7\text{ V to } 5.5\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	120 115	130 130		dB dB
Supply Current per Amplifier	I_{SY}	$V_O = 0\text{ V}$ $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$		750 950	900 1000	μA μA
DYNAMIC PERFORMANCE						
Slew Rate	SR	$R_L = 10\text{ k}\Omega$		0.5		$\text{V}/\mu\text{s}$
Overload Recovery Time				0.05		ms
Gain Bandwidth Product	GBP			1		MHz
NOISE PERFORMANCE						
Voltage Noise	e_n p-p	0 Hz to 10 Hz		2.0		$\mu\text{V p-p}$
Voltage Noise Density	e_n	$f = 1\text{ kHz}$		94		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	i_n	$f = 10\text{ Hz}$		2		$\text{fA}/\sqrt{\text{Hz}}$

¹ Gain testing is dependent upon test bandwidth.

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	6 V
Input Voltage	GND to $V_S + 0.3$ V
Differential Input Voltage ¹	± 5.0 V
ESD (Human Body Model)	2000 V
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	-65°C to $+150^{\circ}\text{C}$
Operating Temperature Range	-55°C to $+125^{\circ}\text{C}$
Junction Temperature Range	-65°C to $+150^{\circ}\text{C}$
Lead Temperature (Soldering, 60 sec)	300°C

¹ Differential input voltage is limited to ± 5.0 V or the supply voltage, whichever is less.

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. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

THERMAL CHARACTERISTICS

θ_{JA} is specified for the worst-case conditions, that is, θ_{JA} is specified for a device soldered in a circuit board for TSSOP packages.

Table 4. Thermal Resistance

Package Type	θ_{JA}	θ_{JC}	Unit
14-Lead TSSOP (RU)	180	36	$^{\circ}\text{C}/\text{W}$

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.

TYPICAL PERFORMANCE CHARACTERISTICS

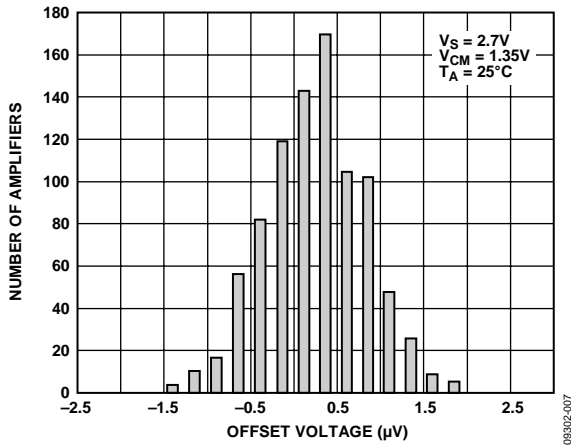


Figure 2. Input Offset Voltage Distribution

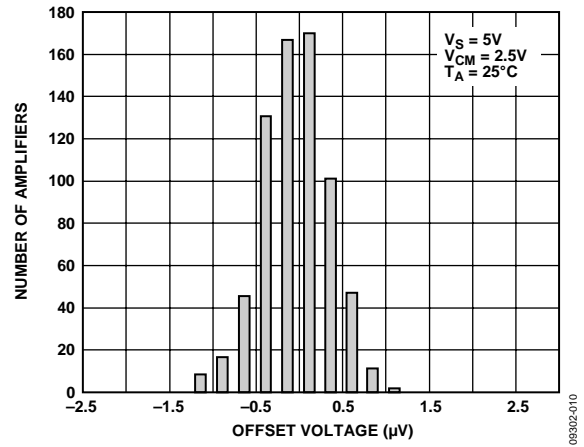


Figure 5. Input Offset Voltage Distribution

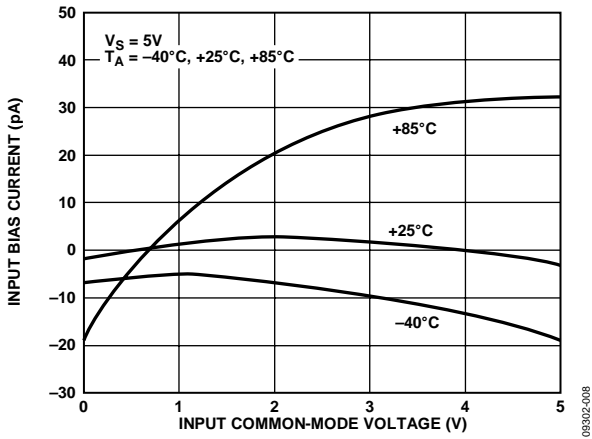


Figure 3. Input Bias Current vs. Input Common-Mode Voltage

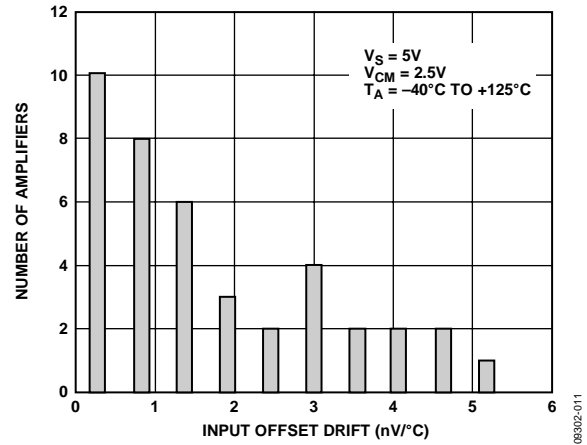


Figure 6. Input Offset Voltage Drift Distribution

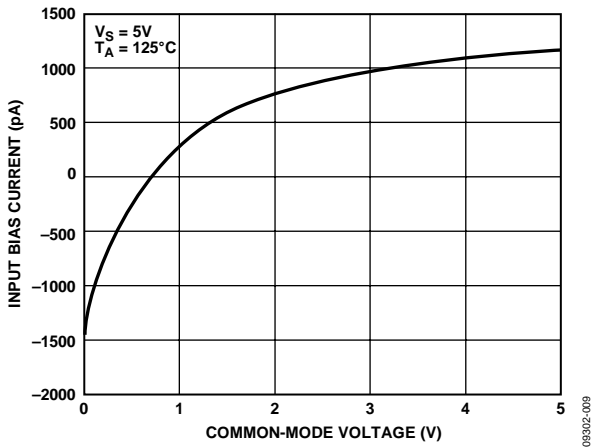


Figure 4. Input Bias Current vs. Common-Mode Voltage

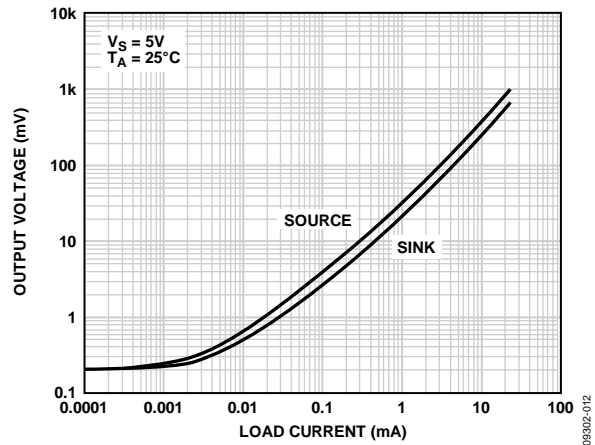


Figure 7. Output Voltage to Supply Rail vs. Load Current

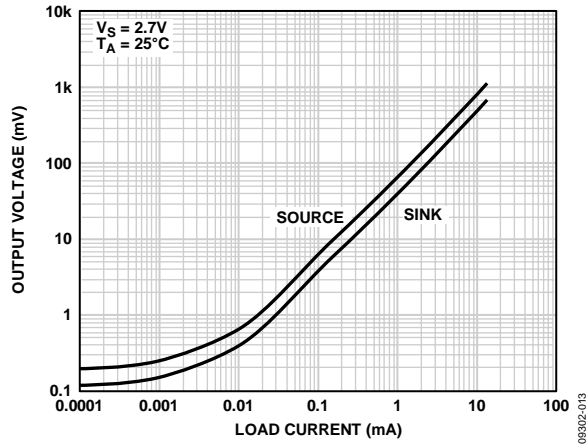


Figure 8. Output Voltage to Supply Rail vs. Load Current

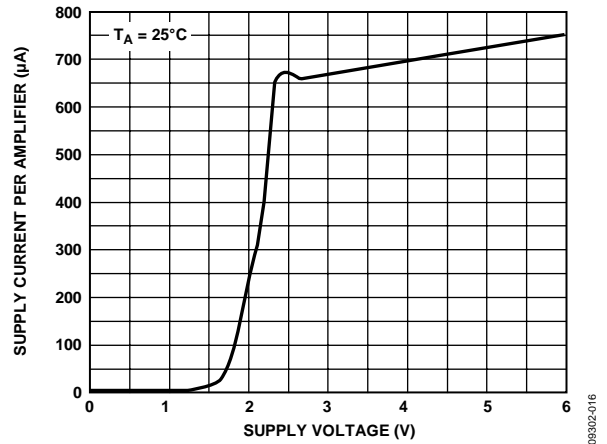


Figure 11. Supply Current per Amplifier vs. Supply Voltage

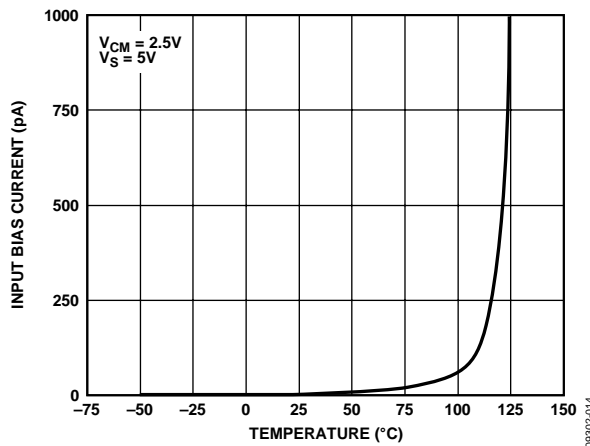


Figure 9. Input Bias Current vs. Temperature

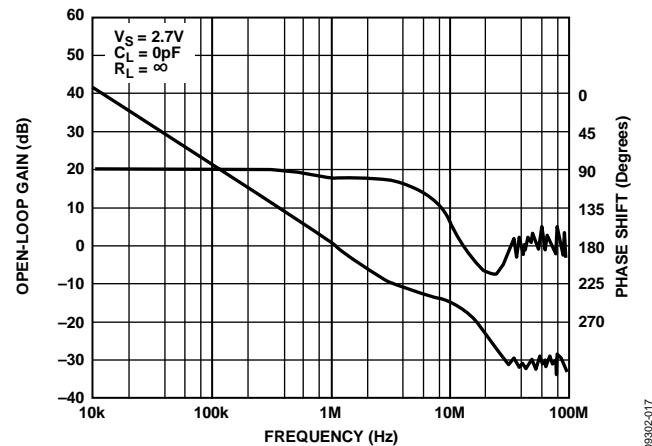


Figure 12. Open-Loop Gain and Phase Shift vs. Frequency

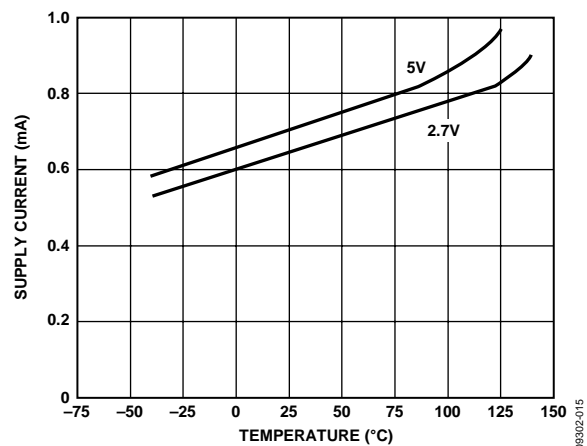


Figure 10. Supply Current vs. Temperature

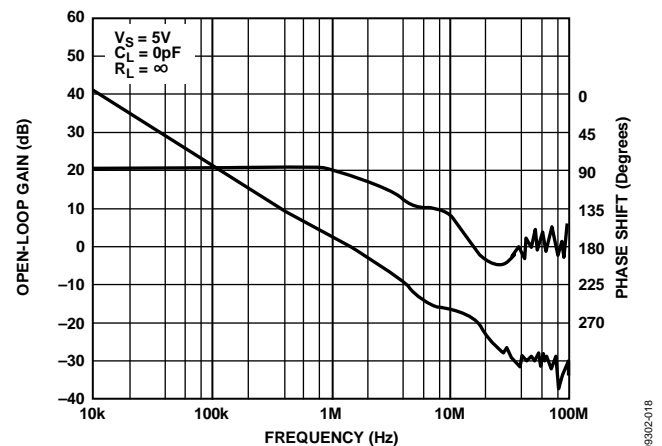


Figure 13. Open-Loop Gain and Phase Shift vs. Frequency

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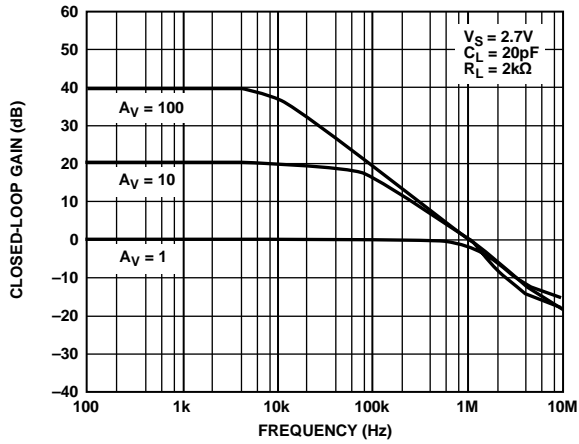


Figure 14. Closed-Loop Gain vs. Frequency

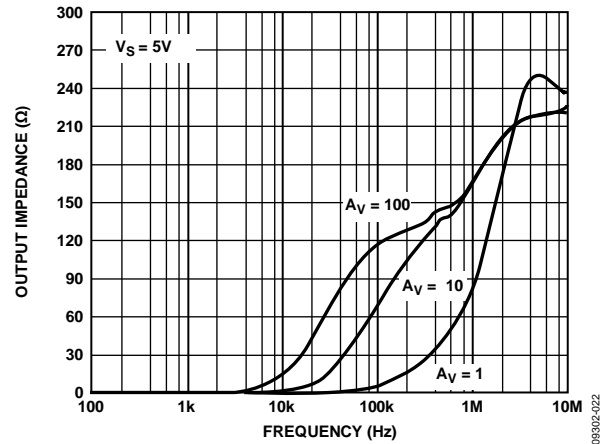


Figure 17. Output Impedance vs. Frequency

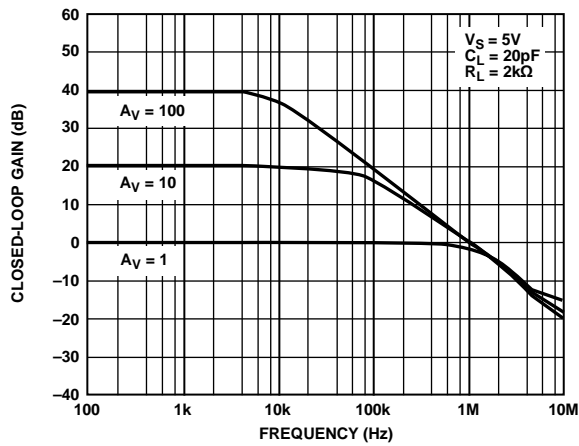


Figure 15. Closed-Loop Gain vs. Frequency

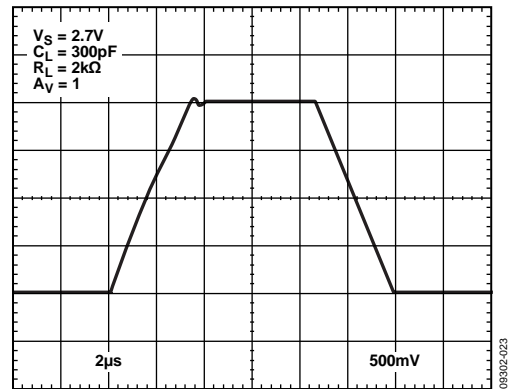


Figure 18. Large Signal Transient Response

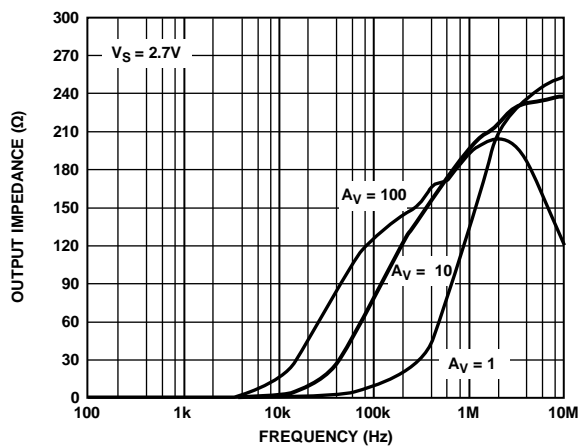


Figure 16. Output Impedance vs. Frequency

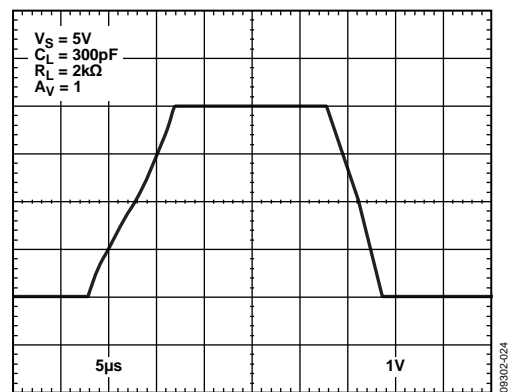


Figure 19. Large Signal Transient Response

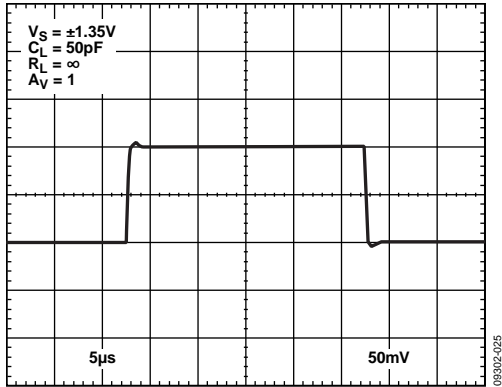


Figure 20. Small Signal Transient Response

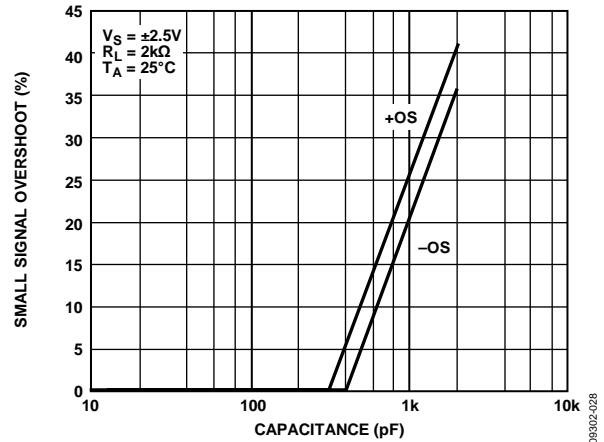


Figure 23. Small Signal Overshoot vs. Load Capacitance

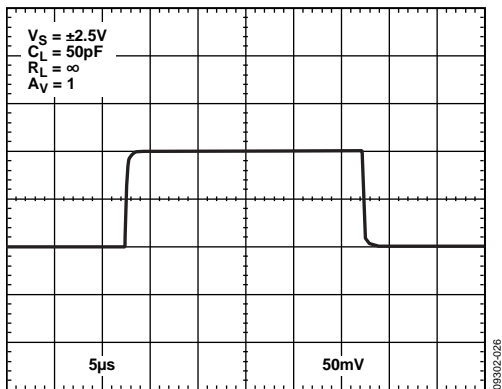


Figure 21. Small Signal Transient Response

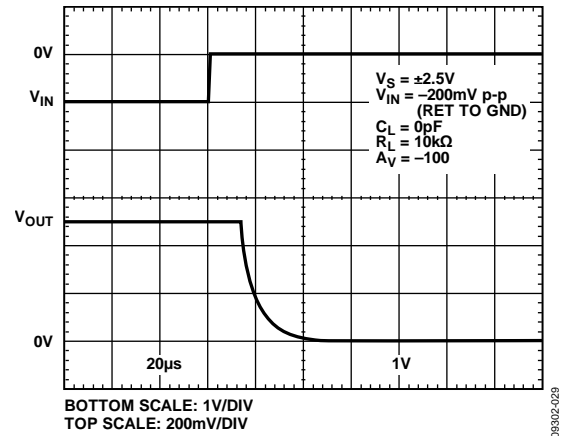


Figure 24. Positive Overvoltage Recovery

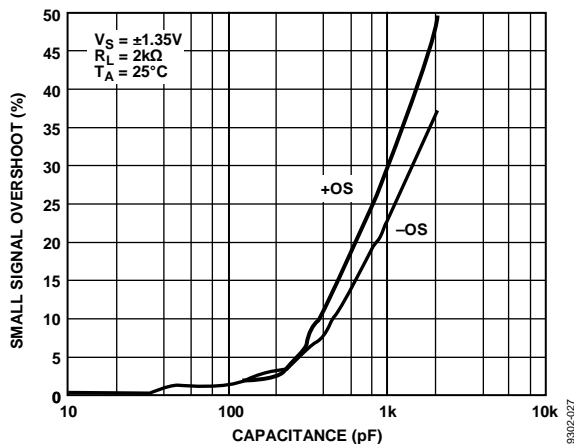


Figure 22. Small Signal Overshoot vs. Load Capacitance

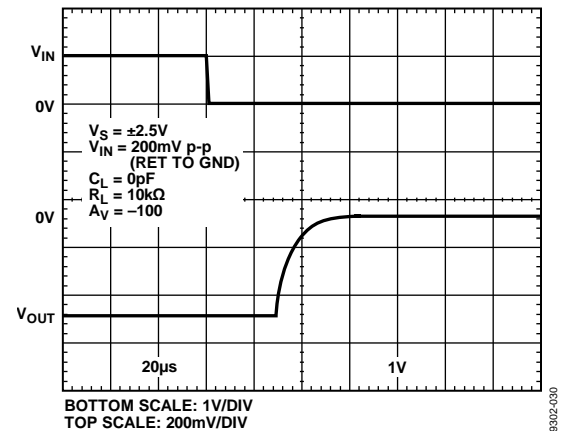


Figure 25. Negative Overvoltage Recovery

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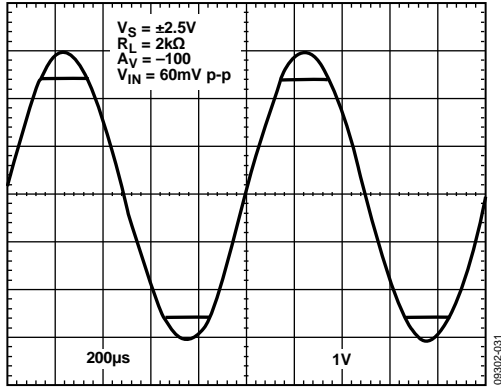


Figure 26. No Phase Reversal

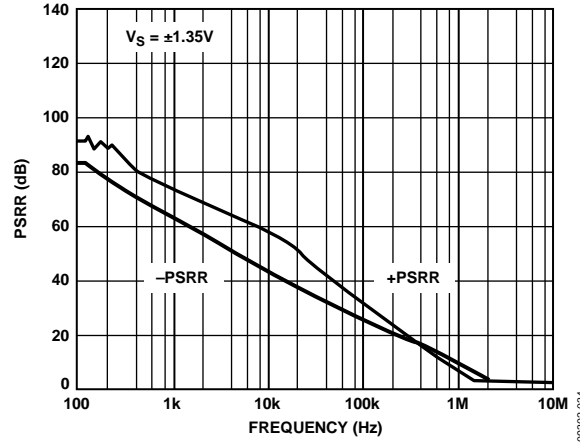


Figure 29. PSRR vs. Frequency

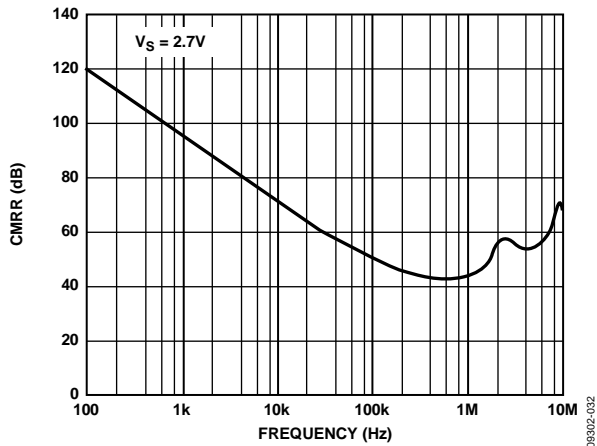


Figure 27. CMRR vs. Frequency

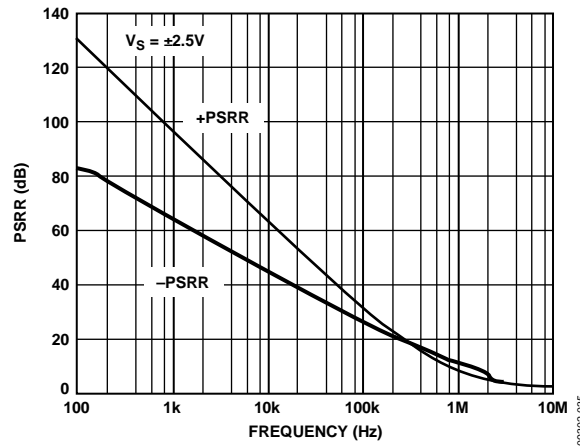


Figure 30. PSRR vs. Frequency

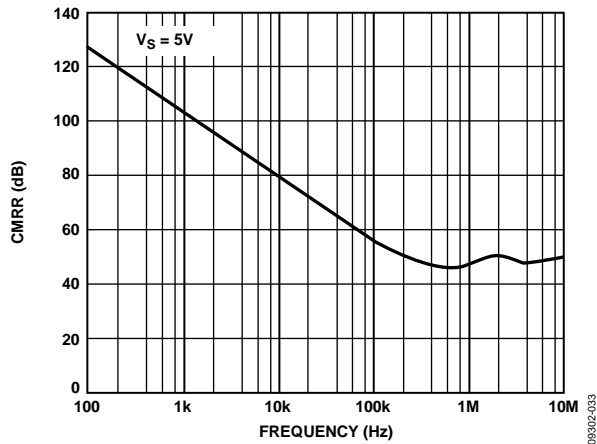


Figure 28. CMRR vs. Frequency

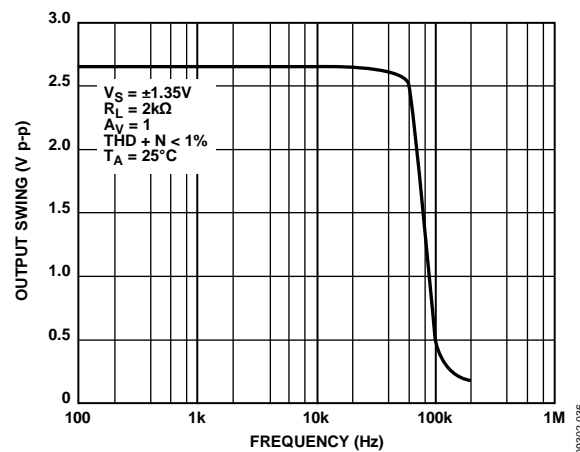


Figure 31. Maximum Output Swing vs. Frequency

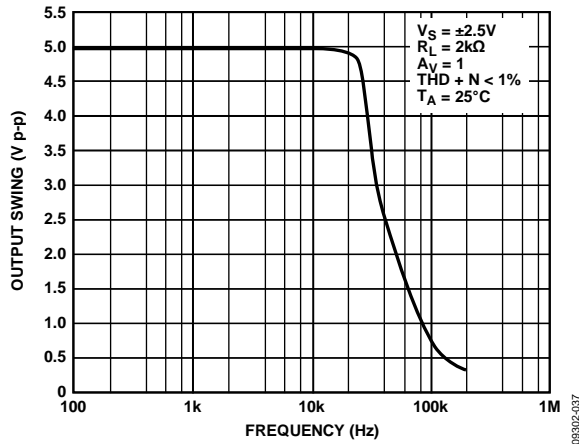


Figure 32. Maximum Output Swing vs. Frequency

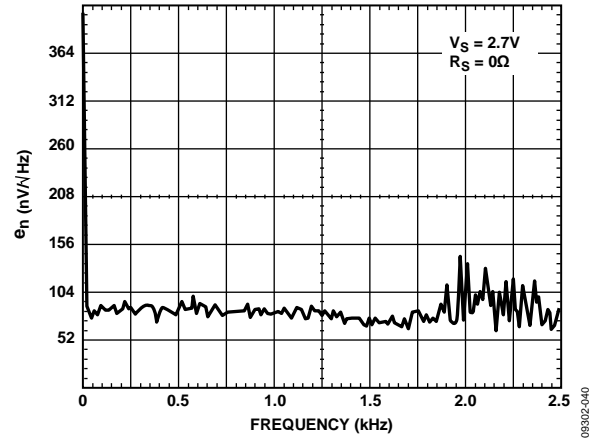


Figure 35. Voltage Noise Density from 0 Hz to 2.5 kHz

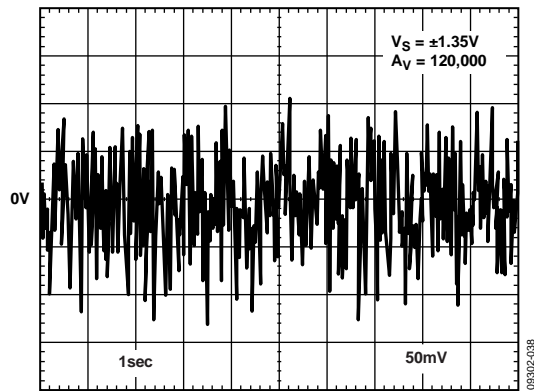


Figure 33. 0.1 Hz to 10 Hz Noise

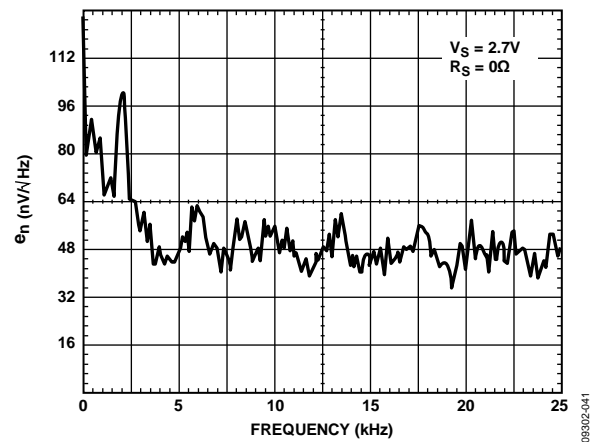


Figure 36. Voltage Noise Density from 0 Hz to 25 kHz

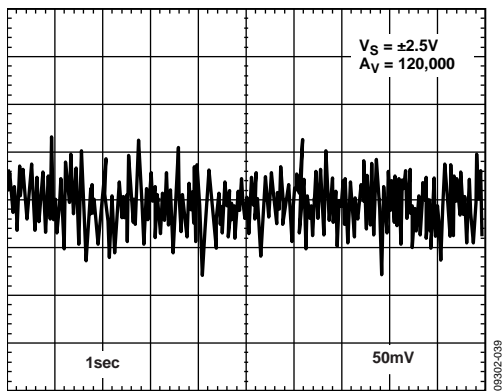


Figure 34. 0.1 Hz to 10 Hz Noise

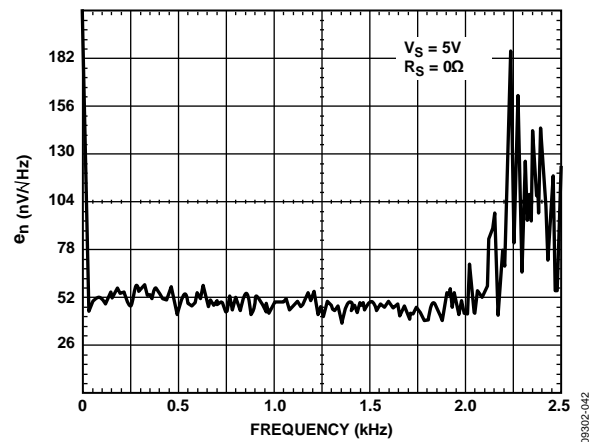


Figure 37. Voltage Noise Density from 0 Hz to 2.5 kHz

AD8574-EP

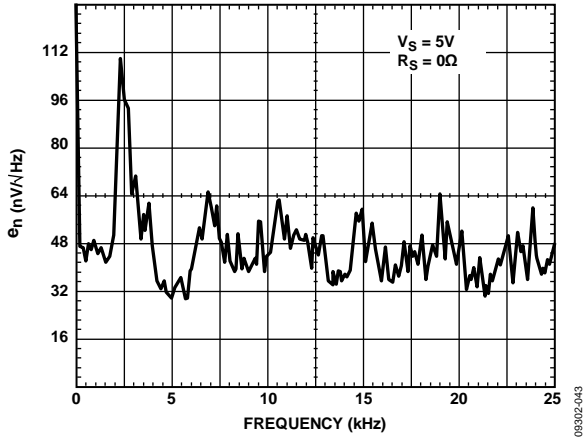


Figure 38. Voltage Noise Density from 0 Hz to 25 kHz

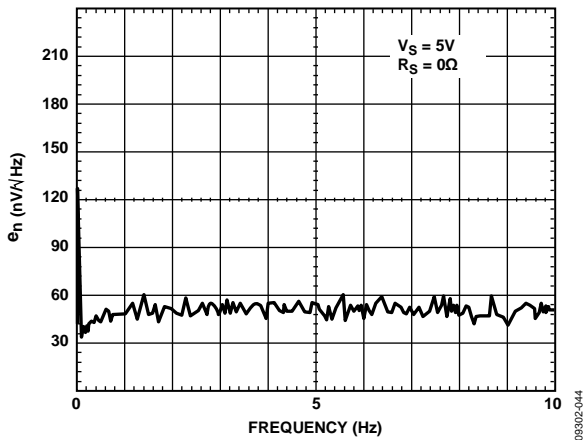


Figure 39. Voltage Noise Density from 0 Hz to 10 Hz

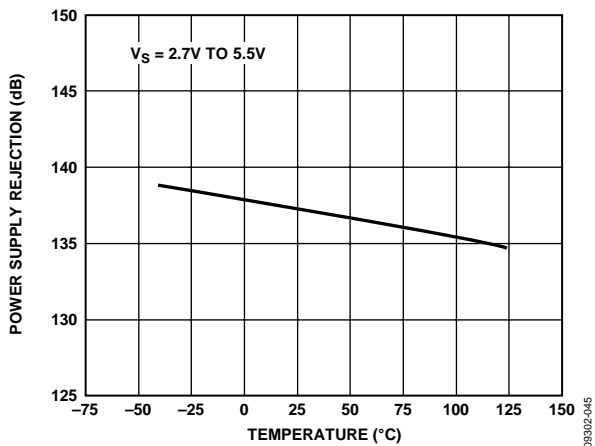


Figure 40. Power Supply Rejection vs. Temperature

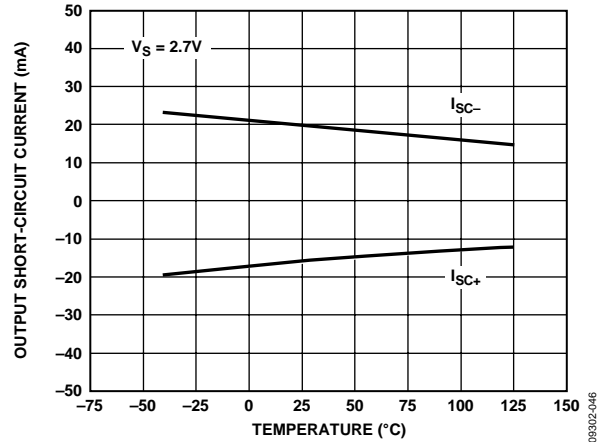


Figure 41. Output Short-Circuit Current vs. Temperature

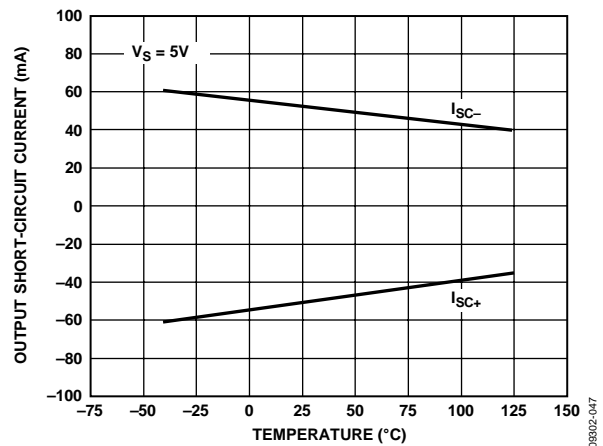


Figure 42. Output Short-Circuit Current vs. Temperature

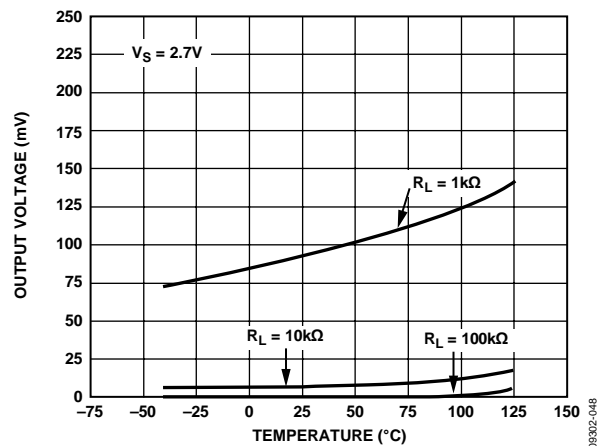


Figure 43. Output Voltage to Supply Rail vs. Temperature

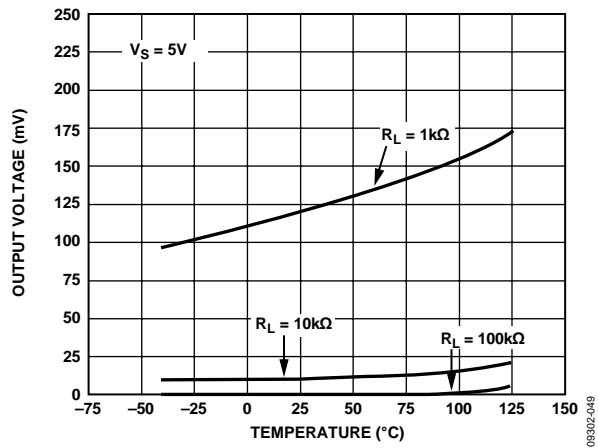
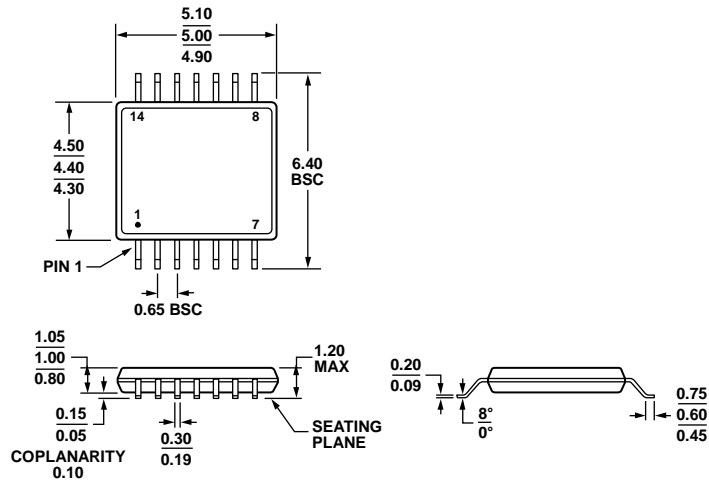


Figure 44. Output Voltage to Supply Rail vs. Temperature

09302-949

AD8574-EP

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MO-153-AB-1

Figure 45. 14-Lead Thin Shrink Small Outline Package [TSSOP] (RU-14)

Dimensions shown in millimeters

061198-A

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD8574TRU-EP	-55°C to +125°C	14-Lead TSSOP	RU-14
AD8574TRU-EP-RL	-55°C to +125°C	14-Lead TSSOP	RU-14

NOTES

AD8574-EP

NOTES