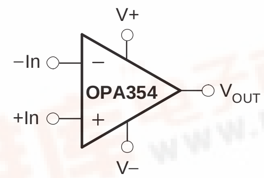
250 MHz, RAIL-TO-RAIL I/O, CMOS OPERATIONAL AMPLIFIERS

FEATURES

- **Qualified for Automotive Applications**
- **Unity-Gain Bandwidth: 250 MHz**
- **Wide Bandwidth: 100-MHz GBW**
- **High Slew Rate: 150 V/μs**
- **Low Noise: 6.5 nV/√Hz**
- **Rail-to-Rail I/O**
- **High Output Current: >100 mA**
- **Excellent Video Performance**
  - **Differential Gain Error: 0.02%**
  - **Differential Phase Error: 0.09°**
  - **0.1-dB Gain Flatness: 40 MHz**
- **Low Input Bias Current: 3 pA**
- **Quiescent Current: 4.9 mA**
- **Thermal Shutdown**
- **Supply Range: 2.5 V to 5.5 V**

APPLICATIONS

- **Video Processing**
- **Ultrasound**
- **Optical Networking, Tunable Lasers**
- **Photodiode Transimpedance Amplifiers**
- **Active Filters**
- **High-Speed Integrators**
- **Analog-to-Digital (A/D) Converter Input Buffers**
- **Digital-to-Analog (D/A) Converter Output Amplifiers**
- **Barcode Scanners**
- **Communications**



DESCRIPTION

The OPA354 series of high-speed, voltage-feedback CMOS operational amplifiers are designed for video and other applications requiring wide bandwidth. They are unity-gain stable and can drive large output currents. Differential gain is 0.02% and differential phase is 0.09°. Quiescent current is only 4.9 mA per channel.

The OPA354 series op amps are optimized for operation on single or dual supplies as low as 2.5 V (±1.25 V) and up to 5.5 V (±2.75 V). Common-mode input range extends beyond the supplies. The output swing is within 100 mV of the rails, supporting wide dynamic range.

The single version (OPA354), is available in the tiny SOT23-5 (DBV) package. The dual version (OPA2354) comes in the miniature MSOP-8 (DGK) package and features completely independent circuitry for lowest crosstalk and freedom from interaction. The devices are specified over the automotive temperature range of –40°C to 125°C.

Table 1. OPAx354 RELATED PRODUCTS

FEATURES	PRODUCT
Shutdown Version of OPA354 Family	OPAx357
200-MHz GBW, Rail-to-Rail Output, CMOS, Shutdown	OPAx355
200-MHz GBW, Rail-to-Rail Output, CMOS	OPAx356
38-MHz GBW, Rail-to-Rail Input/Output, CMOS	OPAx350/3
75-MHz BW, G = 2, Rail-to-Rail Output	OPAx631
150-MHz BW, G = 2, Rail-to-Rail Output	OPAx634
100-MHz BW, Differential Input/Output, 3.3-V Supply	THS412x

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

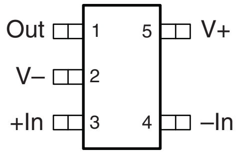
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

ORDERING INFORMATION(1)

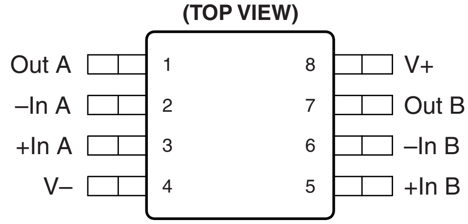
T_A	PACKAGE (2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	SOT-23 – DBV	Reel of 3000	OPA354AQDBVRQ1	OSFQ
	MSOP – DGK	Reel of 2500	OPA2354AQDGKRQ1	OSLQ

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

OPA354
DBV PACKAGE
(TOP VIEW)



OPA2354
DGK PACKAGE
(TOP VIEW)



ABSOLUTE MAXIMUM RATINGS(1)

over operating free-air temperature range (unless otherwise noted)

V_S	Supply voltage, V+ to V–		7.5 V
V_{IN}	Signal input terminals voltage		(V– – 0.5 V) to (V+ + 0.5 V)
	Output short-circuit duration		Continuous
θ_{JA}	Thermal impedance, junction to free air	DBV package	150°C/W
		DGK package	150°C/W
T_{OP}	Operating temperature		–55°C to 150°C
T_{STG}	Storage temperature		–65°C to 150°C
T_J	Junction temperature		150°C
T_{LEAD}	Lead temperature (soldering, 10 s)		300°C

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

		MIN	MAX	UNIT
V_S	Supply voltage, V– to V+	2.5	5.5	V
T_A	Operating free-air temperature	–40	125	°C

ELECTRICAL CHARACTERISTICS

V_S = 2.5 V to 5.5 V, R_F = 0 Ω, R_L = 1 kΩ connected to V_S/2 (unless otherwise noted)

PARAMETER			TEST CONDITIONS	T_A (1)	MIN	TYP	MAX	UNIT
V_{OS}	Input offset voltage		V_S = 5 V, V_{CM} = (V–) + 0.8 V	25°C		±2	±8	mV
				Full range			±10	
$\Delta V_{OS}/\Delta T$	Offset voltage drift over temperature			Full range		±4		µV/°C
PSRR	Offset voltage drift vs power supply		V_S = 2.7 V to 5.5 V, V_{CM} = V_S/2 – 0.15 V	25°C		±200	±800	µV/V
				Full range			±900	
I_B	Input bias current			25°C		3	±50	pA
I_{OS}	Input offset current			25°C		±1	±50	pA
V_n	Input voltage noise density		f = 1 MHz	25°C		6.5		nV/√Hz
I_n	Input current noise density		f = 1 MHz	25°C		50		fA/√Hz
V_{CM}	Input common-mode voltage range			25°C	V– – 0.1		V+ + 0.1	V
CMRR	Input common-mode rejection ratio		V_S = 5.5 V, –0.1 V < V_{CM} < 3.5 V	25°C	66	80		dB
				Full range	64			
			V_S = 5.5 V, –0.1 V < V_{CM} < 5.6 V	25°C	56	68		
				Full range	55			
Z_{ID}	Differential input impedance			25°C		10^{13} || 2		Ω || pF
Z_{ICM}	Common-mode input impedance			25°C		10^{13} || 2		Ω || pF
A_{OL}	Open-loop gain		V_S = 5 V, 0.3 V < V_O < 4.7 V	25°C	94	110		dB
			V_S = 5 V, 0.4 V < V_O < 4.6 V	Full range	90			
f_{-3dB}	Small-signal bandwidth		G = +1, V_O = 100 mVp-p, R_F = 25 Ω	25°C		250		MHz
			G = +2, V_O = 100 mVp-p			90		
GBW	Gain-bandwidth product		G = +10	25°C		100		MHz
$f_{0.1dB}$	Bandwidth for 0.1-dB gain flatness		G = +2, V_O = 100 mVp-p	25°C		40		MHz
SR	Slew rate		V_S = 5 V, G = +1, 4-V step	25°C		150		V/µs
			V_S = 5 V, G = +1, 2-V step			130		
			V_S = 3 V, G = +1, 2-V step			110		
t_{rf}	Rise-and-fall time		G = +1, V_O = 200 mVp-p, 10% to 90%	25°C		2		ns
			G = +1, V_O = 2 Vp-p, 10% to 90%			11		
t_{settle}	Settling time	0.1%	V_S = 5 V, G = +1, 2-V output step	25°C		30		ns
		0.01%				60		
	Overload recovery time		V_{IN} × Gain = V_S	25°C		5		ns
	Second-order harmonic distortion		G = +1, f = 1 MHz, V_O = 2 Vp-p, R_L = 200 Ω, V_{CM} = 1.5 V	25°C		–75		dBc
	Third-order harmonic distortion		G = +1, f = 1 MHz, V_O = 2 Vp-p, R_L = 200 Ω, V_{CM} = 1.5 V	25°C		–83		dBc
	Differential gain error		NTSC, R_L = 150 Ω	25°C		0.02		%
	Differential phase error		NTSC, R_L = 150 Ω	25°C		0.09		°
	Channel-to-channel crosstalk (OPA2354)		f = 5 MHz	25°C		–100		dB
	Voltage output swing from rail		V_S = 5 V, R_L = 1 kΩ, A_{OL} > 94 dB	25°C		0.1	0.3	V
			V_S = 5 V, R_L = 1 kΩ, A_{OL} > 90 dB	Full range			0.4	

(1) Full range T_A = –40°C to 125°C

ELECTRICAL CHARACTERISTICS (continued)

V_S = 2.5 V to 5.5 V, R_F = 0 Ω, R_L = 1 kΩ connected to $V_S/2$ (unless otherwise noted)

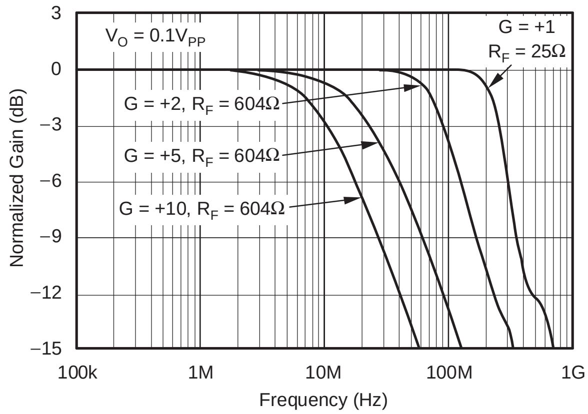
PARAMETER		TEST CONDITIONS	T_A (1)	MIN	TYP	MAX	UNIT
I_O	Output current (2) (3)	V_S = 5 V		100			mA
		V_S = 3 V			50		
	Closed-loop output impedance	f < 100 kHz			0.05		Ω
R_O	Open-loop output resistance				35		Ω
I_Q	Quiescent current (per amplifier)	V_S = 5 V, I_O = 0, Enabled	25°C		4.9	6	mA
			Full range			7.5	
	Thermal shutdown junction temperature	Shutdown			160		°C
		Reset from shutdown			140		

(2) See typical characteristic graph *Output Voltage Swing vs Output Current*.
(3) Not production tested

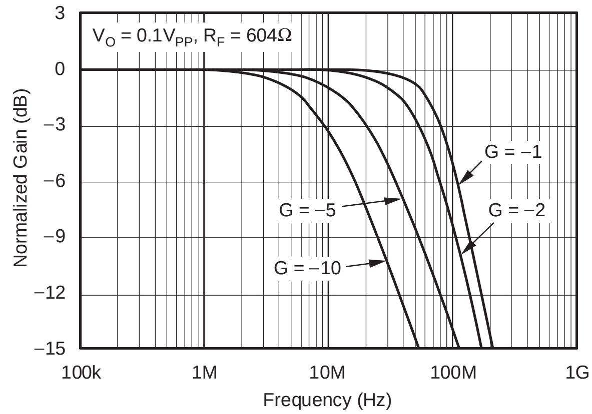
TYPICAL CHARACTERISTICS

T_A = 25°C, V_S = 5 V, R_F = 0 Ω, R_L = 1 kΩ connected to V_S/2 (unless otherwise noted)

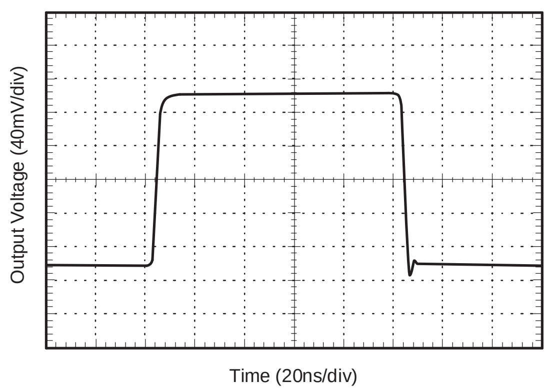
NONINVERTING SMALL−SIGNAL FREQUENCY RESPONSE



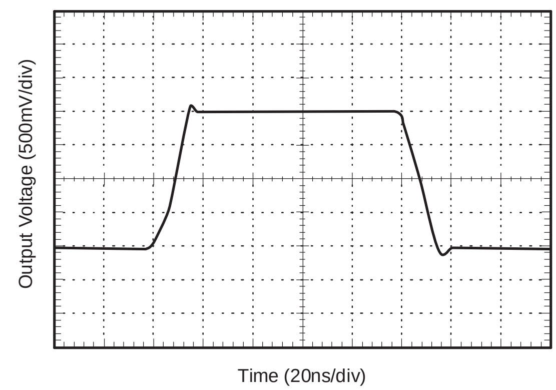
INVERTING SMALL−SIGNAL FREQUENCY RESPONSE



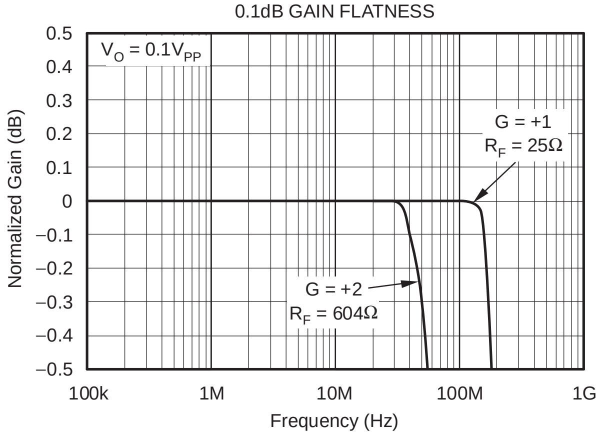
NONINVERTING SMALL−SIGNAL STEP RESPONSE



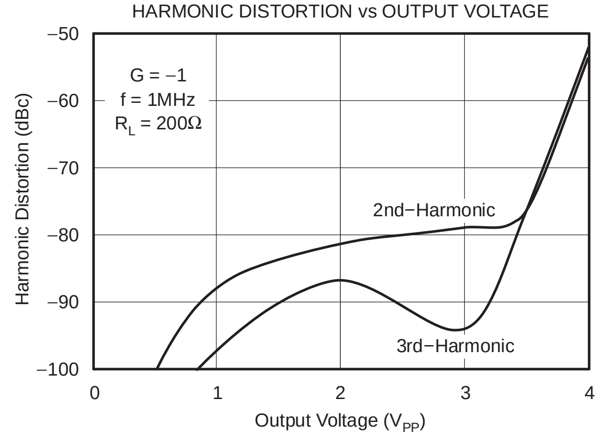
NONINVERTING LARGE−SIGNAL STEP RESPONSE



0.1dB GAIN FLATNESS



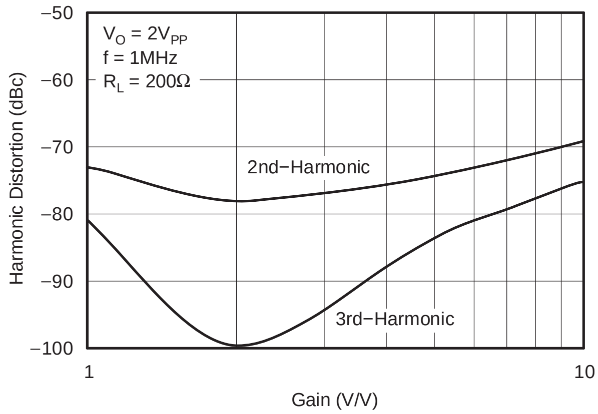
HARMONIC DISTORTION vs OUTPUT VOLTAGE



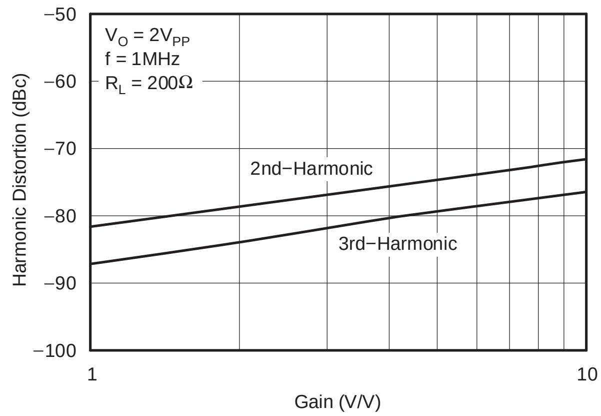
TYPICAL CHARACTERISTICS (continued)

T_A = 25°C, V_S = 5 V, R_F = 0 Ω, R_L = 1 kΩ connected to V_S/2 (unless otherwise noted)

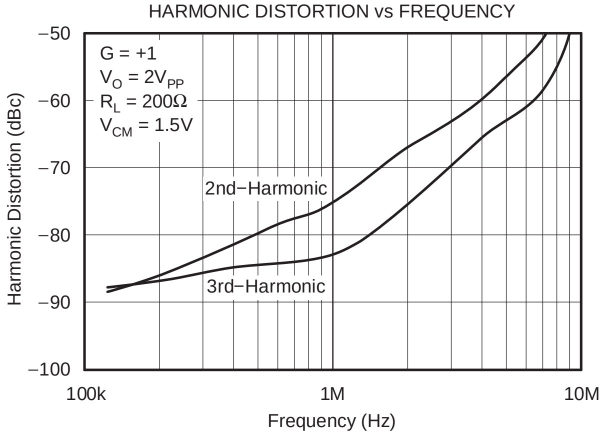
HARMONIC DISTORTION vs NONINVERTING GAIN



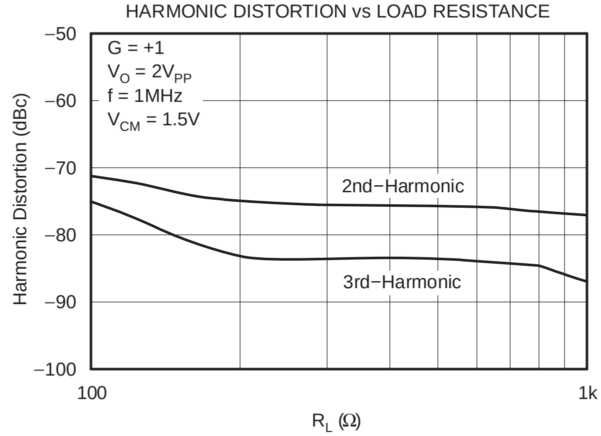
HARMONIC DISTORTION vs INVERTING GAIN



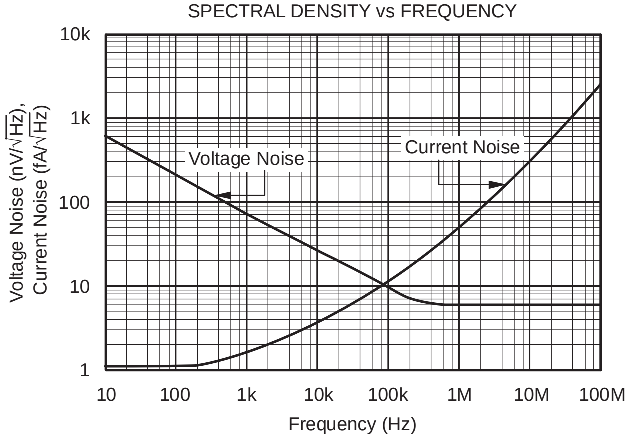
HARMONIC DISTORTION vs FREQUENCY



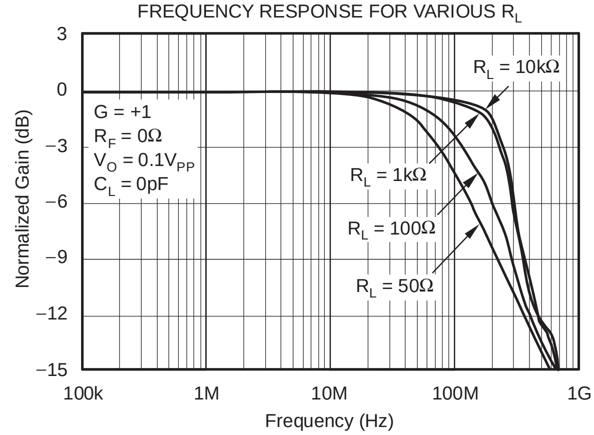
HARMONIC DISTORTION vs LOAD RESISTANCE



INPUT VOLTAGE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



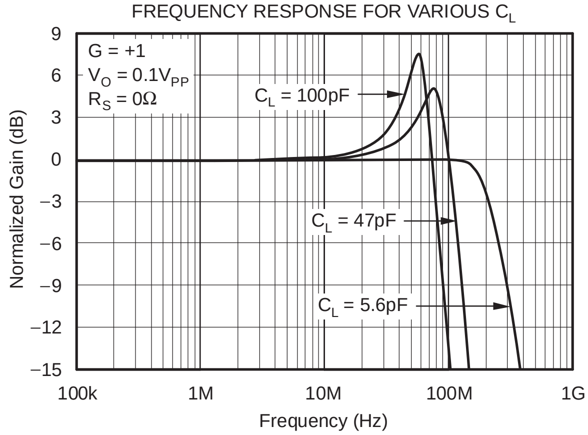
FREQUENCY RESPONSE FOR VARIOUS R_L



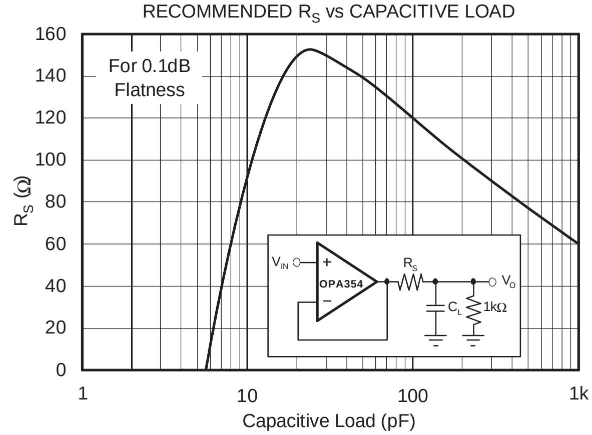
TYPICAL CHARACTERISTICS (continued)

T_A = 25°C, V_S = 5 V, R_F = 0 Ω, R_L = 1 kΩ connected to V_S/2 (unless otherwise noted)

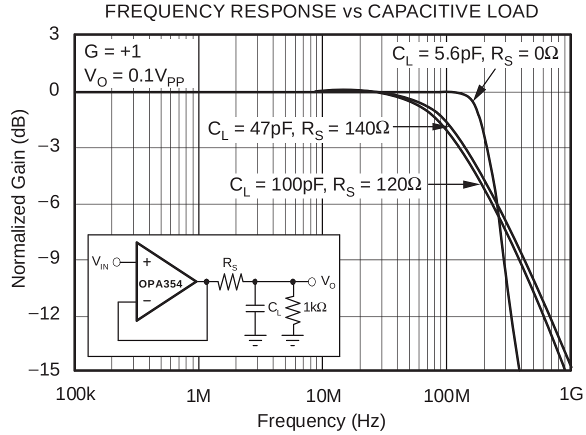
FREQUENCY RESPONSE FOR VARIOUS C_L



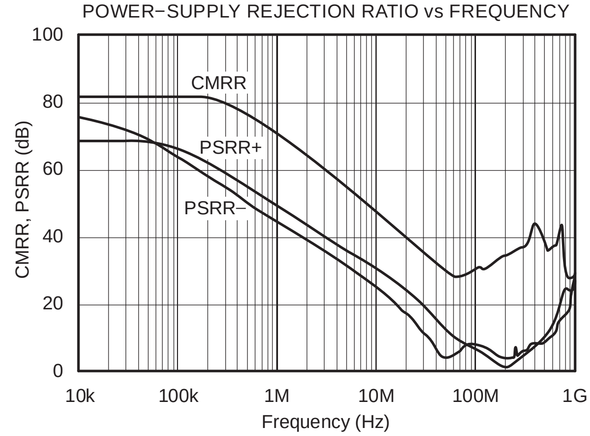
RECOMMENDED R_S vs CAPACITIVE LOAD



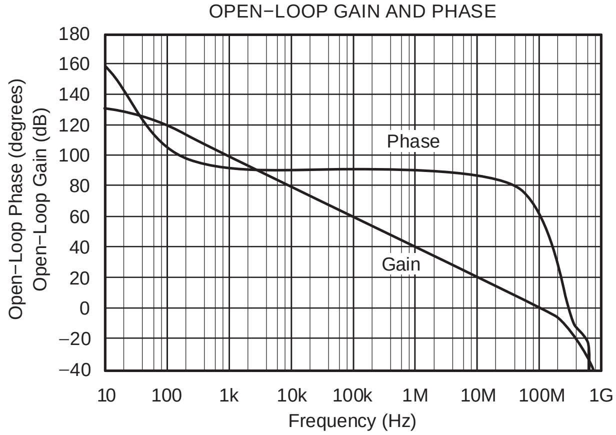
FREQUENCY RESPONSE vs CAPACITIVE LOAD



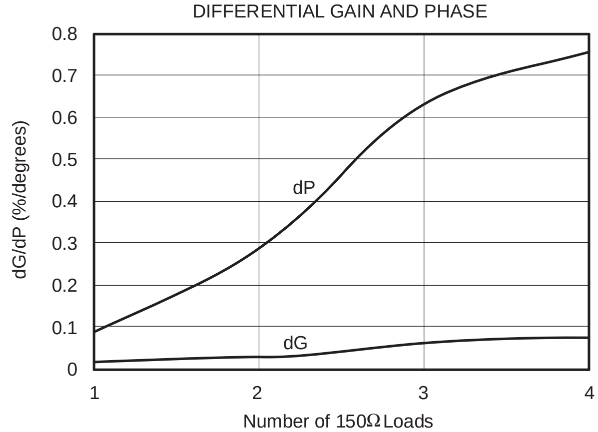
COMMON−MODE REJECTION RATIO AND POWER−SUPPLY REJECTION RATIO vs FREQUENCY



OPEN−LOOP GAIN AND PHASE



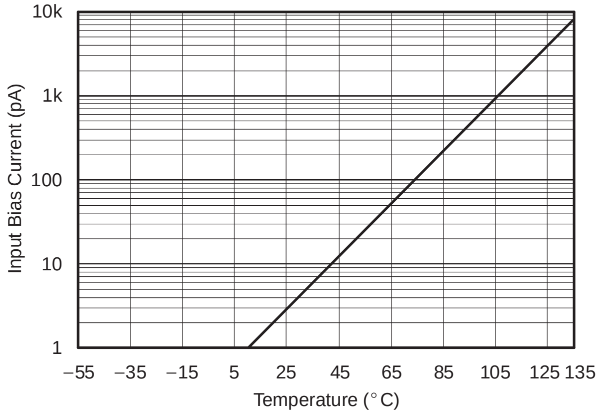
COMPOSITE VIDEO DIFFERENTIAL GAIN AND PHASE



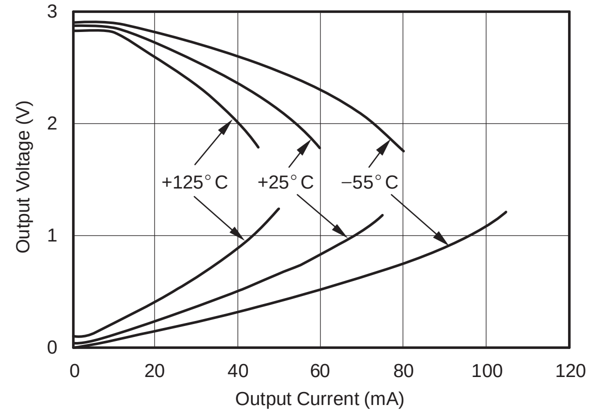
TYPICAL CHARACTERISTICS (continued)

T_A = 25°C, V_S = 5 V, R_F = 0 Ω, R_L = 1 kΩ connected to V_S/2 (unless otherwise noted)

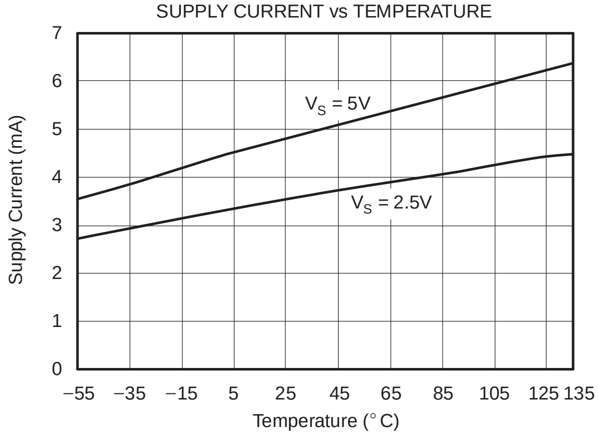
INPUT BIAS CURRENT vs TEMPERATURE



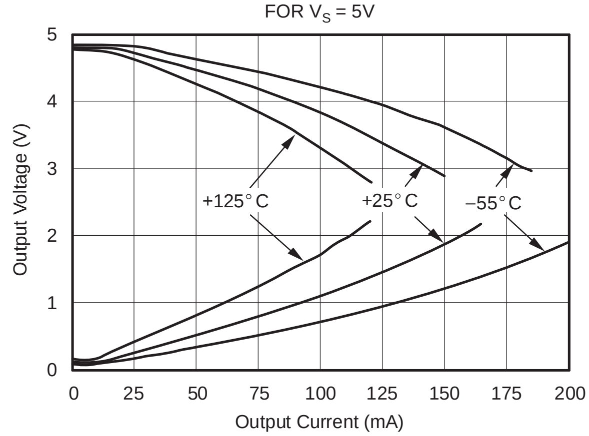
OUTPUT VOLTAGE SWING vs OUTPUT CURRENT FOR V_S = 3V



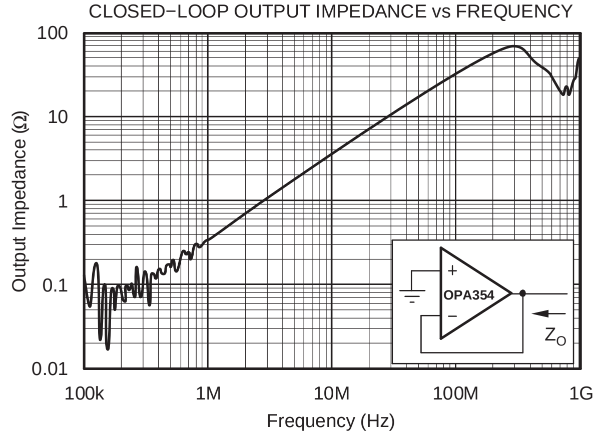
SUPPLY CURRENT vs TEMPERATURE



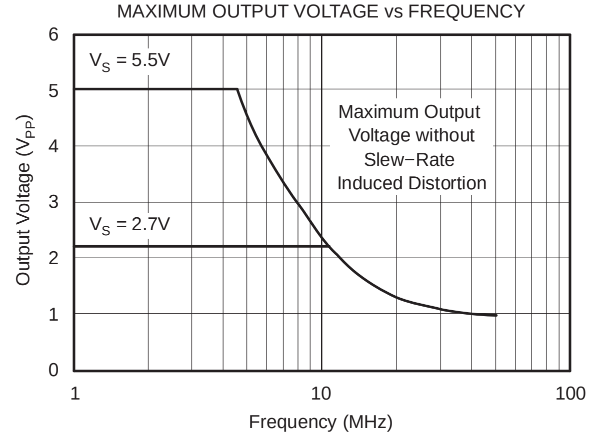
OUTPUT VOLTAGE SWING vs OUTPUT CURRENT FOR V_S = 5V



CLOSED−LOOP OUTPUT IMPEDANCE vs FREQUENCY



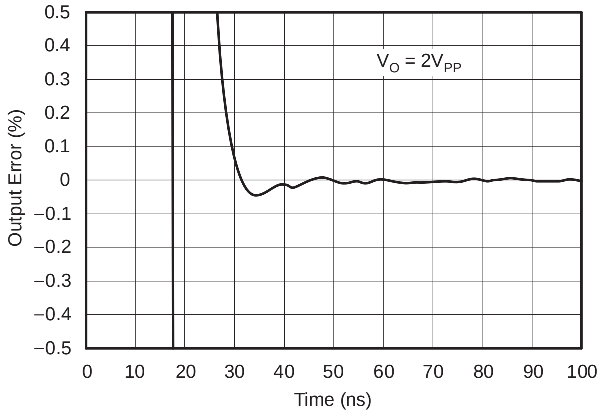
MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



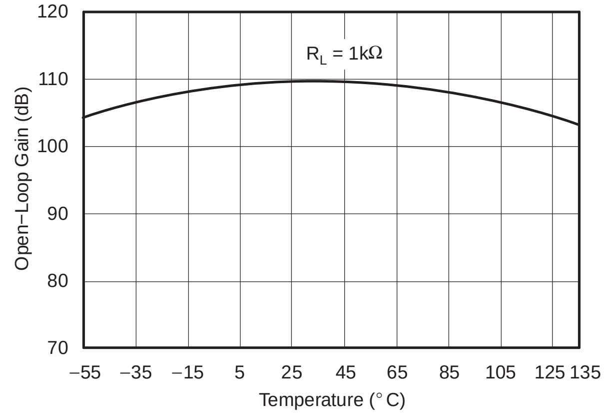
TYPICAL CHARACTERISTICS (continued)

$T_A = 25°C$, $V_S = 5$ V, $R_F = 0\ \Omega$, $R_L = 1\ k\Omega$ connected to $V_S/2$ (unless otherwise noted)

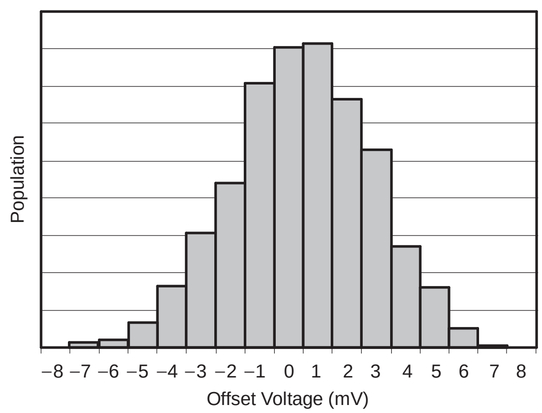
OUTPUT SETTLING TIME TO 0.1%



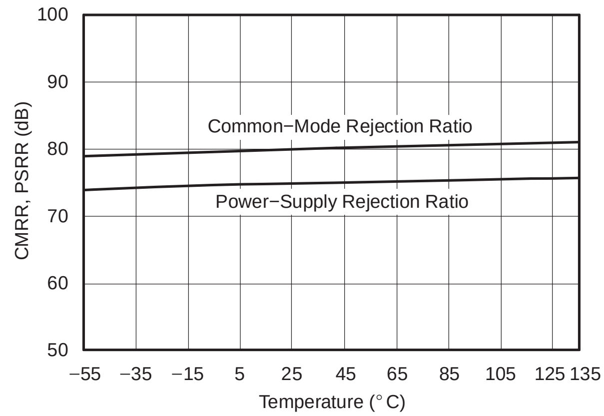
OPEN−LOOP GAIN vs TEMPERATURE



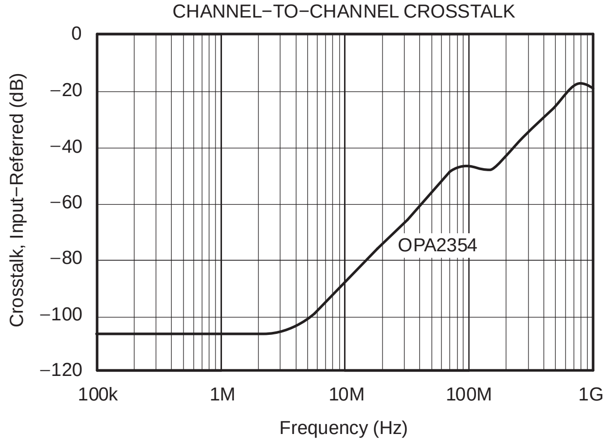
OFFSET VOLTAGE PRODUCTION DISTRIBUTION



COMMON−MODE REJECTION RATIO AND POWER−SUPPLY REJECTION RATIO vs TEMPERATURE



CHANNEL−TO−CHANNEL CROSSTALK



APPLICATION INFORMATION

The OPA354 is a CMOS, rail-to-rail I/O, high-speed, voltage-feedback operational amplifier designed for video, high-speed, and other applications. It is available as a single or dual op amp.

The amplifier features a 100-MHz gain bandwidth, and 150 V/μs slew rate, but it is unity-gain stable and can be operated as a +1-V/V voltage follower.

Operating Voltage

The OPA354 is specified over a power-supply range of 2.7 V to 5.5 V (±1.35 V to ±2.75 V). However, the supply voltage may range from 2.5 V to 5.5 V (±1.25 V to ±2.75 V). Supply voltages higher than 7.5 V (absolute maximum) can permanently damage the amplifier.

Parameters that vary over supply voltage or temperature are shown in the typical characteristics section of this data sheet.

Rail-to-Rail Input

The specified input common-mode voltage range of the OPA354 extends 100 mV beyond the supply rails. This is achieved with a complementary input stage—an N-channel input differential pair in parallel with a P-channel differential pair, as shown in Figure 1. The N-channel pair is active for input voltages close to the positive rail, typically (V+) – 1.2 V to 100 mV above the positive supply, while the P-channel pair is on for inputs from 100 mV below the negative supply to approximately (V+) – 1.2 V. There is a small transition region, typically (V+) – 1.5 V to (V+) – 0.9 V, in which both pairs are on. This 600-mV transition region can vary ±500 mV with process variation. Thus, the transition region (both input stages on) can range from (V+) – 2.0 V to (V+) – 1.5 V on the low end, up to (V+) – 0.9 V to (V+) – 0.4 V on the high end.

A double-folded cascode adds the signal from the two input pairs and presents a differential signal to the class AB output stage.

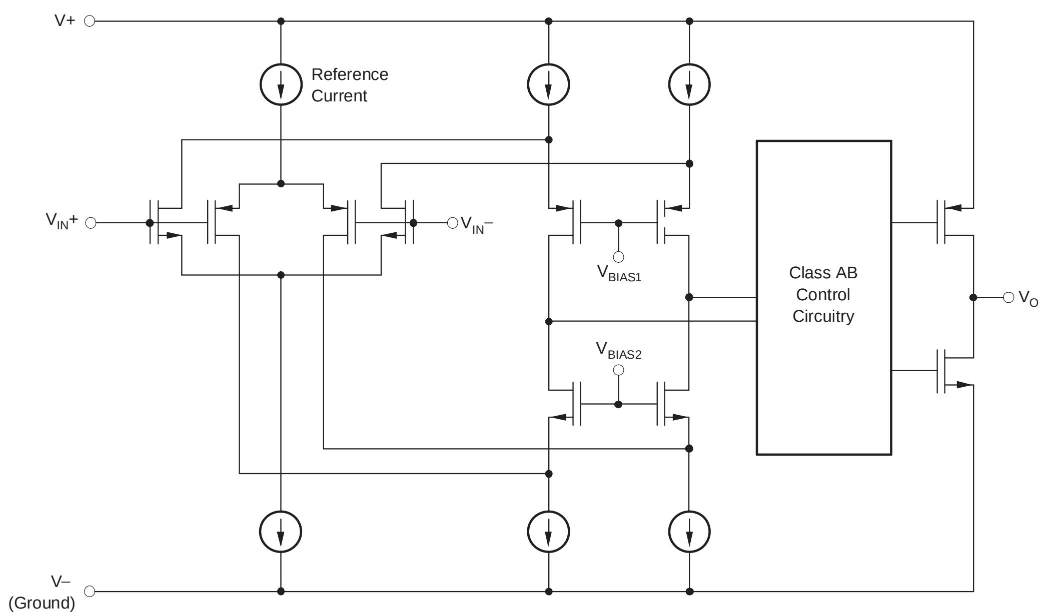


Figure 1. Simplified Schematic

Rail-to-Rail Output

A class AB output stage with common-source transistors is used to achieve rail-to-rail output. For high-impedance loads (> 200 Ω), the output voltage swing is typically 100 mV from the supply rails. With 10-Ω loads, a useful output swing can be achieved while maintaining high open-loop gain. See the typical characteristic curve Output Voltage Swing vs Output Current.

Output Drive

The OPA354's output stage can supply a continuous output current of ±100 mA and still provide approximately 2.7-V output swing on a 5-V supply, as shown in Figure 2.

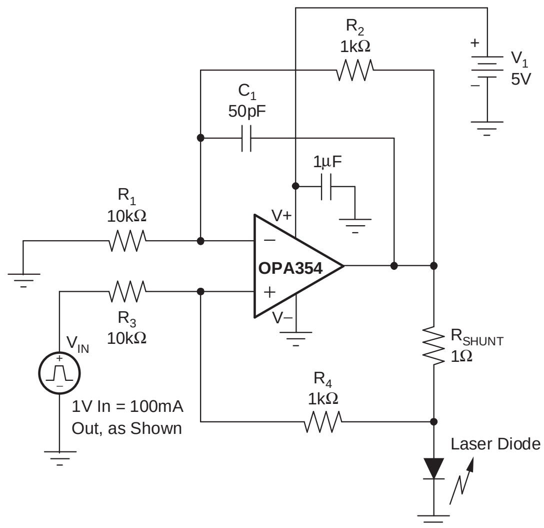


Figure 2. Laser Diode Driver

For maximum reliability, it is not recommended to run a continuous dc current in excess of ±100 mA. See the typical characteristic curve Output Voltage Swing vs Output Current. For supplying continuous output currents greater than ±100 mA, the OPA354 may be operated in parallel, as shown in Figure 3.

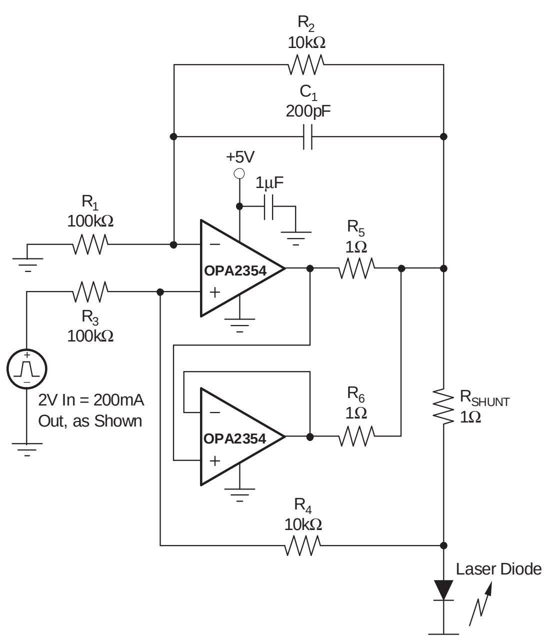


Figure 3. Parallel Operation

The OPA354 provides peak currents up to 200 mA, which corresponds to the typical short-circuit current. Therefore, an on-chip thermal shutdown circuit is provided to protect the OPA354 from dangerously high junction temperatures. At 160°C, the protection circuit shuts down the amplifier. Normal operation resumes when the junction temperature cools to below 140°C.

Video

The OPA354 output stage is capable of driving standard back-terminated 75-Ω video cables (see Figure 4). By back-terminating a transmission line, it does not exhibit a capacitive load to its driver. A properly back-terminated 75-Ω cable does not appear as capacitance; it presents only a 150-Ω resistive load to the OPA354 output.

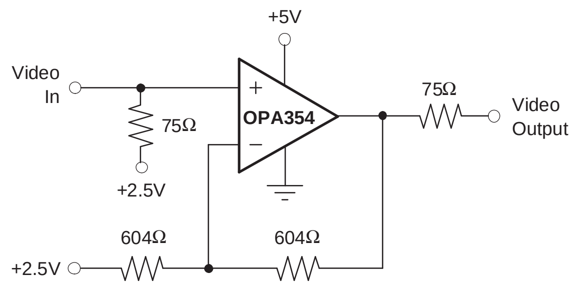


Figure 4. Single-Supply Video Line Driver

The OPA354 can be used as an amplifier for RGB graphic signals, which have a voltage of zero at the video black level, by offsetting and ac-coupling the signal (see Figure 5).

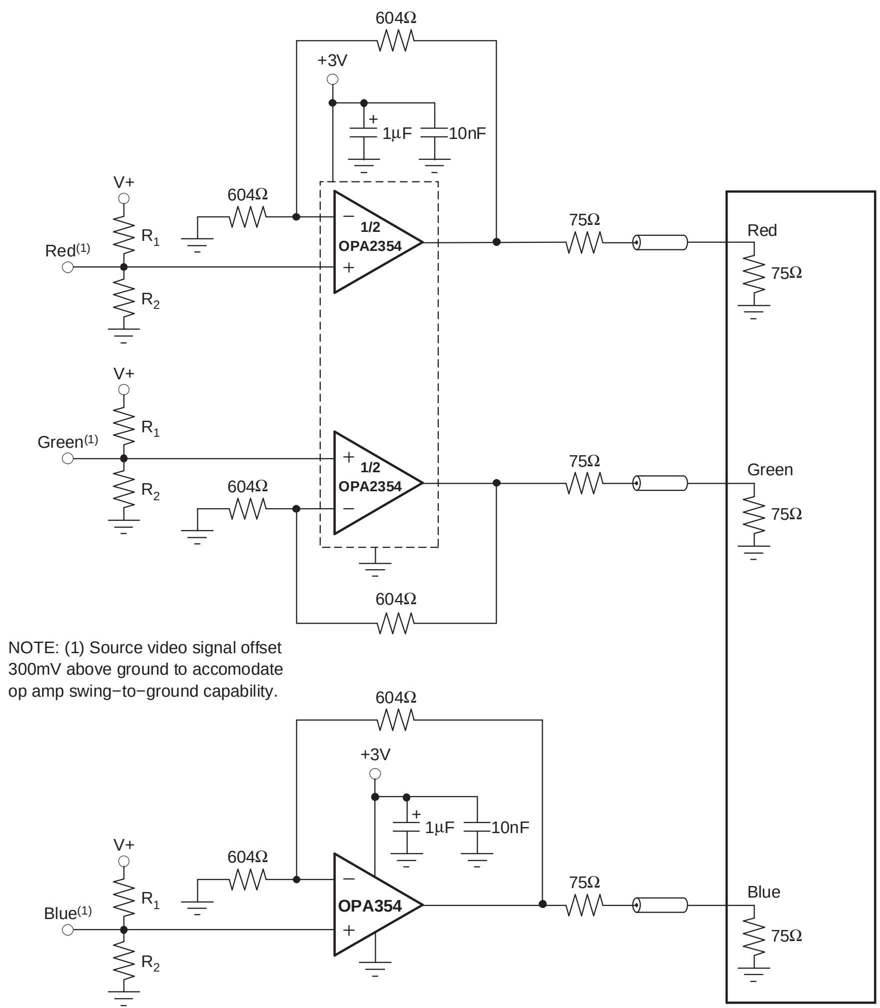


Figure 5. RGB Cable Driver

Driving Analog-to-Digital Converters

The OPA354 series op amps offer 60-ns settling time to 0.01%, making them a good choice for driving high- and medium-speed sampling A/D converters and reference circuits. The OPA354 series provide an effective means of buffering the A/D converter's input capacitance and resulting charge injection while providing signal gain. For applications requiring high DC accuracy, the OPA350 series is recommended.

Figure 6 shows the OPA354 driving an A/D converter. With the OPA354 in an inverting configuration, a capacitor across the feedback resistor can be used to filter high-frequency noise in the signal.

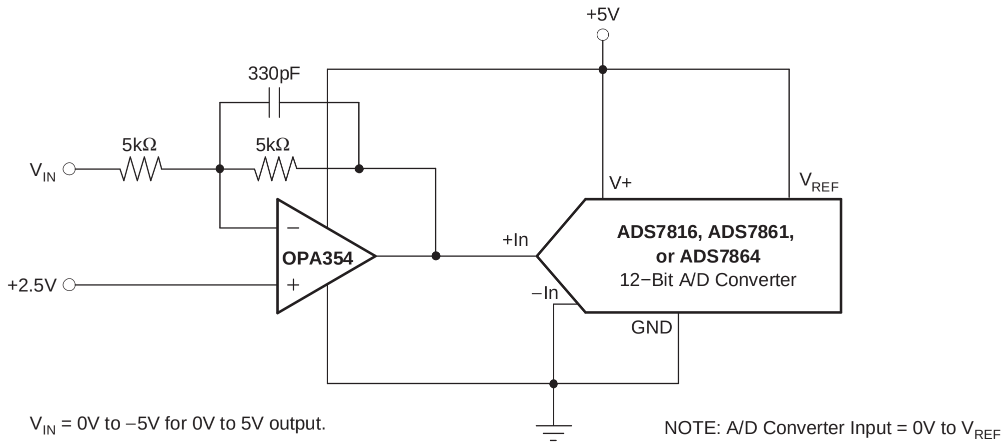


Figure 6. OPA354 Inverting Configuration Driving the ADS7816

Capacitive Load and Stability

The OPA354 series op amps can drive a wide range of capacitive loads. However, all op amps under certain conditions may become unstable. Op amp configuration, gain, and load value are just a few of the factors to consider when determining stability. An op amp in unity-gain configuration is most susceptible to the effects of capacitive loading. The capacitive load reacts with the op amp's output resistance, along with any additional load resistance, to create a pole in the small-signal response that degrades the phase margin. See the typical characteristic curve Frequency Response vs Capacitive Load for details.

The OPA354's topology enhances its ability to drive capacitive loads. In unity gain, these op amps perform well with large capacitive loads. Refer to the typical characteristic curve Recommended R_S vs Capacitive Load and Frequency Response vs Capacitive Load for details.

One method of improving capacitive load drive in the unity-gain configuration is to insert a 10-Ω to 20-Ω resistor in series with the output, as shown in Figure 7. This significantly reduces ringing with large capacitive loads—see the typical characteristic curve Frequency Response vs Capacitive Load. However, if there is a resistive load in parallel with the capacitive load, R_S creates a voltage divider. This introduces a DC error at the output and slightly reduces output swing. This error may be insignificant. For instance, with R_L = 10 kΩ and R_S = 20 Ω, there is only about a 0.2% error at the output.

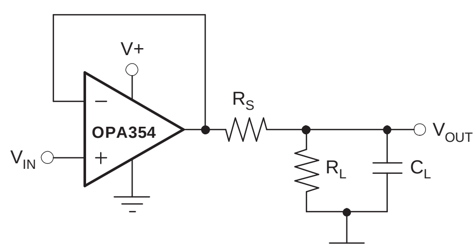


Figure 7. Series Resistor in Unity-Gain Configuration Improves Capacitive Load Drive

Wideband Transimpedance Amplifier

Wide bandwidth, low input bias current, and low input voltage and current noise make the OPA354 an ideal wideband photodiode transimpedance amplifier for low-voltage single-supply applications. Low-voltage noise is important because photodiode capacitance causes the effective noise gain of the circuit to increase at high frequency.

The key elements to a transimpedance design, as shown in Figure 8, are the expected diode capacitance (including the parasitic input common-mode and differential-mode input capacitance (2 + 2) pF for the OPA354), the desired transimpedance gain (R_F), and the gain-bandwidth product (GBW) for the OPA354 (100 MHz). With these three variables set, the feedback capacitor value (C_F) may be set to control the frequency response.

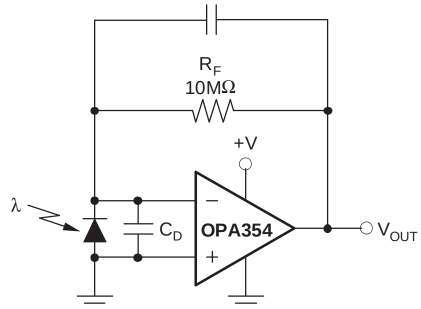


Figure 8. Transimpedance Amplifier

To achieve a maximally flat second-order Butterworth frequency response, the feedback pole should be set as shown in Equation 1.

$$\frac{1}{2\pi R_F C_F} = \sqrt{\frac{GBP}{4\pi R_F C_D}} \quad (1)$$

Typical surface-mount resistors have a parasitic capacitance of around 0.2 pF that must be deducted from the calculated feedback capacitance value.

Bandwidth is calculated as shown in Equation 2.

$$f_{-3dB} = \sqrt{\frac{GBP}{2\pi R_F C_D}}\,\text{Hz} \quad (2)$$

For even higher transimpedance bandwidth, the high-speed CMOS OPA355 (200-MHz GBW) or the OPA655 (400-MHz GBW) may be used.

PCB Layout

Good high-frequency printed circuit board (PCB) layout techniques should be employed for the OPA354. Generous use of ground planes, short and direct signal traces, and a suitable bypass capacitor located at the V+ pin assures clean stable operation. Large areas of copper also provides a means of dissipating heat that is generated in normal operation.

Sockets are not recommended for use with any high-speed amplifier.

A 10-nF ceramic bypass capacitor is the minimum recommended value; adding a 1-μF or larger tantalum capacitor in parallel can be beneficial when driving a low-resistance load. Providing adequate bypass capacitance is essential to achieving very low harmonic and intermodulation distortion.

Power Dissipation

Power dissipation depends on power-supply voltage, signal and load conditions. With dc signals, power dissipation is equal to the product of output current times the voltage across the conducting output transistor, $V_S – V_O$. Power dissipation can be minimized by using the lowest possible power-supply voltage necessary to assure the required output voltage swing.

For resistive loads, the maximum power dissipation occurs at a dc output voltage of one-half the power-supply voltage. Dissipation with ac signals is lower. Application bulletin AB-039 (SBOA022), *Power Amplifier Stress and Power Handling Limitations*, explains how to calculate or measure power dissipation with unusual signals and loads, and can be found at www.ti.com.

Any tendency to activate the thermal protection circuit indicates excessive power dissipation or an inadequate heatsink. For reliable operation, junction temperature should be limited to 150°C, maximum. To estimate the margin of safety in a complete design, increase the ambient temperature until the thermal protection is triggered at 160°C. The thermal protection should trigger more than 35°C above the maximum expected ambient condition of the application.

PACKAGING INFORMATION

Orderable Device	Status [(1)]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [(2)]	Lead/Ball Finish	MSL Peak Temp [(3)]
OPA2354AQDGKRQ1	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA354AQDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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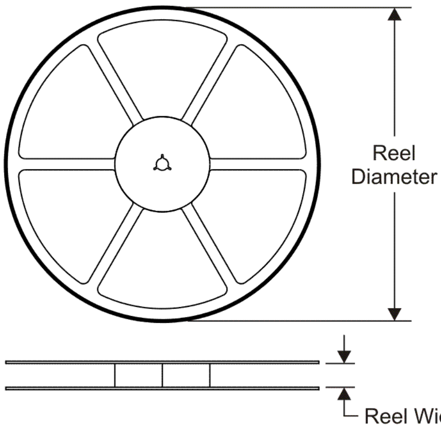
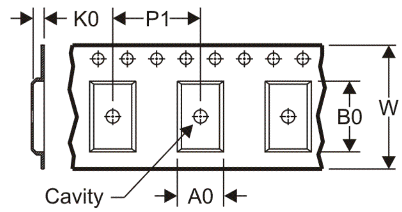
OTHER QUALIFIED VERSIONS OF OPA2354-Q1 :
- Catalog: OPA2354

NOTE: Qualified Version Definitions:
- Catalog - TI's standard catalog product

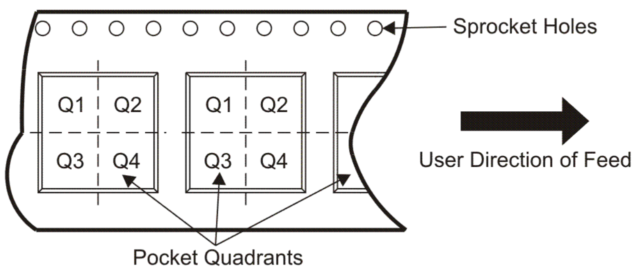
TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

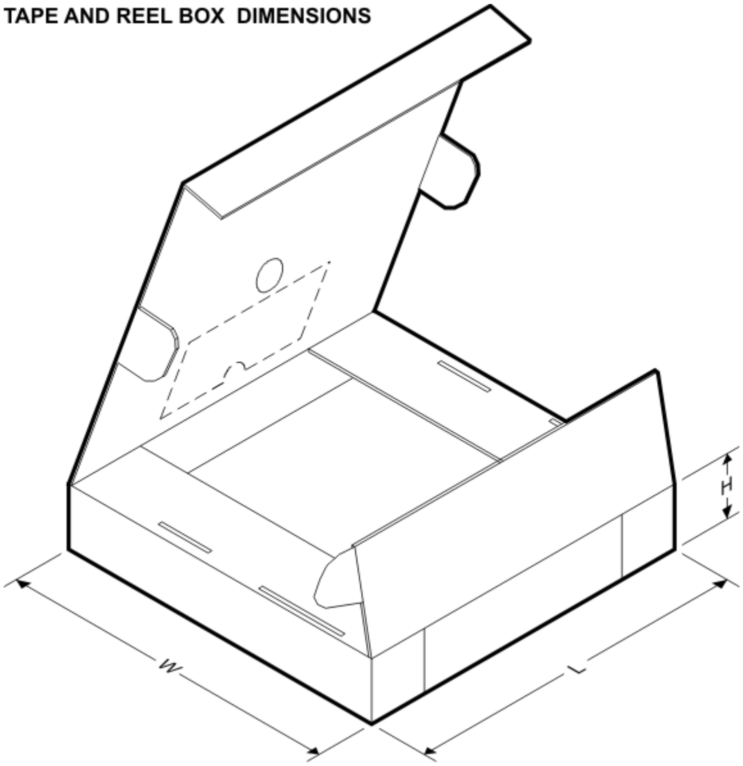
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
OPA2354AQDGKRQ1	MSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
OPA354AQDBVRQ1	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS

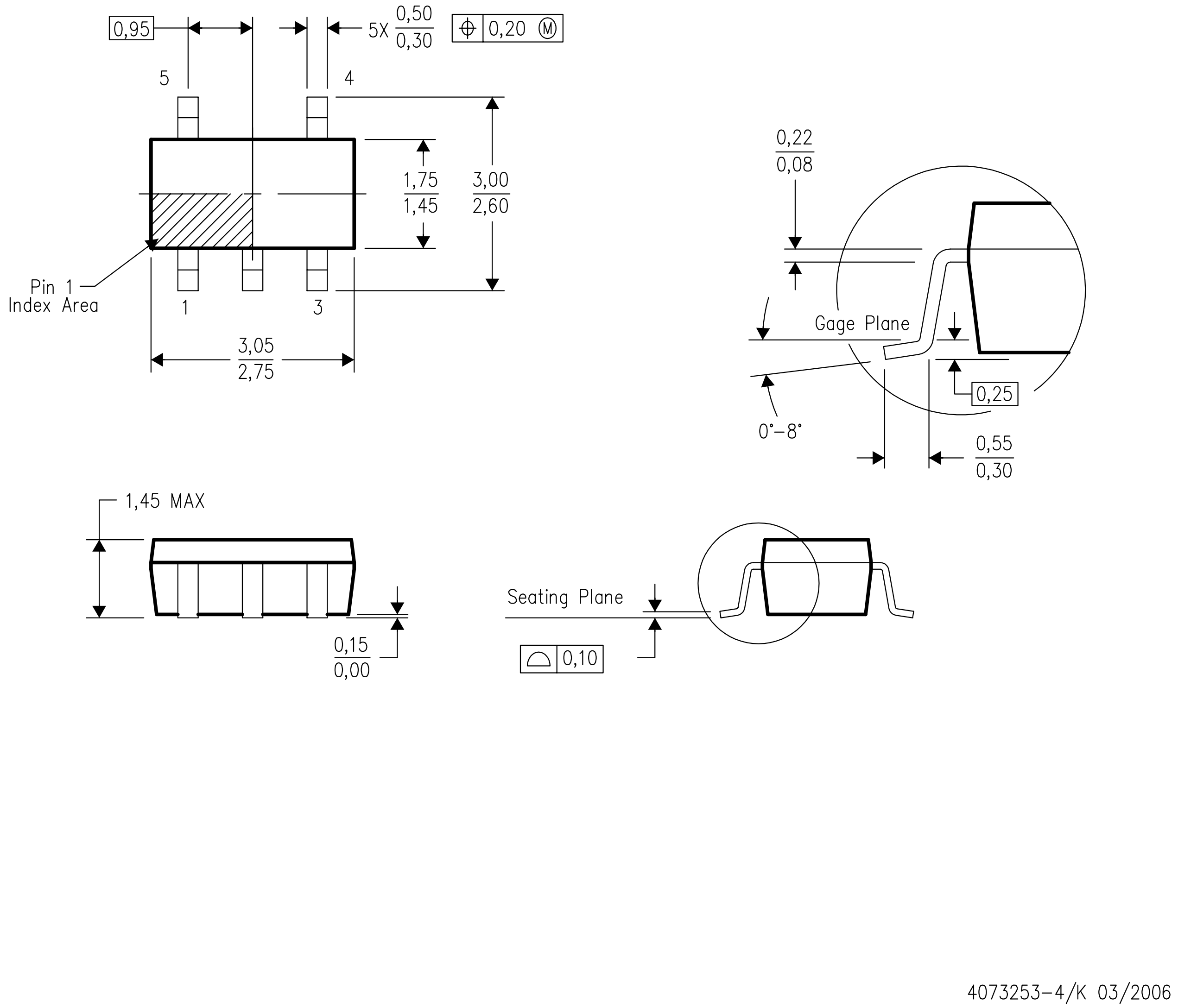


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
OPA2354AQDGKRQ1	MSOP	DGK	8	2500	346.0	346.0	29.0
OPA354AQDBVRQ1	SOT-23	DBV	5	3000	195.0	200.0	45.0

查询"OPA2354-Q1"供应商

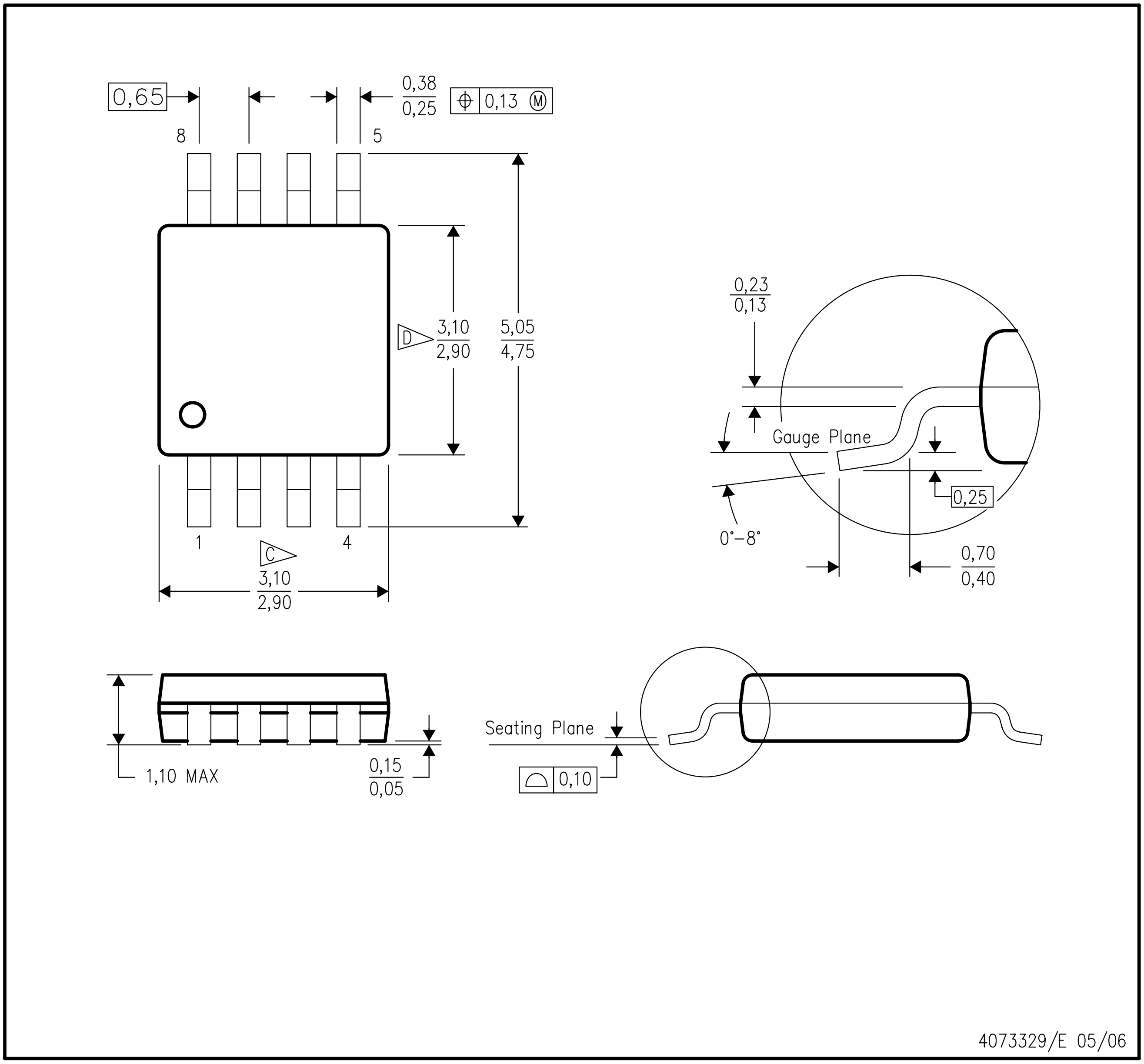
DBV (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–178 Variation AA.

查询"OPA2354-Q1"供应商

DGK (S-PDSO-G8) PLASTIC SMALL-OUTLINE PACKAGE



NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
- D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
- E. Falls within JEDEC MO-187 variation AA, except interlead flash.

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