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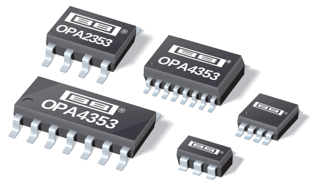


For most current data sheet and other product information, visit www.burr-brown.com

OPA353
OPA2353
OPA4353

High-Speed, Single-Supply, Rail-to-Rail OPERATIONAL AMPLIFIERS
*Micro**Amplifier*™ Series

FEATURES

- RAIL-TO-RAIL INPUT
- RAIL-TO-RAIL OUTPUT (within 10mV)
- WIDE BANDWIDTH: 44MHz
- HIGH SLEW RATE: 22V/µs
- LOW NOISE: 5nV/√Hz
- LOW THD+NOISE: 0.0006%
- UNITY-GAIN STABLE
- *Micro*SIZE PACKAGES
- SINGLE, DUAL, AND QUAD

APPLICATIONS

- CELL PHONE PA CONTROL LOOPS
- DRIVING A/D CONVERTERS
- VIDEO PROCESSING
- DATA ACQUISITION
- PROCESS CONTROL
- AUDIO PROCESSING
- COMMUNICATIONS
- ACTIVE FILTERS
- TEST EQUIPMENT

DESCRIPTION

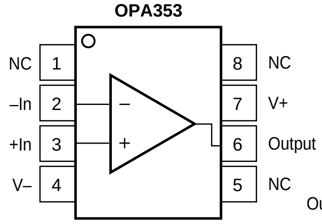
OPA353 series rail-to-rail CMOS operational amplifiers are designed for low cost, miniature applications. They are optimized for low voltage, single-supply operation. Rail-to-rail input/output, low noise (5nV/√Hz), and high speed operation (44MHz, 22V/µs) make them ideal for driving sampling analog-to-digital converters. They are also well suited for cell phone PA control loops and video processing (75Ω drive capability) as well as audio and general purpose applications. Single, dual, and quad versions have identical specifications for design flexibility.

The OPA353 series operates on a single supply as low as 2.5V with an input common-mode voltage range that extends 300mV beyond the supply rails. Output voltage swing is to within 10mV of the supply rails with a 10kΩ load. Dual and quad designs feature completely independent circuitry for lowest crosstalk and freedom from interaction.

The single (OPA353) packages are the tiny 5-lead SOT-23-5 surface mount and SO-8 surface mount. The dual (OPA2353) comes in the miniature MSOP-8 surface mount and SO-8 surface mount. The quad (OPA4353) packages are the space-saving SSOP-16 surface mount and SO-14 surface mount. All are specified from –40°C to +85°C and operate from –55°C to +125°C.

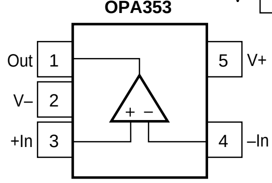
SPICE Model available at www.burr-brown.com

OPA353



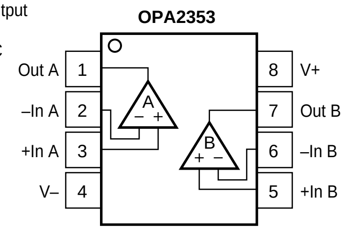
SO-8

OPA353



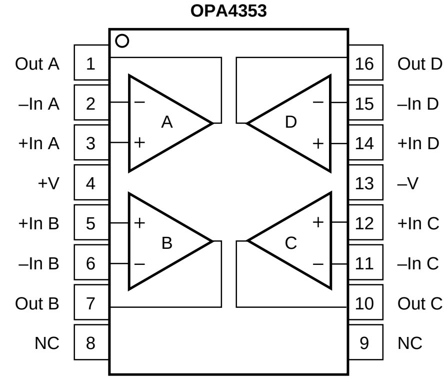
SOT-23-5

OPA2353



SO-8, MSOP-8

OPA4353



SSOP-16

(SO-14 package not shown)

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PDS-1479B

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SBOS103

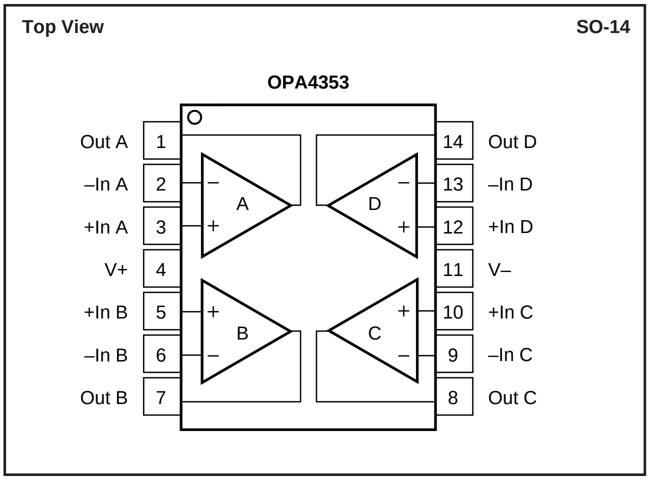
SPECIFICATIONS: V_S = 2.7V to 5.5V

At T_A = +25°C, R_L = 1kΩ connected to V_S/2 and V_{OUT} = V_S/2, unless otherwise noted.
Boldface limits apply over the specified temperature range, T_A = –40°C to +85°C. V_S = 5V.

PARAMETER		CONDITION	OPA353NA, UA OPA2353EA, UA OPA4353EA, UA			UNITS
			MIN	TYP(1)	MAX	
OFFSET VOLTAGE						
Input Offset Voltage	V_{OS}	V_S = 5V		±3	±8	mV
T_A = –40°C to +85°C					**±10**	mV
vs Temperature		**T_A = –40°C to +85°C**		**±5**		μV/°C
vs Power Supply Rejection Ratio	PSRR	V_S = 2.7V to 5.5V, V_{CM} = 0V		40	150	μV/V
T_A = –40°C to +85°C		V_S = 2.7V to 5.5V, V_{CM} = 0V			**175**	μV/V
Channel Separation (dual, quad)		dc		0.15		μV/V
INPUT BIAS CURRENT						
Input Bias Current	I_B			±0.5	±10	pA
T_A = –40°C to +85°C				See Typical Curve		
Input Offset Current	I_{OS}			±0.5	±10	pA
NOISE						
Input Voltage Noise, f = 100Hz to 400kHz				4		μVrms
Input Voltage Noise Density, f = 10kHz	e_n			7		nV/√Hz
f = 100kHz				5		nV/√Hz
Current Noise Density, f = 10kHz	i_n			4		fA/√Hz
INPUT VOLTAGE RANGE						
Common-Mode Voltage Range	V_{CM}		–0.1		(V+) + 0.1	V
Common-Mode Rejection Ratio	CMRR	–0.1V < V_{CM} < (V+) – 2.4V	76	86		dB
		V_S = 5V, –0.1V < V_{CM} < 5.1V	60	74		dB
T_A = –40°C to +85°C		V_S = 5V, –0.1V < V_{CM} < 5.1V	**58**			dB
INPUT IMPEDANCE						
Differential				10^{13} || 2.5		Ω || pF
Common-Mode				10^{13} || 6.5		Ω || pF
OPEN-LOOP GAIN						
Open-Loop Voltage Gain	A_{OL}	R_L = 10kΩ, 50mV < V_O < (V+) – 50mV	100	122		dB
T_A = –40°C to +85°C		R_L = 10kΩ, 50mV < V_O < (V+) – 50mV	**100**			dB
		R_L = 1kΩ, 200mV < V_O < (V+) – 200mV	100	120		dB
T_A = –40°C to +85°C		R_L = 1kΩ, 200mV < V_O < (V+) – 200mV	**100**			dB
FREQUENCY RESPONSE		C_L = 100pF				
Gain-Bandwidth Product	GBW	G = 1		44		MHz
Slew Rate	SR	G = 1		22		V/μs
Settling Time, 0.1%		G = ±1, 2V Step		0.22		μs
0.01%		G = ±1, 2V Step		0.5		μs
Overload Recovery Time		V_{IN} • G = V_S		0.1		μs
Total Harmonic Distortion + Noise	THD+N	R_L = 600Ω, V_O = 2.5Vp-p(2), G = 1, f = 1kHz		0.0006		%
Differential Gain Error		G = 2, R_L = 600Ω, V_O = 1.4V(3)		0.17		%
Differential Phase Error		G = 2, R_L = 600Ω, V_O = 1.4V(3)		0.17		deg
OUTPUT						
Voltage Output Swing from Rail(4)	V_{OUT}	R_L = 10kΩ, A_{OL} ≥ 100dB		10	50	mV
T_A = –40°C to +85°C		R_L = 10kΩ, A_{OL} ≥ 100dB			**50**	mV
		R_L = 1kΩ, A_{OL} ≥ 100dB		25	200	mV
T_A = –40°C to +85°C		R_L = 1kΩ, A_{OL} ≥ 100dB			**200**	mV
Output Current	I_{OUT}			±40(5)		mA
Short-Circuit Current	I_{SC}			±80		mA
Capacitive Load Drive	C_{LOAD}			See Typical Curve		
POWER SUPPLY						
Operating Voltage Range	V_S	**T_A = –40°C to +85°C**	**2.7**		**5.5**	V
Minimum Operating Voltage				2.5		V
Quiescent Current (per amplifier)	I_Q	I_O = 0		5.2	8	mA
T_A = –40°C to +85°C		I_O = 0			**9**	mA
TEMPERATURE RANGE						
Specified Range			–40		+85	°C
Operating Range			–55		+125	°C
Storage Range			–55		+125	°C
Thermal Resistance	θ_{JA}					
SOT-23-5				200		°C/W
MSOP-8 Surface Mount				150		°C/W
SO-8 Surface Mount				150		°C/W
SSOP-16 Surface Mount				100		°C/W
SO-14 Surface Mount				100		°C/W

NOTES: (1) V_S = +5V. (2) V_{OUT} = 0.25V to 2.75V. (3) NTSC signal generator used. See Figure 6 for test circuit. (4) Output voltage swings are measured between the output and power supply rails. (5) See typical performance curve, "Output Voltage Swing vs Output Swing."

PIN CONFIGURATION



ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown 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.

ABSOLUTE MAXIMUM RATINGS(1)

Supply Voltage	5.5V
Signal Input Terminals, Voltage(2)	(V–) – 0.3V to (V+) + 0.3V
Current(2)	10mA
Output Short-Circuit(3)	Continuous
Operating Temperature	–55°C to +125°C
Storage Temperature	–55°C to +125°C
Junction Temperature	150°C
Lead Temperature (soldering, 10s)	300°C

NOTES: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. (2) Input terminals are diode-clamped to the power supply rails. Input signals that can swing more than 0.3V beyond the supply rails should be current-limited to 10mA or less. (3) Short circuit to ground, one amplifier per package.

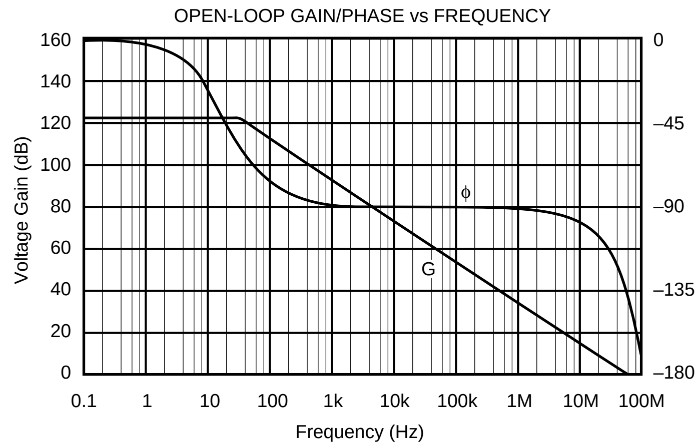
PACKAGE/ORDERING INFORMATION

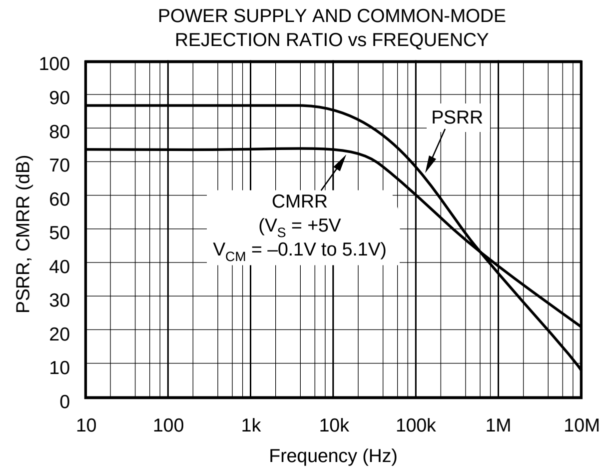
PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER(1)	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER(2)	TRANSPORT MEDIA
Single						
OPA353NA	5-Lead SOT-23-5	331	–40°C to +85°C	D53	OPA353NA/250	Tape and Reel
"	"	"	"	"	OPA353NA/3K	Tape and Reel
OPA353UA	SO-8 Surface Mount	182	–40°C to +85°C	OPA353UA	OPA353UA	Rails
"	"	"	"	"	OPA353UA/2K5	Tape and Reel
Dual						
OPA2353EA	MSOP-8 Surface Mount	337	–40°C to +85°C	E53	OPA2353EA/250	Tape and Reel
"	"	"	"	"	OPA2353EA/2K5	Tape and Reel
OPA2353UA	SO-8 Surface Mount	182	–40°C to +85°C	OPA2353UA	OPA2353UA	Rails
"	"	"	"	"	OPA2353UA/2K5	Tape and Reel
Quad						
OPA4353EA	SSOP-16 Surface Mount	322	–40°C to +85°C	OPA4353EA	OPA4353EA/250	Tape and Reel
"	"	"	"	"	OPA4353EA/2K5	Tape and Reel
OPA4353UA	SO-14 Surface Mount	235	–40°C to +85°C	OPA4353UA	OPA4353UA	Rails
"	"	"	"	"	OPA4353UA/2K5	Tape and Reel

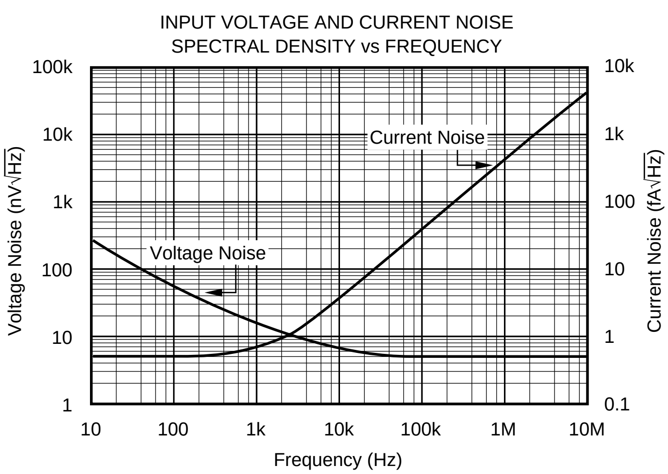
NOTES: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book. (2) Models with a slash (/) are available only in Tape and Reel in the quantities indicated (e.g., /2K5 indicates 2500 devices per reel). Ordering 2500 pieces of "OPA2353EA/2K5" will get a single 2500-piece Tape and Reel. For detailed Tape and Reel mechanical information, refer to Appendix B of Burr-Brown IC Data Book.

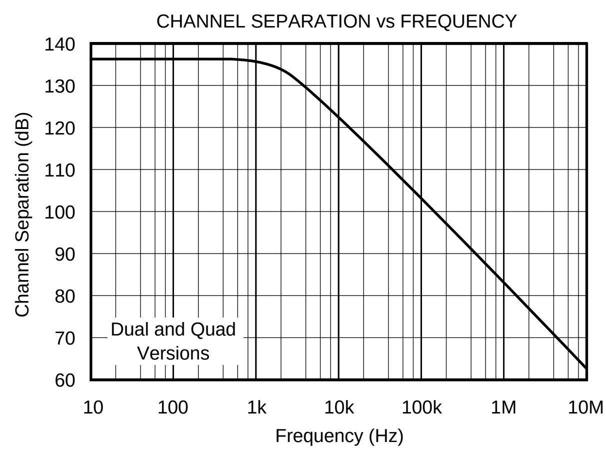
TYPICAL PERFORMANCE CURVES

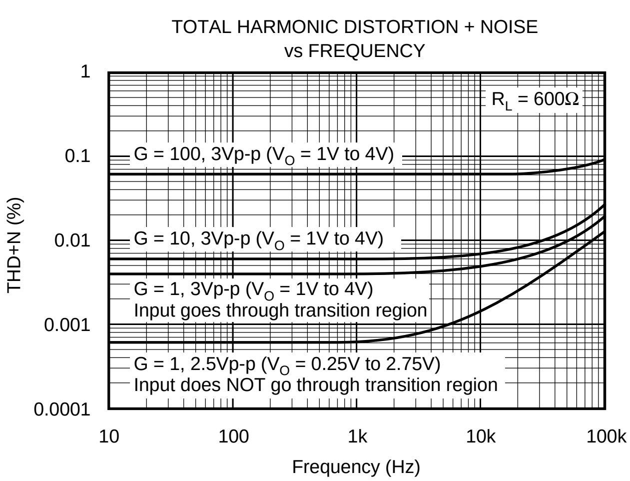
At $T_A = +25°C$, $V_S = +5V$, and $R_L = 1k\Omega$ connected to $V_S/2$, unless otherwise noted.

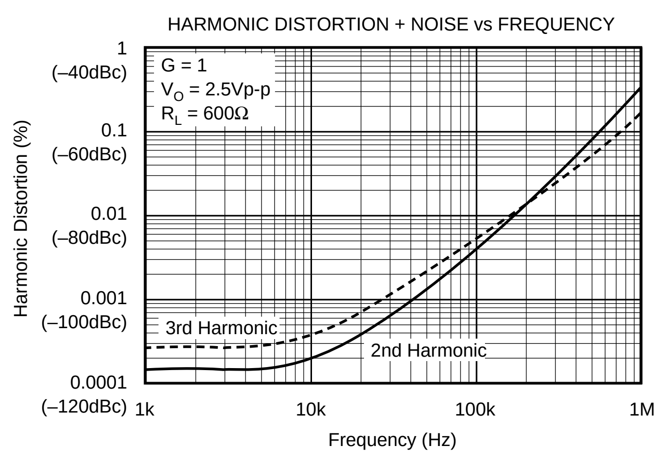








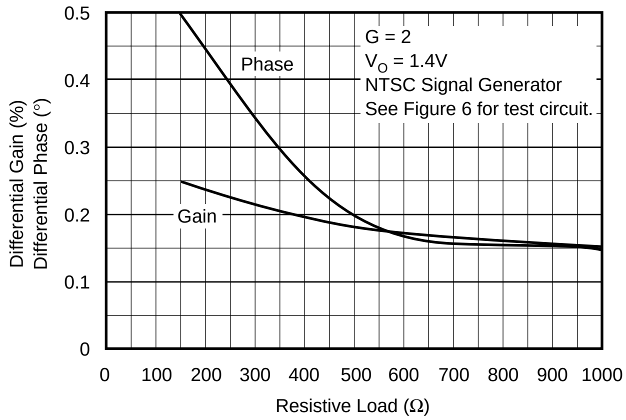




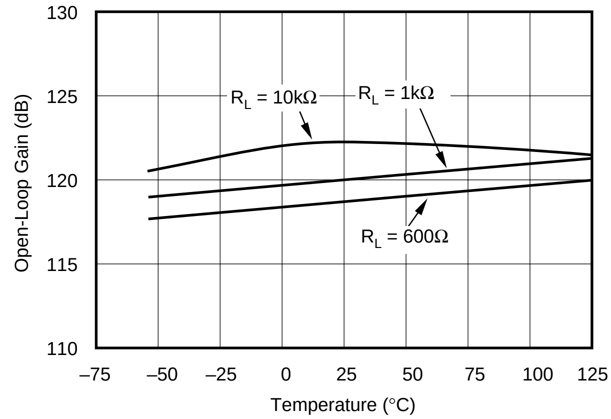
TYPICAL PERFORMANCE CURVES (CONT)

At T_A = +25°C, V_S = +5V, and R_L = 1kΩ connected to V_S/2, unless otherwise noted.

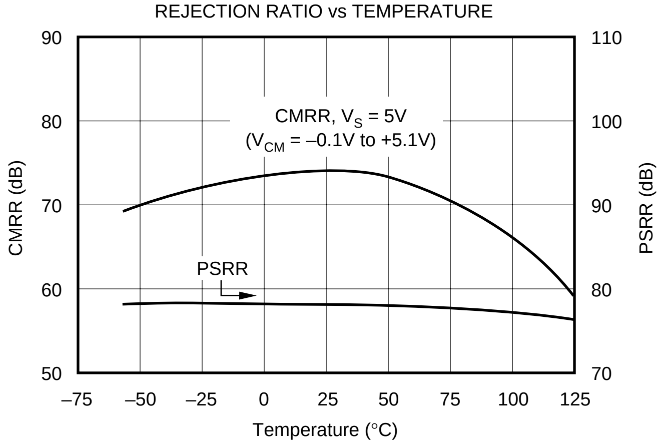
DIFFERENTIAL GAIN/PHASE vs RESISTIVE LOAD



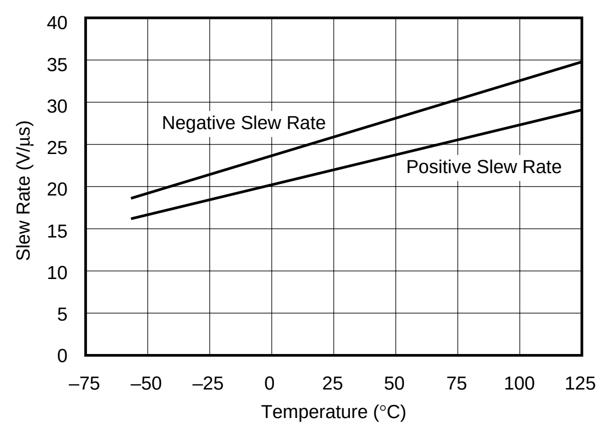
OPEN-LOOP GAIN vs TEMPERATURE



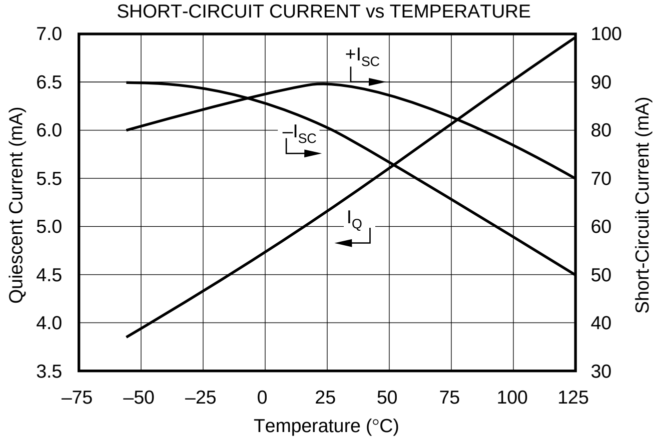
COMMON-MODE AND POWER SUPPLY REJECTION RATIO vs TEMPERATURE



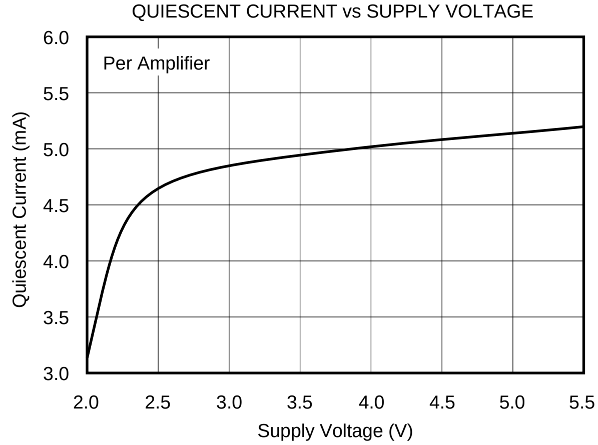
SLEW RATE vs TEMPERATURE



QUIESCENT CURRENT AND SHORT-CIRCUIT CURRENT vs TEMPERATURE



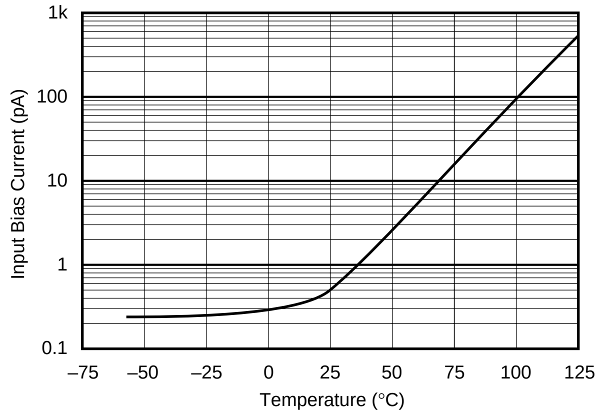
QUIESCENT CURRENT vs SUPPLY VOLTAGE



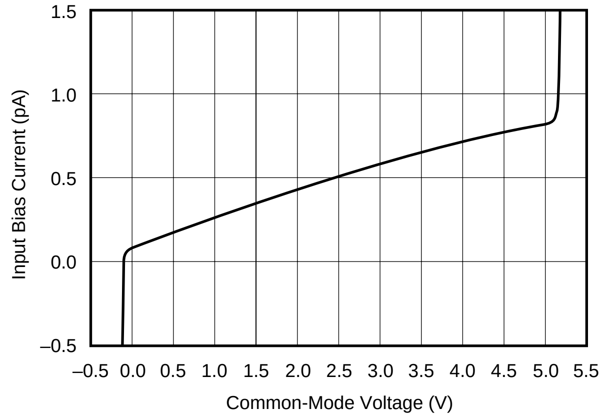
TYPICAL PERFORMANCE CURVES (CONT)

At T_A = +25°C, V_S = +5V, and R_L = 1kΩ connected to V_S/2, unless otherwise noted.

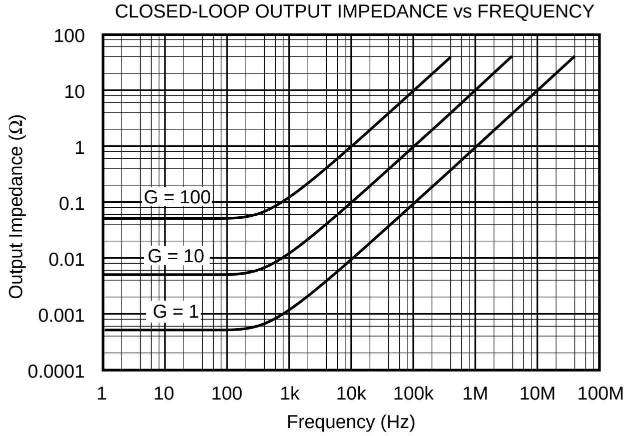
INPUT BIAS CURRENT vs TEMPERATURE



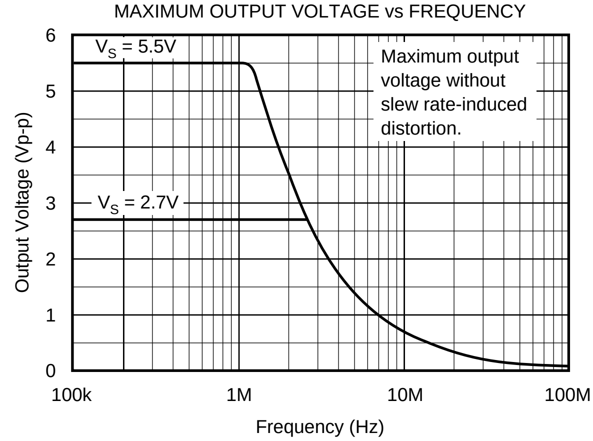
INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE



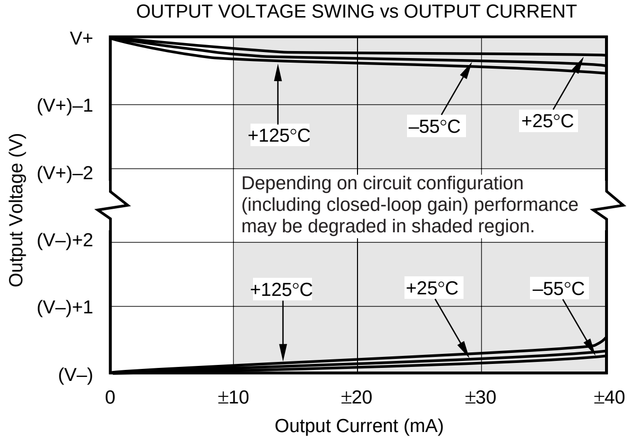
CLOSED-LOOP OUTPUT IMPEDANCE vs FREQUENCY



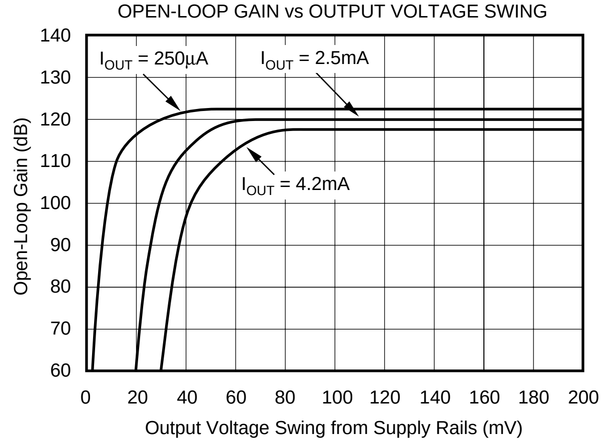
MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



OUTPUT VOLTAGE SWING vs OUTPUT CURRENT



OPEN-LOOP GAIN vs OUTPUT VOLTAGE SWING



TYPICAL PERFORMANCE CURVES (CONT)

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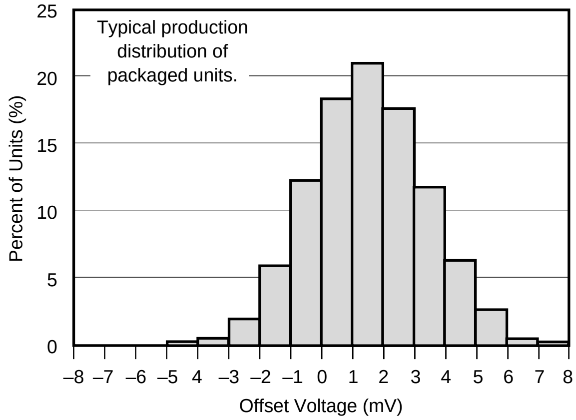
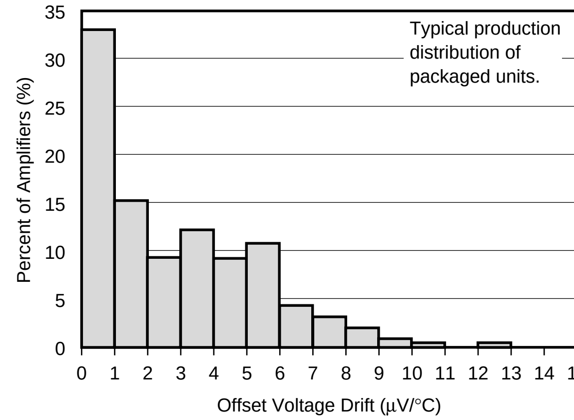
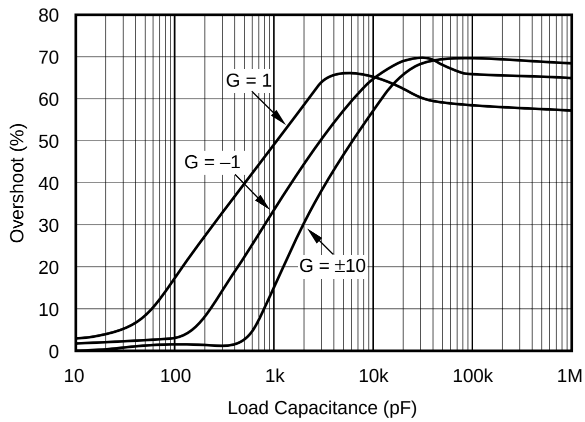
OFFSET VOLTAGE PRODUCTION DISTRIBUTION



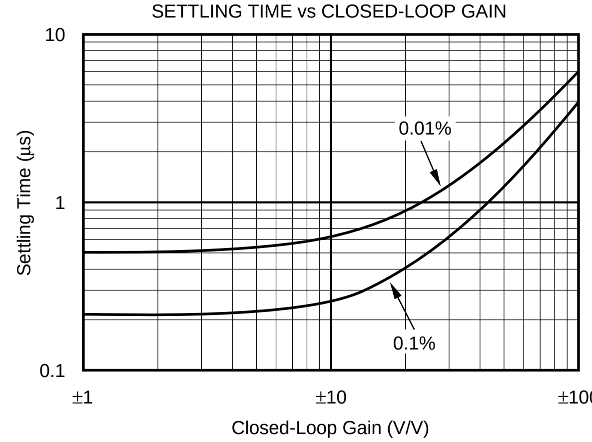
OFFSET VOLTAGE DRIFT PRODUCTION DISTRIBUTION



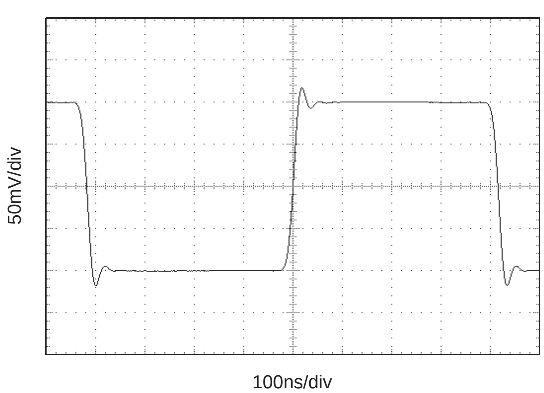
SMALL-SIGNAL OVERSHOOT vs LOAD CAPACITANCE



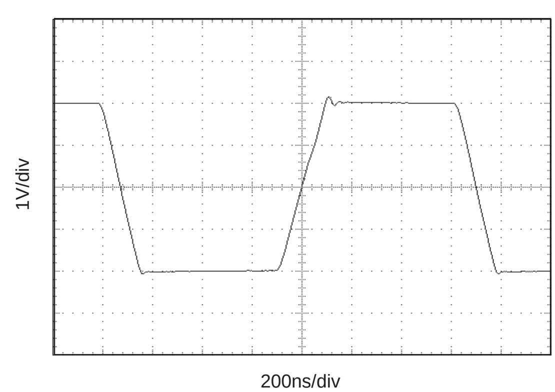
SETTLING TIME vs CLOSED-LOOP GAIN



SMALL-SIGNAL STEP RESPONSE
C_L = 100pF



LARGE-SIGNAL STEP RESPONSE
C_L = 100pF



APPLICATIONS INFORMATION

OPA353 series op amps are fabricated on a state-of-the-art 0.6 micron CMOS process. They are unity-gain stable and suitable for a wide range of general purpose applications. Rail-to-rail input/output make them ideal for driving sampling A/D converters. They are well suited for controlling the output power in cell phones. These applications often require high speed and low noise. In addition, the OPA353 series offers a low cost solution for general purpose and consumer video applications (75Ω drive capability).

Excellent ac performance makes the OPA353 series well suited for audio applications. Their bandwidth, slew rate, low noise ($5nV/\sqrt{Hz}$), low THD (0.0006%), and small package options are ideal for these applications. The class AB output stage is capable of driving 600Ω loads connected to any point between V+ and ground.

Rail-to-rail input and output swing significantly increases dynamic range, especially in low voltage supply applications. Figure 1 shows the input and output waveforms for the OPA353 in unity-gain configuration. Operation is from a single +5V supply with a 1kΩ load connected to $V_S/2$. The input is a 5Vp-p sinusoid. Output voltage is approximately 4.95Vp-p.

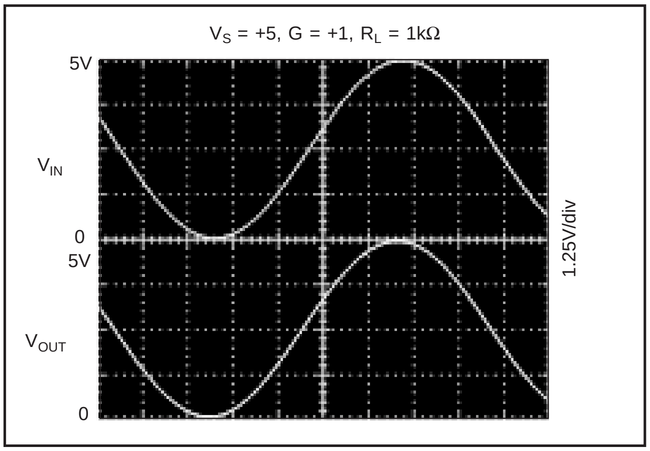


FIGURE 1. Rail-to-Rail Input and Output.

Power supply pins should be bypassed with 0.01µF ceramic capacitors.

OPERATING VOLTAGE

OPA353 series op amps are fully specified from +2.7V to +5.5V. However, supply voltage may range from +2.5V to +5.5V. Parameters are guaranteed over the specified supply range—a unique feature of the OPA353 series. In addition, many specifications apply from –40°C to +85°C. Most behavior remains virtually unchanged throughout the full operating voltage range. Parameters which vary significantly with operating voltages or temperature are shown in the typical performance curves.

RAIL-TO-RAIL INPUT

The guaranteed input common-mode voltage range of the OPA353 series extends 100mV 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 (see Figure 2). The N-channel pair is active for input voltages close to the positive rail, typically (V+) – 1.8V to 100mV above the positive supply, while the P-channel pair is on for inputs from 100mV below the negative supply to approximately (V+) – 1.8V. There is a small transition region, typically (V+) – 2V to (V+) – 1.6V, in which both pairs are on. This 400mV transition region can vary ±400mV with process variation. Thus, the transition region (both input stages on) can range from (V+) – 2.4V to (V+) – 2.0V on the low end, up to (V+) – 1.6V to (V+) – 1.2V on the high end.

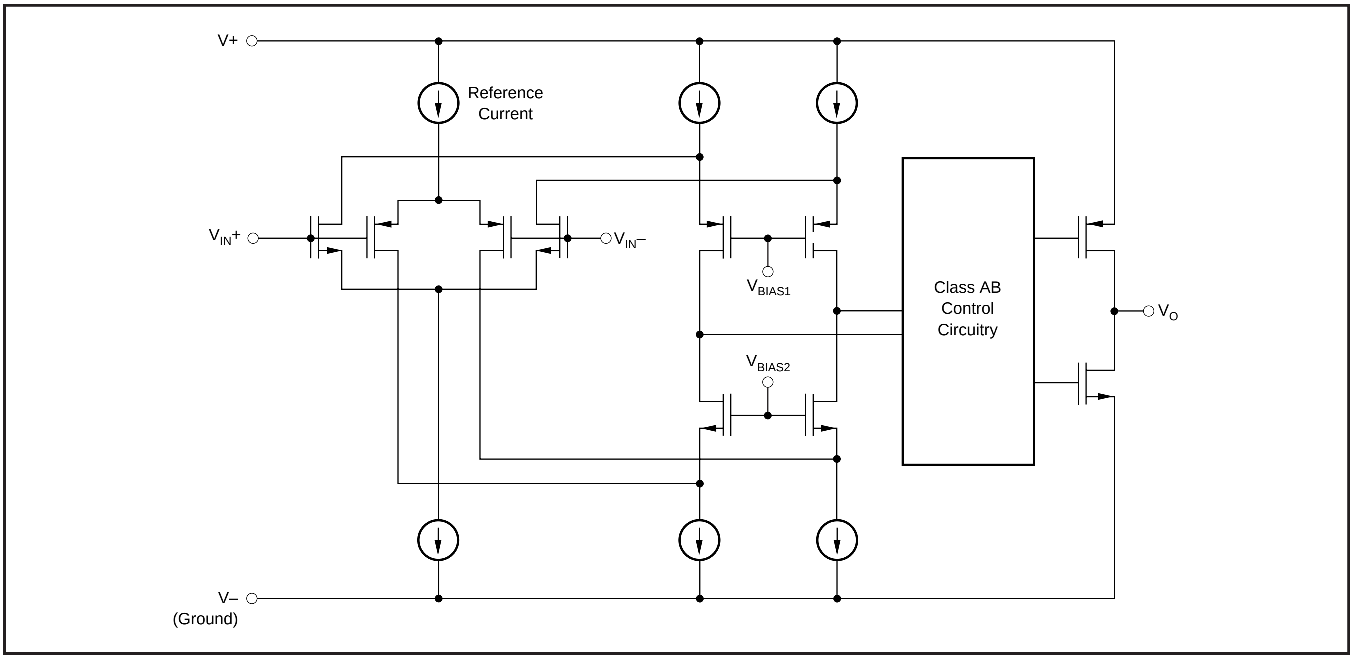


FIGURE 2. Simplified Schematic.

A double-folded cascode adds the signal from the two input pairs and presents a differential signal to the class AB output stage. Normally, input bias current is approximately 500fA. However, large inputs (greater than 300mV beyond the supply rails) can turn on the OPA353's input protection diodes, causing excessive current to flow in or out of the input pins. Momentary voltages greater than 300mV beyond the power supply can be tolerated if the current on the input pins is limited to 10mA. This is easily accomplished with an input resistor as shown in Figure 3. Many input signals are inherently current-limited to less than 10mA, therefore, a limiting resistor is not required.

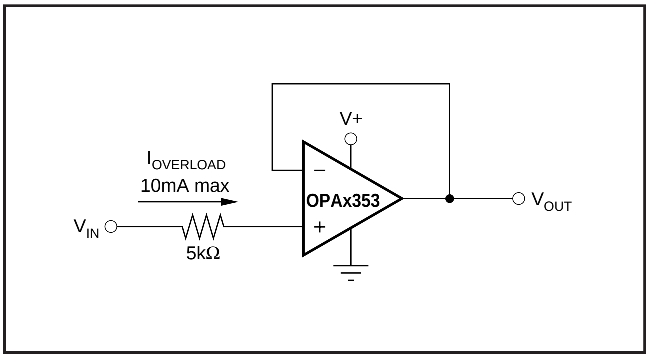


FIGURE 3. Input Current Protection for Voltages Exceeding the Supply Voltage.

RAIL-TO-RAIL OUTPUT

A class AB output stage with common-source transistors is used to achieve rail-to-rail output. For light resistive loads (>10kΩ), the output voltage swing is typically ten millivolts from the supply rails. With heavier resistive loads (600Ω to 10kΩ), the output can swing to within a few tens of millivolts from the supply rails and maintain high open-loop gain. See the typical performance curves "Output Voltage Swing vs Output Current" and "Open-Loop Gain vs Output Voltage."

CAPACITIVE LOAD AND STABILITY

OPA353 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 the most susceptible to the effects of capacitive load. The capacitive load reacts with the op amp's output impedance, along with any additional load resistance, to create a pole in the small-signal response which degrades the phase margin.

In unity gain, OPA353 series op amps perform well with large capacitive loads. Increasing gain enhances the amplifier's ability to drive more capacitance. The typical performance curve "Small-Signal Overshoot vs Capacitive Load" shows performance with a 1kΩ resistive load. Increasing load resistance improves capacitive load drive capability.

FEEDBACK CAPACITOR IMPROVES RESPONSE

For optimum settling time and stability with high-impedance feedback networks, it may be necessary to add a feedback capacitor across the feedback resistor, R_F, as shown in Figure 4. This capacitor compensates for the zero created by the feedback network impedance and the OPA353's input capacitance (and any parasitic layout capacitance). The effect becomes more significant with higher impedance networks.

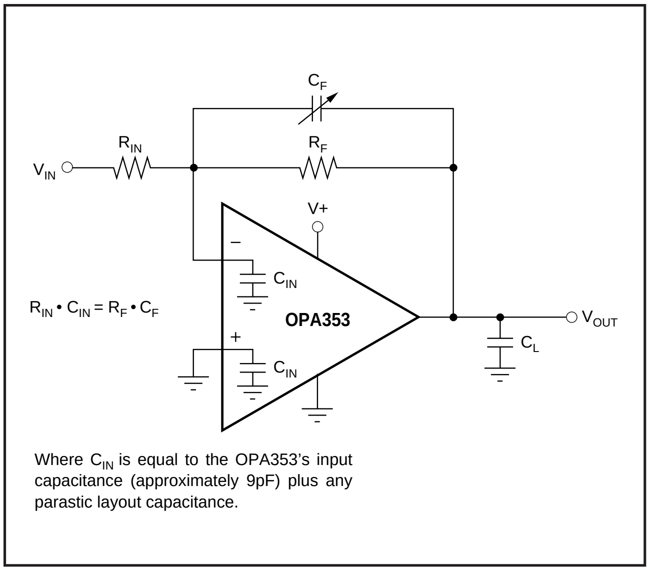


FIGURE 4. Feedback Capacitor Improves Dynamic Performance.

It is suggested that a variable capacitor be used for the feedback capacitor since input capacitance may vary between op amps and layout capacitance is difficult to determine. For the circuit shown in Figure 4, the value of the variable feedback capacitor should be chosen so that the input resistance times the input capacitance of the OPA353 (typically 9pF) plus the estimated parasitic layout capacitance equals the feedback capacitor times the feedback resistor:

$$R_{IN} \cdot C_{IN} = R_F \cdot C_F$$

where C_{IN} is equal to the OPA353's input capacitance (sum of differential and common-mode) plus the layout capacitance. The capacitor can be varied until optimum performance is obtained.

DRIVING A/D CONVERTERS

OPA353 series op amps are optimized for driving medium speed (up to 500kHz) sampling A/D converters. However, they also offer excellent performance for higher speed converters. The OPA353 series provides an effective means of buffering the A/D's input capacitance and resulting charge injection while providing signal gain. For applications requiring high accuracy, the OPA350 series is recommended.

Figure 5 shows the OPA353 driving an ADS7861. The ADS7861 is a dual, 12-bit, 500kHz sampling converter in the small SSOP-24 package. When used with the miniature package options of the OPA353 series, the combination is ideal for space-limited and low power applications. For further information consult the ADS7861 data sheet.

OUTPUT IMPEDANCE

The low frequency open-loop output impedance of the OPA353's common-source output stage is approximately 1kΩ. When the op amp is connected with feedback, this value is reduced significantly by the loop gain of the op amp. For example, with 122dB of open-loop gain, the output impedance is reduced in unity-gain to less than 0.001Ω. For each decade rise in the closed-loop gain, the loop gain is reduced by the same amount which results in a ten-fold increase in output impedance (see the typical performance curve, "Output Impedance vs Frequency").

At higher frequencies, the output impedance will rise as the open-loop gain of the op amp drops. However, at these frequencies the output also becomes capacitive due to parasitic capacitance. This prevents the output impedance from becoming too high, which can cause stability problems when driving capacitive loads. As mentioned previously, the OPA353 has excellent capacitive load drive capability for an op amp with its bandwidth.

VIDEO LINE DRIVER

Figure 6 shows a circuit for a single supply, G = 2 composite video line driver. The synchronized outputs of a composite video line driver extend below ground. As shown, the input to the op amp should be ac-coupled and shifted positively to provide adequate signal swing to account for these negative signals in a single-supply configuration.

The input is terminated with a 75Ω resistor and ac-coupled with a 47µF capacitor to a voltage divider that provides the dc bias point to the input. In Figure 6, this point is approximately (V–) + 1.7V. Setting the optimal bias point requires some understanding of the nature of composite video signals. For best performance, one should be careful to avoid the distortion caused by the transition region of the OPA353's complementary input stage. Refer to the discussion of rail-to-rail input.

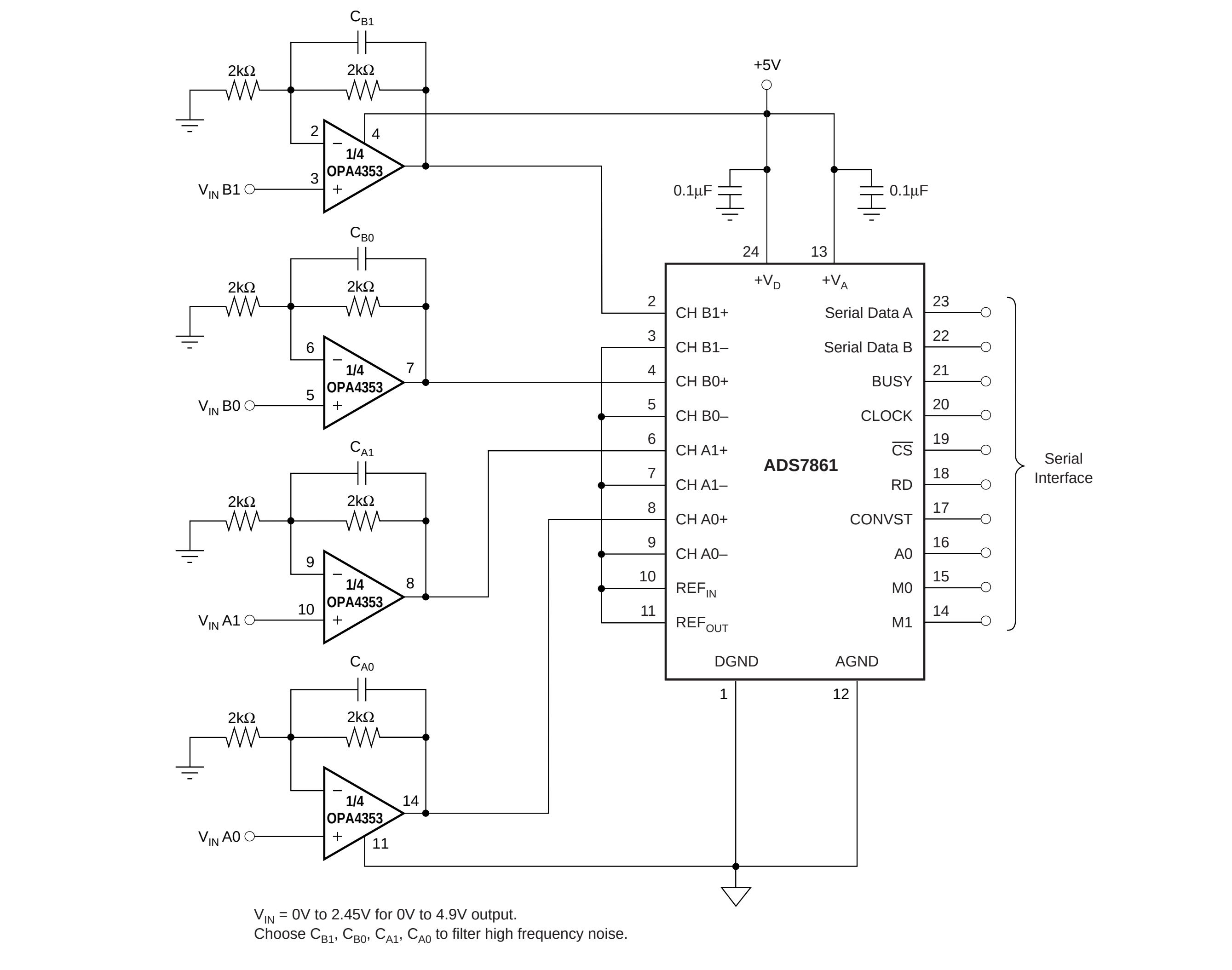


FIGURE 5. OPA4353 Driving Sampling A/D Converter.

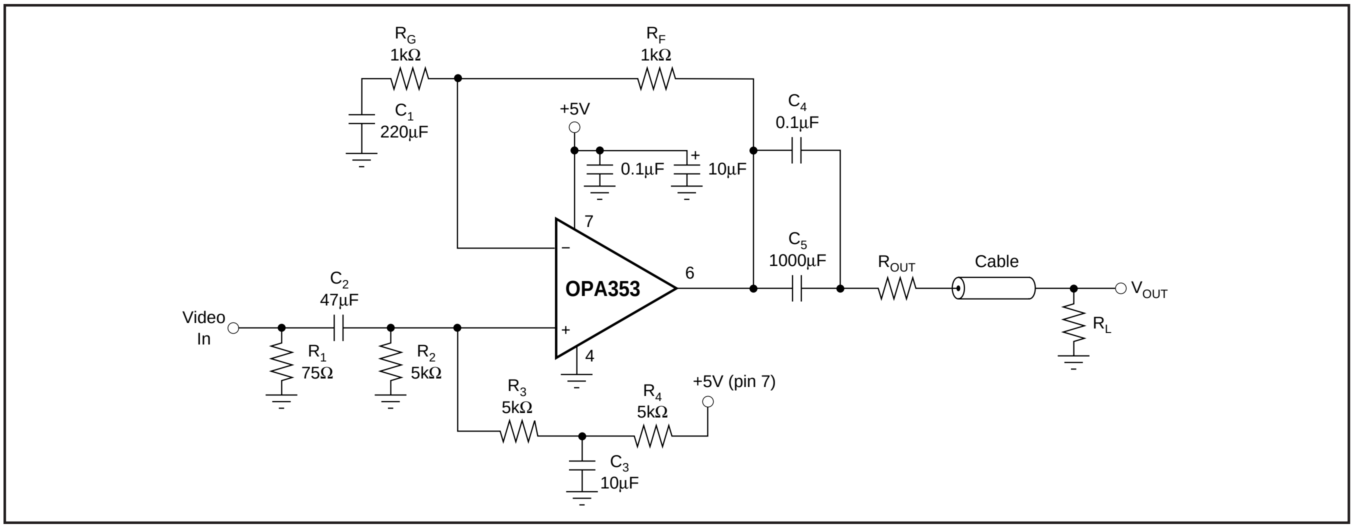


FIGURE 6. Single-Supply Video Line Driver.

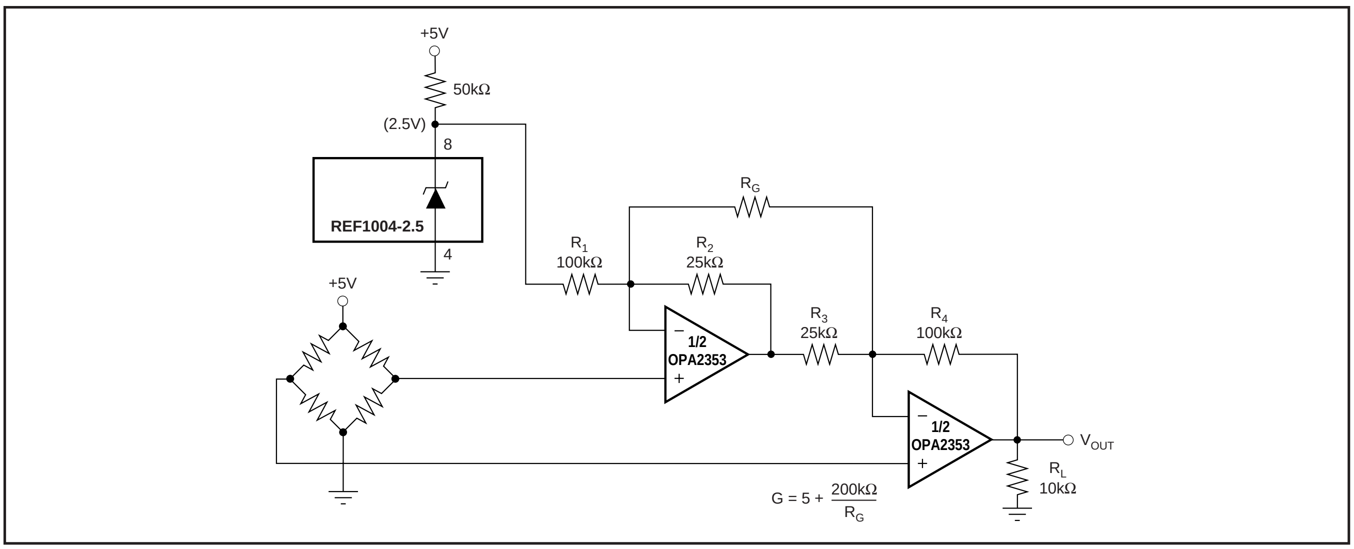


FIGURE 7. Two Op-Amp Instrumentation Amplifier With Improved High Frequency Common-Mode Rejection.

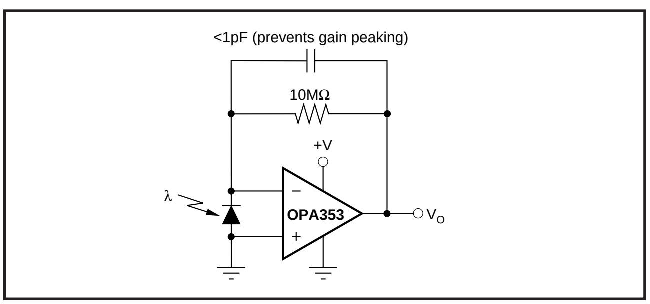


FIGURE 8. Transimpedance Amplifier.

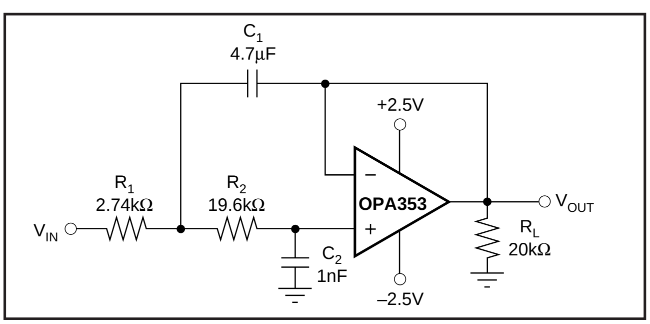


FIGURE 9. 10kHz Low-Pass Filter.

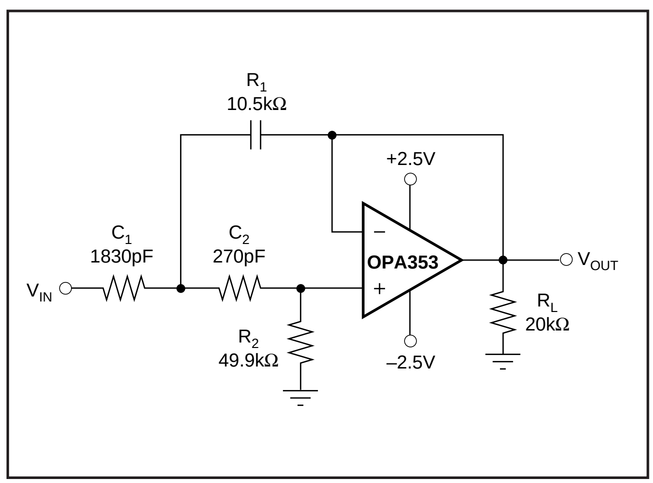


FIGURE 10. 10kHz High-Pass Filter.

BURR - BROWN®

PACKAGING INFORMATION

Orderable Device	Status [(1)]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [(2)]	Lead/Ball Finish	MSL Peak Temp [(3)]
OPA2353EA/250	ACTIVE	MSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2353EA/250G4	ACTIVE	MSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2353EA/2K5	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2353EA/2K5G4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2353UA	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2353UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2353UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA2353UAG4	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA353NA/250	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA353NA/250G4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA353NA/3K	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA353NA/3KG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA353UA	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA353UA/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA353UA/2K5G4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA353UAG4	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4353EA/250	ACTIVE	SSOP/ QSOP	DBQ	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4353EA/250G4	ACTIVE	SSOP/ QSOP	DBQ	16	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4353EA/2K5	ACTIVE	SSOP/ QSOP	DBQ	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4353EA/2K5G4	ACTIVE	SSOP/ QSOP	DBQ	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4353UA	ACTIVE	SOIC	D	14	58	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4353UA/2K5	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4353UA/2K5G4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
OPA4353UAG4	ACTIVE	SOIC	D	14	58	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.
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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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