

Quad Zero-Drift Operational Amplifier

June 2000

FEATURES

- Maximum Offset Voltage of 3 μ V
- Maximum Offset Voltage Drift of 30nV/ $^{\circ}$ C
- Small Footprint, Low Profile GN16 Package
- Single Supply Operation: 2.7V to 11V
- Noise: 1.5 μ V_{P-P} (0.01Hz to 10Hz Typ)
- Voltage Gain: 140dB (Typ)
- PSRR: 130dB (Typ)
- CMRR: 130dB (Typ)
- Supply Current: 0.75mA (Typ) per Amplifier
- Extended Common Mode Input Range
- Output Swings Rail-to-Rail
- Input Overload Recovery Time: 2ms (Typ)
- Operating Temperature Range -40 $^{\circ}$ C to 85 $^{\circ}$ C

APPLICATIONS

- Thermocouple Amplifiers
- Electronic Scales
- Medical Instrumentation
- Strain Gauge Amplifiers
- High Resolution Data Acquisition
- DC Accurate RC Active Filters
- Low Side Current Sense

DESCRIPTION

The LTC[®]2052 is a quad zero-drift operational amplifier available in the GN16 and S14 packages. It operates from a single 2.7V supply while still supporting \pm 5V applications. The current consumption is 750 μ A per op amp.

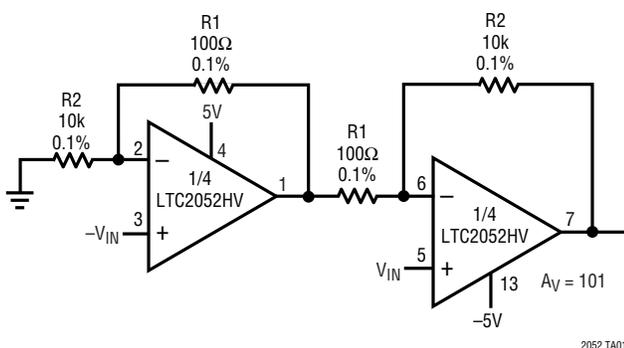
The LTC2052, despite its miniature size, features uncompromising DC performance. The typical input offset voltage and offset drift are 0.5 μ V and 10nV/ $^{\circ}$ C. The almost zero DC offset and drift are supported with a power supply rejection ratio (PSRR) and common mode rejection ratio (CMRR) of more than 130dB.

The input common mode voltage ranges from the negative supply up to 1V from the positive supply. The LTC2052 also has an enhanced output stage capable of driving loads as low as 1k Ω to both supply rails. The open-loop gain, loaded with 1k Ω , is in excess of 140dB. The LTC2052 also features a 1.5 μ V_{P-P} DC to 10Hz noise and a 3MHz gain bandwidth product.

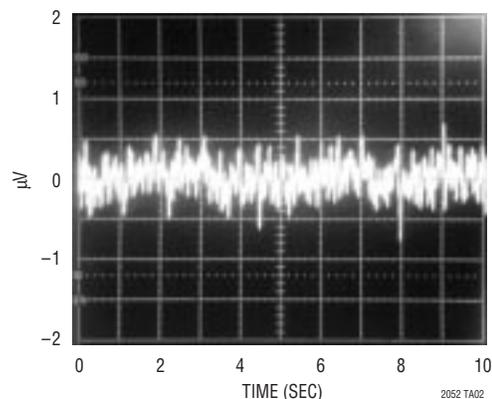
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TYPICAL APPLICATION

High Performance Low Cost Instrumentation Amplifier



Input Referred Noise 0.1Hz to 10Hz

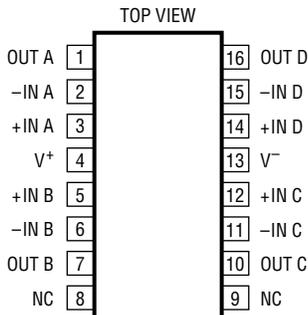
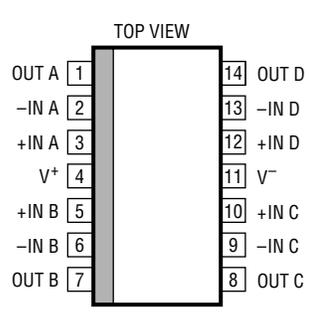


LTC2052

ABSOLUTE MAXIMUM RATINGS (Note 1)

Total Supply Voltage (V^+ to V^-)	Operating Temperature Range	-40°C to 85°C
LTC2052	Specified Temperature Range (Note 3) ..	-40°C to 85°C
LTC2052HV	Storage Temperature Range	-65°C to 150°C
Input Voltage	Lead Temperature (Soldering, 10 sec)	300°C
Output Short-Circuit Duration		Indefinite

PACKAGE/ORDER INFORMATION

TOP VIEW	ORDER PART NUMBER	TOP VIEW	ORDER PART NUMBER
 <p>GN PACKAGE 16-LEAD PLASTIC SSOP $T_{JMAX} = 125^{\circ}\text{C}$, $\theta_{JA} = 110^{\circ}\text{C/W}$</p>	LTC2052CGN LTC2052IGN LTC2052HVCGN LTC2052HVIGN	 <p>S PACKAGE 14-LEAD PLASTIC SO $T_{JMAX} = 125^{\circ}\text{C}$, $\theta_{JA} = 160^{\circ}\text{C/W}$</p>	LTC2052CS LTC2052IS LTC2052HVCS LTC2052HVIS
	GN PART MARKING		
	2052 2052HV 2052I 052HVI		

Consult factory for Military grade parts.

ELECTRICAL CHARACTERISTICS (LTC2052, LTC2052HV) The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^{\circ}\text{C}$. $V_S = 3\text{V}$, 5V unless otherwise noted. (Note 3)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Offset Voltage	(Note 2)		± 0.5	± 3	μV
Average Input Offset Drift	(Note 2)	●		± 0.03	$\mu\text{V}/^{\circ}\text{C}$
Long-Term Offset Drift			50		$\text{nV}/\sqrt{\text{mo}}$
Input Bias Current (Note 4)	$V_S = 3\text{V}$		± 8	± 50	pA
	$V_S = 3\text{V}$	●		± 100	pA
	$V_S = 5\text{V}$		± 25	± 75	pA
	$V_S = 5\text{V}$	●		± 150	pA
Input Offset Current	$V_S = 3\text{V}$			± 100	pA
	$V_S = 3\text{V}$	●		± 150	pA
	$V_S = 5\text{V}$			± 150	pA
	$V_S = 5\text{V}$	●		± 200	pA
Input Noise Voltage	$R_S = 100\Omega$, 0.01Hz to 10Hz		1.5		$\mu\text{V}_{\text{P-P}}$
Common Mode Rejection Ratio	$V_{\text{CM}} = V^-$ to $V^+ - 1.3$, $V_S = 3\text{V}$	115	130		dB
	$V_{\text{CM}} = V^-$ to $V^+ - 1.3$, $V_S = 3\text{V}$	●	110	130	dB
	$V_{\text{CM}} = V^-$ to $V^+ - 1.3$, $V_S = 5\text{V}$		120	130	dB
	$V_{\text{CM}} = V^-$ to $V^+ - 1.3$, $V_S = 5\text{V}$	●	115	130	dB
Power Supply Rejection Ratio	$V_S = 2.7\text{V}$ to 11V		120	130	dB
		●	115	130	dB

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ\text{C}$. $V_S = 3\text{V}$, 5V unless otherwise noted. (Note 3)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Large-Signal Voltage Gain	$R_L = 10\text{k}$, $V_S = 3\text{V}$	●	120	140		dB
			115	140		dB
Maximum Output Voltage Swing	$R_L = 10\text{k}$, $V_S = 5\text{V}$	●	125	140		dB
			120	140		dB
Slew Rate	$R_L = 2\text{k}$ $R_L = 10\text{k}$	●	$V^+ - 0.15$	$V^+ - 0.06$		V
		●	$V^+ - 0.05$	$V^+ - 0.02$		V
Gain Bandwidth Product				2		V/ μs
Supply Current (4 Amplifiers)				3	4	mA
Internal Sampling Frequency	No Load, $V_S = 3\text{V}$	●		3.5	5	mA
	No Load, $V_S = 5\text{V}$	●		7.5		kHz

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ\text{C}$. $V_S = \pm 5\text{V}$ unless otherwise noted. (Note 3) (LTC2052HV)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Input Offset Voltage	(Note 2)			± 1	± 3	μV
Average Input Offset Drift	(Note 2)	●			± 0.03	$\mu\text{V}/^\circ\text{C}$
Long-Term Offset Drift				50		$\text{nV}/\sqrt{\text{mo}}$
Input Bias Current (Note 4)		●		± 90	± 150 ± 300	pA pA
Input Offset Current		●			± 300 ± 500	pA pA
Input Noise Voltage	$R_S = 100\Omega$, 0.01Hz to 10Hz			1.5		$\mu\text{V}_{\text{P-P}}$
Common Mode Rejection Ratio	$V_{\text{CM}} = V^-$ to $V^+ - 1.3$	●	125	130		dB
Power Supply Rejection Ratio	$V_S = 2.7\text{V}$ to 11V	●	120	130		dB
			115	130		dB
Large-Signal Voltage Gain	$R_L = 10\text{k}$	●	125	140		dB
			120	140		dB
Maximum Output Voltage Swing	$R_L = 2\text{k}$ $R_L = 10\text{k}$	●	4.80	4.92		V
		●	4.95	4.98		V
Slew Rate				2		V/ μs
Gain Bandwidth Product				3		MHz
Supply Current (4 Amplifiers)	No Load	●		4	6	mA
Internal Sampling Frequency				7.5		kHz

Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

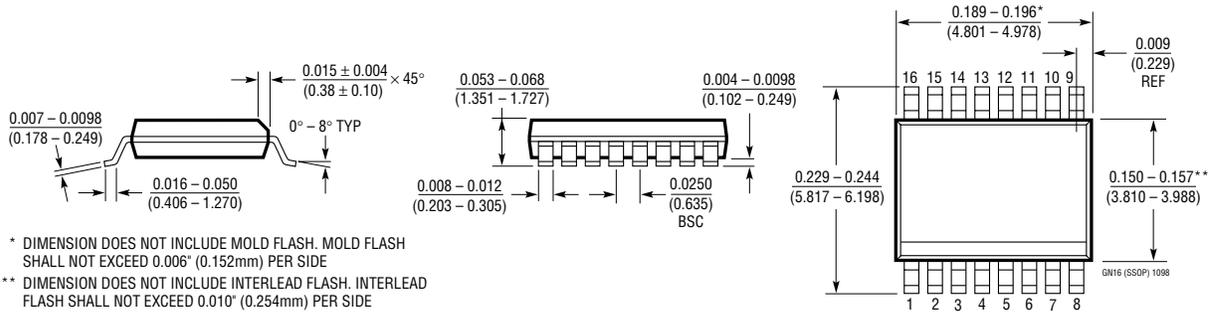
Note 2: These parameters are guaranteed by design. Thermocouple effects preclude measurements of these voltage levels during automated testing.

Note 3: The LTC2052C, LTC2052HVC is guaranteed to meet specified performance from 0°C to 70°C and is designed, characterized and expected to meet these extended temperature limits, but is not tested at -40°C and 85°C . The LTC2052I, LTC2052HVI is guaranteed to meet the extended temperature limits.

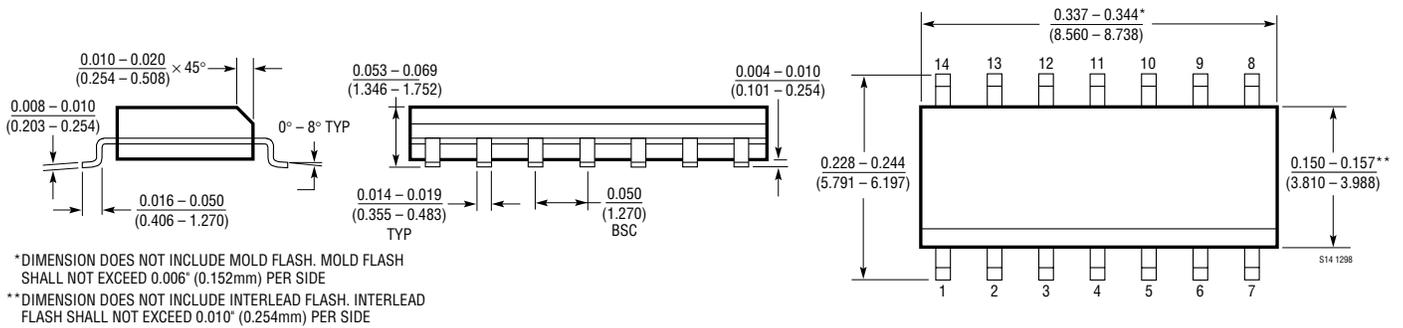
Note 4: The bias current measurement accuracy depends on the proximity of the negative supply bypass capacitors to the device under test. Because of this, only the bias current of channels A and B is 100% tested to the data sheet specifications. The bias current of channels C and D is also 100% tested to relaxed limits; however their values are guaranteed by design to meet the data sheet limits.

PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

GN Package
16-Lead Plastic SSOP (Narrow 0.150)
 (LTC DWG # 05-08-1641)



S Package
14-Lead Plastic Small Outline (Narrow 0.150)
 (LTC DWG # 05-08-1610)



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC1051/LTC1053	Precision Zero-Drift Op Amp	Dual/Quad
LTC1151	±15V Zero-Drift Op Amp	Dual High Voltage Operation ±18V
LTC1152	Rail-to-Rail Input and Output Zero-Drift Op Amp	Single Zero-Drift Op Amp with Rail-to-Rail Input and Output and Shutdown
LTC2050	Zero-Drift Op Amp in SOT-23	Single Supply Operation 2.7V to 6V, Shutdown
LTC2051	Dual Zero-Drift Op Amp in 8-Lead MSOP	Supply Operation 2.7V to 11V, Shutdown