INITIAL RELEASE

Final Electrical Specifications

LTC2052

Quad Zero-Drift Operational Amplifier

June 2000

FEATURES

- **Maximum Offset Voltage of 3μV**
- **Maximum Offset Voltage Drift of 30nV/°C**
- **Small Footprint, Low Profile GN16 Package**
- **Single Supply Operation: 2.7V to 11V**
- Noise: 1.5μV$_{P-P}$ (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°C to 85°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

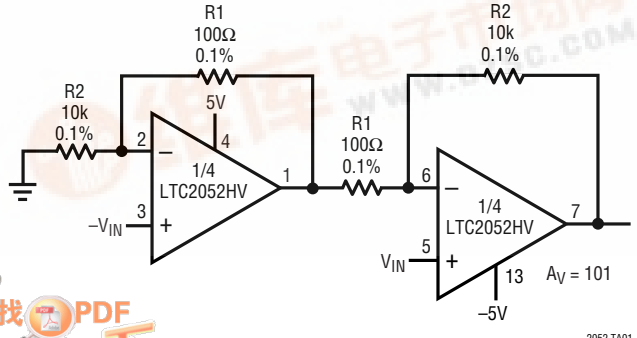
The LTC®2052 is a quad zero-drift operational amplifier available in the GN16 and S14 packages. It operates from a single 2.7V supply while still supporting ±5V applications. The current consumption is 750μA per op amp.

The LTC2052, despite its miniature size, features uncompromising DC performance. The typical input offset voltage and offset drift are 0.5μV and 10nV/°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.

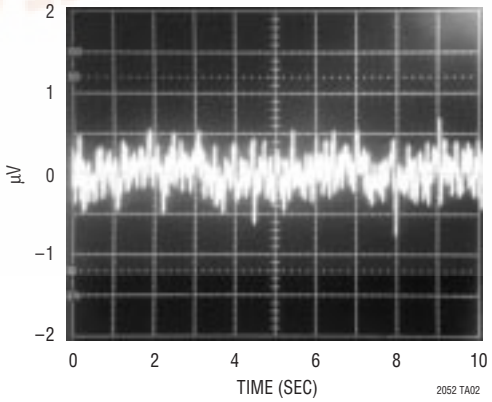
The input common mode voltage ranges from the negative supply up to 1V from the positive supply. The LTC2052 also has an enhanced output stage capable of driving loads as low as 1kΩ to both supply rails. The open-loop gain, loaded with 1kΩ, is in excess of 140dB. The LTC2052 also features a 1.5μV$_{P-P}$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

TYPICAL APPLICATION

High Performance Low Cost Instrumentation Amplifier



Input Referred Noise 0.1Hz to 10Hz

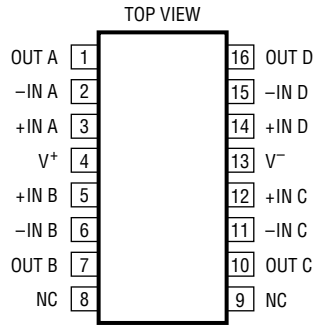


ABSOLUTE MAXIMUM RATINGS (Note 1)

Total Supply Voltage (V^+ to V^-)
LTC2052 ..... 7V
LTC2052HV 12V
Input Voltage ..... (V^+ + 0.3V) to (V^- – 0.3V)
Output Short-Circuit Duration ..... Indefinite

Operating Temperature Range ..... –40°C to 85°C
Specified Temperature Range (Note 3) .. –40°C to 85°C
Storage Temperature Range ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

PACKAGE/ORDER INFORMATION



GN PACKAGE
16-LEAD PLASTIC SSOP

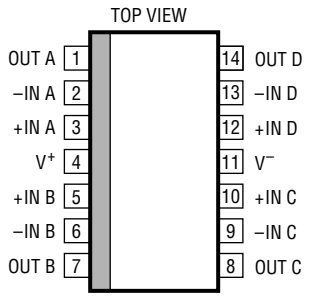
T_{JMAX} = 125°C, θ_{JA} = 110°C/W

ORDER PART NUMBER

LTC2052CGN
LTC2052IGN
LTC2052HVCGN
LTC2052HVIGN

GN PART MARKING

2052 2052HV
2052I 052HVI



S PACKAGE
14-LEAD PLASTIC SO

T_{JMAX} = 125°C, θ_{JA} = 160°C/W

ORDER PART NUMBER

LTC2052CS
LTC2052IS
LTC2052HVCS
LTC2052HVIS

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°C. V_S = 3V, 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	µV/°C
Long-Term Offset Drift				50		nV/√mo
Input Bias Current (Note 4)	V_S = 3V			±8	±50	pA
	V_S = 3V	●			±100	pA
	V_S = 5V			±25	±75	pA
	V_S = 5V	●			±150	pA
Input Offset Current	V_S = 3V				±100	pA
	V_S = 3V	●			±150	pA
	V_S = 5V				±150	pA
	V_S = 5V	●			±200	pA
Input Noise Voltage	R_S = 100Ω, 0.01Hz to 10Hz			1.5		μV_{P-P}
Common Mode Rejection Ratio	V_{CM} = V^- to V^+ – 1.3, V_S = 3V		115	130		dB
	V_{CM} = V^- to V^+ – 1.3, V_S = 3V	●	110	130		dB
	V_{CM} = V^- to V^+ – 1.3, V_S = 5V		120	130		dB
	V_{CM} = V^- to V^+ – 1.3, V_S = 5V	●	115	130		dB
Power Supply Rejection Ratio	V_S = 2.7V 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°C. V_S = 3V, 5V unless otherwise noted. (Note 3)

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

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_S = ±5V 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	µV/°C
Long-Term Offset Drift				50		nV/√mo
Input Bias Current (Note 4)				±90	±150	pA
		●			±300	pA
Input Offset Current					±300	pA
		●			±500	pA
Input Noise Voltage	R_S = 100Ω, 0.01Hz to 10Hz			1.5		μV_{P-P}
Common Mode Rejection Ratio	V_{CM} = V^- to V^+ – 1.3		125	130		dB
		●	120	130		dB
Power Supply Rejection Ratio	V_S = 2.7V to 11V		120	130		dB
		●	115	130		dB
Large-Signal Voltage Gain	R_L = 10k		125	140		dB
		●	120	140		dB
Maximum Output Voltage Swing	R_L = 2k	●	4.80	4.92		V
	R_L = 10k	●	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.

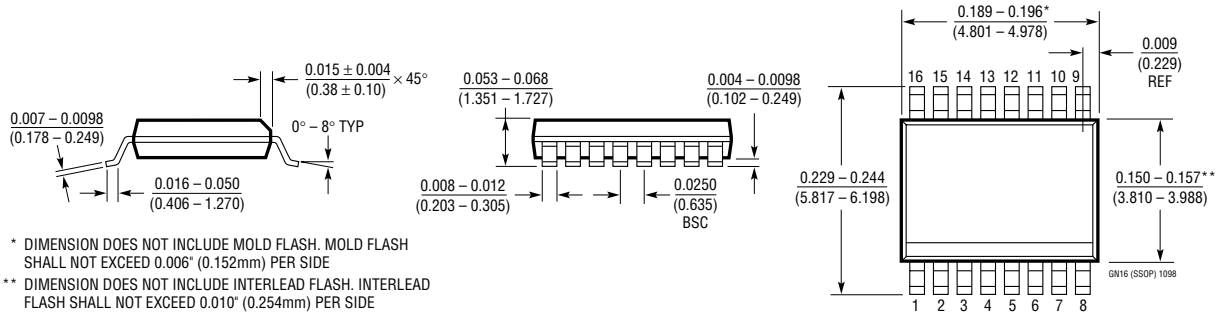
Note 3: The LTC2052C, LTC2052HVC is guaranteed to meet specified performance from 0°C to 70°C and is designed, characterized and expected to meet these extended temperature limits, but is not tested at –40°C and 85°C. The LTC2052I, LTC2052HVI is guaranteed to meet the extended temperature limits.

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.

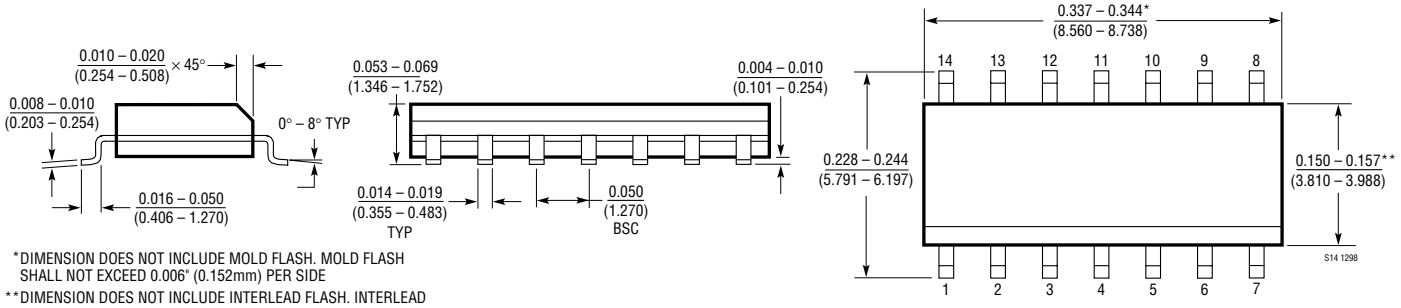
GN Package
16-Lead Plastic SSOP (Narrow 0.150)
(LTC DWG # 05-08-1641)



* DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

** DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

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



*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

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