Chopper-Stabilized Operational Amplifier (CSOA™)

FEATURES

- *Guaranteed* Max. Offset 5μV
- *Guaranteed* Max. Offset Drift 0.05μV/°C
- Typ. Offset Drift 0.01μV/°C
- Excellent Long Term Stability 100nV/√Month
- *Guaranteed* Max. Input Bias Current 30pA
- Over Operating Temperature Range
  - *Guaranteed* Min. Gain 120dB
  - *Guaranteed* Min. CMRR 120dB
  - *Guaranteed* Min. PSRR 120dB
- Single Supply Operation 4.75V to 16V (Input Voltage Range Extends to Ground)
- External Capacitors can be Returned to V^- with No Noise Degradation

APPLICATIONS

- Thermocouple Amplifiers
- Strain Gauge Amplifiers
- Low Level Signal Processing
- Medical Instrumentation

DESCRIPTION

The LTC1052 and LTC7652 are low noise Chopper-stabilized op amps (CSOA™) manufactured using Linear Technology's enhanced LTCMOS™ silicon gate process. Chopper-stabilization constantly corrects offset voltage errors. Both initial offset and changes in the offset due to time, temperature and common-mode voltage are corrected. This, coupled with picoampere input currents, gives these amplifiers unmatched performance.

Low frequency (1/f) noise is also improved by the chopping technique. Instead of increasing continuously at a 3dB/octave rate, the internal chopping causes noise to decrease at low frequencies.

The chopper circuitry is entirely internal and completely transparent to the user. Only two external capacitors are required to alternately sample and hold the offset correction voltage and the amplified input signal. Control circuitry is brought out on the 14-pin version to allow the sampling of the LTC1052 to be synchronized with an external frequency source.

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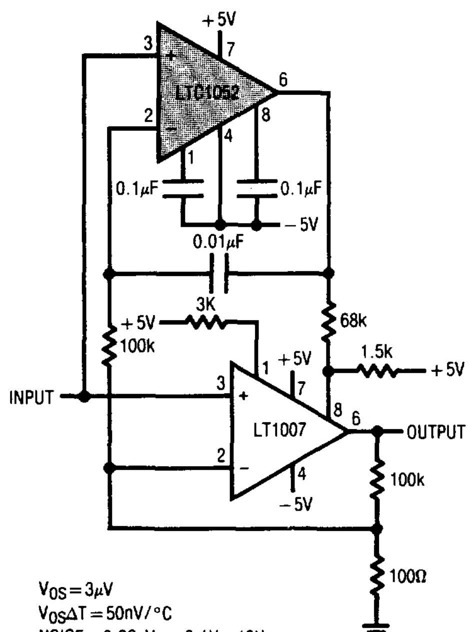
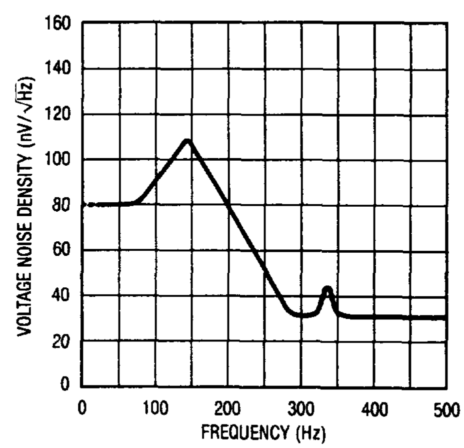
Ultra Low Noise, Low Drift Amplifier



$V_{OS} = 3\mu V$
$V_{OS}\Delta T = 50nV/°C$
NOISE = 0.06μVp-p 0.1Hz-10Hz

LTC1052 Noise Spectrum

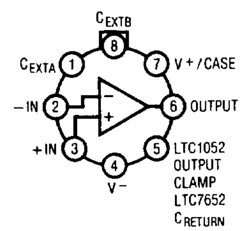


ABSOLUTE MAXIMUM RATINGS

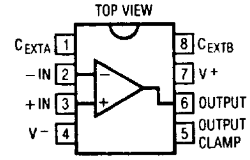
(Notes 1 and 2)

Total Supply Voltage (V^+ to V^-) 18V
Input Voltage .... (V^+ +0.3V) to (V^- −0.3V)
Output Short Circuit Duration .... Indefinite
Operating Temperature Range
  LTC1052C/LTC7652C .... −40°C to 85°C
  LTC1052M .... −55°C to 125°C
Storage Temperature Range .... −55°C to 150°C
Lead Temperature (Soldering, 10 sec.) .... 300°C

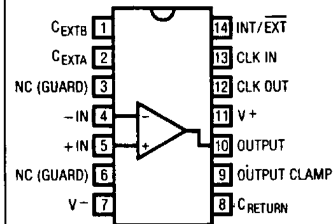
PACKAGE/ORDER INFORMATION



METAL CAN H PACKAGE



HERMETIC DIP J8 PACKAGE
PLASTIC DIP N8 PACKAGE



HERMETIC DIP J14 PACKAGE
PLASTIC DIP N14 PACKAGE

PACKAGE	ORDER PART NUMBER	REPLACES
METAL CAN H PACKAGE	LTC7652CH	ICL7652CTV ICL7652ITV ICL7650CTV-1 ICL7650ITV-1
	LTC1052CH	ICL7650CTV ICL7650ITV
	LTC1052MH	ICL7650MTV
HERMETIC DIP J8 PACKAGE / PLASTIC DIP N8 PACKAGE	LTC1052CN8 LTC1052CJ8 LTC1052MJ8	ICL7650CPA ICL7650IJA
HERMETIC DIP J14 PACKAGE / PLASTIC DIP N14 PACKAGE	LTC1052CJ	ICL7652IJD ICL7650IJD
	LTC1052CN	ICL7652CPD ICL7650CPD
	LTC1052MJ	ICL7650MJD

ELECTRICAL CHARACTERISTICS

V_S = ±5V, T_A = operating temperature range, test circuit TC1, unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		LTC1052M MIN	LTC1052M TYP	LTC1052M MAX	LTC1052C/LTC7652C MIN	LTC1052C/LTC7652C TYP	LTC1052C/LTC7652C MAX	UNITS
V_{OS}	Input Offset Voltage	T_A = 25°C (Note 3)			±0.5	±5		±0.5	±5	μV
$\Delta V_{OS}/\Delta Temp$	Average Input Offset Drift	(Note 3)	●		±0.01	±0.05		±0.01	±0.05	μV/°C
$\Delta V_{OS}/\Delta Time$	Long Term Offset Voltage Stability				100			100		nV/√Month
I_{OS}	Input Offset Current	T_A = 25°C	 ●		±5	±30 ±2000		±5	±30 ±350	pA pA
I_B	Input Bias Current	T_A = 25°C	 ●		±1	±30 ±1000		±1	±30 ±175	pA pA
e_{np-p}	Input Noise Voltage	R_S = 100Ω, DC to 10Hz, TC3 R_S = 100Ω, DC to 1Hz, TC3			1.5 0.5			1.5 0.5		μVp-p μVp-p
i_n	Input Noise Current	f = 10Hz (Note 5)			0.6			0.6		fA/√Hz
CMRR	Common-Mode Rejection Ratio	V_{CM} = V^- to +2.7V	●	120	140		120	140		dB
PSRR	Power Supply Rejection Ratio	V_{SUPPLY} = ±2.375V to ±8V	●	120	150		120	150		dB
A_{VOL}	Large Signal Voltage Gain	R_L = 10k, V_{OUT} = ±4V	●	120	150		120	150		dB
V_{OUT}	Maximum Output Voltage Swing (Note 4)	R_L = 10k R_L = 100k	●	±4.7	±4.85 ±4.95		±4.7	±4.85 ±4.95		V V
SR	Slew Rate	R_L = 10k, C_L = 50pF			4			4		V/μs
GBW	Gain Bandwidth Product				1.2			1.2		MHz
I_S	Supply Current	No Load, T_A = 25°C	 ●		1.7	2.0 3.0		1.7	2.0 3.0	mA mA
f_S	Internal Sampling Frequency				330			330		Hz
	Clamp On Current	R_L = 100k	●	25	100		25	100		μA
	Clamp Off Current	−4V < V_{OUT} < +4V	 ●		10	100 2		10	100 1	pA nA

LINEAR TECHNOLOGY

The ● denotes the specifications which apply over the full operating temperature range.

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

Note 2: Connecting any terminal to voltages greater than V^+ or less than V^- may cause destructive latch-up. It is recommended that no sources operating from external supplies be applied prior to power-up of the LTC1052/LTC7652.

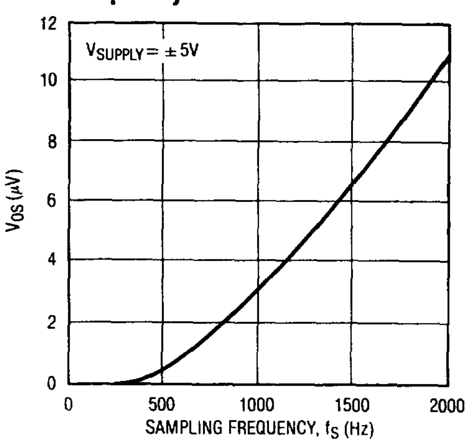
Note 3: These parameters are guaranteed by design. Thermocouple effects preclude measurement of these voltage levels in high speed automatic testing. V_{OS} is measured to a limit determined by test equipment capability. Voltages on C_{EXTA} and C_{EXTB}, A_{VOL}, CMRR and PSRR are measured to insure proper operation of the nulling loop to insure meeting the V_{OS} and V_{OS} drift specifications. See Package-Induced V_{OS} in applications section.

Note 4: Output clamp not connected.

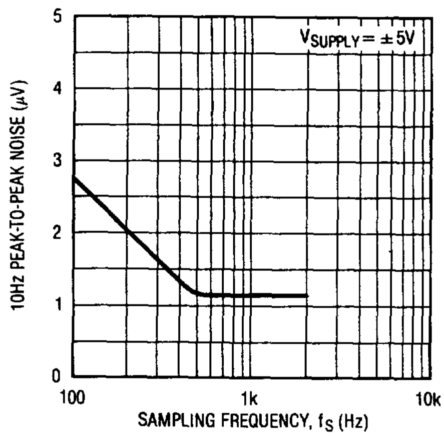
Note 5: Current noise is calculated from the formula: $i_n = (2q\,I_B)^{1/2}$, where $q = 1.6 \times 10^{-19}$ coulomb.

TYPICAL PERFORMANCE CHARACTERISTICS

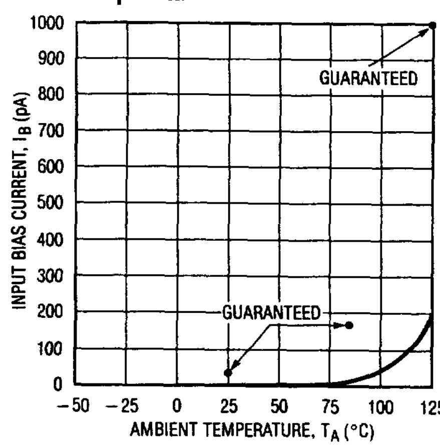
Offset Voltage vs Sampling Frequency



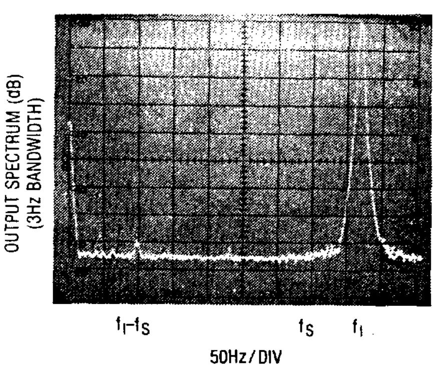
10Hzp-p Noise vs Sampling Frequency



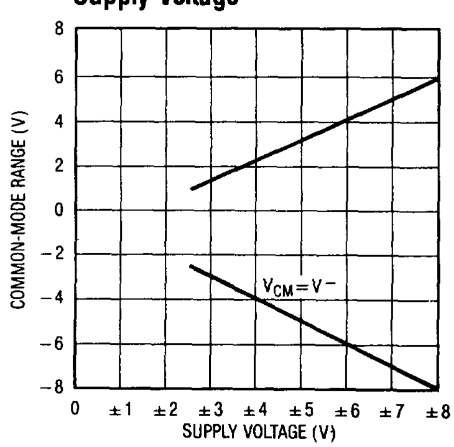
Input Bias Current vs Temperature



Aliasing Error



Common-Mode Input Range vs Supply Voltage



Overload Recovery (Output Clamp Not Used)