

Zero-Drift Operational Amplifier in SOT-23

November 1999

FEATURES

- SOT-23 Package
- Maximum Offset Voltage of $3\mu\text{V}$
- Maximum Offset Voltage Drift of $30\text{nV}/^\circ\text{C}$
- Noise: $1.5\mu\text{V}_{\text{P-P}}$ (0.1Hz to 10Hz Typ)
- Voltage Gain: 140dB (Typ)
- PSRR: 130dB (Typ)
- CMRR: 130dB (Typ)
- Supply Current: 0.8mA (Typ)
- Single Supply Operation: 2.7V to 6V
- Extended Common Mode Input Range
- Output Swings Rail-to-Rail
- Overload Recovery Time: 2ms (Typ)

APPLICATIONS

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

DESCRIPTION

The LTC[®]2050 is a low drift operational amplifier available in the 5- or 6-lead SOT-23 and SO-8 packages. It operates from a single 2.7V supply while still supporting 5V applications. The power consumption is $800\mu\text{A}$ and the versions in the 6-lead SOT-23 and SO-8 packages offer power shutdown (active low).

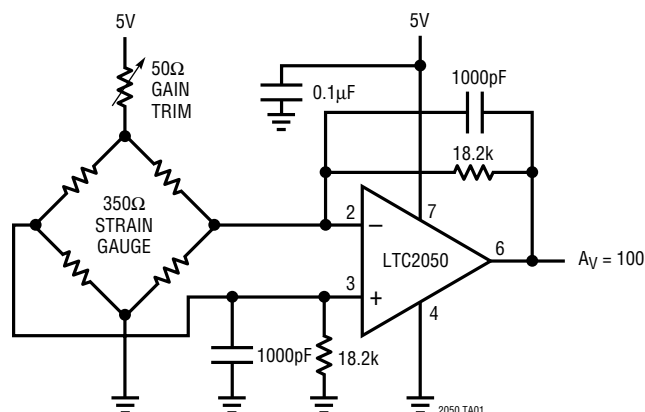
The LTC2050, despite its miniature size, features uncompromising DC performance. The typical input offset voltage and offset drift are $0.5\mu\text{V}$ and $10\text{nV}/^\circ\text{C}$. The almost zero DC offset and drift are supported with a power supply rejection ratio (PSRR) and common mode rejection ratio (CMRR) of more than 130dB.

The input common mode voltage ranges from the negative supply up to 1V from the positive supply. The LTC2050 also has an enhanced output stage capable of driving loads as low as $1\text{k}\Omega$ to both supply rails. The open-loop gain, loaded with $1\text{k}\Omega$, is in excess of 140dB. The LTC2050 also features a $1.5\mu\text{V}_{\text{P-P}}$ DC to 10Hz noise and a 3MHz gain bandwidth product.

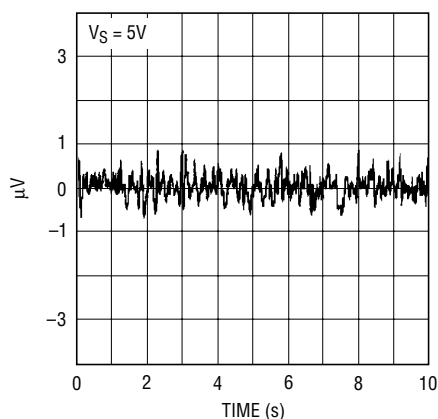
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TYPICAL APPLICATION

Differential Bridge Amplifier



Input Referred Noise 0.1Hz to 10Hz



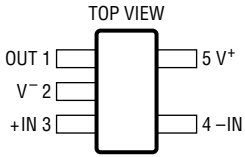
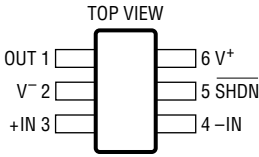
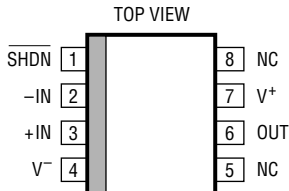
LTC2050 TA02

ABSOLUTE MAXIMUM RATINGS (Note 1)

Total Supply Voltage (V^+ to V^-) 7V
 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

 S5 PACKAGE 5-LEAD PLASTIC SOT-23 $T_{JMAX} = 125^\circ\text{C}$, $\theta_{JA} = 250^\circ\text{C/W}$		 S6 PACKAGE 6-LEAD PLASTIC SOT-23 $T_{JMAX} = 125^\circ\text{C}$, $\theta_{JA} = 230^\circ\text{C/W}$		 S8 PACKAGE 8-LEAD PLASTIC SO $T_{JMAX} = 125^\circ\text{C}$, $\theta_{JA} = 190^\circ\text{C/W}$	
ORDER PART NUMBER	S5 PART MARKING	ORDER PART NUMBER	S6 PART MARKING	ORDER PART NUMBER	S8 PART MARKING
LTC2050CS5	LTIN	LTC2050CS6	LTIP	LTC2050CS8 LTC2050IS8	2050 2050I

Consult factory for Military grade parts.

ELECTRICAL CHARACTERISTICS The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ\text{C}$. $V_S = 3V$ 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	●		± 20	± 75 ± 300	pA
Input Offset Current	●			± 150 ± 200	pA
Input Noise Voltage	$R_S = 100\Omega$, DC to 10Hz		1.5		$\mu\text{V}_{\text{p-p}}$
Common Mode Rejection Ratio	$V_{\text{CM}} = V^-$ to $V^+ - 1.3$	115 110	130 130		dB
Power Supply Rejection Ratio		120 115	130 130		dB
Large-Signal Voltage Gain	$R_L = 10\text{k}$	120 115	140 140		dB
Maximum Output Voltage Swing	$R_L = 2\text{k}$ $R_L = 10\text{k}$	2.85 2.95	2.94 2.98		V
Slew Rate			2		$\text{V}/\mu\text{s}$
Gain Bandwidth Product			3		MHz
Supply Current	$V_{\text{SHDN}} = V^+$, No Load $V_{\text{SHDN}} = V^-$	● ●	0.75	1.1 10	mA μA

ELECTRICAL CHARACTERISTICS

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

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Shutdown Pin Input Low Voltage		●			$V^- + 0.5$	V
Shutdown Pin Input High Voltage		●	$V^+ - 0.5$			V
Shutdown Pin Input Current	$V_{\text{SHDN}} = V^-$	●		-0.5	-3	μA
Internal Sampling Frequency				7.5		kHz

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ\text{C}$. $V_S = 5\text{V}$ 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		●			± 150 ± 300	pA pA
Input Offset Current		●			± 300 ± 400	pA pA
Input Noise Voltage	$R_S = 100\Omega$, DC to 10Hz			1.5		$\mu\text{V}_{\text{P-P}}$
Common Mode Rejection Ratio	$V_{\text{CM}} = V^-$ to $V^+ - 1.3$	●	120 115	130 130		dB dB
Power Supply Rejection Ratio		●	120 115	130 130		dB dB
Large-Signal Voltage Gain	$R_L = 10\text{k}$	●	125 120	140 140		dB dB
Maximum Output Voltage Swing	$R_L = 2\text{k}$ $R_L = 10\text{k}$	● ●	4.85 4.95	4.94 4.98		V V
Slew Rate				2		$\text{V}/\mu\text{s}$
Gain Bandwidth Product				3		MHz
Supply Current	$V_{\text{SHDN}} = V^+$, No Load $V_{\text{SHDN}} = V^-$	● ●		0.8	1.2 10	mA μA
Shutdown Pin Input Low Voltage		●			$V^- + 0.5$	V
Shutdown Pin Input High Voltage		●	$V^+ - 0.5$			V
Shutdown Pin Input Current	$V_{\text{SHDN}} = V^-$	●		-0.5	-5	μA
Internal Sampling Frequency				7.5		kHz

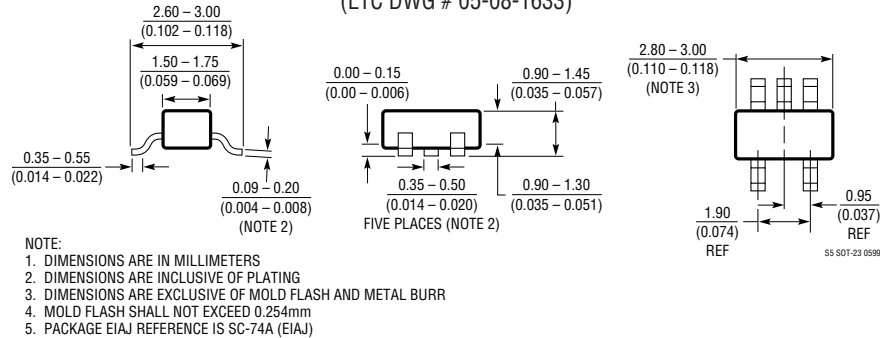
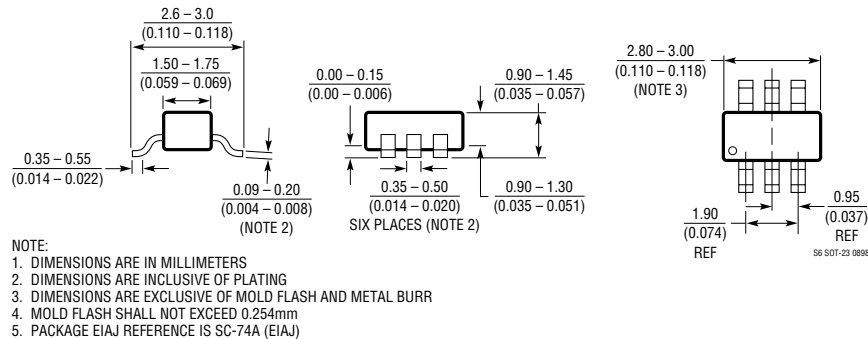
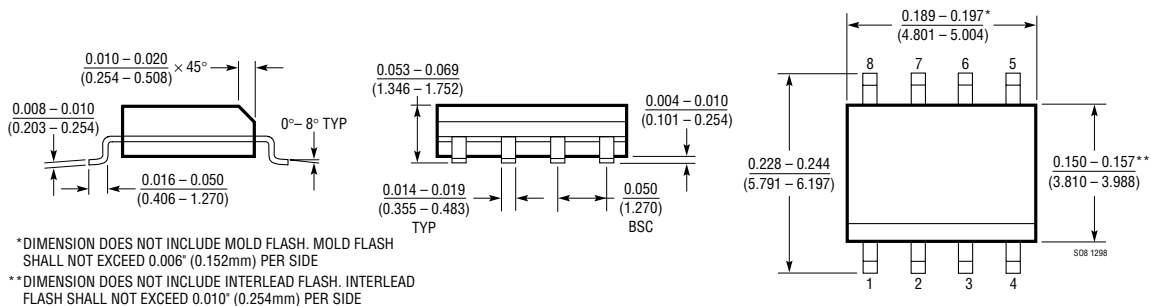
Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

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

Note 3: The LTC2050C 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 LTC2050I is guaranteed to meet the extended temperature limits.

PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

S5 Package
5-Lead Plastic SOT-23
 (LTC DWG # 05-08-1633)

S6 Package
6-Lead Plastic SOT-23
 (LTC DWG # 05-08-1634)

S8 Package
8-Lead Plastic Small Outline (Narrow 0.150)
 (LTC DWG # 05-08-1610)
**RELATED PARTS**

PART NUMBER	DESCRIPTION	COMMENTS
LTC1049	Low Power Zero-Drift Op Amp	Low Supply Current 200µA
LTC1050	Precision Zero-Drift Op Amp	Single Supply Operation 4.75V to 16V, Noise Tested and Guaranteed
LTC1051/LTC1053	Precision Zero-Drift Op Amp	Dual/Quad
LTC1150	±15V Zero-Drift Op Amp	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