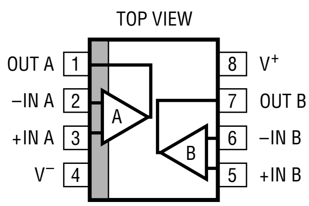
ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage .... ±22V
Differential Input Voltage .... ±30V
Input Voltage .... Equal to Positive Supply Voltage
............5V Below Negative Supply Voltage
Output Short-Circuit Duration .... Indefinite

Specified Temperature Range
Commercial .... 0°C to 70°C
Industrial .... –40°C to 85°C
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION

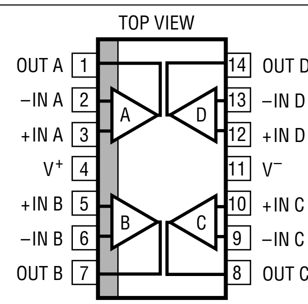


S8 PACKAGE
8-LEAD PLASTIC SO

T_{JMAX} = 150°C, θ_{JA} = 190°C/W

ORDER PART NUMBER
LT2078ACS8 LT2078AIS8 LT2078CS8 LT2078IS8

PART MARKING	
2078A	2078
2078AI	2078I



S PACKAGE
14-LEAD PLASTIC SO

T_{JMAX} = 150°C, θ_{JA} = 150°C/W

ORDER PART NUMBER
LT2079ACS LT2079AIS LT2079CS LT2079IS

Consult LTC Marketing for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS V_S = 5V, 0V, V_{CM} = 0.1V, V_O = 1.4V, T_A = 25°C, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS (NOTE 2)	LT2078AC/LT2078AI LT2079AC/LT2079AI MIN	TYP	MAX	LT2078C/LT2078I LT2079C/LT2079I MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	LT2078 LT2079		30 35	70 110		40 40	120 150	µV µV
$\frac{\Delta V_{OS}}{\Delta Time}$	Long Term Input Offset Voltage Stability			0.4			0.5		µV/Mo
I_{OS}	Input Offset Current			0.05	0.25		0.05	0.35	nA
I_B	Input Bias Current			6	8		6	10	nA
e_n	Input Noise Voltage	0.1Hz to 10Hz (Note 3)		0.6	1.2		0.6		$µV_{P-P}$
	Input Noise Voltage Density	f_O = 10Hz (Note 3) f_O = 1000Hz (Note 3)		29 28	45 37		29 28		nV√Hz nV√Hz
i_n	Input Noise Current	0.1Hz to 10Hz (Note 3)		2.3	4.0		2.3		pA_{P-P}
	Input Noise Current Density	f_O = 10Hz (Note 3) f_O = 1000Hz		0.06 0.02	0.10		0.06 0.02		pA√Hz pA√Hz
	Input Resistance Differential Mode Common Mode	(Note 4)	 400 	 800 6		 300 	 800 6		 MΩ GΩ
	Input Voltage Range		3.5 0	3.8 –0.3		3.5 0	3.8 –0.3		V V
CMRR	Common Mode Rejection Ratio	V_{CM} = 0V to 3.5V	95	110		92	108		dB
PSRR	Power Supply Rejection Ratio	V_S = 2.3V to 12V	100	114		98	114		dB

20789fa

ELECTRICAL CHARACTERISTICS

V_S = 5V, 0V, V_{CM} = 0.1V, V_O = 1.4V, T_A = 25°C, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS (NOTE 1)	LT2078AC/LT2078AI LT2079AC/LT2079AI MIN	TYP	MAX	LT2078C/LT2078I LT2079C/LT2079I MIN	TYP	MAX	UNITS
A_{VOL}	Large-Signal Voltage Gain	V_O = 0.03V to 4V, No Load V_O = 0.03V to 3.5V, R_L = 50k	200 150	1000 600		150 120	1000 600		V/mV V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, 2k to GND Output Low, I_{SINK} = 100µA		3.5 0.55 95	6 1.2 130		3.5 0.55 95	6 1.2 130	mV mV mV
		Output High, No Load Output High, 2k to GND	4.2 3.5	4.4 3.9		4.2 3.5	4.4 3.9		V V
SR	Slew Rate	A_V = 1, V_S = ±2.5V	0.04	0.07		0.04	0.07		V/µs
GBW	Gain Bandwidth Product	f_O ≤ 20kHz		200			200		kHz
I_S	Supply Current per Amplifier			38	50		39	55	µA
	Channel Separation	ΔV_{IN} = 3V, R_L = 10k, f ≤ 10Hz		110			110		dB
	Minimum Supply Voltage	(Note 5)		2.2	2.3		2.2	2.3	V

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_S = 5V, 0V, V_{CM} = 0.1V, V_O = 1.4V, −40°C ≤ T_A ≤ 85°C for I grades, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT2078AI/LT2079AI MIN	TYP	MAX	LT2078I/LT2079I MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	LT2078 LT2079	● ●		70 80	250 280		95 100	370 400	µV µV
$\frac{\Delta V_{OS}}{\Delta T}$	Input Offset Voltage Drift (Note 6)	LT2078 LT2079	● ●		0.4 0.6	1.8 3.0		0.5 0.6	2.5 3.5	µV/°C µV/°C
I_{OS}	Input Offset Current		●		0.07	0.70		0.1	1.0	nA
I_B	Input Bias Current		●		7	10		7	12	nA
CMRR	Common Mode Rejection Ratio	V_{CM} = 0.05V to 3.2V	●	90	106		86	104		dB
PSRR	Power Supply Rejection Ratio	V_S = 3.1V to 12V	●	96	110		92	110		dB
A_{VOL}	Large-Signal Voltage Gain	V_O = 0.05V to 4V, No Load V_O = 0.05V to 3.5V, R_L = 50k	● ●	110 80	600 400		80 60	600 400		V/mV V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, I_{SINK} = 100µA	● ●		4.5 125	8 170		4.5 125	8 170	mV mV
		Output High, No Load Output High, 2k to GND	● ●	3.9 3.0	4.2 3.7		3.9 3.0	4.2 3.7		V V
I_S	Supply Current per Amplifier		●		43	60		45	70	µA

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_S = 5V, 0V, V_{CM} = 0.1V, V_O = 1.4V, 0°C ≤ T_A ≤ 70°C, unless otherwise noted (Note 7)

SYMBOL	PARAMETER	CONDITIONS		LT2078AC/LT2079AC MIN	TYP	MAX	LT2078C/LT2079C MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	LT2078 LT2079	● ●		50 60	150 180		60 70	240 270	µV µV
$\frac{\Delta V_{OS}}{\Delta T}$	Input Offset Voltage Drift (Note 6)	LT2078 LT2079	● ●		0.4 0.5	1.8 3.0		0.5 0.6	2.5 3.5	µV/°C µV/°C
I_{OS}	Input Offset Current		●		0.06	0.35		0.06	0.50	nA
I_B	Input Bias Current		●		6	9		6	11	nA
CMRR	Common Mode Rejection Ratio	V_{CM} = 0V to 3.4V	●	92	108		88	106		dB
PSRR	Power Supply Rejection Ratio	V_S = 2.6V to 12V	●	98	112		95	112		dB

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25°C$. $V_S = 5V$, 0V, $V_{CM} = 0.1V$, $V_O = 1.4V$, $0°C \le T_A \le 70°C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT2078AC/LT2079AC MIN	TYP	MAX	LT2078C/LT2079C MIN	TYP	MAX	UNITS
A_{VOL}	Large-Signal Voltage Gain	V_O = 0.05V to 4V, No Load V_O = 0.05V to 3.5V, R_L = 50k	● ●	150 110	750 500		110 80	750 500		V/mV V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, I_{SINK} = 100μA	● ●		4.0 105	7 150		4.0 105	7 150	mV mV
		Output High, No Load Output High, 2k to GND	● ●	4.1 3.3	4.3 3.8		4.1 3.3	4.3 3.8		V V
I_S	Supply Current per Amplifier		●		40	55		42	63	μA

$V_S = \pm15V$, $T_A = 25°C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	LT2078AC/LT2078AI LT2079AC/LT2079AI MIN	TYP	MAX	LT2078C/LT2078I LT2079C/LT2079I MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	LT2078 LT2079		50 60	250 350		70 80	350 450	μV μV
I_{OS}	Input Offset Current			0.05	0.25		0.05	0.35	nA
I_B	Input Bias Current			6	8		6	10	nA
	Input Voltage Range		13.5 –15.0	13.8 –15.3		13.5 –15.0	13.8 –15.3		V V
CMRR	Common Mode Rejection Ratio	V_{CM} = 13.5V, –15V	98	114		95	114		dB
PSRR	Power Supply Rejection Ratio	V_S = 5V, 0V to ±18V	100	114		98	114		dB
A_{VOL}	Large-Signal Voltage Gain	V_O = ±10V, R_L = 50k V_O = ±10V, R_L = 2k	1000 400	5000 1100		1000 300	5000 1100		V/mV V/mV
V_{OUT}	Maximum Output Voltage Swing	R_L = 50k R_L = 2k	±13.0 ±11.0	±14.0 ±13.2		±13.0 ±11.0	±14.0 ±13.2		V V
SR	Slew Rate		0.06	0.10		0.06	0.10		V/μs
I_S	Supply Current per Amplifier			46	65		47	75	μA

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25°C$. $V_S = \pm15V$, $-40°C \le T_A \le 85°C$ for I grades, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT2078AI/LT2079AI MIN	TYP	MAX	LT2078I/LT2079I MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	LT2078 LT2079	● ●		90 100	430 500		120 130	600 700	μV μV
$\frac{\Delta V_{OS}}{\Delta T}$	Input Offset Voltage Drift (Note 6)	LT2078 LT2079	● ●		0.5 0.6	1.8 3.0		0.6 0.7	2.5 3.8	μV/°C μV/°C
I_{OS}	Input Offset Current		●		0.07	0.70		0.1	1.0	nA
I_B	Input Bias Current		●		7	10		7	12	nA
A_{VOL}	Large-Signal Voltage Gain	V_O = ±10V, R_L = 5k	●	200	700		150	700		V/mV
CMRR	Common Mode Rejection Ratio	V_{CM} = 13V, –14.9V	●	92	110		88	110		dB
PSRR	Power Supply Rejection Ratio	V_S = 5V, 0V to ±18V	●	96	110		92	110		dB
	Maximum Output Voltage Swing	R_L = 5k	●	±11.0	±13.5		±11.0	±13.5		V
I_S	Supply Current per Amplifier		●		52	80		54	95	μA

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. V_S = ±15V, 0°C ≤ T_A ≤ 70°C, unless otherwise noted (Note 7).

SYMBOL	PARAMETER	CONDITIONS		LT2078AC/LT2079AC MIN	TYP	MAX	LT2078C/LT2079C MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	LT2078 LT2079	● ●		70 80	330 410		90 100	460 540	μV μV
$\frac{\Delta V_{OS}}{\Delta T}$	Input Offset Voltage Drift (Note 6)	LT2078 LT2079	● ●		0.5 0.6	1.8 3.0		0.6 0.7	2.5 3.8	μV/°C μV/°C
I_{OS}	Input Offset Current		●		0.06	0.35		0.06	0.50	nA
I_B	Input Bias Current		●		6	9		6	11	nA
A_{VOL}	Large-Signal Voltage Gain	V_O = ±10V, R_L = 5k	●	300	1200		250	1200		V/mV
CMRR	Common Mode Rejection Ratio	V_{CM} = 13V, –15V	●	95	112		92	112		dB
PSRR	Power Supply Rejection Ratio	V_S = 5V, 0V to ±18V	●	98	112		95	112		dB
	Maximum Output Voltage Swing	R_L = 5k	●	±11.0	±13.6		±11.0	±13.6		V
I_S	Supply Current per Amplifier		●		49	73		50	85	μA

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

Note 2: Typical parameters are defined as the 60% yield of parameter distributions of individual amplifiers, i.e., out of 100 LT2079s (or 100 LT2078s) typically 240 op amps (or 120) will be better than the indicated specification.

Note 3: This parameter is tested on a sample basis only. All noise parameters are tested with V_S = ±2.5V, V_O = 0V.

Note 4: This parameter is guaranteed by design and is not tested.

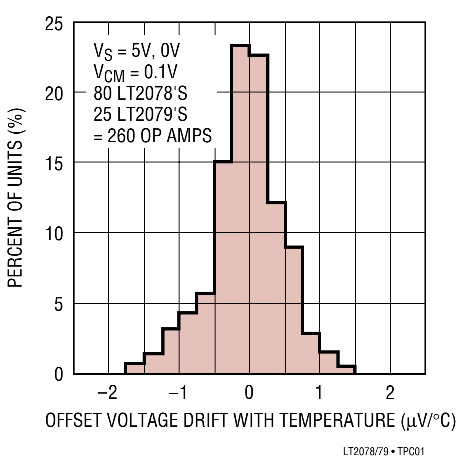
Note 5: Power supply rejection ratio is measured at the minimum supply voltage. The op amps actually work at 1.8V supply but with a typical offset skew of –300μV.

Note 6: This parameter is not 100% tested.

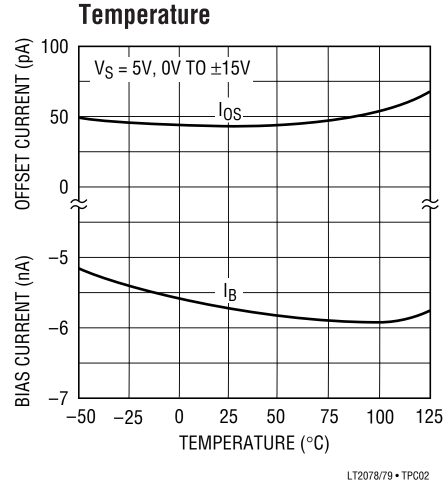
Note 7: The LT2078C/LT2079C are designed, characterized and expected to meet the industrial temperature limits, but are not tested at –40°C and 85°C. I-grade parts are guaranteed.

TYPICAL PERFORMANCE CHARACTERISTICS

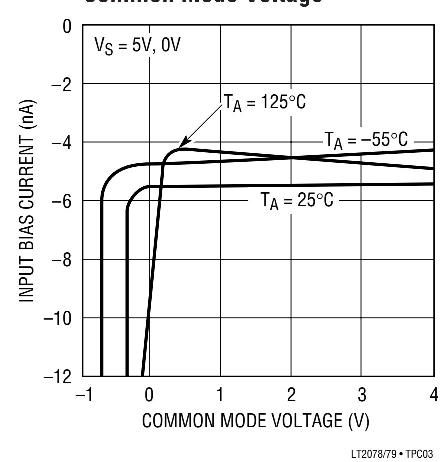
Distribution of Offset Voltage Drift with Temperature



Input Bias and Offset Currents vs Temperature

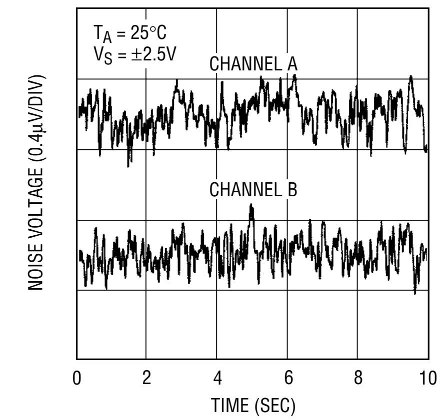


Input Bias Current vs Common Mode Voltage



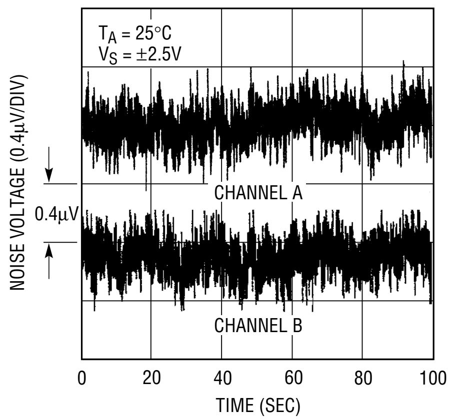
TYPICAL PERFORMANCE CHARACTERISTICS

0.1Hz to 10Hz Noise



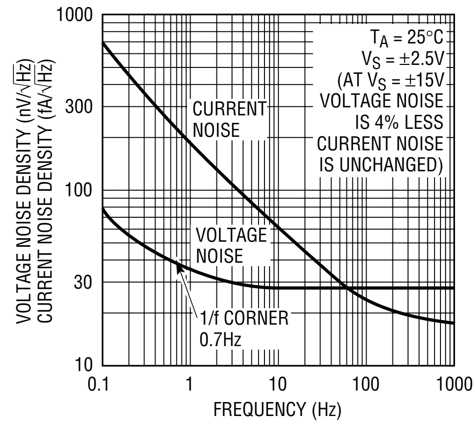
LT2078/79 • TPC04

0.01Hz to 10Hz Noise



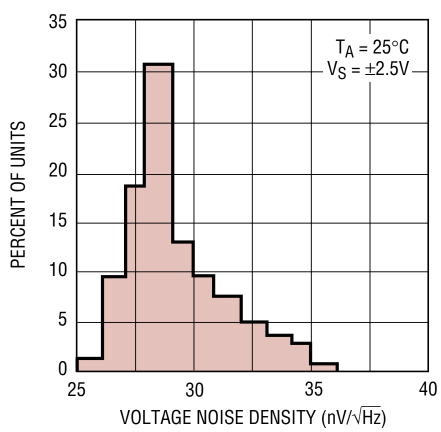
LT2078/79 • TPC05

Noise Spectrum



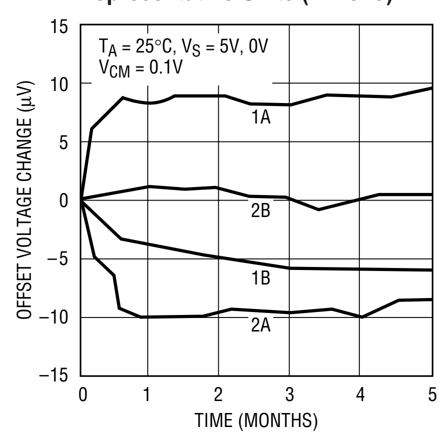
LT2078/79 • TPC06

10Hz Voltage Noise Distribution



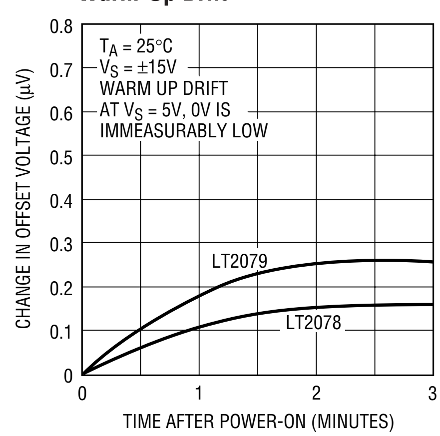
LT2078/79 • TPC07

Long Term Stability of Two Representative Units (LT2078)



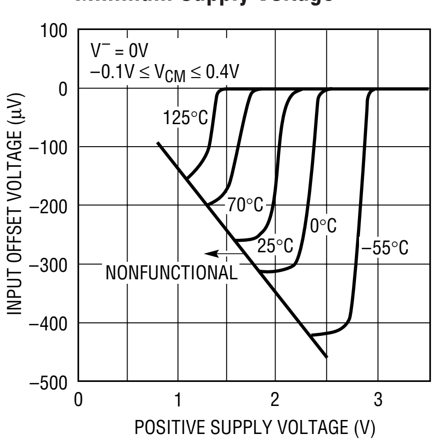
LT2078/79 • TPC08

Warm-Up Drift



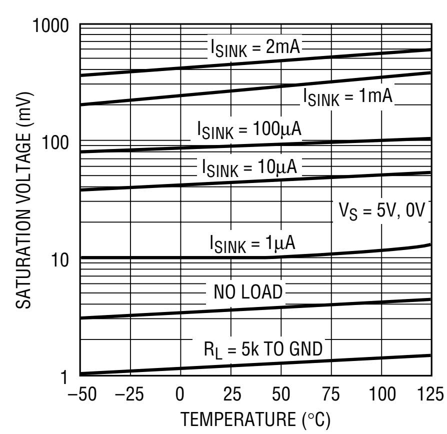
LT2078/79 • TPC09

Minimum Supply Voltage



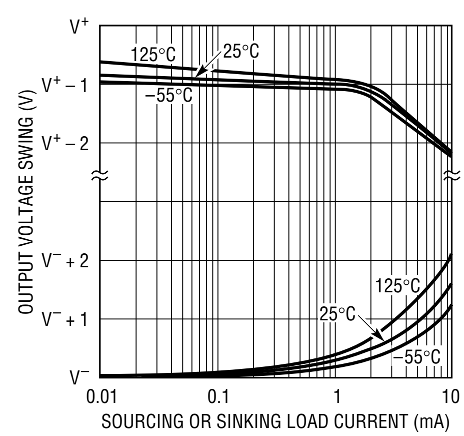
LT2078/79 • TPC10

Output Saturation vs Temperature vs Sink Current



LT2078/79 • TPC11

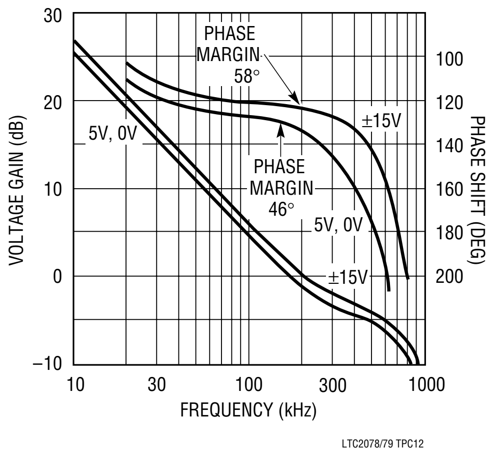
Output Voltage Swing vs Load Current



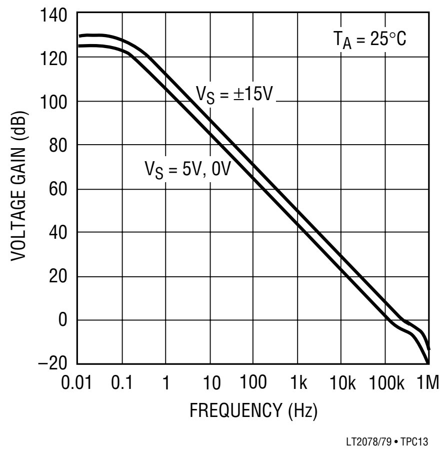
LT2078/79 • TPC11.5

TYPICAL PERFORMANCE CHARACTERISTICS

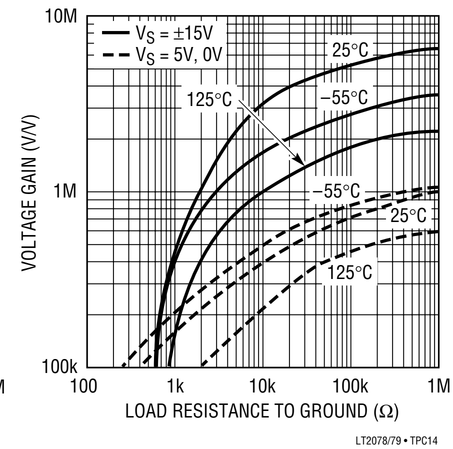
Gain, Phase vs Frequency



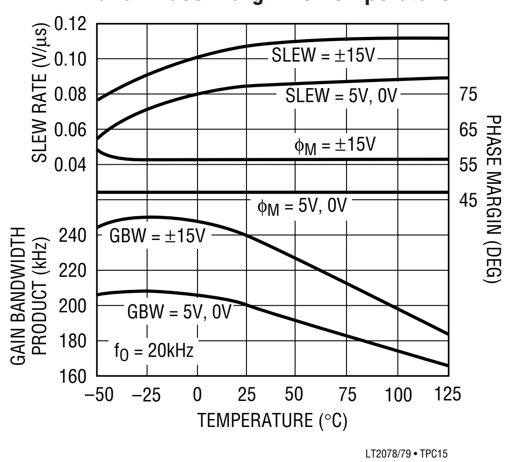
Voltage Gain vs Frequency



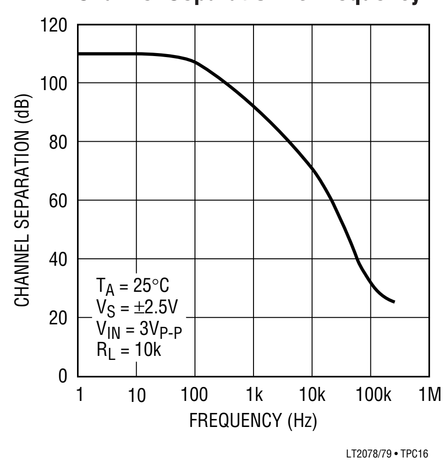
Voltage Gain vs Load Resistance



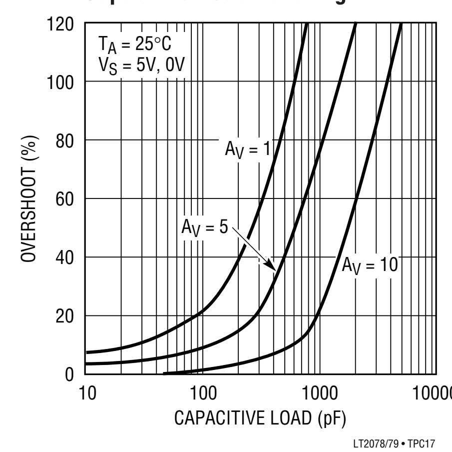
Slew Rate, Gain Bandwidth Product and Phase Margin vs Temperature



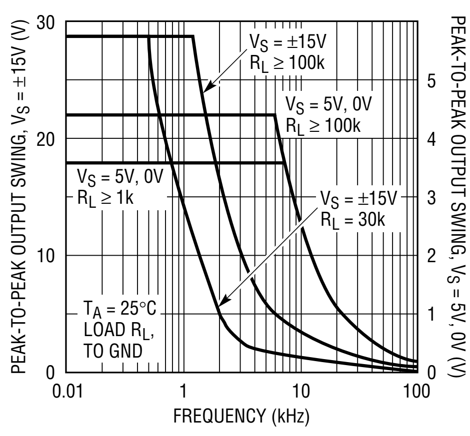
Channel Separation vs Frequency



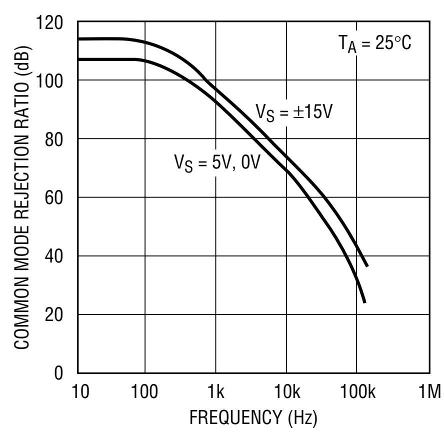
Capacitive Load Handling



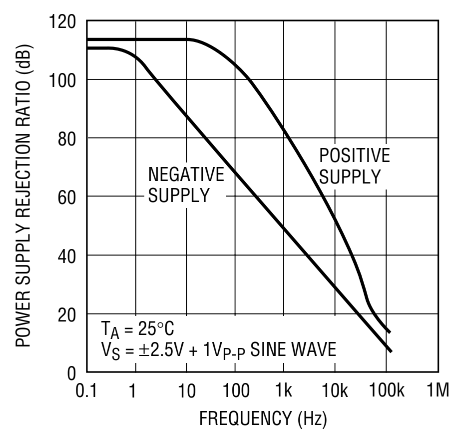
Undistorted Output Swing vs Frequency



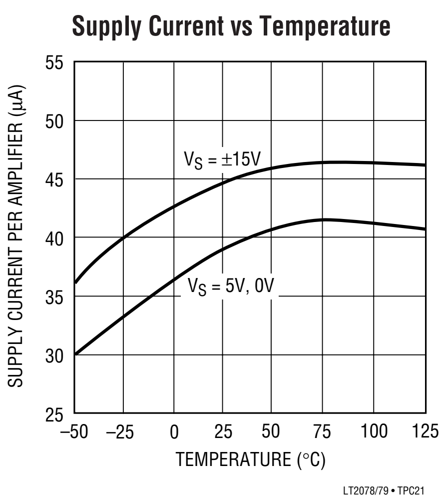
Common Mode Rejection Ratio vs Frequency

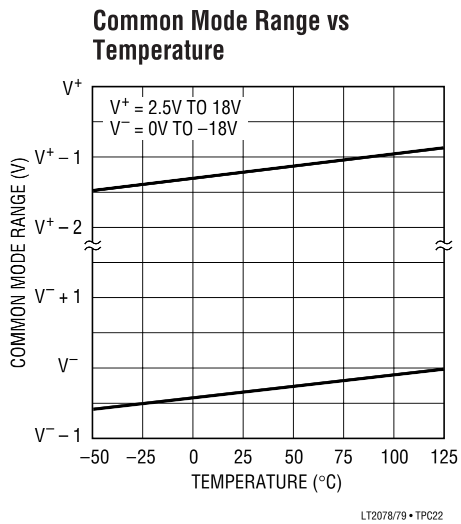


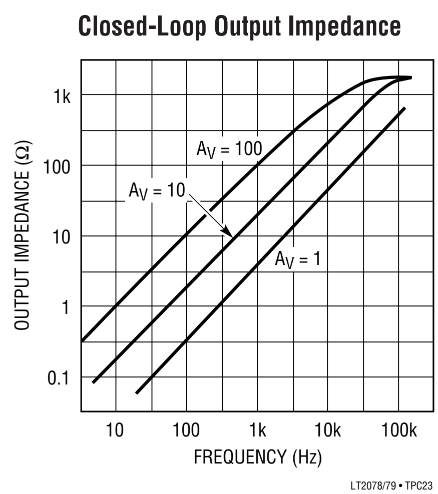
Power Supply Rejection Ratio vs Frequency

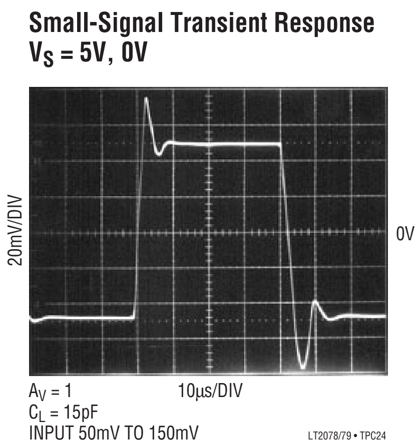


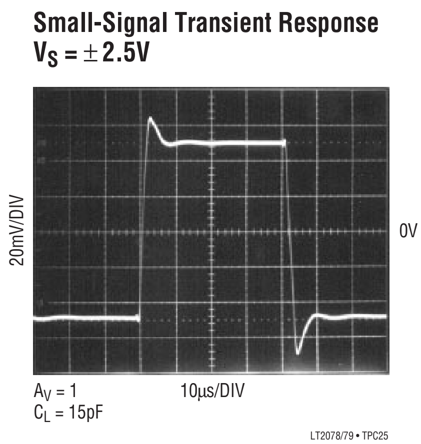
TYPICAL PERFORMANCE CHARACTERISTICS

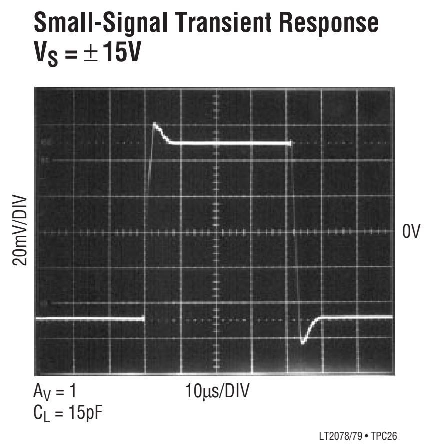


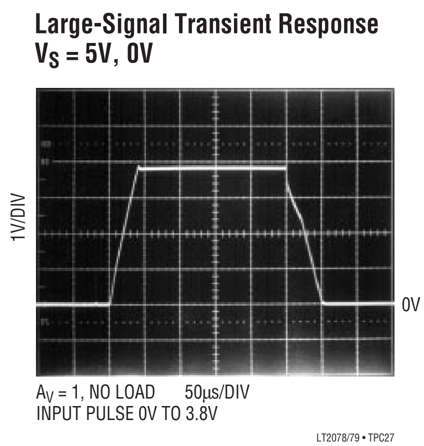


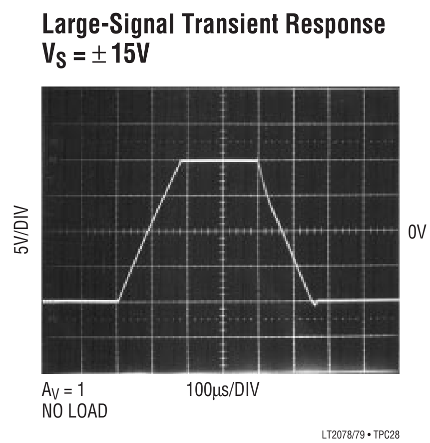






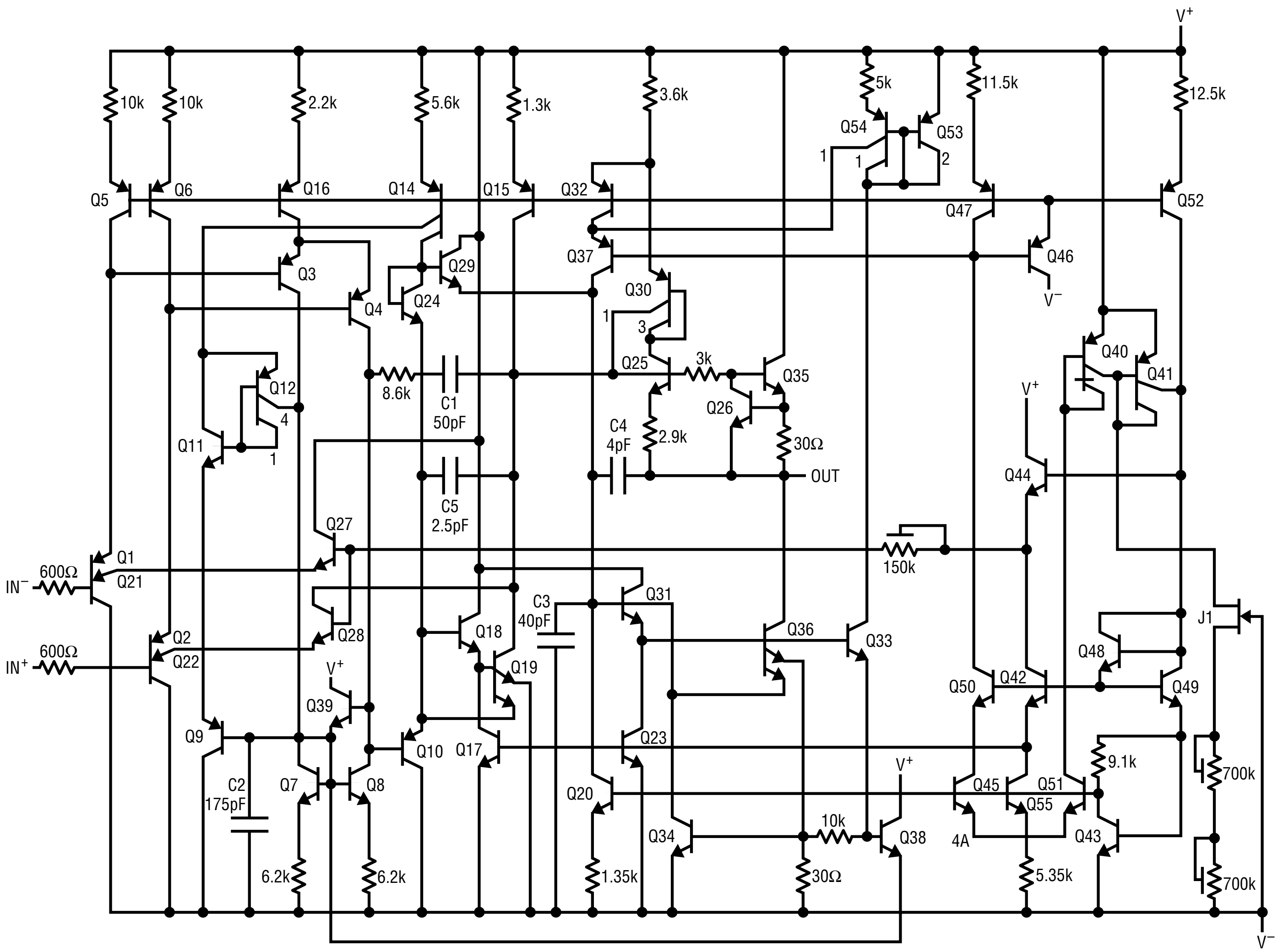






SIMPLIFIED SCHEMATIC

1/2 LT2078, 1/4 LT2079



LT2078/79 • SIMPLIFIED SCHEM

APPLICATIONS INFORMATION

The LT2078/LT2079 devices are fully specified with $V^+ = 5V$, $V^- = 0V$, $V_{CM} = 0.1V$. This set of operating conditions appears to be the most representative for battery powered micropower circuits. Offset voltage is internally trimmed to a minimum value at these supply voltages. When 9V or 3V batteries or ±2.5V dual supplies are used, bias and offset current changes will be minimal. Offset voltage changes will be just a few microvolts as given by the PSRR and CMRR specifications. For example, if PSRR = 114dB (=2μV/V), at 9V the offset voltage change will be 8μV. Similarly, $V_S = \pm 2.5V$, $V_{CM} = 0V$ is equivalent to a common mode voltage change of 2.4V or a V_{OS} change of 7μV if CMRR = 110dB (3μV/V).

A full set of specifications is also provided at ±15V supply voltages for comparison with other devices and for completeness.

Single Supply Operation

The LT2078/LT2079 is quite tolerant of power supply bypassing. In some applications requiring faster settling time the positive supply pin of the LT2078/LT2079 should be bypassed with a small capacitor (about 0.1μF). The same is true for the negative supply pin when using split supplies.

The LT2078/LT2079 are fully specified for single supply operation, i.e., when the negative supply is 0V. Input common mode range goes below ground and the output swings within a few millivolts of ground while sinking current. All competing micropower op amps either cannot swing to within 600mV of ground (OP-20, OP-220, OP-420) or need a pull-down resistor connected to the output to swing to ground (OP-90, OP-290, OP-490, HA5141/42/44). This difference is critical because in many applications these competing devices cannot be operated as micropower op amps and swing to ground simultaneously.

As an example, consider the instrumentation amplifier shown on the front page. When the common mode signal is low and the output is high, amplifier A has to sink current. When the common mode signal is high and the output low, amplifier B has to sink current. The competing devices require a 12k pull-down resistor at the output of amplifier A and a 15k at the output of B to handle the specified signals. (The LT2078 does not need pull-down resistors.) When the common mode input is high and the output is high these pull-down resistors draw 300μA (150μA each), which is excessive for micropower applications.

The instrumentation amplifier is by no means the only application requiring current sinking capability. In seven of the nine single supply applications shown in this data sheet the op amps have to be able to sink current. In two of the applications the first amplifier has to sink only the 6nA input bias current of the second op amp. The competing devices, however, cannot even sink 6nA without a pull-down resistor

Since the output of the LT2078/LT2079 cannot go exactly to ground, but can only approach ground to within a few millivolts, care should be exercised to ensure that the output is not saturated. For example, a 1mV input signal will cause the amplifier to set up in its linear region in the gain 100 configuration shown in Figure 1, but is not enough to make the amplifier function properly in the voltage follower mode.

Single supply operation can also create difficulties at the input. The driving signal can fall below 0V—inadvertently or on a transient basis. If the input is more than a few hundred millivolts below ground, two distinct problems can occur on previous single supply designs, such as the LM124, LM158, OP-20, OP-21, OP-220, OP-221, OP-420 (1 and 2), OP-90/290/490 (2 only):

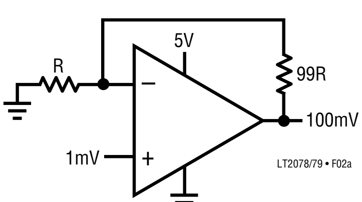


Figure 1a. Gain 100 Amplifier

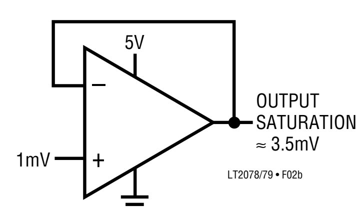


Figure 1b. Voltage Follower

APPLICATIONS INFORMATION

1. When the input is more than a diode drop below ground, unlimited current will flow from the substrate (V^- terminal) to the input. This can destroy the unit. On the LT2078/LT2079, resistors in series with the input protect the devices even when the input is 5V below ground.
2. When the input is more than 400mV below ground (at 25°C), the input stage saturates and phase reversal occurs at the output. This can cause lockup in servo systems. Due to a unique phase reversal protection circuitry, the LT2078/LT2079 output does not reverse, as illustrated in Figure 2, even when the inputs are at –1V.

Distortion

There are two main contributors of distortion in op amps: distortion caused by nonlinear common mode rejection and output crossover distortion as the output transitions from sourcing to sinking current. The common mode rejection of the LT2078/LT2079 is very good, typically 108dB. Therefore, as long as the input operates in the normal common mode range, there will be very little common mode induced distortion. If the op amp is operating inverting there is no common mode induced distortion. Crossover distortion will increase as the output load resistance decreases. For the lowest distortion the LT2078/LT2079 should be operated with the output always sourcing current, this is usually accomplished by putting a resistor from the output to V^-. In an inverting configuration with no load, the output will source and sink current through the feedback resistor. High value feedback resistors will reduce crossover distortion and maintain micropower operation.

Matching Specifications

In many applications the performance of a system depends on the matching between two op amps, rather than

Table 1

		LT2078AC/LT2079AC/LT2078AI/LT2079AI		LT2078C/LT2079C/LT2078I/LT2079I		
PARAMETER		**50% YIELD**	**98% YIELD**	**50% YIELD**	**98% YIELD**	**UNITS**
V_{OS} Match, ΔV_{OS}	LT2078	30	110	50	190	µV
	LT2079	40	150	50	250	µV
Temperature Coefficient ΔV_{OS}		0.5	1.2	0.6	1.8	µV/°C
Average Noninverting I_B		6	8	6	10	nA
Match of Noninverting I_B		0.12	0.4	0.15	0.5	nA
CMRR Match		120	100	117	97	dB
PSRR Match		117	105	117	102	dB

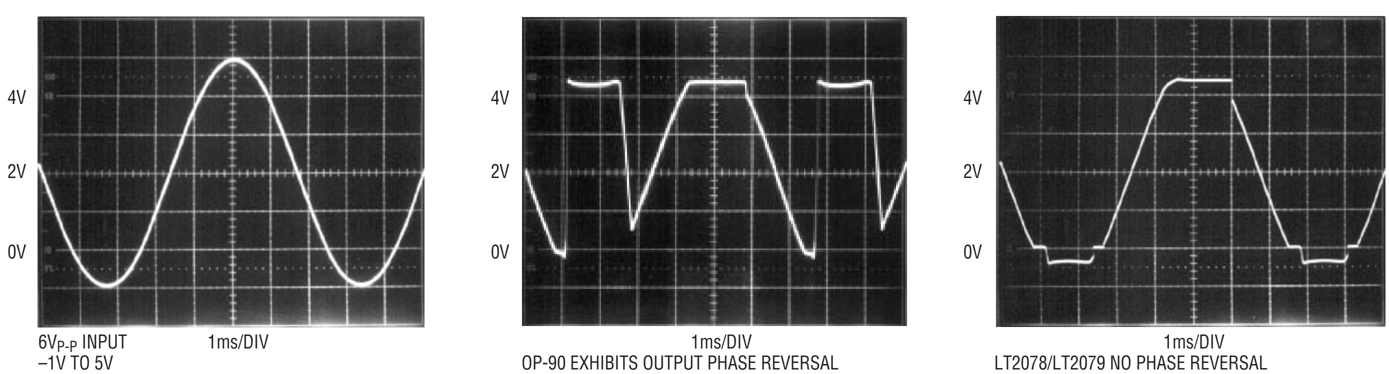


Figure 2. Voltage Follower with Input Exceeding the Negative Common Mode Range (V_S = 5V, 0V)

APPLICATIONS INFORMATION

the individual characteristics of the two devices, the two and three op amp instrumentation amplifier configurations shown in this data sheet are examples. Matching characteristics are not 100% tested on the LT2078/LT2079.

Some specifications are guaranteed by definition. For example, 70µV maximum offset voltage implies that mismatch cannot be more than 140µV. 95dB (= 17.5µV/V) CMRR means that worst-case CMRR match is 89dB (= 35µV/V). However, Table 1 can be used to estimate the expected matching performance at V_S = 5V, 0V between the two sides of the LT2078, and between amplifiers A and D, and between amplifiers B and C of the LT2079.

Comparator Applications

The single supply operation of the LT2078/LT2079 and its ability to swing close to ground while sinking current lends itself to use as a precision comparator with TTL compatible output.

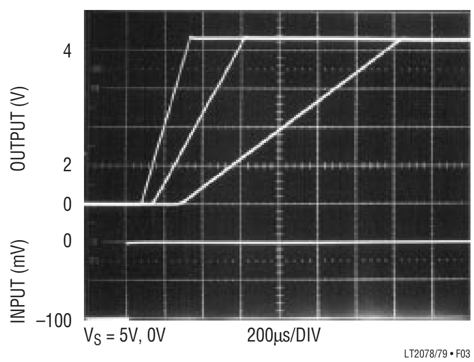


Figure 3. Comparator Rise Response Time to 10mV, 5mV, 2mV Overdrives

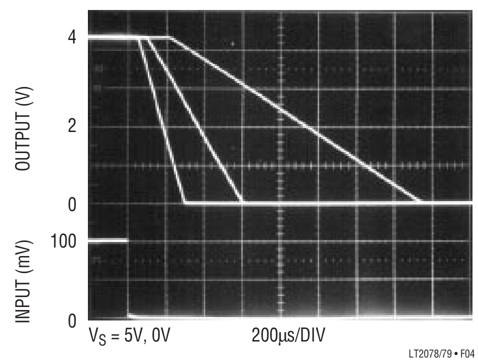
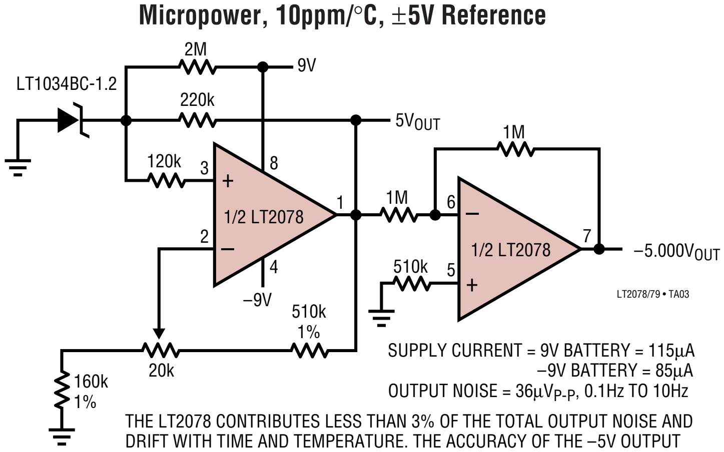


Figure 4. Comparator Fall Response Time to 10mV, 5mV, 2mV Overdrives

TYPICAL APPLICATIONS

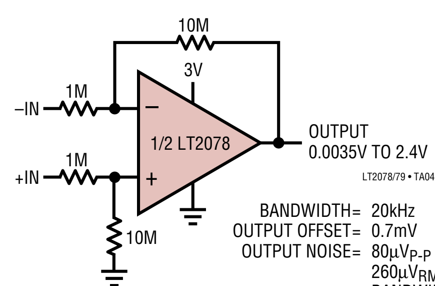
Micropower, 10ppm/°C, ±5V Reference



SUPPLY CURRENT = 9V BATTERY = 115µA
–9V BATTERY = 85µA
OUTPUT NOISE = 36µV_{P-P}, 0.1Hz TO 10Hz

THE LT2078 CONTRIBUTES LESS THAN 3% OF THE TOTAL OUTPUT NOISE AND DRIFT WITH TIME AND TEMPERATURE. THE ACCURACY OF THE –5V OUTPUT DEPENDS ON THE MATCHING OF THE TWO 1M RESISTORS

Gain of 10 Difference Amplifier

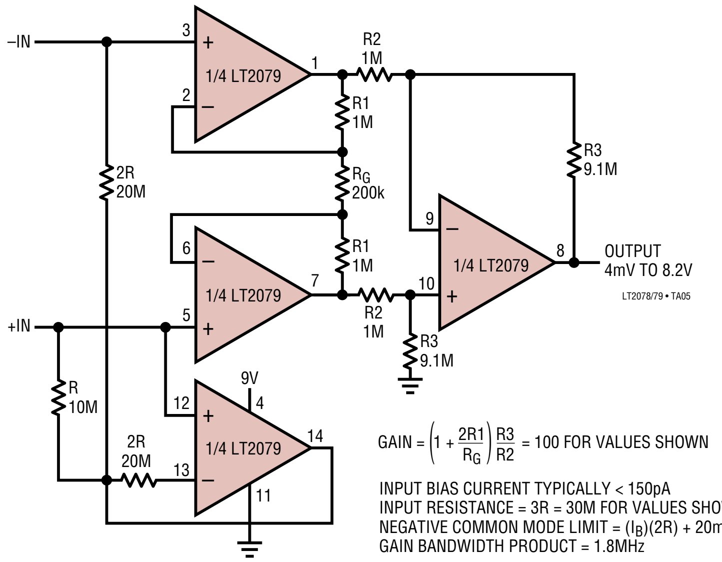


BANDWIDTH= 20kHz
OUTPUT OFFSET= 0.7mV
OUTPUT NOISE= 80µV_{P-P} (0.1Hz TO 10Hz)
260µV_{RMS} OVER FULL BANDWIDTH

THE USEFULNESS OF DIFFERENCE AMPLIFIERS IS LIMITED BY THE FACT THAT THE INPUT RESISTANCE IS EQUAL TO THE SOURCE RESISTANCE. THE PICOAMPERE OFFSET CURRENT AND LOW CURRENT NOISE OF THE LT2078 ALLOWS THE USE OF 1M SOURCE RESISTORS WITHOUT DEGRADATION IN PERFORMANCE. IN ADDITION, WITH MEGOHM RESISTORS MICROPOWER OPERATION CAN BE MAINTAINED

TYPICAL APPLICATIONS

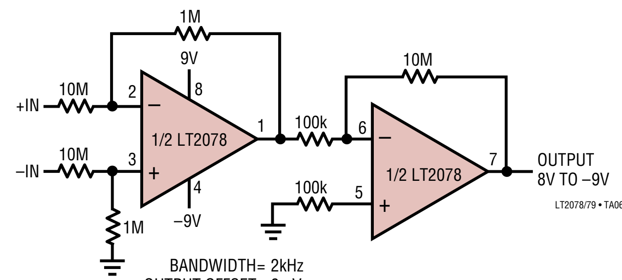
Picoampere Input Current, Triple Op Amp Instrumentation Amplifier with Bias Current Cancellation



GAIN = $\left(1 + \frac{2R1}{R_G}\right)\frac{R3}{R2}$ = 100 FOR VALUES SHOWN

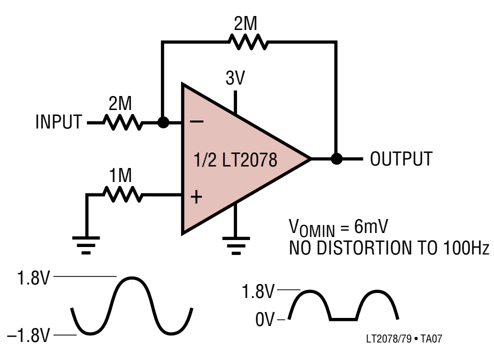
INPUT BIAS CURRENT TYPICALLY < 150pA
INPUT RESISTANCE = 3R = 30M FOR VALUES SHOWN
NEGATIVE COMMON MODE LIMIT = $(I_B)(2R)$ + 20mV ≈ 140mV
GAIN BANDWIDTH PRODUCT = 1.8MHz

85V, –100V Common Mode Range Instrumentation Amplifier (A_V = 10)



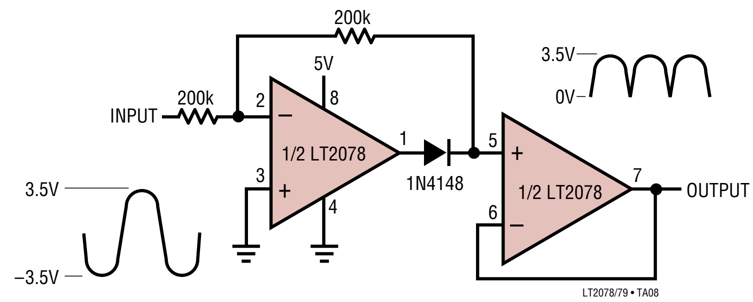
BANDWIDTH= 2kHz
OUTPUT OFFSET= 8mV
OUTPUT NOISE= $0.8mV_{P-P}$ (0.1Hz TO 10Hz)
= $1.4mV_{RMS}$ OVER FULL BANDWIDTH (DOMINATED BY RESISTOR NOISE)
INPUT RESISTANCE = 10M

Half-Wave Rectifier



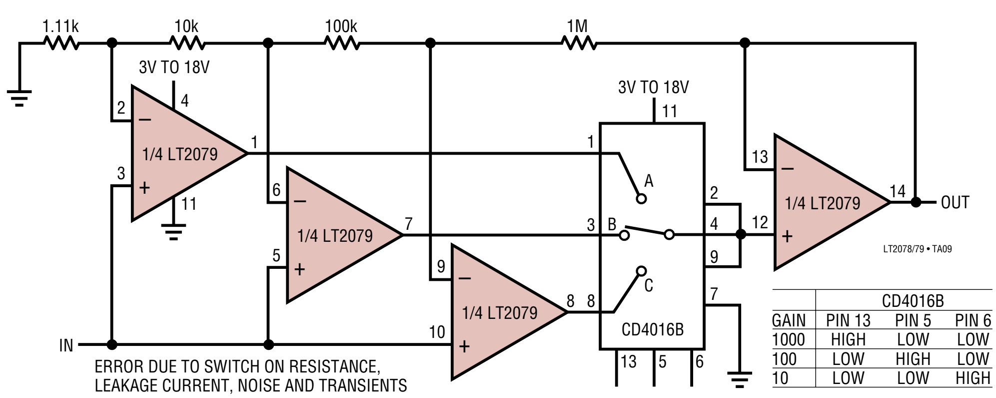
V_{OMIN} = 6mV
NO DISTORTION TO 100Hz

Absolute Value Circuit (Full-Wave Rectifier)



V_{OMIN} = 4mV
NO DISTORTION TO 100Hz

Programmable Gain Amplifier (Single Supply)

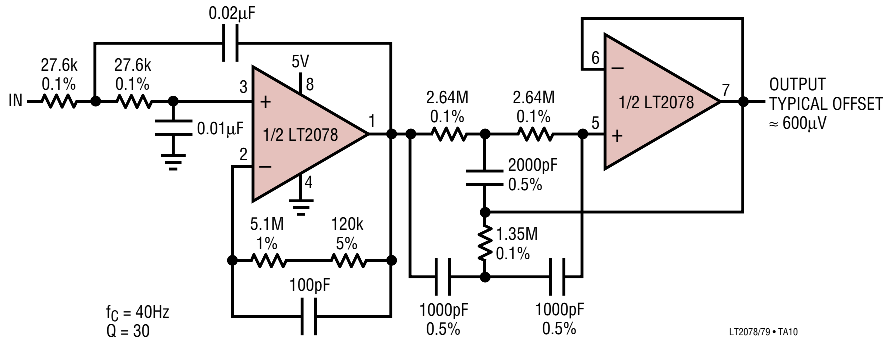


	CD4016B		
GAIN	PIN 13	PIN 5	PIN 6
1000	HIGH	LOW	LOW
100	LOW	HIGH	LOW
10	LOW	LOW	HIGH

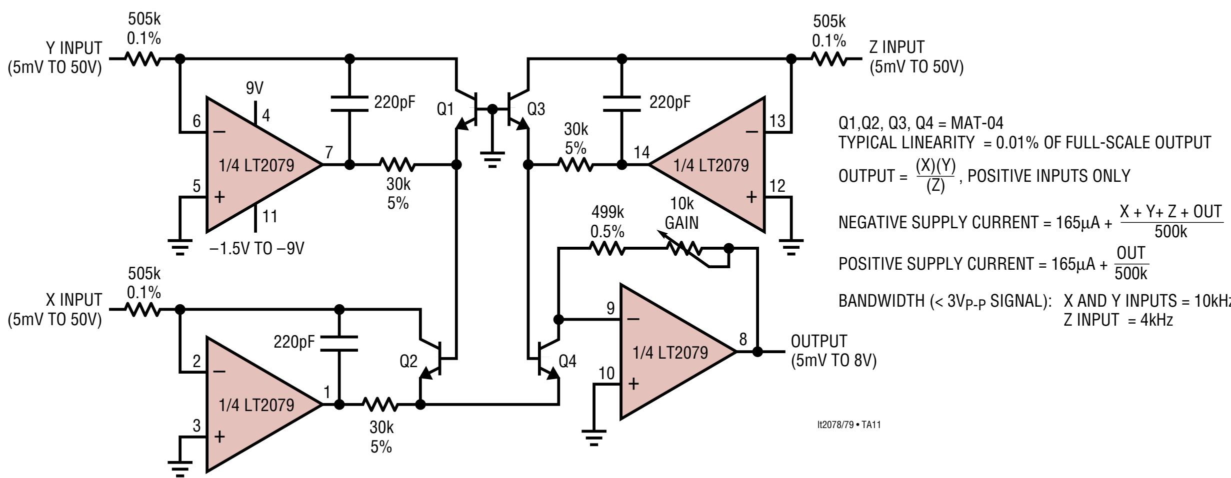
ERROR DUE TO SWITCH ON RESISTANCE, LEAKAGE CURRENT, NOISE AND TRANSIENTS ARE ELIMINATED

TYPICAL APPLICATIONS

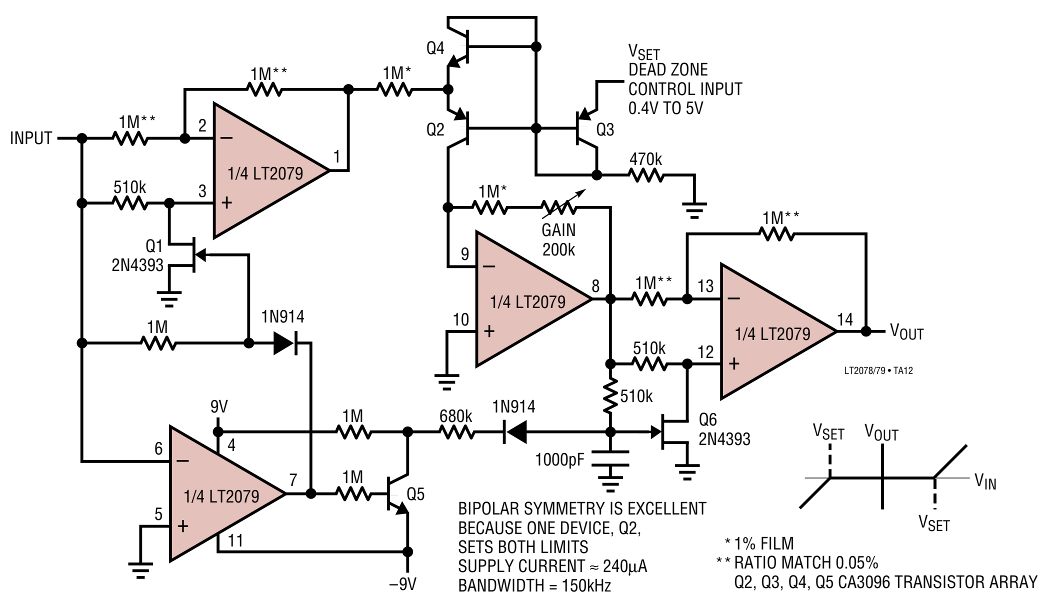
Single Supply, Micropower, Second Order Lowpass Filter with 60Hz Notch



Micropower Multiplier/Divider

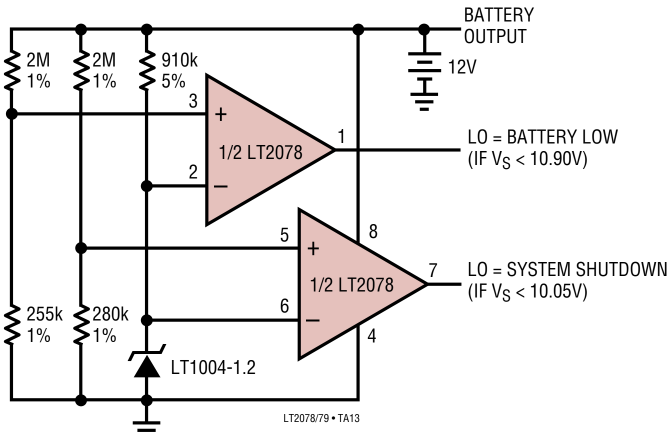


Micropower Dead Zone Generator



TYPICAL APPLICATIONS

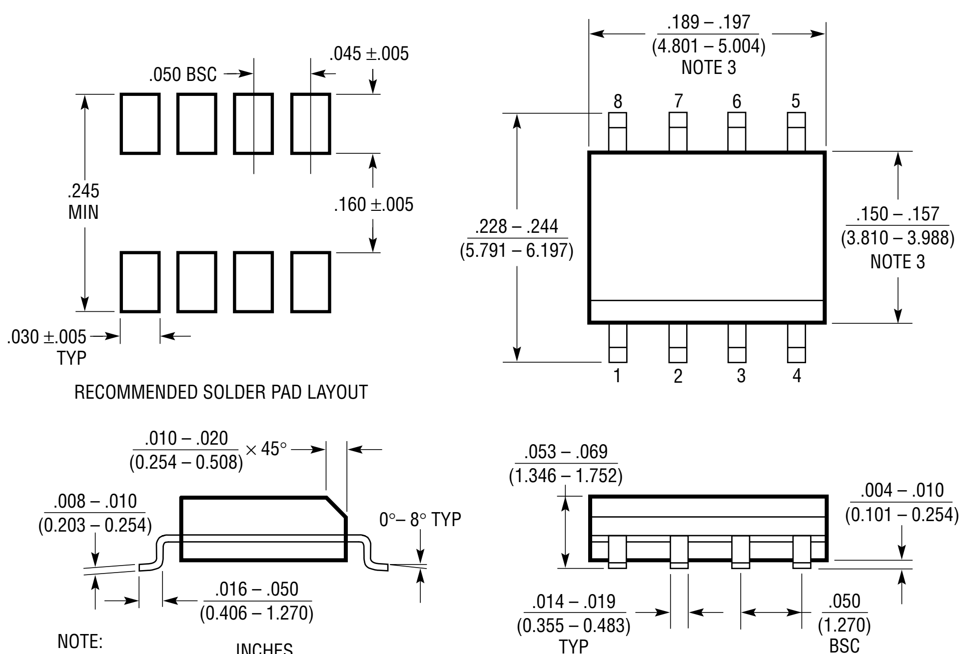
Lead-Acid Low-Battery Detector with System Shutdown



TOTAL SUPPLY CURRENT = 105µA

PACKAGE DESCRIPTION

S8 Package
8-Lead Plastic Small Outline (Narrow .150 Inch)
(Reference LTC DWG # 05-08-1610)

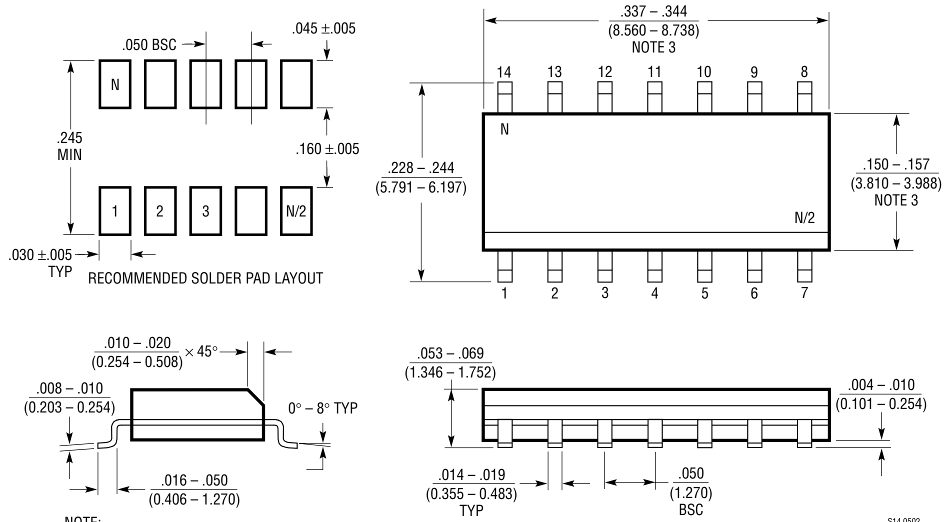


NOTE:
1. DIMENSIONS IN $\frac{\text{INCHES}}{\text{(MILLIMETERS)}}$
2. DRAWING NOT TO SCALE
3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

SO8 0303

PACKAGE DESCRIPTION

S Package
14-Lead Plastic Small Outline (Narrow .150 Inch)
(Reference LTC DWG # 05-08-1610)



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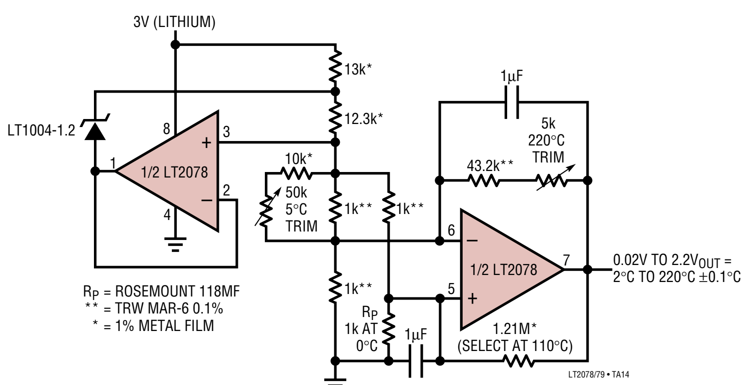
TYPICAL APPLICATION

Platinum RTD Signal Conditioner with Curvature Correction



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1178/LT1179	Dual/Quad 17μA Max, Single Supply Precision Op Amps	70μV V_{OS} Max and 2.5μV/°C Drift Max, 85kHz GBW, 0.04V/μs Slew Rate, Input/Output Common Mode Includes Ground
LT1211/LT1212	14MHz, 7V/μs Single Supply Dual and Quad Precision Op Amps	275μV V_{OS} Max, 6μV/°C Drift Max Input Voltage Range Includes Ground
LT1490/LT1491	Dual/ Quad Micropower Rail-to-Rail Input and Output Op Amps	Single Supply Input Range: –0.4V to 44V, Micropower 50μA Amplifier, Rail-to-Rail Input and Output, 200kHz GBW
LT2178/LT2179	Dual/Quad 17μA Max, Single Supply Precision Op Amps	SO-8 and 14-Lead Standard Pinout, 70μV VOS Max, 85kHz GBW

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