Micropower, Single Supply, Precision Op Amp

FEATURES

- 60μA Max Supply Current
- 40μV Max Offset Voltage
- 350pA Max Offset Current
- 0.5μV_{P-P} 0.1Hz to 10Hz Voltage Noise
- 2.5pA_{P-P} 0.1Hz to 10Hz Current Noise
- 0.4μV/°C Offset Voltage Drift
- 250kHz Gain-Bandwidth Product
- 0.12V/μs Slew Rate
- Single Supply Operation
  - Input Voltage Range Includes Ground
  - Output Swings to Ground while Sinking Current
  - No Pull-Down Resistors are Needed
- Output Sources and Sinks 5mA Load Current

APPLICATIONS

- Replaces OP-07, OP-77, AD707, LT1001, LT1012 at 10 to 60 Times Lower Power
- Battery or Solar Powered Systems
- 4mA to 20mA Current Loops
- Two Terminal Current Source
- Megaohm Source Resistance Difference Amplifier

DESCRIPTION

The LT®1077 is a micropower precision operational amplifier optimized for single supply operation at 5V. In addition, ±15V specifications are provided.

Micropower performance of competing devices is achieved at the expense of seriously degrading precision, noise, speed, and output drive specifications. The LT1077 reduces supply current without sacrificing other parameters. The offset voltage achieved is the lowest of any micropower op amp. Offset current, voltage and current noise, slew rate and gain-bandwidth product are all two to ten times better than on previous micropower op amps.

The 1/f corner of the voltage noise spectrum is at 0.7Hz. This results in low frequency (0.1Hz to 10Hz) noise performance which can only be found on devices with an order of magnitude higher supply current.

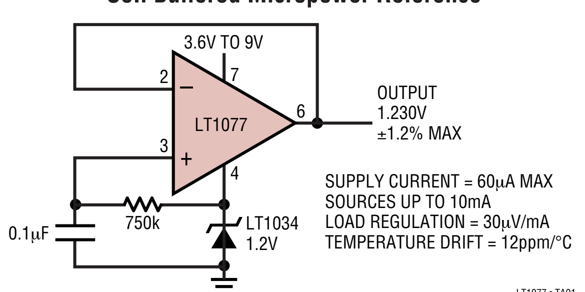
The LT1077 is completely plug-in compatible (including nulling) with all industry standard precision op amps. Thus, it can replace these precision op amps in many applications without sacrificing performance, yet with significant power savings.

The LT1077 can be operated from one lithium cell or two Ni-Cad batteries. The input range goes below ground. The all-NPN output stage swings to ground while sinking current—no pull-down resistors are needed.

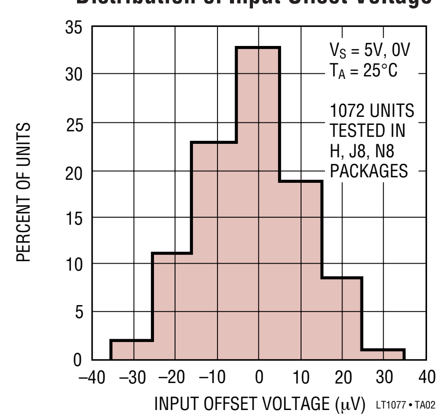
For dual and quad op amps with similar specifications please see the LT1078/LT1079 datasheet.

TYPICAL APPLICATION

Self Buffered Micropower Reference



Distribution of Input Offset Voltage

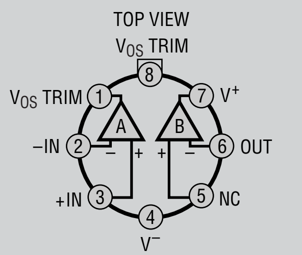


ABSOLUTE MAXIMUM RATINGS (Note 1)

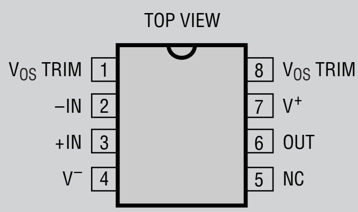
Supply Voltage .... ±22V
Differential Input Voltage .... ±30V
Input Voltage .... Equal to Positive Supply Voltage
Input Voltage .... 5V Below Negative Supply Voltage
Output Short-Circuit Duration .... Indefinite

Operating Temperature Range
LT1077AM/LT1077M **(OBSOLETE)**.... –55°C to 125°C
LT1077AI/LT1077I .... –40°C to 85°C
LT1077AC/LT1077C/LT1077S8 .... 0°C to 70°C
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

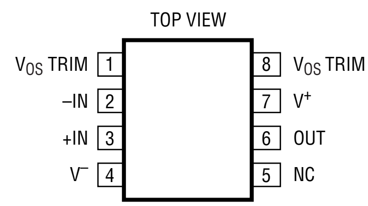
PACKAGE/ORDER INFORMATION



H PACKAGE
8-LEAD TO-5 METAL CAN
T_{JMAX} = 150°C, θ_{JA} = 150°C/W, θ_{JC} = 45°C/W



J8 PACKAGE
8-LEAD CERDIP
T_{JMAX} = 150°C, θ_{JA} = 100°C/W



N8 PACKAGE
8-LEAD PDIP
T_{JMAX} = 100°C, θ_{JA} = 130°C/W

S8 PACKAGE
8-LEAD PLASTIC SO
T_{JMAX} = 150°C, θ_{JA} = 190°C/W

ORDER PART NUMBER	ORDER PART NUMBER	ORDER PART NUMBER	S8 PART MARKING
LT1077AMH LT1077MH LT1077ACH LT1077CH	LT1077AMJ8 LT1077MJ8 LT1077ACJ8 LT1077CJ8	LT1077S8 LT1077IS8 LT1077AIN8 LT1077IN8 LT1077ACN8 LT1077CN8	1077 1077I

OBSOLETE PACKAGE
Consider the N8 or S8 Package for Alternate Source

LT1077 • POI01

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 noted.

SYMBOL	PARAMETER	CONDITIONS	LT1077AM/AI/AC MIN	LT1077AM/AI/AC TYP	LT1077AM/AI/AC MAX	LT1077M/I/C/S8 MIN	LT1077M/I/C/S8 TYP	LT1077M/I/C/S8 MAX	UNITS
V_{OS}	Input Offset Voltage			9	40		10	60	µV
		LT1077S8					12	150	µV
$\frac{\Delta V_{OS}}{\Delta Time}$	Long Term Input Offset Voltage Stability			0.4			0.4		µV/Mo
I_{OS}	Input Offset Current			0.06	0.35		0.06	0.45	nA
I_B	Input Bias Current			7	9		7	11	nA
e_n	Input Noise Voltage	0.1Hz to 10Hz (Note3)		0.5	1.1		0.5		$µV_{P-P}$
	Input Noise Voltage Density	f_O = 10Hz (Note 3)		28	43		28		nV/√Hz
		f_O = 1000Hz (Note3)		27	35		27		nV/√Hz
i_n	Input Noise Current	0.1Hz to 10Hz (Note3)		2.5	4.5		2.5		pA_{P-P}

ELECTRICAL CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	LT1077AM/AI/AC MIN	LT1077AM/AI/AC TYP	LT1077AM/AI/AC MAX	LT1077M/I/C/S8 MIN	LT1077M/I/C/S8 TYP	LT1077M/I/C/S8 MAX	UNITS
	Input Noise Current Density	f_O = 10Hz (Note 3) f_O = 1000Hz		0.065 0.02	0.11		0.065 0.02		pA/√Hz pA/√Hz
	Input Resistance Differential Mode Common Mode	(Note 4)	 350	 700 6		 270	 700 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	97	106		94	105		dB
PSRR	Power Supply Rejection Ratio	V_S = 2.3V to 12V	102	118		100	117		dB
A_{VOL}	Large-Signal Voltage Gain	V_O = 0.03V to 4V, No Load V_O = 0.03V to 3.5V, R_L = 50k	300 250	1000 1000		240 200	1000 1000		V/mV V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, 2k to GND Output Low, I_{SINK} = 100μA Output High, No Load Output High, 2k to GND	 4.2 3.5	3.5 0.7 90 4.4 3.9	6 1.1 130	 4.2 3.5	3.5 0.7 90 4.4 3.9	6 1.1 130	mV mV mV V V
SR	Slew Rate	(Note 2)	0.05	0.08		0.05	0.08		V/μs
GBW	Gain Bandwidth Product	f_O ≤ 20kHz		230			230		kHz
I_S	Supply Current			48	60		48	68	μA
	Offset Adjustment Range	R_{pot} = 10k, Wiper to V+	±500	±900		±500	±900		μV
	Minimum Supply Voltage	(Note 5)		2.2	2.3		2.2	2.3	V

The ● denotes the specifications which apply over the temperature range of −55°C ≤ T_A ≤ 125°C for AM/M grades, −40°C ≤ T_A ≤ 85°C for AI/I grades. V_S = 5V, 0V, V_{CM} = 0.1V, V_O = 1.4V unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1077AM/AI MIN	LT1077AM/AI TYP	LT1077AM/AI MAX	LT1077M/I MIN	LT1077M/I TYP	LT1077M/I MAX	UNITS
V_{OS}	Input Offset Voltage		●		50	200		60	260	μV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	LT1077IS8 (Note 6)	●					1	2.5	μV/°C
I_{OS}	Input Offset Current		●		0.08	0.60		0.08	0.80	nA
I_B	Input Bias Current		●		8	11		8	13	nA
CMRR	Common Mode Rejection Ratio	V_{CM} = 0.05V to 3.2V	●	92	104		88	103		dB
PSRR	Power Supply Rejection Ratio	V_S = 3.1V to 12V	●	98	114		94	113		dB
A_{VOL}	Large-Signal Voltage Gain	V_O = 0.05V to 3.5V, R_L = 50k	●	120	600		100	600		V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, I_{SINK} = 100μA Output High, No Load Output High, 2k to GND	● ● ● ●	 3.9 3	4.5 120 4.2 3.7	8 170	 3.9 3	4.5 120 4.2 3.7	8 170	mV mV V V
I_S	Supply Current		●		54	80		54	90	μA

ELECTRICAL CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS		LT1077AC MIN	LT1077AC TYP	LT1077AC MAX	LT1077C/S8 MIN	LT1077C/S8 TYP	LT1077C/S8 MAX	UNITS
V_{OS}	Input Offset Voltage	 LT1077S8	● ●		30	110		35 40	150 280	µV µV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 6) LT1077S8 (Note 6)	●		0.4	1.6		0.5 0.7	2.0 3.0	µV/°C µV/°C
I_{OS}	Input Offset Current		●		0.07	0.45		0.07	0.60	nA
I_B	Input Bias Current		●		7	10		7	12	nA
CMRR	Common Mode Rejection Ratio	V_{CM} = 0V to 3.4V	●	94	105		90	104		dB
PSRR	Power Supply Rejection Ratio	V_S = 2.6V to 12V	●	100	116		97	115		dB
A_{VOL}	Large-Signal Voltage Gain	V_O = 0.05V to 3.5V, R_L = 50k	●	180	800		150	800		V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, I_{SINK} = 100µA Output High, No Load Output High, 2k to GND	● ● ● ●	 4.1 3.3	4.0 100 4.3 3.8	7 150	 4.1 3.3	4.0 100 4.3 3.8	7 150	mV mV V V
I_S	Supply Current		●		52	70		52	80	µA

V_S = ±15V, T_A = 25°C unless noted.

SYMBOL	PARAMETER	CONDITIONS	LT1077AM/AI/AC MIN	LT1077AM/AI/AC TYP	LT1077AM/AI/AC MAX	LT1077M/I/C/S8 MIN	LT1077M/I/C/S8 TYP	LT1077M/I/C/S8 MAX	UNITS
V_{OS}	Input Offset Voltage	 LT1077S8		20	150		25 30	200 300	µV µV
I_{OS}	Input Offset Current			0.06	0.35		0.06	0.45	nA
I_B	Input Bias Current			7	9		7	11	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 to –15V	100	109		97	108		dB
PSRR	Power Supply Rejection Ratio	V_S = 5V, 0V to ±18V	106	122		103	120		dB
A_{VOL}	Large-Signal Voltage Gain	V_O = ±10V, R_L = 50k V_O = ±10V, R_L = 2k	1000 400	8000 1500		800 300	8000 1500		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		0.07	0.12		0.07	0.12		V/µs
I_S	Supply Current			56	75		56	85	µA

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the temperature range of –55°C ≤ T_A ≤ 125°C for AM/M grades, –40°C ≤ T_A ≤ 85°C for AI/I grades. V_S = ±15V unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1077AM/AI MIN	LT1077AM/AI TYP	LT1077AM/AI MAX	LT1077M/I MIN	LT1077M/I TYP	LT1077M/I MAX	UNITS
V_{OS}	Input Offset Voltage		●		60	330		75	450	µV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	LT1077IS8 (Note 6)	●					1.1	3	µV/°C
I_{OS}	Input Offset Current		●		0.08	0.60		0.08	0.80	nA
I_B	Input Bias Current		●		8	11		8	13	nA
A_{VOL}	Large-Signal Voltage Gain	V_O = ±10V, R_L = 5k	●	300	1000		250	1000		V/mV
CMRR	Common Mode Rejection Ratio	V_{CM} = 13V, –14.9V	●	94	107		90	106		dB
PSRR	Power Supply Rejection Ratio	V_S = 5V, 0V to ±18V	●	100	118		97	116		dB
	Maximum Output Voltage Swing	R_L = 5k	●	±11	±13.5		±11	±13.5		V
I_S	Supply Current		●		60	95		60	105	µA

The ● denotes the specifications which apply over the temperature range of 0°C ≤ T_A ≤ 70°C. V_S = ±15V unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1077AC MIN	LT1077AC TYP	LT1077AC MAX	LT1077C/S8 MIN	LT1077C/S8 TYP	LT1077C/S8 MAX	UNITS
V_{OS}	Input Offset Voltage		●		40	230		50	320	µV
		LT1077S8	●					65	450	µV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 6)	●		0.4	1.8		0.5	2.5	µV/°C
		LT1077S8 (Note 6)	●					0.8	3.5	µV/°C
I_{OS}	Input Offset Current		●		0.07	0.45		0.07	0.60	nA
I_B	Input Bias Current		●		7	10		7	12	nA
A_{VOL}	Large-Signal Voltage Gain	V_O = ±10V, R_L = 5k	●	500	2000		400	2000		V/mV
CMRR	Common Mode Rejection Ratio	V_{CM} = 13V, –15V	●	97	108		94	107		dB
PSRR	Power Supply Rejection Ratio	V_S = 5V, 0V to ±18V	●	103	120		100	118		dB
	Maximum Output Voltage Swing	R_L = 5k	●	±11	±13.6		±11	±13.6		V
I_S	Supply Current		●		59	85		59	95	µA

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

Note 2: Slew rate at 5V, 0V is guaranteed by inference from the slew rate measurement at ±15V.

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

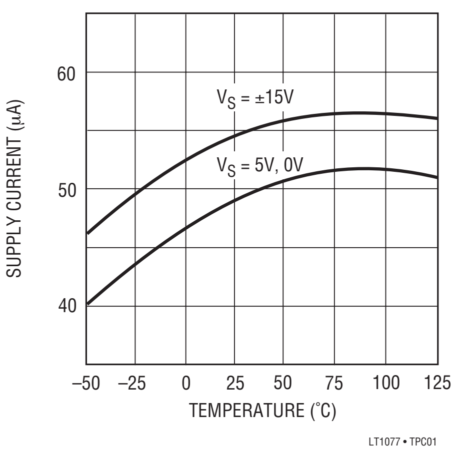
Note 4: This parameter is guaranteed by design and is not tested.

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.

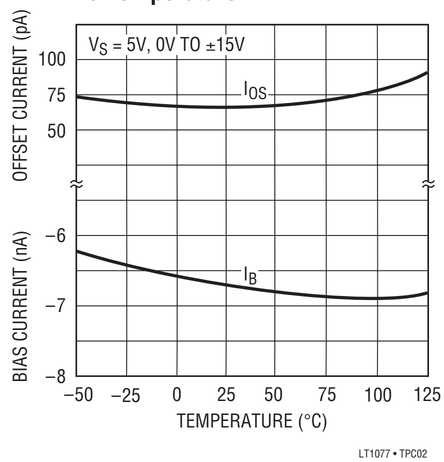
Note 6: This parameter is not 100% tested.

TYPICAL PERFORMANCE CHARACTERISTICS

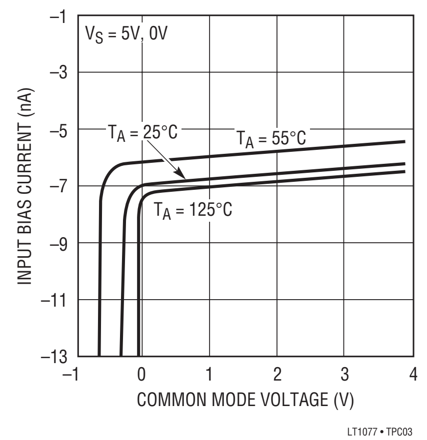
Supply Current vs Temperature



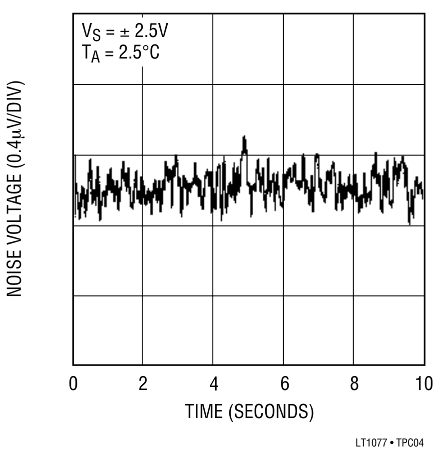
Input Bias and Offset Currents vs Temperature



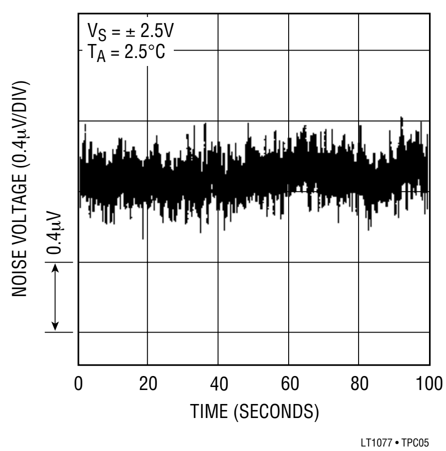
Input Bias Currents vs Common Mode Voltage



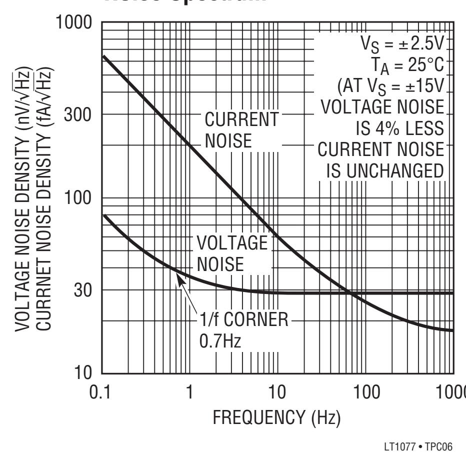
0.1Hz to 10Hz Noise



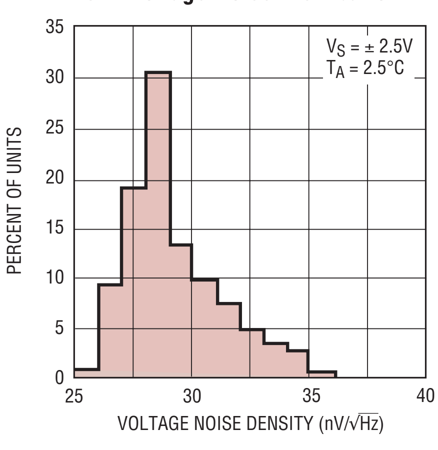
0.01Hz to 10Hz Noise



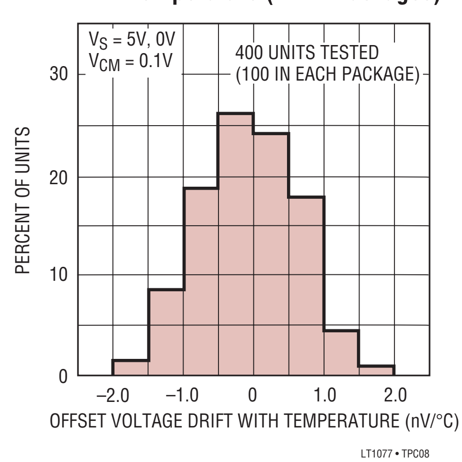
Noise Spectrum



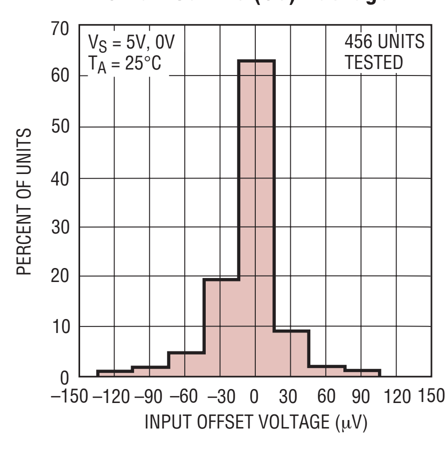
10Hz Voltage Noise Distribution



Distribution of Offset Voltage Drift with Temperature (In All Packages)

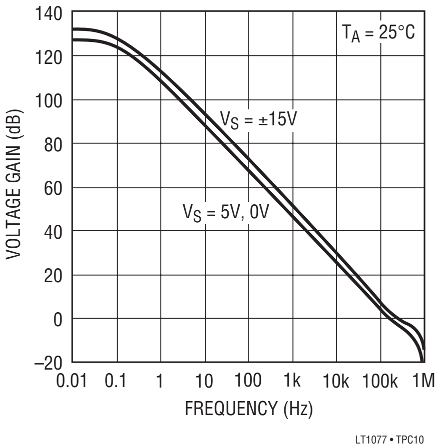


Distribution of Input Offset Voltage in Small Outline (S8) Package

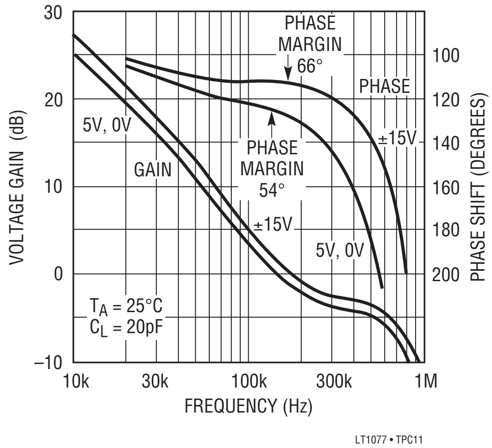


TYPICAL PERFORMANCE CHARACTERISTICS

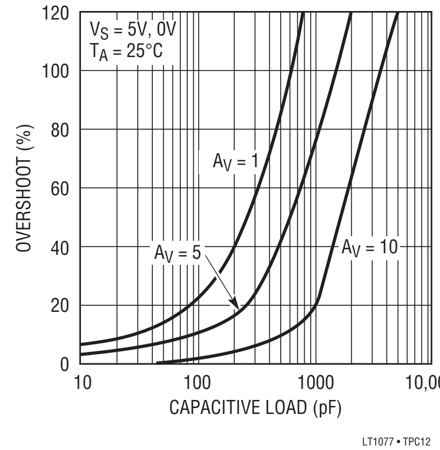
Voltage Gain vs Frequency



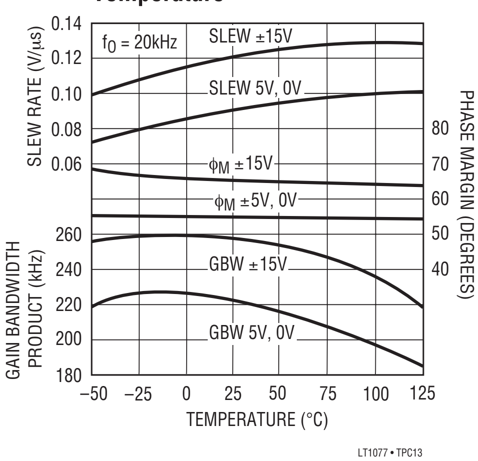
Gain, Phase vs Frequency



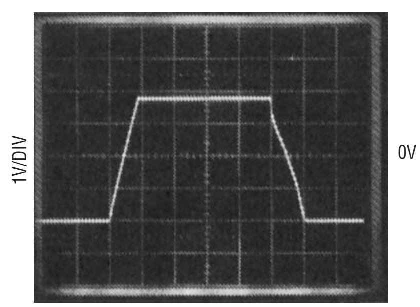
Capacitive Load Handling



Slew Rate, Gain Bandwidth Product and Phase Margin vs Temperature

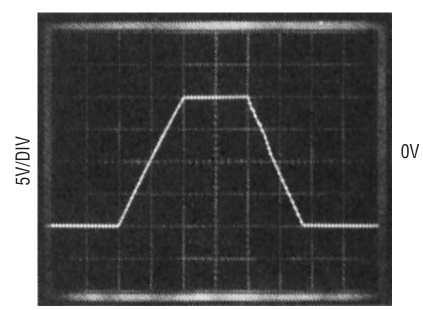


Large-Signal Transient Response V_S = 5V, 0V



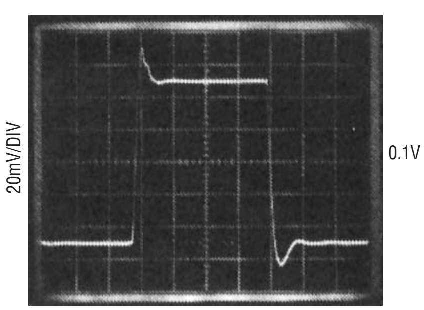
A_V = 1 50µs/DIV
NO LOAD
INPUT PULSE 0V TO 3.8V

Large-Signal Transient Response V_S = ±15V



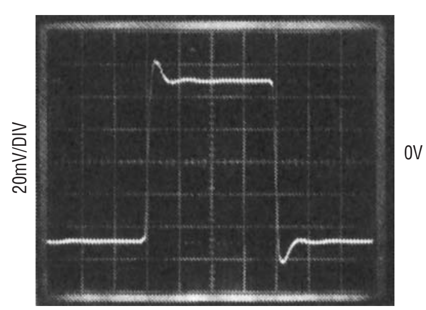
A_V = 1
NO LOAD

Small-Signal Transient Response V_S = 5V, 0V



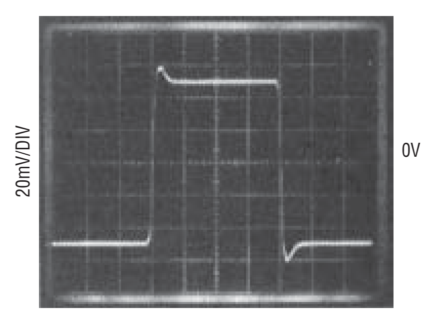
A_V = 1 10µs/DIV
C_L = 15pF
INPUT 50mV TO 150mV

Small-Signal Transient Response V_S = ± 2.5V



A_V = 1 10µs/DIV
C_L = 15pF

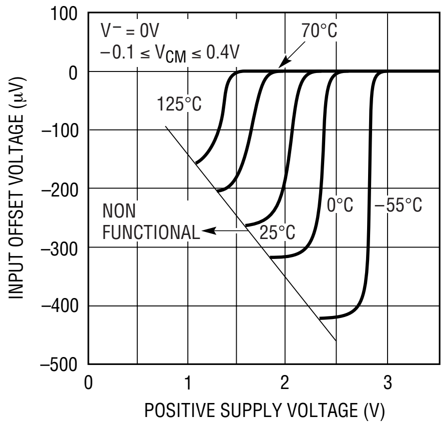
Small-Signal Transient Response V_S = ±15V



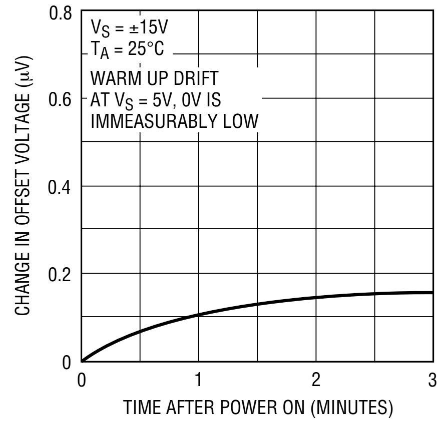
A_V = 1 10µs/DIV
C_L = 15pF

TYPICAL PERFORMANCE CHARACTERISTICS

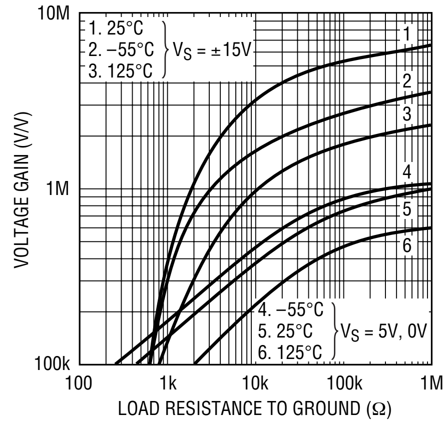
Minimum Supply Voltage



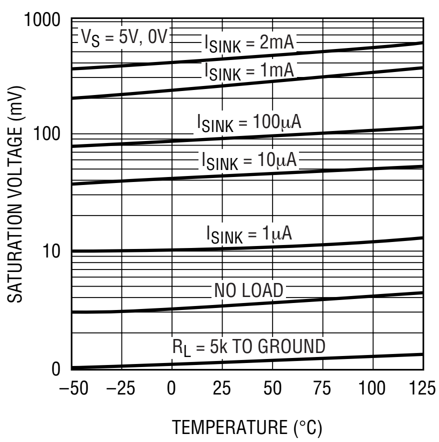
Warm-Up Drift



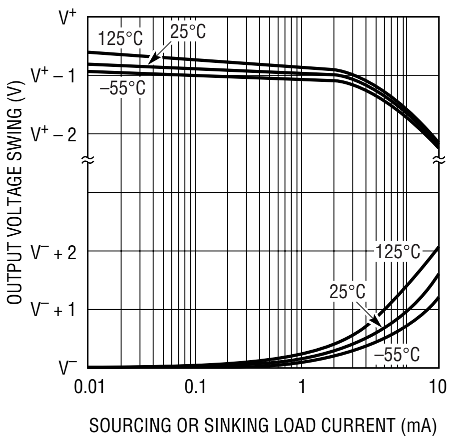
Voltage Gain vs Load Resistance



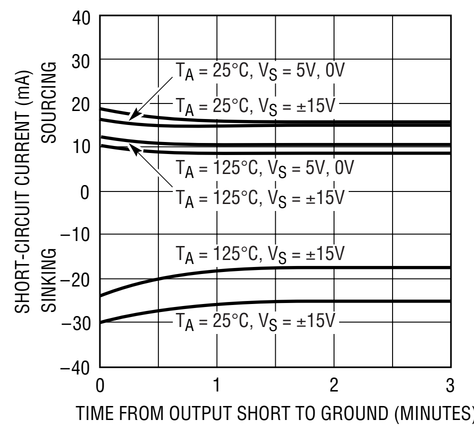
Output Saturation vs Temperature vs Sink Current



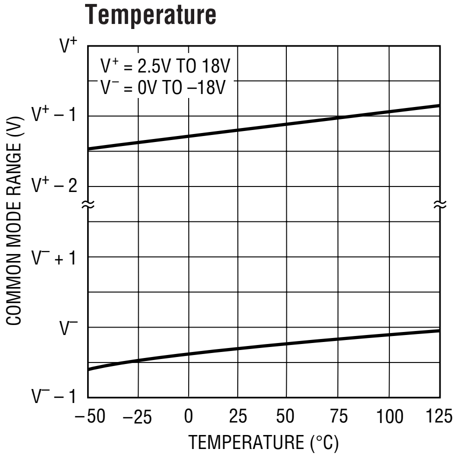
Output Voltage Swing vs Load Current



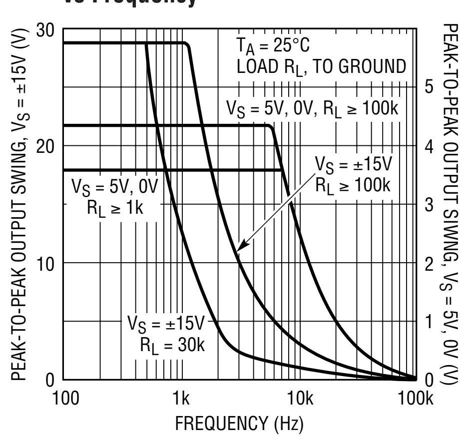
Short-Circuit Current vs Time



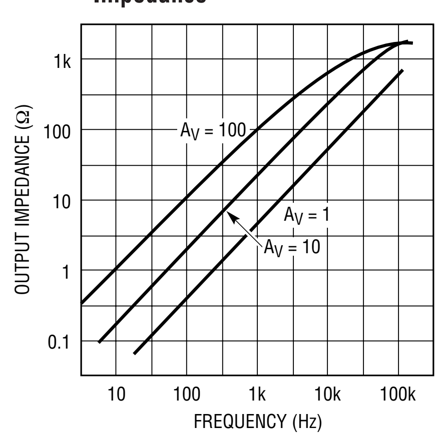
Common Mode Range vs Temperature



Undistorted Output Swing vs Frequency

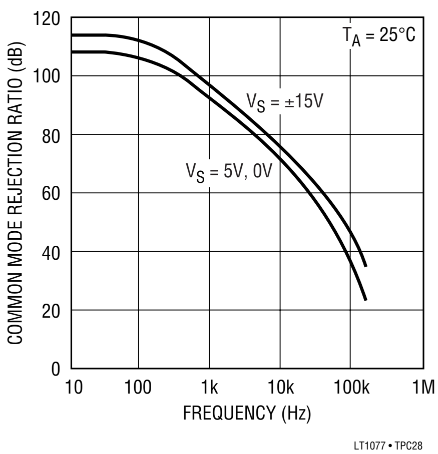


Closed Loop Output Impedance

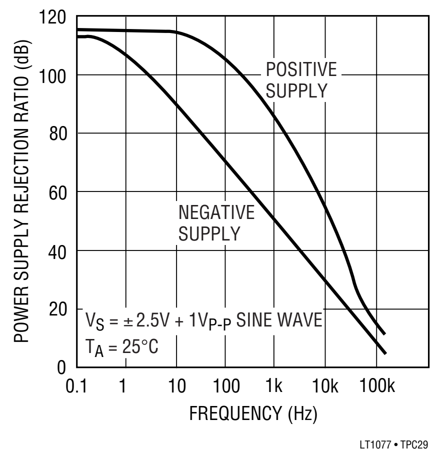


TYPICAL PERFORMANCE CHARACTERISTICS

Common Mode Rejection Ratio vs Frequency



Power Supply Rejection Ratio vs Frequency



APPLICATIONS INFORMATION

The LT1077 is 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 ±2.5V, V_{CM} = 0 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.

The LT1077 is pin compatible to, and directly replaces, such precision op amps as the OP-07, OP-77, AD7O7 and LT1001 with 30 to 60 times savings in supply current. The LT1077 is also a direct plug-in replacement for LT1012 and OP-97 devices with 10 times lower dissipation. Compatibility includes externally nulling the offset voltage, as all of the devices above are trimmed with a potentiometer between Pins 1 and 8 and the wiper tied to V^+.

The LT1077 replaces and upgrades such micropower op amps as the OP-20, LM4250, and OP-90, provided that the external nulling circuitry (and set resistor in the case of the LM4250) are removed. Since the offset voltage of the LT1077 is extremely low, nulling will be unnecessary in most applications.

Single Supply Operation

The LT1077 is 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.

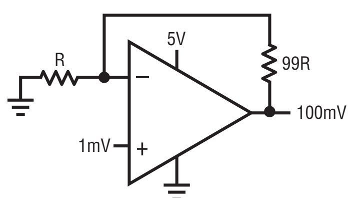
Consider the difference amplifiers shown in Typical Applications as an example. When the common mode signal is high and the output low, the amplifier has to sink current. In the gain of 10 circuit, the competing devices require a 30k pull-down resistor at the output to handle the specified signals. (The LT1077 does not need pull-down

APPLICATIONS INFORMATION

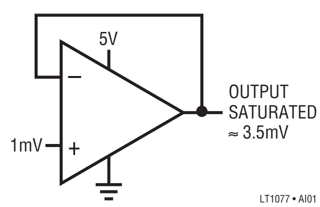
resistors.) When the output is high the pull-down resistor draws 80μA which dominates the micropower current budget. This situation is much worse in the gain of one circuit with V^-=0V. At 100V common mode, the output has to sink 2μA. At a minimum output voltage of 20mV competing devices require a 10k pull-down resistor. As the output now swings to 10V, this resistor draws 1mA of current.

Since the output of the LT1077 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 below; however, it is not enough to make the amplifier function properly in the voltage follower mode.

Gain 100 Amplifier



Voltage Follower

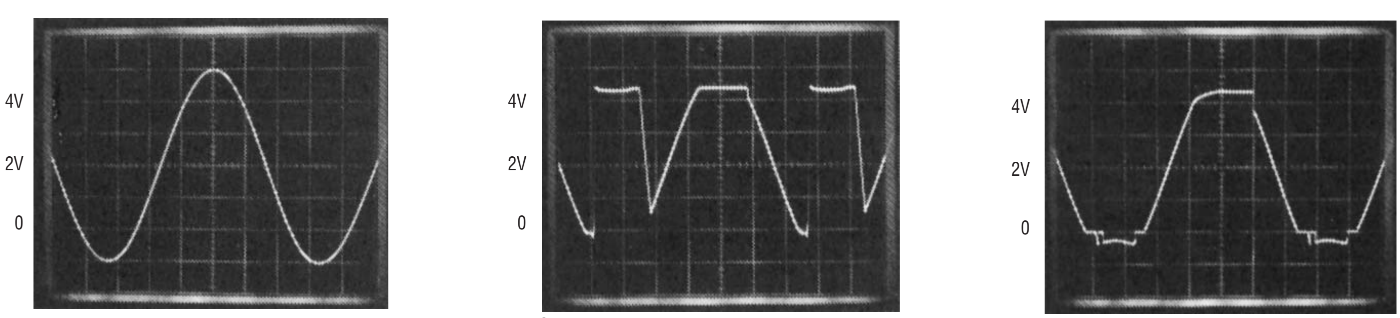


Single supply operation can also create difficulties at the input. The driving signal can fall below 0V—inadvertently or on a transient basis. If the input is more than a few hundred millivolts below ground, two distinct problems can occur on previous single supply designs, such as the LM124, LM158,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

a) 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 LT1077, resistors in series with the input protect the device even when the input is 5V below ground.

b) 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 lock-up in servo systems). Due to a unique phase reversal protection circuitry, the LT1077's output does not reverse, as illustrated below, even when the input is at –1.0V.

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



$6V_{P-P}$ INPUT –1.0 TO 5.0V 1ms/DIV

OP-90 EXHIBITS OUTPUT PHASE REVERSAL 1ms/DIV

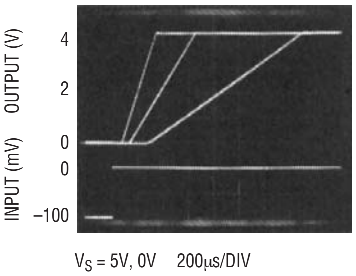
LT1077 NO PHASE REVERSAL 1ms/DIV

APPLICATIONS INFORMATION

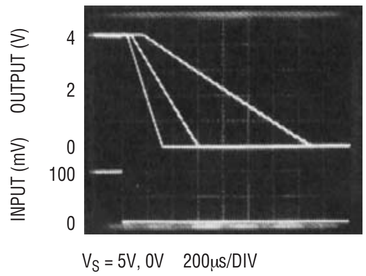
Comparator Applications

The single supply operation of the LT1077 and its ability to swing close to ground while sinking current, lends itself to use as a precision comparator with TTL compatible output.

Comparator Rise Response Time to 10mV, 5mV, 2mV Overdrive

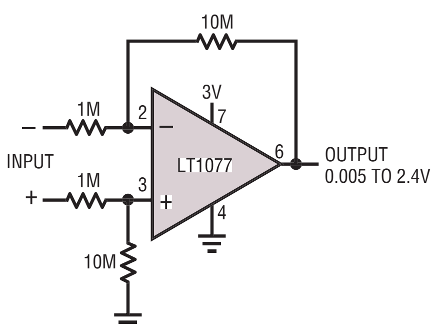


Comparator Fall Response Time to 10mV, 5mV, 2mV Overdrive



TYPICAL APPLICATIONS

Megaohm Input Impedance Gain of 10 Difference Amplifier



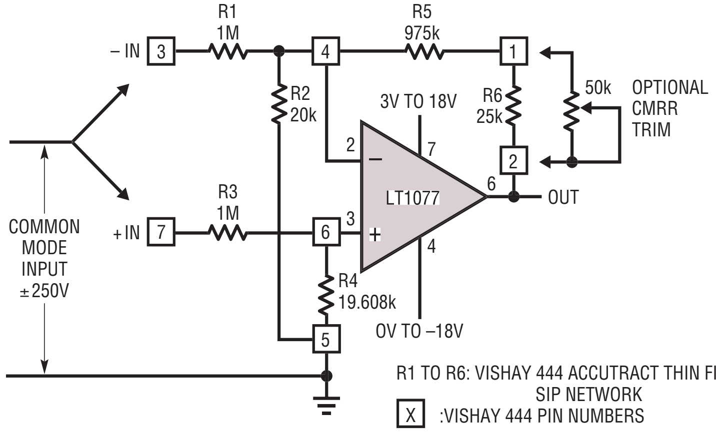
BANDWIDTH = 20KHZ
OUTPUT OFFSET = 0.7mV
OUTPUT NOISE = 80μVPP (0.1Hz TO 10Hz)
260μV_{RMS} OVER FULL BANDWIDTH
SUPPLY CURRENT = 45μA

THE USEFULNESS OF DIFFERENCE AMPLIFIERS IS LIMITED BY THE FACT THAT THE INPUT RESISTANCE IS EQUAL TO THE SOURCE RESISTANCE. THE PICO-AMPERE OFFSET CURRENT AND LOW CURRENT NOISE OF THE LT1077 ALLOWS THE USE OF 1M SOURCE RESISTORS WITHOUT DEGRADATION IN PERFORMANCE. IN ADDITION, WITH MEGAOHM RESISTORS MICROPOWER OPERATION CAN BE MAINTAINED

LT1077 • TA03

TYPICAL APPLICATIONS

±250V Common Mode Range Difference Amplifier (A_V = 1)



R1 TO R6: VISHAY 444 ACCUTRACT THIN FILM SIP NETWORK

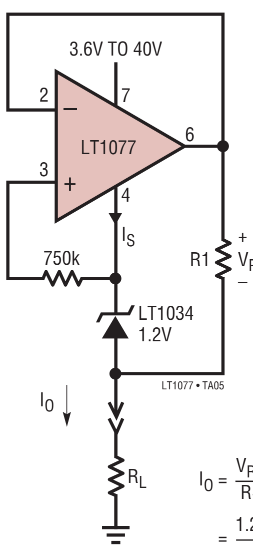
X :VISHAY 444 PIN NUMBERS

VISHAY INTERTECHNOLOGY, INC.
63 LINCOLN HIGHWAY
MALVERN, PA 19355

COMMON MODE REJECTION RATIO = 74dB (RESISTOR LIMITED)
WITH OPTIONAL TRIM = 108dB
OUTPUT OFFSET (TRIMMABLE TO ZERO) = 500µV
OUTPUT OFFSET DRIFT = 25µV/°C
INPUT RESISTANCE = 1M
COMMON MODE RANGE = ±250V, V^+ = 6.2V TO 18V, V^- = –4.7V TO –18V
= ±100V, $V^+ \geq$ 3.2V, $V^- \leq$ –1.8V
= 100V, –13V, $V^+ \geq$ 3.2V, V^- = 0V

LT1077 • TA04

Two Terminal Current Source

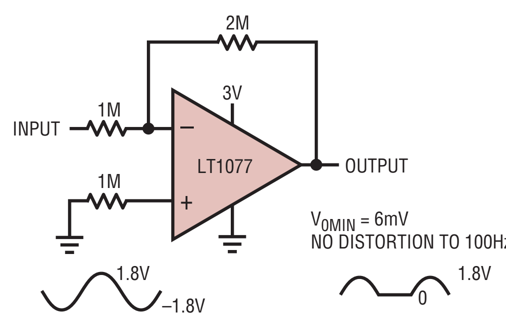


$$I_O = \frac{V_{R1}}{R_1} + I_S$$

$$= \frac{1.230V}{R_1} + 50\mu A$$

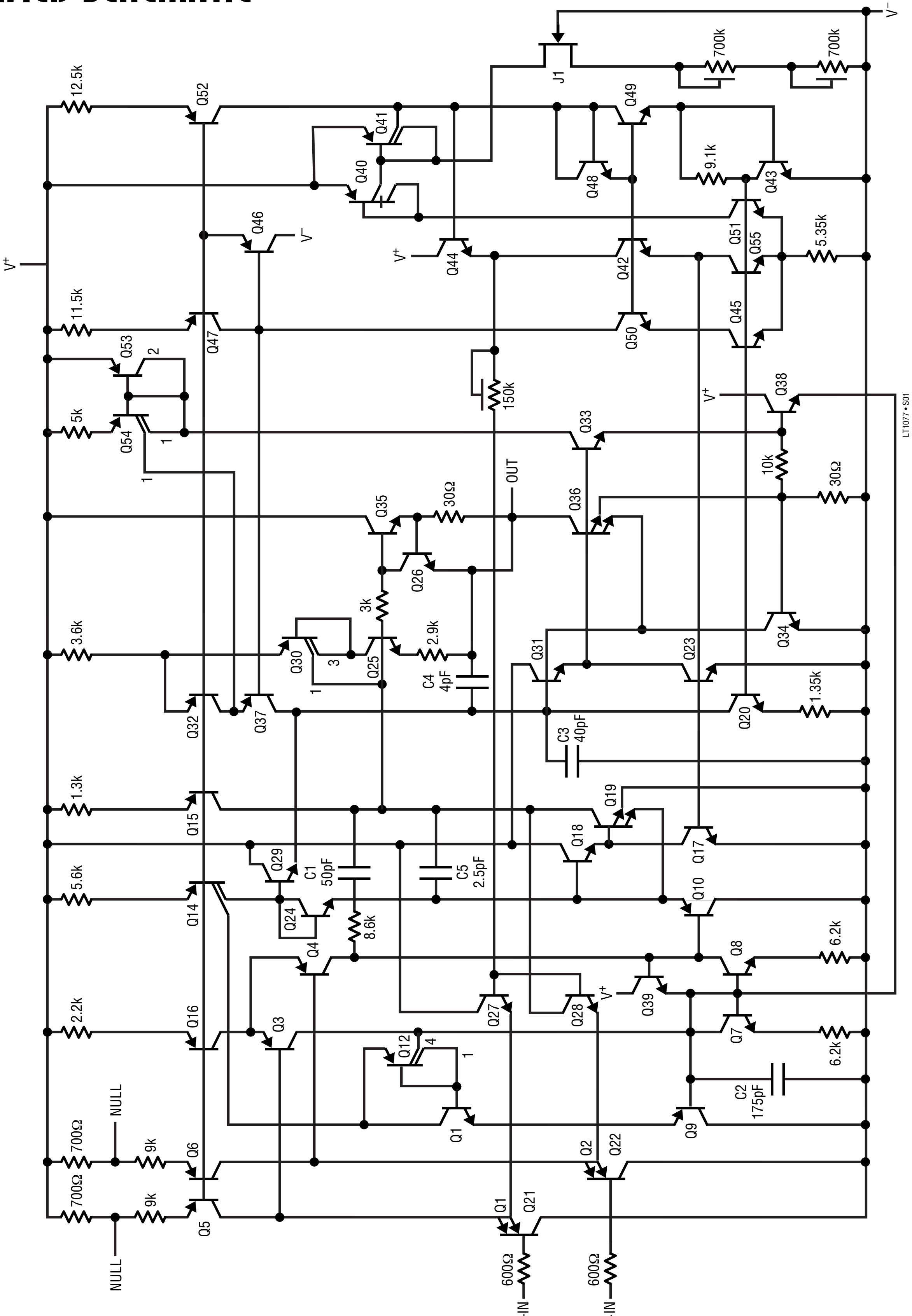
MINIMUM CURRENT = 50µA (R1 → ∞)
MAXIMUM CURRENT = 10.3mA (R1 = 120Ω)

Half-Wave Rectifier



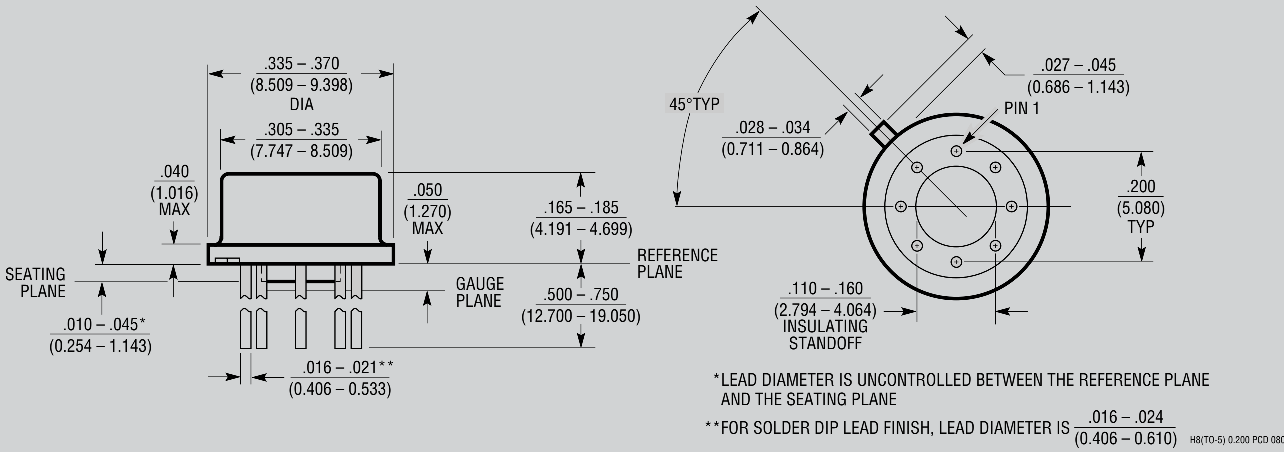
LT1077 • TA06

SIMPLIFIED SCHEMATIC

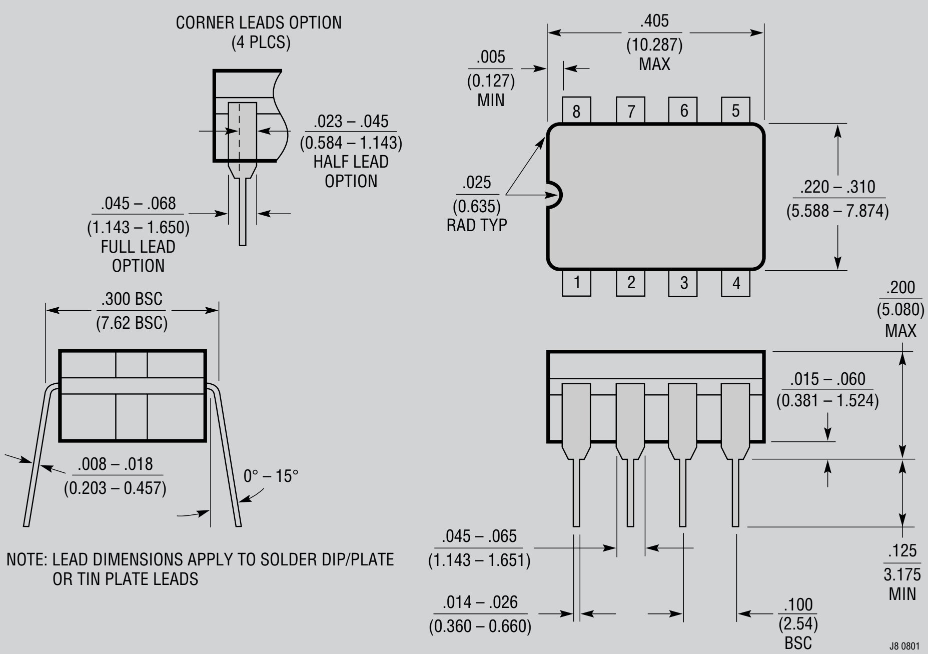


PACKAGE DESCRIPTION

H Package
8-Lead TO-5 Metal Can (.200 Inch PCD)
(Reference LTC DWG # 05-08-1320)



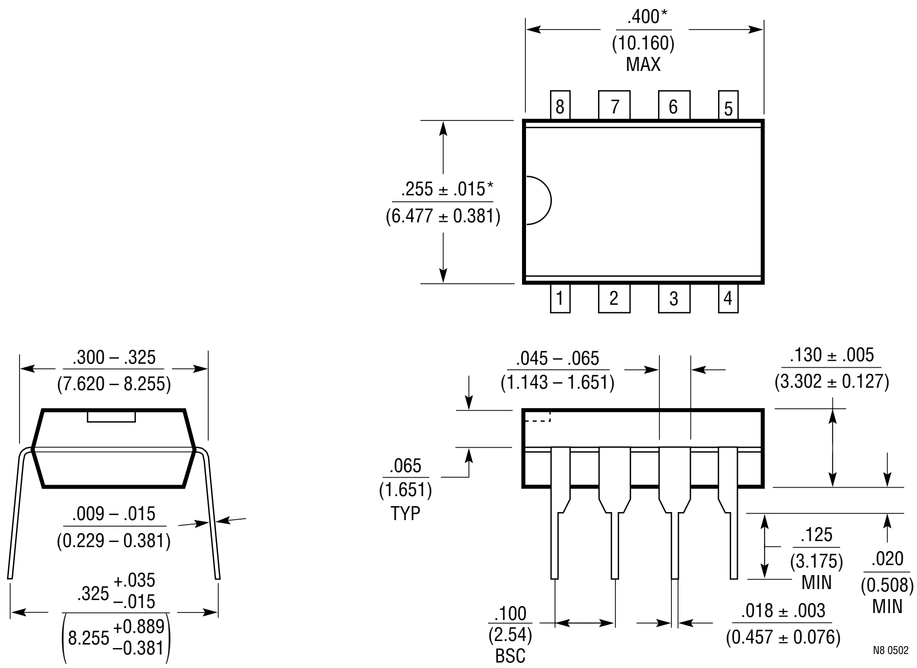
J8 Package
8-Lead CERDIP (Narrow .300 Inch, Hermetic)
(Reference LTC DWG # 05-08-1110)



OBSOLETE PACKAGES

PACKAGE DESCRIPTION

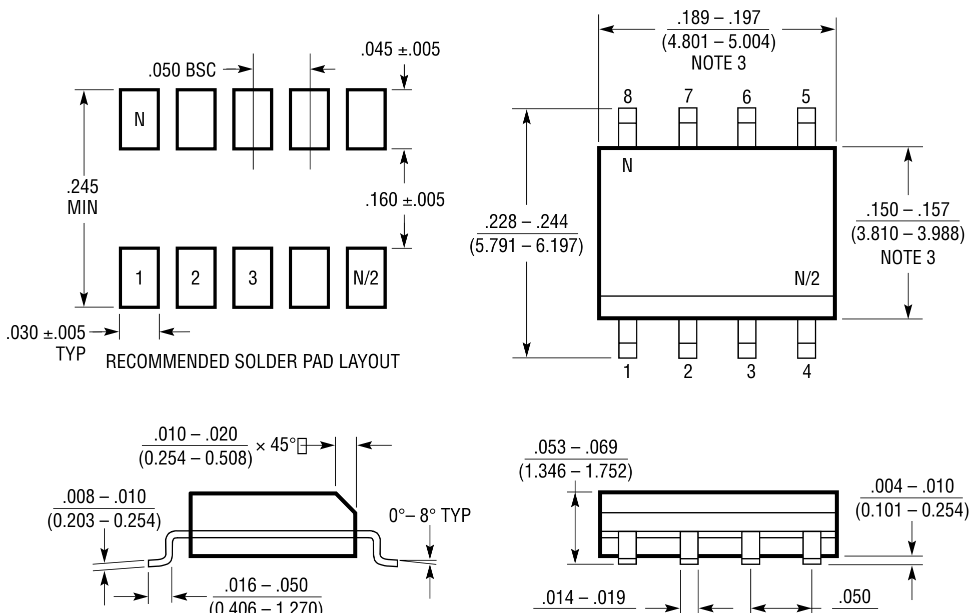
N8 Package
8-Lead PDIP (Narrow .300 Inch)
(Reference LTC DWG # 05-08-1510)



NOTE:
1. DIMENSIONS ARE INCHES / MILLIMETERS
*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

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 0502

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