LT1022

High Speed, Precision JFET Input Operational Amplifier

FEATURES

- *Guaranteed* Slew Rate: 23V/μs Min
- *Guaranteed* Offset Voltage: 250μV Max
  –55°C to 125°C: 750μV Max
- *Guaranteed* Drift: 5μV/°C Max
- *Guaranteed* Bias Current:
  70°C, 180pA Max
  125°C, 4nA Max
- Gain-Bandwidth Product: 8.5MHz Typ
- Settling Time to 0.05% (10V Step): 0.9μs Typ

APPLICATIONS

- Fast D/A Output Amplifiers (12, 14, 16 Bits)
- High Speed Instrumentation
- Fast, Precision Sample and Hold
- Voltage-to-Frequency Converters
- Logarithmic Amplifiers

DESCRIPTION

The LT®1022 JFET input operational amplifier combines high speed and precision performance.

A 26V/μs slew rate and 8.5MHz gain-bandwidth product are simultaneously achieved with offset voltage of typically 80μV, 1.5μV/°C drift, bias currents of 50pA at 70°C, 500pA at 125°C. The output delivers 20mA of load current without gain degradation.

The 250μV maximum offset voltage specification represents less than 1/2 least significant bit error in a 14-bit, 10V system.

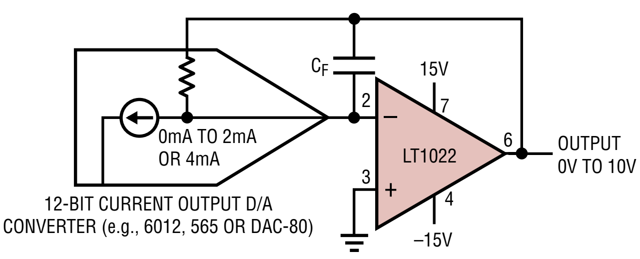
The LT1022A meets or exceeds all OP-16A and OP-16E specifications. It is faster and more accurate without stability problems at cold temperatures.

The LT1022 can be used as the output amplifier for 12-bit current output D/A converters, as shown below.

For a more accurate, lower power dissipation, but slower JFET input op amp, please refer to the LT1055 data sheet.

TYPICAL APPLICATION

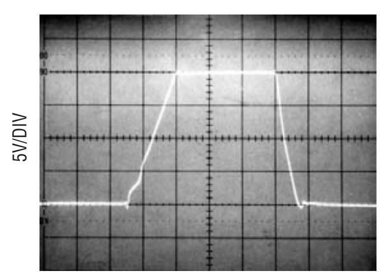
12-Bit Voltage Output D/A Converter



C_F = 15pF TO 33pF
SETTLING TIME TO 2mV (0.8 LSB) = 1.5μs TO 2μs

LT1022 • TA01

Large-Signal Response



$A_V = 1$
C_L = 100pF
T_A = 25°C
V_S = ±15V
0.5μs/DIV

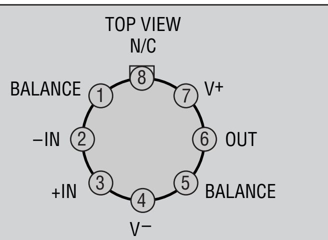
ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage .... ±20V
Differential Input Voltage .... ±40V
Input Voltage .... ±20V
Output Short Circuit Duration .... Indefinite

Operating Temperature Range
LT1022AM/1022M **(OBSOLETE)**.........–55°C to 125°C
LT1022AC/1022C .... 0°C to 70°C
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec.)................. 300°C

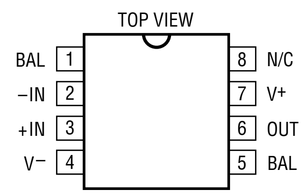
PACKAGE/ORDER INFORMATION



METAL CAN H PACKAGE
T_{JMAX} = 150° C, θ_{JA} = 150°C/W, θ_{JC} = 45° C/W

ORDER PART NUMBER
LT1022AMH
LT1022MH
LT1022ACH
LT1022CH

OBSOLETE PACKAGE
Consider the N8 Package as an Alternate Source



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

ORDER PART NUMBER
LT1022CN8

LT1022 • POI01

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

ELECTRICAL CHARACTERISTICS

V_S = ±15V, T_A = 25°C, V_{CM} = 0V unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	LT1022AM LT1022AC MIN	TYP	MAX	LT1022M, LT1022CH LT1022CN8 MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage (Note 2)	H Package N8 Package		80	250		100 160	600 1000	µV µV
I_{OS}	Input Offset Current	Fully Warmed Up		2	10		2	20	pA
I_B	Input Bias Current	Fully Warmed Up V_{CM} = +10V		±10 30	±50 100		±10 30	±50 150	pA pA
	Input Resistance—Differential —Common Mode	 V_{CM} = –11V to 8V V_{CM} = 8V to 11V		10^{12} 10^{12} 10^{11}			10^{12} 10^{12} 10^{11}		Ω Ω Ω
	Input Capacitance			4			4		pF
e_n	Input Noise Voltage	0.1Hz to 10Hz		2.5			2.8		µV/P-P
e_n	Input Noise Voltage Density	f_O = 10Hz (Note 3) f_O = 1kHz (Note 4)		28 14	50 20		30 15	60 22	nV/√Hz nV/√Hz
i_n	Input Noise Current Density	f_O = 10Hz, 1kHz (Note 5)		1.8	4		1.8	4	fA/√Hz
A_{VOL}	Large Signal Voltage Gain	V_O = ±10V R_L = 2k R_L = 1k	150 130	400 300		120 100	400 300		V/mV V/mV
	Input Voltage Range		±10.5	±12		±10.5	±12		V
CMRR	Common-Mode Rejection Ratio	V_{CM} = ±10.5V	86	94		82	92		dB
PSRR	Power Supply Rejection Ratio	V_S = ±10V to ±18V	88	104		86	102		dB
V_{OUT}	Output Voltage Swing	R_L = 2k	±12	±13.2		±12	±13.2		V
SR	Slew Rate		23	26		18	24		V/µs

ELECTRICAL CHARACTERISTICS

$V_S = \pm15V$, $T_A = 25°C$, $V_{CM} = 0V$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	LT1022AM LT1022AC MIN	TYP	MAX	LT1022M, LT1022CH LT1022CN8 MIN	TYP	MAX	UNITS
GBW	Gain-Bandwidth Product	f = 1MHz		8.5			8.0		MHz
I_S	Supply Current			5.2	7.0		5.2	7.0	mA
	Settling Time	A = +1 or A = –1 10V Step to 0.05% 10V Step to 0.02%		 0.9 1.3			 0.9 1.3		 μs μs
	Offset Voltage Adjustment Range	R_{POT} = 100k		±7			±7		mV

The ● denotes the specifications which apply over the full operating temperature range of V_{CM} = 0V, 0°C ≤ T_A ≤ 70°C. V_S = ± 15V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1022AC MIN	TYP	MAX	LT1022CH LT1022CN8 MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage (Note 2)	H Package N8 Package	● ●		140	480		180 300	1000 1700	μV μV
	Average Temperature Coefficient of Input Offset Voltage	H Package N8 Package (Note 6)	● ●		1.3	5.0		1.8 3.0	9.0 15.0	μV/°C μV/°C
I_{OS}	Input Offset Current	Warmed Up, T_A = 70°C	●		15	80		18	100	pA
I_B	Input Bias Current	Warmed Up, T_A = 70°C	●		±50	±200		±60	±250	pA
A_{VOL}	Large-Signal Voltage Gain	V_O = ±10V, R_L = 2k	●	80	250		60	250		V/mV
CMRR	Common Mode Rejection Ratio	V_{CM} = ±10.4V	●	85	93		80	91		dB
PSRR	Power Supply Rejection Ratio	V_S = ±10V to ±18V	●	86	103		84	101		dB
V_{OUT}	Output Voltage Swing	R_L = 2k	●	±12	±13.1		±12	±13.1		V

The ● denotes the specifications which apply over the full operating temperature range of –55°C ≤ T_A ≤ 125°C. V_S = ±15V, V_{CM} = 0V, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1022AM MIN	TYP	MAX	LT1022M MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage	(Note 2)	●		230	750		300	1500	μV
	Average Temperature Coefficient of Input Offset Voltage	(Note 6)	●		1.5	5.0		2.0	9.0	μV/°C
I_{OS}	Input Offset Current	Warmed Up, T_A = 125°C	●		0.3	2.0		0.30	3.0	nA
I_B	Input Bias Current	Warmed Up, T_A = 125°C	●		± 0.5	± 4.0		± 0.7	± 6.0	nA
A_{VOL}	Large Signal Voltage Gain	V_O = ±10V, R_L = 2k	●	40	120		35	120		V/mV
CMRR	Common-Mode Rejection Ratio	V_{CM} = ±10.4V	●	85	92		80	90		dB
PSRR	Power Supply Rejection Ratio	V_S = ±10V to ±17V	●	86	102		84	100		dB
V_{OUT}	Output Voltage Swing	R_L = 2k	●	±12	±12.9		±12	±12.9		V

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

Note 2: Offset voltage is measured under two different conditions:
(a) approximately 0.5 seconds after application of power;
(b) at T_A = 25°C, with the chip self-heated to approximately 45°C to account for chip temperature rise when the device is fully warmed up.

Note 3: 10Hz noise voltage density is sample tested on every lot of A grades. Devices 100% tested at 10Hz are available on request.

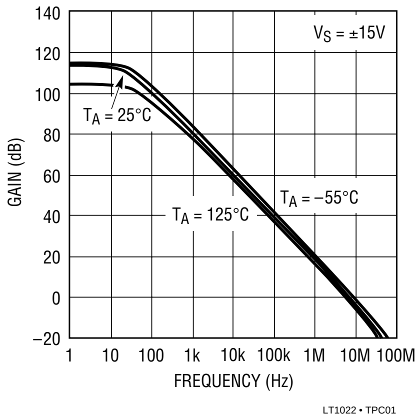
Note 4: This parameter is tested on a sample basis only.

Note 5: Current noise is calculated from the formula: $i_n = (2qI_B)^{1/2}$, where $q = 1.6 \cdot 10^{-19}$ coulomb. The noise of source resistors up to 1GΩ swamps the contribution of current noise.

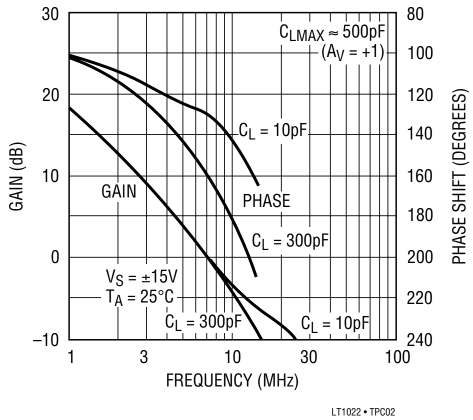
Note 6: Offset voltage drift with temperature is practically unchanged when the offset voltage is trimmed to zero with a 100k potentiometer between the balance terminals and the wiper tied to V^+. Devices tested to tighter drift specifications are available on request.

TYPICAL PERFORMANCE CHARACTERISTICS

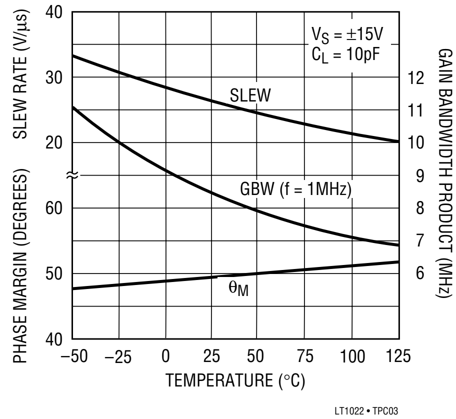
Gain vs Frequency



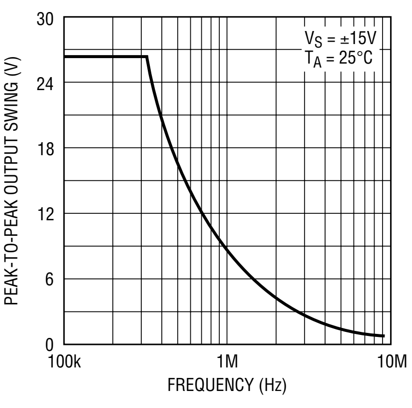
Gain, Phase Shift vs Frequency



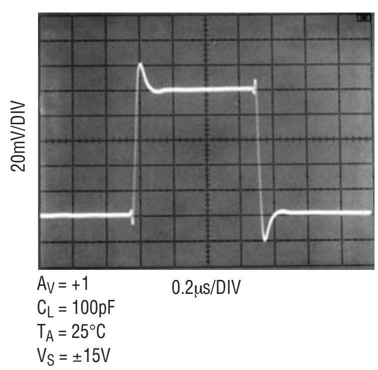
Phase Margin, Gain Bandwidth Product, Slew Rate vs Temperature



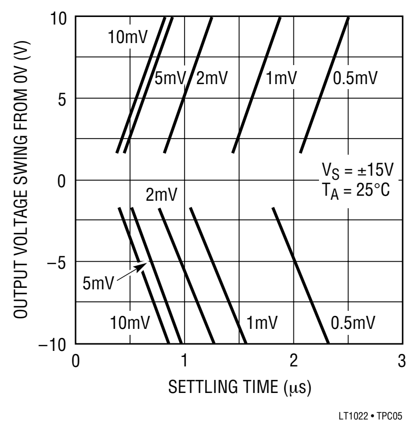
Undistorted Output Swing vs Frequency



Small-Signal Response



Settling Time



The typical behavior of many LT1022 parameters is identical to the LT1056. Please refer to the LT1055/1056 data sheet for the following typical performance characteristics:

- **Input Bias and Offset Currents vs Temperature**
- **Input Bias Current Over the Common-Mode Range**
- **Distribution of Input Offset Voltage (H and N8 Package)**
- **Distribution of Offset Voltage Drift with Temperature**
- **Warm-Up Drift**
- **Long Term Drift of Representative Units**
- **0.1Hz to 10Hz Noise**
- **Voltage Noise vs Frequency**
- **Noise vs Chip Temperature**
- **Short Circuit Current vs Time**
- **Output Impedance vs Frequency**
- **Common Mode Range vs Temperature**
- **Common Mode and Power Supply Rejections vs Temperature**
- **Common Mode Rejection Ratio vs Frequency**
- **Power Supply Rejection Ratio vs Frequency**
- **Voltage Gain vs Temperature**
- **Supply Current vs Supply Voltage**
- **Output Swing vs Load Resistance**

APPLICATIONS INFORMATION

The LT1056 applications information is directly applicable to the LT1022. Please consult the LT1055/1056 data sheet for details on:

(1) plug-in compatibility to industry standard devices

(2) offset nulling

(3) achieving picoampere/microvolt performance

(4) phase-reversal protection

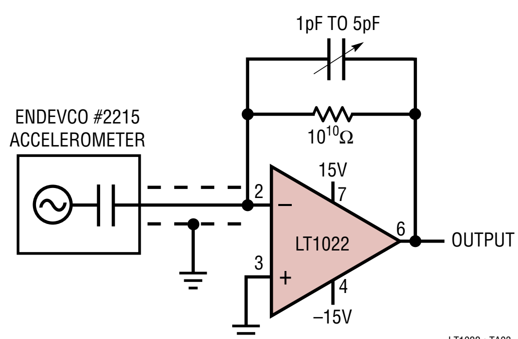
(5) high speed operation (including settling time test circuit)

(6) noise performance

(7) simplified circuit schematic

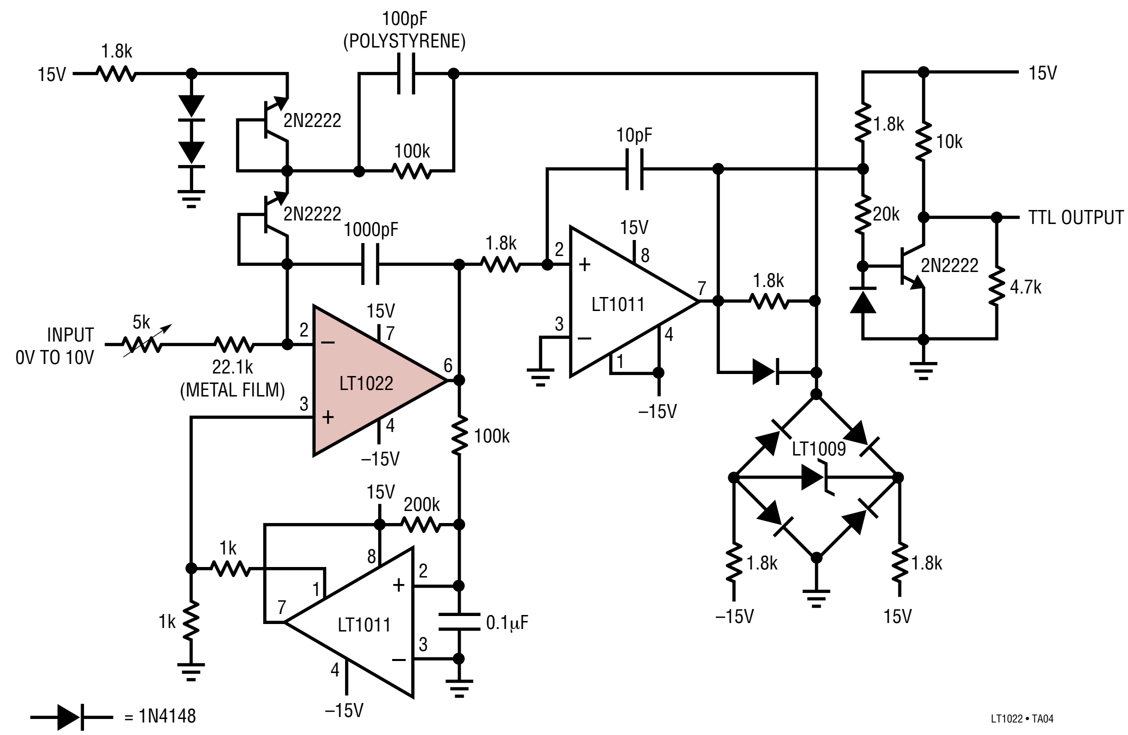
TYPICAL APPLICATIONS

Fast Piezoelectric Accelerometer



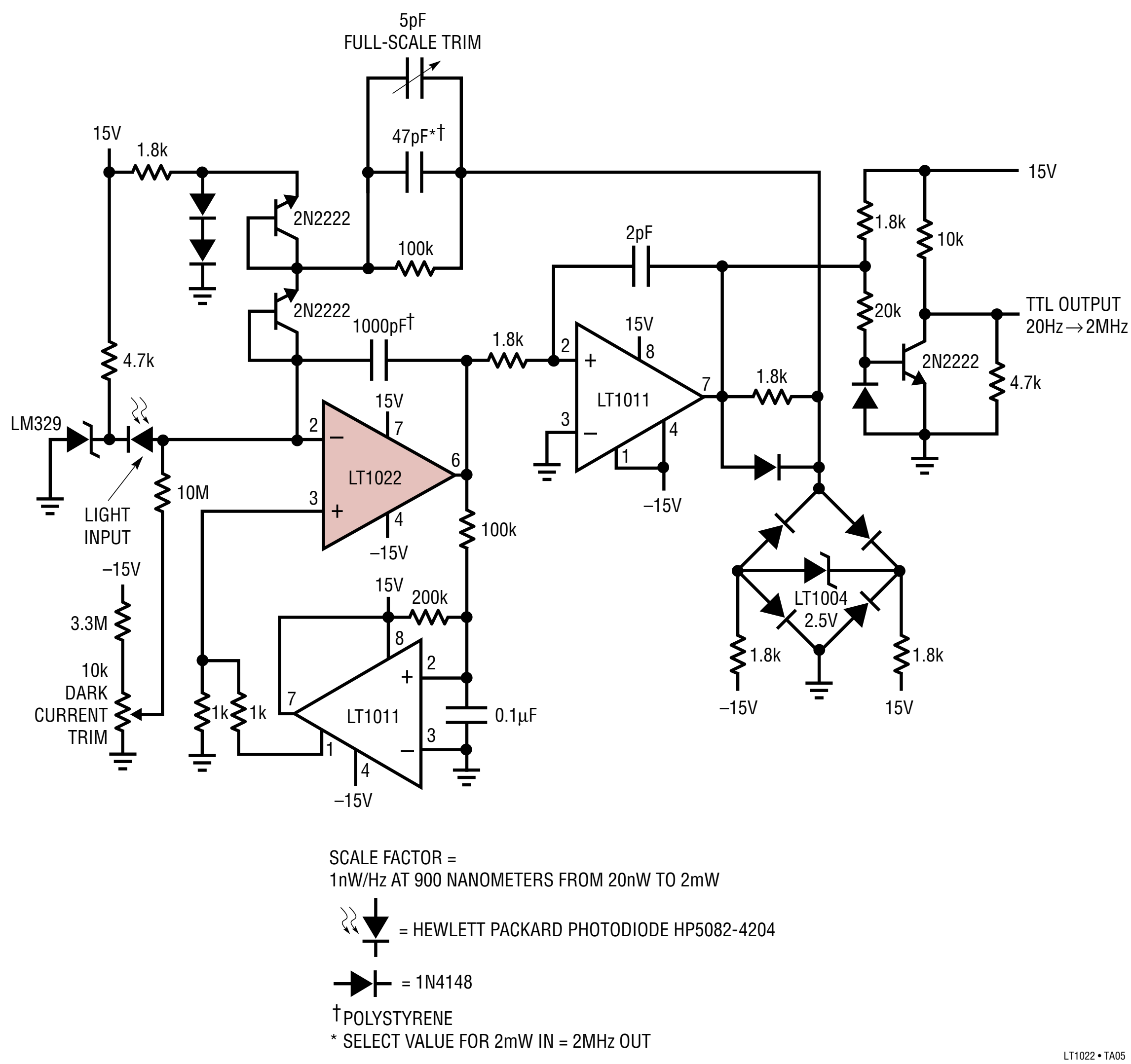
TYPICAL APPLICATIONS

10Hz to 1MHz Voltage-to-Frequency Converter



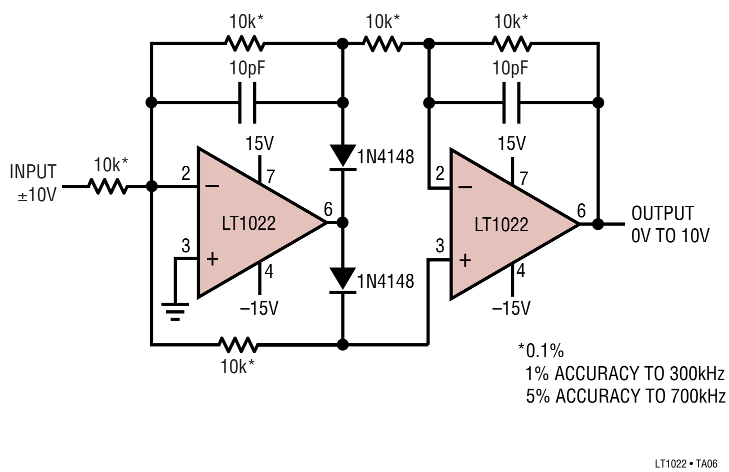
TYPICAL APPLICATIONS

PIN Photodiode-to-Frequency Converter

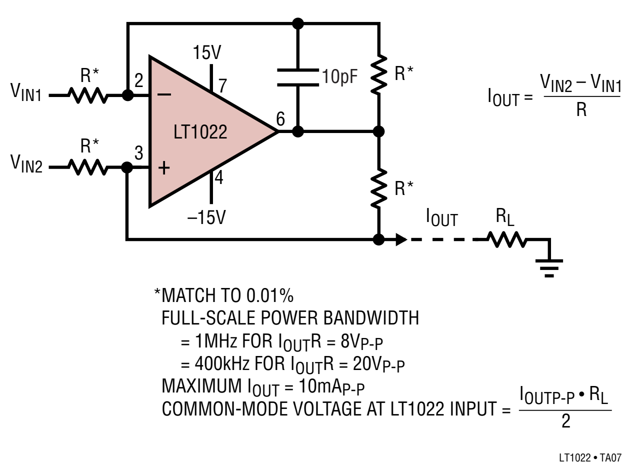


TYPICAL APPLICATIONS

Wide Bandwidth Absolute Value Circuit

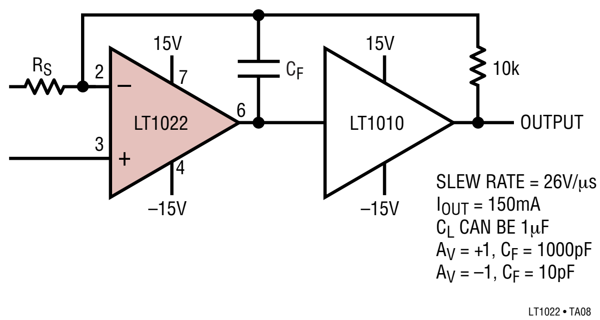


Fast, Differential Input Current Source

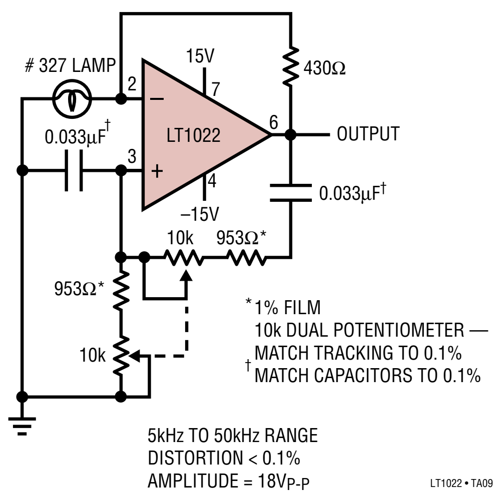


TYPICAL APPLICATIONS

High Output Current Op Amp

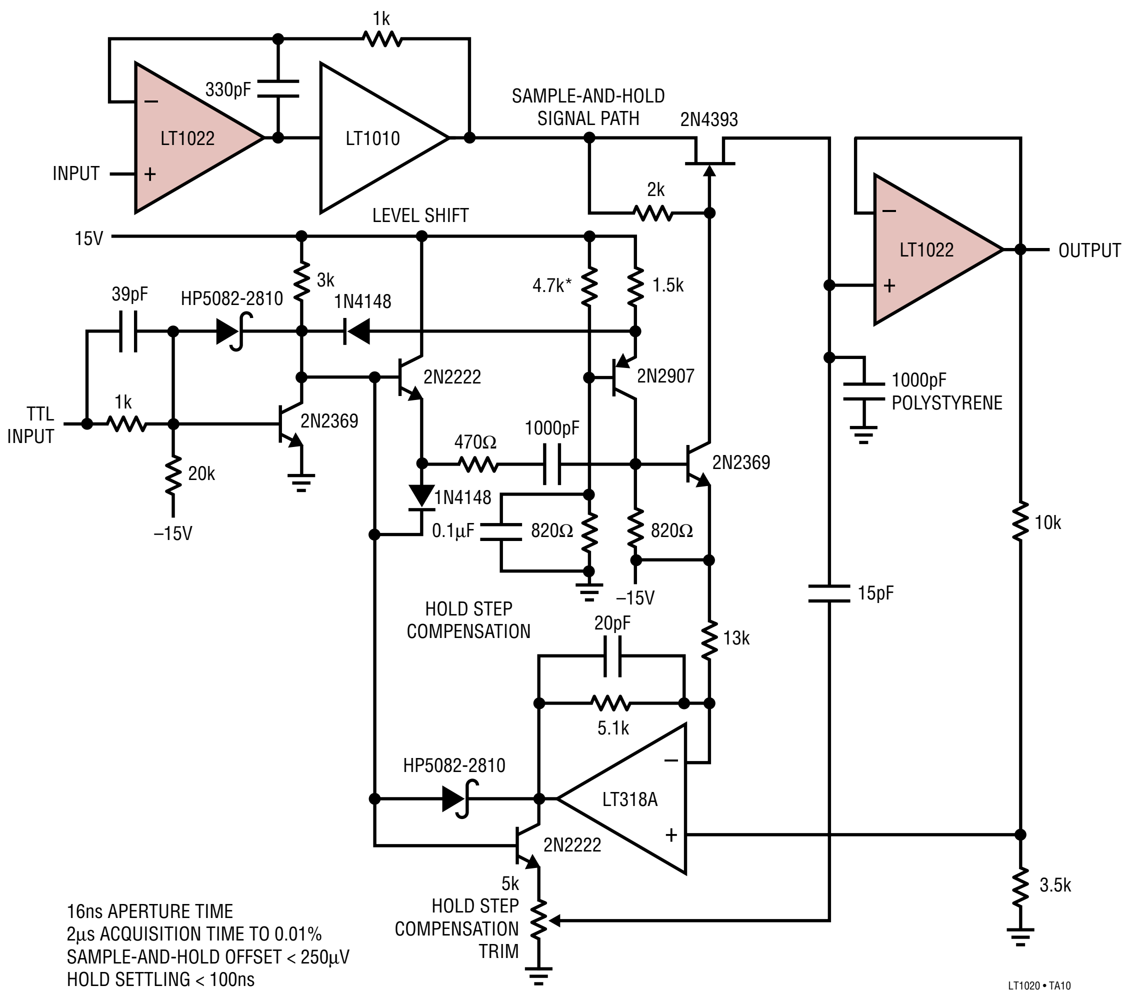


Low Distortion Sine Wave Oscillator



TYPICAL APPLICATIONS

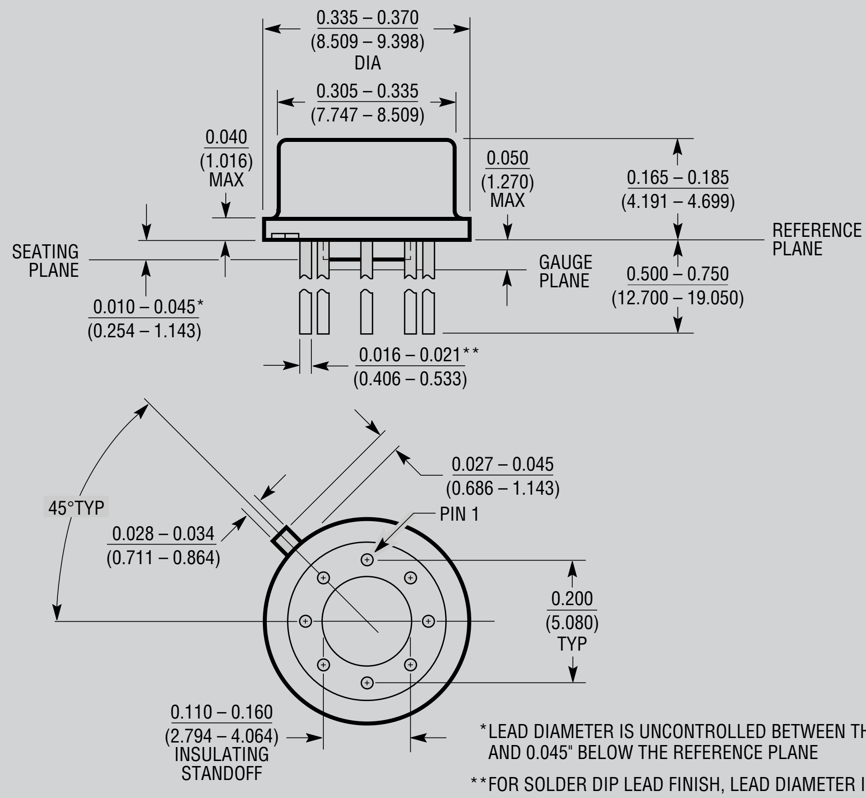
Fast, Precision Sample-And-Hold



16ns APERTURE TIME
2µs ACQUISITION TIME TO 0.01%
SAMPLE-AND-HOLD OFFSET < 250µV
HOLD SETTLING < 100ns

PACKAGE DESCRIPTION

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



*LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND 0.045" BELOW THE REFERENCE PLANE

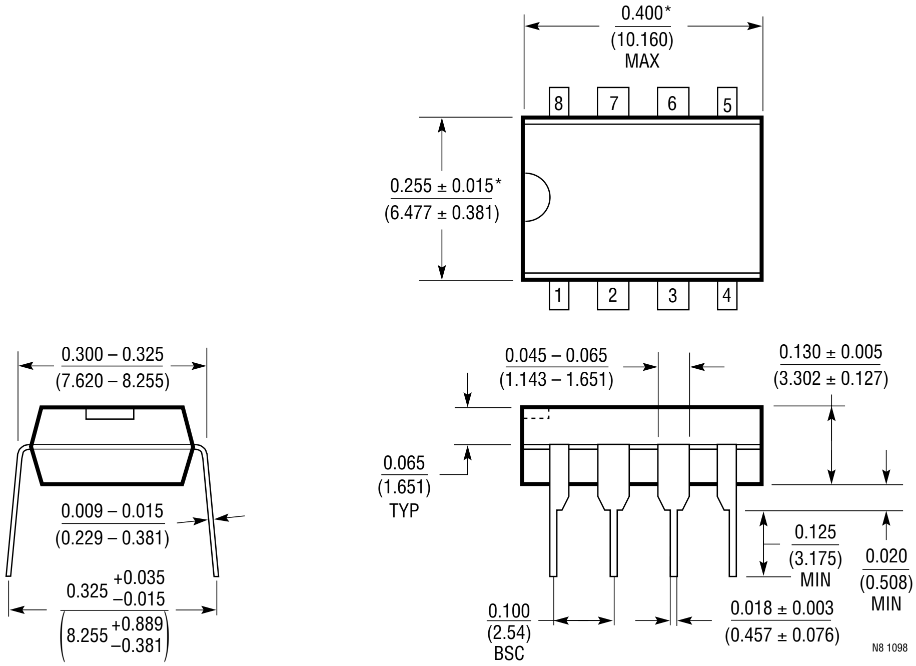
**FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS $\frac{0.016 – 0.024}{(0.406 – 0.610)}$

H8(TO-5) 0.200 PCD 1197

OBSOLETE PACKAGE

PACKAGE DESCRIPTION

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



*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

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