

LT1178/LT1179

ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage $\pm 22\text{V}$
 Differential Input Voltage $\pm 30\text{V}$
 Input Voltage Equal to Positive Supply Voltage
 Input Voltage 5V Below Negative Supply Voltage
 Output Short-Circuit Duration Indefinite

Operating Temperature Range
 LT1178I/LT1179I -40°C to 85°C
 LT1178C/LT1178S/LT1179C/LT1179S 0°C to 70°C
 Storage Temperature Range -65°C to 150°C
 Lead Temperature (Soldering, 10 sec.) 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW H PACKAGE 8-LEAD TO-5 METAL CAN	ORDER PART NUMBER LT1178ACH LT1178CH	TOP VIEW N PACKAGE 8-LEAD PDIP $T_{JMAX} = 100^{\circ}\text{C}, \theta_{JA} = 150^{\circ}\text{C/W}$ J PACKAGE 8-LEAD CERDIP	ORDER PART NUMBER LT1178ACN8 LT1178CN8 LT1178IN8	TOP VIEW S8 PACKAGE 8-LEAD PLASTIC SO $T_{JMAX} = 150^{\circ}\text{C}, \theta_{JA} = 200^{\circ}\text{C/W}$	ORDER PART NUMBER LT1178S8 PART MARKING 1178
TOP VIEW N PACKAGE 14-LEAD PDIP $T_{JMAX} = 110^{\circ}\text{C}, \theta_{JA} = 130^{\circ}\text{C/W}$ J PACKAGE 14-LEAD CERAMIC DIP	ORDER PART NUMBER LT1179ACN LT1179CN LT1179IN	Not Recommended. Use LT1178S8 for New Designs. TOP VIEW LT1178 SW PACKAGE 16-LEAD PLASTIC SO WIDE $T_{JMAX} = 150^{\circ}\text{C}, \theta_{JA} = 90^{\circ}\text{C/W}$	ORDER PART NUMBER LT1178SW LT1179SW	TOP VIEW LT1179 SW PACKAGE 16-LEAD PLASTIC SO WIDE $T_{JMAX} = 150^{\circ}\text{C}, \theta_{JA} = 90^{\circ}\text{C/W}$	

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Consult LTC Marketing for parts specified with wider operating temperature ranges. Please note that the LT1178S8 surface mount pinout differs from that of the LT1178 standard plastic or ceramic dual-in-line packages. For similar performance with standard pinout, see the LT2178.

ELECTRICAL CHARACTERISTICS $V_S = 5\text{V}, 0\text{V}; V_{CM} = 0.1\text{V}, V_O = 1.4\text{V}, T_A = 25^{\circ}\text{C}$, unless noted.

SYMBOL	PARAMETER	CONDITIONS (NOTE 2)	LT1178AC/LT1179AC			LT1178I/C/S/LT1179I/C/S			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178		30	70		40	120	μV
		LT1179		35	100		40	150	μV
		LT1178SW					80	450	μV
		LT1179SW					90	600	μV
		LT1178S8					60	180	μV
$\frac{\Delta V_{OS}}{\Delta \text{Time}}$	Long Term Input Offset Voltage Stability			0.5			0.6		$\mu\text{V/Mo}$
I_{OS}	Input Offset Current			0.05	0.25		0.05	0.35	nA

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ELECTRICAL CHARACTERISTICS $V_S = 5V, 0V; V_{CM} = 0.1V, V_O = 1.4V, T_A = 25^\circ C$, unless noted.

SYMBOL	PARAMETER	CONDITIONS (NOTE 2)	LT1178AC/LT1179AC			LT1178I/C/S/LT1179I/C/S			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
I_B	Input Bias Current			3	5		3	6	nA
e_n	Input Noise Voltage	0.1Hz to 10Hz (Note 3)		0.9	2.0		0.9		μV_{P-P}
	Input Noise Voltage Density	$f_0 = 10Hz$ (Note 3) $f_0 = 1000Hz$ (Note 3)		50 49	75 65		50 49		$nV/\sqrt{Hz}$ $nV/\sqrt{Hz}$
i_n	Input Noise Current	0.1Hz to 10Hz (Note 3)		1.5	2.5		1.5		pA _{p-p}
	Input Noise Current Density	$f_0 = 10Hz$ (Note 3) $f_0 = 1000Hz$		0.03 0.01	0.07		0.03 0.01		$pA/\sqrt{Hz}$ $pA/\sqrt{Hz}$
	Input Resistance Differential Mode Common Mode	(Note 4)	0.8	2.0 12		0.6	2.0 12		$G\Omega$ $G\Omega$
	Input Voltage Range		3.5 0	3.9 -0.3		3.5 0	3.9 -0.3		V V
CMRR	Common Mode Rejection Ratio	$V_{CM} = 0V$ to 3.5V	93	103		90	102		dB
PSRR	Power Supply Rejection Ratio	$V_S = 2.2V$ to 12V	94	104		92	104		dB
A_{VOL}	Large Signal Voltage Gain	$V_O = 0.03V$ to 4V, No Load (Note 4) $V_O = 0.03V$ to 3.5V, $R_L = 50k$	140 80	700		110 70	700		V/mV V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, 2k to GND Output Low, $I_{SINK} = 100\mu A$ Output High, No Load Output High 2k to GND		6.5 0.2 120 4.2 3.5	9 0.6 160		6.5 0.2 120 4.4 3.8		mV mV mV V V
SR	Slew Rate	$A_V = 1, C_L = 10pF$ (Note 4)	0.013	0.025		0.013	0.025		V/ μs
GBW	Gain Bandwidth Product	$f_0 \leq 5kHz$		60			60		kHz
I_S	Supply Current per Amplifier	$V_S = \pm 1.5V, V_O = 0V$		13 12	18 17		14 13	21 20	μA μA
	Channel Separation	$\Delta V_{IN} = 3V, R_L = 10k$		130			130		dB
	Minimum Supply Voltage	(Note 5)		2.0	2.2		2.0	2.2	V

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range of $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$ for I grades, $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$ for SW grades, $V_S = 5\text{V}$, 0V ; $V_{CM} = 0.1\text{V}$, $V_O = 1.4\text{V}$, unless noted. (Note 7)

SYMBOL	PARAMETER	CONDITIONS		LT1178I/LT1179I			LT1178SW/LT1179SW			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178 LT1179	● ●		80 80	315 345	120 130	650 800		μV μV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 6)	●		0.6	3.0	0.8	4.5		$\mu\text{V}/^{\circ}\text{C}$
I_{OS}	Input Offset Current		●		0.07	0.7	0.06	0.50		nA
I_B	Input Bias Current		●		4	8	3	7		nA
CMRR	Common Mode Rejection Ratio	$V_{CM} = 0.05\text{V}$ to 3.2V I grade $V_{CM} = 0\text{V}$ to 3.4V S grade	●	84	98		86	100		dB
PSRR	Power Supply Rejection Ratio	$V_S = 3.0\text{V}$ to 12V I grade $V_S = 2.5\text{V}$ to 12V S grade	●	86	100		88	102		dB
A_{VOL}	Large-Signal Voltage Gain	$V_O = 0.05\text{V}$ to 4V , No Load (Note 4) $V_O = 0.05\text{V}$ to 3.5V , $R_L = 50\text{k}$	● ●	55 35	350 130		80 45	500 160		V/mV V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, $I_{SINK} = 100\mu\text{A}$ Output High, No Load Output High, 2k to GND	● ● ● ●		9 160 4.2 3.7	13 220	8 140 4.3 3.8	11 190		mV mV V V
I_S	Supply Current per Amplifier		●		15	27	15	24		μA

The ● denotes specifications which apply over the full operating temperature range of $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$, $V_S = 5\text{V}$, 0V , $V_{CM} = 0.1\text{V}$, $V_O = 1.4\text{V}$, unless noted.

SYMBOL	PARAMETER	CONDITIONS		LT1178AC/LT1179AC			LT1178C/S8/LT1179C			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178 LT1178S8 LT1179	● ● ●		50 60	170 200	65 85 70	250 350 290		μV μV μV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 6) LT1178S8	● ●		0.5	2.2	0.6 0.6	3.0 3.5		$\mu\text{V}/^{\circ}\text{C}$ $\mu\text{V}/^{\circ}\text{C}$
I_{OS}	Input Offset Current		●		0.06	0.35	0.06	0.50		nA
I_B	Input Bias Current		●		3	6	3	7		nA
CMRR	Common Mode Rejection Ratio	$V_{CM} = 0\text{V}$ to 3.4V	●	90	101		86	100		dB
PSRR	Power Supply Rejection Ratio	$V_S = 2.5\text{V}$ to 12V	●	90	102		88	102		dB
A_{VOL}	Large-Signal Voltage Gain	$V_O = 0.05\text{V}$ to 4V , No Load (Note 4) $V_O = 0.05\text{V}$ to 3.5V , $R_L = 50\text{k}$	● ●	105 55	500 160		80 45	500 160		V/mV V/mV
	Maximum Output Voltage Swing	Output Low, No Load Output Low, $I_{SINK} = 100\mu\text{A}$ Output High, No Load Output High, 2k to GND	● ● ● ●		8 140 4.3 3.8	11 190	8 140 4.3 3.8	11 190		mV mV V V
I_S	Supply Current per Amplifier		●		14	21	15	24		μA

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V$, $T_A = 25^\circ C$, unless noted.

SYMBOL	PARAMETER	CONDITIONS	LT1178AC/LT1179AC			LT1178I/C/S/LT1179I/C/S			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178SW LT1179SW LT1178S8		80	350		100	480	μV
							150	900	μV
							160	1050	μV
							120	350	μV
I_{OS}	Input Offset Current			0.05	0.25		0.05	0.35	nA
I_B	Input Bias Current			3	5		3	6	nA
	Input Voltage Range		13.5	13.9		13.5	13.9		V
			-15.0	-15.3		-15.0	-15.3		V
CMRR	Common Mode Rejection Ratio	$V_{CM} = 13.5V, -15V$	97	106		94	106		dB
PSRR	Power Supply Rejection Ratio	$V_S = 5V, 0V$ to $\pm 18V$	96	112		94	112		dB
A_{VOL}	Large-Signal Voltage Gain	$V_O = \pm 10V, R_L = 50k$ $V_O = \pm 10V$, No Load	300	1200		250	1000		V/mV
			600	2500		400	2500		V/mV
V_{OUT}	Maximum Output Voltage Swing	$R_L = 50k$ $R_L = 2k$	± 13.0	± 14.2		± 13.0	± 14.2		V
			± 11.0	± 12.7		± 11.0	± 12.7		V
SR	Slew Rate	$A_V = 1$	0.02	0.04		0.02	0.04		V/ μs
GBW	Gain Bandwidth Product	$f_0 \leq 5kHz$		85			85		kHz
I_S	Supply Current per Amplifier			16	21		17	25	μA

The ● denotes specifications which apply over the full operating temperature range of $-40^\circ C \leq T_A \leq 85^\circ C$ for I grades, $0^\circ C \leq T_A \leq 70^\circ C$ for SW grades, $V_S = \pm 15V$, unless noted.

SYMBOL	PARAMETER	CONDITIONS		LT1178I/LT1179I			LT1178SW/LT1179SW			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178	●		130	740		190	1150	μV
		LT1179	●		130	740		200	1300	μV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 6)	●		0.7	4.0		0.9	5.5	$\mu V/^\circ C$
I_{OS}	Input Offset Current		●		0.07	0.7		0.06	0.35	nA
I_B	Input Bias Current		●		4	8		3	7	nA
A_{VOL}	Large-Signal Voltage Gain	$V_O = \pm 10V, R_L = 50k$	●		100	500		150	750	V/mV
CMRR	Common Mode Rejection Ratio	$V_{CM} = 13V, -14.9V$	●		88	103		91	104	dB
PSRR	Power Supply Rejection Ratio	$V_S = 5V, 0V$ to $\pm 18V$	●		88	109		91	110	dB
	Maximum Output Voltage Swing	$R_L = 5k$	●	± 11.0	± 13.5		± 11.0	± 13.5		V
I_S	Supply Current per Amplifier		●		19	30		18	28	μA

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ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range of $0^{\circ}\text{C} \leq T_A \leq 70^{\circ}\text{C}$, $V_S = \pm 15\text{V}$, unless noted.

SYMBOL	PARAMETER	CONDITIONS		LT1178AC/LT1179AC			LT1178C/S8/LT1179C			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178S8	●		100	480		130	660	μV
			●				150	540		μV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 6) LT1178S8	●		0.6	2.8		0.7	4.0	$\mu\text{V}/^{\circ}\text{C}$
			●				0.7	3.8		$\mu\text{V}/^{\circ}\text{C}$
I_{OS}	Input Offset Current		●		0.06	0.35		0.06	0.35	nA
I_B	Input Bias Current		●		3	6		3	7	nA
A_{VOL}	Large-Signal Voltage Gain	$V_O = \pm 10\text{V}$, $R_L = 50\text{k}$	●	200	800		150	750		V/mV
CMRR	Common Mode Rejection Ratio	$V_{CM} = 13\text{V}$, -15V	●	94	104		91	104		dB
PSRR	Power Supply Rejection Ratio	$V_S = 5\text{V}$, 0V to $\pm 18\text{V}$	●	93	110		91	110		dB
	Maximum Output Voltage Swing	$R_L = 5\text{k}$	●	± 11.0	± 13.6		± 11.0	± 13.6		V
I_S	Supply Current per Amplifier		●		17	24		18	28	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 LT1179s, or 100 LT1178s, 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 $V_S = \pm 2.5$, $V_O = 0\text{V}$.

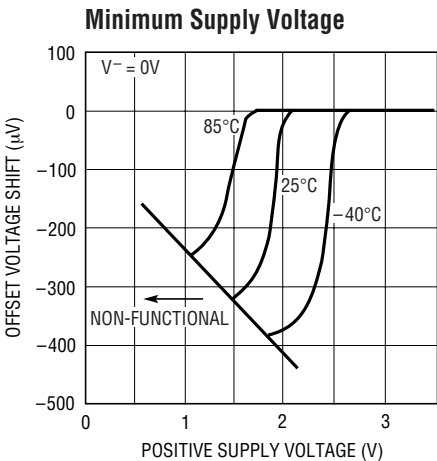
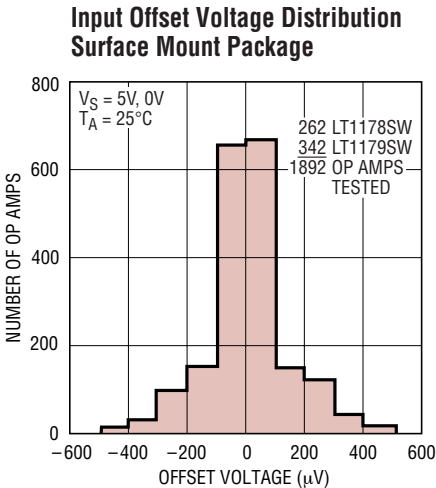
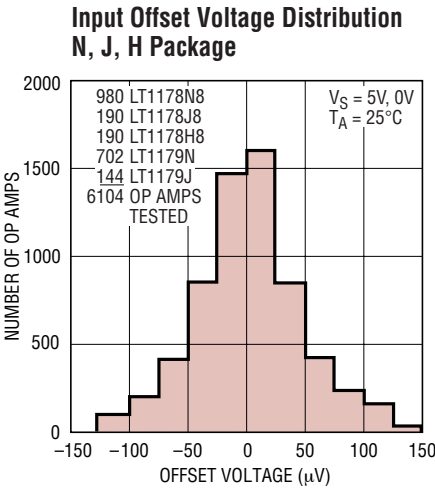
Note 4: This parameter is guaranteed by design and is not tested.

Note 5: Power supply rejection ratio is measured at the minimum supply voltage. The op amps actually work at 1.7V supply but with a typical offset skew of $-300\mu\text{V}$.

Note 6: This parameter is not 100% tested.

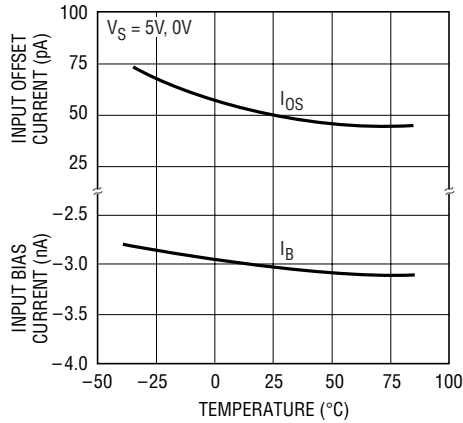
Note 7: During testing at -40°C , the 5V power supply turn on-time is less than 0.5 seconds.

TYPICAL PERFORMANCE CHARACTERISTICS



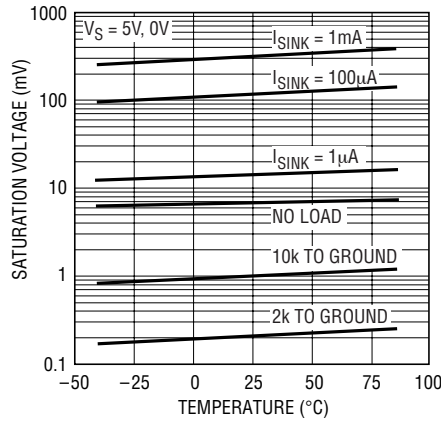
TYPICAL PERFORMANCE CHARACTERISTICS

Input Bias and Offset Currents vs Temperature



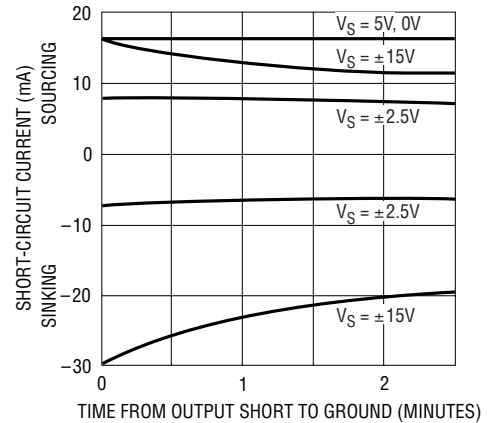
LT1178/LT1179 • TPC04

Output Saturation vs Temperature vs Sink Current



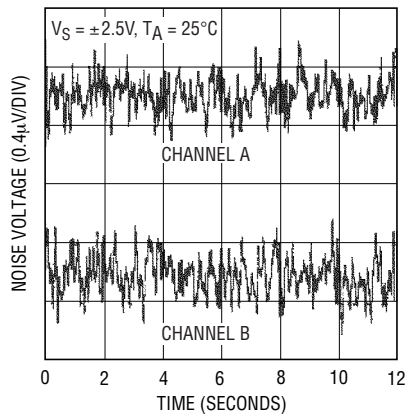
LT1178/LT1179 • TPC05

Short-Circuit Current



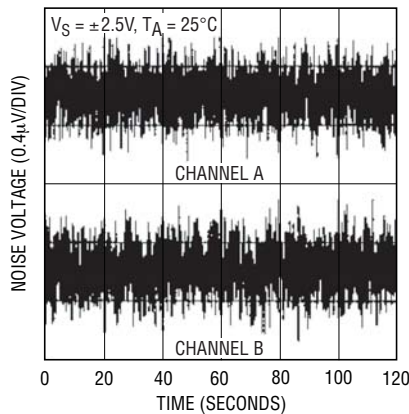
LT1178/LT1179 • TPC06

0.1Hz to 10Hz Noise



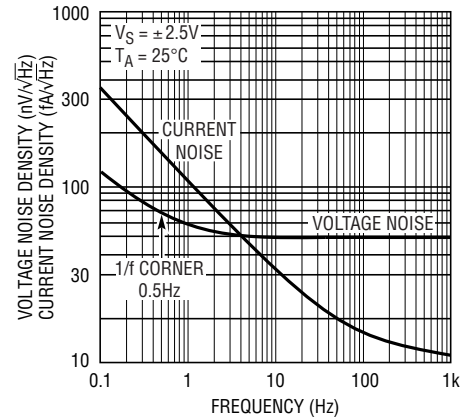
LT1178/LT1179 • TPC07

0.01Hz to 10Hz Noise



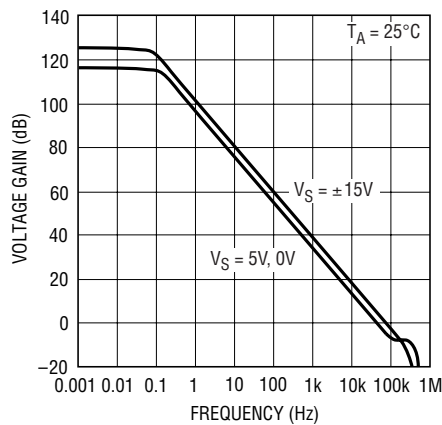
LT1178/LT1179 • TPC08

Noise Spectrum



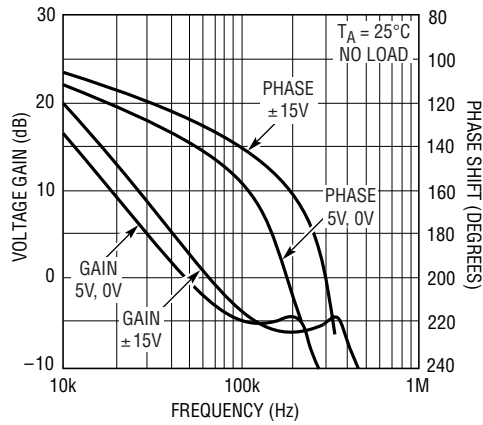
LT1178/LT1179 • TPC09

Voltage Gain vs Frequency



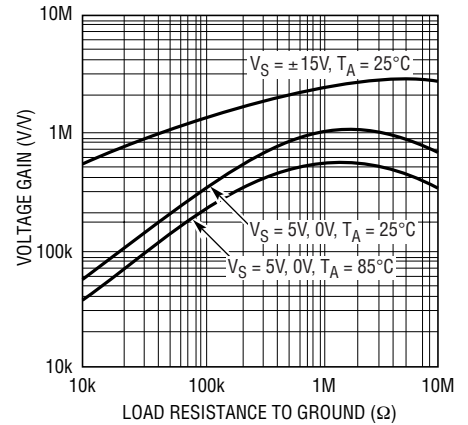
LT1178/LT1179 • TPC10

Gain, Phase vs Frequency



LT1178/LT1179 • TPC11

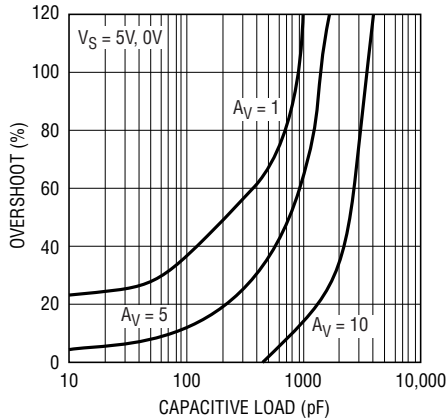
Voltage Gain vs Load Resistance



LT1178/LT1179 • TPC12

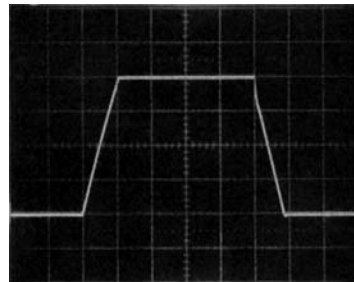
TYPICAL PERFORMANCE CHARACTERISTICS

Capacitive Load Handling



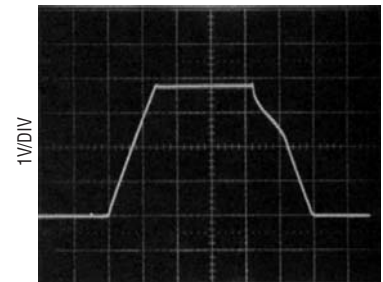
LT1178/LT1179 • TPC13

Large-Signal Transient Response
 $V_S = \pm 15V$



$A_V = 1$
 $C_L = 12pF$

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



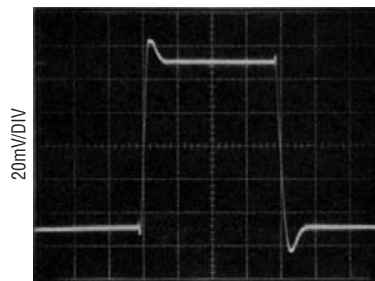
$A_V = 1$
 $C_L = 12pF$
INPUT PULSE = 0V TO 3.8V

Small-Signal Transient Response
 $V_S = \pm 2.5V$



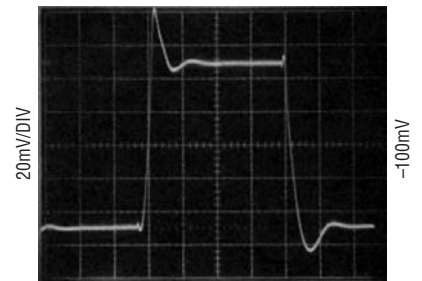
$A_V = 1$
 $C_L = 12pF$

Small-Signal Transient Response
 $V_S = \pm 15V$



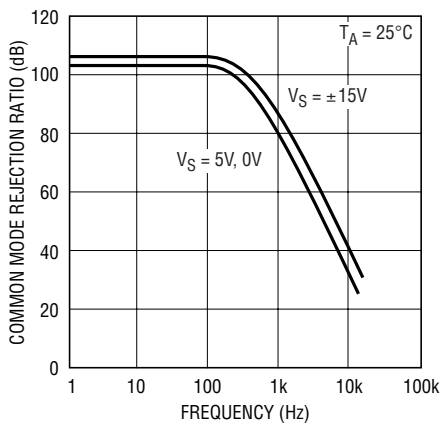
$A_V = 1$
 $C_L = 12pF$

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



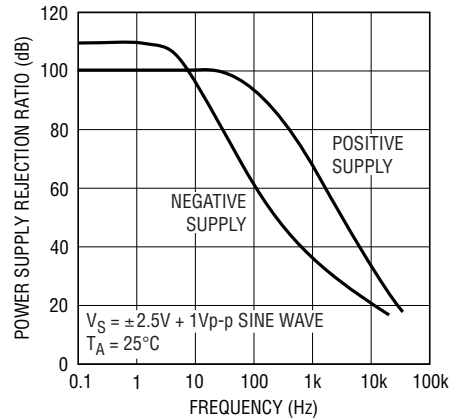
$A_V = 1$
 $C_L = 12pF$
INPUT 50 TO 150mV

Common Mode Rejection Ratio vs Frequency



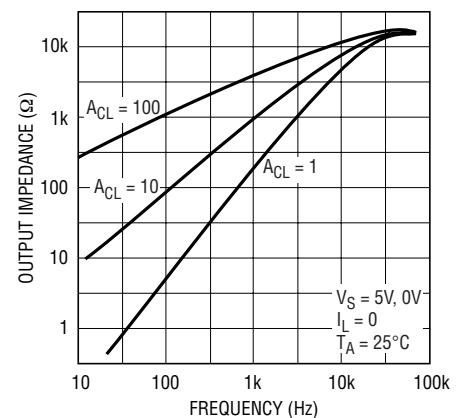
LT1178/LT1179 • TPC19

Power Supply Rejection Ratio vs Frequency



LT1188/LT1189 • TPC20

Closed Loop Output Impedance



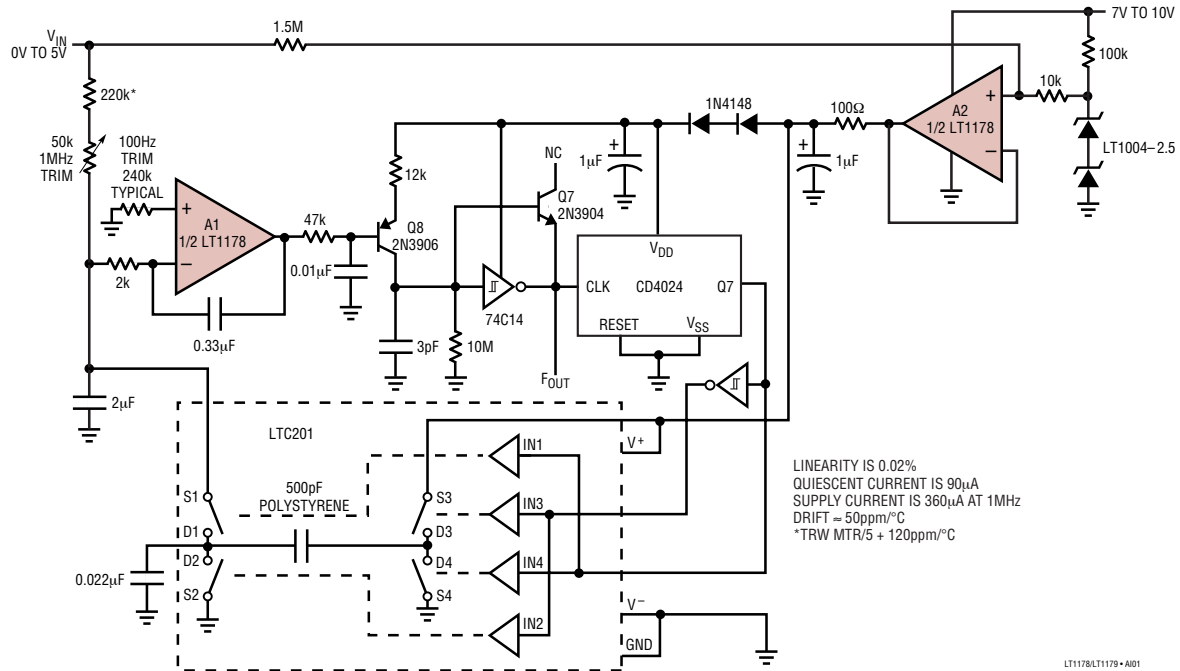
LT1178/LT1179 • TPC21

APPLICATIONS INFORMATION

Please see the LT1078/LT1079 data sheet for applications information. All comments relating to specifications, single

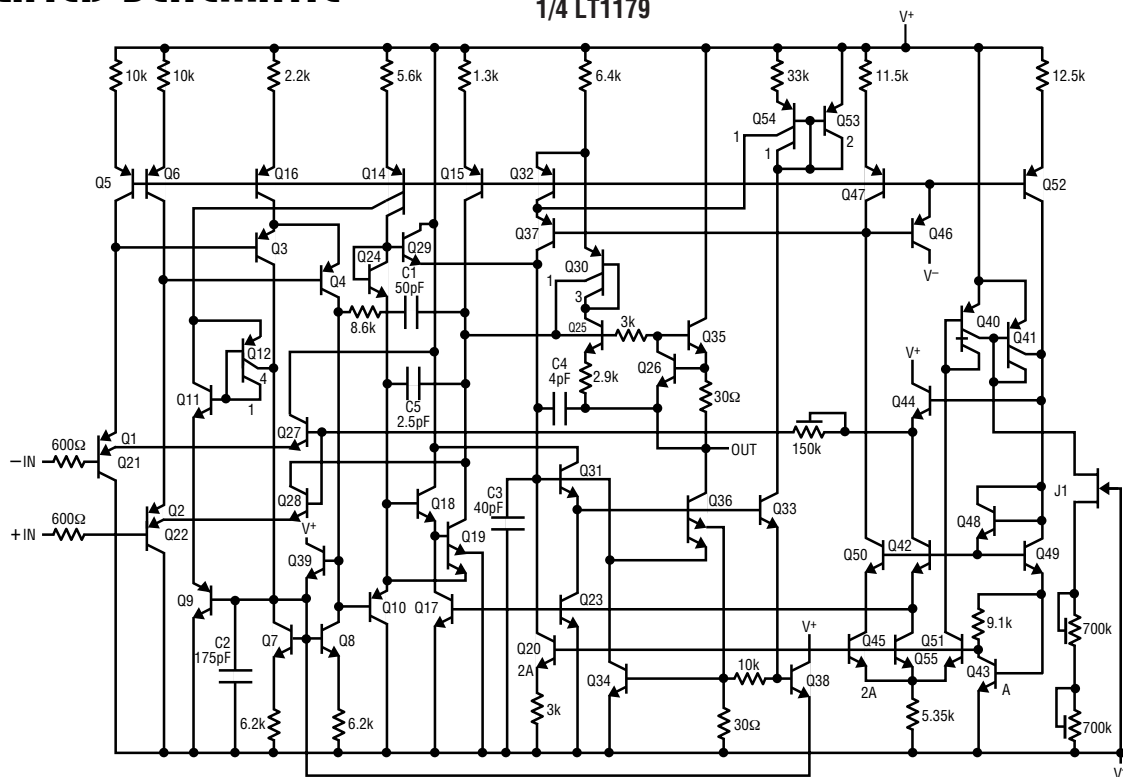
supply operation and phase reversal protection are directly applicable to the LT1178/LT1179.

Micropower 100Hz to 1MHz V-to-F Converter



SIMPLIFIED SCHEMATIC

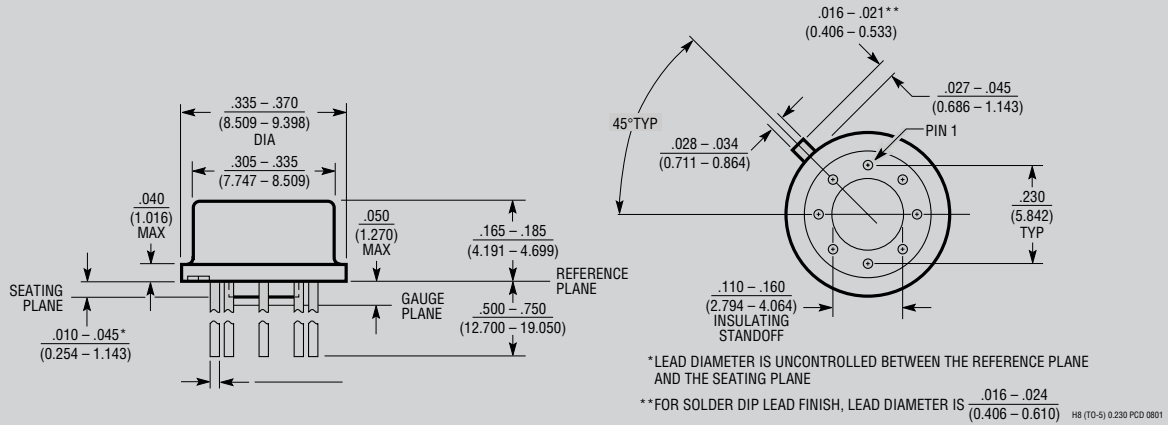
1/2 LT1178
1/4 LT1179



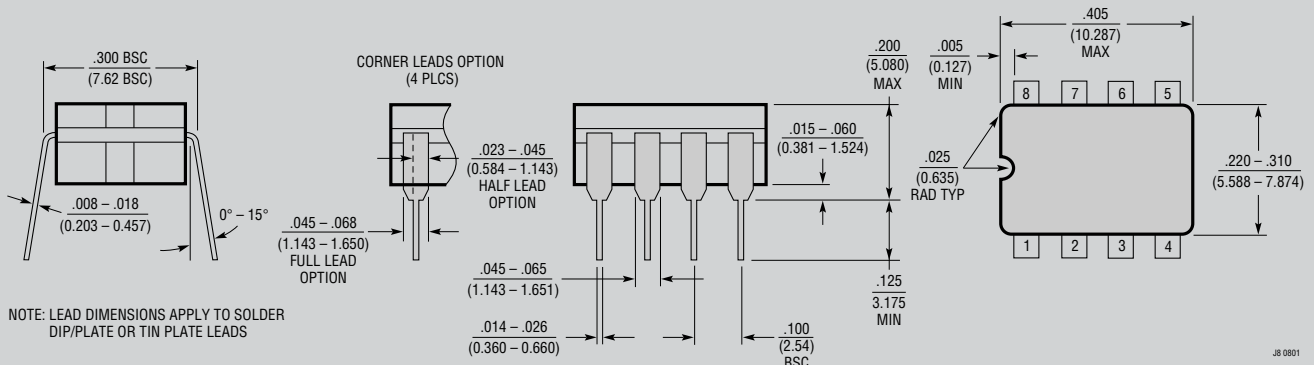
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PACKAGE DESCRIPTION

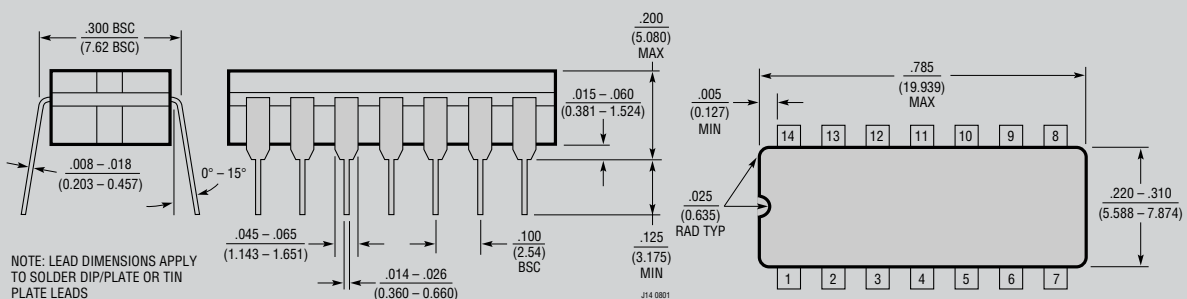
H Package
8-Lead TO-5 Metal Can (.230 Inch PCD)
 (Reference LTC DWG # 05-08-1321)



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



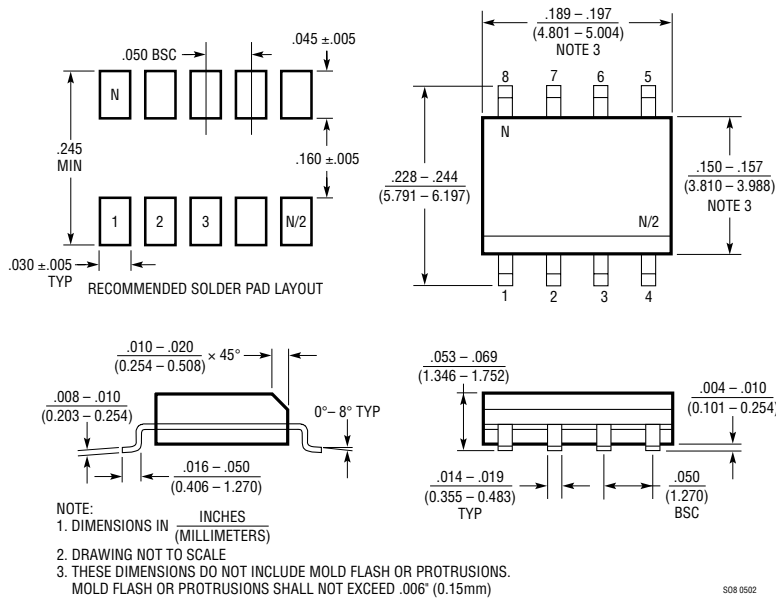
J Package
14-Lead Cerdip (Narrow .300 Inch, Hermetic)
 (Reference LTC DWG # 05-08-1110)



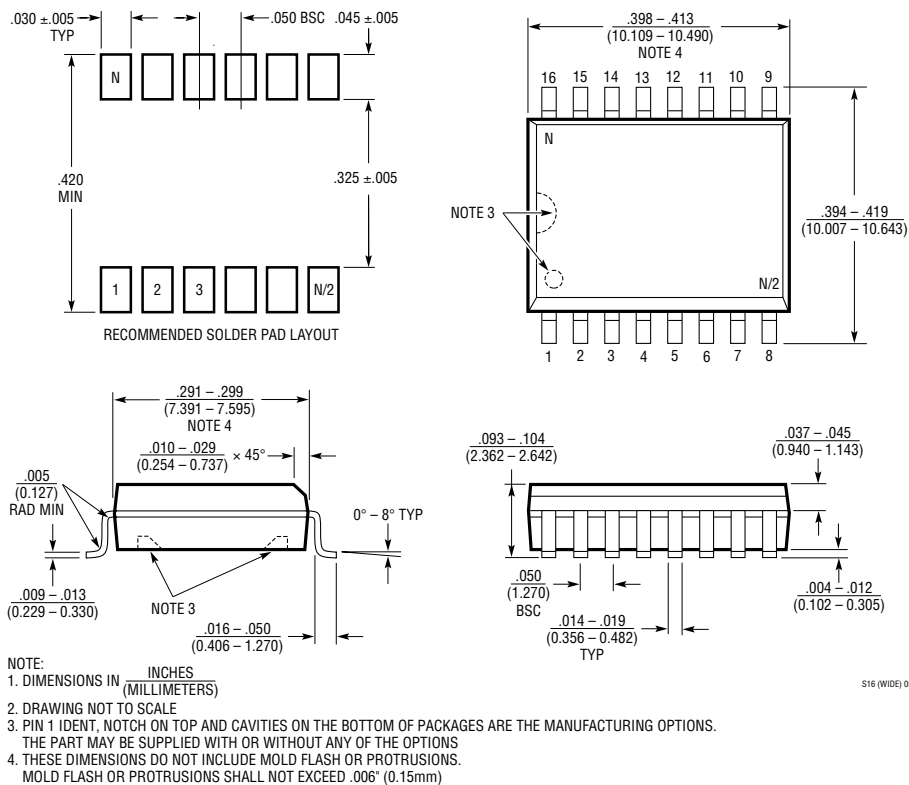
OBSOLETE PACKAGES

PACKAGE DESCRIPTION

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



SW Package 16-Lead Plastic Small Outline (Wide .300 Inch) (Reference LTC DWG # 05-08-1620)



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