

ABSOLUTE MAXIMUM RATINGS

Supply Voltage ± 22V
 Differential Input Voltage ± 30V
 Input Voltage Equal to Positive Supply 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

<p>TOP VIEW</p> <p>OUTPUT A 1, -IN A 2, +IN A 3, V- (CASE) 4, +IN B 5, -IN B 6, OUTPUT B 7, V+ 8</p> <p>H PACKAGE 8-LEAD TO-5 METAL CAN</p>	<p>ORDER PART NUMBER</p> <p>LT1178ACH LT1178CH</p>	<p>TOP VIEW</p> <p>OUTPUT A 1, -IN A 2, +IN A 3, V- 4, V+ 8, OUTPUT B 7, -IN B 6, +IN B 5</p> <p>J PACKAGE 8-LEAD CERAMIC DIP N PACKAGE 8-LEAD PLASTIC DIP</p>	<p>ORDER PART NUMBER</p> <p>LT1178ACJ8 LT1178CJ8 LT1178ACN8 LT1178CN8 LT1178IN8</p>	<p>TOP VIEW</p> <p>OUTPUT A 1, -IN A 2, +IN A 3, V+ 4, +IN B 5, -IN B 6, OUTPUT B 7, OUTPUT D 14, -IN D 13, +IN D 12, V- 11, +IN C 10, -IN C 9, OUTPUT C 8</p> <p>J PACKAGE 14-LEAD CERAMIC DIP N PACKAGE 14-LEAD PLASTIC DIP</p>	<p>ORDER PART NUMBER</p> <p>LT1179ACJ LT1179CJ LT1179ACN LT1179CN LT1179IN</p>
<p>TOP VIEW</p> <p>NC 1, NC 2, OUTPUT A 3, -IN A 4, +IN A 5, V- 6, NC 7, NC 8, NC 16, NC 15, V+ 14, OUTPUT B 13, -IN B 12, +IN B 11, NC 10, NC 9</p> <p>S PACKAGE 16-LEAD PLASTIC SOL</p>	<p>ORDER PART NUMBER</p> <p>LT1178S</p>	<p>TOP VIEW</p> <p>OUTPUT A 1, -IN A 2, +IN A 3, V+ 4, +IN B 5, -IN B 6, OUTPUT B 7, NC 8, OUTPUT D 16, -IN D 15, +IN D 14, V- 13, +IN C 12, -IN C 11, OUTPUT C 10, NC 9</p> <p>S PACKAGE 16-LEAD PLASTIC SOL</p>	<p>ORDER PART NUMBER</p> <p>LT1179S</p>		

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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 1)	LT1178AC/1179AC			LT1178I/C/S/1179I/C/S			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178 LT1179 LT1178S LT1179S		30 35	70 100		40 40	120 150	μV μV
$\frac{\Delta V_{OS}}{\Delta Time}$	Long Term Input Offset Voltage Stability			0.5			0.6		$\mu V/Mo$
I_{OS}	Input Offset Current			0.05	0.25		0.05	0.35	nA
I_B	Input Bias Current			3	5		3	6	nA
e_n	Input Noise Voltage	0.1Hz to 10Hz (Note 2)		0.9	2.0		0.9		μV_{p-p}
	Input Noise Voltage Density	$f_o = 10Hz$ (Note 2) $f_o = 1000Hz$ (Note 2)		50 49	75 65		50 49		nV/\sqrt{Hz} nV/\sqrt{Hz}
i_n	Input Noise Current	0.1Hz to 10Hz (Note 2)		1.5	2.5		1.5		pA_{p-p}
	Input Noise Current Density	$f_o = 10Hz$ (Note 2) $f_o = 1000Hz$		0.03 0.01	0.07		0.03 0.01		pA/\sqrt{Hz} pA/\sqrt{Hz}
	Input Resistance Differential Mode Common-Mode	(Note 3)	0.8	2.0 12		0.6	2.0 12		G Ω G Ω
	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

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 1)	LT1178AC/1179AC			LT1178JC/S/1179JC/S			UNITS	
			MIN	TYP	MAX	MIN	TYP	MAX		
A _{VOL}	Large Signal Voltage Gain	V _O = 0.03V to 4V, No Load (Note 3)	140	700		110	700		V/mV	
		V _O = 0.03V to 3.5V, R _L = 50k	80	200		70	200		V/mV	
	Maximum Output Voltage Swing	Output Low, No Load		6.5	9		6.5	9	mV	
		Output Low, 2k to GND		0.2	0.6		0.2	0.6	mV	
		Output Low, I _{SINK} = 100μA		120	160		120	160	mV	
		Output High, No Load	4.2	4.4		4.2	4.4		V	
		Output High, 2k to GND	3.5	3.8		3.5	3.8		V	
SR	Slew Rate	A _V = +1, C _L = 10pF (Note 3)	0.013	0.025		0.013	0.025		V/μs	
GBW	Gain Bandwidth Product	f _o ≤ 5kHz		60			60		kHz	
I _S	Supply Current per Amplifier	V _S = ±1.5V, V _O = 0V		13	18		14	21		μA
				12	17		13	20		μA
	Channel Separation	ΔV _{IN} = 3V, R _L = 10k		130			130			dB
	Minimum Supply Voltage	(Note 4)		2.0	2.2		2.0	2.2		V

ELECTRICAL CHARACTERISTICS $V_S = 5V, 0V, V_{CM} = 0.1V, V_O = 1.4V, -40^\circ C \leq T_A \leq 85^\circ C$ for I grades, $0^\circ C \leq T_A \leq 70^\circ C$ for S grades, unless noted. (Note 6)

SYMBOL	PARAMETER	CONDITIONS		LT1178I/1179I			LT1178S/1179S			UNITS	
				MIN	TYP	MAX	MIN	TYP	MAX		
V _{OS}	Input Offset Voltage	LT1178	●	80	315		120	650		μV	
			LT1179	●	80	345		130	800		μV
ΔV _{OS} /ΔT	Input Offset Voltage Drift	(Note 5)	●	0.6	3.0		0.8	4.5		μV/°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} = 0.05V to 3.2V I grade V _{CM} = 0V to 3.4V S grade	●	84	98		86	100		dB	
PSRR	Power Supply Rejection Ratio	V _S = 3.0V to 12V I grade V _S = 2.5V to 12V S grade	●	86	100		88	102		dB	
A _{VOL}	Large Signal Voltage Gain	V _O = 0.05V to 4V, No Load (Note 3)	●	55	350		80	500		V/mV	
		V _O = 0.05V to 3.5V, R _L = 50k	●	35	130		45	160		V/mV	
	Maximum Output Voltage Swing	Output Low, No Load	●		9	13		8	11		mV
		Output Low, I _{SINK} = 100μA	●		160	220		140	190		mV
		Output High, No Load	●	3.9	4.2		4.1	4.3			V
		Output High, 2k to GND	●	3.0	3.7		3.3	3.8			V
		I _S	Supply Current per Amplifier		●	15	27		15	24	

ELECTRICAL CHARACTERISTICS $V_S = 5V, 0V, V_{CM} = 0.1V, V_O = 1.4V, 0^\circ C \leq T_A \leq 70^\circ C$, unless noted.

SYMBOL	PARAMETER	CONDITIONS		LT1178AC/1179AC			LT1178C/1179C			UNITS	
				MIN	TYP	MAX	MIN	TYP	MAX		
V _{OS}	Input Offset Voltage	LT1178	●	50	170		65	250		μV	
			LT1179	●	60	200		70	290		μV
ΔV _{OS} /ΔT	Input Offset Voltage Drift	(Note 5)	●	0.5	2.2		0.6	3.0		μV/°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} = 0V to 3.4V	●	90	101		86	100		dB	
PSRR	Power Supply Rejection Ratio	V _S = 2.5V to 12V	●	90	102		88	102		dB	
A _{VOL}	Large Signal Voltage Gain	V _O = 0.05V to 4V, No Load (Note 3)	●	105	500		80	500		V/mV	
		V _O = 0.05V to 3.5V, R _L = 50k	●	55	160		45	160		V/mV	
	Maximum Output Voltage Swing	Output Low, No Load	●		8	11		8	11		mV
		Output Low, I _{SINK} = 100μA	●		140	190		140	190		mV
		Output High, No Load	●	4.1	4.3		4.1	4.3			V
		Output High, 2k to GND	●	3.3	3.8		3.3	3.8			V
		I _S	Supply Current per Amplifier		●	14	21		15	24	

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

SYMBOL	PARAMETER	CONDITIONS	LT1178AC/1179AC			LT1178I/C/S/1179I/C/S			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178S LT1179S		80	350		100	480	μV
							150	900	μV
							160	1050	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	$V_O = \pm 10V, R_L = 50k$	300	1200		250	1000		V/mV
		$V_O = \pm 10V, \text{No Load}$	600	2500		400	2500		V/mV
V_{OUT}	Maximum Output Voltage Swing	$R_L = 50k$	± 13.0	± 14.2		± 13.0	± 14.2		V
		$R_L = 2k$	± 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	$f_o \leq 5kHz$		85			85		kHz
I_S	Supply Current per Amplifier			16	21		17	25	μA

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ELECTRICAL CHARACTERISTICS $V_S = \pm 15V, -40^\circ C \leq T_A \leq 85^\circ C$ for I grades, $0^\circ C \leq T_A \leq 70^\circ C$ for S grades, unless noted.

SYMBOL	PARAMETER	CONDITIONS	LT1178I/1179I			LT1178S/1179S			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 5)	●	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

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V, 0^\circ C \leq T_A \leq 70^\circ C$, unless noted.

SYMBOL	PARAMETER	CONDITIONS	LT1178AC/1179AC			LT1178C/1179C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage		●	100	480		130	660	μV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 5)	●	0.6	2.8		0.7	4.0	$\mu V/^\circ C$
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	$V_O = \pm 10V, R_L = 50k$	●	200	800		150	750	V/mV
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 13V, -15V$	●	94	104		91	104	dB
PSRR	Power Supply Rejection Ratio	$V_S = 5V, 0V$ to $\pm 18V$	●	93	110		91	110	dB
	Maximum Output Voltage Swing	$R_L = 5k$	●	± 11.0	± 13.6		± 11.0	± 13.6	V
I_S	Supply Current per Amplifier		●	17	24		18	28	μA

The ● denotes the specifications which apply over the full operating temperature range.

Note 1: 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 2: This parameter is tested on a sample basis only. All noise parameters are tested with $V_S = \pm 2.5, V_O = 0V$.

Note 3: This parameter is guaranteed by design and is not tested.

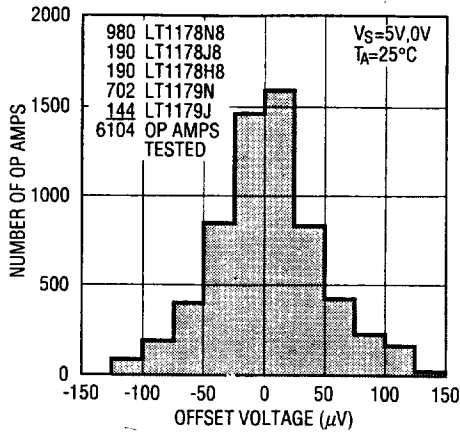
Note 4: Power supply rejection ratio is measured at the minimum supply voltage. The op amps actually work at 1.7V supply but with a typical offset skew of $-300\mu V$.

Note 5: This parameter is not 100% tested.

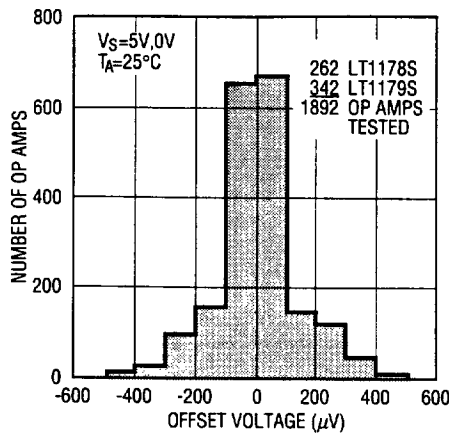
Note 6: During testing at $-40^\circ C$, the 5V power supply turn on time is less than 0.5 seconds.

TYPICAL PERFORMANCE CHARACTERISTICS

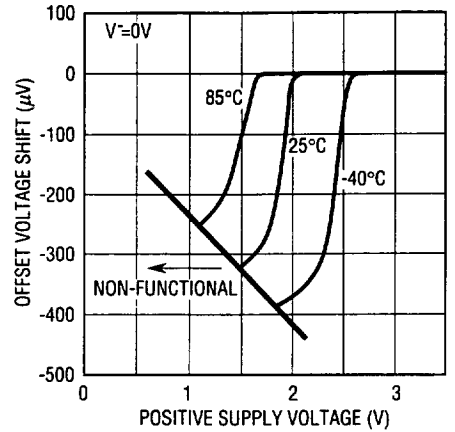
**Input Offset Voltage Distribution
N, J, H Package**



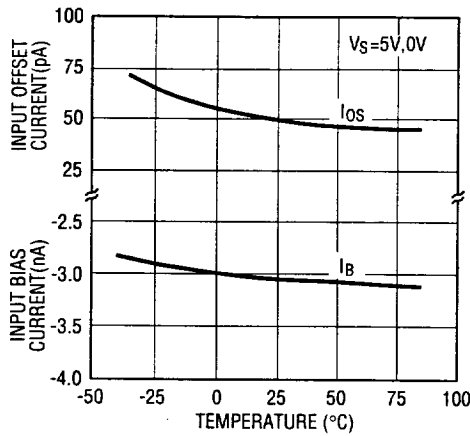
**Input Offset Voltage Distribution
Surface Mount Package**



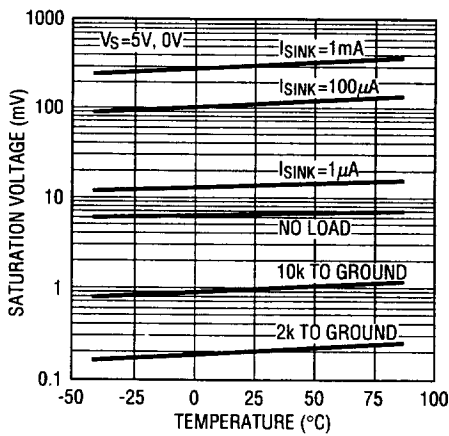
Minimum Supply Voltage



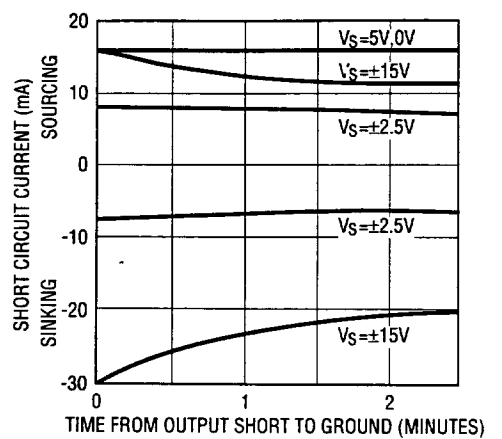
**Input Bias and Offset Currents vs
Temperature**



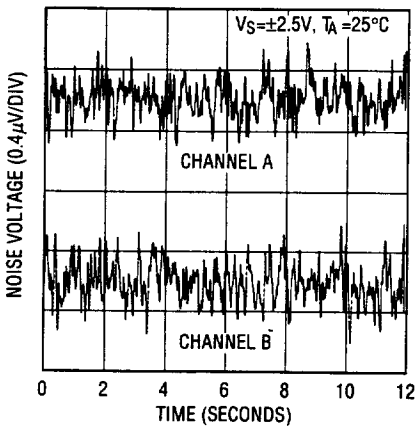
**Output Saturation vs Temperature
vs Sink Current**



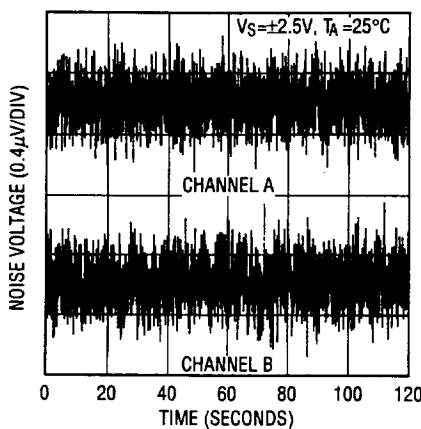
Short Circuit Current



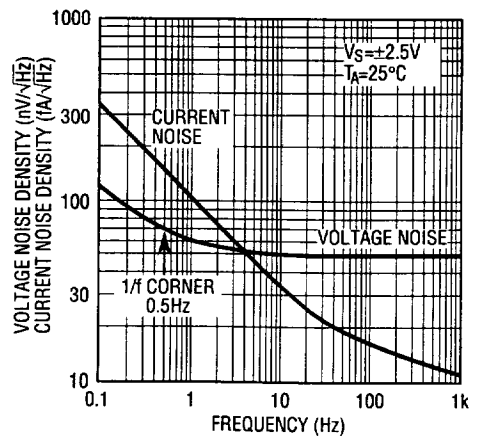
0.1Hz to 10Hz Noise



0.01Hz to 10Hz Noise

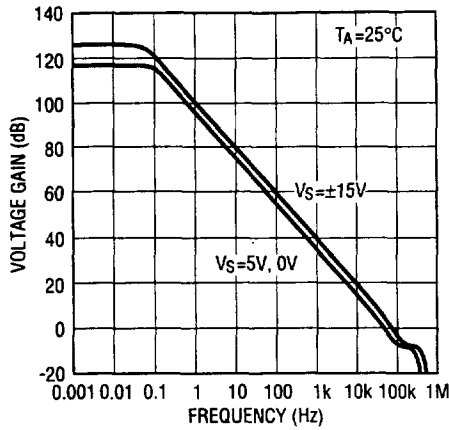


Noise Spectrum

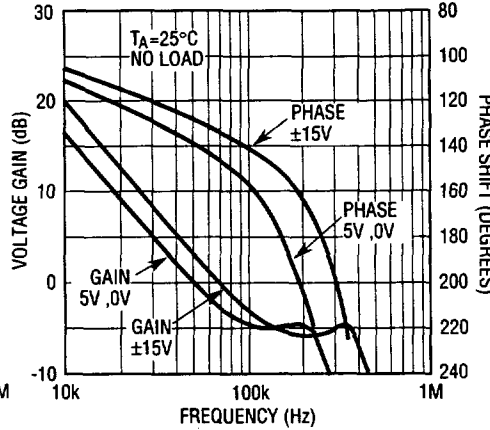


TYPICAL PERFORMANCE CHARACTERISTICS

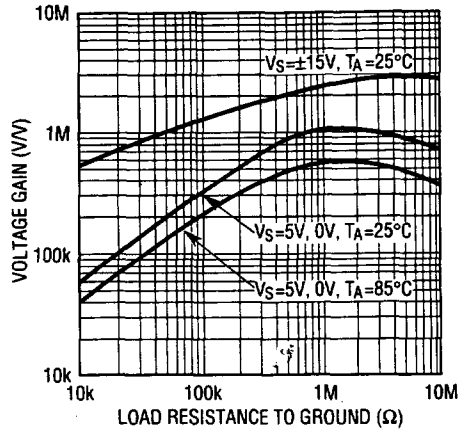
Voltage Gain vs Frequency



Gain, Phase vs Frequency

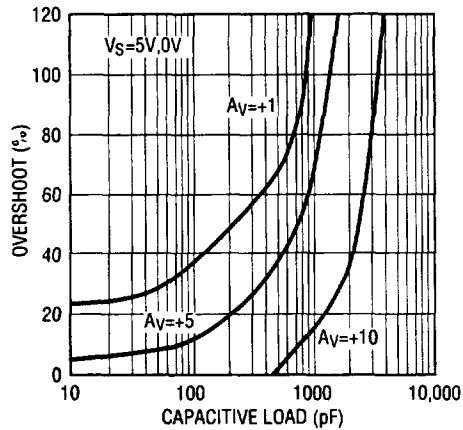


Voltage Gain vs Load Resistance

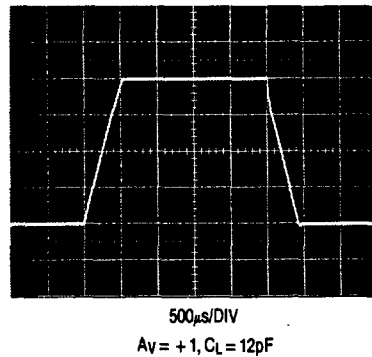


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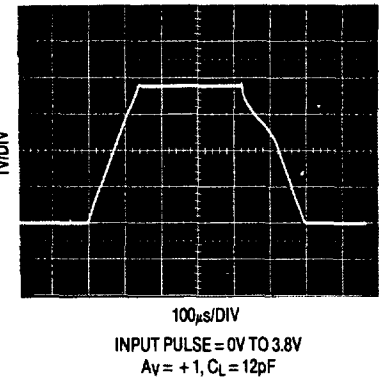
Capacitive Load Handling



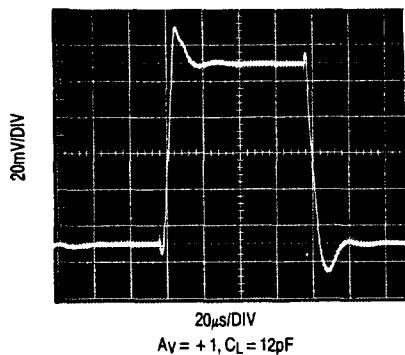
Large Signal Transient Response VS = ±15V



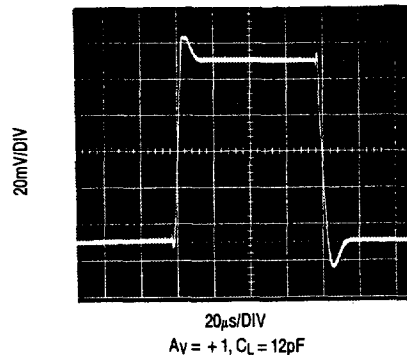
Large Signal Transient Response VS = 5V, 0V



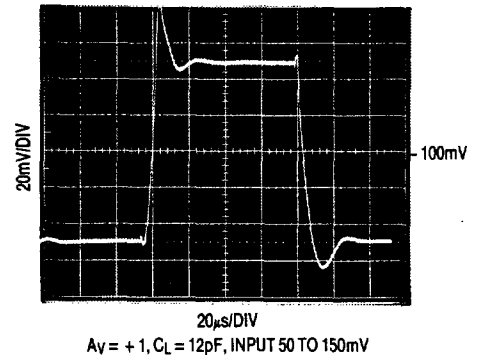
Small Signal Transient Response VS = ±2.5V



Small Signal Transient Response VS = ±15V

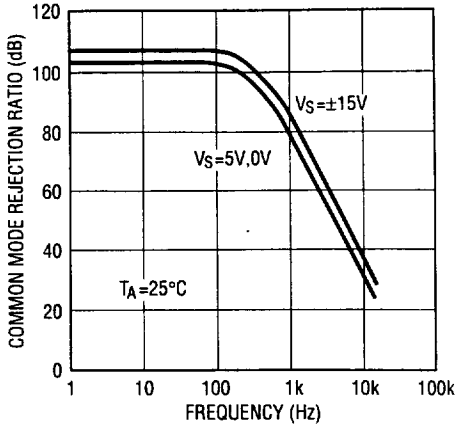


Small Signal Transient Response VS = 5V, 0V

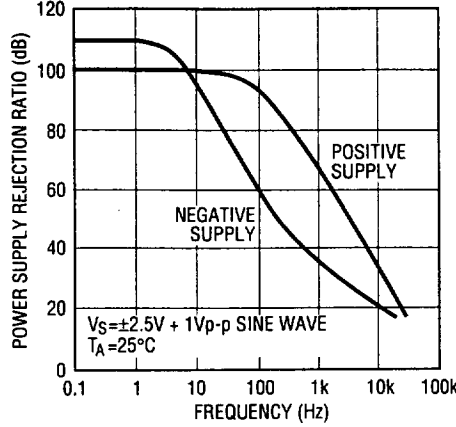


TYPICAL PERFORMANCE CHARACTERISTICS

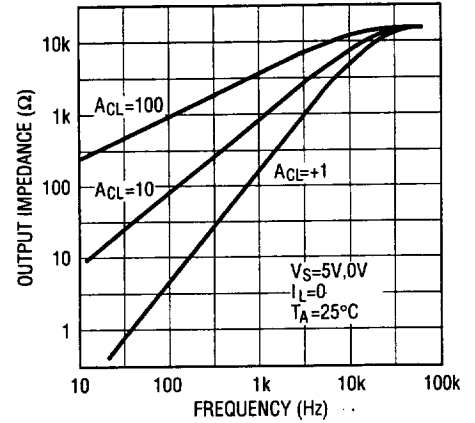
Common Mode Rejection Ratio vs Frequency



Power Supply Rejection Ratio vs Frequency



Closed Loop Output Impedance



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

