



T-79-10 LT1178/LT1179

17 μ A Max, Dual and Quad,
Single Supply, Precision Op Amps

FEATURES

- 17 μ A Max Supply Current per Amplifier
- 70 μ V Max Offset Voltage
- 250pA Max Offset Current
- 5nA Max Input Bias Current
- 0.9 μ Vp-p 0.1Hz to 10Hz Voltage Noise
- 1.5pAp-p 0.1Hz to 10Hz Current Noise
- 0.5 μ V/ $^{\circ}$ C Offset Voltage Drift
- 85kHz Gain-Bandwidth-Product
- 0.04V/ μ s 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

- Battery or Solar Powered Systems
 - Portable Instrumentation
 - Remote Sensor Amplifier
 - Satellite Circuitry
- Micropower Sample and Hold
- Thermocouple Amplifier
- Micropower Filters

DESCRIPTION

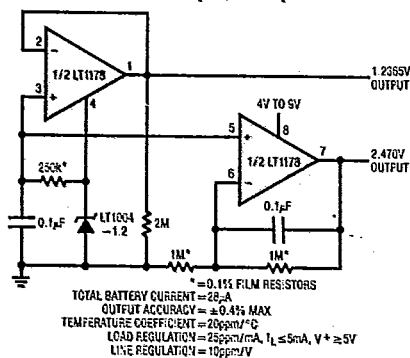
The LT1178 is a micropower dual op amp in the standard 8-pin configuration; the LT1179 is a micropower quad op amp offered in the standard 14-pin packages. Both devices are optimized for single supply operation at 5V. Specifications are also provided at ± 15 V supplies.

The extremely low supply current is combined with true precision specifications: offset voltage is 30 μ V, offset current is 50pA. Both offset parameters have low drift with temperature. The 1.5pAp-p current noise and picoampere offset current permit the use of megaohm level source resistors without introducing serious errors. Voltage noise, at 0.9 μ Vp-p, is remarkably low considering the low supply current.

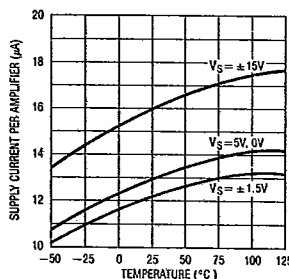
Both the LT1178 and LT1179 can be operated from a single supply (as low as one lithium cell or two Ni-cad batteries). The input range goes below ground. The all-NPN output stage swings to within a few millivolts of ground while sinking current—no power consuming pull down resistors are needed.

For applications where three times higher supply current is acceptable, the micropower LT1078 dual and LT1079 quad are recommended. The LT1078/79 have significantly higher bandwidth, slew rate; lower voltage noise and better output drive capability.

Self-Buffered, Dual Output, Micropower Reference



Supply Current vs Temperature



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PACKAGE/ORDER INFORMATION

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	
LT1178AM/LT1178M/	
LT1179AM/LT1179M	– 55°C to 125°C
LT1178AC/LT1178C/	
LT1179AC/LT1179C	0°C to 70°C
Storage Temperature Range	
All Grades	– 65°C to 150°C
Lead Temperature (Soldering, 10 sec.)	300°C

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LT1178/LT1179

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)	LT1178AM/AC LT1179AM/AC			LT1178M/C LT1179M/C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
	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, $I_{SINK} = 100\mu A$		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	$f_o \leq 5kHz$		60			60		kHz
I_S	Supply Current per Amplifier	$V_S = \pm 1.5V, V_O = 0V$		13	18		14	21	μA
				12	17		13	20	μA
	Channel Separation	$\Delta V_{IH} = 3V, R_L = 10k$		130			130		dB
	Minimum Supply Voltage	(Note 4)		2.0	2.2		2.0	2.2	V

ELECTRICAL CHARACTERISTICS $V_S = 5V, 0V, V_{CM} = 0.1V, V_O = 1.4V, -55^\circ C \leq T_A \leq 125^\circ C$, unless noted.

SYMBOL	PARAMETER	CONDITIONS		LT1178AM/1179AM			LT1178M/1179M			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	LT1178	•		80	290		100	420	μV
		LT1179	•		90	320		110	450	μV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 5)	•		0.5	2.2		0.6	3.0	$\mu V/^\circ C$
I_{OS}	Input Offset Current		•		0.07	0.50		0.07	0.70	nA
I_B	Input Bias Current		•		4	7		4	8	nA
CMRR	Common-Mode Rejection Ratio	$V_{CM} = 0.05V$ to 3.2V	•	87	100		84	98		dB
PSRR	Power Supply Rejection Ratio	$V_S = 3.0V$ to 12V	•	88	100		86	100		dB
A_{VOL}	Large Signal Voltage Gain	$V_O = 0.05V$ to 4V, No Load (Note 3)	•	70	350		55	350		V/mV
		$V_O = 0.05V$ to 3.5V, $R_L = 50k$	•	40	130		35	130		V/mV
	Maximum Output Voltage Swing	Output Low, No Load	•		9	13		9	13	mV
		Output Low, $I_{SINK} = 100\mu A$	•		160	220		160	220	mV
		Output High, No Load	•	3.9	4.2		3.9	4.2		V
		Output High, 2k to GND	•	3.0	3.7		3.0	3.7		V
I_S	Supply Current per Amplifier		•		14	23		15	27	μA

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
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Drift	(Note 5)	•		0.5	2.2		0.6	3.0	$\mu V/^\circ C$
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, $I_{SINK} = 100\mu A$	•		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	μA

LT1178/LT1179

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

SYMBOL	PARAMETER	CONDITIONS	LT1178AM/AC LT1179AM/AC			LT1178M/C LT1179M/C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage		80	350		100	480		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 -15.0	13.9 -15.3		13.5 -15.0	13.9 -15.3		V 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	300 600	1200 2500		250 400	1000 2500		V/mV V/mV
V_{OUT}	Maximum Output Voltage Swing	$R_L = 50k$ $R_L = 2k$	± 13.0 ± 11.0	± 14.2 ± 12.7		± 13.0 ± 11.0	± 14.2 ± 12.7		V 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

ELECTRICAL CHARACTERISTICS $V_S = \pm 15V$, $-55^\circ C \leq T_A \leq 125^\circ C$, unless noted.

SYMBOL	PARAMETER	CONDITIONS	LT1178AM/1179AM			LT1178M/1179M			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
V_{OS}	Input Offset Voltage		●	140	630		170	880	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		●	0.07	0.50		0.07	0.70	nA
I_B	Input Bias Current		●	4	7		4	8	nA
A_{VOL}	Large Signal Voltage Gain	$V_O = \pm 10V, R_L = 50k$	●	120	500		100	500	V/mV
CMRR	Common-Mode Rejection Ratio	$V_{CM} = +13V, -14.9V$	●	92	103		88	103	dB
PSRR	Power Supply Rejection Ratio	$V_S = 5V, 0V$ to $\pm 18V$	●	91	109		88	109	dB
	Maximum Output Voltage Swing	$R_L = 5k$	●	± 11.0	± 13.5		± 11.0	± 13.5	V
I_S	Supply Current per Amplifier		●	18	26		19	30	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 $V_S = \pm 2.5V, V_O = 0V$.

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.