



**PRODUCT NAME** : LT1013 Dual Precision Operational Amplifier

**PRICE** : Rs 45.00

**SKU** : RM2000



## DESCRIPTION

## Features

- Upgrade to the MC1458, MC1558 and LM158
- Input Offset Voltage: 150  $\mu$ V
- Input Offset Current: 0.5 nA
- Input Offset Current: 0.8 nA
- Low Drift: 2  $\mu$ V /  $^{\circ}$ C
- Low Supply Current: 500  $\mu$ A



## LT1013/LT1014

### Quad Precision Op Amp (LT1014) Dual Precision Op Amp (LT1013)

#### FEATURES

- Single Supply Operation
  - Input Voltage Range Extends to Ground
  - Output Swings to Ground while Sinking Current
- Pin Compatible to 1458 and 324 with Precision Specs
- *Guaranteed* Offset Voltage: 150 $\mu$ V Max
- *Guaranteed* Low Drift: 2 $\mu$ V/ $^{\circ}$ C Max
- *Guaranteed* Offset Current: 0.8nA Max
- *Guaranteed* High Gain
  - 5mA Load Current: 1.5 Million Min
  - 17mA Load Current: 0.8 Million Min
- *Guaranteed* Low Supply Current: 500 $\mu$ A Max
- Low Voltage Noise, 0.1Hz to 10Hz: 0.55 $\mu$ Vp-p
- Low Current Noise—Better than OP-07, 0.07pA/ $\sqrt{\text{Hz}}$

#### APPLICATIONS

- Battery-Powered Precision Instrumentation
  - Strain Gauge Signal Conditioners
  - Thermocouple Amplifiers
  - Instrumentation Amplifiers
- 4mA–20mA Current Loop Transmitters
- Multiple Limit Threshold Detection
- Active Filters
- Multiple Gain Blocks

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#### DESCRIPTION

The LT<sup>®</sup>1014 is the first precision quad operational amplifier which directly upgrades designs in the industry standard 14-pin DIP LM324/LM348/OP-11/4156 pin configuration. It is no longer necessary to compromise specifications, while saving board space and cost, as compared to single operational amplifiers.

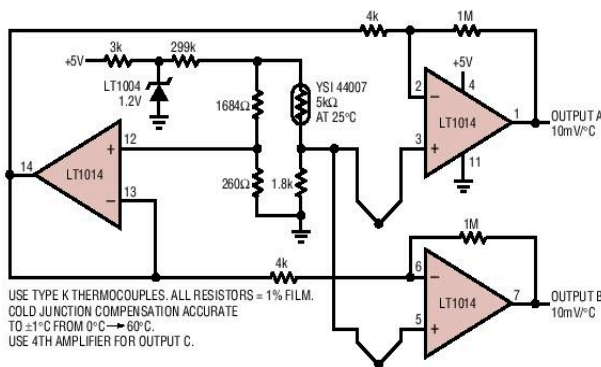
The LT1014's low offset voltage of 50 $\mu$ V, drift of 0.3 $\mu$ V/ $^{\circ}$ C, offset current of 0.15nA, gain of 8 million, common mode rejection of 117dB and power supply rejection of 120dB qualify it as four truly precision operational amplifiers. Particularly important is the low offset voltage, since no offset null terminals are provided in the quad configuration. Although supply current is only 350 $\mu$ A per amplifier, a new output stage design sources and sinks in excess of 20mA of load current, while retaining high voltage gain.

Similarly, the LT1013 is the first precision dual op amp in the 8-pin industry standard configuration, upgrading the performance of such popular devices as the MC1458/1558, LM158 and OP-221. The LT1013's specifications are similar to (even somewhat better than) the LT1014's.

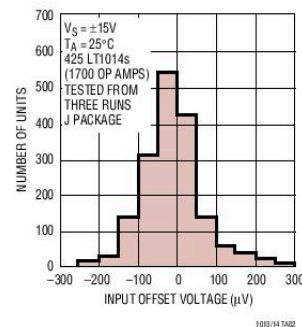
Both the LT1013 and LT1014 can be operated off a single 5V power supply: input common mode range includes ground; the output can also swing to within a few millivolts of ground. Crossover distortion, so apparent on previous single-supply designs, is eliminated. A full set of specifications is provided with  $\pm 15$ V and single 5V supplies.

#### TYPICAL APPLICATION

3 Channel Thermocouple Thermometer



LT1014 Distribution of Offset Voltage



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## LT1013/LT1014

### ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$ . $V_S = \pm 15\text{V}$ , $V_{CM} = 0\text{V}$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	LT1013AM/AC LT1014AM/AC			LT1013C/D/I/M LT1014C/D/I/M			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage	LT1013	—	40	150	—	60	300	$\mu\text{V}$
		LT1014	—	50	180	—	60	300	$\mu\text{V}$
		LT1013D/I, LT1014D/I	—	—	—	—	200	800	$\mu\text{V}$
	Long Term Input Offset Voltage Stability		—	0.4	—	—	0.5	—	$\mu\text{V}/\text{Mo.}$
$I_{SO}$	Input Offset Current		—	0.15	0.8	—	0.2	1.5	nA
$I_B$	Input Bias Current		—	12	20	—	15	30	nA
$e_n$	Input Noise Voltage	0.1Hz to 10Hz	—	0.55	—	—	0.55	—	$\mu\text{Vp-p}$
$e_n$	Input Noise Voltage Density	$f_0 = 10\text{Hz}$	—	24	—	—	24	—	$\text{nV}/\sqrt{\text{Hz}}$
		$f_0 = 1000\text{Hz}$	—	22	—	—	22	—	$\text{nV}/\sqrt{\text{Hz}}$
$i_n$	Input Noise Current Density	$f_0 = 10\text{Hz}$	—	0.07	—	—	0.07	—	$\text{pA}/\sqrt{\text{Hz}}$
	Input Resistance – Differential Common Mode	(Note 2)	100	400	—	70	300	—	M $\Omega$
			—	5	—	—	4	—	G $\Omega$
$A_{VOL}$	Large Signal Voltage Gain	$V_O = \pm 10\text{V}$ , $R_L = 2\text{k}$	1.5	8.0	—	1.2	7.0	—	$\text{V}/\mu\text{V}$
		$V_O = \pm 10\text{V}$ , $R_L = 600\Omega$	0.8	2.5	—	0.5	2.0	—	$\text{V}/\mu\text{V}$
	Input Voltage Range		+13.5	+13.8	—	+13.5	+13.8	—	V
			-15.0	-15.3	—	-15.0	-15.3	—	V
CMRR	Common Mode Rejection Ratio	$V_{CM} = +13.5\text{V}$ , $-15.0\text{V}$	100	117	—	97	114	—	dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2\text{V}$ to $\pm 18\text{V}$	103	120	—	100	117	—	dB
			Channel Separation	$V_O = \pm 10\text{V}$ , $R_L = 2\text{k}$	123	140	—	120	137
$V_{OUT}$	Output Voltage Swing	$R_L = 2\text{k}$	$\pm 13$	$\pm 14$	—	$\pm 12.5$	$\pm 14$	—	V
			Slew Rate	0.2	0.4	—	0.2	0.4	—
$I_S$	Supply Current	Per Amplifier	—	0.35	0.50	—	0.35	0.55	mA

$T_A = 25^\circ\text{C}$ .  $V_S^+ = +5\text{V}$ ,  $V_S^- = 0\text{V}$ ,  $V_{OUT} = 1.4\text{V}$ ,  $V_{CM} = 0\text{V}$  unless otherwise noted

SYMBOL	PARAMETER	CONDITIONS	LT1013AM/AC LT1014AM/AC			LT1013C/D/I/M LT1014C/D/I/M			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage	LT1013	—	60	250	—	90	450	$\mu\text{V}$
		LT1014	—	70	280	—	90	450	$\mu\text{V}$
		LT1013D/I, LT1014D/I	—	—	—	—	250	950	$\mu\text{V}$
$I_{OS}$	Input Offset Current		—	0.2	1.3	—	0.3	2.0	nA
$I_B$	Input Bias Current		—	15	35	—	18	50	nA
$A_{VOL}$	Large Signal Voltage Gain	$V_O = 5\text{mV}$ to $4\text{V}$ , $R_L = 500\Omega$	—	1.0	—	—	1.0	—	$\text{V}/\mu\text{V}$
	Input Voltage Range		+3.5	+3.8	—	+3.5	+3.8	—	V
			0	-0.3	—	0	-0.3	—	V
$V_{OUT}$	Output Voltage Swing	Output Low, No Load	—	15	25	—	15	25	mV
		Output Low, $600\Omega$ to Ground	—	5	10	—	5	10	mV
		Output Low, $I_{SINK} = 1\text{mA}$	—	220	350	—	220	350	mV
		Output High, No Load	4.0	4.4	—	4.0	4.4	—	V
		Output High, $600\Omega$ to Ground	3.4	4.0	—	3.4	4.0	—	V
$I_S$	Supply Current	Per Amplifier	—	0.31	0.45	—	0.32	0.50	mA

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