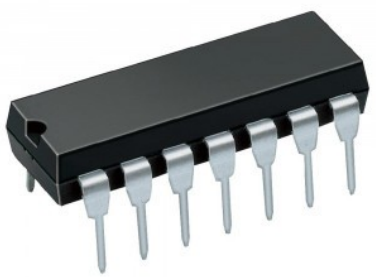
**PRODUCT NAME** : LT1014 Quad Precision Operational Amplifier



**PRICE** : Rs 25.00
**SKU** : RM2001

## DESCRIPTION

## Features

- Upgrade to the LM324, LM348 and OP11
- Input Offset Voltage: 150 µV
- Input Offset Current: 0.5 nA
- Input Offset Current: 0.8 nA
- Low Drift: 2 µV / °C
- Low Supply Current: 500 µA

# 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: 150µV Max
- *Guaranteed* Low Drift: 2µV/°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: 500µA Max
- Low Voltage Noise, 0.1Hz to 10Hz: 0.55µVp-p
- Low Current Noise—Better than 0P-07, 0.07pA/$\sqrt{Hz}$

## 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



## DESCRIPTION

The LT®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.

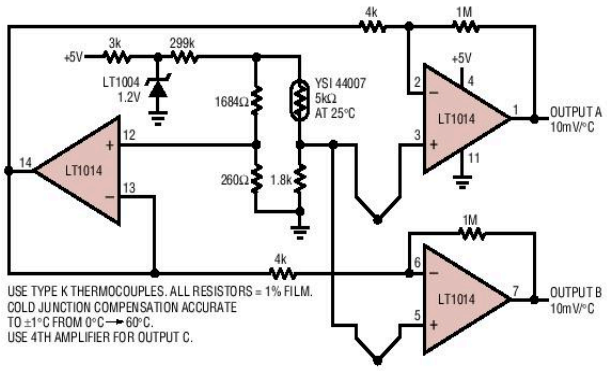
The LT1014's low offset voltage of 50µV, drift of 0.3µV/°C, offset current of 0.15nA, gain of 8 million, common mode rejection of 117dB and power supply rejection of 120dB qualify it as four truly precision operational amplifiers. Particularly important is the low offset voltage, since no offset null terminals are provided in the quad configuration. Although supply current is only 350µA 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.

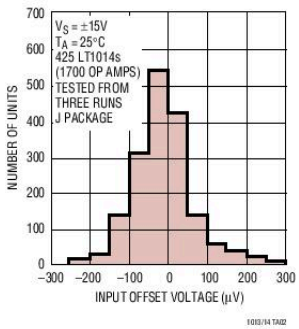
Both the LT1013 and LT1014 can be operated off a single 5V power supply: input common mode range includes ground; the output can also swing to within a few millivolts of ground. Crossover distortion, so apparent on previous single-supply designs, is eliminated. A full set of specifications is provided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

## TYPICAL APPLICATION

**3 Channel Thermocouple Thermometer**




**LT1014 Distribution of Offset Voltage**



## ELECTRICAL CHARACTERISTICS

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

| SYMBOL | PARAMETER | CONDITIONS | LT1013AM/AC LT1014AM/AC MIN | LT1013AM/AC LT1014AM/AC TYP | LT1013AM/AC LT1014AM/AC MAX | LT1013C/D/I/M LT1014C/D/I/M MIN | LT1013C/D/I/M LT1014C/D/I/M TYP | LT1013C/D/I/M LT1014C/D/I/M MAX | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | LT1013 | — | 40 | 150 | — | 60 | 300 | µV |
| | | LT1014 | — | 50 | 180 | — | 60 | 300 | µV |
| | | LT1013D/I, LT1014D/I | — | — | — | — | 200 | 800 | µV |
| | Long Term Input Offset Voltage Stability | | — | 0.4 | — | — | 0.5 | — | µV/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 | — | µVp-p |
| $e_n$ | Input Noise Voltage Density | $f_O$ = 10Hz | — | 24 | — | — | 24 | — | nV/√Hz |
| | | $f_O$ = 1000Hz | — | 22 | — | — | 22 | — | nV/√Hz |
| $i_n$ | Input Noise Current Density | $f_O$ = 10Hz | — | 0.07 | — | — | 0.07 | — | pA/√Hz |
| | Input Resistance – Differential | (Note 2) | 100 | 400 | — | 70 | 300 | — | MΩ |
| | Common Mode | | — | 5 | — | — | 4 | — | GΩ |
| $A_{VOL}$ | Large Signal Voltage Gain | $V_O$ = ±10V, $R_L$ = 2k | 1.5 | 8.0 | — | 1.2 | 7.0 | — | V/µV |
| | | $V_O$ = ±10V, $R_L$ = 600Ω | 0.8 | 2.5 | — | 0.5 | 2.0 | — | V/µV |
| | 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 | $V_{CM}$ = +13.5V, −15.0V | 100 | 117 | — | 97 | 114 | — | dB |
| PSRR | Power Supply Rejection Ratio | $V_S$ = ±2V to ±18V | 103 | 120 | — | 100 | 117 | — | dB |
| | Channel Separation | $V_O$ = ±10V, $R_L$ = 2k | 123 | 140 | — | 120 | 137 | — | dB |
| $V_{OUT}$ | Output Voltage Swing | $R_L$ = 2k | ±13 | ±14 | — | ±12.5 | ±14 | — | V |
| | Slew Rate | | 0.2 | 0.4 | — | 0.2 | 0.4 | — | V/µs |
| $I_S$ | Supply Current | Per Amplifier | — | 0.35 | 0.50 | — | 0.35 | 0.55 | mA |

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

| SYMBOL | PARAMETER | CONDITIONS | LT1013AM/AC LT1014AM/AC MIN | LT1013AM/AC LT1014AM/AC TYP | LT1013AM/AC LT1014AM/AC MAX | LT1013C/D/I/M LT1014C/D/I/M MIN | LT1013C/D/I/M LT1014C/D/I/M TYP | LT1013C/D/I/M LT1014C/D/I/M MAX | UNITS |
|---|---|---|---|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | LT1013 | — | 60 | 250 | — | 90 | 450 | µV |
| | | LT1014 | — | 70 | 280 | — | 90 | 450 | µV |
| | | LT1013D/I, LT1014D/I | — | — | — | — | 250 | 950 | µV |
| $I_{OS}$ | 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 | $V_O$ = 5mV to 4V, $R_L$ = 500Ω | — | 1.0 | — | — | 1.0 | — | V/µV |
| | 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, 600Ω to Ground | — | 5 | 10 | — | 5 | 10 | mV |
| | | Output Low, $I_{SINK}$ = 1mA | — | 220 | 350 | — | 220 | 350 | mV |
| | | Output High, No Load | 4.0 | 4.4 | — | 4.0 | 4.4 | — | V |
| | | Output High, 600Ω 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 |