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National Semiconductor

# LM6142/LM6144
# 17 MHz Rail-to-Rail Input-Output Operational Amplifiers

## General Description

Using patent pending new circuit topologies, the LM6142/LM6144 provides new levels of performance in applications where low voltage supplies or power limitations previously made compromise necessary. Operating on supplies of 1.8V to over 24V, the LM6142/LM6144 is an excellent choice for battery operated systems, portable instrumentation and others.

The greater than rail-to-rail input voltage range eliminates concern over exceeding the common-mode voltage range. The rail-to-rail output swing provides the maximum possible dynamic range at the output. This is particularly important when operating on low supply voltages.

High gain-bandwidth with 650µA/Amplifier supply current opens new battery powered applications where previous higher power consumption reduced battery life to unacceptable levels. The ability to drive large capacitive loads without oscillating functionally removes this common problem.

## Features

At $V_S$ = 5V. Typ unless noted.

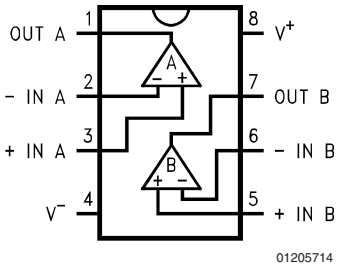
- Rail-to-rail input CMVR –0.25V to 5.25V
- Rail-to-rail output swing 0.005V to 4.995V
- Wide gain-bandwidth: 17MHz at 50kHz (typ)
- Slew rate:
  - Small signal, 5V/µs
  - Large signal, 30V/µs
- Low supply current 650µA/Amplifier
- Wide supply range 1.8V to 24V
- CMRR 107dB
- Gain 108dB with $R_L$ = 10k
- PSRR 87dB

## Applications

- Battery operated instrumentation
- Depth sounders/fish finders
- Barcode scanners
- Wireless communications
- Rail-to-rail in-out instrumentation amps

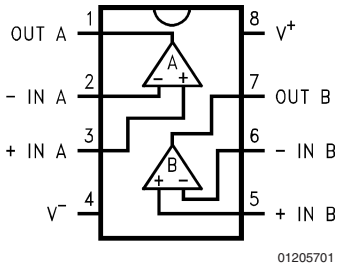
## Connection Diagrams

**8-Pin CDIP**



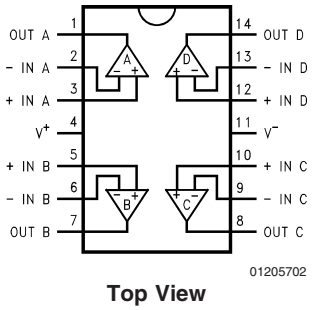

**Top View**

**8-Pin DIP/SO**




**Top View**

**14-Pin DIP/SO**




**Top View**

## Absolute Maximum Ratings (Note 1)

**If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.**

| | |
|---|---|
| ESD Tolerance (Note 2) | 2500V |
| Differential Input Voltage | 15V |
| Voltage at Input/Output Pin | $(V^+)$ + 0.3V, $(V^-)$ − 0.3V |
| Supply Voltage $(V^+ - V^-)$ | 35V |
| Current at Input Pin | ±10mA |
| Current at Output Pin (Note 3) | ±25mA |
| Current at Power Supply Pin | 50mA |
| Lead Temperature (soldering, 10 sec) | 260˚C |
| Storage Temp. Range | −65˚C to +150˚C |
| Junction Temperature (Note 4) | 150˚C |

## Operating Ratings (Note 1)

| | |
|---|---|
| Supply Voltage | $1.8V \le V^+ \le 24V$ |
| Temperature Range | |
| LM6142, LM6144 | $-40˚C \le T_A \le +85˚C$ |
| Thermal Resistance ($\theta_{JA}$) | |
| N Package, 8-Pin Molded DIP | 115˚C/W |
| M Package, 8-Pin Surface Mount | 193˚C/W |
| N Package, 14-Pin Molded DIP | 81˚C/W |
| M Package, 14-Pin Surface Mount | 126˚C/W |

## 5.0V DC Electrical Characteristics (Note 8)

Unless otherwise specified, all limits guaranteed for $T_A = 25˚C$, $V^+ = 5.0V$, $V^- = 0V$, $V_{CM} = V_O = V^+/2$ and $R_L > 1\ M\Omega$ to $V^+/2$. **Boldface limits** apply at the temperature extremes.

| Symbol | Parameter | Conditions | Typ (Note 5) | LM6144AI LM6142AI Limit (Note 6) | LM6144BI LM6142BI Limit (Note 6) | Units |
|---|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | | 0.3 | 1.0<br>**2.2** | 2.5<br>**3.3** | mV<br>max |
| $TCV_{OS}$ | Input Offset Voltage Average Drift | | **3** | | | µV/˚C |
| $I_B$ | Input Bias Current | | 170 | 250 | 300 | nA<br>max |
| | | $0V \le V_{CM} \le 5V$ | 180 | 280<br>**526** | <br>**526** | |
| $I_{OS}$ | Input Offset Current | | 3 | 30<br>**80** | 30<br>**80** | nA<br>max |
| $R_{IN}$ | Input Resistance, $C_M$ | | 126 | | | MΩ |
| CMRR | Common Mode Rejection Ratio | $0V \le V_{CM} \le 4V$ | 107 | 84<br>**78** | 84<br>**78** | |
| | | $0V \le V_{CM} \le 5V$ | 82<br>**79** | 66<br>**64** | 66<br>**64** | dB<br>min |
| PSRR | Power Supply Rejection Ratio | $5V \le V^+ \le 24V$ | **87** | 80<br>**78** | 80<br>**78** | |
| $V_{CM}$ | Input Common-Mode Voltage Range | | −0.25 | **0** | **0** | V |
| | | | 5.25 | **5.0** | **5.0** | |
| $A_V$ | Large Signal Voltage Gain | $R_L$ = 10k | 270<br>**70** | 100<br>**33** | 80<br>**25** | V/mV<br>min |
| $V_O$ | Output Swing | $R_L$ = 100k | 0.005 | 0.01<br>**0.013** | 0.01<br>**0.013** | V<br>max |
| | | | 4.995 | 4.98<br>**4.93** | 4.98<br>**4.93** | V<br>min |
| | | $R_L$ = 10k | 0.02 | | | V max |
| | | | 4.97 | | | V min |
| | | $R_L$ = 2k | 0.06 | 0.1<br>**0.133** | 0.1<br>**0.133** | V<br>max |
| | | | 4.90 | 4.86 | 4.86 | V |

## 24V Electrical Characteristics (Note 8)

Unless Otherwise Specified, All Limits Guaranteed for $T_A$ = 25˚C, $V^+$ = 24V, $V^-$ = 0V, $V_{CM} = V_O = V^+/2$ and $R_L$ > 1 MΩ to $V^+/2$. **Boldface** limits apply at the temperature extreme

| Symbol | Parameter | Conditions | Typ (Note 5) | LM6144AI LM6142AI Limit (Note 6) | LM6144BI LM6142BI Limit (Note 6) | Units |
|---|---|---|---|---|---|---|
| $V_{OS}$ | Input Offset Voltage | | 1.3 | 2 | 3.8 | mV |
| | | | | **4.8** | **4.8** | max |
| $I_B$ | Input Bias Current | | 174 | | | nA |
| | | | | | | max |
| $I_{OS}$ | Input Offset Current | | 5 | | | nA |
| | | | | | | max |
| $R_{IN}$ | Input Resistance | | 288 | | | MΩ |
| CMRR | Common Mode | 0V ≤ $V_{CM}$ ≤ 23V | 114 | | | dB |
| | Rejection Ratio | 0V ≤ $V_{CM}$ ≤ 24V | 100 | | | min |
| PSRR | Power Supply Rejection Ratio | 0V ≤ $V_{CM}$ ≤ 24V | 87 | | | |
| $V_{CM}$ | Input Common-Mode | | –0.25 | 0 | 0 | V min |
| | Voltage Range | | 24.25 | 24 | 24 | V max |
| $A_V$ | Large Signal Voltage Gain | $R_L$ = 10k | 500 | | | V/mV min |
| $V_O$ | Output Swing | $R_L$ = 10 kΩ | 0.07 | 0.15 | 0.15 | V |
| | | | | **0.185** | **0.185** | max |
| | | | 23.85 | 23.81 | 23.81 | V |
| | | | | **23.62** | **23.62** | min |
| $I_S$ | Supply Current | Per Amplifier | 750 | 1100 | 1100 | µA |
| | | | | **1150** | **1150** | max |
| GBW | Gain-Bandwidth Product | f = 50 kHz | 18 | | | MHz |

**Note 1:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Charactenstics.

**Note 2:** Human body model, 1.5kΩ in series with 100pF.

**Note 3:** Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150˚C.

**Note 4:** The maximum power dissipation is a function of $T_{J(MAX)}$, $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A)/\theta_{JA}$. All numbers apply for packages soldered directly into a PC board.

**Note 5:** Typical values represent the most likely parametric norm.

**Note 6:** All limits are guaranteed by testing or statistical analysis.

**Note 7:** For guaranteed military specifications see military datasheet MNLM6142AM-X.

**Note 8:** Electrical Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that $T_J = T_A$. No guarantee of parametric performance is indicated in the electrical tables under conditions of the internal self heating where $T_J > T_A$.