## PRECISION SINGLE OPERATIONAL AMPLIFIER

■ INPUT OFFSET VOLTAGE: 3mV max. OVER TEMPERATURE

- FREQUENCY COMPENSATION WITH A SINGLE 30pF CAPACITOR (C1)
- OPERATION FROM $\pm 5 \mathrm{~V}$ to $\pm 15 \mathrm{~V}$
- LOW POWER CONSUMPTION : 50 mW AT $\pm 15 \mathrm{~V}$
- CONTINUOUS SHORT-CIRCUIT PROTECTION
- OPERATION AS A COMPARATOR WITH DIFFERENTIAL INPUTS AS HIGH AS $\pm 30 \mathrm{~V}$
- NO LATCH-UP WHEN COMMON-MODE RANGE IS EXCEEDED
- SAME PIN CONFIGURATION AS THE LM101A


## DESCRIPTION

The UA748 is a general purpose operational amplifier built on a single silicon chip. The resulting close match and tight thermal coupling gives low offsets and temperature drift as well as fast recovery from thermal transients.

- Short-circuit protection

Offset voltage null capability

- Large common-mode and differential voltage ranges
- Low power consumption
- No latch-up

The unity-gain compensation specified makes the circuit stable for all feedback configurations, even with capacitive loads. However, it is possible to optimize compensation for best high frequency performance at any gain. The low power dissipation permits high voltage operation and simplifies packaging in full-temperature range systems.


ORDER CODE

| Part Number | Temperature Range | Package |  |
| :--- | :---: | :---: | :---: |
|  |  | $\mathbf{N}$ | $\mathbf{D}$ |
| UA748C | $0^{\circ} \mathrm{C},+70^{\circ} \mathrm{C}$ | $\bullet$ | $\bullet$ |
| UA748I | $-40^{\circ} \mathrm{C},+105^{\circ} \mathrm{C}$ | $\bullet$ | $\bullet$ |
| UA748M | $-55^{\circ} \mathrm{C},+125^{\circ} \mathrm{C}$ | $\bullet$ | $\bullet$ |
| Example : UA748CN |  |  |  |

$\mathbf{N}=$ Dual in Line Package (DIP)
$\mathbf{D}=$ Small Outline Package (SO) - also available in Tape \& Reel (DT)

PIN CONNECTIONS (top view)


SCHEMATIC DIAGRAM


ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | UA748M | UA748I | UA748C | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{V}_{\mathrm{CC}}$ | Supply voltage | $\pm 22$ |  |  | V |
| $\mathrm{V}_{\text {id }}$ | Differential Input Voltage | $\pm 30$ |  |  | V |
| $\mathrm{V}_{\mathrm{i}}$ | Input Voltage | $\pm 15$ |  |  | V |
| $\mathrm{P}_{\text {tot }}$ | Power Dissipation ${ }^{1)}$ | 500 |  |  | mW |
|  | Output Short-circuit Duration | Infinite |  |  |  |
| $\mathrm{T}_{\text {oper }}$ | Operating Free-air Temperature Range | -55 to +125 | -40 to +105 | 0 to +70 | ${ }^{\circ} \mathrm{C}$ |
| $\mathrm{T}_{\text {stg }}$ | Storage Temperature Range | -65 to +150 |  |  | ${ }^{\circ} \mathrm{C}$ |

1. Power dissipation must be considered to ensure maximum junction temperature ( Tj ) is not exceeded.

ELECTRICAL CHARACTERISTICS
$\mathrm{V}_{\mathrm{CC}}= \pm 15 \mathrm{~V}, \mathrm{~T}_{\text {amb }}=+25^{\circ} \mathrm{C}, \mathrm{C} 1=30 \mathrm{pF}$ (unless otherwise specified)

| Symbol | Parameter | UA748I/M |  |  | UA748C |  |  | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Min. | Typ. | Max. | Min. | Typ. | Max. |  |
| $V_{\text {io }}$ | $\begin{gathered} \text { Input Offset Voltage }\left(\mathrm{R}_{\mathrm{s}} \leq 10 \mathrm{k} \Omega\right) \\ \mathrm{T}_{\mathrm{amb}}=+25^{\circ} \mathrm{C} \\ \mathrm{~T}_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } \\ \hline \end{gathered}$ |  | 0.7 | $\begin{aligned} & 2 \\ & 3 \end{aligned}$ |  | 2 | $\begin{aligned} & 7.5 \\ & 10 \end{aligned}$ | mV |
| $\mathrm{I}_{\text {io }}$ | $\begin{aligned} & \text { Input Offset Current } \\ & \mathrm{T}_{\mathrm{amb}}=+25^{\circ} \mathrm{C} \\ & \mathrm{~T}_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } \end{aligned}$ |  | 1.5 | $\begin{aligned} & 10 \\ & 20 \end{aligned}$ |  | 2 | $\begin{aligned} & 50 \\ & 70 \end{aligned}$ | nA |
| $\mathrm{l}_{\text {ib }}$ | $\begin{gathered} \text { Input Bias Current } \\ \mathrm{T}_{\mathrm{amb}}=+25^{\circ} \mathrm{C} \\ \mathrm{~T}_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } \end{gathered}$ |  | 25 | $\begin{aligned} & 75 \\ & 10 \end{aligned}$ |  | 70 | $\begin{aligned} & 250 \\ & 300 \end{aligned}$ | nA |
| $\mathrm{A}_{\mathrm{vd}}$ | $\begin{aligned} & \text { Large Signal Voltage Gain }\left(\mathrm{V}_{\mathrm{O}}= \pm 10 \mathrm{~V}, \mathrm{R}_{\mathrm{L}}=2 \mathrm{k} \Omega\right) \\ & \mathrm{T}_{\mathrm{amb}}=+25^{\circ} \mathrm{C} \\ & \mathrm{~T}_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } \\ & \hline \end{aligned}$ | $\begin{aligned} & 50 \\ & 25 \end{aligned}$ | 100 |  | $\begin{aligned} & 25 \\ & 15 \end{aligned}$ | 100 |  | V/mV |
| SVR | $\begin{aligned} & \text { Supply Voltage Rejection Ratio }\left(\mathrm{R}_{\mathrm{s}} \leq 10 \mathrm{k} \Omega\right) \\ & \mathrm{T}_{\mathrm{amb}}=+25^{\circ} \mathrm{C} \\ & \mathrm{~T}_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } \\ & \hline \end{aligned}$ | $\begin{aligned} & 80 \\ & 80 \end{aligned}$ | 96 |  | $\begin{aligned} & 70 \\ & 70 \end{aligned}$ | 96 |  | dB |
| $\mathrm{I}_{\mathrm{CC}}$ | $\begin{gathered} \text { Supply Current, no load } \\ T_{\mathrm{amb}}=+25^{\circ} \mathrm{C} \\ T_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } \end{gathered}$ |  | 1.8 | $\begin{aligned} & 3 \\ & 3 \end{aligned}$ |  | 1.8 | $\begin{aligned} & 3 \\ & 3 \end{aligned}$ | mA |
| $\mathrm{V}_{\mathrm{icm}}$ | Input Common Mode Voltage Range ( $\mathrm{V}_{\mathrm{CC}}= \pm 20 \mathrm{~V}$ ) $\begin{aligned} & \mathrm{T}_{\mathrm{amb}}=+25^{\circ} \mathrm{C} \\ & \mathrm{~T}_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } \end{aligned}$ | $\begin{aligned} & \pm 15 \\ & \pm 15 \end{aligned}$ |  |  | $\begin{aligned} & \pm 15 \\ & \pm 15 \end{aligned}$ |  |  | V |
| CMR | Common Mode Rejection Ratio ( $\mathrm{R}_{\mathrm{S}} \leq 10 \mathrm{k} \Omega$ ) $\begin{aligned} & \mathrm{T}_{\mathrm{amb}}=+25^{\circ} \mathrm{C} \\ & \mathrm{~T}_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } \end{aligned}$ | $\begin{aligned} & 80 \\ & 80 \end{aligned}$ | 96 |  | $\begin{aligned} & 70 \\ & 70 \end{aligned}$ | 96 |  | dB |
| los | Output short Circuit Current | 10 | 30 | 50 | 10 | 30 | 50 | mA |
| $\pm \mathrm{V}_{\text {opp }}$ | $\begin{array}{cl} \text { Output Voltage Swing }\left(\mathrm{V}_{\mathrm{CC}}= \pm 15 \mathrm{~V}\right) \\ \mathrm{T}_{\mathrm{amb}}=+25^{\circ} \mathrm{C} & \mathrm{R}_{\mathrm{L}}=10 \mathrm{k} \Omega \\ & \mathrm{R}_{\mathrm{L}}=2 \mathrm{k} \Omega \\ \mathrm{~T}_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } & \mathrm{R}_{\mathrm{L}}=10 \mathrm{k} \Omega \\ & \mathrm{R}_{\mathrm{L}}=2 \mathrm{k} \Omega \end{array}$ | $\begin{aligned} & 12 \\ & 10 \\ & 12 \\ & 10 \end{aligned}$ | $\begin{aligned} & 14 \\ & 13 \end{aligned}$ |  | $\begin{aligned} & 12 \\ & 10 \\ & 12 \\ & 10 \end{aligned}$ | $\begin{aligned} & 14 \\ & 13 \end{aligned}$ |  | V |
| SR | Slew Rate ${ }^{1)}$ $V_{i}= \pm 10 \mathrm{~V}, R_{L}=2 k \Omega, C_{L}=100 \mathrm{pF}$, unity Gain | 0.25 | 0.5 |  | 0.25 | 0.5 |  | V/ $\mu \mathrm{s}$ |
| $\mathrm{t}_{\mathrm{r}}$ | Rise Time $V_{i}= \pm 20 \mathrm{mV}, R_{L}=2 k \Omega, C_{L}=100 \mathrm{pF}$, unity Gain |  | 0.3 |  |  | 0.3 |  | $\mu \mathrm{S}$ |
| $\mathrm{K}_{\mathrm{ov}}$ | Overshoot $V_{i}=20 \mathrm{mV}, R_{L}=2 \mathrm{k} \Omega, C_{\mathrm{L}}=100 \mathrm{pF}$, unity Gain |  | 5 |  |  | 5 |  | \% |
| $\mathrm{Z}_{\mathrm{i}}$ | Input Impedance ( $\mathrm{V}_{\mathrm{CC}}= \pm 15 \mathrm{~V}$ ) | 1.5 | 4 |  | 1.5 | 4 |  | $\mathrm{M} \Omega$ |
| Ro | Output Resistance ( $\left.\mathrm{V}_{\mathrm{CC}}= \pm 15 \mathrm{~V}\right)$ |  | 75 |  |  | 75 |  | $\Omega$ |
| GBP | Gain Bandwith Product $\mathrm{V}_{\mathrm{i}}=10 \mathrm{mV}, \mathrm{R}_{\mathrm{L}}=2 \mathrm{k} \Omega, \mathrm{C}_{\mathrm{L}}=100 \mathrm{pF}, \mathrm{f}=100 \mathrm{kHz}$ | 0.5 | 1 |  | 0.5 | 1 |  | MHz |
| THD | Total Harmonic Distortion $f=1 \mathrm{kHz}, \mathrm{~A}_{\mathrm{v}}=20 \mathrm{~dB}, \mathrm{R}_{\mathrm{L}}=2 \mathrm{k} \Omega, \mathrm{~V}_{\mathrm{o}}=2 \mathrm{~V}_{\mathrm{pp}}, \mathrm{C}_{\mathrm{L}}=100 \mathrm{pF}$ |  | 0.015 |  |  | 0.015 |  | \% |
| $\mathrm{Dl}_{\text {io }}$ | Input Offset Current Drift $\begin{aligned} & 25^{\circ} \mathrm{C} \leq \mathrm{T}_{\max } \\ & \mathrm{T}_{\min } \leq \mathrm{T}_{\mathrm{amb}} \leq \mathrm{T}_{\max } \end{aligned}$ |  | $\begin{aligned} & 10 \\ & 20 \end{aligned}$ | $\begin{aligned} & 100 \\ & 200 \end{aligned}$ |  | $\begin{aligned} & 10 \\ & 20 \end{aligned}$ | $\begin{aligned} & 300 \\ & 600 \end{aligned}$ | $\mathrm{pA} /{ }^{\circ} \mathrm{C}$ |
| DV ${ }_{\text {io }}$ | Input Offset Voltage Drift $T_{\min } \leq T_{\mathrm{amb}} \leq \mathrm{T}_{\max }$ |  | 3 | 15 |  | 6 | 30 | $\mu \mathrm{V} /{ }^{\circ} \mathrm{C}$ |

1. May be improved up to $10 \mathrm{~V} / \mu \mathrm{s}$ in inverting amplifier configuration.



## SINGLE POLE COMPENSATION





PACKAGE MECHANICAL DATA
8 PINS - PLASTIC DIP


| 家 | Millimeters |  |  | Inches |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A |  | 3.32 |  |  | 0.131 |  |
| a1 | 0.51 |  |  | 0.020 |  |  |
| B | 1.15 |  | 1.65 | 0.045 |  | 0.065 |
| b | 0.356 |  | 0.55 | 0.014 |  | 0.022 |
| b1 | 0.204 |  | 0.304 | 0.008 |  | 0.012 |
| D |  |  | 10.92 |  |  | 0.430 |
| E | 7.95 |  | 9.75 | 0.313 |  | 0.384 |
| e |  | 2.54 |  |  | 0.100 |  |
| e3 |  | 7.62 |  |  | 0.300 |  |
| e4 |  | 7.62 |  |  |  | 0.300 |
| F |  |  | 6.6 |  |  | 0.200 |
| i |  |  | 5.08 |  |  | 0.150 |
| L | 3.18 |  | 3.81 | 0.125 |  | 0.060 |
| Z |  |  | 1.52 |  |  |  |

PACKAGE MECHANICAL DATA
8 PINS - PLASTIC MICROPACKAGE (SO)


| Dim. | Millimeters |  |  | Inches |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A |  |  | 1.75 |  |  | 0.069 |
| a1 | 0.1 |  | 0.25 | 0.004 |  | 0.010 |
| a2 |  |  | 1.65 |  |  | 0.065 |
| a3 | 0.65 |  | 0.85 | 0.026 |  | 0.033 |
| b | 0.35 |  | 0.48 | 0.014 |  | 0.019 |
| b1 | 0.19 |  | 0.25 | 0.007 |  | 0.010 |
| C | 0.25 |  | 0.5 | 0.010 |  | 0.020 |
| c1 | $45^{\circ}$ (typ.) |  |  |  |  |  |
| D | 4.8 |  | 5.0 | 0.189 |  | 0.197 |
| E | 5.8 |  | 6.2 | 0.228 |  | 0.244 |
| e |  | 1.27 |  |  | 0.050 |  |
| e3 |  | 3.81 |  |  | 0.150 |  |
| F | 3.8 |  | 4.0 | 0.150 |  | 0.157 |
| L | 0.4 |  | 1.27 | 0.016 |  | 0.050 |
| M |  |  | 0.6 |  |  | 0.024 |
| S | $8^{\circ}$ (max.) |  |  |  |  |  |

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