NCP4894

Audio Power Amplifier, 1.8 Watt, with Selectable Shutdown

The NCP4894 is a differential audio power amplifier designed for portable communication device applications. This feature and the excellent audio characteristics of the NCP4894 are a guarantee of a high quality sound, for example, in mobile phones applications. With a 10% THD+N value the NCP4894 is capable of delivering 1.8 W of continuous average power to an 8.0 Ω load from a 5.5 V power supply. With the same load conditions and a 5.0 V battery voltage, it ensures 1.0 W to be delivered with less than 0.01% distortion.

The NCP4894 provides high quality audio while requiring few external components and minimal power consumption. It features a low-power consumption shutdown mode.

To be flexible, shutdown may be enabled by either a logic high or low depending on the voltage applied on the SD MODE pin.

The NCP4894 contains circuitry to prevent from “pop and click” noise that would otherwise occur during turn–on and turn–off transitions.

For maximum flexibility, the NCP4894 provides an externally controlled gain (with resistors), as well as an externally controlled turn–on time (with bypass capacitor).

Due to its excellent PSRR, it can be directly connected to the battery, saving the use of an LDO.

This device is available in 9–Pin Flip–Chip, Micro–10 and DFN10 3x3 mm packages.

Features
• Differential Amplification
• Shutdown High or Low Selectivity
• 1.0 W to an 8.0 Ω Load from a 5.0 V Power Supply
• Superior PSRR: Direct Connection to the Battery
• “Pop and Click” Noise Protection Circuit
• Ultra Low Current Shutdown Mode
• 2.2 V–5.5 V Operation
• External Gain Configuration Capability
• External Turn–on Configuration Capability
• Thermal Overload Protection Circuitry
• Pb–Free Packages are Available

Typical Applications
• Portable Electronic Devices
• PDAs
• Mobile Phones
Figure 1. Typical NCP4894 Application Circuit with Differential Input
Figure 2. Typical NCP4894 Application Circuit for Driving Earpiece
PIN DESCRIPTION

<table>
<thead>
<tr>
<th>Pin</th>
<th>Type</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>I</td>
<td>INP</td>
<td>Positive Differential Input</td>
</tr>
<tr>
<td>A2</td>
<td>O</td>
<td>BYPASS</td>
<td>Bypass Capacitor Pin which Provides the Common Mode Voltage</td>
</tr>
<tr>
<td>A3</td>
<td>I</td>
<td>OUTB</td>
<td>Negative BTL Output</td>
</tr>
<tr>
<td>B1</td>
<td>I</td>
<td>VP</td>
<td>Positive Analog Supply of the Cell</td>
</tr>
<tr>
<td>B2</td>
<td>I</td>
<td>SD MODE</td>
<td>Shutdown High or Low Selectivity (Note 1)</td>
</tr>
<tr>
<td>B3</td>
<td>I</td>
<td>VM</td>
<td>Ground</td>
</tr>
<tr>
<td>C1</td>
<td>I</td>
<td>INM</td>
<td>Negative Differential Input</td>
</tr>
<tr>
<td>C2</td>
<td>O</td>
<td>SD SELECT</td>
<td>(Note 1)</td>
</tr>
<tr>
<td>C3</td>
<td>I</td>
<td>OUTA</td>
<td>Positive BTL Output</td>
</tr>
</tbody>
</table>

1. The SD SELECT pin must be toggled to the same state as the SD MODE pin to force the device in shutdown mode.
## MAXIMUM RATINGS (Note 2)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>VP</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>Operating Supply Voltage</td>
<td>Op VP</td>
<td>2.2 to 5.5 V</td>
<td>–</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>Vin</td>
<td>–0.3 to Vcc +0.3</td>
<td>V</td>
</tr>
<tr>
<td>Max Output Current</td>
<td>Iout</td>
<td>500</td>
<td>mA</td>
</tr>
<tr>
<td>Power Dissipation (Note 3)</td>
<td>Pd</td>
<td>Internally Limited</td>
<td>–</td>
</tr>
<tr>
<td>Operating Ambient Temperature</td>
<td>TA</td>
<td>–40 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Max Junction Temperature</td>
<td>TJ</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>Tstg</td>
<td>–65 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>Thermal Resistance Junction–to–Air</td>
<td>RθJA</td>
<td>200</td>
<td>°C/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>70</td>
<td>(Note 4)</td>
</tr>
<tr>
<td>ESD Protection</td>
<td></td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 2000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 200</td>
<td></td>
</tr>
<tr>
<td>Latchup Current at TA = 85°C (Note 7)</td>
<td></td>
<td>±100 mA</td>
<td></td>
</tr>
</tbody>
</table>

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Maximum electrical ratings are defined as those values beyond which damage to the device may occur at TA = +25°C.
2. The thermal shutdown set to 160°C (typical) avoids irreversible damage on the device due to power dissipation. For further information see page 7.
3. For the 9–Pin Flip–Chip CSP package, the RθJA is highly dependent of the PCB Heatsink area. For example, RθJA can equal 195°C/W with 50 mm² total area and also 135°C/W with 500 mm². For further information see page 10. The bumps have the same thermal resistance and all need to be connected to optimize the power dissipation.
4. Human Body Model, 100 pF discharged through a 1.5 kΩ resistor following specification JESD22/A114.
5. Machine Model, 200 pF discharged through all pins following specification JESD22/A115.
6. Maximum ratings per JEDEC standard JESD78.
## ELECTRICAL CHARACTERISTICS

Limits apply for $T_A$ between $-40\,^\circ C$ to $+85\,^\circ C$ (Unless otherwise noted).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Min (Note 8)</th>
<th>Typ</th>
<th>Max (Note 8)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Quiescent Current</td>
<td>$I_{dd}$</td>
<td>$V_P = 3.0, V$, No Load</td>
<td>–</td>
<td>1.9</td>
<td>–</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 5.0, V$, No Load</td>
<td>–</td>
<td>2.1</td>
<td>–</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 3.0, V$, $8.0, \Omega$</td>
<td>–</td>
<td>2.0</td>
<td>–</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 5.0, V$, $8.0, \Omega$</td>
<td>–</td>
<td>2.2</td>
<td>4.0</td>
<td>mA</td>
</tr>
<tr>
<td>Common Mode Voltage</td>
<td>$V_{cm}$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>$V_P/2$</td>
<td>V</td>
</tr>
<tr>
<td>Shutdown Current</td>
<td>$I_{SD}$</td>
<td>For $V_P$ between 2.2 to 5.5 V</td>
<td>–</td>
<td>20</td>
<td>600</td>
<td>nA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$SDM = SDS = GND$, $T_A = 25,^\circ C$</td>
<td>–</td>
<td>–</td>
<td>2.0</td>
<td>$\mu A$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_A = -40,^\circ C$ to $+85,^\circ C$</td>
<td>–</td>
<td>–</td>
<td>2.0</td>
<td>$\mu A$</td>
</tr>
<tr>
<td>SD SELECT Threshold High</td>
<td>$V_{SDIH}$</td>
<td>–</td>
<td>1.4</td>
<td>–</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td>SD SELECT Threshold Low</td>
<td>$V_{SDIL}$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.4</td>
<td>V</td>
</tr>
<tr>
<td>Turning On Time (Note 10)</td>
<td>$T_{WU}$</td>
<td>$C_{by} = 1.0, \mu F$</td>
<td>–</td>
<td>140</td>
<td>–</td>
<td>ms</td>
</tr>
<tr>
<td>Turning Off Time (Note 10)</td>
<td>$T_{SD}$</td>
<td>–</td>
<td>–</td>
<td>20</td>
<td>–</td>
<td>ms</td>
</tr>
<tr>
<td>Output Swing</td>
<td>$V_{loadpeak}$</td>
<td>$V_P = 3.0, V$, $R_L = 8.0, \Omega$</td>
<td>–</td>
<td>2.5</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 5.0, V$, $R_L = 8.0, \Omega$ (Note 9)</td>
<td>4.0</td>
<td>4.3</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_A = 25,^\circ C$</td>
<td>3.85</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$T_A = -40,^\circ C$ to $+85,^\circ C$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Rms Output Power</td>
<td>$P_O$</td>
<td>$V_P = 3.0, V$, $R_L = 8.0, \Omega$</td>
<td>–</td>
<td>0.39</td>
<td>–</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$THD + N &lt; 0.1%$</td>
<td>–</td>
<td>0.48</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 3.3, V$, $R_L = 8.0, \Omega$</td>
<td>–</td>
<td>1.08</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$THD + N &lt; 0.1%$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Output Offset Voltage</td>
<td>$V_{OS}$</td>
<td>For $V_P$ between 2.2 V to 5.5 V</td>
<td>$-30$</td>
<td>1.0</td>
<td>30</td>
<td>mV</td>
</tr>
<tr>
<td>Power Supply Rejection Ratio</td>
<td>PSRR V+</td>
<td>$G = 2.0$, $R_L = 8.0, \Omega$</td>
<td>–</td>
<td>64</td>
<td>–</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{ripple_{pp}} = 200, mV$</td>
<td>–</td>
<td>63</td>
<td>–</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$C_{by} = 1.0, \mu F$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Input Terminated with 10 \Omega</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$F = 217, Hz$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 5.0, V$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 3.0, V$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$F = 1.0, kHz$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 5.0, V$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 3.0, V$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Efficiency</td>
<td>$\eta$</td>
<td>$V_P = 3.0, V$, $P_{rms} = 380, mW$</td>
<td>–</td>
<td>64</td>
<td>–</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 5.0, V$, $P_{rms} = 1.0, W$</td>
<td>–</td>
<td>63</td>
<td>–</td>
<td>%</td>
</tr>
<tr>
<td>Thermal Shutdown Temperature</td>
<td>$T_{sd}$</td>
<td>–</td>
<td>160</td>
<td>–</td>
<td>–</td>
<td>°C</td>
</tr>
<tr>
<td>Total Harmonic Distortion</td>
<td>THD</td>
<td>$V_P = 3.0, V$, $F = 1.0, kHz$</td>
<td>–</td>
<td>0.007</td>
<td>–</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$R_L = 8.0, \Omega$, $A_V = 2.0$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$P_O = 0.32, W$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_P = 5.0, V$, $F = 1.0, kHz$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$R_L = 8.0, \Omega$, $A_V = 2.0$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$P_O = 1.0, W$</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

8. Min/Max limits are guaranteed by design, test or statistical analysis.

9. This parameter is not tested in production for 9−Pin Flip−Chip CSP package in case of a 5.0 V power supply, however it is correlated based on a 3.0 V power supply testing.

10. See page 12 for a theoretical approach of these parameters.
TYPICAL PERFORMANCE CHARACTERISTICS

Figure 3. THDN versus Frequency

Figure 4. THDN versus Frequency

Figure 5. THDN versus Frequency

Figure 6. THDN versus Frequency

Figure 7. THDN versus Output Power

Figure 8. THDN versus Output Power
TYPICAL PERFORMANCE CHARACTERISTICS

Figure 9. THDN versus Output Power

Figure 10. THDN versus Output Power

Figure 11. THD+N versus Output Power

Figure 12. PSRR @ VP = 5 V

Figure 13. PSRR @ VP = 3 V

Figure 14. PSRR @ VP = 2.2 V
Figure 15. PSRR versus Av @ VP = 3 V

Figure 16. CMRR @ VP = 5 V

Figure 17. CMRR @ VP = 3 V

Figure 18. CMRR @ VP = 2.2 V

Figure 19. Noise Floor @ VP = 3.6 V

Figure 20. PSRR versus Cb @ VP = 3 V
TYPICAL PERFORMANCE CHARACTERISTICS

Figure 21. Turning–on Sequence
@ VP = 5 V and f = 1 kHz

Figure 22. Turning–on Sequence Zoom
@ VP = 5 V and f = 1 kHz

Figure 23. Turning–off Sequence
@ VP = 5 V and f = 1 kHz

Figure 24. Turning–off Sequence Zoom
@ VP = 5 V and f = 1 kHz
TYPICAL PERFORMANCE CHARACTERISTICS

**Figure 25. Power Dissipation versus Output Power**

- $P_D$, POWER DISSIPATION (W)
- $P_{out}$, OUTPUT POWER (W)
- $VP = 5\, V$
- $R_L = 8\, \Omega$
- $F = 1\, kHz$
- $THD + N < 0.1\%$

**Figure 26. Power Dissipation versus Output Power**

- $P_D$, POWER DISSIPATION (W)
- $P_{out}$, OUTPUT POWER (W)
- $VP = 3.3\, V$
- $R_L = 8\, \Omega$
- $F = 1\, kHz$
- $THD + N < 0.1\%$

**Figure 27. Power Dissipation versus Output Power**

- $P_D$, POWER DISSIPATION (W)
- $P_{out}$, OUTPUT POWER (W)
- $VP = 3\, V$
- $R_L = 8\, \Omega$
- $F = 1\, kHz$
- $THD + N < 0.1\%$

**Figure 28. Power Dissipation versus Output Power**

- $P_D$, POWER DISSIPATION (W)
- $P_{out}$, OUTPUT POWER (W)
- $VP = 2.6\, V$
- $R_L = 8\, \Omega$
- $F = 1\, kHz$
- $THD + N < 0.1\%$

**Figure 29. Power Derating – 9–Pin Flip–Chip CSP**

- $P_D$, POWER DISSIPATION (mW)
- $T_A$, AMBIENT TEMPERATURE ($^\circ C$)
- PCB Heatsink Area
- $P_{D_{max}} = 633\, mW$
- for $VP = 5\, V$, $R_L = 8\, \Omega$

**Figure 30. Maximum Die Temperature versus PCB Heatsink Area**

- Maximum Die Temperature 150$^\circ$C
- $VP = 5\, V$
- $VP = 4.2\, V$
- $VP = 3.3\, V$
- $VP = 2.6\, V$
APPLICATION INFORMATION

Detailed Description
The NCP4894 audio amplifier can operate under 2.6 V until 5.5 V power supply. It delivers 320 mW rms output power to 4.0 \( \Omega \) load (VP = 2.6 V) and 1.0 W rms output power to 8.0 \( \Omega \) load (VP = 5.0 V).

The structure of the NCP4894 is basically composed of two identical internal power amplifiers. Both are externally configurable with gain−setting resistors \( R_{in} \) and \( R_{f} \) (the closed−loop gain is fixed by the ratios of these resistors). The load is driven differentially through OUTA and OUTB outputs. This configuration eliminates the need for an output coupling capacitor.

Internal Power Amplifier
The output PMOS and NMOS transistors of the amplifier were designed to deliver the output power of the specifications without clipping. The channel resistance (\( R_{on} \)) of the NMOS and PMOS transistors does not exceed 0.6 \( \Omega \) when they drive current.

The structure of the internal power amplifier is composed of three symmetrical gain stages, first and medium gain stages are transconductance gain stages to obtain maximum bandwidth and DC gain.

Turn–On and Turn–Off Transitions
A cycle with a turn−on and turn−off transition is illustrated with plots that show both single ended signals on the previous page.

In order to eliminate “pop and click” noises during transitions, output power in the load must be slowly established or cut. When logic high is applied to the shutdown pin, the bypass voltage begins to rise exponentially and once the output DC level is around the common mode voltage, the gain is established slowly (20 ms). Using this turn−on mode, the device is optimized in terms of rejection of “pop and click” noises.

A theoretical value of turn−on time at 25°C is given by the following formula.

\[
C_{by} \cdot \text{bypass capacitor} \\
R \cdot \text{internal 150 k resistor with a 25% accuracy} \\
T_{on} = 0.95 \cdot R \cdot C_{by}
\]

The device has the same behavior when it is turned−off by a logic low on the shutdown pin. During the shutdown mode, amplifier outputs are connected to the ground. However, to totally cut the output audio signal, you only need to wait for 20 ms.

Shutdown Function
The device enters shutdown mode once the SD SELECT and SD MODE pins are in the same logic state. This brings flexibility to the design, as the SD MODE pin must be permanently connected to VP or GND on the PCB. If the SD SELECT pin is not connected to the output of a microcontroller or microprocessor, it’s not advisable to let it float. A pulldown or pullup resistor is then suitable.

During the shutdown state, the DC quiescent current has a typical value of 10 nA.

Current Limit Circuit
The maximum output power of the circuit (\( P_{orms} = 1.0 \text{ W}, \text{VP} = 5.0 \text{ V}, R_{L} = 8.0 \Omega \)) requires a peak current in the load of 500 mA.

In order to limit the excessive power dissipation in the load when a short−circuit occurs between both outputs, the current limit in the load is fixed to 800 mA.

Thermal Overload Protection
Internal amplifiers are switched off when the temperature exceeds 160°C, and will be switched on again only when the temperature decreases below 140°C.

The NCP4894 is unity−gain stable and requires no external components besides gain−setting resistors, an input coupling capacitor and a proper bypassing capacitor in the typical application.

Both internal amplifiers are externally configurable (\( R_{f} \) and \( R_{in} \)) with gain configuration.

The differential−ended amplifier presents two major advantages:
– The possible output power is four times larger (the output swing is doubled) as compared to a single−ended amplifier under the same conditions.
– Output pins (OUTA and OUTB) are biased at the same potential VP/2, this eliminates the need for an output coupling capacitor required with a single−ended amplifier configuration.

The differential closed loop−gain of the amplifier is given by

\[
A_{vd} = \frac{V_{orms}}{V_{inrms}}
\]

\( V_{orms} \) is the rms value of the voltage seen by the load and \( V_{inrms} \) is the rms value of the input differential signal.

Output power delivered to the load is given by

\[
P_{orms} = \frac{(V_{peak})^2}{2 \cdot R_{L}}
\]

(Vpeak is the peak differential output voltage).

When choosing gain configuration to obtain the desired output power, check that the amplifier is not current limited or clipped.

The maximum current which can be delivered to the load is 500 mA

\[
I_{opeak} = \frac{V_{peak}}{R_{L}}
\]
Gain-Setting Resistor Selection ($R_{in}$ and $R_f$)

$R_{in}$ and $R_f$ set the closed-loop gain of both amplifiers. In order to optimize device and system performance, the NCP4894 should be used in low gain configurations.

The low gain configuration minimizes THD + noise values and maximizes the signal to noise ratio, and the amplifier can still be used without running into the bandwidth limitations.

A closed loop gain in the range from 2 to 5 is recommended to optimize overall system performance.

An input resistor ($R_{in}$) value of 22 kΩ is realistic in most applications, and doesn’t require the use of a very large capacitor $C_{in}$.

Input Capacitor Selection ($C_{in}$)

The input coupling capacitor blocks the DC voltage at the amplifier input terminal. This capacitor creates a high-pass filter with $R_{in}$, the cut-off frequency is given by $f_c = \frac{1}{2 \pi R_{in} C_{in}}$.

The size of the capacitor must be large enough to couple in low frequencies without severe attenuation. However a large input coupling capacitor requires more time to reach its quiescent DC voltage (VP/2) and can increase the turn-on pops.

An input capacitor value between 0.1 µ and 0.39 µF performs well in many applications (With $R_{in} = 22$ kΩ).

Bypass Capacitor Selection ($C_{by}$)

The by-pass capacitor $C_{by}$ provides half-supply filtering and determines how fast the NCP4894 turns on.

This capacitor is a critical component to minimize the turn-on pop. A 1.0 µF bypass capacitor value ($C_{in} = < 0.39$ µF) should produce clickless and popless shutdown transitions. The amplifier is still functional with a 0.1 µF capacitor value but is more susceptible to “pop and click” noises.

Thus, a 1.0 µF bypassing capacitor is recommended.
Figure 32. Demonstration Board for 9–Pin Flip–Chip CSP Device – PCB Layers
# BILL OF MATERIAL

<table>
<thead>
<tr>
<th>Item</th>
<th>Part Description</th>
<th>Ref</th>
<th>PCB Footprint</th>
<th>Manufacturer</th>
<th>Manufacturer Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NCP4894 Audio Amplifier</td>
<td></td>
<td></td>
<td>ON Semiconductor</td>
<td>NCP4894</td>
</tr>
<tr>
<td>2</td>
<td>SMD Resistor 100 kΩ</td>
<td>R3</td>
<td>0603</td>
<td>Vishay–Draloric</td>
<td>CRCW0603 Series</td>
</tr>
<tr>
<td>3</td>
<td>SMD Resistor 20 kΩ</td>
<td>R1, R2, R4, R5</td>
<td>0603</td>
<td>Vishay–Draloric</td>
<td>CRCW0603 Series</td>
</tr>
<tr>
<td>4</td>
<td>Ceramic Capacitor 1.0 μF 6.3 V X5R</td>
<td>C1, C2, C3, C4</td>
<td>0603</td>
<td>Murata</td>
<td>GRM188 Series</td>
</tr>
<tr>
<td>5</td>
<td>Jumper Header Vertical Mount, 2*1, 100 mils</td>
<td>J4, J5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Jumper Connector, 400 mils</td>
<td>J10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I/O Connector. It can be plugged by MC–1,5/3–ST–3,81 (Phoenix Contact Reference)</td>
<td>J2</td>
<td></td>
<td>Phoenix Contact</td>
<td>MC–1,5/3–G</td>
</tr>
<tr>
<td>8</td>
<td>I/O Connector. It can be plugged by BLZ5.08/2 (Weidmüller Reference)</td>
<td>J1, J3</td>
<td></td>
<td>Weidmüller</td>
<td>SL5.08/2/90B</td>
</tr>
</tbody>
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## ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device</th>
<th>Marking</th>
<th>Package</th>
<th>Shipping</th>
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</thead>
<tbody>
<tr>
<td>NCP4894FCT1</td>
<td>MAI</td>
<td>9−Pin Flip−Chip</td>
<td>3000 / Tape &amp; Reel</td>
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<tr>
<td>NCP4894FCT1G</td>
<td>MAI</td>
<td>9−Pin Flip−Chip (Pb−Free)</td>
<td>3000 / Tape &amp; Reel</td>
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<tr>
<td>NCP4894DMR2</td>
<td>MAK</td>
<td>Micro−10</td>
<td>4000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>NCP4894DMR2G</td>
<td>MAK</td>
<td>Micro−10 (Pb−Free)</td>
<td>4000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>NCP4894MNR2</td>
<td>4894</td>
<td>DFN10</td>
<td>3000 / Tape &amp; Reel</td>
</tr>
<tr>
<td>NCP4894MNR2G</td>
<td>4894</td>
<td>DFN10 (Pb−Free)</td>
<td>3000 / Tape &amp; Reel</td>
</tr>
</tbody>
</table>

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

NOTE: This product is offered with either autectic (SnPb−tin/lead) or lead−free solder bumps (G suffix) depending on the PCB assembly process. The NCP4894FCT1G, NCP4894DMR2G, NCP4894MNR2G version requires a lead−free solder paste and should not be used with a SnPb solder paste.
NOTE:
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. TERMINAL b MAY HAVE MOLD COMPOUND MATERIAL ALONG SIDE EDGE. MOLD FLASH MAY NOT EXCEED 30 MICRONS ON TOP SURFACE OF TERMINAL.
6. FOR DEVICE DPN CONTAINING W OPTION, DETAIL A AND DETAIL B ALTERNATE CONSTRUCTIONS ARE NOT APPLICABLE. WETTABLE FLANK CONSTRUCTION IS DETAIL B AS SHOWN ON SIDE VIEW OF PACKAGE.

**This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, “G” or microdot “*”, may or may not be present. Some products may not follow the Generic Marking.**

**NOTES:**

**SCALE 2:1**

**GENERIC MARKING DIAGRAM**

- XXXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- * = Pb-Free Package

(Note: Microdot may be in either location)

**MECHANICAL CASE OUTLINE**

**PACKAGE DIMENSIONS**

**DOCUMENT NUMBER:** 98AON03161D

**DESCRIPTION:** DFN10, 3X3 MM, 0.5 MM PITCH

**PAGE 1 OF 1**

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MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

9 PIN FLIP–CHIP 1.45x1.45x0.596
CASE 499AL
ISSUE A

DATE 21 JUN 2022

NOTES:
2. CONTROLLING DIMENSIONS MILLIMETERS
3. DIMENSION b IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER PARALLEL TO DATUM C.
4. COPLANARITY APPLIES TO THE SPHERICAL CROWNS OF THE SOLDER BALLS.
5. DATUM C, THE SEATING PLANE, IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.

<table>
<thead>
<tr>
<th>DIM</th>
<th>MIN.</th>
<th>NOM.</th>
<th>MAX.</th>
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<tbody>
<tr>
<td>A</td>
<td>0.541</td>
<td>0.596</td>
<td>0.651</td>
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<tr>
<td>A1</td>
<td>0.206</td>
<td>0.236</td>
<td>0.266</td>
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<tr>
<td>A2</td>
<td>0.335</td>
<td>0.360</td>
<td>0.385</td>
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<tr>
<td>b</td>
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<td>0.319</td>
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<tr>
<td>D</td>
<td>1.450 BSC</td>
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<tr>
<td>D1</td>
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</tr>
<tr>
<td>E</td>
<td>1.450 BSC</td>
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</tr>
<tr>
<td>E1</td>
<td>1.000 BSC</td>
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<tr>
<td>e</td>
<td>0.50 BSC</td>
<td></td>
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</tbody>
</table>

**RECOMMENDED MOUNTING FOOTPRINT**

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLIDERRM/B.

**GENERIC MARKING DIAGRAM**

XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G or / = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "x", may or may not be present. Some products may not follow the Generic Marking.
NOTES:
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION "A" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION "B" DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 846B−01 OBSOLETE. NEW STANDARD 846B−02

NOTES:
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