NCP2990

1.3 Wa Ad Pe Amp fe Fa T O Tme s

The NCP2990 is an audio power amplifier designed for portable communication device applications such as mobile phone applications. The NCP2990 is capable of delivering 1.3 W of continuous average power to an 8.0 Ω BTL load from a 5.0 V power supply, and 1.0 W to a 4.0 Ω BTL load from a 3.6 V power supply.

The NCP2990 provides high quality audio while requiring few external components and minimal power consumption. It features a low−power consumption shutdown mode, which is achieved by driving the $\overline{\text{SHUTDOWN}}$ pin with logic low.

The NCP2990 contains circuitry to prevent from “pop and click” noise that would otherwise occur during turn−on and turn−off transitions. It is a zero pop noise device when a single ended audio input is used.

For maximum flexibility, the NCP2990 provides an externally controlled gain (with resistors), as well as an externally controlled turn−on time (with the bypass capacitor). When using a 1 μF bypass capacitor, it offers 60 ms wake up time.

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

This device is available in a 9−Pin Flip−Chip CSP (Lead−Free).

Features

- 1.3 W to an 8.0 Ω BTL Load from a 5.0 V Power Supply
- Superior PSRR: Direct Connection to the Battery
- Zero Pop Noise Signature with a Single Ended Audio Input
- Ultra Low Current Shutdown Mode: 10 nA
- 2.2 V−5.5 V Operation
- External Gain Configuration Capability
- External Turn−on Time Configuration Capability: 60 ms (1 μF Bypass Capacitor)
- Up to 1.0 nF Capacitive Load Driving Capability
- Thermal Overload Protection Circuitry
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Publication Order Number:
NCP2990/D

PIN DESCRIPTION

Pin	Type	Symbol	Description
A1	I	INM	Negative input of the first amplifier, receives the audio input signal. Connected to the feedback resistor R_f and to the input resistor R_{in}.
A2	O	OUTA	Negative output of the NCP2990. Connected to the load and to the feedback resistor Rf.
A3	I	INP	Positive input of the first amplifier, receives the common mode voltage.
B1	I	VM_P	Power Analog Ground.
B2	I	VM	Core Analog Ground.
B3	I	V_p	Positive analog supply of the cell. Range: 2.2 V−5.5 V.
C1	I	BYPASS	Bypass capacitor pin which provides the common mode voltage (Vp/2).
C2	O	OUTB	Positive output of the NCP2990. Connected to the load.
C3	I	$\overline{\text{SHUTDOWN}}$	The device enters in shutdown mode when a low level is applied on this pin.

MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
Supply Voltage	V_p	6.0	V
Operating Supply Voltage	Op Vp	2.2 to 5.5 V 2.0 V = Functional Only	−
Input Voltage	V_{in}	−0.3 to Vcc +0.3	V
Max Output Current	Iout	500	mA
Power Dissipation (Note 2)	Pd	Internally Limited	−
Operating Ambient Temperature	$T_{416.88\ Tm\text{-}0.0119\ Tc[(Operatin.72ef59.76\ 426\ 277.2\ 0.96\ 426.72\ etrefBT8\ 0\ 0\ 8\ 426.}$		

ELECTRICAL CHARACTERISTICS Limits apply for T_A between −40°C to +85°C (Unless otherwise noted).

Characteristic	Symbol	Conditions	Min (Note 6)	Typ	Max (Note 6)	Unit
Supply Quiescent Current	I_{dd}	V_p = 2.6 V, No Load	−	1.5	4	mA
		V_p = 5.0 V, No Load	−	1.7		
		V_p = 2.6 V, 8 Ω	−	1.7	5.5	
		V_p = 5.0 V, 8 Ω	−	1.9		
Common Mode Voltage	V_{cm}	−	1.0	1.7		

TYPICAL PERFORMANCE CHARACTERISTICS

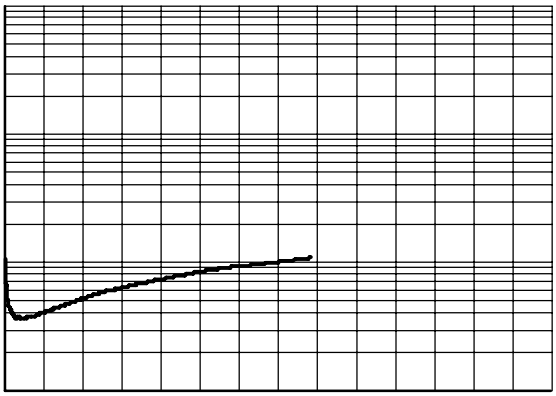
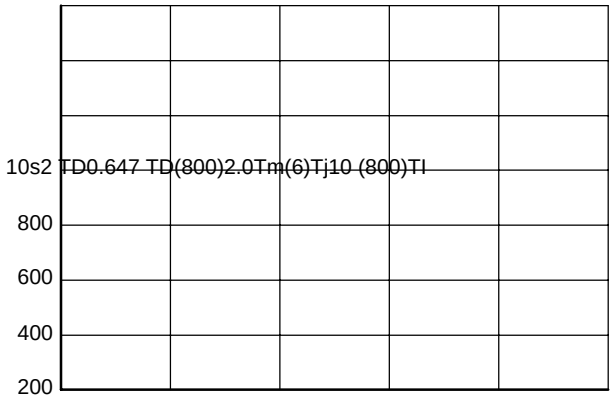


Figure 2. THD+N versus Output Power

TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS

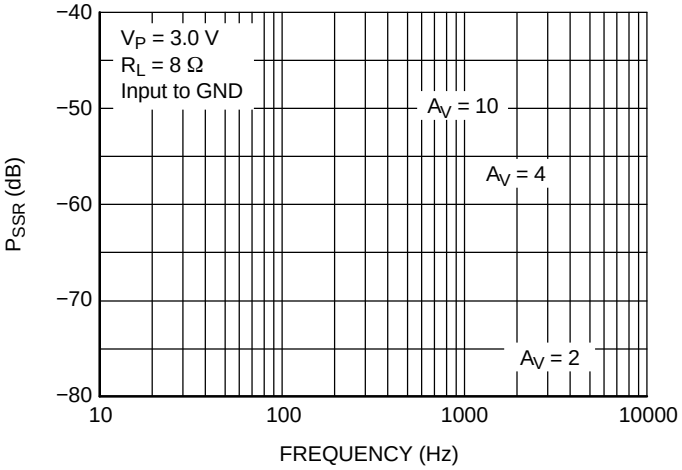


Figure 14. P_{SRR} versus Frequency and Gain @ V_P = 3.0 V

TYPICAL PERFORMANCE CHARACTERISTICS

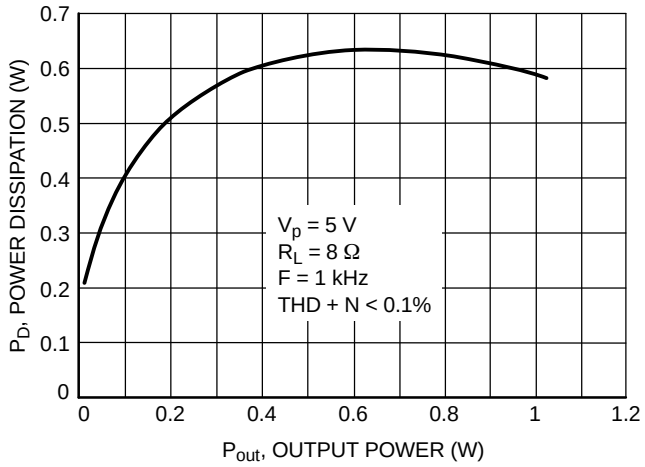


Figure 19. Power Dissipation versus Output Power

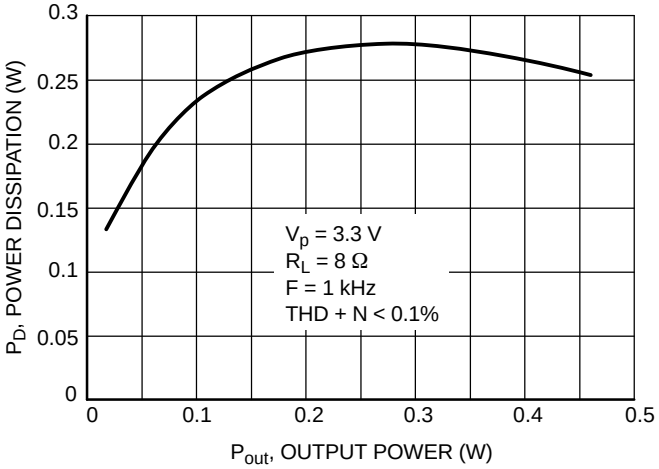


Figure 20. Power Dissipation versus Output Power

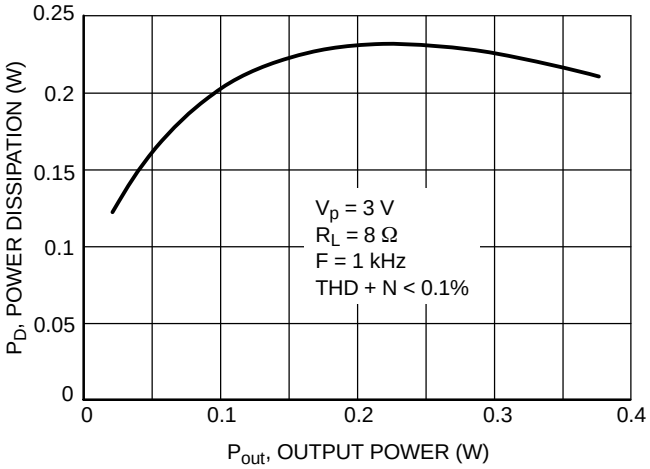


Figure 21. Power Dissipation versus Output Power

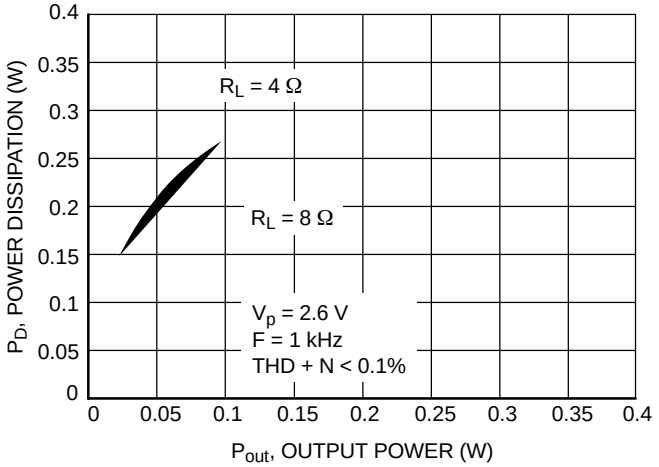


Figure 22. Power Dissipation versus Output Power

APPLICATION INFORMATION

Detailed Description

The NCP2990 audio amplifier can operate under 2.6 V until 5.5 V power supply. With less than 1% THD + N, it can deliver up to 1.2 W RMS output power to an 8.0 Ω load (V_P = 5.0 V). If application allows to reach 10% THD + N, then 1.6 W can be provided using a 5.0 V power supply.

The structure of the NCP2990 is basically composed of two identical internal power amplifiers; the first one is externally configurable with gain−setting resistors R_{in} and R_f (the closed−loop gain is fixed by the ratios of these resistors) and the second is internally fixed in an inverting unity−gain configuration by two resistors of 20 kΩ. So 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 Ω 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

Gain−Setting Resistor Selection (R_{in} and R_f)

R_{in} and R_f set the closed−loop gain of the amplifier.

In order to optimize device and system performance, the NCP2990 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 of applications, and doesn't require the use of a too 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 $fc = \frac{1}{2 * \Pi * R_{in} * C_{in}}$.

The size of the capacitor must be large enough to couple in low frequencies without severe attenuation.

An input capacitor value between 33 nF and 220 nF performs well in many applications (With R_{in} = 22 KΩ).

Bypass Capacitor Selection (Cby)

The bypass capacitor Cby provides half−supply filtering and determines how fast the NCP2990 turns on. With a single−ended audio input, the amplifier will be a zero pop noise device no matter the bypass capacitor.

Figure 25. Schematic of the NCP2990 Demonstration Board

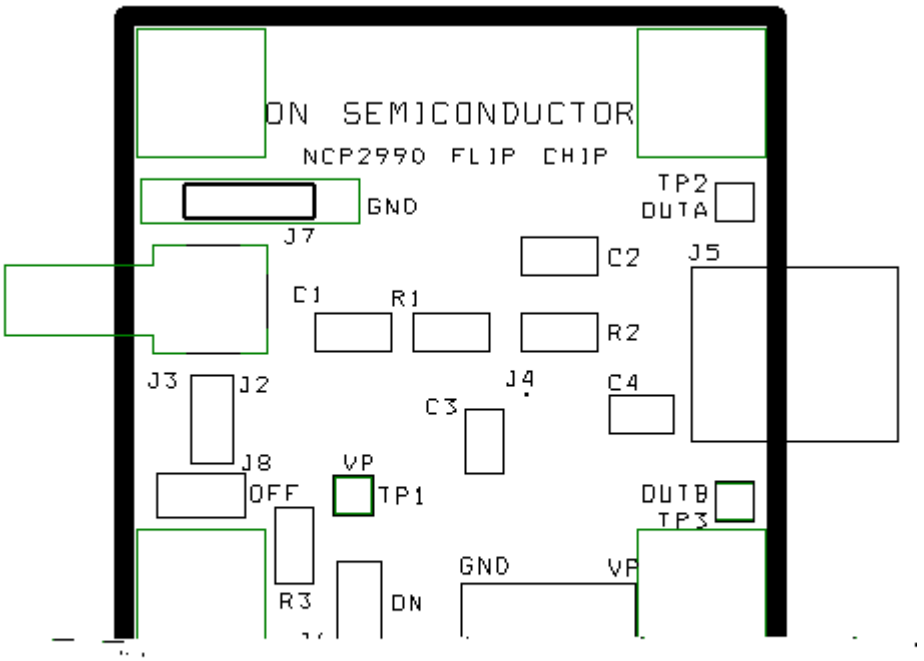


Figure 26. Demonstration Board for 9−Pin Flip−Chip CSP Device − Silkscreen Layers

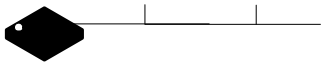
BILL OF MATERIAL

Item	Part Description	Ref.	PCB Footprint	Manufacturer	Manufacturer Reference
1	NCP2990 Audio Amplifier	−	−	ON Semiconductor	NCP2990
2	SMD Resistor 20 KΩ	R1, R2	0805	Panasonic	ERJ−6GEYJ203V
4	SMD Resistor 150 KΩ	R3	0805	Panasonic	ERJ−6GEYJ203V
5	Ceramic Capacitor 47 nF 100 V X7R	C1	0805	TDK	C2012X7R2A473K
6	Ceramic Capacitor 1.0 μF 10 V X7R	C3, C4	0805	TDK	C2012X7R1A105K
7	Jumper Header Vertical Mount, 2 positions, 100 mils	J2, J6, J18	100 mils	Tyco Electronics / AMP	5−826629−0
8	I/O Connector, 2 positions	J1, J5	200 mils	Phoenix Contact	1757242
9	Jumper Connector	J7	400 mils	Harwin	D3082−B01
10	Not Mounted	C2, TP1, TP2, TP3	−	−	−

ORDERING INFORMATION

Device	Marking	Package	Shipping†
NCP2990FCT2G	MBA	9−Pin Flip−Chip CSP (Pb−Free)	3000/Tape and Reel

†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.



9 PIN FLIP−CHIP
CASE 499E 01
ISSUE A

DATE 30 JUN 2004

SCALE 4:1

	MILLIMETERS	
DIM	**MIN**	**MAX**
A	0.540	0.660
A1	0.210	0.270
A2		