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AUD4988
2 x 2W High PSRR 3D Stereowide Audio Amplifier with shutdown mode

General Description

The AUD4988 is a 3D stereo audio power amplifier essentially designed for communication purpose such as mobile phone and other portable devices. It can deliver 2 watt, per channel, of continuous average power to an 4 Ohm BTL load. There is less than 1% distortion from a 5V DC power supply.

The AUD4988 were specifically designed to provide high quality output power with a minimal amount of external components. It requires no output coupling capacitors, for this reason, it is perfectly meet the needs of mobile phone and other low voltage applications where require the consumption of power in the smallest amount.

The AUD4988 add a selectable 3D Stereowide Function to provide the 3D stereo imaging effect. The 3D Stereowide function can be adjusted by the external capacitor to meet user requirement.

To optimize the external components, AUD4988 built-in the gain network with preset gain (Av = 2, 2.8, 4, 5.6 & 8).

The AUD4988 allows shutdown control on the device, if shutdown control pin is being driven to logic low, a low power consumption shutdown mode will be activated. Additionally, the AUD4988 features an internal thermal shutdown protection mechanism.

The AUD4988 has an advanced pop & click circuitry that eliminates the noise during turning on and turning off of the device.

Key Specifications

- Wide Power Supply Voltage Range: $2.7V \leq V_{DD} \leq 5.5V$
- Typical THD at 1W, 8Ω, 1kHz: 0.2% (typ)
- Typical THD at 2W, 4Ω, 1kHz: < 1%
- High PSRR: 64 dB (typ)
- Low Quiescent Current: 2.5 mA per ch (typ)

Features

- 3D Stereowide Function
- Space Saving Thermal Package
- Ultra Low Current Shutdown Mode
- Built-in Gain Configuration
- Unity-gain stable
- Can drive C_L up to 200pF

Applications

- Mobile Phones
- PDAs
- MP3
- PMP
- Notebook Computers
- Portable electronic devices

Typical Application

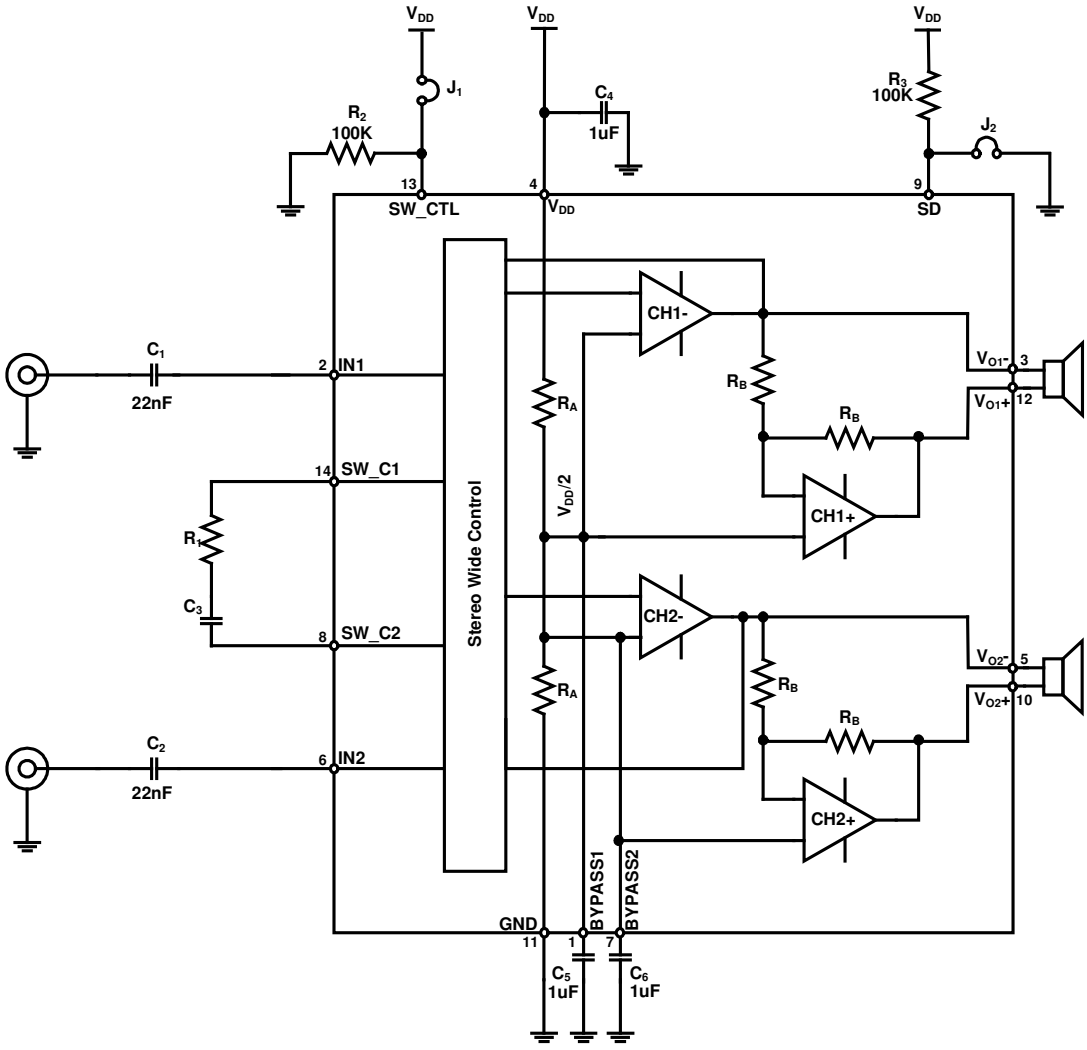
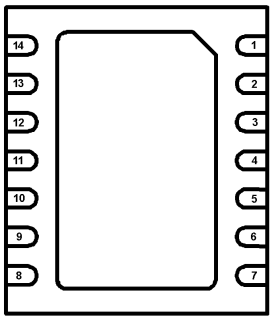


Figure 1 Stereo Audio Power Amplifier with A_V = 2 / 2.8 / 4 / 5.6 / 8

Pin Assignment



AUD4988AD14-4 / AUD4988BD14-4 / AUD4988CD14-4 / AUD4988DD14-4 / AUD4988ED14-4 (Bottom View)

Pin No.	Pin Name	Type	Description
1	BYPASS1	I	Channel 1 common mode voltage
2	IN1	I	Channel 1 Signal Input Pin
3	V_{O1} -	O	Channel 1 negative BTL output
4	V_{DD}	I	Power supply
5	V_{O2} -	O	Channel 2 negative BTL output
6	IN2	I	Channel 2 signal Input Pin
7	BYPASS2	I	Channel 2 common mode voltage
8	SW_C2	I	3D Stereowide Function Capacitor input terminal
9	SD	I	Shutdown selection pin
10	V_{O2} +	O	Channel 2 positive BTL Output
11	GND	I	Ground
12	V_{O1} +	O	Channel 1 positive BTL Output
13	SW_CTL	I	3D Stereowide Function Control pin
14	SW_C1	I	3D Stereowide Function Capacitor input terminal

Operation Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V_{DD}	2.7		5.5	V
Operating Temperature Range	T_A	-40		85	°C

Ordering Information

Part Number*	Package	Marking+
AUD4988AD14-4	14-lead DFN 4x3	A4988AD WXYZ
AUD4988BD14-4	14-lead DFN 4x3	A4988BD WXYZ
AUD4988CD14-4	14-lead DFN 4x3	A4988CD WXYZ
AUD4988DD14-4	14-lead DFN 4x3	A4988DD WXYZ
AUD4988ED14-4	14-lead DFN 4x3	A4988ED WXYZ

+ WXYZ = assembly and date code

* AUD4988 DFN14 package have five options with preset Av configuration

Part Number	Av
AUD4988AD14-4	2
AUD4988BD14-4	2.8
AUD4988CD14-4	4
AUD4988DD14-4	5.6
AUD4988ED14-4	8

Absolute Maximum Ratings

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

Supply Voltage	6.0V	Thermal Resistance	
Storage Temperature	-65℃ to +150℃	θ_{JC} (DFN14 4x3)	63℃/W
Input Voltage	-0.3V to V_{DD} + 0.3V	θ_{JA} (DFN14 4x3)	12℃/W
Power Dissipation	Internally Limited		
ESD Susceptibility	HBM 2000V		
Junction Temperature	150℃		

Electrical Characteristics, V_{DD} = 5V

The following specifications apply for the circuit shown in Figure 1, unless otherwise specified. Limits apply for T_A = 25℃.

Symbol	Parameter	Conditions	AUD4988		Units (Limits)
			Typical	Limit	
I_{DD}	Quiescent Power Supply Current per channel	V_{IN} = 0V, I_O = 0A, No Load	2.5	7.5	mA (max)
		V_{IN} = 0V, I_O = 0A, 8Ω Load	3.5	9	mA (max)
I_{SD}	Shutdown Current	V_{SD} = V_{SD} Mode	-	2	μA (max)
V_{OS}	Output Offset Voltage			30	mV (max)
R_{OUT}	Resistor Output to GND		8.5	9.7	kΩ (max)
				7.0	kΩ (min)
P_O	Output Power (8Ω)	THD+N = 1% (max); f = 1kHz THD+N = 10% (max); f = 1kHz	1.3 1.6		W
	(4Ω)	THD+N = 1% (max); f = 1kHz THD+N = 10% (max); f = 1kHz	TBD TBD		W
T_{WU}	Wake-up time		100	300	ms
THD+N	Total Harmonic Distortion+Noise	P_O = 0.5W; f = 1kHz; R_L = 8Ω P_O = 0.5W; f = 1kHz; R_L = 4Ω	0.2 0.3		%
Xtalk	Crosstalk	P_O = 0.5W; f = 1kHz	-80		dB
PSRR	Power Supply Rejection Ratio	V_{RIPPLE} = 200mV sine p-p Input terminated with 10Ω	-61 (217Hz) -64 (1kHz)		dB
Efficiency	η	V_{DD} = 5.0V, P_O = 1W	63		%

Electrical Characteristics, V_{DD} = 3.7V

The following specifications apply for the circuit shown in Figure 1, unless otherwise specified. Limits apply for T_A = 25℃.

Symbol	Parameter	Conditions	AUD4988		Units (Limits)
			Typical	Limit	
I_{DD}	Quiescent Power Supply Current Per channel	V_{IN} = 0V, I_O = 0A, No Load	3	7.5	mA (max)
		V_{IN} = 0V, I_O = 0A, 8Ω Load	4	9	mA (max)
I_{SD}	Shutdown Current	V_{SD} = V_{SD} Mode	-	2	μA (max)
V_{OS}	Output Offset Voltage			30	mV (max)
P_O	Output Power (8Ω)	THD+N = 1% (max); f = 1kHz THD+N = 10% (max); f = 1kHz	0.65 0.8		W
	(4Ω)	THD+N = 1% (max); f = 1kHz THD+N = 10% (max); f = 1kHz	TBD TBD		W
THD+N	Total Harmonic Distortion+Noise	P_O = 0.5W; f = 1kHz; RL = 4Ω P_O = 0.5W; f = 1kHz; RL = 8Ω	0.2 0.3		%
Xtalk	Crosstalk	P_O = 0.5W; f = 1kHz	-80		dB
PSRR	Power Supply Rejection Ratio	V_{RIPPLE} = 200mV sine p-p Input terminated with 10Ω	-61 (217Hz) -63 (1kHz)		dB
Efficiency	η	V_{DD} = 5.0V, P_O = 1W	63		%

Electrical Characteristics, V_{DD} = 3V

The following specifications apply for the circuit shown in Figure 1, unless otherwise specified. Limits apply for T_A = 25℃.

Symbol	Parameter	Conditions	AUD4988		Units (Limits)
			Typical	Limit	
I_{DD}	Quiescent Power Supply Current Per channel	V_{IN} = 0V, I_O = 0A, No Load	3.5	7.5	mA (max)
		V_{IN} = 0V, I_O = 0A, 8Ω Load	4.5	9	mA (max)
I_{SD}	Shutdown Current	V_{SD} = V_{SD} Mode	-	2	μA (max)
V_{OS}	Output Offset Voltage			30	mV (max)
P_O	Output Power (8Ω)	THD+N = 1% (max); f = 1kHz THD+N = 10% (max); f = 1kHz	0.4 0.5		W
	(4Ω)	THD+N = 1% (max); f = 1kHz THD+N = 10% (max); f = 1kHz	TBD TBD		W
THD+N	Total Harmonic Distortion+Noise	P_O = 0.3W; f = 1kHz; R_L = 8Ω P_O = 0.5W; f = 1kHz; R_L = 4Ω	0.2 0.2		%
Xtalk	Crosstalk	P_O = 0.3W; f = 1kHz	-80		dB
PSRR	Power Supply Rejection Ratio	V_{RIPPLE} = 200mV sine p-p Input terminated with 10Ω	-61 (217Hz) -63 (1kHz)		dB
Efficiency	η	V_{DD} = 5.0V, P_O = 1W	63		%

Application Information

3D Stereowide Function

AUD4988 provided the 3D stereowide function to enhance the sound stage form a stereo audio signal.
Due to the system size constraints or product limitation, the left and right speaker are usually too close to each other, so that the stereo effect should degrade. The 3D sterewide function improves the stereo effect during these situations.
The 3D stereowide effect can be adjusted by the external component R1 and C3, shown in figure 1, while the 3D stereowide mode is enabled by providing the logic high signal on the SW_CLT pin. The R1 adjust the 3D stereowide effect in gain. The low cutoff frequency can be adjusted by R1 and C3.

Shutdown Control

In order to reduce the power consumption while device is not in use, there is shutdown circuitry employed to switch off the amplifier bias of each channel. By applying a logic low signal to shutdown pin of selected channel, the related bias circuitry will be switched off to minimize the current draw. While the device may be disabled with shutdown voltages in between ground and supply, the idle current may be greater than the typical value. To avoid unwanted state changes, the shutdown pin should be tied to a definite voltage.

In many applications, output signal from a microcontroller is used to control the shutdown circuitry, which provides a quick, smooth transition to shutdown. Another solution is to use a single-throw switch in conjunction with an external resistor (pull-up or pull-down, depending on shutdown mode selection). This scheme guarantees that the shutdown pin will not float, thus preventing unwanted state changes.

Selection of External Components

The external components will be the one of the important factor to affect the amplifier performance, proper selection on them will allow system function in more efficiency way. The AUD4988 should be used in low gain configurations to minimize THD+N values, and maximize the signal to noise ratio. Besides gain, another major consideration in system performance is the closed loop bandwidth of the amplifier. To a large extent, the bandwidth is dictated by the choice of external components.

The input coupling capacitor forms a first order high pass filter, which limits low frequency response, and should be chosen based on needed frequency response for a few distinct reasons. In many cases the speakers used in portable systems, whether internal or external, have little ability to reproduce signals below 100Hz to 150Hz. Thus, using a large input capacitor may not increase actual system performance.

Besides minimizing the input capacitor size, careful consideration should be paid to the bypass capacitor value. It will determine how fast the chip turns on.

Power Dissipation

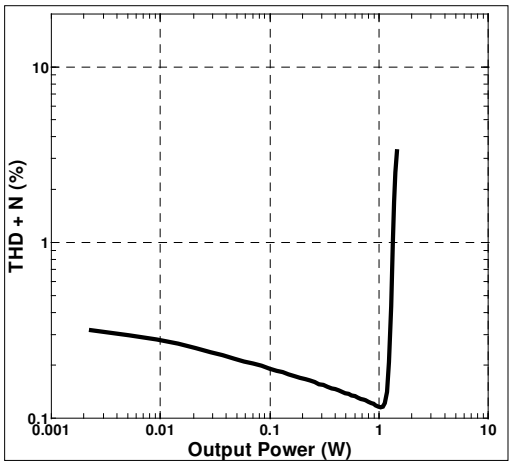
The maximum internal power dissipation pre channel is 4 times that of a single-ended amplifier. The maximum power dissipation for a given application can be derived from the power dissipation graphs or from equation listed below.

$$P_{DMAX} = 4*(V_{DD})^2/(2\pi^2 R_L)$$

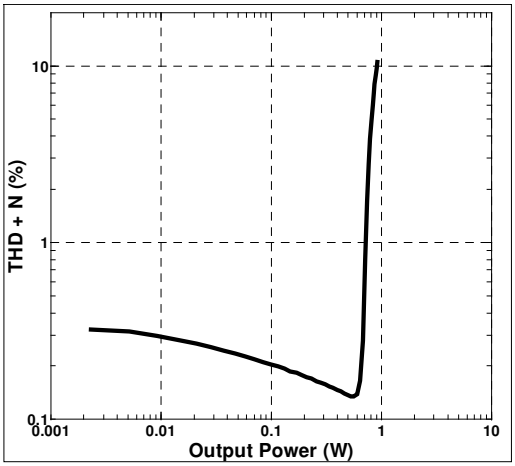
It is critical that the maximum junction temperature T_{JMAX} of 150°C is not exceeded. T_{JMAX} is a function of P_{DMAX} and the PC board foil area. By adding copper foil, the thermal resistance of the application can be reduced from the free air value of θ_{JA}, resulting in higher P_{DMAX} values without thermal shutdown protection circuitry being activated. Additional copper foil can be added to any of the leads connected to the AUD4988.

Typical Performance Characteristics

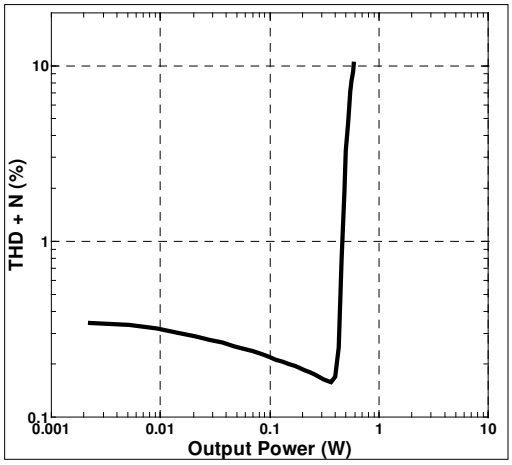
THD+N vs Output Power
V_{DD} = 5V, R_L = 8Ω, and f = 1kHz



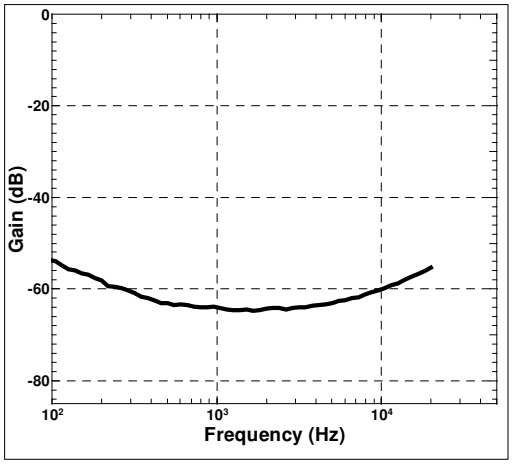
THD+N vs Output Power
V_{DD} = 3.7V, R_L = 8Ω, and f = 1kHz



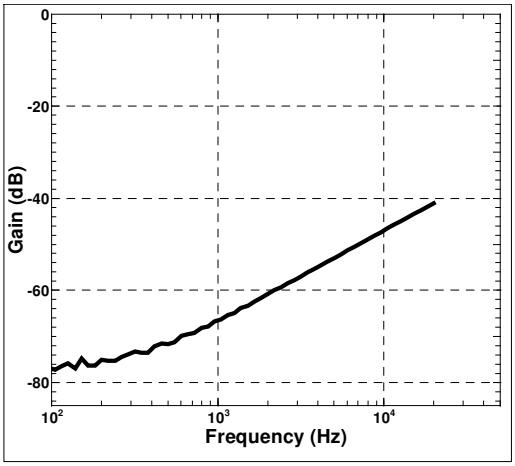
THD+N vs Output Power
V_{DD} = 3V, R_L = 8Ω, and f = 1kHz



Power Supply Rejection Ratio (PSRR) vs Frequency
V_{DD} = 5V, R_L = 8Ω, and Input terminated with 10Ω

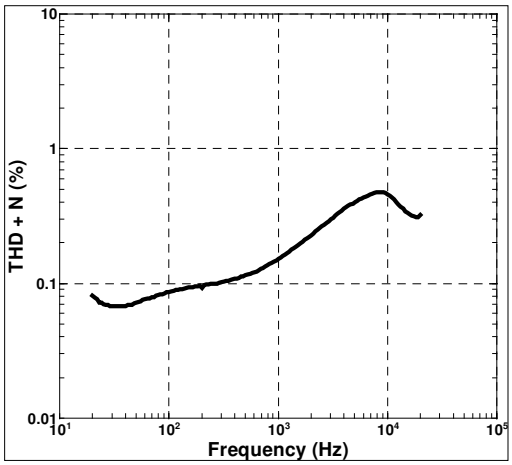


Power Supply Rejection Ratio (PSRR) vs Frequency
V_{DD} = 5V, R_L = 8Ω, and Input Floating

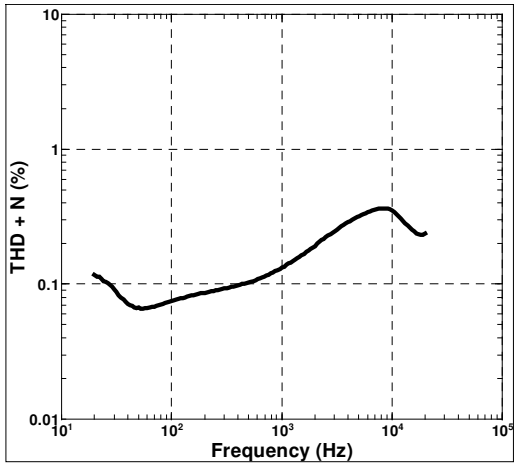


Typical Performance Characteristics

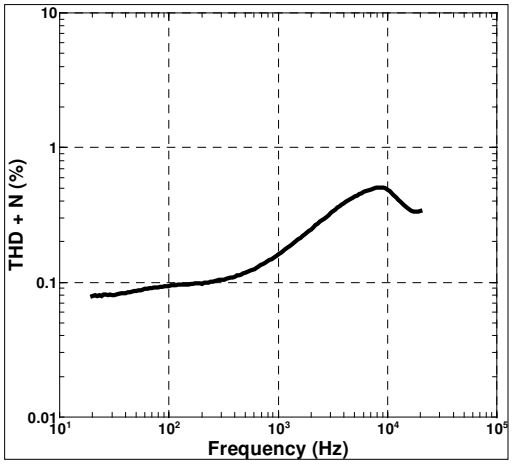
THD + N vs Frequency
V_{DD} = 5V, P_O=250mW, R_L = 8Ω



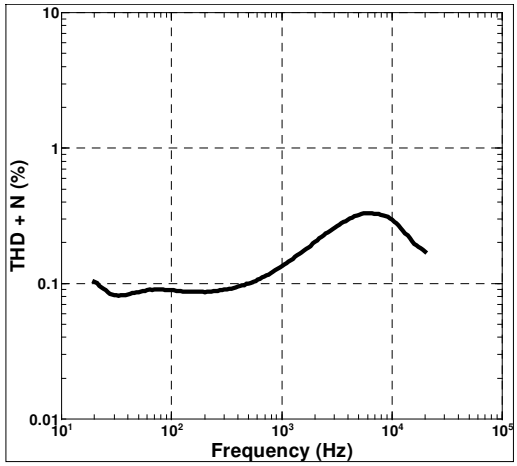
THD + N vs Frequency
V_{DD} = 5V, P_O=500mW, R_L = 8Ω



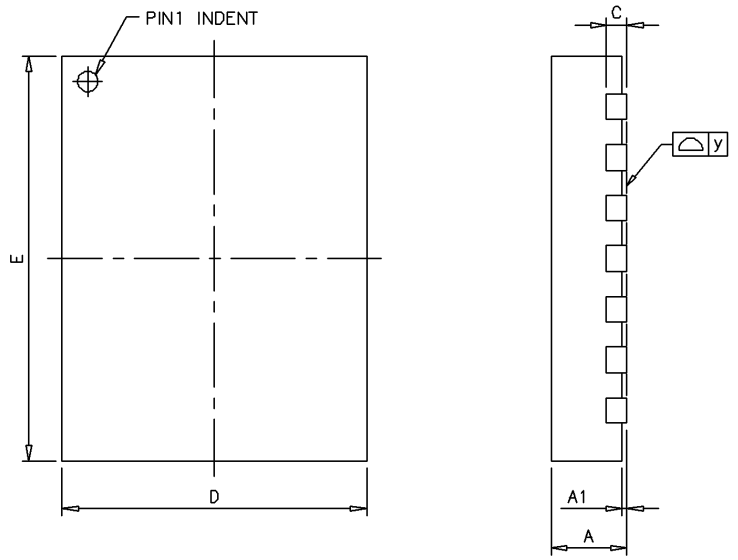
THD + N vs Frequency
V_{DD} = 3.7V, P_O=250mW, R_L = 8Ω



THD + N vs Frequency
V_{DD} = 3.7V, P_O=500mW, R_L = 8Ω



Package Dimensions



NOTE:

1.THE TERMINAL #1 IDENTIFIER IS A LASER MARKED FEATURE

SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
b	0.18	0.25	0.30
C	——	0.20 REF.	——
D	2.90	3.00	3.10
D2	1.55	1.60	1.65
E	3.90	4.00	4.10
E2	2.95	3.00	3.05
e	——	0.50	——
L	0.35	0 40	0.45
y	0 00	——	0.075

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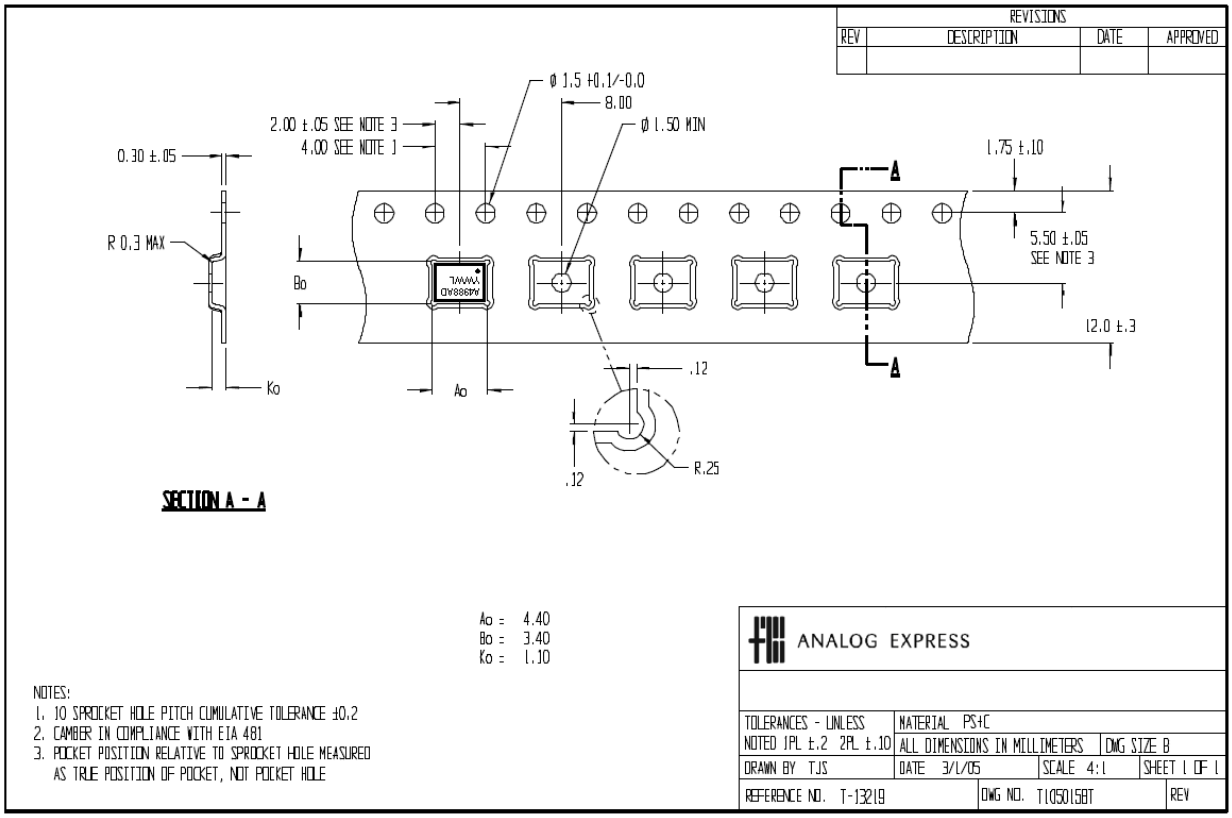
TITLE:

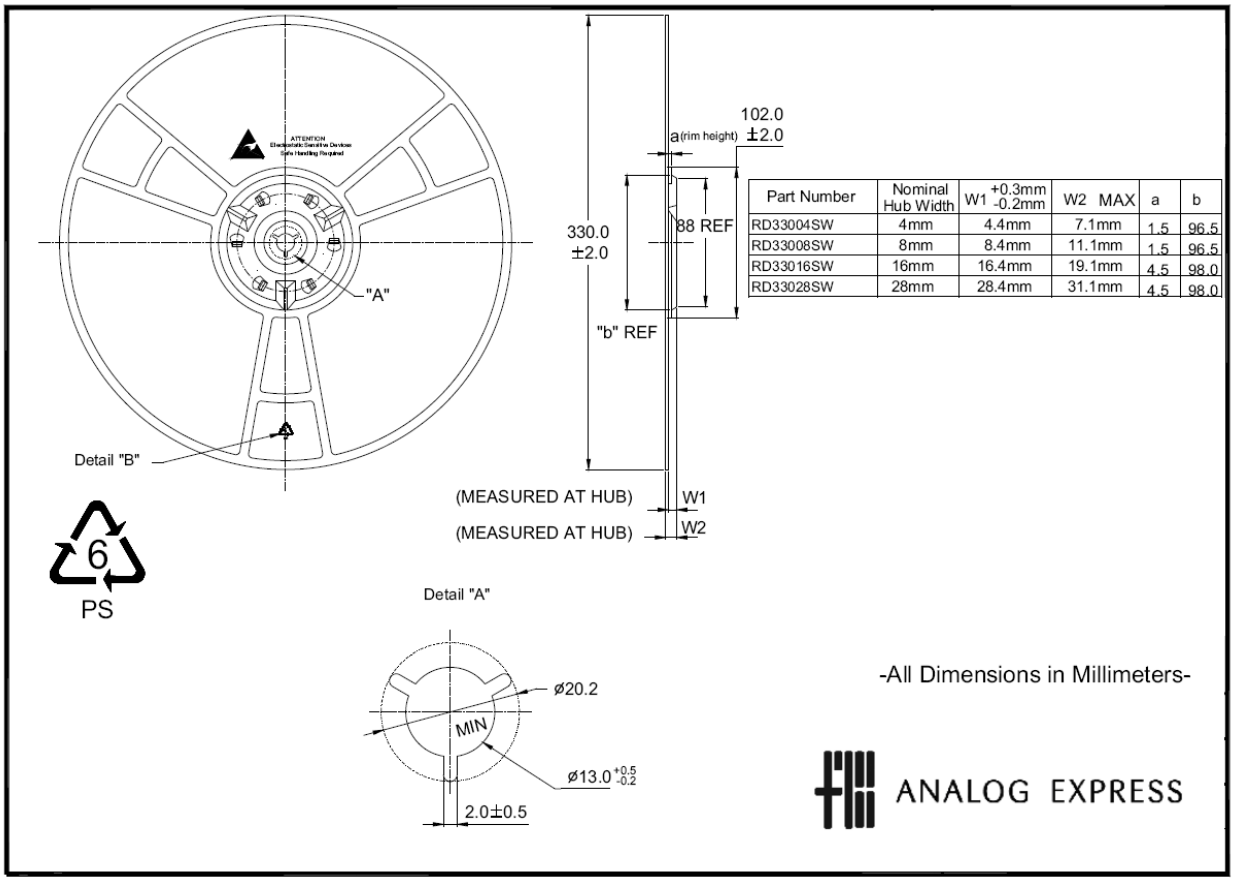
PACKAGE OUTLINE

DFN14 4X3

REF NO. 070314-1443 REV. A

Tape and Reel Drawing





Part Number	Nominal Hub Width	W1 +0.3mm -0.2mm	W2 MAX	a	b
RD33004SW	4mm	4.4mm	7.1mm	1.5	96.5
RD33008SW	8mm	8.4mm	11.1mm	1.5	96.5
RD33016SW	16mm	16.4mm	19.1mm	4.5	98.0
RD33028SW	28mm	28.4mm	31.1mm	4.5	98.0

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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