ANALOG EXPRESS

October 2008

AUD4990
2W Audio Power Amplifier with Selectable Shutdown

General Description

The AUD4990 is an audio power amplifier for mobile phone and other portable electronic device applications. It can deliver 1.3 watts of continuous average power to an 8 ohm BTL (bridge tied load) and 2 watts of continuous average power to a 4 ohm BTL, with less than 1% distortion from a 5V DC power supply.

The AUD4990 is specifically designed to provide high output power with a minimal amount of external components. It requires no output coupling capacitors, for instance. Because of its space-saving footprint, it perfectly meets the needs of mobile phones, PDAs, notebook computers and other low-voltage applications that require small power sources in a small package.

The AUD4990 can offer a low standby current and a zero shutdown current. Furthermore, the amplifier's startup time is fast enough to use its shutdown mode as a mute function.

The AUD4990 features circuitry that eliminates pop-and-click noise whenever the device is turned on or off.

Key Specifications

- Wide Power Supply Voltage Range: $2.7V \leq V_{DD} \leq 5.5$
- Typical THD at 1W, 8Ω: 0.2% (typ)
- High PSRR: 68 dB (typ)
- Low Quiescent Current: 2.5 mA (typ)

Features

- Space Saving Thermal Package
- Active High or Low Shutdown Mode
- External Gain Configuration
- Stable Unity Gain
- Can Drive C_L up to 200pF

Applications

- Mobile Phones
- PDAs
- Notebook Computers
- Portable Electronic Devices

Typical Application

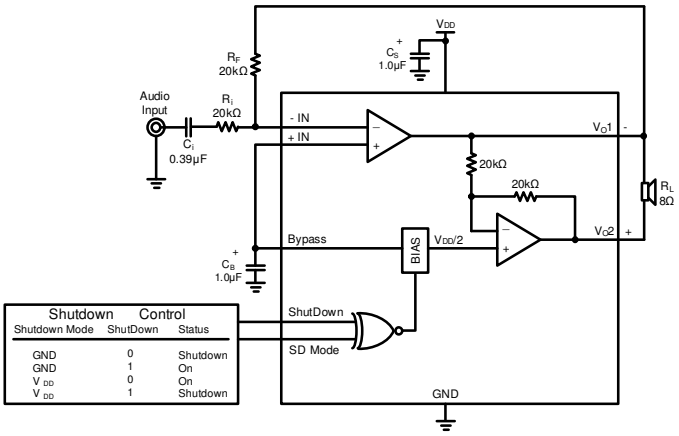


Figure 1 Audio Power Amplifier with $A_V = 2$

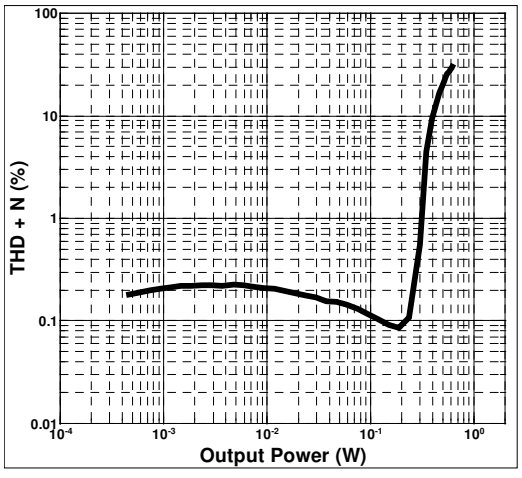
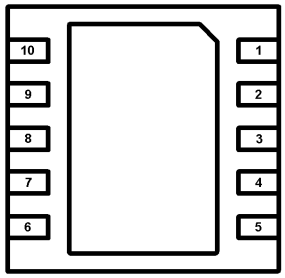
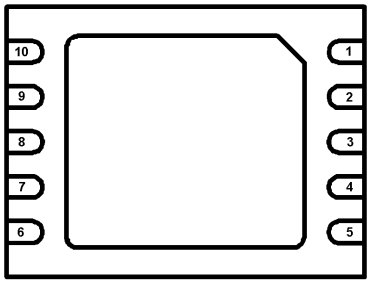


Figure 2 THD + N vs Output Power

Pin Assignment



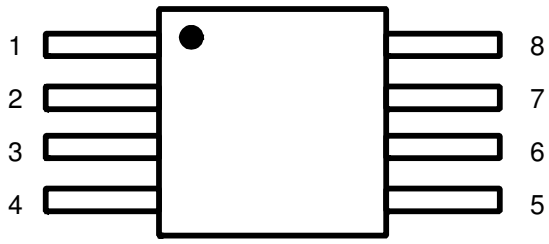
AUD4990D10-3 (Bottom View)



AUD4990D10-4 (Bottom View)

Pin No.	Pin Name	Type	Description
1	SD	I	Shutdown Selection Pin
2	BYPASS	I	Common Mode Voltage
3	SD MODE	I	Shutdown Mode Selection Pin
4	+ IN	I	Positive Differential Input
5	- IN	I	Negative Differential Input
6	V_{O1}	O	Negative BTL Output
7	--	--	NC Pin
8	V_{DD}	I	Power Supply
9	GND	I	Ground
10	V_{O2}	O	Positive BTL Output

Pin Assignment (continuous)

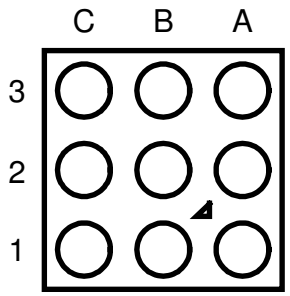


AUD4990MS08 (Top View)

Pin No.	Pin Name	Type	Description
1	SD	I	Shutdown Selection Pin
2	BYPASS	I	Common Mode Voltage
3	+ IN	I	Positive Differential Input
4	- IN	I	Negative Differential Input
5	V_{O1}	O	Negative BTL Output
6	V_{DD}	I	Power Supply
7	GND	I	Ground
8	V_{O2}	O	Positive BTL Output

**SD MODE pin shorted to GND in the MSOP8 package*

Pin Assignment (continuous)



AUD4990CS09 (Ball View)

Pin No.	Pin Name	Type	Description
A1	- IN	I	Negative Differential Input
A2	V_{O1}	O	Negative BTL Output
A3	+ IN	I	Positive Differential Input
B1	SD MODE	I	Shutdown Mode Selection Pin
B2	GND	I	Ground
B3	V_{DD}	I	Power Supply
C1	BYPASS	I	Common Mode Voltage
C2	V_{O2}	O	Positive BTL Output
C3	SD	I	Shutdown Selection Pin

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+
AUD4990D10-3	10-lead DFN 3x3 (Pb-Free)	A4990D WXYZ
AUD4990D10-4	10-lead DFN 4x3 (Pb-Free)	A4990D WXYZ
AUD4990MS08	8-lead MSOP8 (Pb-Free)	A4990M WXYZ
AUD4990CS09	9-Ball CSP09 (Pb-Free)	4990 WXYZ

+ WXYZ = assembly and date code

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} (DFN10 4x3)	63℃/W
Input Voltage	-0.3V to V_{DD} + 0.3V	θ_{JA} (DFN10 4x3)	12℃/W
Power Dissipation	Internally Limited	θ_{JC} (DFN10 3x3)	55℃/W
ESD Susceptibility	HBM 2000V	θ_{JA} (DFN10 3x3)	10℃/W
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	AUD4990		Units
			Typical	Limit	
I_{DD}	Quiescent Power Supply Current	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	0.1	2.0	µA (max)
V_{OS}	Output Offset Voltage			25	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 = 10% (max); f = 1kHz THD+N = 1% (max); f = 1kHz	1.6 1.2		W
	(4Ω)	THD+N = 10% (max); f = 1kHz THD+N = 1% (max); f = 1kHz	2.5 2.0		W
T_{WU}	Wake-up time			300	ms
THD+N	Total Harmonic Distortion+Noise	P_O = 0.5W; f = 1kHz	0.2		%
PSRR	Power Supply Rejection Ratio	V_{RIPPLE} = 200mV sine p-p Input terminated with 10Ω	60 (217Hz) 68 (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	AUD4990		Units (Limits)
			Typical	Limit	
I_{DD}	Quiescent Power Supply Current	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	0.1	2.0	µA (max)
V_{OS}	Output Offset Voltage			25	mV (max)
P_O	Output Power (8Ω)	THD+N = 10% (max); f = 1kHz THD+N = 1% (max); f = 1kHz	0.75 0.65		W
	(4Ω)	THD+N = 10% (max); f = 1kHz THD+N = 1% (max); f = 1kHz	1.3 1.0		W

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	AUD4990		Units (Limits)
			Typical	Limit	
I_{DD}	Quiescent Power Supply Current	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	0.1	2.0	μA (max)
V_{OS}	Output Offset Voltage			25	mV (max)
P_O	Output Power (8Ω)	THD+N = 10% (max); f = 1kHz THD+N = 1% (max); f = 1kHz	0.55 0.4		W
	(4Ω)	THD+N = 10% (max); f = 1kHz THD+N = 1% (max); f = 1kHz	0.8 0.6		W

Application Information

Shutdown Control

Shutdown circuitry is employed to switch off the amplifier bias in order to reduce power consumption. The circuit contains two input pins: a shutdown mode pin (SD Mode) and shutdown pin with selectable input level. This allows the user to implement high- or low-switch commands to control the shutdown circuit. Normally, the SD mode pin is permanently tied to VDD or GND, with the shutdown pin controlling the shutdown function. When the SD mode is calibrated to VDD, the device's shutdown mode is set at its high switch position. On the other hand, if SD mode is set to GND, the low switch setting will trigger the device to shut down. To avoid unwanted status changes, the shutdown pin should be tied to a definite voltage.

In many applications, the 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 status changes.

Selection of External Components

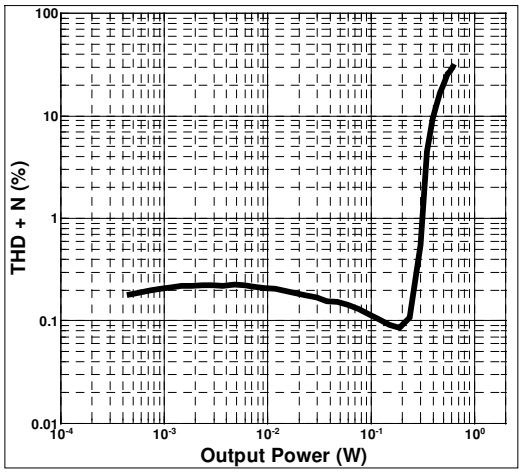
The external components used play an important factor in affecting amplifier performance, with the proper selection enabling more efficient system functions. The AUD4990 should be used in low gain configurations to minimize THD+N values, and maximize the signal-to-noise ratio. Besides gain, another major 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 that limits low frequency response, and should be chosen based on the required frequency response. 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.

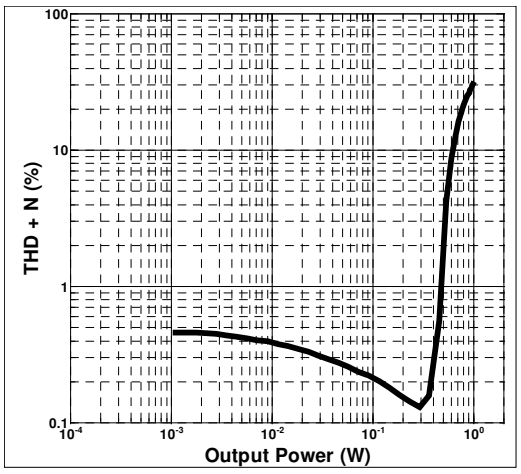
Besides minimizing the input capacitor size, careful consideration should be paid to the bypass capacitor value, as it will determine how fast the chip turns on.

Typical Performance Characteristics

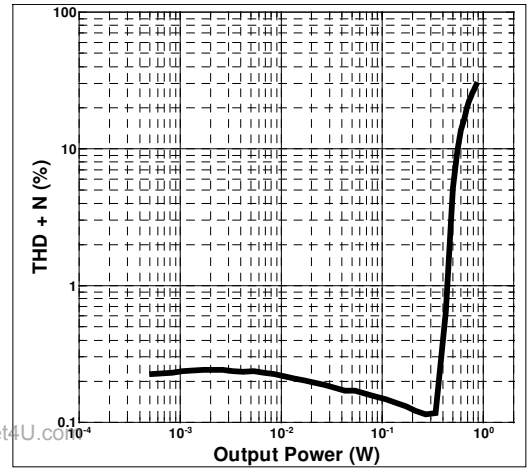
THD+N vs Output Power
V_{DD} = 2.7V, R_L = 8Ω, and f = 1kHz



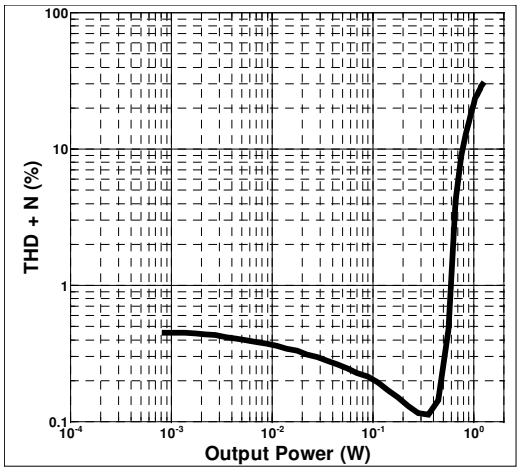
THD+N vs Output Power
V_{DD} = 2.7V, R_L = 4Ω, and f = 1kHz



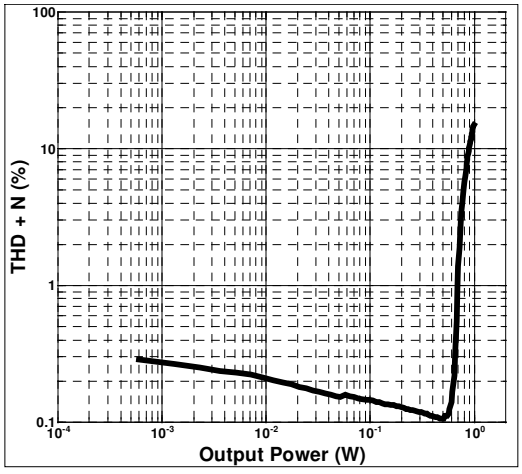
THD+N vs Output Power
V_{DD} = 3V, R_L = 8Ω, and f = 1kHz



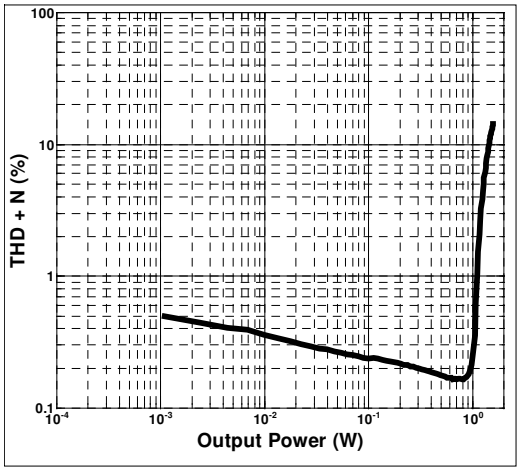
THD+N vs Output Power
V_{DD} = 3V, R_L = 4Ω, and f = 1kHz



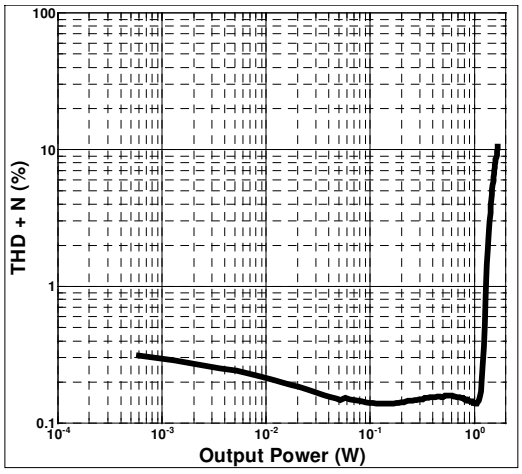
THD+N vs Output Power
V_{DD} = 3.7V, R_L = 8Ω, and f = 1kHz



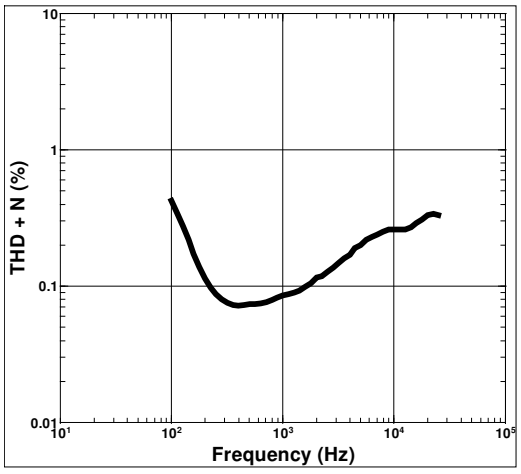
THD+N vs Output Power
V_{DD} = 3.7V, R_L = 4Ω, and f = 1kHz



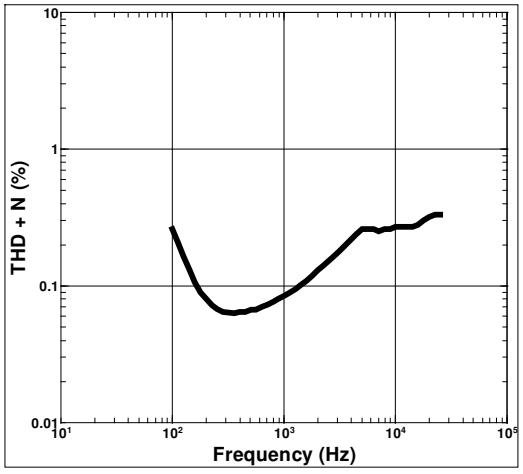
THD+N vs Output Power
V_{DD} = 5V, R_L = 8Ω, and f = 1kHz



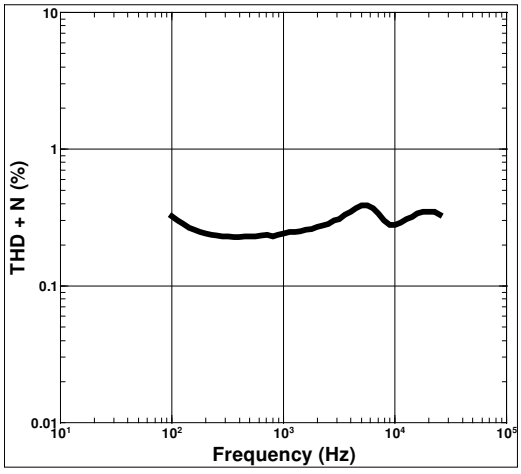
THD+N vs Frequency
V_{DD} = 5V, R_L = 8Ω, and P_O = 500mW



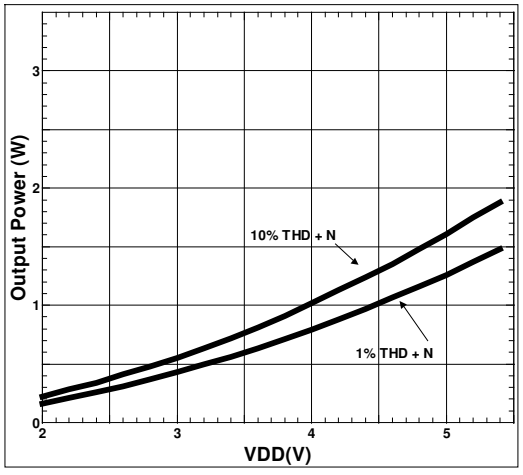
THD+N vs Frequency
V_{DD} = 3.3V, R_L = 8Ω, and P_O = 350mW



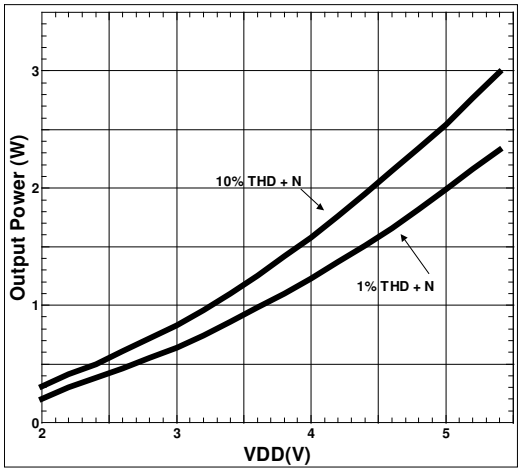
THD+N vs Frequency
V_{DD} = 3.3V, R_L = 4Ω, and P_O = 500mW



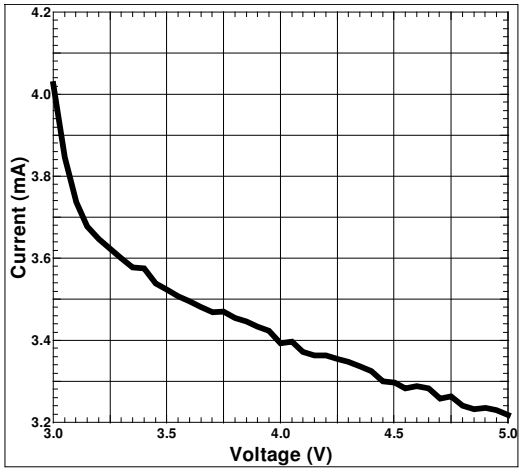
Output Power vs V_{DD}
Freq = 1kHz, R_L = 8Ω



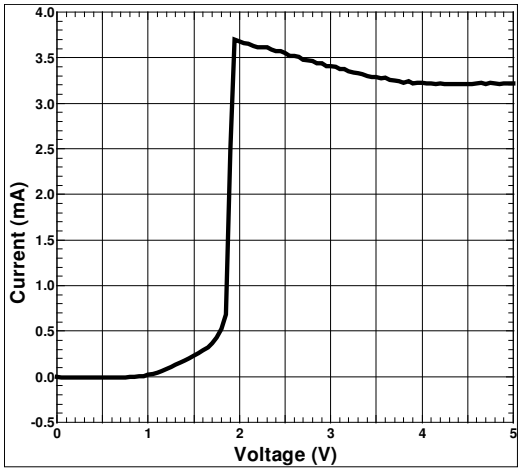
Output Power vs V_{DD}
Freq = 1kHz, R_L = 4Ω



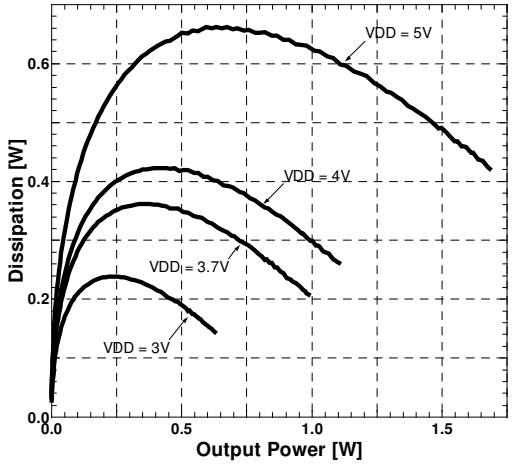
Enable Current vs V_{DD}



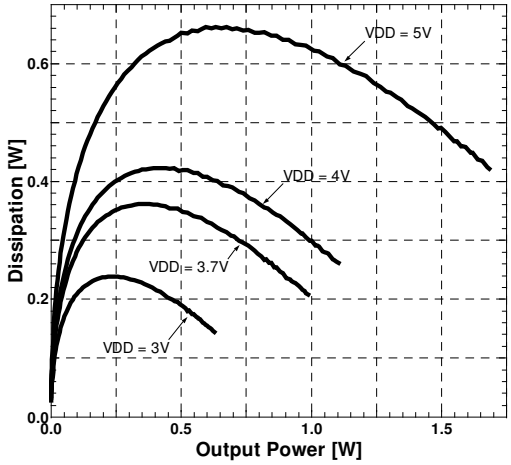
Enable Current vs Enable Voltage



Power Dissipation Vs Output Power @ R_L = 8Ohm

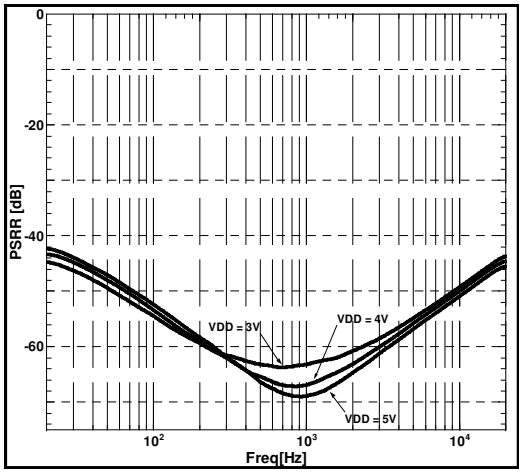


Power Dissipation Vs Output Power @ R_L = 4Ohm

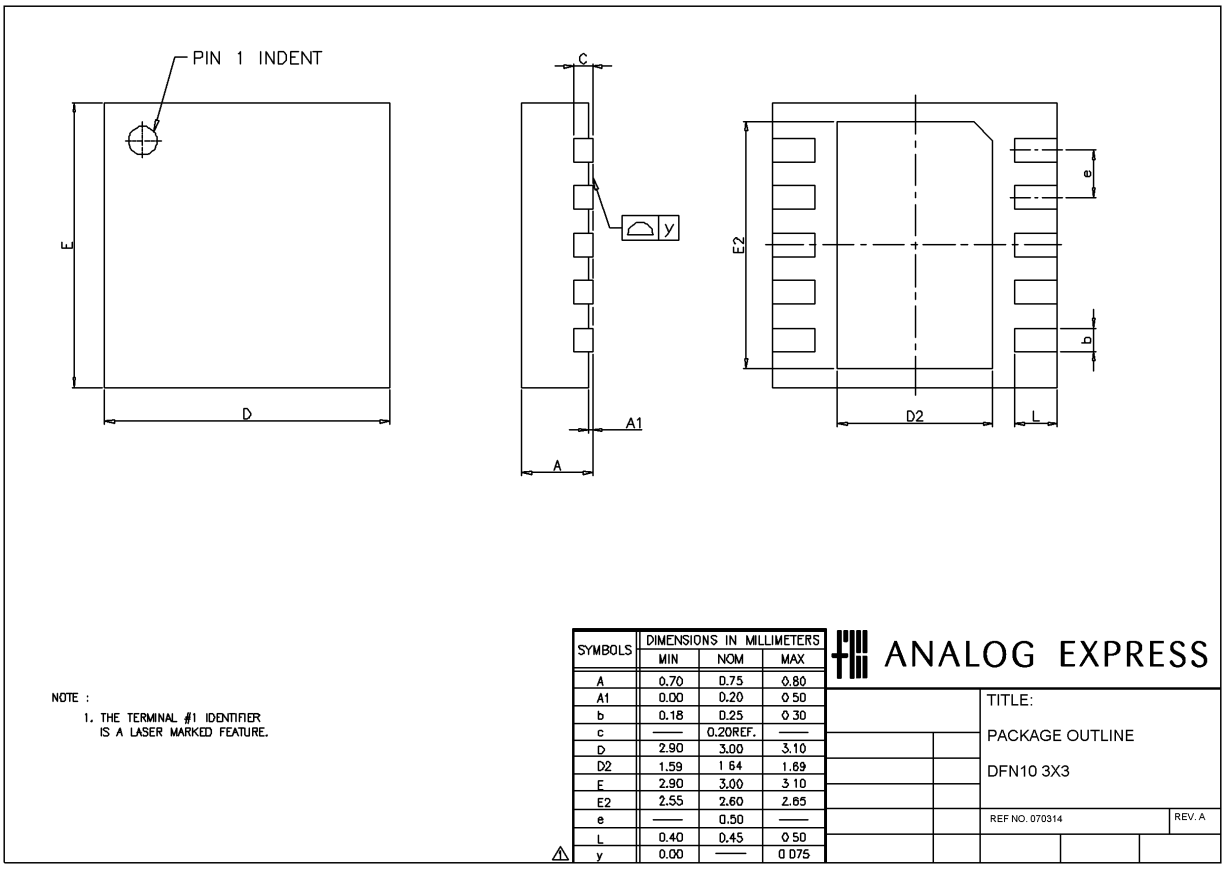


Power Supply Rejection Ratio (PSRR) vs Frequency

V_{DD} = 5V, R_L = 8Ω, Input 10Ω terminated



Package Dimensions

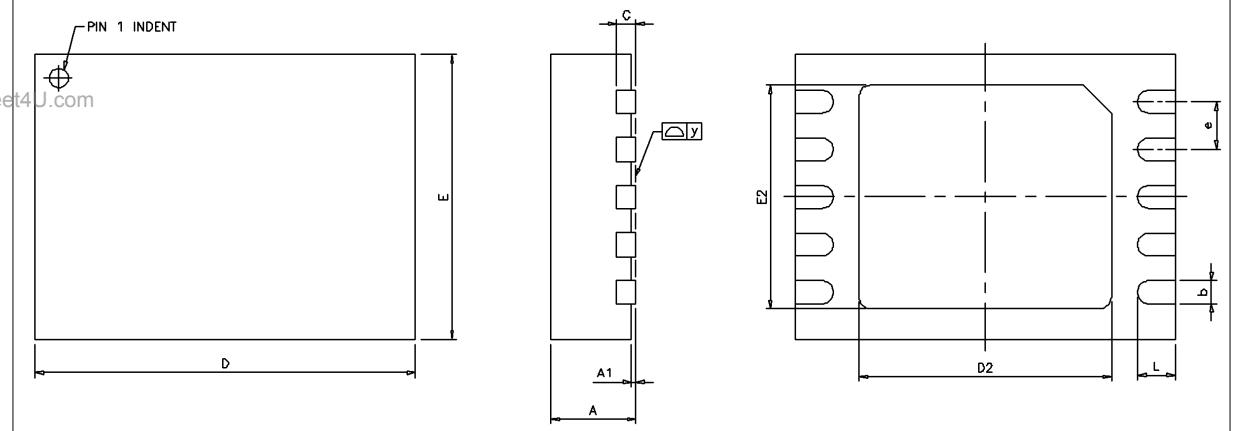


NOTE :
1. THE TERMINAL #1 IDENTIFIER IS A LASER MARKED FEATURE.

SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.20	0.50
b	0.18	0.25	0.30
c	——	0.20REF.	——
D	2.90	3.00	3.10
D2	1.59	1.64	1.69
E	2.90	3.00	3.10
E2	2.55	2.60	2.65
e	——	0.50	——
L	0.40	0.45	0.50
⚠ y	0.00	——	0.075

ANALOG EXPRESS

TITLE:
PACKAGE OUTLINE
DFN10 3X3
REF NO. 070314 REV. A



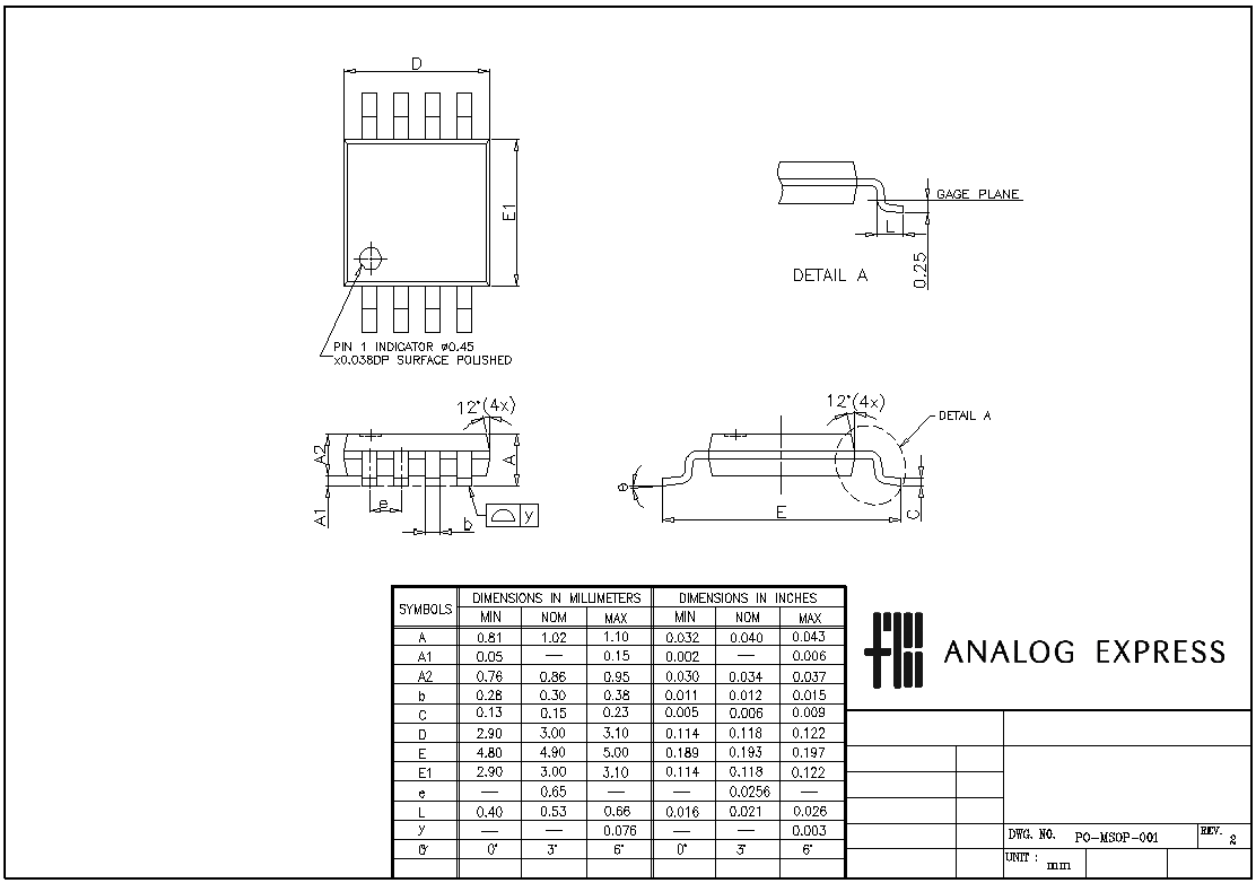
NOTE
1.THE TERMINAL #1 IDENTIFIER IS A LASER MARKED FEATURE

SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0.00	0.02	0.05
b	0.18	0.25	0.30
C	——	0.20 REF.	——
⚠ D	3.90	4.00	4.10
⚠ D2	2.60	2.65	2.70
⚠ E	2.90	3.00	3.10
⚠ E2	2.30	2.35	2.40
e	——	0.50	——
⚠ L	0.35	0.40	0.45
⚠ y	0.00	——	0.075

ANALOG EXPRESS

TITLE:
PACKAGE OUTLINE
DFN10 4X3
REF NO. 070314-1043 REV. A

Package Dimensions

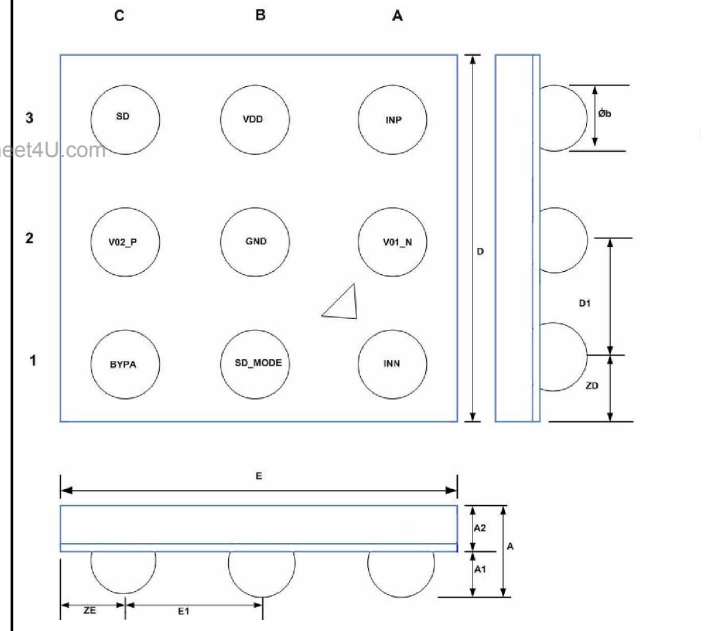


SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.81	1.02	1.10	0.032	0.040	0.043
A1	0.05	—	0.15	0.002	—	0.006
A2	0.76	0.86	0.95	0.030	0.034	0.037
b	0.28	0.30	0.38	0.011	0.012	0.015
C	0.13	0.15	0.23	0.005	0.006	0.009
D	2.90	3.00	3.10	0.114	0.118	0.122
E	4.80	4.90	5.00	0.189	0.193	0.197
E1	2.90	3.00	3.10	0.114	0.118	0.122
e	—	0.65	—	—	0.0256	—
L	0.40	0.53	0.66	0.016	0.021	0.026
y	—	—	0.076	—	—	0.003
θ	0°	3°	6°	0°	3°	6°

ANALOG EXPRESS

DWG. NO. PO-MSOP-001 REV. 2

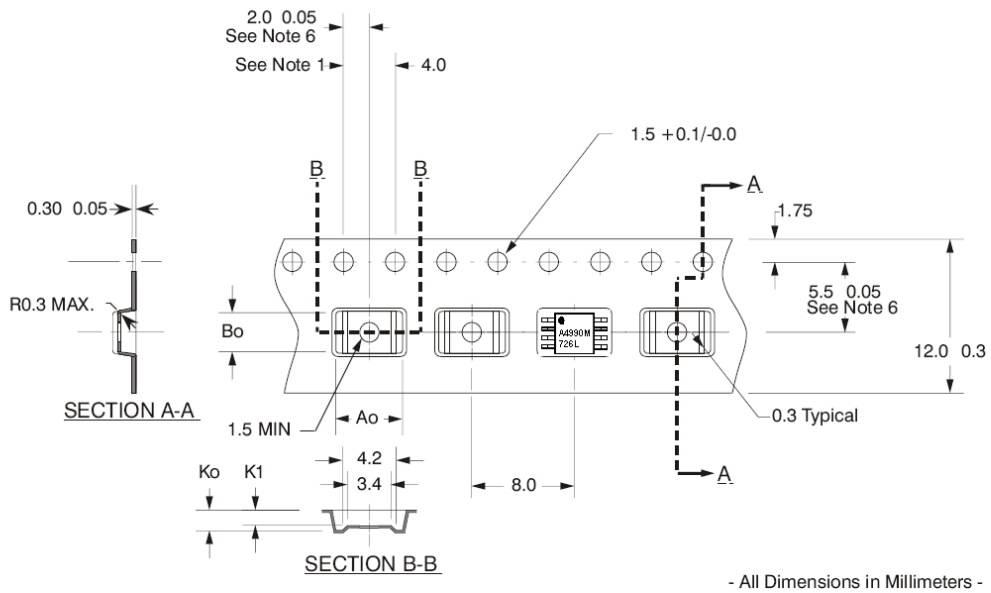
UNIT : mm



Symbol	Dimensions in Millimeter		
	Min.	Nom.	Max.
A	0.525	0.630	0.675
A1	0.250	0.250	0.265
A2	0.330	0.380	0.390
Ø b	0.305	0.320	0.335
D	1.410	1.460	1.510
D1	0.500		
E	1.41	1.460	1.510
E1	0.500		
ZD	0.230		
ZE	0.230		

Tape and Reel Drawing

8-lead MSOP8



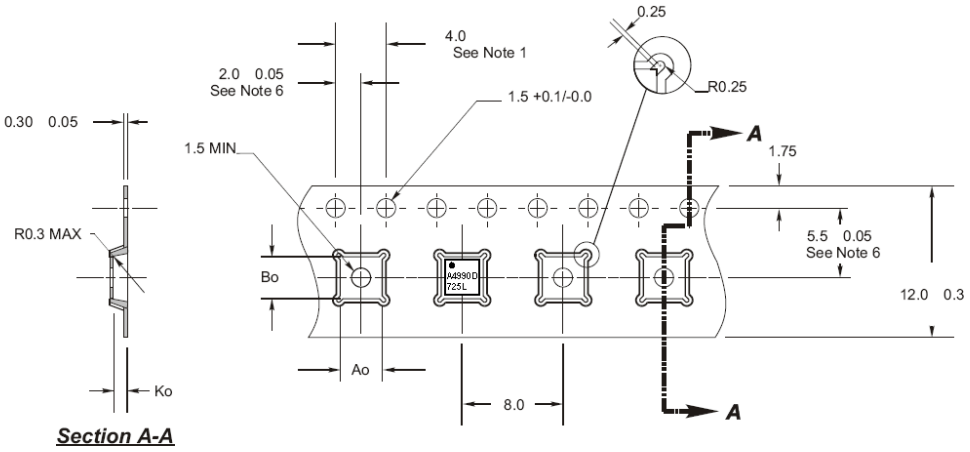
- All Dimensions in Millimeters -

Notes:
1. 10 sprocket hole pitch cumulative tolerance 0.2
2. Camber not to exceed 1mm in 100mm
3. Material: Black Conductive Advantek Polystyrene .
4. Ao and Bo measured on a plane 0.3mm above the bottom of the pocket
5. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

Ao = 5.2 mm
Bo = 3.3 mm
Ko = 1.6 mm
K1 = 1.2 mm

ANALOG EXPRESS

10-lead DFN 3x3

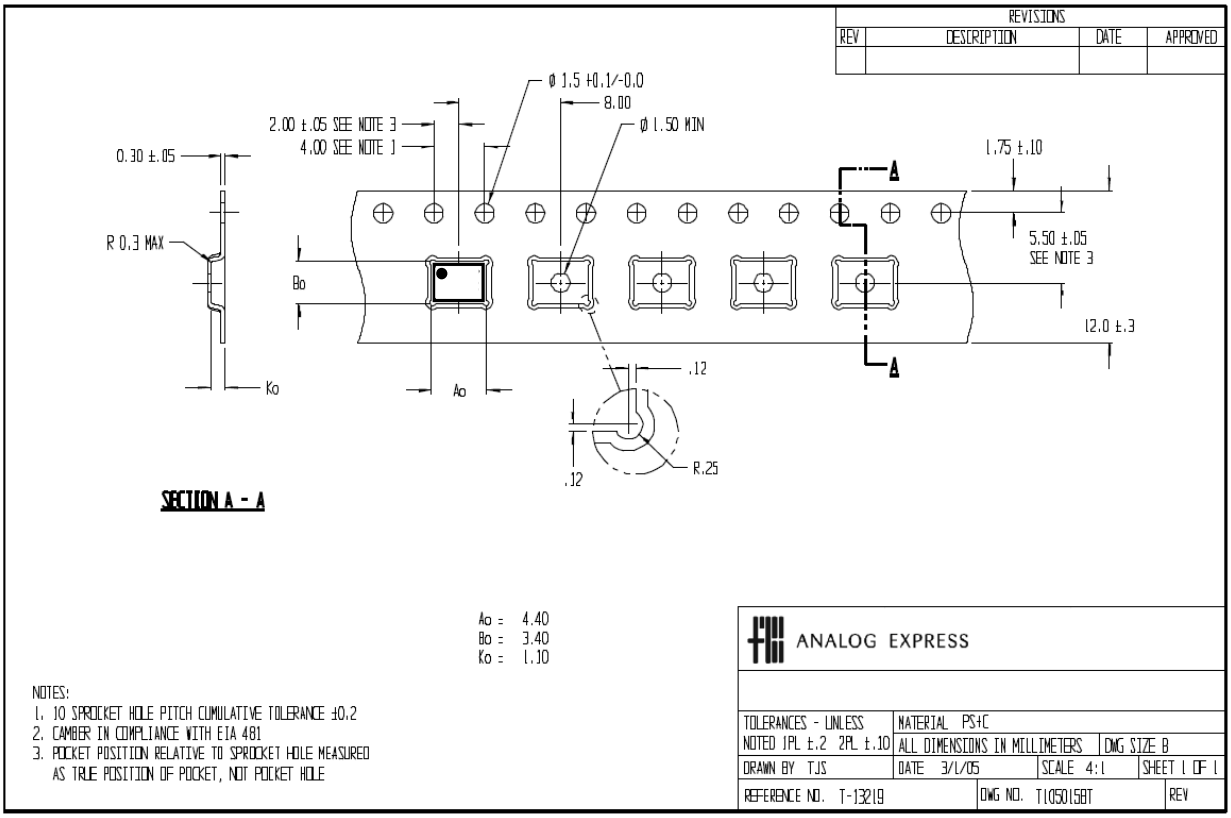


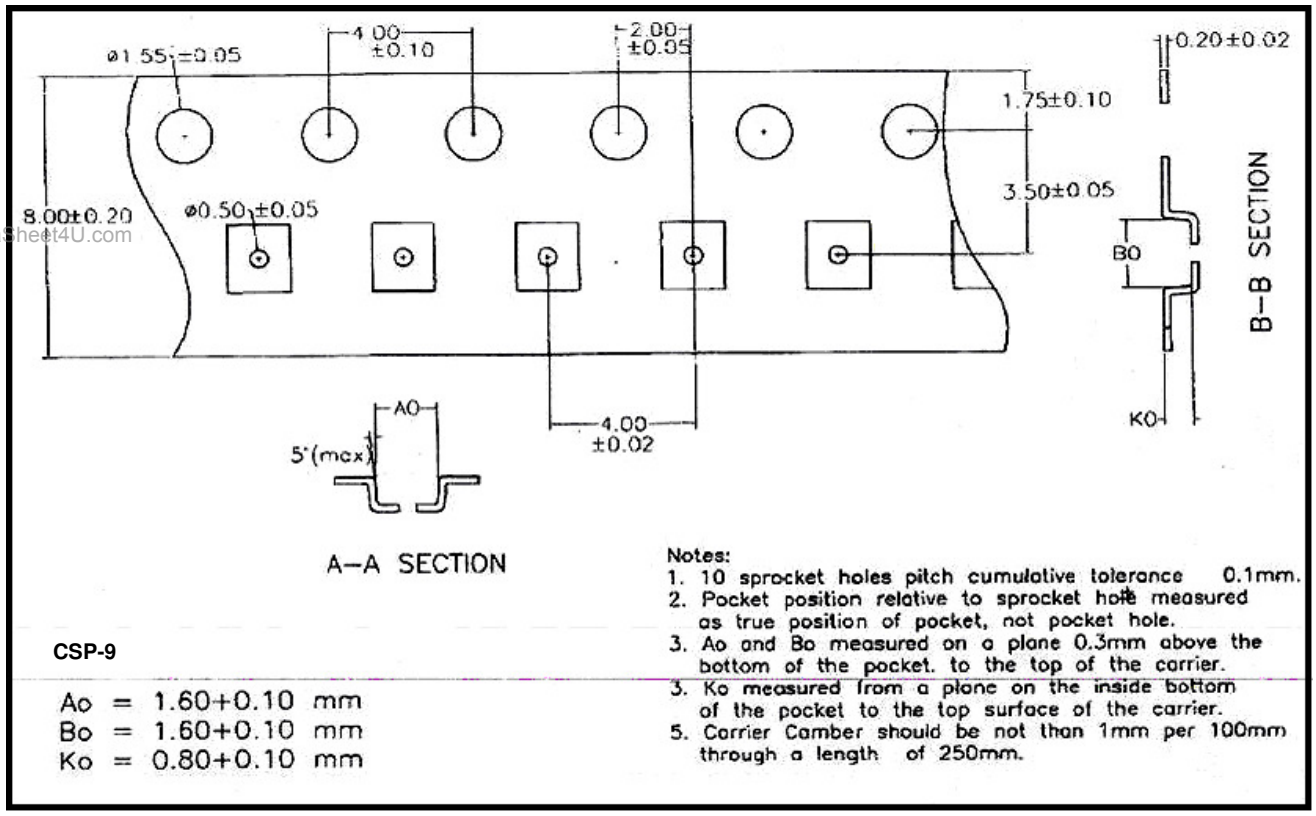
Ao = 3.3 mm
Bo = 3.3 mm
Ko = 1.1 mm

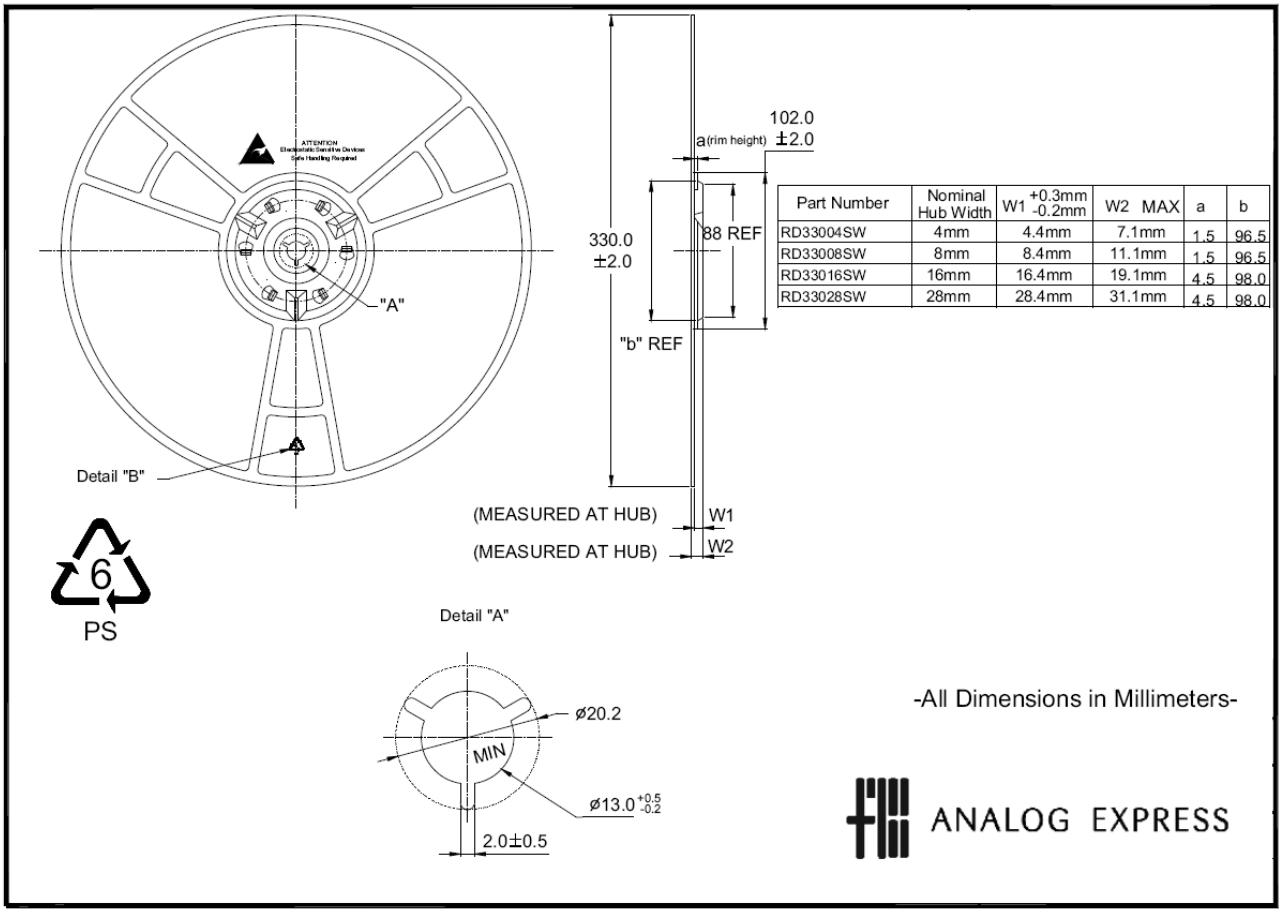
-All Dimensions in Millimeters-

Notes:
1. 10 sprocket hole pitch cumulative tolerance .02.
2. Camber not to exceed 1mm in 100mm.
3. Material: PS + C.
4. Ao and Bo measured as indicated.
5. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

ANALOG EXPRESS







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

LIFE SUPPORT POLICY

ANALOG EXPRESS'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEM WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF ANALOG EXPRESS. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
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.

Analog Express, Inc.

US Tel: (1) 713 666 9459
HK Tel: (852) 2823 9300

www.analogexpress.com
Email: sales@analogexpress.com