ANGUS ELECTRONICS CO., LTD

Tel: (852) 2345 0540 Fax: (852) 2345 9948

Web Site: www.angus.com.hk

2W x 2 Class AB Audio Power Amplifier **PT2300**

DESCRIPTION

The PT2300 is a power amplifier utilizing CMOS Technology specially designed for audio purpose. It can deliver 2W × 2 power output to the 4Ω load. The power consumption is very low in stand-by. Total harmonic distortion is lower than 0.03%. The output mode can be switched between the SE (Single-Ended) or BTL (Bridge-Tied Load) mode. The built-in volume controller can change the output volume by an external supplied DC voltage. Built-in over-temperature protection, package size is not occupies PCB space. It is suitable for small or portable products.

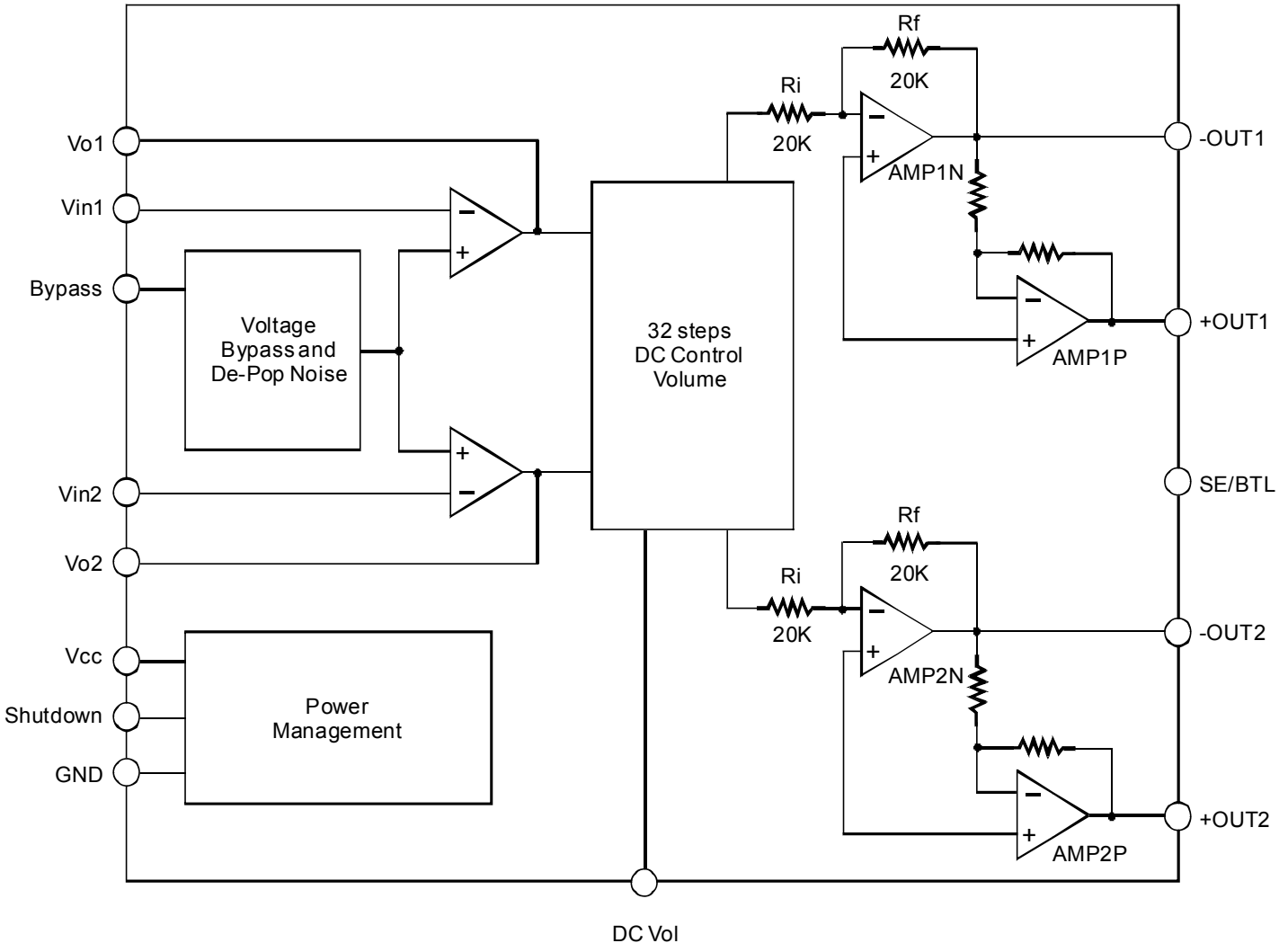
FEATURES

- CMOS Technology
- Stereo input
- Output power 2W × 2 (Vcc=6V, THD=1%, RL=4Ω)
- Low harmonics distortion (0.03%)
- Include 32 steps volume controller
- SE and BTL modes operation
- Suppress the pop and click noise when mode changed
- Shutdown function, turn on can into save mode (Icc<0.7μA)
- Built-in overheat protect

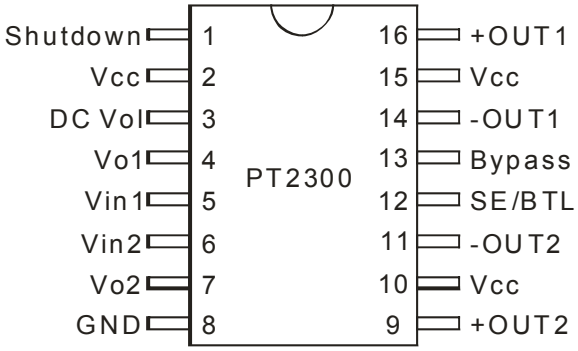
APPLICATIONS

- LCD monitor (for TV)
- Portable audio
- Multimedia speakers
- Other audio applications

BLOCK DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTION

Pin Name	I/O	Description	Pin No.
Shutdown	I	Shutdown pin ◦ Entire IC into the shutdown mode when this pin connected to the Vcc,	1
Vcc		Supply voltage input	2
DC Vol	I	DC Volume control input pin	3
Vo1	I	Channel 1 output for external feedback circuit	4
Vin1	I	Channel 1 audio input	5
Vin2	I	Channel 2 audio input	6
Vo2	I	Channel 2 output for external feedback circuit	7
GND		Ground	8
+OUT2	O	Channel 2 output (+)	9
Vcc		Supply voltage input	
-OUT2	O	Channel 2 output (-)	11
SE/BTL	I	Output mode select, connected to the Vcc for SE mode or GND for BTL mode	12
Bypass	O	Internal bias reference bypassing	13
-OUT1	O	Channel 1 output (-)	14
Vcc	O	Supply voltage input	15
+OUT1	O	Channel 1 output (+)	16

FUNCTION DESCRIPTION

POWER SUPPLY

The operating voltage of PT2300 is from 3V to 6V, In general operation 5V is recommended. When the supply voltage less then 3V the IC can work properly, but the distortion reading will rise. After the supply voltage over 6.5V, the higher stand-by current consumption will rising the temperature on chip surface。

SHUTDOWN

When the DC supply still powered the chip Vcc, pull-up the shutdown pin to the Vcc level will take the chip into the shutdown mode. After the shutdown mode is active the total current consumption is less than 0.7μA, and the all of input or output pins no voltage output. When shutdown pin set to GND, the IC is back to the normal operation.

Shutdown pin	Output state
Vcc	Shutdown ON
GND	Normal

INPUT GAIN ADJUST

The output gain of the PT2300 can be adjust by the external resistor, in normal operation 0dB gain setting is recommended, please refer to the application circuit. If the source output level is not so high (ex :< 2Vpp), input gain can be increase to get the proper volume. The minimum value of the input series resistance is 10KΩ for the modest input impedance.
To make sure the input stage will not be distortion by overload, please confirm the input signal level, for the gain set please refer to the following table:

Operating voltage	Input gain = –6dB	Input gain = 0dB	Input gain = +6dB
VDD=3V	Vin <5Vpp	Vin <2.5Vpp	Vin <1.25Vpp
VDD=5V	Vin <8Vpp	Vin<4Vpp	Vin<2Vpp

SE/BTL MODE SWITCHING

PT2300 have two output mode, SE (Single-Ended) or BTL (Bridge-Tied Load). When driving a speaker load suggestion set to the BTL mode for get the more power output. And driving a headphone load, it can be set to SE mode and turn-off the un-work amplifier to decrease stand-by power consumption. Switching between the SE/BTL modes is controlled by the SE/BTL pin, please refer to following table:

SE/BTL	Mode
Vcc	SE
GND	BTL

OVER TEMPERATURE PROTECTION

The PT2300 has a built-in over temperature protection circuit, it will turn off all power output when the chip temperature over 120℃, the chip will return to normal operation automatically after the temperature cool down to 80℃.

POP AND CLICK SURPPRESS

A power amplifier uses single supply voltage may almost have noise on output in the power-on period. It is because of the output DC potential needs time to stable on 1/2Vcc, the period relative with the capacitance on the Bypass pin. Higher CB value will extend the stable time, and also can suppress the noise when power-on. In supply voltage=5V and CB=2.2μF, stable time is about 300ms. The value of CB also relative with the value of the DC blocking capacitor connected in input terminal. In general condition the time constant of DC blocking capacitor should be less than CB stable time. Recommend parts values please refer to application circuit.

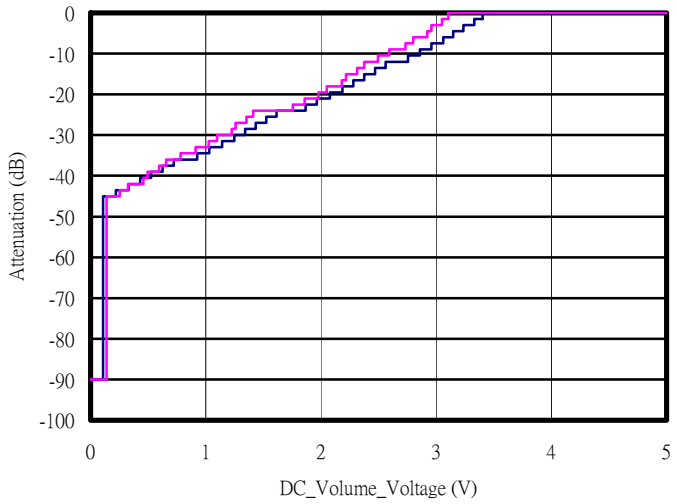
VOLUME CONTROLLER

The PT2300 has a built-in 32 steps volume controller, output volume is determinate by the voltage applied on the DC Vol pin. Higher DC voltage means more output level, the relation between the volume setup and DC Vol, please refer the following table.

[Supply voltage 5V, DC Vol input voltage showing by percentage of Vcc]

Step	Volume (dB)	Voltage range (%VCC)		Step	Volume (dB)	Voltage range (%VCC)	
		High	Low			High	Low
1	0	Vcc	64.0	17	-24	36.0	29.7
2	-1.5	64.1	62.6	18	-25.5	29.9	28.0
3	-3	63.1	60.9	19	-27	28.7	26.3
4	-4.5	61.1	59.2	20	-28.5	26.6	24.6
5	-6	60.4	57.6	21	-30	26.0	22.9
6	-7.5	57.8	55.7	22	-31.5	23.2	20.9
7	-9	56.4	53.8	23	-33	21.8	18.9
8	-10.5	53.8	51.3	24	-34.5	19.3	15.9
9	-12	52.1	48.5	25	-36	17.2	13.4
10	-13.5	48.7	46.8	26	-37.5	13.7	11.6
11	-15	47.5	45.1	27	-39	12.4	9.8
12	-16.5	45.4	43.3	28	-40.5	10.2	8.0
13	-18	44.7	41.6	29	-42	9.5	6.3
14	-19.5	41.8	39.5	30	-43.5	6.7	4.2
15	-21	40.4	37.4	31	-45	5.2	2.1
16	-22.5	37.8	35.4	32	MUTE	2.7	GND

If an ordinary potential meter is use to decide the DC_Vol level, the volume setting is just to rotating the shaft knob of potential meter to got desire volume, an extra indicator is not necessary. The output volume is respect to the current DC_Vol level after power ON. Please take note that there is a slight variance between the volume attenuation between different PT2300 chips at the same DC control voltage. Thus, to obtain the same level of volume the control voltage may differ to from chip to chip. Applying the same voltage at the DC_Vol pin, the attenuation drift may vary up to ± 4dB for different PT2300 chips.



HEAT DISSIPATION

During normal operation, the chip only consumes very little stand-by current. In high output power conditions, the package temperature will rise. For proper operating temperature, a modest heat sink mounted on the top side of the chip is required. The thermal resistance requirement of the heat sink demand may be obtained by the formula below:

$\theta_{JA} = (T_{J(max)} - T_A) \div P_{DISS}$

PDISS = IC dissipation power
TJ (max) = Maximum chip conjunction temperature
TA = external environment temperature
θ JA = thermal resistance from chip conjunction to ambience environment

With 60% estimated efficiency (eff), PT2300 in 2W + 2W output power dissipation is probably

$P_{DISS} = (Po \div eff) - Po = 2.6W$

The maximum chip conjunction temperature is 150℃. Exceeding this temperature will damage the chip, assuming the outside environment air temperature is 50°C. From the chip conjunction dissipation to external environment thermal resistance θJA should be:

$\theta_{JA} = (150 - 50) \div 2.6 = 38.4℃/W$

The PT2300 chip conjunction to case thermal resistance θJC is 26℃ /W. Therefore the heat sink thermal resistance should be:

$\theta_{JA} - \theta_{JC} = 12.4℃/W$

In normal operating, no need extra heat sink, only utilize the ground (copper foil) of PCB to heat dissipation.

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Condition	Min.	Max.	Unit
Supply Voltage	Vcc		0	7	V
Operating Temperature	Topr		-40	+85	℃
Storage Temperature	Tstg		-65	+150	℃
Maximum Input Voltage	Vimax		-0.3	Vcc+0.3	V
Maximum Input Current	Iimax	*	-10	+10	mA

Note: * Input pins surge current can be reached 100mA will not induce the CMOS latched up.

PACKAGE THERMAL CHARACTERISTIC

PACKAGE TYPE: SOP16L, 300MIL

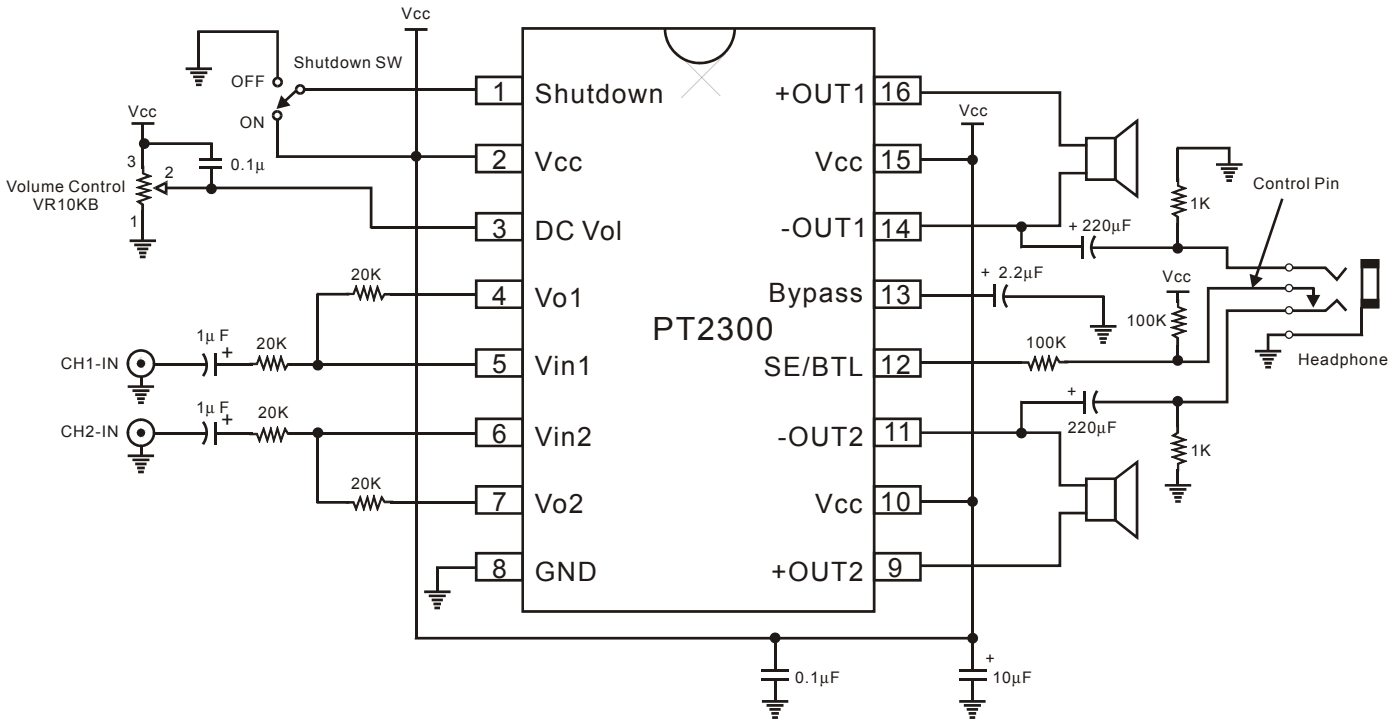
Parameter	Symbol	Condition	Value	Unit
From chip conjunction dissipation to external environment	θ_{JA}	Ta=25℃	88.8	℃/W
From chip conjunction dissipation to package surface	θ_{JC}		26	℃/W

ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Vcc=5V, bandwidth=22~22KHz)

Parameter	Symbol	Condition			Min.	Typ.	Max.	Unit
Supply Voltage	Vcc				3	5	6	V
Operating Current	Is	SE Mode			6	8	12	mA
		BTL Mode			8	10	14	
		Shutdown=ON			0.2	0.7	1	μA
Two Channels Gain Error	Gerr	RIN=RF=20KΩ			-1	0	+1	dB
THD+N	THD	Po=0.2W, RL=4Ω			0.03	0.05	0.07	%
		Po=1W, RL=4Ω			0.06	0.08	0.15	
		Po=50mW, RL= 32Ω			0.03	0.05	0.07	
Power Output	Po	BTL	THD=1%, RL=8Ω		1.0	1.1	1.2	W
			THD=10%, RL=8Ω		1.2	1.4	1.6	
			THD=1%, RL=4Ω		1.4	1.6	1.8	
			THD=10%, RL=4Ω		1.8	2.0	2.1	
			THD=1%, RL=4Ω, VCC=6V		1.9	2.0	2.2	
		SE	THD=1%, RL=32Ω		80	85	90	mW
			THD=10%, RL=32Ω		100	110	120	
Signal-to-Noise Ratio	SNR	A-weighted			85	90	91	dB
Residual Noise	Vno	A-weighted			25	40	50	μV
Output Offset	Voff	DC Vo=0V, +OUT ~ -OUT			25	50	100	mV
Channel Separation	CS	BTL	F=1KHz		85	88	91	dB
		SE			77	80	83	
Power Signal-to-Noise Repel Rate	PSRR	BTL	F=1KHz		58	60	63	dB
		SE			52	55	58	
Volume Control Range	Vatt	DC Vol=5V		F=1KHz	-1	0	+1	dB
		DC Vol=17%Vcc			-44	-45	-46	
Volume Control Step	Vstep	Vatt=0 ~ -45dB			1.3	1.5	1.7	dB
Mute	mute	DC Vol=0V			-85	-88	-90	dB
Temperature Protect	TH	Overheat close			-	120	-	℃
		Back to work			-	80	-	
Shutdown Voltage	V_{SD}	Shutdown ON		VDD=3 ~ 5V Shutdown pin	0.5	0.6	-	Vcc
		Shutdown OFF			-	0.2	0.3	
SE/BTL Voltage	V_{SB}	SE		VDD=3 ~ 5V	0.8	0.9	-	Vcc
		BTL			-	0.1	0.2	

APPLICATION CIRCUIT

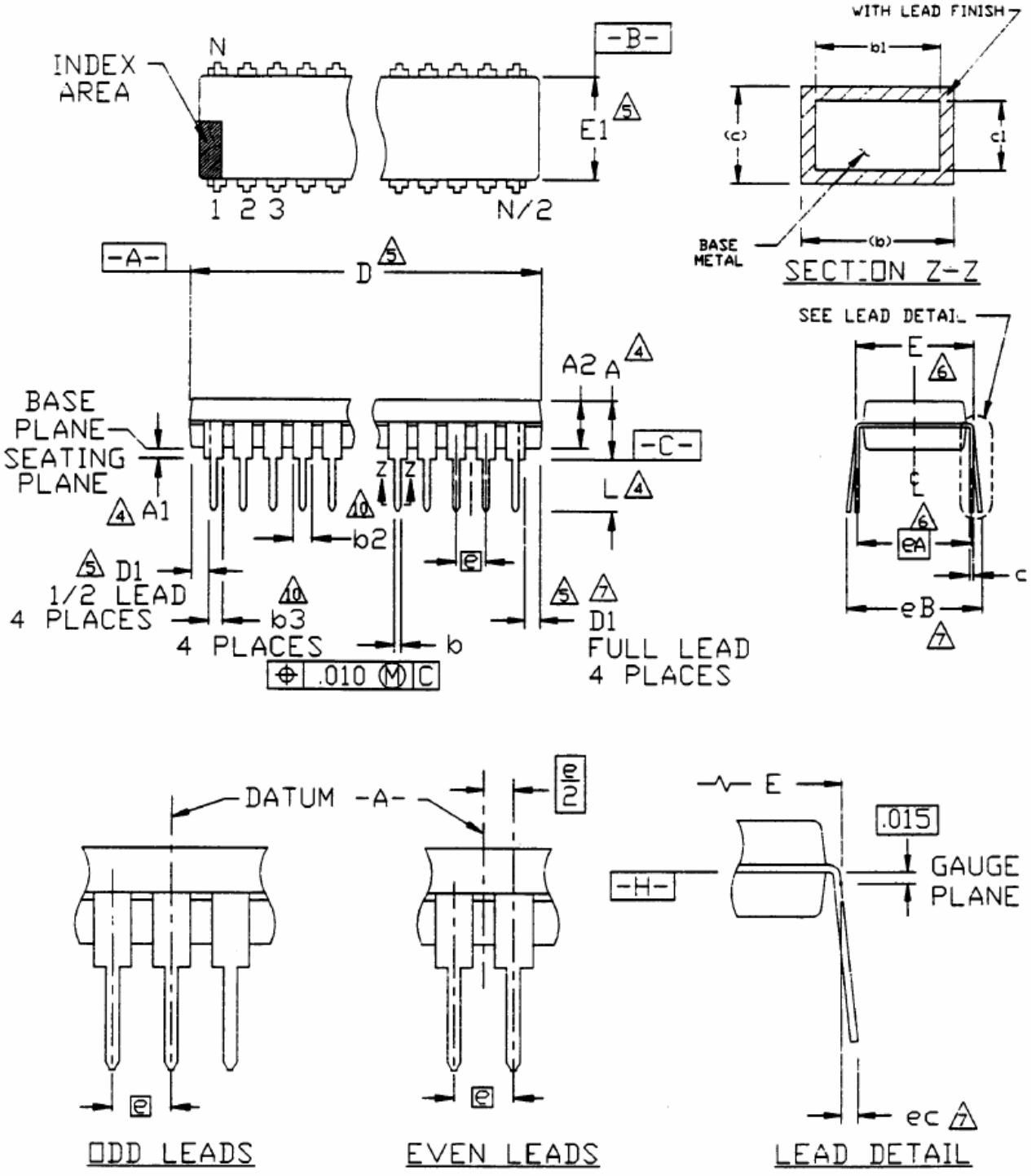


ORDER INFORMATION

Valid Part Number	Package Type	Top Code
PT2300	16-Pin, DIP, 300mil	PT2300
PT2300-S	16-Pin, SOP, 300mil	PT2300-S

PACKAGE INFORMATION

16 PINS, DIP, 300MIL



Symbol	Min.	Nom.	Max.
A	-	-	0.210
A1	0.015	-	-
A2	0.115	0.130	0.195
b	0.014	0.018	0.022
b1	0.014	0.018	0.020
b2	0.045	0.060	0.070
b3	0.030	0.039	0.045
c	0.008	0.010	0.014
c1	0.008	0.010	0.011
D	0.780	0.790	0.800
D1	0.005	-	-
E	0.300	0.310	0.325
E1	0.240	0.250	0.280
e		0.100 bsc	
eA		0.300 bsc	
eB	-	-	0.430
eC	0.000	-	0.060
L	0.115	0.130	0.150

Notes:
1. Controlling Dimension: INCHES.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimensions A, A1 and L are measured with the package seated in JEDEC Seating Plane Gauge GS-3.
4. D, D1 and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch.
5. E and eA measured with the leads constrained to be perpendicular to datum -C-.
6. eB and eA are measured at the lead tips with the leads unconstrained.
7. N is the maximum number of terminal positions (N=16).
8. Pointed or rounded lead tips are preferred to ease insertion.
9. b2 and b3 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 (0.25mm).
10. Variation AB is a full lead package.
11. Distance between leads including dambar protrusions to be 0.005 in minimum.
12. Datum plane -H- coincident with the bottom of lead where lead exits body.
13. Refer to JEDEC MS-001 Variation AB.

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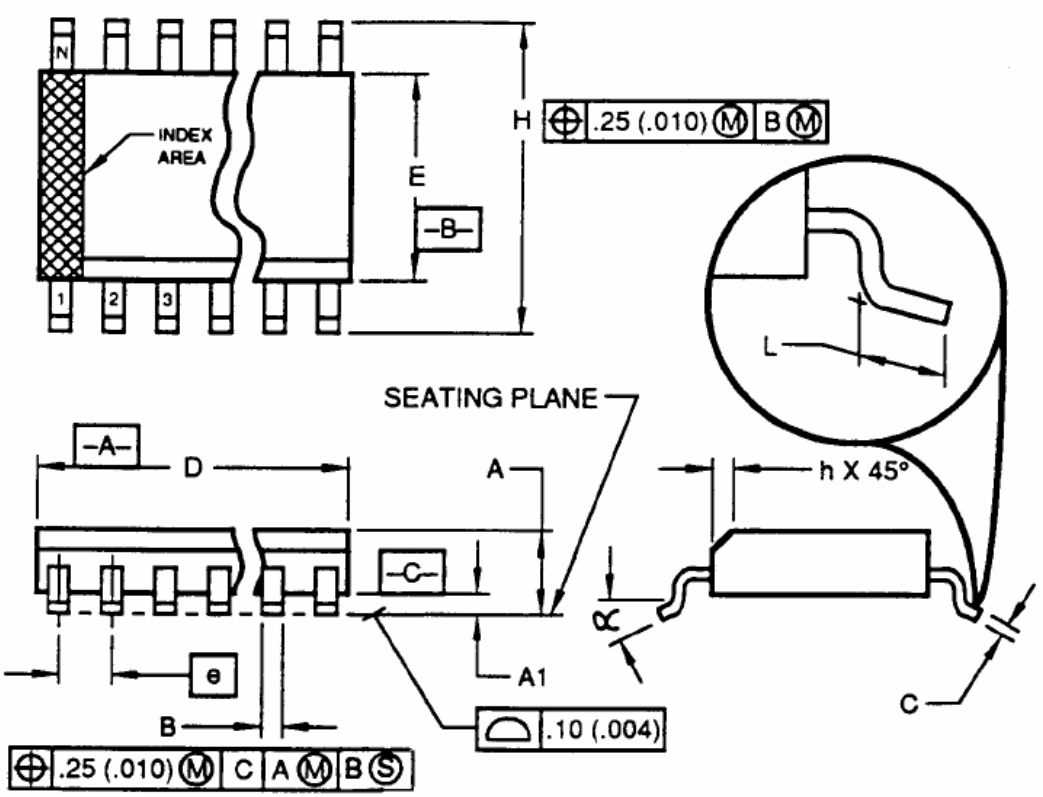
16 PINS, SOP, 300MIL



Symbol	Min.	Max
A	2.35	2.65
A1	0.10	0.30
B	0.33	0.51
C	0.23	0.32
D	10.10	10.50
E	7.40	7.60
e	1.27 BSC	
H	10.00	10.65
h	0.25	0.75
L	0.40	1.27
α	0^o	8^o

Notes:
1. Controlling Dimension: MILLIMETER
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions and gate burrs shall not exceed 0.15mm (0.006 in) per side.
4. Dimension E does not include interlead flash or protrusions. Interlead flash and protrusionsshall not exceed 0.25 mm (0.010 in.) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. L is the length of the terminal for soldering to a substrate.
7. N is the number of terminal positions (N=16).
8. The lead width B, as measured 0.36 mm (0.014in) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024in.)
9. Refer to JEDEC MS-013 Variation AA.

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