

Stereo 2.2W Audio Power Amplifier

Features

- **Depop Circuitry Integrated**
- **Thermal Shutdown Circuitry Integrated**
- **Bridge-Tied Load (BTL) or Single-Ended (SE) Modes Operation**
- **Output Power at 1% THD+N, $V_{DD}=5V$**
 - 2.2W/Ch (Typ.) into a 3W Load
 - 1.8W/Ch (Typ.) into a 4W Load
 - 1.2W/Ch (Typ.) into a 8W Load
- **Shutdown Control Mode, $I_{SD} = 0.5 \mu A$**
- **Output Power (SE) at 0.5% THD+N, $V_{DD}=5V$**
 - 90mW/Ch (Typ.) into a 32W Load
- **Various Power Packages Available**
SOP-16, TSSOP-20, and TSSOP-20P
- **Lead Free and Green Devices Available**
(RoHS Compliant)

Applications

- **Stereo Audio Power Amplifier for Notebook Computer**
- **Portable Televisions**
- **Portable and Desktop Computers**

General Description

The APA4863 is a stereo bridge-tied audio power amplifier in various power packages, including SOP, TSSOP, and TSSOP-P. When connecting to a 5V voltage supply, the APA4863 is capable of delivering 2.2W/1.8W/1.2W of continuous RMS power per channel into 3Ω/4Ω/8Ω bridge-tied loads with less than 1% THD+N respectively. When APA4863 operates in the single-ended load, it is capable of delivering 90mW of continuous RMS power per channel into 32Ω load. The APA4863 simplifies design and frees up board space for other features.

The APA4863 also served well in low-voltage applications, which provides 750mW (1% THD+N) per channel into 4Ω loads with a 3.3V supply voltage. Both of the depop circuitry and the thermal shutdown protection circuitry are integrated in the APA4863, which reduces pops and clicks noise during power up and when using the shutdown mode and protects the chip from being destroyed by over-temperature failure. To simplify the audio system design in notebook computer applications, the APA4863 combines a stereo bridge-tied loads mode for speaker drive and a stereo single-end mode for head-phone drive into a single chip, where both modes are easily switched by the HP-IN input control pin signal. For power sensitive applications, the APA4863 also features a shutdown function which keeps the supply current only 0.5 μA (typ.).

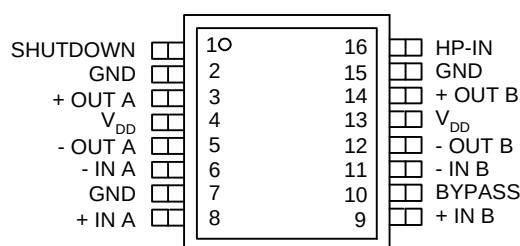
Ordering and Marking Information

APA4863 □□-□□□ Assembly Material Handling Code Temperature Range Package Code	Package Code K : SOP-16 O : TSSOP-20 R : TSSOP-20P Operating Ambient Temperature Range I : -40 to 85 °C Handling Code TR : Tape & Reel Assembly Material G : Halogen and Lead Free Device
APA4863 K/O/R : APA4863 XXXXX	XXXXX - Date Code

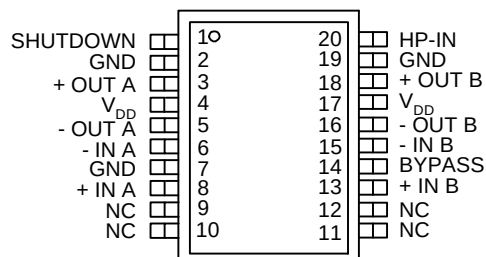
Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. ANPEC defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

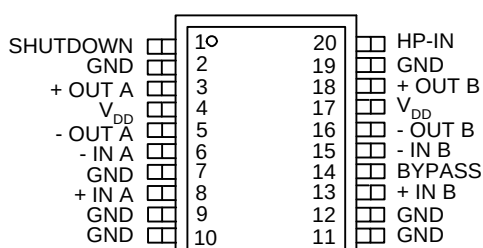
Pin Configuration



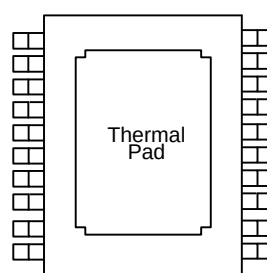
SOP-16
(Top View)



TSSOP-20
(Top View)



TSSOP-20P
(Top View)



TSSOP-20P
(Bottom View)

Absolute Maximum Ratings (Note 1)

(Over operating free-air temperature range unless otherwise noted.)

Symbol	Parameter	Rating	Unit
V _{DD}	Supply Voltage	6	V
T _A	Operating Ambient Temperature Range	-40 to 85	°C
T _J	Maximum Junction Temperature	150	°C
T _{STG}	Storage Temperature Range	-65 to +150	°C
T _S	Maximum Lead Soldering Temperature, 10 Seconds	260	°C

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Symbol	Parameter		Range			Unit
			Min.	Typ.	Max.	
V _{DD}	Supply Voltage		3	5	5.5	V
T _A	Operating Free-Air Temperature	V _{DD} =5V, 250mW/Ch average power 4-Ω stereo BTL drive, with proper PCB design	-20	-	85	°C
		V _{DD} =5V, 1.8 W/Ch average power 4-Ω stereo BTL drive, with proper PCB design and 300 CFM forced-air cooling	-20	-	85	
V _{ICM}	Common Mode Input Voltage	V _{DD} =5 V	1.25	-	4.5	V
		V _{DD} =3.3V	1.25	-	2.7	

Dissipation Rating Table

Package	Air Flow (CFM)	Thermal Resistance θ_{JA} (°C/W)	$T_A=25^{\circ}\text{C}$	$T_A=70^{\circ}\text{C}$
SOP-16 (Note 2)	0	80	1.6W	1.0W
TSSOP-20 (Note 3)	0	73.2	1.7W	1.1W
	200	66.6	1.8W	1.2W
TSSOP-20P (Note 3)	0	37.6	3.3W	2.1W
	200	32.3	3.8W	2.4W

Note 2 : The parameter is measured with the recommended copper heat sink pattern on an 2-layer PCB, 11.7 in² 3.0×2.4 in² in PCB, 1oz. copper, 3.0×1.5 in² in coverage at Top-layer and Bottom-layer at 100% coverage (7.2in²).

Note 3 :The parameter is measured with the JEDEC standard test boards (multi-layer PCB).

Electrical Characteristics

Electrical Characteristics for Entire IC

The following specifications apply for $V_{DD}=5\text{V}$ unless otherwise noted. Limits apply for $T_A=25^{\circ}\text{C}$

Symbol	Parameter	Test Conditions	APA4863			Unit
			Min.	Typ.	Max.	
V_{DD}	Supply Voltage		3	-	5.5	V
I_{DD}	Quiescent Power Supply Current	$V_{IN}=0\text{V}$, $I_O=0\text{A}$, HP-IN=0V $V_{IN}=0\text{V}$, $I_O=0\text{A}$, HP-IN=4V	-	9 5	13.5 7.5	mA
I_{SD}	Shutdown Current	$V_{PIN1}=V_{DD}$	5	0.5	-	μA
V_{IH}	Headphone High Input Voltage		4	-	-	V
V_{IL}	Headphone Low Input Voltage		-	-	0.8	V

Electrical Characteristics for BTL Mode Operation

The following specifications apply for $V_{DD}=5\text{V}$ unless otherwise noted. Limits apply for $T_A=25^{\circ}\text{C}$

Symbol	Parameter	Test Conditions	APA4863			Unit
			Min.	Typ.	Max.	
V_{OS}	Output Offset Voltage	$V_{IN}=0\text{V}$	-	5	-	mV
P_O	Output Power	THD+N=1%, $f_{in}=1\text{kHz}$ $R_L=3\Omega$ $R_L=4\Omega$ $R_L=8\Omega$	-	2.2 1.8 1.2	-	W
		THD+N=10%, $f_{in}=1\text{kHz}$ $R_L=3\Omega$ $R_L=4\Omega$ $R_L=8\Omega$	-	2.7 2.3 1.5	-	
THD+N	Total Harmonic Distortion Plus Noise	$A_{VD}=2$, $f_{in}=1\text{kHz}$ $R_L=4\Omega$, $P_O=1.8\text{W}$ $R_L=8\Omega$, $P_O=1\text{W}$	-	0.3 0.15	-	%
PSRR	Power Supply Rejection Ratio	$V_{DD}=5\text{V}$, $V_{RIPPLE}=200\text{mV}_{RMS}$, $R_L=8\Omega$, $C_B=2.2\mu\text{F}$	-	64	-	dB
X_{TALK}	Channel Separation	$f_{in}=1\text{kHz}$, $C_B=2.2\mu\text{F}$, $P_O=1\text{W}$, $R_L=8\Omega$	-	90	-	dB
SNR	Signal-to-Noise Ratio	$V_{DD}=5\text{V}$, $P_O=1.1\text{W}$, $R_L=8\Omega$	-	95	-	dB

Electrical Characteristics (Cont.)

Electrical Characteristics for SE Mode Operation

The following specifications apply for $V_{DD} = 5V$ unless otherwise noted. Limits apply for $T_A = 25^\circ C$

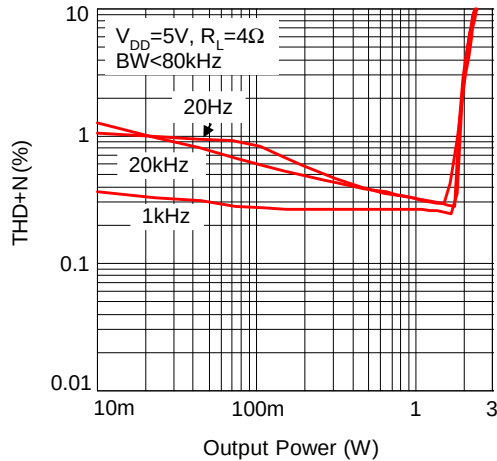
Symbol	Parameter	Test Conditions	APA4863			Unit
			Min.	Typ.	Max.	
V_{OS}	Output Offset Voltage	$V_{IN}=0V$	-	5	-	mV
P_O	Output Power	THD+N=0.5%, $f_{in}=1kHz$, $R_L=32\Omega$ THD+N=1%, $f_{in}=1kHz$, $R_L=8\Omega$ THD+N=10%, $f_{in}=1kHz$, $R_L=8\Omega$	-	90 320 400	-	mW
THD+N	Total Harmonic Distortion Plus Noise	$A_V=-1$, $P_O=75mW$, $f_{in}=1kHz$, $R_L=32\Omega$	-	0.02	-	%
PSRR	Power Supply Rejection Ratio	$V_{RIPPLE}=200mV_{RMS}$, $f_{in}=1kHz$, $C_B=2.2\mu F$, $R_L=8\Omega$	-	49	-	dB
X_{TALK}	Channel Separation	$f_{in}=1kHz$, $C_B=2.2\mu F$, $P_O=32mW$, $R_L=32\Omega$	-	85	-	dB
SNR	Signal-to-Noise Ratio	$V_{DD}=5V$, $P_O=340mW$, $R_L=8\Omega$	-	95	-	dB

Truth Table for Logic Inputs

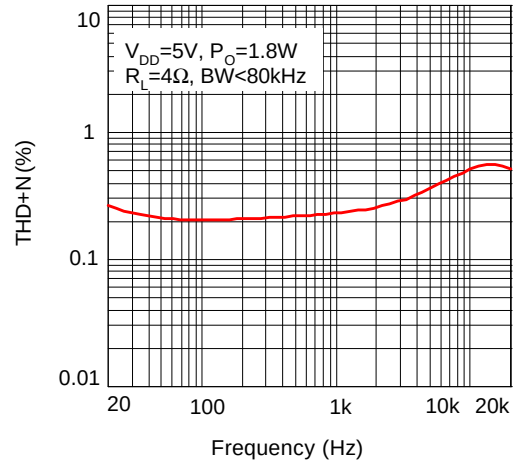
Shutdown	HP-IN	APA4863 Mode
Low	Low	Bridge-Tied
Low	High	Single-Ended
High	Low	APA4863 Shutdown
High	High	APA4863 Shutdown

Typical Operating Characteristics

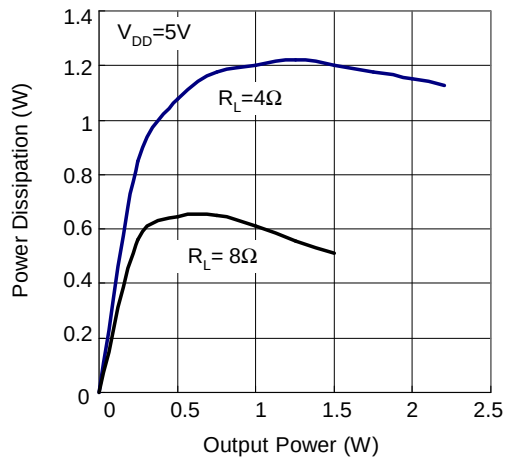
THD+N vs. Output Power



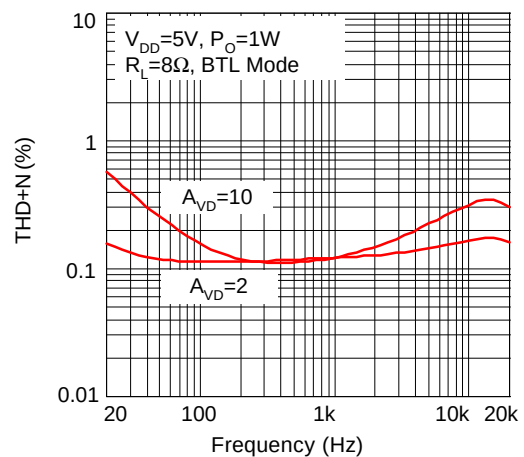
THD+N vs. Frequency



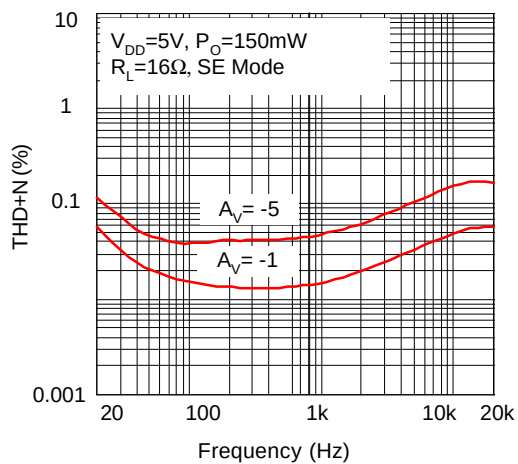
Power Dissipation vs. Output Power



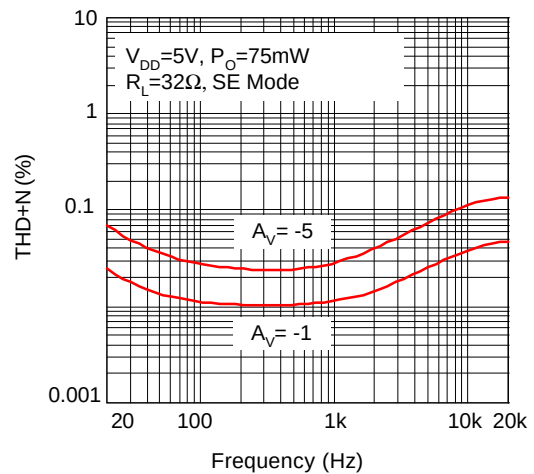
THD+N vs. Frequency



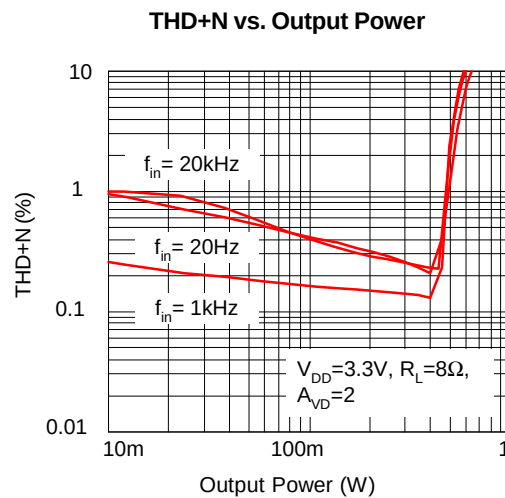
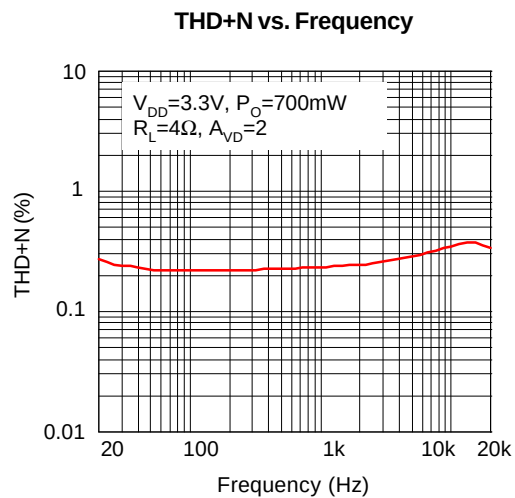
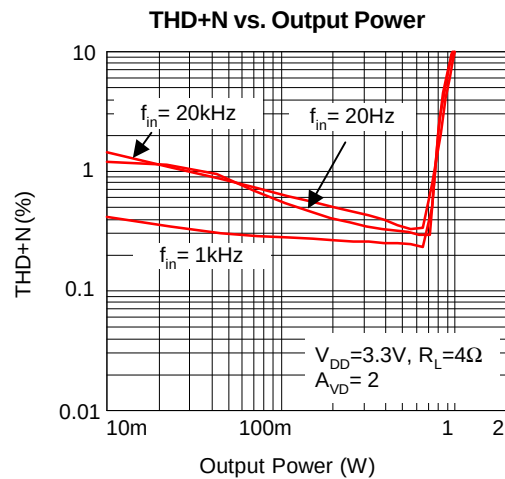
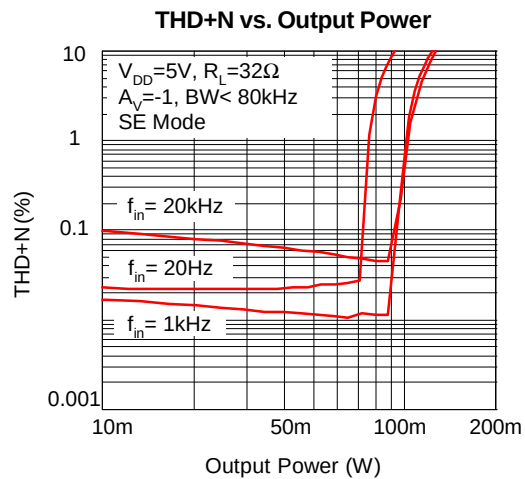
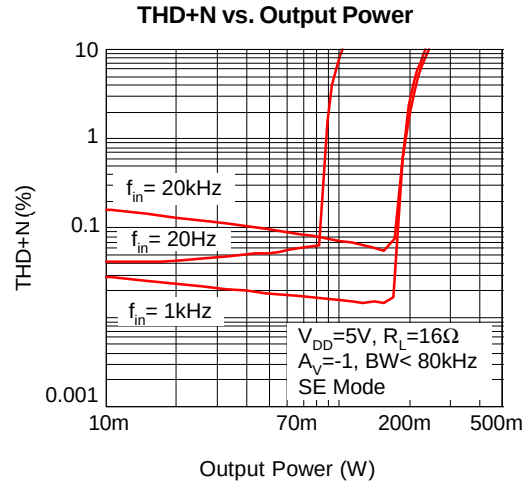
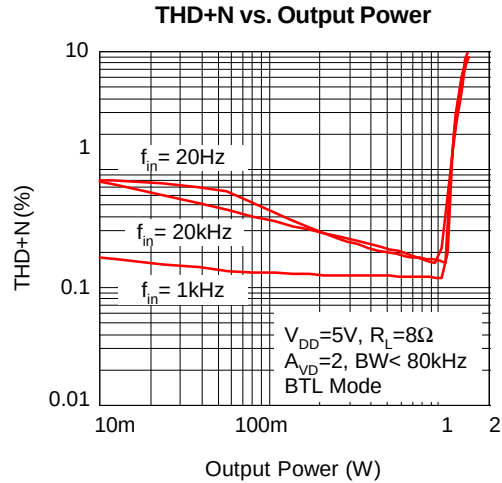
THD+N vs. Frequency



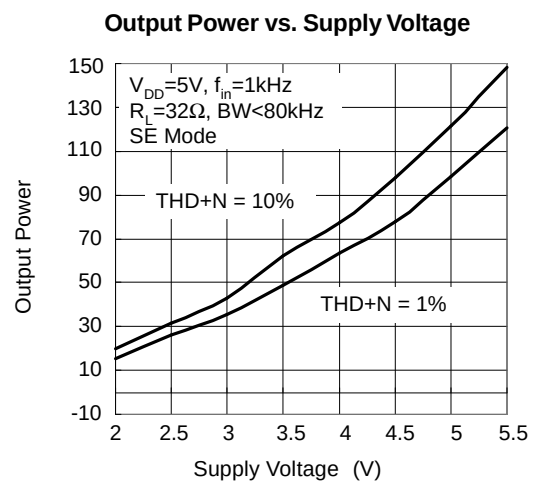
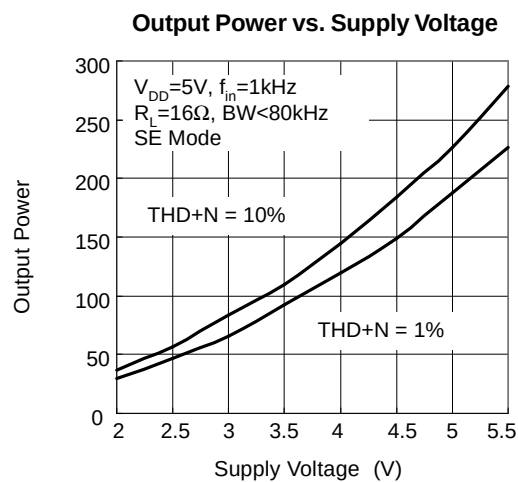
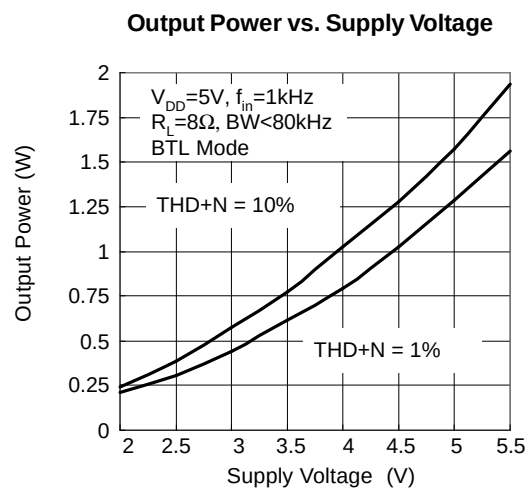
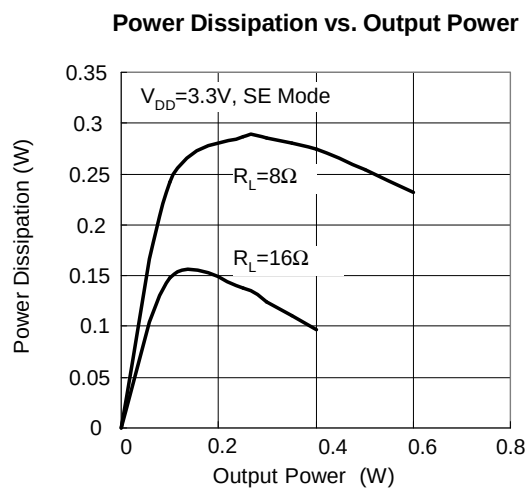
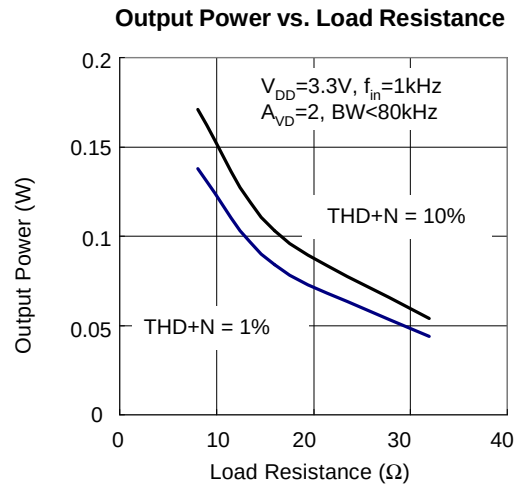
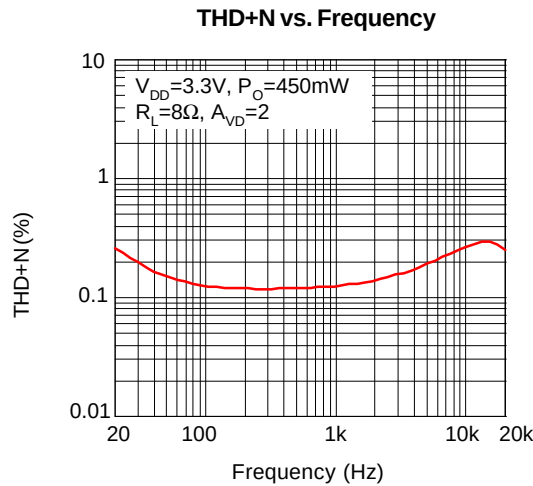
THD+N vs. Frequency



Typical Operating Characteristics (Cont.)

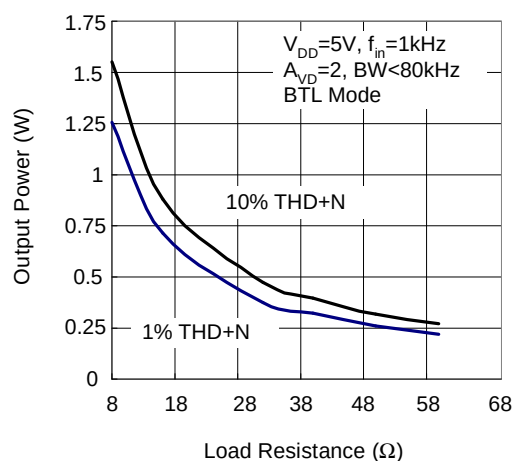


Typical Operating Characteristics (Cont.)

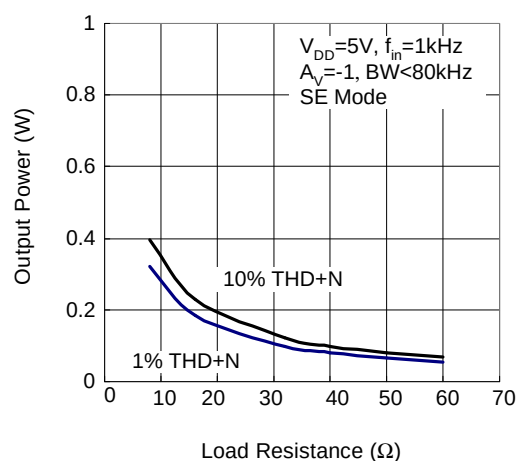


Typical Operating Characteristics (Cont.)

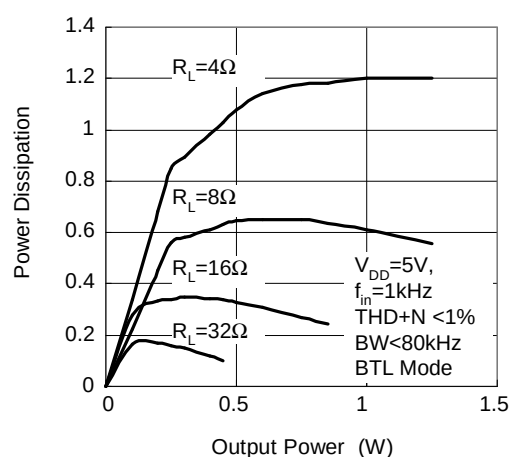
Output Power vs. Load Resistance



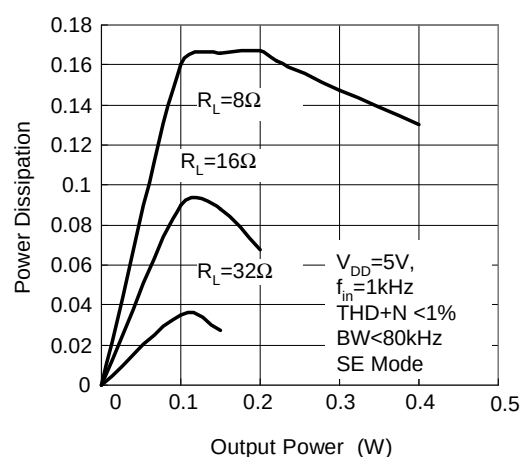
Output Power vs. Load Resistance



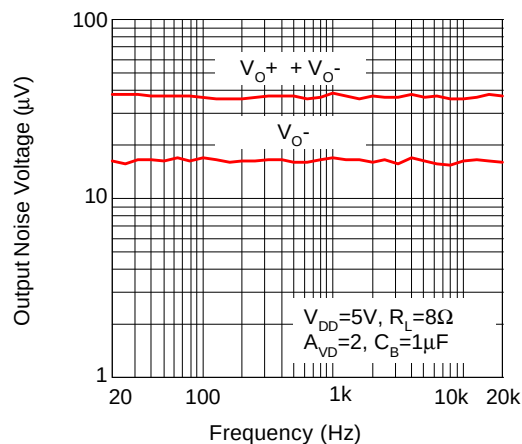
Power Dissipation vs. Output Power



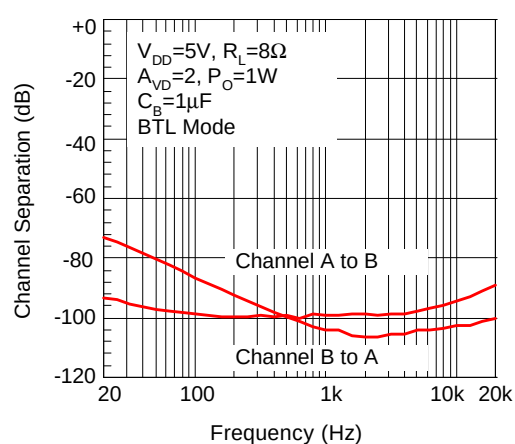
Power Dissipation vs. Output Power



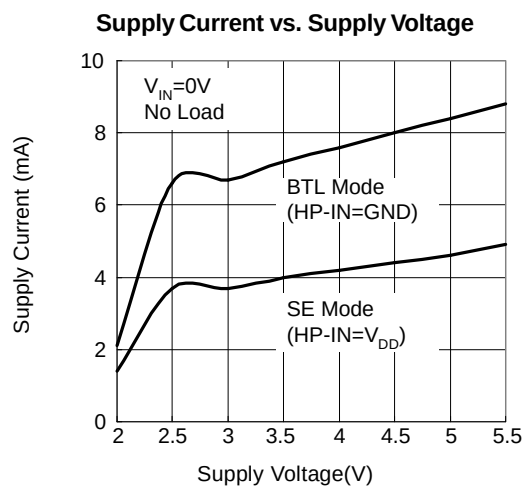
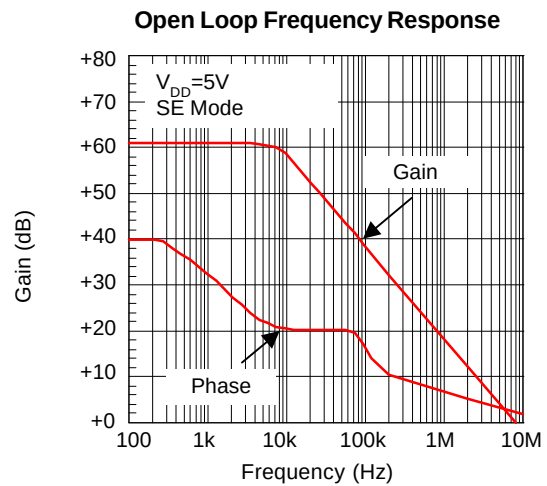
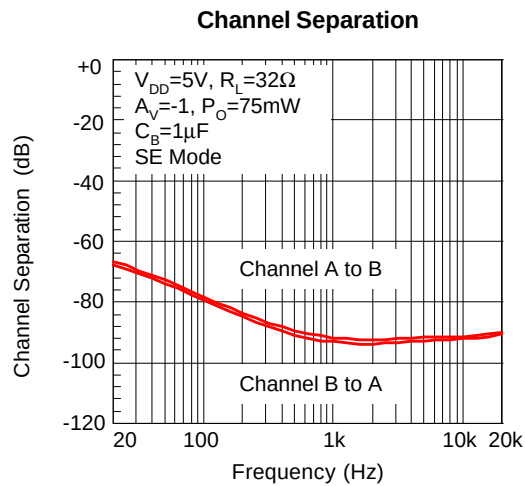
Noise Floor



Channel Separation



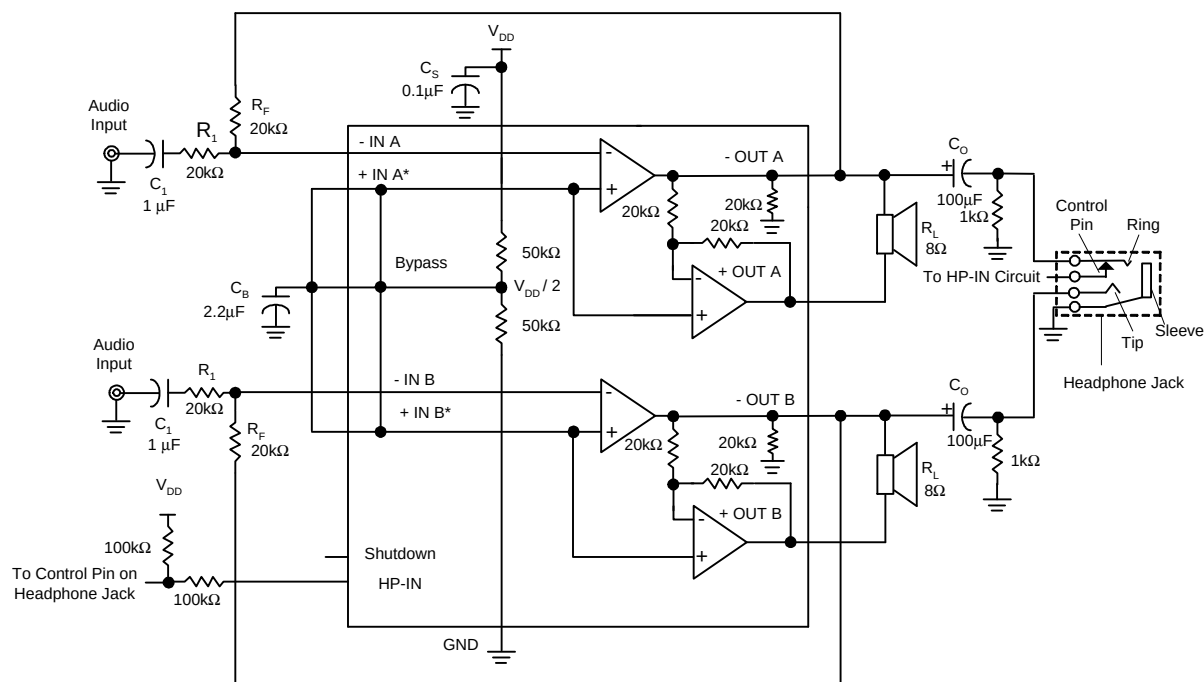
Typical Operating Characteristics (Cont.)



Pin Description

PIN			I/O	FUNCTION	
NO.		NAME			
TSSOP-20	TSSOP-20P				SOP-16
1	1	1	SHUTDOWN	I	Shutdown mode control pin input, places entire IC in shutdown mode when held high, I _{DD} =0.5μA.
2,7,19	2,7,9,10,11,12,19	2,7,15	GND	-	Ground connection of circuitry.
3	3	3	+OUT A	O	A channel + output in BTL mode, high impedance in SE mode.
4,17	4,17	4,13	V _{DD}	I	Supply voltage input.
5	5	5	-OUT A	O	A channel - output in BTL mode, + output in SE mode.
6	6	6	-INA	I	Input pin of channel A.
8	8	8	+INA	I	Non-inverting input of channel A, connected to bypass pin inside the IC.
13	13	9	+IN B	I	Non-inverting input of channel B, connected to bypass pin inside the IC.
14	14	10	BYPASS	-	Connect to voltage divider for internal mid-supply bias.
15	15	11	-IN B	I	Input pin of channel B.
16	16	12	-OUT B	O	B channel - output in BTL mode, + output in SE mode.
18	18	14	+OUT B	O	B channel + output in BTL mode, high impedance in SE mode.
20	20	16	HP-IN	I	Headphone control pin input, hold high for single-ended mode operation.
9,10,11,12	-	-	NC	-	No connection.

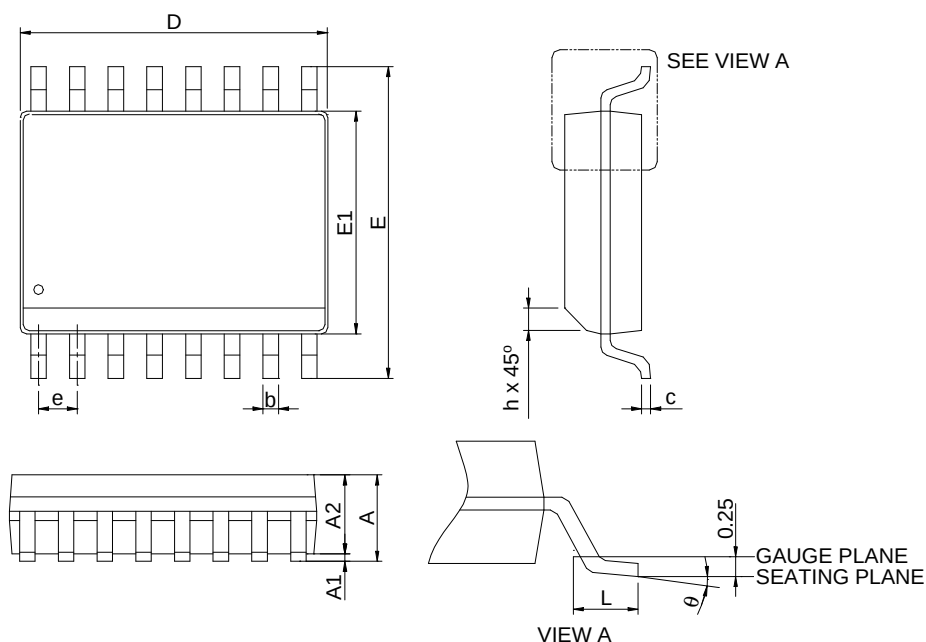
Block Diagram



Note : * $+IN A$ and $+IN B$ pins are connected to Bypass pin inside the IC.

Package Information

SOP-16 (300 mil)

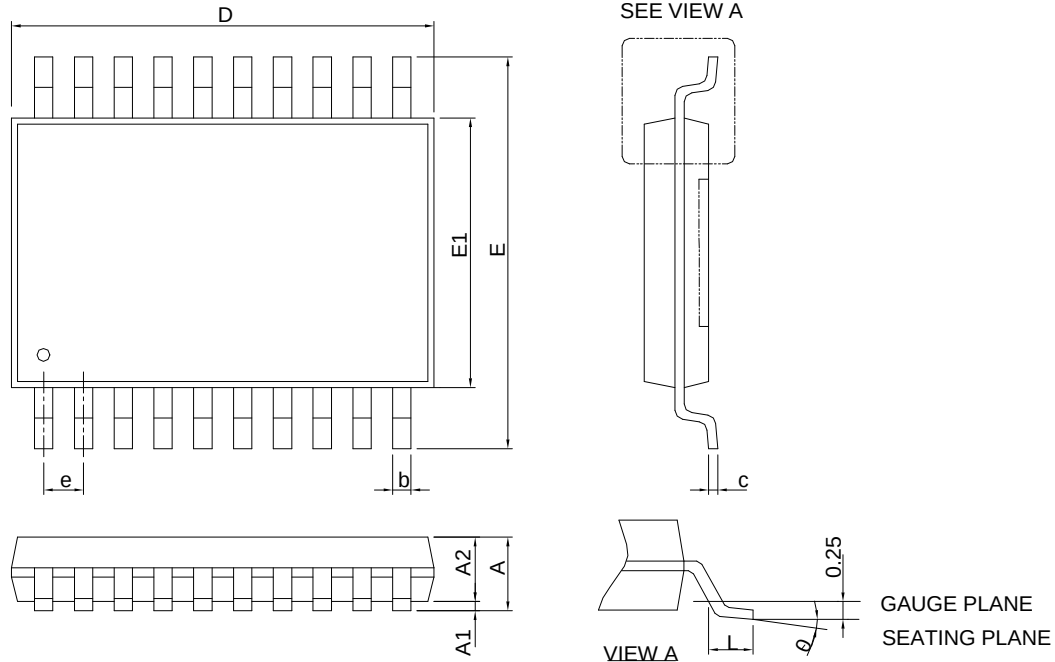


SYMBOL	SOP-16 (300mil)			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		2.65		0.104
A1	0.10	0.30	0.004	0.012
A2	2.05		0.081	
b	0.31	0.51	0.012	0.020
c	0.20	0.33	0.008	0.013
D	10.10	10.50	0.396	0.413
E	10.10	10.50	0.398	0.413
E1	7.40	7.60	0.291	0.299
e	1.27 BSC		0.050 BSC	
h	0.25	0.75	0.010	0.030
L	0.40	1.27	0.016	0.050
θ	0°	8°	0°	8°

- Note : 1. Followed from JEDEC MS-013 AA.
 2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side .
 3. Dimension "E" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

Package Information

TSSOP-20



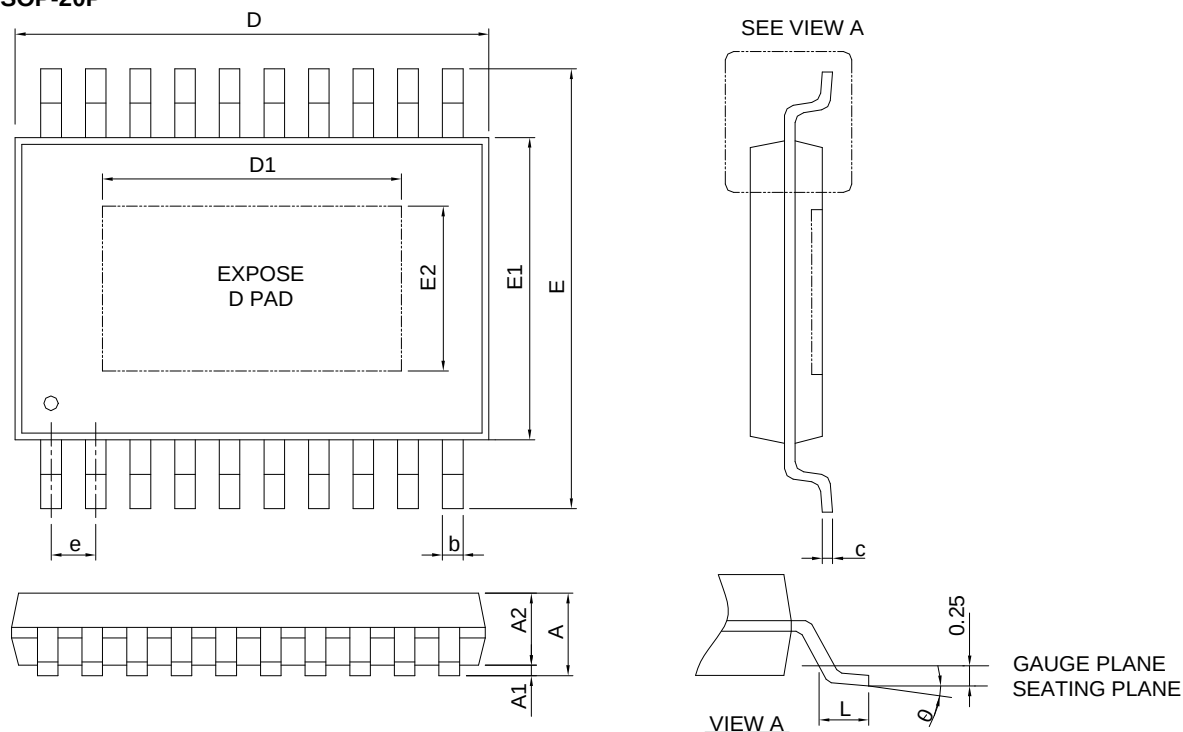
SYMBOL	TSSOP-20			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.20		0.047
A1	0.05	0.15	0.002	0.006
A2	0.80	1.05	0.031	0.041
b	0.19	0.30	0.007	0.012
c	0.09	0.20	0.004	0.008
D	6.40	6.60	0.252	0.260
E	6.20	6.60	0.244	0.260
E1	4.30	4.50	0.169	0.177
e	0.65 BSC		0.026 BSC	
L	0.45	0.75	0.018	0.030
θ	0°	8°	0°	8°

Note : 1. Follow JEDEC MO-153 AC.

2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side .
3. Dimension "E1" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

Package Information

TSSOP-20P



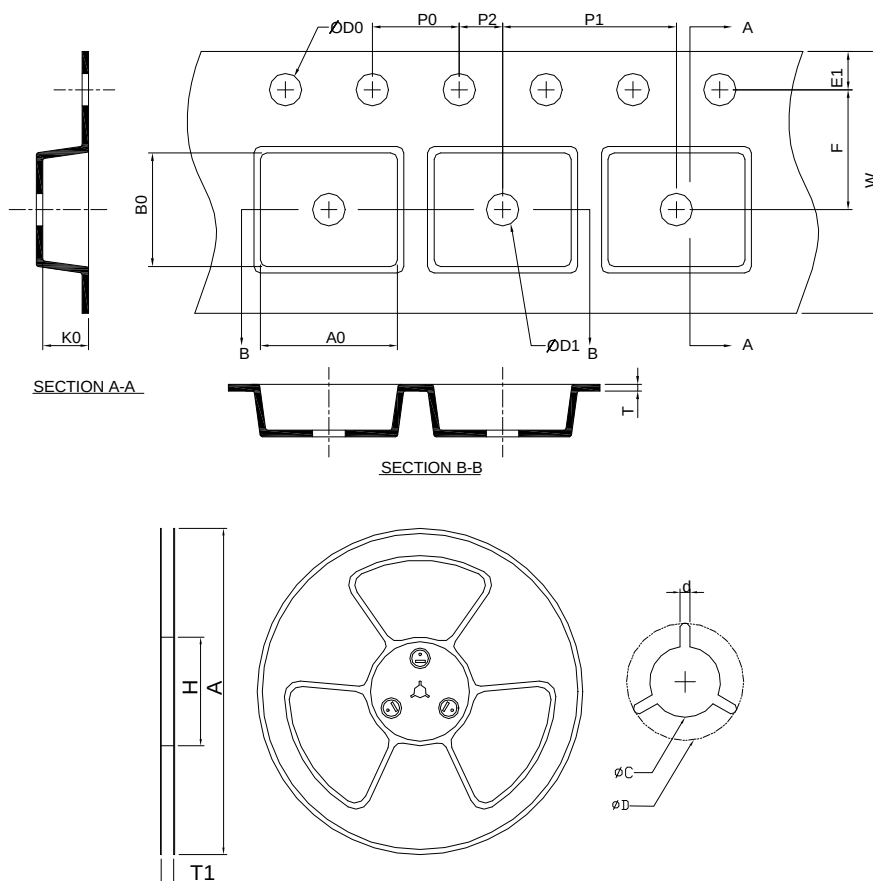
SYMBOL	TSSOP-20P			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.20		0.047
A1	0.05	0.15	0.002	0.006
A2	0.80	1.05	0.031	0.041
b	0.19	0.30	0.007	0.012
c	0.09	0.20	0.004	0.008
D	6.40	6.60	0.252	0.260
D1	3.00	4.50	0.118	0.177
E	6.20	6.40	0.244	0.260
E1	4.30	4.50	0.169	0.177
E2	2.50	3.50	0.098	0.138
e	0.65 BSC		0.026 BSC	
L	0.45	0.75	0.018	0.030
θ	0°	8°	0°	8°

Note : 1. Follow JEDEC MO-153 ACT.

2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.

3. Dimension "E1" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

Carrier Tape & Reel Dimensions



Application	A	H	T1	C	d	D	W	E1	F
SOP-16	330.0 $\pm$ 2.00	50 MIN.	16.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	16.0 $\pm$ 0.30	1.75 $\pm$ 0.10	7.5 $\pm$ 0.10
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0 $\pm$ 0.10	8.0 $\pm$ 0.10	2.0 $\pm$ 0.10	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	6.40 $\pm$ 0.20	10.30 $\pm$ 0.20	2.10 $\pm$ 0.20
Application	A	H	T1	C	d	D	W	E1	F
TSSOP-20	330.0 $\pm$ 2.00	50 MIN.	16.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	16.0 $\pm$ 0.30	1.75 $\pm$ 0.10	7.50 $\pm$ 0.10
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.00 $\pm$ 0.10	8.00 $\pm$ 0.10	2.00 $\pm$ 0.10	1.5+0.10 -0.00	1.5 MIN.	0.30 $\pm$ 0.05	6.9 $\pm$ 0.20	6.90 $\pm$ 0.20	1.60 $\pm$ 0.20
Application	A	H	T1	C	d	D	W	E1	F
TSSOP-20P	330.0 $\pm$ 2.00	50 MIN.	16.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	16.0 $\pm$ 0.30	1.75 $\pm$ 0.10	7.50 $\pm$ 0.10
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.00 $\pm$ 0.10	8.00 $\pm$ 0.10	2.00 $\pm$ 0.10	1.5+0.10 -0.00	1.5 MIN.	0.30 $\pm$ 0.05	6.9 $\pm$ 0.20	6.90 $\pm$ 0.20	1.60 $\pm$ 0.20

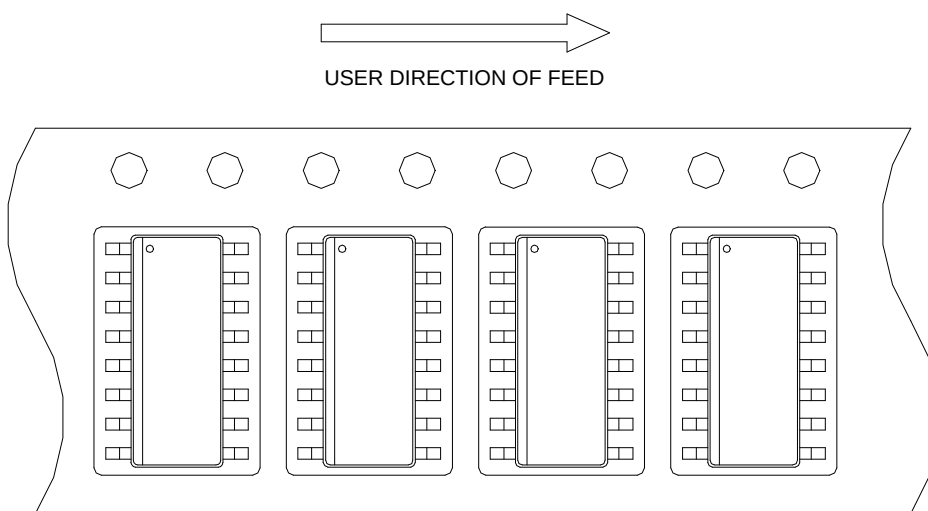
(mm)

Devices Per Unit

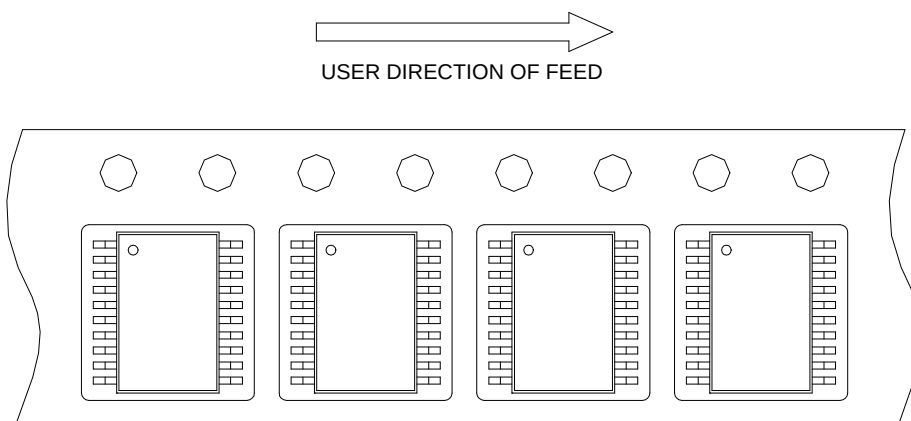
Package Type	Unit	Quantity
SOP- 16	Tape & Reel	1000
TSSOP- 20	Tape & Reel	2000
TSSOP- 20P	Tape & Reel	2000

Taping Direction Information

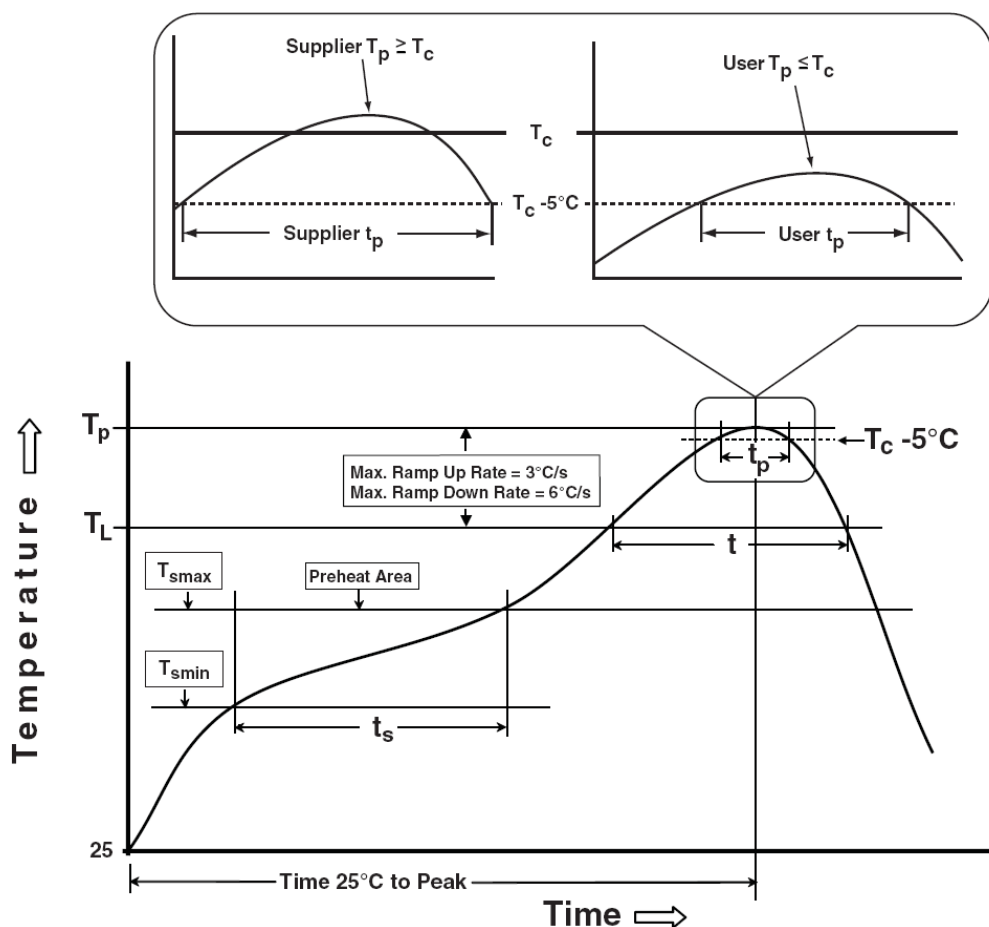
SOP-16



TSSOP-20(P)



Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T_{smin})	100 °C	150 °C
Temperature max (T_{smax})	150 °C	200 °C
Time (T_{smin} to T_{smax}) (t_s)	60-120 seconds	60-120 seconds
Average ramp-up rate (T_{smax} to T_p)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L)	183 °C	217 °C
Time at liquidous (t_L)	60-150 seconds	60-150 seconds
Peak package body Temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_p)** within 5°C of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
* Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.		

Classification Reflow Profiles (Cont.)

Table 1. SnPb Eutectic Process – Classification Temperatures (Tc)

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures (Tc)

Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HOLT	JESD-22, A108	1000 Hrs, Bias @ 125°C
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C
HBM	MIL-STD-883-3015.7	VHBM ≥ 2KV
MM	JESD-22, A115	VMM ≥ 200V
Latch-Up	JESD 78	10ms, 1 _{tr} ≥ 100mA

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