

## Rail to Rail Output CMOS Operating Amplifier

### Features

- Operating Voltage  
Single Supply 3V to 6V
- Low Input current 2pA
- Rail to Rail Output Swing
- Push-Pull Output Driving
- High Output Current Drive 310mA
- Bandwidth:7MHz
- Wide Temperature Range
- Available in 8 pin SOP ,DIP , TSSOP or MSOP Package

### Applications

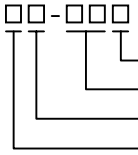


- Amplifiers
- Filters
- Analog circuit

### General Description

The APC308 consists of two independent, high gain, CMOS operating amplifier, combining rail to rail output range with large output current. It provides a low input bias current 2pA.

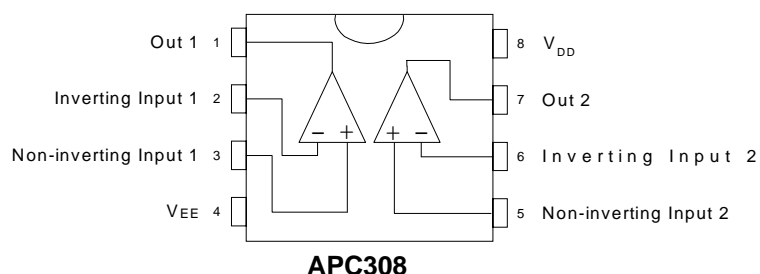
The output swing of the amplifier, guaranteed for loads down to 1kΩ and output current to an 10Ω load from a 5V power supply. APC308 designed to operating at 3V is especially well-suited for low voltage application.

### Ordering and Marking Information

<p>APC308</p>  <p>Lead Free Code Handling Code Temp. Range Package Code</p>	<p>Package Code J : PDIP - 8      K : SOP - 8 O : TSSOP - 8    X : MSOP-8</p> <p>Temp. Range I : - 40 to 85 °C</p> <p>Handling Code TU : Tube            TR : Tape &amp; Reel</p> <p>Lead Free Code L : Lead Free Device    Blank : Original Device</p>
<p>APC308 J :</p> 	<p>XXXXX - Date Code</p>
<p>APC308 K/O :</p> 	<p>XXXXX - Date Code</p>

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.

## Block Diagram



## Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
$V_{DD}$	Supply Voltage	7	V
$T_{SC(O)}$	Output Short-circuit duration, at $T_A=25^{\circ}C$ , $P_{TOT}=1W$	20	S
$T_A$	Operating Ambient Temperature range	-40 to 85	$^{\circ}C$
$T_J$	Maximum Junction Temperature	150	$^{\circ}C$
$T_{STG}$	Storage Temperature Range	-65 to +150	$^{\circ}C$
$T_S$	Soldering Temperature, 10 seconds	260	$^{\circ}C$
$V_{ESD}$	Electrostatic Discharge	-3000 to 3000 <sup>*1</sup>	V

Note : \*1. Human body model :  $C=100pF$  ,  $R=1500\Omega$  , 3 positive pulses plus 3 negative pulses

## Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{THJA}$	Thermal Resistance from Junction to Ambient in Free Air		
	DIP-8	109	K/W
	SO-8	180	K/W
	TSSOP	220	K/W
	MSOP	220	K/W

## Electrical Characteristics

$V_{DD}=5V$  ,  $T_A=25^{\circ}C$  (unless otherwise noted)

Symbol	Parameter	Condition	APC308			Unit
			Min.	Typ.	Max.	
Vos	Input Offset Voltage	$T_A=25^{\circ}C$		4	10	mV
		$-25^{\circ}C < T_A < 75^{\circ}C$		5		mV
Ibias	Input Bias Current	$T_A=25^{\circ}C$		2		pA
Vicm	Input Common Mode Voltage Range	$T_A=25^{\circ}C$	0		$V_{DD}-0.8$	V

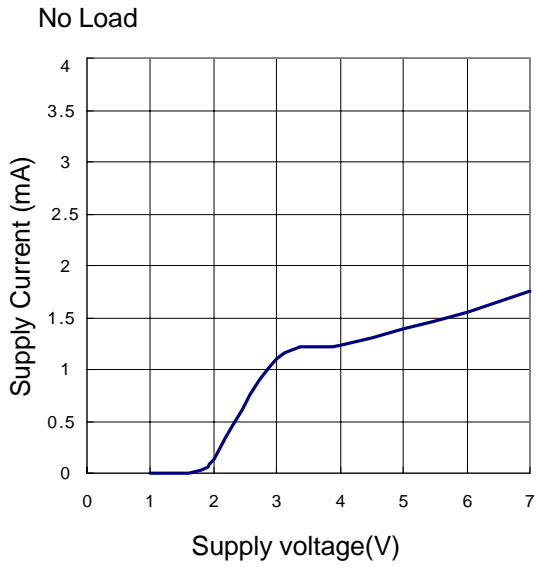
## Electrical Characteristics Cont.

$V_{DD}=5V$  ,  $T_A=25^\circ C$  (unless otherwise noted)

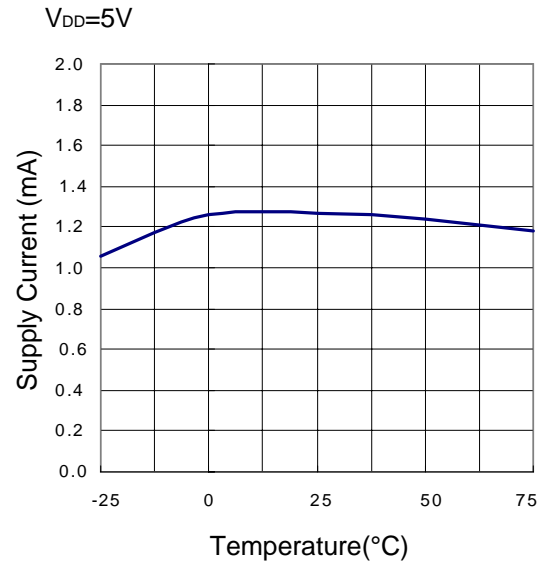
Symbol	Parameter	Condition	APC308			Unit
			Min.	Typ.	Max.	
$R_{IN}$	Input Resistance			5		$M\Omega$
$V_o$	Output Voltage Swing	$R_L=2k\Omega$	0		5	V
$V_{oh}$	Output Voltage High	$R_L=10k\Omega$ , $-25^\circ C < T_a < 75^\circ C$		5		V
$V_{ol}$	Output Voltage Low	$R_L=10k\Omega$ , $-25^\circ C < T_a < 75^\circ C$		0		V
$I_{out}$	Output Current Source	$V_o=4.5V$		-310		mA
	Output Current Sink	$V_o=0.5V$		370		mA
CMRR	Common Mode Rejection Ratio			-80		dB
PSRR	Supply Voltage Rejection Ratio	$V_{rr}=100mV_{pp}$ , $f_{in}=100Hz, R_L=2k\Omega$		-50		dB
$A_v$	Large Signal Voltage Gain			85		dB
GBW	Gain Bandwidth Product			7		MHz
SR	Slew Rate			5.6		$V/\mu s$
$I_{cc}$	Supply Current	$-25^\circ C < T_a < 75^\circ C$		2.0	4	mA
		$2.4V < V_{cc} < 6V, T_a=25^\circ C$		2.5	5	mA

## Typical Characteristics

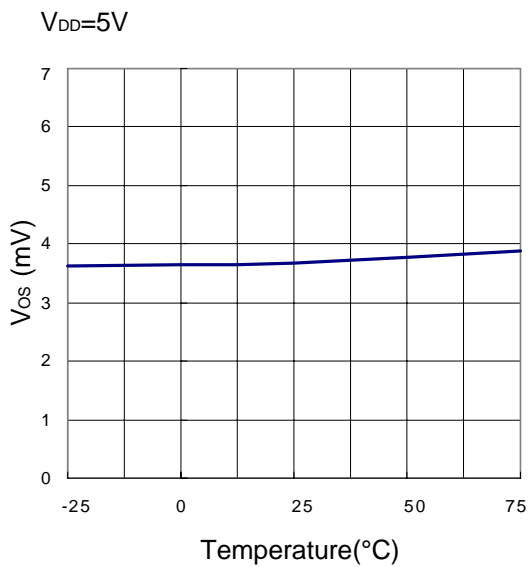
Supply Current vs Supply Voltage



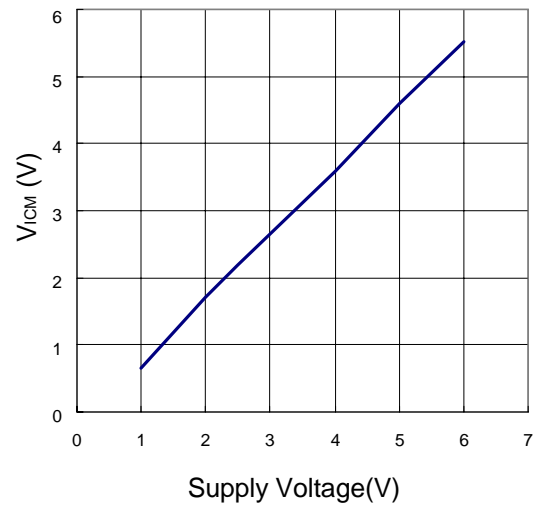
Supply Current vs Temperature



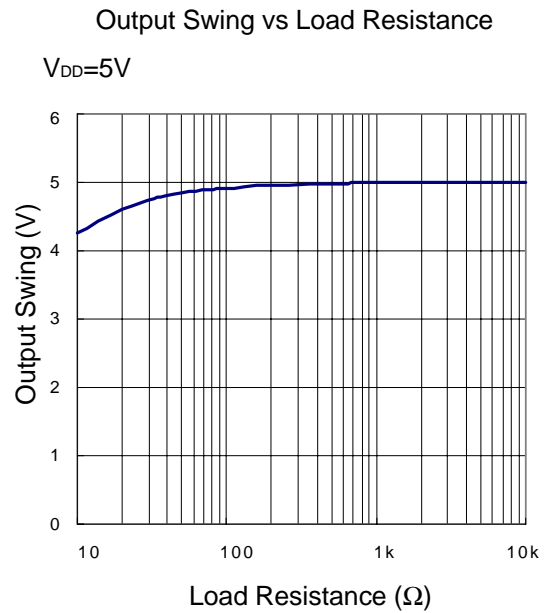
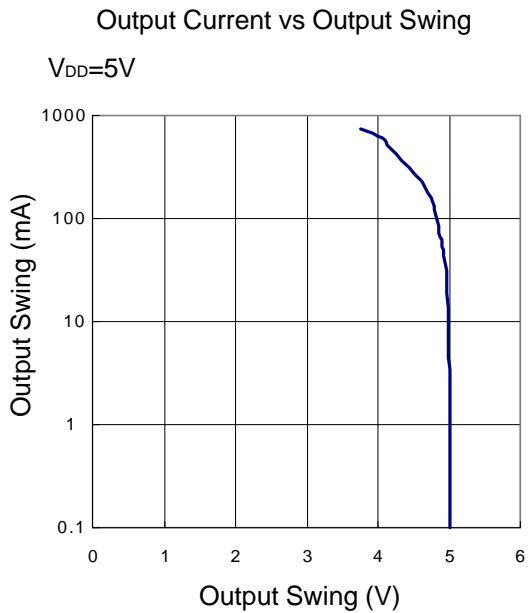
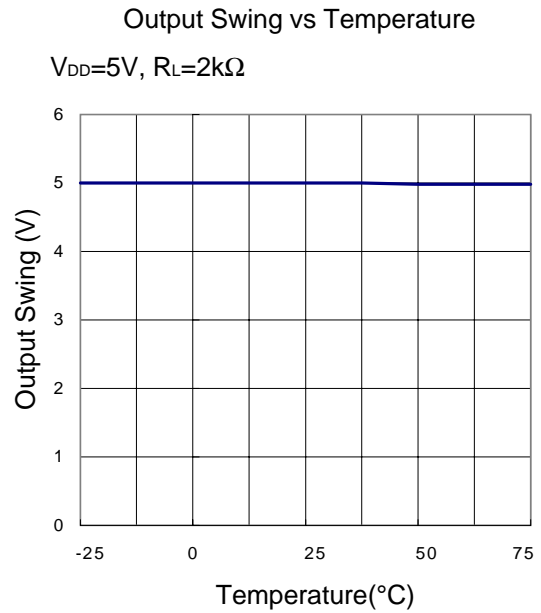
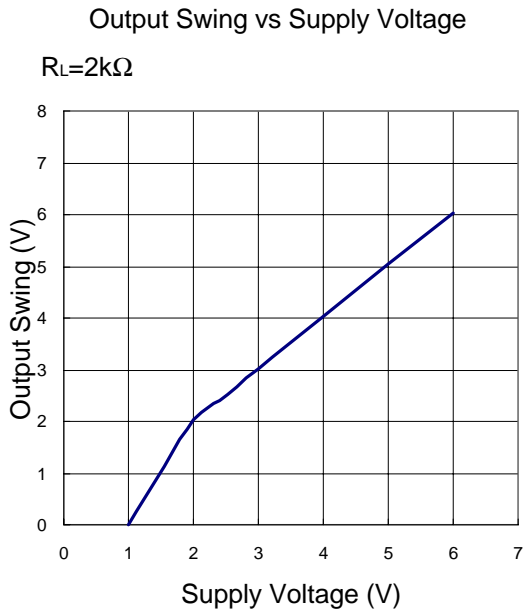
Input Offset Voltage vs Temperature



Input Common Mode Voltage vs Supply Voltage

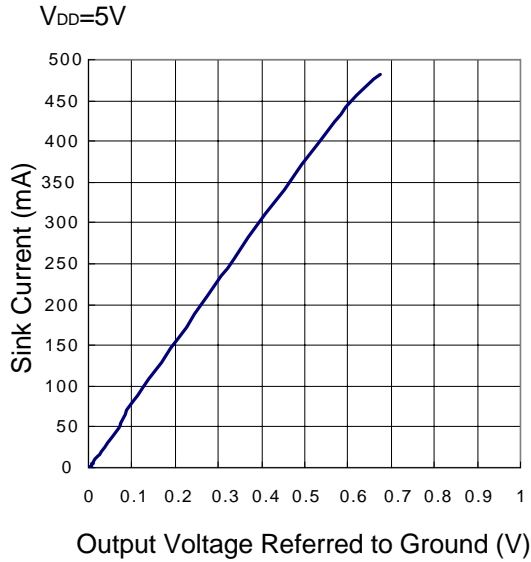


## Typical Characteristics

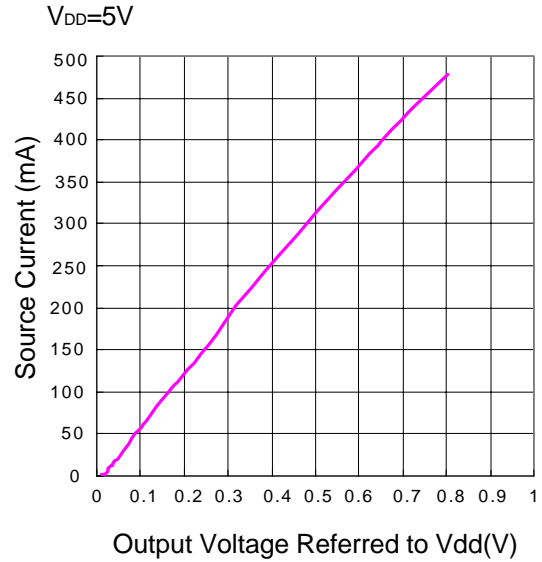


## Typical Characteristics

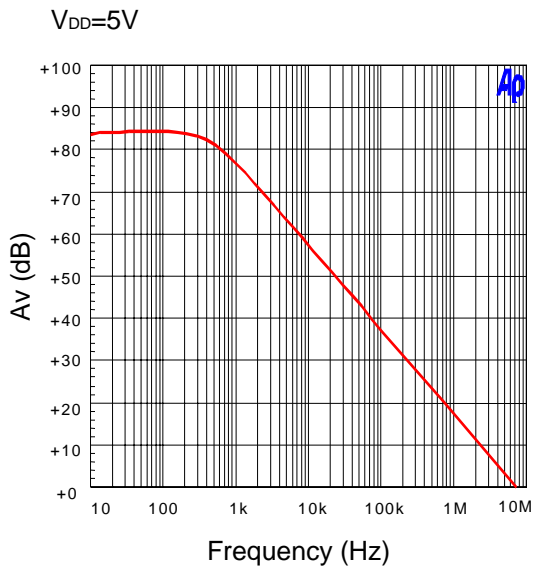
Sink Current vs Output Voltage



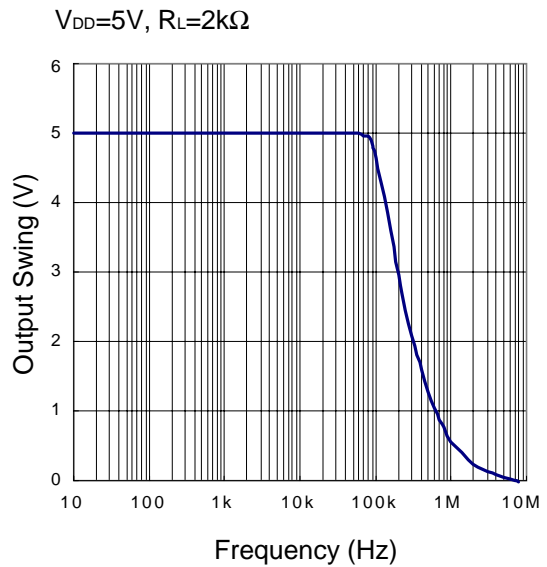
Source Current vs Output Voltage



Large Signal Voltage Gain vs Frequency

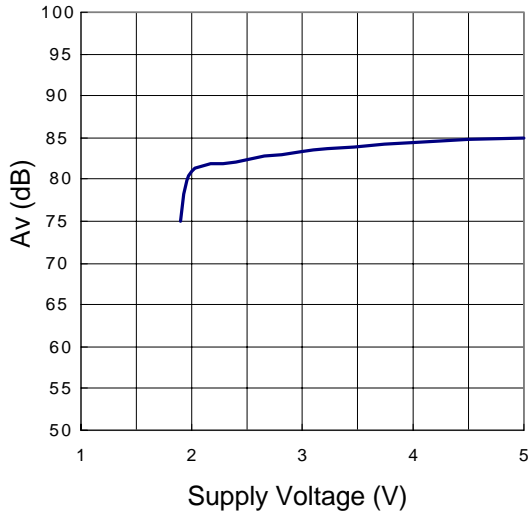


Large Signal Frequency Response

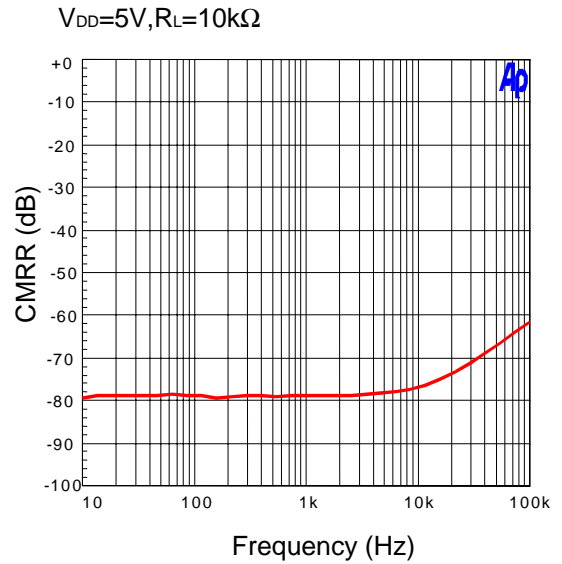


## Typical Characteristics

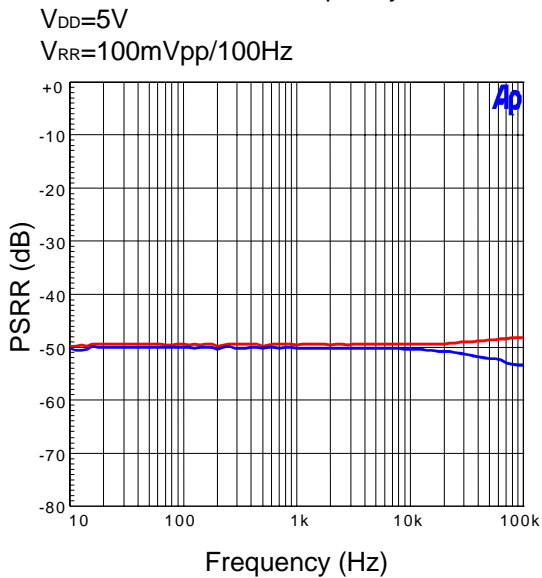
Large Signal Voltage Gain vs Supply Voltage



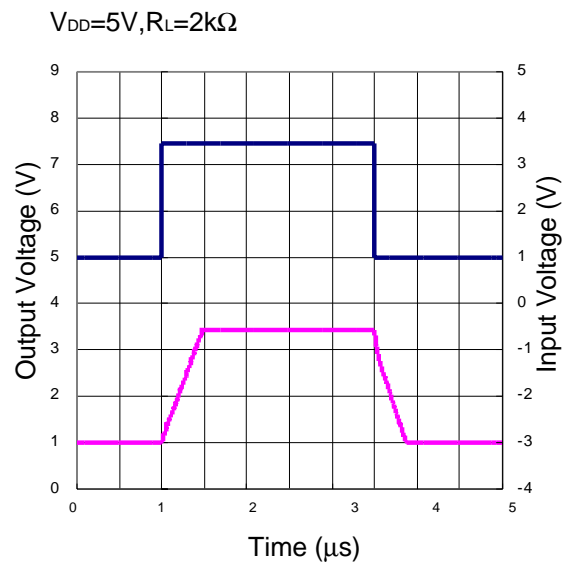
CMRR vs Frequency



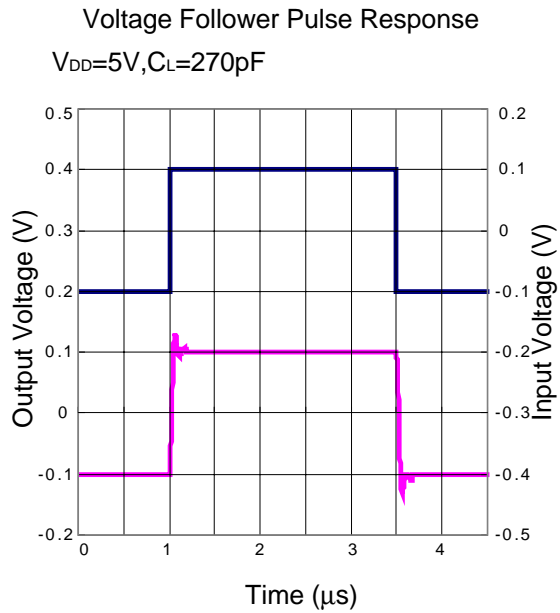
PSRR vs Frequency



Voltage Follower Pulse Response



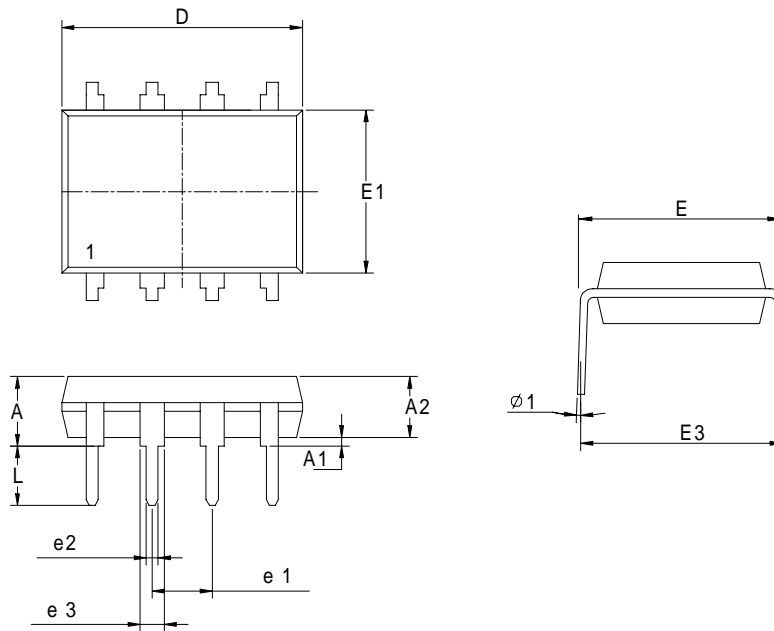
## Typical Characteristics





## Packaging Information

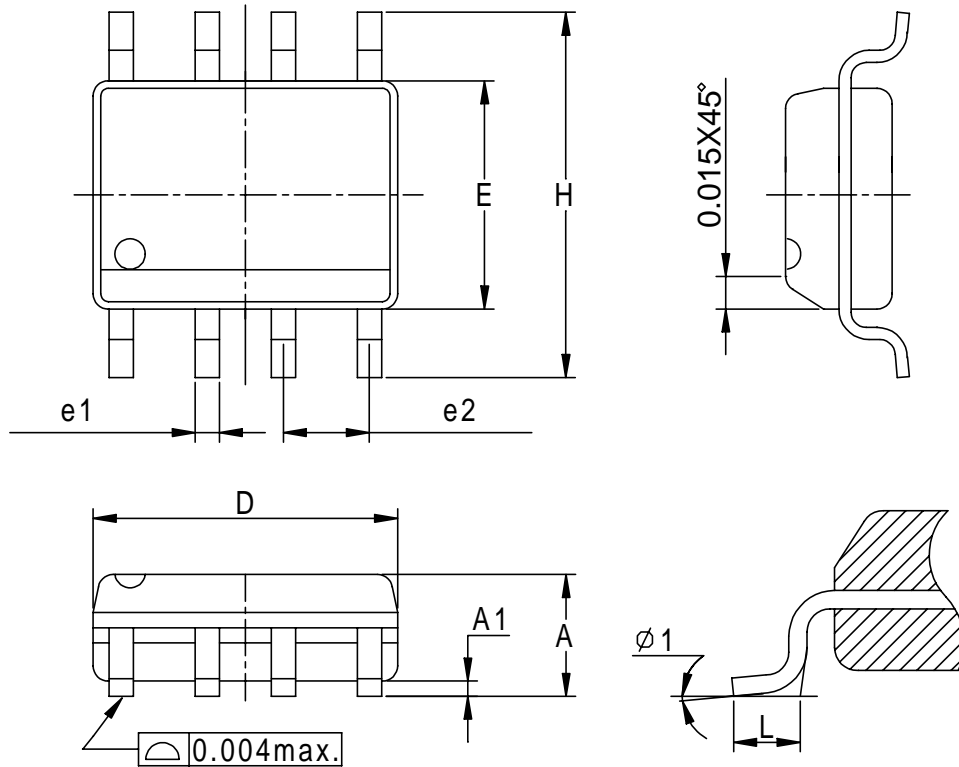
PDIP-8 pin ( Reference JEDEC Registration MS-001)



Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A		5.33		0.210
A1	0.38		0.015	
A2	2.92	3.68	0.115	0.145
D	9.02	10.16	0.355	0.400
e1	2.54BSC		0.100BSC	
e2	0.36	0.56	0.014	0.022
e3	1.14	1.78	0.045	0.070
E	7.62 BSC		0.300 BSC	
E1	6.10	7.11	0.240	0.280
E3		10.92		0.430
L	2.92	3.81	0.115	0.150
φ 1	15°		15°	

## Packaging Information

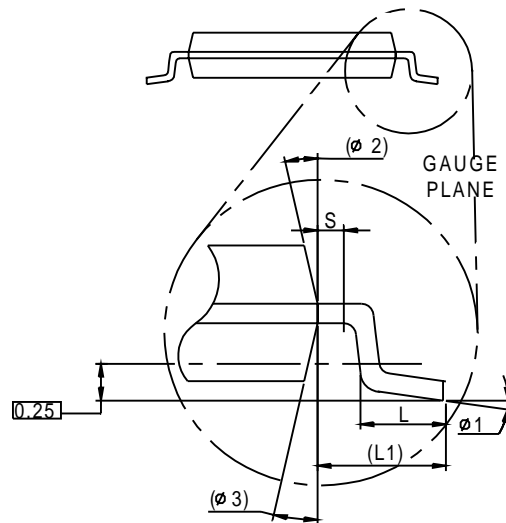
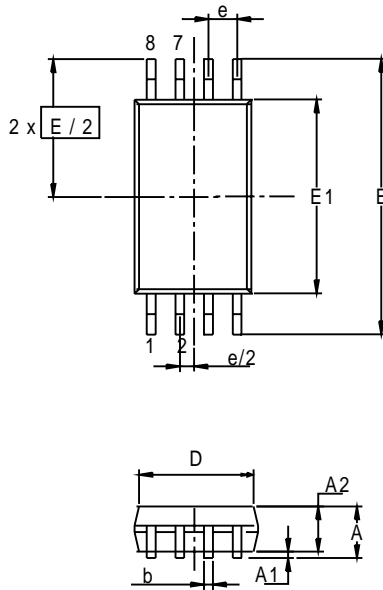
SOP-8 pin ( Reference JEDEC Registration MS-012)



Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
D	4.80	5.00	0.189	0.197
E	3.80	4.00	0.150	0.157
H	5.80	6.20	0.228	0.244
L	0.40	1.27	0.016	0.050
e1	0.33	0.51	0.013	0.020
e2	1.27BSC		0.50BSC	
φ 1	8°		8°	

## Packaging Information

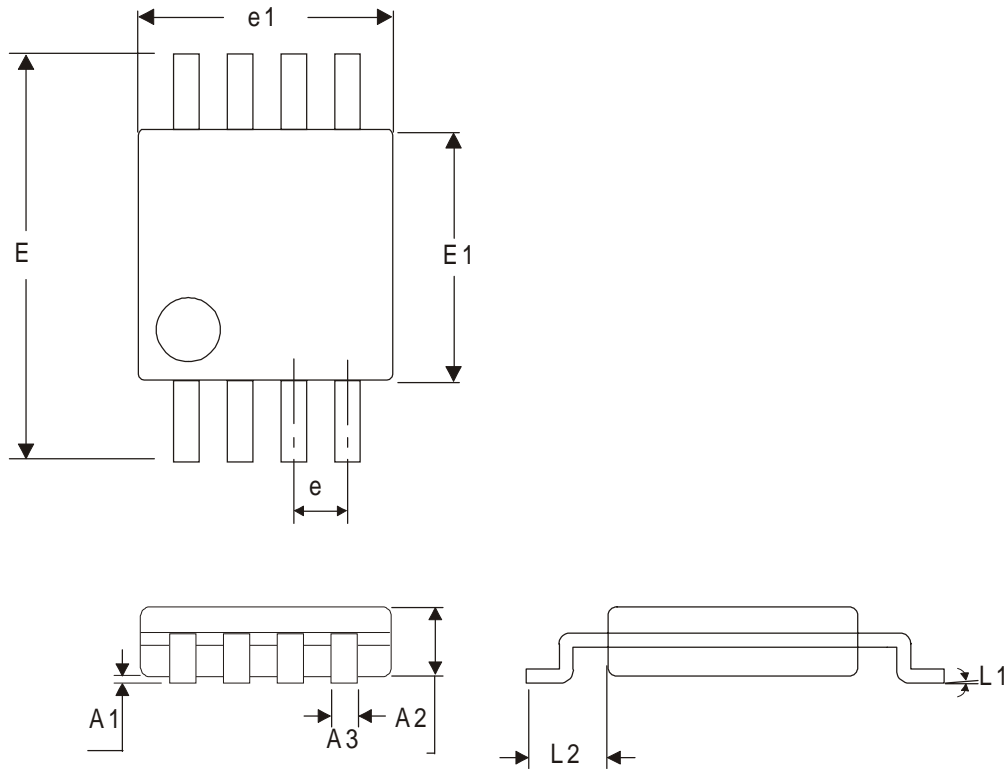
TSSOP-8



Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A		1.2		0.047
A1	0.00	0.15	0.000	0.006
A2	0.80	1.05	0.031	0.041
b	0.19	0.30	0.007	0.012
D	2.9	3.1	0.114	0.122
e	0.65 BSC		0.026 BSC	
E	6.40 BSC		0.252 BSC	
E1	4.30	4.50	0.169	0.177
L	0.45	0.75	0.018	0.030
L1	1.0 REF		0.039 REF	
R	0.09		0.004	
R1	0.09		0.004	
S	0.2		0.008	
$\phi 1$	0°	8°	0°	8°
$\phi 2$	12° REF		12° REF	
$\phi 3$	12° REF		12° REF	

## Packaging Information

MSOP

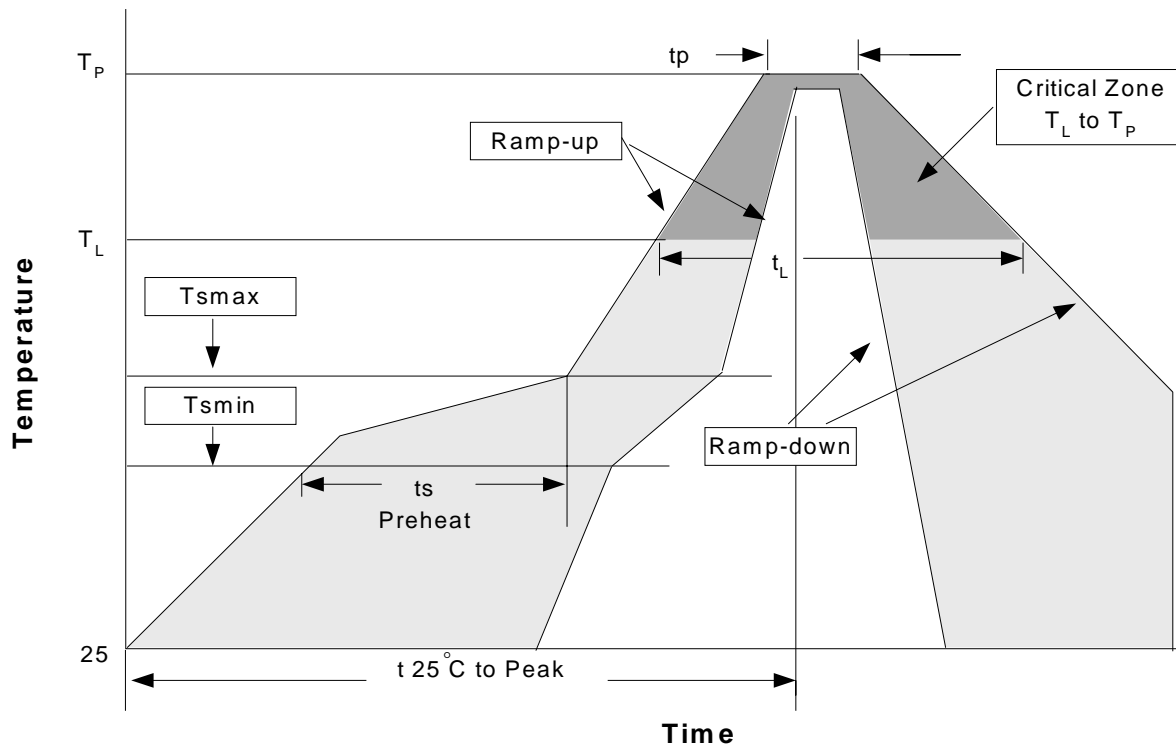


Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A1	0.06	0.15	0.002	0.006
A2	0.86 TYP		0.34 TYP	
A3	0.25	0.4	0.01	0.0126
e	0.65 TYP		0.0256TYP	
e1	2.90	3.1	0.114	0.122
E	4.8	5.0	0.189	0.197
E1	2.90	3.1	0.114	0.122
L1	0.25 REF		0.039REF	
L2	0.0375 REF		0.953 REF	

## Physical Specifications

Terminal Material	Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb), 100%Sn
Lead Solderability	Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3.

### Reflow Condition (IR/Convection or VPR Reflow)



### Classification Reflow Profiles

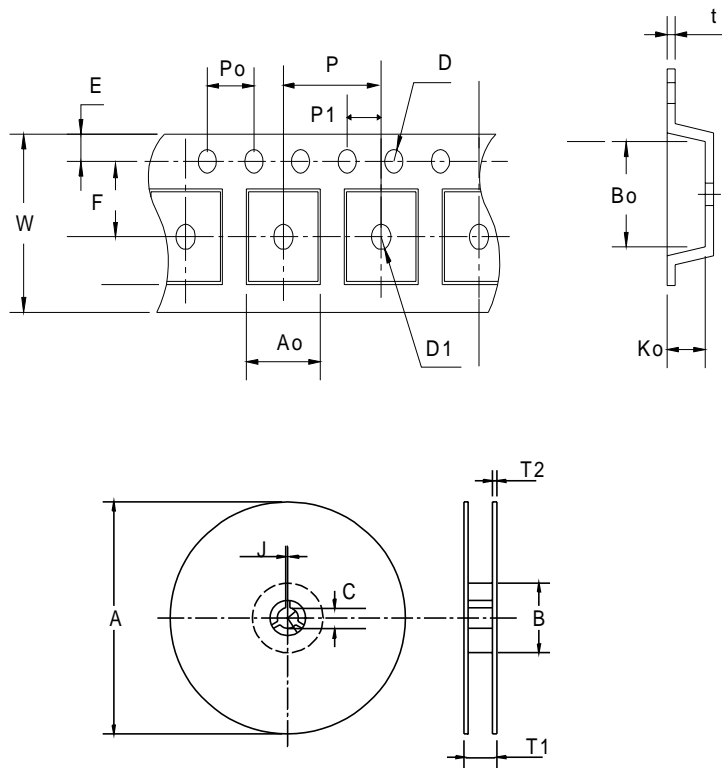
Profile Feature	Sn-Pb Eutectic Assembly		Pb-Free Assembly	
	Large Body	Small Body	Large Body	Small Body
Average ramp-up rate (T <sub>L</sub> to T <sub>P</sub> )	3°C/second max.		3°C/second max.	
Preheat - Temperature Min (T <sub>smin</sub> ) - Temperature Mix (T <sub>smax</sub> ) - Time (min to max)(t <sub>s</sub> )	100°C 150°C 60-120 seconds		150°C 200°C 60-180 seconds	
T <sub>smax</sub> to T <sub>L</sub> - Ramp-up Rate			3°C/second max	
T <sub>smax</sub> to T <sub>L</sub> - Temperature(T <sub>L</sub> ) - Time (t <sub>L</sub> )	183°C 60-150 seconds		217°C 60-150 seconds	
Peak Temperature(T <sub>p</sub> )	225 +0/-5°C	240 +0/-5°C	245 +0/-5°C	250 +0/-5°C
Time within 5°C of actual Peak Temperature(t <sub>p</sub> )	10-30 seconds	10-30 seconds	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max.		6°C/second max.	
Time 25°C to Peak Temperature	6 minutes max.		8 minutes max.	

Note: All temperatures refer to topside of the package. Measured on the body surface.

## Reliability Test Program

Test item	Method	Description
SOLDERABILITY	MIL-STD-883D-2003	245°C, 5 SEC
HOLT	MIL-STD-883D-1005.7	1000 Hrs Bias @ 125°C
PCT	JESD-22-B,A102	168 Hrs, 100%RH, 121°C
TST	MIL-STD-883D-1011.9	-65°C~150°C, 200 Cycles
ESD	MIL-STD-883D-3015.7	VHBM > 2KV, VMM > 200V
Latch-Up	JESD 78	10ms, $1_{tr} > 100mA$

## Carrier Tape & Reel Dimensions



## Carrier Tape & Reel Dimensions

Application	A	B	C	J	T1	T2	W	P	E
SOP- 8	330 ± 1	62 +1.5	12.75+ 0.15	2 ± 0.5	12.4 ± 0.2	2 ± 0.2	12± 0. 3	8± 0.1	1.75±0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	5.5± 1	1.55 +0.1	1.55+ 0.25	4.0 ± 0.1	2.0 ± 0.1	6.4 ± 0.1	5.2± 0. 1	2.1± 0.1	0.3±0.013
Application	A	B	C	J	T1	T2	W	P	E
TSSOP-8	330 ± 1	62 +1.5	12.75+ 0.15	2 + 0.5	12.4 ± 0.2	2 ± 0.2	12± 0. 3	8± 0.1	1.75±0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	5.5 ± 0. 1	1.5 + 0.1	1.5 + 0.1	4.0 ± 0.1	2.0 ± 0.1	7.0 ± 0.1	3.6 ± 0.3	1.6 ± 0.1	0.3±0.013

(mm)

## Cover Tape Dimensions

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOP- 8	12	9.3	2500
TSSOP- 8	12	9.3	2500

## Customer Service

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