

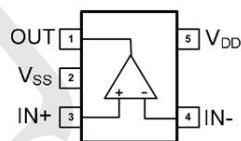
Features

- Single-Supply Operation from +2.5V ~ +5.5V
- Rail-to-Rail Input / Output
- Gain-Bandwidth Product: 200MHz (Typ.)
- Low Input Bias Current: 10pA (Typ.)

General Description

The TPA356 is wideband, low-noise, low-distortion operational amplifier, that offer rail-to-rail output and single-supply operation down to 2.5V. They draw 2.8mA of quiescent supply current, as well as low input voltage-noise density (13nV/ $\sqrt{\text{Hz}}$) and low input current-noise density (400fA/ $\sqrt{\text{Hz}}$). These features make the devices an ideal choice for applications that require low distortion and low noise. The TP8111 has output which swing rail-to-rail and their input common-mode voltage range includes ground and offer wide bandwidth to 200MHz (G=+1). They are specified over the extended industrial temperature range (-45°C ~ 125°C). The single TP8111 is available in space-saving, SOT23-5 packages.

Pin Assignments



SOT23-5

Applications

- Low Offset Voltage: 5mV (Max.)
- Quiescent Current: 2.8mA (Typ.)
- Operating Temperature: -40°C ~ +125°C
- Available in SOT23-5 and SOP8 Packages

Package/Ordering Information

Order Number	Package Description	Package Option
TPA356AIDBVR	SOT23-5	Tape and Reel 3000

Absolute Maximum Ratings

Condition	Min	Max
Power Supply Voltage (V_{DD} to V_{SS})	-0.5V	+7V
Analog Input Voltage (IN+ or IN-)	$V_{SS}-0.5V$	$V_{DD}+0.5V$
PDB Input Voltage	$V_{SS}-0.5V$	+7V
Operating Temperature Range	-40°C	+125°C
Junction Temperature		+150°C
Storage Temperature Range	-65°C	+150°C
Lead Temperature (soldering, 10sec)		+300°C
Package Thermal Resistance ($T_A=+25^\circ\text{C}$)		
SOP23-5, θ_{JA}		190°C
SOP8, θ_{JA}		130°C

Note: Stress greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions outside those indicated in the operational sections of this specification are not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

Electrical Characteristics ($T_A=25^\circ\text{C}$ unless otherwise noted)

($V_{DD} = +5\text{V}$, $V_{SS} = 0\text{V}$, $V_{CM} = 0\text{V}$, $V_{OUT} = V_{DD}/2$, $R_L=100\text{K}$ tied to $V_{DD}/2$, $\text{SHDNB} = V_{DD}$, $T_A = -40^\circ\text{C}$ to $+125^\circ\text{C}$, unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$.) (Notes 1,2)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Supply-Voltage Range	V_{DD}	Guaranteed by the PSRR test	2.5	-	5.5	V
Quiescent Supply Current (per Amplifier)		$V_{DD} = 5\text{V}$	-	2.8	3.5	mA
Input Offset Voltage	V_{OS}	$T_A=25^\circ\text{C}$	-	± 1	-	mV
		$T_A=-40^\circ\text{C}\sim+85^\circ\text{C}$	-	± 8	-	
		$T_A=-40^\circ\text{C}\sim+125^\circ\text{C}$	-	-	± 10	
Input Offset Voltage Tempco	$\Delta V_{OS}/\Delta T$		-	± 2	-	$\mu\text{V}/^\circ\text{C}$
Input Bias Current	I_B	(Note 3)	-	± 10	± 100	pA
Input Offset Current	I_{OS}	(Note 3)	-	± 10	± 100	pA
Input Common-Mode Voltage Range	V_{CM}	Guaranteed by the $T_A = 25^\circ\text{C}$ CMRR test, $T_A = -40^\circ\text{C} \sim +125^\circ\text{C}$	-0.1	-	$V_{DD}+0.1.5$	V
Common-Mode Rejection Ratio	CMRR	$V_{SS}-0.1\text{V}\leq V_{CM}\leq V_{DD}+0.1\text{V}$ $T_A = 25^\circ\text{C}$	-	75	-	dB
		$V_{SS}\leq V_{CM}\leq 5V_{DD}$ $T_A = 25^\circ\text{C}$	72	90	-	
		$V_{SS}-0.1\text{V}\leq V_{CM}\leq V_{DD}+0.1\text{V}$ $T_A = -40^\circ\text{C} \sim +125^\circ\text{C}$	-	68	-	
Power-Supply Rejection Ratio	PSRR	$V_{DD} = +2.5\text{V}$ to $+5.5\text{V}$	75	90	-	dB
Open-Loop Voltage Gain	A_V	$R_L = 10\text{k}\Omega$ to $V_{DD}/2$ $V_{OUT} = 100\text{mV}$ to $V_{DD}-125\text{mV}$	90	100	-	dB
		$R_L = 1\text{k}\Omega$ to $V_{DD}/2$ $V_{OUT} = 200\text{mV}$ to $V_{DD}-250\text{mV}$	80	95	-	
		$R_L = 500\Omega$ to $V_{DD}/2$ $V_{OUT} = 350\text{mV}$ to $V_{DD}-500\text{mV}$	70	80	-	
Output Voltage Swing	V_{OUT}	$ V_{IN+}-V_{IN-} \geq 10\text{mV}$ $V_{DD}-V_{OH}$	-	10	30	mV
		$R_L = 10\text{k}\Omega$ to $V_{DD}/2$ $V_{OL}-V_{SS}$	-	10	35	
		$ V_{IN+}-V_{IN-} \geq 10\text{mV}$ $V_{DD}-V_{OH}$	-	80	50	
		$R_L = 1\text{k}\Omega$ to $V_{DD}/2$ $V_{OL}-V_{SS}$	-	30	50	
		$ V_{IN+}-V_{IN-} \geq 10\text{mV}$ $V_{DD}-V_{OH}$	-	100	140	
		$R_L = 500\Omega$ to $V_{DD}/2$ $V_{OL}-V_{SS}$	-	100	140	
Output Short-Circuit Current	I_{SC}	Sinking or Sourcing	-	± 100	-	mA
-3 dB Gain Bandwidth Product	GBW	$A_V = +1\text{V}/\text{V}$	-	200	-	MHz
Slew Rate	SR	$A_V = +1\text{V}/\text{V}$	-	125	-	V/ μs

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Differential Phase error (NTSC)	DP	$G=2, R_L=150\Omega$	-	0.03	-	deg
Differential Gain error (NTSC)	DG	$G=2, R_L=150\Omega$	-	0.09	-	dB
Settling Time	t_s	To 0.01%, $V_{OUT} = 2V$ step $A_v = +1V/V$	-	42	-	ns
Over Load Recovery Time		$V_{IN} \times \text{Gain} = V_s$	-	35	-	ns
Input Voltage Noise Density	e_n	$f = 1\text{MHz}$	-	16	-	nV/ $\sqrt{\text{Hz}}$
Total Harmonic Distortion plus Noise	THD+N	$f_c=5\text{MHz}, V_{OUT}=2V_{p-p}, G=+2$	-	-60	-	dB

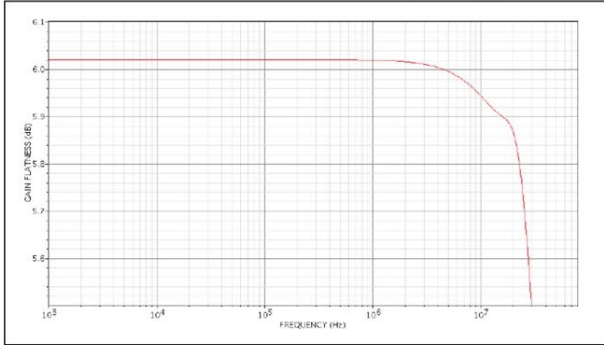
Note 1: All devices are 100% production tested at $T_A = +25^\circ\text{C}$; all specifications over the automotive temperature range is guaranteed by design, not production tested.

Note 2: Parameter is guaranteed by design.

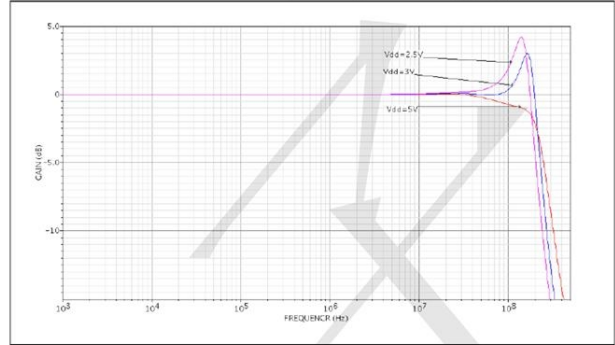
Note 3: Peak-to-peak input noise voltage is defined as six times rms value of input noise voltage.

TYPICAL PERFORMANCE CHARACTERISTICS

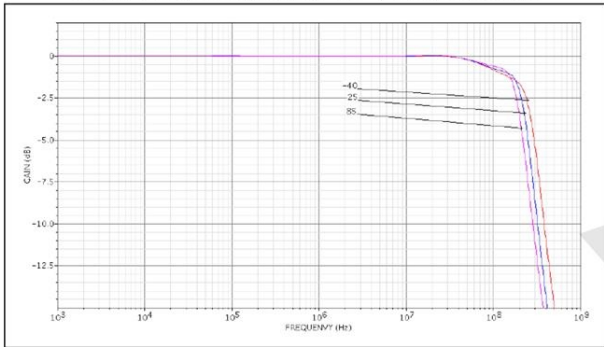
0.1dB Gain Flatness vs. Frequency; G=+2



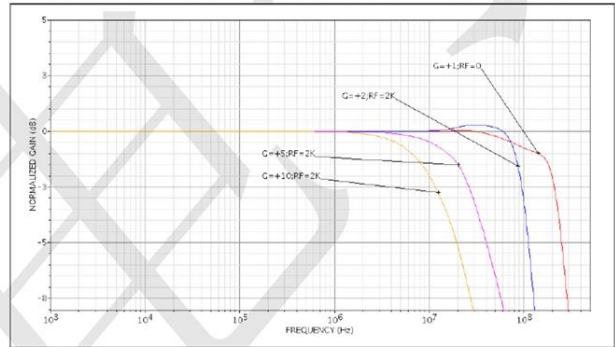
Gain vs. Frequency vs Supply



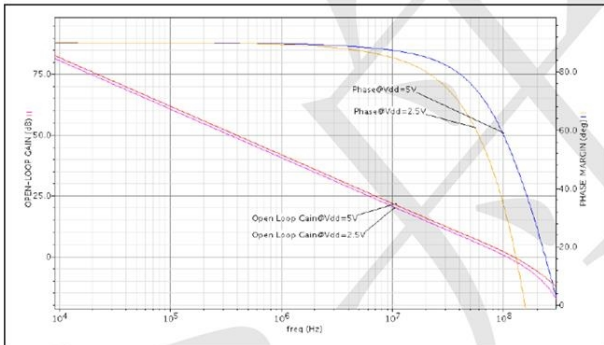
Gain vs. Frequency vs Temperature



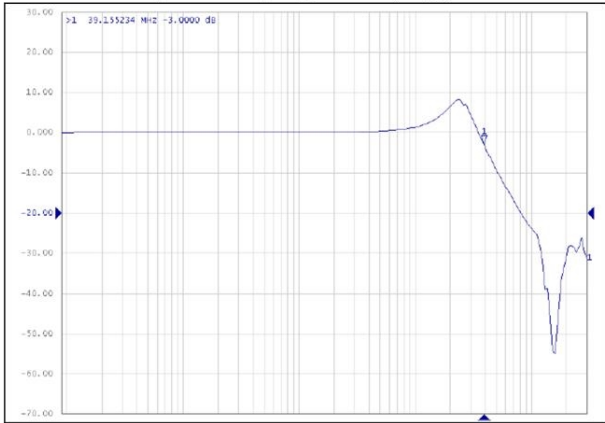
Normalized Gain vs. Frequency; VDD=5V



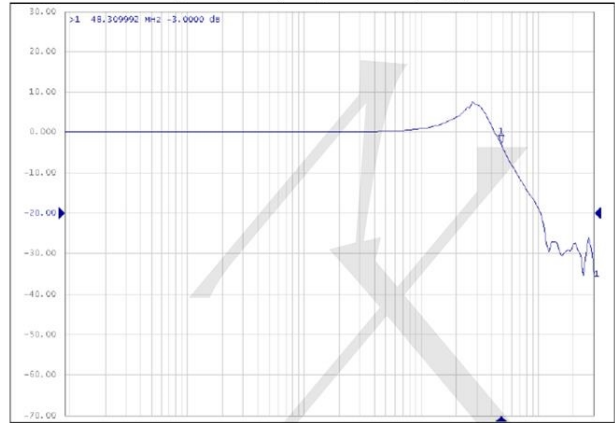
STB_RL=2K



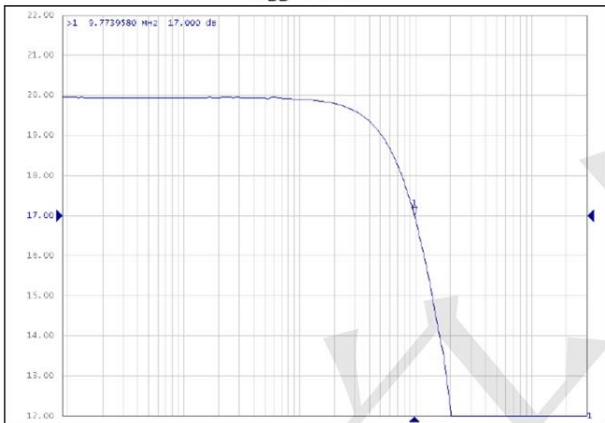
G=+1; RF=2K; V_{PP}=0.2V; V_{DD}=2.5V



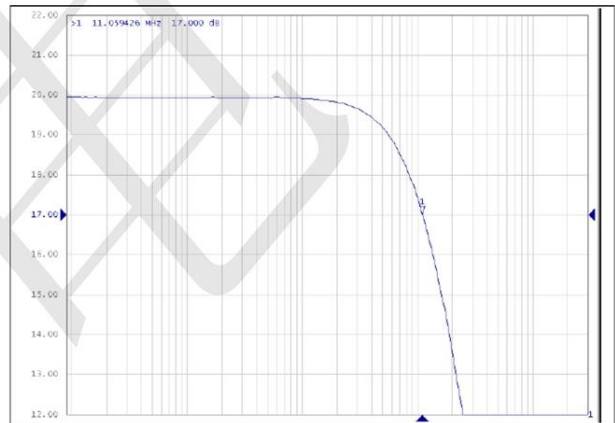
G=+1; RF=2K; V_{PP}=0.2V; V_{DD}=5V



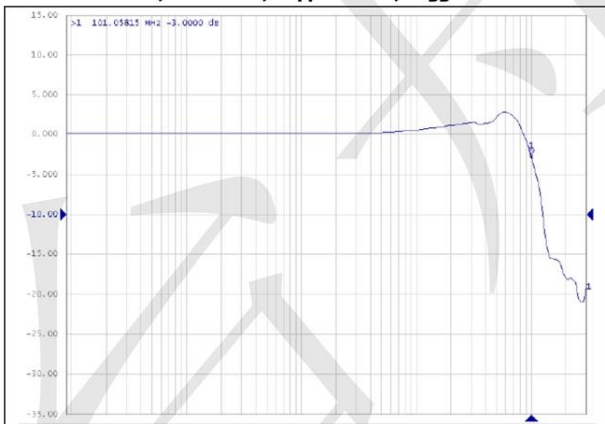
**G=+2; RF=100Ω; RI=150Ω V_{PP}=0.2V;
 V_{DD}=2.5V**



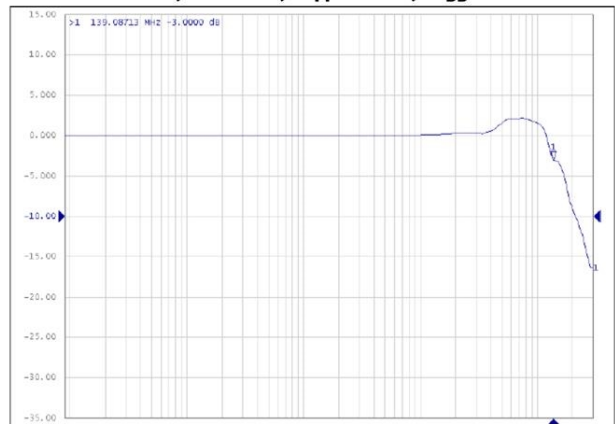
G=-10; RF=2K; V_{PP}=0.2V; V_{DD}=5V



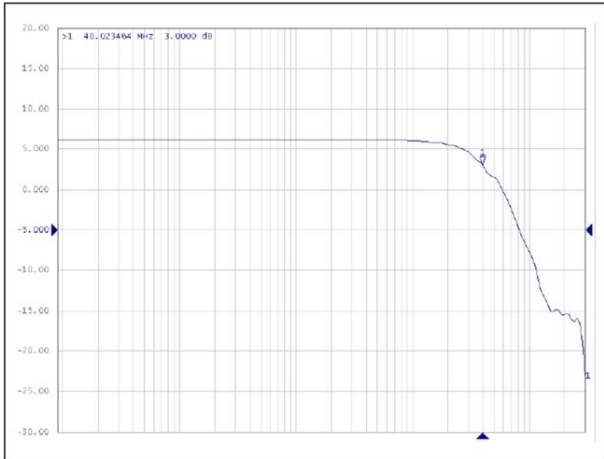
G=+1; RF=2K; V_{PP}=0.2V; V_{DD}=2.5V



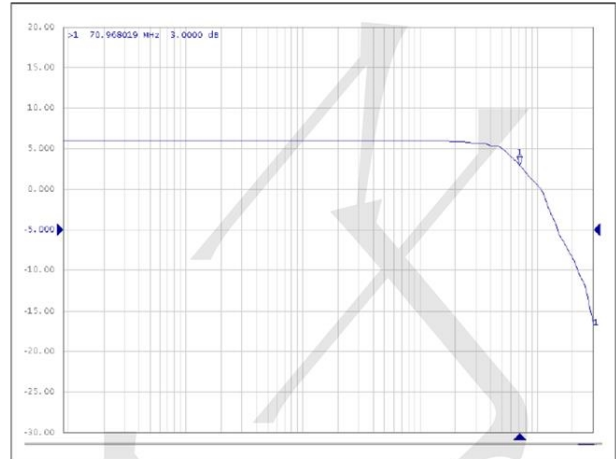
G=+1; RF=2K; V_{PP}=0.2V; V_{DD}=5V



**G=+2; RF=100 Ω; RI=150 Ω V_{pp}=0.2V;
V_{DD}=2.5V**



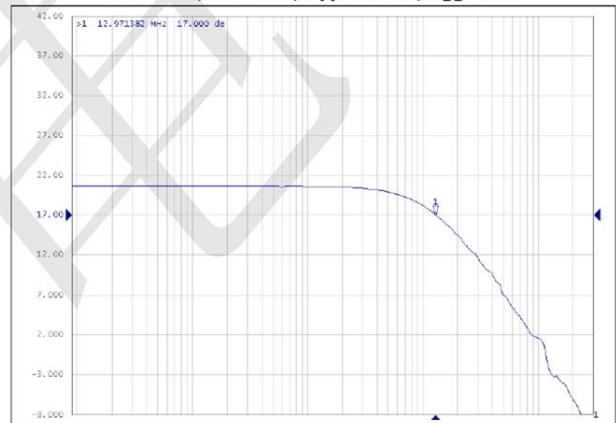
G=+2; RF=100 Ω; RI=150 Ω V_{pp}=0.2V; V_{DD}=5V



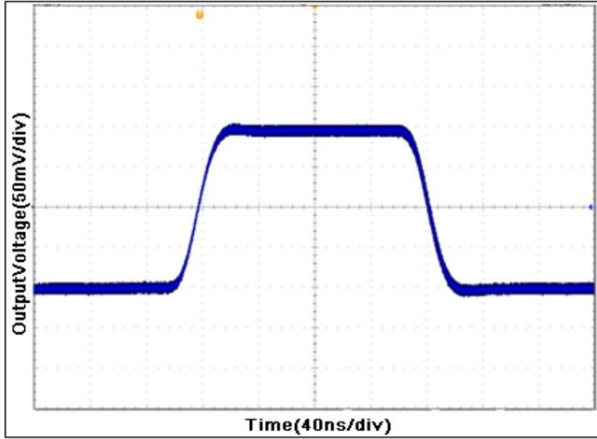
G=+10; RF=2K; V_{pp}=0.2V; V_{DD}=2.5V



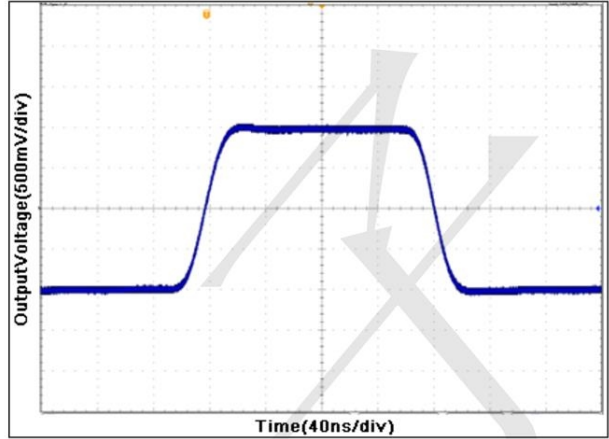
G=+10; RF=2K; V_{pp}=0.2V; V_{DD}=5V



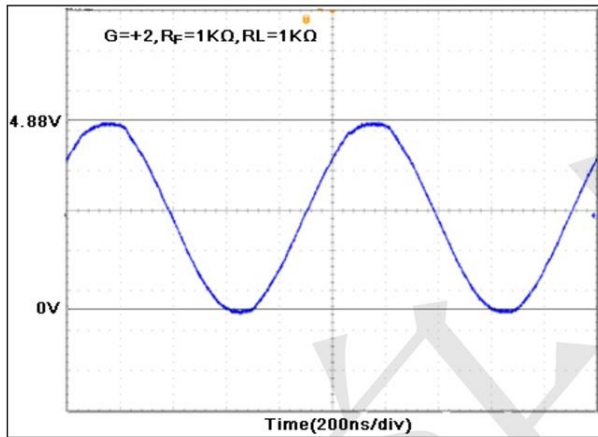
Non-Inverting Small Signal Step Response



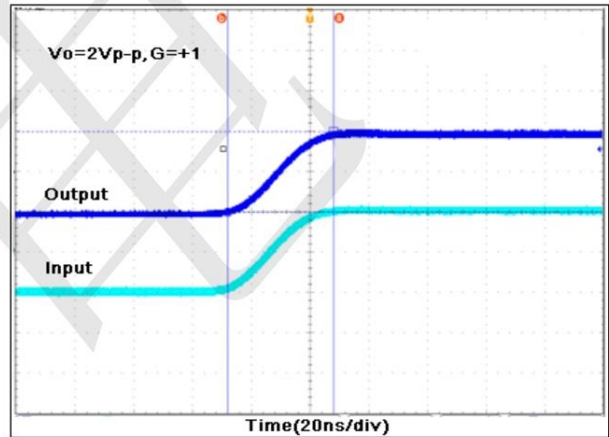
Non-Inverting Large Signal Step Response



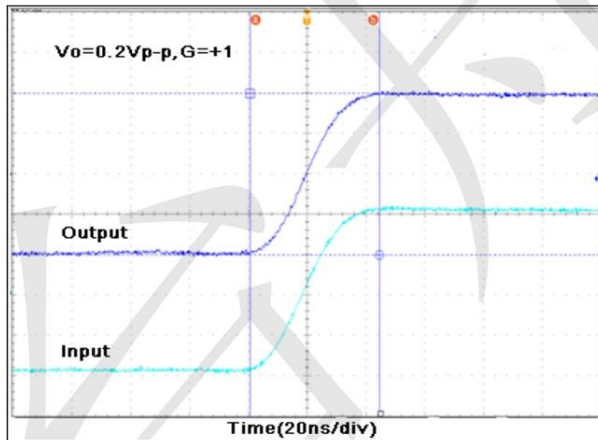
Rail-To-Rail



Output Settling Time(large signal)

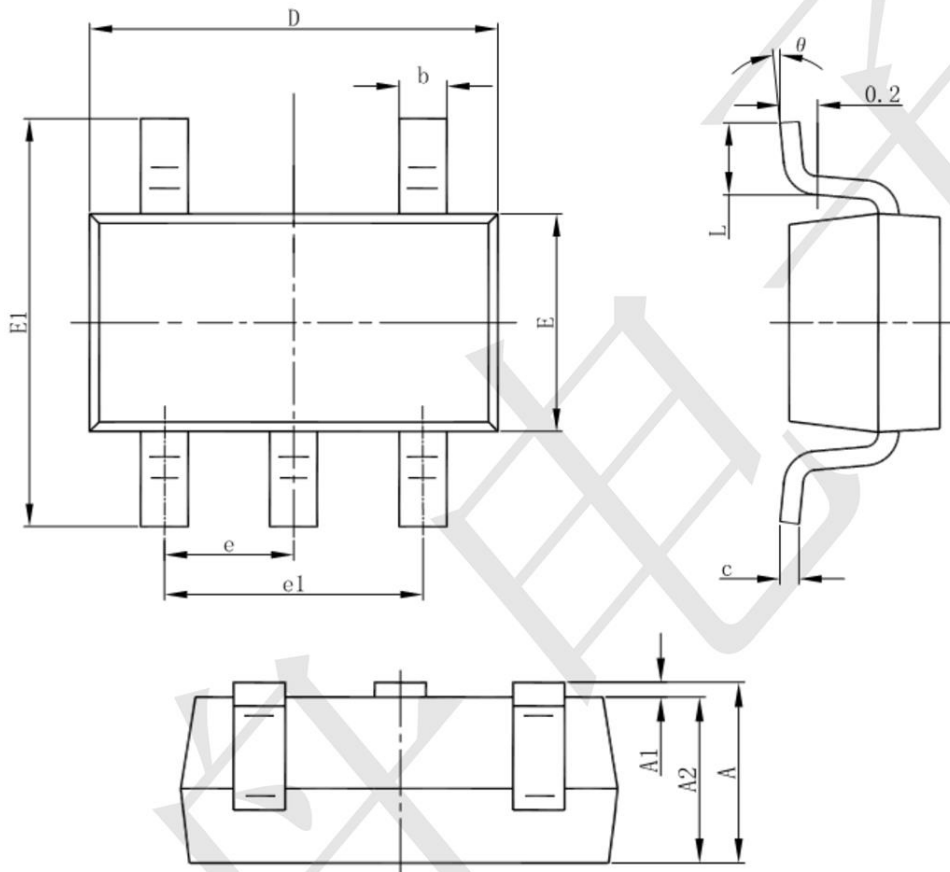


Output Settling Time(small signal)



Package Information

SOT23-5



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
theta	0°	8°	0°	8°