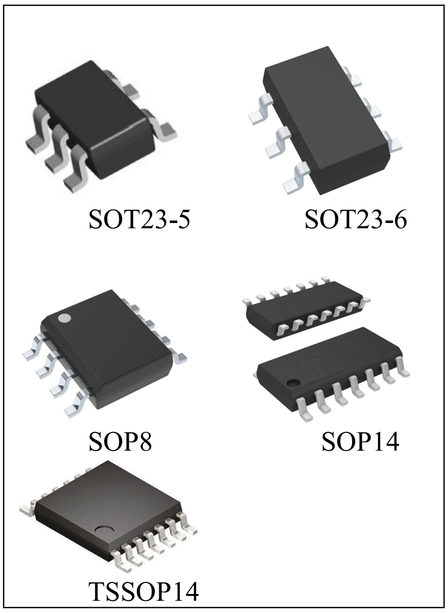
D8051/2/3/4

250MHz Rail-to-Rail Output CMOS Operational Amplifier

General Description



The D8051/3 (single), D8052(dual) and D8054(quad) are rail-to-rail output voltage feedback amplifiers offering ease of use and low cost. They have bandwidth and slew rate typically found in current feedback amplifiers. All have a wide input common-mode voltage range and output voltage swing, making them easy to use on single supplies as low as 2.5V.

Despite being low cost, the D8051 series provides excellent overall performance. They offers wide bandwidth to 250MHz (G = +1) along with 0.1dB flatness out to 37MHz（G=+2）and offers a typical low power of 2.3mA/amplifier.

The D8051 series is low distortion and fast settling make it ideal for buffering high speed A/D or D/A converters. The D8053 has a power-down disable feature that reduces the supply current to 75 µA. These features make the D8053 ideal for portable and battery-powered applications where size and power are critical. All are specified over the extended – 40°C to +125°C temperature range.

The D8051(single) is available in SOT23-5 and SOP8 packages.
The D8052(dual) is available in SOP8 package.
The D8053(single) is available in SOT23-6 package.
The D8054(quad) is available in SOP14 and TSSOP14 packages.

Features

- Low Cost
- Rail-to-Rail Input and Output: 2mV Typical V_{OS}
- High Speed
  250MHz, –3dB Bandwidth (G=+1)
  130V/µs, Slew Rate
  58ns Settling Time to 0.1% with 2V Step
- Input Voltage Range=–0.2V to +3.8V with VS=5V
- Excellent Video Specs (R_L=150Ω, G=+2)
  Gain Flatness 0.1dB to 37MHz
  Diff Gain: 0.03% , Diff Phase: 0.08 degree

- Low Power

  2.3mA/Amplifier Typical Supply Current

  75µA/Amplifier when Disabled (D8053 only)

Package Information

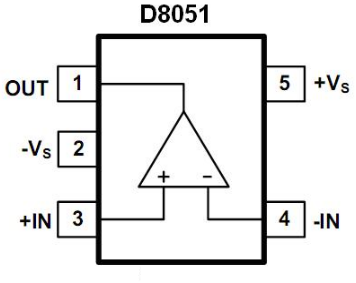
Part NO.	Package Description	Package Marking	Package Option
D8051	SOT23-5	D8051 SXXXX	3000/Reel
D8051	SOP8	CHMC D8051 SXXXX	100/Tube 4000/Reel
D8052	SOP8	CHMC D8052 SXXXX	100/Tube 4000/Reel
D8053	SOT23-6	D8053 SXXXX	3000/Reel
D8054F	SOP14	CHMC SXXXX D8054F	50/Tube 4000/Reel
D8054	TSSOP14	CHMC D8054 SXXXX	60/Tube 3000/Reel

CHMC:Trademark D8051/D8052/D8053/D8054F/D8054:Part NO. SXXXX:Lot NO.

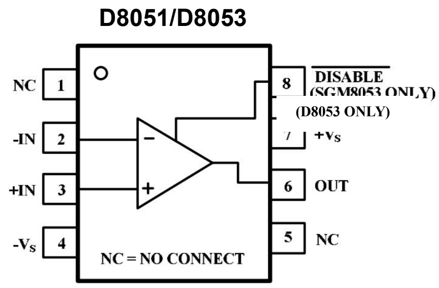
Applications

- Imaging
- Photodiode Preamp
- Professional Video and Cameras
- Hand Sets
- DVD/CD
- Base Stations
- Filters
- A-to-D Driver

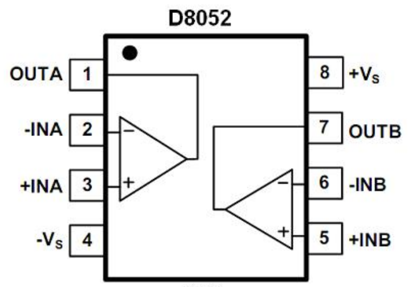
Pin Configuration



SOT23-5



SOP8



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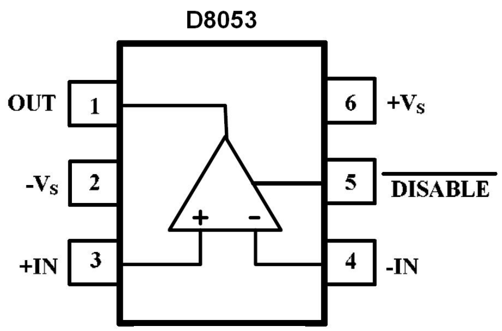
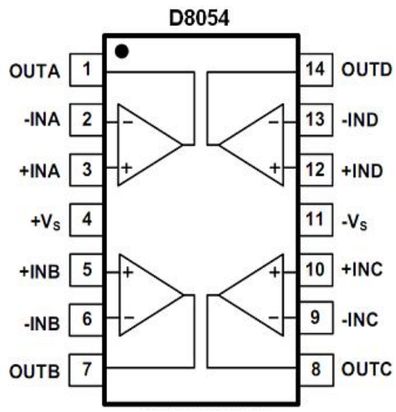


SOT23-6



SOP14/TSSOP14

Pin Description

D8051/D8053 (SOT23-5/SOP8/SOT23-6)

Pin Name	Pin Number			Function Description
	D8051 (SOT23-5)	D8051 (SOP8)	D8053 (SOT23-6)	
OUT	1	6	1	Output Terminal
-Vs	2	4	2	Negative Supply voltage
+IN	3	3	3	Non-inverting Input Terminal
-IN	4	2	4	Inverting Input Terminal
+Vs	5	7	6	Positive Supply Voltage
DISABLE			5	Power-down Disable
NC		1,5,8		No Connect

D8052 (SOP8)

Pin Name	Pin Name	Function Description	Pin Name	Pin Name	Function Description
1	OUTA	Output A-ch	5	+INB	Non-inverting Input B-ch
2	-INA	Inverting Input A-ch	6	-INB	Inverting Input Bc-h
3	+INA	Non-inverting Input A-ch	7	OUTB	Output B-ch
4	-Vs	Negative Supply voltage	8	+Vs	Positive Supply Voltage

D8054 (SOP14/TSSOP14)

Pin Name	Pin Name	Function Description	Pin Name	Pin Name	Function Description
1	OUTA	Output A-ch	8	OUTC	Output C-ch
2	-INA	Inverting Input A-ch	9	-INC	Inverting Input C-ch
3	+INA	Non-inverting Input A-ch	10	+INC	Non-inverting Input C-ch
4	+Vs	Positive Supply voltage	11	-Vs	Negative Supply Voltage
5	+INB	Non-inverting Input B-ch	12	+INB	Non-inverting Input D-ch
6	-INB	Inverting Input B-ch	13	-INB	Inverting Input D-ch
7	OUTB	Output B-ch	14	OUTB	Output D-ch

Absolute Maximum Ratings

Parameter		Value	Unit
Supply Voltage V+ to V-		7.5	V
Common-Mode input Voltage		(-Vs)-0.5～(+Vs)+0.5	V
Storage Temperature Range		-65～+150	°C
Junction Temperature		160	°C
Operating Temperature Range		-55～+150	°C
Package thermal resistance @T_A=25°C θ_{JA}	SOT23-5 SOT23-6	190	°C/W
	SOP8	125	°C/W
	SOP14	82	°C/W
	TSSOP14	105	°C/W
Lead temperature range (Soldering 10 sec)		260	°C
ESD susceptibility	HBM	1000	V
	MM	400	V

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

CAUTION

This integrated circuit can be damaged by ESD. Silicore Technology recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Electrical Characteristics (Vs=+5V, G=+2, R_F=887Ω, R_L=150Ω, Unless otherwise specified.)

	Parameter	Condition	Type +25℃	Min/Max Over Temperature +25℃	0~ 70℃	-40~ 85℃	-40~ 125℃	Units	Min/ Max
Dynamic Performance	-3Db Small Signal Bandwidth	G=+1,Vo=0.1Vpp,R_F=24Ω,R_L=150Ω	180					MHz	Type
		G=+1,Vo=0.1Vpp,R_F=24Ω,R_L=1kΩ	250						
		G=+2,Vo=0.1Vpp,R_L=50Ω	40						
		G=+2,Vo=0.1Vpp,R_L=150Ω	80						
		G=+2,Vo=0.1Vpp,R_L=1kΩ	130						
		G=+2,Vo=0.1Vpp,R_L=10kΩ	160						
	Gain-Bandwidth Product	G=+10,R_L=150Ω	90						
		G=+10,R_L=1kΩ	120						
	Bandwidth for 0.1dB Flatness	G=+2,Vo=0.1Vpp,R_F=887Ω,R_L=150Ω	37						
	Slew Rate	G=+1,2V Output Step	93/-118					V/μs	Type
		G=+2,2V Output Step	116/-103						
		G=+2,4V Output Step	130/-130						
	Rise/Fall Time	G=+2,Vo=0.2Vpp,10% to 90%	4					ns	Type
		G=+2,Vo=2Vpp,10% to 90%	14						
	Settling Time to 0.1%	G=+2,2V Output Step	58						
	Overload Recovery Time	Vin.G=+Vs	18						
Noise/Distortion Performance	Harmonic Distortion 2nd-Harmonic	G=+2,f=1MHz,Vo=2Vpp,R_L=150Ω						dBc	Type
	3rd-Harmonic	G=+2,f=1MHz,Vo=2Vpp,R_L=150Ω							
	Input Voltage Noise	f=1MHz	8.1					nV/$\sqrt{Hz}$	Type
	Input Current Noise	f=1MHz						fA/$\sqrt{Hz}$	Type
	Differential Gain Error(NTSC)	G=+2,R_L=150Ω	0.03					%	
	Differential Phase Error(NTSC)	G=+2,R_L=150Ω	0.08					degree	Type
DC Performance	Input Offset Voltage(V_{OS})		±2.0	±8.0	±8.9	±9.5	±9.8	mV	Max
	Input Offset Voltage Drift		4.4					μV/℃	Type
	Input Bias Current(I_B)		6					pA	Type
	Input Offset Current(I_{OS})		2						
	Open-Loop Gain (A_{OL})	Vo=0.3V to 4.7V,R_L=150Ω	80	75	74	74	73	dB	Type
		Vo=0.2V to 4.8V,R_L=1kΩ	104	92	91	91	80		
Input Characteristics	Input Common-Mode Voltage Range(VCM)		-0.2 to +3.8V					V	Type
	Common-Mode Rejection Ratio(CMRR)	VCM= -0.1V to +3.5V	80	66	65	65	62	dB	Min
Output Characteristics	Output Voltage Swing from Rail	R_L=150Ω	0.12					V	Type
		R_L=1kΩ	0.03						
	Output Current		130	100	95	90	84	mA	Min
	Closed-Loop Output Impedance	f<100kHz	0.08					Ω	Type
Power Supply	Operating Voltage Range			2.5	2.7	2.7	2.7	V	Min
				5.5	5.5	5.5	5.5	V	Max
	Quiescent Current (per amplifier)		2.3	2.9	3.4	3.8	4.0	mA	Max
	Supply Current when Disabled per amplifier (D8053 only)		75	120	127	130	137	μA	Max
	Power Supply Rejection Ratio (PSRR)	ΔVs=+2.7V to +5.5V,V_{CM}=(-Vs)+0.5	80	67	67	65	62	dB	Min

Electrical Characteristics (Vs=+5V, G=+2, R_F=887Ω, R_L=150Ω, Unless otherwise specified.) (Cont.)

Parameter			Condition	Type	Min/Max Over Temperature					
				+25℃	+25℃	0~70℃	-40~85℃	-40~125℃	Units	Min/Max
Power-down Disable	(D8053 only)	Turn-On Time		236					ns	Type
		Turn-Off Time		52					ns	Type
		$\overline{Disable}$ Voltage-Off			0.8				V	Max
		$\overline{Disable}$ Voltage-On			2.0				V	Min

Specifications subject to change without notice.

Application Summary

Driving Capacitive Loads

The D805X family is optimized for bandwidth and speed, not for driving capacitive loads. Output capacitance will create a pole in the amplifier's feedback path, leading to excessive peaking and potential oscillation. If dealing with load capacitance is a requirement of the application, the two strategies to consider are (1) using a small resistor in series with the amplifier's output and the load capacitance and (2) reducing the bandwidth of the amplifier's feedback loop by increasing the overall noise gain.

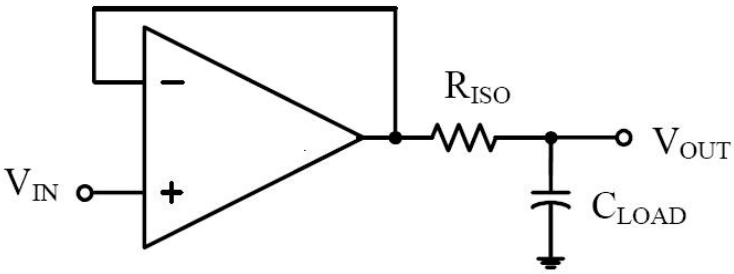


Fig1. Series Resistor Isolating Capacitive Load

Fig.1 shows a unity gain follower using the series resistor strategy. The resistor isolates the output from the capacitance and, more importantly, creates a zero in the feedback path that compensates for the pole created by the output capacitance.

Power-Supply Bypassing and Layout

The D805X family operates from either a single +2.7V to+5.5V supply or dual ±1.35V to ±2.75V supplies. For single-supply operation, bypass the power supply V_{DD} with a 0.1μF ceramic capacitor which should be placed close to the V_{DD} pin. For dual-supply operation, both the V_{DD} and the V_{SS} supplies should be bypassed to ground with separate 0.1μF ceramic capacitors. 2.2μF tantalum capacitor can be added for better performance.

Good PC board layout techniques optimize performance by decreasing the amount of stray capacitance at the op amp's inputs and output. To decrease stray capacitance, minimize trace lengths and widths by placing external components as close to the device as possible. Use surface-mount components whenever possible.

For the high speed operational amplifier, soldering the part to the board directly is strongly recommended. Try to keep the high frequency big current loop area small to minimize the EMI (electromagnetic interfacing).

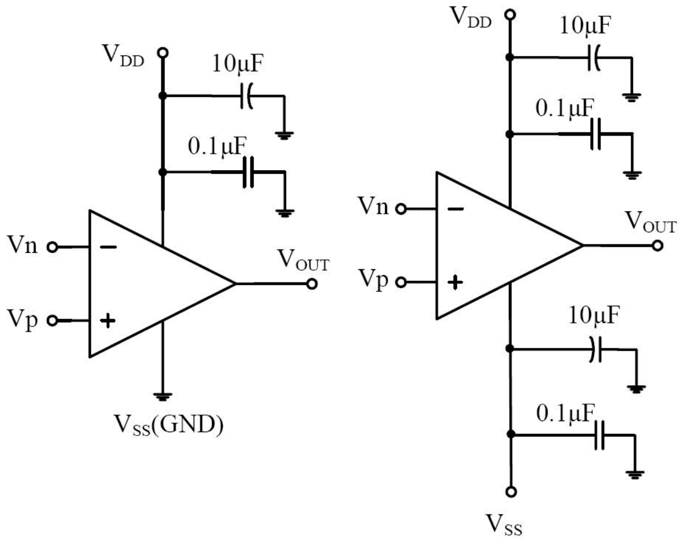


Fig. 2. Amplifier with Bypass Capacitors

Grounding

A ground plane layer is important for high speed circuit design. The length of the current path speed currents in an inductive ground return will create an unwanted voltage noise. Broad ground plane areas will reduce the parasitic inductance.

Input-to-Output Coupling

To minimize capacitive coupling, the input and output signal traces should not be parallel. This helps reduce unwanted positive feedback.

Differential Amplifier

The circuit shown in Figure 3 performs the difference function. If the resistors ratios are equal (R4 / R3 = R2 / R1), then V_{OUT} = (Vp – Vn) × R2 / R1 + Vref.

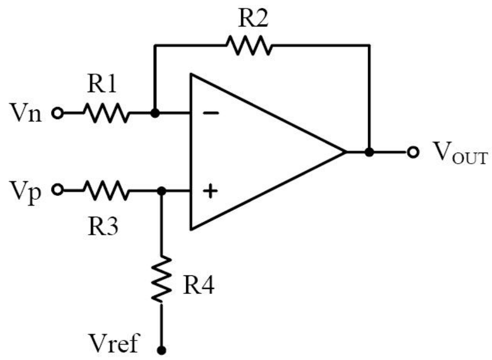


Fig. 3. Differential Amplifier

Low Pass Active Filter

The low pass filter shown in Fig.4 has a DC gain of (-R2/R1) and the –3dB corner frequency is 1/2πR2C. Make sure the filter is within the bandwidth of the amplifier. The Large values of feedback resistors can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistors value as low as possible and consistent with output loading consideration.

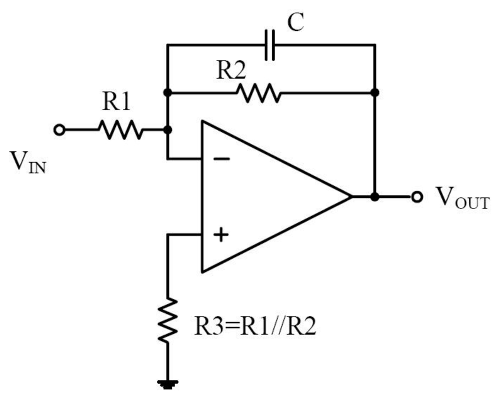
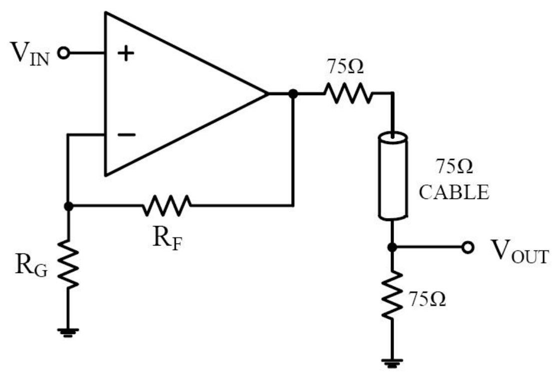


Fig. 4. Low Pass Active Filter

Driving Video

The D805X can be used in video applications like in Fig.5.



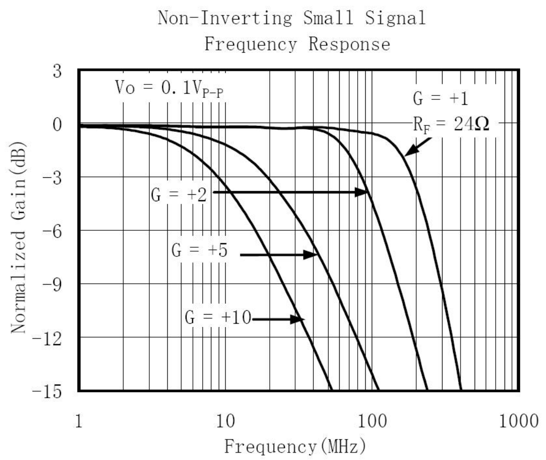
$G = 1 + R_F / R_G$

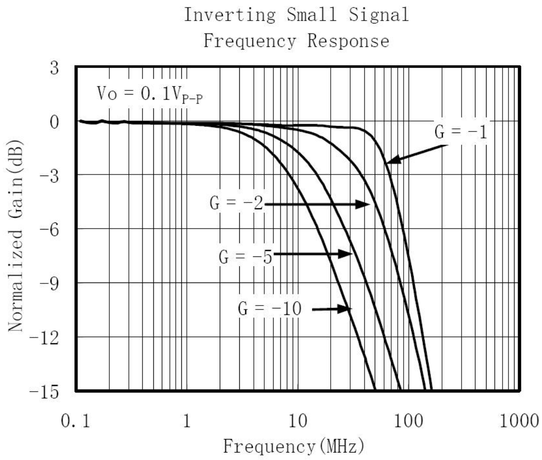
Fig. 5. Typical Video Driving

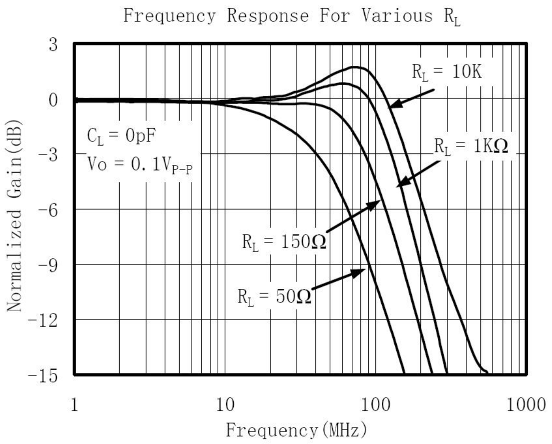
Characteristics curves

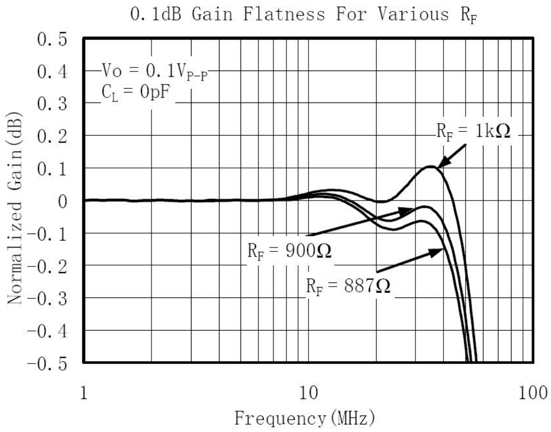
At T_A= +25°C, V_S = +5V, G = +2, R_F = 887Ω, R_G = 887Ω, and R_L = 150Ω connected to Vs/2,

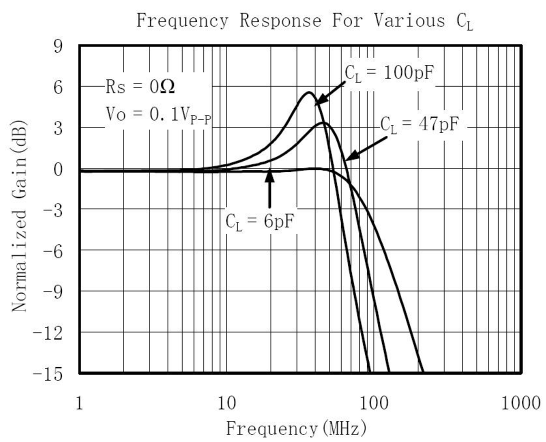
Unless otherwise noted..

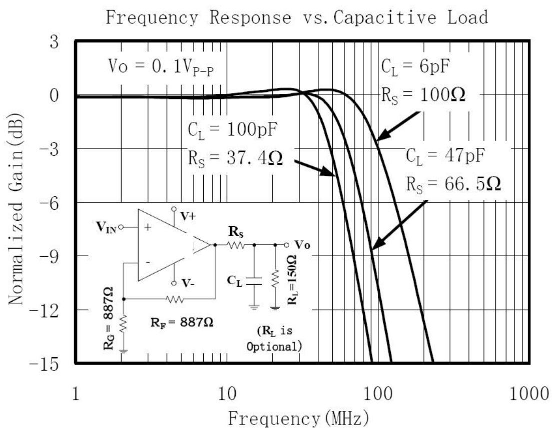












Characteristics curves

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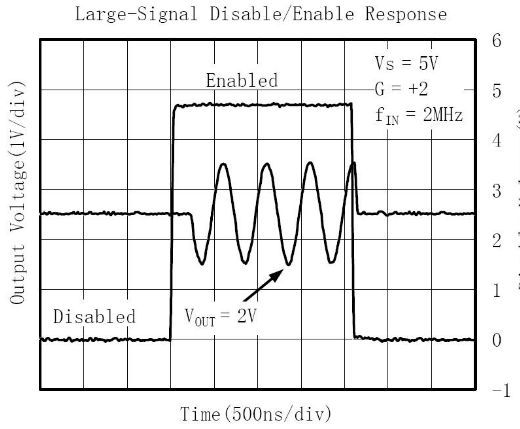

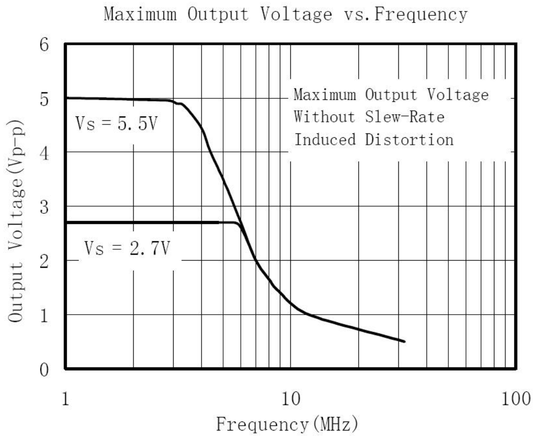

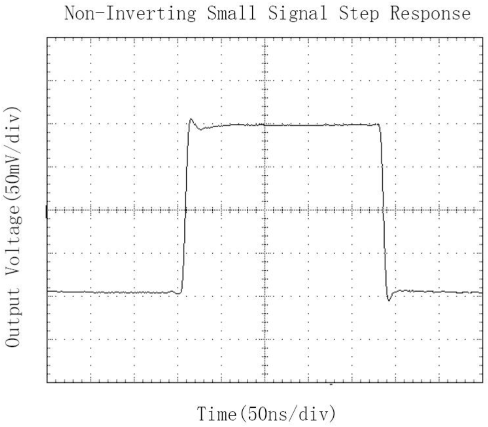

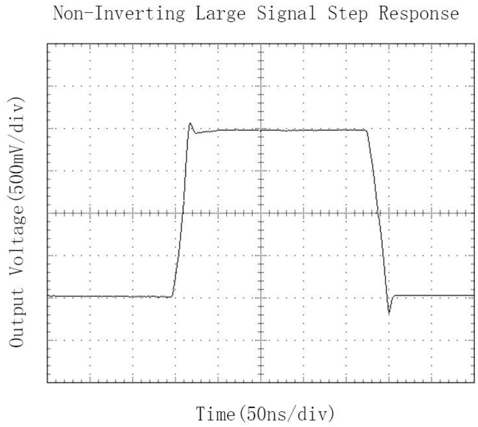

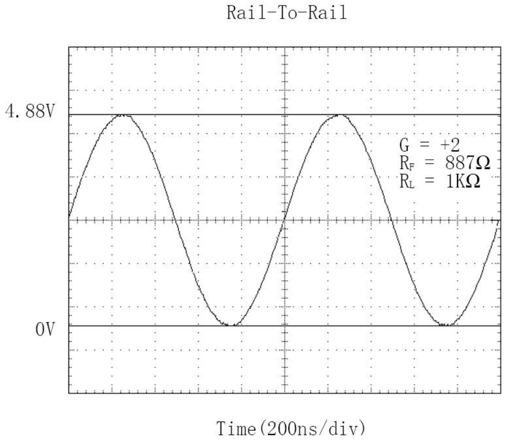

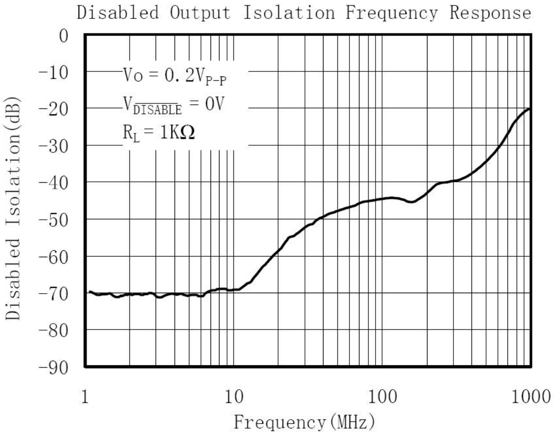

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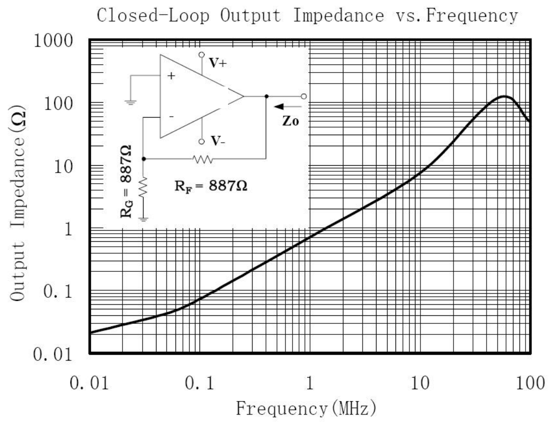

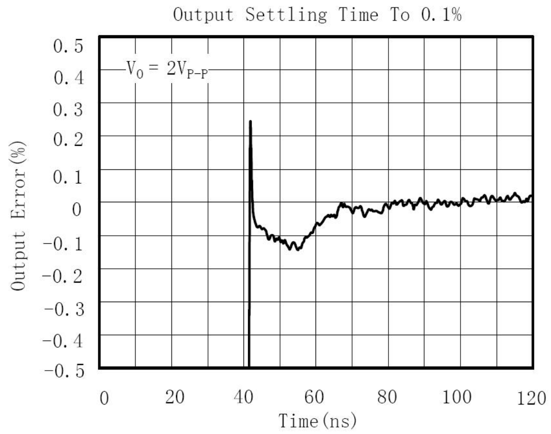

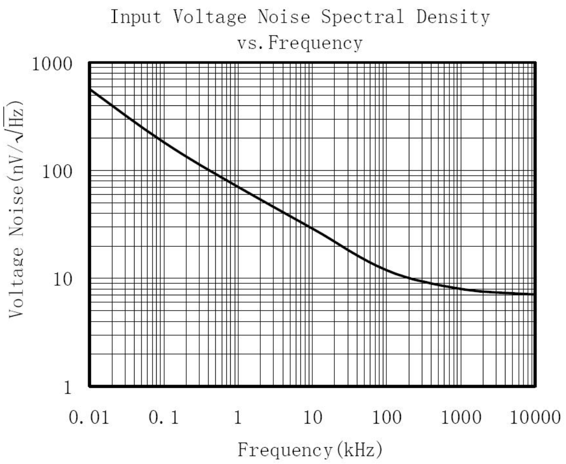

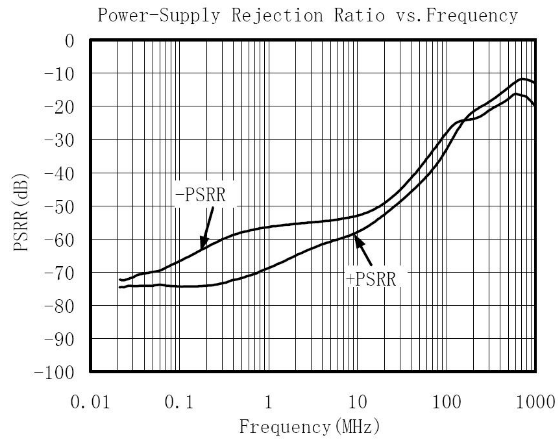

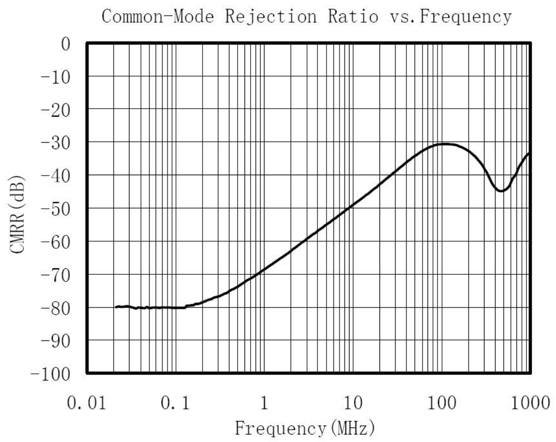

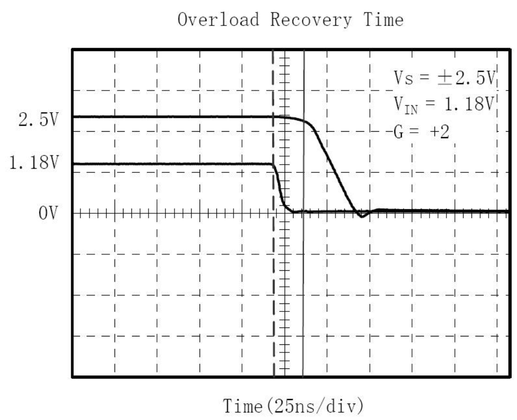

Characteristics curves

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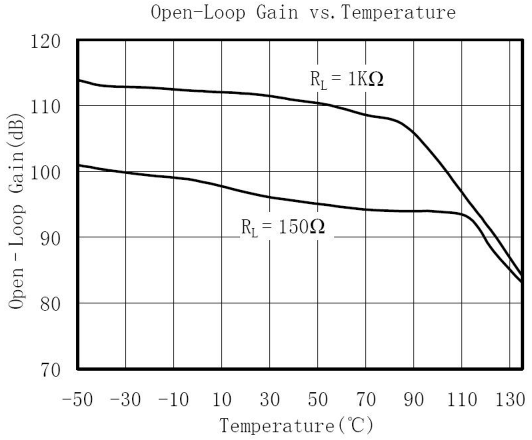

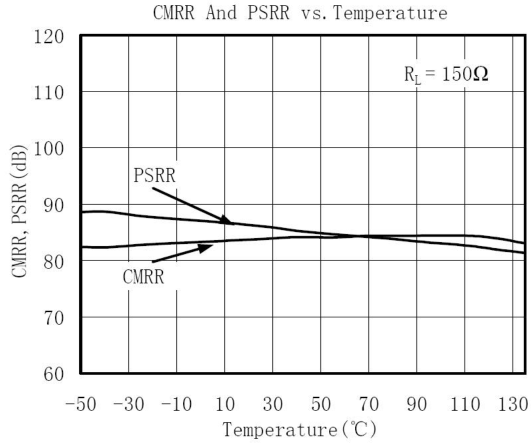

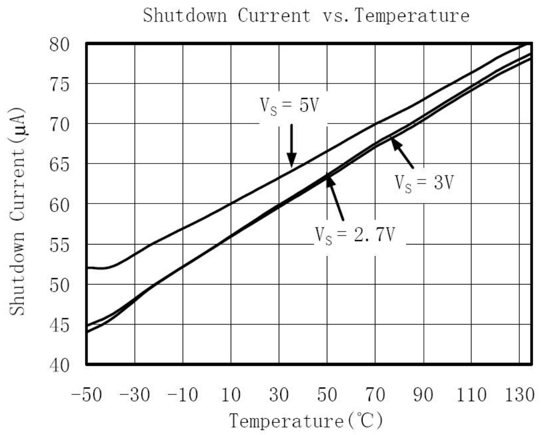

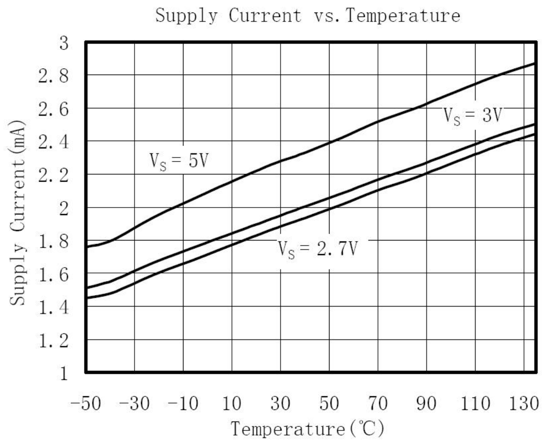

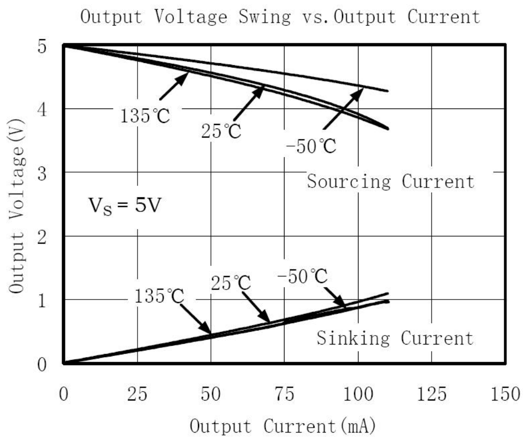

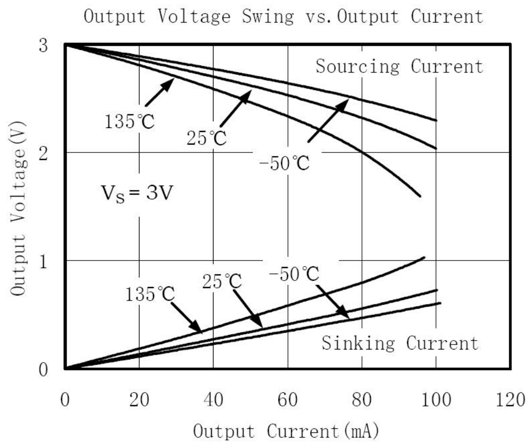

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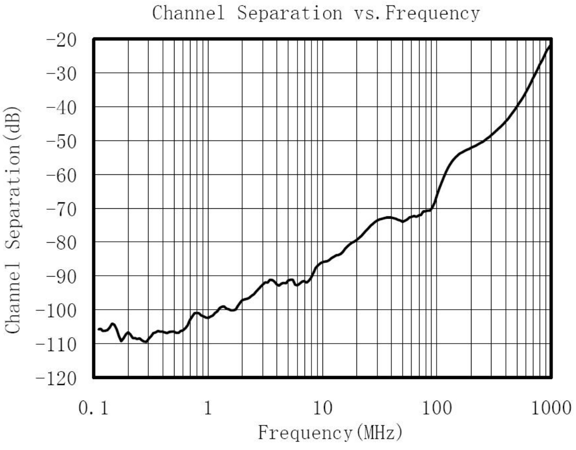
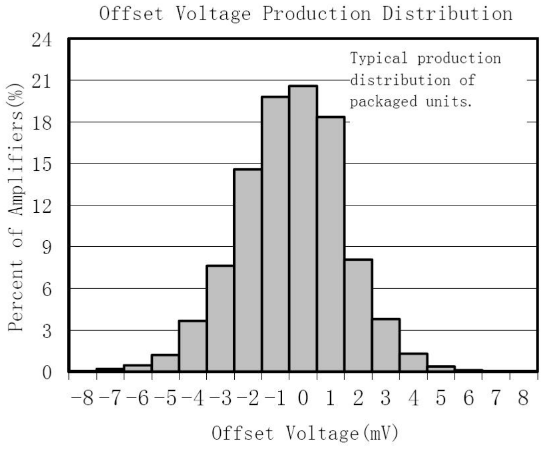
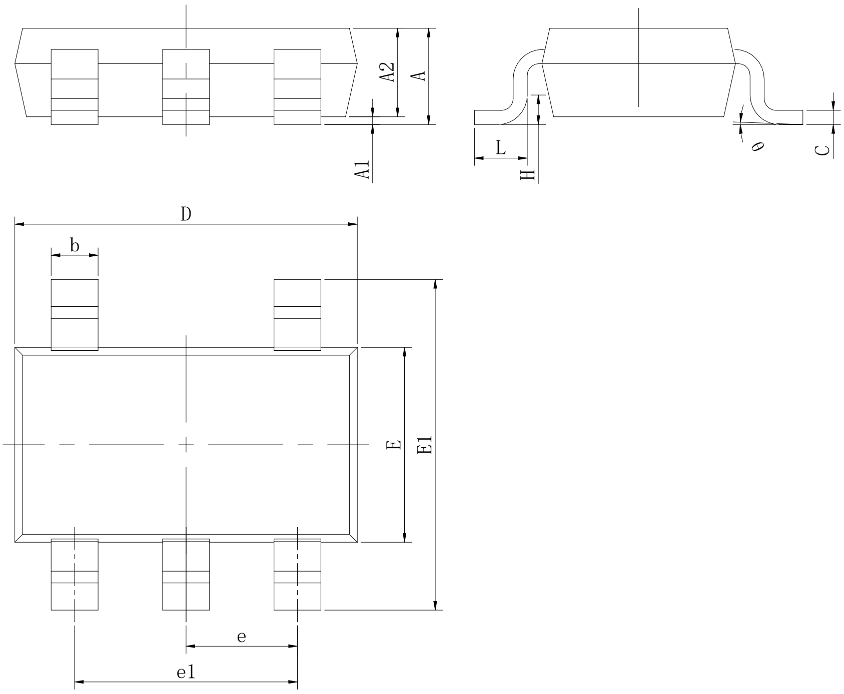




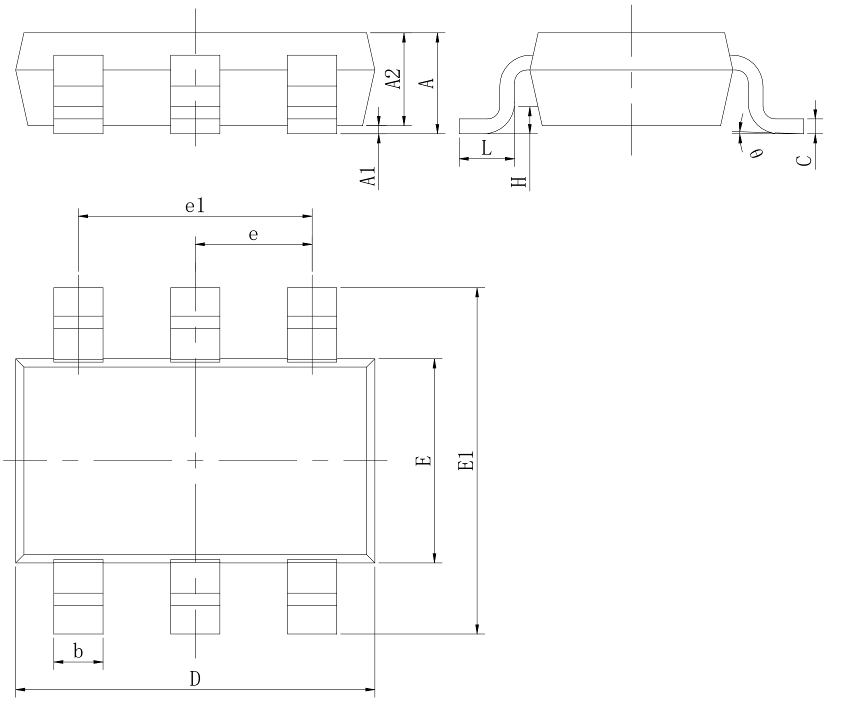
Outline Dimensions

SOT23-5	Unit: mm



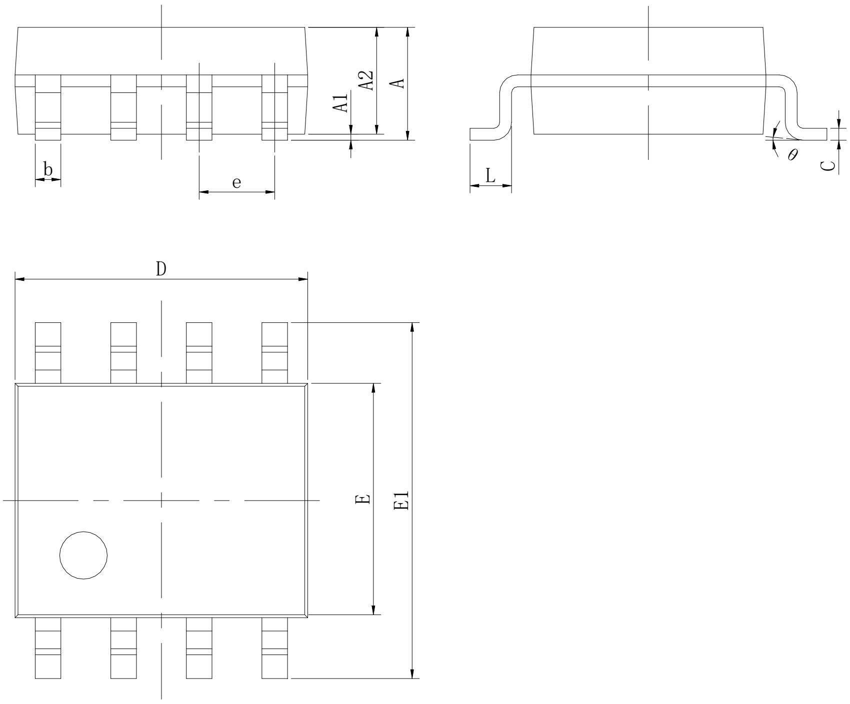
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.130	0.000	0.005
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.95（BSC）		0.037(BSC)	
e1	1.90（BSC）		0.075(BSC)	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

SOT23-6 Unit: mm



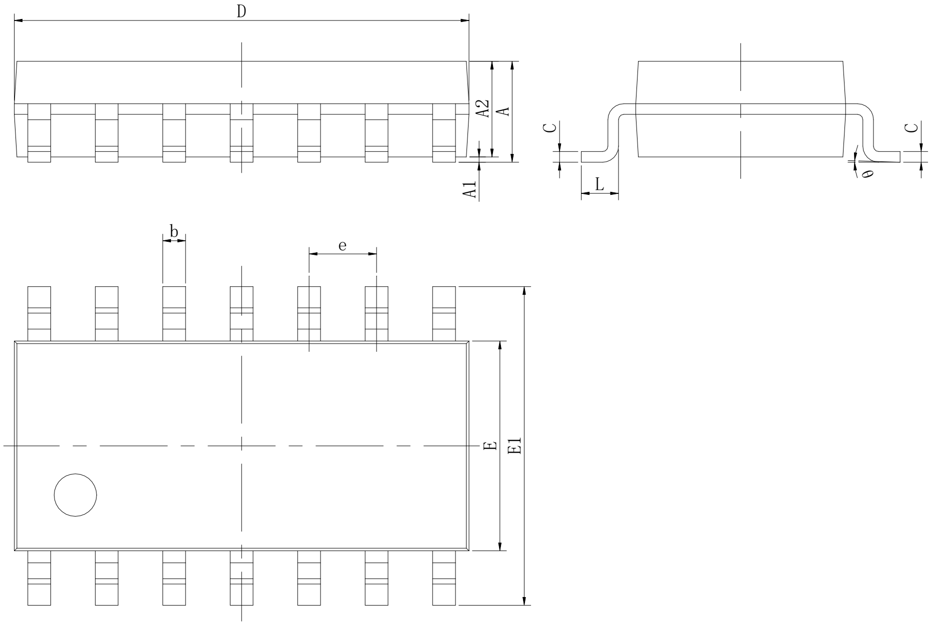
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.130	0.000	0.005
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.95（BSC）		0.037(BSC)	
e1	1.90（BSC）		0.075(BSC)	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

SOP8 Unit: mm



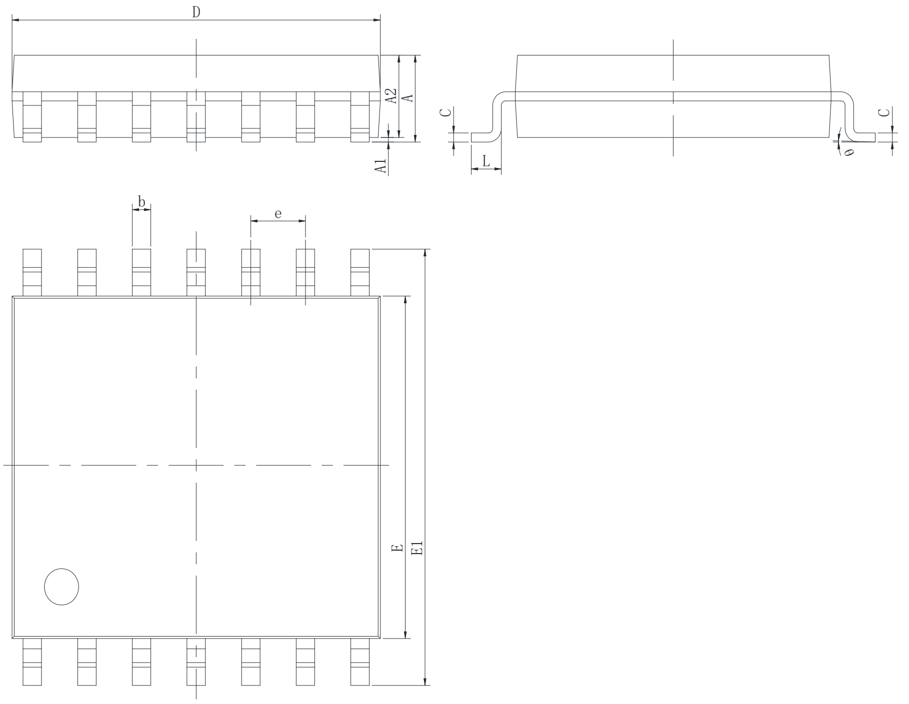
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.800	0.053	0.071
A1	0.000	0.250	0.000	0.010
A2	1.250	1.550	0.053	0.061
b	0.300	0.510	0.011	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.201
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOP14 Unit: mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	8.360	8.760	0.329	0.345
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

TSSOP14 Unit: mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.200		0.047
A1	0.050	0.150	0.002	0.006
A2	0.900	1.050	0.035	0.041
b	0.200	0.280	0.007	0.011
c	0.130	0.170	0.005	0.006
D	4.900	5.100	0.192	0.200
E	4.300	4.500	0.169	0.177
E1	6.200	6.600	0.244	0.259
e	0.650(BSC)		0.025(BSC)	
L	0.450	0.750	0.017	0.029
θ	0°	8°	0°	8°

Statements

- Silicore Technology reserves the right to make changes without further notice to any products or specifications herein. Before customers place an order, customers need to confirm whether datasheet obtained is the latest version, and to verify the integrity of the relevant information.

- Failure or malfunction of any semiconductor products may occur under particular conditions, customers shall have obligation to comply with safety standards when customers use Silicore Technology products to do their system design and machine manufacturing, and take corresponding safety measures in order to avoid potential risk of failure that may cause personal injury or property damage.

- The product upgrades without end, Silicore Technology will wholeheartedly provide customers integrated circuits that have better performance and better quality.