

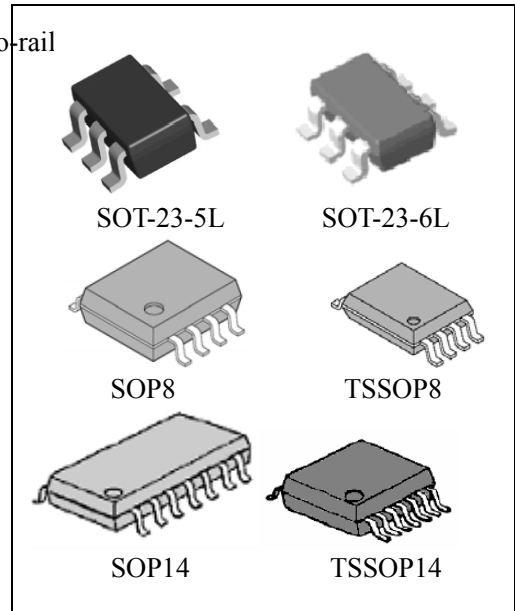
HM8051/2/3/4

250MHz Rail-to-Rail Output CMOS Operational Amplifier

General Description

The HM8051/3 (single), HM8052(dual) and HM8054(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 HM8051 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 2.3 mA/amplifier.



The HM8051 series is low distortion and fast settling make it ideal for buffering high speed A/D or D/A converters. The HM8053 has a power-down disable feature that reduces the supply current to 75 μ A. These features make the HM8053 ideal for portable and battery-powered applications where size and power are critical. All are specified over the extended -40°C to $+125^{\circ}\text{C}$ temperature range.

The HM8051(single) is available in SOT-23-5L and SOP8 packages.

The HM8053(single) is available in SOT-23-6L.

The HM8052(dual) is available in SOP8 package.

The HM8054(quad) is available in SOP14 and TSSOP14 package.

Features

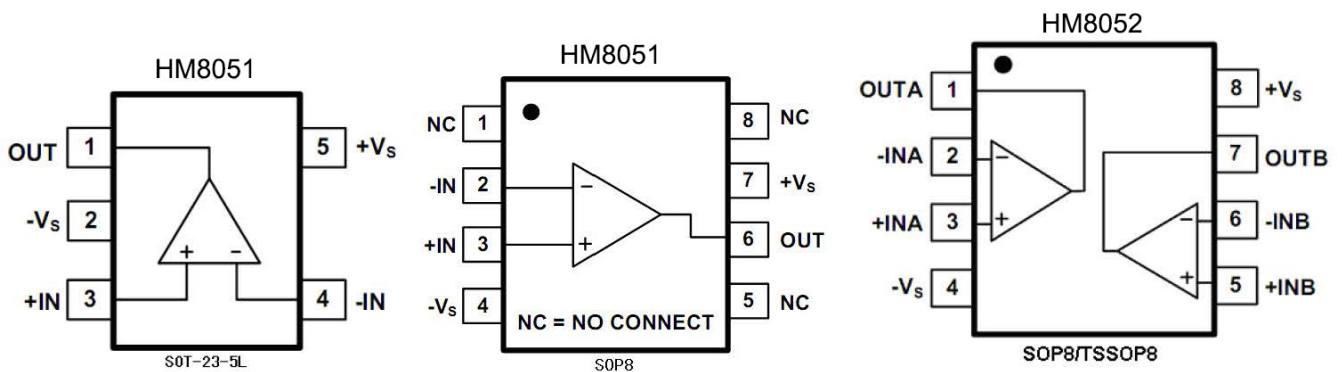
- Low Cost
- Rail-to-Rail Input and Output: 2mV Typical V_{OS}
- High Speed
 - 250MHz, -3dB Bandwidth ($G = +1$)
 - 130V/ μ s, Slew Rate
 - 58ns Settling Time to 0.1% with 2V Step
- Input Voltage Range $= -0.2\text{V}$ to $+3.8\text{V}$ with $V_S = 5\text{V}$

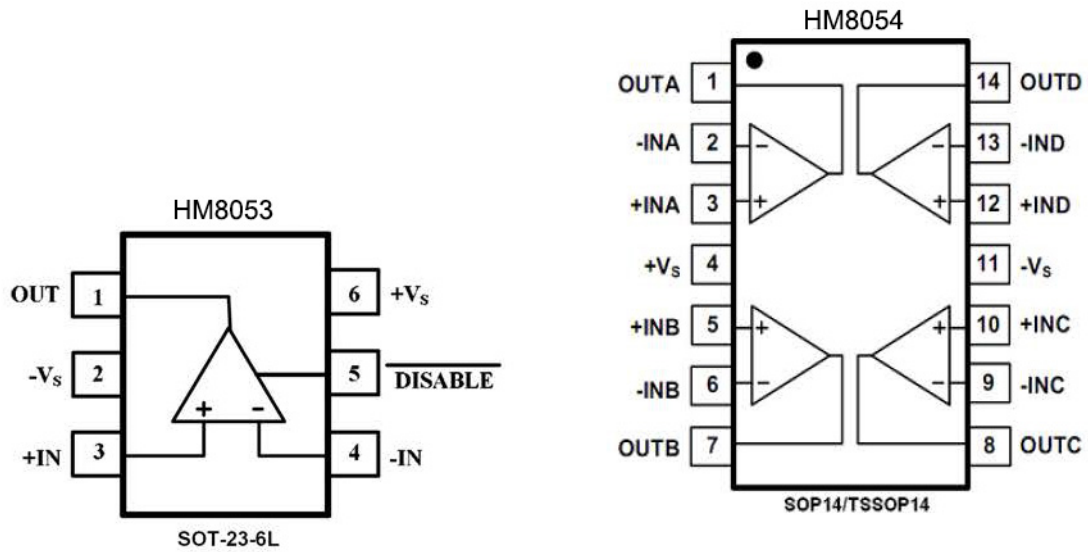
- Excellent Video Specs ($R_L=150\Omega$, $G=+2$)
Gain Flatness 0.1dB to 37MHz
Diff Gain: 0.03% , Diff Phase: 0.08 degree
- Low Power
2.3 mA/Amplifier Typical Supply Current
75 μ A/Amplifier when Disabled (HM8053 only)

Applications

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

Pin Configuration





Pin Description

HM8051/HM8053

Pin Name	Pin Number			Function Description
	HM8051 (SOT-23-5L)	HM8051 (SOP8)	HM8053 (SOT-23-6L)	
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
<i>DISABLE</i>			5	Power-down Disable
NC		1,5,8		No Connect

HM8052

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

HM8054

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

Characteristic		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}	SOT-23-5L SOT-23-6L	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, Rf=887Ω, RL=150Ω, Unless otherwise specified.)

PARAMETER	CONDITION	D8051/2/3/4						
		TYP	MIN/MAX OVER TEMPERATURE					
		+25°C	+25°C	0°C to 70°C	-40°C to 85°C	-40°C to 125°C	UNITS	MIN/MAX
DYNAMIC PERFORMANCE								
-3dB Small Signal Bandwidth	G = +1, Vo = 0.1 V p-p, Rf = 24Ω, RL = 150Ω	180					MHz	TYP
	G = +1, Vo = 0.1 V p-p, Rf = 24Ω, RL = 1KΩ	250					MHz	TYP
	G = +2, Vo = 0.1 V p-p, RL = 50Ω	40					MHz	TYP
	G = +2, Vo = 0.1 V p-p, RL = 150Ω	80					MHz	TYP
	G = +2, Vo = 0.1 V p-p, RL = 1kΩ	130					MHz	TYP
	G = +2, Vo = 0.1 V p-p, RL = 10kΩ	160					MHz	TYP
Gain-Bandwidth Product	G = +10, RL = 150Ω	90					MHz	TYP
	G = +10, RL = 1KΩ	120					MHz	TYP
Bandwidth for 0.1dB Flatness	G = +2, Vo = 0.1 V p-p, RL = 150Ω, Rf = 887Ω	37					MHz	TYP
Slew Rate	G = +1, 2V Output Step	93/-118					V/μs	TYP
	G = +2, 2V Output Step	116/-103					V/μs	TYP
	G = +2, 4V Output Step	130/-130					V/μs	TYP
Rise-and-Fall Time	G = +2, Vo = 0.2 V p-p, 10% to 90%	4					ns	TYP
	G = +2, Vo = 2 V p-p, 10% to 90%	14					ns	TYP
Settling Time to 0.1%	G = +2, 2 V Output Step	58					ns	TYP
Overload Recovery Time	VIN - G = +Vs	18					ns	TYP
NOISE/DISTORTION PERFORMANCE								
Harmonic Distortion								
2nd-Harmonic	G = +2, f = 1MHz, Vo = 2Vp-p, RL = 150Ω						dBc	TYP
3rd-Harmonic	G = +2, f = 1MHz, Vo = 2Vp-p, RL = 150Ω						dBc	TYP
Input Voltage Noise	f = 1 MHz	8.1					nV/√Hz	TYP
Input Current Noise	f = 1 MHz						fA/√Hz	TYP
Differential Gain Error (NTSC)	G = +2, RL = 150Ω	0.03					%	TYP
Differential Phase Error (NTSC)	G = +2, RL = 150Ω	0.08					degree	TYP
DC PERFORMANCE								
Input Offset Voltage (Vos)		±2	±8	±8.9	±9.5	±9.8	mV	MAX
Input Offset Voltage Drift		4.4					μV/°C	TYP
Input Bias Current (IB)		6					PA	TYP
Input offset Current (IOS)		2					PA	TYP
Open-Loop Gain (AOL)	Vo = 0.3 V to 4.7 V, RL = 150Ω	80	75	74	74	73	dB	MIN
	Vo = 0.2 V to 4.8 V, RL = 1KΩ	104	92	91	91	80	dB	MIN
INPUT CHARACTERISTICS								
Input Common-Mode Voltage Range		-0.2 to +3.8					V	TYP
Common-Mode Rejection Ratio(CMRR)	VCM = -0.1 V to +3.5 V	80	66	65	65	62	dB	MIN
OUTPUT CHARACTERISTICS								
Output Voltage Swing from Rail	RL = 150Ω	0.12					V	TYP
	RL = 1KΩ	0.03					V	TYP
Output Current		130	100	95	90	84	mA	MIN
Closed-Loop Output Impedance	f < 100kHz	0.08					Ω	TYP
POWER-DOWN DISABLE (D8053 only)								
Turn-On Time		236					ns	TYP
Turn-Off Time		52					ns	TYP
DISABLE Voltage-Off			0.8				V	MAX
DISABLE Voltage-On			2				V	MIN
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	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, VCM = (-Vs) + 0.5	80	67	67	65	62	dB	MIN

Specifications subject to change without notice.

Application Summary

Driving Capacitive Loads

The HM805X 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.

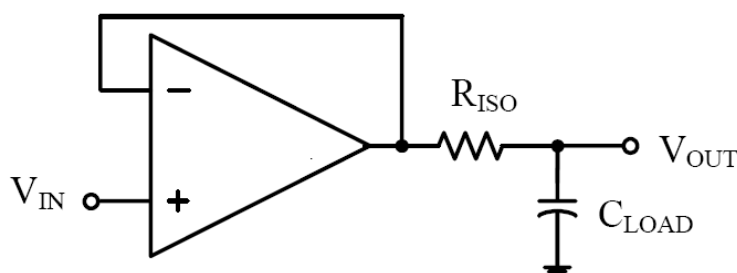


Fig1. Series Resistor Isolating Capacitive Load

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 HM805X family operates from either a single +2.7V to +5.5V supply or dual $\pm 1.35V$ to $\pm 2.75V$ supplies. For single-supply operation, bypass the power supply V_{DD} with a 0.1 μF 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 0.1 μF ceramic capacitors. 2.2 μF 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).

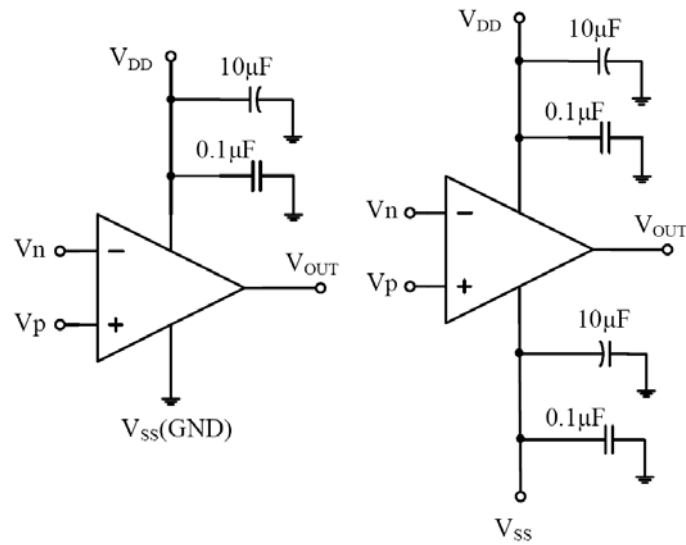


Fig. 2. Amplifier with Bypass Capacitors

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

($R_4 / R_3 = R_2 / R_1$), then $V_{OUT} = (V_p - V_n) \times R_2 / R_1 + V_{ref}$.

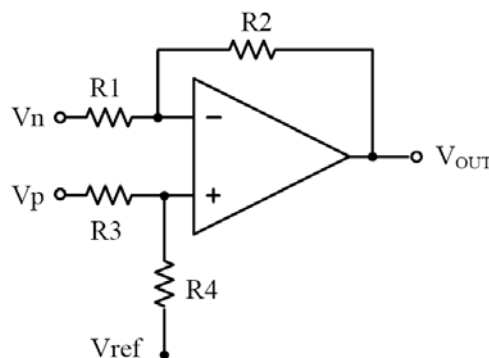


Fig. 3. Differential Amplifier

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 $1/2\pi R2C$. 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.

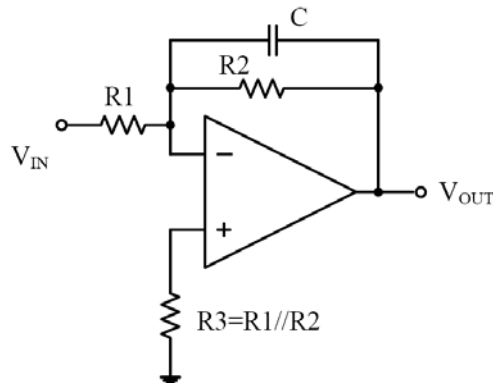


Fig. 4. Low Pass Active Filter

Driving Video

The HM805X can be used in video applications like in Fig.5.

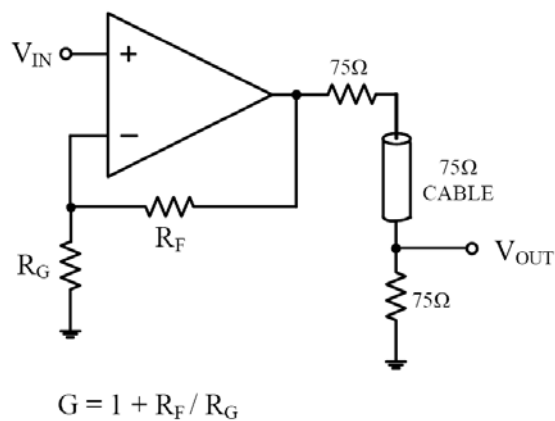
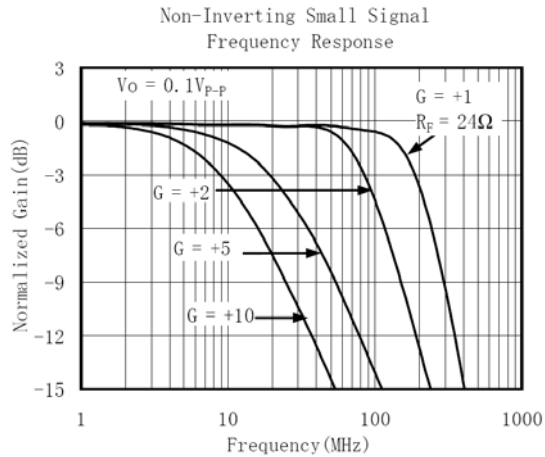
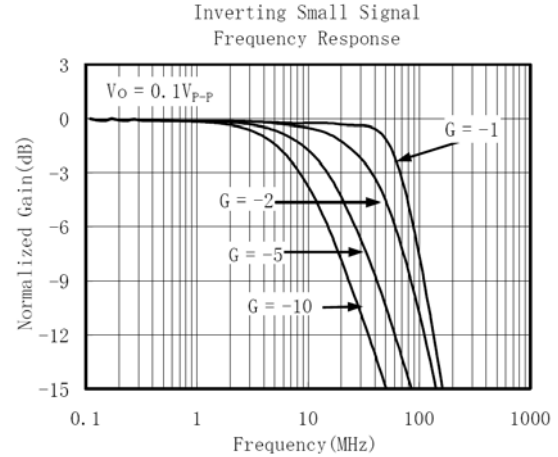
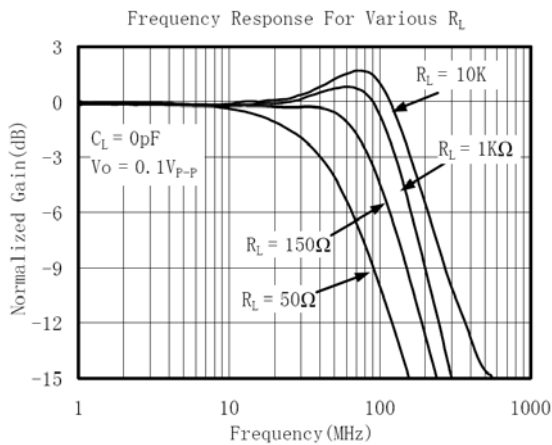
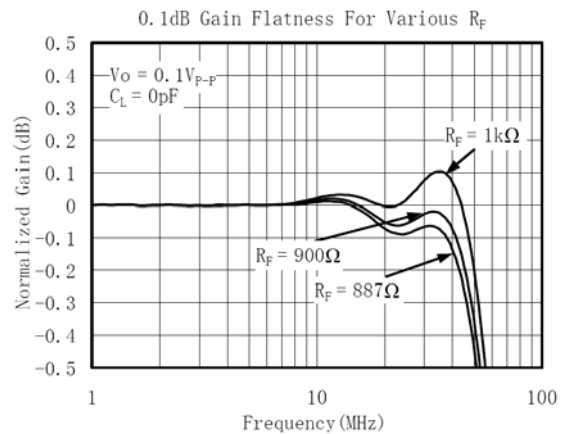
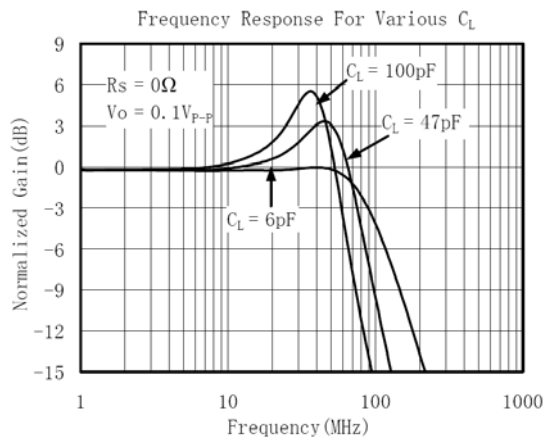
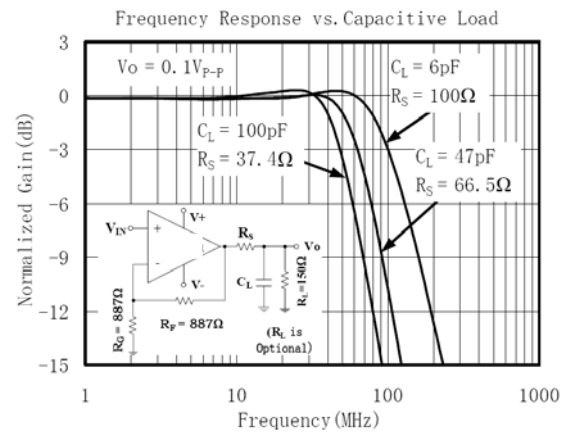


Fig. 5. Typical Video Driving

Characteristics curves

At $T_A = +25^\circ\text{C}$, $V_S = +5\text{V}$, $G = +2$, $R_F = 887\Omega$, $R_G = 887\Omega$, and $R_L = 150\Omega$ connected to $V_S/2$,

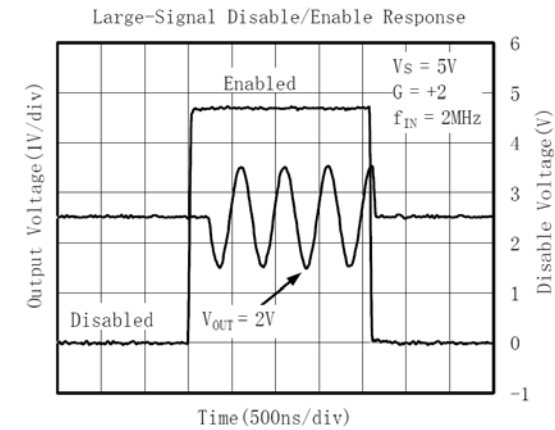
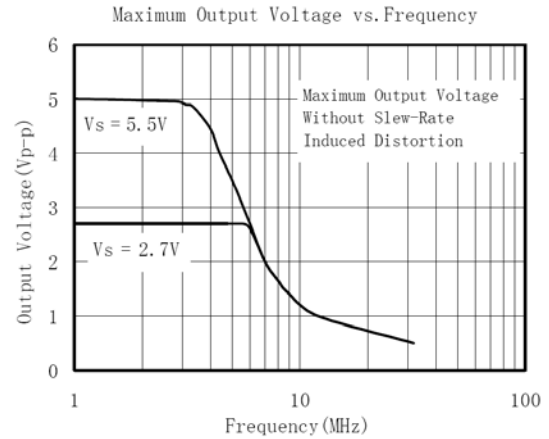
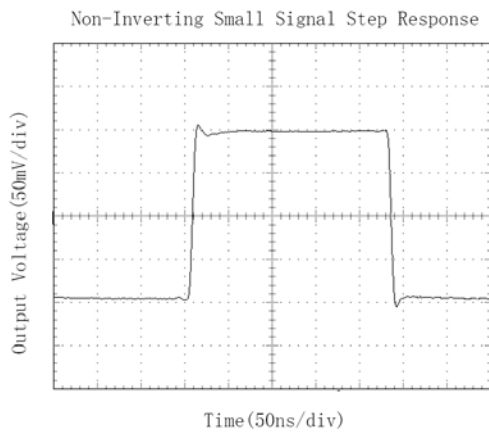
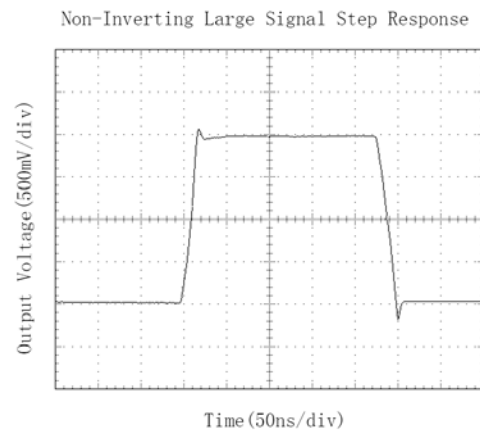
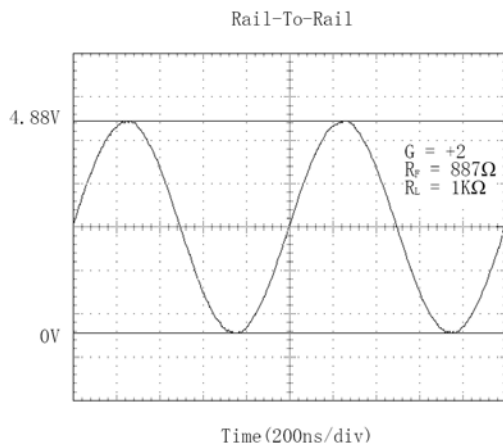
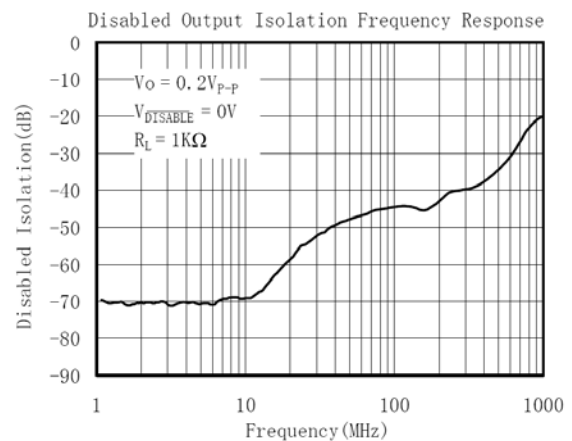
Unless otherwise noted..



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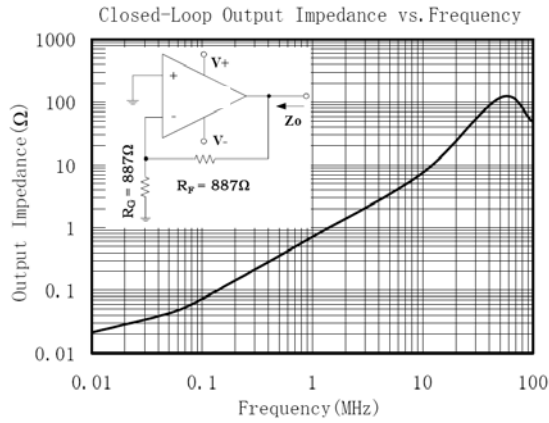
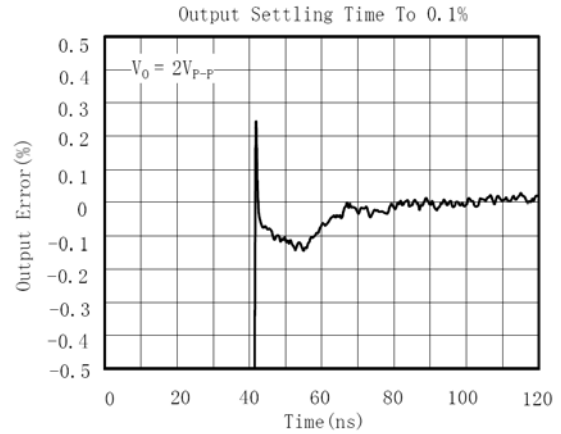
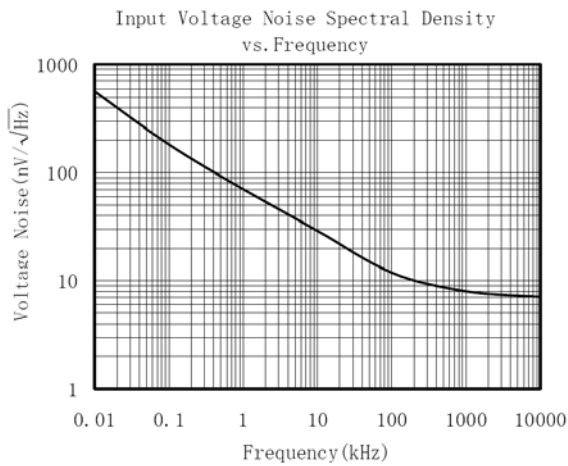
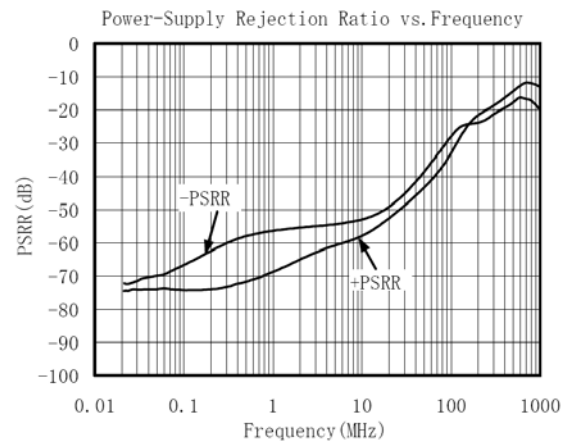
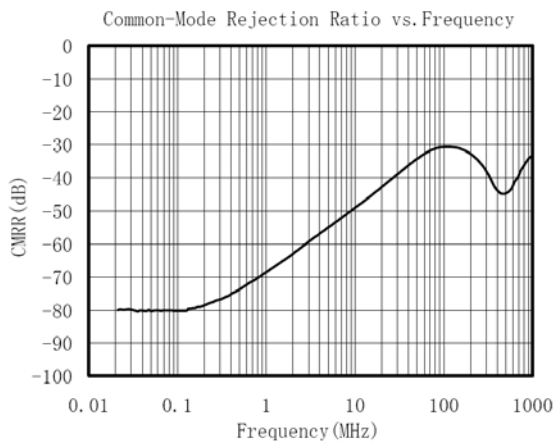
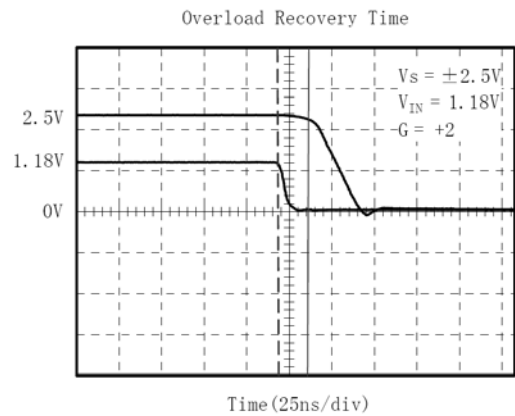
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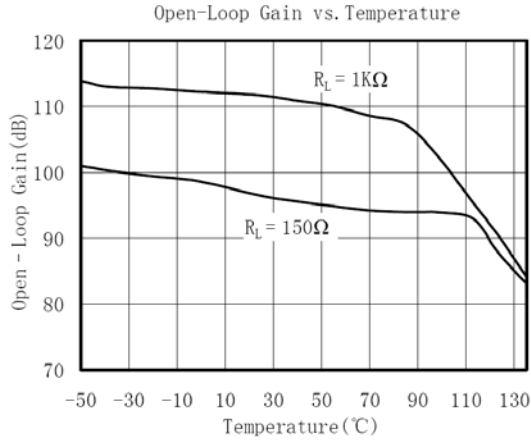
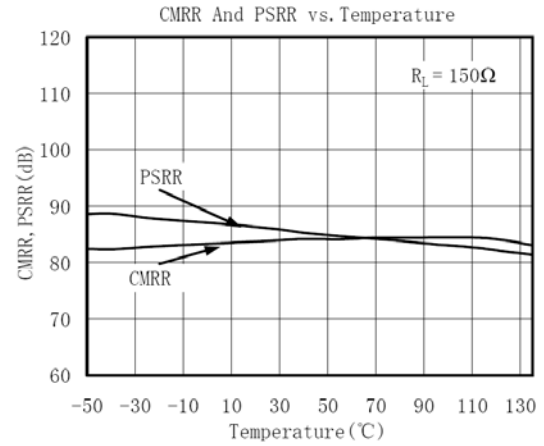
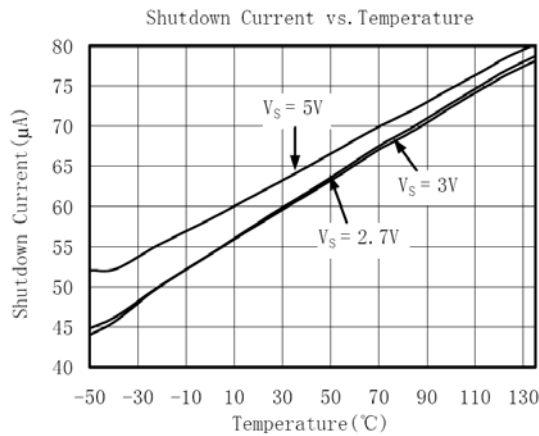
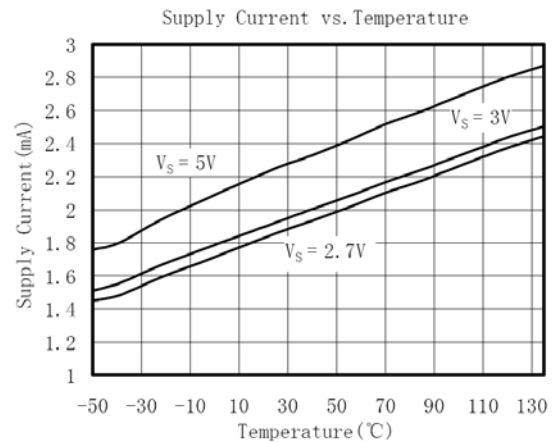
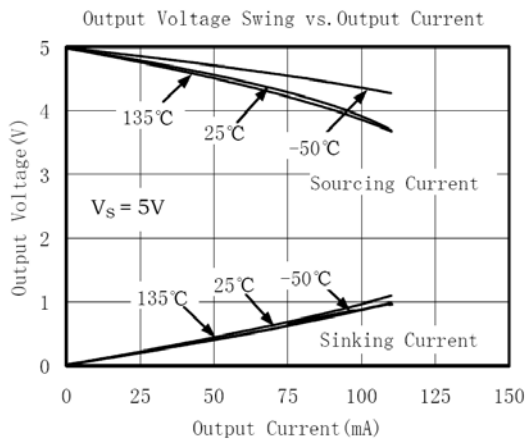
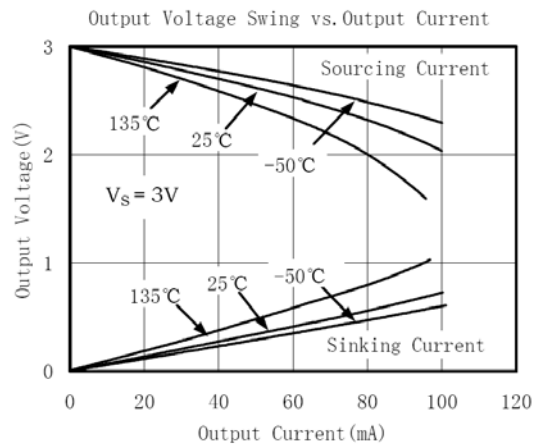
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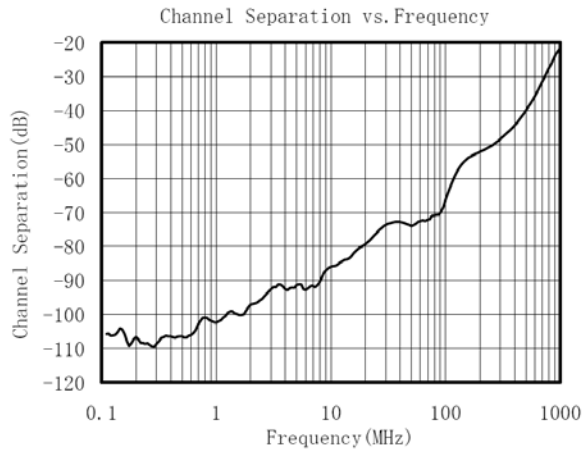
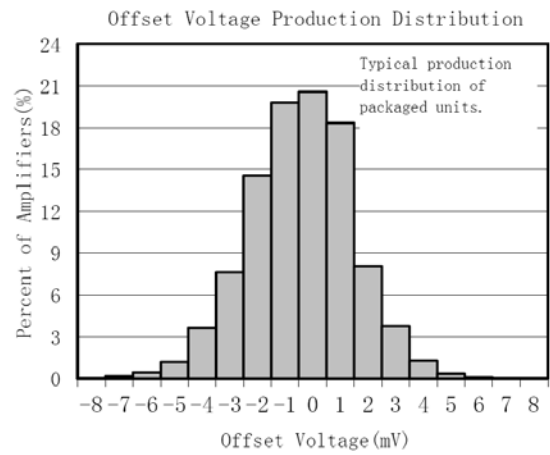
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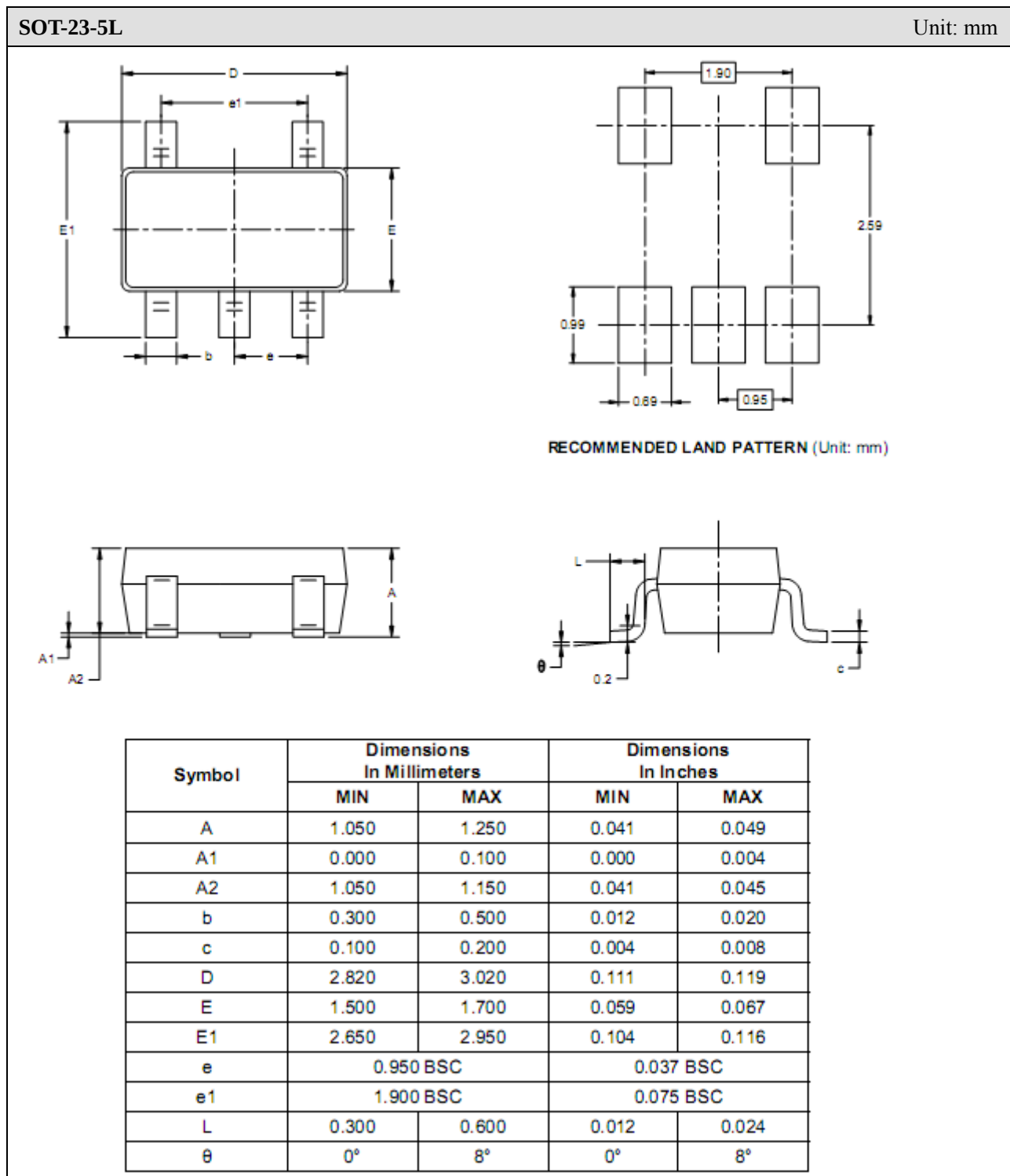
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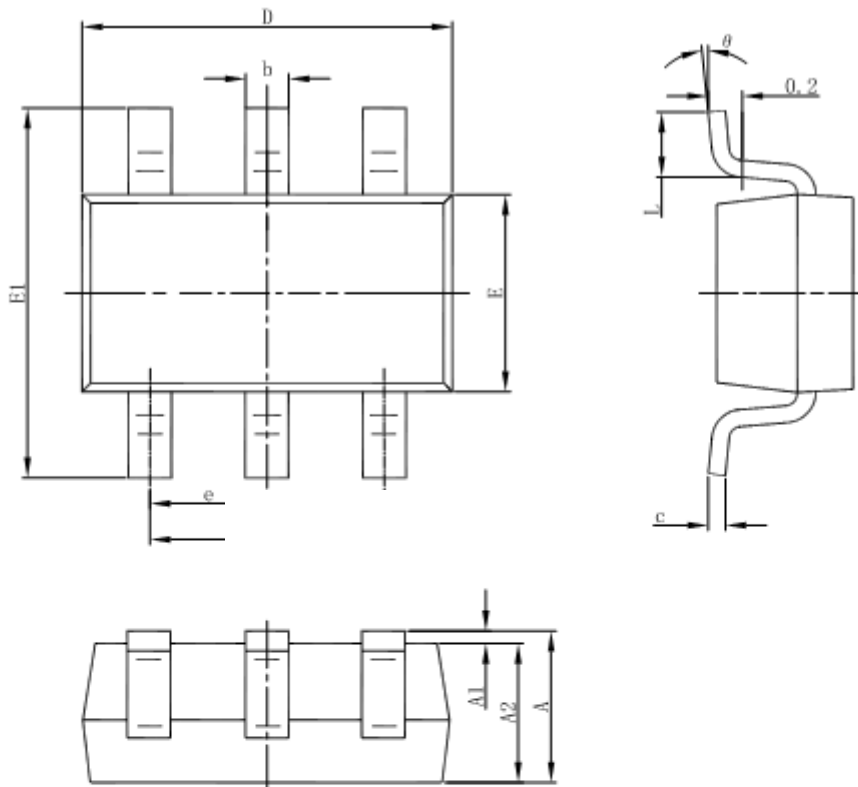


Outline Dimensions



SOT-23-6L

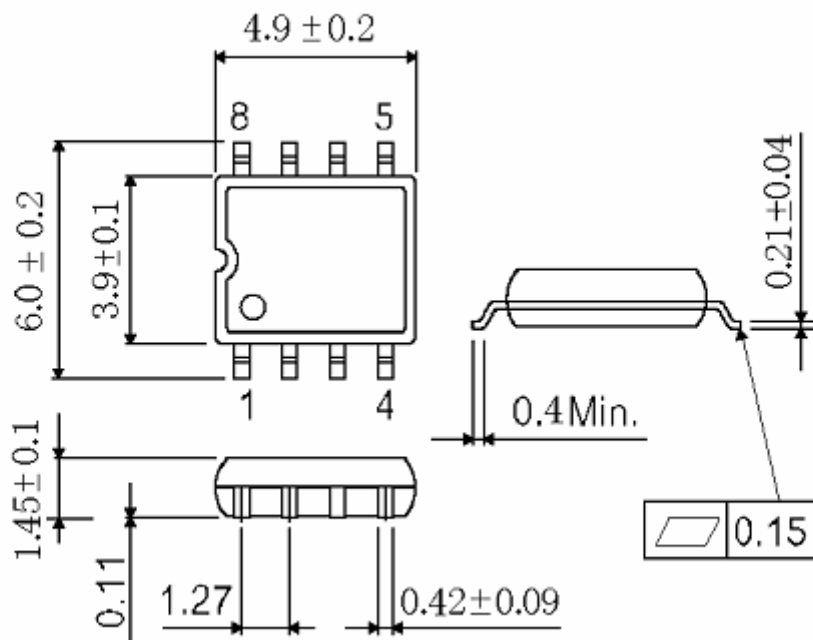
Unit: mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	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
θ	0°	8°	0°	8°

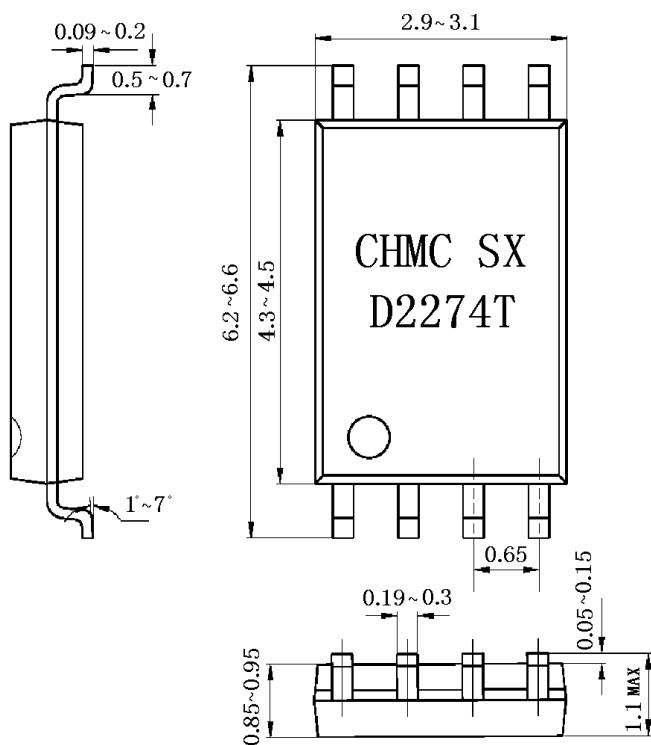
SOP8

Unit: mm



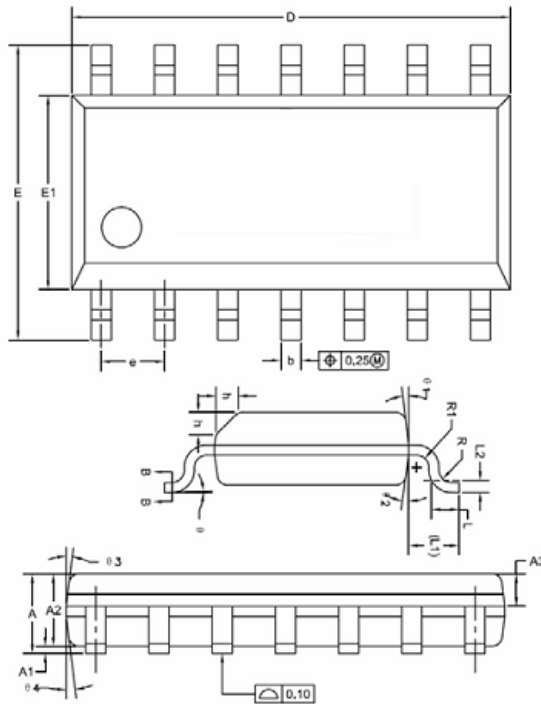
TSSOP8

Unit: mm



SOP14

Unit: mm



SYMBOL	MIN	NOM	MAX
A	1.35	1.60	1.75
A1	0.10	0.15	0.25
A2	1.25	1.45	1.65
A3	0.55	0.65	0.75
b	0.36	-	0.49
b1	0.35	0.40	0.45
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	8.53	8.63	8.73
E	5.80	6.00	6.20
F1	3.80	3.90	4.00
e	1.17	1.27	1.37
L	0.45	0.60	0.80
L1		1.04REF	
L2		0.25BSC	
R	0.07	-	-
R1	0.07	-	-
h	0.30	0.40	0.50
0	0°	-	8°
0 1	6°	8°	10°
0 2	6°	8°	10°
0 3	5°	7°	9°
0 4	5°	7°	9°

TSSOP14

Unit: mm

