FEATURES

- Single-Supply Operation from +2.5V ~ +5.5V
- Rail-to-Rail Output
- −3dB Bandwidth(G=+1): 350MHz (Typ)
- Low Input Bias Current: 1pA (Typ)
- Quiescent Current: 4.2mA/Amplifier (Typ)
- Operating Temperature: −40°C ~ +125°C
- Small Package:
  AT8091 Available in SOT23-5 and SC70-5 Packages
  AT8092 Available in SOP-8 and MSOP-8 Packages
  AT8094 Available in SOP-14 and TSSOP-14 Packages
  AT8091N Available in SOT23-6 and SC70-6 Packages
  AT8092N Available in MSOP-10 Packages

APPLICATIONS

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

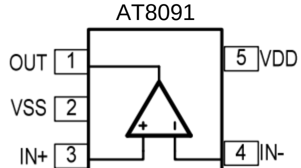
DESCRIPTION

The AT8091/1N(single), AT8092/2N(dual), AT8094 (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 AT809X series provide excellent overall performance. They offer wide bandwidth to 350MHz (G = +1) along with 0.1dB flatness out to 58MHz (G = +2) and offer a typical low power of 4.2mA/amplifier.

The AT809X series is low distortion and fast settling make it ideal for buffering high speed A/D or D/A converters. The AT8091/2N has a power-down disable feature that reduces the supply current to 75μA. These features make the AT8091/2N 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.

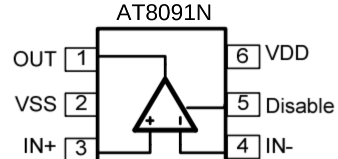
PIN CONFIGURATIONS

AT8091



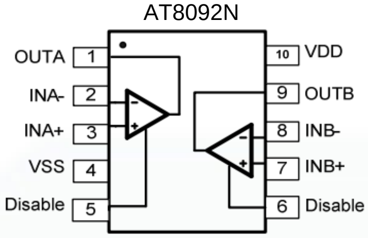
SOT23-5/SC70-5

AT8091N



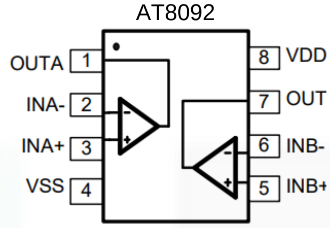
SOT23-6/SC70-6

AT8092N



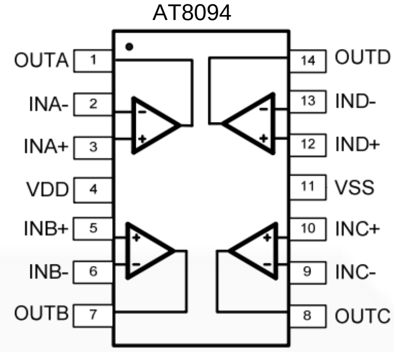
MSOP-10

AT8092



SOP-8/MSOP-8

AT8094



SOP-14/TSSOP-14

ABSOLUTE MAXIMUM RATINGS

Table 1.

Parameter	Min.	Max.
Power Supply Voltage (V_{DD} to V_{SS})	−0.5V	+7.5V
Analog Input Voltage (IN+ or IN−)	V_{SS} − 0.5	V_{DD} + 0.5V
PDB Input Voltage	V_{SS} − 0.5	+7V
Operating Temperature Range	−40°C	+125°C
Junction Temperature	+160°C	
Storage Temperature Range	−55°C	+150°C
Lead Temperature (soldering, 10sec)		
Package Thermal Resistance @ T_A = +25°C		
SOP-8, θJA	125°C/W	
MSOP-8, θJA	216°C/W	
SOT23-5, θJA	190°C/W	
SOT23-6, θJA	190°C/W	
SC70-5, θJA	333°C/W	
SC70-6, θJA	333°C/W	
ESD Susceptibility		
HBM	6kV	
MM	400V	

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

(G=+2, R_F=600Ω, R_G=600Ω, and R_L=150Ω connected to V_S/2, unless otherwise noted. Typical values are at T_A =+25°C)

Table 2.

PARAMETER	CONDITIONS	AT8091/92/94/91N/92N TYP. +25°C	MIN./MAX. OVER TEMPERATURE +25°C	0 to70°C	−40°C to70°C	−40°C to125°C	UNITS	MIN./ MAX.
DYNAMIC PERFORMANCE								
−3dB Small Signal Bandwidth	G = +1, Vo = 0.1V_{p-p}, R_F = 24Ω, R_L = 150Ω	335					MHz	TYP.
	G = +1, Vo = 0.1V p-p, R_F = 24Ω, RL = 1kΩ	330					MHz	TYP.
	G = +2, Vo = 0.1V_{p-p}, R_L = 50Ω	79					MHz	TYP.
	G = +2, Vo = 0.1V_{p-p}, R_L = 150Ω	130					MHz	TYP.
	G = +2, Vo = 0.1V_{p-p}, R_L = 1kΩ	165					MHz	TYP.
	G = +2, V_O = 0.1V_{p-p}, R_L = 10kΩ	172					MHz	TYP.
Gain-Bandwidth Product	G = +10, R_L = 150Ω	180					MHz	TYP.
	G = +10, R_L = 150Ω	195					MHz	TYP.
Bandwidth for 0.1dB Flatness	G = +2, Vo = 0.1V_{p-p}, R_L = 150Ω, R_F =600Ω	71					MHz	TYP.
Slew Rate	G = +1, 2V Output Step	119/−232					V/μS	TYP.
	G = +2, 2V Output Step	135/−180					V/μS	TYP.
	G = +2, 4V Output Step	142/−206					V/μS	TYP.
Rise-and-Fall Time	G = +2, V_O = 0.2V_{p-p}, 10% to 90%	3.5					ns	TYP.
	G = +2, V_O = 2V_{p-p}, 10% to 90%	8.5					ns	TYP.
Settling Time to 0.1%	G = +2, 2V Output Step	35					ns	TYP.
Overload Recovery Time	V_{IN} · G = +VS	14.5					ns	TYP.
NOISE/DISTORTION PERFORMANCE								
Input Voltage Noise	f = 1MHz	4.3					nV/√Hz	TYP.
Differential Gain Error	G = +2, R_L = 150Ω	0.004					%	TYP.

(NTSC)								
Differential Phase Error (NTSC)	G = +2, R_L = 150Ω	0.08					°	TYP.
DC PERFORMANCE								
Input Offset Voltage (V_{OS})		±2	±8	±8.5		±9.3	mV	MAX.
Input Offset Voltage Drift		2					μV/°C	TYP.
Input Bias Current (I_B)		1					pA	TYP.
Input offset Current (I_{OS})		2					pA	TYP.
Open-Loop Gain (A_{OL})	V_O = 0.3V to 4.7V, R_L = 150Ω	80	75	74	74	70	dB	MIN.
	V_O = 0.2V to 4.8V, R_L = 1kΩ	104	92	91	91	80	dB	MIN.
INPUT CHARACTERISTICS								
Input Common-Mode Voltage Range (V_{CM})		−0.2 to +3.8					V	TYP.
Common-Mode Rejection Ratio (CMRR)	V_{CM} = −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	TYP.
	R_L = 1kΩ	0.03					V	TYP.
Output Current		120	100	98	93	87	mA	MIN.
Closed-Loop Output Impedance	f＜100kHz	0.045					Ω	TYP.
POWER-DOWN DISABLE(AT8091/2N only)								
Turn-On Time			108				ns	TYP.
Turn-Off Time			60				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)		4.2	5.3	5.6	5.7	6.1	mA	MAX.
Supply Current when Disabled per amplifier (AT8091/2N only)		75	120	130	132	137	μA	MAX.
Power Supply Rejection Ratio (PSRR)	ΔV_S = +2.7V to +5.5V, V_{CM} = ($-V_S$) +0.5	80	67	67	65	62	dB	MIN.

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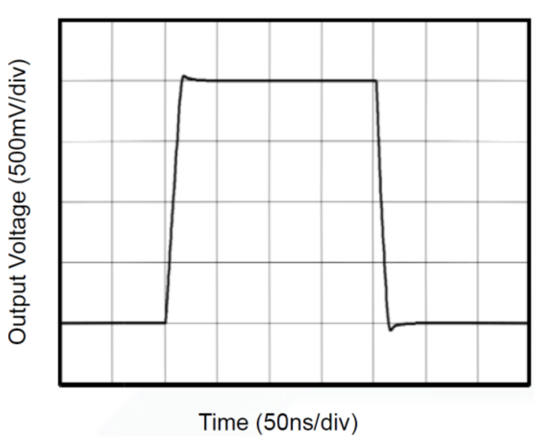
 Email: staff@analogti.com/sales@analogti.com

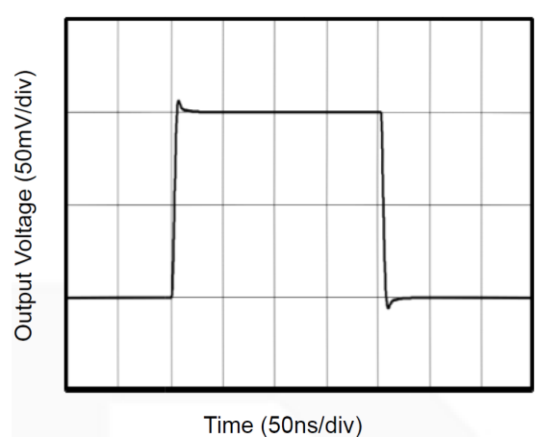
TYPICAL CHARACTERISTICS

(G=+2, R_F=600Ω, R_G=600Ω, and R_L=150Ω connected to $V_S/2$, unless otherwise noted. Typical values are at T_A =+25°C).

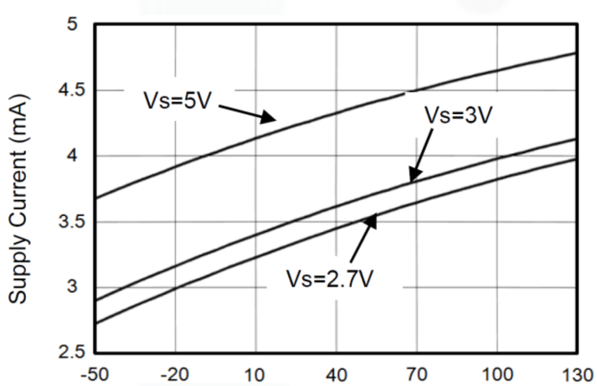
Non-Inverting Large-Signal Step Response



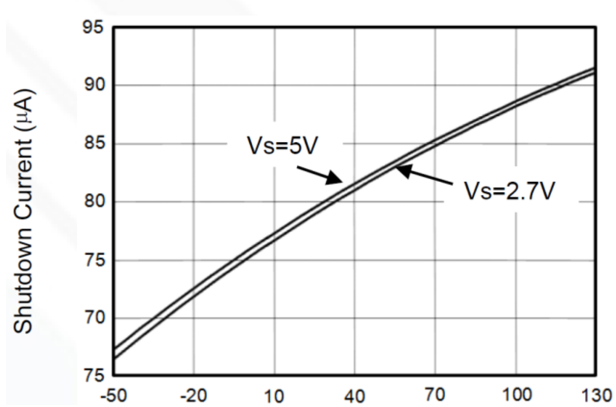
Non-Inverting Small-Signal Step Response



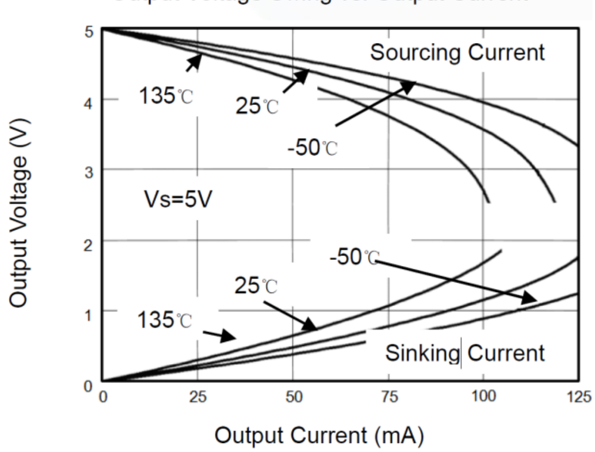
Supply Current vs. Temperature



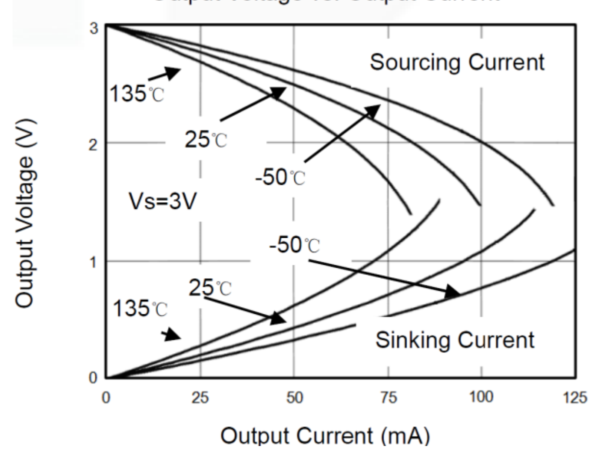
Sutdown Current vs. Temperature



Output Voltage Swing vs. Output Current



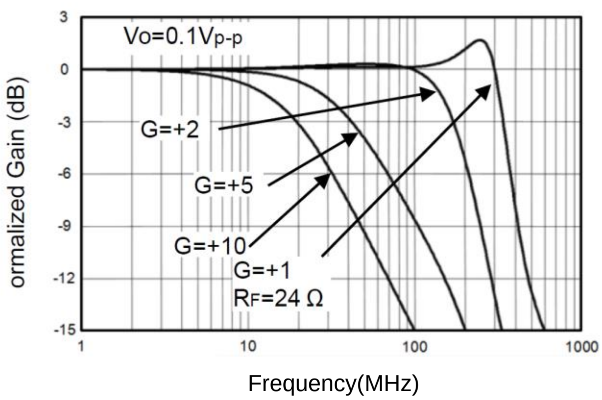
Output Voltage vs. Output Current



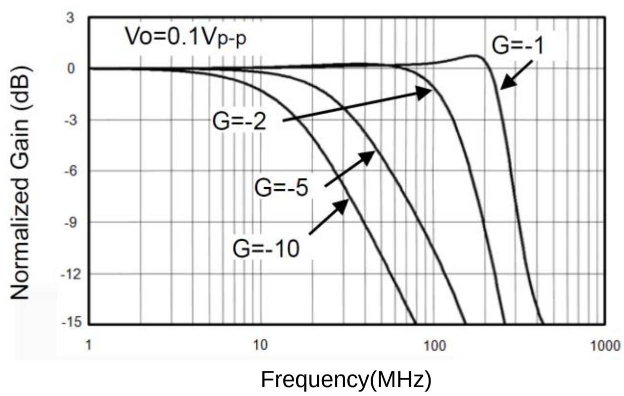
TYPICAL CHARACTERISTICS

(G=+2, R_F=600Ω, R_G=600Ω, and R_L=150Ω connected to V_S/2, unless otherwise noted. Typical values are at T_A =+25°C).

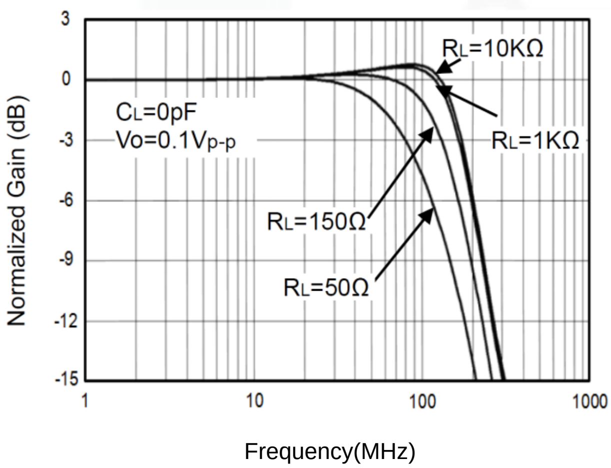
Non-Inverting Small Signal Frequency Response



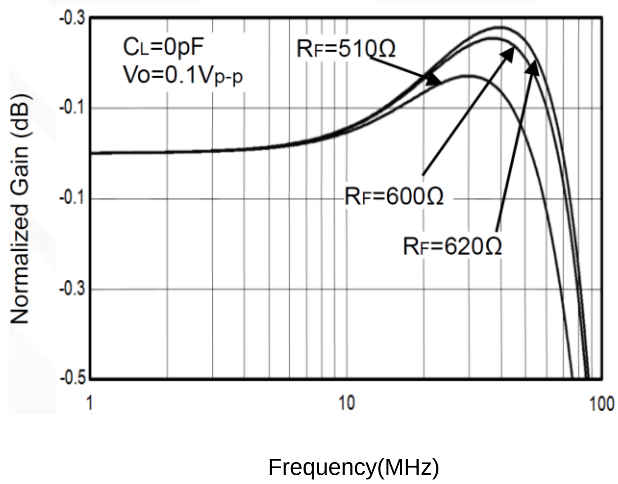
Inverting Small Signal Frequency Response



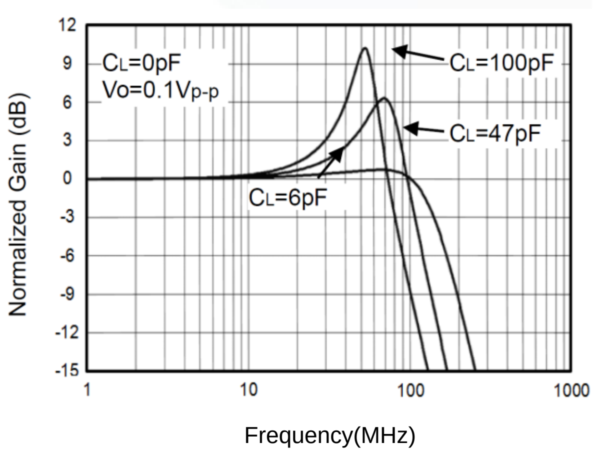
Frequency Response For Various RL



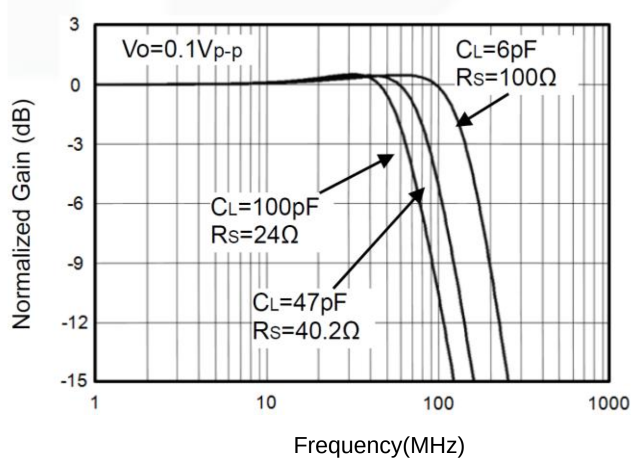
0.1dB Gain Flatness For Various RF



Frequency Response For Various CL



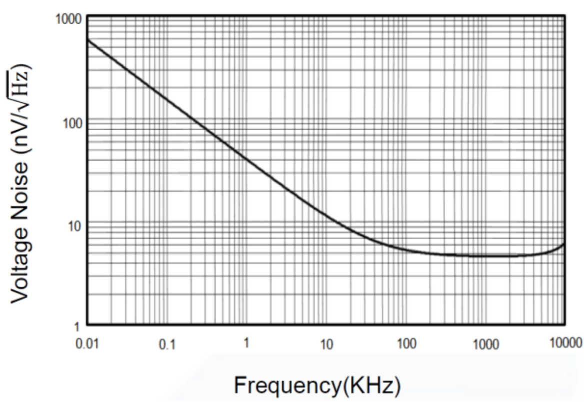
Frequency Response vs.Capacitive Load



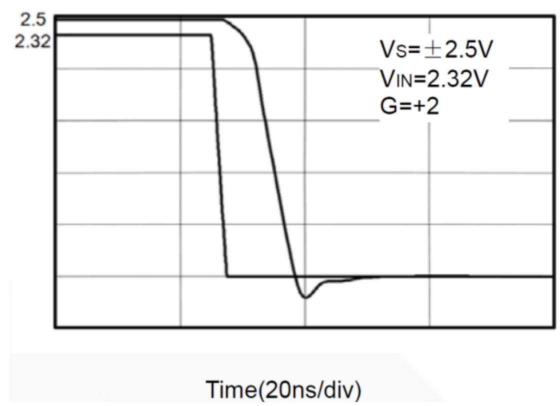
TYPICAL CHARACTERISTICS

(G=+2, R_F=600Ω, R_G=600Ω, and R_L=150Ω connected to V_S/2, unless otherwise noted. Typical values are at T_A =+25°C).

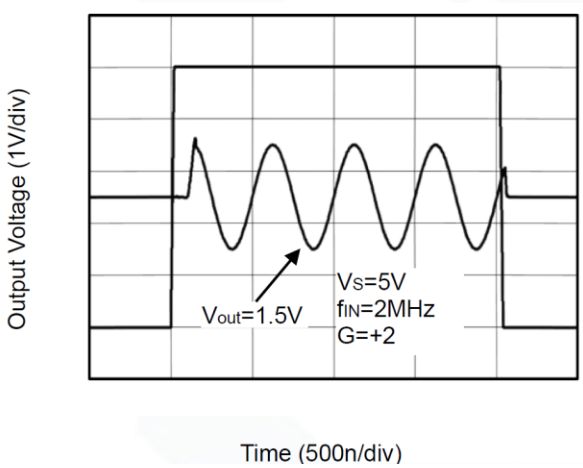
Input Voltage Noise Spectral Density vs. Frequency



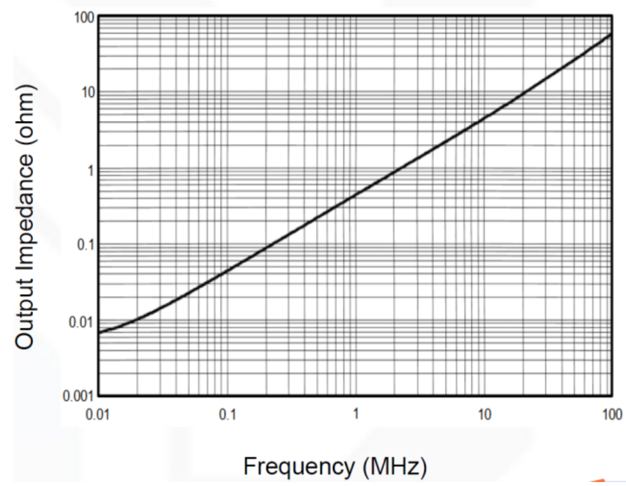
Overload Recovery Time



Large-Signal Disable/Enable Response



Closed-Loop Output Impedance vs Frequency



APPLICATION NOTES

Driving Capacitive Loads

AT809X series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the AT809X series packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

AT809X series operates from a single 2.5V to 5.5V supply or dual ±1.25V to ±2.75V supplies. For best performance, a 0.1μF ceramic capacitor should be placed close to the V_{DD} pin in single supply operation. For dual supply operation, both V_{DD} and V_{SS} supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

Low Supply Current

The low supply current (typical 4.2mA per channel) of AT809X series will help to maximize battery life. They are ideal for battery powered systems.

Operating Voltage

AT809X series operate under wide input supply voltage (2.5V to 5.5V). In addition, all temperature specifications apply from −40°C to +125°C. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensure operation throughout the single Li-Ion battery lifetime.

Rail-to-Rail Output

Rail-to-Rail output swing provides maximum possible dynamic range at the output. This is particularly important when operating in low supply voltages. The output voltage of AT809X series can typically swing to less than 30mV from supply rail in light resistive loads (>1kΩ), and 120mV of supply rail in moderate resistive loads (150Ω).

Capacitive Load Tolerance

The AT809X 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.

Figure 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.

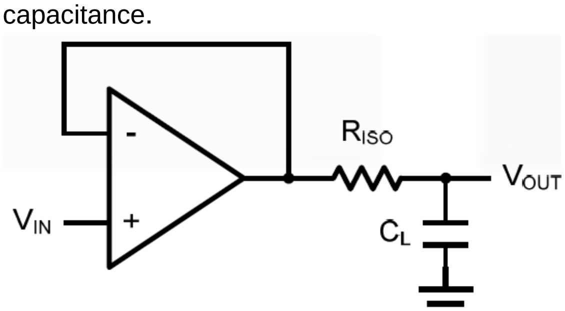


Figure 1. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the RISO resistor value, the more stable VOUT will be. However, if there is a resistive load RL in parallel with the capacitive load, a voltage divider (proportional to R_{ISO}/R_L) is formed, this will result in a gain error.

The circuit in Figure 2 is an improvement to the one in Figure 1. RF provides the DC accuracy by feed-forward the V_{IN} to R_L. C_F and R_{ISO} serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier's inverting input, thereby preserving the phase margin in the overall feedback loop. Capacitive drive can be increased by increasing the value of C_F. This in turn will slow down the pulse response.

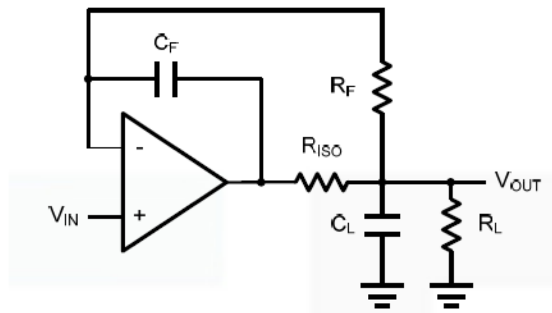


Figure 2. Indirectly Driving a Capacitive Load with DC Accuracy

APPLICATION CIRCUITS

Differential amplifier

The differential amplifier allows the subtraction of two input voltages or cancellation of a signal common the two inputs. It is useful as a computational amplifier in making a differential to single-end conversion or in rejecting a common mode signal. Figure 3. shown the differential amplifier using AT809X.

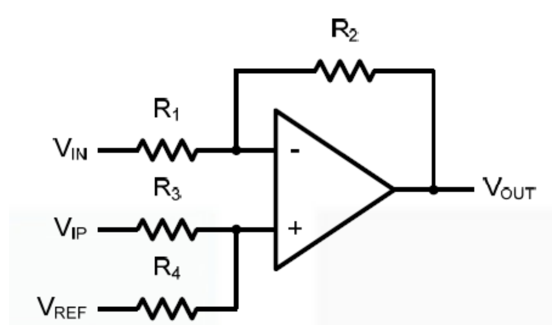


Figure 3. Differential Amplifier

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$$V_{OUT}=\left(\frac{R_1+R_2}{R_3+R_4}\right)\frac{R_4}{R_1}V_{IN}-\frac{R2}{R1}V_{IP}+\left(\frac{R_1+R_2}{R_3+R_4}\right)\frac{R_3}{R_1}V_{REF}$$

If the resistor ratios are equal (i.e. R1=R3 and R2=R4), then

$$V_{OUT}=\frac{R_2}{R_1}(V_{IP}-V_{IN})+V_{REF}$$

Low Pass Active Filter

The low pass active filter is shown in Figure 4. The DC gain is defined by –R2/R1. The filter has a −20dB/decade roll-off after its corner frequency ƒC=1/(2πR3C1).

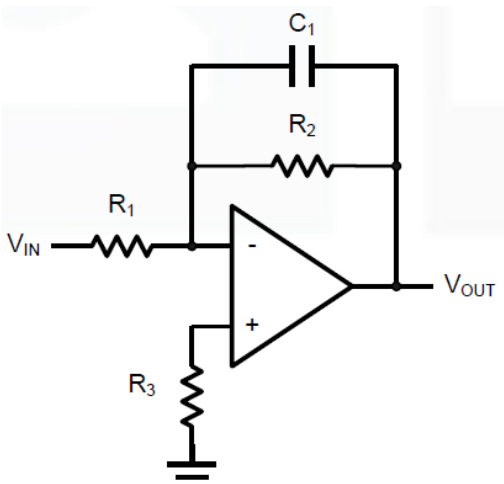


Figure 4. Low Pass Active Filter

Driving Video

The AT809X can be used in video applications like in Figure 5.

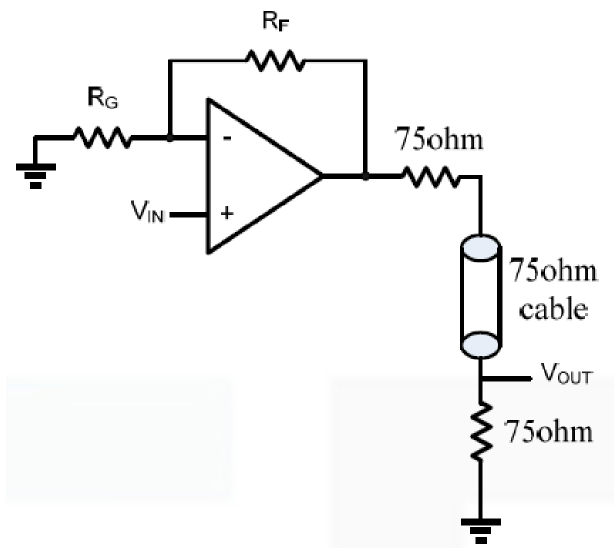
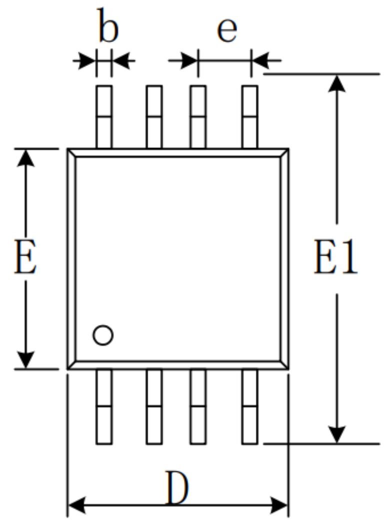
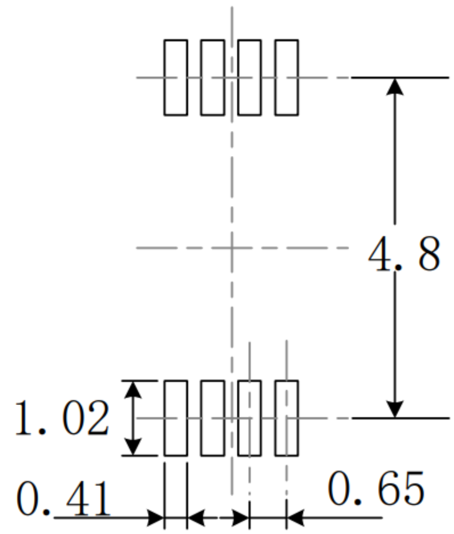


Figure 5. Typical video driving

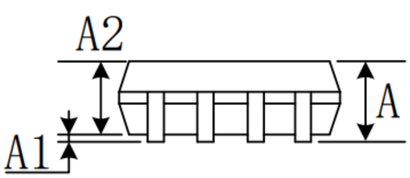
OUTLINE DIMENSIONS

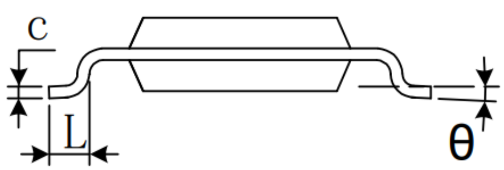
MSOP-8





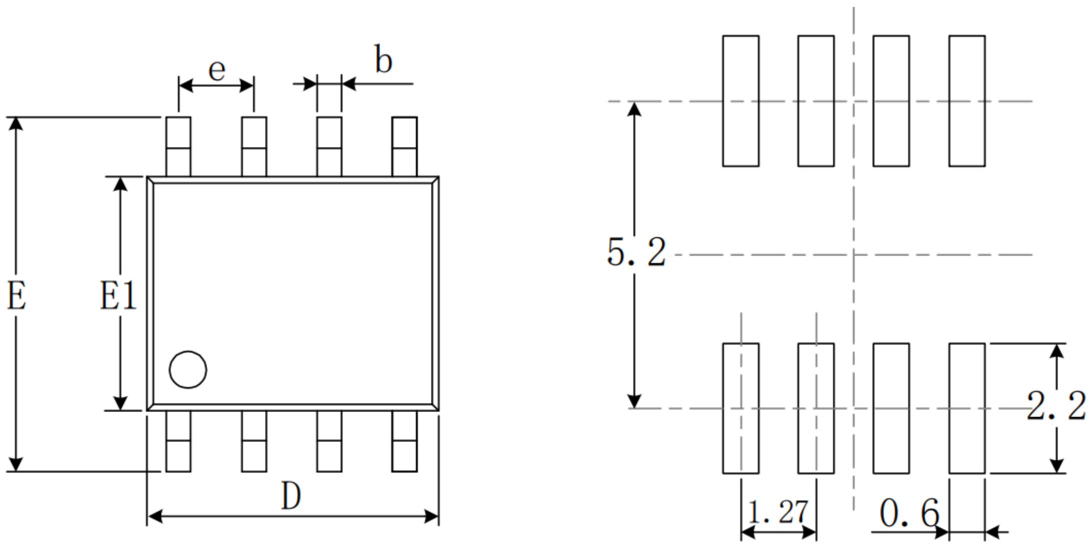
RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650(BSC)		0.026(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

SOP8



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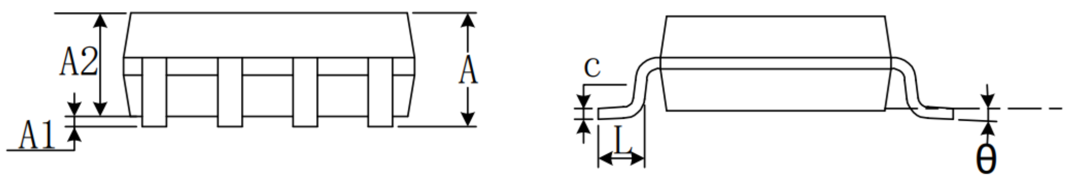
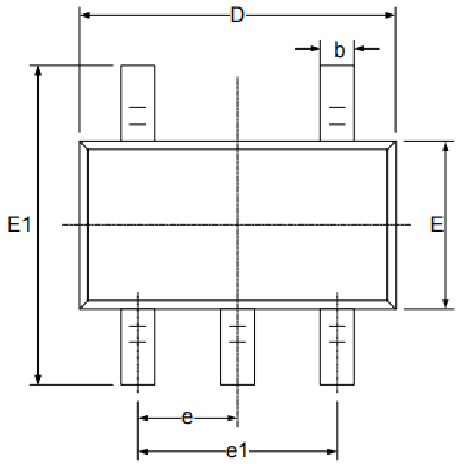
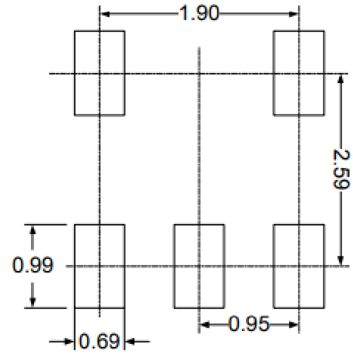


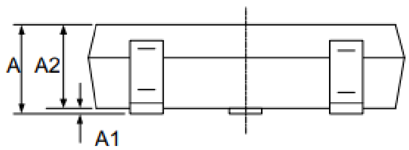
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

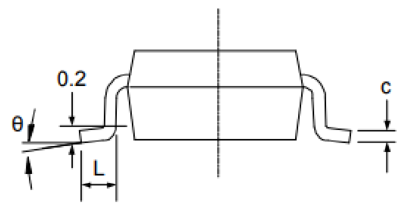
SOT23-5





RECOMMENDED LAND PATTERN (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°

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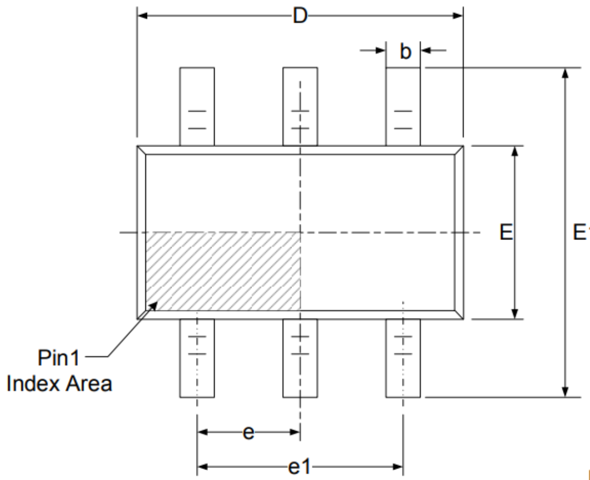
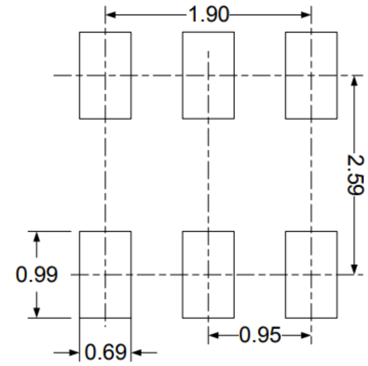
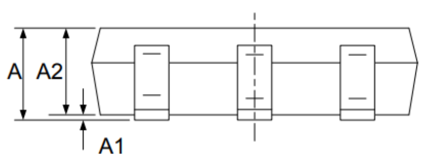
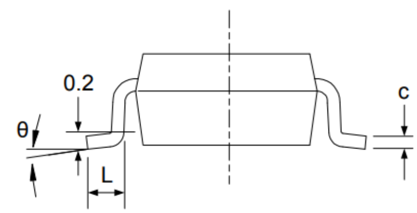
SOT23-6





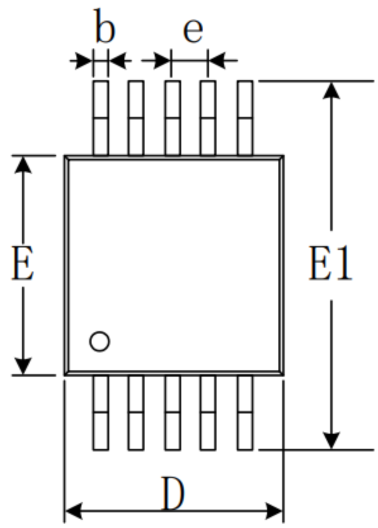
RECOMMENDED LAND PATTERN (Unit: mm)

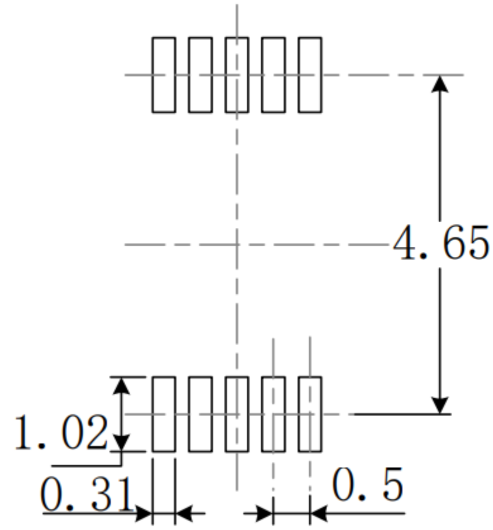




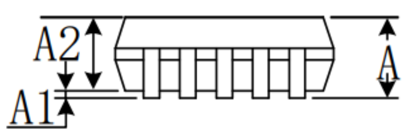
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)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

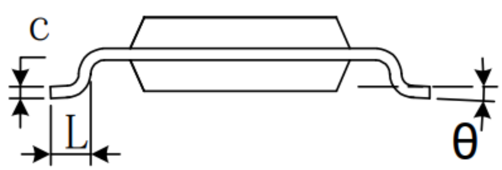
MSOP-10





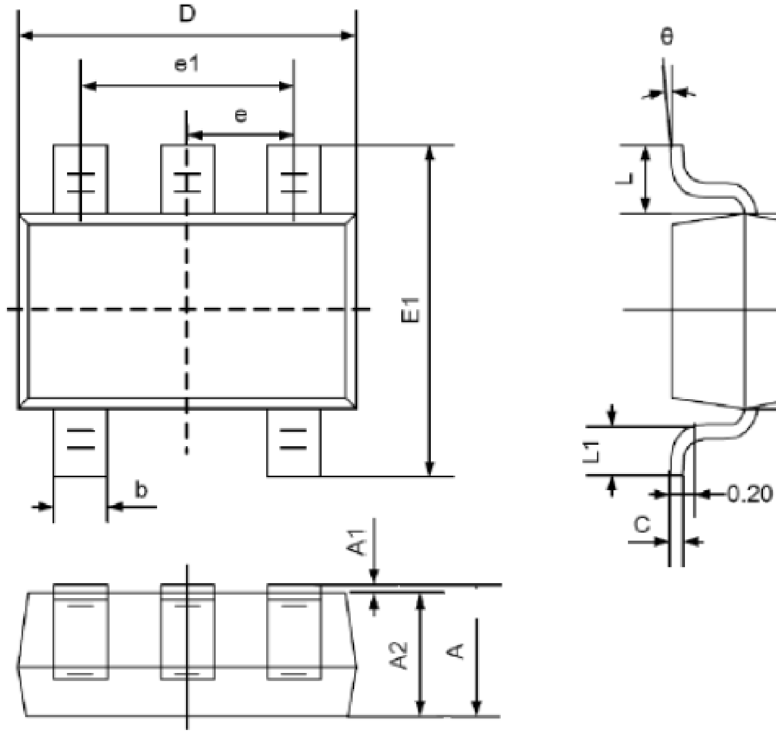
RECOMMENDED LAND PATTERN (Unit: mm)





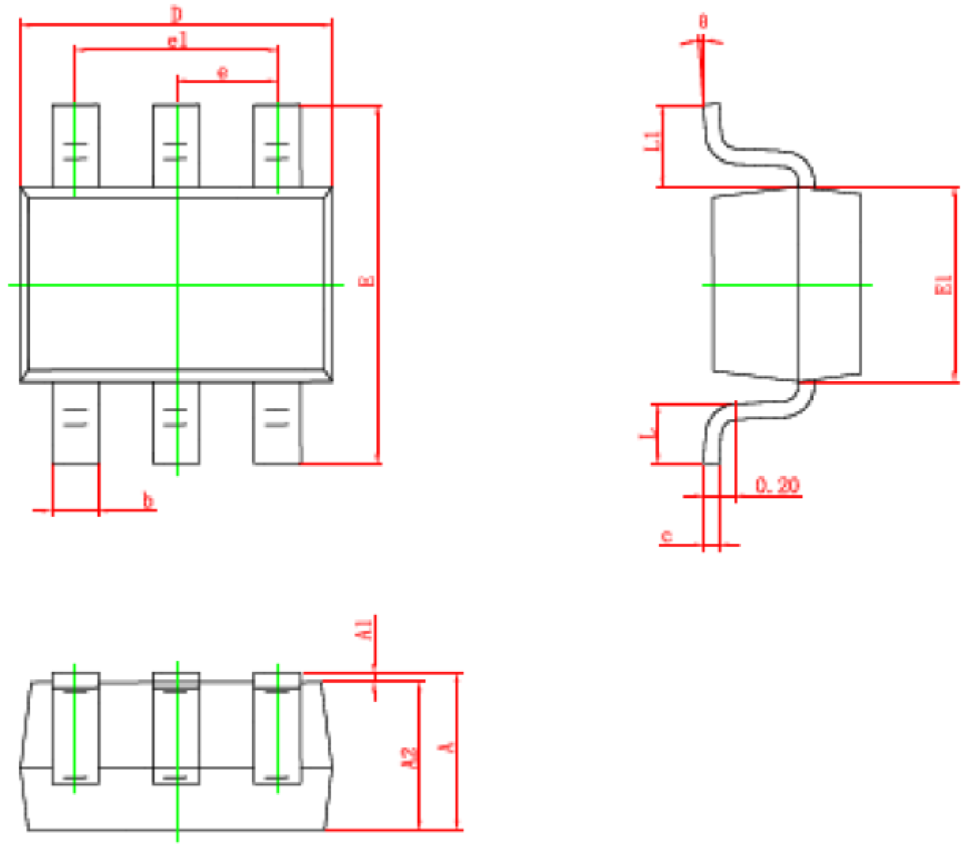
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.180	0.280	0.007	0.011
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.50(BSC)		0.020(BSC)	
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

SC70-5



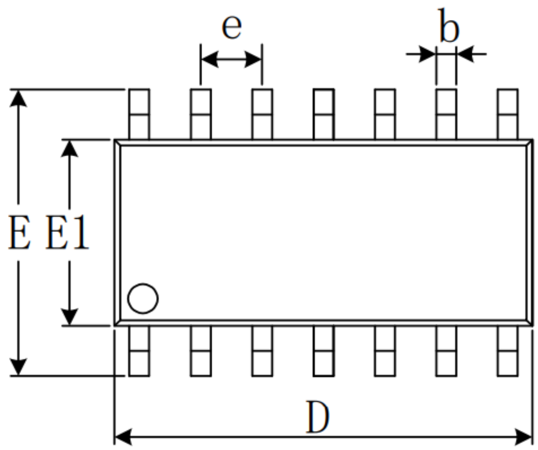
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
C	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650TYP		0.026TYP	
e1	1.200	1.400	0.047	0.055
L	0.525REF		0.021REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

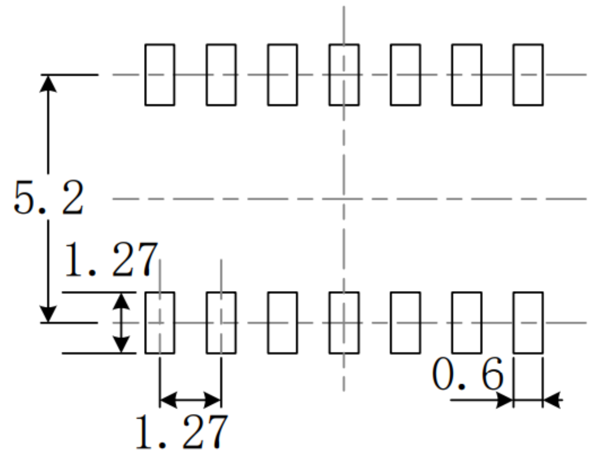
SC70-6



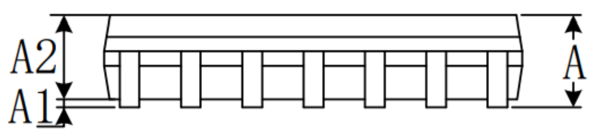
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.080	0.150	0.003	0.006
D	2.000	2.200	0.079	0.087
E	2.150	2.450	0.085	0.096
E1	1.150	1.350	0.045	0.053
e	0.650 TYP.		0.026 TYP.	
e1	1.200	1.400	0.047	0.055
L	0.260	0.460	0.010	0.018
L1	0.525 REF.		0.021 REF.	
θ	0°	8°	0°	8°

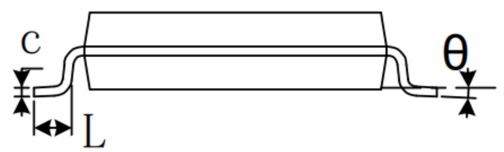
SOP14





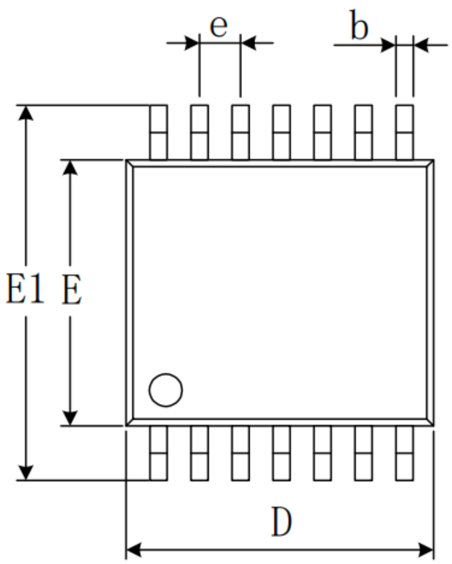
RECOMMENDED LAND PATTERN (Unit: mm)

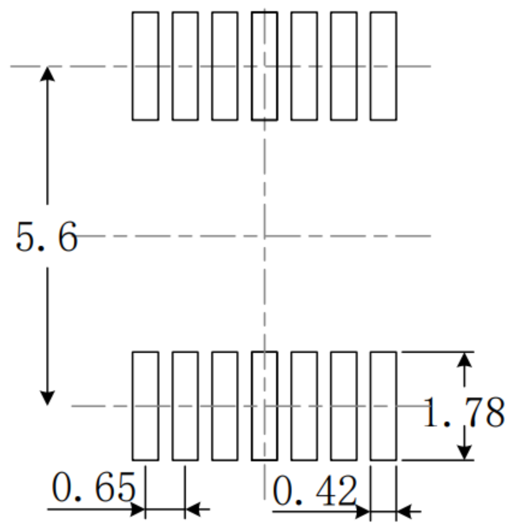




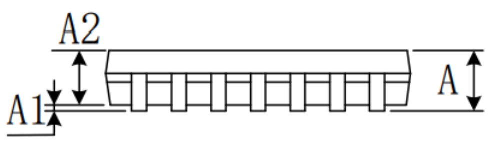
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	8.450	8.850	0.333	0.348
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

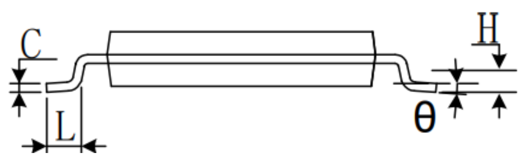
TSSOP-14





RECOMMENDED LAND PATTERN (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	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.008
D	4.860	5.100	0.191	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.020	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

PACKAGE/ORDERING INFORMATION

Product	Channel	Ordering Number	Package	Package Option	Package Marking
AT8091	Single	AT8091-CR	SC70-5	Tape and Reel, 3000	8091
		AT8091-TR	SOT23-5	Tape and Reel, 3000	8091
AT8092	Dual	AT8092-SR	SOP-8	Tape and Reel, 4000	AT8092
		AT8092-SR	MSOP-8	Tape and Reel, 3000	AT8092
AT8094	Quad	AT8094-MR	TSSOP-14	Tape and Reel, 3000	AT8094
		AT8094-SR	SOP-14	Tape and Reel, 2500	AT8094
AT8091N	Single with shutdown	AT8091N-CR	SC70-6	Tape and Reel, 3000	8091N
		AT8091N-TR	SOT23-6	Tape and Reel, 3000	8091N
AT8092N	Dual with shutdown	AT8092N-MR	MSOP-10	Tape and Reel, 2500	GS8092N

ORDERING INFORMATION

Table 3. Ordering Information

Part Number	Buy Now
AT8091	* *

*: both and are our online store icons. Our products can be ordered from either one of them with the same pricing and delivery time.

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