Precision Operational Amplifiers

FEATURES

- **Low Offset Voltage: ±20μV (TYP)**
- **Low Bias Current:±1nA (TYP)**
- **Gain Bandwidth Product: 1.9MHz**
- **Rail-to-Rail Output**
- **Low Quiescent Current: 1mA (TYP)**
- **Overload Recovery Time: 1.5us**
- **Supply Voltage Range: 5V to 36V**
- **No External Components Required**
- **Extended Temperature: -40°C to +125°C**
- **Micro SIZE PACKAGES: SOP8**

APPLICATIONS

- **Optical Network Control Circuits**
- **Sensors and Controls**
- **Wireless Base Station Control Circuits**
- **Cellular and Cordless Phones**
- **Photodiode Amplification**
- **Precision Filters**
- **Instrumentation**
- **A/D Converters**
- **Laptops and PDAs**
- **Medical and industrial instrumentation**

DESCRIPTION

The RS07 is a low noise, low offset voltage and high voltage operational amplifier, which can be designed into a wide range of applications. The RS07 has a gain-bandwidth product of 1.9MHz, a slew rate of 1V/us and a quiescent current of 1mA at wide power supply range.

The RS07 is designed to provide optimal performance in low noise systems. It provides rail-to-rail output swing into heavy loads.

The RS07 is available in Green SOP8 packages. It operates over an ambient temperature range of -40°C to +125°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
RS07	SOP8	4.90mm x 3.90mm

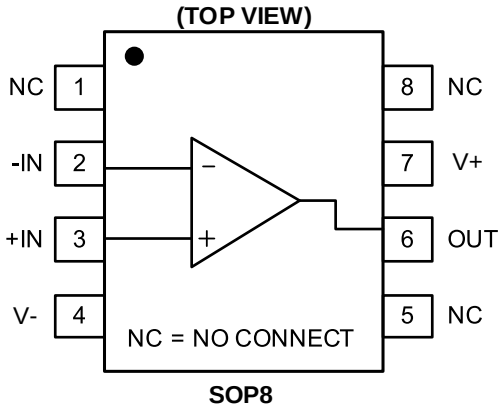
(1) For all available packages, see the orderable addendum at the end of the data sheet.

Revision History

Note: Page numbers for previous revisions may different from page numbers in the current version.

Version	Change Date	Change Item
A.0	2021/11/22	Initial version completed
A.0.1	2022/3/1	Initial version completed

Pin Configuration and Functions (Top View)



Pin Description

NAME	PIN	I/O	DESCRIPTION
	RS07		
	SOP8		
-IN	2	I	Negative (inverting) input
+IN	3	I	Positive (noninverting) input
NC	1,5,8	-	No internal connection (can be left floating)
OUT	6	O	Output
V-	4	-	Negative (lowest) power supply
V+	7	-	Positive (highest) power supply

SPECIFICATIONS

Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted) (1)

		MIN	MAX	UNIT
Voltage	Supply, V_S= (V+) - (V-)		36	V
	Signal input pin (2)	(V-) -0.3	(V+) +0.3	
	Signal output pin (3)	(V-) -0.3	(V+) +0.3	
Current	Signal input pin (2)	-10	10	mA
	Signal output pin (3)	-150	150	mA
	Output short-circuit (4)	Continuous		
Temperature	Operating range, T_A	-40	125	°C
	Junction, T_J		150	
	Storage, T_{stg}	-65	150	

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.
(2) Input terminals are diode-clamped to the power-supply rails. Input signals that can swing more than 0.5V beyond the supply rails should be current-limited to 10mA or less.
(3) Output terminals are diode-clamped to the power-supply rails. Output signals that can swing more than 0.5V beyond the supply rails should be current-limited to ±150mA or less.
(4) Short-circuit to ground, one amplifier per package.

ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM)	±2500	V
		Machine Model (MM)	±300	

Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
Supply voltage, V_S= (V+) - (V-)	Single-supply	5		36	V
	Dual-supply	±2.5		±18	

Thermal Information: RS07

THERMAL METRIC		RS07 8PINS SOP8	UNIT
$R_{\Theta JA}$	Junction-to-ambient thermal resistance	116	°C/W
$R_{\Theta JC\ (top)}$	Junction-to-case (top) thermal resistance	60	°C/W
$R_{\Theta JB}$	Junction-to-board thermal resistance	56	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	12.8	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	98.3	°C/W
$R_{\Theta JC\ (bot)}$	Junction-to-case (bottom) thermal resistance	N/A	°C/W

PACKAGE/ORDERING INFORMATION

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING (1)	PACKAGE OPTION
RS07	RS07XK	-40°C ~125°C	SOP8	RS07	Tape and Reel,4000

NOTE:

(1) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.

ELECTRICAL CHARACTERISTICS

(At T_A = +25°C, V_S = ±2.5V to ±18V, V_{CM} = 0V, V_{OUT} = 0V and R_L = 2kΩ connected to 0V, Full = -40°C to +125°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITION	TEMP	MIN	TYP	MAX	UNIT
INPUT CHARACTERISTICS							
Input Offset Voltage	V_{OS}	V_{CM}= 0V	+25°C		±20		μV
			FULL		±300		
Input Offset Voltage Average Drift	V_{OS} T_C		FULL		±3		μV/°C
Power-Supply Rejection Ratio	PSRR	V_S= 5V to 36V	+25°C		115		dB
			FULL	100			
Input Bias Current	I_B		+25°C		±1		nA
			FULL			±40	
Input Offset Current	I_{OS}		+25°C		±1		nA
			FULL			±30	
Input Common-Mode Voltage Range	V_{CM}		FULL	(V-) +0.5		(V+)- 2	V
Common-Mode Rejection Ratio	CMRR	(V-) +0.5V < V_{CM} < (V+)−2V	+25°C		120		dB
			FULL	100			
Open-Loop Voltage Gain	A_{OL}	V_S=±15V, Vo=(V-)-0.6V to (V+)-0.6V, R_L=10KΩ	+25°C		150		dB
			FULL	125			
NOISE PERFORMANCE							
Input Voltage Noise	e_{np-p}	f= 0.1Hz to 10Hz	+25°C		4		μV_{PP}
Input Voltage Noise Density	e_n	f= 1KHz	+25°C		20		$nV/\sqrt{Hz}$
Input Current Noise Density	i_n	f= 1KHz	+25°C		1		$pA/\sqrt{Hz}$
DYNAMIC PERFORMANCE							
Slew Rate	SR	G=+1	+25°C		1.0		V/μs
Settling Time to 0.01%	t_S	V_S = ±2.5V, V_{PP}=1V, G = +1 C_L=100PF	+25°C		1.5		μs
Gain-Bandwidth Product	GBP	V_{OUT} = 50mV_{P-P}, C_L = 10pF	+25°C		1.9		MHz
Overload Recovery Time	t_{OR}	V_{IN} × G ≥ V_S	+25°C		1.5		μs
Phase Margin	φ_O	V_{OUT} = 100mV_{P-P}, C_L = 10pF	+25°C		60		°
Total Harmonic Distortion + Noise	THD+N	V_{IN} = 1V_{RMS}, G = +1, f = 1kHz	+25°C		TBD		%
OUTPUT CHARACTERISTICS							
Output Voltage Swing from Rail	V_{OH}	V_S=±18V, R_L=10 KΩ	+25°C	17.90			V
	V_{OL}		+25°C			-17.90	
Output Source Current	I_{SOURCE}	V_S = ±18V	+25°C		90		mA
Output Sink Current	I_{SINK}				-70		
POWER SUPPLY							
Operating Voltage Range	V_S		FULL	5		36	V
Quiescent Current/ Amplifier	I_Q	I_{OUT}=0mA	+25°C		1		mA
			FULL		1.2		

TYPICAL CHARACTERISTICS

At T_A= +25°C, V_S= ±18V, unless otherwise noted.

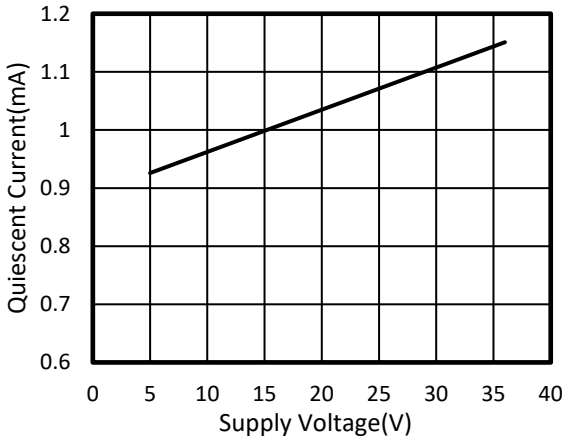


Figure 1. Supply Voltage vs Quiescent Current

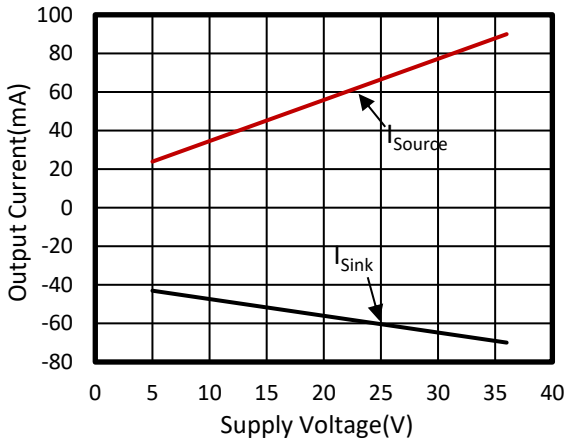


Figure 2. Supply Voltage vs Output Current

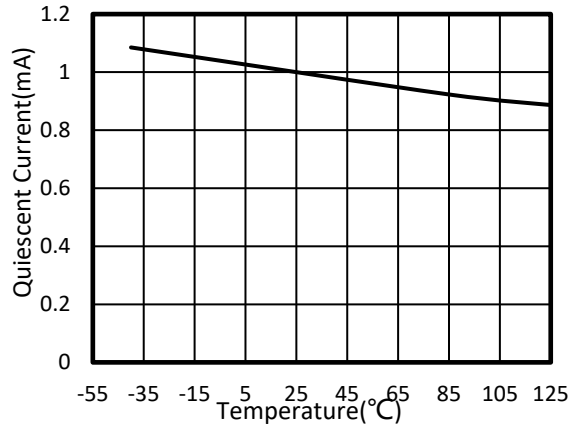


Figure 3. Quiescent Current vs Temperature

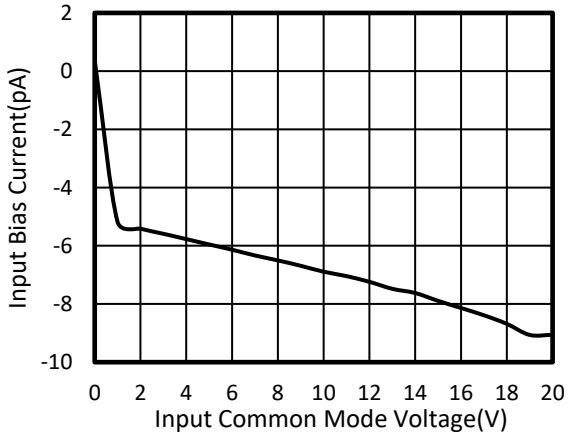


Figure 4. Input Bias Current vs Input Common Mode Voltage

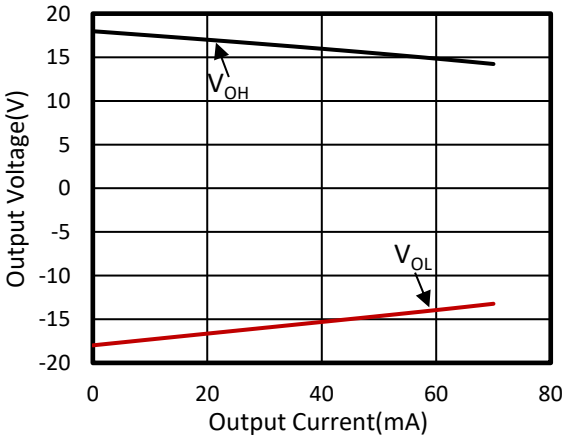


Figure 5. Output Voltage vs Output Current

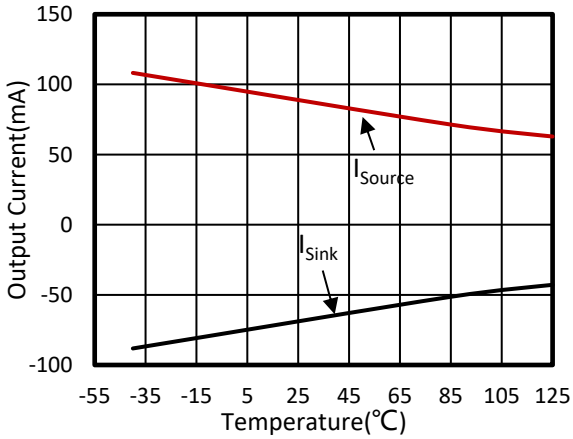


Figure 6. Output Current vs Temperature

TYPICAL CHARACTERISTICS

At T_A= +25°C, V_S= ±18V, unless otherwise noted.

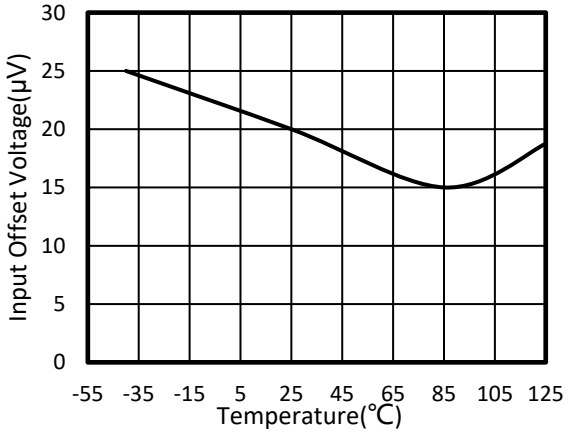


Figure 7. Input Offset Voltage vs Temperature

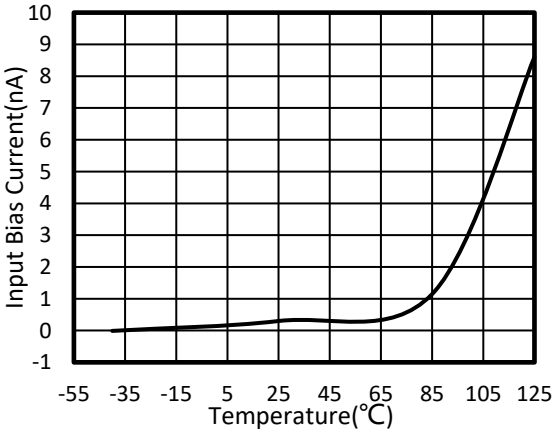


Figure 8. Input Bias Current vs Temperature

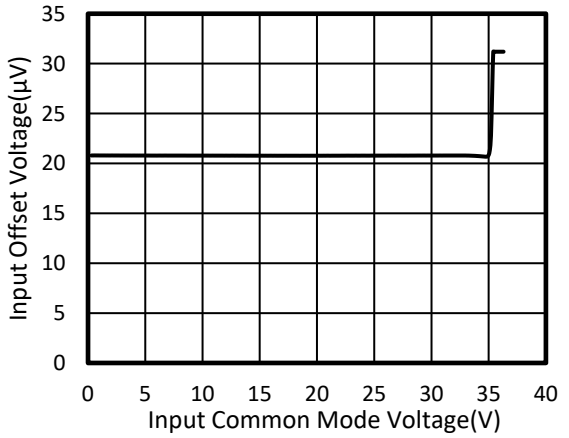


Figure 9. Input Offset Voltage vs Input Common Mode Voltage

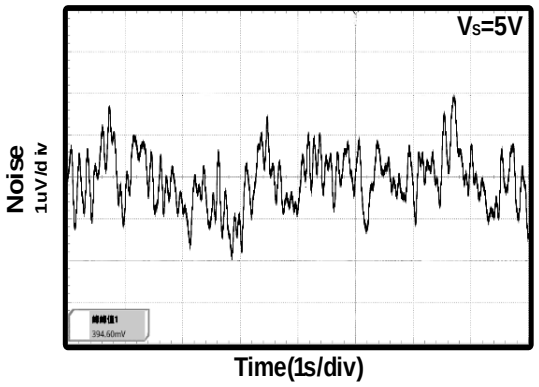


Figure 10. 0.1Hz to 10Hz Input Voltage Noise

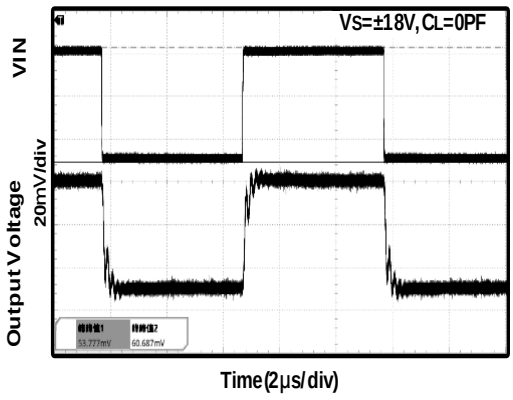


Figure 11. Small-Signal Step Response

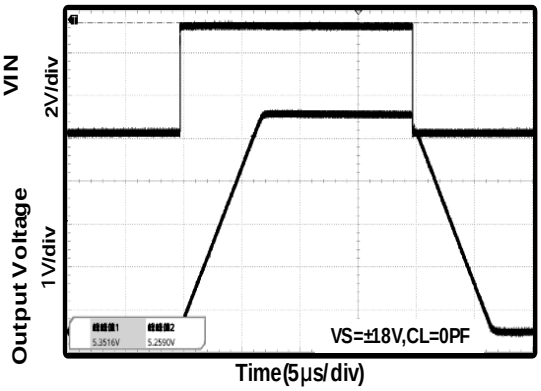


Figure 12. Large-Signal Step Response

APPLICATION NOTES

Power Supply Bypassing and Layout

The RS07 operates from either a single 5V to 36V supply or dual ±2.5V to ±18V supplies. For single-supply operation, bypass the power supply V+ with a 0.1μF ceramic capacitor which should be placed close to the V+ pin. For dual-supply operation, both the V+ and the V- supplies should be bypassed to ground with separate 0.1μF ceramic capacitors. 10μF tantalum capacitor can be added for better performance.

Good PC board layout techniques optimize performance by decreasing the amount of stray capacitance at the operational amplifier'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 operational amplifier, soldering the part to the board directly is strongly recommended. Try to keep the high frequency current loop area small to minimize the EMI (electromagnetic interference).

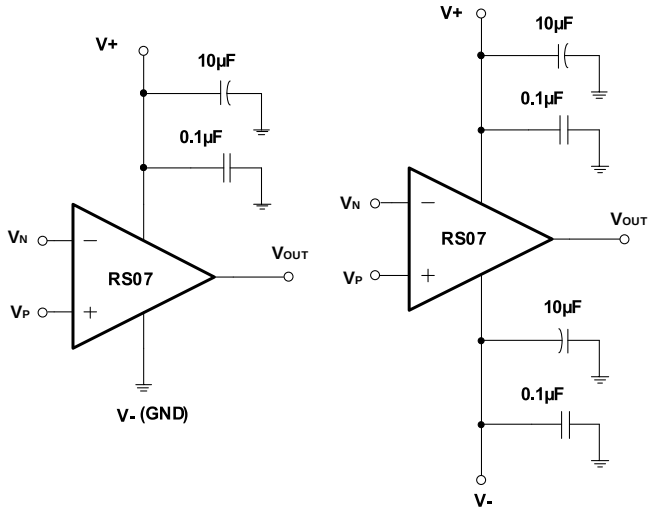


Figure 13. Amplifier with Bypass Capacitors

Grounding

A ground plane layer is important for RS07 circuit design. The length of the current path 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 in parallel. This helps reduce unwanted positive feedback.

Differential Amplifier

The circuit shown in Figure 14 performs the difference function. If the resistor ratios are equal ($R_4/R_3 = R_2/R_1$), then $V_{OUT} = (V_P - V_N) \times R_2/R_1 + V_{REF}$.

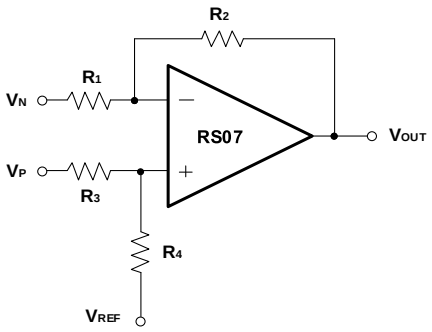


Figure 14. Differential Amplifier

Instrumentation Amplifier

The circuit in Figure 15 performs the same function as that in Figure 14 but with a high input impedance.

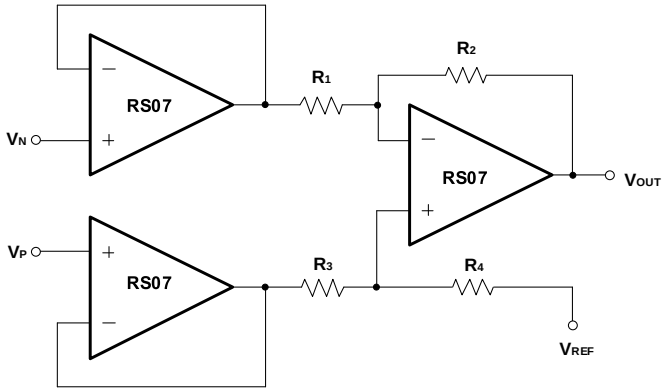


Figure 15. Instrumentation Amplifier

Active Low-Pass Filter

The low-pass filter shown in Figure 16 has a DC gain of ($-R_2/R_1$) and the -3dB corner frequency is $1/2\pi R_2 C$. Make sure the filter bandwidth is within the bandwidth of the amplifier. Feedback resistors with large values can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistor values as low as possible and consistent with output loading consideration.

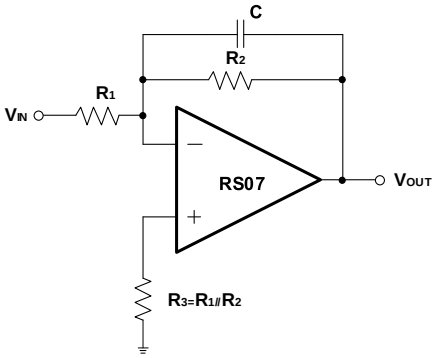
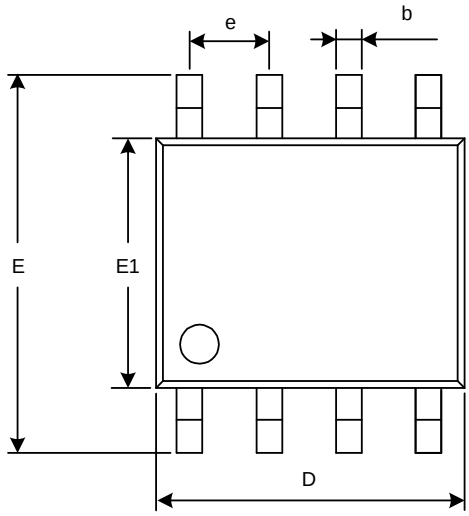
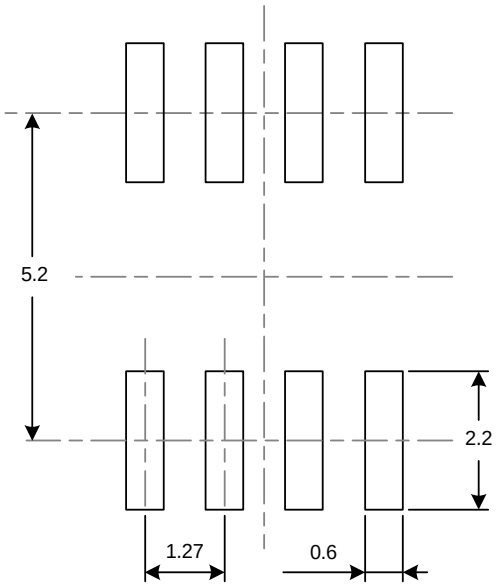


Figure 16. Active Low-Pass Filter

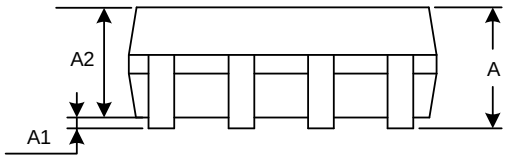
PACKAGE OUTLINE DIMENSIONS

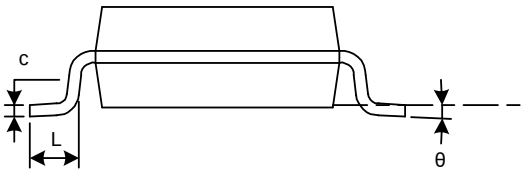
SOP8





RECOMMENDED LAND PATTERN (Unit: mm)



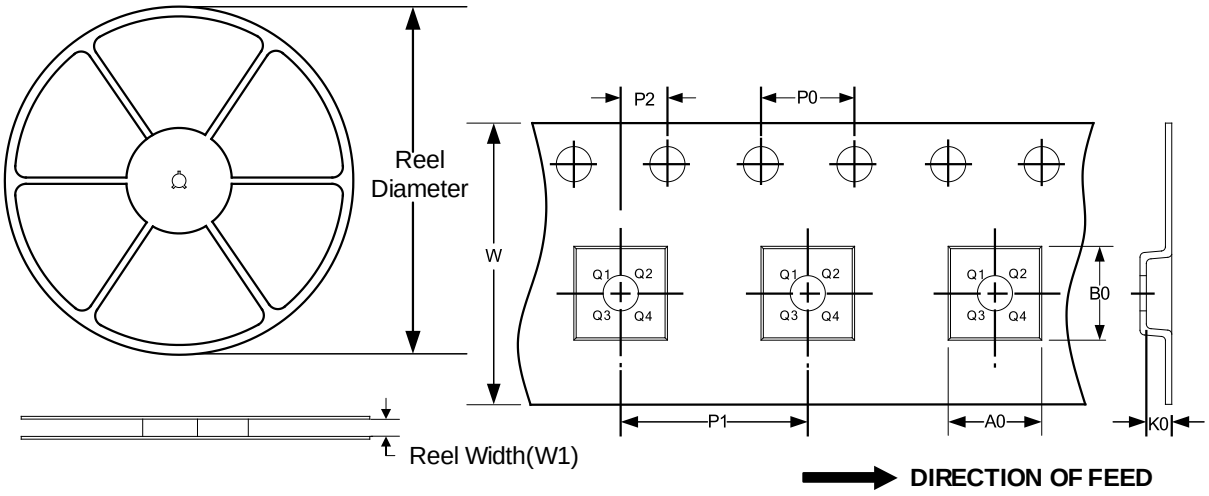


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270 (BSC)		0.050 (BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150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

TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOP8	13”	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1