DESCRIPTION

The AO1521 has a high gain-bandwidth product of 7kHz, a slew rate of 3V/ms, and a quiescent current of 350nA/amplifier at 5V. The AO1521 is designed to provide optimal performance in low voltage and low noise systems.

They provide rail-to-rail output swing into heavy loads. The input common mode voltage range includes ground, and the maximum input offset voltage is 3mV for AO1521. They are specified over the extended industrial temperature range (-40℃ to +125℃).

The AO1521 single is available in SOT-25 and SC70-5 packages.

ORDERING INFORMATION

Package Type	Part Number	
SOT-25 SPQ: 3,000pcs/Reel	E5	AO1521E5R
		AO1521E5VR
SC70-5 SPQ: 3,000pcs/Reel	C5	AO1521C5R
		AO1521C5VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

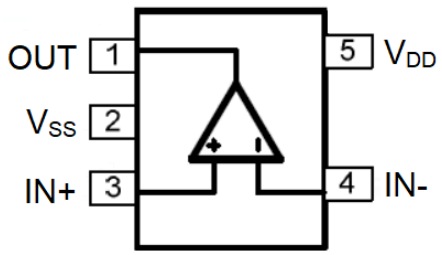
FEATURES

- Single-Supply Operation from +1.4V ~ +5.5V
- Rail-to-Rail Input / Output
- Gain-Bandwidth Product: 7kHz (Typ)
- Low Input Bias Current: 1pA (Typ)
- Low Offset Voltage: 3mV (Max)
- Quiescent Current: 350nA per Amplifier (Typ)
- Operating Temperature: -40°C ~ +125°C
- Embedded RF Anti-EMI Filter
- Available in SOT-25 and SC70-5 packages

APPLICATION

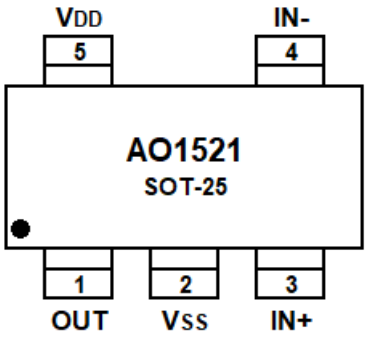
- ASIC Input or Output Amplifier
- Sensor Interface
- Medical Communication
- Smoke Detectors
- Audio Output
- Piezoelectric Transducer Amplifier
- Medical Instrumentation
- Portable Systems

TYPICAL APPLICATION

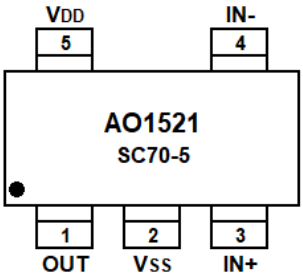


SOT-25/SC70-5

PIN DESCRIPTION



Top View



Top View

Pin #		Symbol	Function
SOT-25	SC70-5		
1	1	OUT	Output
2	2	V_{SS}	Ground or Negative Power Supply Input
3	3	IN+	Analog Positive Input
4	4	IN-	Analog Inverting Input
5	5	V_{DD}	Positive Power Supply Input

ABSOLUTE MAXIMUM RATINGS

Power Supply Voltage (V_{DD} to V_{SS})	-0.5V~+7.5V
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	+160°C
Storage Temperature Range	-55°C~+150°C
Lead Temperature (soldering, 10sec)	+260°C
Package Thermal Resistance (T_A=+25°C)	
θ_{JA}, SOT-25	190°C/W
θ_{JA}, SC70-5	333°C/W
ESD Susceptibility	
HBM	6kV
MM	300V

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

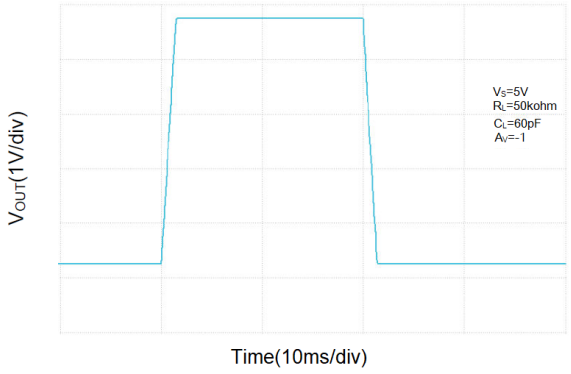
At V_S = +5V, R_L = 1MΩ connected to $V_S/2$, and V_{OUT} = $V_S/2$, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}	V_{CM} = $V_S/2$	-	0.4	3	mV
Input Bias Current	I_B		-	1	-	pA
Input Offset Current	I_{OS}		-	1	-	pA
Common-Mode Voltage Range	V_{CM}	V_S = 5.5V		-0.1 to +5.6		V
Common-Mode Rejection Ratio	CMRR	V_S = 5V, V_{CM} = -0.1V to 2.5V	63	77	-	dB
		V_S = 5V, V_{CM} = -0.1V to 5.1V	68	83	-	
Open-Loop Voltage Gain	A_{OL}	Vs=1.4V, R_L = 50kΩ, V_O = V_S-0.1V	75	84	-	dB
		Vs=5V, R_L = 50kΩ, V_O = V_S-0.1V	87	93	-	
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		-	2.5	-	μV/℃
OUTPUT CHARACTERISTICS						
Output Voltage Swing from Rail	V_{OH}	V_S=1.4V, R_L = 50kΩ	1.390	1.395	-	V
		V_S=5V, R_L = 50kΩ	4.990	4.997	-	
	V_{OL}	V_S=1.4V, R_L = 50kΩ	-	4.5	10	mV
		V_S=5V, R_L = 50kΩ	-	3.5	10	
Output Current	I_{SOURCE}	R_L = 10Ω to $V_S/2$	-	20	-	mA
	I_{SINK}		-	20	-	
POWER SUPPLY						
Operating Voltage Range			-	1.4	-	V
			-	5.5	-	
Power Supply Rejection Ratio	PSRR	V_S = +1.4V to +5.5V, V_{CM} = +0.5V	69	80	-	dB
Quiescent Current / Amplifier	I_Q		-	600	-	nA
DYNAMIC PERFORMANCE (C_L = 100pF)						
Gain-Bandwidth Product	GBP		-	7	-	kHz
Slew Rate	SR	G = +1, 2V Output Step	-	3	-	V/ms

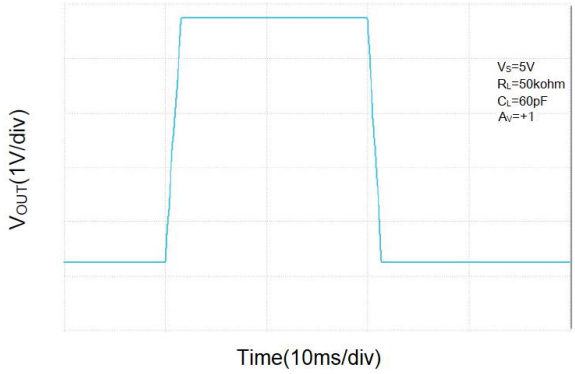
TYPICAL PERFORMANCE CHARACTERISTIC

At T_A=+25℃, V_S=+5V and R_L=100kΩ connected to V_S/2, unless otherwise noted.

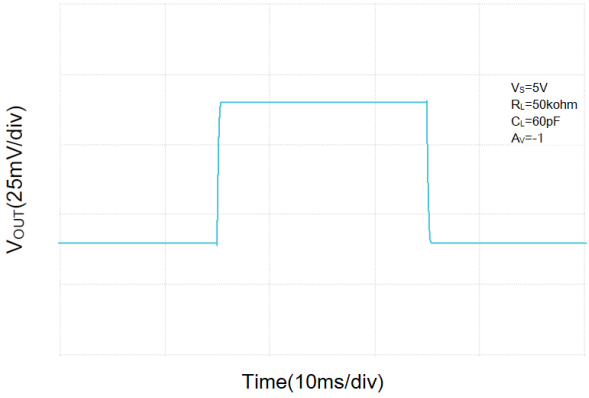
1. Large Signal Inverting Pulse Response



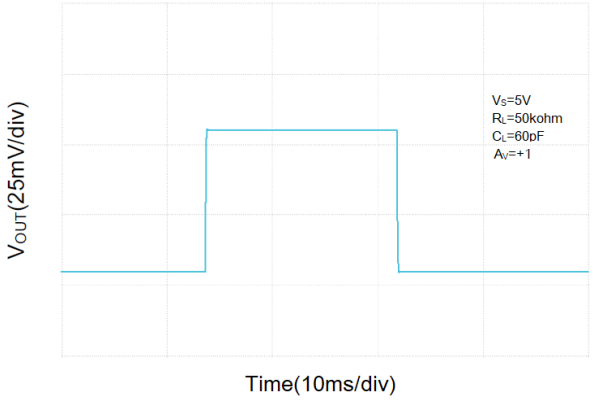
2. Large Signal Non-Inverting Pulse Response



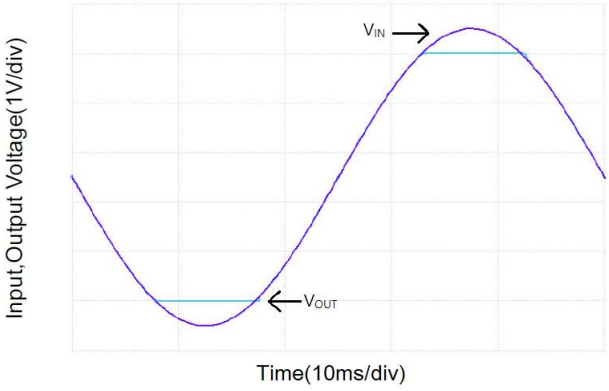
3. Small Signal Inverting Pulse Response



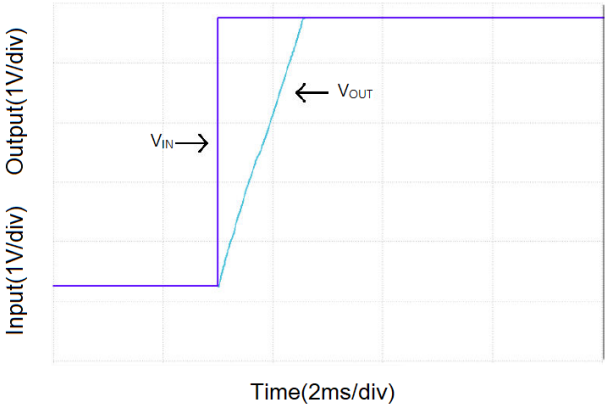
4. Small Signal Non-Inverting Pulse Response



5. No Phase Reversal



6. Output Settling Time



DETAILED INFORMATION

Size

AO1521 op amps are unity-gain stable and suitable for a wide range of general-purpose applications. The small footprints of the AO1521 packages save space on printed circuit boards and enable the design of smaller electronic products.

Power Supply Bypassing and Board Layout

AO1521 operates from a single 1.4V to 5.5V supply or dual ±0.7V 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 350nA per channel) of AO1521 will help to maximize battery life. They are ideal for battery powered systems.

Operating Voltage

AO1521 operates under wide input supply voltage (1.4V to 5.5V). In addition, all temperature specifications apply from -40℃ to +125℃. Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensure operation throughout the single Li-Ion battery lifetime.

Rail-to-Rail Input

The input common-mode range of AO1521 extends 100mV beyond the supply rails (V_{SS}-0.1V to V_{DD}+0.1V). This is achieved by using complementary input stage. For normal operation, inputs should be limited to this range.

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 AO1521 can typically swing to less than 50mV from supply rail in light resistive loads (>50kΩ).

Capacitive Load Tolerance

The AO1521 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 shown 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.

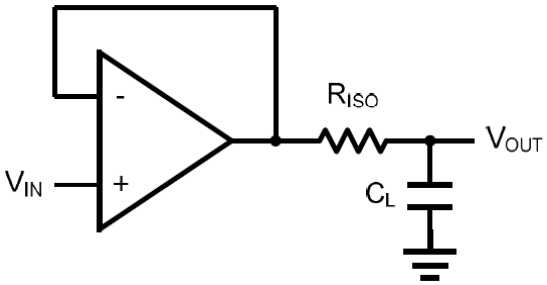


Figure 1. Indirectly Driving a Capacitive Load Using Isolation Resistor

The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. However, if there is a resistive load R_L 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 R_F 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.

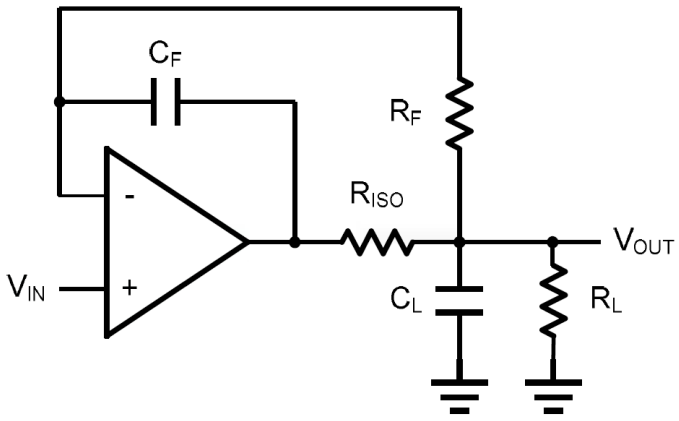


Figure 2. Indirectly Driving a Capacitive Load with DC Accuracy

Typical 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 AO1521.

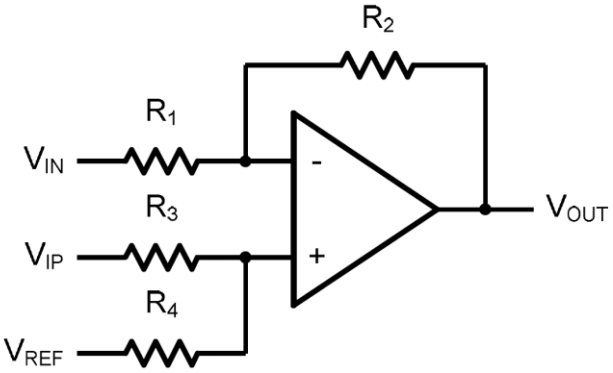


Figure 3. Differential Amplifier

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

If the resistor ratios are equal (i.e. $R_1=R_3$ and $R_2=R_4$), 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 $-R_2/R_1$. The filter has a -20dB/decade roll-off after its corner frequency $f_C=1/(2\pi R_3 C_1)$.

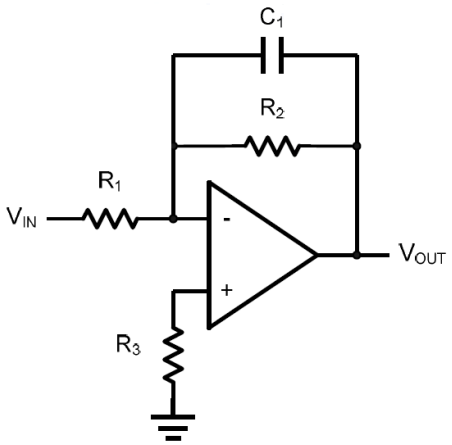


Figure 4. Low Pass Active Filter

Instrumentation Amplifier

The triple AO1521 can be used to build a three-op-amp instrumentation amplifier as shown in Figure 5. The amplifier in Figure 5 is a high input impedance differential amplifier with gain of R_2/R_1. The two differential voltage followers assure the high input impedance of the amplifier.

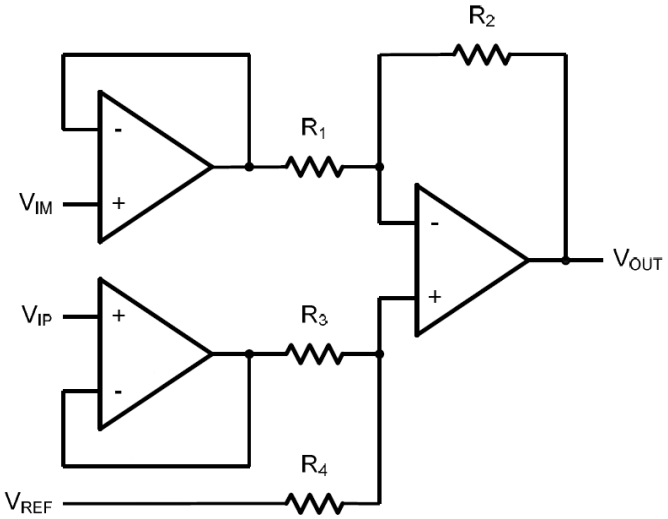
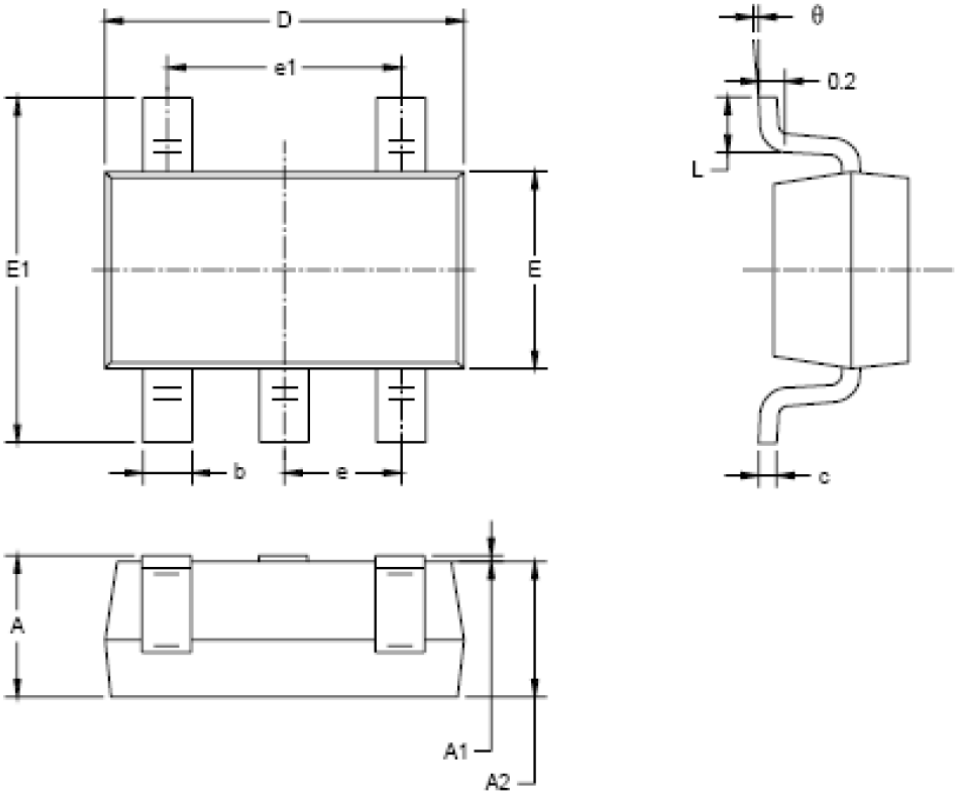


Figure 5. Instrument Amplifier

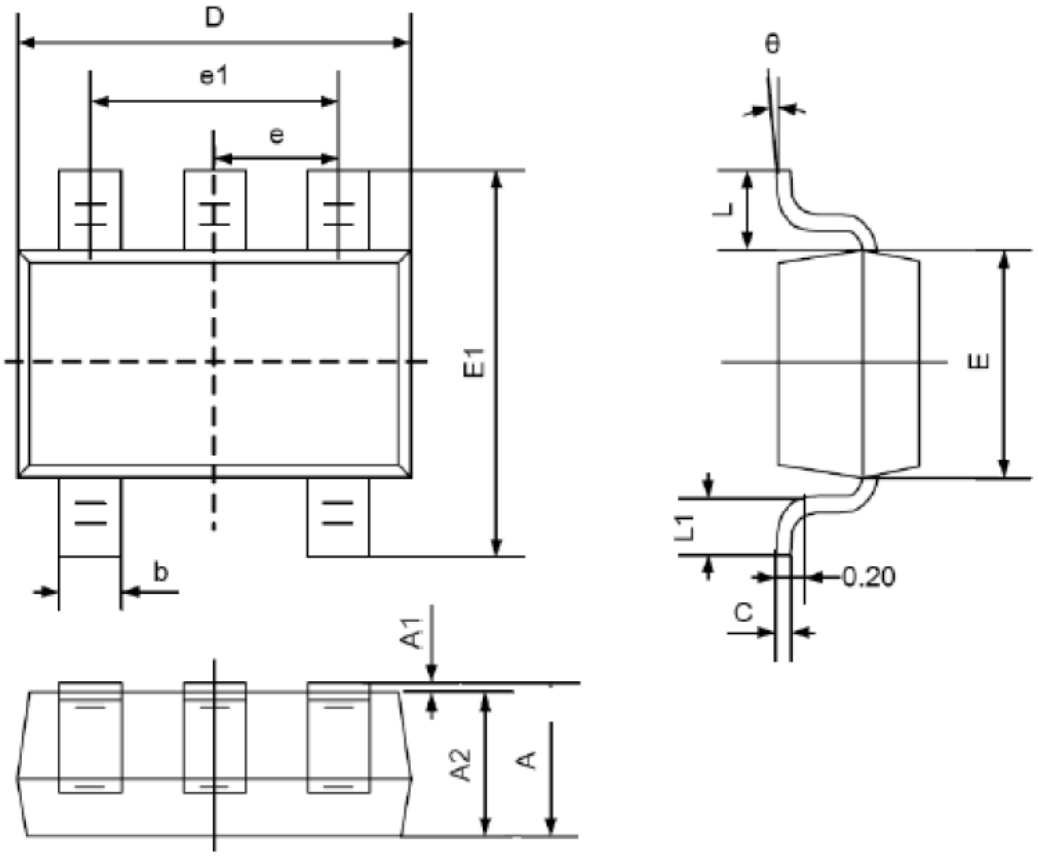
PACKAGE INFORMATION

Dimension in SOT-25 (Unit: mm)



Symbol	Millimeters		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	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Dimension in SC70-5 (Unit: mm)



Symbol	Millimeters		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	0.650 TYP		0.026 TYP	
e1	1.200	1.400	0.047	0.055
L	0.525 REF		0.021 REF	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

IMPORTANT NOTICE

AiT Semiconductor Inc. (AiT) reserves the right to make changes to any its product, specifications, to discontinue any integrated circuit product or service without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

AiT Semiconductor Inc.'s integrated circuit products are not designed, intended, authorized, or warranted to be suitable for use in life support applications, devices or systems or other critical applications. Use of AiT products in such applications is understood to be fully at the risk of the customer. As used herein may involve potential risks of death, personal injury, or servere property, or environmental damage. In order to minimize risks associated with the customer's applications, the customer should provide adequate design and operating safeguards.

AiT Semiconductor Inc. assumes to no liability to customer product design or application support. AiT warrants the performance of its products of the specifications applicable at the time of sale.