

# CAT5120, CAT5121, CAT5122

## 16-Tap Digitally Programmable Potentiometers with 2-Wire Interface

### Description

CAT5120/5121/5122 linear-taper digitally programmable potentiometers perform the same function as a mechanical potentiometer or a variable resistor. These devices consist of a fixed resistor and a wiper contact with 16-tap points that are digitally controlled through a 2-wire up/down serial interface.

The CAT5120 is configured as a potentiometer. The CAT5121 and CAT5122 are configured as variable resistors. See *Pin Configurations* for part functionality.

Three resistance values are available: 10 k $\Omega$ , 50 k $\Omega$  and 100 k $\Omega$ . These are available in space-saving 5-pin and 6-pin SC-70 and SOT-23 packages.

### Features

- 0.3  $\mu$ A Ultra-low Standby Current
- Single-supply Operation: 2.7 V to 5.5 V
- Glitchless Switching between Resistor Taps
- Power-on Reset to Midscale
- 2-wire Up/Down Serial Interface
- Resistance Values: 10 k $\Omega$ , 50 k $\Omega$  and 100 k $\Omega$
- Available in SC-70 and SOT-23 Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Applications

- LCD Screen Adjustment
- Volume Control
- Mechanical Potentiometer Replacement
- Gain Adjustment
- Line Impedance Matching



ON Semiconductor®

<http://onsemi.com>



SC-70  
SD SUFFIX  
CASE 419AD



SOT-23  
TB SUFFIX  
CASE 527AJ

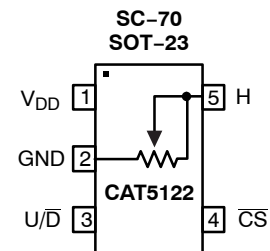
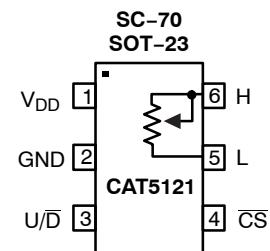
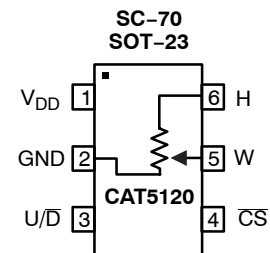


SC-70  
SD SUFFIX  
CASE 419AC



SOT-23  
TB SUFFIX  
CASE 527AH

### PIN CONFIGURATIONS



### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

# CAT5120, CAT5121, CAT5122

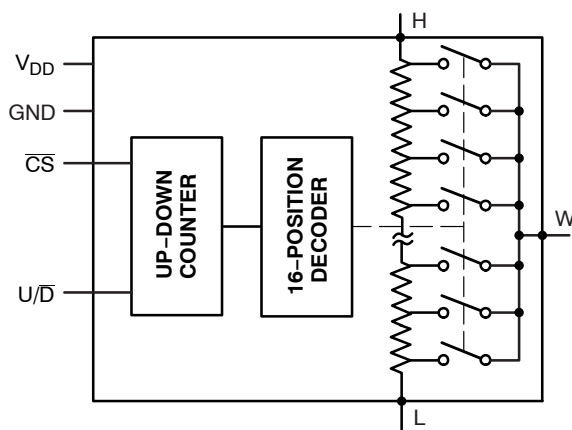


Figure 1. Functional Diagram

Table 1. PIN DESCRIPTIONS

Name	Description
V <sub>DD</sub>	Power Supply
GND	Ground
U/ $\bar{D}$	Up/ $\bar{D}$ own Control Input. With $\bar{CS}$ low, a low-to-high transition increments or decrements the wiper position.
$\bar{CS}$	Chip Select Input. A high-to-low $\bar{CS}$ transition determines the mode: increment if U/ $\bar{D}$ is high, or decrement if U/ $\bar{D}$ is low.
L	Low Terminal of Resistor
W	Wiper Terminal of Resistor
H	High Terminal of Resistor

Table 2. ABSOLUTE MAXIMUM RATINGS

Parameters	Ratings	Units
V <sub>DD</sub> to GND	-0.3 to +6	V
All Other Pins to GND	-0.3 to (V <sub>DD</sub> + 0.3)	V
Input and Output Latch-Up Immunity	±200	mA
Maximum Continuous Current into H, L and W		mA
100 k $\Omega$	±0.6	
50 k $\Omega$	±1.3	
10 k $\Omega$	±1.3	
Continuous Power Dissipation (T <sub>A</sub> = +70°C)		mW
5-pin SC-70 (Note 1)	247	
6-pin SC-70 (Note 1)	245	
Operating Temperature Range	-40 to +85	°C
Junction Temperature	+150	°C
Storage Temperature Range	-65 to +150	°C
Soldering Temperature (soldering, 10 s)	+300	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Derate 3.1 mW/°C above T<sub>A</sub> = +70°C

# CAT5120, CAT5121, CAT5122

**Table 3. ELECTRICAL CHARACTERISTICS**

( $V_{DD} = 2.7\text{ V to }5.5\text{ V}$ ,  $V_H = V_{DD}$ ,  $V_L = 0$ ,  $T_A = -40^\circ\text{C to }+85^\circ\text{C}$ . Typical values are at  $V_{DD} = 2.7\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
<b>DC PERFORMANCE</b>						
Resolution			16			Taps
End-to-End Resistance (-00)			75	100	125	k $\Omega$
End-to-End Resistance (-50)			37.5	50	62.5	
End-to-End Resistance (-10)			7.5	10	12.5	
End-to-End Resistance Tempco	$TC_R$			200		ppm/ $^\circ\text{C}$
Ratiometric Resistance Tempco				5		ppm/ $^\circ\text{C}$
Integral Nonlinearity	INL				$\pm 0.5$	LSB
Differential Nonlinearity	DNL				$\pm 0.5$	LSB
Zero/Full-Scale Error				$\pm 0.1$	$\pm 0.5$	LSB
Wiper Resistance	$R_W$			200	600	$\Omega$

### DIGITAL INPUTS

Input High Voltage	$V_{IH}$		$0.7 \times V_{DD}$			V
Input Low Voltage	$V_{IL}$				$0.3 \times V_{DD}$	V

### TIMING CHARACTERISTICS (Figures 7, 8)

U/ $\bar{D}$ Mode to $\bar{CS}$ Setup	$t_{CU}$		25			ns
$\bar{CS}$ to U/ $\bar{D}$ Step Setup	$t_{CI}$		50			ns
$\bar{CS}$ to U/ $\bar{D}$ Step Hold	$t_{CH}$		25			ns
U/ $\bar{D}$ Step Low Period	$t_{L}$		25			ns
U/ $\bar{D}$ Step High Period	$t_{H}$		25			ns
Up/Down Toggle Rate (Note 2)	$f_{TOGGLE}$			1		MHz
Output Settling Time (Note 3)	$t_{SETTLE}$	100 k $\Omega$ variable resistor configuration, $C_L = 10\text{ pF}$		1		$\mu\text{s}$
		100 k $\Omega$ potentiometer configuration, $C_L = 10\text{ pF}$		0.25		

### POWER SUPPLY

Supply Voltage	$V_{DD}$		2.7		5.5	V
Active Supply Current (Note 4)	$I_{DD}$				25	$\mu\text{A}$
Standby Supply Current (Note 5)	$I_{SB}$	$V_{DD} = +5\text{ V}$		0.3	1	$\mu\text{A}$

2. Up/Down Toggle Rate:  $f_{TOGGLE} = 1 / t_{SETTLE}$
3. Typical settling times are dependent on end-to-end resistance.
4. Supply current measured while changing wiper tap,  $f_{TOGGLE} = 1\text{ MHz}$ .
5. Supply current measured while wiper position is fixed.

# CAT5120, CAT5121, CAT5122

## TYPICAL OPERATING CHARACTERISTICS

( $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

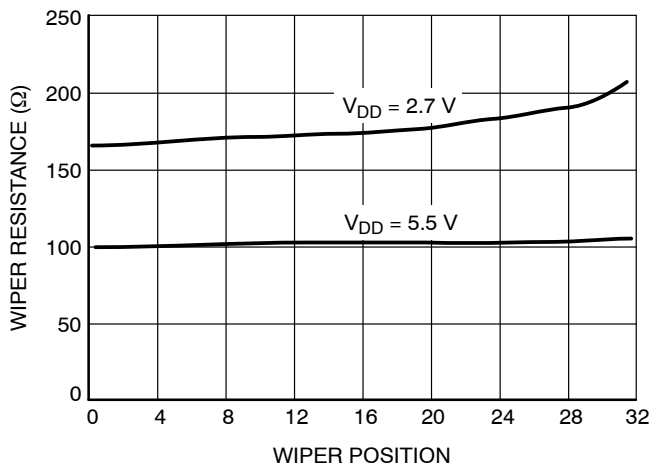


Figure 2. Wiper Resistance vs. Tap Position

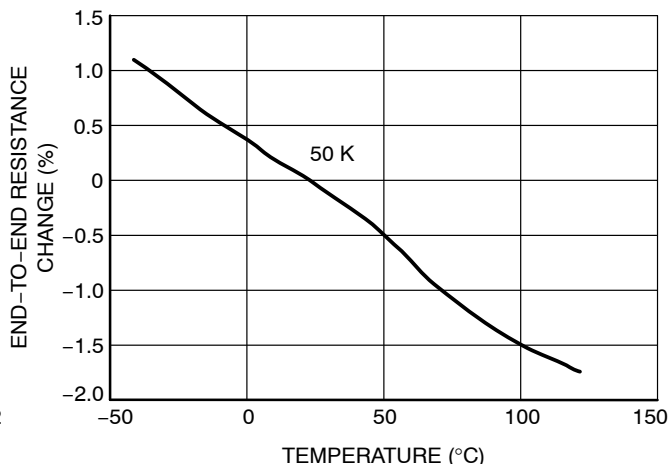


Figure 3. Change in End-to-End Resistance vs. Temperature

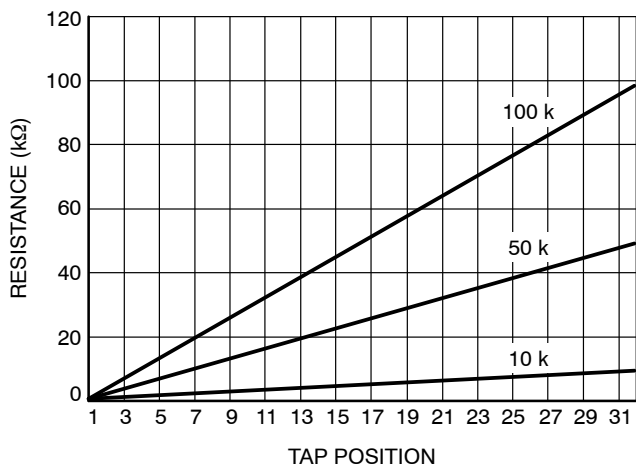


Figure 4. W-to-L Resistance vs. Tap Position

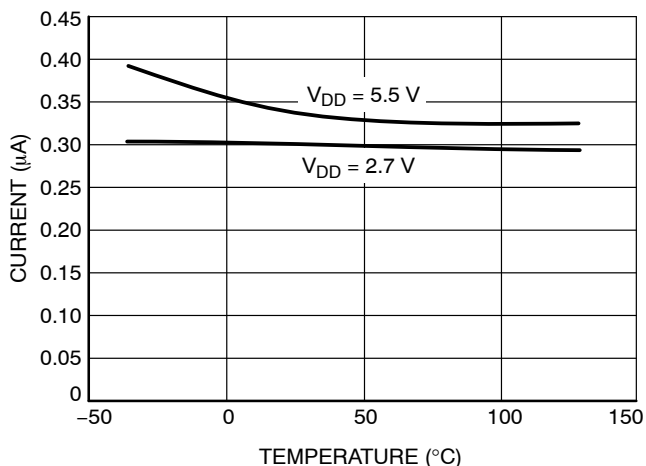


Figure 5. Supply Current vs. Temperature

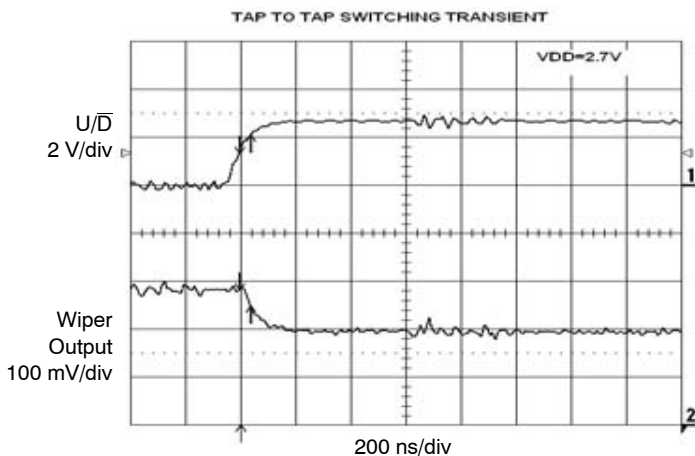


Figure 6. Tap-to-Tap Switching Transient



# CAT5120, CAT5121, CAT5122

## Applications Information

The devices are intended for circuits requiring digitally controlled adjustable resistance, such as LCD contrast control, where voltage biasing adjusts the display contrast.

### Alternative Positive LCD Bias Control

Use an op amp to provide buffering and gain on the output of the CAT5120. Connect the mechanical potentiometer to the positive input of a noninverting op amp (Figure 9) to select a portion of the input signal by digitally controlling the wiper terminal. Figure 10 shows a similar circuit for the CAT5121.

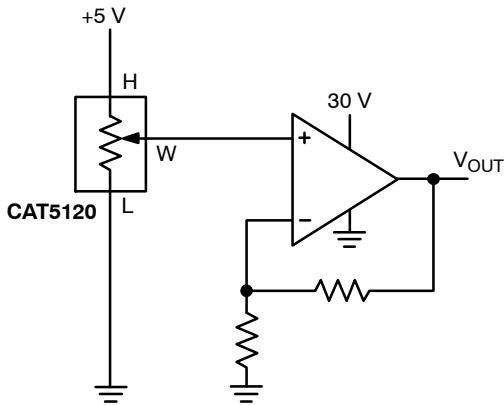


Figure 9. Positive LCD Bias Control

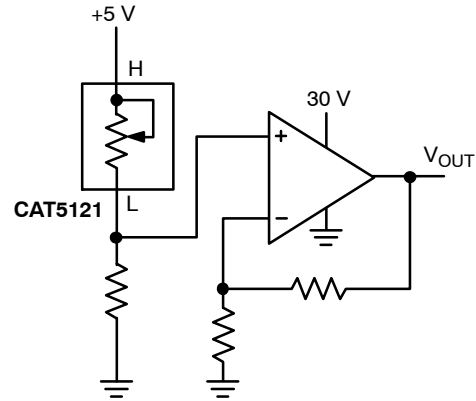


Figure 10. Positive LCD Bias Control

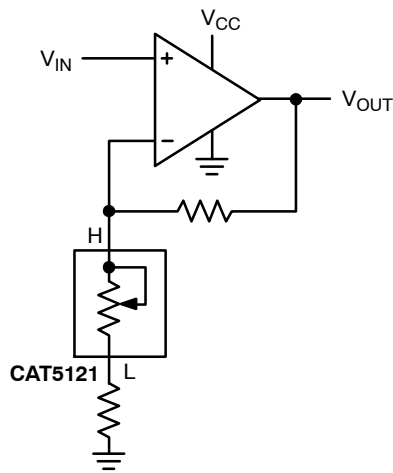


Figure 11. Adjustable Gain Circuit

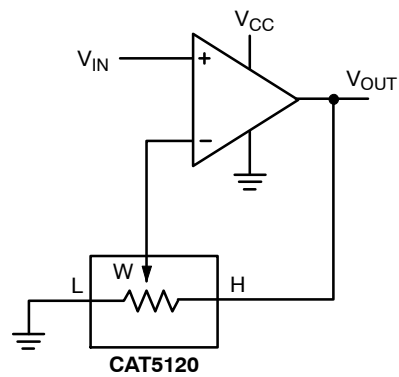


Figure 12. Adjustable Gain Circuit

### Adjustable Gain

Figures 11 and 12 show how to use the variable resistor to digitally adjust the gain of a noninverting op amp configuration. Connect the CAT5121 in series with a resistor to ground to form the adjustable gain control of a noninverting amplifier. The devices have a low 5 ppm/°C ratiometric tempco that allows for a very stable adjustable gain configuration over temperature.

## CAT5120, CAT5121, CAT5122

**Table 4. ORDERING INFORMATION**

Orderable Part Number	Resistor [kΩ]	Package	Shipping <sup>†</sup>
CAT5120SDI-10GT3	10	SC70-6 (Pb-Free)	3000 / Tape & Reel
CAT5120TBI-10-T3	10	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5120TBI-10GT3	10	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5120SDI-50GT3	50	SC70-6 (Pb-Free)	3000 / Tape & Reel
CAT5120TBI-50-T3	50	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5120TBI-50GT3	50	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5120SDI-00GT3	100	SC70-6 (Pb-Free)	3000 / Tape & Reel
CAT5120TBI-00-T3	100	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5120TBI-00GT3	100	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5121SDI-10GT3	10	SC70-6 (Pb-Free)	3000 / Tape & Reel
CAT5121TBI-10-T3	10	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5121TBI-10GT3	10	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5121SDI-50GT3	50	SC70-6 (Pb-Free)	3000 / Tape & Reel
CAT5121TBI-50-T3	50	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5121TBI-50GT3	50	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5121SDI-00GT3	100	SC70-6 (Pb-Free)	3000 / Tape & Reel
CAT5121TBI-00-T3	100	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5121TBI-00GT3	100	SOT23-6 (Pb-Free)	3000 / Tape & Reel
CAT5122SDI-10GT3	10	SC70-5 (Pb-Free)	3000 / Tape & Reel
CAT5122TBI-10-T3	10	SOT23-5 (Pb-Free)	3000 / Tape & Reel
CAT5122TBI-10GT3	10	SOT23-5 (Pb-Free)	3000 / Tape & Reel
CAT5122SDI-50GT3	50	SC70-5 (Pb-Free)	3000 / Tape & Reel
CAT5122TBI-50-T3	50	SOT23-5 (Pb-Free)	3000 / Tape & Reel
CAT5122TBI-50GT3	50	SOT23-5 (Pb-Free)	3000 / Tape & Reel
CAT5122SDI-00GT3	100	SC70-5 (Pb-Free)	3000 / Tape & Reel
CAT5122TBI-00-T3	100	SOT23-5 (Pb-Free)	3000 / Tape & Reel
CAT5122TBI-00GT3	100	SOT23-5 (Pb-Free)	3000 / Tape & Reel

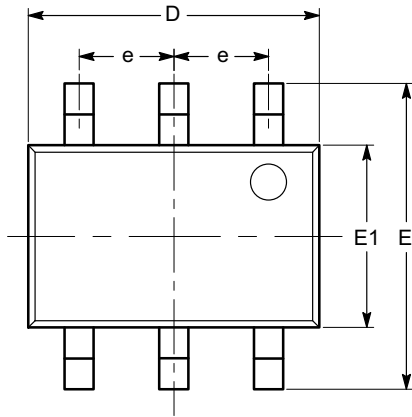
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

6. For detailed information and a breakdown of device nomenclature and numbering systems, please see the ON Semiconductor Device Nomenclature document, TND310/D, available at [www.onsemi.com](http://www.onsemi.com).

# CAT5120, CAT5121, CAT5122

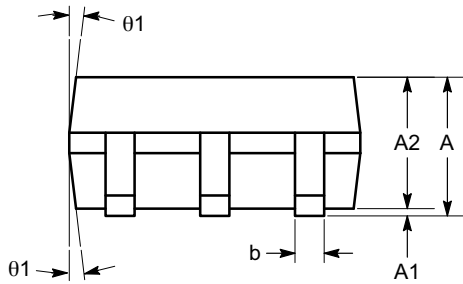
## PACKAGE DIMENSIONS

SC-88 (SC-70 6 Lead), 1.25x2  
 CASE 419AD-01  
 ISSUE A

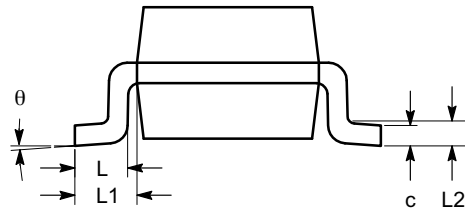


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	0.80		1.10
A1	0.00		0.10
A2	0.80		1.00
b	0.15		0.30
c	0.10		0.18
D	1.80	2.00	2.20
E	1.80	2.10	2.40
E1	1.15	1.25	1.35
e	0.65 BSC		
L	0.26	0.36	0.46
L1	0.42 REF		
L2	0.15 BSC		
$\theta$	0°		8°
$\theta_1$	4°		10°



SIDE VIEW



END VIEW

**Notes:**

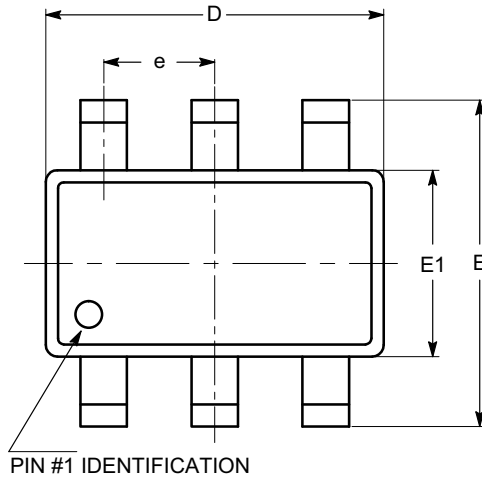
- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-203.



# CAT5120, CAT5121, CAT5122

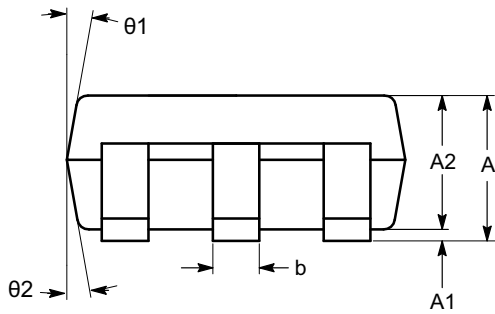
## PACKAGE DIMENSIONS

SOT-23, 6 Lead  
CASE 527AJ-01  
ISSUE O

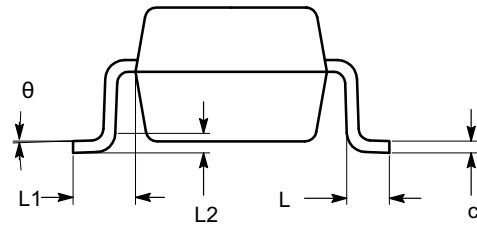


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	0.90		1.45
A1	0.00		0.15
A2	0.90	1.15	1.30
b	0.30		0.50
c	0.08		0.22
D	2.90 BSC		
E	2.80 BSC		
E1	1.60 BSC		
e	0.95 BSC		
L	0.30	0.45	0.60
L1	0.60 REF		
L2	0.25 REF		
$\theta$	0°	4°	8°
$\theta 1$	5°	10°	15°
$\theta 2$	5°	10°	15°



SIDE VIEW



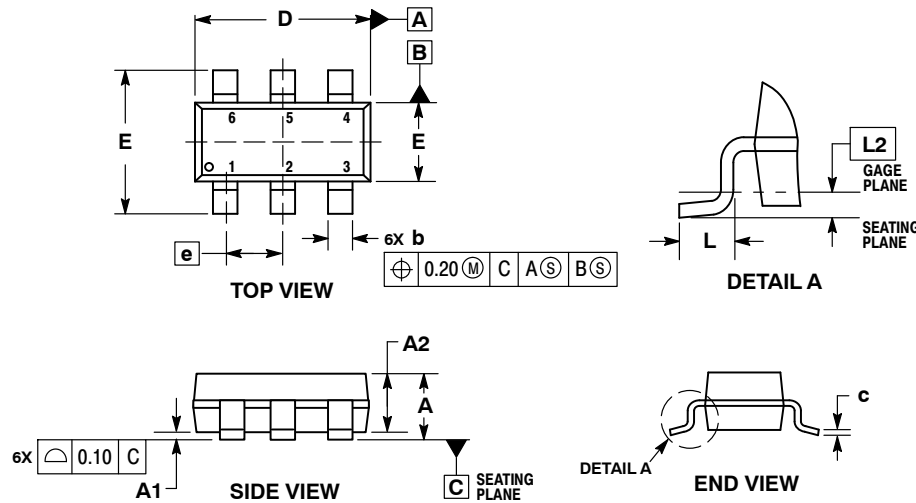
END VIEW

**Notes:**

- (1) All dimensions in millimeters. Angles in degrees.
- (2) Complies with JEDEC standard MO-178.

# CAT5120, CAT5121, CAT5122

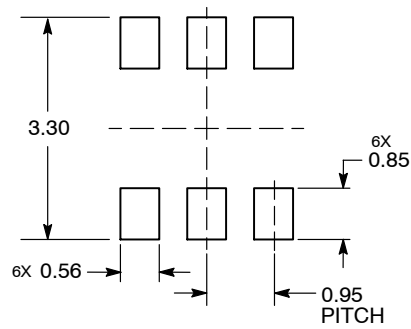
SOT-23, 6 Lead  
CASE 527AJ-01  
ISSUE A



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DATUM C IS THE SEATING PLANE.

MILLIMETERS		
DIM	MIN	MAX
A	---	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.20	0.50
c	0.08	0.26
D	2.70	3.00
E	2.50	3.10
E1	1.30	1.80
e	0.95 BSC	
L	0.20	0.60
L2	0.25 BSC	

## RECOMMENDED SOLDERING FOOTPRINT\*



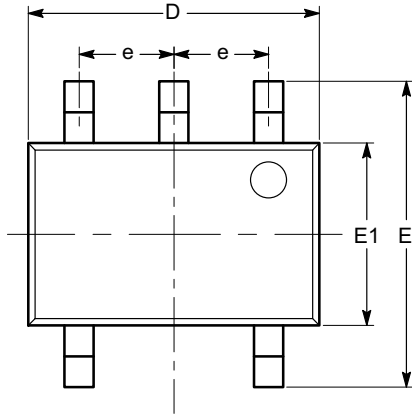
DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# CAT5120, CAT5121, CAT5122

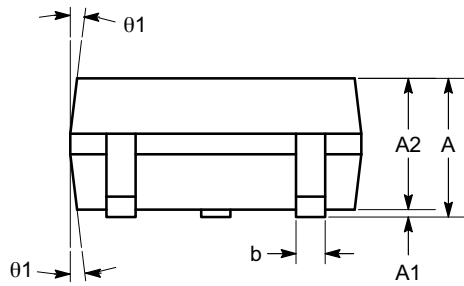
## PACKAGE DIMENSIONS

SC-88A (SC-70 5 Lead), 1.25x2  
CASE 419AC-01  
ISSUE A

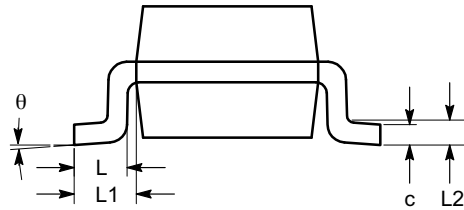


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	0.80		1.10
A1	0.00		0.10
A2	0.80		1.00
b	0.15		0.30
c	0.10		0.18
D	1.80	2.00	2.20
E	1.80	2.10	2.40
E1	1.15	1.25	1.35
e	0.65 BSC		
L	0.26	0.36	0.46
L1	0.42 REF		
L2	0.15 BSC		
$\theta$	0°		8°
$\theta_1$	4°		10°



SIDE VIEW



END VIEW

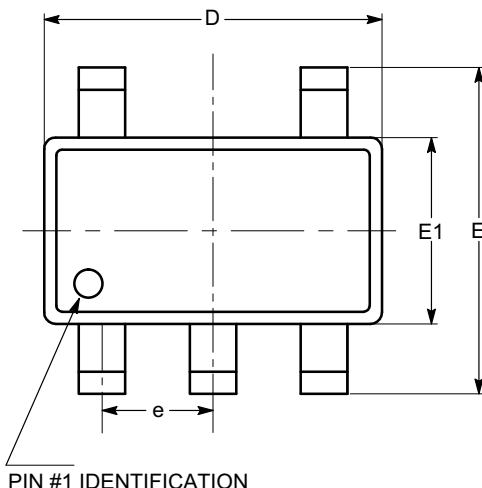
**Notes:**

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-203.

# CAT5120, CAT5121, CAT5122

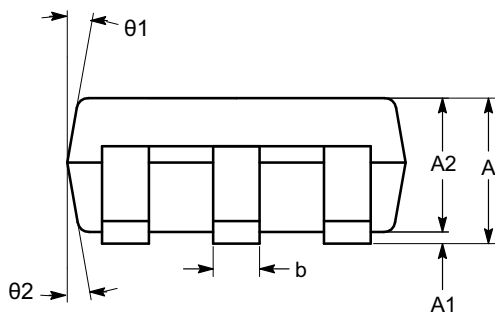
## PACKAGE DIMENSIONS

SOT-23, 5 Lead  
CASE 527AH-01  
ISSUE O

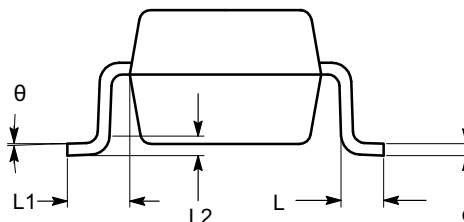


TOP VIEW

SYMBOL	MIN	NOM	MAX
A	0.90		1.45
A1	0.00		0.15
A2	0.90	1.15	1.30
b	0.30		0.50
c	0.08		0.22
D	2.90 BSC		
E	2.80 BSC		
E1	1.60 BSC		
e	0.95 BSC		
L	0.30	0.45	0.60
L1	0.60 REF		
L2	0.25 REF		
$\theta$	0°	4°	8°
$\theta 1$	5°	10°	15°
$\theta 2$	5°	10°	15°



SIDE VIEW



END VIEW

**Notes:**

- (1) All dimensions in millimeters. Angles in degrees.
- (2) Complies with JEDEC standard MO-178.

ON Semiconductor and are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

**PUBLICATION ORDERING INFORMATION**

**LITERATURE FULFILLMENT:**  
Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** orderlit@onsemi.com

**N. American Technical Support:** 800-282-9855 Toll Free USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910  
**Japan Customer Focus Center**  
Phone: 81-3-5817-1050

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)