

PRELIMINARY - April 13, 1998

TEL:805-498-2111 FAX:805-498-3804 WEB:http://www.semtech.com

## DESCRIPTION

The SC4040 is a two terminal precision voltage reference with thermal stability guaranteed over temperature. The SC4040 has a typical dynamic output impedance of 0.25Ω. Active output circuitry provides a very sharp turn on characteristic - the minimum operating current is 60μA, with a maximum of 20mA.

Available with five voltage tolerances (0.1%, 0.2%, 0.5%, 1.0% and 2.0%) and three package outlines (SOT-23, SO-8 and TO-92), this part allows the designer the opportunity to select the optimum combination of cost and performance for their application.

## FEATURES

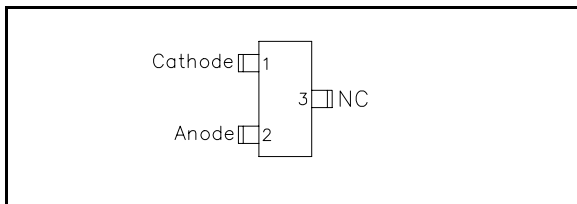
- Trimmed bandgap design (0.2%)
- Wide operating current range 60μA to 20mA
- Low dynamic impedance (0.25Ω)
- Available in SOT-23, TO-92 and SO-8

## APPLICATIONS

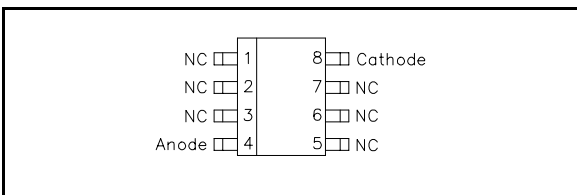
- Cellular telephones
- Portable computers
- Instrumentation
- Automotive

## PIN CONFIGURATIONS

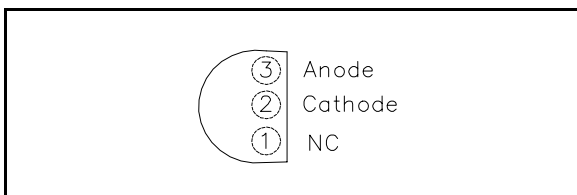
### SOT-23-3 Lead (Top View)



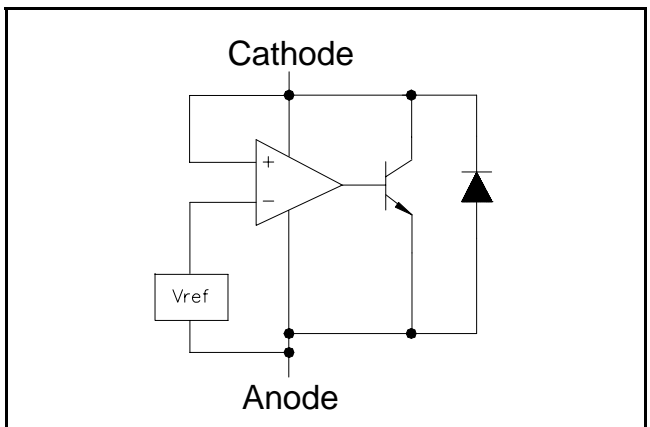
### SO-8 Lead (Top View)



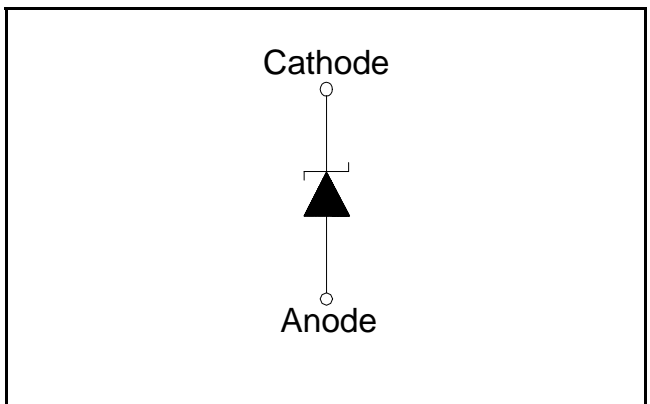
### TO-92 (Top View)



## BLOCK DIAGRAM



## SYMBOL DIAGRAM



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**ABSOLUTE MAXIMUM RATINGS**

| Parameter                               | Symbol     | Maximum          | Units        |
|-----------------------------------------|------------|------------------|--------------|
| Reverse Current                         |            | 60 $\mu$ A to 20 | mA           |
| Operating Temperature Range             | $T_A$      | -40 to +85       | $^{\circ}$ C |
| Operating Junction Temperature Range    | $T_J$      | -40 to +150      | $^{\circ}$ C |
| Storage Temperature Range               | $T_{STG}$  | -65 to +150      | $^{\circ}$ C |
| Lead Temperature (Soldering) 10 seconds | $T_{LEAD}$ | 260              | $^{\circ}$ C |
| ESD Rating                              | ESD        | 2                | kV           |

**ORDERING INFORMATION**

| PACKAGE                  | TOLERANCE |           |           |           |           | T/R Quantity |
|--------------------------|-----------|-----------|-----------|-----------|-----------|--------------|
|                          | 0.1%      | 0.2%      | 0.5%      | 1.0%      | 2.0%      |              |
| SOT-23-3L <sup>(1)</sup> | SC4040ASK | SC4040BSK | SC4040CSK | SC4040DSK | SC4040ESK | 3K           |
| SO-8 <sup>(1)</sup>      | SC4040AS  | SC4040BS  | SC4040CS  | SC4040DS  | SC4040ES  | 2.5K         |
| TO-92 <sup>(1)(2)</sup>  | SC4040AZ  | SC4040BZ  | SC4040CZ  | SC4040DZ  | SC4040EZ  | TR=3K, TA=2K |

Notes:

- (1) Add suffix 'TR' for Tape & Reel.
- (2) Add suffix 'TA' for Tape Ammo.

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**ELECTRICAL CHARACTERISTICS**

| T <sub>A</sub> = 25°C unless otherwise specified.             |                                 |                                                                         |                               | SC4040A (0.1%) |        |        | SC4040B (0.2%) |       |       |        |
|---------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------|-------------------------------|----------------|--------|--------|----------------|-------|-------|--------|
| Parameter                                                     | Symbol                          | Condition                                                               |                               | MIN            | TYP    | MAX    | MIN            | TYP   | MAX   | UNITS  |
| Reverse Breakdown Voltage                                     | V <sub>Z</sub>                  | I <sub>Z</sub> = 100µA                                                  | T <sub>A</sub> = 25°C         | 2.4975         | 2.5000 | 2.5025 | 2.495          | 2.500 | 2.505 | V      |
|                                                               |                                 |                                                                         | T <sub>A</sub> = -40 to +85°C | 2.481          | 2.500  | 2.519  | 2.479          | 2.500 | 2.521 | V      |
| Minimum Operating Current                                     | I <sub>Z(min)</sub>             |                                                                         |                               |                | 60     | 80     |                | 60    | 80    | µA     |
| Reverse Breakdown Voltage Temperature Coefficient             | $\frac{\Delta V_Z}{\Delta T}$   | I <sub>Z</sub> = 10mA<br>I <sub>Z</sub> = 1mA<br>I <sub>Z</sub> = 100µA | T <sub>A</sub> = -40 to +85°C |                |        | ±100   |                |       | ±100  | ppm/°C |
| Ratio of Change in V <sub>Z</sub> to Change in I <sub>Z</sub> | $\frac{\Delta V_Z}{\Delta I_Z}$ | I <sub>Z(min)</sub> ≤ I <sub>Z</sub> ≤ 1mA                              | T <sub>A</sub> = 25°C         |                |        | 0.8    |                |       | 0.8   | mV     |
|                                                               |                                 |                                                                         | T <sub>A</sub> = -40 to +85°C |                |        | 1.0    |                |       | 1.0   | mV     |
|                                                               |                                 | 1mA ≤ I <sub>Z</sub> ≤ 12mA                                             | T <sub>A</sub> = 25°C         |                |        | 6.0    |                |       | 6.0   | mV     |
|                                                               |                                 |                                                                         | T <sub>A</sub> = -40 to +85°C |                |        | 8.0    |                |       | 8.0   | mV     |
| Reverse Dynamic Impedance                                     | Z <sub>R</sub>                  | I <sub>Z</sub> = 1mA, f = 120 Hz, I <sub>AC</sub> = 0.1 I <sub>Z</sub>  |                               |                | 0.25   | 0.8    |                | 0.25  | 0.8   | Ω      |
| Wideband Noise (RMS)                                          | e <sub>N</sub>                  | I <sub>Z</sub> = 100µA<br>10Hz ≤ f ≤ 10kHz                              |                               |                | 35     |        |                | 35    |       | µV     |
| Long Term Stability of Reverse Breakdown Voltage              | ΔV <sub>Z</sub>                 | t = 1000 hours<br>T = 25°C ± 0.1°C<br>I <sub>Z</sub> = 100µA            |                               |                | 120    |        |                | 120   |       | ppm    |

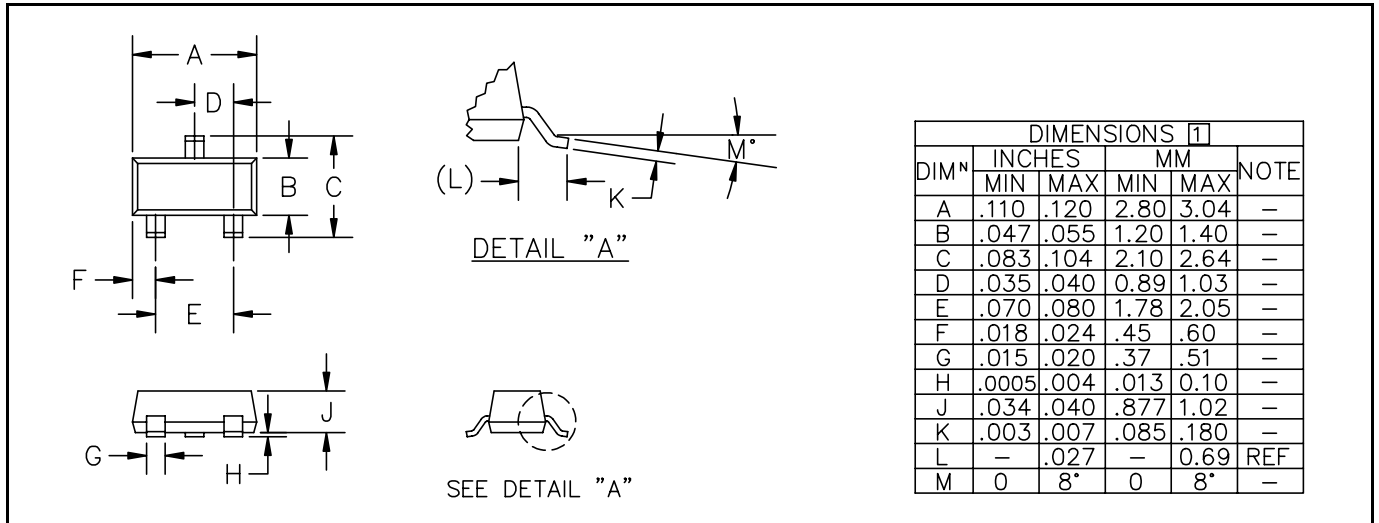
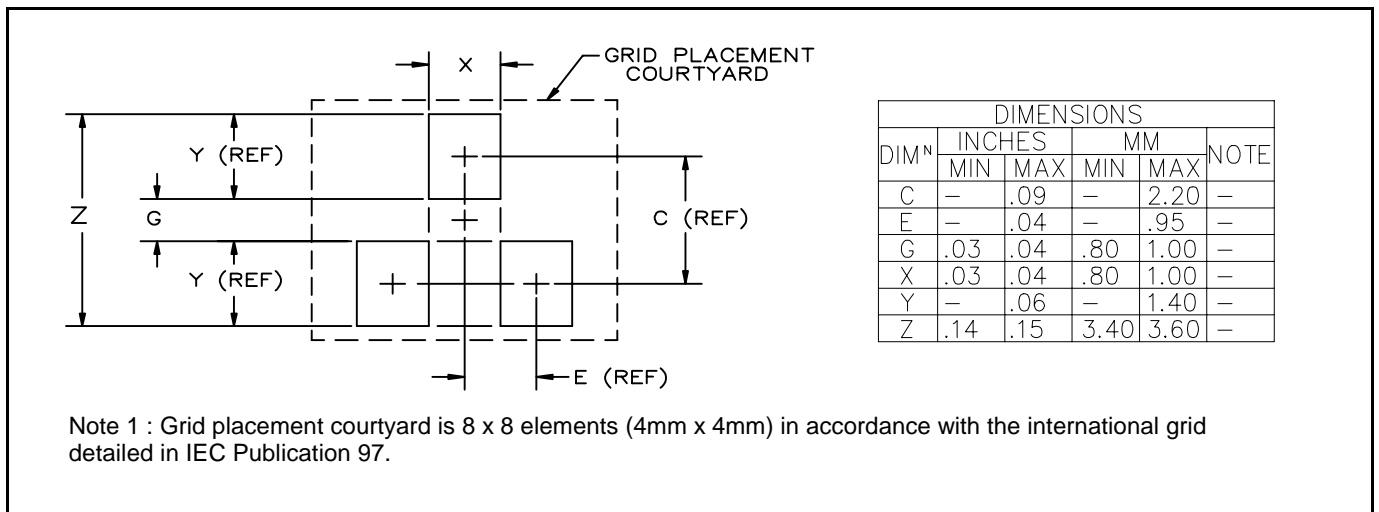
| T <sub>A</sub> = 25°C unless otherwise specified.             |                                 |                                                                         |                               | SC4040C (0.5%) |       |       | SC4040D (1.0%) |       |       |        |
|---------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------|-------------------------------|----------------|-------|-------|----------------|-------|-------|--------|
| Parameter                                                     | Symbol                          | Condition                                                               |                               | MIN            | TYP   | MAX   | MIN            | TYP   | MAX   | UNITS  |
| Reverse Breakdown Voltage                                     | V <sub>Z</sub>                  | I <sub>Z</sub> = 100µA                                                  | T <sub>A</sub> = 25°C         | 2.488          | 2.500 | 2.512 | 2.475          | 2.500 | 2.525 | V      |
|                                                               |                                 |                                                                         | T <sub>A</sub> = -40 to +85°C | 2.471          | 2.500 | 2.529 | 2.451          | 2.500 | 2.549 | V      |
| Minimum Operating Current                                     | I <sub>Z(min)</sub>             |                                                                         |                               |                | 60    | 80    |                | 60    | 80    | µA     |
| Reverse Breakdown Voltage Temperature Coefficient             | $\frac{\Delta V_Z}{\Delta T}$   | I <sub>Z</sub> = 10mA<br>I <sub>Z</sub> = 1mA<br>I <sub>Z</sub> = 100µA | T <sub>A</sub> = -40 to +85°C |                |       | ±100  |                |       | ±150  | ppm/°C |
| Ratio of Change in V <sub>Z</sub> to Change in I <sub>Z</sub> | $\frac{\Delta V_Z}{\Delta I_Z}$ | I <sub>Z(min)</sub> ≤ I <sub>Z</sub> ≤ 1mA                              | T <sub>A</sub> = 25°C         |                |       | 0.8   |                |       | 1.0   | mV     |
|                                                               |                                 |                                                                         | T <sub>A</sub> = -40 to +85°C |                |       | 1.0   |                |       | 1.2   | mV     |
|                                                               |                                 | 1mA ≤ I <sub>Z</sub> ≤ 12mA                                             | T <sub>A</sub> = 25°C         |                |       | 6.0   |                |       | 8.0   | mV     |
|                                                               |                                 |                                                                         | T <sub>A</sub> = -40 to +85°C |                |       | 8.0   |                |       | 10.0  | mV     |
| Reverse Dynamic Impedance                                     | Z <sub>R</sub>                  | I <sub>Z</sub> = 1mA, f = 120 Hz, I <sub>AC</sub> = 0.1 I <sub>Z</sub>  |                               |                | 0.25  | 0.9   |                | 0.25  | 1.1   | Ω      |
| Wideband Noise (RMS)                                          | e <sub>N</sub>                  | I <sub>Z</sub> = 100µA<br>10Hz ≤ f ≤ 10kHz                              |                               |                | 20    |       |                | 35    |       | µV     |
| Long Term Stability of Reverse Breakdown Voltage              | ΔV <sub>Z</sub>                 | t = 1000 hours<br>T = 25°C ± 0.1°C<br>I <sub>Z</sub> = 100µA            |                               |                | 120   |       |                | 120   |       | ppm    |

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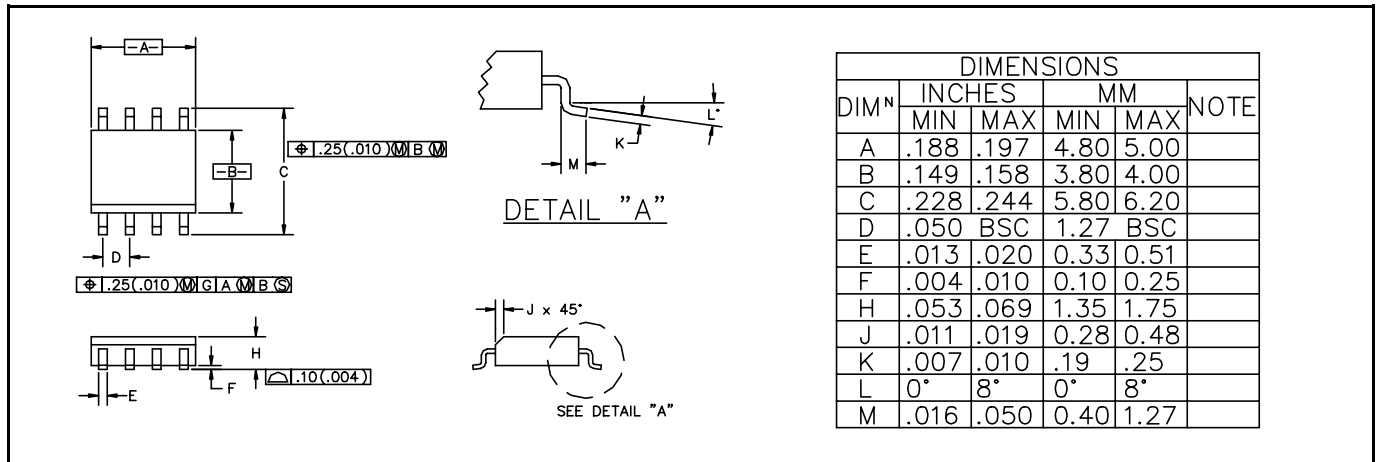
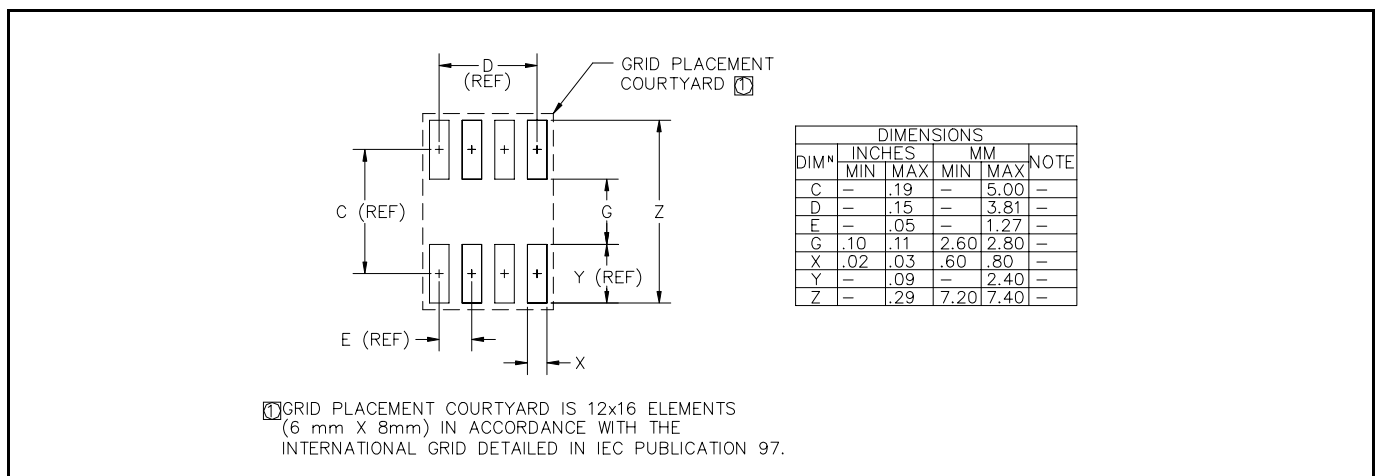
**ELECTRICAL CHARACTERISTICS**

| T <sub>A</sub> = 25°C unless otherwise specified.             |                                 |                                                                         |                               | SC4040E (2.0%) |       |       |        |
|---------------------------------------------------------------|---------------------------------|-------------------------------------------------------------------------|-------------------------------|----------------|-------|-------|--------|
| Parameter                                                     | Symbol                          | Condition                                                               |                               | MIN            | TYP   | MAX   | UNITS  |
| Reverse Breakdown Voltage                                     | V <sub>Z</sub>                  | I <sub>Z</sub> = 100μA                                                  | T <sub>A</sub> = 25°C         | 2.450          | 2.500 | 2.550 | V      |
|                                                               |                                 |                                                                         | T <sub>A</sub> = -40 to +85°C | 2.426          | 2.500 | 2.574 | V      |
| Minimum Operating Current                                     | I <sub>Z(min)</sub>             |                                                                         |                               |                | 60    | 80    | μA     |
| Reverse Breakdown Voltage Temperature Coefficient             | $\frac{\Delta V_Z}{\Delta T}$   | I <sub>Z</sub> = 10mA<br>I <sub>Z</sub> = 1mA<br>I <sub>Z</sub> = 100μA | T <sub>A</sub> = -40 to +85°C |                |       | ±150  | ppm/°C |
| Ratio of Change in V <sub>Z</sub> to Change in I <sub>Z</sub> | $\frac{\Delta V_Z}{\Delta I_Z}$ | I <sub>Z(min)</sub> ≤ I <sub>Z</sub> ≤ 1mA                              | T <sub>A</sub> = 25°C         |                |       | 1.0   | mV     |
|                                                               |                                 |                                                                         | T <sub>A</sub> = -40 to +85°C |                |       | 1.2   | mV     |
|                                                               |                                 | 1mA ≤ I <sub>Z</sub> ≤ 12mA                                             | T <sub>A</sub> = 25°C         |                |       | 8.0   | mV     |
|                                                               |                                 |                                                                         | T <sub>A</sub> = -40 to +85°C |                |       | 10.0  | mV     |
| Reverse Dynamic Impedance                                     | Z <sub>R</sub>                  | I <sub>Z</sub> = 1mA, f = 120 Hz, I <sub>AC</sub> = 0.1 I <sub>Z</sub>  |                               |                | 0.25  | 1.1   | Ω      |
| Wideband Noise (RMS)                                          | e <sub>N</sub>                  | I <sub>Z</sub> = 100μA<br>10Hz ≤ f ≤ 10kHz                              |                               |                | 35    |       | μV     |
| Long Term Stability of Reverse Breakdown Voltage              | ΔV <sub>Z</sub>                 | t = 1000 hours<br>T = 25°C ± 0.1°C<br>I <sub>Z</sub> = 100μA            |                               |                | 120   |       | ppm    |

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**OUTLINE DRAWING SOT-23**

**LAND PATTERN SOT-23**


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**OUTLINE DRAWING SO-8**

**LAND PATTERN SO-8**

**OUTLINE DRAWING TO-92**
