

## LM4040-N/-Q1 Precision Micropower Shunt Voltage Reference

### 1 Features

- LM4040-N-Q1 AEC Q-100 qualified for automotive applications
  - Extended Grade 1:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $T_A$
  - Industrial Grade 3:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $T_A$
- Small packages: SOT-23, TO-92, and SC70
- No output capacitor required
- Tolerates capacitive loads
- Fixed reverse breakdown voltages of 2.048V, 2.5V, 3V, 4.096V, 5V, 8.192V, and 10V
- Key specifications (2.5V LM4040-N)
  - Output voltage tolerance (A Grade,  $25^{\circ}\text{C}$ ):  $\pm 0.1\%$  (maximum)
  - Low output noise (10Hz to 10kHz):  $35\mu\text{V}_{\text{rms}}$  (typical)
  - Wide operating current range:  $60\mu\text{A}$  to  $15\text{mA}$
  - Industrial temperature range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
  - Extended temperature range:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
  - Low temperature coefficient:  $100\text{ppm}/^{\circ}\text{C}$  (maximum)

### 2 Applications

- [Field Transmitters](#)
- [Energy Infrastructure](#)
- [Data Acquisition](#)
- [Analog Input Module](#)
- [Automotive](#)
- [Audio and Video](#)

### 3 Description

Designed for space-critical applications, the LM4040-N precision voltage reference is available in small SC70 and SOT-23 surface-mount package. The advanced design of the LM4040-N eliminates the need for an external stabilizing capacitor while maintaining stability with any capacitive load, thus making the LM4040-N easy to use. Further reducing design effort is the availability of several fixed reverse breakdown voltages: 2.048V, 2.5V, 3V, 4.096V, 5V, 8.192V, and 10V. The minimum operating current increases from  $60\mu\text{A}$  for the 2.5V LM4040-N to  $100\mu\text{A}$  for the 10V LM4040-N. All versions have a maximum operating current of  $15\text{mA}$ .

The LM4040-N uses a fuse and Zener-zap reverse breakdown voltage trim during wafer sort to make sure that the prime parts have an accuracy of better than  $\pm 0.1\%$  (A grade) at  $25^{\circ}\text{C}$ . Bandgap reference temperature drift curvature correction and low dynamic impedance provide stable reverse breakdown voltage accuracy over a wide range of operating temperatures and currents.

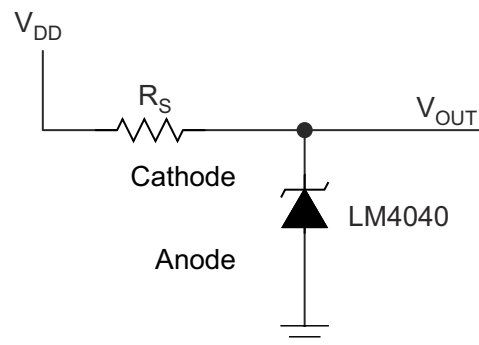
Also available is the LM4041-N with two reverse breakdown voltage versions: adjustable and 1.2V. See the LM4041-N data sheet ([SNOS641](#)).

#### Device Information

| PART NUMBER | PACKAGE <sup>(1)</sup> | BODY SIZE (NOM) <sup>(2)</sup> |
|-------------|------------------------|--------------------------------|
| LM4040-N    | TO-92 (3)              | 4.30mm × 4.30mm                |
|             | SC70 (5)               | 2.00mm × 1.25mm                |
|             | SOT-23 (3)             | 2.92mm × 1.30mm                |

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

(2) The package size (length × width) is a nominal value and includes pins, where applicable.



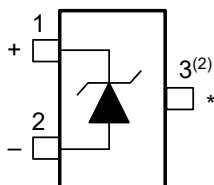
**Shunt Reference Application Schematic**



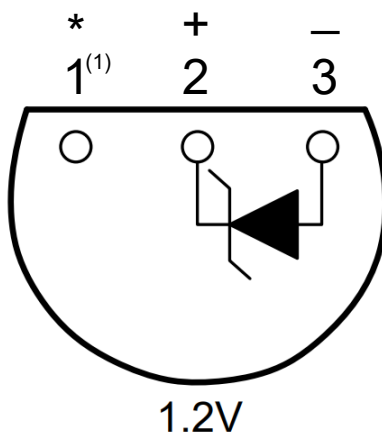
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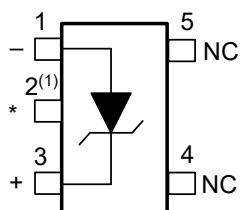
## 4 Pin Configuration and Functions



**Figure 4-1. DBZ Package  
3-Pin SOT-23  
Top View**



**Figure 4-2. LP Package  
3-Pin TO-92  
Bottom View**



**Figure 4-3. DCK Package  
5-Pin SC70  
Top View**

**Table 4-1. Pin Functions**

| NAME    | PIN              |                  |                  | I/O | DESCRIPTION                    |
|---------|------------------|------------------|------------------|-----|--------------------------------|
|         | SOT-23           | TO-92            | SC70             |     |                                |
| Anode   | 2                | 3                | 1                | O   | Anode pin, normally grounded   |
| Cathode | 1                | 2                | 3                | I/O | Shunt Current/Output Voltage   |
| *       | 3 <sup>(2)</sup> | 1 <sup>(1)</sup> | 2 <sup>(1)</sup> | —   | Must float or connect to anode |
| NC      | —                | —                | 4, 5             | —   | No connect                     |

- (1) This pin must be left floating or connected to pin 1. **In applications with high electromagnetic interference (for example, when placed near transformers or other electromagnetic sources) or significant high-frequency switching noise, TI recommends to connect this pin to the anode.**
- (2) This pin must be left floating or connected to pin 2. **In applications with high electromagnetic interference (for example, when placed near transformers or other electromagnetic sources) or significant high-frequency switching noise, TI recommends to connect this pin to the anode.**

## 5 Specifications

### 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1) (2)</sup>

|                                                               |                     | MIN | MAX | UNIT             |
|---------------------------------------------------------------|---------------------|-----|-----|------------------|
| Reverse current                                               |                     |     | 20  | mA               |
| Forward current                                               |                     |     | 10  | mA               |
| Power dissipation ( $T_A = 25^\circ\text{C}$ ) <sup>(3)</sup> | SOT-23 (M3) package |     | 306 | mW               |
|                                                               | TO-92 (Z) package   |     | 550 | mW               |
|                                                               | SC70 (M7) package   |     | 241 | mW               |
| Storage temperature, $T_{\text{stg}}$                         |                     | –65 | 150 | $^\circ\text{C}$ |

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* can cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under [Section 5.3](#). Exposure to absolute-maximum-rated conditions for extended periods can affect device reliability.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
- (3) The maximum power dissipation must be derated at elevated temperatures and is dictated by  $T_{\text{Jmax}}$  (maximum junction temperature),  $R_{\theta\text{JA}}$  (junction to ambient thermal resistance), and  $T_A$  (ambient temperature). The maximum allowable power dissipation at any temperature is  $\text{PD}_{\text{max}} = (T_{\text{Jmax}} - T_A)/R_{\theta\text{JA}}$  or the number given in the *Absolute Maximum Ratings*, whichever is lower. For the LM4040-N,  $T_{\text{Jmax}} = 125^\circ\text{C}$ , and the typical thermal resistance ( $R_{\theta\text{JA}}$ ), when board mounted, is  $326^\circ\text{C/W}$  for the SOT-23 package, and  $180^\circ\text{C/W}$  with 0.4" lead length and  $170^\circ\text{C/W}$  with 0.125" lead length for the TO-92 package and  $415^\circ\text{C/W}$  for the SC70 Package.

### 5.2 ESD Ratings

|                    |                         |                                                                                                     | VALUE | UNIT |
|--------------------|-------------------------|-----------------------------------------------------------------------------------------------------|-------|------|
| $V_{\text{(ESD)}}$ | Electrostatic discharge | Human-body model (HBM), per AEC Q100-002 <sup>(1)</sup> & per ANSI/ESDA/JEDEC JS-001 <sup>(2)</sup> | ±2000 | V    |
|                    |                         | Charged-device model (CDM), per AEC Q100-011, per JEDEC specification JESD22-C101 <sup>(3)</sup>    | ±750  |      |

- (1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.
- (2) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
- (3) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process

### 5.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)<sup>(1) (2)</sup>

|                                                      |                        | MIN                                     | MAX | UNIT                |
|------------------------------------------------------|------------------------|-----------------------------------------|-----|---------------------|
| Temperature<br>( $T_{\min} \leq T_A \leq T_{\max}$ ) | Industrial Temperature | $-40^{\circ}\text{C} \leq T_A \leq 85$  |     | $^{\circ}\text{C}$  |
|                                                      | Extended Temperature   | $-40 \leq T_A \leq 125^{\circ}\text{C}$ |     | $^{\circ}\text{C}$  |
| Reverse Current                                      | LM4040-N-2.0           | 60                                      | 15  | $\mu\text{A}$ to mA |
|                                                      | LM4040-N-2.5           | 60                                      | 15  | $\mu\text{A}$ to mA |
|                                                      | LM4040-N-3.0           | 62                                      | 15  | $\mu\text{A}$ to mA |
|                                                      | LM4040-N-4.1           | 68                                      | 15  | $\mu\text{A}$ to mA |
|                                                      | LM4040-N-5.0           | 74                                      | 15  | $\mu\text{A}$ to mA |
|                                                      | LM4040-N-8.2           | 91                                      | 15  | $\mu\text{A}$ to mA |
|                                                      | LM4040-N-10.0          | 100                                     | 15  | $\mu\text{A}$ to mA |

- (1) *Absolute Maximum Ratings* indicate limits beyond which damage to the device can occur. *Recommended Operating Conditions* indicate conditions for which the device is functional, but do not maintain specific performance limits. For verified specifications and test conditions, see the *Electrical Characteristics*. The verified specifications apply only for the test conditions listed. Some performance characteristics can degrade when the device is not operated under the listed test conditions.
- (2) The maximum power dissipation must be derated at elevated temperatures and is dictated by  $T_{J\max}$  (maximum junction temperature),  $R_{\theta JA}$  (junction to ambient thermal resistance), and  $T_A$  (ambient temperature). The maximum allowable power dissipation at any temperature is  $PD_{\max} = (T_{J\max} - T_A)/R_{\theta JA}$  or the number given in the Absolute Maximum Ratings, whichever is lower. For the LM4040-N,  $T_{J\max} = 125^{\circ}\text{C}$ , and the typical thermal resistance ( $R_{\theta JA}$ ), when board mounted, is  $326^{\circ}\text{C/W}$  for the SOT-23 package, and  $180^{\circ}\text{C/W}$  with 0.4" lead length and  $170^{\circ}\text{C/W}$  with 0.125" lead length for the TO-92 package and  $415^{\circ}\text{C/W}$  for the SC70 package.

### 5.4 Thermal Information

| THERMAL METRIC <sup>(1)</sup> |                                              | LM4040-N     |            |            | UNIT                 |
|-------------------------------|----------------------------------------------|--------------|------------|------------|----------------------|
|                               |                                              | DBZ (SOT-23) | LP (TO-92) | DCK (SC70) |                      |
|                               |                                              | 3 PINS       | 3 PINS     | 5 PINS     |                      |
| $R_{\theta JA}$               | Junction-to-ambient thermal resistance       | 291.9        | 166        | 267        | $^{\circ}\text{C/W}$ |
| $R_{\theta JC(\text{top})}$   | Junction-to-case (top) thermal resistance    | 114.3        | 88.2       | 95.6       | $^{\circ}\text{C/W}$ |
| $R_{\theta JB}$               | Junction-to-board thermal resistance         | 62.3         | 145.2      | 48.1       | $^{\circ}\text{C/W}$ |
| $\psi_{JT}$                   | Junction-to-top characterization parameter   | 7.4          | 32.5       | 2.4        | $^{\circ}\text{C/W}$ |
| $\psi_{JB}$                   | Junction-to-board characterization parameter | 61           | N/A        | 47.3       | $^{\circ}\text{C/W}$ |
| $R_{\theta JC(\text{bot})}$   | Junction-to-case (bottom) thermal resistance | N/A          | N/A        | N/A        | $^{\circ}\text{C/W}$ |

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report (SPRA953).

## 5.5 Electrical Characteristics: 2V LM4040-N $V_R$ Tolerance Grades 'A' And 'B'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades A and B designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.1\%$  and  $\pm 0.2\%$ , respectively.

| PARAMETER                 |                                                                                      | TEST CONDITIONS                                                                                |                                                  | MIN <sup>(1)</sup>                               | TYP      | MAX <sup>(1)</sup> | UNIT                       |
|---------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------|----------|--------------------|----------------------------|
| $V_R$                     | Reverse Breakdown Voltage                                                            | $I_R = 100\mu\text{A}$                                                                         |                                                  |                                                  | 2.048    |                    | V                          |
|                           | Reverse Breakdown Voltage Tolerance <sup>(2)</sup>                                   | $I_R = 100\mu\text{A}$                                                                         | LM4040AIM3<br>LM4040AIZ                          |                                                  |          | $\pm 2$            | mV                         |
|                           |                                                                                      |                                                                                                | LM4040BIM3<br>LM4040BIZ<br>LM4040BIM7            |                                                  |          | $\pm 4.1$          |                            |
|                           |                                                                                      |                                                                                                | LM4040AIM3<br>LM4040AIZ                          | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | $\pm 15$           | mV                         |
|                           |                                                                                      |                                                                                                | LM4040BIM3<br>LM4040BIZ<br>LM4040BIM7            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | $\pm 17$           |                            |
| $I_{\text{RMIN}}$         | Minimum Operating Current                                                            |                                                                                                | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 45       | 60                 | $\mu\text{A}$              |
|                           |                                                                                      |                                                                                                | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |          | 65                 |                            |
| $\Delta V_R / \Delta T$   | Average Reverse Breakdown Voltage Change with Temperature Coefficient <sup>(2)</sup> | $I_R = 10\text{mA}$                                                                            |                                                  |                                                  | $\pm 20$ |                    | ppm/ $^\circ\text{C}$      |
|                           |                                                                                      | $I_R = 1\text{mA}$                                                                             | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | $\pm 15$ |                    | ppm/ $^\circ\text{C}$      |
|                           |                                                                                      |                                                                                                | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |          | $\pm 100$          |                            |
|                           |                                                                                      | $I_R = 100\mu\text{A}$                                                                         |                                                  |                                                  | $\pm 15$ |                    | ppm/ $^\circ\text{C}$      |
| $\Delta V_R / \Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(3)</sup>        | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                     | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 0.3      | 0.8                | mV                         |
|                           |                                                                                      |                                                                                                | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |          | 1                  |                            |
|                           |                                                                                      | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                         | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 2.5      | 6                  | mV                         |
|                           |                                                                                      |                                                                                                | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |          | 8                  |                            |
| $Z_R$                     | Reverse Dynamic Impedance                                                            | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                         |                                                  |                                                  | 0.3      | 0.8                | $\Omega$                   |
| $e_N$                     | Wideband Noise                                                                       | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                               |                                                  |                                                  | 35       |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$              | Reverse Breakdown Voltage Long Term Stability                                        | $t = 1000\text{hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                                                  |                                                  | 120      |                    | ppm                        |
| $V_{\text{HYST}}$         | Thermal Hysteresis <sup>(4)</sup>                                                    | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                          |                                                  |                                                  | 0.08%    |                    |                            |

- (1) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- (2) The overtemperature limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R / \Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:  
A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:  
C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{mV}$ .
- (3) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (4) Thermal hysteresis is defined as the difference in voltage measured at  $25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.6 Electrical Characteristics: 2V LM4040-N $V_R$ Tolerance Grades 'C', 'D', And 'E'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$ ,  $\pm 1\%$  and  $\pm 2\%$ , respectively.

| PARAMETER               |                                                                               | TEST CONDITIONS                                                  |                                       | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|-------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------|---------------------------------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                   | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                           |                                       |                                                  | 2.048              |                    | V                          |
|                         | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                           | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 10$           | mV                         |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 23$           |                            |
|                         |                                                                               |                                                                  | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 20$           |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 40$           |                            |
|                         |                                                                               |                                                                  | LM4040EIZ<br>LM4040EIM7               | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 41$           |                            |
| $I_{R\text{MIN}}$       | Minimum Operating Current                                                     |                                                                  | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 45                 | 60                 | $\mu\text{A}$              |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 65                 |                            |
|                         |                                                                               |                                                                  | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 45                 | 65                 |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 70                 |                            |
|                         |                                                                               |                                                                  | LM4040EIZ<br>LM4040EIM7               | $T_A = T_J = 25^\circ\text{C}$                   | 45                 | 65                 |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 70                 |                            |
| $\Delta V_R/\Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                              |                                       |                                                  | $\pm 20$           |                    | ppm/ $^\circ\text{C}$      |
|                         |                                                                               | $I_R = 1\text{mA}$                                               | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                         |                                                                               |                                                                  | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
|                         |                                                                               | $I_R = 100\mu\text{A}$                                           |                                       |                                                  | $\pm 15$           |                    |                            |
| $\Delta V_R/\Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{R\text{MIN}} \leq I_R \leq 1\text{mA}$                       | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 0.3                | 0.8                | mV                         |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1                  |                            |
|                         |                                                                               |                                                                  | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 0.3                | 1                  |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.2                |                            |
|                         |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                           | LM4040EIZ<br>LM4040EIM7               | $T_A = T_J = 25^\circ\text{C}$                   | 0.3                | 1                  |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.2                |                            |
|                         |                                                                               |                                                                  | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 2.5                | 6                  |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 8                  |                            |
|                         |                                                                               |                                                                  | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 2.5                | 8                  |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 10                 |                            |
|                         |                                                                               |                                                                  | LM4040EIZ<br>LM4040EIM7               | $T_A = T_J = 25^\circ\text{C}$                   | 2.5                | 8                  |                            |
|                         |                                                                               |                                                                  |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 10                 |                            |
| $Z_R$                   | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$<br>$I_{AC} = 0.1 I_R$    | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 |                                                  | 0.3                | 0.9                | $\Omega$                   |
|                         |                                                                               |                                                                  | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 |                                                  | 0.3                | 1.1                |                            |
|                         |                                                                               |                                                                  | LM4040EIZ<br>LM4040EIM7               |                                                  | 0.3                | 1.1                |                            |
| $e_N$                   | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$ |                                       |                                                  | 35                 |                    | $\mu\text{V}_{\text{rms}}$ |



## 5.6 Electrical Characteristics: 2V LM4040-N $V_R$ Tolerance Grades 'C', 'D', And 'E'; Temperature Grade 'I' (continued)

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$ ,  $\pm 1\%$  and  $\pm 2\%$ , respectively.

| PARAMETER                                                  | TEST CONDITIONS                                                                                  | MIN <sup>(2)</sup> | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT |
|------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|------|
| $\Delta V_R$ Reverse Breakdown Voltage Long Term Stability | $t = 1000 \text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                    | 120                |                    | ppm  |
| $V_{\text{HYST}}$ Thermal Hysteresis <sup>(5)</sup>        | $\Delta T = -40^\circ\text{C} \text{ to } 125^\circ\text{C}$                                     |                    | 0.08%              |                    |      |

- (1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.
- (2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- (3) The overtemperature limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R/\Delta T)(\max\Delta T)(V_R)]$ . Where,  $\Delta V_R/\Delta T$  is the  $V_R$  temperature coefficient,  $\max\Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max\Delta T = 65^\circ\text{C}$  is shown below:  
 A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 The total overtemperature tolerance for the different grades in the extended temperature range where  $\max\Delta T = 100^\circ\text{C}$  is shown below:  
 C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19 \text{ mV}$ .
- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at  $25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.7 Electrical Characteristics: 2V LM4040-N $V_R$ Tolerance Grades 'C', 'D', And 'E'; Temperature Grade 'E'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$ ,  $\pm 1\%$  and  $\pm 2\%$ , respectively.

| PARAMETER               |                                                                               | TEST CONDITIONS                                                                                  |            | MIN <sup>(2)</sup>                                      | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|-------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------|---------------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                   | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                           |            |                                                         | 2.048              |                    | V                          |
|                         | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                                                           | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 10$           | mV                         |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 30$           |                            |
|                         |                                                                               |                                                                                                  | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 20$           |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 50$           |                            |
|                         |                                                                               |                                                                                                  | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 41$           |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 70$           |                            |
| $I_{\text{RMIN}}$       | Minimum Operating Current                                                     |                                                                                                  | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | 45                 | $\mu\text{A}$              |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 60                 |                            |
|                         |                                                                               |                                                                                                  | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | 45                 |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 65                 |                            |
|                         |                                                                               |                                                                                                  | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | 45                 |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 73                 |                            |
| $\Delta V_R/\Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                              |            |                                                         |                    | $\pm 20$           | ppm/ $^\circ\text{C}$      |
|                         |                                                                               | $I_R = 1\text{mA}$                                                                               | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 15$           |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                         |                                                                               |                                                                                                  | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 15$           |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
|                         |                                                                               |                                                                                                  | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 15$           |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
|                         |                                                                               | $I_R = 100\mu\text{A}$                                                                           |            |                                                         |                    | $\pm 15$           |                            |
| $\Delta V_R/\Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                       | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | 0.3                | mV                         |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 0.8                |                            |
|                         |                                                                               |                                                                                                  | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | 0.3                |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 1                  |                            |
|                         |                                                                               |                                                                                                  | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | 0.3                |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 1.2                |                            |
|                         |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                           | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | 2.5                |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 6                  |                            |
|                         |                                                                               |                                                                                                  | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | 8                  |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 10                 |                            |
|                         |                                                                               |                                                                                                  | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                          |                    | 8                  |                            |
|                         |                                                                               |                                                                                                  |            | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 10                 |                            |
| $Z_R$                   | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                           | LM4040CEM3 |                                                         | 0.3                | 0.9                | $\Omega$                   |
|                         |                                                                               |                                                                                                  | LM4040DEM3 |                                                         | 0.3                | 1.1                |                            |
|                         |                                                                               |                                                                                                  | LM4040EEM3 |                                                         | 0.3                | 1.1                |                            |
| $e_N$                   | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                 |            |                                                         | 35                 |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$            | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000 \text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |            |                                                         | 120                |                    | ppm                        |
| $V_{\text{HYST}}$       | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C} \text{ to } 125^\circ\text{C}$                                     |            |                                                         | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

- (3) The overtemperature limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R/\Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R/\Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of 25°C to  $T_{MIN}$  or  $T_{MAX}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:
- A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$
- The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:
- C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$
- Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .
- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at 25°C after cycling to temperature  $-40^\circ\text{C}$  and the 25°C measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.8 Electrical Characteristics: 2.5V LM4040-N $V_R$ Tolerance Grades 'A' And 'B'; Temperature Grade 'I' (AEC Grade 3)

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades A and B designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.1\%$  and  $\pm 0.2\%$ , respectively.

| PARAMETER                 |                                                                               | TEST CONDITIONS                                                                                 |                                                  | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|---------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                     | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                          |                                                  |                                                  | 2.5                |                    | V                          |
|                           | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                                                          | LM4040AIM3<br>LM4040AIZ                          | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 2.5$          | mV                         |
|                           |                                                                               |                                                                                                 | LM4040AIM3                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 19$           |                            |
|                           |                                                                               |                                                                                                 | LM4040BIM3<br>LM4040BIZ                          | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 5$            |                            |
|                           |                                                                               |                                                                                                 | LM4040BIM7<br>LM4040QBIM3                        | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 21$           |                            |
| $I_{\text{RMIN}}$         | Minimum Operating Current                                                     |                                                                                                 | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 45                 | 60                 | $\mu\text{A}$              |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 65                 |                            |
| $\Delta V_R / \Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | $\pm 20$           |                    | ppm/ $^\circ\text{C}$      |
|                           |                                                                               | $I_R = 1\text{mA}$                                                                              | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | $\pm 15$           |                    |                            |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | $\pm 100$          |                            |
|                           |                                                                               | $I_R = 100\mu\text{A}$                                                                          |                                                  |                                                  | $\pm 15$           |                    |                            |
| $\Delta V_R / \Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                      | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 0.3                | 0.8                | mV                         |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 1                  |                            |
|                           |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 2.5                | 6                  |                            |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 8                  |                            |
| $Z_R$                     | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                          |                                                  |                                                  | 0.3                | 0.8                | $\Omega$                   |
| $e_N$                     | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |                                                  |                                                  | 35                 |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$              | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                                                  |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYS}}$          | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |                                                  |                                                  | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The overtemperature limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R / \Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:

A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:

C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .

(4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

(5) Thermal hysteresis is defined as the difference in voltage measured at  $25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.9 Electrical Characteristics: 2.5V LM4040-N $V_R$ Tolerance Grades 'C', 'D', and 'E'; Temperature Grade 'I' (AEC Grade 3)

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$ ,  $\pm 1\%$  and  $\pm 2\%$ , respectively.

| PARAMETER             |                                                                          | TEST CONDITIONS        |                                                      | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                  |
|-----------------------|--------------------------------------------------------------------------|------------------------|------------------------------------------------------|--------------------------------------------------|--------------------|--------------------|-----------------------|
| $V_R$                 | Reverse Breakdown Voltage                                                | $I_R = 100\mu\text{A}$ |                                                      |                                                  | 2.5                |                    | V                     |
|                       | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                       | $I_R = 100\mu\text{A}$ | LM4040CIZ<br>LM4040CIM3<br>LM4040CIM7<br>LM4040QCIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 12$           | mV                    |
|                       |                                                                          |                        |                                                      | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 29$           |                       |
|                       |                                                                          |                        | LM4040DIZ<br>LM4040DIM3<br>LM4040DIM7<br>LM4040QDIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 25$           |                       |
|                       |                                                                          |                        |                                                      | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 49$           |                       |
|                       |                                                                          |                        | LM4040EIZ<br>LM4040EIM3<br>LM4040EIM7<br>LM4040QEIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 50$           |                       |
|                       |                                                                          |                        |                                                      | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 74$           |                       |
| $I_{\text{RMIN}}$     | Minimum Operating Current                                                |                        | LM4040CIZ<br>LM4040CIM3<br>LM4040CIM7<br>LM4040QCIM3 | $T_A = T_J = 25^\circ\text{C}$                   | 45                 | 60                 | $\mu\text{A}$         |
|                       |                                                                          |                        |                                                      | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 65                 |                       |
|                       |                                                                          |                        | LM4040DIZ<br>LM4040DIM3<br>LM4040DIM7<br>LM4040QDIM3 | $T_A = T_J = 25^\circ\text{C}$                   | 45                 | 65                 |                       |
|                       |                                                                          |                        |                                                      | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 70                 |                       |
|                       |                                                                          |                        | LM4040EIZ<br>LM4040EIM3<br>LM4040EIM7<br>LM4040QEIM3 | $T_A = T_J = 25^\circ\text{C}$                   | 45                 | 65                 |                       |
|                       |                                                                          |                        |                                                      | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 70                 |                       |
| $\Delta V_R/\Delta T$ | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup> | $I_R = 10\text{mA}$    |                                                      |                                                  |                    | $\pm 20$           | ppm/ $^\circ\text{C}$ |
|                       |                                                                          | $I_R = 1\text{mA}$     | LM4040CIZ<br>LM4040CIM3<br>LM4040CIM7<br>LM4040QCIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 15$           |                       |
|                       |                                                                          |                        |                                                      | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 100$          |                       |
|                       |                                                                          |                        | LM4040DIZ<br>LM4040DIM3<br>LM4040DIM7<br>LM4040QDIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 15$           |                       |
|                       |                                                                          |                        |                                                      | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                       |
|                       |                                                                          |                        | LM4040EIZ<br>LM4040EIM3<br>LM4040EIM7<br>LM4040QEIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 15$           |                       |
|                       |                                                                          |                        |                                                      | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                       |
|                       |                                                                          | $I_R = 100\mu\text{A}$ |                                                      |                                                  |                    | $\pm 15$           |                       |

## 5.9 Electrical Characteristics: 2.5V LM4040-N $V_R$ Tolerance Grades 'C', 'D', and 'E'; Temperature Grade 'I' (AEC Grade 3) (continued)

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$ ,  $\pm 1\%$  and  $\pm 2\%$ , respectively.

| PARAMETER                                                                                               | TEST CONDITIONS                                                                                 |                                                      | MIN <sup>(2)</sup>                        | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                |
|---------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------|--------------------|--------------------|---------------------|
| $\Delta V_R / \Delta I_R$ Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{RMIN} \leq I_R \leq 1\text{mA}$                                                             | LM4040CIZ<br>LM4040CIM3<br>LM4040CIM7<br>LM4040QCIM3 | $T_A = T_J = 25^\circ\text{C}$            | 0.3                | 0.8                | mV                  |
|                                                                                                         |                                                                                                 |                                                      | $T_A = T_J = T_{MIN} \text{ to } T_{MAX}$ |                    | 1                  |                     |
|                                                                                                         |                                                                                                 | LM4040DIZ<br>LM4040DIM3<br>LM4040DIM7<br>LM4040QDIM3 | $T_A = T_J = 25^\circ\text{C}$            | 0.3                | 1                  |                     |
|                                                                                                         |                                                                                                 |                                                      | $T_A = T_J = T_{MIN} \text{ to } T_{MAX}$ |                    | 1.2                |                     |
|                                                                                                         |                                                                                                 | LM4040EIZ<br>LM4040EIM3<br>LM4040EIM7<br>LM4040QEIM3 | $T_A = T_J = 25^\circ\text{C}$            | 0.3                | 1                  |                     |
|                                                                                                         |                                                                                                 |                                                      | $T_A = T_J = T_{MIN} \text{ to } T_{MAX}$ |                    | 1.2                |                     |
|                                                                                                         | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | LM4040CIZ<br>LM4040CIM3<br>LM4040CIM7<br>LM4040QCIM3 | $T_A = T_J = 25^\circ\text{C}$            | 2.5                | 6                  |                     |
|                                                                                                         |                                                                                                 |                                                      | $T_A = T_J = T_{MIN} \text{ to } T_{MAX}$ |                    | 8                  |                     |
|                                                                                                         |                                                                                                 | LM4040DIZ<br>LM4040DIM3<br>LM4040DIM7<br>LM4040QDIM3 | $T_A = T_J = 25^\circ\text{C}$            | 2.5                | 8                  |                     |
|                                                                                                         |                                                                                                 |                                                      | $T_A = T_J = T_{MIN} \text{ to } T_{MAX}$ |                    | 10                 |                     |
|                                                                                                         |                                                                                                 | LM4040EIZ<br>LM4040EIM3<br>LM4040EIM7<br>LM4040QEIM3 | $T_A = T_J = 25^\circ\text{C}$            | 2.5                | 8                  |                     |
|                                                                                                         |                                                                                                 |                                                      | $T_A = T_J = T_{MIN} \text{ to } T_{MAX}$ |                    | 10                 |                     |
| $Z_R$ Reverse Dynamic Impedance                                                                         | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$<br>$I_{AC} = 0.1 I_R$                                   | LM4040CIZ<br>LM4040CIM3<br>LM4040CIM7<br>LM4040QCIM3 |                                           | 0.3                | 0.9                | $\Omega$            |
|                                                                                                         |                                                                                                 | LM4040DIZ<br>LM4040DIM3<br>LM4040DIM7<br>LM4040QDIM3 |                                           | 0.3                | 1.1                |                     |
|                                                                                                         |                                                                                                 | LM4040EIZ<br>LM4040EIM3<br>LM4040EIM7<br>LM4040QEIM3 |                                           | 0.3                | 1.1                |                     |
| $e_N$ Wideband Noise                                                                                    | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |                                                      |                                           | 35                 |                    | $\mu\text{V}_{rms}$ |
| $\Delta V_R$ Reverse Breakdown Voltage Long Term Stability                                              | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                                                      |                                           | 120                |                    | ppm                 |
| $V_{HYST}$ Thermal Hysteresis <sup>(5)</sup>                                                            | $\Delta T = -40^\circ\text{C} \text{ to } 125^\circ\text{C}$                                    |                                                      |                                           | 0.08%              |                    |                     |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The overtemperature limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R / \Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{MIN}$  or  $T_{MAX}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:

A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:

C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .

- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at 25°C after cycling to temperature –40°C and the 25°C measurement after cycling to temperature 125°C.

## 5.10 Electrical Characteristics: 2.5V LM4040-N $V_R$ Tolerance Grades 'C', 'D', And 'E'; Temperature Grade 'E' (AEC Grade 1)

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$ ,  $\pm 1\%$  and  $\pm 2\%$ , respectively.

| PARAMETER               |                                                                               | TEST CONDITIONS                                                                                 |                           | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|-------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                   | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                          |                           |                                                  | 2.5                |                    | V                          |
|                         | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                                                          | LM4040CEM3<br>LM4040QCEM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 12$           | mV                         |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 38$           |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3<br>LM4040QDEM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 25$           |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 63$           |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3<br>LM4040QEEM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 50$           |                            |
| $I_{R\text{MIN}}$       | Minimum Operating Current                                                     |                                                                                                 | LM4040CEM3<br>LM4040QCEM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | 45                 | $\mu\text{A}$              |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 60                 |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3<br>LM4040QDEM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | 45                 |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 65                 |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3<br>LM4040QEEM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | 45                 |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 73                 |                            |
| $\Delta V_R/\Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             |                           |                                                  | $\pm 20$           |                    | ppm/ $^\circ\text{C}$      |
|                         |                                                                               | $I_R = 1\text{mA}$                                                                              | LM4040CEM3<br>LM4040QCEM3 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3<br>LM4040QDEM3 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3<br>LM4040QEEM3 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 15$           |                    |                            |
| $\Delta V_R/\Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{R\text{MIN}} \leq I_R \leq 1\text{mA}$                                                      | LM4040CEM3<br>LM4040QCEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.3                | 0.8                | mV                         |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1                  |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3<br>LM4040QDEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.3                | 1                  |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.2                |                            |
|                         |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | LM4040EEM3<br>LM4040QEEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.3                | 1                  |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.2                |                            |
|                         |                                                                               |                                                                                                 | LM4040CEM3<br>LM4040QCEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 2.5                | 6                  |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 8                  |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3<br>LM4040QDEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 2.5                | 8                  |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 10                 |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3<br>LM4040QEEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 2.5                | 8                  |                            |
|                         |                                                                               |                                                                                                 |                           | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 10                 |                            |
| $Z_R$                   | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{AC} = 0.1 I_R$                                 | LM4040CEM3<br>LM4040QCEM3 |                                                  | 0.3                | 0.9                | $\Omega$                   |
|                         |                                                                               |                                                                                                 | LM4040DEM3<br>LM4040QDEM3 |                                                  | 0.3                | 1.1                |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3<br>LM4040QEEM3 |                                                  | 0.3                | 1.1                |                            |
| $e_N$                   | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |                           |                                                  | 35                 |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$            | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                           |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYS}}$        | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |                           |                                                  | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.



- (2) Limits are 100% production tested at 25°C. Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- (3) The overtemperature limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R/\Delta T)(\max\Delta T)(V_R)]$ . Where,  $\Delta V_R/\Delta T$  is the  $V_R$  temperature coefficient,  $\max\Delta T$  is the maximum difference in temperature from the reference point of 25°C to  $T_{MIN}$  or  $T_{MAX}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max\Delta T = 65^\circ\text{C}$  is shown below:  
 A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 The total overtemperature tolerance for the different grades in the extended temperature range where  $\max\Delta T = 100^\circ\text{C}$  is shown below:  
 C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .
- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at +25°C after cycling to temperature -40°C and the 25°C measurement after cycling to temperature 125°C.

## 5.11 Electrical Characteristics: 3V LM4040-N $V_R$ Tolerance Grades 'A' And 'B'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades A and B designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.1\%$  and  $\pm 0.2\%$ , respectively.

| PARAMETER                 |                                                                               | TEST CONDITIONS                                                                                  |                                       | MIN <sup>(2)</sup>                                      | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|---------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                     | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                           |                                       |                                                         | 3                  |                    | V                          |
|                           | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                                                           | LM4040AIM3<br>LM4040AIZ               | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 3$            | mV                         |
|                           |                                                                               |                                                                                                  |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 22$           |                            |
|                           |                                                                               |                                                                                                  | LM4040BIM3<br>LM4040BIZ<br>LM4040BIM7 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 6$            |                            |
| $I_{\text{RMIN}}$         | Minimum Operating Current                                                     |                                                                                                  |                                       | $T_A = T_J = 25^\circ\text{C}$                          | 47                 | 62                 | $\mu\text{A}$              |
|                           |                                                                               |                                                                                                  |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 67                 |                            |
| $\Delta V_R / \Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                              |                                       |                                                         | $\pm 20$           |                    | ppm/ $^\circ\text{C}$      |
|                           |                                                                               | $I_R = 1\text{mA}$                                                                               |                                       | $T_A = T_J = 25^\circ\text{C}$                          | $\pm 15$           |                    |                            |
|                           |                                                                               |                                                                                                  |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                           |                                                                               | $I_R = 100\mu\text{A}$                                                                           |                                       |                                                         | $\pm 15$           |                    |                            |
| $\Delta V_R / \Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                       |                                       | $T_A = T_J = 25^\circ\text{C}$                          | 0.6                | 0.8                | mV                         |
|                           |                                                                               |                                                                                                  |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 1.1                |                            |
|                           |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                           |                                       | $T_A = T_J = 25^\circ\text{C}$                          | 2.7                | 6                  |                            |
|                           |                                                                               |                                                                                                  |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 9                  |                            |
| $Z_R$                     | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                           |                                       |                                                         | 0.4                | 0.9                | $\Omega$                   |
| $e_N$                     | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                 |                                       |                                                         | 35                 |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$              | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000 \text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                                       |                                                         | 120                |                    | ppm                        |
| $V_{\text{HYST}}$         | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C} \text{ to } 125^\circ\text{C}$                                     |                                       |                                                         | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The overtemperature limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R / \Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:

A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:

C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19 \text{ mV}$ .

(4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

(5) Thermal hysteresis is defined as the difference in voltage measured at  $+25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.12 Electrical Characteristics: 3V LM4040-N $V_R$ Tolerance Grades 'C', 'D', And 'E'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$ ,  $\pm 1\%$  and  $\pm 2\%$ , respectively.

| PARAMETER               |                                                                               | TEST CONDITIONS                                                      |                                       | MIN <sup>(2)</sup>                                      | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|-------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                   | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                               |                                       |                                                         | 3                  |                    | V                          |
|                         | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                               | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 15$           | mV                         |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 34$           |                            |
|                         |                                                                               |                                                                      | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 30$           |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 59$           |                            |
|                         |                                                                               |                                                                      | LM4040EIM7<br>LM4040EIZ               | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 60$           |                            |
| $I_{\text{RMIN}}$       | Minimum Operating Current                                                     |                                                                      | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                          | 45                 | 60                 | $\mu\text{A}$              |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 65                 |                            |
|                         |                                                                               |                                                                      | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                          | 45                 | 65                 |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 70                 |                            |
|                         |                                                                               |                                                                      | LM4040EIM7<br>LM4040EIZ               | $T_A = T_J = 25^\circ\text{C}$                          | 45                 | 65                 |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 70                 |                            |
| $\Delta V_R/\Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                  |                                       |                                                         | $\pm 20$           |                    | ppm/ $^\circ\text{C}$      |
|                         |                                                                               | $I_R = 1\text{mA}$                                                   | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                          | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                         |                                                                               |                                                                      | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                          | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
|                         |                                                                               |                                                                      | LM4040EIM7<br>LM4040EIZ               | $T_A = T_J = 25^\circ\text{C}$                          | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
| $\Delta V_R/\Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_R = 100\mu\text{A}$                                               |                                       |                                                         | $\pm 15$           |                    | mV                         |
|                         |                                                                               | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                           | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                          | 0.4                | 0.8                |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 1.1                |                            |
|                         |                                                                               |                                                                      | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                          | 0.4                | 1.1                |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 1.3                |                            |
|                         |                                                                               |                                                                      | LM4040EIM7<br>LM4040EIZ               | $T_A = T_J = 25^\circ\text{C}$                          | 0.4                | 1.1                |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 1.3                |                            |
|                         |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                               | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                          | 2.7                | 6                  |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 9                  |                            |
|                         |                                                                               |                                                                      | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                          | 2.7                | 8                  |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 11                 |                            |
|                         |                                                                               |                                                                      | LM4040EIM7<br>LM4040EIZ               | $T_A = T_J = 25^\circ\text{C}$                          | 2.7                | 8                  |                            |
|                         |                                                                               |                                                                      |                                       | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | 11                 |                            |
| $Z_R$                   | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$<br>$I_{\text{AC}} = 0.1 I_R$ | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 |                                                         | 0.4                | 0.9                | $\Omega$                   |
|                         |                                                                               |                                                                      | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 |                                                         | 0.4                | 1.2                |                            |
|                         |                                                                               |                                                                      | LM4040EIM7<br>LM4040EIZ               |                                                         | 0.4                | 1.2                |                            |
|                         |                                                                               |                                                                      |                                       |                                                         |                    |                    |                            |
| $e_N$                   | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$     |                                       |                                                         | 35                 |                    | $\mu\text{V}_{\text{rms}}$ |

## 5.12 Electrical Characteristics: 3V LM4040-N $V_R$ Tolerance Grades 'C', 'D', And 'E'; Temperature Grade 'I' (continued)

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$ ,  $\pm 1\%$  and  $\pm 2\%$ , respectively.

| PARAMETER                                                  | TEST CONDITIONS                                                                                  | MIN <sup>(2)</sup> | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT |
|------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|------|
| $\Delta V_R$ Reverse Breakdown Voltage Long Term Stability | $t = 1000 \text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                    | 120                |                    | ppm  |
| $V_{\text{HYST}}$ Thermal Hysteresis <sup>(5)</sup>        | $\Delta T = -40^\circ\text{C} \text{ to } 125^\circ\text{C}$                                     |                    | 0.08%              |                    |      |

- (1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.
- (2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- (3) The overtemperature limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R/\Delta T)(\max\Delta T)(V_R)]$ . Where,  $\Delta V_R/\Delta T$  is the  $V_R$  temperature coefficient,  $\max\Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max\Delta T = 65^\circ\text{C}$  is shown below:  
 A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 The total overtemperature tolerance for the different grades in the extended temperature range where  $\max\Delta T = 100^\circ\text{C}$  is shown below:  
 C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19 \text{ mV}$ .
- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at  $+25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

### 5.13 Electrical Characteristics: 3V LM4040-N $V_R$ Tolerance Grades 'C', 'D', And 'E'; Temperature Grade 'E'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C, D and E designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$ ,  $\pm 1\%$  and  $\pm 2\%$ , respectively.

| PARAMETER               |                                                                               | TEST CONDITIONS                                                                                 |            | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|-------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                   | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                          |            |                                                  | 3                  |                    | V                          |
|                         | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                                                          | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 15$           | mV                         |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 45$           |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 30$           |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 75$           |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 60$           |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 105$          |                            |
| $I_{\text{RMIN}}$       | Minimum Operating Current                                                     |                                                                                                 | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 47                 | 62                 | $\mu\text{A}$              |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 70                 |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 47                 | 67                 |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 75                 |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 47                 | 67                 |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 75                 |                            |
| $\Delta V_R/\Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             |            |                                                  | $\pm 20$           |                    | ppm/ $^\circ\text{C}$      |
|                         |                                                                               | $I_R = 1\text{mA}$                                                                              | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 15$           |                    |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
|                         |                                                                               | $I_R = 100\mu\text{A}$                                                                          |            |                                                  | $\pm 15$           |                    |                            |
| $\Delta V_R/\Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                      | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.4                | 0.8                | mV                         |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.1                |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.4                | 1.1                |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.3                |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.4                | 1.1                |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.3                |                            |
|                         |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 2.7                | 6.0                |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 9                  |                            |
|                         |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 2.7                | 8                  |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 11.0               |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 2.7                | 8                  |                            |
|                         |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 11.0               |                            |
| $Z_R$                   | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                          | LM4040CEM3 |                                                  | 0.4                | 0.9                | $\Omega$                   |
|                         |                                                                               |                                                                                                 | LM4040DEM3 |                                                  | 0.4                | 1.2                |                            |
|                         |                                                                               |                                                                                                 | LM4040EEM3 |                                                  | 0.4                | 1.2                |                            |
| $e_N$                   | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |            |                                                  | 35                 |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$            | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |            |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYST}}$       | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |            |                                                  | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

- (3) The (overtemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R/\Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R/\Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of 25°C to  $T_{MIN}$  or  $T_{MAX}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:
- A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$
- The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:
- C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$
- Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{mV}$ .
- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at +25°C after cycling to temperature -40°C and the 25°C measurement after cycling to temperature 125°C.

## 5.14 Electrical Characteristics: 4.1V LM4040-N $V_R$ Tolerance Grades 'A' And 'B'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades A and B designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.1\%$  and  $\pm 0.2\%$ , respectively.

| PARAMETER                 |                                                                               | TEST CONDITIONS                                                                                 |                                                  | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|---------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                     | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                          |                                                  |                                                  | 4.096              |                    | V                          |
|                           | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                                                          | LM4040AIM3                                       | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 4.1$          | mV                         |
|                           |                                                                               |                                                                                                 | LM4040AIZ                                        | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 31$           |                            |
|                           |                                                                               |                                                                                                 | LM4040BIM3                                       | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 8.2$          |                            |
|                           |                                                                               |                                                                                                 | LM4040BIZ<br>LM4040BIM7                          | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 35$           |                            |
| $I_{\text{RMIN}}$         | Minimum Operating Current                                                     |                                                                                                 | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 50                 | 68                 | $\mu\text{A}$              |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 73                 |                            |
| $\Delta V_R / \Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             |                                                  |                                                  | $\pm 30$           |                    | ppm/ $^\circ\text{C}$      |
|                           |                                                                               | $I_R = 1\text{mA}$                                                                              | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | $\pm 20$           |                    |                            |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | $\pm 100$          |                            |
|                           |                                                                               | $I_R = 100\mu\text{A}$                                                                          |                                                  |                                                  | $\pm 20$           |                    |                            |
| $\Delta V_R / \Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                      | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 0.5                | 0.9                | mV                         |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 1.2                |                            |
|                           |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 3                  | 7                  |                            |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 10                 |                            |
| $Z_R$                     | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                          |                                                  |                                                  | 0.5                | 1                  | $\Omega$                   |
| $e_N$                     | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |                                                  |                                                  | 80                 |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$              | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                                                  |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYST}}$         | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |                                                  |                                                  | 0.08%              |                    |                            |

- (1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.
- (2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- (3) The (overtemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R / \Delta T)(\text{max}\Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\text{max}\Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\text{max}\Delta T = 65^\circ\text{C}$  is shown below:  
 A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
 The total overtemperature tolerance for the different grades in the extended temperature range where  $\text{max}\Delta T = 100^\circ\text{C}$  is shown below:  
 C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
 Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .
- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at  $+25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.15 Electrical Characteristics: 4.1V LM4040-N $V_R$ Tolerance Grades 'C' and 'D'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C and D designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$  and  $\pm 1\%$ , respectively.

| PARAMETER                 |                                                                               | TEST CONDITIONS                                                                                 |                                       | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|---------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                     | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                          |                                       |                                                  | 4.096              |                    | V                          |
|                           | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                                                          | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 20$           | mV                         |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 47$           |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 41$           |                            |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 81$           |                            |
| $I_{\text{RMIN}}$         | Minimum Operating Current                                                     |                                                                                                 | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 50                 | 68                 | $\mu\text{A}$              |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 73                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 50                 | 73                 |                            |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 78                 |                            |
|                           |                                                                               |                                                                                                 |                                       |                                                  |                    |                    |                            |
| $\Delta V_R / \Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             |                                       |                                                  | $\pm 30$           |                    | ppm/ $^\circ\text{C}$      |
|                           |                                                                               | $I_R = 1\text{mA}$                                                                              | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 20$           |                    |                            |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 20$           |                    |                            |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
| $\Delta V_R / \Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_R = 100\mu\text{A}$                                                                          |                                       |                                                  | $\pm 20$           |                    | mV                         |
|                           |                                                                               | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                      | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 0.5                | 0.9                |                            |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.2                |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 0.5                | 1.2                |                            |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.5                |                            |
|                           |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 3                  | 7                  |                            |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 10                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 | $T_A = T_J = 25^\circ\text{C}$                   | 3                  | 9                  |                            |
|                           |                                                                               |                                                                                                 |                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 13                 |                            |
|                           |                                                                               |                                                                                                 |                                       |                                                  |                    |                    |                            |
| $Z_R$                     | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                          | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7 |                                                  | 0.5                | 1                  | $\Omega$                   |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7 |                                                  | 0.5                | 1.3                |                            |
| $e_N$                     | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |                                       |                                                  | 80                 |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$              | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                                       |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYST}}$         | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |                                       |                                                  | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The (overttemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R / \Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:

A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$



E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:

C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .

- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at  $+25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.16 Electrical Characteristics: 5V LM4040-N $V_R$ Tolerance Grades 'A' And 'B'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades A and B designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.1\%$  and  $\pm 0.2\%$ , respectively.

| PARAMETER                 |                                                                               | TEST CONDITIONS                                                                                 |                                                  | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|---------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                     | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                          |                                                  |                                                  | 5                  |                    | V                          |
|                           | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                                                          | LM4040AIM3<br>LM4040AIZ                          | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 5$            | mV                         |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 38$           |                            |
|                           |                                                                               |                                                                                                 | LM4040BIM3<br>LM4040BIZ                          | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 10$           |                            |
|                           |                                                                               |                                                                                                 | LM4040BIM7                                       | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 43$           |                            |
| $I_{\text{RMIN}}$         | Minimum Operating Current                                                     |                                                                                                 | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 54                 | 74                 | $\mu\text{A}$              |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 80                 |                            |
| $\Delta V_R / \Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             |                                                  |                                                  | $\pm 30$           |                    | ppm/ $^\circ\text{C}$      |
|                           |                                                                               | $I_R = 1\text{mA}$                                                                              | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | $\pm 20$           |                    |                            |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | $\pm 100$          |                            |
|                           |                                                                               | $I_R = 100\mu\text{A}$                                                                          |                                                  |                                                  | $\pm 20$           |                    |                            |
| $\Delta V_R / \Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                      | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 0.5                | 1                  | mV                         |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 1.4                |                            |
|                           |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 3.5                | 8                  |                            |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 12                 |                            |
| $Z_R$                     | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                          |                                                  |                                                  | 0.5                | 1.1                | $\Omega$                   |
| $e_N$                     | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |                                                  |                                                  | 80                 |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$              | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                                                  |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYST}}$         | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |                                                  |                                                  | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The (overtemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R / \Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:

A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:

C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .

(4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

(5) Thermal hysteresis is defined as the difference in voltage measured at  $+25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.17 Electrical Characteristics: 5V LM4040-N $V_R$ Tolerance Grades 'C' And 'D'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C and D designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$  and  $\pm 1\%$ , respectively.

| PARAMETER                 |                                                                               | TEST CONDITIONS                                                                                 |                                                  | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|---------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                     | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                          |                                                  |                                                  | 5                  |                    | V                          |
|                           | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 100\mu\text{A}$                                                                          | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7            | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 25$           | mV                         |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 58$           |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7            | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 50$           |                            |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 99$           |                            |
| $I_{\text{RMIN}}$         | Minimum Operating Current                                                     |                                                                                                 | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7            | $T_A = T_J = 25^\circ\text{C}$                   | 54                 | 74                 | $\mu\text{A}$              |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 80                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7            | $T_A = T_J = 25^\circ\text{C}$                   | 54                 | 79                 |                            |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 85                 |                            |
|                           |                                                                               |                                                                                                 |                                                  |                                                  |                    |                    |                            |
| $\Delta V_R / \Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             |                                                  |                                                  | $\pm 30$           |                    | ppm/ $^\circ\text{C}$      |
|                           |                                                                               | $I_R = 1\text{mA}$                                                                              | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7            | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 20$           |                    |                            |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7            | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 20$           |                    |                            |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
| $\Delta V_R / \Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                      | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7            | $T_A = T_J = 25^\circ\text{C}$                   | 0.5                | 1                  | mV                         |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.4                |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7            | $T_A = T_J = 25^\circ\text{C}$                   | 0.5                | 1.3                |                            |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 1.8                |                            |
|                           |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | LM4040CIM3<br>LM4040CIZ<br>LM4040CIM7            | $T_A = T_J = 25^\circ\text{C}$                   | 3.5                | 8                  |                            |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 12                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ<br>LM4040DIM7            | $T_A = T_J = 25^\circ\text{C}$                   | 3.5                | 10                 |                            |
|                           |                                                                               |                                                                                                 |                                                  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 15                 |                            |
|                           |                                                                               |                                                                                                 |                                                  |                                                  |                    |                    |                            |
|                           |                                                                               |                                                                                                 |                                                  |                                                  |                    |                    |                            |
|                           |                                                                               |                                                                                                 |                                                  |                                                  |                    |                    |                            |
|                           |                                                                               |                                                                                                 |                                                  |                                                  |                    |                    |                            |
|                           |                                                                               |                                                                                                 |                                                  |                                                  |                    |                    |                            |
| $Z_R$                     | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                          | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 0.5                | 1.1                | $\Omega$                   |
|                           |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 1.5                |                            |
| $e_N$                     | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |                                                  |                                                  | 80                 |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$              | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |                                                  |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYST}}$         | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |                                                  |                                                  | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The (overtemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R / \Delta T)(\text{max} \Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\text{max} \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\text{max} \Delta T = 65^\circ\text{C}$  is shown below:

A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total overtemperature tolerance for the different grades in the extended temperature range where  $\text{max} \Delta T = 100^\circ\text{C}$  is shown below:

C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

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D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$ E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$ 

Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .

- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at  $+25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.18 Electrical Characteristics: 5V LM4040-N $V_R$ Tolerance Grades 'C' And 'D'; Temperature Grade 'E'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C and D designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$  and  $\pm 1\%$ , respectively.

| PARAMETER                 |                                                                               | TEST CONDITIONS                                                                                 |            | MIN <sup>(1)</sup>                               | TYP      | MAX <sup>(1)</sup> | UNIT                       |
|---------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------|--------------------------------------------------|----------|--------------------|----------------------------|
| $V_R$                     | Reverse Breakdown Voltage                                                     | $I_R = 100\mu\text{A}$                                                                          |            |                                                  | 5        |                    | V                          |
|                           | Reverse Breakdown Voltage Tolerance <sup>(2)</sup>                            | $I_R = 100\mu\text{A}$                                                                          | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   |          | $\pm 25$           | mV                         |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | $\pm 75$           |                            |
|                           |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   |          | $\pm 50$           |                            |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | $\pm 125$          |                            |
| $I_{\text{RMIN}}$         | Minimum Operating Current                                                     |                                                                                                 | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 54       | 74                 | $\mu\text{A}$              |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | 83                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 54       | 79                 |                            |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | 88                 |                            |
| $\Delta V_R / \Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(2)</sup>      | $I_R = 10\text{mA}$                                                                             |            |                                                  | $\pm 30$ |                    | ppm/ $^\circ\text{C}$      |
|                           |                                                                               | $I_R = 1\text{mA}$                                                                              | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 20$ |                    |                            |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | $\pm 100$          |                            |
|                           |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 20$ |                    |                            |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | $\pm 150$          |                            |
|                           |                                                                               | $I_R = 100\mu\text{A}$                                                                          |            |                                                  | $\pm 20$ |                    |                            |
| $\Delta V_R / \Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(3)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                      | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.5      | 1                  | mV                         |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | 1.4                |                            |
|                           |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.5      | 1                  |                            |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | 1.8                |                            |
|                           |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | LM4040CEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 3.5      | 8                  |                            |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | 12                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DEM3 | $T_A = T_J = 25^\circ\text{C}$                   | 3.5      | 8                  |                            |
|                           |                                                                               |                                                                                                 |            | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |          | 15                 |                            |
| $Z_R$                     | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                          |            |                                                  | 0.5      | 1.1                | $\Omega$                   |
| $e_N$                     | Wideband Noise                                                                | $I_R = 100\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |            |                                                  | 80       |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$              | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 100\mu\text{A}$ |            |                                                  | 120      |                    | ppm                        |
| $V_{\text{HYST}}$         | Thermal Hysteresis <sup>(4)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |            |                                                  | 0.08%    |                    |                            |

- Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- The (overtemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm [(\Delta V_R / \Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:  
A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:  
C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .
- Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

- (4) Thermal hysteresis is defined as the difference in voltage measured at +25°C after cycling to temperature -40°C and the 25°C measurement after cycling to temperature 125°C.

## 5.19 Electrical Characteristics: 8.2V LM4040-N $V_R$ Tolerance Grades 'A' And 'B'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades A and B designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.1\%$  and  $\pm 0.2\%$ , respectively.

| PARAMETER               |                                                                               | TEST CONDITIONS                                                                                 |                                                  | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|-------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                   | Reverse Breakdown Voltage                                                     | $I_R = 150\mu\text{A}$                                                                          |                                                  |                                                  | 8.192              |                    | V                          |
|                         | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 150\mu\text{A}$                                                                          | LM4040AIM3                                       | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 8.2$          | mV                         |
|                         |                                                                               |                                                                                                 | LM4040AIZ                                        | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 61$           |                            |
|                         |                                                                               |                                                                                                 | LM4040BIM3                                       | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 16$           |                            |
|                         |                                                                               |                                                                                                 | LM4040BIZ                                        | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 70$           |                            |
| $I_{\text{RMIN}}$       | Minimum Operating Current                                                     |                                                                                                 | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 67                 | 91                 | $\mu\text{A}$              |
|                         |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 95                 |                            |
| $\Delta V_R/\Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             |                                                  |                                                  | $\pm 40$           |                    | ppm/ $^\circ\text{C}$      |
|                         |                                                                               | $I_R = 1\text{mA}$                                                                              | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | $\pm 20$           |                    |                            |
|                         |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | $\pm 100$          |                            |
|                         |                                                                               | $I_R = 150\mu\text{A}$                                                                          |                                                  |                                                  | $\pm 20$           |                    |                            |
| $\Delta V_R/\Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                      | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 0.6                | 1.3                | mV                         |
|                         |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 2.5                |                            |
|                         |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | $T_A = T_J = 25^\circ\text{C}$                   |                                                  | 7                  | 10                 |                            |
|                         |                                                                               |                                                                                                 | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                                                  |                    | 18                 |                            |
| $Z_R$                   | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                          |                                                  |                                                  | 0.6                | 1.5                | $\Omega$                   |
| $e_N$                   | Wideband Noise                                                                | $I_R = 150\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |                                                  |                                                  | 130                |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$            | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 150\mu\text{A}$ |                                                  |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYST}}$       | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |                                                  |                                                  | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The (overtemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R/\Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R/\Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:

A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:

C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5\text{V} \times 0.75\% = \pm 19\text{ mV}$ .

(4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

(5) Thermal hysteresis is defined as the difference in voltage measured at  $+25^\circ\text{C}$  after cycling to temperature  $-40^\circ\text{C}$  and the  $25^\circ\text{C}$  measurement after cycling to temperature  $125^\circ\text{C}$ .

## 5.20 Electrical Characteristics: 8.2V Lm4040-N $V_R$ Tolerance Grades 'C' And 'D'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C and D designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$  and  $\pm 1\%$ , respectively.

| PARAMETER                 |                                                                               | TEST CONDITIONS                                                                                 |            | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|---------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                     | Reverse Breakdown Voltage                                                     | $I_R = 150\mu\text{A}$                                                                          |            |                                                  | 8.192              |                    | V                          |
|                           | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 150\mu\text{A}$                                                                          | LM4040CIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 41$           | mV                         |
|                           |                                                                               |                                                                                                 | LM4040CIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 94$           |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 82$           |                            |
|                           |                                                                               |                                                                                                 | LM4040DIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 162$          |                            |
| $I_{R\text{MIN}}$         | Minimum Operating Current                                                     |                                                                                                 | LM4040CIM3 | $T_A = T_J = 25^\circ\text{C}$                   | 67                 | 91                 | $\mu\text{A}$              |
|                           |                                                                               |                                                                                                 | LM4040CIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 95                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3 | $T_A = T_J = 25^\circ\text{C}$                   | 67                 | 96                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 100                |                            |
| $\Delta V_R / \Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             |            |                                                  |                    | $\pm 40$           | ppm/ $^\circ\text{C}$      |
|                           |                                                                               | $I_R = 1\text{mA}$                                                                              | LM4040CIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 20$           |                            |
|                           |                                                                               |                                                                                                 | LM4040CIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3 | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 20$           |                            |
|                           |                                                                               |                                                                                                 | LM4040DIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
| $\Delta V_R / \Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{R\text{MIN}} \leq I_R \leq 1\text{mA}$                                                      | LM4040CIM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.6                | 1.3                | mV                         |
|                           |                                                                               |                                                                                                 | LM4040CIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 2.5                |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3 | $T_A = T_J = 25^\circ\text{C}$                   | 0.6                | 1.7                |                            |
|                           |                                                                               |                                                                                                 | LM4040DIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 3                  |                            |
|                           |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | LM4040CIM3 | $T_A = T_J = 25^\circ\text{C}$                   | 7                  | 10                 |                            |
|                           |                                                                               |                                                                                                 | LM4040CIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 18                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DIM3 | $T_A = T_J = 25^\circ\text{C}$                   | 7                  | 15                 |                            |
|                           |                                                                               |                                                                                                 | LM4040DIZ  | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 24                 |                            |
| $Z_R$                     | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{AC} = 0.1 I_R$                                 | LM4040CIM3 |                                                  | 0.6                | 1.5                | $\Omega$                   |
|                           |                                                                               |                                                                                                 | LM4040DIZ  |                                                  | 0.6                | 1.9                |                            |
| $e_N$                     | Wideband Noise                                                                | $I_R = 150\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |            |                                                  | 130                |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$              | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 150\mu\text{A}$ |            |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYST}}$         | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |            |                                                  | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The (overtemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R / \Delta T)(\text{max} \Delta T)(V_R)]$ . Where,  $\Delta V_R / \Delta T$  is the  $V_R$  temperature coefficient,  $\text{max} \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\text{max} \Delta T = 65^\circ\text{C}$  is shown below:

A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total overtemperature tolerance for the different grades in the extended temperature range where  $\text{max} \Delta T = 100^\circ\text{C}$  is shown below:

C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$



Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5V \times 0.75\% = \pm 19 \text{ mV}$ .

- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at +25°C after cycling to temperature -40°C and the 25°C measurement after cycling to temperature 125°C.

## 5.21 Electrical Characteristics: 10V LM4040-N $V_R$ Tolerance Grades 'A' And 'B'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades A and B designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.1\%$  and  $\pm 0.2\%$ , respectively.

| PARAMETER               |                                                                               | TEST CONDITIONS                                                                                  |                                                         | MIN <sup>(2)</sup>                                      | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|-------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                   | Reverse Breakdown Voltage                                                     | $I_R = 150\mu\text{A}$                                                                           |                                                         |                                                         | 10                 |                    | V                          |
|                         | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 150\mu\text{A}$                                                                           | LM4040AIM3<br>LM4040AIZ                                 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 10$           | mV                         |
|                         |                                                                               |                                                                                                  |                                                         | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 75$           |                            |
|                         |                                                                               |                                                                                                  | LM4040BIM3<br>LM4040BIZ                                 | $T_A = T_J = 25^\circ\text{C}$                          |                    | $\pm 20$           |                            |
|                         |                                                                               |                                                                                                  |                                                         | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                    | $\pm 85$           |                            |
| $I_{\text{RMIN}}$       | Minimum Operating Current                                                     |                                                                                                  | $T_A = T_J = 25^\circ\text{C}$                          |                                                         | 75                 | 100                | $\mu\text{A}$              |
|                         |                                                                               |                                                                                                  | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                                                         |                    | 103                |                            |
| $\Delta V_R/\Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                              |                                                         |                                                         | $\pm 40$           |                    | ppm/ $^\circ\text{C}$      |
|                         |                                                                               | $I_R = 1\text{mA}$                                                                               | $T_A = T_J = 25^\circ\text{C}$                          |                                                         | $\pm 20$           |                    |                            |
|                         |                                                                               |                                                                                                  | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                                                         |                    | $\pm 100$          |                            |
|                         |                                                                               | $I_R = 150\mu\text{A}$                                                                           |                                                         |                                                         | $\pm 20$           |                    |                            |
| $\Delta V_R/\Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                       | $T_A = T_J = 25^\circ\text{C}$                          |                                                         | 0.8                | 1.5                | mV                         |
|                         |                                                                               |                                                                                                  | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                                                         |                    | 3.8                |                            |
|                         |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                           | $T_A = T_J = 25^\circ\text{C}$                          |                                                         | 8                  | 12                 |                            |
|                         |                                                                               |                                                                                                  | $T_A = T_J = T_{\text{MIN}} \text{ to } T_{\text{MAX}}$ |                                                         |                    | 23                 |                            |
| $Z_R$                   | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                           |                                                         |                                                         | 0.7                | 1.7                | $\Omega$                   |
| $e_N$                   | Wideband Noise                                                                | $I_R = 150\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                 |                                                         |                                                         | 180                |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$            | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000 \text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 150\mu\text{A}$ |                                                         |                                                         | 120                |                    | ppm                        |
| $V_{\text{HYST}}$       | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C} \text{ to } 125^\circ\text{C}$                                     |                                                         |                                                         | 0.08%              |                    |                            |

- (1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.
- (2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.
- (3) The (overtemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R/\Delta T)(\max \Delta T)(V_R)]$ . Where,  $\Delta V_R/\Delta T$  is the  $V_R$  temperature coefficient,  $\max \Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\max \Delta T = 65^\circ\text{C}$  is shown below:  
A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$   
The total overtemperature tolerance for the different grades in the extended temperature range where  $\max \Delta T = 100^\circ\text{C}$  is shown below:  
C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$   
Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5V \times 0.75\% = \pm 19 \text{ mV}$ .
- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at +25°C after cycling to temperature -40°C and the 25°C measurement after cycling to temperature 125°C.

## 5.22 Electrical Characteristics: 10V LM4040-N $V_R$ Tolerance Grades 'C' And 'D'; Temperature Grade 'I'

all other limits  $T_A = T_J = 25^\circ\text{C}$ . The grades C and D designate initial Reverse Breakdown Voltage tolerances of  $\pm 0.5\%$  and  $\pm 1\%$ , respectively.

| PARAMETER               |                                                                               | TEST CONDITIONS                                                                                 |                         | MIN <sup>(2)</sup>                               | TYP <sup>(1)</sup> | MAX <sup>(2)</sup> | UNIT                       |
|-------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------|--------------------------------------------------|--------------------|--------------------|----------------------------|
| $V_R$                   | Reverse Breakdown Voltage                                                     | $I_R = 150\mu\text{A}$                                                                          |                         |                                                  | 10                 |                    | V                          |
|                         | Reverse Breakdown Voltage Tolerance <sup>(3)</sup>                            | $I_R = 150\mu\text{A}$                                                                          | LM4040CIM3              | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 50$           | mV                         |
|                         |                                                                               |                                                                                                 | LM4040CIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 115$          |                            |
|                         |                                                                               |                                                                                                 | LM4040DIM3              | $T_A = T_J = 25^\circ\text{C}$                   |                    | $\pm 100$          |                            |
|                         |                                                                               |                                                                                                 | LM4040DIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 198$          |                            |
| $I_{\text{RMIN}}$       | Minimum Operating Current                                                     |                                                                                                 | LM4040CIM3              | $T_A = T_J = 25^\circ\text{C}$                   | 75                 | 100                | $\mu\text{A}$              |
|                         |                                                                               |                                                                                                 | LM4040CIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 103                |                            |
|                         |                                                                               |                                                                                                 | LM4040DIM3              | $T_A = T_J = 25^\circ\text{C}$                   | 75                 | 110                |                            |
|                         |                                                                               |                                                                                                 | LM4040DIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 113                |                            |
| $\Delta V_R/\Delta T$   | Average Reverse Breakdown Voltage Temperature Coefficient <sup>(3)</sup>      | $I_R = 10\text{mA}$                                                                             |                         |                                                  | $\pm 40$           |                    | ppm/ $^\circ\text{C}$      |
|                         |                                                                               | $I_R = 1\text{mA}$                                                                              | LM4040CIM3              | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 20$           |                    |                            |
|                         |                                                                               |                                                                                                 | LM4040CIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 100$          |                            |
|                         |                                                                               |                                                                                                 | LM4040DIM3              | $T_A = T_J = 25^\circ\text{C}$                   | $\pm 20$           |                    |                            |
|                         |                                                                               |                                                                                                 | LM4040DIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | $\pm 150$          |                            |
| $\Delta V_R/\Delta I_R$ | Reverse Breakdown Voltage Change with Operating Current Change <sup>(4)</sup> | $I_{\text{RMIN}} \leq I_R \leq 1\text{mA}$                                                      | LM4040CIM3              | $T_A = T_J = 25^\circ\text{C}$                   | 0.8                | 1.5                | mV                         |
|                         |                                                                               |                                                                                                 | LM4040CIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 3.8                |                            |
|                         |                                                                               |                                                                                                 | LM4040DIM3              | $T_A = T_J = 25^\circ\text{C}$                   | 0.8                | 2                  |                            |
|                         |                                                                               |                                                                                                 | LM4040DIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 4                  |                            |
|                         |                                                                               | $1\text{mA} \leq I_R \leq 15\text{mA}$                                                          | LM4040CIM3              | $T_A = T_J = 25^\circ\text{C}$                   | 8                  | 12                 |                            |
|                         |                                                                               |                                                                                                 | LM4040CIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 23                 |                            |
|                         |                                                                               |                                                                                                 | LM4040DIM3              | $T_A = T_J = 25^\circ\text{C}$                   | 8                  | 18                 |                            |
|                         |                                                                               |                                                                                                 | LM4040DIZ               | $T_A = T_J = T_{\text{MIN}}$ to $T_{\text{MAX}}$ |                    | 29                 |                            |
| $Z_R$                   | Reverse Dynamic Impedance                                                     | $I_R = 1\text{mA}$ , $f = 120\text{Hz}$ ,<br>$I_{\text{AC}} = 0.1 I_R$                          | LM4040CIM3<br>LM4040CIZ |                                                  | 0.7                | 1.7                | $\Omega$                   |
|                         |                                                                               |                                                                                                 | LM4040DIM3<br>LM4040DIZ |                                                  |                    | 2.3                |                            |
| $e_N$                   | Wideband Noise                                                                | $I_R = 150\mu\text{A}$<br>$10\text{Hz} \leq f \leq 10\text{kHz}$                                |                         |                                                  | 180                |                    | $\mu\text{V}_{\text{rms}}$ |
| $\Delta V_R$            | Reverse Breakdown Voltage Long Term Stability                                 | $t = 1000\text{ hrs}$<br>$T = 25^\circ\text{C} \pm 0.1^\circ\text{C}$<br>$I_R = 150\mu\text{A}$ |                         |                                                  | 120                |                    | ppm                        |
| $V_{\text{HYST}}$       | Thermal Hysteresis <sup>(5)</sup>                                             | $\Delta T = -40^\circ\text{C}$ to $125^\circ\text{C}$                                           |                         |                                                  | 0.08%              |                    |                            |

(1) Typicals are at  $T_J = 25^\circ\text{C}$  and represent most likely parametric norm.

(2) Limits are 100% production tested at  $25^\circ\text{C}$ . Limits over temperature are verified through correlation using Statistical Quality Control (SQC) methods. The limits are used to calculate AOQL.

(3) The (overtemperature) limit for Reverse Breakdown Voltage Tolerance is defined as the room temperature Reverse Breakdown Voltage Tolerance  $\pm[(\Delta V_R/\Delta T)(\text{max}\Delta T)(V_R)]$ . Where,  $\Delta V_R/\Delta T$  is the  $V_R$  temperature coefficient,  $\text{max}\Delta T$  is the maximum difference in temperature from the reference point of  $25^\circ\text{C}$  to  $T_{\text{MIN}}$  or  $T_{\text{MAX}}$ , and  $V_R$  is the reverse breakdown voltage. The total overtemperature tolerance for the different grades in the industrial temperature range where  $\text{max}\Delta T = 65^\circ\text{C}$  is shown below:

A-grade:  $\pm 0.75\% = \pm 0.1\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

B-grade:  $\pm 0.85\% = \pm 0.2\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

C-grade:  $\pm 1.15\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

D-grade:  $\pm 1.98\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

E-grade:  $\pm 2.98\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 65^\circ\text{C}$

The total overtemperature tolerance for the different grades in the extended temperature range where  $\text{max}\Delta T = 100^\circ\text{C}$  is shown below:

C-grade:  $\pm 1.5\% = \pm 0.5\% \pm 100\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

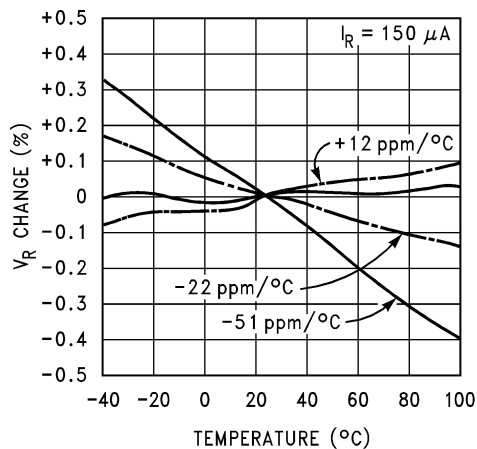
D-grade:  $\pm 2.5\% = \pm 1.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

E-grade:  $\pm 3.5\% = \pm 2.0\% \pm 150\text{ppm}/^\circ\text{C} \times 100^\circ\text{C}$

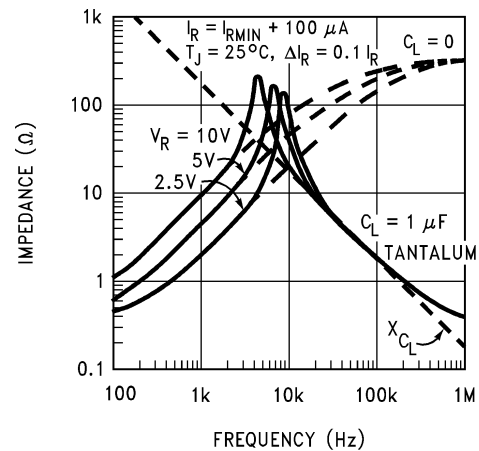
Therefore, as an example, the A-grade 2.5V LM4040-N has an overtemperature Reverse Breakdown Voltage tolerance of  $\pm 2.5V \times 0.75\% = \pm 19 \text{ mV}$ .

- (4) Load regulation is measured on pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.
- (5) Thermal hysteresis is defined as the difference in voltage measured at +25°C after cycling to temperature -40°C and the 25°C measurement after cycling to temperature 125°C.

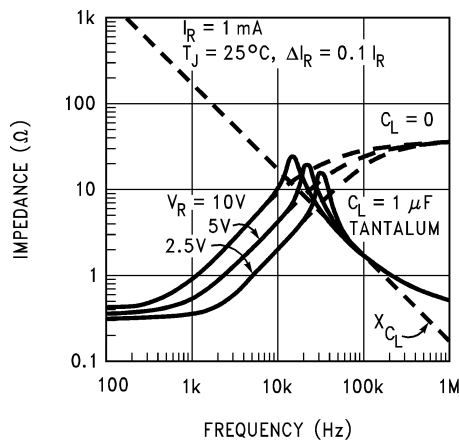
## 5.23 Typical Characteristics



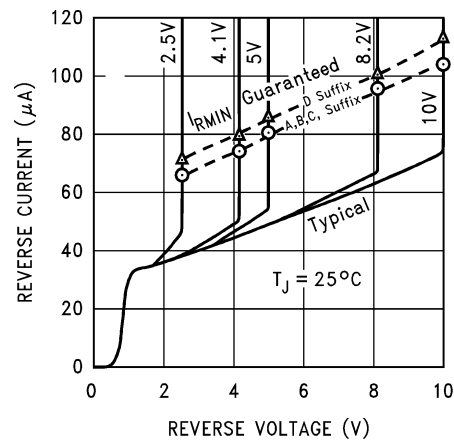
**Figure 5-1. Temperature Drift For Different Average Temperature Coefficient**



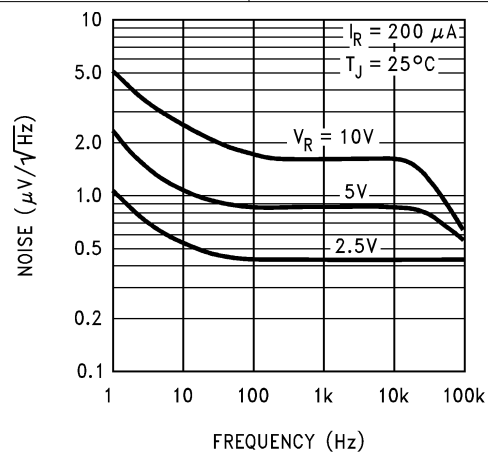
**Figure 5-2. Output Impedance vs Frequency**



**Figure 5-3. Output Impedance vs Frequency**

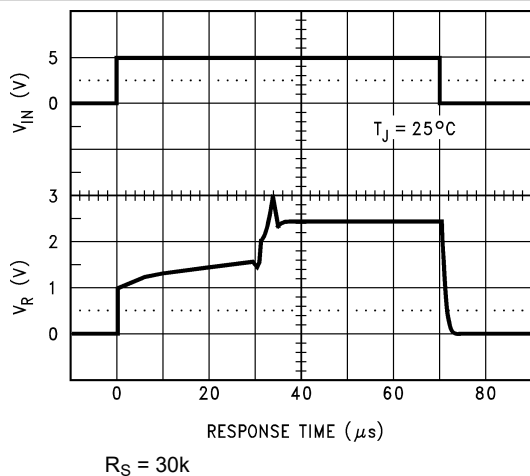


**Figure 5-4. Reverse Characteristics And Minimum Operating Current**

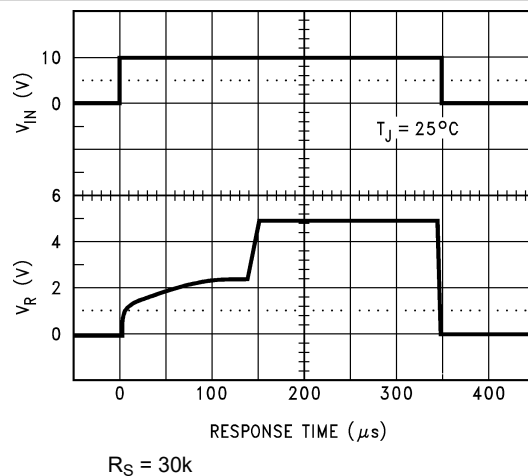


**Figure 5-5. Noise Voltage vs Frequency**

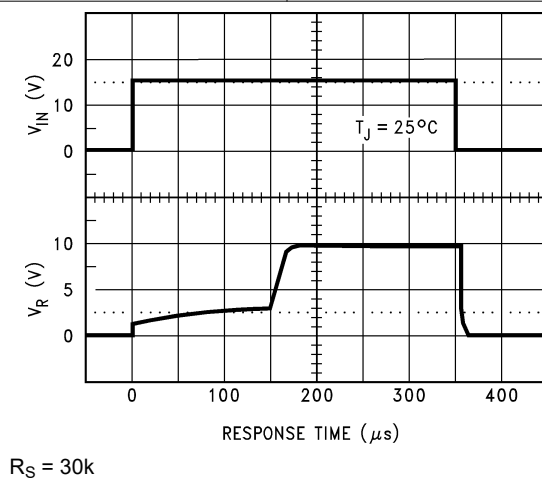
### 5.23.1 Start-Up Characteristics



**Figure 5-6. Input Voltage Step Response LM4040-N-2.5**



**Figure 5-7. Input Voltage Step Response LM4040-N-5**



**Figure 5-8. Input Voltage Step Response LM4040-N-10**

## 6 Parameter Measurement Information

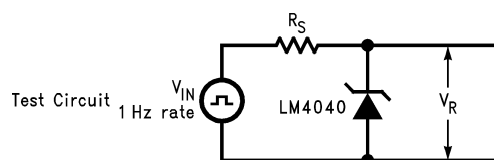


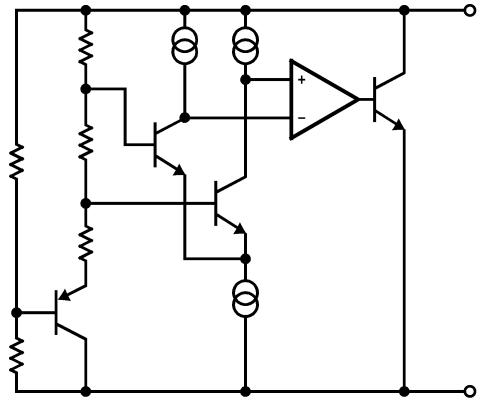
Figure 6-1. Test Circuit

## 7 Detailed Description

### 7.1 Overview

The LM4040 device is a precision micropower shunt voltage reference available in 7 different fixed-output voltage options and three different packages to meet small footprint requirements. The part is also available in five different tolerance grades.

### 7.2 Functional Block Diagram



### 7.3 Feature Description

The LM4040 device is effectively a precision Zener diode. The part requires a small quiescent current for regulation, and regulates the output voltage by shunting more or less current to ground, depending on input voltage and load. The only external component requirement is a resistor between the cathode and the input voltage to set the input current. An external capacitor can be used on the input or output, but is not required.

### 7.4 Device Functional Modes

The LM4040 device is a fixed output voltage part, where the feedback is internal. Therefore, the part can only operate in a closed loop mode and the output voltage cannot be adjusted. The output voltage remains in regulation as long as  $I_R$  is between  $I_{RMIN}$ , see [Section 5.5](#), and  $I_{RMAX}$ , 15mA. Proper selection of the external resistor for input voltage range and load current range make sure these conditions are met.

## 8 Application and Implementation

### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

### 8.1 Application Information

The LM4040-N is a precision micropower curvature-corrected bandgap shunt voltage reference. For space critical applications, the LM4040-N is available in SOT-23 and SC70 surface-mount packages. The LM4040-N has been designed for stable operation without the need of an external capacitor connected between the + pin and the – pin. If, however, a bypass capacitor is used, the LM4040-N remains stable. Reducing design effort is the availability of several fixed reverse breakdown voltages: 2.048V, 2.5V, 3V, 4.096V, 5V, 8.192V, and 10V. The minimum operating current increases from 60µA for the LM4040-N-2.048 and LM4040-N-2.5 to 100µA for the 10V LM4040-N. All versions have a maximum operating current of 15mA.

LM4040-Ns in the SOT-23 packages have a parasitic Schottky diode between pin 2 (–) and pin 3 (Die attach interface contact). Therefore, pin 3 of the SOT-23 package must be left floating or connected to pin 2.

LM4040-Ns in the SC70 have a parasitic Schottky diode between pin 1 (–) and pin 2 (Die attach interface contact). Therefore, pin 2 must be left floating or connected to pin 1.

The 4.096V version allows single 5V 12-bit ADCs or DACs to operate with an LSB equal to 1mV. For 12-bit ADCs or DACs that operate on supplies of 10V or greater, the 8.192V version gives 2mV per LSB.

The typical thermal hysteresis specification is defined as the change in 25°C voltage measured after thermal cycling. The device is thermal cycled to temperature –40°C and then measured at 25°C. Next the device is thermal cycled to temperature 125°C and again measured at 25°C. The resulting  $V_{OUT}$  delta shift between the 25°C measurements is thermal hysteresis. Thermal hysteresis is common in precision references and is induced by thermal-mechanical package stress. Changes in environmental storage temperature, operating temperature and board mounting temperature are all factors that can contribute to thermal hysteresis.

In a conventional shunt regulator application ([Figure 8-1](#)), an external series resistor ( $R_S$ ) is connected between the supply voltage and the LM4040-N.  $R_S$  determines the current that flows through the load ( $I_L$ ) and the LM4040-N ( $I_Q$ ). Since load current and supply voltage can vary,  $R_S$  must be small enough to supply at least the minimum acceptable  $I_Q$  to the LM4040-N even when the supply voltage is at the minimum and the load current is at the maximum value. When the supply voltage is at the maximum and  $I_L$  is at the minimum,  $R_S$  must be large enough so that the current flowing through the LM4040-N is less than 15mA.

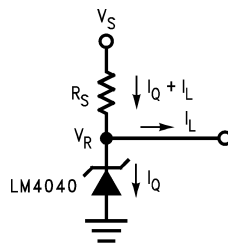
$R_S$  is determined by the supply voltage, ( $V_S$ ), the load and operating current, ( $I_L$  and  $I_Q$ ), and the LM4040-N's reverse breakdown voltage,  $V_R$ .

$$R_S = \frac{V_S - V_R}{I_L + I_Q} \quad (1)$$



## 8.2 Typical Applications

### 8.2.1 Shunt Regulator



**Figure 8-1. Shunt Regulator Schematic**

### 8.2.1.1 Design Requirements

$$V_{IN} > V_{OUT}$$

Select  $R_S$  such that:

$$I_{RMIN} < I_R < I_{RMAX} \text{ where } I_{RMAX} = 15\text{mA}$$

See [Section 5.5](#)

for minimum operating current for each voltage option and grade.

### 8.2.1.2 Detailed Design Procedure

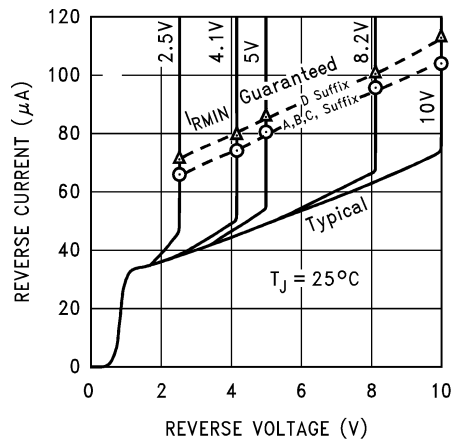
The resistor  $R_S$  must be selected such that current  $I_R$  remains in the operational region of the part for the entire  $V_{IN}$  range and load current range. The two extremes to consider are  $V_{IN}$  at the minimum, and the load at the maximum, where  $R_S$  must be small enough for  $I_R$  to remain above  $I_{RMIN}$ . The other extreme is  $V_{IN}$  at the maximum, and the load at the minimum, where  $R_S$  must be large enough to maintain  $I_R < I_{RMAX}$ . For most designs,  $0.1\text{mA} \leq I_R \leq 1\text{mA}$  is a good starting point.

Use [Equation 2](#) and [Equation 3](#) to set  $R_S$  between  $R_{S\_MIN}$  and  $R_{S\_MAX}$ .

$$R_{S\_MIN} = \frac{V_{IN\_MAX} - V_{OUT}}{I_{LOAD\_MIN} + I_{R\_MAX}} \quad (2)$$

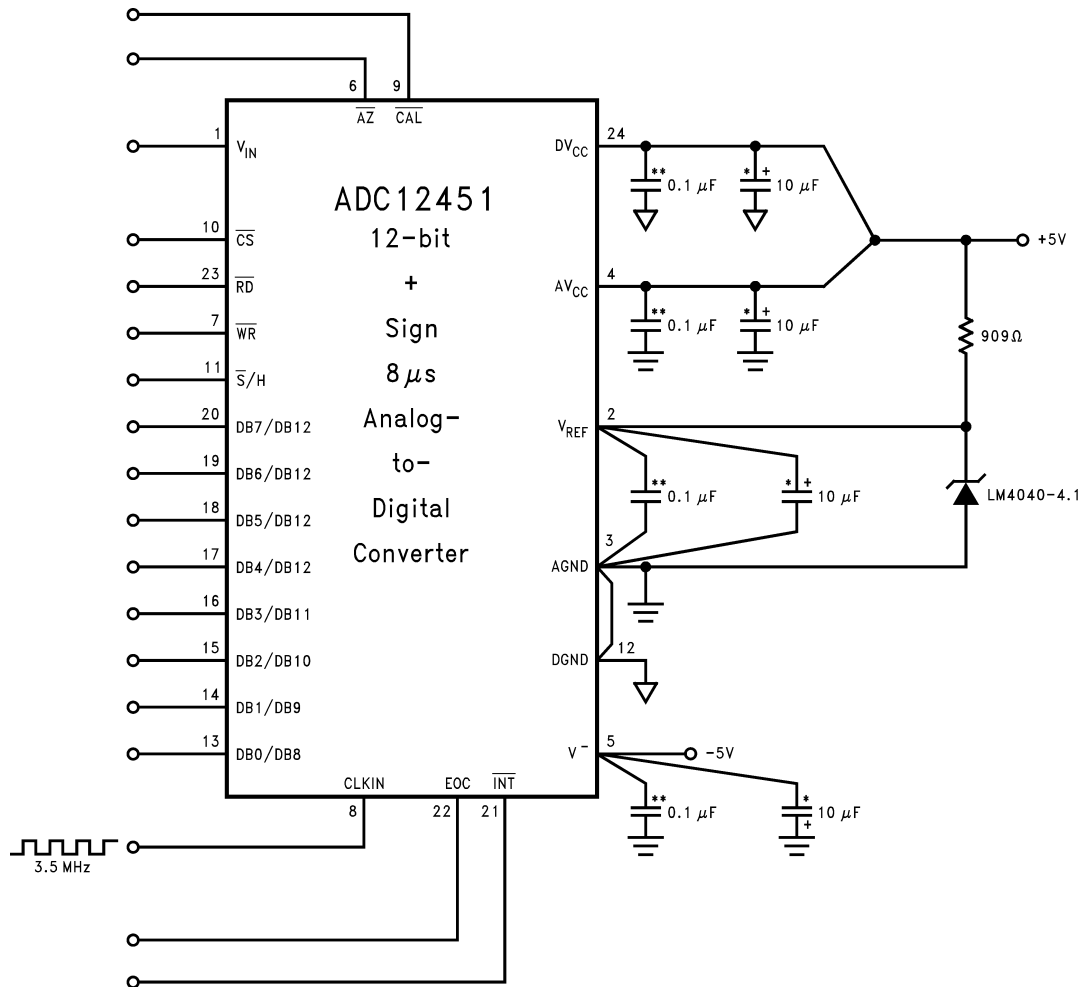
$$R_{S\_MAX} = \frac{V_{IN\_MIN} - V_{OUT}}{I_{LOAD\_MAX} + I_{R\_MIN}} \quad (3)$$

### 8.2.1.3 Application Curve



**Figure 8-2. Reverse Characteristics And Minimum Operating Current**

### 8.2.2 4.1V ADC Application



\*\*Ceramic monolithic \*Tantalum

**Figure 8-3. 4.1V LM4040-N'S Nominal 4.096 Breakdown Voltage Gives ADC12451 1 MV/LSB**

#### 8.2.2.1 Design Requirements

The only design requirement is for an output voltage of 4.096V.

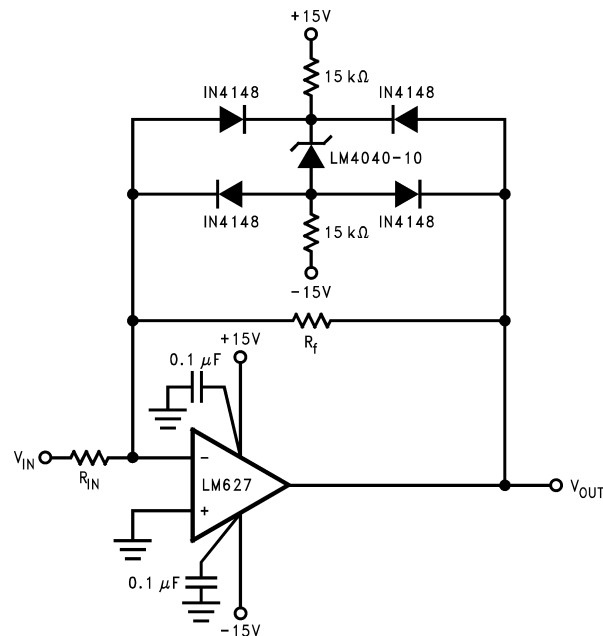
#### 8.2.2.2 Detailed Design Procedure

Using an LM4040-4.1, select an appropriate  $R_S$  to sufficiently power the device. Set the target  $I_R$  for 1mA. With an input voltage of 5V, the resistor can be calculated:

$$R = \frac{5\text{ V} - 4.096\text{ V}}{1\text{ mA}} = 904\ \Omega \quad (4)$$

The closest available resistance of 909Ω is used here, which in turn yields an  $I_R$  of 994μA.

### 8.2.3 Bounded Amplifier



Nominal clamping voltage is  $\pm 11.5\text{V}$  (LM4040-N's reverse breakdown voltage +2 diode  $V_F$ ).

**Figure 8-4. Bounded Amplifier Reduces Saturation-Induced Delays and Can Prevent Succeeding Stage Damage**

#### 8.2.3.1 Design Requirements

Design an amplifier with output clamped at  $\pm 11.5\text{V}$ .

#### 8.2.3.2 Detailed Design Procedure

With amplifier rails of  $\pm 15\text{V}$ , the output can be bound to  $\pm 11.5\text{V}$  with the LM4040-10 and two nominal diode voltage drops of  $0.7\text{V}$ .

$$V_{\text{OUTBound}} = 2 \times V_{\text{FWD}} + V_Z \quad (5)$$

$$V_{\text{OUTBound}} = 1.4\text{V} + 10\text{V} \quad (6)$$

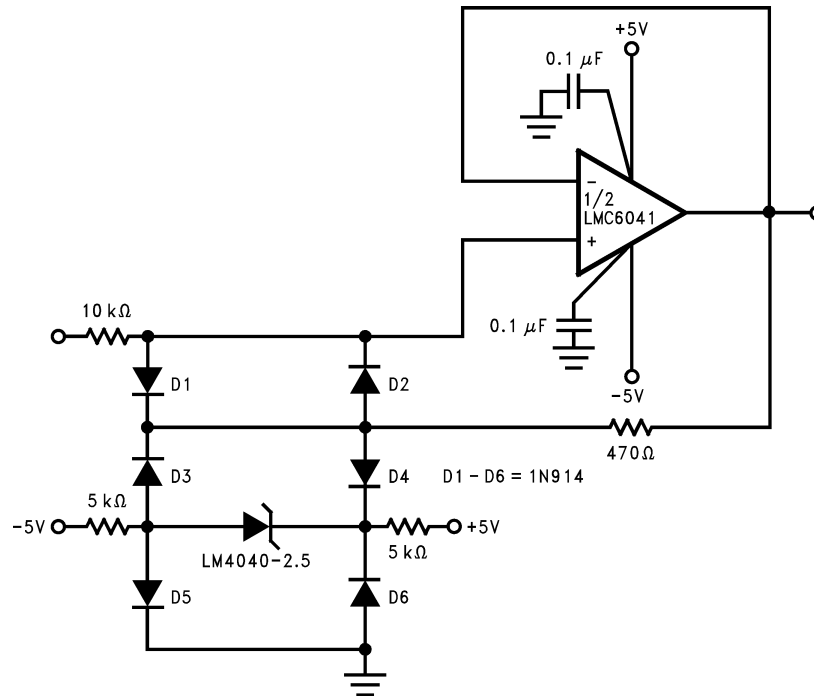
Select  $R_S = 15\text{k}\Omega$  to keep  $I_R$  low. Calculate  $I_R$  to confirm  $R_S$  selection.

$$I_R = (V_{\text{IN}} - V_{\text{OUT}}) / R, \text{ however in this case, the negative supply must be taken into account.} \quad (7)$$

$$I_R = (V_{\text{IN+}} - V_{\text{IN-}} - V_{\text{OUT}}) / R = (30\text{V} - 10\text{V}) / (R_{S1} + R_{S2}) = 20\text{V} / 30\text{k}\Omega = 0.667\text{mA} \quad (8)$$

This is an acceptable value for  $I_R$  that does not draw excessive current, but prevents the part from being starved for current.

## 8.2.4 Protecting Op-Amp Input



The bounding voltage is  $\pm 4$  V with the 2.5V LM4040-N (LM4040-N's reverse breakdown voltage + 3 diode  $V_F$ ).

**Figure 8-5. Protecting Op Amp Input**

### 8.2.4.1 Design Requirements

Limit the input voltage to the op-amp to  $\pm 4$ V.

### 8.2.4.2 Detailed Design Procedure

Similar to [Section 8.2.3](#), this design uses a LM4040-2.5 and three forward diode voltage drops to create a voltage clamp. The procedure for selecting the  $R_S$  resistors, in this case  $5\text{k}\Omega$ , is the same as [Section 8.2.3.2](#).

$$I_R = (V_{IN+} - V_{IN-} - V_{OUT}) / R = (10\text{V} - 2.5\text{V}) / (R_{S1} + R_{S2}) = 7.5\text{V} / 10\text{k}\Omega = 0.75\text{mA} \quad (9)$$

## 8.2.5 Precision $\pm 4.096\text{V}$ Reference

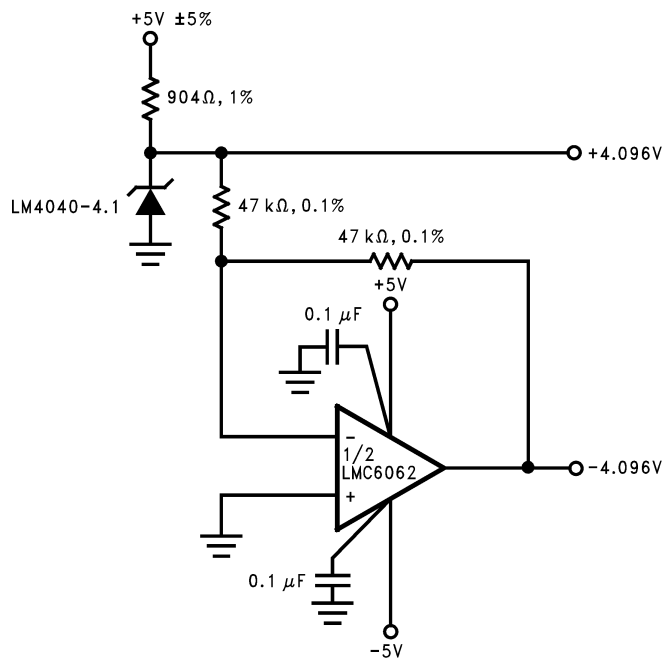


Figure 8-6. Precision  $\pm 4.096\text{V}$  Reference

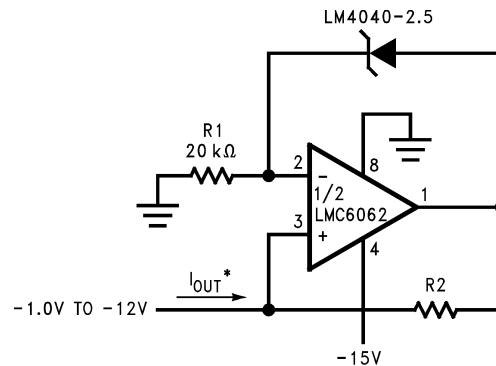
### 8.2.5.1 Design Requirements

Use a single voltage reference to create positive and negative reference rails,  $\pm 4.096\text{V}$ .

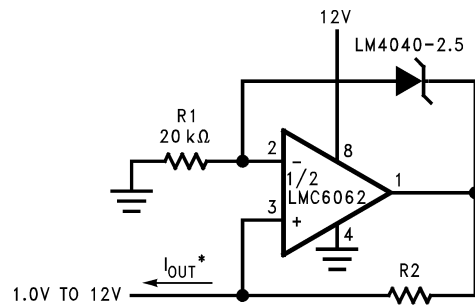
### 8.2.5.2 Detailed Design Procedure

The procedure for selecting the  $R_S$  resistor is same as detailed in [Section 8.2.2.2](#). The output of the voltage reference is used as the inverting input to the op-amp, with unity gain.

## 8.2.6 Precision Current Sink/Source



**Figure 8-7. Precision 1mA Current Sink**



**Figure 8-8. Precision 1mA Current Source**

### 8.2.6.1 Design Requirements

Create precision 1mA current sink and/or 1mA current source.

### 8.2.6.2 Detailed Design Procedure

Set R1 such that the current through the shunt reference,  $I_R$ , is greater than  $I_{RMIN}$ .

$I_{OUT} = V_{OUT} / R_2$  where  $V_{OUT}$  is the voltage drop across the shunt reference. In this case,

$$I_{OUT} = 2.5 / R_2$$

## 8.3 Power Supply Recommendations

While a bypass capacitor is not required on the input voltage line, TI recommends reducing noise on the input which can affect the output. A 0.1μF ceramic capacitor or larger is recommended.

## 8.4 Layout

### 8.4.1 Layout Guidelines

Place external components as close to the device as possible. Place  $R_S$  close the cathode, as well as the input bypass capacitor, if used.

### 8.4.2 Layout Example

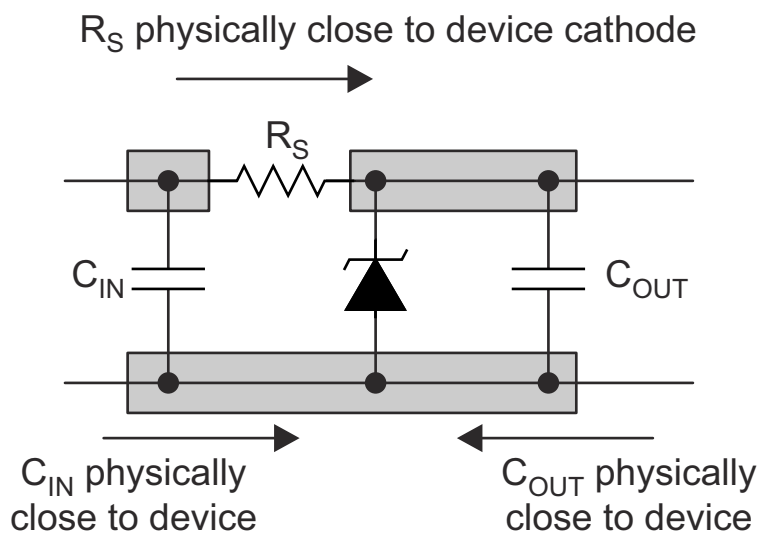


Figure 8-9. Layout Diagram



## 9 Device and Documentation Support

### 9.1 Documentation Support

#### 9.1.1 Related Documentation

For related documentation, see the following:

- [Absolute Maximum Ratings for Soldering Application Report](#) (SNOA549)
- [LM4041-N/LM4041-N-Q1 Precision Micropower Shunt Voltage Reference](#) (SNOS641)

### 9.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to order now.

**Table 9-1. Related Links**

| PARTS       | PRODUCT FOLDER             | ORDER NOW                  | TECHNICAL DOCUMENTS        | TOOLS & SOFTWARE           | SUPPORT & COMMUNITY        |
|-------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|
| LM4040-N    | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |
| LM4040-N-Q1 | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> | <a href="#">Click here</a> |

### 9.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](#). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 9.4 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

### 9.5 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

### 9.6 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 9.7 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 10 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision M (March 2025) to Revision N (May 2025) | Page              |
|---------------------------------------------------------------|-------------------|
| • Updated CDM value from 500V to 750V .....                   | <a href="#">5</a> |

| <b>Changes from Revision L (October 2018) to Revision M (March 2025)</b>                     | <b>Page</b>        |
|----------------------------------------------------------------------------------------------|--------------------|
| • Updated pinout diagrams.....                                                               | <a href="#">3</a>  |
| • Updated CDM ESD rating.....                                                                | <a href="#">5</a>  |
| • Updated reverse breakdown voltage change with operating current change specification.....  | <a href="#">33</a> |
| • Updated reverse breakdown voltage change with operating current change specification. .... | <a href="#">34</a> |
| • Added information on part numbers. ....                                                    | <a href="#">53</a> |

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**Changes from Revision K (June 2016) to Revision L (June 2024)****Page**

- Updated the numbering format for tables, figures, and cross-references throughout the document..... [1](#)
  - Removed soldering information from the *Absolute Maximum Ratings* table ..... [5](#)
-

## 11 Mechanical, Packaging, And Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation. Part numbers containing an "X" contain the same electrical properties as those which do not contain an "X"

### 11.1 SOT-23 and SC70 Package Marking Information

Only three fields of marking are possible on the SOT-23's and SC70's small surface. This table gives the meaning of the three fields.

First Field:

R = Reference

Second Field: Voltage Option

J = 2.048V Voltage Option

2 = 2.5V Voltage Option

K = 3V Voltage Option

4 = 4.096V Voltage Option

5 = 5V Voltage Option

8 = 8.192V Voltage Option

0 = 10V Voltage Option

Third Field: Initial Reverse Breakdown Voltage or Reference Voltage Tolerance

A =  $\pm 0.1\%$

B =  $\pm 0.2\%$

C =  $+0.5\%$

D =  $\pm 1.0\%$

E =  $\pm 2.0\%$

| PART MARKING      | FIELD DEFINITION               |
|-------------------|--------------------------------|
| RJA (SOT-23 only) | Reference, 2.048V, $\pm 0.1\%$ |
| R2A (SOT-23 only) | Reference, 2.5V, $\pm 0.1\%$   |
| RKA (SOT-23 only) | Reference, 3V, $\pm 0.1\%$     |
| R4A (SOT-23 only) | Reference, 4.096V, $\pm 0.1\%$ |
| R5A (SOT-23 only) | Reference, 5V, $\pm 0.1\%$     |
| R8A (SOT-23 only) | Reference, 8.192V, $\pm 0.1\%$ |
| R0A (SOT-23 only) | Reference, 10V, $\pm 0.1\%$    |
| RJB               | Reference, 2.048V, $\pm 0.2\%$ |
| R2B               | Reference, 2.5V, $\pm 0.2\%$   |
| RKB               | Reference, 3V, $\pm 0.2\%$     |
| R4B               | Reference, 4.096V, $\pm 0.2\%$ |
| R5B               | Reference, 5V, $\pm 0.2\%$     |
| R8B (SOT-23 only) | Reference, 8.192V, $\pm 0.2\%$ |
| R0B (SOT-23 only) | Reference, 10V, $\pm 0.2\%$    |
| RJC               | Reference, 2.048V, $\pm 0.5\%$ |
| R2C               | Reference, 2.5V, $\pm 0.5\%$   |

| PART MARKING      | FIELD DEFINITION               |
|-------------------|--------------------------------|
| RKC               | Reference, 3V, $\pm 0.5\%$     |
| R4C               | Reference, 4.096V, $\pm 0.5\%$ |
| R5C               | Reference, 5V, $\pm 0.5\%$     |
| R8C (SOT-23 only) | Reference, 8.192V, $\pm 0.5\%$ |
| R0C (SOT-23 only) | Reference, 10V, $\pm 0.5\%$    |
| RJD               | Reference, 2.048V, $\pm 1.0\%$ |
| R2D               | Reference, 2.5V, $\pm 1.0\%$   |
| RKD               | Reference, 3V, $\pm 1.0\%$     |
| R4D               | Reference, 4.096V, $\pm 1.0\%$ |
| R5D               | Reference, 5V, $\pm 1.0\%$     |
| R8D (SOT-23 only) | Reference, 8.192V, $\pm 1.0\%$ |
| R0D (SOT-23 only) | Reference, 10V, $\pm 1.0\%$    |
| RJE               | Reference, 2.048V, $\pm 2.0\%$ |
| R2E               | Reference, 2.5V, $\pm 2.0\%$   |
| RKE               | Reference, 3V, $\pm 2.0\%$     |

## PACKAGING INFORMATION

| Orderable part number                | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| LM4040AIM3-10.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R0A                 |
| <a href="#">LM4040AIM3-10.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R0A                 |
| LM4040AIM3-2.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJA                 |
| <a href="#">LM4040AIM3-2.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | RJA                 |
| LM4040AIM3-2.5/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2A                 |
| <a href="#">LM4040AIM3-2.5/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R2A                 |
| LM4040AIM3-3.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKA                 |
| <a href="#">LM4040AIM3-3.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKA                 |
| LM4040AIM3-4.1/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4A                 |
| <a href="#">LM4040AIM3-4.1/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R4A                 |
| LM4040AIM3-5.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5A                 |
| <a href="#">LM4040AIM3-5.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R5A                 |
| LM4040AIM3X-10/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R0A                 |
| <a href="#">LM4040AIM3X-10/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R0A                 |
| LM4040AIM3X-2.0/G4                   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJA                 |
| LM4040AIM3X-2.0/G4.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJA                 |
| LM4040AIM3X-2.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJA                 |
| <a href="#">LM4040AIM3X-2.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | RJA                 |
| LM4040AIM3X-2.5/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2A                 |
| <a href="#">LM4040AIM3X-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R2A                 |
| LM4040AIM3X-3.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKA                 |
| <a href="#">LM4040AIM3X-3.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | RKA                 |
| LM4040AIM3X-4.1/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4A                 |
| <a href="#">LM4040AIM3X-4.1/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R4A                 |
| LM4040AIM3X-5.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5A                 |
| <a href="#">LM4040AIM3X-5.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R5A                 |
| <a href="#">LM4040AIZ-10.0/NOPB</a>  | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI                              | N/A for Pkg Type                  | -            | 4040A<br>IZ10       |
| <a href="#">LM4040AIZ-2.5/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040A<br>IZ2.5      |

| Orderable part number                | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| LM4040AIZ-2.5/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI                              | N/A for Pkg Type                  | -40 to 85    | 4040A<br>IZ2.5      |
| LM4040AIZ-2.5/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI                              | N/A for Pkg Type                  | -40 to 85    | 4040A<br>IZ2.5      |
| <a href="#">LM4040AIZ-4.1/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040A<br>IZ4.1      |
| LM4040AIZ-4.1/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI                              | N/A for Pkg Type                  | -40 to 85    | 4040A<br>IZ4.1      |
| LM4040AIZ-4.1/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI                              | N/A for Pkg Type                  | -40 to 85    | 4040A<br>IZ4.1      |
| <a href="#">LM4040AIZ-5.0/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040A<br>IZ5.0      |
| LM4040AIZ-5.0/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040A<br>IZ5.0      |
| LM4040AIZ-5.0/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040A<br>IZ5.0      |
| LM4040BIM3-10.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R0B                 |
| <a href="#">LM4040BIM3-10.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R0B                 |
| LM4040BIM3-2.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJB                 |
| <a href="#">LM4040BIM3-2.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RJB                 |
| <a href="#">LM4040BIM3-2.5</a>       | Obsolete      | Production           | SOT-23 (DBZ)   3 | -                     | -           | Call TI                              | Call TI                           | -            | R2B                 |
| LM4040BIM3-2.5/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2B                 |
| <a href="#">LM4040BIM3-2.5/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R2B                 |
| LM4040BIM3-3.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKB                 |
| <a href="#">LM4040BIM3-3.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKB                 |
| LM4040BIM3-4.1/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4B                 |
| <a href="#">LM4040BIM3-4.1/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R4B                 |
| LM4040BIM3-5.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5B                 |
| <a href="#">LM4040BIM3-5.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5B                 |
| LM4040BIM3-8.2/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R8B                 |
| <a href="#">LM4040BIM3-8.2/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R8B                 |
| LM4040BIM3X-10/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R0B                 |
| <a href="#">LM4040BIM3X-10/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R0B                 |



| Orderable part number                | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| LM4040BIM3X-2.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJB                 |
| <a href="#">LM4040BIM3X-2.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RJB                 |
| LM4040BIM3X-2.5/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2B                 |
| <a href="#">LM4040BIM3X-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R2B                 |
| LM4040BIM3X-3.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKB                 |
| <a href="#">LM4040BIM3X-3.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKB                 |
| LM4040BIM3X-4.1/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4B                 |
| <a href="#">LM4040BIM3X-4.1/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R4B                 |
| LM4040BIM3X-5.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5B                 |
| <a href="#">LM4040BIM3X-5.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5B                 |
| LM4040BIM7-2.0/NO.A                  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | RJB                 |
| <a href="#">LM4040BIM7-2.0/NOPB</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | RJB                 |
| LM4040BIM7-2.5/NO.A                  | Active        | Production           | SC70 (DCK)   5   | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R2B                 |
| <a href="#">LM4040BIM7-2.5/NOPB</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R2B                 |
| LM4040BIM7-5.0/NO.A                  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R5B                 |
| <a href="#">LM4040BIM7-5.0/NOPB</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R5B                 |
| LM4040BIM7X-2.5/NO.A                 | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R2B                 |
| <a href="#">LM4040BIM7X-2.5/NOPB</a> | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R2B                 |
| <a href="#">LM4040BIZ-10.0/NOPB</a>  | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI                              | N/A for Pkg Type                  | -            | 4040B<br>IZ10       |
| <a href="#">LM4040BIZ-2.5/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040B<br>IZ2.5      |
| LM4040BIZ-2.5/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040B<br>IZ2.5      |
| LM4040BIZ-2.5/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040B<br>IZ2.5      |
| <a href="#">LM4040BIZ-4.1/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040B<br>IZ4.1      |
| LM4040BIZ-4.1/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040B<br>IZ4.1      |
| LM4040BIZ-4.1/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040B<br>IZ4.1      |

| Orderable part number                | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">LM4040BIZ-5.0/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040B<br>IZ5.0      |
| LM4040BIZ-5.0/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040B<br>IZ5.0      |
| LM4040BIZ-5.0/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040B<br>IZ5.0      |
| LM4040CEM3-2.5/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2C                 |
| <a href="#">LM4040CEM3-2.5/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R2C                 |
| LM4040CEM3-3.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKC                 |
| <a href="#">LM4040CEM3-3.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKC                 |
| LM4040CEM3-5.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5C                 |
| <a href="#">LM4040CEM3-5.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5C                 |
| LM4040CEM3X-3.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKC                 |
| <a href="#">LM4040CEM3X-3.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKC                 |
| LM4040CEM3X-5.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5C                 |
| <a href="#">LM4040CEM3X-5.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5C                 |
| LM4040CIM3-10.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R0C                 |
| <a href="#">LM4040CIM3-10.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R0C                 |
| LM4040CIM3-2.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJC                 |
| <a href="#">LM4040CIM3-2.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RJC                 |
| LM4040CIM3-2.5/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2C                 |
| <a href="#">LM4040CIM3-2.5/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R2C                 |
| LM4040CIM3-3.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKC                 |
| <a href="#">LM4040CIM3-3.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKC                 |
| LM4040CIM3-4.1/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4C                 |
| <a href="#">LM4040CIM3-4.1/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R4C                 |
| LM4040CIM3-5.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5C                 |
| <a href="#">LM4040CIM3-5.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5C                 |
| LM4040CIM3-8.2/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R8C                 |
| <a href="#">LM4040CIM3-8.2/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R8C                 |
| LM4040CIM3X-10/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R0C                 |

| Orderable part number                | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">LM4040CIM3X-10/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R0C                 |
| LM4040CIM3X-2.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJC                 |
| <a href="#">LM4040CIM3X-2.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RJC                 |
| LM4040CIM3X-2.5/G4                   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2C                 |
| LM4040CIM3X-2.5/G4.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2C                 |
| LM4040CIM3X-2.5/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2C                 |
| <a href="#">LM4040CIM3X-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R2C                 |
| LM4040CIM3X-3.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKC                 |
| <a href="#">LM4040CIM3X-3.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKC                 |
| LM4040CIM3X-4.1/G4                   | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4C                 |
| LM4040CIM3X-4.1/G4.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4C                 |
| LM4040CIM3X-4.1/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4C                 |
| <a href="#">LM4040CIM3X-4.1/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R4C                 |
| LM4040CIM3X-5.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5C                 |
| <a href="#">LM4040CIM3X-5.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5C                 |
| LM4040CIM7-2.0/NO.A                  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | RJC                 |
| <a href="#">LM4040CIM7-2.0/NOPB</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | RJC                 |
| LM4040CIM7-2.5/NO.A                  | Active        | Production           | SC70 (DCK)   5   | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R2C                 |
| <a href="#">LM4040CIM7-2.5/NOPB</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R2C                 |
| LM4040CIM7X-2.5/NO.A                 | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R2C                 |
| <a href="#">LM4040CIM7X-2.5/NOPB</a> | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R2C                 |
| <a href="#">LM4040CIZ-10.0/NOPB</a>  | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI                              | N/A for Pkg Type                  | -            | 4040C<br>IZ10       |
| <a href="#">LM4040CIZ-2.5/LFT8</a>   | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | Call TI                              | N/A for Pkg Type                  | -            | 4040C<br>IZ2.5      |
| LM4040CIZ-2.5/LFT8.A                 | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | Call TI                              | N/A for Pkg Type                  | -40 to 85    | 4040C<br>IZ2.5      |
| LM4040CIZ-2.5/LFT8.B                 | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | Call TI                              | N/A for Pkg Type                  | -40 to 85    | 4040C<br>IZ2.5      |
| <a href="#">LM4040CIZ-2.5/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040C<br>IZ2.5      |

| Orderable part number                | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| LM4040CIZ-2.5/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040C<br>IZ2.5      |
| LM4040CIZ-2.5/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040C<br>IZ2.5      |
| <a href="#">LM4040CIZ-4.1/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040C<br>IZ4.1      |
| LM4040CIZ-4.1/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040C<br>IZ4.1      |
| LM4040CIZ-4.1/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040C<br>IZ4.1      |
| <a href="#">LM4040CIZ-5.0/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040C<br>IZ5.0      |
| LM4040CIZ-5.0/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040C<br>IZ5.0      |
| LM4040CIZ-5.0/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040C<br>IZ5.0      |
| LM4040DEM3-2.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJD                 |
| <a href="#">LM4040DEM3-2.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RJD                 |
| LM4040DEM3-2.5/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2D                 |
| <a href="#">LM4040DEM3-2.5/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R2D                 |
| LM4040DEM3-3.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKD                 |
| <a href="#">LM4040DEM3-3.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKD                 |
| LM4040DEM3-5.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5D                 |
| <a href="#">LM4040DEM3-5.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5D                 |
| LM4040DEM3X-2.5/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2D                 |
| <a href="#">LM4040DEM3X-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R2D                 |
| LM4040DEM3X-5.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5D                 |
| <a href="#">LM4040DEM3X-5.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5D                 |
| LM4040DIM3-10.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R0D                 |
| <a href="#">LM4040DIM3-10.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R0D                 |
| LM4040DIM3-2.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJD                 |
| <a href="#">LM4040DIM3-2.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RJD                 |
| LM4040DIM3-2.5/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2D                 |

| Orderable part number                | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">LM4040DIM3-2.5/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R2D                 |
| <a href="#">LM4040DIM3-3.0/NO.A</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKD                 |
| <a href="#">LM4040DIM3-3.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKD                 |
| <a href="#">LM4040DIM3-4.1/NO.A</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4D                 |
| <a href="#">LM4040DIM3-4.1/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R4D                 |
| <a href="#">LM4040DIM3-5.0/NO.A</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5D                 |
| <a href="#">LM4040DIM3-5.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5D                 |
| <a href="#">LM4040DIM3-8.2/NO.A</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R8D                 |
| <a href="#">LM4040DIM3-8.2/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R8D                 |
| <a href="#">LM4040DIM3X-10/NO.A</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R0D                 |
| <a href="#">LM4040DIM3X-10/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R0D                 |
| <a href="#">LM4040DIM3X-2.0/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RJD                 |
| <a href="#">LM4040DIM3X-2.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RJD                 |
| <a href="#">LM4040DIM3X-2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2D                 |
| <a href="#">LM4040DIM3X-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R2D                 |
| <a href="#">LM4040DIM3X-3.0/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKD                 |
| <a href="#">LM4040DIM3X-3.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKD                 |
| <a href="#">LM4040DIM3X-4.1/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R4D                 |
| <a href="#">LM4040DIM3X-4.1/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R4D                 |
| <a href="#">LM4040DIM3X-5.0/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R5D                 |
| <a href="#">LM4040DIM3X-5.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R5D                 |
| <a href="#">LM4040DIM7-2.0/NO.A</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | RJD                 |
| <a href="#">LM4040DIM7-2.0/NOPB</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | RJD                 |
| <a href="#">LM4040DIM7-2.5/NO.A</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R2D                 |
| <a href="#">LM4040DIM7-2.5/NOPB</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R2D                 |
| <a href="#">LM4040DIM7-5.0/NO.A</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | R5D                 |
| <a href="#">LM4040DIM7-5.0/NOPB</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R5D                 |
| <a href="#">LM4040DIZ-10.0/NOPB</a>  | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI                              | N/A for Pkg Type                  | -            | 4040D<br>IZ10       |
| <a href="#">LM4040DIZ-2.5/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040D<br>IZ2.5      |

| Orderable part number                | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| LM4040DIZ-2.5/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040D<br>IZ2.5      |
| LM4040DIZ-2.5/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040D<br>IZ2.5      |
| <a href="#">LM4040DIZ-4.1/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040D<br>IZ4.1      |
| LM4040DIZ-4.1/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040D<br>IZ4.1      |
| LM4040DIZ-4.1/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040D<br>IZ4.1      |
| <a href="#">LM4040DIZ-5.0/LFT1</a>   | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -            | 4040D<br>IZ5.0      |
| LM4040DIZ-5.0/LFT1.B                 | Active        | Production           | TO-92 (LP)   3   | 2000   LARGE T&R      | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040D<br>IZ5.0      |
| <a href="#">LM4040DIZ-5.0/NOPB</a>   | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | Call TI   Sn                         | N/A for Pkg Type                  | -            | 4040D<br>IZ5.0      |
| LM4040DIZ-5.0/NOPB.A                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040D<br>IZ5.0      |
| LM4040DIZ-5.0/NOPB.B                 | Active        | Production           | TO-92 (LP)   3   | 1800   BULK           | Yes         | SN                                   | N/A for Pkg Type                  | -40 to 85    | 4040D<br>IZ5.0      |
| LM4040EEM3-2.5/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2E                 |
| <a href="#">LM4040EEM3-2.5/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R2E                 |
| LM4040EIM3-2.5/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2E                 |
| <a href="#">LM4040EIM3-2.5/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | R2E                 |
| LM4040EIM3-3.0/NO.A                  | Active        | Production           | SOT-23 (DBZ)   3 | 1000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKE                 |
| <a href="#">LM4040EIM3-3.0/NOPB</a>  | Active        | Production           | SOT-23 (DBZ)   3 | 1000   SMALL T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKE                 |
| LM4040EIM3X-2.5/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | R2E                 |
| <a href="#">LM4040EIM3X-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU   SN                          | Level-1-260C-UNLIM                | -            | R2E                 |
| LM4040EIM3X-3.0/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -40 to 85    | RKE                 |
| <a href="#">LM4040EIM3X-3.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | NIPDAU                               | Level-1-260C-UNLIM                | -            | RKE                 |
| LM4040EIM7-2.0/NO.A                  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 85    | RJE                 |
| <a href="#">LM4040EIM7-2.0/NOPB</a>  | Active        | Production           | SC70 (DCK)   5   | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | RJE                 |
| LM4040QAIM3-2.5/NO.A                 | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R6A                 |



| Orderable part number                | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">LM4040QAIM3-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6A                 |
| <a href="#">LM4040QAIM3X2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R6A                 |
| <a href="#">LM4040QAIM3X2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6A                 |
| <a href="#">LM4040QBIM3-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 1000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6B                 |
| <a href="#">LM4040QBIM3X2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R6B                 |
| <a href="#">LM4040QBIM3X2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6B                 |
| <a href="#">LM4040QCEM3-2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R2C                 |
| <a href="#">LM4040QCEM3-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R2C                 |
| <a href="#">LM4040QCEM3-3.0/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R3C                 |
| <a href="#">LM4040QCEM3-3.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R3C                 |
| <a href="#">LM4040QCIM3-2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R6C                 |
| <a href="#">LM4040QCIM3-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6C                 |
| <a href="#">LM4040QCIM3X2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R6C                 |
| <a href="#">LM4040QCIM3X2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6C                 |
| <a href="#">LM4040QDEM3-2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R2D                 |
| <a href="#">LM4040QDEM3-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R2D                 |
| <a href="#">LM4040QDEM3-3.0/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R3D                 |
| <a href="#">LM4040QDEM3-3.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R3D                 |
| <a href="#">LM4040QDIM3-2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R6D                 |
| <a href="#">LM4040QDIM3-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6D                 |
| <a href="#">LM4040QDIM3X2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R6D                 |
| <a href="#">LM4040QDIM3X2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6D                 |
| <a href="#">LM4040QEEM3-2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R2E                 |
| <a href="#">LM4040QEEM3-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R2E                 |
| <a href="#">LM4040QEEM3-3.0/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R3E                 |
| <a href="#">LM4040QEEM3-3.0/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R3E                 |
| <a href="#">LM4040QEIM3-2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R6E                 |
| <a href="#">LM4040QEIM3-2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   SMALL T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6E                 |
| <a href="#">LM4040QEIM3X2.5/NO.A</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -40 to 125   | R6E                 |
| <a href="#">LM4040QEIM3X2.5/NOPB</a> | Active        | Production           | SOT-23 (DBZ)   3 | 3000   LARGE T&R      | Yes         | SN                                   | Level-1-260C-UNLIM                | -            | R6E                 |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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**OTHER QUALIFIED VERSIONS OF LM4040-N, LM4040-N-Q1 :**

- Catalog : [LM4040-N](#)
- Automotive : [LM4040-N-Q1](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects



**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

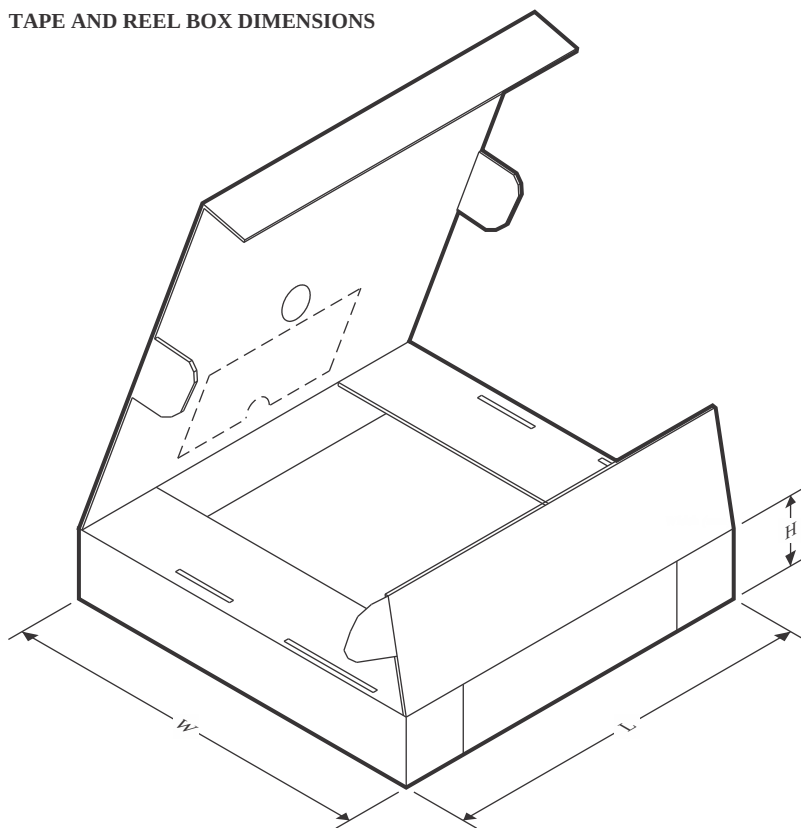
| Device               | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM4040AIM3-10.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040AIM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3-4.1/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3X-10/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040AIM3X-2.0/G4   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3X-2.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3X-4.1/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040AIM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM3-10.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040BIM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |

| Device               | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM4040BIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM3-4.1/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM3-8.2/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040BIM3X-10/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040BIM3X-2.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM3X-4.1/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040BIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040BIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040BIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040BIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040BIM7-5.0/NOPB  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040BIM7-5.0/NOPB  | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040BIM7X-2.5/NOPB | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040BIM7X-2.5/NOPB | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040CEM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CEM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CEM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CEM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CEM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3-10.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040CIM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3-4.1/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3-8.2/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040CIM3X-10/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040CIM3X-2.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3X-2.5/G4   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3X-4.1/G4   | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3X-4.1/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040CIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040CIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040CIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |

| Device               | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM4040CIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040CIM7X-2.5/NOPB | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040CIM7X-2.5/NOPB | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040DEM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DEM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DEM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DEM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DEM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DEM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3-10.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040DIM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3-4.1/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3-8.2/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040DIM3X-10/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040DIM3X-2.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3X-4.1/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040DIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040DIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040DIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040DIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040DIM7-5.0/NOPB  | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040DIM7-5.0/NOPB  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040EEM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040EIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040EIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040EIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040EIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 2.9     | 3.35    | 1.35    | 4.0     | 8.0    | Q3            |
| LM4040EIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 180.0              | 8.4                | 2.3     | 2.5     | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040EIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 178.0              | 8.4                | 2.25    | 2.45    | 1.2     | 4.0     | 8.0    | Q3            |
| LM4040QAIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QAIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QAIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QAIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QBIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 1000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QBIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |

| Device               | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|----------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM4040QBIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QCEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QCEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QCEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QCEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QCIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QCIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QCIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QCIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QDEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QDEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QDEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QDEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QDIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QDIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QDIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QDIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QEEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QEEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QEEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QEEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QEIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |
| LM4040QEIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QEIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 178.0              | 8.4                | 3.3     | 2.9     | 1.22    | 4.0     | 8.0    | Q3            |
| LM4040QEIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 180.0              | 8.4                | 3.2     | 2.85    | 1.3     | 4.0     | 8.0    | Q3            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device               | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM4040AIM3-10.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040AIM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3-4.1/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3X-10/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040AIM3X-2.0/G4   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3X-2.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3X-4.1/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040AIM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM3-10.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040BIM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM3-4.1/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |

| Device               | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM4040BIM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM3-8.2/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040BIM3X-10/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040BIM3X-2.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM3X-4.1/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040BIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040BIM7-5.0/NOPB  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM7-5.0/NOPB  | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040BIM7X-2.5/NOPB | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040BIM7X-2.5/NOPB | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040CEM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CEM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CEM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CEM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CEM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3-10.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040CIM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3-4.1/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3-8.2/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040CIM3X-10/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040CIM3X-2.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3X-2.5/G4   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3X-4.1/G4   | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3X-4.1/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040CIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040CIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM7X-2.5/NOPB | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040CIM7X-2.5/NOPB | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040DEM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |

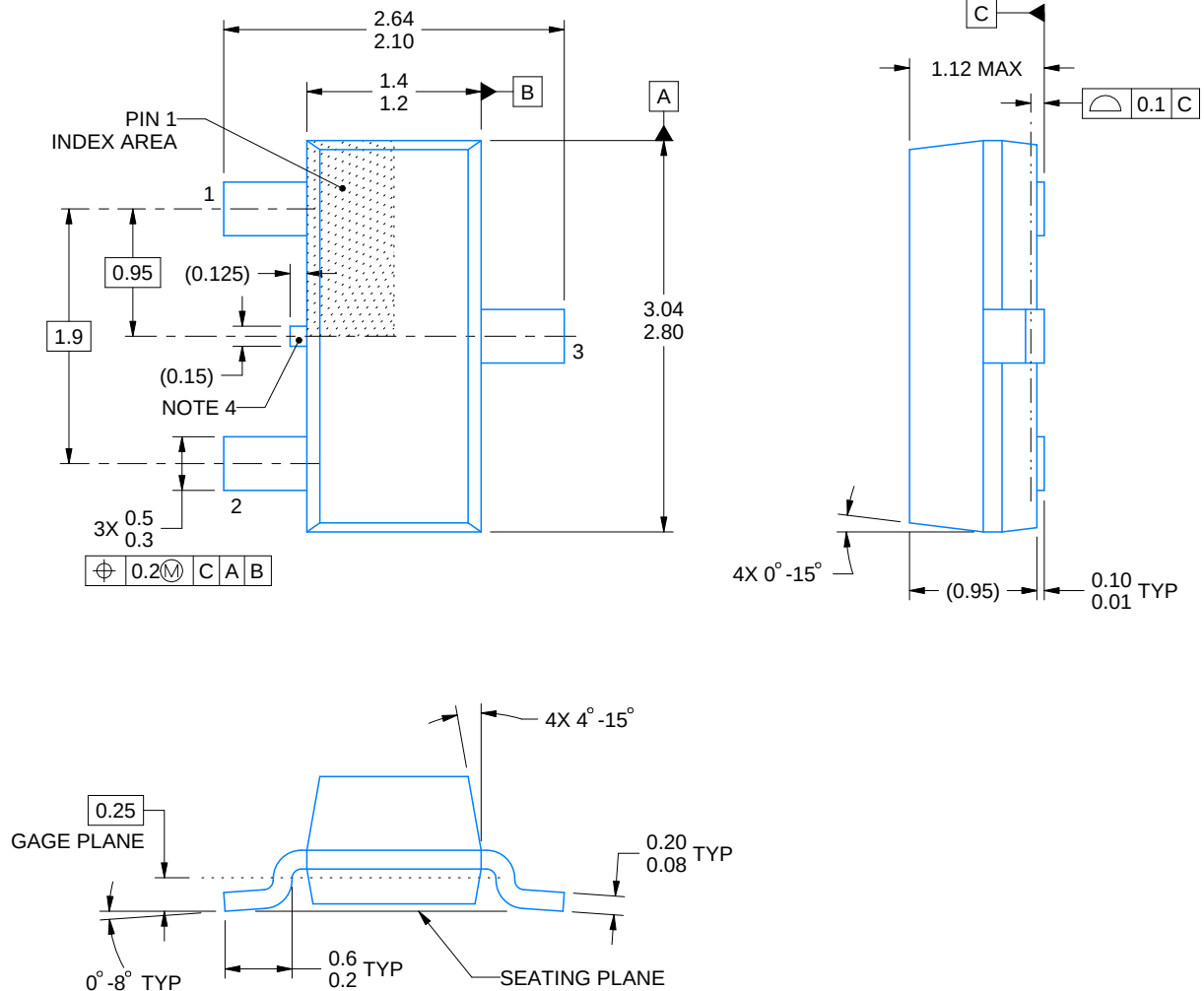
| Device               | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM4040DEM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DEM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DEM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DEM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DEM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3-10.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040DIM3-2.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3-4.1/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3-5.0/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3-8.2/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040DIM3X-10/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040DIM3X-2.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3X-4.1/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM3X-5.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040DIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040DIM7-2.5/NOPB  | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040DIM7-5.0/NOPB  | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040DIM7-5.0/NOPB  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040EEM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040EIM3-2.5/NOPB  | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040EIM3-3.0/NOPB  | SOT-23       | DBZ             | 3    | 1000 | 210.0       | 185.0      | 35.0        |
| LM4040EIM3X-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040EIM3X-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040EIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040EIM7-2.0/NOPB  | SC70         | DCK             | 5    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QAIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QAIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QAIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QAIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QBIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 1000 | 208.0       | 191.0      | 35.0        |
| LM4040QBIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QBIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QCEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QCEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QCEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QCEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040OCIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |

| Device               | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM4040QCIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QCIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QCIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QDEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QDEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QDEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QDEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QDIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QDIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QDIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QDIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QEEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QEEM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QEEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QEEM3-3.0/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QEIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |
| LM4040QEIM3-2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QEIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 208.0       | 191.0      | 35.0        |
| LM4040QEIM3X2.5/NOPB | SOT-23       | DBZ             | 3    | 3000 | 210.0       | 185.0      | 35.0        |



**DBZ0003A****PACKAGE OUTLINE****SOT-23 - 1.12 mm max height**

SMALL OUTLINE TRANSISTOR



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**NOTES:**

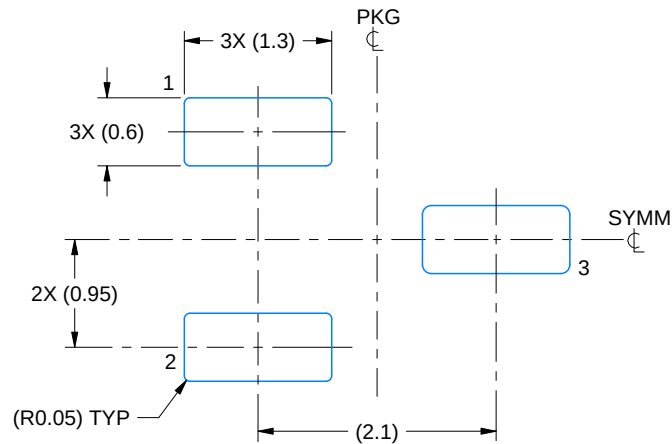
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-236, except minimum foot length.
4. Support pin may differ or may not be present.
5. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side

# EXAMPLE BOARD LAYOUT

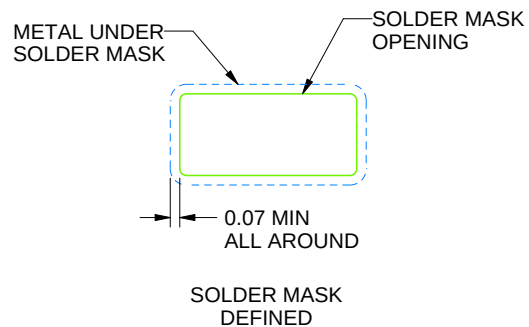
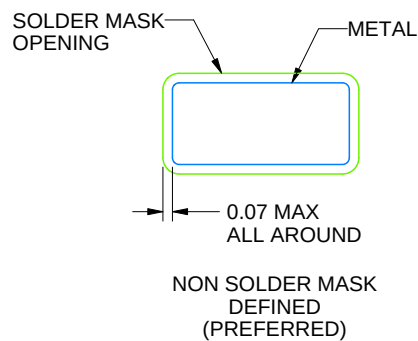
DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

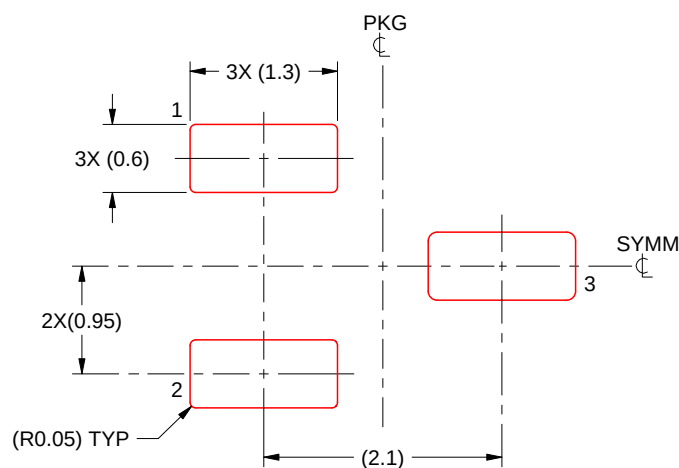
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR

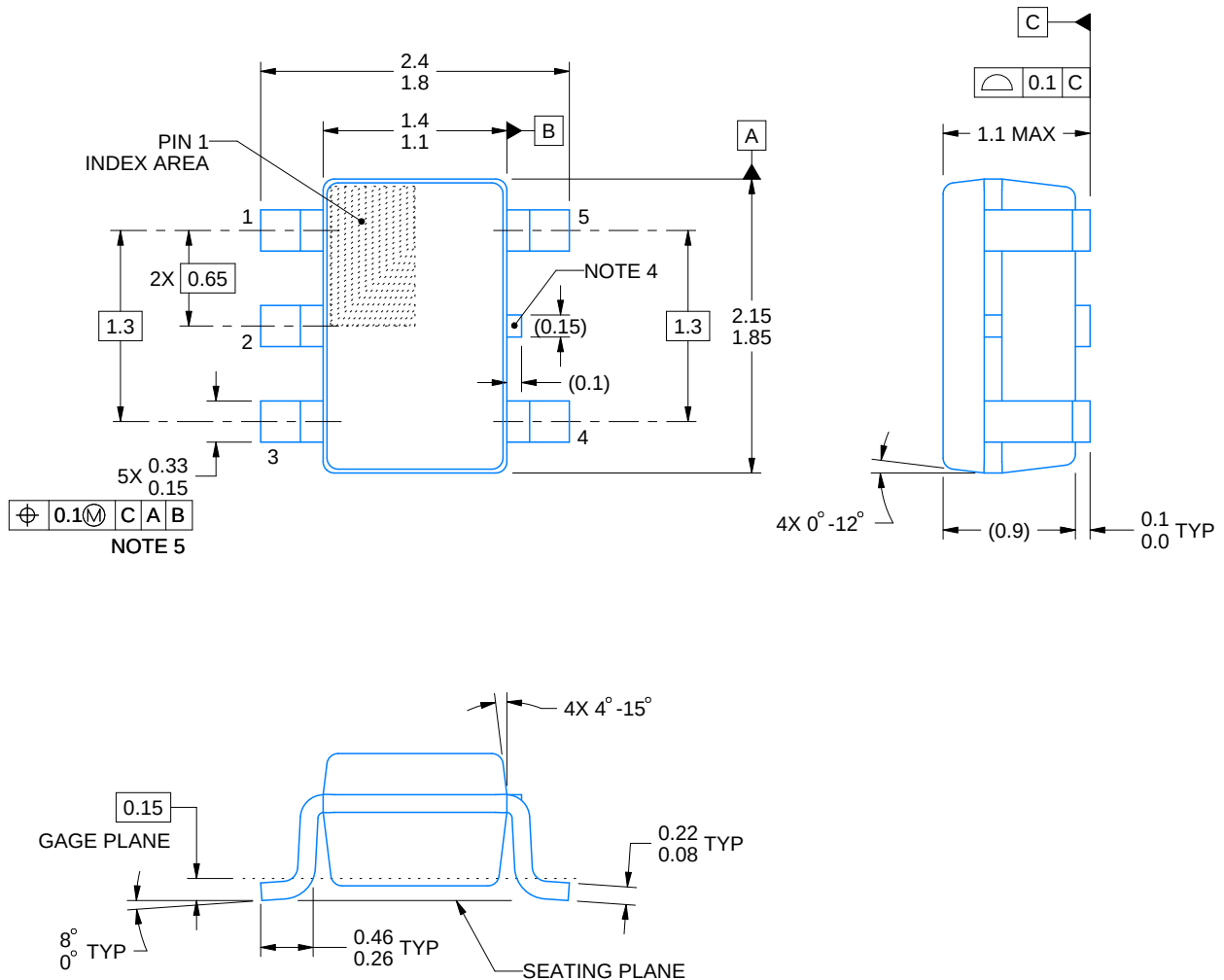


SOLDER PASTE EXAMPLE  
BASED ON 0.125 THICK STENCIL  
SCALE:15X

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NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.



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## NOTES:

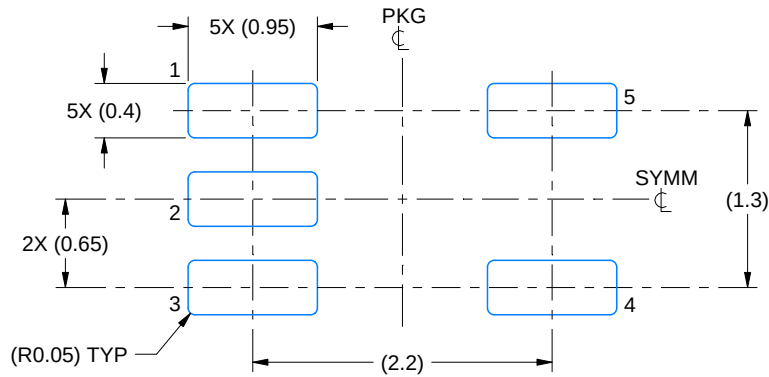
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC MO-203.
4. Support pin may differ or may not be present.
5. Lead width does not comply with JEDEC.
6. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side

# EXAMPLE BOARD LAYOUT

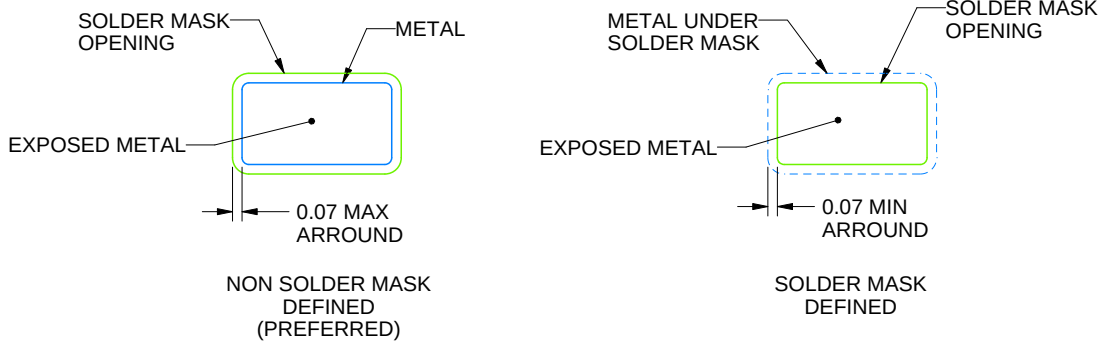
DCK0005A

SOT - 1.1 max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:18X

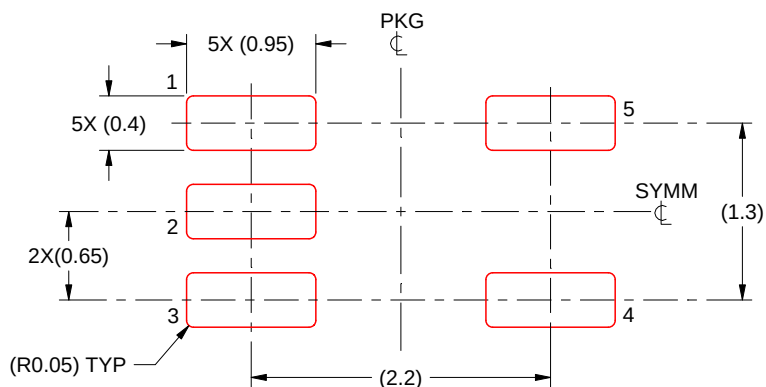


SOLDER MASK DETAILS

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NOTES: (continued)

7. Publication IPC-7351 may have alternate designs.
8. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE  
BASED ON 0.125 THICK STENCIL  
SCALE:18X

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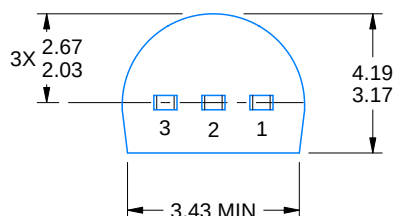
NOTES: (continued)

9. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
10. Board assembly site may have different recommendations for stencil design.



**TO-92 - 5.34 mm max height**

### STRAIGHT LEAD OPTION



NOTES:

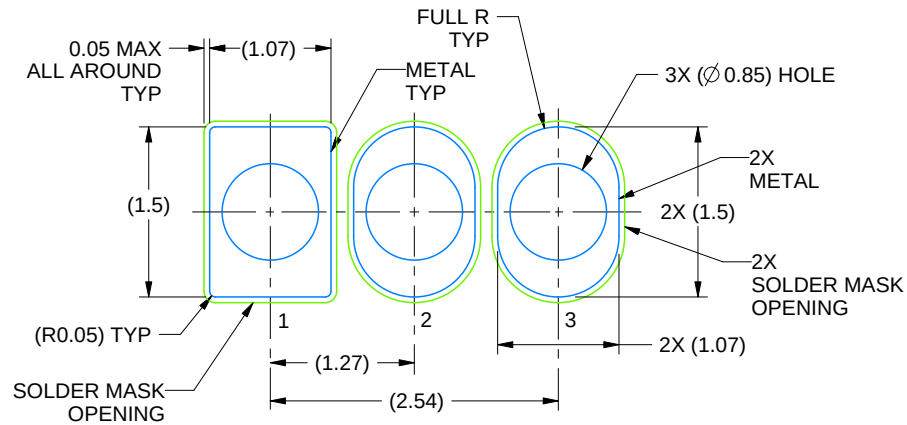
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Lead dimensions are not controlled within this area.
4. Reference JEDEC TO-226, variation AA.
5. Shipping method:
  - a. Straight lead option available in bulk pack only.
  - b. Formed lead option available in tape and reel or ammo pack.
  - c. Specific products can be offered in limited combinations of shipping medium and lead options.
  - d. Consult product folder for more information on available options.

# EXAMPLE BOARD LAYOUT

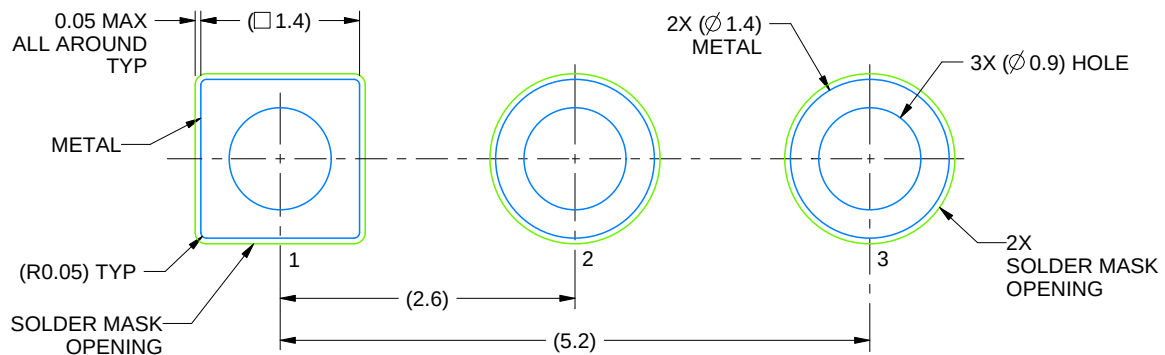
LP0003A

TO-92 - 5.34 mm max height

TO-92



LAND PATTERN EXAMPLE  
STRAIGHT LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X



LAND PATTERN EXAMPLE  
FORMED LEAD OPTION  
NON-SOLDER MASK DEFINED  
SCALE:15X

4215214/C 04/2025





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