

## REF19x Series

### FEATURES

**Initial accuracy:**  $\pm 2$  mV max  
**Temperature coefficient:** 5 ppm/ $^{\circ}$ C max  
**Low supply current:** 45  $\mu$ A max  
**Sleep mode:** 15  $\mu$ A max  
**Low dropout voltage**  
**Load regulation:** 4 ppm/mA  
**Line regulation:** 4 ppm/V  
**High output current:** 30 mA  
**Short-circuit protection**

### APPLICATIONS

**Portable instruments**  
**A/D and D/A converters**  
**Smart sensors**  
**Solar-powered applications**  
**Loop-current-powered instruments**

### GENERAL DESCRIPTION

The REF19x series precision band gap voltage references use a patented temperature drift curvature correction circuit and laser trimming of highly stable, thin-film resistors to achieve a very low temperature coefficient and high initial accuracy.

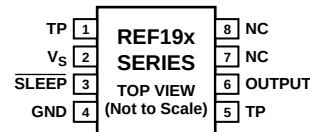
The REF19x series is made up of micropower, low dropout voltage (LDV) devices, providing stable output voltage from supplies as low as 100 mV above the output voltage and consuming less than 45  $\mu$ A of supply current. In sleep mode, which is enabled by applying a low TTL or CMOS level to the SLEEP pin, the output is turned off and supply current is further reduced to less than 15  $\mu$ A.

The REF19x series references are specified over the extended industrial temperature range ( $-40^{\circ}$ C to  $+85^{\circ}$ C) with typical performance specifications over  $-40^{\circ}$ C to  $+125^{\circ}$ C for applications, such as automotive.

All electrical grades are available in an 8-lead SOIC package; the PDIP and TSSOP packages are available only in the lowest electrical grade. Products are also available in die form.

### TEST PINS

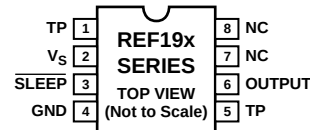
Test Pin 1 and Test Pin 5 are reserved for in-package Zener zap. To achieve the highest level of accuracy at the output, the Zener zapping technique is used to trim the output voltage. Since each unit may require a different amount of adjustment, the resistance value at the test pins varies widely from pin to pin and from part to part. The user should leave Pin 1 and Pin 5 unconnected.



**NOTES**  
 1. NC = NO CONNECT.  
 2. TP PINS ARE FACTORY TEST POINTS, NO USER CONNECTION.

00371-001

Figure 1. 8-Lead SOIC and TSSOP Pin Configuration  
(S Suffix and RU Suffix)



**NOTES**  
 1. NC = NO CONNECT.  
 2. TP PINS ARE FACTORY TEST POINTS, NO USER CONNECTION.

00371-002

Figure 2. 8-Lead PDIP Pin Configuration  
(P Suffix)

Table 1. Nominal Output Voltage

| Part Number | Nominal Output Voltage (V) |
|-------------|----------------------------|
| REF191      | 2.048                      |
| REF192      | 2.50                       |
| REF193      | 3.00                       |
| REF194      | 4.50                       |
| REF195      | 5.00                       |
| REF196      | 3.30                       |
| REF198      | 4.096                      |

### Rev. H

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## SPECIFICATIONS

### ELECTRICAL CHARACTERISTICS—REF191 @ $T_A = 25^\circ\text{C}$

@  $V_S = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ , unless otherwise noted.

Table 2.

| Parameter                        | Mnemonic                       | Condition                                                           | Min   | Typ   | Max   | Unit              |
|----------------------------------|--------------------------------|---------------------------------------------------------------------|-------|-------|-------|-------------------|
| INITIAL ACCURACY <sup>1</sup>    |                                |                                                                     |       |       |       |                   |
| E Grade                          | $V_O$                          | $I_{OUT} = 0\text{ mA}$                                             | 2.046 | 2.048 | 2.050 | V                 |
| F Grade                          |                                |                                                                     | 2.043 |       | 2.053 | V                 |
| G Grade                          |                                |                                                                     | 2.038 |       | 2.058 | V                 |
| LINE REGULATION <sup>2</sup>     |                                |                                                                     |       |       |       |                   |
| E Grade                          | $\Delta V_O / \Delta V_{IN}$   | $3.0\text{ V} \leq V_S \leq 15\text{ V}$ , $I_{OUT} = 0\text{ mA}$  |       | 2     | 4     | ppm/V             |
| F and G Grades                   |                                |                                                                     |       | 4     | 8     | ppm/V             |
| LOAD REGULATION <sup>2</sup>     |                                |                                                                     |       |       |       |                   |
| E Grade                          | $\Delta V_O / \Delta V_{LOAD}$ | $V_S = 5.0\text{ V}$ , $0\text{ mA} \leq I_{OUT} \leq 30\text{ mA}$ |       | 4     | 10    | ppm/mA            |
| F and G Grades                   |                                |                                                                     |       | 6     | 15    | ppm/mA            |
| DROPOUT VOLTAGE                  | $V_S - V_O$                    | $V_S = 3.15\text{ V}$ , $I_{LOAD} = 2\text{ mA}$                    |       |       | 0.95  | V                 |
|                                  |                                | $V_S = 3.3\text{ V}$ , $I_{LOAD} = 10\text{ mA}$                    |       |       | 1.25  | V                 |
|                                  |                                | $V_S = 3.6\text{ V}$ , $I_{LOAD} = 30\text{ mA}$                    |       |       | 1.55  | V                 |
| LONG-TERM STABILITY <sup>3</sup> | $DV_O$                         | 1,000 hours @ $125^\circ\text{C}$                                   |       | 1.2   |       | mV                |
| NOISE VOLTAGE                    | $e_N$                          | 0.1 Hz to 10 Hz                                                     |       | 20    |       | $\mu\text{V p-p}$ |

<sup>1</sup> Initial accuracy includes temperature hysteresis effect.

<sup>2</sup> Line and load regulation specifications include the effect of self-heating.

<sup>3</sup> Long-term stability specification is noncumulative. The drift in subsequent 1,000 hour periods is significantly lower than in the first 1,000 hour period.

# REF19x Series

## ELECTRICAL CHARACTERISTICS—REF191 @ $-40^{\circ}\text{C} \leq +85^{\circ}\text{C}$

@  $V_S = 3.3\text{ V}$ ,  $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ , unless otherwise noted.

Table 3.

| Parameter                               | Mnemonic                        | Condition                                                                                                                                                   | Min | Typ | Max                  | Unit        |
|-----------------------------------------|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----------------------|-------------|
| TEMPERATURE COEFFICIENT <sup>1, 2</sup> |                                 |                                                                                                                                                             |     |     |                      |             |
| E Grade                                 | TCV <sub>O</sub> /°C            | I <sub>OUT</sub> = 0 mA                                                                                                                                     |     | 2   | 5                    | ppm/°C      |
| F Grade                                 |                                 |                                                                                                                                                             |     | 5   | 10                   | ppm/°C      |
| G Grade <sup>3</sup>                    |                                 |                                                                                                                                                             |     | 10  | 25                   | ppm/°C      |
| LINE REGULATION <sup>4</sup>            |                                 |                                                                                                                                                             |     |     |                      |             |
| E Grade                                 | $\Delta V_O / \Delta V_{IN}$    | 3.0 V $\leq V_S \leq$ 15 V, I <sub>OUT</sub> = 0 mA                                                                                                         |     | 5   | 10                   | ppm/V       |
| F and G Grades                          |                                 |                                                                                                                                                             |     | 10  | 20                   | ppm/V       |
| LOAD REGULATION <sup>4</sup>            |                                 |                                                                                                                                                             |     |     |                      |             |
| E Grade                                 | $\Delta V_O / \Delta V_{LOAD}$  | V <sub>S</sub> = 5.0 V, 0 mA $\leq$ I <sub>OUT</sub> $\leq$ 25 C                                                                                            |     | 5   | 15                   | ppm/mA      |
| F and G Grades                          |                                 |                                                                                                                                                             |     | 10  | 20                   | ppm/mA      |
| DROPOUT VOLTAGE                         | V <sub>S</sub> – V <sub>O</sub> | V <sub>S</sub> = 3.15 V, I <sub>LOAD</sub> = 2 mA<br>V <sub>S</sub> = 3.3 V, I <sub>LOAD</sub> = 10 mA<br>V <sub>S</sub> = 3.6 V, I <sub>LOAD</sub> = 25 mA |     |     | 0.95<br>1.25<br>1.55 | V<br>V<br>V |
| SLEEP PIN                               |                                 |                                                                                                                                                             |     |     |                      |             |
| Logic High Input Voltage                | V <sub>H</sub>                  |                                                                                                                                                             | 2.4 |     |                      | V           |
| Logic High Input Current                | I <sub>H</sub>                  |                                                                                                                                                             |     |     | –8                   | μA          |
| Logic Low Input Voltage                 | V <sub>L</sub>                  |                                                                                                                                                             |     |     | 0.8                  | V           |
| Logic Low Input Current                 | I <sub>L</sub>                  |                                                                                                                                                             |     |     | –8                   | μA          |
| SUPPLY CURRENT                          |                                 | No load                                                                                                                                                     |     |     | 45                   | μA          |
| Sleep Mode                              |                                 | No load                                                                                                                                                     |     |     | 15                   | μA          |

<sup>1</sup> For proper operation, a 1 μF capacitor is required between the output pin and the GND pin of the device.

<sup>2</sup> TCV<sub>O</sub> is defined as the ratio of output change with temperature variation to the specified temperature range expressed in ppm/°C.  

$$TCV_O = (V_{MAX} - V_{MIN}) / V_O (T_{MAX} - T_{MIN})$$

<sup>3</sup> Guaranteed by characterization.

<sup>4</sup> Line and load regulation specifications include the effect of self-heating.

**ELECTRICAL CHARACTERISTICS—REF191 @  $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$** 

@  $V_S = 3.3\text{ V}$ ,  $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ , unless otherwise noted.

**Table 4.**

| Parameter                               | Mnemonic                        | Condition                                                          | Min | Typ | Max  | Unit   |
|-----------------------------------------|---------------------------------|--------------------------------------------------------------------|-----|-----|------|--------|
| TEMPERATURE COEFFICIENT <sup>1, 2</sup> |                                 |                                                                    |     |     |      |        |
| E Grade                                 | TCV <sub>O</sub> /°C            | I <sub>OUT</sub> = 0 mA                                            |     | 2   |      | ppm/°C |
| F Grade                                 |                                 |                                                                    |     | 5   |      | ppm/°C |
| G Grade <sup>3</sup>                    |                                 |                                                                    |     | 10  |      | ppm/°C |
| LINE REGULATION <sup>4</sup>            |                                 |                                                                    |     |     |      |        |
| E Grade                                 | $\Delta V_O / \Delta V_{IN}$    | $3.0\text{ V} \leq V_S \leq 15\text{ V}$ , I <sub>OUT</sub> = 0 mA |     | 10  |      | ppm/V  |
| F and G Grades                          |                                 |                                                                    |     | 20  |      | ppm/V  |
| LOAD REGULATION <sup>4</sup>            |                                 |                                                                    |     |     |      |        |
| E Grade                                 | $\Delta V_O / \Delta V_{LOAD}$  | $V_S = 5.0\text{ V}$ , 0 mA ≤ I <sub>OUT</sub> ≤ 20 mA             |     | 10  |      | ppm/mA |
| F and G Grades                          |                                 |                                                                    |     | 20  |      | ppm/mA |
| DROPOUT VOLTAGE                         | V <sub>S</sub> – V <sub>O</sub> | V <sub>S</sub> = 3.3 V, I <sub>LOAD</sub> = 10 mA                  |     |     | 1.25 | V      |
|                                         |                                 | V <sub>S</sub> = 3.6 V, I <sub>LOAD</sub> = 20 mA                  |     |     | 1.55 | V      |

<sup>1</sup> For proper operation, a 1 μF capacitor is required between the output pin and the GND pin of the device.

<sup>2</sup> TCV<sub>O</sub> is defined as the ratio of output change with temperature variation to the specified temperature range expressed in ppm/°C.

$$TCV_O = (V_{MAX} - V_{MIN}) / V_O (T_{MAX} - T_{MIN})$$

<sup>3</sup> Guaranteed by characterization.

<sup>4</sup> Line and load regulation specifications include the effect of self-heating.

**ELECTRICAL CHARACTERISTICS—REF192 @  $T_A = 25^{\circ}\text{C}$** 

@  $V_S = 3.3\text{ V}$ ,  $T_A = 25^{\circ}\text{C}$ , unless otherwise noted.

**Table 5.**

| Parameter                        | Mnemonic                        | Condition                                                          | Min   | Typ   | Max   | Unit   |
|----------------------------------|---------------------------------|--------------------------------------------------------------------|-------|-------|-------|--------|
| INITIAL ACCURACY <sup>1</sup>    |                                 |                                                                    |       |       |       |        |
| E Grade                          | V <sub>O</sub>                  | I <sub>OUT</sub> = 0 mA                                            | 2.498 | 2.500 | 2.502 | V      |
| F Grade                          |                                 |                                                                    | 2.495 |       | 2.505 | V      |
| G Grade                          |                                 |                                                                    | 2.490 |       | 2.510 | V      |
| LINE REGULATION <sup>2</sup>     |                                 |                                                                    |       |       |       |        |
| E Grade                          | $\Delta V_O / \Delta V_{IN}$    | $3.0\text{ V} \leq V_S \leq 15\text{ V}$ , I <sub>OUT</sub> = 0 mA |       | 2     | 4     | ppm/V  |
| F and G Grades                   |                                 |                                                                    |       | 4     | 8     | ppm/V  |
| LOAD REGULATION <sup>2</sup>     |                                 |                                                                    |       |       |       |        |
| E Grade                          | $\Delta V_O / \Delta V_{LOAD}$  | $V_S = 5.0\text{ V}$ , 0 mA ≤ I <sub>OUT</sub> ≤ 30 mA             |       | 4     | 10    | ppm/mA |
| F and G Grades                   |                                 |                                                                    |       | 6     | 15    | ppm/mA |
| DROPOUT VOLTAGE                  | V <sub>S</sub> – V <sub>O</sub> | V <sub>S</sub> = 3.5 V, I <sub>LOAD</sub> = 10 mA                  |       |       | 1.00  | V      |
|                                  |                                 | V <sub>S</sub> = 3.9 V, I <sub>LOAD</sub> = 30 mA                  |       |       | 1.40  | V      |
| LONG-TERM STABILITY <sup>3</sup> | DV <sub>O</sub>                 | 1,000 hours @ 125°C                                                |       | 1.2   |       | mV     |
| NOISE VOLTAGE                    | e <sub>N</sub>                  | 0.1 Hz to 10 Hz                                                    |       | 25    |       | μV p-p |

<sup>1</sup> Initial accuracy includes temperature hysteresis effect.

<sup>2</sup> Line and load regulation specifications include the effect of self-heating.

<sup>3</sup> Long-term stability specification is noncumulative. The drift in subsequent 1,000 hour periods is significantly lower than in the first 1,000 hour period.

# REF19x Series

## ELECTRICAL CHARACTERISTICS—REF192 @ $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$

@  $V_S = 3.3\text{ V}$ ,  $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ , unless otherwise noted.

Table 6.

| Parameter                               | Mnemonic                        | Condition                                               | Min | Typ | Max  | Unit   |
|-----------------------------------------|---------------------------------|---------------------------------------------------------|-----|-----|------|--------|
| TEMPERATURE COEFFICIENT <sup>1, 2</sup> |                                 |                                                         |     |     |      |        |
| E Grade                                 | TCV <sub>O</sub> /°C            | I <sub>OUT</sub> = 0 mA                                 |     | 2   | 5    | ppm/°C |
| F Grade                                 |                                 |                                                         |     | 5   | 10   | ppm/°C |
| G Grade <sup>3</sup>                    |                                 |                                                         |     | 10  | 25   | ppm/°C |
| LINE REGULATION <sup>4</sup>            |                                 |                                                         |     |     |      |        |
| E Grade                                 | $\Delta V_O/\Delta V_{IN}$      | 3.0 V ≤ V <sub>S</sub> ≤ 15 V, I <sub>OUT</sub> = 0 mA  |     | 5   | 10   | ppm/V  |
| F and G Grades                          |                                 |                                                         |     | 10  | 20   | ppm/V  |
| LOAD REGULATION <sup>4</sup>            |                                 |                                                         |     |     |      |        |
| E Grade                                 | $\Delta V_O/\Delta V_{LOAD}$    | V <sub>S</sub> = 5.0 V, 0 mA ≤ I <sub>OUT</sub> ≤ 25 mA |     | 5   | 15   | ppm/mA |
| F and G Grades                          |                                 |                                                         |     | 10  | 20   | ppm/mA |
| DROPOUT VOLTAGE                         | V <sub>S</sub> – V <sub>O</sub> | V <sub>S</sub> = 3.5 V, I <sub>LOAD</sub> = 10 mA       |     |     | 1.00 | V      |
|                                         |                                 | V <sub>S</sub> = 4.0 V, I <sub>LOAD</sub> = 25 mA       |     |     | 1.50 | V      |
| SLEEP PIN                               |                                 |                                                         |     |     |      |        |
| Logic High Input Voltage                | V <sub>H</sub>                  |                                                         | 2.4 |     |      | V      |
| Logic High Input Current                | I <sub>H</sub>                  |                                                         |     |     | –8   | μA     |
| Logic Low Input Voltage                 | V <sub>L</sub>                  |                                                         |     |     | 0.8  | V      |
| Logic Low Input Current                 | I <sub>L</sub>                  |                                                         |     |     | –8   | μA     |
| SUPPLY CURRENT                          |                                 | No load                                                 |     |     | 45   | μA     |
| Sleep Mode                              |                                 | No load                                                 |     |     | 15   | μA     |

<sup>1</sup> For proper operation, a 1 μF capacitor is required between the output pin and the GND pin of the device.

<sup>2</sup> TCV<sub>O</sub> is defined as the ratio of output change with temperature variation to the specified temperature range expressed in ppm/°C.

$$TCV_O = (V_{MAX} - V_{MIN})/V_O(T_{MAX} - T_{MIN})$$

<sup>3</sup> Guaranteed by characterization.

<sup>4</sup> Line and load regulation specifications include the effect of self-heating.

## ELECTRICAL CHARACTERISTICS—REF192 @ $-40^{\circ} \leq T_A \leq +125^{\circ}\text{C}$

@  $V_S = 3.3\text{ V}$ ,  $-40^{\circ} \leq T_A \leq +125^{\circ}\text{C}$ , unless otherwise noted.

Table 7.

| Parameter                               | Mnemonic                        | Condition                                               | Min | Typ | Max  | Unit   |
|-----------------------------------------|---------------------------------|---------------------------------------------------------|-----|-----|------|--------|
| TEMPERATURE COEFFICIENT <sup>1, 2</sup> |                                 |                                                         |     |     |      |        |
| E Grade                                 | TCV <sub>O</sub> /°C            | I <sub>OUT</sub> = 0 mA                                 |     | 2   |      | ppm/°C |
| F Grade                                 |                                 |                                                         |     | 5   |      | ppm/°C |
| G Grade <sup>3</sup>                    |                                 |                                                         |     | 10  |      | ppm/°C |
| LINE REGULATION <sup>4</sup>            |                                 |                                                         |     |     |      |        |
| E Grade                                 | $\Delta V_O/\Delta V_{IN}$      | 3.0 V ≤ V <sub>S</sub> ≤ 15 V, I <sub>OUT</sub> = 0 mA  |     | 10  |      | ppm/V  |
| F and G Grades                          |                                 |                                                         |     | 20  |      | ppm/V  |
| LOAD REGULATION <sup>4</sup>            |                                 |                                                         |     |     |      |        |
| E Grade                                 | $\Delta V_O/\Delta V_{LOAD}$    | V <sub>S</sub> = 5.0 V, 0 mA ≤ I <sub>OUT</sub> ≤ 20 mA |     | 10  |      | ppm/mA |
| F and G Grades                          |                                 |                                                         |     | 20  |      | ppm/mA |
| DROPOUT VOLTAGE                         | V <sub>S</sub> – V <sub>O</sub> | V <sub>S</sub> = 3.5 V, I <sub>LOAD</sub> = 10 mA       |     |     | 1.00 | V      |
|                                         |                                 | V <sub>S</sub> = 4.0 V, I <sub>LOAD</sub> = 20 mA       |     |     | 1.50 | V      |

<sup>1</sup> For proper operation, a 1 μF capacitor is required between the output pin and the GND pin of the device.

<sup>2</sup> TCV<sub>O</sub> is defined as the ratio of output change with temperature variation to the specified temperature range expressed in ppm/°C.

$$TCV_O = (V_{MAX} - V_{MIN})/V_O(T_{MAX} - T_{MIN})$$

<sup>3</sup> Guaranteed by characterization.

<sup>4</sup> Line and load regulation specifications include the effect of self-heating.

# REF19x Series

## ELECTRICAL CHARACTERISTICS—REF195 @ T<sub>A</sub> = 25°C

@ V<sub>S</sub> = 5.10 V, T<sub>A</sub> = 25°C, unless otherwise noted.

Table 14.

| Parameter                        | Mnemonic                            | Condition                                                                                                | Min   | Typ | Max          | Unit   |
|----------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------|-------|-----|--------------|--------|
| INITIAL ACCURACY <sup>1</sup>    |                                     |                                                                                                          |       |     |              |        |
| E Grade                          | V <sub>O</sub>                      | I <sub>OUT</sub> = 0 mA                                                                                  | 4.998 | 5.0 | 5.002        | V      |
| F Grade                          |                                     |                                                                                                          | 4.995 |     | 5.005        | V      |
| G Grade                          |                                     |                                                                                                          | 4.990 |     | 5.010        | V      |
| LINE REGULATION <sup>2</sup>     |                                     |                                                                                                          |       |     |              |        |
| E Grade                          | ΔV <sub>O</sub> /ΔV <sub>IN</sub>   | 5.10 V ≤ V <sub>S</sub> ≤ 15 V, I <sub>OUT</sub> = 0 mA                                                  |       | 2   | 4            | ppm/V  |
| F and G Grades                   |                                     |                                                                                                          |       | 4   | 8            | ppm/V  |
| LOAD REGULATION <sup>2</sup>     |                                     |                                                                                                          |       |     |              |        |
| E Grade                          | ΔV <sub>O</sub> /ΔV <sub>LOAD</sub> | V <sub>S</sub> = 6.30 V, 0 mA ≤ I <sub>OUT</sub> ≤ 30 mA                                                 |       | 2   | 4            | ppm/mA |
| F and G Grades                   |                                     |                                                                                                          |       | 4   | 8            | ppm/mA |
| DROPOUT VOLTAGE                  | V <sub>S</sub> – V <sub>O</sub>     | V <sub>S</sub> = 5.50 V, I <sub>LOAD</sub> = 10 mA<br>V <sub>S</sub> = 6.30 V, I <sub>LOAD</sub> = 30 mA |       |     | 0.50<br>1.30 | V<br>V |
| LONG-TERM STABILITY <sup>3</sup> | DV <sub>O</sub>                     | 1,000 hours @ 125°C                                                                                      |       | 1.2 |              | mV     |
| NOISE VOLTAGE                    | e <sub>N</sub>                      | 0.1 Hz to 10 Hz                                                                                          |       | 50  |              | μV p-p |

<sup>1</sup> Initial accuracy includes temperature hysteresis effect.

<sup>2</sup> Line and load regulation specifications include the effect of self-heating.

<sup>3</sup> Long-term stability specification is noncumulative. The drift in subsequent 1,000 hour periods is significantly lower than in the first 1,000 hour period.

## ELECTRICAL CHARACTERISTICS—REF195 @ –40°C ≤ T<sub>A</sub> ≤ +85°C

@ V<sub>S</sub> = 5.15 V, T<sub>A</sub> = –40°C ≤ T<sub>A</sub> ≤ +85°C, unless otherwise noted.

Table 15.

| Parameter                              | Mnemonic                            | Condition                                                                                                | Min | Typ | Max          | Unit   |
|----------------------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------|-----|-----|--------------|--------|
| TEMPERATURE COEFFICIENT <sup>1,2</sup> |                                     |                                                                                                          |     |     |              |        |
| E Grade                                | TCV <sub>O</sub> /°C                | I <sub>OUT</sub> = 0 mA                                                                                  |     | 2   | 5            | ppm/°C |
| F Grade                                |                                     |                                                                                                          |     | 5   | 10           | ppm/°C |
| G Grade <sup>3</sup>                   |                                     |                                                                                                          |     | 10  | 25           | ppm/°C |
| LINE REGULATION <sup>4</sup>           |                                     |                                                                                                          |     |     |              |        |
| E Grade                                | ΔV <sub>O</sub> /ΔV <sub>IN</sub>   | 5.15 V ≤ V <sub>S</sub> ≤ 15 V, I <sub>OUT</sub> = 0 mA                                                  |     | 5   | 10           | ppm/V  |
| F and G Grades                         |                                     |                                                                                                          |     | 10  | 20           | ppm/V  |
| LOAD REGULATION <sup>4</sup>           |                                     |                                                                                                          |     |     |              |        |
| E Grade                                | ΔV <sub>O</sub> /ΔV <sub>LOAD</sub> | V <sub>S</sub> = 6.30 V, 0 mA ≤ I <sub>OUT</sub> ≤ 25 mA                                                 |     | 5   | 10           | ppm/mA |
| F and G Grades                         |                                     |                                                                                                          |     | 10  | 20           | ppm/mA |
| DROPOUT VOLTAGE                        | V <sub>S</sub> – V <sub>O</sub>     | V <sub>S</sub> = 5.50 V, I <sub>LOAD</sub> = 10 mA<br>V <sub>S</sub> = 6.30 V, I <sub>LOAD</sub> = 25 mA |     |     | 0.50<br>1.30 | V<br>V |
| SLEEP PIN                              |                                     |                                                                                                          |     |     |              |        |
| Logic High Input Voltage               | V <sub>H</sub>                      |                                                                                                          | 2.4 |     |              | V      |
| Logic High Input Current               | I <sub>H</sub>                      |                                                                                                          |     |     | –8           | μA     |
| Logic Low Input Voltage                | V <sub>L</sub>                      |                                                                                                          |     |     | 0.8          | V      |
| Logic Low Input Current                | I <sub>L</sub>                      |                                                                                                          |     |     | –8           | μA     |
| SUPPLY CURRENT                         |                                     | No load                                                                                                  |     |     | 45           | μA     |
| Sleep Mode                             |                                     | No load                                                                                                  |     |     | 15           | μA     |

<sup>1</sup> For proper operation, a 1 μF capacitor is required between the output pin and the GND pin of the device.

<sup>2</sup> TCV<sub>O</sub> is defined as the ratio of output change with temperature variation to the specified temperature range expressed in ppm/°C.

$$TCV_O = (V_{MAX} - V_{MIN}) / V_O (T_{MAX} - T_{MIN})$$

<sup>3</sup> Guaranteed by characterization.

<sup>4</sup> Line and load regulation specifications include the effect of self-heating.

**ELECTRICAL CHARACTERISTICS—REF195 @  $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$** 

@  $V_S = 5.20\text{ V}$ ,  $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ , unless otherwise noted.

**Table 16.**

| Parameter                               | Mnemonic                        | Condition                                                          | Min | Typ | Max  | Unit   |
|-----------------------------------------|---------------------------------|--------------------------------------------------------------------|-----|-----|------|--------|
| TEMPERATURE COEFFICIENT <sup>1, 2</sup> |                                 |                                                                    |     |     |      |        |
| E Grade                                 | TCV <sub>O</sub> /°C            | I <sub>OUT</sub> = 0 mA                                            |     | 2   |      | ppm/°C |
| F Grade                                 |                                 |                                                                    |     | 5   |      | ppm/°C |
| G Grade <sup>3</sup>                    |                                 |                                                                    |     | 10  |      | ppm/°C |
| LINE REGULATION <sup>4</sup>            |                                 |                                                                    |     |     |      |        |
| E Grade                                 | $\Delta V_O / \Delta V_{IN}$    | 5.20 V $\leq V_S \leq 15\text{ V}$ , I <sub>OUT</sub> = 0 mA       |     | 5   |      | ppm/V  |
| F and G Grades                          |                                 |                                                                    |     | 10  |      | ppm/V  |
| LOAD REGULATION <sup>4</sup>            |                                 |                                                                    |     |     |      |        |
| E Grade                                 | $\Delta V_O / \Delta V_{LOAD}$  | V <sub>S</sub> = 6.45 V, 0 mA $\leq$ I <sub>OUT</sub> $\leq$ 20 mA |     | 5   |      | ppm/mA |
| F and G Grades                          |                                 |                                                                    |     | 10  |      | ppm/mA |
| DROPOUT VOLTAGE                         | V <sub>S</sub> – V <sub>O</sub> | V <sub>S</sub> = 5.60 V, I <sub>LOAD</sub> = 10 mA                 |     |     | 0.60 | V      |
|                                         |                                 | V <sub>S</sub> = 6.45 V, I <sub>LOAD</sub> = 20 mA                 |     |     | 1.45 | V      |

<sup>1</sup> For proper operation, a 1  $\mu\text{F}$  capacitor is required between the output pin and the GND pin of the device.

<sup>2</sup> TCV<sub>O</sub> is defined as the ratio of output change with temperature variation to the specified temperature range expressed in ppm/°C.

$$TCV_O = (V_{MAX} - V_{MIN}) / V_O (T_{MAX} - T_{MIN})$$

<sup>3</sup> Guaranteed by characterization.

<sup>4</sup> Line and load regulation specifications include the effect of self-heating.

**ELECTRICAL CHARACTERISTICS—REF196 @  $T_A = 25^{\circ}\text{C}$** 

@  $V_S = 3.5\text{ V}$ ,  $T_A = 25^{\circ}\text{C}$ , unless otherwise noted.

**Table 17.**

| Parameter                        | Mnemonic                        | Condition                                                         | Min       | Typ | Max   | Unit              |
|----------------------------------|---------------------------------|-------------------------------------------------------------------|-----------|-----|-------|-------------------|
| INITIAL ACCURACY <sup>1</sup>    |                                 |                                                                   |           |     |       |                   |
| G Grade                          | V <sub>O</sub>                  | I <sub>OUT</sub> = 0 mA                                           | 3.29<br>0 | 3.3 | 3.310 | V                 |
| LINE REGULATION <sup>2</sup>     |                                 |                                                                   |           |     |       |                   |
| G Grade                          | $\Delta V_O / \Delta V_{IN}$    | 3.50 V $\leq V_S \leq 15\text{ V}$ , I <sub>OUT</sub> = 0 mA      |           | 4   | 8     | ppm/V             |
| LOAD REGULATION <sup>2</sup>     |                                 |                                                                   |           |     |       |                   |
| G Grade                          | $\Delta V_O / \Delta V_{LOAD}$  | V <sub>S</sub> = 5.0 V, 0 mA $\leq$ I <sub>OUT</sub> $\leq$ 30 mA |           | 6   | 15    | ppm/mA            |
| DROPOUT VOLTAGE                  | V <sub>S</sub> – V <sub>O</sub> | V <sub>S</sub> = 4.1 V, I <sub>LOAD</sub> = 10 mA                 |           |     | 0.80  | V                 |
|                                  |                                 | V <sub>S</sub> = 4.3 V, I <sub>LOAD</sub> = 30 mA                 |           |     | 1.00  | V                 |
| LONG-TERM STABILITY <sup>3</sup> | DV <sub>O</sub>                 | 1,000 hours @ 125°C                                               |           | 1.2 |       | mV                |
| NOISE VOLTAGE                    | e <sub>N</sub>                  | 0.1 Hz to 10 Hz                                                   |           | 33  |       | $\mu\text{V p-p}$ |

<sup>1</sup> Initial accuracy includes temperature hysteresis effect.

<sup>2</sup> Line and load regulation specifications include the effect of self-heating.

<sup>3</sup> Long-term stability specification is noncumulative. The drift in subsequent 1,000 hour periods is significantly lower than in the first 1,000 hour period.

## ABSOLUTE MAXIMUM RATINGS

Table 24.

| Parameter <sup>1</sup>                    | Rating                |
|-------------------------------------------|-----------------------|
| Supply Voltage                            | −0.3 V, +18 V         |
| Output to GND                             | −0.3 V, $V_S + 0.3$ V |
| Output to GND Short-Circuit Duration      | Indefinite            |
| Storage Temperature Range                 |                       |
| PDIP, SOIC Package                        | −65°C to +150°C       |
| Operating Temperature Range               |                       |
| REF19x                                    | −40°C to +85°C        |
| Junction Temperature Range                |                       |
| PDIP, SOIC Package                        | −65°C to +150°C       |
| Lead Temperature Range (Soldering 60 sec) | 300°C                 |

<sup>1</sup> Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 25. Package Type

| Package Type      | $\theta_{JA}$ <sup>1</sup> | $\theta_{JC}$ | Unit |
|-------------------|----------------------------|---------------|------|
| 8-Lead PDIP       | 103                        | 43            | °C/W |
| 8-Lead SOIC       | 158                        | 43            | °C/W |
| 8-Lead TSSOP (RU) | 240                        | 43            | °C/W |

<sup>1</sup>  $\theta_{JA}$  is specified for worst-case conditions; that is,  $\theta_{JA}$  is specified for the device in socket for PDIP and is specified for the device soldered in the circuit board for the SOIC package.

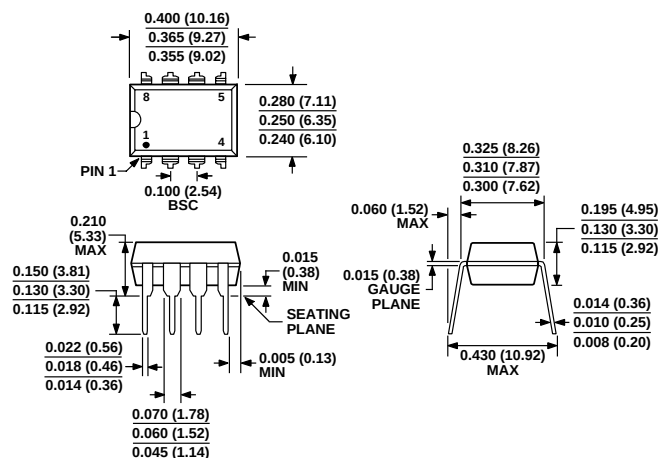
## ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



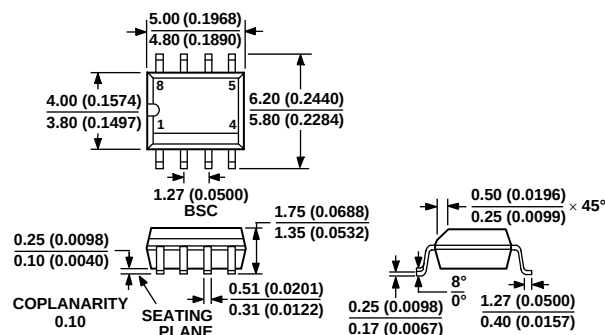


# OUTLINE DIMENSIONS



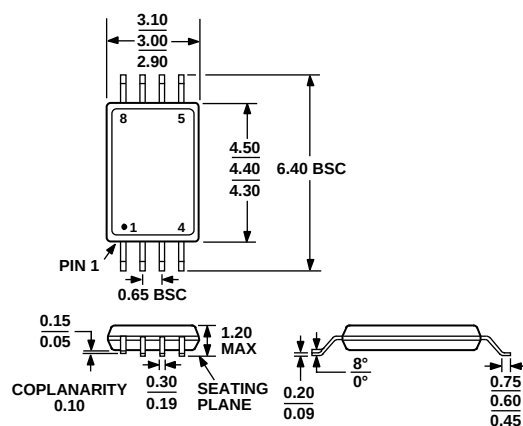
COMPLIANT TO JEDEC STANDARDS MS-001-BA  
CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETER DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN. CORNER LEADS MAY BE CONFIGURED AS WHOLE OR HALF LEADS.

Figure 32. 8-Lead Plastic Dual In-Line Package [PDIP]  
(N-8)  
P-Suffix  
Dimensions shown in inches and (millimeters)



COMPLIANT TO JEDEC STANDARDS MS-012AA  
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

Figure 34. 8-Lead Standard Small Outline Package [SOIC]  
Narrow Body  
(R-8)  
S-Suffix  
Dimensions shown in millimeters and (inches)



COMPLIANT TO JEDEC STANDARDS MO-153AA

Figure 33. 8-Lead Thin Shrink Small Outline Package [TSSOP]  
(RU-8)  
Dimensions shown in millimeters

# REF19x Series

## ORDERING GUIDE

| Model                         | Temperature Range | Package Description | Package Option | Minimum Quantities/Reel |
|-------------------------------|-------------------|---------------------|----------------|-------------------------|
| REF191ES                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF191ES-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF191ESZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF191ESZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF191GP                      | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) | 2,500                   |
| REF191GPZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) |                         |
| REF191GS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF191GS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF191GSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF191GSZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF192ES                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF192ES-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF192ES-REEL7                | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF192ESZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF192ESZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF192ESZ-REEL7 <sup>1</sup>  | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF192FS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF192FS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF192FS-REEL7                | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF192FSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF192FSZ-REEL7 <sup>1</sup>  | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF192GP                      | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) | 1,000                   |
| REF192GPZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) |                         |
| REF192GRU                     | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           | 1,000                   |
| REF192GRU-REEL7               | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           |                         |
| REF192GRUZ <sup>1</sup>       | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           | 1,000                   |
| REF192GRUZ-REEL7 <sup>1</sup> | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           |                         |
| REF192GS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF192GS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF192GS-REEL7                | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF192GSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF192GSZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF192GSZ-REEL7 <sup>1</sup>  | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF193GS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF193GS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF193GSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF193GSZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF194ES                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF194ES-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF194ESZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF194ESZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF194FS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF194FSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF194GP                      | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) | 2,500                   |
| REF194GPZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) |                         |
| REF194GS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF194GS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF194GS-REEL7                | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF194GSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF194GSZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF194GSZ-REEL7 <sup>1</sup>  | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |

# REF19x Series

| Model                         | Temperature Range | Package Description | Package Option | Minimum Quantities/Reel |
|-------------------------------|-------------------|---------------------|----------------|-------------------------|
| REF195ES                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF195ES-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF195ESZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF195ESZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF195FS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF195FS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF195FSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF195FSZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF195GP                      | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) |                         |
| REF195GPZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) |                         |
| REF195GRU                     | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           |                         |
| REF195GRU-REEL7               | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           | 1,000                   |
| REF195GRUZ <sup>1</sup>       | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           |                         |
| REF195GRUZ-REEL7 <sup>1</sup> | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           | 1,000                   |
| REF195GS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF195GS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF195GS-REEL7                | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF195GSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF195GSZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF195GSZ-REEL7 <sup>1</sup>  | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF196GRU-REEL7               | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           | 1,000                   |
| REF196GRUZ-REEL7 <sup>1</sup> | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           | 1,000                   |
| REF196GS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF196GS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF196GSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF196GSZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF196GSZ-REEL7 <sup>1</sup>  | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF198ES                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF198ES-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF198ESZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF198ESZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF198ESZ-REEL7 <sup>1</sup>  | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 1,000                   |
| REF198FS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF198FS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF198FSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF198FSZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF198GP                      | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) |                         |
| REF198GPZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead PDIP         | P-Suffix (N-8) |                         |
| REF198GRU                     | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           |                         |
| REF198GRU-REEL7               | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           | 1,000                   |
| REF198GRUZ <sup>1</sup>       | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           |                         |
| REF198GRUZ-REEL7 <sup>1</sup> | −40°C to +85°C    | 8-Lead TSSOP        | RU-8           | 2,500                   |
| REF198GS                      | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF198GS-REEL                 | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |
| REF198GSZ <sup>1</sup>        | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) |                         |
| REF198GSZ-REEL <sup>1</sup>   | −40°C to +85°C    | 8-Lead SOIC         | S-Suffix (R-8) | 2,500                   |

<sup>1</sup> Z = Pb-free part.