FEATURES
Conversion loss: 8 dB
LO to RF isolation: 50 dB
LO to IF isolation: 35 dB
Input third-order intercept (IP3): 18 dBm
Input second-order intercept (IP2): 55 dBm
LO port return loss: 8 dBm
RF port return loss: 10 dBm
Passive double balanced topology
Wide IF bandwidth: dc to 3 GHz
24-terminal ceramic leadless chip carrier package

APPLICATIONS
WiMAX and fixed wireless
Point to point radios
Point to multipoint radios
Test equipment and sensors
Military end use

GENERAL DESCRIPTION
The HMC557A is a general-purpose, double balanced mixer in a 24-terminal, ceramic leadless chip carrier, RoHS-compliant package. The device can be used as an upconverter or down-converter from 2.5 GHz to 7.0 GHz. This mixer is fabricated in a gallium arsenide (GaAs) metal semiconductor field effect transistor (MESFET) process and requires no external components or matching circuitry. The HMC557A provides excellent local oscillator (LO) to radio frequency (RF) and LO to intermediate frequency (IF) isolation due to optimized balun structures. The RoHS-compliant HMC557A eliminates the need for wire bonding and is compatible with high volume surface-mount manufacturing techniques.
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REVISION HISTORY

4/2018—Rev. E to Rev. F
Changes to Table 3............................................................................ 4

10/2017—Rev. D to Rev. E
  Added Field Induced Charge Device Model (FICDM) Parameter,
  Table 3......................................................................................... 4
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6/2017—Rev. C to Rev. D
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8/2016—Rev. B to Rev. C
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1/2016—Rev. A to Rev. B
  Change to LO to RF Isolation Parameter, Table 2............... 3

9/2015—Rev. 0 to Rev. A
  Changes to Features Section ....................................................... 1
  Added Maximum Peak Reflow Temperature Parameter,
  Table 3 ....................................................................................... 4
  Updated Outline Dimensions ...................................................... 23
  Changes to Ordering Guide .......................................................... 23

7/2015—Revision 0: Initial Version


## ELECTRICAL SPECIFICATIONS

### 2.5 GHz TO 5.0 GHz FREQUENCY RANGE

\( T_A = 25^\circ C, \text{IF} = 100 \text{ MHz}, \text{LO drive} = 15 \text{ dBm}. \) All measurements performed as a downconverter with the upper sideband selected, unless otherwise noted.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPERATING CONDITIONS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF Frequency Range</td>
<td>2.5</td>
<td>5.0</td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>LO Frequency Range</td>
<td>2.5</td>
<td>5.0</td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>IF Frequency Range</td>
<td>DC</td>
<td>3</td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td><strong>PERFORMANCE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conversion Loss</td>
<td>8</td>
<td>10.5</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Noise Figure, Single Sideband (SSB)</td>
<td>8</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>LO to RF Isolation</td>
<td>40</td>
<td>50</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>LO to IF Isolation</td>
<td>26</td>
<td>35</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>RF to IF Isolation</td>
<td>20</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Input Third-Order Intercept (IP3)</td>
<td>14</td>
<td>18</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Input Second-Order Intercept (IP2)</td>
<td>55</td>
<td></td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Input Power for 1 dB Compression (P1dB)</td>
<td>10</td>
<td></td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>RF Port Return Loss</td>
<td>10</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>LO Port Return Loss</td>
<td>8</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
</tbody>
</table>

### 5.0 GHz TO 7.0 GHz FREQUENCY RANGE

\( T_A = 25^\circ C, \text{IF} = 100 \text{ MHz}, \text{LO drive} = 15 \text{ dBm}. \) All measurements performed as a downconverter with the upper sideband selected, unless otherwise noted.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPERATING CONDITIONS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RF Frequency Range</td>
<td>5.0</td>
<td>7.0</td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>LO Frequency Range</td>
<td>5.0</td>
<td>7.0</td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>IF Frequency Range</td>
<td>DC</td>
<td>3</td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td><strong>PERFORMANCE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conversion Loss</td>
<td>8.5</td>
<td>10.5</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Noise Figure, Single Sideband (SSB)</td>
<td>8.5</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>LO to RF Isolation</td>
<td>37</td>
<td>43</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>LO to IF Isolation</td>
<td>25</td>
<td>33</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>RF to IF Isolation</td>
<td>25</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Input Third-Order Intercept (IP3)</td>
<td>14</td>
<td>18</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Input Second-Order Intercept (IP2)</td>
<td>55</td>
<td></td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Input Power for 1 dB Compression (P1dB)</td>
<td>10</td>
<td></td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>RF Port Return Loss</td>
<td>12</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>LO Port Return Loss</td>
<td>12</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
</tbody>
</table>
ABSOLUTE MAXIMUM RATINGS

Table 3.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
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</thead>
<tbody>
<tr>
<td>RF Input Power</td>
<td>25 dBm</td>
</tr>
<tr>
<td>LO Input Power</td>
<td>27 dBm</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>175°C</td>
</tr>
<tr>
<td>Continuous Pdiss (T = 85°C), Derate 9.5 mW/°C</td>
<td>857 mW</td>
</tr>
<tr>
<td>Continuous Pdiss (T = 85°C), Derate Above 85°C</td>
<td>857 mW</td>
</tr>
<tr>
<td>Thermal Resistance (Channel to Ground Pad)</td>
<td>105°C/W</td>
</tr>
<tr>
<td>Maximum Peak Reflow Temperature (MSL3)</td>
<td>260°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>−65°C to +150°C</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>−40°C to +85°C</td>
</tr>
<tr>
<td>ESD Sensitivity, Human Body Model (HBM)</td>
<td>1000 V (Class 1C)</td>
</tr>
<tr>
<td>Field Induced Charge Device Model (FICDM)</td>
<td>1250 V (Class C3)</td>
</tr>
</tbody>
</table>

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

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.
PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

Table 4. Pin Function Descriptions

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Mnemonic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 5 to 7, 11 to 14, 18 to 24</td>
<td>NIC</td>
<td>No Internal Connection. No connection is required on these pins. These pins are not internally connected. However, all data is measured with these pins connected to RF/dc ground externally.</td>
</tr>
<tr>
<td>2, 4, 8, 10, 15, 17</td>
<td>GND</td>
<td>Ground Connect. Connect these pins and the package bottom to RF/dc ground.</td>
</tr>
<tr>
<td>3</td>
<td>LO</td>
<td>Local Oscillator Port. This pin is dc-coupled and matched to 50 Ω.</td>
</tr>
<tr>
<td>9</td>
<td>IF</td>
<td>Intermediate Frequency Port. This pin is dc-coupled. For applications not requiring operation to dc, block this pin externally using a series capacitor with a value chosen to pass the necessary IF frequency range. For operation to dc, this pin must not source or sink more than 2 mA of current or device nonfunctionality or device failure may result.</td>
</tr>
<tr>
<td>16</td>
<td>RF</td>
<td>Radio Frequency Port. This pin is dc-coupled and matched to 50 Ω.</td>
</tr>
<tr>
<td></td>
<td>EPAD</td>
<td>Exposed Pad. Connect the exposed pad to a low impedance thermal and electrical ground plane.</td>
</tr>
</tbody>
</table>

Figure 2. Pin Configuration
INTERFACE SCHEMATICS

Figure 3. GND Interface Schematic

Figure 4. LO Interface Schematic

Figure 5. IF Interface Schematic

Figure 6. RF Interface Schematic
TYPICAL PERFORMANCE CHARACTERISTICS

DOWNCONVERTER PERFORMANCE WITH UPPER SIDEBAND SELECTED, IF = 100 MHz

Figure 7. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 8. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 9. Conversion Gain and IF Return Loss Response vs. IF Frequency, LO Frequency = 4.5 GHz

Figure 10. Isolation vs. RF/LO Frequency

Figure 11. LO Port Return Loss vs. LO Frequency, LO Drive = 15 dBm

Figure 12. RF Port Return Loss vs. RF Frequency, LO Frequency = 4.6 GHz, LO Drive = 15 dBm
Figure 13. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 14. Input IP2 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 15. Input IP3 vs. RF Frequency at Various LO Drives

Figure 16. Input IP2 vs. RF Frequency at Various LO Drives
DOWNCONVERTER PERFORMANCE WITH UPPER SIDEBAND SELECTED, IF = 1000 MHz

Figure 17. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 18. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 19. Input IP2 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 20. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 21. Input IP3 vs. RF Frequency at Various LO Drives

Figure 22. Input IP2 vs. RF Frequency at Various LO Drives
DOWNCONVERTER PERFORMANCE WITH UPPER SIDEBAND SELECTED, IF = 2000 MHz

Figure 23. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 26. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 24. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 27. Input IP3 vs. RF Frequency at Various LO Drives

Figure 25. Input IP2 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 28. Input IP2 vs. RF Frequency at Various LO Drives
DOWNCONVERTER PERFORMANCE WITH LOWER SIDEBAND SELECTED, IF = 100 MHz

Figure 29. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 30. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 31. Input IP2 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 32. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 33. Input IP3 vs. RF Frequency at Various LO Drives

Figure 34. Input IP2 vs. RF Frequency at Various LO Drives
DOWNCONVERTER PERFORMANCE WITH LOWER SIDEBAND SELECTED, IF = 1000 MHz

- **Figure 35.** Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm
- **Figure 36.** Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm
- **Figure 37.** Input IP2 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm
- **Figure 38.** Conversion Gain vs. RF Frequency at Various LO Drives
- **Figure 39.** Input IP3 vs. RF Frequency at Various LO Drives
- **Figure 40.** Input IP2 vs. RF Frequency at Various LO Drives
DOWNCONVERTER PERFORMANCE WITH LOWER SIDEBAND SELECTED, IF = 2000 MHz

![Figure 41. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm](image)

![Figure 44. Conversion Gain vs. RF Frequency at Various LO Drives](image)

![Figure 42. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm](image)

![Figure 45. Input IP3 vs. RF Frequency at Various LO Drives](image)

![Figure 43. Input IP2 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm](image)

![Figure 46. Input IP2 vs. RF Frequency at Various LO Drives](image)
P1\text{dB} PERFORMANCE WITH DOWNCONVERTER MODE SELECTED AT LO DRIVE = 15 dBm

Figure 47. Input P1\text{dB} vs. RF Frequency at Various Temperatures, IF = 100 MHz, USB

Figure 48. Input P1\text{dB} vs. RF Frequency at Various Temperatures, IF = 2000 MHz, USB

Figure 49. Input P1\text{dB} vs. RF Frequency at Various Temperatures, IF = 1000 MHz, LSB

Figure 50. Input P1\text{dB} vs. RF Frequency at Various Temperatures, IF = 1000 MHz, USB

Figure 51. Input P1\text{dB} vs. RF Frequency at Various Temperatures, IF = 100 MHz, LSB

Figure 52. Input P1\text{dB} vs. RF Frequency at Various Temperatures, IF = 2000 MHz, LSB
UPCONVERTER PERFORMANCE WITH UPPER SIDEBAND SELECTED, IF = 100 MHz

Figure 53. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 56. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 54. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 57. Input IP3 vs. RF Frequency at Various LO Drives

Figure 55. Input P1dB vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm
UPCONVERTER PERFORMANCE WITH UPPER SIDEBAND SELECTED, IF = 1000 MHz

Figure 58. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 59. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 60. Input P1dB vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 61. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 62. Input IP3 vs. RF Frequency at Various LO Drives
UPCONVERTER PERFORMANCE WITH UPPER SIDEBAND SELECTED, IF = 2000 MHz

Figure 63. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 66. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 64. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 67. Input IP3 vs. RF Frequency at Various LO Drives

Figure 65. Input P1dB vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm
UPCONVERTER PERFORMANCE WITH LOWER SIDEBAND SELECTED, IF = 100 MHz

Figure 68. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 69. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 70. Input P1dB vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 71. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 72. Input IP3 vs. RF Frequency at Various LO Drives

Figure 73. Input P1dB vs. RF Frequency at Various LO Drives
UPCONVERTER PERFORMANCE WITH LOWER SIDEBAND SELECTED, IF = 1000 MHz

Figure 73. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 76. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 74. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 77. Input IP3 vs. RF Frequency at Various LO Drives

Figure 75. Input P1dB vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm
UPCONVERTER PERFORMANCE WITH LOWER SIDEBAND SELECTED, IF = 2000 MHz

Figure 78. Conversion Gain vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 79. Input IP3 vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 80. Input P1dB vs. RF Frequency at Various Temperatures, LO Drive = 15 dBm

Figure 81. Conversion Gain vs. RF Frequency at Various LO Drives

Figure 82. Input IP3 vs. RF Frequency at Various LO Drives
SPURIOUS PERFORMANCE WITH UPPER SIDEBAND SELECTED, IF = 100 MHz

Mixer spurious products are measured in dBc from the IF output power level. Spur values are \( (M \times RF) - (N \times LO) \).

**M × N Spurious Outputs**

RF frequency = 5 GHz, RF input power = −10 dBm, LO frequency = 4.9 GHz, LO drive = 15 dBm.

<table>
<thead>
<tr>
<th>M × RF</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N/A</td>
<td>+3.6</td>
<td>+33.3</td>
<td>+25.2</td>
<td>+43.3</td>
<td>+28.6</td>
</tr>
<tr>
<td>1</td>
<td>+15.9</td>
<td>+0.00</td>
<td>+31.7</td>
<td>+38.1</td>
<td>+60.8</td>
<td>+73.4</td>
</tr>
<tr>
<td>2</td>
<td>+74.8</td>
<td>+64.7</td>
<td>+61.2</td>
<td>+63.6</td>
<td>+79.5</td>
<td>+75.1</td>
</tr>
<tr>
<td>3</td>
<td>+74.2</td>
<td>+78.6</td>
<td>+80.8</td>
<td>+72</td>
<td>+78.5</td>
<td>+79.2</td>
</tr>
<tr>
<td>4</td>
<td>+73.2</td>
<td>+77.5</td>
<td>+75.3</td>
<td>+78</td>
<td>+90.7</td>
<td>+79.3</td>
</tr>
<tr>
<td>5</td>
<td>−92.8</td>
<td>+72.7</td>
<td>+76.7</td>
<td>+77.6</td>
<td>+81.3</td>
<td>+88.9</td>
</tr>
</tbody>
</table>

1 N/A means not applicable.
Table 5. List of Materials for Evaluation PCB

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1, J2, J3</td>
<td>Johnson SMA connector</td>
</tr>
<tr>
<td>U1</td>
<td>HMC557ALC4 mixer</td>
</tr>
<tr>
<td>PCB³</td>
<td>118703 evaluation PCB³</td>
</tr>
</tbody>
</table>

1 Reference this number when ordering the complete evaluation PCB.
2 The circuit board material is Rogers 4350.
3 This is the bare PCB of the evaluation PCB kit (see Figure 83).

It is recommended that the application circuit board use RF circuit design techniques. Use signal lines with a 50 Ω impedance, and connect the package ground leads and exposed pad directly to the ground plane. Use a sufficient number of via holes to connect the top and bottom ground planes. The evaluation circuit board shown in Figure 83 is available from Analog Devices, Inc., upon request.
OUTLINE DIMENSIONS

Figure 84. 24-Terminal Ceramic Leadless Chip Carrier [LCC] (E-24-1)
Dimensions shown in millimeters

ORDERING GUIDE

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature Range</th>
<th>Package Body Material</th>
<th>Lead Finish</th>
<th>MSL Rating</th>
<th>Package Description</th>
<th>Package Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC557ALC4</td>
<td>−40°C to +85°C</td>
<td>Alumina Ceramic</td>
<td>Gold over Nickel</td>
<td>MSL3</td>
<td>24-Terminal Ceramic LCC</td>
<td>E-24-1</td>
</tr>
<tr>
<td>HMC557ALC4TR</td>
<td>−40°C to +85°C</td>
<td>Alumina Ceramic</td>
<td>Gold over Nickel</td>
<td>MSL3</td>
<td>24-Terminal Ceramic LCC</td>
<td>E-24-1</td>
</tr>
<tr>
<td>HMC557ALC4TR-R5</td>
<td>−40°C to +85°C</td>
<td>Alumina Ceramic</td>
<td>Gold over Nickel</td>
<td>MSL3</td>
<td>24-Terminal Ceramic LCC</td>
<td>E-24-1</td>
</tr>
<tr>
<td>EV1HMC557ALC4</td>
<td>−40°C to +85°C</td>
<td>Alumina Ceramic</td>
<td>Gold over Nickel</td>
<td>MSL3</td>
<td>Evaluation Board</td>
<td>E-24-1</td>
</tr>
</tbody>
</table>

1 All models are RoHS Compliant parts.
2 Maximum peak reflow temperature of 260°C.