



**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  Unless Otherwise Noted)

| Symbol                        | Parameter                              |                       | Rating     | Unit |
|-------------------------------|----------------------------------------|-----------------------|------------|------|
| Common Ratings                |                                        |                       |            |      |
| V <sub>DSS</sub>              | Drain-Source Voltage                   |                       | 40         | V    |
| V <sub>GSS</sub>              | Gate-Source Voltage                    |                       | ±20        |      |
| T <sub>J</sub>                | Maximum Junction Temperature           |                       | 150        | °C   |
| T <sub>STG</sub>              | Storage Temperature Range              |                       | -55 to 150 |      |
| I <sub>S</sub>                | Diode Continuous Forward Current       | T <sub>C</sub> =25°C  | 30         | A    |
| I <sub>D</sub>                | Continuous Drain Current               | T <sub>C</sub> =25°C  | 67         |      |
|                               |                                        | T <sub>C</sub> =100°C | 42         |      |
| I <sub>DM</sub> <sup>a</sup>  | Pulsed Drain Current                   | T <sub>C</sub> =25°C  | 200        |      |
| P <sub>D</sub>                | Maximum Power Dissipation              | T <sub>C</sub> =25°C  | 54         | W    |
|                               |                                        | T <sub>C</sub> =100°C | 21         |      |
| R <sub>θJC</sub>              | Thermal Resistance-Junction to Case    | Steady State          | 2.3        | °C/W |
| I <sub>D</sub>                | Continuous Drain Current               | T <sub>A</sub> =25°C  | 14         | A    |
|                               |                                        | T <sub>A</sub> =70°C  | 11         |      |
| P <sub>D</sub>                | Maximum Power Dissipation              | T <sub>A</sub> =25°C  | 2.5        | W    |
|                               |                                        | T <sub>A</sub> =70°C  | 1.6        |      |
| R <sub>θJA</sub> <sup>c</sup> | Thermal Resistance-Junction to Ambient | t ≤ 10s               | 20         | °C/W |
|                               |                                        | Steady State          | 50         |      |
| I <sub>AS</sub> <sup>b</sup>  | Avalanche Current, Single pulse        | L=0.5mH               | 18         | A    |
| E <sub>AS</sub> <sup>b</sup>  | Avalanche Energy, Single pulse         | L=0.5mH               | 81         | mJ   |

Note a : Pulse width limited by max. junction temperature.

Note b : UIS tested and pulse width limited by maximum junction temperature  $150^\circ\text{C}$  (initial temperature  $T_J=25^\circ\text{C}$ ).

Note c : Surface Mounted on  $1\text{in}^2$  pad area, steady state  $t=999\text{s}$ .

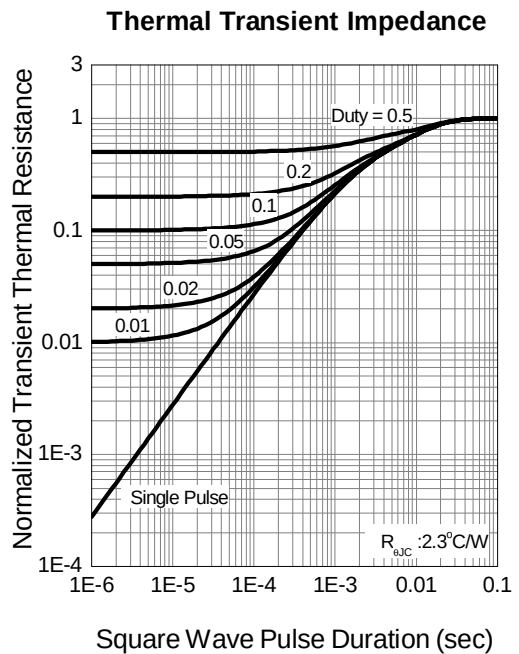
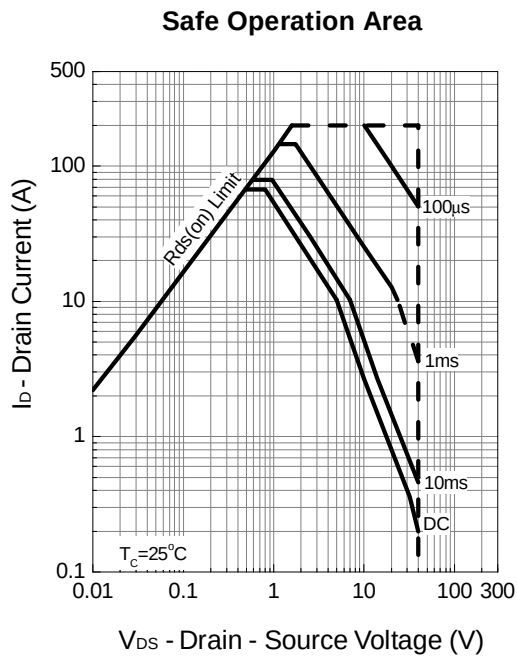
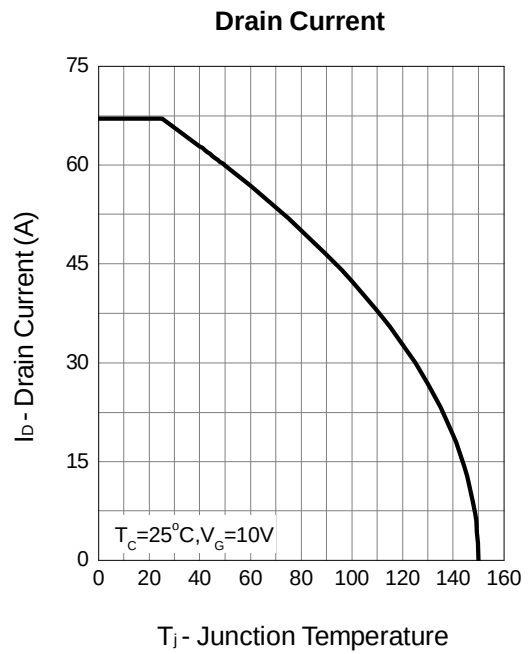
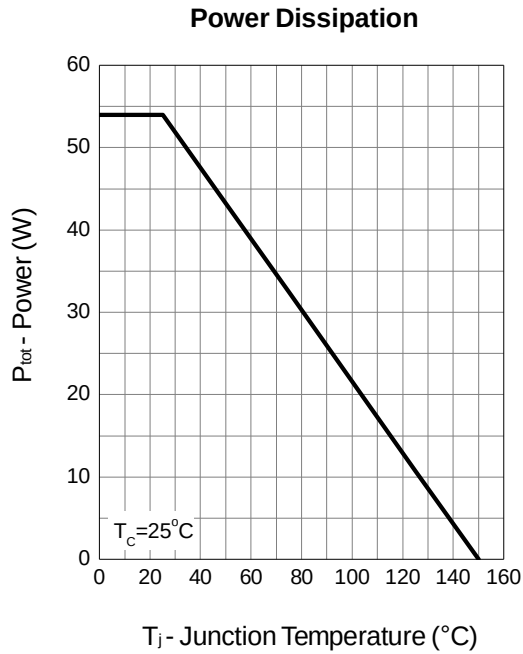
**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

| Symbol                                   | Parameter                        | Test Conditions                                                                                                    | Min.        | Typ.            | Max.        | Unit |
|------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------|-------------|-----------------|-------------|------|
| Static Characteristics                   |                                  |                                                                                                                    |             |                 |             |      |
| BV <sub>DSS</sub>                        | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA                                                                        | 40          | -               | -           | V    |
| I <sub>DSS</sub>                         | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =32V, V <sub>GS</sub> =0V<br>T <sub>j</sub> =85°C                                                  | -<br>-      | -<br>-          | 1<br>30     | μA   |
| V <sub>GS(th)</sub>                      | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA                                                          | 1.5         | 1.8             | 2.5         | V    |
| I <sub>GSS</sub>                         | Gate Leakage Current             | V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V                                                                         | -           | -               | ±100        | nA   |
| R <sub>DS(ON)</sub> <sup>d</sup>         | Drain-Source On-state Resistance | V <sub>GS</sub> =10V, I <sub>DS</sub> =20A<br>T <sub>j</sub> =125°C<br>V <sub>GS</sub> =4.5V, I <sub>DS</sub> =10A | -<br>-<br>- | 5.8<br>9.2<br>7 | 7<br>-<br>9 | mΩ   |
| Gfs                                      | Forward Transconductance         | V <sub>DS</sub> =5V, I <sub>D</sub> =10A                                                                           | -           | 45              | -           | S    |
| Diode Characteristics                    |                                  |                                                                                                                    |             |                 |             |      |
| V <sub>SD</sub> <sup>d</sup>             | Diode Forward Voltage            | I <sub>SD</sub> =20A, V <sub>GS</sub> =0V                                                                          | -           | 0.75            | 1.1         | V    |
| t <sub>rr</sub>                          | Reverse Recovery Time            | I <sub>F</sub> =20A, dI <sub>SD</sub> /dt=100A/μs                                                                  | -           | 7.7             | -           | ns   |
| t <sub>a</sub>                           | Charge Time                      |                                                                                                                    | -           | 4.1             | -           |      |
| t <sub>b</sub>                           | Discharge Time                   |                                                                                                                    | -           | 3.6             | -           |      |
| Q <sub>rr</sub>                          | Reverse Recovery Charge          |                                                                                                                    | -           | 1.3             | -           | nC   |
| Dynamic Characteristics <sup>e</sup>     |                                  |                                                                                                                    |             |                 |             |      |
| R <sub>G</sub>                           | Gate Resistance                  | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1MHz                                                                   | 1           | 2.3             | 3           | Ω    |
| C <sub>iss</sub>                         | Input Capacitance                | V <sub>GS</sub> =0V, V <sub>DS</sub> =20V, Frequency=1.0MHz                                                        | -           | 1650            | -           | pF   |
| C <sub>oss</sub>                         | Output Capacitance               |                                                                                                                    | -           | 190             | -           |      |
| C <sub>rss</sub>                         | Reverse Transfer Capacitance     |                                                                                                                    | -           | 130             | -           |      |
| t <sub>d(ON)</sub>                       | Turn-on Delay Time               | V <sub>DD</sub> =20V, R <sub>L</sub> =20Ω, I <sub>DS</sub> =1A, V <sub>GEN</sub> =10V, R <sub>G</sub> =1Ω          | -           | 14              | -           | ns   |
| t <sub>r</sub>                           | Turn-on Rise Time                |                                                                                                                    | -           | 10              | -           |      |
| t <sub>d(OFF)</sub>                      | Turn-off Delay Time              |                                                                                                                    | -           | 43              | -           |      |
| t <sub>f</sub>                           | Turn-off Fall Time               |                                                                                                                    | -           | 14              | -           |      |
| Gate Charge Characteristics <sup>e</sup> |                                  |                                                                                                                    |             |                 |             |      |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =20V, V <sub>GS</sub> =10V, I <sub>DS</sub> =20A                                                   | -           | 31.8            | 44.5        | nC   |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =20V, V <sub>GS</sub> =4.5V, I <sub>DS</sub> =20A                                                  | -           | 14.8            | -           |      |
| Q <sub>gth</sub>                         | Threshold Gate Charge            |                                                                                                                    | -           | 3.2             | -           |      |
| Q <sub>gs</sub>                          | Gate-Source Charge               |                                                                                                                    | -           | 6.4             | -           |      |
| Q <sub>gd</sub>                          | Gate-Drain Charge                |                                                                                                                    | -           | 5.6             | -           |      |

Note d : Pulse test ; pulse width $\leq 300\mu s$ , duty cycle $\leq 2\%$ .

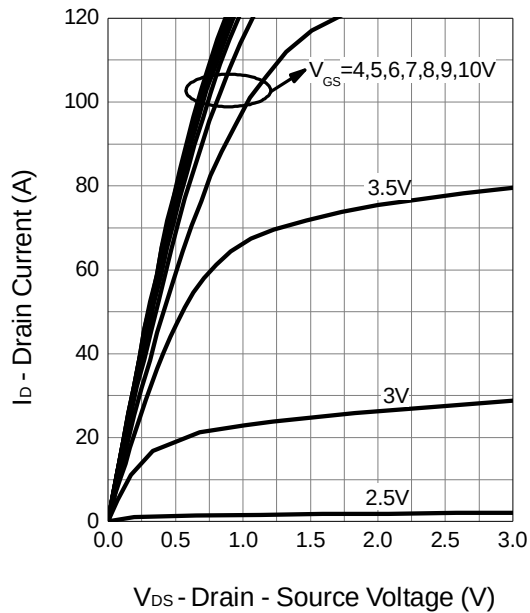
Note e : Guaranteed by design, not subject to production testing.

## Typical Operating Characteristics

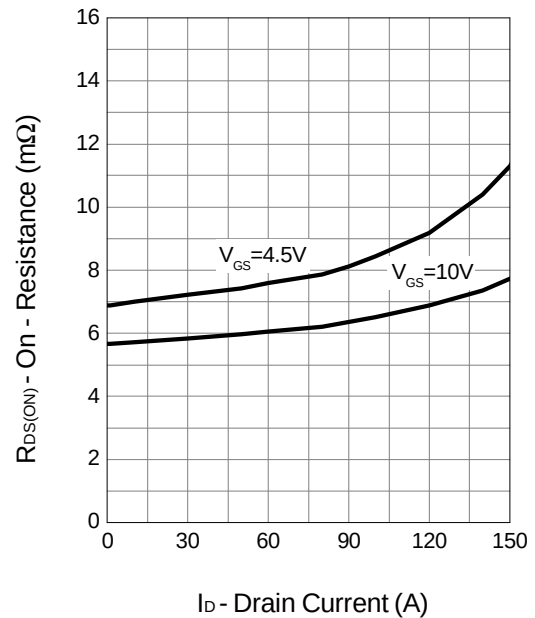


## Typical Operating Characteristics (Cont.)

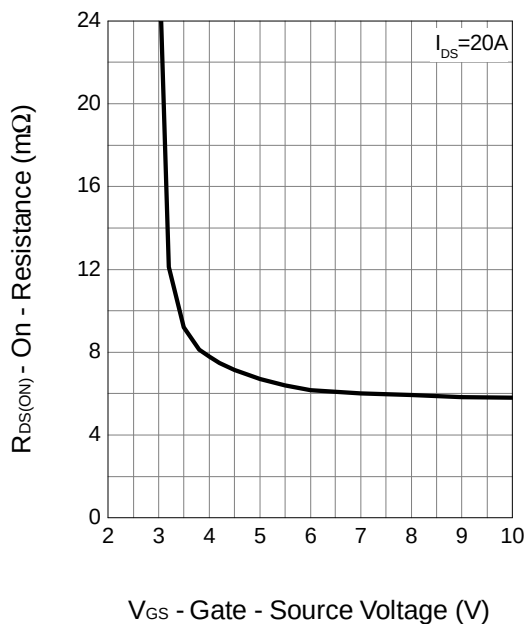
Output Characteristics



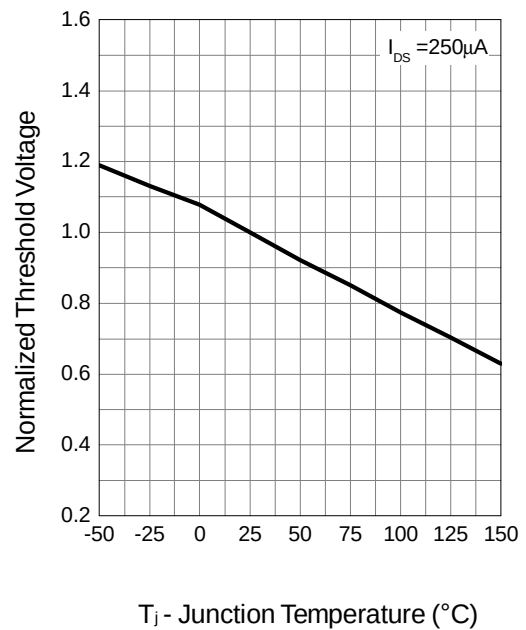
Drain-Source On Resistance



Transfer Characteristics

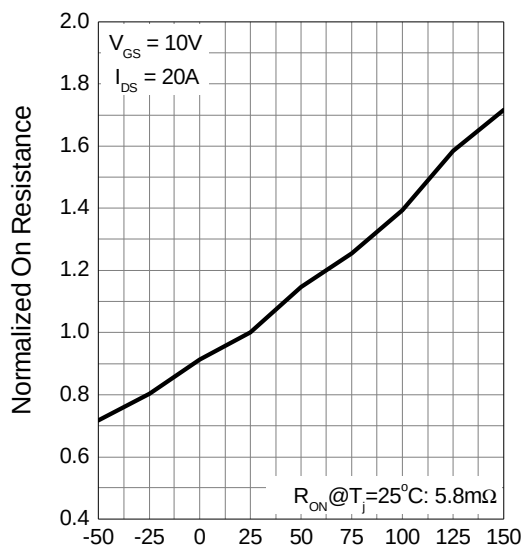


Gate Threshold Voltage



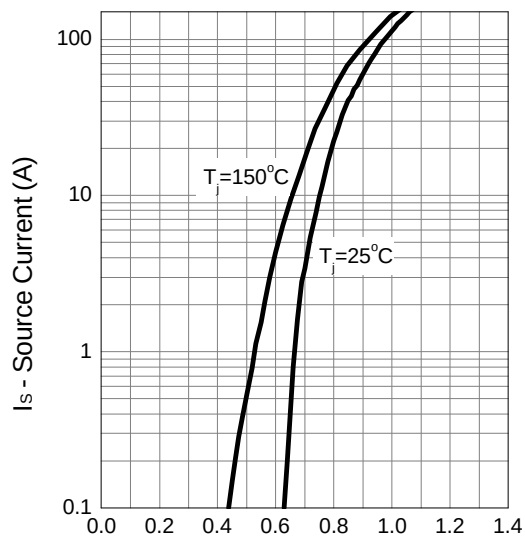
## Typical Operating Characteristics (Cont.)

**Drain-Source On Resistance**



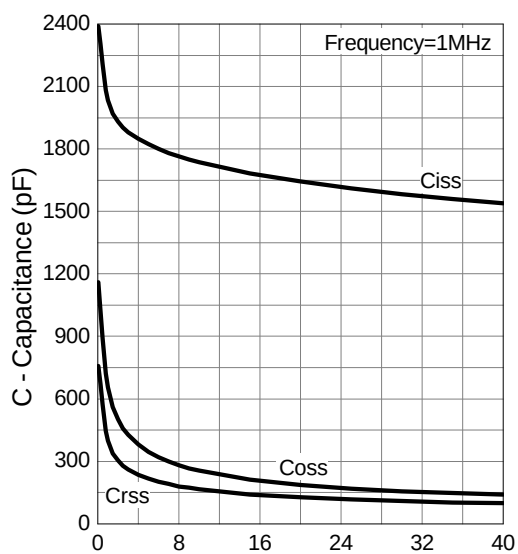
$T_j$  - Junction Temperature ( $^{\circ}\text{C}$ )

**Source-Drain Diode Forward**



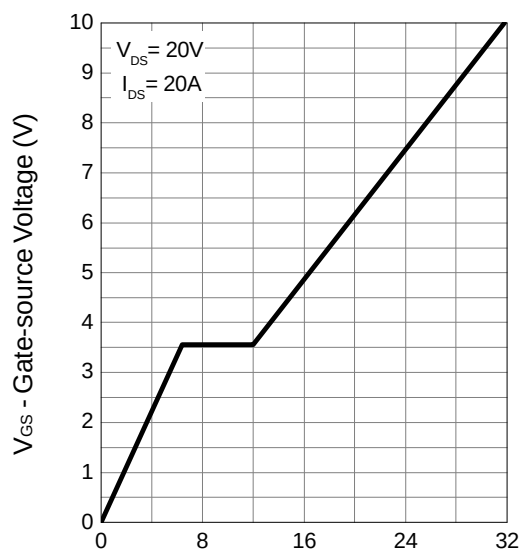
$V_{SD}$  - Source - Drain Voltage (V)

**Capacitance**



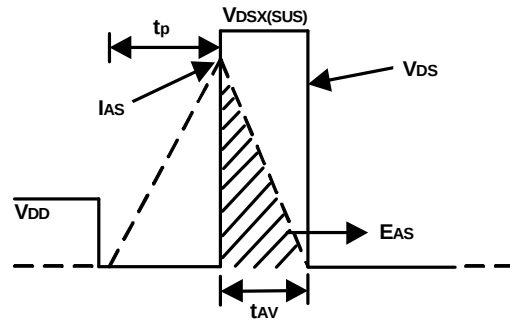
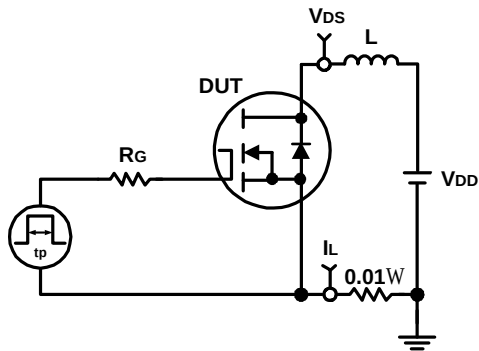
$V_{DS}$  - Drain-Source Voltage (V)

**Gate Charge**

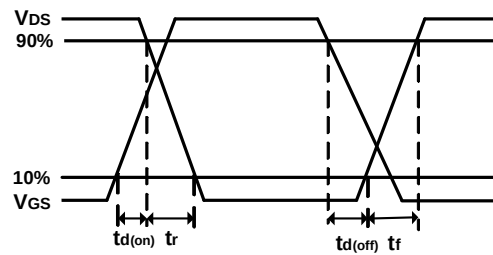
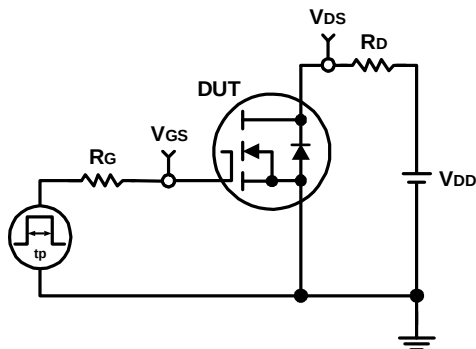


$Q_G$  - Gate Charge (nC)

## Avalanche Test Circuit and Waveforms



## Switching Time Test Circuit and Waveforms



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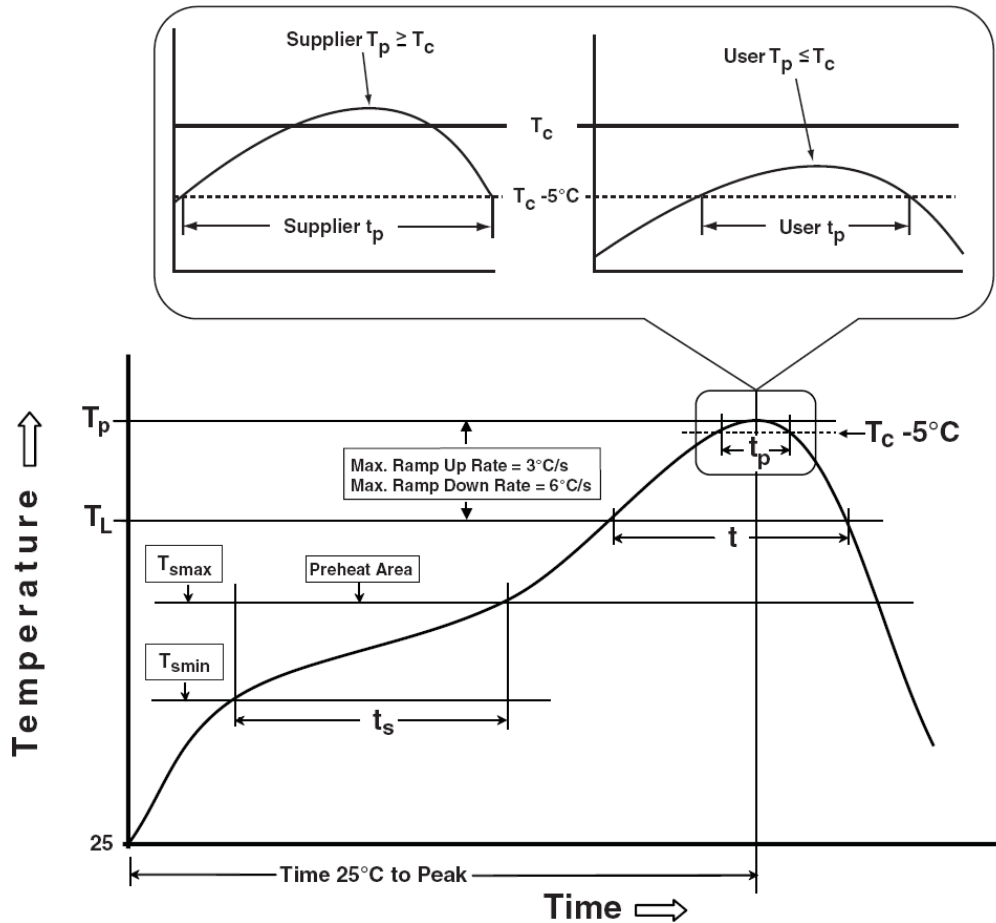
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## Classification Profile



## Classification Reflow Profiles

| Profile Feature                                                                                                                                                                                                             | Sn-Pb Eutectic Assembly            | Pb-Free Assembly                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------|
| <b>Preheat &amp; Soak</b><br>Temperature min ( $T_{smin}$ )<br>Temperature max ( $T_{smax}$ )<br>Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )                                                                                | 100 °C<br>150 °C<br>60-120 seconds | 150 °C<br>200 °C<br>60-120 seconds |
| Average ramp-up rate<br>( $T_{smax}$ to $T_p$ )                                                                                                                                                                             | 3 °C/second max.                   | 3°C/second max.                    |
| Liquidous temperature ( $T_L$ )<br>Time at liquidous ( $t_L$ )                                                                                                                                                              | 183 °C<br>60-150 seconds           | 217 °C<br>60-150 seconds           |
| Peak package body Temperature<br>( $T_p$ )*                                                                                                                                                                                 | See Classification Temp in table 1 | See Classification Temp in table 2 |
| Time ( $t_p$ )** within 5°C of the specified<br>classification temperature ( $T_c$ )                                                                                                                                        | 20** seconds                       | 30** seconds                       |
| Average ramp-down rate ( $T_p$ to $T_{smax}$ )                                                                                                                                                                              | 6 °C/second max.                   | 6 °C/second max.                   |
| Time 25°C to peak temperature                                                                                                                                                                                               | 6 minutes max.                     | 8 minutes max.                     |
| * Tolerance for peak profile Temperature ( $T_p$ ) is defined as a supplier minimum and a user maximum.<br>** Tolerance for time at peak profile temperature ( $t_p$ ) is defined as a supplier minimum and a user maximum. |                                    |                                    |

Table 1. SnPb Eutectic Process – Classification Temperatures ( $T_c$ )

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>≥350 |
|-------------------|--------------------------------|--------------------------------|
| <2.5 mm           | 235 °C                         | 220 °C                         |
| ≥2.5 mm           | 220 °C                         | 220 °C                         |

Table 2. Pb-free Process – Classification Temperatures ( $T_c$ )

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350-2000 | Volume mm <sup>3</sup><br>>2000 |
|-------------------|--------------------------------|------------------------------------|---------------------------------|
| <1.6 mm           | 260 °C                         | 260 °C                             | 260 °C                          |
| 1.6 mm – 2.5 mm   | 260 °C                         | 250 °C                             | 245 °C                          |
| ≥2.5 mm           | 250 °C                         | 245 °C                             | 245 °C                          |

## Reliability Test Program

| Test item     | Method        | Description                            |
|---------------|---------------|----------------------------------------|
| SOLDERABILITY | JESD-22, B102 | 5 Sec, 245°C                           |
| HTRB          | JESD-22, A108 | 1000 Hrs, 80% of VDS max @ $T_{jmax}$  |
| HTGB          | JESD-22, A108 | 1000 Hrs, 100% of VGS max @ $T_{jmax}$ |
| PCT           | JESD-22, A102 | 168 Hrs, 100%RH, 2atm, 121°C           |
| TCT           | JESD-22, A104 | 500 Cycles, -65°C~150°C                |

## Customer Service

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