

P-Channel Enhancement Mode MOSFET

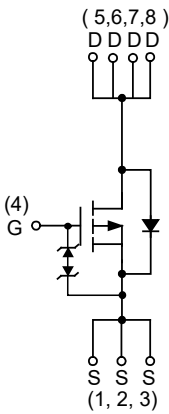
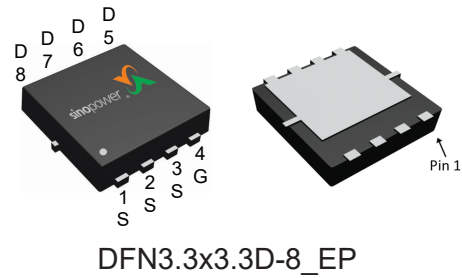
Features

- 30V/-100A\*  
 $R_{DS(ON)}=5.8m\Omega(max.)@V_{GS}=-10V$   
 $R_{DS(ON)}=10.8m\Omega(max.)@V_{GS}=-4.5V$
- 100% UIS +  $R_g$  Tested
- ESD Protection
- Reliable and Rugged
- Lead Free and Green Devices Available  
(RoHS Compliant)

Applications

- Power Management in Notebook Computer, Portable Equipment and Battery Powered Systems.

Pin Description



P-Channel MOSFET

Ordering and Marking Information

|                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div>SM3451PS    □□□-□□□</div> <div><div></div><div></div><div></div><div></div></div> <div>Assembly Material</div> <div>Handling Code</div> <div>Temperature Range</div> <div>Package Code</div> | <div>Package Code</div> <div>QA : DFN3.3x3.3D-8_EP</div> <div>Operating Junction Temperature Range</div> <div>C : -55 to 150 °C</div> <div>Handling Code</div> <div>TR : Tape &amp; Reel</div> <div>Assembly Material</div> <div>G : Halogen and Lead Free Device</div> |
| <div>SM3451PS    QA :</div> <div><div>SM</div><div>3451PS</div><div>XXXXX</div><div>●</div></div>                                                                                                 | <div>XXXXXX - Lot Code</div>                                                                                                                                                                                                                                            |

Note : SINOPOWER lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. SINOPOWER lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. SINOPOWER defines “Green” to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

**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                   |                       | -30        | V    |
| V <sub>GSS</sub>              | Gate-Source Voltage                    |                       | ±25        |      |
| 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  | -53        | A    |
| I <sub>D</sub>                | Continuous Drain Current               | T <sub>C</sub> =25°C  | -100*      | A    |
|                               |                                        | T <sub>C</sub> =100°C | -67        |      |
| I <sub>DM</sub> <sup>a</sup>  | Pulsed Drain Current                   | T <sub>C</sub> =25°C  | -400*      | A    |
| P <sub>D</sub>                | Maximum Power Dissipation              | T <sub>C</sub> =25°C  | 104        | W    |
|                               |                                        | T <sub>C</sub> =100°C | 41         |      |
| R <sub>θJC</sub>              | Thermal Resistance-Junction to Case    |                       | 1.2        | °C/W |
| I <sub>D</sub>                | Continuous Drain Current               | T <sub>A</sub> =25°C  | 15         | A    |
|                               |                                        | T <sub>A</sub> =70°C  | 12         |      |
| P <sub>D</sub>                | Maximum Power Dissipation              | T <sub>A</sub> =25°C  | 2.1        | W    |
|                               |                                        | T <sub>A</sub> =70°C  | 1.3        |      |
| R <sub>θJA</sub> <sup>c</sup> | Thermal Resistance-Junction to Ambient |                       | 60         | °C/W |
| I <sub>AS</sub> <sup>b</sup>  | Avalanche Current, Single pulse        | L=0.5mH               | -25        | A    |
| E <sub>AS</sub> <sup>b</sup>  | Avalanche Energy, Single pulse         | L=0.5mH               | 156        | mJ   |

Note \* : Current limited by bonding wire.

Note a : Pulse width is limited by maximum junction temperature.

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

Note c : Surface mounted on  $1\text{in}^2$  pad area.

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

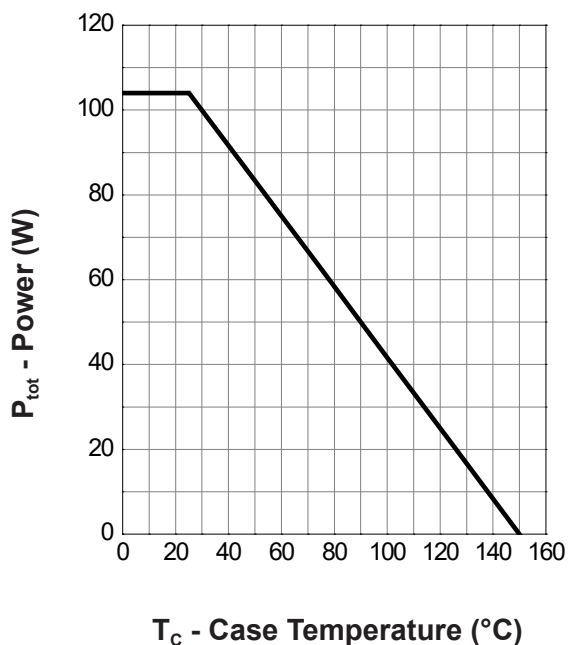
| Symbol                                   | Parameter                        | Test Conditions                                                                                                    | Min. | Typ.       | Max.        | Unit |
|------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------|------|------------|-------------|------|
| Static Characteristics                   |                                  |                                                                                                                    |      |            |             |      |
| BV <sub>DSS</sub>                        | Drain-Source Breakdown Voltage   | V <sub>GS</sub> =0V, I <sub>DS</sub> =-250μA                                                                       | -30  | -          | -           | V    |
| I <sub>DSS</sub>                         | Zero Gate Voltage Drain Current  | V <sub>DS</sub> =-24V, V <sub>GS</sub> =0V<br>T <sub>J</sub> =85°C                                                 | -    | -          | -1          | μA   |
|                                          |                                  |                                                                                                                    | -    | -          | -30         |      |
| V <sub>GS(th)</sub>                      | Gate Threshold Voltage           | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =-250μA                                                         | -1.3 | -1.8       | -2.3        | V    |
| I <sub>GSS</sub>                         | Gate Leakage Current             | V <sub>GS</sub> =±25V, V <sub>DS</sub> =0V                                                                         | -    | -          | ±10         | μA   |
| R <sub>DS(ON)</sub> <sup>d</sup>         | Drain-Source On-state Resistance | V <sub>GS</sub> =-10V, I <sub>DS</sub> =-36A<br>V <sub>GS</sub> =-4.5V, I <sub>DS</sub> =-22A                      | -    | 4.8<br>8.3 | 5.8<br>10.8 | mΩ   |
|                                          |                                  |                                                                                                                    |      |            |             |      |
| Diode Characteristics                    |                                  |                                                                                                                    |      |            |             |      |
| V <sub>SD</sub> <sup>d</sup>             | Diode Forward Voltage            | I <sub>SD</sub> =-18A, V <sub>GS</sub> =0V                                                                         | -    | -0.8       | -1.1        | V    |
| t <sub>rr</sub>                          | Reverse Recovery Time            | I <sub>SD</sub> =-36A, dI <sub>SD</sub> /dt=100A/μs                                                                | -    | 22         | -           | ns   |
| Q <sub>rr</sub>                          | Reverse Recovery Charge          |                                                                                                                    | -    | 8          | -           | nC   |
| Dynamic Characteristics <sup>e</sup>     |                                  |                                                                                                                    |      |            |             |      |
| R <sub>G</sub>                           | Gate Resistance                  | V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, F=1MHz                                                                   | -    | 3          | -           | Ω    |
| C <sub>iss</sub>                         | Input Capacitance                | V <sub>GS</sub> =0V,<br>V <sub>DS</sub> =-15V,<br>Frequency=1.0MHz                                                 | -    | 3477       | 4520        | pF   |
| C <sub>oss</sub>                         | Output Capacitance               |                                                                                                                    | -    | 472        | -           |      |
| C <sub>rss</sub>                         | Reverse Transfer Capacitance     |                                                                                                                    | -    | 328        | -           |      |
| t <sub>d(ON)</sub>                       | Turn-on Delay Time               | V <sub>DD</sub> =-15V, R <sub>L</sub> =15Ω,<br>I <sub>DS</sub> =-1A, V <sub>GEN</sub> =-10V,<br>R <sub>G</sub> =6Ω | -    | 17         | 31          | ns   |
| t <sub>r</sub>                           | Turn-on Rise Time                |                                                                                                                    | -    | 14         | 25          |      |
| t <sub>d(OFF)</sub>                      | Turn-off Delay Time              |                                                                                                                    | -    | 84         | 151         |      |
| t <sub>f</sub>                           | Turn-off Fall Time               |                                                                                                                    | -    | 46         | 83          |      |
| Gate Charge Characteristics <sup>e</sup> |                                  |                                                                                                                    |      |            |             |      |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-10V,<br>I <sub>DS</sub> =-36A                                             | -    | 58         | 87          | nC   |
| Q <sub>g</sub>                           | Total Gate Charge                | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-4.5V,<br>I <sub>DS</sub> =-36A                                            | -    | 29         | -           |      |
| Q <sub>gs</sub>                          | Gate-Source Charge               |                                                                                                                    | -    | 12         | -           |      |
| Q <sub>gd</sub>                          | Gate-Drain Charge                |                                                                                                                    | -    | 13         | -           |      |

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

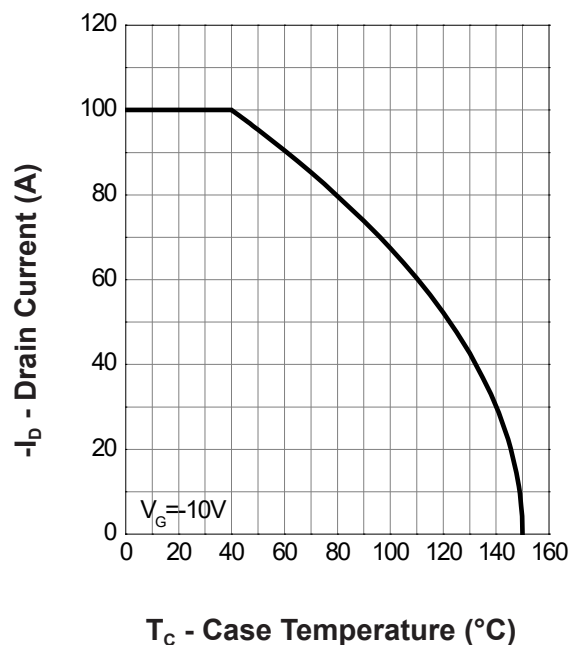
Note e : Guaranteed by design, not subject to production testing.

## Typical Operating Characteristics

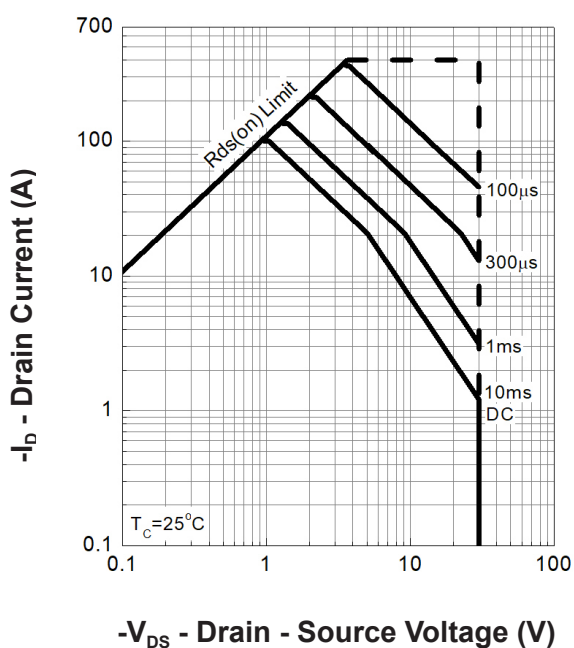
Power Dissipation



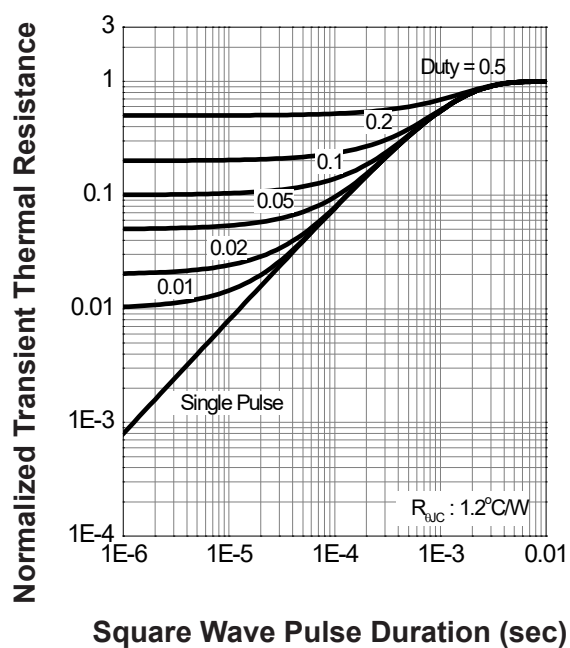
Drain Current



Safe Operation Area

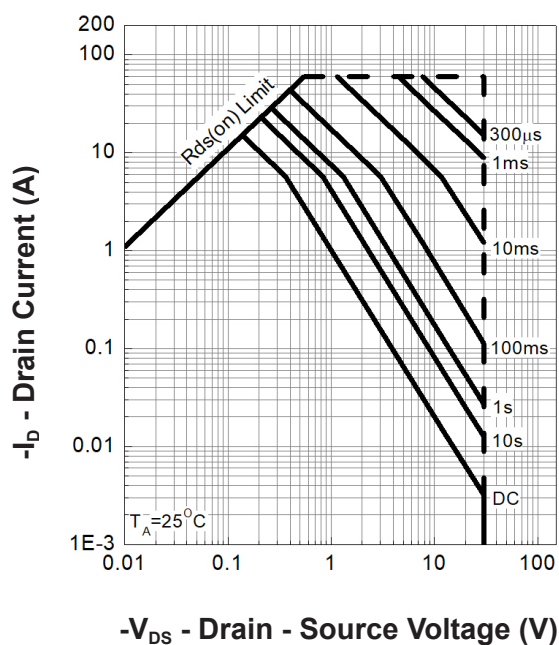


Thermal Transient Impedance

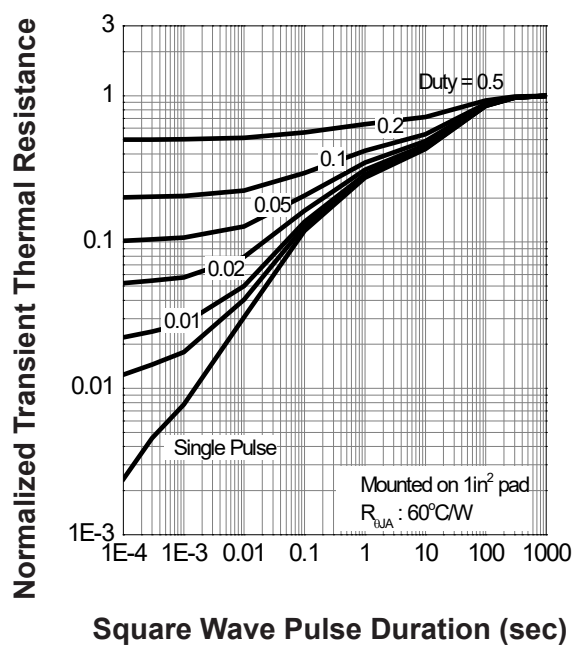


## Typical Operating Characteristics(Cont.)

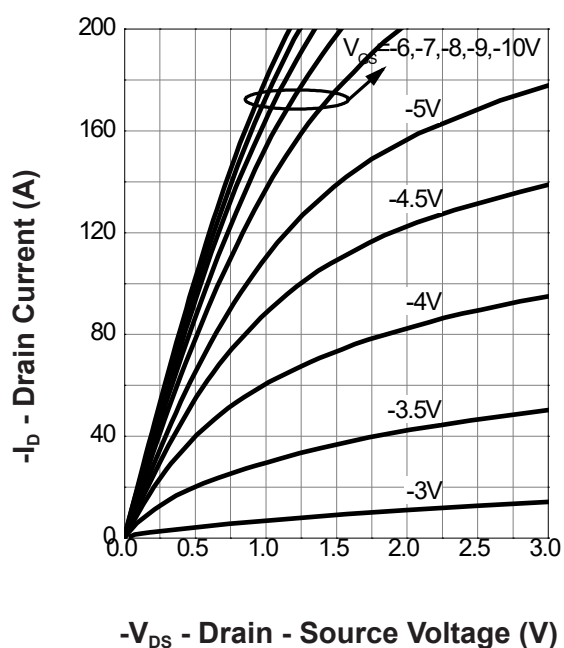
Safe Operation Area



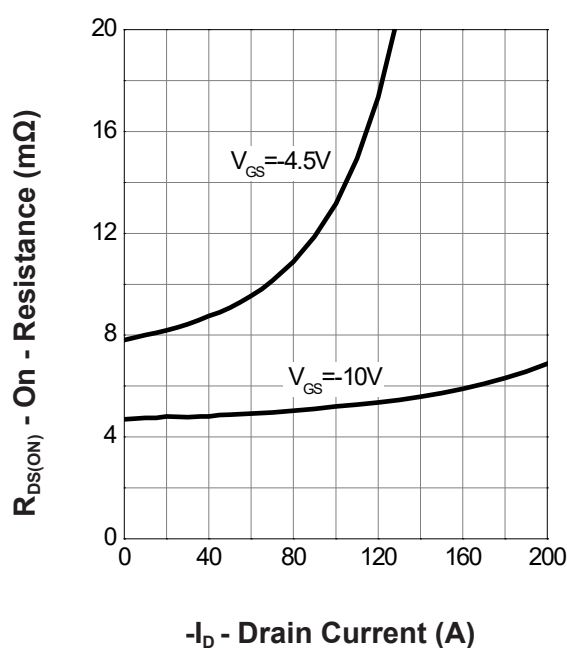
Thermal Transient Impedance



Output Characteristics

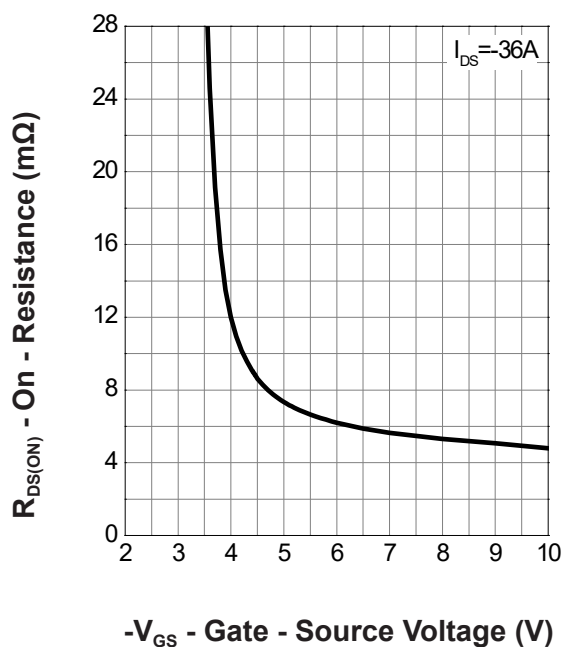


Drain-Source On Resistance

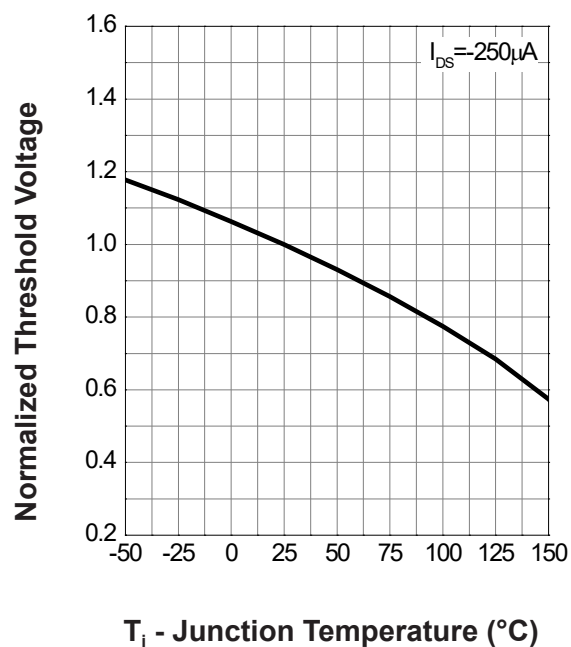


## Typical Operating Characteristics(Cont.)

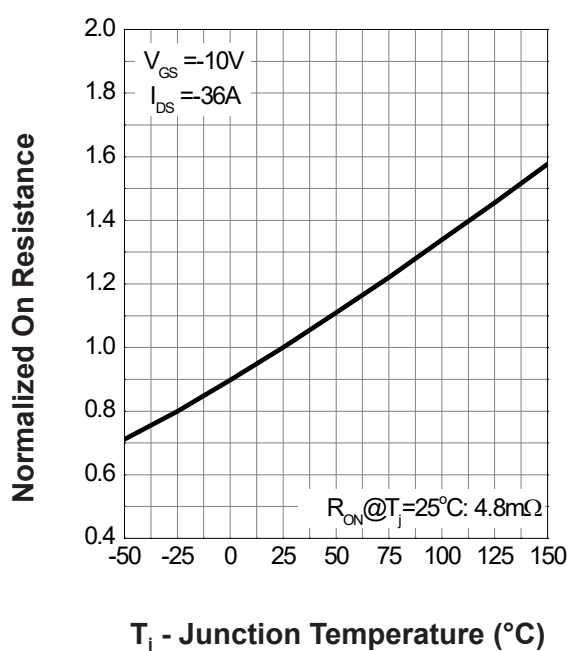
Gate-Source On Resistance



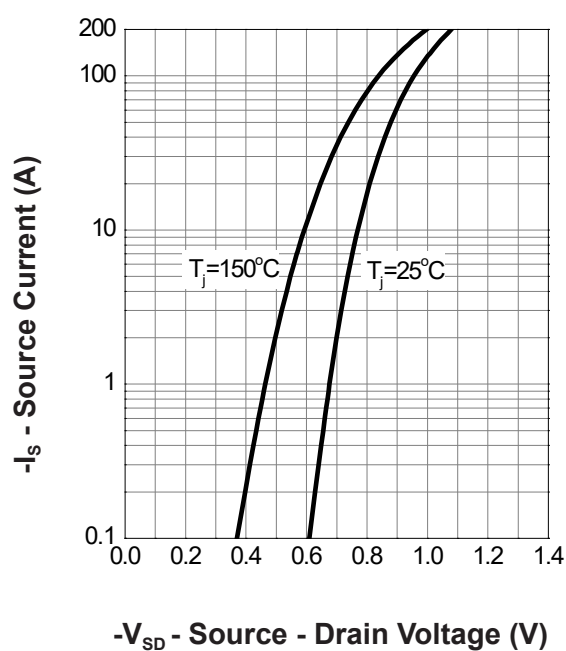
Gate Threshold Voltage



Drain-Source On Resistance

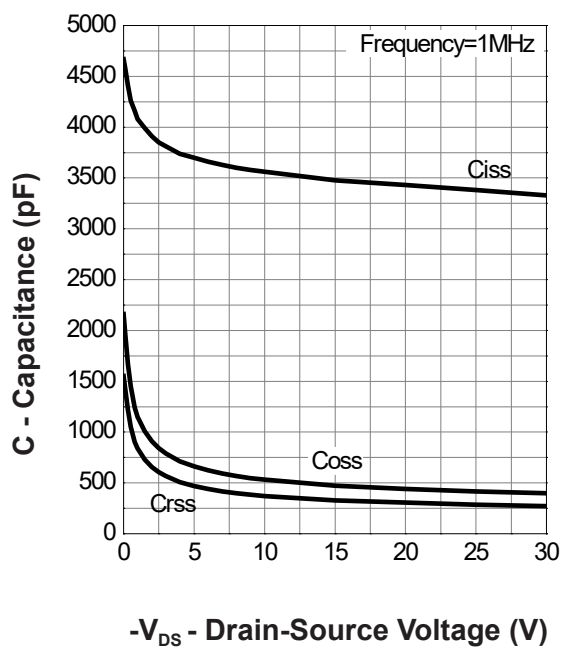


Source-Drain Diode Forward

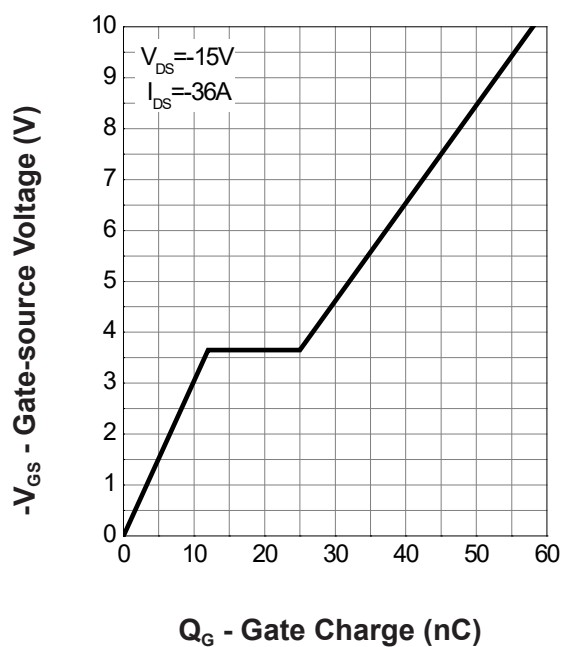


## Typical Operating Characteristics(Cont.)

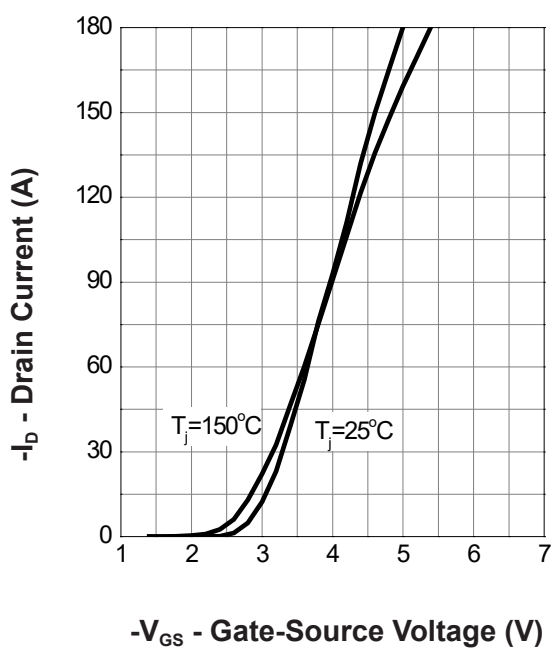
Capacitance



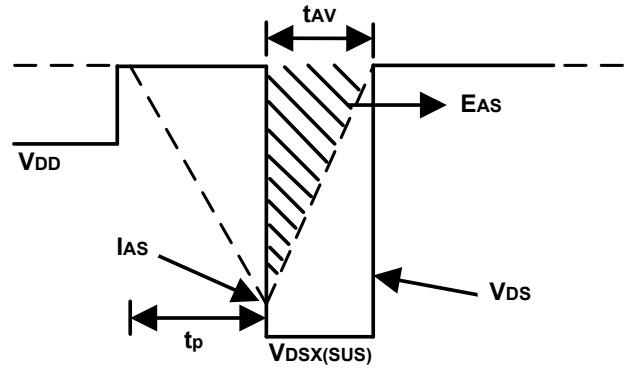
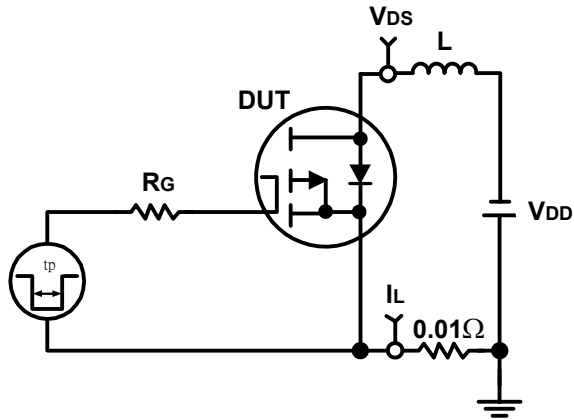
Gate Charge



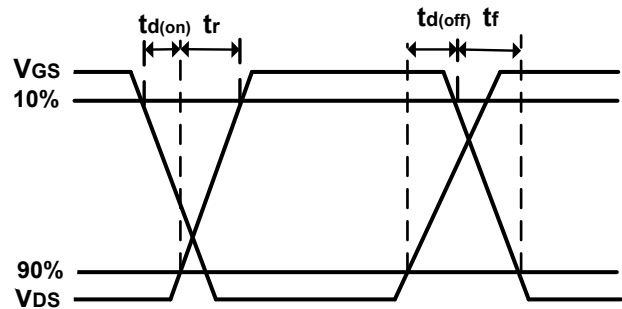
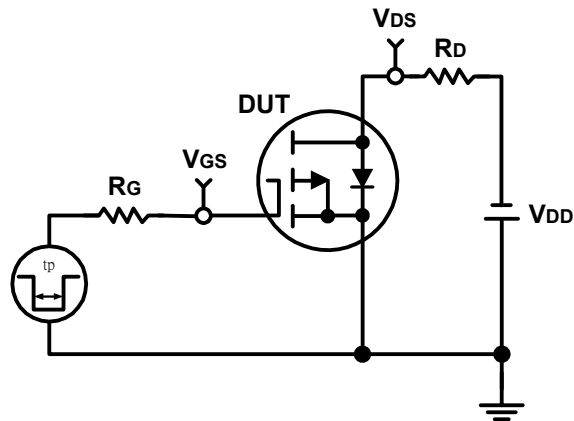
Transfer Characteristics



## Avalanche Test Circuit and Waveforms



## Switching Time Test Circuit and Waveforms



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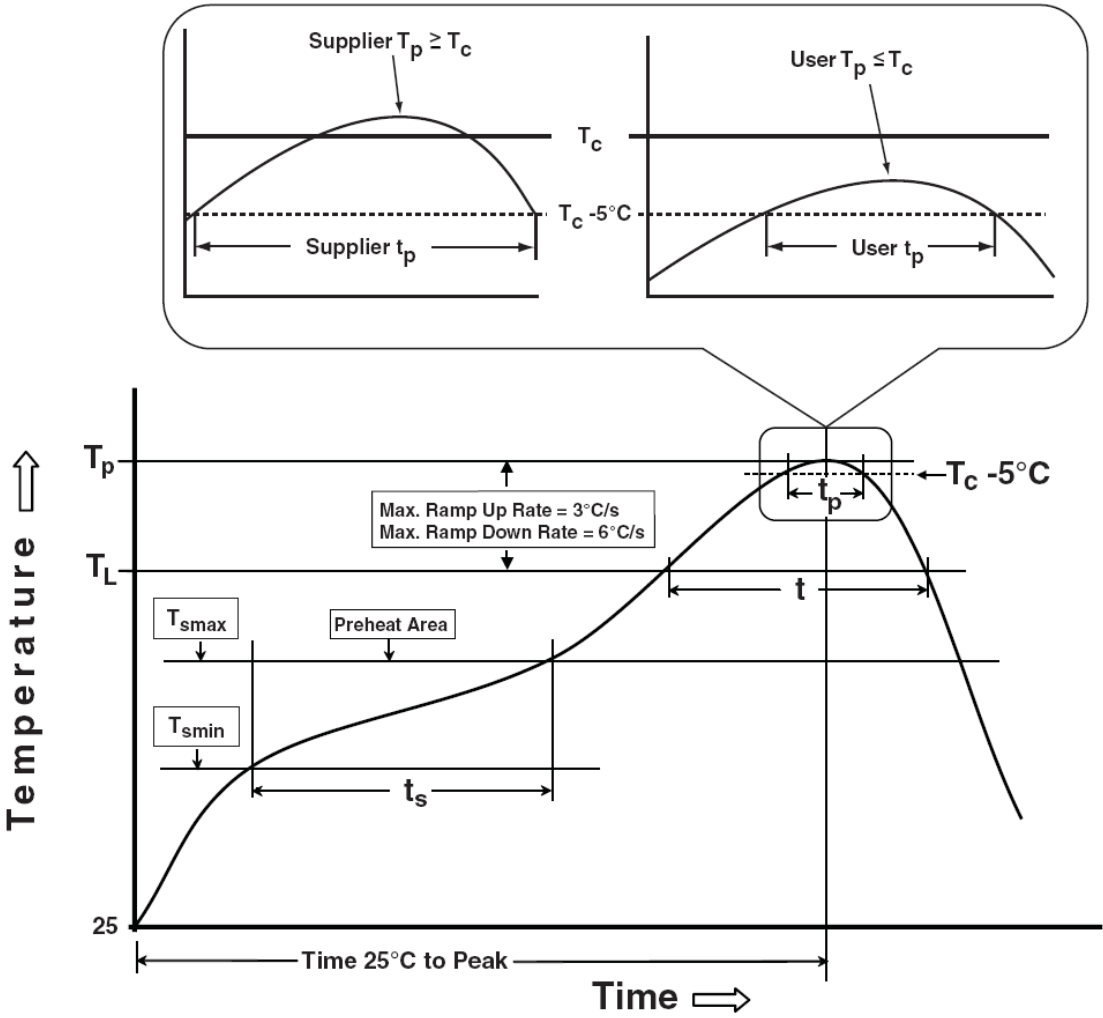
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Classification Profile



## Classification Reflow Profiles

| Profile Feature                                                                                                  | Sn-Pb Eutectic Assembly            | Pb-Free Assembly                   |
|------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------|
| <b>Preheat &amp; Soak</b>                                                                                        |                                    |                                    |
| Temperature min ( $T_{smin}$ )                                                                                   | 100 °C                             | 150 °C                             |
| Temperature max ( $T_{smax}$ )                                                                                   | 150 °C                             | 200 °C                             |
| Time ( $T_{smin}$ to $T_{smax}$ ) ( $t_s$ )                                                                      | 60-120 seconds                     | 60-120 seconds                     |
| Average ramp-up rate ( $T_{smax}$ to $T_p$ )                                                                     | 3 °C/second max.                   | 3°C/second max.                    |
| Liquidous temperature ( $T_L$ )                                                                                  | 183 °C                             | 217 °C                             |
| Time at liquidous ( $t_L$ )                                                                                      | 60-150 seconds                     | 60-150 seconds                     |
| Peak package body Temperature ( $T_p$ )*                                                                         | See Classification Temp in table 1 | See Classification Temp in table 2 |
| Time ( $t_p$ )** within 5°C of the specified 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.          |                                    |                                    |
| ** 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                          |

## Customer Service

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