# Dual Enhancement Mode MOSFET (N-and P-Channel)

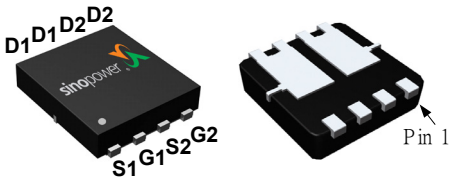
## Features

- N Channel : 100V/7A,
  $R_{DS(ON)}$=162mΩ(max.)@$V_{GS}$=10V
  $R_{DS(ON)}$=180mΩ(max.)@$V_{GS}$=4.5V
- P Channel : -100V/-6.6A,
  $R_{DS(ON)}$=219mΩ(max.)@$V_{GS}$=-10V
  $R_{DS(ON)}$=254mΩ(max.)@$V_{GS}$=-4.5V
- 100% UIS + $R_g$ Tested
- ESD Protection
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)
- Moisture Sensitivity Level MSL1 (per JEDEC J-STD-020D)

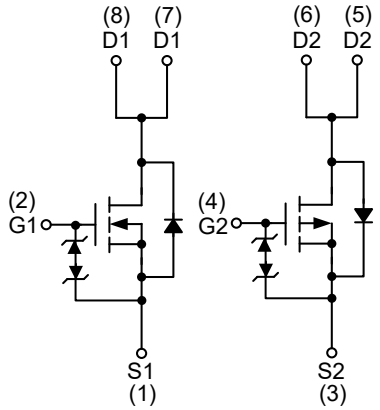
## Applications

- DC Motor Control.

## Pin Description




DFN5x6C-8_EP2




N-Channel MOSFET P-Channel MOSFET

## Ordering and Marking Information

| | |
|---|---|
| SM1A42CS □□□-□□ □<br>Assembly Material<br>Handling Code<br>Temperature Range<br>Package Code | Package Code<br>KP : DFN5x6C-8_EP2<br>Operating Junction Temperature Range<br>C : -55 to 150 °C<br>Handling Code<br>TR : Tape & Reel<br>Assembly Material<br>G : Halogen and Lead Free Device |
| SM1A42CS KP : 1A42CS XXXXX ● | XXXXX - Lot Code |

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).

SINOPOWER reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

## Absolute Maximum Ratings ($T_A$=25°C Unless Otherwise Noted)

| Symbol | Parameter | | N Channel | P Channel | Unit |
|---|---|---|---|---|---|
| **Common Ratings** | | | | | |
| $V_{DSS}$ | Drain-Source Voltage | | 100 | -100 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±20 | ±20 | |
| $T_J$ | Maximum Junction Temperature | | 150 | | °C |
| $T_{STG}$ | Storage Temperature Range | | -55 to 150 | | |
| $I_S$ | Diode Continuous Forward Current | $T_C$=25°C | 3.5 | -3.2 | A |
| $I_D$ | Continuous Drain Current | $T_C$=25°C | 7 | -6.6 | A |
| | | $T_C$=100°C | 4.4 | -4.1 | |
| $I_{DM}$ [a] | Pulse Drain Current Tested | $T_C$=25°C | 28 | -26.4 | A |
| $P_D$ | Maximum Power Dissipation | $T_C$=25°C | 17.8 | | W |
| | | $T_C$=100°C | 7.1 | | |
| $R_{\theta JC}$ | Thermal Resistance-Junction to Case | Steady State | 7 | | °C/W |
| $I_D$ | Continuous Drain Current | $T_A$=25°C | 2 | -1.9 | A |
| | | $T_A$=70°C | 1.6 | -1.5 | |
| $P_D$ | Maximum Power Dissipation | $T_A$=25°C | 1.47 | | W |
| | | $T_A$=70°C | 0.94 | | |
| $R_{\theta JA}$ [b] | Thermal Resistance-Junction to Ambient | Steady State | 85 | | °C/W |
| $I_{AS}$ [c] | Avalanche Current, Single pulse | L=0.5mH | 5 | -9 | A |
| $E_{AS}$ [c] | Avalanche Energy, Single pulse | L=0.5mH | 6.25 | 20 | mJ |

Note a：Pulse width limited by max. junction temperature.
Note b：Surface Mounted on 1in$^2$ pad area.
Note c：UIS tested and pulse width limited by maximum junction temperature (initial temperature $T_j$=25°C).

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## N Channel Electrical Characteristics ($T_A$ = 25°C unless otherwise noted)

| Symbol | Parameter | Test Conditions | N Channel | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| **Static Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V, $I_{DS}$=250μA | 100 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=80V, $V_{GS}$=0V | - | - | 1 | μA |
| | | $T_J$=85°C | - | - | 30 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_{DS}$=250μA | 1 | 2 | 3 | V |
| $I_{GSS}$ | Gate Leakage Current | $V_{GS}$=±20V, $V_{DS}$=0V | - | - | ±10 | μA |
| $R_{DS(ON)}$ [d] | Drain-Source On-state Resistance | $V_{GS}$=10V, $I_{DS}$=4A | - | 135 | 162 | mΩ |
| | | $V_{GS}$=4.5V, $I_{DS}$=3A | - | 138 | 180 | |
| **Diode Characteristics** | | | | | | |
| $V_{SD}$ [d] | Diode Forward Voltage | $I_{SD}$=2A, $V_{GS}$=0V | - | 0.8 | 1.3 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$=4A, $dI_{SD}/dt$=100A/μs | - | 25 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 32 | - | nC |
| **Dynamic Characteristics** [e] | | | | | | |
| $R_G$ | Gate Resistance | $V_{GS}$=0V,$V_{DS}$=0V,f=1MHz | - | 2.5 | | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=30V, Frequency=1.0MHz | - | 440 | 570 | pF |
| $C_{oss}$ | Output Capacitance | | - | 30 | - | |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 16 | - | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{DD}$=30V, $R_L$=30Ω, $I_{DS}$=1A, $V_{GEN}$=10V, $R_G$=6Ω | - | 9 | 17 | ns |
| $t_r$ | Turn-on Rise Time | | - | 7 | 13 | |
| $t_{d(OFF)}$ | Turn-off Delay Time | | - | 18 | 33 | |
| $t_f$ | Turn-off Fall Time | | - | 4 | 8 | |
| **Gate Charge Characteristics** [e] | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{DS}$=50V, $V_{GS}$=4.5V, $I_{DS}$=4A | - | 4.7 | - | nC |
| $Q_g$ | Total Gate Charge | $V_{DS}$=50V, $V_{GS}$=10V, $I_{DS}$=4A | - | 10 | 14 | |
| $Q_{gs}$ | Gate-Source Charge | | - | 1.7 | - | |
| $Q_{gd}$ | Gate-Drain Charge | | - | 1.8 | - | |

Note d：Pulse test ; pulse width≤300μs, duty cycle≤2%.
Note e：Guaranteed by design, not subject to production testing.

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## P Channel Electrical Characteristics ($T_A$ = 25°C unless otherwise noted)

| Symbol | Parameter | Test Conditions | P Channel | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| **Static Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V, $I_{DS}$=-250μA | -100 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=-80V, $V_{GS}$=0V | - | - | -1 | μA |
| | | $T_J$=85°C | - | - | -30 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_{DS}$=250μA | -1 | -2 | -3 | V |
| $I_{GSS}$ | Gate Leakage Current | $V_{GS}$=±20V, $V_{DS}$=0V | - | - | ±10 | μA |
| $R_{DS(ON)}$ [d] | Drain-Source On-state Resistance | $V_{GS}$=-10V, $I_{DS}$=-3A | - | 175 | 219 | mΩ |
| | | $V_{GS}$=-4.5V, $I_{DS}$=-2A | - | 188 | 254 | |
| **Diode Characteristics** | | | | | | |
| $V_{SD}$ [d] | Diode Forward Voltage | $I_{SD}$=-1.5A, $V_{GS}$=0V | - | -0.8 | -1.3 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$=-3A, $dI_{SD}/dt$=100A/μs | - | 29 | - | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 39 | - | nC |
| **Dynamic Characteristics** [e] | | | | | | |
| $R_G$ | Gate Resistance | $V_{GS}$=0V,$V_{DS}$=0V,f=1MHz | - | 10 | - | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=-30V, Frequency=1.0MHz | - | 700 | 910 | pF |
| $C_{oss}$ | Output Capacitance | | - | 45 | - | |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 27 | - | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{DD}$=-30V, $R_L$=-30Ω, $I_{DS}$=-1A, $V_{GEN}$=-10V, $R_G$=6Ω | - | 9 | 16.2 | ns |
| $t_r$ | Turn-on Rise Time | | - | 5 | 9 | |
| $t_{d(OFF)}$ | Turn-off Delay Time | | - | 54 | 97 | |
| $t_f$ | Turn-off Fall Time | | - | 32 | 58 | |
| **Gate Charge Characteristics** [e] | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{DS}$=-50V, $V_{GS}$=-4.5V, $I_{DS}$=-3A | - | 7.8 | - | nC |
| $Q_g$ | Total Gate Charge | $V_{DS}$=-50V, $V_{GS}$=-10V, $I_{DS}$=-3A | - | 16 | 22.4 | |
| $Q_{gs}$ | Gate-Source Charge | | - | 2.5 | - | |
| $Q_{gd}$ | Gate-Drain Charge | | - | 3.1 | - | |

Note d：Pulse test ; pulse width≤300μs, duty cycle≤2%.
Note e：Guaranteed by design, not subject to production testing.

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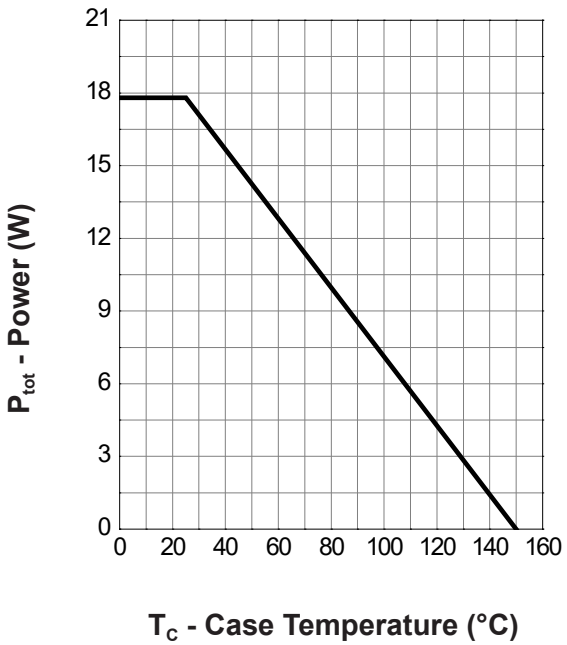
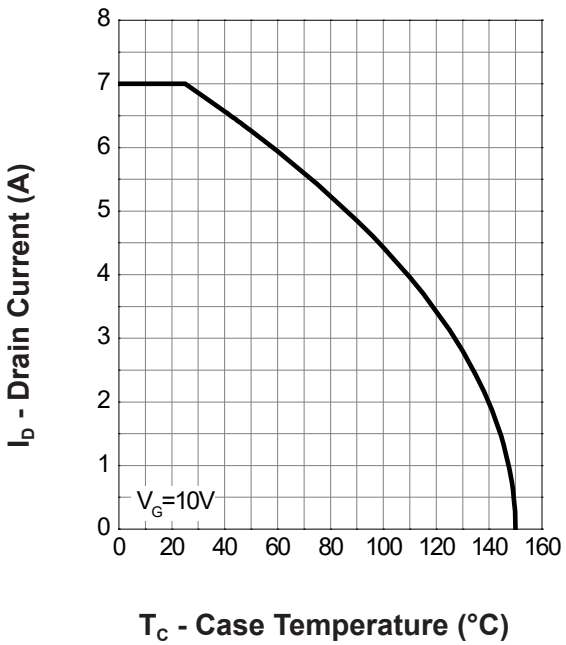
## N Channel Typical Operating Characteristics

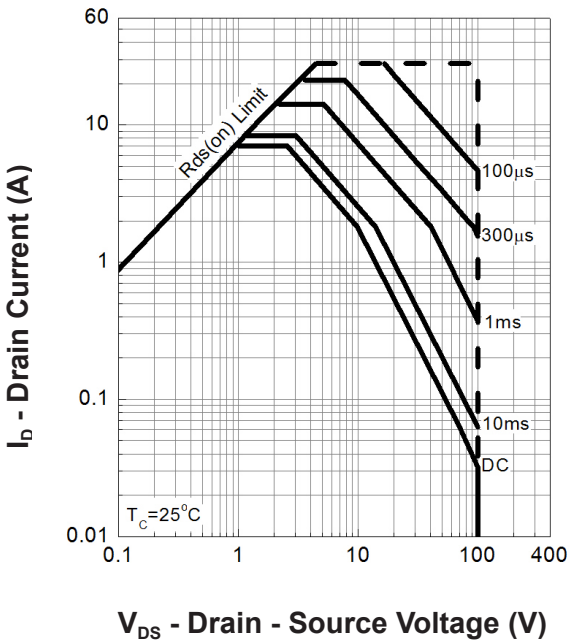
### Power Dissipation



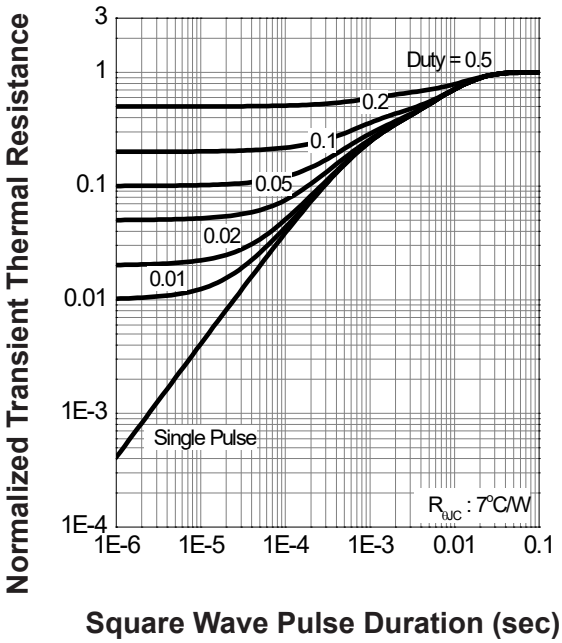

### Drain Current




### Safe Operation Area

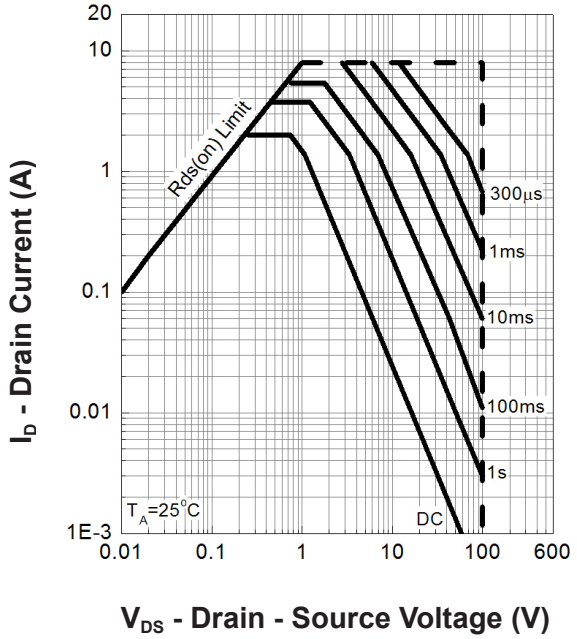



### Thermal Transient Impedance

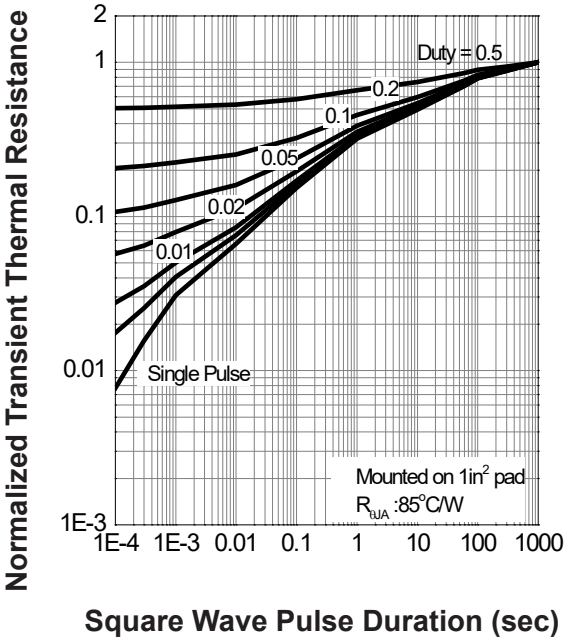


## N Channel Typical Operating Characteristics(Cont.)

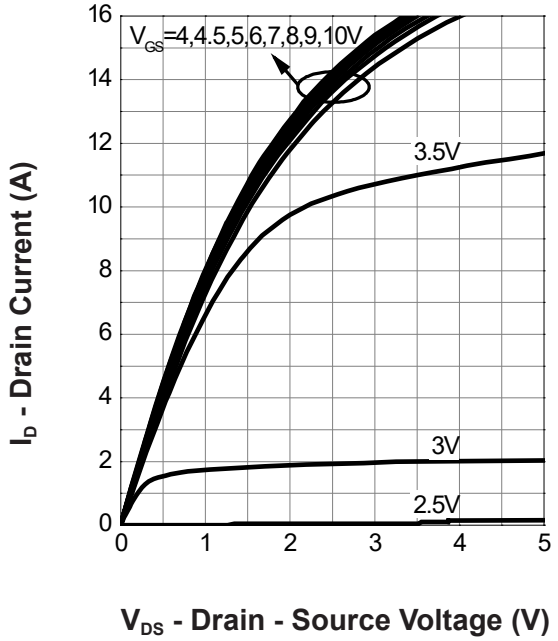
### Safe Operation Area



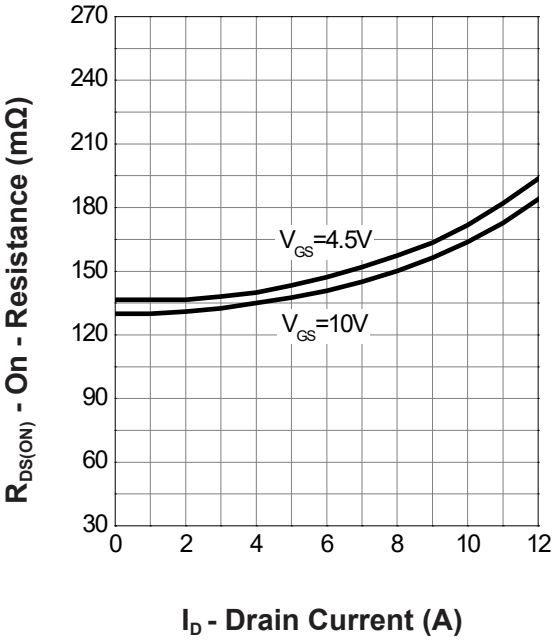

### Thermal Transient Impedance




### Output Characteristics

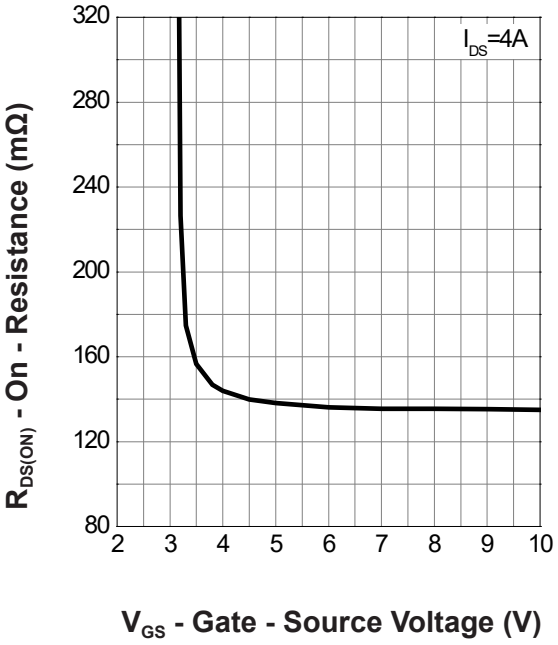



### Drain-Source On Resistance

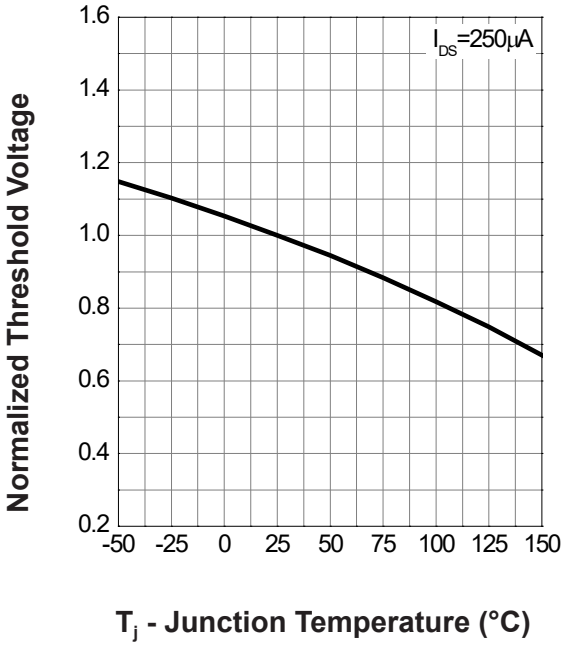


## N Channel Typical Operating Characteristics(Cont.)

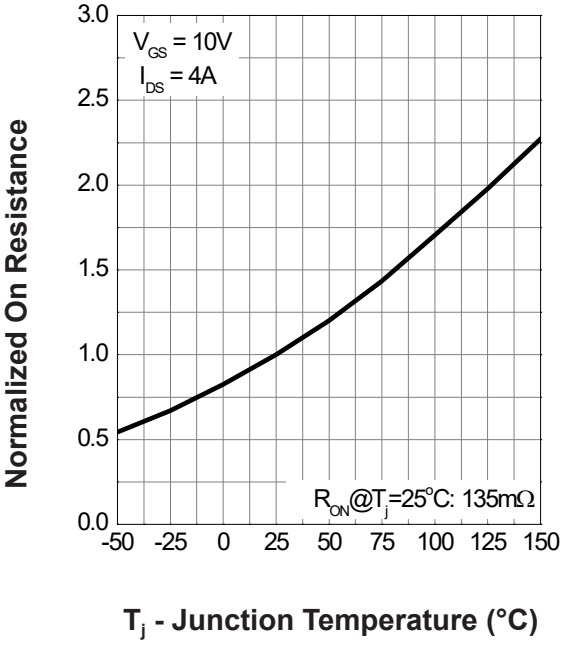
### Gate-Source On Resistance



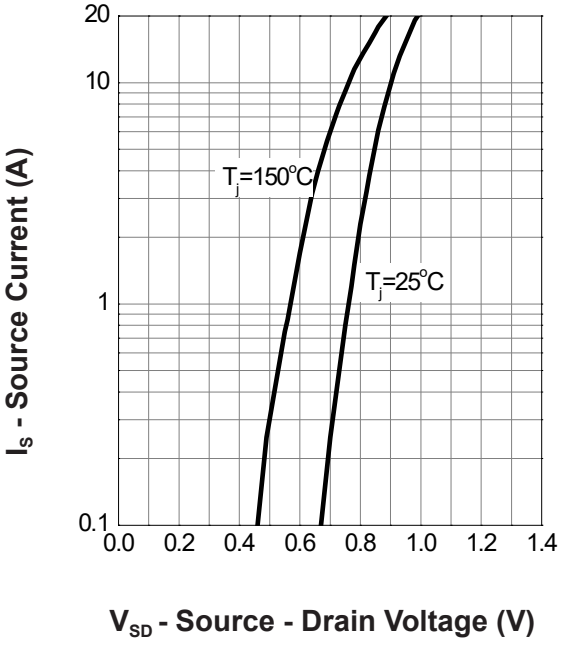

### Gate Threshold Voltage




### Drain-Source On Resistance




### Source-Drain Diode Forward

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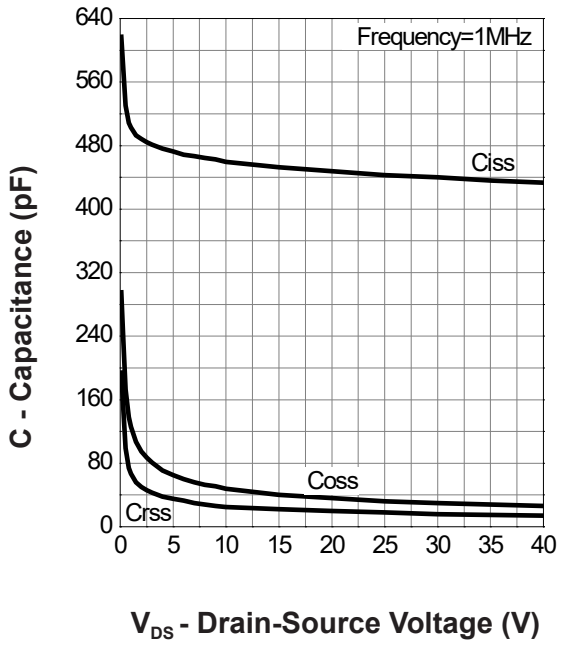
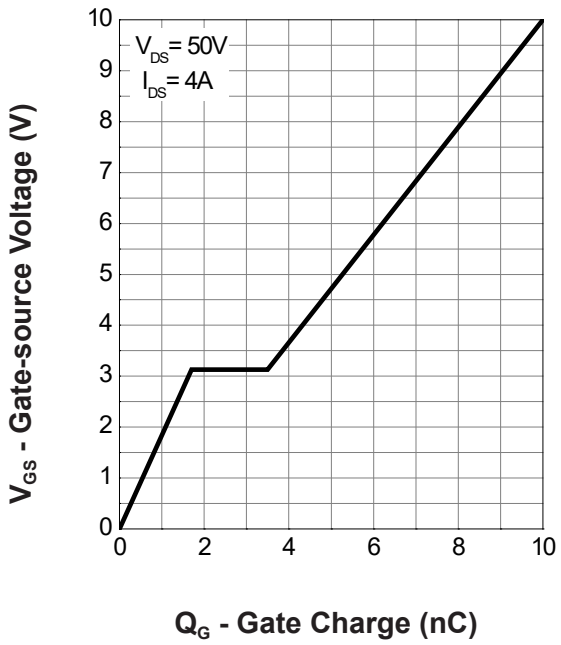
## N Channel Typical Operating Characteristics(Cont.)

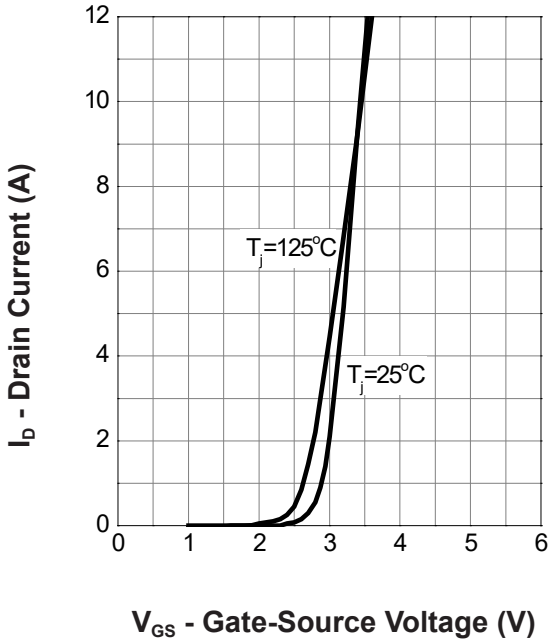
**Capacitance**




**Gate Charge**




**Transfer Characteristics**

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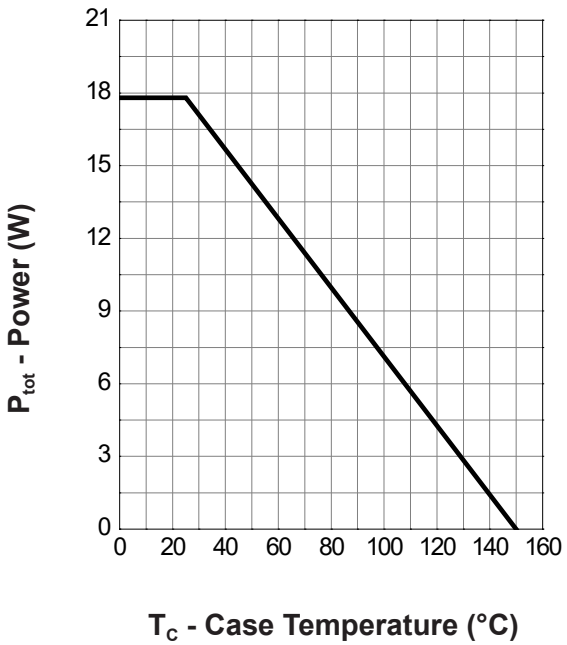
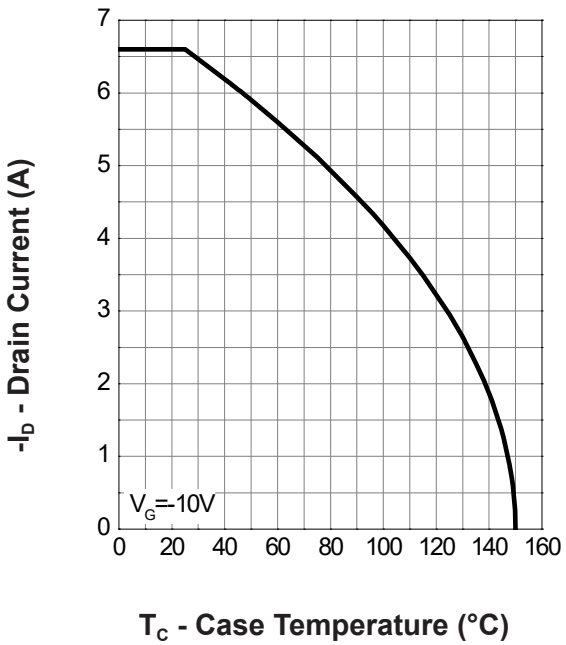
## P Channel Typical Operating Characteristics

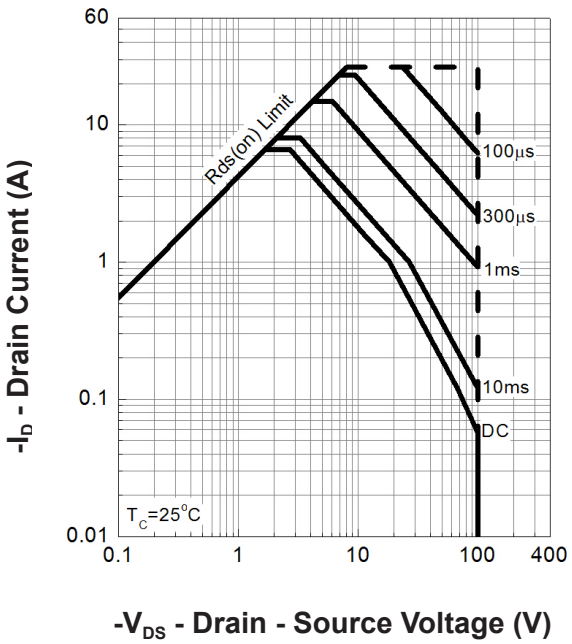
### Power Dissipation



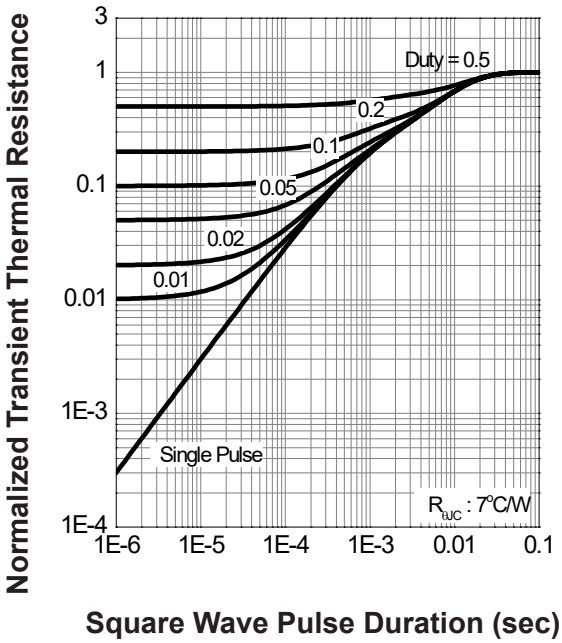

### Drain Current




### Safe Operation Area

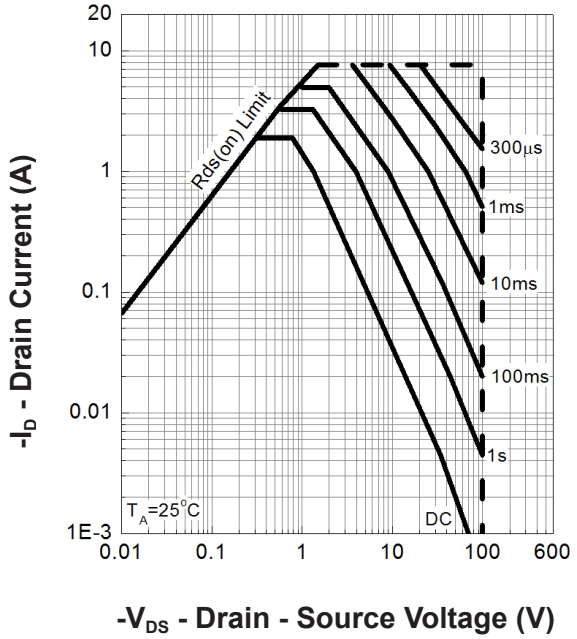



### Thermal Transient Impedance

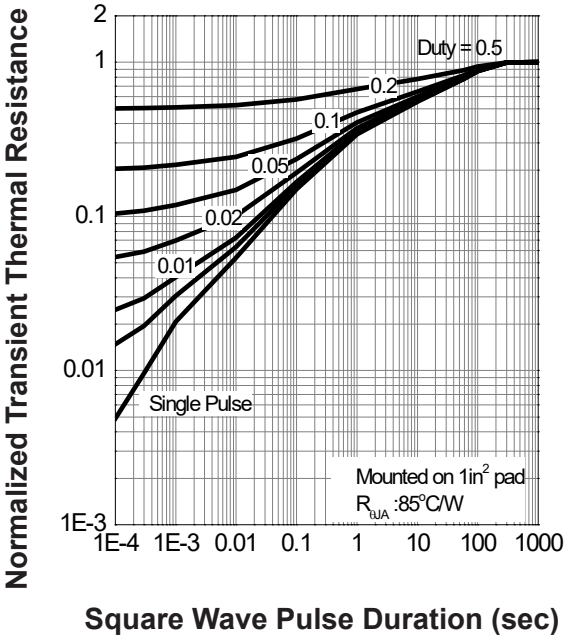


## P Channel Typical Operating Characteristics(Cont.)

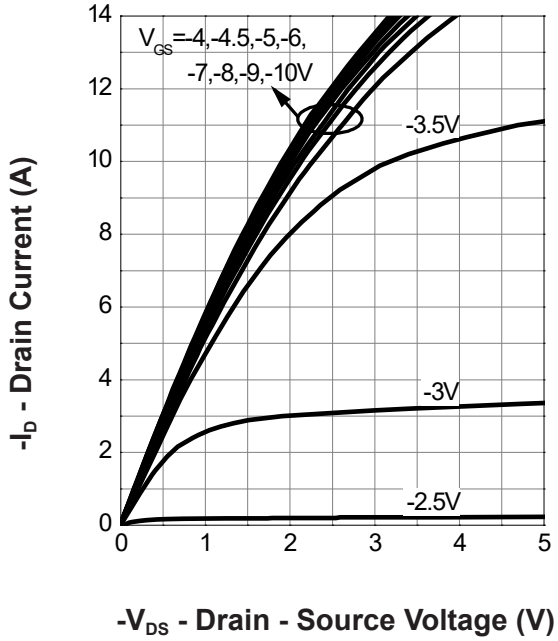
### Safe Operation Area



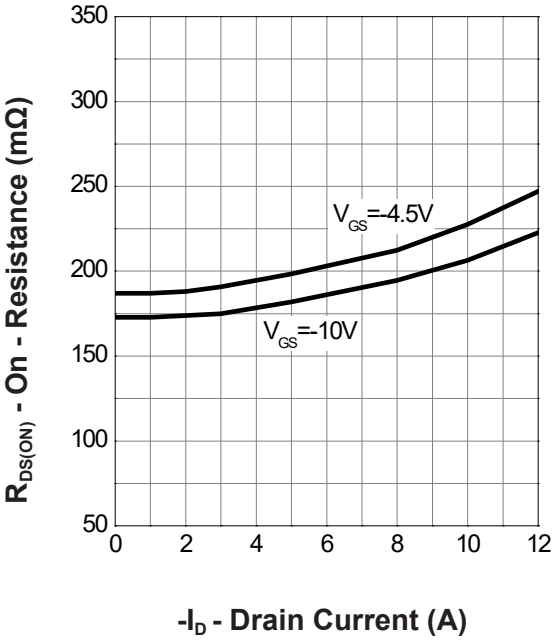

### Thermal Transient Impedance




### Output Characteristics




### Drain-Source On Resistance

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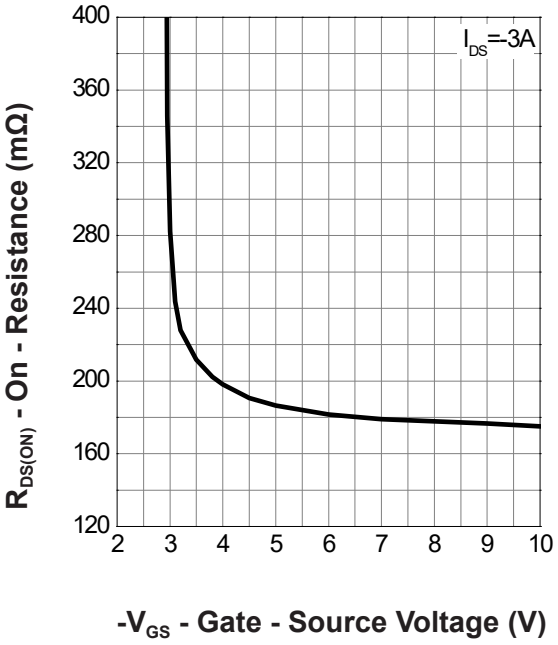
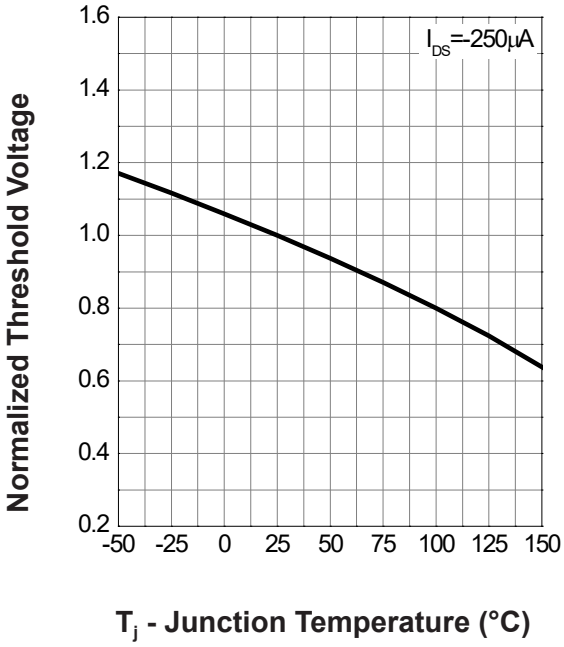
## P Channel Typical Operating Characteristics(Cont.)

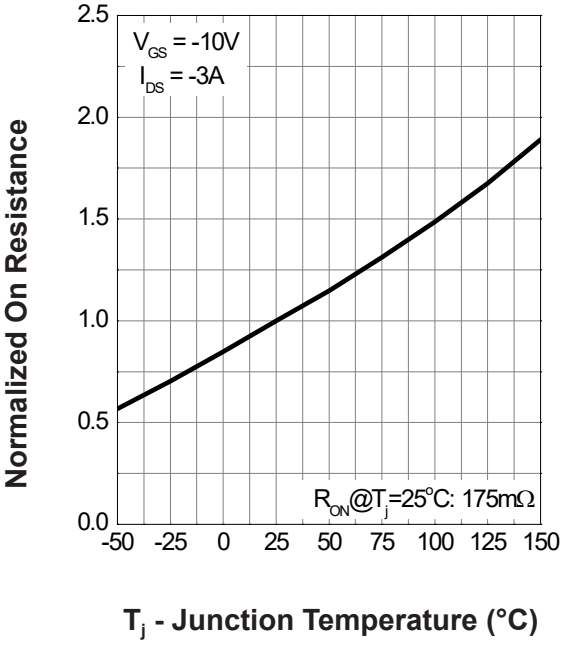
### Gate-Source On Resistance



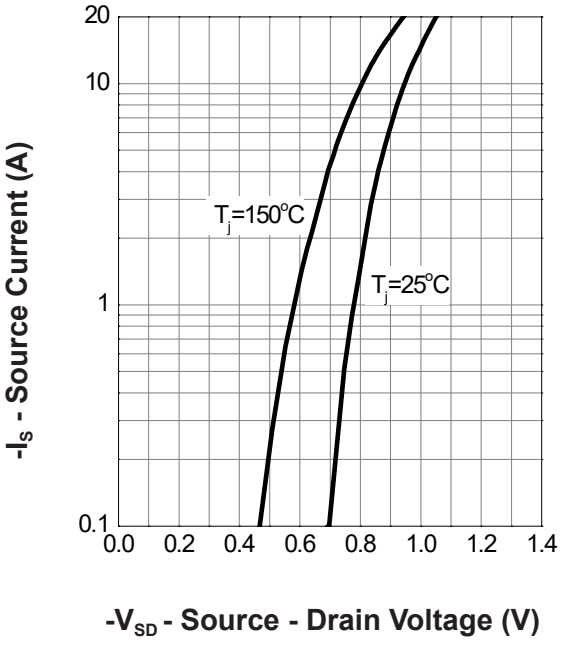

### Gate Threshold Voltage




### Drain-Source On Resistance

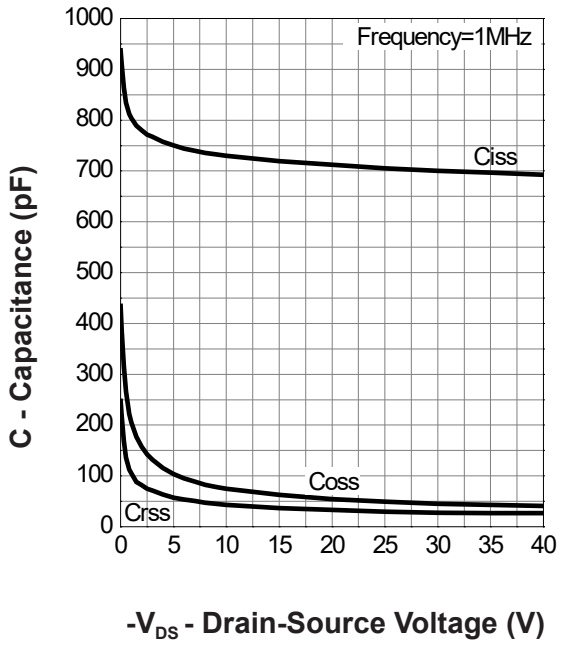



### Source-Drain Diode Forward

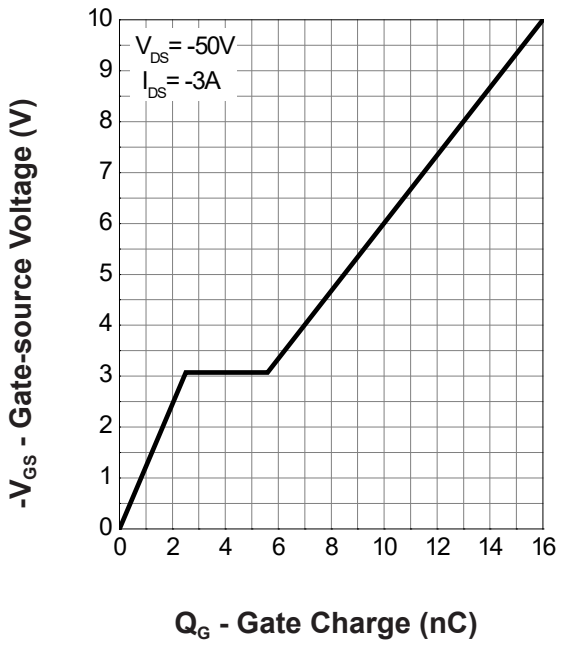


## P Channel Typical Operating Characteristics(Cont.)

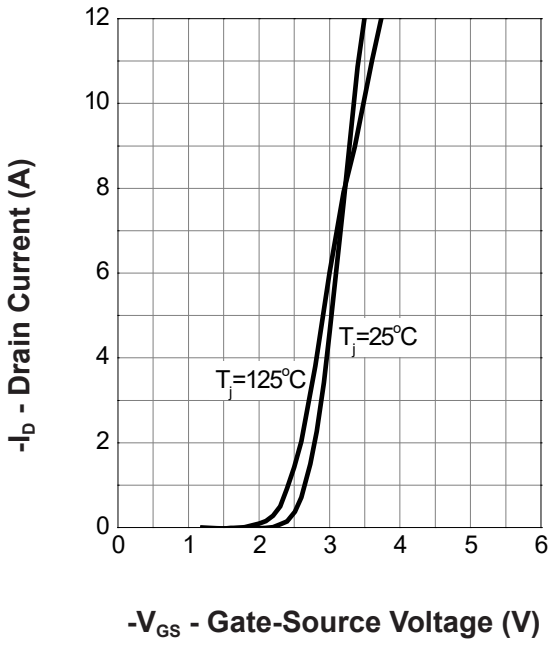
### Capacitance




### Gate Charge




### Transfer Characteristics

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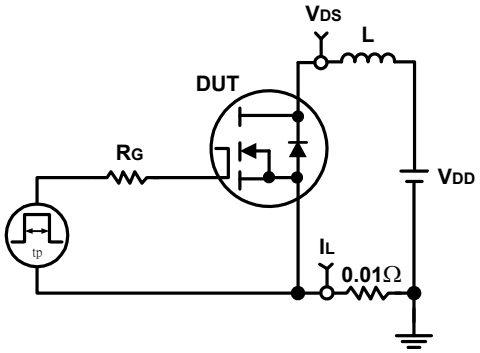
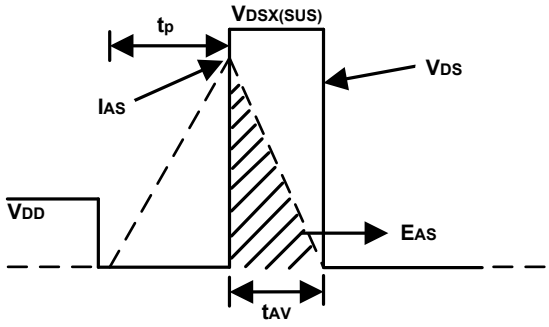
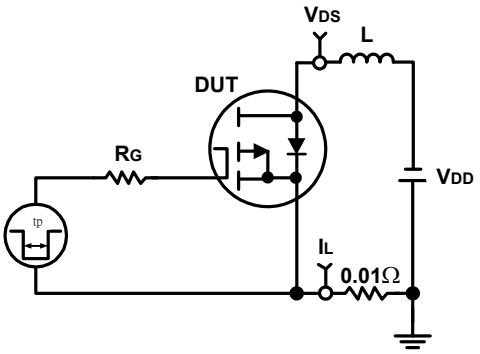
## Avalanche Test Circuit and Waveforms

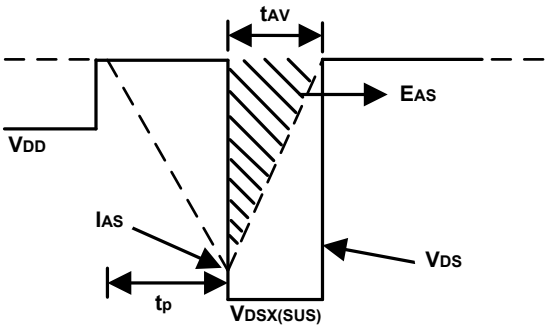
### N Channel



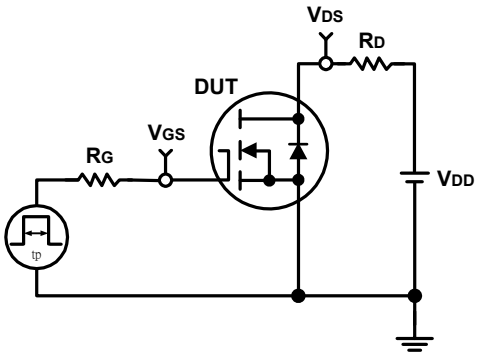

### P Channel

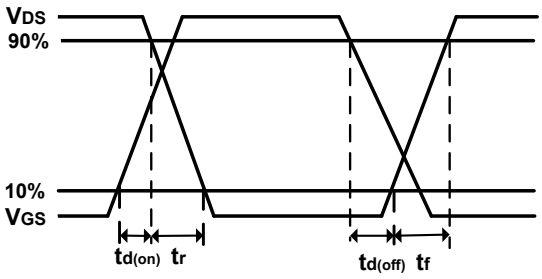


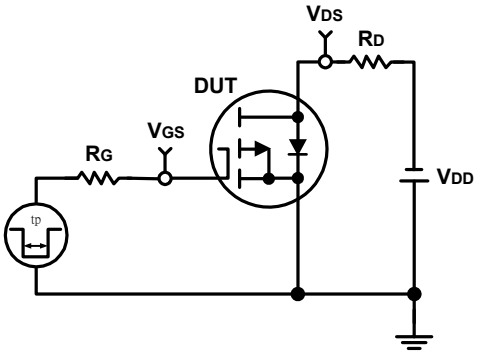

## Switching Time Test Circuit and Waveforms

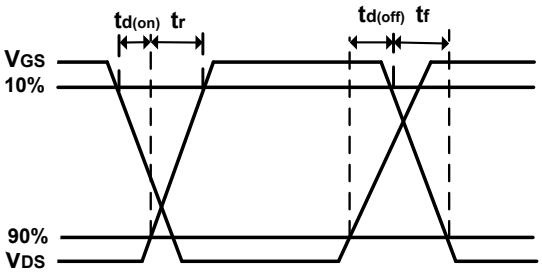
### N Channel




### P Channel

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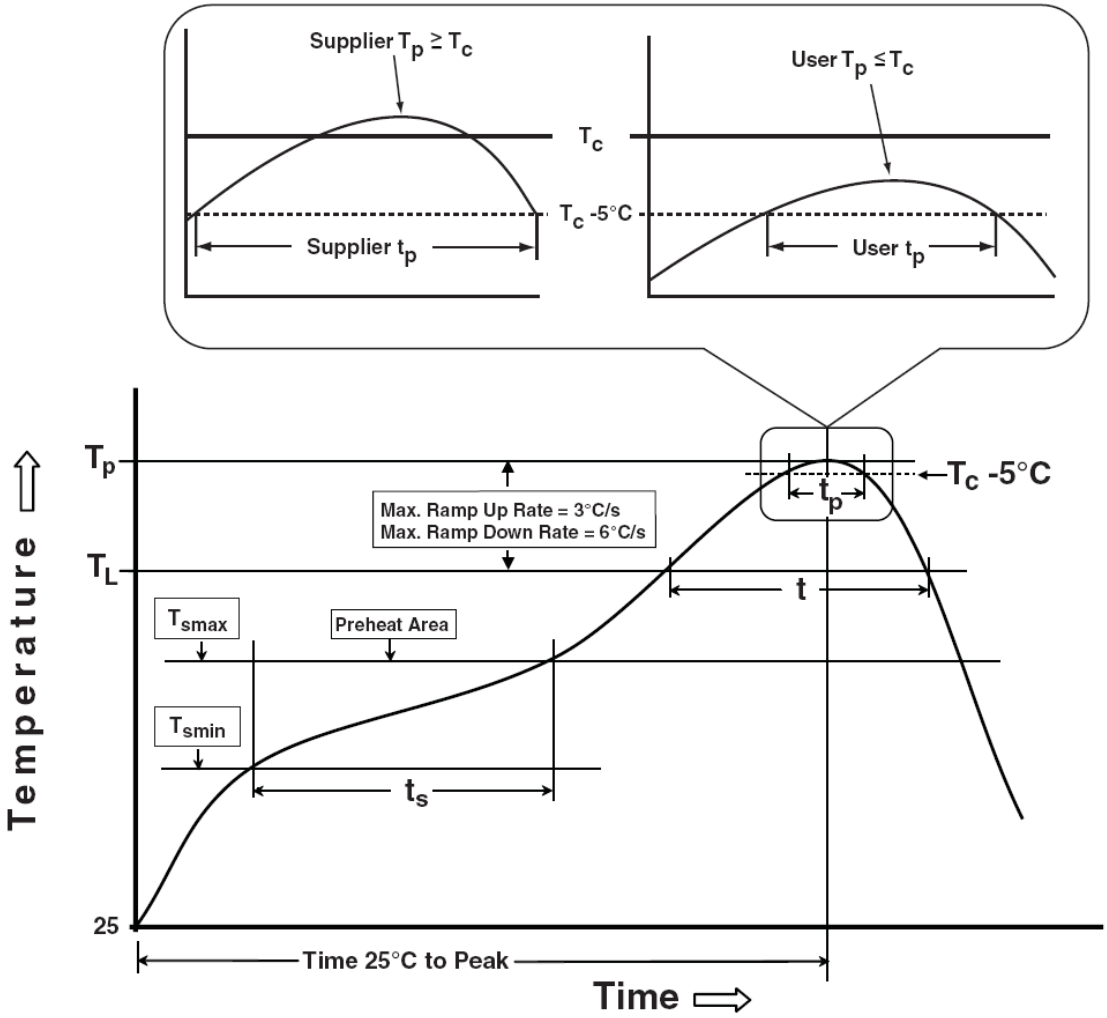
## Classification Profile



## Classification Reflow Profiles

| Profile Feature | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|---|---|---|
| **Preheat & Soak**<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 ($T_p$)* | 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.<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 (Tc)

| Package Thickness | Volume $mm^3$ <350 | Volume $mm^3$ ≥350 |
|---|---|---|
| <2.5 mm | 235 °C | 220 °C |
| ≥2.5 mm | 220 °C | 220 °C |

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

| Package Thickness | Volume $mm^3$ <350 | Volume $mm^3$ 350-2000 | Volume $mm^3$ >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 @ Tjmax |
| HTGB | JESD-22, A108 | 1000 Hrs, 100% of VGS max @ Tjmax |
| 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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