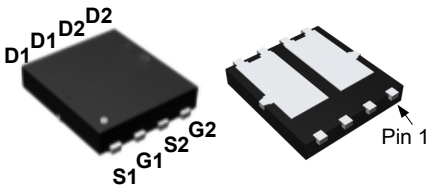
## Dual Enhancement Mode MOSFET (N-and P-Channel)

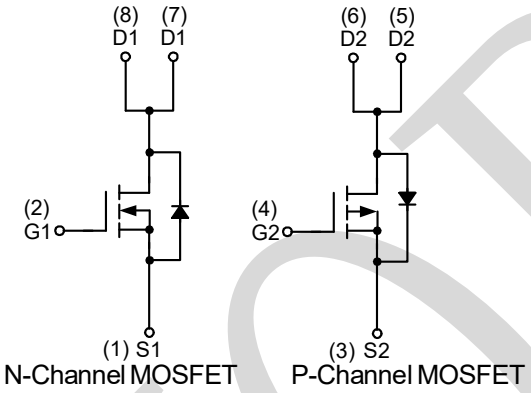
**MSR013X03SD2**

**PDFN5x6**




| | | | |
|---|---|---|---|
| N-channel | $V_{DS}$ | 30 | V |
| | $R_{DS(on),TYP}$@ $V_{GS}$=10 V | 10 | mΩ |
| | $R_{DS(on),TYP}$@ $V_{GS}$=4.5 V | 17 | mΩ |
| | $I_D$ | 15 | A |

| | | | |
|---|---|---|---|
| P-channel | $V_{DS}$ | -30 | V |
| | $R_{DS(on),TYP}$@$V_{GS}$= -10 V | 25 | mΩ |
| | $R_{DS(on),TYP}$@$V_{GS}$= -4.5V | 34 | mΩ |
| | $I_D$ | -15 | A |




## Features

1、Reliable and Rugged

2、High power package (PDFN5X6)

3、Lead Free Available (RoHS Compliant)

## Applications

1、Synchronous Rectification.

2、Motor Control.

3、High Current, High Speed Switching.

## Absolute Maximum Ratings ($T_A$ = 25°C unless otherwise noted)

| Symbol | Parameter | | N Channel | P Channel | Unit |
|---|---|---|---|---|---|
| **Common Ratings** | | | | | |
| $V_{DSS}$ | Drain-Source Voltage | | 30 | -30 | V |
| $V_{GSS}$ | Gate-Source Voltage | | ±20 | ±25 | |
| $T_J$ | Maximum Junction Temperature | | 150 | | °C |
| $T_{STG}$ | Storage Temperature Range | | -55 to 150 | | |
| $I_S$ | Diode Continuous Forward Current | $T_C$=25°C | 15 | -15 | A |
| $I_D$ | Continuous Drain Current(Wire Bond Limited) | $T_C$=25°C | 15 | -15 | A |
| | | $T_C$=100°C | 6 | -6 | |
| $P_D$ | Maximum Power Dissipation | $T_C$=25°C | 19 | 19 | W |
| | | $T_C$=100°C | 7.7 | 7.7 | |
| $R_{\theta JC}$ | Thermal Resistance-Junction to Case | Steady State | 6.5 | 6.5 | °C/W |
| $I_D$ | Continuous Drain Current | $T_A$=25°C | 9.3 | -6.8 | A |
| | | $T_A$=70°C | 7.4 | -5.4 | |
| $I_{DM}$ [a] | Pulsed Drain Current | $T_A$=25°C | 37 | -28 | A |
| $P_D$ | Maximum Power Dissipation | $T_A$=25°C | 1.42 | 1.42 | W |
| | | $T_A$=70°C | 0.9 | 0.9 | |
| $R_{\theta JA}$ [b] | Thermal Resistance-Junction to Ambient | t ≤ 10s | 45 | 45 | °C/W |
| | | Steady State | 88 | 88 | °C/W |
| $I_{AS}$ [c] | Avalanche Current, Single pulse | L=0.1mH | 23 | -24 | A |
| $E_{AS}$ [c] | Avalanche Energy, Single pulse | L=0.1mH | 26.45 | -28.8 | mJ |

Note a : Max. continuous current is limited by bonding wire.
Note b : Pulse width limited by max. junction temperature.
Note c : Surface Mounted on $1in^2$ pad area, steady state t = 999s.
Note d : UIS tested and pulse width limited by maximum junction temperature 150°C (initial temperature $T_j$=25°C)

## 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 | 30 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=24V, $V_{GS}$=0V | - | - | 1 | μA |
| | | $T_J$=85°C | - | - | 30 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_{DS}$=250μA | 1.5 | 1.8 | 2.5 | V |
| $I_{GSS}$ | Gate Leakage Current | $V_{GS}$=±20V, $V_{DS}$=0V | - | - | ±100 | nA |
| $R_{DS(ON)}$ [e] | Drain-Source On-state Resistance | $V_{GS}$=10V, $I_{DS}$=8A | - | 10 | 13 | mΩ |
| | | $T_J$=125°C | - | 13.9 | - | |
| | | $V_{GS}$=4.5V, $I_{DS}$=5A | - | 17 | 19 | |
| Gfs | Forward Transconductance | $V_{DS}$=5V, $I_{DS}$=5A | - | 15 | - | S |
| **Diode Characteristics** | | | | | | |
| $V_{SD}$ [e] | Diode Forward Voltage | $I_{SD}$=3A, $V_{GS}$=0V | - | 0.75 | 1.1 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$=8A, $dI_{SD}/dt$=100A/μs | - | 11.7 | - | ns |
| $t_a$ | Charge Time | | - | 4.8 | - | |
| $t_b$ | Discharge Time | | - | 6.9 | - | |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 1.7 | - | nC |
| **Dynamic Characteristics** [f] | | | | | | |
| $R_G$ | Gate Resistance | $V_{GS}$=0V,$V_{DS}$=0V,f=1MHz | - | 0.9 | - | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=15V, Frequency=1.0MHz | - | 940 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 150 | - | |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 100 | - | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{DD}$=15V, $R_L$=15Ω, $I_{DS}$=1A, $V_{GEN}$=10V, $R_G$=1Ω | - | 11.9 | - | ns |
| $t_r$ | Turn-on Rise Time | | - | 10.1 | - | |
| $t_{d(OFF)}$ | Turn-off Delay Time | | - | 22 | - | |
| $t_f$ | Turn-off Fall Time | | - | 5 | - | |
| **Gate Charge Characteristics** [f] | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{DS}$=15V, $V_{GS}$=4.5V, $I_{DS}$=8A | - | 8.7 | - | nC |
| $Q_g$ | Total Gate Charge | $V_{DS}$=15V, $V_{GS}$=10V, $I_{DS}$=8A | - | 18 | - | |
| $Q_{gth}$ | Threshold Gate Charge | | - | 1.24 | - | |
| $Q_{gs}$ | Gate-Source Charge | | - | 2 | - | |
| $Q_{gd}$ | Gate-Drain Charge | | - | 4 | - | |

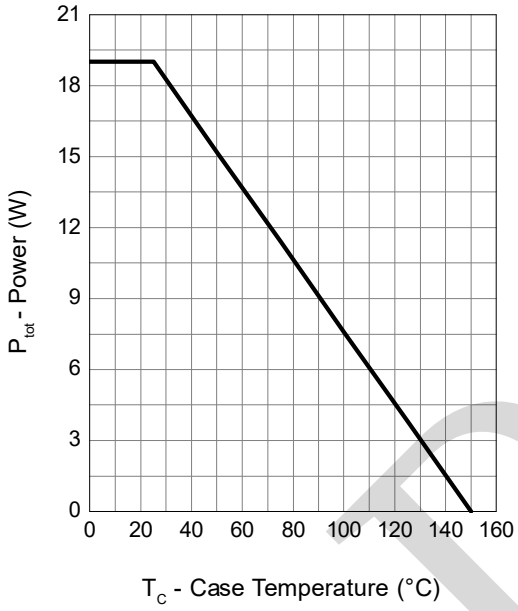
Note e：Pulse test ; pulse width≤300μs, duty cycle≤2%.
Note f：Guaranteed by design, not subject to production testing.

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

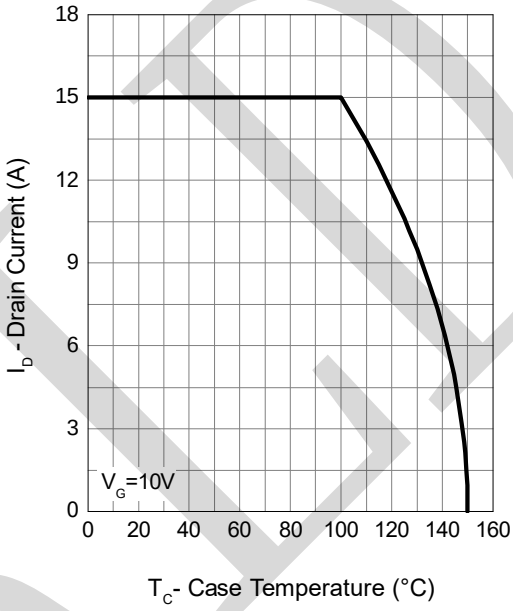
| Symbol | Parameter | Test Conditions | P Channel | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| **Static Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V, $I_{DS}$=-250μA | -30 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=-24V, $V_{GS}$=0V | - | - | -1 | μA |
| | | $T_J$=85°C | - | - | -30 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_{DS}$=-250μA | -1.5 | -2 | -2.5 | V |
| $I_{GSS}$ | Gate Leakage Current | $V_{GS}$=±25V, $V_{DS}$=0V | - | - | ±100 | nA |
| $R_{DS(ON)}$ [e] | Drain-Source On-state Resistance | $V_{GS}$=-10V, $I_{DS}$=-10A | - | 25 | 28 | mΩ |
| | | $T_J$=125°C | - | 21.9 | - | |
| | | $V_{GS}$=-4.5V, $I_{DS}$=-5A | - | 34 | 40 | |
| Gfs | Forward Transconductance | $V_{DS}$=5V, $I_{DS}$=5A | - | 13 | - | S |
| **Diode Characteristics** | | | | | | |
| $V_{SD}$ [e] | Diode Forward Voltage | $I_{SD}$=-1A, $V_{GS}$=0V | - | -0.75 | -1 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_{SD}$=-10A, $dI_{SD}/dt$=100A/μs | - | 26 | - | ns |
| $t_a$ | Charge Time | | - | 8 | - | |
| $t_b$ | Discharge Time | | - | 18 | - | |
| $Q_{rr}$ | Reverse Recovery Charge | | - | 7 | - | nC |
| **Dynamic Characteristics** [f] | | | | | | |
| $R_G$ | Gate Resistance | $V_{GS}$=0V,$V_{DS}$=0V,f=1MHz | - | 3.4 | - | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, $V_{DS}$=-15V, Frequency=1.0MHz | - | 1000 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 210 | - | |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 150 | - | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{DD}$=-15V, $R_L$=15Ω, $I_{DS}$=-1A, $V_{GEN}$=-10V, $R_G$=6Ω | - | 11 | - | ns |
| $t_r$ | Turn-on Rise Time | | - | 12 | - | |
| $t_{d(OFF)}$ | Turn-off Delay Time | | - | 26 | - | |
| $t_f$ | Turn-off Fall Time | | - | 12 | - | |
| **Gate Charge Characteristics** [f] | | | | | | |
| $Q_g$ | Total Gate Charge | $V_{DS}$=-15V, $V_{GS}$=-4.5V, $I_{DS}$=-10A | - | 9.6 | - | nC |
| $Q_g$ | Total Gate Charge | $V_{DS}$=-15V, $V_{GS}$=-10V, $I_{DS}$=-10A | - | 21 | - | |
| $Q_{gth}$ | Threshold Gate Charge | | - | 1.5 | - | |
| $Q_{gs}$ | Gate-Source Charge | | - | 3.5 | - | |
| $Q_{gd}$ | Gate-Drain Charge | | - | 5.9 | - | |

## N Channel Typical Operating Characteristics

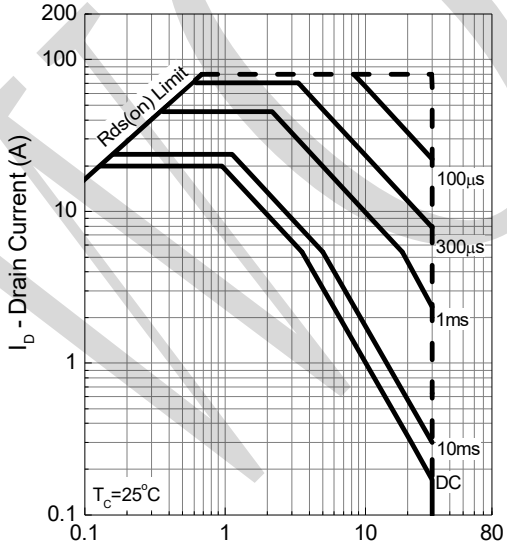
### Power Dissipation



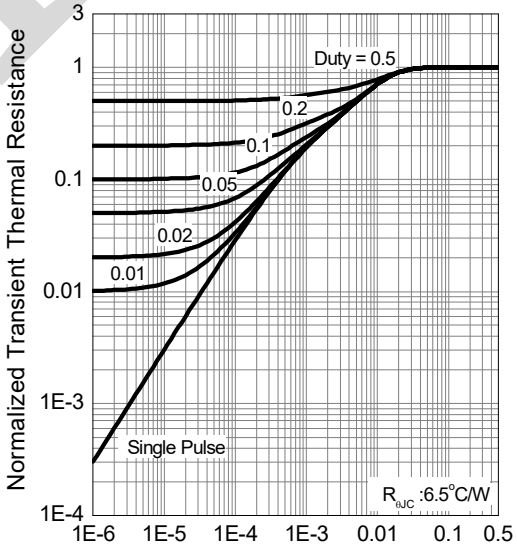

### Drain Current




### Safe Operation Area

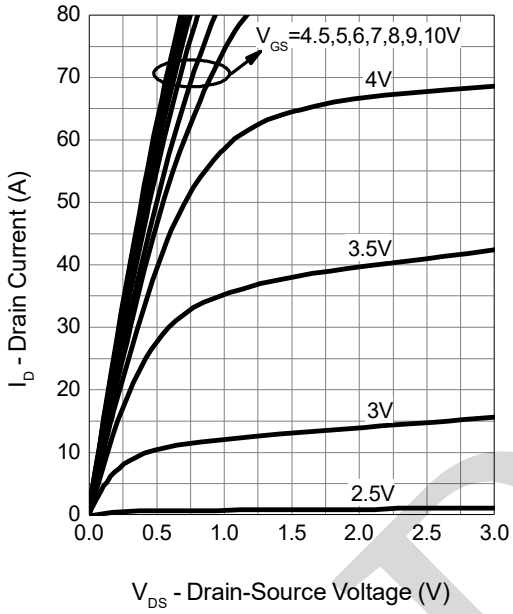



### Thermal Transient Impedance

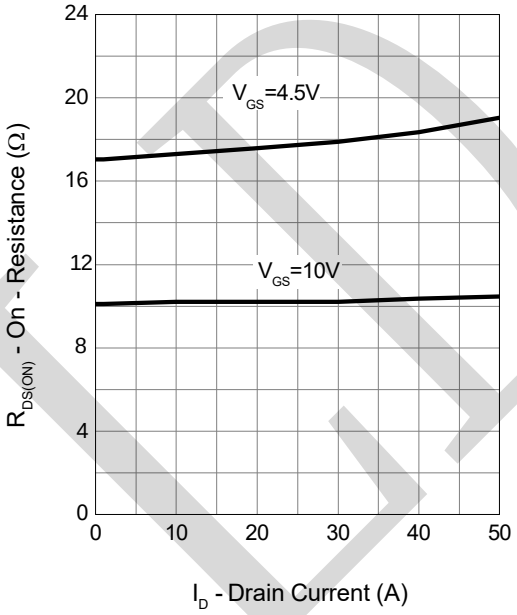


## N Channel Typical Operating Characteristics (Cont.)

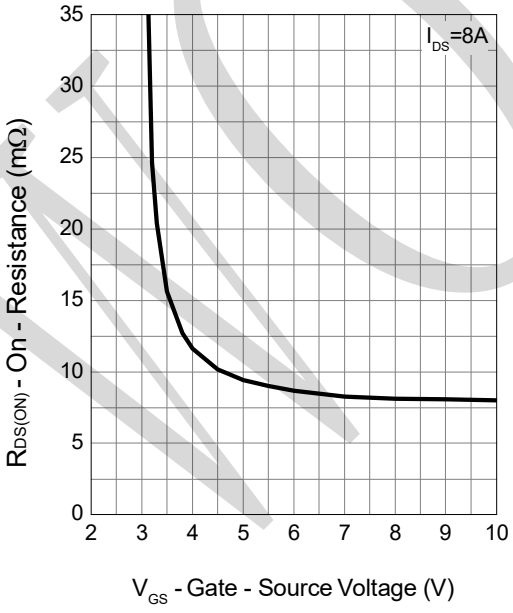
**Output Characteristics**



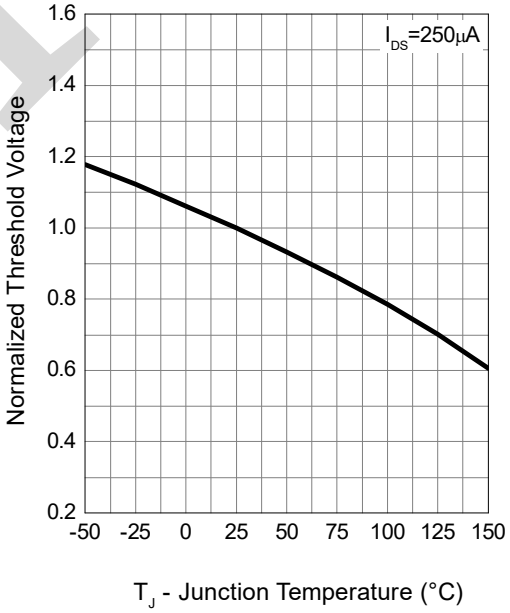

**Drain-Source On Resistance**




**Transfer Characteristics**

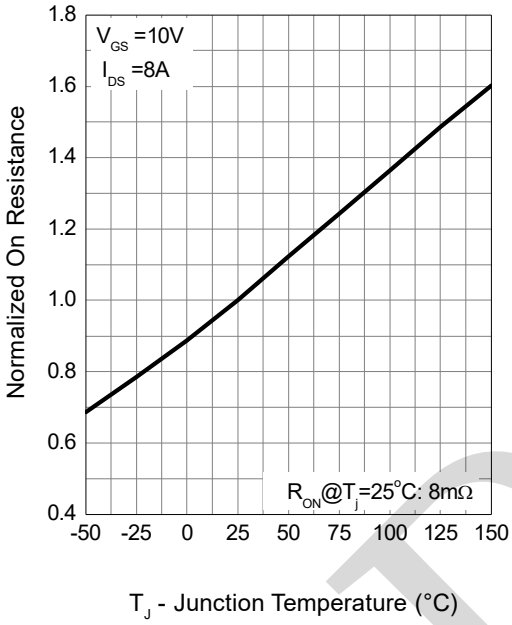



**Gate Threshold Voltage**



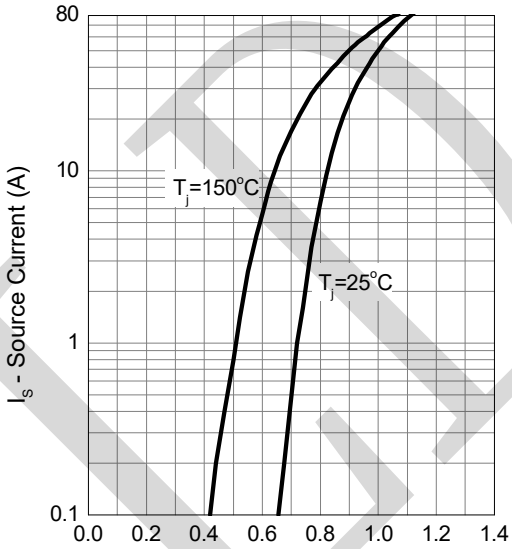
## N Channel Typical Operating Characteristics (Cont.)

**Drain-Source On Resistance**



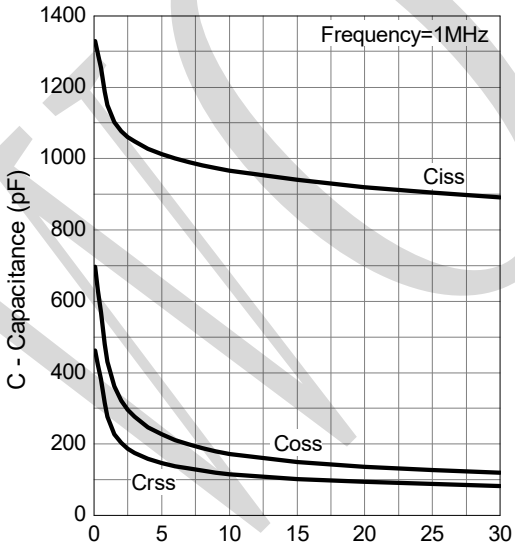

$T_J$ - Junction Temperature (°C)

**Source-Drain Diode Forward**



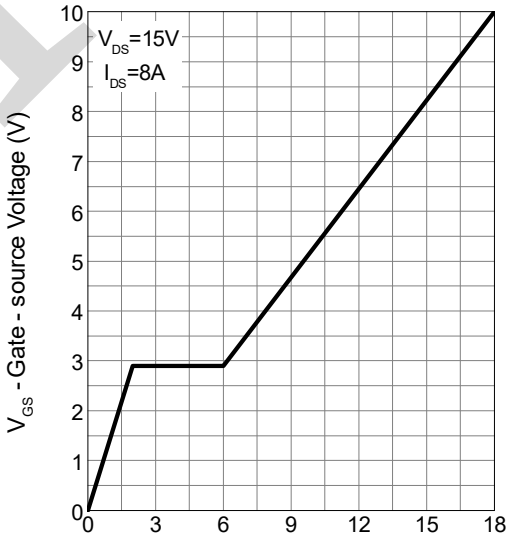

$V_{SD}$ - Source - Drain Voltage (V)

**Capacitance**




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

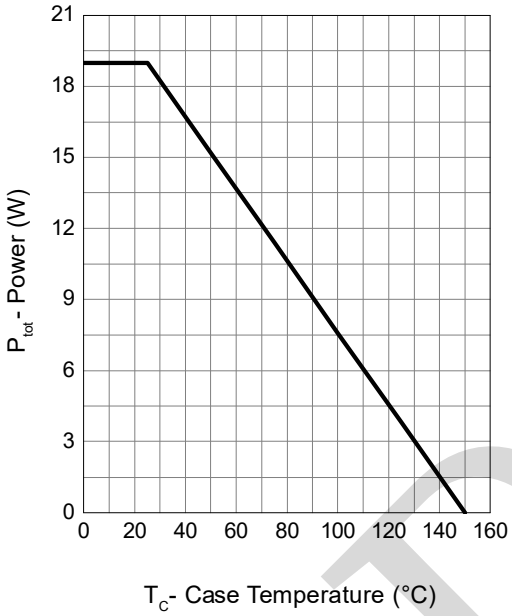
**Gate Charge**



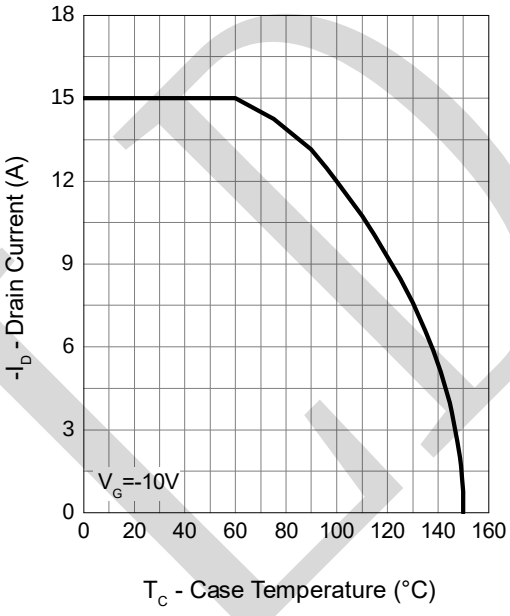

$Q_G$ - Gate Charge (nC)

## P Channel Typical Operating Characteristics

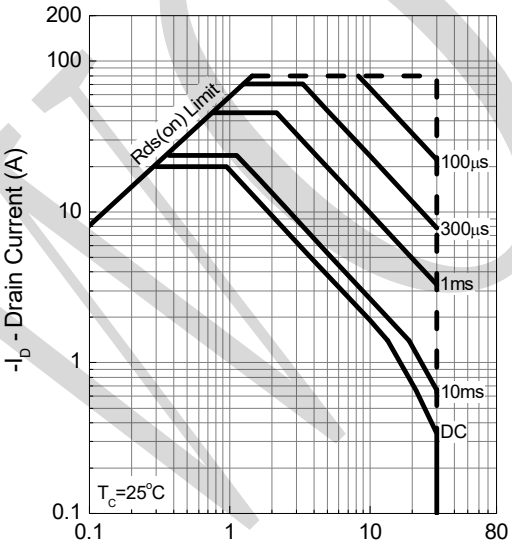
### Power Dissipation



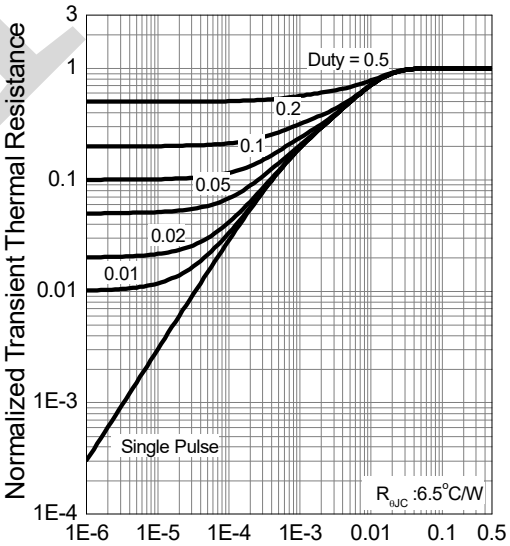

### Drain Current




### Safe Operation Area

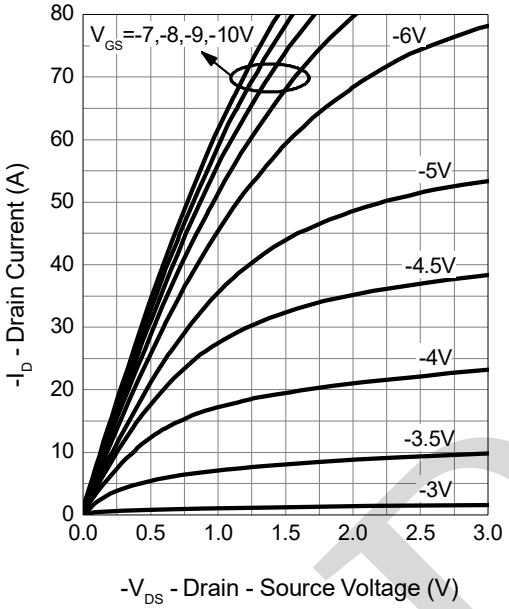



### Thermal Transient Impedance

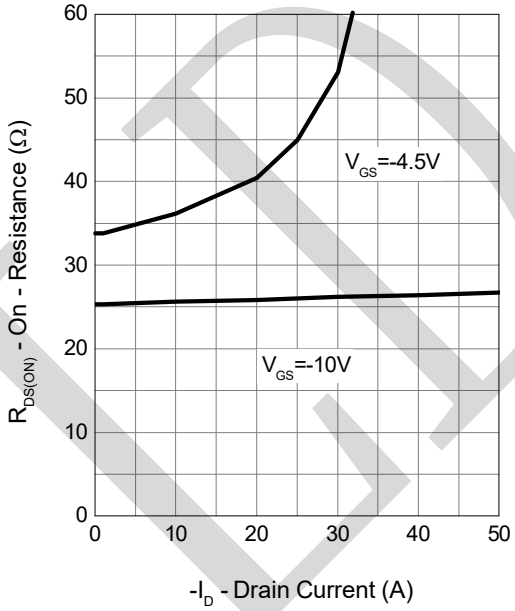


## P Channel Typical Operating Characteristics (Cont.)

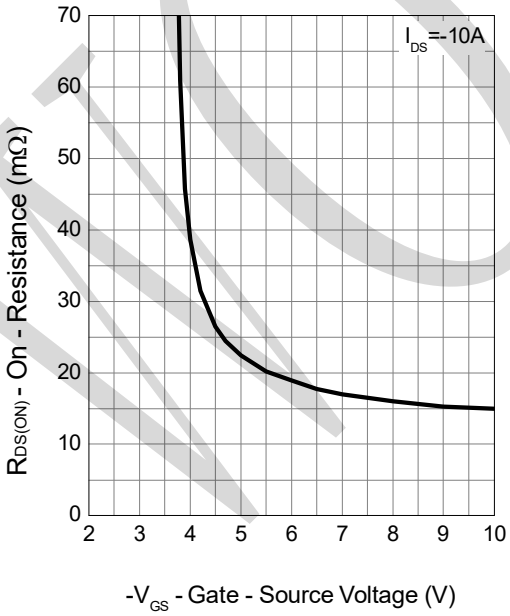
### Output Characteristics



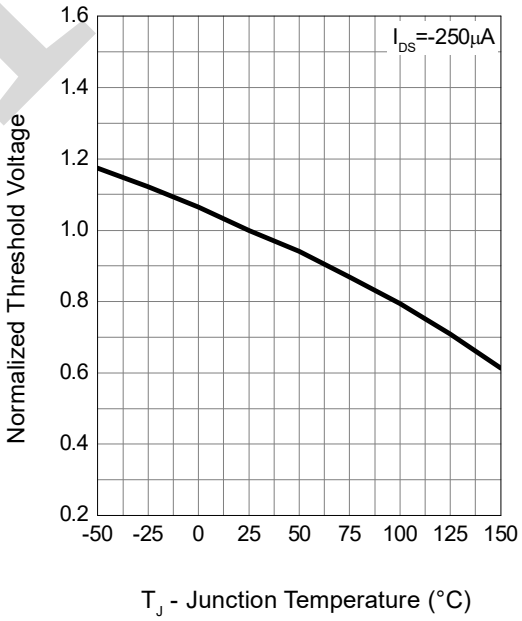

### Drain-Source On Resistance




### Transfer Characteristics

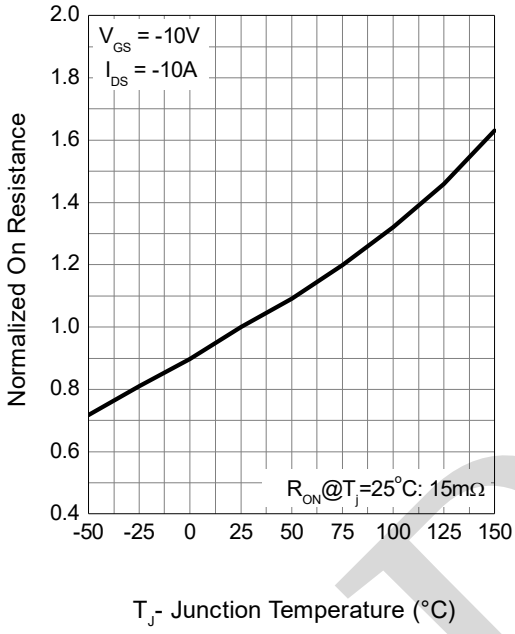



### Gate Threshold Voltage



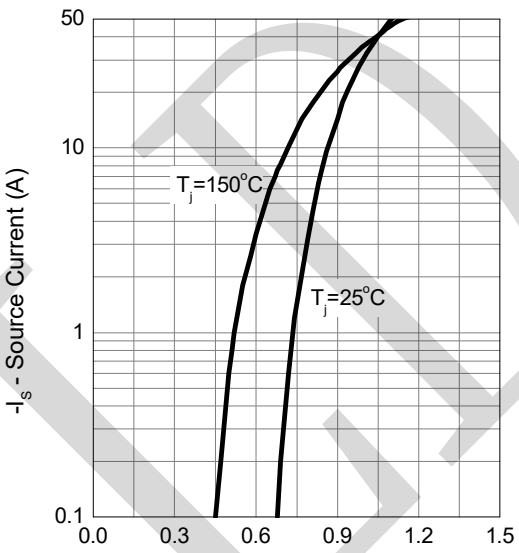
## P Channel Typical Operating Characteristics (Cont.)

**Drain-Source On Resistance**



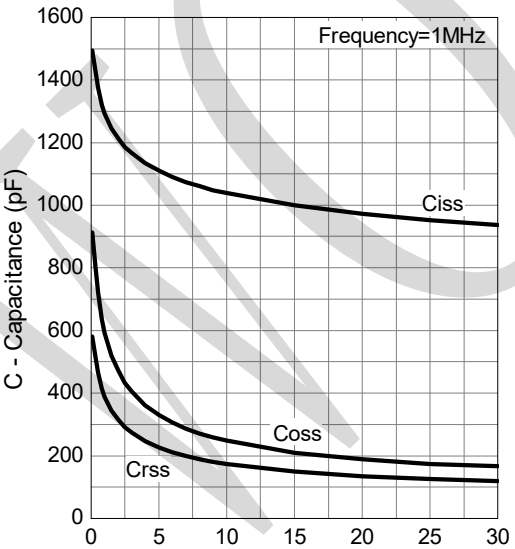

$T_J$- Junction Temperature (°C)

**Source-Drain Diode Forward**



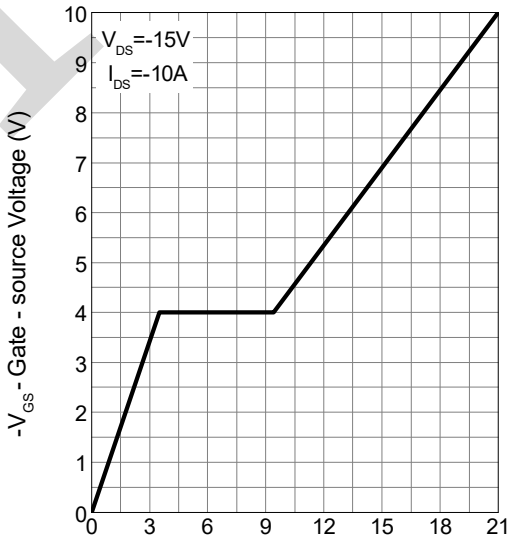

$-V_{SD}$ - Source - Drain Voltage (V)

**Capacitance**




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

**Gate Charge**




$Q_G$ - Gate Charge (nC)

## PACKAGE OUTLINE DIMENSIONS

Note:unit mm

PDFN5X6