JJMICROELECTRONICS

# ±40V, ±16A, 18.5mΩ&37.3mΩ N And P-channel Power Trench MOSFET

## JMTG170C04D

### Features

- Excellent $R_{DS(ON)}$ and Low Gate Charge
- 100% UIS TESTED
- 100% ΔVds TESTED
- Halogen-free; RoHS-compliant
- Pb-free plating

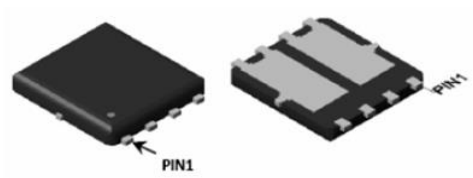
### Applications

- Load Switch
- PWM Application
- Power Management

### Product Summary

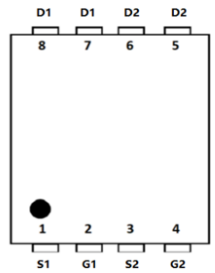
| Parameters | N | P | Unit |
|---|---|---|---|
| $V_{DSS}$ | 40 | -40 | V |
| $V_{GS(th)\_Typ}$ | 1.9 | -1.6 | V |
| $I_D$(@$V_{GS}$=10V) | 16 | -16 | A |
| $R_{DS(ON)\_Typ}$(@$V_{GS}$=10V | 14.4 | 31.1 | mΩ |
| $R_{DS(ON)\_Typ}$(@$V_{GS}$=4.5V | 18.5 | 37.3 | mΩ |

RoHS

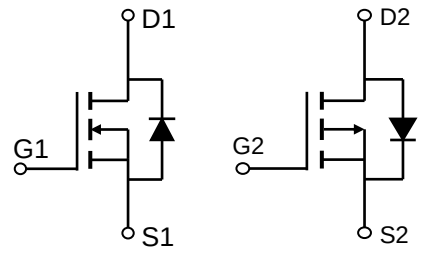



Top View Bottom View

PDFN5x6-8L-D




Pin Assignment




Schematic Diagram

### Ordering Information

| Device | Marking | MSL | Form | Package | Reel(pcs) | Per Carton (pcs) |
|---|---|---|---|---|---|---|
| JMTG170C04D | G170C04D | 1 | Tape&Reel | PDFN5x6-8L-D | 5000 | 50000 |

### Absolute Maximum Ratings (@ $T_C$ = 25°C unless otherwise specified)

| Symbol | Parameter | | Value-N | Value-P | Unit |
|---|---|---|---|---|---|
| $V_{DS}$ | Drain-to-Source Voltage | | 40 | -40 | V |
| $V_{GS}$ | Gate-to-Source Voltage | | ±20 | | V |
| $I_D$ | Continuous Drain Current | $T_C$ = 25°C | 16 | -16 | A |
| | | $T_C$ = 100°C | 11 | -11 | |
| $I_{DM}$ | Pulsed Drain Current (1) | | Refer to Fig.4 | | A |
| $E_{AS}$ | Single Pulsed Avalanche Energy (2) | | 24 | 24 | mJ |
| $P_D$ | Power Dissipation | $T_C$ = 25°C | 43 | 54 | W |
| | | $T_C$ = 100°C | 17.2 | 21.5 | |
| $T_J$, $T_{STG}$ | Junction & Storage Temperature Range | | -55 to 150 | | °C |

### Thermal Characteristics

| Symbol | Parameter | Max | | Unit |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient(3) | 57 | 59 | °C/W |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 2.9 | 2.3 | |

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**Electrical Characteristics-N**($T_J$ = 25°C unless otherwise specified)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $I_D$ = 250μA, $V_{GS}$ = 0V | 40 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 40V, $V_{GS}$ = 0V | - | - | 1.0 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{DS}$ = 0V, $V_{GS}$ = ±20V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | 1.3 | 1.9 | 2.5 | V |
| $R_{DS(ON)}$ | Static Drain-Source ON-Resistance(4) | $V_{GS}$ = 10V, $I_D$ = 15A | - | 14.4 | 20 | mΩ |
| | | $V_{GS}$ = 4.5V, $I_D$ = 10A | - | 18.5 | 29 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| $R_g$ | Gate Resistance | f = 1MHz | - | 2.6 | - | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V, $V_{DS}$ = 20V, f = 1MHz | - | 1114 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 75 | - | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 61 | - | pF |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 to 10V $V_{DS}$ = 20V, $I_D$ = 5A | - | 22 | - | nC |
| $Q_{gs}$ | Gate Source Charge | | - | 4.2 | - | nC |
| $Q_{gd}$ | Gate Drain("Miller") Charge | | - | 3.9 | - | nC |
| | | | | | | |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On DelayTime | $V_{GS}$ = 10V, $V_{DD}$ = 20V $I_D$= 5A, $R_{GEN}$ = 2.7Ω | - | 6 | - | ns |
| $t_r$ | Turn-On Rise Time | | - | 6 | - | ns |
| $t_{d(off)}$ | Turn-Off DelayTime | | - | 24 | - | ns |
| $t_f$ | Turn-Off Fall Time | | - | 3 | - | ns |
| **Body Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Body Diode Forward Current | | - | - | 16 | A |
| $I_{SM}$ | Maximum Pulsed Body Diode Forward Current | | - | - | 65 | A |
| $V_{SD}$ | Body Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = 15A | - | | 1.2 | V |
| trr | Body Diode Reverse Recovery Time | $I_F$ = 5A, di/dt = 100A/us | - | 10 | - | ns |
| Qrr | Body Diode Reverse Recovery Charge | | - | 4.8 | - | nC |

Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
2. $E_{AS}$ condition: Starting $T_J$=25C, $V_{DD}$=20V, $V_G$=10V, $R_G$=25ohm, L=0.5mH, $I_{AS}$=9.8A, $V_{DD}$=0V during time in avalanche.
3. $R_{\theta JA}$ is measured with the device mounted on a 1inch$^2$ pad of 2oz copper FR4 PCB.
4. Pulse Test: Pulse Width≤300μs, Duty Cycle≤0.5%.

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**Electrical Characteristics-P** ($T_J$ = 25°C unless otherwise specified)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $I_D$ = -250μA, $V_{GS}$ = 0V | -40 | - | - | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = -40V, $V_{GS}$ = 0V | - | - | -1.0 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{DS}$ = 0V, $V_{GS}$ = ±20V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = -250μA | -1.1 | -1.6 | -2.5 | V |
| $R_{DS(ON)}$ | Static Drain-Source ON-Resistance(5) | $V_{GS}$ = -10V, $I_D$ = -8A | - | 31 | 50 | mΩ |
| | | $V_{GS}$ = -4.5V, $I_D$ = -5A | - | 37 | 65 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| $R_g$ | Gate Resistance | f = 1MHz | - | 12 | - | Ω |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V, $V_{DS}$ = -20V, f = 1MHz | - | 1157 | - | pF |
| $C_{oss}$ | Output Capacitance | | - | 89 | - | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | - | 73 | - | pF |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 0 to -4.5V, $V_{DS}$ = -20V, $I_D$ = -5A | - | 22 | - | nC |
| $Q_{gs}$ | Gate Source Charge | | - | 4 | - | nC |
| $Q_{gd}$ | Gate Drain("Miller") Charge | | - | 4 | - | nC |
| | | | | | | |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On DelayTime | $V_{GS}$ = -10V, $V_{DD}$ = -20V, $I_D$= -5A, $R_{GEN}$ = 2.7Ω | - | 5 | - | ns |
| $t_r$ | Turn-On Rise Time | | - | 2 | - | ns |
| $t_{d(off)}$ | Turn-Off DelayTime | | - | 58 | - | ns |
| $t_f$ | Turn-Off Fall Time | | - | 27 | - | ns |
| **Body Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Body Diode Forward Current | | - | - | -4 | A |
| $I_{SM}$ | Maximum Pulsed Body Diode Forward Current | | - | - | -14 | A |
| $V_{SD}$ | Body Diode Forward Voltage | $V_{GS}$ = 0V, $I_S$ = -8A | - | | 1.2 | V |
| trr | Body Diode Reverse Recovery Time | $I_F$ = -5A, di/dt = 100A/us | - | 12 | - | ns |
| Qrr | Body Diode Reverse Recovery Charge | | - | 6.6 | - | nC |

Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
2. $E_{AS}$ condition: Starting $T_J$=25C, $V_{DD}$=-20V, $V_G$=-10V, $R_G$=25ohm, L=0.5mH, $I_{AS}$=-9.8A, $V_{DD}$=0V during time in avalanche.
3. $R_{\theta JA}$ is measured with the device mounted on a minimum recommended pad of 2oz copper FR4 PCB.
4. $R_{\theta JA}$ is measured with the device mounted on a 1inch$^2$ pad of 2oz copper FR4 PCB.
5. Pulse Test: Pulse Width≤300μs, Duty Cycle≤0.5%.

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# Typical Performance Characteristics-N

Figure 1: Power De-rating

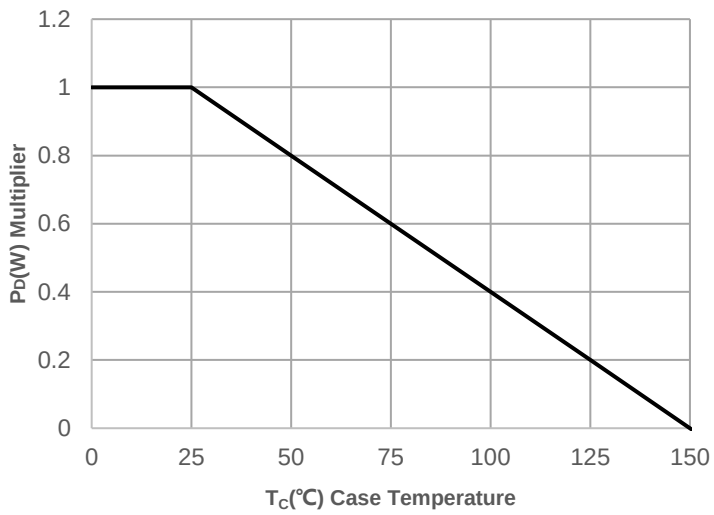



Figure 2: Current De-rating

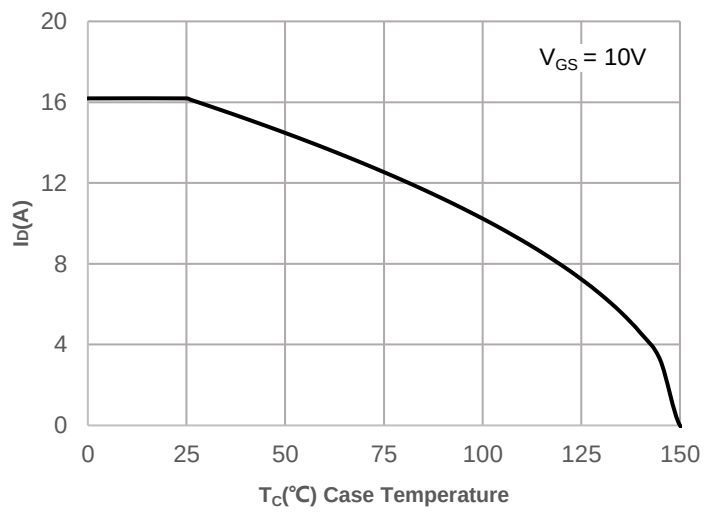



Figure 3: Normalized Maximum Transient Thermal Impedance

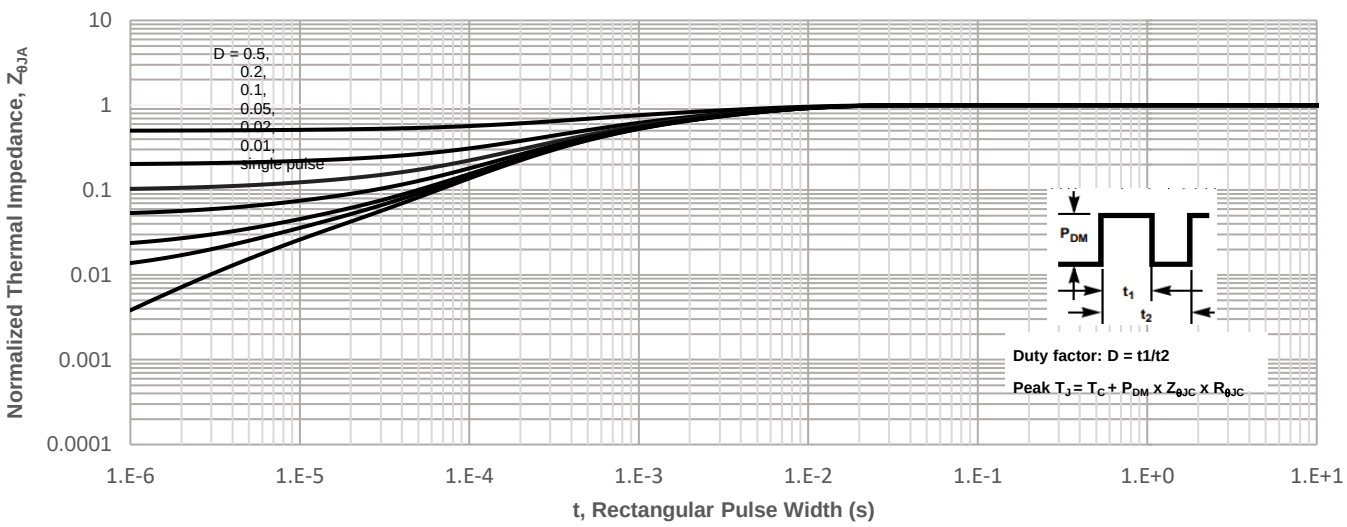
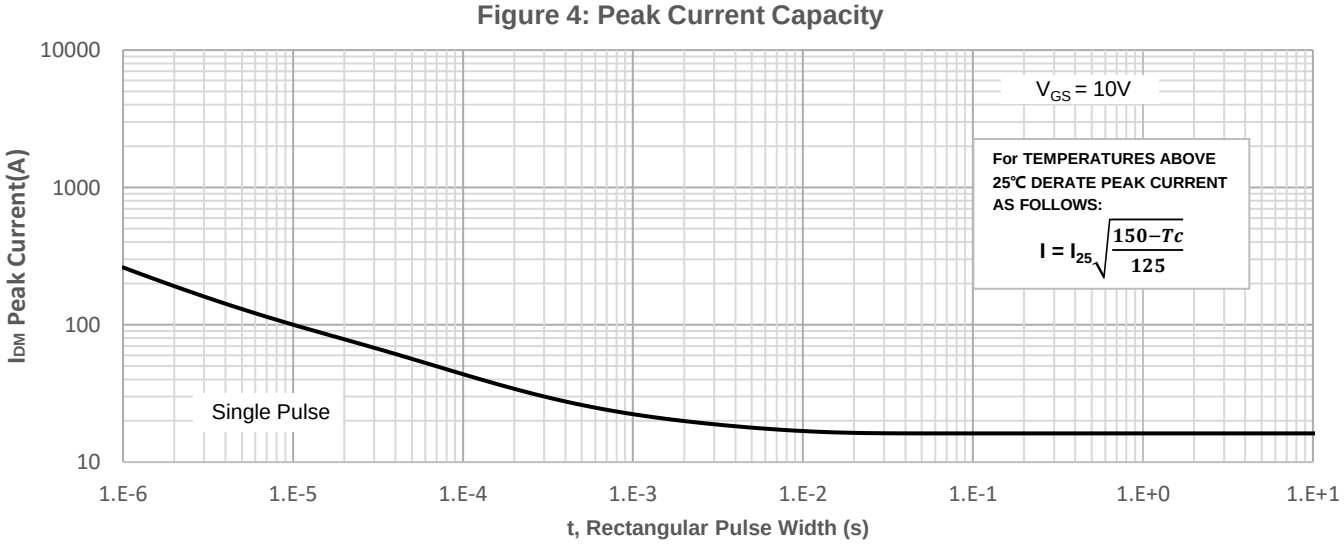



Figure 4: Peak Current Capacity

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# Typical Performance Characteristics-N

Figure 5: Output Characteristics

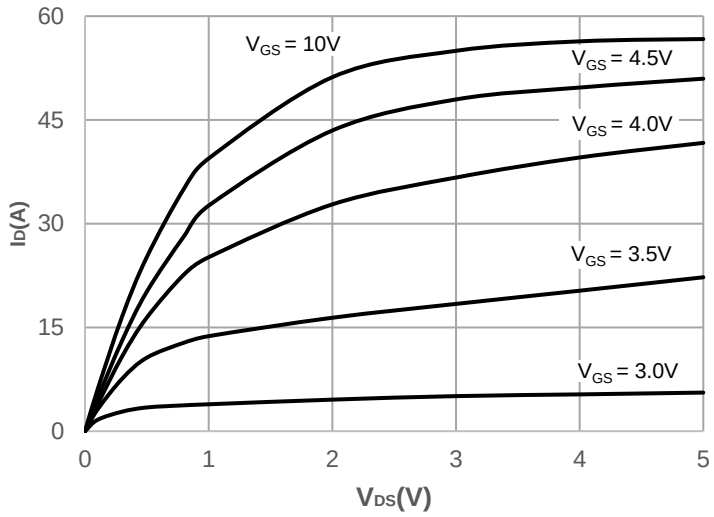



Figure 6: Typical Transfer Characteristics

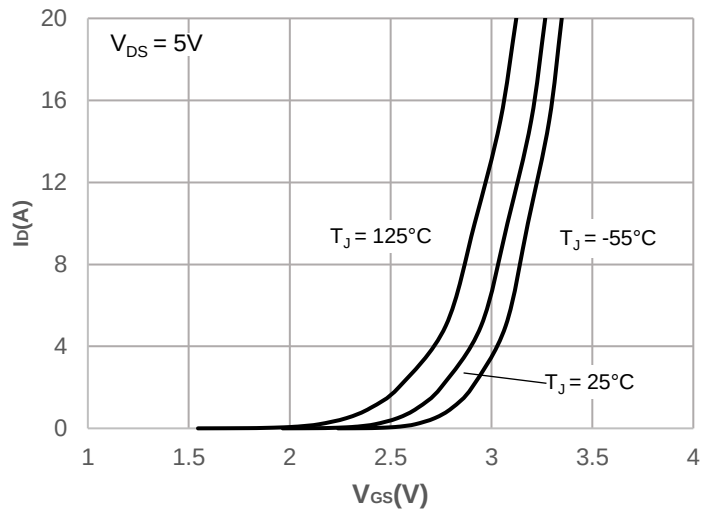



Figure 7: On-resistance vs. Drain Current

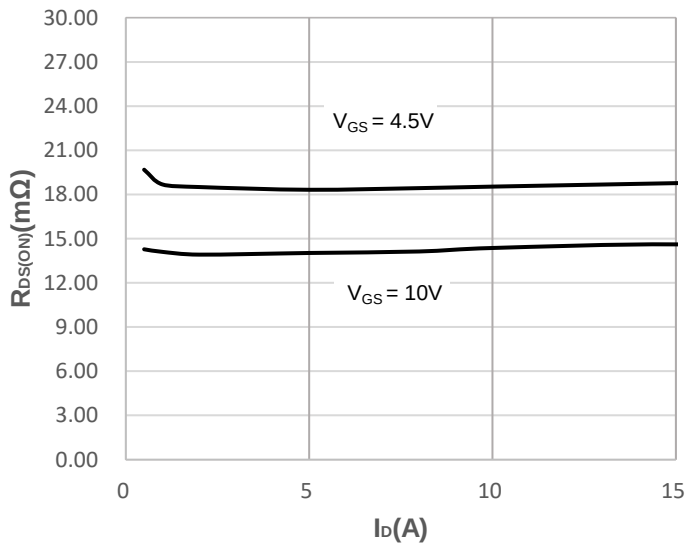



Figure 8: Body Diode Characteristics

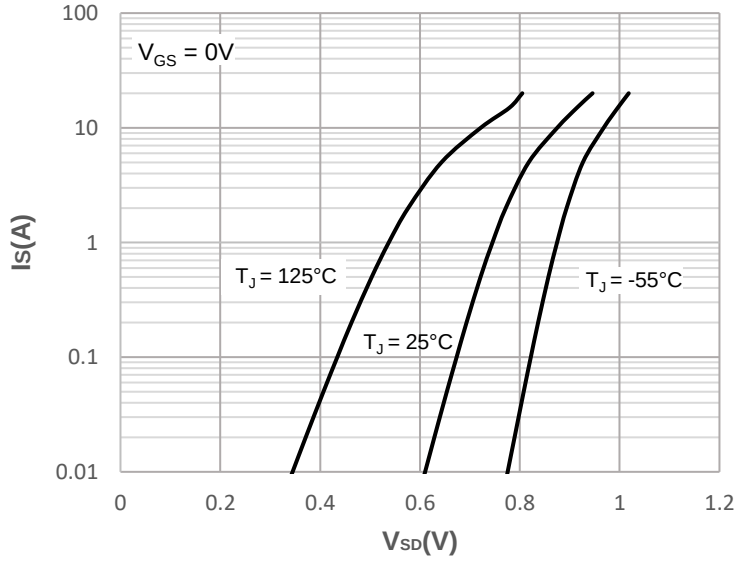



Figure 9: Gate Charge Characteristics

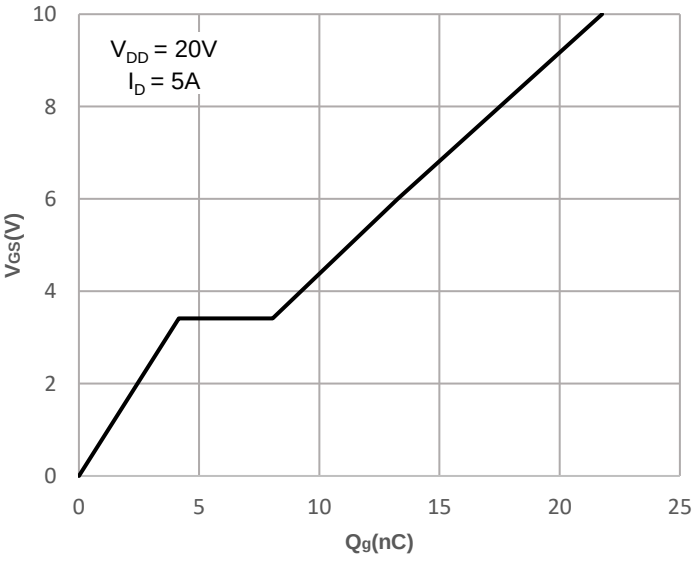
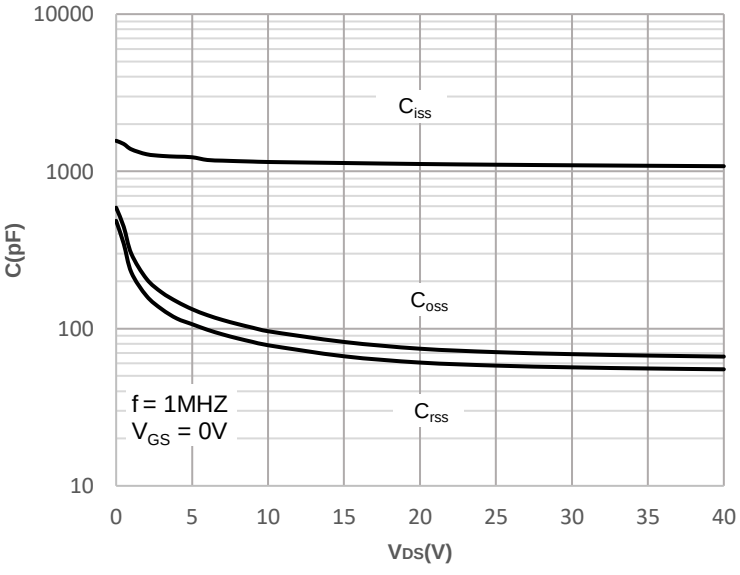



Figure 10: Capacitance Characteristics

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# Typical Performance Characteristics-N

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

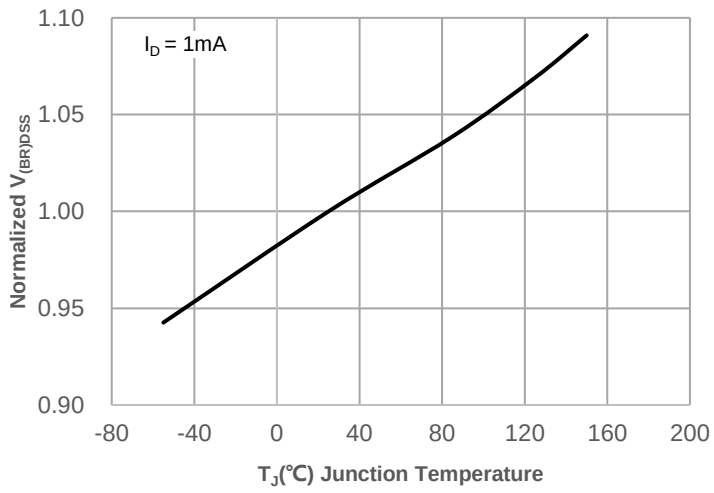



Figure 12: Normalized on Resistance vs. Junction Temperature

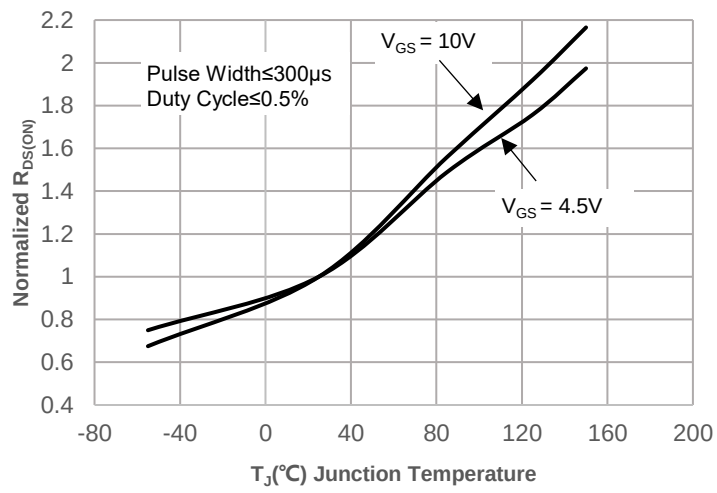



Figure 13: Normalized Threshold Voltage vs. Junction Temperature

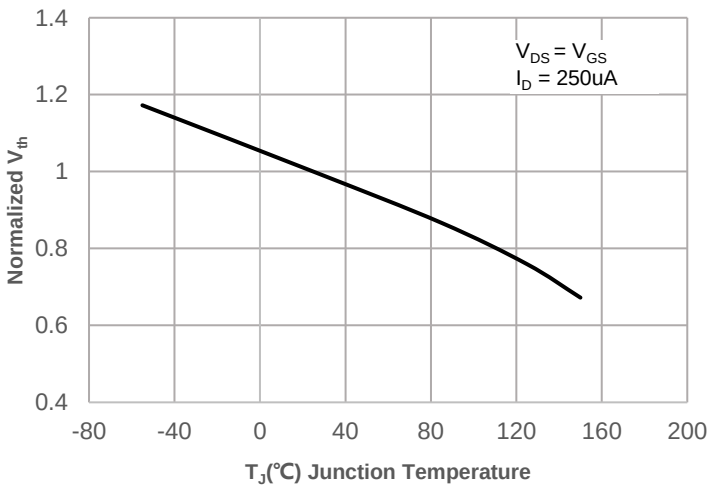



Figure 14: $R_{DS(ON)}$ vs. $V_{GS}$

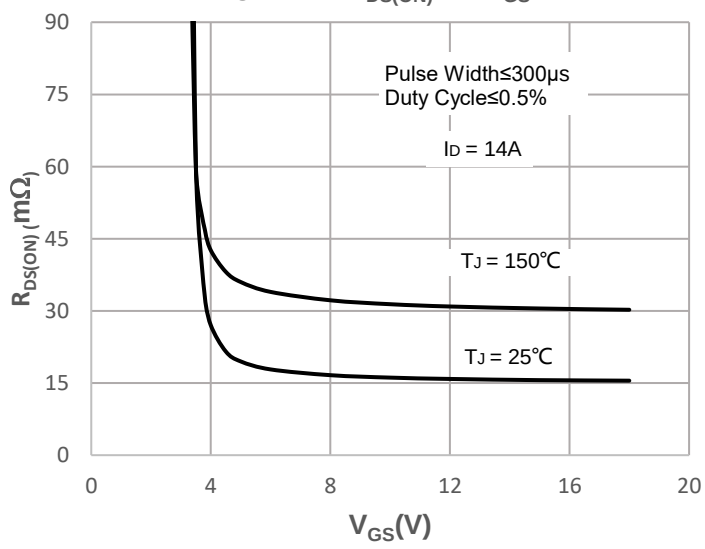
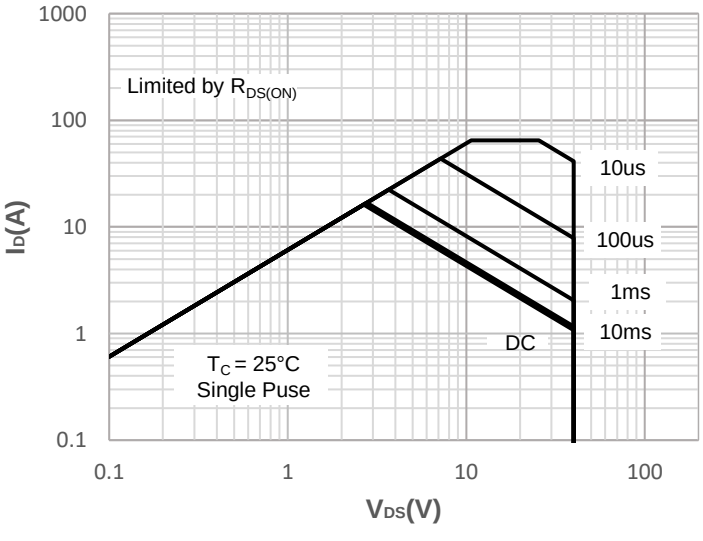



Figure 15: Maximum Safe Operating Area

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# Typical Performance Characteristics-P

Figure 1: Power De-rating

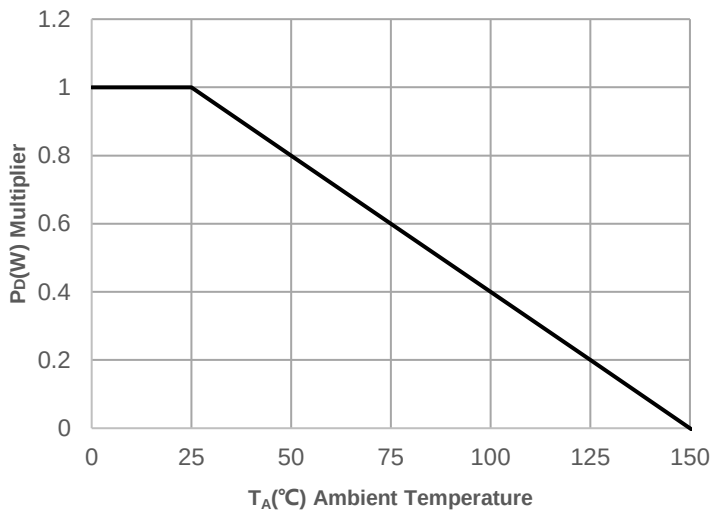



Figure 2: Current De-rating

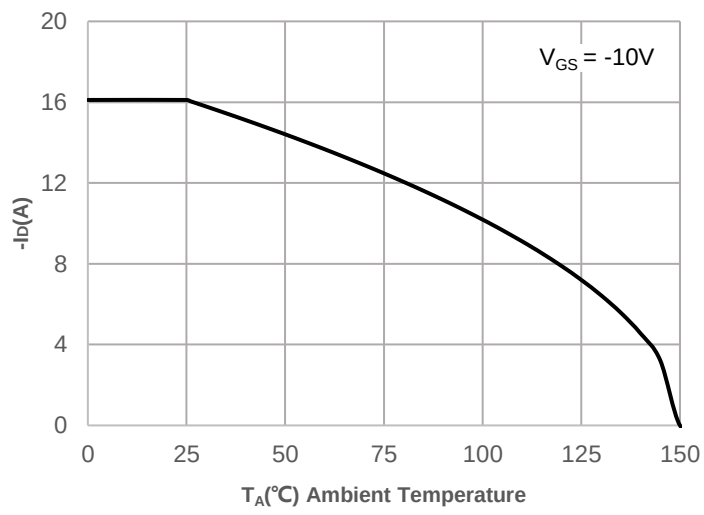



Figure 3: Normalized Maximum Transient Thermal Impedance

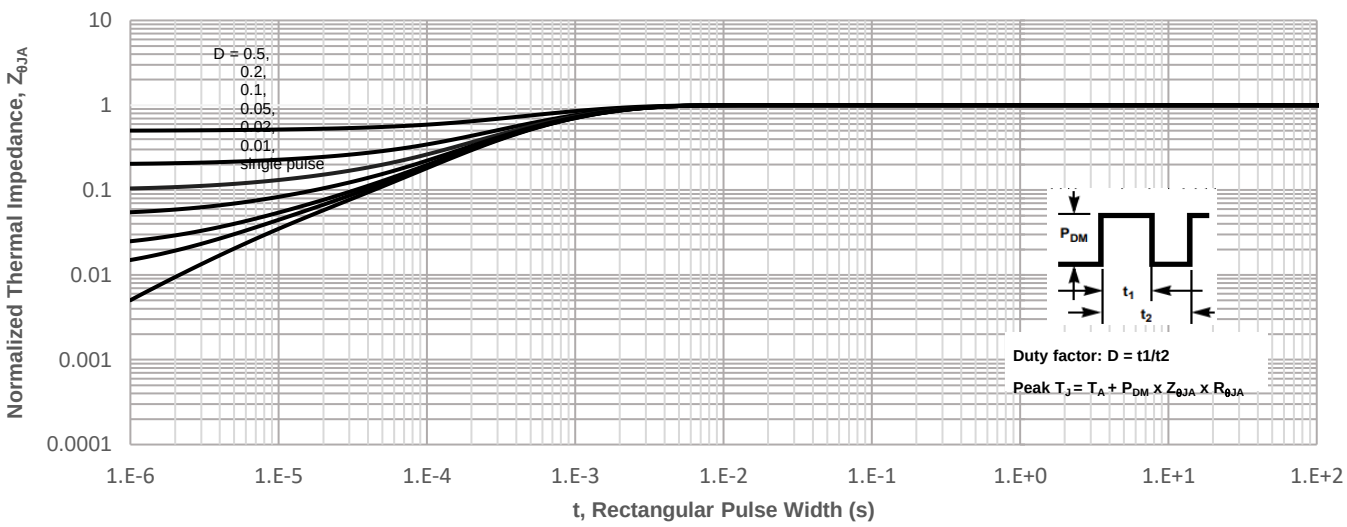
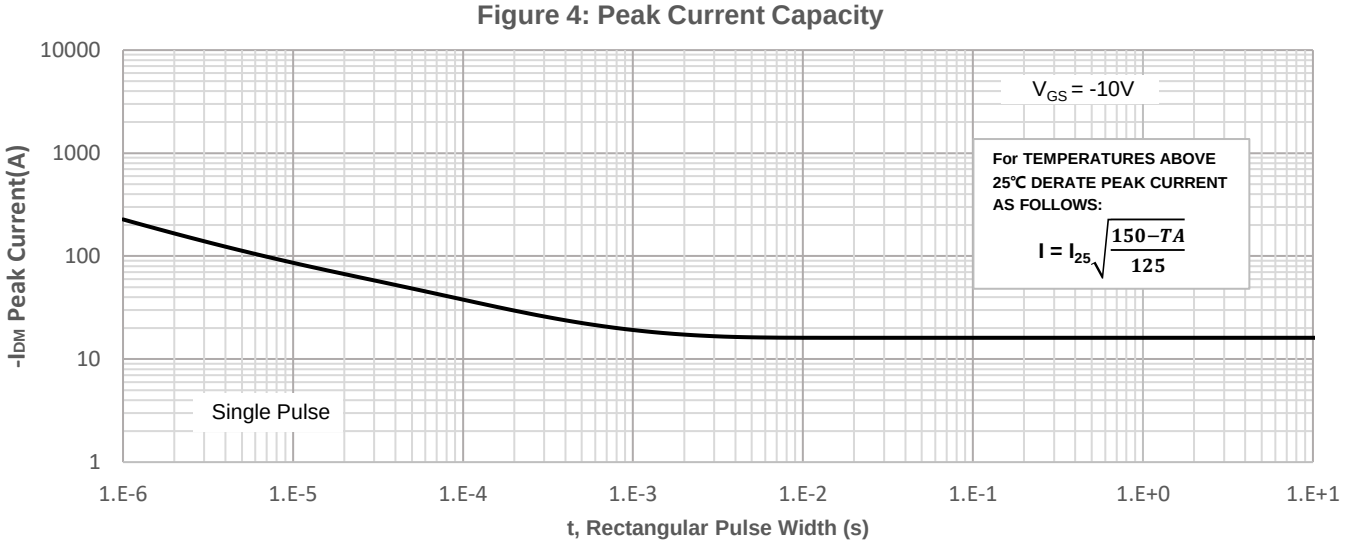



Figure 4: Peak Current Capacity

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# Typical Performance Characteristics-P

Figure 5: Output Characteristics

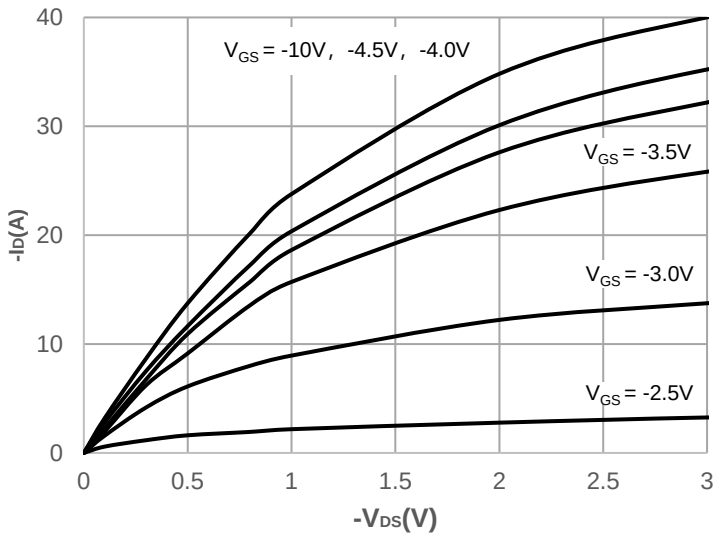



Figure 6: Typical Transfer Characteristics

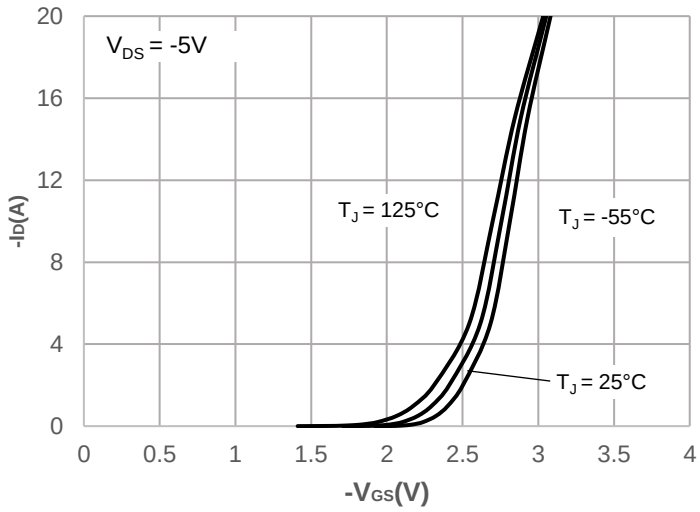



Figure 7: On-resistance vs. Drain Current

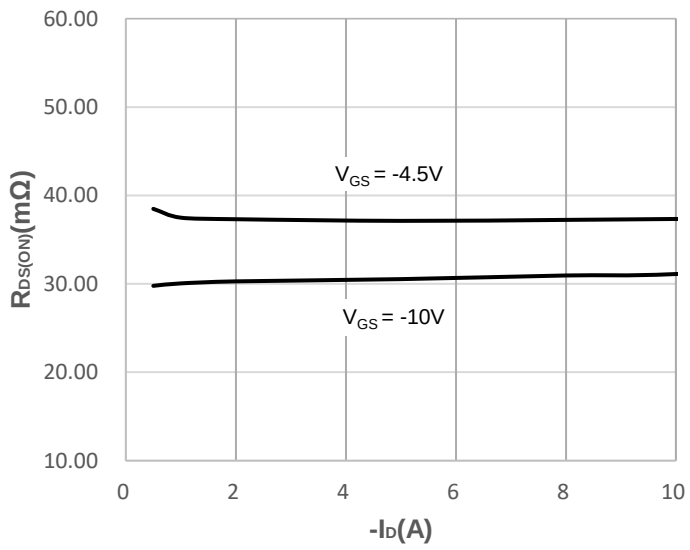



Figure 8: Body Diode Characteristics

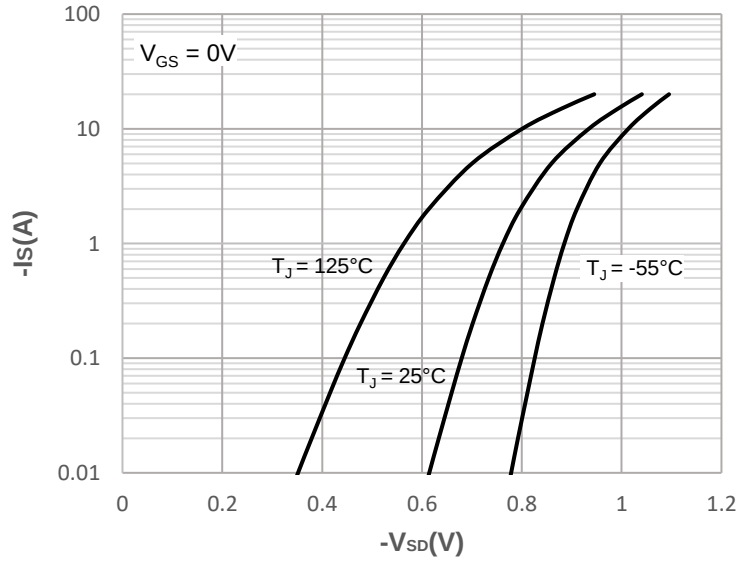



Figure 9: Gate Charge Characteristics

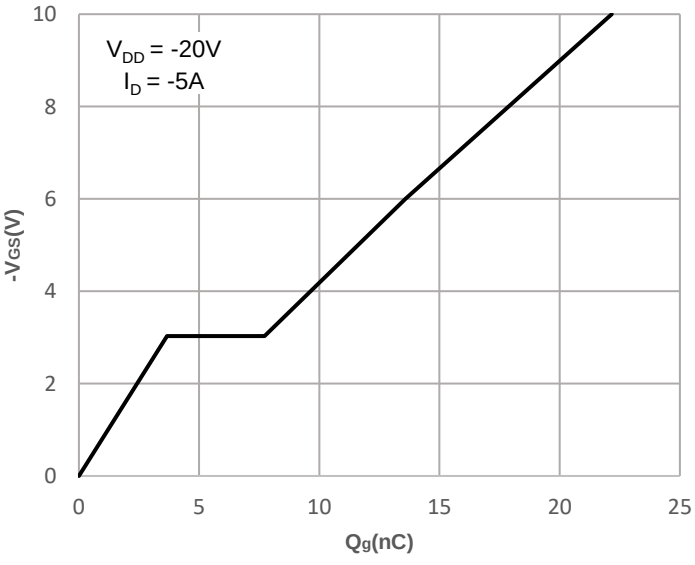
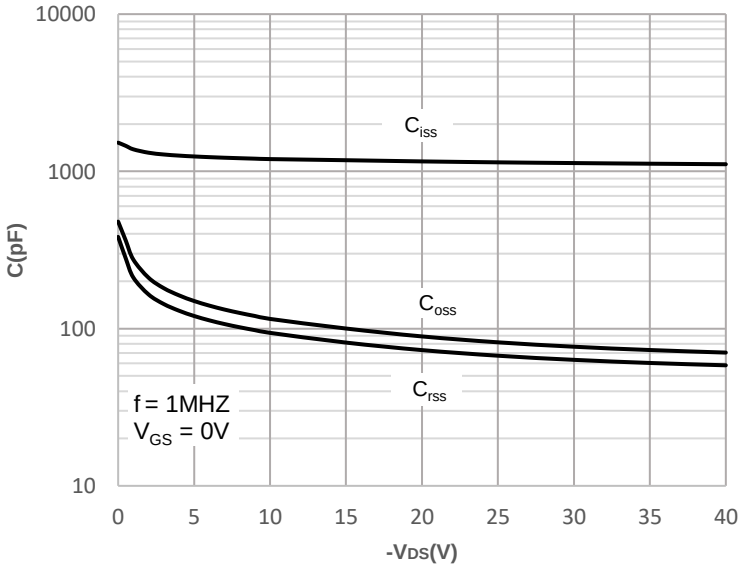



Figure 10: Capacitance Characteristics

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# Typical Performance Characteristics-P

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

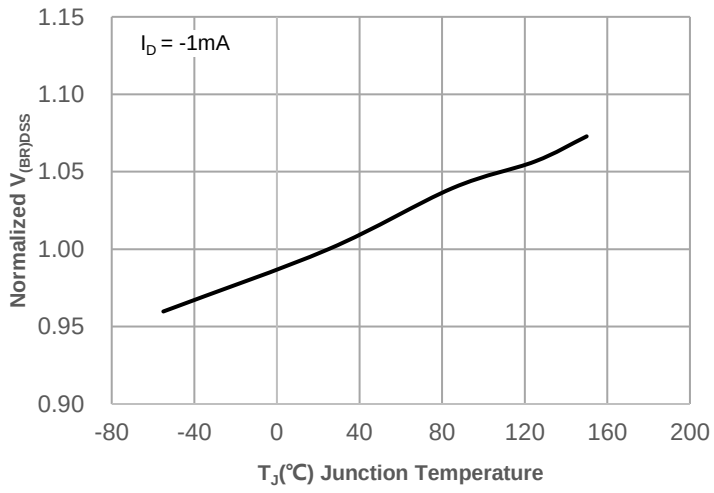


Figure 12: Normalized on Resistance vs. Junction Temperature

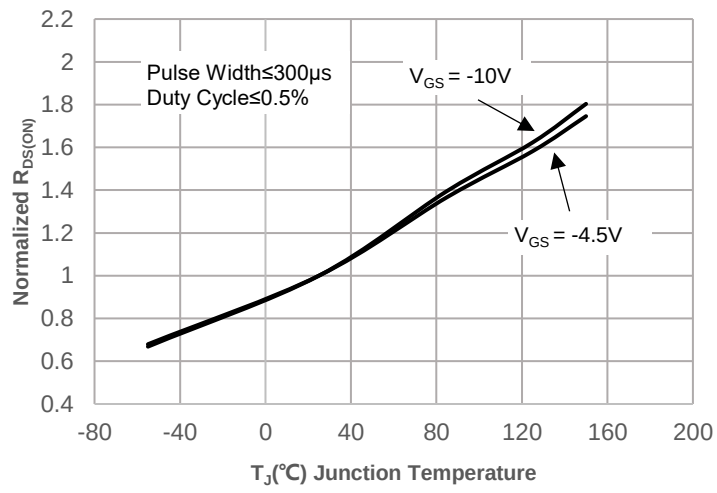


Figure 13: Normalized Threshold Voltage vs. Junction Temperature




Figure 14: $R_{DS(ON)}$ vs. $V_{GS}$




Figure 15: Maximum Safe Operating Area




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## Test Circuit

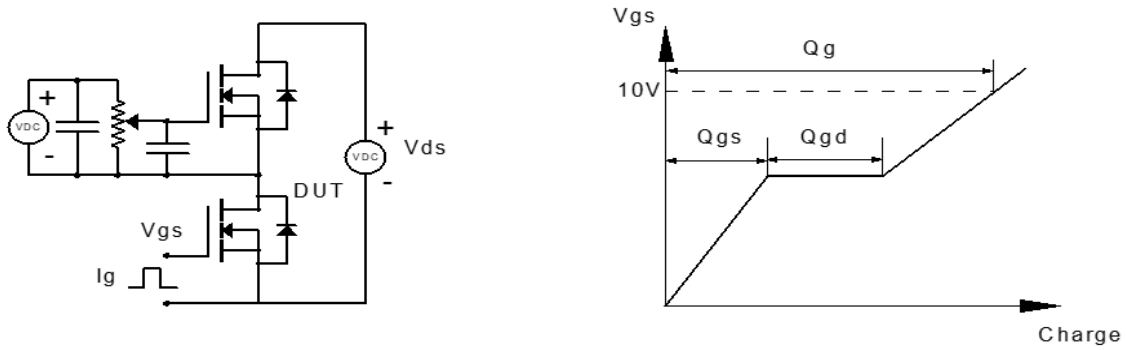


**Figure 1: Gate Charge Test Circuit & Waveform**

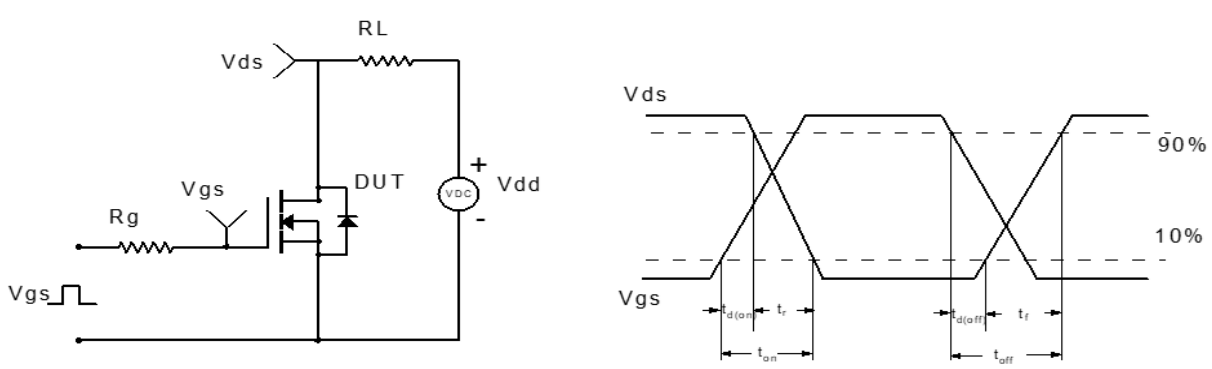


**Figure 2: Resistive Switching Test Circuit & Waveform**

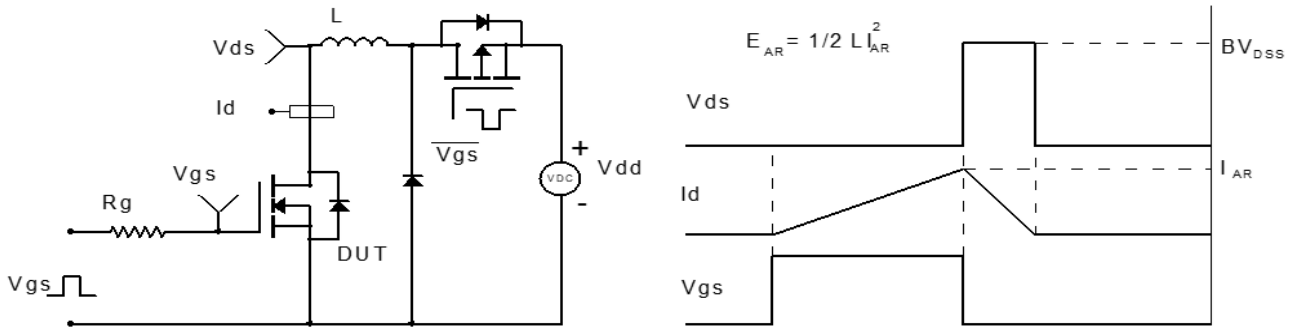


**Figure 3: Unclamped Inductive Switching Test Circuit& Waveform**

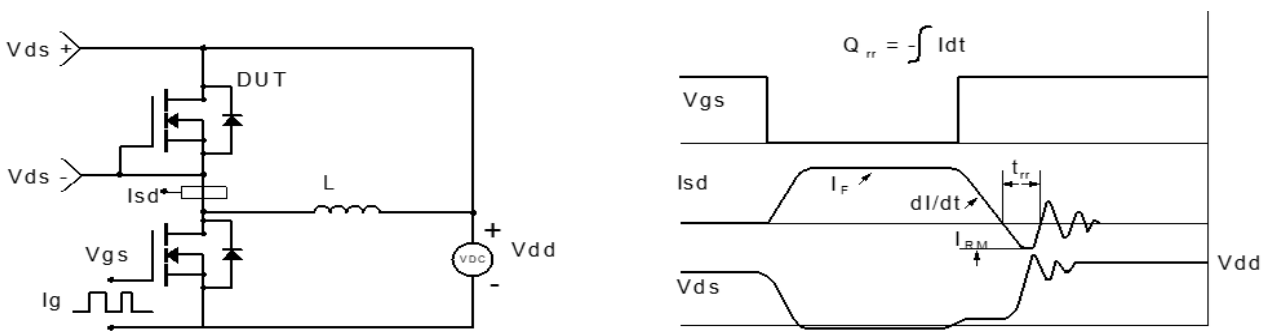


**Figure 4: Diode Recovery Test Circuit & Waveform**

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## Test Circuit

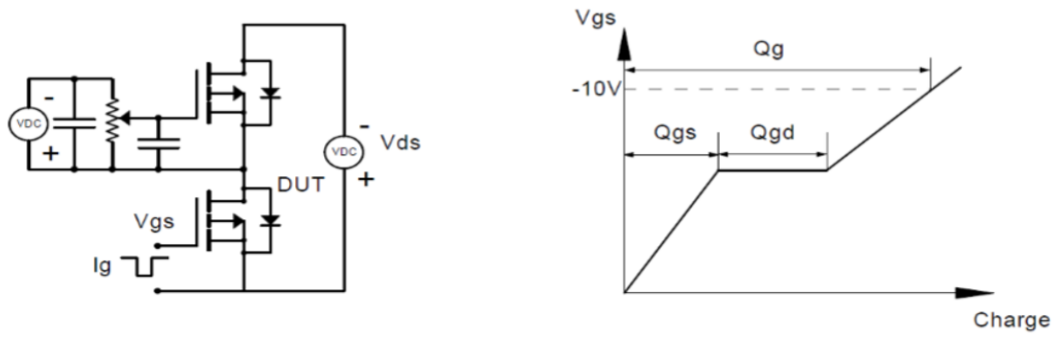


**Figure 1: Gate Charge Test Circuit & Waveform**

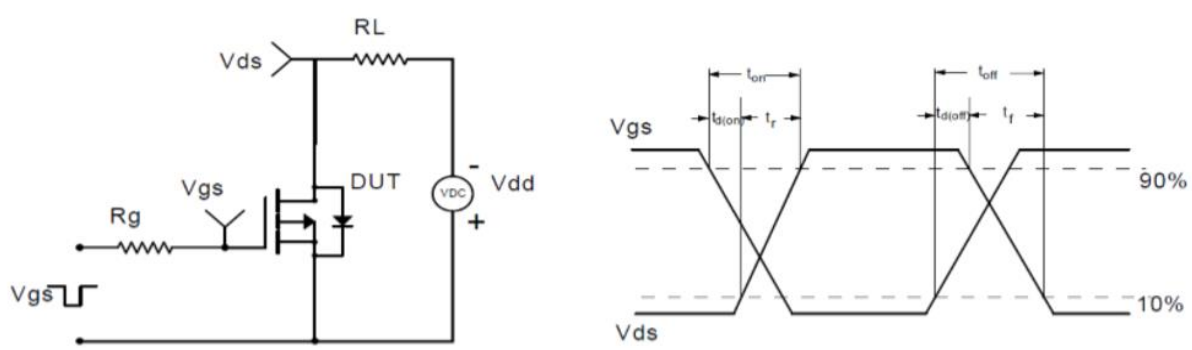


**Figure 2: Resistive Switching Test Circuit & Waveform**

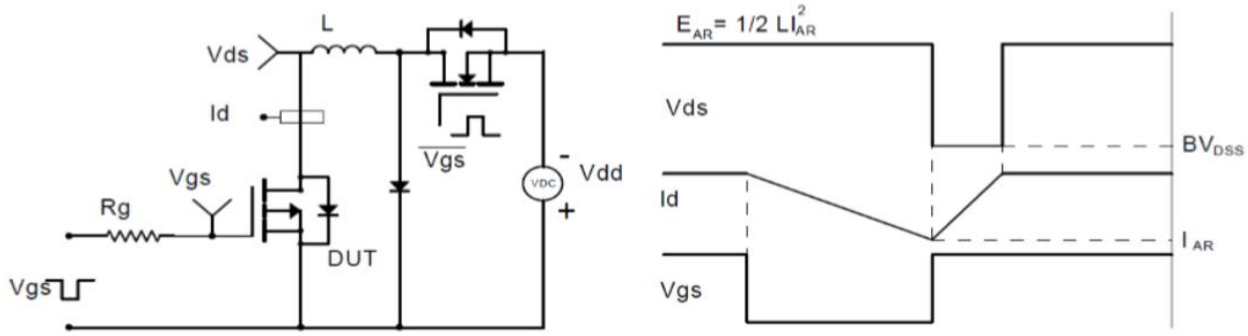


**Figure 3: Unclamped Inductive Switching Test Circuit& Waveform**

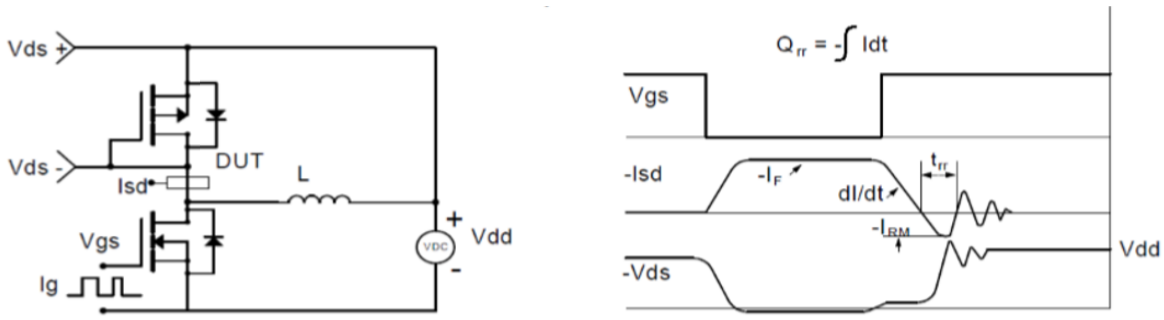


**Figure 4: Diode Recovery Test Circuit & Waveform**

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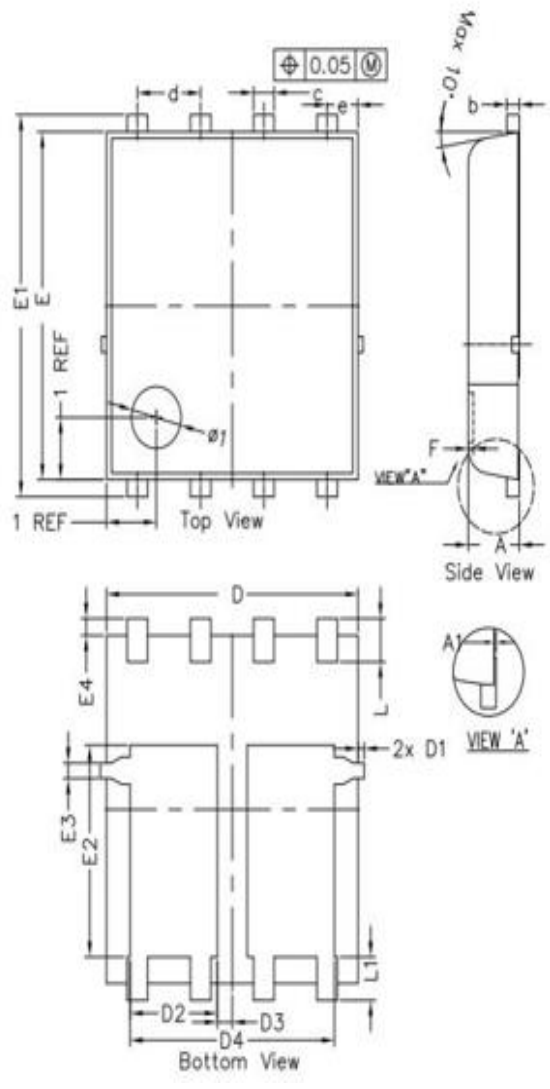
## Package Mechanical Data(PDFN5X6-8L-D)




| SYMBOLS | DIMENSION IN MM | | | DIMENSION IN INCHES | | |
|---|---|---|---|---|---|---|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| * A | 0.900 | 1.000 | 1.100 | 0.035 | 0.039 | 0.043 |
| A1 | 0.000 | --- | 0.050 | 0.000 | ---- | 0.002 |
| b | 0.246 | 0.254 | 0.312 | 0.010 | 0.010 | 0.012 |
| * c | 0.310 | 0.410 | 0.510 | 0.012 | 0.016 | 0.020 |
| d | 1.27 BSC | | | 0.050 BSC | | |
| * D | 4.950 | 5.050 | 5.150 | 0.195 | 0.199 | 0.203 |
| *D1 | --- | --- | 0.125 | --- | --- | 0.005 |
| *D2 | 1.650 | 1.750 | 1.850 | 0.065 | 0.069 | 0.073 |
| D3 | 0.200 | 0.300 | 0.400 | 0.008 | 0.012 | 0.016 |
| D4 | 4.000 | 4.100 | 4.200 | 0.157 | 0.161 | 0.165 |
| e | 0.62 BSC | | | 0.024 BSC | | |
| * E | 5.500 | 5.600 | 5.700 | 0.217 | 0.220 | 0.224 |
| * E1 | 6.050 | 6.150 | 6.250 | 0.238 | 0.242 | 0.246 |
| E2 | 3.310 | 3.410 | 3.510 | 0.130 | 0.134 | 0.138 |
| E3 | 0.150 | 0.250 | 0.350 | 0.006 | 0.010 | 0.014 |
| * E4 | 0.175 | 0.275 | 0.375 | 0.007 | 0.011 | 0.015 |
| F | - | - | 0.100 | - | - | 0.004 |
| * L | 0.500 | 0.600 | 0.700 | 0.02 | 0.02 | 0.03 |
| L1 | 0.600 | 0.700 | 0.800 | 0.02 | 0.03 | 0.03 |

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