# G3R45MT17D
# 1700 V 45 mΩ SiC MOSFET

## Silicon Carbide MOSFET
**N-Channel Enhancement Mode**

| | | |
|---|---|---|
| $V_{DS}$ | = | 1700 V |
| $R_{DS(ON)(Typ.)}$ | = | 45 mΩ |
| $I_{D(T_C = 100°C)}$ | = | 37 A |

## Features

- G3R™ Technology with +15 V Gate Drive
- Superior $Q_G$ x $R_{DS(ON)}$ Figure of Merit
- Superior Cost-Performance Index
- Low Capacitances and Low Gate Charge
- Fast and Reliable Body Diode
- Low Losses at All Operating Temperatures

## Package

Case(D)

G D S

TO-247-3

D = Drain
G = Gate
S = Source

RoHS

REACH

## Advantages

- Compatible with Commercial Gate Drivers
- Increased Power Density for Compact System
- High Frequency Switching
- Improved Thermal Capability
- Ease of Paralleing without Thermal Runaway

## Applications

- Electric Vehicle Fast Charging
- Solar Inverters
- Traction Inverters
- Smart Grid and HVDC
- High Voltage DC-DC Converters
- Switched Mode Power Supply
- Wind Energy Converters
- Pulsed Power

## Absolute Maximum Ratings (At $T_C$ = 25°C Unless Otherwise Stated)

| Parameter | Symbol | Conditions | Values | Unit | Note |
|---|---|---|---|---|---|
| Drain-Source Voltage | $V_{DS(max)}$ | $V_{GS}$ = 0 V, $I_D$ = 100 µA | 1700 | V | |
| Gate-Source Voltage (Dynamic) | $V_{GS(max)}$ | | -10 / +20 | V | |
| Gate-Source Voltage (Static) | $V_{GS(op)}$ | Recommended Operation | -5 / +15 | V | |
| Continuous Forward Current | $I_D$ | $T_C$ = 25°C, $V_{GS}$ = -5 / +15 V | 52 | A | Fig. 15 |
| | | $T_C$ = 100°C, $V_{GS}$ = -5 / +15 V | 37 | | |
| | | $T_C$ = 135°C, $V_{GS}$ = -5 / +15 V | 27 | | |
| Pulsed Drain Current | $I_{D(pulse)}$ | $t_P$ ≤ 3µs, D ≤ 1%, $V_{GS}$ = 15 V, Note 1 | 120 | A | Fig. 14 |
| Power Dissipation | $P_D$ | $T_C$ = 25°C | 364 | W | Fig. 16 |
| Non-Repetitive Avalanche Energy | $E_{AS}$ | L = 3.9 mH, $I_{AS}$ = 17.5 A | 592 | mJ | |
| Operating and Storage Temperature | $T_j$ , $T_{stg}$ | | -55 to 175 | °C | |

## Thermal/Package Characteristics

| Parameter | Symbol | Conditions | Values Min. | Values Typ. | Values Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Thermal Resistance, Junction - Case | $R_{thJC}$ | | | 0.30 | 0.41 | °C/W | Fig. 13 |
| Weight | $W_T$ | | | 6.1 | | g | |
| Mounting Torque | $T_M$ | Screws to Heatsink | | | 1.1 | Nm | |

*Note 1: Pulse Width $t_P$ Limited by $T_{j(max)}$*

## Electrical Characteristics (At $T_C$ = 25°C Unless Otherwise Stated)

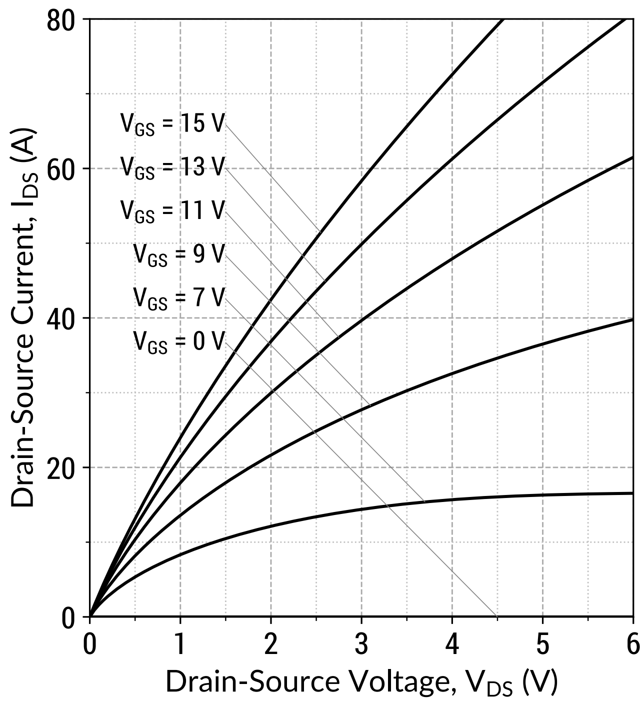
| Parameter | Symbol | Conditions | Values | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Drain-Source Breakdown Voltage | $V_{DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 100 µA | 1700 | | | V | |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$ = 1700 V, $V_{GS}$ = 0 V | | 1 | | µA | |
| Gate Source Leakage Current | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = 20 V<br>$V_{DS}$ = 0 V, $V_{GS}$ = -10 V | | | 100<br>-100 | nA | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 30.0 mA<br>$V_{DS}$ = $V_{GS}$, $I_D$ = 30.0 mA, $T_j$ = 175°C | 1.8 | 2.70<br>1.90 | | V | Fig. 9 |
| Transconductance | $g_{fs}$ | $V_{DS}$ = 10 V, $I_D$ = 35 A<br>$V_{DS}$ = 10 V, $I_D$ = 35 A, $T_j$ = 175°C | | 17.1<br>17.4 | | S | Fig. 4 |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$ = 15 V, $I_D$ = 35 A<br>$V_{GS}$ = 15 V, $I_D$ = 35 A, $T_j$ = 175°C | | 45<br>97 | 62 | mΩ | Fig. 5-8 |
| Input Capacitance | $C_{iss}$ | $V_{DS}$ = 1000 V, $V_{GS}$ = 0 V<br>f = 1 MHz, $V_{AC}$ = 25mV | | 3199 | | pF | Fig. 11 |
| Output Capacitance | $C_{oss}$ | | | 86 | | pF | Fig. 11 |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 15.3 | | pF | Fig. 11 |
| $C_{oss}$ Stored Energy | $E_{oss}$ | | | 57 | | µJ | Fig. 12 |
| $C_{oss}$ Stored Charge | $Q_{oss}$ | | | 172 | | nC | |
| Gate-Source Charge | $Q_{gs}$ | $V_{DS}$ = 1000 V, $V_{GS}$ = -5 / +15 V<br>$I_D$ = 35 A<br>Per IEC607478-4 | | 33 | | nC | Fig. 10 |
| Gate-Drain Charge | $Q_{gd}$ | | | 37 | | nC | Fig. 10 |
| Total Gate Charge | $Q_g$ | | | 106 | | nC | Fig. 10 |
| Internal Gate Resistance | $R_{G(int)}$ | f = 1 MHz, $V_{AC}$ = 25 mV | | 1.3 | | Ω | |
| Turn-On Switching Energy (Body Diode) | $E_{On}$ | $T_j$ = 25°C, $V_{GS}$ = -5/+15V, $R_{G(ext)}$ = 6 Ω, L = 60.0 µH, $I_D$ = 35 A, $V_{DD}$ = 1200 V | | 926 | | µJ | Fig. 22 |
| Turn-Off Switching Energy (Body Diode) | $E_{Off}$ | | | 412 | | µJ | Fig. 22 |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD}$ = 1200 V, $V_{GS}$ = -5/+15V<br>$R_{G(ext)}$ = 6 Ω, L = 60.0 µH, $I_D$ = 35 A<br>Timing relative to $V_{DS}$, Inductive load | | 70 | | ns | Fig. 24 |
| Rise Time | $t_r$ | | | 32 | | ns | Fig. 24 |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 31 | | ns | Fig. 24 |
| Fall Time | $t_f$ | | | 53 | | ns | Fig. 24 |

## Reverse Diode Characteristics

| Parameter | Symbol | Conditions | Values | | | Unit | Note |
|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | | |
| Diode Forward Voltage | $V_{SD}$ | $V_{GS}$ = -5 V, $I_{SD}$ = 17 A<br>$V_{GS}$ = -5 V, $I_{SD}$ = 17 A, $T_j$ = 175°C | | 4.5<br>4.3 | | V | Fig. 17-18 |
| Continuous Diode Forward Current | $I_S$ | $V_{GS}$ = -5 V, $T_c$ = 100°C | 33 | | | A | |
| Diode Pulse Current | $I_{S(pulse)}$ | $V_{GS}$ = -5 V, Note 1 | | 132 | | A | |
| Reverse Recovery Time | $t_{rr}$ | $V_{GS}$ = -5 V, $I_{SD}$ = 35 A, $V_R$ = 1200 V<br>dif/dt = 2200 A/µs, $T_j$ = 25°C | | 31 | | ns | |
| Reverse Recovery Charge | $Q_{rr}$ | | | 305 | | nC | |
| Peak Reverse Recovery Current | $I_{rrm}$ | | | 8 | | A | |
| Reverse Recovery Time | $t_{rr}$ | $V_{GS}$ = -5 V, $I_{SD}$ = 35 A, $V_R$ = 1200 V<br>dif/dt = 2200 A/µs, $T_j$ = 175°C | | 53 | | ns | |
| Reverse Recovery Charge | $Q_{rr}$ | | | 1144 | | nC | |
| Peak Reverse Recovery Current | $I_{rrm}$ | | | 17 | | A | |

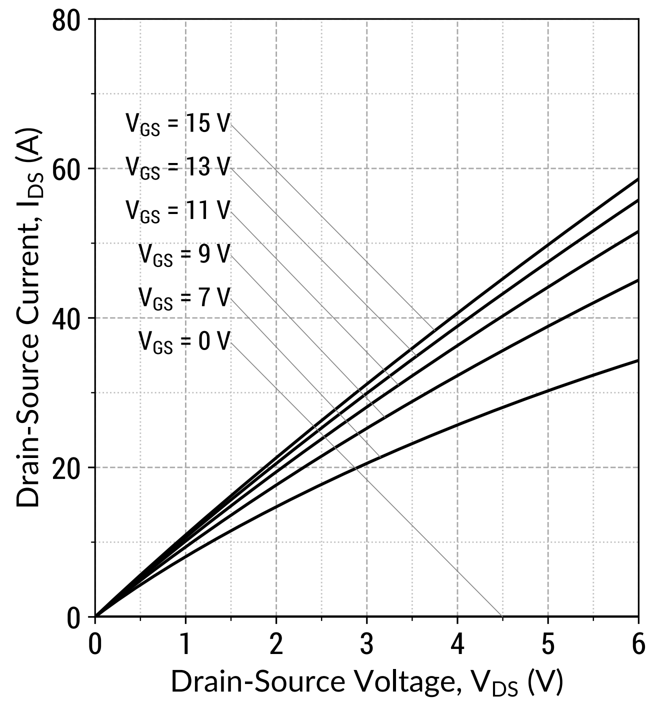
**The chip technology was characterized up to 200 V/ns. The measured dV/dt was limited by measurement test setup and package.*

Figure 1: Output Characteristics ($T_j$ = 25°C)



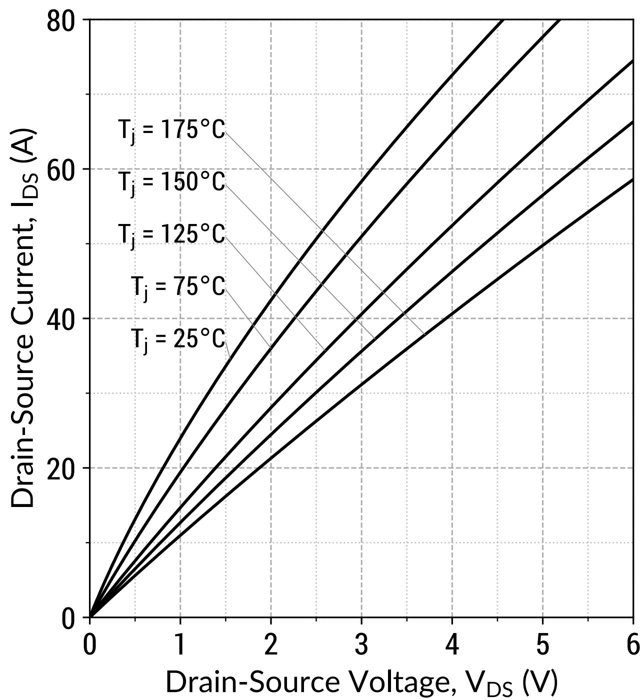

$I_D = f(V_{DS}, V_{GS})$; $t_P$ = 250 µs

Figure 2: Output Characteristics ($T_j$ = 175°C)



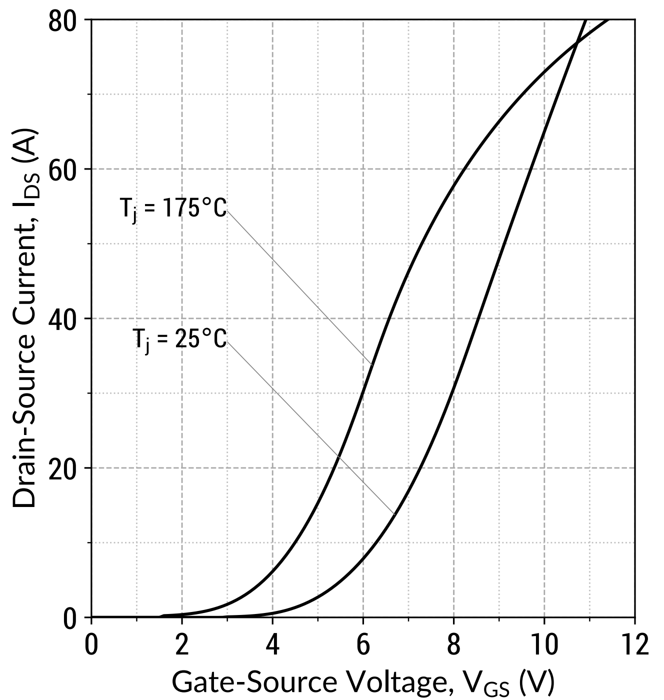

$I_D = f(V_{DS}, V_{GS})$; $t_P$ = 250 µs

Figure 3: Output Characteristics ($V_{GS}$ = 15 V)



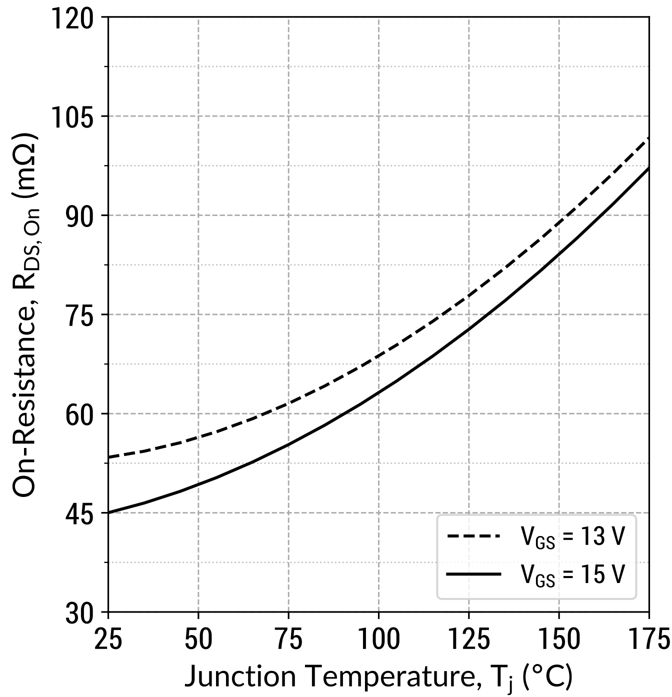

$I_D = f(V_{DS}, T_j)$; $t_P$ = 250 µs

Figure 4: Transfer Characteristics ($V_{DS}$ = 10 V)



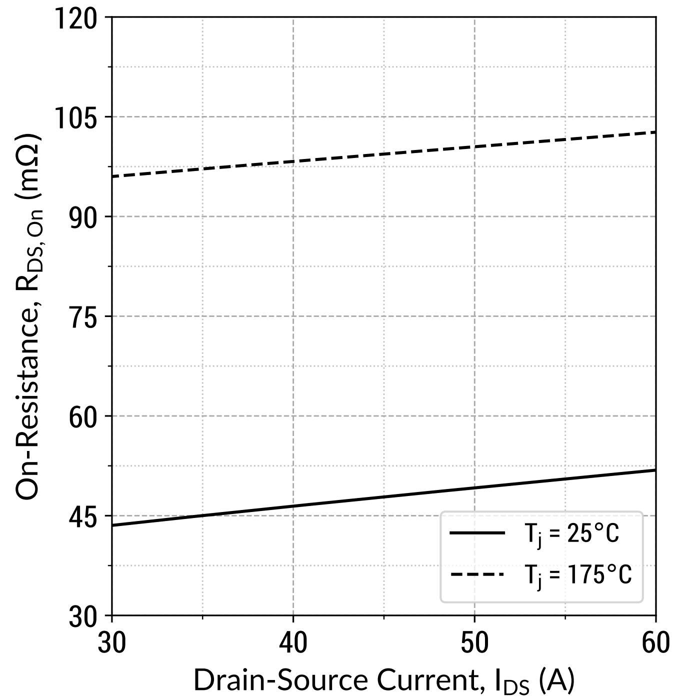

$I_D = f(V_{GS}, T_j)$; $t_P$ = 100 µs

**Figure 5: On-State Resistance v/s Temperature**



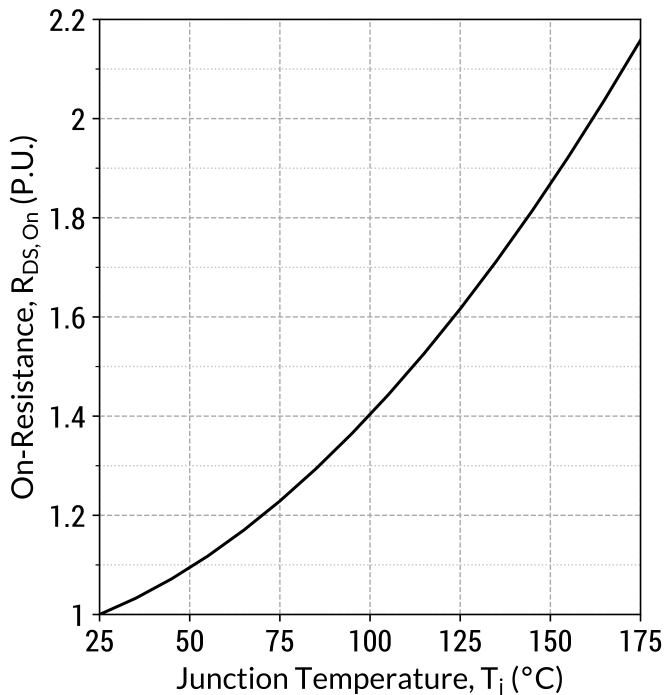

$R_{DS(ON)} = f(T_j, V_{GS})$; $t_P = 250$ µs; $I_D = 35$ A

**Figure 6: On-State Resistance v/s Drain Current**



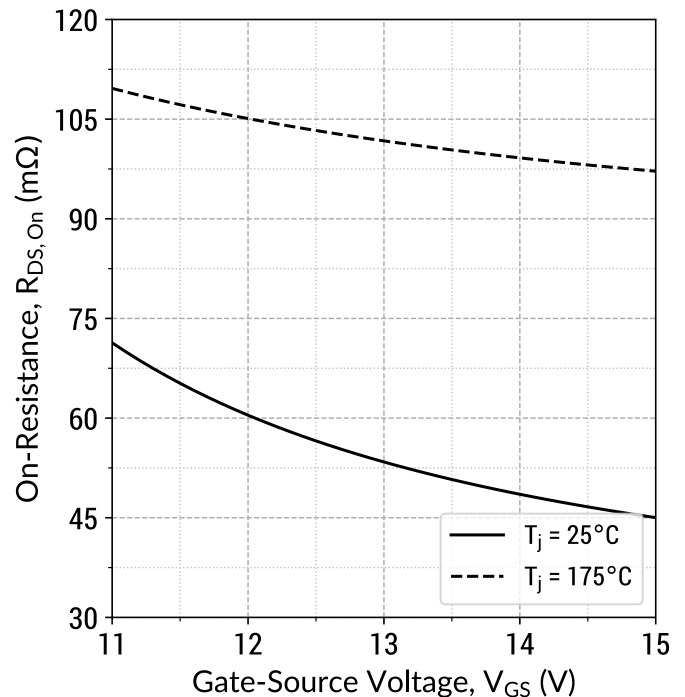

$R_{DS(ON)} = f(T_j, I_D)$; $t_P = 250$ µs; $V_{GS} = 15$ V

**Figure 7: Normalized On-State Resistance v/s Temperature**



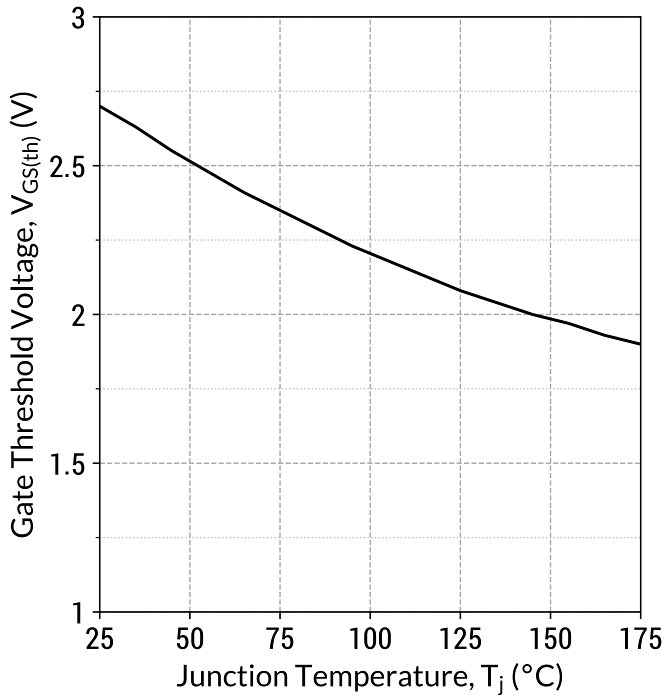

$R_{DS(ON)} = f(T_j)$; $t_P = 250$ µs; $I_D = 35$ A; $V_{GS} = 15$ V

**Figure 8: On-State Resistance v/s Gate Voltage**



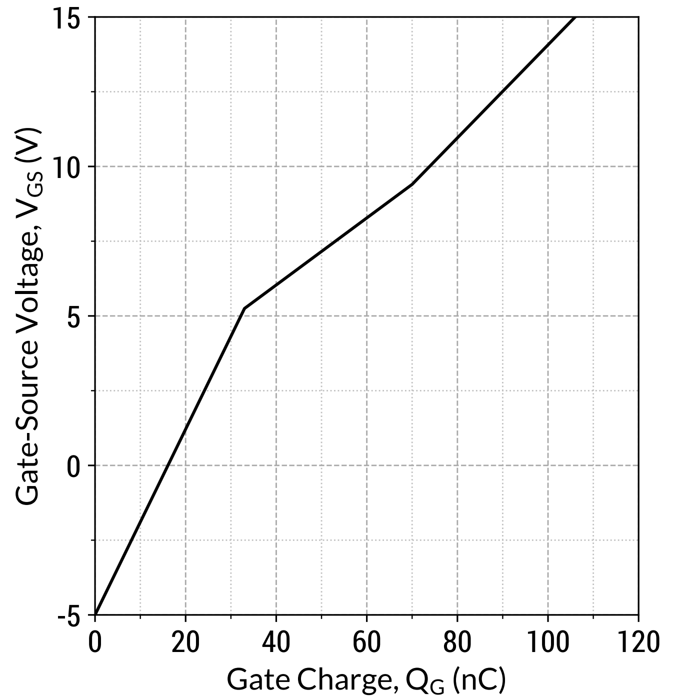

$R_{DS(ON)} = f(T_j, V_{GS})$; $t_P = 250$ µs; $I_D = 35$ A

Figure 9: Threshold Voltage Characteristics



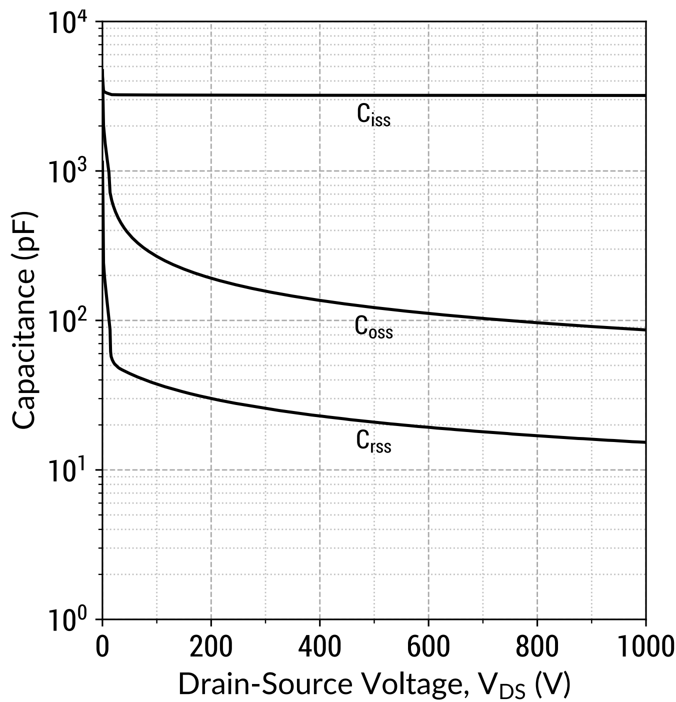

$V_{GS(th)} = f(T_j)$; $V_{DS} = V_{GS}$; $I_D$ = 30.0 mA

Figure 10: Gate Charge Characteristics



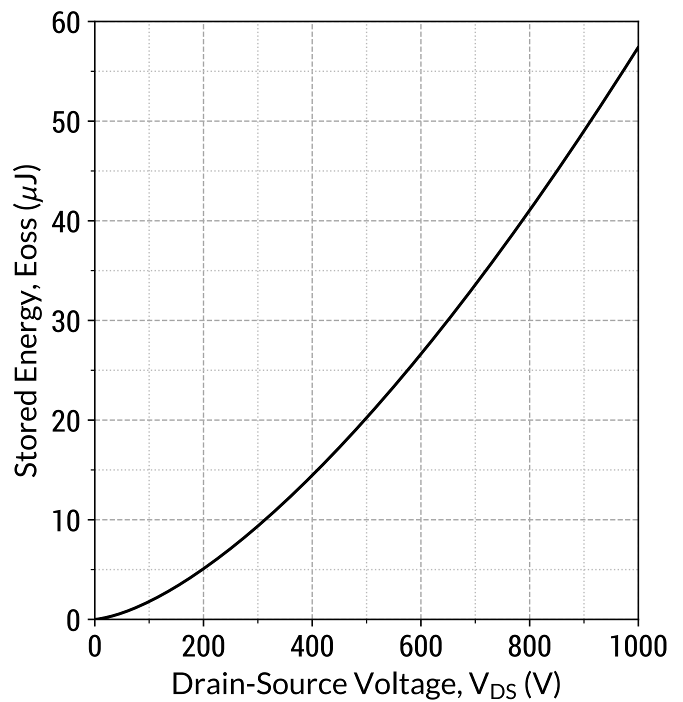

$I_D$ = 35 A; $V_{DS}$ = 1000 V; $T_c$ = 25°C

Figure 11: Capacitance v/s Drain-Source Voltage



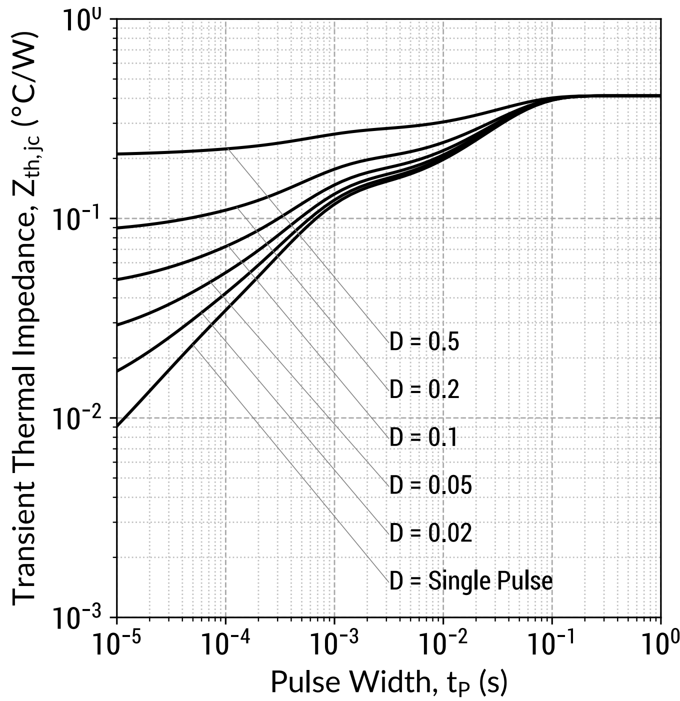

f = 1 MHz; $V_{AC}$ = 25mV

Figure 12: Output Capacitor Stored Energy



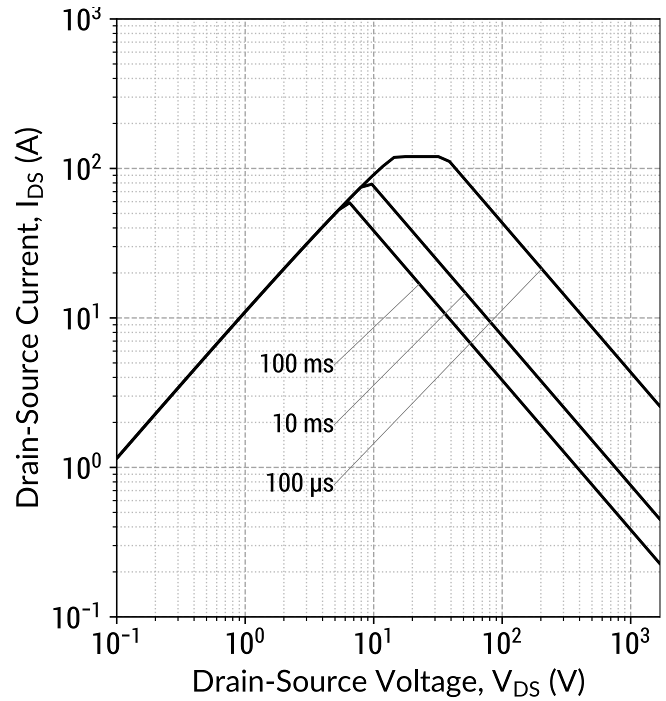

$E_{oss} = f(V_{DS})$

## Figure 13: Transient Thermal Impedance



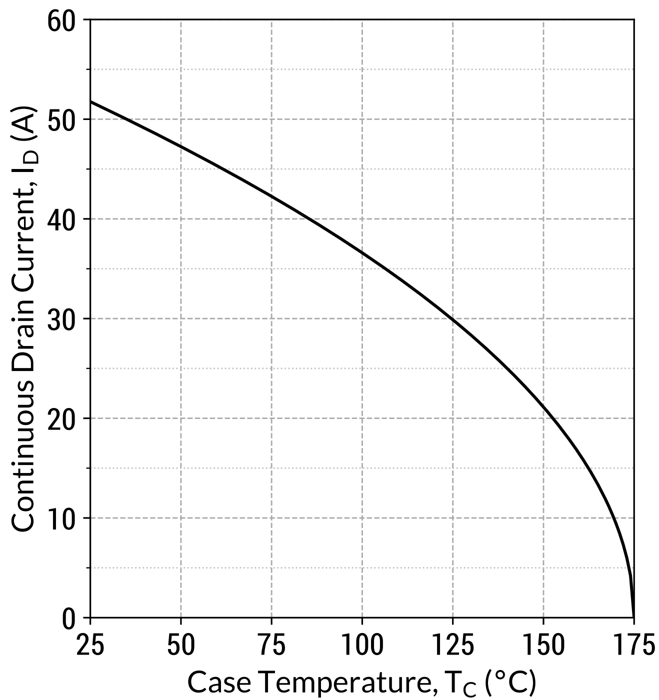

$Z_{th,jc} = f(t_P, D)$; $D = t_P/T$

## Figure 14: Safe Operating Area ($T_c$ = 25°C)



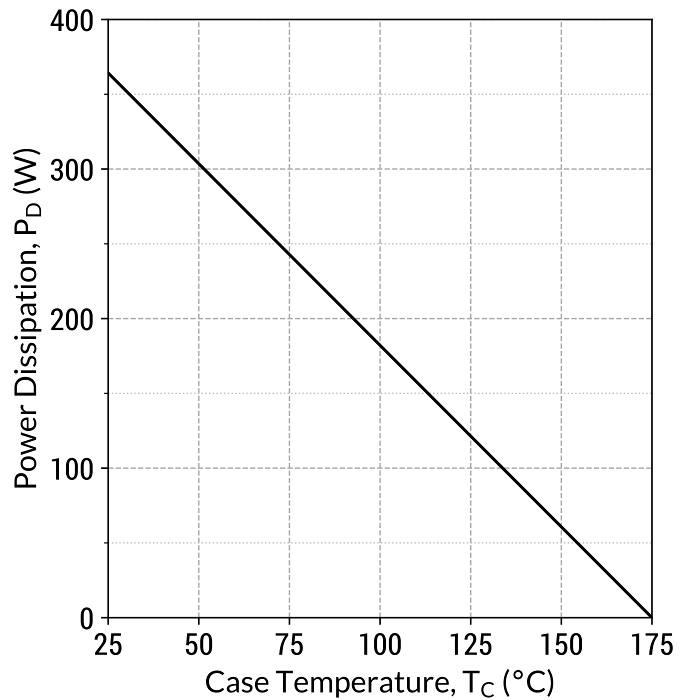

$I_D = f(V_{DS}, t_P)$; $T_j \leq 175°C$; $D = 0$

## Figure 15: Current De-rating Curve



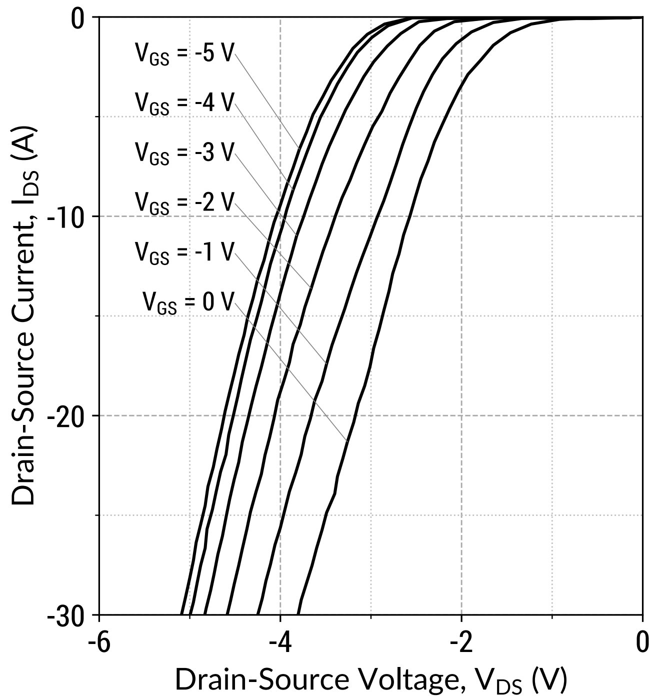

$I_D = f(T_C)$; $T_j \leq 175°C$

## Figure 16: Power De-rating Curve



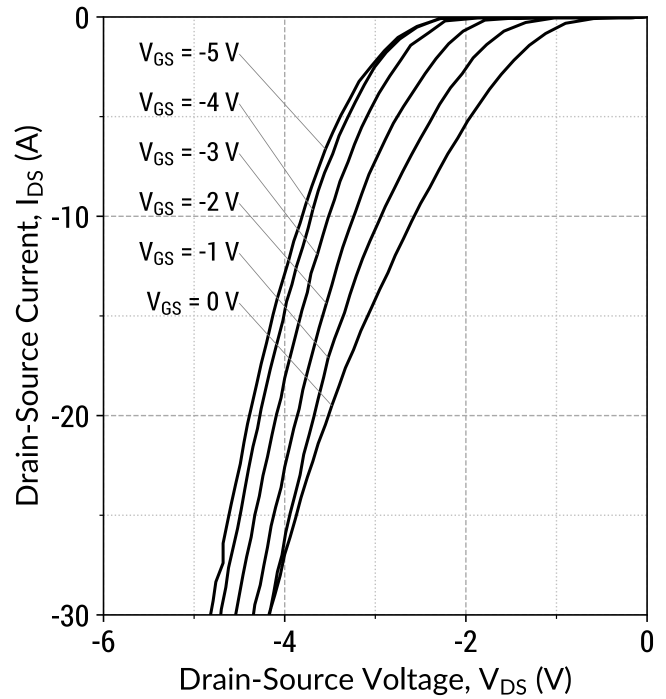

$P_D = f(T_C)$; $T_j \leq 175°C$

Figure 17: Body Diode Characteristics ($T_j$ = 25°C)



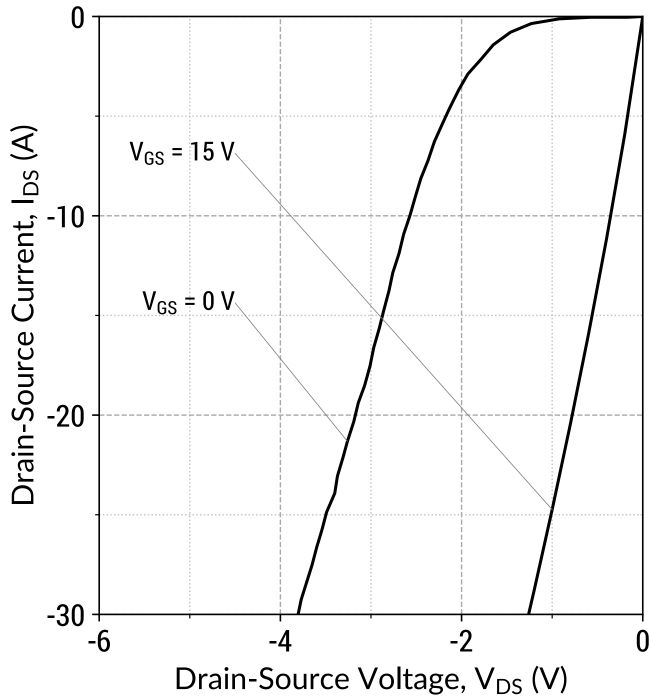

$I_D = f(V_{DS}, V_{GS})$; $t_P$ = 250 µs

Figure 18: Body Diode Characteristics ($T_j$ = 175°C)



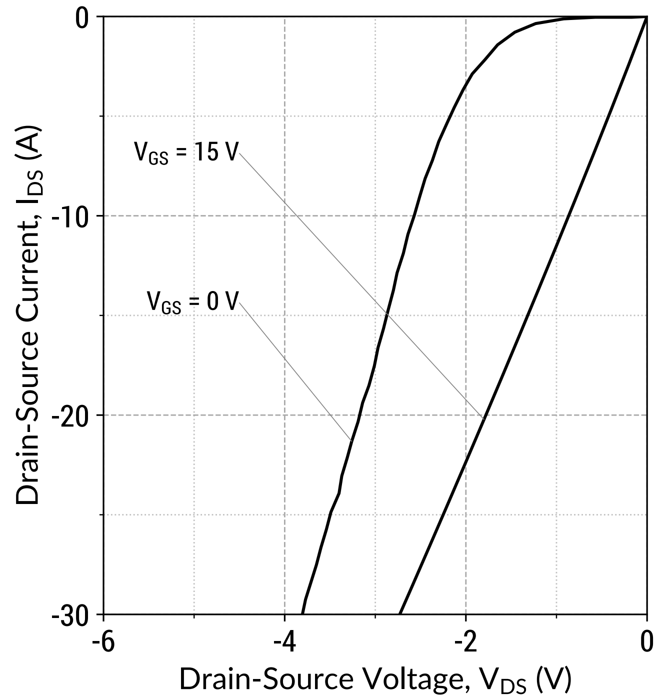

$I_D = f(V_{DS}, V_{GS})$; $t_P$ = 250 µs

Figure 19: Third Quadrant Characteristics ($T_j$ = 25°C)



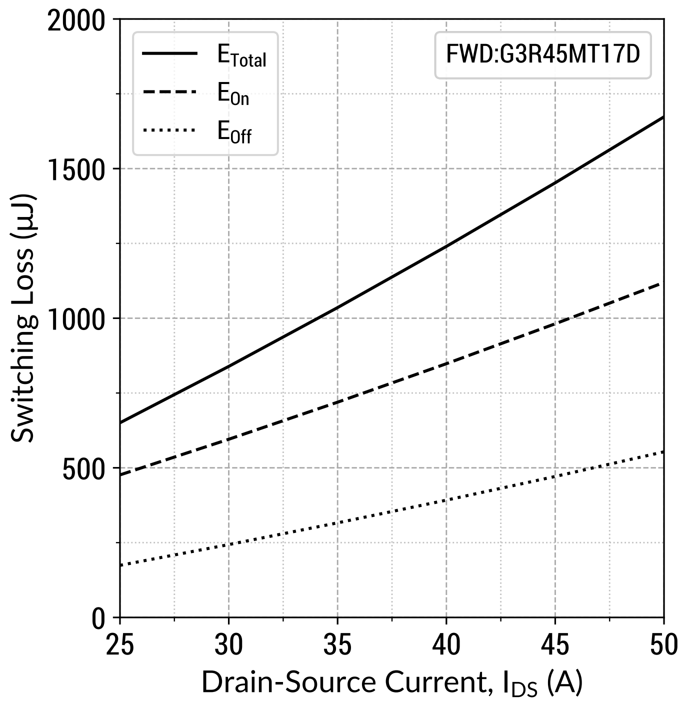

$I_D = f(V_{DS}, V_{GS})$; $t_P$ = 250 µs

Figure 20: Third Quadrant Characteristics ($T_j$ = 175°C)



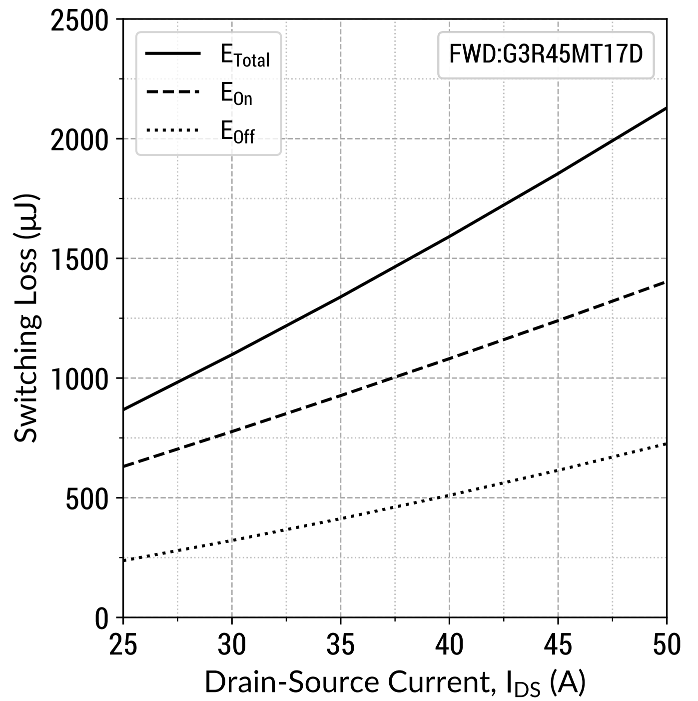

$I_D = f(V_{DS}, V_{GS})$; $t_P$ = 250 µs

**Figure 21: Inductive Switching Energy v/s Drain Current ($V_{DD}$ = 1000V)**



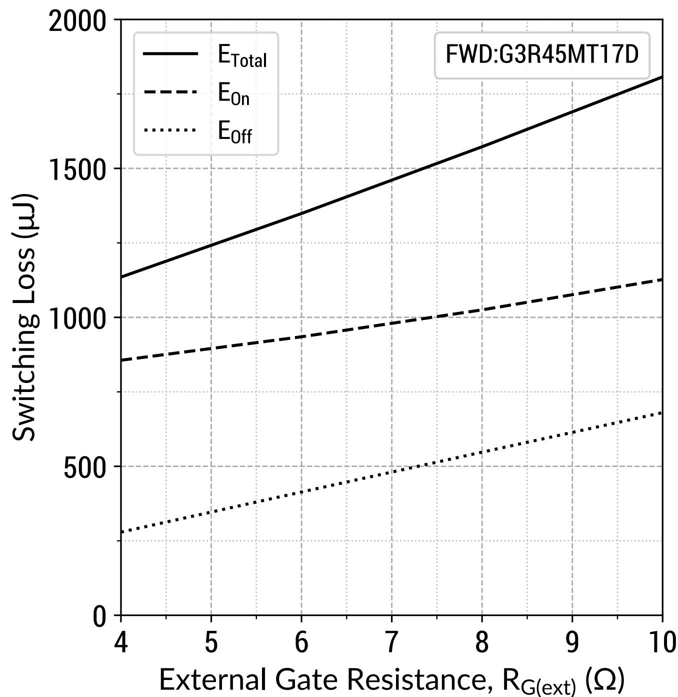

$T_j$ = 25°C; $V_{GS}$ = -5/+15V; $R_{G(ext)}$ = 6 Ω; L = 60.0μH

**Figure 22: Inductive Switching Energy v/s Drain Current ($V_{DD}$ = 1200V)**



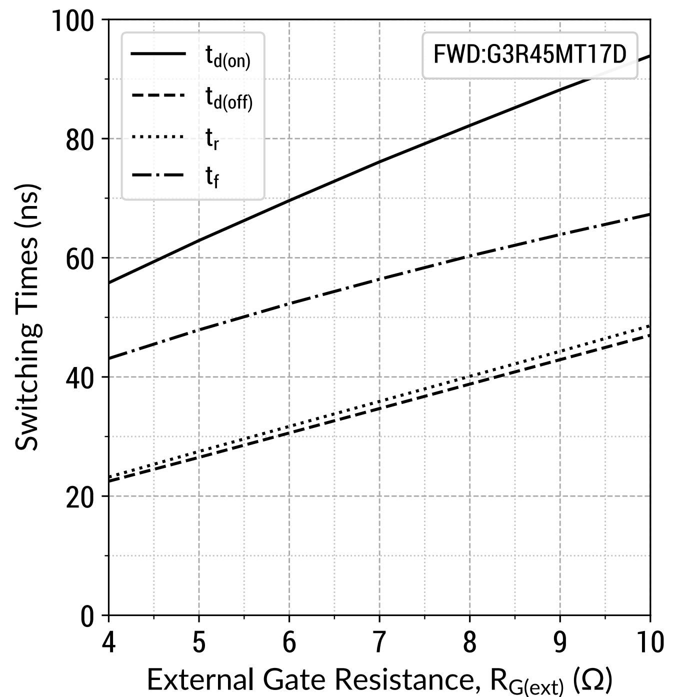

$T_j$ = 25°C; $V_{GS}$ = -5/+15V; $R_{G(ext)}$ = 6 Ω; L = 60.0μH

**Figure 23: Inductive Switching Energy v/s $R_{G(ext)}$ ($V_{DD}$ = 1200V)**



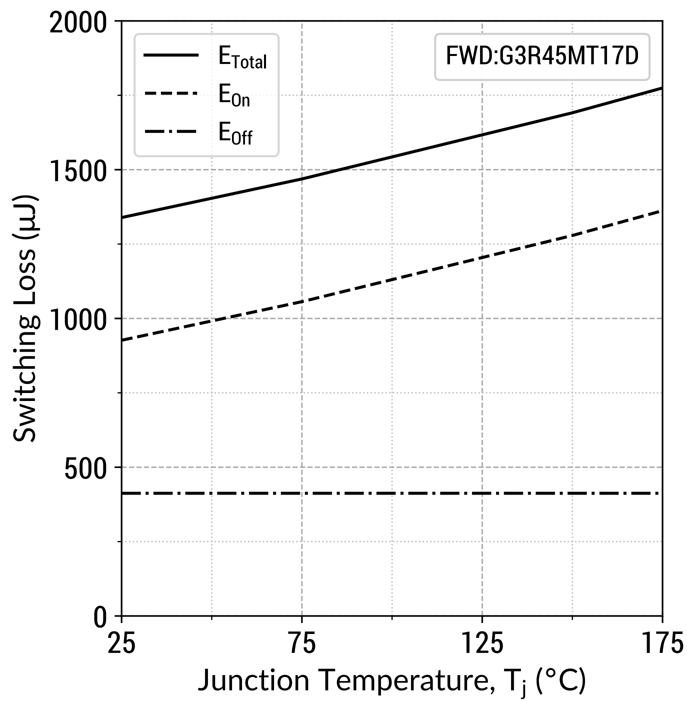

$T_j$ = 25°C; $V_{GS}$ = -5/+15V; $I_{DS}$ = 35 A; L = 60.0μH

**Figure 24: Switching Time v/s $R_{G(ext)}$ ($V_{DD}$ = 1200V)**




$T_j$ = 25°C; $V_{GS}$ = -5/+15V; $I_{DS}$ = 35 A; L = 60.0μH

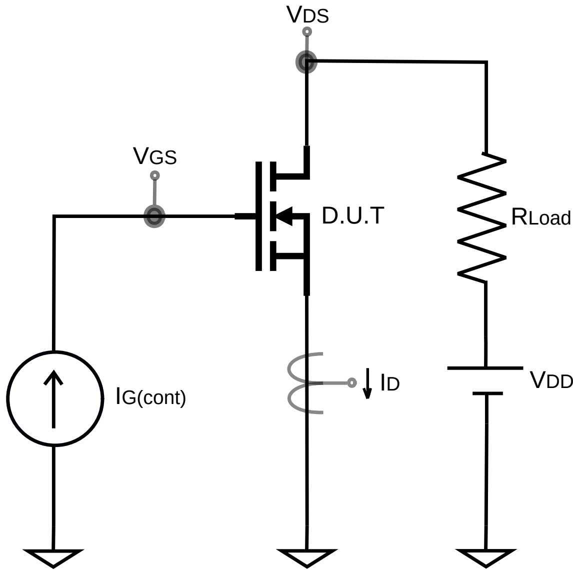
Figure 25: Inductive Switching Energy v/s Temperature ($V_{DD}$ = 1200V)



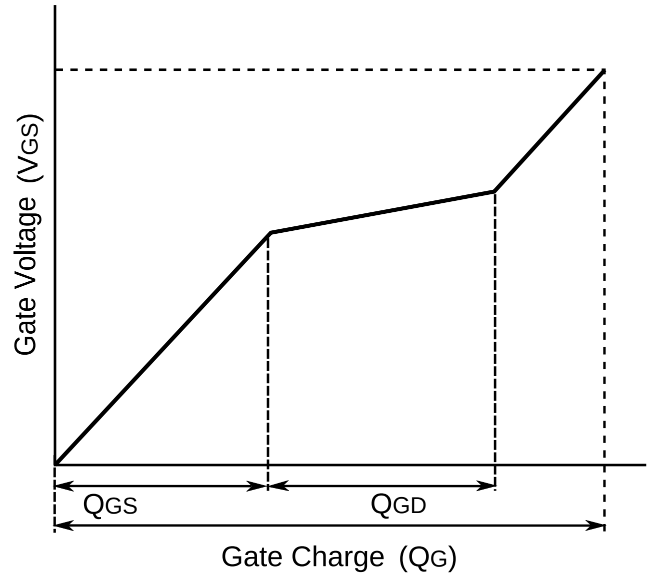

$T_j$ = 25°C; $V_{GS}$ = -5/+15V; $R_{G(ext)}$ = 6 Ω; $I_{DS}$ = 35 A; L = 60.0μH

GeneSiC SEMICONDUCTOR

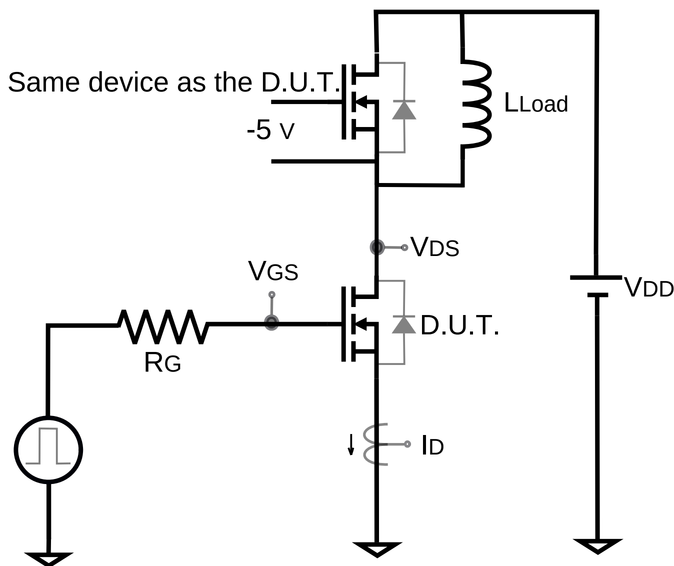
## Gate Charge Circuit



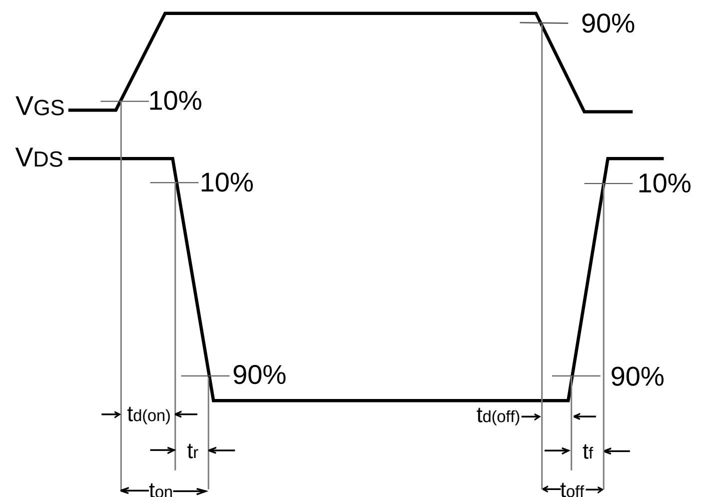

## Gate Charge Waveform




## Switching Time Circuit

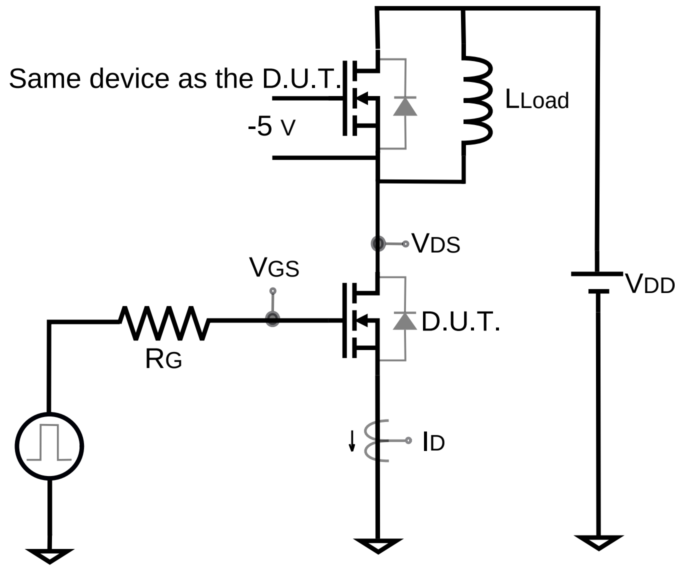



## Switching Time Waveform

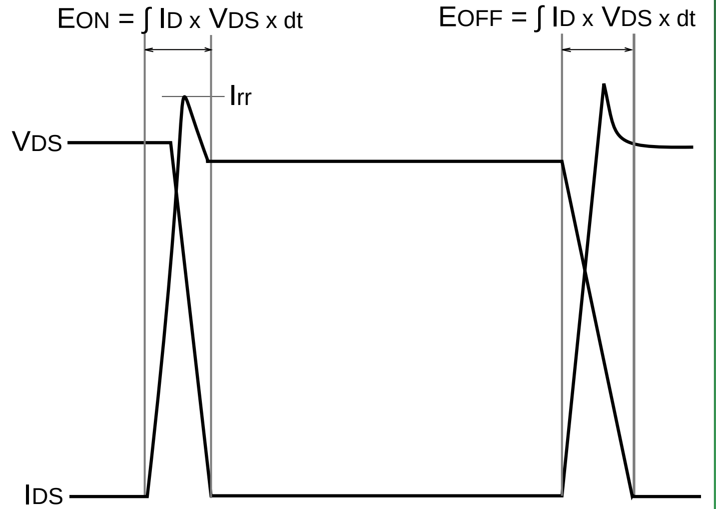


GeneSiC SEMICONDUCTOR

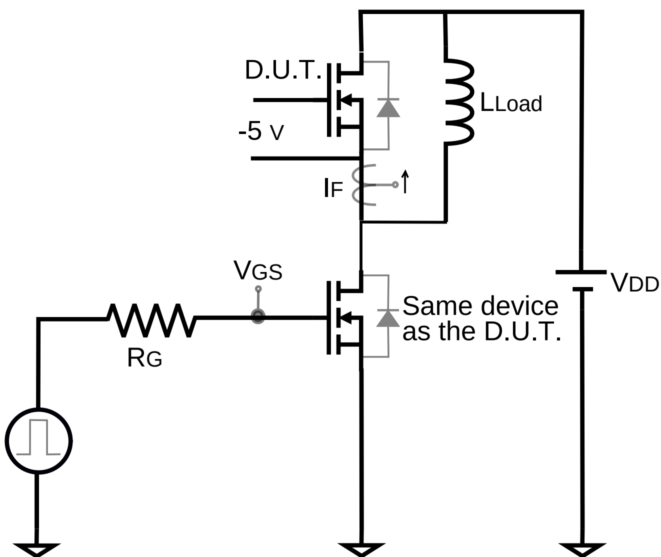
## Switching Energy Circuit



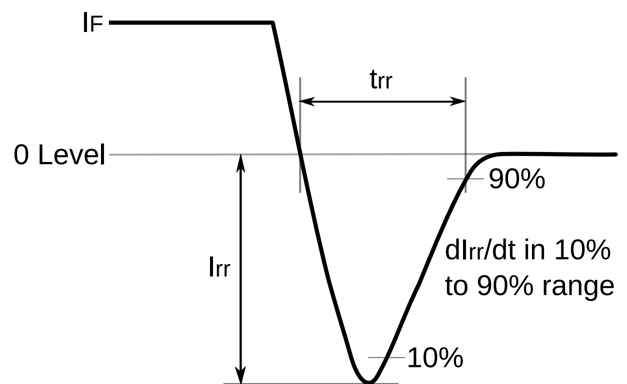

## Switching Energy Waveform




## Reverse Recovery Circuit

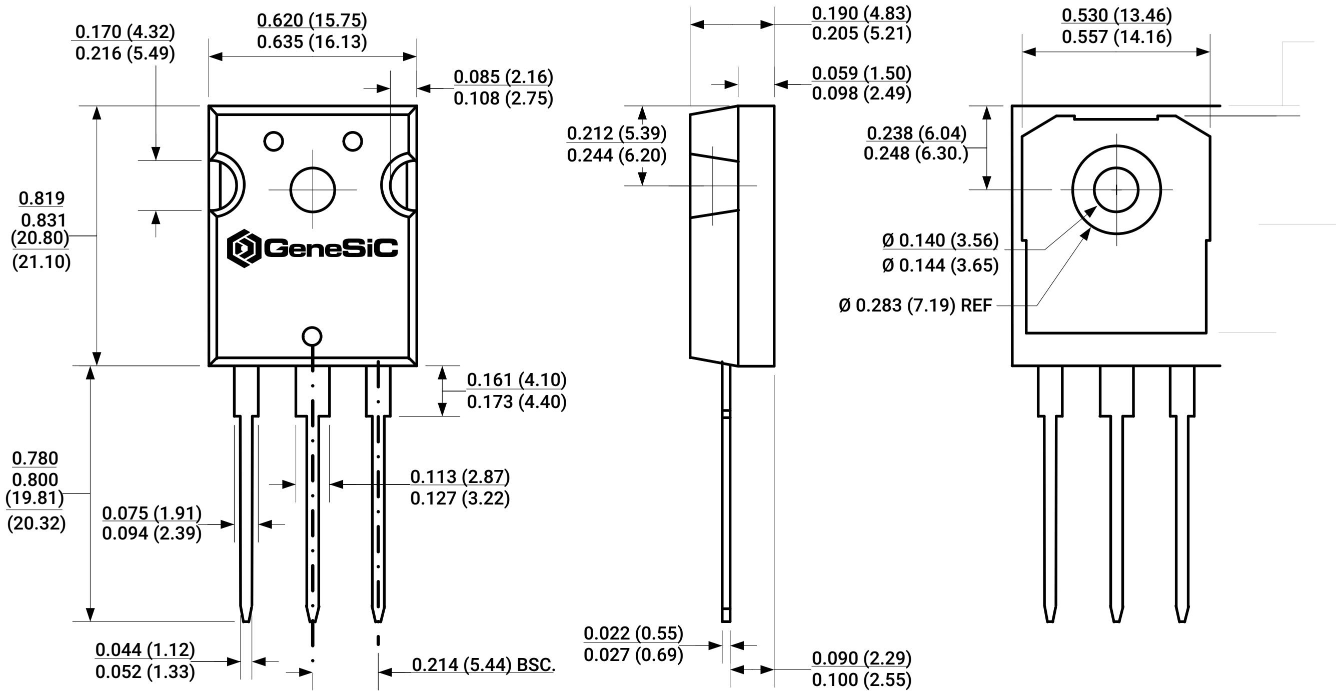



## Reverse Recovery Waveform

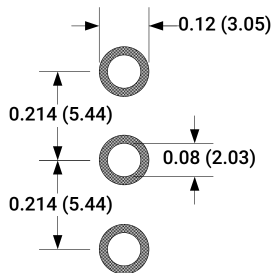


## Package Dimensions

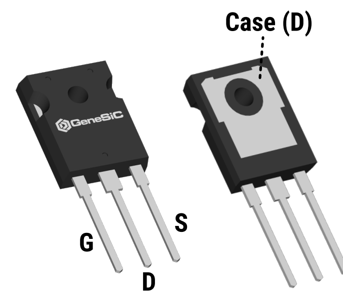
### TO-247-3 Package Outline




### Recommended Solder Pad Layout




### Package View




NOTE

1. CONTROLLED DIMENSION IS INCH. DIMENSION IN BRACKET IS MILLIMETER.
2. DIMENSIONS DO NOT INCLUDE END FLASH, MOLD FLASH, MATERIAL PROTRUSIONS.

## Compliance

### RoHS Compliance

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS 2), as adopted by EU member states on January 2, 2013 and amended on March 31, 2015 by EU Directive 2015/863. RoHS Declarations for this product can be obtained from your GeneSiC representative.

### REACH Compliance

REACH substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact a GeneSiC representative to insure you get the most up-to-date REACH SVHC Declaration. REACH banned substance information (REACH Article 67) is also available upon request.

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## Related Links

- SPICE Models: https://www.genesicsemi.com/sic-mosfet/G3R45MT17D/G3R45MT17D_SPICE.zip
- PLECS Models: https://www.genesicsemi.com/sic-mosfet/G3R45MT17D/G3R45MT17D_PLECS.zip
- CAD Models: https://www.genesicsemi.com/sic-mosfet/G3R45MT17D/G3R45MT17D_3D.zip
- Gate Driver Reference: https://www.genesicsemi.com/technical-support
- Evaluation Boards: https://www.genesicsemi.com/technical-support
- Reliability: https://www.genesicsemi.com/reliability
- Compliance: https://www.genesicsemi.com/compliance
- Quality Manual: https://www.genesicsemi.com/quality

## Revision History

- Rev 21/Feb: Added switching time and switching energy data
- Supersedes: Rev 20/Jun, Rev 20/Sep

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