# HCT65N27M1

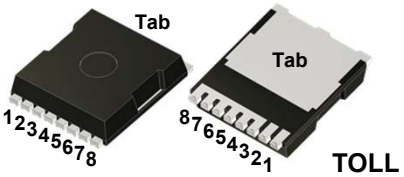
## N-Channel SiC Silicon Carbide Power MOSFET

650 V, 84 A, 27 mΩ

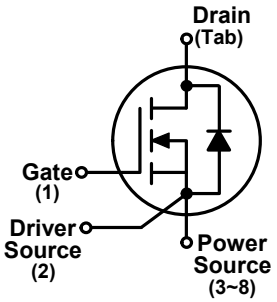
### Features

- High switching speed with a low gate charge
- Fast intrinsic diode with low reverse recovery
- Robust Avalanche Capability
- 100% Avalanche Tested
- Pb-free, Halogen Free, and RoHS Compliant

| $BV_{DSS, Tc=25℃}$ | $I_{D, Tc=25℃}$ | $R_{DS(on),typ}$ | $Q_{g,typ}$ |
|---|---|---|---|
| 650 V | 84 A | 27 mΩ | 91 nC |




TOLL




### Benefits

- System efficiency improvement
- Higher frequency applicability
- Increased power density
- Reduced cooling effort

### Applications

- Server & Telecom power
- EV charging station
- Solar inverter / ESS / UPS
- Industrial power supply

### Absolute Maximum Ratings ($T_C$ = 25℃ unless otherwise noted)

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain to Source Voltage | | 650 | V |
| $V_{GS}$ | Gate to Source Voltage (DC) | | -10 / +22 | V |
| $V_{GSop}$ | Recommended Operation Value | | -5 / +18 | V |
| $I_D$ | Drain Current | Continuous ($T_C$ = 25℃) | 84 | A |
| | | Continuous ($T_C$ = 100℃) | 60 | |
| $I_{DM}$ | Drain Current | Pulsed (Note1) | 225 | A |
| $P_D$ | Power Dissipation | ($T_C$ = 25℃) | 349 | W |
| | | Derate Above 25℃ | 2.33 | W/℃ |
| $T_J$, $T_{STG}$ | Operating and Storage Temperature Range | | -55 to 175 | ℃ |
| $T_L$ | Maximum Lead Temperature for Soldering, 1/8" from Case for 10 Seconds | | 260 | ℃ |

※Note 1 : Limited by maximum junction temperature.

### Thermal Characteristics

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case, Max. | 0.43 | ℃/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient, Max. | 40 | |

### Package Marking and Ordering Information

| Part Number | Top Marking | Package | Packing Method | Quantity |
|---|---|---|---|---|
| HCT65N27M1 | HCT65N27M1 | TOLL | Tape & Reel | 1000 units |

## Electrical Characteristics ($T_C$ = 25℃ unless otherwise noted)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain to Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 1 mA | 650 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | | 1 | 100 | μA |
| | | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V, $T_J$ = 175℃ | | 10 | | |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{GS}$ = +22 V, $V_{DS}$ = 0 V | | | +100 | nA |
| | | $V_{GS}$ = -10 V, $V_{DS}$ = 0 V | | | -100 | |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 11.7 mA (tested after $V_{GS}$ = 22V, 1 ms pulse) | 1.8 | 2.8 | 4.5 | V |
| $R_{DS(on)}$ | Static Drain to Source On Resistance | $V_{GS}$ = 18 V, $I_D$ = 35 A | | 27 | 38 | mΩ |
| | | $V_{GS}$ = 18 V, $I_D$ = 35 A, $T_J$ = 175℃ | | 35 | | |
| $g_{fs}$ | Transconductance | $V_{DS}$ = 20 V, $I_D$ = 35 A | | 25.9 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ = 400 V, $V_{GS}$ = 0V, f = 250 kHz | | 1853 | | pF |
| $C_{oss}$ | Output Capacitance | | | 207 | | |
| $C_{rss}$ | Reverse Capacitance | | | 10.5 | | |
| $E_{oss}$ | Stored Energy in Output Capacitance | $V_{DS}$ = 0 V to 400 V, $V_{GS}$ = 0 V | | 20.6 | | μJ |
| $C_{o(er)}$ | Energy Related Output Capacitance | | | 257 | | pF |
| $C_{o(tr)}$ | Time Related Output Capacitance | | | 372 | | |
| $Q_{g(tot)}$ | Total Gate Charge | $V_{DS}$ = 400 V, $I_D$ = 35 A, $V_{GS}$ = -5 V / 18 V, Inductive load | | 91 | | nC |
| $Q_{gs}$ | Gate to Source Charge | | | 25 | | |
| $Q_{gd}$ | Gate to Drain “Miller” Charge | | | 21 | | |
| $R_G$ | Internal Gate Resistance | f = 1MHz | | 3.0 | | Ω |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DS}$ = 400 V, $I_D$ = 35 A, $V_{GS}$ = -5 V / 18 V, $R_G$ = 5.6 Ω, FWD : HCH65S20D1, Inductive load | | 19 | | ns |
| $t_r$ | Turn-On Rise Time | | | 17 | | |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 40 | | |
| $t_f$ | Turn-Off Fall Time | | | 8 | | |
| $E_{on}$ | Turn-on Switching Energy | | | 65 | | μJ |
| $E_{off}$ | Turn-off Switching Energy | | | 105 | | |
| $E_{tot}$ | Total Switching Energy | | | 170 | | |
| **Source-Drain Diode Characteristics** | | | | | | |
| $I_S$ | Maximum Continuous Diode Forward Current | | | | 84 | A |
| $I_{SM}$ | Maximum Pulsed Diode Forward Current | | | | 225 | |
| $V_{SD}$ | Diode Forward Voltage | $V_{GS}$ = -5 V, $I_{SD}$ = 35 A | | 4.2 | | V |
| $t_{rr}$ | Reverse Recovery Time | $V_{DD}$ = 400 V, $I_{SD}$ = 35 A, $dI_F/dt$ = 1000 A/μs, Includes $Q_{OSS}$ | | 20 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 141 | | nC |
| $I_{rrm}$ | Peak Reverse Recovery Current | | | 11.5 | | A |

## Typical Performance Characteristics

**Figure 1. On-Region Characteristics** $T_J$ = -40℃

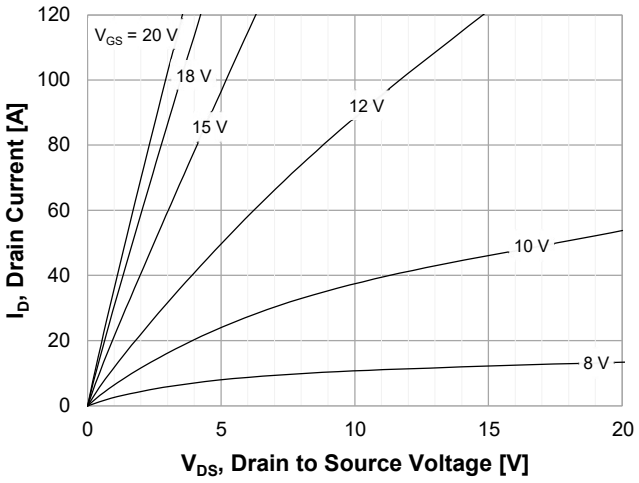



**Figure 2. On-Region Characteristics** $T_J$ = 25℃

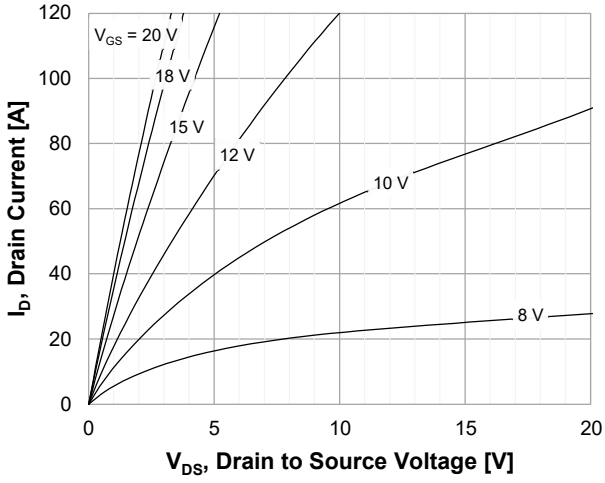



**Figure 3. On-Region Characteristics** $T_J$ = 125℃

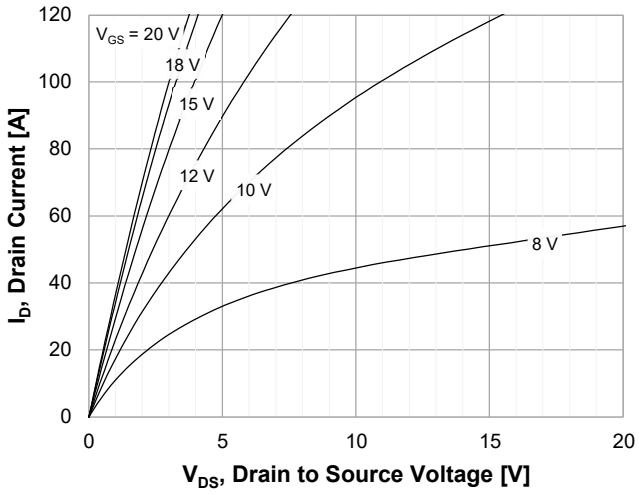



**Figure 4. On-Region Characteristics** $T_J$ = 175℃

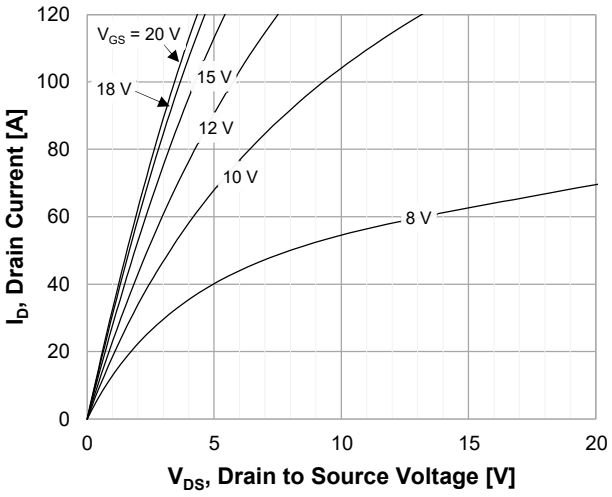



**Figure 5. On-Resistance Characteristics vs. Temperature**

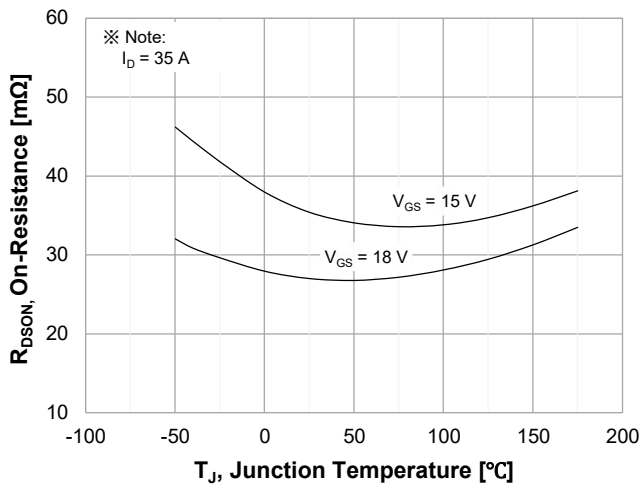
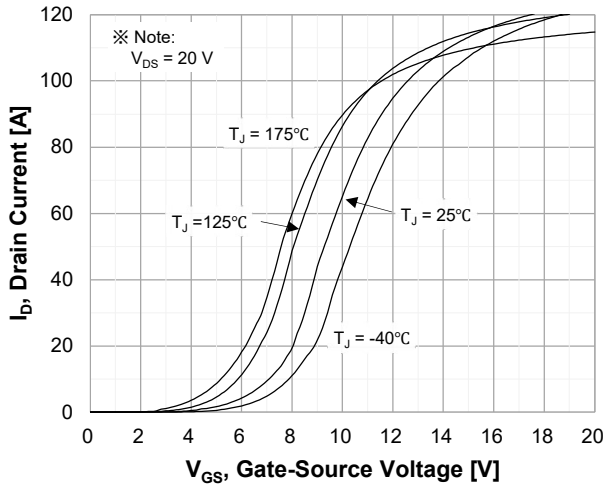



**Figure 6. Transfer Characteristics**



## Typical Performance Characteristics

**Figure 7. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J$ = -40℃**

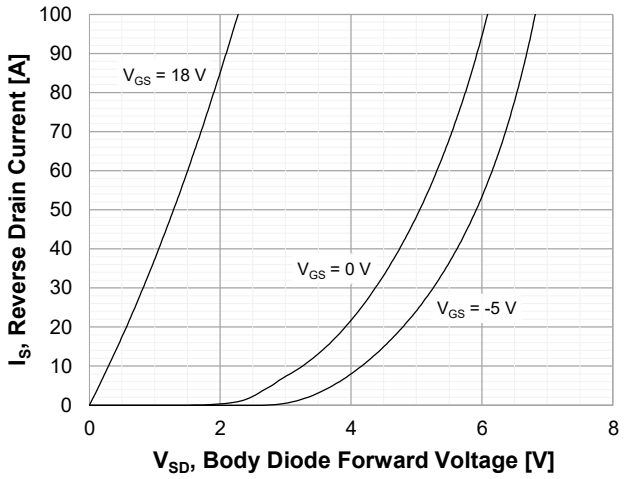



**Figure 8. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J$ = 25℃**

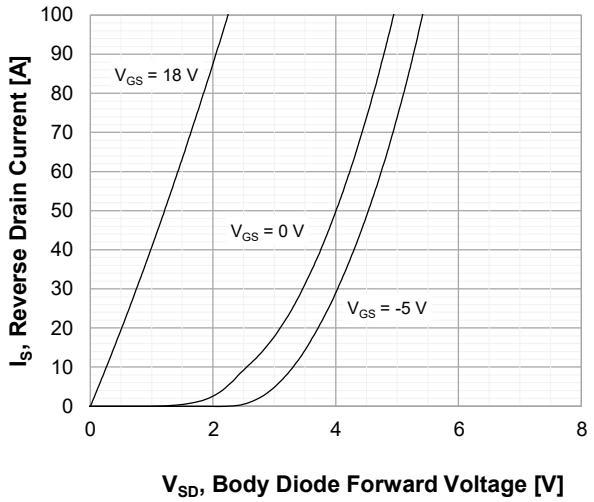



**Figure 9. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J$ = 125℃**

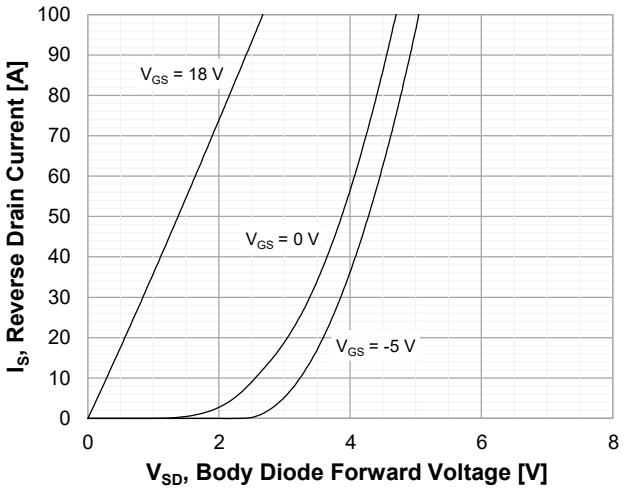



**Figure 10. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J$ = 175℃**

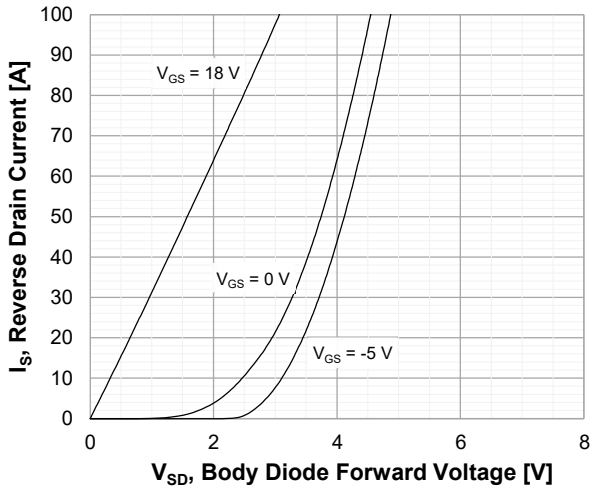



**Figure 11. Threshold Voltage vs. Temperature**

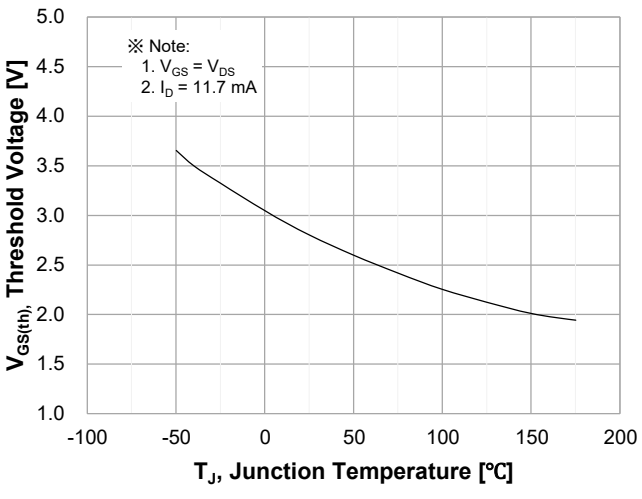
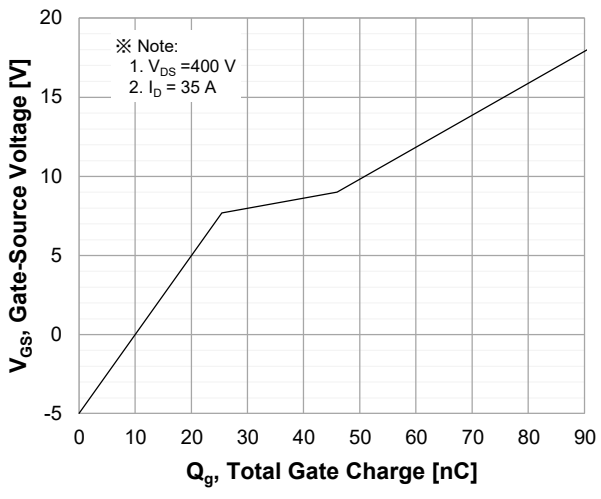



**Figure 12. Gate Charge Characteristics**



## Typical Performance Characteristics

**Figure 13. Stored Energy in Output Capacitance**

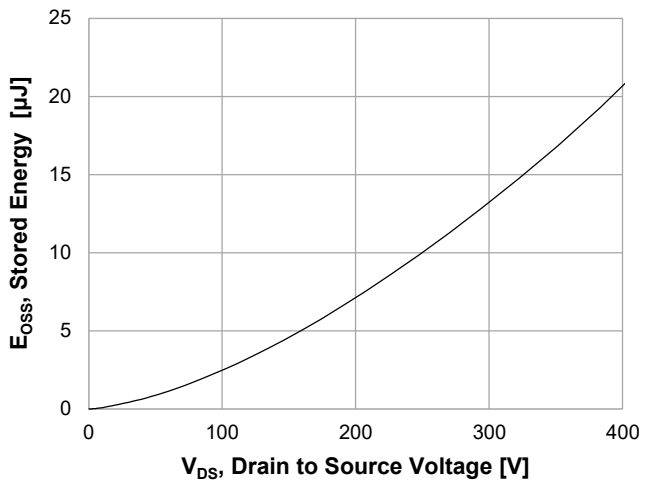



**Figure 14. Capacitance Characteristics**

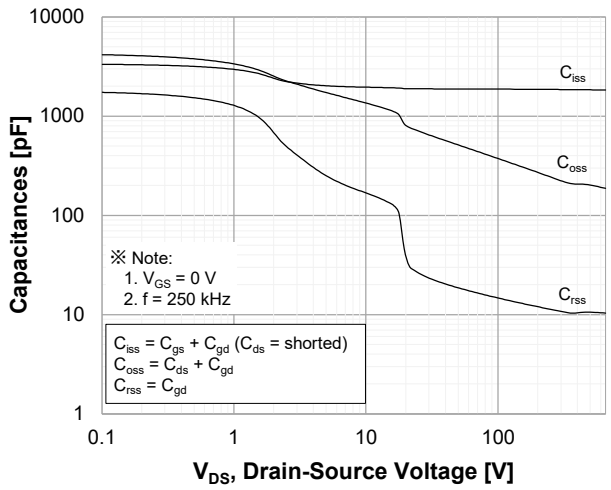



**Figure 15. Continuous Drain Current Derating vs. Case Temperature**

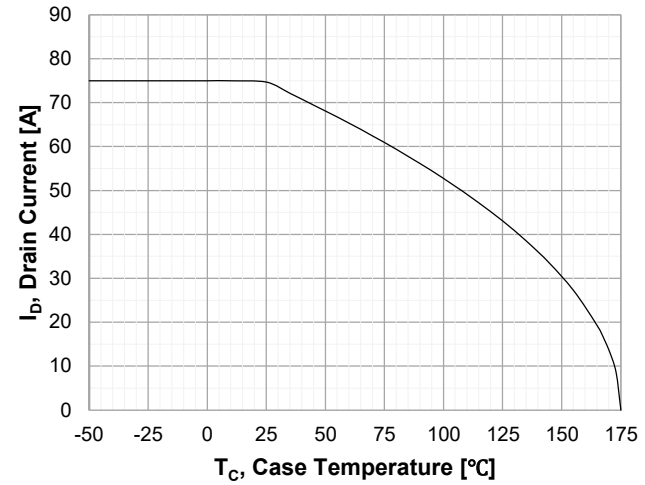



**Figure 16. Maximum Power Dissipation Derating vs. Case Temperature**

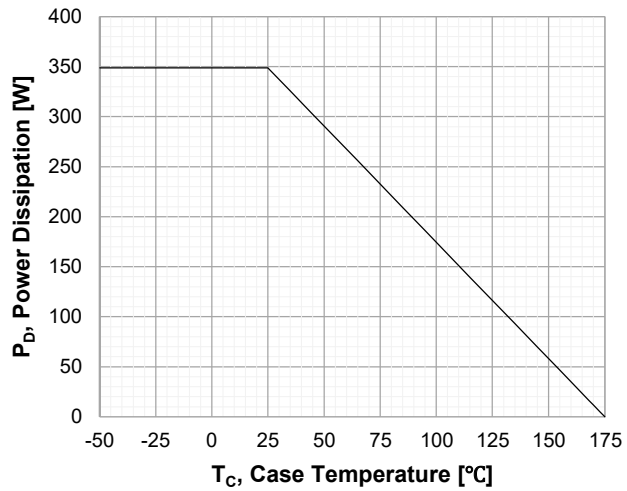



**Figure 17. Typ. Switching Losses vs. Drain Current**

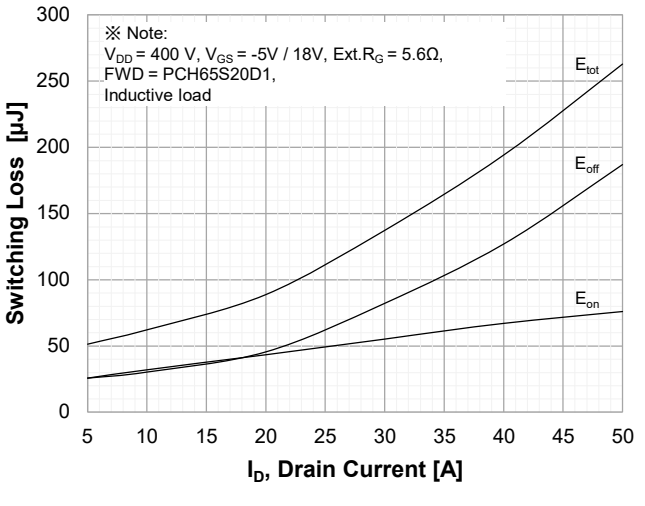
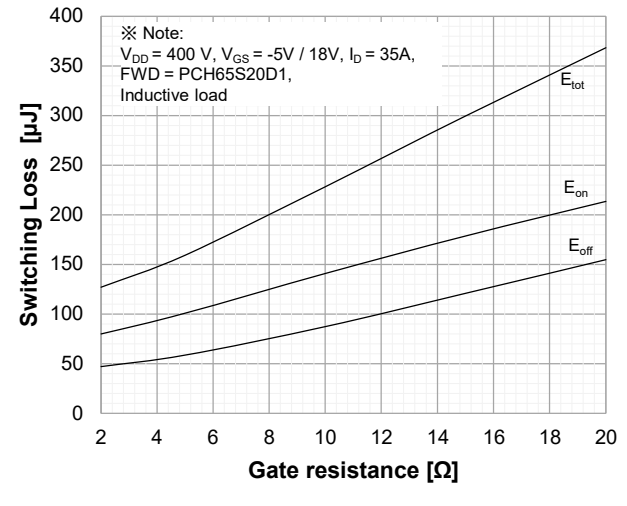



**Figure 18. Typ. Switching Losses vs. Gate Resistance**



## Typical Performance Characteristics

**Figure 19. Typ. Switching Losses vs. Drain Current**

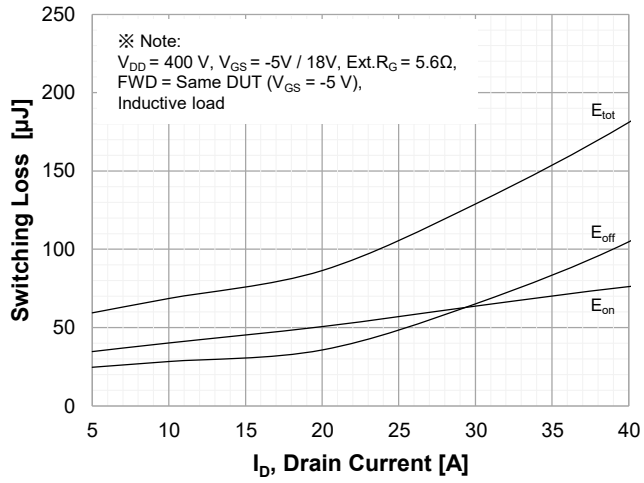



**Figure 20. Typ. Switching Losses vs. Gate Resistance**

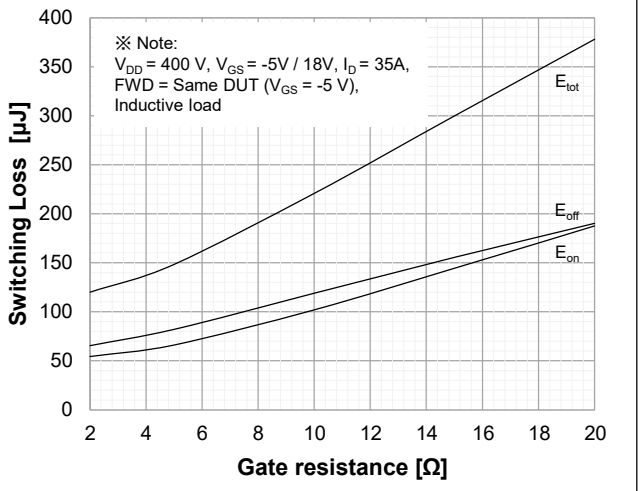



**Figure 21. Maximum Safe Operating Area**

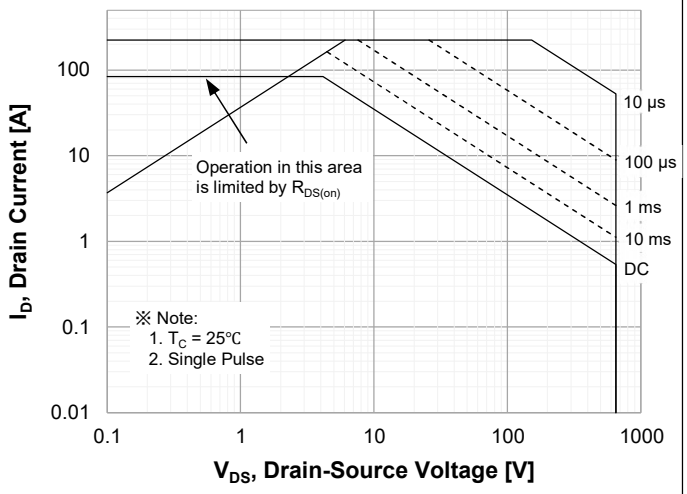
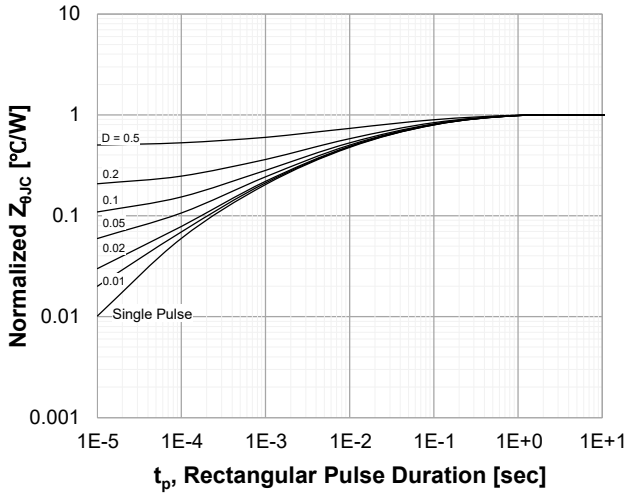



**Figure 22. Transient Thermal Response Curve**



## Typical Performance Characteristics

**Figure 23. Inductive Load Switching Test Circuit and Waveforms**

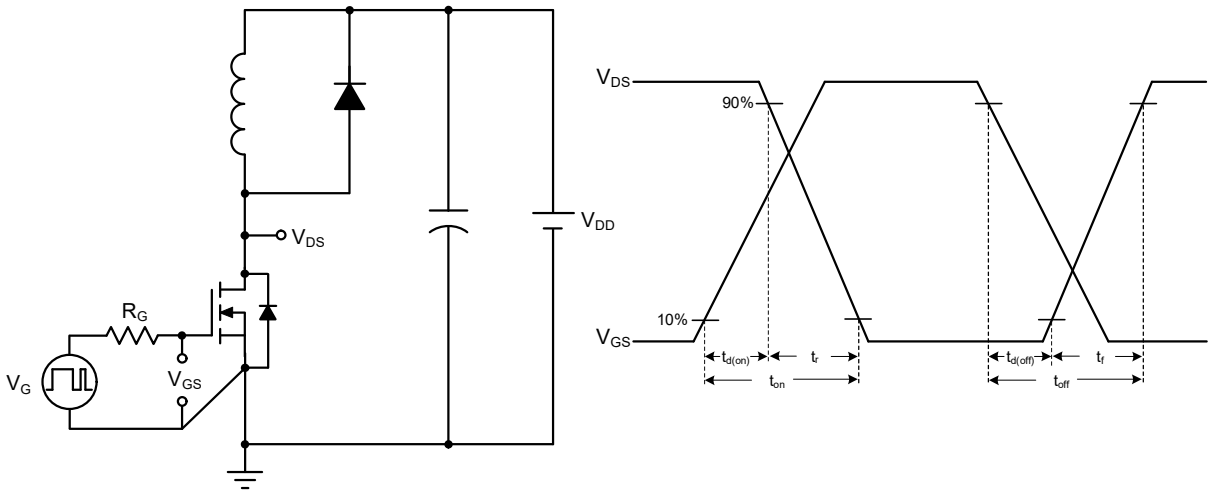
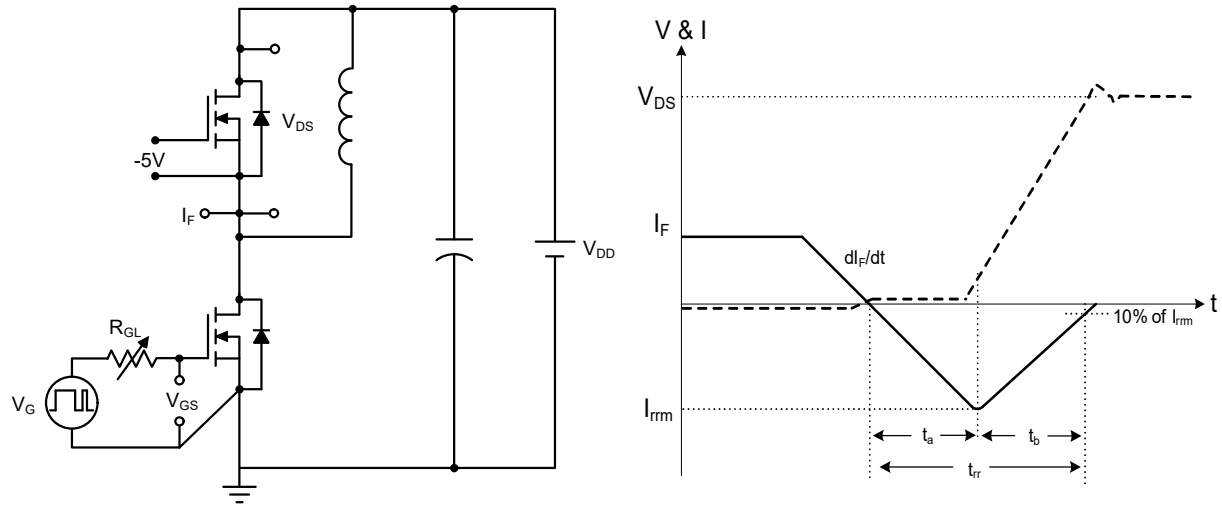
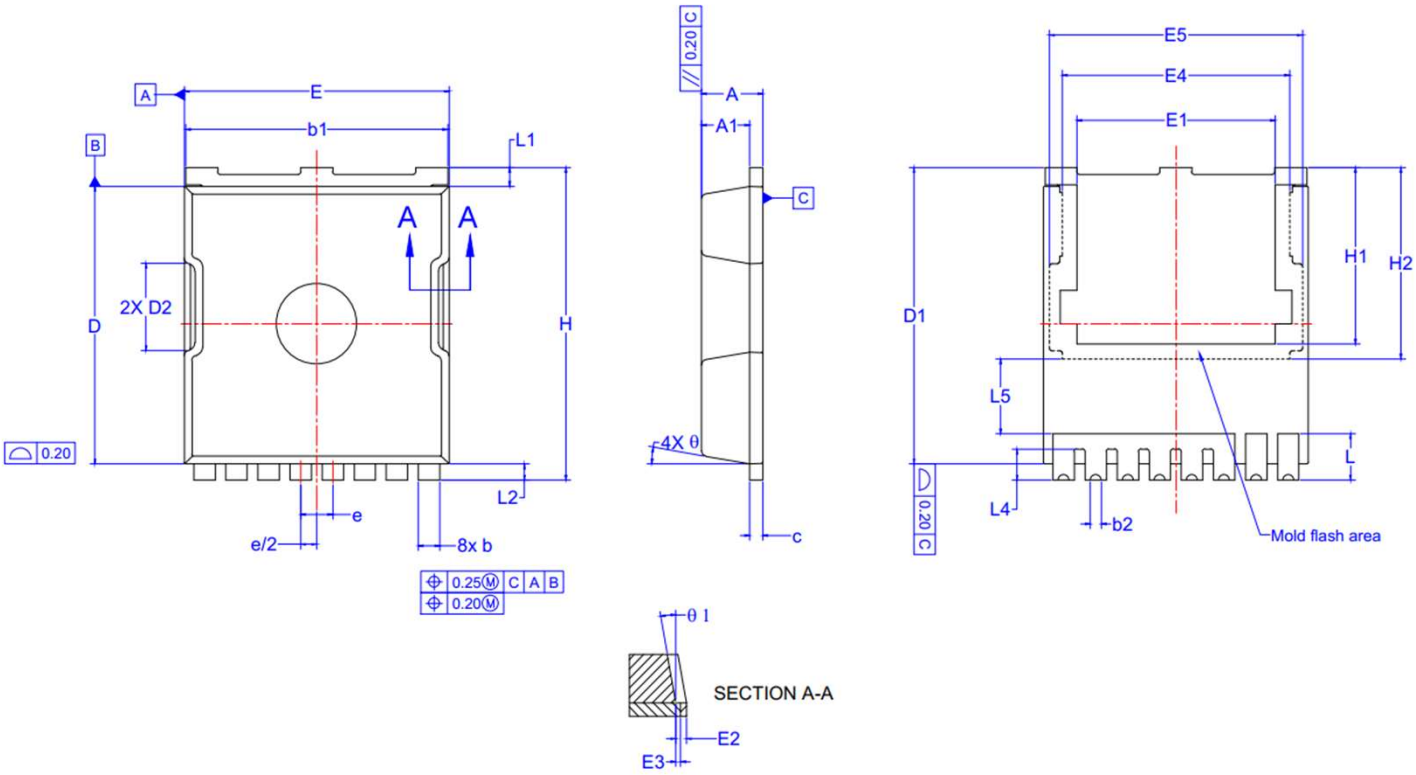



**Figure 24. Peak Diode Recovery dv/dt Test Circuit and Waveforms**



## Package Outlines

# TOLL




| SYMBOL | MIN. | NOM. | MAX. |
|---|---|---|---|
| A | 2.20 | 2.30 | 2.40 |
| A1 | 1.70 | 1.80 | 1.90 |
| b | 0.70 | 0.80 | 0.90 |
| b1 | 9.70 | 9.80 | 9.90 |
| b2 | 0.36 | 0.41 | 0.51 |
| c | 0.40 | 0.50 | 0.60 |
| D | 10.28 | 10.38 | 10.48 |
| D1 | 10.98 | 11.08 | 11.18 |
| D2 | | 3.30 | |
| E | 9.80 | 9.90 | 10.00 |
| E1 | 7.32 | 7.42 | 7.52 |
| E2 | 0.30 | 0.40 | 0.50 |
| E3 | 0.15 | 0.18 | 0.21 |
| E4 | | 8.50 | |
| E5 | | 9.46 | |
| e | | 1.20 BASIC | |
| H | 11.58 | 11.68 | 11.78 |
| H1 | 6.55 | 6.65 | 6.75 |
| H2 | 7.05 | 7.15 | 7.25 |
| L | 1.63 | 1.73 | 1.83 |
| L1 | 0.60 | 0.70 | 0.80 |
| L2 | 0.50 | 0.60 | 0.70 |
| L4 | 1.00 | 1.15 | 1.30 |
| L5 | 2.70 | 2.80 | 2.90 |
| N | | 8 | |
| θ | | 10° REF. | |
| θ1 | | 10° REF. | |

* Dimensions in millimeters