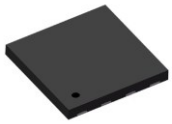
# Enhancement-mode 650V 140mΩ (Typ) GaN Power Transistor

## 1 FEATURES

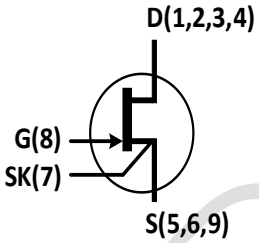
- Enhancement mode transistor
- Ultra-fast switching on/off
- Low gate charge, low output charge
- No reverse recovery charge

## 2 APPLICATIONS

- AC-DC, DC-DC
- Buck, boost, half bridge, full bridge
- Active Clamp Flyback, LLC resonant
- Mobile fast-chargers, adapters
- Notebook adaptors
- LED lighting, solar micro-inverters
- TV / monitor, wireless power
- Server, telecom & networking SMPS



PDFN8*8-9L




## 3 ORDERING INFORMATION

| TYPE | MARKING | PACKAGE |
|---|---|---|
| GBG65200NMAR | 65200 | PDFN8*8 |

## 4 DISCRIPTION

The GBG65200 is enhancement-mode normally-off Gallium Nitride (GaN) field effect transistors with very fast switching and no reverse recovery charge. It offer best-in-class performance and outstanding reliability. The GBG65200 is available in PDFN8*8-9L package.

## 5 KEY PERFORMANCE PARAMETERS

| PARAMETER | VALUE | UNIT |
|---|---|---|
| $V_{DS}$ max@ Tj=25 | 650 | V |
| $R_{DS-ON}$ max @Vgs=6V | 180 | mΩ |
| $Q_g$ (Typ) | 1.9 | nC |
| $I_{D-pulse}$ | 21 | A |
| Qoss@400V | 21 | nC |
| Qrr@400V | 0 | nC |

# 6 SPECIFICATIONS

## 6.1 ABSOLUTE MAXIMUM RATINGS

$T_J$=25°C operating free-air temperature unless otherwise noted

| SYMBOL | PARAMETER | TEST CONDITION | VALUE | | | UNIT |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $V_{DS, max}$ | Drain-source voltage, continuous | $V_{GS}$=0V | | | 650 | V |
| $V_{DS, bd}$ | Drain source destructive breakdown voltage | $V_{GS}$ = 0 V, $I_{DS}$ = 4.3 mA | 800 | | | V |
| $V_{DS, pulse}$ | Drain source voltage, pulsed | $T_j$ = 25 °C; $V_{GS}$ ≤ 0 V; ≤1 hour of total time | | | 750 | V |
| | | $T_j$ = 125 °C, $V_{GS}$ ≤ 0 V; ≤1 hour of total time | | | 650 | V |
| $V_{DS, surge}$ | Switching surge voltage, pulsed [2] | DC bus voltage = 700 V; turn off $V_{DS, pulse}$ = 750 V; turn on $I_{D, pulse}$ = 10 A; $T_j$ = 105 °C; f ≤ 100 kHz, t ≤ 100 secs (10 million pulses) | | | 750 | V |
| $I_D$ | Continuous drain current | $T_j$=25°C | | | 11 | A |
| | | $T_j$=125°C | | | 6 | |
| $I_{D-pulse}$ | Pulsed drain current | $T_j$=25°C | | | 20 | A |
| | | $T_j$=125°C | | | 11 | A |
| $V_{GS}$ | Gate-source voltage, continuous | $T_j$=-55℃ to 125°C | -1.4 | | 7 | V |
| $V_{GS}$ | Gate-source voltage, continuous | $T_j$ = -55 °C to 150 °C; $t_{PULSE}$ = 50 ns, f = 100 kHz; open drain | -20 | | 10 | V |
| $P_D$ | Power dissipation | $T_j$ = 25 °C | | | 83 | W |
| dv/dt | Drain-source voltage slew-rate | | | | 46 | V/ns |
| $T_j$ | Operating junction temperature | | -55 | | 150 | °C |
| $T_{stg}$ | Storage temperature | | -55 | | 150 | °C |



## 6.2 THERMAL INFORMATION

| SYMBOL | PARAMETER | VALUE | UNIT |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal resistance, junction - case | 1.5 | °C/W |
| $R_{\theta JA\ max.}$ | Max. Thermal resistance, junction - ambient | 33.6 | °C/W |
| $T_{sold}$ | Soldering temperature | 260 | °C |

## 6.3 ELECTRICAL CHARACTERISTICS

$T_J$=25°C operating free-air temperature unless otherwise noted

| SYMBOL | PARAMETER | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **STATIC CHARACTERISTICS** | | | | | | |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$=10V, $I_D$=12mA, $T_j$ =25 °C | 0.9 | 1.4 | 1.9 | V |
| | | $V_{DS}$=10V, $I_D$=1mA, $T_j$=125 °C | | 1.8 | | V |
| $R_{DS-ON}$ | Drain-source on state resistance | $V_{GS}$=6V, $I_D$=4A, $T_j$=25℃ | | 140 | 190 | mΩ |
| | | $V_{GS}$=6V, $I_D$=4A, $T_j$=150℃ | | 345 | | |
| $I_{GSS}$ | Gate-source leakage current | $V_{GS}$=6V, $V_{DS}$=0V | | 10 | | nA |
| $I_{DSS}$ | Drain-source leakage current | $V_{DS}$=650V; $V_{GS}$=0V; $T_j$=25 °C | | 0.3 | 1 | uA |
| | | $V_{DS}$=650V; $V_{GS}$=0V; $T_j$=150 °C | | 8 | | |
| Rg | Gate resistance | F=1MHz, open drain | | 3 | | Ω |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input capacitance | $V_{GS}$=0V $V_{DS}$=400V, f=100KHz | | 68 | | pF |
| $C_{oss}$ | Output capacitance | | | 30 | | pF |
| $C_{rss}$ | Reverse transfer capacitance | | | 0.8 | | pF |
| $C_o$(er) | Effective output capacitance, energy related | $V_{GS}$ = 0V, $V_{DS}$ = 0V~400V | | 34 | | pF |
| $C_o$(tr) | Effective output capacitance, | | | 45 | | pF |



| SYMBOL | PARAMETER | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| | time related | | | | | |
| $Q_{oss}$ | Output charge | $V_{DS}$ = 0V~400V | | 21 | | nC |
| $t_{d(on)}$ | Turn-on delay time | $V_{GS}$=6V, $V_{DS}$=400V, $I_D$=5A, $R_{on}$=10Ω, $R_{off}$=10Ω | | 5.5 | | ns |
| $t_r$ | Rise time | | | 4.5 | | ns |
| $t_{d(off)}$ | Turn-off delay time | | | 4.5 | | ns |
| $t_f$ | Fall time | | | 8 | | ns |
| **GATE CHARGE CHARACTERISTICS** | | | | | | |
| $Q_g$ | Gate charge total | $V_{DS}$=400V, $I_D$=5A $V_{GS}$=0~6V | | 1.9 | | nC |
| $Q_{gd}$ | Gate to drain charge | | | 1.0 | | nC |
| $Q_{gs}$ | Gate to source charge | | | 0.3 | | nC |
| $V_{plateau}$ | Gate plateau voltage | | | 2.8 | | V |
| **REVERSE CONDUCTION CHARACTERISTICS** | | | | | | |
| $V_{SD}$ | Source-drain reverse voltage | $V_{GS}$=0V, $I_{SD}$=5A | | 3.0 | 3.5 | V |
| $I_{S,\ pulse}$ | Pulsed current, reverse | $V_{GS}$=6V; $t_{PULSE}$=10μs | | | 20 | A |
| $t_{rr}$ | Reverse recovery time | $I_{SD}$=5A, $V_{DS}$=400V | | 0 | | ns |
| $Q_{rr}$ | Reverse recovery charge | | | 0 | | nC |
| $I_{rrm}$ | Peak reverse recovery current | | | 0 | | A |



# 7 Electrical Characteristic Diagram

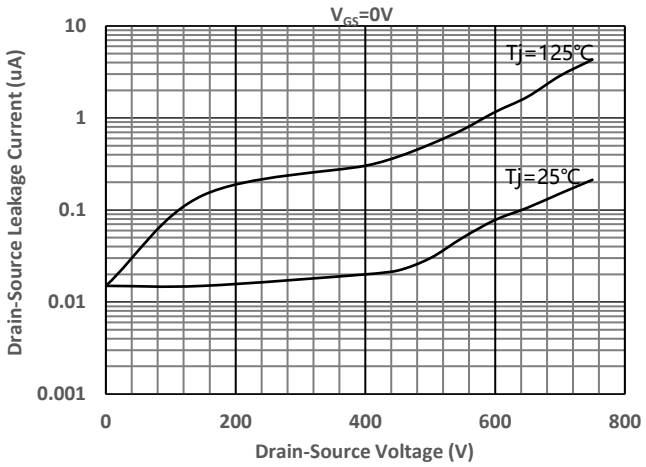



**Figure 1. Drain-source Leakage Current**

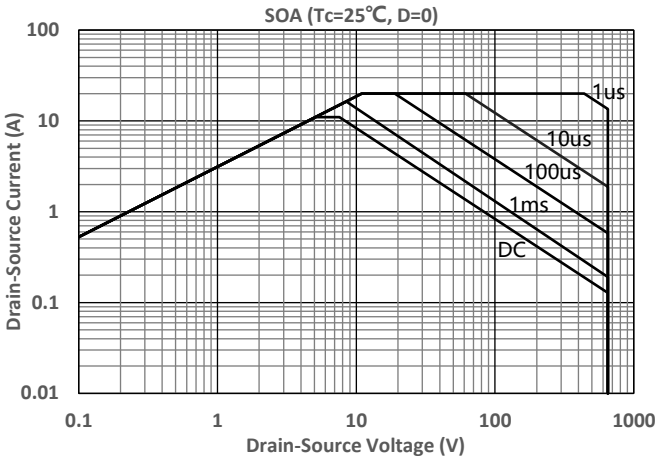



**Figure 2. Safety Operating Area**

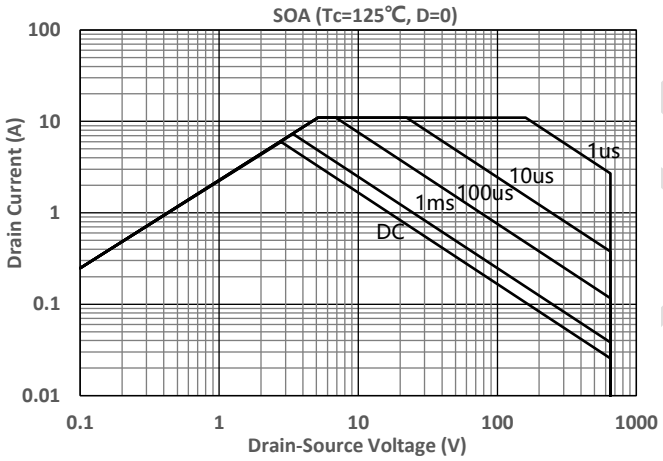



**Figure 3. Safety Operating Area(Ta=125℃)**

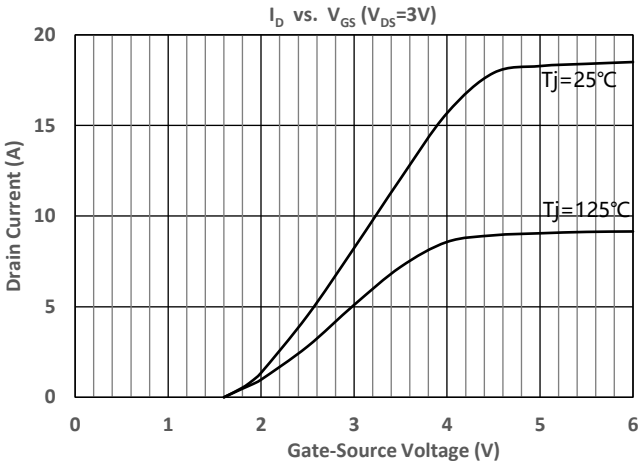



**Figure 4. Typ. Transfer Characteristics**

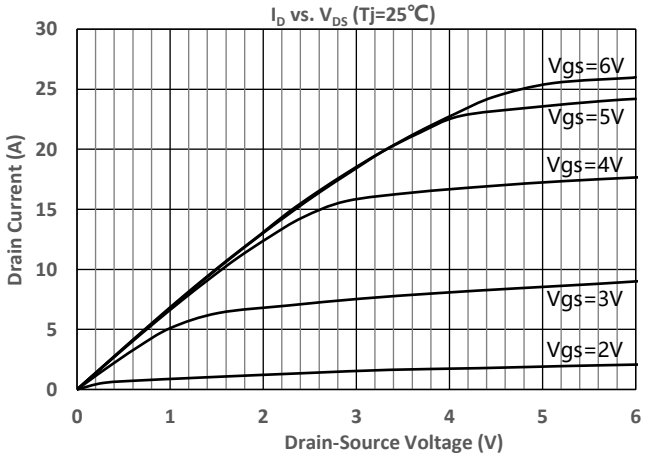



**Figure 5. Typ. Output Characteristics**

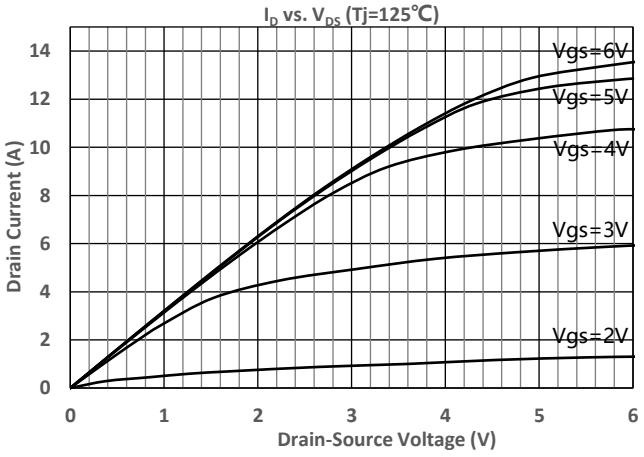



**Figure 6. Typ. Output Characteristics**

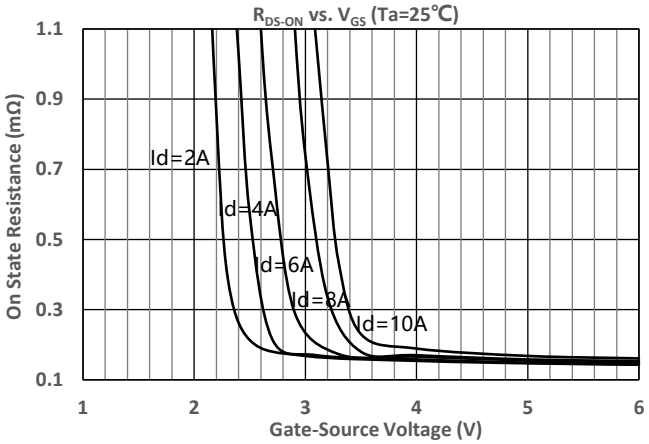



**Figure 7. Typ. Drain Source On-state Resistance**

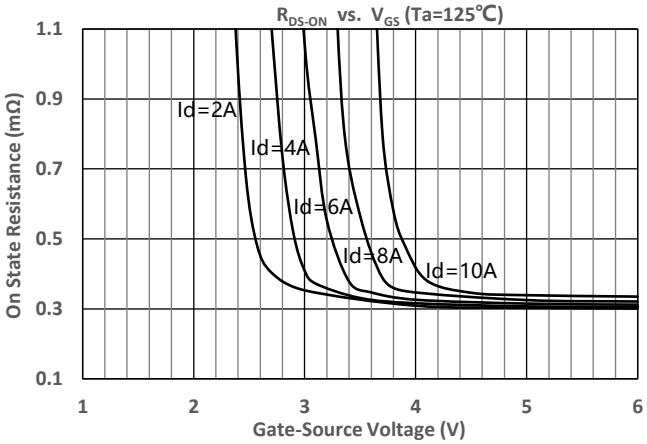



**Figure 8. Typ. Drain Source On-state Resistance**

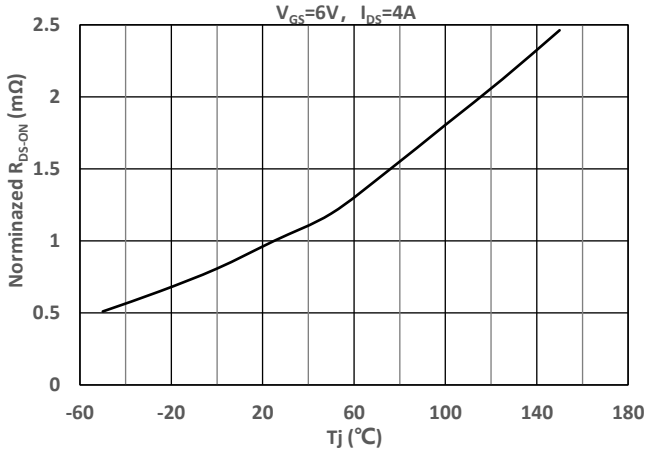



**Figure 9. $R_{DS-ON}$ vs. Tj**

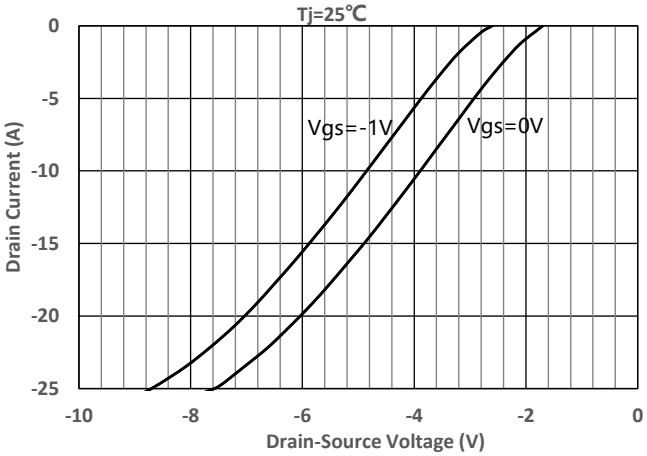



**Figure 10. Typ. Channel reverse characteristics**

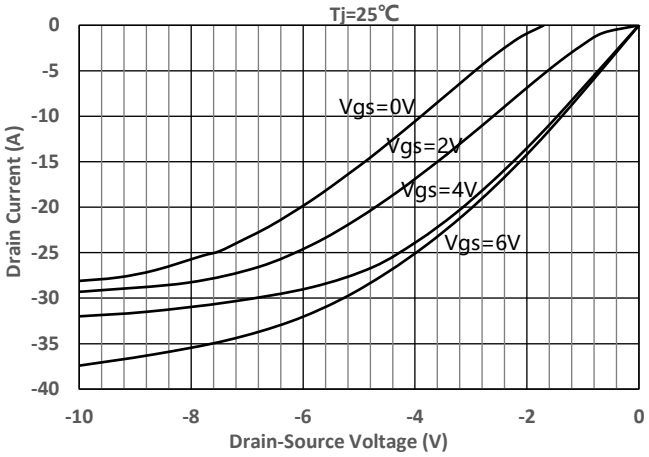



**Figure 11. Typ. Channel reverse characteristics**

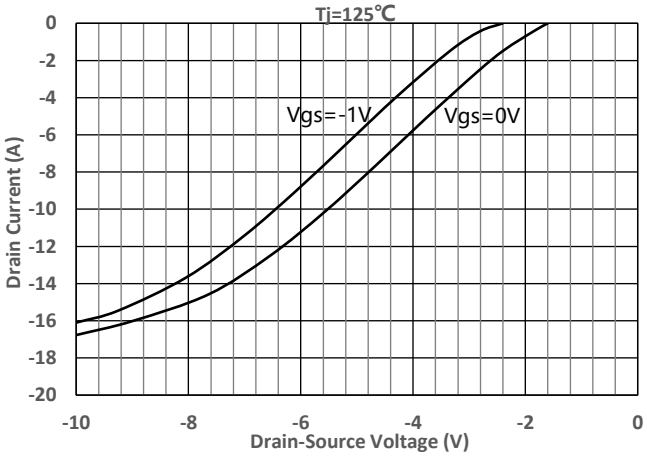



**Figure 12. Typ. Channel reverse characteristics**

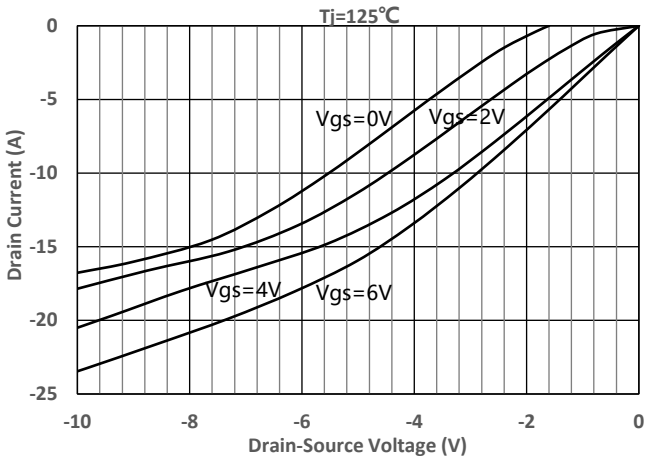



**Figure 13. Typ. Channel reverse characteristics**

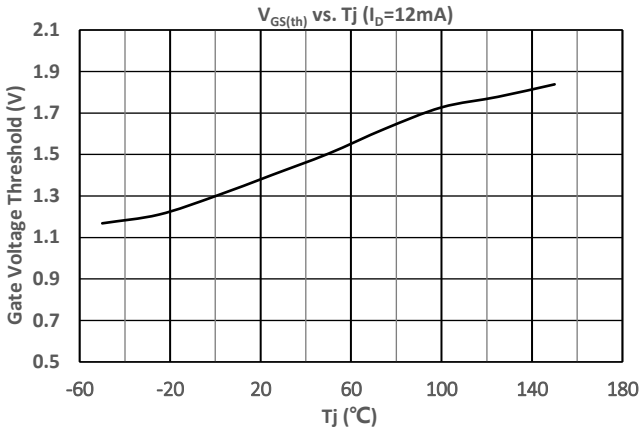



**Figure 14. Threshold Voltage vs. Tj**

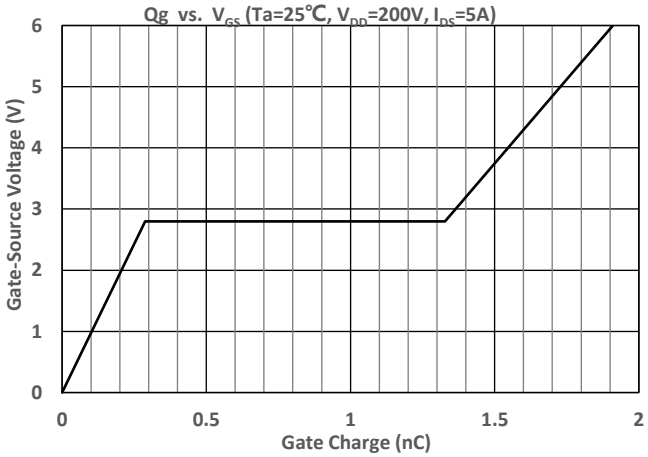



**Figure 15. Typ. Gate Charge**

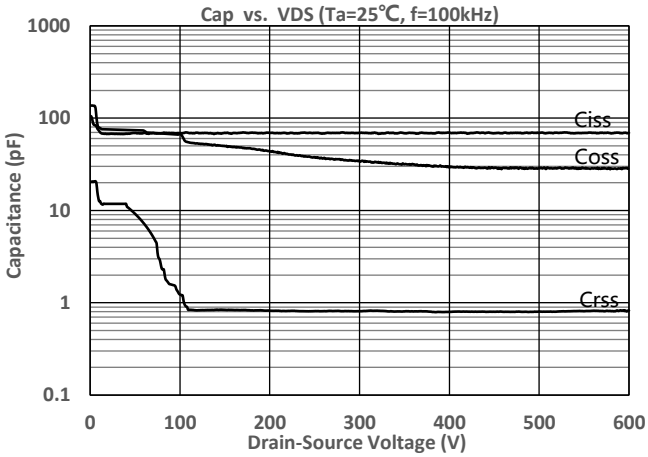



**Figure 16. Typ. Capacitance**

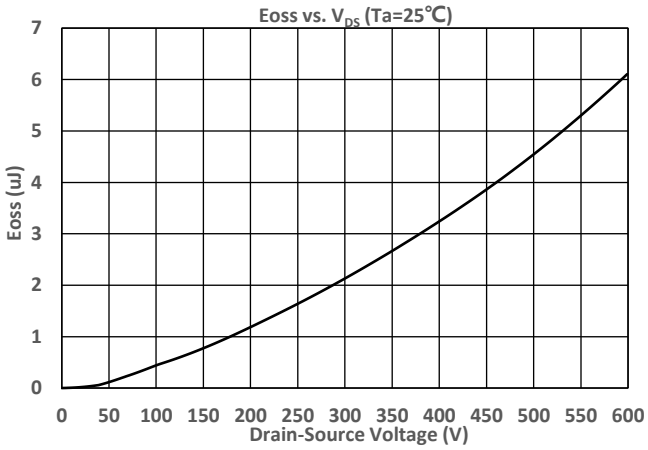



**Figure 17. Typ. Coss Stored Energy**

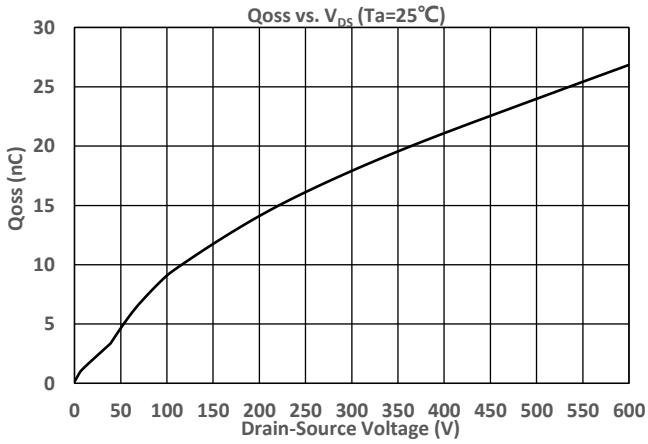



**Figure 18. Typ. output charge**

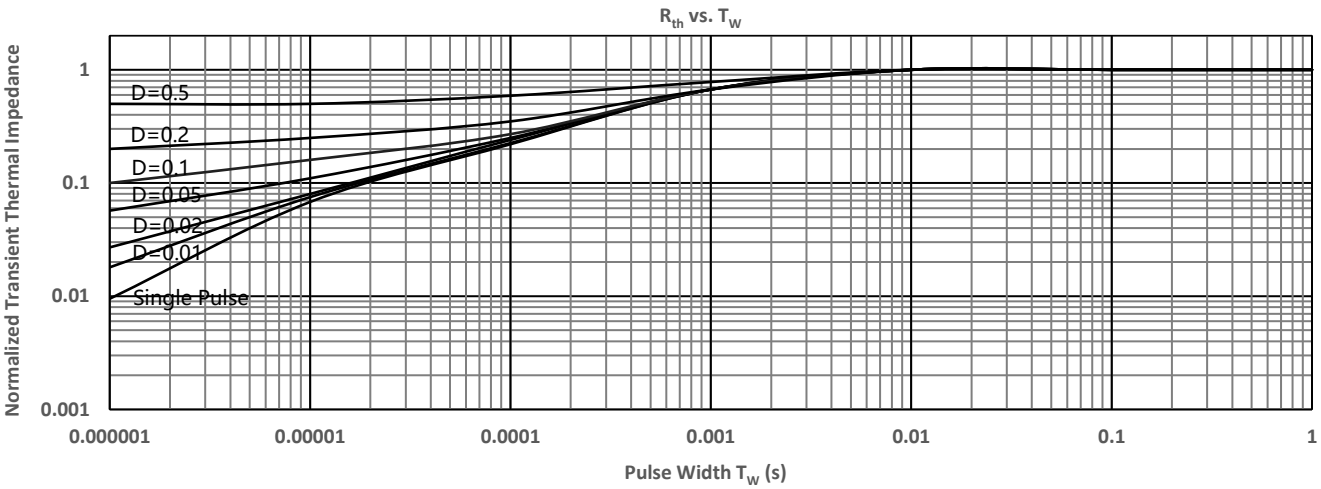



**Figure 19. $R_{th}$ vs. $T_w$**



## 8 Test Circuit

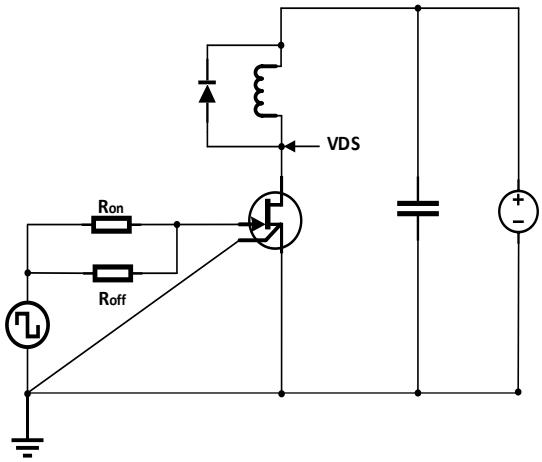
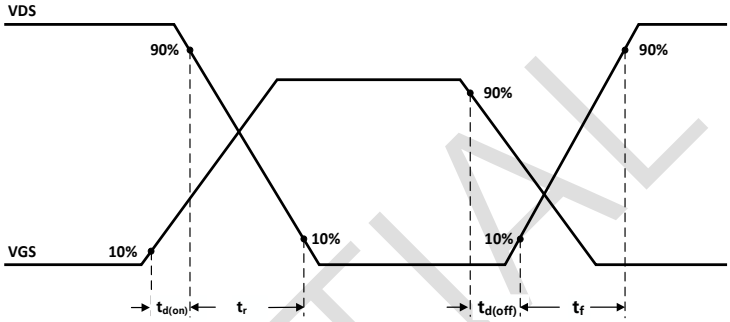



**Figure 20. Switching time test circuit**

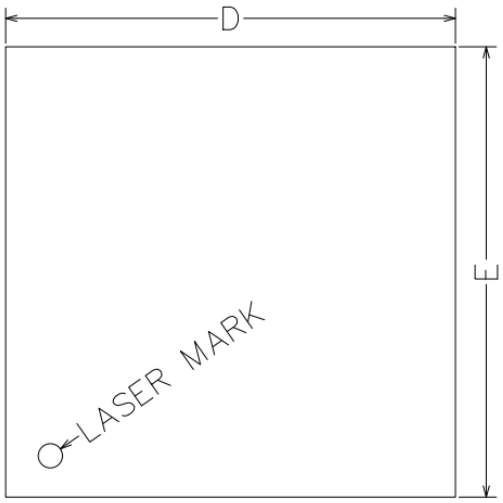



**Waveform 1. Switching time waveform**

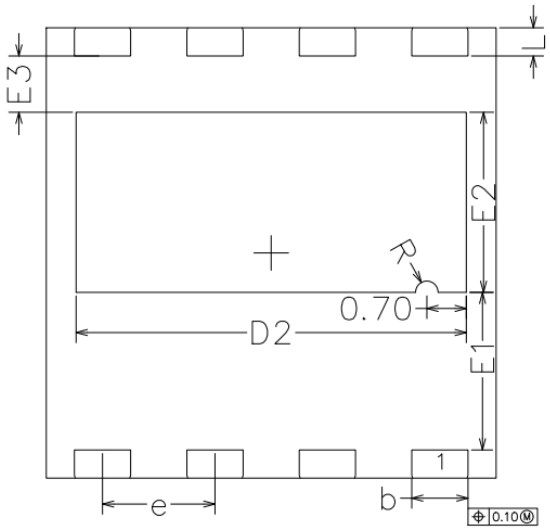


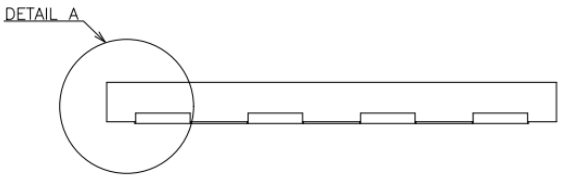
## PACKAGE INFORMATION



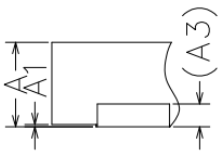

TOP VIEW




BOTTOM VIEW




SIDE VIEW




DETAIL A

| SYMBOL | mm | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 0.80 | 0.85 | 0.90 |
| A1 | 0.00 | 0.02 | 0.05 |
| A3 | | 0.20REF | |
| b | 0.90 | 1.00 | 1.10 |
| D | 7.90 | 8.00 | 8.10 |
| E | 7.90 | 8.00 | 8.10 |
| D2 | 6.84 | 6.94 | 7.04 |
| E2 | 3.10 | 3.20 | 3.30 |
| e | | 2.00BSC | |
| R | | 0.20REF | |
| E1 | 2.70 | 2.80 | 2.90 |
| E3 | 0.90 | 1.00 | 1.10 |
| L | 0.40 | 0.50 | 0.60 |