



650V N-Channel MOSFET

Lead Free Package and Finish

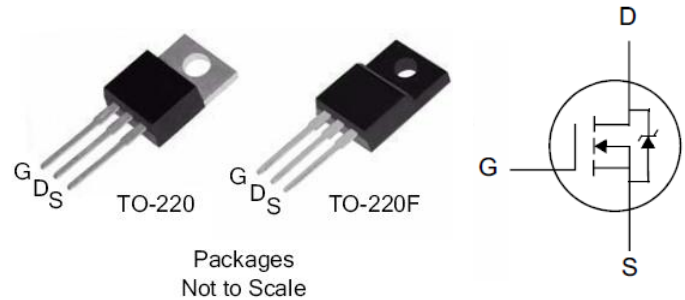
General Features

- Proprietary New Planar Technology
- $R_{DS(ON),typ.}=0.36\ \Omega @ V_{GS}=10V$
- Low Gate Charge Minimize Switching Loss
- Fast Recovery Body Diode

| | | |
|------------|-------------------|-------|
| BV_{DSS} | $R_{DS(ON),typ.}$ | I_D |
| 650V | 0.36 Ω | 20A |

Applications

- Adaptor
- TV Main Power
- SMPS Power Supply
- LCD Panel Power



Ordering Information

| Part Number | Package | Brand |
|-------------|---------|-------|
| PTP20N65 | TO-220 | |
| PTA20N65 | TO-220F | |

Absolute Maximum Ratings

$T_C=25^\circ\text{C}$ unless otherwise specified

| Symbol | Parameter | PTP20N65 | PTA20N65 | Unit |
|-------------------------------|--|------------|----------|---------------------|
| V_{DSS} | Drain-to-Source Voltage ^[1] | 650 | | V |
| V_{GSS} | Gate-to-Source Voltage | ± 30 | | |
| I_D | Continuous Drain Current | 20 | | A |
| $I_D @ T_C=100^\circ\text{C}$ | Continuous Drain Current @ $T_C=100^\circ\text{C}$ | Figure 3 | | |
| I_{DM} | Pulsed Drain Current at $V_{GS}=10V$ ^[2] | Figure 6 | | |
| E_{AS} | Single Pulse Avalanche Energy | 550 | | mJ |
| dv/dt | Peak Diode Recovery dv/dt ^[3] | 5.0 | | V/ns |
| P_D | Power Dissipation | 160 | 65 | W |
| | Derating Factor above 25°C | 1.28 | 0.52 | W/ $^\circ\text{C}$ |
| T_L T_{PAK} | Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10 seconds, Package Body for 10 seconds | 300 260 | | $^\circ\text{C}$ |
| T_J & T_{STG} | Operating and Storage Temperature Range | -55 to 150 | | |

Caution: Stresses greater than those listed in the "Absolute Maximum Ratings" may cause permanent damage to the device.

Thermal Characteristics

| Symbol | Parameter | PTP20N65 | PTA20N65 | Unit |
|-----------------|---|----------|----------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 0.78 | 1.92 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 62 | 100 | |



Electrical Characteristics

OFF Characteristics $T_J = 25^\circ\text{C}$ unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|------------|-----------------------------------|------|------|------|---------|---|
| BV_{DSS} | Drain-to-Source Breakdown Voltage | 650 | -- | -- | V | $V_{GS}=0V, I_D=250\mu A$ |
| I_{DSS} | Drain-to-Source Leakage Current | -- | -- | 1 | μA | $V_{DS}=650V, V_{GS}=0V$ |
| | | -- | -- | 100 | | $V_{DS}=520V, V_{GS}=0V, T_J=125^\circ\text{C}$ |
| I_{GSS} | Gate-to-Source Leakage Current | -- | -- | +100 | nA | $V_{GS}=+30V, V_{DS}=0V$ |
| | | -- | -- | -100 | | $V_{GS}=-30V, V_{DS}=0V$ |

ON Characteristics

$T_J = 25^\circ\text{C}$ unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|--------------|---|------|------|------|----------|-------------------------------|
| $R_{DS(ON)}$ | Static Drain-to-Source On-Resistance ^[4] | -- | 0.36 | 0.50 | Ω | $V_{GS}=10V, I_D=10A$ |
| $V_{GS(TH)}$ | Gate Threshold Voltage | 2.0 | -- | 4.0 | V | $V_{DS}=V_{GS}, I_D=250\mu A$ |
| gfs | Forward Transconductance ^[4] | -- | 15 | -- | S | $V_{DS}=15V, I_D=10A$ |

Dynamic Characteristics

Essentially independent of operating temperature

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|-----------|-------------------------------|------|------|------|------|--|
| C_{iss} | Input Capacitance | -- | 2400 | -- | pF | $V_{GS}=0V, V_{DS}=25V, f=1.0MHz$ |
| C_{rss} | Reverse Transfer Capacitance | -- | 105 | -- | | |
| C_{oss} | Output Capacitance | -- | 225 | -- | | |
| Q_g | Total Gate Charge | -- | 65 | -- | nC | $V_{DD}=325V, I_D=20A, V_{GS}=0 \text{ to } 10V$ |
| Q_{gs} | Gate-to-Source Charge | -- | 11 | -- | | |
| Q_{gd} | Gate-to-Drain (Miller) Charge | -- | 26 | -- | | |

Resistive Switching Characteristics

Essentially independent of operating temperature

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|--------------|---------------------|------|------|------|------|--|
| $t_{d(ON)}$ | Turn-on Delay Time | -- | 35 | -- | nS | $V_{DD}=325V, I_D=20A, V_{GS}=10V, R_G=25\Omega$ |
| t_{rise} | Rise Time | -- | 82 | -- | | |
| $t_{d(OFF)}$ | Turn-Off Delay Time | -- | 180 | -- | | |
| t_{fall} | Fall Time | -- | 90 | -- | | |



Source-Drain Body Diode Characteristics

$T_J=25^{\circ}\text{C}$ unless otherwise specified

| Symbol | Parameter | Min | Typ. | Max. | Unit | Test Conditions |
|----------|--|-----|------|------|------|--|
| I_{SD} | Continuous Source Current ^[4] | -- | -- | 20 | A | Integral PN-diode in MOSFET |
| I_{SM} | Pulsed Source Current ^[4] | -- | -- | 80 | | |
| V_{SD} | Diode Forward Voltage | -- | -- | 1.5 | V | $I_S=20\text{A}$, $V_{GS}=0\text{V}$ |
| trr | Reverse recovery time | -- | 390 | -- | ns | $V_{GS}=0\text{V}$, $I_F=20\text{A}$, $di_F/dt=100\text{A}/\mu\text{s}$ |
| Qrr | Reverse recovery charge | -- | 3.4 | -- | uC | |

Note:

- [1] $T_J=+25^{\circ}\text{C}$ to $+150^{\circ}\text{C}$
[2] Repetitive rating; pulse width limited by maximum junction temperature.
[3] $I_{SD}=20\text{A}$ $di/dt < 100\text{A}/\mu\text{s}$, $V_{DD} < BV_{DSS}$, $T_J=+150^{\circ}\text{C}$.
[4] Pulse width $\leq 380\mu\text{s}$; duty cycle $\leq 2\%$.



Typical Characteristics

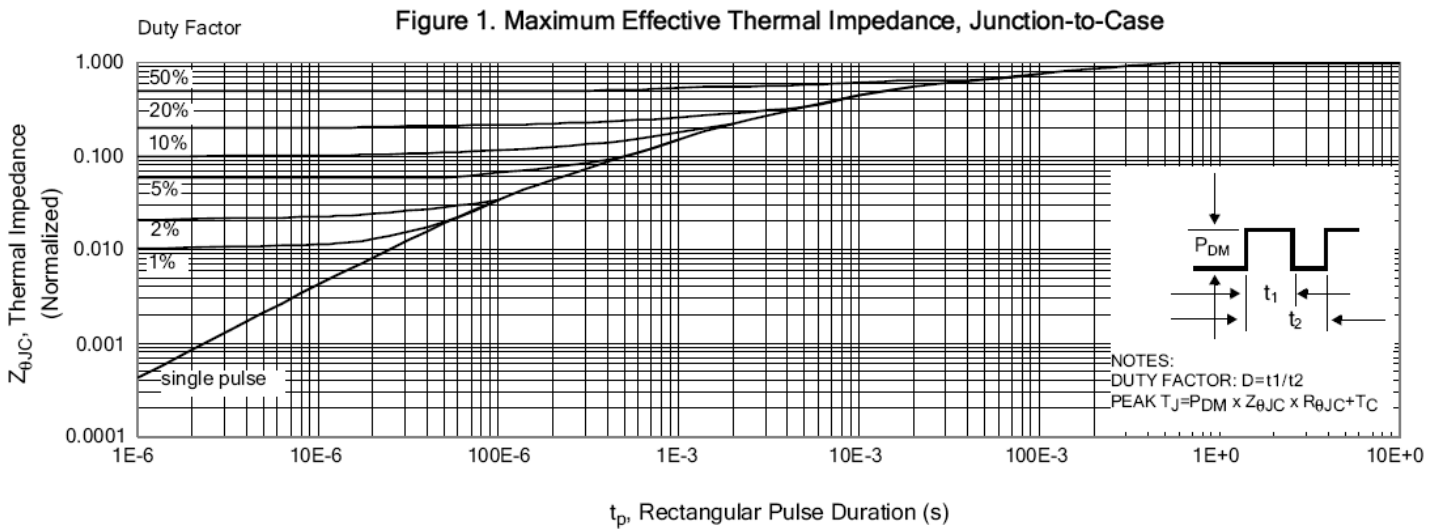


Figure 2. Maximum Power Dissipation vs Case Temperature

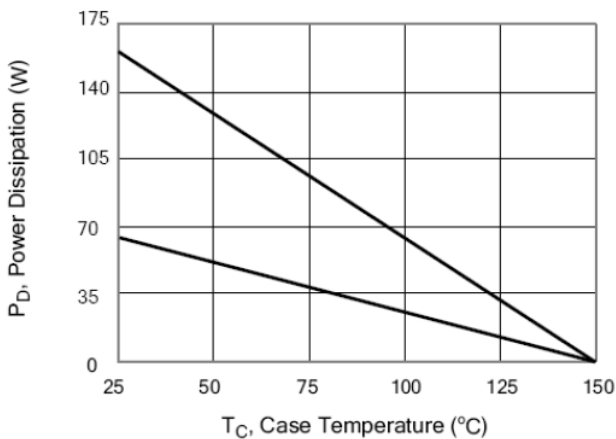


Figure 4. Typical Output Characteristics

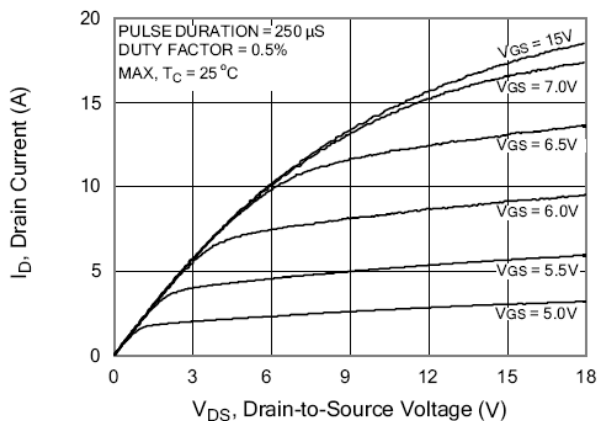


Figure 3. Maximum Continuous Drain Current vs Case Temperature

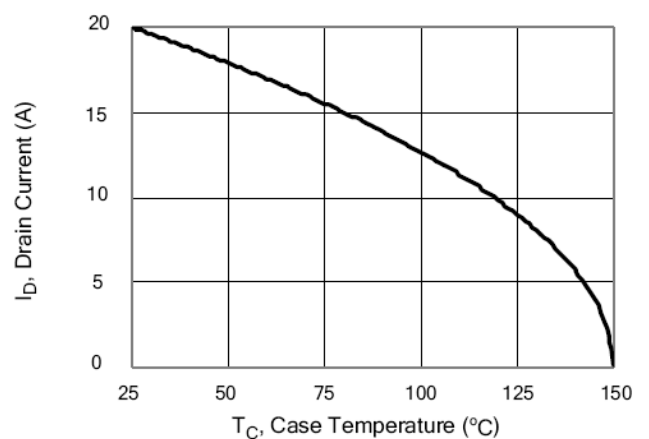
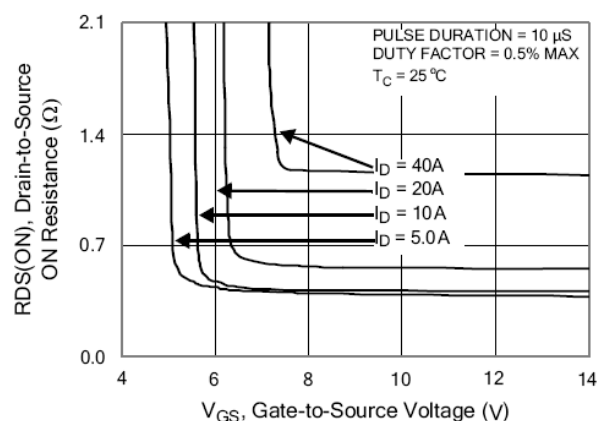


Figure 5. Typical Drain-to-Source ON Resistance vs Gate Voltage and Drain Current





Typical Characteristics(Cont.)

Figure 6. Maximum Peak Current Capability

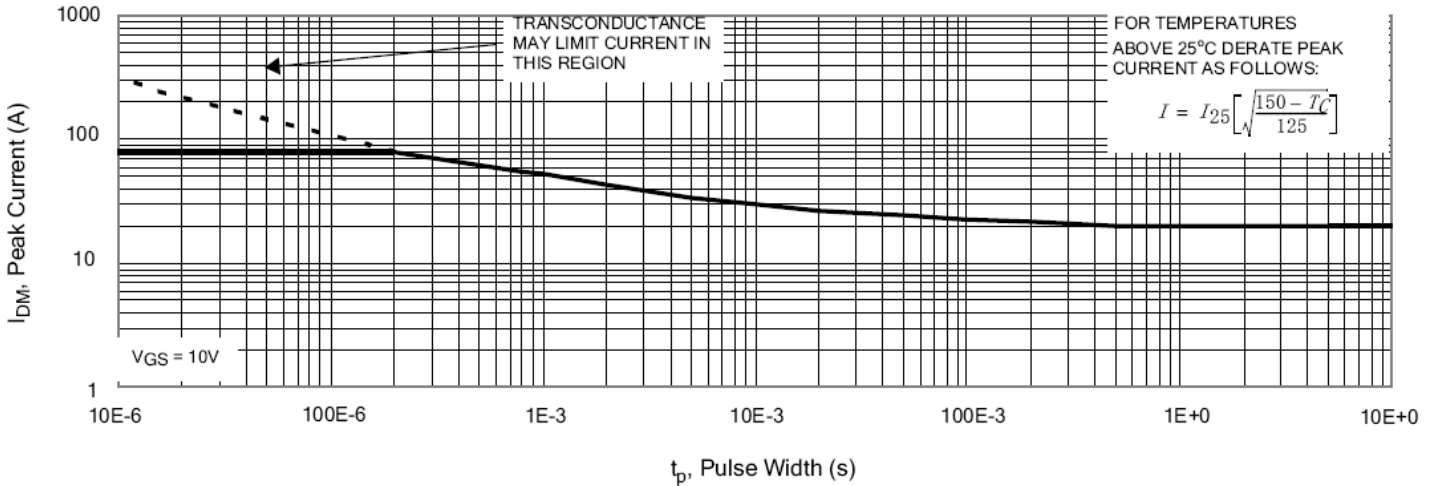


Figure 7. Typical Transfer Characteristics

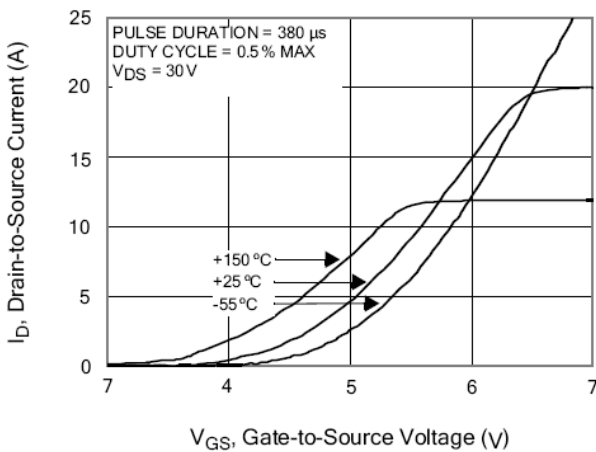


Figure 9. Typical Drain-to-Source ON Resistance vs Drain Current

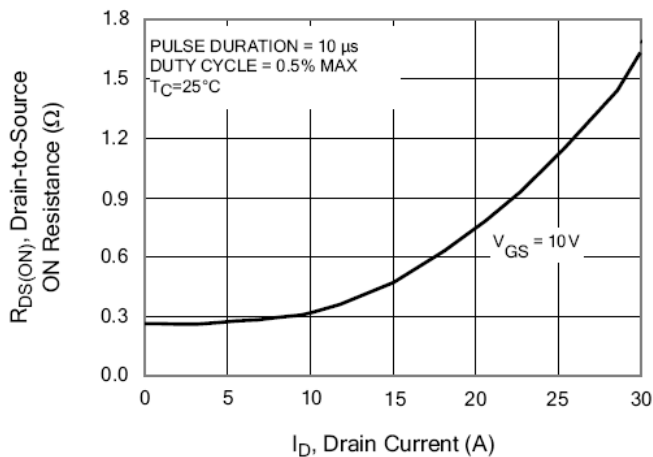


Figure 8. Unclamped Inductive Switching Capability

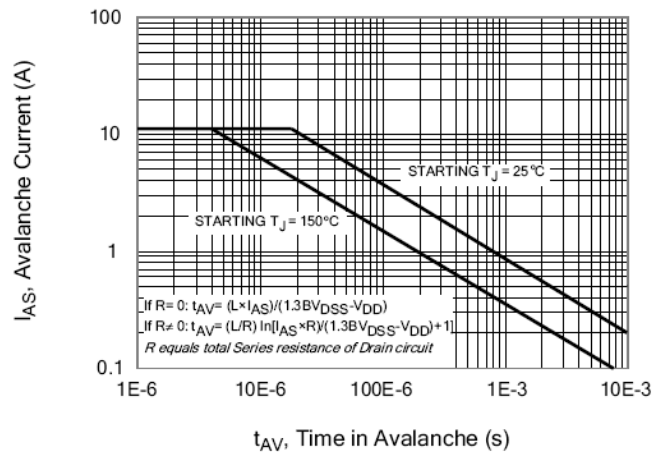
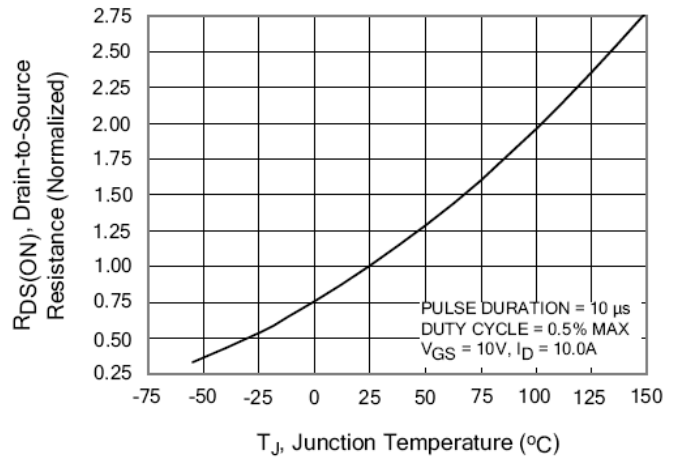


Figure 10. Typical Drain-to-Source ON Resistance vs Junction Temperature





Typical Characteristics(Cont.)

Figure 11. Typical Breakdown Voltage vs Junction Temperature

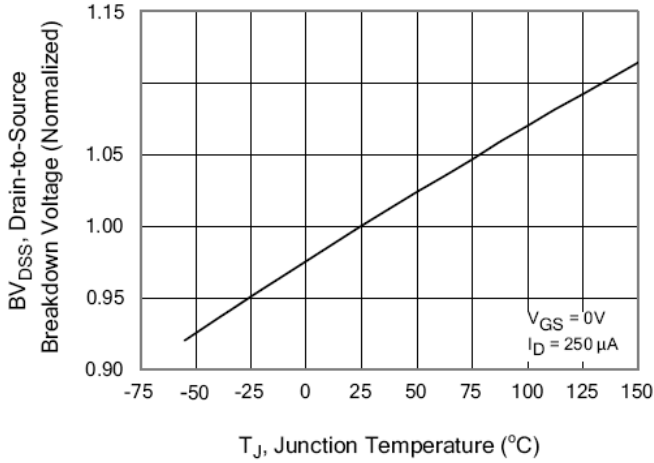


Figure 12. Typical Threshold Voltage vs Junction Temperature

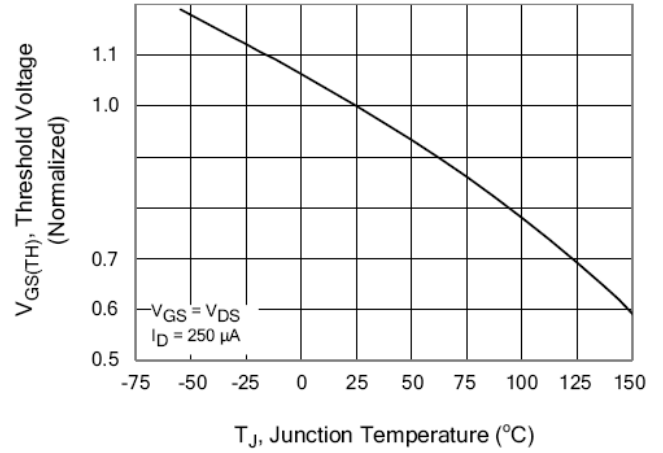


Figure 13. Maximum Forward Bias Safe Operating Area

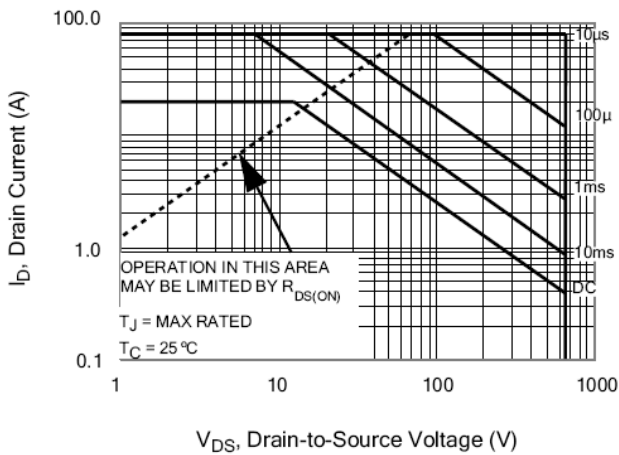


Figure 14. Typical Capacitance vs Drain-to-Source Voltage

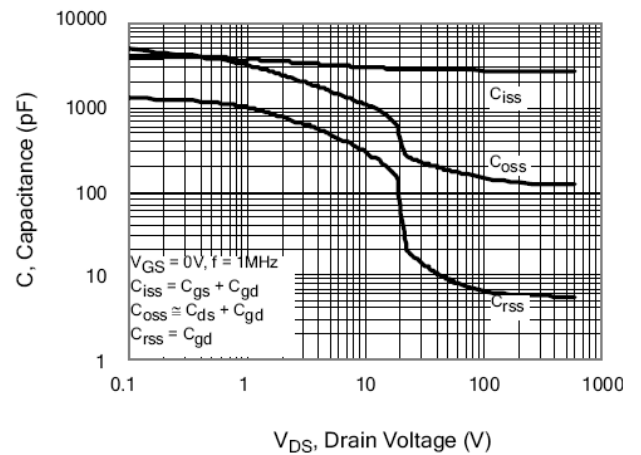


Figure 15. Typical Gate Charge vs Gate-to-Source Voltage

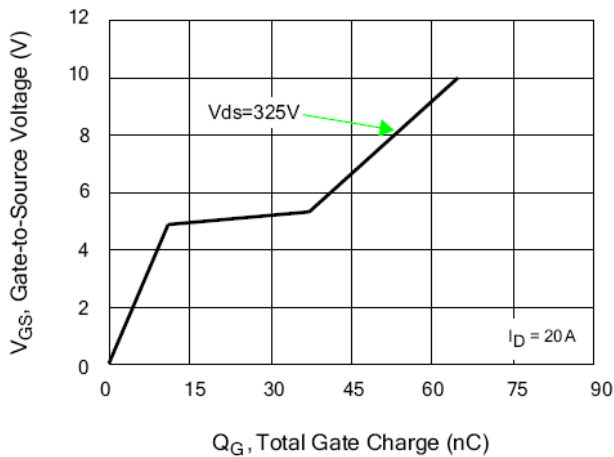
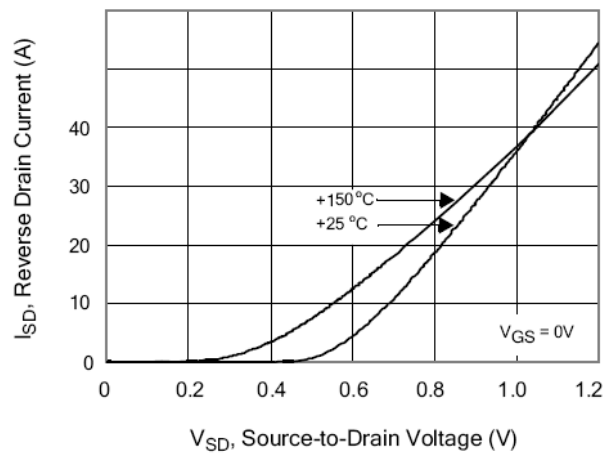


Figure 16. Typical Body Diode Transfer Characteristics





Test Circuits and Waveforms

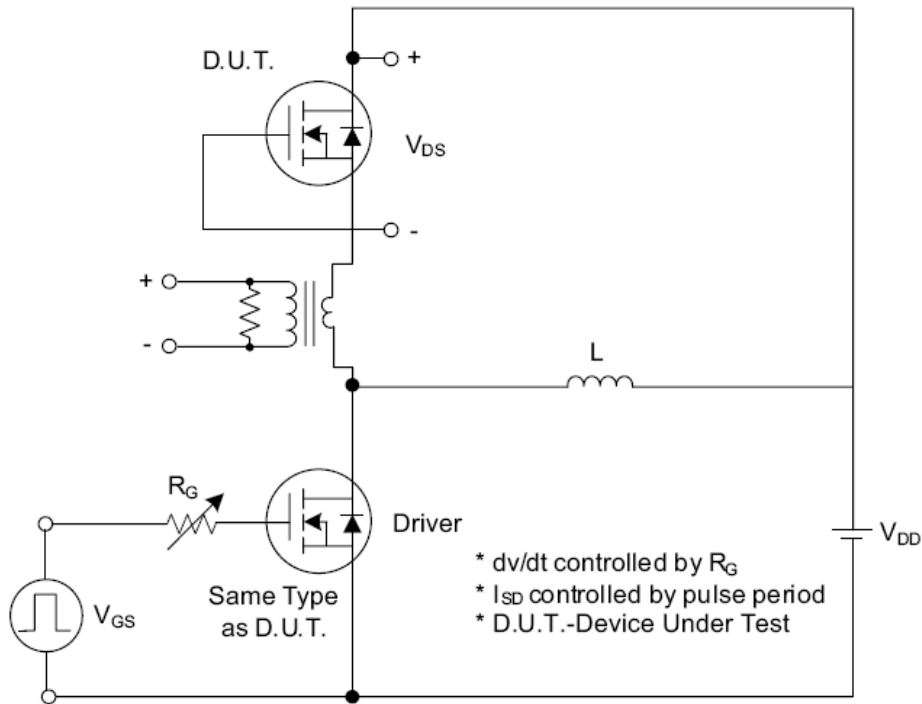


Fig. 1.1 Peak Diode Recovery dv/dt Test Circuit

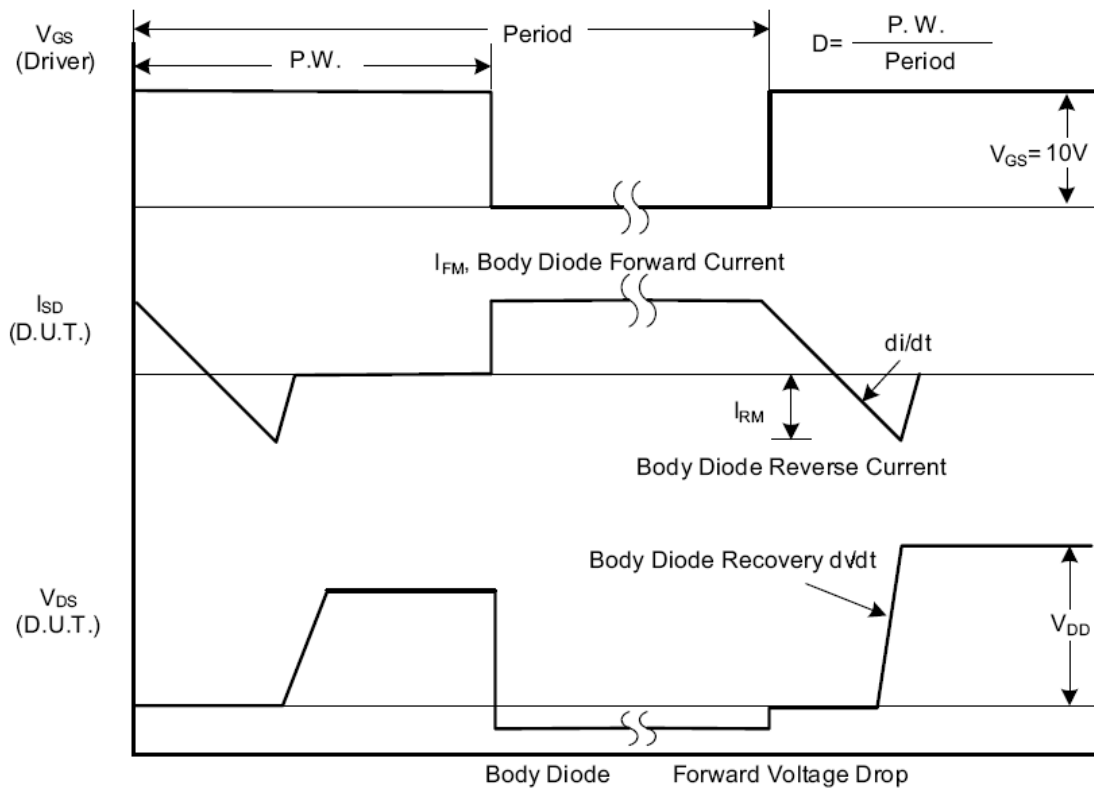


Fig. 1.2 Peak Diode Recovery dv/dt Waveforms



Test Circuits and Waveforms (Cont.)

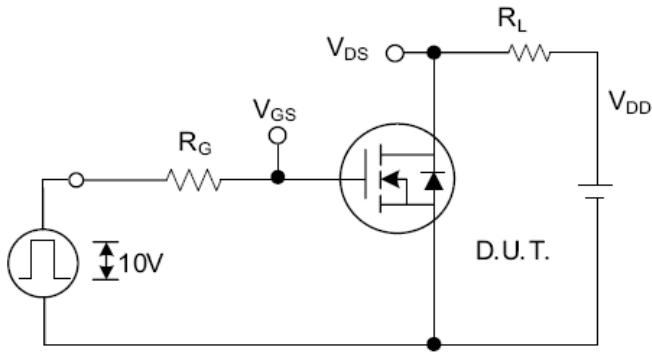


Fig. 2.1 Switching Test Circuit

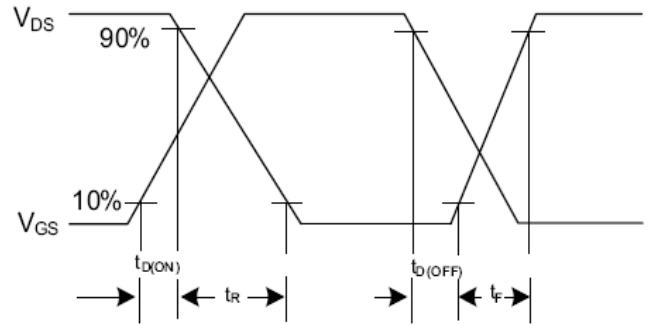


Fig. 2.2 Switching Waveforms

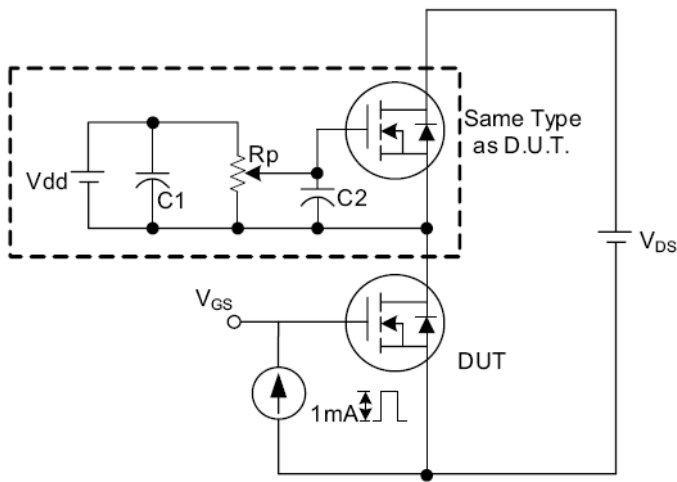


Fig. 3.1 Gate Charge Test Circuit

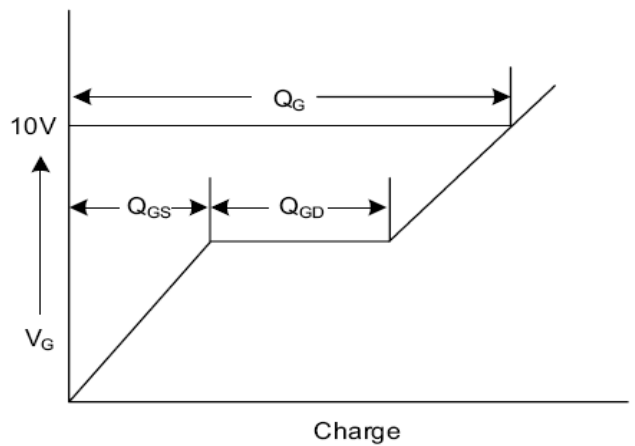


Fig. 3.2 Gate Charge Waveform

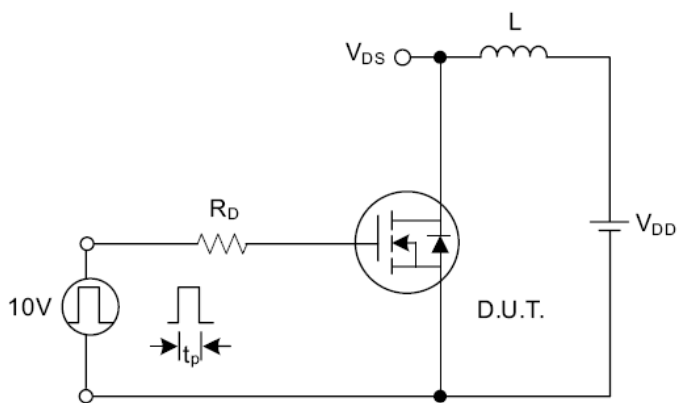


Fig. 4.1 Unclamped Inductive Switching Test Circuit

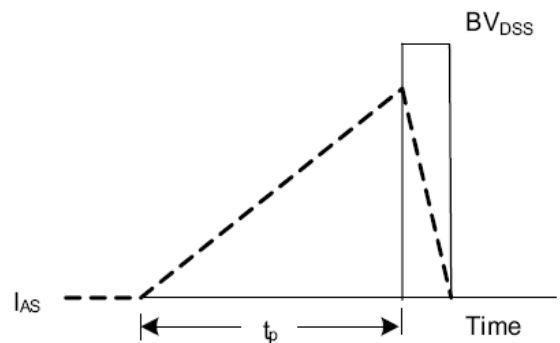


Fig. 4.2 Unclamped Inductive Switching Waveforms



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