# CS7N60FA9HD

**600V Silicon N-Channel Power MOSFET**

## ■ Features

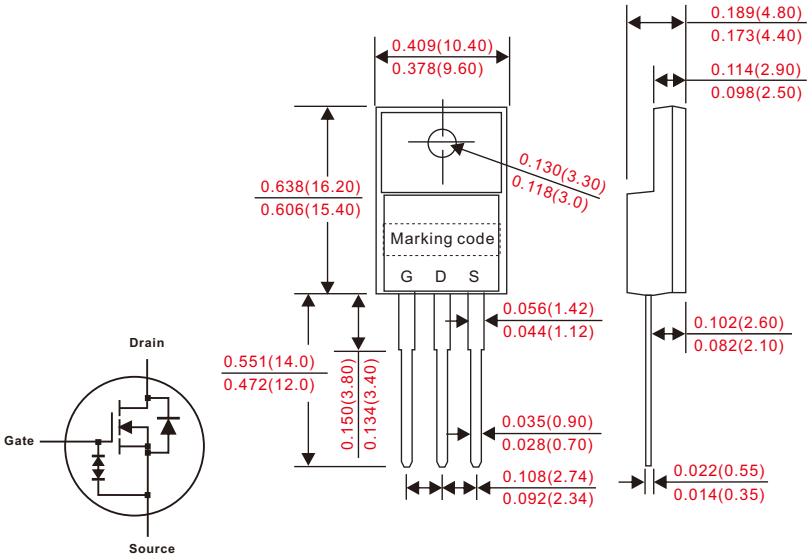
- Fast switching.
- ESD improved capability.
- Low gate charge.
- Low reverse transfer capacitances.
- 100% single pulse avalanche energy test.

## ■ Mechanical data

- Epoxy : UL94-V0 rated flame retardant.
- Case : JEDEC TO-220F molded plastic body.
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026.
- Polarity: As marked.
- Mounting Position : Any.
- Weight : Approximated 2.25 gram.

## ■ Outline

TO-220F




Dimensions in inches and (millimeters)

## ■ Absolute($T_C$ = 25°C unless otherwise specified)

| PARAMETER | CONDITIONS | Symbol | CS7N60FA9HD | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 600 | V |
| Continuous Drain Current | | $I_D$ | 7 | A |
| Continuous Drain Current | $T_C$ = 100°C | | 4.5 | |
| Pulsed Drain Current(1) | | $I_{DM}$ | 28 | |
| Gate-Source Voltage | | $V_{GS}$ | ±30 | V |
| Single Pulse Avalanche Energy(2) | | $E_{AS}$ | 550 | mJ |
| Avalanche Current(1) | | $I_{AR}$ | 3.3 | A |
| Repetitive Avalanche Energy(1) | | $E_{AR}$ | 54 | mJ |
| Power Dissipation | | $P_D$ | 40 | W |
| | Derating factor above 25°C | | 0.32 | W/°C |
| Peak Diode Recovery dv/dt(3) | | dV/dt | 5.0 | V/ns |
| Gate source ESD | HBM-C = 100pf, R = 1.5kΩ | $V_{ESD(G-S)}$ | 3000 | V |
| Operating and Storage Temperature Range | | $T_J$, $T_{STG}$ | -55 ~ +150 | °C |
| Maximum temperature for soldering | | $T_L$ | 300 | °C |

NOTE : 1.Repetitive rating; pulse width limited by maximum junction temperature.
2.L=10.0mH, $I_D$ = 10.5A, Start $T_J$ = 25°C.
3.$I_{SD}$ =7A,di/dt ≤100A/us, $V_{DD}$≤$BV_{DS}$, Start $T_J$ = 25°C.



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■ Electrical characteristics($T_C$ = 25°C unless otherwise specified)

| PARAMETER | CONDITIONS | Symbol | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Drain-Source Breakdown Voltage | $V_{GS}$ = 0V, $I_D$ = 250μA | $V_{DSS}$ | 600 | | | V |
| Bvdss Temperature Coefficient | $I_D$ = 250uA, Reference 25°C | $BV_{DSS}$ / $T_J$ | | 0.74 | | V/°C |
| Drain-Source Leakage Current | $V_{DS}$ = 600V, $V_{GS}$ = 0V, $T_a$ = 25°C | $I_{DSS}$ | | | 1 | uA |
| | $V_{DS}$ = 480V, $V_{GS}$ = 0V, $T_a$ = 125°C | | | | 100 | |
| Gate-Source Leakage Current, Forward | $V_{GS}$ = 20V | $I_{GSS(F)}$ | | | 10 | uA |
| Gate-Source Leakage Current, Reverse | $V_{GS}$ = -20V | $I_{GSS(R)}$ | | | -10 | |

■ ON Characteristics

| PARAMETER | CONDITIONS | Symbol | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250μA | $V_{GS(th)}$ | 2.0 | | 4.0 | V |
| Static Drain-Source On-Resistance | $V_{GS}$ = 10V, $I_D$ = 3.5A | $R_{DS(on)}$ | | 0.88 | 1.25 | Ω |

■ Dynamic Characteristics

| PARAMETER | CONDITIONS | Symbol | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Forward Transconductance | $V_{DS}$ = 15V, $I_D$ = 3.5A | $g_{fs}$ | | 6.0 | | S |
| Input Capacitance | $V_{DS}$ = 25V, $V_{GS}$ = 0V, f = 1.0MHz | $C_{iss}$ | | 1071 | | pF |
| Output Capacitance | | $C_{oss}$ | | 112 | | |
| Reverse Transfer Capacitance | | $C_{rss}$ | | 12 | | |

■ Resistive Switching Characteristics

| PARAMETER | CONDITIONS | Symbol | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Turn-on Delay Time | $I_D$ = 7A, $V_{DD}$ = 300V, $V_{GS}$ = 10V, $R_G$ = 4.7Ω | $td_{(ON)}$ | | 11 | | ns |
| Rise Time | | tr | | 11 | | |
| Turn-off Delay Time | | $td_{(OFF)}$ | | 35 | | |
| Fail Time | | tf | | 13 | | |
| Total Gate Charge | $I_D$ = 7A, $V_{DD}$ = 300V, $V_{GS}$ = 10V | $Q_g$ | | 28 | | nC |
| Gate-Source Charge | | $Q_{gs}$ | | 6 | | |
| Gate-Drain Charge | | $Q_{gd}$ | | 12 | | |

■ Source-Drain Diode Characteristics

| PARAMETER | CONDITIONS | Symbol | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Continuous Source-Drain Diode Current | Boby Diode | $I_S$ | | | 7 | A |
| Pulse Diode Forward Current | Boby Diode | $I_{SM}$ | | | 28 | |
| Body Diode Voltage | $I_S$ = 7.0A, $V_{GS}$ = 0V | $V_{SD}$ | | | 1.5 | V |
| Reverse recovery time | $I_S$ = 7A, $T_J$ = 25°C, $dI_F/dt$ = 100A/μs, $V_{GS}$ = 0V | $t_{rr}$ | | 255 | | ns |
| Reverse recovery charge | | $Q_{rr}$ | | 1506 | | uC |

■ Thermal characteristics

| PARAMETER | CONDITIONS | Symbol | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Thermal Resistance | Junction to Case | $R_{\theta JC}$ | | 3.13 | | °C/W |
| | Junction to Ambient | $R_{\theta JA}$ | | 100 | | |

■ Thermal characteristics

| PARAMETER | CONDITIONS | Symbol | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Gate-Source Breakdown Voltage | $I_{GS}$ = ±1mA(open Drain) | $V_{GSO}$ | 30 | | | V |



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■ Rating and characteristic curves

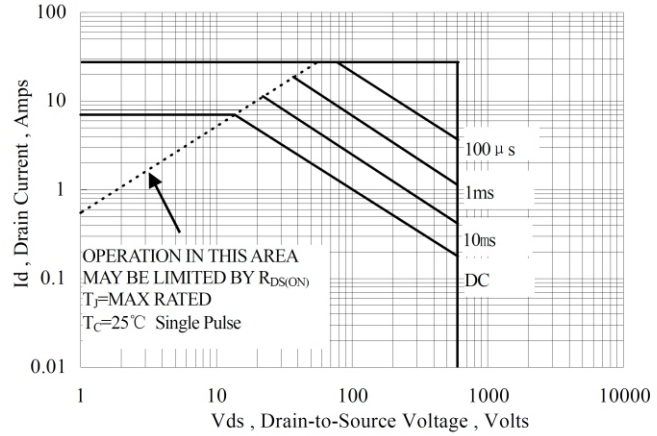


Figure 1 Maximun Forward Bias Safe Operating Area

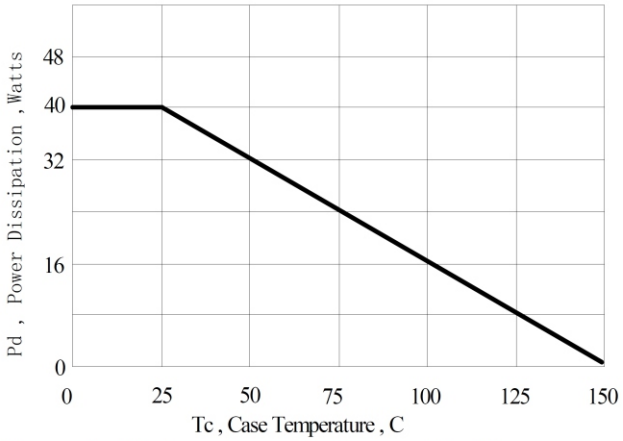


Figure 2 Maximun Power Dissipation vs Case Temperature

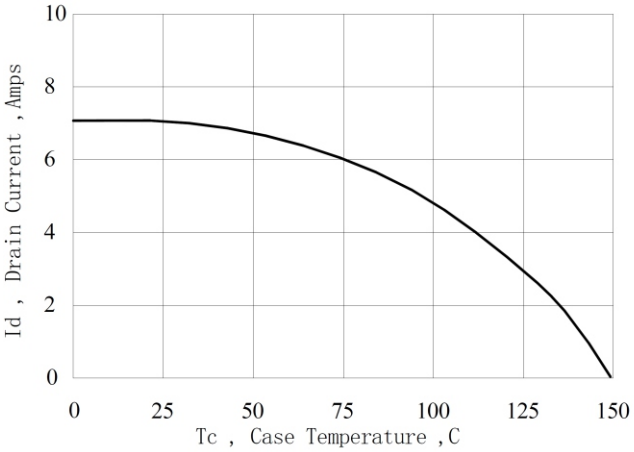


Figure 3 Maximum Continuous Drain Current vs Case Temperature

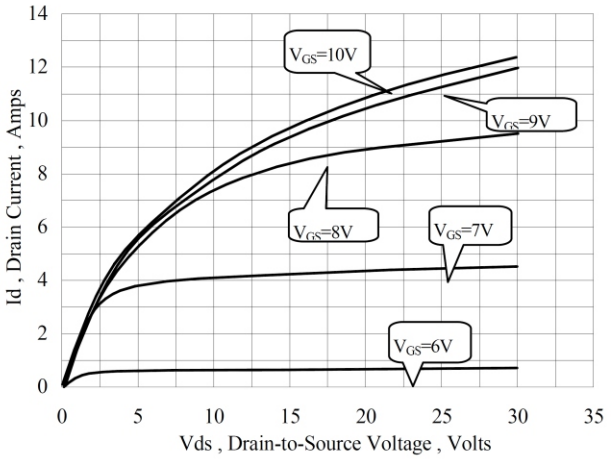


Figure 4 Typical Output Characteristics

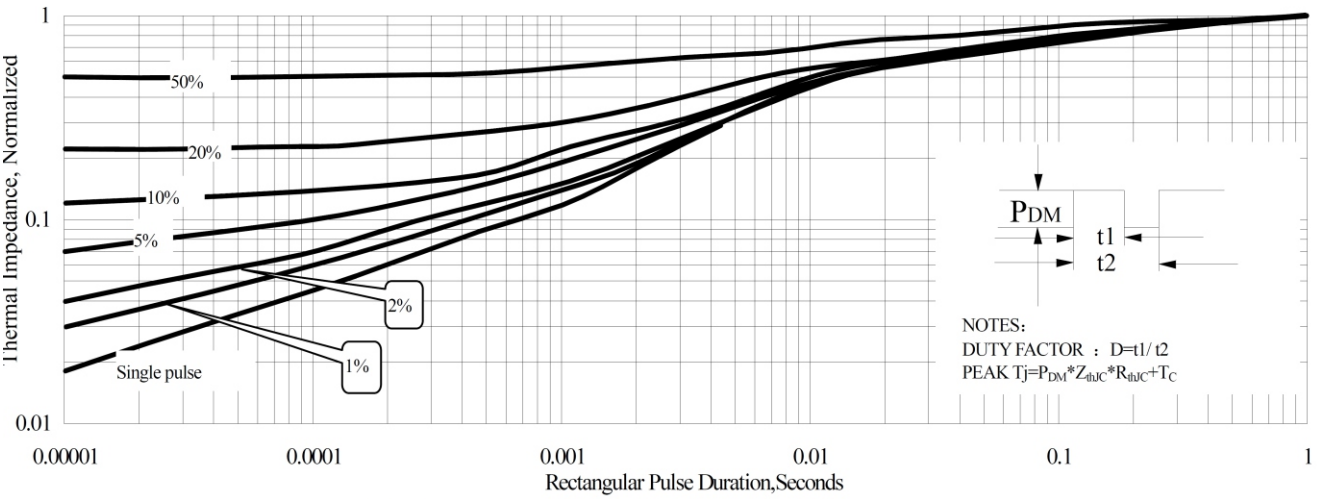


Figure 5 Maximum Effective Thermal Impendance , Junction to Case



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■ Rating and characteristic curves

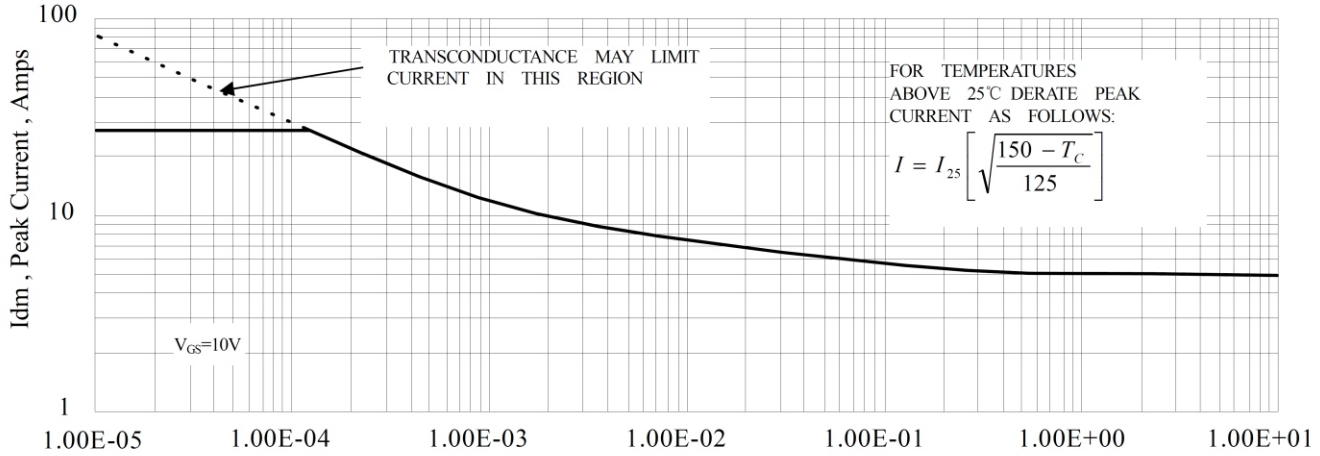


Figure 6 Maximun Peak Current Capability

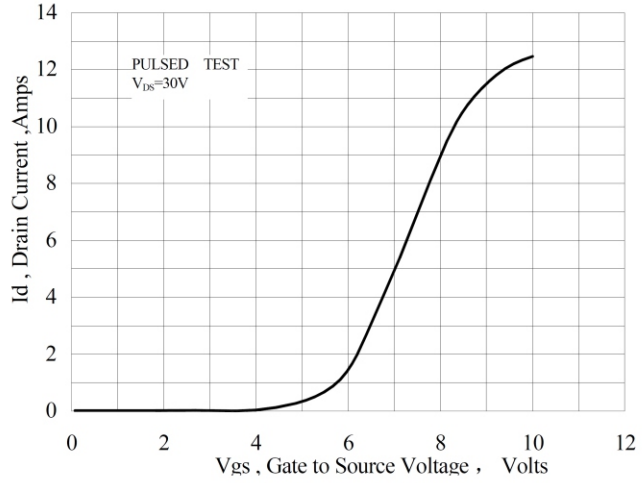


Figure 7 Typical Transfer Characteristics

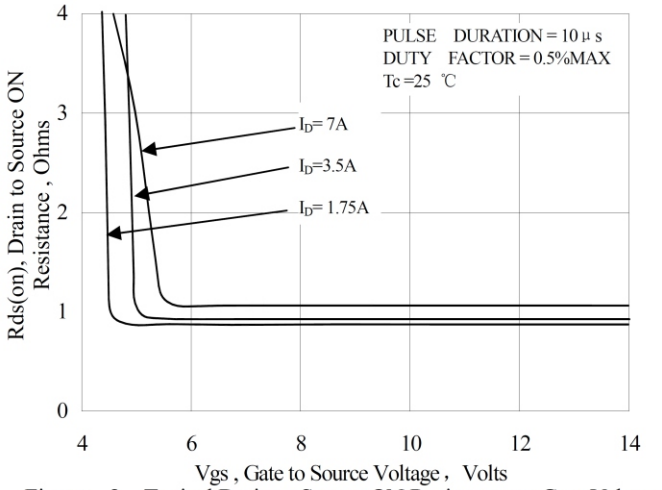


Figure 8 Typical Drain to Source ON Resistance vs Gate Voltage and Drain Current

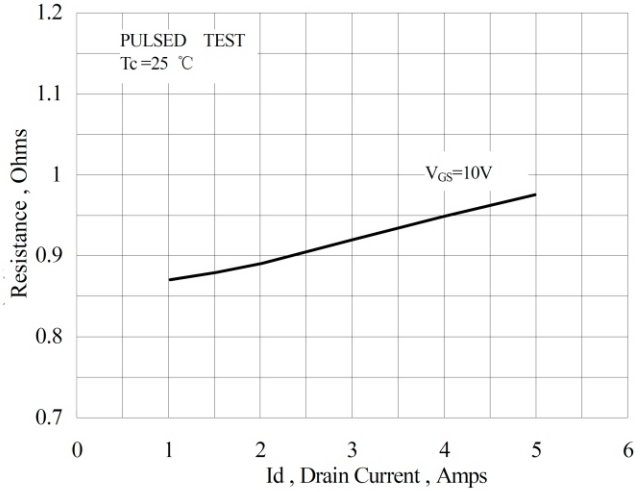


Figure 9 Typical Drain to Source ON Resistance vs Drain Current

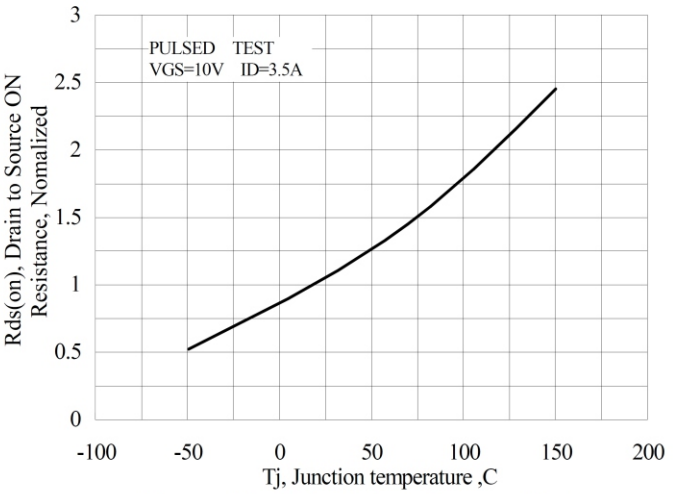


Figure 10 Typical Drian to Source on Resistance vs Junction Temperature



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■ Rating and characteristic curves

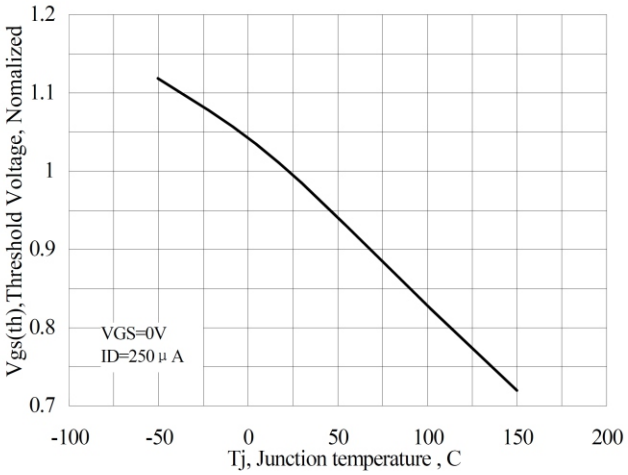


Figure 11 Typical Theshold Voltage vs Junction Temperature

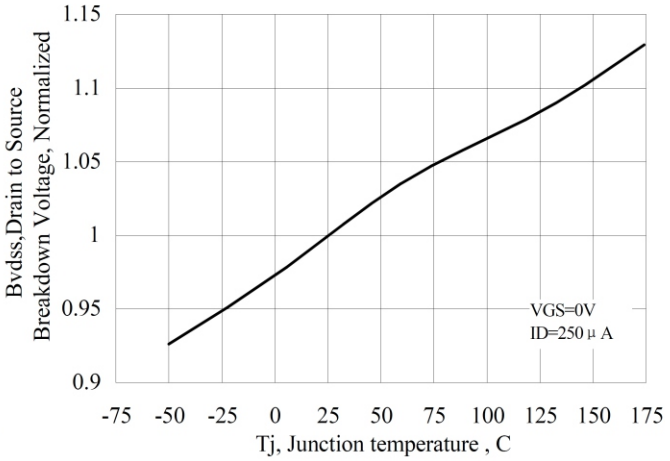


Figure 12 Typical Breakdown Voltage vs Junction Temperature

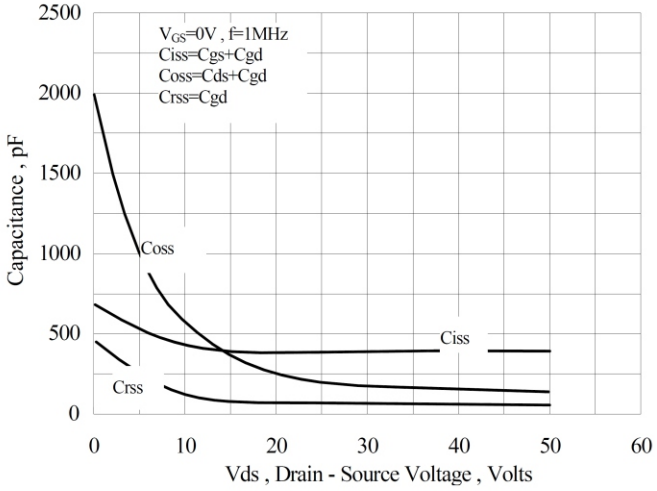


Figure 13 Typical Capacitance vs Drain to Source Voltage

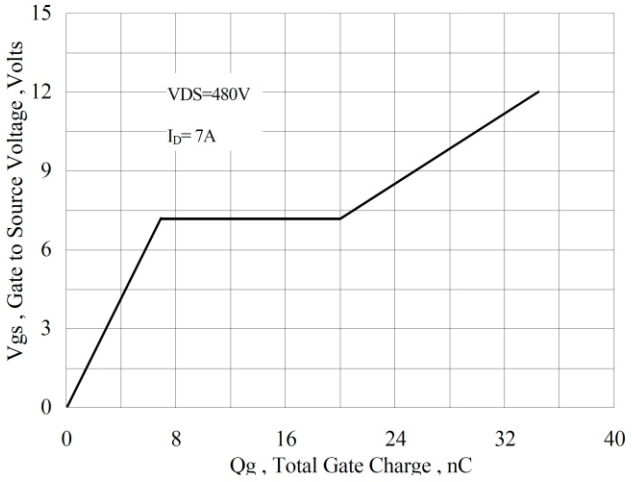


Figure 14 Typical Gate Charge vs Gate to Source Voltage

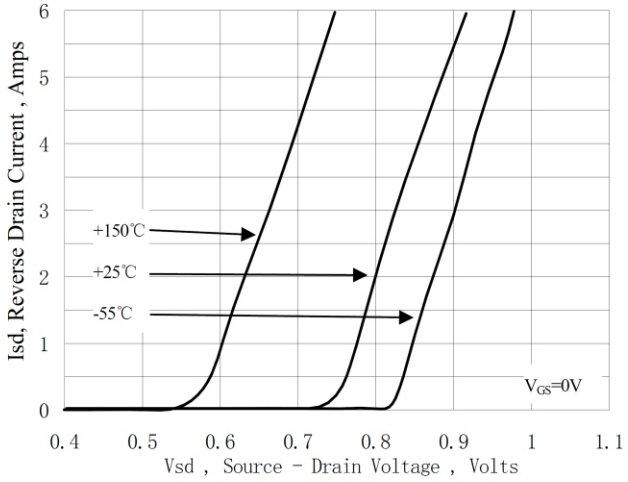


Figure 15 Typical Body Diode Transfer Characteristics

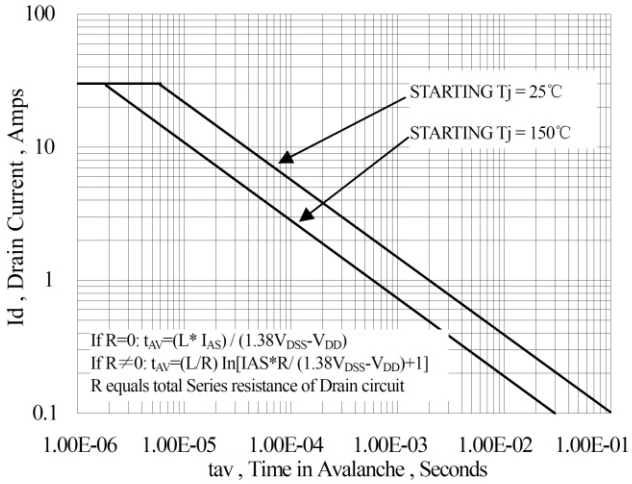


Figure 16 Unclamped Inductive Switching Capability



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■ Test circuit and waveform

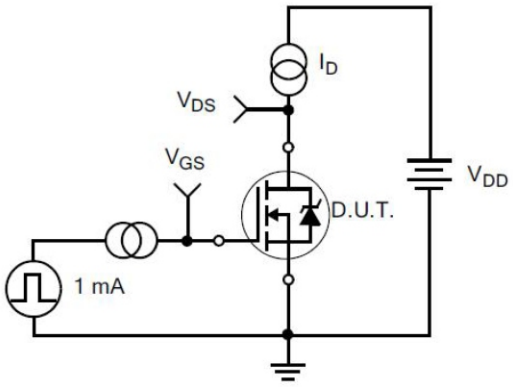


Figure 17. Gate Charge Test Circuit

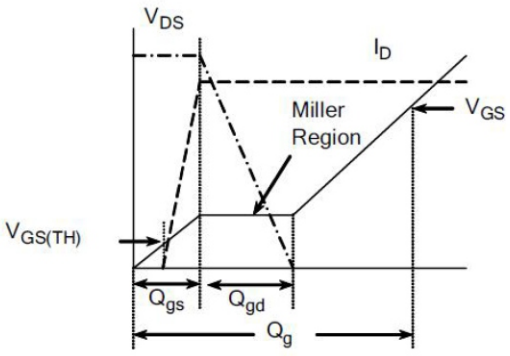


Figure 18. Gate Charge Waveform

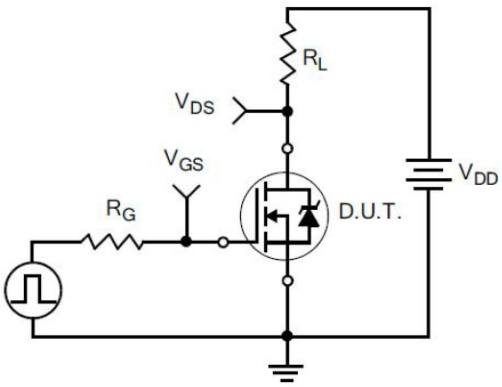


Figure 19. Resistive Switching Test Circuit

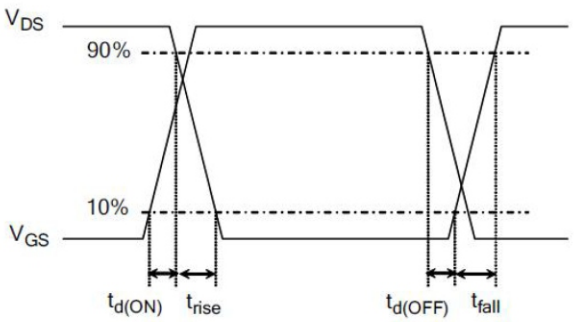


Figure 20. Resistive Switching Waveforms



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■ Test circuit and waveform

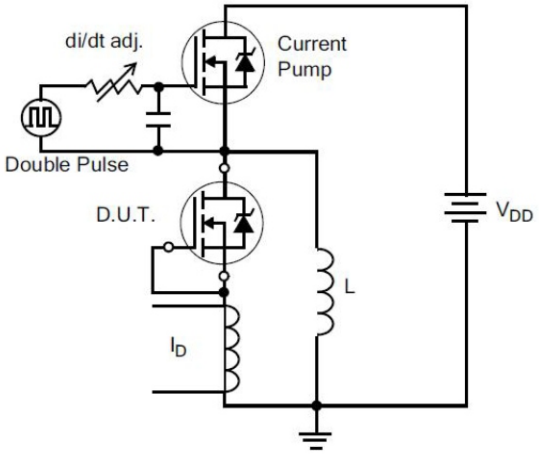


Figure 21. Diode Reverse Recovery Test Circuit

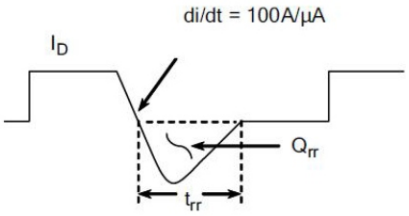


Figure 22. Diode Reverse Recovery Waveform

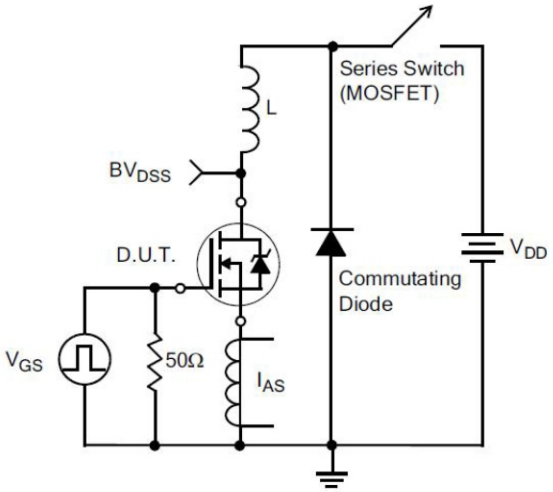


Figure 23. Unclamped Inductive Switching Test Circuit

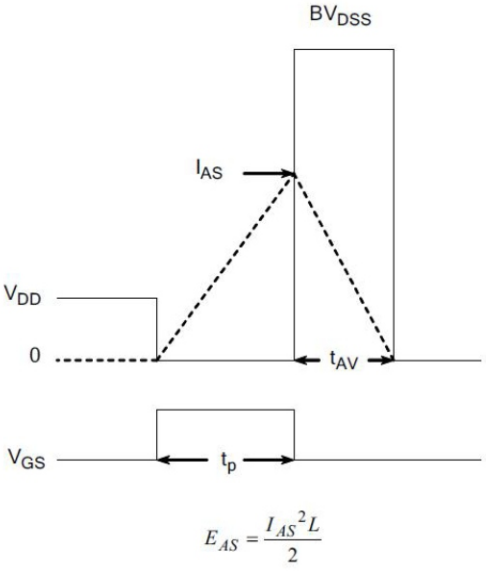


Figure 24. Unclamped Inductive Switching Waveforms



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