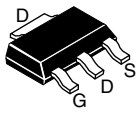
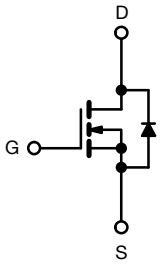
## Power MOSFET

SOT-223




N-Channel MOSFET

Marking code: FC

### FEATURES

- Surface-mount
- Available in tape and reel
- Dynamic dV/dt rating
- Repetitive avalanche rated
- Fast switching
- Ease of paralleling
- Simple drive requirements
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE Available

### DESCRIPTION

Third generation power MOSFETs from Vishay provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The SOT-223 package is designed for surface-mounting using vapor phase, infrared, or wave soldering techniques. Its unique package design allows for easy automatic pick-and-place as with other SOT or SOIC packages but has the added advantage of improved thermal performance due to an enlarged tab for heatsinking. Power dissipation of greater than 1.25 W is possible in a typical surface mount application.

| PRODUCT SUMMARY | | |
|---|---|---|
| $V_{DS}$ (V) | 200 | |
| $R_{DS(on)}$ (Ω) | $V_{GS}$ = 10 V | 1.5 |
| $Q_g$ (Max.) (nC) | 8.2 | |
| $Q_{gs}$ (nC) | 1.8 | |
| $Q_{gd}$ (nC) | 4.5 | |
| Configuration | Single | |

| ORDERING INFORMATION | |
|---|---|
| Package | SOT-223 |
| Lead (Pb)-free and halogen-free | SiHFL210TR-GE3 [a] |
| | IRFL210TRPbF-BE3 [a, b] |
| Lead (Pb)-free | IRFL210TRPbF [a] |

**Notes**

a. See device orientation
b. "-BE3" denotes alternate manufacturing location

| ABSOLUTE MAXIMUM RATINGS ($T_C$ = 25 °C, unless otherwise noted) | | | | | |
|---|---|---|---|---|---|
| **PARAMETER** | | | **SYMBOL** | **LIMIT** | **UNIT** |
| Drain-source voltage | | | $V_{DS}$ | 200 | V |
| Gate-source voltage | | | $V_{GS}$ | ± 20 | |
| Continuous drain current | $V_{GS}$ at 10 V | $T_C$ = 25 °C | $I_D$ | 0.96 | A |
| | | $T_C$ = 100 °C | | 0.6 | |
| Pulsed drain current [a] | | | $I_{DM}$ | 7.7 | |
| Linear derating factor | | | | 0.025 | W/°C |
| Linear derating factor (PCB mount) [e] | | | | 0.017 | |
| Single pulse avalanche energy [b] | | | $E_{AS}$ | 50 | mJ |
| Avalanche current [a] | | | $I_{AR}$ | 0.96 | A |
| Repetitive avalanche energy [a] | | | $E_{AR}$ | 0.31 | mJ |
| Maximum power dissipation | $T_C$ = 25 °C | | $P_D$ | 3.1 | W |
| Maximum power dissipation (PCB mount) [e] | $T_A$ = 25 °C | | | 2.0 | |
| Peak diode recovery dv/dt [c] | | | dV/dt | 5.0 | V/ns |
| Operating junction and storage temperature range | | | $T_J$, $T_{stg}$ | -55 to +150 | °C |
| Soldering recommendations (peak temperature) [d] | For 10 s | | | 300 | |

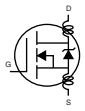
**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)
b. $V_{DD}$ = 50 V, starting $T_J$ = 25 °C, L = 81 mH, $R_G$ = 25 Ω, $I_{AS}$ = 0.96 A (see fig. 12)
c. $I_{SD}$ ≤ 3.3 A, dI/dt ≤ 70 A/μs, $V_{DD}$ ≤ $V_{DS}$, $T_J$ ≤ 150 °C
d. 1.6 mm from case
e. When mounted on 1" square PCB (FR-4 or G-10 material)

| THERMAL RESISTANCE RATINGS | | | | | |
|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| Maximum junction-to-ambient (PCB mount) [a] | $R_{thJA}$ | - | - | 40 | °C/W |
| Maximum junction-to-case (drain) | $R_{thJC}$ | - | - | 60 | |

**Note**

a. When mounted on 1" square PCB (FR-4 or G-10 material)

| **SPECIFICATIONS** ($T_J$ = 25 °C, unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | |
| Drain-source breakdown voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | 200 | - | - | V |
| $V_{DS}$ temperature coefficient | $\Delta V_{DS}/T_J$ | Reference to 25 °C, $I_D$ = 1 mA | - | 0.30 | - | V/°C |
| Gate-source threshold voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2.0 | - | 4.0 | V |
| Gate-source leakage | $I_{GSS}$ | $V_{GS}$ = ± 20 V | - | - | ± 100 | nA |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$ = 200 V, $V_{GS}$ = 0 V | - | - | 25 | µA |
| | | $V_{DS}$ = 160 V, $V_{GS}$ = 0 V, $T_J$ = 125 °C | - | - | 250 | |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V; $I_D$ = 0.58 A [b] | - | - | 1.5 | Ω |
| Forward transconductance | $g_{fs}$ | $V_{DS}$ = 50 V, $I_D$ = 0.58 A | 0.51 | - | - | S |
| **Dynamic** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 25 V, f = 1.0 MHz, see fig. 5 | - | 140 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 53 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 15 | - | |
| Total gate charge | $Q_g$ | $V_{GS}$ = 10 V; $I_D$ = 3.3 A, $V_{DS}$ = 160 V, see fig. 6 and 13 [b] | - | - | 8.2 | nC |
| Gate-source charge | $Q_{gs}$ | | - | - | 1.8 | |
| Gate-drain charge | $Q_{gd}$ | | - | - | 4.5 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$ = 100 V, $I_D$ = 3.3 A, $R_g$ = 24 Ω, $R_D$ = 30 Ω, see fig. 10 [b] | - | 8.2 | - | ns |
| Rise time | $t_r$ | | - | 17 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 14 | - | |
| Fall time | $t_f$ | | - | 8.9 | - | |
| Internal drain inductance | $L_D$ | Between lead, 6 mm (0.25") from package and center of die contact  | - | 4.0 | - | nH |
| Internal source inductance | $L_S$ | | - | 6.0 | - | |
| **Drain-Source Body Diode Characteristics** | | | | | | |
| Continuous source-drain diode current | $I_S$ | MOSFET symbol showing the integral reverse p - n junction diode  | - | - | 0.96 | A |
| Pulsed diode forward current [a] | $I_{SM}$ | | - | - | 7.7 | |
| Body diode voltage | $V_{SD}$ | $T_J$ = 25 °C, $I_S$ = 0.96 A, $V_{GS}$ = 0 V [b] | - | - | 2.0 | V |
| Body diode reverse recovery time | $t_{rr}$ | $T_J$ = 25 °C, $I_F$ = 3.3 A, dI/dt = 100 A/µs [b] | - | 150 | 310 | ns |
| Body diode reverse recovery charge | $Q_{rr}$ | | - | 0.60 | 1.4 | µC |
| Forward turn-on time | $t_{on}$ | Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$) | | | | |

**Notes**

a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11)

b. Pulse width ≤ 300 µs; duty cycle ≤ 2 %

## TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

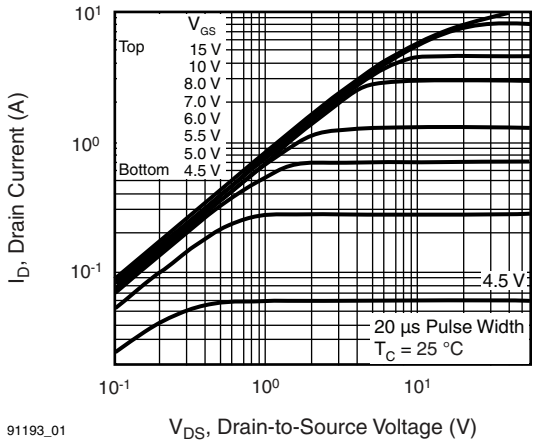



**Fig. 1 - Typical Output Characteristics, $T_C$ = 25 °C**

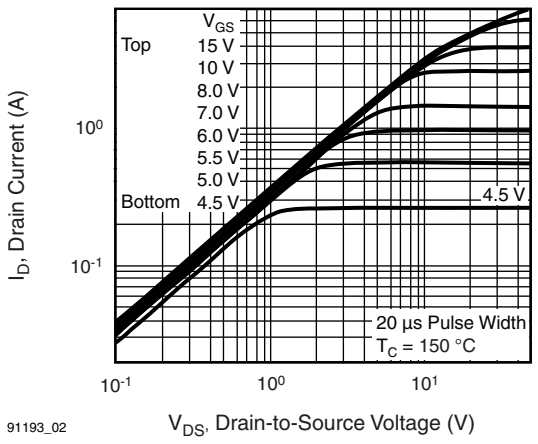



**Fig. 2 - Typical Output Characteristics, $T_C$ = 150 °C**

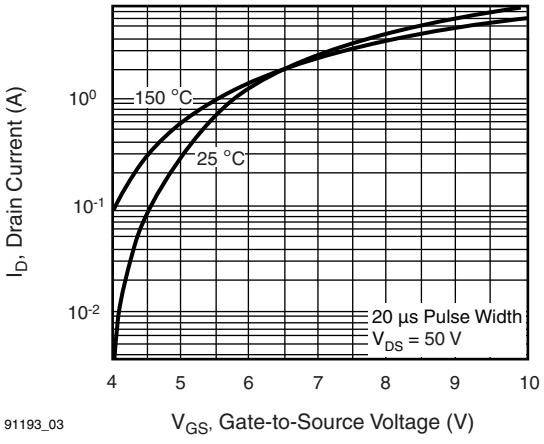



**Fig. 3 - Typical Transfer Characteristics**

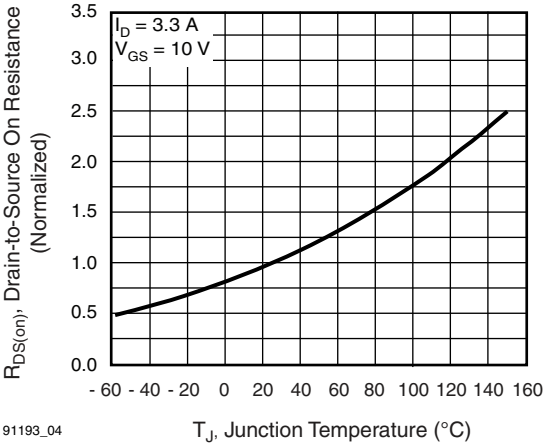



**Fig. 4 - Normalized On-Resistance vs. Temperature**

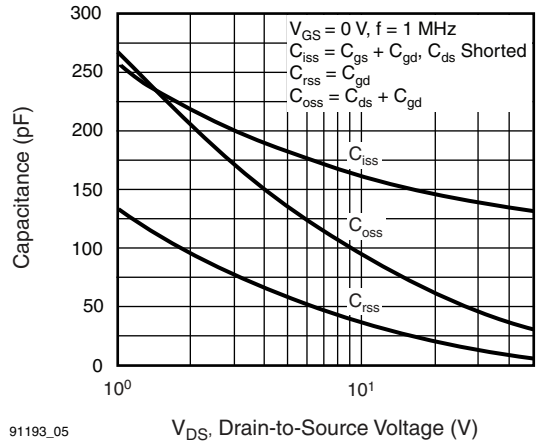



**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

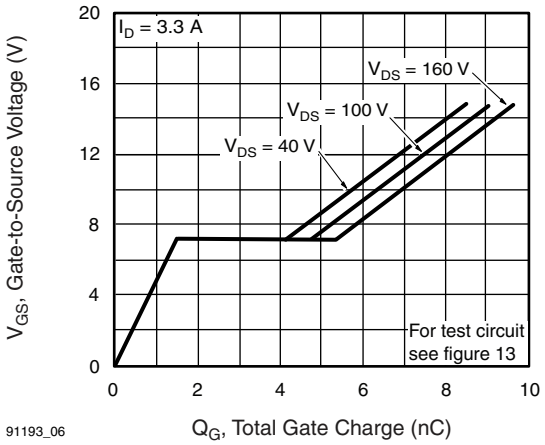



**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**

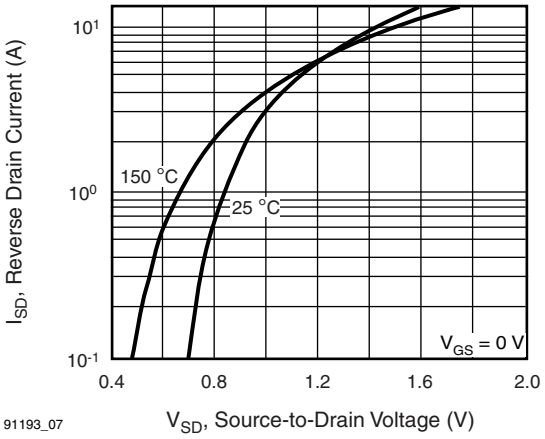



**Fig. 7 - Typical Source-Drain Diode Forward Voltage**

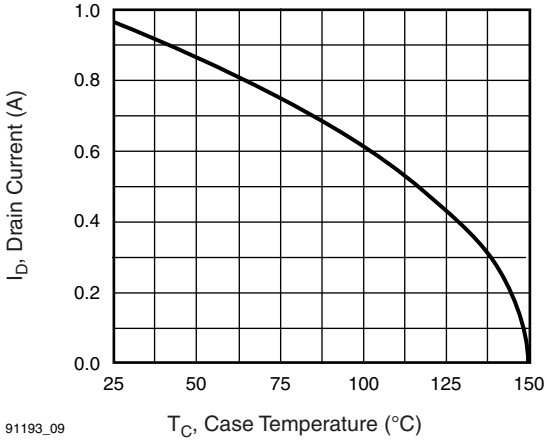



**Fig. 9 - Maximum Drain Current vs. Case Temperature**

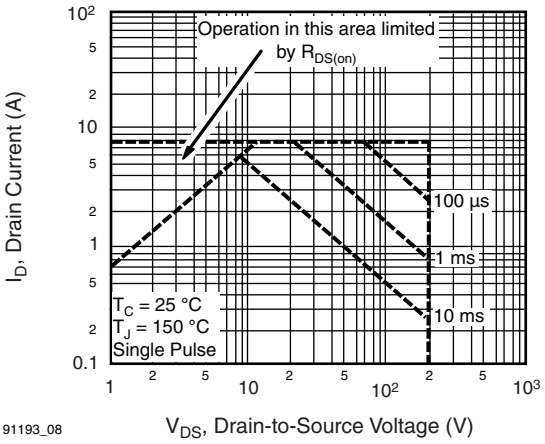



**Fig. 8 - Maximum Safe Operating Area**

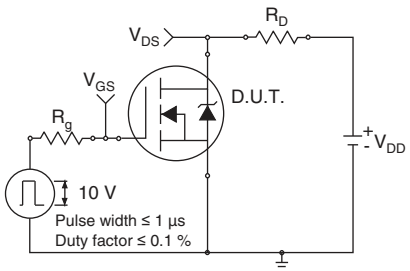



**Fig. 10a - Switching Time Test Circuit**

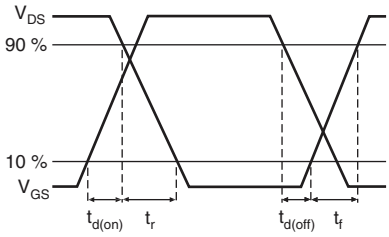



**Fig. 10b - Switching Time Waveforms**

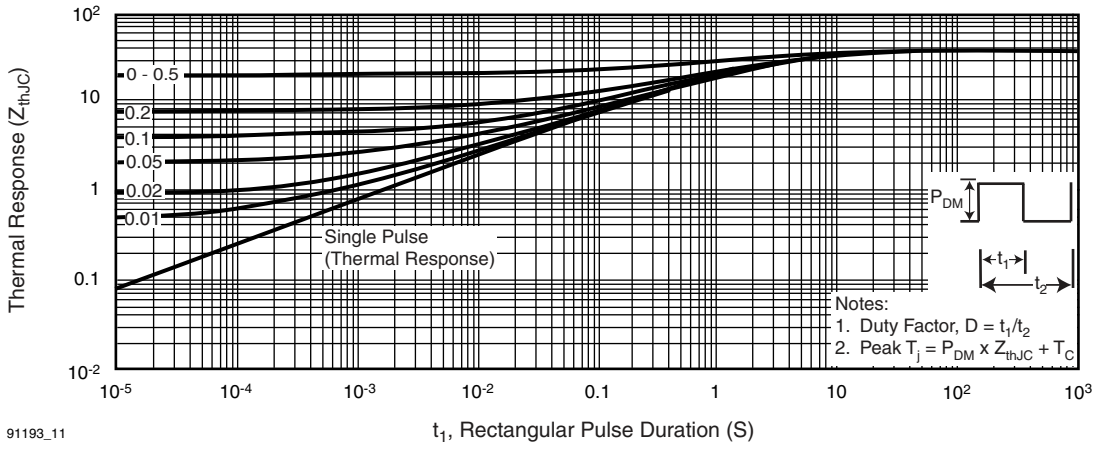



**Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case**

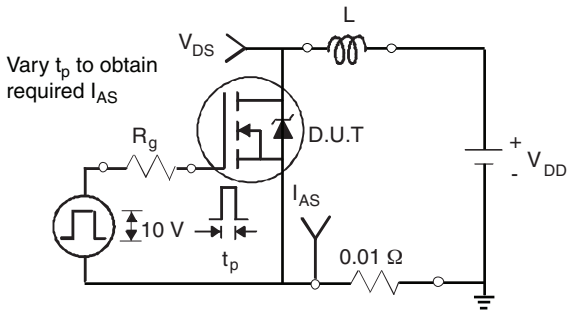



**Fig. 12a - Unclamped Inductive Test Circuit**

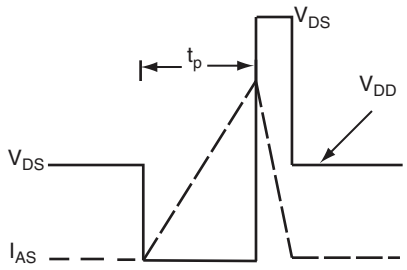



**Fig. 12b - Unclamped Inductive Waveforms**

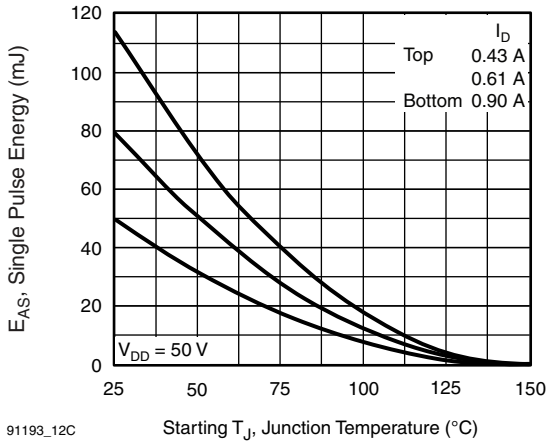



**Fig. 12c - Maximum Avalanche Energy vs. Drain Current**

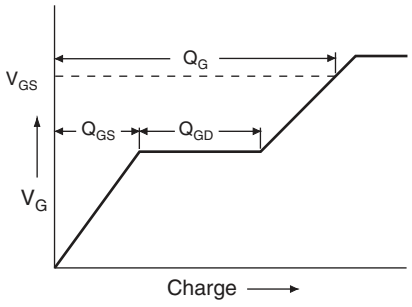



**Fig. 13a - Basic Gate Charge Waveform**

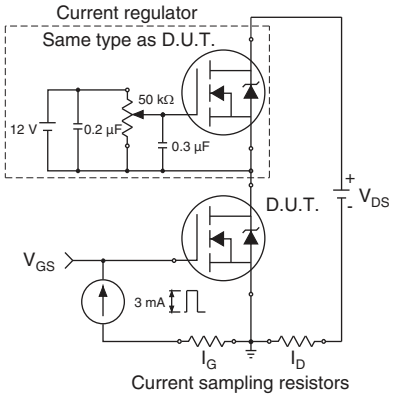
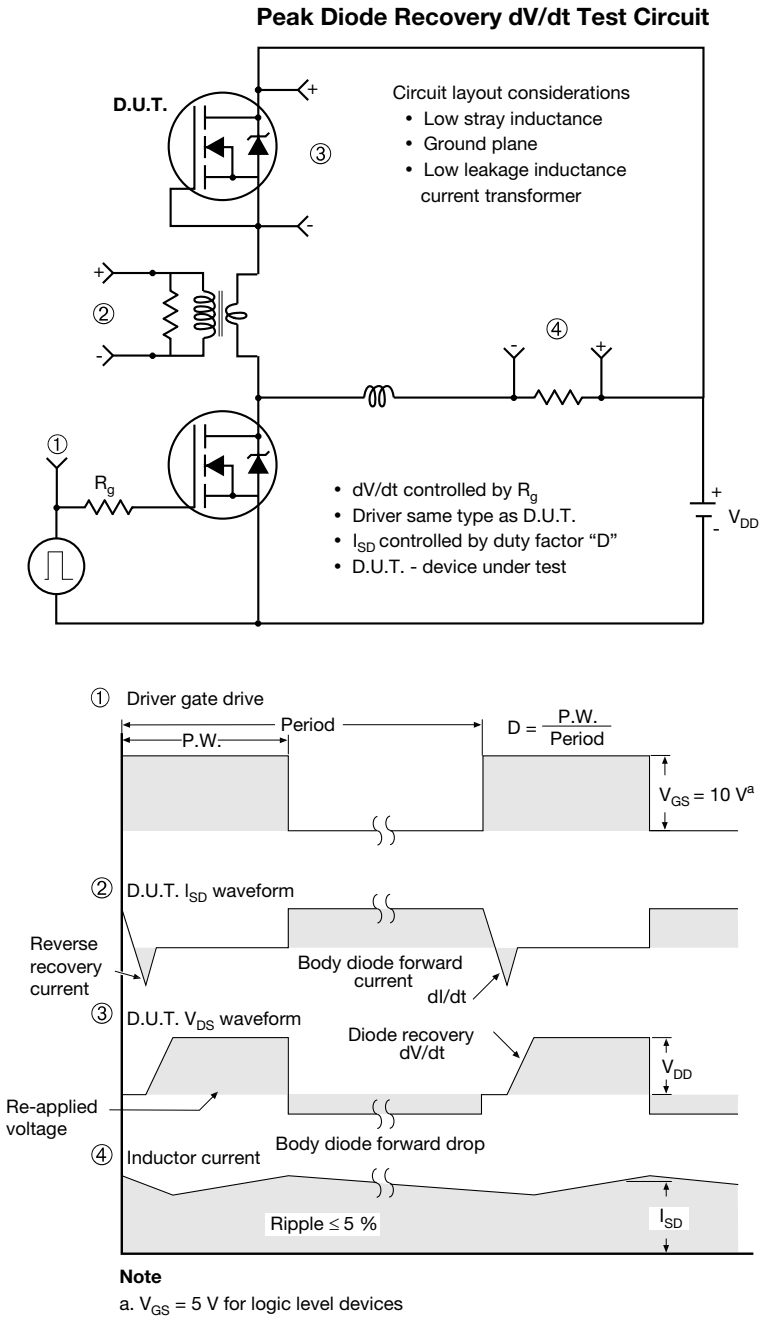



**Fig. 13b - Gate Charge Test Circuit**

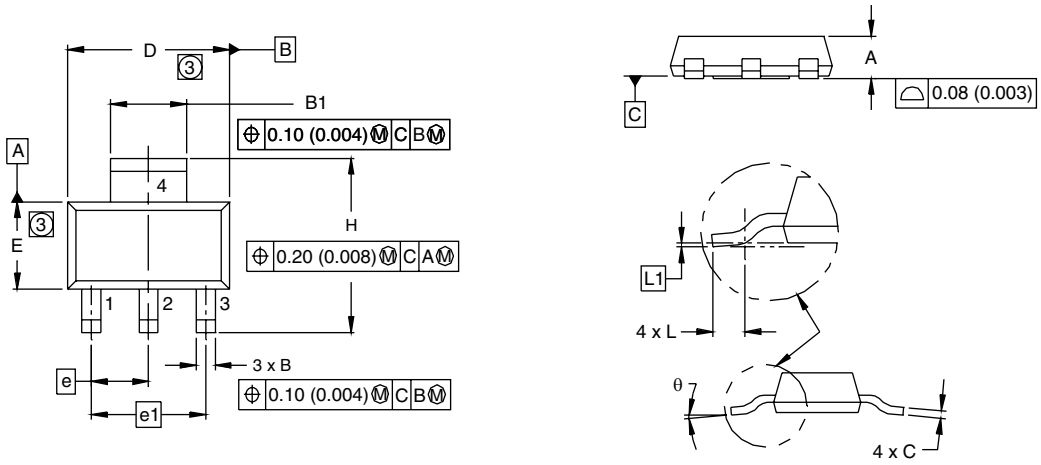



**Note**

a. $V_{GS}$ = 5 V for logic level devices

**Fig. 14 - For N-Channel**

## SOT-223 (HIGH VOLTAGE)




| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| **DIM.** | **MIN.** | **MAX.** | **MIN.** | **MAX.** |
| A | 1.55 | 1.80 | 0.061 | 0.071 |
| B | 0.65 | 0.85 | 0.026 | 0.033 |
| B1 | 2.95 | 3.15 | 0.116 | 0.124 |
| C | 0.25 | 0.35 | 0.010 | 0.014 |
| D | 6.30 | 6.70 | 0.248 | 0.264 |
| E | 3.30 | 3.70 | 0.130 | 0.146 |
| e | 2.30 BSC | | 0.0905 BSC | |
| e1 | 4.60 BSC | | 0.181 BSC | |
| H | 6.71 | 7.29 | 0.264 | 0.287 |
| L | 0.91 | - | 0.036 | - |
| L1 | 0.061 BSC | | 0.0024 BSC | |
| θ | - | 10' | - | 10' |
| ECN: S-82109-Rev. A, 15-Sep-08<br>DWG: 5969 | | | | |

**Notes**

1. Dimensioning and tolerancing per ASME Y14.5M-1994.
2. Dimensions are shown in millimeters (inches).
3. Dimension do not include mold flash.
4. Outline conforms to JEDEC outline TO-261AA.

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