

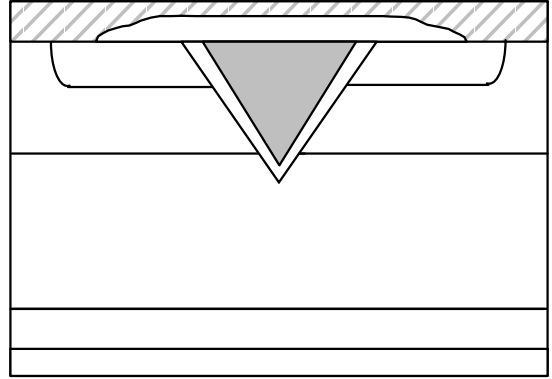


**FETS**

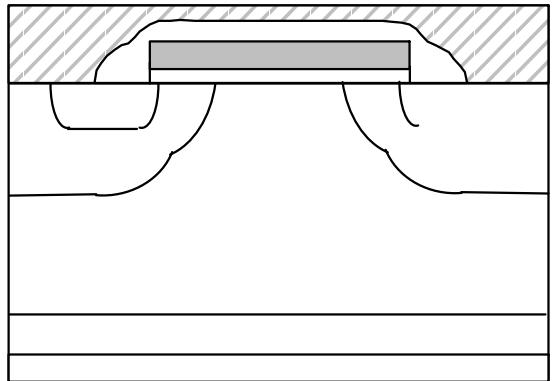
**Junction Field Effect Transistors (JFETs)**

**STRUCTURE OF A MOSFET**

**Lateral Channel Design**



**Vertical Channel Design**



**Figure 4. Vertical Channel Structure**

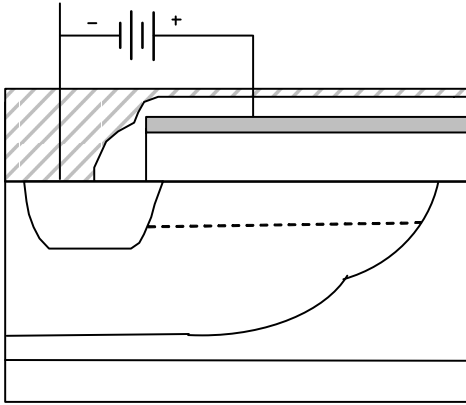




**CHARACTERISTICS OF MOSFET IN ON AND OFF  
STATE**

**OFF State**

ON State



**Figure 9. Inversion Layer Thickness Changes due to the Increase of the Drain-to-Source Voltage ( $V_{DD}$ ) where  $V_{DD1} < V_{GS} - V_{GS(th)}$ ,  $V_{DD2} > V_{GS} - V_{GS(th)}$ ,  $I_{D2}$  (Saturation Current)  $> I_{D1}$**

User's manual

Characteristics of Capacitance

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$$C_{ds} \text{ (per unit area)} = \frac{q k_s \epsilon_0 C_B}{2 |V_{DS} + \phi_B|}$$

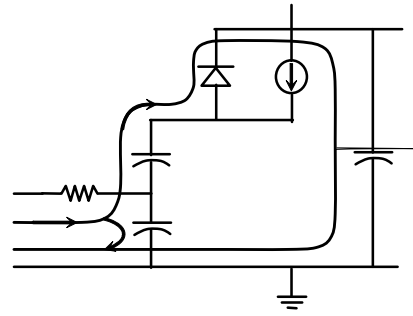
×

$\epsilon$

×

$\phi$

$$C_{ds} \propto \frac{1}{|V_{DS}|}$$



**Characteristics of the Gate Charge**

- 
- 
- 

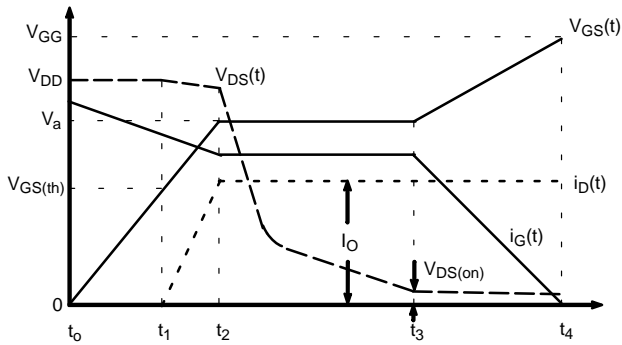


Figure 12.  $V_{GS}(t)$ ,  $I_G(t)$ ,  $V_{DS}(t)$ ,  $I_D(t)$  When Turned On

Figure 13. Equivalent Circuits of the MOSFET with Turn-on Divided into 4 Periods at the Diode-clamped Inductive Load Circuit





$$g_{fs}(T) = g_{fs}(25^{\circ}\text{C}) \left(\frac{T}{300}\right)^{-2.3} \quad (\text{eq. 8})$$

**Drain-Source Breakdown Voltage ( $BV_{DS}$  Breakdown  
Voltage Temperature Coefficient ( $\Delta BV/\Delta T_J$ ))**

AN-9010/D

-

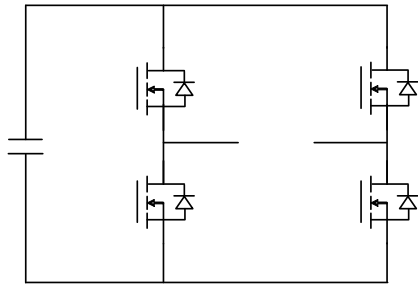


Figure 22. Motor Control Circuit

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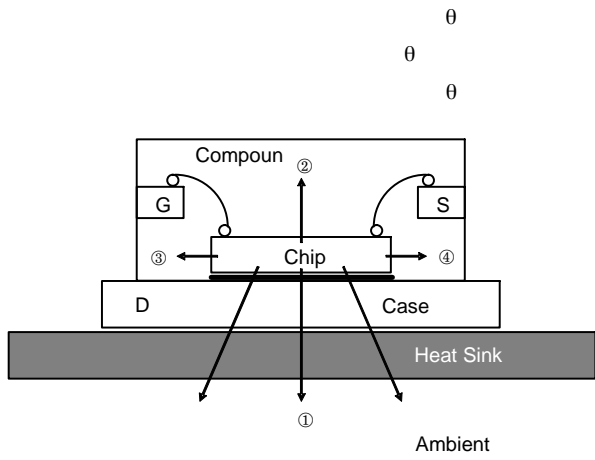


Figure 25. Thermal Discharge Path at Chip Junction

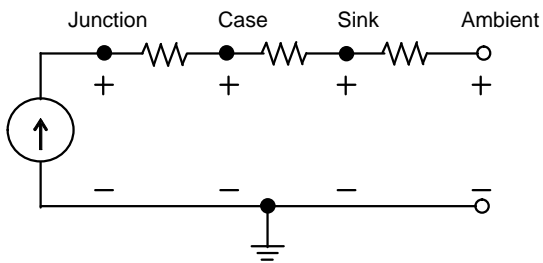


Figure 26. Circuit Based on Thermal Resistance

θ



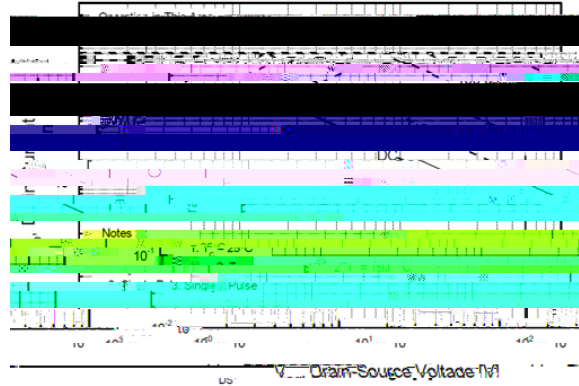
$$R_{\theta JC}(t) = R_{\theta JC} \cdot D + (1 - D) \cdot S_{\theta JC}(t) \quad (eq. 15)$$

$$\frac{1}{R_{\theta JC}} \quad (eq. 19)$$

**Safe Operating Areas (SOA)**

θ  
θ

$$I_D(T_C) = \frac{T_{Jmax} - T_C}{R_{DS(on)}(T_{Jmax}) \cdot R_{\theta JC}} \quad (eq. 16)$$



**Figure 29. Maximum Safe Operating Area**

$$\frac{1}{2} \cdot I_D$$

θ

○  
○  
○  
○

$$I_D(T_C) = \frac{T_{Jmax} - T_C}{R_{DS(on)}(T_{Jmax}) \cdot R_{\theta JC}} \quad (eq. 20)$$

$$I_{DM} = I_D(T_C) \times 4 \quad (eq. 21)$$

*The Upper Limit with Positive (+) Slope*

*The Upper Limit with Negative (-) Slope*

$$I_{DM} = I_D(T_C = 25^\circ\text{C}) \times 4 \quad (eq. 17)$$

**Total Power Dissipation (P<sub>D</sub>), Linear Derating Factor**

$$P_D(T_C) = I_D^2(T_C) \cdot R_{DS(on)}(T_{Jmax}) = \frac{T_{Jmax} - T_C}{R_{\theta JC}} \quad (eq. 18)$$

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