

Description

These N-Channel enhancement mode power field effect transistors are using trench DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and with stand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

Features

- ◆ 40V,120A, $R_{DS(on),max}=3.5m\Omega@V_{GS}=10V$
- ◆ Improved dv/dt capability
- ◆ Fast switching
- ◆ 100% EAS Guaranteed
- ◆ Green device available

Applications

- ◆ Motor Drives
- ◆ UPS
- ◆ DC-DC Converter

Product Summary

| | |
|-----------------------------|---------------|
| V_{DSS} | 40V |
| $R_{DS(on),max}@V_{GS}=10V$ | 3.5m Ω |
| I_D | 120A |

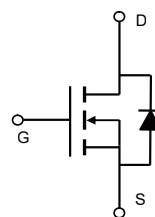
Pin Configuration



TO-220F



TO-220C



Schematic

Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

| Parameter | Symbol | Value | Unit |
|--|-----------|-------------|------------------|
| Drain-Source Voltage | V_{DSS} | 40 | V |
| Continuous drain current ($T_C = 25^\circ\text{C}$) ¹⁾ | I_D | 120 | A |
| Continuous drain current ($T_C = 100^\circ\text{C}$) ¹⁾ | | 82 | A |
| Pulsed drain current ²⁾ | I_{DM} | 480 | A |
| Gate-Source voltage | V_{GSS} | ± 20 | V |
| Avalanche energy ³⁾ | E_{AS} | 1040 | mJ |
| Power Dissipation ($T_C = 25^\circ\text{C}$) C C TO-220 | P_D | 150 | W |
| Power Dissipation ($T_C = 25^\circ\text{C}$) C C TO-220F | | 48 | W |
| Storage Temperature Range | T_{STG} | -55 to +150 | $^\circ\text{C}$ |
| Operating Junction Temperature Range | T_J | -55 to +150 | $^\circ\text{C}$ |

Thermal Characteristics

| Parameter | Symbol | Value | Unit |
|---|-----------------|-------|--------------------|
| Thermal Resistance, Junction-to-Case C C TO-220 | $R_{\theta JC}$ | 0.83 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case C C TO-220F | | 2.6 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Ambient C C TO-220 | $R_{\theta JA}$ | 62 | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Ambient C C TO-220F | | 80 | $^\circ\text{C/W}$ |

Package Marking and Ordering Information

| Device | Device Package | Marking |
|--------------|----------------|--------------|
| VSM120N04-TF | TO-220F | VSM120N04-TF |
| VSM120N04-TC | TO-220C | VSM120N04-TC |

Electrical Characteristics

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

| Parameter | Symbol | Test Condition | Min. | Typ. | Max. | Unit |
|--|---------------------|--|------|------|------|------|
| Static characteristics | | | | | | |
| Drain-source breakdown voltage | BV _{DSS} | V _{GS} =0 V, I _D =250uA | 40 | --- | --- | V |
| Gate threshold voltage | V _{GS(th)} | V _{DS} =V _{GS} , I _D =250uA | 1.3 | --- | 2.5 | V |
| Drain-source leakage current | I _{DSS} | V _{DS} =40 V, V _{GS} =0 V, T _J = 25°C | --- | --- | 1 | μA |
| | | V _{DS} =40 V, V _{GS} =0 V, T _J = 125°C | --- | --- | 10 | μA |
| Gate leakage current, Forward | I _{GSSF} | V _{GS} =20 V, V _{DS} =0 V | --- | --- | 100 | nA |
| Gate leakage current, Reverse | I _{GSSR} | V _{GS} =-20 V, V _{DS} =0 V | --- | --- | -100 | nA |
| Drain-source on-state resistance | R _{DS(on)} | V _{GS} =10 V, I _D =20 A | --- | 2.7 | 3.5 | mΩ |
| | | V _{GS} =4.5 V, I _D =10 A | --- | 3.8 | 6.0 | mΩ |
| Forward transconductance | g _{fs} | V _{DS} =5 V , I _D =50A | 26 | --- | --- | S |
| Dynamic characteristics | | | | | | |
| Input capacitance | C _{iss} | V _{DS} = 20 V, V _{GS} = 0 V, F = 1MHz | --- | 7810 | --- | pF |
| Output capacitance | C _{oss} | | --- | 677 | --- | |
| Reverse transfer capacitance | C _{rss} | | --- | 370 | --- | |
| Turn-on delay time | t _{d(on)} | V _{DD} = 20V,V _{GS} =10V, I _D =20 A | --- | 15 | --- | ns |
| Rise time | t _r | | --- | 17 | --- | |
| Turn-off delay time | t _{d(off)} | | --- | 52 | --- | |
| Fall time | t _f | | --- | 23 | --- | |
| Gate resistance | R _g | V _{GS} =0V, V _{DS} =0V, F=1MHz | --- | 2.12 | --- | Ω |
| Gate charge characteristics | | | | | | |
| Gate to source charge | Q _{gs} | V _{DS} =20 V, I _D =100A, V _{GS} = 10 V | --- | 36.4 | --- | nC |
| Gate to drain charge | Q _{gd} | | --- | 37.3 | --- | |
| Gate charge total | Q _g | | --- | 139 | --- | |
| Drain-Source diode characteristics and Maximum Ratings | | | | | | |
| Continuous Source Current | I _S | | --- | --- | 120 | A |
| Pulsed Source Current ⁴⁾ | I _{SM} | | --- | --- | 480 | A |
| Diode Forward Voltage | V _{SD} | V _{GS} =0V, I _S =50A, T _J =25°C | --- | --- | 1.2 | V |
| Reverse Recovery Time | t _{rr} | I _S =100A, di/dt=100A/us, | --- | 42 | --- | ns |
| Reverse Recovery Charge | Q _{rr} | T _J =25°C | --- | 120 | --- | nC |

Notes:

- 1: The maximum junction current rating is package limited.
- 2: Repetitive Rating: Pulse width limited by maximum junction temperature.
- 3: $V_{DD}=20\text{V}, V_{GS}=10\text{V}, L=1\text{mH}, I_{AS}=45.6\text{A}, R_G=25\Omega$, Starting $T_J=25^{\circ}\text{C}$.
- 4: Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.

Electrical Characteristics Diagrams

Figure 1. Typ. Output Characteristics

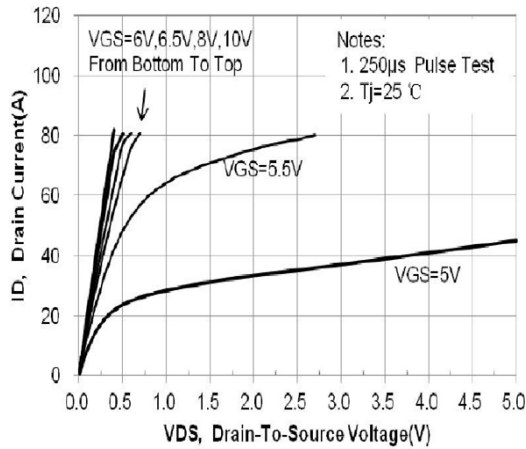


Figure 2. Transfer Characteristics

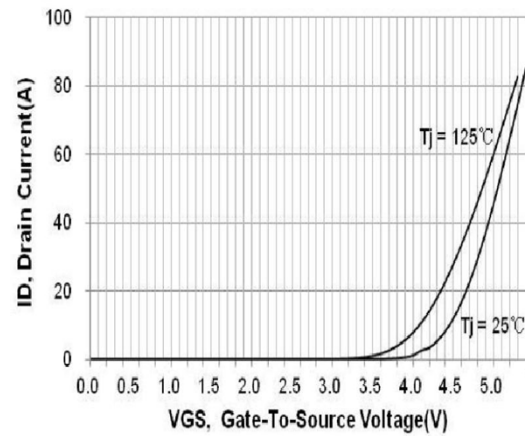


Figure 3. Capacitance Characteristics

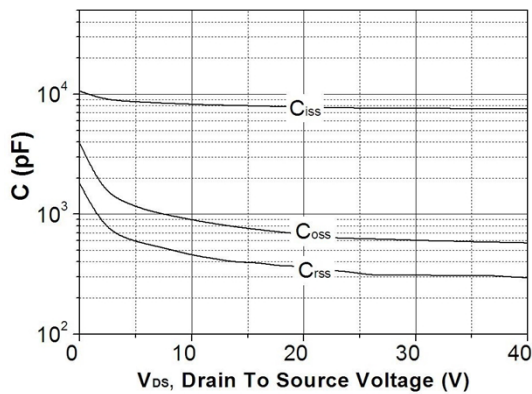


Figure 4. Gate Charge Waveform

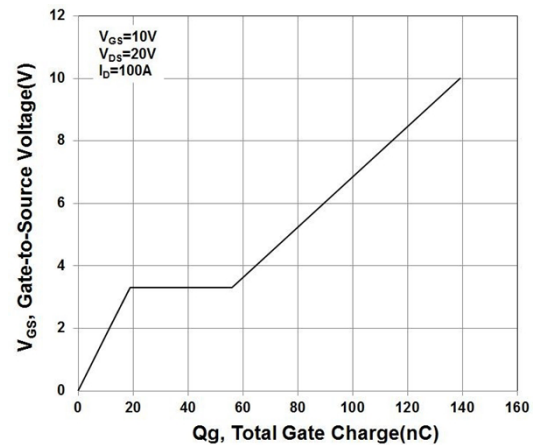


Figure 5. Body-Diode Characteristics

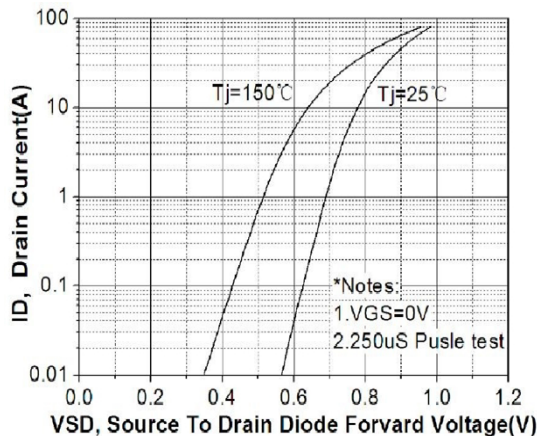


Figure 6. Maximum Safe Operating Area

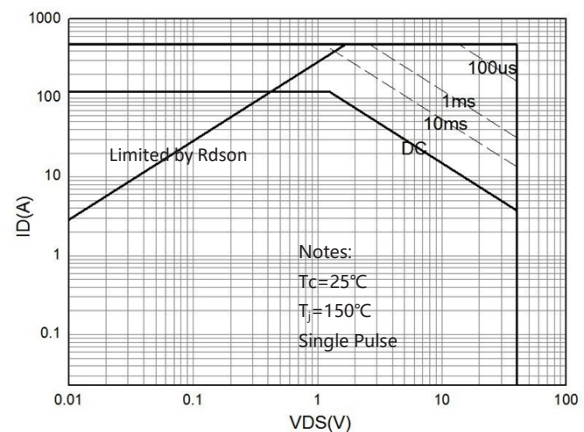


Figure 6. Normalized Maximum Transient Thermal Impedance (RthJC)

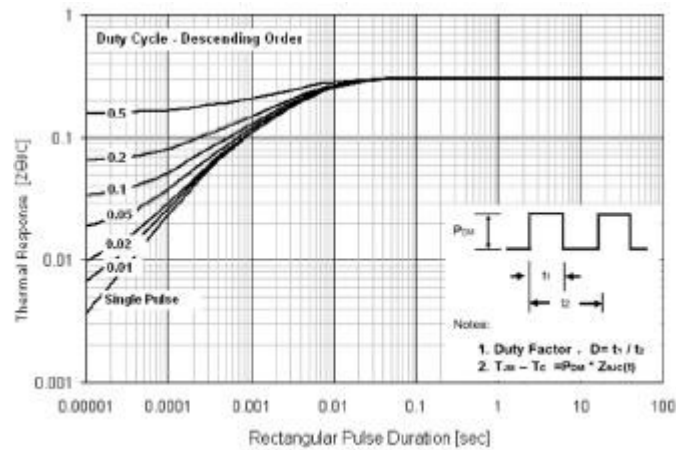
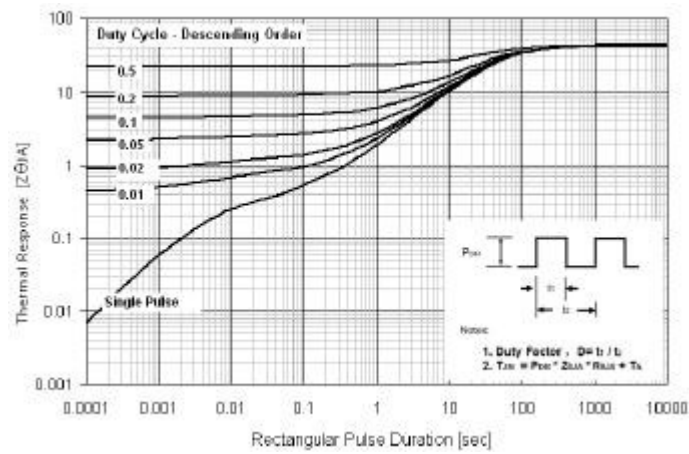


Figure 7. Normalized Maximum Transient Thermal Impedance (RthJA)



Test Circuit & Waveform

Figure 8. Gate Charge Test Circuit & Waveform

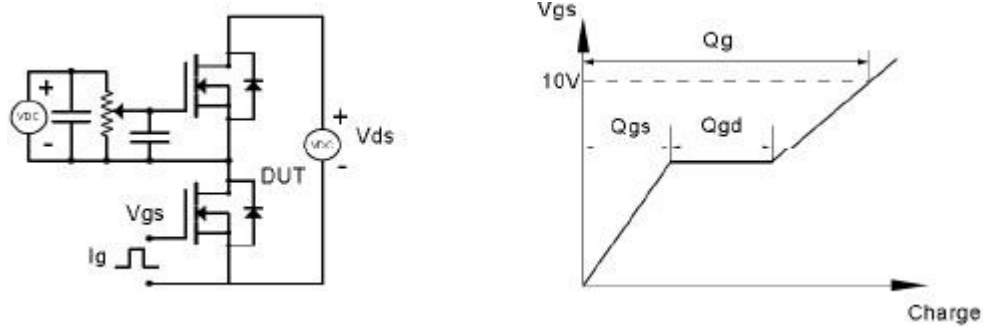


Figure 9. Resistive Switching Test Circuit & Waveforms

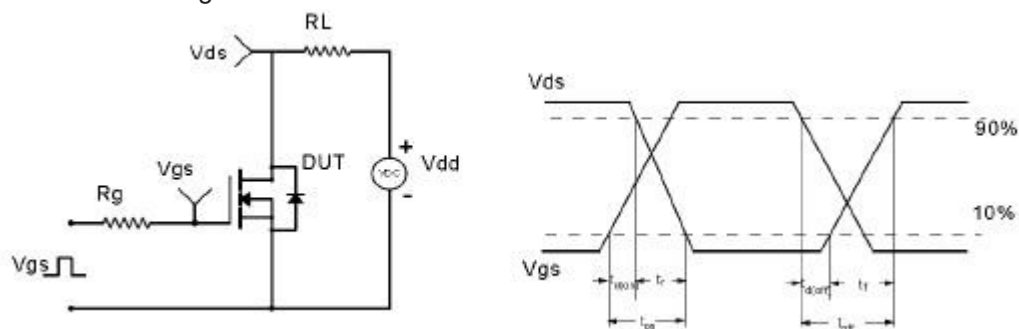


Figure 10. Unclamped Inductive Switching (UIS) Test Circuit & Waveform

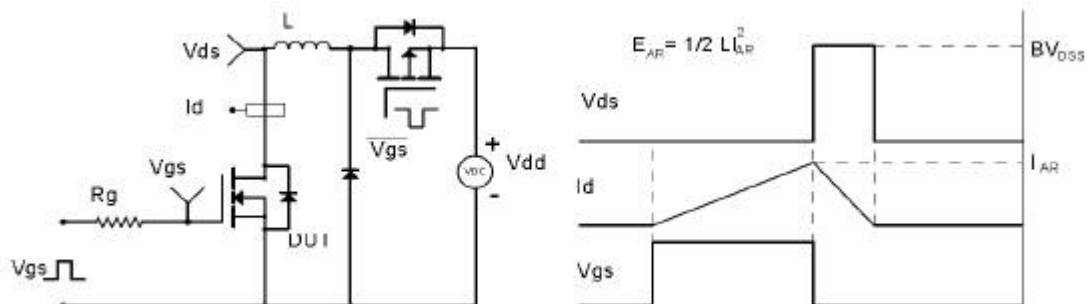


Figure 11. Diode Recovery Circuit & Waveform

