

Description

The VSM120N04 uses advanced trench technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. It can be used in a wide variety of applications.

General Features

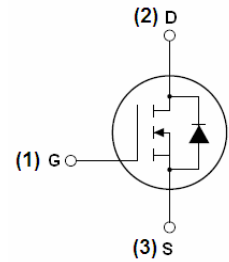
- $V_{DS} = 40V, I_D = 120A$
 $R_{DS(ON)} < 4.0m\Omega @ V_{GS} = 10V$
 $R_{DS(ON)} < 7m\Omega @ V_{GS} = 4.5V$
- High density cell design for ultra low R_{dson}
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high E_{AS}
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

Application

- Load switching
- Hard switched and high frequency circuits
- Uninterruptible power supply



TO-252



Schematic Diagram

Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|----------------|-----------|----------------|-----------|------------|----------|
| VSM120N04-T2 | VSM120N04 | TO-252 | - | - | - |

Absolute Maximum Ratings ($T_C = 25^\circ C$ unless otherwise noted)

| Parameter | Symbol | Limit | Unit |
|--|--------------------|------------|---------------|
| Drain-Source Voltage | V_{DS} | 40 | V |
| Gate-Source Voltage | V_{GS} | ± 20 | V |
| Drain Current-Continuous | I_D | 120 | A |
| Drain Current-Continuous($T_C = 100^\circ C$) | $I_D(100^\circ C)$ | 85 | A |
| Pulsed Drain Current | I_{DM} | 330 | A |
| Maximum Power Dissipation | P_D | 120 | W |
| Derating factor | | 0.8 | W/ $^\circ C$ |
| Single pulse avalanche energy (Note 5) | E_{AS} | 1080 | mJ |
| Operating Junction and Storage Temperature Range | T_J, T_{STG} | -55 To 175 | $^\circ C$ |

Thermal Characteristic

| | | | |
|--|-----------------|------|----------------------|
| Thermal Resistance, Junction-to-Case ^(Note 2) | $R_{\theta JC}$ | 1.25 | $^{\circ}\text{C/W}$ |
|--|-----------------|------|----------------------|

Electrical Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---------------------|--|-----|------|------|------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | BV _{DSS} | V _{GS} =0V I _D =250μA | 40 | 45 | - | V |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} =40V, V _{GS} =0V | - | - | 1 | μA |
| Gate-Body Leakage Current | I _{GSS} | V _{GS} =±20V, V _{DS} =0V | - | - | ±100 | nA |
| On Characteristics ^(Note 3) | | | | | | |
| Gate Threshold Voltage | V _{GS(th)} | V _{DS} =V _{GS} , I _D =250μA | 1.2 | 1.8 | 2.5 | V |
| Drain-Source On-State Resistance | R _{DS(ON)} | V _{GS} =10V, I _D =20A | - | 3.6 | 4.0 | mΩ |
| | | V _{GS} =4.5V, I _D =10A | - | 5.8 | 7.0 | |
| Forward Transconductance | g _{FS} | V _{DS} =10V, I _D =20A | 26 | - | - | S |
| Dynamic Characteristics ^(Note4) | | | | | | |
| Input Capacitance | C _{iss} | V _{DS} =20V, V _{GS} =0V, F=1.0MHz | - | 5400 | - | PF |
| Output Capacitance | C _{Oss} | | - | 970 | - | PF |
| Reverse Transfer Capacitance | C _{rss} | | - | 380 | - | PF |
| Switching Characteristics ^(Note 4) | | | | | | |
| Turn-on Delay Time | t _{d(on)} | V _{DD} =20V, I _D =2A, R _L =1Ω V _{GS} =10V, R _G =3Ω | - | 15 | - | nS |
| Turn-on Rise Time | t _r | | - | 18 | - | nS |
| Turn-Off Delay Time | t _{d(off)} | | - | 52 | - | nS |
| Turn-Off Fall Time | t _f | | - | 23 | - | nS |
| Total Gate Charge | Q _g | V _{DS} =20V, I _D =20A, V _{GS} =10V | - | 75 | | nC |
| Gate-Source Charge | Q _{gs} | | - | 10.5 | | nC |
| Gate-Drain Charge | Q _{gd} | | - | 17 | | nC |
| Drain-Source Diode Characteristics | | | | | | |
| Diode Forward Voltage ^(Note 3) | V _{SD} | V _{GS} =0V, I _S =40A | - | | 1.2 | V |
| Diode Forward Current ^(Note 2) | I _S | | - | - | 120 | A |
| Reverse Recovery Time | t _{rr} | T _J = 25°C, IF = 40A di/dt = 100A/μs ^(Note3) | - | 42 | - | nS |
| Reverse Recovery Charge | Q _{rr} | | - | 45 | - | nC |
| Forward Turn-On Time | t _{on} | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD) | | | | |

Notes:

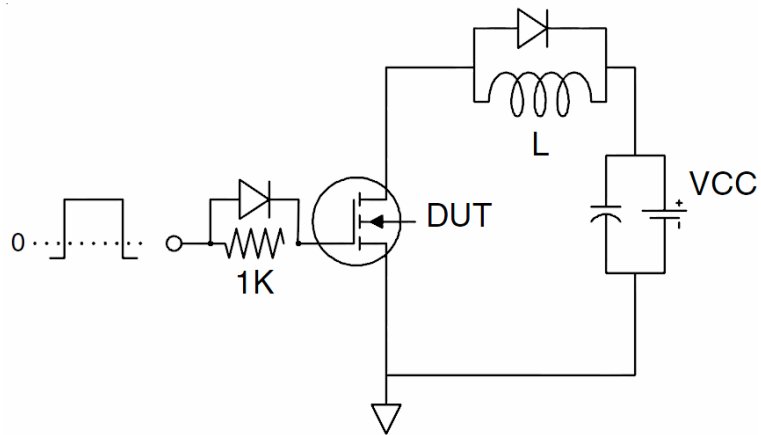
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, $t \leq 10$ sec.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production
5. E_{AS} condition : $T_J=25^{\circ}\text{C}, V_{DD}=20V, V_G=10V, L=1\text{mH}, R_g=25\Omega, I_{AS}=46.5A$

Test circuit

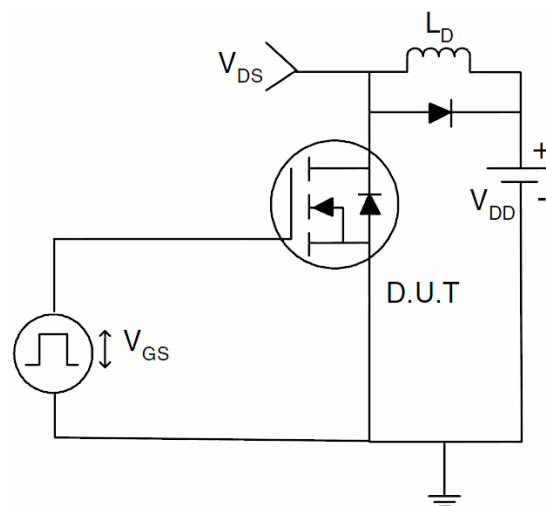
1) E_{AS} Test Circuit



2) Gate Charge Test Circuit



3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics (Curves)

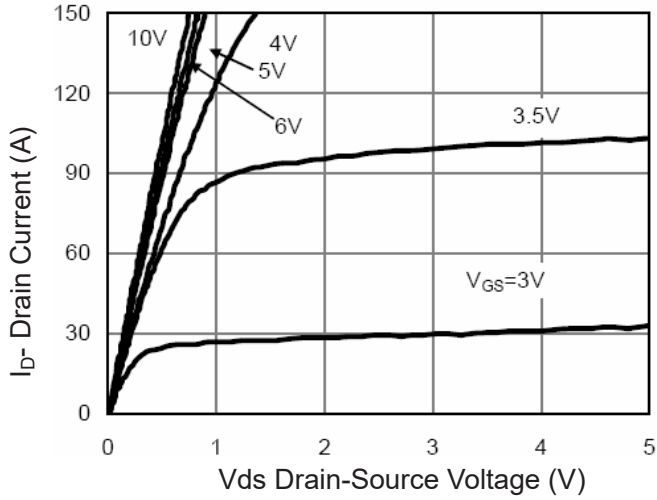


Figure 1 Output Characteristics

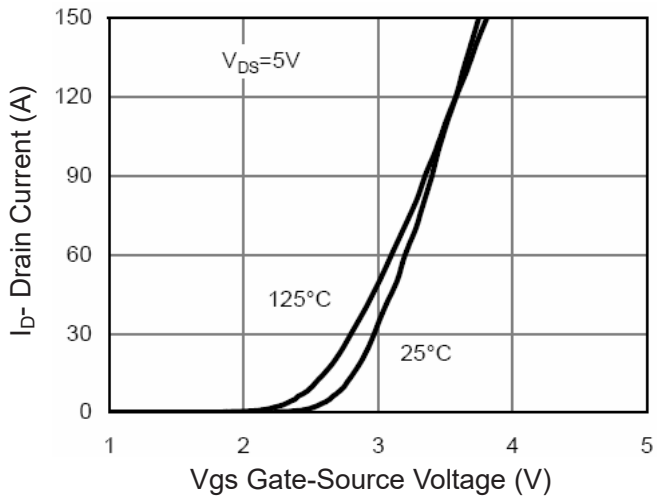


Figure 2 Transfer Characteristics

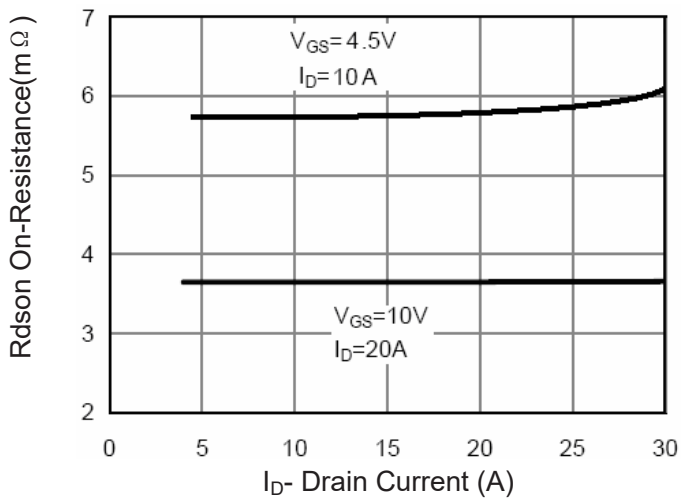


Figure 3 Rdson- Drain Current

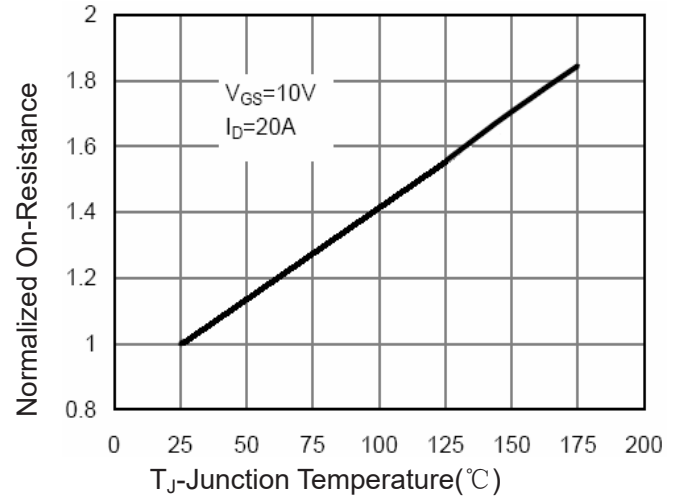


Figure 4 Rdson-Junction Temperature

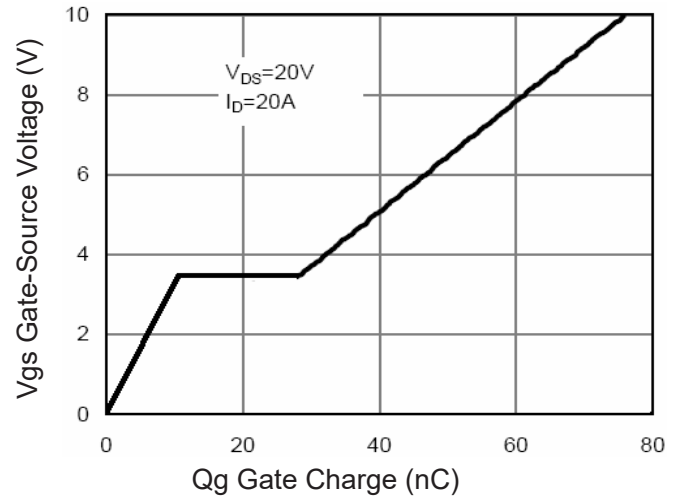


Figure 5 Gate Charge

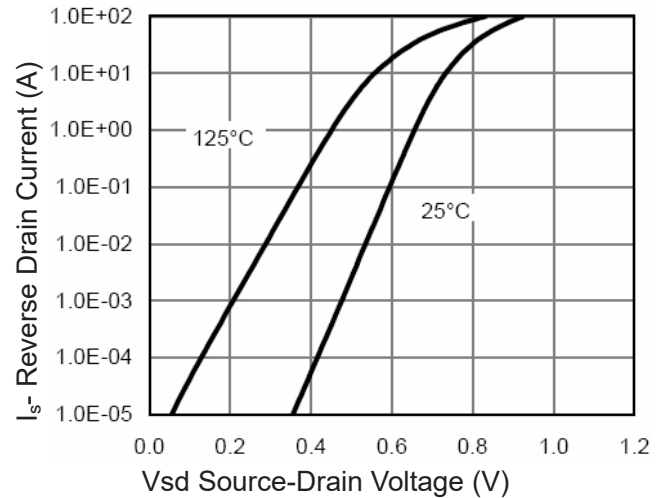
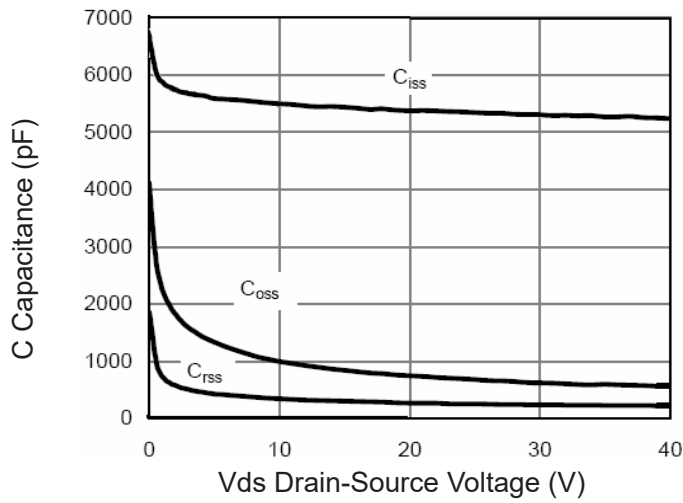
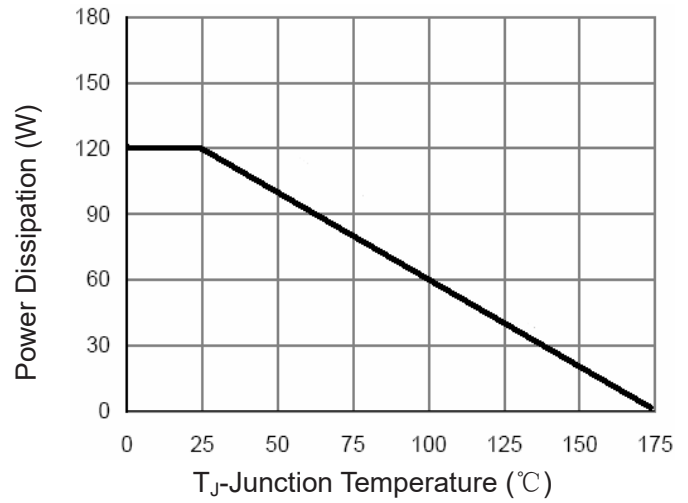
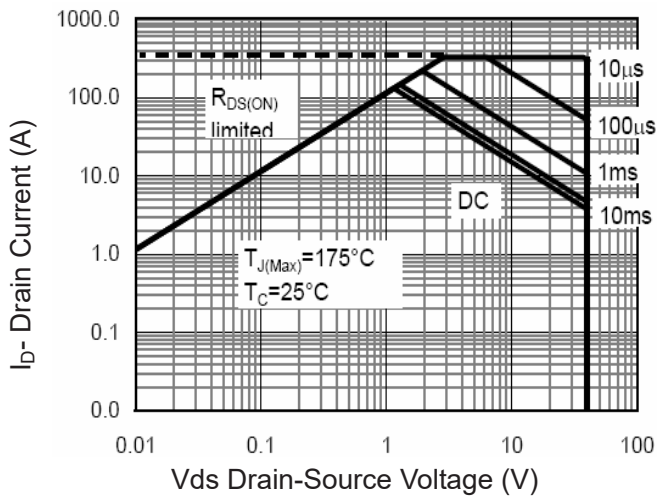
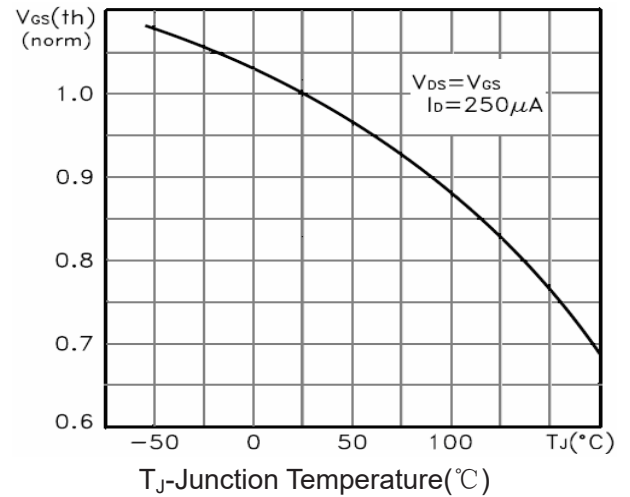
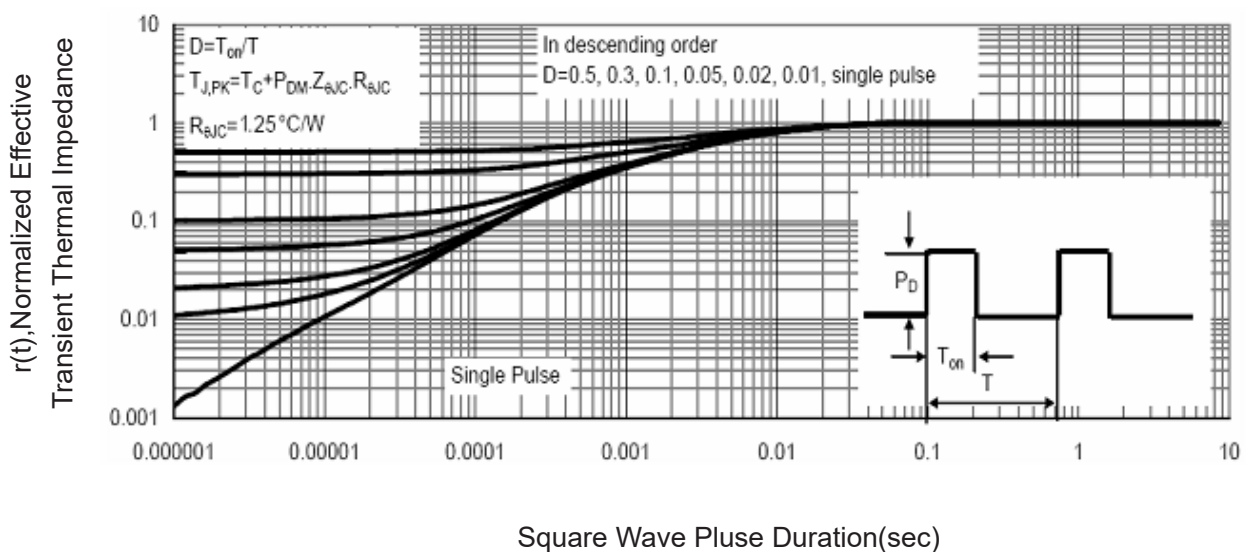


Figure 6 Source- Drain Diode Forward


Figure 7 Capacitance vs Vds

Figure 9 Power De-rating

Figure 8 Safe Operation Area

Figure 10 $V_{GS(\text{th})}$ vs Junction Temperature

Figure 11 Normalized Maximum Transient Thermal Impedance