

NCE60T1K5I-VB Datasheet

Power MOSFET

PRODUCT SUMMARY

| | | |
|---------------------------|------------------------|-----|
| V_{DS} (V) | 600 | |
| $R_{DS(on)}$ (Ω) | $V_{GS} = 10\text{ V}$ | 2.2 |
| Q_g (Max.) (nC) | 39 | |
| Q_{gs} (nC) | 10 | |
| Q_{gd} (nC) | 19 | |
| Configuration | Single | |

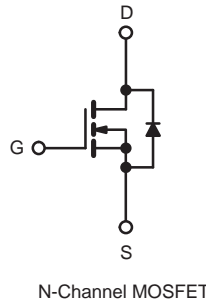
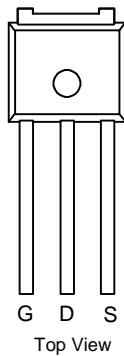
FEATURES

- Ultra Low Gate Charge
- Reduced Gate Drive Requirement
- Enhanced 30 V, V_{GS} Rating
- Reduced C_{iss} , C_{oss} , C_{rss}
- Extremely High Frequency Operation
- Repetitive Avalanche Rated
- Compliant to RoHS Directive 2002/95/EC



Available
RoHS*
 COMPLIANT

TO-251



ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted)

| PARAMETER | | | SYMBOL | LIMIT | UNIT |
|--|-------------------------|-------------------------|-----------------------------------|------------------|----------|
| Drain-Source Voltage | | | V _{DS} | 600 | V |
| Gate-Source Voltage | | | V _{GS} | ± 30 | |
| Continuous Drain Current | V _{GS} at 10 V | T _C = 25 °C | I _D | 5.5 | A |
| | | T _C = 100 °C | | 4.9 | |
| Pulsed Drain Current ^a | | | I _{DM} | 25 | |
| Linear Derating Factor | | | | 1.0 | W/°C |
| Single Pulse Avalanche Energy ^b | | | E _{AS} | 530 | mJ |
| Repetitive Avalanche Current ^a | | | I _{AR} | 6.2 | A |
| Repetitive Avalanche Energy ^a | | | E _{AR} | 13 | mJ |
| Maximum Power Dissipation | T _C = 25 °C | | P _D | 125 | W |
| Peak Diode Recovery dV/dt ^c | | | dV/dt | 3.0 | V/ns |
| Operating Junction and Storage Temperature Range | | | T _J , T _{stg} | - 55 to + 150 | °C |
| Soldering Recommendations (Peak Temperature) | for 10 s | | | 300 ^d | |
| Mounting Torque | 6-32 or M3 screw | | | 10 | lbf · in |
| | | | | 1.1 | N · m |

Notes

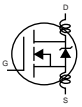

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 50\text{ V}$, starting $T_J = 25\text{ }^\circ\text{C}$, $L = 25\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 6.2\text{ A}$ (see fig. 12).
- $I_{SD} \leq 6.2\text{ A}$, $dI/dt \leq 80\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^\circ\text{C}$.
- 1.6 mm from case.

* Pb containing terminations are not RoHS compliant, exemptions may apply

THERMAL RESISTANCE RATINGS

| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
|-------------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient | R_{thJA} | - | 62 | °C/W |
| Case-to-Sink, Flat, Greased Surface | R_{thCS} | 0.50 | - | |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 1.0 | |

SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---------------------|--|---|------|------|-----------|-----------------------|
| Static | | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | | 600 | - | - | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}, I_D = 1\text{ mA}$ | | - | 0.70 | - | V/ $^{\circ}\text{C}$ |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | | 2.0 | - | 4.0 | V |
| Gate-Source Leakage | I_{GSS} | $V_{GS} = \pm 20$ | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$ | | - | - | 100 | μA |
| | | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^{\circ}\text{C}$ | | - | - | 500 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 3.7\text{ A}^b$ | - | 2.2 | - | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 100\text{ V}, I_D = 3.7\text{ A}^b$ | | 3.7 | - | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}$ $V_{DS} = 25\text{ V}$ $f = 1.0\text{ MHz}$, see fig. 5 | | - | 1100 | - | pF |
| Output Capacitance | C_{oss} | | | - | 140 | - | |
| Reverse Transfer Capacitance | C_{rss} | | | - | 15 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10\text{ V}$ | $I_D = 4\text{ A}, V_{DS} = 360\text{ V}$, see fig. 6 and 13 ^b | - | - | 39 | nC |
| Gate-Source Charge | Q_{gs} | | | - | - | 10 | |
| Gate-Drain Charge | Q_{gd} | | | - | - | 19 | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 300\text{ V}, I_D = 4\text{ A}$ $R_g = 9.1\text{ }\Omega, R_D = 47\text{ }\Omega$, see fig. 10 ^b | | - | 12 | - | ns |
| Rise Time | t_r | | | - | 20 | - | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 27 | - | |
| Fall Time | t_f | | | - | 17 | - | |
| Internal Drain Inductance | L_D | Between lead, 6 mm (0.25") from package and center of die contact  | | - | 4.5 | - | nH |
| Internal Source Inductance | L_S | | | - | 7.5 | - | |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 4.0 | A |
| Pulsed Diode Forward Current ^a | I_{SM} | | | - | - | 25 | |
| Body Diode Voltage | V_{SD} | $T_J = 25\text{ }^{\circ}\text{C}, I_S = 4\text{ A}, V_{GS} = 0\text{ V}^b$ | | - | - | 1.5 | V |
| Body Diode Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^{\circ}\text{C}, I_F = 4\text{ A}, dI/dt = 100\text{ A}/\mu\text{s}^b$ | | - | 440 | 680 | ns |
| Body Diode Reverse Recovery Charge | Q_{rr} | | | - | 2.1 | 3.2 | 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 $\leq 300\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

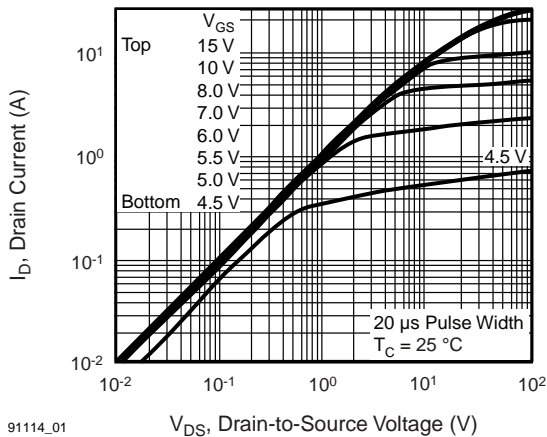


Fig. 1 - Typical Output Characteristics, $T_C = 25\text{ }^{\circ}\text{C}$

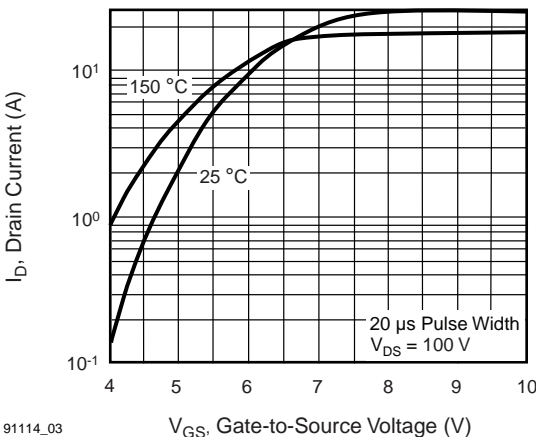


Fig. 3 - Typical Transfer Characteristics

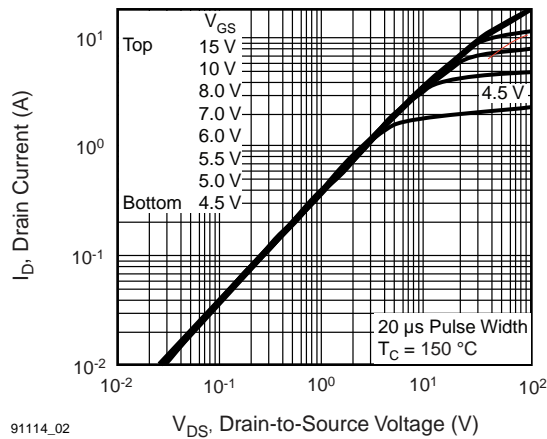


Fig. 2 - Typical Output Characteristics, $T_C = 150\text{ }^{\circ}\text{C}$

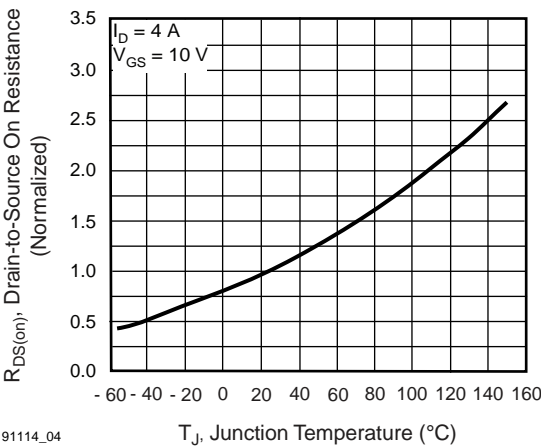
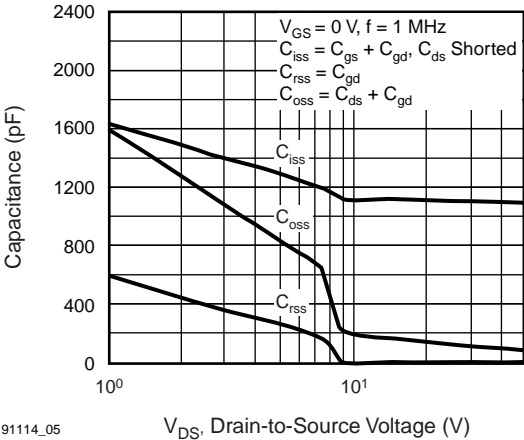
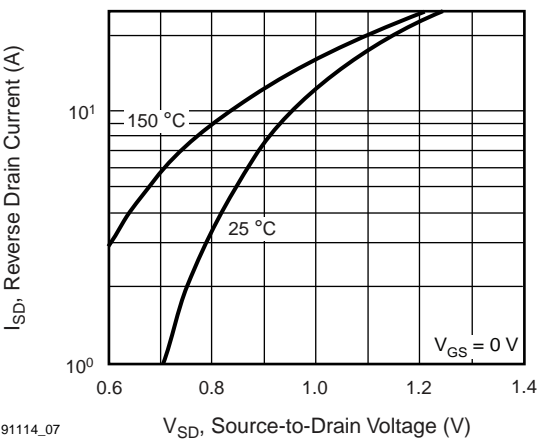


Fig. 4 - Normalized On-Resistance vs. Temperature



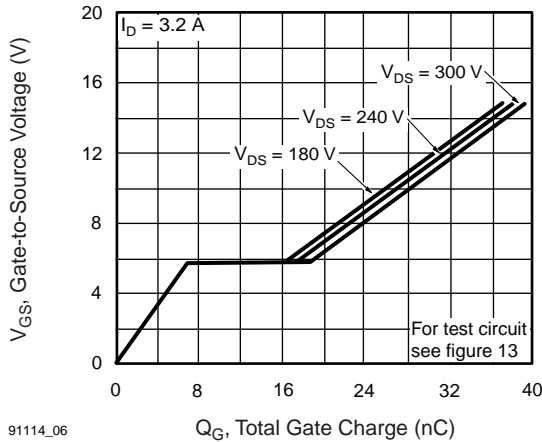
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Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage



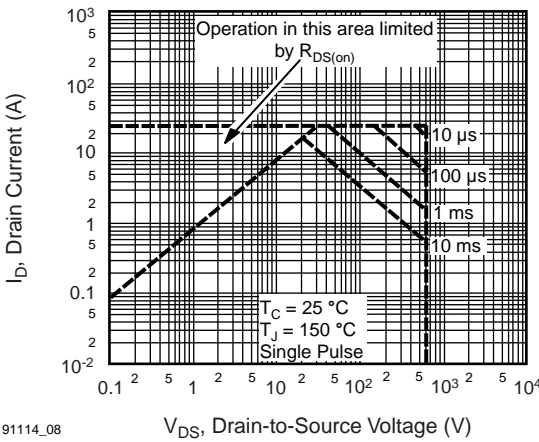
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Fig. 7 - Typical Source-Drain Diode Forward Voltage



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



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Fig. 8 - Maximum Safe Operating Area

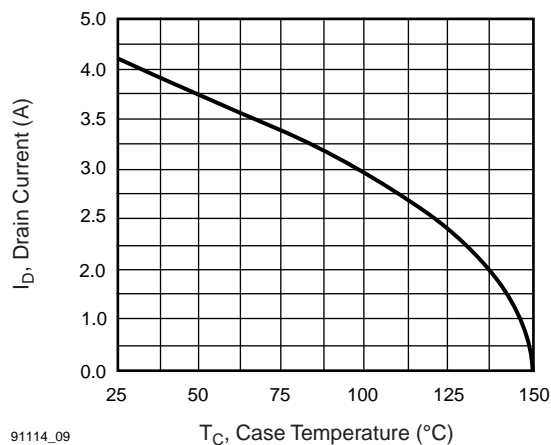


Fig. 9 - Maximum Drain Current vs. Case Temperature

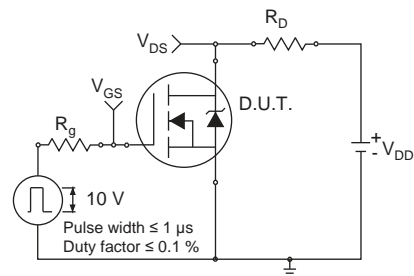


Fig. 10a - Switching Time Test Circuit

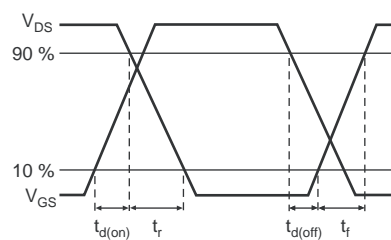


Fig. 10b - Switching Time Waveforms

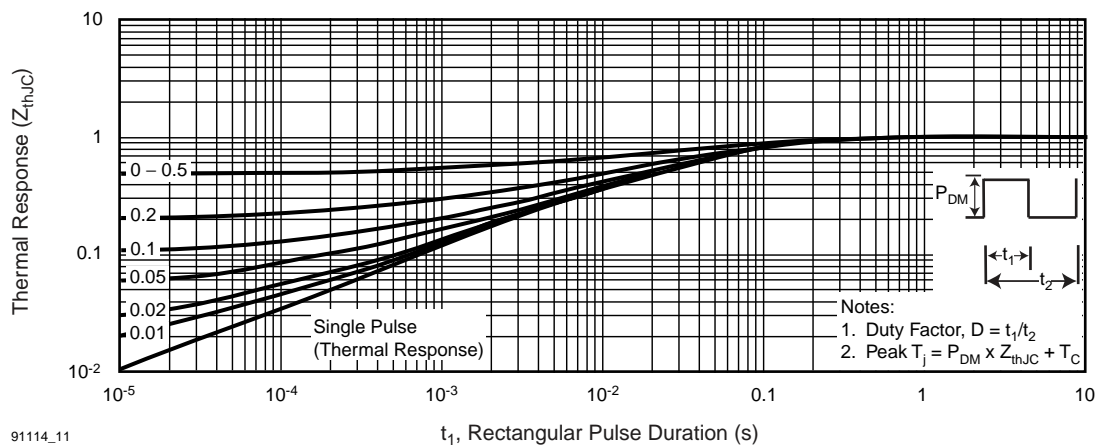


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

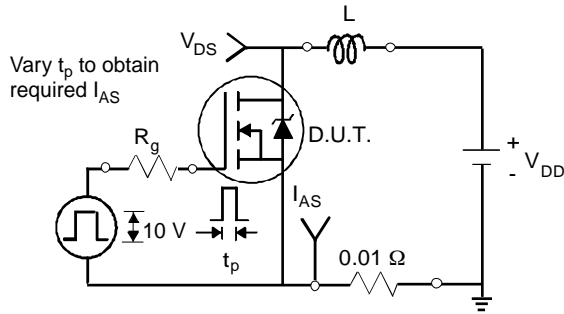


Fig. 12a - Unclamped Inductive Test Circuit

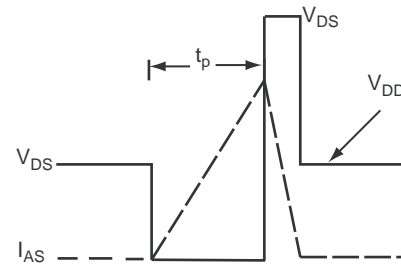


Fig. 12b - Unclamped Inductive Waveforms

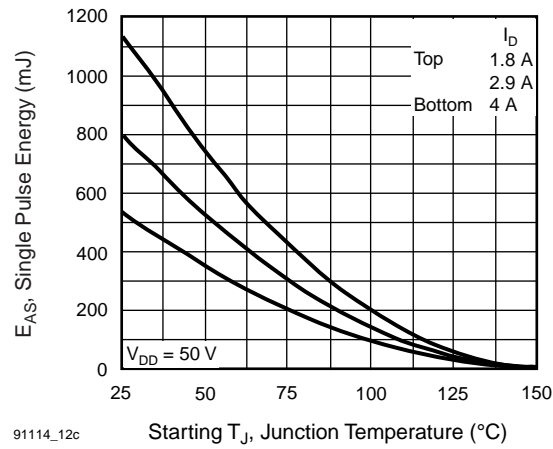


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

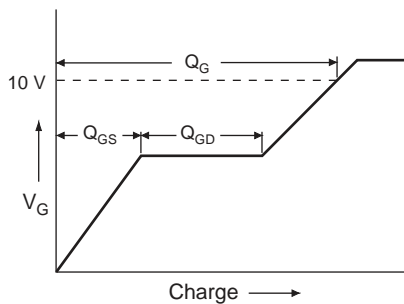


Fig. 13a - Basic Gate Charge Waveform

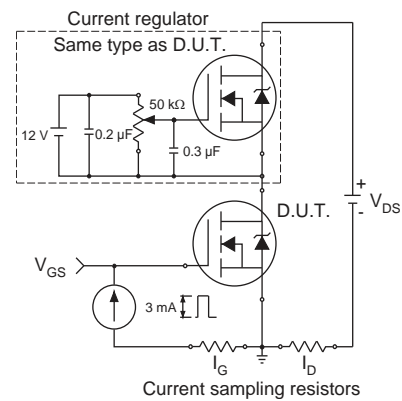
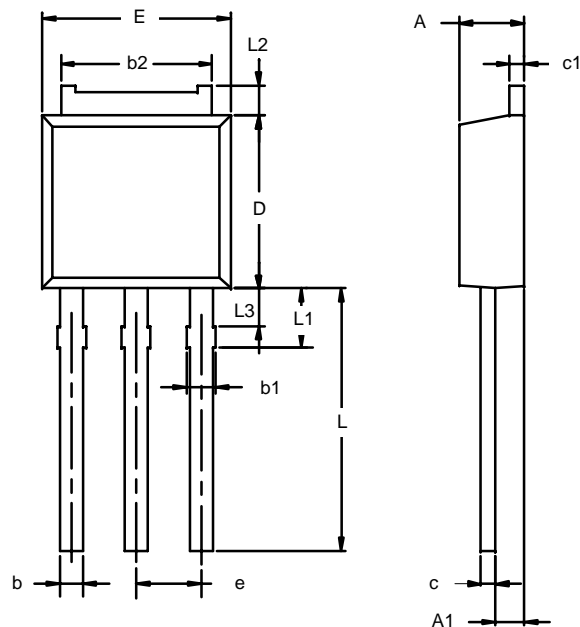


Fig. 13b - Gate Charge Test Circuit

TO-251AA (DPAK)



Note: Dimension L3 is for reference only.

| Dim | MILLIMETERS | | INCHES | |
|---|-------------|------|-----------|-------|
| | Min | Max | Min | Max |
| A | 2.21 | 2.38 | 0.087 | 0.094 |
| A1 | 0.89 | 1.14 | 0.035 | 0.045 |
| b | 0.71 | 0.89 | 0.028 | 0.035 |
| b1 | 0.76 | 1.14 | 0.030 | 0.045 |
| b2 | 5.23 | 5.43 | 0.206 | 0.214 |
| c | 0.46 | 0.58 | 0.018 | 0.023 |
| c1 | 0.46 | 0.58 | 0.018 | 0.023 |
| D | 5.97 | 6.22 | 0.235 | 0.245 |
| E | 6.48 | 6.73 | 0.255 | 0.265 |
| e | 2.28 BSC | | 0.090 BSC | |
| L | 8.89 | 9.53 | 0.350 | 0.375 |
| L1 | 1.91 | 2.28 | 0.075 | 0.090 |
| L2 | 0.89 | 1.27 | 0.035 | 0.050 |
| L3 | 1.15 | 1.52 | 0.045 | 0.060 |
| ECN: S-03946—Rev. E, 09-Jul-01 DWG: 5346 | | | | |

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