

NCE N-Channel Super Trench Power MOSFET

Description

The NCEP0178AF uses **Super Trench** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of $R_{DS(ON)}$ and Q_g . This device is ideal for high-frequency switching and synchronous rectification.

General Features

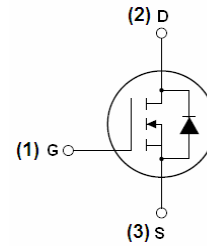
- $V_{DS} = 100V, I_D = 78A$
 $R_{DS(ON)} = 7.2m\Omega$ (typical) @ $V_{GS} = 10V$
 $R_{DS(ON)} = 9.5m\Omega$ (typical) @ $V_{GS} = 4.5V$
- Excellent gate charge x $R_{DS(on)}$ product(FOM)
- Very low on-resistance $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested

Application

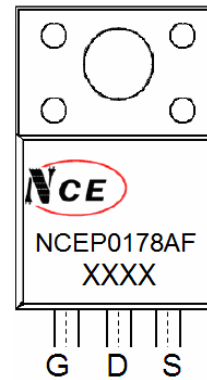
- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

100% UIS TESTED!

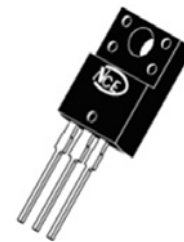
100% ΔV_{ds} TESTED!



Schematic diagram



Marking and pin assignment



TO-220F top view

Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|----------------|------------|----------------|-----------|------------|----------|
| NCEP0178AF | NCEP0178AF | TO-220F | - | - | - |

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

| Parameter | Symbol | Limit | Unit |
|---|--------------------|------------|---------------|
| Drain-Source Voltage | V_{DS} | 100 | V |
| Gate-Source Voltage | V_{GS} | ± 20 | V |
| Drain Current-Continuous | I_D | 78 | A |
| Drain Current-Continuous($T_C = 100^\circ C$) | $I_D(100^\circ C)$ | 60 | A |
| Pulsed Drain Current | I_{DM} | 320 | A |
| Maximum Power Dissipation | P_D | 50 | W |
| Derating factor | | 0.33 | W/ $^\circ C$ |
| Single pulse avalanche energy ^(Note 5) | E_{AS} | 320 | 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) | $R_{\theta JC}$ | 3 | $^{\circ}C/W$ |
|--|-----------------|---|---------------|

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

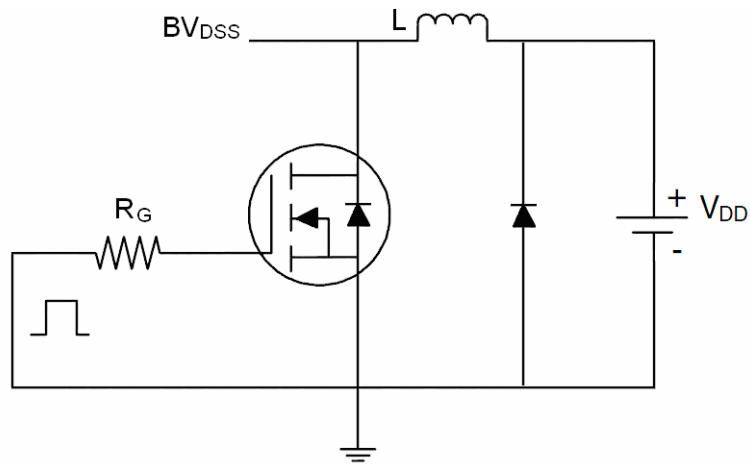
| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|--|--------------|--|-----|------|-----------|------------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0V, I_D=250\mu A$ | 100 | | - | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS}=100V, V_{GS}=0V$ | - | - | 1 | μA |
| Gate-Body Leakage Current | I_{GSS} | $V_{GS}=\pm 20V, V_{DS}=0V$ | - | - | ± 100 | nA |
| On Characteristics ^(Note 3) | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$ | 1.2 | 1.7 | 2.2 | V |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=39A$ | - | 7.2 | 8.5 | m Ω |
| | | $V_{GS}=4.5V, I_D=39A$ | - | 9.5 | 12 | m Ω |
| Forward Transconductance | g_{FS} | $V_{DS}=10V, I_D=39A$ | 40 | - | - | S |
| Dynamic Characteristics ^(Note 4) | | | | | | |
| Input Capacitance | C_{iss} | $V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$ | - | 4200 | 5480 | PF |
| Output Capacitance | C_{oss} | | - | 354 | 425 | PF |
| Reverse Transfer Capacitance | C_{rss} | | - | 23 | 30 | PF |
| Switching Characteristics ^(Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=50V, I_D=39A$ $V_{GS}=10V, R_G=4.7\Omega$ | - | 15 | - | nS |
| Turn-on Rise Time | t_r | | - | 10 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 41 | - | nS |
| Turn-Off Fall Time | t_f | | - | 6 | - | nS |
| Total Gate Charge | Q_g | $V_{DS}=50V, I_D=39A,$ $V_{GS}=10V$ | - | 65 | | nC |
| Gate-Source Charge | Q_{gs} | | - | 15.3 | | nC |
| Gate-Drain Charge | Q_{gd} | | - | 9 | | nC |
| Drain-Source Diode Characteristics | | | | | | |
| Diode Forward Voltage ^(Note 3) | V_{SD} | $V_{GS}=0V, I_S=78A$ | - | | 1.2 | V |
| Diode Forward Current ^(Note 2) | I_S | | - | - | 78 | A |
| Reverse Recovery Time | t_{rr} | $T_J = 25^{\circ}C, I_F = I_S$ $di/dt = 100A/\mu s$ ^(Note 3) | - | 101 | | nS |
| Reverse Recovery Charge | Q_{rr} | | - | 193 | | nC |

Notes:

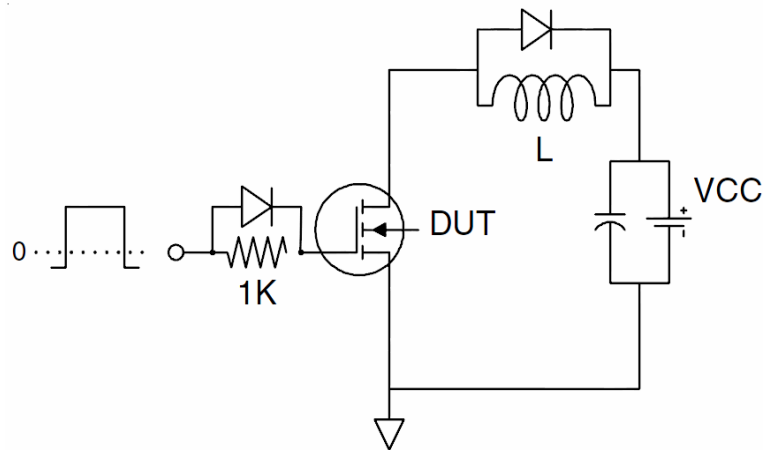
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, $t \leq 10$ sec.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production
5. EAS condition : $T_J=25^{\circ}C, V_{DD}=50V, V_G=10V, L=0.5mH, R_g=25\Omega$

Test Circuit

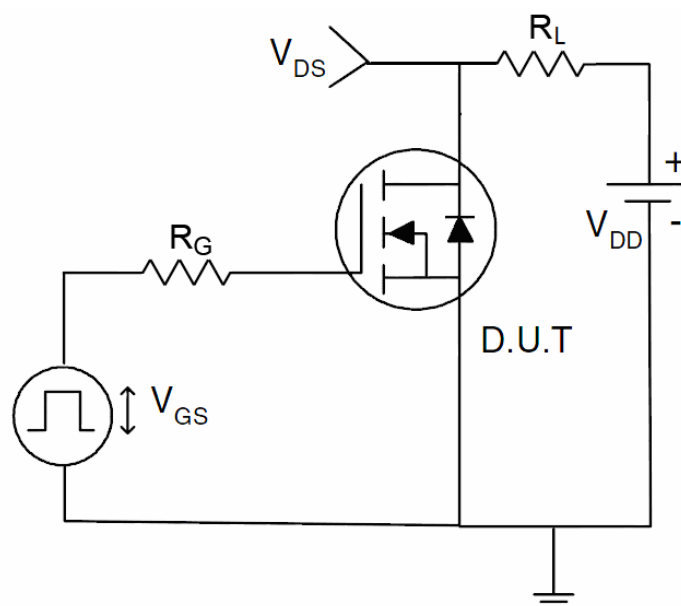
1) E_{AS} test Circuit



2) Gate charge test Circuit



3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics

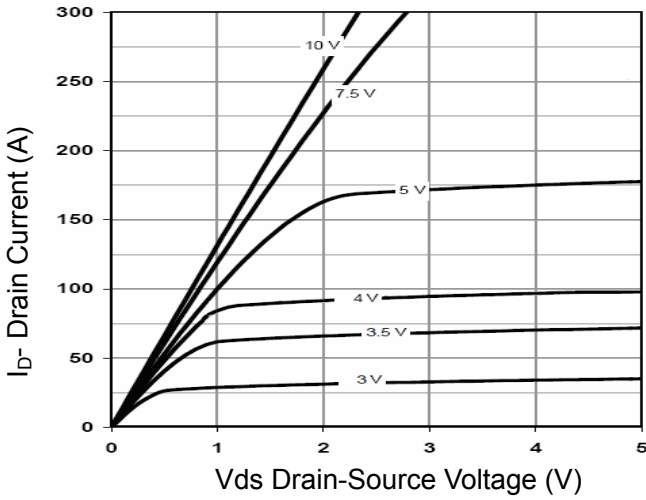


Figure 1 Output Characteristics

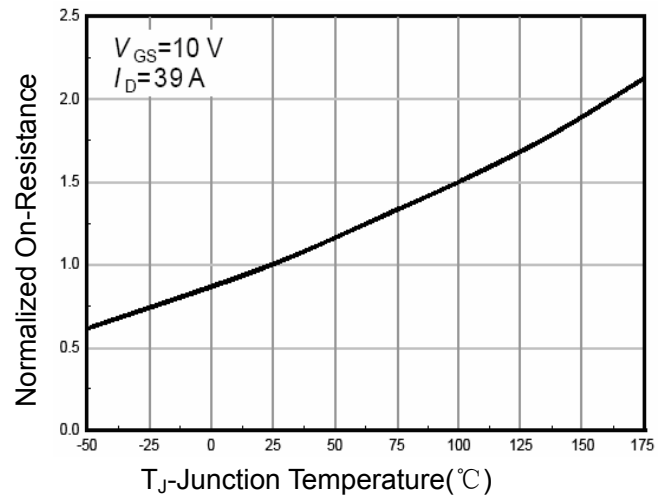


Figure 4 R_{dson} -Junction Temperature

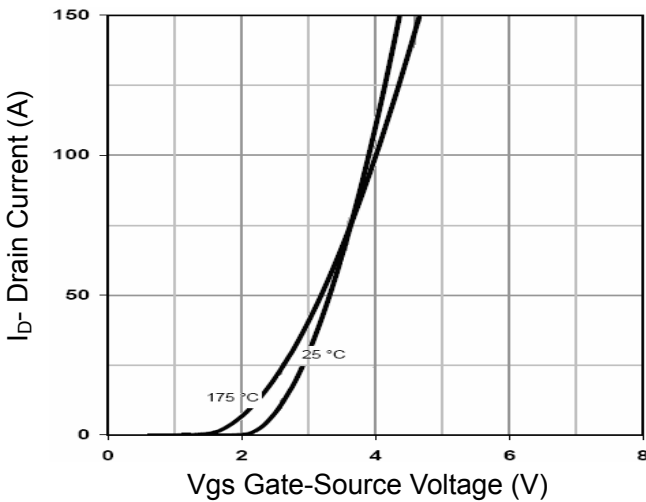


Figure 2 Transfer Characteristics

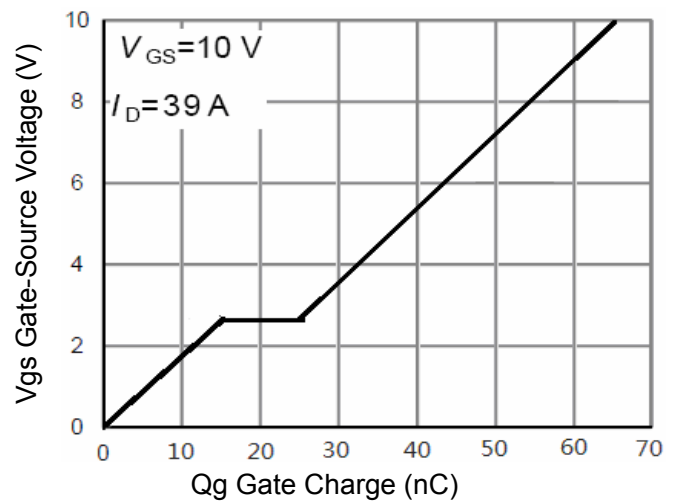


Figure 5 Gate Charge

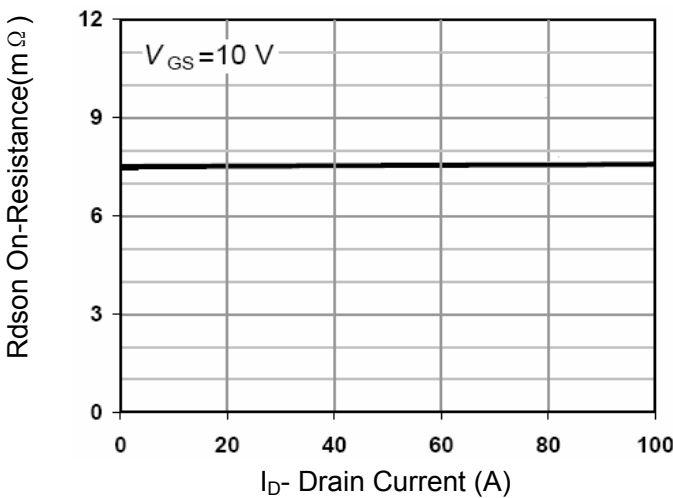


Figure 3 R_{dson} - Drain Current

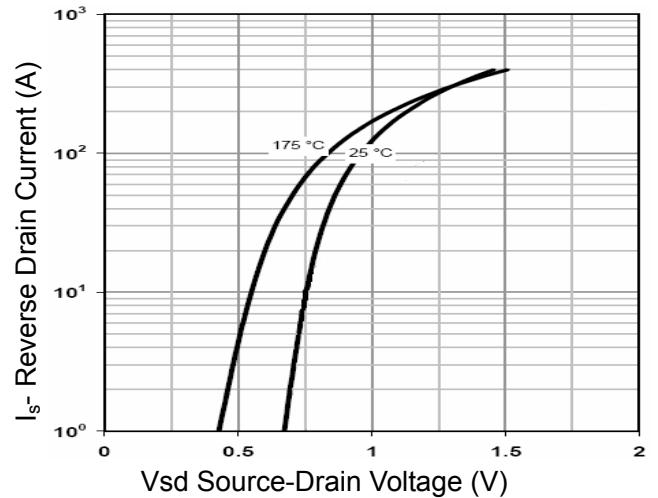


Figure 6 Source- Drain Diode Forward

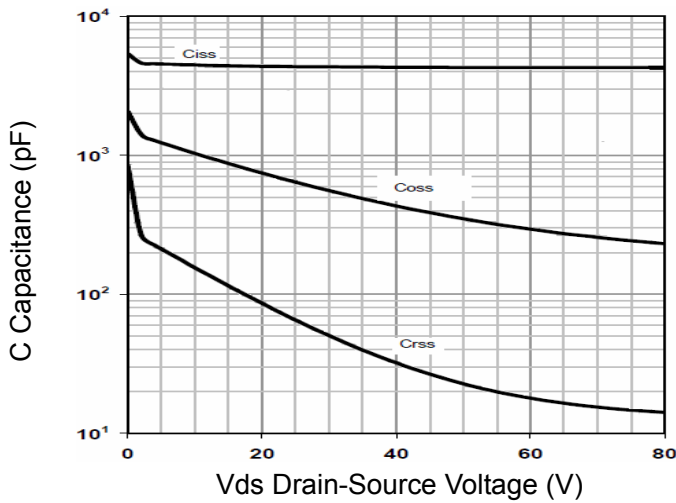


Figure 7 Capacitance vs Vds

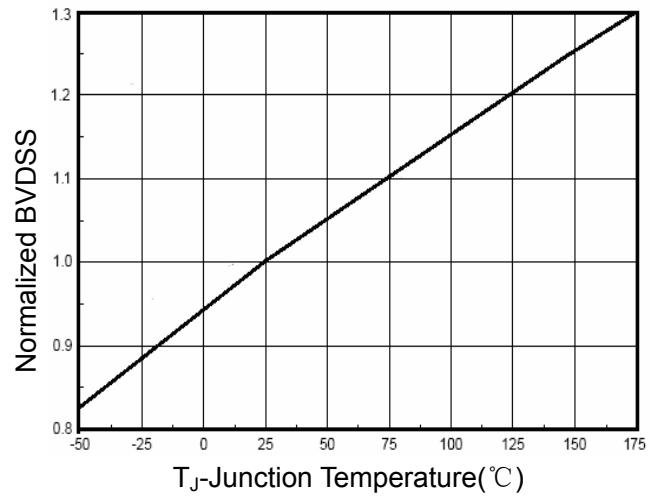


Figure 9 BV_{DSS} vs Junction Temperature

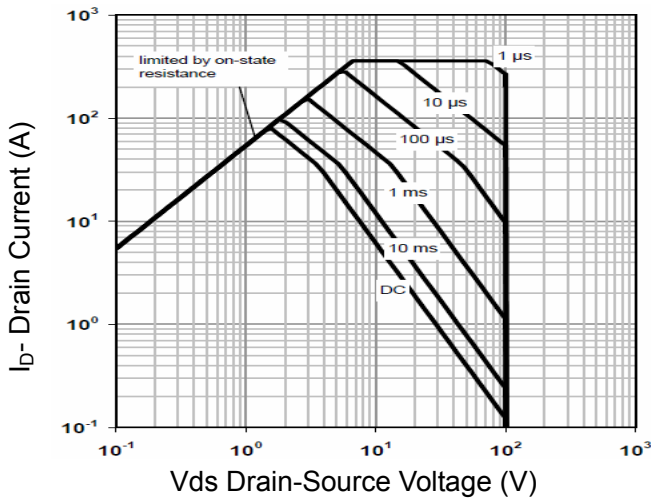


Figure 8 Safe Operation Area

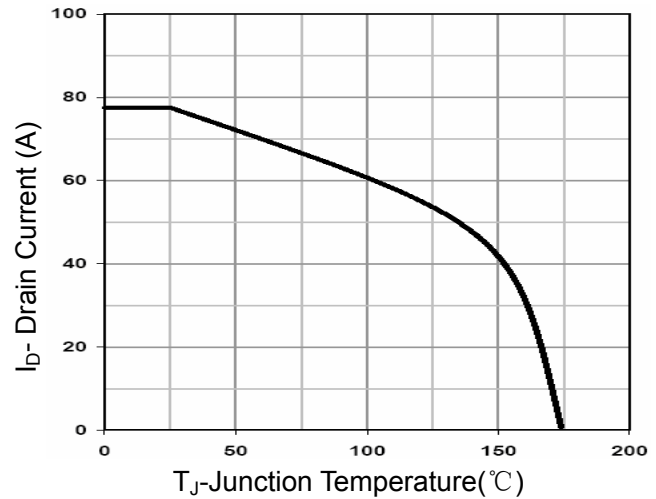


Figure 10 Current De-rating

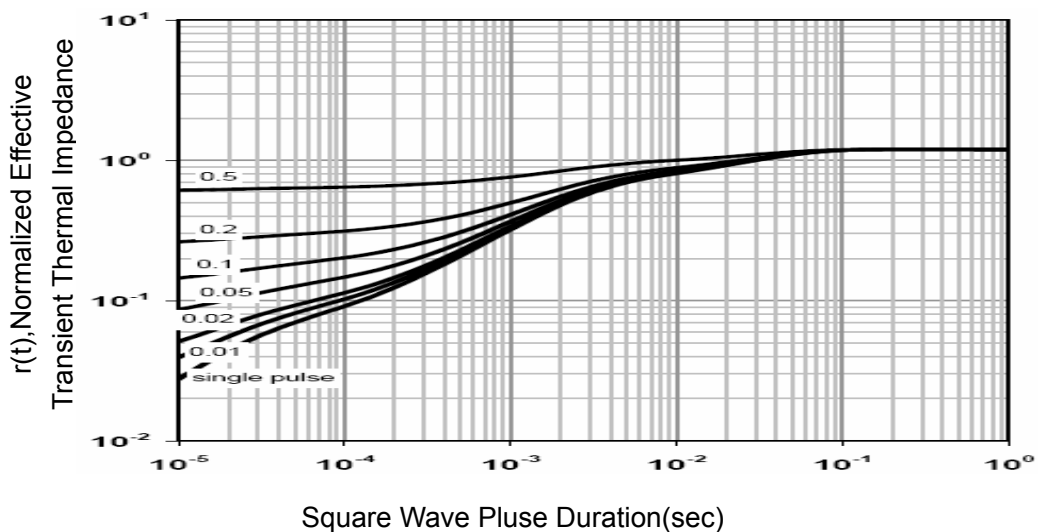
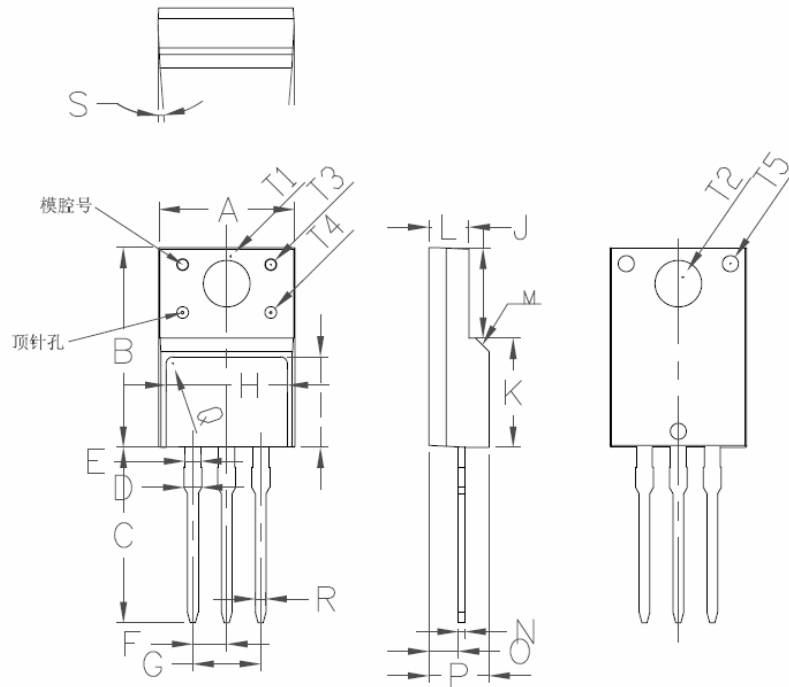


Figure 11 Normalized Maximum Transient Thermal Impedance

TO-220F Package Information



| Symbol | Dimensions In Millimeters | | |
|--------|---------------------------|-------|-------|
| | Min. | Non | Max. |
| A | 9.96 | 10.16 | 10.36 |
| B | 15.67 | 15.87 | 16.07 |
| C | 13.14 | 13.34 | 13.54 |
| D | 1.20 | 1.30 | 1.40 |
| E | | 1.20 | |
| F | | 2.54 | |
| G | | 5.08 | |
| H | 7.60 | 7.80 | 8.00 |
| I | 7.10 | 7.30 | 7.50 |
| J | 6.48 | 6.68 | 6.88 |
| K | 8.99 | 9.19 | 9.39 |
| L | 2.34 | 2.54 | 2.74 |
| N | 0.49 | 0.50 | 0.52 |
| O | 2.15 | 2.35 | 2.55 |
| P | 4.50 | 4.70 | 4.90 |
| T1 | | 3.45 | |
| T2 | | 3.18 | |
| T3 | | 1.50 | |
| T4 | | 1.20 | |
| T5 | | 1.50 | |
| R | 0.77 | 0.80 | 0.83 |

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