# NCE N-Channel Enhancement Mode Power MOSFET

## DESCRIPTION

The NCE60H21 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

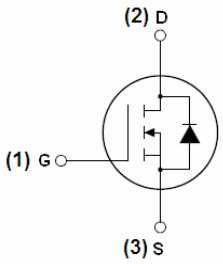
- $V_{DS}$ =60V ,$I_D$ =210A
  $R_{DS(ON)}$ < 4mΩ @ $V_{GS}$=10V
- High density cell design for ultra low Rdson
- Fully characterized Avalanche voltage and current
- Good stability and uniformity with high $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

## Application

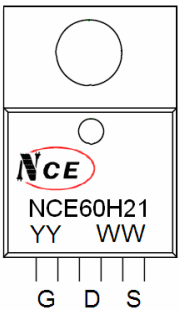
- Power switching application
- Hard Switched and High Frequency Circuits
- Uninterruptible Power Supply

***100% UIS TESTED!***

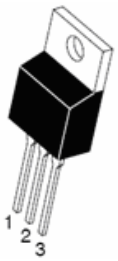
***100% ΔVds TESTED!***




**Schematic diagram**




**Marking and pin Assignment**




**TO-220 top view**

## Package Marking And Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|---|---|---|---|---|---|
| NCE60H21 | NCE60H21 | TO-220 | - | - | - |

## Absolute Maximum Ratings (TA=25℃unless otherwise noted)

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 60 | V |
| Gate-Source Voltage | $V_{GS}$ | ±20 | V |
| Drain Current-Continuous | $I_D$ | 210 | A |
| Drain Current-Continuous($T_C$=100℃) | $I_D$ (100℃) | 148 | A |
| Pulsed Drain Current | $I_{DM}$ | 840 | A |
| Maximum Power Dissipation | $P_D$ | 330 | W |
| Derating factor | | 2.2 | W/℃ |
| Single pulse avalanche energy (Note 5) | $E_{AS}$ | 1800 | mJ |
| Operating Junction and Storage Temperature Range | $T_J$,$T_{STG}$ | -55 To 175 | ℃ |

## Thermal Characteristic

| | | | |
|---|---|---|---|
| Thermal Resistance,Junction-to-Case(Note 2) | $R_{\theta JC}$ | 0.455 | ℃/W |

## Electrical Characteristics (TA=25℃unless otherwise noted)

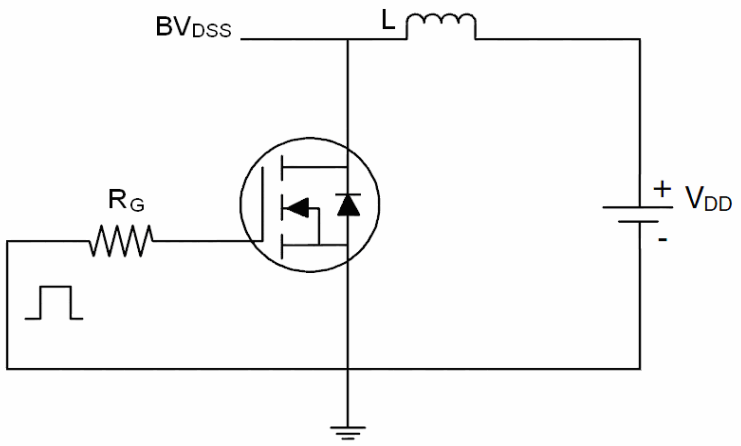
| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V $I_D$=250μA | 60 | 68 | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=60V,$V_{GS}$=0V | - | - | 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 | 2 | 3 | 4 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=40A | - | | 4 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=24V,$I_D$=40A | 160 | - | - | S |
| **Dynamic Characteristics (Note4)** | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=25V,$V_{GS}$=0V, F=1.0MHz | - | 11000 | - | PF |
| Output Capacitance | $C_{oss}$ | | - | 1120 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 950 | - | PF |
| **Switching Characteristics (Note 4)** | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | VDD=30V,ID=2A,RL=15Ω, RG=2.5Ω,VGS=10V | - | 40 | - | nS |
| Turn-on Rise Time | $t_r$ | | - | 38 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 140 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 60 | - | nS |
| Total Gate Charge | $Q_g$ | ID=30A,VDD=30V,VGS=10V | - | 250 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 48 | - | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 98 | - | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| Diode Forward Voltage (Note 3) | $V_{SD}$ | $V_{GS}$=0V,$I_S$=40A | - | 0.85 | 1.2 | V |
| Diode Forward Current (Note 2) | $I_S$ | | - | - | 210 | A |
| Reverse Recovery Time | $t_{rr}$ | TJ = 25°C, IF = 40A di/dt = 100A/μs(Note3) | - | 48 | | nS |
| Reverse Recovery Charge | Qrr | | - | 78 | | nC |
| Forward Turn-On Time | $t_{on}$ | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD) | | | | |

## Notes:

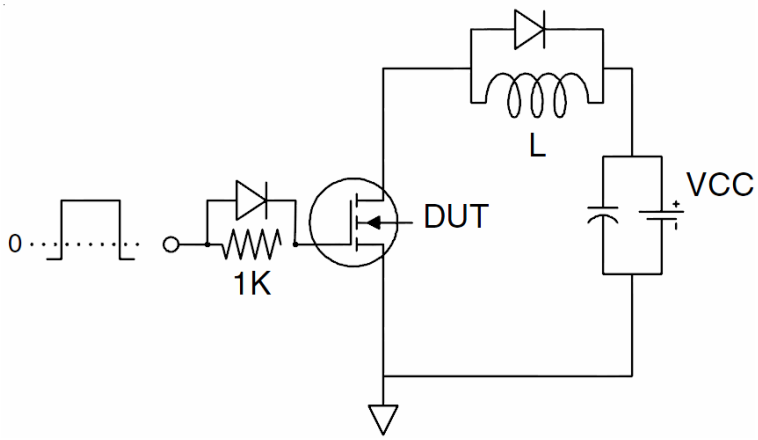
**1.** Repetitive Rating: Pulse width limited by maximum junction temperature.
**2.** Surface Mounted on FR4 Board, t ≤ 10 sec.
**3.** Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
**4.** Guaranteed by design, not subject to production
**5.** EAS condition：Tj=25℃,$V_{DD}$=30V,$V_G$=10V,L=1mH,Rg=25Ω

# Test circuit

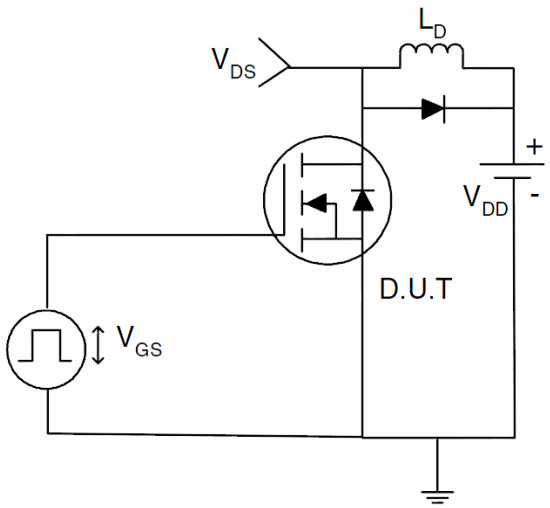
**1）$E_{AS}$ test Circuits**




**2）Gate charge test Circuit:**




**3）Switch Time Test Circuit:**



## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (Curves)

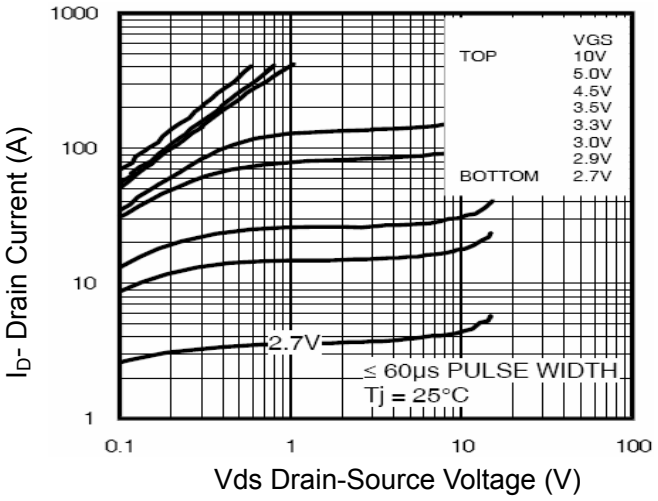



**Figure 1 Output Characteristics**

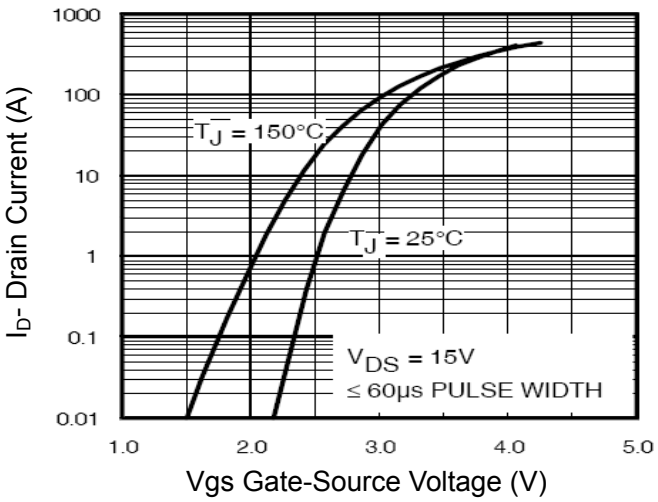



**Figure 2 Transfer Characteristics**

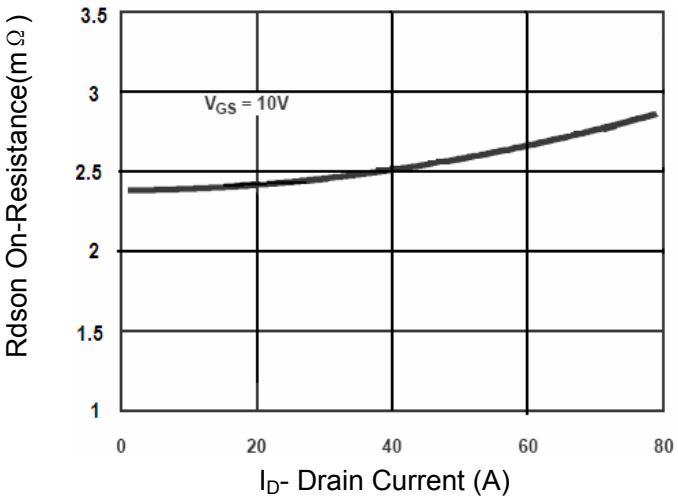



**Figure 3 Rdson- Drain Current**

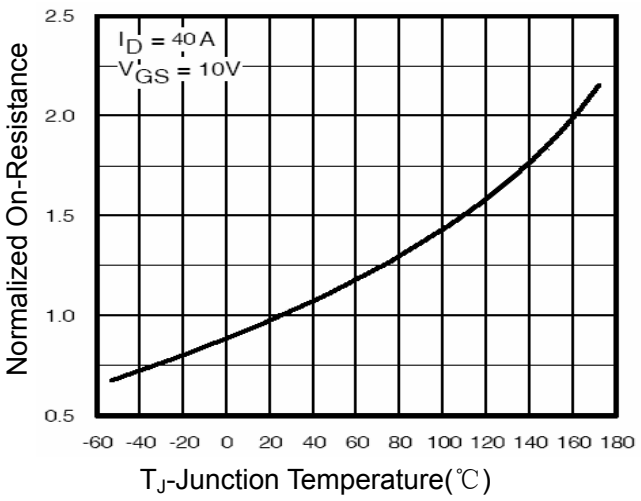



**Figure 4 Rdson-JunctionTemperature**

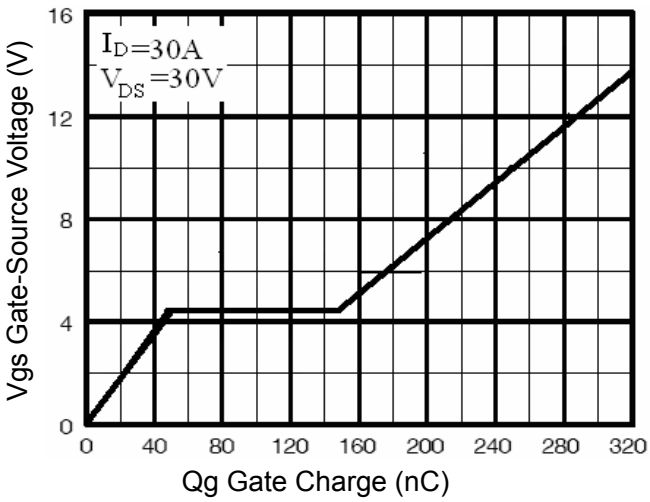



**Figure 5 Gate Charge**

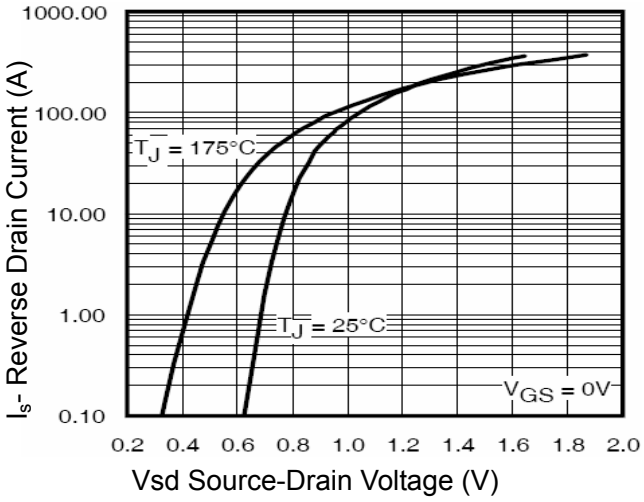



**Figure 6 Source- Drain Diode Forward**

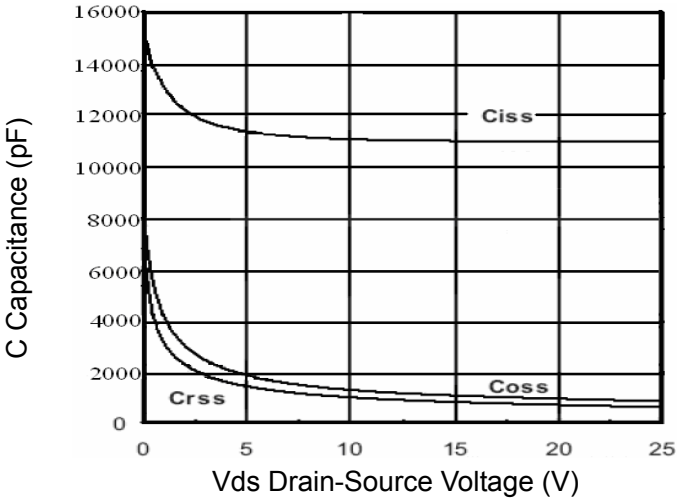



**Figure 7 Capacitance vs Vds**

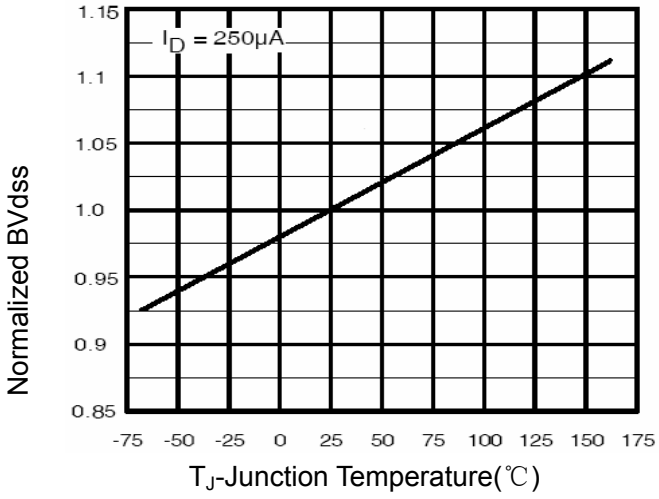



**Figure 9 $BV_{DSS}$ vs Junction Temperature**

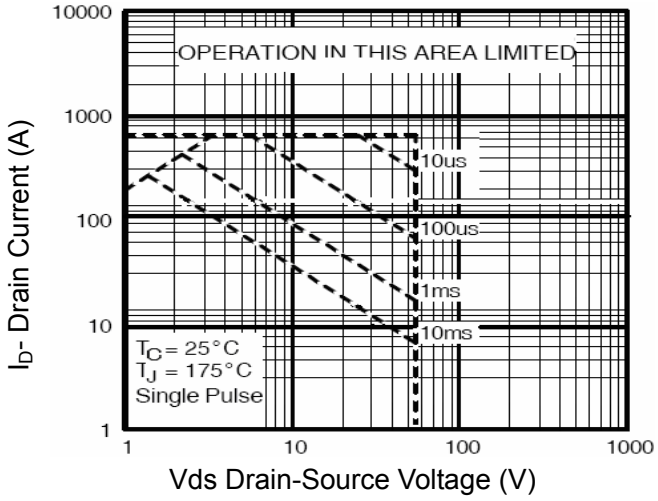



**Figure 8 Safe Operation Area**

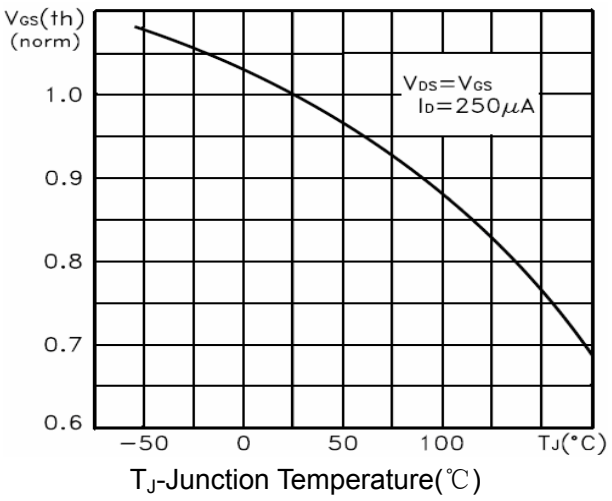



**Figure 10 $V_{GS(th)}$ vs Junction Temperature**

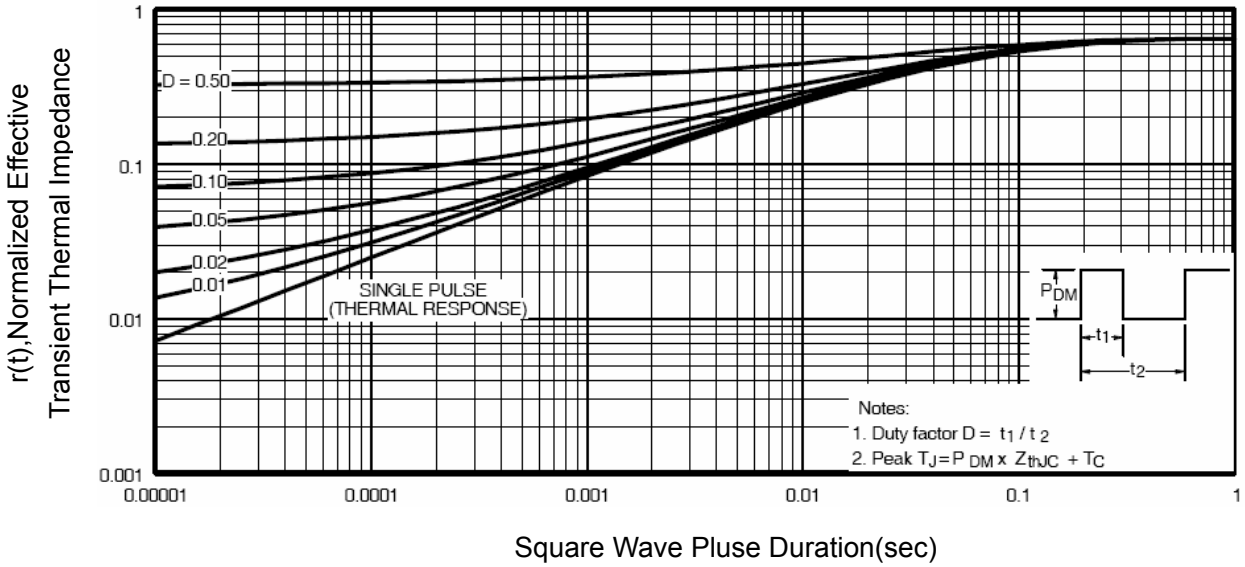
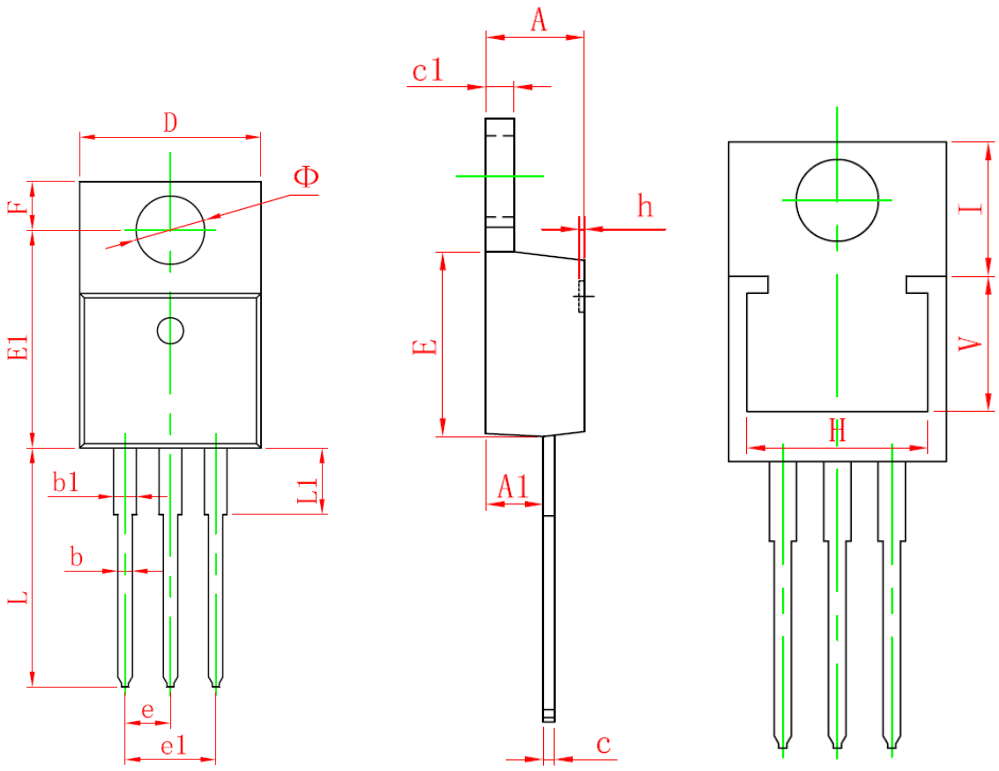



**Figure 11 Normalized Maximum Transient Thermal Impedance**

# TO-220-3L Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 4.470 | 4.670 | 0.176 | 0.184 |
| A1 | 2.520 | 2.820 | 0.099 | 0.111 |
| b | 0.710 | 0.910 | 0.028 | 0.036 |
| b1 | 1.170 | 1.370 | 0.046 | 0.054 |
| c | 0.330 | 0.650 | 0.013 | 0.026 |
| c1 | 1.200 | 1.400 | 0.047 | 0.055 |
| D | 10.010 | 10.350 | 0.394 | 0.407 |
| E | 8.500 | 8.900 | 0.335 | 0.350 |
| E1 | 12.060 | 12.460 | 0.475 | 0.491 |
| e | 2.540（TYP.） | | 0.100（TYP.） | |
| e1 | 4.980 | 5.180 | 0.196 | 0.204 |
| F | 2.590 | 2.890 | 0.102 | 0.114 |
| H | 8.440 REF. | | 0.332 REF. | |
| h | 0.000 | 0.300 | 0.000 | 0.012 |
| L | 13.400 | 13.800 | 0.528 | 0.543 |
| L1 | 3.560 | 3.960 | 0.140 | 0.156 |
| V | 6.360 REF. | | 0.250 REF. | |
| I | 6.300 REF. | | 0.248 REF. | |
| Φ | 3.735 | 3.935 | 0.147 | 0.155 |

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