

VCRRN-Channel Enhancement Mode Power MOSFET

Description

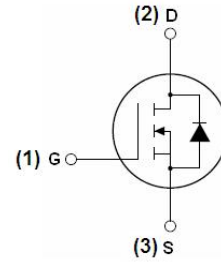
The VCRR40H12 uses advanced trench technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. It can be used in a wide variety of applications.

General Features

- $V_{DS} = 40V, I_D = 120A$
 $R_{DS(ON)} < 3.1m\Omega @ V_{GS} = 10V$
 $R_{DS(ON)} < 7 m\Omega @ V_{GS} = 4.5V$
- 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

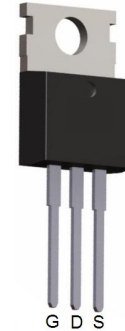
- Load switching
- Hard switched and high frequency circuits
- Uninterruptible power supply



Schematic diagram



Marking and pin assignment



TO-220-3L top view

Package Marking and Ordering Information

| Device Marking | Device | Device Package |
|----------------|--------|----------------|
| VCRR40H12 | | TO-220-3L |

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} | 480 | A |
| Maximum Power Dissipation | P_D | 130 | W |
| Derating factor | | 0.87 | 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) | $R_{\theta JC}$ | 1.15 | $^{\circ}\text{C}/\text{W}$ |
|--|-----------------|------|-----------------------------|

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

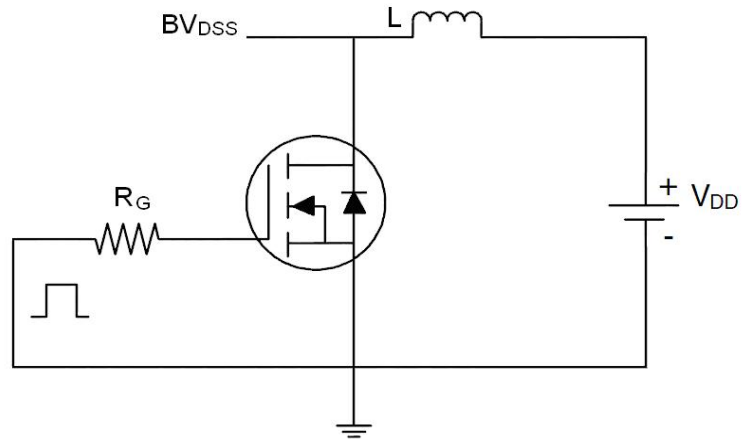
| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|--|--------------|---|------|------|-----------|------------|
| Off Characteristics | | | | | | |
| Drain-Source Breakdown Voltage | BV_{DSS} | $V_{GS}=0V, I_D=250\mu A$ | 40 | 45 | - | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS}=40V, V_{GS}=0V$ | - | - | 1 | μA |
| Gate-Body Leakage Current | I_{GSS} | $V_{GS}=\pm 20V, V_{DS}=0V$ | - | - | ± 100 | nA |
| On Characteristics ^(Note 3) | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$ | 1.2 | 1.9 | 2.5 | V |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS}=10V, I_D=20A$ | - | 2.6 | 3.1 | m Ω |
| | | $V_{GS}=4.5V, I_D=10A$ | - | 5.5 | 7.0 | |
| Forward Transconductance | g_{FS} | $V_{DS}=10V, I_D=20A$ | 26 | - | - | S |
| Dynamic Characteristics ^(Note 4) | | | | | | |
| Input Capacitance | C_{iss} | $V_{DS}=20V, V_{GS}=0V,$ $F=1.0\text{MHz}$ | 4600 | 5000 | 5400 | PF |
| Output Capacitance | C_{oss} | | 826 | 898 | 970 | PF |
| Reverse Transfer Capacitance | C_{rss} | | 324 | 351 | 380 | PF |
| Switching Characteristics ^(Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=20V, I_D=2A, R_L=1\Omega$ $V_{GS}=10V, R_G=3\Omega$ | - | 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 | $V_{DS}=20V, I_D=20A,$ $V_{GS}=10V$ | - | 90 | - | nC |
| Gate-Source Charge | Q_{gs} | | - | 14 | - | nC |
| Gate-Drain Charge | Q_{gd} | | - | 22 | - | nC |
| Drain-Source Diode Characteristics | | | | | | |
| Diode Forward Voltage ^(Note 3) | V_{SD} | $V_{GS}=0V, I_S=20A$ | - | - | 1.2 | V |
| Diode Forward Current ^(Note 2) | I_S | | - | - | 120 | A |
| Reverse Recovery Time | t_{rr} | $T_J = 25^{\circ}\text{C}, I_F = 20A$ $di/dt = 100A/\mu s$ ^(Note 3) | - | 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:

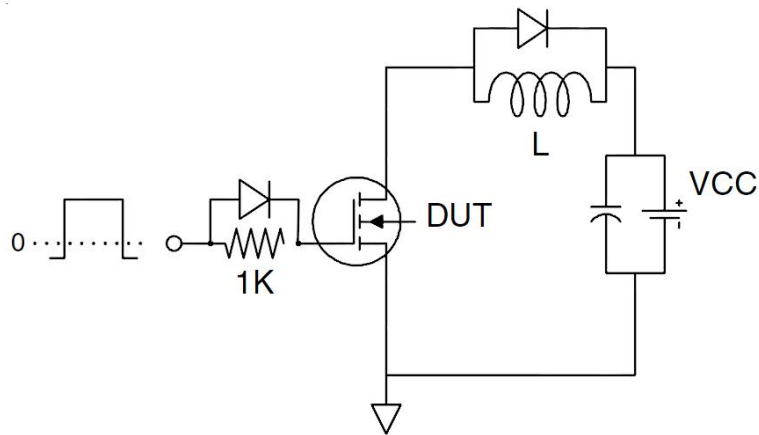
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, $t \leq 10$ sec.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production
5. E_{AS} condition : $T_J=25^{\circ}\text{C}, V_{DD}=20V,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

Test circuit

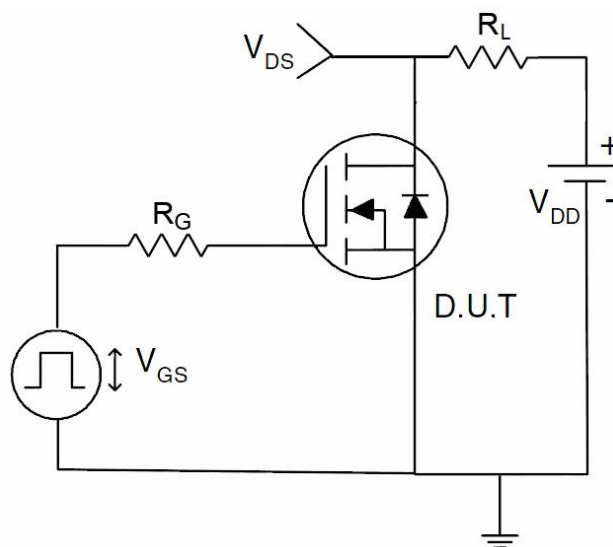
1) E_{AS} Test Circuit



2) Gate Charge Test Circuit



3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics (Curves)

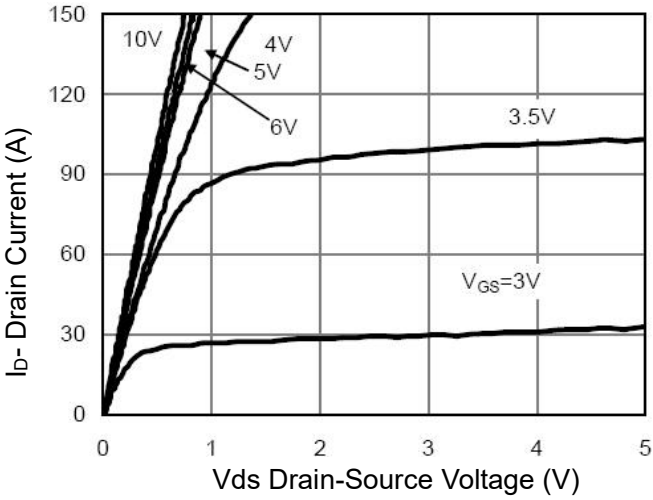


Figure 1 Output Characteristics

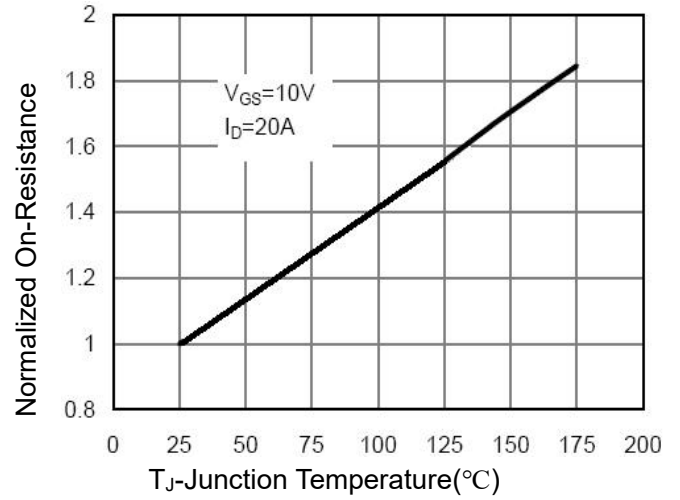


Figure 4 Rdson-Junction Temperature

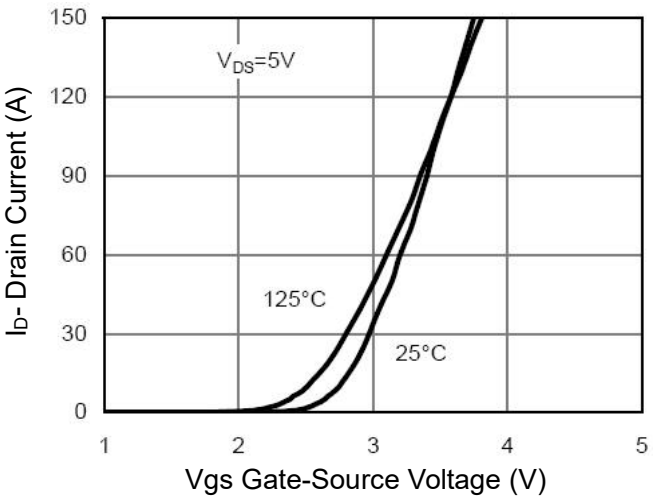


Figure 2 Transfer Characteristics

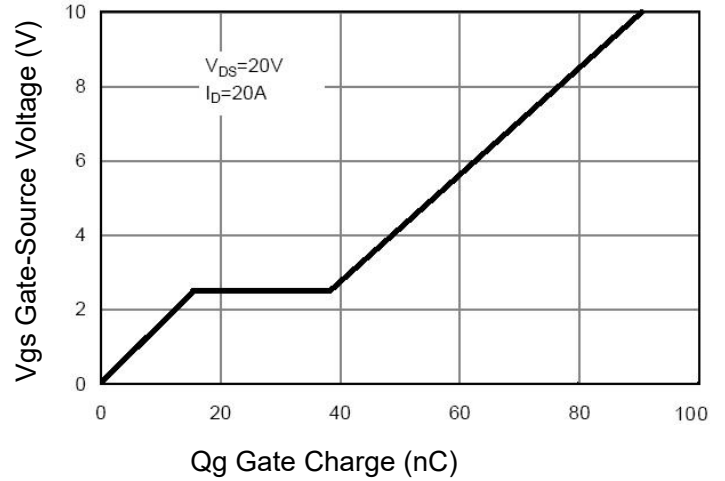


Figure 5 Gate Charge

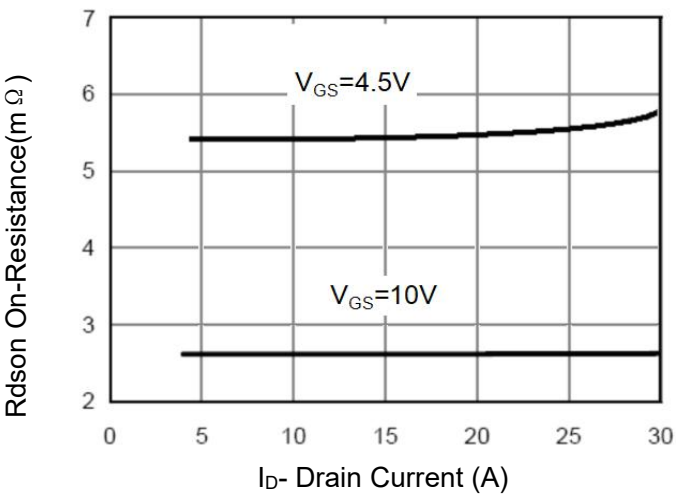


Figure 3 Rdson- Drain Current

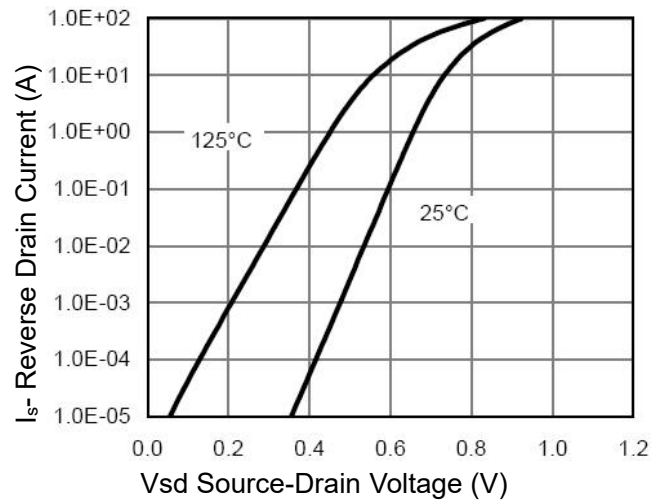


Figure 6 Source- Drain Diode Forward

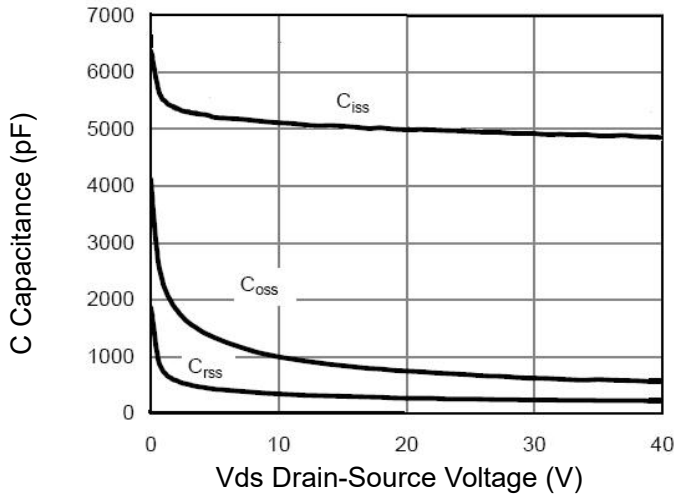


Figure 7 Capacitance vs Vds

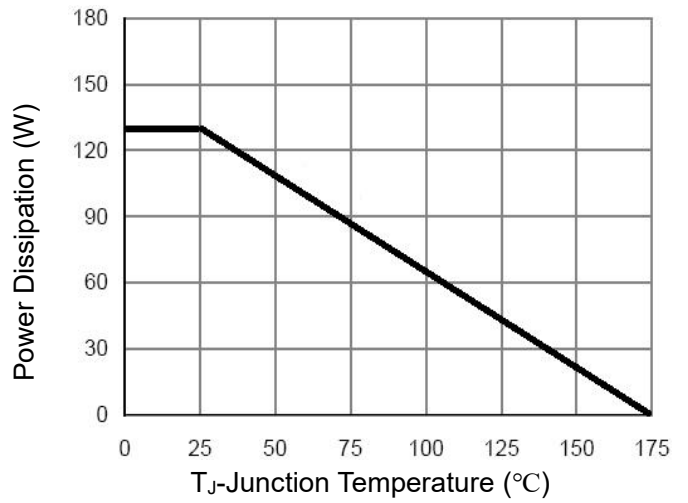


Figure 9 Power De-rating

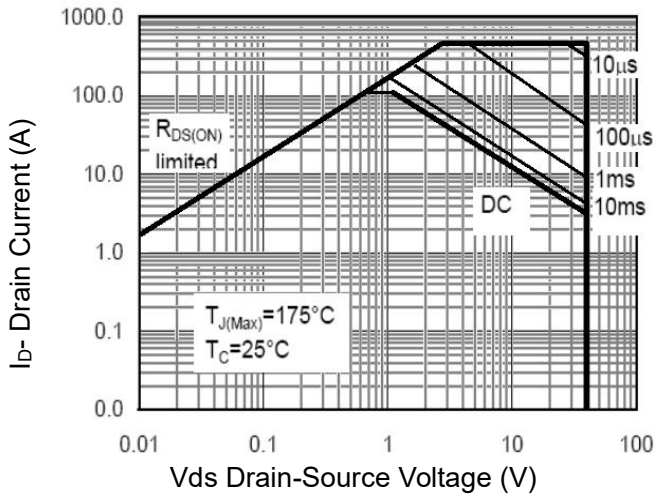


Figure 8 Safe Operation Area

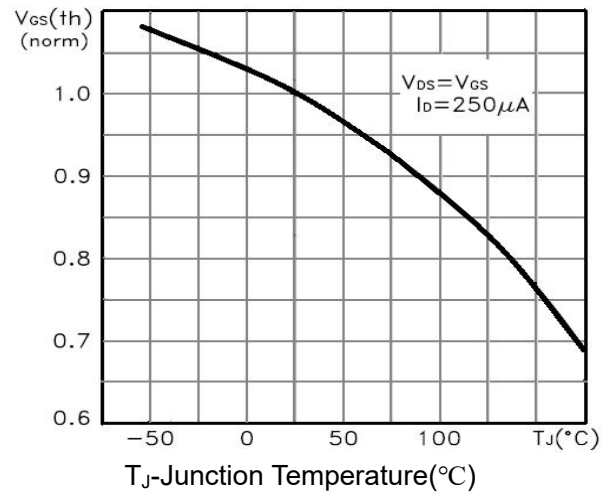


Figure 10 VGS(th) vs Junction Temperature

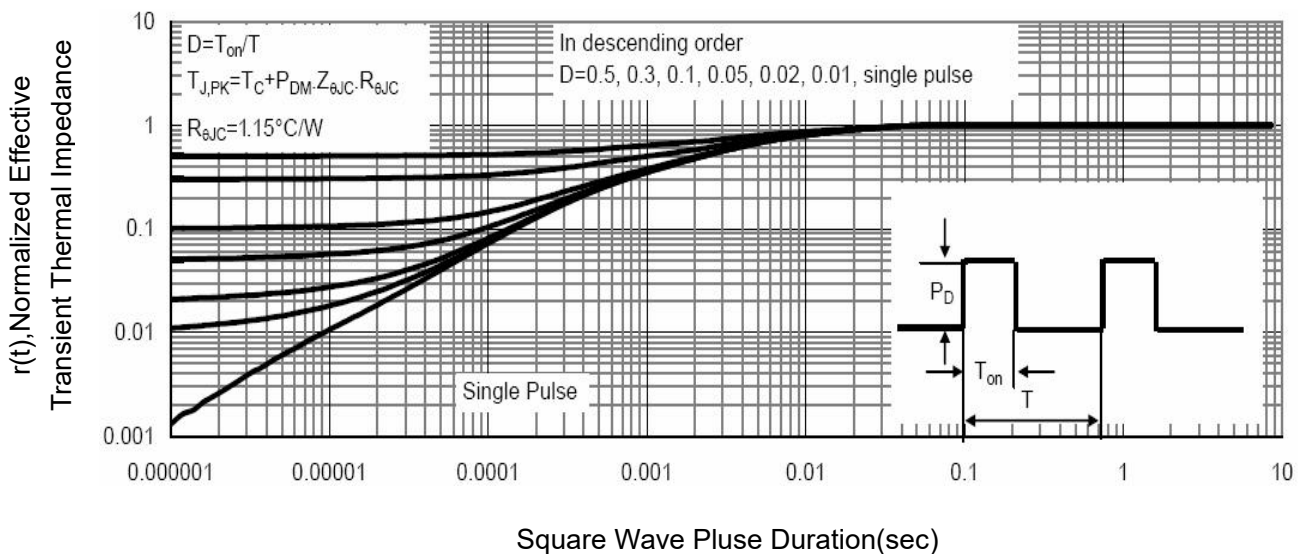
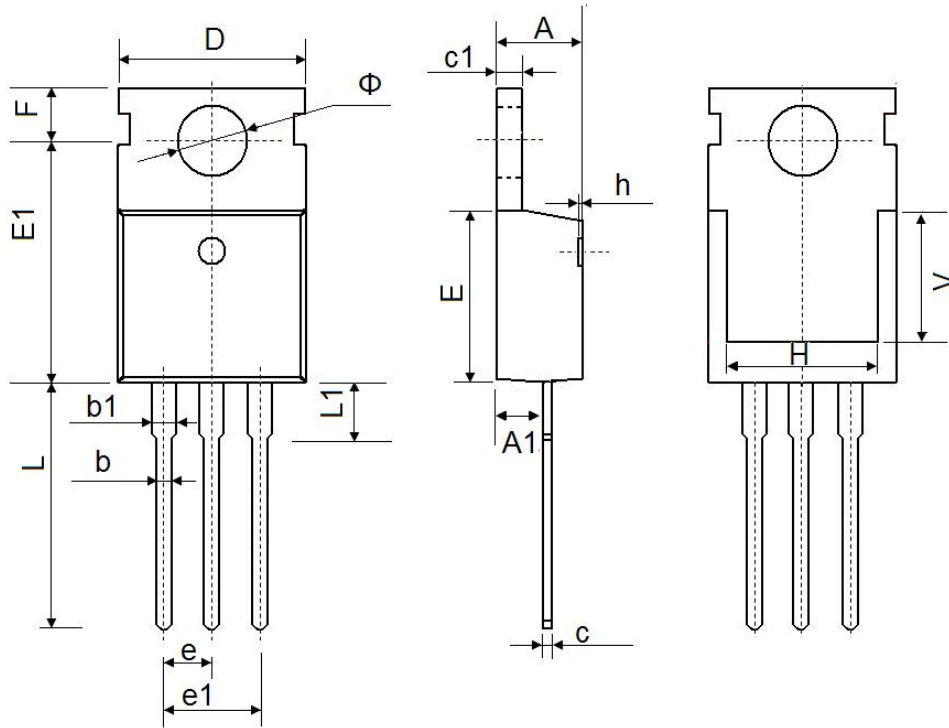


Figure 11 Normalized Maximum Transient Thermal Impedance

TO-220-3L Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|--------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.400 | 4.600 | 0.173 | 0.181 |
| A1 | 2.250 | 2.550 | 0.089 | 0.100 |
| 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 | 9.910 | 10.250 | 0.390 | 0.404 |
| E | 8.9500 | 9.750 | 0.352 | 0.384 |
| E1 | 12.650 | 12.950 | 0.498 | 0.510 |
| e | 2.540 TYP. | | 0.100 TYP. | |
| e1 | 4.980 | 5.180 | 0.196 | 0.204 |
| F | 2.650 | 2.950 | 0.104 | 0.116 |
| H | 7.900 | 8.100 | 0.311 | 0.319 |
| h | 0.000 | 0.300 | 0.000 | 0.012 |
| L | 12.900 | 13.400 | 0.508 | 0.528 |
| L1 | 2.850 | 3.250 | 0.112 | 0.128 |
| V | 7.500 REF. | | 0.295 REF. | |
| Φ | 3.400 | 3.800 | 0.134 | 0.150 |

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