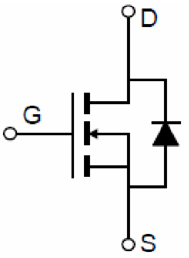
## QIAOXIN N-Channel Super Trench Power MOSFET

### Description

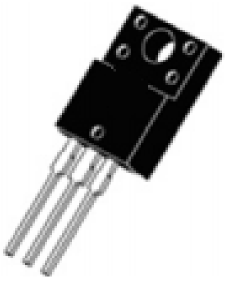
The VCRRP60T12T uses **Super Trench** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of $R_{DS(ON)}$ and $Q_g$. This device is ideal for high-frequency switching and synchronous rectification.



**Schematic diagram**

### General Features

- $V_{DS}$ =60V,$I_D$ =120A
  $R_{DS(ON)}$ < 4.0mΩ @ $V_{GS}$=10V (Typ:3.5mΩ)
- Excellent gate charge x $R_{DS(on)}$ product
- Very low on-resistance $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested



**TO-247 top view**

### Application

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

### Package Marking and Ordering Information

| Device Marking | Device | Device Package |
|---|---|---|
| VCRRP60T12T | | TO-247 |

### Absolute Maximum Ratings ($T_C$=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 (Silicon Limited) | $I_D$ | 120 | A |
| Drain Current-Continuous($T_C$=100℃) | $I_D$ (100℃) | 100 | A |
| Pulsed Drain Current | $I_{DM}$ | 480 | A |
| Maximum Power Dissipation | $P_D$ | 155 | W |
| Derating factor | | 1.03 | W/℃ |
| Single pulse avalanche energy (Note 5) | $E_{AS}$ | 500 | mJ |
| Operating Junction and Storage Temperature Range | $T_J$,$T_{STG}$ | -55 To 175 | ℃ |

### Thermal Characteristic

| | | | |
|---|---|---|---|
| Thermal Resistance,Junction-to-Case(Note 2) | $R_{\theta JC}$ | 0.97 | ℃/W |

## Electrical Characteristics ($T_C$=25℃unless otherwise noted)

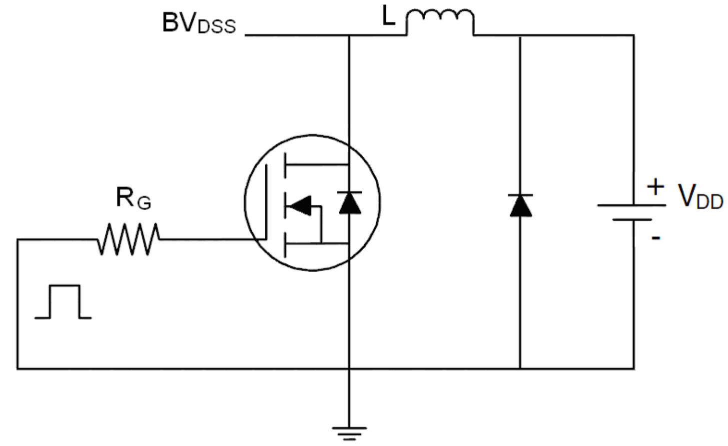
| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V $I_D$=250μA | 60 | | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=60V,$V_{GS}$=0V | - | - | 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 | 2.0 | 3.0 | 4.0 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=60A | - | 3.5 | 4.0 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=10V,$I_D$=60A | 40 | - | - | S |
| **Dynamic Characteristics** (Note4) | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=30V,$V_{GS}$=0V, F=1.0MHz | - | 3400 | - | PF |
| Output Capacitance | $C_{oss}$ | | - | 650 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 20 | - | PF |
| **Switching Characteristics** (Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=30V,$I_D$=60A<br>$V_{GS}$=10V,$R_G$=4.7Ω | - | 11 | - | nS |
| Turn-on Rise Time | $t_r$ | | - | 5 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 56 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 12 | - | nS |
| Total Gate Charge | $Q_g$ | $V_{DS}$=30V,$I_D$=60A,<br>$V_{GS}$=10V | - | 51 | | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 12 | | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 7.3 | | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| Diode Forward Voltage (Note 3) | $V_{SD}$ | $V_{GS}$=0V,$I_S$=120A | - | | 1.2 | V |
| Diode Forward Current (Note 2) | $I_S$ | | - | - | 120 | A |
| Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25°C, $I_F$ = $I_S$<br>di/dt = 100A/μs(Note3) | - | 47 | | nS |
| Reverse Recovery Charge | Qrr | | - | 59 | | nC |

Notes:

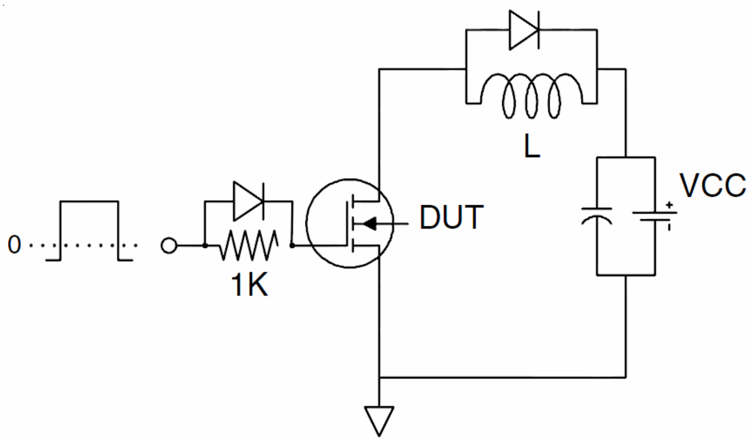
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production
5. EAS condition : Tj=25℃,$V_{DD}$=30V,$V_G$=10V,L=0.5mH,Rg=25Ω

## Test Circuit

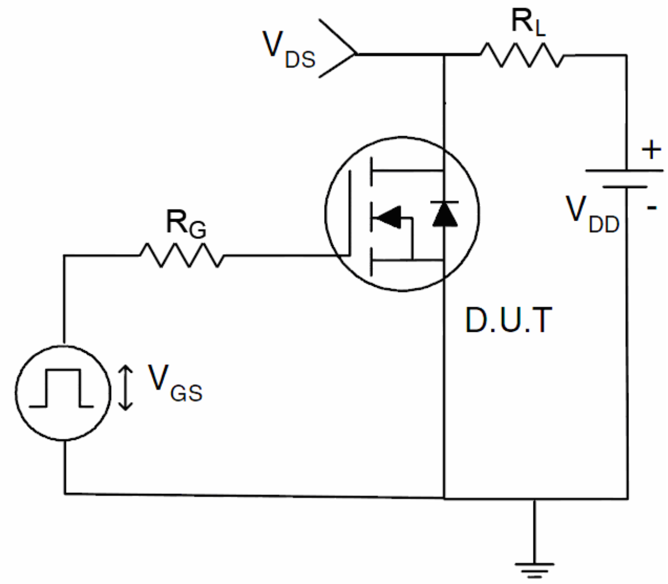
### 1) $E_{AS}$ test Circuit



### 2) Gate charge test Circuit



### 3) Switch Time Test Circuit



## Typical Electrical and Thermal Characteristics

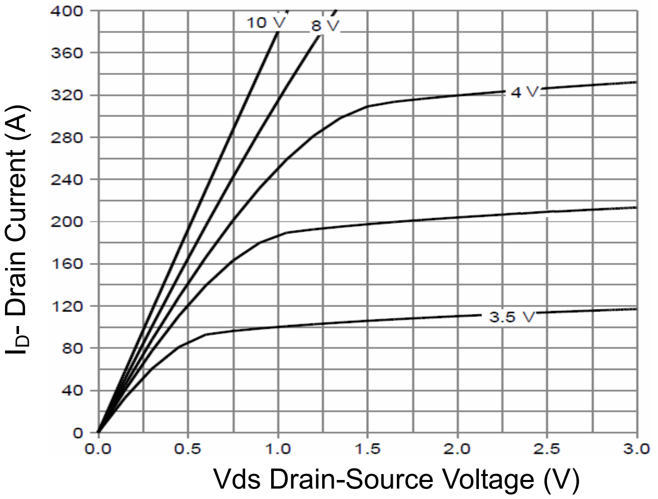


**Figure 1 Output Characteristics**

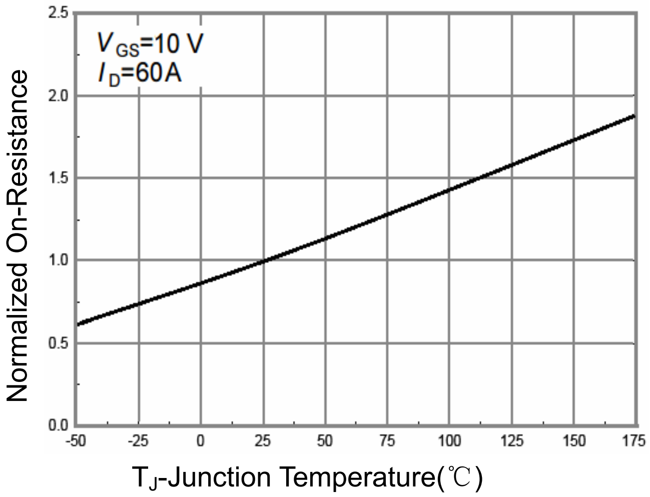


**Figure 4 Rdson-JunctionTemperature**

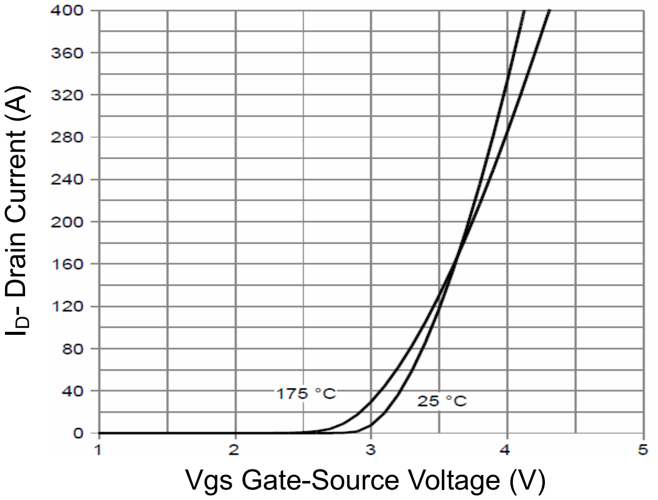


**Figure 2 Transfer Characteristics**

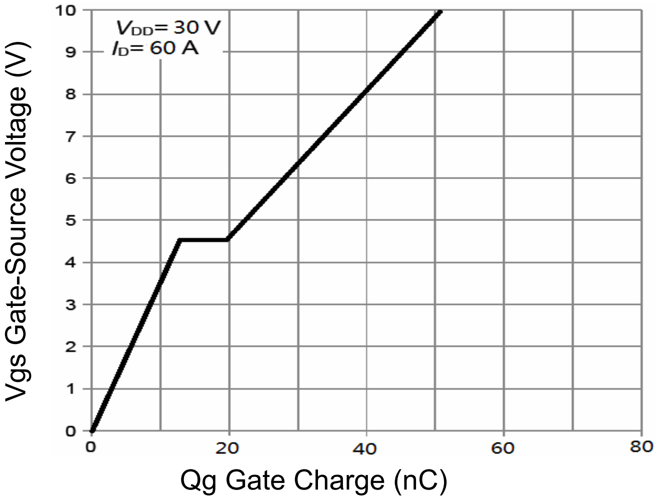


**Figure 5 Gate Charge**

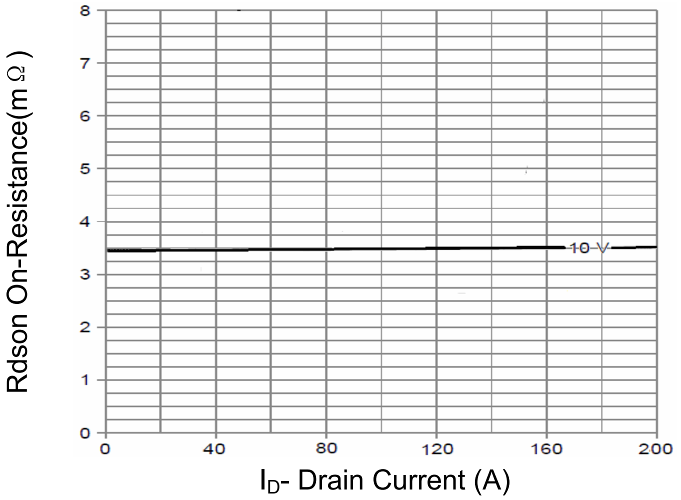


**Figure 3 Rdson- Drain Current**

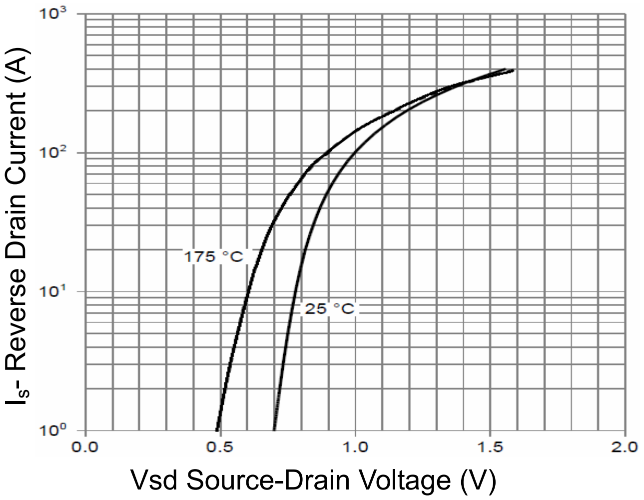


**Figure 6 Source- Drain Diode Forward**

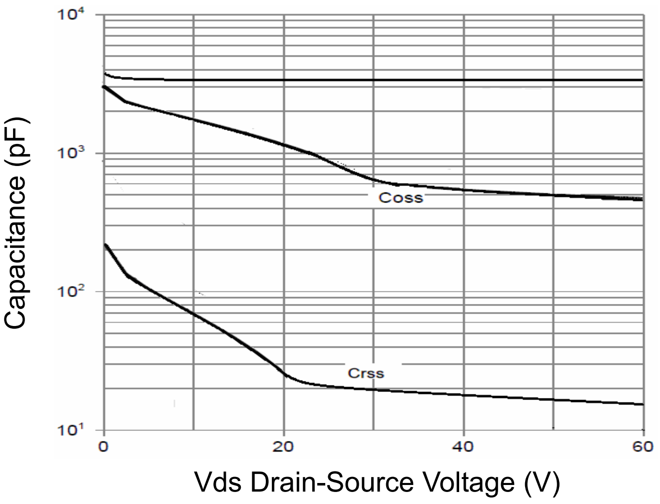


**Figure 7 Capacitance vs Vds**

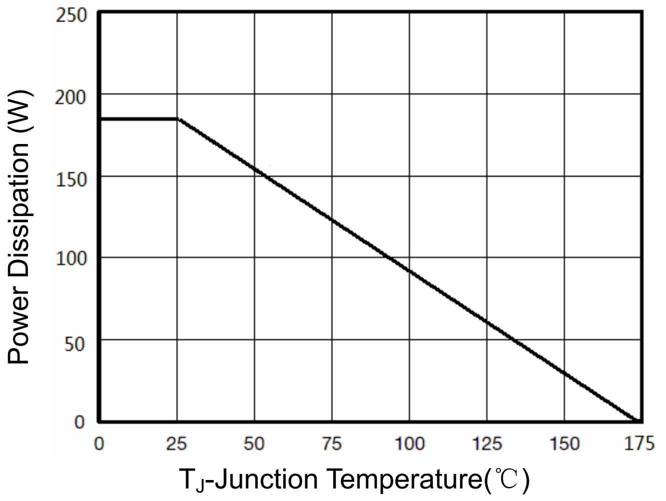


**Figure 9 Power De-rating**

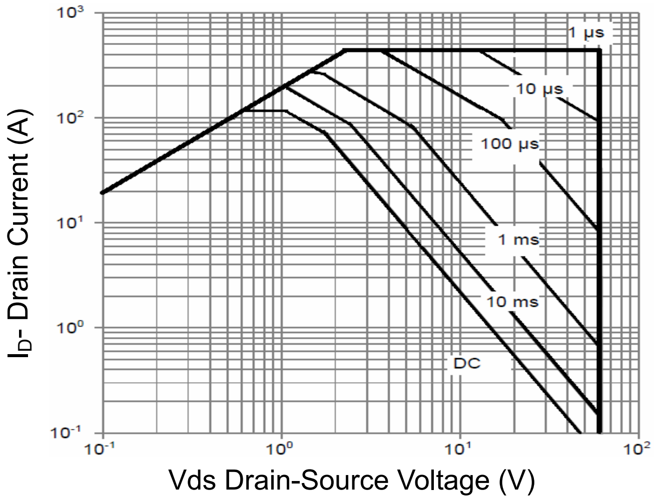


**Figure 8 Safe Operation Area**

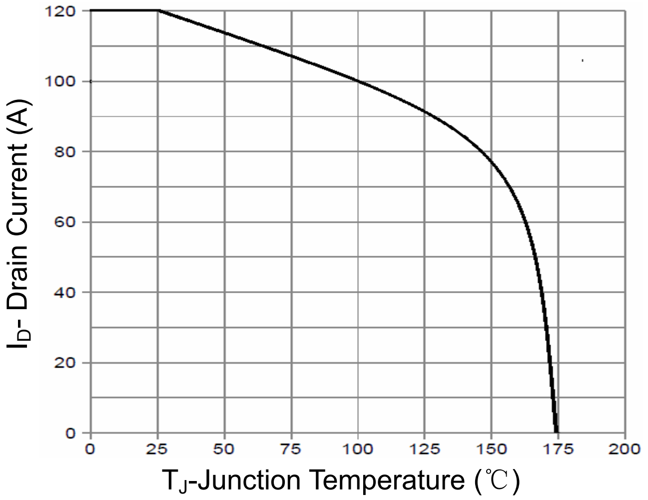


**Figure 10 Current De-rating**

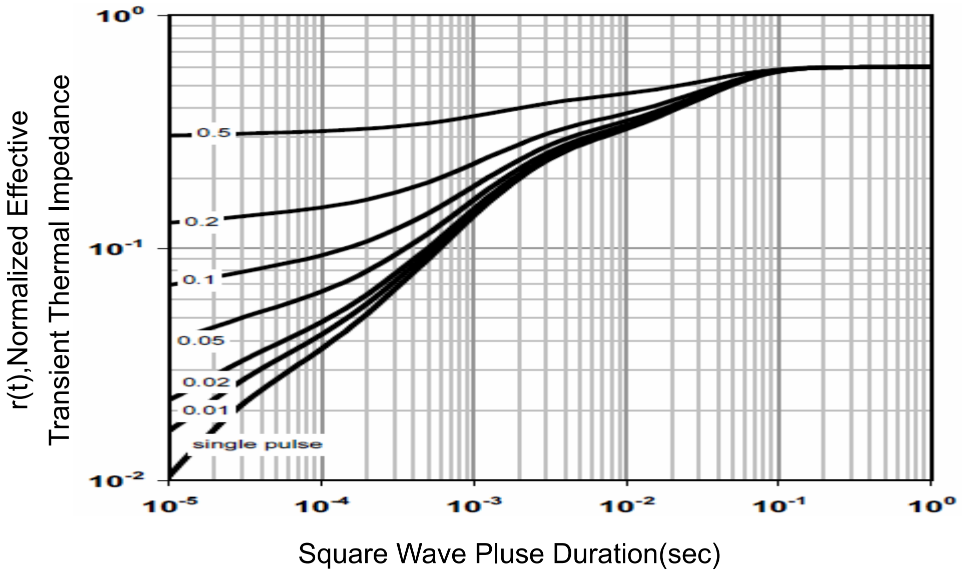
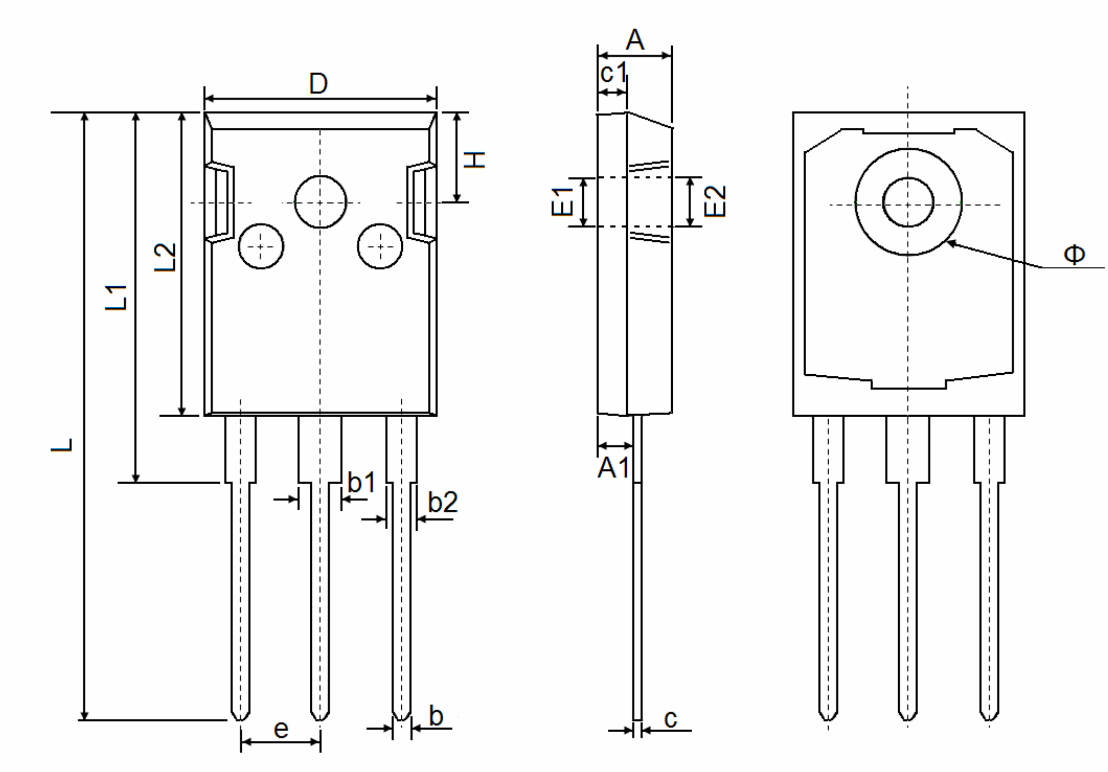


**Figure 11 Normalized Maximum Transient Thermal Impedance**

## TO-247 Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 4.850 | 5.150 | 0.191 | 0.200 |
| A1 | 2.200 | 2.600 | 0.087 | 0.102 |
| b | 1.000 | 1.400 | 0.039 | 0.055 |
| b1 | 2.800 | 3.200 | 0.110 | 0.126 |
| b2 | 1.800 | 2.200 | 0.071 | 0.087 |
| c | 0.500 | 0.700 | 0.020 | 0.028 |
| c1 | 1.900 | 2.100 | 0.075 | 0.083 |
| D | 15.450 | 15.750 | 0.608 | 0.620 |
| E1 | 3.500 REF | | 0.138 REF | |
| E2 | 3.600 REF | | 0.142 REF | |
| L | 40.900 | 41.300 | 1.610 | 1.626 |
| L1 | 24.800 | 25.100 | 0.976 | 0.988 |
| L2 | 20.300 | 20.600 | 0.799 | 0.811 |
| Φ | 7.100 | 7.300 | 0.280 | 0.287 |
| e | 5.450 TYP | | 0.215 TYP | |
| H | 5.980 REF | | 0.235 REF | |

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