# QIAOXIN N-Channel Super Trench Power MOSFET

## Description

The VCRR60T12AD 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.

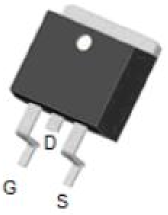
## Application

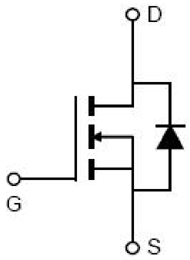
- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

## General Features

- $V_{DS}$ =60V, $I_D$ =120A
  $R_{DS(ON)}$ < 4.0mΩ @ $V_{GS}$=10V (Typ:3.5mΩ)
  $R_{DS(ON)}$ < 5.0mΩ @ $V_{GS}$=4.5V (Typ:4.0mΩ)
- Excellent gate charge x $R_{DS(on)}$ product(FOM)
- Very low on-resistance $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating

**TO-263**





**Schematic Diagram**

## Package Marking and Ordering Information

| Device Marking | Device | Device Package |
|---|---|---|
| VCRR60T12AD |  | TO-263 |

## 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 | $P_D$ | 180 | W |
| Derating factor |  | 1.2 | W/℃ |
| Single pulse avalanche energy (Note 1) | $E_{AS}$ | 500 | mJ |
| Operating Junction and Storage Temperature Range | $T_J$,$T_{STG}$ | -55 To 175 | ℃ |

## Thermal Characteristic

| | | | |
|---|---|---|---|
| Thermal Resistance,Junction-to-Case | $R_{\theta JC}$ | 0.83 | ℃/W |

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

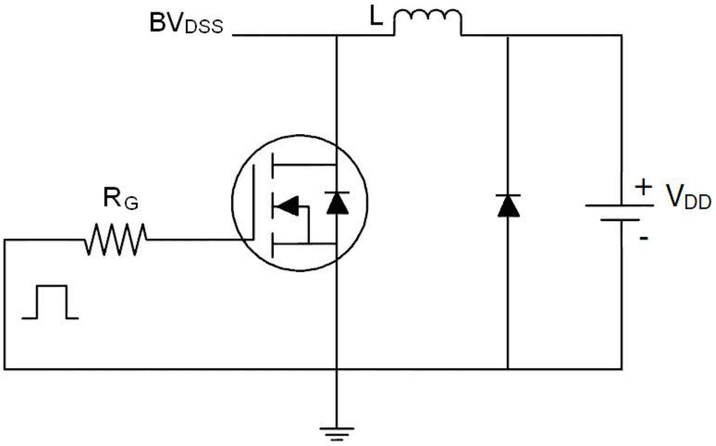
| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V $I_D$=250μA | 60 | | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=60V,$V_{GS}$=0V | - | - | 1 | μA |
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±20V,$V_{DS}$=0V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$,$I_D$=250μA | 1.0 | 1.7 | 2.4 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=60A | - | 3.5 | 4.0 | mΩ |
| | | $V_{GS}$=4.5V, $I_D$=60A | - | 4.0 | 5.0 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=10V,$I_D$=60A | 40 | - | - | S |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=30V,$V_{GS}$=0V,<br>F=1.0MHz | - | 4000 | - | PF |
| Output Capacitance | $C_{oss}$ | | - | 680 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 23 | - | PF |
| **Switching Characteristics** (Note 2) | | | | | | |
| 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 | - | 67 | | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 12 | | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 8.5 | | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| Diode Forward Voltage | $V_{SD}$ | $V_{GS}$=0V,$I_S$=120A | - | | 1.2 | V |
| Diode Forward Current | $I_S$ | | - | - | 120 | A |
| Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25°C, $I_F$ = $I_S$<br>di/dt = 100A/μs | - | 48 | | nS |
| Reverse Recovery Charge | Qrr | | - | 60 | | nC |

## Notes:

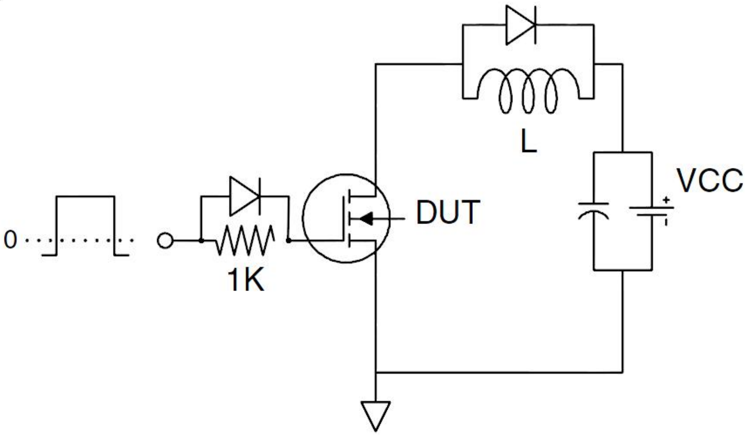
1. EAS condition : Tj=25℃,$V_{DD}$=30V,$V_G$=10V,L=0.5mH,Rg=25Ω
2. Guaranteed by design, not subject to production
3. These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsin k, assuming a maximum junction temperature of TJ(MAX)=175° C. The SOA curve provides a single pulse rating.

# Test Circuit

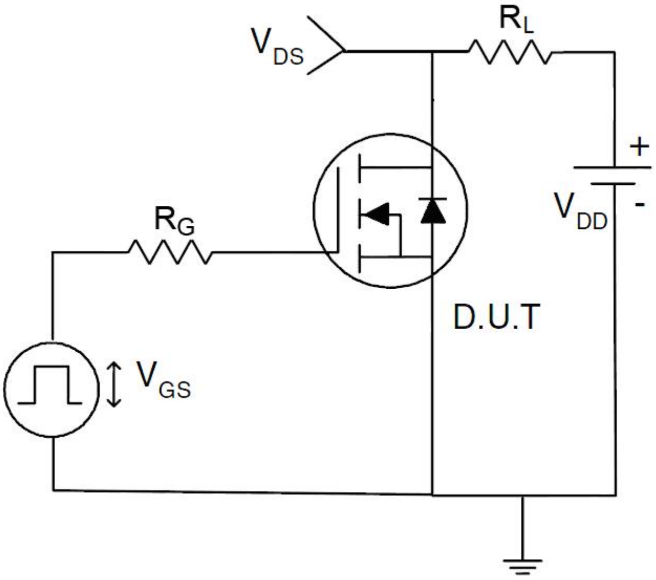
## 1) $E_{AS}$ test Circuit



## 2) Gate charge test Circuit



## 3) Switch Time Test Circuit



## Typical Electrical and Thermal Characteristics

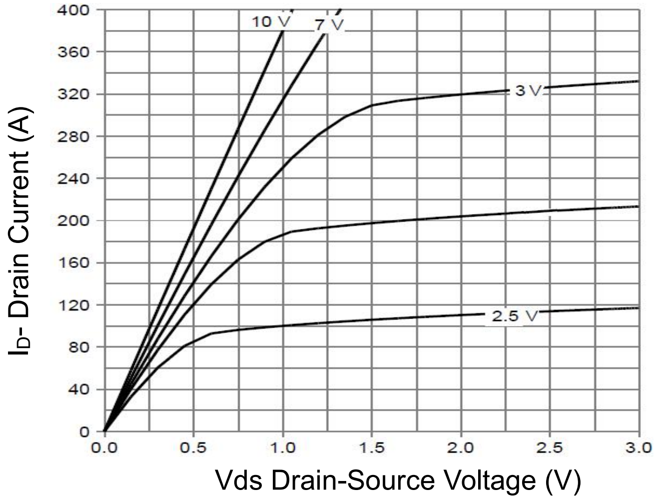


**Figure 1 Output Characteristics**

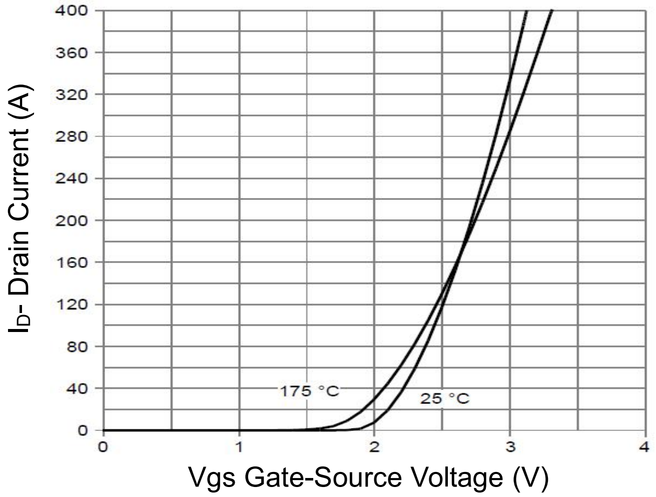


**Figure 2 Transfer Characteristics**

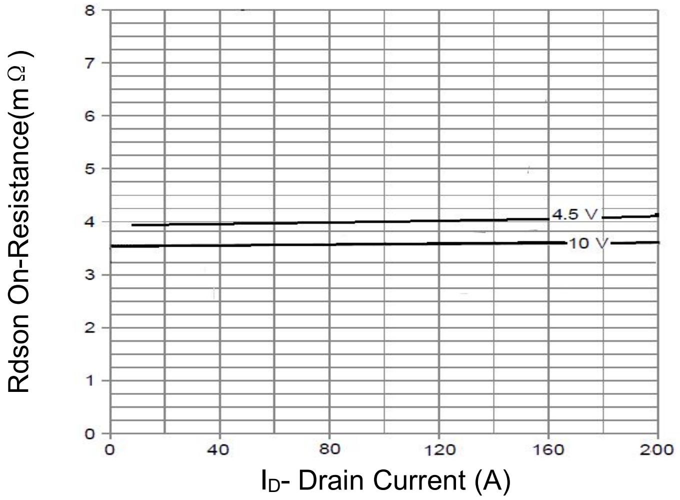


**Figure 3 Rdson- Drain Current**

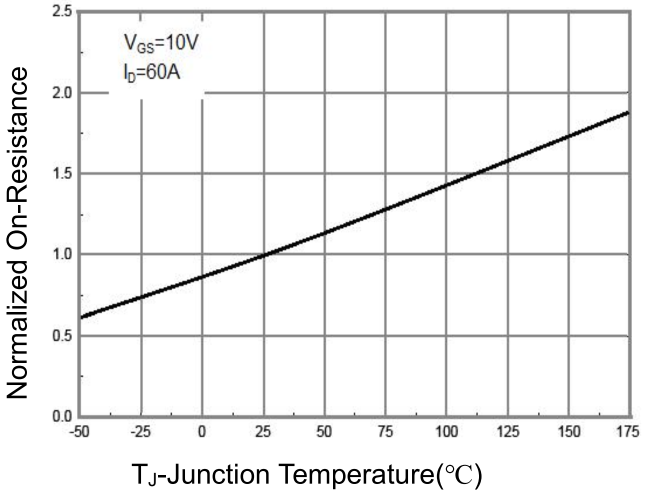


**Figure 4 Rdson-JunctionTemperature**

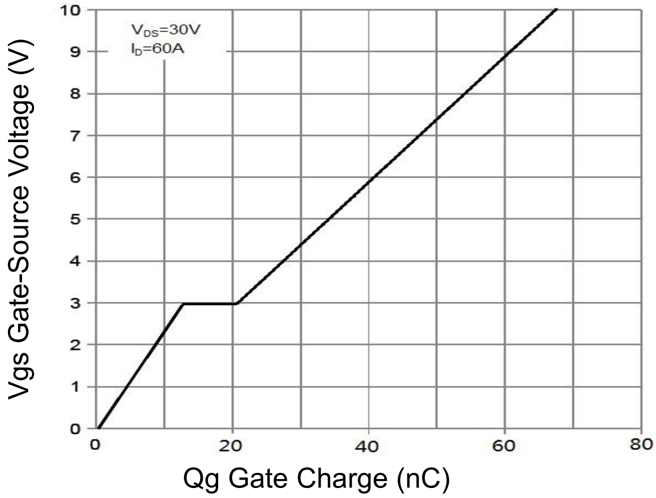


**Figure 5 Gate Charge**

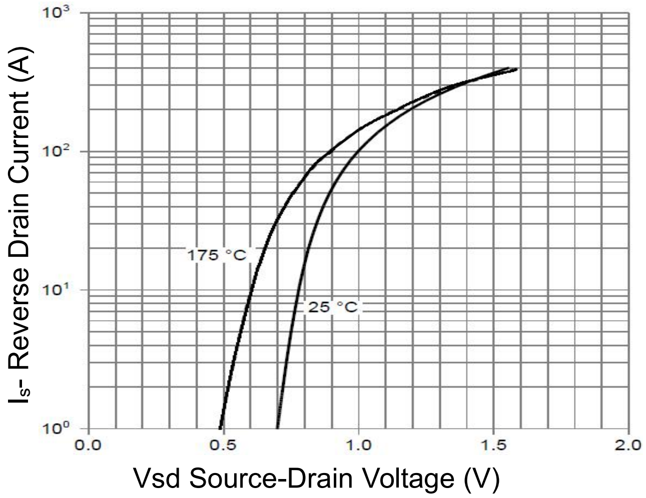


**Figure 6 Source- Drain Diode Forw**

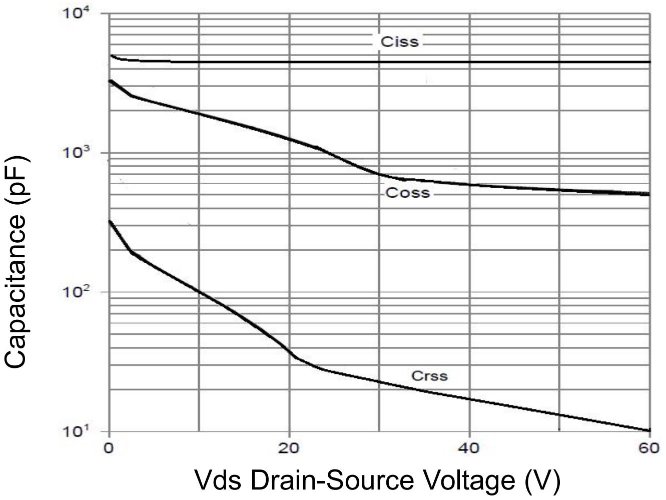


Figure 7 Capacitance vs Vds

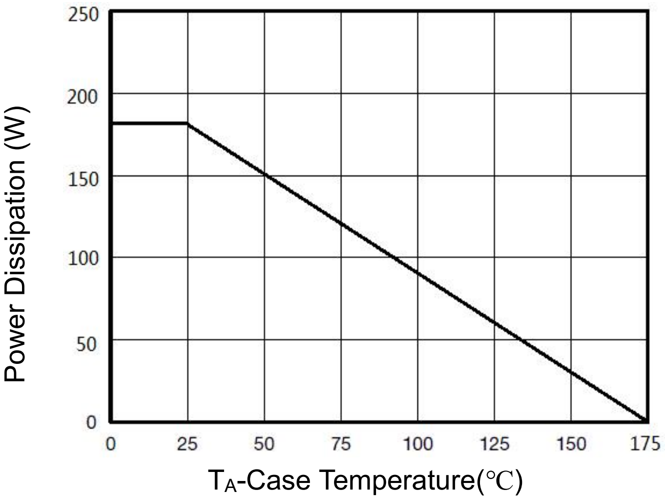


Figure 9 Power De-rating

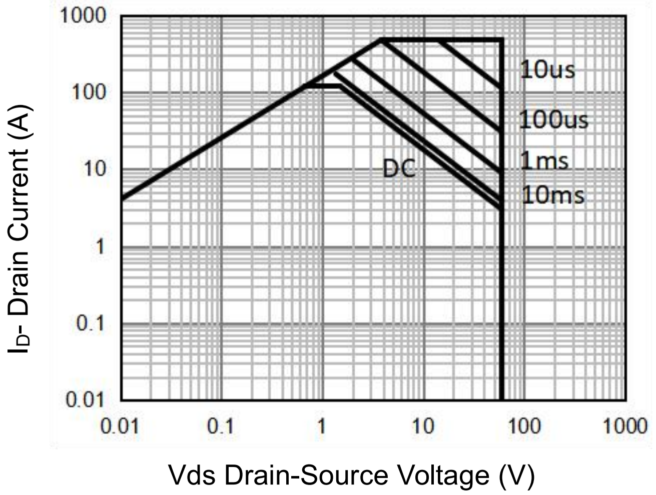


Figure 8 Safe Operation Area (Note 3)

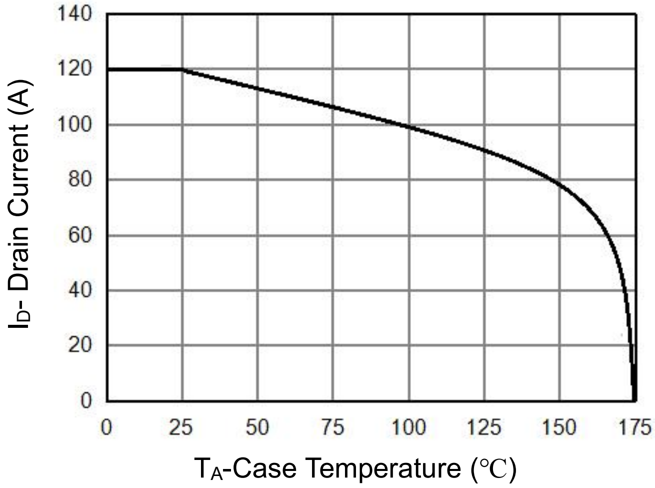


Figure 10 Current De-rating

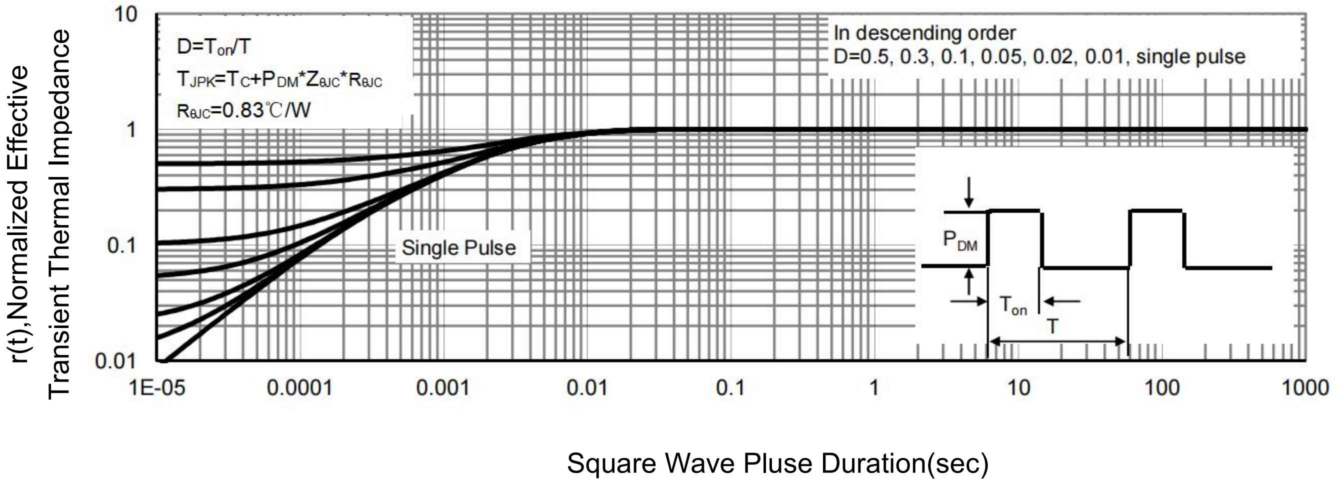
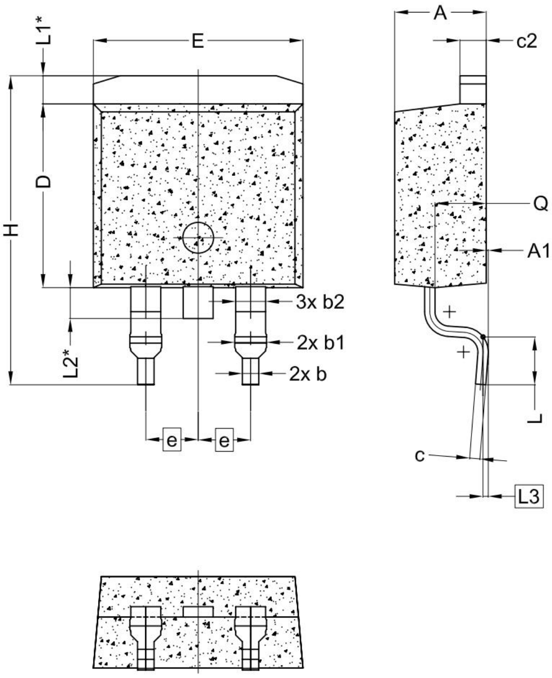
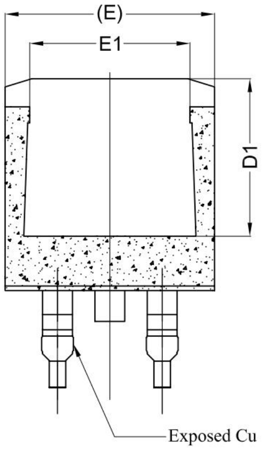


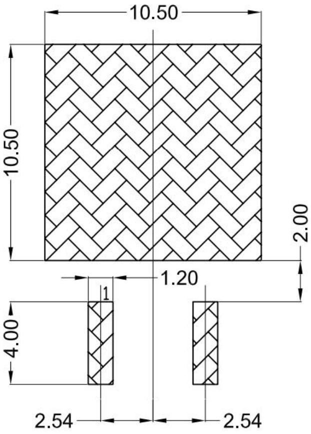
Figure 11 Normalized Maximum Transient Thermal Impedance

## TO-263-2L Package Information





Land Pattern
(Only for Reference)



Note:

1. All Dimensions Are In mm.
2. Dimension D & E Do Not Include Mold Flash.
   Mold Flash Shall Not Exceed 0.127mm Pre Side.
   These Dimensions Are Measured At The Outermost
   Extreme Of The Plastic Body.
3. Thermal Pad Contour Optional Within Dimensions E, L1, D1 & E1.
4. Dimension D1 & E1 Establish A Minmum Mounting Surface for
   The Thermal Pad.
5. "*" is reference .

| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 4.24 | 4.44 | 4.64 |
| A1 | 0.00 | 0.10 | 0.25 |
| b | 0.70 | 0.80 | 0.90 |
| b1 | 1.20 | 1.55 | 1.75 |
| b2 | 1.20 | 1.45 | 1.70 |
| c | 0.40 | 0.50 | 0.60 |
| c2 | 1.15 | 1.27 | 1.40 |
| D | 8.82 | 8.92 | 9.02 |
| D1 | 6.86 | 7.65 | — |
| E | 9.96 | 10.16 | 10.36 |
| E1 | 6.89 | 7.77 | 7.89 |
| e | 2.54 BSC | | |
| H | 14.61 | 15.00 | 15.88 |
| L | 1.78 | 2.32 | 2.79 |
| L1 | 1.36 REF. | | |
| L2 | 1.50 REF. | | |
| L3 | 0.25 BSC | | |
| Q | 2.30 | 2.48 | 2.70 |

# Attention

QIAOXIN assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all QIAOXIN products described or contained herein. QIAOXIN products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. QIAOXIN reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.