# VCRR P-Channel Super Trench Power MOSFET

## Description

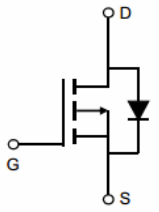
The VCRRP50P80AK uses **Super Trench** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of $R_{DS(ON)}$ and $Q_g$. This device is ideal for high-frequency switching and synchronous rectification.

## General Features

- $V_{DS}$ =-50V,$I_D$ =-80A
  $R_{DS(ON)}$=7.6mΩ (typical) @ $V_{GS}$=-10V
  $R_{DS(ON)}$=9.4mΩ (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

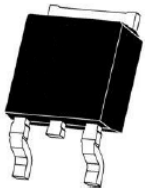
## Application

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




**Schematic Diagram**


**Marking and pin assignment**



**TO-252 -2Ltop view**

## Package Marking and Ordering Information

| Device Marking | Device | Device Package |
|---|---|---|
| VCRRP50P80AK | | TO-252-2L |

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

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | -50 | V |
| Gate-Source Voltage | $V_{GS}$ | ±20 | V |
| Drain Current-Continuous | $I_D$ | -80 | A |
| Drain Current-Continuous($T_C$=100℃) | $I_D$ (100℃) | -56 | A |
| Pulsed Drain Current | $I_{DM}$ | -300 | A |
| Maximum Power Dissipation | $P_D$ | 140 | W |
| Derating factor | | 0.93 | W/℃ |
| Single pulse avalanche energy (Note 5) | $E_{AS}$ | 720 | mJ |
| Operating Junction and Storage Temperature Range | $T_J$,$T_{STG}$ | -55 To 175 | ℃ |

## Thermal Characteristic

| | | | |
|---|---|---|---|
| Thermal Resistance,Junction-to-Case (Note 2) | $R_{\theta JC}$ | 1.07 | ℃/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 | -50 | | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=-50V,$V_{GS}$=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 | -1.0 | | -2.2 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=-10V, $I_D$=-20A | - | 7.6 | 9 | mΩ |
| | | $V_{GS}$=-4.5V, $I_D$=-20A | - | 9.4 | 11.8 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=-5V,$I_D$=-20A | - | 35 | - | S |
| **Dynamic Characteristics** (Note4) | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=-25V,$V_{GS}$=0V, F=1.0MHz | - | 3445 | - | PF |
| Output Capacitance | $C_{oss}$ | | - | 1155 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 22 | - | PF |
| **Switching Characteristics** (Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=-25V,$I_D$=-20A $V_{GS}$=-10V,$R_G$=1.6Ω | - | 12.5 | - | nS |
| Turn-on Rise Time | $t_r$ | | - | 5 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 45 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 8 | - | nS |
| Total Gate Charge | $Q_g$ | $V_{DS}$=-25V,$I_D$=-20A, $V_{GS}$=-10V | - | 38.5 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 8 | - | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 6.5 | - | 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) | $I_S$ | | - | - | -80 | A |
| Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25°C, $I_F$ =-20A di/dt = 100A/μs (Note3) | - | | 30 | nS |
| Reverse Recovery Charge | Qrr | | - | | 75 | 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℃,$V_{DD}$=-25V,$V_G$=-10V,L=0.5mH,Rg=25Ω

## Typical Electrical and Thermal Characteristics

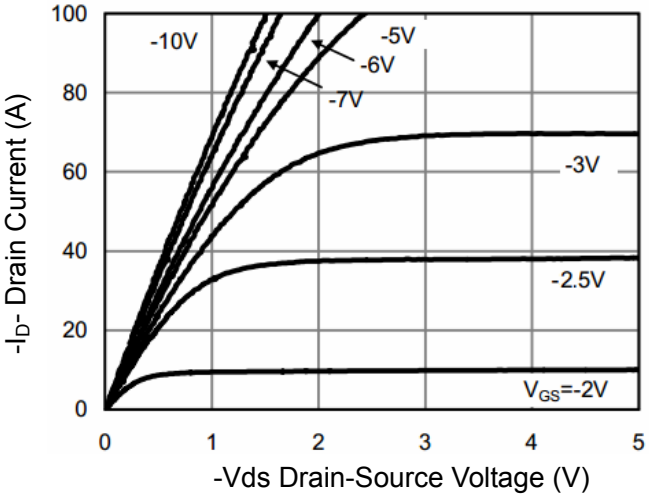



**Figure 1 Output Characteristics**

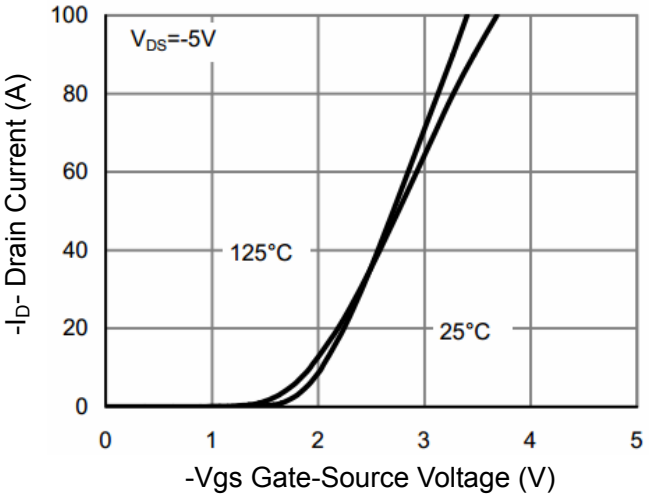



**Figure 2 Transfer Characteristics**

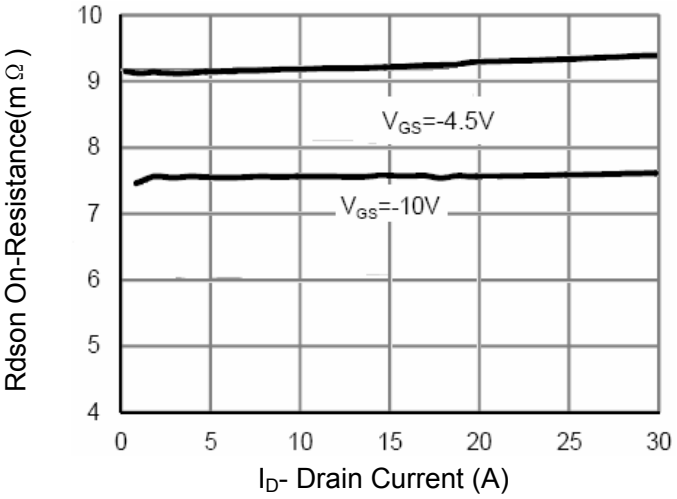



**Figure 3 Rdson- Drain Current**

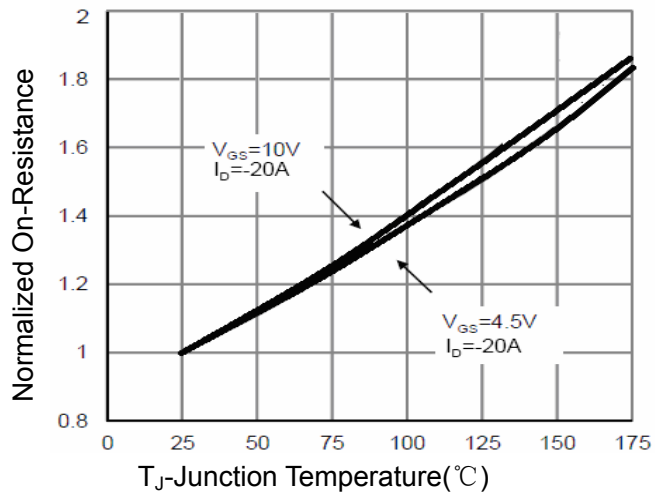



**Figure 4 Rdson-JunctionTemperature**

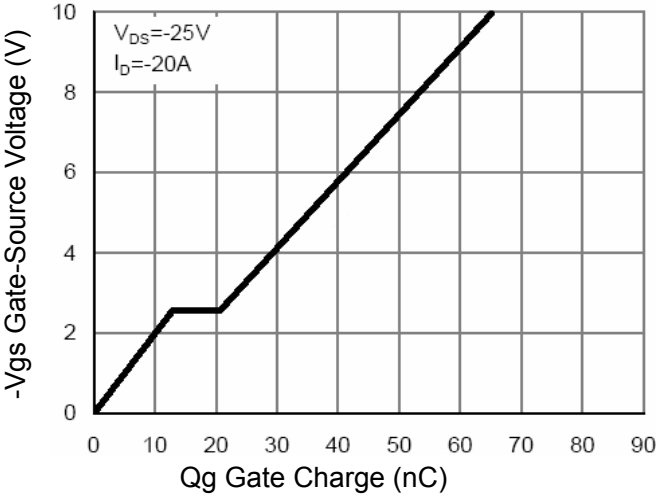



**Figure 5 Gate Charge**

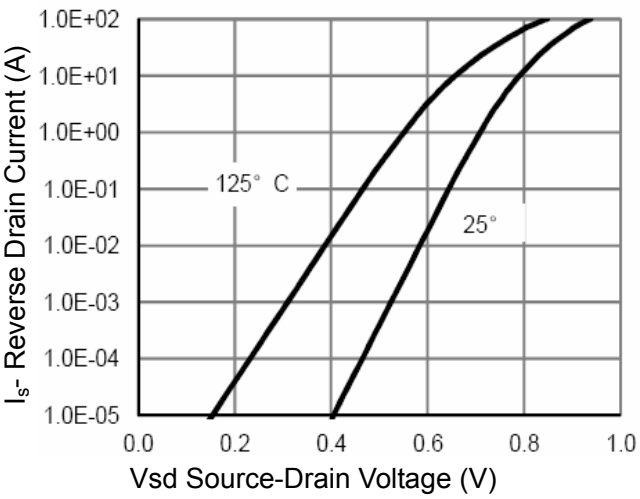



**Figure 6 Source- Drain Diode Forward**

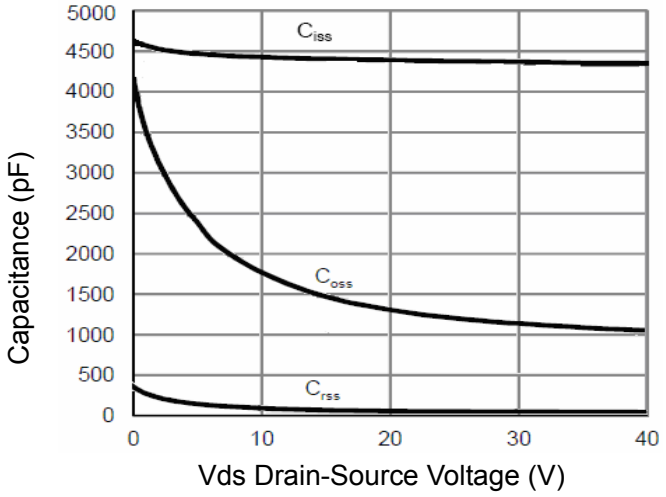



**Figure 7 Capacitance vs Vds**

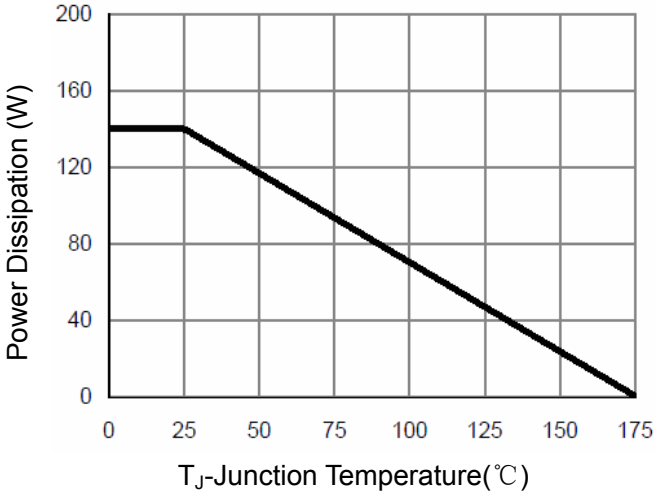



**Figure 9 Power De-rating**

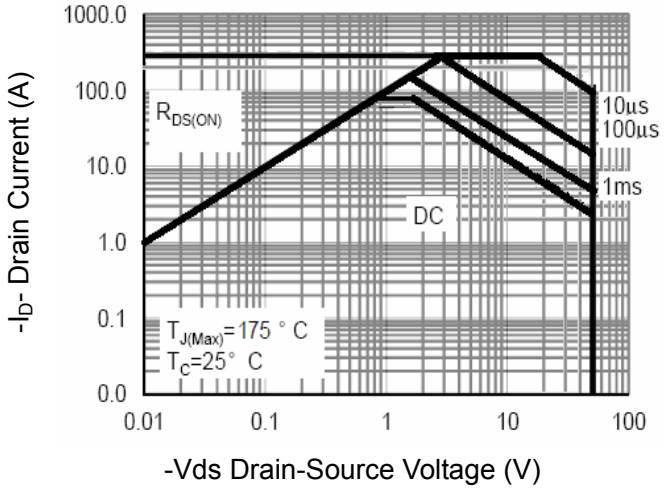



**Figure 8 Safe Operation Area**

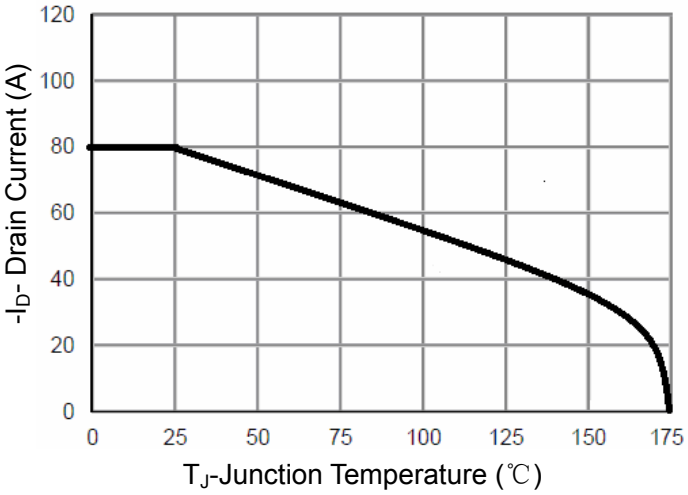



**Figure 10 Current De-rating**

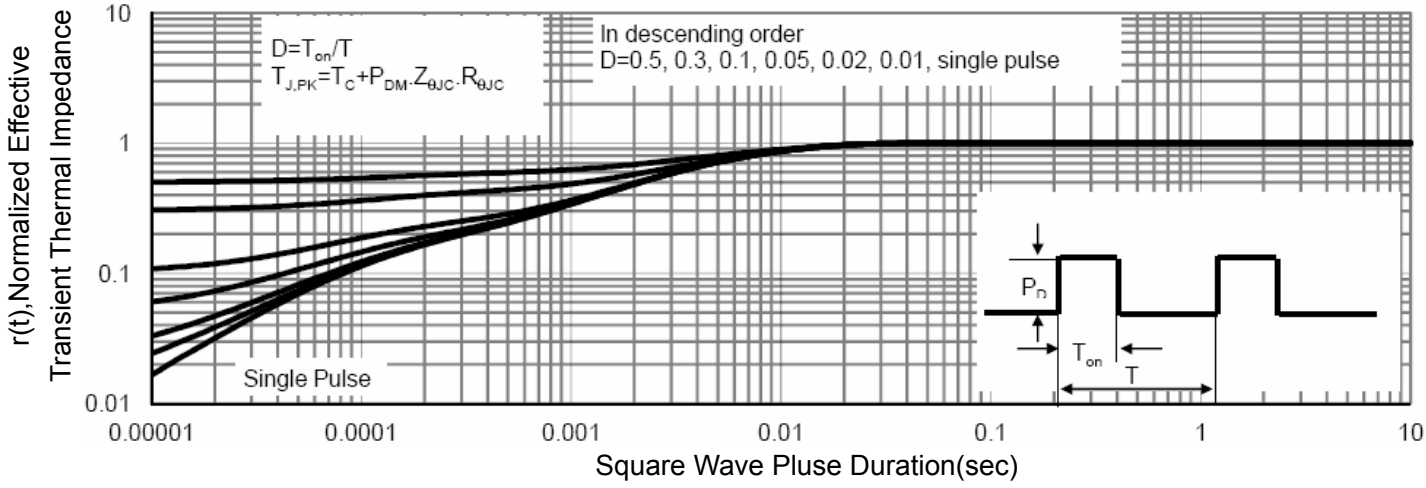
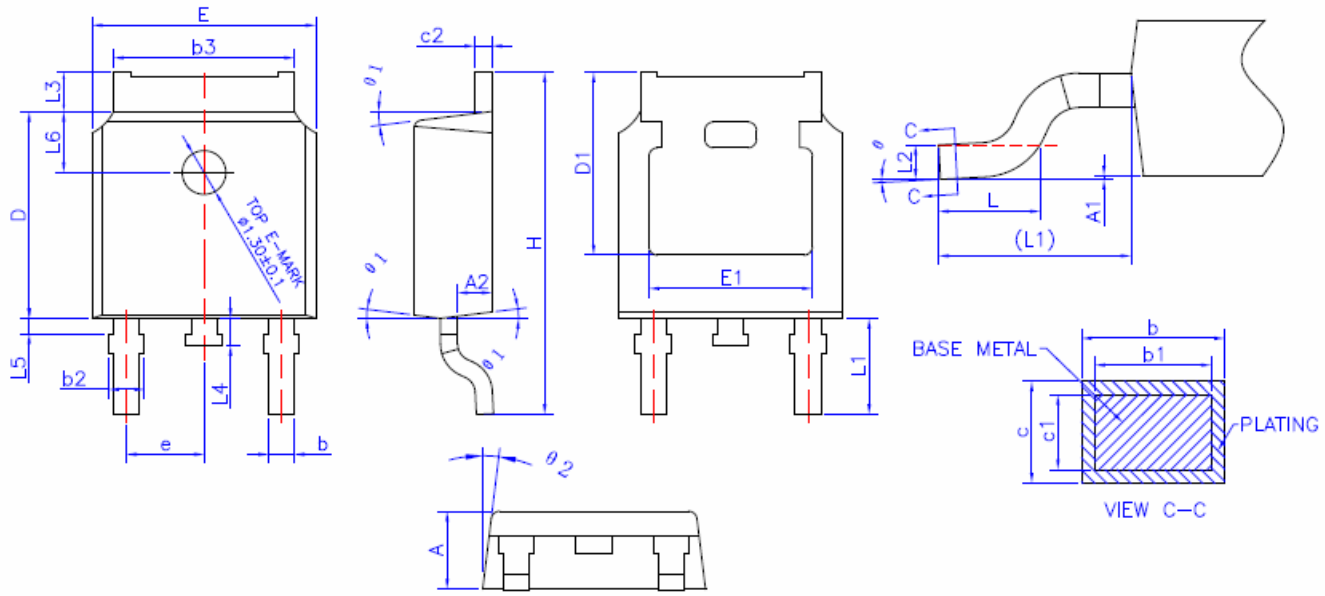



**Figure 11 Normalized Maximum Transient Thermal Impedance**

## TO-252 Package Information




COMMON DIMENSIONS
(UNITS OF MEASURE =MILLIMETER)

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | 2.20 | 2.30 | 2.38 |
| A1 | 0 | — | 0.10 |
| A2 | 0.90 | 1.01 | 1.10 |
| b | 0.72 | — | 0.85 |
| b1 | 0.71 | 0.76 | 0.81 |
| b2 | 0.72 | — | 0.90 |
| b3 | 5.13 | 5.33 | 5.46 |
| c | 0.47 | — | 0.60 |
| c1 | 0.46 | 0.51 | 0.56 |
| c2 | 0.47 | — | 0.60 |
| D | 6.00 | 6.10 | 6.20 |
| D1 | 5.25 | — | --- |
| E | 6.50 | 6.60 | 6.70 |
| E1 | 4.70 | — | --- |
| e | 2.186 | 2.286 | 2.386 |
| H | 9.80 | 10.10 | 10.40 |
| L | 1.40 | 1.50 | 1.70 |
| L1 | 2.90 REF | | |
| L2 | 0.508 BSC | | |
| L3 | 0.90 | — | 1.25 |
| L4 | 0.60 | 0.80 | 1.00 |
| L5 | 0.15 | — | 0.75 |
| L6 | 1.80 REF | | |
| θ | 0° | — | 8° |
| θ1 | 5° | 7° | 9° |
| θ2 | 5° | 7° | 9° |

## Attention

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