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Boost Chopper with Field Stop Trench IGBT + SiC SBD

$V_{CES} = 1200V$
 $I_C = 40A @ T_C = 100^{\circ}C$

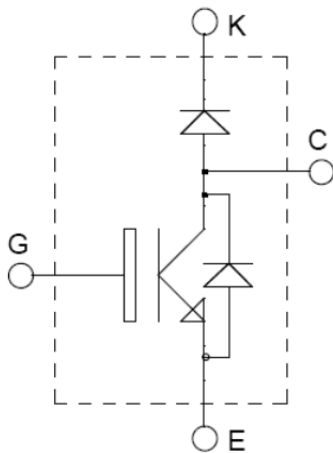


Features

- **Field Stop Trench Fast IGBT**
 - Low voltage drop
 - Low tail current
 - Switching frequency up to 50 kHz
 - Low leakage current
- **Chopper SiC Schottky Diode**
 - Zero reverse recovery current
 - Temperature Independent switching behavior
 - Positive temperature coefficient on VF

Applications

- Solar inverters
- AC and DC motor control
- Power Factor Correction
- Aerospace Actuators



Benefits

- Outstanding performance at high frequency operation
- Low switching losses
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Easy paralleling due to positive T_C of V_{CESat}
- RoHS Compliant

Absolute Maximum Ratings ($T_j = 25^{\circ}C$ unless otherwise specified)

| Parameters | Symbol | Conditions | Specifications | Units |
|---------------------------------------|-----------|----------------------|----------------|-------------|
| Collector - Emitter Breakdown Voltage | V_{CES} | | 1200 | V |
| Continuous Collector Current | I_C | $T_C = 25^{\circ}C$ | 80 | A |
| | | $T_C = 100^{\circ}C$ | 40 | A |
| Gate-Emitter Voltage | V_{GES} | | ± 20 | V |
| Pulsed Collector Current | ICM | | 120 | A |
| Maximum Power Dissipation | P_D | $T_C = 25^{\circ}C$ | 480 | W |
| | | $T_C = 100^{\circ}C$ | 200 | W |
| Operating Junction Temperature | T_J | | -55 ~ 150 | $^{\circ}C$ |
| Storage Temperature | T_{STG} | | -55 ~ 150 | $^{\circ}C$ |

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

| Parameters | Symbol | Conditions | Min | Typ | Max | Units |
|--------------------------------------|---------------|---|-----|------|-----------|---------------|
| OFF | | | | | | |
| Zero Gate Voltage Collector Current | I_{CES} | $V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}$ | -- | -- | 1 | mA |
| Gate-Emitter Leakage Current | I_{GES} | $V_{CE} = 0\text{V}, V_{GE} = 20\text{V}$ | -- | -- | ± 250 | nA |
| ON | | | | | | |
| Gate-Emitter Threshold Voltage | $V_{GE(TH)}$ | $V_{GE} = V_{CE}, I_C = 40\text{mA}$ | 4.5 | 6.5 | 8.5 | V |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$ | $V_{CE} = 15\text{V}, I_C = 40\text{A}, T_J = 25^{\circ}\text{C}$ | -- | 2.0 | 2.6 | V |
| | | $V_{CE} = 15\text{V}, I_C = 40\text{A}, T_J = 125^{\circ}\text{C}$ | -- | 2.45 | -- | V |
| DYNAMIC | | | | | | |
| Input Capacitance | C_{IES} | $V_{CE} = 30\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$ | -- | 5150 | -- | pF |
| Output Capacitance | C_{OES} | | -- | 150 | -- | pF |
| Reverse Transfer Capacitance | C_{RES} | | -- | 100 | -- | pF |
| SWITCHING | | | | | | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CE} = 600\text{V}, I_C = 40\text{A}$ $R_G = 5\Omega, V_{GE} = 15\text{V}$ Inductive Load, $T_J = 25^{\circ}\text{C}$ | -- | 55 | -- | ns |
| Rise Time | t_r | | -- | 80 | -- | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | -- | 200 | -- | ns |
| Fall Time | t_f | | -- | 55 | -- | ns |
| Turn-On Switching Energy Loss | E_{ON} | | -- | 3.5 | -- | mJ |
| Turn-Off Switching Energy Loss | E_{OFF} | | -- | 1.1 | -- | mJ |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{CE} = 600\text{V}, I_C = 40\text{A}$ $R_G = 5\Omega, V_{GE} = 15\text{V}$ Inductive Load, $T_J = 125^{\circ}\text{C}$ | -- | 45 | -- | ns |
| Rise Time | t_r | | -- | 75 | -- | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | -- | 210 | -- | ns |
| Fall Time | t_f | | -- | 115 | -- | ns |
| Turn-On Switching Energy Loss | E_{ON} | | -- | 3.7 | -- | mJ |
| Turn-Off Switching Energy Loss | E_{OFF} | | -- | 2.2 | -- | mJ |
| Total Gate Charge | Q_g | $V_{CE} = 600\text{V}, I_C = 40\text{A}$ $V_{GE} = 15\text{V}$ | -- | 320 | 480 | nC |
| Gate-Emitter Charge | Q_{ge} | | -- | 40 | 60 | nC |
| Gate-Collector Charge | Q_{gc} | | -- | 150 | 225 | nC |
| Short Circuit Withstanding Time | t_{sc} | $V_{CE} = 600\text{V}, V_{GE} = 15\text{V}$ $T_J = 125^{\circ}\text{C}$ | -- | -- | 10 | μs |

SiC Diode Rating and Characteristics ($T_j=25^{\circ}\text{C}$ unless otherwise specified)

| Parameters | Symbol | Conditions | Min | Typ | Max | Units |
|---|-----------|--|------|------|-----|---------------|
| Maximum peak repetitive reverse voltage | V_{RRM} | | 1200 | -- | -- | V |
| Maximum Reverse Leakage Current | I_{RM} | $V_R = 1200\text{V}, T_j = 25^{\circ}\text{C}$ | -- | 10 | 100 | μA |
| | | $V_R = 1200\text{V}, T_j = 150^{\circ}\text{C}$ | -- | 1212 | | μA |
| Diode Forward Voltage | V_F | $I_F = 20\text{A}, T_j = 25^{\circ}\text{C}$ | -- | 1.5 | 1.7 | V |
| | | $I_F = 20\text{A}, T_j = 150^{\circ}\text{C}$ | -- | 2.3 | -- | V |
| Total Capacitive Charge | Q_C | $V_R=1200\text{V}, I_F<I_{F,max}$ | -- | 104 | -- | nC |
| Switching Time | t_C | $di_F/dt = 200\text{A}/\mu\text{s}, T_j = 175^{\circ}\text{C}$ | -- | -- | 10 | ns |
| Total Capacitance | C | $V_R = 1\text{V}, f = 1\text{MHz}$ | -- | 1800 | -- | pF |
| | | $V_R = 600\text{V}, f = 1\text{MHz}$ | -- | 114 | -- | pF |
| | | $V_R = 1200\text{V}, f = 1\text{MHz}$ | -- | 86 | -- | pF |

Thermal and Package Characteristics ($T_j=25^{\circ}\text{C}$ unless otherwise specified)

| Parameters | Symbol | Conditions | Min | Typ | Max | Units |
|-------------------------------------|------------|--|------|-----|------|-----------------------------|
| Junction to Case Thermal Resistance | R_{THIC} | IGBT chip | -- | -- | 0.26 | $^{\circ}\text{C}/\text{W}$ |
| | | SiC SBD chip | -- | -- | 0.65 | $^{\circ}\text{C}/\text{W}$ |
| Mounting Torque | M_d | | | | 1.5 | N-m |
| Terminal Connection Torque | M_{dt} | | 1.3 | -- | 1.5 | N-m |
| Package Weight | W_t | | | 29 | | g |
| Isolation Voltage | V_{ISOL} | $I_{ISOL} < 1\text{mA}, 50/60\text{Hz}, t=1\text{min}$ | 2500 | V | | |

IGBT Characteristics

Fig. 1 Output characteristics

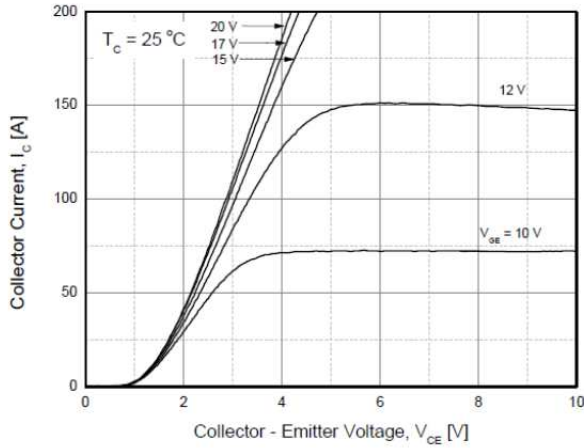


Fig. 2 Saturation voltage characteristics

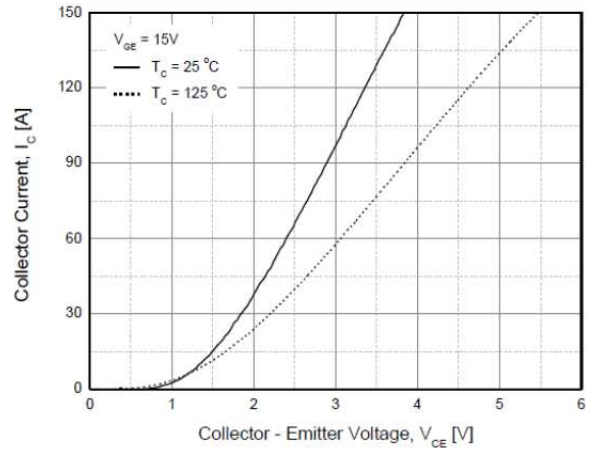


Fig. 3 Saturation voltage vs. collector current

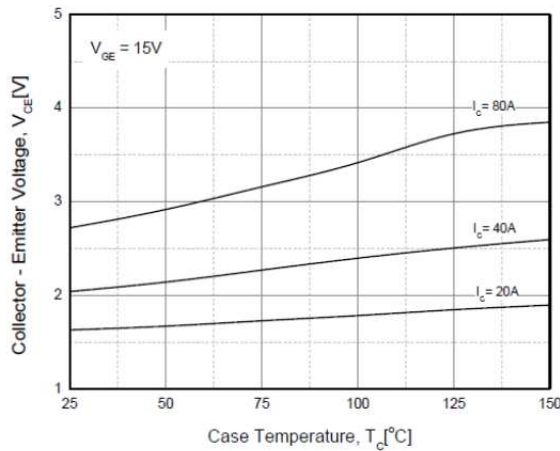


Fig. 4 Saturation voltage vs. gate bias

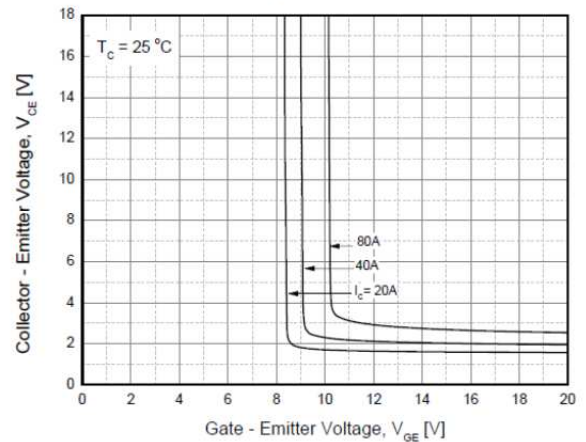


Fig. 5 Saturation voltage vs. gate bias

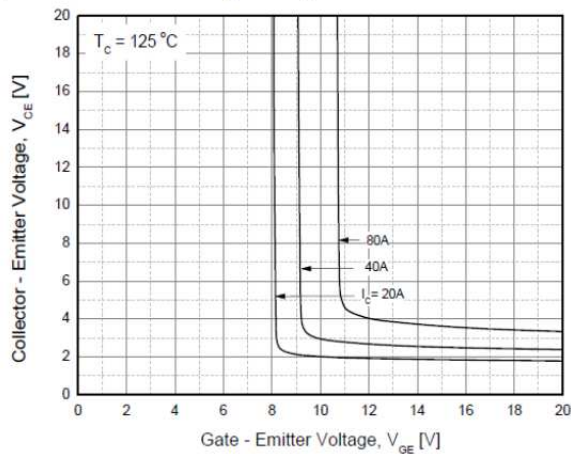


Fig. 6 Capacitance characteristics

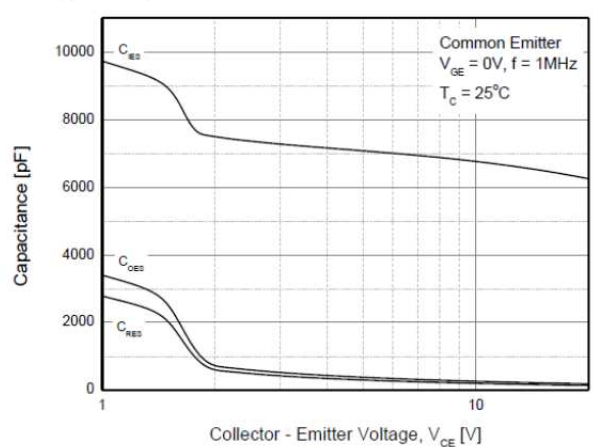


Fig. 7 Turn-on time vs. gate resistor

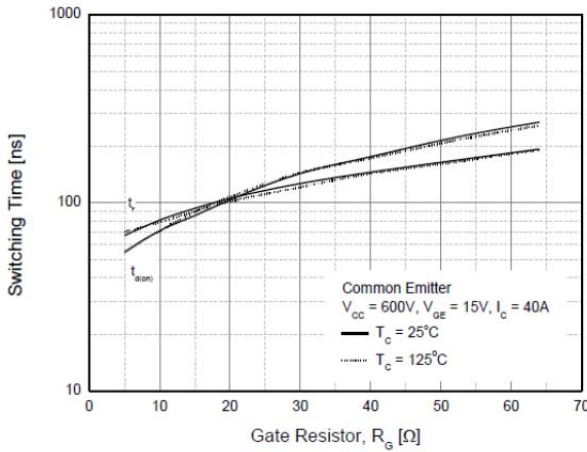


Fig. 8 Turn-off time vs. gate resistor

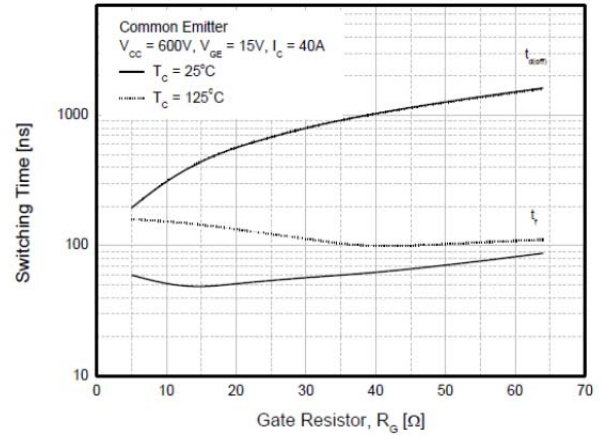


Fig. 9 Switching loss vs. gate resistor

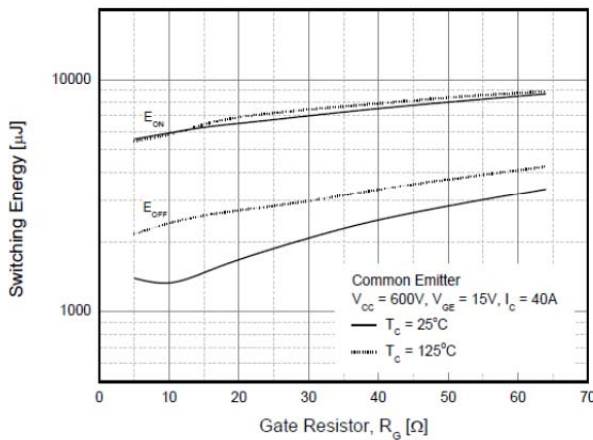


Fig. 10 Turn-on time vs. collector current

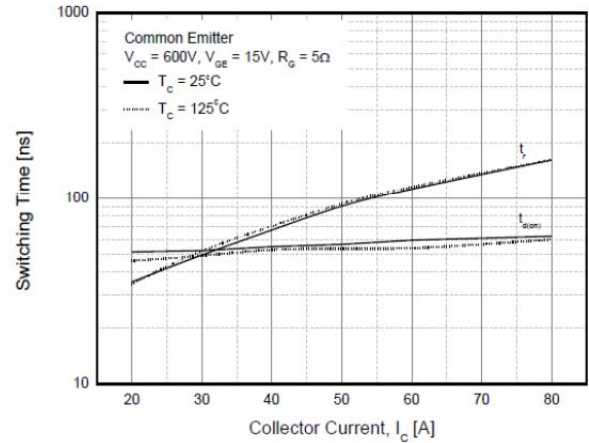


Fig. 11 Turn-off time vs. collector current

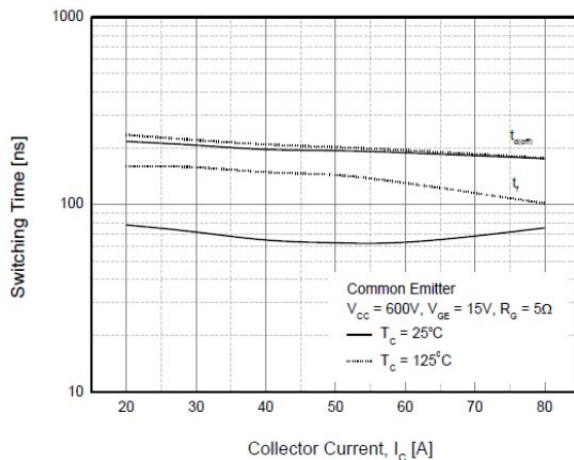


Fig. 12 Switching loss vs. collector current

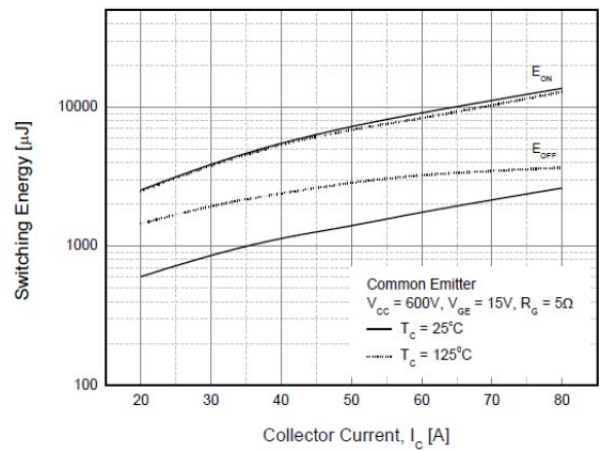


Fig. 13 Gate charge characteristics

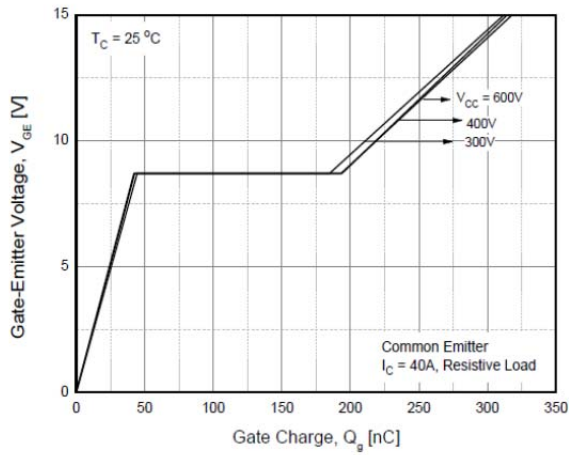


Fig. 14 SOA

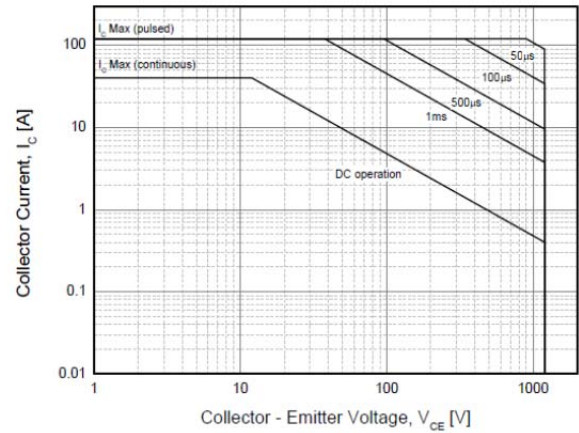


Fig. 15 RBSOA

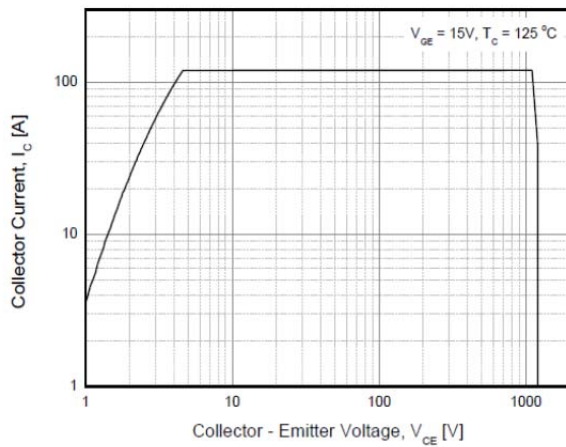
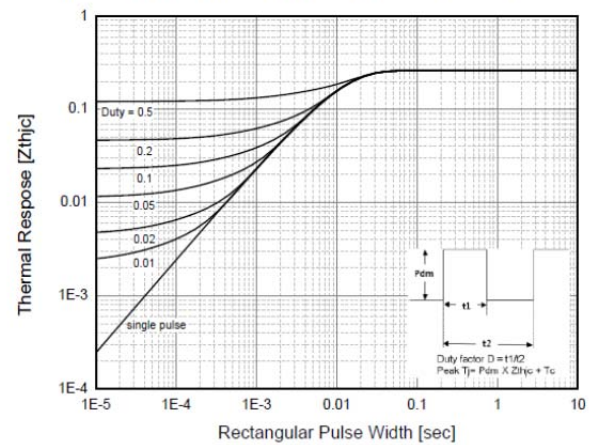


Fig. 16 Transient thermal impedance of IGBT



Boost SiC Diode Characteristics

Fig. 17 Forward Characteristics

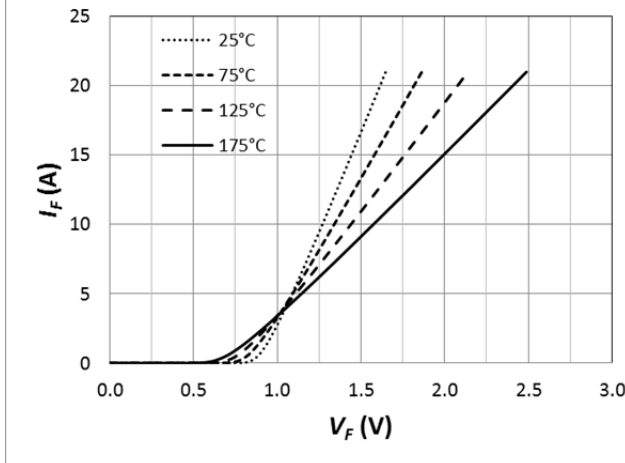


Fig. 18 Reverse Characteristics

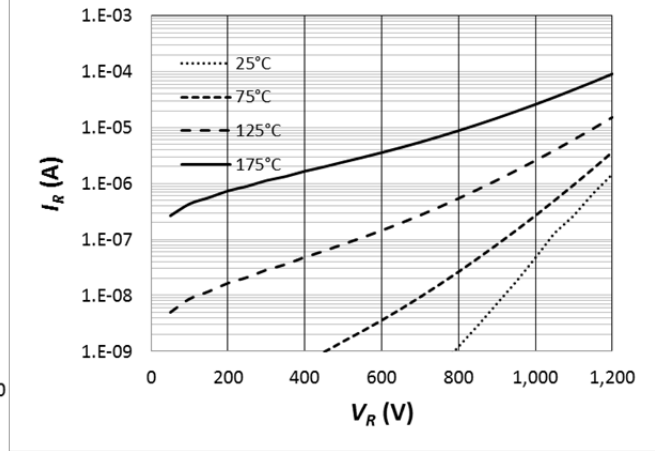


Fig. 19 Power Derating

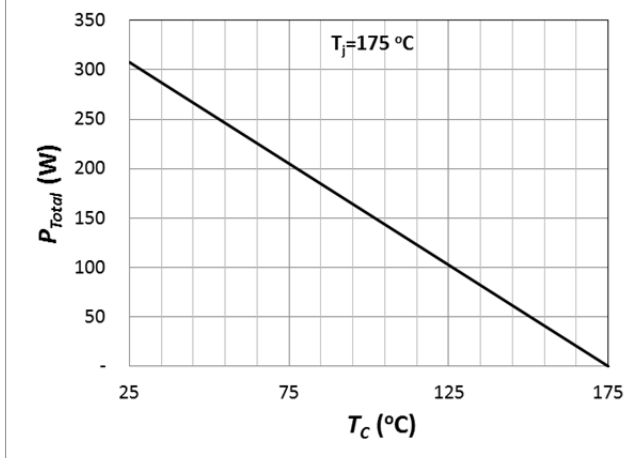


Fig. 20 Current Derating

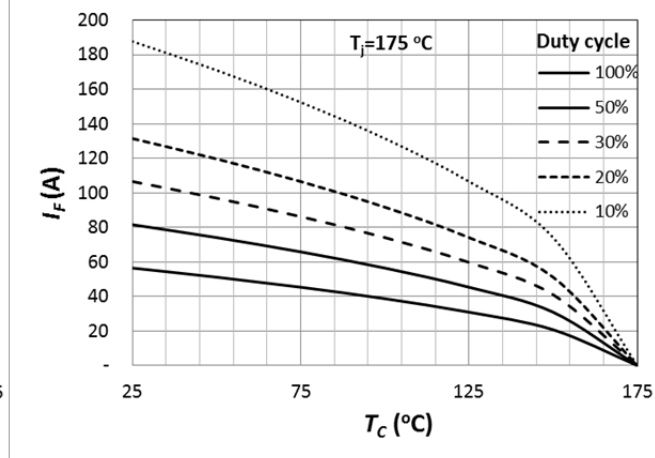


Fig. 21 Capacitance Curve

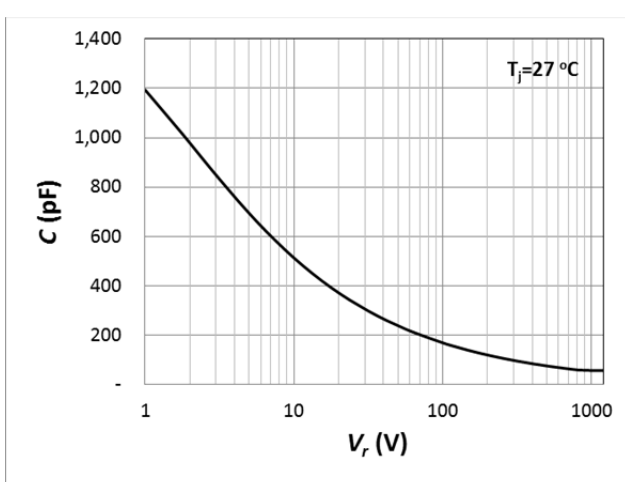
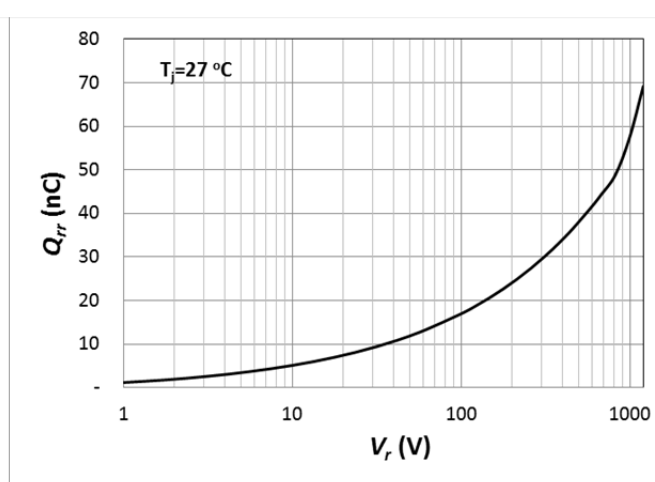
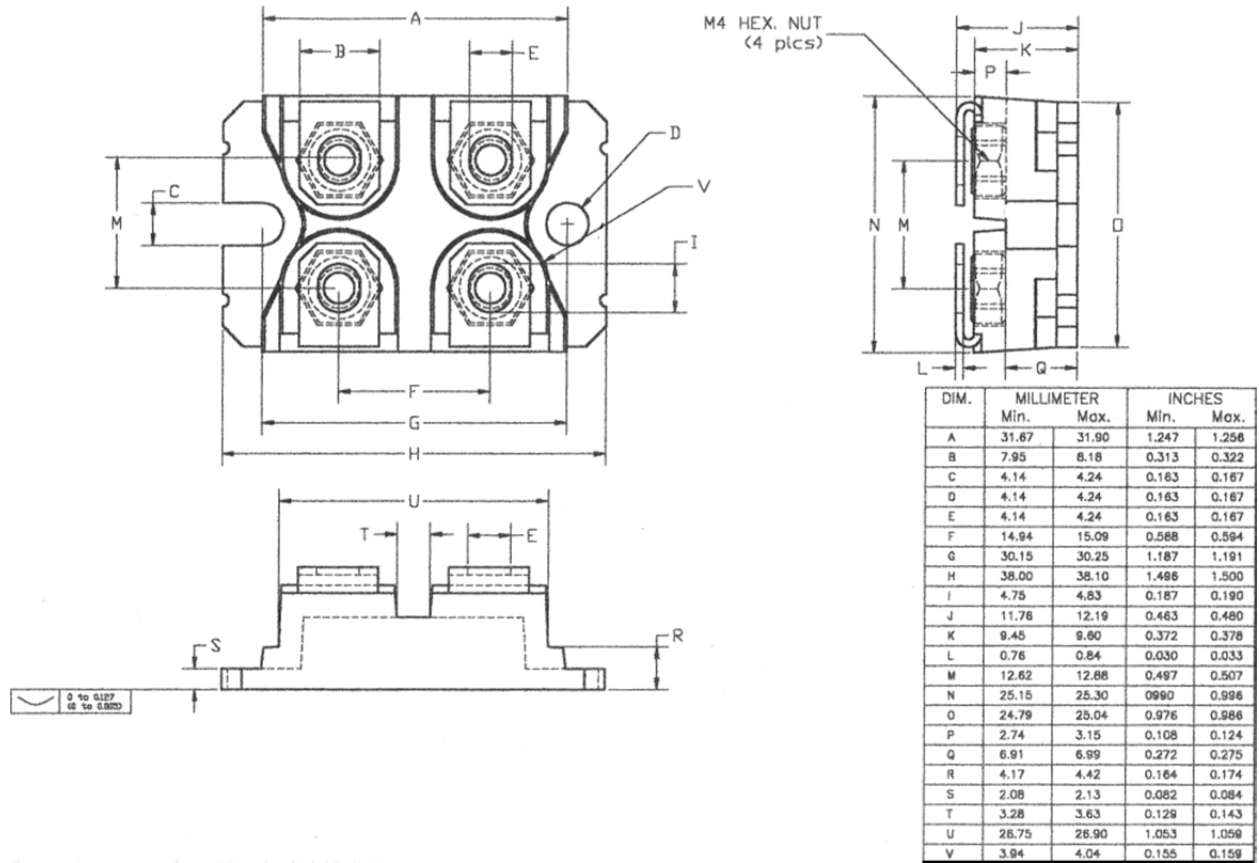


Fig. 22 Recovery Charge



SOT-227 Package Outline



Revision History

| Date | Revision | Notes |
|----------|----------|-----------------|
| 6/3/2014 | 1.0 | Initial release |
| | | |
| | | |

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Notes

- **RoHS Compliance**

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as implemented March, 2013. RoHS Declarations for this product can be obtained from the Product Documentation sections of www.gptechgroup.com.

- **REACH Compliance**

REACH substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact our office at GPTG Headquarters in Lake Forest, California to insure you get the most up-to-date REACH SVHC Declaration.

REACH banned substance information (REACH Article 67) is also available upon request.

- This product has not been designed or tested for use in, and is not intended for use in, applications implanted into the human body nor in applications in which failure of the product could lead to death, personal injury or property damage, including but not limited to equipment used in the operation of nuclear facilities, life-support machines, cardiac defibrillators or similar emergency medical equipment, aircraft navigation or communication or control systems, or air traffic control.

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