# INT-A-PAK, Half Bridge - Trench IGBT, 200 A

**INT-A-PAK**

| PRODUCT SUMMARY | |
|---|---|
| $V_{CES}$ | 650 V |
| $I_C$ (DC) at $T_C$ = 80 °C | 166 A |
| $V_{CE(on)}$ (typical) at $I_C$ = 200 A, $T_J$ = 25 °C | 1.9 V |
| Speed | 8 kHz to 30 kHz |
| Package | INT-A-PAK |
| Circuit | Half bridge |

## FEATURES

RoHS COMPLIANT

- Trench IGBT
- Very low $V_{CE(on)}$
- 5 μs short circuit capability
- Positive $V_{CE(on)}$ temperature coefficient
- FRED Pt® anti-parallel diode low $Q_{rr}$ and low switching energy
- Industry and standard package
- $T_J$ = 175 °C
- UL pending
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

## BENEFITS

- Benchmark efficiency for UPS and welding application
- Rugged transient performance
- Direct mounting on heatsink
- Very low junction to case thermal resistance

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER | | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
|---|---|---|---|---|---|
| Collector to emitter voltage | | $V_{CES}$ | | 650 | V |
| Continuous collector current | | $I_C$ | $T_C$ = 25 °C | 221 | A |
| | | | $T_C$ = 80 °C | 166 | |
| Pulsed collector current | | $I_{CM}$ | | 320 | |
| Clamped inductive load current | | $I_{LM}$ | | 320 | |
| Diode continuous forward current | | $I_F$ | $T_C$ = 25 °C | 138 | |
| | | | $T_C$ = 80 °C | 103 | |
| Maximum non-repetitive peak current | | $I_{FSM}$ | 10 ms sine or 6 ms rectangular pulse, $T_J$ = 25 °C | 700 | |
| Gate to emitter voltage | | $V_{GE}$ | | ± 20 | V |
| Maximum power dissipation | IGBT | $P_D$ | $T_C$ = 25 °C | 600 | W |
| | | | $T_C$ = 80 °C | 380 | |
| | Diode | | $T_C$ = 25 °C | 288 | |
| | | | $T_C$ = 80 °C | 183 | |
| RMS isolation voltage | | $V_{ISOL}$ | $T_J$ = 25 °C, f = 50 Hz, t = 1 s | 3500 | V |
| Operating junction temperature range | | $T_J$ | | -40 to +175 | °C |

| **ELECTRICAL SPECIFICATIONS** ($T_J$ = 25 °C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Collector to emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$ = 0 V, $I_C$ = 500 μA | 650 | - | - | V |
| Collector to emitter voltage | $V_{CE(on)}$ | $V_{GE}$ = 15 V, $I_C$ = 100 A | - | 1.45 | 1.56 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 200 A | - | 1.9 | 2.12 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 100 A, $T_J$ = 125 °C | - | 1.58 | - | |
| | | $V_{GE}$ = 15 V, $I_C$ = 200 A, $T_J$ = 125 °C | - | 2.21 | - | |
| Gate threshold voltage | $V_{GE(th)}$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 6.6 mA | 5.0 | 5.8 | 8.4 | |
| Temperature coefficient of threshold voltage | $\Delta V_{GE(th)}/\Delta T_J$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 6.6 mA (25 °C to 125 °C) | - | -15.6 | - | mV/°C |
| Forward transconductance | $g_{fe}$ | $V_{CE}$ = 20 V, $I_C$ = 50 A | - | 67 | - | S |
| Transfer characteristics | $V_{GE}$ | $V_{CE}$ = 20 V, $I_C$ = 200 A | - | 9.8 | - | V |
| Collector to emitter leakage current | $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 650 V | - | 0.3 | 60 | μA |
| | | $V_{GE}$ = 0 V, $V_{CE}$ = 650 V, $T_J$ = 125 °C | - | 0.1 | - | mA |
| Diode forward voltage drop | $V_{FM}$ | $I_{FM}$ = 100 A | - | 1.75 | 2.24 | V |
| | | $I_{FM}$ = 200 A | - | 2.08 | 3.04 | |
| | | $I_{FM}$ = 100 A, $T_J$ = 125 °C | - | 1.41 | - | |
| | | $I_{FM}$ = 200 A, $T_J$ = 125 °C | - | 1.80 | - | |
| Gate to emitter leakage current | $I_{GES}$ | $V_{GE}$ = ± 20 V | - | - | 600 | nA |

| **SWITCHING CHARACTERISTICS** | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Turn-on switching loss | $E_{on}$ | $V_{CC}$ = 325 V, $I_C$ = 200 A, $R_g$ = 4.7 Ω, L = 500 μH, $V_{GE}$ = 15 V | - | 1.2 | - | mJ |
| Turn-off switching loss | $E_{off}$ | | - | 4.6 | - | |
| Total switching loss | $E_{tot}$ | | - | 5.8 | - | |
| Turn-on switching loss | $E_{on}$ | $V_{CC}$ = 325 V, $I_C$ = 200 A, $R_g$ = 4.7 Ω, L = 500 μH, $V_{GE}$ = 15 V, $T_J$ = 125 °C | - | 1.53 | - | mJ |
| Turn-off switching loss | $E_{off}$ | | - | 5.29 | - | |
| Total switching loss | $E_{tot}$ | | - | 6.82 | - | |
| Turn-on delay time | $t_{d(on)}$ | | - | 214 | - | ns |
| Rise time | $t_r$ | | - | 103 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 203 | - | |
| Fall time | $t_f$ | | - | 90 | - | |
| Reverse bias safe operating area | RBSOA | $I_C$ = 320 A, $R_g$ = 4.7 Ω, $V_{CC}$ = 325 V, $V_p$ = 650 V, $V_{GE}$ = 15 V to 0 V, $T_J$ = 175 °C | | | | |
| Short circuit safe operating area | SCSOA | $V_{CC}$ = 325 V, $V_p$ = 650 V, $R_g$ = 4.7 Ω, $V_{GE}$ = 15 V to 0 V, $T_J$ = 175 °C | - | - | 5.5 | μs |
| **ANTI-PARALLEL DIODE** | | | | | | |
| Diode reverse recovery time | $t_{rr}$ | $I_F$ = 50 A, $dI_F/dt$ = 500 A/μs $V_{rr}$ = 200 V, $T_J$ = 25 °C | - | 73 | - | ns |
| Diode peak reverse current | $I_{rr}$ | | - | 13 | - | A |
| Diode recovery charge | $Q_{rr}$ | | - | 465 | - | nC |
| Diode reverse recovery time | $t_{rr}$ | $I_F$ = 50 A, $dI_F/dt$ = 500 A/μs $V_{rr}$ = 200 V, $T_J$ = 125 °C | - | 146 | - | ns |
| Diode peak reverse current | $I_{rr}$ | | - | 28 | - | A |
| Diode recovery charge | $Q_{rr}$ | | - | 2064 | - | nC |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Operating junction temperature range | | $T_J$ | | -40 | - | 175 | °C |
| Storage temperature range | | $T_{Stg}$ | | -40 | - | 125 | °C |
| Junction to case per leg | IGBT | $R_{thJC}$ | | - | - | 0.25 | °C/W |
| | Diode | | | - | - | 0.52 | |
| Case to sink per module (conductive grease applied) | | $R_{thCS}$ | | - | 0.05 | - | |
| Mounting torque | Power terminal screw: M5 | | | 2.5 | - | 5.0 | Nm |
| | Mounting screw: M6 | | | 3.0 | - | 5.0 | |
| Weight | | | | - | 150 | - | g |

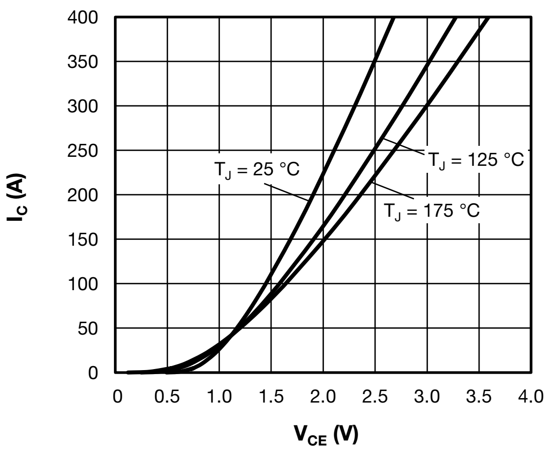



Fig. 1 - Typical IGBT Output Characteristics, $V_{GE}$ = 15 V

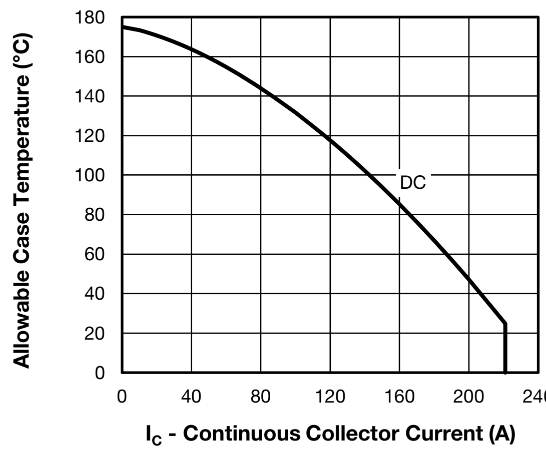



Fig. 3 - Maximum IGBT Continuous Collector Current vs. Case Temperature

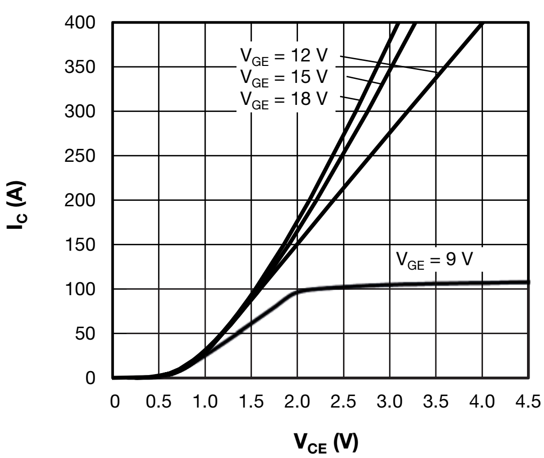



Fig. 2 - Typical IGBT Output Characteristics, $T_J$ = 125 °C

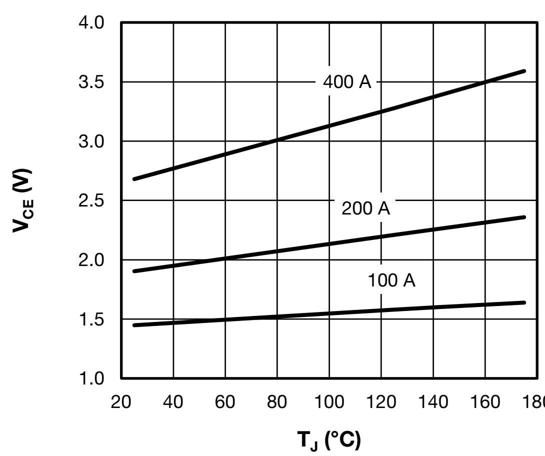



Fig. 4 - Collector to Emitter Voltage vs. Junction Temperature

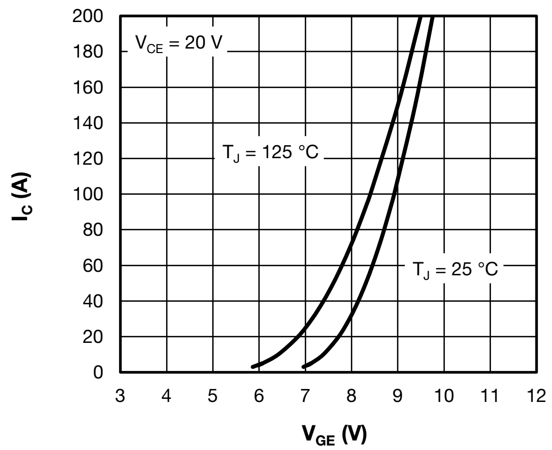



Fig. 5 - Typical IGBT Transfer Characteristics

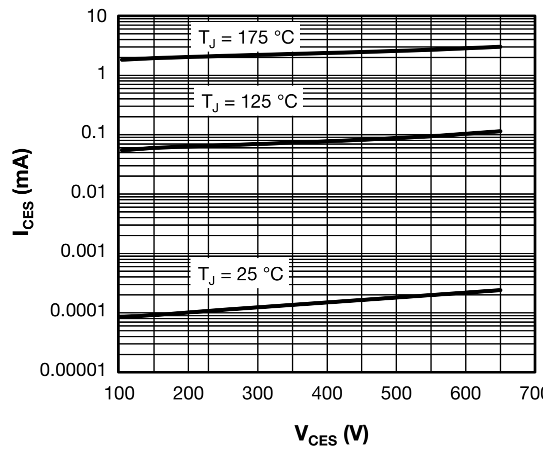



Fig. 8 - Typical IGBT Zero Gate Voltage Collector Current

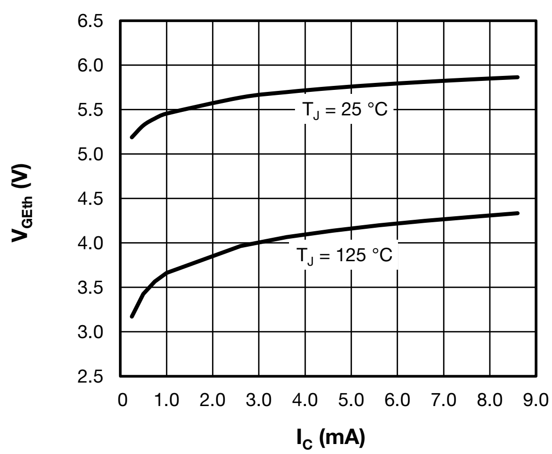



Fig. 6 - Typical IGBT Threshold Voltage

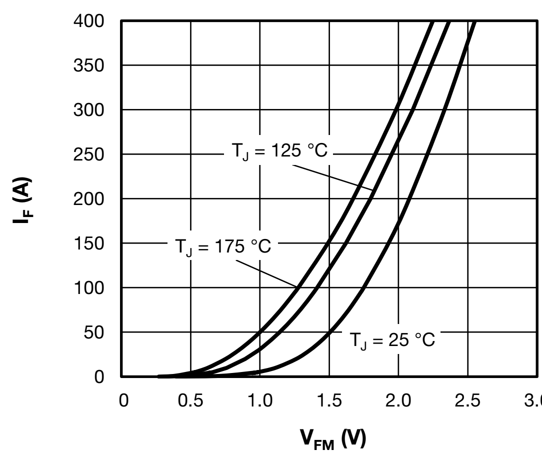



Fig. 9 - Typical Diode Forward Characteristics

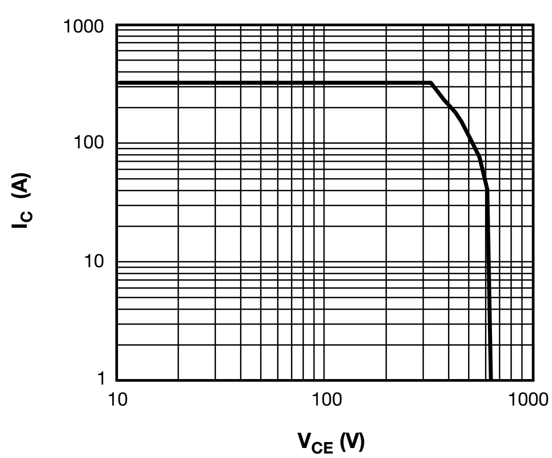



Fig. 7 - IGBT Reverse BIAS SOA $T_J$ = 175 °C, $V_{GE}$ = 15 V

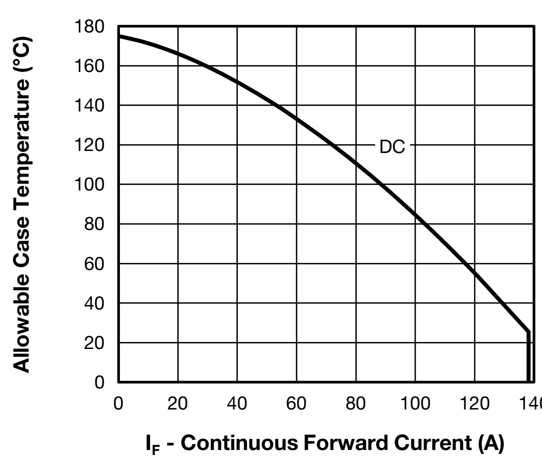



Fig. 10 - Maximum Diode Continuous Forward Current vs. Case Temperature

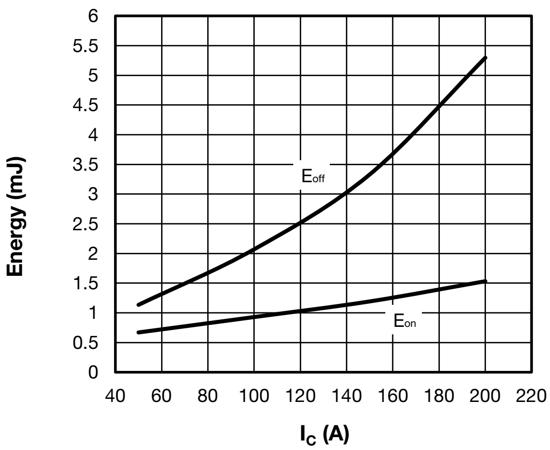



Fig. 11 - Typical IGBT Energy Loss vs. $I_C$
$T_J$ = 125 °C, $V_{CC}$ = 325 V, $R_g$ = 4.7 Ω, $V_{GE}$ = 15 V, L = 500 μH

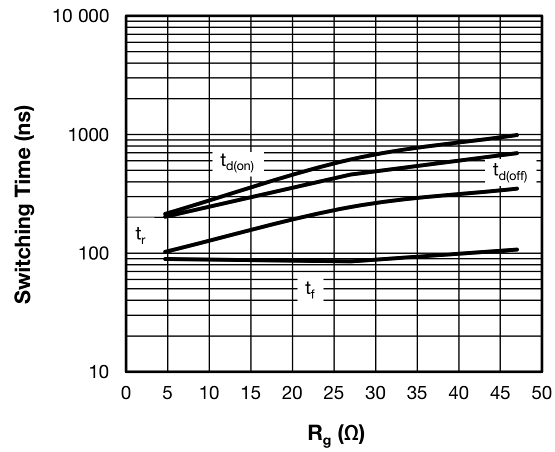



Fig. 14 - Typical IGBT Switching Time vs. $R_g$
$T_J$ = 125 °C, $V_{CC}$ = 325 V, $I_C$ = 200 A, $V_{GE}$ = 15 V, L = 500 μH

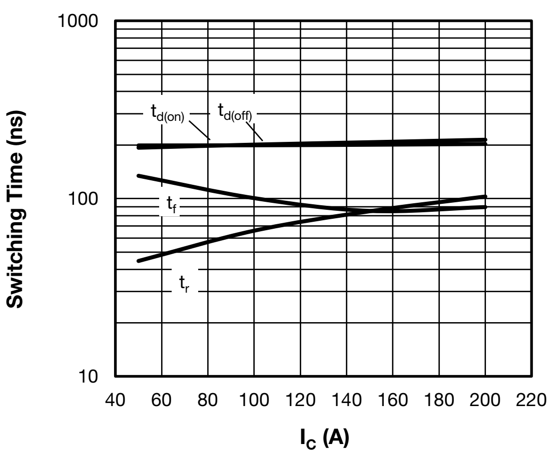



Fig. 12 - Typical IGBT Switching Time vs. $I_C$
$T_J$ = 125 °C, $V_{CC}$ = 325 V, $R_g$ = 4.7 Ω, $V_{GE}$ = 15 V, L = 500 μH

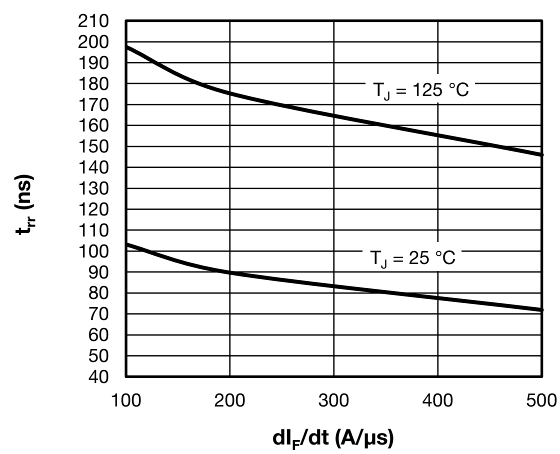



Fig. 15 - Typical Diode Reverse Recovery Time vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 50 A

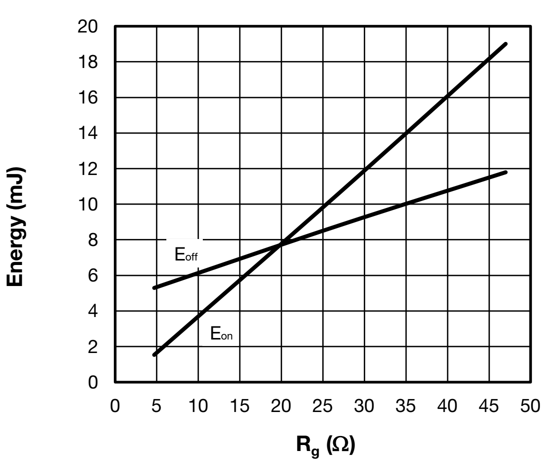



Fig. 13 - Typical IGBT Energy Loss vs. $R_g$
$T_J$ = 125 °C, $V_{CC}$ = 325 V, $I_C$ = 200 A, $V_{GE}$ = 15 V, L = 500 μH

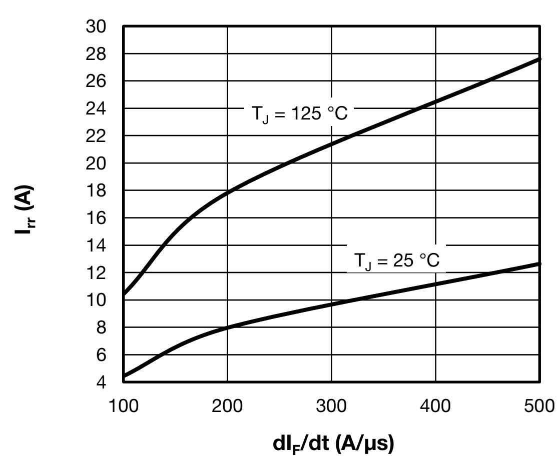



Fig. 16 - Typical Diode Reverse Recovery Current vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 50 A

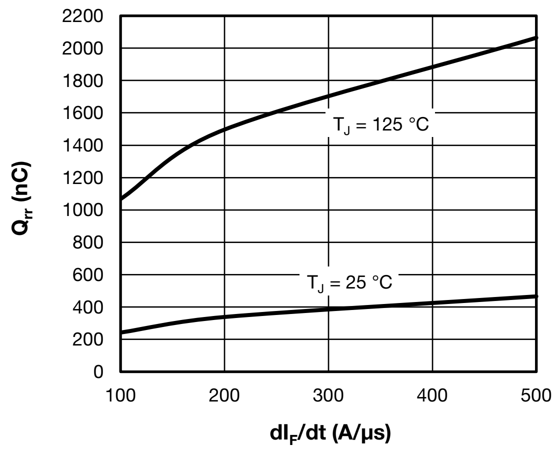



Fig. 17 - Typical Diode Reverse Recovery Charge vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 50 A

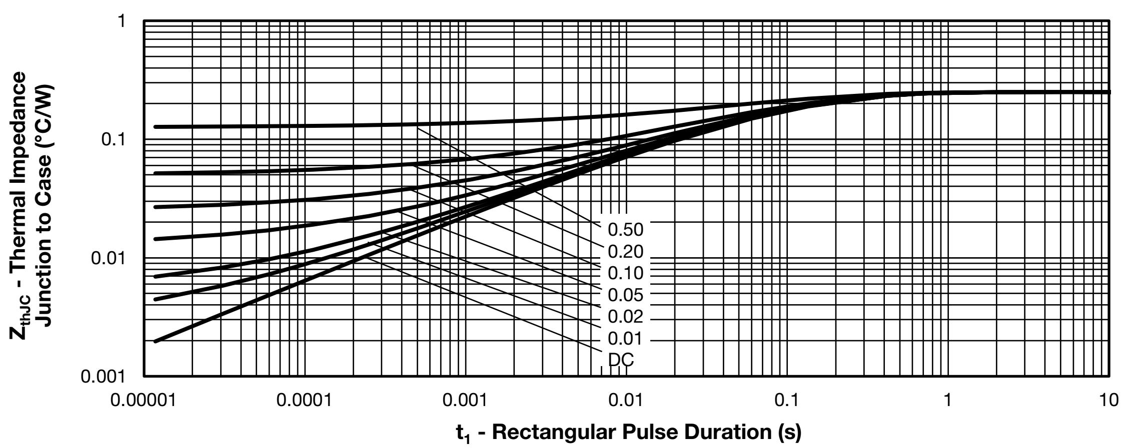



Fig. 18 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics - (IGBT)

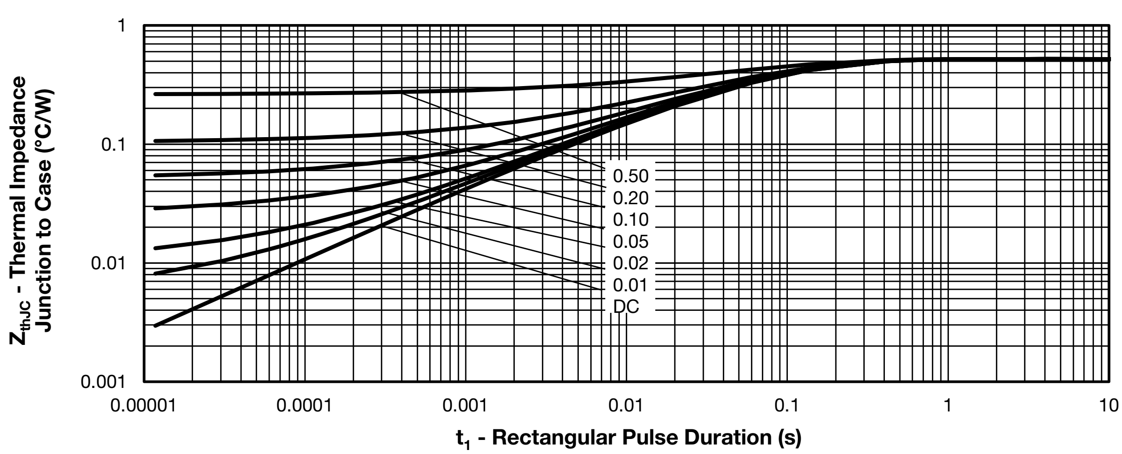
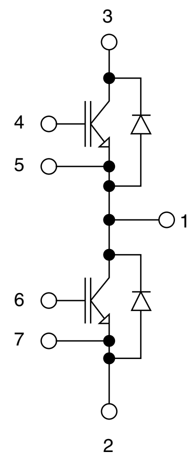



Fig. 19 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics - (Diode)

## CIRCUIT CONFIGURATION

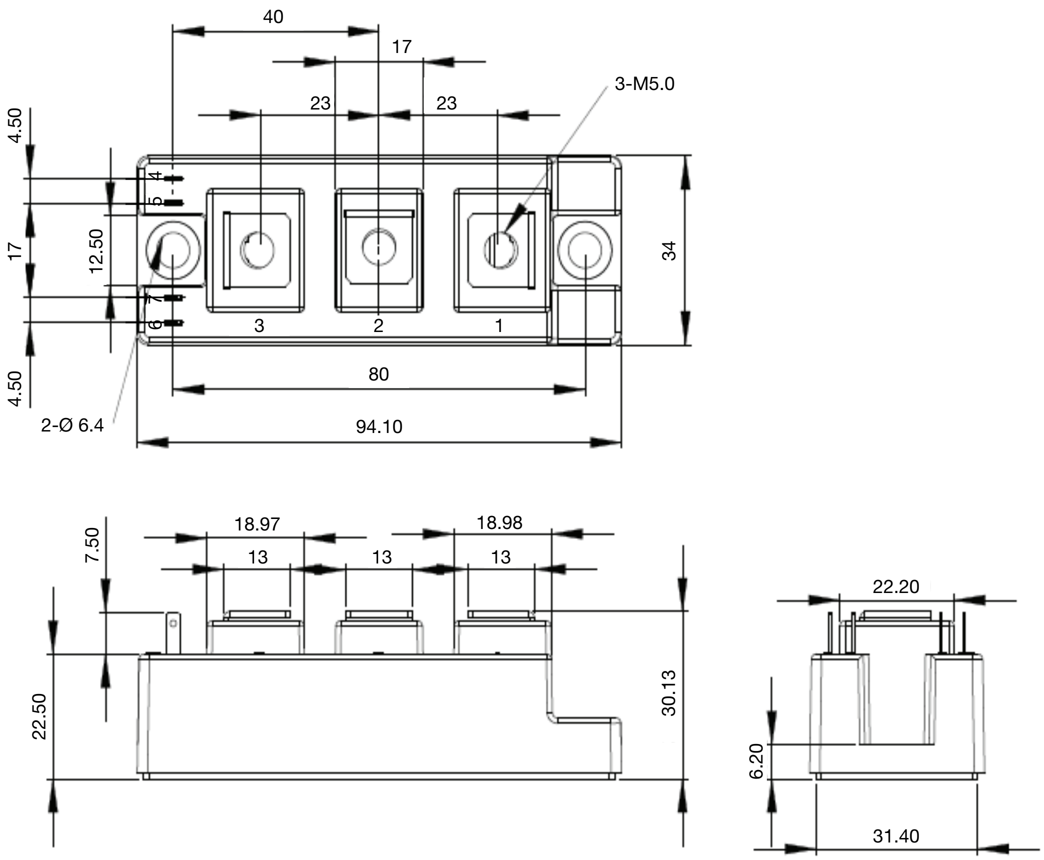



## ORDERING INFORMATION TABLE

| Device code | VS- | G | T | 200 | T | P | 065 | N |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

| | | |
|---|---|---|
| 1 | - | Vishay Semiconductors product |
| 2 | - | Insulated gate bipolar transistor (IGBT) |
| 3 | - | T = Trench IGBT |
| 4 | - | Current rating (200 = 200 A) |
| 5 | - | Circuit configuration (T = Half bridge) |
| 6 | - | Package indicator (P = INT-A-PAK IGBT) |
| 7 | - | Voltage rating (065 = 650 V) |
| 8 | - | Speed/type (N = ultrafast) |

**DIMENSIONS** in millimeters



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