# EMIPAK-1B PressFit Power Module Neutral Point Clamp Topology, 30 A

**EMIPAK-1B**
**(package example)**

## FEATURES

- Ultrafast Trench IGBT technology
- HEXFRED® and silicon carbide diode technology
- PressFit pins technology
- Exposed $Al_2O_3$ substrate with low thermal resistance
- Low internal inductances
- PressFit pins locking technology. Patent # US.263.820 B2
- UL approved file E78996
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

| PRODUCT SUMMARY | |
|---|---|
| **TRENCH IGBT 1200 V STAGE** | |
| $V_{CES}$ | 1200 V |
| $V_{CE(ON)}$ typical at $I_C$ = 30 A | 2.12 V |
| $I_C$ at $T_C$ = 102 °C | 30 A |
| **TRENCH IGBT 600 V STAGE** | |
| $V_{CES}$ | 600 V |
| $V_{CE(ON)}$ typical at $I_C$ = 30 A | 1.42 V |
| $I_C$ at $T_C$ = 106 °C | 30 A |
| Speed | 8 kHz to 30 kHz |
| Package | EMIPAK-1B |
| Circuit | 3-levels neutral point clamp topology |

## DESCRIPTION

VS-ENQ030L120S is an integrated solution for a neutral point clamp topology in a single package. The EMIPAK-1B package is easy to use thanks to the PressFit pins and the exposed substrate provides improved thermal performance. The optimized layout also helps to minimize stray parameters, allowing for better EMI performance.

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
|---|---|---|---|---|
| Operating junction temperature | $T_J$ | | 150 | °C |
| Storage temperature range | $T_{Stg}$ | | -40 to +150 | |
| RMS isolation voltage | $V_{ISOL}$ | $T_J$ = 25 °C, all terminals shorted, f = 50 Hz, t = 1 s | 3500 | V |
| **Q1 - Q4 TRENCH IGBT 1200 V** | | | | |
| Collector to emitter voltage | $V_{CES}$ | | 1200 | V |
| Gate to emitter voltage | $V_{GES}$ | | ± 30 | |
| Pulsed collector current | $I_{CM}$ | | 120 | A |
| Clamped inductive load current | $I_{LM}$ (1) | | 120 | |
| Continuous drain current | $I_C$ | $T_C$ = 25 °C | 61 | A |
| | | $T_C$ = 80 °C | 40 | |
| | | $T_{SINK}$ = 80 °C | 21 | |
| Power dissipation | $P_D$ | $T_C$ = 25 °C | 216 | W |
| | | $T_C$ = 80 °C | 121 | |

**PATENT(S): www.vishay.com/patents**
**This Vishay product is protected by one or more United States and International patents.**

| ABSOLUTE MAXIMUM RATINGS | | | | |
|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MAX.** | **UNITS** |
| **Q2 - Q3 TRENCH IGBT 600 V** | | | | |
| Collector to emitter voltage | $V_{CES}$ | | 600 | V |
| Gate to emitter voltage | $V_{GES}$ | | ± 20 | |
| Pulsed collector current | $I_{CM}$ | | 130 | A |
| Clamped inductive load current | $I_{LM}$ (2) | | 130 | |
| Continuous collector current | $I_C$ | $T_C$ = 25 °C | 64 | A |
| | | $T_C$ = 80 °C | 42 | |
| | | $T_{SINK}$ = 80 °C | 25 | |
| Power dissipation | $P_D$ | $T_C$ = 25 °C | 174 | W |
| | | $T_C$ = 80 °C | 97 | |
| **D1 - D4 HEXFRED ANTIPARALLEL DIODE** | | | | |
| Single pulse forward current | $I_{FSM}$ | 10 ms sine or 6 ms rectangular pulse, $T_J$ = 25 °C | 180 | A |
| Diode continuous forward current | $I_F$ | $T_C$ = 25 °C | 46 | A |
| | | $T_C$ = 80 °C | 30 | |
| | | $T_{SINK}$ = 80 °C | 17 | |
| Power dissipation | $P_D$ | $T_C$ = 25 °C | 187 | W |
| | | $T_C$ = 80 °C | 105 | |
| **D2 - D3 SILICON CARBIDE ANTIPARALLEL DIODE** | | | | |
| Single pulse forward current | $I_{FSM}$ | 10 ms sine or 6 ms rectangular pulse, $T_J$ = 25 °C | 150 | A |
| Diode continuous forward current | $I_F$ | $T_C$ = 25 °C | 40 | A |
| | | $T_C$ = 80 °C | 28 | |
| | | $T_{SINK}$ = 80 °C | 20 | |
| Power dissipation | $P_D$ | $T_C$ = 25 °C | 140 | W |
| | | $T_C$ = 80 °C | 79 | |

**Notes**

- Absolute Maximum Ratings indicate sustained limits beyond which damage to the device may occur.

(1) $V_{CC}$ = 600 V, $V_{GE}$ = 15 V, L = 500 μH, $R_g$ = 4.7 Ω, $T_J$ = 150 °C

(2) $V_{CC}$ = 300 V, $V_{GE}$ = 15 V, L = 500 μH, $R_g$ = 4.7 Ω, $T_J$ = 150 °C

| ELECTRICAL SPECIFICATIONS ($T_J$ = 25 °C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| **Q1 - Q4 TRENCH IGBT 1200 V** | | | | | | |
| Collector to emitter breakdown voltage | $BV_{CES}$ | $V_{GE}$ = 0 V, $I_C$ = 100 μA | 1200 | - | - | V |
| Collector to emitter voltage | $V_{CE(ON)}$ | $V_{GE}$ = 15 V, $I_C$ = 30 A | - | 2.12 | 2.52 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 30 A, $T_J$ = 125 °C | - | 2.31 | - | |
| Gate threshold voltage | $V_{GE(th)}$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 1.0 mA | 2.6 | 4.6 | 6.6 | |
| Temperature coefficient of threshold voltage | $\Delta V_{GE(th)}/\Delta T_J$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 1 mA (25 °C to 125 °C) | - | - 14 | - | mV/°C |
| Forward transconductance | $g_{fe}$ | $V_{CE}$ = 20 V, $I_C$ = 30 A | - | 36 | - | S |
| Transfer characteristics | $V_{GE}$ | $V_{CE}$ = 20 V, $I_C$ = 30 A | - | 7.1 | - | V |
| Zero gate voltage collector current | $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V | - | 0.001 | 0.23 | mA |
| | | $V_{GE}$ = 0 V, $V_{CE}$ = 1200 V, $T_J$ = 125 °C | - | 0.5 | - | |
| Gate to emitter leakage current | $I_{GES}$ | $V_{GE}$ = ± 30 V, $V_{CE}$ = 0 V | - | - | ± 200 | nA |

| **ELECTRICAL SPECIFICATIONS** ($T_J$ = 25 °C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| **Q2 - Q3 TRENCH IGBT 600 V** | | | | | | |
| Collector to emitter breakdown voltage | $BV_{CES}$ | $V_{GE}$ = 0 V, $I_C$ = 150 μA | 600 | - | - | V |
| Collector to emitter voltage | $V_{CE(ON)}$ | $V_{GE}$ = 15 V, $I_C$ = 30 A | - | 1.42 | 1.87 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 30 A, $T_J$ = 125 °C | - | 1.56 | - | |
| Gate threshold voltage | $V_{GE(th)}$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 1.4 mA | 3.6 | 5.6 | 7.1 | |
| Temperature coefficient of threshold voltage | $\Delta V_{GE(th)}/\Delta T_J$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 1 mA (25 °C to 125 °C) | - | -17 | - | mV/°C |
| Forward transconductance | $g_{fe}$ | $V_{CE}$ = 20 V, $I_C$ = 30 A | - | 24 | - | S |
| Transfer characteristics | $V_{GE}$ | $V_{CE}$ = 20 V, $I_C$ = 30 A | - | 10 | - | V |
| Zero gate voltage collector current | $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 600 V | - | 0.0003 | 0.23 | mA |
| | | $V_{GE}$ = 0 V, $V_{CE}$ = 600 V, $T_J$ = 125 °C | - | 0.028 | - | |
| Gate to emitter leakage current | $I_{GES}$ | $V_{GE}$ = ± 20 V, $V_{CE}$ = 0 V | - | - | ± 200 | nA |
| **D1 - D4 ANTIPARALLEL DIODE** | | | | | | |
| Forward voltage drop | $V_{FM}$ | $I_F$ = 20 A | - | 2.42 | 3.18 | V |
| | | $I_F$ = 20 A, $T_J$ = 125 °C | - | 2.32 | - | |
| **D2 - D3 ANTIPARALLEL DIODE** | | | | | | |
| Forward voltage drop | $V_{FM}$ | $I_F$ = 20 A | - | 1.54 | 1.8 | V |
| | | $I_F$ = 20 A $T_J$ = 125 °C | - | 1.86 | - | |

| **SWITCHING CHARACTERISTICS** ($T_J$ = 25 °C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| **Q1 - Q4 TRENCH IGBT (WITH FREEWHEELING D1 - D4 ANTIPARALLEL DIODE)** | | | | | | |
| Total gate charge (turn-on) | $Q_g$ | $I_C$ = 30 A<br>$V_{CC}$ = 600 V<br>$V_{GE}$ = 15 V | - | 157 | - | nC |
| Gate to emitter charge (turn-on) | $Q_{ge}$ | | - | 21 | - | |
| Gate to collector charge (turn-on) | $Q_{gc}$ | | - | 69 | - | |
| Turn-on switching loss | $E_{ON}$ | $I_C$ = 30 A<br>$V_{CC}$ = 600 V<br>$V_{GE}$ = 15 V<br>$R_g$ = 4.7 Ω<br>L = 500 μH (1) | - | 0.52 | - | mJ |
| Turn-off switching loss | $E_{OFF}$ | | - | 0.9 | - | |
| Total switching loss | $E_{TOT}$ | | - | 1.42 | - | |
| Turn-on delay time | $t_{d(on)}$ | | - | 93 | - | ns |
| Rise time | $t_r$ | | - | 39 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 133 | - | |
| Fall time | $t_f$ | | - | 156 | - | |
| Turn-on switching loss | $E_{ON}$ | $I_C$ = 30 A<br>$V_{CC}$ = 600 V<br>$V_{GE}$ = 15 V<br>$R_g$ = 4.7 Ω<br>L = 500 μH<br>$T_J$ = 125 °C (1) | - | 0.64 | - | mJ |
| Turn-off switching loss | $E_{OFF}$ | | - | 1.61 | - | |
| Total switching loss | $E_{TOT}$ | | | 2.24 | | |
| Turn-on delay time | $t_{d(on)}$ | | - | 93 | - | ns |
| Rise time | $t_r$ | | - | 39 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 136 | - | |
| Fall time | $t_f$ | | - | 193 | - | |
| Input capacitance | $C_{ies}$ | $V_{GE}$ = 0 V<br>$V_{CC}$ = 30 V<br>f = 1 MHz | - | 3338 | - | pF |
| Output capacitance | $C_{oes}$ | | - | 124 | - | |
| Reverse transfer capacitance | $C_{res}$ | | - | 75 | - | |
| Reverse bias safe operating area | RBSOA | $T_J$ = 150 °C, $I_C$ = 120 A, $V_{CC}$ = 600 V, $V_P$ = 1200 V, $R_g$ = 4.7 Ω, $V_{GE}$ = 15 V to 0 V | Fullsquare | | | |

| **SWITCHING CHARACTERISTICS** ($T_J$ = 25 °C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| **Q2 - Q3 TRENCH IGBT (WITH FREEWHEELING EXTERNAL TO-247 DIODE DISCRETE 30ETH06)** | | | | | | |
| Total gate charge (turn-on) | $Q_g$ | $I_C$ = 48 A<br>$V_{CC}$ = 400 V<br>$V_{GE}$ = 15 V | - | 95 | - | nC |
| Gate to emitter charge (turn-on) | $Q_{ge}$ | | - | 28 | - | |
| Gate to collector charge (turn-on) | $Q_{gc}$ | | - | 35 | - | |
| Turn-on switching loss | $E_{ON}$ | $I_C$ = 30 A<br>$V_{CC}$ = 300 V<br>$V_{GE}$ = 15 V<br>$R_g$ = 4.7 Ω<br>L = 500 μH (1) | - | 0.23 | - | mJ |
| Turn-off switching loss | $E_{OFF}$ | | - | 0.26 | - | |
| Total switching loss | $E_{TOT}$ | | - | 0.49 | - | |
| Turn-on delay time | $t_{d(on)}$ | | - | 70 | - | ns |
| Rise time | $t_r$ | | - | 31 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 91 | - | |
| Fall time | $t_f$ | | - | 87 | - | |
| Turn-on switching loss | $E_{ON}$ | $I_C$ = 30 A<br>$V_{CC}$ = 300 V<br>$V_{GE}$ = 15 V<br>$R_g$ = 4.7 Ω<br>L = 500 μH<br>$T_J$ = 125 °C (1) | - | 0.33 | - | mJ |
| Turn-off switching loss | $E_{OFF}$ | | - | 0.48 | - | |
| Total switching loss | $E_{TOT}$ | | - | 0.61 | - | |
| Turn-on delay time | $t_{d(on)}$ | | - | 70 | - | ns |
| Rise time | $t_r$ | | - | 31 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 96 | - | |
| Fall time | $t_f$ | | - | 117 | - | |
| Input capacitance | $C_{ies}$ | $V_{GE}$ = 0 V<br>$V_{CC}$ = 30 V<br>f = 1 MHz | - | 3025 | - | pF |
| Output capacitance | $C_{oes}$ | | - | 245 | - | |
| Reverse transfer capacitance | $C_{res}$ | | - | 90 | - | |
| Reverse bias safe operating area | RBSOA | $T_J$ = 150 °C, $I_C$ = 130 A<br>$V_{CC}$ = 300 V, $V_P$ = 600 V<br>$R_g$ = 4.7 Ω, $V_{GE}$ = 15 V to 0 V | Fullsquare | | | |
| **D1 - D4 ANTIPARALLEL DIODE** | | | | | | |
| Diode reverse recovery time | $t_{rr}$ | $V_R$ = 400 V<br>$I_F$ = 20 A<br>dI/dt = 500 A/μs | - | 103 | - | ns |
| Diode peak reverse current | $I_{rr}$ | | - | 16 | - | A |
| Diode recovery charge | $Q_{rr}$ | | - | 800 | - | nC |
| Diode reverse recovery time | $t_{rr}$ | $V_R$ = 400 V<br>$I_F$ = 20 A<br>dI/dt = 500 A/μs, $T_J$ = 125 °C | - | 135 | - | ns |
| Diode peak reverse current | $I_{rr}$ | | - | 21 | - | A |
| Diode recovery charge | $Q_{rr}$ | | - | 1412 | - | nC |
| **D2 - D3 ANTIPARALLEL DIODE** | | | | | | |
| Diode reverse recovery time | $t_{rr}$ | $V_R$ = 200 V<br>$I_F$ = 20 A<br>dI/dt = 500 A/μs | - | 30 | - | ns |
| Diode peak reverse current | $I_{rr}$ | | - | 4.8 | - | A |
| Diode recovery charge | $Q_{rr}$ | | - | 73 | - | nC |
| Diode reverse recovery time | $t_{rr}$ | $V_R$ = 200 V<br>$I_F$ = 20 A<br>dI/dt = 500 A/μs, $T_J$ = 125 °C | - | 31 | - | ns |
| Diode peak reverse current | $I_{rr}$ | | - | 5 | - | A |
| Diode recovery charge | $Q_{rr}$ | | - | 78 | - | nC |

**Note**

(1) Energy losses include "tail" and diode reverse recovery.

| INTERNAL NTC - THERMISTOR SPECIFICATIONS | | | | |
|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | VALUE | UNITS |
| Resistance | $R_{25}$ | $T_C$ = 25 °C | 5000 | Ω |
| | $R_{100}$ | $T_C$ = 100 °C | 493 ± 5 % | |
| B-value | $B_{25/50}$ | $R_2 = R_{25}$ exp. $[B_{25/50}$ (1/$T_2$ - 1/(298.15 K))] | 3375 ± 5 % | K |
| Maximum operating temperature | | | 220 | °C |
| Dissipation constant | | | 2 | mW/°C |
| Thermal time constant | | | 8 | s |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | |
|---|---|---|---|---|---|
| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNITS |
| Q1 - Q4 TRENCH IGBT 1200 V - Junction to case thermal resistance (per switch) | $R_{thJC}$ | - | - | 0.58 | °C/W |
| Q2 - Q3 TRENCH IGBT 600 V- Junction to case thermal resistance (per switch) | | - | - | 0.72 | |
| D1 - D4 AP diode - Junction to case thermal resistance (per diode) | | - | - | 0.67 | |
| D2 - D3 AP diode - Junction to case thermal resistance (per diode) | | - | - | 0.89 | |
| Q1 - Q4 TRENCH IGBT 1200 V - Case to sink thermal resistance (per switch) | $R_{thCS}$ (1) | - | 0.75 | - | |
| Q2 - Q3 TRENCH IGBT 600 V - Case to sink thermal resistance (per switch) | | - | 0.77 | - | |
| D1 - D4 AP diode - Case to sink thermal resistance (per diode) | | - | 0.78 | - | |
| D2 - D3 AP diode - Case to sink thermal resistance (per diode) | | - | 0.65 | - | |
| Case to sink thermal resistance (per module) | | - | 0.1 | - | |
| Mounting torque (M4) | | 2 | - | 3 | Nm |
| Weight | | - | 28 | - | g |

**Note**

(1) Mounting surface flat, smooth, and greased

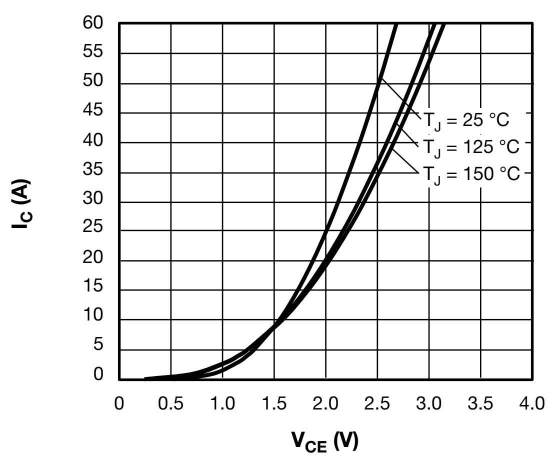



Fig. 1 - Typical Q1 - Q4 Trench IGBT 1200 V Output Characteristics $V_{GE}$ = 15 V

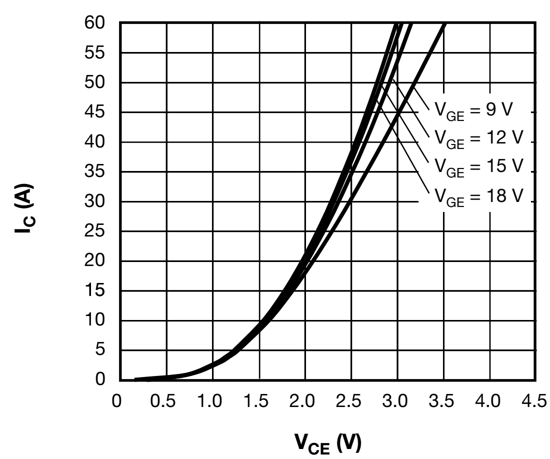



Fig. 2 - Typical Q1 - Q4 Trench IGBT 1200 V Output Characteristics $T_J$ = 125 °C

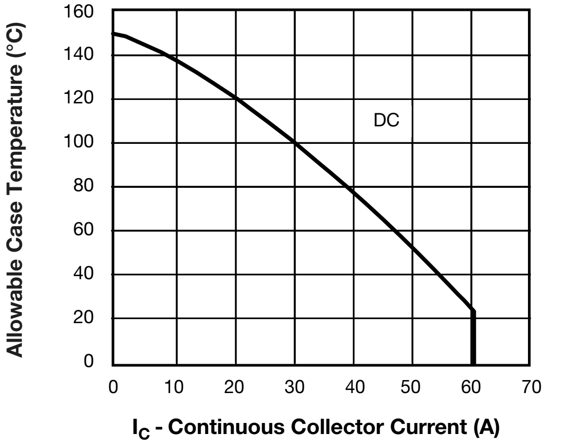



Fig. 3 - Maximum Q1 - Q4 Trench IGBT 1200 V
Continuous Collector Current vs. Case Temperature

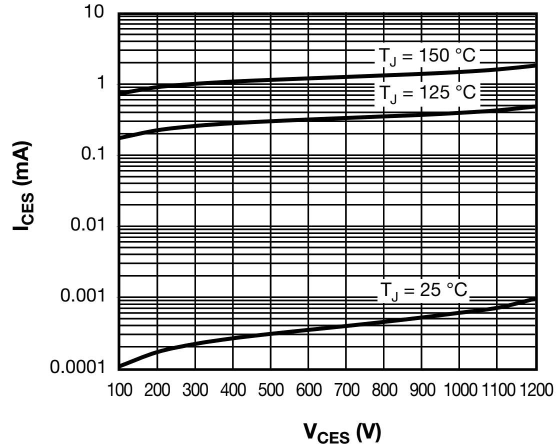



Fig. 6 - Typical Q1 - Q4 Trench IGBT 1200 V
Zero Gate Voltage Collector Current

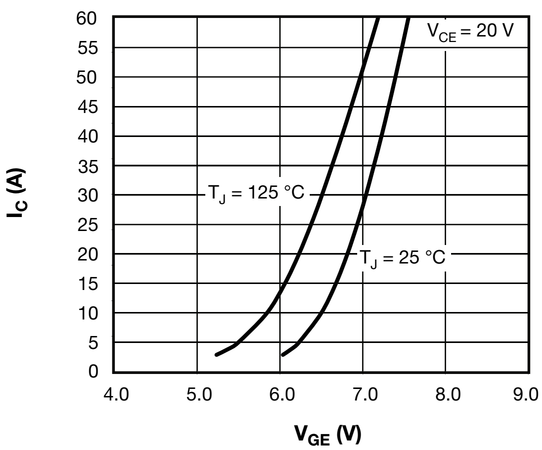



Fig. 4 - Typical Q1 - Q4 Trench IGBT 1200 V
Transfer Characteristics

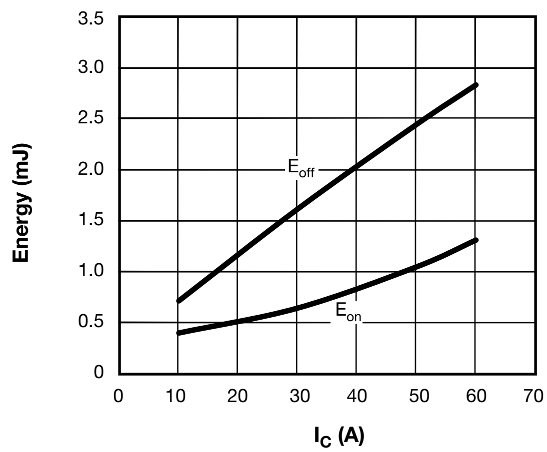



Fig. 7 - Typical Q1 - Q4 Trench IGBT 1200 V
Energy Loss vs. $I_C$ (with D1 - D4 Freewheeling Diode),
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $R_g$ = 4.7 Ω, $V_{GE}$ = 15 V, L = 500 μH

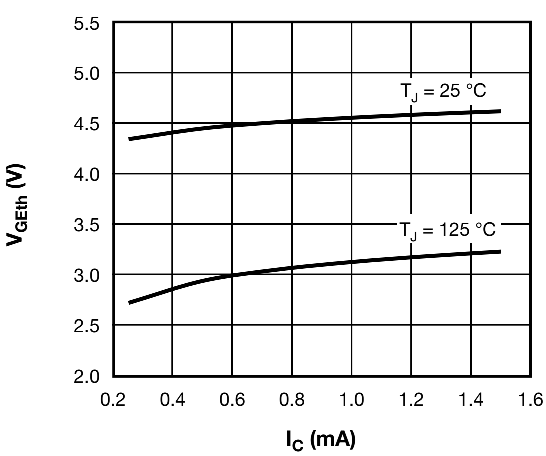



Fig. 5 - Typical Q1 - Q4 Trench IGBT 1200 V
Gate Threshold Voltage

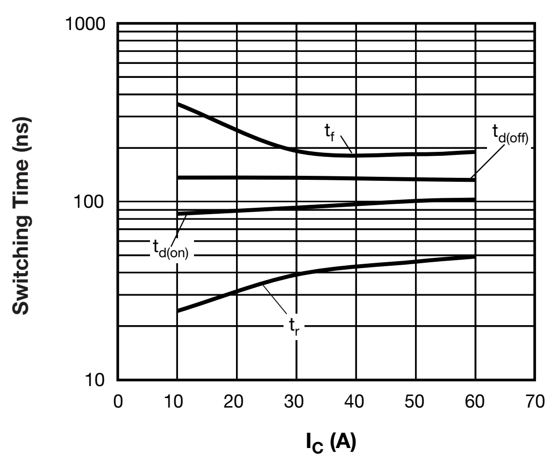



Fig. 8 - Typical Q1 - Q4 Trench IGBT 1200 V
Switching Time vs. $I_C$ (with D1 - D4 Freewheeling Diode)
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $R_g$ = 4.7 Ω, $V_{GE}$ = 15 V, L = 500 μH

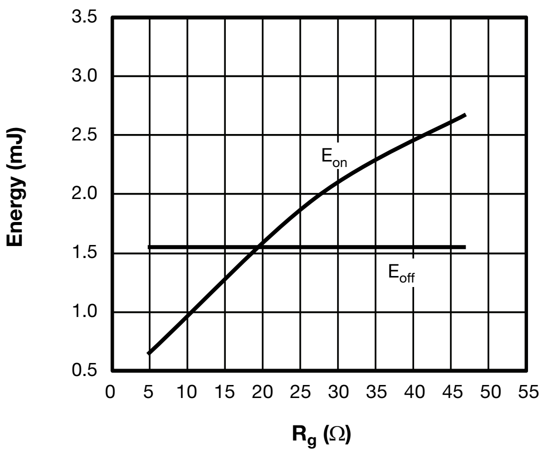



Fig. 9 - Typical Q1 - Q4 Trench IGBT 1200 V
Energy Loss vs. $R_g$ (with D1 - D4 Freewheeling Diode)
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $I_C$ = 30 A, $V_{GE}$ = 15 V, L = 500 μH

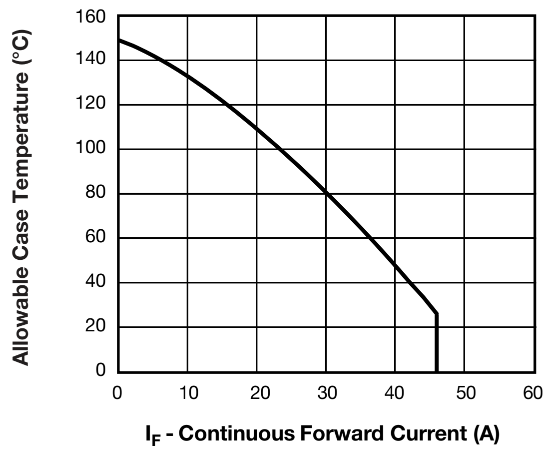



Fig. 12 - Maximum D1 - D4 Antiparallel Diode
Forward Current vs. Case Temperature

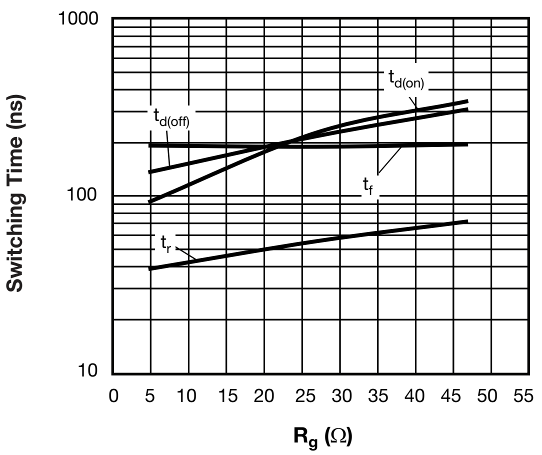



Fig. 10 - Typical Q1 - Q4 Trench IGBT 1200 V
Switching Time vs. $R_g$ (with D1 - D4 Freewheeling Diode)
$T_J$ = 125 °C, $V_{CC}$ = 600 V, $I_C$ = 30 A, $V_{GE}$ = 15 V, L = 500 μH

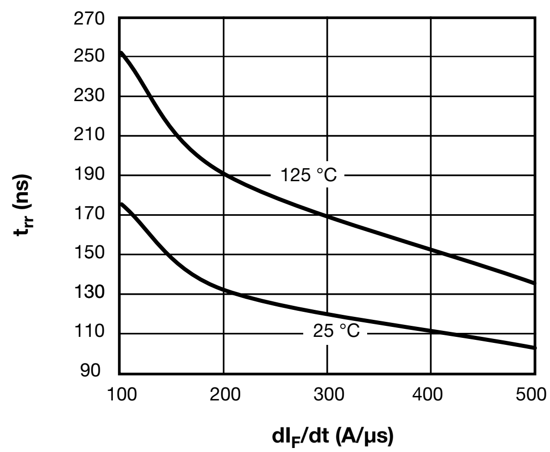



Fig. 13 - Typical D1 - D4 Antiparallel Diode
Reverse Recovery Time vs. $dI_F/dt$
$V_{rr}$ = 400 V, $I_F$ = 20 A

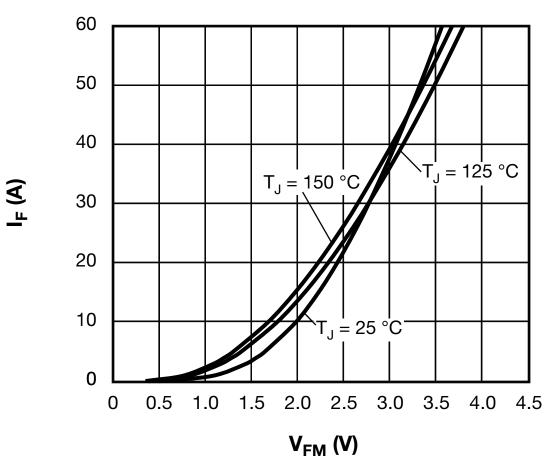



Fig. 11 - Typical D1 - D4 Antiparallel Diode Forward Characteristics

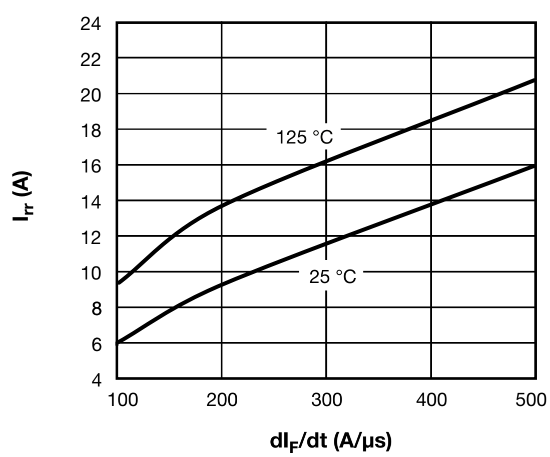



Fig. 14 - Typical D1 - D4 Antiparallel Diode
Reverse Recovery Current vs. $dI_F/dt$
$V_{rr}$ = 400 V, $I_F$ = 20 A

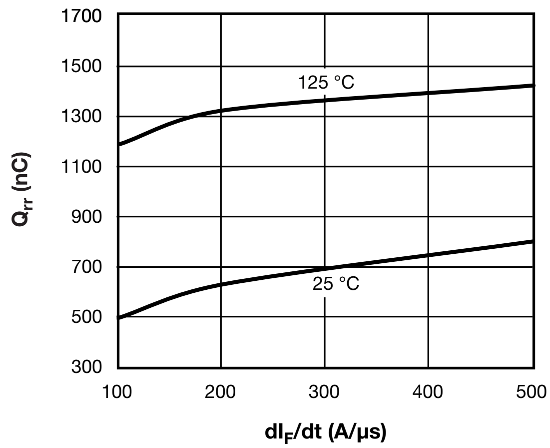



Fig. 15 - Typical D1 - D4 Antiparallel Diode
Reverse Recovery Charge vs. $dI_F/dt$
$V_{rr}$ = 400 V, $I_F$ = 20 A

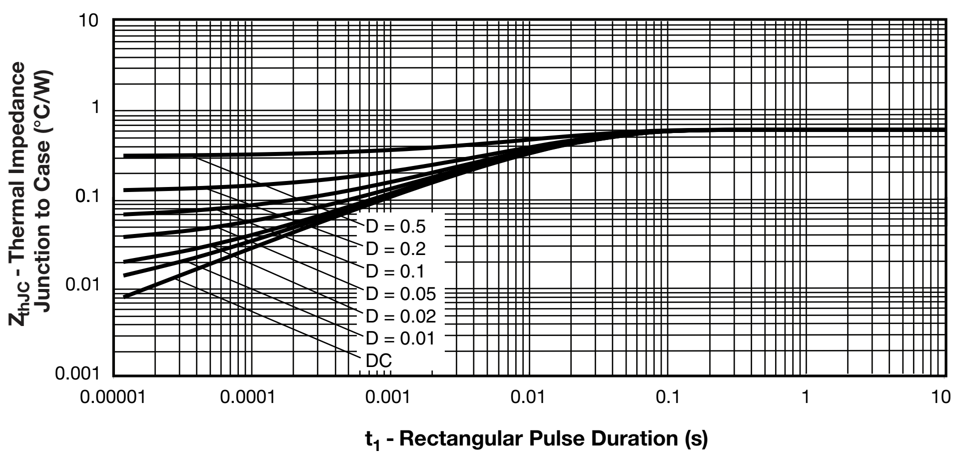



Fig. 16 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (Q1 - Q4 Trench IGBT 1200 V)

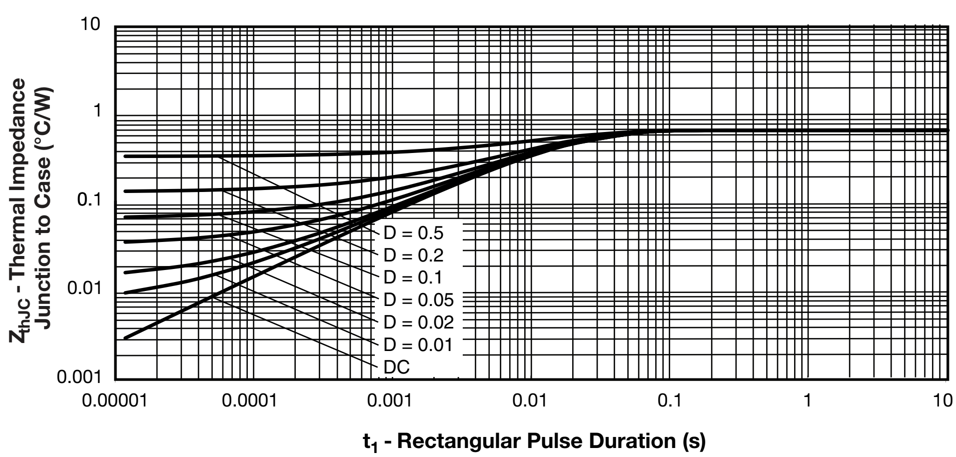



Fig. 17 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (D1 - D4 Antiparallel Diode)

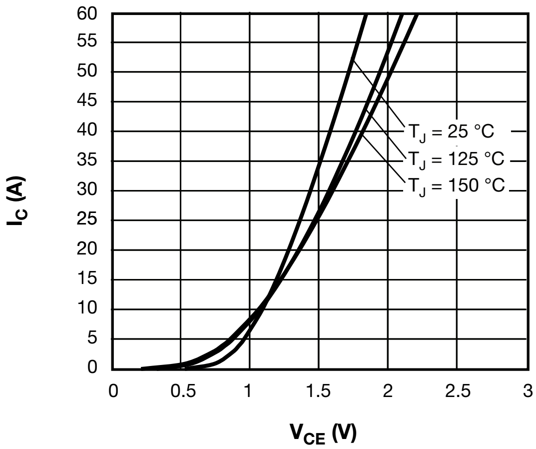



Fig. 18 - Typical Q2 - Q3 Trench IGBT 600 V Output Characteristics
$V_{GE}$ = 15 V

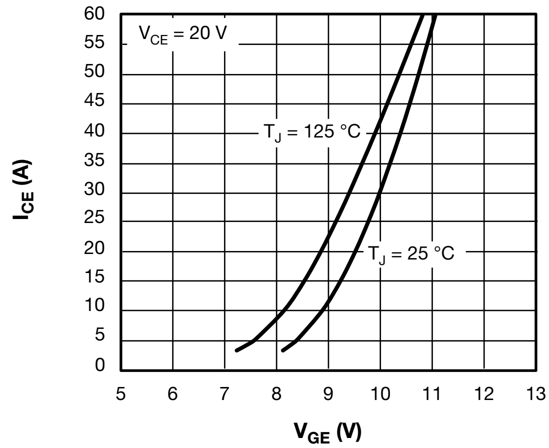



Fig. 21 - Typical Q2 - Q3 Trench IGBT 600 V
Transfer Characteristics

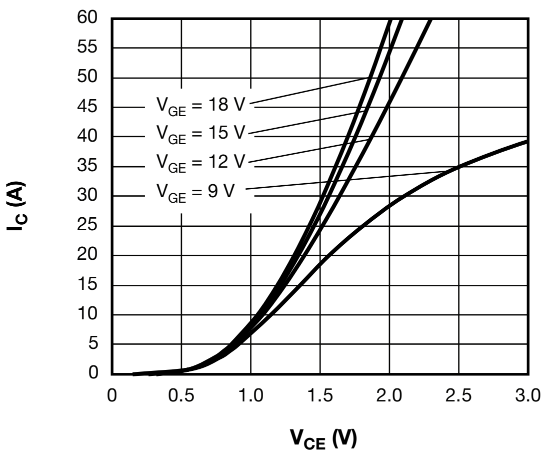



Fig. 19 - Typical Q2 - Q3 Trench IGBT 600 V Output Characteristics
$T_J$ = 125 °C

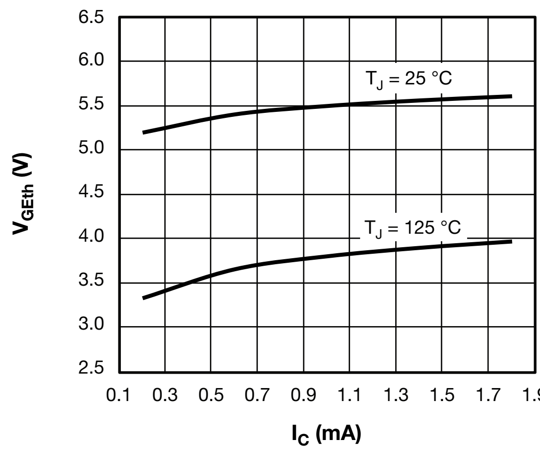



Fig. 22 - Typical Q2 - Q3 Trench IGBT 600 V
Gate Threshold Voltage

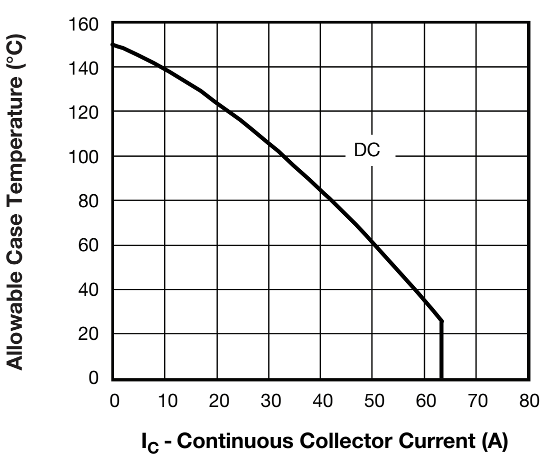



Fig. 20 - Maximum Q2 - Q3 Trench IGBT 600 V
Continuous Collector Current vs. Case Temperature

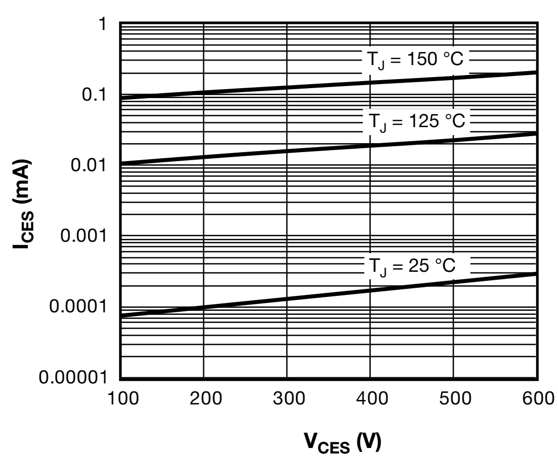



Fig. 23 - Typical Q2 - Q3 Trench IGBT 600 V
Zero Gate Voltage Collector Current

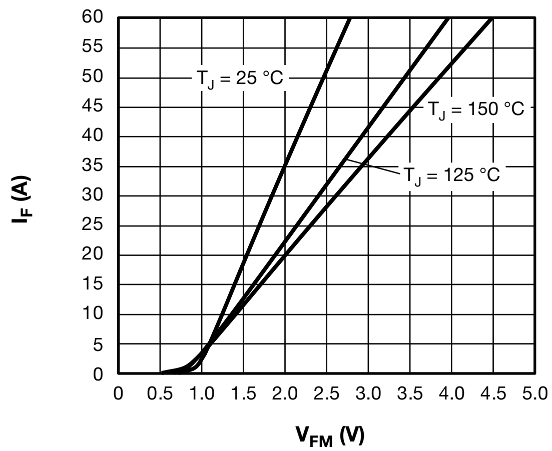



Fig. 24 - Typical D2 - D3 Antiparallel Diode Forward Characteristics

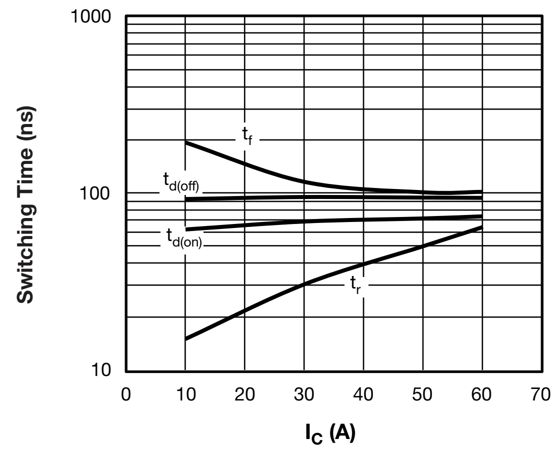



Fig. 27 - Typical Q2 - Q3 Trench IGBT 600 V Switching Time vs. $I_C$ (with Freewheeling External TO-247 Diode Discrete 30ETH06) $T_J$ = 125 °C, $V_{CC}$ = 300 V, $R_g$ = 4.7 Ω, $V_{GE}$ = 15 V, L = 500 µH

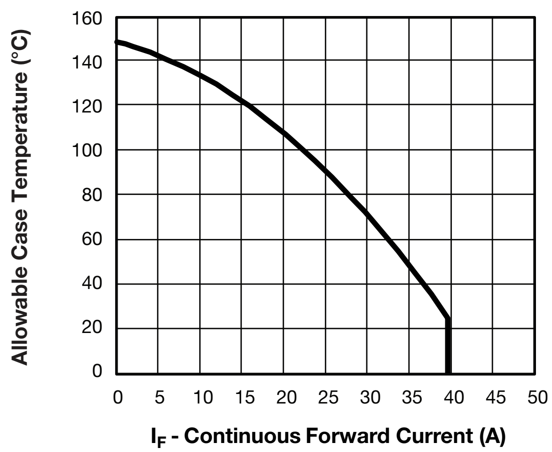



Fig. 25 - Maximum D2 - D3 Antiparallel Diode Forward Current vs. Case Temperature

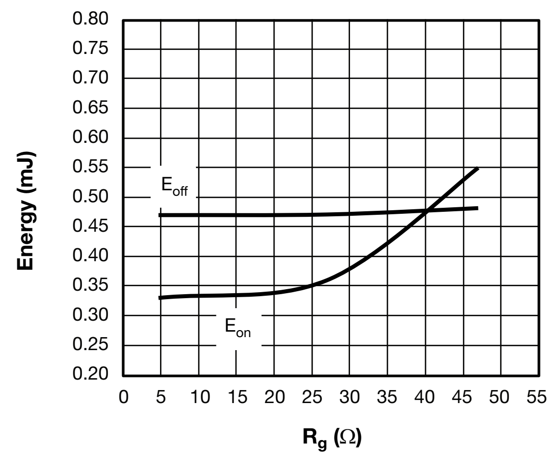



Fig. 28 - Typical Q2 - Q3 Trench IGBT 600 V Energy Loss vs. $R_g$ (with Freewheeling External TO-247 Diode Discrete 30ETH06) $T_J$ = 125 °C, $V_{CC}$ = 300 V, $I_C$ =30 A, $V_{GE}$ = 15 V, L = 500 µH

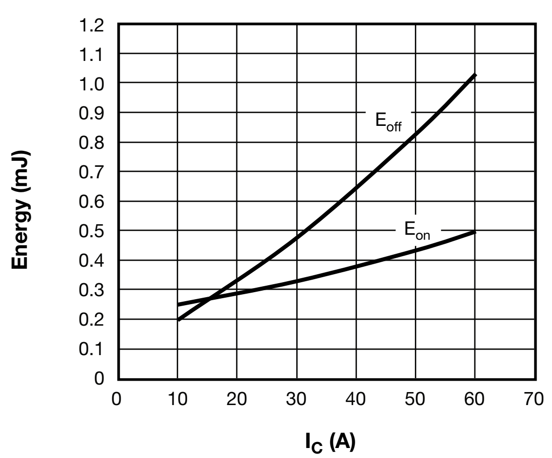



Fig. 26 - Typical Q2 - Q3 Trench IGBT 600 V Energy Loss vs. $I_C$ (with Freewheeling External TO-247 Diode Discrete 30ETH06 ) $T_J$ = 125 °C, $V_{CC}$ = 300 V, $R_g$ = 4.7 Ω, $V_{GE}$ = 15 V, L = 500 µH

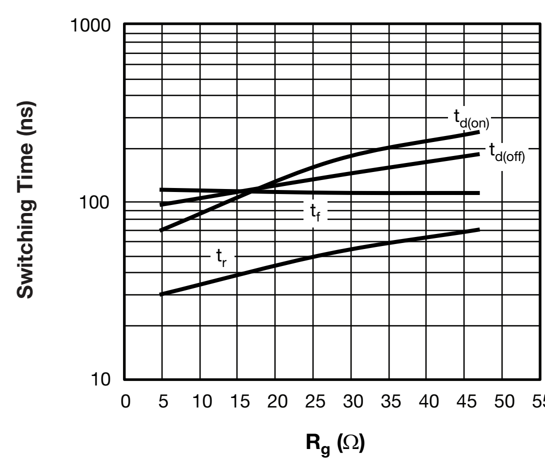



Fig. 29 - Typical Q2 - Q3 Trench IGBT 600 V Switching Time vs. $R_g$ (with Freewheeling External TO-247 Diode Discrete 30ETH06) $T_J$ = 125 °C, $V_{CC}$ = 300 V, $I_C$ = 30 A, $V_{GE}$ = 15 V, L = 500 µH

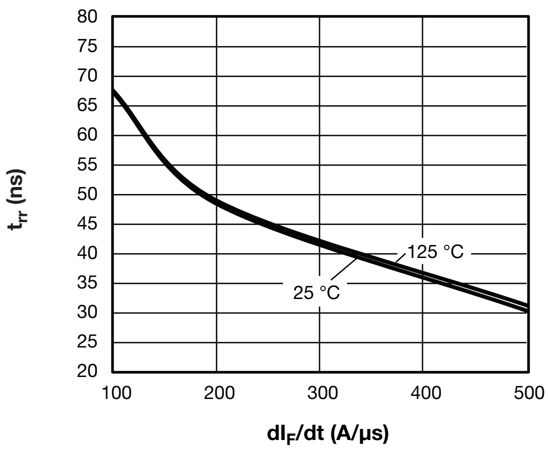



Fig. 30 - Typical D2 - D3 Antiparallel Diode
Reverse Recovery Time vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 20 A

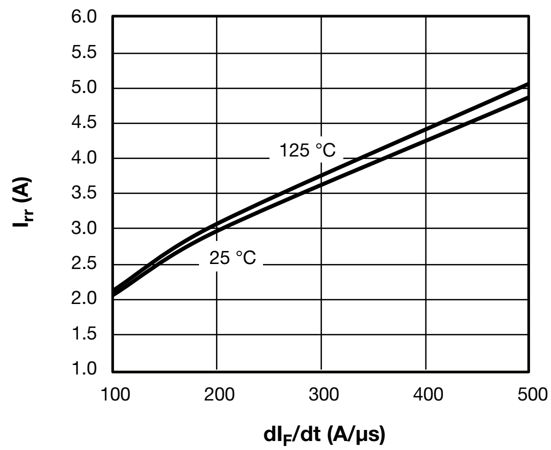



Fig. 31 - Typical D2 - D3 Antiparallel Diode
Reverse Recovery Current vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 20 A

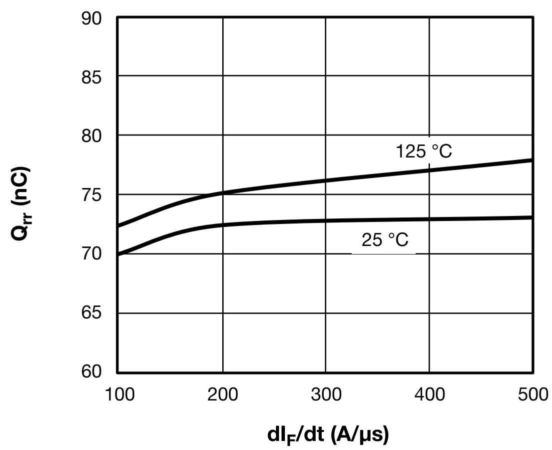



Fig. 32 - Typical D2 - D3 Antiparallel Diode
Reverse Recovery Charge vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 20 A

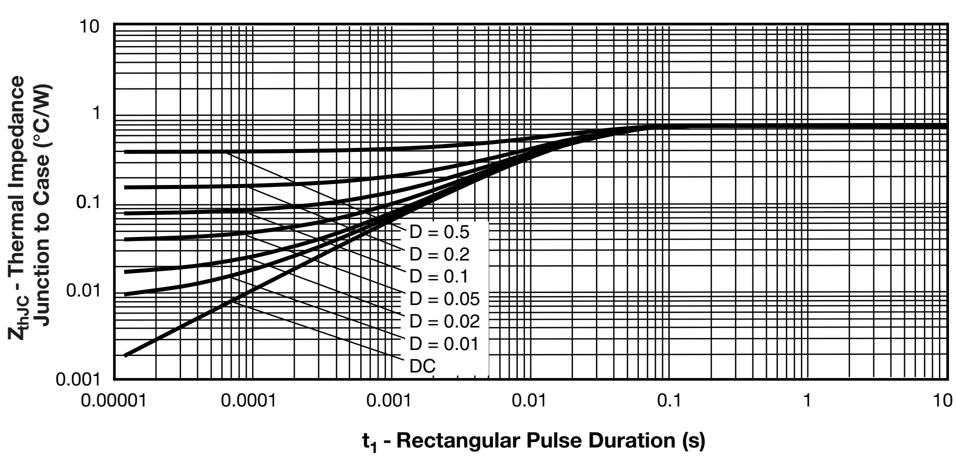



Fig. 33 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (Q2 - Q3 Trench IGBT 600 V)

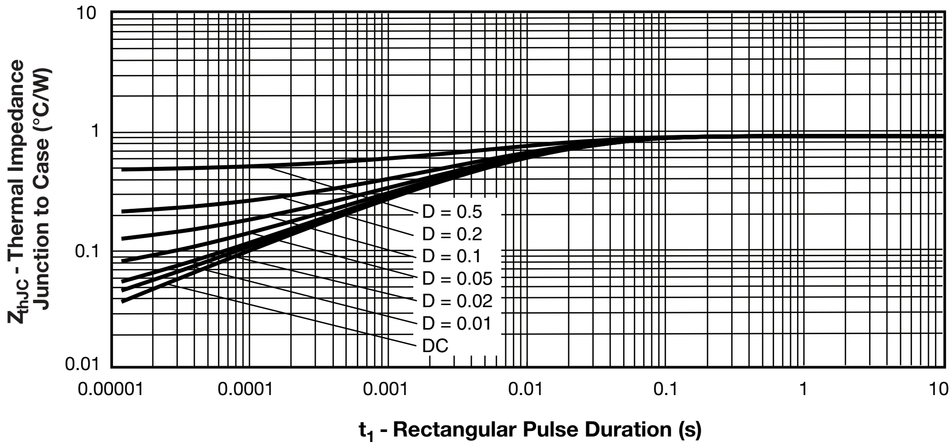



Fig. 34 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (D2 - D3 Antiparallel Diode)

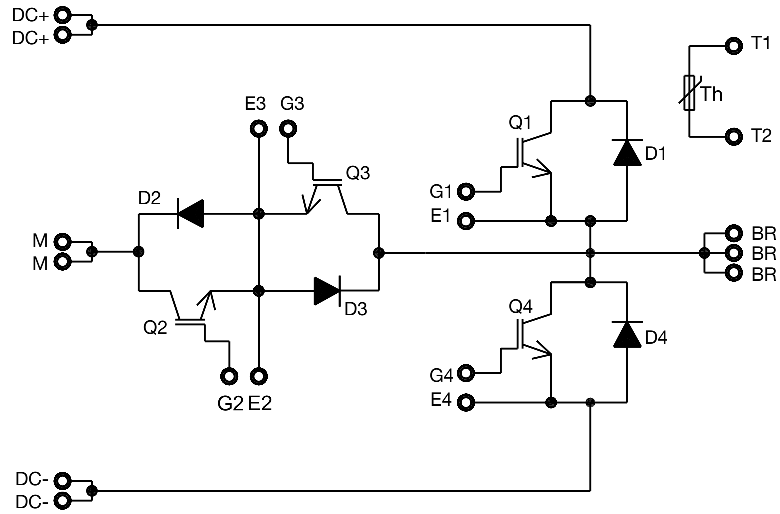
## ORDERING INFORMATION TABLE

**Device code**

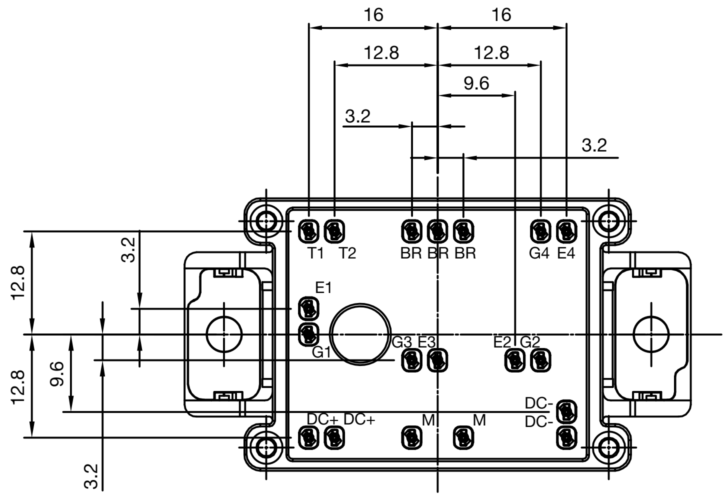
| VS- | EN | Q | 030 | L | 120 | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

1 - Vishay Semiconductors product
2 - Package indicator (EN = EMIPAK-1B)
3 - Circuit configuration (Q = neutral point clamp topology)
4 - Current rating (030 = 30 A)
5 - Switch die technology (L = ultrafast Trench IGBT 1200 V and Trench IGBT 600 V)
6 - Voltage rating (120 = 1200 V)
7 - Diode die technology (S = SiC diode)

## CIRCUIT CONFIGURATION



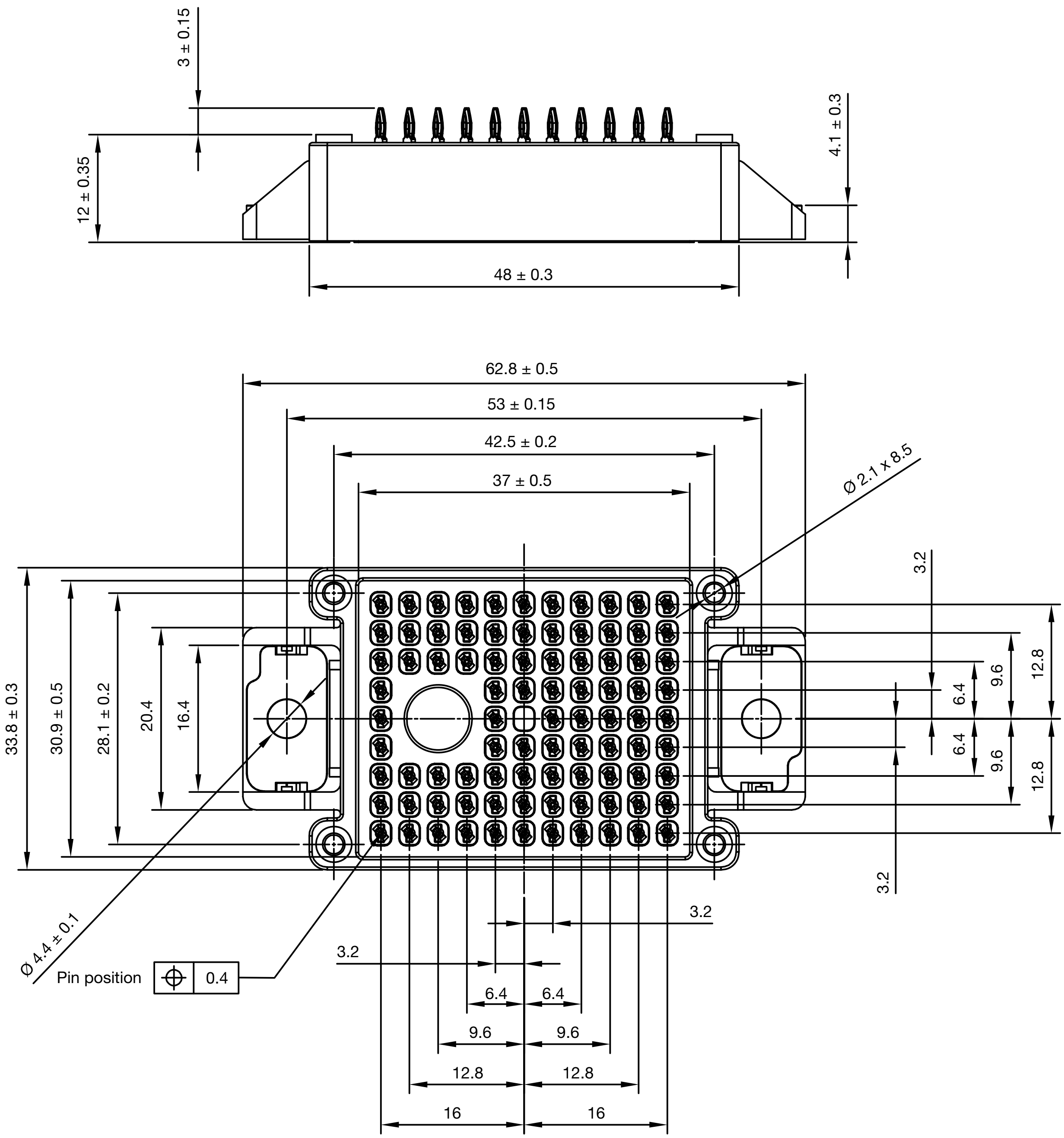

## PACKAGE




| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95558 |

# EMIPAK-1B PressFit

**DIMENSIONS** in millimeters



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