# Primary MTP IGBT Power Module

MTP

## FEATURES

- Buck PFC stage with warp 2 IGBT and FRED Pt® hyperfast diode
- Integrated thermistor
- Isolated baseplate
- Compliant to RoHS Directive 2011/65/EU
- Very low stray inductance design for high speed operation
- Designed and qualified for industrial level

Pb-free
RoHS
COMPLIANT

## BENEFITS

- Lower conduction losses and switching losses
- Higher switching frequency up to 150 kHz
- Optimized for welding, UPS, and SMPS applications
- PCB solderable terminals
- Direct mounting to heatsink

| PRODUCT SUMMARY | |
|---|---|
| **FRED Pt® AP DIODE, $T_J$ = 150 °C** | |
| $V_{RRM}$ | 600 V |
| $I_{F(DC)}$ at 80 °C | 11 A |
| $V_F$ at 25 °C at 60 A | 2.08 V |
| **IGBT, $T_J$ = 150 °C** | |
| $V_{CES}$ | 600 V |
| $V_{CE(ON)}$ at 25 °C at 60 A | 1.98 V |
| $I_C$ at 80°C | 83 A |
| **FRED Pt® CHOPPER DIODE, $T_J$ = 150 °C** | |
| $V_R$ | 600 V |
| $I_{F(DC)}$ at 80 °C | 17 A |
| $V_F$ at 25 °C at 60 A | 2.06 V |

**ABSOLUTE MAXIMUM RATINGS**

| | PARAMETER | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
|---|---|---|---|---|---|
| FRED Pt Antiparallel Diode | Repetitive peak reverse voltage | $V_{RRM}$ | | 600 | V |
| | Maximum continuous forward current $T_J$ = 150 °C maximum | $I_{F(DC)}$ | $T_C$ = 25 °C | 17 | A |
| | | | $T_C$ = 80 °C | 11 | |
| | Maximum power dissipation | $P_D$ | $T_C$ = 25 °C | 25 | W |
| IGBT | Collector to emitter voltage | $V_{CES}$ | $T_J$ = 25 °C | 600 | V |
| | Gate to emitter voltage | $V_{GE}$ | $I_{GES}$ max. ± 250 ns | ± 20 | V |
| | Maximum continuous collector current at $V_{GE}$ = 15 V, $T_J$ = 150 °C maximum | $I_C$ | $T_C$ = 25 °C | 121 | A |
| | | | $T_C$ = 80 °C | 83 | |
| | Clamped inductive load current | $I_{LM}$ | | 300 | |
| | Maximum power dissipation | $P_D$ | $T_C$ = 25 °C | 462 | W |
| FRED Pt Chopper Diode | Repetitive peak reverse voltage | $V_{RRM}$ | | 600 | V |
| | Maximum continuous forward current $T_J$ = 150 °C maximum | $I_F$ | $T_C$ = 25 °C | 26 | A |
| | | | $T_C$ = 80 °C | 17 | |
| | Maximum power dissipation | $P_D$ | $T_C$ = 25 °C | 56 | W |
| | Maximum operating junction temperature | $T_J$ | | 150 | °C |
| | Storage temperature range | $T_{Stg}$ | | - 40 to + 150 | |
| | Isolation voltage | $V_{ISOL}$ | $V_{RMS}$ t = 1 s, $T_J$ = 25 °C | 3500 | V |

| ELECTRICAL SPECIFICATIONS ($T_J$ = 25 °C unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| AP Diode | Blocking voltage | $BV_{RRM}$ | 0.5 mA | 600 | - | - | V |
| | Forward voltage drop | $V_{FM}$ | $I_F$ = 60 A | - | 2.08 | 2.43 | V |
| | | | $I_F$ = 60 A, $T_J$ = 125 °C | - | 2.05 | 2.3 | |
| IGBT | Collector to emitter breakdown voltage | $BV_{CES}$ | $V_{GE}$ = 0 V, $I_C$ = 0.5 mA | 600 | - | - | V |
| | Temperature coefficient of breakdown voltage | $\Delta V_{BR(CES)}/\Delta T_J$ | $I_C$ = 0.5 mA (25 °C to 125 °C) | - | 0.6 | - | V/°C |
| | Collector to emitter voltage | $V_{CE(ON)}$ | $V_{GE}$ 15 V, $I_C$ = 60 A | - | 1.93 | 2.29 | V |
| | | | $V_{GE}$ = 15 V, $I_C$ = 60 A, $T_J$ = 125 °C | - | 2.36 | 2.80 | |
| | Gate threshold voltage | $V_{GE(th)}$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 500 µA | 2.9 | - | 6.0 | V |
| | Collector to emitter leakage current | $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 600 V | - | - | 100 | µA |
| | | | $V_{GE}$ = 0 V, $V_{CE}$ = 600 V, $T_J$ = 125 °C | - | - | 2.0 | mA |
| | Gate to emitter leakage | $I_{GES}$ | $V_{GE}$ = ± 20 V | - | - | ± 100 | nA |
| FRED Pt Chopper Diode | Forward voltage drop | $V_{FM}$ | $I_F$ = 60 A | - | 2.06 | 2.53 | V |
| | | | $I_F$ = 60 A, $T_J$ = 125 °C | - | 1.83 | 2.26 | |
| | Blocking voltage | $BV_{RM}$ | 0.5 mA | 600 | - | - | |
| | Reverse leakage current | $I_{RM}$ | $V_{RRM}$ = 600 V | - | - | 75 | µA |
| | | | $V_{RRM}$ = 600 V, $T_J$ = 125 °C | - | - | 0.5 | mA |
| **RECOVERY PARAMETER** | | | | | | | |
| AP Diode | Peak reverse recovery current | $I_{rr}$ | $I_F$ = 60 A<br>dI/dt = 200 A/µs<br>$V_R$ = 200 V | - | 67 | 11 | A |
| | Reverse recovery time | $t_{rr}$ | | - | 120 | 160 | ns |
| | Reverse recovery charge | $Q_{rr}$ | | - | 620 | 850 | nC |
| FRED Pt Chopper Diode | Peak reverse recovery current | $I_{rr}$ | $I_F$ = 60 A<br>dI/dt = 200 A/µs<br>$V_R$ = 200 V | - | 4.5 | 6.0 | A |
| | Reverse recovery time | $t_{rr}$ | | - | 67 | 85 | ns |
| | Reverse recovery charge | $Q_{rr}$ | | - | 130 | 250 | nC |
| | Peak reverse recovery current | $I_{rr}$ | $I_F$ = 60 A<br>dI/dt = 200 A/µs<br>$V_R$ = 200 V, $T_J$ = 125 °C | - | 9.5 | 12.0 | A |
| | Reverse recovery time | $t_{rr}$ | | - | 128 | 165 | ns |
| | Reverse recovery charge | $Q_{rr}$ | | - | 601 | 900 | nC |

| SWITCHING CHARACTERISTICS ($T_J$ = 25 °C unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| PFC IGBT | Total gate charge | $Q_g$ | $I_C$ = 60 A<br>$V_{CC}$ = 480 V<br>$V_{GE}$ = 15 V | - | 460 | - | nC |
| | Gate to source charge | $Q_{gs}$ | | - | 160 | - | |
| | Gate to drain (Miller) charge | $Q_{gd}$ | | - | 70 | - | |
| | Turn-on switching loss | $E_{on}$ | $I_C$ = 100 A, $V_{CC}$ = 360 V, $V_{GE}$ = 15 V<br>$R_g$ = 5 Ω, L = 500 μH, $T_J$ = 25 °C | - | 0.2 | - | mJ |
| | Turn-off switching loss | $E_{off}$ | | - | 0.96 | - | |
| | Total switching loss | $E_{tot}$ | | - | 1.16 | - | |
| | Turn-on delay time | $t_{d(on)}$ | | - | 240 | - | ns |
| | Rise time | $t_r$ | | - | 47 | - | |
| | Turn-off delay time | $t_{d(off)}$ | | - | 240 | - | |
| | Fall time | $t_f$ | | - | 66 | - | |
| | Turn-on switching loss | $E_{on}$ | $I_C$ = 100 A, $V_{CC}$ = 360 V, $V_{GE}$ = 15 V<br>$R_g$ = 5 Ω, L = 500 μH, $T_J$ = 125 °C | - | 0.33 | - | mJ |
| | Turn-off switching loss | $E_{off}$ | | - | 1.45 | - | |
| | Total switching loss | $E_{tot}$ | | - | 1.78 | - | |
| | Turn-on delay time | $t_{d(on)}$ | | - | 246 | - | ns |
| | Rise time | $t_r$ | | - | 50 | - | |
| | Turn-off delay time | $t_{d(off)}$ | | - | 246 | - | |
| | Fall time | $t_f$ | | - | 71 | - | |
| | Input capacitance | $C_{ies}$ | $V_{GE}$ = 0 V<br>$V_{CC}$ = 30 V<br>f = 1 MHz | - | 9500 | - | pF |
| | Output capacitance | $C_{oes}$ | | - | 780 | - | |
| | Reverse transfer capacitance | $C_{res}$ | | - | 120 | - | |

| THERMISTOR ELECTRICAL CHARACTERISTICS ($T_J$ = 25 °C unless otherwise noted) | | | | | | |
|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Resistance | R | $T_J$ = 25 °C | - | 30 000 | - | Ω |
| B value | B | $T_J$ = 25 °C/$T_J$ = 85 °C | - | 4000 | - | K |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | | |
|---|---|---|---|---|---|---|
| | PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNITS |
| AP FRED Pt Diode | Junction to case diode thermal resistance | $R_{thJC}$ | - | - | 4.9 | °C/W |
| IGBT | Junction to case IGBT thermal resistance | | - | - | 0.27 | |
| FRED Pt Chopper Diode | Junction to case diode thermal resistance | | - | - | 2.25 | |
| | Case to sink, flat, greased surface per module | $R_{thCS}$ | - | 0.06 | - | °C/W |
| | Mounting torque ± 10 % to heatsink [(1)] | | - | - | 4 | Nm |
| | Approximate weight | | - | 65 | - | g |

**Note**

[(1)] A mounting compound is recommended and the torque should be rechecked after a period of 3 hours to allow for the spread of the compound.

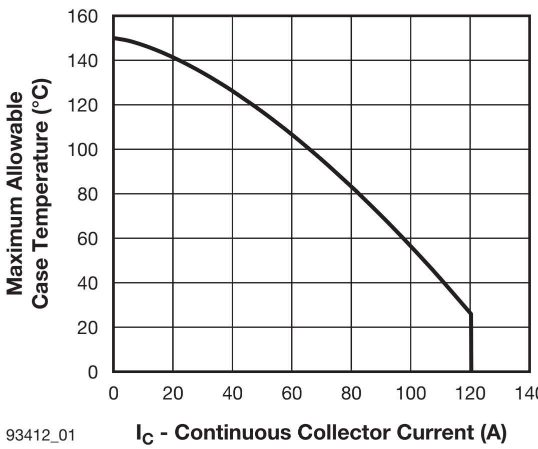



Fig. 1 - Maximum IGBT Continuous Collector Current vs. Case Temperature

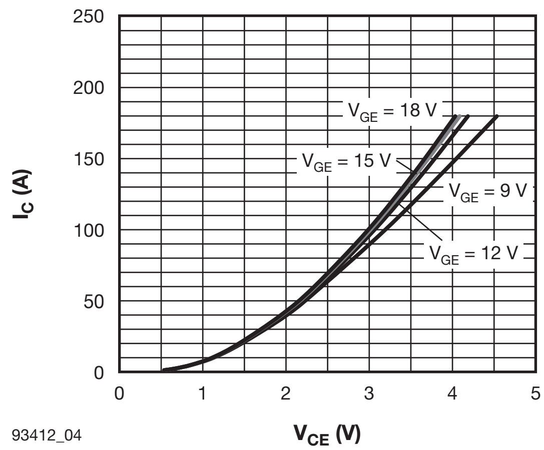



Fig. 4 - Typical IGBT Output Characteristics, $T_J$ = 125 °C

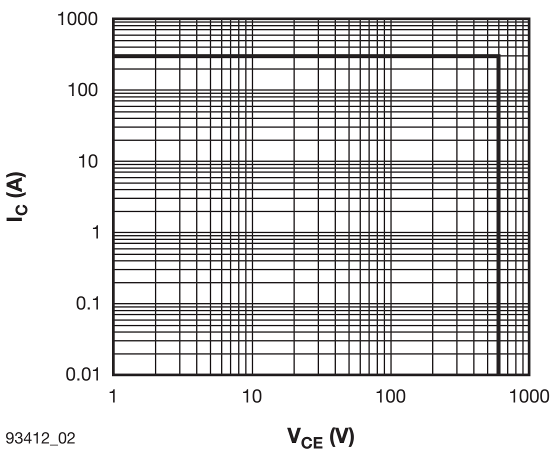



Fig. 2 - IGBT Reverse BIAS SOA $T_J$ = 150 °C, $V_{GE}$ = 15 V

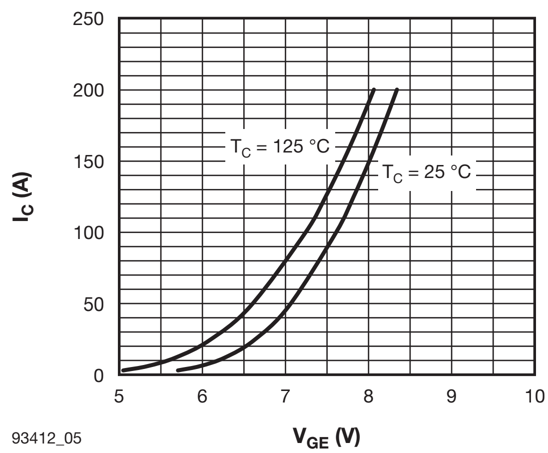



Fig. 5 - Typical IGBT Transfer Characteristics, $T_J$ = 125 °C

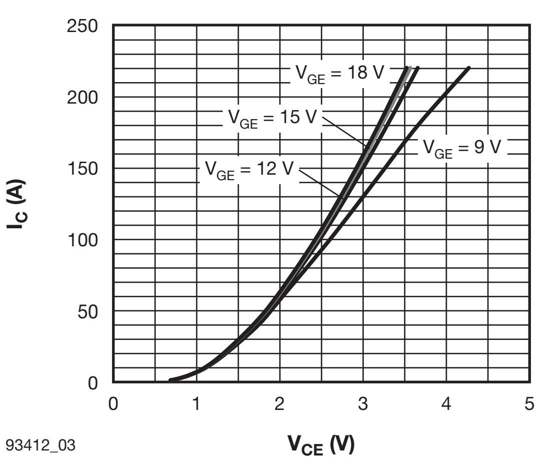



Fig. 3 - Typical IGBT Output Characteristics, $T_J$ = 25 °C

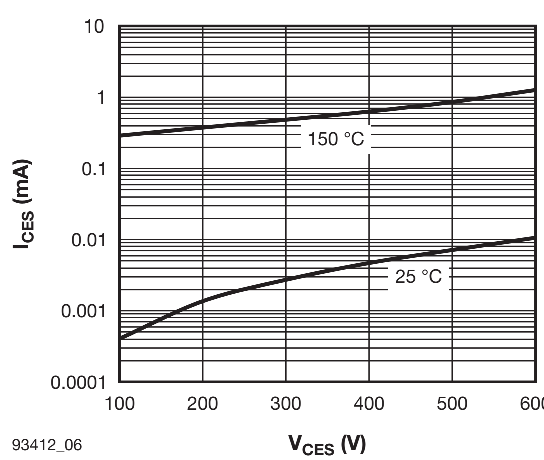



Fig. 6 - Typical IGBT Zero Gate Voltage Collector Current

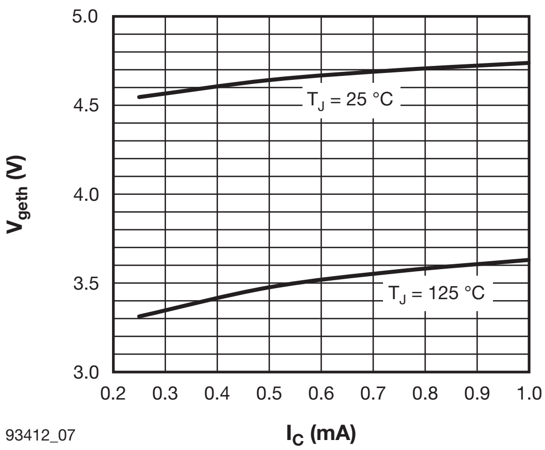



Fig. 7 - Typical IGBT Gate Thresold Voltage

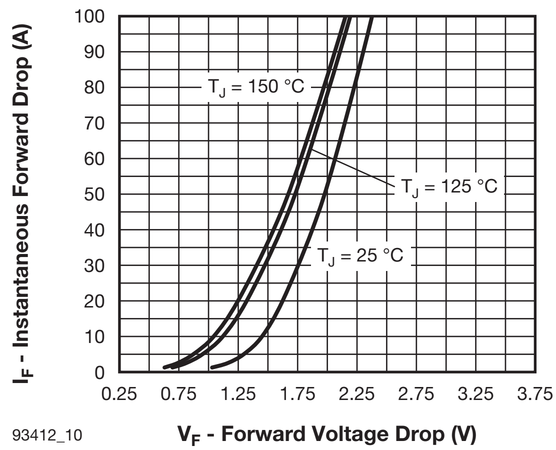



Fig. 10 - Typical PFC Diode Forward Voltage

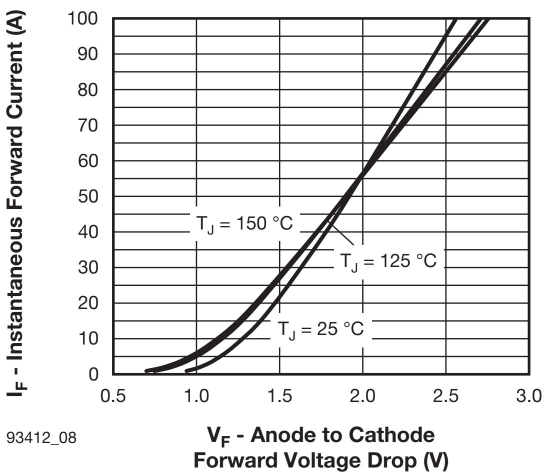



Fig. 8 - Typical Diode Forward Voltage Characteristics of Antiparallel Diode, $t_p$ = 500 μs

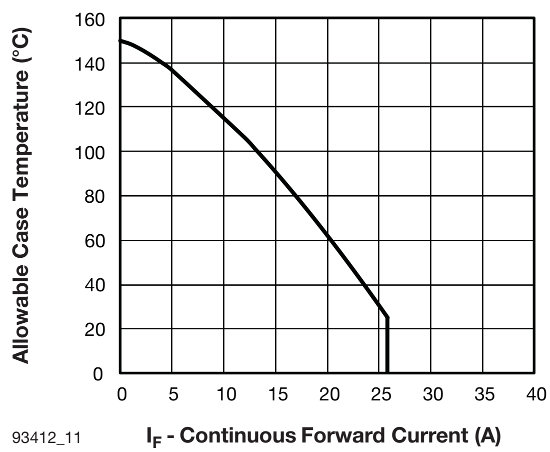



Fig. 11 - Maximum Continuous Forward Current vs. Case Temperature PFC Diode

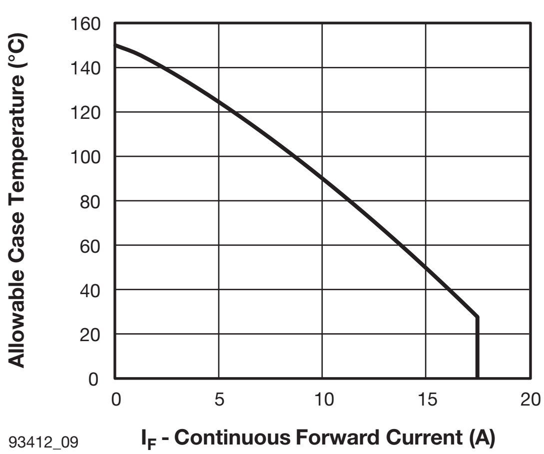



Fig. 9 - Maximum Continuous Forward Current vs. Case Temperature Antiparallel Diode

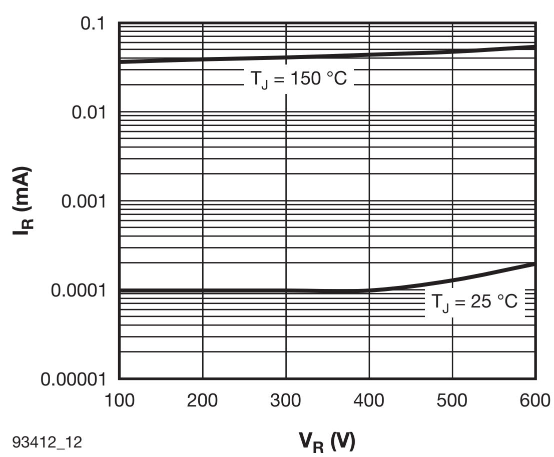



Fig. 12 - Typical FRED Pt Chopper Diode Reverse Current vs. Reverse Voltage

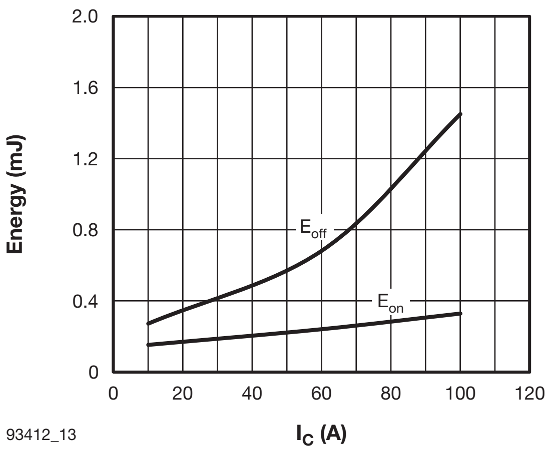



Fig. 13 - Typical IGBT Energy Loss vs. $I_C$
$T_J$ = 125 °C, $V_{CC}$ = 360 V, $V_{GE}$ = 15 V, L = 500 µH, $R_g$ = 5 Ω

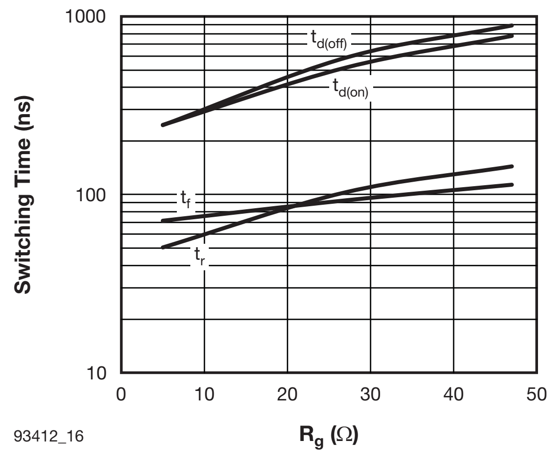



Fig. 16 - Typical IGBT Switching Time vs. $R_g$, $T_J$ = 125 °C
$I_C$ = 100 A, $V_{CE}$ = 360 V, $V_{GE}$ = 15 V, L = 500 µH

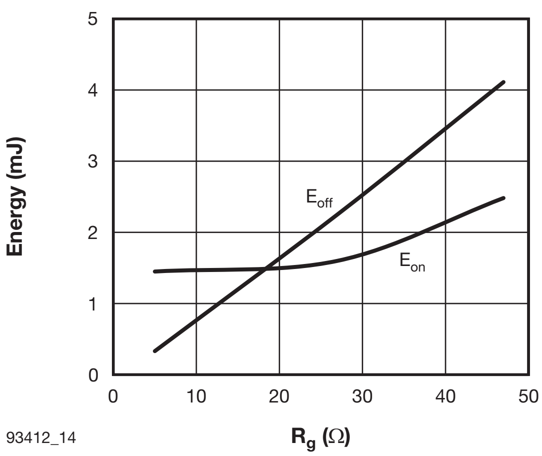



Fig. 14 - Typical IGBT Energy Loss vs. $R_g$, $T_J$ = 125 °C
$I_C$ = 100 A, $V_{CC}$ = 360 V, $V_{GE}$ = 15 V, L = 500 µH, $R_g$ = 5 Ω

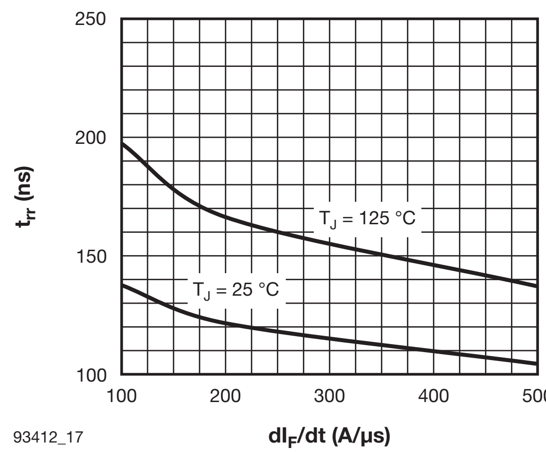



Fig. 17 - Typical $t_{rr}$ Antiparallel Diode vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 60 A

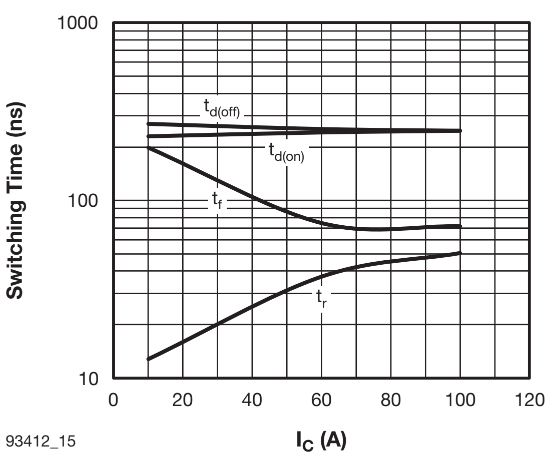



Fig. 15 - Typical IGBT Switching Time vs. $I_C$
$T_J$ = 125 °C, $V_{DD}$ = 360 V, $V_{GE}$ = 15 V, L = 500 µH, $R_g$ = 5 Ω

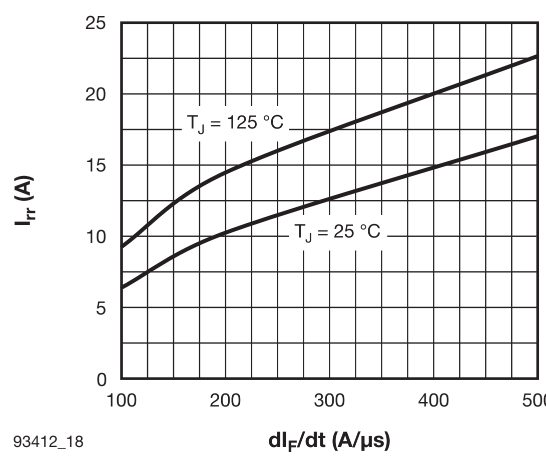



Fig. 18 - Typical $I_{rr}$ Antiparallel Diode vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 60 A

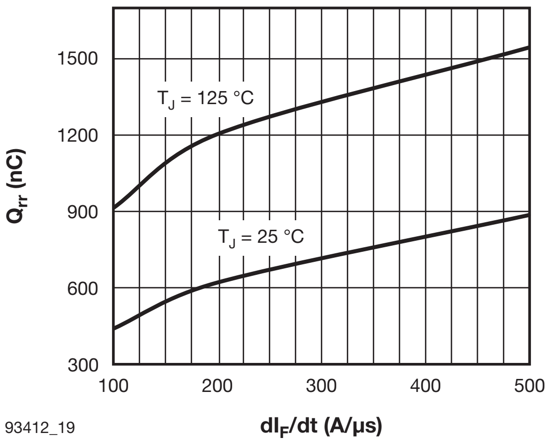



Fig. 19 - Typical $Q_{rr}$ Antiparallel Diode vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 60 A

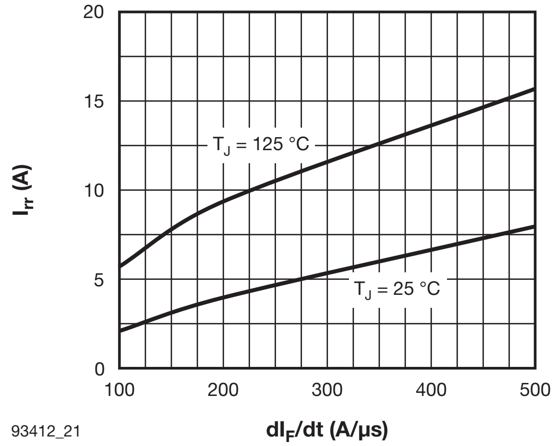



Fig. 21 - Typical $I_{rr}$ Chopper Diode vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 60 A

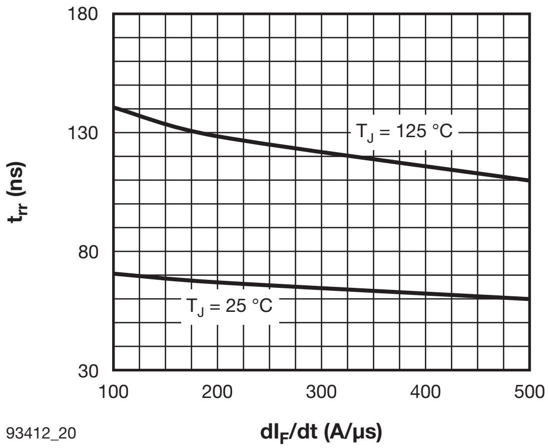



Fig. 20 - Typical $t_{rr}$ Chopper Diode vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 60 A

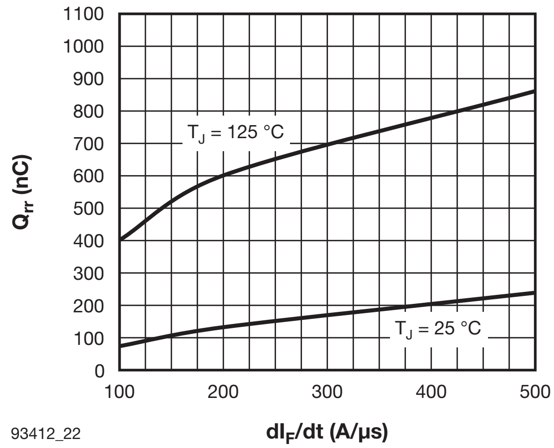



Fig. 22 - Typical $Q_{rr}$ Chopper Diode vs. $dI_F/dt$
$V_{rr}$ = 200 V, $I_F$ = 40 A

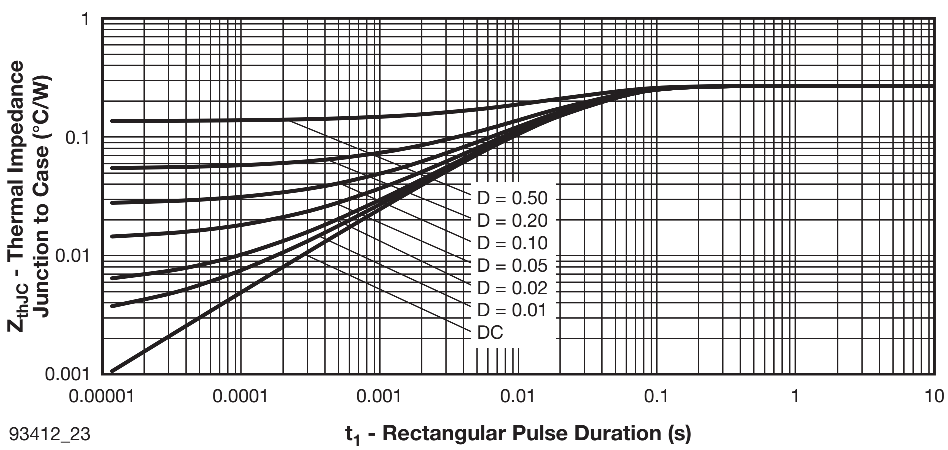



Fig. 23 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (IGBT)

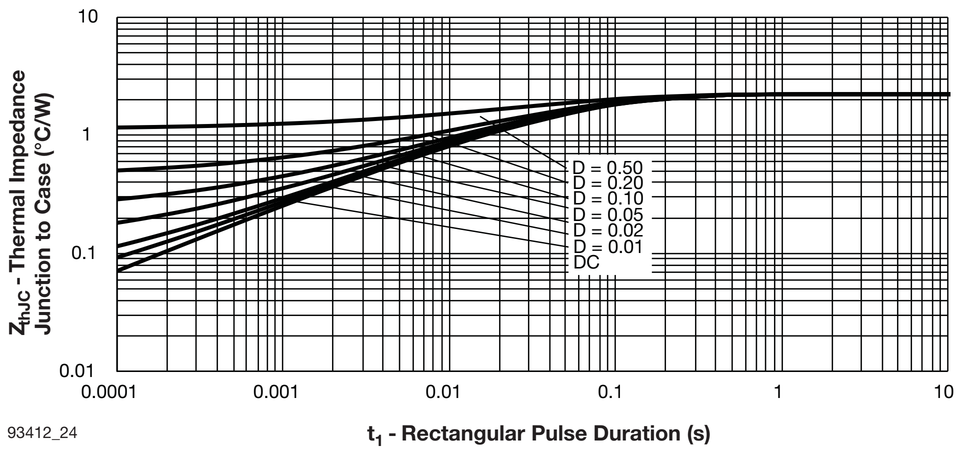



Fig. 24 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (PFC Diode)

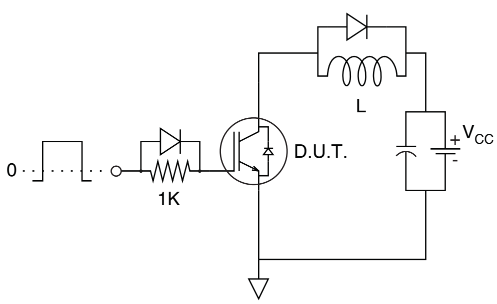



Fig. C.T.1 - Gate Charge Circuit (Turn-Off)

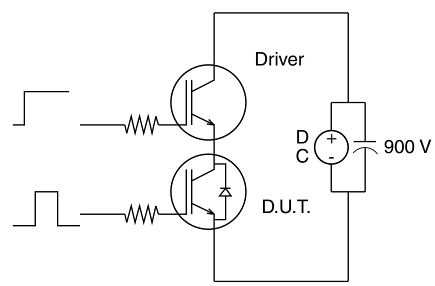



Fig. C.T.3 - S.C. SOA Circuit

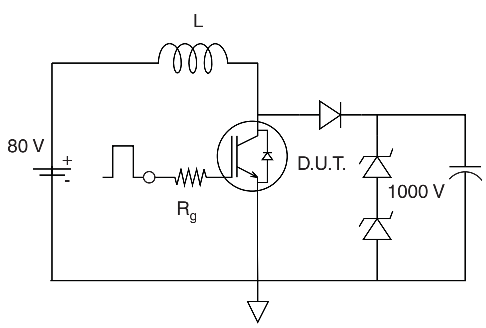



Fig. C.T.2 - RBSOA Circuit

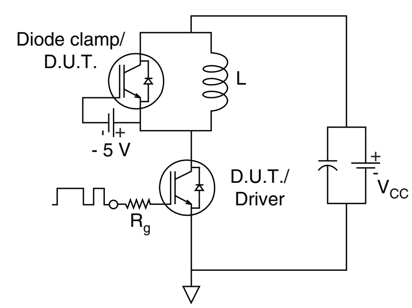



Fig. C.T.4 - Switching Loss Circuit

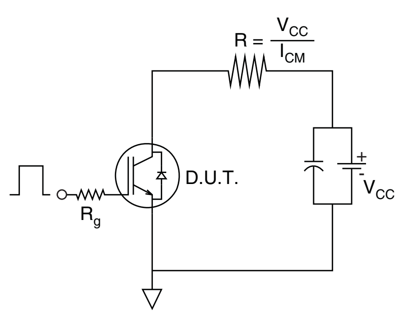
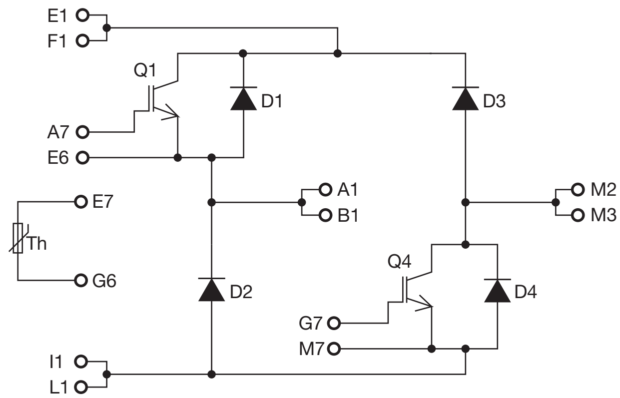
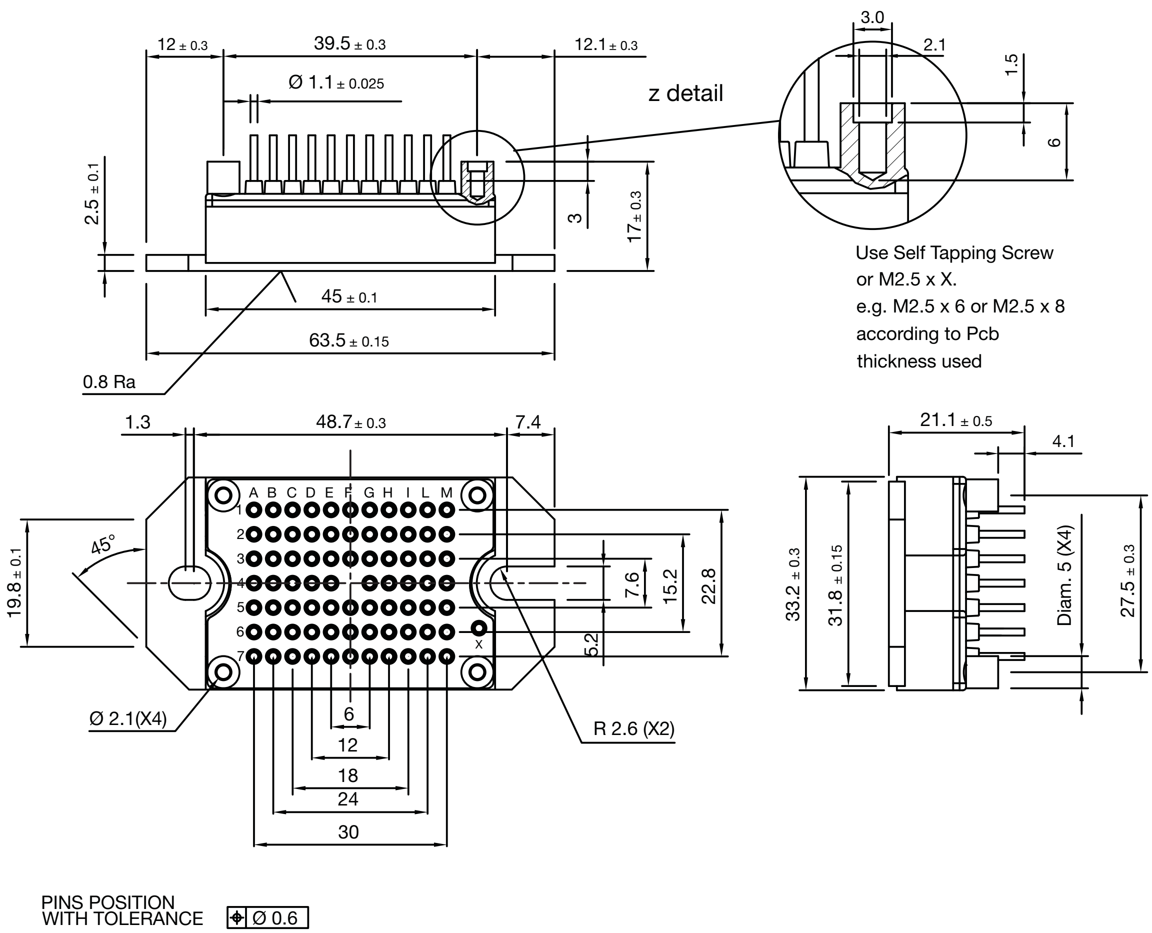



Fig. C.T.5 - Resistive Load Circuit

## CIRCUIT CONFIGURATION



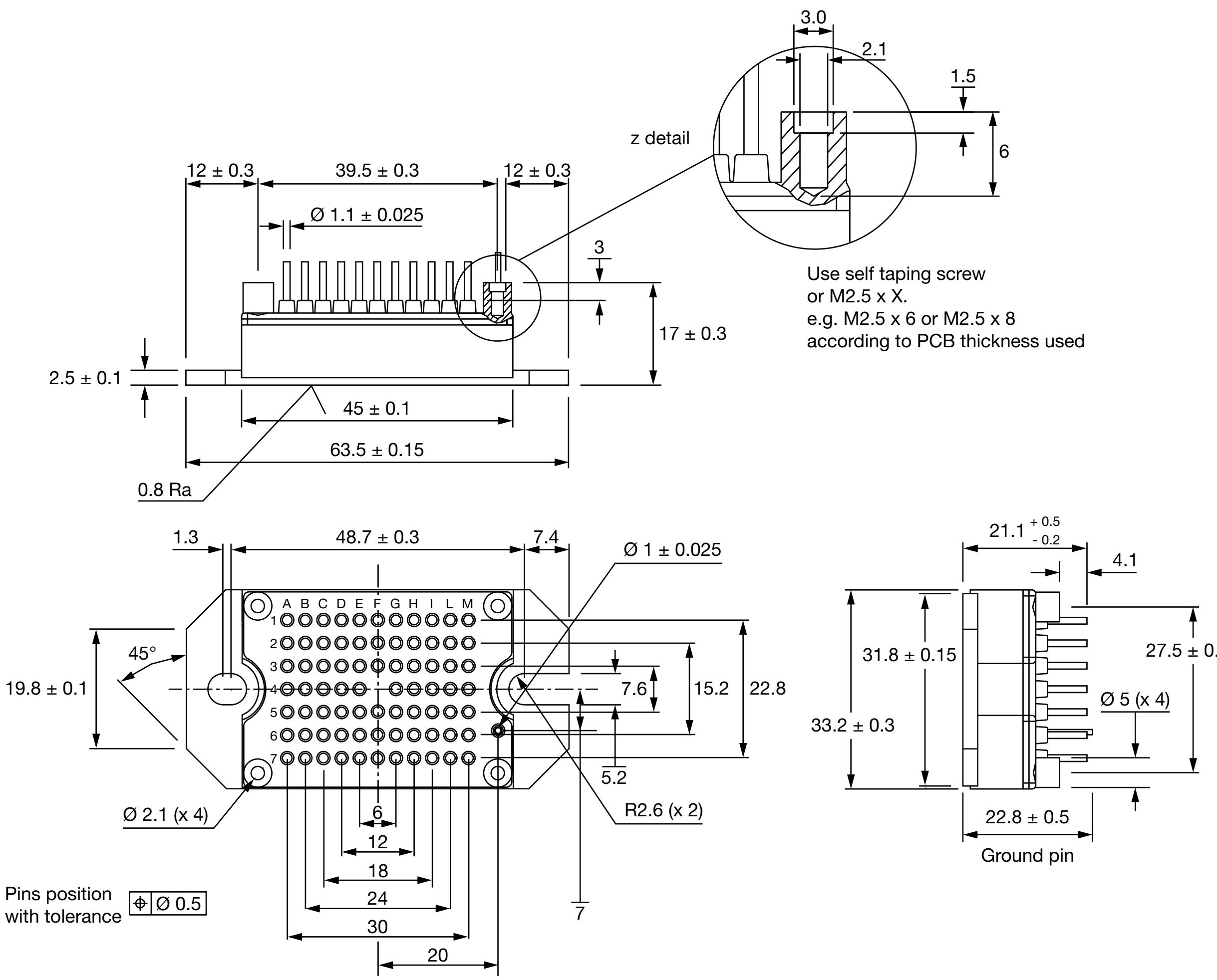

## **DIMENSIONS** in millimeters




| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95383 |

# MTP - Full Pin

**DIMENSIONS** in millimeters



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# Material Category Policy

**Vishay Intertechnology, Inc. hereby certifies that all its products that are identified as RoHS-Compliant fulfill the definitions and restrictions defined under Directive 2011/65/EU of The European Parliament and of the Council of June 8, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (EEE) - recast, unless otherwise specified as non-compliant.**

**Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.**

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>>Vishay(威世)