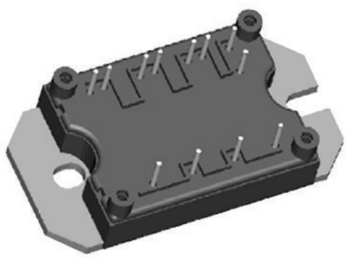
# "Half Bridge" IGBT MTP (Warp 2 Speed IGBT), 70 A



MTP

| PRODUCT SUMMARY | |
|---|---|
| $V_{CES}$ | 600 V |
| $V_{CE(on)}$ typical at $V_{GE}$ = 15 V | 2.1 V |
| $I_C$ at $T_C$ = 78 °C | 70 A |
| Package | MTP |
| Circuit | Half bridge |

## FEATURES

- NPT warp 2 speed IGBT technology with positive temperature coefficient
- HEXFRED® antiparallel diodes with ultrasoft reverse recovery
- SMD thermistor (NTC)
- $Al_2O_3$ BDC
- Very low stay inductance design for high speed operation
- UL pending
- Speed 60 kHz to 150 kHz
- UL approved file E78996
- Designed and qualified for industrial level
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

## BENEFITS

- Optimized for welding, UPS and SMPS applications
- Lower coduction losses and switching losses
- Low EMI, requires less snubbing
- Direct mounting to heatsink
- PCB solderable terminals

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
|---|---|---|---|---|
| Collector to emitter voltage | $V_{CES}$ | | 600 | V |
| Continuous collector current | $I_C$ | $T_C$ = 25 °C | 100 | A |
| | | $T_C$ = 78 °C | 70 | |
| Pulsed collector current | $I_{CM}$ | | 300 | |
| Peak switching current | $I_{LM}$ | | 300 | |
| Diode continuous forward current | $I_F$ | $T_C$ = 78 °C | 53 | |
| Peak diode forward current | $I_{FM}$ | | 200 | |
| Gate to emitter voltage | $V_{GE}$ | | ± 20 | V |
| RMS isolation voltage | $V_{ISOL}$ | Any terminal to case, t = 1 min | 2500 | |
| Maximum power dissipation, IGBT | $P_D$ | $T_C$ = 25 °C | 347 | W |
| | | $T_C$ = 100 °C | 139 | |

| **ELECTRICAL SPECIFICATIONS** ($T_J$ = 25 °C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Collector to emitter breakdown voltage | $V_{(BR)CES}$ | $V_{GE}$ = 0 V, $I_C$ = 500 μA | 600 | - | - | V |
| Collector to emitter voltage | $V_{CE(on)}$ | $V_{GE}$ = 15 V, $I_C$ = 70 A | - | 2.1 | 2.4 | V |
| | | $V_{GE}$ = 15 V, $I_C$ = 140 A | - | 2.8 | 3.4 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 70 A, $T_J$ = 150 °C | - | 2.7 | 3 | |
| Gate threshold voltage | $V_{GE(th)}$ | $I_C$ = 0.5 mA | 3 | - | 6 | |
| Collector to emitter leaking current | $I_{CES}$ | $V_{GE}$ = 0 V, $I_C$ = 600 V | - | - | 0.7 | mA |
| | | $V_{GE}$ = 0 V, $I_C$ = 600 V, $T_J$ = 150 °C | - | - | 10 | |
| Gate to emitter leakage current | $I_{GES}$ | $V_{GE}$ = ± 20 V | - | - | ± 250 | nA |

| **SWITCHING CHARACTERISTICS** ($T_J$ = 25 °C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Total gate charge (turn-on) | $Q_g$ | $I_C$ = 70 A<br>$V_{CC}$ = 480 V<br>$V_{GE}$ = 15 V | - | 460 | 690 | nC |
| Gate to emitter charge (turn-on) | $Q_{ge}$ | | - | 160 | 250 | |
| Gate to collector charge (turn-on) | $Q_{gc}$ | | - | 70 | 130 | |
| Turn-on switching loss | $E_{on}$ | $R_g$ = 10 Ω<br>$I_C$ = 70 A, $V_{CC}$ = 480 V, $V_{GE}$ = 15 V, L = 200 μH<br>Energy losses include tail and diode reverse recovery, $T_J$ = 25 °C | - | 1.1 | - | mJ |
| Turn-off switching loss | $E_{off}$ | | - | 0.9 | - | |
| Total switching loss | $E_{ts}$ | | - | 2 | - | |
| Turn-on switching loss | $E_{on}$ | $R_g$ = 10 Ω<br>$I_C$ = 70 A, $V_{CC}$ = 480 V, $V_{GE}$ = 15 V, L = 200 μH<br>Energy losses include tail and diode reverse recovery, $T_J$ = 150 °C | - | 1.27 | - | |
| Turn-off switching loss | $E_{off}$ | | - | 1.13 | - | |
| Total switching loss | $E_{ts}$ | | - | 2.4 | - | |
| Turn-on delay time | $td_{on}$ | $R_g$ = 10 Ω<br>$I_C$ = 70 A, $V_{CC}$ = 480 V, $V_{GE}$ = 15 V, L = 200 μH<br>Energy losses include tail and diode reverse recovery | - | 314 | - | ns |
| Rise time | $t_r$ | | - | 49 | - | |
| Turn-off delay time | $td_{off}$ | | - | 308 | - | |
| Fail time | $t_f$ | | - | 68 | - | |
| Turn-on delay time | $td_{on}$ | $R_g$ = 10 Ω<br>$I_C$ = 70 A, $V_{CC}$ = 480 V, $V_{GE}$ = 15 V, L = 200 μH<br>Energy losses include tail and diode reverse recovery, $T_J$ = 150 °C | - | 312 | - | |
| Rise time | $t_r$ | | - | 50 | - | |
| Turn-off delay time | $td_{off}$ | | - | 320 | - | |
| Fail time | $t_f$ | | - | 78 | - | |
| Input capacitance | $C_{ies}$ | $V_{GE}$ = 0 V<br>$V_{CC}$ = 30 V<br>f = 1.0 MHz | - | 8000 | - | pF |
| Output capacitane | $C_{oes}$ | | - | 790 | - | |
| Reverse transfer capacitance | $C_{res}$ | | - | 110 | - | |
| Reverse BIAS safe operating area | RBSOA | $T_J$ = 150 °C, $I_C$ = 300 A<br>$V_{CC}$ = 400 V, $V_P$ = 600 V<br>$R_g$ = 22 Ω, $V_{GE}$ = + 15 V to 0 V | Fullsquare | | | |

| THERMISTOR SPECIFICATIONS | | | | | | |
|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Resistance | $R_0$ (1) | $T_0$ = 25 °C | - | 30 | - | kΩ |
| Sensitivity index of the thermistor material | β (1)(2) | $T_0$ = 25 °C<br>$T_1$ = 85 °C | - | 4000 | - | K |

**Notes**

(1) $T_0$, $T_1$ are thermistor´s temperatures

(2) $\frac{R_0}{R_1} = \exp\left[\beta\left(\frac{1}{T_0} - \frac{1}{T_1}\right)\right]$, temperature in Kelvin

| DIODE SPECIFICATIONS ($T_J$ = 25 °C unless otherwise specified) | | | | | | |
|---|---|---|---|---|---|---|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Diode forward voltage drop | $V_{FM}$ | $I_C$ = 70 A, $V_{GE}$ = 0 V | - | 1.64 | 2.1 | V |
| | | $I_C$ = 140 A, $V_{GE}$ = 0 V | - | 2.1 | 2.4 | |
| | | $I_C$ = 70 A, $V_{GE}$ = 0 V, $T_J$ = 150 °C | - | 1.69 | 1.9 | |
| Diode reverse recovery time | $t_{rr}$ | $V_{CC}$ = 200 V, $I_C$ = 70 A<br>dI/dt = 200 A/μs | - | 96 | 126 | ns |
| Diode peak reverse current | $I_{rr}$ | | - | 9.4 | 12.8 | A |
| Diode recovery charge | $Q_{rr}$ | | - | 440 | 750 | nC |
| Diode reverse recovery time | $t_{rr}$ | $V_{CC}$ = 200 V, $I_C$ = 70 A<br>dI/dt = 200 A/μs<br>$T_J$ = 125 °C | - | 140 | 194 | ns |
| Diode peak reverse current | $I_{rr}$ | | - | 14 | 19 | A |
| Diode recovery charge | $Q_{rr}$ | | - | 950 | 1700 | nC |

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|
| PARAMETER | | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Operating junction temperature range | IGBT, Diode | $T_J$ | | - 40 | - | 150 | °C |
| | Thermistor | | | - 40 | - | 125 | |
| Storage temperature range | | $T_{Stg}$ | | - 40 | - | 125 | |
| Junction to case | IGBT | $R_{thJC}$ | | - | - | 0.36 | °C/W |
| | Diode | | | - | - | 0.8 | |
| Case to sink per module | | $R_{thCS}$ | Heatsink compound thermal conductivity = 1 W/mK | - | 0.06 | - | |
| Mounting torque to heatsink | | | A mounting compound is recommended and the torque should be checked after 3 hours to allow for the spread of the compound. Lubricated threads. | 3 ± 10 % | | | Nm |
| Weight | | | | 66 | | | g |

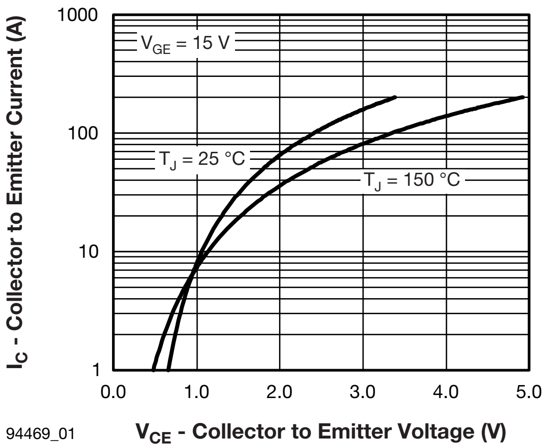



Fig. 1 - Typical Output Characteristics

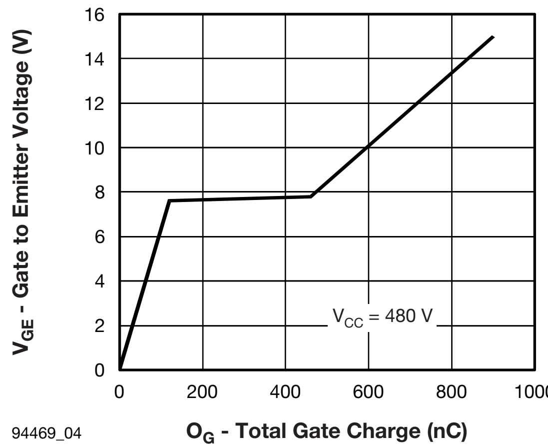



Fig. 4 - Typical Gate Charge vs. Gate to Emitter Votlage

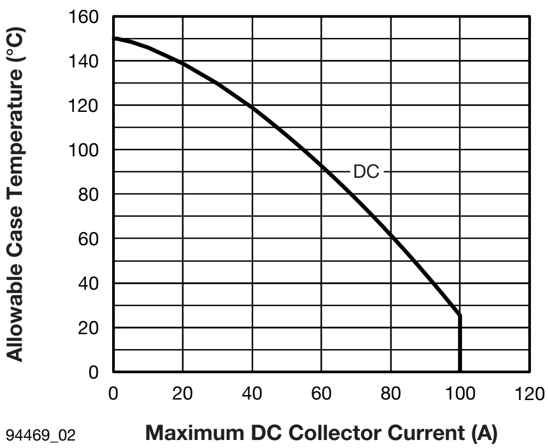



Fig. 2 - Maximum Collector Current vs. Case Temperature

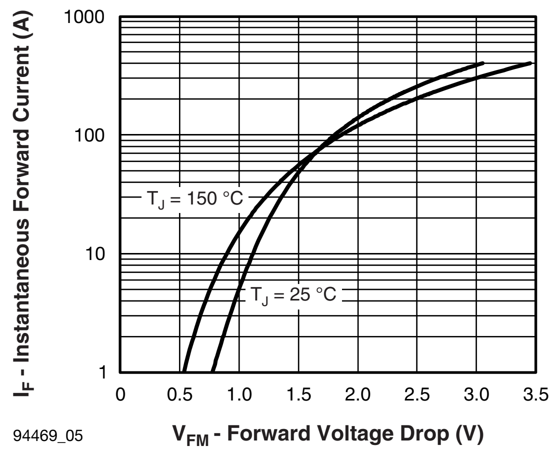



Fig. 5 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

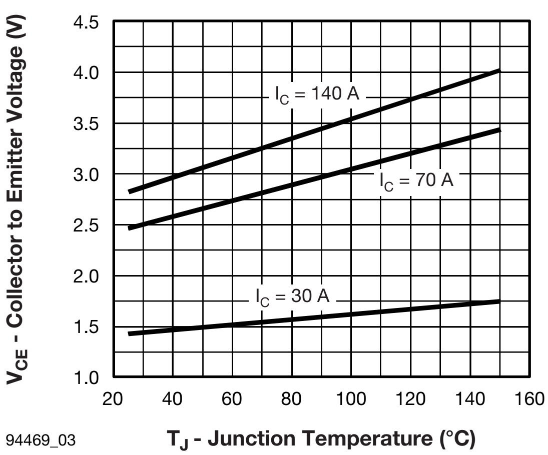



Fig. 3 - Typical Collector to Emitter Voltage vs. Junction Temperature

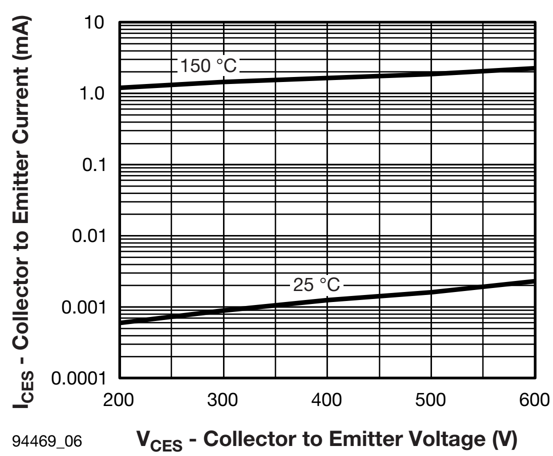



Fig. 6 - Typical Zero Gate Voltage Collector Current

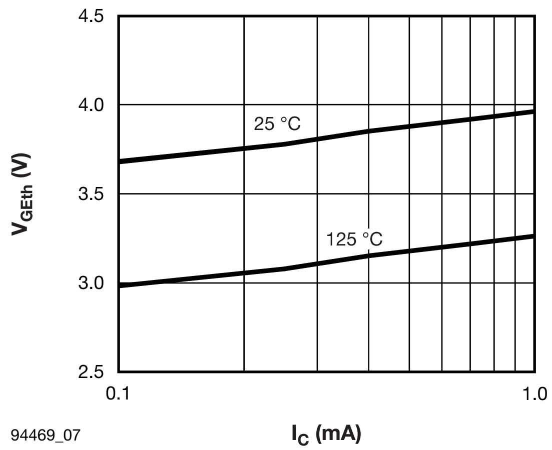



Fig. 7 - Typical Gate Threshold Voltage

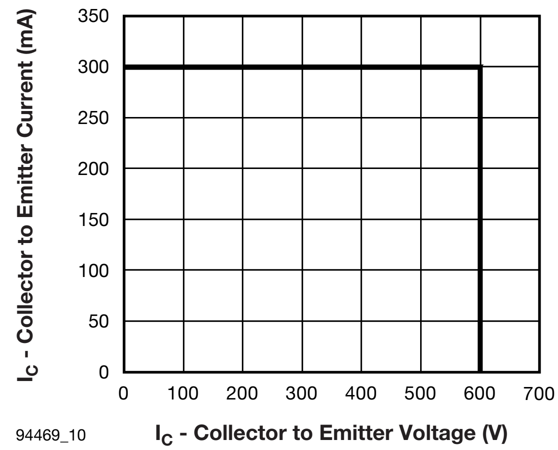



Fig. 10 - Reverse BIAS SOA, $T_J$ = 150 °C

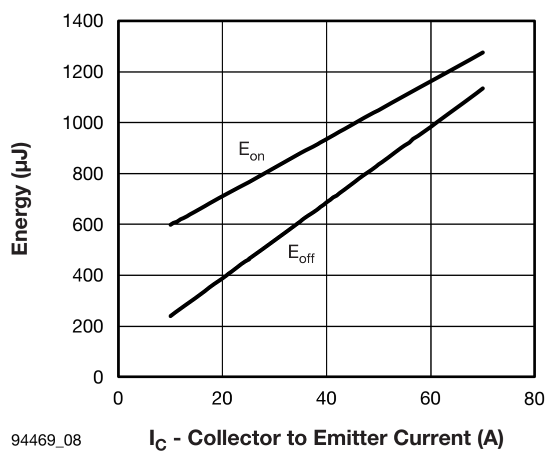



Fig. 8 - Typical Energy Losses vs. $I_C$ ( $T_J$ = 150 °C)

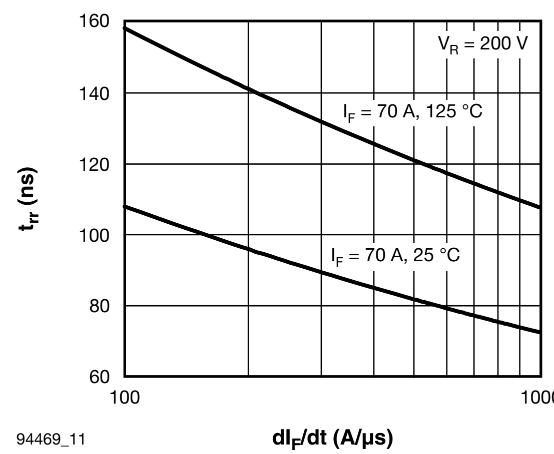



Fig. 11 - Typical Reverse Recovery Time vs. $dI_F/dt$

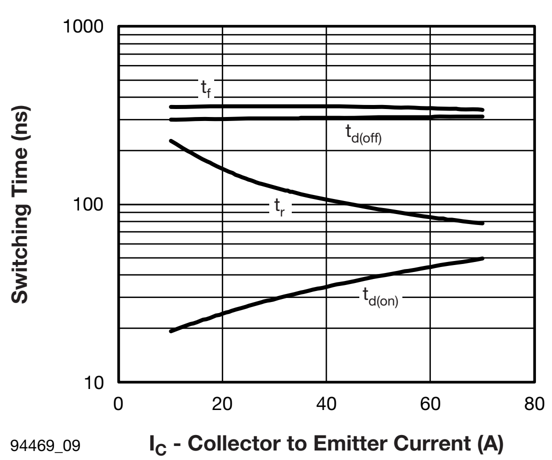



Fig. 9 - Switching Time vs. $I_C$

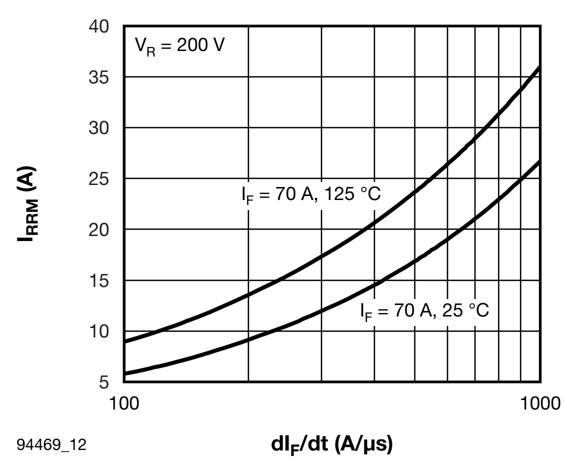



Fig. 12 - Typical Reverse Recovery Current vs. $dI_F/dt$

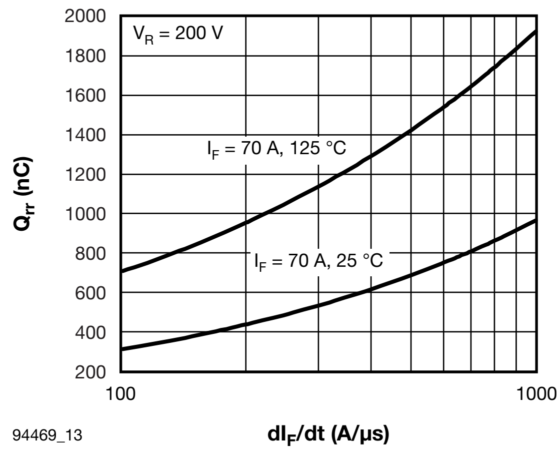



Fig. 13 - Typical Stored Charge vs. $dI_F/dt$

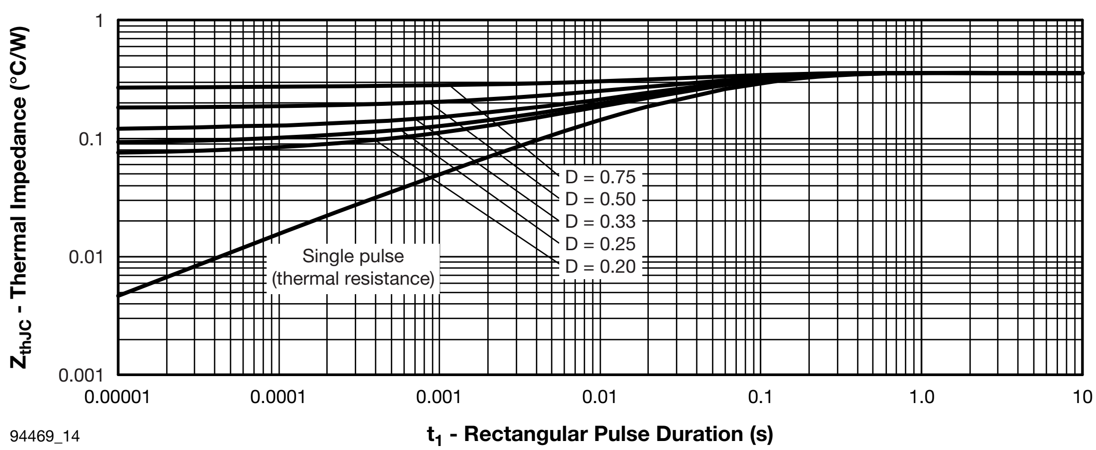



Fig. 14 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (IGBT)

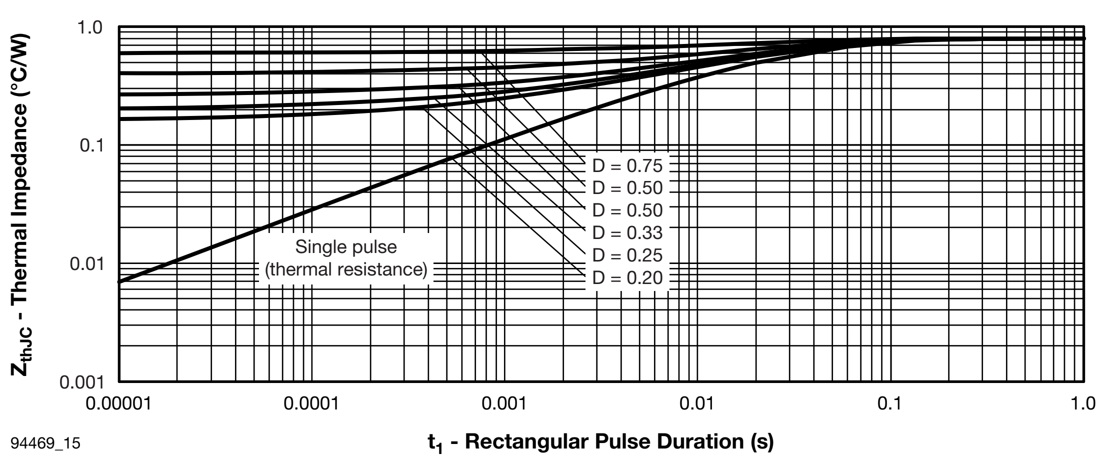



Fig. 15 - Maximum Thermal Impedance $Z_{thJC}$ Characteristics (Diode)

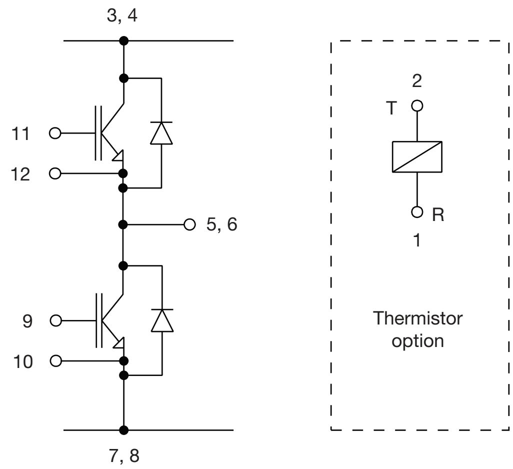



Fig. 16 - Electrical Diagram

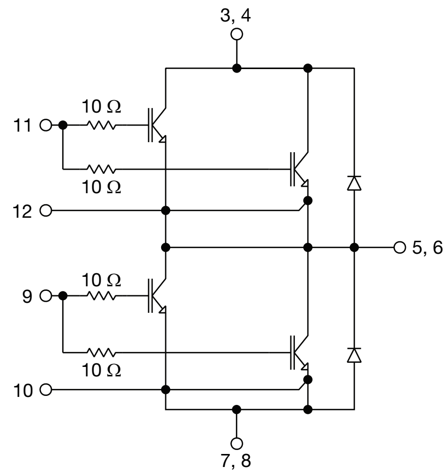


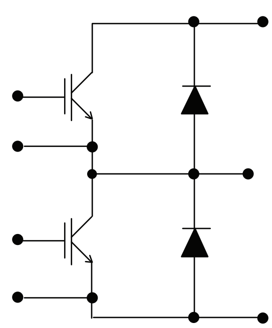

Fig. 17 - Functional Diagram

## ORDERING INFORMATION TABLE

| Device code | VS- | 70 | MT | 060 | W | H | T | A | PbF |
|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

1 - Vishay Semiconductors product
2 - Current rating (70 = 70 A)
3 - Essential part number
4 - Voltage rating (060 = 600 V)
5 - Speed/type (W = Warp IGBT)
6 - Circuit configuration (H = Half bridge)
7 - T = Thermistor
8 - A = $Al_2O_3$ DBC substrate
9 - Lead (Pb)-free

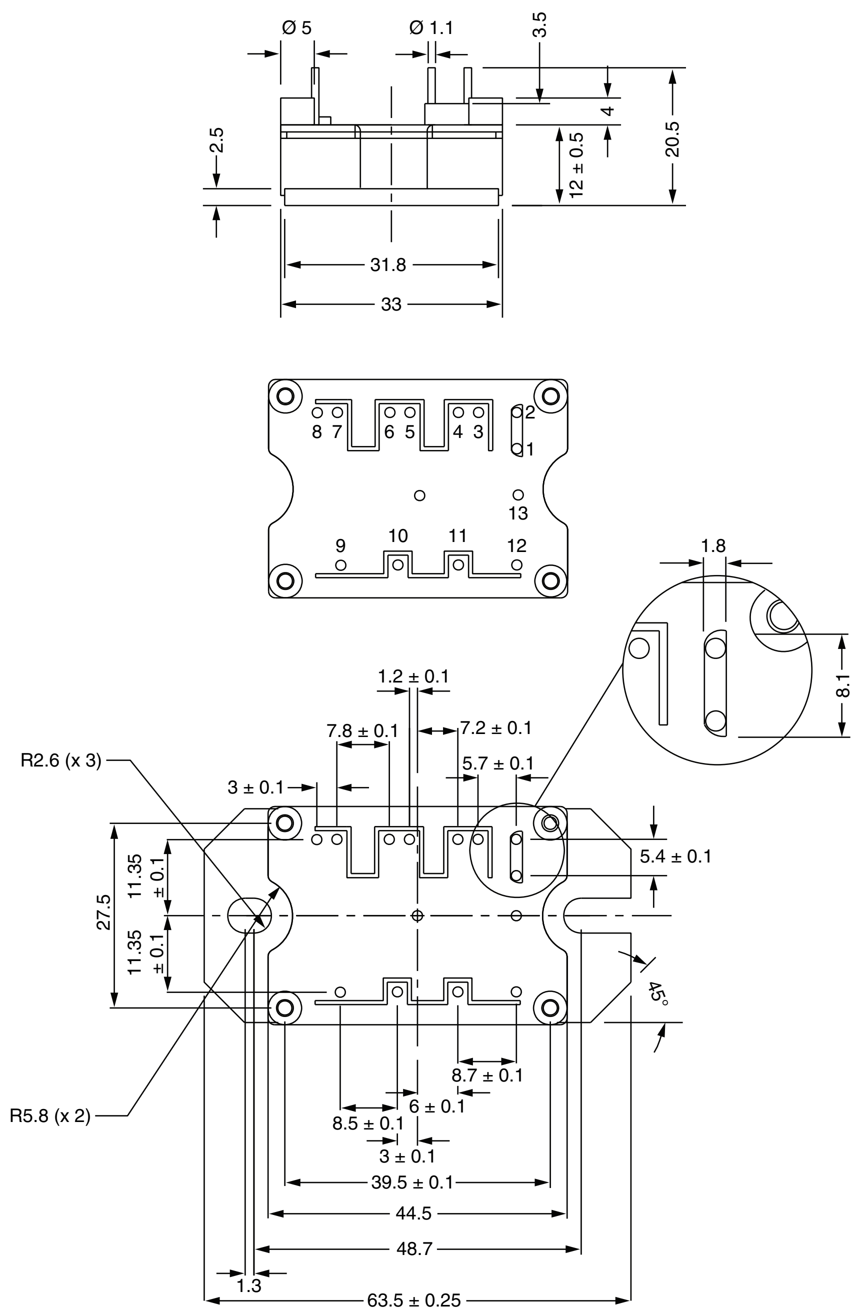
## CIRCUIT CONFIGURATION



| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95175 |

# MTP

**DIMENSIONS** in millimeters




**Note**

- Unused terminals are not assembled in the package

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