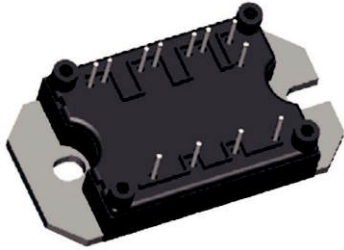


"Half Bridge" IGBT MTP (Warp 2 Speed IGBT), 70 A


MTP
FEATURES

- NPT warp 2 speed IGBT technology with positive temperature coefficient
- HEXFRED® antiparallel diodes with ultrasoft reverse recovery
- SMD thermistor (NTC)
- Al₂O₃ BDC
- Very low stay inductance design for high speed operation
- UL pending
- Speed 60 kHz to 150 kHz
- UL approved file E78996
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for industrial level


RoHS
COMPLIANT

| PRODUCT SUMMARY | |
|---|-------|
| V _{CES} | 600 V |
| V _{CE(on)} typical at V _{GE} = 15 V | 2.1 V |
| I _C at T _C = 25 °C | 70 A |

BENEFITS

- Optimized for welding, UPS and SMPS applications
- Lower conduction 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 | |

70MT060WHTAPbF



Vishay High Power Products "Half Bridge" IGBT MTP
(Warp 2 Speed IGBT), 70 A

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

| SWITCHING CHARACTERISTICS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified) | | | | | | |
|---|------------|--|------------|------|------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Total gate charge (turn-on) | Q_g | $I_C = 70\text{ A}$ $V_{CC} = 480\text{ V}$ $V_{GE} = 15\text{ V}$ | - | 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} | $R_g = 10\text{ }\Omega$ $I_C = 70\text{ A}, V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}, L = 200\text{ }\mu\text{H}$ Energy losses include tail and diode reverse recovery, $T_J = 25\text{ }^\circ\text{C}$ | - | 1.1 | - | mJ |
| Turn-off switching loss | E_{off} | | - | 0.9 | - | |
| Total switching loss | E_{ts} | | - | 2 | - | |
| Turn-on switching loss | E_{on} | $R_g = 10\text{ }\Omega$ $I_C = 70\text{ A}, V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}, L = 200\text{ }\mu\text{H}$ Energy losses include tail and diode reverse recovery, $T_J = 150\text{ }^\circ\text{C}$ | - | 1.27 | - | mJ |
| Turn-off switching loss | E_{off} | | - | 1.13 | - | |
| Total switching loss | E_{ts} | | - | 2.4 | - | |
| Turn-on delay time | td_{on} | $R_g = 10\text{ }\Omega$ $I_C = 70\text{ A}, V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}, L = 200\text{ }\mu\text{H}$ 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} | $R_g = 10\text{ }\Omega$ $I_C = 70\text{ A}, V_{CC} = 480\text{ V}, V_{GE} = 15\text{ V}, L = 200\text{ }\mu\text{H}$ Energy losses include tail and diode reverse recovery, $T_J = 150\text{ }^\circ\text{C}$ | - | 312 | - | ns |
| Rise time | t_r | | - | 50 | - | |
| Turn-off delay time | td_{off} | | - | 320 | - | |
| Fail time | t_f | | - | 78 | - | |
| Input capacitance | C_{ies} | $V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1.0\text{ MHz}$ | - | 8000 | - | pF |
| Output capacitance | C_{oes} | | - | 790 | - | |
| Reverse transfer capacitance | C_{res} | | - | 110 | - | |
| Reverse BIAS safe operating area | RBSOA | $T_J = 150\text{ }^\circ\text{C}, I_C = 300\text{ A}$ $V_{CC} = 400\text{ V}, V_P = 600\text{ V}$ $R_g = 22\text{ }\Omega, V_{GE} = +15\text{ V to }0\text{ V}$ | Fullsquare | | | |



| THERMISTOR SPECIFICATIONS | | | | | | |
|--|------------------|--|------|------|------|-----------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Resistance | $R_0^{(1)}$ | $T_0 = 25\text{ }^\circ\text{C}$ | - | 30 | - | $k\Omega$ |
| Sensitivity index of the thermistor material | $\beta^{(1)(2)}$ | $T_0 = 25\text{ }^\circ\text{C}$ $T_1 = 85\text{ }^\circ\text{C}$ | - | 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

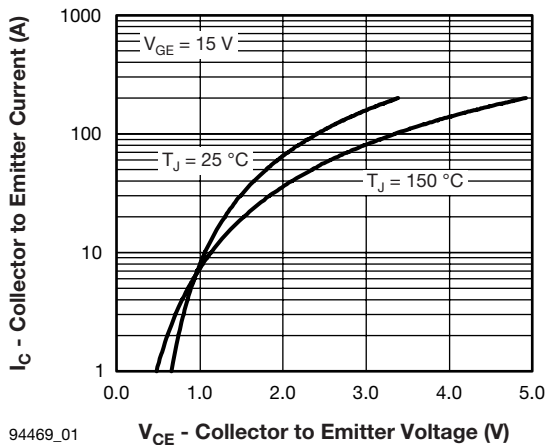
| DIODE SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$ unless otherwise specified) | | | | | | |
|---|----------|--|---|------|------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Diode forward voltage drop | V_{FM} | $I_C = 70\text{ A}, V_{GE} = 0\text{ V}$ | - | 1.64 | 2.1 | V |
| | | $I_C = 140\text{ A}, V_{GE} = 0\text{ V}$ | - | 2.1 | 2.4 | |
| | | $I_C = 70\text{ A}, V_{GE} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$ | - | 1.69 | 1.9 | |
| Diode reverse recovery time | t_{rr} | $V_{CC} = 200\text{ V}, I_C = 70\text{ A}$ $di/dt = 200\text{ A}/\mu\text{s}$ | - | 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} | | $V_{CC} = 200\text{ V}, I_C = 70\text{ A}$ $di/dt = 200\text{ A}/\mu\text{s}$ $T_J = 125\text{ }^\circ\text{C}$ | - | 140 | 194 |
| 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 Thermistor | T_J | - 40 | - | 150 | $^\circ\text{C}$ |
| | | | - 40 | - | 125 | |
| Storage temperature range | T_{Stg} | | - 40 | - | 125 | |
| Junction to case | IGBT Diode | R_{thJC} | - | - | 0.36 | $^\circ\text{C}/\text{W}$ |
| | | | - | - | 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 |

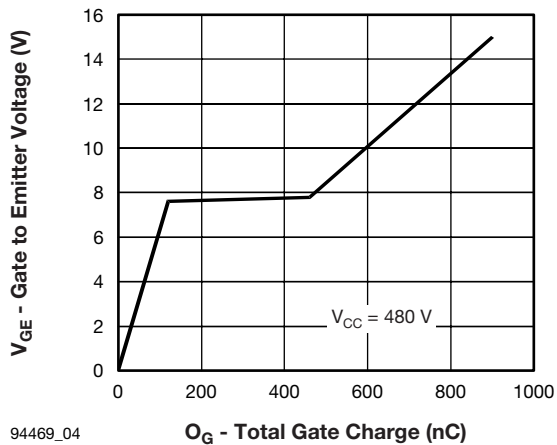
70MT060WHTAPbF



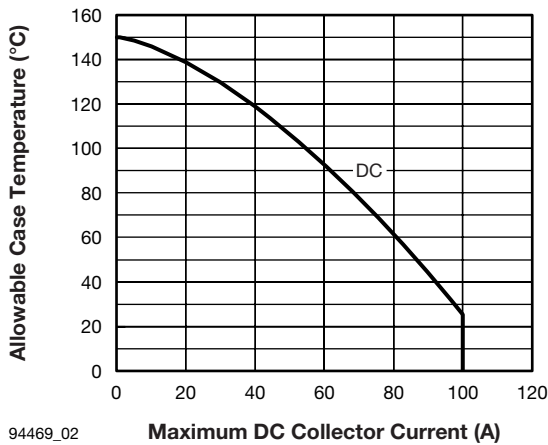
Vishay High Power Products "Half Bridge" IGBT MTP
(Warp 2 Speed IGBT), 70 A



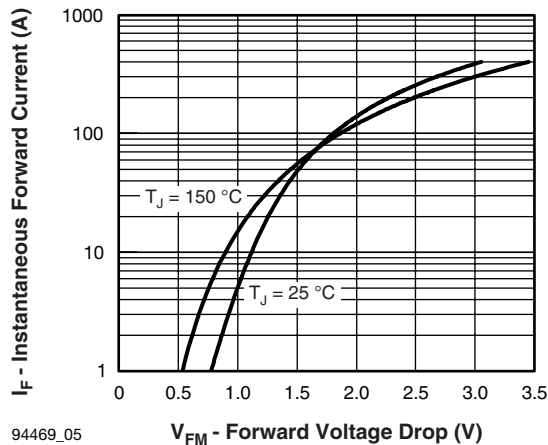
94469_01 **V_{CE} - Collector to Emitter Voltage (V)**
Fig. 1 - Typical Output Characteristics



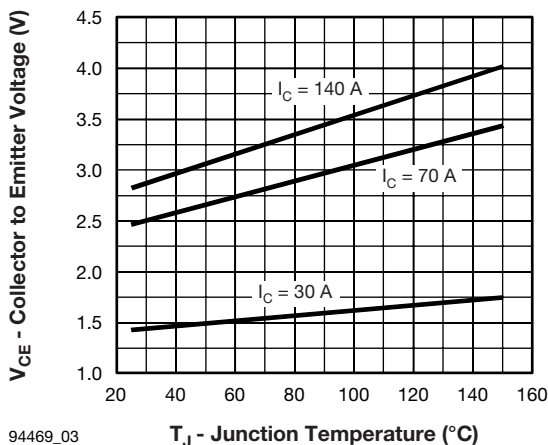
94469_04 **O_G - Total Gate Charge (nC)**
Fig. 4 - Typical Gate Charge vs. Gate to Emitter Voltage



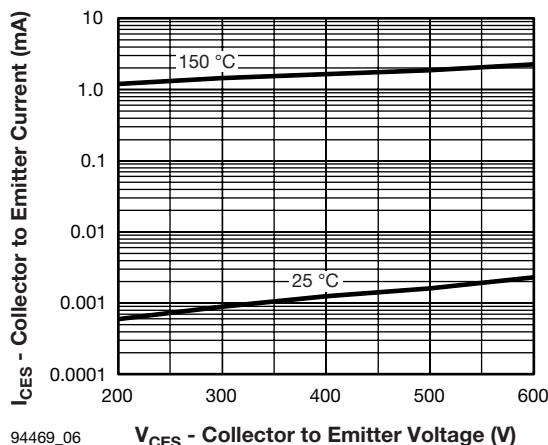
94469_02 **Maximum DC Collector Current (A)**
Fig. 2 - Maximum Collector Current vs. Case Temperature



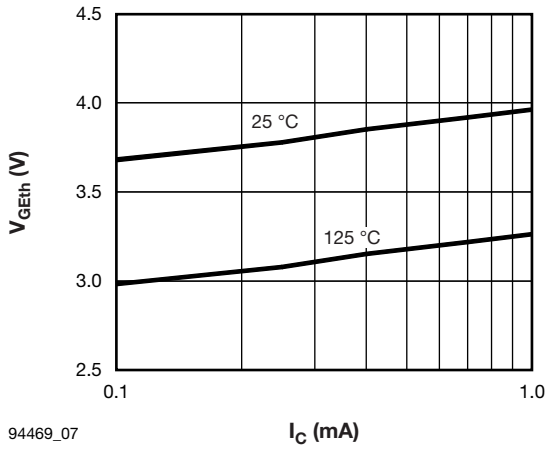
94469_05 **V_{FM} - Forward Voltage Drop (V)**
Fig. 5 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current



94469_03 **T_J - Junction Temperature (°C)**
Fig. 3 - Typical Collector to Emitter Voltage vs. Junction Temperature

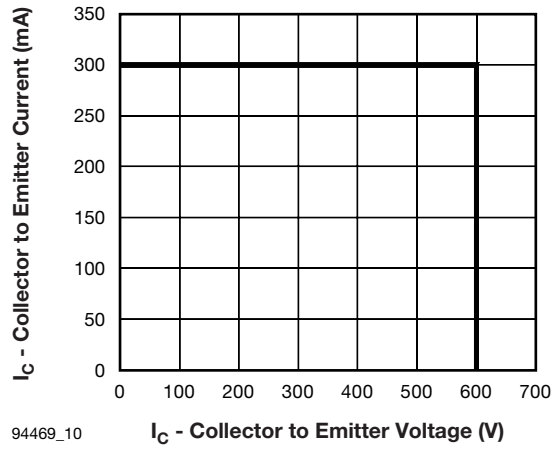


94469_06 **V_{CES} - Collector to Emitter Voltage (V)**
Fig. 6 - Typical Zero Gate Voltage Collector Current



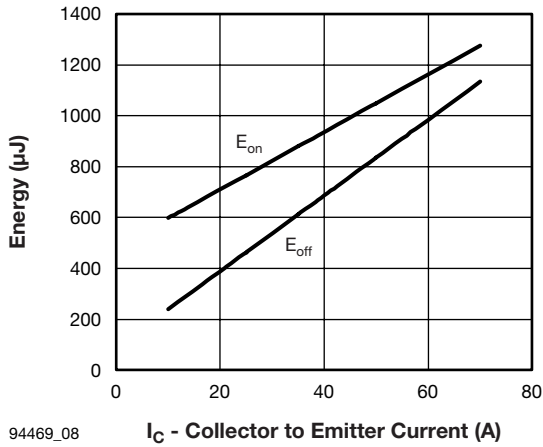
94469_07

Fig. 7 - Typical Gate Threshold Voltage



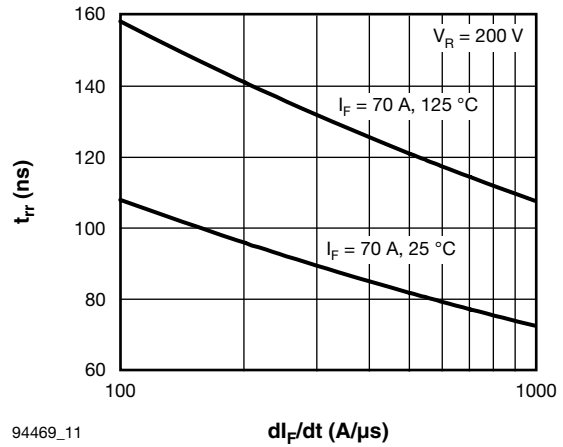
94469_10

Fig. 10 - Reverse BIAS SOA, $T_J = 150\text{ }^\circ\text{C}$



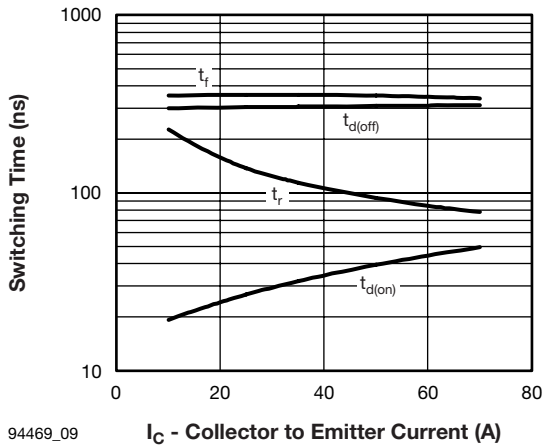
94469_08

Fig. 8 - Typical Energy Losses vs. I_C ($T_J = 150\text{ }^\circ\text{C}$)



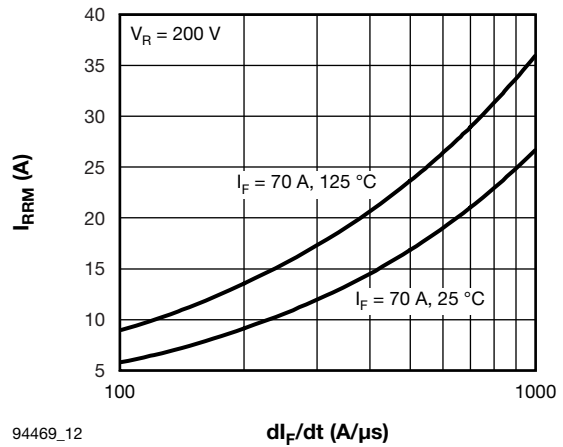
94469_11

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



94469_09

Fig. 9 - Switching Time vs. I_C



94469_12

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

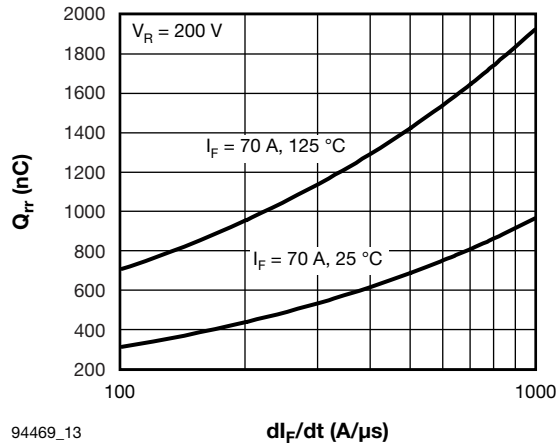


Fig. 13 - Typical Stored Charge vs. di_F/dt

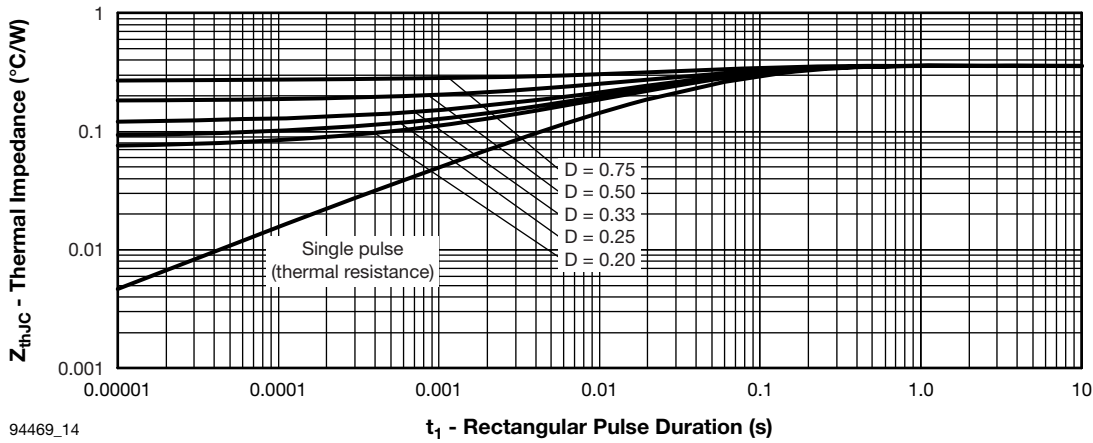


Fig. 14 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

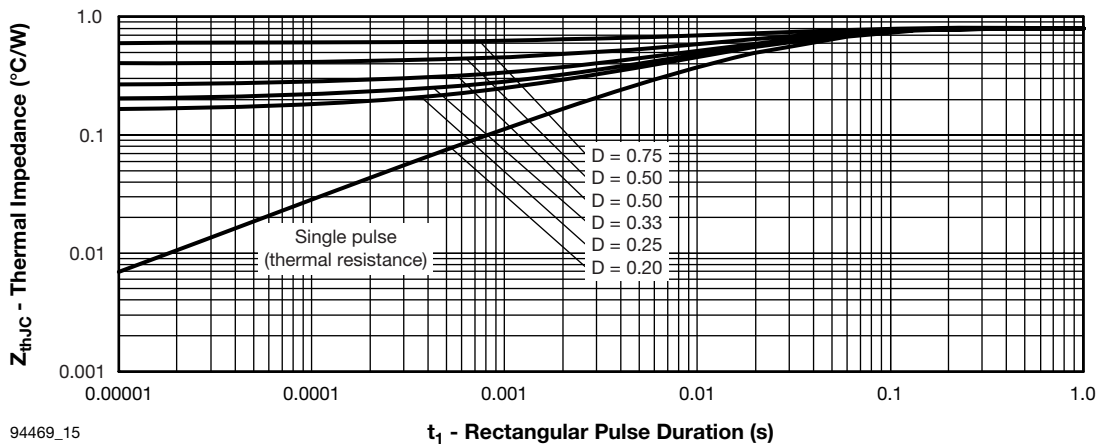


Fig. 15 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

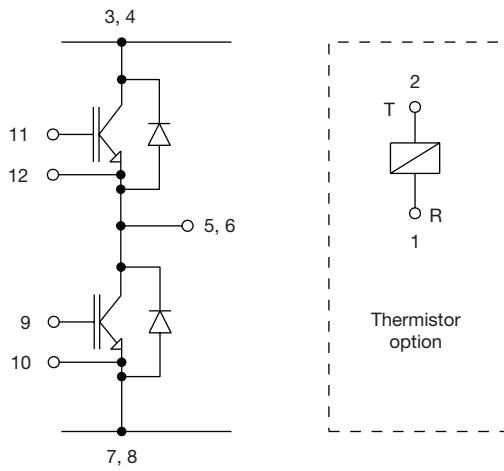


Fig. 16 - Electrical Diagram

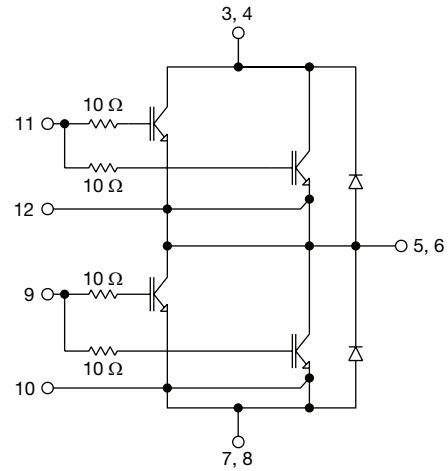
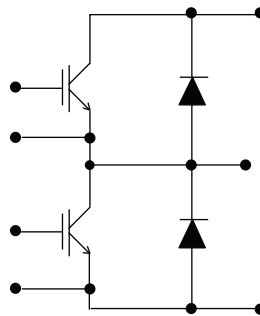


Fig. 17 - Functional Diagram

ORDERING INFORMATION TABLE

| | | | | | | | | |
|-------------|-----------|--|------------|----------|----------|----------|----------|------------|
| Device code | 70 | MT | 060 | W | H | T | A | PbF |
| | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ |
| 1 | - | Current rating (70 = 70 A) | | | | | | |
| 2 | - | Essential part number | | | | | | |
| 3 | - | Voltage rating (060 = 600 V) | | | | | | |
| 4 | - | Speed/type (W = Warp IGBT) | | | | | | |
| 5 | - | Circuit configuration (H = Half bridge) | | | | | | |
| 6 | - | T = Thermistor | | | | | | |
| 7 | - | A = Al ₂ O ₃ DBC substrate | | | | | | |
| 8 | - | Lead (Pb)-free | | | | | | |

CIRCUIT CONFIGURATION



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



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