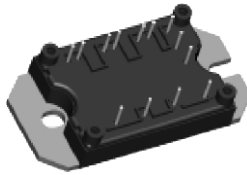



Three Phase Inverter Module in MTP Package 1200 V NPT IGBT and HEXFRED® Diodes, 15 A


MTP

| PRODUCT SUMMARY | |
|---|--------------|
| V_{CES} | 1200 V |
| $V_{CE(on)}$ typical at $V_{GE} = 15$ V | 2.51 V |
| I_C at $T_C = 100$ °C | 15 A |
| t_{sc} at $T_J = 150$ °C | > 10 μ s |

FEATURES

- Generation 5 NPT 1200 V IGBT technology
- HEXFRED® diode with ultrasoft reverse recovery
- Very low conduction and switching losses
- Optional SMT thermistor (NTC)
- Aluminum oxide DBC
- Very low stray inductance design for high speed operation
- Short circuit 10 μ s
- Square RBSOA
- Operating frequencies 8 kHz to 60 kHz
- UL approved file E78996 
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for industrial level


RoHS
COMPLIANT

BENEFITS

- Optimized for inverter motor drive applications
- Low EMI, requires less snubbing
- Direct mounting to heatsink
- PCB solderable terminals
- Very low junction to case thermal resistance

| ABSOLUTE MAXIMUM RATINGS | | | | |
|---|------------|-----------------------------------|----------|-------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MAX. | UNITS |
| Collector to emitter voltage | V_{CES} | | 1200 | V |
| Continuous collector current | I_C | $T_C = 25$ °C | 30 | A |
| | | $T_C = 100$ °C | 15 | |
| Pulsed collector current | I_{CM} | | 60 | |
| Peak switching current | I_{LM} | | 60 | |
| Diode continuous forward current | I_F | $T_C = 100$ °C | 15 | |
| Peak diode forward current | I_{FM} | | 30 | |
| Gate to emitter voltage | V_{GE} | | ± 20 | V |
| RMS isolation voltage | V_{ISOL} | Any terminal to case, $t = 1$ min | 2500 | |
| Maximum power dissipation (including diode and IGBT) | P_D | $T_C = 25$ °C | 187 | W |
| | | $T_C = 100$ °C | 75 | |

| 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 | $V_{(BR)CES}$ | $V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$ | 1200 | - | - | V |
| Temperature coefficient of $V_{(BR)CES}$ | $\Delta V_{(BR)CES}/\Delta T_J$ | $V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$ | - | 1.11 | - | V/ $^\circ\text{C}$ |
| Collector to emitter voltage | $V_{CE(on)}$ | $V_{GE} = 15\text{ V}, I_C = 15\text{ A}$ | - | 2.51 | 2.70 | V |
| | | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}$ | - | 3.36 | 3.66 | |
| | | $V_{GE} = 15\text{ V}, I_C = 15\text{ A}, T_J = 125\text{ }^\circ\text{C}$ | - | 2.94 | 3.16 | |
| | | $V_{GE} = 15\text{ V}, I_C = 30\text{ A}, T_J = 125\text{ }^\circ\text{C}$ | - | 4.12 | 4.46 | |
| Gate threshold voltage | $V_{GE(th)}$ | $I_C = 250\text{ }\mu\text{A}$ | 4 | - | 6 | |
| Temperature coefficient of threshold voltage | $\Delta V_{GE(th)}/\Delta T_J$ | $V_{CE} = V_{GE}, I_C = 1\text{ mA}$ | - | - 10 | - | mV/ $^\circ\text{C}$ |
| Forward transconductance | g_{fe} | $V_{CE} = 25\text{ V}, I_C = 15\text{ A}$ | - | 12 | - | S |
| Collector to emitter leaking current | I_{CES} | $V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$ | - | - | 250 | μA |
| | | $V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | - | - | 1000 | |
| Diode forward voltage drop | V_{FM} | $I_F = 15\text{ A}, V_{GE} = 0\text{ V}$ | - | 2.13 | 2.58 | V |
| | | $I_F = 30\text{ A}, V_{GE} = 0\text{ V}$ | - | 2.70 | 3.33 | |
| | | $I_F = 15\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | - | 2.27 | 2.75 | |
| | | $I_F = 30\text{ A}, V_{GE} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | - | 3.06 | 3.76 | |
| 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 | $I_C = 15\text{ A}$ $V_{CC} = 600\text{ V}$ $V_{GE} = 15\text{ V}$ | - | 98 | 146 | nC |
| Gate to emitter charge (turn-on) | Q_{ge} | | - | 12 | 17 | |
| Gate to collector charge (turn-on) | Q_{gc} | | - | 46 | 69 | |
| Turn-on switching loss | E_{on} | $I_C = 15\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$ $R_g = 10\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 25\text{ }^\circ\text{C}$ Energy losses include tail and diode reverse recovery | - | 0.990 | 1.485 | mJ |
| Turn-off switching loss | E_{off} | | - | 0.827 | 1.241 | |
| Total switching loss | E_{ts} | | - | 1.817 | 2.726 | |
| Turn-on switching loss | E_{on} | $I_C = 15\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$ $R_g = 10\text{ }\Omega, L = 500\text{ }\mu\text{H}, T_J = 125\text{ }^\circ\text{C}$ Energy losses include tail and diode reverse recovery | - | 1.352 | 2.028 | mJ |
| Turn-off switching loss | E_{off} | | - | 1.138 | 1.707 | |
| Total switching loss | E_{ts} | | - | 2.490 | 3.735 | |
| Turn-on delay time | $t_{d(on)}$ | $I_C = 15\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$ $L = 500\text{ }\mu\text{H}, L_S = 100\text{ nH}$ $R_g = 10\text{ }\Omega, T_J = 125\text{ }^\circ\text{C}$ | - | 95 | 143 | ns |
| Rise time | t_r | | - | 18 | 27 | |
| Turn-off delay time | $t_{d(off)}$ | | - | 134 | 200 | |
| Fall time | t_f | | - | 227 | 341 | |
| Reverse BIAS safe operating area | RBSOA | $T_J = 150\text{ }^\circ\text{C}, I_C = 60\text{ A}$ $R_g = 10\text{ }\Omega, V_{GE} = 15\text{ V to }0$ | Fullsquare | | | |
| Short circuit safe operating area | SCSOA | $V_{CC} = 600\text{ V}, V_{GE} = +15\text{ V to }0$ $T_J = 150\text{ }^\circ\text{C}, V_P = 1200\text{ V}, R_g = 10\text{ }\Omega$ | 10 | - | - | μs |
| Input capacitance | C_{ies} | $V_{GE} = 0\text{ V}$ $V_{CC} = 30\text{ V}$ $f = 1\text{ MHz}$ | - | 1302 | 1953 | pF |
| Output capacitance | C_{oes} | | - | 717 | 1076 | |
| Reverse transfer capacitance | C_{res} | | - | 38 | 57 | |
| Diode reverse recovery energy | E_{rec} | $I_C = 15\text{ A}, V_{CC} = 600\text{ V}, V_{GE} = 15\text{ V}$ $L = 500\text{ }\mu\text{H}, L_S = 100\text{ nH}$ $R_g = 10\text{ }\Omega, T_J = 125\text{ }^\circ\text{C}$ | - | 819 | - | μJ |
| Diode reverse recovery time | t_{rr} | | - | 96 | - | ns |
| Diode peak reverse current | I_{rr} | | - | 35 | - | A |



| THERMISTOR SPECIFICATIONS (T CODE ONLY) | | | | | | |
|--|---------------------------|--|------|------|------|------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Resistance | R_0 ⁽¹⁾ | $T_0 = 25\text{ °C}$ | - | 30 | - | k Ω |
| Sensitivity index of the thermistor material | β ⁽¹⁾⁽²⁾ | $T_0 = 25\text{ °C}$ $T_1 = 85\text{ °C}$ | - | 4000 | - | K |

Notes

⁽¹⁾ T_0, T_1 are thermistor's temperatures

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

| THERMAL AND MECHANICAL SPECIFICATIONS | | | | | | |
|---------------------------------------|------------|---|------|------|------|----------------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNITS |
| Operating junction temperature range | T_J | | - 40 | - | 150 | $^{\circ}\text{C}$ |
| Storage temperature range | T_{Stg} | | - 40 | - | 125 | |
| Junction to case | IGBT | R_{thJC} | - | - | 1.1 | $^{\circ}\text{C/W}$ |
| | Diode | | - | - | 1.7 | |
| | Module | | - | 0.50 | - | |
| Case to sink per module | R_{thCS} | Heatsink compound thermal conductivity = 1 W/mK | - | 0.1 | - | |
| Mounting torque | | | - | - | 4 | Nm |
| Weight | | | - | 65 | - | g |

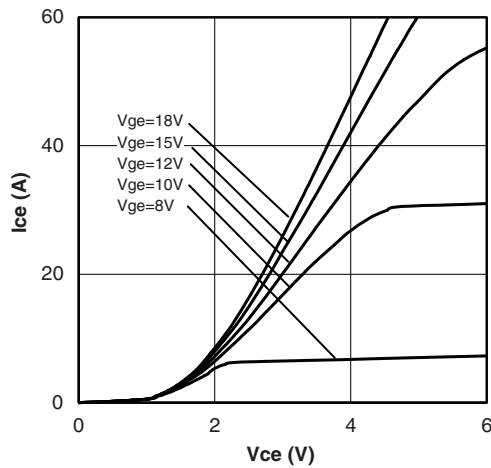


Fig. 1 - Typical Output Characteristics
 $T_J = 25\text{ °C}$

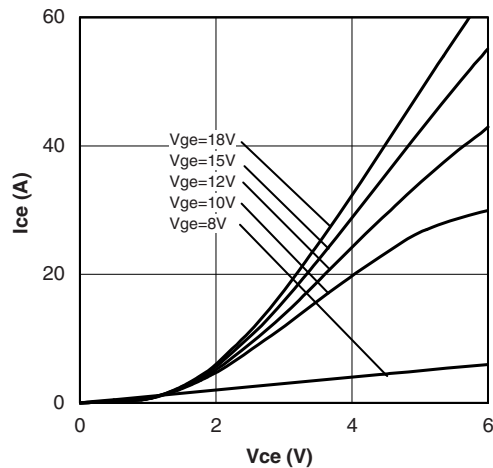


Fig. 2 - Typical Output Characteristics
 $T_J = 125\text{ °C}$

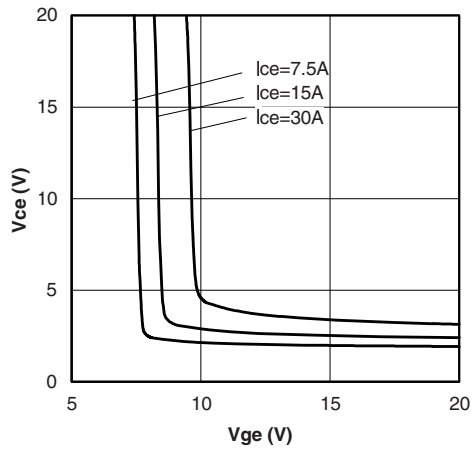


Fig. 3 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

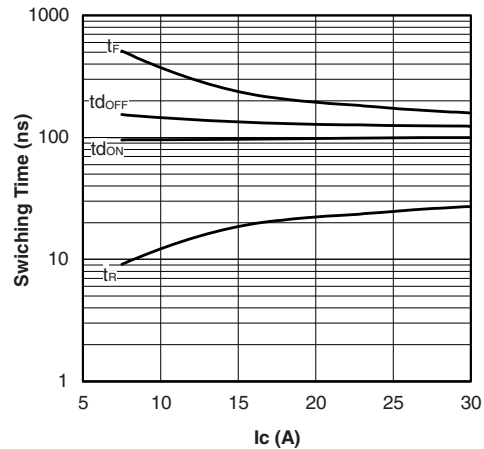


Fig. 6 - Typical Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$, $L = 500\ \mu\text{H}$, $V_{CE} = 600\ \text{V}$
 $R_g = 10\ \Omega$; $V_{GE} = 15\ \text{V}$

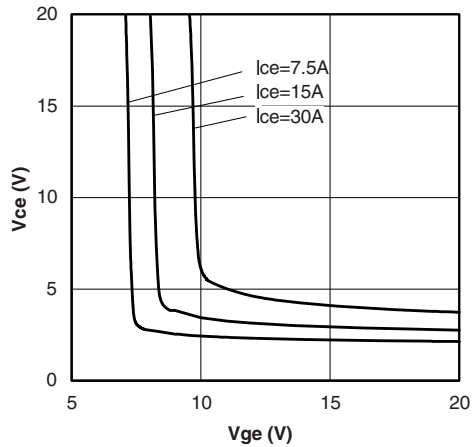


Fig. 4 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

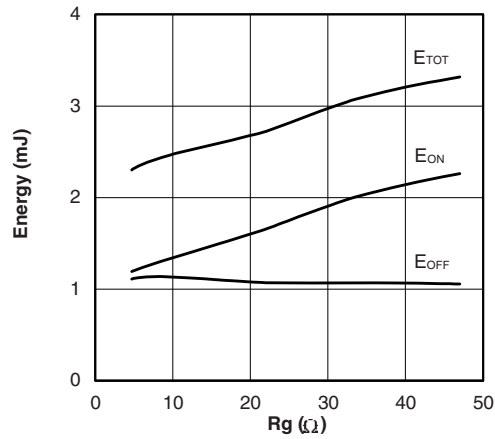


Fig. 7 - Typical Energy Loss vs. R_g
 $T_J = 125^\circ\text{C}$, $L = 500\ \mu\text{H}$, $V_{CE} = 600\ \text{V}$
 $I_C = 15\ \text{A}$; $V_{GE} = 15\ \text{V}$

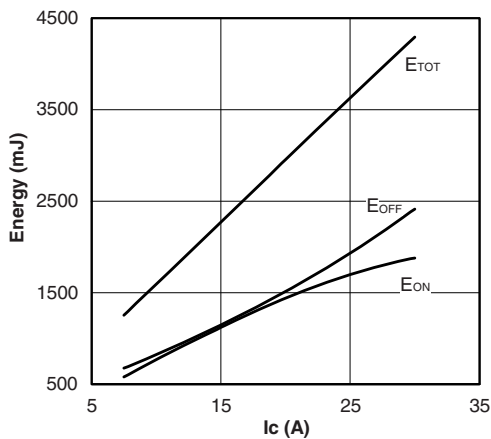


Fig. 5 - Typical Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$, $L = 500\ \mu\text{H}$, $V_{CE} = 600\ \text{V}$
 $R_g = 10\ \Omega$; $V_{GE} = 15\ \text{V}$

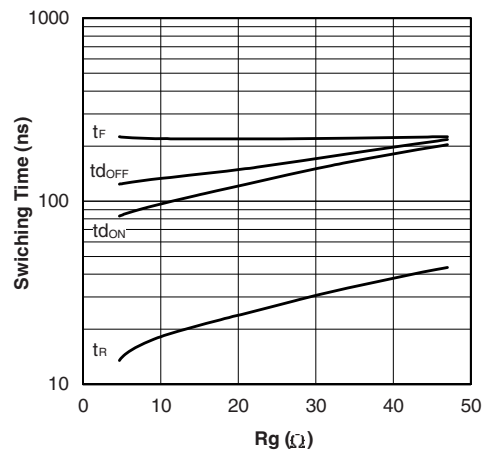


Fig. 8 - Typical Switching Time vs. R_g
 $T_J = 125^\circ\text{C}$, $L = 500\ \mu\text{H}$, $V_{CE} = 600\ \text{V}$
 $I_C = 15\ \text{A}$; $V_{GE} = 15\ \text{V}$

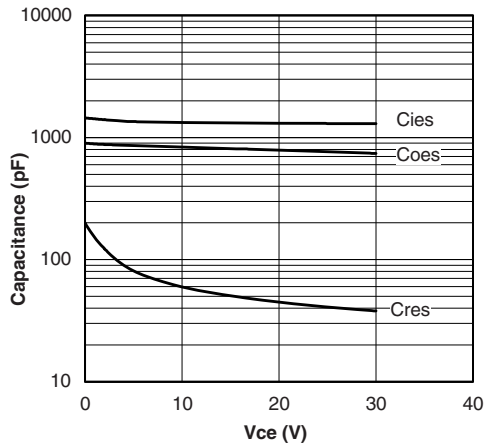


Fig. 9 - Typical Capacitance vs. V_{CE}
 $V_{GE} = 0\text{ V}$; $f = 1\text{ MHz}$

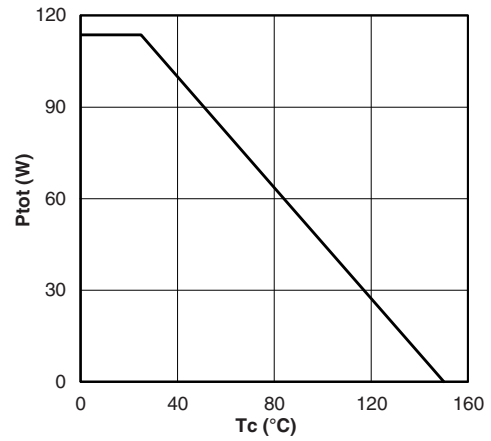


Fig. 12 - Power Dissipation vs. Case Temperature
(IGBT only)

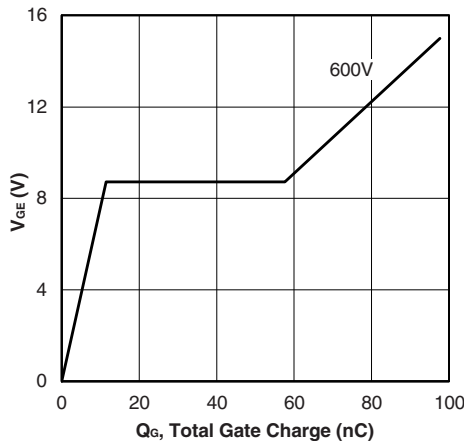


Fig. 10 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 15\text{ A}$

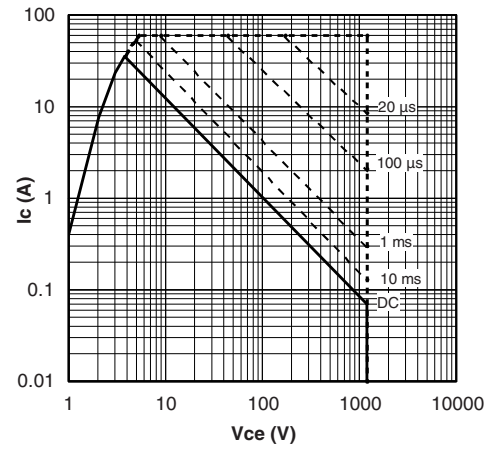


Fig. 13 - Forward SOA
 $T_C = 25\text{ °C}$, $T_J \leq 150\text{ °C}$

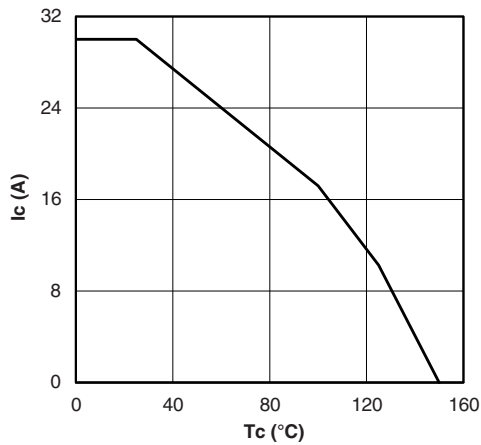


Fig. 11 - Maximum DC Collector Current vs. Case Temperature

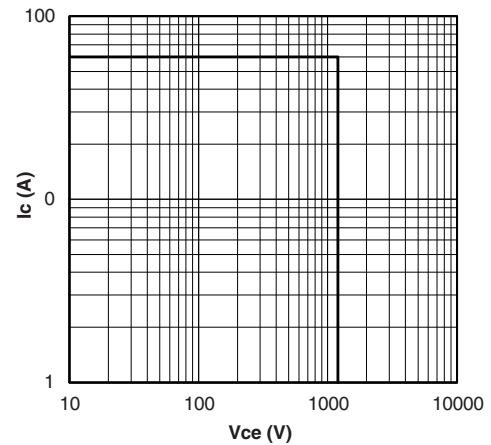


Fig. 14 - Reverse BIAS SOA
 $T_J = 150\text{ °C}$, $V_{GE} = 15\text{ V}$

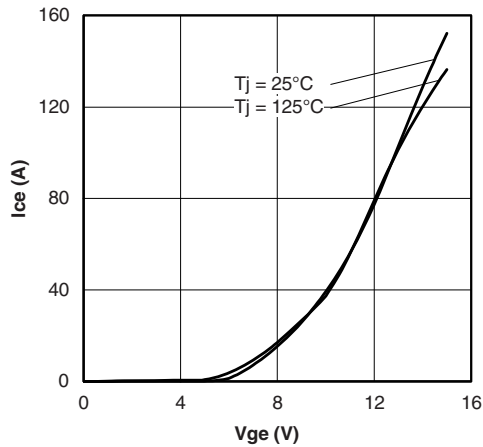


Fig. 15 - Typical Transfer Characteristics
 $V_{CE} = 50 \text{ V}$; $t_p = 10 \mu\text{s}$

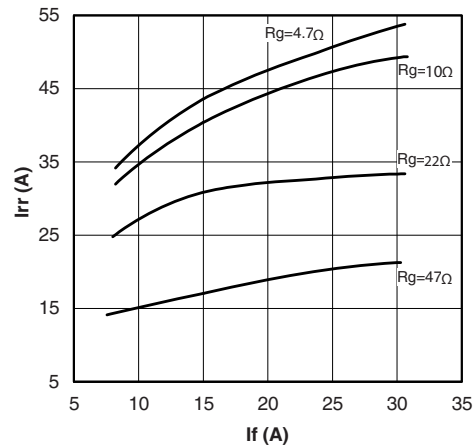


Fig. 17 - Typical Diode I_{rr} vs. I_F
 $T_J = 125^\circ\text{C}$

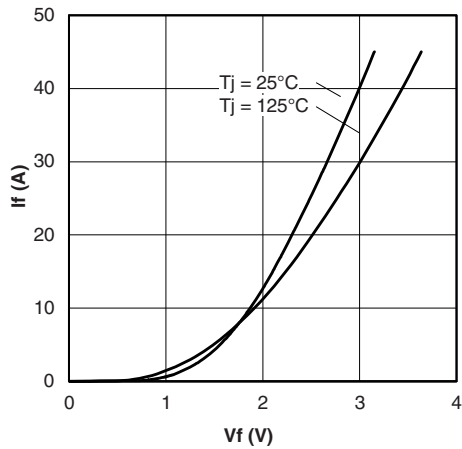


Fig. 16 - Typical Diode Forward Characteristics
 $t_p = 80 \mu\text{s}$

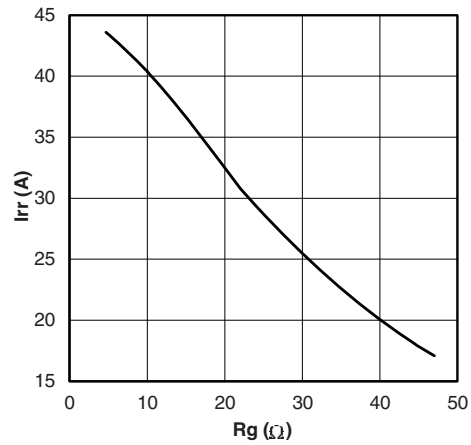


Fig. 18 - Typical Diode I_{rr} vs. R_g
 $T_J = 125^\circ\text{C}$; $I_F = 10 \text{ A}$

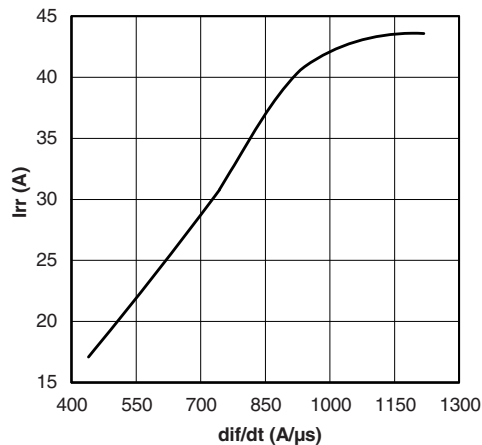


Fig. 19 - Typical Diode I_{rr} vs. dI_F/dt ; $V_{CC} = 600 \text{ V}$;
 $V_{GE} = 15 \text{ V}$; $I_{CE} = 10 \text{ A}$, $T_J = 125^\circ\text{C}$



Three Phase Inverter Module in MTP Package Vishay Semiconductors
 1200 V NPT IGBT and HEXFRED® Diodes, 15 A

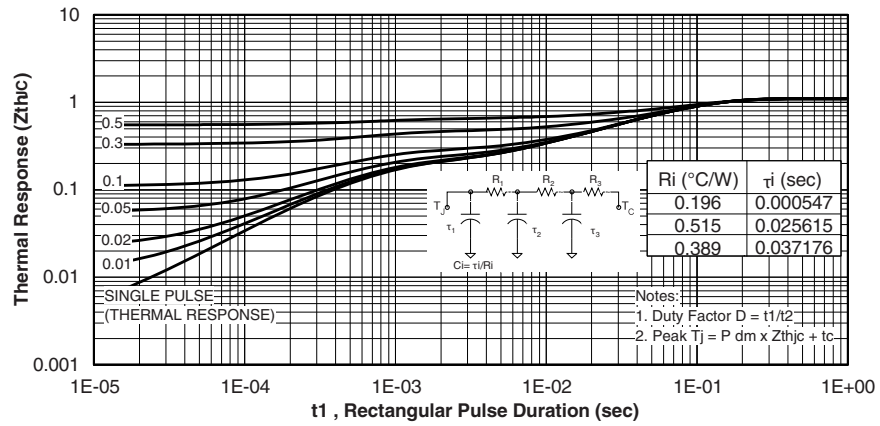


Fig. 20 - Maximum Transient Thermal Impedance, Junction to Case (IGBT)

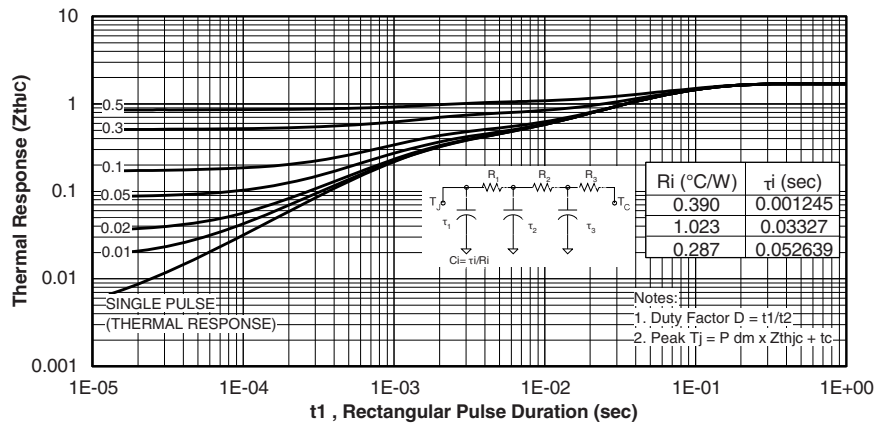


Fig. 21 - Maximum Transient Thermal Impedance, Junction to Case (Diode)

GB15XP120KTPbF



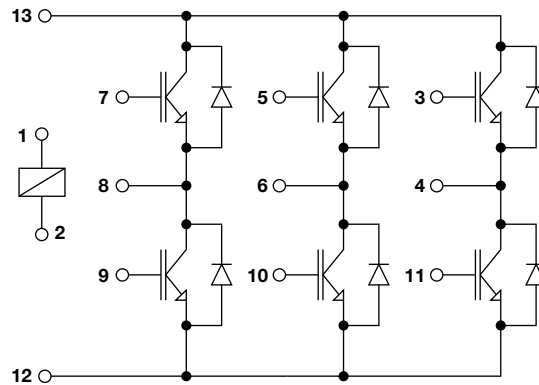
Vishay Semiconductors Three Phase Inverter Module in MTP Package
1200 V NPT IGBT and HEXFRED® Diodes, 15 A

ORDERING INFORMATION TABLE

| | | | | | | | |
|-------------|-----------|-----------|-----------|------------|----------|----------|------------|
| Device code | GB | 15 | XP | 120 | K | T | PbF |
| | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ |

- 1** - IGBT module
- 2** - Nominal current rating (15 = 15 A)
- 3** - Circuit configuration (XP = Three phase inverter)
- 4** - Voltage code (120 = 1200 V)
- 5** - Speed/type (K = Ultrafast IGBT/inverter motor drive application)
- 6** - Special option:
 - None = No special option
 - T = Thermistor
- 7** - PbF = Lead (Pb)-free

CIRCUIT CONFIGURATION

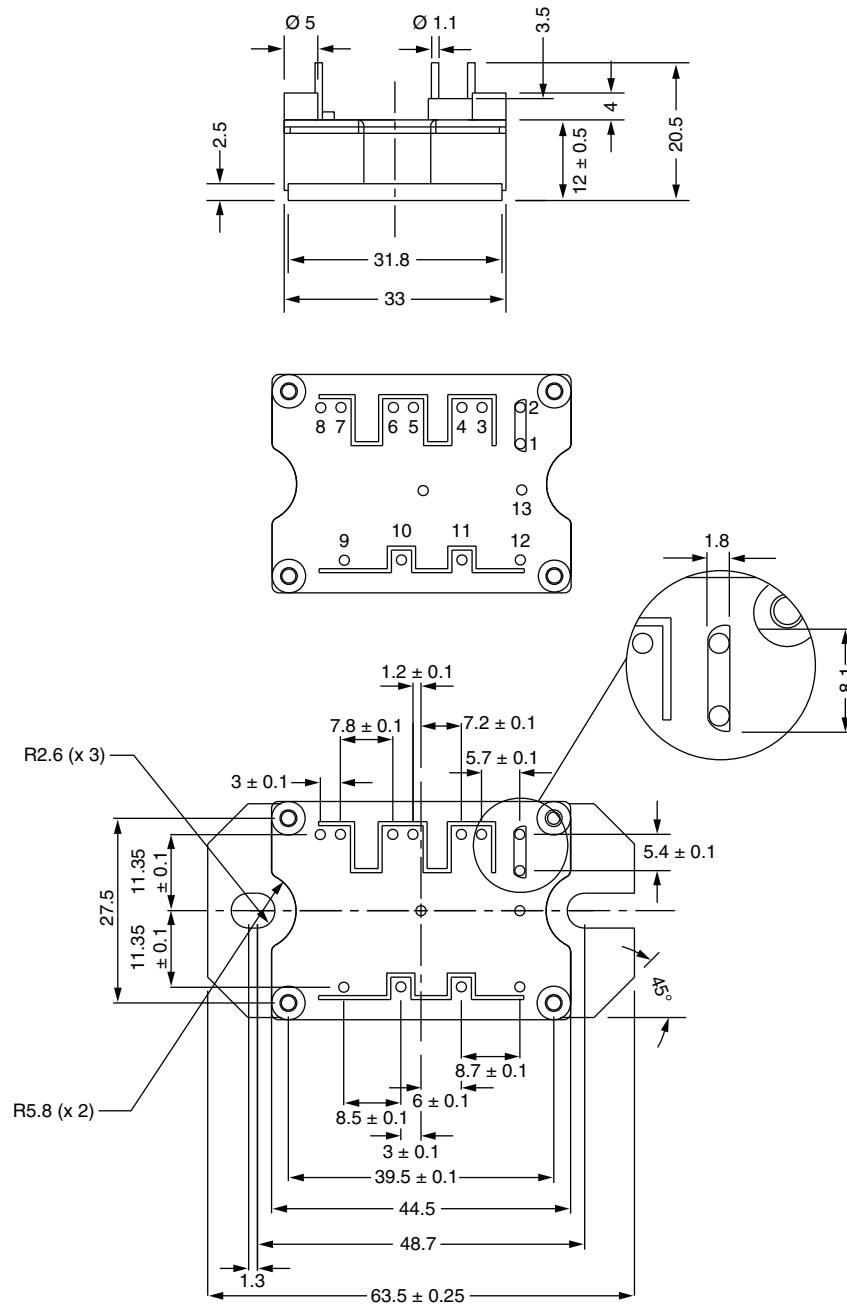


LINKS TO RELATED DOCUMENTS

| | |
|------------|--|
| Dimensions | www.vishay.com/doc?95175 |
|------------|--|

MTP

DIMENSIONS in millimeters



Note

- Unused terminals are not assembled in the package



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