# "Half-Bridge" IGBT INT-A-PAK (Ultrafast Speed IGBT), 200 A

INT-A-PAK

| PRODUCT SUMMARY | |
|---|---|
| $V_{CES}$ | 600 V |
| $I_C$ DC | 265 A |
| $V_{CE(on)}$ at 200 A, 25 °C | 1.74 V |

## FEATURES

- Generation 4 IGBT technology
- Ultrafast: Optimized for high speed 8 kHz to 40 kHz in hard switching, > 200 kHz in resonant mode
- Very low conduction and switching losses
- HEXFRED® antiparallel diodes with ultrasoft recovery
- Industry standard package
- UL approved file E78996
- Compliant to RoHS directive 2002/95/EC
- Designed and qualified for industrial level

Pb-free
RoHS COMPLIANT

## BENEFITS

- Increased operating efficiency
- Direct mounting to heatsink
- Performance optimized for power conversion: UPS, SMPS, welding
- Low EMI, requires less snubbing

**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 | 265 | A |
| | | $T_C$ = 67 °C | 200 | |
| Pulsed collector current | $I_{CM}$ | | 400 | |
| Peak switching current | $I_{LM}$ | | 400 | |
| Peak diode forward current | $I_{FM}$ | | 400 | |
| Gate to emitter voltage | $V_{GE}$ | | ± 20 | V |
| RMS isolation voltage | $V_{ISOL}$ | Any terminal to case, t = 1 min | 2500 | |
| Maximum power dissipation | $P_D$ | $T_C$ = 25 °C | 625 | W |
| | | $T_C$ = 85 °C | 325 | |

**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, $I_C$ = 1 mA | 600 | - | - | V |
| Collector to emitter voltage | $V_{CE(on)}$ | $V_{GE}$ = 15 V, $I_C$ = 200 A | - | 1.74 | 2.2 | |
| | | $V_{GE}$ = 15 V, $I_C$ = 200 A, $T_J$ = 125 °C | - | 1.79 | 2.25 | |
| Gate threshold voltage | $V_{GE(th)}$ | $I_C$ = 0.25 mA | 3 | 4.4 | 6 | |
| Temperature coeff. of threshold voltage | $\Delta V_{GE(th)}/\Delta T_J$ | $V_{CE}$ = $V_{GE}$, $I_C$ = 0.25 mA | - | - 11 | - | mV/°C |
| Forward transconductance | $g_{fe}$ | $V_{CE}$ = 20 V, $I_C$ = 200 A | - | 220 | - | S |
| Collector to emitter leakage current | $I_{CES}$ | $V_{GE}$ = 0 V, $V_{CE}$ = 600 V | - | 0.014 | 1 | mA |
| | | $V_{GE}$ = 0 V, $V_{CE}$ = 600 V, $T_J$ = 125 °C | - | - | 10 | |
| Diode forward voltage drop | $V_{FM}$ | $I_C$ = 200 A, $V_{GE}$ = 0 V | - | 4.2 | 6.0 | V |
| | | $I_C$ = 200 A, $V_{GE}$ = 0 V, $T_J$ = 125 °C | - | 4.4 | 6.2 | |
| 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 | $Q_g$ | $I_C$ = 200 A<br>$I_C$ = 270 A<br>$V_{GE}$ = 15 V | - | 900 | - | nC |
| Gate to emitter charge | $Q_{ge}$ | | - | 125 | - | |
| Gate to collector charge | $Q_{gc}$ | | - | 306 | - | |
| Turn-on delay time | $t_{d(on)}$ | $I_C$ = 200 A<br>$V_{CC}$ = 360 V<br>$V_{GE}$ = ± 15 V<br>$T_J$ = 25 °C<br>$R_{g1}$ = 15 Ω<br>$R_{g2}$ = 0 Ω | - | 220 | - | ns |
| Rise time | $t_r$ | | - | 154 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 300 | - | |
| Fall time | $t_f$ | | - | 180 | - | |
| Turn-on switching energy | $E_{on}$ | | - | 2.2 | - | mJ |
| Turn-off switching energy | $E_{off}$ | | - | 6.6 | - | |
| Total switching energy | $E_{ts}$ | | - | 8.8 | - | |
| Turn-on delay time | $t_{d(on)}$ | $I_C$ = 200 A<br>$V_{CC}$ = 360 V<br>$V_{GE}$ = ± 15 V<br>$T_J$ = 125 °C<br>$R_{g1}$ = 15 Ω<br>$R_{g2}$ = 0 Ω | - | 342 | - | ns |
| Rise time | $t_r$ | | - | 194 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 366 | - | |
| Fall time | $t_f$ | | - | 213 | - | |
| Turn-on switching energy | $E_{on}$ | | - | 5 | - | mJ |
| Turn-off switching energy | $E_{off}$ | | - | 16 | - | |
| Total switching energy | $E_{ts}$ | | - | 21 | - | |
| Input capacitance | $C_{ies}$ | $V_{GE}$ = 0 V<br>$V_{CC}$ = 30 V<br>f = 1.0 MHz | - | 20 068 | - | pF |
| Output capacitance | $C_{oes}$ | | - | 1254 | - | |
| Reverse transfer capacitance | $C_{res}$ | | - | 261 | - | |
| Diode reverse recovery time | $t_{rr}$ | $I_C$ = 200 A<br>$V_{CC}$ = 360 V<br>dI/dt = 1300 A/µs | - | 179 | - | ns |
| Diode peak reverse current | $I_{rr}$ | | - | 120 | - | A |
| Diode recovery charge | $Q_{rr}$ | | - | 10 714 | - | µC |
| Diode peak rate of fall of recovery during $t_b$ | $dI_{(rec)M}/dt$ | | - | 1922 | - | A/µs |

| **THERMAL AND MECHANICAL SPECIFICATIONS** | | | | | | |
|---|---|---|---|---|---|---|
| **PARAMETER** | | **SYMBOL** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Operating junction temperature range | | $T_J$ | - 40 | - | 150 | °C |
| Storage temperature range | | $T_{Stg}$ | - 40 | - | 125 | |
| Junction to case | IGBT | $R_{thJC}$ | - | - | 0.2 | °C/W |
| | Diode | | - | - | 0.4 | |
| Case to sink per module | | $R_{thCS}$ | - | 0.1 | - | |
| Mounting torque | case to heatsink | | - | - | 4 | Nm |
| | case to terminal 1, 2, 3 | | - | - | 3 | |
| Weight | | | - | 200 | - | g |

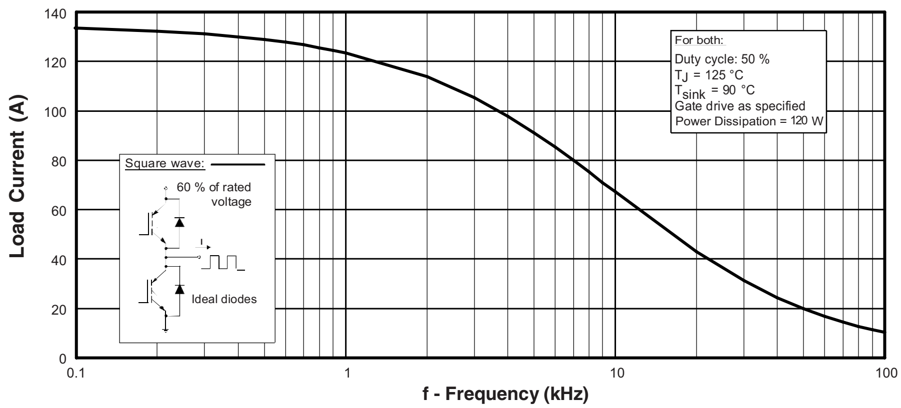



Fig. 1 - Typical Load Current vs. Frequency
(Load Current = $I_{RMS}$ of Fundamental)

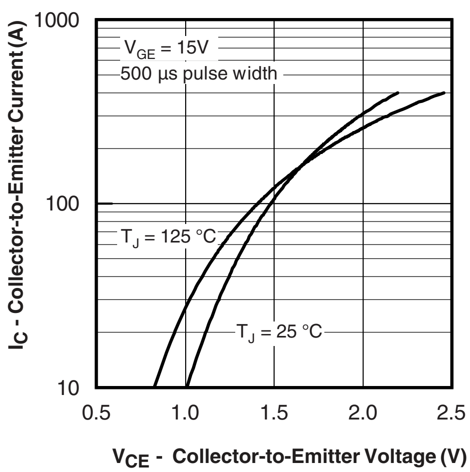



Fig. 2 - Typical Output Characteristics

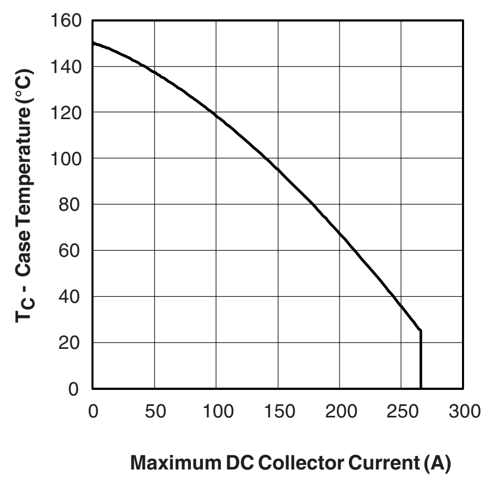



Fig. 4 - Case Temperature vs. Maximum Collector Current

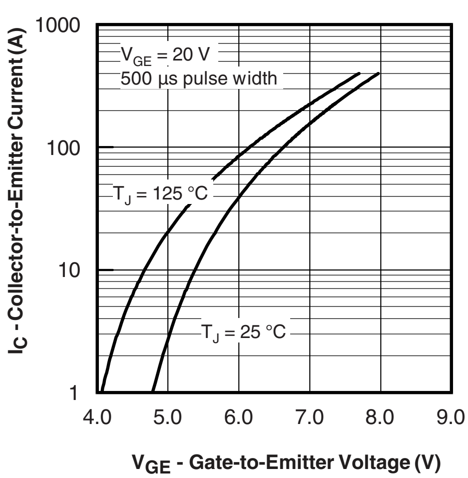



Fig. 3 - Typical Transfer Characteristics

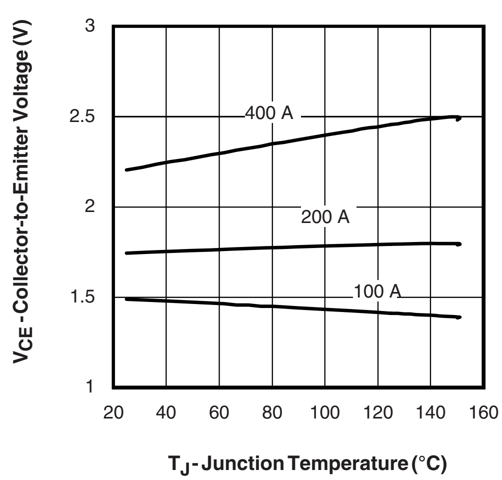



Fig. 5 - Typical Collector to Emitter Voltage vs. Junction Temperature

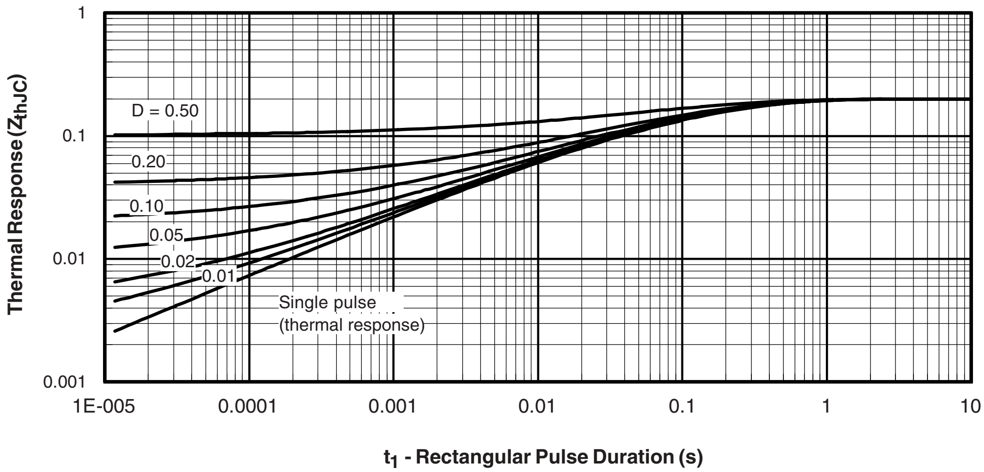



Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction to Case

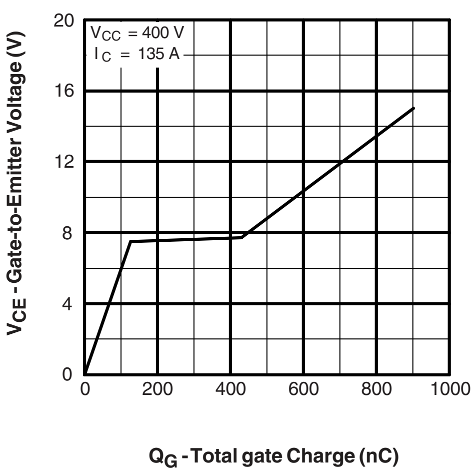



Fig. 7 - Typical Gate Charge vs. Gate to Emitter Voltage

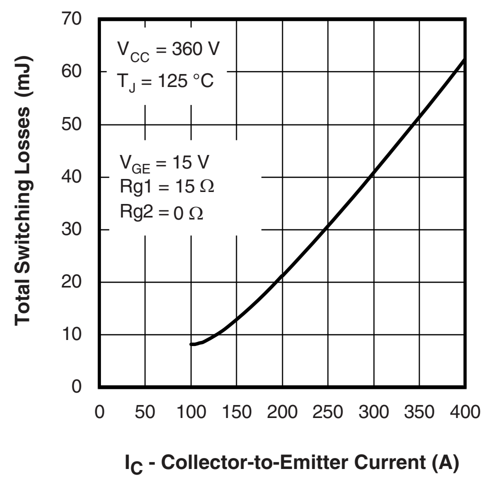



Fig. 9 - Typical Switching Losses vs. Collector to Emitter Current

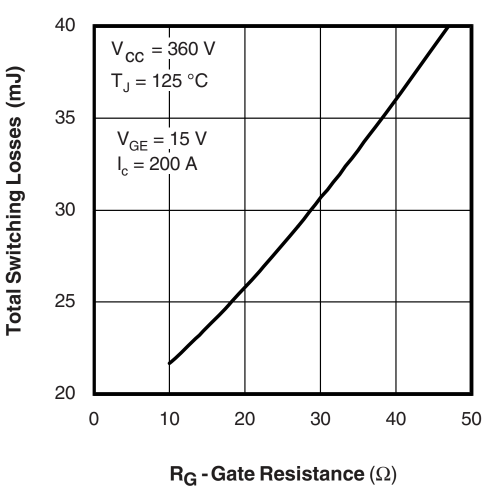



Fig. 8 - Typical Switching Losses vs. Gate Resistance

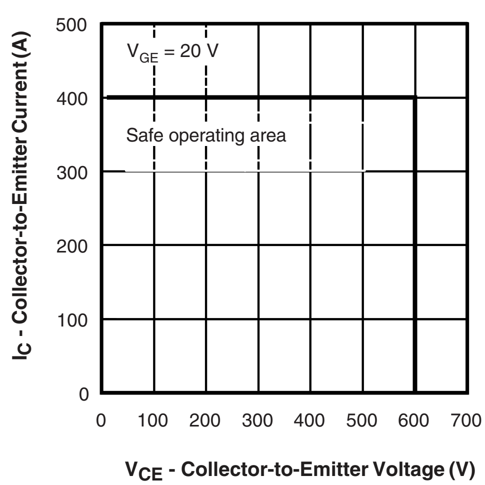



Fig. 10 - Reverse Bias SOA

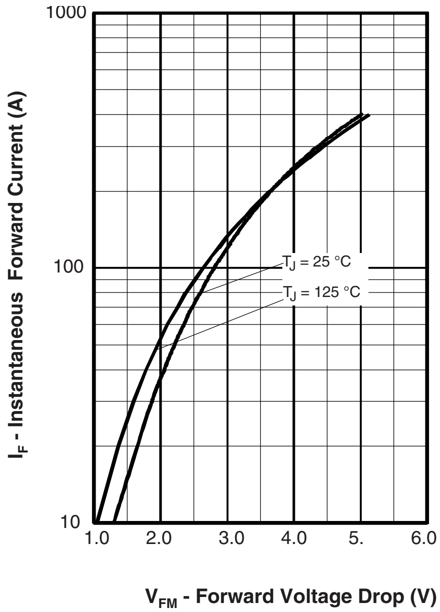



Fig. 11 - Typical Forward Voltage Drop vs. Instantaneous Forward Current

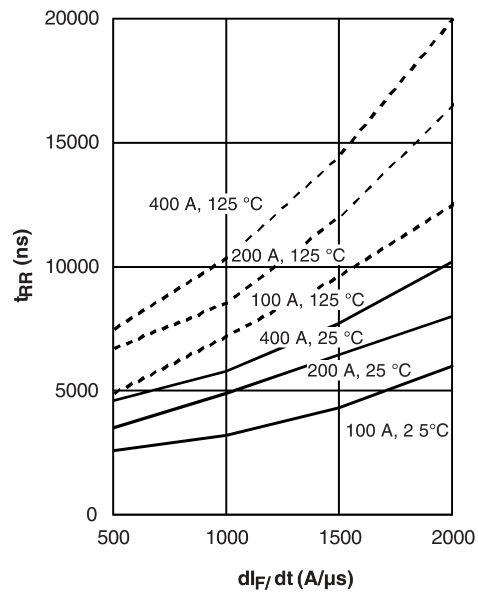



Fig. 13 - Typical Reverse Recovery Time vs. $dI_F/dt$

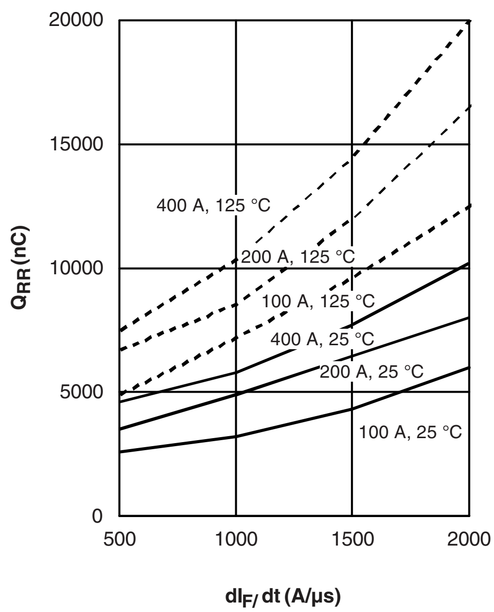



Fig. 12 - Typical Stored Charge vs. $dI_F/dt$

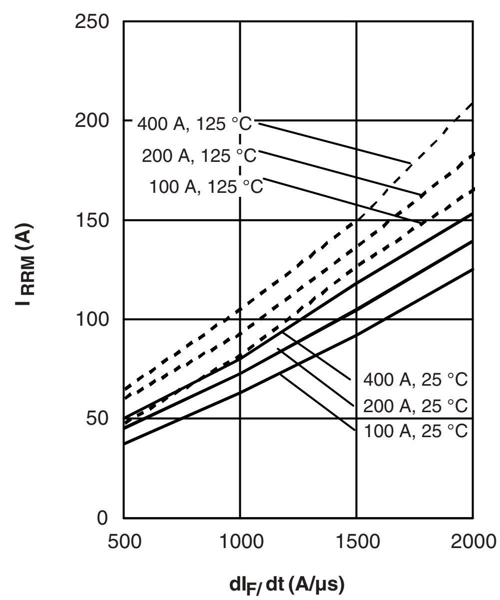



Fig. 14 - Typical Reverse Recovery vs. $dI_F/dt$

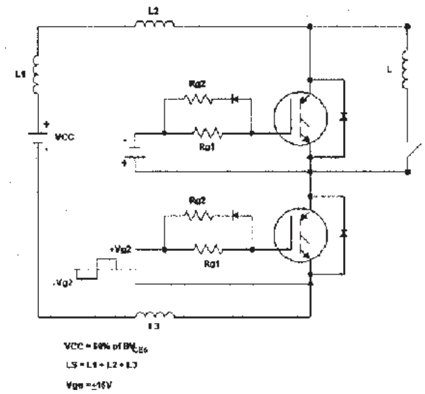



Fig. 15a - Test Circuit for Measurement of $I_{LM}$, $E_{on}$, $E_{off(diode)}$, $t_{rr}$, $Q_{rr}$, $I_{rr}$, $t_{d(on)}$, $t_r$, $t_{d(off)}$, $t_f$

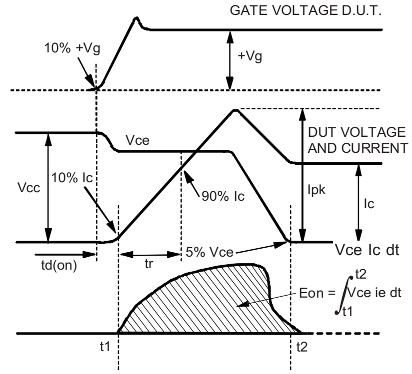



Fig. 15c - Test Waveforms for Circuit of Fig. 18a, Defining $E_{on}$, $t_{d(on)}$, $t_r$

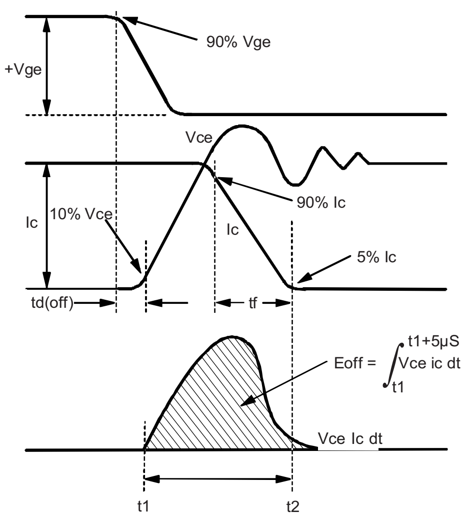



Fig. 15b - Test Waveforms for Circuit of Fig. 18a, Defining $E_{off}$, $t_{d(off)}$, $t_f$

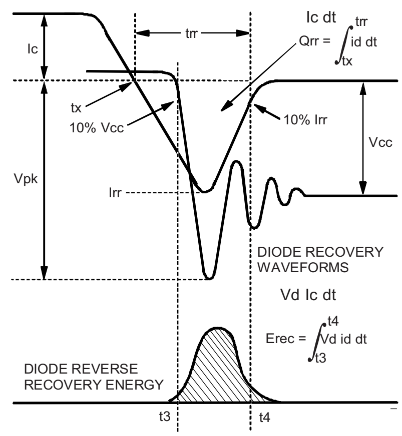



Fig. 15d - Test Waveforms for Circuit of Fig. 18a, Defining $E_{rec}$, $t_{rr}$, $Q_{rr}$, $I_{rr}$

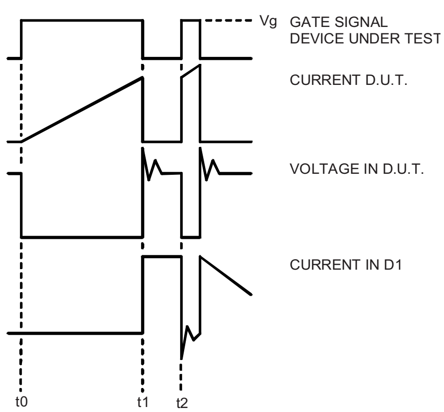



Fig. 15e - Macro Waveforms for Figure 18a's Test Circuit

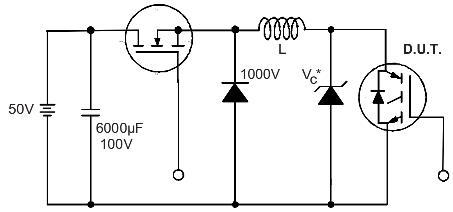



Fig. 16 - Clamped Inductive Load Test Circuit

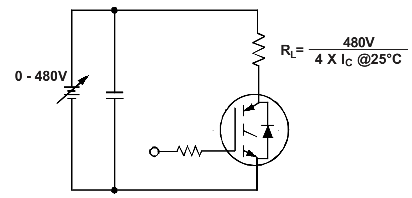


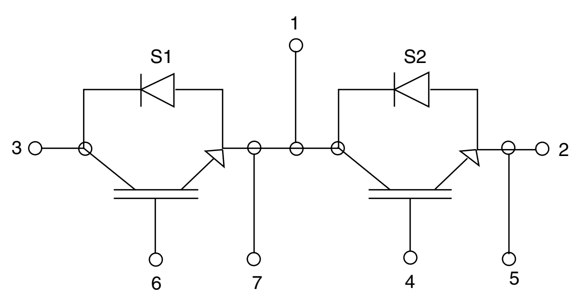

Fig. 17 - Pulsed Collector Current Test Circuit

## ORDERING INFORMATION TABLE

| Device code | GA | 200 | T | S | 60 | U | PbF |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

1 - Essential part number IGBT modules
2 - Current rating (200 = 200 A)
3 - Circuit configuration (T = Half bridge)
4 - INT-A-PAK
5 - Voltage code (60 = 600 V)
6 - Speed/type (U = Ultrafast IGBT)
7 - PbF = Lead (Pb)-free

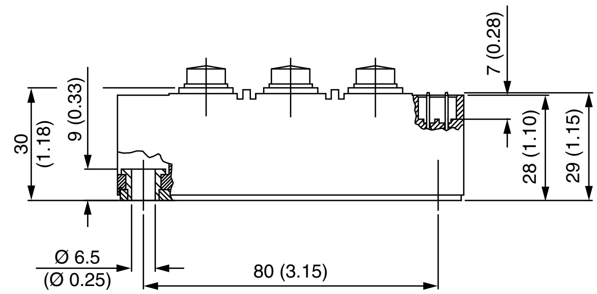
## CIRCUIT CONFIGURATION

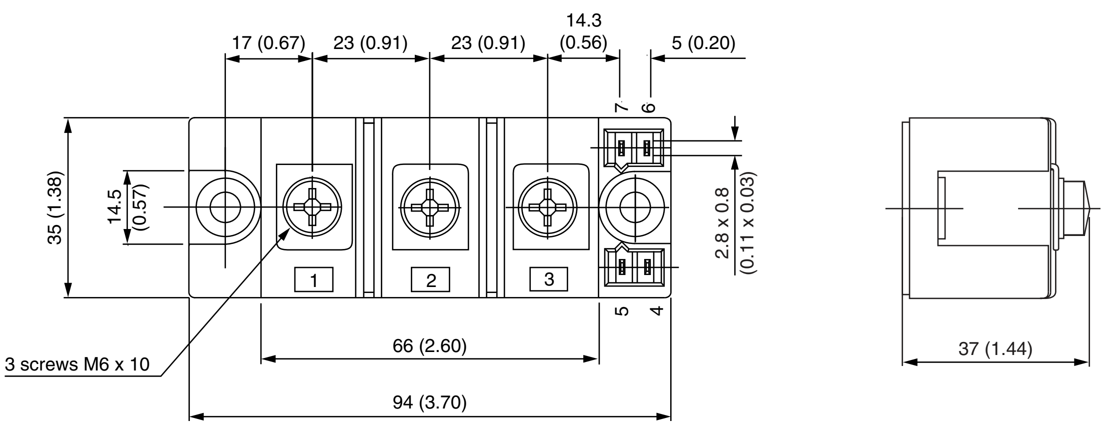



| LINKS TO RELATED DOCUMENTS | |
|---|---|
| Dimensions | www.vishay.com/doc?95173 |

# INT-A-PAK IGBT

**DIMENSIONS** in millimeters (inches)



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