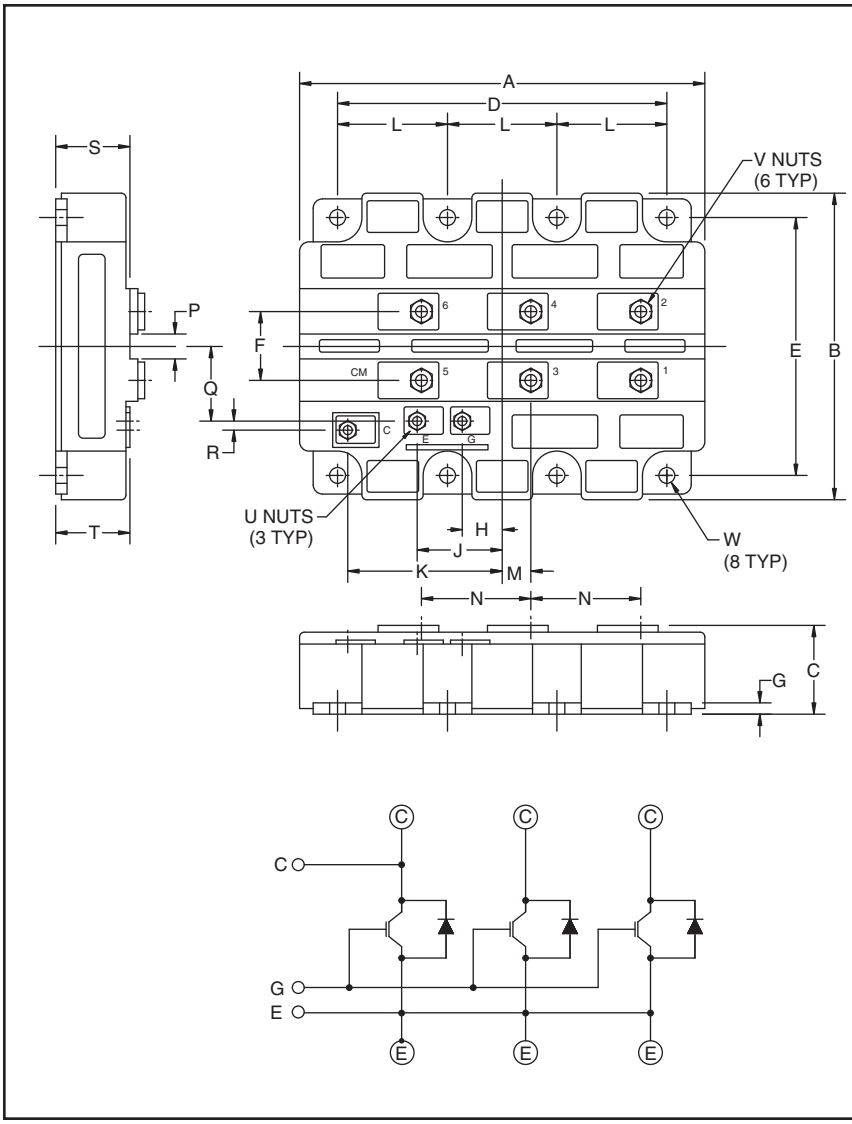
Powerex, Inc., 173 Pavilion Lane, Youngwood, Pennsylvania 15697 (724) 925-7272

# CM1500HC-66R

## Single IGBTMOD™ HVIGBT Module
### 1500 Amperes/3300 Volts




**Outline Drawing and Circuit Diagram**

| Dimensions | Inches | Millimeters |
|---|---|---|
| A | 7.48±0.02 | 190.0±0.5 |
| B | 5.51±0.02 | 140.0±0.5 |
| C | 1.50+0.04/-0.0 | 38.0+1.0/-0.0 |
| D | 6.73 | 171.0 |
| E | 4.88±0.01 | 124.0±0.25 |
| F | 1.57±0.012 | 40.0±0.3 |
| G | 0.20±0.012 | 5.0±0.3 |
| H | 0.80±0.012 | 20.25±0.3 |
| J | 1.62±0.012 | 41.25±0.3 |
| K | 3.13±0.012 | 79.4±0.3 |
| L | 2.24±0.01 | 57.0±0.25 |

| Dimensions | Inches | Millimeters |
|---|---|---|
| M | 0.51±0.012 | 13.0±0.3 |
| N | 2.42±0.012 | 61.5±0.3 |
| P | 0.59±0.012 | 15.0±0.3 |
| Q | 1.57±0.012 | 40.0±0.3 |
| R | 0.20±0.012 | 5.2±0.3 |
| S | 1.16±0.02 | 29.5±0.5 |
| T | 1.10±0.02 | 28.0±0.5 |
| U | M4 Metric | M4 |
| V | M8 Metric | M8 |
| W | 0.28 Dia. | Dia. 7.0 |

**Description:**

Powerex IGBTMOD™ Modules are designed for use in switching applications. Each module consists of an IGBT Transistor and a reverse-connected super-fast recovery free-wheel diode. All components and interconnects are isolated from the heat sinking baseplate, offering simplified system assembly and thermal management.

**Features:**

- ☐ Low Drive Power
- ☐ Low $V_{CE(sat)}$
- ☐ Super-Fast Recovery Free-Wheel Diode
- ☐ Isolated Baseplate for Easy Heat Sinking

**Applications:**

- ☐ Traction
- ☐ Pulsed Power
- ☐ Renewable Energy
- ☐ Medium Voltage Drives
- ☐ High Voltage Power Supplies

**Ordering Information:**

Example: Select the complete part module number you desire from the table below -i.e. CM1500HB-66R is a 3300V ($V_{CES}$), 1500 Ampere Single IGBTMOD™ Power Module.

| Type | Current Rating Amperes | $V_{CES}$ Volts (x 50) |
|---|---|---|
| CM | 1500 | 66 |

***CM1500HC-66R***
***Single IGBTMOD™ HVIGBT Module***
*1500 Amperes/3300 Volts*

## Absolute Maximum Ratings, $T_j$ = 25 °C unless otherwise specified

| Ratings | Symbol | CM1500HC-66R | Units |
|---|---|---|---|
| Junction Temperature | $T_j$ | -40 to 150 | °C |
| Storage Temperature | $T_{stg}$ | -55 to 125 | °C |
| Collector-Emitter Voltage ($V_{GE}$ = 0V, $T_j$ = -40 ~ 125°C) | $V_{CES}$ | 3300 | Volts |
| Gate-Emitter Voltage ($V_{CE}$ = 0V) | $V_{GES}$ | ±20 | Volts |
| Collector Current (DC, $T_c$ = 100°C) | $I_C$ | 1500 | Amperes |
| Peak Collector Current (Pulse) | $I_{CM}$ | 3000* | Amperes |
| Diode Forward Current** ($T_c$ = 25°C) | $I_E$ | 1500 | Amperes |
| Diode Forward Surge Current** (Pulse) | $I_{EM}$ | 3000* | Amperes |
| Maximum Short Circuit Pulse Width ($V_{CC}$ = 2500V, $V_{CE} \leq V_{CES}$, $V_{GE}$ = 15V, $T_j$ = 150°C) | $t_{psc}$ | 10 | μs |
| Maximum Collector Dissipation ($T_c$ = 25°C, $T_j \leq$ 150°C) | $P_C$ | 15600 | Watts |
| Max. Mounting Torque M8 Terminal Screws | – | 195 | in-lb |
| Max. Mounting Torque M6 Mounting Screws | – | 53 | in-lb |
| Max. Mounting Torque M4 Auxiliary Terminal Screws | – | 27 | in-lb |
| Module Weight (Typical) | – | 1.2 | kg |
| V Isolation (Charged Part to Baseplate, AC 60Hz 1 min.) | $V_{iso}$ | 6000 | Volts |

* Pulse width and repetition rate should be such that device junction temperature ($T_j$) does not exceed $T_{op(max)}$ rating (150°C).
**Represents characteristics of the anti-parallel, emitter-to-collector free-wheel diode (FWDi).

## Static Electrical Characteristics, $T_j$ = 25 °C unless otherwise specified

| Characteristics | | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| Collector-Cutoff Current | | $I_{CES}$ | $V_{CE} = V_{CES}$, $V_{GE}$ = 0V, $T_j$ = 25°C | – | – | 5.0 | mA |
| | | | $V_{CE} = V_{CES}$, $V_{GE}$ = 0V, $T_j$ = 125°C | – | 5.0 | – | mA |
| | | | $V_{CE} = V_{CES}$, $V_{GE}$ = 0V, $T_j$ = 150°C | – | 18.0 | – | mA |
| Gate-Emitter Threshold Voltage | | $V_{GE(th)}$ | $I_C$ = 150mA, $V_{CE}$ = 10V | 5.5 | 6.0 | 6.5 | Volts |
| Gate Leakage Current | | $I_{GES}$ | $V_{GE} = V_{GES}$, $V_{CE}$ = 0V | -0.5 | – | 0.5 | μA |
| Input Capacitance | | $C_{ies}$ | $V_{GE}$ = 0V, $V_{CE}$ = 10V, f = 100 kHz | – | 210.0 | – | nF |
| Output Capacitance | | $C_{oes}$ | | – | 13.0 | – | nF |
| Reverse Transfer Capacitance | | $C_{res}$ | | – | 6.0 | – | nF |
| Total Gate Charge | | $Q_G$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, $V_{GE}$ = ±15V | – | 16.0 | – | μC |
| Internal Gate Resistor | | $r_G$ | | – | 1.5 | – | Ω |
| Collector-Emitter Saturation Voltage | | $V_{CE(sat)}$* | $I_C$ = 1500A, $V_{GE}$ = 15V, $T_j$ = 25°C | – | 2.5 | – | Volts |
| | | | $I_C$ = 1500A, $V_{GE}$ = 15V, $T_j$ = 125°C | – | 3.0 | – | Volts |
| | | | $I_C$ = 1500A, $V_{GE}$ = 15V, $T_j$ = 150°C | – | 3.10 | – | Volts |
| Emitter-Collector Voltage** | | $V_{EC}$* | $I_E$ = 1500A, $V_{GE}$ = 0V, $T_j$ = 25°C | – | 2.15 | – | Volts |
| | | | $I_E$ = 1500A, $V_{GE}$ = 0V, $T_j$ = 125°C | – | 2.30 | – | Volts |
| | | | $I_E$ = 1500A, $V_{GE}$ = 0V, $T_j$ = 150°C | – | 2.25 | – | Volts |
| Resistive | Turn-on Delay Time | $t_{d(on)}$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, | – | 1.0 | – | μs |
| Load | Turn-on Rise Time | $t_r$ | $V_{GE}$ = ±15V, $R_{G(on)}$ = 1.6Ω, | – | 0.25 | – | μs |
| Switching | Turn-on Switching Energy | $E_{on(10\%)}$ | $T_j$ = 25°C, $L_s$ = 100nH | – | 2.1 | – | J/Pulse |
| Times | Turn-on Switching Energy | $E_{on}$ | | – | 2.4 | – | J/Pulse |
| Resistive | Turn-off Delay Time | $t_{d(off)}$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, | – | 2.7 | – | μs |
| Load | Turn-off Fall Time | $t_f$ | $V_{GE}$ = 15V, $R_{G(off)}$ = 5.6Ω, | – | 0.3 | – | μs |
| Switching | Turn-off Switching Energy | $E_{off(10\%)}$ | $T_j$ = 25°C, $L_s$ = 100nH | – | 1.85 | – | J/Pulse |
| Times | Turn-off Switching Energy | $E_{off}$ | | – | 2.05 | – | J/Pulse |
| Reverse Recovery Time | | $t_{rr}$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, $V_{GE}$ = ±15V, $R_{G(on)}$ = 1.6Ω, $T_j$ = 25°C, $L_s$ = 100nH | – | 0.55 | – | μs |
| Reverse Recovery Current | | $I_{rr}$ | | – | 1400 | – | A |
| Reverse Recovery Charge | | $Q_{rr}$ | | – | 1100 | – | μC |
| Reverse Recovery Energy | | $E_{rec(10\%)}$ | | – | 1.15 | – | J/Pulse |
| Reverse Recovery Energy | | $E_{rec}$ | | – | 1.25 | – | J/Pulse |

* Pulse width and repetition rate should be such that device junction temperature rise is negligible.

## Static Electrical Characteristics, $T_j$ = 25 °C unless otherwise specified

| Characteristics | | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| Resistive | Turn-on Delay Time | $t_{d(on)}$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, | – | 1.0 | – | µs |
| Load | Turn-on Rise Time | $t_r$ | $V_{GE}$ = ±15V, $R_{G(on)}$ = 1.6Ω, | – | 0.26 | – | µs |
| Switching | Turn-on Switching Energy | $E_{on(10\%)}$ | $T_j$ = 125°C, $L_s$ = 100nH | – | 2.8 | – | J/Pulse |
| Times | Turn-on Switching Energy | $E_{on}$ | | – | 3.1 | – | J/Pulse |
| Resistive | Turn-off Delay Time | $t_{d(off)}$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, | – | 2.8 | – | µs |
| Load | Turn-off Rise Time | $t_r$ | $V_{GE}$ = ±15V, $R_{G(off)}$ = 5.6Ω, | – | 0.35 | – | µs |
| Switching | Turn-off Switching Energy | $E_{off(10\%)}$ | $T_j$ = 125°C, $L_s$ = 100nH | – | 2.4 | – | J/Pulse |
| Times | Turn-off Switching Energy | $E_{off}$ | | – | 2.7 | – | J/Pulse |
| Reverse Recovery Time | | $t_{rr}$ | | – | 0.75 | – | µs |
| Reverse Recovery Current | | $I_{rr}$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, | – | 1600 | – | A |
| Reverse Recovery Charge | | $Q_{rr}$ | $V_{GE}$ = ±15V, $R_{G(on)}$ = 1.6Ω, | – | 1700 | – | µC |
| Reverse Recovery Energy | | $E_{rec(10\%)}$ | $T_j$ = 125°C, $L_s$ = 100nH | – | 1.85 | – | J/Pulse |
| Reverse Recovery Energy | | $E_{rec}$ | | – | 2.00 | – | J/Pulse |
| Resistive | Turn-on Delay Time | $t_{d(on)}$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, | – | 1.0 | – | µs |
| Load | Turn-on Rise Time | $t_r$ | $V_{GE}$ = ±15V, $R_{G(on)}$ = 1.6Ω, | – | 0.26 | – | µs |
| Switching | Turn-on Switching Energy | $E_{on(10\%)}$ | $T_j$ = 150°C, $L_s$ = 100nH | – | 2.9 | – | J/Pulse |
| Times | Turn-on Switching Energy | $E_{on}$ | | – | 3.5 | – | J/Pulse |
| Resistive | Turn-off Delay Time | $t_{d(off)}$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, | – | 2.9 | – | µs |
| Load | Turn-off Rise Time | $t_r$ | $V_{GE}$ = ±15V, $R_{G(off)}$ = 5.6Ω, | – | 0.4 | – | µs |
| Switching | Turn-off Switching Energy | $E_{off(10\%)}$ | $T_j$ = 150°C, $L_s$ = 100nH | – | 2.65 | – | J/Pulse |
| Times | Turn-off Switching Energy | $E_{off}$ | | – | 3.00 | – | J/Pulse |
| Reverse Recovery Time | | $t_{rr}$ | | – | 0.8 | – | µs |
| Reverse Recovery Current | | $I_{rr}$ | $V_{CC}$ = 1800V, $I_C$ = 1500A, | – | 1600 | – | A |
| Reverse Recovery Charge | | $Q_{rr}$ | $V_{GE}$ = ±15V, $R_{G(on)}$ = 1.6Ω, | – | 2000 | – | µC |
| Reverse Recovery Energy | | $E_{rec(10\%)}$ | $T_j$ = 150°C, $L_s$ = 100nH | – | 2.2 | – | J/Pulse |
| Reverse Recovery Energy | | $E_{rec}$ | | – | 2.4 | – | J/Pulse |

## Thermal and Mechanical Characteristics, $T_j$ = 25 °C unless otherwise specified

| Characteristics | Symbol | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{th(j-c)}$ Q | | – | – | 8.0 | K/W |
| Thermal Resistance, Junction to Case | $R_{th(j-c)}$ D | | – | – | 15.0 | K/W |
| Contact Thermal Resistance, Case to Fin | $R_{th(c-f)}$ | Per Module, Thermal Grease Applied | – | 6.0 | – | K/W |
| Comparative Tracking Index | CTI | | 600 | – | – | |
| Clearance | $D_{cl}$ | | 19.5 | – | – | mm |
| Creepage Distance | $D_{cr}$ | | 32.0 | – | – | mm |
| Internal Inductance | $L_{C-E(int)}$ | | – | 11.0 | – | nH |
| Internal Lead Resistance | $R_{C-E(int)}$ | | – | 0.12 | – | mΩ |

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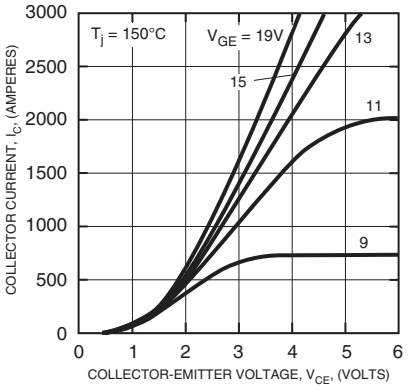
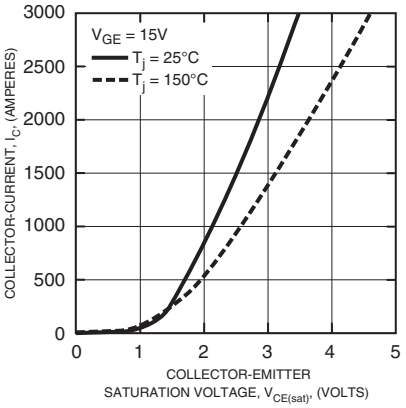
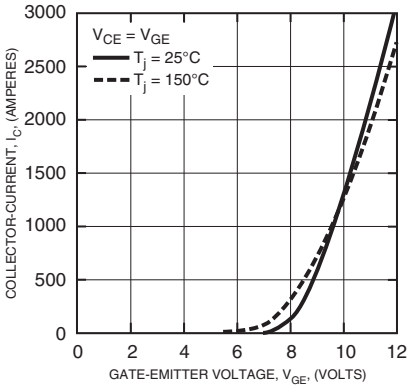
**OUTPUT CHARACTERISTICS (TYPICAL)**



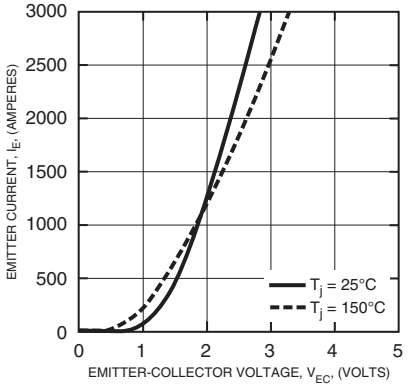

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



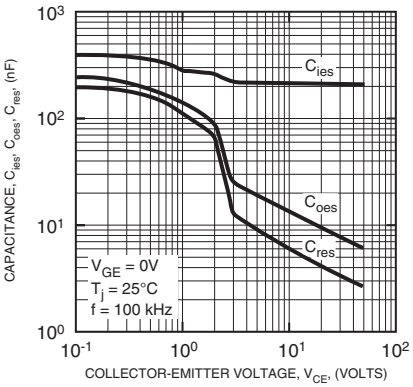

**TRANSFER CHARACTERISTICS (TYPICAL)**



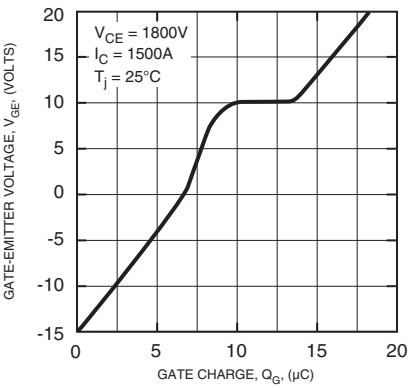

**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**



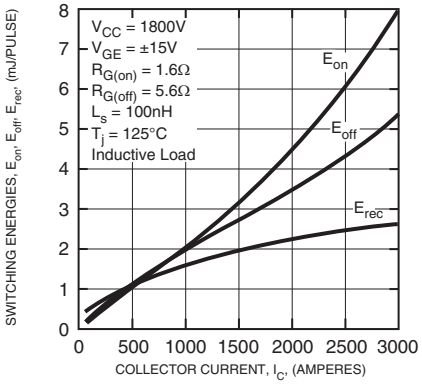

**CAPACITANCE VS. $V_{CE}$ (TYPICAL)**




**GATE CHARGE VS. $V_{GE}$**




**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**

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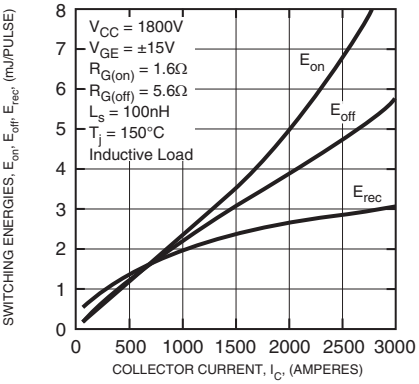
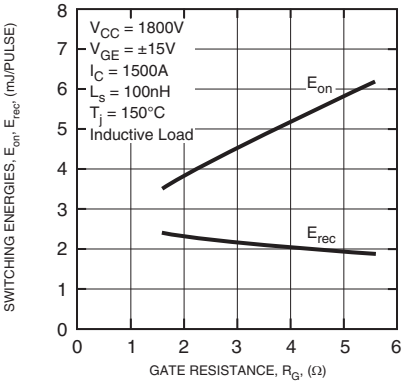



**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**



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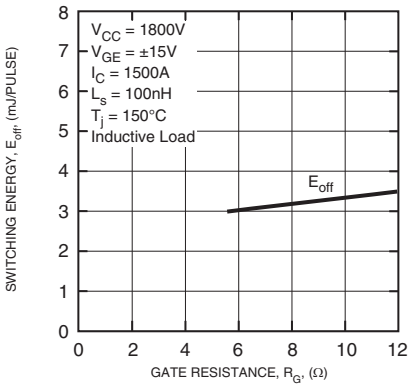
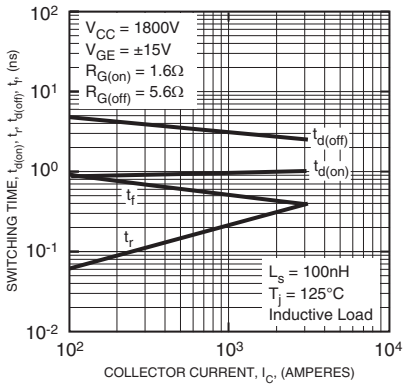
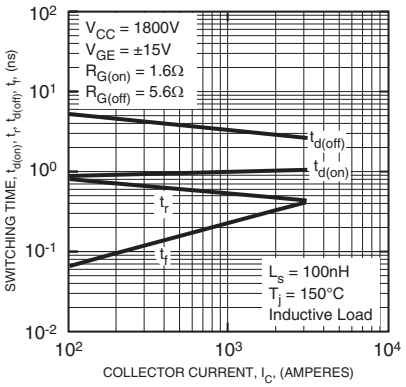
**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**



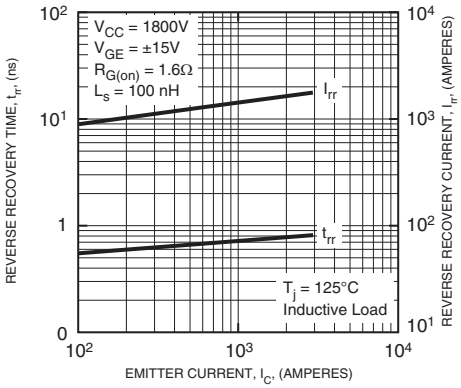

**HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)**




**HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)**




**FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**

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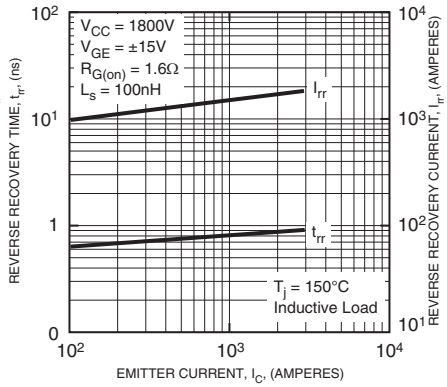
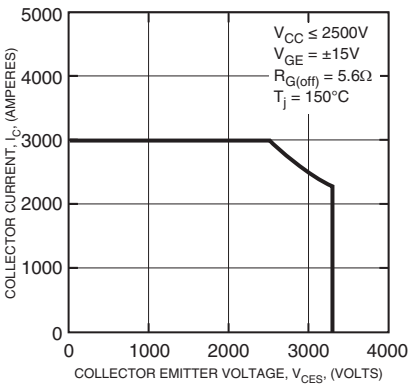
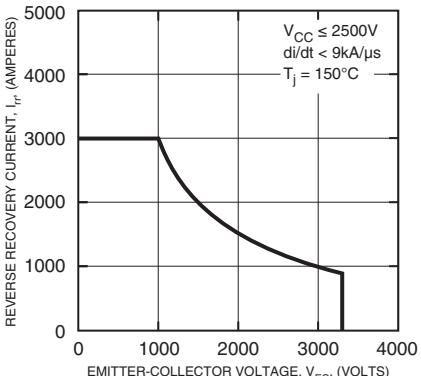


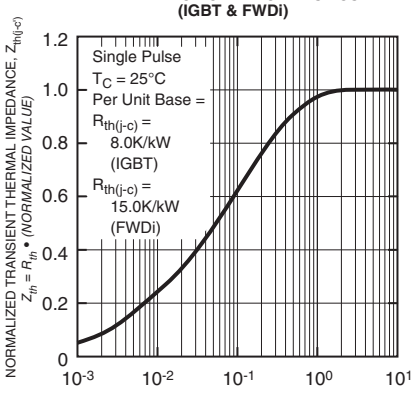

**REVERSE BIAS SAFE OPERATING AREA (TYPICAL)**




**FREE-WHEEL DIODE REVERSE RECOVERY SAFE OPERATING AREA (TYPICAL)**




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT & FWDi)**




$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left(1 - \exp^{\left(-\frac{t}{\tau_i}\right)}\right)$$

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| $R_i$ [K/kW] : | 0.0096 | 0.1893 | 0.4044 | 0.3967 |
| $t_i$ [sec] : | 0.0001 | 0.0058 | 0.0602 | 0.3512 |