**CM500HA-34A**

**Single**

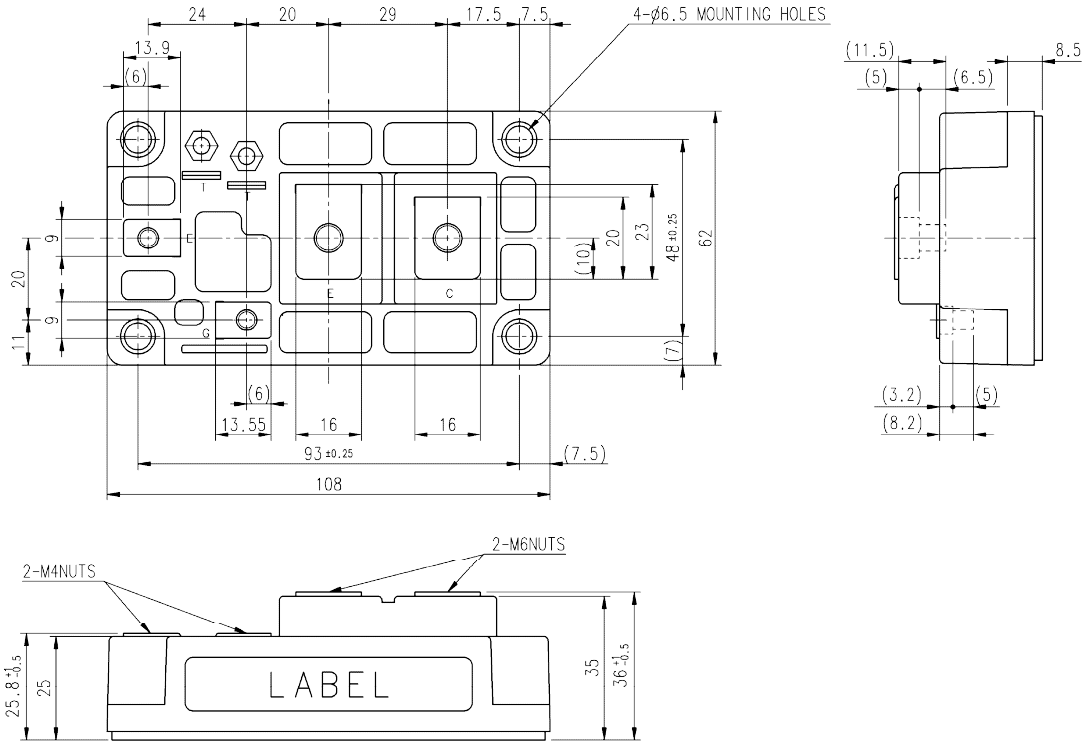
- $I_C$ ..... 500 A
- $V_{CES}$ ..... 1700 V
- Flat base Type
  Copper (non-plating) base plate
  No accessory (terminal screw) attach
- RoHS Directive compliant

## APPLICATION

AC Motor Control, Motion/Servo Control, Power supply, etc.

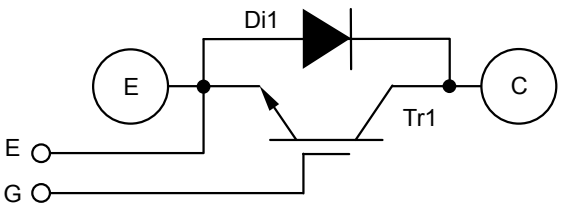
**OUTLINE DRAWING & INTERNAL CONNECTION**

**Dimension in mm**




| Tolerance otherwise specified | |
|---|---|
| Division of Dimension | Tolerance |
| 0.5 to 3 | ±0.2 |
| over 3 to 6 | ±0.3 |
| over 6 to 30 | ±0.5 |
| over 30 to 120 | ±0.8 |
| over 120 to 400 | ±1.2 |

**INTERNAL CONNECTION**



## ABSOLUTE MAXIMUM RATINGS ($T_j$=25 °C, unless otherwise specified)

| Symbol | Item | Conditions | Rating | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage | G-E short-circuited | 1700 | V |
| $V_{GES}$ | Gate-emitter voltage | C-E short-circuited | ±20 | V |
| $I_C$ | Collector current | DC, $T_C$=87 °C (Note.2) | 500 | A |
| $I_{CRM}$ | | Pulse, Repetitive (Note.3) | 1000 | |
| $P_{tot}$ | Total power dissipation | $T_C$=25 °C (Note.2, 4) | 5000 | W |
| $I_E$ (Note.1) | Emitter current (Free wheeling diode forward current) | $T_C$=25 °C (Note.2, 4) | 500 | A |
| $I_{ERM}$ (Note.1) | | Pulse, Repetitive (Note.3) | 1000 | |
| $T_j$ | Junction temperature | - | -40 ~ +150 | °C |
| $T_{stg}$ | Storage temperature | - | -40 ~ +125 | |
| $V_{isol}$ | Isolation voltage | Terminals to base plate, RMS, f=60 Hz, AC 1 min | 3500 | V |

## MECHANICAL CHARACTERISTICS

| Symbol | Item | Conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $M_t$ | Mounting torque | Main terminals M 6 screw | 1.96 | 2.45 | 2.94 | N·m |
| $M_t$ | | Auxiliary terminals M 4 screw | 0.98 | 1.18 | 1.47 | |
| $M_s$ | | Mounting to heat sink M 6 screw | 1.96 | 2.45 | 2.94 | |
| m | Weight | - | - | 480 | - | g |
| $e_c$ | Flatness of base plate | On the centerline X, Y (Note.5) | ±0 | - | +100 | μm |

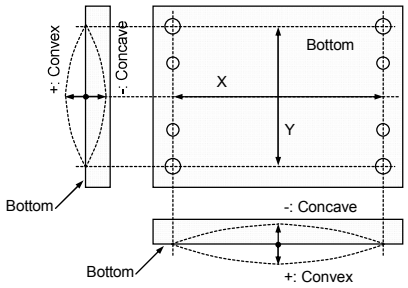
## ELECTRICAL CHARACTERISTICS ($T_j$=25 °C, unless otherwise specified)

| Symbol | Item | Conditions | | Limits | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| $I_{CES}$ | Collector-emitter cut-off current | $V_{CE}$=$V_{CES}$, G-E short-circuited | | - | - | 1 | mA |
| $I_{GES}$ | Gate-emitter leakage current | ±$V_{GE}$=$V_{GES}$, C-E short-circuited | | - | - | 3 | μA |
| $V_{GE(th)}$ | Gate-emitter threshold voltage | $I_C$=50 mA, $V_{CE}$=10 V | | 5.5 | 7 | 8.5 | V |
| $V_{CEsat}$ | Collector-emitter saturation voltage | $I_C$=500 A (Note.6), $V_{GE}$=15 V | $T_j$=25 °C | - | 2.2 | 3.0 | V |
| | | | $T_j$=125 °C | - | 2.45 | - | |
| $C_{ies}$ | Input capacitance | $V_{CE}$=10 V, G-E short-circuited | | - | - | 120 | nF |
| $C_{oes}$ | Output capacitance | | | - | - | 14 | |
| $C_{res}$ | Reverse transfer capacitance | | | - | - | 2.6 | |
| $Q_G$ | Gate charge | $V_{CC}$=1000 V, $I_C$=500 A, $V_{GE}$=15 V | | - | 3300 | - | nC |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC}$=1000 V, $I_C$=500 A, $V_{GE}$=±15 V, $R_G$=3.0 Ω, Inductive load | | - | - | 900 | ns |
| $t_r$ | Rise time | | | - | - | 500 | |
| $t_{d(off)}$ | Turn-off delay time | | | - | - | 700 | |
| $t_f$ | Fall time | | | - | - | 350 | |
| $V_{EC}$ (Note.1) | Emitter-collector voltage | $I_E$=500 A (Note.6), G-E short-circuited | | - | 2.3 | 3.2 | V |
| $t_{rr}$ (Note.1) | Reverse recovery time | $V_{CC}$=1000 V, $I_E$=500 A, $V_{GE}$=±15 V, $R_G$=3.0 Ω, Inductive load | | - | - | 650 | ns |
| $Q_{rr}$ (Note.1) | Reverse recovery charge | | | - | 50 | - | μC |
| $E_{on}$ | Turn-on switching energy per pulse | $V_{CC}$=1000 V, $I_C$=$I_E$=500 A, $V_{GE}$=±15 V, $R_G$=3.0 Ω, $T_j$=125 °C, Inductive load | | - | 267.8 | - | mJ |
| $E_{off}$ | Turn-off switching energy per pulse | | | - | 138.5 | - | |
| $E_{rr}$ (Note.1) | Reverse recovery energy per pulse | | | - | 98.1 | - | |
| $r_g$ | Internal gate resistance | $T_C$=25 °C | | - | 1.0 | - | Ω |
| $R_G$ | External gate resistance | - | | 3.0 | - | 10 | Ω |

## THERMAL RESISTANCE CHARACTERISTICS

| Symbol | Item | Conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $R_{th(j-c)Q}$ | Thermal resistance (Note.2) | Junction to case, IGBT part | - | - | 25 | K/kW |
| $R_{th(j-c)D}$ | | Junction to case, FWDi part | - | - | 42 | K/kW |
| $R_{th(c-s)}$ | Contact thermal resistance (Note.2) | Case to heat sink, Thermal grease applied (Note.7) | - | 20 | - | K/kW |

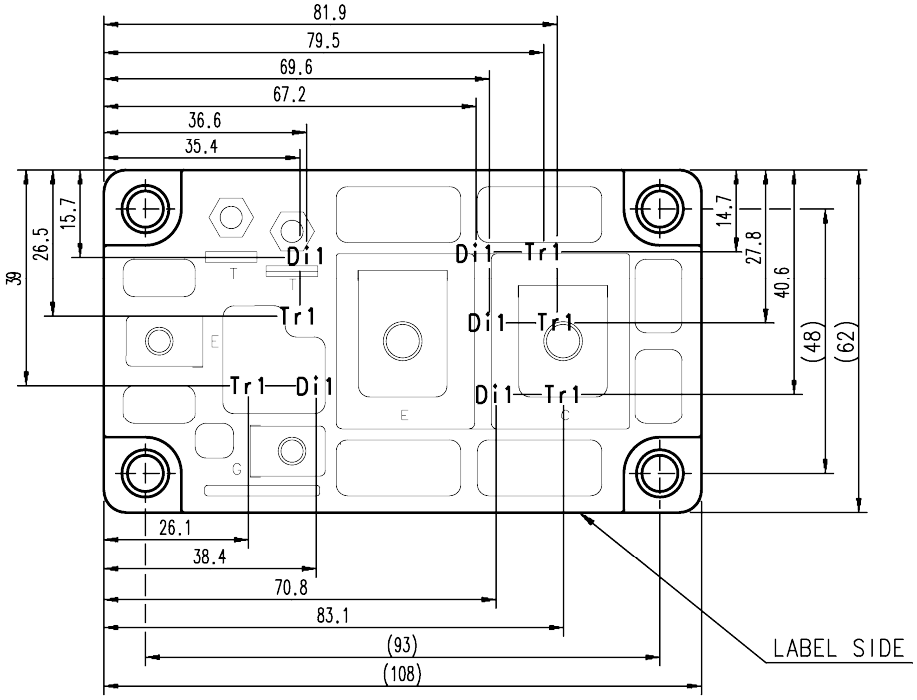
Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).
Note.2: Case temperature ($T_C$) and heat sink temperature ($T_s$) are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)
The heat sink thermal resistance {$R_{th(s-a)}$} should measure just under the chips.
Note.3: Pulse width and repetition rate should be such that the device junction temperature ($T_j$) dose not exceed $T_{jmax}$ rating.
Note.4: Junction temperature ($T_j$) should not increase beyond $T_{jmax}$ rating.
Note.5: Base plate flatness measurement point is as in the following figure.




Note.6: Pulse width and repetition rate should be such as to cause negligible temperature rise.
(Refer to the figure of test circuit)
Note.7: Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).

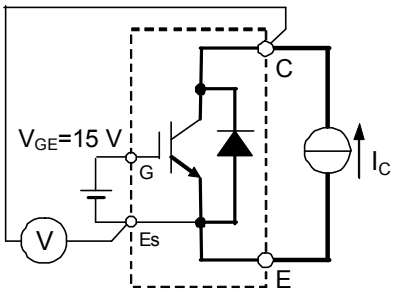
## CHIP LOCATION (Top view)

**Dimension in mm, tolerance: ±1 mm**

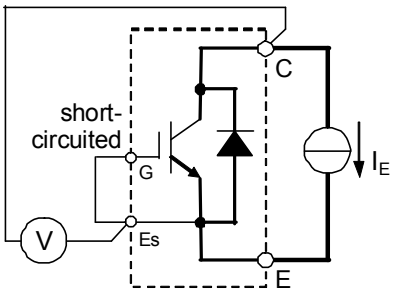



Tr1: IGBT, Di1: FWDi. Each mark points the center position of each chip.

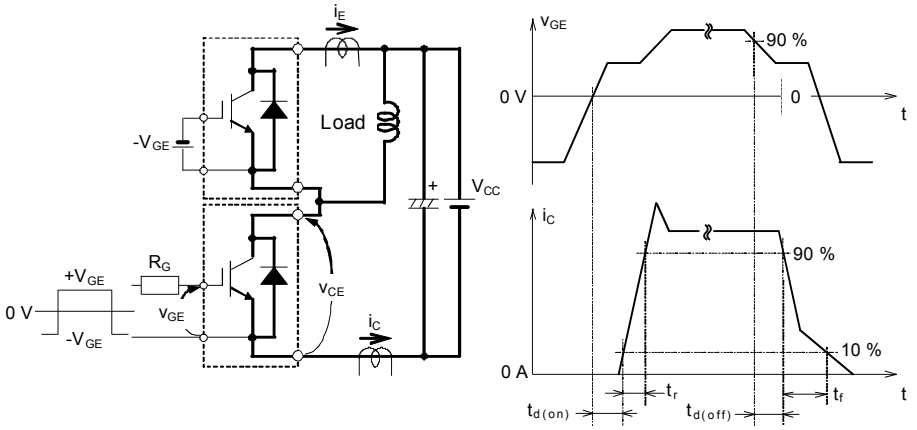
## TEST CIRCUIT AND WAVEFORMS



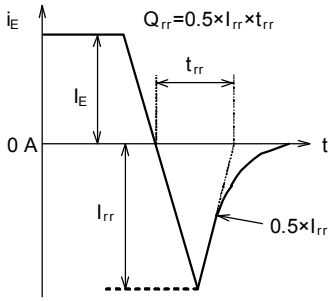

$V_{CEsat}$ test circuit



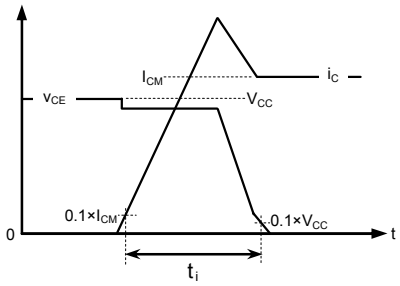

$V_{EC}$ test circuit



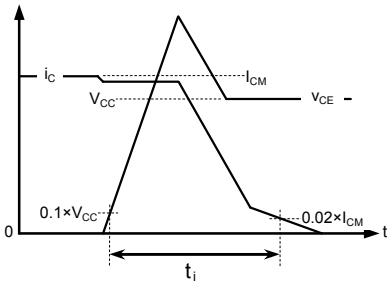

Switching characteristics test circuit and waveforms



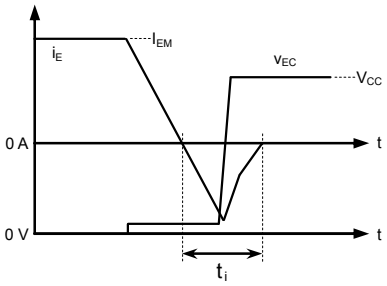

$t_{rr}$, $Q_{rr}$ test waveform




IGBT Turn-on switching energy




IGBT Turn-off switching energy

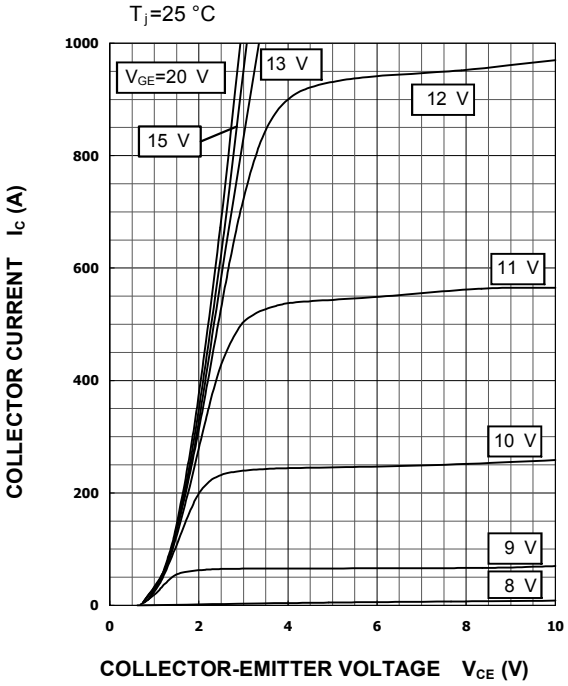



FWDi Reverse recovery energy

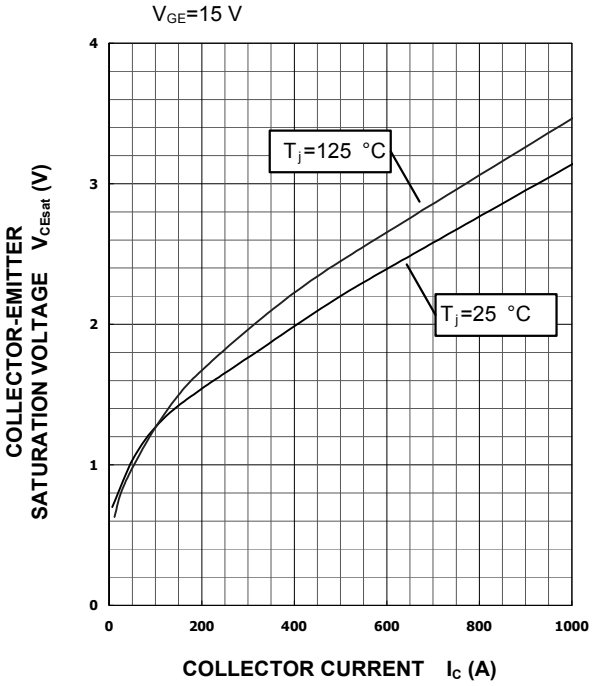
Turn-on, Turn-off switching and Reverse recovery energy test waveforms (integral range)

## PERFORMANCE CURVES

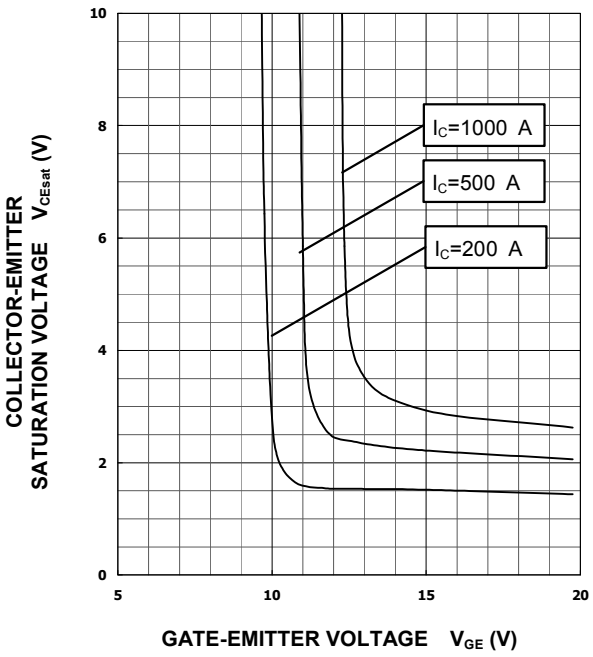
**OUTPUT CHARACTERISTICS (TYPICAL)**



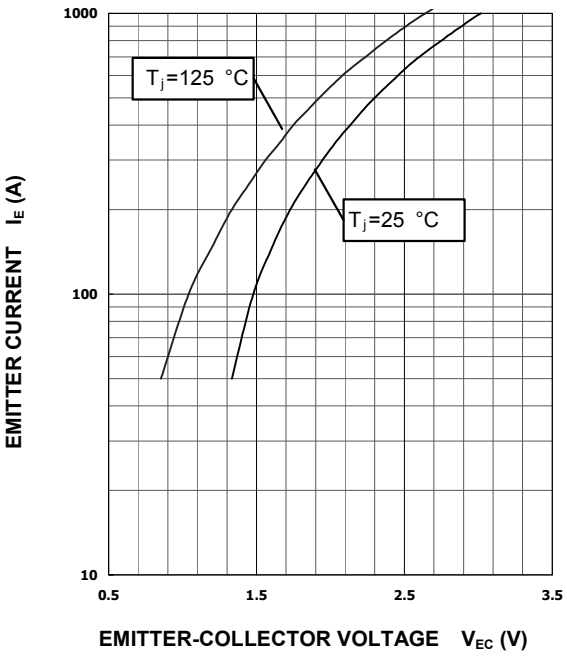

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



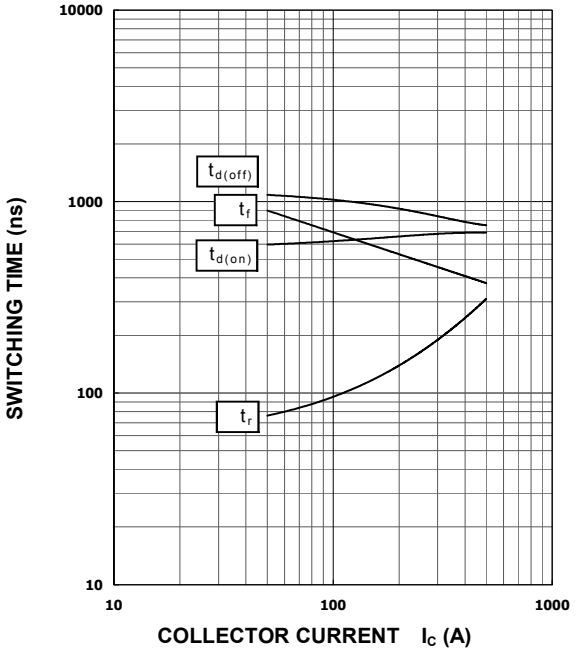

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



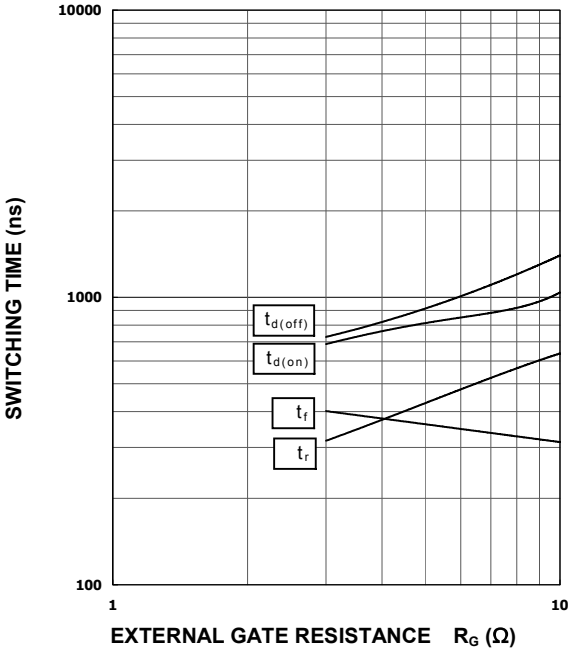

**FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)**



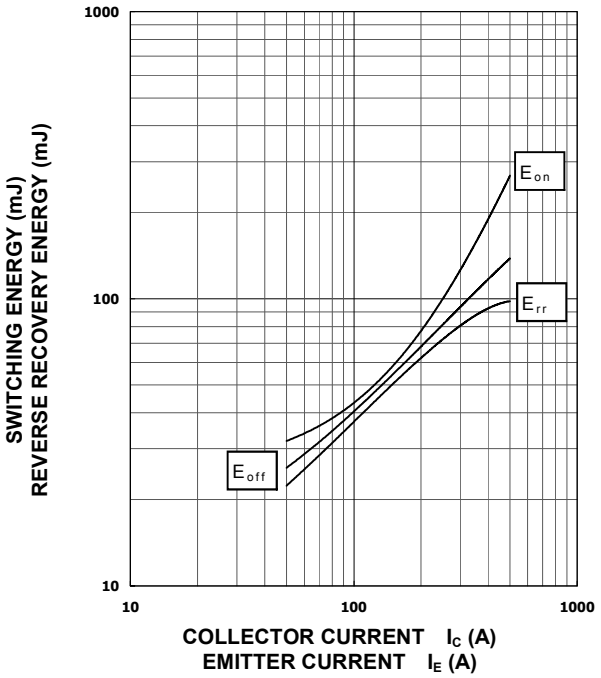
**HALF-BRIDGE**
**SWITCHING CHARACTERISTICS**
**(TYPICAL)**
$V_{CC}$=1000 V, $V_{GE}$=±15 V, $R_G$=3.0 Ω, $T_j$=125 °C
INDUCTIVE LOAD



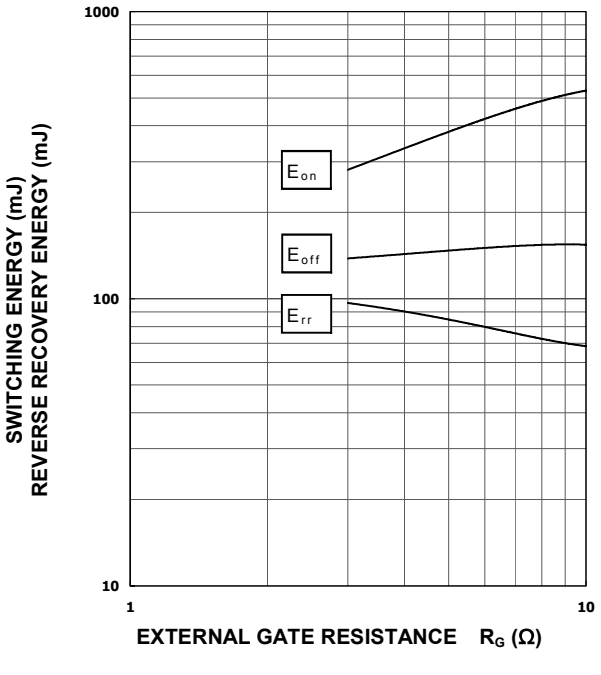

**HALF-BRIDGE**
**SWITCHING CHARACTERISTICS**
**(TYPICAL)**
$V_{CC}$=1000 V, $I_C$=500 A, $V_{GE}$=±15 V, $T_j$=125 °C
INDUCTIVE LOAD




**HALF-BRIDGE**
**SWITCHING CHARACTERISTICS**
**(TYPICAL)**
$V_{CC}$=1000 V, $V_{GE}$=±15 V, $R_G$=3.0 Ω, $T_j$=125 °C
INDUCTIVE LOAD, PER PULSE

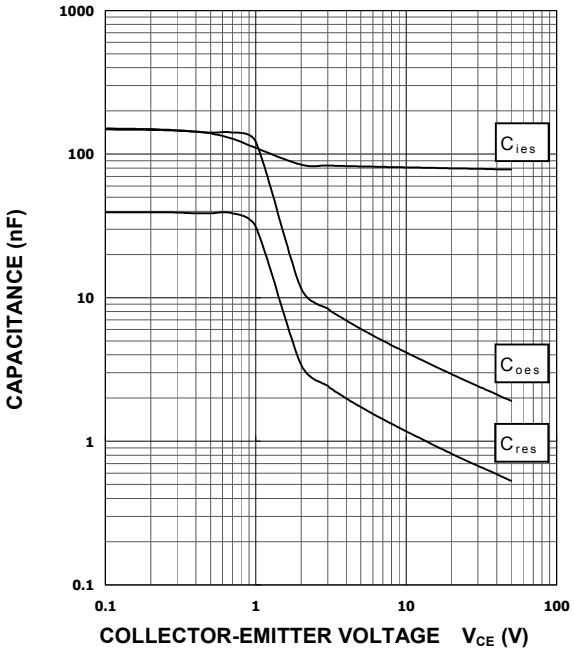



**HALF-BRIDGE**
**SWITCHING CHARACTERISTICS**
**(TYPICAL)**
$V_{CC}$=1000 V, $I_C/I_E$=500 A, $V_{GE}$=±15 V, $T_j$=125 °C
INDUCTIVE LOAD, PER PULSE



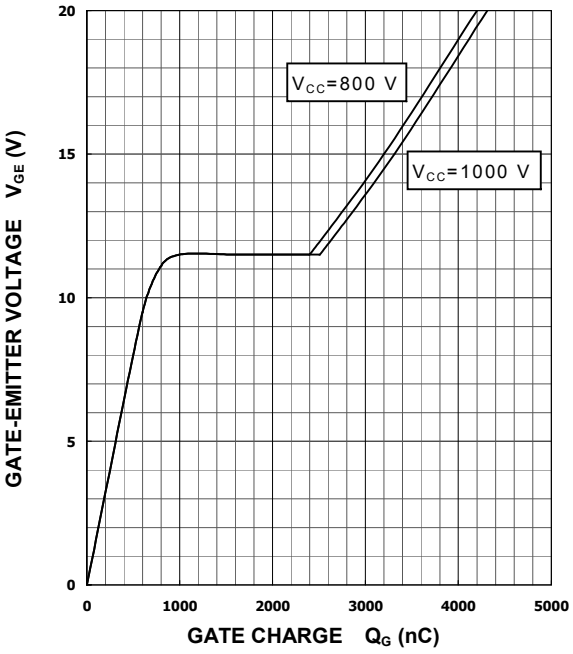
**CAPACITANCE CHARACTERISTICS (TYPICAL)**

G-E short-circuited, $T_j$=25 °C




**GATE CHARGE CHARACTERISTICS (TYPICAL)**

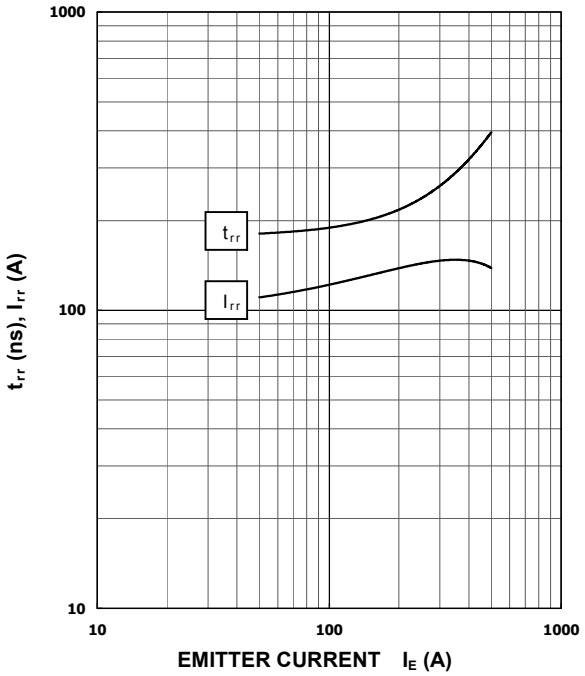
$I_C$=500 A, $T_j$=25 °C




**FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**

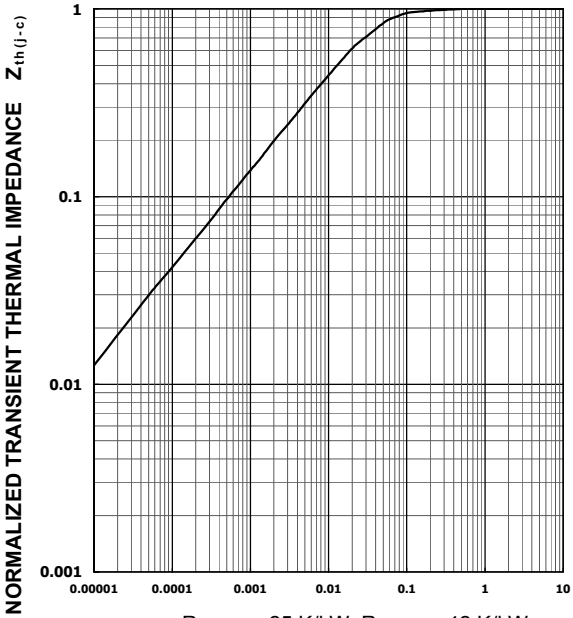
$V_{CC}$=1000 V, $V_{GE}$=±15 V, $R_G$=3.0 Ω, $T_j$=125 °C

INDUCTIVE LOAD




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)**

Single pulse, $T_C$=25°C




$R_{th(j-c)Q}$=25 K/kW, $R_{th(j-c)D}$=42 K/kW

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