# CM100DUS-12F

HIGH POWER SWITCHING USE
INSULATED TYPE

**CM100DUS-12F** — **- 4th generation Fast switching IGBT module -**

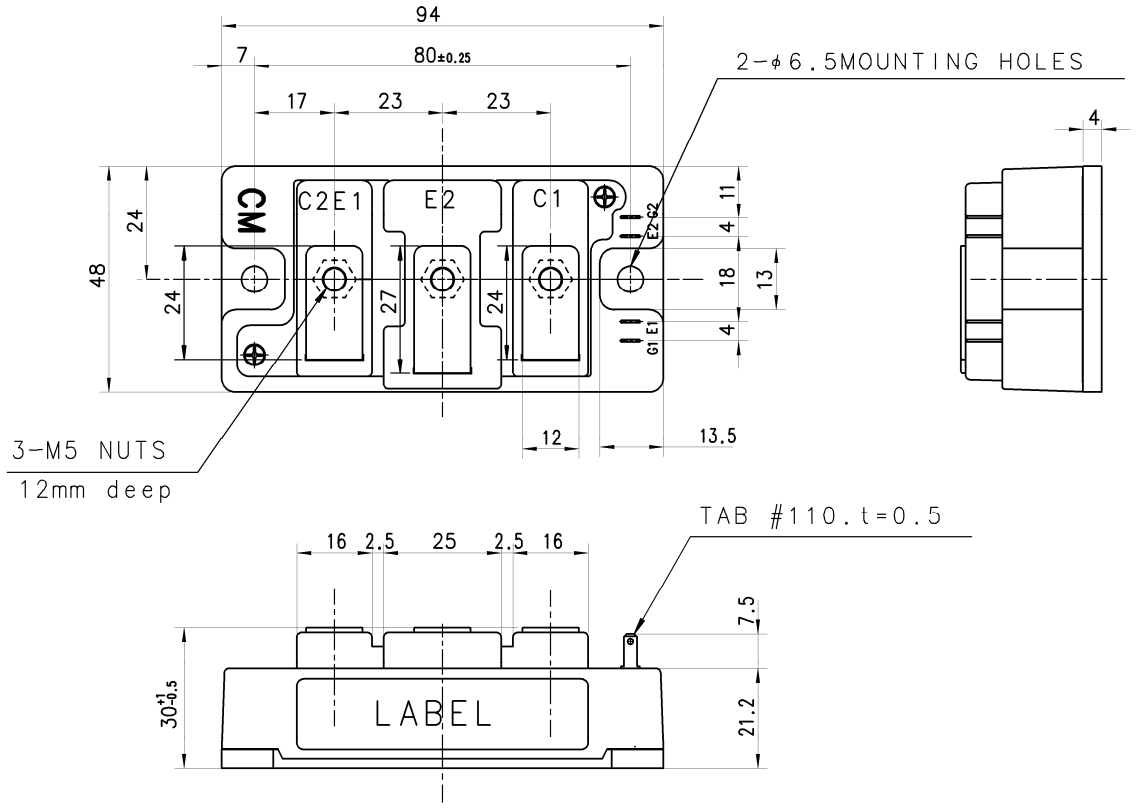
**Dual (Half-Bridge)**

- Collector current $I_C$ ..... **100** A
- Collector-emitter voltage $V_{CES}$ ..... **600** V
- Maximum junction temperature $T_{jmax}$ ... **150** °C
- ●Flat base Type
- ●Copper base plate
- ●RoHS Directive compliant
- ●UL Recognized under UL1557, File E323585

## APPLICATION

High frequency (30 kHz ~ 60 kHz) switching use: Induction heating, Power supply, etc.

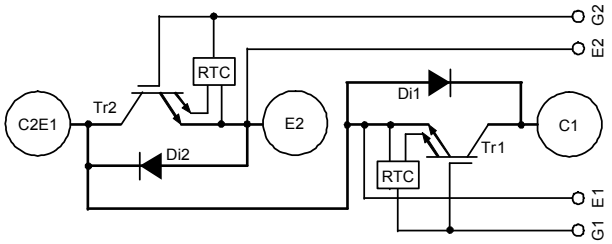
**OUTLINE DRAWING & INTERNAL CONNECTION** — **Dimension in mm**




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**






MITSUBISHI ELECTRIC

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

| Symbol | Item | Conditions | Rating | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage | G-E short-circuited | 600 | V |
| $V_{GES}$ | Gate-emitter voltage | C-E short-circuited | ±20 | V |
| $I_C$ | Collector current | $T_C$=25 °C (Note.2) | 100 | A |
| $I_{CRM}$ | | Pulse, Repetitive (Note.4) | 200 | |
| $P_{tot}$ | Total power dissipation | $T_C$=25 °C (Note.2, 5) | 350 | W |
| $P_{tot}$' | | $T_C$'=25 °C (Note.3, 5) | 445 | |
| $I_E$ (Note.1) | Emitter current (Free wheeling diode forward current) | $T_C$=25 °C (Note.2) | 100 | A |
| $I_{ERM}$ (Note.1) | | Pulse, Repetitive (Note.4) | 200 | |
| $T_j$ | 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 | 2500 | V |

## 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 | | - | - | 20 | μA |
| $V_{GE(th)}$ | Gate-emitter threshold voltage | $I_C$=10 mA, $V_{CE}$=10 V | | 5 | 6 | 7 | V |
| $V_{CEsat}$ | Collector-emitter saturation voltage | $I_C$=100 A (Note.6), $V_{GE}$=15 V | $T_j$=25 °C | 1.7 | 2.0 | 2.7 | V |
| | | | $T_j$=125 °C | - | 1.95 | - | |
| $C_{ies}$ | Input capacitance | $V_{CE}$=10 V, G-E short-circuited | | - | - | 27 | nF |
| $C_{oes}$ | Output capacitance | | | - | - | 1.8 | |
| $C_{res}$ | Reverse transfer capacitance | | | - | - | 1.0 | |
| $Q_G$ | Gate charge | $V_{CC}$=300 V, $I_C$=100 A, $V_{GE}$=15 V | | - | 620 | - | nC |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC}$=300 V, $I_C$=100 A, $V_{GE}$=±15 V, $R_G$=6.3 Ω, Inductive load | | - | - | 100 | ns |
| $t_r$ | Rise time | | | - | - | 80 | |
| $t_{d(off)}$ | Turn-off delay time | | | - | - | 300 | |
| $t_f$ | Fall time | | | - | - | 150 | |
| $V_{EC}$ (Note.1) | Emitter-collector voltage | $I_E$=100 A (Note.6), G-E short-circuited | | - | 2.0 | 2.6 | V |
| $t_{rr}$ (Note.1) | Reverse recovery time | $V_{CC}$=300 V, $I_E$=100 A, $V_{GE}$=±15 V, $R_G$=6.3 Ω, Inductive load | | - | - | 150 | ns |
| $Q_{rr}$ (Note.1) | Reverse recovery charge | | | - | 1.9 | - | μC |
| $E_{on}$ | Turn-on switching energy per pulse | $V_{CC}$=300 V, $I_C$=$I_E$=100 A, $V_{GE}$=±15 V, $R_G$=6.3 Ω, $T_j$=125 °C, Inductive load | | - | 1.55 | - | mJ |
| $E_{off}$ | Turn-off switching energy per pulse | | | - | 2.2 | - | |
| $E_{rr}$ (Note.1) | Reverse recovery energy per pulse | | | - | 1.2 | - | |
| $r_g$ | Internal gate resistance | Per switch | | - | 0 | - | Ω |

## THERMAL RESISTANCE CHARACTERISTICS

| Symbol | Item | Conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $R_{th(j-c)Q}$ | Thermal resistance (Note.2) | Junction to case, per IGBT | - | - | 0.35 | K/W |
| $R_{th(j-c)D}$ | | Junction to case, per FWDi | - | - | 0.70 | K/W |
| $R_{th(c-s)}$ | Contact thermal resistance (Note.2) | Case to heat sink, per 1/2 module, Thermal grease applied (Note.7) | - | 0.07 | - | K/W |
| $R_{th(j-c')Q}$ | Thermal resistance (Note.3) | Junction to case, per IGBT | - | - | 0.28 | K/W |
| $R_{th(j-c')D}$ | | Junction to case, per FWDi | - | - | 0.40 | K/W |

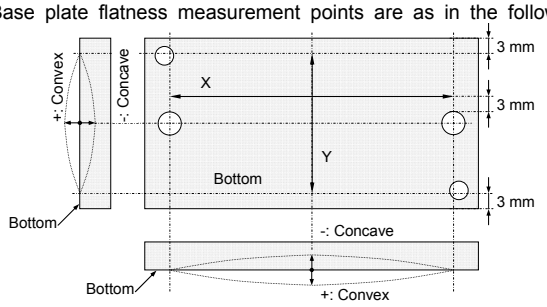
## MECHANICAL CHARACTERISTICS

| Symbol | Item | Conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $M_t$ | Mounting torque | Main terminals M 5 screw | 2.5 | 3.0 | 3.5 | N·m |
| $M_s$ | | Mounting to heat sink M 6 screw | 3.5 | 4.0 | 4.5 | |
| m | Weight | - | - | 310 | - | g |
| $e_c$ | Flatness of base plate | On the centerline X, Y (Note.8) | -100 | - | +100 | μm |

## RECOMMENDED OPERATING CONDITIONS ($T_a$=25 °C)

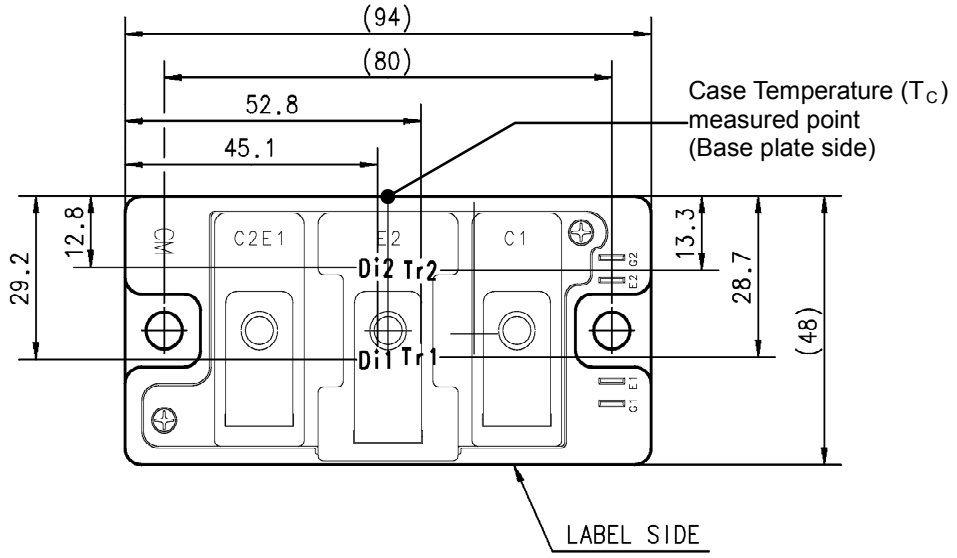
| Symbol | Item | Conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $V_{CC}$ | (DC) Supply voltage | Applied across C1-E2 | - | 300 | 400 | V |
| $V_{GEon}$ | Gate (-emitter drive) voltage | Applied across G1-Es1/G2-Es2 | 13.5 | 15.0 | 16.5 | |
| $R_G$ | External gate resistance | Per switch | 6.3 | - | 63 | Ω |

Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).
Note.2: Case temperature ($T_C$) measured point is base plate side. (Refer to the figure of chip location)
Note.3: 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.4: Pulse width and repetition rate should be such that the device junction temperature ($T_j$) dose not exceed $T_{jmax}$ rating.
Note.5: Junction temperature ($T_j$) should not increase beyond $T_{jmax}$ rating.
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).
Note.8: Base plate flatness measurement points are as in the following figure.



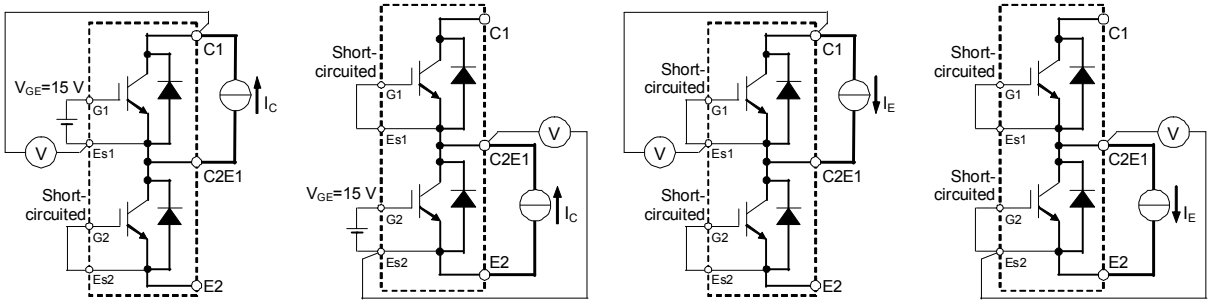

## CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



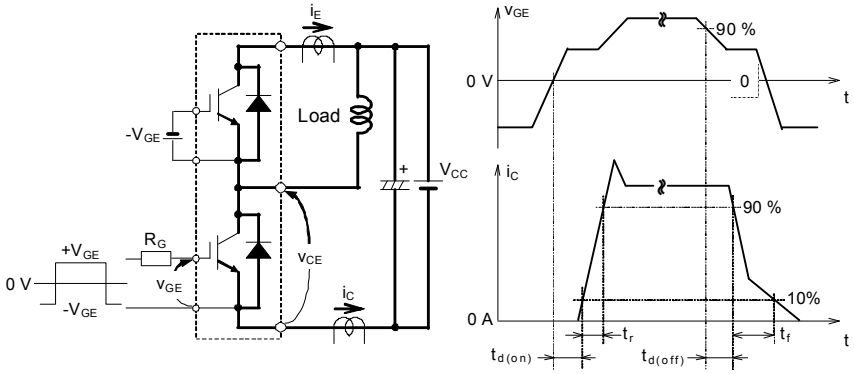

Tr1/Tr2: IGBT, Di1/Di2: FWDi

## TEST CIRCUIT AND WAVEFORMS

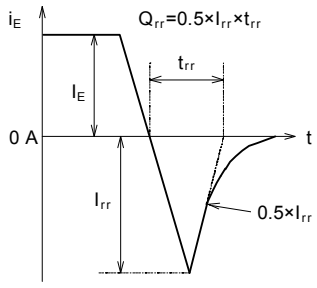



Tr1 Tr2 Di1 Di2

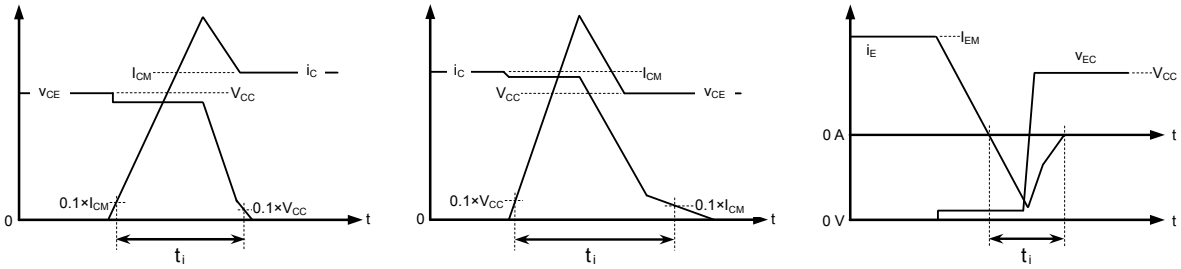
$V_{CEsat}$ test circuit $V_{EC}$ test circuit




Switching characteristics test circuit and waveforms




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



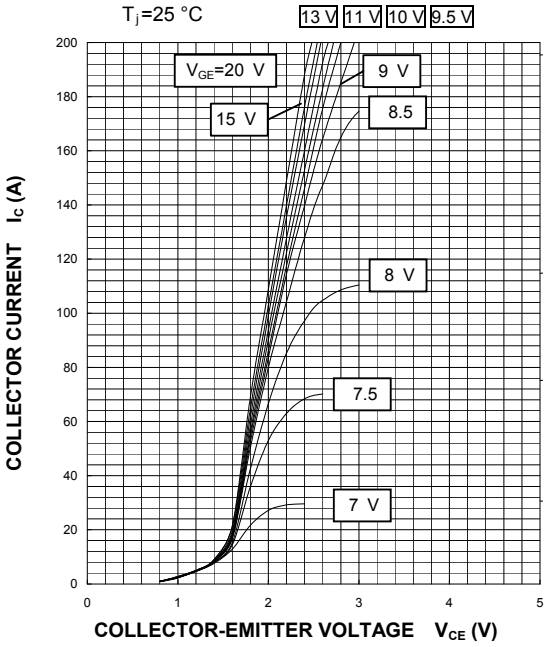

IGBT Turn-on switching energy IGBT Turn-off switching energy FWDi Reverse recovery energy

Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

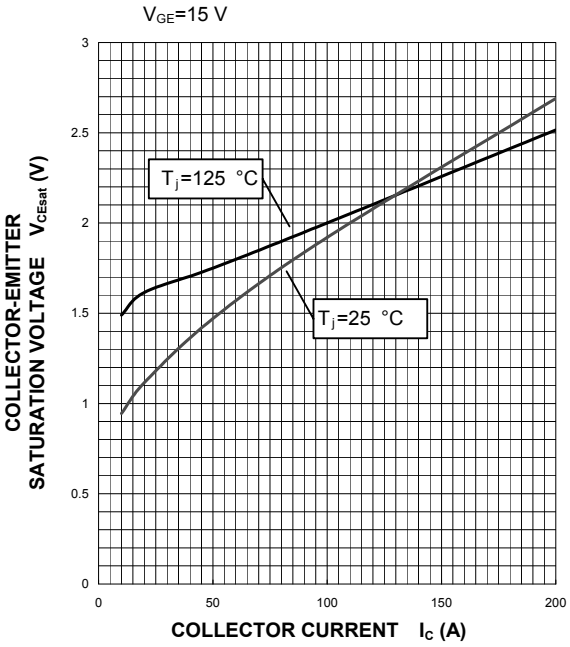
## PERFORMANCE CURVES

### INVERTER PART

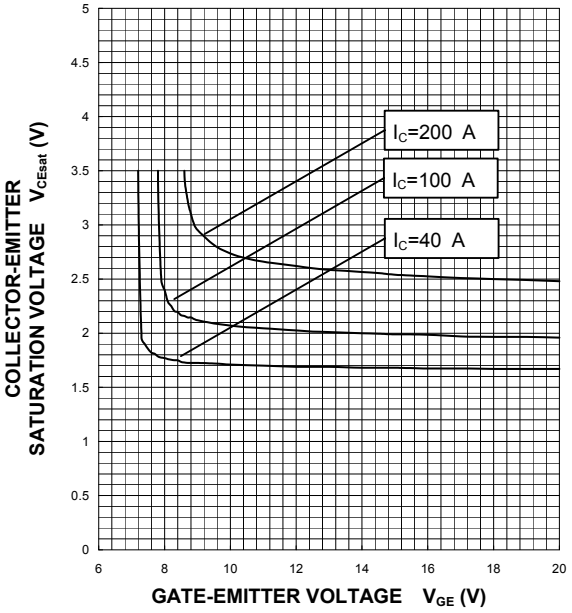
**OUTPUT CHARACTERISTICS (TYPICAL)**



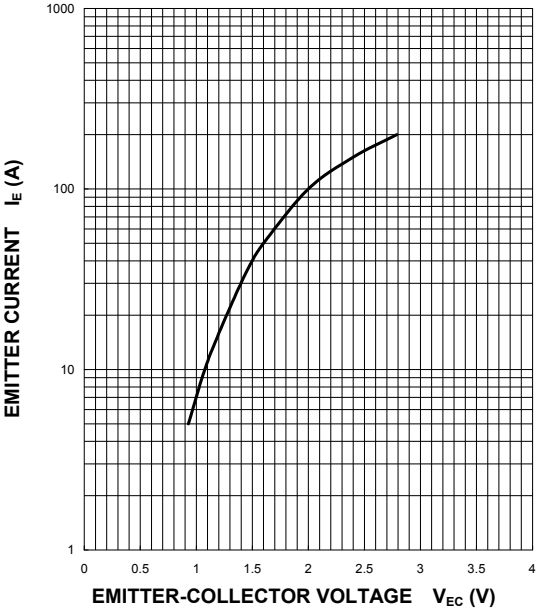

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



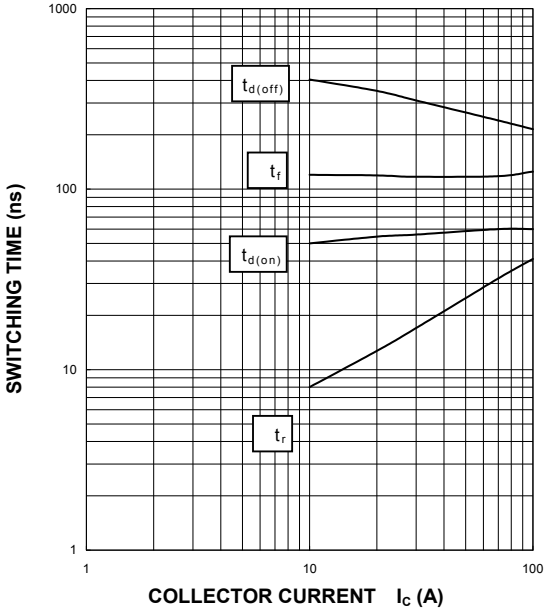

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



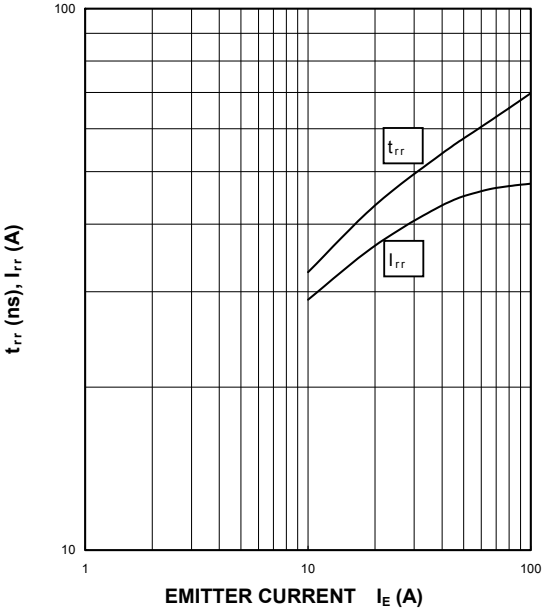

**FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)**



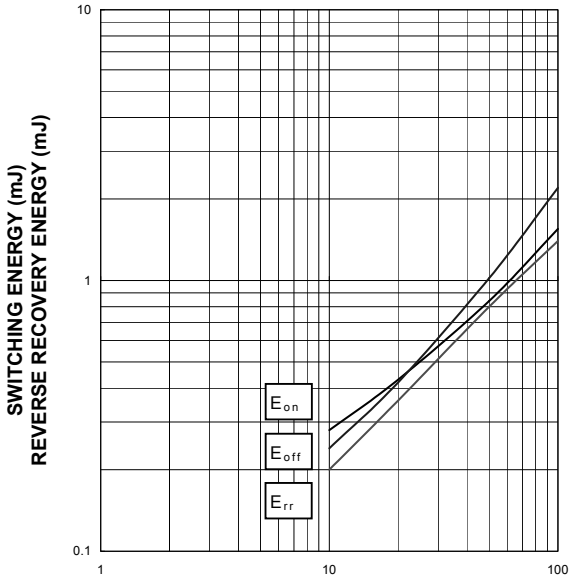
**HALF-BRIDGE**
**SWITCHING CHARACTERISTICS**
**(TYPICAL)**
$V_{CC}$=300 V, $V_{GE}$=±15 V, $R_G$=6.3 Ω,
$T_j$=125 °C, INDUCTIVE LOAD



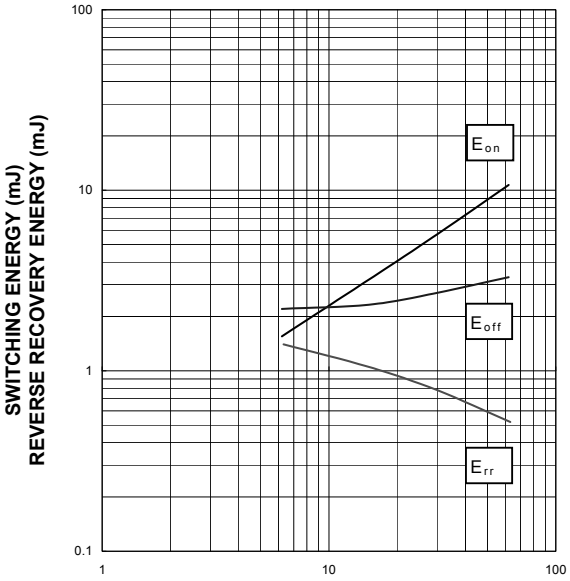

**FREE WHEELING DIODE**
**REVERSE RECOVERY CHARACTERISTICS**
**(TYPICAL)**
$V_{CC}$=300 V, $V_{GE}$=±15 V, $R_G$=6.3 Ω,
$T_j$=125 °C, INDUCTIVE LOAD




**HALF-BRIDGE**
**SWITCHING CHARACTERISTICS**
**(TYPICAL)**
$V_{CC}$=300 V, $V_{GE}$=±15 V, $R_G$=6.3 Ω, $T_j$=125 °C,
INDUCTIVE LOAD, PER PULSE

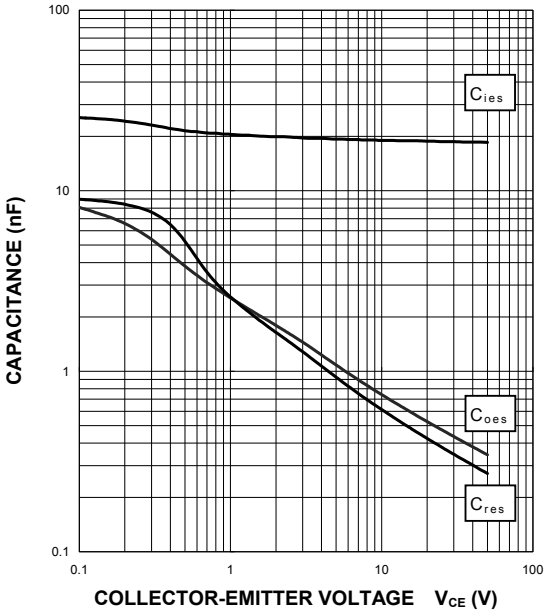



**HALF-BRIDGE**
**SWITCHING CHARACTERISTICS**
**(TYPICAL)**
$V_{CC}$=300 V, $I_C$/$I_E$=100 A, $V_{GE}$=±15 V, $T_j$=125 °C,
INDUCTIVE LOAD, PER PULSE



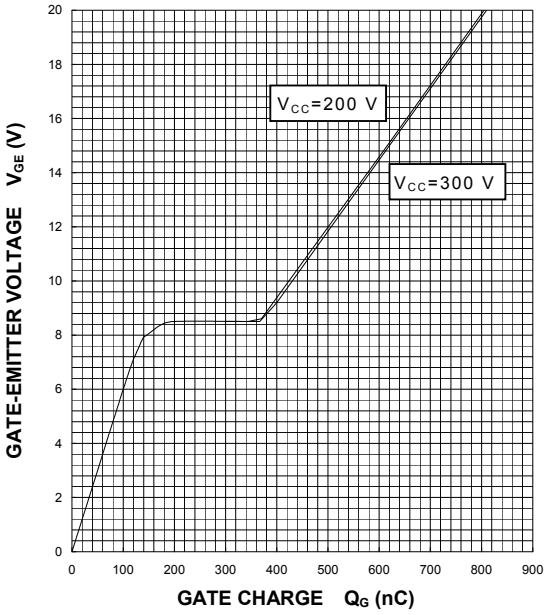
**CAPACITANCE CHARACTERISTICS (TYPICAL)**

G-E short-circuited, $T_j$=25 °C



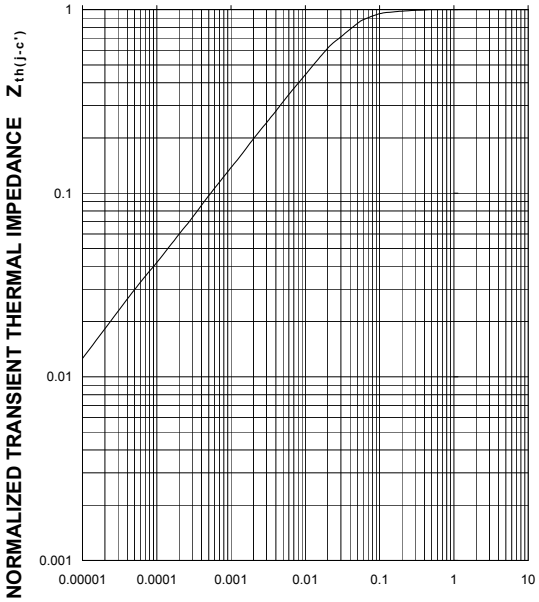

**GATE CHARGE CHARACTERISTICS (TYPICAL)**

$I_C$=100 A, $T_j$=25 °C




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)**

Single pulse, $T_C$'=25°C




$R_{th(j-c')Q}$=0.28 K/W, $R_{th(j-c')D}$=0.40 K/W

**TIME (S)**

## Keep safety first in your circuit designs!

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