

<IGBT Modules>

CM400DY-34T

**HIGH POWER SWITCHING USE
INSULATED TYPE**



dual switch (half-bridge)

Collector current I_C **400 A**
 Collector-emitter voltage V_{CES} **1700 V**
 Maximum junction temperature T_{vjmax} **175 °C**

- Flat base type
- Nickel-plating tab terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File No.E323585

APPLICATION

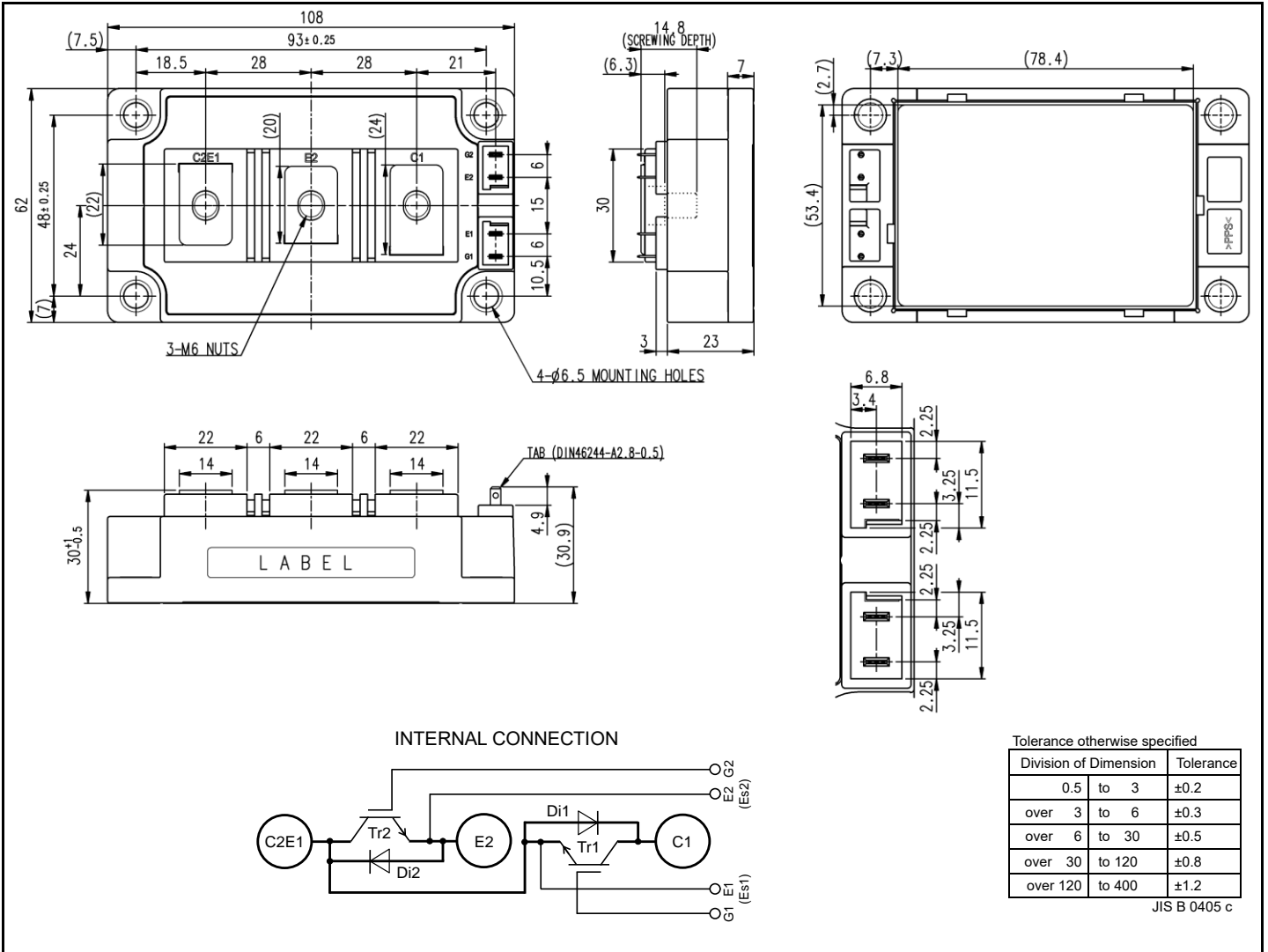
AC Motor Control, Motion/Servo Control, Power supply, etc.

OPTION (Below options are available.)

- PC-TIM (Phase Change Thermal Interface Material) pre-apply (Note8)
- V_{CEsat} selection for parallel connection

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



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MAXIMUM RATINGS (T_{vj}=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 =132 °C* (Note2, 4) | 400 | A |
| I _{CRM} | | Pulse, Repetitive (Note3) | 800 | |
| P _{tot} | Total power dissipation | T _C =25 °C (Note2, 4) | 4345 | W |
| I _E (Note1) | Emitter current | DC (Note2) | 400 | A |
| I _{ERM} (Note1) | | Pulse, Repetitive (Note3) | 800 | |
| V _{isol} | Isolation voltage | Terminals to base plate, RMS, f=60 Hz, AC 1 min | 4000 | V |
| T _{vjmax} | Maximum junction temperature | Instantaneous event (overload) (Note8) | 175 | °C |
| T _{Cmax} | Maximum case temperature | (Note4,8) | 150* | |
| T _{vjop} | Operating junction temperature | Continuous operation (under switching) (Note8) | -40 ~ +150 | °C |
| T _{stg} | Storage temperature | - | -40 ~ +150* | |

ELECTRICAL CHARACTERISTICS (T_{vj}=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 | - | - | 1.0 | mA | |
| I _{GES} | Gate-emitter leakage current | V _{GE} =V _{GES} , C-E short-circuited | - | - | 0.5 | µA | |
| V _{GE(th)} | Gate-emitter threshold voltage | I _C =40 mA, V _{CE} =10 V | 5.4 | 6.0 | 6.6 | V | |
| V _{CESat} (Terminal) | Collector-emitter saturation voltage | I _C =400 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5) | T _{vj} =25 °C | - | 2.10 | 2.50 | V |
| V _{CESat} (Chip) | | | T _{vj} =125 °C | - | 2.55 | - | |
| | | | T _{vj} =150 °C | - | 2.65 | - | |
| V _{CEsat} (Chip) | Collector-emitter saturation voltage | I _C =400 A, V _{GE} =15 V, (Note5) | T _{vj} =25 °C | - | 1.95 | 2.35 | V |
| V _{CEsat} (Terminal) | | | T _{vj} =125 °C | - | 2.35 | - | |
| | | | T _{vj} =150 °C | - | 2.45 | - | |
| C _{ies} | Input capacitance | V _{CE} =10 V, G-E short-circuited | - | - | 110 | nF | |
| C _{oes} | Output capacitance | | - | - | 2.9 | | |
| C _{res} | Reverse transfer capacitance | | - | - | 0.9 | | |
| Q _G | Gate charge | V _{CC} =1000 V, I _C =400 A, V _{GE} =15 V | - | 3.1 | - | µC | |
| t _{d(on)} | Turn-on delay time | V _{CC} =1000 V, I _C =400 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load | - | - | 800 | ns | |
| t _r | Rise time | | - | - | 200 | | |
| t _{d(off)} | Turn-off delay time | | - | - | 800 | | |
| t _f | Fall time | | - | - | 600 | | |
| V _{EC} (Note.1) (Terminal) | Emitter-collector voltage | I _E =400 A, G-E short-circuited, Refer to the figure of test circuit (Note5) | T _{vj} =25 °C | - | 2.80 | 3.55 | V |
| V _{EC} (Note.1) (Chip) | | | T _{vj} =125 °C | - | 3.05 | - | |
| | | | T _{vj} =150 °C | - | 3.05 | - | |
| V _{EC} (Note.1) (Chip) | Emitter-collector voltage | I _E =400 A, G-E short-circuited, (Note5) | T _{vj} =25 °C | - | 2.65 | 3.35 | V |
| V _{EC} (Note.1) (Terminal) | | | T _{vj} =125 °C | - | 2.75 | - | |
| | | | T _{vj} =150 °C | - | 2.75 | - | |
| t _{rr} (Note1) | Reverse recovery time | V _{CC} =1000 V, I _E =400 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load | - | - | 300 | ns | |
| Q _{rr} (Note1) | Reverse recovery charge | R _G =0 Ω, Inductive load | - | 20 | - | µC | |
| E _{on} | Turn-on switching energy per pulse | V _{CC} =1000 V, I _C =I _E =400 A, V _{GE} =±15 V, R _G =0 Ω, T _{vj} =150 °C, | - | 80.6 | - | mJ | |
| E _{off} | Turn-off switching energy per pulse | Inductive load | - | 97.5 | - | | |
| E _{rr} (Note1) | Reverse recovery energy per pulse | Inductive load | - | 50.6 | - | mJ | |
| R _{CC'+EE'} | Internal lead resistance | Main terminals-chip, per switch, T _C =25 °C (Note4) | - | 0.3 | - | mΩ | |
| r _g | Internal gate resistance | Per switch | - | 2.0 | - | Ω | |

*The value of PC-TIM applied module is limited by the heat resistant temperature of PC-TIM.

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HIGH POWER SWITCHING USE
INSULATED TYPE

THERMAL RESISTANCE CHARACTERISTICS

| Symbol | Item | Conditions | Limits | | | Unit |
|----------------|----------------------------|---|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| $R_{th(j-c)Q}$ | Thermal resistance | Junction to case, per Inverter IGBT (Note4) | - | - | 34.5 | K/kW |
| $R_{th(j-c)D}$ | | Junction to case, per Inverter FWD (Note4) | - | - | 58.3 | |
| $R_{th(c-s)}$ | Contact thermal resistance | Case to heat sink, per 1 module Thermal grease applied (Note4,6,8) | - | 13.3 | - | K/kW |

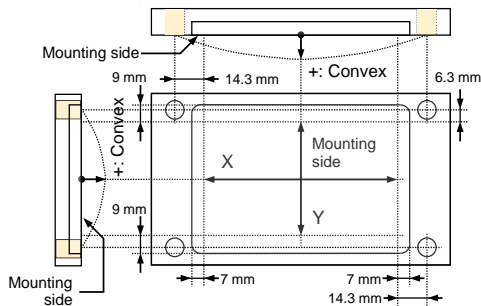
MECHANICAL CHARACTERISTICS

| Symbol | Item | Conditions | Limits | | | Unit |
|--------|------------------------|---------------------------------|---------|------|------|---------------|
| | | | Min. | Typ. | Max. | |
| M_t | Mounting torque | Main terminals M 6 screw | 3.5 | 4.0 | 4.5 | N·m |
| M_s | Mounting torque | Mounting to heat sink M 6 screw | 3.5 | 4.0 | 4.5 | N·m |
| d_s | Creepage distance | Terminal to terminal | 17.3 | - | - | mm |
| | | Terminal to base plate | 25.3 | - | - | |
| d_a | Clearance | Terminal to terminal | 12.6 | - | - | mm |
| | | Terminal to base plate | 21.8 | - | - | |
| e_c | Flatness of base plate | On the centerline X, Y (Note7) | ± 0 | - | +200 | μm |
| m | mass | - | - | 260 | - | g |

*. This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU and (EU) 2015/863.

Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free-wheeling diode (FWD).

- Junction temperature (T_{vj}) should not increase beyond T_{vjmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} rating.
- Case temperature (T_c) and heat sink temperature (T_s) are defined on the each surface (mounting side) of base plate and heat sink just under the chips.
Refer to the figure of chip location.
- Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.
- Typical value is measured by using thermally conductive grease of $\lambda=3.0 \text{ W}/(\text{m}\cdot\text{K})/D_{(C-S)}=50 \mu\text{m}$.
- The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



- Long term performance related to thermal conductive grease and PC-TIM (including but not limited to aspects such as the increase of thermal resistance due to pumping out, etc.) should be verified under your specific application conditions. Each temperature condition (T_{vjmax} , T_{vjop} , T_{cmax}) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

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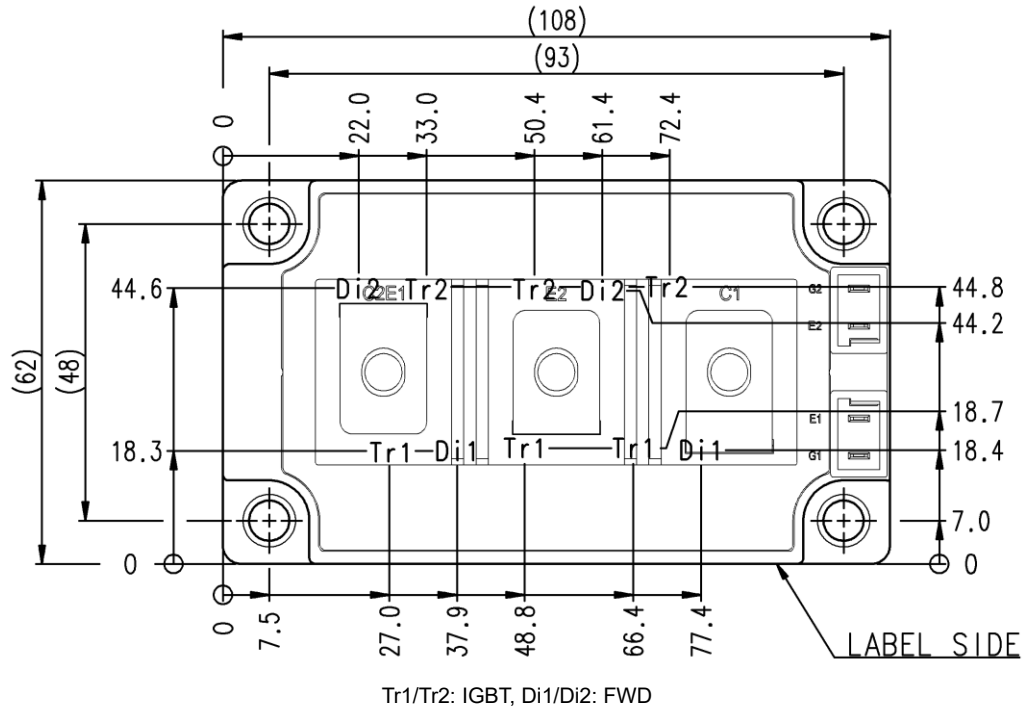
HIGH POWER SWITCHING USE
INSULATED TYPE

RECMENDED OPERATING CONDITIONS

| Symbol | Item | Conditions | Limits | | | Unit |
|------------|-------------------------------|--|--------|------|------|----------|
| | | | Min. | Typ. | Max. | |
| V_{CC} | (DC) Supply voltage | Applied across C1-E2 terminals | - | 1000 | 1200 | V |
| V_{GEon} | Gate (-emitter drive) voltage | Applied across G1-Es1/G2-Es2 terminals | 13.5 | 15.0 | 16.5 | V |
| R_G | External gate resistance | Per switch | 0 | - | 30 | Ω |

CHIP LOCATION (Top view)

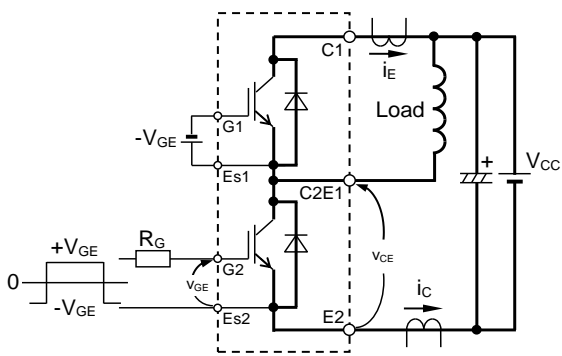
Dimension in mm, tolerance: ± 1 mm



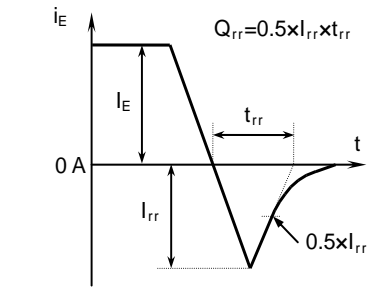
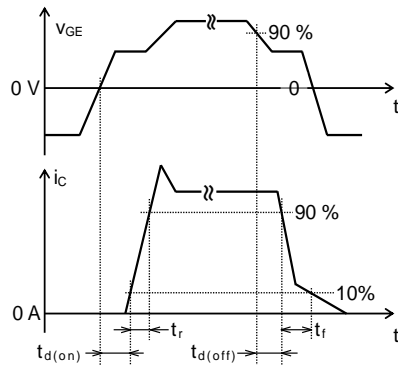
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HIGH POWER SWITCHING USE
INSULATED TYPE

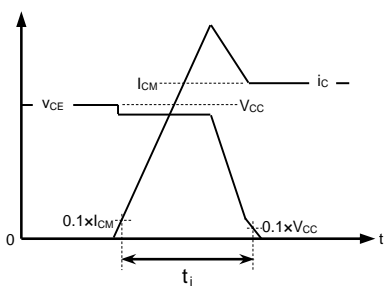
TEST CIRCUIT AND WAVEFORMS



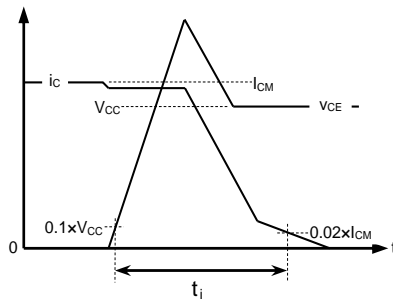
Switching characteristics test circuit and waveforms



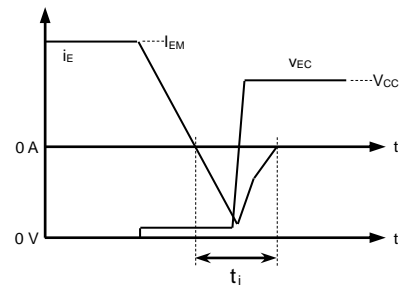
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



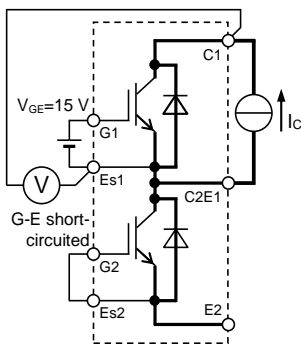
IGBT Turn-off switching energy



FWD Reverse recovery energy

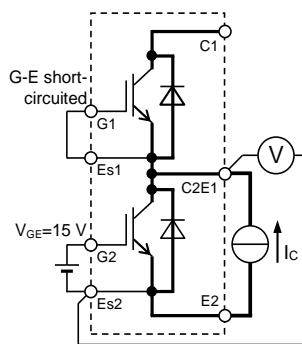
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

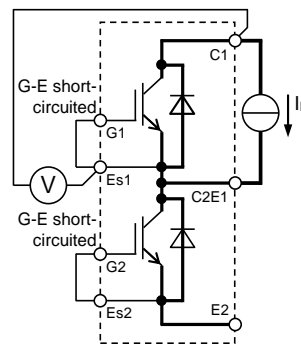


Tr1

V_{CEsat} characteristics test circuit

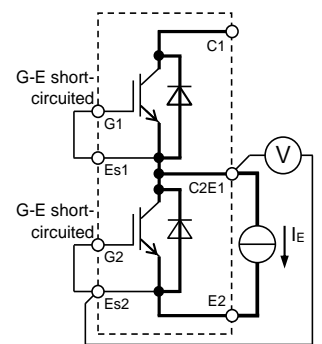


Tr2



Di1

V_{CE} characteristics test circuit



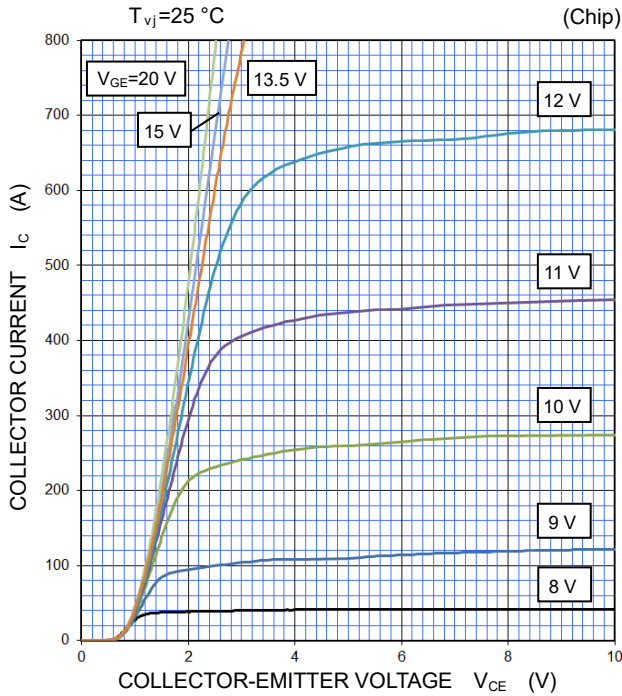
Di2

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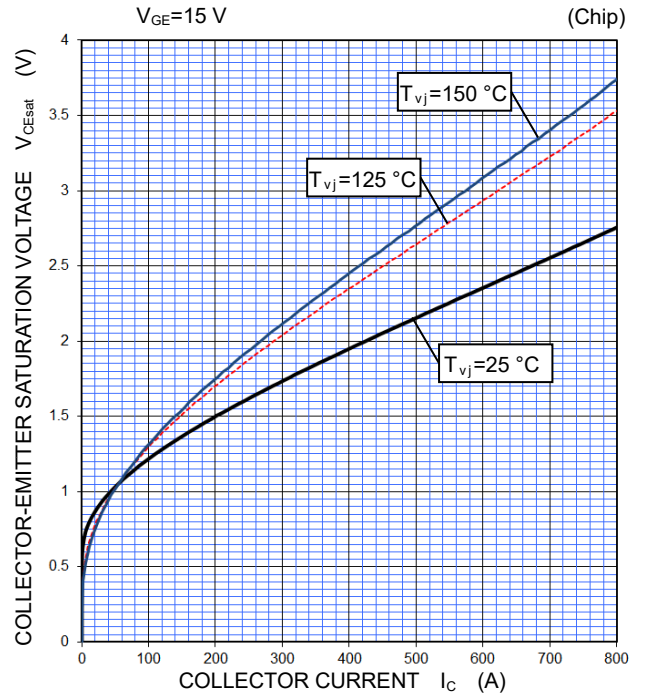
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

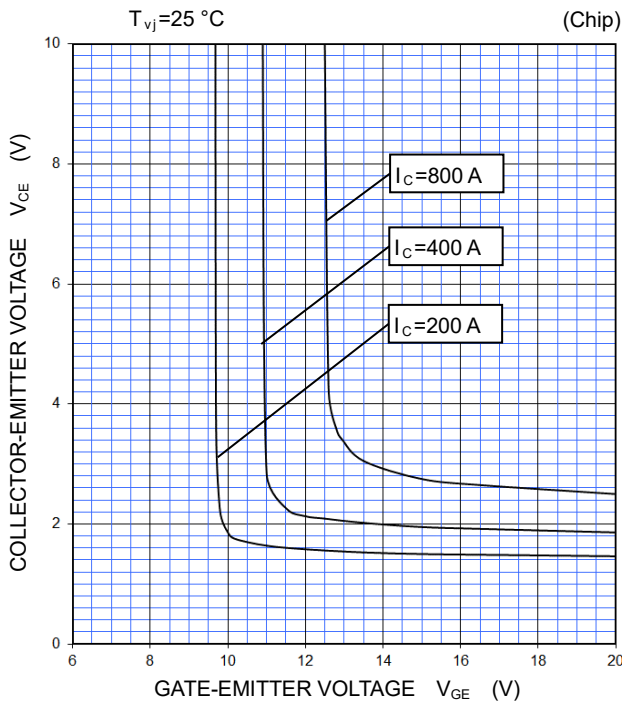
**OUTPUT CHARACTERISTICS
(TYPICAL)**



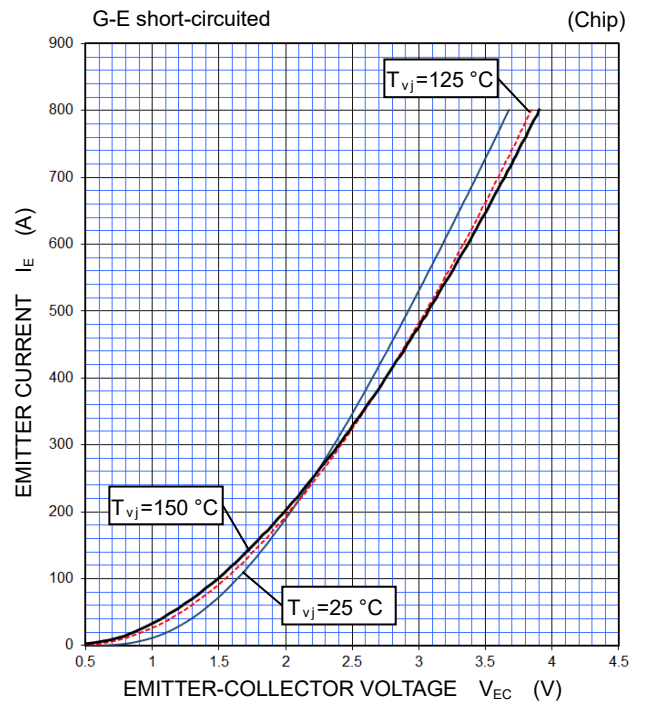
**COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)**



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



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



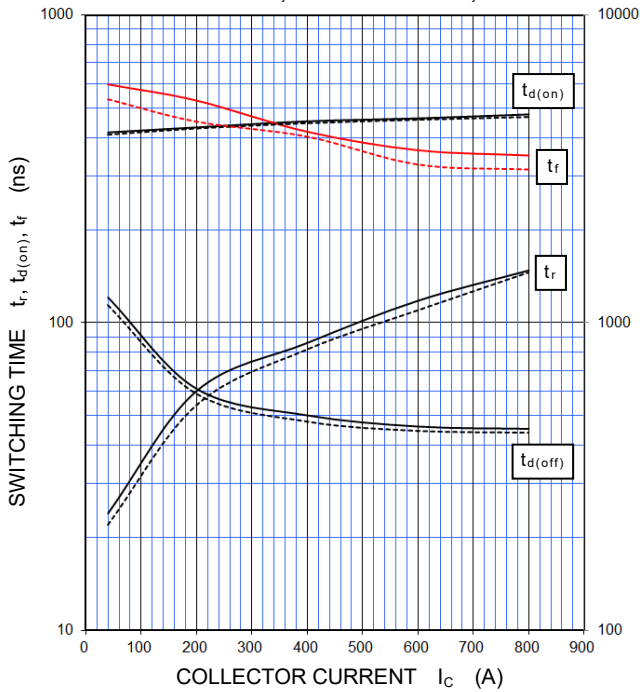
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HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

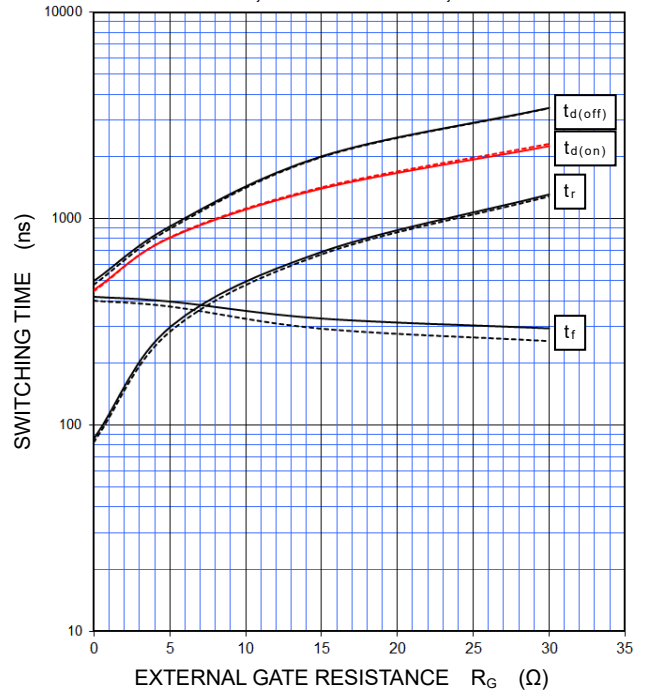
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



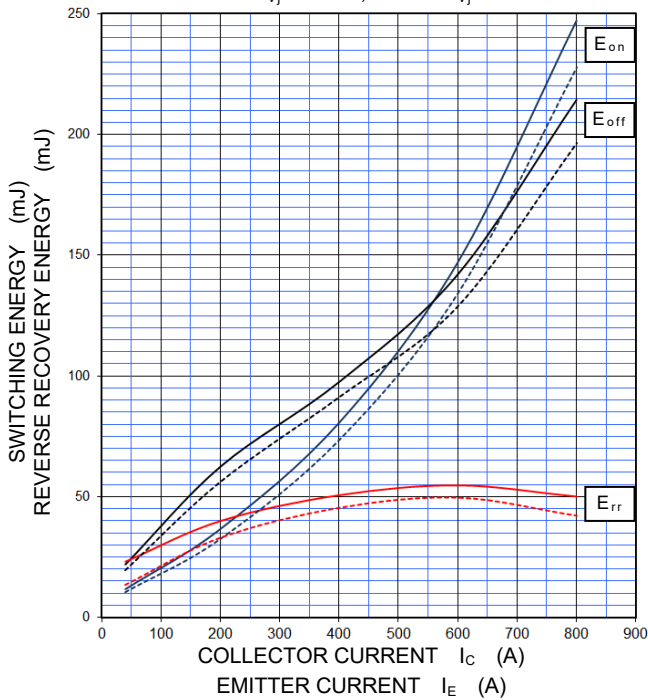
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=400\text{ A}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



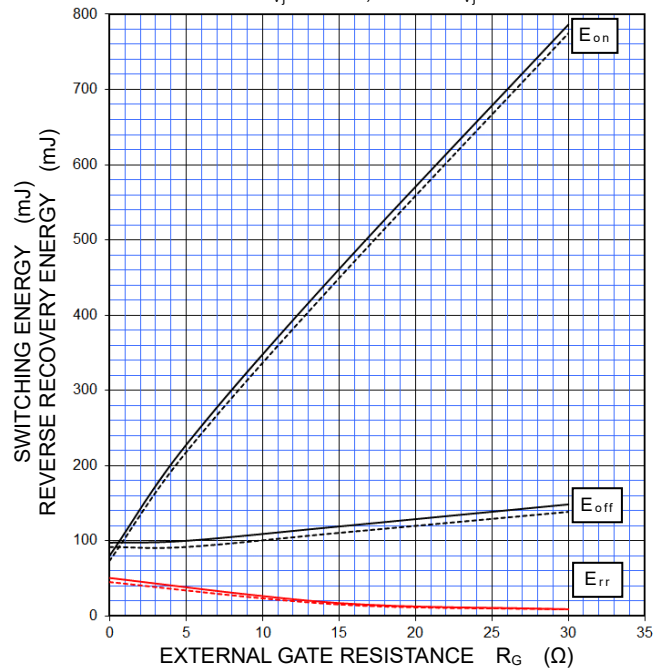
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=400\text{ A}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$

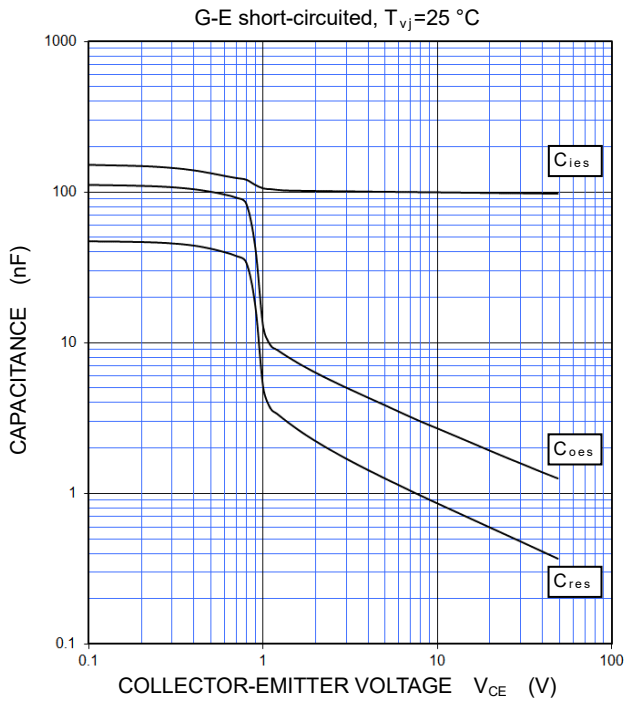


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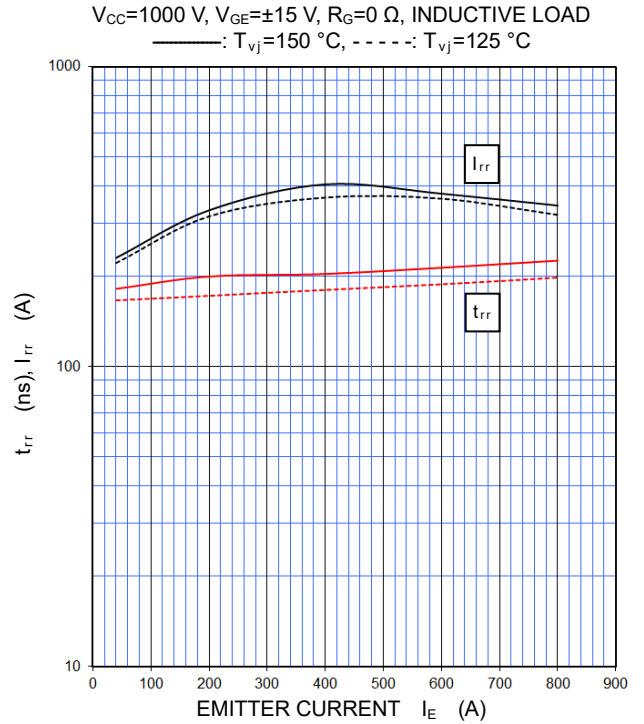
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

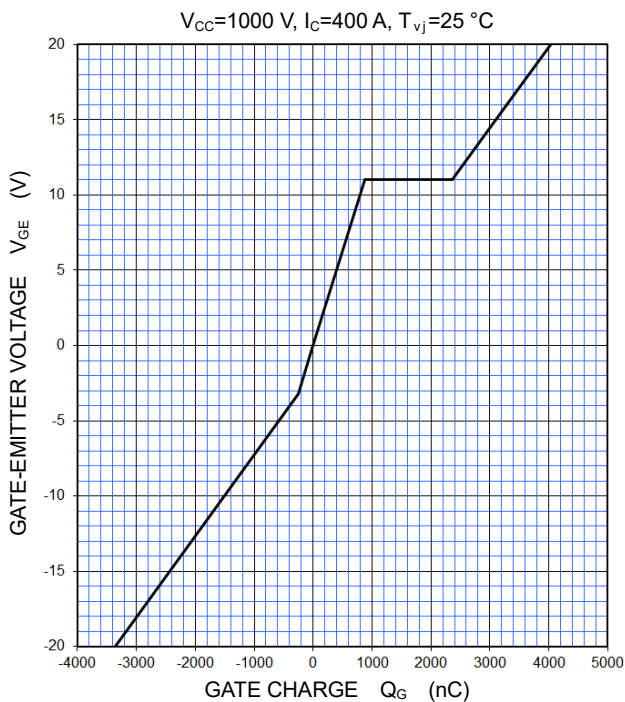
**CAPACITANCE CHARACTERISTICS
(TYPICAL)**



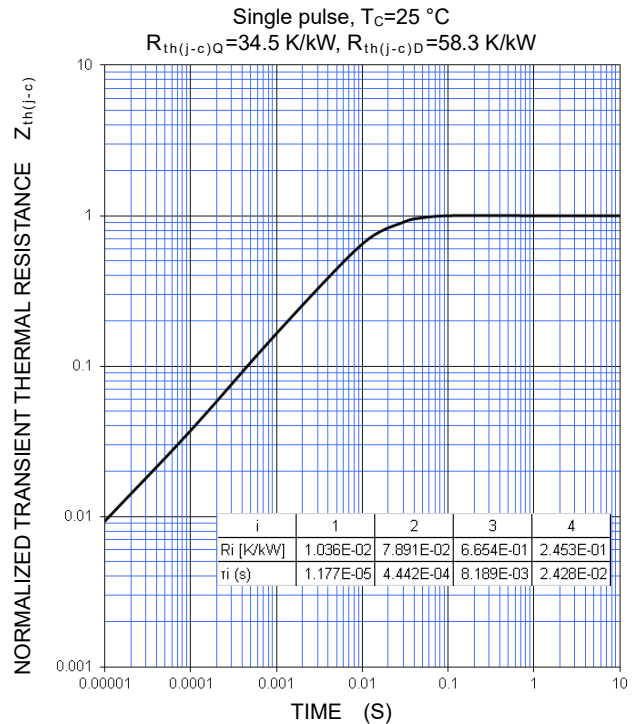
**FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)**



**GATE CHARGE CHARACTERISTICS
(TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)**



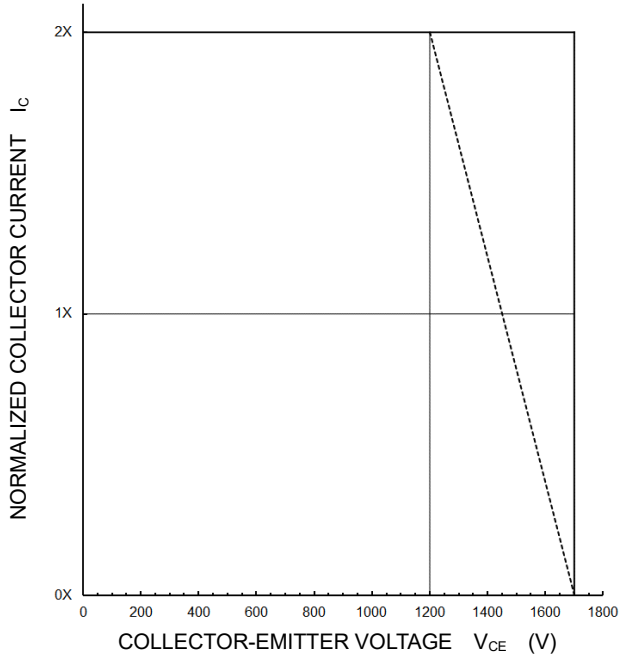
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HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

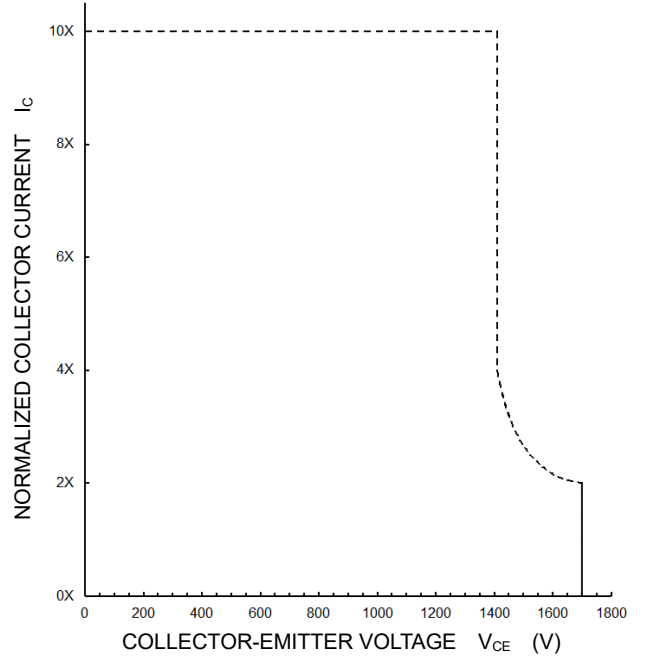
**TURN-OFF SWITCHING SAFE OPERATING AREA
(REVERSE BIAS SAFE OPERATING AREA)
(MAXIMUM)**

$V_{CC} \leq 1200 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0 \sim 30 \ \Omega$,
——: $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ (Normal load operations (Continuous))
- - - -: $T_{vj} = 175 \text{ }^\circ\text{C}$ (Unusual load operations (Limited period))



**SHORT-CIRCUIT SAFE OPERATING AREA
(MAXIMUM)**

$V_{CC} \leq 1200 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0 \sim 30 \ \Omega$,
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$, $t_W \leq 8 \ \mu\text{s}$, Non-Repetitive



Note: The characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

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