

# CM200DX-24S

HIGH POWER SWITCHING USE  
INSULATED TYPE

## CM200DX-24S



Dual (Half-Bridge)

- 6th Generation NX series -

Collector current  $I_C$  ..... 200 A

Collector-emitter voltage  $V_{CES}$  ..... 1200 V

Maximum junction temperature  $T_{jmax}$  ... 175 °C

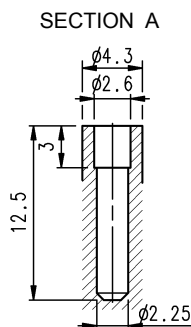
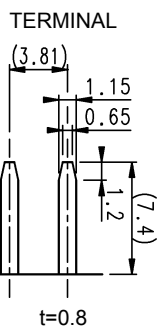
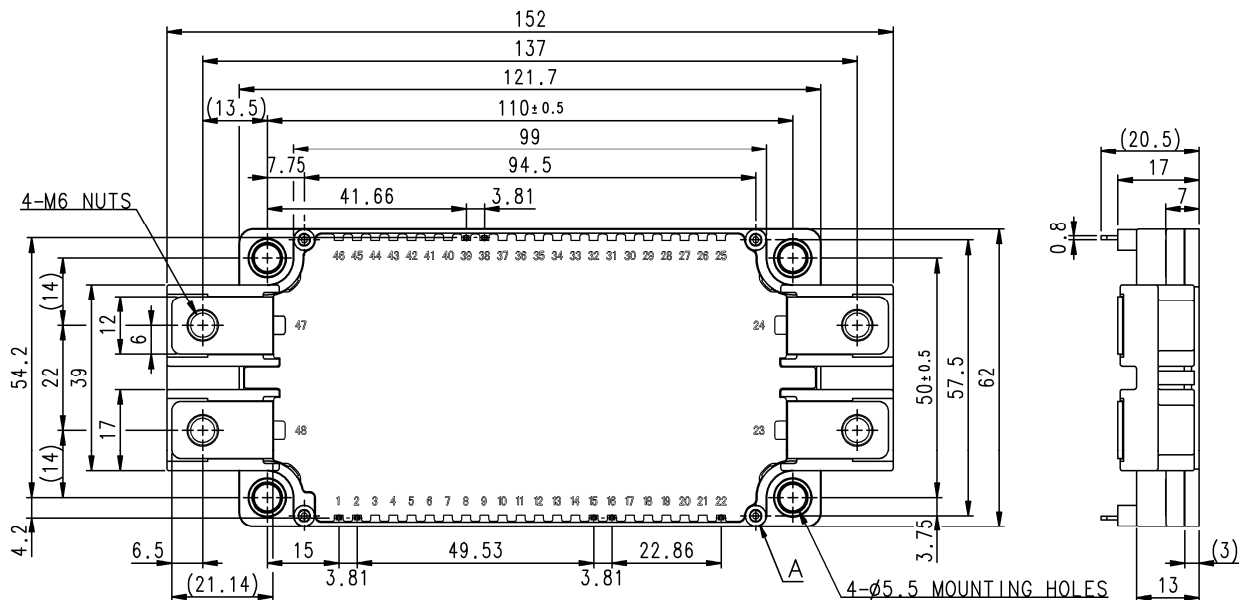
- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File E323585

## APPLICATION

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

## OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm

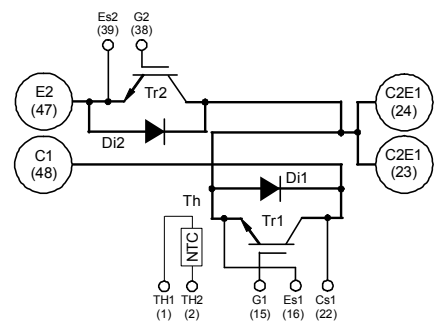


Tolerance otherwise specified

| 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      |

The tolerance of size between terminals is assumed to be ±0.4.

### INTERNAL CONNECTION



**ABSOLUTE MAXIMUM RATINGS ( $T_j=25\text{ }^\circ\text{C}$ , unless otherwise specified)****INVERTER PART IGBT/FWDI**

| Symbol             | Item                      | Conditions                                   | Rating   | Unit |
|--------------------|---------------------------|--|----------|------|
| $V_{CES}$          | Collector-emitter voltage | G-E short-circuited                          | 1200     | V    |
| $V_{GES}$          | Gate-emitter voltage      | C-E short-circuited                          | $\pm 20$ | V    |
| $I_C$              | Collector current         | DC, $T_C=119\text{ }^\circ\text{C}$ (Note.2) | 200      | A    |
| $I_{CRM}$          |                           | Pulse, Repetitive (Note.3)                   | 400      |      |
| $P_{tot}$          | Total power dissipation   | $T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)   | 1500     | W    |
| $I_E$ (Note.1)     | Emitter current           | $T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)   | 200      | A    |
| $I_{ERM}$ (Note.1) |                           | Pulse, Repetitive (Note.3)                   | 400      |      |

**MODULE**

| Symbol     | Item                           | Conditions                                      | Rating     | Unit             |
|------------|--------------------------------|---|------------|------------------|
| $T_{jmax}$ | Maximum junction temperature   | -   | 175        | $^\circ\text{C}$ |
| $T_{Cmax}$ | Maximum case temperature       | (Note.2)  | 125        |                  |
| $T_{jop}$  | Operating junction temperature | -   | -40 ~ +150 | $^\circ\text{C}$ |
| $T_{stg}$  | Storage temperature            | -   | -40 ~ +125 |                  |
| $V_{isol}$ | Isolation voltage              | Terminals to base plate, RMS, f=60 Hz, AC 1 min | 2500       | V                |

**ELECTRICAL CHARACTERISTICS ( $T_j=25\text{ }^\circ\text{C}$ , unless otherwise specified)****INVERTER PART IGBT/FWDI**

| 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  | -                               | -    | 0.5  | $\mu\text{A}$ |   |
| $V_{GE(th)}$                    | Gate-emitter threshold voltage       | $I_C=20\text{ mA}$ , $V_{CE}=10\text{ V}$   | 5.4                             | 6.0  | 6.6  | V             |   |
| $V_{CESat}$<br>(Terminal)       | Collector-emitter saturation voltage | $I_C=200\text{ A}$ (Note.5),<br>$V_{GE}=15\text{ V}$  | $T_j=25\text{ }^\circ\text{C}$  | -    | 1.80 | 2.25          | V |
|                                 |                                      |   | $T_j=125\text{ }^\circ\text{C}$ | -    | 2.00 | -             |   |
|                                 |                                      |   | $T_j=150\text{ }^\circ\text{C}$ | -    | 2.05 | -             |   |
| $V_{CESat}$<br>(Chip)           | Collector-emitter saturation voltage | $I_C=200\text{ A}$ (Note.5),<br>$V_{GE}=15\text{ V}$  | $T_j=25\text{ }^\circ\text{C}$  | -    | 1.70 | 2.15          | V |
|                                 |                                      |   | $T_j=125\text{ }^\circ\text{C}$ | -    | 1.90 | -             |   |
|                                 |                                      |   | $T_j=150\text{ }^\circ\text{C}$ | -    | 1.95 | -             |   |
| $C_{ies}$                       | Input capacitance                    | $V_{CE}=10\text{ V}$ , G-E short-circuited  | -                               | -    | 20   | nF            |   |
| $C_{oes}$                       | Output capacitance                   |   | -                               | -    | 4.0  |               |   |
| $C_{res}$                       | Reverse transfer capacitance         |   | -                               | -    | 0.33 |               |   |
| $Q_G$                           | Gate charge                          | $V_{CC}=600\text{ V}$ , $I_C=200\text{ A}$ , $V_{GE}=15\text{ V}$   | -                               | 466  | -    | nC            |   |
| $t_{d(on)}$                     | Turn-on delay time                   | $V_{CC}=600\text{ V}$ , $I_C=200\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ ,<br>$R_G=0\text{ }\Omega$ , Inductive load | -                               | -    | 800  | ns            |   |
| $t_r$                           | Rise time                            |   | -                               | -    | 200  |               |   |
| $t_{d(off)}$                    | Turn-off delay time                  |   | -                               | -    | 600  |               |   |
| $t_f$                           | Fall time                            |   | -                               | -    | 300  |               |   |
| $V_{EC}$ (Note.1)<br>(Terminal) | Emitter-collector voltage            | $I_E=200\text{ A}$ (Note.5),<br>G-E short-circuited   | $T_j=25\text{ }^\circ\text{C}$  | -    | 1.8  | 2.25          | V |
|                                 |                                      |   | $T_j=125\text{ }^\circ\text{C}$ | -    | 1.8  | -             |   |
|                                 |                                      |   | $T_j=150\text{ }^\circ\text{C}$ | -    | 1.8  | -             |   |
| $V_{EC}$ (Note.1)<br>(Chip)     | Emitter-collector voltage            | $I_E=200\text{ A}$ (Note.5),<br>G-E short-circuited   | $T_j=25\text{ }^\circ\text{C}$  | -    | 1.7  | 2.15          | V |
|                                 |                                      |   | $T_j=125\text{ }^\circ\text{C}$ | -    | 1.7  | -             |   |
|                                 |                                      |   | $T_j=150\text{ }^\circ\text{C}$ | -    | 1.7  | -             |   |
| $t_{rr}$ (Note.1)               | Reverse recovery time                | $V_{CC}=600\text{ V}$ , $I_E=200\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ ,   | -                               | -    | 300  | ns            |   |
| $Q_{rr}$ (Note.1)               | Reverse recovery charge              | $R_G=0\text{ }\Omega$ , Inductive load  | -                               | 10.7 | -    | $\mu\text{C}$ |   |
| $E_{on}$                        | Turn-on switching energy per pulse   | $V_{CC}=600\text{ V}$ , $I_C=I_E=200\text{ A}$ ,  | -                               | 30.7 | -    | mJ            |   |
| $E_{off}$                       | Turn-off switching energy per pulse  | $V_{GE}=\pm 15\text{ V}$ , $R_G=0\text{ }\Omega$ , $T_j=150\text{ }^\circ\text{C}$ ,                              | -                               | 21.5 | -    |               |   |
| $E_{rr}$ (Note.1)               | Reverse recovery energy per pulse    | Inductive load  | -                               | 14.2 | -    | mJ            |   |
| $R_{CC'+EE'}$                   | Internal lead resistance             | Main terminals-chip, per switch,<br>$T_C=25\text{ }^\circ\text{C}$ (Note.2)                                       | -                               | -    | 1.1  | m $\Omega$    |   |
| $r_g$                           | Internal gate resistance             | Per switch  | -                               | 9.8  | -    | $\Omega$      |   |

**ELECTRICAL CHARACTERISTICS (cont.; T<sub>j</sub>=25 °C, unless otherwise specified)**

**NTC THERMISTOR PART**

| Symbol               | Item                    | Conditions                                      | Limits |      |      | Unit |
|----------------------|-------------------------|---|--------|------|------|------|
|                      |                         |   | Min.   | Typ. | Max. |      |
| R <sub>25</sub>      | Zero-power resistance   | T <sub>C</sub> =25 °C (Note.2)                  | 4.85   | 5.00 | 5.15 | kΩ   |
| ΔR/R                 | Deviation of resistance | T <sub>C</sub> =100 °C, R <sub>100</sub> =493 Ω | -7.3   | -    | +7.8 | %    |
| B <sub>(25/50)</sub> | B-constant              | Approximate by equation (Note.6)                | -      | 3375 | -    | K    |
| P <sub>25</sub>      | Power dissipation       | T <sub>C</sub> =25 °C (Note.2)                  | -      | -    | 10   | mW   |

**THERMAL RESISTANCE CHARACTERISTICS**

| Symbol                | Item                                | Conditions  | Limits |      |      | Unit |
|-----------------------|-------------------------------------|---|--------|------|------|------|
|                       |                                     |   | Min.   | Typ. | Max. |      |
| R <sub>th(j-c)Q</sub> | Thermal resistance (Note.2)         | Junction to case, per Inverter IGBT                                 | -      | -    | 0.10 | K/W  |
| R <sub>th(j-c)D</sub> |                                     | Junction to case, per Inverter FWDi                                 | -      | -    | 0.19 | K/W  |
| R <sub>th(c-s)</sub>  | Contact thermal resistance (Note.2) | Case to heat sink, per 1 module,<br>Thermal grease applied (Note.7) | -      | 15   | -    | K/kW |

**MECHANICAL CHARACTERISTICS**

| Symbol         | Item                   | Conditions                      | Limits |      |      | Unit |
|----------------|------------------------|---------------------------------|--------|------|------|------|
|                |                        |                                 | Min.   | Typ. | Max. |      |
| M <sub>t</sub> | Mounting torque        | Main terminals M 6 screw        | 3.5    | 4.0  | 4.5  | N·m  |
| M <sub>s</sub> |                        | Mounting to heat sink M 5 screw | 2.5    | 3.0  | 3.5  |      |
| d <sub>s</sub> | Creepage distance      | Terminal to terminal            | 11.55  | -    | -    | mm   |
|                |                        | Terminal to base plate          | 12.32  | -    | -    |      |
| d <sub>a</sub> | Clearance              | Terminal to terminal            | 10.00  | -    | -    | mm   |
|                |                        | Terminal to base plate          | 10.85  | -    | -    |      |
| m              | Weight                 | -                               | -      | 350  | -    | g    |
| e <sub>c</sub> | Flatness of base plate | On the centerline X, Y (Note.8) | ±0     | -    | +100 | μm   |

Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).

Note.2: Case temperature (T<sub>C</sub>) and heat sink temperature (T<sub>s</sub>) 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.  
The heat sink thermal resistance should measure just under the chips.

Note.3: Pulse width and repetition rate should be such that the device junction temperature (T<sub>j</sub>) dose not exceed T<sub>jmax</sub> rating.

Note.4: Junction temperature (T<sub>j</sub>) should not increase beyond T<sub>jmax</sub> rating.

Note.5: Pulse width and repetition rate should be such as to cause negligible temperature rise.

Refer to the figure of test circuit for V<sub>CEsat</sub>, V<sub>EC</sub>.

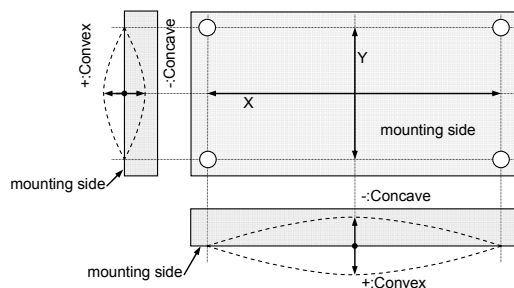
Note.6:  $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$

R<sub>25</sub>: resistance at absolute temperature T<sub>25</sub> [K]; T<sub>25</sub>=25 [°C]+273.15=298.15 [K]

R<sub>50</sub>: resistance at absolute temperature T<sub>50</sub> [K]; T<sub>50</sub>=50 [°C]+273.15=323.15 [K]

Note.7: Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).

Note.8: The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



Note.9: Japan Electronics and Information Technology Industries Association (JEITA) standards,

"EIAJ ED-4701/300: Environmental and endurance test methods for semiconductor devices (Stress test I)"

Note.10: Use the following screws when mounting the printed circuit board (PCB) on the stand offs.

"M2.6×10 or M2.6×12 self tapping screw"

The length of the screw depends on the thickness of the PCB.

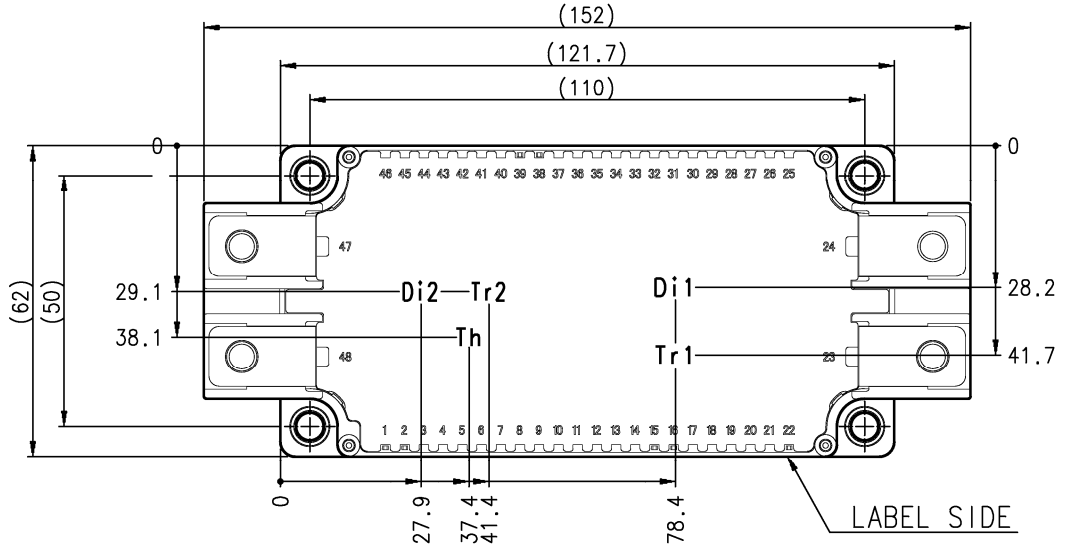
MITSUBISHI IGBT MODULES  
**CM200DX-24S**  
 HIGH POWER SWITCHING USE  
 INSULATED TYPE

**RECOMMENDED OPERATING CONDITIONS (T<sub>a</sub>=25 °C)**

| Symbol            | Item                          | Conditions                   | Limits |      |      | Unit |
|-------------------|-------------------------------|------------------------------|--------|------|------|------|
|                   |                               |                              | Min.   | Typ. | Max. |      |
| V <sub>CC</sub>   | (DC) Supply voltage           | Applied across C1-E2         | -      | 600  | 850  | V    |
| V <sub>GEon</sub> | Gate (-emitter drive) voltage | Applied across G1-Es1/G2-Es2 | 13.5   | 15.0 | 16.5 | V    |
| R <sub>G</sub>    | External gate resistance      | Per switch                   | 0      | -    | 22   | Ω    |

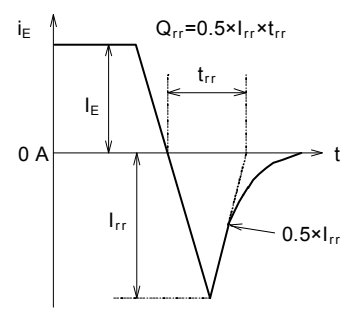
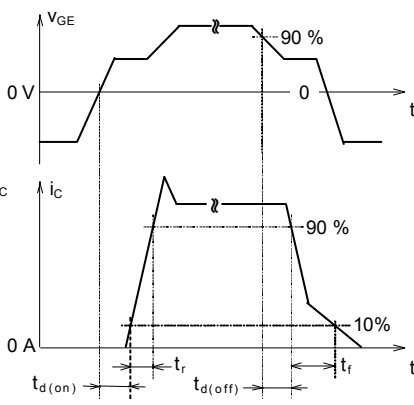
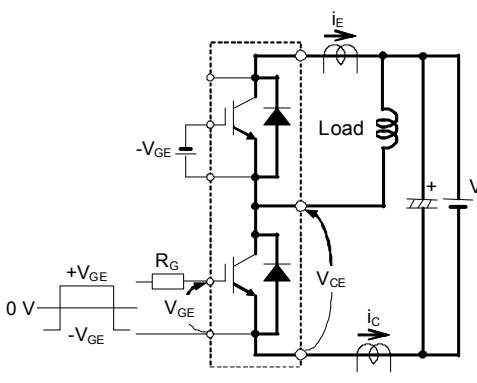
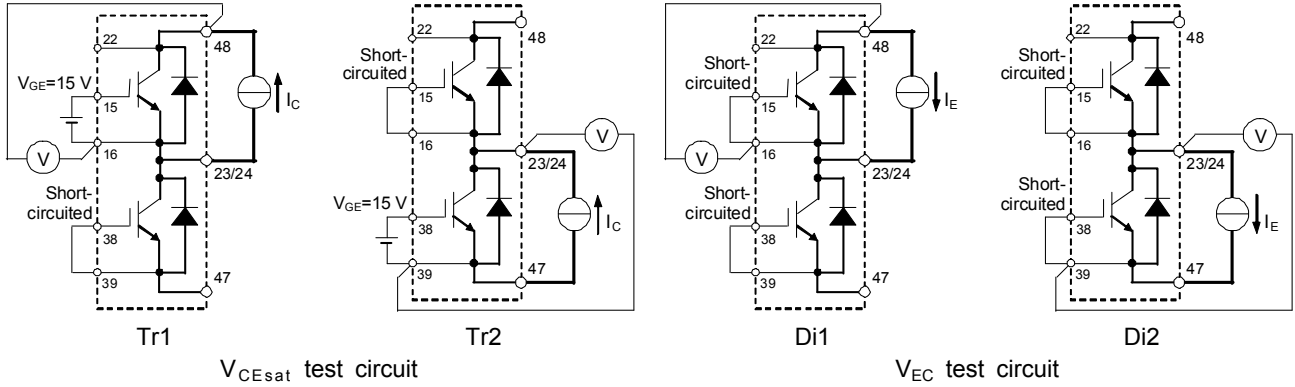
**CHIP LOCATION (top view)**

Dimension in mm, tolerance: ±1 mm



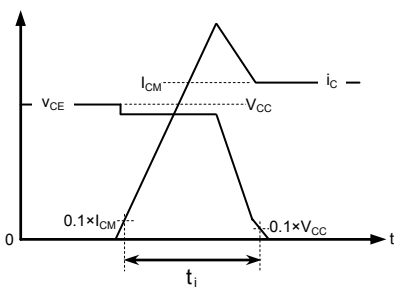
Tr1/Tr2: IGBT, Di1/Di2: FWDi, Th: NTC thermistor. Each mark points the center position of each chip.

**TEST CIRCUIT AND WAVEFORMS**

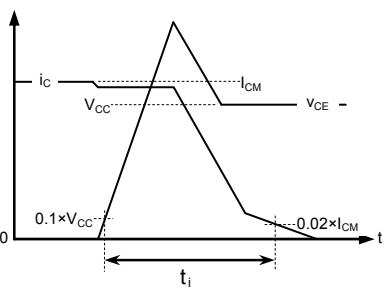


Switching characteristics test circuit and waveforms

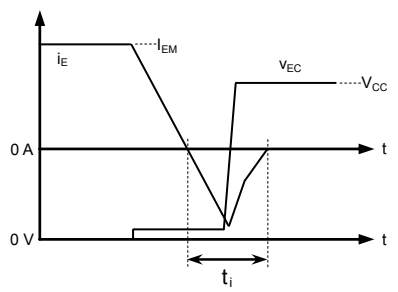
$t_{rr}$ ,  $Q_{rr}$  test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



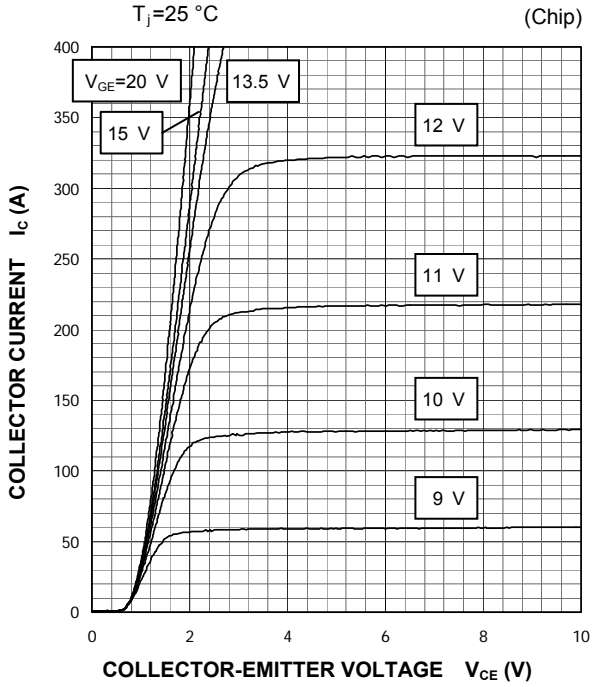
FWDi Reverse recovery energy

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

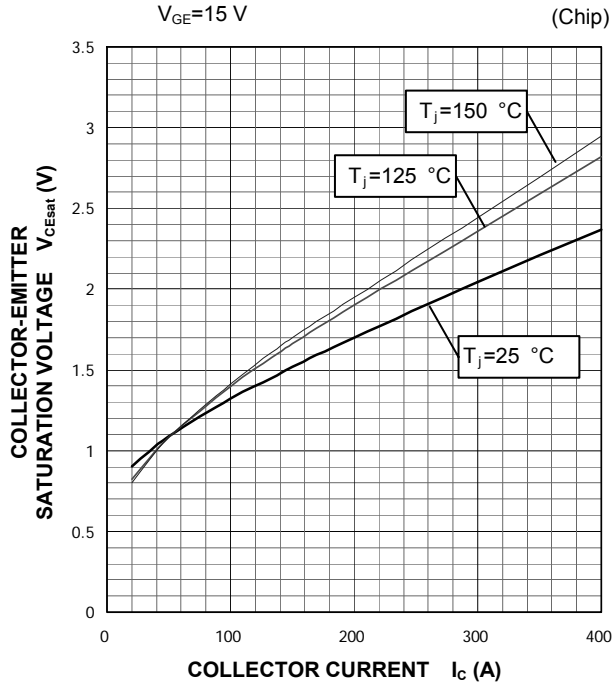
**PERFORMANCE CURVES**

**INVERTER PART**

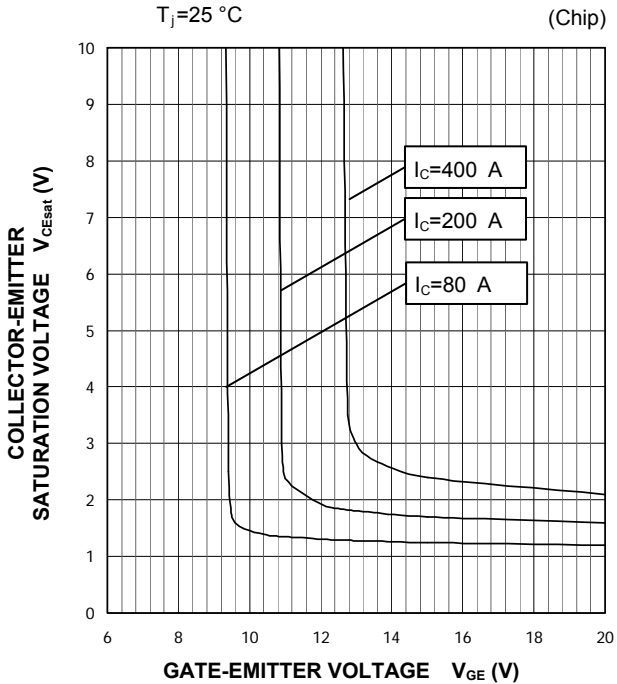
**OUTPUT CHARACTERISTICS (TYPICAL)**



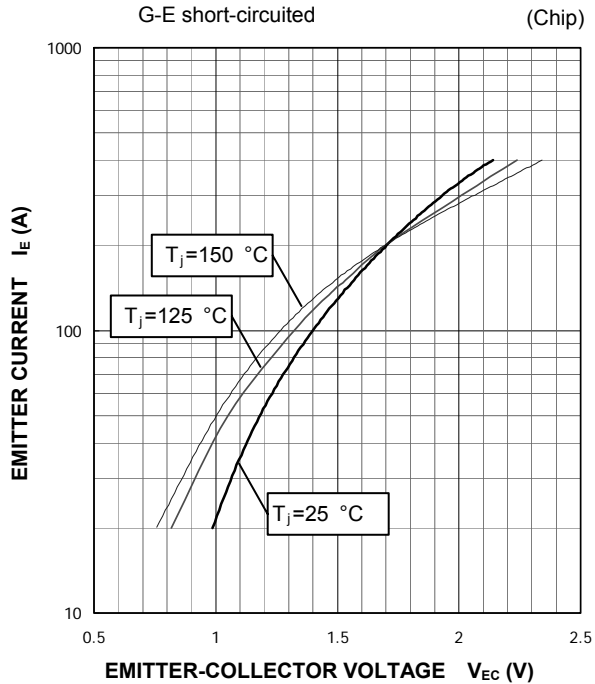
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



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

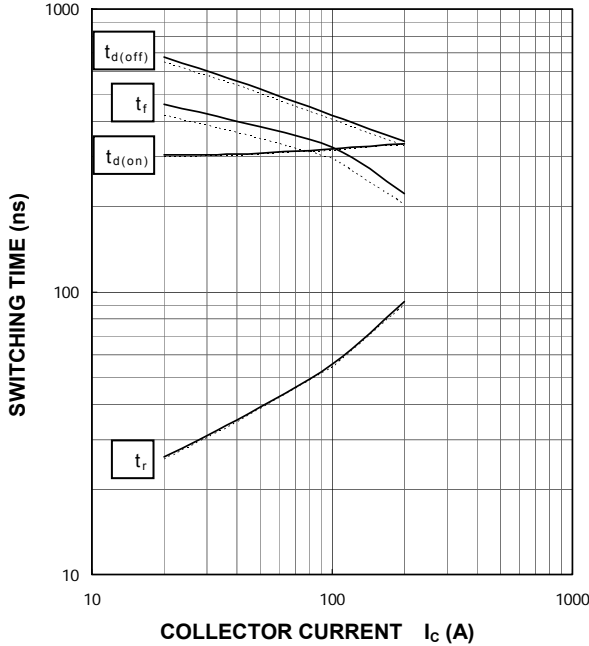


**FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)**



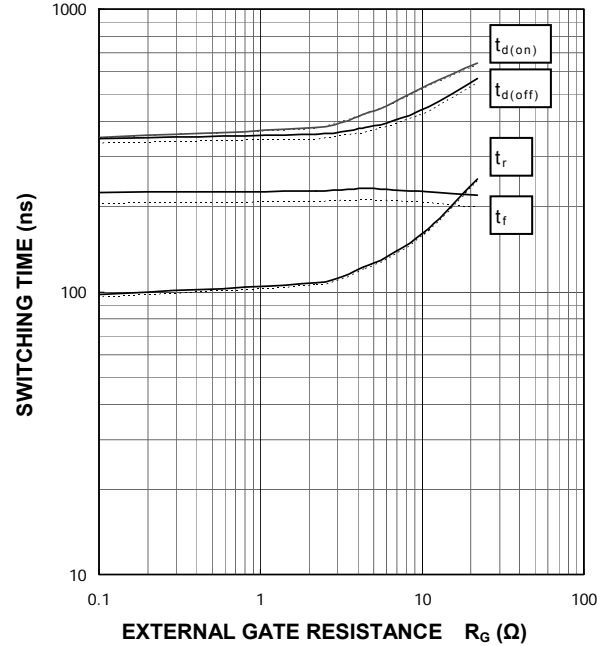
**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0\ \Omega$ , INDUCTIVE LOAD  
 —:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



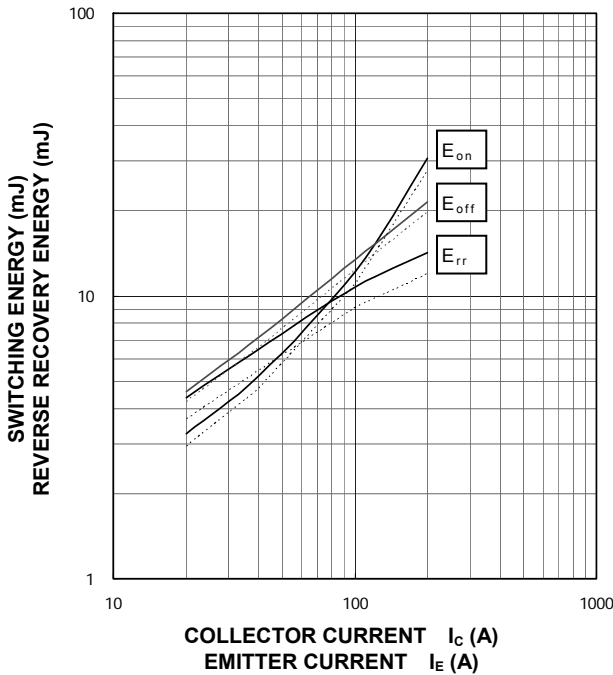
**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $I_C=200\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



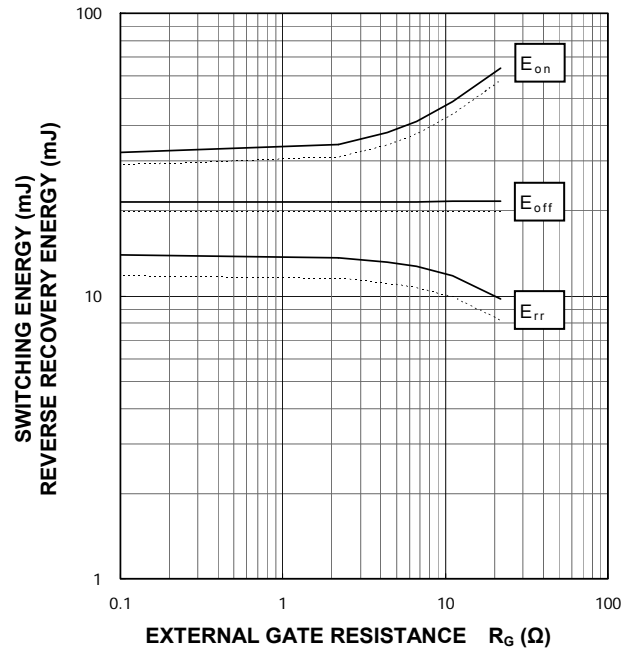
**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0\ \Omega$ ,  
 INDUCTIVE LOAD, PER PULSE  
 —:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



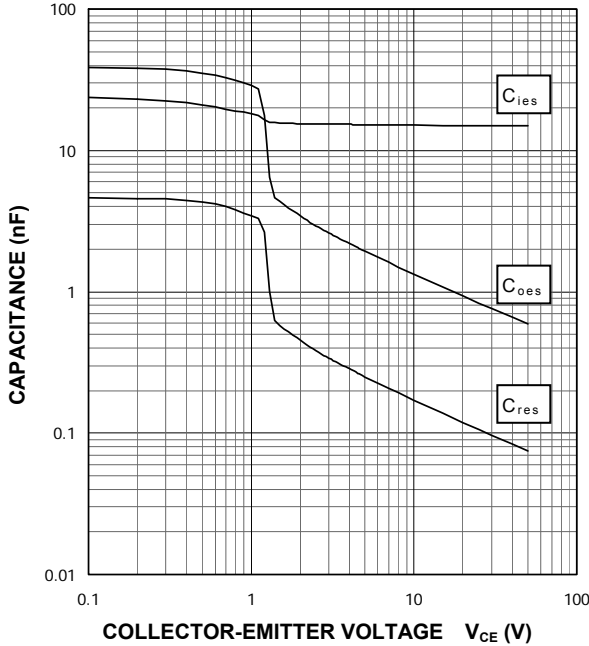
**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $I_C/I_E=200\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  
 INDUCTIVE LOAD, PER PULSE  
 —:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



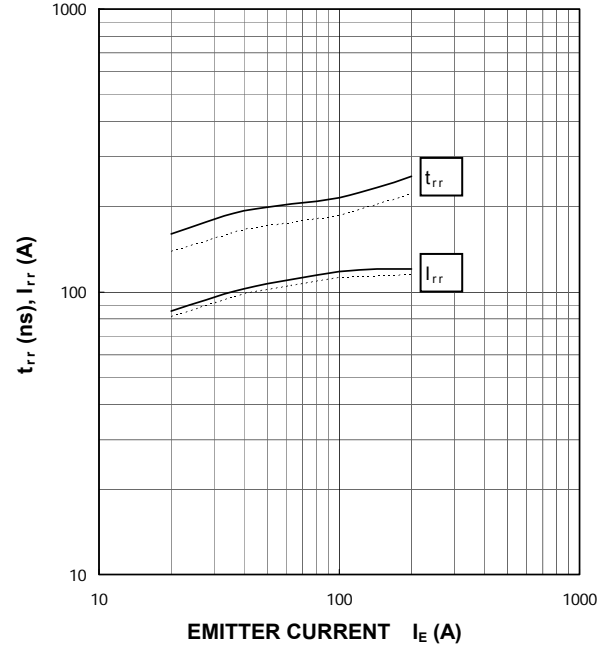
**CAPACITANCE CHARACTERISTICS  
 (TYPICAL)**

G-E short-circuited,  $T_j=25^\circ\text{C}$



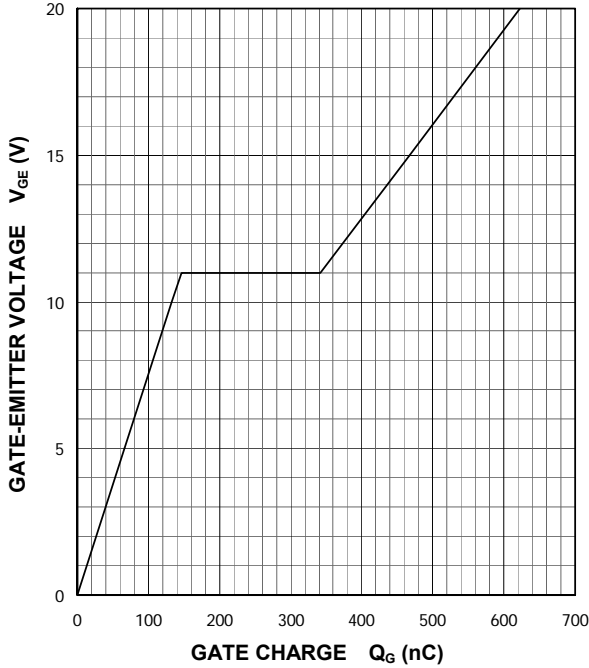
**FREE WHEELING DIODE  
 REVERSE RECOVERY CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0\ \Omega$ , INDUCTIVE LOAD  
 —:  $T_j=150^\circ\text{C}$ , - - - -:  $T_j=125^\circ\text{C}$



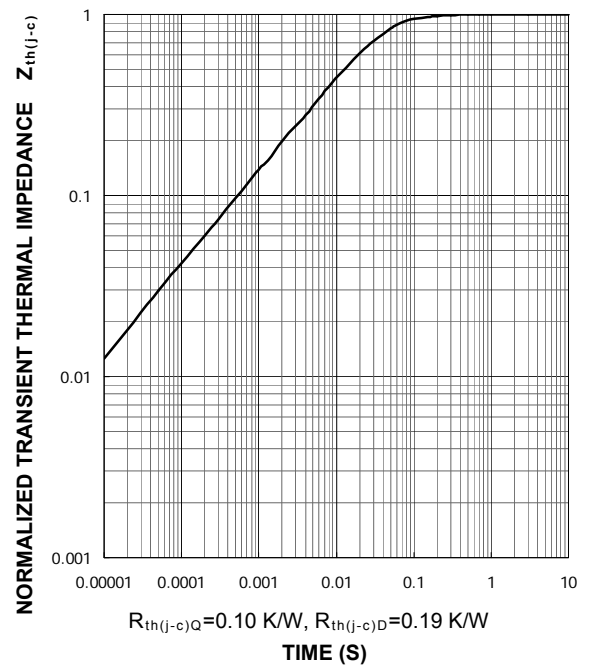
**GATE CHARGE CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $I_C=200\text{ A}$ ,  $T_j=25^\circ\text{C}$



**TRANSIENT THERMAL IMPEDANCE  
 CHARACTERISTICS  
 (MAXIMUM)**

Single pulse,  $T_C=25^\circ\text{C}$





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