

<Hybrid-SiC Modules>

CMH200DU-24NFH

HIGH POWER SWITCHING USE
INSULATED TYPE



dual switch (Half-Bridge)

Collector current I_C 200 A
 Collector-emitter voltage V_{CES} 1200 V
 Maximum junction temperature T_{jmax} 150 °C

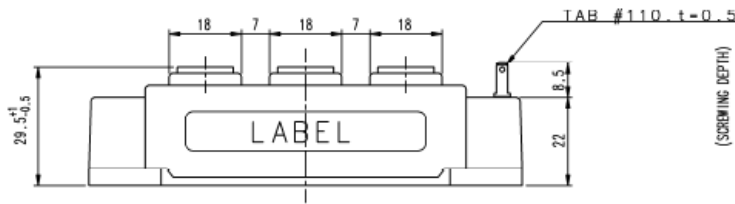
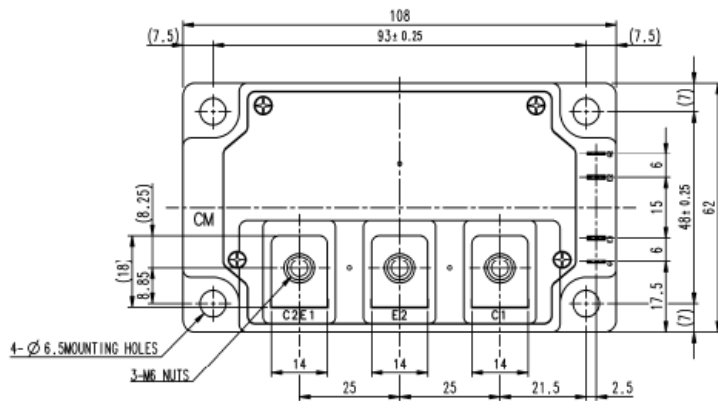
- Silicon IGBT + Silicon Carbide Schottky Barrier Diode
- Flat base Type
- Copper base plate
- RoHS Directive compliant
- Recognized under UL1557, File E323585

APPLICATION

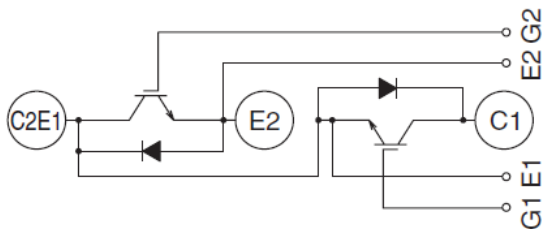
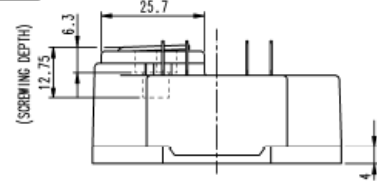
High frequency switching use(30kHz to 60kHz)
 Gradient magnetic power supply, Induction heating, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



INTERNAL CONNECTION



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 |

CMH200DU-24NFH

HIGH POWER SWITCHING USE
INSULATED TYPEMAXIMUM RATINGS ($T_j=25\text{ }^\circ\text{C}$, unless otherwise specified, per 1/2 module)

| 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 | ± 20 | V |
| I_C | Collector current | DC, $T_C=25\text{ }^\circ\text{C}$ (Note2, 4) | 200 | A |
| I_{CRM} | | Pulse, Repetitive (Note3) | 400 | |
| P_{tot} | Total power dissipation | $T_C=25\text{ }^\circ\text{C}$ (Note2, 4) | 1300 | W |
| I_E (Note1) | Emitter current | DC, $T_C=25\text{ }^\circ\text{C}$ (Note2, 4) | 200 | A |
| I_{ERM} (Note1) | | Pulse, Repetitive (Note3) | 400 | |
| V_{isol} | Isolation voltage | Terminals to base plate, RMS, f=60 Hz, AC 1 min | 4000 | V |
| T_j | Junction temperature | - (Note8) | -40 ~ +150 | $^\circ\text{C}$ |
| T_{stg} | Storage temperature | - | -40 ~ +125 | |

ELECTRICAL CHARACTERISTICS ($T_j=25\text{ }^\circ\text{C}$, unless otherwise specified, per 1/2 module)

| Symbol | Item | Conditions | Limits | | | Unit | |
|-------------------|--------------------------------------|---|--------|---------------------------------|------|---------------|---|
| | | | Min. | Typ. | Max. | | |
| I_{CES} | Collector-emitter cut-off current | $V_{CE}=V_{CES}$, G-E short-circuited | - | - | 11.0 | mA | |
| I_{GES} | Gate-emitter leakage current | $V_{GE}=V_{GES}$, C-E short-circuited | - | - | 0.7 | μA | |
| $V_{GE(th)}$ | Gate-emitter threshold voltage | $I_C=20\text{ mA}$, $V_{CE}=10\text{ V}$ | 4.5 | 6.0 | 7.5 | V | |
| V_{CESat} | Collector-emitter saturation voltage | $I_C=200\text{ A}$, $V_{GE}=15\text{ V}$ (Note5) | - | $T_j=25\text{ }^\circ\text{C}$ | 5.0 | 6.5 | V |
| | | Refer to the figure of test circuit | | $T_j=125\text{ }^\circ\text{C}$ | 5.0 | - | |
| C_{ies} | Input capacitance | $V_{CE}=10\text{ V}$, G-E short-circuited | - | - | 32 | nF | |
| C_{oes} | Output capacitance | | - | - | 2.7 | | |
| C_{res} | Reverse transfer capacitance | | - | - | 0.6 | | |
| Q_G | Gate charge | $V_{CC}=600\text{ V}$, $I_C=200\text{ A}$, $V_{GE}=15\text{ V}$ | - | 900 | - | nC | |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC}=600\text{ V}$, $I_C=200\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.6\text{ }\Omega$, Inductive load | - | - | 300 | ns | |
| t_r | Rise time | | - | - | 80 | | |
| $t_{d(off)}$ | Turn-off delay time | | - | - | 500 | | |
| t_f | Fall time | | - | - | 150 | | |
| V_{EC} (Note1) | Emitter-collector voltage | $I_E=200\text{ A}$, G-E short-circuited (Note5) | - | $T_j=25\text{ }^\circ\text{C}$ | 1.7 | 2.2 | V |
| | | Refer to the figure of test circuit | | $T_j=125\text{ }^\circ\text{C}$ | 2.2 | - | |
| Q_C (Note1) | Collector - emitter charge | $V_{CC}=600\text{ V}$, $I_E=200\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.6\text{ }\Omega$, Inductive load | - | 1.8 | - | μC | |
| E_{on} | Turn-on switching energy per pulse | $V_{CC}=600\text{ V}$, $I_C/I_E=200\text{ A}$, | - | 3.3 | - | mJ | |
| E_{off} | Turn-off switching energy per pulse | $V_{GE}=\pm 15\text{ V}$, $R_G=1.6\Omega$, | - | 8.0 | - | | |
| E_{rec} (Note1) | Reverse energy per pulse | $T_j=125\text{ }^\circ\text{C}$, Inductive load | - | 0.65 | - | mJ | |
| r_g | Internal gate resistance | Per switch | - | 0.8 | - | Ω | |

THERMAL RESISTANCE CHARACTERISTICS (per 1/2 module)

| Symbol | Item | Conditions | Limits | | | Unit |
|----------------|----------------------------|---|--------|------|-------|------|
| | | | Min. | Typ. | Max. | |
| $R_{th(j-c)Q}$ | Thermal resistance | Junction to case (Note4) | - | - | 0.095 | K/W |
| $R_{th(j-c)D}$ | | Junction to case (Note4) | - | - | 0.245 | |
| $R_{th(c-s)}$ | Contact thermal resistance | Case to heat sink, Thermal grease applied (Note4, 6, 8) | - | 0.04 | - | K/W |

Caution; No short-circuit capability is designed.

CMH200DU-24NFH

HIGH POWER SWITCHING USE
INSULATED TYPE

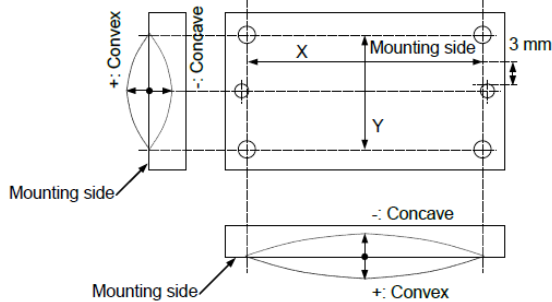
MECHANICAL CHARACTERISTICS

| 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 | 17.0 | - | - | mm |
| | | Terminal to base plate | 32.0 | - | - | |
| d_a | Clearance | Terminal to terminal | 11.0 | - | - | mm |
| | | Terminal to base plate | 29.4 | - | - | |
| m | mass | - | - | 400 | - | g |
| e_c | Flatness of base plate | On the centerline X (Note7) | -100 | - | 100 | μm |
| | | On the centerline Y (Note7) | -100 | - | 100 | |

*: 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 (DIODE).

- Junction temperature (T_j) should not increase beyond T_{jmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} 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.
- Typical value is measured by using thermally conductive grease of $\lambda=0.9 \text{ W/(m}\cdot\text{K)}$.
- The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



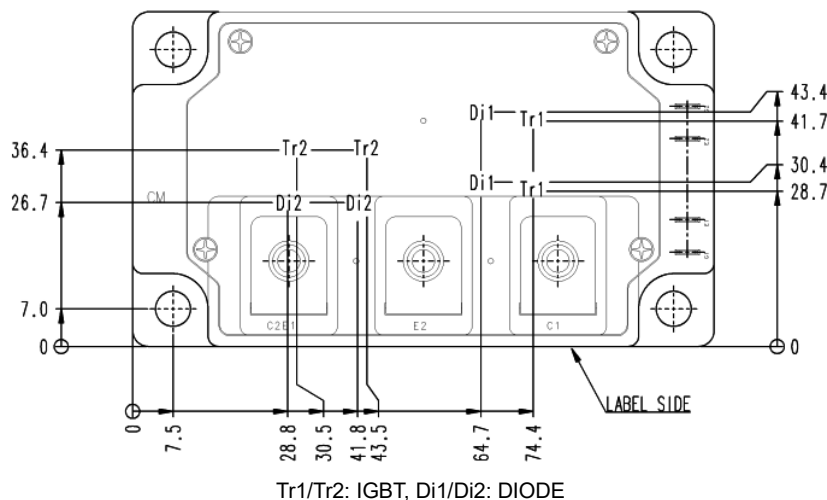
- Long term performance related to thermal conductive material such as thermal grease (including but not limited to aspects such as the increase of thermal resistance due to pumping out, etc.) should be verified under your specific application conditions. Temperature condition (T_j) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Item | Conditions | Limits | | | Unit |
|------------|-------------------------------|--|--------|------|------|----------|
| | | | Min. | Typ. | Max. | |
| V_{CC} | (DC) Supply voltage | Applied across C1-E2 terminals | - | 600 | 800 | 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 | 1.6 | - | 16 | Ω |

CHIP LOCATION (Top view)

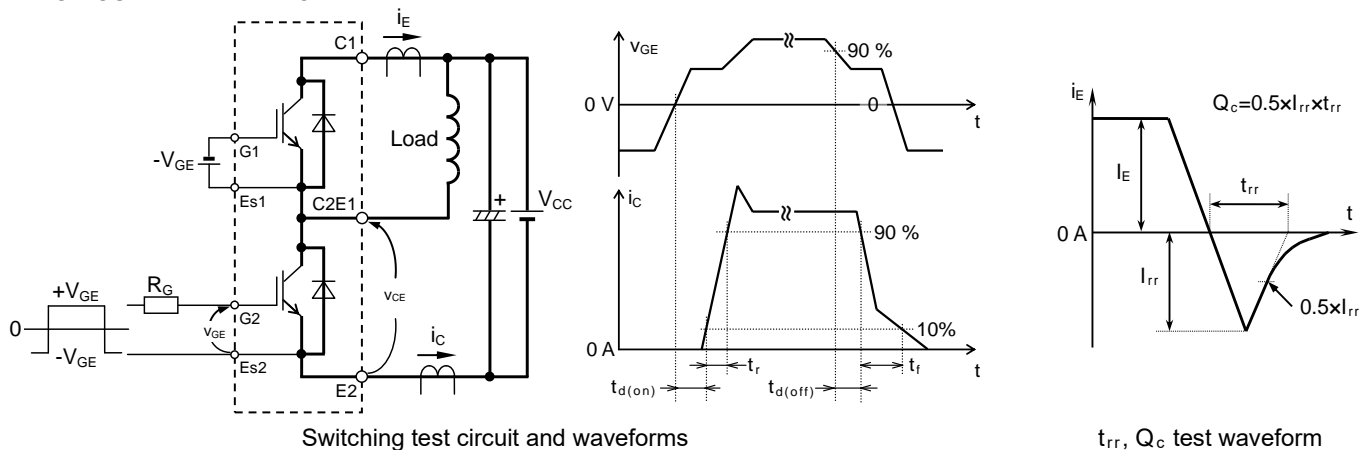
Dimension in mm, tolerance: $\pm 1 \text{ mm}$



CMH200DU-24NFH

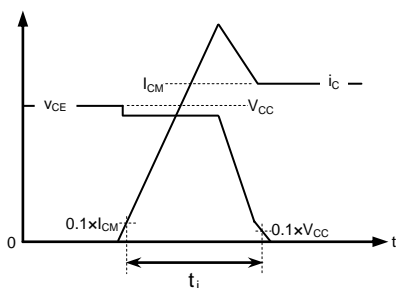
HIGH POWER SWITCHING USE
INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS

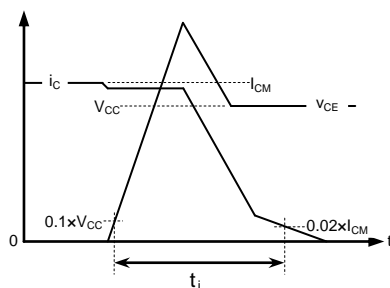


Switching test circuit and waveforms

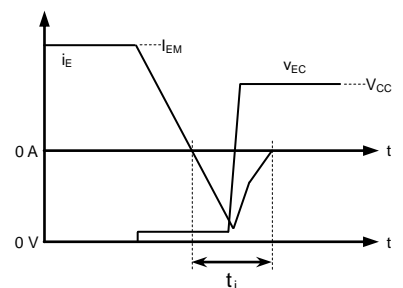
t_{rr} , Q_c test waveform



IGBT Turn-on switching energy



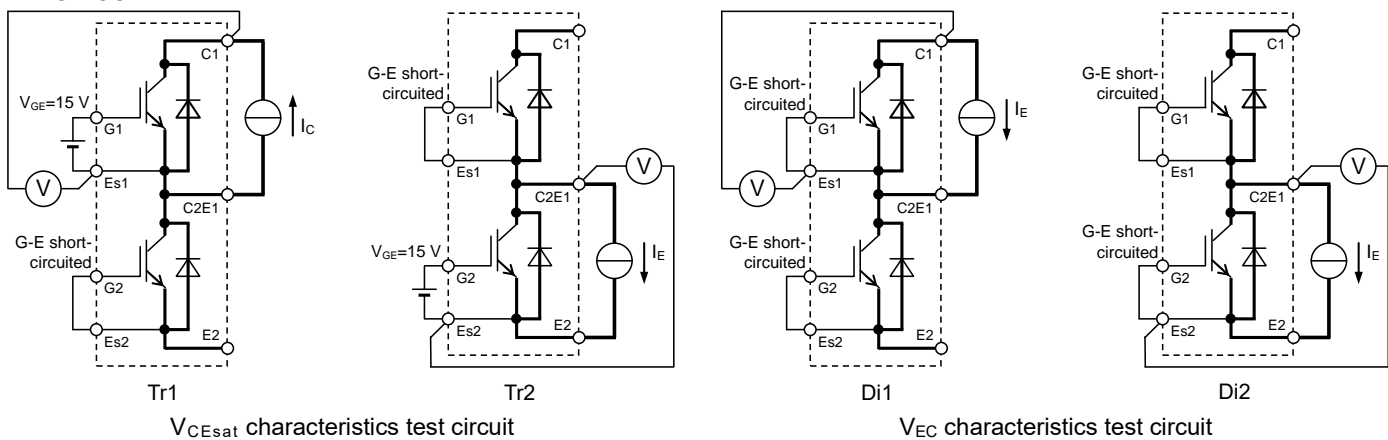
IGBT Turn-off switching energy



DIODE 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

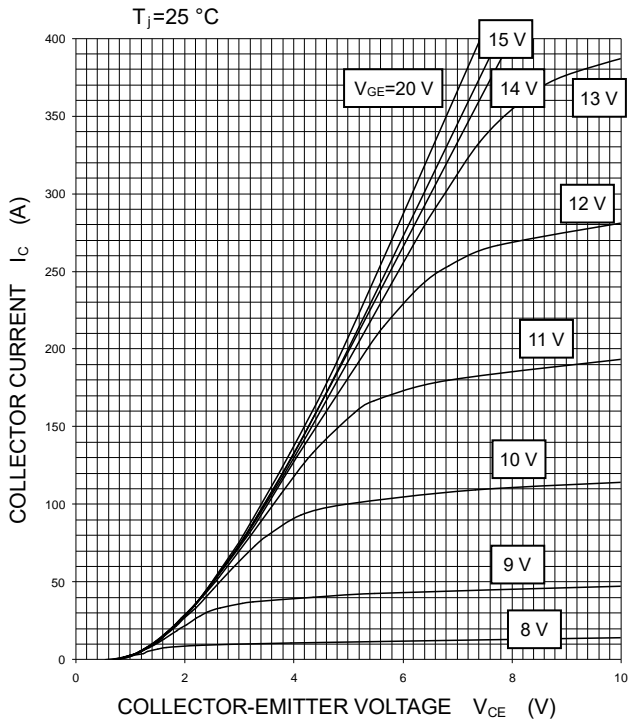
Di2

CMH200DU-24NFH

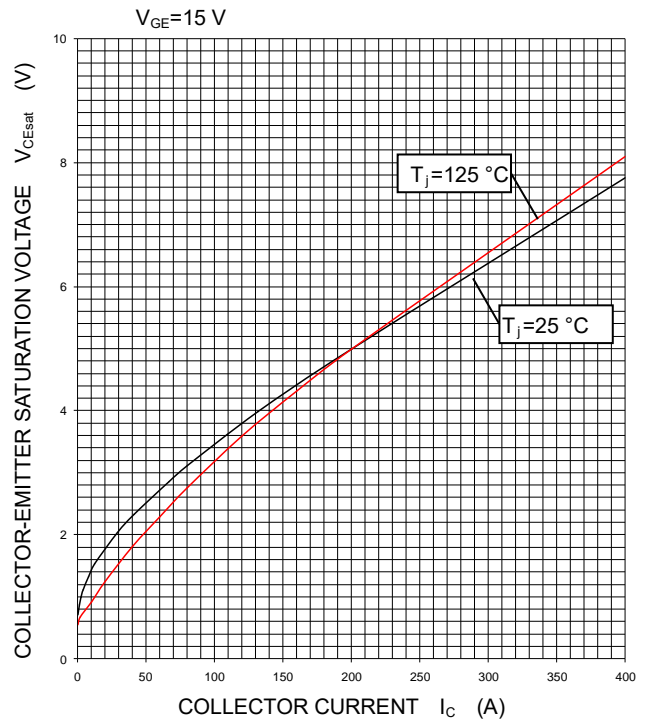
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

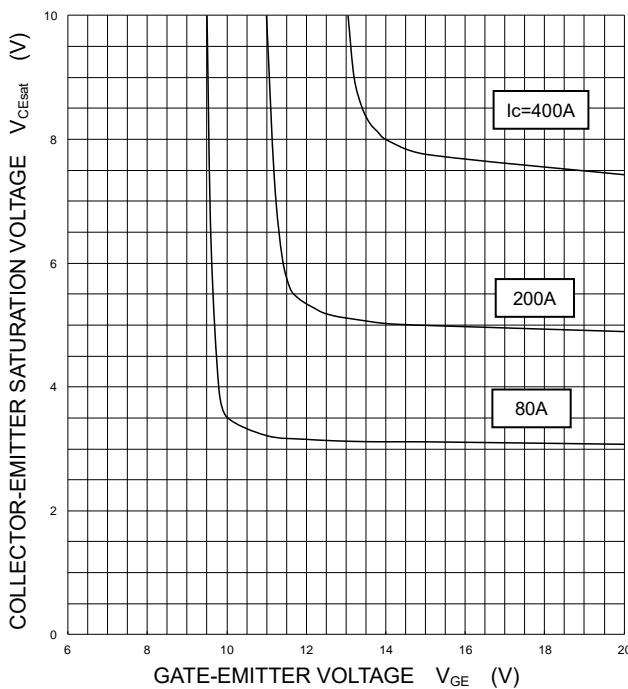
OUTPUT CHARACTERISTICS (TYPICAL)



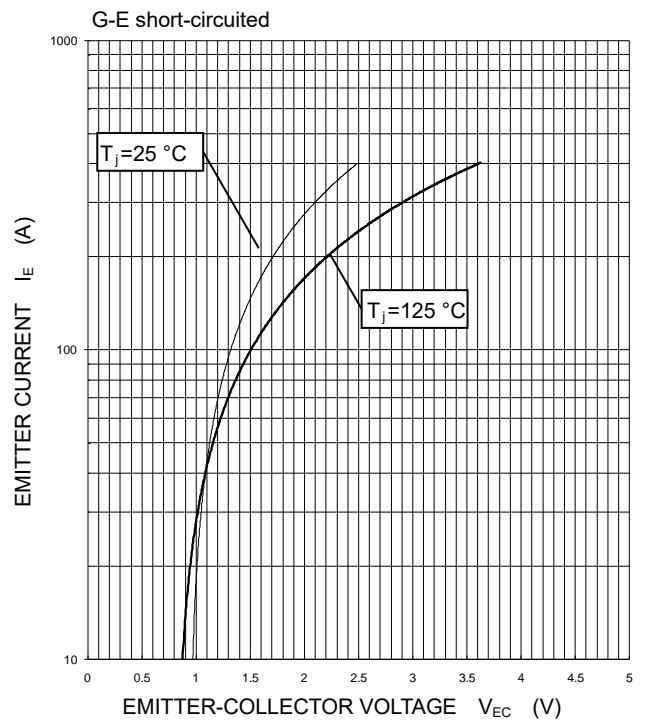
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



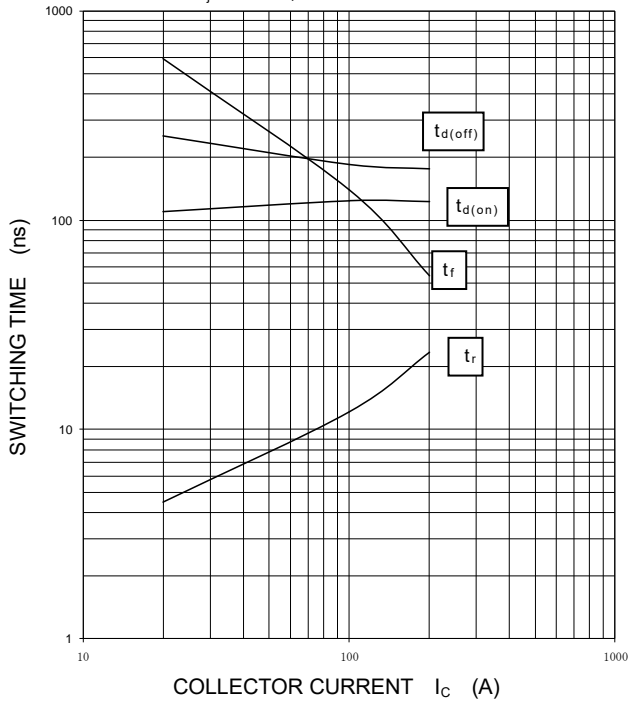
CMH200DU-24NFH

HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

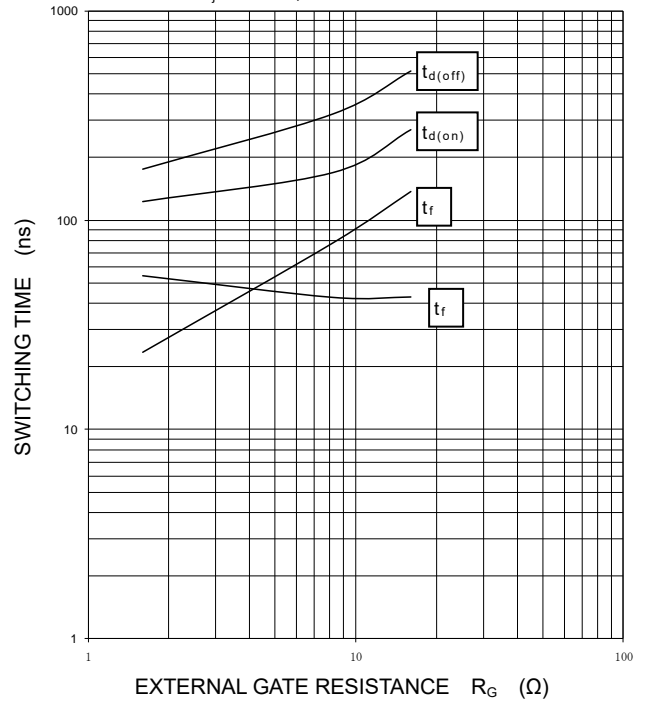
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.6\ \Omega$,
 $T_j=125\text{ }^\circ\text{C}$, INDUCTIVE LOAD



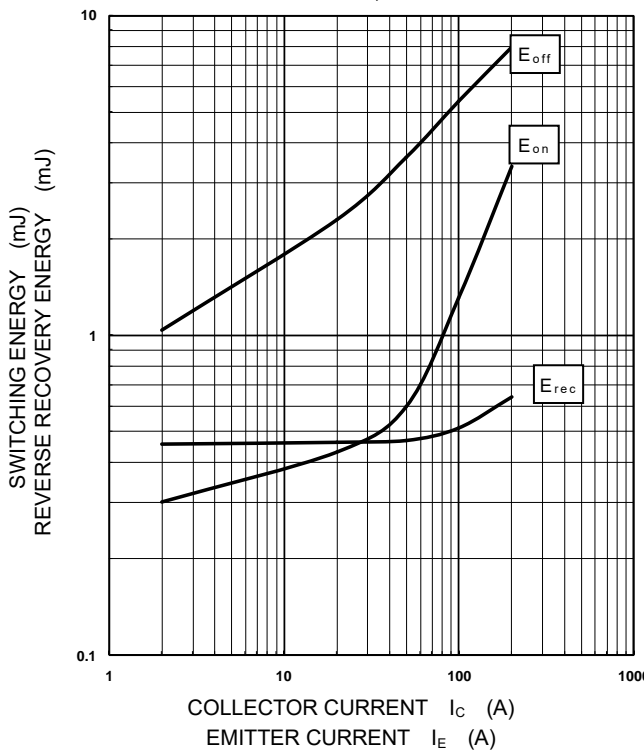
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



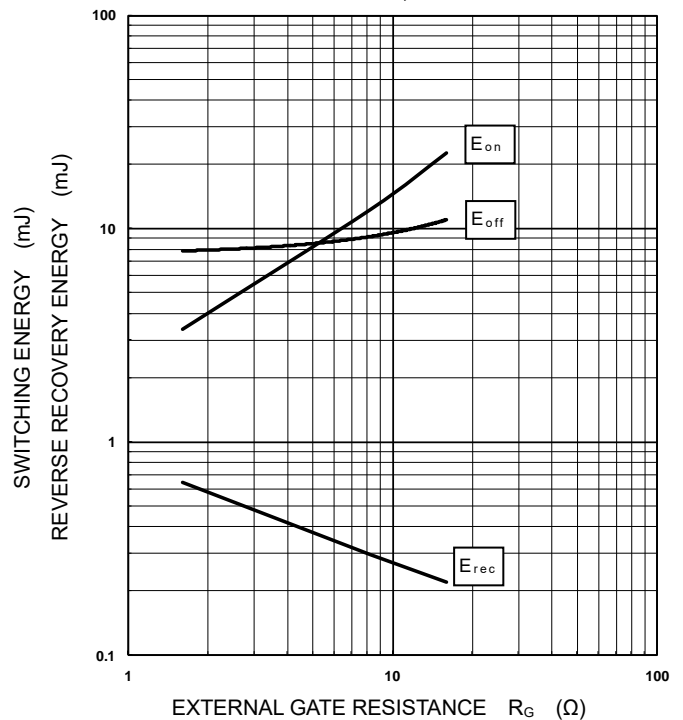
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.6\ \Omega$, $T_j=125\text{ }^\circ\text{C}$,
INDUCTIVE LOAD, PER PULSE



HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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

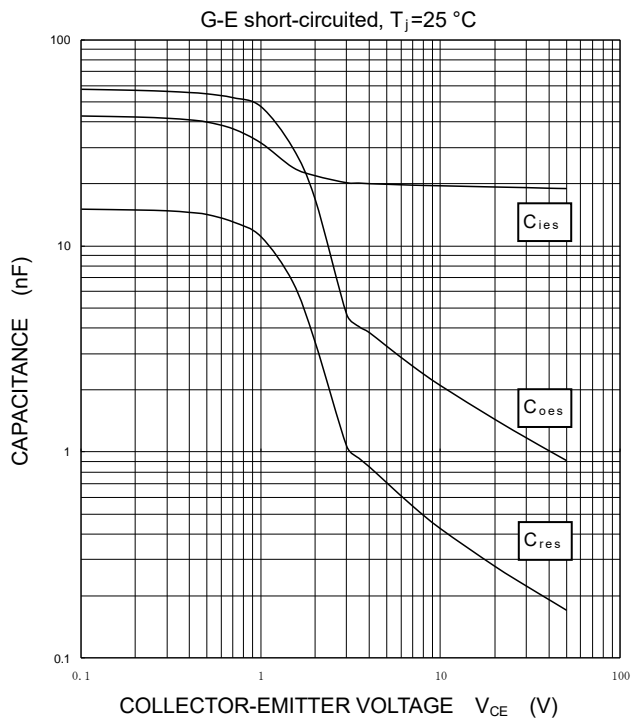


CMH200DU-24NFH

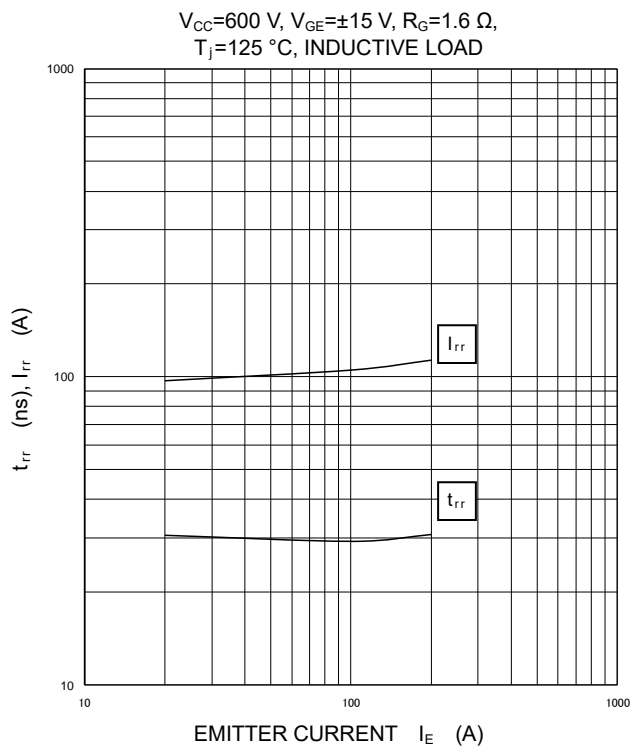
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

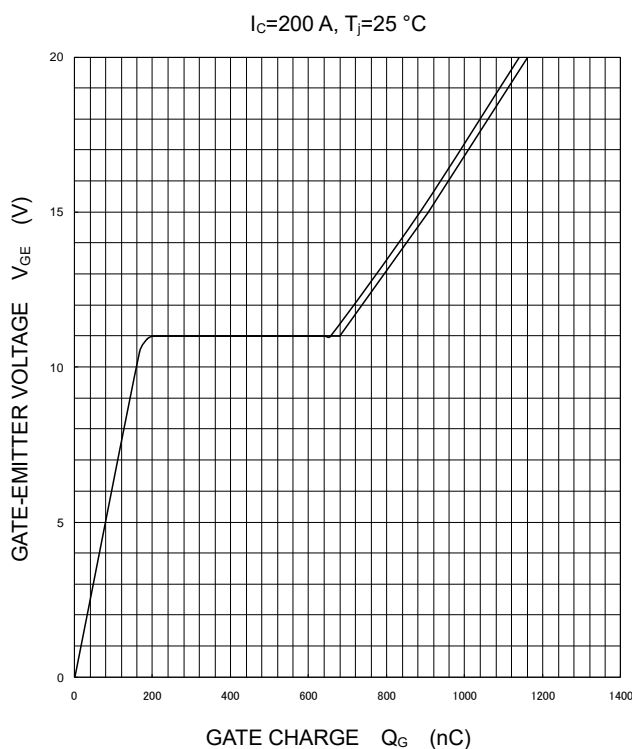
CAPACITANCE CHARACTERISTICS (TYPICAL)



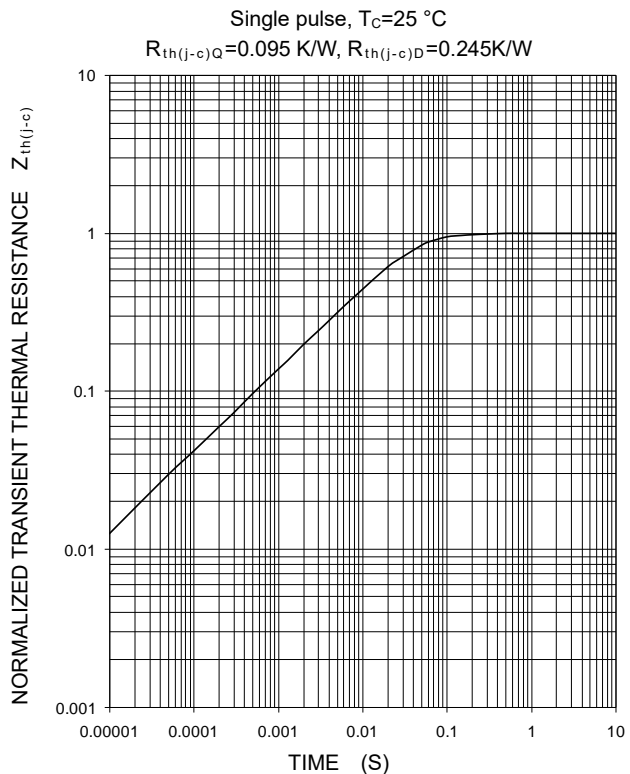
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)



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

CMH200DU-24NFH

HIGH POWER SWITCHING USE
INSULATED TYPE

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