

MITSUBISHI IGBT MODULES  
**CM400DU-12NFH**

HIGH POWER SWITCHING USE

**CM400DU-12NFH**



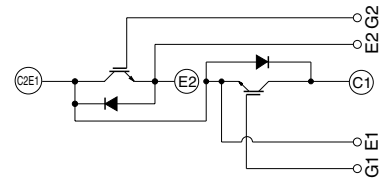
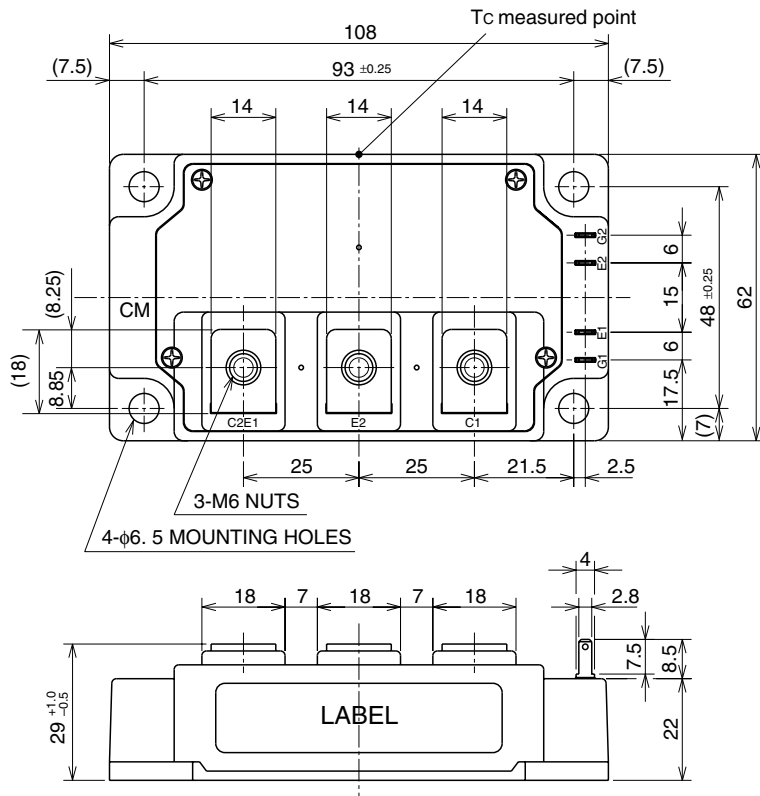
- IC ..... 400A
- VCES ..... 600V
- Insulated Type
- 2-elements in a pack

**APPLICATION**

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

**OUTLINE DRAWING & CIRCUIT DIAGRAM**

Dimensions in mm



CIRCUIT DIAGRAM

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**MAXIMUM RATINGS** (Tj = 25°C, unless otherwise specified)

| Symbol                    | Parameter                     | Conditions                                     | Ratings    | Unit             |
|---------------------------|-------------------------------|------------------------------------------------|------------|------------------|
| V <sub>CE</sub>           | Collector-emitter voltage     | G-E Short                                      | 600        | V                |
| V <sub>GE</sub>           | Gate-emitter voltage          | C-E Short                                      | ±20        | V                |
| I <sub>C</sub>            | Collector current             | Operation                                      | 400        | A                |
| I <sub>CM</sub>           |                               | Pulse (Note 2)                                 | 800        | A                |
| I <sub>E</sub> (Note 1)   | Emitter current               | Operation                                      | 400        | A                |
| I <sub>EM</sub> (Note 1)  |                               | Pulse (Note 2)                                 | 800        | A                |
| P <sub>C</sub> (Note 3)   | Maximum collector dissipation | T <sub>c</sub> = 25°C                          | 960        | W                |
| P <sub>C</sub> ' (Note 3) | Maximum collector dissipation | T <sub>c</sub> ' = 25°C <sup>4</sup>           | 1640       | W                |
| T <sub>j</sub>            | Junction temperature          |                                                | -40 ~ +150 | °C               |
| T <sub>stg</sub>          | Storage temperature           |                                                | -40 ~ +125 | °C               |
| V <sub>iso</sub>          | Isolation voltage             | Terminals to base plate, f = 60Hz, AC 1 minute | 2500       | V <sub>rms</sub> |
| —                         | Mounting torque               | Main terminals M6 screw                        | 3.5 ~ 4.5  | N • m            |
| —                         |                               | Mounting M6 screw                              | 3.5 ~ 4.5  | N • m            |
| —                         | Weight                        | Typical value                                  | 400        | g                |

**ELECTRICAL CHARACTERISTICS** (Tj = 25°C, unless otherwise specified)

| Symbol                   | Parameter                            | Test conditions                                                                                                  | Limits                |      |         | Unit |
|--------------------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------|------|---------|------|
|                          |                                      |                                                                                                                  | Min.                  | Typ. | Max.    |      |
| I <sub>CE</sub>          | Collector cutoff current             | V <sub>CE</sub> = V <sub>CE</sub> , V <sub>GE</sub> = 0V                                                         | —                     | —    | 1       | mA   |
| V <sub>GE(th)</sub>      | Gate-emitter threshold voltage       | I <sub>C</sub> = 40mA, V <sub>CE</sub> = 10V                                                                     | 5                     | 6    | 7       | V    |
| I <sub>GES</sub>         | Gate leakage current                 | ±V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V                                                       | —                     | —    | 0.5     | μA   |
| V <sub>CE(sat)</sub>     | Collector-emitter saturation voltage | I <sub>C</sub> = 400A, V <sub>GE</sub> = 15V                                                                     | —                     | 2.0  | 2.7     | V    |
|                          |                                      | T <sub>j</sub> = 25°C                                                                                            |                       | 1.95 | —       |      |
| C <sub>ies</sub>         | Input capacitance                    | V <sub>CE</sub> = 10V<br>V <sub>GE</sub> = 0V                                                                    | —                     | —    | 110     | nF   |
| C <sub>oes</sub>         | Output capacitance                   |                                                                                                                  | —                     | —    | 7.2     | nF   |
| C <sub>res</sub>         | Reverse transfer capacitance         |                                                                                                                  | —                     | —    | 4.0     | nF   |
| Q <sub>G</sub>           | Total gate charge                    | V <sub>CC</sub> = 300V, I <sub>C</sub> = 400A, V <sub>GE</sub> = 15V                                             | —                     | 2480 | —       | nC   |
| t <sub>d(on)</sub>       | Turn-on delay time                   | V <sub>CC</sub> = 300V, I <sub>C</sub> = 400A<br>V <sub>GE</sub> = ±15V<br>R <sub>G</sub> = 3.1Ω, Inductive load | —                     | —    | 400     | ns   |
| t <sub>r</sub>           | Turn-on rise time                    |                                                                                                                  | —                     | —    | 200     | ns   |
| t <sub>d(off)</sub>      | Turn-off delay time                  |                                                                                                                  | —                     | —    | 700     | ns   |
| t <sub>f</sub>           | Turn-off fall time                   |                                                                                                                  | —                     | —    | 150     | ns   |
| t <sub>rr</sub> (Note 1) | Reverse recovery time                |                                                                                                                  | I <sub>E</sub> = 400A | —    | —       | 200  |
| Q <sub>rr</sub> (Note 1) | Reverse recovery charge              |                                                                                                                  | —                     | 7.7  | —       | μC   |
| V <sub>EC</sub> (Note 1) | Emitter-collector voltage            | I <sub>E</sub> = 400A, V <sub>GE</sub> = 0V                                                                      | —                     | —    | 2.6     | V    |
| R <sub>th(j-c)Q</sub>    | Thermal resistance*1                 | IGBT part (1/2 module)                                                                                           | —                     | —    | 0.13    | K/W  |
| R <sub>th(j-c)R</sub>    |                                      | FWDi part (1/2 module)                                                                                           | —                     | —    | 0.18    | K/W  |
| R <sub>th(c-f)</sub>     | Contact thermal resistance           | Case to heat sink, Thermal compound Applied*2 (1/2 module)                                                       | —                     | 0.04 | —       | K/W  |
| R <sub>th(j-c)Q</sub>    | Thermal resistance                   | Case temperature measured point is just under the chips (1/2 module)                                             | —                     | —    | 0.076*3 | K/W  |
| R <sub>G</sub>           | External gate resistance             |                                                                                                                  | 1.6                   | —    | 16      | Ω    |

\*1 : Case temperature (T<sub>c</sub>) measured point is shown in page OUTLINE DRAWING.

\*2 : Typical value is measured by using thermally conductive grease of λ = 0.9[W/(m • K)].

\*3 : If you use this value, R<sub>th(f-a)</sub> should be measured just under the chips.

\*4 : Case temperature (T<sub>c</sub>) measured point is just under the chips.

Note 1. I<sub>E</sub>, I<sub>EM</sub>, V<sub>EC</sub>, t<sub>rr</sub> & Q<sub>rr</sub> represent characteristics of the anti-parallel, emitter-collector free-wheel diode (FWDi).

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

3. Junction temperature (T<sub>j</sub>) should not increase beyond 150°C.

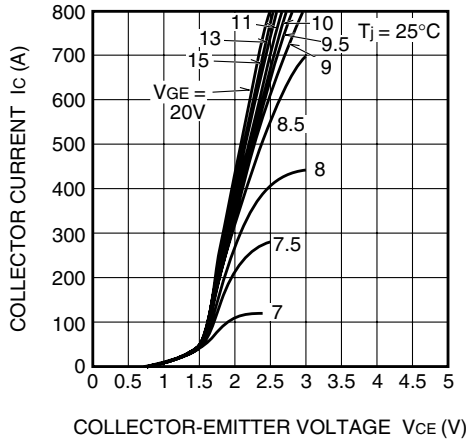
4. No short circuit capability is designed.

# CM400DU-12NFH

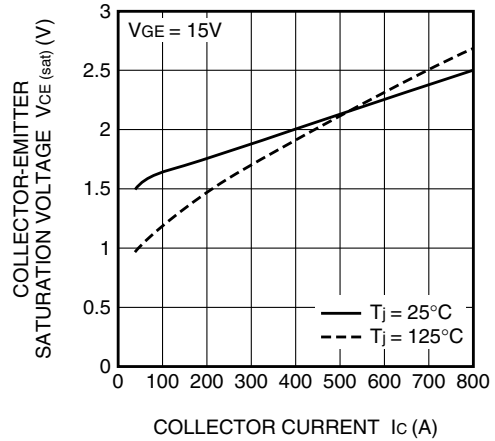
HIGH POWER SWITCHING USE

PERFORMANCE CURVES

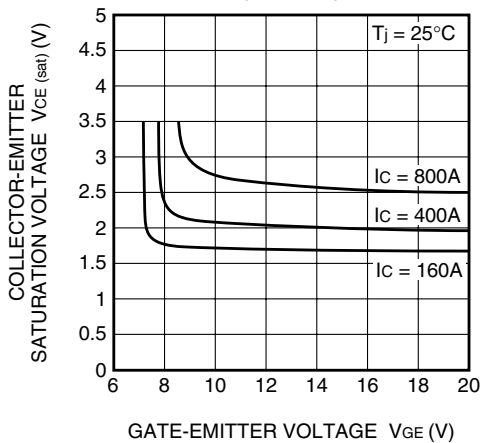
OUTPUT CHARACTERISTICS (TYPICAL)



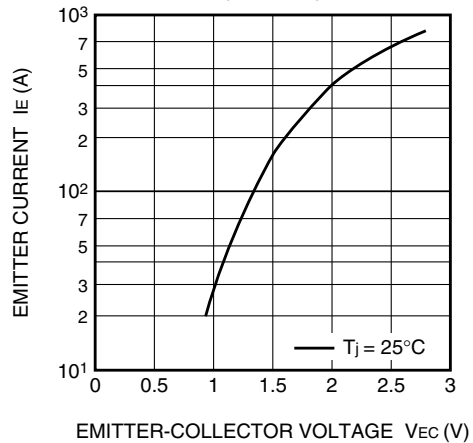
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



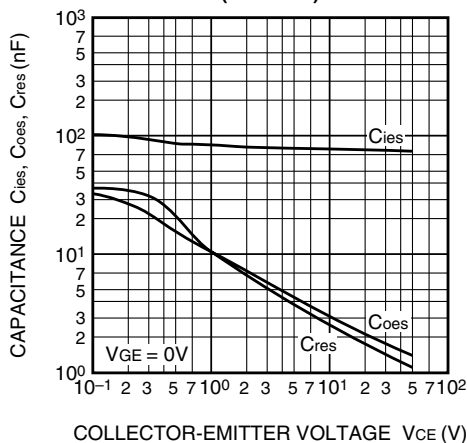
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



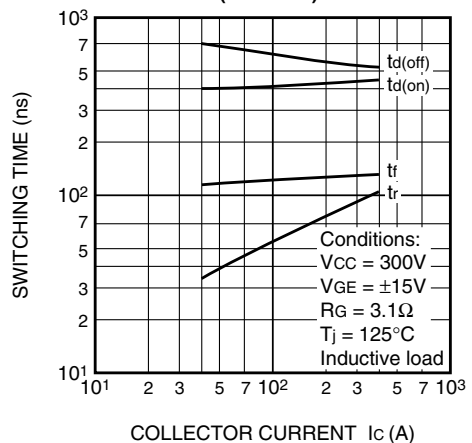
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



CAPACITANCE- $V_{ce}$  CHARACTERISTICS (TYPICAL)



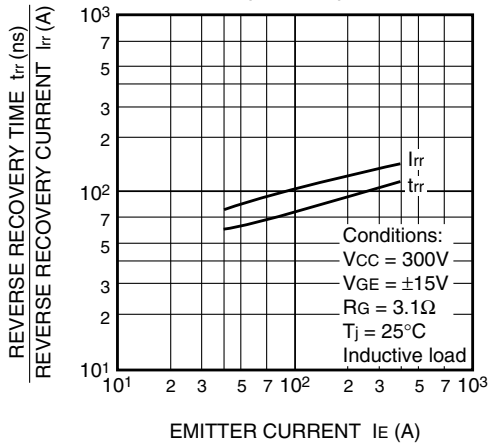
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)



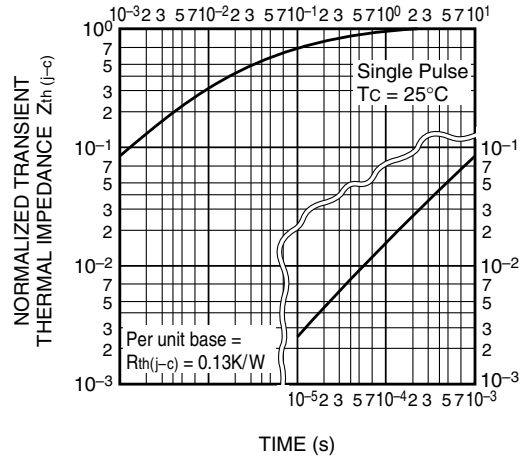
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HIGH POWER SWITCHING USE

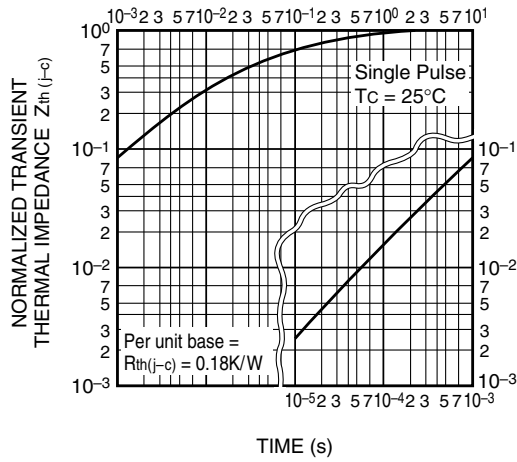
REVERSE RECOVERY CHARACTERISTICS OF FREE-WHEEL DIODE (TYPICAL)



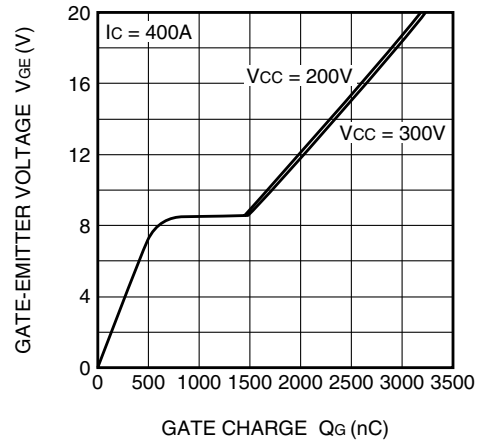
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT part)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (FWDi part)



GATE CHARGE CHARACTERISTICS (TYPICAL)



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