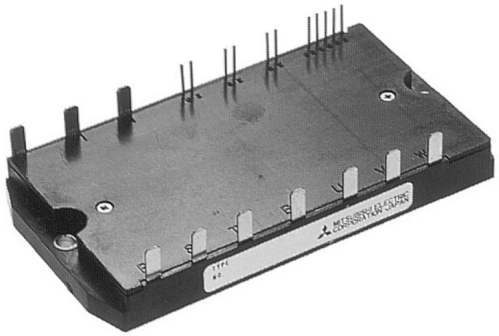
# CM15MD-24H

**MEDIUM POWER SWITCHING USE**
**INSULATED TYPE**

**CM15MD-24H**



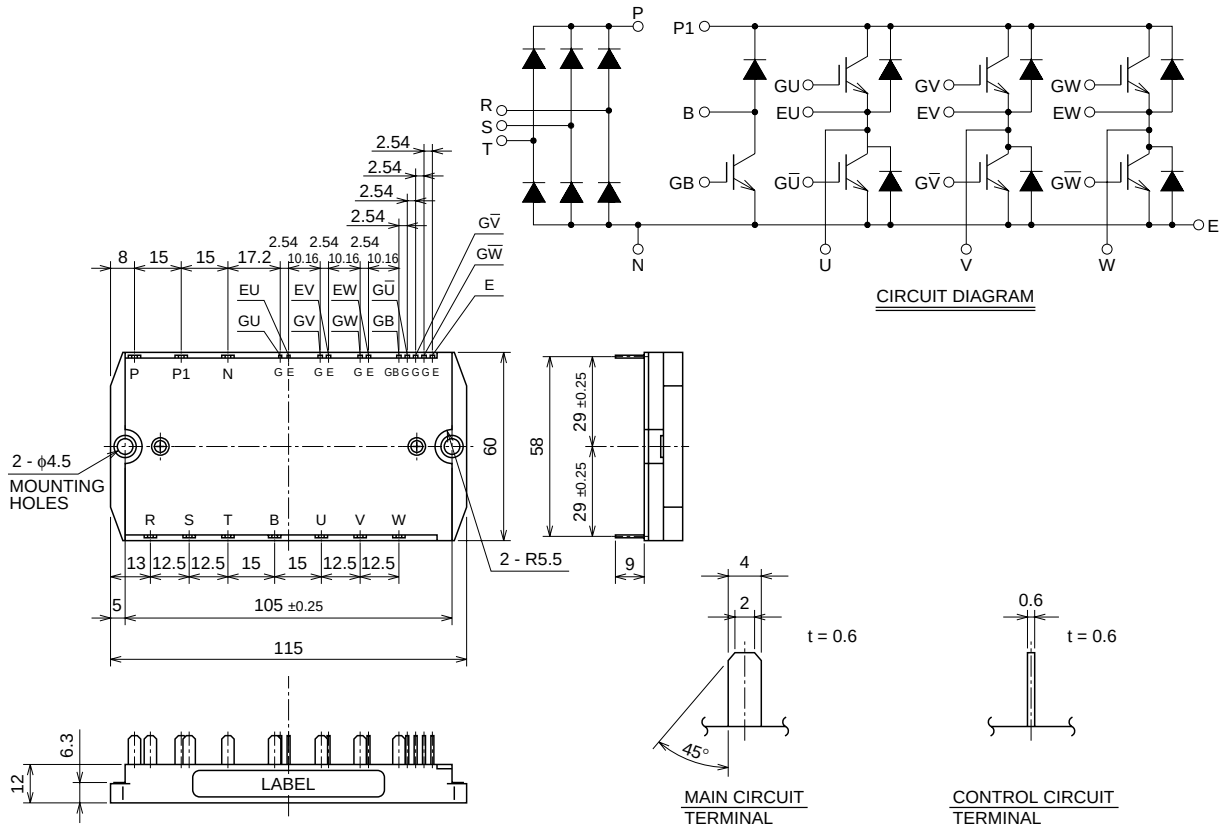
- $I_C$ ..... 15A
- $V_{CES}$ ..... 1200V
- Insulated Type
- CIB Module
  3ϕ Inverter+3ϕ Converter+Brake
- UL Recognized
  Yellow Card No. E80276 (N)
  File No. E80271

## APPLICATION

AC & DC motor controls, General purpose inverters, Servo controls, NC, Robotics

**OUTLINE DRAWING & CIRCUIT DIAGRAM**

Dimensions in mm






MITSUBISHI ELECTRIC

**MAXIMUM RATINGS** ($T_j$ = 25°C)
**INVERTER PART**

| Symbol | Parameter | Condition | Rating | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage | G – E Short | 1200 | V |
| $V_{GES}$ | Gate-emitter voltage | C – E Short | ±20 | V |
| $I_C$ | Collector Current | $T_C$ = 25°C | 15 | A |
| $I_{CM}$ | | PULSE (Note. 2) | 30 | A |
| $I_E$ (Note. 1) | Emitter Current | $T_C$ = 25°C | 15 | A |
| $I_{EM}$ (Note. 1) | | PULSE (Note. 2) | 30 | A |
| $P_C$ (Note. 3) | Maximum collector dissipation | $T_f$ = 25°C | 66 | W |

**BRAKE PART**

| Symbol | Parameter | Condition | Rating | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage | G – E Short | 1200 | V |
| $V_{GES}$ | Gate-emitter voltage | C – E Short | ±20 | V |
| $I_C$ | Collector Current | $T_C$ = 25°C | 15 | A |
| $I_{CM}$ | | PULSE (Note. 2) | 30 | A |
| $P_C$ (Note. 3) | Maximum Collector dissipation | $T_f$ = 25°C | 66 | W |
| $V_{RRM}$ | Repetitive peak reverse voltage | Clamp diode part | 1200 | V |
| $I_{FM}$ (Note. 3) | Forward current | Clamp diode part | 15 | A |

**CONVERTER PART**

| Symbol | Parameter | Condition | Rating | Unit |
|---|---|---|---|---|
| $V_{RRM}$ | Repetitive peak reverse voltage | | 1600 | V |
| $E_a$ | Recommended AC input voltage | | 440 | V |
| $I_O$ | DC output current | 3ϕ rectifying circuit | 15 | A |
| $I_{FSM}$ | Surge (non-repetitive) forward current | 1 cycle at 60Hz, peak value Non-repetitive | 150 | A |
| $I^2t$ | $I^2t$ for fusing | Value for one cycle of surge current | 93 | $A^2s$ |

**COMMON RATING**

| Symbol | Parameter | Condition | Rating | Unit |
|---|---|---|---|---|
| $T_j$ | Junction temperature | | –40 ~ +150 | °C |
| $T_{stg}$ | Storage temperature | | –40 ~ +125 | °C |
| $V_{iso}$ | Isolation voltage | AC 1 min. | 2500 | V |
| — | Mounting torque | Mounting M4 screw | 0.98 ~1.47 | N·m |
| — | Weight | Typical value | 100 | g |

## ELECTRICAL CHARACTERISTICS ($T_j$ = 25°C)

### INVERTER PART

| Symbol | Parameter | Test conditions | | | Limits | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min. | Typ. | Max. | |
| $I_{CES}$ | Collector cutoff current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0V | | | — | — | 1 | mA |
| $V_{GE(th)}$ | Gate-emitter threshold voltage | $I_C$ = 1.5mA, $V_{CE}$ = 10V | | | 4.5 | 6 | 7.5 | V |
| $I_{GES}$ | Gate-emitter cutoff current | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0V | | | — | — | 0.5 | μA |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $T_j$ = 25°C | $I_C$ = 15A, $V_{GE}$ = 15V | (Note. 4) | — | 2.7 | 3.4 | V |
| | | $T_j$ = 150°C | | | — | 2.45 | — | |
| $C_{ies}$ | Input capacitance | $V_{CE}$ = 10V, $V_{GE}$ = 0V | | | — | — | 3.0 | nF |
| $C_{oes}$ | Output capacitance | | | | — | — | 2.4 | nF |
| $C_{res}$ | Reverse transfer capacitance | | | | — | — | 0.6 | nF |
| $Q_G$ | Total gate charge | $V_{CC}$ = 600V, $I_C$ = 15A, $V_{GE}$ = 15V | | | — | 75 | — | nC |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC}$ = 600V, $I_C$ = 15A, $V_{GE1}$ = $V_{GE2}$ = 15V, $R_G$ = 21Ω, Resistive load | | | — | — | 100 | ns |
| $t_r$ | Turn-on rise time | | | | — | — | 200 | ns |
| $t_{d(off)}$ | Turn-off delay time | | | | — | — | 150 | ns |
| $t_f$ | Turn-off fall time | | | | — | — | 350 | ns |
| $V_{EC}$ (Note. 1) | Emitter-collector voltage | $I_E$ = 15A, $V_{GE}$ = 0V | | | — | — | 3.5 | V |
| $t_{rr}$ (Note. 1) | Reverse recovery time | $I_E$ = 15A, $V_{GE}$ = 0V | | | — | — | 250 | ns |
| $Q_{rr}$ (Note. 1) | Reverse recovery charge | die / dt = – 30A / μs | | | — | 0.11 | — | μC |
| $R_{th(j-f)Q}$ (Note. 5) | Thermal resistance | IGBT part, Per 1/6 module | | | — | — | 1.9 | °C/W |
| $R_{th(j-f)R}$ (Note. 5) | | FWDi part, Per 1/6 module | | | — | — | 2.4 | °C/W |

### BRAKE PART

| Symbol | Parameter | Condition | | | Limits | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min. | Typ. | Max. | |
| $I_{CES}$ | Collector cutoff current | $V_{CE}$ = $V_{CES}$, $V_{GE}$ = 0V | | | — | — | 1 | mA |
| $V_{GE(th)}$ | Gate-emitter threshold voltage | $I_C$ = 1.5mA, $V_{CE}$ = 10V | | | 4.5 | 6 | 7.5 | V |
| $I_{GES}$ | Gate-emitter cutoff current | $V_{GE}$ = $V_{GES}$, $V_{CE}$ = 0V | | | — | — | 0.5 | μA |
| $V_{CE(sat)}$ | Collector-to-emitter saturation voltage | $T_j$ = 25°C | $I_C$ = 15A, $V_{GE}$ = 15V | (Note. 4) | — | 2.7 | 3.4 | V |
| | | $T_j$ = 150°C | | | — | 2.45 | — | |
| $C_{ies}$ | Input capacitance | $V_{CE}$ = 10V, $V_{GE}$ = 0V | | | — | — | 3.0 | nF |
| $C_{oes}$ | Output capacitance | | | | — | — | 2.4 | nF |
| $C_{res}$ | Reverse transfer capacitance | | | | — | — | 0.6 | nF |
| $Q_G$ | Total gate charge | $V_{CC}$ = 600V, $I_C$ = 15A, $V_{GE}$ = 15V | | | — | 75 | — | nC |
| $V_{FM}$ | Forward voltage drop | $I_F$ = 15A, Clamp diode part | | | — | — | 1.5 | V |
| $R_{th(j-f)Q}$ (Note. 5) | Thermal resistance | IGBT part | | | — | — | 1.9 | °C/W |
| $R_{th(j-f)R}$ (Note. 5) | | Clamp diode part | | | — | — | 1.7 | °C/W |

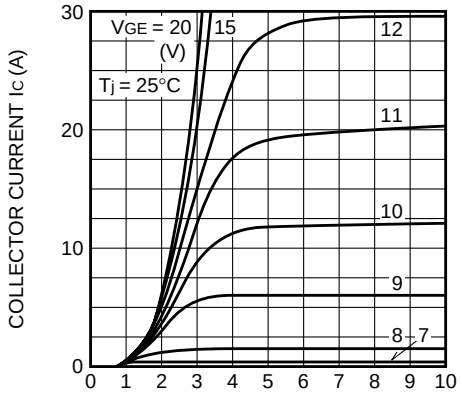
### CONVERTER PART

| Symbol | Parameter | Condition | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $I_{RRM}$ | Repetitive reverse current | $V_R$ = $V_{RRM}$, $T_j$ = 150°C | — | — | 8 | mA |
| $V_{FM}$ | Forward voltage drop | $I_F$ = 15A | — | — | 1.5 | V |
| $R_{th(j-f)}$ (Note. 5) | Thermal resistance | Per 1/6 module | — | — | 1.7 | °C/W |

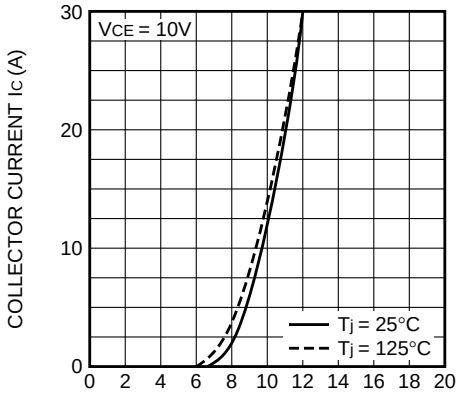
Note 1. $I_E$, $V_{EC}$, $t_{rr}$, $Q_{rr}$ & die/dt represent characteristics of the anti-parallel, emitter to collector free-wheel diode.
2. Pulse width and repetition rate should be such that the device junction temp. ($T_j$) does not exceed $T_{jmax}$ rating.
3. Junction temperature ($T_j$) should not increase beyond 150°C.
4. Pulse width and repetition rate should be such as to cause negligible temperature rise.
5. Thermal resistance is specified under following conditions.
   • The conductive greese applied, between module and fin.
   • Al plate is used as fin.

## PERFORMANCE CURVES

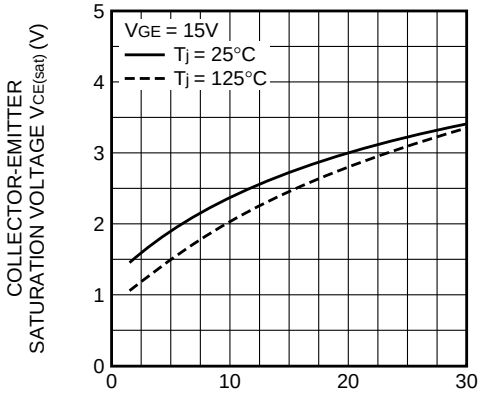
### OUTPUT CHARACTERISTICS (TYPICAL)



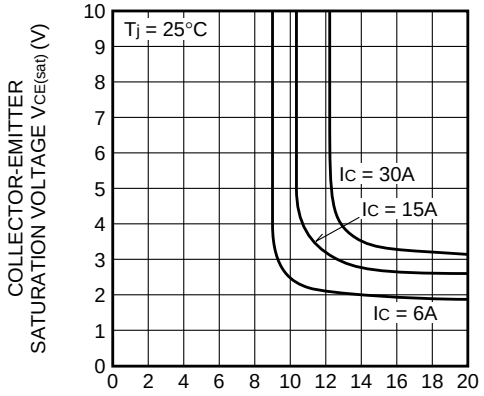

### TRANSFER CHARACTERISTICS (TYPICAL)



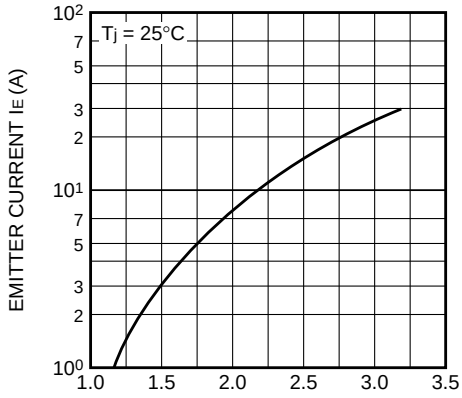

### COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



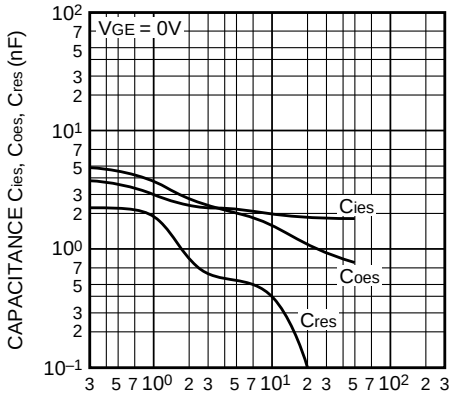

### COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



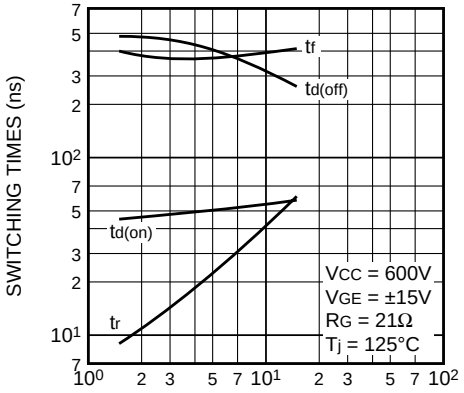

### FREE-WHEEL DIODE FORWARD CHARACTERISITICS (TYPICAL)



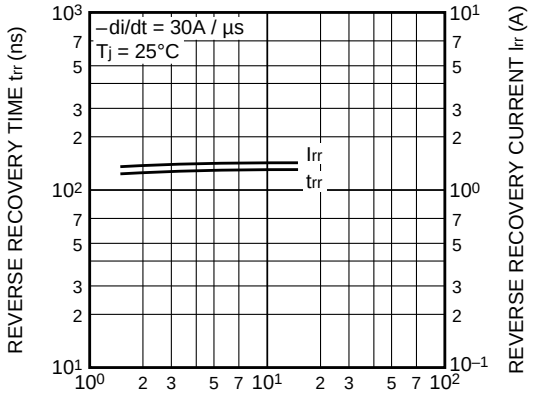

### CAPACITANCE VS. VCE (TYPICAL)



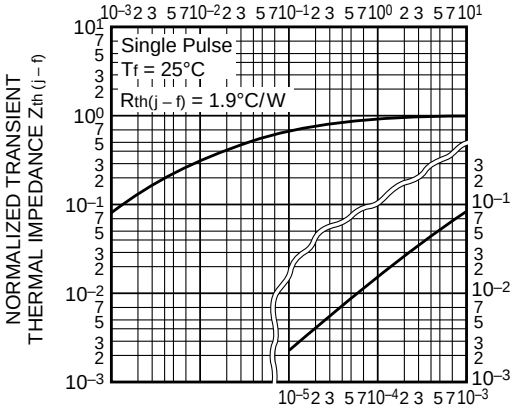
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**



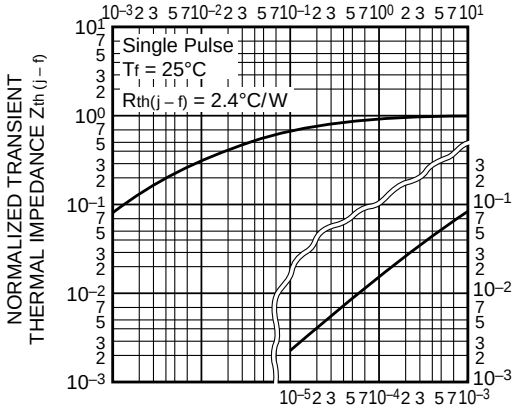

**REVERSE RECOVERY CHARACTERISTICS OF FREE-WHEEL DIODE (TYPICAL)**




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (IGBT part)**




**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (FWDi part)**




**VGE – GATE CHARGE (TYPICAL)**