CM300DY-13T
HIGH POWER SWITCHING USE
INSULATED TYPE

Collector current \( I_c \) ......................... \( 3 \ 0 \ 0 \ \text{A} \)
Collector-emitter voltage \( V_{CES} \) .............. \( 6 \ 5 \ 0 \ \text{V} \)
Maximum junction temperature \( T_{V\text{max}} \) ........ \( 1 \ 7 \ 5 \ ^\circ \text{C} \)
- Flat base type
- Copper base plate (Nickel-plating)
- Tin-plating signal 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
- \( V_{CE\text{sat}} \) selection for parallel connection

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

JIS B 0405 c
## MAXIMUM RATINGS (T_{j}=25 \, ^{\circ}C, \text{unless otherwise specified})

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Conditions</th>
<th>Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{GES}</td>
<td>Collector-emitter voltage</td>
<td>G-E short-circuited</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>I_{C}</td>
<td>Gate-emitter voltage</td>
<td>C-E short-circuited</td>
<td>± 20</td>
<td>A</td>
</tr>
<tr>
<td>I_{CM}</td>
<td>Collector current</td>
<td>DC, T_{C}=125 , ^{\circ}C (Note 2)</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>P_{tot}</td>
<td>Pulse, Repetitive (Note 3)</td>
<td>600</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>P_{is}</td>
<td>Total power dissipation</td>
<td>T_{C}=25 , ^{\circ}C (Note 4)</td>
<td>2205</td>
<td></td>
</tr>
<tr>
<td>I_{E}</td>
<td>Emitter current</td>
<td>DC (Note 5)</td>
<td>300</td>
<td>A</td>
</tr>
<tr>
<td>V_{is}</td>
<td>Isolation voltage</td>
<td>Terminals to base plate, RMS, f=60 Hz, AC 1 min</td>
<td>4000</td>
<td>V</td>
</tr>
<tr>
<td>T_{vj}</td>
<td>Maximum junction temperature</td>
<td>Instantaneous event (overload)</td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td>T_{max}</td>
<td>Maximum case temperature</td>
<td>125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T_{jop}</td>
<td>Operating junction temperature</td>
<td>Continuous operation (under switching)</td>
<td>-40 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>T_{sig}</td>
<td>Storage temperature</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## ELECTRICAL CHARACTERISTICS (T_{j}=25 \, ^{\circ}C, \text{unless otherwise specified})

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Conditions</th>
<th>Limits</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_{C1}</td>
<td>Collector-emitter cut-off current</td>
<td>V_{GEB}=V_{GES}, G-E short-circuited</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>I_{C2}</td>
<td>Gate-emitter leakage current</td>
<td>V_{GEB}=V_{GES}, C-E short-circuited</td>
<td>-</td>
<td>μA</td>
</tr>
<tr>
<td>V_{GE1}</td>
<td>Gate-emitter threshold voltage</td>
<td></td>
<td>5.4</td>
<td>V</td>
</tr>
<tr>
<td>V_{GE2}</td>
<td>Collector-emitter saturation voltage</td>
<td>I_{C}=300 A, V_{GEB}=15 V, Refer to the figure of test circuit</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>C_{R1}</td>
<td>Input capacitance</td>
<td></td>
<td>-</td>
<td>nF</td>
</tr>
<tr>
<td>C_{R2}</td>
<td>Output capacitance</td>
<td>V_{CE}=10 V, G-E short-circuited</td>
<td>-</td>
<td>μF</td>
</tr>
<tr>
<td>Q_{G}</td>
<td>Reverse transfer capacitance</td>
<td></td>
<td>-</td>
<td>μF</td>
</tr>
<tr>
<td>V_{CC}</td>
<td>Gate charge</td>
<td>V_{GEB}=300 V, I_{C}=300 A, V_{GEB}=15 V</td>
<td>-</td>
<td>μC</td>
</tr>
<tr>
<td>t_{on}</td>
<td>Turn-on delay time</td>
<td>V_{CC}=300 V, I_{C}=300 A, V_{GEB}=±15 V,</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{R}</td>
<td>Rise time</td>
<td></td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{off}</td>
<td>Turn-off delay time</td>
<td>R_{O}=2.2 , \Omega, Inductive load</td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>t_{F}</td>
<td>Fall time</td>
<td></td>
<td>-</td>
<td>ns</td>
</tr>
<tr>
<td>V_{E1}</td>
<td>Emitter-collector voltage</td>
<td>I_{E}=300 A, G-E short-circuited, Refer to the figure of test circuit</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>V_{E2}</td>
<td>Collector-emitter voltage</td>
<td>I_{E}=300 A, G-E short-circuited,</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Q_{R1}</td>
<td>Reverse recovery charge</td>
<td></td>
<td>-</td>
<td>μC</td>
</tr>
<tr>
<td>E_{on}</td>
<td>Turn-on switching energy per pulse</td>
<td>V_{CC}=300 V, I_{C}=I_{E}=300 A,</td>
<td>-</td>
<td>mJ</td>
</tr>
<tr>
<td>E_{off}</td>
<td>Turn-off switching energy per pulse</td>
<td>V_{GEB}=±15 V, R_{O}=2.2 , \Omega,</td>
<td>-</td>
<td>mJ</td>
</tr>
<tr>
<td>E_{R}</td>
<td>Reverse recovery energy per pulse</td>
<td>Inductive load</td>
<td>-</td>
<td>mJ</td>
</tr>
<tr>
<td>R_{CC}</td>
<td>Internal lead resistance</td>
<td>Main terminals-chip, per switch, T_{C}=25 , ^{\circ}C</td>
<td>-</td>
<td>mΩ</td>
</tr>
<tr>
<td>r_{g}</td>
<td>Internal gate resistance</td>
<td>Per switch</td>
<td>-</td>
<td>Ω</td>
</tr>
<tr>
<td>Symbol</td>
<td>Item</td>
<td>Conditions</td>
<td>Limits</td>
<td>Unit</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>------------</td>
<td>--------</td>
<td>------</td>
</tr>
<tr>
<td>$R_{th(j-c)}$</td>
<td>Thermal resistance</td>
<td>Junction to case, per Inverter IGBT (Note 4)</td>
<td>-</td>
<td>K/kW</td>
</tr>
<tr>
<td>$R_{th(j-c)}$</td>
<td>Thermal resistance</td>
<td>Junction to case, per Inverter FWD (Note 4)</td>
<td>-</td>
<td>K/kW</td>
</tr>
<tr>
<td>$R_{th(c-s)}$</td>
<td>Contact thermal resistance</td>
<td>Case to heat sink, per 1 module, Thermal grease applied (Note 4, 6)</td>
<td>-</td>
<td>K/kW</td>
</tr>
</tbody>
</table>

**MECHANICAL CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Item</th>
<th>Conditions</th>
<th>Limits</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_t$</td>
<td>Mounting torque</td>
<td>Main terminals</td>
<td>2.5</td>
<td>N·m</td>
</tr>
<tr>
<td>$M_s$</td>
<td>Mounting torque</td>
<td>Mounting to heat sink</td>
<td>3.5</td>
<td>N·m</td>
</tr>
<tr>
<td>$d_a$</td>
<td>Creepage distance</td>
<td>Terminal to terminal</td>
<td>18</td>
<td>mm</td>
</tr>
<tr>
<td>$d_a$</td>
<td>Creepage distance</td>
<td>Terminal to base plate</td>
<td>21.1</td>
<td>mm</td>
</tr>
<tr>
<td>$e_c$</td>
<td>Flatness of base plate</td>
<td>On the centerline (Note 8)</td>
<td>±0</td>
<td>μm</td>
</tr>
<tr>
<td>$m$</td>
<td>mass</td>
<td>-</td>
<td>155</td>
<td>g</td>
</tr>
</tbody>
</table>

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

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

2. Junction temperature ($T_{j}$) should not increase beyond $T_{j,max}$ rating.

3. Pulse width and repetition rate should be such that the device junction temperature ($T_{j}$) do not exceed $T_{j,max}$ rating.

4. 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.

5. Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.

6. Typical value is measured by using thermally conductive grease of $\lambda=0.9$ W/(m·K)/$D_{C:S}=50$ μm.

7. Typical value is measured by using PC-TIM of $\lambda=3.4$ W/(m·K)/$D_{C:S}=50$ μm.

8. The base plate (mounting side) flatness measurement points (X) are shown in the following figure.
**RECOMMENDED OPERATING CONDITIONS**

<table>
<thead>
<tr>
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<th>Conditions</th>
<th>Limits</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{CC}</td>
<td>(DC) Supply voltage</td>
<td>Applied across C1-E2 terminals</td>
<td>-</td>
<td>300</td>
</tr>
<tr>
<td>V_{GEon}</td>
<td>Gate (-emitter drive) voltage</td>
<td>Applied across G1-Es1/G2-Es2 terminals</td>
<td>13.5</td>
<td>15.0</td>
</tr>
<tr>
<td>R_{G}</td>
<td>External gate resistance</td>
<td>Per switch</td>
<td>2.2</td>
<td>-</td>
</tr>
</tbody>
</table>

**CHIP LOCATION** (Top view)

Dimension in mm, tolerance: ±1 mm

Option: PC-TIM applied baseplate outline
<IGBT Modules>
CM300DY-13T
HIGH POWER SWITCHING USE
INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS

Switching characteristics test circuit and waveforms

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

VCEsat characteristics test circuit

VBC characteristics test circuit

Publication Date : February 2017
CMH-11280 Ver.1.0
**OUTPUT CHARACTERISTICS (TYPICAL)**

- Collector-emitter voltage $V_{CE}$ vs. collector current $I_C$ for $T_{j}=25^\circ C$
  - $V_{GE}=20$ V, $15$ V, $12$ V, $11$ V, $10$ V, $9$ V, $8$ V

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

- Collector-emitter saturation voltage $V_{CEsat}$ vs. collector current $I_C$
  - $V_{GE}=15$ V, $T_{j}=150 ^{\circ} C$, $T_{j}=125 ^{\circ} C$, $T_{j}=25 ^{\circ} C$

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

- Collector-emitter voltage $V_{CE}$ vs. gate-emitter voltage $V_{GE}$ for $T_{j}=25 ^{\circ} C$
  - $I_C=600$ A, $I_C=300$ A, $I_C=150$ A

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

- Emitter-collector voltage $V_{EC}$ vs. emitter current $I_E$
  - G-E short-circuited, $T_{j}=125 ^{\circ} C$, $T_{j}=25 ^{\circ} C$
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

\[ V_{CC} = 300 \text{ V}, \ V_{GE} = \pm 15 \text{ V}, \ R_0 = 2.2 \Omega, \ \text{INDUCTIVE LOAD} \]

\[ T_{vj}=150 \degree C, \ - \ - \ - ; \ T_{vj}=125 \degree C \]

HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

\[ V_{CC} = 300 \text{ V}, \ V_{GE} = \pm 15 \text{ V}, \ I_C = 300 \text{ A}, \ \text{INDUCTIVE LOAD} \]

\[ T_{vj}=150 \degree C, \ - \ - \ - ; \ T_{vj}=125 \degree C \]
PERFORMANCE CURVES

CAPACITANCE CHARACTERISTICS (TYPICAL)

G-E short-circuited, \( T_{\text{oj}} = 25 \, ^\circ\text{C} \)

FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

\( V_{\text{CC}} = 300 \, \text{V}, \, V_{\text{GE}} = \pm 15 \, \text{V}, \, R_{\text{o}} = 2.2 \, \Omega, \) INDUCTIVE LOAD

- \( T_{\text{oj}} = 150 \, ^\circ\text{C}, \) 
- \( T_{\text{oj}} = 125 \, ^\circ\text{C} \)

CAPACITANCE (nF)

COLLECTOR-EMITTER VOLTAGE \( V_{\text{CE}} \) (V)

GATE CHARGE CHARACTERISTICS (TYPICAL)

\( V_{\text{CC}} = 300 \, \text{V}, \, I_{\text{C}} = 300 \, \text{A}, \, T_{\text{oj}} = 25 \, ^\circ\text{C} \)

TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

Single pulse, \( T_{\text{oj}} = 25 \, ^\circ\text{C} \)

\( R_{\text{th(j-e)}} = 68 \, \text{K}/\text{W}, \, R_{\text{th(j-e)D}} = 117 \, \text{K}/\text{W} \)
PERFORMANCE CURVES

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

- $V_{CC} \leq 450$ V, $V_{GE} = \pm 15$ V, $R_G = 2.2$–$22$ Ω,
- $T_{j} = 25$–$150$ °C (Normal load operations (Continuous))
- $T_{j} = 175$ °C (Unusual load operations (Limited period))

SHORT-CIRCUIT SAFE OPERATING AREA
(MAXIMUM)

- $V_{CC} \leq 400$ V, $V_{GE} = \pm 15$ V, $R_G = 2.2$–$22$ Ω,
- $T_{j} = 25$ – $150$ °C, $t_{W} \leq 8$ μs, Non-Repetitive

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