



<IGBT Modules>

CM600DX-24T/CM600DXP-24T

**HIGH POWER SWITCHING USE
INSULATED TYPE**

| | |
|---|---|
| <p>DX</p>  | <p>Collector current I_C 600 A Collector-emitter voltage V_{CES} 1200 V Maximum junction temperature T_{vjmax} 175 °C</p> <ul style="list-style-type: none"> • Flat base type • Copper base plate (Nickel-plating) • RoHS Directive compliant • Tin-plating pin terminals |
| <p>DXP</p>  | <p>Collector current I_C 600 A Collector-emitter voltage V_{CES} 1200 V Maximum junction temperature T_{vjmax} 175 °C</p> <ul style="list-style-type: none"> • Flat base type • Copper base plate (Nickel-plating) • RoHS Directive compliant • Tin-plating pressfit terminals <p>dual switch (half-bridge)</p> <ul style="list-style-type: none"> • UL Recognized under UL1557, File No. E323585 |

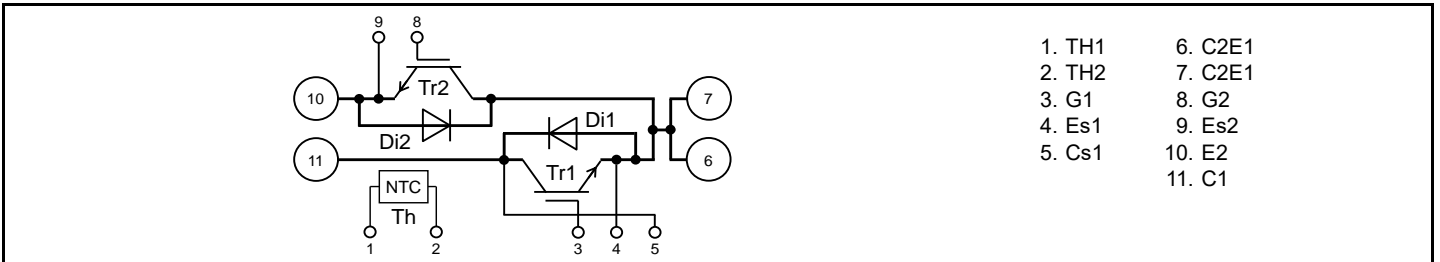
APPLICATION

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

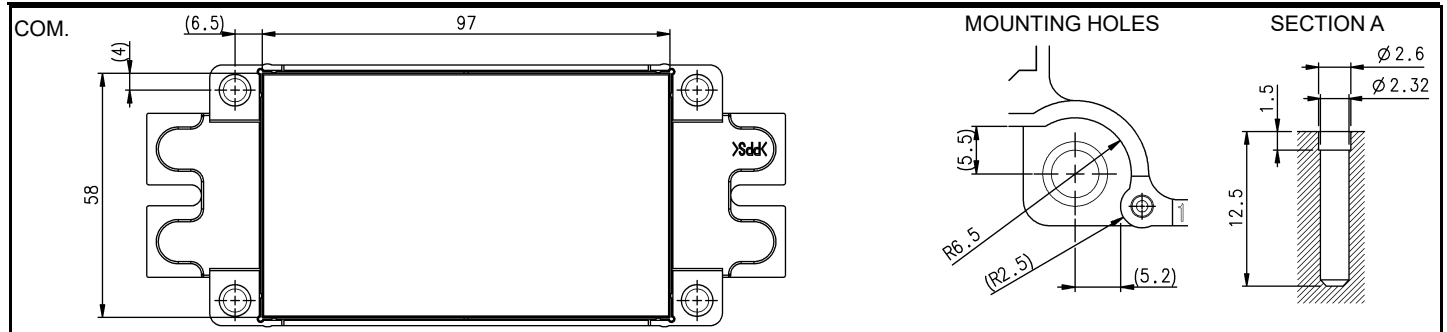
OPTION (Below options are available.)

- PC-TIM (Phase Change Thermal Interface Material) pre-apply
- V_{CESat} selection for parallel connection

INTERNAL CONNECTION



OUTLINE DRAWING

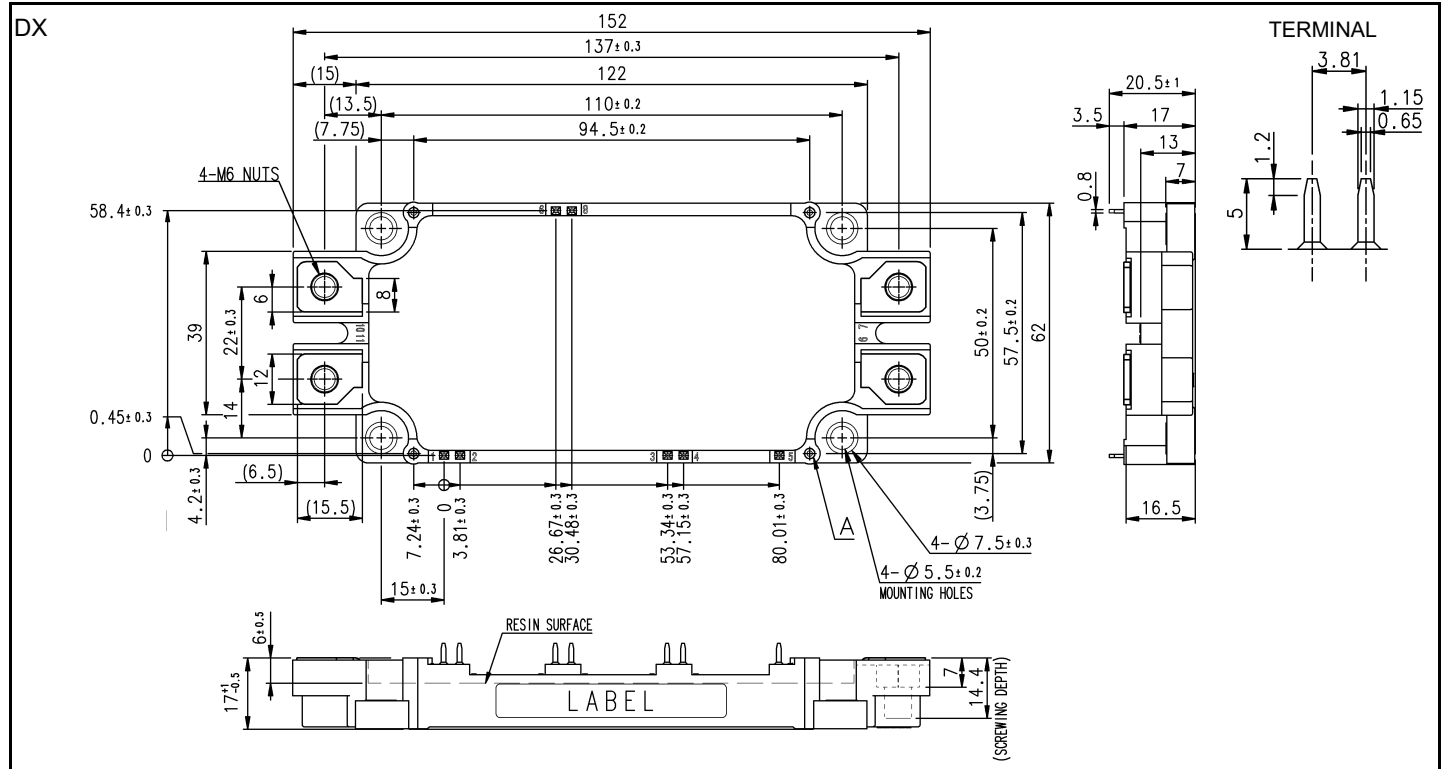


CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPE

OUTLINE DRAWING

Dimension in mm



Tolerance otherwise specified

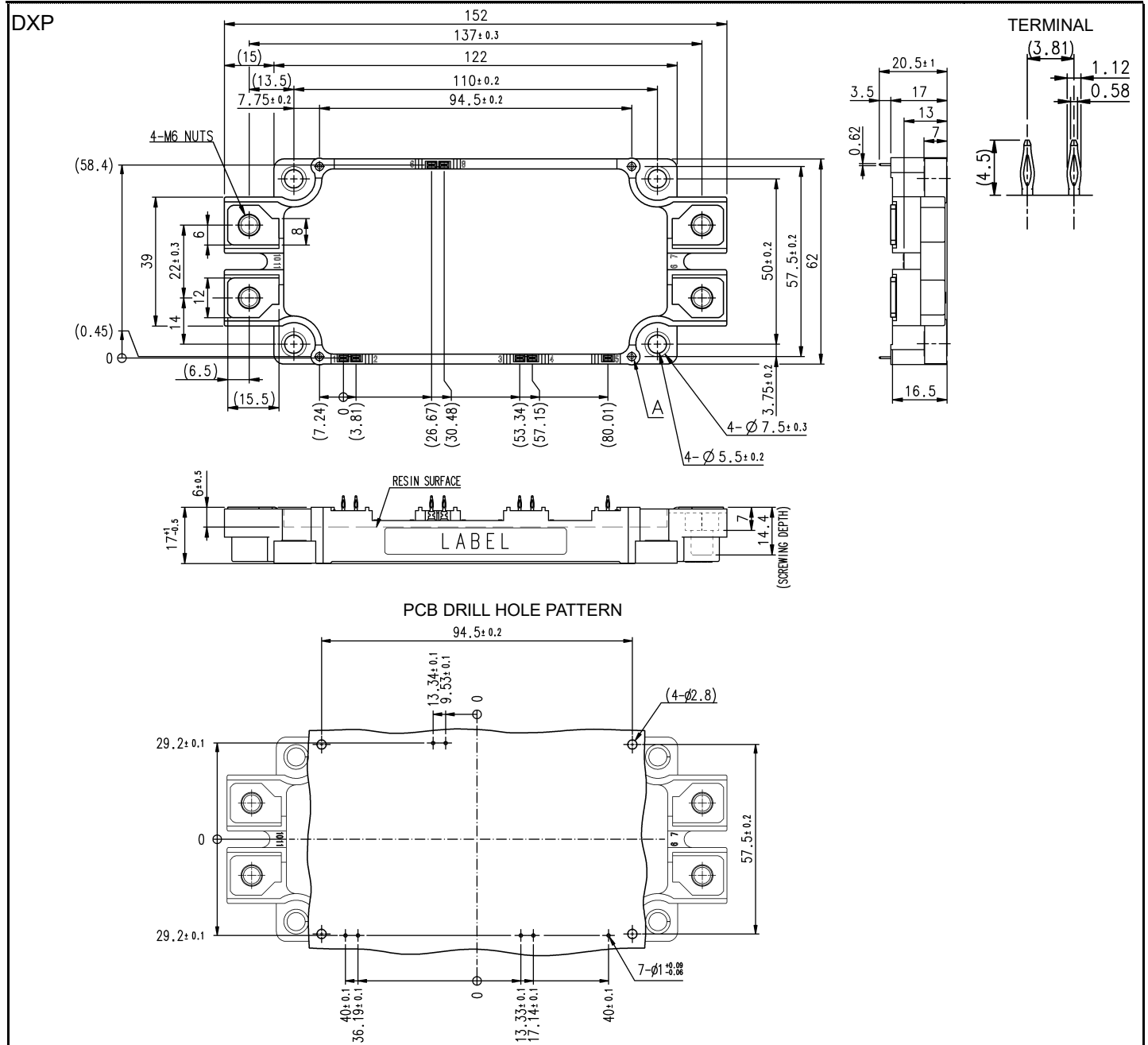
| Division of Dimension | Tolerance |
|-----------------------|-----------|
| 0.5 to 3 | ±0.2 |
| over 3 to 6 | ±0.3 |
| over 6 to 30 | ±0.5 |
| over 30 to 120 | ±0.8 |
| over 120 to 400 | ±1.2 |

CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPE

OUTLINE DRAWING

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 |

CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPE

MAXIMUM RATINGS (T_{vj}=25 °C, unless otherwise specified)

INVERTER PART IGBT/FWD

| 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 =114 °C (Note2, 4) | 600 | A |
| I _{CRM} | | Pulse, Repetitive (Note3) | 1200 | |
| P _{tot} | Total power dissipation | T _C =25 °C (Note2, 4) | 3125 | W |
| I _E (Note1) | Emitter current | DC (Note2) | 600 | A |
| I _{ERM} (Note1) | | Pulse, Repetitive (Note3) | 1200 | |

MODULE

| Symbol | Item | Conditions | Rating | Unit |
|--------------------|--------------------------------|---|------------|------|
| V _{isol} | Isolation voltage | Terminals to base plate, RMS, f=60 Hz, AC 1 min | 2500 | V |
| T _{vjmax} | Maximum junction temperature | Instantaneous event (overload) (Note9) | 175 | °C |
| T _{Cmax} | Maximum case temperature | (Note4, 9) | 125 | |
| T _{vjop} | Operating junction temperature | Continuous operation (under switching) (Note9) | -40 ~ +150 | °C |
| T _{stg} | Storage temperature | - | -40 ~ +125 | |

ELECTRICAL CHARACTERISTICS (T_{vj}=25 °C, unless otherwise specified)

INVERTER PART IGBT/FWD

| Symbol | Item | Conditions | Limits | | | Unit | |
|------------------------------------|--------------------------------------|---|-------------------------|------|-------|------|---|
| | | | Min. | Typ. | Max. | | |
| I _{CES} | Collector-emitter cut-off current | V _{CE} =V _{CES} , G-E short-circuited | - | - | 1.0 | mA | |
| I _{GES} | Gate-emitter leakage current | V _{GE} =V _{GES} , C-E short-circuited | - | - | 0.5 | µA | |
| V _{GE(th)} | Gate-emitter threshold voltage | I _C =60 mA, V _{CE} =10 V | 5.4 | 6.0 | 6.6 | V | |
| V _{CESat} (Terminal) | Collector-emitter saturation voltage | I _C =600 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5) | T _{vj} =25 °C | - | 1.65 | 2.05 | V |
| V _{CESat} (Chip) | | | T _{vj} =125 °C | - | 1.85 | - | |
| | | | T _{vj} =150 °C | - | 1.90 | - | |
| V _{CESat} (Chip) | Collector-emitter saturation voltage | I _C =600 A, V _{GE} =15 V, (Note5) | T _{vj} =25 °C | - | 1.50 | 1.75 | V |
| | | | T _{vj} =125 °C | - | 1.70 | - | |
| | | | T _{vj} =150 °C | - | 1.75 | - | |
| C _{ies} | Input capacitance | V _{CE} =10 V, G-E short-circuited | - | - | 145.5 | nF | |
| C _{oes} | Output capacitance | | - | - | 4.1 | | |
| C _{res} | Reverse transfer capacitance | | - | - | 1.8 | | |
| Q _G | Gate charge | V _{CC} =600 V, I _C =600 A, V _{GE} =15 V | - | 4.5 | - | µC | |
| t _{d(on)} | Turn-on delay time | V _{CC} =600 V, I _C =600 A, V _{GE} =±15 V, R _G =1.0 Ω, Inductive load | - | - | 600 | ns | |
| t _r | Rise time | | - | - | 200 | | |
| t _{d(off)} | Turn-off delay time | | - | - | 800 | | |
| t _f | Fall time | | - | - | 400 | | |
| V _{EC} (Terminal) (Note1) | Emitter-collector voltage | I _E =600 A, G-E short-circuited, Refer to the figure of test circuit (Note5) | T _{vj} =25 °C | - | 1.75 | 2.25 | V |
| V _{EC} (Chip) (Note1) | | | T _{vj} =125 °C | - | 1.90 | - | |
| | | | T _{vj} =150 °C | - | 1.95 | - | |
| V _{EC} (Chip) (Note1) | Emitter-collector voltage | I _E =600 A, G-E short-circuited, (Note5) | T _{vj} =25 °C | - | 1.60 | 1.95 | V |
| | | | T _{vj} =125 °C | - | 1.60 | - | |
| | | | T _{vj} =150 °C | - | 1.60 | - | |
| t _{rr} (Note1) | Reverse recovery time | V _{CC} =600 V, I _E =600 A, V _{GE} =±15 V, | - | - | 400 | ns | |
| Q _{rr} (Note1) | Reverse recovery charge | R _G =1.0 Ω, Inductive load | - | 46.8 | - | µC | |
| E _{on} | Turn-on switching energy per pulse | V _{CC} =600 V, I _C =I _E =600 A, | - | 50.6 | - | mJ | |
| E _{off} | Turn-off switching energy per pulse | V _{GE} =±15 V, R _G =1.0 Ω, T _{vj} =150 °C, | - | 61.9 | - | | |
| E _{rr} (Note1) | Reverse recovery energy per pulse | Inductive load | - | 48.5 | - | mJ | |
| R _{CC'+EE'} | Internal lead resistance | Main terminals-chip, per switch, T _C =25 °C (Note4) | - | 0.71 | - | mΩ | |
| r _g | Internal gate resistance | Per switch | - | 0.67 | - | Ω | |

CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPE

ELECTRICAL CHARACTERISTICS (cont.; T_{vj}=25 °C, unless otherwise specified)

NTC THERMISTOR PART

| Symbol | Item | Conditions | Limits | | | Unit |
|----------------------|-------------------------|---|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| R ₂₅ | Zero-power resistance | T _c =25 °C (Note4) | 4.85 | 5.00 | 5.15 | kΩ |
| ΔR/R | Deviation of resistance | R ₁₀₀ =493 Ω, T _c =100 °C (Note4) | -7.3 | - | +7.8 | % |
| B _(25/50) | B-constant | Approximate by equation (Note6) | - | 3375 | - | K |
| P ₂₅ | Power dissipation | T _c =25 °C (Note4) | - | - | 10 | mW |

THERMAL RESISTANCE CHARACTERISTICS

| Symbol | Item | Conditions | Limits | | | Unit |
|-----------------------|----------------------------|---|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| R _{th(j-c)Q} | Thermal resistance | Junction to case, per Inverter IGBT (Note4) | - | - | 48 | K/kW |
| R _{th(j-c)D} | | Junction to case, per Inverter FWD (Note4) | - | - | 76 | |
| R _{th(c-s)} | Contact thermal resistance | Case to heat sink, per 1 module, Thermal grease applied (Note4, 7, 9) | - | 11.5 | - | K/kW |

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 5 screw | 2.5 | 3.0 | 3.5 | N·m | |
| d _s | Creepage distance | Solder pin type (DX) | Terminal to terminal | 17 | - | - | mm |
| | | | Terminal to base plate | 16.4 | - | - | |
| | | Pressfit pin type (DXP) | Terminal to terminal | 17 | - | - | mm |
| | | | Terminal to base plate | 16.8 | - | - | |
| d _a | Clearance | Solder pin type (DX) | Terminal to terminal | 10 | - | - | mm |
| | | | Terminal to base plate | 16.2 | - | - | |
| | | Pressfit pin type (DXP) | Terminal to terminal | 10 | - | - | mm |
| | | | Terminal to base plate | 16.2 | - | - | |
| e _c | Flatness of base plate | On the centerline X, Y (Note8) | ±0 | - | +200 | μm | |
| m | mass | - | - | 300 | - | g | |

*. 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 (FWD).

- Junction temperature (T_{vj}) should not increase beyond T_{vjmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} 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. Refer to the figure of test circuit.

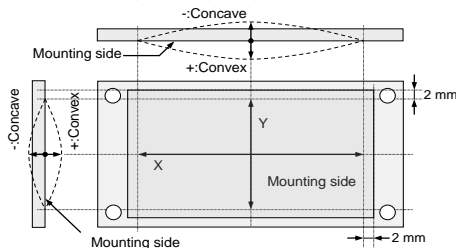
$$B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

R₂₅: resistance at absolute temperature T₂₅ [K]; T₂₅=25 [°C]+273.15=298.15 [K]

R₅₀: resistance at absolute temperature T₅₀ [K]; T₅₀=50 [°C]+273.15=323.15 [K]

7. Reference value. Thermally conductive grease of thermal conductivity λ=0.9 W/(m·K) and thickness D_(c-s)=50 μm.

8. The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



9. Long term performance related to thermal conductive grease (including but not limited to aspects such as the increase of thermal resistance due to pumping out, etc.) should be verified under user's specific application conditions. Each temperature condition (T_{vjmax}, T_{vjop}, T_{cmax}) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE

INSULATED TYPE

Note10. Use the following screws when mounting the printed circuit board (PCB) on the standoffs.

PCB thickness : t1.6

| Type | Manufacturer | Size | Tightening torque (N·m) | Recommended tightening method |
|----------------------|--------------|--------------------|-------------------------|--|
| (1) PT® | EJOT | K25×8 | 0.55 ± 0.055 | by handwork (equivalent to 30 rpm by mechanical screw driver) ~ 600 rpm (by mechanical screw driver) |
| (2) PT® | | K25×10 | 0.75 ± 0.075 N·m | |
| (3) DELTA PT® | | 25×8 | 0.55 ± 0.055 N·m | |
| (4) DELTA PT® | | 25×10 | 0.75 ± 0.075 N·m | |
| (5) B1 tapping screw | - | φ2.6×10 φ2.6×12 | 0.75 ± 0.075 N·m | |

RECOMMENDED OPERATING CONDITIONS

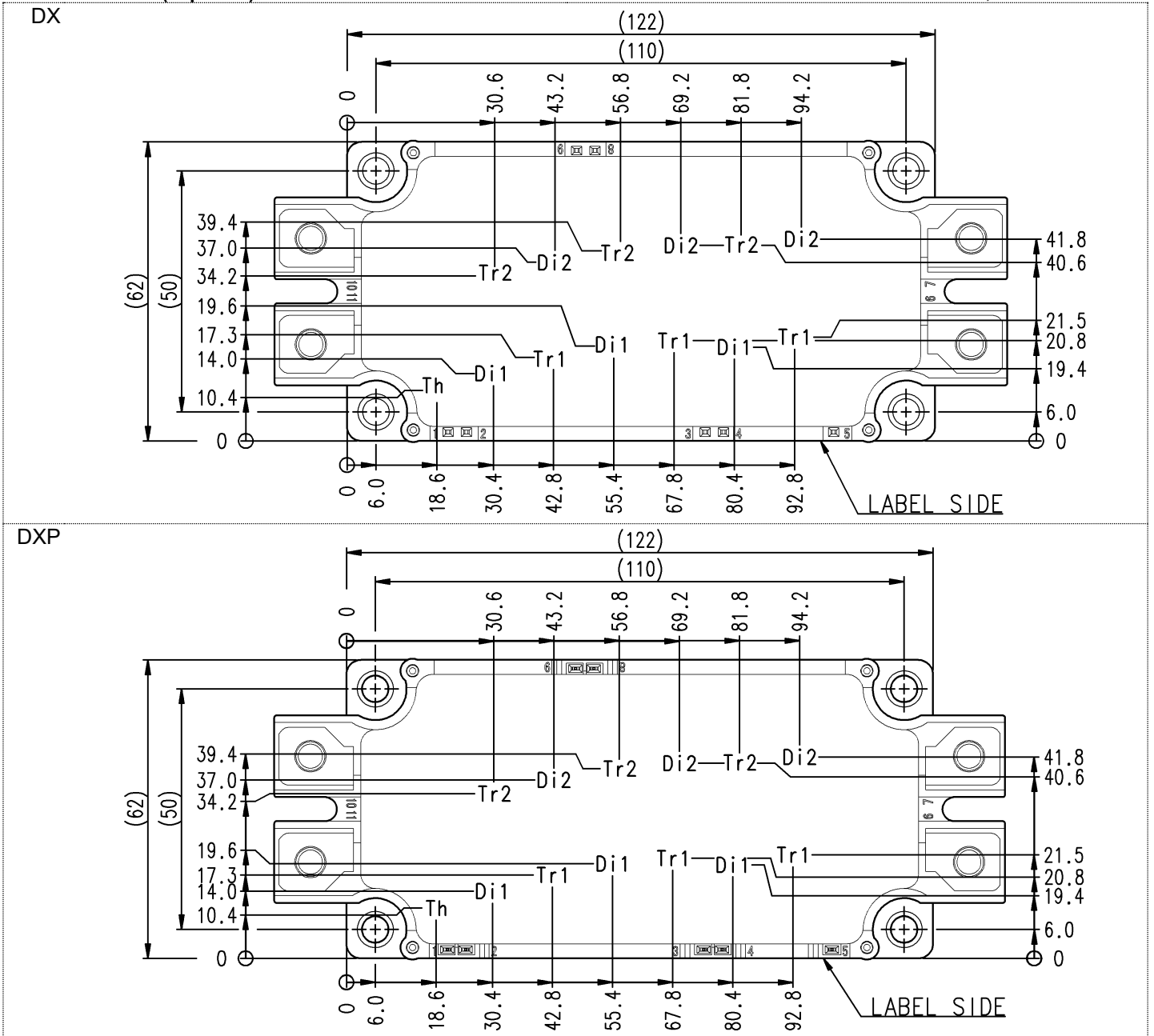
| Symbol | Item | Conditions | Limits | | | Unit |
|------------|-------------------------------|--|--------|------|------|------|
| | | | Min. | Typ. | Max. | |
| V_{CC} | (DC) Supply voltage | Applied across C1-E2 terminals | - | 600 | 850 | V |
| V_{GEon} | Gate (-emitter drive) voltage | Applied across G1-E1s/G2-E2s terminals | 13.5 | 15.0 | 16.5 | V |
| R_G | External gate resistance | Per switch | 1.0 | - | 6.8 | Ω |

CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPE

CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm



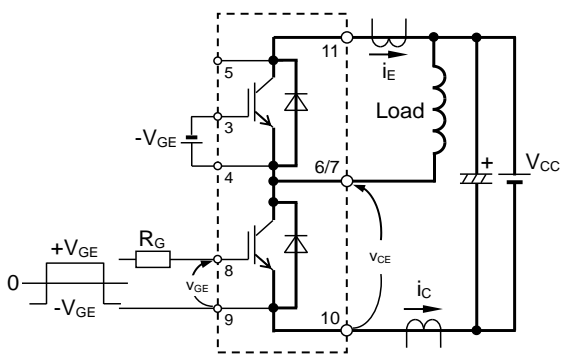
Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

CM600DX-24T/CM600DXP-24T

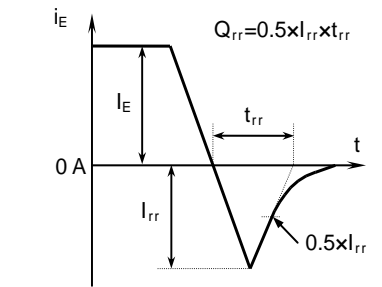
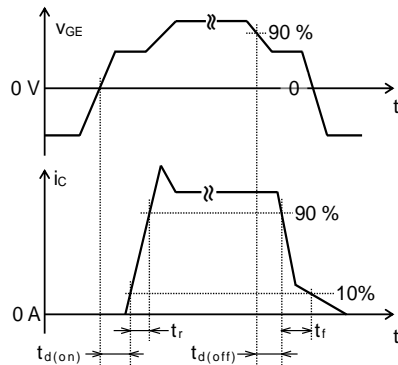
HIGH POWER SWITCHING USE

INSULATED TYPE

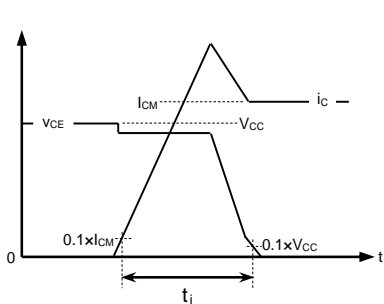
TEST CIRCUIT AND WAVEFORMS



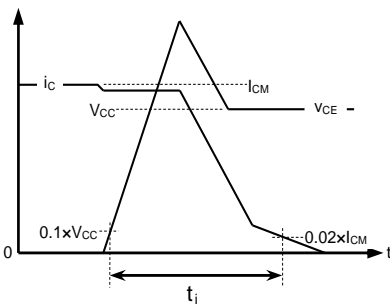
Switching characteristics test circuit and waveforms



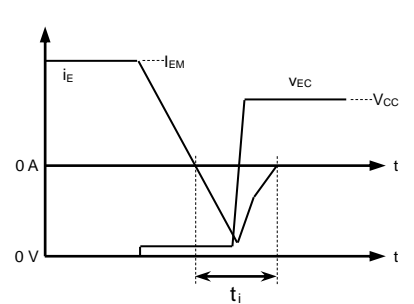
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



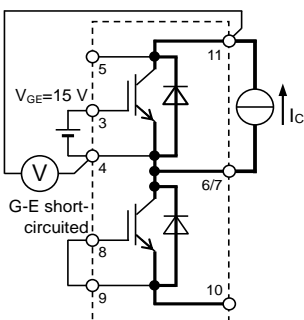
IGBT Turn-off switching energy



FWD Reverse recovery energy

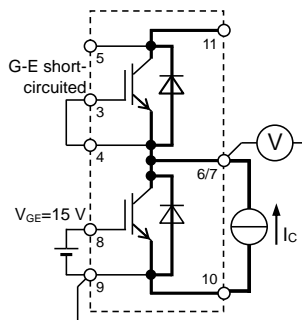
Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

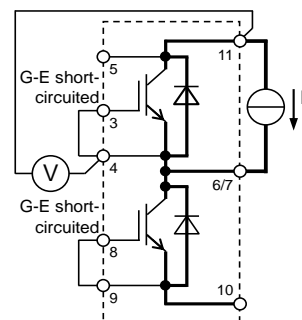


Tr1

V_{CEsat} characteristics test circuit

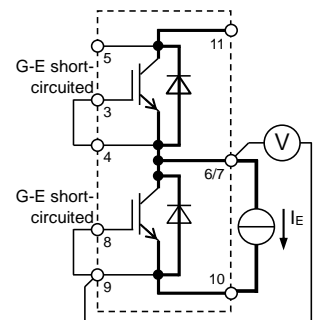


Tr2



Di1

V_{EC} characteristics test circuit



Di2

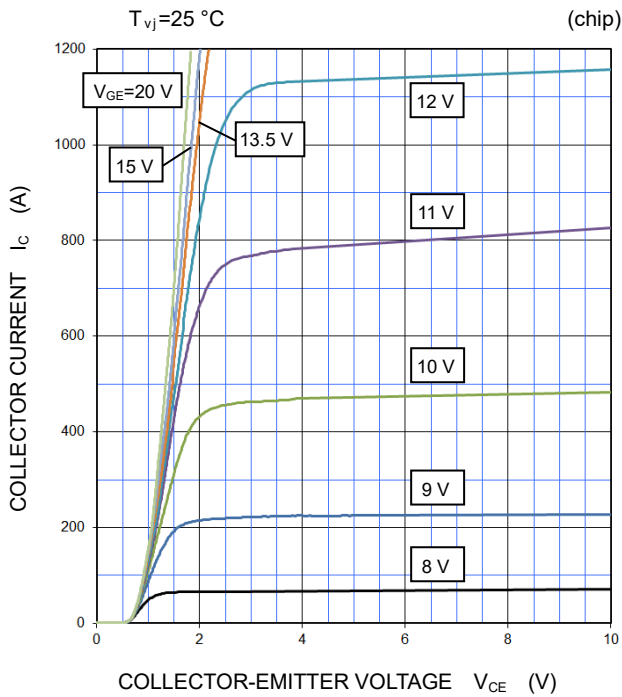
CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPE

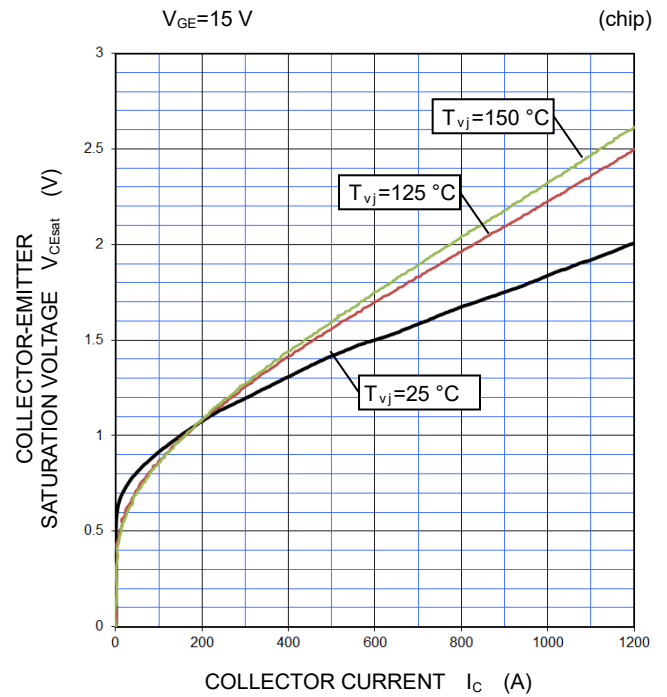
PERFORMANCE CURVES

INVERTER PART

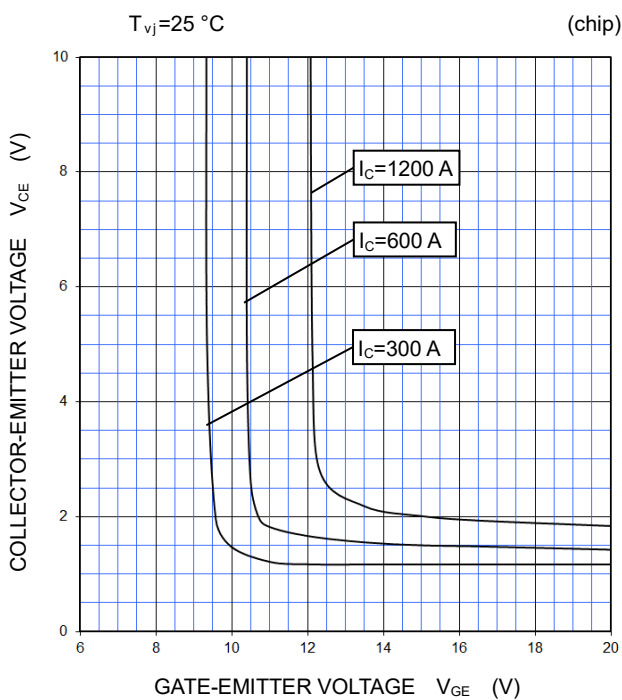
OUTPUT CHARACTERISTICS (TYPICAL)



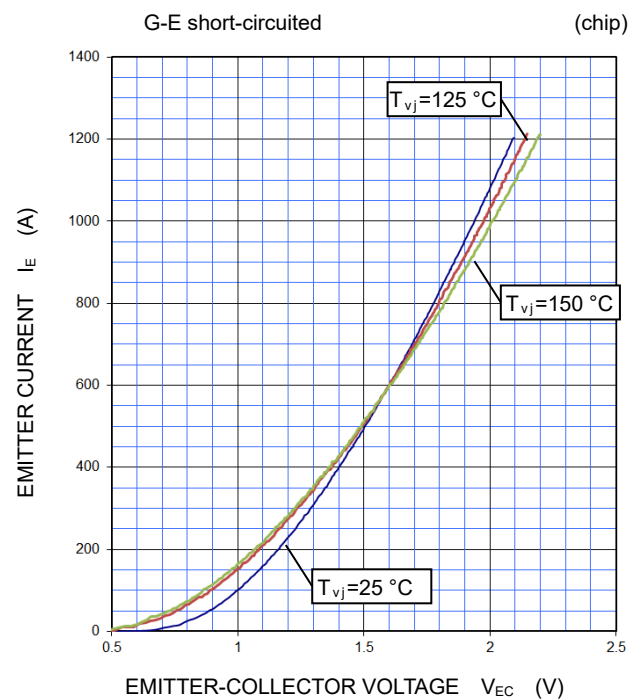
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



CM600DX-24T/CM600DXP-24T

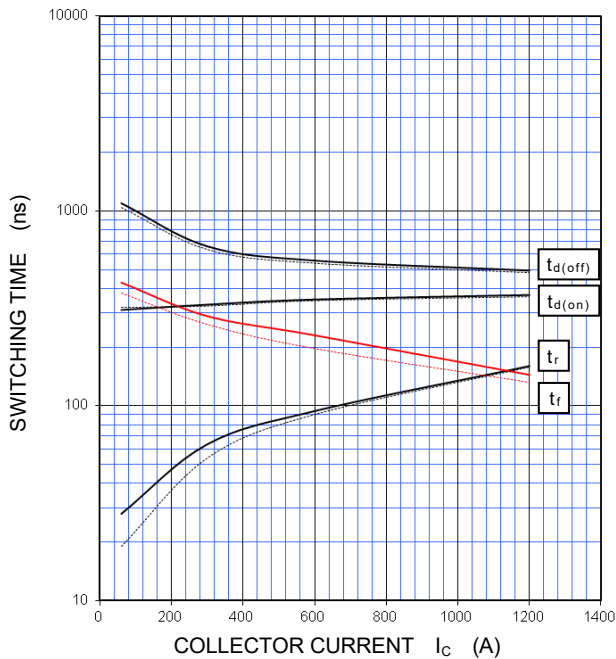
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

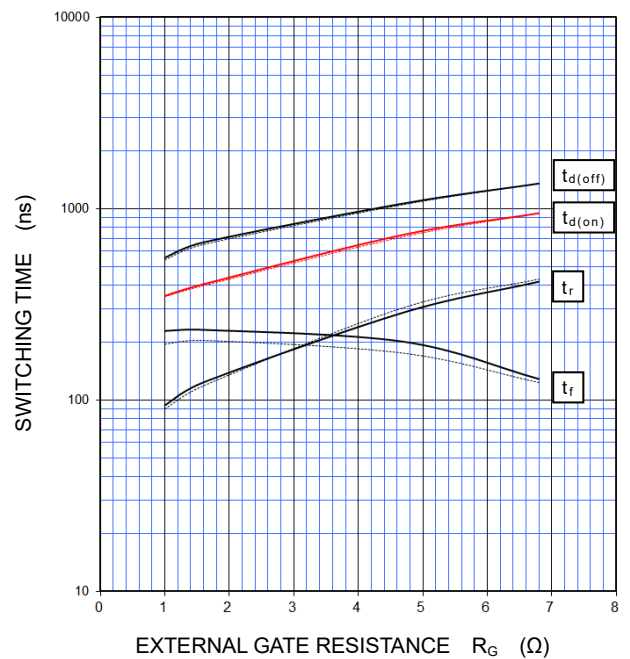
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $R_G=1.0\ \Omega$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



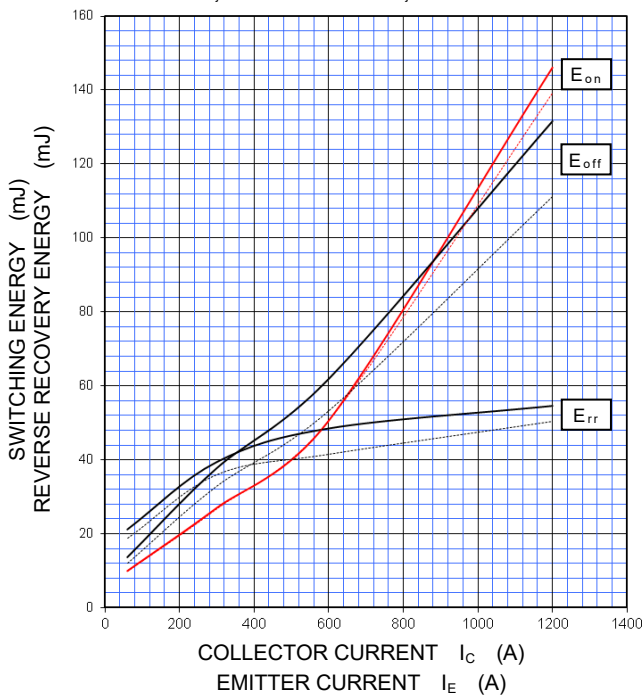
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



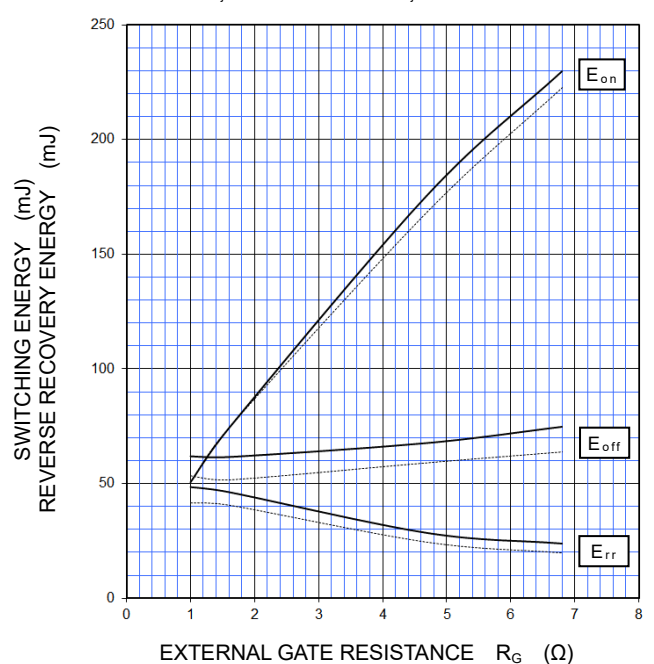
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $R_G=1.0\ \Omega$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD,
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$, PER PULSE



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



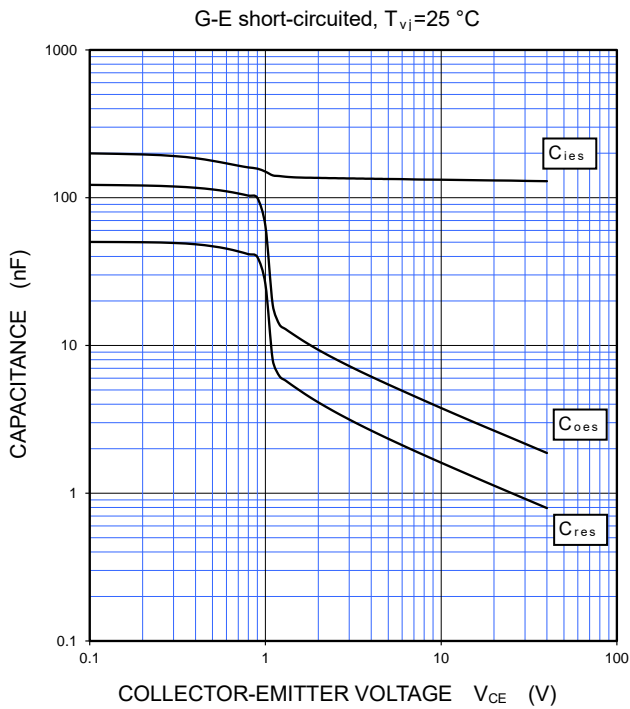
CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPE

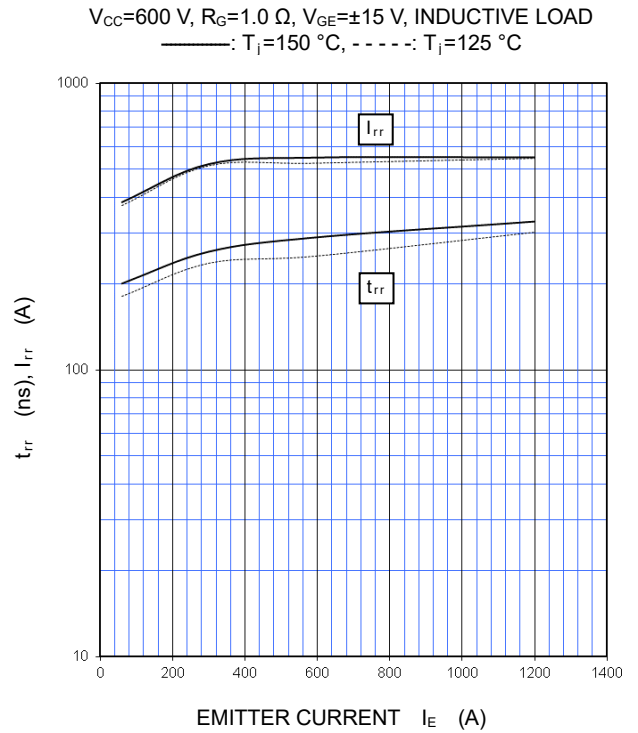
PERFORMANCE CURVES

INVERTER PART

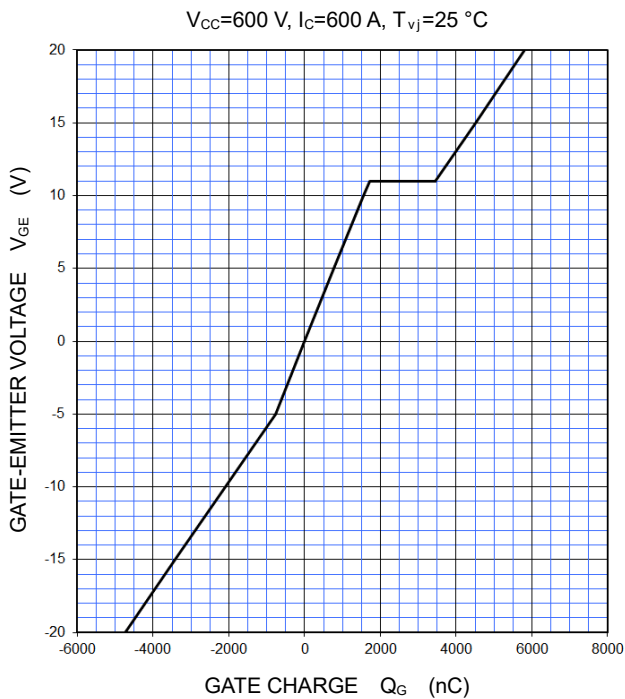
CAPACITANCE CHARACTERISTICS (TYPICAL)



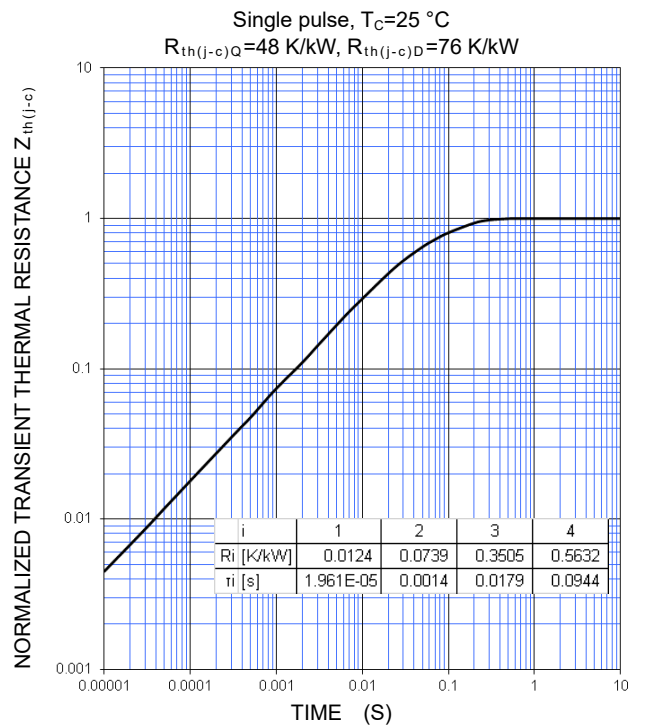
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)



CM600DX-24T/CM600DXP-24T

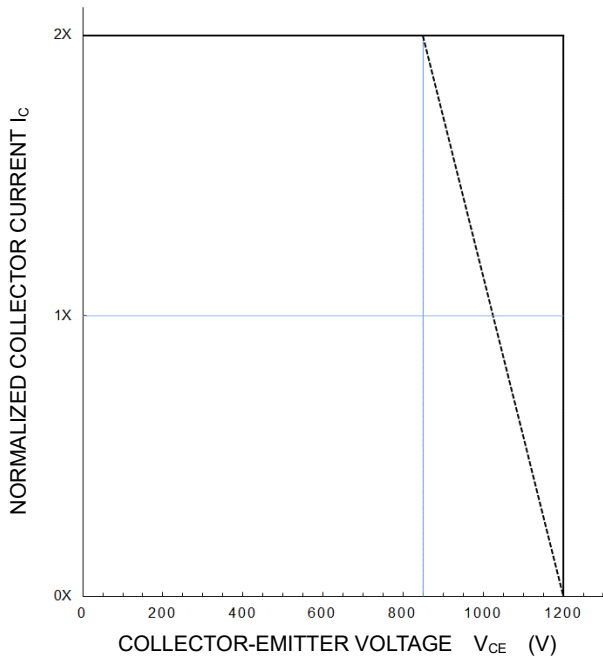
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

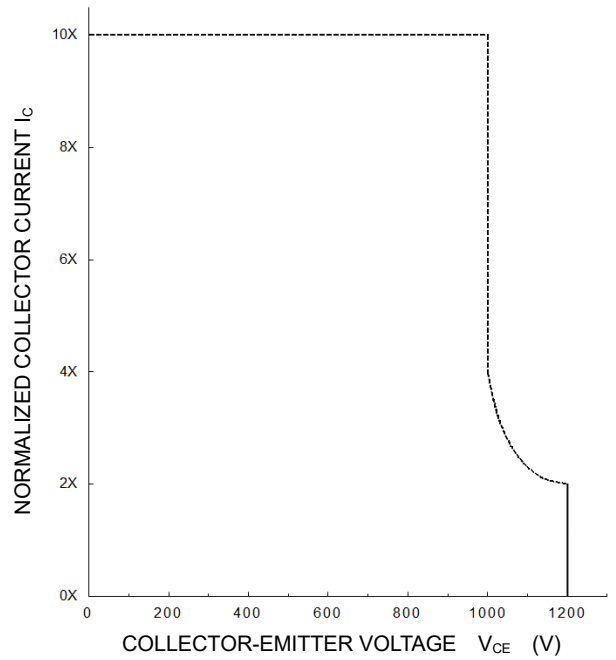
**TURN-OFF SWITCHING SAFE OPERATING AREA
(REVERSE BIAS SAFE OPERATING AREA)
(MAXIMUM)**

$V_{CC} \leq 850 \text{ V}$, $R_G = 1.0 \sim 6.8 \ \Omega$, $V_{GE} = \pm 15 \text{ V}$,
 ———: $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ (Normal load operations (Continuous))
 - - - - -: $T_{vj} = 175 \text{ }^\circ\text{C}$ (Unusual load operations (Limited period))



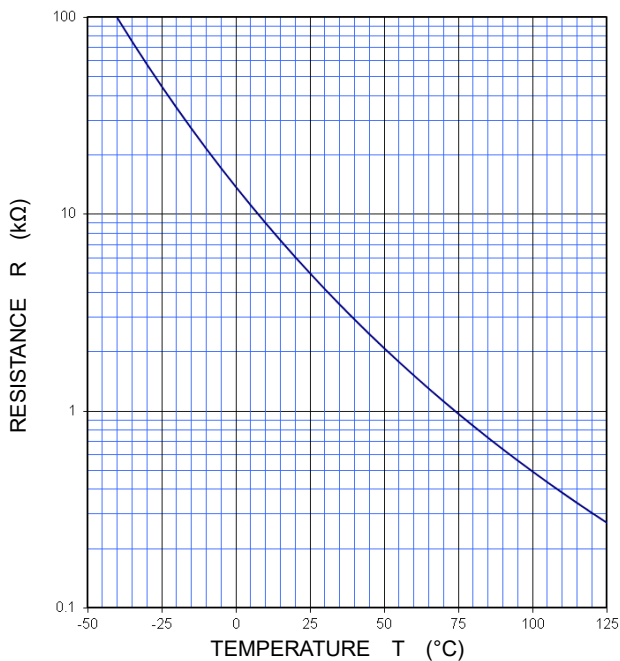
**SHORT-CIRCUIT SAFE OPERATING AREA
(MAXIMUM)**

$V_{CC} \leq 800 \text{ V}$, $R_G = 1.0 \sim 6.8 \ \Omega$, $V_{GE} = \pm 15 \text{ V}$,
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$, $t_W \leq 8 \ \mu\text{s}$, Non-Repetitive



NTC thermistor part

**TEMPERATURE CHARACTERISTICS
(TYPICAL)**



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

CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPE

Important Notice

The information contained in this datasheet shall in no event be regarded as a guarantee of conditions or characteristics. This product has to be used within its specified maximum ratings, and is subject to customer's compliance with any applicable legal requirement, norms and standards.

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CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPE

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