

<IGBT Modules>

CM225DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE



dual switch (Half-Bridge)

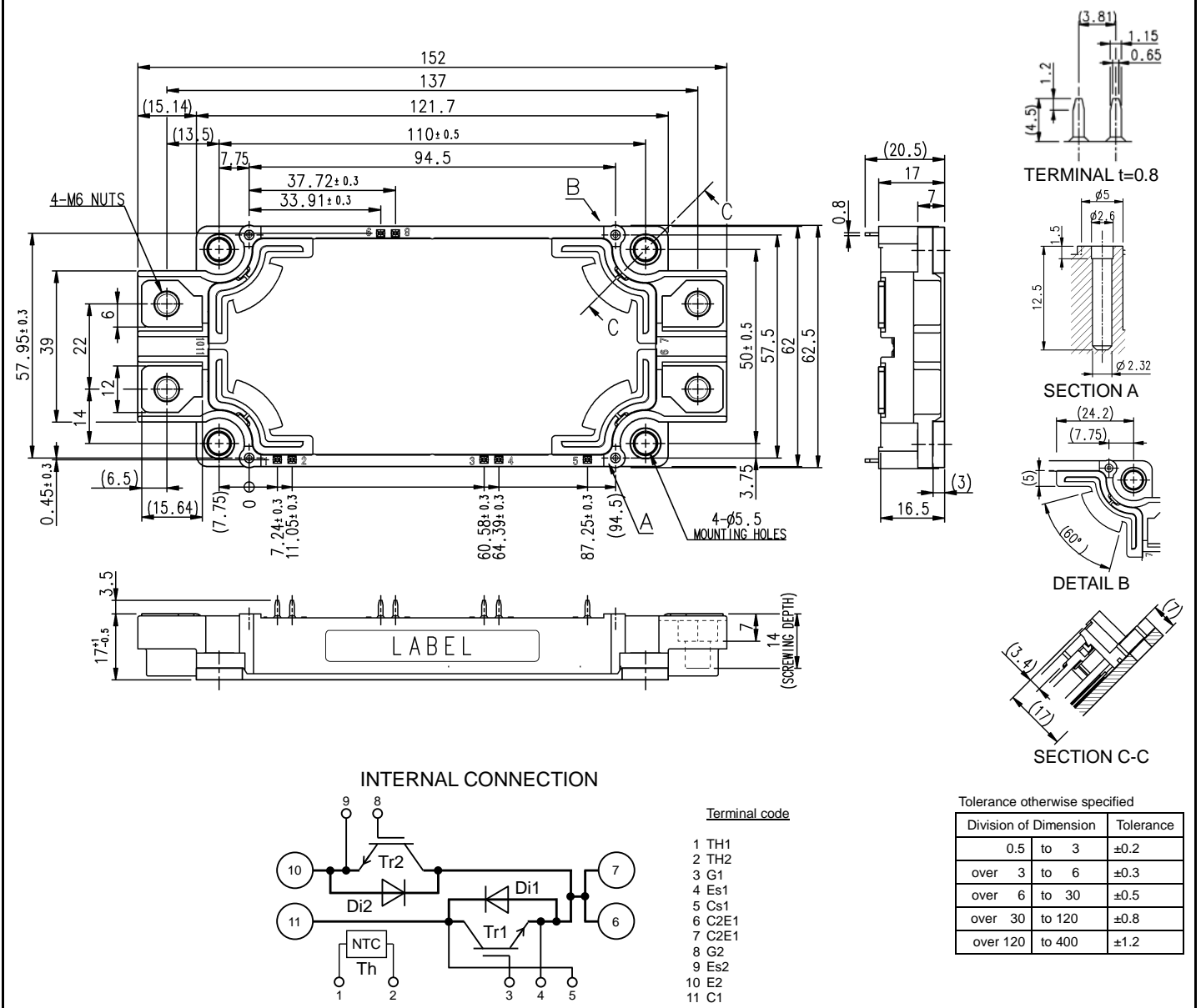
Collector current I_c 225 A
 Collector-emitter voltage V_{CES} 1200 V
 Maximum junction temperature T_{jmax} 175 °C

- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File No. E323585

APPLICATION

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

OUTLINE DRAWING & INTERNAL CONNECTION



CM225DX-24S1HIGH POWER SWITCHING USE
INSULATED TYPEMAXIMUM RATINGS ($T_j=25\text{ }^\circ\text{C}$, 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, $T_C=96\text{ }^\circ\text{C}$ (Note2, 4) | 225 | A |
| I_{CRM} | | Pulse, Repetitive, $V_{GE}=15\text{ V}$ (Note3) | 450 | |
| P_{tot} | Total power dissipation | $T_C=25\text{ }^\circ\text{C}$ (Note2, 4) | 1250 | W |
| I_E (Note1) | Emitter current | DC (Note2) | 225 | A |
| I_{ERM} (Note1) | | Pulse, Repetitive (Note3) | 450 | |

MODULE

| Symbol | Item | Conditions | Rating | Unit |
|------------|--------------------------------|---|------------|------------------|
| V_{isol} | Isolation voltage | Terminals to base plate, RMS, $f=60\text{ Hz}$, AC 1 min | 4000 | V |
| T_{jmax} | Maximum junction temperature | Instantaneous event (overload) | 175 | $^\circ\text{C}$ |
| T_{Cmax} | Maximum case temperature | (Note4) | 125 | |
| T_{jop} | Operating junction temperature | Continuous operation (under switching) | -40 ~ +150 | $^\circ\text{C}$ |
| T_{stg} | Storage temperature | - | -40 ~ +125 | |

ELECTRICAL CHARACTERISTICS ($T_j=25\text{ }^\circ\text{C}$, 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 | $I_C=22.5\text{ mA}$, $V_{CE}=10\text{ V}$ | 5.4 | 6.0 | 6.6 | V | |
| V_{CESat} (Terminal) | Collector-emitter saturation voltage | $I_C=225\text{ A}$, $V_{GE}=15\text{ V}$, Refer to the figure of test circuit (Note5) | $T_j=25\text{ }^\circ\text{C}$ | - | 1.90 | 2.35 | V |
| | | | $T_j=125\text{ }^\circ\text{C}$ | - | 2.10 | - | |
| | | | $T_j=150\text{ }^\circ\text{C}$ | - | 2.15 | - | |
| V_{CESat} (Chip) | | $I_C=225\text{ A}$, $V_{GE}=15\text{ V}$, (Note5) | $T_j=25\text{ }^\circ\text{C}$ | - | 1.80 | 2.25 | V |
| | | | $T_j=125\text{ }^\circ\text{C}$ | - | 2.00 | - | |
| | | | $T_j=150\text{ }^\circ\text{C}$ | - | 2.05 | - | |
| C_{ies} | Input capacitance | $V_{CE}=10\text{ V}$, G-E short-circuited | - | - | 20 | nF | |
| C_{oes} | Output capacitance | | - | - | 4.0 | | |
| C_{res} | Reverse transfer capacitance | | - | - | 0.33 | | |
| Q_G | Gate charge | $V_{CC}=600\text{ V}$, $I_C=225\text{ A}$, $V_{GE}=15\text{ V}$ | - | 420 | - | nC | |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC}=600\text{ V}$, $I_C=225\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.5\text{ }\Omega$, Inductive load | - | - | 800 | ns | |
| t_r | Rise time | | - | - | 200 | | |
| $t_{d(off)}$ | Turn-off delay time | | - | - | 600 | | |
| t_f | Fall time | | - | - | 300 | | |
| V_{EC} (Terminal) (Note1) | Emitter-collector voltage | $I_E=225\text{ A}$, G-E short-circuited, Refer to the figure of test circuit (Note5) | $T_j=25\text{ }^\circ\text{C}$ | - | 2.75 | 3.55 | V |
| | | | $T_j=125\text{ }^\circ\text{C}$ | - | 2.30 | - | |
| | | | $T_j=150\text{ }^\circ\text{C}$ | - | 2.20 | - | |
| V_{EC} (Chip) (Note1) | | $I_E=225\text{ A}$, G-E short-circuited, (Note5) | $T_j=25\text{ }^\circ\text{C}$ | - | 2.65 | 3.45 | V |
| | | | $T_j=125\text{ }^\circ\text{C}$ | - | 2.20 | - | |
| | | | $T_j=150\text{ }^\circ\text{C}$ | - | 2.10 | - | |
| t_{rr} (Note1) | Reverse recovery time | $V_{CC}=600\text{ V}$, $I_E=225\text{ A}$, $V_{GE}=\pm 15\text{ V}$, | - | - | 300 | ns | |
| Q_{rr} (Note1) | Reverse recovery charge | $R_G=1.5\text{ }\Omega$, Inductive load | - | 6.0 | - | μC | |
| E_{on} | Turn-on switching energy per pulse | $V_{CC}=600\text{ V}$, $I_C=I_E=225\text{ A}$, | - | 21.7 | - | mJ | |
| E_{off} | Turn-off switching energy per pulse | $V_{GE}=\pm 15\text{ V}$, $R_G=1.5\text{ }\Omega$, $T_j=150\text{ }^\circ\text{C}$, | - | 23.1 | - | | |
| E_{rr} (Note1) | Reverse recovery energy per pulse | Inductive load | - | 17.1 | - | mJ | |
| R_{CC+EE} | Internal lead resistance | Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note4) | - | - | 1.0 | $\text{m}\Omega$ | |
| r_g | Internal gate resistance | Per switch | - | 3.2 | - | Ω | |

CM225DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

ELECTRICAL CHARACTERISTICS (cont.; T_j=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) | - | - | 0.12 | K/W |
| R _{th(j-c)D} | | Junction to case, per Inverter FWD (Note4) | - | - | 0.18 | |
| R _{th(c-s)} | Contact thermal resistance | Case to heat sink, per 1 module, Thermal grease applied (Note4, 7) | - | 15 | - | 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 |
| m | mass | - | - | 350 | - | g |
| d _s | Creepage distance | Terminal to terminal | 17 | - | - | mm |
| | | Terminal to base plate | 18.5 | - | - | |
| d _a | Clearance | Terminal to terminal | 10 | - | - | mm |
| | | Terminal to base plate | 16.3 | - | - | |
| e _c | Flatness of base plate | On the centerline X, Y (Note8) | ±0 | - | +100 | μm |

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

Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free-wheeling diode (FWD).

- 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.

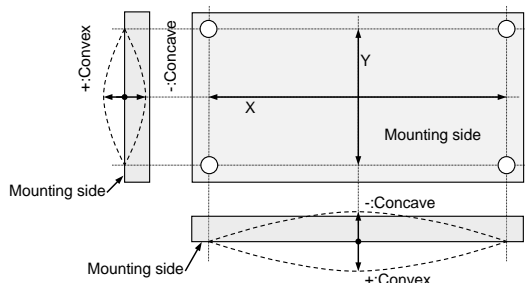
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

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. Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).

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



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Note9. Use the following screws when mounting the printed circuit board (PCB) on the standoffs.

PCB thickness : t=1.6

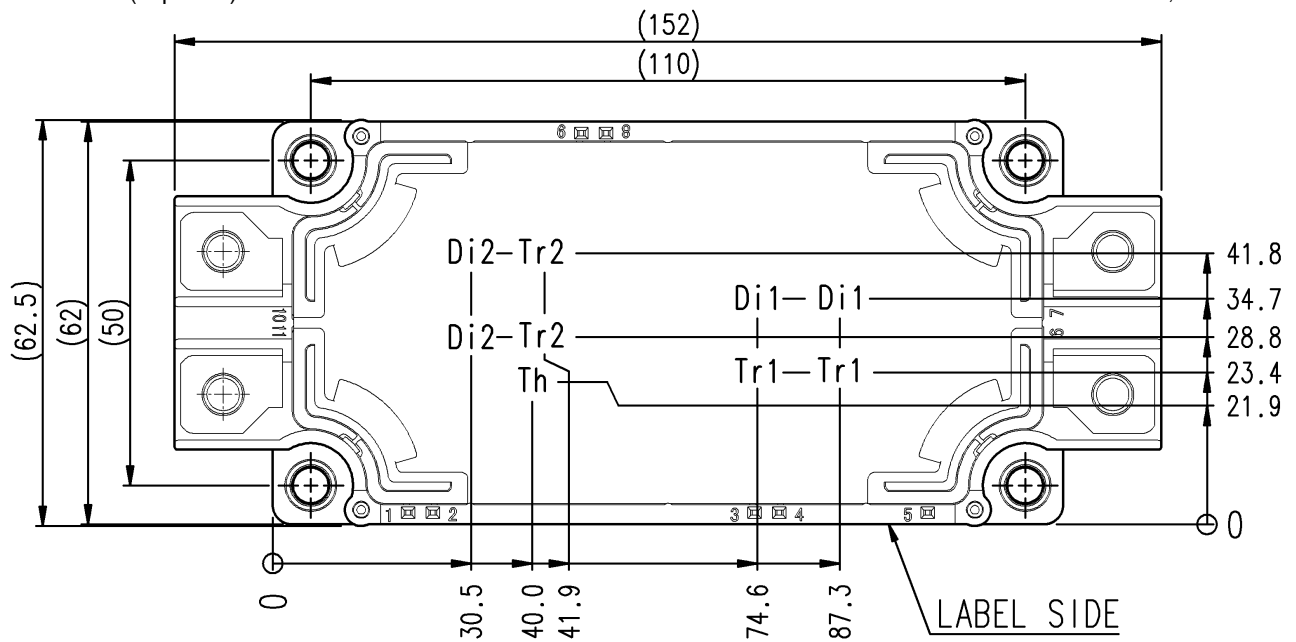
| Type | Manufacturer | Size | Tightening torque (N·m) | Recommended tightening method |
|----------------------|--------------|---------|-------------------------|--|
| (1) PT® | EJOT | K25×8 | 0.55 ± 0.055 | by handwork (equivalent to 30 rpm by mechanical screw driver) ~ 600 rpm (by mechanical screw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

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-Es1/G2-Es2 terminals | 14.0 | 15.0 | 16.5 | V |
| R _G | External gate resistance | Per switch | 1.5 | - | 15 | Ω |

CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm

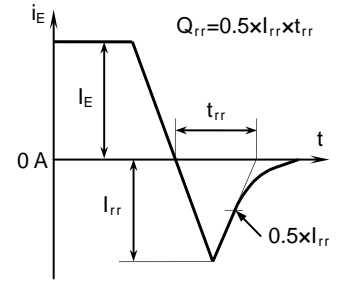
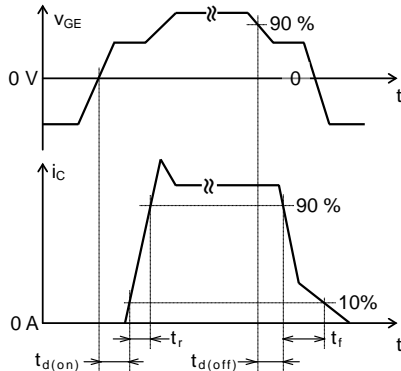
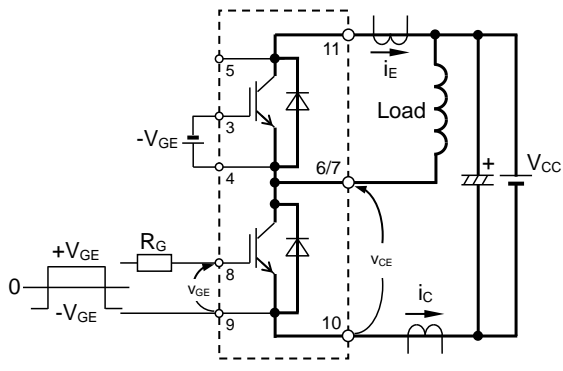


Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

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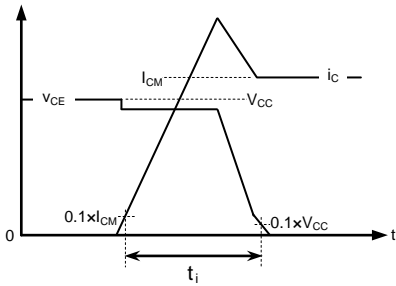
HIGH POWER SWITCHING USE
INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS

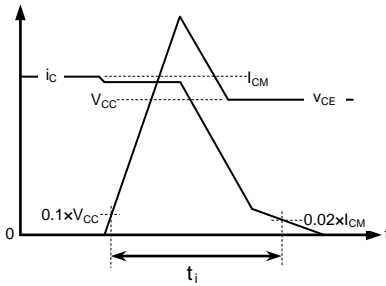


Switching characteristics test circuit and waveforms

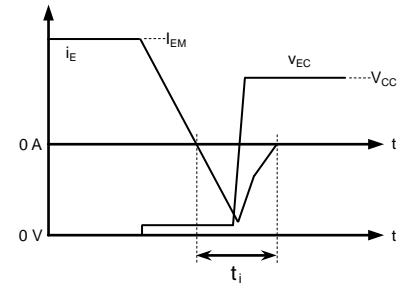
t_{rr}, Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



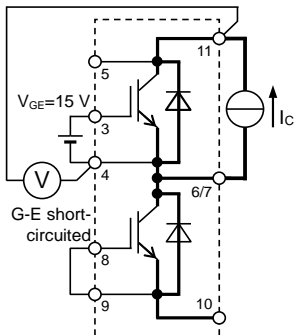
IGBT Turn-off switching energy



FWD Reverse recovery energy

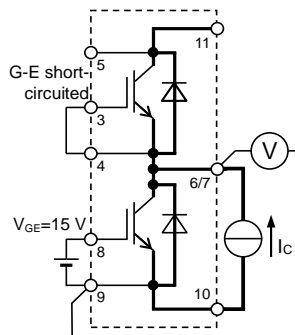
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

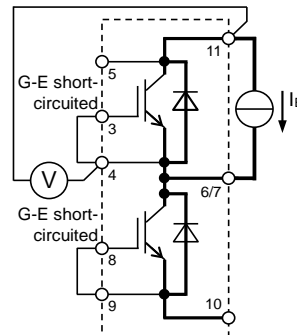


Q1

V_{CEsat} characteristics test circuit

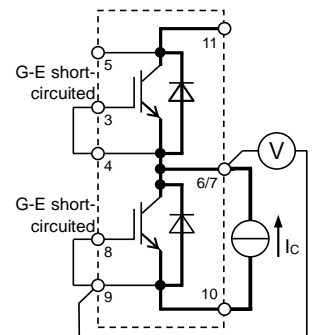


Q2



D1

V_{EC} characteristics test circuit



D2

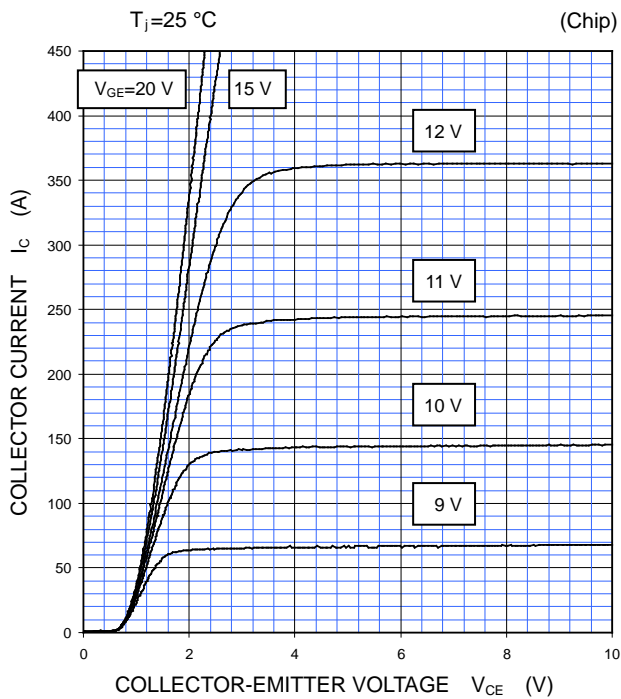
CM225DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

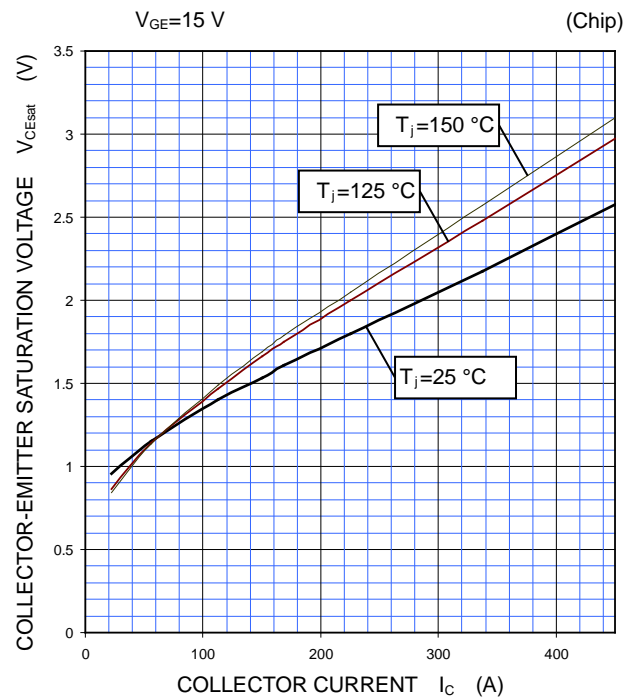
PERFORMANCE CURVES

INVERTER PART

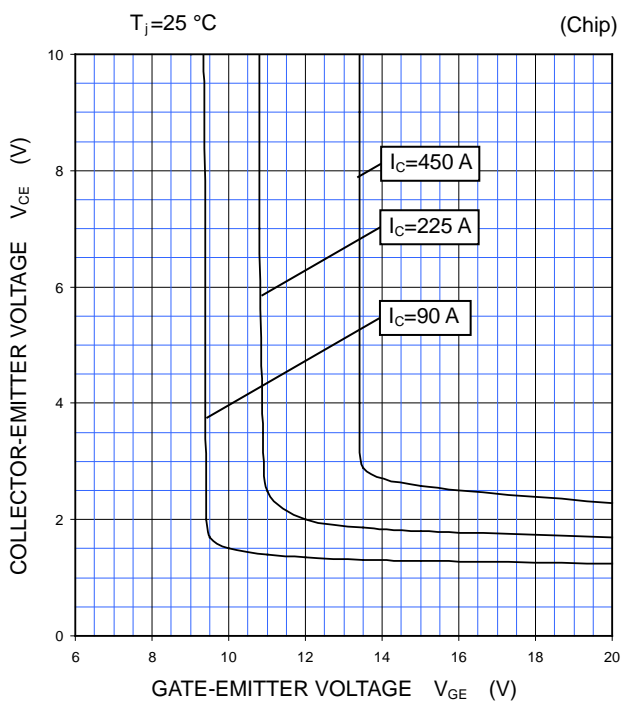
OUTPUT CHARACTERISTICS (TYPICAL)



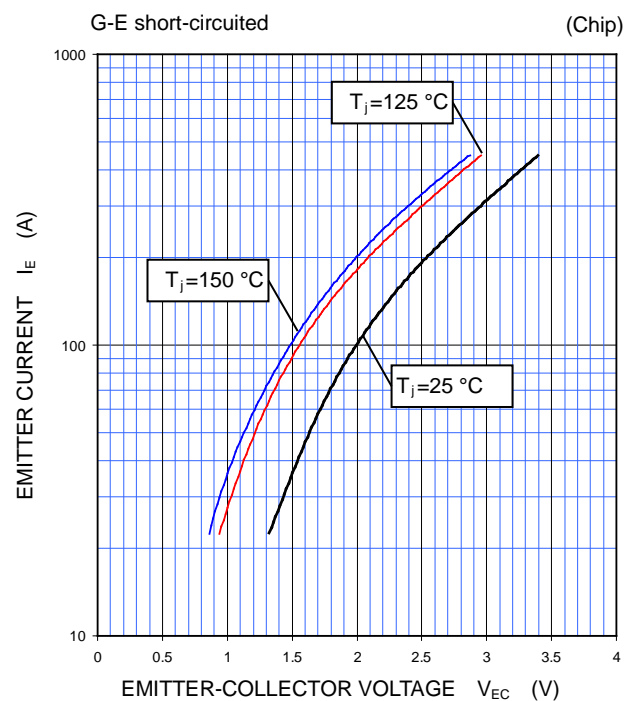
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



CM225DX-24S1

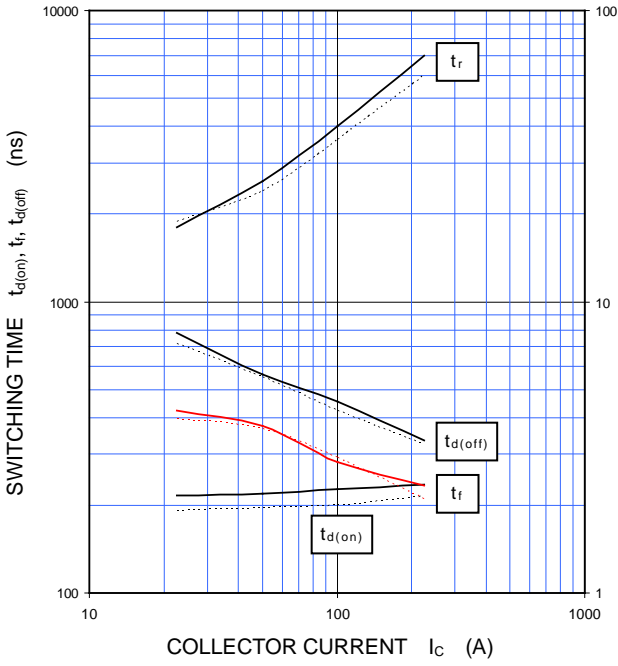
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

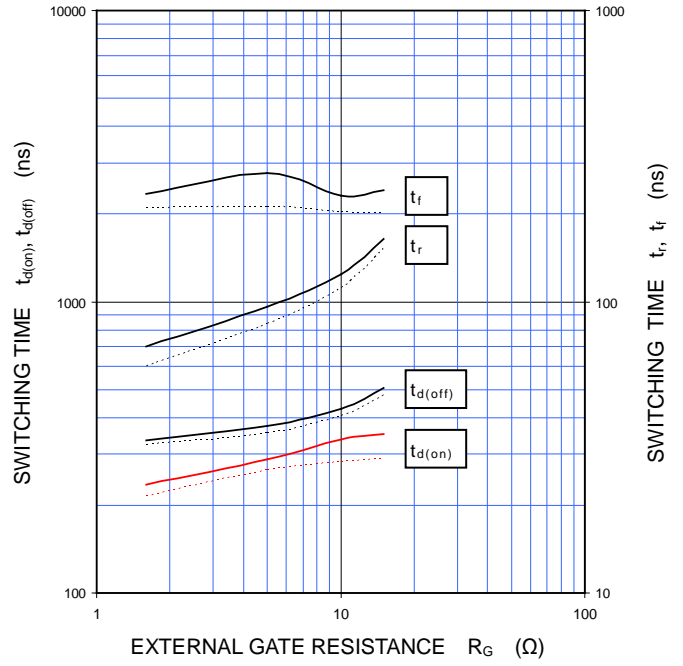
HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.6\ \Omega$, INDUCTIVE LOAD
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



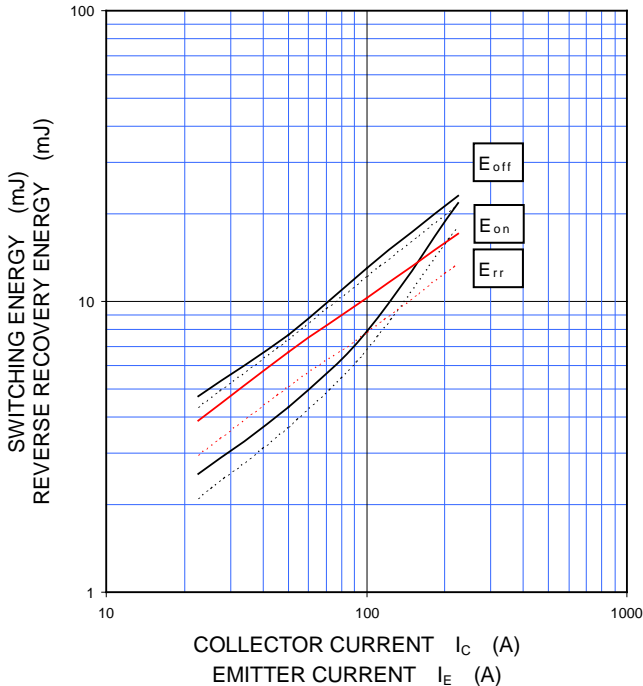
HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_c=225\text{ A}$, INDUCTIVE LOAD
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



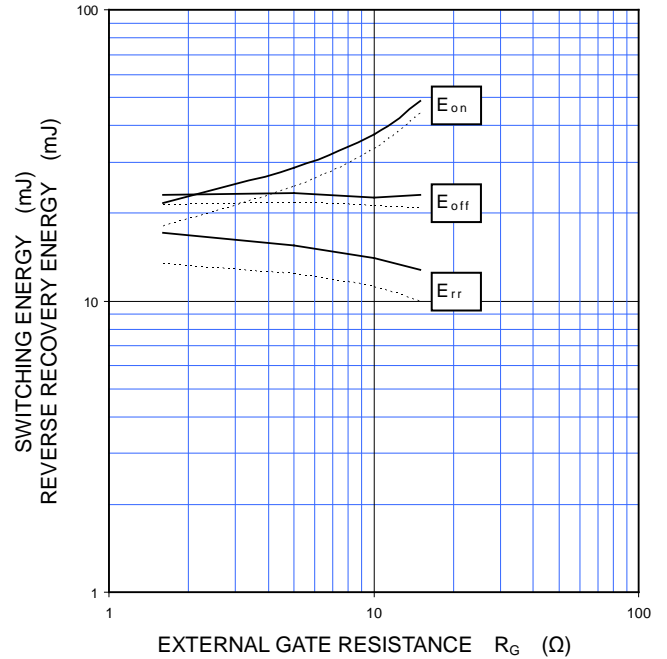
HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.6\ \Omega$,
INDUCTIVE LOAD, PER PULSE
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_c/I_E=225\text{ A}$,
INDUCTIVE LOAD, PER PULSE
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



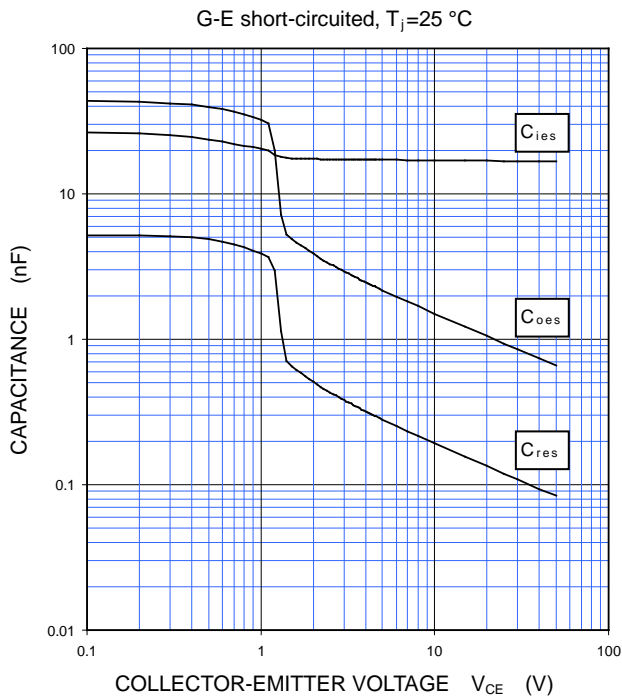
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HIGH POWER SWITCHING USE
INSULATED TYPE

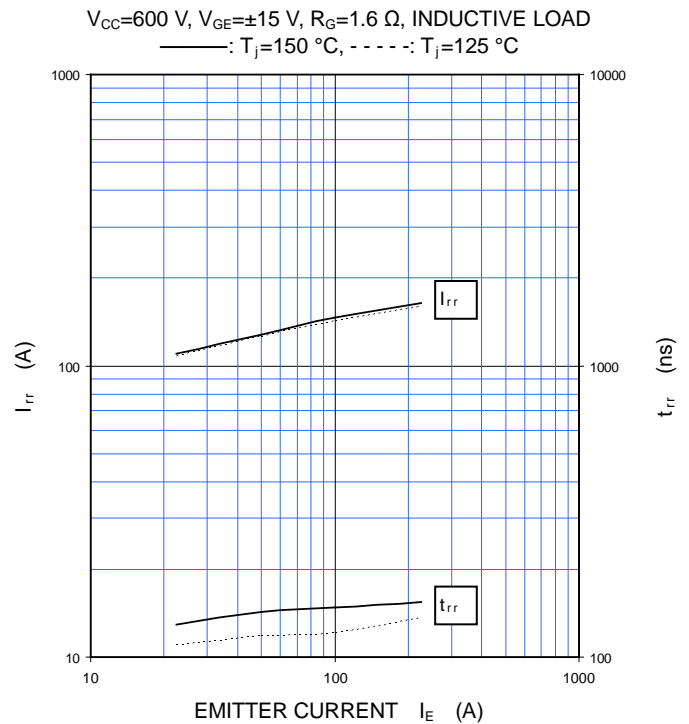
PERFORMANCE CURVES

INVERTER PART

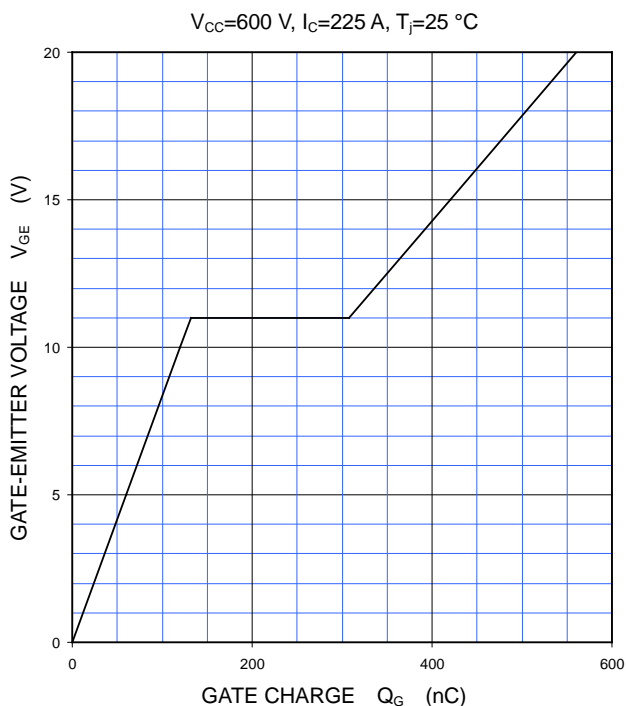
CAPACITANCE CHARACTERISTICS
(TYPICAL)



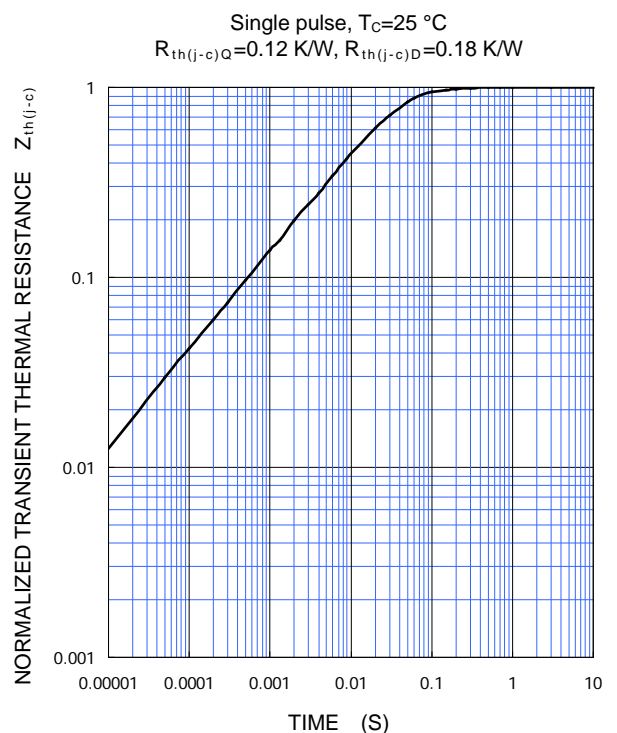
FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)



GATE CHARGE CHARACTERISTICS
(TYPICAL)



TRANSIENT THERMAL IMPEDANCE
CHARACTERISTICS
(MAXIMUM)



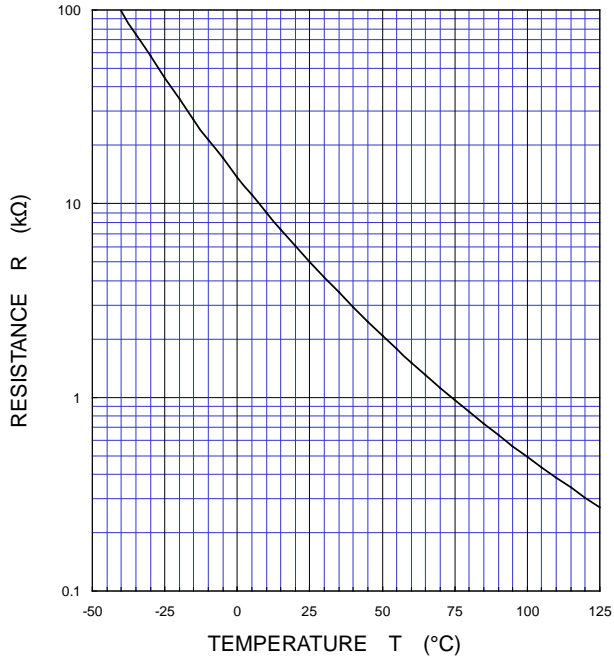
CM225DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS
(TYPICAL)



Keep safety first in your circuit designs!

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