

<IGBT Modules>

CM1400HA-24S

HIGH POWER SWITCHING USE
INSULATED TYPE



single pack

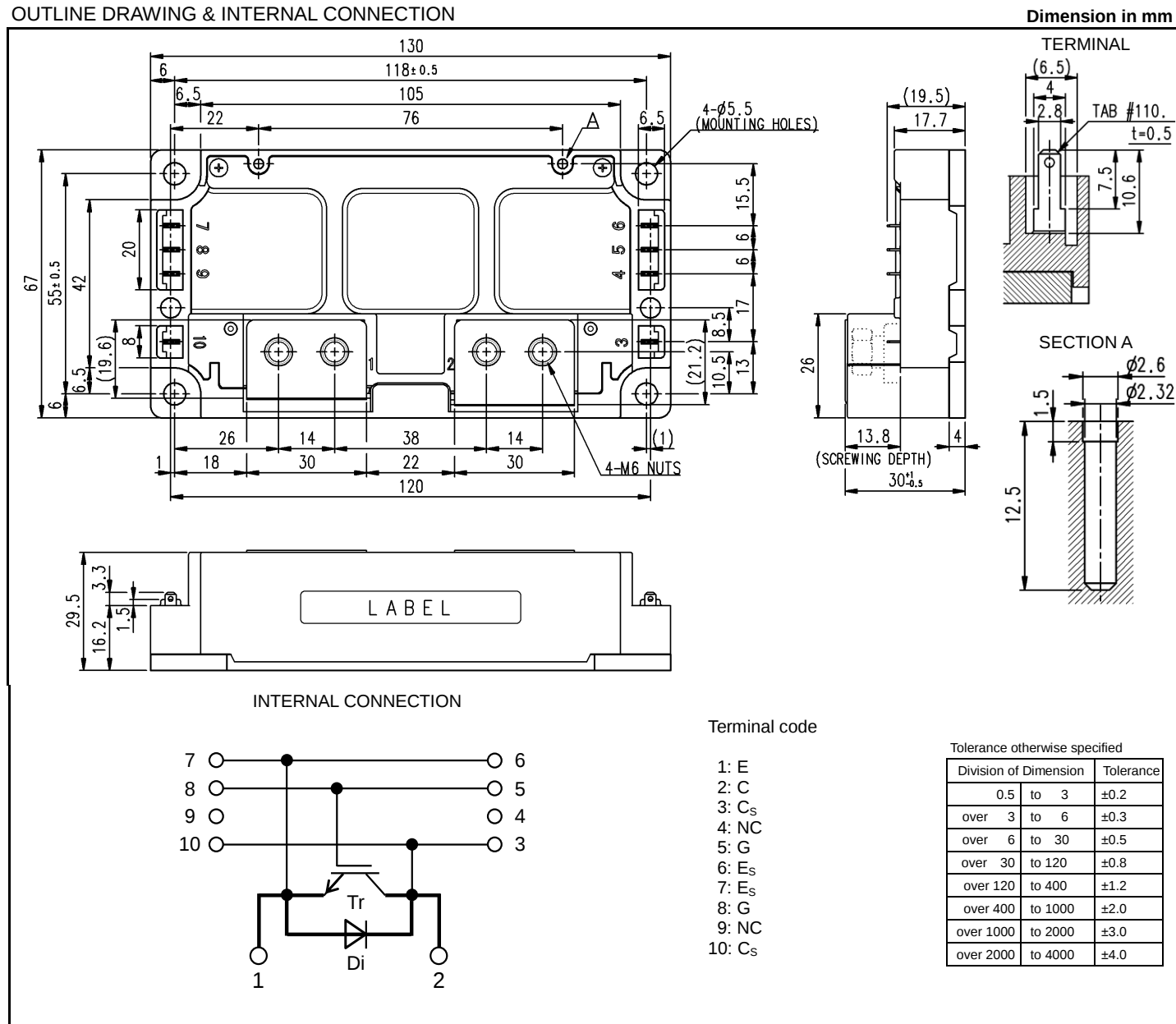
Collector current I_C **1 4 0 0 A**
Collector-emitter voltage V_{CES} **1 2 0 0 V**
Maximum junction temperature T_{vjmax} **1 7 5 °C**

- Flat base Type
- Copper base plate
- Tin plating tab terminals
- RoHS Directive compliant
- Recognized under UL1557, File E323585

APPLICATION

AC Motor Control, Motion/Servo Control, Power supply, Photovoltaic power, Wind power, etc.

OUTLINE DRAWING & INTERNAL CONNECTION



CM1400HA-24S

HIGH POWER SWITCHING USE
INSULATED TYPEMAXIMUM RATINGS (T_{vj}=25 °C, unless otherwise specified)

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 =94 °C (Note2, 4)	1400	A
I _{CRM}		Pulse, Repetitive (Note3)	2800	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	7140	W
I _E (Note1)	Emitter current	DC (Note2)	1400	A
I _{ERM} (Note1)		Pulse, Repetitive (Note3)	2800	
V _{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	4000	V
T _{vjmax}	Maximum junction temperature	Instantaneous event (overload)	175	°C
T _{Cmax}	Maximum case temperature	(Note4)	125	
T _{vjop}	Operating junction temperature	Continuous operation (under switching)	-40 ~ +150	°C
T _{stg}	Storage temperature	-	-40 ~ +125	

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

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 =140 mA, V _{CE} =10 V		5.4	6.0	6.6	V
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =1400 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	1.90	2.35	V
			T _{vj} =125 °C	-	2.10	-	
			T _{vj} =150 °C	-	2.20	-	
V _{CEsat} (Chip)		I _C =1400 A, V _{GE} =15 V, (Note5)	T _{vj} =25 °C	-	1.80	2.25	V
			T _{vj} =125 °C	-	2.00	-	
			T _{vj} =150 °C	-	2.10	-	
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited		-	-	125	nF
C _{oes}	Output capacitance			-	-	25	
C _{res}	Reverse transfer capacitance			-	-	2.1	
Q _G	Gate charge	V _{CC} =600 V, I _C =1400 A, V _{GE} =15 V		-	2.9	-	μC
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =1400 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load		-	-	600	ns
t _r	Rise time			-	-	300	
t _{d(off)}	Turn-off delay time			-	-	600	
t _f	Fall time			-	-	300	
V _{EC} (Note.1) (Terminal)	Emitter-collector voltage	I _E =1400 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	1.85	2.30	V
			T _{vj} =125 °C	-	1.90	-	
			T _{vj} =150 °C	-	1.90	-	
V _{EC} (Note.1) (Chip)		I _E =1400 A, G-E short-circuited, (Note5)	T _{vj} =25 °C	-	1.75	2.20	V
			T _{vj} =125 °C	-	1.80	-	
			T _{vj} =150 °C	-	1.80	-	
t _{rr} (Note1)	Reverse recovery time	V _{CC} =600 V, I _E =1400 A, V _{GE} =±15 V,		-	-	300	ns
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load		-	150	-	
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =1400 A,		-	181	-	mJ
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =0 Ω, T _{vj} =150 °C,		-	161	-	
E _{rr} (Note1)	Reverse recovery energy per pulse	Inductive load		-	104	-	mJ
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip, T _C =25 °C (Note4)		-	0.2	-	mΩ
r _g	Internal gate resistance	-		-	2.2	-	Ω

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to case, IGBT (Note4)	-	-	21	K/kW
$R_{th(j-c)D}$		Junction to case, FWD (Note4)	-	-	32	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, Thermal grease applied (Note4, 6)	-	18	-	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	Terminal to terminal	22.0	-	-	mm
		Terminal to base plate	21.9	-	-	
d_a	Clearance	Terminal to terminal	16.5	-	-	mm
		Terminal to base plate	12.5	-	-	
e_c	Flatness of base plate	On the centerline X, Y (Note7)	-50	-	+100	μm
m	mass	-	-	490	-	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.

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

2. Junction temperature (T_{vj}) should not exceed T_{vjmax} rating.

3. Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} rating.

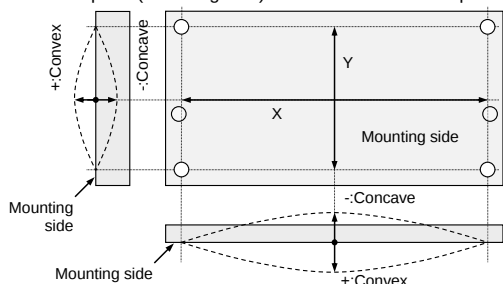
4. Case temperature (T_c) and heat sink temperature (T_s) are defined on the each surface (mounting side) of base plate and heat sink just under the chips.

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 $\lambda=0.9 \text{ W/(m}\cdot\text{K)}/D_{(c-s)}=100 \text{ }\mu\text{m}$.

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



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

The length of the screw depends on the PCB thickness ($t_{1.0}$).

Type	Size	Tightening torque	Recommended tightening method
(1) PT®	K25×8	$0.55 \pm 0.055 \text{ N}\cdot\text{m}$	by handwork (equivalent to 30 r/min by mechanical screw driver) ~ 600 r/min (by mechanical screw driver)
(2) PT®	K25×10	$0.85 \pm 0.085 \text{ N}\cdot\text{m}$	
(3) DELTA PT®	25×8	$0.55 \pm 0.055 \text{ N}\cdot\text{m}$	
(4) DELTA PT®	25×10	$0.85 \pm 0.085 \text{ N}\cdot\text{m}$	
(5) B1 tapping screw	$\phi 2.6 \times 10$ or $\phi 2.6 \times 12$	$0.85 \pm 0.085 \text{ N}\cdot\text{m}$	

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HIGH POWER SWITCHING USE

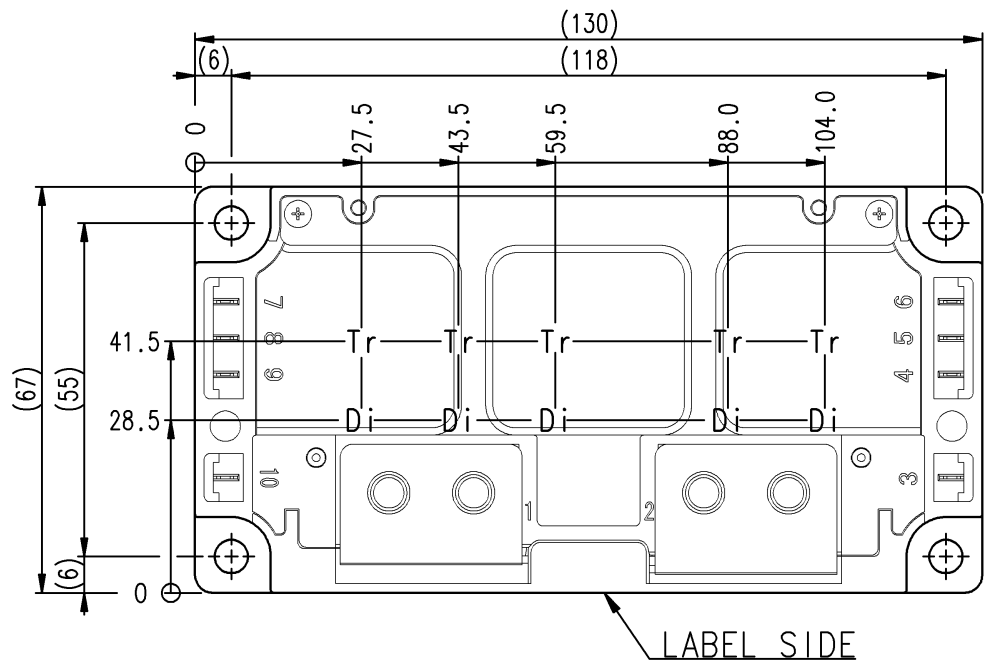
INSULATED TYPE

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C-E terminals	-	600	850	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G-Es terminals	13.5	15.0	16.5	V
R_G	External gate resistance	-	0	-	15	Ω

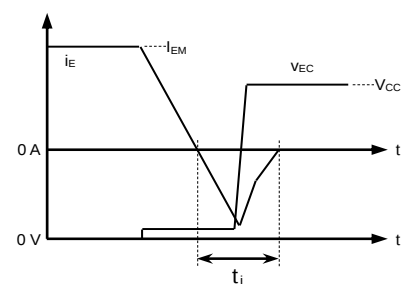
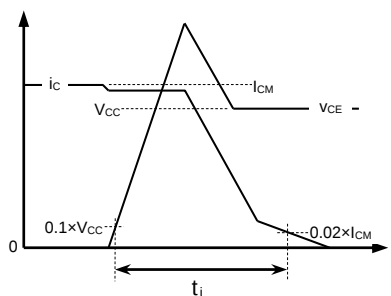
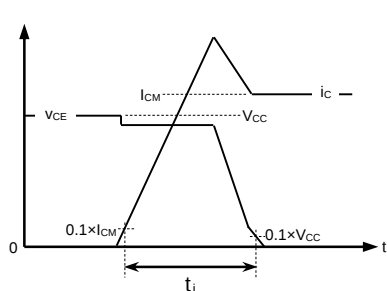
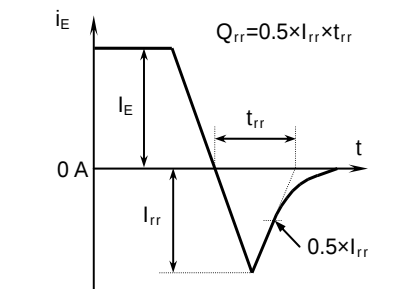
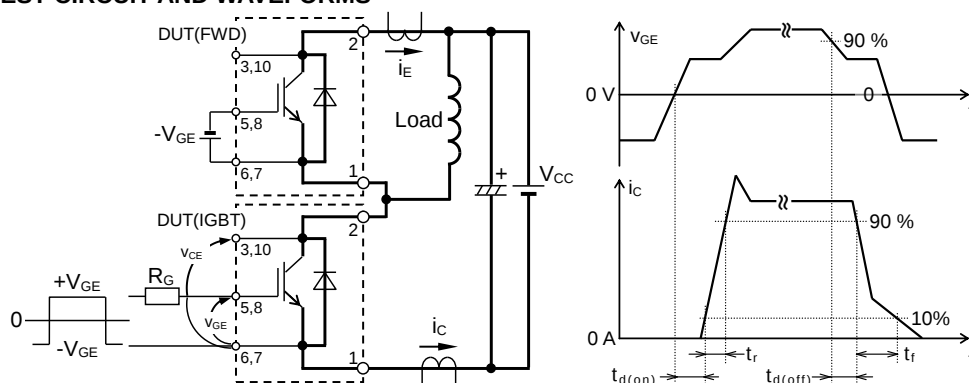
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm



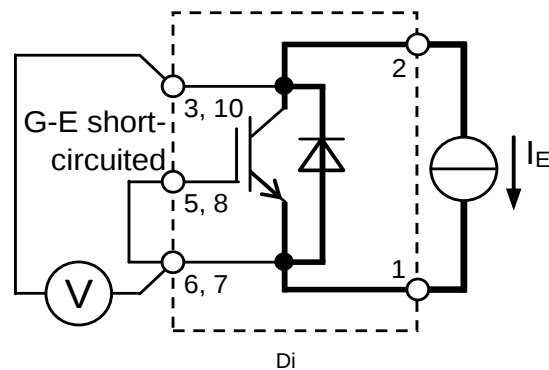
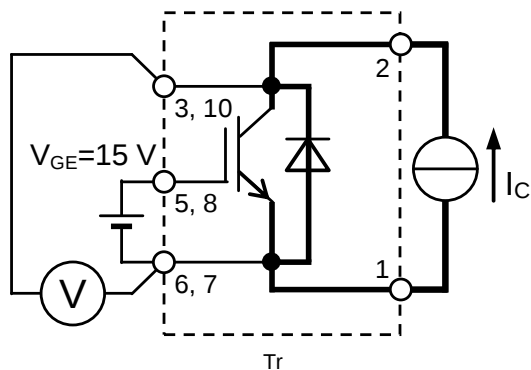
Tr: IGBT, Di: FWD

TEST CIRCUIT AND WAVEFORMS



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

TEST CIRCUIT

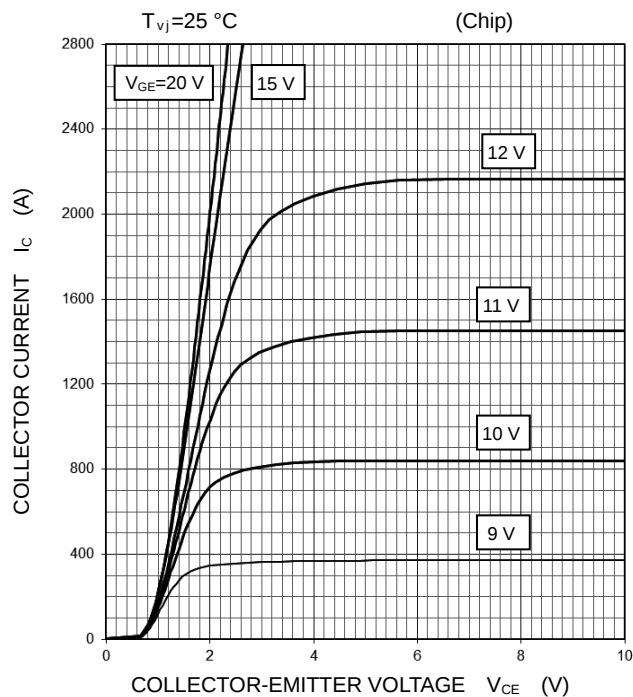
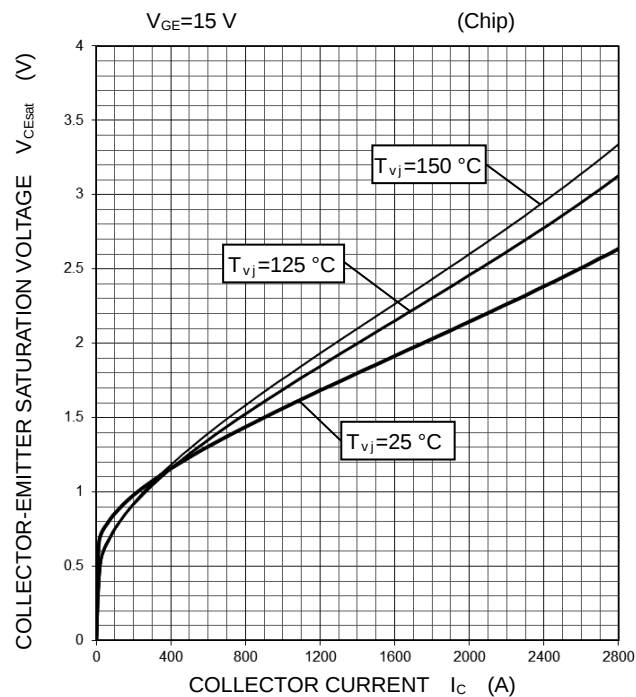
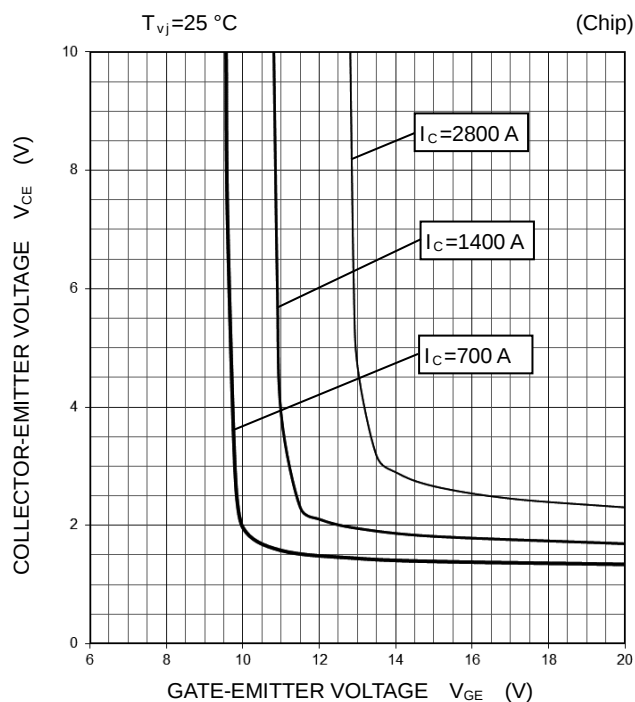
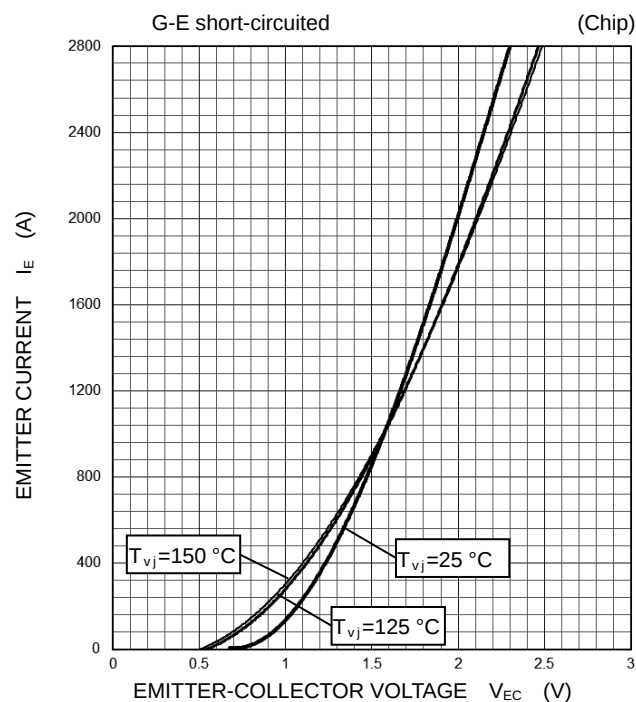


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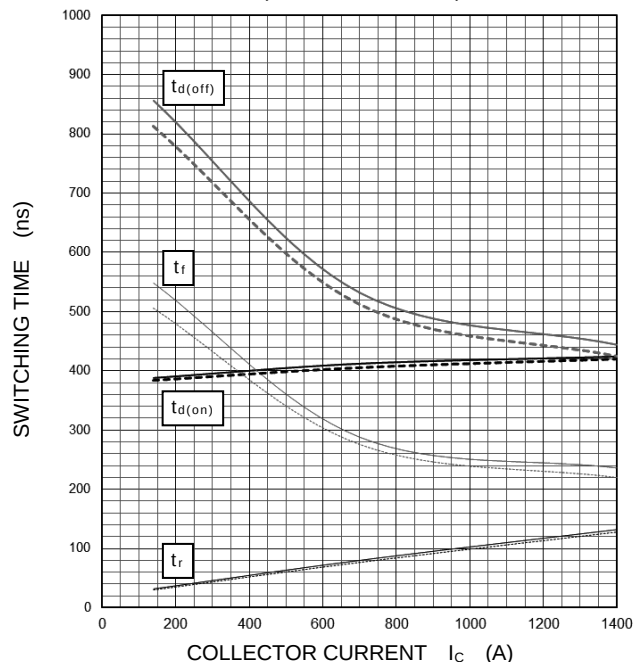
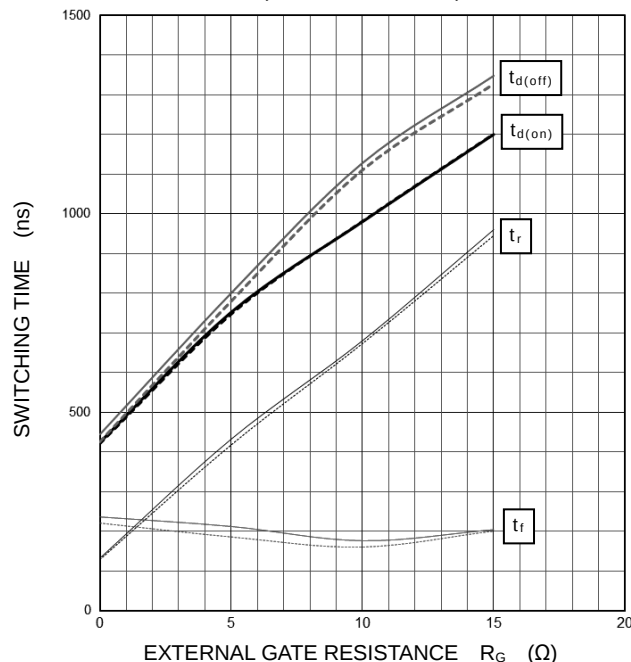
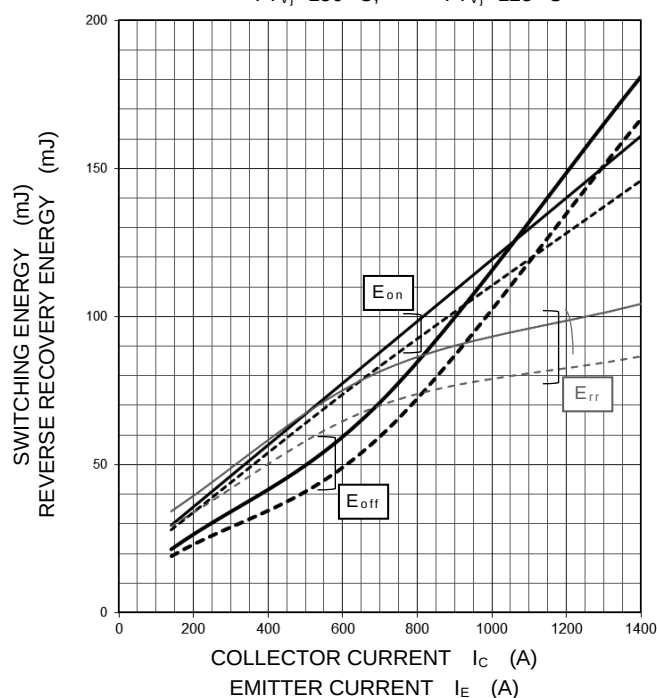
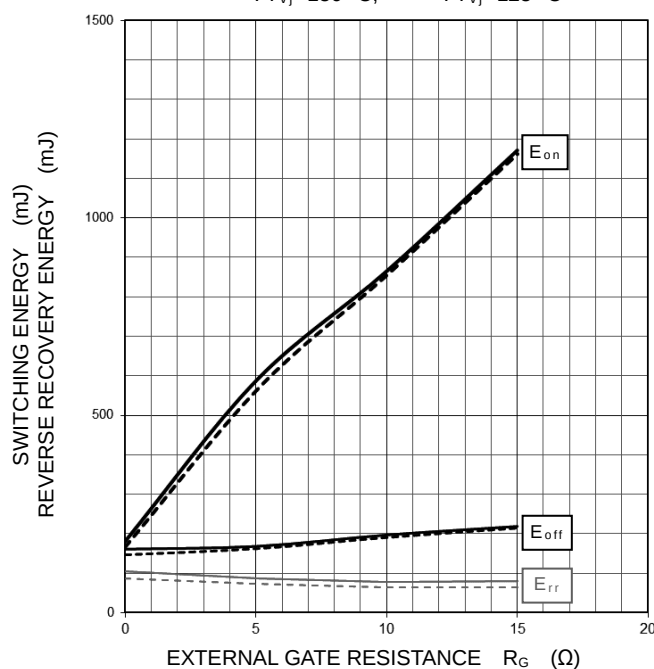
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES**OUTPUT CHARACTERISTICS**

(TYPICAL)

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)****COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS (TYPICAL)****FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)**

PERFORMANCE CURVES

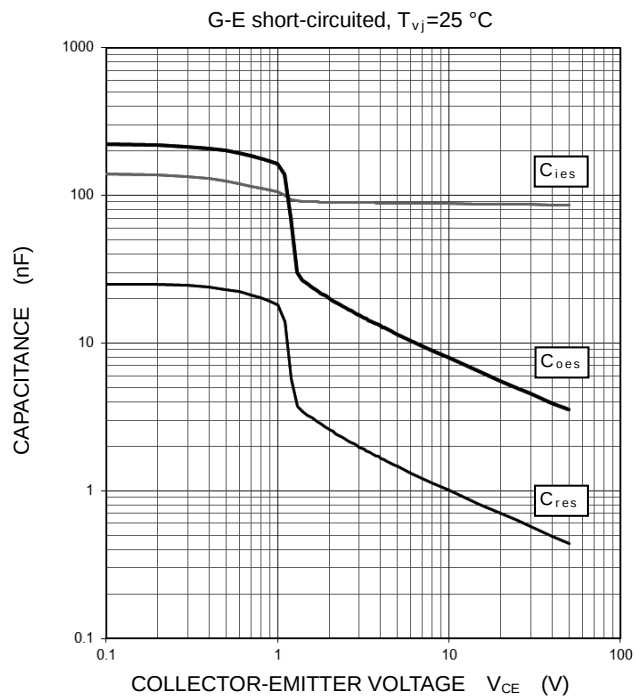
HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL) $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD
—: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$ HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL) $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=1400\text{ A}$, INDUCTIVE LOAD
—: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$ HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL) $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$,
INDUCTIVE LOAD, PER PULSE
—: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$ HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL) $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C/I_E=1400\text{ A}$,
INDUCTIVE LOAD, PER PULSE
—: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$ 

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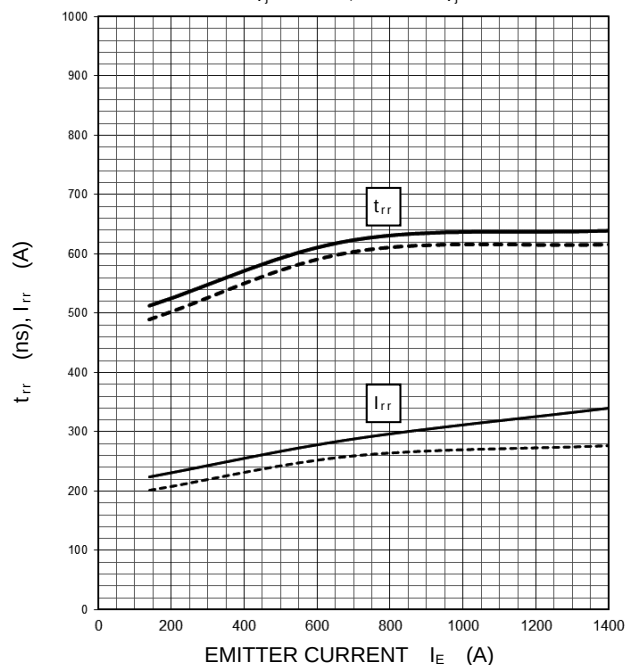
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES**CAPACITANCE CHARACTERISTICS**

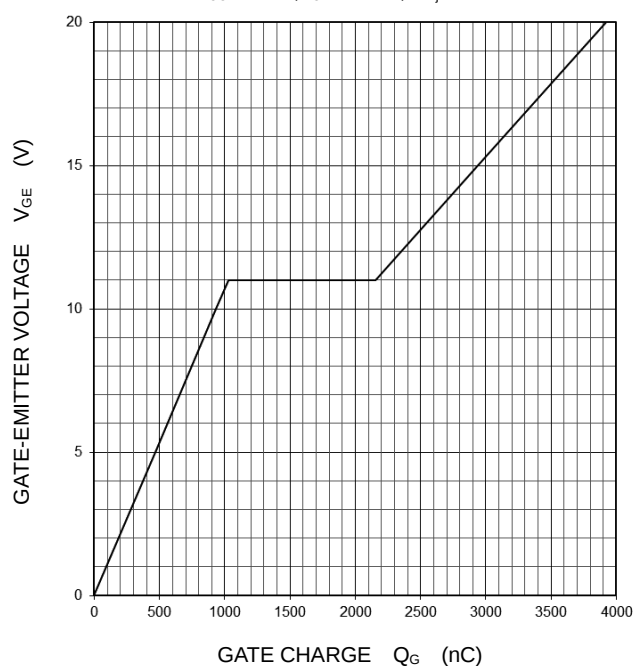
(TYPICAL)

**FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)**

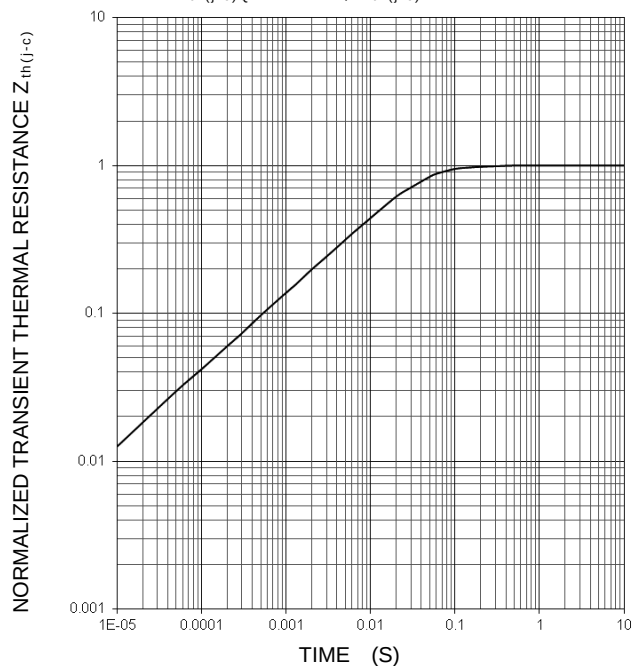
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, INDUCTIVE LOAD
—: $T_{vj}=150\text{ }^{\circ}\text{C}$, - - - -: $T_{vj}=125\text{ }^{\circ}\text{C}$

**GATE CHARGE CHARACTERISTICS
(TYPICAL)**

$V_{CC}=600\text{ V}$, $I_C=1400\text{ A}$, $T_{vj}=25\text{ }^{\circ}\text{C}$

**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)**

Single pulse, $T_C=25\text{ }^{\circ}\text{C}$
 $R_{th(j-c)Q}=21\text{ K/kW}$, $R_{th(j-c)D}=32\text{ K/kW}$



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

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