

<IGBT Modules>

CM1400HA-24S

**HIGH POWER SWITCHING USE
INSULATED TYPE**



single pack

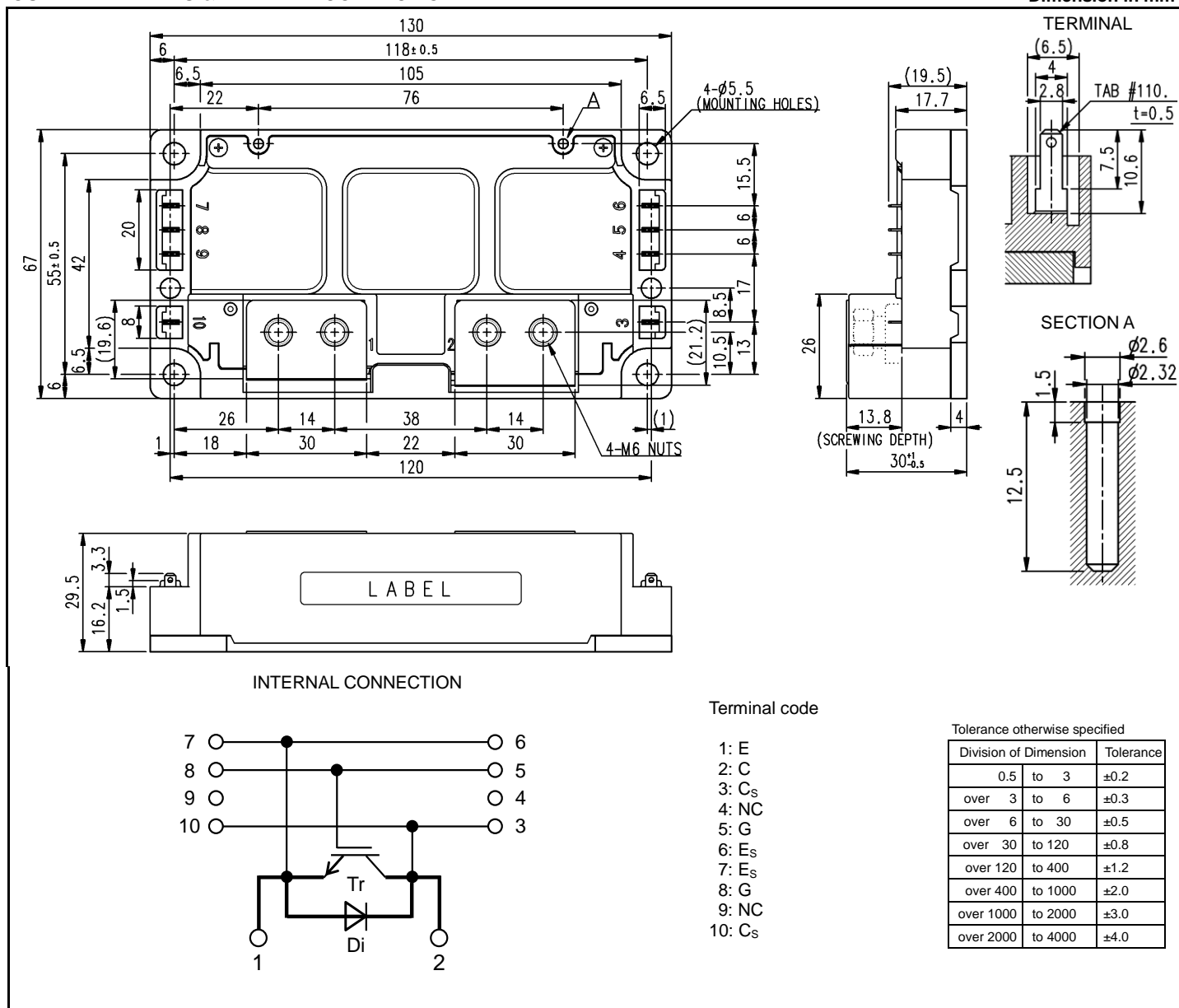
Collector current I_C **1 4 0 0 A**
 Collector-emitter voltage V_{CES} **1 2 0 0 V**
 Maximum junction temperature T_{vjmax} **1 7 5 °C**

- 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



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MAXIMUM 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	
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
V _{CESat} (Chip)			T _{vj} =125 °C	-	2.10	-	
			T _{vj} =150 °C	-	2.20	-	
	T _{vj} =25 °C	-	1.80	2.25	V		
V _{GESat} (Chip)	I _C =1400 A, V _{GE} =15 V, (Note5)	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		-
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} (Note1) (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
V _{EC} (Note1) (Chip)			T _{vj} =125 °C	-	1.90	-	
			T _{vj} =150 °C	-	1.90	-	
	T _{vj} =25 °C	-	1.75	2.20	V		
V _{EC} (Note1) (Chip)	I _E =1400 A, G-E short-circuited, (Note5)	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, R _G =0 Ω, Inductive load	-	-	300	ns	
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load	-	150	-	µC	
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	

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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

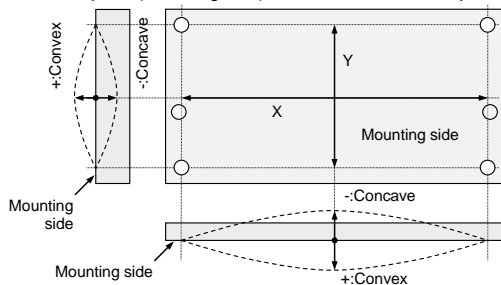
MECHANICAL CHARACTERISTICS

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	μ m
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).

- Junction temperature (T_{vj}) should not exceed 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.
- Typical value is measured by using thermally conductive grease of $\lambda=0.9$ W/(m·K)/ $D_{(c-s)}=100$ μ m.
- The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



- 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®	K25x8	0.55 ± 0.055 N·m	by handwork (equivalent to 30 r/min by mechanical screw driver) ~ 600 r/min (by mechanical screw driver)
(2) PT®	K25x10	0.85 ± 0.085 N·m	
(3) DELTA PT®	25x8	0.55 ± 0.055 N·m	
(4) DELTA PT®	25x10	0.85 ± 0.085 N·m	
(5) B1 tapping screw	$\phi 2.6 \times 10$ or $\phi 2.6 \times 12$	0.85 ± 0.085 N·m	

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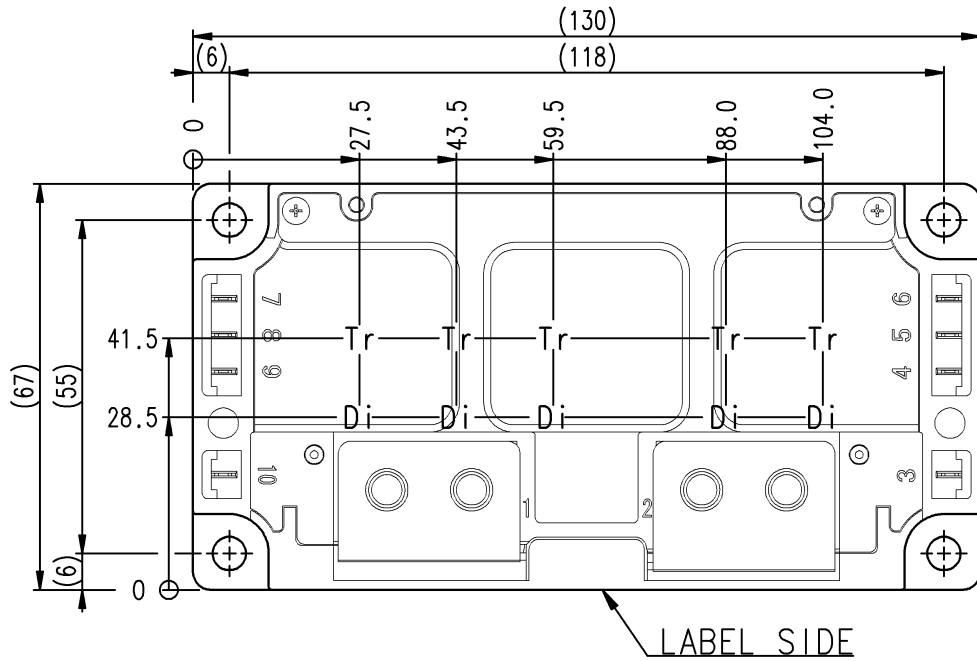
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RECOMMENDED OPERATING CONDITIONS

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

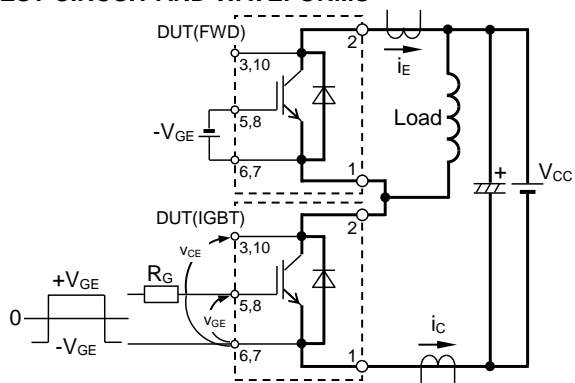


Tr: IGBT, Di: FWD

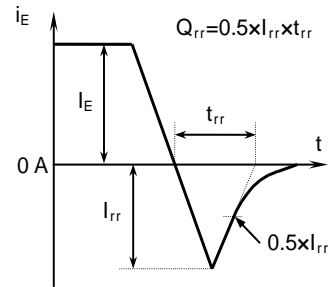
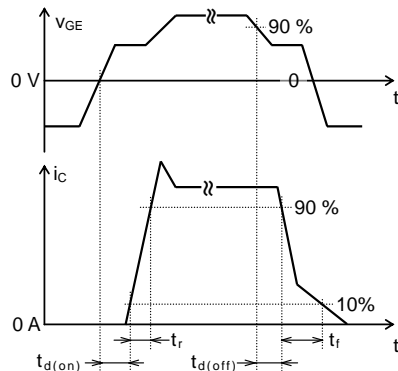
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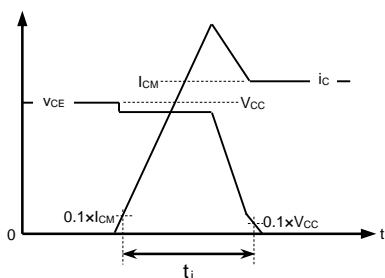
TEST CIRCUIT AND WAVEFORMS



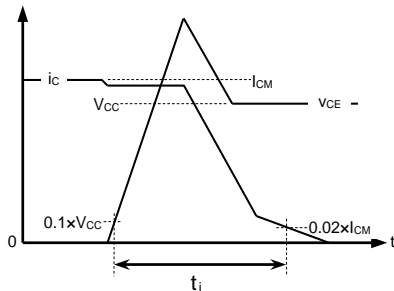
Switching characteristics test circuit and waveforms



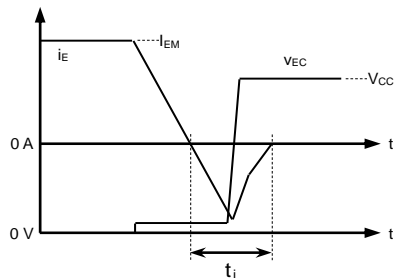
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



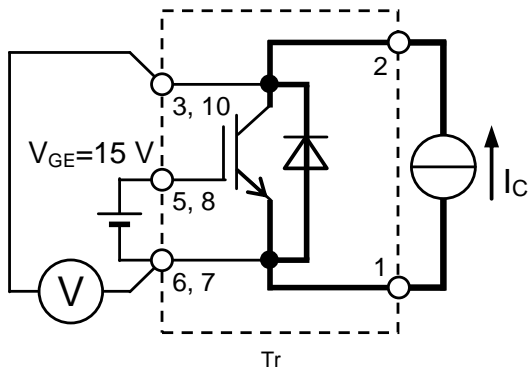
IGBT Turn-off switching energy



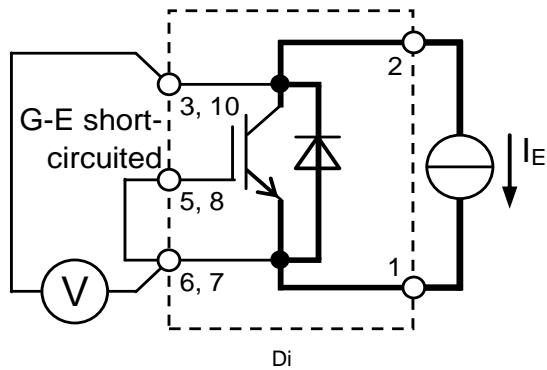
FWD Reverse recovery energy

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

TEST CIRCUIT



V_{CEsat} characteristics test circuit



V_{EC} characteristics test circuit

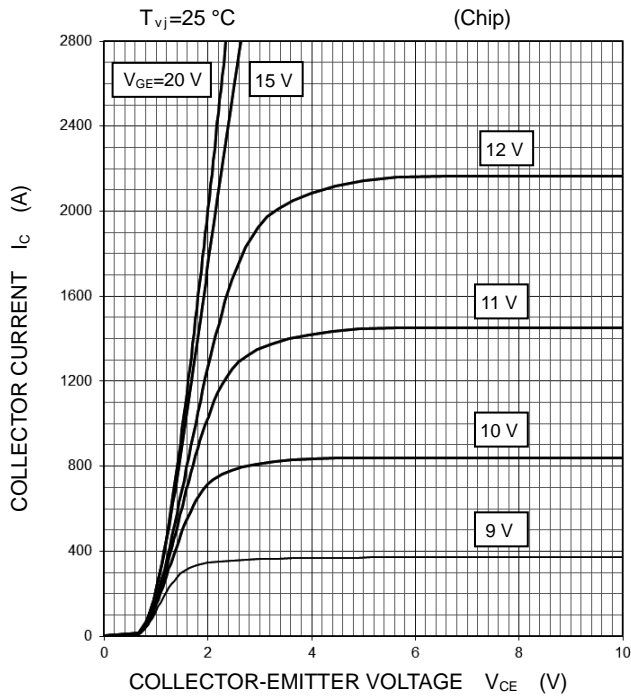
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PERFORMANCE CURVES

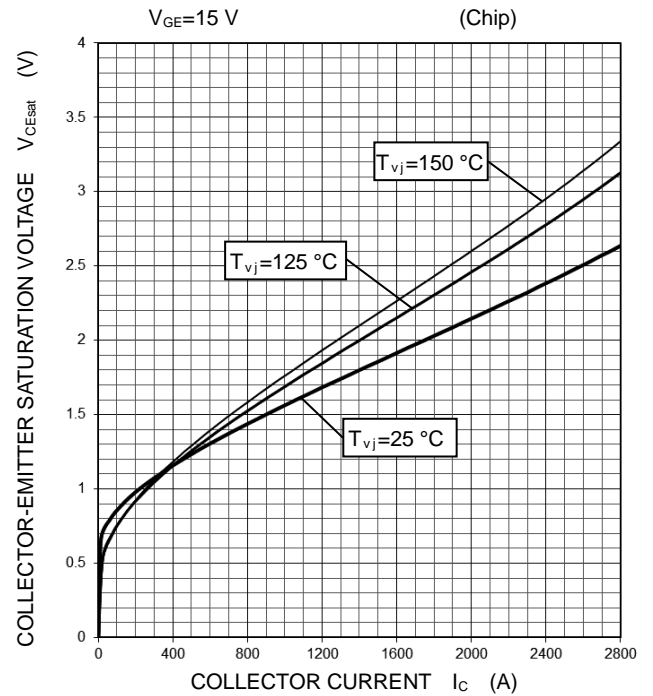
OUTPUT CHARACTERISTICS

(TYPICAL)



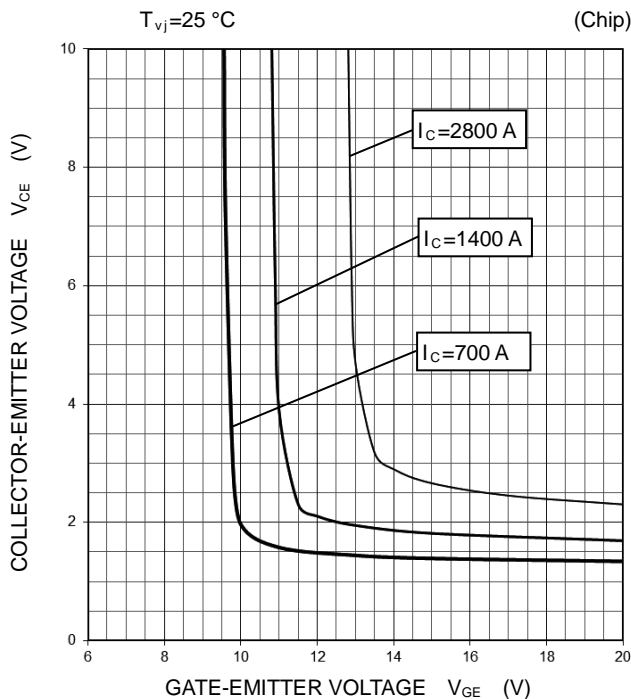
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



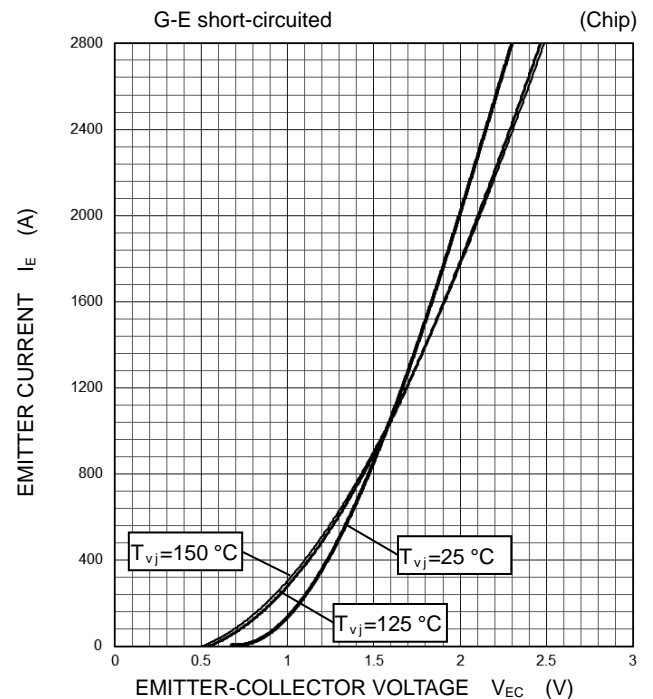
COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS

(TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)



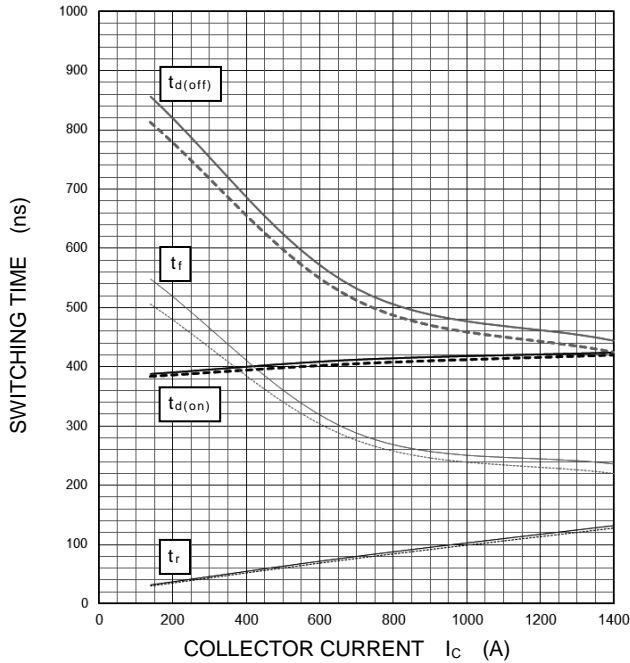
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PERFORMANCE CURVES

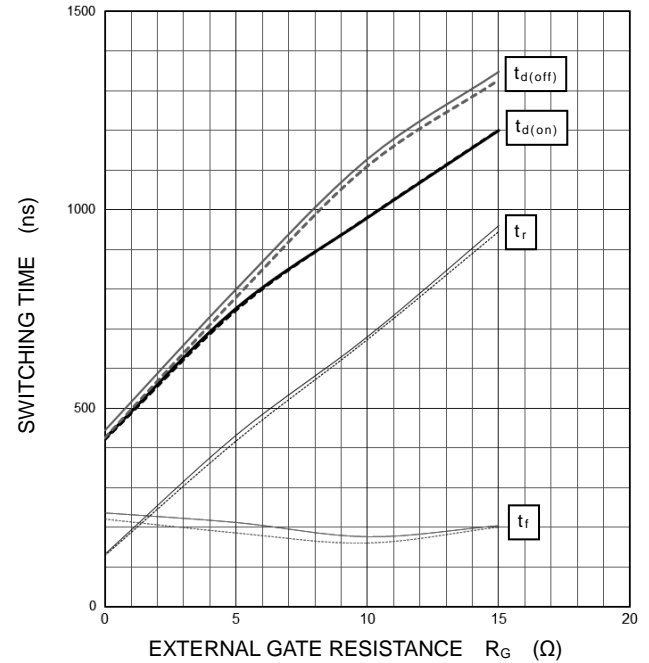
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



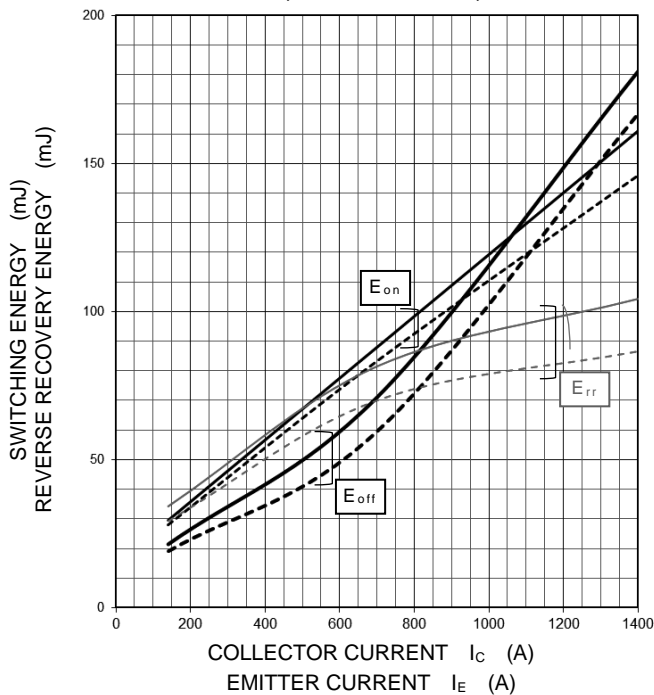
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=1400\text{ A}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



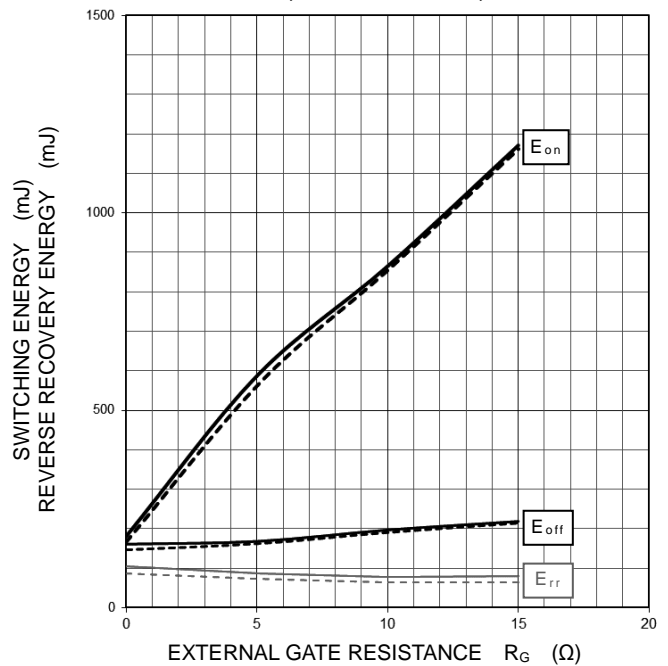
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$,
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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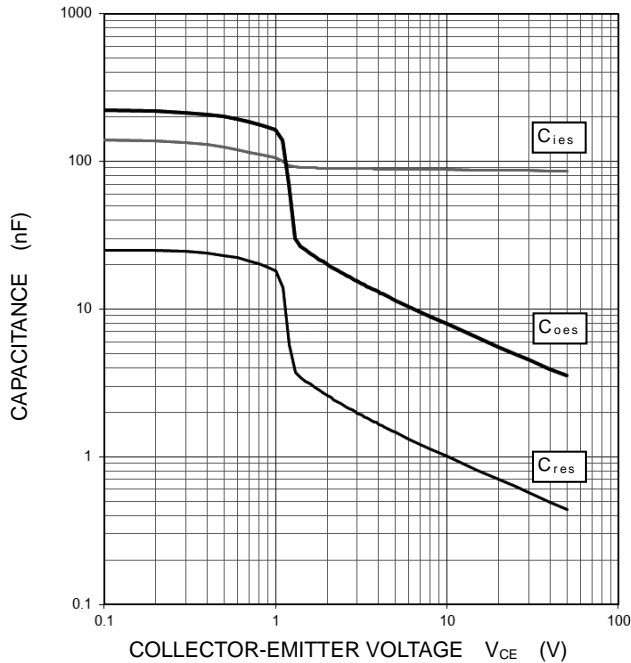
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PERFORMANCE CURVES

CAPACITANCE CHARACTERISTICS

(TYPICAL)

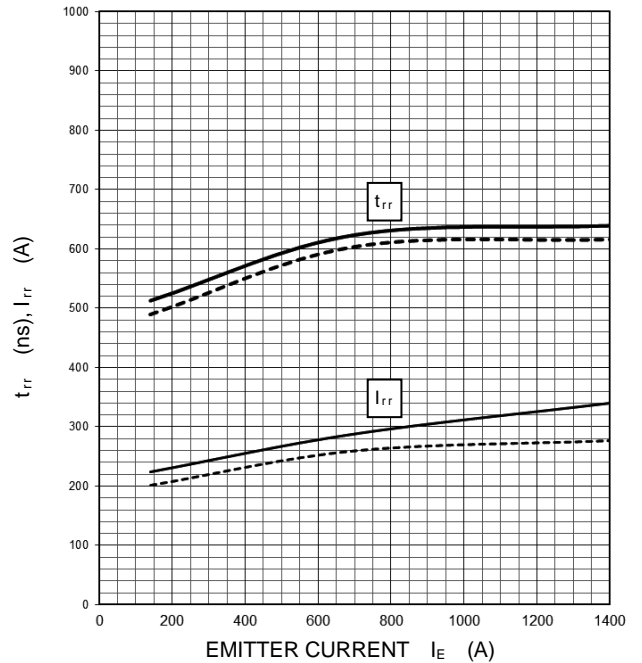
G-E short-circuited, $T_{vj}=25\text{ }^{\circ}\text{C}$



FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS

(TYPICAL)

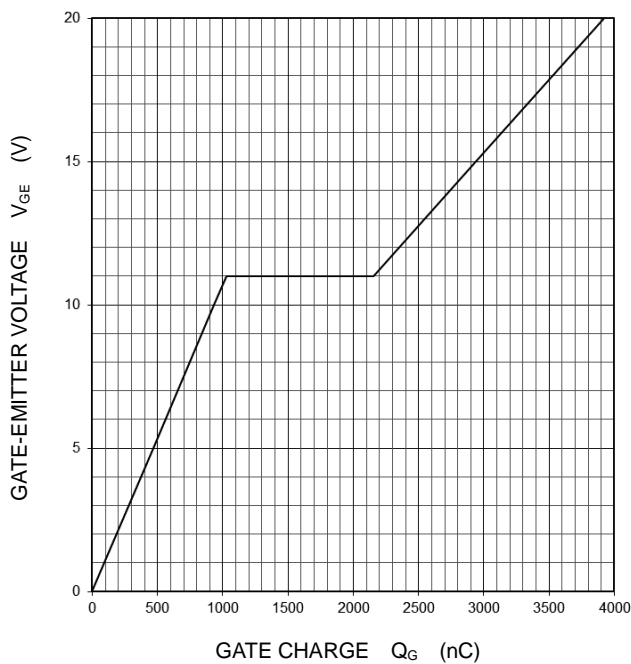
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD
—: $T_{vj}=150\text{ }^{\circ}\text{C}$, - - - -: $T_{vj}=125\text{ }^{\circ}\text{C}$



GATE CHARGE CHARACTERISTICS

(TYPICAL)

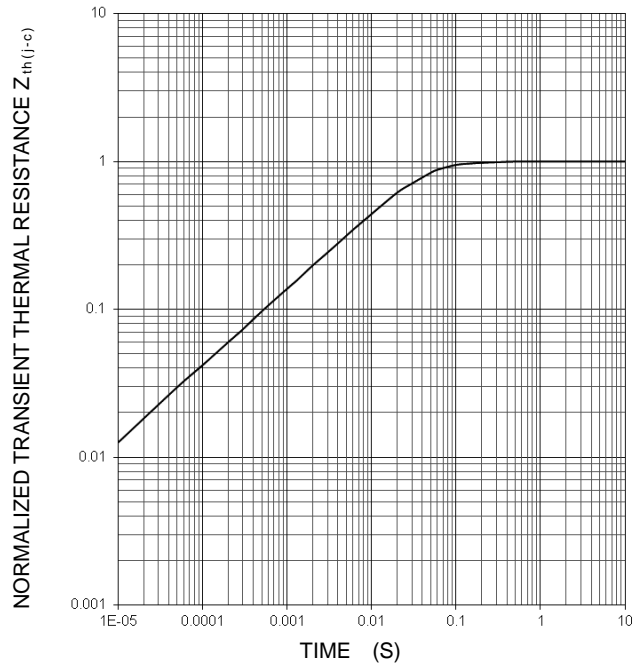
$V_{CC}=600\text{ V}$, $I_C=1400\text{ A}$, $T_{vj}=25\text{ }^{\circ}\text{C}$



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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