MITSUBISHI ELECTRIC

< IGBT MODULES >

CM400C1Y-24S

HIGH POWER SWITCHING USE
INSULATED TYPE

Dual (AC switch)

Collector current I_C ..... **350** A*
Collector-emitter voltage V_{CES} ..... **1200** V
Maximum junction temperature T_{jmax} ..... **175** °C

- ●Flat base Type
- ●Copper base plate
- ●RoHS Directive compliance
- ●UL Recognized under UL1557, File E323585

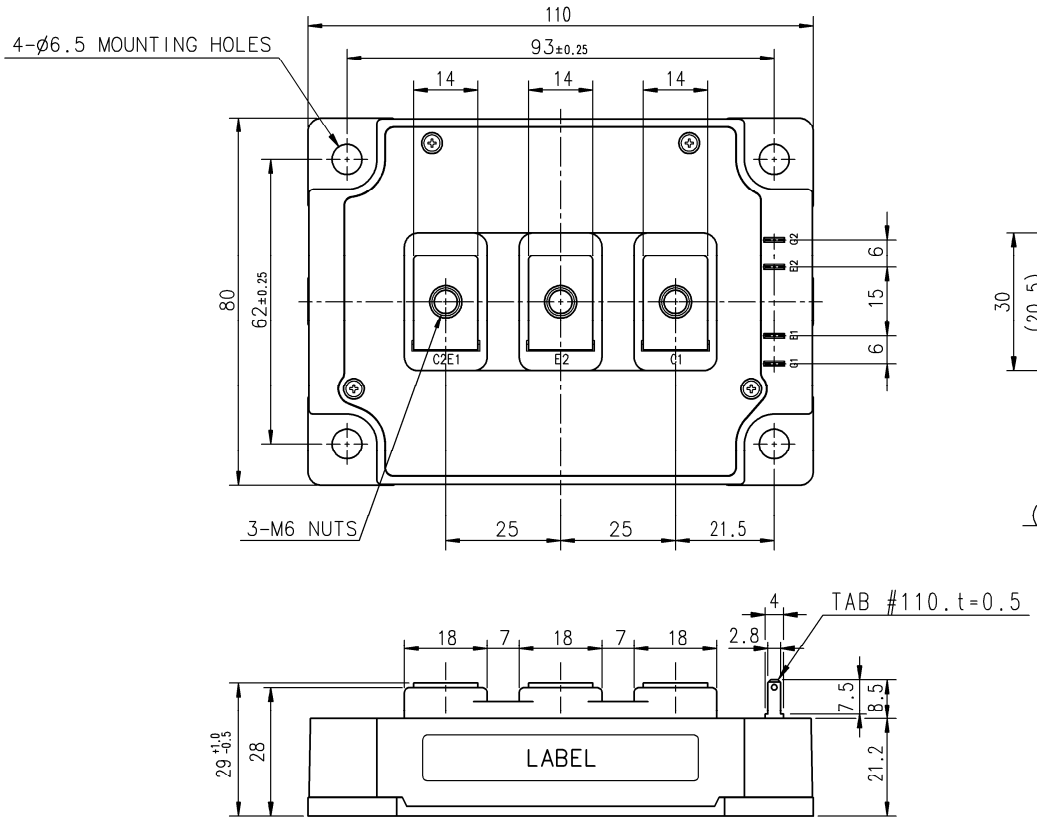
*. DC current rating is limited by power terminals.

APPLICATION

AC Power Switch for NPC

OUTLINE DRAWING & INTERNAL CONNECTION

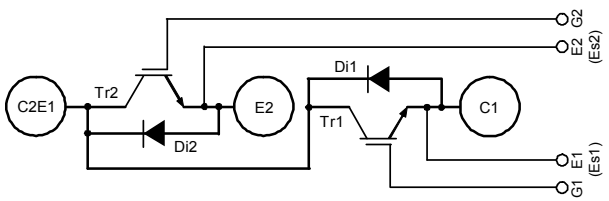
Dimension in mm



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

INTERNAL CONNECTION



ABSOLUTE MAXIMUM RATINGS (T_j=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=124 °C (Note.2, 4)	350 *	A
I_{CRM}		Pulse, Repetitive (Note.3)	800	
P_{tot}	Total power dissipation	T_C=25 °C (Note.2, 4)	2670	W
I_E (Note.1)	Emitter current	T_C=25 °C (Note.2, 4)	350 *	A
I_{ERM} (Note.1)		Pulse, Repetitive (Note.3)	800	
V_{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V
T_{jmax}	Maximum junction temperature	-	175	°C
T_{cmax}	Maximum case temperature	(Note.2)	125	
T_{jopr}	Operating junction temperature	-	-40 ~ +150	°C
T_{stg}	Storage temperature	-	-40 ~ +125	

ELECTRICAL CHARACTERISTICS (T_j=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=40 mA, V_{CE}=10 V		5.4	6.0	6.6	V
V_{CEsat}	Collector-emitter saturation voltage	I_C=400 A (Note.5), V_{GE}=15 V, Terminal	T_j=25 °C	-	1.85	2.30	V
			T_j=125 °C	-	2.05	-	
			T_j=150 °C	-	2.10	-	
		I_C=400 A (Note.5), V_{GE}=15 V, Chip	T_j=25 °C	-	1.70	2.15	V
			T_j=125 °C	-	1.90	-	
			T_j=150 °C	-	1.95	-	
C_{ies}	Input capacitance	V_{CE}=10 V, G-E short-circuited		-	-	40	nF
C_{oes}	Output capacitance			-	-	8.0	
C_{res}	Reverse transfer capacitance			-	-	0.66	
Q_G	Gate charge	V_{CC}=600 V, I_C=400 A, V_{GE}=15 V		-	934	-	nC
$t_{d(on)}$	Turn-on delay time	V_{CC}=600 V, I_C=400 A, V_{GE}=±15 V, R_G=0 Ω, Inductive load		-	-	800	ns
t_r	Rise time			-	-	200	
$t_{d(off)}$	Turn-off delay time			-	-	600	
t_f	Fall time			-	-	300	
V_{EC} (Note.1)	Emitter-collector voltage	I_E=400 A (Note.5), G-E short-circuited, Terminal	T_j=25 °C	-	1.85	2.30	V
			T_j=125 °C	-	1.85	-	
			T_j=150 °C	-	1.85	-	
		I_E=400 A (Note.5), G-E short-circuited, Chip	T_j=25 °C	-	1.70	2.15	V
			T_j=125 °C	-	1.70	-	
			T_j=150 °C	-	1.70	-	
t_{rr} (Note.1)	Reverse recovery time	V_{CC}=600 V, I_E=400 A, V_{GE}=±15 V, R_G=0 Ω, Inductive load		-	-	300	ns
Q_{rr} (Note.1)	Reverse recovery charge			-	21.4	-	µC
E_{on}	Turn-on switching energy per pulse	V_{CC}=600 V, I_C=I_E=400 A, V_{GE}=±15 V, R_G=0 Ω, T_j=150 °C, Inductive load		-	39.8	-	mJ
E_{off}	Turn-off switching energy per pulse			-	44.9	-	
E_{rr} (Note.1)	Reverse recovery energy per pulse			-	35.2	-	mJ
r_g	Internal gate resistance	Per switch		-	4.9	-	Ω

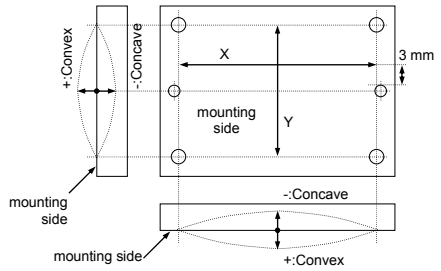
THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance (Note.2)	Junction to case, per IGBT	-	-	56	K/kW
$R_{th(j-c)D}$		Junction to case, per FWDi	-	-	95	K/kW
$R_{th(c-s)}$	Contact thermal resistance (Note.2)	Case to heat sink, per 1/2 module, Thermal grease applied (Note.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 to heat sink M 6 screw	3.5	4.0	4.5	N·m
m	Weight	-	-	580	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note.7)	-100	-	+100	μm

Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).
2. 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.
The heat sink thermal resistance should measure just under the chips.
3. Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
4. Junction temperature (T_j) should not increase beyond T_{jmax} rating.
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 λ=0.9 W/(m·K).
7. Base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



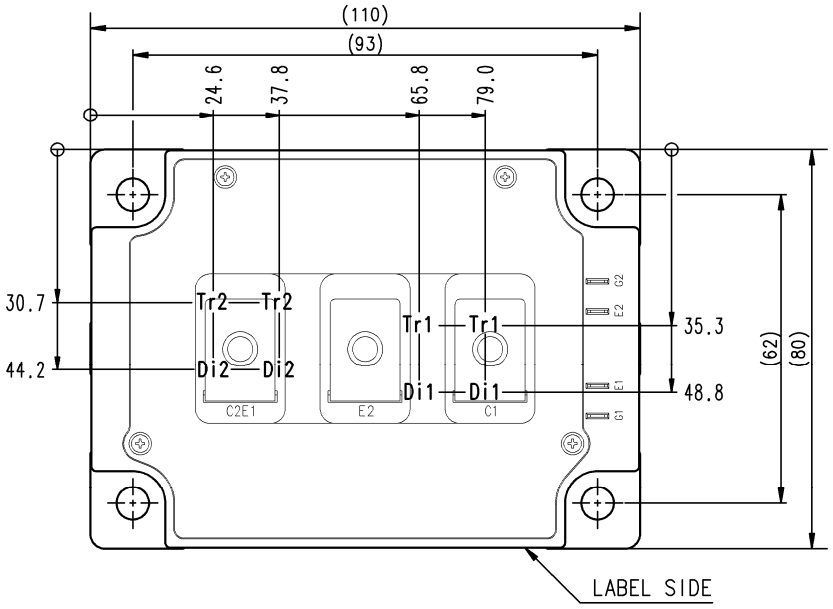
*. DC current rating is limited by power terminals.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2	-	600	850	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	0	-	10	Ω

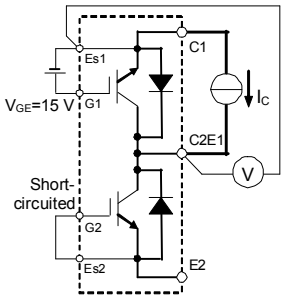
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm

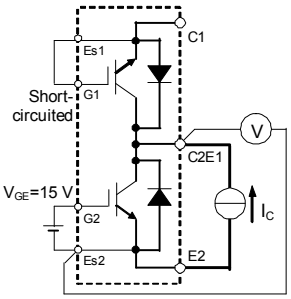


Tr1/Tr2: IGBT, Di1/Di2: FWDi

TEST CIRCUIT

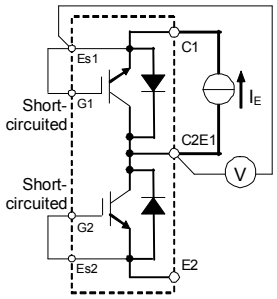


Tr1

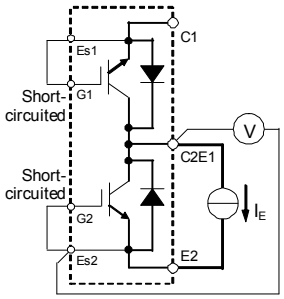


Tr2

V_{CEsat} test circuit



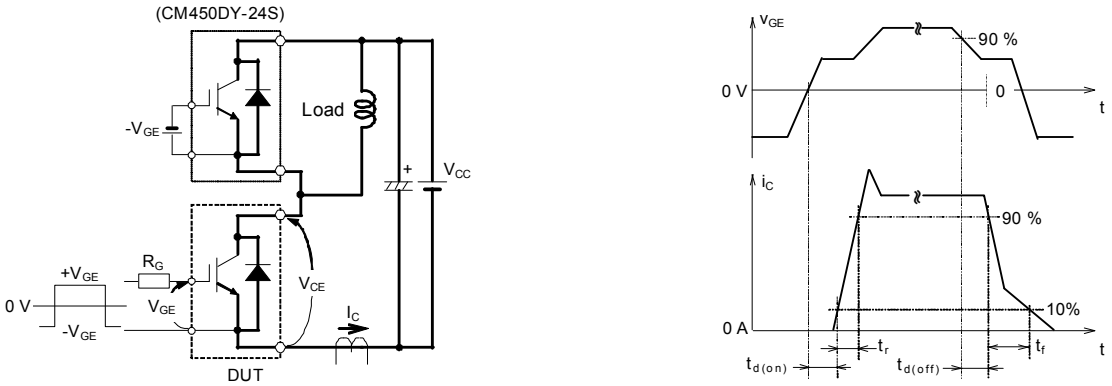
Di1



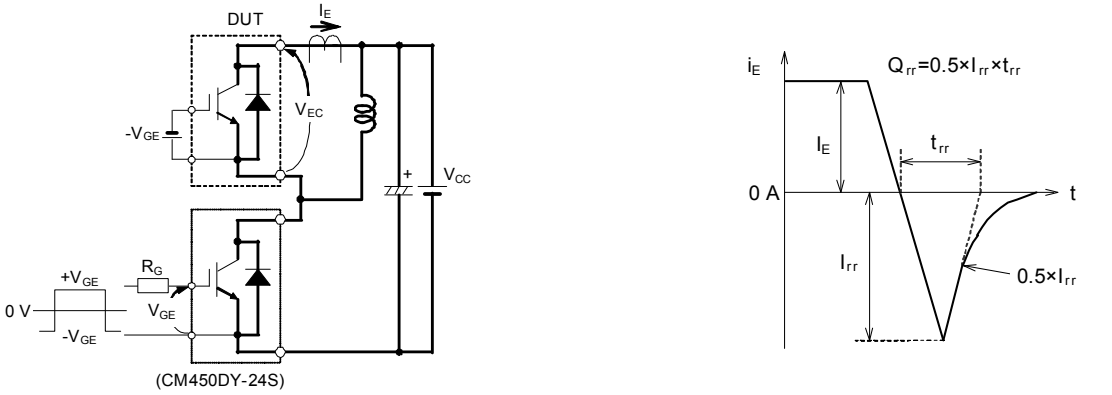
Di2

V_{EC} test circuit

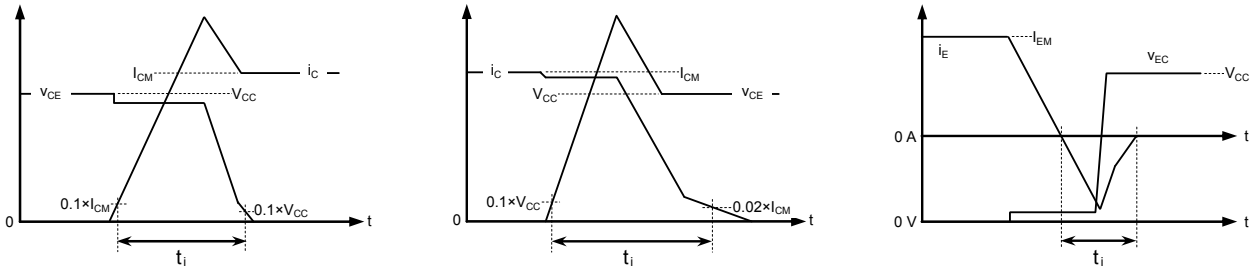
TEST CIRCUIT AND WAVEFORMS



Switching characteristics test circuit and waveform



Reverse recovery characteristics (t_{rr}, Q_{rr}) test circuit

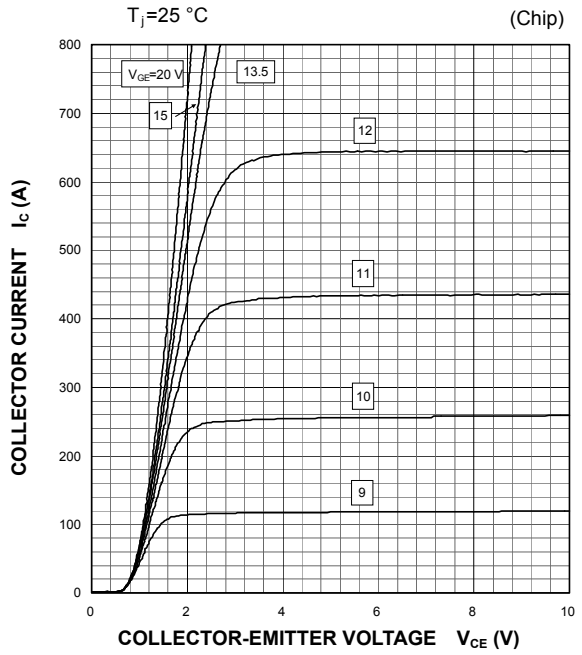


IGBT Turn-on switching energy **IGBT Turn-off switching energy** **FWDi Reverse recovery energy**

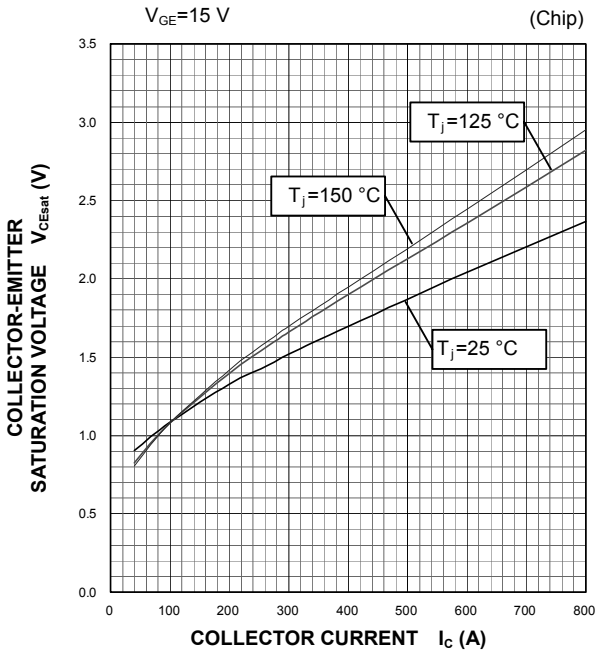
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

PERFORMANCE CURVES

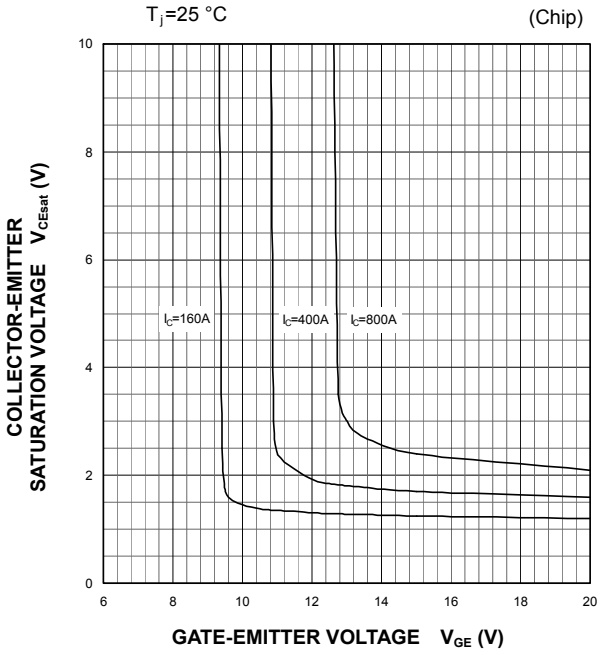
OUTPUT CHARACTERISTICS (TYPICAL)



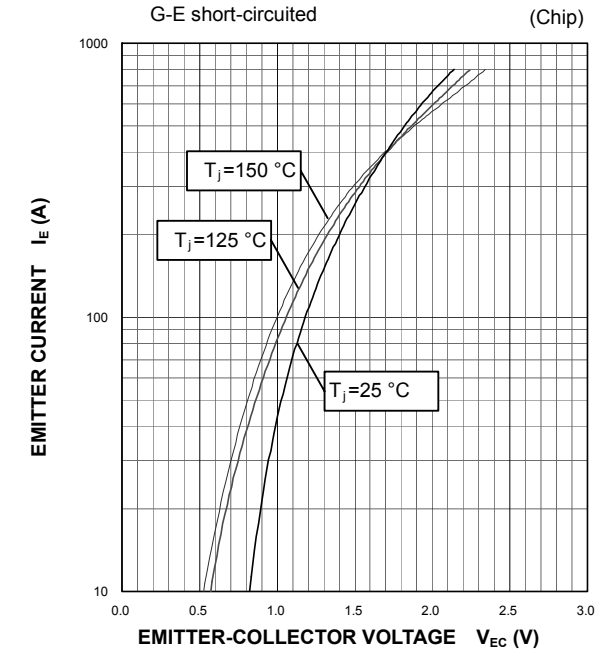
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



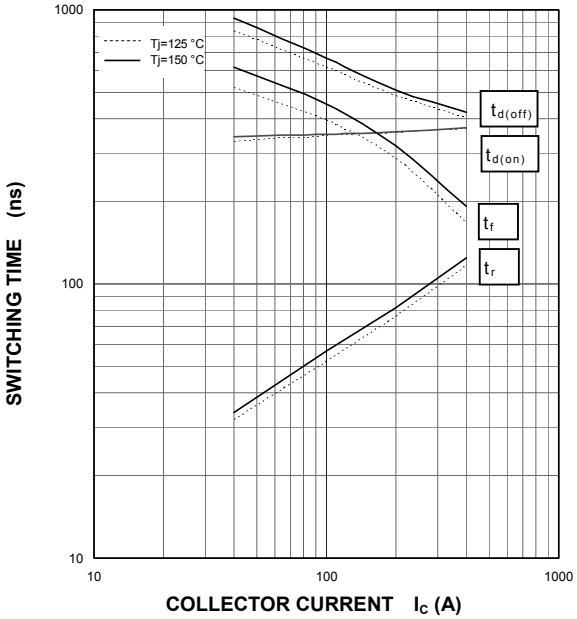
FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



PERFORMANCE CURVES

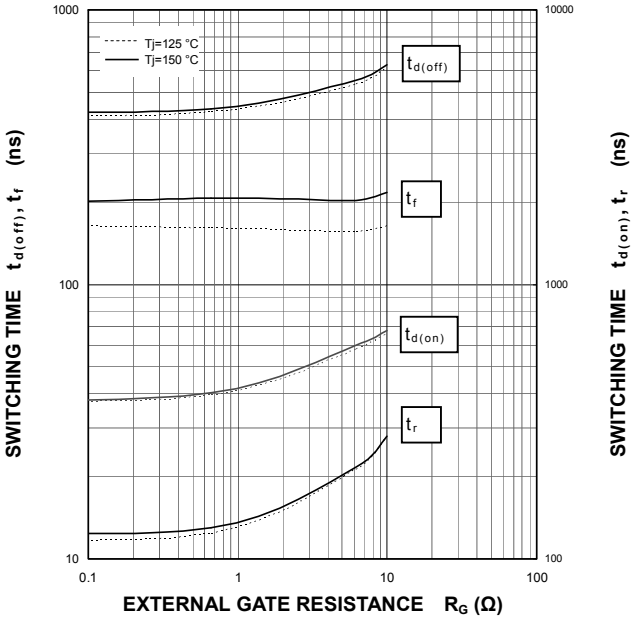
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, R_G=0 Ω, INDUCTIVE LOAD



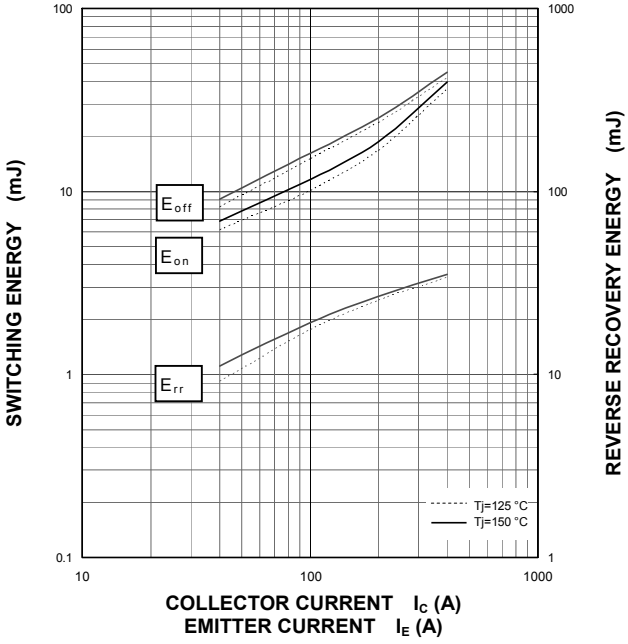
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, I_C=400 A, V_{GE}=±15 V, INDUCTIVE LOAD



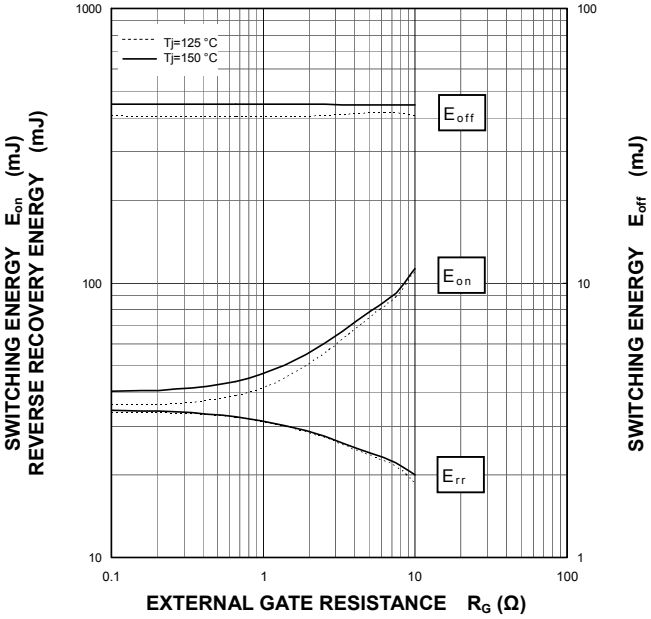
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, R_G=0 Ω, INDUCTIVE LOAD, PER PULSE



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

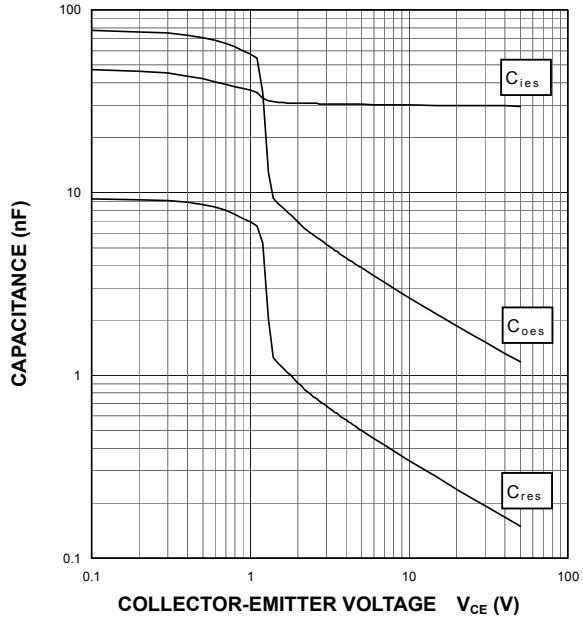
V_{CC}=600 V, I_C/I_E=400 A, V_{GE}=±15 V, INDUCTIVE LOAD, PER PULSE



PERFORMANCE CURVES

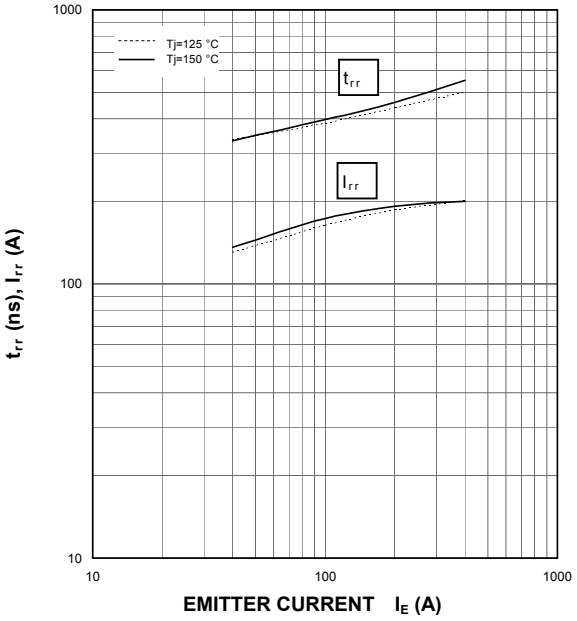
CAPACITANCE CHARACTERISTICS (TYPICAL)

G-E short-circuited, T_j=25 °C



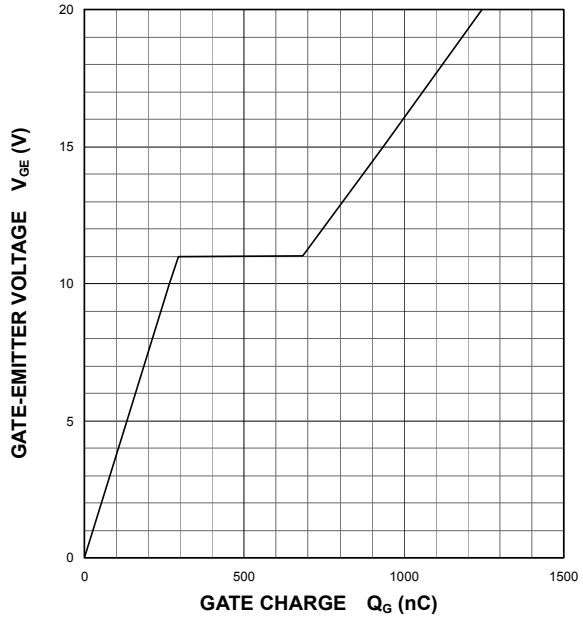
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, R_G=0 Ω,
INDUCTIVE LOAD



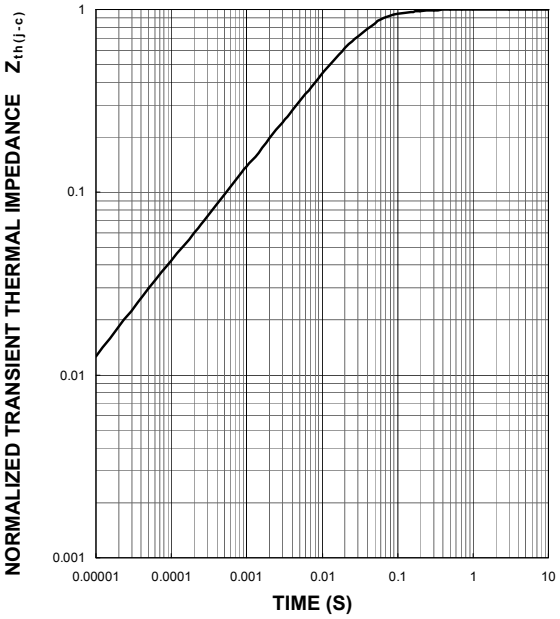
GATE CHARGE CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, I_C=400 A, T_j=25 °C



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

Single pulse, T_C=25°C
$R_{th(j-c)Q}$=56 K/kW, $R_{th(j-c)D}$=95 K/kW



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