

MITSUBISHI IGBT MODULES
CM1400DUC-24NF
HIGH POWER SWITCHING USE
INSULATED TYPE

ABSOLUTE MAXIMUM RATINGS ($T_j=25\text{ }^{\circ}\text{C}$, 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, $T_C=94\text{ }^{\circ}\text{C}$ (Note2)	1400	A
I_{CRM}		Pulse, Repetitive (Note3)	2800	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	8925	W
I_E (Note1)	Emitter current	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	1400	A
I_{ERM} (Note1)	(Free wheeling diode forward current)	Pulse, Repetitive (Note3)	2800	
V_{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V
T_j	Junction temperature	-	$-40 \sim +150$	$^{\circ}\text{C}$
T_{stg}	Storage temperature	(Note7)	$-40 \sim +125$	

ELECTRICAL CHARACTERISTICS ($T_j=25\text{ }^{\circ}\text{C}$, 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	mA
I_{GES}	Gate-emitter leakage current	$V_{GE}=V_{GES}$, C-E short-circuited	-	-	1.5	μA
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=140\text{ mA}$, $V_{CE}=10\text{ V}$	6	7	8	V
V_{CESat}	Collector-emitter saturation voltage	$I_C=1400\text{ A}$ (Note5), $T_j=25\text{ }^{\circ}\text{C}$	-	1.8	2.5	V
		$V_{GE}=15\text{ V}$, $T_j=125\text{ }^{\circ}\text{C}$	-	2.0	-	
C_{ies}	Input capacitance	$V_{CE}=10\text{ V}$, G-E short-circuited	-	-	220	nF
C_{oes}	Output capacitance		-	-	25	
C_{res}	Reverse transfer capacitance		-	-	4.7	
Q_G	Gate charge	$V_{CC}=600\text{ V}$, $I_C=1400\text{ A}$, $V_{GE}=15\text{ V}$	-	7200	-	nC
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$, $I_C=1400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.22\text{ }\Omega$, Inductive load	-	-	800	ns
t_r	Rise time		-	-	300	
$t_{d(off)}$	Turn-off delay time		-	-	1000	
t_f	Fall time		-	-	300	
V_{EC} (Note1)	Emitter-collector voltage	$I_E=1400\text{ A}$, G-E short-circuited (Note5)	-	2.5	3.2	V
t_{rr} (Note1)	Reverse recovery time	$V_{CC}=600\text{ V}$, $I_E=1400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.22\text{ }\Omega$, Inductive load	-	-	700	ns
Q_{rr} (Note1)	Reverse recovery charge		-	90	-	μC
E_{on}	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$, $I_C=I_E=1400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.22\text{ }\Omega$, $T_j=125\text{ }^{\circ}\text{C}$, Inductive load	-	122.8	-	mJ
E_{off}	Turn-off switching energy per pulse		-	161.2	-	
E_{rr} (Note1)	Reverse recovery energy per pulse		-	136.9	-	
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^{\circ}\text{C}$ (Note2)	-	0.286	-	m Ω
r_g	Internal gate resistance	Per switch	-	1.0	-	Ω

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance (Note2)	Junction to case, per IGBT	-	-	14	K/kW
$R_{th(j-c)D}$		Junction to case, per FWDi	-	-	23	K/kW
$R_{th(c-s)}$	Contact thermal resistance (Note2)	Case to heat sink, per 1/2 module, Thermal grease applied (Note6)	-	12	-	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	
m	Weight	-	-	1450	-	g
e_c	Flatness of base plate	On the centerline X, Y1, Y2 (Note8)	-50	-	+100	μm

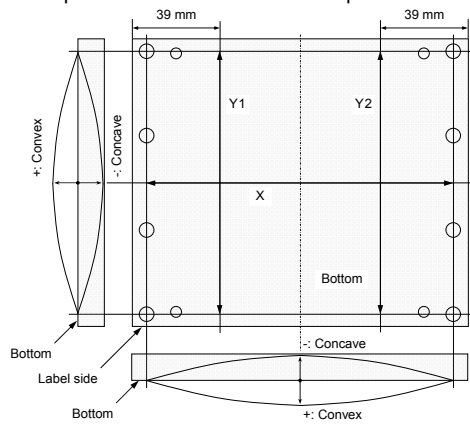
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RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2	-	600	800	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2	13.5	15.0	16.5	
R_G	External gate resistance	Per switch	0.22	-	2.2	Ω

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

- Case temperature (T_c) and heat sink temperature (T_s) are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)
The heat sink thermal resistance $\{R_{th(s-a)}\}$ should measure just under the chips.
- Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
- Junction temperature (T_j) should not increase beyond T_{jmax} rating.
- 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 $\lambda=0.9 \text{ W/(m}\cdot\text{K)}$.
- The operation temperature is restrained by the permission temperature of female connector housing.
- Base plate flatness measurement points are as in the following figure.

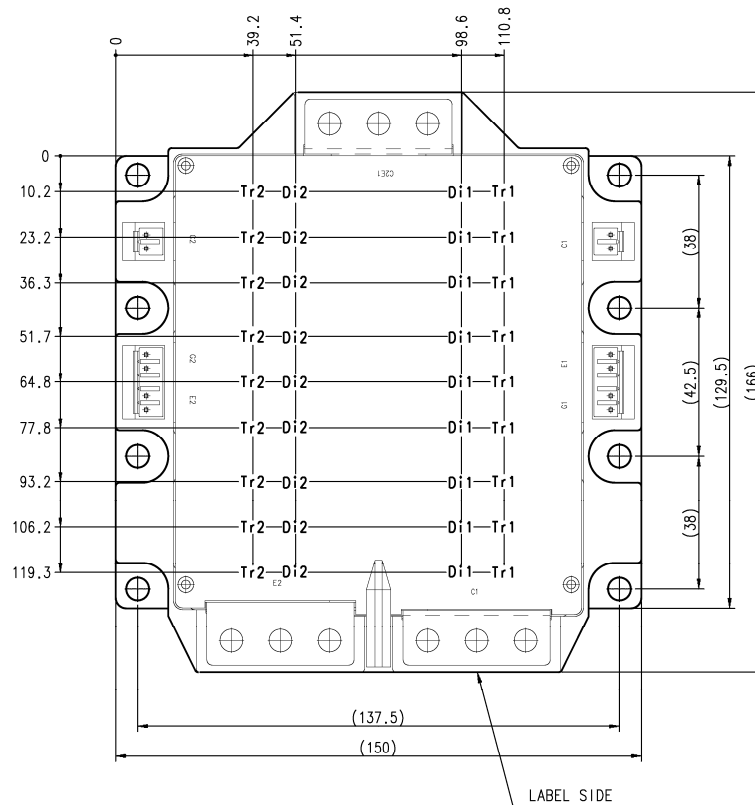


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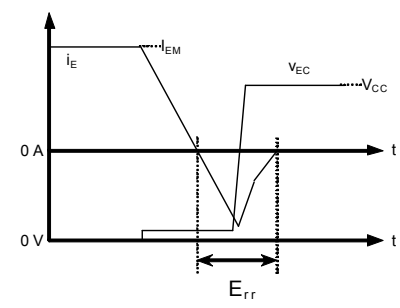
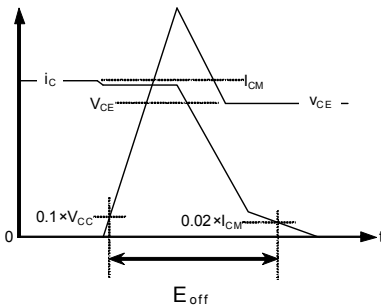
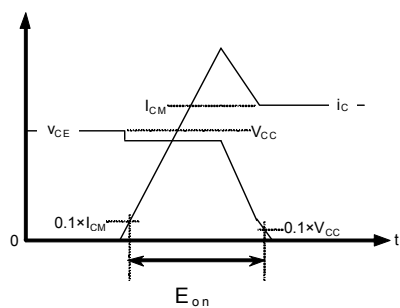
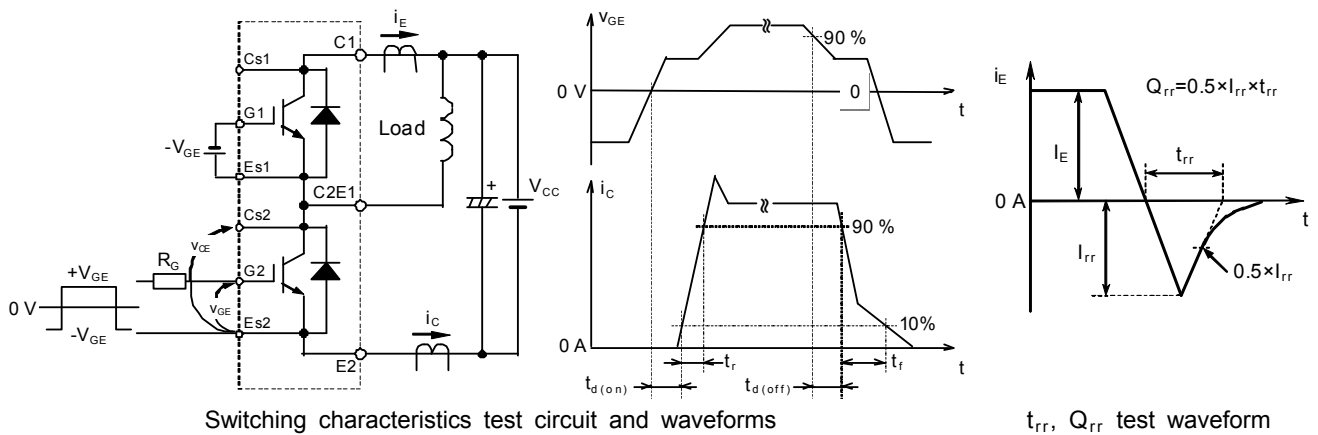
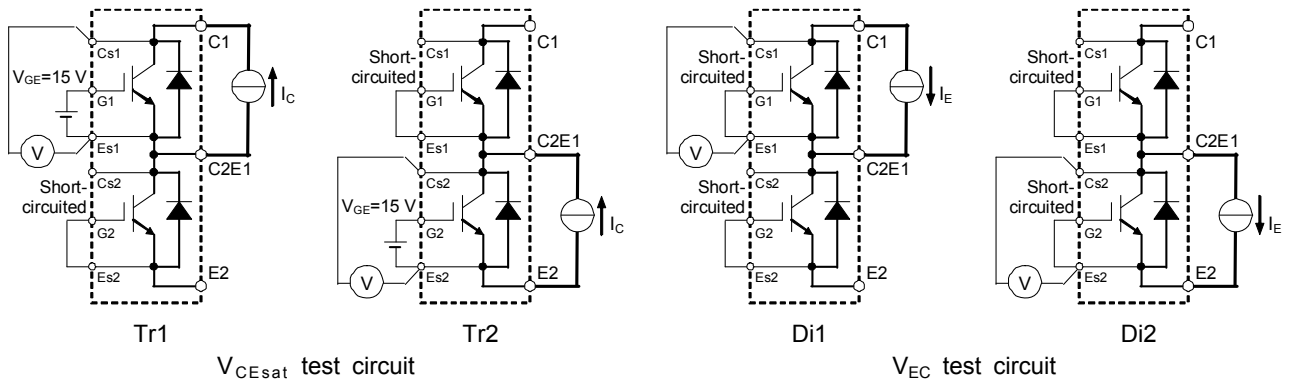
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm



Tr1/Tr2: IGBT, Di1/Di2: FWDi. Each mark points the center position of each chip.

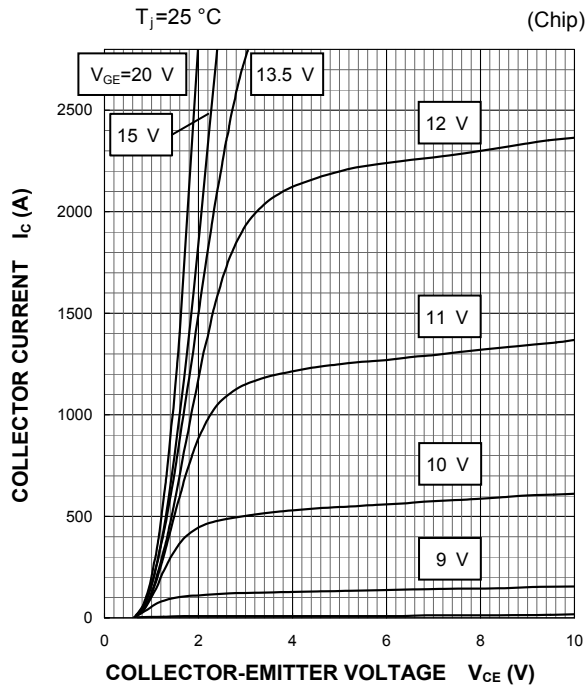
TEST CIRCUIT AND WAVEFORMS



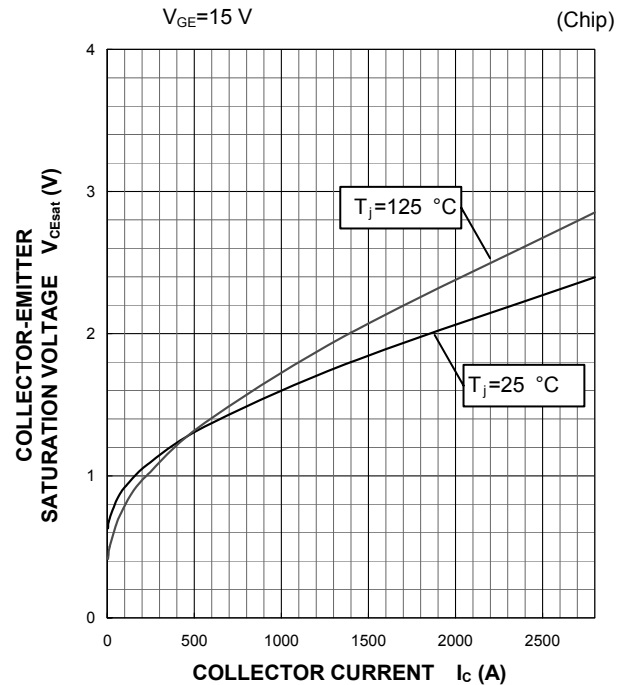
Turn-on / Turn-off switching energy and Reverse recovery energy integral range

PERFORMANCE CURVES

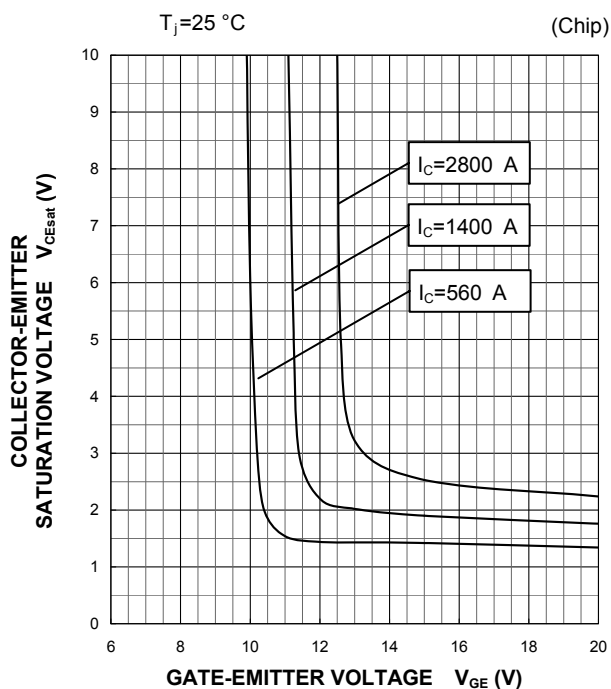
OUTPUT CHARACTERISTICS
(TYPICAL)



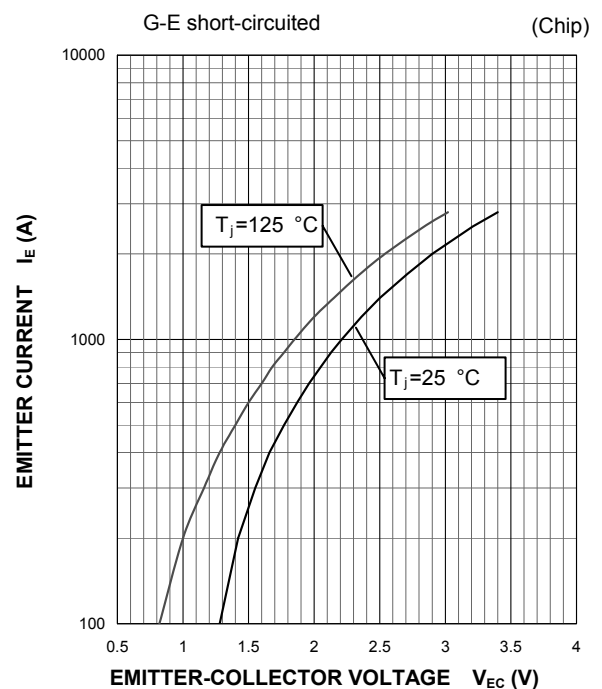
COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)



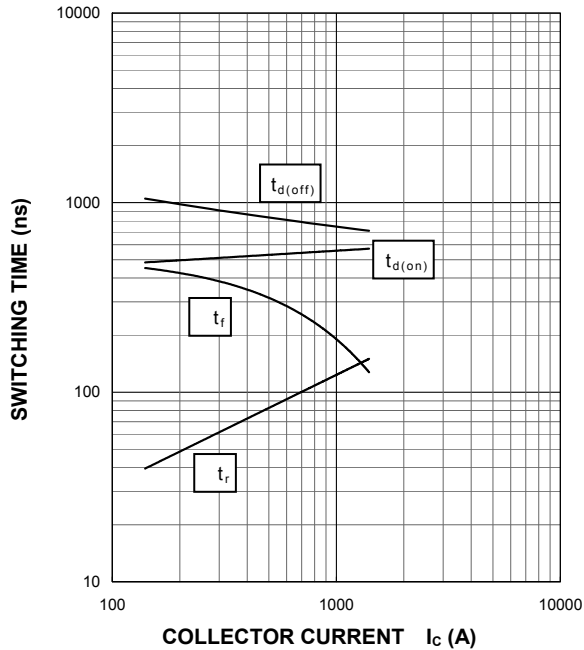
FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)



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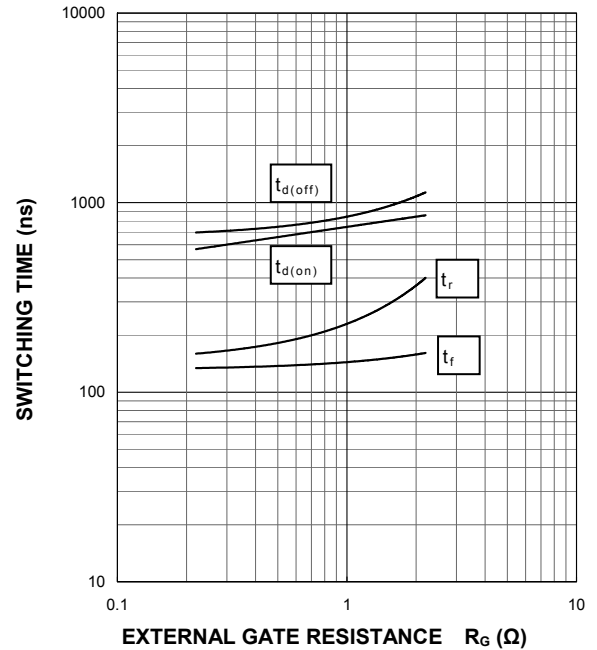
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.22\ \Omega$, $T_J=125\text{ }^\circ\text{C}$,
 INDUCTIVE LOAD



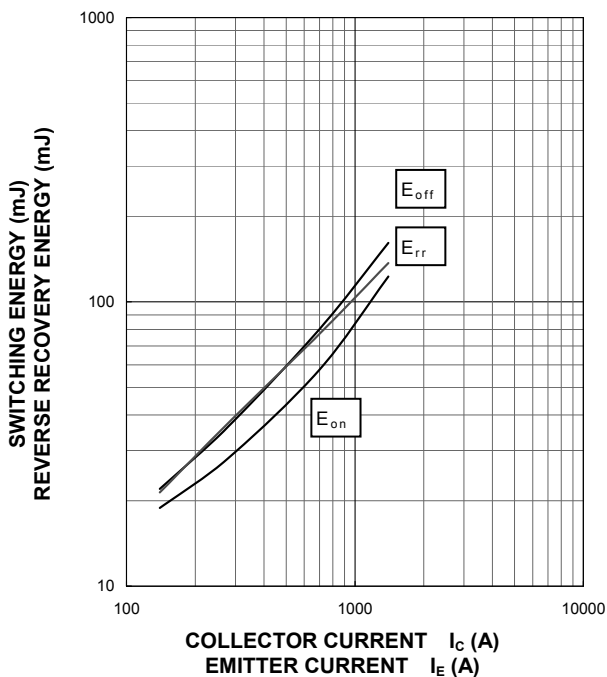
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=600\text{ V}$, $I_C=1400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $T_J=125\text{ }^\circ\text{C}$,
 INDUCTIVE LOAD



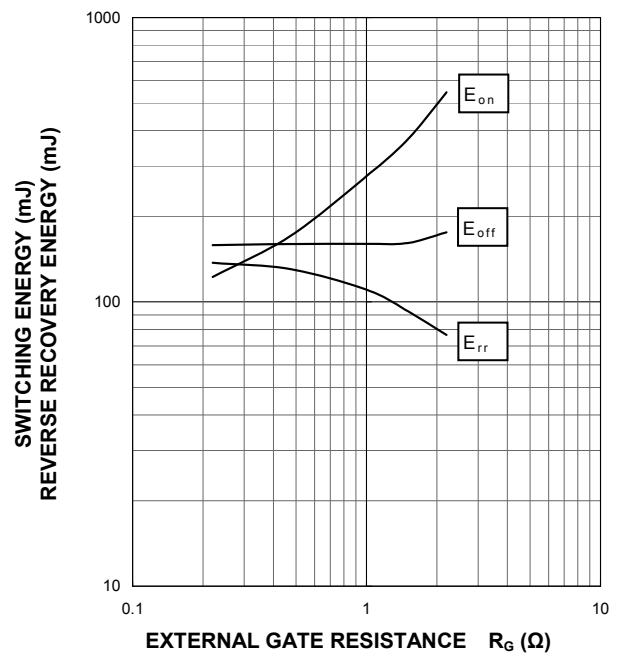
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.22\ \Omega$, $T_J=125\text{ }^\circ\text{C}$,
 INDUCTIVE LOAD, PER PULSE



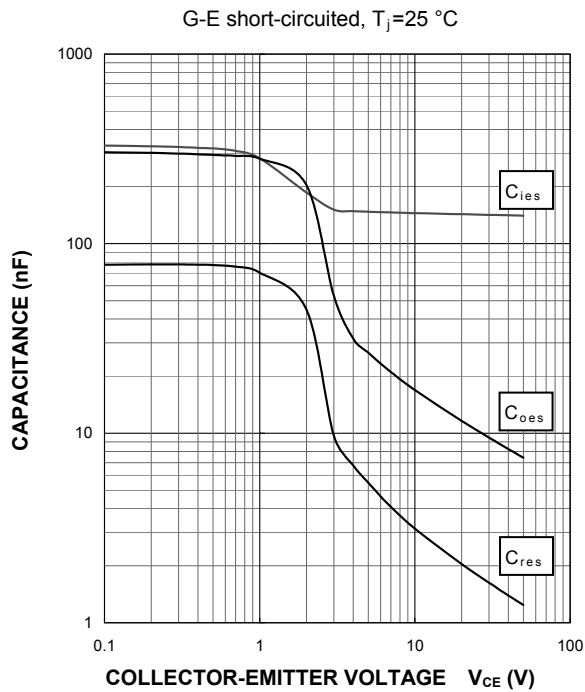
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=600\text{ V}$, $I_C/I_E=1400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $T_J=125\text{ }^\circ\text{C}$,
 INDUCTIVE LOAD, PER PULSE

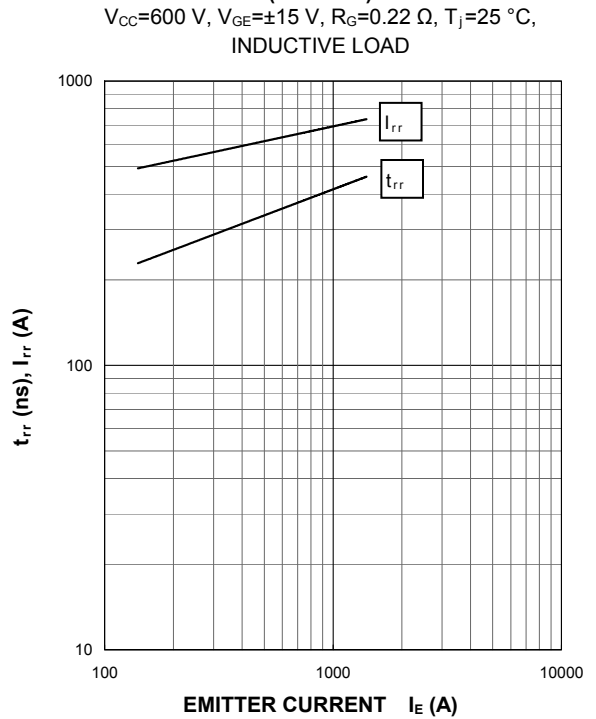


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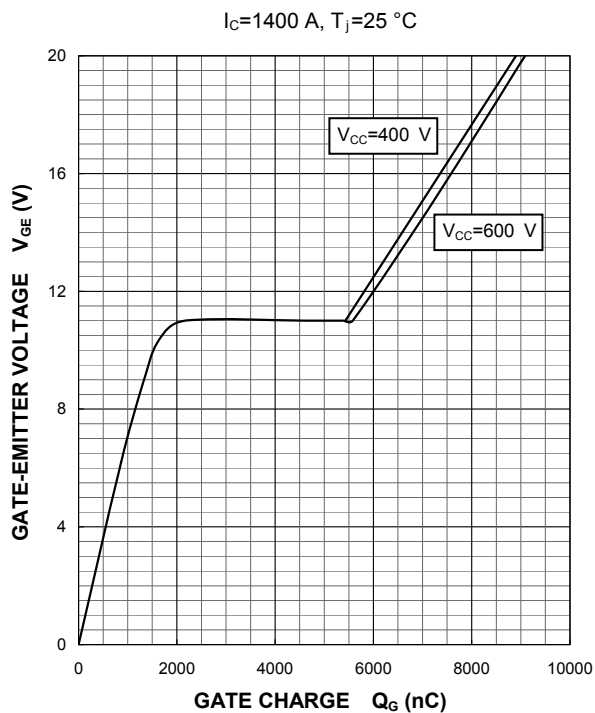
**CAPACITANCE CHARACTERISTICS
(TYPICAL)**



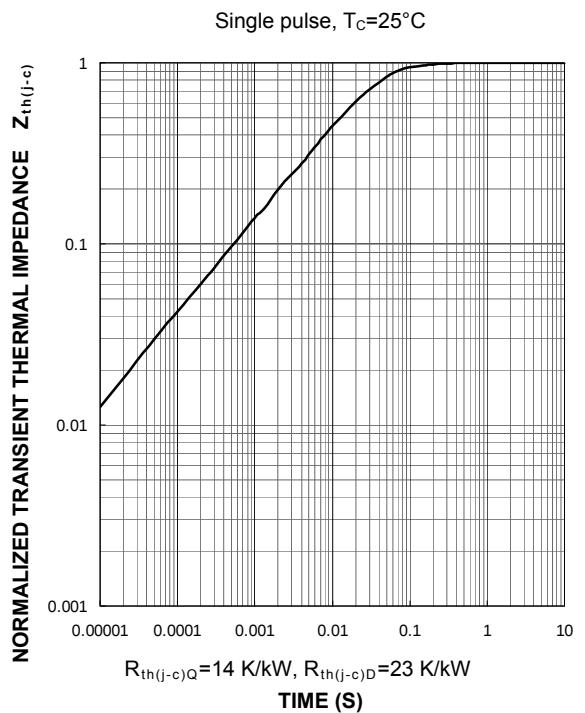
**FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)**



**GATE CHARGE CHARACTERISTICS
(TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE
CHARACTERISTICS
(MAXIMUM)**



Keep safety first in your circuit designs!

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