

< IGBT MODULES >

CM1400DUC-24NF

HIGH POWER SWITCHING USE
INSULATED TYPE



dual switch (Half-Bridge)

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

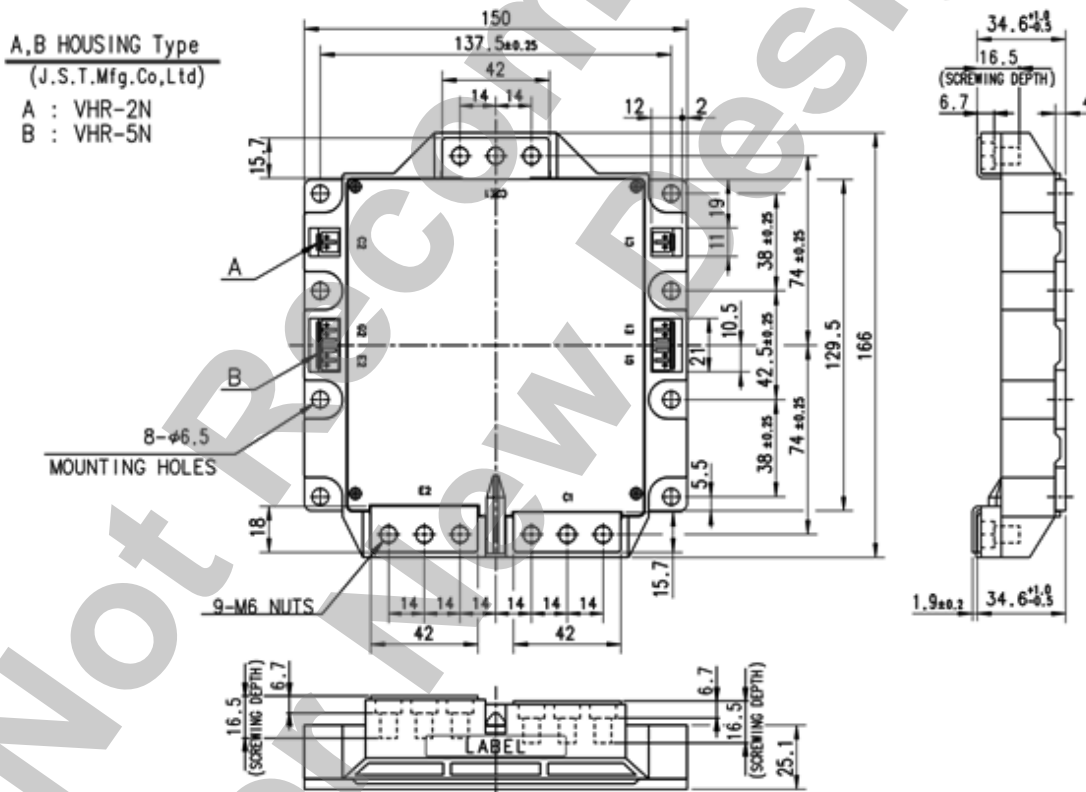
- Flat base Type
- Copper base plate (non-plating)
- RoHS Directive compliant
- Recognized under UL1557, File E323585

APPLICATION

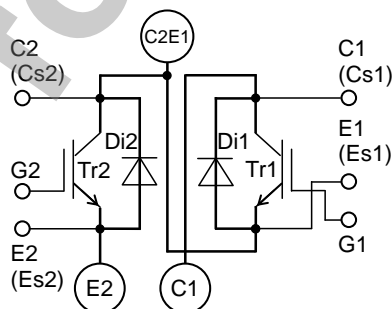
Wind power, Photovoltaic (Solar) power, AC Motor Control, Motion/Servo Control, Power supply, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



INTERNAL CONNECTION



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

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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, 4)	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	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	2500	V
T_j	Junction temperature	-	-40 ~ +150	$^\circ\text{C}$
T_{stg}	Storage temperature	(Note7)	-40 ~ +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	-	-	1.0	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	$I_C=1400\text{ A}$, $V_{GE}=15\text{ V}$ (Note5) Refer to the figure of test circuit	$T_j=25\text{ }^\circ\text{C}$	-	1.8	2.5	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, Refer to the figure of test circuit (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	2.5	3.2	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.1	-	
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	$R_G=0.22\text{ }\Omega$, Inductive load	-	90	-	μC	
E_{on}	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$, $I_C=I_E=1400\text{ A}$,	-	122.8	-	mJ	
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=0.22\text{ }\Omega$, $T_j=150\text{ }^\circ\text{C}$,	-	161.2	-		
E_{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	136.9	-	mJ	
R_{CC+EE}	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note4)	-	0.286	-	m Ω	
r_g	Internal gate resistance	Per switch	-	1.0	-	Ω	

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THERMAL RESISTANCE CHARACTERISTICS

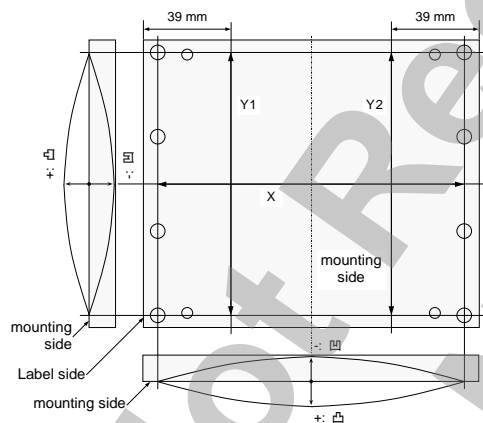
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to case, per Inverter IGBT (Note4)	-	-	14	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter DIODE (Note4)	-	-	23	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, per 1/2 module, Thermal grease applied (Note4, 6)	-	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	N·m
d_s	Creepage distance	Terminal to terminal	24	-	-	mm
		Terminal to base plate	33	-	-	
d_a	Clearance	Terminal to terminal	14	-	-	mm
		Terminal to base plate	33	-	-	
m	mass	-	-	1450	-	g
e_c	Flatness of base plate	On the centerline X, Y1, Y2 (Note8)	-50	-	+100	μ m

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

2. Junction temperature (T_j) should not increase beyond T_{jmax} rating.
3. Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} 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.
The heat sink thermal resistance should measure just under the chips.
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 $\lambda=0.9$ W/(m·K).
- 7: The operation temperature is restrained by the permission temperature of female connector housing.
8. Base plate (mounting side) flatness measurement points (X, Y1 and Y2) are as follows of the following figure.



9. The company name and product names herein are the trademarks and registered trademarks of the respective companies.

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HIGH POWER SWITCHING USE

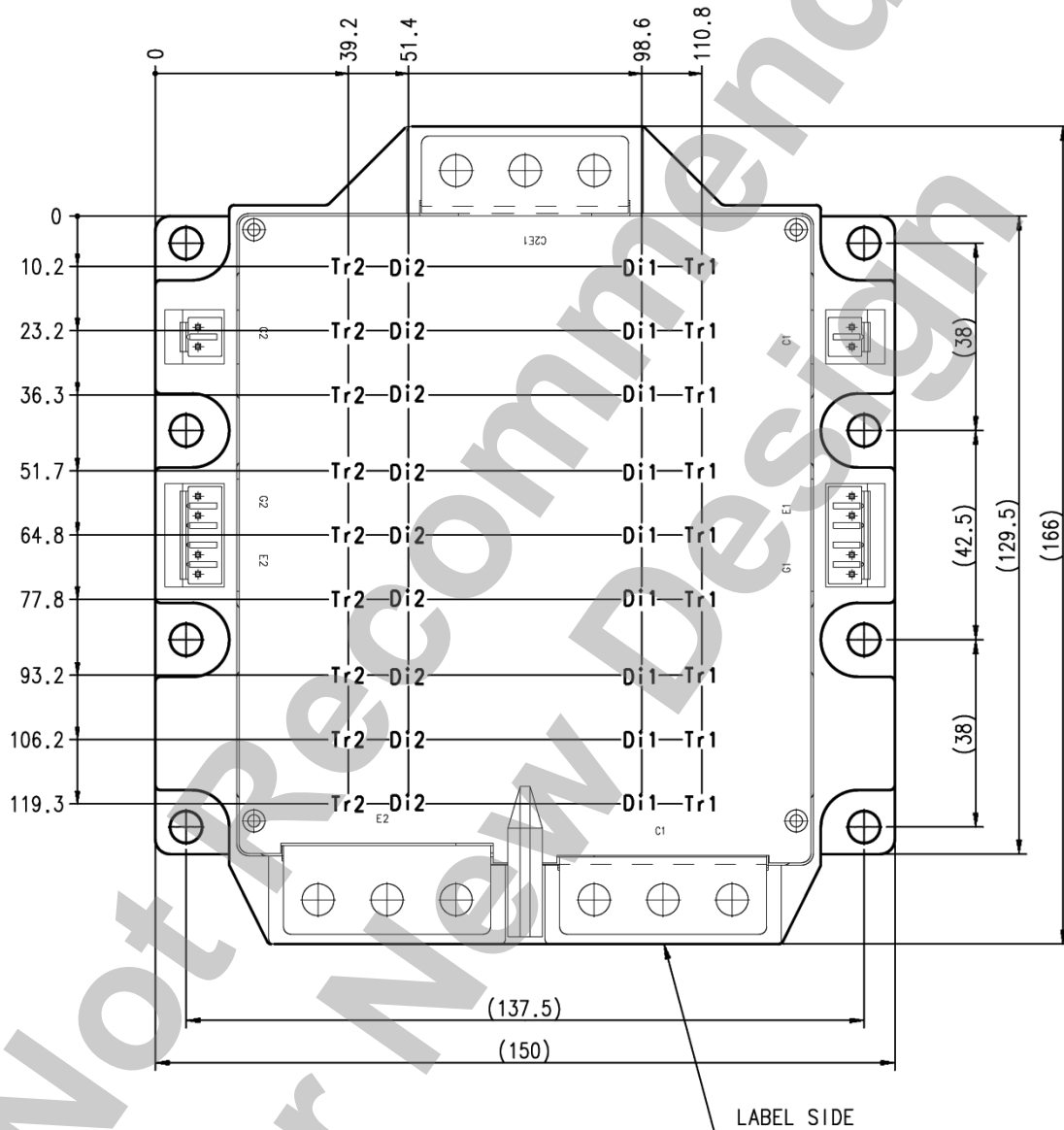
INSULATED TYPE

RECOMMENDED OPERATING CONDITIONS

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

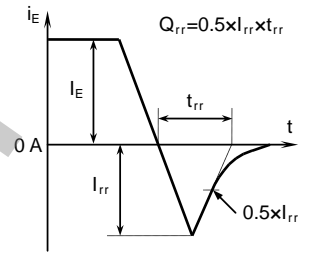
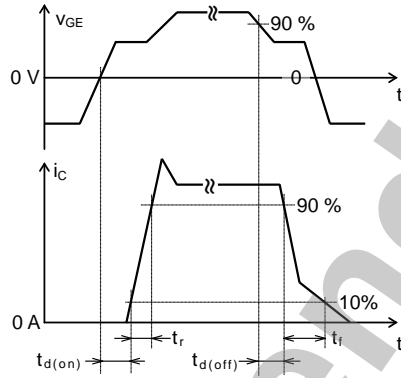
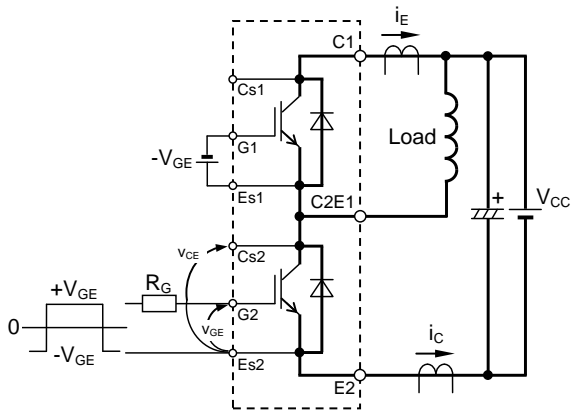
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm



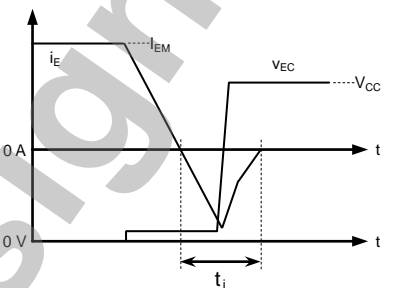
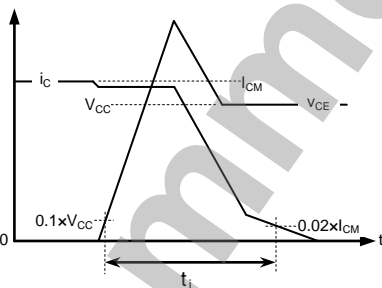
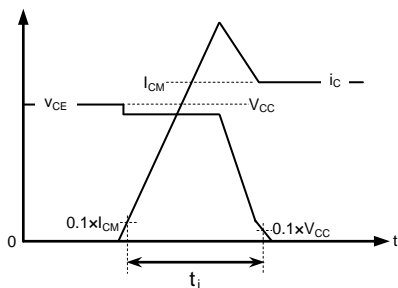
Tr1/Tr2: IGBT, Di1/Di2: DIODE

TEST CIRCUIT AND WAVEFORMS



Switching characteristics test circuit and waveforms

t_{rr} , Q_{rr} test waveform



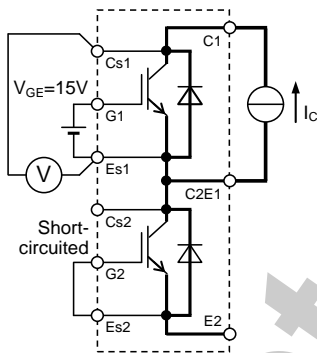
IGBT Turn-on switching energy

IGBT Turn-off switching energy

DIODE Reverse recovery energy

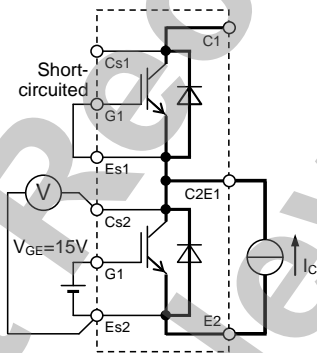
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

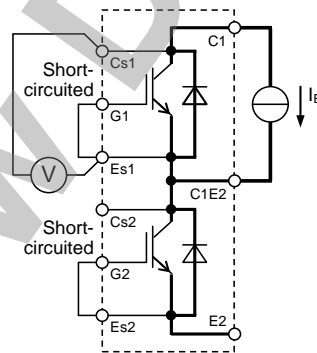


Tr1

V_{CEsat} test circuit

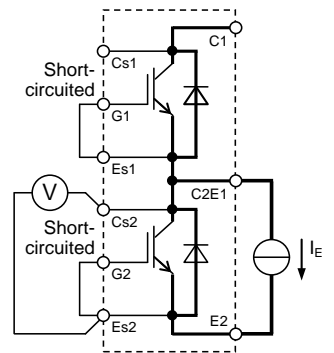


Tr2



Di1

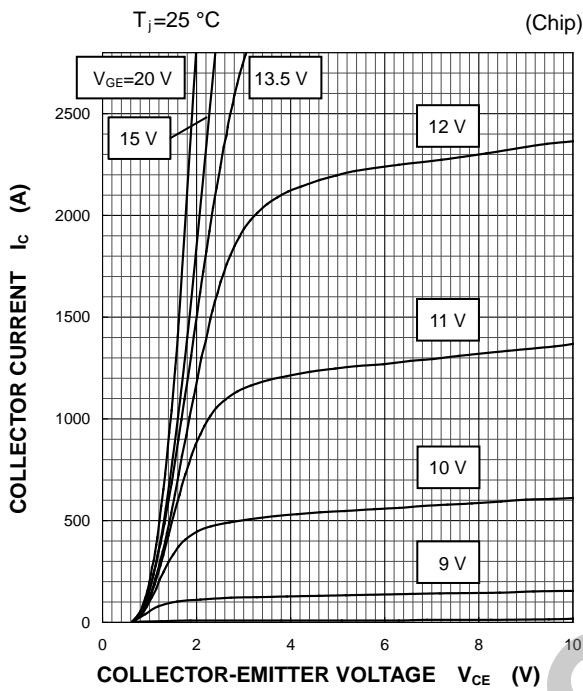
V_{EC} test circuit



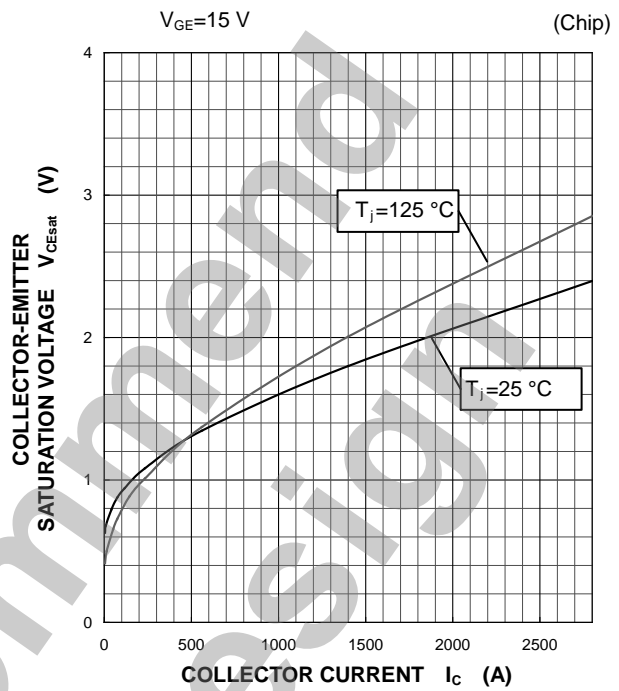
Di2

PERFORMANCE CURVES

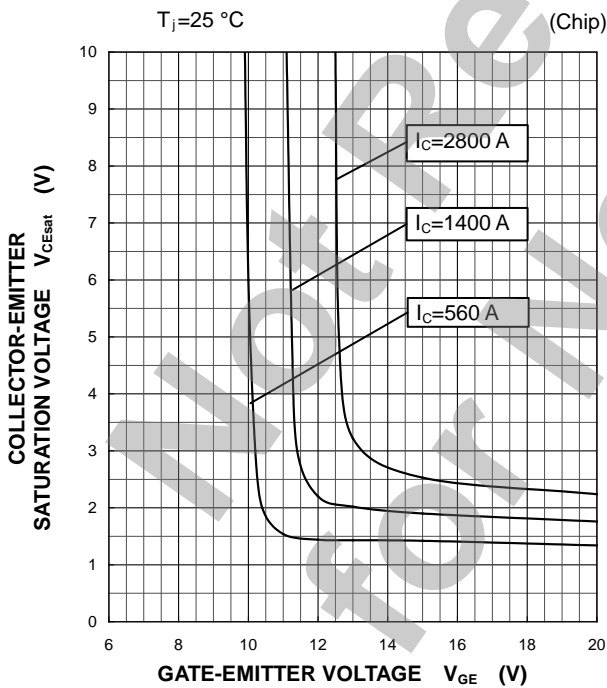
OUTPUT CHARACTERISTICS
(TYPICAL)



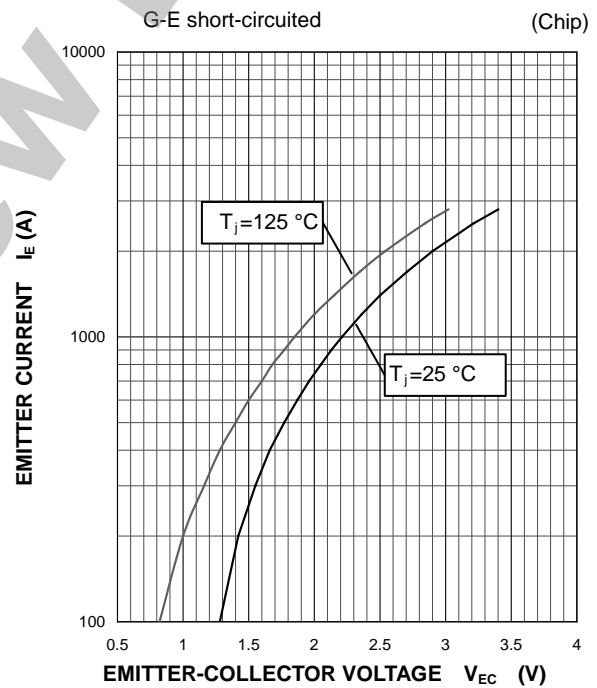
COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)



FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)



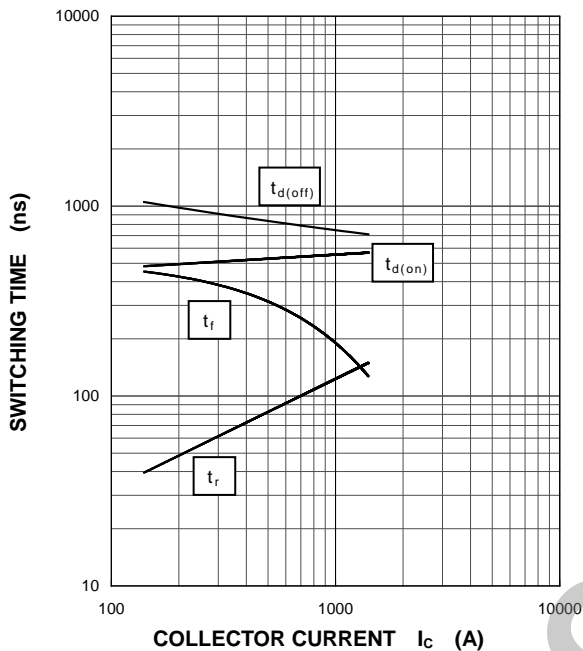
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PERFORMANCE CURVES

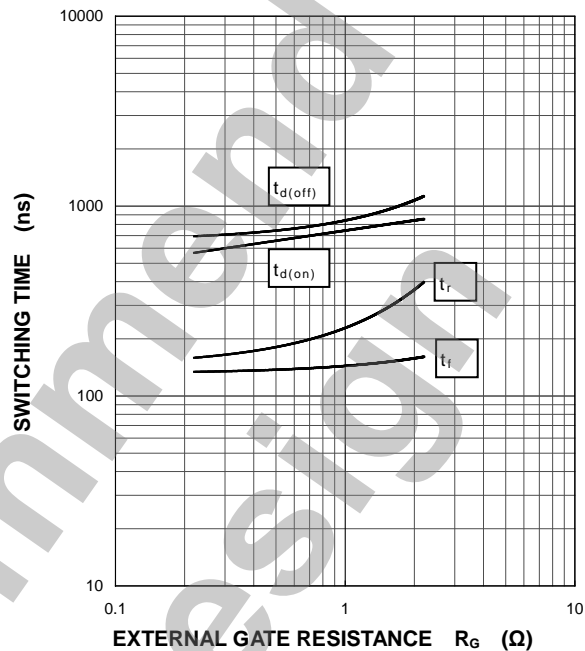
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



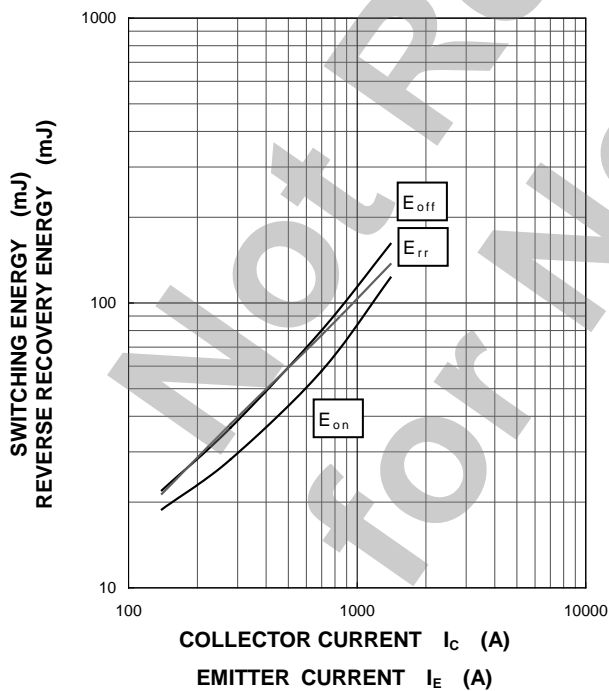
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



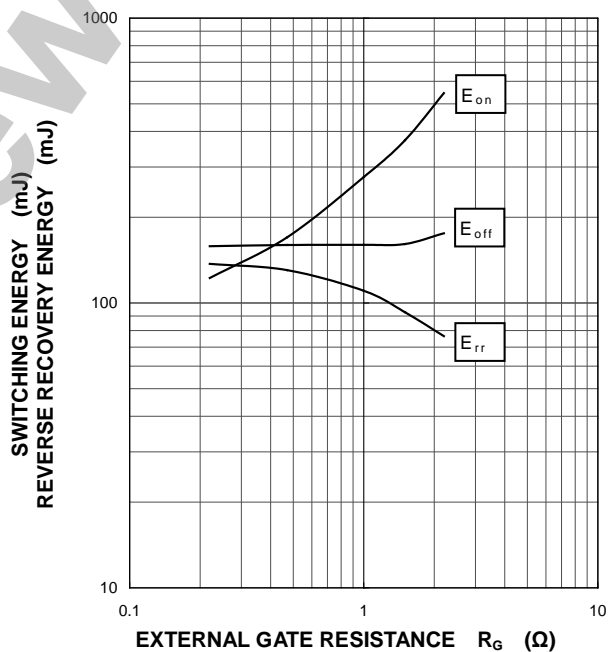
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

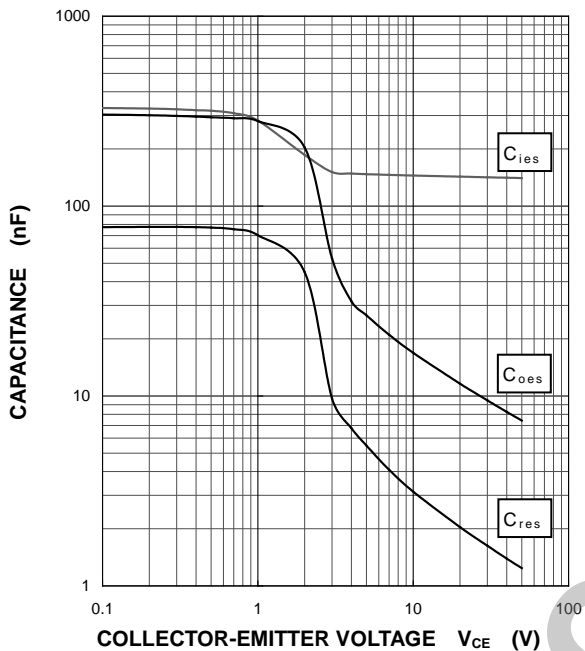
$V_{CC}=600\text{ V}$, $I_C/I_E=1400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $T_J=125\text{ }^\circ\text{C}$,
INDUCTIVE LOAD, PER PULSE



PERFORMANCE CURVES

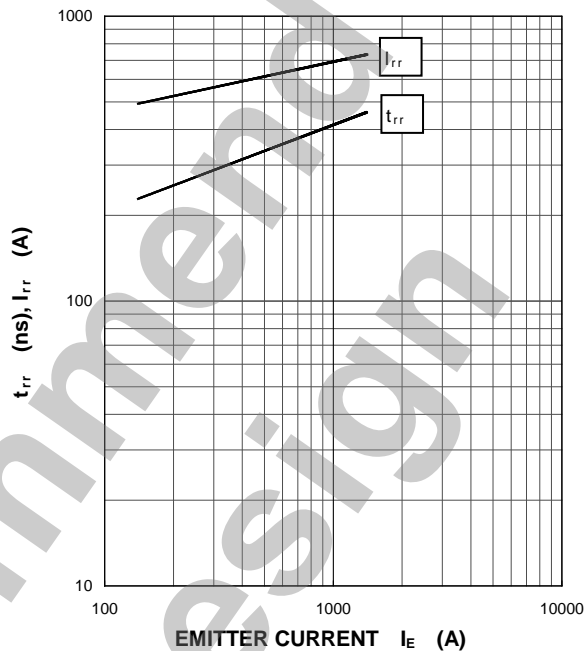
CAPACITANCE CHARACTERISTICS
(TYPICAL)

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



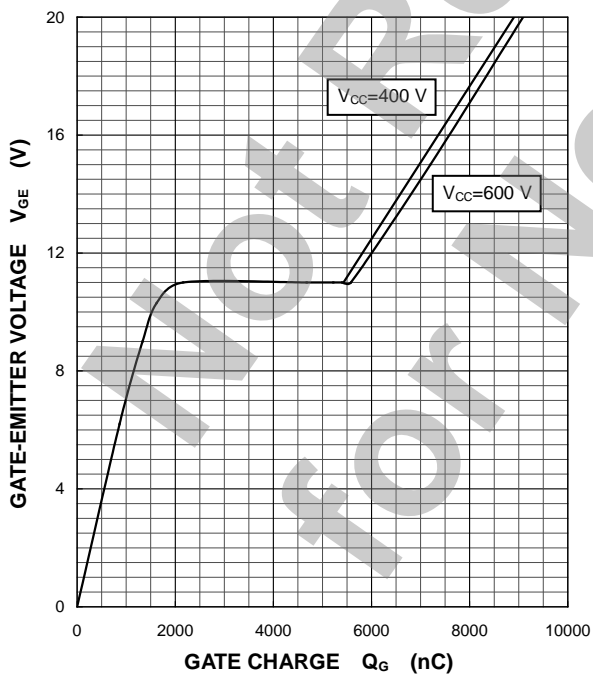
FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.22\ \Omega$, $T_j=25^\circ\text{C}$,
INDUCTIVE LOAD



GATE CHARGE CHARACTERISTICS
(TYPICAL)

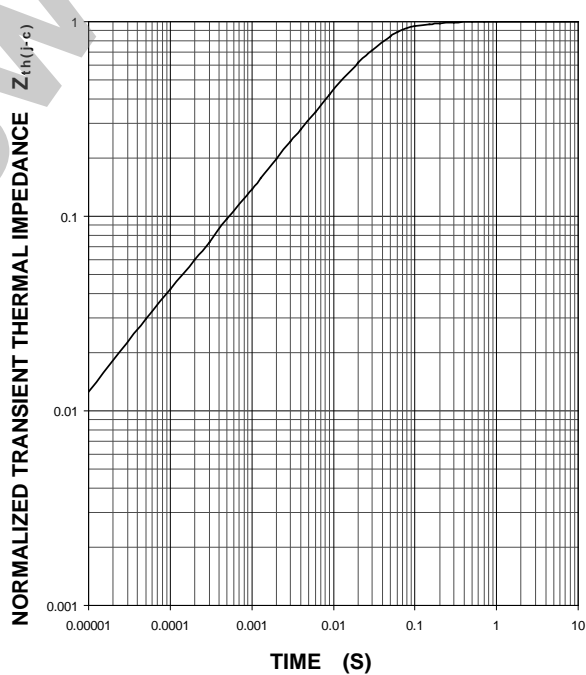
$I_C=1400\text{ A}$, $T_j=25^\circ\text{C}$



TRANSIENT THERMAL IMPEDANCE
CHARACTERISTICS
(MAXIMUM)

Single pulse, $T_C=25^\circ\text{C}$

$R_{th(j-c)Q}=14\text{ K/kW}$, $R_{th(j-c)D}=23\text{ K/kW}$



Keep safety first in your circuit designs!

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