

<IGBT Modules>

# CM500C2Y-24S

**HIGH POWER SWITCHING USE  
INSULATED TYPE**



**dual pack (Emitter common)**

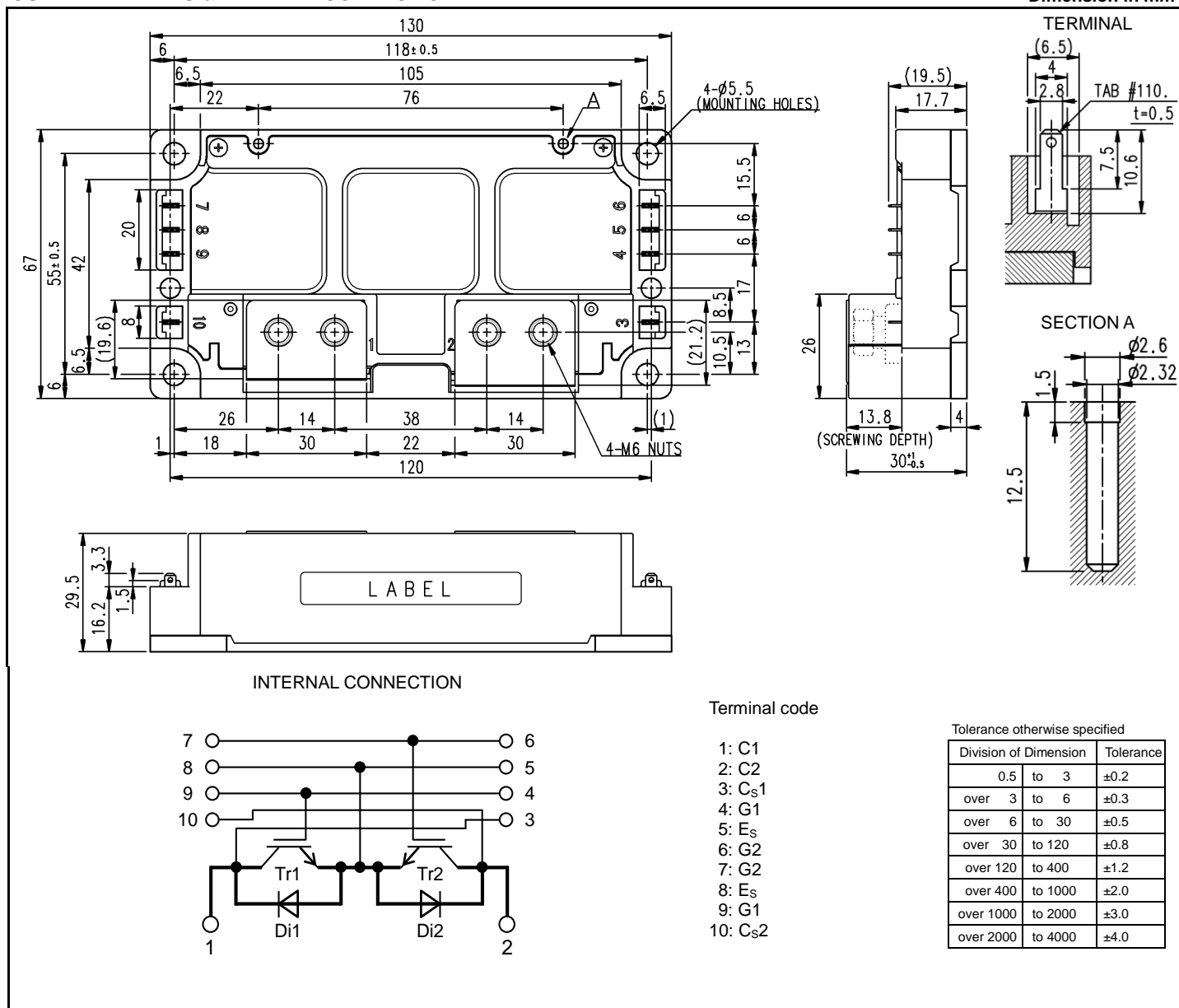
Collector current  $I_C$  ..... **500 A**  
 Collector-emitter voltage  $V_{CES}$  ..... **1200 V**  
 Maximum junction temperature  $T_{vjmax}$  ..... **175 °C**

- 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<sub>vj</sub>=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Rating	Unit
V <sub>CES</sub>	Collector-emitter voltage	G-E short-circuited	1200	V
V <sub>GES</sub>	Gate-emitter voltage	C-E short-circuited	± 20	V
I <sub>C</sub>	Collector current	DC, T <sub>C</sub> =108 °C (Note2, 4)	500	A
I <sub>CRM</sub>		Pulse, Repetitive (Note3)	1000	
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25 °C (Note2, 4)	2880	W
I <sub>E</sub> (Note1)	Emitter current	DC (Note2)	500	A
I <sub>ERM</sub> (Note1)		Pulse, Repetitive (Note3)	1000	
V <sub>isol</sub>	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	4000	V
T <sub>vjmax</sub>	Maximum junction temperature	Instantaneous event (overload)	175	°C
T <sub>Cmax</sub>	Maximum case temperature	(Note4)	125	
T <sub>vjop</sub>	Operating junction temperature	Continuous operation (under switching)	-40 ~ +150	
T <sub>stg</sub>	Storage temperature	-	-40 ~ +125	

## ELECTRICAL CHARACTERISTICS (T<sub>vj</sub>=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I <sub>CES</sub>	Collector-emitter cut-off current	V <sub>CE</sub> =V <sub>CES</sub> , G-E short-circuited	-	-	1.0	mA	
I <sub>GES</sub>	Gate-emitter leakage current	V <sub>GE</sub> =V <sub>GES</sub> , C-E short-circuited	-	-	0.5	µA	
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	I <sub>C</sub> =50 mA, V <sub>CE</sub> =10 V	5.4	6.0	6.6	V	
V <sub>CESat</sub> (Terminal)	Collector-emitter saturation voltage	I <sub>C</sub> =500 A, V <sub>GE</sub> =15 V, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	1.80	2.25	V
V <sub>CESat</sub> (Chip)			T <sub>vj</sub> =125 °C	-	2.00	-	
			T <sub>vj</sub> =150 °C	-	2.05	-	
	V <sub>EC</sub> (Terminal)	I <sub>E</sub> =500 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	1.80	2.25	V
T <sub>vj</sub> =125 °C			-	2.00	-		
T <sub>vj</sub> =150 °C			-	2.05	-		
V <sub>EC</sub> (Chip)	I <sub>E</sub> =500 A, G-E short-circuited, (Note5)	T <sub>vj</sub> =25 °C	-	1.70	2.15	V	
		T <sub>vj</sub> =125 °C	-	1.90	-		
		T <sub>vj</sub> =150 °C	-	1.95	-		
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10 V, G-E short-circuited	-	-	50	nF	
C <sub>oes</sub>	Output capacitance		-	-	10		
C <sub>res</sub>	Reverse transfer capacitance		-	-	0.9		
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =600 V, I <sub>C</sub> =500 A, V <sub>GE</sub> =15 V	-	1.16	-	µC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =600 V, I <sub>C</sub> =500 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, Inductive load	-	-	600	ns	
t <sub>r</sub>	Rise time		-	-	200		
t <sub>d(off)</sub>	Turn-off delay time		-	-	500		
t <sub>f</sub>	Fall time		-	-	200		
t <sub>rr</sub> (Note1)	Reverse recovery time	V <sub>CC</sub> =600 V, I <sub>E</sub> =500 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, Inductive load	-	-	300	ns	
Q <sub>rr</sub> (Note1)	Reverse recovery charge		-	60	-	µC	
E <sub>on</sub>	Turn-on switching energy per pulse	V <sub>CC</sub> =600 V, I <sub>C</sub> =I <sub>E</sub> =500 A,	-	66	-	mJ	
E <sub>off</sub>	Turn-off switching energy per pulse	V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, T <sub>vj</sub> =150 °C,	-	54	-		
E <sub>rr</sub> (Note1)	Reverse recovery energy per pulse	Inductive load	-	41	-	mJ	
R <sub>CC'+EE'</sub>	Internal lead resistance	Main terminals-chip, per switch, T <sub>C</sub> =25 °C (Note4)	-	0.2	-	mΩ	
r <sub>g</sub>	Internal gate resistance	Per switch	-	5.5	-	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 IGBT (Note4)	-	-	52	K/kW
$R_{th(j-c)D}$		Junction to case, per FWD (Note4)	-	-	80	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note4, 6)	-	18	-	K/kW

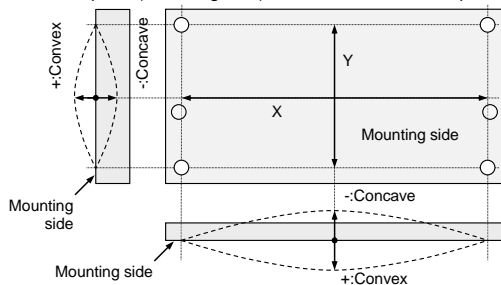
## MECHANICAL CHARACTERISTICS

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	$\mu$ 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)/ $D_{(c-s)}=100$   $\mu$ 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	$0.55 \pm 0.055$ N·m	by handwork (equivalent to 30 r/min by mechanical screw driver) ~ 600 r/min (by mechanical screw driver)
(2) PT®	K25x10	$0.85 \pm 0.085$ N·m	
(3) DELTA PT®	25x8	$0.55 \pm 0.055$ N·m	
(4) DELTA PT®	25x10	$0.85 \pm 0.085$ N·m	
(5) B1 tapping screw	$\phi 2.6 \times 10$ or $\phi 2.6 \times 12$	$0.85 \pm 0.085$ N·m	

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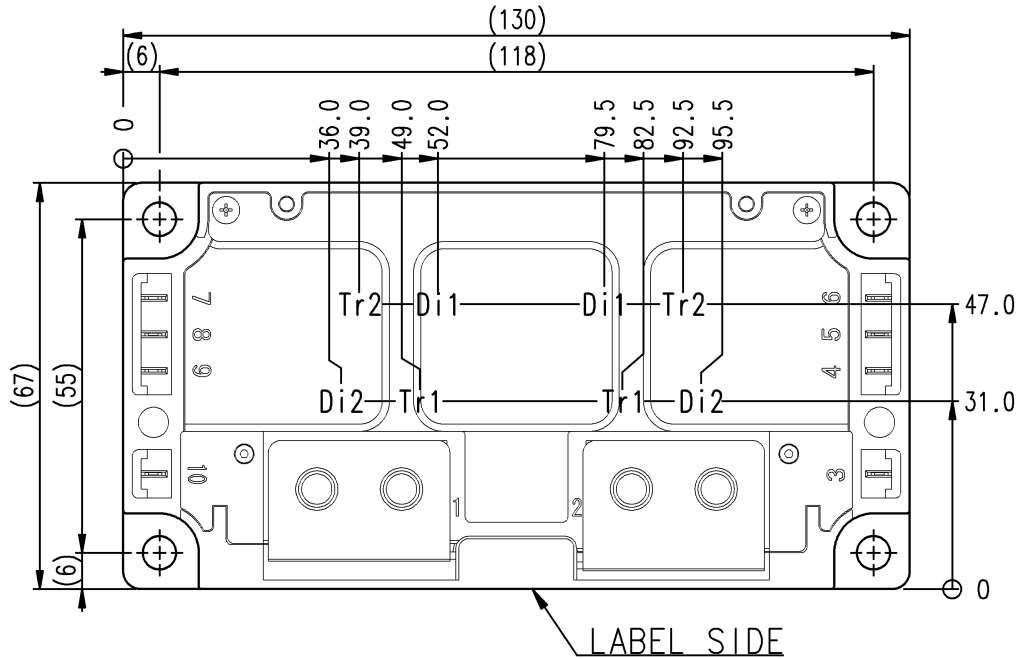
HIGH POWER SWITCHING USE  
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## RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{CC}$	(DC) Supply voltage	Applied across C1-E2 terminals	-	600	850	V
$V_{GEon}$	Gate (-emitter drive) voltage	Applied across G1-Es/ G2-Es terminals	13.5	15.0	16.5	V
$R_G$	External gate resistance	Per switch	0	-	15	$\Omega$

### CHIP LOCATION (Top view)

Dimension in mm, tolerance:  $\pm 1$  mm

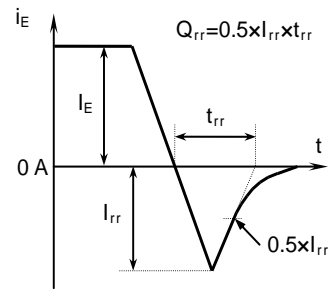
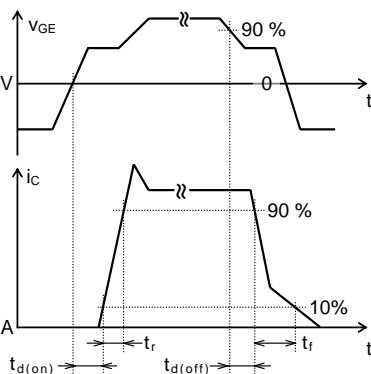
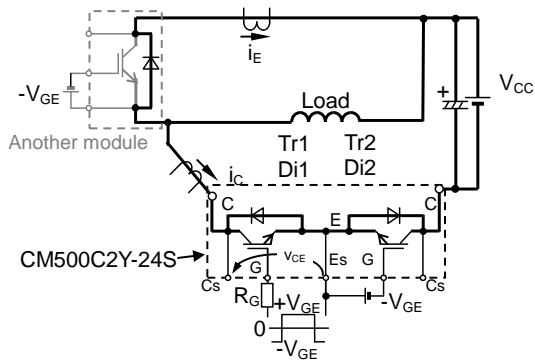


Tr1/Tr2: IGBT, Di1/Di2: FWD

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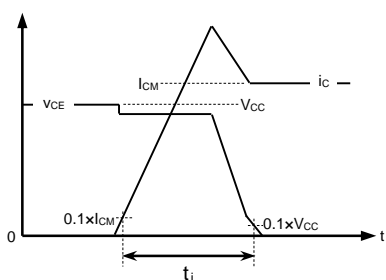
HIGH POWER SWITCHING USE  
INSULATED TYPE

## TEST CIRCUIT AND WAVEFORMS

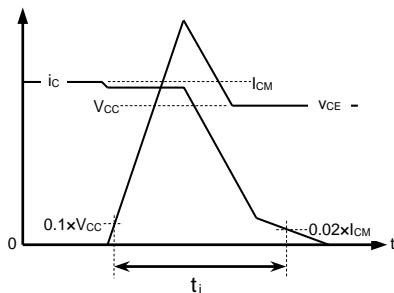


Switching characteristics test circuit and waveforms

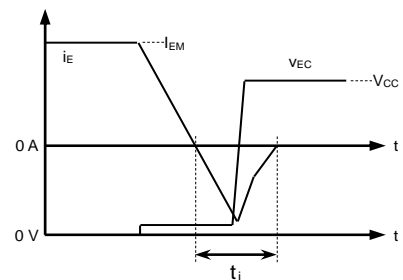
$t_{rr}$ ,  $Q_{rr}$  characteristics test waveform



IGBT Turn-on switching energy



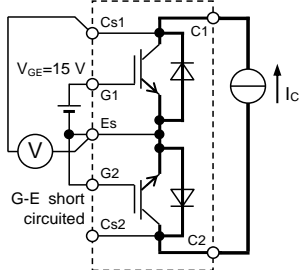
IGBT Turn-off switching energy



FWD Reverse recovery energy

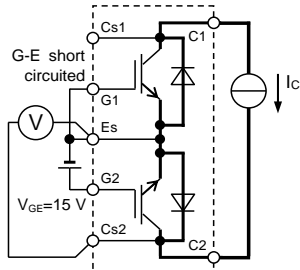
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

## TEST CIRCUIT

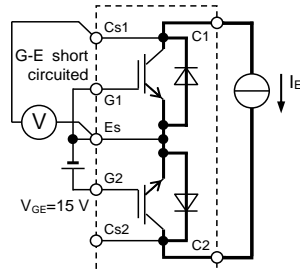


Tr1

$V_{CEsat}$  characteristics test circuit

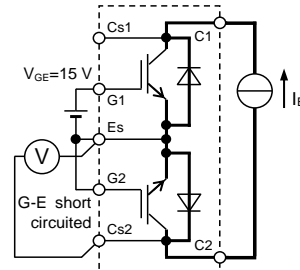


Tr2



Di1

$V_{CE}$  characteristics test circuit



Di2

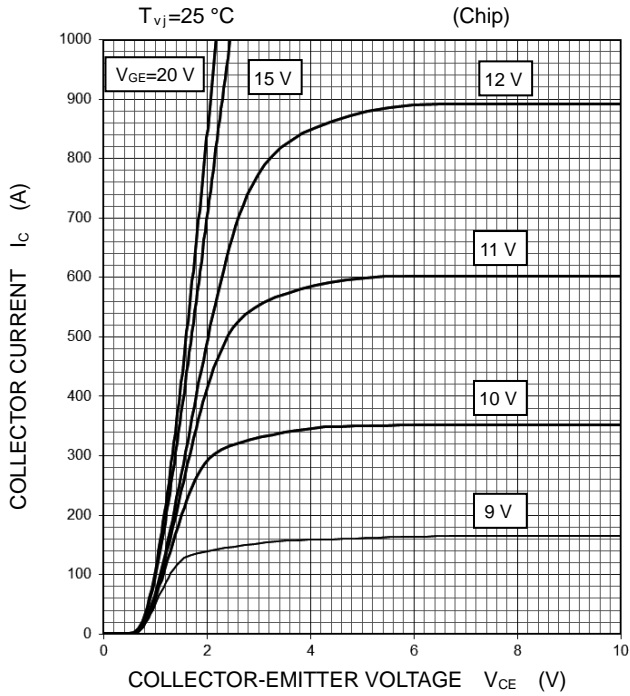
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## PERFORMANCE CURVES

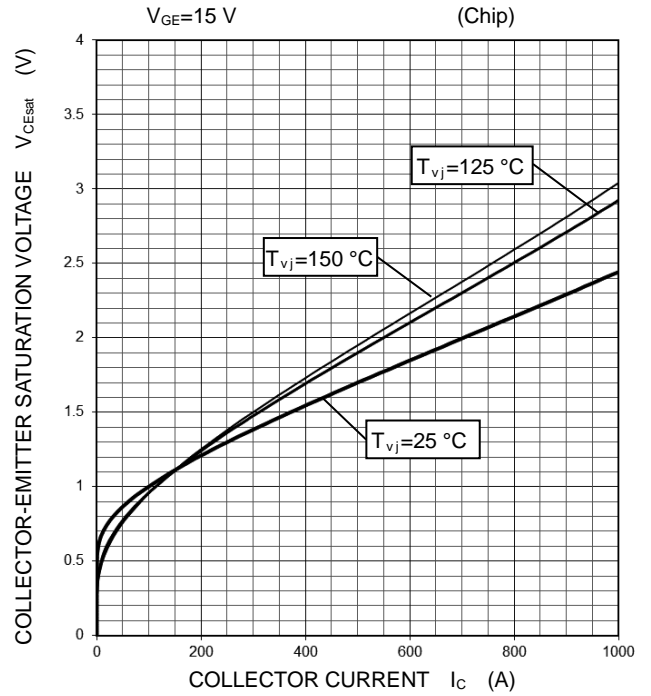
OUTPUT CHARACTERISTICS

(TYPICAL)



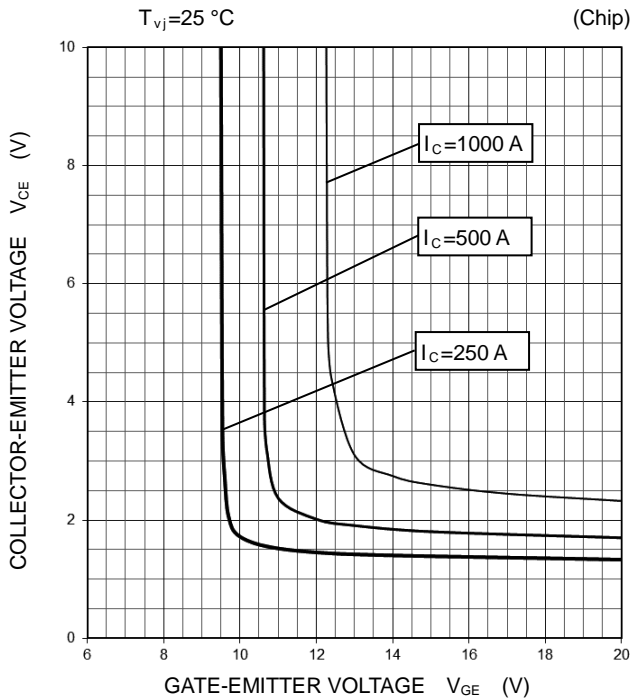
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



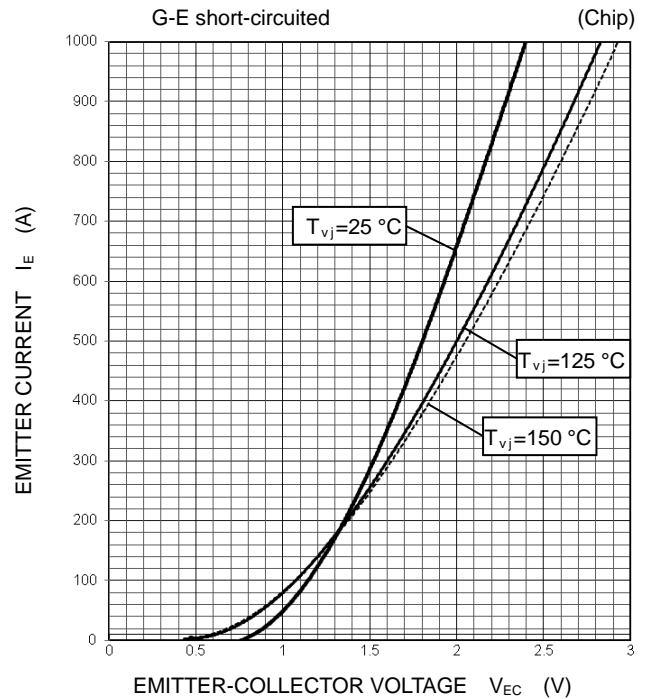
COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS

(TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)



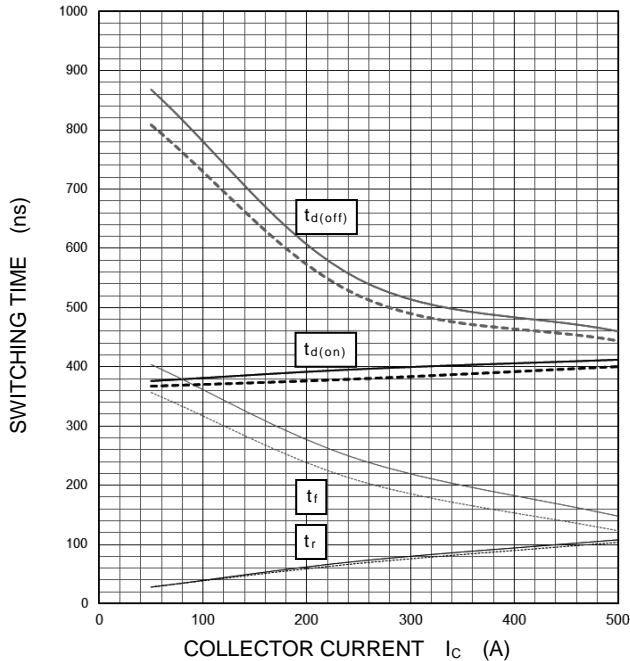
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## PERFORMANCE CURVES

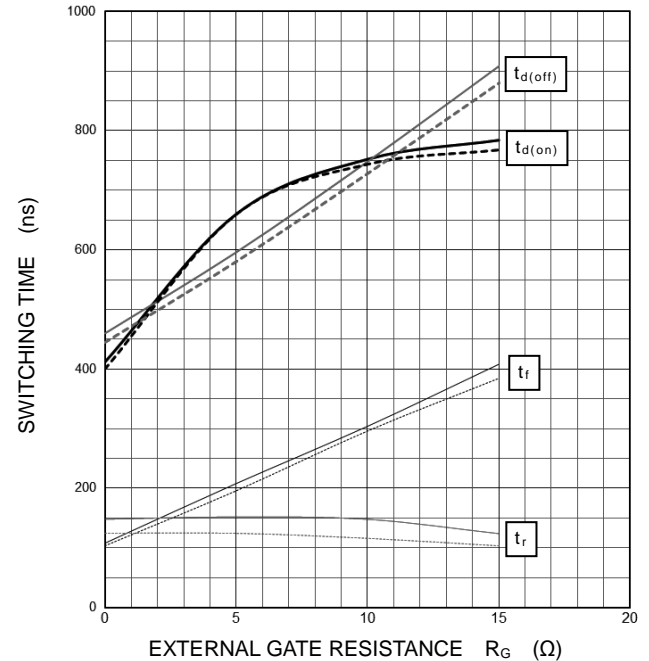
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

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



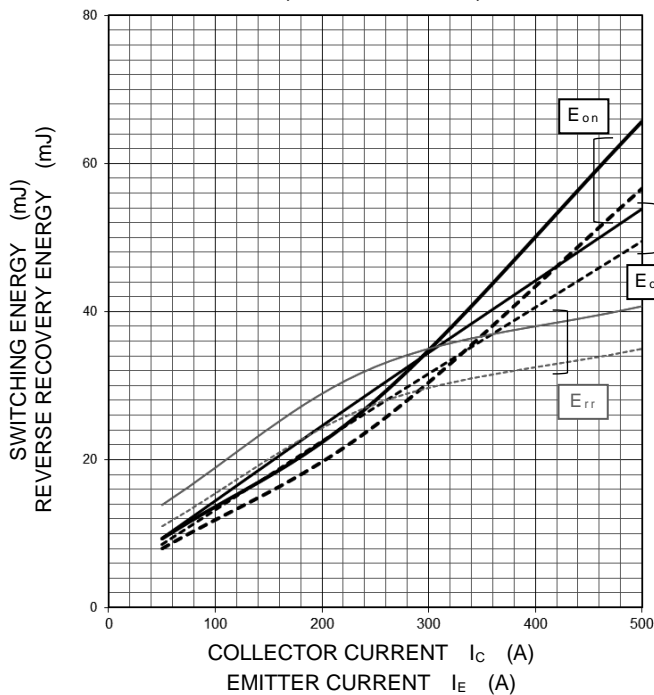
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_C=500\text{ A}$ , INDUCTIVE LOAD  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



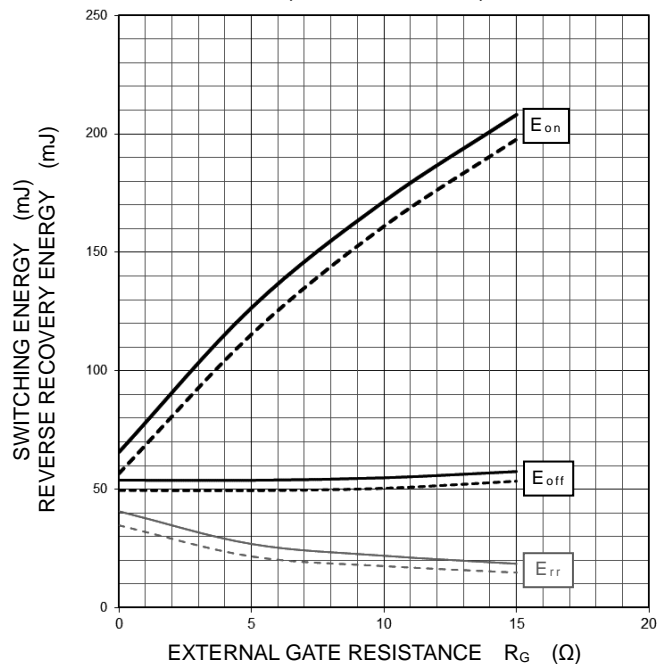
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

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



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

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_C/I_E=500\text{ A}$ ,  
INDUCTIVE LOAD, PER PULSE  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



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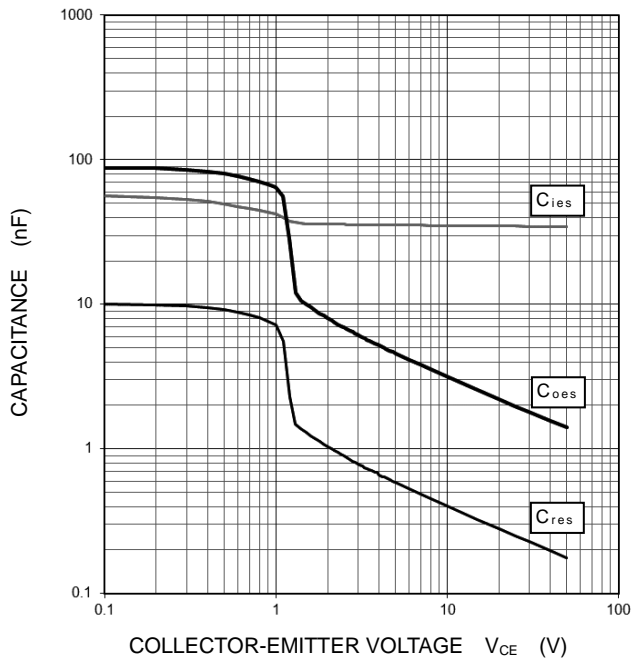
HIGH POWER SWITCHING USE  
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## PERFORMANCE CURVES

### CAPACITANCE CHARACTERISTICS

(TYPICAL)

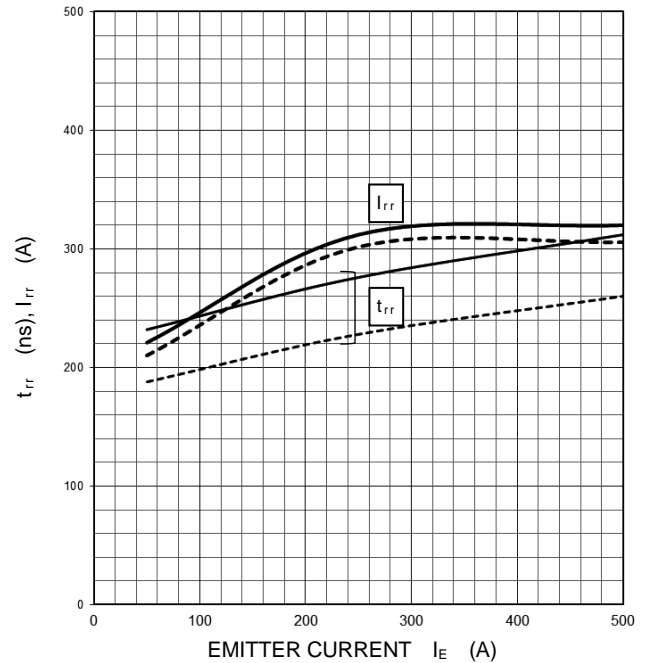
G-E short-circuited,  $T_{vj}=25\text{ }^{\circ}\text{C}$



### FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS

(TYPICAL)

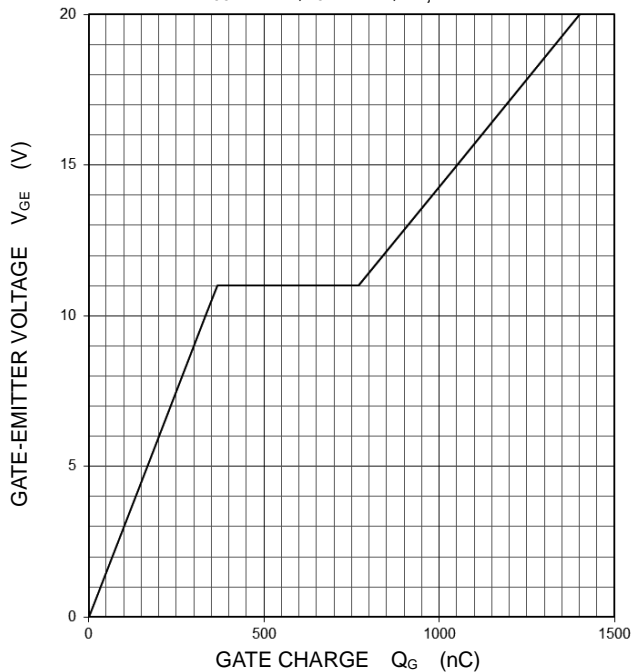
$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0\ \Omega$ , INDUCTIVE LOAD  
—:  $T_{vj}=150\text{ }^{\circ}\text{C}$ , - - - -:  $T_{vj}=125\text{ }^{\circ}\text{C}$



### GATE CHARGE CHARACTERISTICS

(TYPICAL)

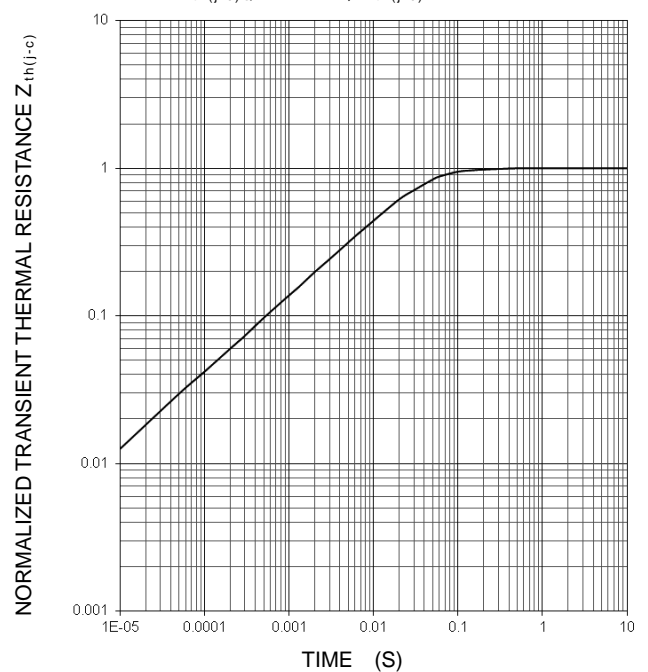
$V_{CC}=600\text{ V}$ ,  $I_C=500\text{ A}$ ,  $T_{vj}=25\text{ }^{\circ}\text{C}$



### TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

(MAXIMUM)

Single pulse,  $T_C=25\text{ }^{\circ}\text{C}$   
 $R_{th(j-c)Q}=52\text{ K/kW}$ ,  $R_{th(j-c)D}=80\text{ K/kW}$



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



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