

# CM500HA-34A

HIGH POWER SWITCHING USE  
INSULATED TYPE

## CM500HA-34A



Single

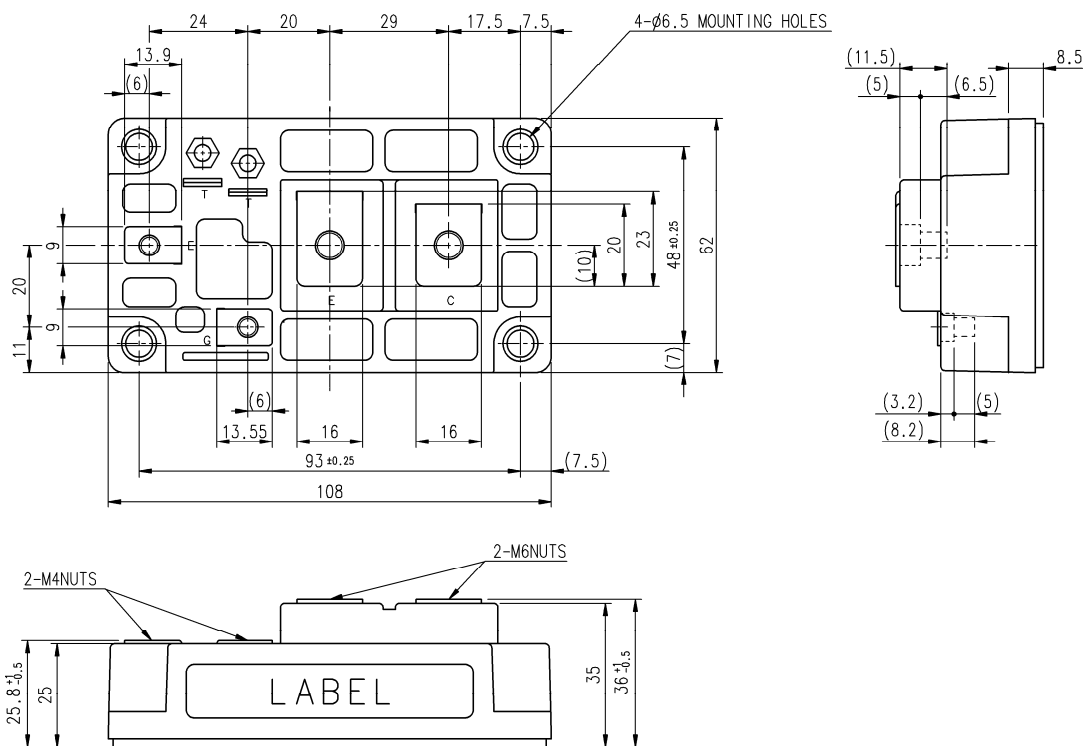
- $I_C$  ..... 500 A
- $V_{CES}$  ..... 1700 V
- Flat base Type  
Copper (non-plating) base plate  
No accessory (terminal screw) attach
- RoHS Directive compliant

## APPLICATION

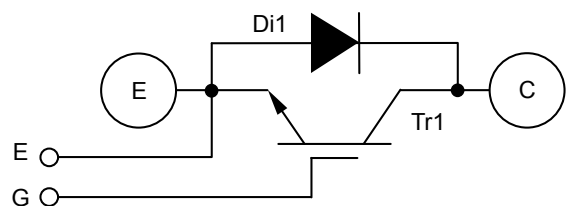
AC Motor Control, Motion/Servo Control, Power supply, etc.

## 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

**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	1700	V
$V_{GES}$	Gate-emitter voltage	C-E short-circuited	$\pm 20$	V
$I_C$	Collector current	DC, $T_C=87\text{ }^\circ\text{C}$ (Note.2)	500	A
$I_{CRM}$		Pulse, Repetitive (Note.3)	1000	
$P_{tot}$	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	5000	W
$I_E$ (Note.1)	Emitter current (Free wheeling diode forward current)	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	500	A
$I_{ERM}$ (Note.1)		Pulse, Repetitive (Note.3)	1000	
$T_j$	Junction temperature	-	-40 ~ +150	$^\circ\text{C}$
$T_{stg}$	Storage temperature	-	-40 ~ +125	
$V_{isol}$	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	3500	V

**MECHANICAL CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$M_t$	Mounting torque	Main terminals M 6 screw	1.96	2.45	2.94	N·m
$M_t$		Auxiliary terminals M 4 screw	0.98	1.18	1.47	
$M_s$		Mounting to heat sink M 6 screw	1.96	2.45	2.94	
$m$	Weight	-	-	480	-	g
$e_c$	Flatness of base plate	On the centerline X, Y (Note.5)	$\pm 0$	-	+100	$\mu\text{m}$

**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	$\pm V_{GE}=V_{GES}$ , C-E short-circuited	-	-	3	$\mu\text{A}$	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=50\text{ mA}$ , $V_{CE}=10\text{ V}$	5.5	7	8.5	V	
$V_{CESat}$	Collector-emitter saturation voltage	$I_C=500\text{ A}$ (Note.6), $V_{GE}=15\text{ V}$	$T_j=25\text{ }^\circ\text{C}$	-	2.2	3.0	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.45	-	
$C_{ies}$	Input capacitance	$V_{CE}=10\text{ V}$ , G-E short-circuited	-	-	120	nF	
$C_{oes}$	Output capacitance		-	-	14		
$C_{res}$	Reverse transfer capacitance		-	-	2.6		
$Q_G$	Gate charge	$V_{CC}=1000\text{ V}$ , $I_C=500\text{ A}$ , $V_{GE}=15\text{ V}$	-	3300	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=1000\text{ V}$ , $I_C=500\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=3.0\text{ }\Omega$ , Inductive load	-	-	900	ns	
$t_r$	Rise time		-	-	500		
$t_{d(off)}$	Turn-off delay time		-	-	700		
$t_f$	Fall time		-	-	350		
$V_{EC}$ (Note.1)	Emitter-collector voltage	$I_E=500\text{ A}$ (Note.6), G-E short-circuited	-	2.3	3.2	V	
$t_{rr}$ (Note.1)	Reverse recovery time	$V_{CC}=1000\text{ V}$ , $I_E=500\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=3.0\text{ }\Omega$ , Inductive load	-	-	650	ns	
$Q_{rr}$ (Note.1)	Reverse recovery charge		-	50	-		$\mu\text{C}$
$E_{on}$	Turn-on switching energy per pulse	$V_{CC}=1000\text{ V}$ , $I_C=I_E=500\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=3.0\text{ }\Omega$ , $T_j=125\text{ }^\circ\text{C}$ , Inductive load	-	267.8	-	mJ	
$E_{off}$	Turn-off switching energy per pulse		-	138.5	-		
$E_{rr}$ (Note.1)	Reverse recovery energy per pulse		-	98.1	-		
$r_g$	Internal gate resistance	$T_C=25\text{ }^\circ\text{C}$	-	1.0	-	$\Omega$	
$R_G$	External gate resistance	-	3.0	-	10	$\Omega$	

**THERMAL RESISTANCE CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance (Note.2)	Junction to case, IGBT part	-	-	25	K/KW
$R_{th(j-c)D}$		Junction to case, FWDi part	-	-	42	
$R_{th(c-s)}$	Contact thermal resistance (Note.2)	Case to heat sink, Thermal grease applied (Note.7)	-	20	-	K/KW

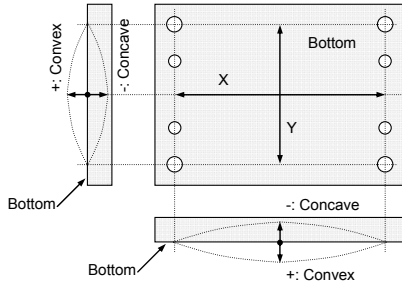
Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).  
 Note.2: Case temperature ( $T_c$ ) and heat sink temperature ( $T_s$ ) are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)

The heat sink thermal resistance  $\{R_{th(s-a)}\}$  should measure just under the chips.

Note.3: Pulse width and repetition rate should be such that the device junction temperature ( $T_j$ ) dose not exceed  $T_{jmax}$  rating.

Note.4: Junction temperature ( $T_j$ ) should not increase beyond  $T_{jmax}$  rating.

Note.5: Base plate flatness measurement point is as in the following figure.

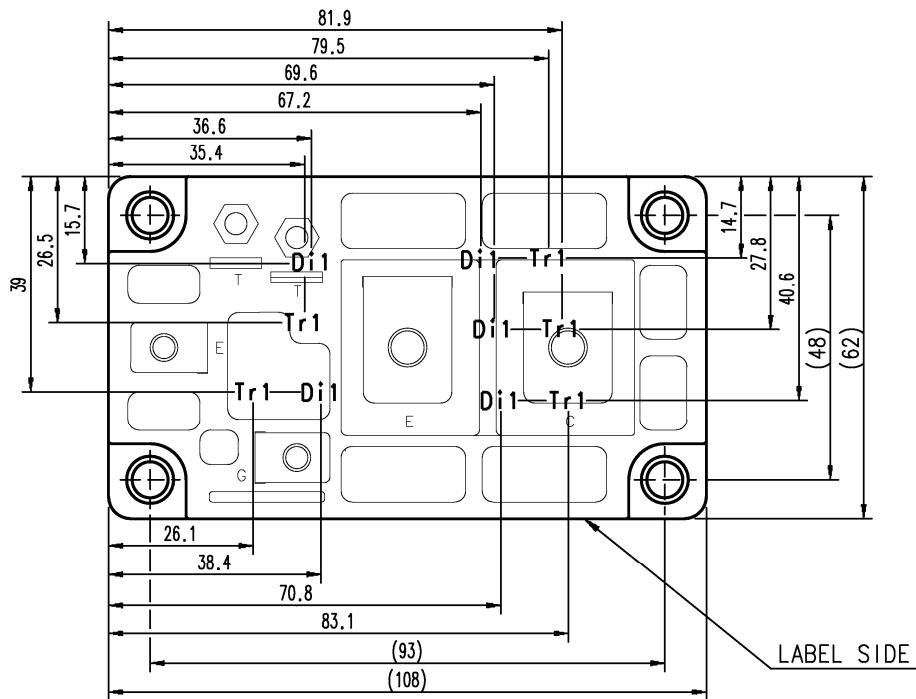


Note.6: Pulse width and repetition rate should be such as to cause negligible temperature rise. (Refer to the figure of test circuit)

Note.7: Typical value is measured by using thermally conductive grease of  $\lambda=0.9$  W/(m·K).

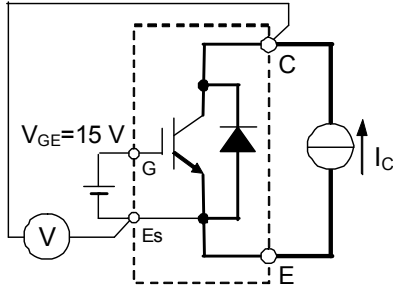
### CHIP LOCATION (Top view)

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

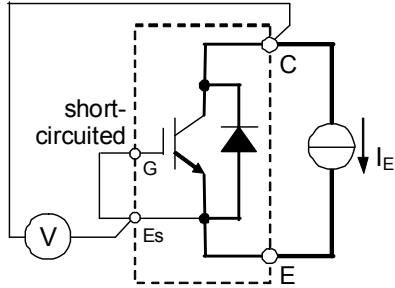


Tr1: IGBT, Di1: FWDi. Each mark points the center position of each chip.

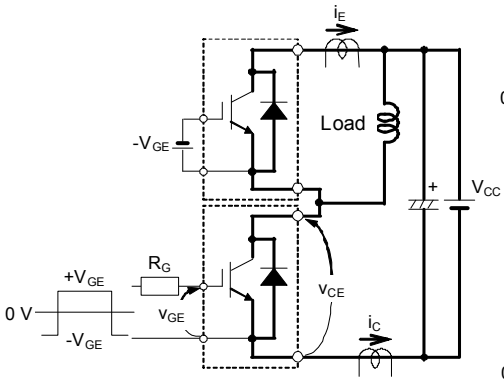
**TEST CIRCUIT AND WAVEFORMS**



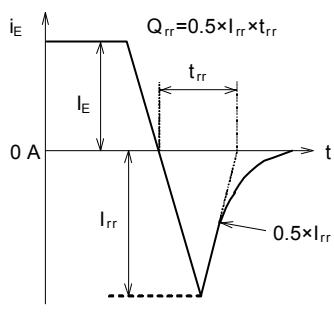
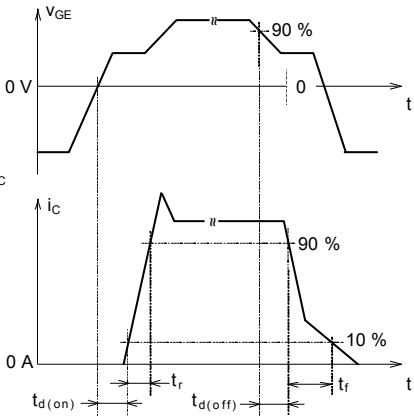
$V_{CEsat}$  test circuit



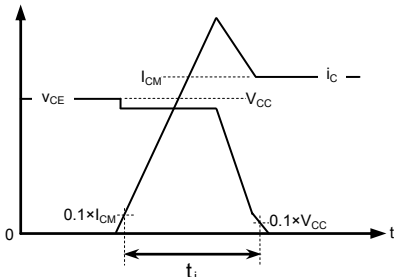
$V_{EC}$  test circuit



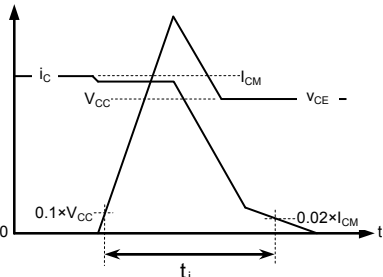
Switching characteristics test circuit and waveforms



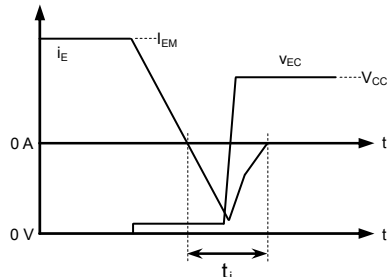
$t_{rr}$ ,  $Q_{rr}$  test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy

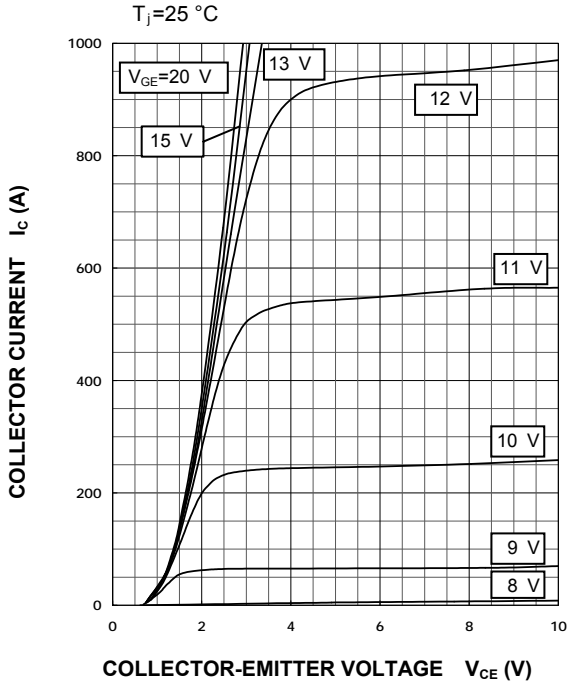


FWDi Reverse recovery energy

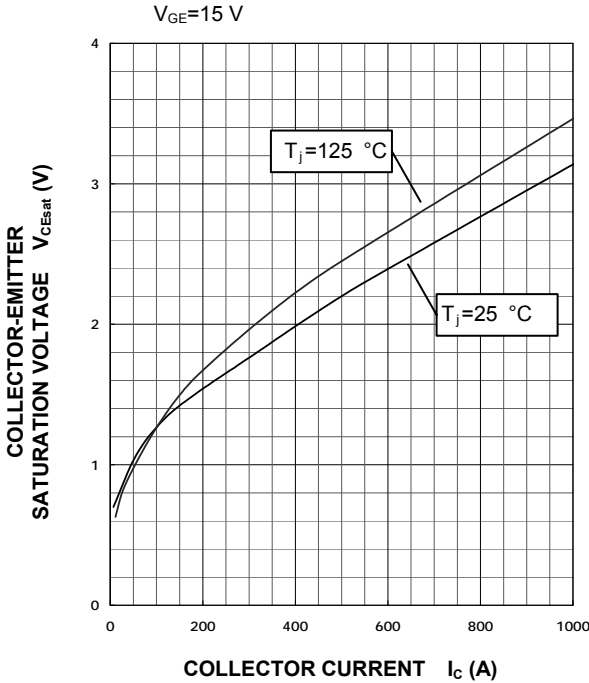
Turn-on, Turn-off switching and Reverse recovery energy test waveforms (integral range)

## PERFORMANCE CURVES

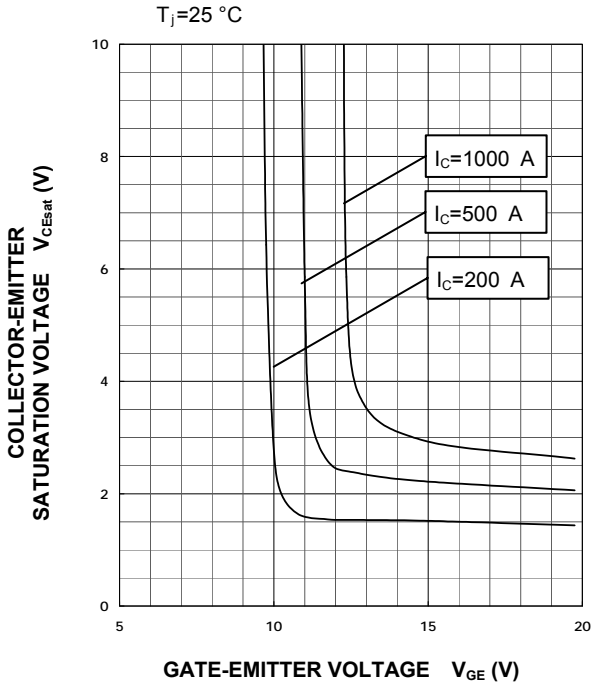
### OUTPUT CHARACTERISTICS (TYPICAL)



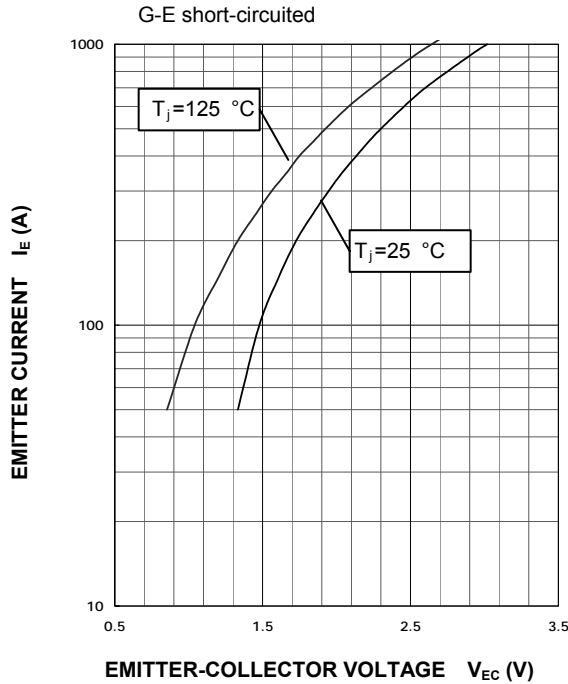
### COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



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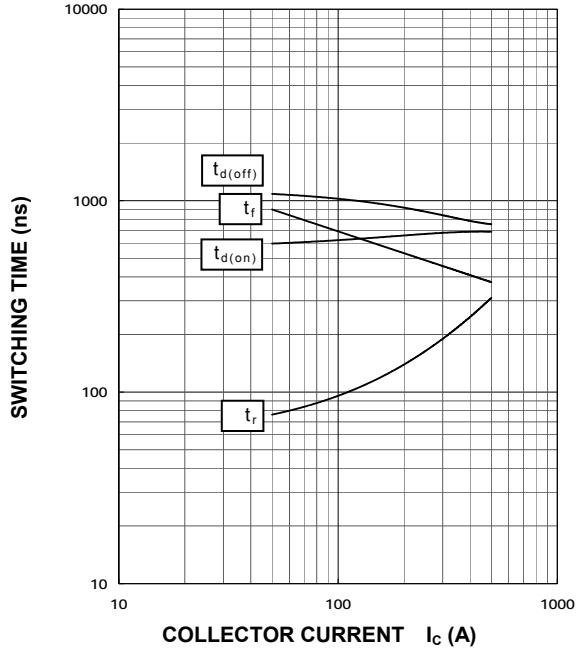


### FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



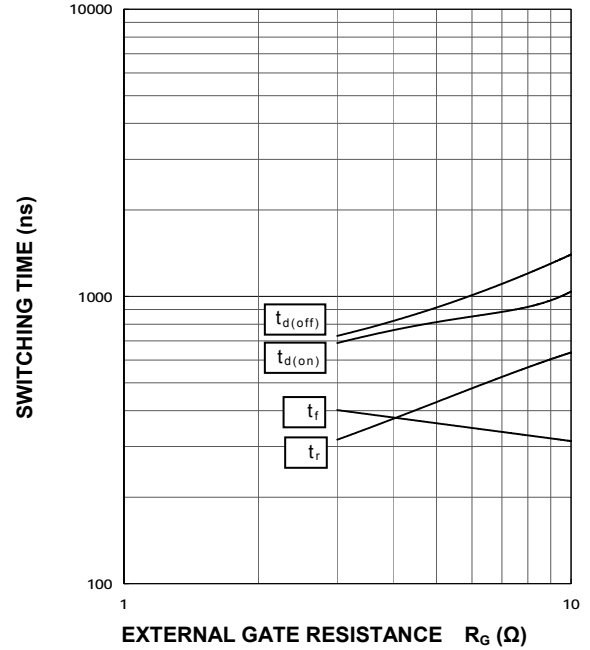
**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=1000\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=3.0\ \Omega$ ,  $T_J=125\text{ }^\circ\text{C}$   
 INDUCTIVE LOAD



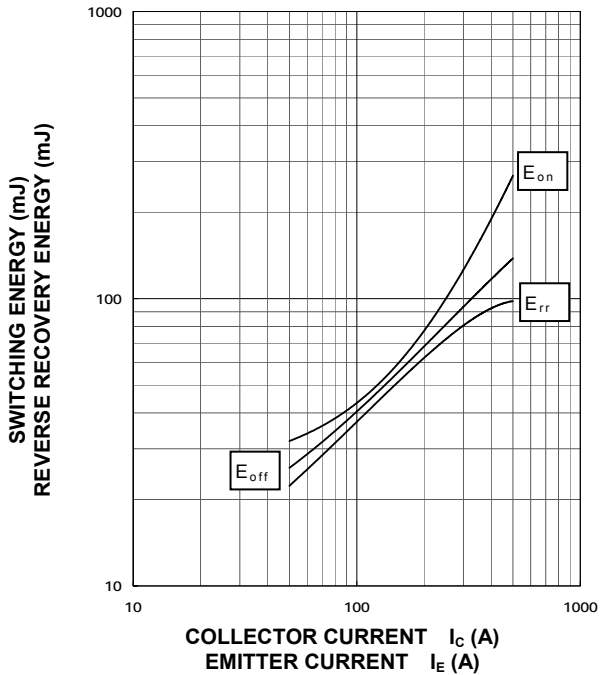
**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

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 INDUCTIVE LOAD



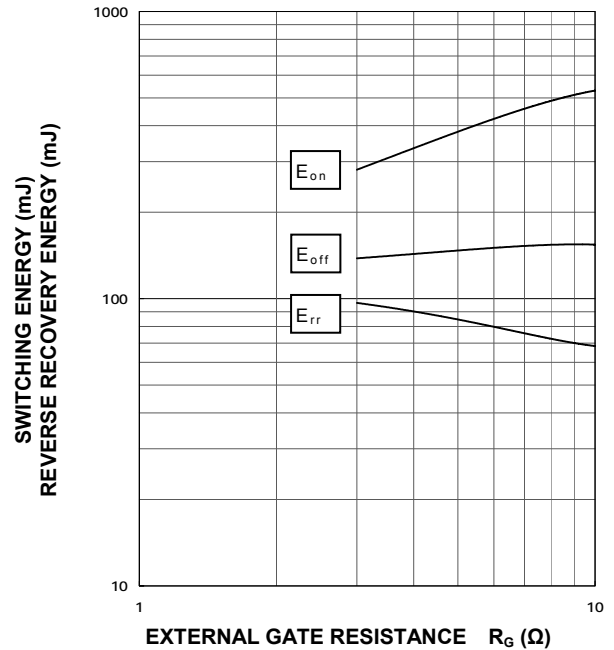
**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=1000\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=3.0\ \Omega$ ,  $T_J=125\text{ }^\circ\text{C}$   
 INDUCTIVE LOAD, PER PULSE

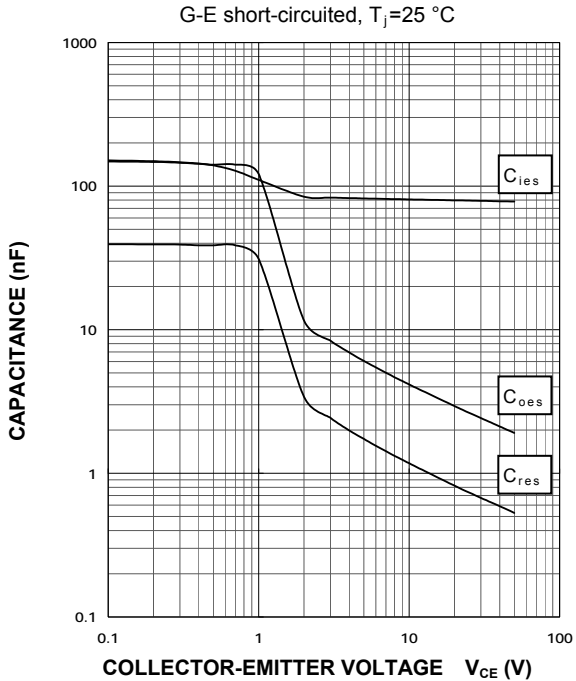


**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

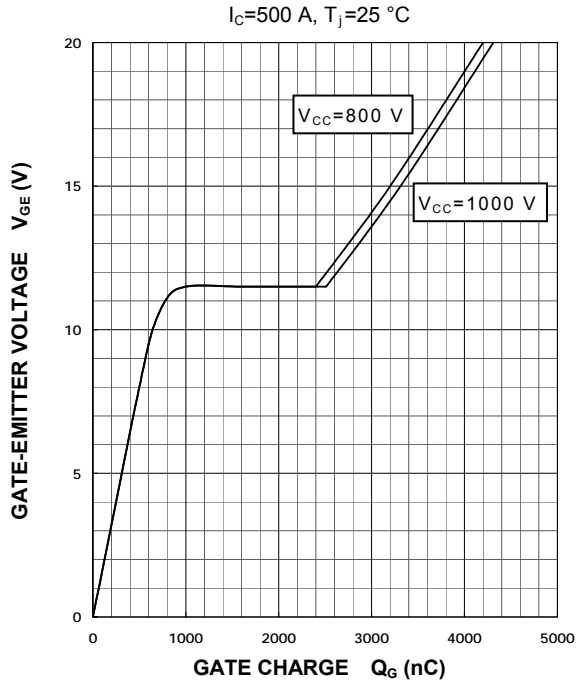
$V_{CC}=1000\text{ V}$ ,  $I_C/I_E=500\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $T_J=125\text{ }^\circ\text{C}$   
 INDUCTIVE LOAD, PER PULSE



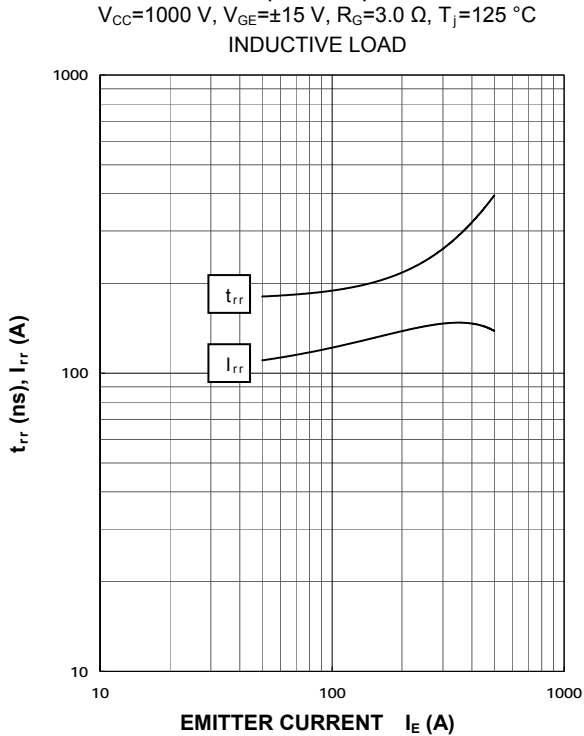
**CAPACITANCE CHARACTERISTICS (TYPICAL)**



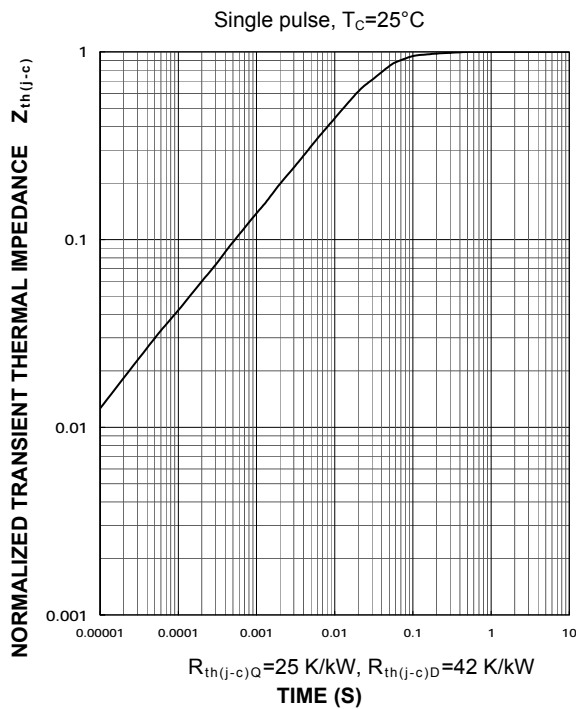
**GATE CHARGE CHARACTERISTICS (TYPICAL)**



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



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)**



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