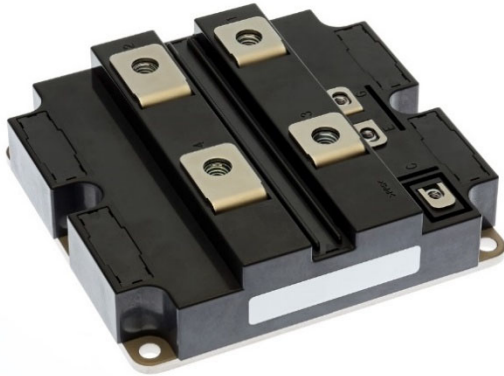


# CM2400HC-34X

HIGH POWER SWITCHING USE  
INSULATED TYPE

6th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

## CM2400HC-34X



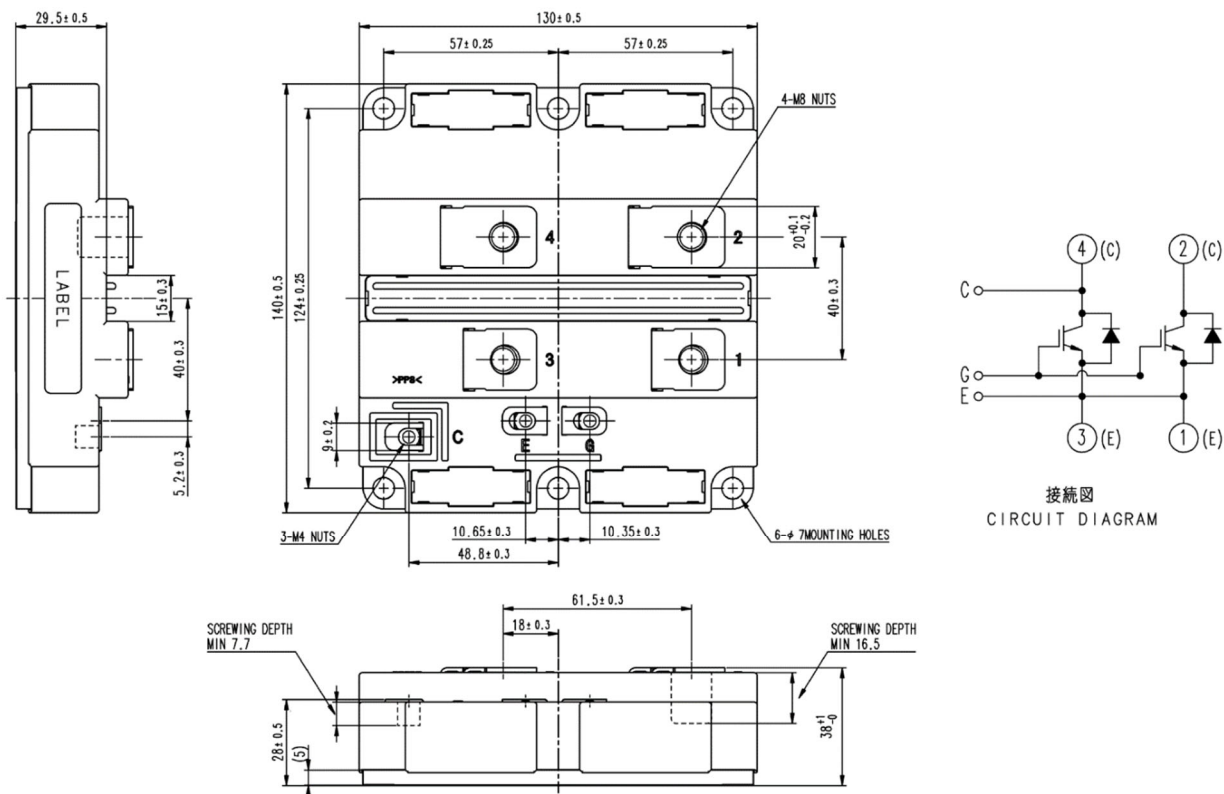
- $I_C$  ..... 2400A
- $V_{CES}$  ..... 1700V
- 1-element in a Pack
- Insulated Type
- CSTBT™(III) / RFC Diode
- AlSiC Baseplate
- UL recognized under UL1557

## APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

## OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



# CM2400HC-34X

HIGH POWER SWITCHING USE

INSULATED TYPE

6th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

## MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V <sub>CES</sub>	Collector-emitter voltage	V <sub>GE</sub> = 0V, T <sub>J</sub> = -40...+150°C	1700	V
		V <sub>GE</sub> = 0V, T <sub>J</sub> = -50°C	1650	V
V <sub>GES</sub>	Gate-emitter voltage	V <sub>CE</sub> = 0V, T <sub>J</sub> = 25°C	±20	V
I <sub>C</sub>	Collector current	DC, T <sub>c</sub> = 95°C	2400	A
I <sub>CRM</sub>		Pulse (Note 1)	4800	A
I <sub>E</sub>	Emitter current (Note 2)	DC, T <sub>c</sub> = 75°C	2400	A
I <sub>ERM</sub>		Pulse (Note 1)	4800	A
P <sub>tot</sub>	Maximum power dissipation (Note 3)	T <sub>c</sub> = 25°C, IGBT part	13800	W
V <sub>iso</sub>	Isolation voltage	RMS, sinusoidal, f = 60Hz, t = 1min	6000	V
V <sub>e</sub>	Partial discharge extinction voltage	RMS, sinusoidal, f = 60Hz, Q <sub>PD</sub> ≤ 10pC	2600	V
T <sub>J</sub>	Junction temperature		-50 ~ +150	°C
T <sub>top</sub>	Operating junction temperature		-50 ~ +150	°C
T <sub>stg</sub>	Storage temperature		-55 ~ +150	°C
t <sub>psc</sub>	Short circuit pulse width	V <sub>CC</sub> = 1200V, V <sub>CE</sub> ≤ V <sub>CES</sub> , V <sub>GE</sub> = 15V, T <sub>J</sub> = 150°C	6.5	μs

## ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
I <sub>CES</sub>	Collector cutoff current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V	T <sub>J</sub> = 25°C	—	—	2.0	mA
			T <sub>J</sub> = 125°C	—	3.5	—	
			T <sub>J</sub> = 150°C	—	20.0	—	
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	V <sub>CE</sub> = 10V, I <sub>C</sub> = 240mA, T <sub>J</sub> = 25°C	5.5	6.0	6.5	V	
I <sub>GES</sub>	Gate leakage current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V, T <sub>J</sub> = 25°C	-0.5	—	0.5	μA	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> = 10V, V <sub>GE</sub> = 0V, f = 100kHz T <sub>J</sub> = 25°C	—	817	—	nF	
C <sub>oes</sub>	Output capacitance		—	17.8	—		
C <sub>res</sub>	Reverse transfer capacitance		—	7.2	—		
Q <sub>G</sub>	Total gate charge	V <sub>CC</sub> = 900V, I <sub>C</sub> = 2400A, V <sub>GE</sub> = ±15V	—	51.0	—	μC	
V <sub>CEsat</sub>	Collector-emitter saturation voltage	I <sub>C</sub> = 2400A (Note 4) V <sub>GE</sub> = 15V	T <sub>J</sub> = 25°C	—	1.60	—	V
			T <sub>J</sub> = 125°C	—	1.85	—	
			T <sub>J</sub> = 150°C	—	1.95	2.45	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> = 900V I <sub>C</sub> = 2400A V <sub>GE</sub> = ±15V	T <sub>J</sub> = 150°C	—	—	1.50	μs
t <sub>r</sub>	Rise time		T <sub>J</sub> = 150°C	—	—	0.50	
E <sub>on(10%)</sub>	Turn-on switching energy (per pulse) (Note 5)	R <sub>G(on)</sub> = 0.62Ω L <sub>S</sub> = 75nH Inductive load	T <sub>J</sub> = 25°C	—	0.40	—	J
			T <sub>J</sub> = 125°C	—	0.70	—	
			T <sub>J</sub> = 150°C	—	0.75	—	
E <sub>on</sub>	Turn-on switching energy (per pulse) (Note 6)	Inductive load	T <sub>J</sub> = 25°C	—	0.50	—	J
			T <sub>J</sub> = 125°C	—	0.75	—	
			T <sub>J</sub> = 150°C	—	0.80	—	
t <sub>d(off)</sub>	Turn-off delay time		T <sub>J</sub> = 25°C	—	6.00	—	μs
			T <sub>J</sub> = 125°C	—	6.20	—	
			T <sub>J</sub> = 150°C	—	6.35	10.0	
t <sub>f</sub>	Fall time	V <sub>CC</sub> = 900V I <sub>C</sub> = 2400A V <sub>GE</sub> = ±15V	T <sub>J</sub> = 25°C	—	0.30	—	μs
			T <sub>J</sub> = 125°C	—	0.32	—	
			T <sub>J</sub> = 150°C	—	0.34	1.00	
E <sub>off(10%)</sub>	Turn-off switching energy (per pulse) (Note 5)	R <sub>G(off)</sub> = 5.6Ω L <sub>S</sub> = 75nH Inductive load	T <sub>J</sub> = 25°C	—	0.95	—	J
			T <sub>J</sub> = 125°C	—	1.10	—	
			T <sub>J</sub> = 150°C	—	1.20	—	
E <sub>off</sub>	Turn-off switching energy (per pulse) (Note 6)		T <sub>J</sub> = 25°C	—	1.00	—	J
			T <sub>J</sub> = 125°C	—	1.15	—	
			T <sub>J</sub> = 150°C	—	1.25	—	

# CM2400HC-34X

HIGH POWER SWITCHING USE

INSULATED TYPE

6th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

## ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
V <sub>EC</sub>	Emitter-collector voltage (Note 2)	I <sub>E</sub> = 2400A (Note 4) V <sub>GE</sub> = 0V	T <sub>i</sub> = 25°C	—	1.80	—	V
			T <sub>i</sub> = 125°C	—	1.95	—	
			T <sub>i</sub> = 150°C	—	1.95	2.45	
t <sub>rr</sub>	Reverse recovery time (Note 2)		T <sub>i</sub> = 25°C	—	0.40	—	μs
			T <sub>i</sub> = 125°C	—	0.55	—	
			T <sub>i</sub> = 150°C	—	0.60	—	
I <sub>rr</sub>	Reverse recovery current (Note 2)		T <sub>i</sub> = 25°C	—	1790	—	A
			T <sub>i</sub> = 125°C	—	1930	—	
			T <sub>i</sub> = 150°C	—	1980	—	
Q <sub>rr(10%)</sub>	Reverse recovery charge (Note 2,7)	V <sub>CC</sub> = 900V I <sub>E</sub> = 2400A V <sub>GE</sub> = ±15V	T <sub>i</sub> = 25°C	—	430	—	μC
			T <sub>i</sub> = 125°C	—	720	—	
			T <sub>i</sub> = 150°C	—	820	—	
Q <sub>rr</sub>	Reverse recovery charge (Note 2,6)	R <sub>G(on)</sub> = 0.62Ω L <sub>S</sub> = 75nH Inductive load	T <sub>i</sub> = 25°C	—	480	—	μC
			T <sub>i</sub> = 125°C	—	785	—	
			T <sub>i</sub> = 150°C	—	890	—	
E <sub>rec(10%)</sub>	Reverse recovery energy (per pulse) (Note 2,5)		T <sub>i</sub> = 25°C	—	0.22	—	J
			T <sub>i</sub> = 125°C	—	0.40	—	
			T <sub>i</sub> = 150°C	—	0.46	—	
E <sub>rec</sub>	Reverse recovery energy (per pulse) (Note 2,6)		T <sub>i</sub> = 25°C	—	0.25	—	J
			T <sub>i</sub> = 125°C	—	0.45	—	
			T <sub>i</sub> = 150°C	—	0.55	—	

## THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
R <sub>th(j-c)Q</sub>	Thermal resistance	Junction to Case, IGBT part	—	—	9.0	K/kW
R <sub>th(j-c)D</sub>		Junction to Case, FWDi part	—	—	12.5	
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink, λ <sub>grease</sub> = 1W/m <sup>2</sup> ·K, D <sub>(c-s)</sub> = 80μm	—	7.5	—	K/kW

## MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
M <sub>t</sub>	Mounting torque	M8 : Main terminals screw	7.0	—	19.0	N·m
M <sub>s</sub>	Mounting torque	M6 : Mounting screw	3.0	—	6.0	N·m
M <sub>t</sub>	Mounting torque (Note 8)	M4 : Auxiliary terminals screw	1.0	—	3.0	N·m
m	Mass		—	0.9	—	kg
CTI	Comparative tracking index		600	—	—	—
d <sub>a</sub>	Clearance		19.5	—	—	mm
d <sub>s</sub>	Creepage distance		32.0	—	—	mm
L <sub>P-CE</sub>	Parasitic stray inductance		—	12.0	—	nH
R <sub>CC+EE'</sub>	Internal lead resistance	T <sub>C</sub> = 25°C	—	0.14	—	mΩ

Note1. Pulse width and repetition rate should be such that junction temperature (T<sub>j</sub>) does not exceed T<sub>jppmax</sub> rating.

Note2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWDi).

Note3. Junction temperature (T<sub>j</sub>) should not exceed T<sub>jmax</sub> rating (150°C).

Note4. Pulse width and repetition rate should be such as to cause negligible temperature rise.

Note5. The integration range of switching energies is from 10%V<sub>CE</sub> to 10%I<sub>C</sub>(10%I<sub>E</sub>).

Note6. Definition of all items is according to IEC 60747, unless otherwise specified.

Note7. The integration range of reverse recovery charge is from I<sub>E</sub> = 0A to 10%I<sub>E</sub>.

Note8. The maximum specified value is under the condition of using PCB mounted on the power module. In case no PCB is used this maximum torque for M4 screw is 1.9 Nm.

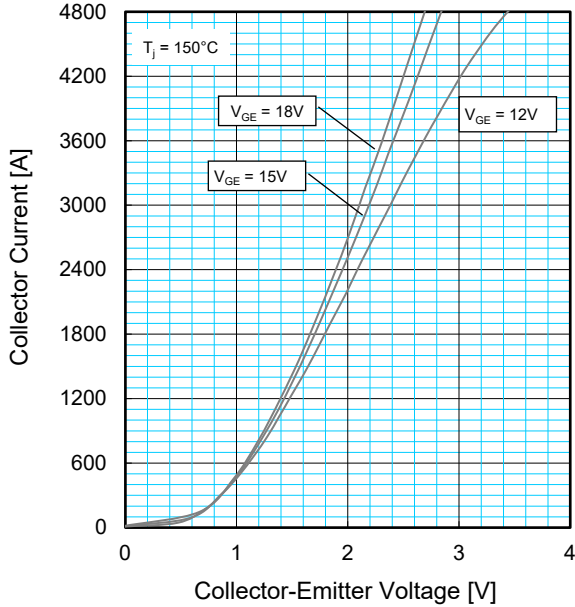
# CM2400HC-34X

HIGH POWER SWITCHING USE

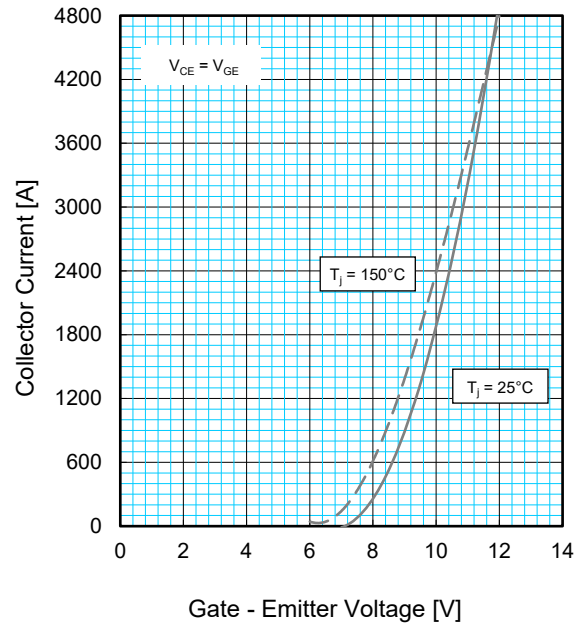
INSULATED TYPE

## PERFORMANCE CURVES

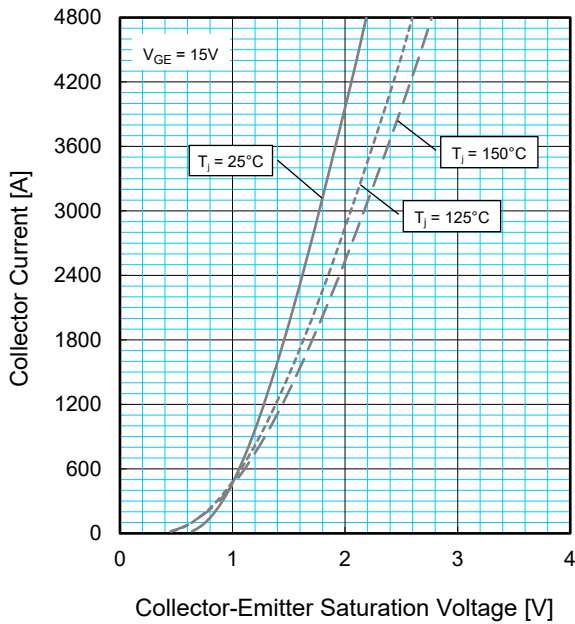
**OUTPUT CHARACTERISTICS (TYPICAL)**



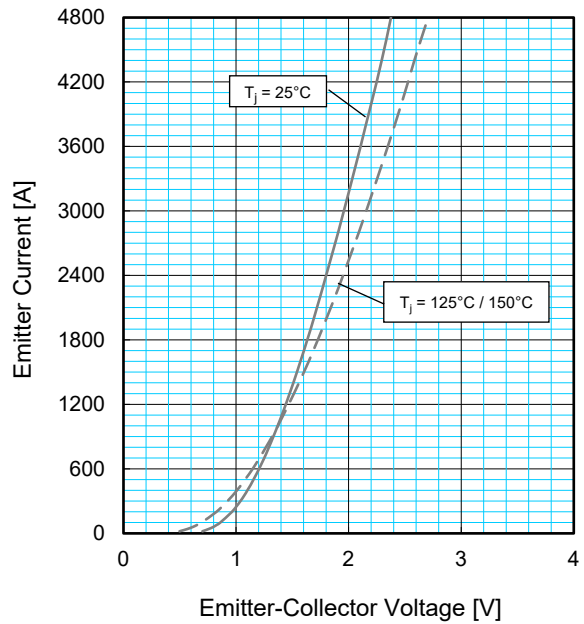
**TRANSFER CHARACTERISTICS (TYPICAL)**



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



**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**



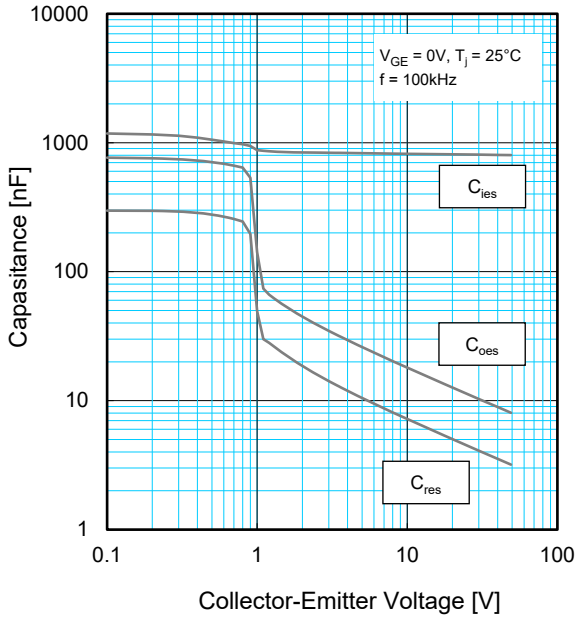
# CM2400HC-34X

HIGH POWER SWITCHING USE

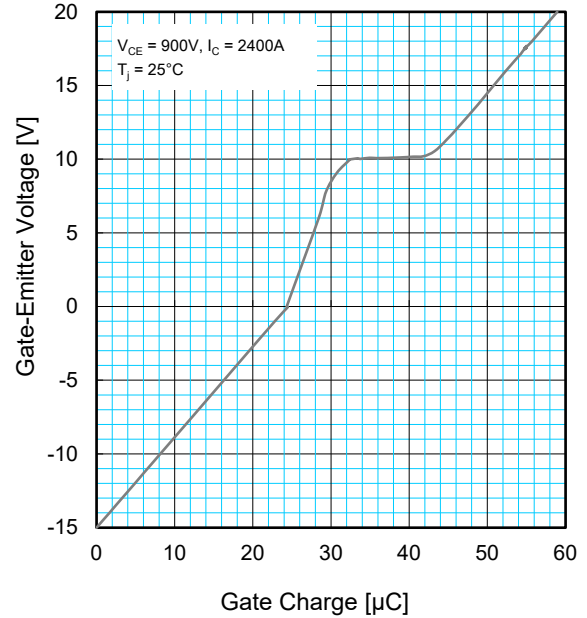
INSULATED TYPE

## PERFORMANCE CURVES

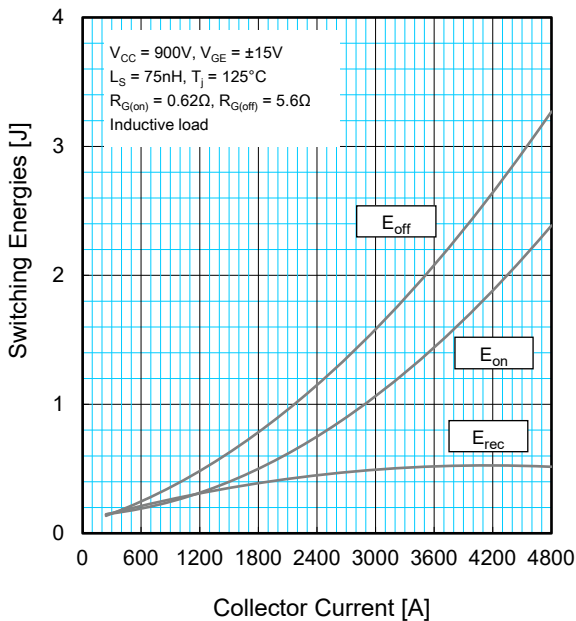
**CAPACITANCE CHARACTERISTICS (TYPICAL)**



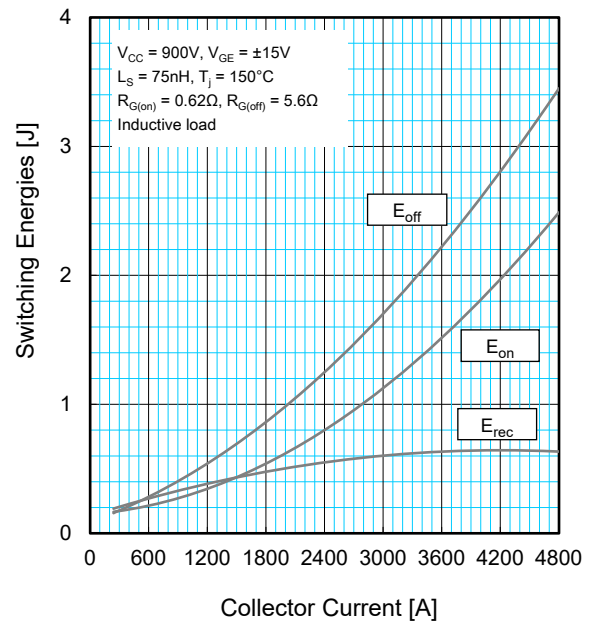
**GATE CHARGE CHARACTERISTICS (TYPICAL)**



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



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



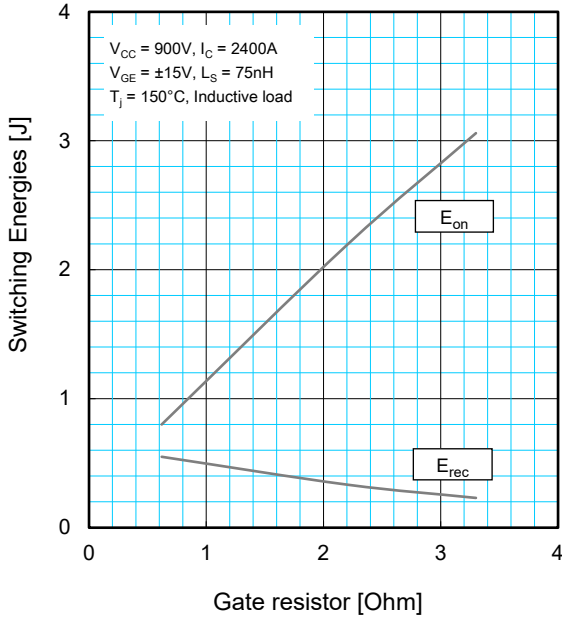
# CM2400HC-34X

HIGH POWER SWITCHING USE

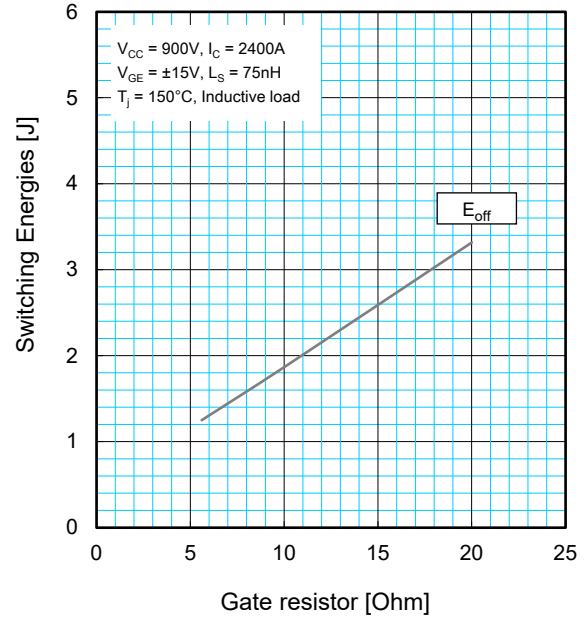
INSULATED TYPE

## PERFORMANCE CURVES

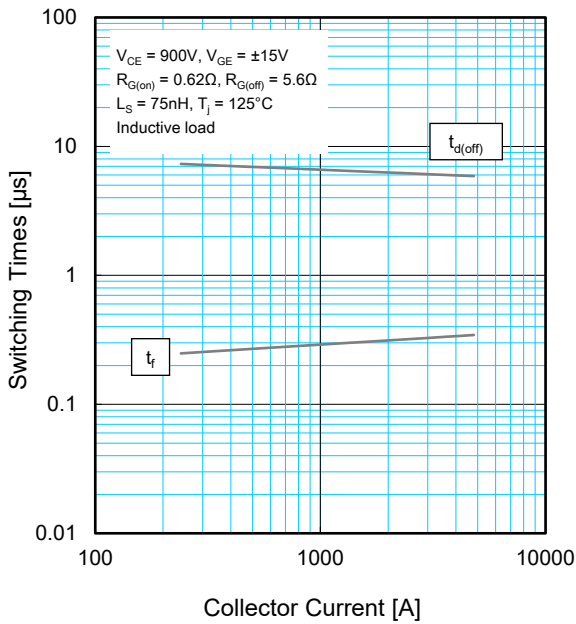
**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**



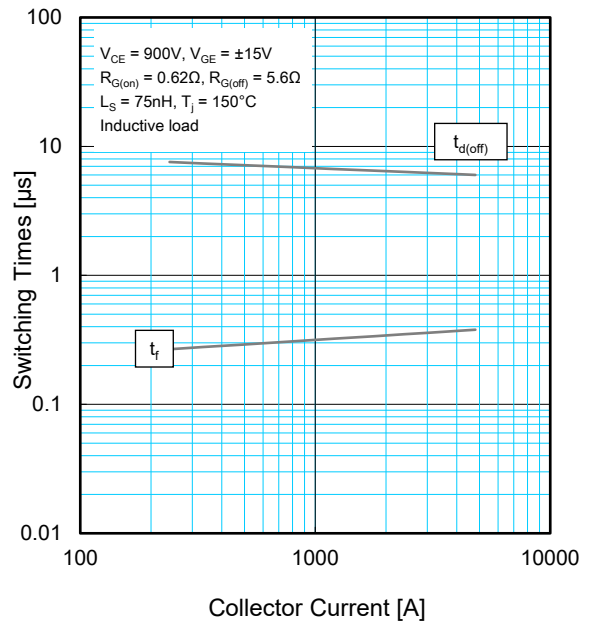
**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**



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



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



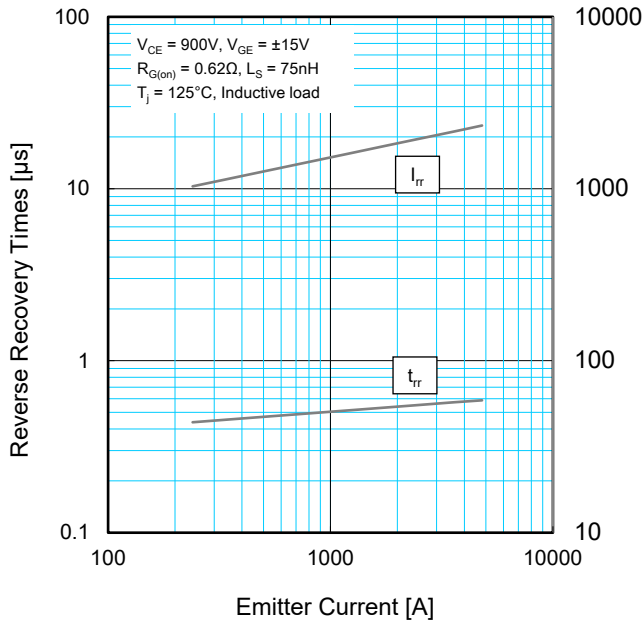
# CM2400HC-34X

HIGH POWER SWITCHING USE

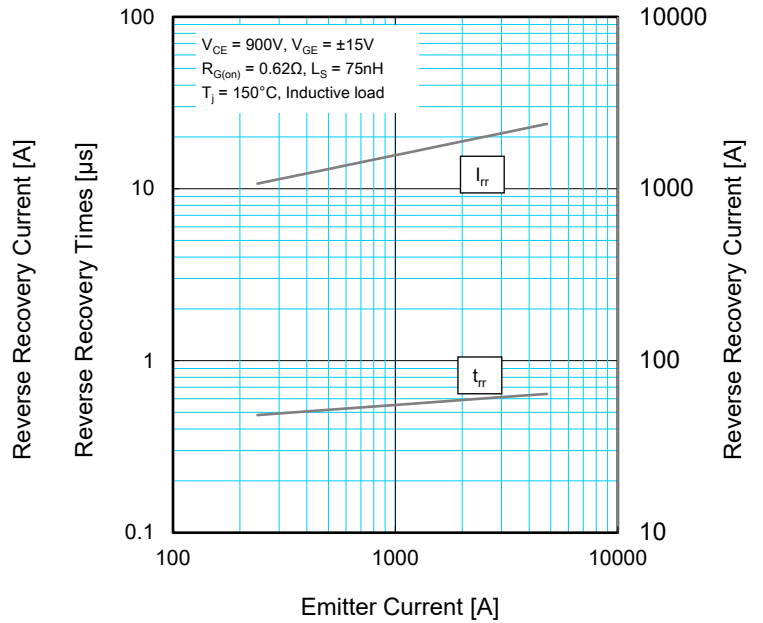
INSULATED TYPE

## PERFORMANCE CURVES

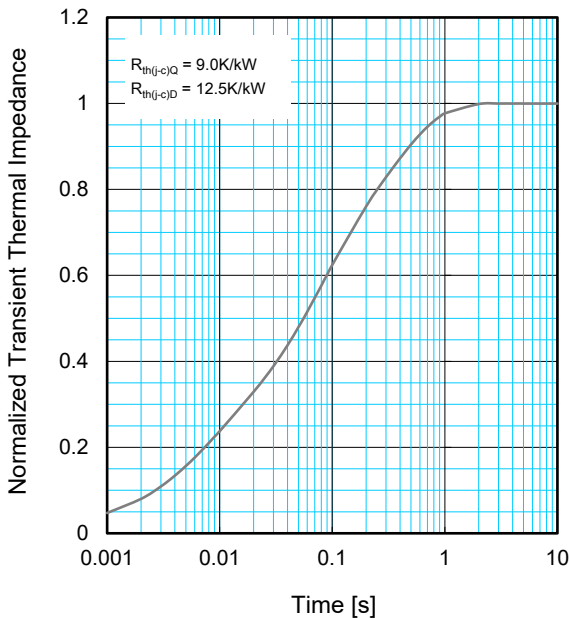
**FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



**FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS**



$$Z_{th(j-c)}(t) = \sum_{i=1}^n R_i \left\{ 1 - \exp\left(-\frac{t}{\tau_i}\right) \right\}$$

	1	2	3	4
$R_i / R_{th(j-c)}$ :	0.0096	0.1893	0.4044	0.3967
$\tau_i$ [sec]:	0.0001	0.0058	0.0602	0.3512

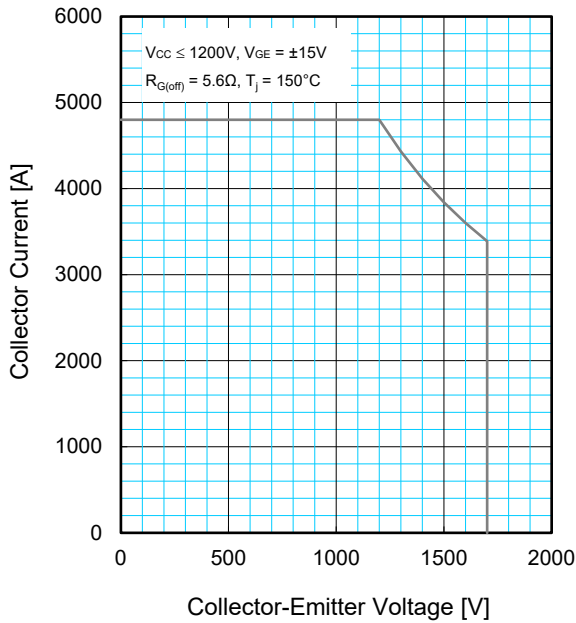
# CM2400HC-34X

HIGH POWER SWITCHING USE

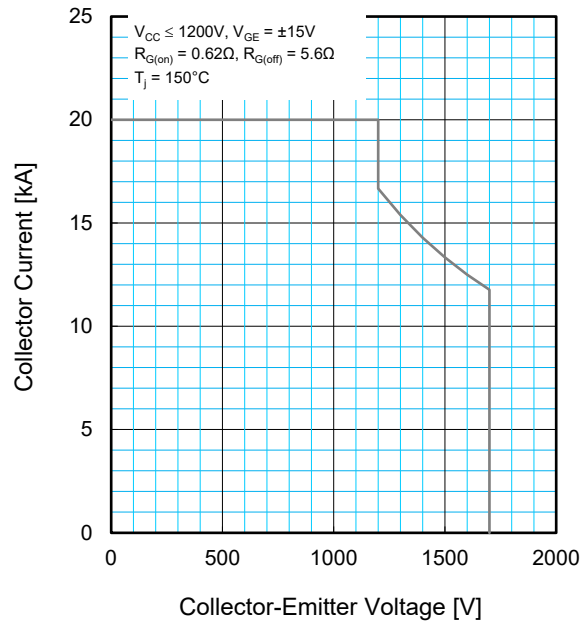
INSULATED TYPE

## PERFORMANCE CURVES

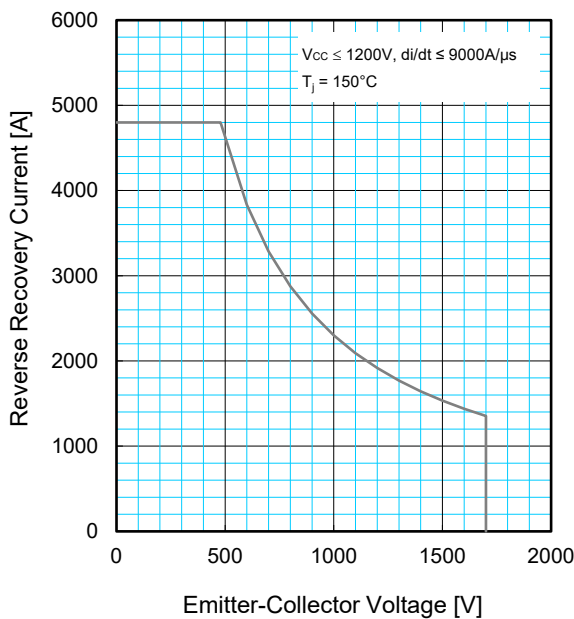
**REVERSE BIAS SAFE OPERATING AREA (RBSOA)**



**SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)**



**FREE-WHEEL DIODE REVERSE RECOVERY SAFE OPERATING AREA (RRSOA)**





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## CM2400HC-34X

HIGH POWER SWITCHING USE

INSULATED TYPE

6th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

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