< High Voltage Insulated Gate Bipolar Transistor：HVIGBT >

CM1200E4C-34S1

HIGH POWER SWITCHING USE
INSULATED TYPE

5th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

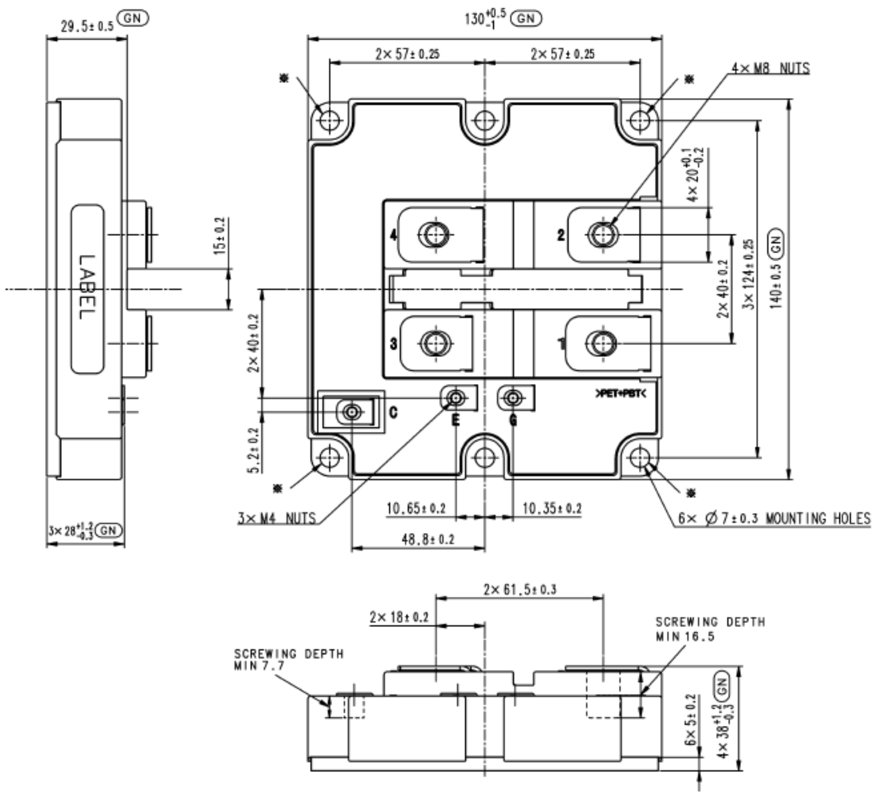
CM1200E4C-34S1

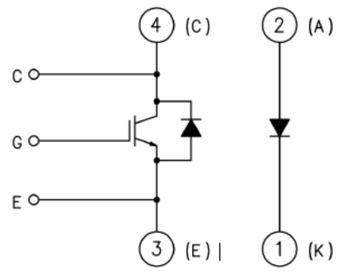
- I_C 1200A
- V_{CES} 1700V
- 2-elements in a Pack (for brake chopper)
- Insulated Type
- CSTBT™(III) / RFC Diode

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM **Dimensions in mm**





CIRCUIT DIAGRAM

MAXIMUM RATINGS

Item	Symbol	Conditions		Ratings	Unit
Collector-emitter voltage Gate-emitter short-circuited	V_{CES}	V_{GE} = 0 V	T_j = −40~+150 °C	1700	V
			T_j = -50 °C	1650	V
Gate-emitter voltage Collector-emitter short-circuited	V_{GES}	V_{CE} = 0 V	T_j = 25 °C	±20	V
Repetitive peak reverse voltage	V_{RRM}	(Note 1)	T_j = −40~+150 °C	1700	V
			T_j = -50 °C	1650	
Collector current	I_C	T_c = 90 °C , DC		1200	A
(Repetitive peak) Collector current	I_{CRM}	Pulse (Note 2)		2400	A
Emitter current	I_E	DC (Note 3)		1200	A
(Repetitive peak) Emitter current	I_{ERM}	Pulse (Note 2, 3)		2400	A
Forward current	I_F	DC (Note 1)		1200	A
Repetitive peak forward current	I_{FRM}	Pulse (Note 1, 2)		2400	A
Total power dissipation	P_{tot}	T_c = 25 °C , IGBT part(Note 4)		6750	W
Isolation voltage	V_{isol}	Charged part to the baseplate RMS sinusoidal, 60Hz 1min		6000	V_{rms}
Partial discharge charge	Q_{pd}	Charged part to the baseplate, RMS sinusoidal, 60 Hz V_1 = 3500 V, V_2 = 2600 V, (acc. to IEC 61287-1)		10	pC
Junction temperature	T_j	Maximum temperature range in off-state or on-state(non-switching)		-50~+150	°C
Storage temperature	T_{stg}	Maximum case temperature range in off-state		-50~+150	°C
Operating junction temperature	T_{jop}	Maximum junction temperature range for switching operation		-50~+150	°C
Turn-off cllector current	$I_{C(off)}$	V_{GE} = ±15 V , L_s = 70 nH , $R_{G(off)}$ = 3.3 Ω , V_{CC}≤1200V, V_{CE} ≤1700V	T_j = 150 °C	2400	A
Short-circuit withstand pulse duration	t_{pSC}	V_{GE} = ±15 V , L_S ≤ 70 nH , $R_{G(off)}$ = 3.3 Ω , V_{CC}≤1200V, V_{CE} ≤1700V	T_j = 150 °C	10	μs
Reverse recovery power dissipation	P_{rr}	I_E = 2400 A , L_s = 70 nH , V_{CC}≤1200V, di/dt≤8000A/us,V_{CE} ≤1700V(Note 3)	T_j = 150 °C	1.1	MW
Reverse recovery power dissipation	P_{rr}	I_F = 2400 A , L_s = 70 nH , V_{CC}≤1200V, di/dt≤8000A/us,V_{RM} ≤1700V(Note 1)	T_j = 150 °C	1.1	MW
Non-repetitive surge forward current	I_{FSM}	t_p = 10 ms , V_R = 50 V , F(t)weibull=1%, Half sine wave(Note 1)	T_j = 150 °C	5.1	kA
I2t value	I^2t	t_p = 10 ms , V_R = 50 V , F(t)weibull=1%, Half sine wave(Note 1)	T_j = 150 °C	130	kA^2s

ELECTRICAL CHARACTERISTICS

Item	Symbol	Conditions		Limits			Unit
				Min.	Typ.	Max.	
Collector-emitter cut-off current Gate-emitter short-circuited	I_{CES}	V_{CE} = 1700 V , V_{GE} = 0 V	T_j = 25 °C	-	-	4.0	mA
			T_j = 125 °C	-	1.8	-	mA
			T_j = 150 °C	-	-	40.0	mA
Peak reverse recovery current	I_{RRM}	V_{RM} = 1700 V(Note 1)	T_j = 25 °C	-	-	2.5	mA
			T_j = 125 °C	-	1.1	-	mA
			T_j = 150 °C	-	-	25	mA
Gate-emitter threshold voltage	$V_{GE(th)}$	V_{CE} = 10 V , I_C = 120mA	T_j = 25 °C	5.40	6.00	6.60	V
Gate leakage current Collector-emitter short-circuited	I_{GES}	V_{CE} = 0 V , V_{GE} = ±20 V	T_j = 25 °C	-0.5	-	0.5	μA
Gate charge	Q_G	V_{CC} = 850 V , I_C = 1200 A , V_{GE} = ±15 V	T_j = 25 °C	-	12.0	-	μC
Input capacitance	C_{ies}	V_{CE} = 10 V , V_{GE} = 0 V , f = 100kHz	T_j = 25 °C	-	216	-	nF
Output capacitance	C_{oes}	V_{CE} = 10 V , V_{GE} = 0 V , f = 100kHz	T_j = 25 °C	-	8.0	-	nF
Reverse transfer capacitance	C_{res}	V_{CE} = 10 V , V_{GE} = 0 V , f = 100kHz	T_j = 25 °C	-	1.6	-	nF
Collector-emitter saturation voltage	V_{CEsat}	I_C = 1200 A , V_{GE} = +15 V Between Collector - Eemitter auxiliary terminal(Note 5)	T_j = 25 °C	-	1.95	-	V
			T_j = 125 °C	-	2.25	-	V
			T_j = 150 °C	-	2.30	2.80	V
Emitter-collector voltage	V_{EC}	I_E = 1200 A , V_{GE} = 0 V Between Collector - Eemitter auxiliary terminal(Note 3,5)	T_j = 25 °C	-	2.20	-	V
			T_j = 125 °C	-	2.35	-	V
			T_j = 150 °C	-	2.35	2.85	V
Forward voltage	$V_{FM(Chip)}$	I_F = 1200 A(Note 1,5)	T_j = 25 °C	-	2.20	-	V
			T_j = 125 °C	-	2.35	-	V
			T_j = 150 °C	-	2.35	2.85	V
Forward voltage	$V_{FM(Terminal)}$	I_F = 1200 A (Note 1,5)	T_j = 25 °C	-	2.43	-	V
			T_j = 125 °C	-	2.63	-	V
			T_j = 150 °C	-	2.64	-	V

ELECTRICAL CHARACTERISTICS

Item	Symbol	Conditions		Limits			Unit
				Min.	Typ.	Max.	
Turn-on delay time	$t_{d(on)}$	V_{CC} = 850 V , I_C = 1200 A , V_{GE} = ±15 V , L_s = 70 nH $R_{G(on)}$ = 1.3 Ω , $R_{G(off)}$ = 3.3 Ω Inductive load(Note 6)	T_j = 150 °C	-	-	1.10	μs
Rise time	t_r		T_j = 150 °C	-	-	0.41	μs
Turn-on (switching) energy per pulse 10% integral	$E_{on(10\%)}$		T_j = 25 °C	-	265	-	mJ
			T_j = 125 °C	-	350	-	mJ
			T_j = 150 °C	-	355	-	mJ
Turn-on (switching) energy per pulse	E_{on}		T_j = 25 °C	-	290	-	mJ
			T_j = 125 °C	-	370	-	mJ
			T_j = 150 °C	-	380	-	mJ
Reverse recovery time	t_{rr}	V_{CC} = 850 V , I_E = 1200 A , V_{GE} = ±15 V , L_s = 70 nH $R_{G(on)}$ = 1.3 Ω , $R_{G(off)}$ = 3.3 Ω Inductive load(Note 3,6,7)	T_j = 25 °C	-	0.30	-	μs
			T_j = 125 °C	-	0.40	-	μs
			T_j = 150 °C	-	0.45	-	μs
Reverse recovery current	I_{rr}		T_j = 25 °C	-	735	-	A
			T_j = 125 °C	-	865	-	A
			T_j = 150 °C	-	875	-	A
Reverse recovery charge 10% integral	$Q_{rr(10\%)}$		T_j = 25 °C	-	190	-	μC
			T_j = 125 °C	-	295	-	μC
			T_j = 150 °C	-	365	-	μC
Reverse recovered charge	Q_{rr}		T_j = 25 °C	-	265	-	μC
			T_j = 125 °C	-	340	-	μC
			T_j = 150 °C	-	420	-	μC
Reverse recovery energy per pulse 10% integral	$E_{rec(10\%)}$		T_j = 25 °C	-	90	-	mJ
			T_j = 125 °C	-	150	-	mJ
			T_j = 150 °C	-	195	-	mJ
Reverse recovery energy per pulse	E_{rec}		T_j = 25 °C	-	150	-	mJ
			T_j = 125 °C	-	190	-	mJ
			T_j = 150 °C	-	240	-	mJ
Reverse recovery time	t_{rr}	V_{CC} = 850 V , I_F = 1200 A , V_{GE} = ±15 V , L_s = 70 nH $R_{G(on)}$ = 1.3 Ω , $R_{G(off)}$ = 3.3 Ω Inductive load(Note 1,6,7)	T_j = 25 °C	-	0.30	-	μs
			T_j = 125 °C	-	0.40	-	μs
			T_j = 150 °C	-	0.45	-	μs
Reverse recovery current	I_{rr}		T_j = 25 °C	-	735	-	A
			T_j = 125 °C	-	865	-	A
			T_j = 150 °C	-	875	-	A
Reverse recovery charge 10% integral	$Q_{rr(10\%)}$		T_j = 25 °C	-	190	-	μC
			T_j = 125 °C	-	295	-	μC
			T_j = 150 °C	-	365	-	μC
Reverse recovered charge	Q_{rr}		T_j = 25 °C	-	265	-	μC
			T_j = 125 °C	-	340	-	μC
			T_j = 150 °C	-	420	-	μC
Reverse recovery energy per pulse 10% integral	$E_{rec(10\%)}$		T_j = 25 °C	-	90	-	mJ
			T_j = 125 °C	-	150	-	mJ
			T_j = 150 °C	-	195	-	mJ
Reverse recovery energy per pulse	E_{rec}		T_j = 25 °C	-	150	-	mJ
			T_j = 125 °C	-	190	-	mJ
			T_j = 150 °C	-	240	-	mJ
Turn-off delay time	$t_{d(off)}$	V_{CC} = 850 V , I_C = 1200 A , V_{GE} = ±15 V , L_s = 70 nH $R_{G(on)}$ = 1.3 Ω , $R_{G(off)}$ = 3.3 Ω Inductive load(Note 6)	T_j = 25 °C	-	1.20	-	μs
			T_j = 125 °C	-	1.30	-	μs
			T_j = 150 °C	-	1.32	-	μs
Fall time	t_f		T_j = 25 °C	-	0.12	-	μs
			T_j = 125 °C	-	0.15	-	μs
			T_j = 150 °C	-	0.17	-	μs
Turn-off (switching) energy per pulse 10% integral	$E_{off(10\%)}$		T_j = 25 °C	-	200	-	mJ
			T_j = 125 °C	-	280	-	mJ
			T_j = 150 °C	-	310	-	mJ
Turn-off (switching) energy per pulse	E_{off}		T_j = 25 °C	-	260	-	mJ
			T_j = 125 °C	-	360	-	mJ
			T_j = 150 °C	-	400	-	mJ

THERMAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Thermal resistance junction to case, IGBT	$R_{th(j-c)Q}$	Junction to Case, IGBT part, 1/2 module	-	-	18.5	K/kW
Thermal resistance Junction to case, DIODE	$R_{th(j-c)D}$	Junction to Case, FWDi part, 1/2 module	-	-	38.0	K/kW
Thermal resistance Junction to case, DIODE	$R_{th(j-c)D}$	Junction to Case, Clamp-Di part, 1/2 module	-	-	38.0	K/kW
Contact thermal resistance case to heatsink	$R_{th(c-s)}$	Case to heat sink, 1/2 module λ_{grease} = 1 W/m·k, $D_{(c-s)}$ = 100 µm	-	16.0	-	K/kW

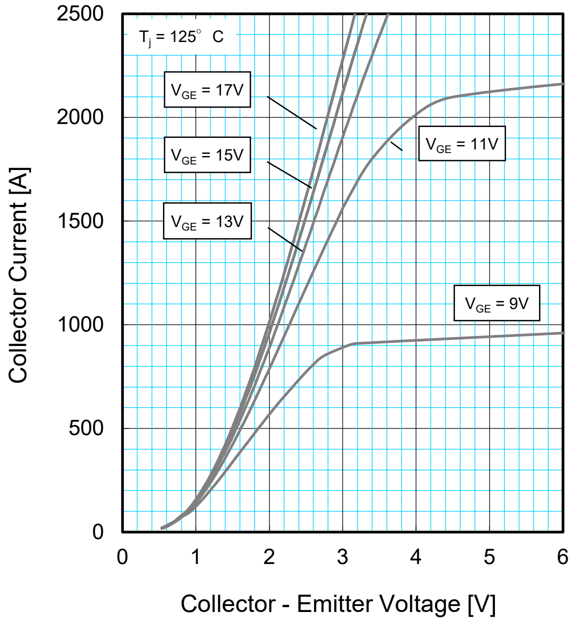
MECHANICAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Mounting torque	M_t	Main terminals screw: M8	7.0	-	20.0	N·m
		Mounting screw: M6	3.0	-	6.0	N·m
		Auxiliary terminals screw: M4	1.0	-	3.0	N·m
Mass	m	-	-	0.8	-	kg
Comparative tracking index	CTI	-	600	-	-	-
Clearance distance in air	d_a	Collector main terminal - Emitter main terminal Terminal - Baseplate	19.5	-	-	mm
Creepage distance along surface	d_s	Collector main terminal - Emitter main terminal	32.0	-	-	mm
Creepage distance along surface	d_s	Terminal - Baseplate	32.0	-	-	mm
Internal inductance (C-E)	$L_{P(C-E)}$	1/2 module, IGBT part, T_C=25°C	-	22	-	nH
Internal inductance (A-K)	$L_{P(A-K)}$	1/2 module, Clamp-Di part, T_C=25°C	-	22	-	nH
Internal lead resistance, CC'-EE'	$R_{CC'+EE'}$	1/2 module, IGBT part, T_C=25°C	-	0.19	-	mΩ
Internal lead resistance, AA'-KK'	$R_{AA'+KK'}$	1/2 module, Clamp-Di part, T_C=25°C	-	0.19	-	mΩ
		1/2 module, Clamp-Di part, T_C=125°C	-	0.23	-	mΩ
		1/2 module, Clamp-Di part, T_C=150°C	-	0.24	-	mΩ

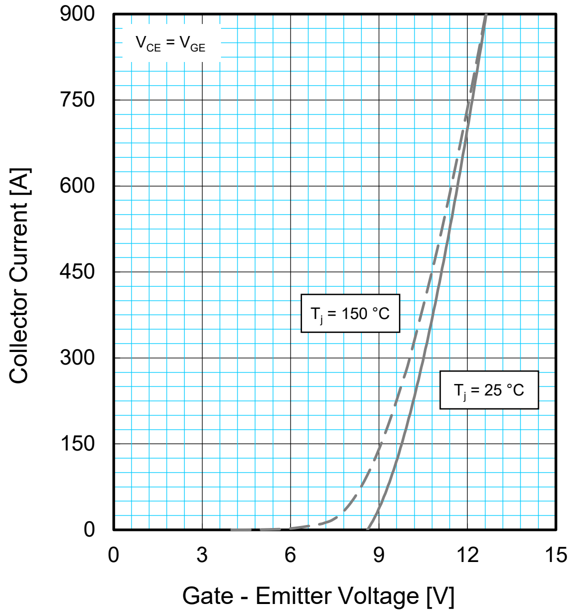
Note1. The symbols represent characteristics of the clamp diode (Clamp-Di).
Note2. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{jopmax} rating.
Note3. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD_i).
Note4. Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).
Note5. Pulse width and repetition rate should be such as to cause negligible temperature rise.
Note6. The integration range of switching energies($E_{on(10\%)}$, $E_{rec(10\%)}$, $E_{off(10\%)}$) is from 10%V_{CE} to 10%I_C(10%I_E).
Note7. The integration range of reverse recovery charge($Q_{rr(10\%)}$) is from I_E = 0A to 10%I_E.

PERFORMANCE CURVES

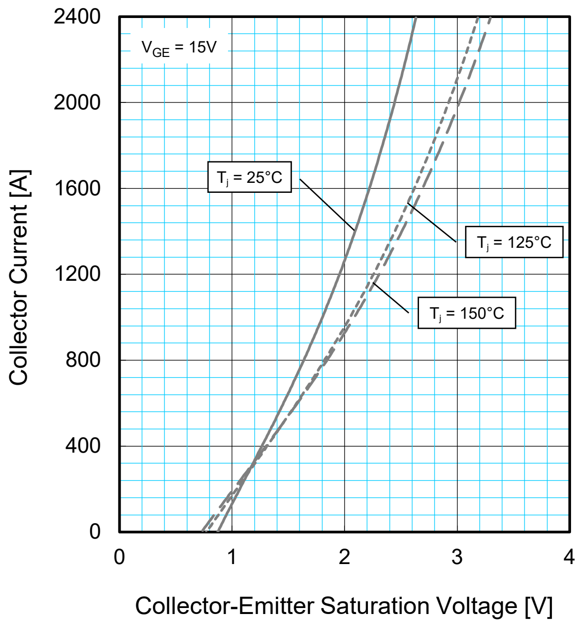
OUTPUT CHARACTERISTICS (TYPICAL)



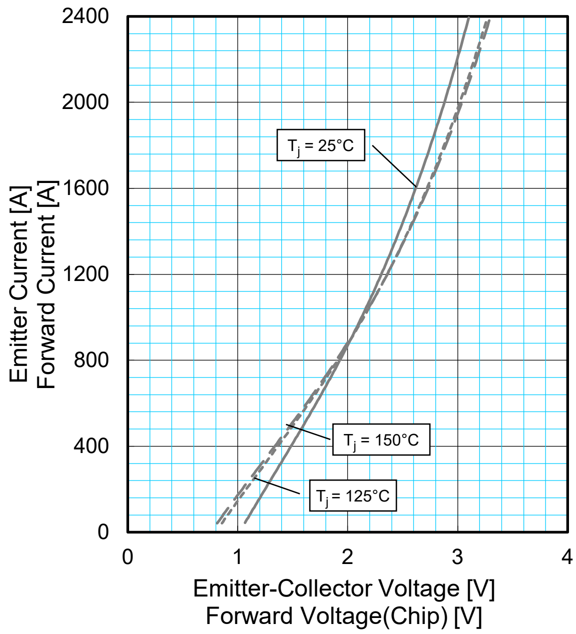
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

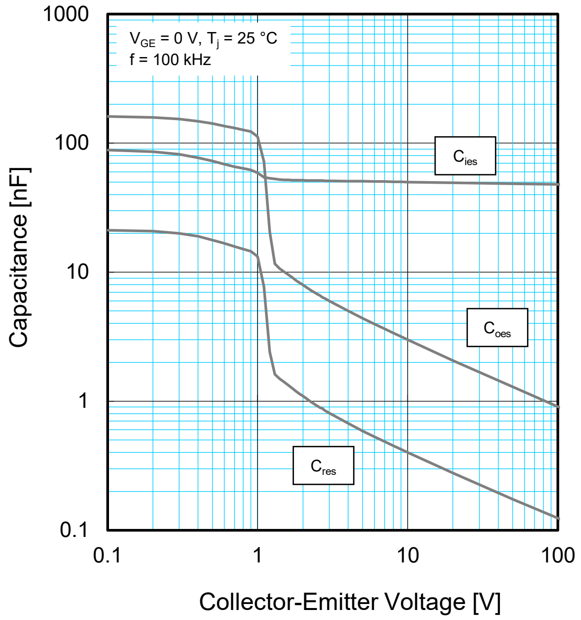


DIODE FORWARD CHARACTERISTICS (TYPICAL)

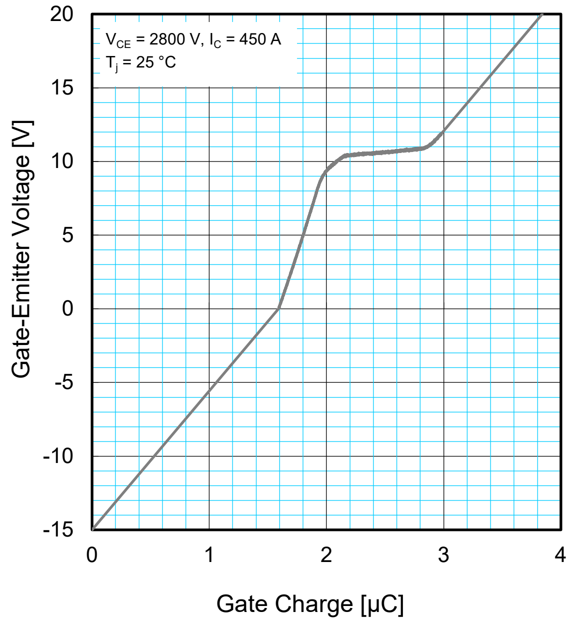


PERFORMANCE CURVES

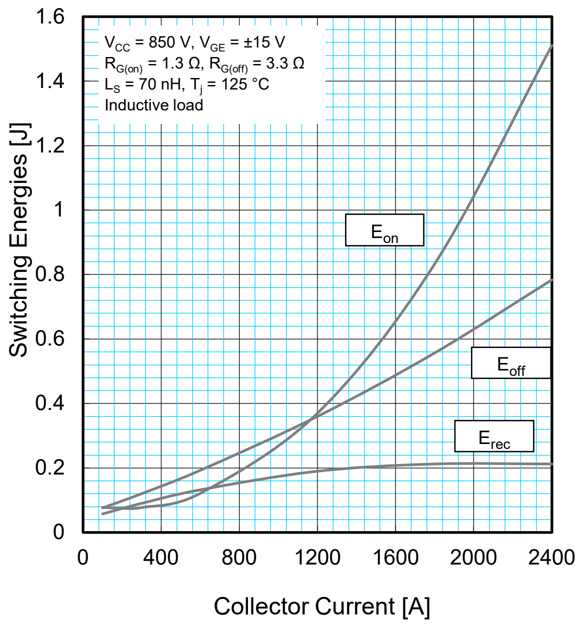
CAPACITANCE CHARACTERISTICS (TYPICAL)



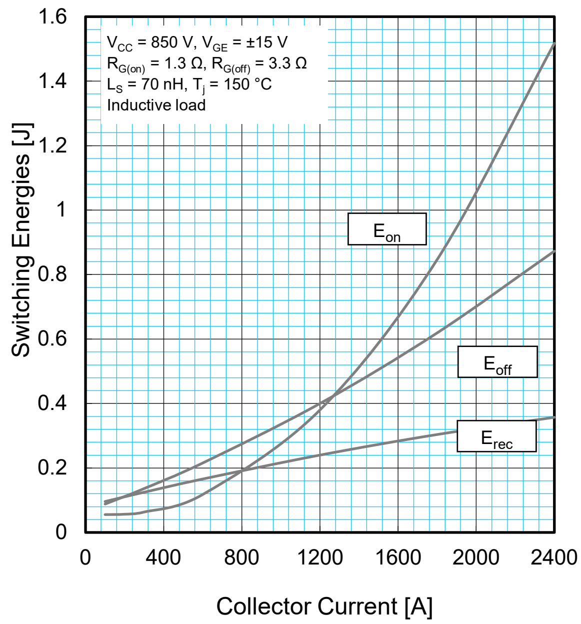
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

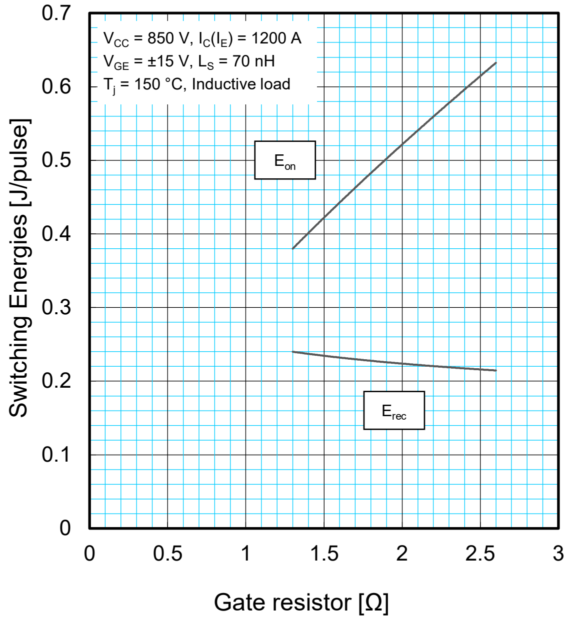


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

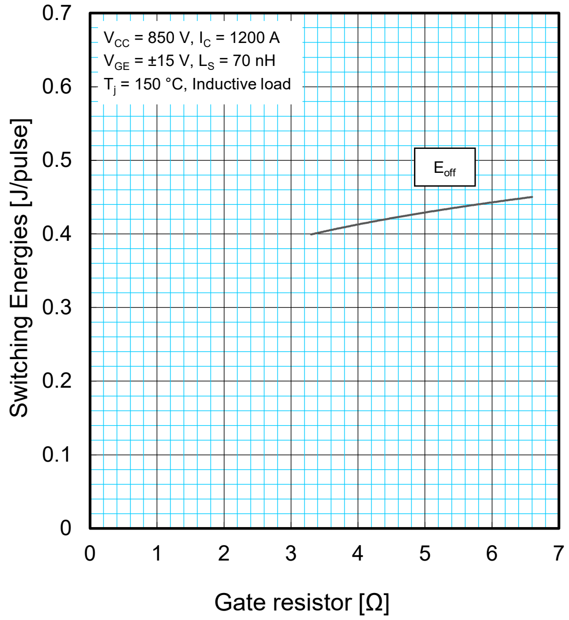


PERFORMANCE CURVES

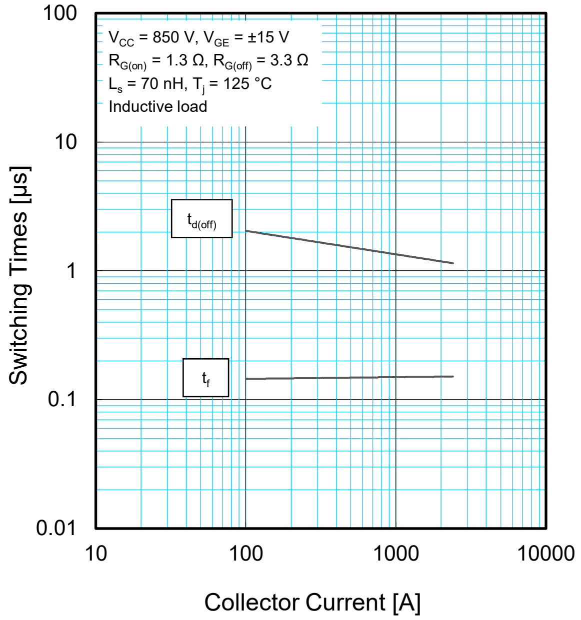
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



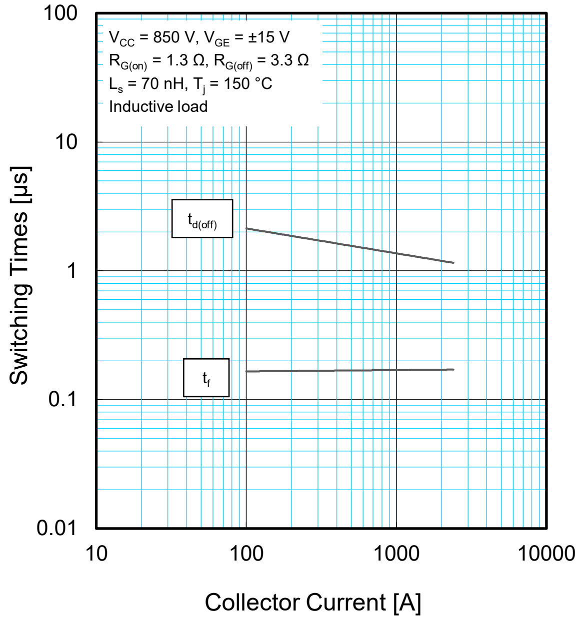
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

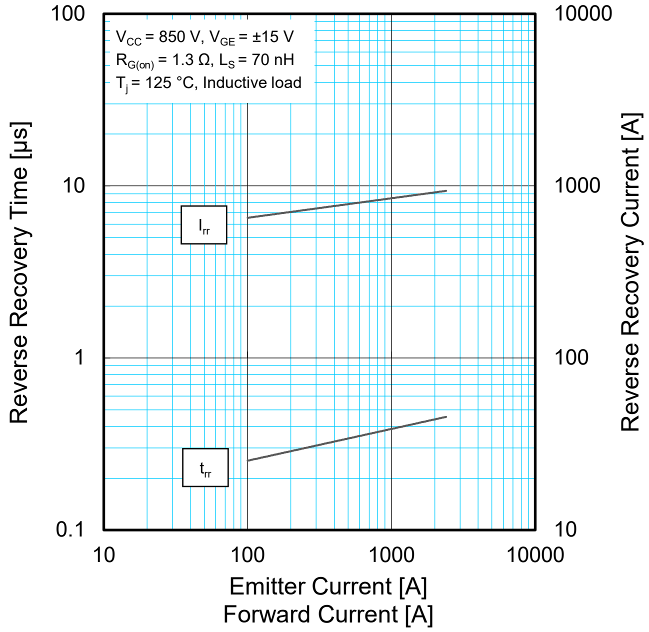


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

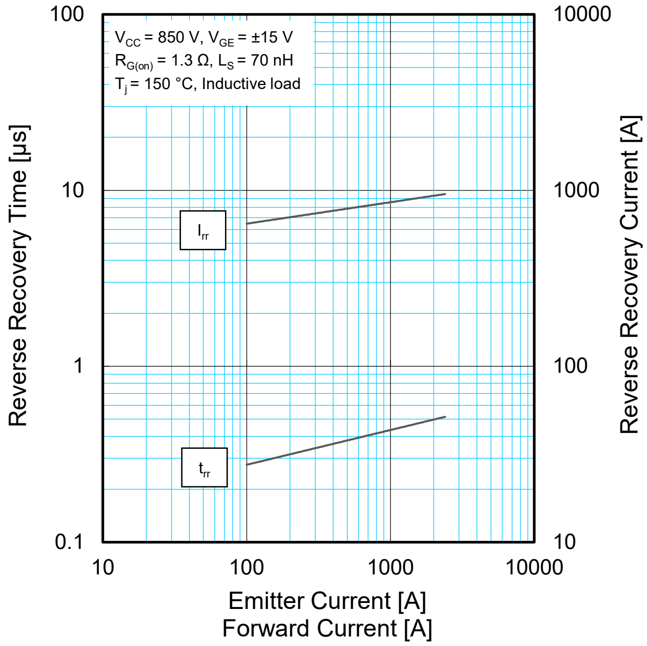


PERFORMANCE CURVES

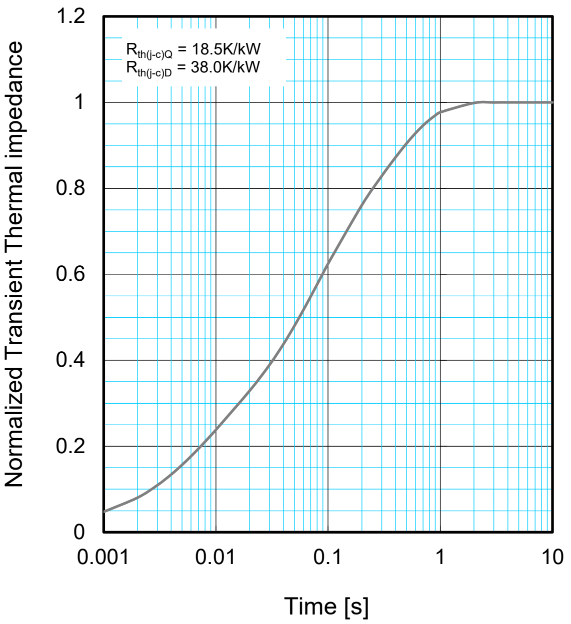
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

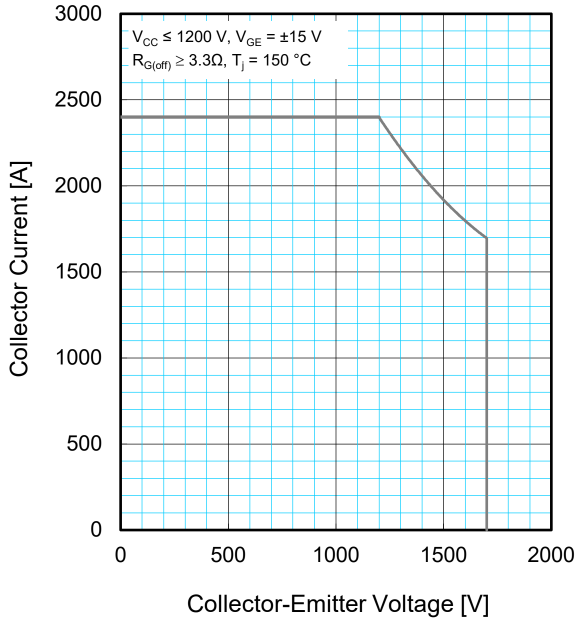


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{1 - exp^{\left(-\frac{t}{\tau_i}\right)}\right\}$$

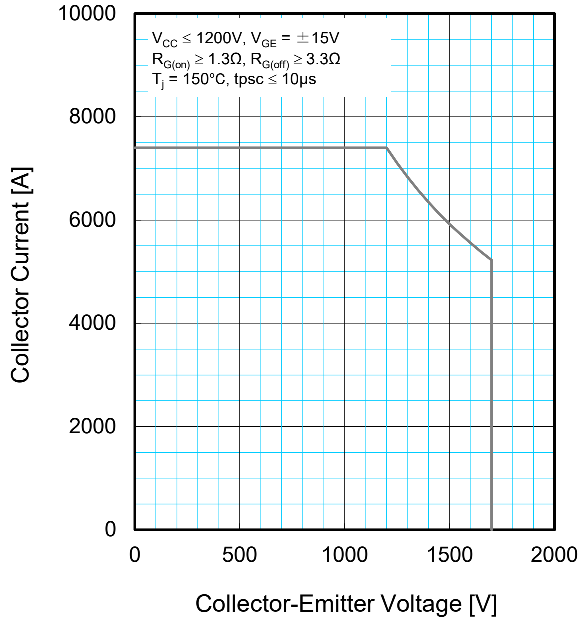
	1	2	3	4
R_i [K/kW] :	0.0096	0.1893	0.4044	0.3967
τ_i [sec.] :	0.0001	0.0058	0.0602	0.3512

PERFORMANCE CURVES

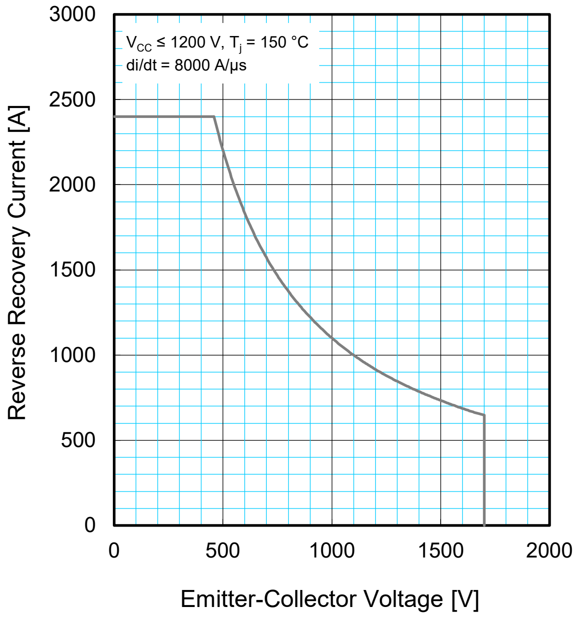
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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