<IGBT Modules>

CM1800DW-24ME

HIGH POWER SWITCHING USE
INSULATED TYPE

Collector current I_C ..... **1 8 0 0** A
Collector-emitter voltage V_{CES} ..... **1 2 0 0** V
Maximum junction temperature T_{vjmax} ..... **1 7 5** °C

- Dual switch (Half-bridge)
- Copper base plate (Nickel-plating)
- Ni-plating signal terminals
- RoHS Directive compliant
- UL Recognized under UL 1557, File No. E323585

APPLICATION

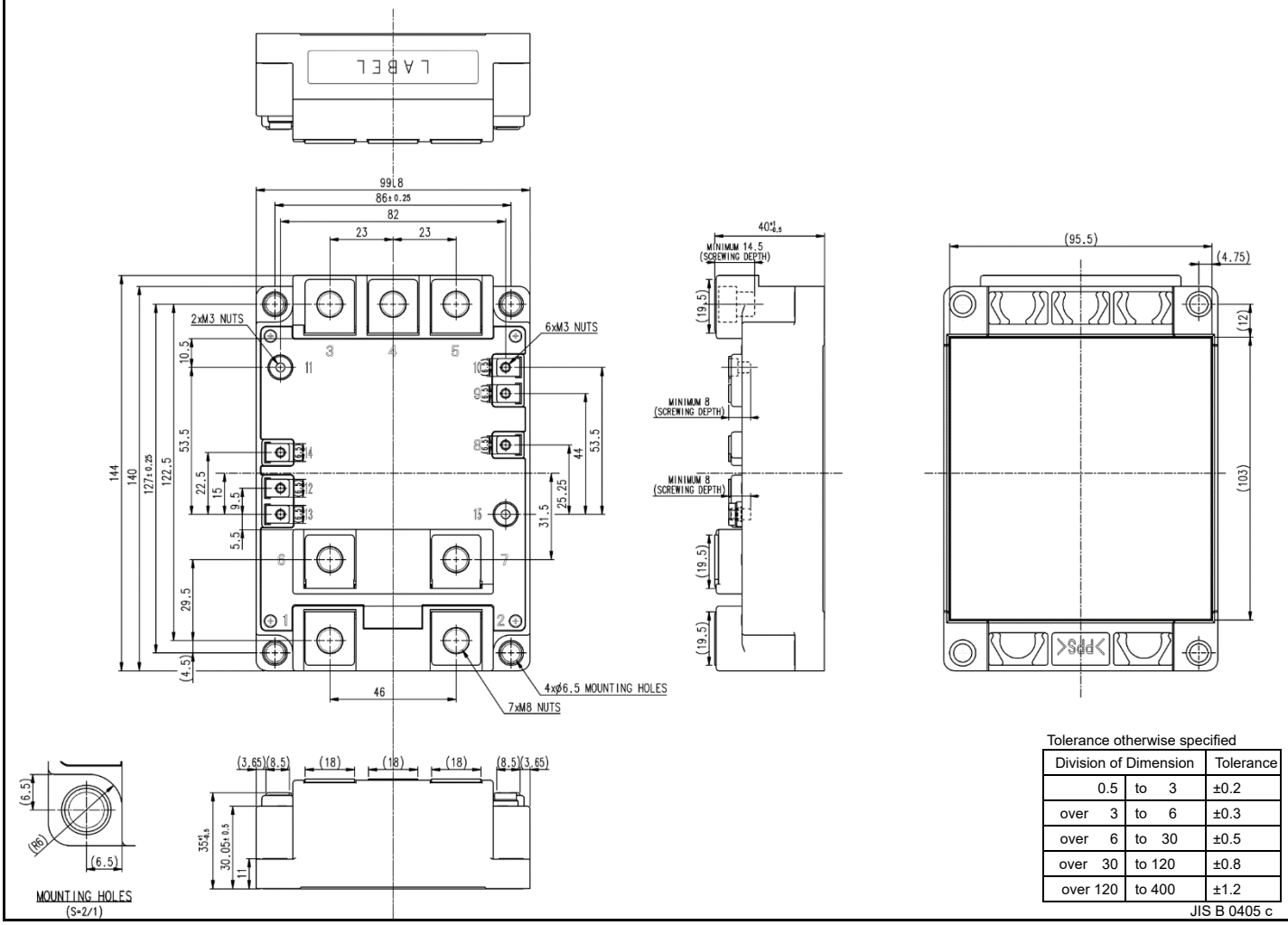
Photovoltaic power converter, Energy storage system, Motion control, etc.

OPTION

- V_{CEsat} selection for parallel connection
- PC-TIM (Phase Change Thermal Interface Material) pre-apply

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



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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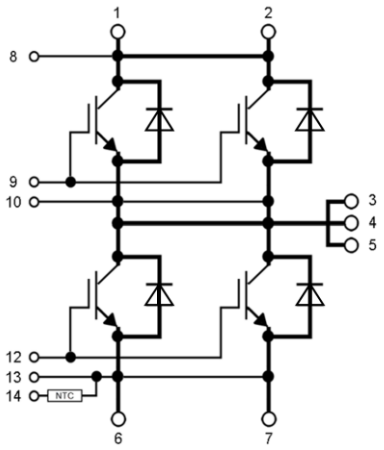
<IGBT Modules>

CM1800DW-24ME

HIGH POWER SWITCHING USE
INSULATED TYPE

INTERNAL CONNECTION

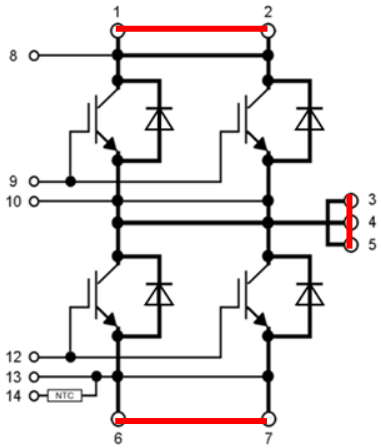


TERMINAL CODE

1. C1	9. G1
2. C1	10. Es1
3. C2E1	11. NC
4. C2E1	12. G2
5. C2E1	13. Es2, TH2
6. E2	14. TH1
7. E2	15. NC
8. Cs1	

NOTE

Terminal 1 and 2, Terminal 3,4 and 5, Terminal 6 and 7,
These terminals should be connected respectively when it is used.



CM1800DW-24ME

HIGH POWER SWITCHING USE
INSULATED TYPE

MAXIMUM RATINGS (T_{vj} = 25 °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 (Note2, 4), T_C = 81 °C	1800	A
I_{CRM}		Pulse, Repetitive (Note3)	3600	
P_{tot}	Total power dissipation	T_C = 25 °C (Note2, 4)	6250	W
I_E (Note1)	Emitter current	DC (Note2), T_C = 25 °C	1800	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	3600	
V_{isol}	Isolation voltage	Teminals to base plate, RMS, f = 60 Hz, AC 1 min	4000	V
T_{vjmax}	Maximum junction temperature	Instaneous event (overload) (Note8)	175	°C
T_{cmax}	Maximum case temperature	(Note4,8)	140	°C
T_{stg}	Storage temperature	-	-40 ~ 140	°C
T_{vjop}	Operating junction temperature	Continuous operation (Note8)	-40 ~ 150	

ELECTRICAL CHARACTERISTICS (T_{vj} = 25 °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} = ± 20 V, C-E short-circuited		-	-	1.0	μA
$V_{GE(th)}$	Gate-emitter threshold voltage	I_C = 180 mA, V_{CE} = 10 V		5.4	6.0	6.6	V
V_{CEsat}	Collector-emitter saturation voltage	I_C = 1800 A (Note5), V_{GE} = 15 V, (Terminal)	T_{vj} = 25 °C	-	1.55	1.90	V
			T_{vj} = 125 °C	-	1.80	-	
			T_{vj} = 150 °C	-	1.85	-	
		I_C = 1800 A (Note5), V_{GE} = 15 V, (Chip)	T_{vj} = 25 °C	-	1.50	1.75	V
			T_{vj} = 125 °C	-	1.75	-	
			T_{vj} = 150 °C	-	1.80	-	
C_{ies}	Input capacitance	V_{CE} = 10 V, G-E short-circuited		-	310	-	nF
C_{oes}	Output capacitance			-	14	-	
C_{res}	Reverse transfer capacitance			-	8	-	
Q_G	Gate charge	V_{CC} = 600 V, I_C = 1800 A, V_{GE} = ± 15 V		-	18	-	μC
$t_{d(on)}$	Turn-on delay time	V_{CC} = 600 V, I_C = I_E = 1800 A, V_{GE} = ± 15 V, R_{Gon} = 0.47 Ω, R_{Goff} = 0 Ω Inductive load		-	-	900	ns
t_r	Rise time			-	-	200	
$t_{d(off)}$	Turn-off delay time			-	-	2000	
t_f	Fall time			-	-	1000	
V_{EC} (Note1)	Emitter-collector voltage	I_E = 1800 A (Note5), G-E short-circuited (Terminal)	T_{vj} = 25 °C	-	1.50	1.85	V
			T_{vj} = 125 °C	-	1.55	-	
			T_{vj} = 150 °C	-	1.60	-	
		I_E = 1800 A (Note5), G-E short-circuited, (Chip)	T_{vj} = 25 °C	-	1.45	1.70	V
			T_{vj} = 125 °C	-	1.50	-	
			T_{vj} = 150 °C	-	1.55	-	
t_{rr} (Note1)	Reverse recovery time	V_{CC} = 600 V, I_C = I_E = 1800 A, V_{GE} = ± 15 V, R_{Gon} = 0.47 Ω, R_{Goff} = 0 Ω, Inductive load		-	-	400	ns
Q_{rr} (Note1)	Reverse recovery charge			-	150	-	μC
E_{on}	Turn-on switching energy per pulse	V_{CC} = 600 V, I_C = I_E = 1800 A, V_{GE} = ± 15 V, R_{Gon} = 0.47 Ω, R_{Goff} = 0 Ω, T_{vj} = 150 °C, L_σ = 15 nH (Note9), Inductive load	di/dt (Note10) = 12.5 kA/μs	-	134	-	mJ
E_{off}	Turn-off switching energy per pulse		dv/dt (Note10) = 5.6 kV/μs	-	197	-	
E_{rr} (Note1)	Reverse recovery energy per pulse		di/dt (Note10) = 12.5 kA/μs	-	140	-	
I_{SC}	Short circuit current	T_{vj} = 150 °C, V_{CC} = 800 V, V_{GE} = ± 15 V, R_{Gon} = 0.47 Ω, $t_W \leq$ 6 μs		-	7.0	-	kA

NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	Zero-power resistance	T_C = 25 °C (Note4)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R_{100} = 493 Ω, T_C = 100 °C (Note4)	-7.3	-	+7.8	%
$B_{(25/50)}$	B-constant	Approximate by equation (Note6)	-	3375	-	K
P_{25}	Power dissipation	T_C = 25 °C (Note4)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to case, per IGBT switch (Note4)	-	-	24	K/kW
$R_{th(j-c)D}$		Junction to case, per FWD switch (Note4)	-	-	39	
$R_{th(c-s)}$	Contact thermal resistance	Grease, per 1 module	-	10	-	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
M_t	Mounting torque	Main terminals	M 8 screw	7.0	10.5	14.0	N·m
M_t		Auxiliary terminals	M 3 screw	0.4	0.5	0.6	N·m
M_s		Mounting to heat sink	M 6 screw	3.5	4.0	4.5	N·m

MODULE

Symbol	Item	Conditions	Value	Unit
m	Mass	-	860	g
d_s	Creepage distance	Terminal to terminal	19.2	mm
		Terminal to base plate	34.1	
d_a	Clearance	Terminal to terminal	8.7	mm
		Terminal to base plate	32.2	
$R_{CC'+EE'}$	Internal lead resistance	Main terminals - chip, T_C = 25 °C (Note4)	0.15	mΩ
L_s	Internal stray inductance	P-N	9	nH
r_g	Internal gate resistance	Per switch	0.33	Ω

*: This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU and (EU)2015/863.

Note 1. Represent ratings and characteristics of the anti-parallel, emitter-collector free-wheeling diode (FWD).

2. Junction temperature (T_{vj}) should not increase beyond T_{vjmax} rating.

3. Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} 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.

5. Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.

6. $B(25/50) - \ln(\frac{R_{25}}{R_{50}}) / (\frac{1}{T_{25}} - \frac{1}{T_{50}})$
   R_{25}: resistance at absolute temperature T_{25} [K]; T_{25} = 25 [°C] + 273.15 = 298.15 [K]
   R_{50}: resistance at absolute temperature T_{50} [K]; T_{50} = 50 [°C] + 273.15 = 323.15 [K]

7. Reference value. Thermally conductive grease of thermal conductivity λ = 0.9 W/(m·K) and thickness $D_{(C-S)}$ = 50 μm.

8. Long term performance related to thermal conductive grease (including but not limited to aspects such as the increase of thermal resistance due to pumping out, etc.) should be verified under user's specific application conditions. Each temperature condition ($T_{vj\,max}$, $T_{vj\,op}$, $T_{C\,max}$) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

9. L_σ represents the inductance of the switching circuit including the power module's inductance, which is calculated from the voltage and current waveforms during the switching.

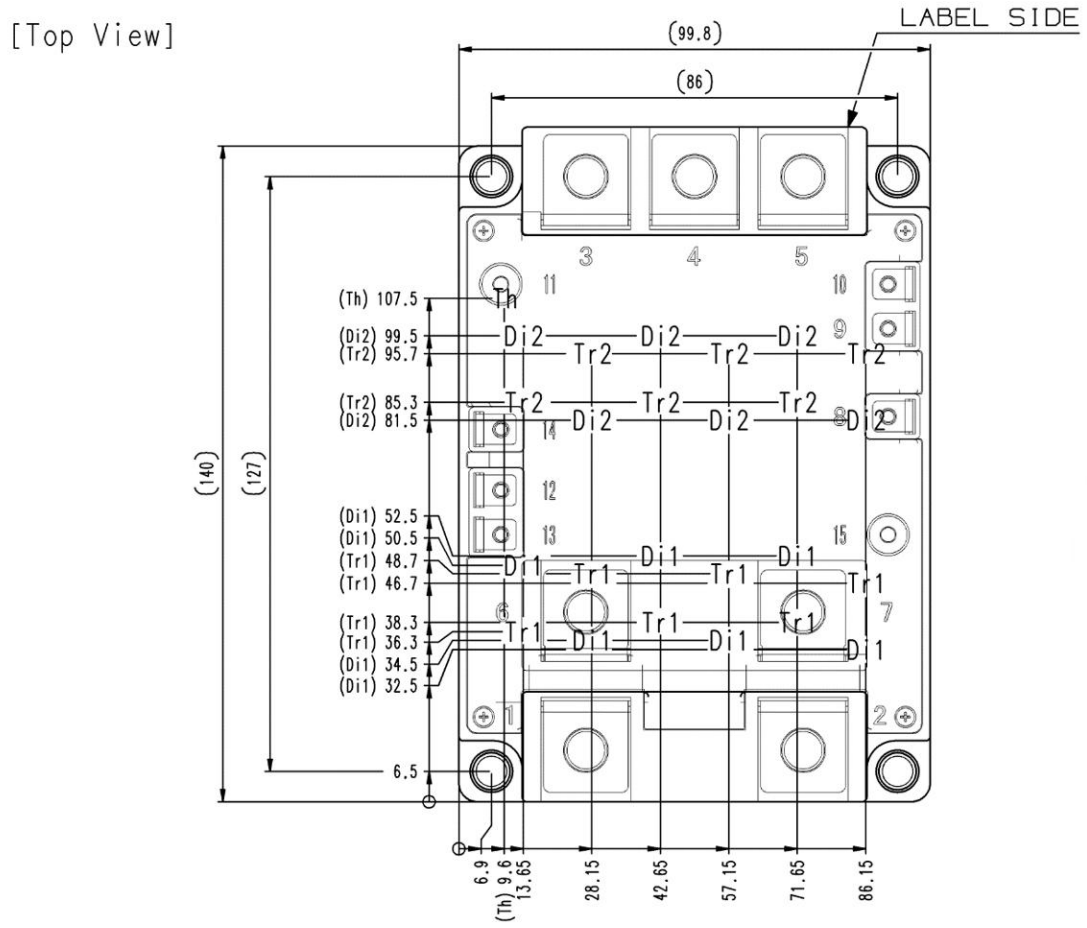
10. 10–90% range of the specified condition.

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-Es1/G2-Es2 terminals		13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	On	0.47	-	10	Ω
			Off	0	-	10	Ω

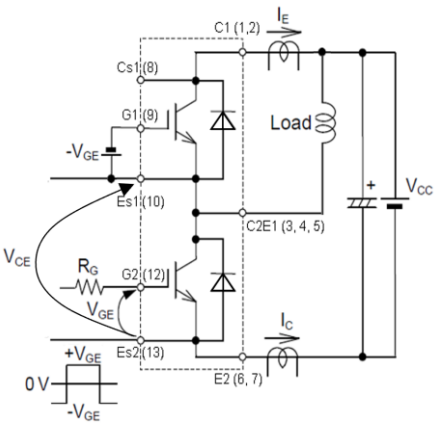
Note・The performance has been confirmed under the conditions specified above.
Optimum operating conditions should be selected with careful confirmation for no occurrence of any maximum rating violation (T_{vj}, V_{CES}, etc.) or any unexpected malfunction (arm-short-through, oscillation, etc.) at the actual application conditions.

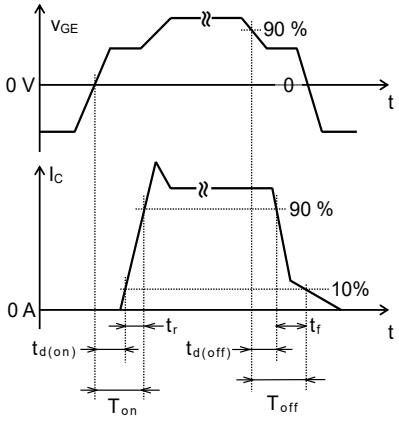
CHIP LOCATION (Top view) Dimension in mm, typ value



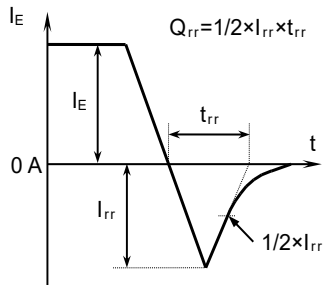
Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS

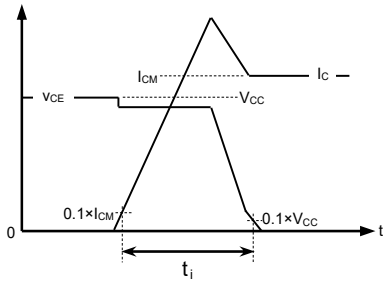




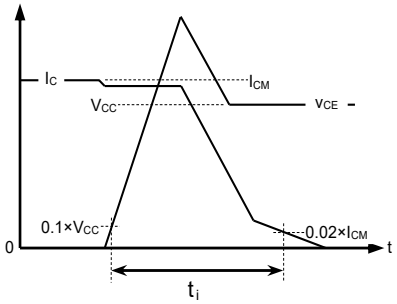
Switching characteristics test circuit and waveforms



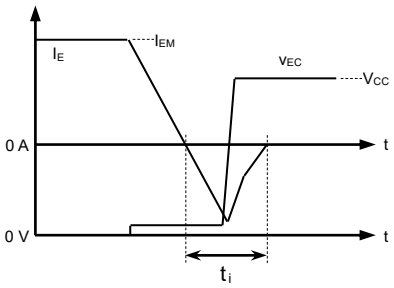
t_{rr}, Q_{rr} characteristics test waveform



IGBT Turn-on switching energy

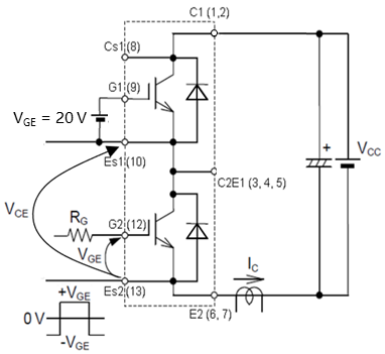


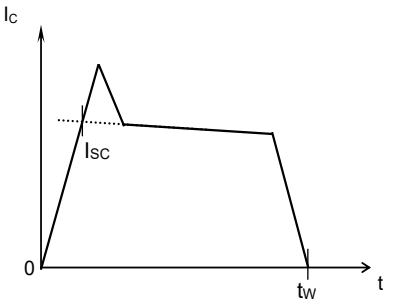
IGBT Turn-off switching energy



FWD Reverse recovery energy

Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

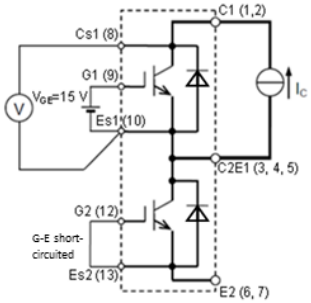




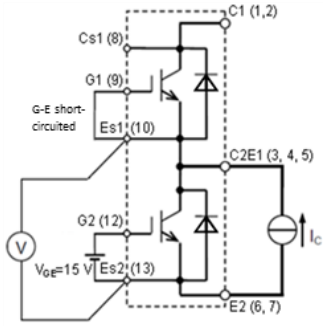
Short-circuit characteristics test circuit

I_{SC} characteristics test waveform

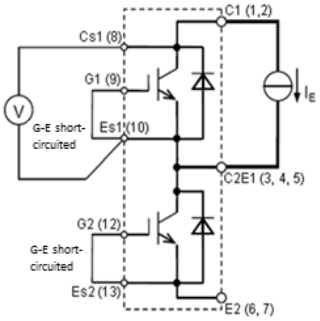
TEST CIRCUIT



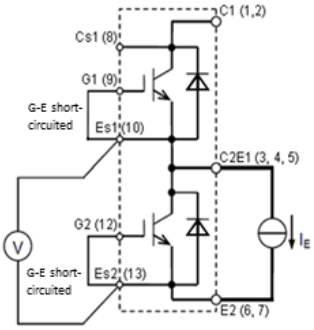
Tr1



Tr2



Di1



Di2

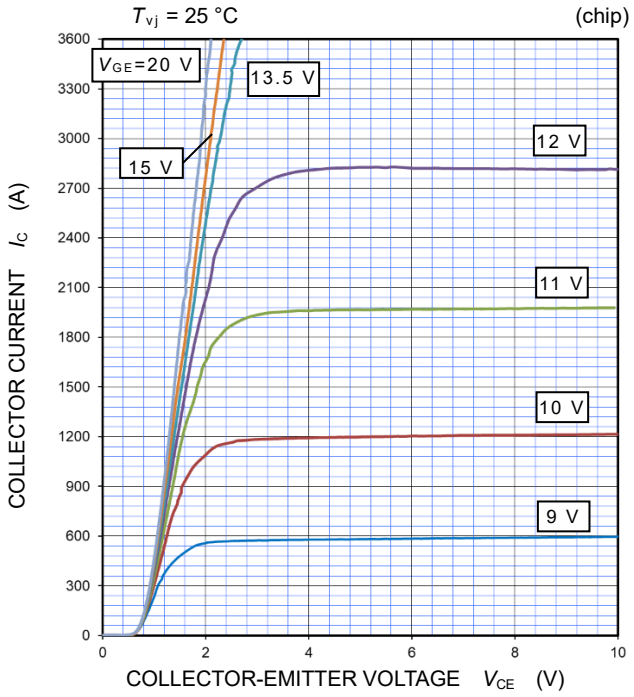
V_{CEsat} characteristics test circuit

V_{EC} characteristics test circuit

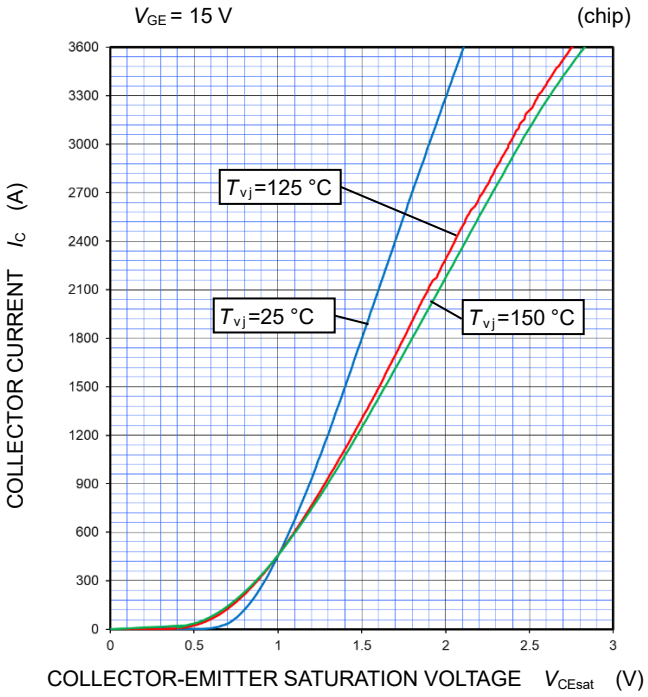
PERFORMANCE CURVES

INVERTER PART

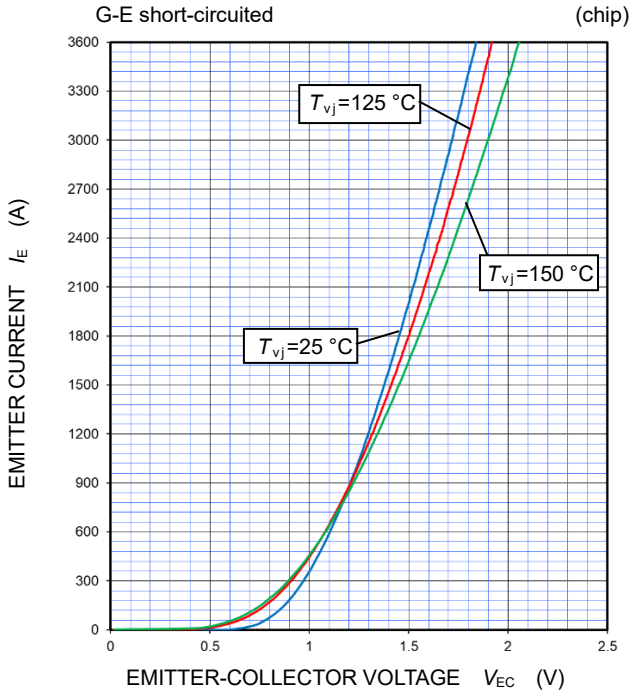
OUTPUT CHARACTERISTICS (TYPICAL)



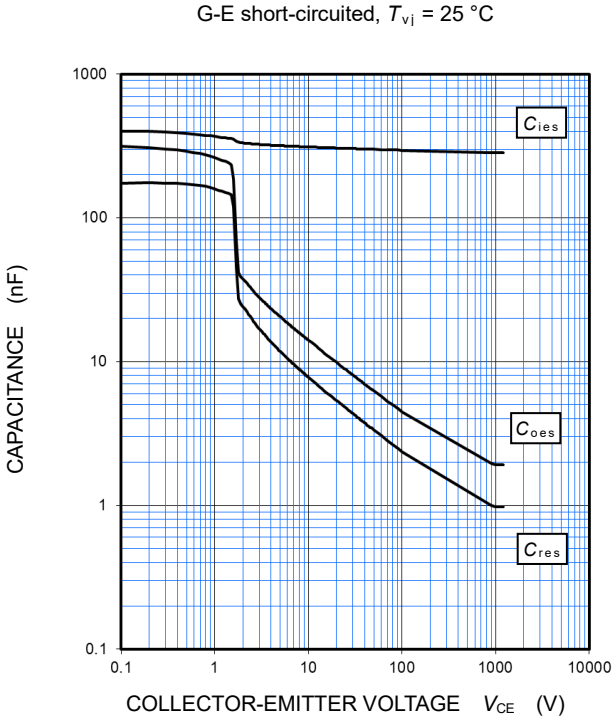
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



CAPACITANCE CHARACTERISTICS (TYPICAL)

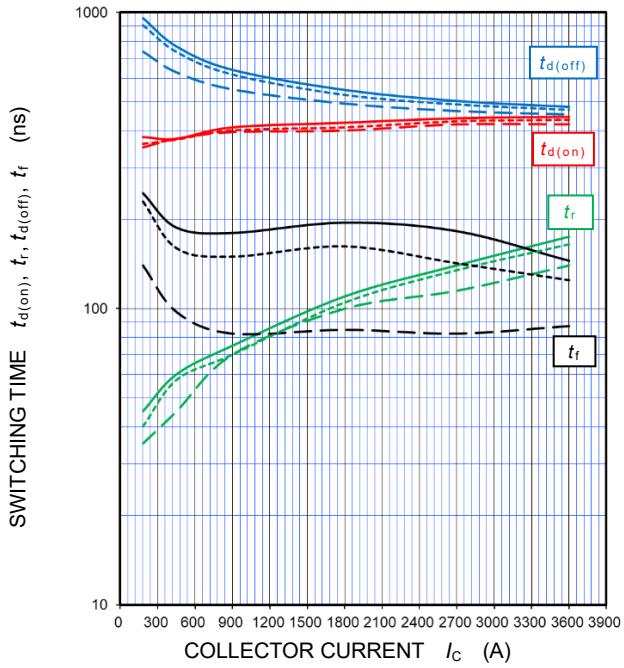


PERFORMANCE CURVES

INVERTER PART

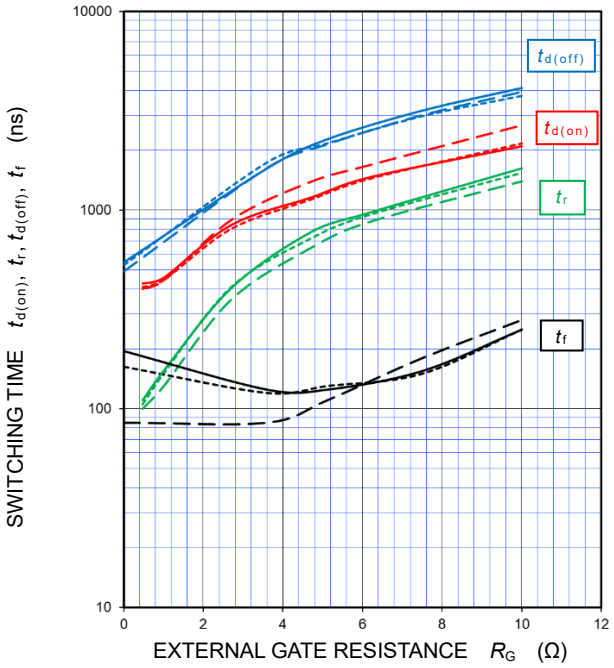
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, R_{Gon} = 0.47 Ω, R_{Goff} = 0 Ω, V_{GE} = ±15 V,
L_σ = 15 nH, INDUCTIVE LOAD,
——: T_{vj} = 150 °C, ------: T_{vj} = 125 °C, – – –: T_{vj} = 25 °C



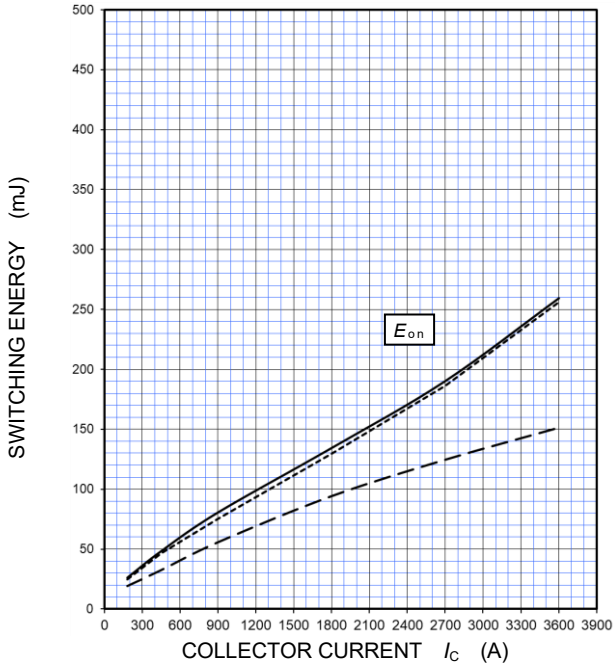
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, I_C/I_E = 1800 A, V_{GE} = ±15 V, L_σ = 15 nH,
INDUCTIVE LOAD,
——: T_{vj} = 150 °C, ------: T_{vj} = 125 °C, – – –: T_{vj} = 25 °C



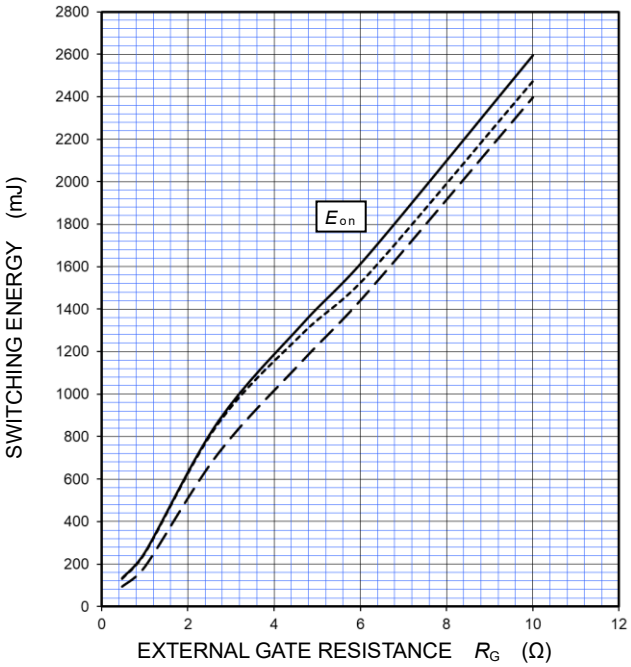
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, R_{Gon} = 0.47 Ω, V_{GE} = ±15 V, L_σ = 15 nH
INDUCTIVE LOAD, PER PULSE
——: T_{vj} = 150 °C, ------: T_{vj} = 125 °C, – – –: T_{vj} = 25 °C



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, I_C = 1800 A, V_{GE} = ±15 V, L_σ = 15 nH
INDUCTIVE LOAD, PER PULSE
——: T_{vj} = 150 °C, ------: T_{vj} = 125 °C, – – –: T_{vj} = 25 °C

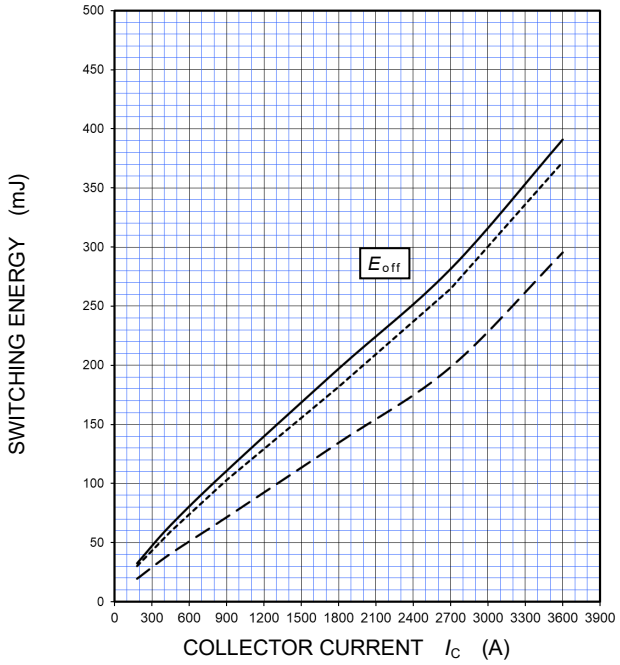


PERFORMANCE CURVES

INVERTER PART

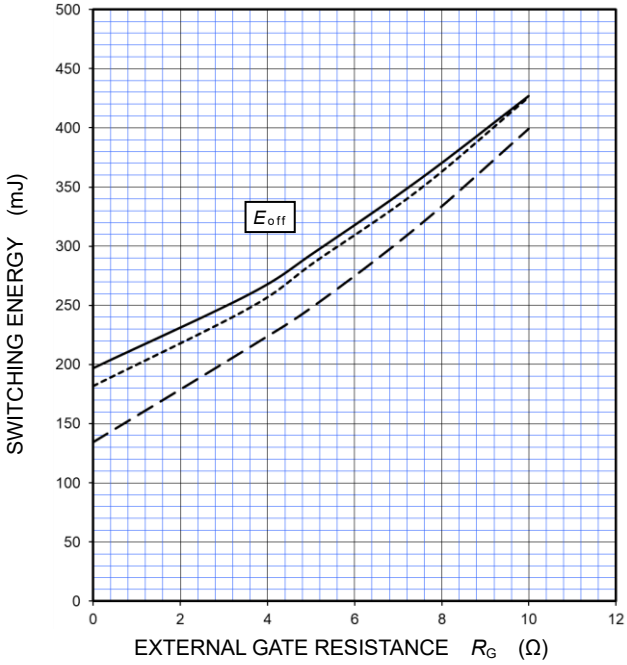
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, R_{Goff} = 0 Ω, V_{GE} = ±15 V, L_σ = 15 nH
INDUCTIVE LOAD, PER PULSE
——: T_{vj} = 150 °C, ------: T_{vj} = 125 °C, – – –: T_{vj} = 25 °C



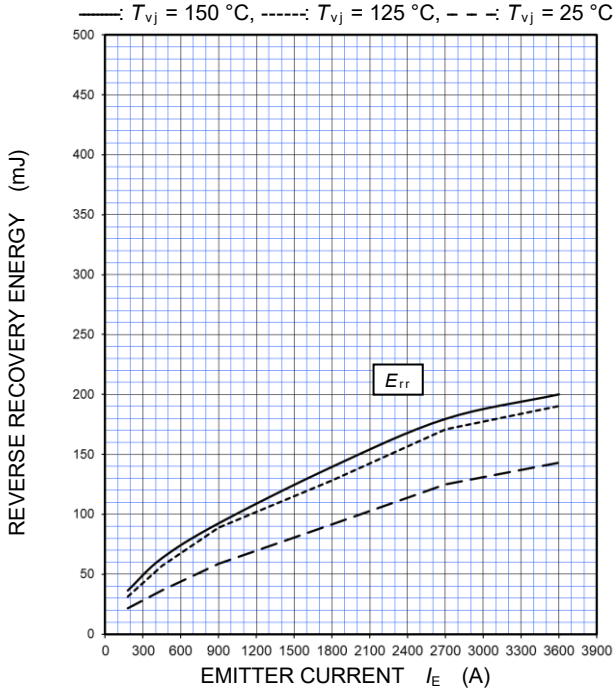
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, I_C = 1800 A, V_{GE} = ±15 V, L_σ = 15 nH
INDUCTIVE LOAD, PER PULSE
——: T_{vj} = 150 °C, ------: T_{vj} = 125 °C, – – –: T_{vj} = 25 °C



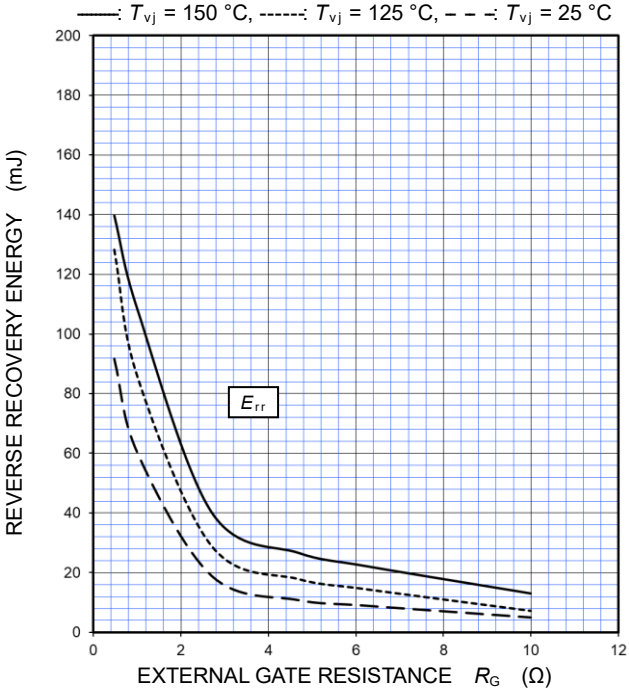
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, R_{Gon} = 0.47 Ω, V_{GE} = ±15 V, L_σ = 15 nH
INDUCTIVE LOAD, PER PULSE
——: T_{vj} = 150 °C, ------: T_{vj} = 125 °C, – – –: T_{vj} = 25 °C



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, I_E = 1800 A, V_{GE} = ±15 V, L_σ = 15 nH
INDUCTIVE LOAD, PER PULSE
——: T_{vj} = 150 °C, ------: T_{vj} = 125 °C, – – –: T_{vj} = 25 °C

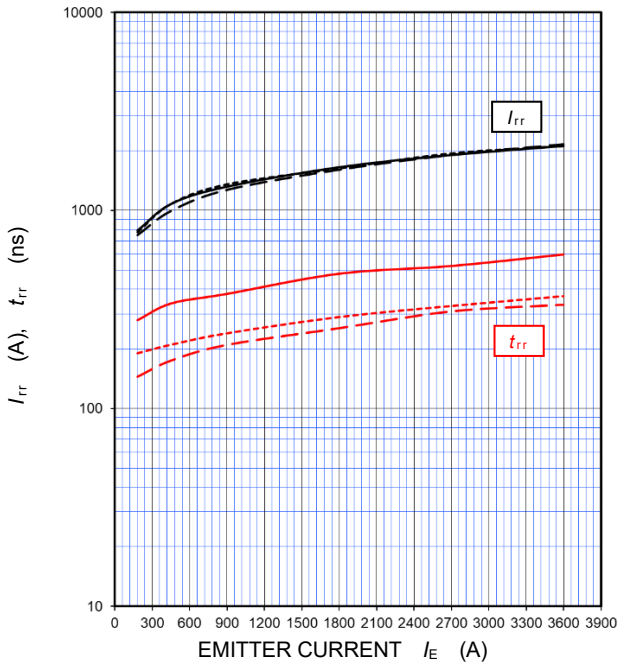


PERFORMANCE CURVES

INVERTER PART

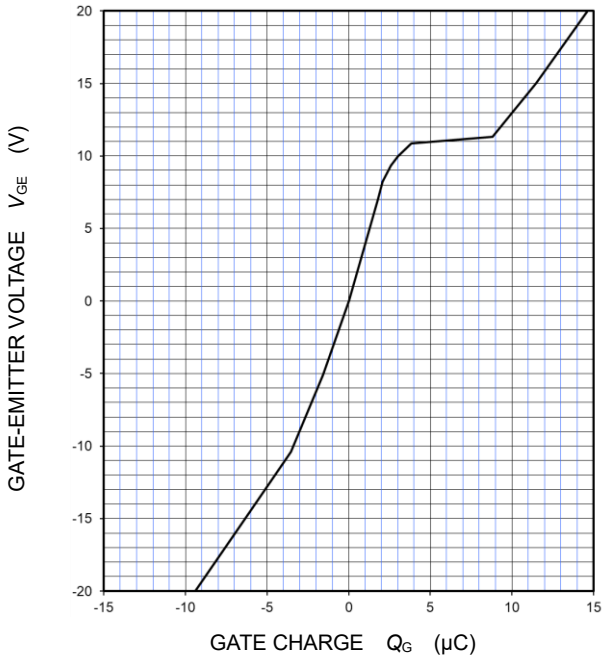
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, R_{Gon} = 0.47 Ω, V_{GE} = ±15 V, INDUCTIVE LOAD
——: T_{vj} = 150 °C, ------: T_{vj} = 125 °C, – – –: T_{vj} = 25 °C



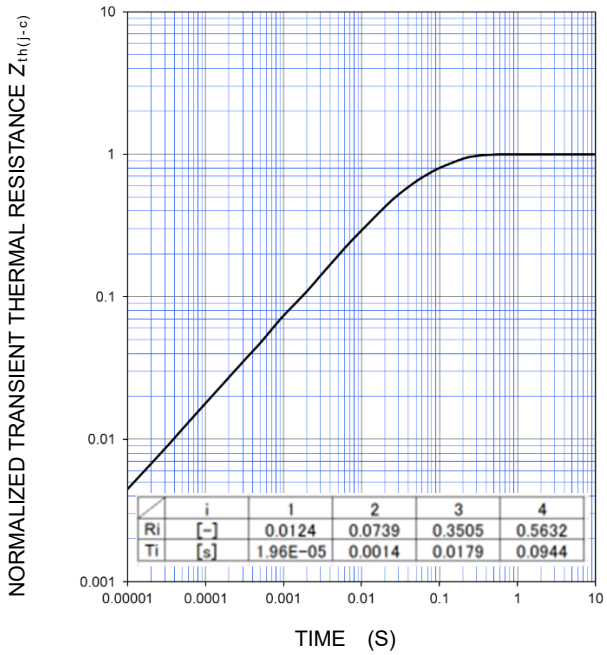
GATE CHARGE CHARACTERISTICS (TYPICAL)

V_{CC} = 600 V, I_C = 1800 A, T_{vj} = 25 °C



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

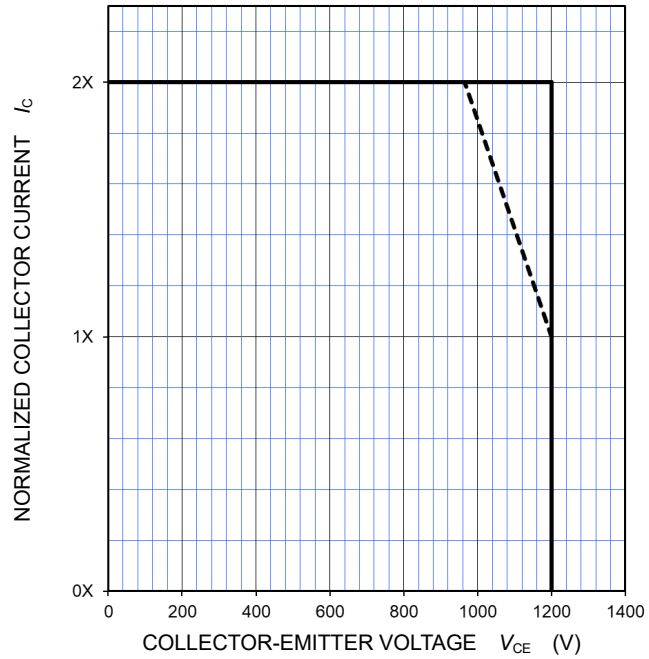
Single pulse, T_C = 25 °C
$R_{th(j-c)Q}$ = 24 K/kW, $R_{th(j-c)D}$ = 39 K/kW



i		1	2	3	4
Ri	[–]	0.0124	0.0739	0.3505	0.5632
Ti	[s]	1.96E-05	0.0014	0.0179	0.0944

TURN-OFF SWITCHING SAFE OPERATIONG AREA (REVERSE BIAS SAFE OPERATING AREA) (MAXIMUM)

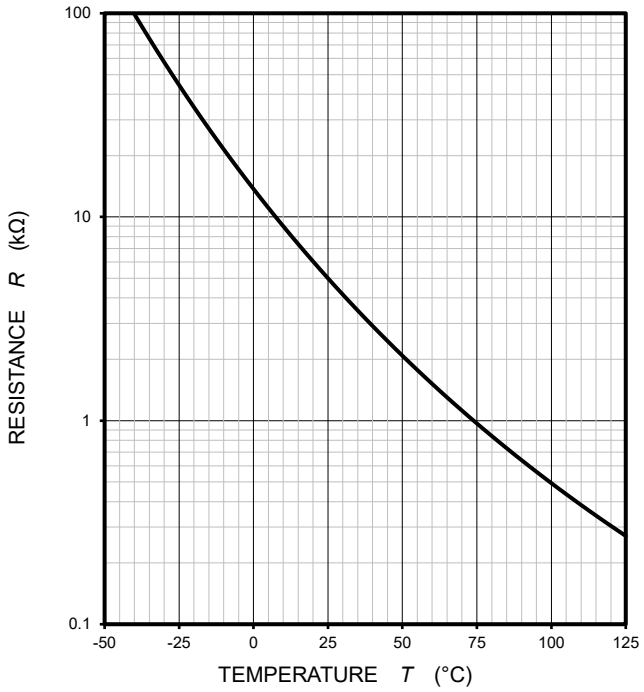
$V_{CC} \leq$ 850 V, $R_{G(off)}$ = 0 Ω, V_{GE} = ±15 V
——: T_{vj} = 150°C, – – –: T_{vj} = 175 °C



PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS (TYPICAL)



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

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