

CM50MXA-24S

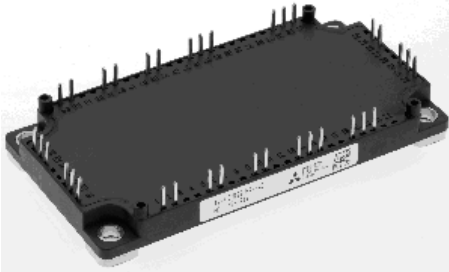
HIGH POWER SWITCHING USE
INSULATED TYPE

CM50MXA-24S

- 6th Generation NX series -

Collector current I_C **50 A**

Collector-emitter voltage V_{CES} **1200 V**



- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant

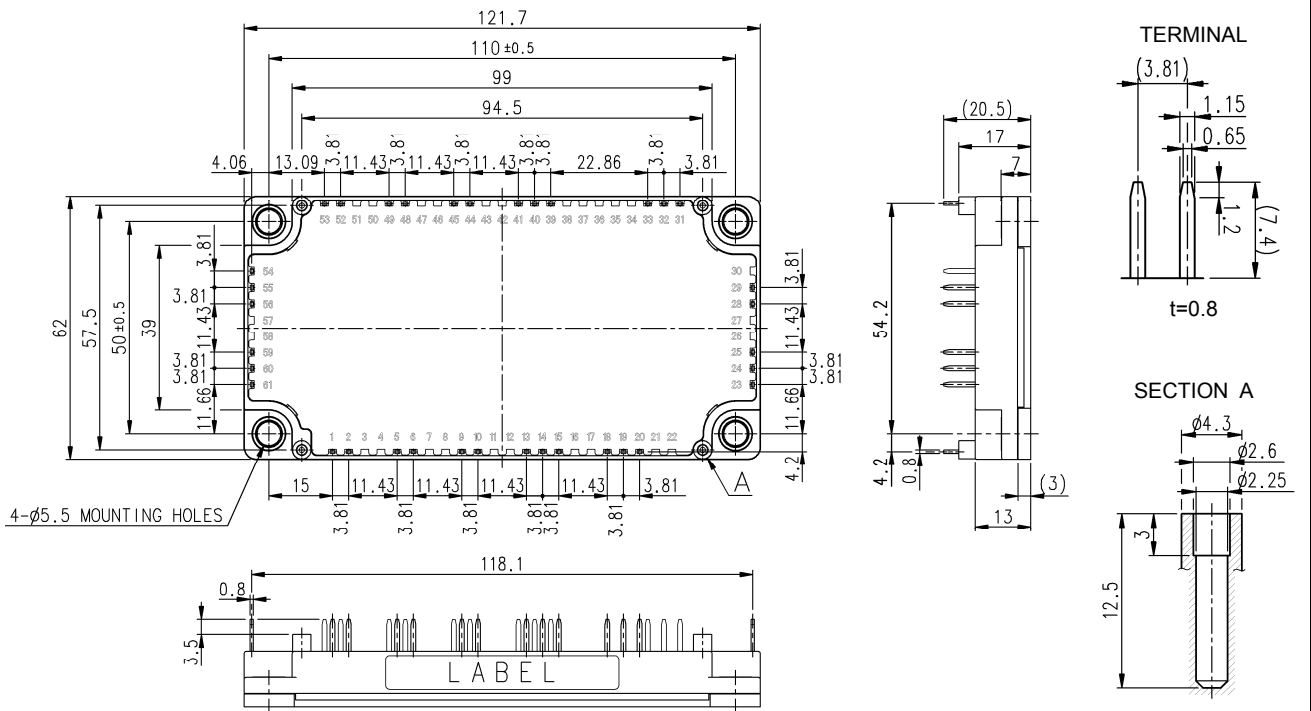
CIB (Converter+Inverter+BrakeCopper)

- UL Recognized under UL1557, File E323585

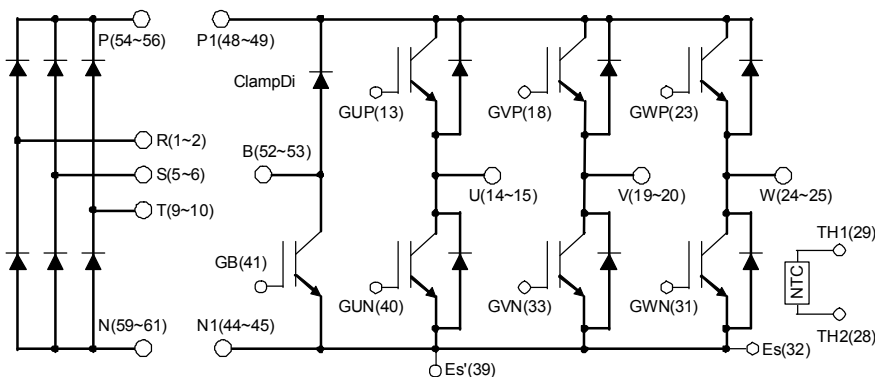
APPLICATION

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

OUTLINE DRAWING & INTERNAL CONNECTION



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

The tolerance of size between terminals is assumed to be ±0.4.

Caution: Each (two or three) pin terminal of P/N/R/S/T/P1/N1/U/V/W/B is connected in the module, but should use all each three pins for the external wiring.

ABSOLUTE MAXIMUM RATINGS ($T_j=25\text{ }^\circ\text{C}$, unless otherwise specified)

Inverter part IGBT/FWDi

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, $T_C=125\text{ }^\circ\text{C}$ (Note.2, 4)	50	A
I_{CRM}		Pulse (Note.3)	100	
P_{tot}	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	425	W
I_E (Note.1)	Emitter current	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	50	A
I_{ERM} (Note.1)		Pulse (Note.3)	100	
T_{jmax}	Maximum junction temperature	-	175	$^\circ\text{C}$

Brake part IGBT/ClampDi

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, $T_C=125\text{ }^\circ\text{C}$ (Note.2)	35	A
I_{CRM}		Pulse (Note.3)	70	
P_{tot}	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	355	W
V_{RRM}	Repetitive peak reverse voltage	G-E short-circuited	1200	V
I_F (Note.1)	Forward current	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	35	A
I_{FRM} (Note.1)		Pulse (Note.3)	70	
T_{jmax}	Maximum junction temperature	-	175	$^\circ\text{C}$

Converter part ConvDi

Symbol	Item	Conditions	Rating	Unit
V_{RRM}	Repetitive peak reverse voltage	-	1600	V
E_a	Recommended AC input voltage	RMS	440	V
I_O	DC output current	3-phase full wave rectifying, $T_C=125\text{ }^\circ\text{C}$ (Note.2)	50	A
I_{FSM}	Surge forward current	The sine half wave 1 cycle peak value, $f=60\text{ Hz}$, non-repetitive	500	A
I^2t	Current square time	Value for one cycle of surge current	1040	A^2s
T_{jmax}	Maximum junction temperature	-	150	$^\circ\text{C}$

Module

Symbol	Item	Conditions	Rating	Unit
T_{Cmax}	Maximum case temperature	(Note.2)	125	$^\circ\text{C}$
T_{jop}	Operating junction temperature	-	-40 ~ +150	$^\circ\text{C}$
T_{stg}	Storage temperature	-	-40 ~ +125	
V_{isol}	Isolation voltage	Terminals to base plate, RMS, $f=60\text{ Hz}$, AC 1 min	2500	V

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
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	6.47	-	-	mm
		Terminal to base plate	14.27	-	-	
d_a	Clearance	Terminal to terminal	6.47	-	-	mm
		Terminal to base plate	12.33	-	-	
m	Weight	-	-	300	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note.5)	± 0	-	+100	μm

ELECTRICAL CHARACTERISTICS (T_j=25 °C, unless otherwise specified)

Inverter part IGBT/FWDi

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	V _{GE} =V _{GES} , C-E short-circuited	-	-	0.5	μA	
V _{GE(th)}	Gate-emitter threshold voltage	I _C =5 mA, V _{CE} =10 V	5.4	6.0	6.6	V	
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =50 A ^(Note.6) , V _{GE} =15 V	T _j =25 °C	-	1.80	2.25	V
			T _j =125 °C	-	2.00	-	
			T _j =150 °C	-	2.05	-	
V _{CEsat} (Chip)	Collector-emitter saturation voltage	I _C =50 A ^(Note.6) , V _{GE} =15 V	T _j =25 °C	-	1.70	2.15	V
			T _j =125 °C	-	1.90	-	
			T _j =150 °C	-	1.95	-	
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	5.0	nF	
C _{oes}	Output capacitance		-	-	1.0		
C _{res}	Reverse transfer capacitance		-	-	0.08		
Q _G	Gate charge	V _{CC} =600 V, I _C =50 A, V _{GE} =15 V	-	117	-	nC	
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =50 A, V _{GE} =±15 V, R _G =13 Ω, Inductive load	-	-	300	ns	
t _r	Rise time		-	-	200		
t _{d(off)}	Turn-off delay time		-	-	600		
t _f	Fall time		-	-	300		
V _{EC} ^(Note.1) (Terminal)	Emitter-collector voltage	I _E =50 A ^(Note.6) , G-E short-circuited	T _j =25 °C	-	1.8	2.25	V
			T _j =125 °C	-	1.8	-	
			T _j =150 °C	-	1.8	-	
V _{EC} ^(Note.1) (Chip)	Emitter-collector voltage	I _E =50 A ^(Note.6) , G-E short-circuited	T _j =25 °C	-	1.7	2.15	V
			T _j =125 °C	-	1.7	-	
			T _j =150 °C	-	1.7	-	
t _{rr} ^(Note.1)	Reverse recovery time	V _{CC} =600 V, I _E =50 A, V _{GE} =±15 V, R _G =13 Ω, Inductive load	-	-	300	ns	
Q _{rr} ^(Note.1)	Reverse recovery charge	R _G =13 Ω, Inductive load	-	2.7	-	μC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =50 A,	-	5.5	-	mJ	
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =13 Ω, T _j =150 °C,	-	5.3	-		
E _{rr} ^(Note.1)	Reverse recovery energy per pulse	Inductive load	-	4.5	-	mJ	
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C ^(Note.2)	-	-	5.0	mΩ	
r _g	Internal gate resistance	Per switch	-	0	-	Ω	

Brake part IGBT/ClampDi

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	V _{GE} =V _{GES} , C-E short-circuited	-	-	0.5	μA	
V _{GE(th)}	Gate-emitter threshold voltage	I _C =3.5 mA, V _{CE} =10 V	5.4	6.0	6.6	V	
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =35 A ^(Note.6) , V _{GE} =15 V	T _j =25 °C	-	1.80	2.25	V
			T _j =125 °C	-	2.00	-	
			T _j =150 °C	-	2.05	-	
V _{CEsat} (Chip)	Collector-emitter saturation voltage	I _C =35 A ^(Note.6) , V _{GE} =15 V	T _j =25 °C	-	1.70	2.15	V
			T _j =125 °C	-	1.90	-	
			T _j =150 °C	-	1.95	-	
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	3.5	nF	
C _{oes}	Output capacitance		-	-	0.7		
C _{res}	Reverse transfer capacitance		-	-	0.06		
Q _G	Gate charge	V _{CC} =600 V, I _C =35 A, V _{GE} =15 V	-	82	-	nC	

ELECTRICAL CHARACTERISTICS (cont.; T_j=25 °C, unless otherwise specified)

Brake part IGBT/ClampDi

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =35 A, V _{GE} =±15 V, R _G =18 Ω, Inductive load	-	-	300	ns	
t _r	Rise time		-	-	200		
t _{d(off)}	Turn-off delay time		-	-	600		
t _f	Fall time		-	-	300		
I _{RRM}	Repetitive peak reverse current	V _R =V _{RRM} , G-E short-circuited	-	-	1	mA	
V _F (Terminal)	Forward voltage	I _F =35 A (Note.6), G-E short-circuited	T _j =25 °C	-	1.8	2.25	V
			T _j =125 °C	-	1.8	-	
			T _j =150 °C	-	1.8	-	
V _F (Chip)	Forward voltage	I _F =35 A (Note.6), G-E short-circuited	T _j =25 °C	-	1.7	2.15	V
			T _j =125 °C	-	1.7	-	
			T _j =150 °C	-	1.7	-	
t _{rr}	Reverse recovery time	V _{CC} =600 V, I _F =35 A, V _{GE} =±15 V, R _G =18 Ω, Inductive load	-	-	300	ns	
Q _{rr}	Reverse recovery charge	R _G =18 Ω, Inductive load	-	1.9	-	μC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _F =35 A, V _{GE} =±15 V, R _G =18 Ω, T _j =150 °C, Inductive load	-	4.2	-	mJ	
E _{off}	Turn-off switching energy per pulse		-	3.7	-		
E _{rr}	Reverse recovery energy per pulse		-	3.5	-		
r _g	Internal gate resistance	-	-	0	-	Ω	

Converter part ConvDi

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
I _{RRM}	Repetitive peak reverse current	V _R =V _{RRM} , T _j =150 °C	-	-	6	mA
V _F (Terminal)	Forward voltage	I _F =50 A (Note.6)	-	1.2	1.6	V

NTC thermistor part

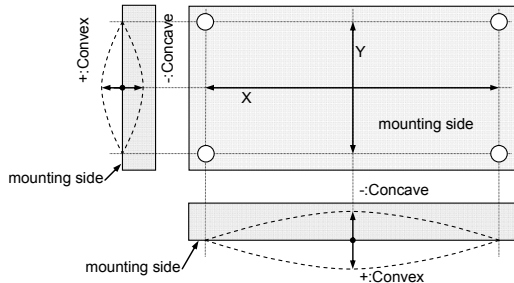
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R ₂₅	Zero power resistance	T _C =25 °C (Note.2)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	T _C =100 °C, R ₁₀₀ =493 Ω	-7.3	-	+7.8	%
B _(25/50)	B constant	Approximate by equation (Note.7)	-	3375	-	K
P ₂₅	Power dissipation	T _C =25 °C (Note.2)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance (Note. 2)	Junction to case, per Inverter IGBT	-	-	0.35	K/W
R _{th(j-c)D}		Junction to case, per Inverter FWDi	-	-	0.63	
R _{th(j-c)Q}		Junction to case, per Brake IGBT	-	-	0.42	K/W
R _{th(j-c)D}		Junction to case, per Brake ClampDi	-	-	0.69	
R _{th(j-c)D}		Junction to case, per ConvDi	-	-	0.33	
R _{th(c-s)}	Contact thermal resistance (Note. 2)	Case to heat sink, per 1 module, Thermal grease applied (Note.8)	-	15	-	K/kW

MITSUBISHI IGBT MODULES
CM50MXA-24S
HIGH POWER SWITCHING USE
INSULATED TYPE

- 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 (mounting side) of base plate and heat sink just under the chips. Refer to the figure of chip location.
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: The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.

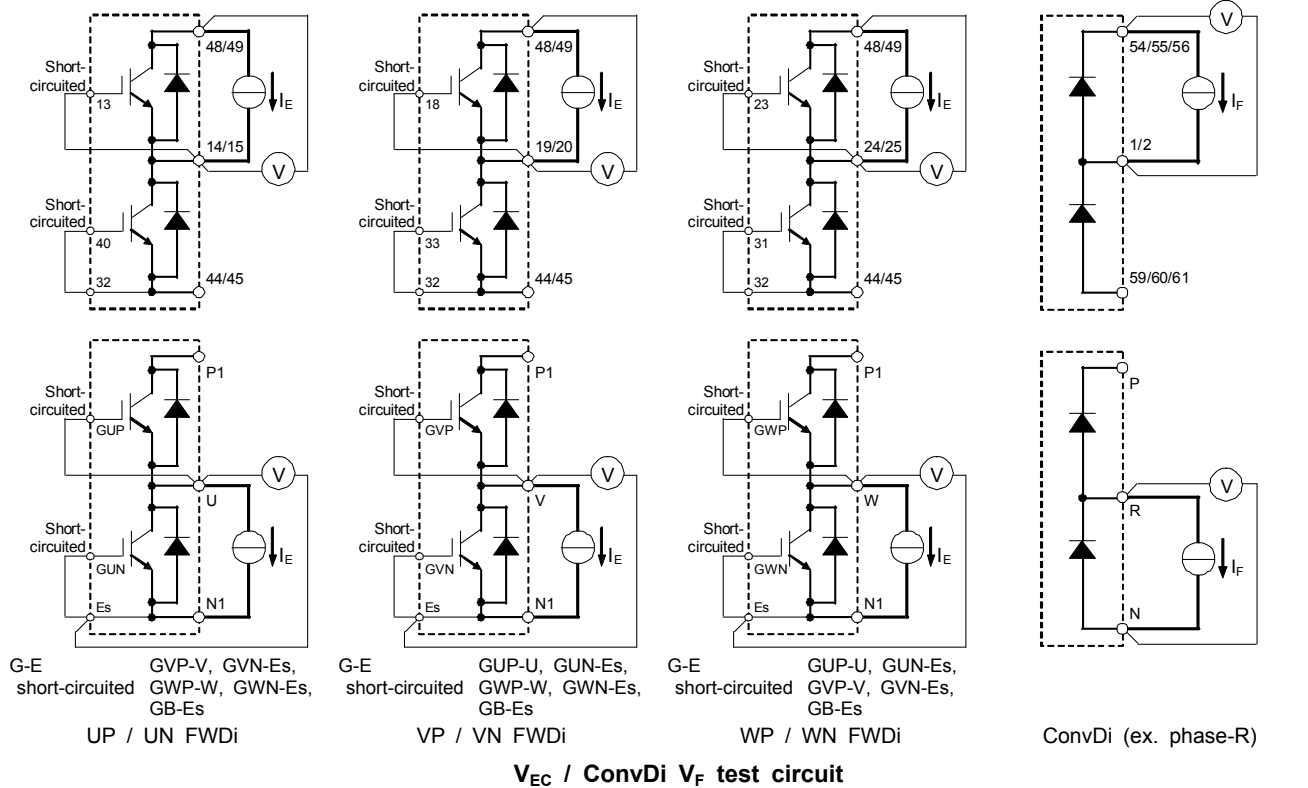
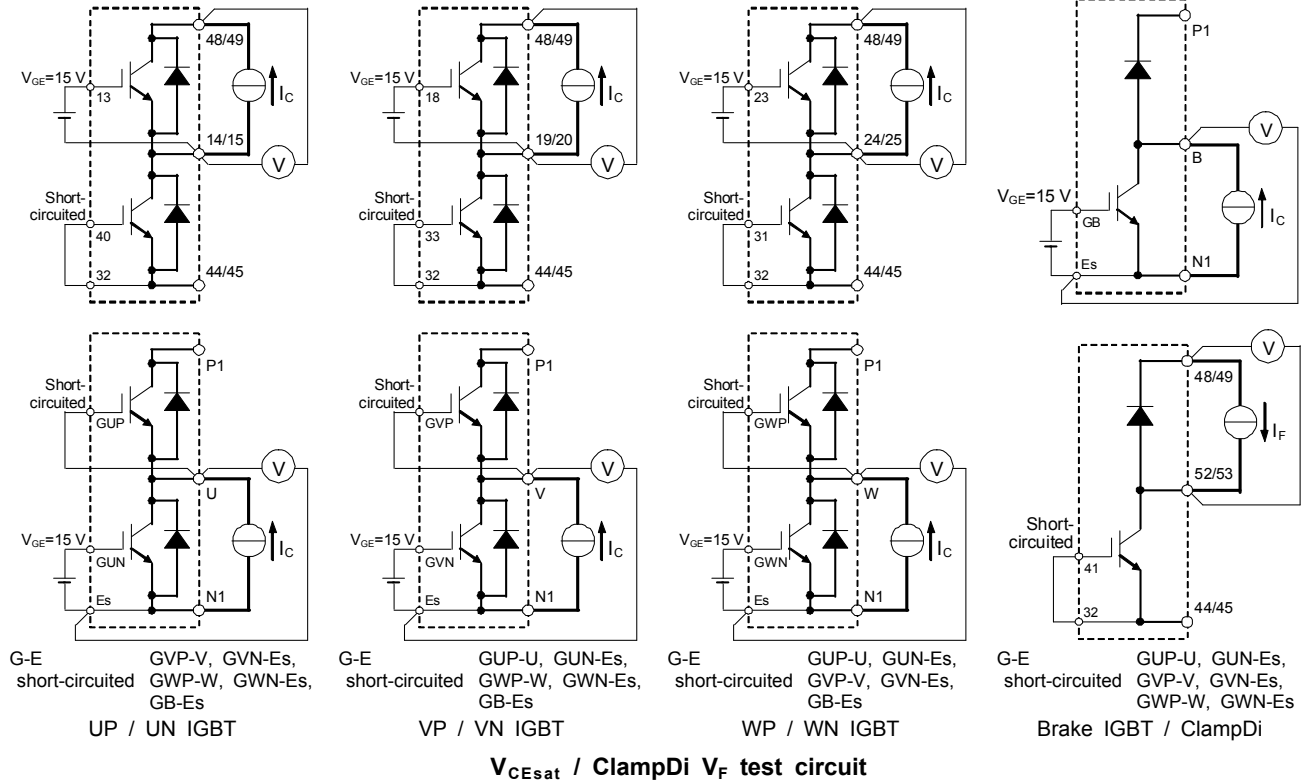


- Note.6: Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.
Note.7: $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$,
 R_{25} : resistance at absolute temperature T_{25} [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]
Note.8: Typical value is measured by using thermally conductive grease of $\lambda=0.9$ W/(m·K).
Note.9: Japan Electronics and Information Technology Industries Association (JEITA) standards, "EIAJ ED-4701/300: Environmental and endurance test methods for semiconductor devices (Stress test I)"
Note.10: Use the following screws when mounting the printed circuit board (PCB) on the stand offs.
"M2.6×10 or M2.6×12 self tapping screw"
The length of the screw depends on the thickness of the PCB.

RECOMMENDED OPERATING CONDITIONS ($T_a=25$ °C)

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
V_{CC}	DC supply voltage	Applied across P1(P)-N1(N) terminals	-	600	850	V	
V_{GEon}	Gate-emitter drive voltage	Applied across GB-Es/ G*P-*/G*N-Es (*=U,V,W) terminals	13.5	15.0	16.5	V	
R_G	External gate resistance	Per switch	Inverter IGBT	13	-	130	Ω
			Brake IGBT	18	-	180	

TEST CIRCUIT

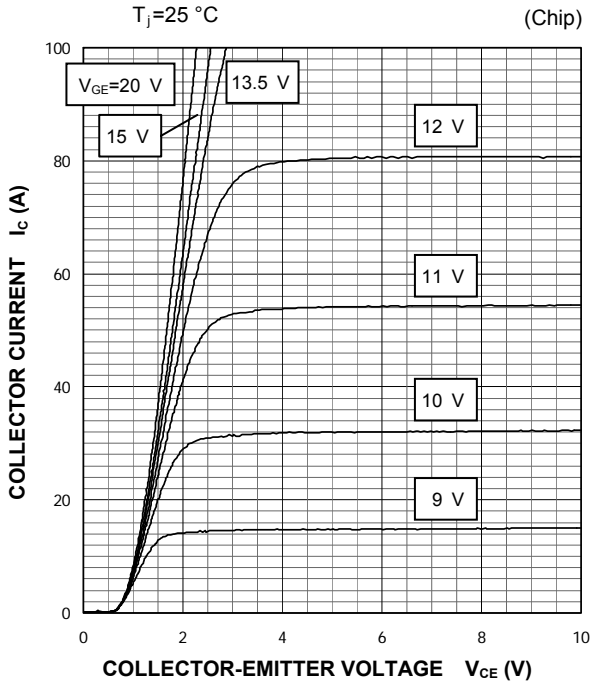


* In case of the above example, P1/N1/U/V/W should use all each three pin terminals for the external wiring.

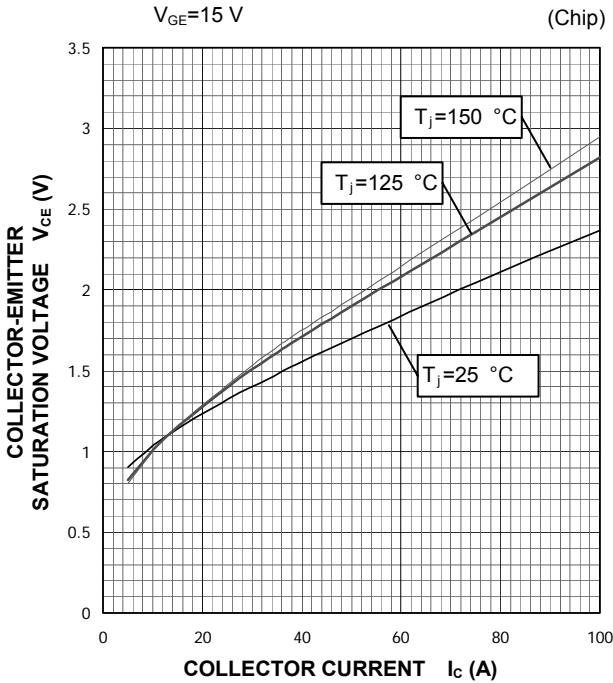
PERFORMANCE CURVES

INVERTER PART

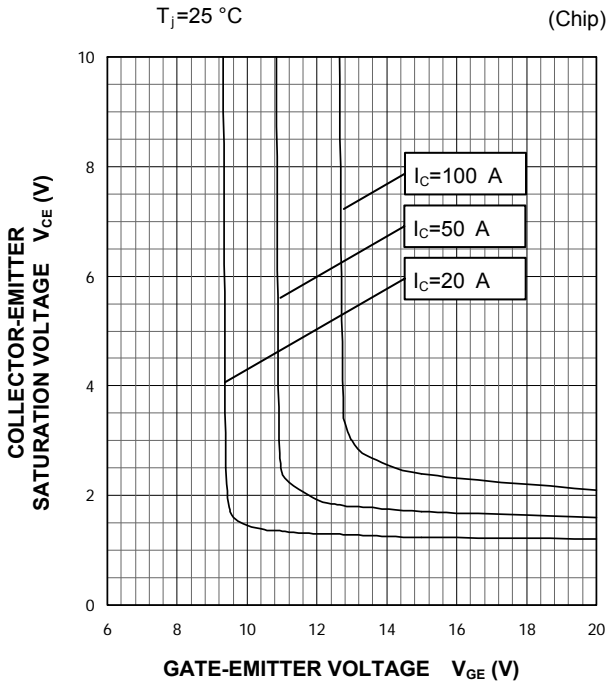
OUTPUT CHARACTERISTICS (TYPICAL)



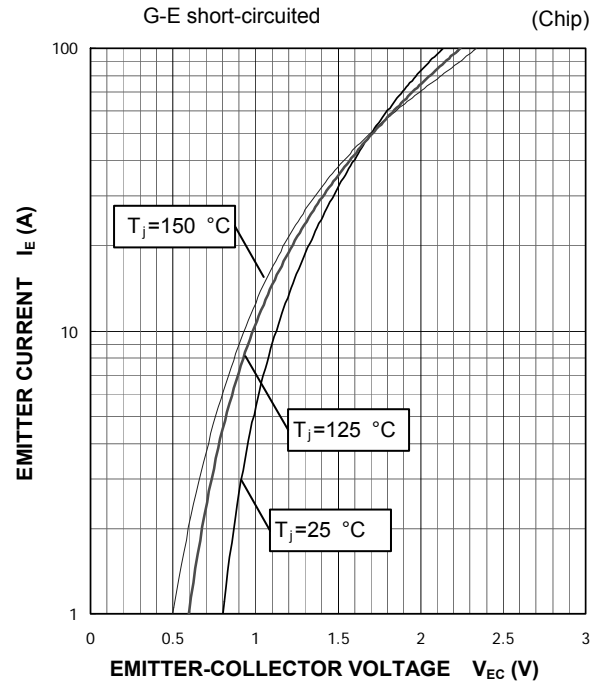
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

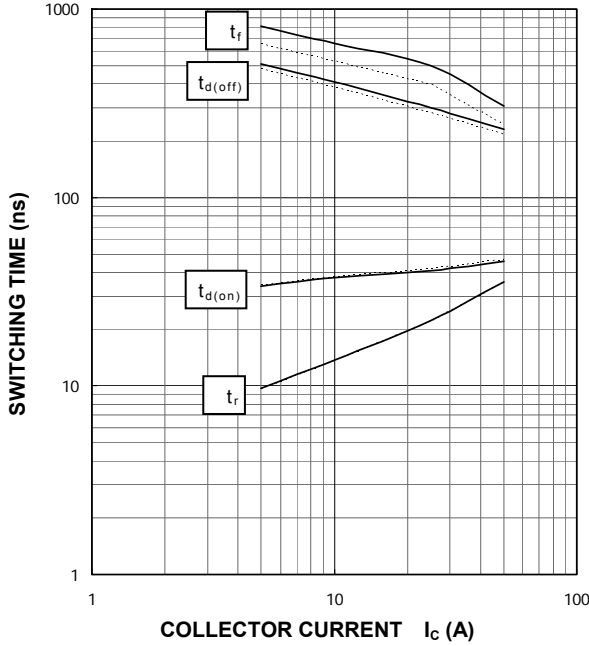


FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



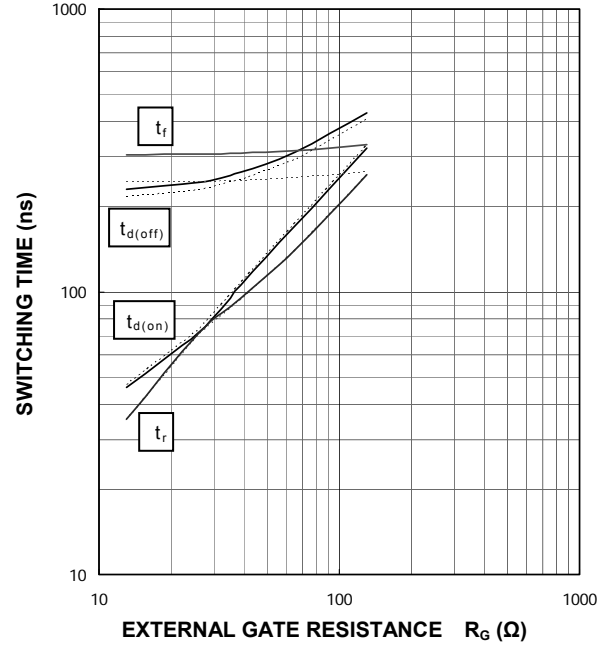
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=13\ \Omega$,
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



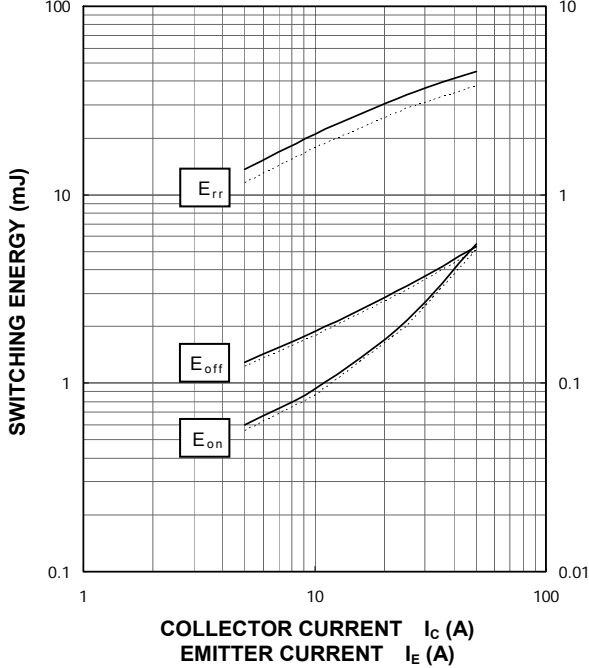
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_c=50\text{ A}$,
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



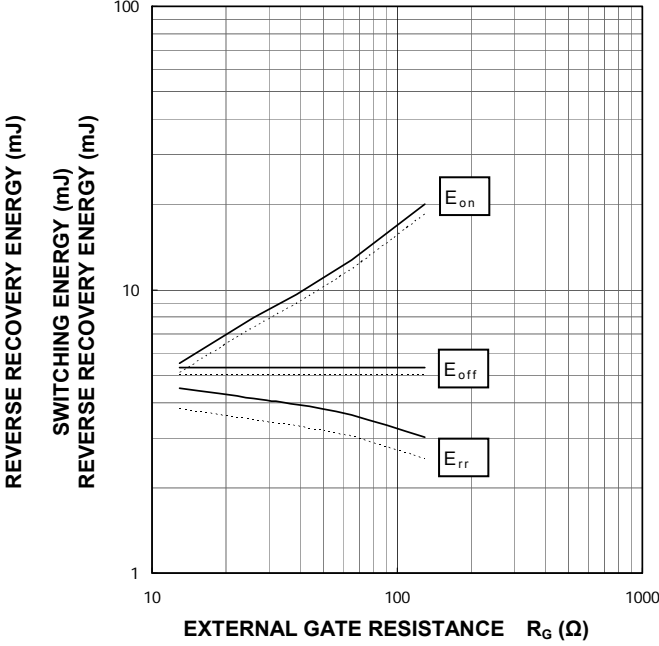
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=13\ \Omega$,
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



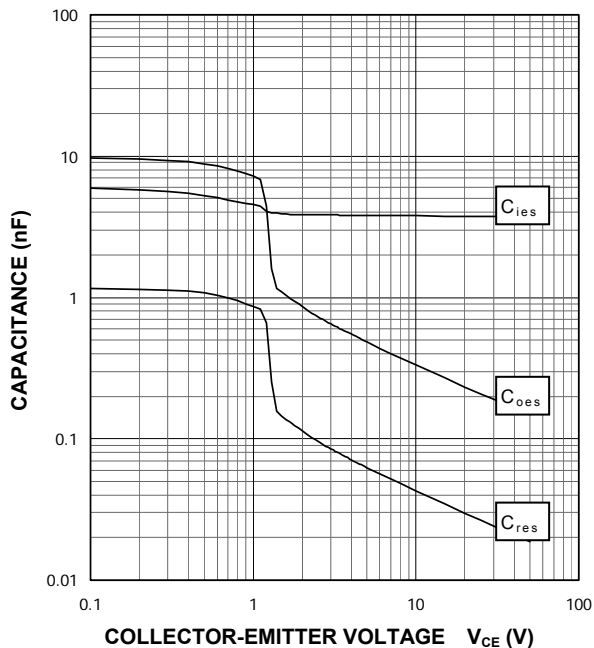
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_c=50\text{ A}$,
 —: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



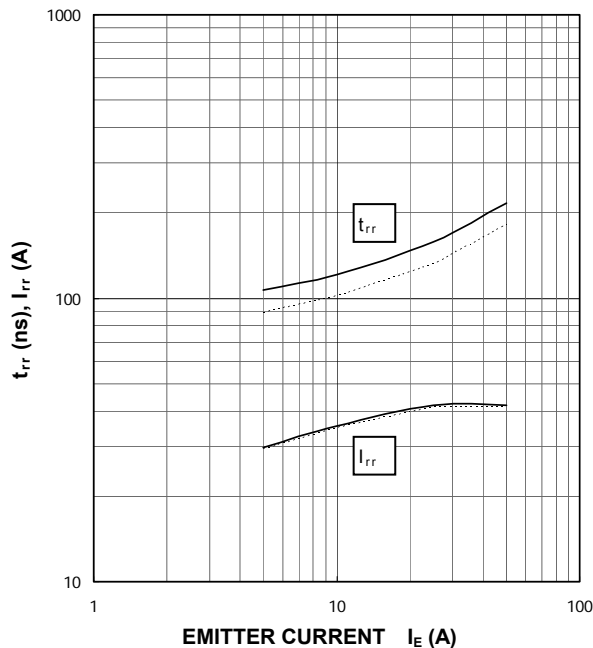
**CAPACITANCE CHARACTERISTICS
(TYPICAL)**

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



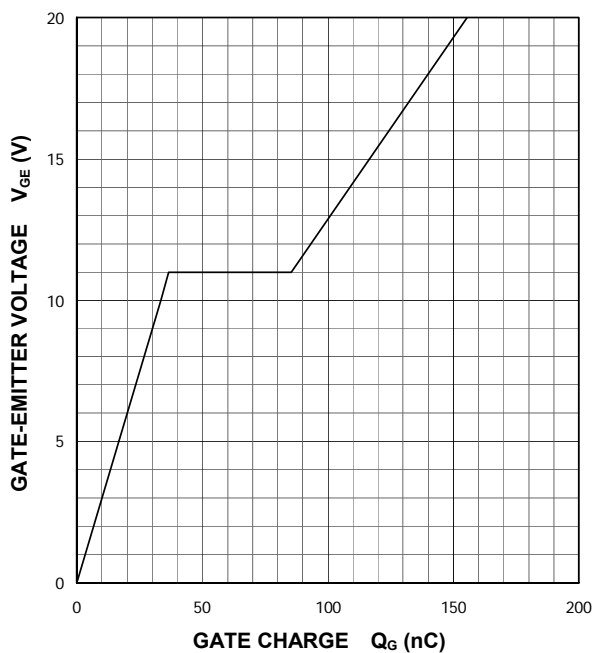
**FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)**

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=13\text{ }\Omega$,
—: $T_j=150\text{ }^\circ\text{C}$, - - - -: $T_j=125\text{ }^\circ\text{C}$



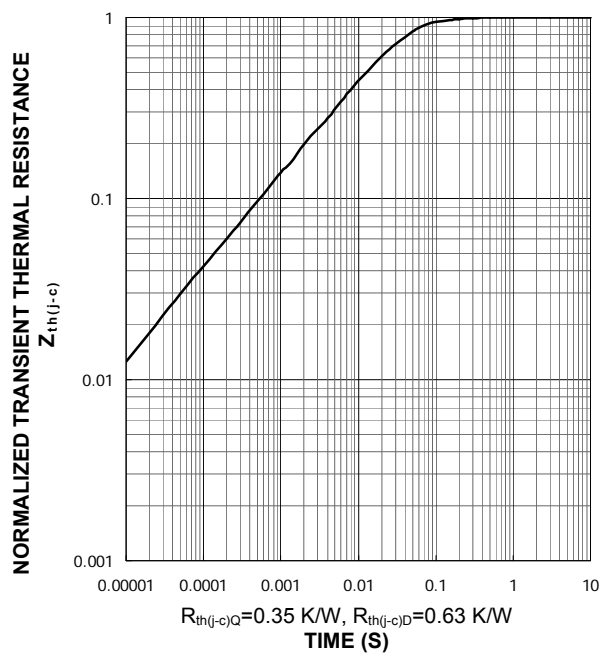
**GATE CHARGE CHARACTERISTICS
(TYPICAL)**

$V_{CC}=600\text{ V}$, $I_C=50\text{ A}$, $T_j=25\text{ }^\circ\text{C}$



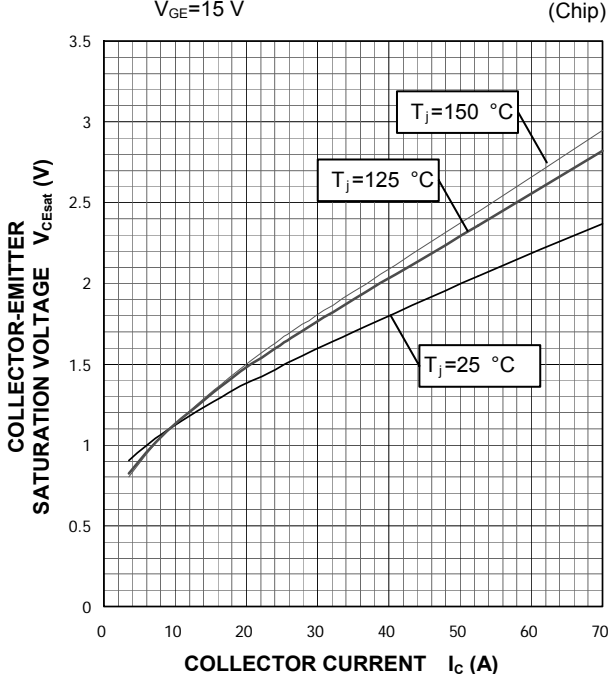
**TRANSIENT THERMAL IMPEDANCE
CHARACTERISTICS
(MAXIMUM)**

Single pulse, $T_c=25\text{ }^\circ\text{C}$

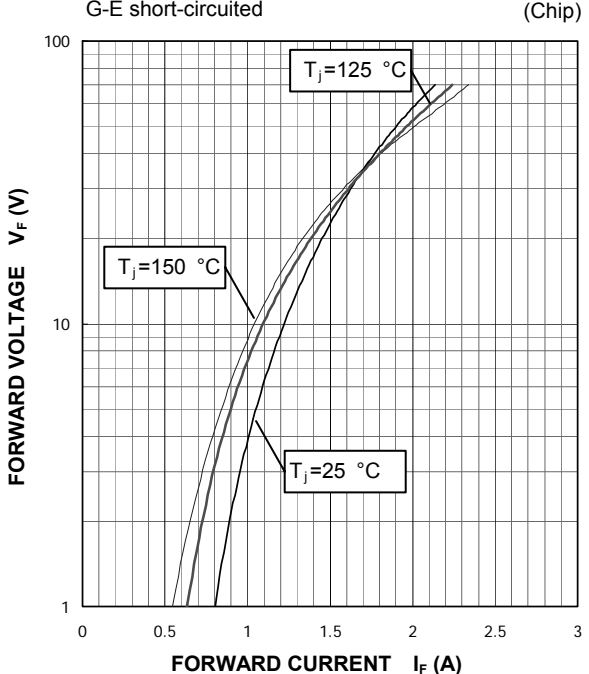


BRAKE PART

COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

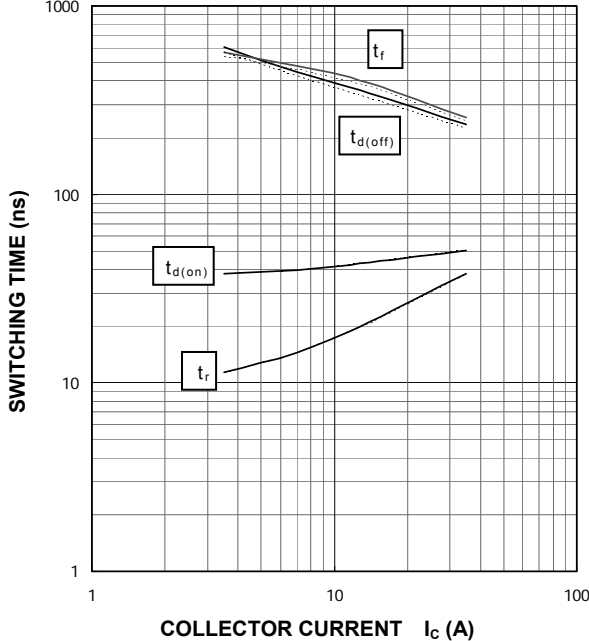


CLAMP DIODE FORWARD CHARACTERISTICS (TYPICAL)



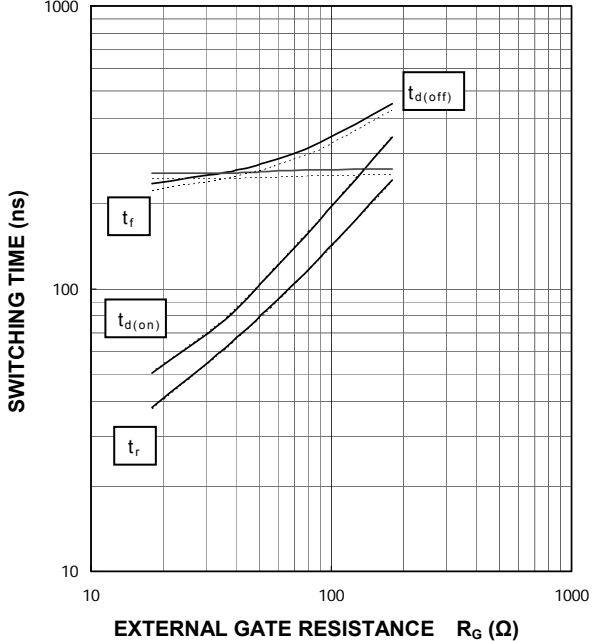
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC} = 600 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 18 \Omega$, INDUCTIVE LOAD
 —: $T_j = 150 \text{ }^\circ\text{C}$, - - - -: $T_j = 125 \text{ }^\circ\text{C}$

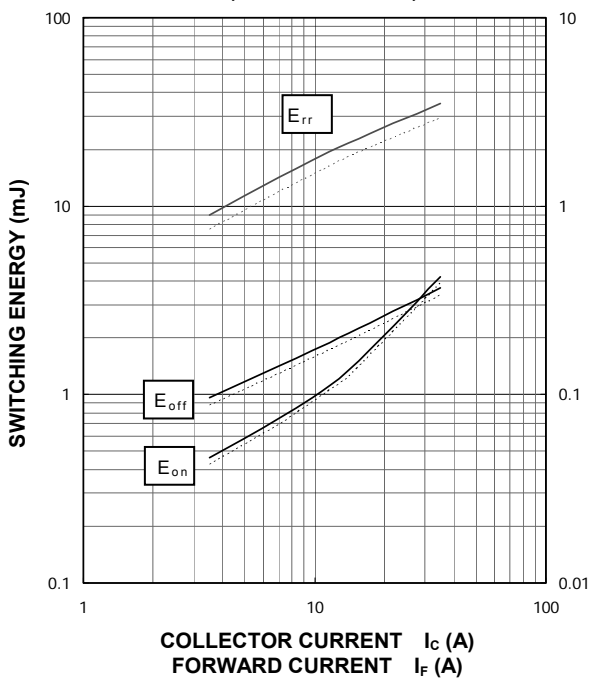


HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

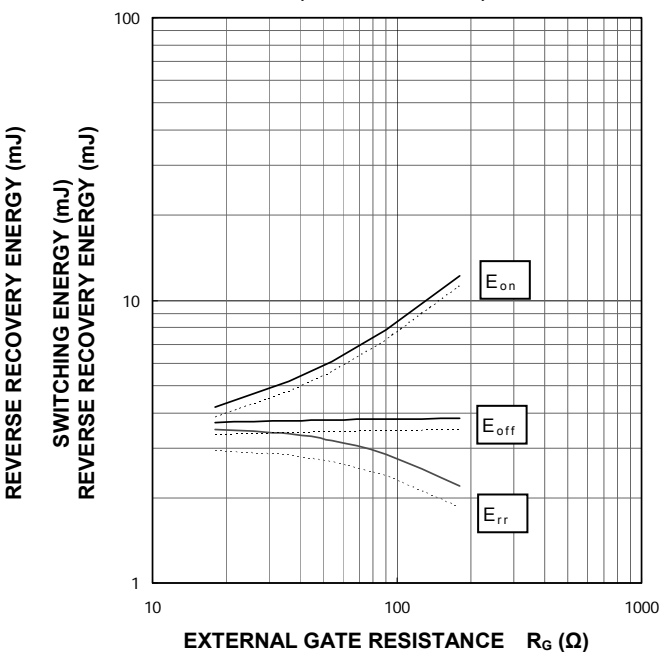
$V_{CC} = 600 \text{ V}$, $I_c = 35 \text{ A}$, $V_{GE} = \pm 15 \text{ V}$, INDUCTIVE LOAD
 —: $T_j = 150 \text{ }^\circ\text{C}$, - - - -: $T_j = 125 \text{ }^\circ\text{C}$



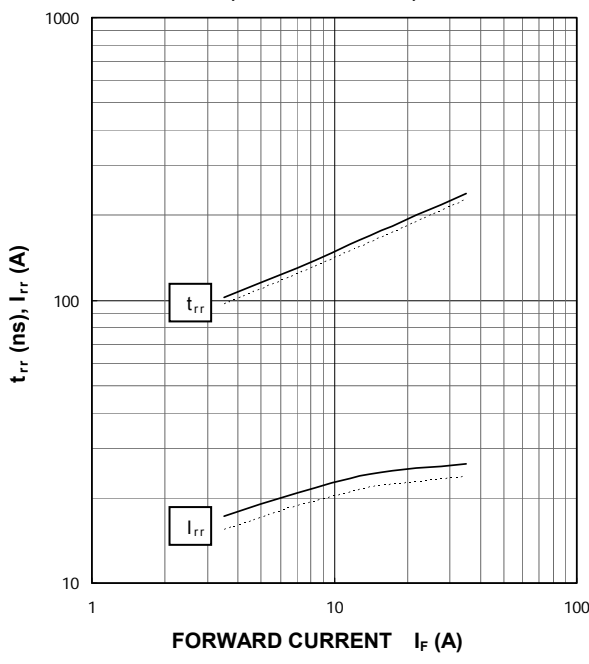
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)
 $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=18\ \Omega$,
 INDUCTIVE LOAD, PER PULSE
 ———: $T_j=150\text{ }^\circ\text{C}$, - - - - -: $T_j=125\text{ }^\circ\text{C}$



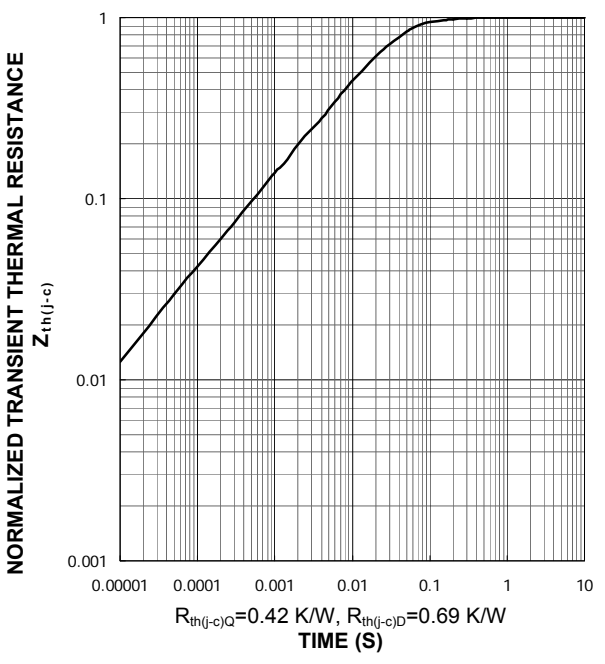
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)
 $V_{CC}=600\text{ V}$, $I_C/I_F=35\text{ A}$, $V_{GE}=\pm 15\text{ V}$,
 INDUCTIVE LOAD, PER PULSE
 ———: $T_j=150\text{ }^\circ\text{C}$, - - - - -: $T_j=125\text{ }^\circ\text{C}$



CLAMP DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)
 $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=18\ \Omega$, INDUCTIVE LOAD
 ———: $T_j=150\text{ }^\circ\text{C}$, - - - - -: $T_j=125\text{ }^\circ\text{C}$

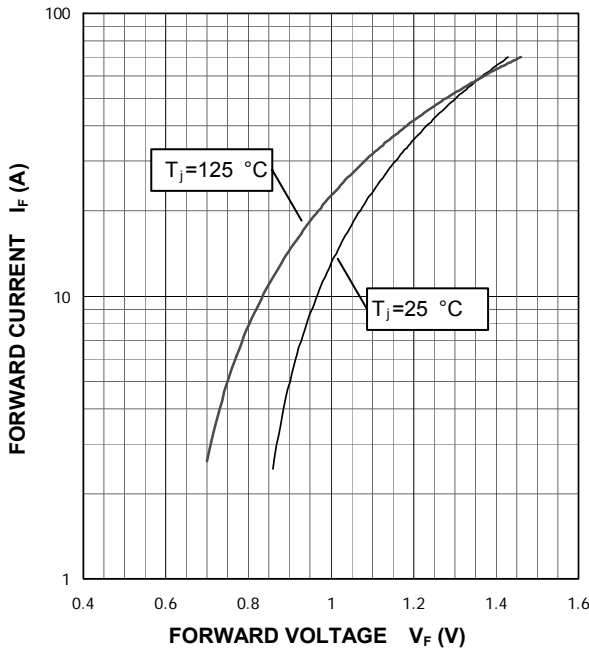


TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)
 Single pulse, $T_c=25\text{ }^\circ\text{C}$



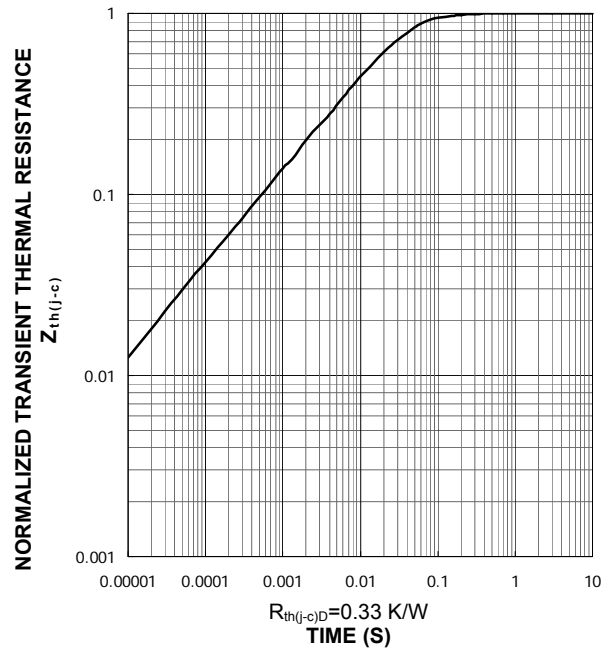
CONVERTER PART

CONVERTER DIODE
 FORWARD CHARACTERISTICS
 (TYPICAL)



TRANSIENT THERMAL IMPEDANCE
 CHARACTERISTICS
 (MAXIMUM)

Single pulse, $T_C = 25\text{ °C}$



Keep safety first in your circuit designs!

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Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

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