

< IGBT MODULES >

CM100MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPEABSOLUTE MAXIMUM RATINGS ($T_J=25\text{ }^{\circ}\text{C}$, unless otherwise specified)

INVERTER PART IGBT/DIODE

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, $T_C=119\text{ }^{\circ}\text{C}$ (Note2, 4)	100	A
I_{CRM}		Pulse, Repetitive (Note3)	200	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	750	W
I_E (Note1)	Emitter current	(Note2)	100	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	200	
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	$^{\circ}\text{C}$

BRAKE PART IGBT/DIODE

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, $T_C=125\text{ }^{\circ}\text{C}$ (Note2, 4)	50	A
I_{CRM}		Pulse, Repetitive (Note3)	100	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	425	W
V_{RRM}	Repetitive peak reverse voltage	G-E short-circuited	1200	V
I_F	Forward current	(Note2)	50	A
I_{FRM}		Pulse, Repetitive (Note3)	100	
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	$^{\circ}\text{C}$

CONVERTER PART DIODE

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, $T_C=125\text{ }^{\circ}\text{C}$ (Note4)	100	A
I_{FSM}	Surge forward current	The sine half wave 1 cycle peak value, $f=60\text{ Hz}$, non-repetitive	1000	A
I^2t	Current square time	Value for one cycle of surge current	4160	A^2s
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	150	$^{\circ}\text{C}$

MODULE

Symbol	Item	Conditions	Rating	Unit
V_{isol}	Isolation voltage	Terminals to base plate, RMS, $f=60\text{ Hz}$, AC 1 min	2500	V
T_{Cmax}	Maximum case temperature	(Note4)	125	$^{\circ}\text{C}$
T_{jop}	Operating junction temperature	Continuous operation (under switching)	-40 ~ +150	$^{\circ}\text{C}$
T_{stg}	Storage temperature	-	-40 ~ +125	

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	mass	-	-	300	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note5)	± 0	-	+100	μm

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CM100MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPEELECTRICAL CHARACTERISTICS (T_j=25 °C, unless otherwise specified)

INVERTER PART IGBT/DIODE

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} =V _{GES} , C-E short-circuited		-	-	0.5	μA
V _{GE(th)}	Gate-emitter threshold voltage	I _C =10 mA, V _{CE} =10 V		5.4	6.0	6.6	V
V _{CESat}	Collector-emitter saturation voltage	I _C =100 A ^(Note6) , V _{GE} =15 V, (Terminal)	T _J =25 °C	-	1.80	2.25	V
			T _J =125 °C	-	2.00	-	
			T _J =150 °C	-	2.05	-	
		I _C =100 A ^(Note6) , V _{GE} =15 V, (Chip)	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		-	-	10	nF
C _{oes}	Output capacitance			-	-	2.0	
C _{res}	Reverse transfer capacitance			-	-	0.17	
Q _G	Gate charge	V _{CC} =600 V, I _C =100 A, V _{GE} =15 V		-	233	-	nC
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =100 A, V _{GE} =±15 V, R _G =6.2 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} ^(Note1)	Emitter-collector voltage	I _E =100 A ^(Note6) , G-E short-circuited, (Terminal)	T _J =25 °C	-	1.80	2.25	V
			T _J =125 °C	-	1.80	-	
			T _J =150 °C	-	1.80	-	
		I _E =100 A ^(Note6) , G-E short-circuited, (Chip)	T _J =25 °C	-	1.70	2.15	V
			T _J =125 °C	-	1.70	-	
			T _J =150 °C	-	1.70	-	
t _{rr} ^(Note1)	Reverse recovery time	V _{CC} =600 V, I _E =100 A, V _{GE} =±15 V, R _G =6.2 Ω, Inductive load		-	-	300	ns
Q _{rr} ^(Note1)	Reverse recovery charge			-	5.3	-	
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =100 A, V _{GE} =±15 V, R _G =6.2 Ω, T _J =150 °C,		-	8.6	-	mJ
E _{off}	Turn-off switching energy per pulse			-	10.7	-	
E _{rr} ^(Note1)	Reverse recovery energy per pulse	Inductive load		-	10.2	-	mJ
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C ^(Note4)		-	-	3.5	mΩ
r _g	Internal gate resistance	Per switch		-	0	-	Ω

BRAKE PART IGBT/DIODE

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} =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}	Collector-emitter saturation voltage	I _C =50 A ^(Note6) , V _{GE} =15 V, (Terminal)	T _J =25 °C	-	1.80	2.25	V
			T _J =125 °C	-	2.00	-	
			T _J =150 °C	-	2.05	-	
		I _C =50 A ^(Note6) , V _{GE} =15 V, (Chip)	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	

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CM100MXA-24S

HIGH POWER SWITCHING USE
INSULATED TYPEELECTRICAL CHARACTERISTICS (cont.; $T_j=25\text{ }^{\circ}\text{C}$, unless otherwise specified)

BRAKE PART IGBT/DIODE

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$, $I_C=50\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=13\text{ }\Omega$, Inductive load	-	-	300	ns
t_r	Rise time		-	-	200	
$t_{d(off)}$	Turn-off delay time		-	-	600	
t_f	Fall time		-	-	300	
I_{RRM}	Reverse current	$V_R=V_{RRM}$, G-E short-circuited	-	-	1.0	mA
V_F	Forward voltage	$I_F=50\text{ A}$ (Note6), G-E short-circuited, (Terminal)	$T_j=25\text{ }^{\circ}\text{C}$	1.80	2.25	V
			$T_j=125\text{ }^{\circ}\text{C}$	1.80	-	
			$T_j=150\text{ }^{\circ}\text{C}$	1.80	-	
		$I_F=50\text{ A}$ (Note6), G-E short-circuited, (Chip)	$T_j=25\text{ }^{\circ}\text{C}$	1.70	2.15	V
			$T_j=125\text{ }^{\circ}\text{C}$	1.70	-	
			$T_j=150\text{ }^{\circ}\text{C}$	1.70	-	
t_{rr}	Reverse recovery time	$V_{CC}=600\text{ V}$, $I_F=50\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=13\text{ }\Omega$, Inductive load	-	-	300	ns
Q_{rr}	Reverse recovery charge		-	2.7	-	μC
E_{on}	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$, $I_C=I_F=50\text{ A}$,	-	5.5	-	mJ
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=13\text{ }\Omega$, $T_j=150\text{ }^{\circ}\text{C}$,	-	5.3	-	
E_{rr}	Reverse recovery energy per pulse	Inductive load	-	4.5	-	mJ
r_g	Internal gate resistance	-	-	0	-	Ω

CONVERTER PART DIODE

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
I_{RRM}	Repetitive peak reverse current	$V_R=V_{RRM}$, $T_j=150\text{ }^{\circ}\text{C}$	-	-	20	mA
V_F (Terminal)	Forward voltage	$I_F=100\text{ A}$ (Note6)	-	1.28	1.8	V

NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	Zero-power resistance	$T_C=25\text{ }^{\circ}\text{C}$ (Note4)	4.85	5.00	5.15	k Ω
$\Delta R/R$	Deviation of resistance	$R_{100}=493\text{ }\Omega$, $T_C=100\text{ }^{\circ}\text{C}$ (Note4)	-7.3	-	+7.8	%
$B_{(25/50)}$	B-constant	Approximate by equation (Note7)	-	3375	-	K
P_{25}	Power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note4)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance (Note4)	Junction to case, per Inverter IGBT	-	-	0.20	K/W
$R_{th(j-c)D}$		Junction to case, per Inverter DIODE	-	-	0.29	
$R_{th(j-c)Q}$		Junction to case, per Brake IGBT	-	-	0.35	K/W
$R_{th(j-c)D}$		Junction to case, per Brake DIODE	-	-	0.63	
$R_{th(j-c)D}$		Junction to case, per Converter DIODE	-	-	0.24	K/W
$R_{th(c-s)}$	Contact thermal resistance (Note4)	Case to heat sink, per 1 module, Thermal grease applied (Note8)	-	15	-	K/kW

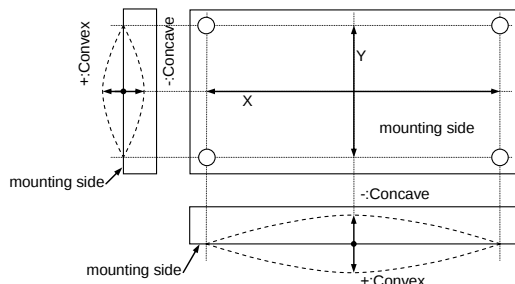
< IGBT MODULES >

CM100MXA-24S

HIGH POWER SWITCHING USE INSULATED TYPE

Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).

- Junction temperature (T_j) should not increase beyond T_{jmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
- 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.
- The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



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

$$7. B_{(25/50)} = \ln \left(\frac{R_{25}}{R_{50}} \right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}} \right),$$

R_{25} : resistance at absolute temperature T_{25} [K]; $T_{25}=25 [^{\circ}\text{C}]+273.15=298.15$ [K]

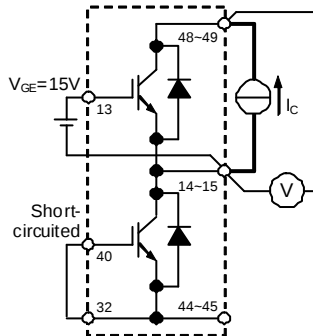
R_{50} : resistance at absolute temperature T_{50} [K]; $T_{50}=50 [^{\circ}\text{C}]+273.15=323.15$ [K]

- Typical value is measured by using thermally conductive grease of $\lambda=0.9$ W/(m·K).
- Use the following screws when mounting the printed circuit board (PCB) on the stand offs.
"φ2.6×10 or φ2.6×12 self tapping screw"
The length of the screw depends on the thickness (t1.6~t2.0) of the PCB.

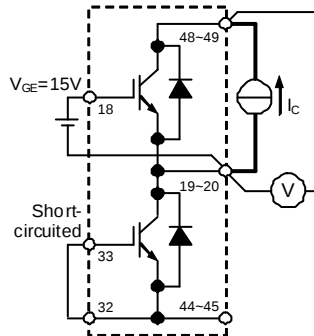
RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across P-N/P1-N1 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				Ω
		Inverter IGBT	6.2	-	62	
		Brake IGBT	13	-	130	

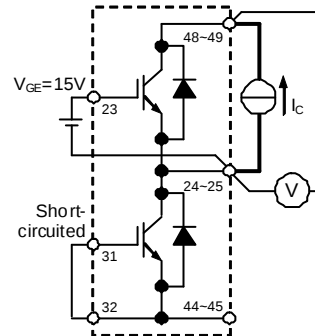
TEST CIRCUIT



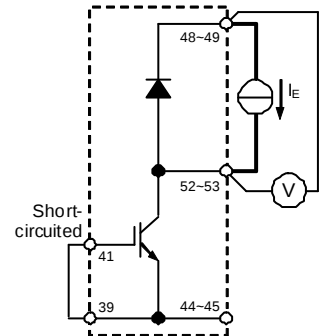
G-E short-circuited
UP / UN IGBT



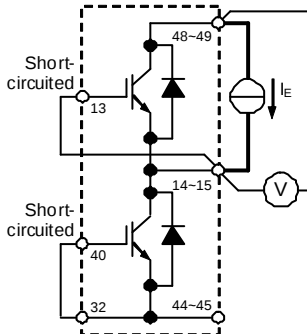
G-E short-circuited
VP / VN IGBT



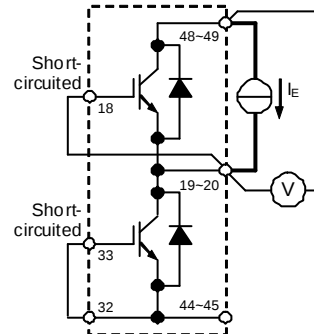
G-E short-circuited
WP / WN IGBT



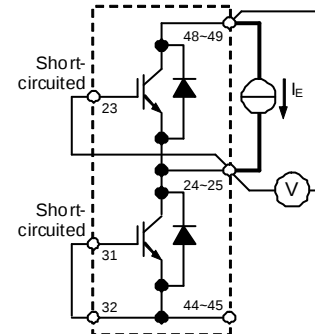
G-E short-circuited
Brake IGBT / DIODE

 V_{CEsat} / BRAKE DIODE V_F test circuit

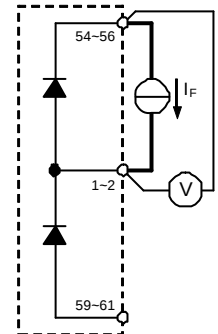
G-E short-circuited
UP / UN DIODE



G-E short-circuited
VP / VN DIODE



G-E short-circuited
WP / WN DIODE



CONVERTER DIODE (ex. phase-R)

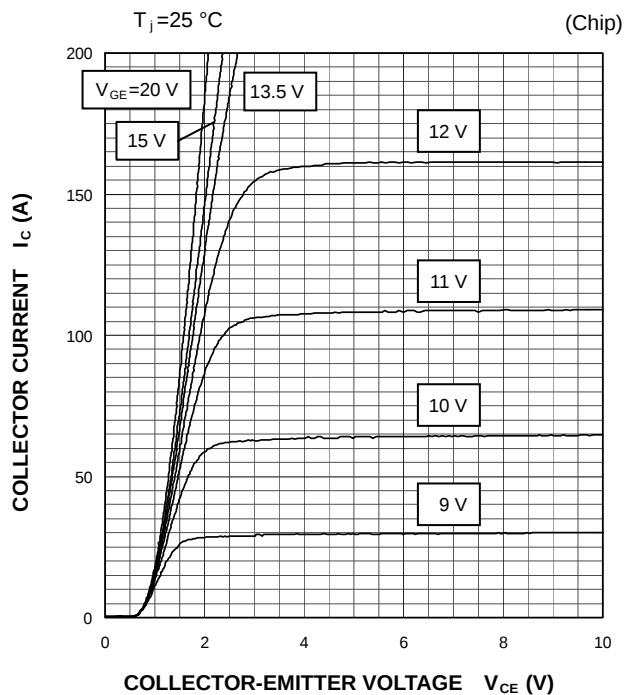
 V_{EC} / CONVERTER DIODE V_F test circuit

* In the above test circuit, should use all three main pin terminals (P1/N1/P/N/U/V/W) for connection with the terminals and the current source.

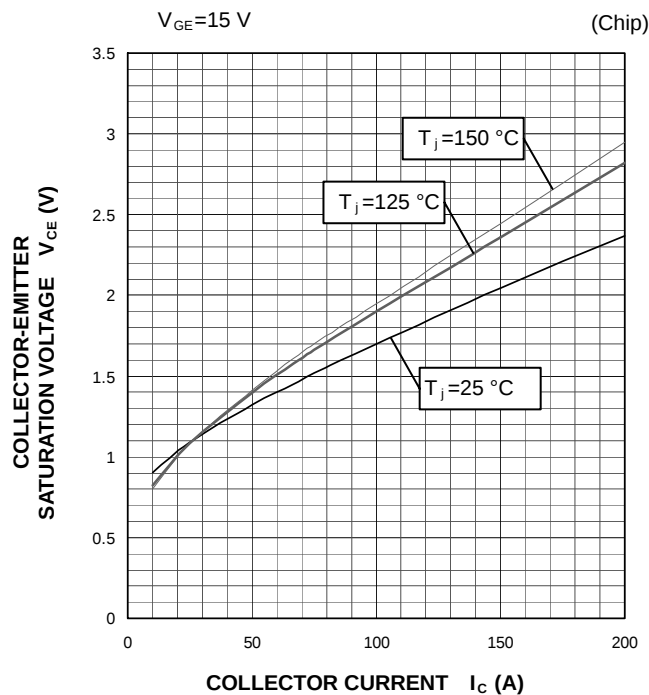
PERFORMANCE CURVES

INVERTER PART

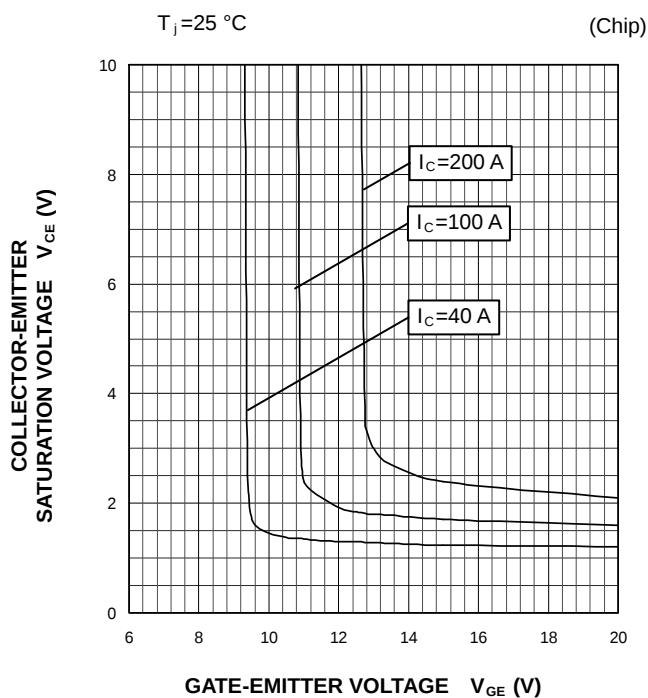
OUTPUT CHARACTERISTICS
(TYPICAL)



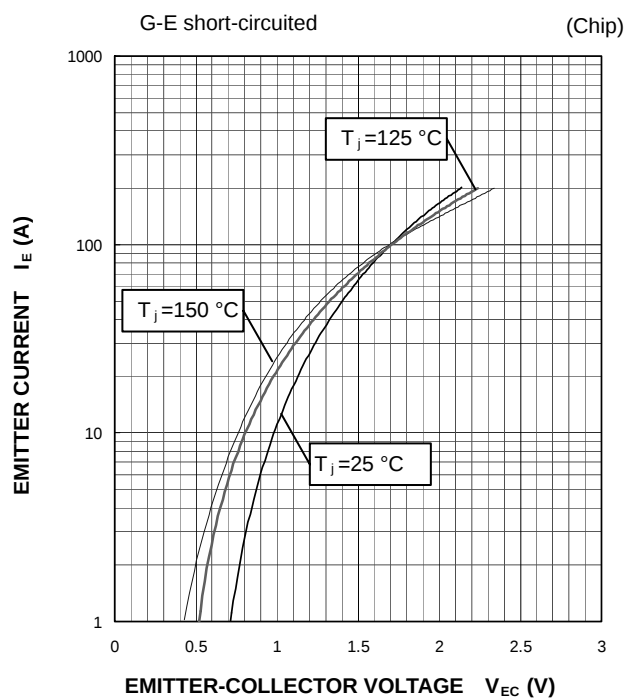
COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)

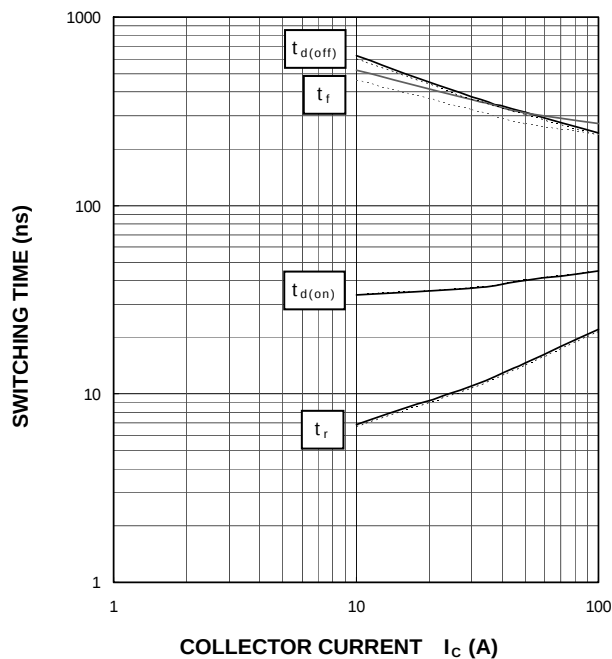


PERFORMANCE CURVES

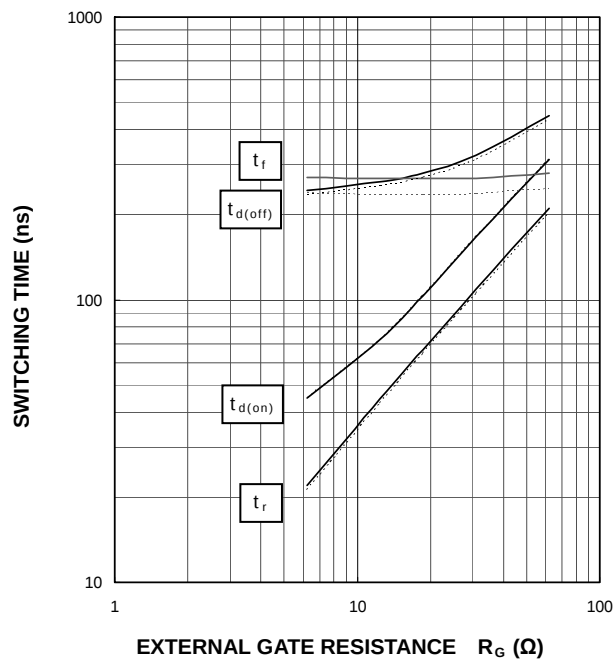
INVERTER PART

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

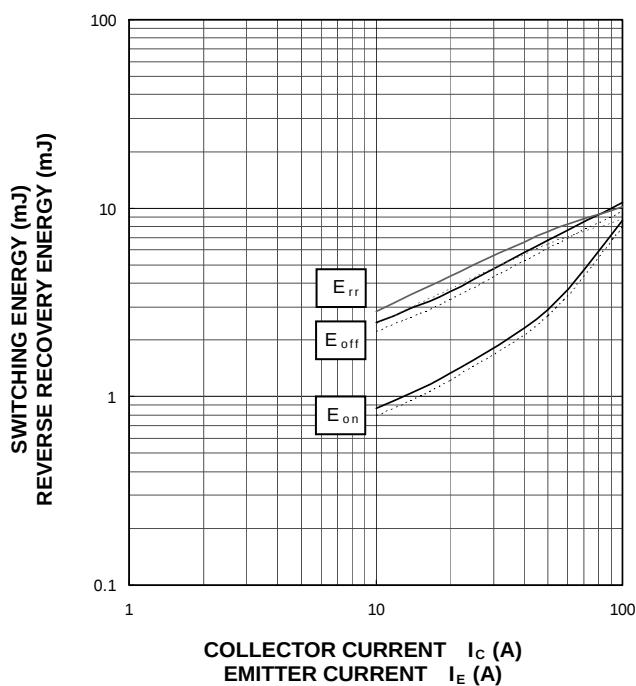
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=6.2\ \Omega$, INDUCTIVE LOAD
 —: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

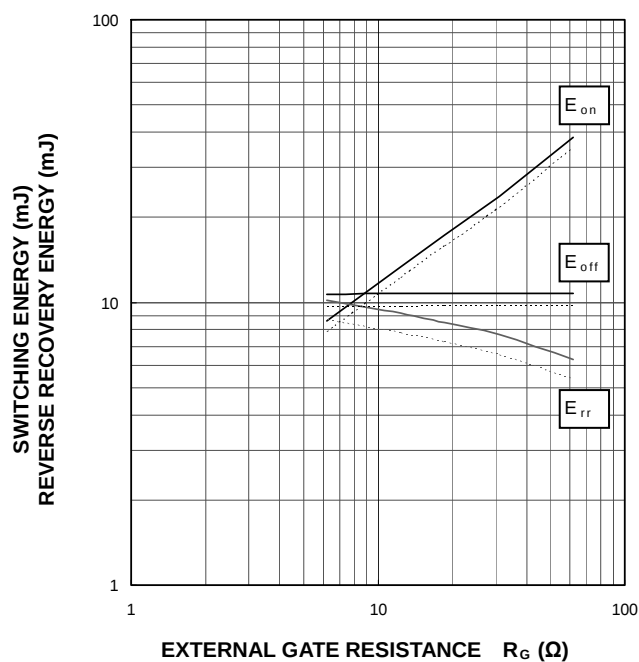
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=100\text{ A}$, INDUCTIVE LOAD
 —: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=6.2\ \Omega$,
INDUCTIVE LOAD, PER PULSE
 —: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$

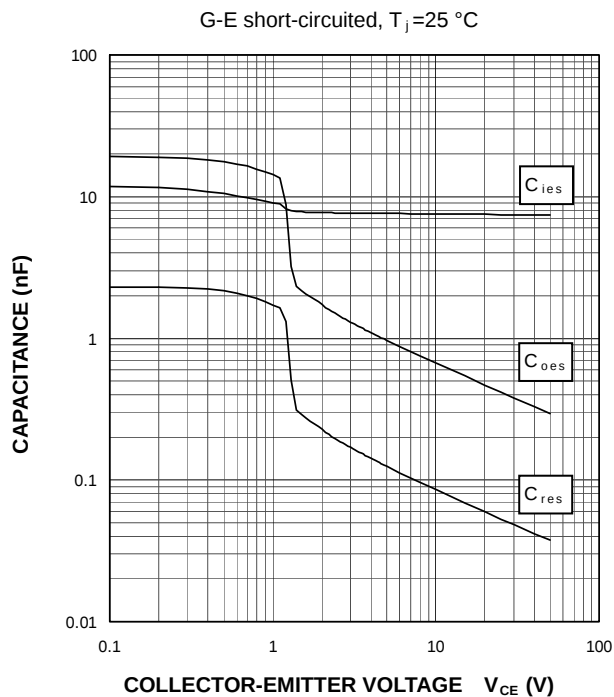
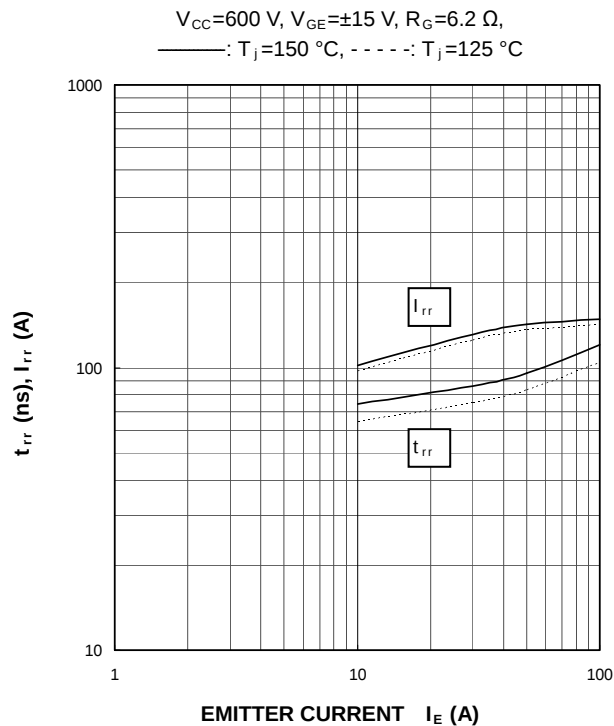
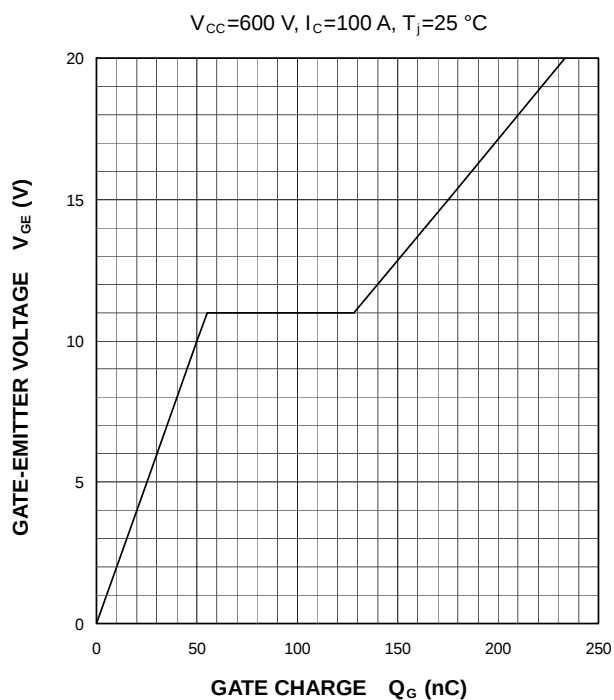
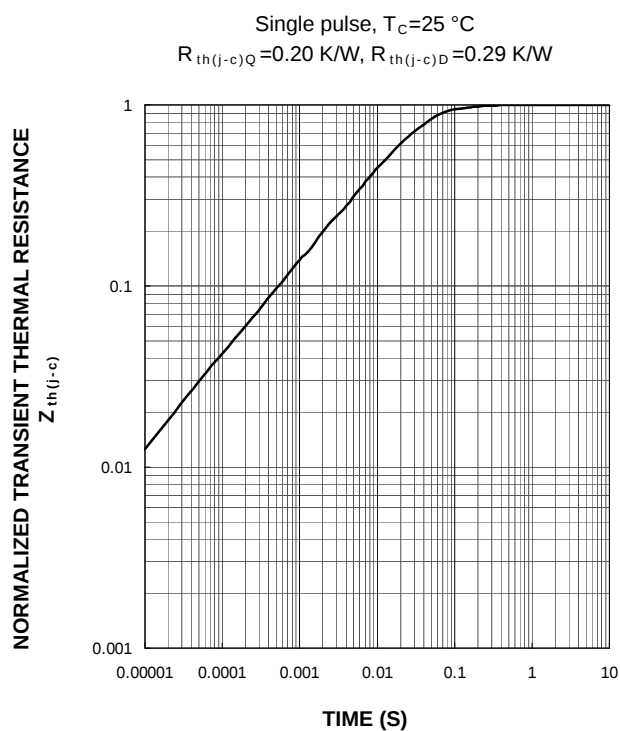
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=100\text{ A}$,
INDUCTIVE LOAD, PER PULSE
 —: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$



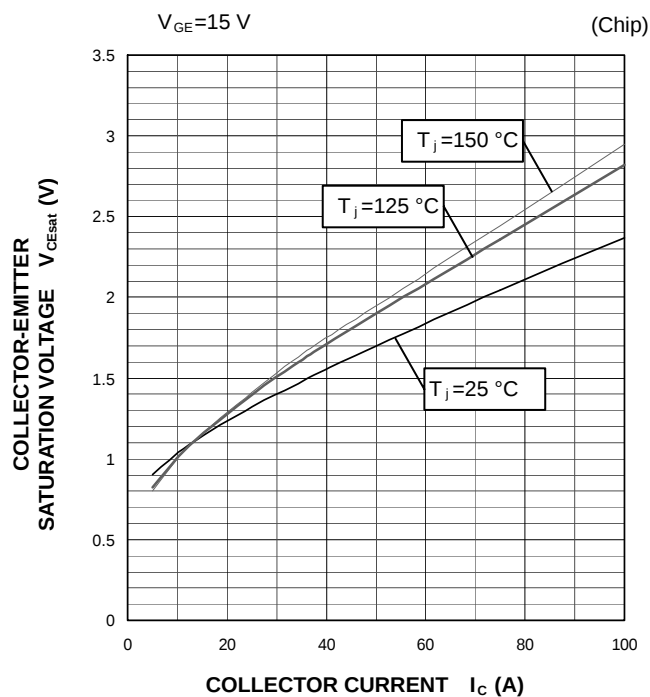
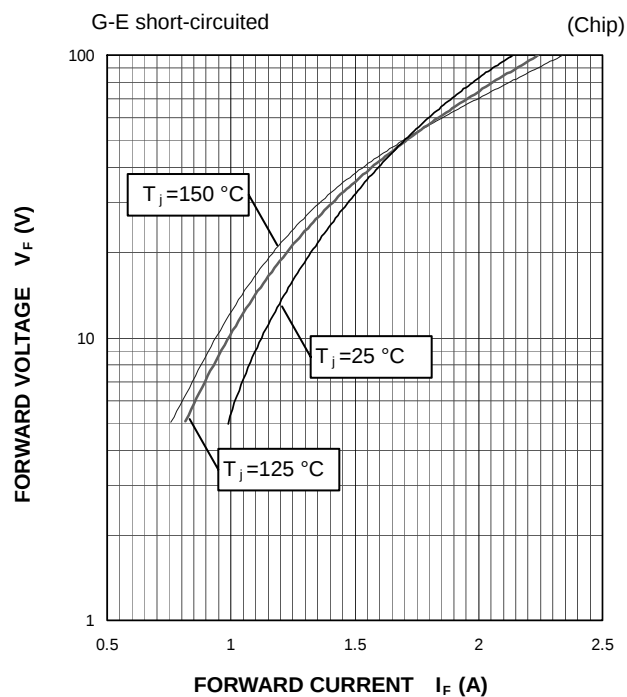
PERFORMANCE CURVES

INVERTER PART

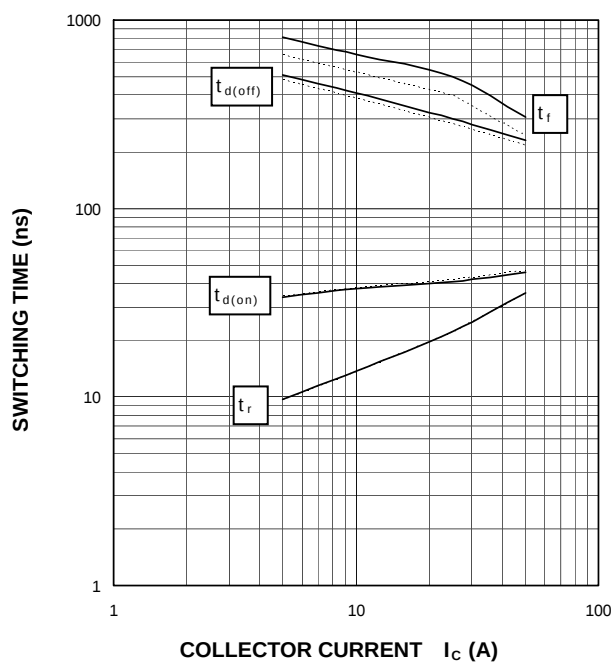
CAPACITANCE CHARACTERISTICS
(TYPICAL)FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)GATE CHARGE CHARACTERISTICS
(TYPICAL)TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

PERFORMANCE CURVES

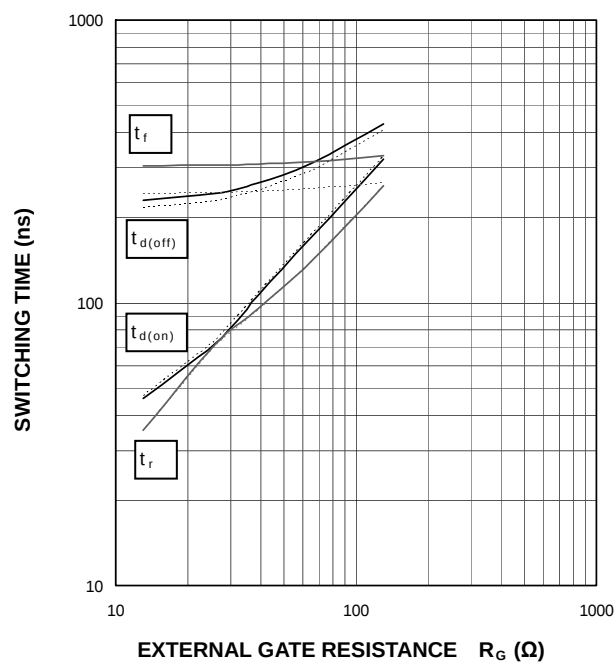
BRAKE PART

COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)CLAMP DIODE
FORWARD CHARACTERISTICS
(TYPICAL)HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



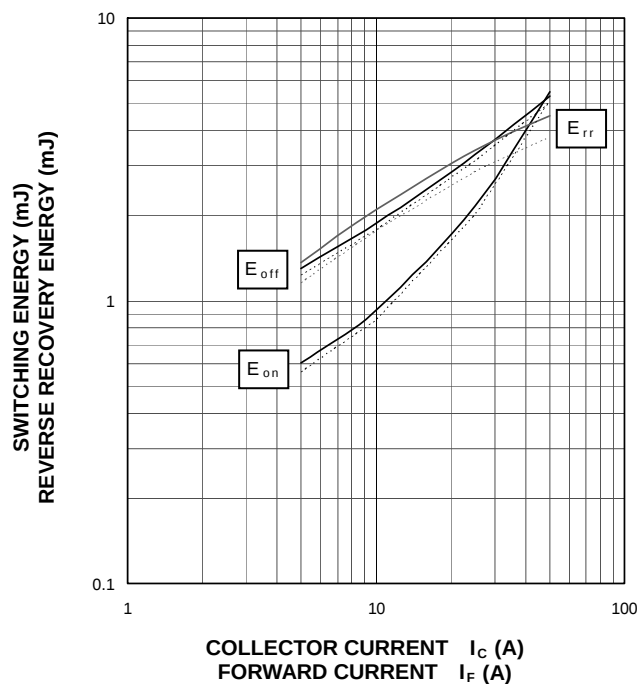
PERFORMANCE CURVES

BRAKE PART

HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=13\ \Omega$,
INDUCTIVE LOAD, PER PULSE

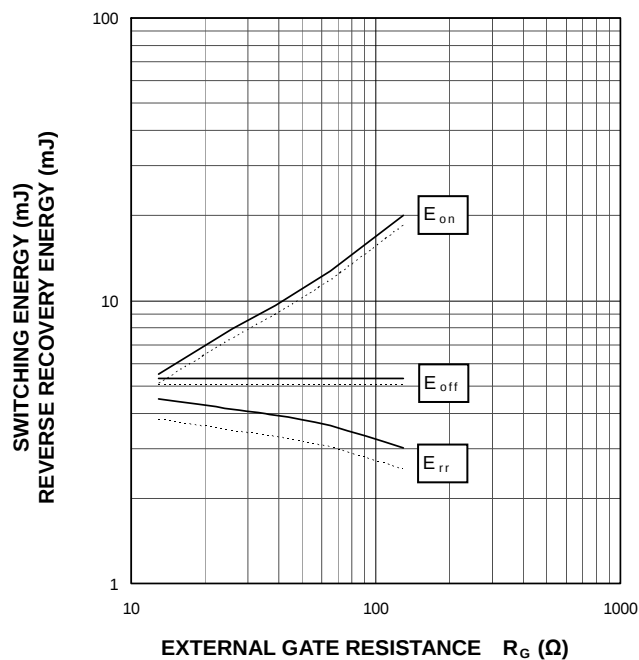
—: $T_J=150\text{ }^\circ\text{C}$, - - - - -: $T_J=125\text{ }^\circ\text{C}$



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $I_C/I_F=50\text{ A}$, $V_{GE}=\pm 15\text{ V}$,
INDUCTIVE LOAD, PER PULSE

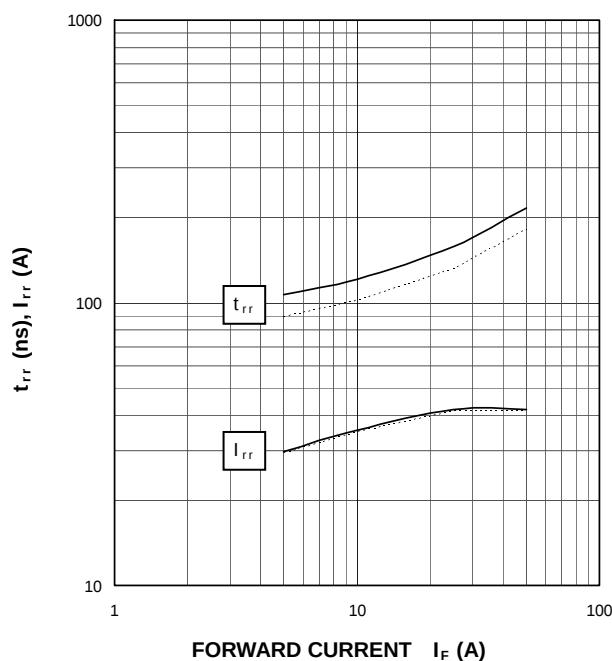
—: $T_J=150\text{ }^\circ\text{C}$, - - - - -: $T_J=125\text{ }^\circ\text{C}$



CLAMP DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=13\ \Omega$, INDUCTIVE LOAD

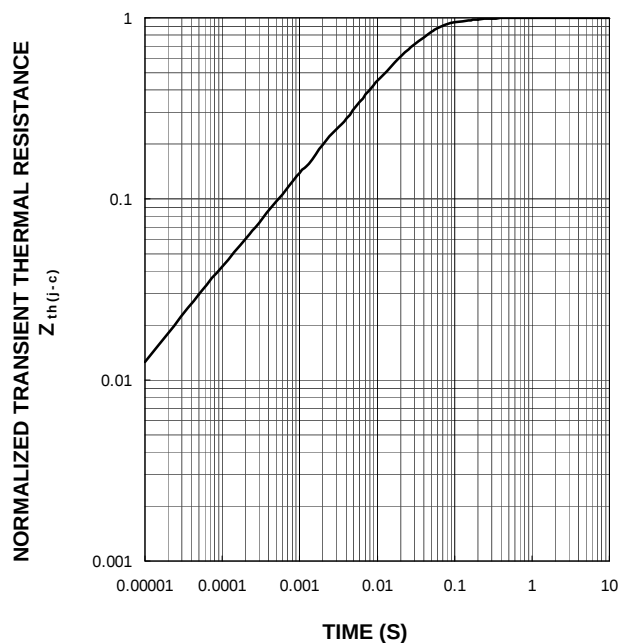
—: $T_J=150\text{ }^\circ\text{C}$, - - - - -: $T_J=125\text{ }^\circ\text{C}$



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

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

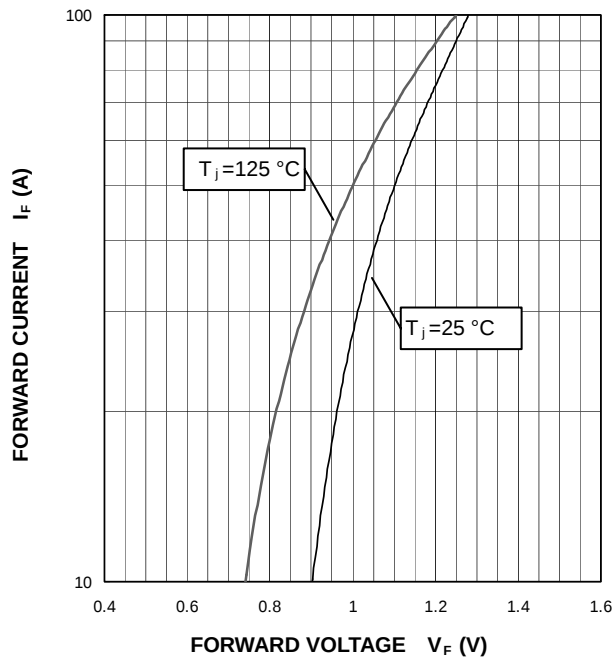
$R_{th(j-c)Q}=0.35\text{ K/W}$, $R_{th(j-c)D}=0.63\text{ K/W}$



PERFORMANCE CURVES

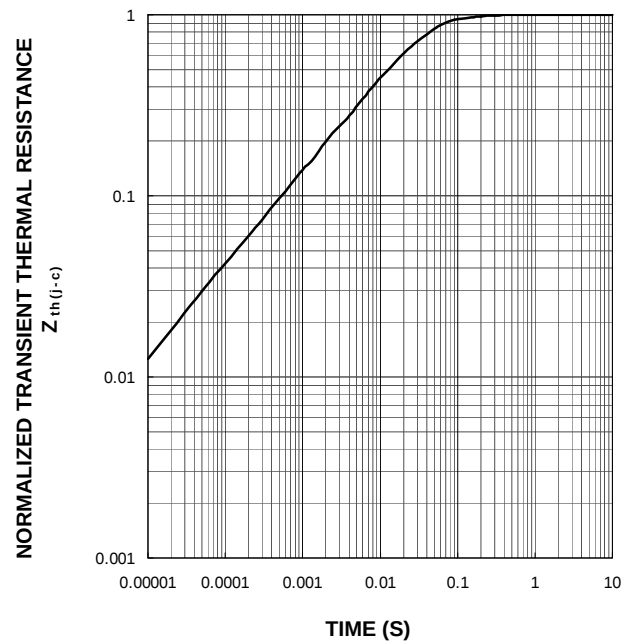
CONVERTER PART

CONVERTER DIODE
FORWARD CHARACTERISTICS
(TYPICAL)



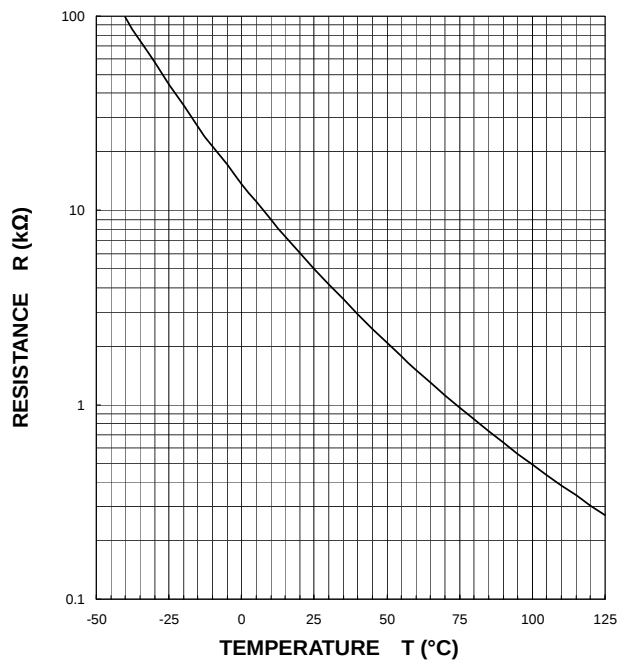
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

Single pulse, $T_C = 25\text{ °C}$
 $R_{th(j-c)D} = 0.24\text{ K/W}$



NTC thermistor part

TEMPERATURE CHARACTERISTICS
(TYPICAL)



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