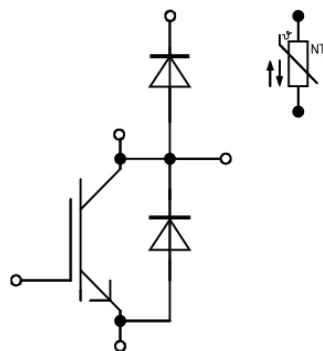


PrimePACK™3 モジュール トレンチ/フィールドストップ IGBT4 and エミッターコントロール4 diode内蔵
PrimePACK™3 module with Trench/Fieldstop IGBT4, enlarged Emitter Controlled 4 diode

暫定データ / Preliminary Data



$V_{CES} = 1200V$
 $I_{C\ nom} = 1400A / I_{CRM} = 2800A$

一般応用

- チョッパアプリケーション

電気的特性

- 拡張された動作温度 $T_{vj\ op}$
- 高いDC電圧での安定性
- 高い短絡電流耐量、自己抑制型短絡電流
- 正温度特性を持った V_{CESat} 飽和電圧
- 低 V_{CESat} 飽和電圧

機械的特性

- 4 kV AC 1分 絶縁耐圧
- CTI(比較トラッキング指数) >400のモジュールパッケージ
- 長い縁面/空間距離
- 高いパワー/サーマルサイクル耐量
- 高いパワー密度
- 低熱インピーダンスのDCB

Typical Applications

- Chopper Applications

Electrical Features

- Extended Operation Temperature $T_{vj\ op}$
- High DC Stability
- High Short Circuit Capability, Self Limiting Short Circuit Current
- V_{CESat} with positive Temperature Coefficient
- Low V_{CESat}

Mechanical Features

- 4 kV AC 1min Insulation
- Package with CTI > 400
- High Creepage and Clearance Distances
- High Power and Thermal Cycling Capability
- High Power Density
- Substrate for Low Thermal Resistance

Module Label Code

Barcode Code 128



DMX - Code



Content of the Code

Content of the Code	Digit
Module Serial Number	1 - 5
Module Material Number	6 - 11
Production Order Number	12 - 19
Datecode (Production Year)	20 - 21
Datecode (Production Week)	22 - 23

prepared by: AC	date of publication: 2013-11-05	
approved by: MS	revision: 2.2	UL approved (E83335)



暫定データ
Preliminary Data

IGBT、チヨッパ- / IGBT-Chopper
最大定格 / Maximum Rated Values

コレクタ・エミッタ間電圧 Collector-emitter voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{CES}	1200	V
連続DCコレクタ電流 Continuous DC collector current	$T_C = 100^{\circ}\text{C}, T_{vj\max} = 175^{\circ}\text{C}$	$I_{C\text{nom}}$	1400	A
繰り返しピークコレクタ電流 Repetitive peak collector current	$t_P = 1\text{ms}$	I_{CRM}	2800	A
トータル損失 Total power dissipation	$T_C = 25^{\circ}\text{C}, T_{vj\max} = 175^{\circ}\text{C}$	P_{tot}	7,70	kW
ゲート・エミッタ間ピーク電圧 Gate-emitter peak voltage		V_{GES}	+/-20	V

電気的特性 / Characteristic Values

			min.	typ.	max.		
コレクタ・エミッタ間飽和電圧 Collector-emitter saturation voltage	$I_C = 1400\text{A}, V_{GE} = 15\text{V}$ $I_C = 1400\text{A}, V_{GE} = 15\text{V}$ $I_C = 1400\text{A}, V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$V_{CE\text{sat}}$	1,75 2,05 2,15	2,10	V V V	
ゲート・エミッタ間しきい値電圧 Gate threshold voltage	$I_C = 49,0\text{mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$		V_{GEth}	5,0	5,8	6,5	V
ゲート電荷量 Gate charge	$V_{GE} = -15\text{V} \dots +15\text{V}$		Q_G	9,60			μC
内蔵ゲート抵抗 Internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$		R_{Gint}	0,8			Ω
入力容量 Input capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		C_{ies}	82,0			nF
帰還容量 Reverse transfer capacitance	$f = 1\text{MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{V}, V_{GE} = 0\text{V}$		C_{res}	4,60			nF
コレクタ・エミッタ間遮断電流 Collector-emitter cut-off current	$V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$		I_{CES}			5,0	mA
ゲート・エミッタ間漏れ電流 Gate-emitter leakage current	$V_{CE} = 0\text{V}, V_{GE} = 20\text{V}, T_{vj} = 25^{\circ}\text{C}$		I_{GES}			400	nA
ターンオン遅れ時間 (誘導負荷) Turn-on delay time, inductive load	$I_C = 1400\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Gon} = 1,0\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_{don}	0,20 0,21 0,21			μs μs μs
ターンオン上昇時間 (誘導負荷) Rise time, inductive load	$I_C = 1400\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Gon} = 1,0\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_r	0,12 0,13 0,13			μs μs μs
ターンオフ遅れ時間 (誘導負荷) Turn-off delay time, inductive load	$I_C = 1400\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Goff} = 1,0\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_{doff}	0,87 0,95 0,97			μs μs μs
ターンオフ下降時間 (誘導負荷) Fall time, inductive load	$I_C = 1400\text{A}, V_{CE} = 600\text{V}$ $V_{GE} = \pm 15\text{V}$ $R_{Goff} = 1,0\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_f	0,20 0,23 0,23			μs μs μs
ターンオンスイッチング損失 Turn-on energy loss per pulse	$I_C = 1400\text{A}, V_{CE} = 600\text{V}, L_S = 30\text{nH}$ $V_{GE} = \pm 15\text{V}, di/dt = 8600\text{A}/\mu\text{s} (T_{vj} = 150^{\circ}\text{C})$ $R_{Gon} = 1,0\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{on}	65,0 80,0 95,0			mJ mJ mJ
ターンオフスイッチング損失 Turn-off energy loss per pulse	$I_C = 1400\text{A}, V_{CE} = 600\text{V}, L_S = 30\text{nH}$ $V_{GE} = \pm 15\text{V}, du/dt = 2700\text{V}/\mu\text{s} (T_{vj} = 150^{\circ}\text{C})$ $R_{Goff} = 1,0\Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{off}	180 250 280			mJ mJ mJ
短絡電流 SC data	$V_{GE} \leq 15\text{V}, V_{CC} = 800\text{V}$ $V_{CE\text{max}} = V_{CES} - L_{SCE} \cdot di/dt$ $t_P \leq 10\mu\text{s}, T_{vj} = 150^{\circ}\text{C}$		I_{SC}	5600			A
ジャンクション・ケース間熱抵抗 Thermal resistance, junction to case	IGBT部 (1素子当り) / per IGBT		R_{thJC}			19,5	K/kW
ケース・ヒートシンク間熱抵抗 Thermal resistance, case to heatsink	IGBT部 (1素子当り) / per IGBT $\lambda_{\text{Paste}} = 1\text{W}/(\text{m}\cdot\text{K})$ / $\lambda_{\text{grease}} = 1\text{W}/(\text{m}\cdot\text{K})$		R_{thCH}	9,30			K/kW
動作温度 Temperature under switching conditions			$T_{vj\text{op}}$	-40		150	$^{\circ}\text{C}$

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暫定データ
Preliminary Data

Diode-、チヨツパー / Diode-Chopper
最大定格 / Maximum Rated Values

ピーク繰返し逆電圧 Repetitive peak reverse voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{RRM}	1200	V
連続DC電流 Continuous DC forward current		I_F	1400	A
ピーク繰返し順電流 Repetitive peak forward current	$t_p = 1\text{ ms}$	I_{FRM}	2800	A
電流二乗時間積 I^2t - value	$V_R = 0\text{ V}, t_p = 10\text{ ms}, T_{vj} = 125^{\circ}\text{C}$ $V_R = 0\text{ V}, t_p = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$	I^2t	270 260	kA^2s kA^2s

電気的特性 / Characteristic Values

			min.	typ.	max.	
順電圧 Forward voltage	$I_F = 1400\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 1400\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 1400\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	V_F	1,65 1,55 1,55	2,15	V V V
ピーク逆回復電流 Peak reverse recovery current	$I_F = 1400\text{ A}, -di_F/dt = 8600\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 600\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	I_{RM}	1000 1200 1250		A A A
逆回復電荷量 Recovered charge	$I_F = 1400\text{ A}, -di_F/dt = 8600\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 600\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	Q_r	170 300 330		μC μC μC
逆回復損失 Reverse recovery energy	$I_F = 1400\text{ A}, -di_F/dt = 8600\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 600\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{rec}	80,0 140 160		mJ mJ mJ
ジャンクション・ケース間熱抵抗 Thermal resistance, junction to case	/Diode (1 素子当り) / per diode		R_{thJC}		25,0	K/kW
ケース・ヒートシンク間熱抵抗 Thermal resistance, case to heatsink	/Diode (1 素子当り) / per diode $\lambda_{Paste} = 1\text{ W}/(\text{m}\cdot\text{K}) / \lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		R_{thCH}	17,0		K/kW
動作温度 Temperature under switching conditions			$T_{vj op}$	-40	150	$^{\circ}\text{C}$

Diode、リバーズ / Diode, Reverse
最大定格 / Maximum Rated Values

ピーク繰返し逆電圧 Repetitive peak reverse voltage	$T_{vj} = 25^{\circ}\text{C}$	V_{RRM}	1200	V
連続DC電流 Continuous DC forward current		I_F	180	A
ピーク繰返し順電流 Repetitive peak forward current	$t_p = 1\text{ ms}$	I_{FRM}	360	A
電流二乗時間積 I^2t - value	$V_R = 0\text{ V}, t_p = 10\text{ ms}, T_{vj} = 125^{\circ}\text{C}$	I^2t	0,23	kA^2s

電気的特性 / Characteristic Values

			min.	typ.	max.	
順電圧 Forward voltage	$I_F = 180\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 180\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	V_F	1,65 1,65	2,15	V V
ジャンクション・ケース間熱抵抗 Thermal resistance, junction to case	/Diode (1 素子当り) / per diode		R_{thJC}		225	K/kW
ケース・ヒートシンク間熱抵抗 Thermal resistance, case to heatsink	/Diode (1 素子当り) / per diode $\lambda_{Paste} = 1\text{ W}/(\text{m}\cdot\text{K}) / \lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		R_{thCH}	120		K/kW
動作温度 Temperature under switching conditions			$T_{vj op}$	-40	150	$^{\circ}\text{C}$

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暫定データ
Preliminary Data

NTC-サーミスタ / NTC-Thermistor
電気的特性 / Characteristic Values

			min.	typ.	max.	
定格抵抗値 Rated resistance	$T_C = 25^\circ\text{C}$	R_{25}		5,00		k Ω
R100の偏差 Deviation of R100	$T_C = 100^\circ\text{C}, R_{100} = 493 \Omega$	$\Delta R/R$	-5		5	%
損失 Power dissipation	$T_C = 25^\circ\text{C}$	P_{25}			20,0	mW
B-定数 B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$	$B_{25/50}$		3375		K
B-定数 B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$	$B_{25/80}$		3411		K
B-定数 B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$	$B_{25/100}$		3433		K

適切なアプリケーションノートによる仕様
Specification according to the valid application note.

モジュール / Module

絶縁耐圧 Isolation test voltage	RMS, f = 50 Hz, t = 1 min.	V_{ISOL}		4,0		kV
ベースプレート材質 Material of module baseplate				Cu		
内部絶縁 Internal isolation	基礎絶縁 (クラス1, IEC 61140) basic insulation (class 1, IEC 61140)			Al_2O_3		
沿面距離 Creepage distance	連絡方法 - ヒートシンク / terminal to heatsink 連絡方法 - 連絡方法 / terminal to terminal			33,0 33,0		mm
空間距離 Clearance	連絡方法 - ヒートシンク / terminal to heatsink 連絡方法 - 連絡方法 / terminal to terminal			19,0 19,0		mm
相対トラッキング指数 Comperative tracking index		CTI		> 400		
			min.	typ.	max.	
内部インダクタンス Stray inductance module		L_{SCE}		10		nH
パワーターミナル・チップ間抵抗 Module lead resistance, terminals - chip	$T_C = 25^\circ\text{C}, / \text{スイッチ} / \text{per switch}$	R_{CC+EE}		0,20		m Ω
保存温度 Storage temperature		T_{stg}	-40		150	$^\circ\text{C}$
取り付けネジ締め付けトルク Mounting torque for modul mounting	取り付けネジ M5 適切なアプリケーションノートによるマウンティング Screw M5 - Mounting according to valid application note	M	3,00	-	6,00	Nm
主端子ネジ締め付けトルク Terminal connection torque	取り付けネジ M4 適切なアプリケーションノートによるマウンティング Screw M4 - Mounting according to valid application note 取り付けネジ M8 適切なアプリケーションノートによるマウンティング Screw M8 - Mounting according to valid application note	M	1,8 8,0	- -	2,1 10	Nm Nm
質量 Weight		G		1200		g

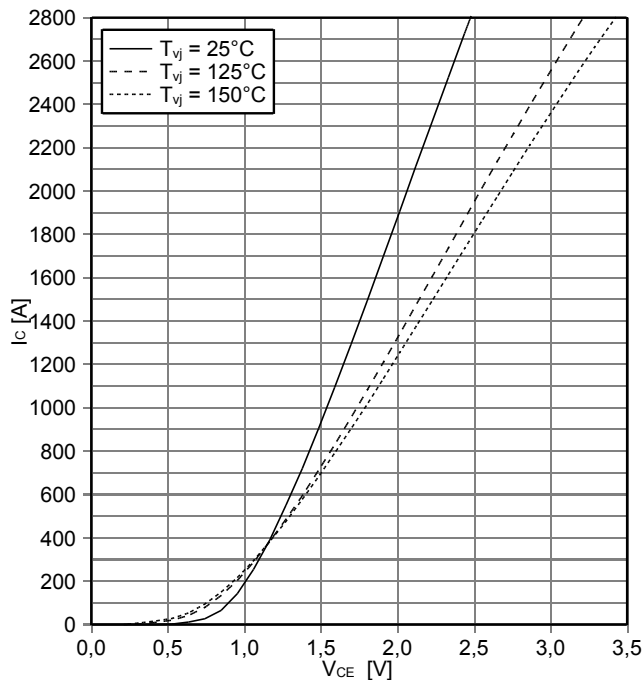
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暫定データ
Preliminary Data

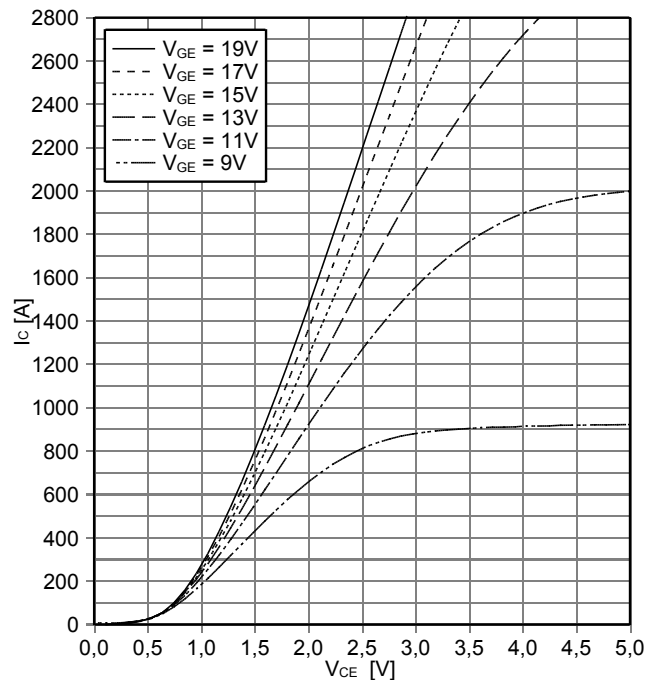
出力特性 IGBT、チヨッパー (Typical)
output characteristic IGBT-Chopper (typical)

$I_c = f(V_{CE})$
 $V_{GE} = 15\text{ V}$



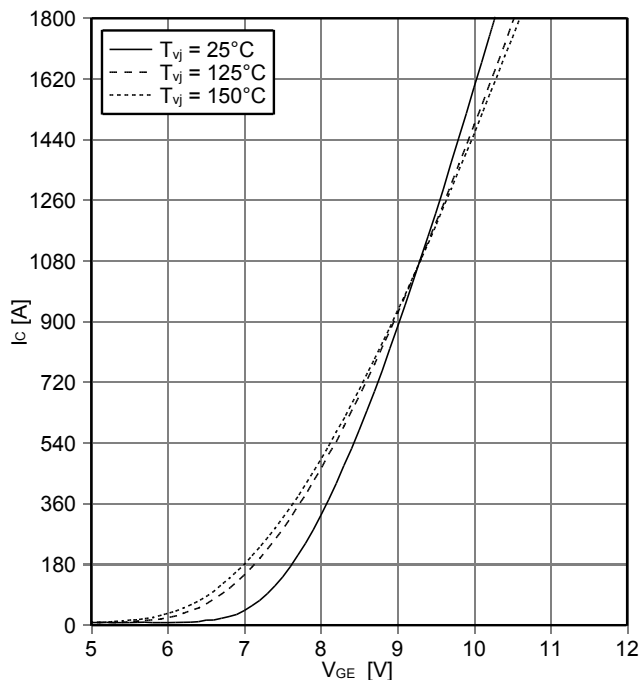
出力特性 IGBT、チヨッパー (Typical)
output characteristic IGBT-Chopper (typical)

$I_c = f(V_{CE})$
 $T_{vj} = 150^\circ\text{C}$



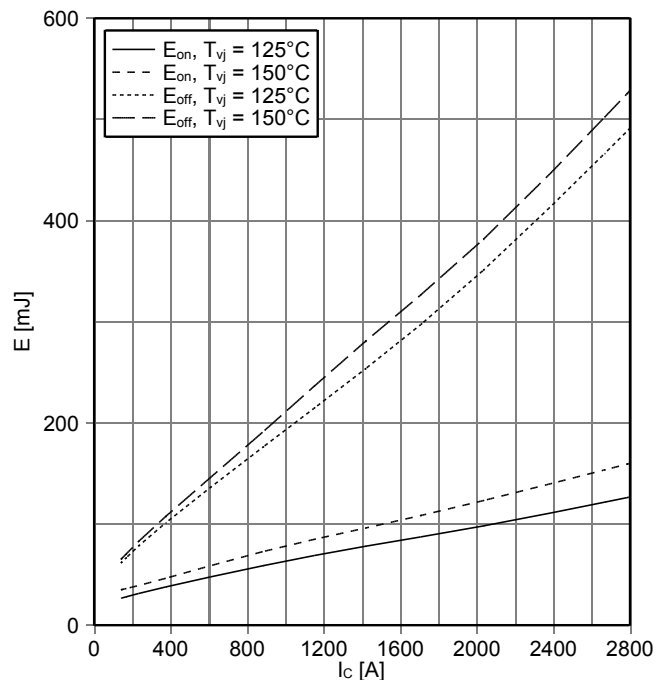
伝達特性 IGBT、チヨッパー (Typical)
transfer characteristic IGBT-Chopper (typical)

$I_c = f(V_{GE})$
 $V_{CE} = 20\text{ V}$



スイッチング損失 IGBT、チヨッパー (Typical)
switching losses IGBT-Chopper (typical)

$E_{on} = f(I_c)$, $E_{off} = f(I_c)$
 $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 1\ \Omega$, $R_{Goff} = 1\ \Omega$, $V_{CE} = 600\text{ V}$



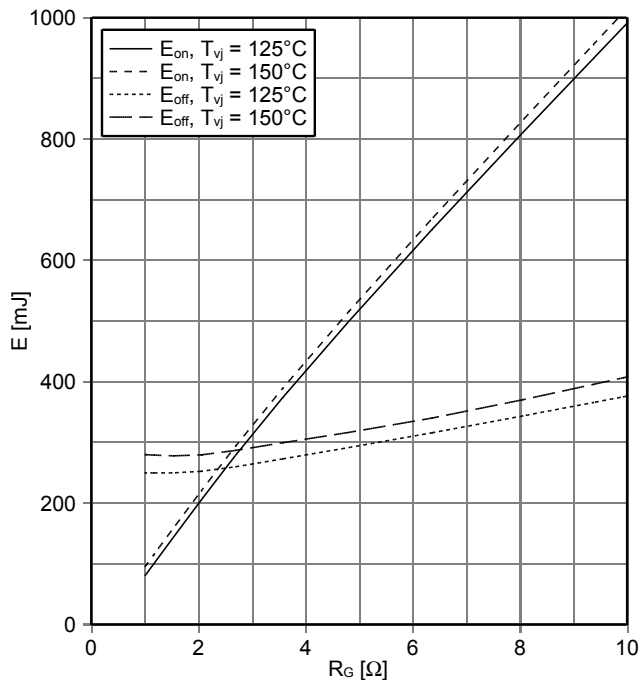
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暫定データ
Preliminary Data

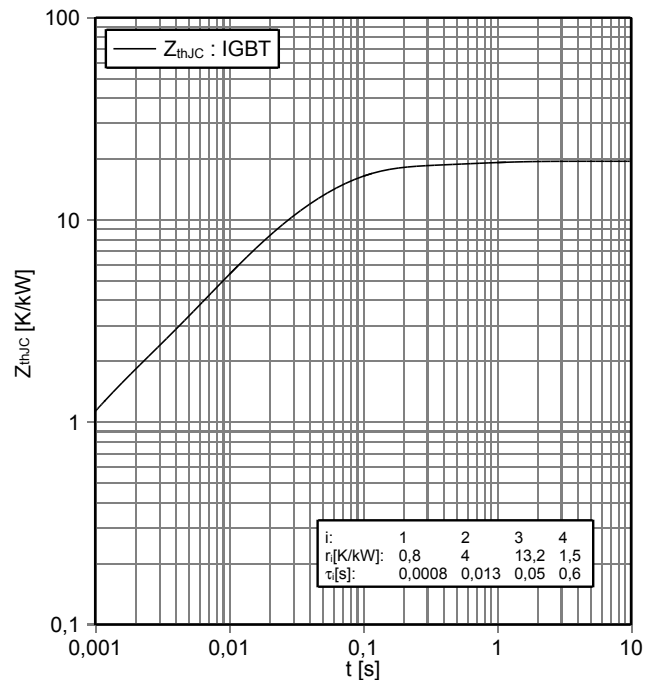
スイッチング損失 IGBT、チョッパー (Typical)
switching losses IGBT-Chopper (typical)

$E_{on} = f(R_G)$, $E_{off} = f(R_G)$
 $V_{GE} = \pm 15\text{ V}$, $I_C = 1400\text{ A}$, $V_{CE} = 600\text{ V}$



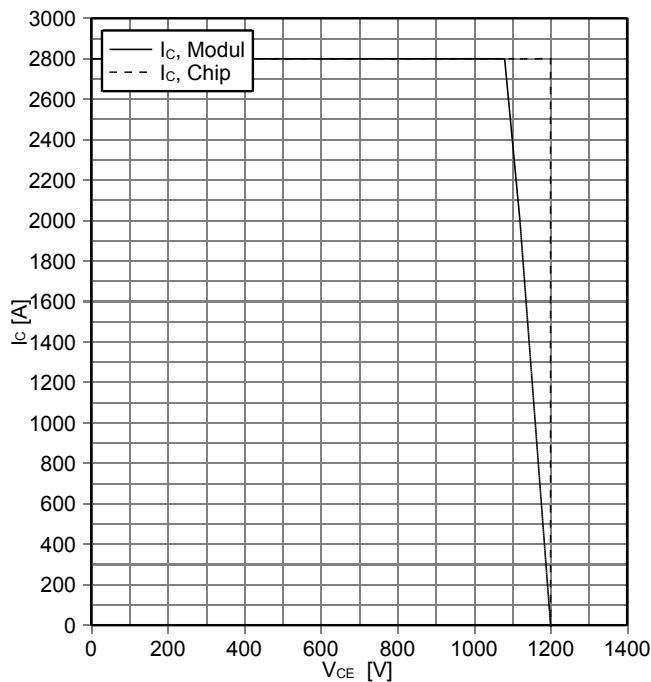
過渡熱インピーダンス IGBT、チョッパー
transient thermal impedance IGBT-Chopper

$Z_{thJC} = f(t)$



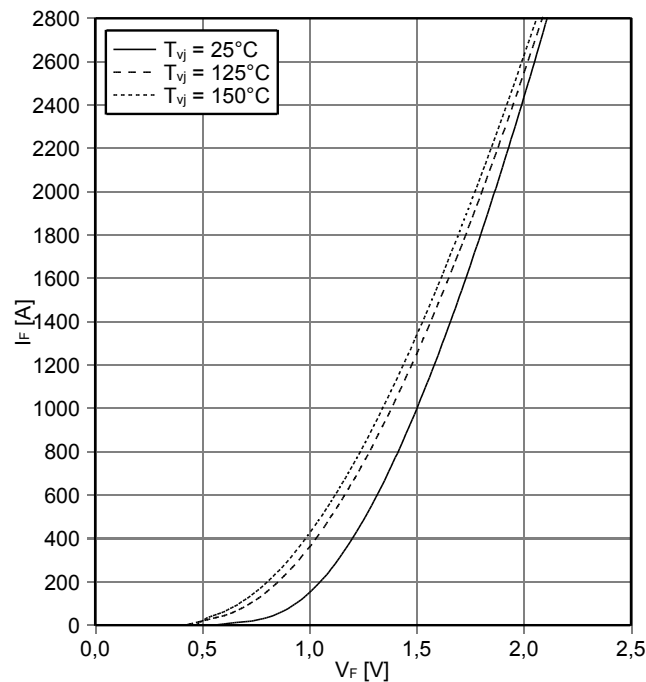
逆バイアス安全動作領域 IGBT、チョッパー (RBSOA)
reverse bias safe operating area IGBT-Chopper (RBSOA)

$I_C = f(V_{CE})$
 $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 1\ \Omega$, $T_{vj} = 150^\circ\text{C}$



順電圧特性 Diode-, チョッパー (typical)
forward characteristic of Diode-Chopper (typical)

$I_F = f(V_F)$



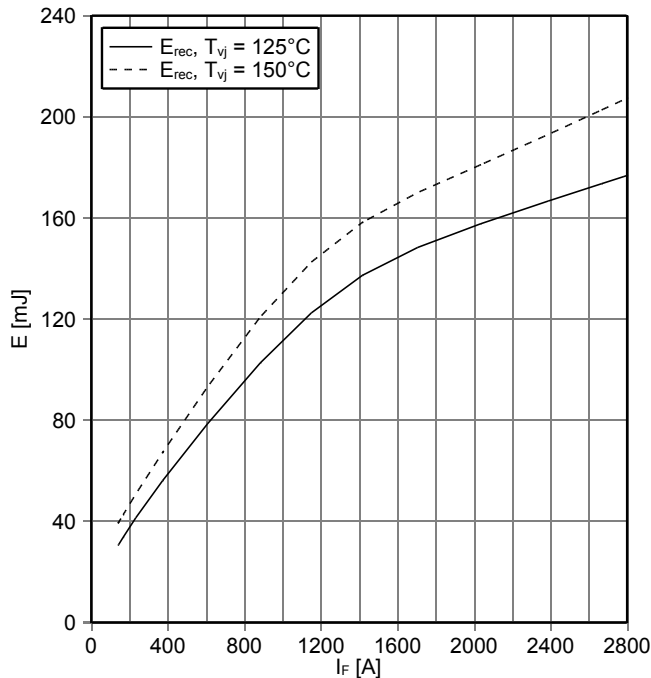
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暫定データ
Preliminary Data

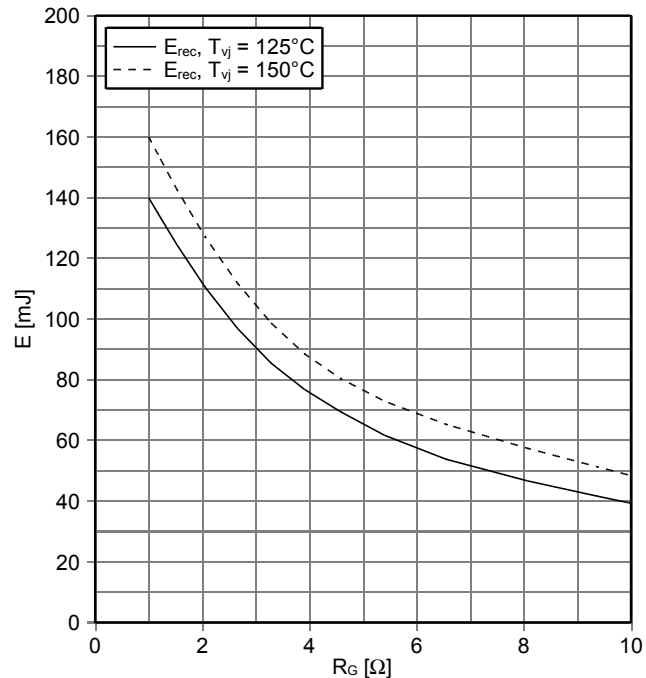
スイッチング損失 Diode-, チョッパー (Typical)
switching losses Diode-Chopper (typical)

$E_{rec} = f(I_F)$
 $R_{Gon} = 1 \Omega, V_{CE} = 600 V$



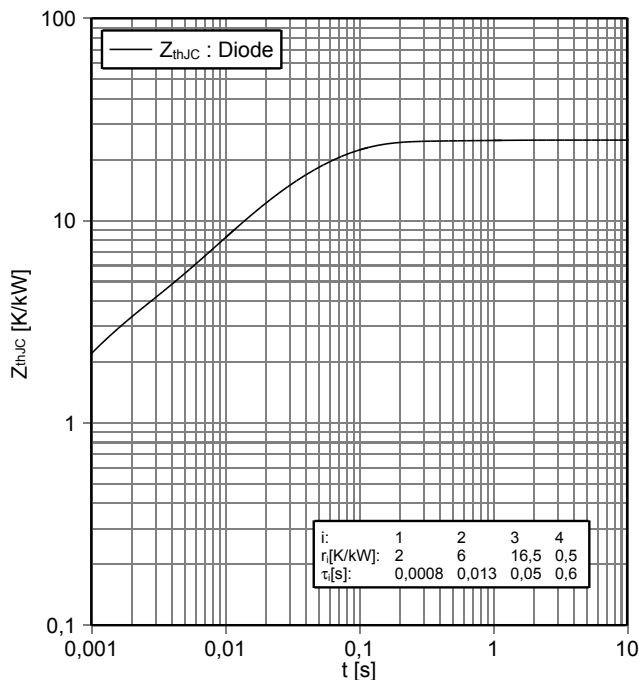
スイッチング損失 Diode-, チョッパー (Typical)
switching losses Diode-Chopper (typical)

$E_{rec} = f(R_G)$
 $I_F = 1400 A, V_{CE} = 600 V$



過渡熱インピーダンス Diode-, チョッパー
transient thermal impedance Diode-Chopper

$Z_{thJC} = f(t)$



NTC-サーミスタ サーミスタの温度特性
NTC-Thermistor-temperature characteristic (typical)

$R = f(T)$



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