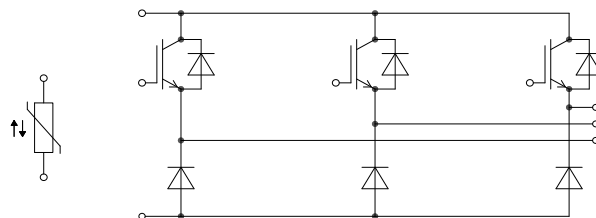
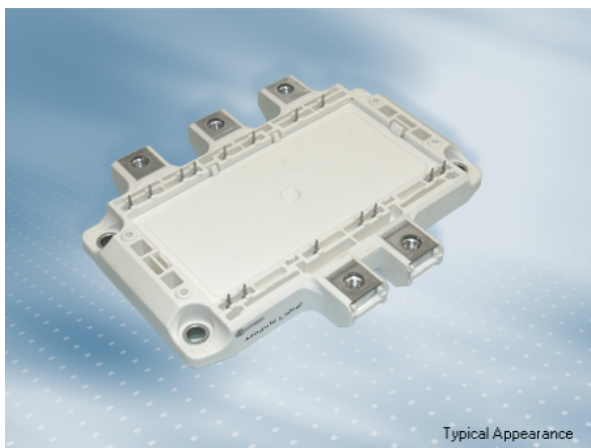


EconoPACK™4 モジュール トレンチ/フィールドストップ IGBT4 and エミッターコントロール diode内蔵 and NTCサーミスタ

EconoPACK™4 module with trench/fieldstop IGBT4 and Emitter Controlled Diode and NTC



$V_{CES} = 1200V$   
 $I_{C\ nom} = 200A / I_{CRM} = 400A$

### 一般応用

- 3レベル アプリケーション
- 高周波スイッチングアプリケーション
- チョッパアプリケーション
- モーター駆動
- ソーラーアプリケーション
- UPSシステム

### Typical Applications

- 3-Level-Applications
- High Frequency Switching Application
- Chopper Applications
- Motor Drives
- Solar Applications
- UPS Systems

### 電気的特性

- 拡張された動作温度  $T_{vj\ op}$
- トレンチ IGBT 4
- $T_{vj\ op} = 150^{\circ}C$
- 正温度特性を持った  $V_{CESat}$  飽和電圧

### Electrical Features

- Extended Operation Temperature  $T_{vj\ op}$
- Trench IGBT 4
- $T_{vj\ op} = 150^{\circ}C$
- $V_{CESat}$  with positive Temperature Coefficient

### 機械的特性

- 2.5 kV AC 1分 絶縁耐圧
- 強いメカニカルロバストネス
- 内蔵されたNTCサーミスタ
- 絶縁されたベースプレート
- 標準ハウジング

### Mechanical Features

- 2.5 kV AC 1min Insulation
- High mechanical robustness
- Integrated NTC temperature sensor
- Isolated Base Plate
- Standard Housing

## 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: KY	date of publication: 2013-11-11	
approved by: MK	revision: 3.0	UL approved (E83335)



**IGBT-ブレーキチョッパー / IGBT, Brake-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	$T_C = 95^{\circ}\text{C}, T_{vj\max} = 175^{\circ}\text{C}$ $T_C = 25^{\circ}\text{C}, T_{vj\max} = 175^{\circ}\text{C}$	$I_{C\text{nom}}$ $I_C$	200 300	A A
繰り返しピークコレクタ電流 Repetitive peak collector current	$t_P = 1\text{ ms}$	$I_{CRM}$	400	A
トータル損失 Total power dissipation	$T_C = 25^{\circ}\text{C}, T_{vj\max} = 175^{\circ}\text{C}$	$P_{\text{tot}}$	1100	W
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	$I_C = 200\text{ A}, V_{GE} = 15\text{ V}$ $I_C = 200\text{ A}, V_{GE} = 15\text{ V}$ $I_C = 200\text{ A}, V_{GE} = 15\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$V_{CE\text{sat}}$	1,75 2,05 2,10	2,10	V V V	
ゲート・エミッタ間しきい値電圧 Gate threshold voltage	$I_C = 3,80\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$		$V_{GEth}$	5,2	5,8	6,4	V
ゲート電荷量 Gate charge	$V_{GE} = -15\text{ V} \dots +15\text{ V}$		$Q_G$	1,65			$\mu\text{C}$
内蔵ゲート抵抗 Internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$		$R_{Gint}$	3,8			$\Omega$
入力容量 Input capacitance	$f = 1\text{ MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		$C_{ies}$	12,5			nF
帰還容量 Reverse transfer capacitance	$f = 1\text{ MHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		$C_{res}$	0,54			nF
コレクタ・エミッタ間遮断電流 Collector-emitter cut-off current	$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}, T_{vj} = 25^{\circ}\text{C}$		$I_{CES}$			0,015	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	$I_C = 200\text{ A}, V_{CE} = 600\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Gon} = 1,0\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$t_{don}$	0,19 0,20 0,205			$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
ターンオン上昇時間 (誘導負荷) Rise time, inductive load	$I_C = 200\text{ A}, V_{CE} = 600\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Gon} = 1,0\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$t_r$	0,035 0,043 0,044			$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
ターンオフ遅れ時間 (誘導負荷) Turn-off delay time, inductive load	$I_C = 200\text{ A}, V_{CE} = 600\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 1,0\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$t_{doff}$	0,365 0,45 0,47			$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
ターンオフ下降時間 (誘導負荷) Fall time, inductive load	$I_C = 200\text{ A}, V_{CE} = 600\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 1,0\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$t_f$	0,042 0,072 0,078			$\mu\text{s}$ $\mu\text{s}$ $\mu\text{s}$
ターンオンスイッチング損失 Turn-on energy loss per pulse	$I_C = 200\text{ A}, V_{CE} = 600\text{ V}, L_S = 30\text{ nH}$ $V_{GE} = \pm 15\text{ V}, di/dt = 4500\text{ A}/\mu\text{s} (T_{vj} = 150^{\circ}\text{C})$ $R_{Gon} = 1,0\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$E_{on}$	11,0 17,5 20,0			mJ mJ mJ
ターンオフスイッチング損失 Turn-off energy loss per pulse	$I_C = 200\text{ A}, V_{CE} = 600\text{ V}, L_S = 30\text{ nH}$ $V_{GE} = \pm 15\text{ V}, du/dt = 3500\text{ V}/\mu\text{s} (T_{vj} = 150^{\circ}\text{C})$ $R_{Goff} = 1,0\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$E_{off}$	14,0 21,0 23,0			mJ mJ mJ
短絡電流 SC data	$V_{GE} \leq 15\text{ V}, V_{CC} = 800\text{ V}$ $V_{CE\text{max}} = V_{CES} - L_{SCE} \cdot di/dt$ $t_P \leq 10\ \mu\text{s}, T_{vj} = 150^{\circ}\text{C}$		$I_{SC}$	920			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		$R_{thJC}$		0,14		K/W
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 $\lambda_{\text{Paste}} = 1\text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{\text{grease}} = 1\text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	0,071			K/W
動作温度 Temperature under switching conditions			$T_{vj\text{op}}$	-40	150		$^{\circ}\text{C}$

prepared by: KY	date of publication: 2013-11-11
approved by: MK	revision: 3.0



**Diode、ブレーキチョッパー / Diode, Brake-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		$I_F$	200	A
ピーク繰返し順電流 Repetitive peak forward current	$t_P = 1\text{ ms}$	$I_{FRM}$	400	A
電流二乗時間積 $I^2t$ - value	$V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 125^{\circ}\text{C}$ $V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$	$I^2t$	7500 6500	$\text{A}^2\text{s}$ $\text{A}^2\text{s}$

**電気的特性 / Characteristic Values**

			min.	typ.	max.	
順電圧 Forward voltage	$I_F = 200\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 200\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 200\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$V_F$	1,65 1,65 1,65	2,10	V V V
ピーク逆回復電流 Peak reverse recovery current	$I_F = 200\text{ A}, -di_F/dt = 4500\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 600\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$I_{RM}$	210 235 240		A A A
逆回復電荷量 Recovered charge	$I_F = 200\text{ A}, -di_F/dt = 4500\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 600\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$Q_r$	19,0 34,0 40,5		$\mu\text{C}$ $\mu\text{C}$ $\mu\text{C}$
逆回復損失 Reverse recovery energy	$I_F = 200\text{ A}, -di_F/dt = 4500\text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 600\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$E_{rec}$	8,65 15,5 18,0		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		$R_{thJC}$		0,21	K/W
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 $\lambda_{Paste} = 1\text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	0,069		K/W
動作温度 Temperature under switching conditions			$T_{vj\text{ op}}$	-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		$I_F$	25	A
ピーク繰返し順電流 Repetitive peak forward current	$t_P = 1\text{ ms}$	$I_{FRM}$	50	A
電流二乗時間積 $I^2t$ - value	$V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 125^{\circ}\text{C}$ $V_R = 0\text{ V}, t_P = 10\text{ ms}, T_{vj} = 150^{\circ}\text{C}$	$I^2t$	90,0 75,0	$\text{A}^2\text{s}$ $\text{A}^2\text{s}$

**電気的特性 / Characteristic Values**

			min.	typ.	max.	
順電圧 Forward voltage	$I_F = 25\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 25\text{ A}, V_{GE} = 0\text{ V}$ $I_F = 25\text{ A}, V_{GE} = 0\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$V_F$	1,75 1,75 1,75	2,25	V 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		$R_{thJC}$		1,30	K/W
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 $\lambda_{Paste} = 1\text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		$R_{thCH}$	0,125		K/W
動作温度 Temperature under switching conditions			$T_{vj\text{ op}}$	-40	150	$^{\circ}\text{C}$

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approved by: MK	revision: 3.0



**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 $\Omega$
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**

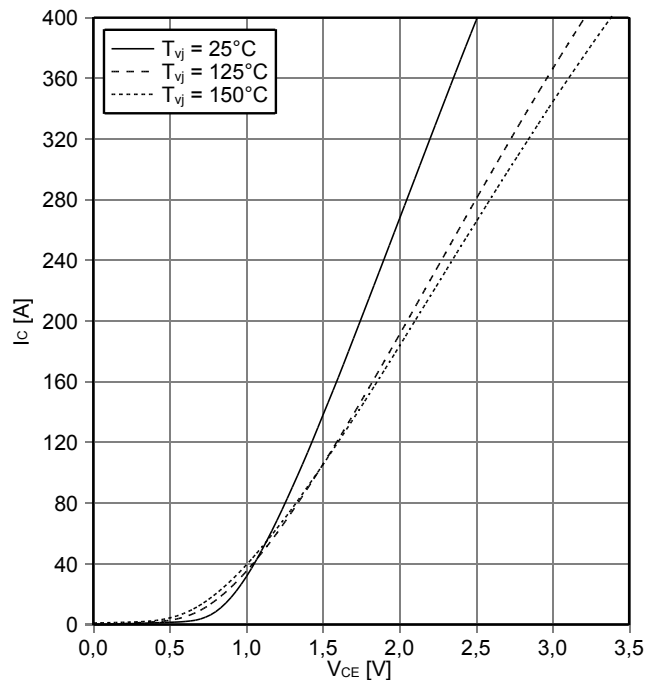
絶縁耐圧 Isolation test voltage	RMS, f = 50 Hz, t = 1 min.	$V_{ISOL}$	2,5		kV
ベースプレート材質 Material of module baseplate			Cu		
内部絶縁 Internal isolation	基礎絶縁 (クラス1, IEC 61140) basic insulation (class 1, IEC 61140)		$\text{Al}_2\text{O}_3$		
沿面距離 Creepage distance	連絡方法 - ヒートシンク / terminal to heatsink 連絡方法 - 連絡方法 / terminal to terminal		15,0 12,5		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		11,0 7,0		mm
相対トラッキング指数 Comperative tracking index		CTI	> 200		
min. typ. max.					
内部インダクタンス Stray inductance module		$L_{SCE}$	20		nH
パワーターミナル・チップ間抵抗 Module lead resistance, terminals - chip	$T_C = 25^\circ\text{C}, / \text{スイッチ} / \text{per switch}$	$R_{CC+EE}$	1,40		m $\Omega$
保存温度 Storage temperature		$T_{stg}$	-40	125	$^\circ\text{C}$
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 M6 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 M6 - Mounting according to valid application note	M	3,0	-	6,0 Nm
質量 Weight		G	400		g

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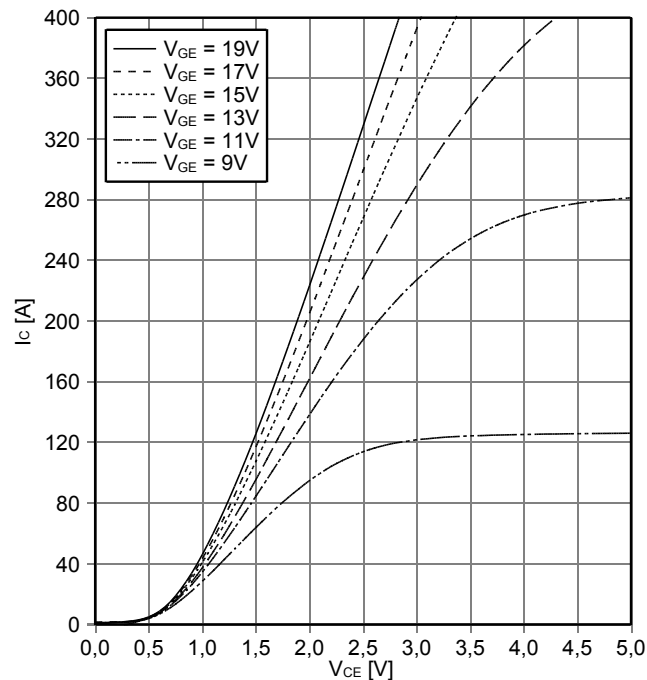
出力特性 IGBT-ブレーキチョッパー (Typical)  
output characteristic IGBT, Brake-Chopper (typical)

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



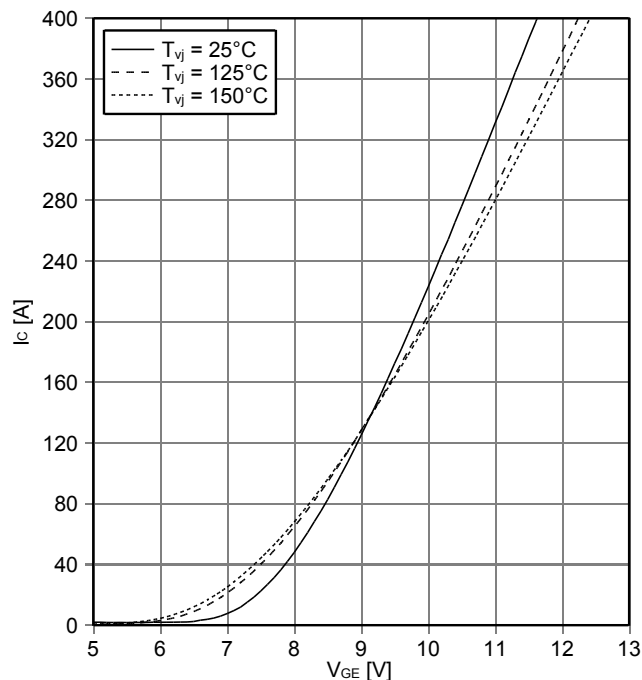
出力特性 IGBT-ブレーキチョッパー (Typical)  
output characteristic IGBT, Brake-Chopper (typical)

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



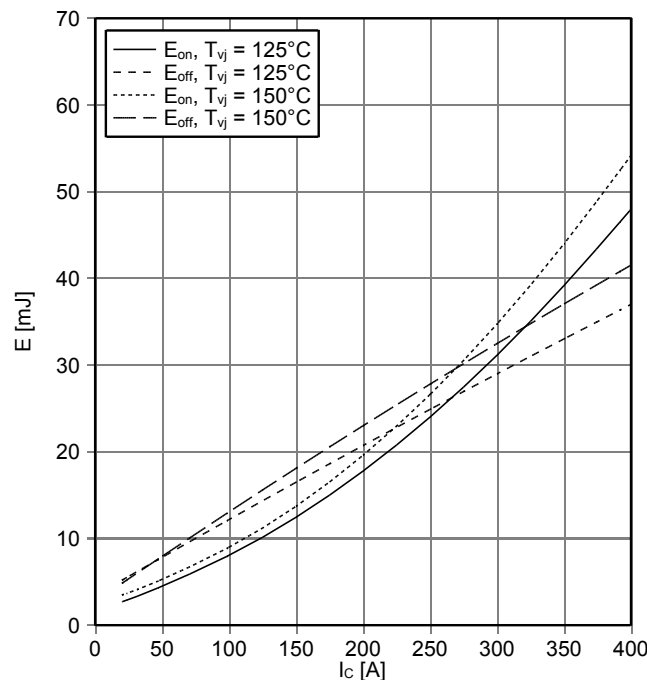
伝達特性 IGBT-ブレーキチョッパー (Typical)  
transfer characteristic IGBT, Brake-Chopper (typical)

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



スイッチング損失 IGBT-ブレーキチョッパー (Typical)  
switching losses IGBT, Brake-Chopper (typical)

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

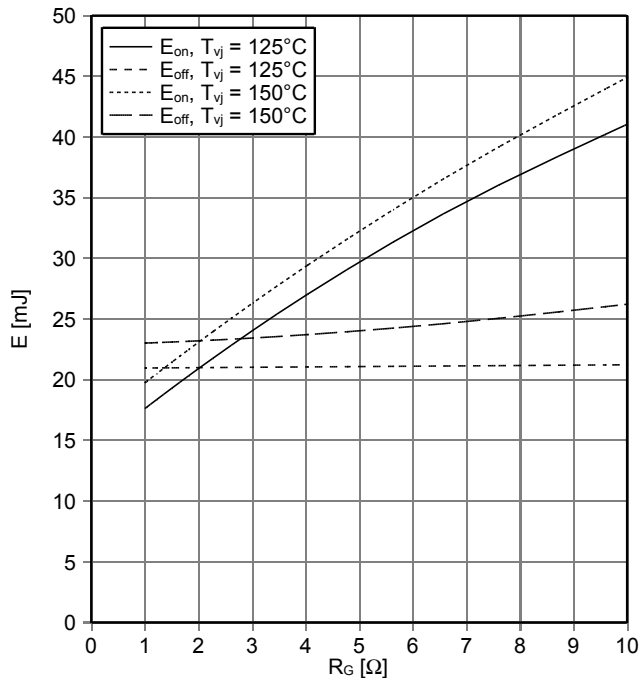


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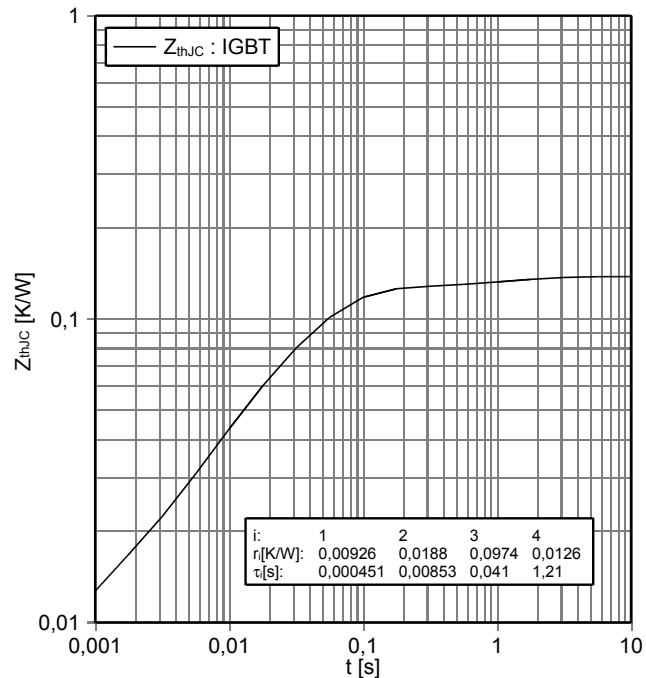
スイッチング損失 IGBT-ブレーキチョッパー (Typical)  
switching losses IGBT, Brake-Chopper (typical)

$E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$   
 $V_{GE} = \pm 15\text{ V}$ ,  $I_C = 200\text{ A}$ ,  $V_{CE} = 600\text{ V}$



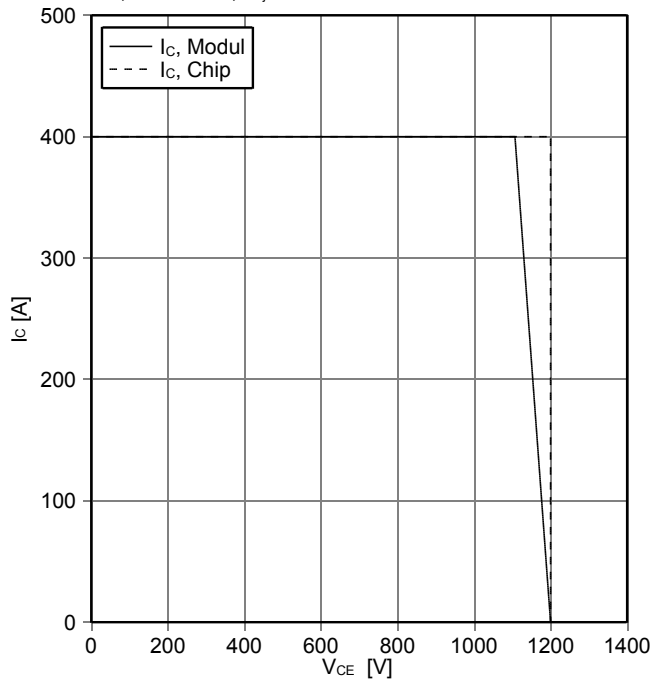
過渡熱インピーダンス IGBT-ブレーキチョッパー  
transient thermal impedance IGBT, Brake-Chopper

$Z_{thJC} = f(t)$



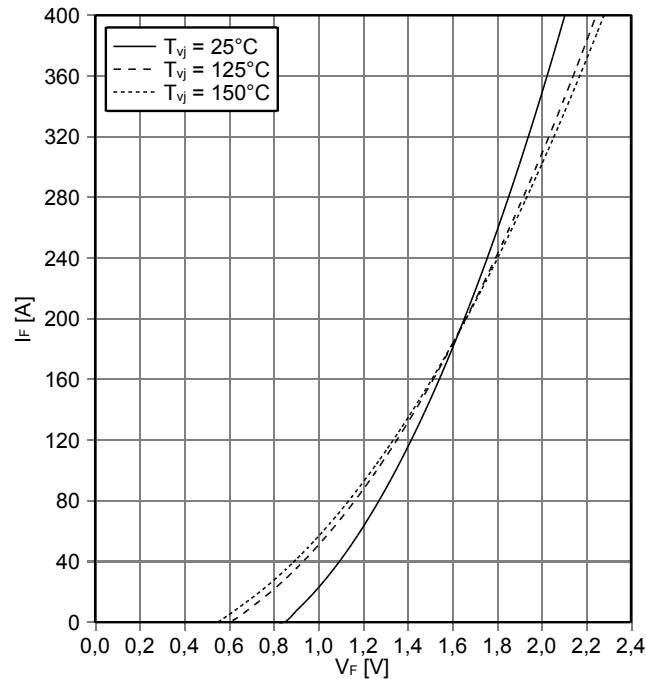
逆バイアス安全動作領域 IGBT-ブレーキチョッパー (RBSOA)  
reverse bias safe operating area IGBT, Brake-Chopper (RBSOA)

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



順電圧特性 Diode、ブレーキチョッパー (typical)  
forward characteristic of Diode, Brake-Chopper (typical)

$I_F = f(V_F)$

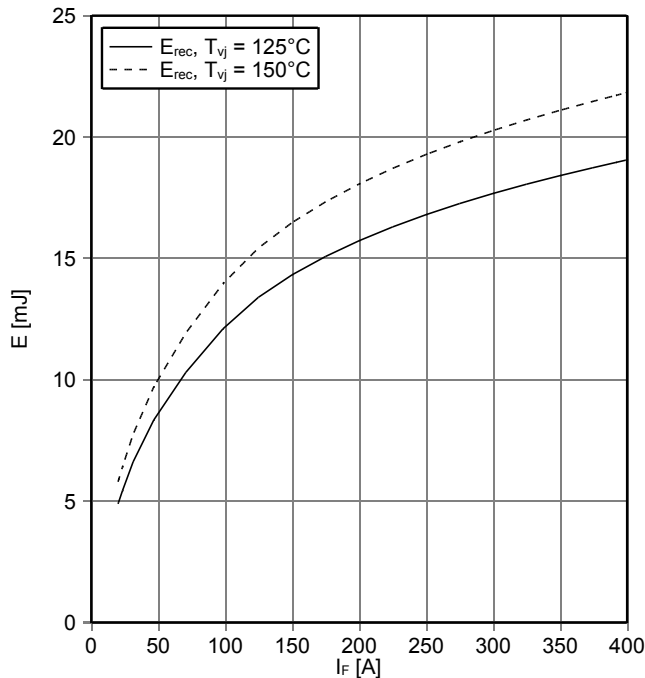


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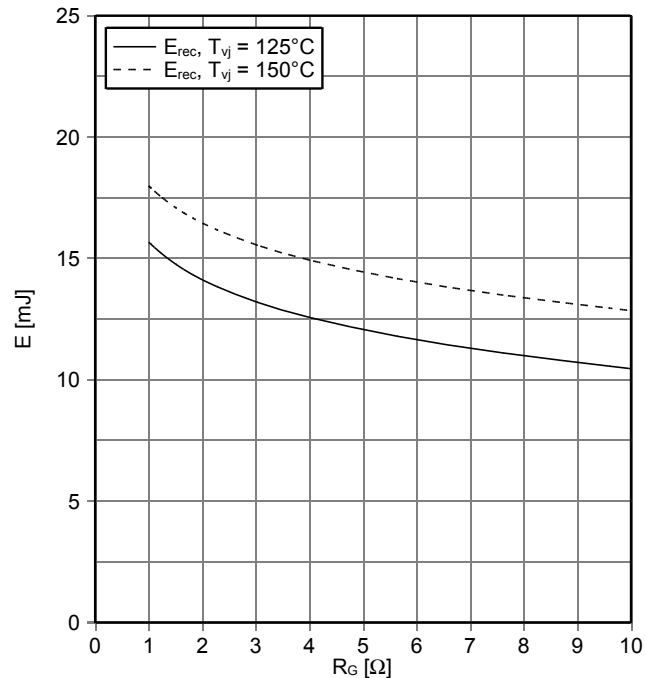
スイッチング損失 Diode、ブレーキチョッパー (Typical)  
switching losses Diode, Brake-Chopper (typical)

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



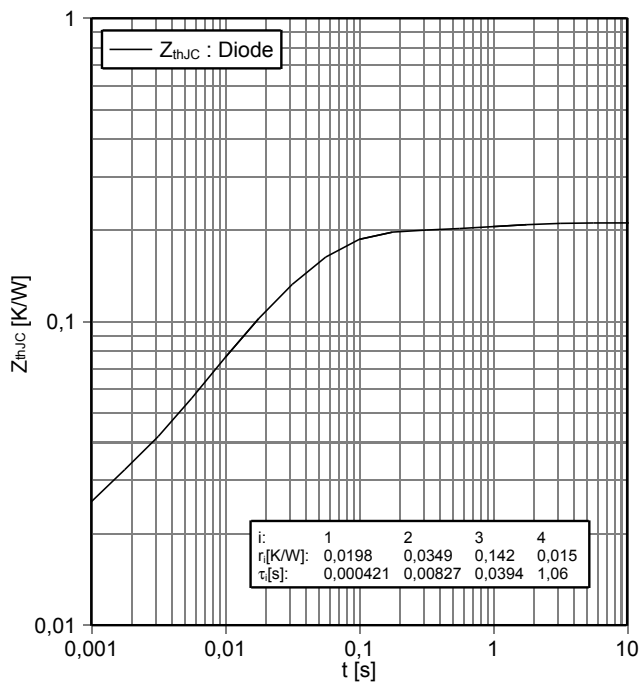
スイッチング損失 Diode、ブレーキチョッパー (Typical)  
switching losses Diode, Brake-Chopper (typical)

$E_{rec} = f(R_G)$   
 $I_F = 200 A, V_{CE} = 600 V$



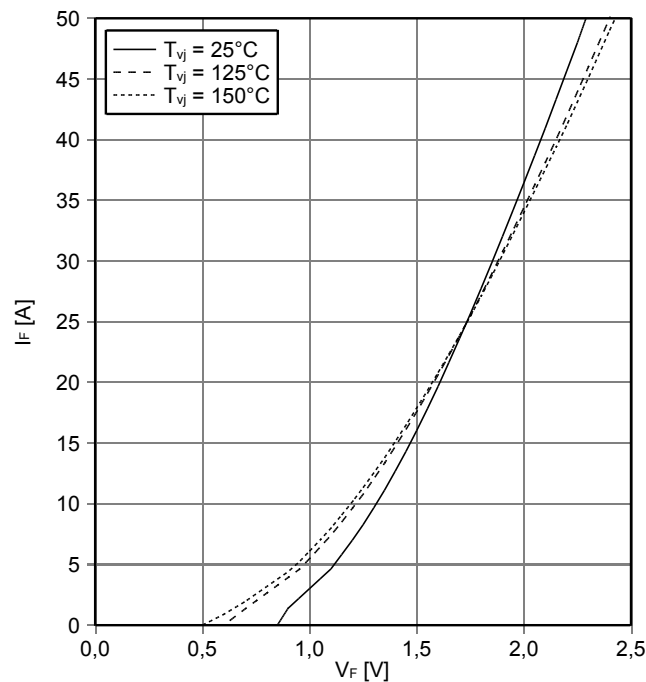
過渡熱インピーダンス Diode、ブレーキチョッパー  
transient thermal impedance Diode, Brake-Chopper

$Z_{thJC} = f(t)$



順電圧特性 Diode、リバー ( typical)  
forward characteristic of Diode, Reverse ( typical)

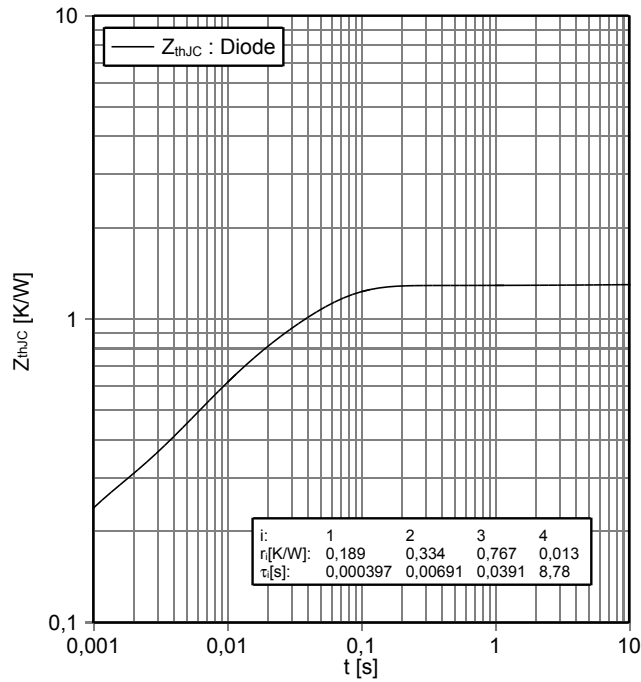
$I_F = f(V_F)$



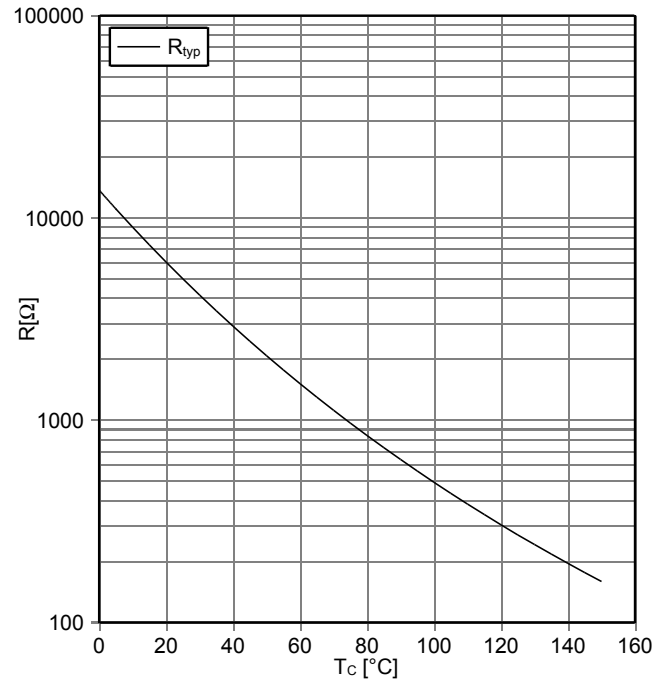
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過渡熱インピーダンス Diode、リバース  
transient thermal impedance Diode, Reverse  
 $Z_{thJC} = f(t)$



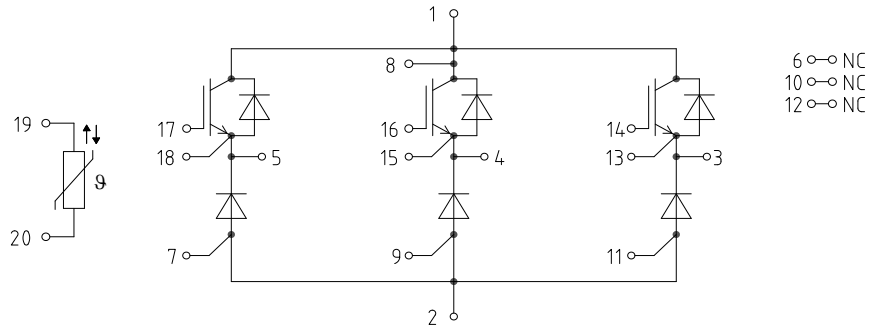
NTC-サーミスタ サーミスタの温度特性  
NTC-Thermistor-temperature characteristic (typical)  
 $R = f(T)$



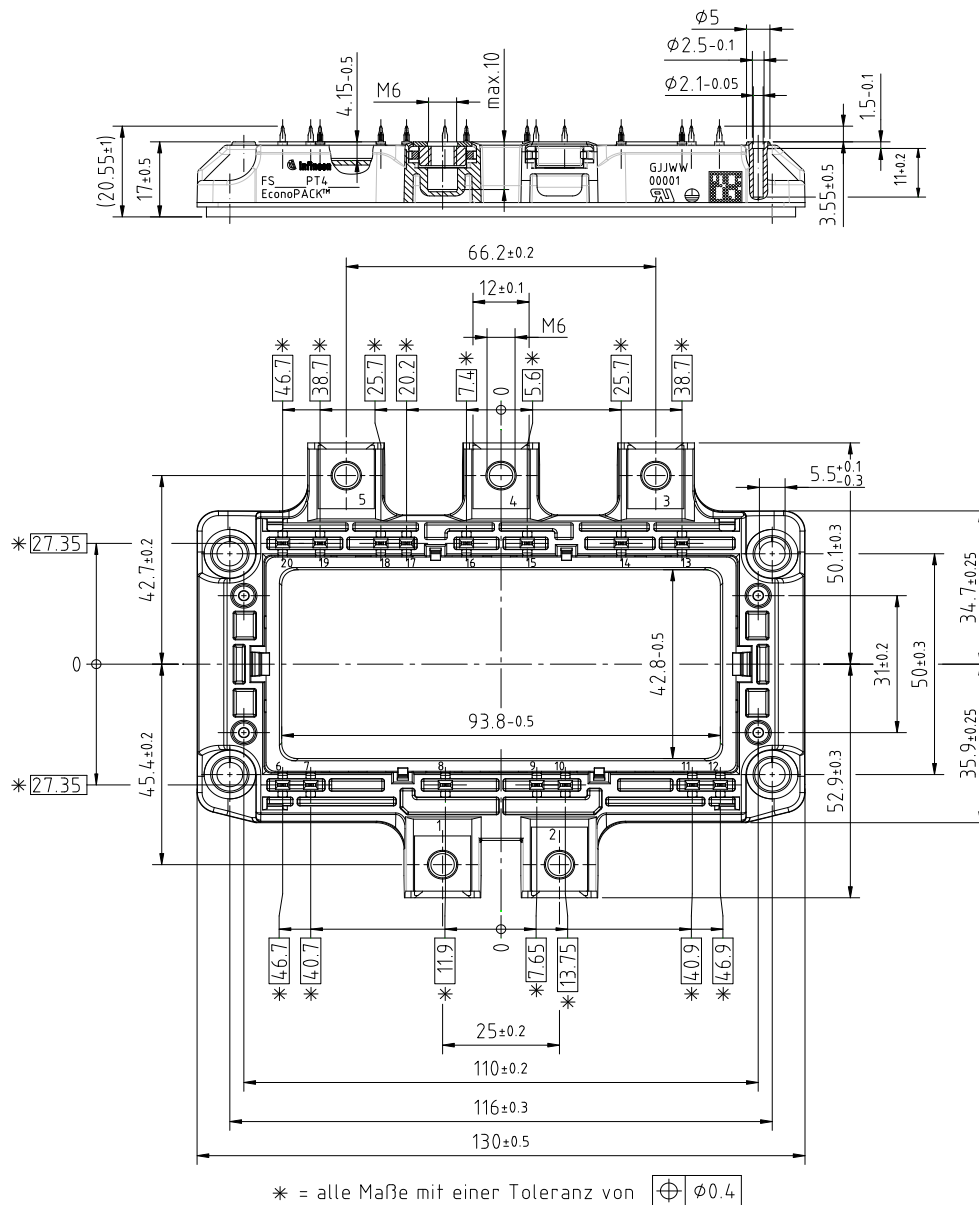
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回路図 / circuit\_diagram\_headline



パッケージ概要 / package outlines



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