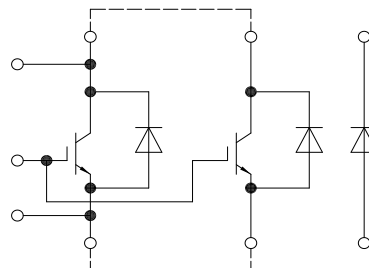


IGBT-モジュール IGBT-Module **FD1600/1200R17HP4_B2**

IHM-B モジュール チョッパー内蔵
IHM-B module with chopper configuration



$V_{CES} = 1700V$
 $I_{C\ nom} = 1600A / I_{CRM} = 3200A$

一般応用

- チョッパーアプリケーション
- ハイパワーコンバータ
- 電鉄駆動
- 風力タービン

Typical Applications

- Chopper applications
- High power converters
- Traction drives
- Wind turbines

電気的特性

- 拡張された動作温度 $T_{vj\ op}$
- 低 V_{CESat} 飽和電圧

Electrical Features

- Extended operating temperature $T_{vj\ op}$
- Low V_{CESat}

機械的特性

- 4 kV AC 1分 絶縁耐圧
- サーマルサイクル耐量を増加するAlSiCベースプレート
- 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
- IHM Bハウジング

Mechanical Features

- 4 kV AC 1min insulation
- AlSiC base plate for increased thermal cycling capability
- Package with CTI > 400
- High creepage and clearance distances
- High power and thermal cycling capability
- High power density
- IHM B 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

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

コレクタ・エミッタ間電圧 Collector-emitter voltage	$T_{vj} = -40^{\circ}\text{C}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	V_{CES}	1570 1700 1700	V
連続DCコレクタ電流 Continuous DC collector current	$T_C = 100^{\circ}\text{C}$, $T_{vj\max} = 175^{\circ}\text{C}$	$I_{C\text{nom}}$	1600	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}	3200	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}	10,5	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	$I_C = 1600\text{ A}$, $V_{GE} = 15\text{ V}$ $I_C = 1600\text{ A}$, $V_{GE} = 15\text{ V}$ $I_C = 1600\text{ A}$, $V_{GE} = 15\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	$V_{CE\text{sat}}$	1,90 2,30 2,40	2,25	V V V	
ゲート・エミッタ間しきい値電圧 Gate threshold voltage	$I_C = 64,0\text{ mA}$, $V_{CE} = V_{GE}$, $T_{vj} = 25^{\circ}\text{C}$		V_{GEth}	5,20	5,80	6,40	V
ゲート電荷量 Gate charge	$V_{GE} = -15\text{ V} \dots +15\text{ V}$		Q_G	17,0			μC
内蔵ゲート抵抗 Internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$		R_{Gint}	0,97			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}	130			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}	4,20			nF
コレクタ・エミッタ間遮断電流 Collector-emitter cut-off current	$V_{CE} = 1570\text{ V}$, $V_{GE} = 0\text{ V}$, $T_{vj} = 25^{\circ}\text{C}$		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	$I_C = 1600\text{ A}$, $V_{CE} = 900\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Gon} = 1,1\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_{don}	0,40 0,43 0,45			μs μs μs
ターンオン上昇時間 (誘導負荷) Rise time, inductive load	$I_C = 1600\text{ A}$, $V_{CE} = 900\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Gon} = 1,1\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_r	0,18 0,20 0,20			μs μs μs
ターンオフ遅れ時間 (誘導負荷) Turn-off delay time, inductive load	$I_C = 1600\text{ A}$, $V_{CE} = 900\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 0,6\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_{doff}	1,05 1,20 1,20			μs μs μs
ターンオフ下降時間 (誘導負荷) Fall time, inductive load	$I_C = 1600\text{ A}$, $V_{CE} = 900\text{ V}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 0,6\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	t_f	0,30 0,46 0,51			μs μs μs
ターンオンスイッチング損失 Turn-on energy loss per pulse	$I_C = 1600\text{ A}$, $V_{CE} = 900\text{ V}$, $L_S = 50\text{ nH}$ $V_{GE} = \pm 15\text{ V}$ $R_{Gon} = 1,1\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{on}	380 500 535			mJ mJ mJ
ターンオフスイッチング損失 Turn-off energy loss per pulse	$I_C = 1600\text{ A}$, $V_{CE} = 900\text{ V}$, $L_S = 50\text{ nH}$ $V_{GE} = \pm 15\text{ V}$ $R_{Goff} = 0,6\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{off}	420 570 600			mJ mJ mJ
短絡電流 SC data	$V_{GE} \leq 15\text{ V}$, $V_{CC} = 1000\text{ V}$ $V_{CE\text{max}} = V_{CES} - L_{sCE} \cdot di/dt$ $t_P \leq 10\ \mu\text{s}$, $T_{vj} = 150^{\circ}\text{C}$		I_{SC}	7500			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}			11,6	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}	15,0			K/kW
動作温度 Temperature under switching conditions			$T_{vj\text{op}}$	-40	150		$^{\circ}\text{C}$

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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	$T_{vj} = -40^{\circ}\text{C}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	V_{RRM}	1570 1700 1700	V
連続DC電流 Continuous DC forward current		I_F	1600	A
ピーク繰返し順電流 Repetitive peak forward current	$t_P = 1 \text{ ms}$	I_{FRM}	3200	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	630 595	kA^2s kA^2s
最大損失 Maximum power dissipation	$T_{vj} = 125^{\circ}\text{C}$	P_{RQM}	2400	kW
最小ターンオン時間 Minimum turn-on time		$t_{on \text{ min}}$	10,0	μs

電気的特性 / Characteristic Values

			min.	typ.	max.	
順電圧 Forward voltage	$I_F = 1600 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 1600 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 1600 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	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	$I_F = 1600 \text{ A}, -di_F/dt = 9000 \text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 900 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	I_{RM}	1700 1950 2000		A A A
逆回復電荷量 Recovered charge	$I_F = 1600 \text{ A}, -di_F/dt = 9000 \text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 900 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	Q_r	450 740 840		μC μC μC
逆回復損失 Reverse recovery energy	$I_F = 1600 \text{ A}, -di_F/dt = 9000 \text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 900 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{rec}	250 460 525		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}		15,9	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 $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$		R_{thCH}	16,0		K/kW
動作温度 Temperature under switching conditions			$T_{vj \text{ op}}$	-40	150	$^{\circ}\text{C}$

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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	$T_{vj} = -40^{\circ}\text{C}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	V_{RRM}	1570 1700 1700	V
連続DC電流 Continuous DC forward current		I_F	1200	A
ピーク繰返し順電流 Repetitive peak forward current	$t_P = 1 \text{ ms}$	I_{FRM}	2400	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	140 130	kA^2s kA^2s
最大損失 Maximum power dissipation	$T_{vj} = 125^{\circ}\text{C}$	P_{RQM}	1200	kW
最小ターンオン時間 Minimum turn-on time		$t_{on \text{ min}}$	10,0	μs

電気的特性 / Characteristic Values

			min.	typ.	max.	
順電圧 Forward voltage	$I_F = 1200 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 1200 \text{ A}, V_{GE} = 0 \text{ V}$ $I_F = 1200 \text{ A}, V_{GE} = 0 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	V_F	1,80 1,90 1,95	2,20	V V V
ピーク逆回復電流 Peak reverse recovery current	$I_F = 1200 \text{ A}, -di_F/dt = 7700 \text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 900 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	I_{RM}	1250 1350 1400		A A A
逆回復電荷量 Recovered charge	$I_F = 1200 \text{ A}, -di_F/dt = 7700 \text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 900 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	Q_r	280 460 510		μC μC μC
逆回復損失 Reverse recovery energy	$I_F = 1200 \text{ A}, -di_F/dt = 7700 \text{ A}/\mu\text{s} (T_{vj}=150^{\circ}\text{C})$ $V_R = 900 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 150^{\circ}\text{C}$	E_{rec}	180 300 345		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}		31,9	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 $\lambda_{\text{Paste}} = 1 \text{ W}/(\text{m}\cdot\text{K})$ / $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m}\cdot\text{K})$		R_{thCH}	32,5		K/kW
動作温度 Temperature under switching conditions			$T_{vj \text{ op}}$	-40	150	$^{\circ}\text{C}$

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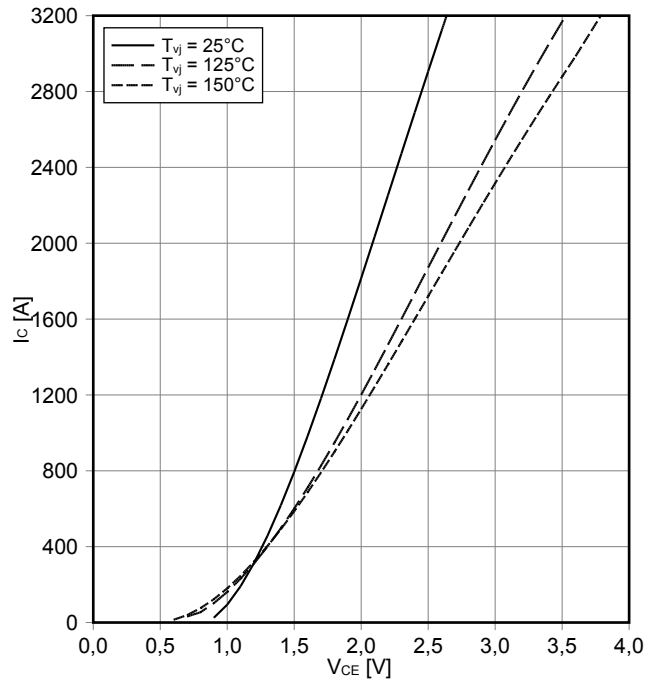
モジュール / Module

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			AISiC		
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		32,2 32,2		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		19,1 19,1		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}	6,0		nH
パワーターミナル・チップ間抵抗 Module lead resistance, terminals - chip	T _c = 25°C, /スイッチ / per switch	R _{CC'+EE'} R _{AA'+CC'}	0,15 0,24		mΩ
保存温度 Storage temperature		T _{stg}	-40	150	°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 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	4,25		5,75 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
質量 Weight		G	1200		g

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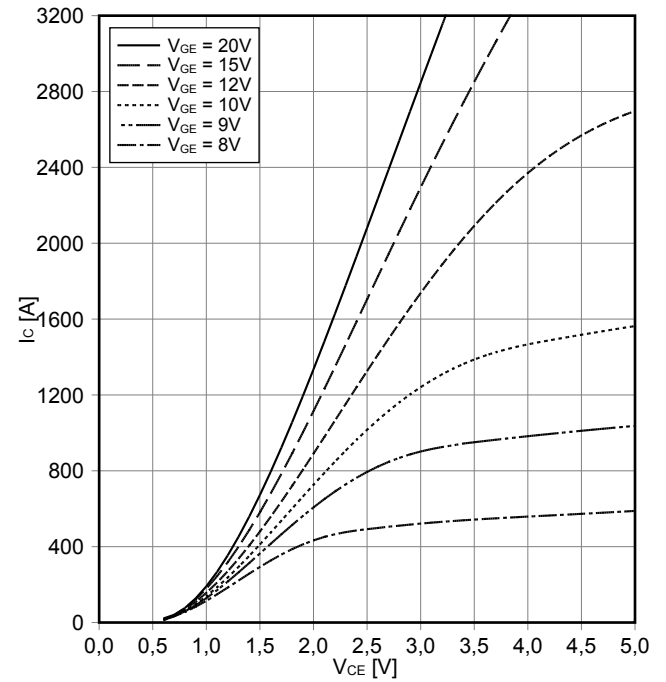
出力特性 IGBT、チヨッパー (Typical)
output characteristic IGBT-Chopper (typical)

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



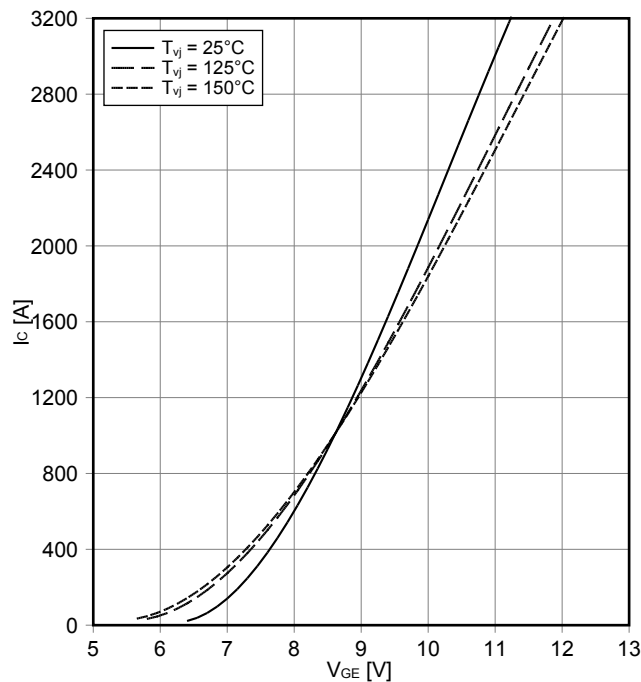
出力特性 IGBT、チヨッパー (Typical)
output characteristic IGBT-Chopper (typical)

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



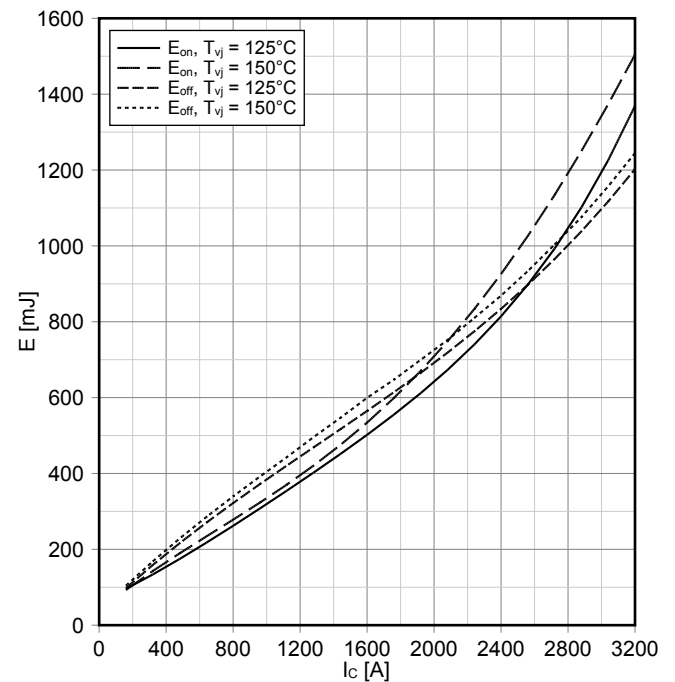
伝達特性 IGBT、チヨッパー (Typical)
transfer characteristic IGBT-Chopper (typical)

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



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

$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
 $V_{GE} = \pm 15\text{ V}$, $R_{Gon} = 1.1\ \Omega$, $R_{Goff} = 0.6\ \Omega$, $V_{CE} = 900\text{ V}$



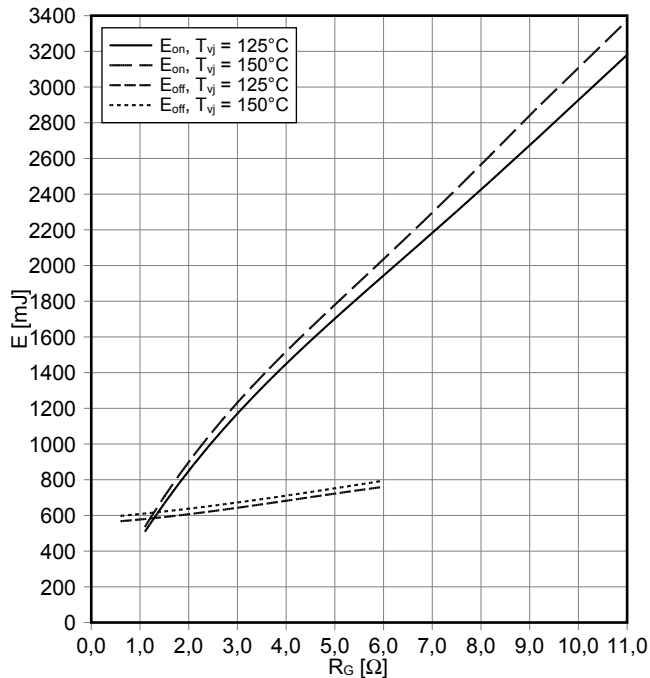
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IGBT-モジュール FD1600/1200R17HP4_B2
IGBT-Module

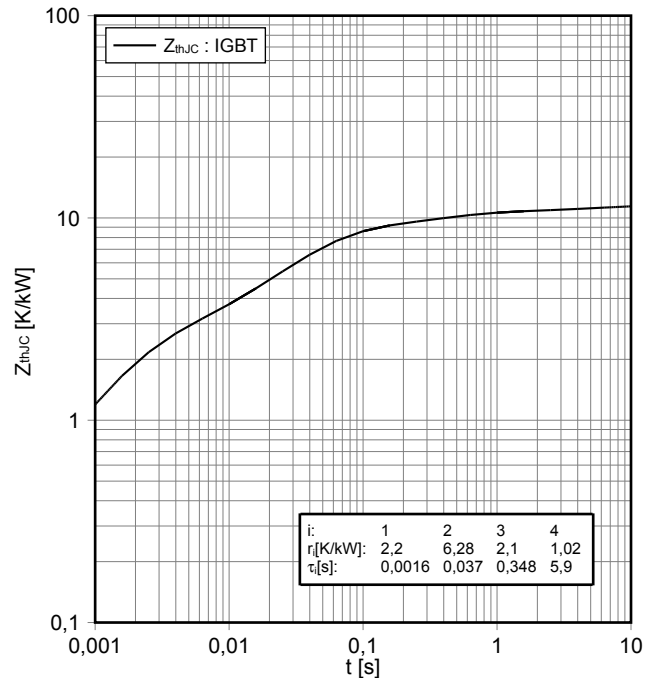
スイッチング損失 IGBT、チョッパー (Typical)
switching losses IGBT-Chopper (typical)

$E_{on} = f(R_G)$, $E_{off} = f(R_G)$
 $V_{GE} = \pm 15\text{ V}$, $I_C = 1600\text{ A}$, $V_{CE} = 900\text{ V}$



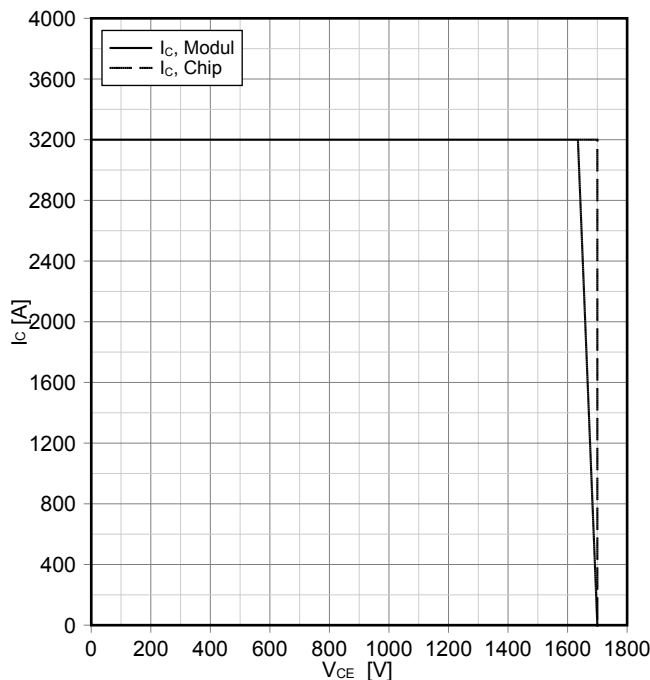
過渡熱インピーダンス IGBT、チョッパー
transient thermal impedance IGBT-Chopper

$Z_{thJC} = f(t)$



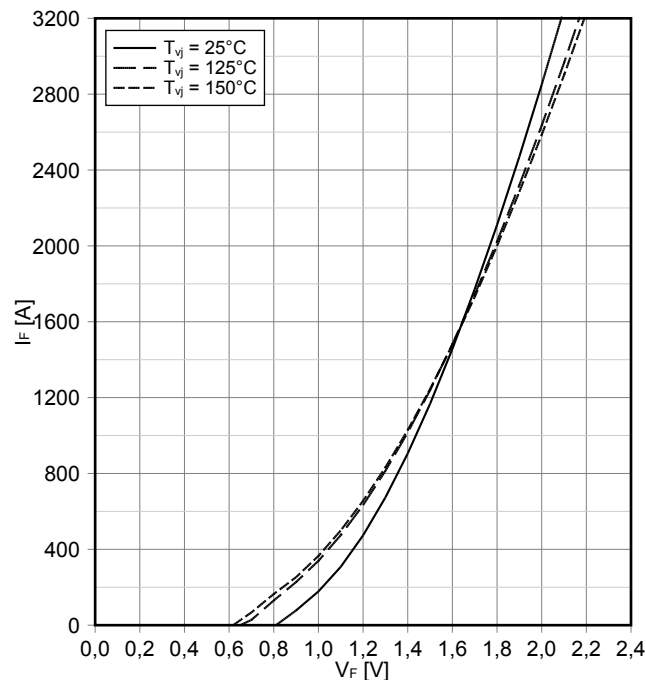
逆バイアス安全動作領域 IGBT、チョッパー (RBSOA)
reverse bias safe operating area IGBT-Chopper (RBSOA)

$I_C = f(V_{CE})$
 $V_{GE} = \pm 15\text{ V}$, $R_{Goff} = 0.6\ \Omega$, $T_{vj} = 150^\circ\text{C}$



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

$I_F = f(V_F)$



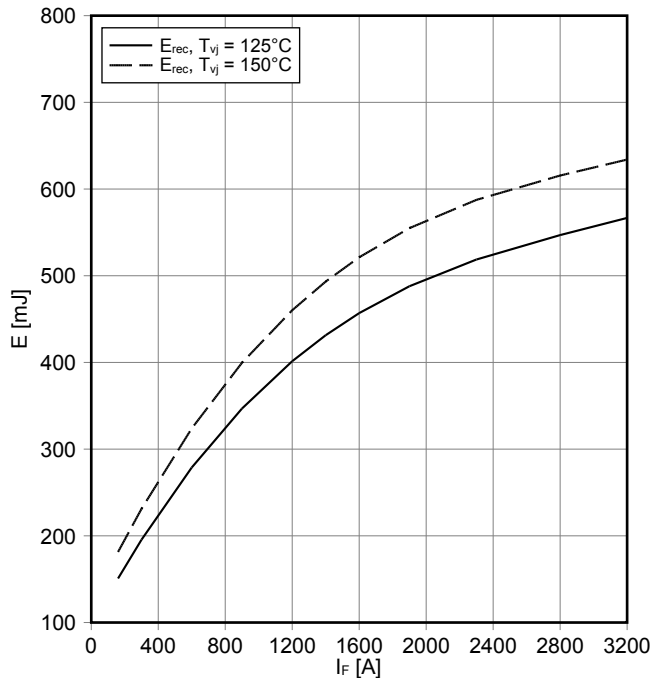
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IGBT-モジュール **FD1600/1200R17HP4_B2**
IGBT-Module

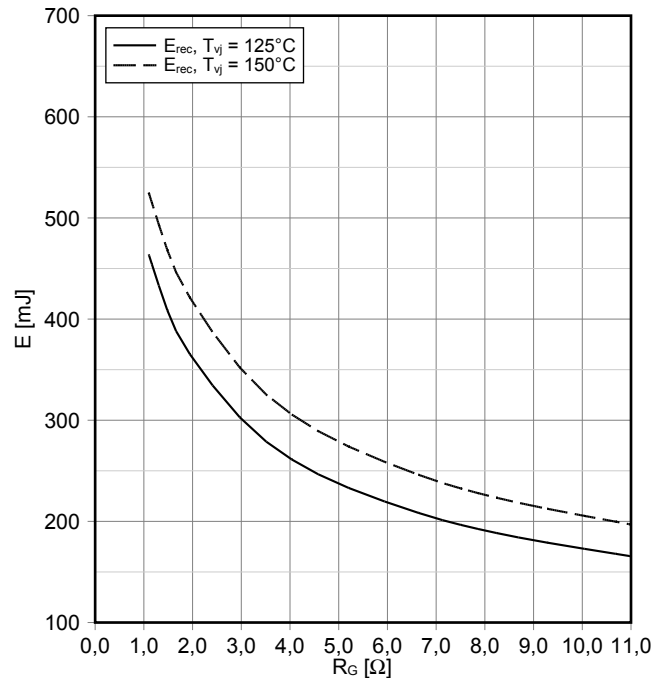
スイッチング損失 Diode、ブレーキチョッパー (Typical)
switching losses Diode, Brake-Chopper (typical)

$E_{rec} = f(I_F)$
 $R_{Gon} = 1.1 \Omega, V_{CE} = 900 V$



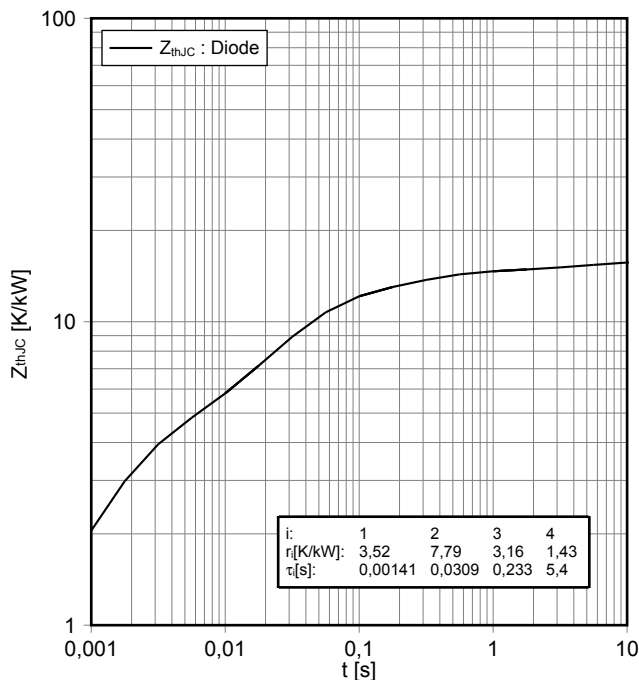
スイッチング損失 Diode、ブレーキチョッパー (Typical)
switching losses Diode, Brake-Chopper (typical)

$E_{rec} = f(R_G)$
 $I_F = 1600 A, V_{CE} = 900 V$



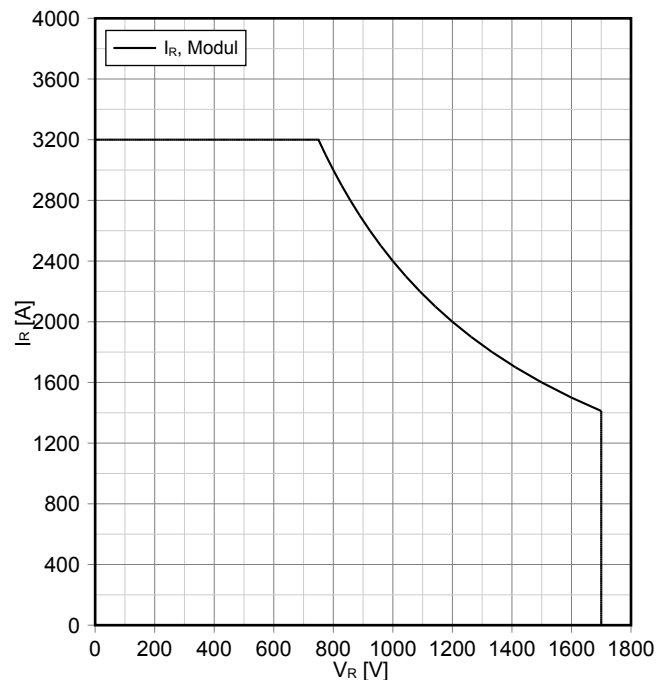
過渡熱インピーダンス Diode、ブレーキチョッパー
transient thermal impedance Diode, Brake-Chopper

$Z_{thJC} = f(t)$



安全動作領域 Diode、ブレーキチョッパー (SOA)
safe operation area Diode, Brake-Chopper (SOA)

$I_R = f(V_R)$
 $T_{vj} = 150^\circ C$

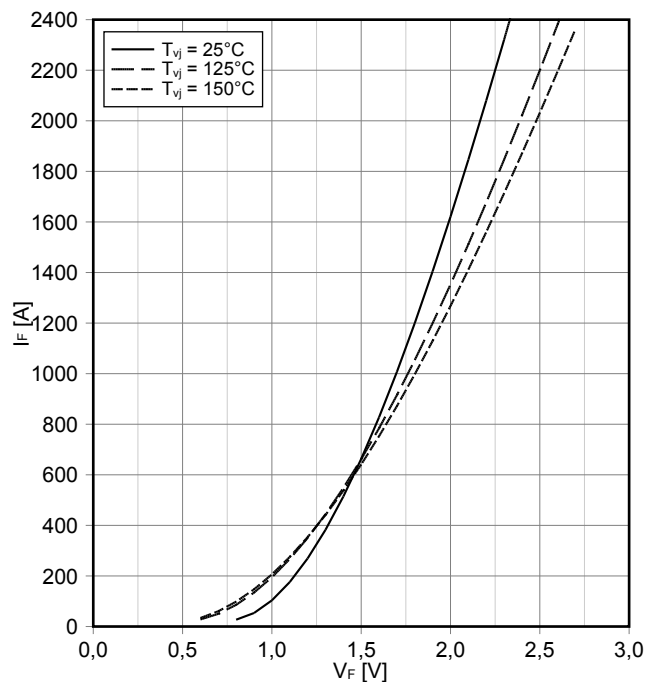


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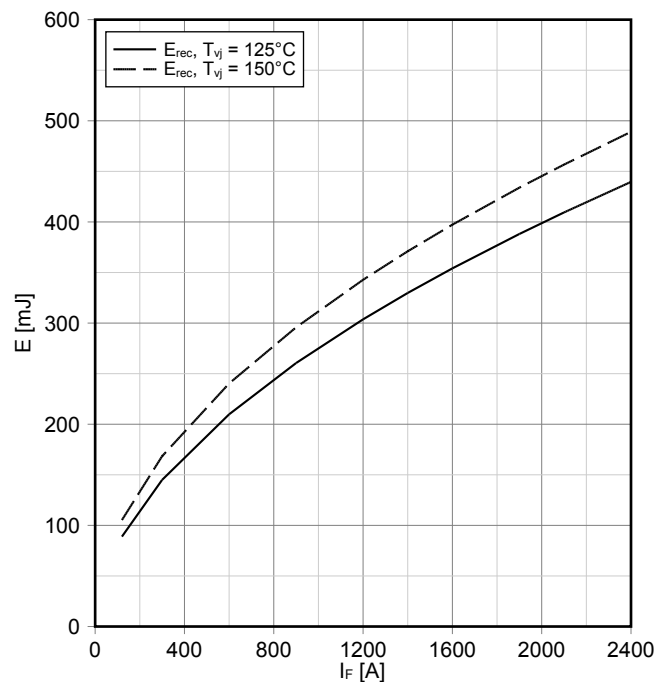


IGBT-モジュール **FD1600/1200R17HP4_B2**
IGBT-Module

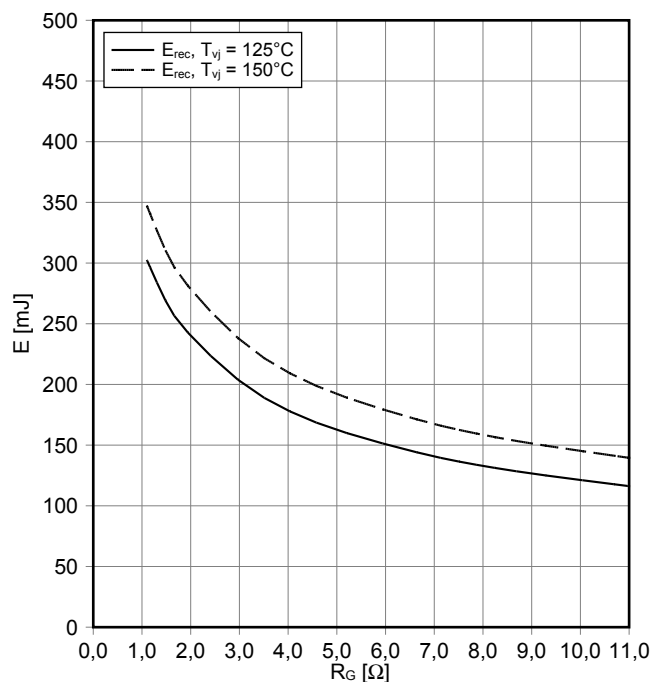
順電圧特性 Diode、リバース (typical)
forward characteristic of Diode, Reverse (typical)
 $I_F = f(V_F)$



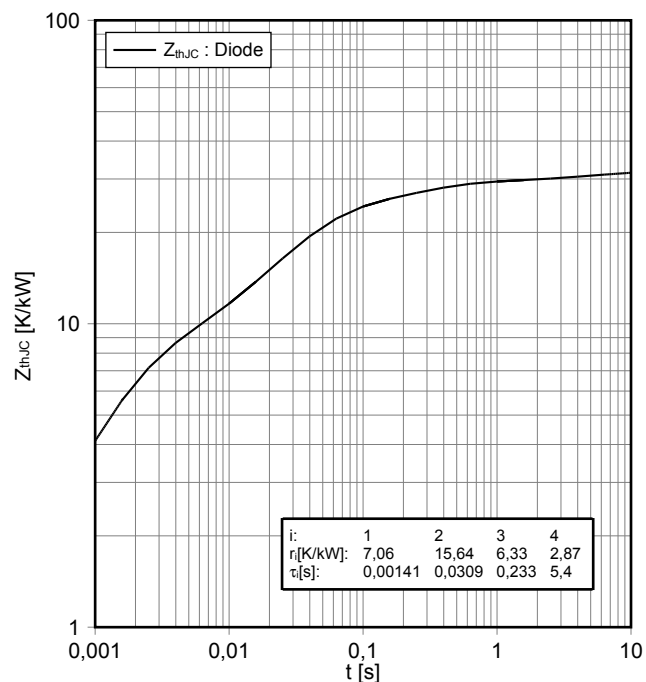
スイッチング損失 Diode、リバース (Typical)
switching losses Diode, Reverse (typical)
 $E_{rec} = f(I_F)$
 $R_{Gon} = 1.1 \Omega, V_{CE} = 900 V$



スイッチング損失 Diode、リバース (Typical)
switching losses Diode, Reverse (typical)
 $E_{rec} = f(R_G)$
 $I_F = 1200 A, V_{CE} = 900 V$



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

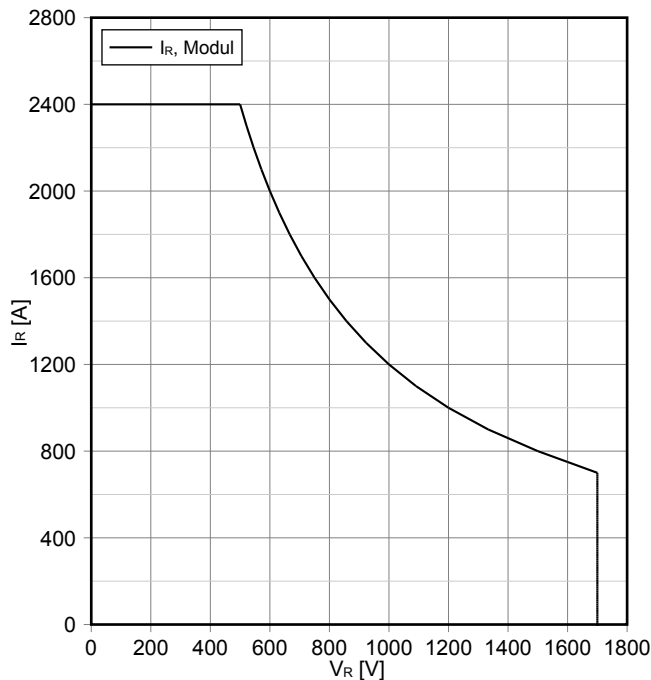


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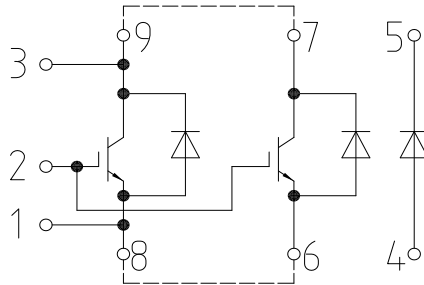
安全動作領域 Diode、リバーズ (SOA)
safe operation area Diode, Reverse (SOA)

$I_R = f(V_R)$
 $T_{vj} = 150^\circ\text{C}$

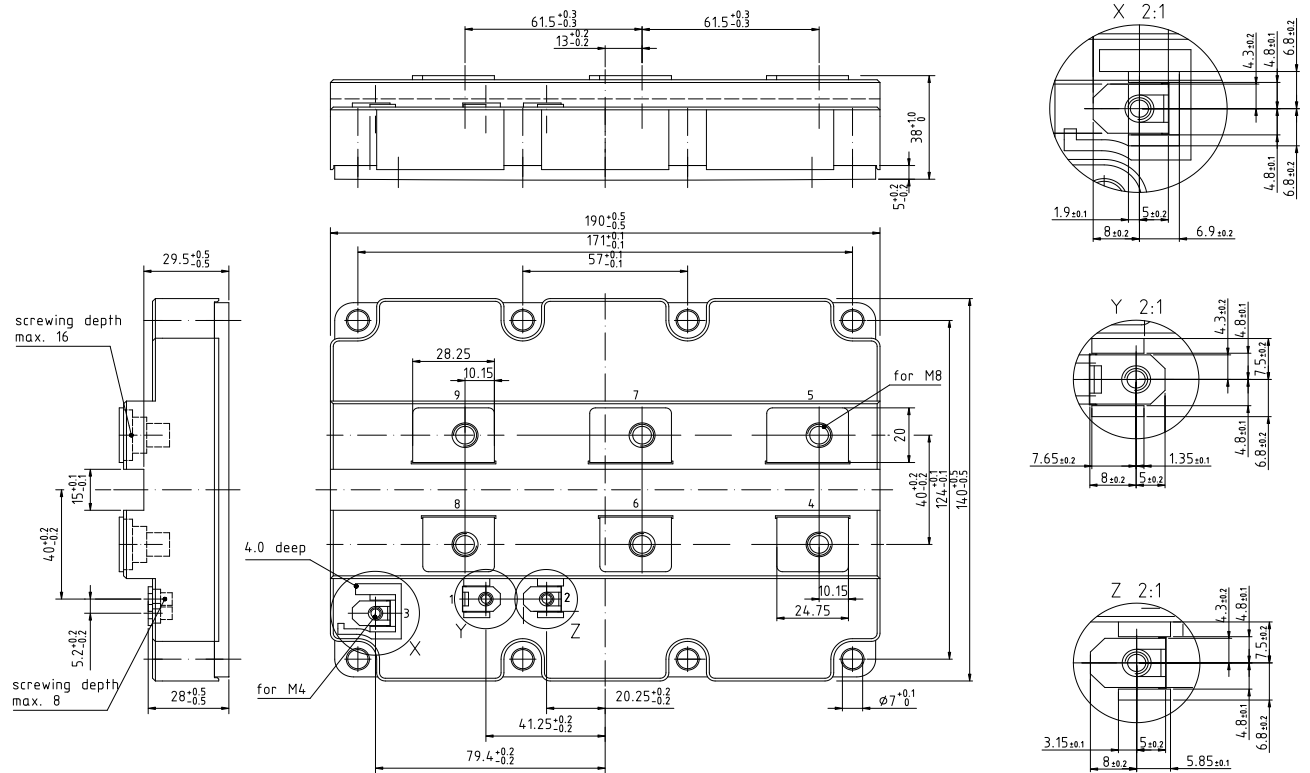


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回路図 / Circuit diagram



パッケージ概要 / Package outlines



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