

高绝缘等级模块 采用第三代沟槽栅/场终止IGBT3和第三代发射极控制二极管
highly insulated module with Trench/Fieldstop IGBT3 and Emitter Controlled 3 diode



潜在应用

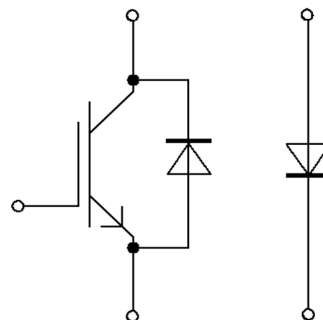
- 中压变流器
- 斩波应用
- 牵引变流器

电气特性

- 低 V_{CEsat}

机械特性

- 加强绝缘封装, 10.4kV 交流 10秒
- 封装的 CTI > 600
- 扩大存储温度范围至 $T_{stg} = -55^{\circ}\text{C}$
- 碳化硅铝 (AlSiC) 基板提供更高的温度循环能力
- 高爬电距离和电气间隙



$$V_{CES} = 6500\text{V}$$

$$I_{C\text{ nom}} = 500\text{A} / I_{CRM} = 1000\text{A}$$

Potential Applications

- Medium voltage converters
- Chopper applications
- Traction drives

Electrical Features

- Low V_{CEsat}

Mechanical Features

- Package with enhanced insulation of 10.4kV AC 10s
- Package with CTI > 600
- Extended storage temperature down to $T_{stg} = -55^{\circ}\text{C}$
- AlSiC base plate for increased thermal cycling capability
- High creepage and clearance distances

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

IGBT, 制动-斩波器 / IGBT, Brake-Chopper

最大额定值 / Maximum Rated Values

集电极 - 发射极电压 Collector-emitter voltage	$T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = -50^{\circ}\text{C}$	V_{CES}	6500 6500 5900	V
连续集电极直流电流 Continuous DC collector current	$T_C = 80^{\circ}\text{C}, T_{vj\max} = 150^{\circ}\text{C}$	I_{CDC}	500	A
集电极重复峰值电流 Repetitive peak collector current	$t_P = 1\text{ ms}$	I_{CRM}	1000	A
栅极 - 发射极峰值电压 Gate-emitter peak voltage		V_{GES}	+/-20	V

特征值 / Characteristic Values

			min.	typ.	max.	
集电极 - 发射极饱和电压 Collector-emitter saturation voltage	$I_C = 500\text{ A}$ $V_{GE} = 15\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	$V_{CE\text{ sat}}$		3,00 3,70	3,40 4,20 V V
栅极阈值电压 Gate threshold voltage	$I_C = 70,0\text{ mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$		V_{GEth}	5,40	6,00	6,60 V
栅极电荷 Gate charge	$V_{GE} = -15 / 15\text{ V}, V_{CE} = 3600\text{ V}$		Q_G		20,0	μC
内部栅极电阻 Internal gate resistor	$T_{vj} = 25^{\circ}\text{C}$		R_{Gint}		1,1	Ω
输入电容 Input capacitance	$f = 1000\text{ kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		C_{ies}		135	nF
反向传输电容 Reverse transfer capacitance	$f = 1000\text{ kHz}, T_{vj} = 25^{\circ}\text{C}, V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$		C_{res}		2,10	nF
集电极-发射极截止电流 Collector-emitter cut-off current	$V_{CE} = 6500\text{ V}, V_{GE} = 0\text{ V}$	$T_{vj} = 25^{\circ}\text{C}$	I_{CES}			5,0 mA
栅极-发射极漏电流 Gate-emitter leakage current	$V_{CE} = 0\text{ V}, V_{GE} = 20\text{ V}, T_{vj} = 25^{\circ}\text{C}$		I_{GES}			400 nA
开通延迟时间(电感负载) Turn-on delay time, inductive load	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}$ $V_{GE} = -15 / 15\text{ V}$ $R_{Gon} = 1,5\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	t_{don}		0,64 0,65	μs μs
上升时间(电感负载) Rise time, inductive load	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}$ $V_{GE} = -15 / 15\text{ V}$ $R_{Gon} = 1,5\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	t_r		0,18 0,20	μs μs
关断延迟时间(电感负载) Turn-off delay time, inductive load	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}$ $V_{GE} = -15 / 15\text{ V}$ $R_{Goff} = 10\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	t_{doff}		7,30 7,60	μs μs
下降时间(电感负载) Fall time, inductive load	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}$ $V_{GE} = -15 / 15\text{ V}$ $R_{Goff} = 10\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	t_f		0,40 0,50	μs μs
开通损耗能量(每脉冲) Turn-on energy loss per pulse	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}, L\sigma = 280\text{ nH}$ $di/dt = 2000\text{ A}/\mu\text{s}$ $V_{GE} = -15 / 15\text{ V}, R_{Gon} = 1,5\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	E_{on}		2800 4300	mJ mJ
关断损耗能量(每脉冲) Turn-off energy loss per pulse	$I_C = 500\text{ A}, V_{CE} = 3600\text{ V}, L\sigma = 280\text{ nH}$ $V_{GE} = -15 / 15\text{ V}, R_{Goff} = 10\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	E_{off}		2400 2800	mJ mJ
短路数据 SC data	$V_{GE} \leq 15\text{ V}, V_{CC} = 4500\text{ V}$ $V_{CEmax} = V_{CES} - L_{SCE} \cdot di/dt$ $t_P \leq 10\ \mu\text{s}, T_{vj} = 125^{\circ}\text{C}$		I_{SC}		3000	A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R_{thJC}			13,1 K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个 IGBT / per IGBT $\lambda_{Paste} = 1\text{ W}/(\text{m}\cdot\text{K}) / \lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$		R_{thCH}		13,0	K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj\text{ op}}$	-50		125 $^{\circ}\text{C}$

二极管，制动-斩波器 / Diode, Brake-Chopper

最大额定值 / Maximum Rated Values

反向重复峰值电压 Repetitive peak reverse voltage	$T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = -50^{\circ}\text{C}$	V_{RRM}	6500 6500 5900	V
连续正向直流电流 Continuous DC forward current		I_F	500	A
正向重复峰值电流 Repetitive peak forward current	$t_P = 1 \text{ ms}$	I_{FRM}	1000	A
I^2t -值 I^2t - value	$V_R = 0 \text{ V}$, $t_P = 10 \text{ ms}$, $T_{vj} = 125^{\circ}\text{C}$	I^2t	210	kA^2s
最大损耗功率 Maximum power dissipation	$T_{vj} = 125^{\circ}\text{C}$	P_{RQM}	2000	kW
最小开通时间 Minimum turn-on time		$t_{on \text{ min}}$	10,0	μs

特征值 / Characteristic Values

			min.	typ.	max.	
正向电压 Forward voltage	$I_F = 500 \text{ A}$, $V_{GE} = 0 \text{ V}$ $I_F = 500 \text{ A}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	V_F		3,00 2,95	3,50 3,50 V
反向恢复峰值电流 Peak reverse recovery current	$I_F = 500 \text{ A}$, $-di_F/dt = 2000 \text{ A}/\mu\text{s}$ ($T_{vj}=125^{\circ}\text{C}$) $V_R = 3600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	I_{RM}		730 800	A A
恢复电荷 Recovered charge	$I_F = 500 \text{ A}$, $-di_F/dt = 2000 \text{ A}/\mu\text{s}$ ($T_{vj}=125^{\circ}\text{C}$) $V_R = 3600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	Q_r		570 1050	μC μC
反向恢复损耗 (每脉冲) Reverse recovery energy	$I_F = 500 \text{ A}$, $-di_F/dt = 2000 \text{ A}/\mu\text{s}$ ($T_{vj}=125^{\circ}\text{C}$) $V_R = 3600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	E_{rec}		930 2000	mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}			28,0 K/kW
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个二极管 / 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}		21,0	K/kW
在开关状态下温度 Temperature under switching conditions			$T_{vj \text{ op}}$	-50		125 $^{\circ}\text{C}$

二極體, 反轉 / Diode, Reverse

最大額定值 / Maximum Rated Values

反向重複峰值電壓 Repetitive peak reverse voltage	$T_{vj} = 125^{\circ}\text{C}$ $T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = -50^{\circ}\text{C}$	V_{RRM}	6500 6500 5900	V
連續正向直流電流 Continuous DC forward current		I_F	500	A
正向重複峰值電流 Repetitive peak forward current	$t_P = 1 \text{ ms}$	I_{FRM}	1000	A
I^2t -值 I^2t - value	$V_R = 0 \text{ V}$, $t_P = 10 \text{ ms}$, $T_{vj} = 125^{\circ}\text{C}$	I^2t	210	kA^2s
最大損耗功率 Maximum power dissipation	$T_{vj} = 125^{\circ}\text{C}$	P_{RQM}	2000	kW
最小開通時間 Minimum turn-on time		$t_{on \min}$	10,0	μs

特征值 / Characteristic Values

			min.	typ.	max.	
正向電壓 Forward voltage	$I_F = 500 \text{ A}$, $V_{GE} = 0 \text{ V}$ $I_F = 500 \text{ A}$, $V_{GE} = 0 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	V_F		3,00 2,95	3,50 3,50 V
反向恢復峰值電流 Peak reverse recovery current	$I_F = 500 \text{ A}$, $-di_F/dt = 2000 \text{ A}/\mu\text{s}$ ($T_{vj}=125^{\circ}\text{C}$) $V_R = 3600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	I_{RM}		730 800	A A
恢復電荷 Recovered charge	$I_F = 500 \text{ A}$, $-di_F/dt = 2000 \text{ A}/\mu\text{s}$ ($T_{vj}=125^{\circ}\text{C}$) $V_R = 3600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	Q_r		570 1050	μC μC
反向恢復損耗 (每脈沖) Reverse recovery energy	$I_F = 500 \text{ A}$, $-di_F/dt = 2000 \text{ A}/\mu\text{s}$ ($T_{vj}=125^{\circ}\text{C}$) $V_R = 3600 \text{ V}$ $V_{GE} = -15 \text{ V}$	$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 125^{\circ}\text{C}$	E_{rec}		930 2000	mJ mJ
結 - 外殼熱阻 Thermal resistance, junction to case	每個二極管 / per diode		R_{thJC}			28,0 K/kW
外殼 - 散熱器熱阻 Thermal resistance, case to heatsink	每個二極管 / 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
在開關狀態下溫度 Temperature under switching conditions			$T_{vj \text{ op}}$	-50		125 $^{\circ}\text{C}$

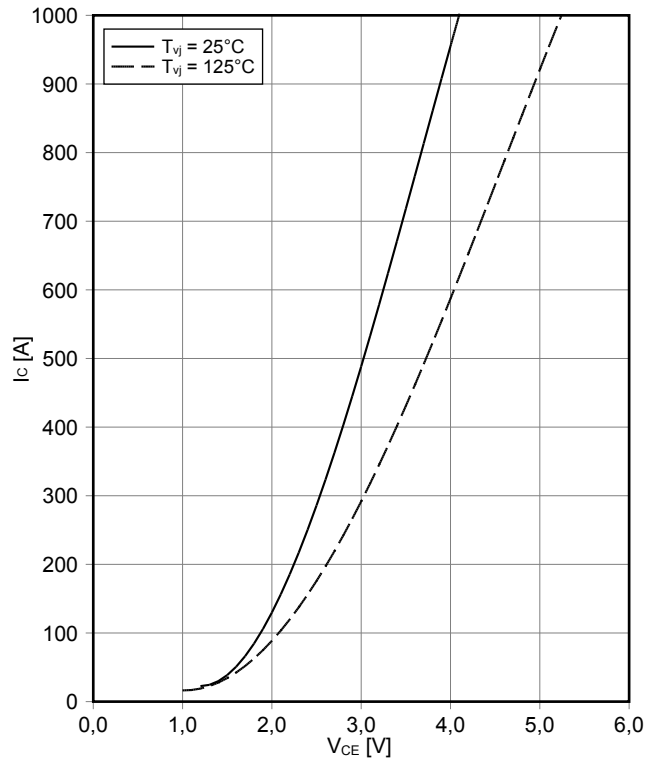
模块 / Module

绝缘测试电压 Isolation test voltage	RMS, f = 50 Hz, t = 10 s	V _{ISOL}	10,4	kV
局部放电停止电压 Partial discharge extinction voltage	RMS, f = 50 Hz, Q _{PD} typ 10 pC	V _{ISOL}	5,10	kV
DC 稳定性 DC stability	T _{vj} = 25°C, 100 fit	V _{CE D}	3800	V
模块基板材料 Material of module baseplate			AlSiC	
内部绝缘 Internal isolation	基本绝缘 (class 1, IEC 61140) basic insulation (class 1, IEC 61140)		AlN	
爬电距离 Creepage distance	端子至散热器 / terminal to heatsink 端子至端子 / terminal to terminal		56,0 56,0	mm
电气间隙 Clearance	端子至散热器 / terminal to heatsink 端子至端子 / terminal to terminal		26,0 26,0	mm
相对电痕指数 Comperative tracking index		CTI	> 600	
min. typ. max.				
杂散电感, 模块 Stray inductance module		L _{sCE}	20	nH
模块引线电阻, 端子-芯片 Module lead resistance, terminals - chip	T _c = 25°C, 每个开关 / per switch	R _{CC'+EE'} R _{AA'+CC'}	0,18 0,18	mΩ
储存温度 Storage temperature		T _{stg}	-55	125 °C
模块安装的安装扭矩 Mounting torque for modul mounting	螺丝 M6 根据相应的应用手册进行安装 Screw M6 - Mounting according to valid application note	M	4,25	5,75 Nm
端子联接扭矩 Terminal connection torque	螺丝 M4 根据相应的应用手册进行安装 Screw M4 - Mounting according to valid application note	M	1,8	2,1 Nm
	螺丝 M8 根据相应的应用手册进行安装 Screw M8 - Mounting according to valid application note		8,0	10 Nm
重量 Weight		G	1400	g

输出特性 IGBT, 制动-斩波器 (典型)

output characteristic IGBT, Brake-Chopper (typical)

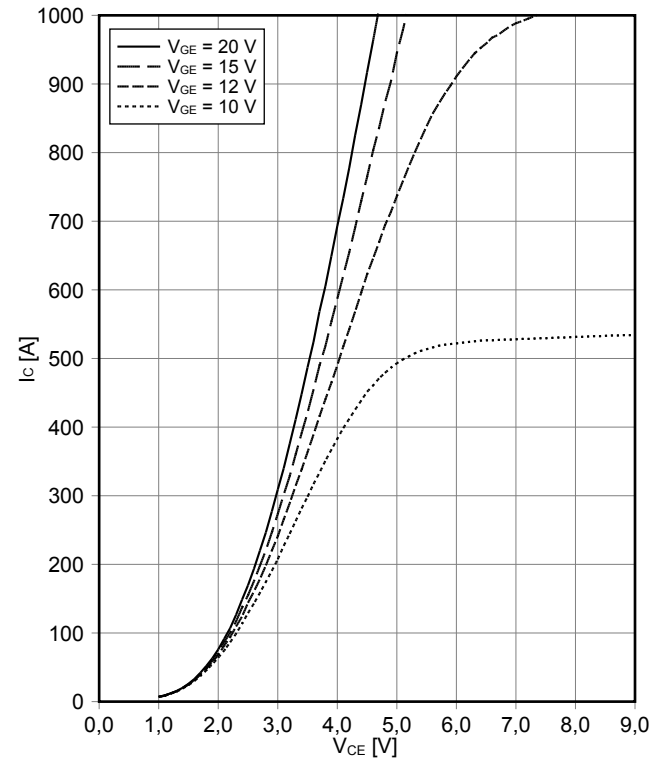
$I_C = f(V_{CE})$
 $V_{GE} = 15 \text{ V}$



输出特性 IGBT, 制动-斩波器 (典型)

output characteristic IGBT, Brake-Chopper (typical)

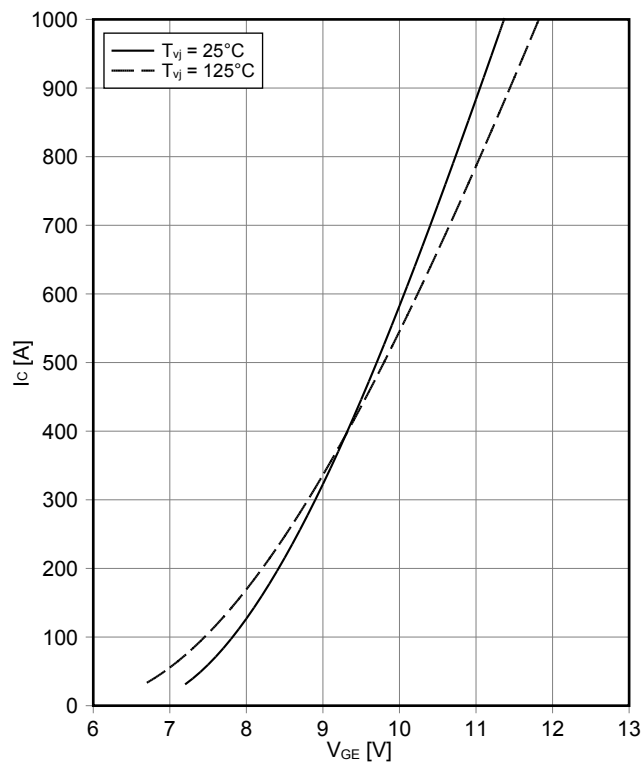
$I_C = f(V_{CE})$
 $T_{vj} = 125^\circ\text{C}$



传输特性 IGBT, 制动-斩波器 (典型)

transfer characteristic IGBT, Brake-Chopper (typical)

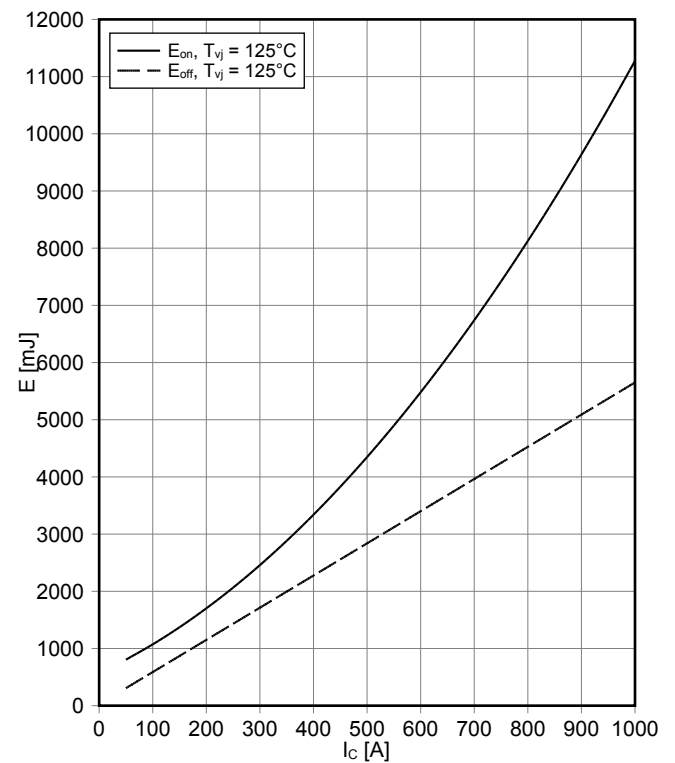
$I_C = f(V_{GE})$
 $V_{CE} = 20 \text{ V}$



开关损耗 IGBT, 制动-斩波器 (典型)

switching losses IGBT, Brake-Chopper (typical)

$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
 $V_{GE} = \pm 15 \text{ V}$, $R_{Gon} = 1.5 \Omega$, $R_{Goff} = 10 \Omega$, $V_{CE} = 3600 \text{ V}$

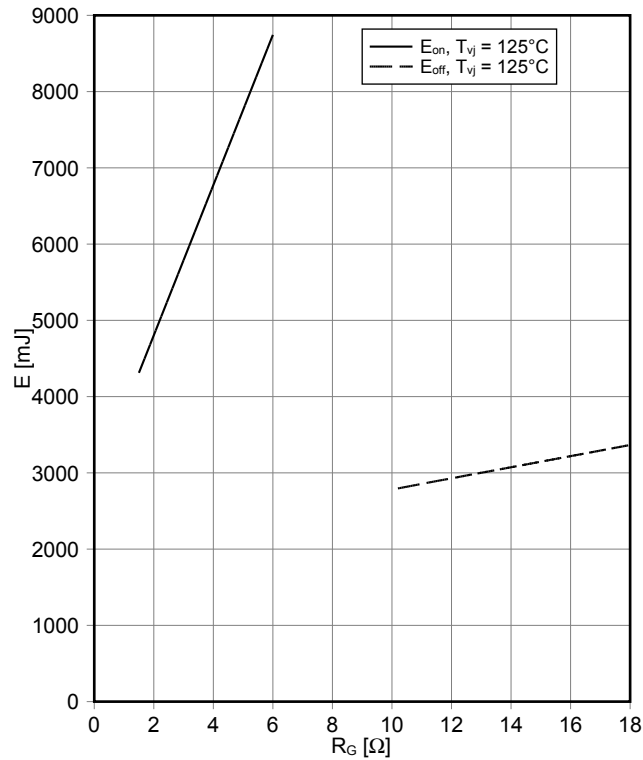


开关损耗 IGBT, 制动-斩波器 (典型)

switching losses IGBT, Brake-Chopper (typical)

$E_{on} = f(R_G)$, $E_{off} = f(R_G)$

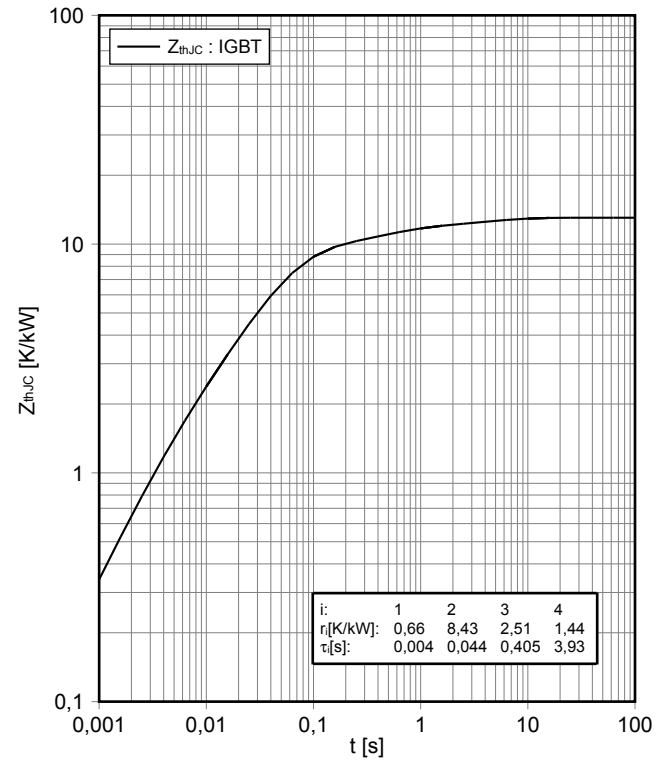
$V_{GE} = \pm 15 \text{ V}$, $I_C = 500 \text{ A}$, $V_{CE} = 3600 \text{ V}$



瞬态热阻抗 IGBT, 制动-斩波器

transient thermal impedance IGBT, Brake-Chopper

$Z_{thJC} = f(t)$

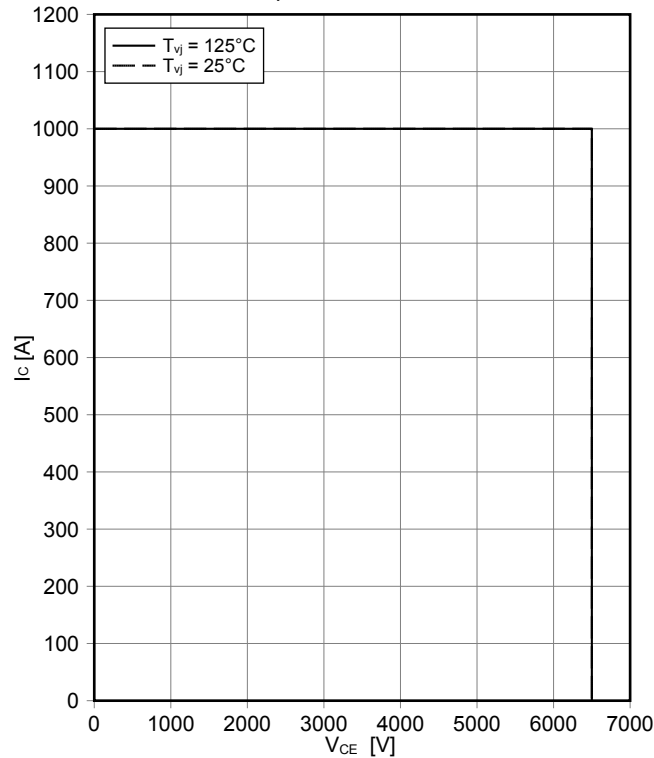


反偏安全工作区 IGBT, 制动-斩波器 (RBSOA)

reverse bias safe operating area IGBT, Brake-Chopper (RBSOA)

$I_C = f(V_{CE})$

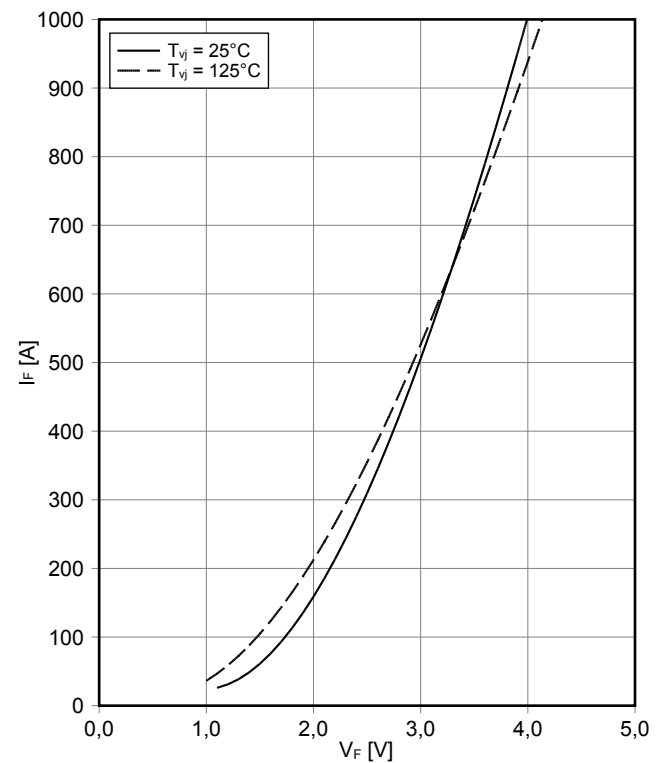
$V_{GE} = \pm 15 \text{ V}$, $R_{Goff} = 10 \Omega$, $T_{vj} = 125^\circ\text{C}$



正向偏压特性 二极管, 制动-斩波器 (典型)

forward characteristic of Diode, Brake-Chopper (typical)

$I_F = f(V_F)$

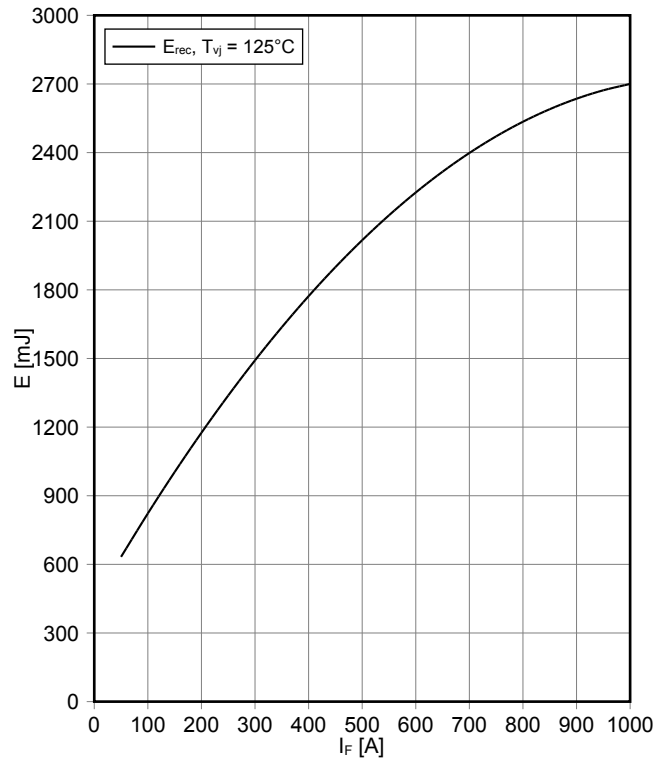


开关损耗 二极管，制动-斩波器（典型）

switching losses Diode, Brake-Chopper (typical)

$E_{rec} = f(I_F)$

$R_{Gon} = 1.5 \Omega$, $V_{CE} = 3600 V$

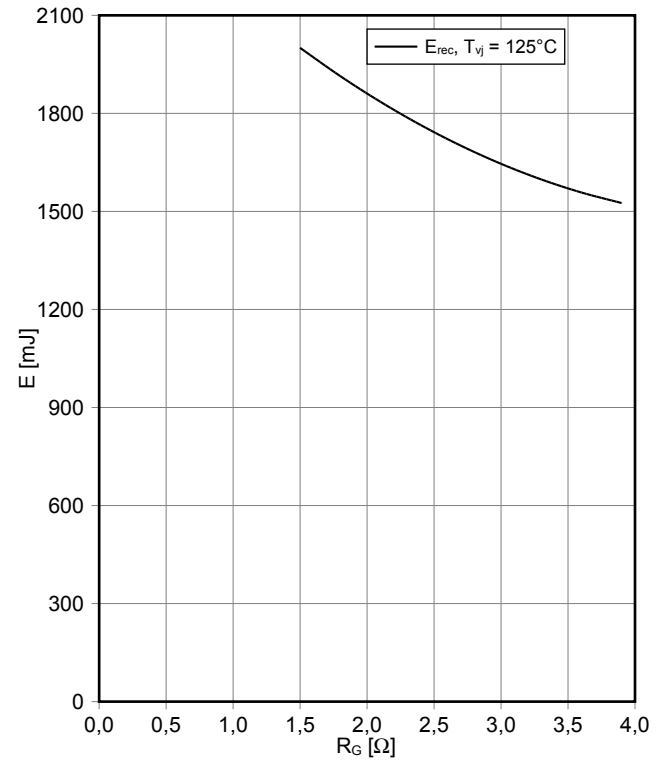


开关损耗 二极管，制动-斩波器（典型）

switching losses Diode, Brake-Chopper (typical)

$E_{rec} = f(R_G)$

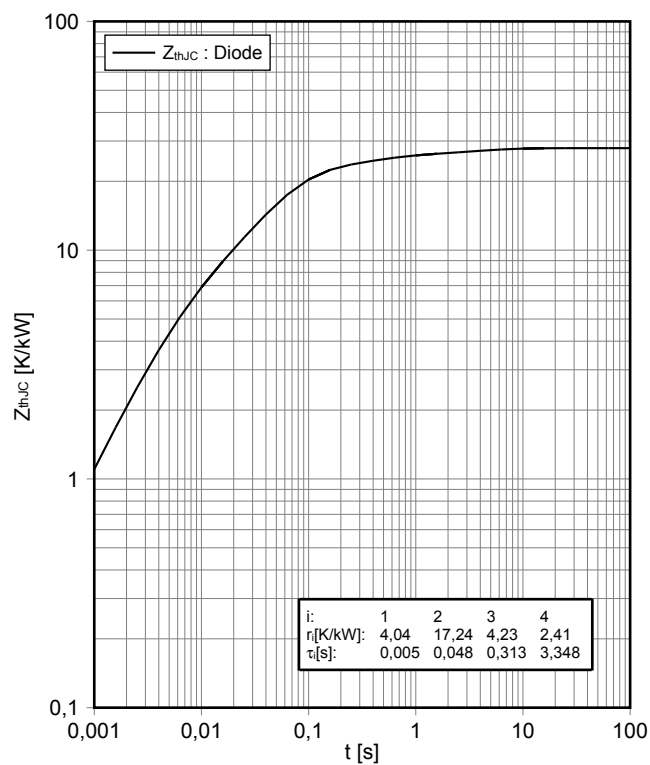
$I_F = 500 A$, $V_{CE} = 3600 V$



瞬态热阻抗 二极管，制动-斩波器

transient thermal impedance Diode, Brake-Chopper

$Z_{thJC} = f(t)$

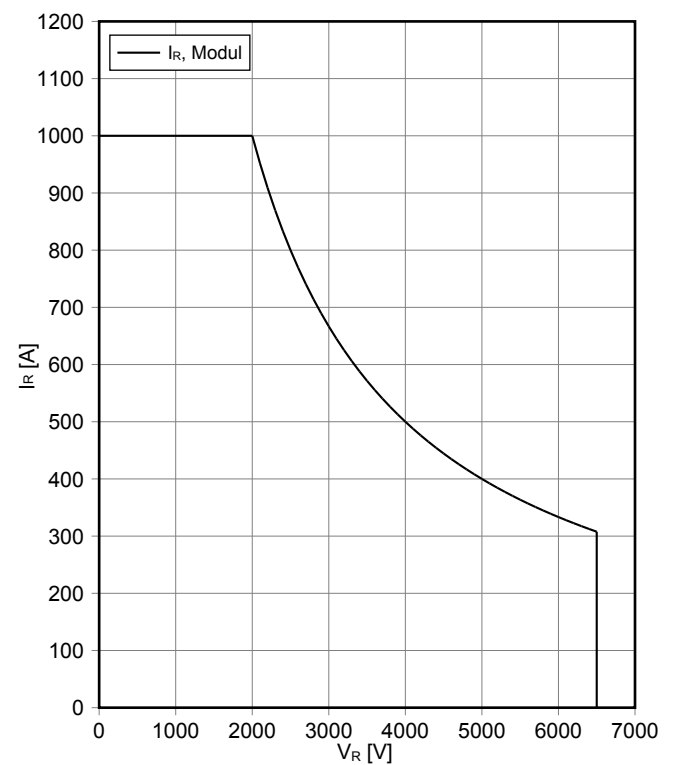


安全工作区 二极管，制动-斩波器 (SOA)

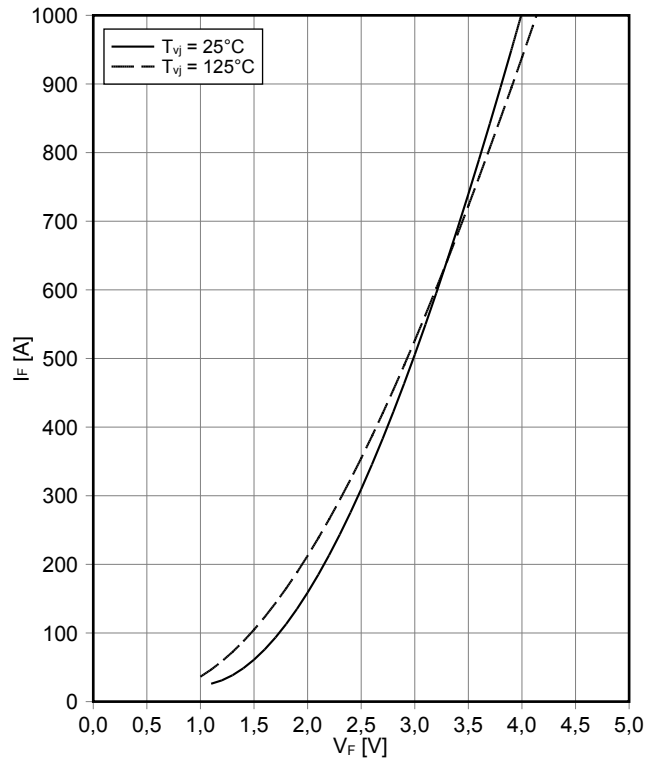
safe operation area Diode, Brake-Chopper (SOA)

$I_R = f(V_R)$

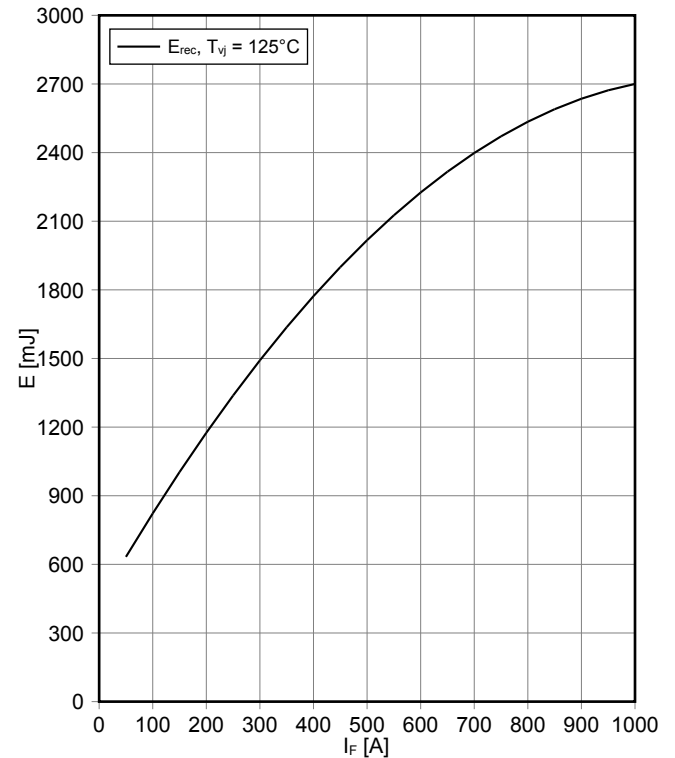
$T_{vj} = 125^\circ C$



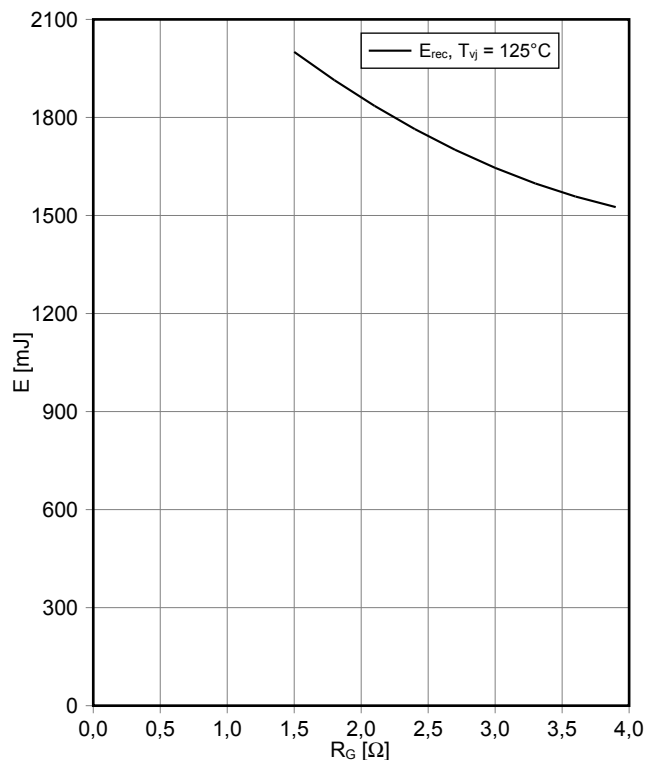
正向偏压特性 二極體, 反轉 (典型)
forward characteristic of Diode, Reverse (typical)
 $I_F = f(V_F)$



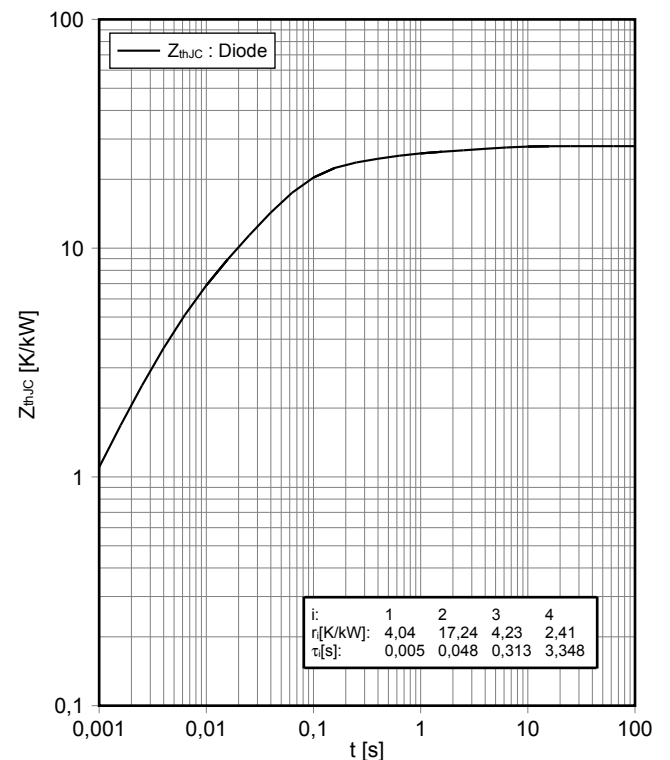
开关损耗 二極體, 反轉 (典型)
switching losses Diode, Reverse (typical)
 $E_{rec} = f(I_F)$
 $R_{Gon} = 1.5 \Omega$, $V_{CE} = 3600 \text{ V}$



开关损耗 二極體, 反轉 (典型)
switching losses Diode, Reverse (typical)
 $E_{rec} = f(R_G)$
 $I_F = 500 \text{ A}$, $V_{CE} = 3600 \text{ V}$



瞬态热阻抗 二極體, 反轉
transient thermal impedance Diode, Reverse
 $Z_{thJC} = f(t)$

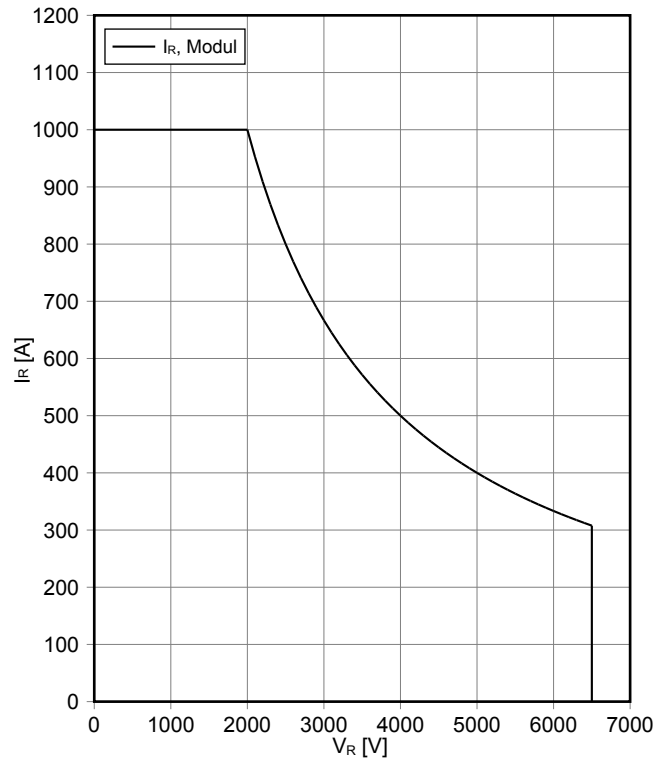


安全工作区 二極體, 反轉 (SOA)

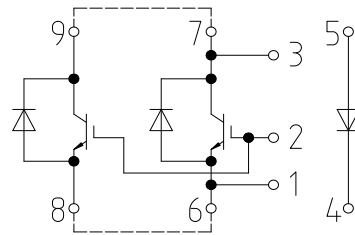
safe operation area Diode, Reverse (SOA)

$I_R = f(V_R)$

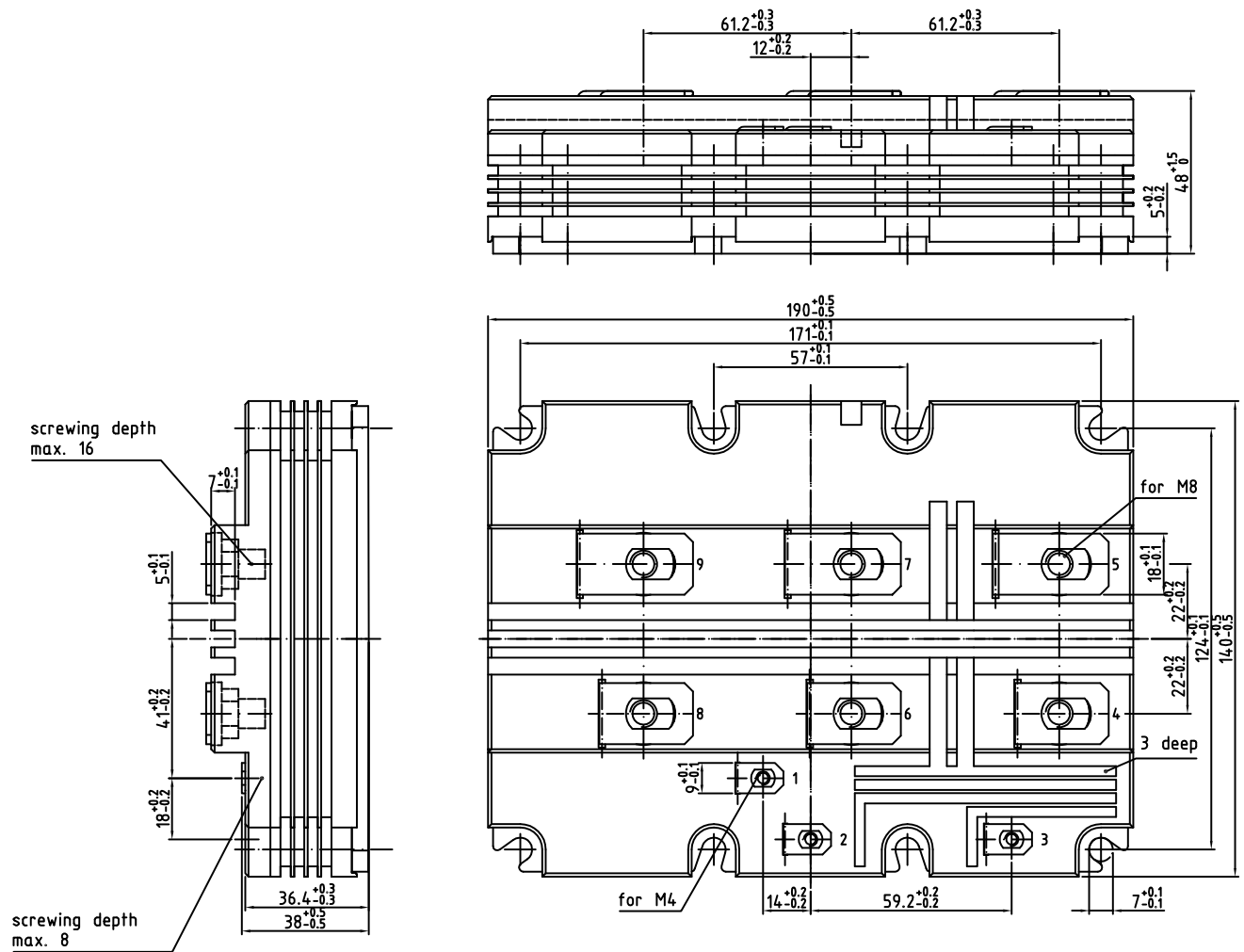
$T_{vj} = 125^\circ\text{C}$



接线图 / Circuit diagram



封装尺寸 / Package outlines



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Edition 2020-05-06

Published by
Infineon Technologies AG
81726 München, Germany

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