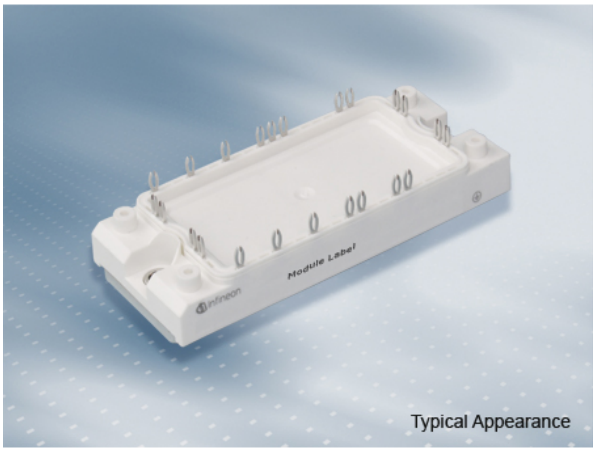
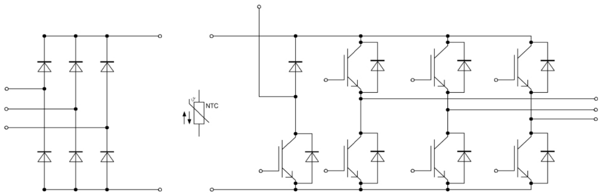
技术信息 / Technical Information

IGBT-模块
IGBT-modules

FP50R12KT4_B11

EconoPIM™2 模块 采用第四代沟槽栅/场终止IGBT4和第四代发射极控制二极管
带有pressfit压接管脚和温度检测NTC
EconoPIM™2 module with Trench/Fieldstop IGBT4 and Emitter Controlled 4 diode and PressFIT / NTC





V_{CES} = 1200V
$I_{C\ nom}$ = 50A / I_{CRM} = 100A

典型应用
- 辅助逆变器
- 电机传动
- 伺服驱动器

Typical Applications
- Auxiliary Inverters
- Motor Drives
- Servo Drives

电气特性
- 低开关损耗
- $T_{vj\ op}$ = 150°C
- V_{CEsat} 带正温度系数
- 低 V_{CEsat}

Electrical Features
- Low Switching Losses
- $T_{vj\ op}$ = 150°C
- V_{CEsat} with positive Temperature Coefficient
- Low V_{CEsat}

机械特性
- 高功率循环和温度循环能力
- 高功率密度
- 集成NTC温度传感器
- 铜基板
- PressFIT 压接技术
- 标封装

Mechanical Features
- High Power and Thermal Cycling Capability
- High Power Density
- Integrated NTC temperature sensor
- Copper Base Plate
- PressFIT Contact Technology
- Standard Housing

Module Label Code

Barcode Code 128

00000123456000000000000

DMX - 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, 逆变器 / IGBT,Inverter

最大额定值 / Maximum Rated Values

集电极 - 发射极电压 Collector-emitter voltage	T_{vj} = 25°C	V_{CES}	1200	V
连续集电极直流电流 Continuous DC collector current	T_C = 95°C, $T_{vj\,max}$ = 175°C	$I_{C\,nom}$	50	A
集电极重复峰值电流 Repetitive peak collector current	t_P = 1 ms	I_{CRM}	100	A
总功率损耗 Total power dissipation	T_C = 25°C, $T_{vj\,max}$ = 175	P_{tot}	280	W
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 = 50 A, V_{GE} = 15 V I_C = 50 A, V_{GE} = 15 V I_C = 50 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$V_{CE\,sat}$		1,85 2,15 2,25	2,15	V V V
栅极阈值电压 Gate threshold voltage	I_C = 1,70 mA, V_{CE} = V_{GE}, T_{vj} = 25°C		V_{GEth}	5,2	5,8	6,4	V
栅极电荷 Gate charge	V_{GE} = -15 V ... +15 V		Q_G		0,38		µC
内部栅极电阻 Internal gate resistor	T_{vj} = 25°C		R_{Gint}		4,0		Ω
输入电容 Input capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{ies}		2,80		nF
反向传输电容 Reverse transfer capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{res}		0,10		nF
集电极-发射极截止电流 Collector-emitter cut-off current	V_{CE} = 1200 V, V_{GE} = 0 V, T_{vj} = 25°C		I_{CES}			1,0	mA
栅极-发射极漏电流 Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25°C		I_{GES}			100	nA
开通延迟时间(电感负载) Turn-on delay time, inductive load	I_C = 50 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Gon} = 15 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,on}$		0,16 0,17 0,17		µs µs µs
上升时间(电感负载) Rise time, inductive load	I_C = 50 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Gon} = 15 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		0,03 0,04 0,04		µs µs µs
关断延迟时间(电感负载) Turn-off delay time, inductive load	I_C = 50 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Goff} = 15 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,off}$		0,33 0,43 0,45		µs µs µs
下降时间(电感负载) Fall time, inductive load	I_C = 50 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Goff} = 15 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		0,08 0,15 0,17		µs µs µs
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	I_C = 50 A, V_{CE} = 600 V, L_S = 20 nH V_{GE} = ±15 V, di/dt = 1400 A/µs (T_{vj} = 150°C) R_{Gon} = 15 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		5,70 7,70 8,40		mJ mJ mJ
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	I_C = 50 A, V_{CE} = 600 V, L_S = 20 nH V_{GE} = ±15 V, du/dt = 3600 V/µs (T_{vj} = 150°C) R_{Goff} = 15 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		2,80 4,30 4,80		mJ mJ mJ
短路数据 SC data	V_{GE} ≤ 15 V, V_{CC} = 800 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	t_P ≤ 10 µs, T_{vj} = 150°C	I_{SC}		180		A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R_{thJC}			0,54	K/W
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个 IGBT / per IGBT λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		0,295		K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		150	°C

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二极管,逆变器 / Diode, Inverter

最大额定值 / Maximum Rated Values

反向重复峰值电压 Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current		I_F	50	A
正向重复峰值电流 Repetitive peak forward current	t_P = 1 ms	I_{FRM}	100	A
I2t-值 I²t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 125°C	I²t	560	A²s

特征值 / Characteristic Values

				min.	typ.	max.	
正向电压 Forward voltage	I_F = 50 A, V_{GE} = 0 V I_F = 50 A, V_{GE} = 0 V I_F = 50 A, V_{GE} = 0 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	V_F		1,70 1,65 1,65	2,15	V V V
反向恢复峰值电流 Peak reverse recovery current	I_F = 50 A, - di_F/dt = 1400 A/µs (T_{vj}=150°C) V_R = 600 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		54,0 60,0 63,0		A A A
恢复电荷 Recovered charge	I_F = 50 A, - di_F/dt = 1400 A/µs (T_{vj}=150°C) V_R = 600 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		5,50 8,80 10,0		µC µC µC
反向恢复损耗（每脉冲） Reverse recovery energy	I_F = 50 A, - di_F/dt = 1400 A/µs (T_{vj}=150°C) V_R = 600 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		1,70 3,00 3,70		mJ mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}			0,81	K/W
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个二极管 / per diode λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		0,44		K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\ op}$	-40		150	°C

二极管,整流器 / Diode, Rectifier

最大额定值 / Maximum Rated Values

反向重复峰值电压 Repetitive peak reverse voltage	T_{vj} = 25°C	V_{RRM}	1600	V
最大正向均方根电流(每芯片) Maximum RMS forward current per chip	T_C = 80°C	I_{FRMSM}	70	A
最大整流器输出均方根电流 Maximum RMS current at rectifier output	T_C = 80°C	I_{RMSM}	80	A
正向浪涌电流 Surge forward current	t_p = 10 ms, T_{vj} = 25°C t_p = 10 ms, T_{vj} = 150°C	I_{FSM}	450 370	A A
I2t-值 I²t - value	t_p = 10 ms, T_{vj} = 25°C t_p = 10 ms, T_{vj} = 150°C	I²t	1000 685	A²s A²s

特征值 / Characteristic Values

			min.	typ.	max.	
正向电压 Forward voltage	T_{vj} = 150°C, I_F = 50 A	V_F		1,05		V
反向电流 Reverse current	T_{vj} = 150°C, V_R = 1600 V	I_R		1,00		mA
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode	R_{thJC}			0,85	K/W
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个二极管 / per diode λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)	R_{thCH}		0,465		K/W
在开关状态下温度 Temperature under switching conditions		$T_{vj\ op}$	-40		150	°C

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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} = 25°C	V_{CES}	1200	V
连续集电极直流电流 Continuous DC collector current	T_C = 100°C, $T_{vj\,max}$ = 175°C	$I_{C\,nom}$	25	A
集电极重复峰值电流 Repetitive peak collector current	t_P = 1 ms	I_{CRM}	50	A
总功率损耗 Total power dissipation	T_C = 25°C, $T_{vj\,max}$ = 175	P_{tot}	160	W
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 = 25 A, V_{GE} = 15 V I_C = 25 A, V_{GE} = 15 V I_C = 25 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$V_{CE\,sat}$		1,85 2,15 2,25	2,15	V V V
栅极阈值电压 Gate threshold voltage	I_C = 0,85 mA, V_{CE} = V_{GE}, T_{vj} = 25°C		V_{GEth}	5,2	5,8	6,4	V
栅极电荷 Gate charge	V_{GE} = -15 V ... +15 V		Q_G		0,20		µC
内部栅极电阻 Internal gate resistor	T_{vj} = 25°C		R_{Gint}		0,0		Ω
输入电容 Input capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{ies}		1,45		nF
反向传输电容 Reverse transfer capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{res}		0,05		nF
集电极-发射极截止电流 Collector-emitter cut-off current	V_{CE} = 1200 V, V_{GE} = 0 V, T_{vj} = 25°C		I_{CES}			1,0	mA
栅极-发射极漏电流 Gate-emitter leakage current	V_{CE} = 0 V, V_{GE} = 20 V, T_{vj} = 25°C		I_{GES}			100	nA
开通延迟时间(电感负载) Turn-on delay time, inductive load	I_C = 25 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Gon} = 37 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,on}$		0,05 0,06 0,06		µs µs µs
上升时间(电感负载) Rise time, inductive load	I_C = 25 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Gon} = 37 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		0,03 0,04 0,05		µs µs µs
关断延迟时间(电感负载) Turn-off delay time, inductive load	I_C = 25 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Goff} = 37 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,off}$		0,34 0,43 0,45		µs µs µs
下降时间(电感负载) Fall time, inductive load	I_C = 25 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Goff} = 37 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		0,05 0,07 0,08		µs µs µs
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	I_C = 25 A, V_{CE} = 600 V, L_S = 20 nH V_{GE} = ±15 V R_{Gon} = 37 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		2,00 2,65 2,90		mJ mJ mJ
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	I_C = 25 A, V_{CE} = 600 V, L_S = 20 nH V_{GE} = ±15 V R_{Goff} = 37 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		1,40 2,20 2,40		mJ mJ mJ
短路数据 SC data	$V_{GE} \leq$ 15 V, V_{CC} = 800 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	$t_P \leq$ 10 µs, T_{vj} = 150°C	I_{SC}		90		A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R_{thJC}			0,95	K/W
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个 IGBT / per IGBT λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		0,52		K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		150	°C

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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} = 25°C	V_{RRM}	1200	V
连续正向直流电流 Continuous DC forward current		I_F	15	A
正向重复峰值电流 Repetitive peak forward current	t_P = 1 ms	I_{FRM}	30	A
I2t-值 I²t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 125°C	I^2t	48,0	A²s

特征值 / Characteristic Values

				min.	typ.	max.	
正向电压 Forward voltage	I_F = 15 A, V_{GE} = 0 V I_F = 15 A, V_{GE} = 0 V I_F = 15 A, V_{GE} = 0 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	V_F		1,75 1,75 1,75	2,15	V V V
反向恢复峰值电流 Peak reverse recovery current	I_F = 15 A, - di_F/dt = 1000 A/µs (T_{vj}=150°C) V_R = 600 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		20,0 22,0 23,0		A A A
恢复电荷 Recovered charge	I_F = 15 A, - di_F/dt = 1000 A/µs (T_{vj}=150°C) V_R = 600 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		1,50 2,50 2,70		µC µC µC
反向恢复损耗（每脉冲） Reverse recovery energy	I_F = 15 A, - di_F/dt = 1000 A/µs (T_{vj}=150°C) V_R = 600 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		0,55 0,90 1,00		mJ mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}			1,50	K/W
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个二极管 / per diode λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)		R_{thCH}		0,82		K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		150	°C

负温度系数热敏电阻 / NTC-Thermistor

特征值 / Characteristic Values

			min.	typ.	max.	
额定电阻值 Rated resistance	T_C = 25°C	R_{25}		5,00		kΩ
R100 偏差 Deviation of R100	T_C = 100°C, R_{100} = 493 Ω	ΔR/R	-5		5	%
耗散功率 Power dissipation	T_C = 25°C	P_{25}			20,0	mW
B-值 B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15\ K))]$	$B_{25/50}$		3375		K
B-值 B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15\ K))]$	$B_{25/80}$		3411		K
B-值 B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15\ K))]$	$B_{25/100}$		3433		K

根据应用手册标定
Specification according to the valid application note.

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模块 / Module

绝缘测试电压 Isolation test voltage	RMS, f = 50 Hz, t = 1 min.	V_{ISOL}		2,5		kV
模块基板材料 Material of module baseplate				Cu		
内部绝缘 Internal isolation	基本绝缘 (class 1, IEC 61140) basic insulation (class 1, IEC 61140)			Al_2O_3		
爬电距离 Creepage distance	端子- 散热片 / terminal to heatsink 端子- 端子 / terminal to terminal			10,0		mm
电气间隙 Clearance	端子- 散热片 / terminal to heatsink 端子- 端子 / terminal to terminal			7,5		mm
相对电痕指数 Comperative tracking index		CTI		> 200		
			min.	typ.	max.	
外壳 - 散热器热阻 Thermal resistance, case to heatsink	每个模块 / per module λ_{Paste} = 1 W/(m·K) / λ_{grease} = 1 W/(m·K)	R_{thCH}		0,02		K/W
杂散电感,模块 Stray inductance module		L_{sCE}		35		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	$R_{CC'+EE'}$ $R_{AA'+CC'}$		4,00 3,00		mΩ
最大结温 Maximum junction temperature	逆变器,制动-斩波器 / inverter, brake-chopper 整流器 / rectifier	$T_{vj\ max}$			175 150	°C °C
在开关状态下温度 Temperature under switching conditions	逆变器,制动-斩波器 / inverter, brake-chopper 整流器 / rectifier	$T_{vj\ op}$	-40 -40		150 150	°C °C
储存温度 Storage temperature		T_{stg}	-40		125	°C
模块安装的安装扭距 Mounting torque for modul mounting	螺丝 M5 根据相应的应用手册进行安装 Screw M5 - Mounting according to valid application note	M	3,00	-	6,00	Nm
重量 Weight		G		180		g

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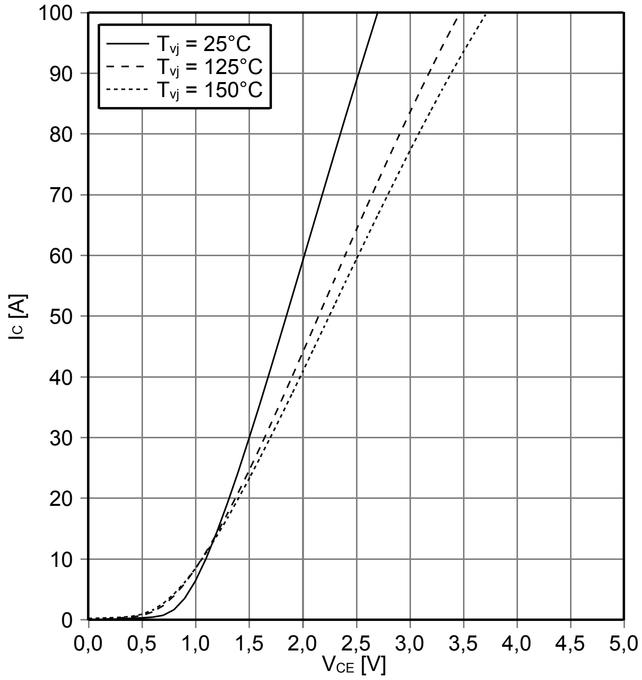
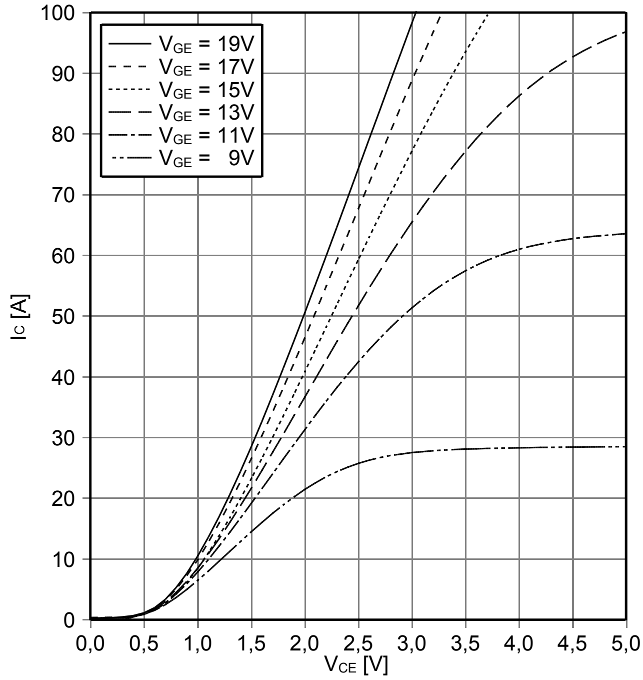
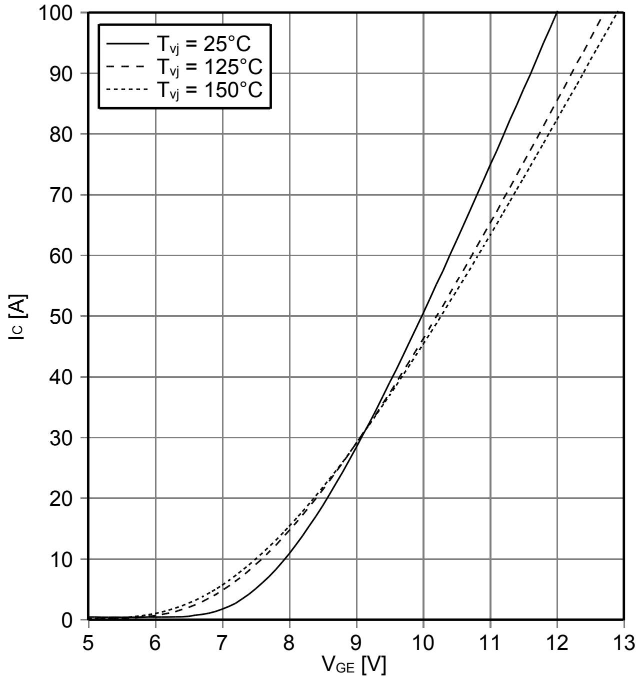
输出特性 IGBT, 逆变器 (典型)
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



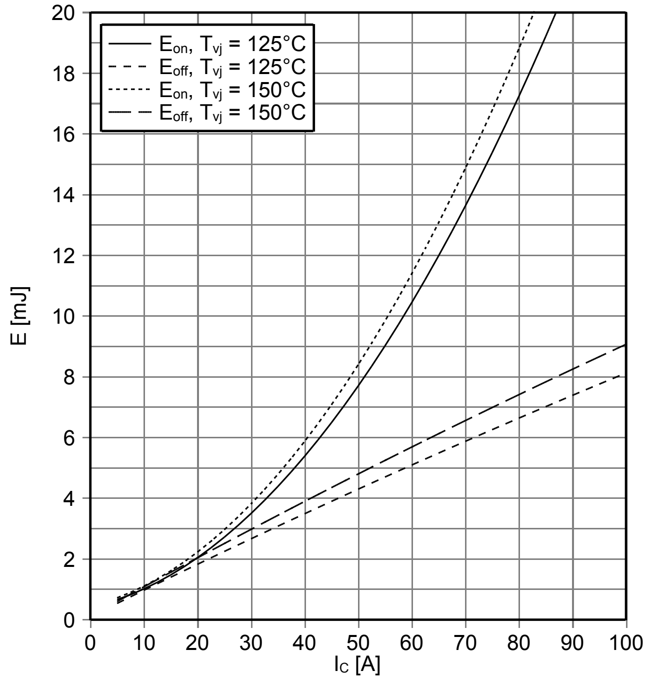
输出特性 IGBT, 逆变器 (典型)
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$T_{vj} = 150°C$



传输特性 IGBT, 逆变器 (典型)
transfer characteristic IGBT,Inverter(typical)
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



开关损耗 IGBT, 逆变器 (典型)
switching losses IGBT,Inverter (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
$V_{GE} = \pm 15$ V, $R_{Gon} = 15\ \Omega$, $R_{Goff} = 15\ \Omega$, $V_{CE} = 600$ V



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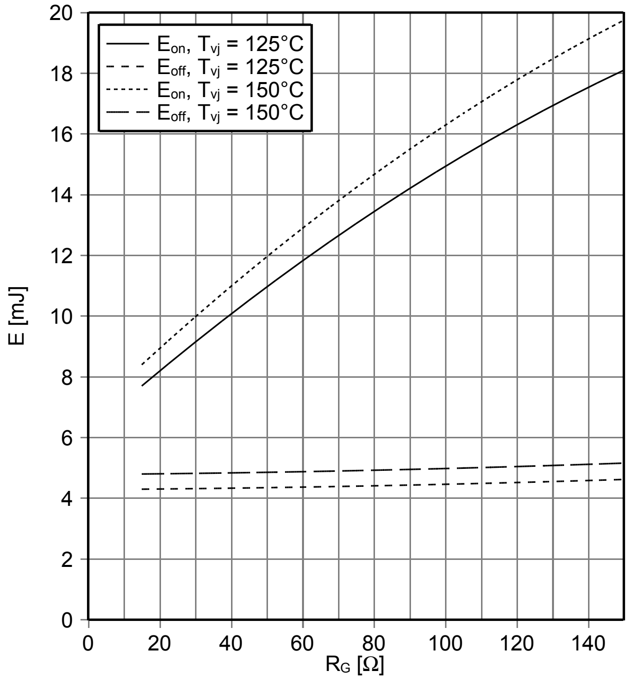
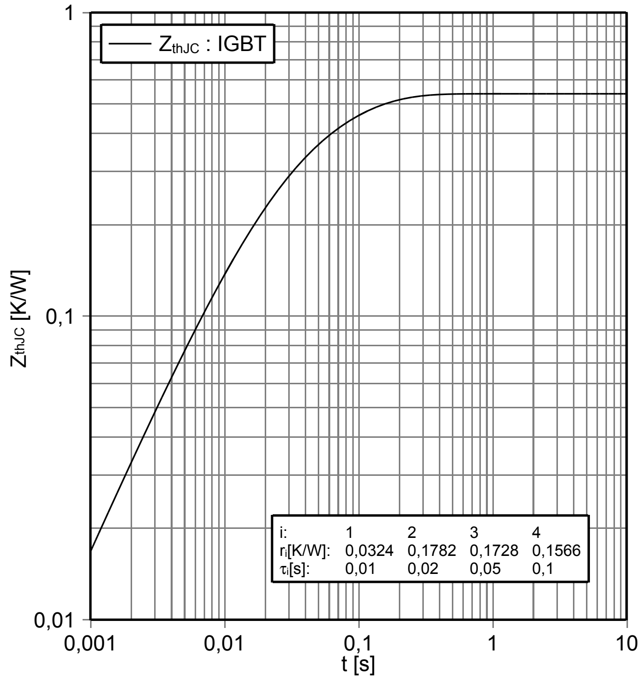
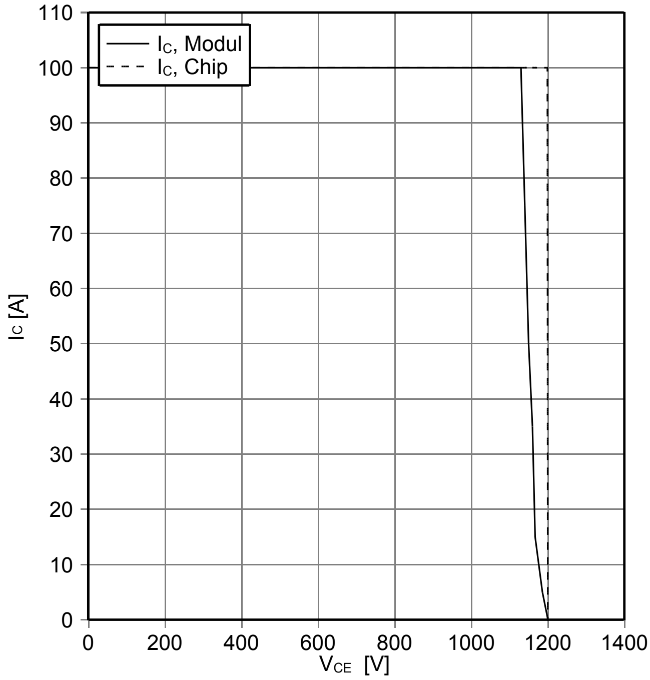
开关损耗 IGBT, 逆变器 （典型)
switching losses IGBT,Inverter (typical)
E_{on} = f (R_G), E_{off} = f (R_G)
V_{GE} = ±15 V, I_C = 50 A, V_{CE} = 600 V



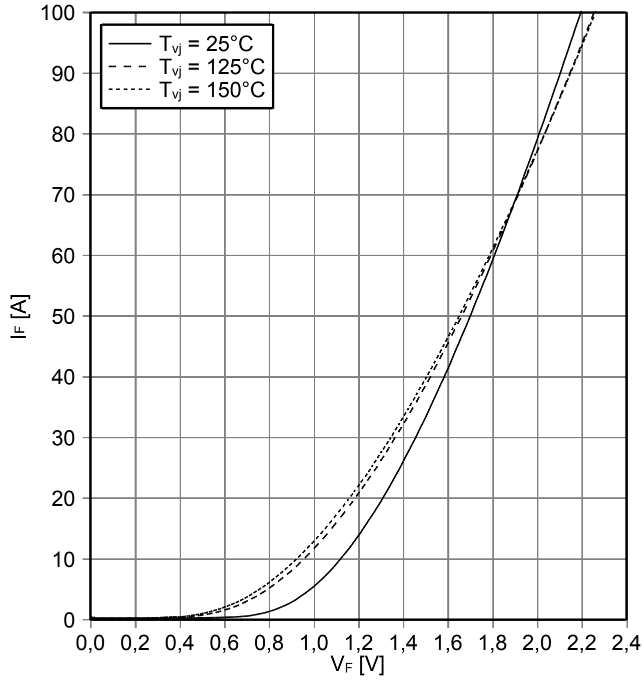
瞬态热阻抗 IGBT, 逆变器
transient thermal impedance IGBT,Inverter
Z_{thJC} = f (t)



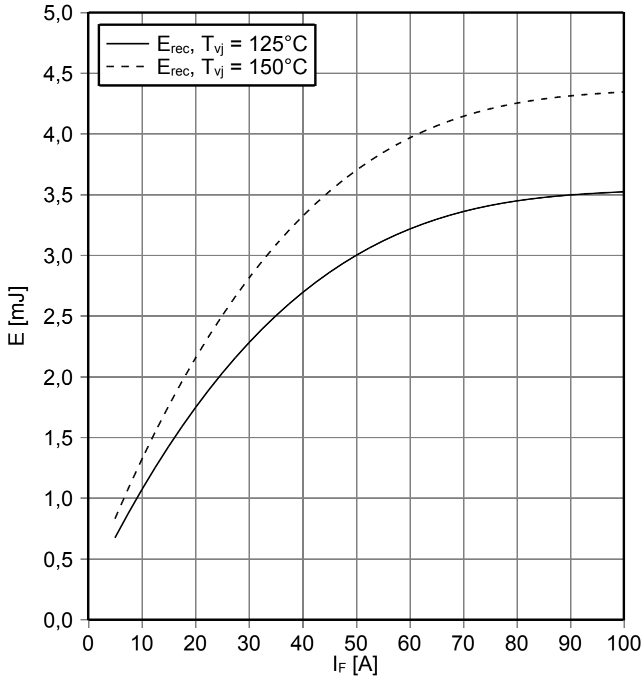
反偏安全工作区 IGBT, 逆变器 （RBSOA）
reverse bias safe operating area IGBT,Inverter (RBSOA)
I_C = f (V_{CE})
V_{GE} = ±15 V, R_{Goff} = 15 Ω, T_{vj} = 150°C



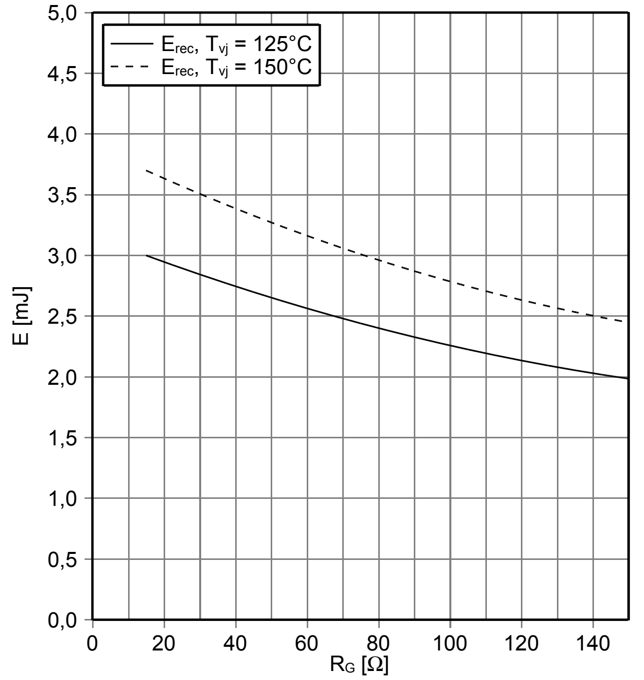
正向偏压特性 二极管,逆变器（典型)
forward characteristic of Diode, Inverter (typical)
I_F = f (V_F)



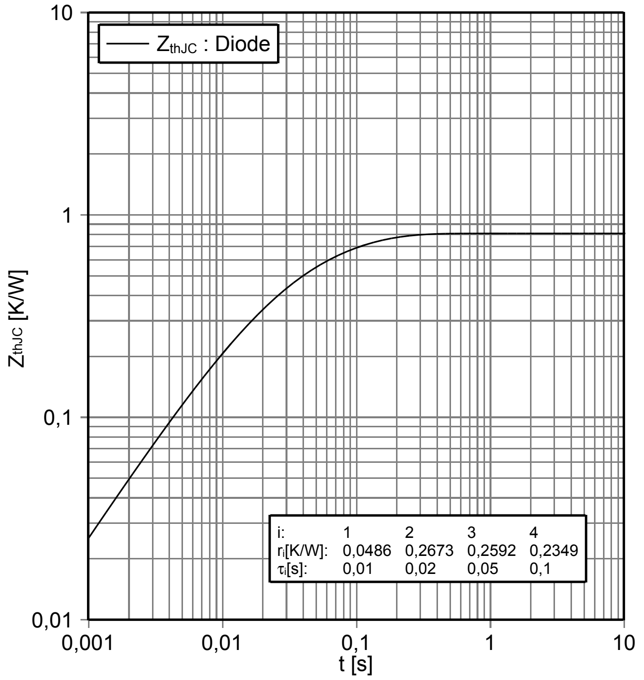
开关损耗 二极管,逆变器 (典型)
switching losses Diode, Inverter (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 15\ \Omega$, $V_{CE} = 600$ V



开关损耗 二极管,逆变器 (典型)
switching losses Diode, Inverter (typical)
$E_{rec} = f(R_G)$
$I_F = 50$ A, $V_{CE} = 600$ V

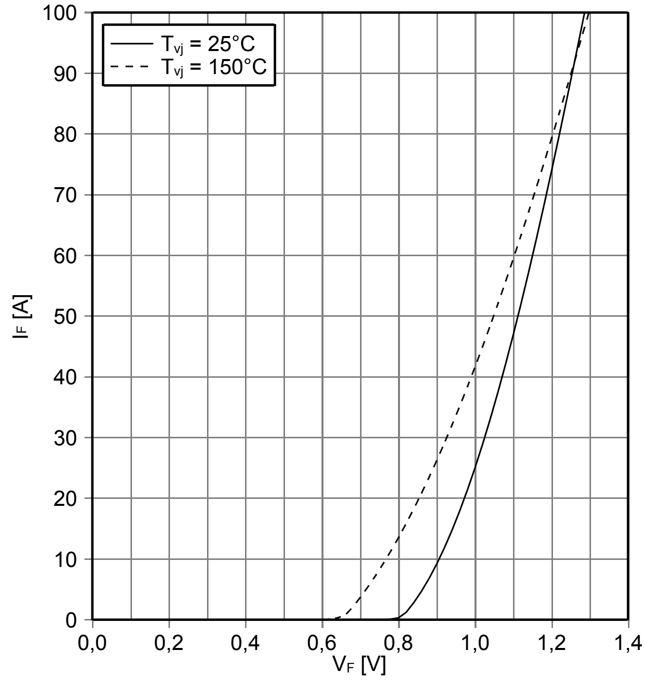


瞬态热阻抗 二极管,逆变器
transient thermal impedance Diode, Inverter
$Z_{thJC} = f(t)$



i:	1	2	3	4
r_i[K/W]:	0,0486	0,2673	0,2592	0,2349
τ_i[s]:	0,01	0,02	0,05	0,1

正向偏压特性 二极管,整流器 (典型)
forward characteristic of Diode, Rectifier (typical)
$I_F = f(V_F)$



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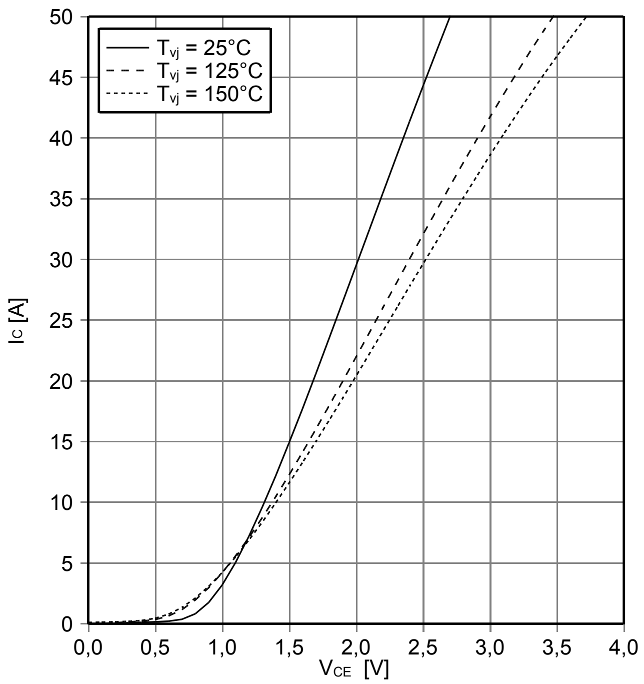
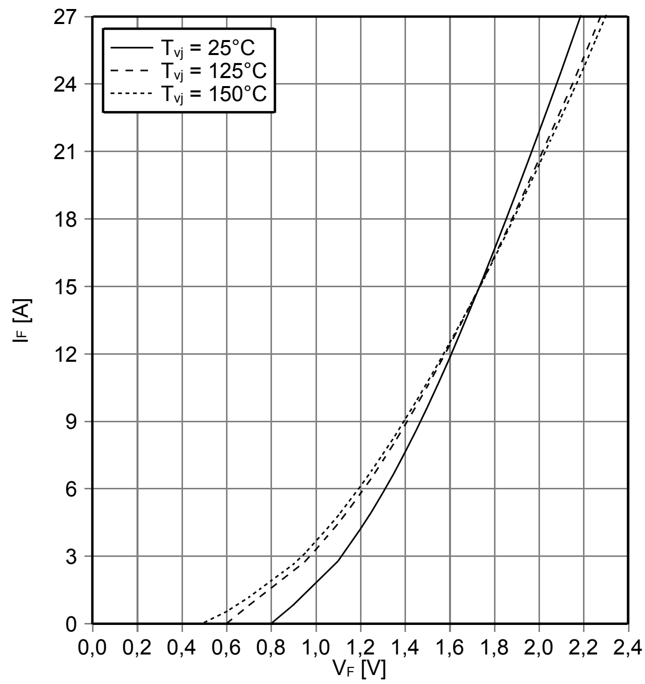
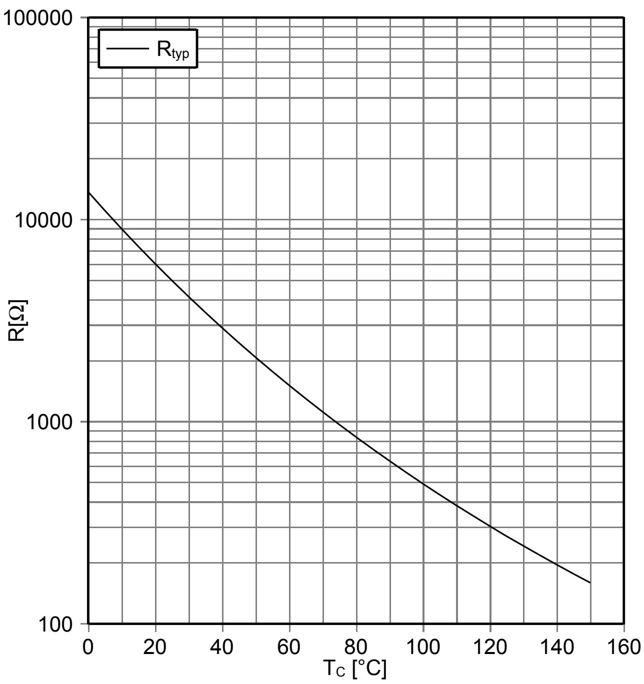
输出特性 IGBT, 制动-斩波器 （典型)
output characteristic IGBT, Brake-Chopper (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



正向偏压特性 二极管，制动-斩波器 (典型)
forward characteristic of Diode, Brake-Chopper (typical)
$I_F = f(V_F)$



负温度系数热敏电阻 温度特性
NTC-Thermistor-temperature characteristic (typical)
R = f (T)



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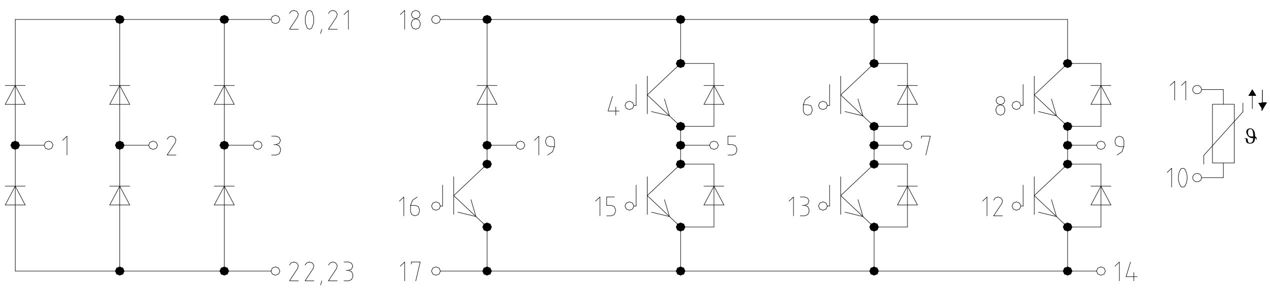
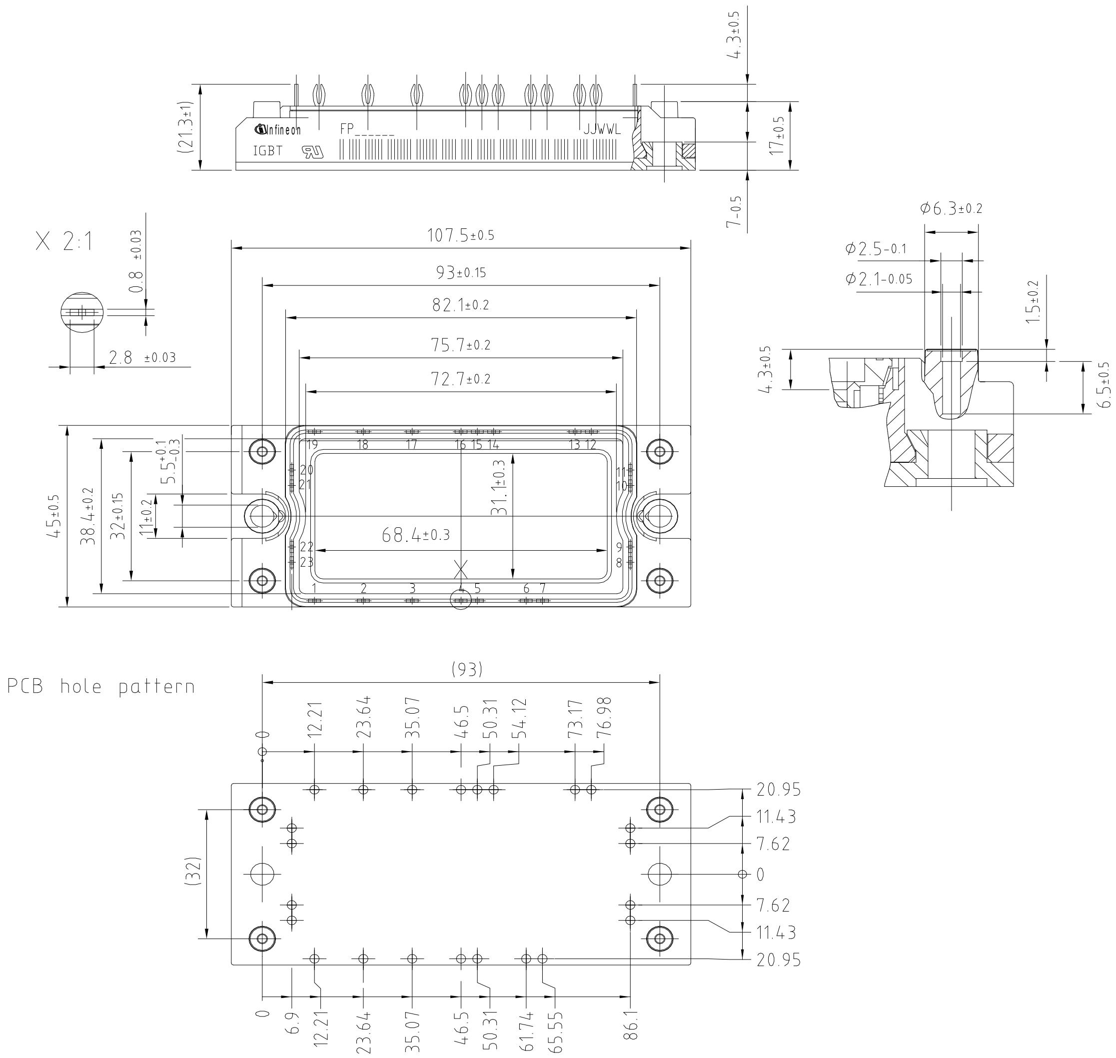
接线图 / circuit_diagram_headline



封装尺寸 / package outlines



- Tolerance of PCB hole pattern ⌖ Φ0.1
- hole specifications see AN 2007-09
- Diameters of plated holes Φ 2.14mm - 2.29mm
- Diameter of drill Φ 2.35mm

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- the conclusion of Quality Agreements;
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