技术信息 / Technical Information

IGBT-模块
IGBT-modules

FP40R12KT3G

初步数据
Preliminary Data

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 = 80°C, $T_{vj\,max}$ = 150°C T_C = 25°C, $T_{vj\,max}$ = 150°C	$I_{C\,nom}$ I_C	40 55	A A
集电极重复峰值电流 Repetitive peak collector current	t_P = 1 ms	I_{CRM}	80	A
总功率损耗 Total power dissipation	T_C = 25°C, $T_{vj\,max}$ = 150	P_{tot}	210	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 = 40 A, V_{GE} = 15 V I_C = 40 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 125°C	$V_{CE\,sat}$		1,80 2,05	2,30	V V
栅极阈值电压 Gate threshold voltage	I_C = 1,50 mA, V_{CE} = V_{GE}, T_{vj} = 25°C		V_{GEth}	5,0	5,8	6,5	V
栅极电荷 Gate charge	V_{GE} = -15 V ... +15 V		Q_G		0,33		µC
内部栅极电阻 Internal gate resistor	T_{vj} = 25°C		R_{Gint}		6,0		Ω
输入电容 Input capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{ies}		2,50		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}		0,09		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}			5,0	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}			400	nA
开通延迟时间(电感负载) Turn-on delay time, inductive load	I_C = 40 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Gon} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	$t_{d\,on}$		0,09 0,09		µs µs
上升时间(电感负载) Rise time, inductive load	I_C = 40 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Gon} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	t_r		0,03 0,05		µs µs
关断延迟时间(电感负载) Turn-off delay time, inductive load	I_C = 40 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Goff} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	$t_{d\,off}$		0,42 0,52		µs µs
下降时间(电感负载) Fall time, inductive load	I_C = 40 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Goff} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	t_f		0,07 0,09		µs µs
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	I_C = 40 A, V_{CE} = 600 V, L_S = 45 nH V_{GE} = ±15 V R_{Gon} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	E_{on}		4,10 6,00		mJ mJ
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	I_C = 40 A, V_{CE} = 600 V, L_S = 45 nH V_{GE} = ±15 V R_{Goff} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	E_{off}		3,10 3,60		mJ mJ
短路数据 SC data	V_{GE} ≤ 15 V, V_{CC} = 900 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	t_P ≤ 10 µs, T_{vj} = 125°C	I_{SC}		160		A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R_{thJC}			0,60	K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		125	°C

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初步数据
Preliminary Data

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	40	A
正向重复峰值电流 Repetitive peak forward current	t_P = 1 ms	I_{FRM}	80	A
I2t-值 I²t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 125°C	I^2t	320	A²s

特征值 / Characteristic Values

				min.	typ.	max.	
正向电压 Forward voltage	I_F = 40 A, V_{GE} = 0 V I_F = 40 A, V_{GE} = 0 V	T_{vj} = 25°C T_{vj} = 125°C	V_F		1,75 1,75	2,30	V V
反向恢复峰值电流 Peak reverse recovery current	I_F = 40 A, - di_F/dt = 900 A/µs (T_{vj}=125°C) V_R = 600 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C	I_{RM}		39,0 38,0		A A
恢复电荷 Recovered charge	I_F = 40 A, - di_F/dt = 900 A/µs (T_{vj}=125°C) V_R = 600 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C	Q_r		4,20 7,80		µC µC
反向恢复损耗（每脉冲） Reverse recovery energy	I_F = 40 A, - di_F/dt = 900 A/µs (T_{vj}=125°C) V_R = 600 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C	E_{rec}		1,35 2,80		mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}			0,95	K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		125	°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}	50	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}	75	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}	315 260	A A
I2t-值 I²t - value	t_p = 10 ms, T_{vj} = 25°C t_p = 10 ms, T_{vj} = 150°C	I^2t	500 340	A²s A²s

特征值 / Characteristic Values

			min.	typ.	max.	
正向电压 Forward voltage	T_{vj} = 150°C, I_F = 40 A	V_F		1,20		V
反向电流 Reverse current	T_{vj} = 150°C, V_R = 1600 V	I_R		2,00		mA
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode	R_{thJC}			1,00	K/W
在开关状态下温度 Temperature under switching conditions		$T_{vj\,op}$				°C

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初步数据
Preliminary Data

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 = 80°C, $T_{vj\,max}$ = 150°C T_C = 25°C, $T_{vj\,max}$ = 150°C	$I_{C\,nom}$ I_C	40 55	A A
集电极重复峰值电流 Repetitive peak collector current	t_P = 1 ms	I_{CRM}	80	A
总功率损耗 Total power dissipation	T_C = 25°C, $T_{vj\,max}$ = 150	P_{tot}	210	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 = 40 A, V_{GE} = 15 V I_C = 40 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 125°C	$V_{CE\,sat}$		1,80 2,05	2,30	V V
栅极阈值电压 Gate threshold voltage	I_C = 1,50 mA, V_{CE} = V_{GE}, T_{vj} = 25°C		V_{GEth}	5,0	5,8	6,5	V
栅极电荷 Gate charge	V_{GE} = -15 V ... +15 V		Q_G		0,33		µC
内部栅极电阻 Internal gate resistor	T_{vj} = 25°C		R_{Gint}		6,0		Ω
输入电容 Input capacitance	f = 1 MHz, T_{vj} = 25°C, V_{CE} = 25 V, V_{GE} = 0 V		C_{ies}		2,50		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}		0,09		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}			5,0	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}			400	nA
开通延迟时间(电感负载) Turn-on delay time, inductive load	I_C = 40 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Gon} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	$t_{d\,on}$		0,09 0,09		µs µs
上升时间(电感负载) Rise time, inductive load	I_C = 40 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Gon} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	t_r		0,03 0,05		µs µs
关断延迟时间(电感负载) Turn-off delay time, inductive load	I_C = 40 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Goff} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	$t_{d\,off}$		0,42 0,52		µs µs
下降时间(电感负载) Fall time, inductive load	I_C = 40 A, V_{CE} = 600 V V_{GE} = ±15 V R_{Goff} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	t_f		0,07 0,09		µs µs
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	I_C = 40 A, V_{CE} = 600 V, L_S = t.b.d. nH V_{GE} = ±15 V R_{Gon} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	E_{on}		4,10 6,00		mJ mJ
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	I_C = 40 A, V_{CE} = 600 V, L_S = t.b.d. nH V_{GE} = ±15 V R_{Goff} = 27 Ω	T_{vj} = 25°C T_{vj} = 125°C	E_{off}		3,10 3,60		mJ mJ
短路数据 SC data	V_{GE} ≤ 15 V, V_{CC} = 900 V V_{CEmax} = V_{CES} -L_{sCE} ·di/dt	t_P ≤ 10 µs, T_{vj} = 125°C	I_{SC}		160		A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R_{thJC}			0,60	K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		125	°C

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初步数据
Preliminary Data

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 I^2t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 125°C	I^2t	60,0	A^2s

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	T_{vj} = 25°C T_{vj} = 125°C	V_F		1,65 1,65	2,20	V V
反向恢复峰值电流 Peak reverse recovery current	I_F = 15 A, - di_F/dt = 400 A/µs (T_{vj}=125°C) V_R = 600 V	T_{vj} = 25°C T_{vj} = 125°C	I_{RM}		16,0 15,0		A A
恢复电荷 Recovered charge	I_F = 15 A, - di_F/dt = 400 A/µs (T_{vj}=125°C) V_R = 600 V	T_{vj} = 25°C T_{vj} = 125°C	Q_r		1,80 3,00		µC µC
反向恢复损耗（每脉冲） Reverse recovery energy	I_F = 15 A, - di_F/dt = 400 A/µs (T_{vj}=125°C) V_R = 600 V	T_{vj} = 25°C T_{vj} = 125°C	E_{rec}		0,55 1,10		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
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		125	°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	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15\ K))]$	$B_{25/80}$		t.b.d.		K
B-值 B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15\ K))]$	$B_{25/100}$		t.b.d.		K

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

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初步数据
Preliminary Data

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		> 225		
			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}		0,009		K/W
杂散电感,模块 Stray inductance module		L_{sCE}		60		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 2,00		mΩ
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		300		g

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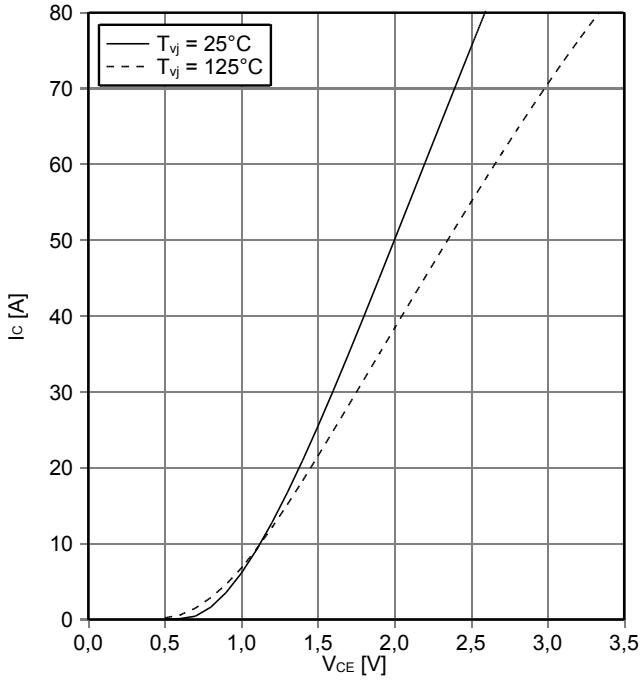
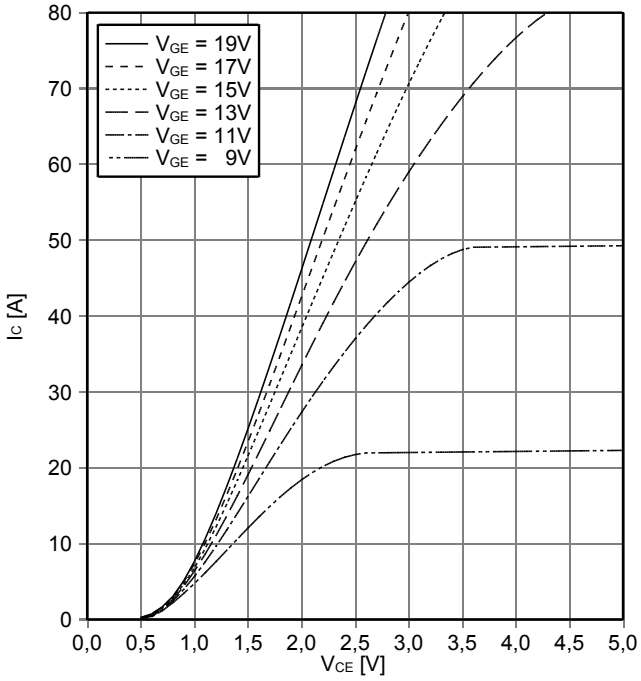
初步数据
Preliminary Data

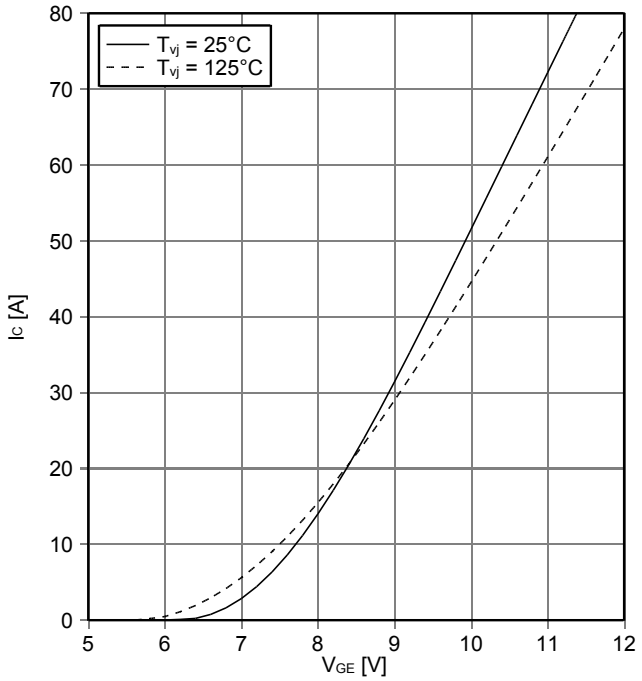
输出特性 IGBT, 逆变器 （典型)
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



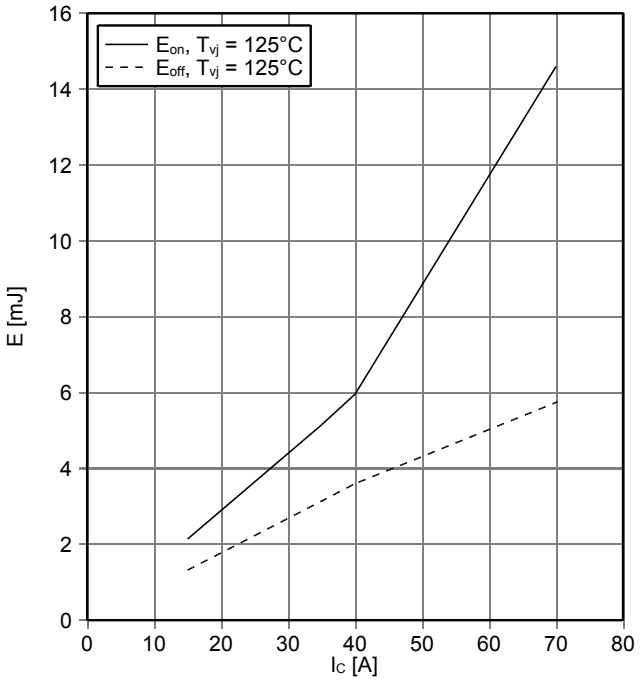
输出特性 IGBT, 逆变器 （典型)
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
$T_{vj} = 125°C$



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, $R_{Gon} = 27\ \Omega$, $R_{Goff} = 27\ \Omega$, $V_{CE} = 600$ V



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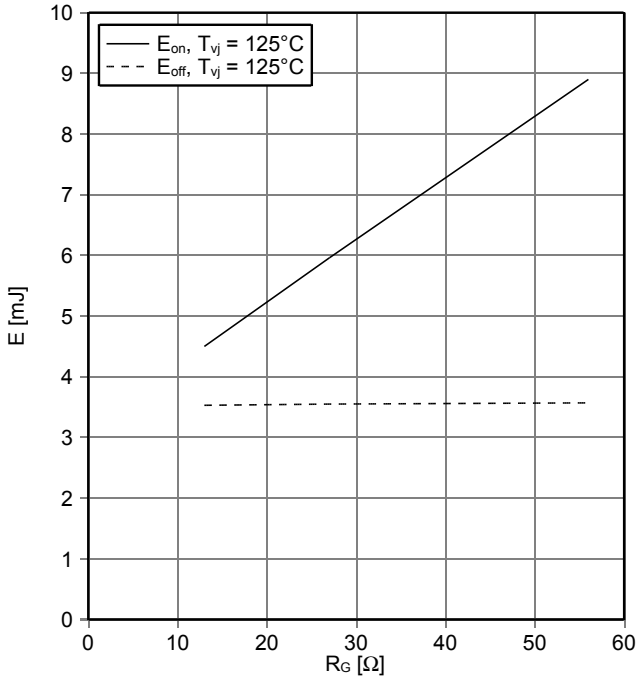
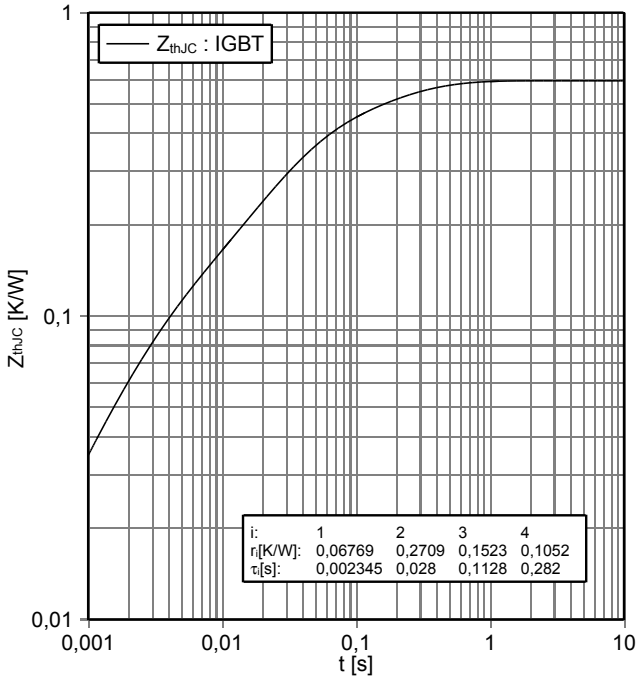
初步数据
Preliminary Data

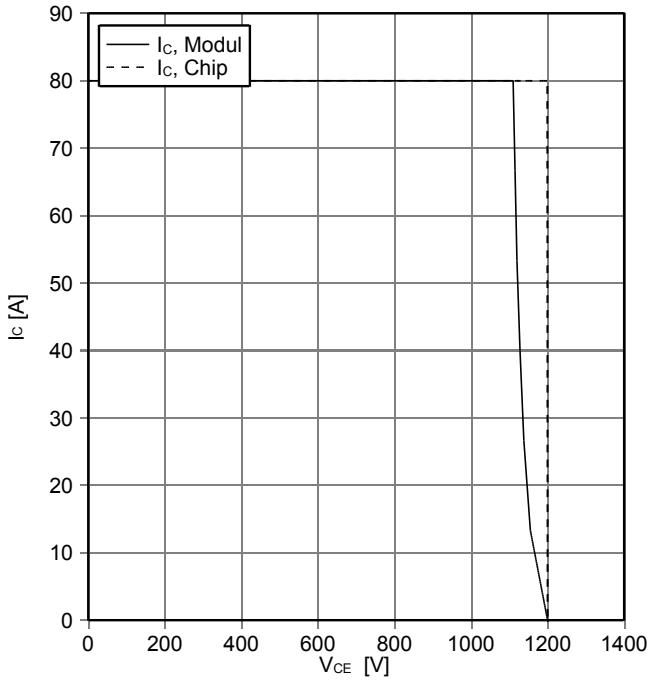
开关损耗 IGBT, 逆变器 （典型)
switching losses IGBT,Inverter (typical)
$E_{on} = f(R_G)$, $E_{off} = f(R_G)$
$V_{GE} = \pm 15$ V, $I_C = 40$ A, $V_{CE} = 600$ V



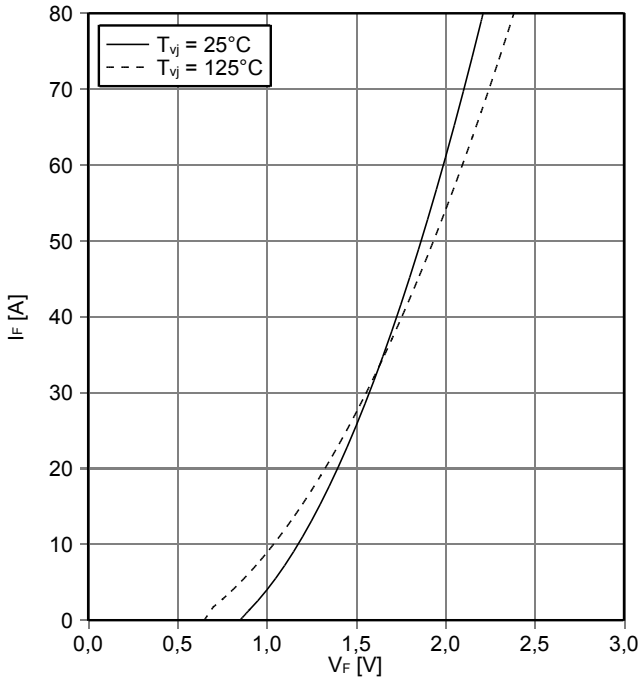
瞬态热阻抗 IGBT, 逆变器
transient thermal impedance IGBT,Inverter
$Z_{thJC} = f(t)$



反偏安全工作区 IGBT, 逆变器 （RBSOA）
reverse bias safe operating area IGBT,Inverter (RBSOA)
$I_C = f(V_{CE})$
$V_{GE} = \pm 15$ V, $R_{Goff} = 27\ \Omega$, $T_{vj} = 125°C$



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



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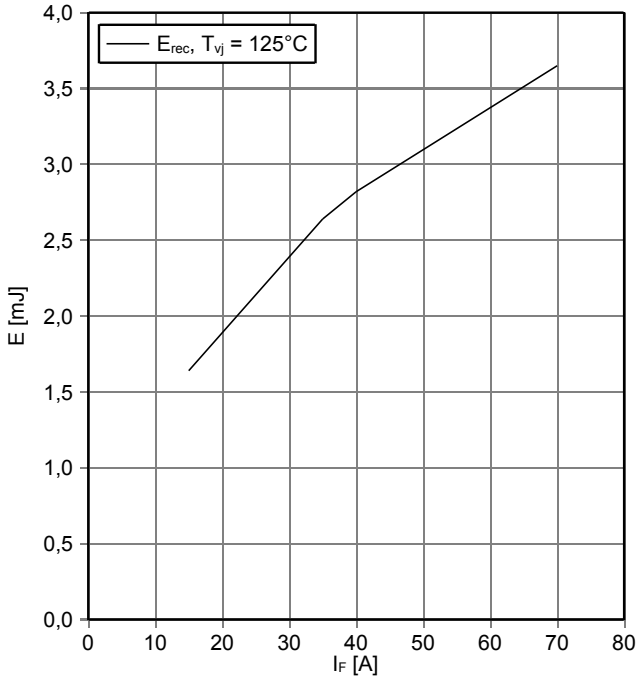
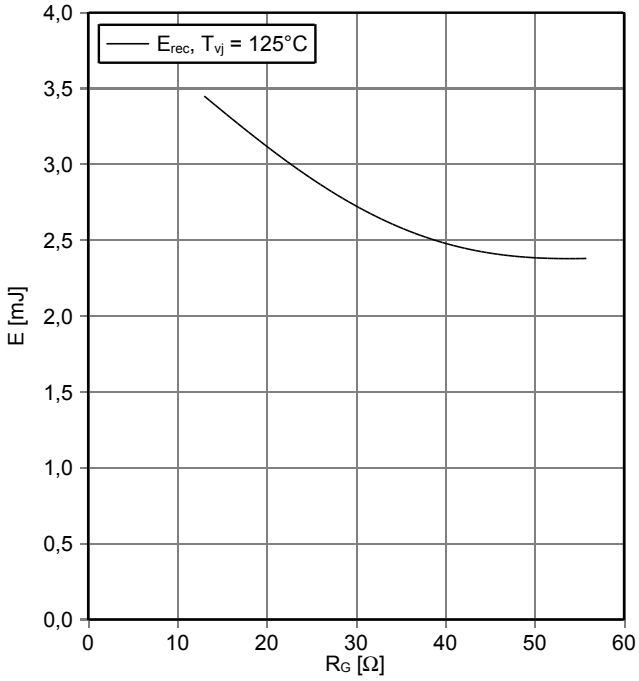
初步数据
Preliminary Data

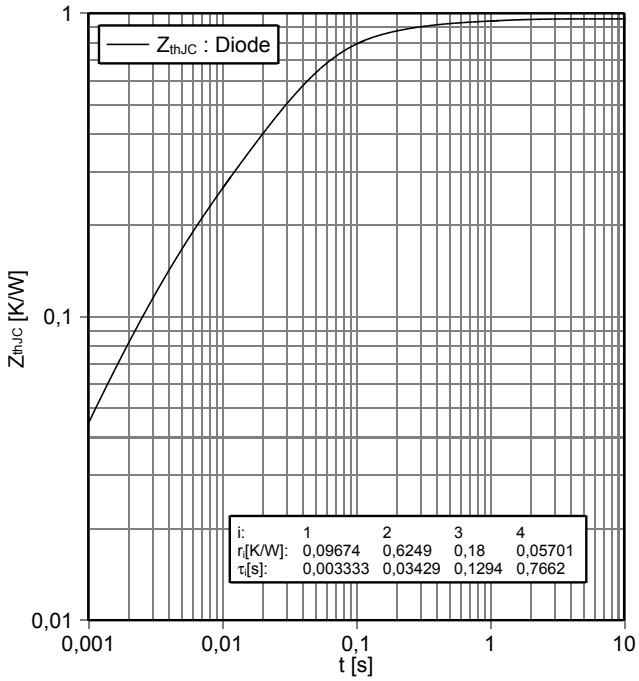
开关损耗 二极管,逆变器 (典型)
switching losses Diode, Inverter (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 27\ \Omega$, $V_{CE} = 600$ V



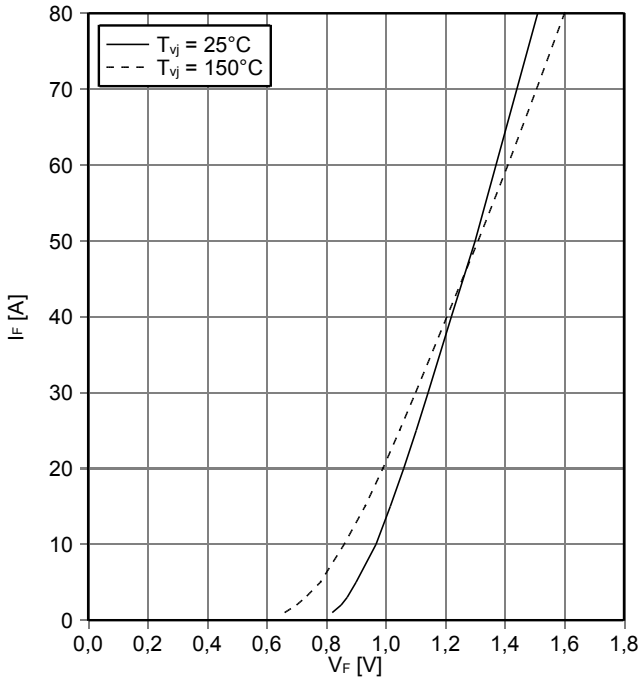
开关损耗 二极管,逆变器 (典型)
switching losses Diode, Inverter (typical)
$E_{rec} = f(R_G)$
$I_F = 40$ A, $V_{CE} = 600$ V



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



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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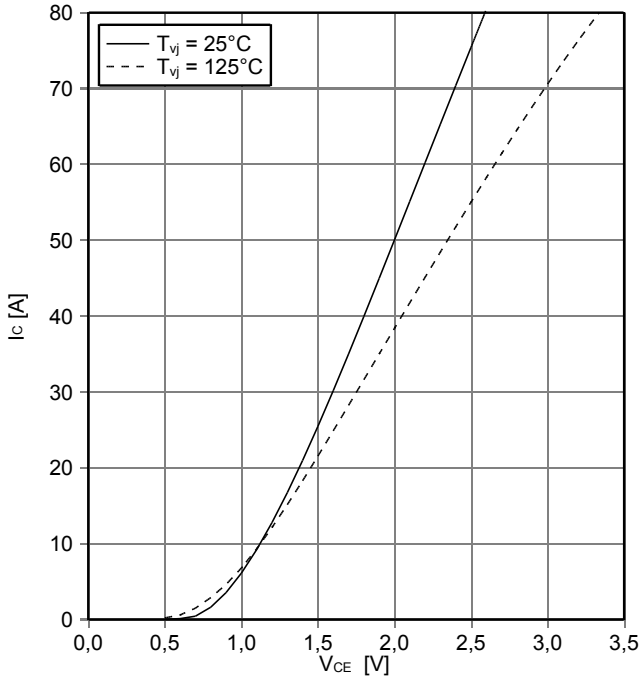
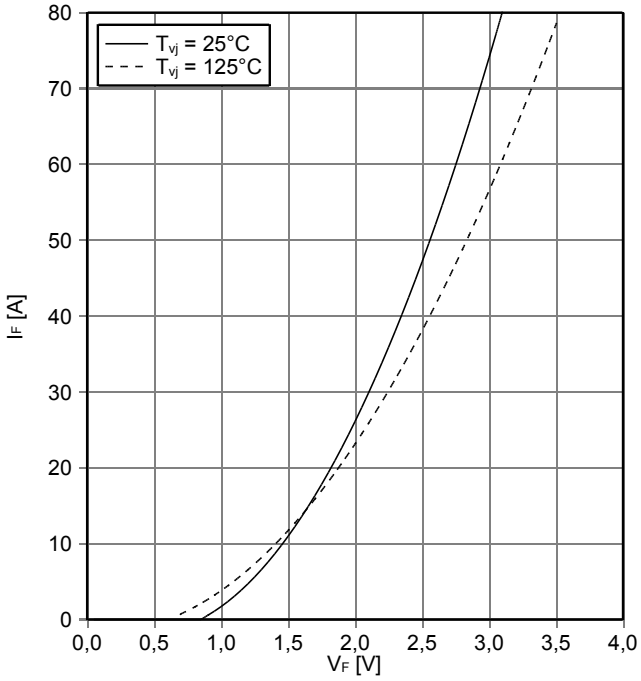
初步数据
Preliminary Data

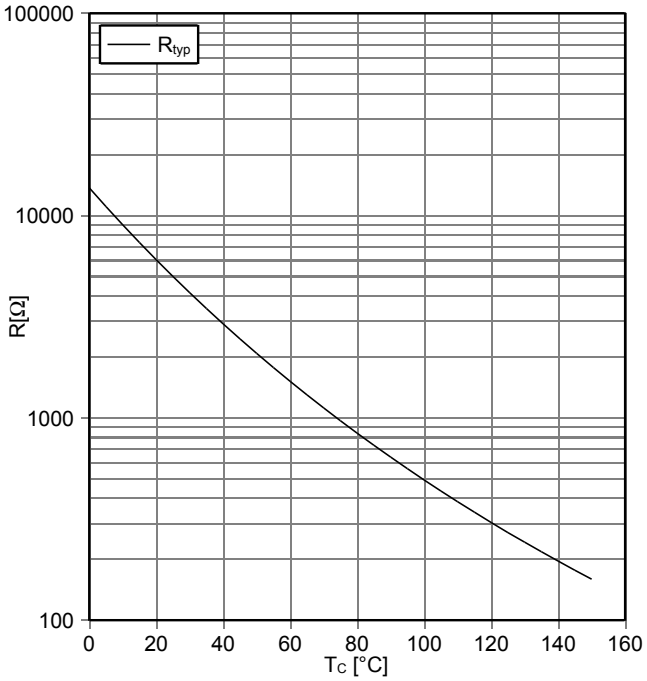
输出特性 IGBT, 制动-斩波器 （典型)
output characteristic IGBT, Brake-Chopper (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



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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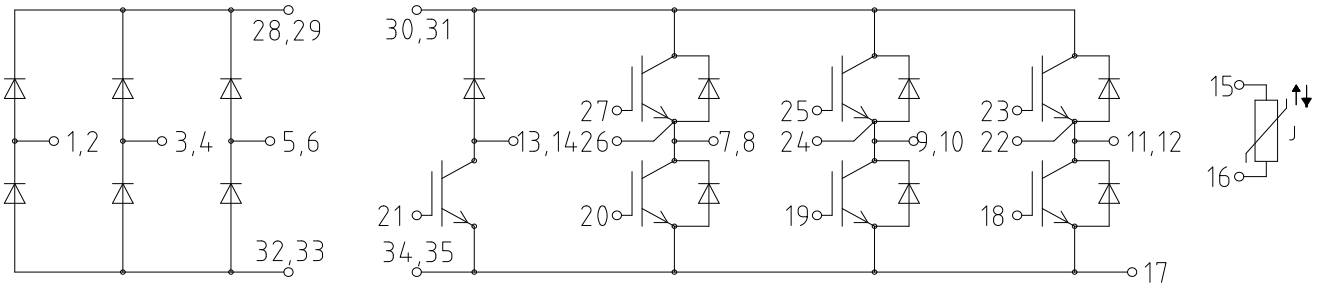
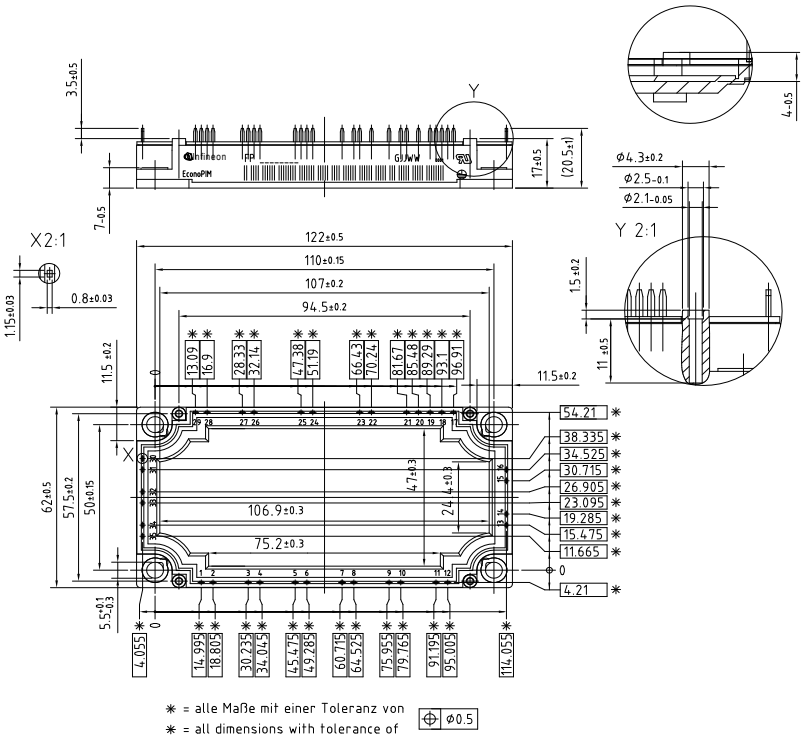
初步数据
Preliminary Data

接线图 / circuit_diagram_headline



封装尺寸 / package outlines



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初步数据
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使用条件和条款

使用条件和条款
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- the conclusion of Quality Agreements;
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