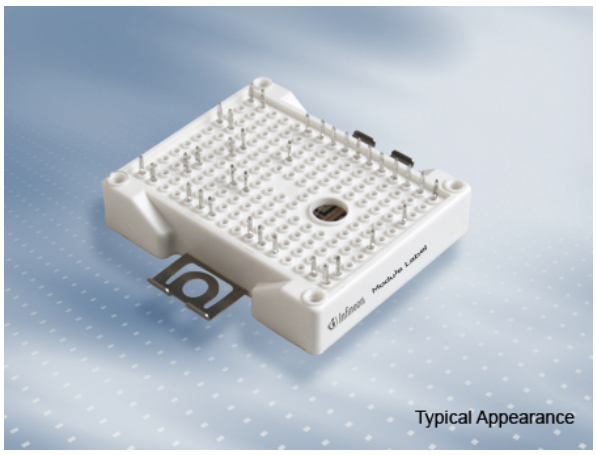
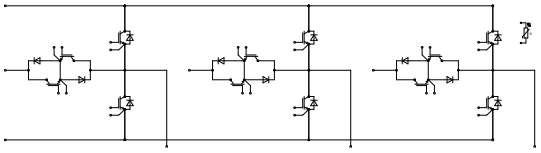
技术信息 / Technical Information

IGBT-模块
IGBT-modules

F3L15R12W2H3_B27

初步数据 / Preliminary Data





V_{CES} = 1200V
$I_{C\ nom}$ = 15A / I_{CRM} = 30A

典型应用
- 三电平应用
- 太阳能应用

Typical Applications
- 3-Level-Applications
- Solar Applications

电气特性
- 低电感设计
- 低开关损耗
- 低 V_{CEsat}

Electrical Features
- Low inductive design
- Low Switching Losses
- Low V_{CEsat}

机械特性
- 低热阻的三氧化二铝（ Al_2O_3 衬底
- 紧凑型设计
- PressFIT 压接技术
- 集成的安装夹使安装坚固

Mechanical Features
- Al_2O_3 Substrate with Low Thermal Resistance
- Compact design
- PressFIT Contact Technology
- Rugged mounting due to integrated mounting clamps

Module Label Code

Barcode Code 128

Sample
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

prepared by: CM	date of publication: 2013-11-25	
approved by: MB	revision: 2.0	UL approved (E83335)

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 = 100°C, $T_{vj\,max}$ = 175°C T_C = 25°C, $T_{vj\,max}$ = 175°C	$I_{C\,nom}$ I_C	15 20	A A
集电极重复峰值电流 Repetitive peak collector current	t_P = 1 ms	I_{CRM}	30	A
总功率损耗 Total power dissipation	T_C = 25°C, $T_{vj\,max}$ = 175°C	P_{tot}	145	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 = 15 A, V_{GE} = 15 V I_C = 15 A, V_{GE} = 15 V I_C = 15 A, V_{GE} = 15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$V_{CE\,sat}$		2,05 2,50 2,60	2,40	V V V
栅极阈值电压 Gate threshold voltage	I_C = 0,50 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		0,075		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}		0,875		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}		0,045		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 = 15 A, V_{CE} = 350 V V_{GE} = 15 V R_{Gon} = 35 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,on}$		0,04 0,04 0,04		µs µs µs
上升时间(电感负载) Rise time, inductive load	I_C = 15 A, V_{CE} = 350 V V_{GE} = 15 V R_{Gon} = 35 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_r		0,025 0,026 0,027		µs µs µs
关断延迟时间(电感负载) Turn-off delay time, inductive load	I_C = 15 A, V_{CE} = 350 V V_{GE} = 15 V R_{Goff} = 35 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	$t_{d\,off}$		0,27 0,31 0,32		µs µs µs
下降时间(电感负载) Fall time, inductive load	I_C = 15 A, V_{CE} = 350 V V_{GE} = 15 V R_{Goff} = 35 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	t_f		0,02 0,03 0,035		µs µs µs
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	I_C = 15 A, V_{CE} = 350 V, L_S = 30 nH V_{GE} = 15 V, di/dt = 700 A/µs (T_{vj} = 150°C) R_{Gon} = 35 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{on}		0,40 0,60 0,64		mJ mJ mJ
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	I_C = 15 A, V_{CE} = 350 V, L_S = 30 nH V_{GE} = 15 V, du/dt = 2800 V/µs (T_{vj} = 150°C) R_{Goff} = 35 Ω	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{off}		0,37 0,53 0,54		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}		48		A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT		R_{thJC}		0,95	1,05	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}		0,80		K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		150	°C

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	15	A
正向重复峰值电流 Repetitive peak forward current	t_P = 1 ms	I_{FRM}	50	A
I2t-值 I²t - value	V_R = 0 V, t_P = 10 ms, T_{vj} = 125°C V_R = 0 V, t_P = 10 ms, T_{vj} = 150°C	I²t	40,0 34,0	A²s 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 = 1300 A/µs (T_{vj}=150°C) V_R = 350 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		36,0 38,0 38,0		A A A
恢复电荷 Recovered charge	I_F = 15 A, - di_F/dt = 1300 A/µs (T_{vj}=150°C) V_R = 350 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		1,05 2,10 2,40		µC µC µC
反向恢复损耗（每脉冲） Reverse recovery energy	I_F = 15 A, - di_F/dt = 1300 A/µs (T_{vj}=150°C) V_R = 350 V V_{GE} = -15 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		0,40 0,66 0,70		mJ mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}		1,30	1,45	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}		1,05		K/W
在开关状态下温度 Temperature under switching conditions			$T_{vj\,op}$	-40		150	°C

初步数据
Preliminary Data

IGBT, 三电平 / IGBT,3-Level

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}	650	V
集电极电流 Implemented collector current		I_{CN}	30	A
连续集电极直流电流 Continuous DC collector current	T_C = 100°C, $T_{vj\,max}$ = 175°C T_C = 25°C, $T_{vj\,max}$ = 175°C	$I_{C\,nom}$ I_C	15 25	A A
集电极重复峰值电流 Repetitive peak collector current	t_P = 1 ms	I_{CRM}	60	A
总功率损耗 Total power dissipation	T_C = 25°C, $T_{vj\,max}$ = 175°C	P_{tot}	150	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 = 15 A, V_{GE} = 15 V, T_{vj} = 25°C I_C = 15 A, V_{GE} = 15 V, T_{vj} = 125°C I_C = 15 A, V_{GE} = 15 V, T_{vj} = 150°C	$V_{CE\,sat}$		1,20 1,25 1,25	1,45	V V V
栅极阈值电压 Gate threshold voltage	I_C = 0,30 mA, V_{CE} = V_{GE}, T_{vj} = 25°C	V_{GEth}	4,9	5,8	6,5	V
栅极电荷 Gate charge	V_{GE} = -15 V ... +15 V	Q_G		0,30		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}		1,65		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}		0,051		nF
集电极-发射极截止电流 Collector-emitter cut-off current	V_{CE} = 650 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 = 15 A, V_{CE} = 350 V, T_{vj} = 25°C V_{GE} = 15 V, T_{vj} = 125°C R_{Gon} = 15 Ω, T_{vj} = 150°C	$t_{d\,on}$		0,035 0,035 0,035		µs µs µs
上升时间(电感负载) Rise time, inductive load	I_C = 15 A, V_{CE} = 350 V, T_{vj} = 25°C V_{GE} = 15 V, T_{vj} = 125°C R_{Gon} = 15 Ω, T_{vj} = 150°C	t_r		0,01 0,012 0,013		µs µs µs
关断延迟时间(电感负载) Turn-off delay time, inductive load	I_C = 15 A, V_{CE} = 350 V, T_{vj} = 25°C V_{GE} = 15 V, T_{vj} = 125°C R_{Goff} = 15 Ω, T_{vj} = 150°C	$t_{d\,off}$		0,34 0,38 0,39		µs µs µs
下降时间(电感负载) Fall time, inductive load	I_C = 15 A, V_{CE} = 350 V, T_{vj} = 25°C V_{GE} = 15 V, T_{vj} = 125°C R_{Goff} = 15 Ω, T_{vj} = 150°C	t_f		0,045 0,07 0,075		µs µs µs
开通损耗能量 (每脉冲) Turn-on energy loss per pulse	I_C = 15 A, V_{CE} = 350 V, L_S = 40 nH, T_{vj} = 25°C V_{GE} = 15 V, di/dt = 1300 A/µs (T_{vj} = 150°C), T_{vj} = 125°C R_{Gon} = 15 Ω, T_{vj} = 150°C	E_{on}		0,19 0,26 0,28		mJ mJ mJ
关断损耗能量 (每脉冲) Turn-off energy loss per pulse	I_C = 15 A, V_{CE} = 350 V, L_S = 40 nH, T_{vj} = 25°C V_{GE} = 15 V, du/dt = 2600 V/µs (T_{vj} = 150°C), T_{vj} = 125°C R_{Goff} = 15 Ω, T_{vj} = 150°C	E_{off}		0,47 0,60 0,64		mJ mJ mJ
短路数据 SC data	V_{GE} ≤ 15 V, V_{CC} = 360 V, t_P ≤ 8 µs, T_{vj} = 25°C V_{CEmax} = V_{CES} -L_{sCE} ·di/dt, t_P ≤ 6 µs, T_{vj} = 150°C	I_{SC}		210 150		A A
结 - 外壳热阻 Thermal resistance, junction to case	每个 IGBT / per IGBT	R_{thJC}		0,90	1,00	K/W

初步数据
Preliminary Data

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}		0,85		K/W
在开关状态下温度 Temperature under switching conditions		$T_{vj\ op}$	-40		150	°C

二极管, 三电平 / Diode, 3-Level

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}	650		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 V_R = 0 V, t_P = 10 ms, T_{vj} = 150°C	I²t	32,0 28,0		A²s 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		1,45 1,35 1,30	t.b.d.	V V V
反向恢复峰值电流 Peak reverse recovery current	I_F = 15 A, - di_F/dt = 700 A/µs (T_{vj}=150°C) V_R = 350 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	I_{RM}		13,0 15,0 16,0		A A A
恢复电荷 Recovered charge	I_F = 15 A, - di_F/dt = 700 A/µs (T_{vj}=150°C) V_R = 350 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	Q_r		0,60 1,00 1,15		µC µC µC
反向恢复损耗（每脉冲） Reverse recovery energy	I_F = 15 A, - di_F/dt = 700 A/µs (T_{vj}=150°C) V_R = 350 V	T_{vj} = 25°C T_{vj} = 125°C T_{vj} = 150°C	E_{rec}		0,12 0,18 0,22		mJ mJ mJ
结 - 外壳热阻 Thermal resistance, junction to case	每个二极管 / per diode		R_{thJC}		1,95	2,15	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}		1,35		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.

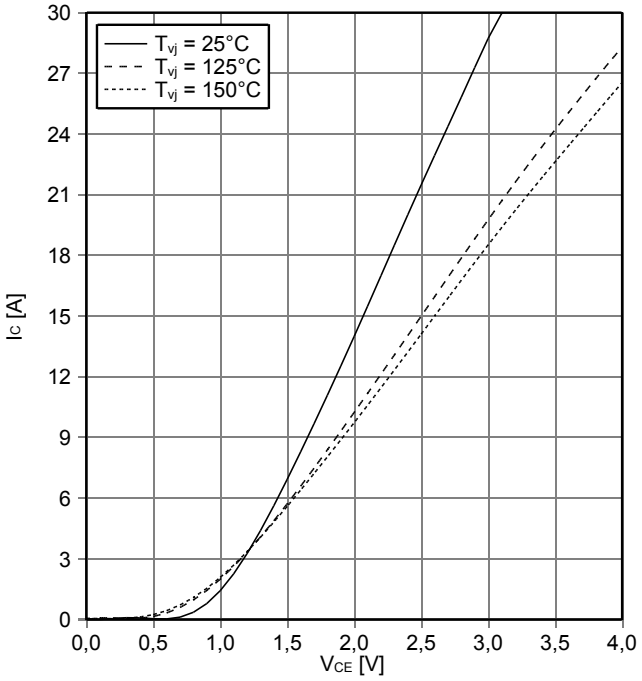
初步数据
Preliminary Data

模块 / Module

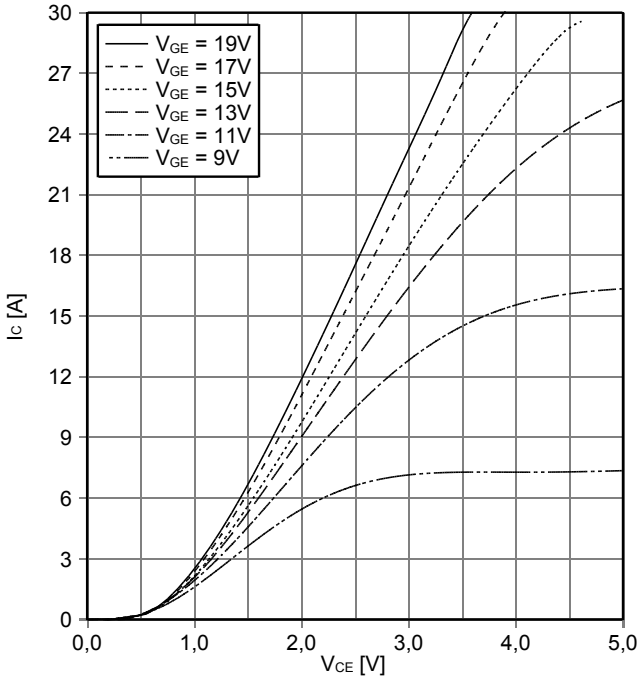
绝缘测试电压 Isolation test voltage	RMS, f = 50 Hz, t = 1 min.	V_{ISOL}		2,5		kV
内部绝缘 Internal isolation	基本绝缘 (class 1, IEC 61140) basic insulation (class 1, IEC 61140)			Al_2O_3		
爬电距离 Creepage distance	端子- 散热片 / terminal to heatsink 端子- 端子 / terminal to terminal			13,5 7,5		mm
电气间隙 Clearance	端子- 散热片 / terminal to heatsink 端子- 端子 / terminal to terminal			12,0 7,5		mm
相对电痕指数 Comperative tracking index		CTI		> 200		
			min.	typ.	max.	
杂散电感,模块 Stray inductance module		L_{sCE}		25		nH
储存温度 Storage temperature		T_{stg}	-40		125	°C
Anpresskraft für mech. Bef. pro Feder mountig force per clamp		F	40	-	80	N
重量 Weight		G		36		g

初步数据
Preliminary Data

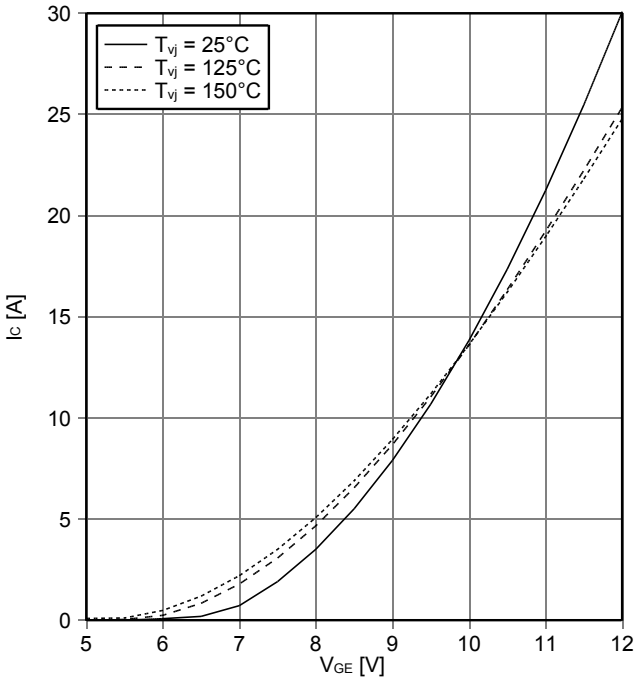
输出特性 IGBT, 逆变器 （典型)
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
V_{GE} = 15 V



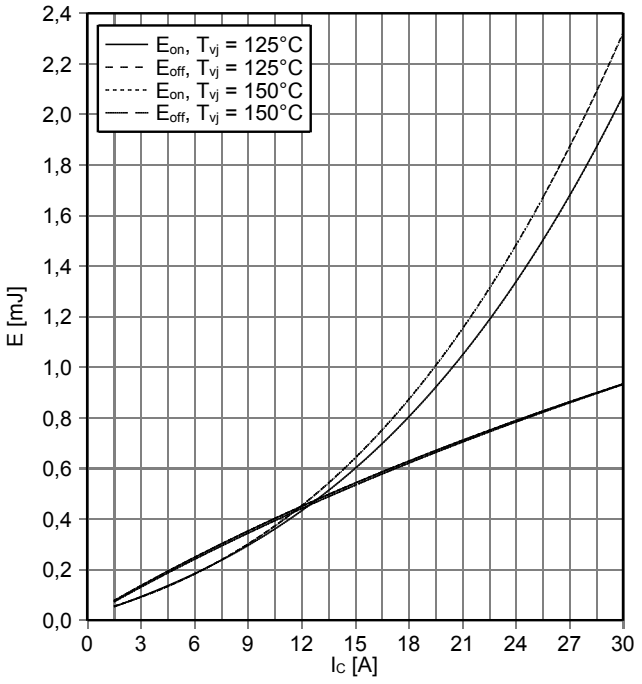
输出特性 IGBT, 逆变器 （典型)
output characteristic IGBT,Inverter (typical)
$I_C = f(V_{CE})$
T_{vj} = 150°C



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} = ±15 V, R_{Gon} = 35 Ω, R_{Goff} = 35 Ω, V_{CE} = 350 V



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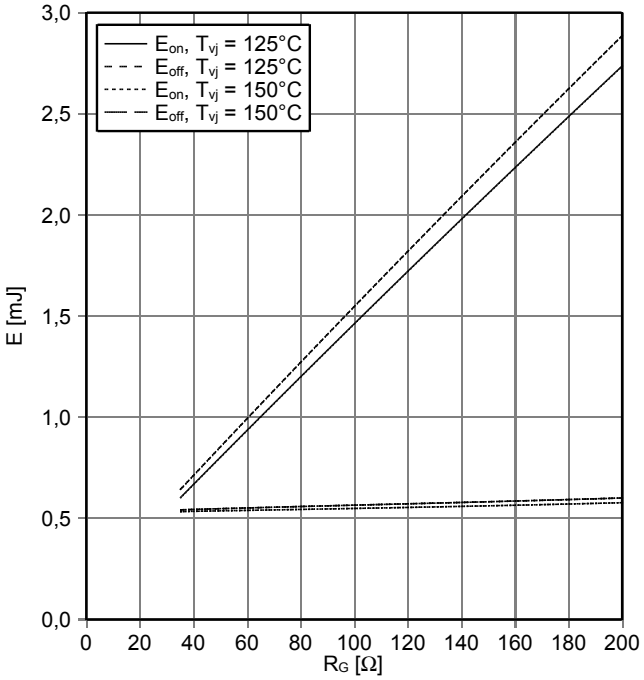
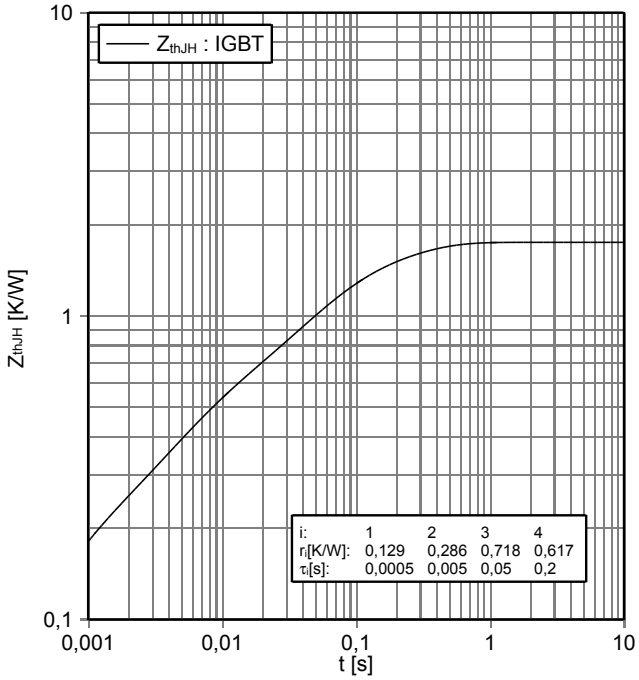
approved by: MB	revision: 2.0

初步数据
Preliminary Data

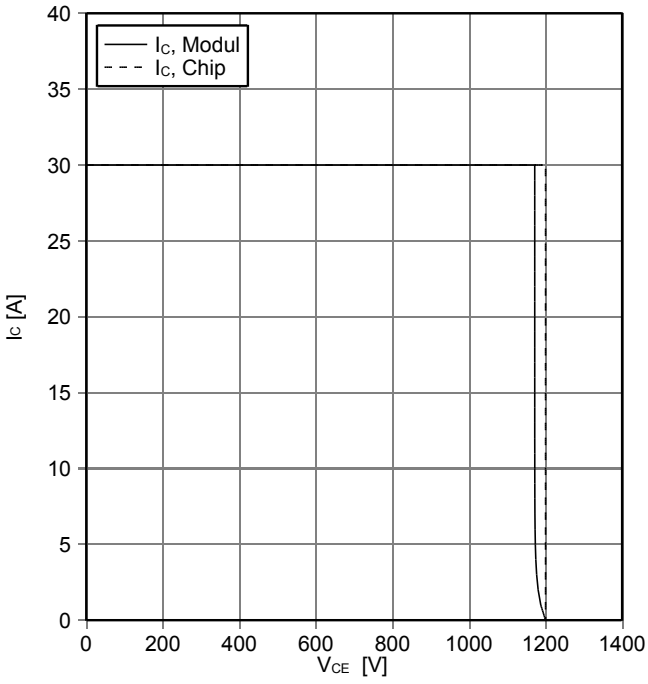
开关损耗 IGBT, 逆变器 （典型）
switching losses IGBT,Inverter (typical)
$E_{on} = f(R_G)$, $E_{off} = f(R_G)$
V_{GE} = ±15 V, I_C = 15 A, V_{CE} = 350 V



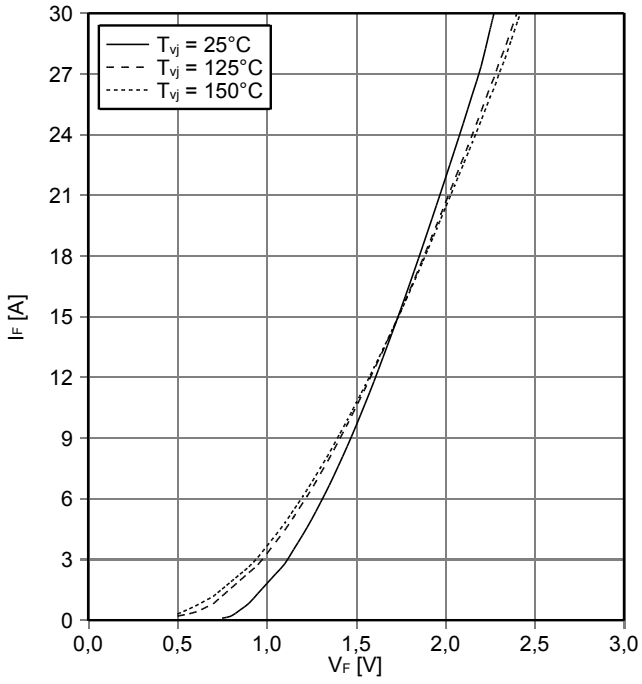
瞬态热阻抗 IGBT, 逆变器
transient thermal impedance IGBT,Inverter
$Z_{thJH} = f(t)$



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} = 35 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)
$I_F = f(V_F)$



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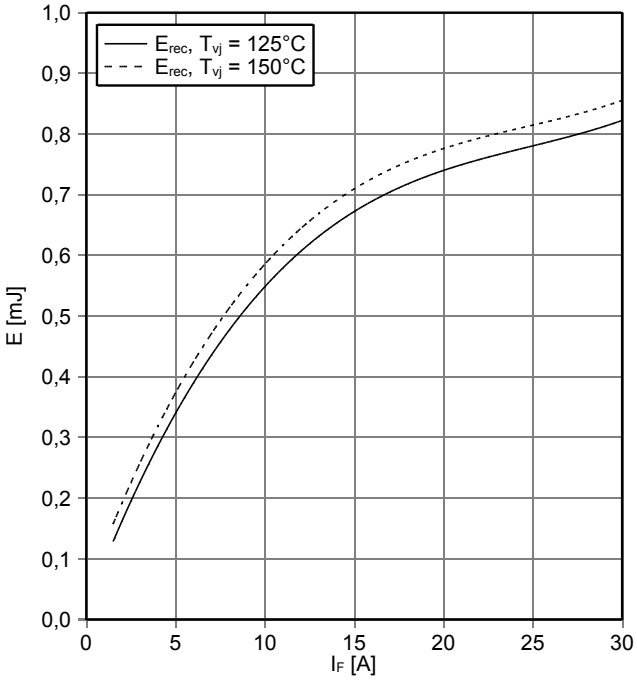
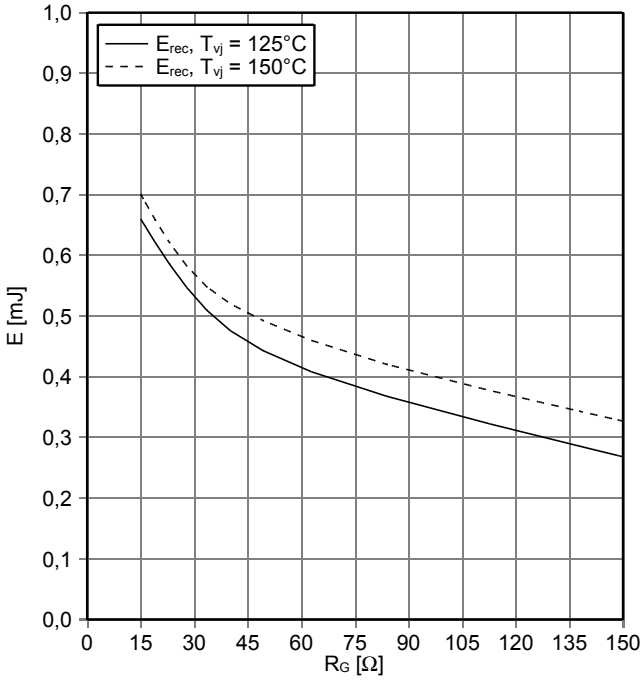
approved by: MB	revision: 2.0

初步数据
Preliminary Data

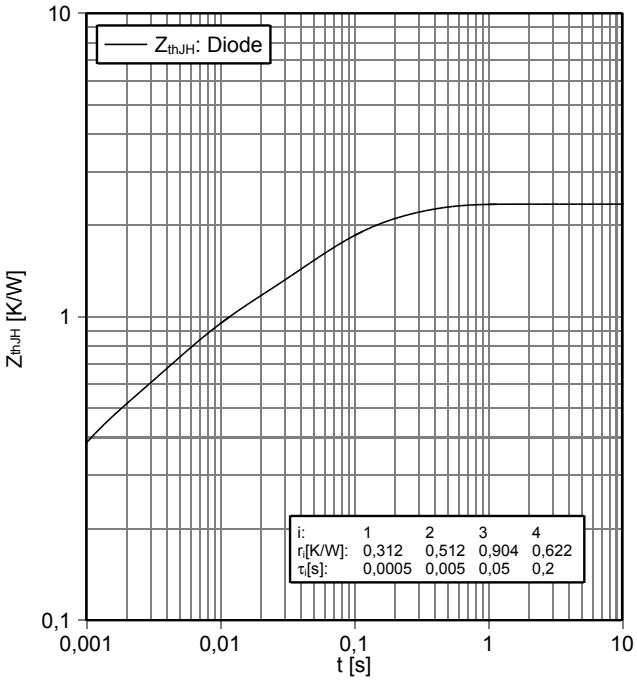
开关损耗 二极管,逆变器 （典型)
switching losses Diode, Inverter (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 15\ \Omega$, $V_{CE} = 350$ V



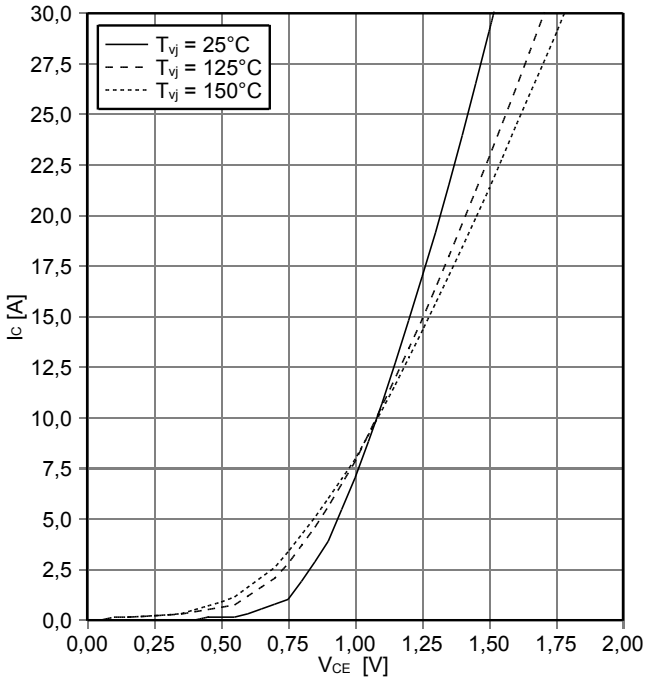
开关损耗 二极管,逆变器 （典型)
switching losses Diode, Inverter (typical)
$E_{rec} = f(R_G)$
$I_F = 15$ A, $V_{CE} = 350$ V



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



输出特性 IGBT, 三电平 （典型)
output characteristic IGBT,3-Level (typical)
$I_C = f(V_{CE})$
$V_{GE} = 15$ V



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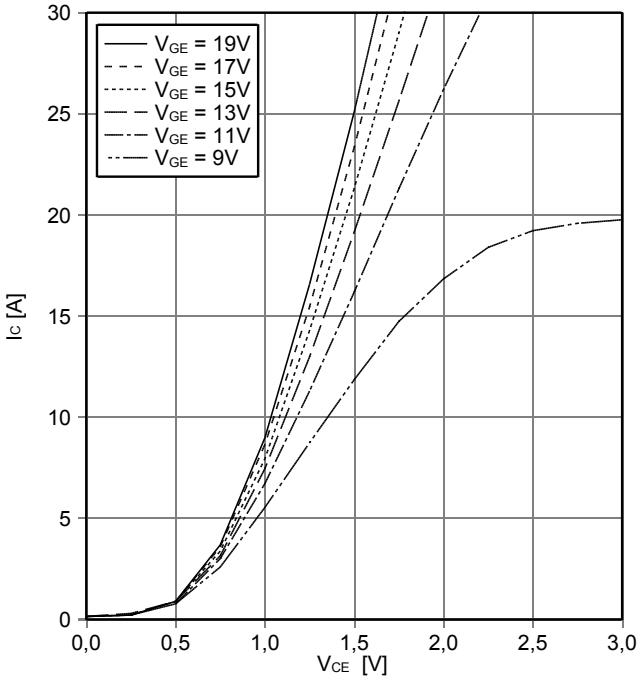
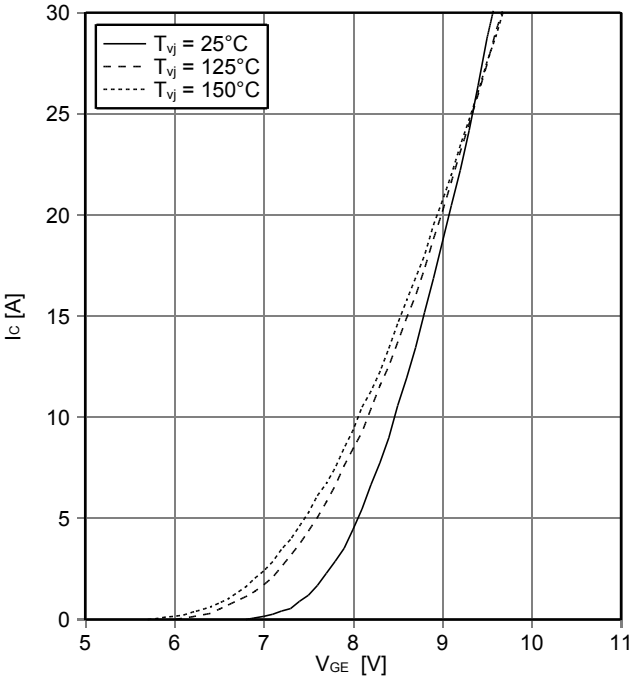
初步数据
Preliminary Data

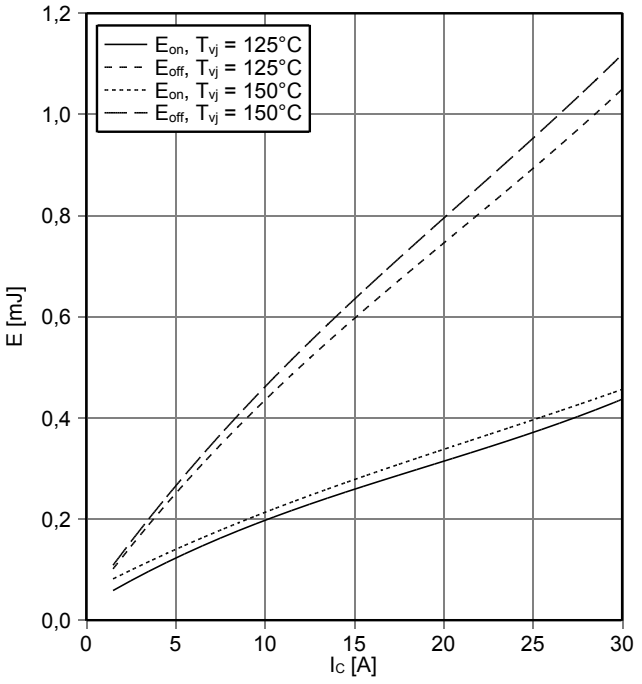
输出特性 IGBT, 三电平 （典型)
output characteristic IGBT,3-Level (typical)
$I_C = f(V_{CE})$
$T_{vj} = 150°C$



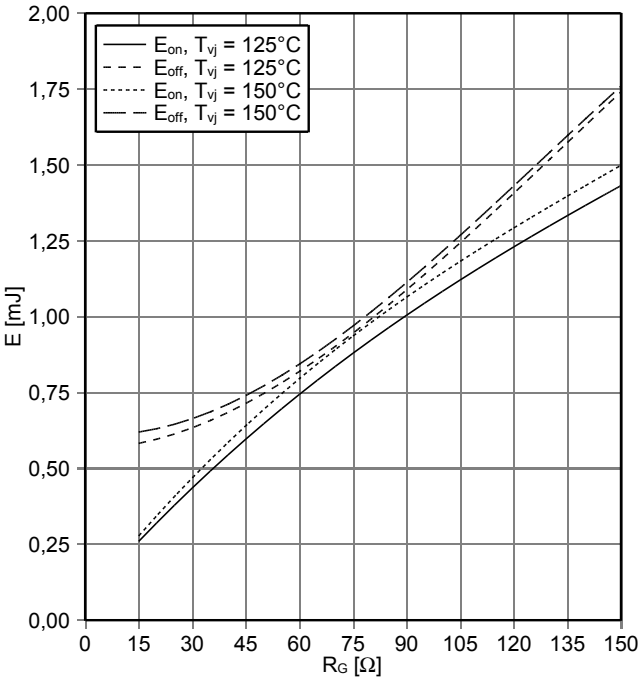
传输特性 IGBT, 三电平 (典型)
transfer characteristic IGBT,3-Level (typical)
$I_C = f(V_{GE})$
$V_{CE} = 20$ V



开关损耗 IGBT, 三电平 （典型)
switching losses IGBT,3-Level (typical)
$E_{on} = f(I_C)$, $E_{off} = f(I_C)$
$V_{GE} = \pm 15$ V, $R_{Gon} = 15\ \Omega$, $R_{Goff} = 15\ \Omega$, $V_{CE} = 350$ V



开关损耗 IGBT, 三电平 （典型)
switching losses IGBT,3-Level (typical)
$E_{on} = f(R_G)$, $E_{off} = f(R_G)$
$V_{GE} = \pm 15$ V, $I_C = 15$ A, $V_{CE} = 350$ V



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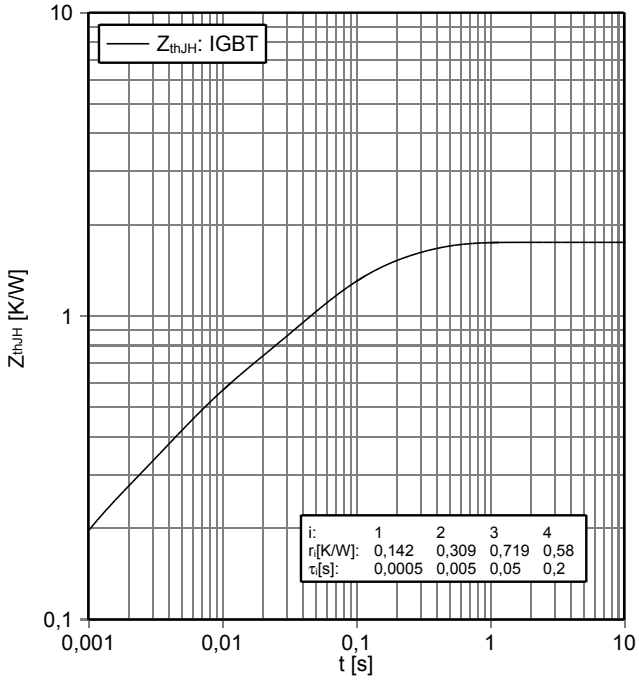
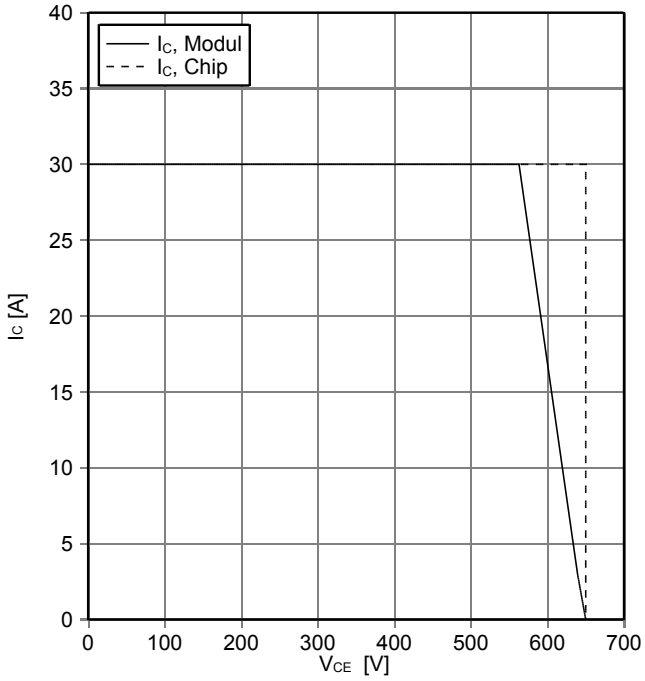
Preliminary Data

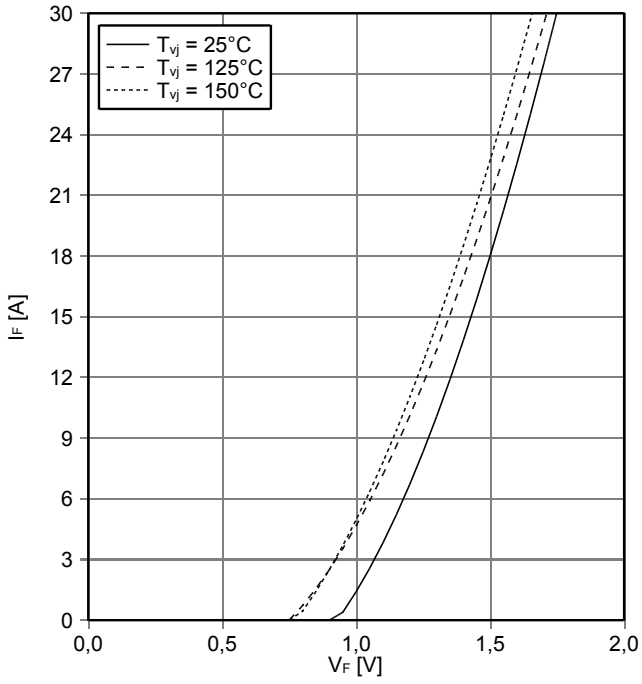
瞬态热阻抗 IGBT, 三电平
transient thermal impedance IGBT,3-Level
$Z_{thJH} = f(t)$



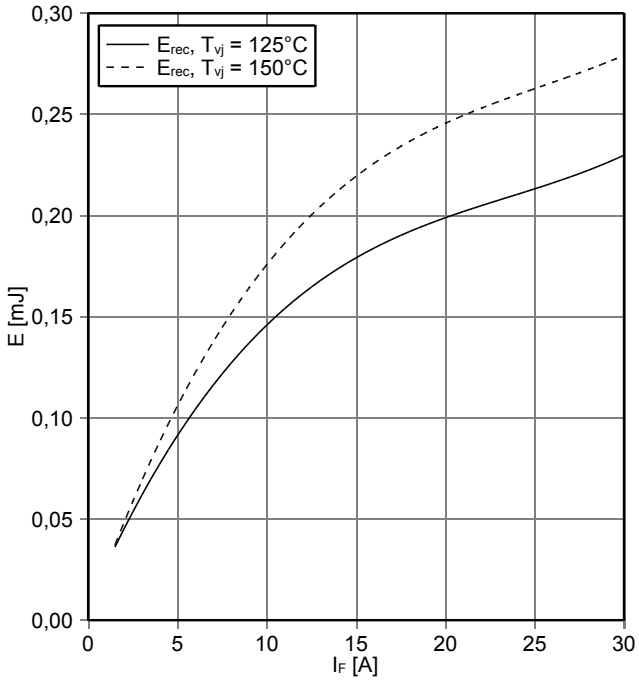
反偏安全工作区 IGBT, 三电平 (RBSOA)
reverse bias safe operating area IGBT,3-Level (RBSOA)
$I_C = f(V_{CE})$
$V_{GE} = \pm 15$ V, $R_{Goff} = 15\ \Omega$, $T_{vj} = 150°C$



正向偏压特性 二极管, 三电平 (典型)
forward characteristic of Diode, 3-Level (typical)
$I_F = f(V_F)$



开关损耗 二极管, 三电平 (典型)
switching losses Diode, 3-Level (typical)
$E_{rec} = f(I_F)$
$R_{Gon} = 35\ \Omega$, $V_{CE} = 350$ V



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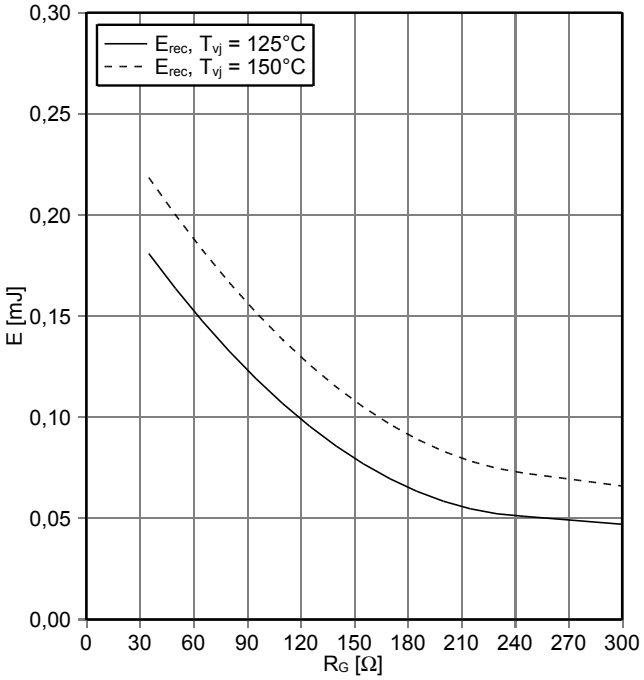
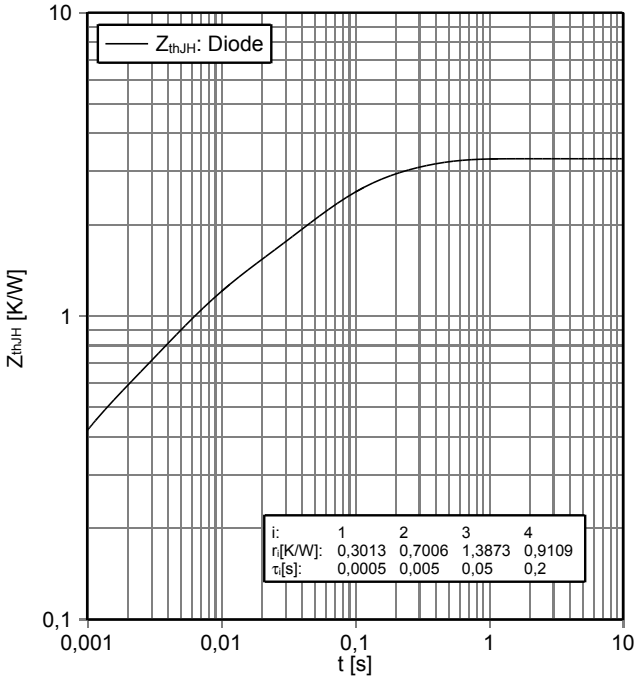
初步数据
Preliminary Data

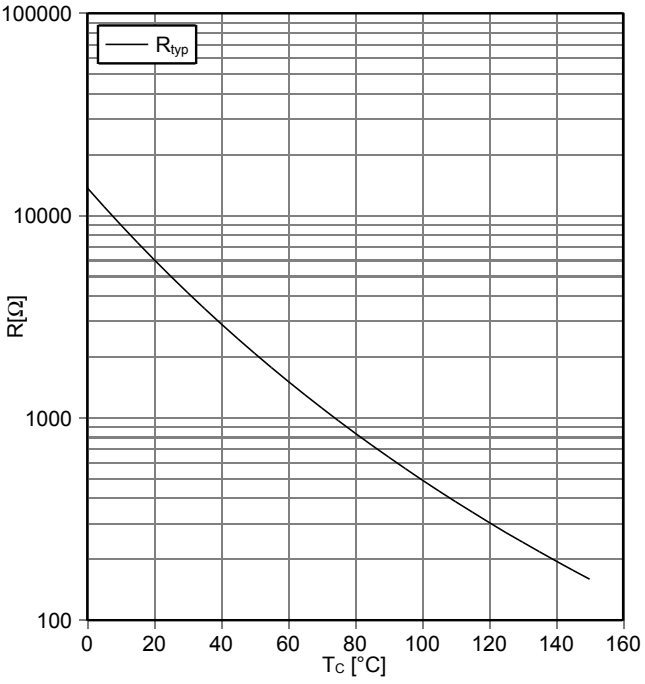
开关损耗 二极管, 三电平 （典型)
switching losses Diode, 3-Level (typical)
$E_{rec} = f(R_G)$
$I_F = 15\ A,\ V_{CE} = 350\ V$



瞬态热阻抗 二极管, 三电平
transient thermal impedance Diode, 3-Level
$Z_{thJH} = f(t)$



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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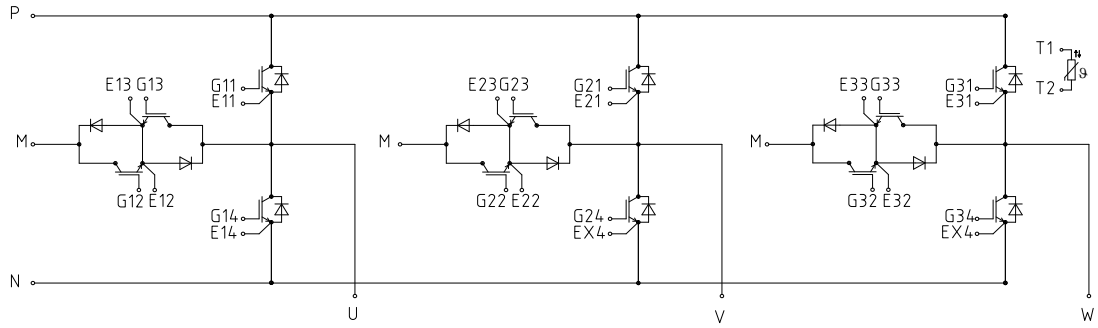
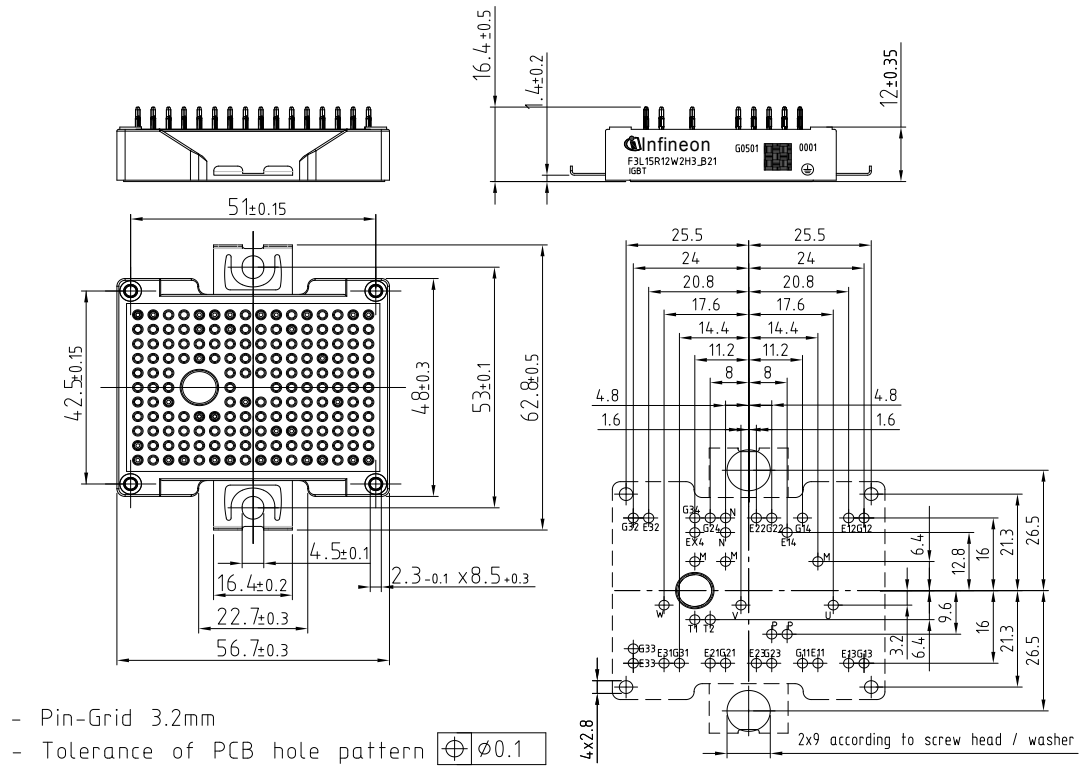
初步数据
Preliminary Data

接线图 / circuit_diagram_headline



封装尺寸 / package outlines



- Pin-Grid 3.2mm
- Tolerance of PCB hole pattern ⌖ ⌀0.1
- Hole specification for contacts see AN 2009-09
- Diameters of plated holes ⌀ 1.0mm $^{+0.09}_{-0.06}$
- Diameters of drill ⌀ 1.15mm

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Preliminary Data

使用条件和条款

使用条件和条款
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- the conclusion of Quality Agreements;
- to establish joint measures of an ongoing product survey, and that we may make delivery depended on the realization of any such measures.

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