

## 1. Product Features

### 1.1 Electrical features

- $V_{CES}=650V$
- $I_{C\ nom}=400A / I_{CRM}=800A$
- Low switching losses
- Low inductance
- Fast switching and short tail current
- Integrated NTC temperature sensor
- High power and thermal cycling capability



Figure1 IGBT Module

### 1.2 Mechanical features

- $Al_2O_3$  substrate with low thermal resistance
- Copper base plate

## 2. Typical Applications

- Automotive application
- Hybrid and electric vehicle
- Inverter for motor drive

## 3. Description

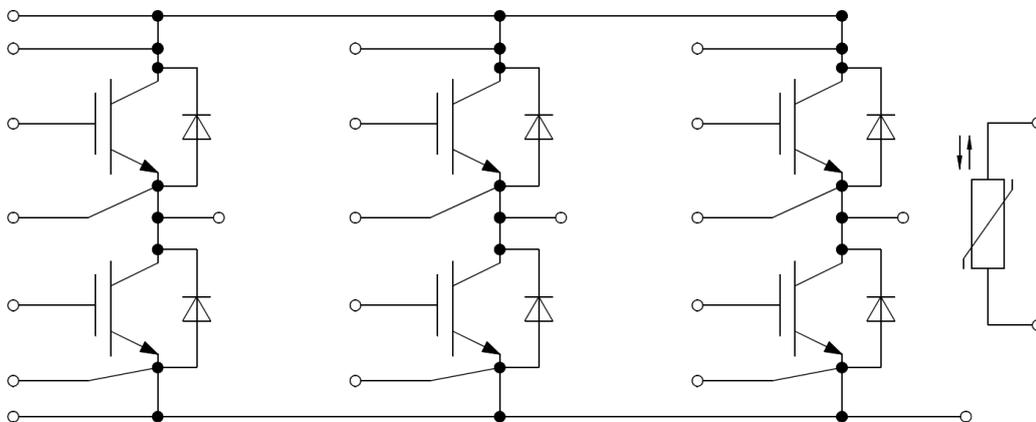


Figure 2 3 Phase Bridge

## 4. IGBT

### 4.1 Maximum rated values

Parameter	Note or test condition	Symbol	Values	Unit
Collector-emitter voltage 集电极—发射极间电压	$T_{vj} = 25^{\circ}\text{C}$	$V_{CES}$	650	V
Continuous DC collector current 连续集电极电流	$T_C = 55^{\circ}\text{C}, T_{vj\ max} = 150^{\circ}\text{C}$	$I_{C\ nom}$	400	A
Repetitive peak collector current 集电极峰值电流	$t_P = 1\ \text{ms}$	$I_{CRM}$	800	A
Total power dissipation 总功率损耗	$T_C = 25^{\circ}\text{C}, T_{vj\ max} = 175^{\circ}\text{C}$	$P_{tot}$	955	W
Gate-emitter peak voltage 栅极—发射极峰值电压		$V_{GES}$	+/- 20	V

### 4.2 Characteristic value

Parameter	Note or test condition	Symbol	Values			Unit
			Min.	Typ.	Max.	
Collector-emitter saturation voltage 集电极—发射极饱和电压	$I_C = 400\ \text{A}, V_{GE} = 15\ \text{V}$	$T_{vj} = 25^{\circ}\text{C}$		1.38		V
		$T_{vj} = 125^{\circ}\text{C}$		1.48		V
		$T_{vj} = 150^{\circ}\text{C}$		1.51		V
Gate threshold voltage 栅极阈值电压	$I_C = 6.4\ \text{mA}, V_{CE} = V_{GE}, T_{vj} = 25^{\circ}\text{C}$	$V_{GE,th}$	5.0	5.8	6.5	V
Gate charge 栅极电荷	$V_{GE} = -15\ \text{V} \dots +15\ \text{V}$	$Q_G$		3.02		$\mu\text{C}$
Internal gate resistor 内部栅极电阻	$T_{vj} = 25^{\circ}\text{C}$	$R_{Gint}$		1.45		$\Omega$
Input capacitance 输入电容	$f=1\ \text{MHz}, T_{vj}=25^{\circ}\text{C}, V_{CE}=25\ \text{V}, V_{GE}=0\ \text{V}$	$C_{ies}$		64.7		nF
Reverse transfer capacitance 反向传输电容	$f=1\ \text{MHz}, T_{vj}=25^{\circ}\text{C}, V_{CE}=25\ \text{V}, V_{GE}=0\ \text{V}$	$C_{res}$		0.27		nF
Collector-emitter cut-off current 集电极-发射极截止电流	$V_{CE} = 650\ \text{V}, V_{GE} = 0\ \text{V}, T_{vj} = 25^{\circ}\text{C}$	$I_{CES}$			1	mA
Gate-emitter leakage current 栅极-发射极漏电流	$V_{CE} = 0\ \text{V}, V_{GE} = 20\ \text{V}, T_{vj} = 25^{\circ}\text{C}$	$I_{GES}$			100	nA
Turn-on delay time, inductive load 开通延迟时间	$I_C = 400\ \text{A}, V_{CE} = 300\ \text{V}$ $V_{GE} = +15/-15\ \text{V}$ $R_{G,on} = 3.3\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$		0.10		us
		$T_{vj} = 125^{\circ}\text{C}$		0.11		us
		$T_{vj} = 150^{\circ}\text{C}$		0.11		us
Rise time, inductive load 上升时间	$I_C = 400\ \text{A}, V_{CE} = 300\ \text{V}$ $V_{GE} = +15/-15\ \text{V}$ $R_{G,on} = 3.3\ \Omega$	$T_{vj} = 25^{\circ}\text{C}$		0.06		us
		$T_{vj} = 125^{\circ}\text{C}$		0.07		us
		$T_{vj} = 150^{\circ}\text{C}$		0.07		us

(table continues...) 待续

Parameter	Note or test condition		Symbol	Values			Unit
				Min.	Typ.	Max.	
Turn-off delay time, inductive load 关断延迟时间	$I_C = 400A, V_{CE} = 300V$ $V_{GE} = +15/-15V$ $R_{G,off} = 3.3\Omega$	$T_{vj} = 25^\circ C$	$t_{d,off}$		0.21		us
		$T_{vj} = 125^\circ C$			0.24		us
		$T_{vj} = 150^\circ C$			0.24		us
Fall time, inductive load 下降时间	$I_C = 400A, V_{CE} = 300V$ $V_{GE} = +15/-15V$ $R_{G,off} = 3.3\Omega$	$T_{vj} = 25^\circ C$	$t_f$		0.10		us
		$T_{vj} = 125^\circ C$			0.18		us
		$T_{vj} = 150^\circ C$			0.23		us
Turn-on energy loss per pulse 开通损耗能量	$I_C = 400A, V_{CE} = 300V, L_s = 50nH$ $V_{GE} = +15/-15V, di/dt = 4461A/\mu s$ $R_{G,on} = 3.3\Omega (T_{vj} = 150^\circ C)$	$T_{vj} = 25^\circ C$	$E_{on}$		0.71		mJ
		$T_{vj} = 125^\circ C$			7.85		mJ
		$T_{vj} = 150^\circ C$			9.24		mJ
Turn-off energy loss per pulse 关断损耗能量	$I_C = 400A, V_{CE} = 300V, L_s = 50nH$ $V_{GE} = +15/-15V, dv/dt = 3970V/\mu s$ $R_{G,off} = 3.3\Omega (T_{vj} = 150^\circ C)$	$T_{vj} = 25^\circ C$	$E_{off}$		13.7		mJ
		$T_{vj} = 125^\circ C$			18.1		mJ
		$T_{vj} = 150^\circ C$			18.9		mJ
SC data 短路数据	$V_{GE} \leq 15V, V_{CC} = 300V, t_P \leq 8\mu s, T_{vj} = 150^\circ C,$ $C_{GE} = 0.0\mu F, V_{CEmax} = V_{CES} - L_{SCE} \cdot di/dt$		$I_{sc}$		1960		A
Thermal resistance, junction to case 结-外壳热阻	Per IGBT		$R_{th,jc}$			0.157	K/W

## 5. Diode

### 5.1 Maximum rated values

Parameter	Note or test condition	Symbol	Values	Unit
Repetitive peak reverse voltage 反向重复峰值电压	$T_{vj} = 25^\circ C$	$V_{RRM}$	650	V
Continuous DC forward current 连续正向直流电流		$I_F$	400	A
Repetitive peak forward current 正向重复峰值电流	$t_P = 1ms$	$I_{FRM}$	800	A

### 5.2 Characteristic value

Parameter	Note or test condition		Symbol	Values			Unit
				Min.	Typ.	Max.	
Forward voltage 正向电压	$I_F = 400A, V_{GE} = 0V$	$T_{vj} = 25^\circ C$	$V_F$		1.22		V
		$T_{vj} = 125^\circ C$			1.19		V
		$T_{vj} = 150^\circ C$			1.17		V

(table continues...) 待续

Parameter	Note or test condition		Symbol	Values			Unit
				Min.	Typ.	Max.	
Peak reverse recovery current 反向恢复峰值电流	$I_F = 400A, V_R = 300V$ $V_{GE} = -15V, -di_F/dt = 4430 A/\mu s$ $(T_{vj}=150^\circ C)$	$T_{vj} = 25^\circ C$	$I_{RM}$		336		A
		$T_{vj} = 125^\circ C$			367		A
		$T_{vj} = 150^\circ C$			375		A
Recovered charge 恢复电荷	$I_F = 400A, V_R = 300V$ $V_{GE} = -15V, -di_F/dt = 4430 A/\mu s$ $(T_{vj}=150^\circ C)$	$T_{vj} = 25^\circ C$	$Q_r$		31.5		$\mu C$
		$T_{vj} = 125^\circ C$			49.5		$\mu C$
		$T_{vj} = 150^\circ C$			54.2		$\mu C$
Reverse recovery energy 反向恢复损耗 (每脉冲)	$I_F = 400A, V_R = 300V$ $V_{GE} = -15V, -di_F/dt = 4430 A/\mu s$ $(T_{vj}=150^\circ C)$	$T_{vj} = 25^\circ C$	$E_{rec}$		5.6		mJ
		$T_{vj} = 125^\circ C$			10.6		mJ
		$T_{vj} = 150^\circ C$			11.8		mJ
Thermal resistance, junction to case 结—外壳热阻	Per diode		$R_{th,jc}$			0.232	K/W

## 6. NTC-Thermistor

### 6.1 Characteristic value

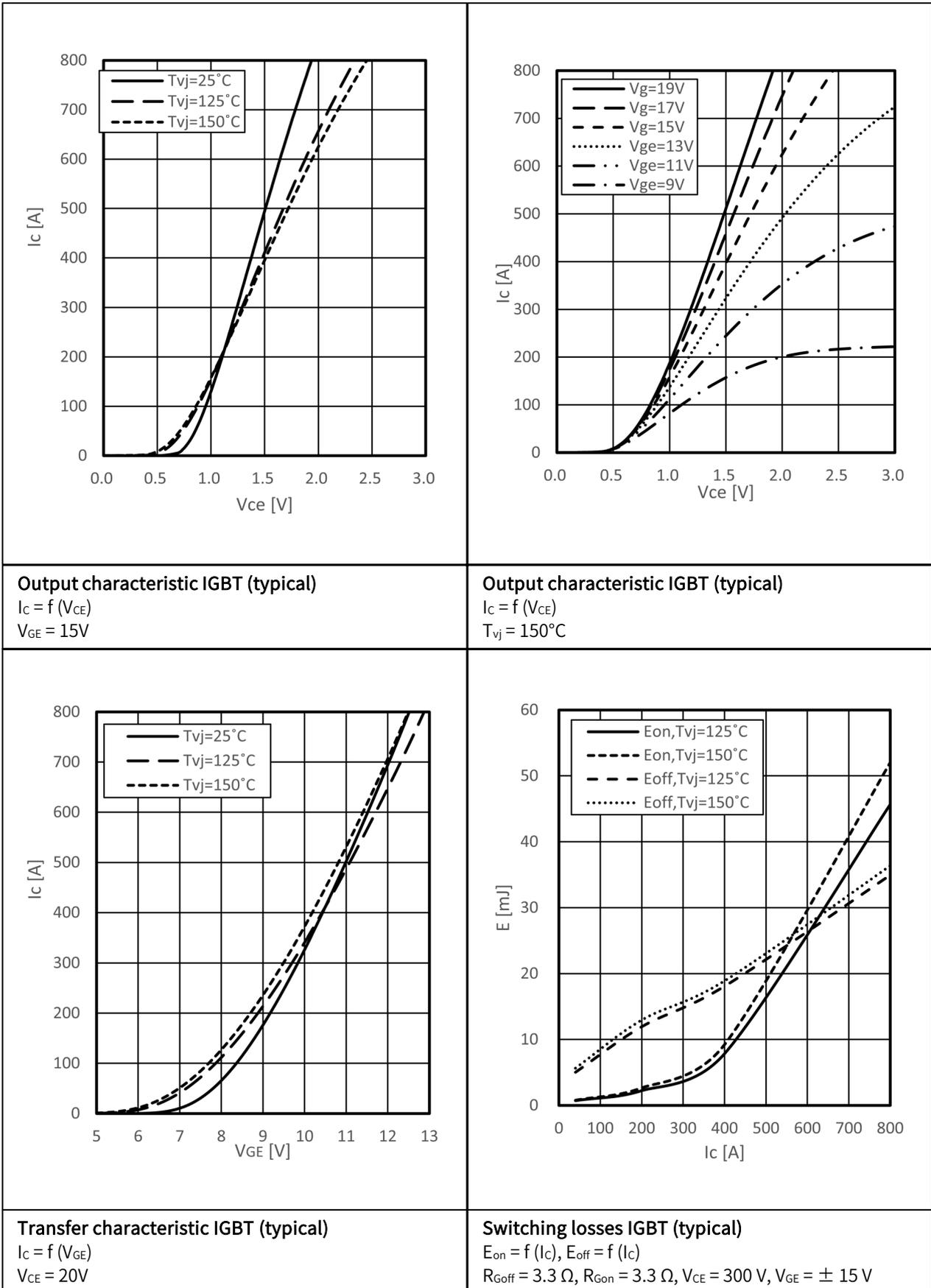
Parameter	Note or test condition	Symbol	Values			Unit
			Min.	Typ.	Max.	
Rated resistance 额定电阻值	$T_c = 25^\circ C$	$R_{25}$		5.00		K $\Omega$
Power dissipation 耗散功耗	$T_c = 25^\circ C$	$P_{25}$			20	mW
B-value B-Z 值	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298, 15K))]$	$B_{25}/B_{50}$		3375		K
B-value B-Z 值	$R_2=R_{25}\exp[B_{25/75}(1/T_2-1/(298, 15K))]$	$B_{25}/B_{75}$		3408		K
B-value B-Z 值	$R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298, 15K))]$	$B_{25}/B_{100}$		3436		K

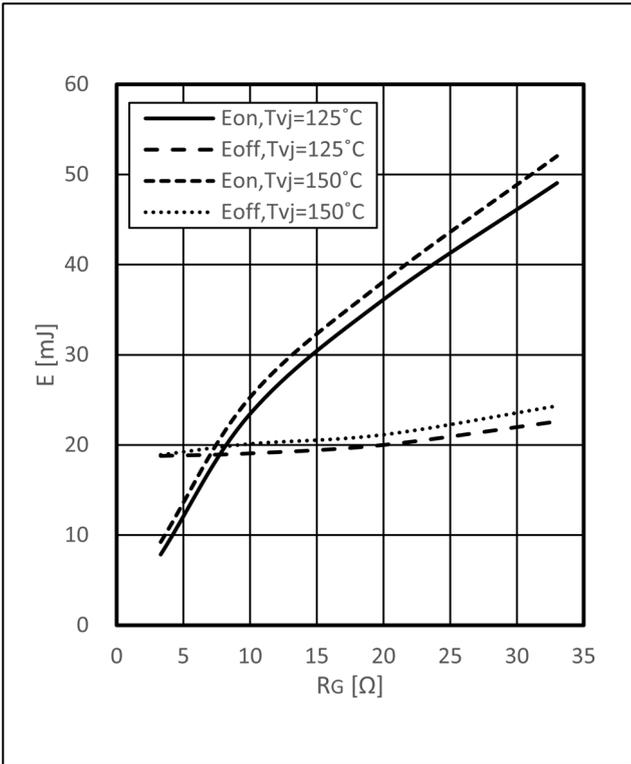
## 7. Module

### 7.1 Characteristic value

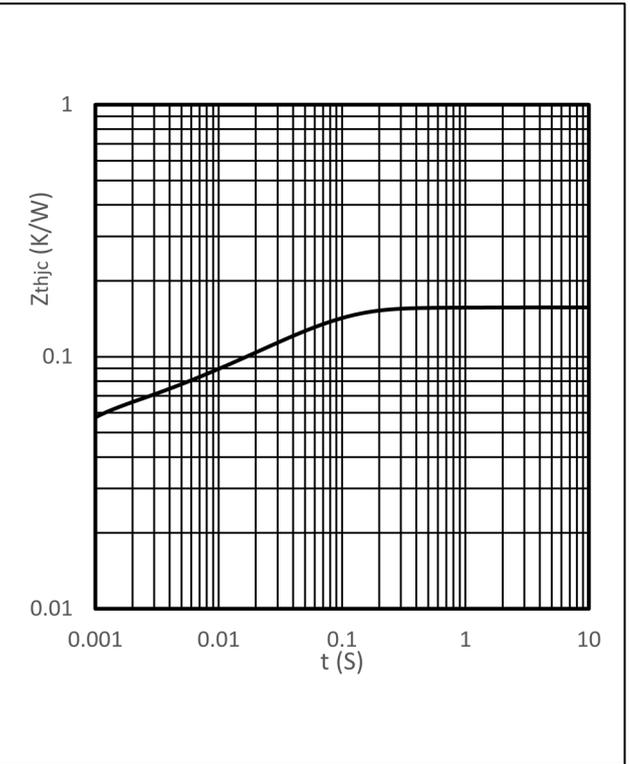
Parameter	Note or test condition	Symbol	Values			Unit
			Min.	Typ.	Max.	
Isolation Voltage 隔离电压	RMS, f=50HZ,1min	$V_{ISOL}$			2500	V
Stray inductance module 杂散电感		$L_{sCE}$		30		nH
Operation Junction Temperature 结温		$T_{jop}$	-40		150	°C
Storage Temperature Range 存储温度范围		$T_{stg}$	-40		125	°C
Mounting Torque 安装扭矩	Screw M5	M	2.5		6.0	N.m
Terminal Connection Torque 端子扭矩	Screw M6	M	3.0		6.0	N.m
Weight of Module 重量		G		485		g

## 8. Characteristics diagrams

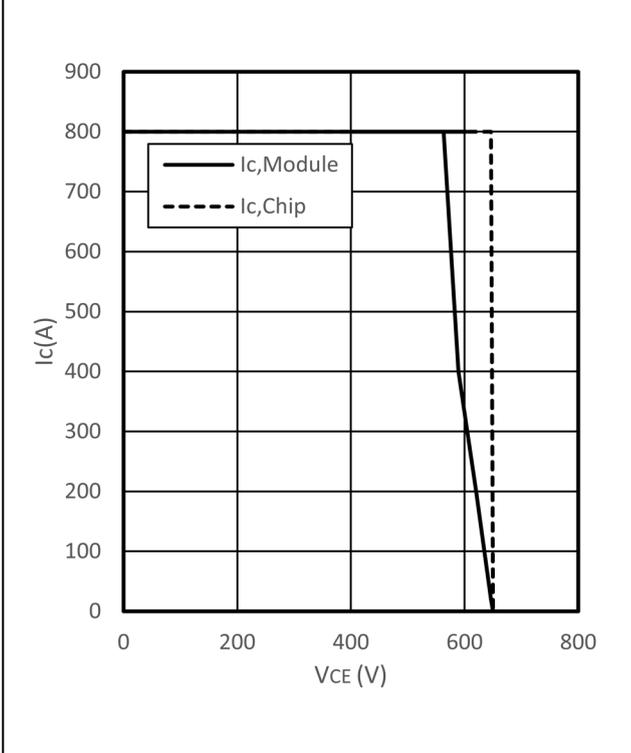




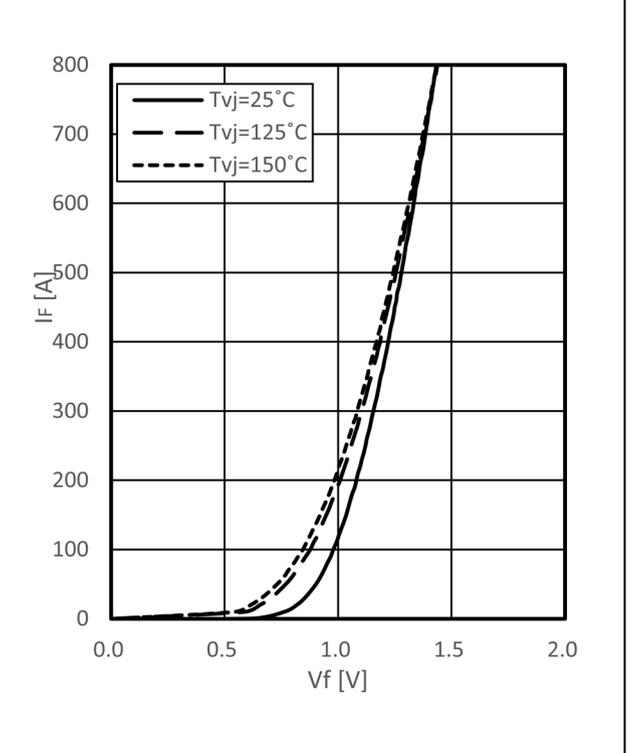
**Switching losses IGBT (typical)**  
 $E_{on} = f(R_G)$ ,  $E_{off} = f(R_G)$   
 $I_C = 400\text{ A}$ ,  $V_{CE} = 300\text{ V}$ ,  $V_{GE} = \pm 15\text{ V}$



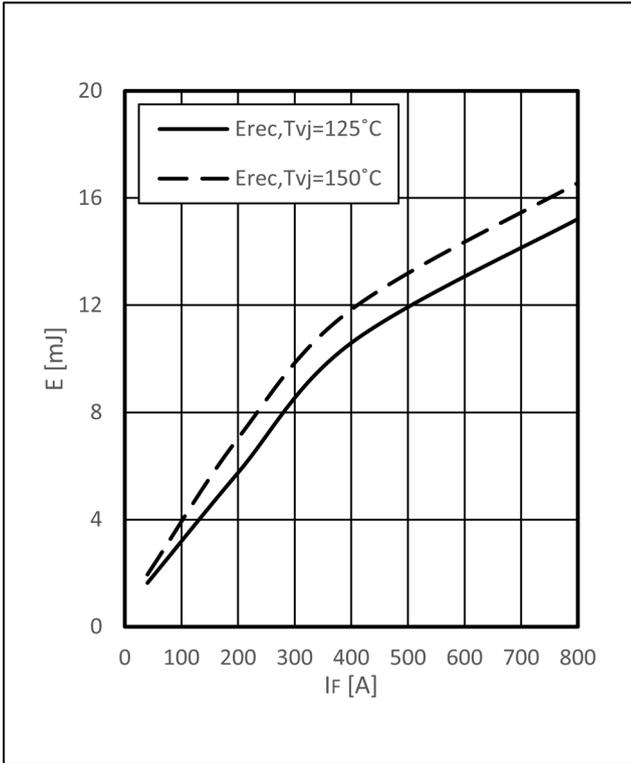
**Transient thermal impedance IGBT**  
 $Z_{thjC} = f(t)$



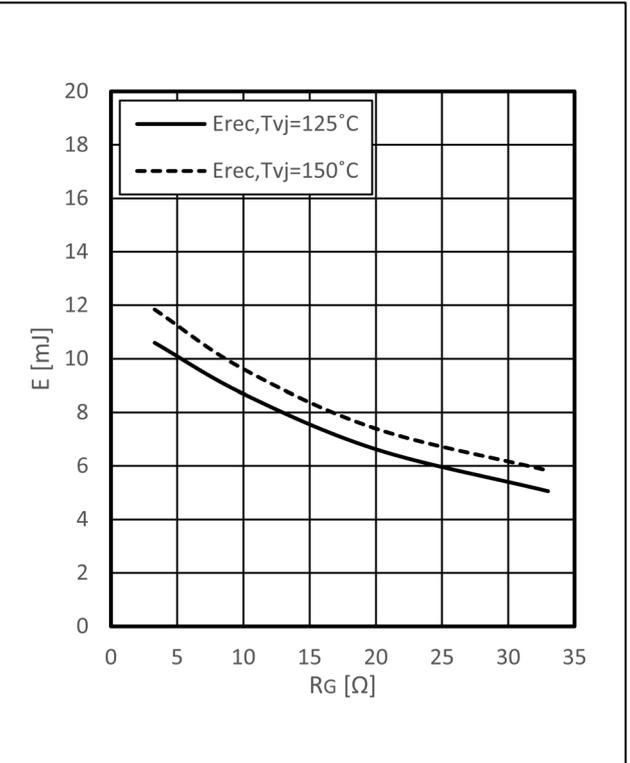
**Reverse bias safe operating area IGBT (RBSOA)**  
 $I_C = f(V_{CE})$   
 $V_{GE} = 15\text{ V}$ ,  $R_{Goff} = 3.3\ \Omega$ ,  $T_{vj} = 150\text{ }^\circ\text{C}$



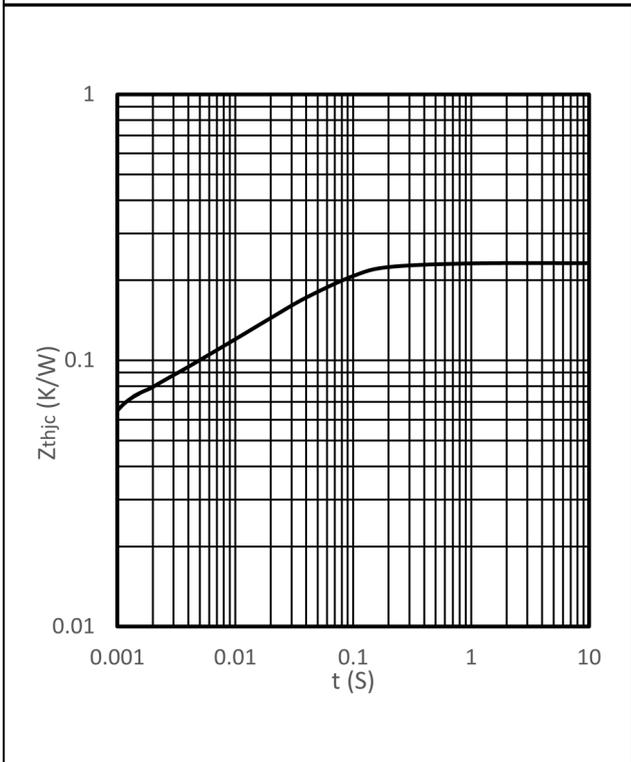
**Forward characteristic of Diode (typical)**  
 $I_F = f(V_F)$



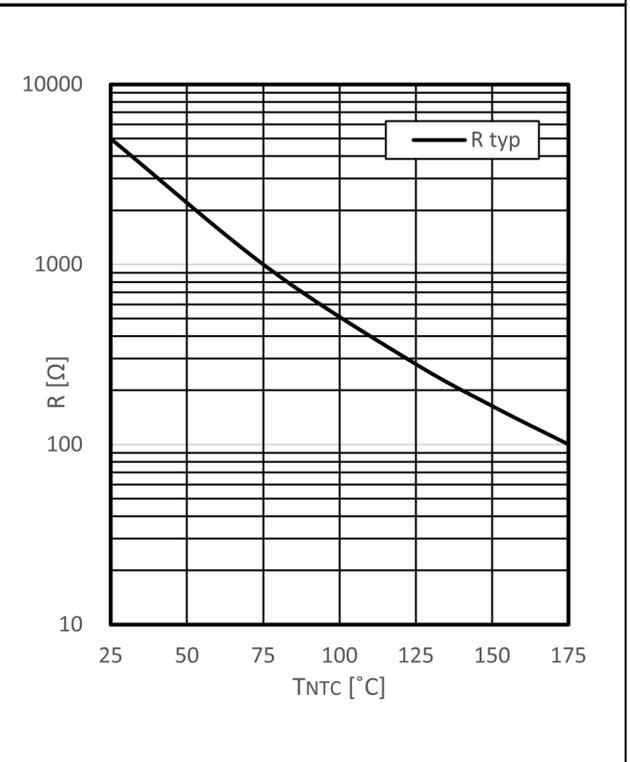
**Switching losses Diode (typical)**  
 $E_{rec} = f(I_F)$   
 $R_{Gon} = 3.3\Omega, V_{CE} = 300\text{ V}$



**Switching losses Diode (typical)**  
 $E_{rec} = f(R_G)$   
 $I_F = 400\text{ A}, V_{CE} = 300\text{ V}$



**Transient thermal impedance Diode**  
 $Z_{thjC} = f(t)$



**NTC-Thermistor-temperature characteristic (typical)**  
 $R = f(T_{NTC})$

### 9. Circuit Diagram

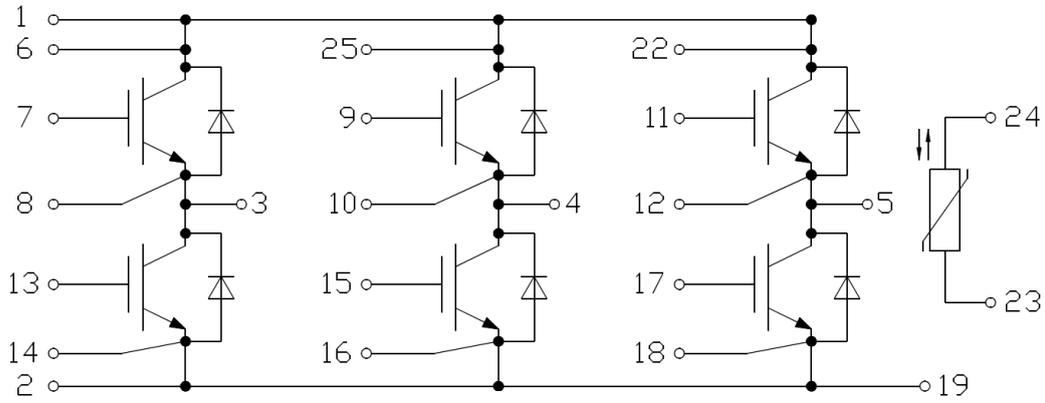


Figure 3

### 10. Package Outlines

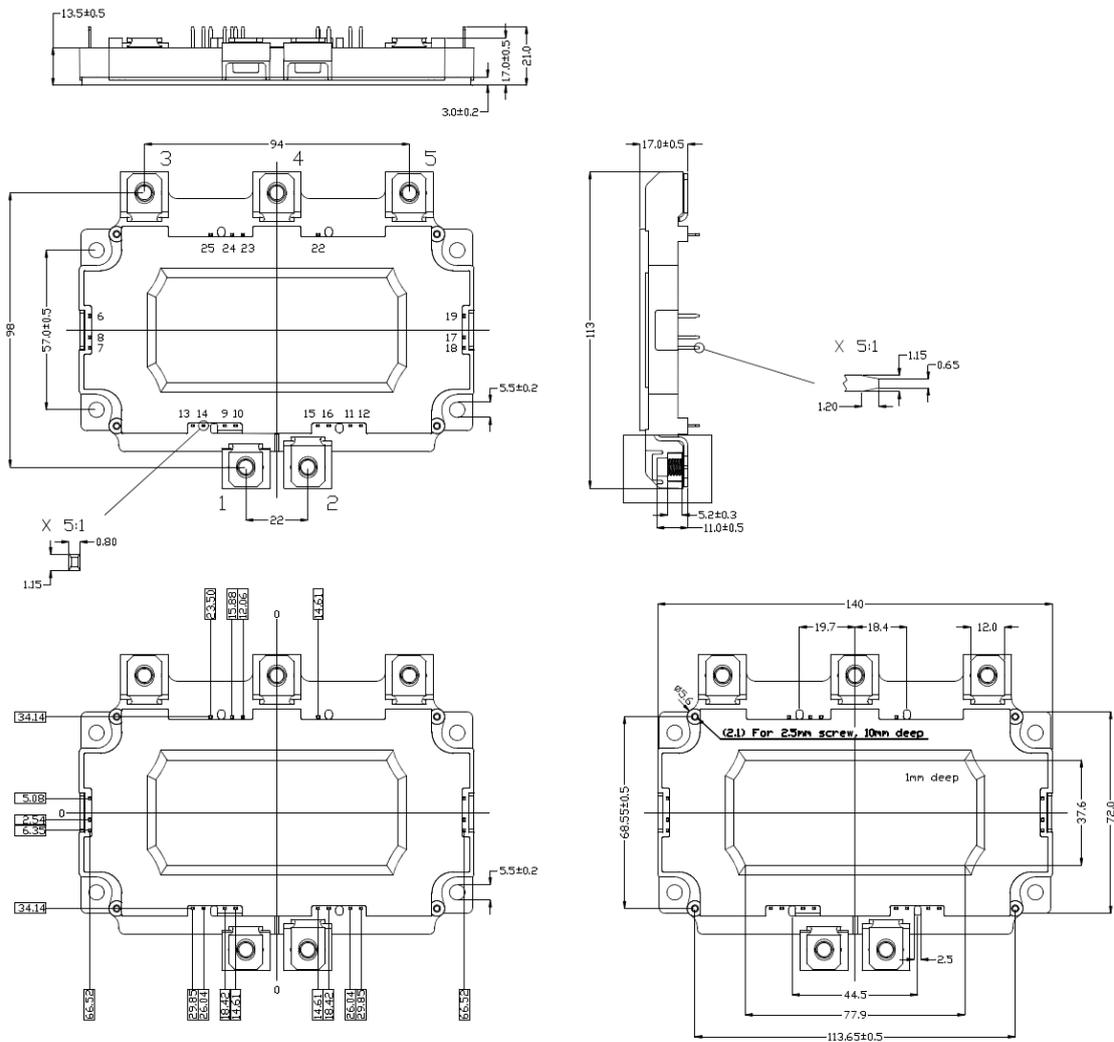


Figure 4