

**PIM IGBT Module**

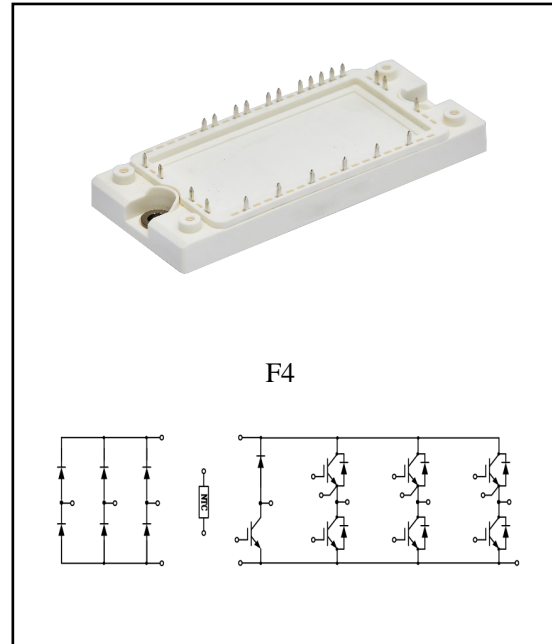
$V_{CES} = 1200V$ ,  $I_{C\ nom} = 25A / I_{CRM} = 50A$

**Electrical characteristics :**

- 1200V Trench /Field Stop process
- Low switching losses
- $V_{cesat}$  has a positive temperature coefficient

**Applications:**

- Variable Frequency Drive
- Servo drive
- Inverter



**IGBT, Inverter**

**Maximum Ratings**

Parameter	Conditions	Symbol	Value	Unit
Collector-Emitter voltage	$T_{vj} = 25^{\circ}C$	$V_{CES}$	1200	V
Continuous DC collector current	$T_C = 100^{\circ}C, T_{vj\ max} = 175^{\circ}C$	$I_{C\ nom}$	25	A
Repetitive peak collector current	$t_p = 1\ ms$	$I_{CRM}$	50	A
Total power dissipation	$T_C = 25^{\circ}C, T_{vj\ max} = 175^{\circ}C$	$P_{tot}$	187	W
Gate emitter voltage		$V_{GE}$	$\pm 20$	V

**Characteristic Values**

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Collector-Emitter saturation voltage	$V_{GE} = 15V, I_C = 25A$	$T_{vj} = 25^{\circ}C$		1.65	2.05	V
	$V_{GE} = 15V, I_C = 25A$	$T_{vj} = 125^{\circ}C$		1.93		
	$V_{GE} = 15V, I_C = 25A$	$T_{vj} = 150^{\circ}C$		2.00		

Gate-Emitter threshold voltage	$I_C=1\text{mA}, V_{GE}=V_{CE}$	$T_{vj}=25^\circ\text{C}$	$V_{GE(th)}$	5.0	5.6	6.20	
Internal gate resistor			$R_{Gint}$		None		$\Omega$
Input capacitance	$f=1\text{MHz}, V_{CE}=25\text{V}, V_{GE}=0\text{V}$	$T_{vj}=25^\circ\text{C}$	$C_{ies}$		1.66		nF
Reverse transfer capacitance			$C_{res}$		0.08		
Collector-emitter cut-off current	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}$	$T_{vj}=25^\circ\text{C}$	$I_{CES}$			1	mA
Gate-emitter leakage current	$V_{CE}=0\text{V}, V_{GE}=20\text{V}$	$T_{vj}=25^\circ\text{C}$	$I_{GES}$			100	nA
Turn-on delay time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ\text{C}$	$t_{don}$		67		ns
		$T_{vj}=125^\circ\text{C}$			58		
		$T_{vj}=150^\circ\text{C}$			60		
Rise time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ\text{C}$	$t_r$		46		ns
		$T_{vj}=125^\circ\text{C}$			56		
		$T_{vj}=150^\circ\text{C}$			55		
Turn-off delay time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ\text{C}$	$t_{doff}$		311		ns
		$T_{vj}=125^\circ\text{C}$			347		
		$T_{vj}=150^\circ\text{C}$			360		
Fall time	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ\text{C}$	$t_f$		202		ns
		$T_{vj}=125^\circ\text{C}$			274		
		$T_{vj}=150^\circ\text{C}$			288		
Turn-on energy loss per pulse	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ\text{C}$	$E_{on}$		2.74		mJ
		$T_{vj}=125^\circ\text{C}$			3.95		
		$T_{vj}=150^\circ\text{C}$			4.46		
Turn-off energy loss per pulse	$I_C=25\text{A}, V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ\text{C}$	$E_{off}$		1.71		mJ
		$T_{vj}=125^\circ\text{C}$			2.15		
		$T_{vj}=150^\circ\text{C}$			2.36		
SC data	$V_{GE}\leq 15\text{V}, V_{CC}=800\text{V}$ $V_{CEmax}=V_{CES}-L_s C_E \cdot di/dt$	$t_p\leq 8\mu\text{s}, T_{vj}=150^\circ\text{C}$	$I_{SC}$		125		A
Thermal resistance, junction to case	per IGBT		$R_{thJC}$			0.80	K/W
Temperature under switching conditions			$T_{vj op}$	-40		150	$^\circ\text{C}$

## Diode, Inverter

### Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	$T_{vj}=25^\circ\text{C}$	$V_{RRM}$	1200	V
Continuous DC forward current		$I_F$	25	A
Repetitive peak forward current	$t_p=1\text{ms}$	$I_{FRM}$	50	A

I <sup>2</sup> t-value	t <sub>p</sub> =10ms, sin180°, T <sub>j</sub> =125°C	I <sup>2</sup> t	200	A <sup>2</sup> s
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### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Forward voltage	I <sub>F</sub> =25A, V <sub>GE</sub> =0V	T <sub>vj</sub> =25°C		1.85	2.40	V
	I <sub>F</sub> =25A, V <sub>GE</sub> =0V	T <sub>vj</sub> =125°C		1.54		
	I <sub>F</sub> =25A, V <sub>GE</sub> =0V	T <sub>vj</sub> =150°C		1.46		
Peak reverse recovery current	I <sub>F</sub> =25A,	T <sub>vj</sub> =25°C		19		A
	-di <sub>F</sub> /dt=464A/μs(T <sub>vj</sub> =150°C)	T <sub>vj</sub> =125°C		25		
	V <sub>R</sub> =600V, V <sub>GE</sub> =-15V	T <sub>vj</sub> =150°C		28		
Recovered charge	I <sub>F</sub> =25A,	T <sub>vj</sub> =25°C		1.93		μC
	-di <sub>F</sub> /dt=464A/μs(T <sub>vj</sub> =150°C)	T <sub>vj</sub> =125°C		4.83		
	V <sub>R</sub> =600V, V <sub>GE</sub> =-15V	T <sub>vj</sub> =150°C		5.79		
Reverse recovered energy	I <sub>F</sub> =25A,	T <sub>vj</sub> =25°C		0.63		mJ
	-di <sub>F</sub> /dt=464A/μs(T <sub>vj</sub> =150°C)	T <sub>vj</sub> =125°C		1.57		
	V <sub>R</sub> =600V, V <sub>GE</sub> =-15V	T <sub>vj</sub> =150°C		1.90		
Thermal resistance, junction to case	per diode	R <sub>thJC</sub>			1.35	K/W
Temperature under switching conditions		T <sub>vj op</sub>	-40		150	°C

## Diode, Rectifier

### Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	T <sub>vj</sub> =25°C	V <sub>RRM</sub>	1600	V
Non-Repetitive peak reverse voltage	T <sub>vj</sub> =25°C	V <sub>RSM</sub>	1800	V
Maximum Average Forward Current		I <sub>F(AV)</sub>	25	A
Surge forward current	t <sub>p</sub> =10ms, sin180°, T <sub>vj</sub> =25°C	I <sub>FSM</sub>	320	A
I <sup>2</sup> t-value	t <sub>p</sub> =10ms, sin180°, T <sub>vj</sub> =25°C	I <sup>2</sup> t	512	A <sup>2</sup> s

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Forward voltage	I <sub>F</sub> =25A, T <sub>vj</sub> =25°C	V <sub>F</sub>			1.1	V

Reverse current	$V_R=V_{RRM}$	$T_{vj}=25^{\circ}\text{C}$	$I_R$			5	$\mu\text{A}$
Temperature under switching conditions			$T_{vj\text{ op}}$	-40		150	$^{\circ}\text{C}$

## IGBT, Brake-Chopper

### Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Collector-Emitter voltage	$T_{vj}=25^{\circ}\text{C}$	$V_{CES}$	1200	V
Continuous DC collector current	$T_C=100^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$	$I_{C\text{ nom}}$	25	A
Repetitive peak collector current	$t_p=1\text{ ms}$	$I_{CRM}$	50	A
Total power dissipation	$T_C = 25^{\circ}\text{C}, T_{vj\text{ max}} = 175^{\circ}\text{C}$	$P_{\text{tot}}$	125	W
Gate emitter voltage		$V_{GE}$	$\pm 20$	V

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Collector-Emitter saturation voltage	$V_{GE}=15\text{V}, I_C=25\text{A}$ $V_{GE}=15\text{V}, I_C=25\text{A}$ $V_{GE}=15\text{V}, I_C=25\text{A}$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$V_{CE\text{ sat}}$	1.81 2.17 2.24	2.20	V
Gate-Emitter threshold voltage	$I_C=1\text{mA}, V_{GE}=V_{CE}$	$T_{vj}=25^{\circ}\text{C}$	$V_{GE(\text{th})}$	5.10	5.68 6.30	
Internal gate resistor			$R_{G\text{int}}$		None	$\Omega$
Input capacitance	$f=1\text{MHz}, V_{CE}=25\text{ V}, V_{GE}=0\text{ V}$	$T_{vj}=25^{\circ}\text{C}$	$C_{\text{ies}}$		1.66	nF
Reverse transfer capacitance			$C_{\text{res}}$		0.08	
Collector-emitter cut-off current	$V_{CE}=1200\text{V}, V_{GE}=0\text{ V}$	$T_{vj}=25^{\circ}\text{C}$	$I_{CES}$		1	mA
Gate-emitter leakage current	$V_{CE}=0\text{ V}, V_{GE}=20\text{ V}$	$T_{vj}=25^{\circ}\text{C}$	$I_{GES}$		100	nA
Turn-on delay time	$I_C=25\text{A}, V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}, R_G=40\Omega$ (inductive load)	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_{d\text{ on}}$		69 58 60	ns
Rise time	$I_C=25\text{A}, V_{CE}=600\text{ V}$ $V_{GE}=\pm 15\text{ V}, R_G=40\Omega$ (inductive load)	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_r$		69 60 59	

Turn-off delay time	$I_C=25A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$t_{d\ off}$		299 351 361		
Fall time	$I_C=25A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$t_f$		224 299 309		
Turn-on energy loss per pulse	$I_C=25A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$E_{on}$		2.01 2.48 2.68		mJ
Turn-off energy loss per pulse	$I_C=25A, V_{CE}=600V$ $V_{GE}=\pm 15V, R_G=40\Omega$ (inductive load)	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$E_{off}$		1.59 2.14 2.26		
Thermal resistance, junction to case	per IGBT		$R_{thJC}$			1.2	K/W
Temperature under switching conditions			$T_{vj\ op}$	-40		150	$^\circ C$

## Diode, Brake-Chopper

### Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	$T_{vj}=25^\circ C$	$V_{RRM}$	1200	V
Continuous DC forward current		$I_F$	8	A
Repetitive peak forward current	$t_p=1ms$	$I_{FRM}$	16	A
$I^2t$ -value	$V_R=0V, t_p=10ms, T_{vj}=125^\circ C$	$I^2t$	24	$A^2s$

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Forward voltage	$I_F=8A, V_{GE}=0V$ $I_F=8A, V_{GE}=0V$ $I_F=8A, V_{GE}=0V$	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$V_F$	2.03 1.71 1.64	2.50	V
Peak reverse recovery current	$I_F=8A,$ $-di_F/dt=254A/\mu s(T_{vj}=150^\circ C)$ $V_R=600V, V_{GE}=-15V$	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$I_{RM}$	8 12 13		A
Recovered charge	$I_F=8A,$ $-di_F/dt=254A/\mu s(T_{vj}=150^\circ C)$ $V_R=600V, V_{GE}=-15V$	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$Q_f$	0.23 1.16 1.30		$\mu C$
Reverse recovered energy	$I_F=8A,$ $-di_F/dt=254A/\mu s(T_{vj}=150^\circ C)$ $V_R=600V, V_{GE}=-15V$	$T_{vj}=25^\circ C$ $T_{vj}=125^\circ C$ $T_{vj}=150^\circ C$	$E_{rec}$	0.03 0.36 0.40		mJ

Thermal resistance, junction to case	per diode	$R_{thJC}$			2.30	K/W
Temperature under switching conditions		$T_{vj\ op}$	-40		150	°C

## NTC-Thermistor

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Rated resistances	$T_c=25^\circ\text{C}, \pm 5\%$	$R_{25}$		5.0		K $\Omega$
B-value	$\pm 1\%$	$B_{25/50}$		3380		K

## Module

Parameter	Conditions	Symbol	Value			Unit
Isolation test voltage	RMS, $f=50\text{Hz}, t=1\text{min}$	$V_{ISOL}$	2500			V
Internal isolation			$\text{Al}_2\text{O}_3$			
Storage temperature		$T_{stg}$	-40		125	°C
Mounting torque for modul mounting		M	3.0		6.0	Nm
Weight		W		170		g

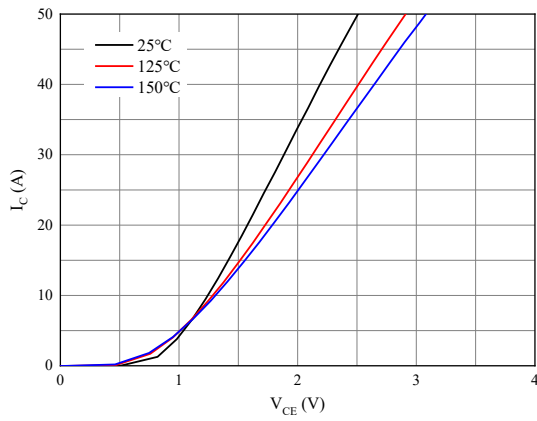


Fig 1. Typical output characteristics ( $V_{GE}=15V$ )

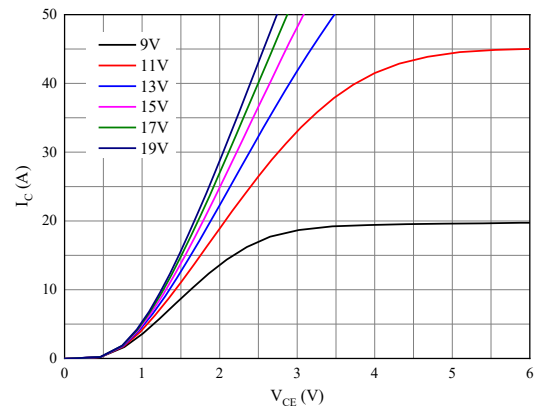


Fig 2. Typical output characteristics ( $T_{vj}=150^{\circ}C$ )

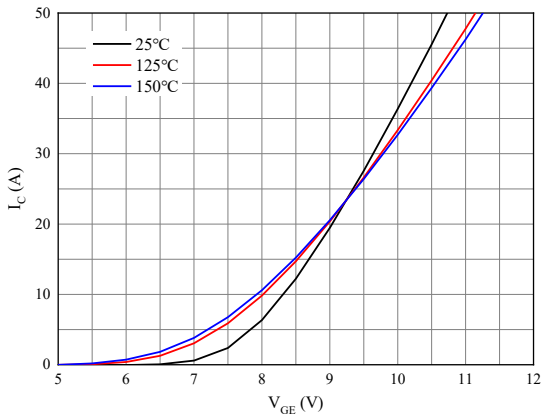


Fig 3. Typical transfer characteristic ( $V_{CE}=20V$ )

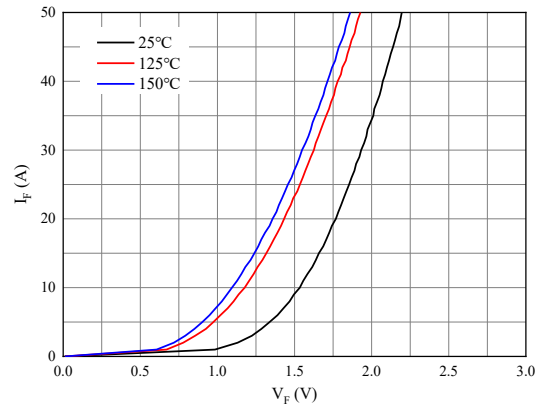


Fig 4. Forward characteristic of Diode

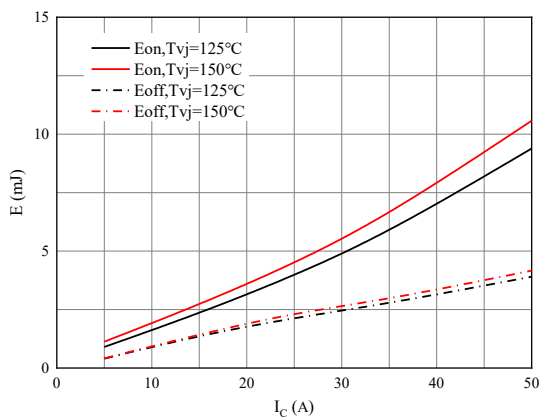


Fig 5. Switching losses of IGBT  
 $V_{GE}=\pm 15V$ ,  $R_{Gon}=40\Omega$ ,  $R_{Goff}=40\Omega$ ,  $V_{CE}=600V$

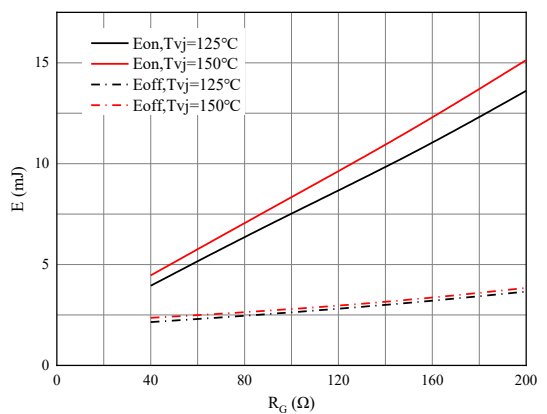
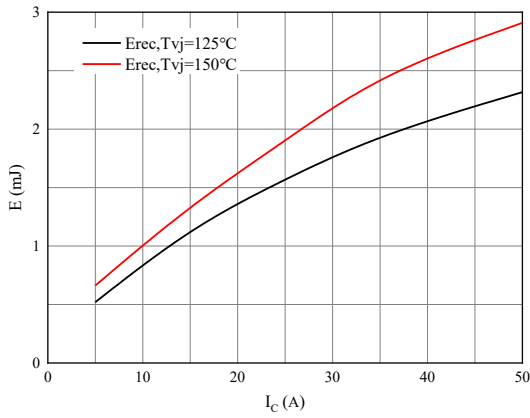
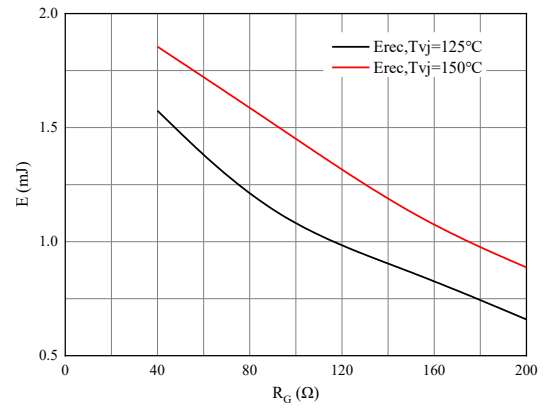


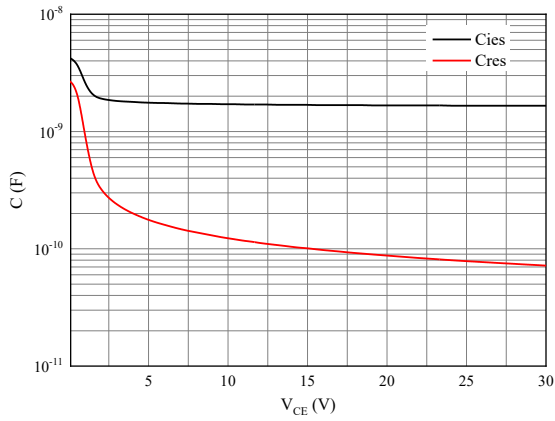
Fig 6. Switching losses of IGBT  
 $V_{GE}=\pm 15V$ ,  $I_C=25A$ ,  $V_{CE}=600V$



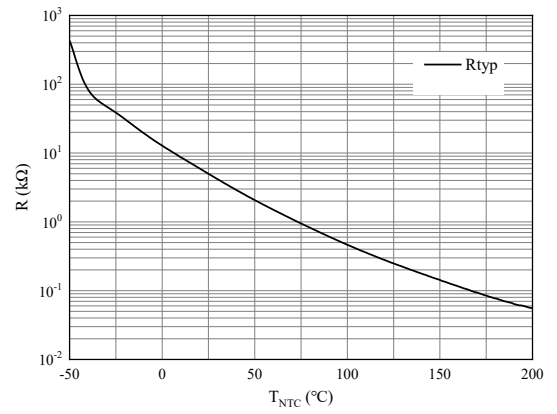
**Fig 7. Switching losses of Diode**  
R<sub>Gon</sub>=40Ω, V<sub>CE</sub>=600V



**Fig 8. Switching losses of Diode**  
I<sub>F</sub>=25A, V<sub>CE</sub>=600V



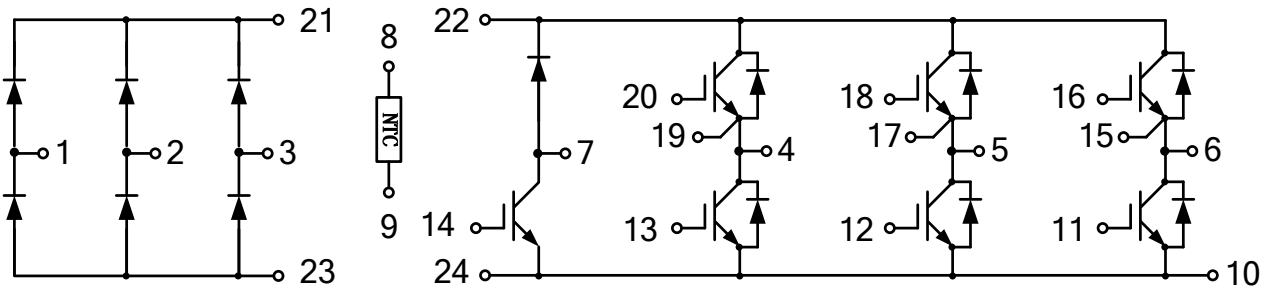
**Fig 9. Capacitance characteristic**



**Fig10. NTC-Thermistor-temperature characteristic**



**Circuit diagram**



**Package outlines**

