

## PIM IGBT Module

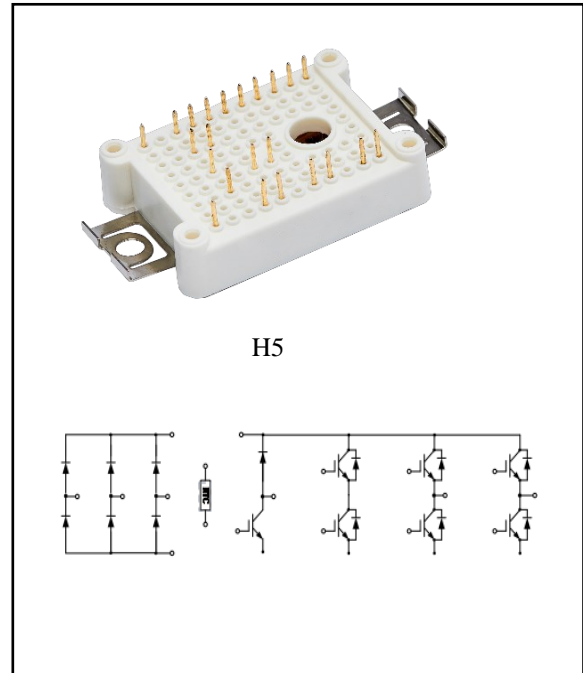
$V_{CES} = 1200V$ ,  $I_{C\ nom} = 15A$  /  $I_{CRM} = 30A$

### 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	$T_C = 100^{\circ}C$ , $T_{vj\ max} = 175^{\circ}C$	$I_{C\ nom}$	15	A
Repetitive peak collector current	$t_p = 1\ ms$	$I_{CRM}$	30	A
Total power dissipation	$T_C = 25^{\circ}C$ , $T_{vj\ max} = 175^{\circ}C$	$P_{tot}$	130	W
Gate emitter voltage		$V_{GE}$	$\pm 20$	V

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Collector-Emitter saturation voltage	$V_{GE} = 15V$ , $I_C = 15A$ $T_{vj} = 25^{\circ}C$ $V_{GE} = 15V$ , $I_C = 15A$ $T_{vj} = 125^{\circ}C$ $V_{GE} = 15V$ , $I_C = 15A$ $T_{vj} = 150^{\circ}C$	$V_{CEsat}$		1.95 2.46 2.54	2.40	V
Gate-Emitter threshold voltage	$I_C = 0.48mA$ , $V_{GE} = V_{CE}$ $T_{vj} = 25^{\circ}C$	$V_{GE(th)}$	5.10	5.70	6.30	
Internal gate resistor		$R_{Gint}$		None		$\Omega$

Gate charge	$V_{GE} = -15V \dots +15V$	$Q_G$		0.10		$\mu C$
Input capacitance	$f = 1MHz, V_{CE} = 25V, V_{GE} = 0V \quad T_{vj} = 25^\circ C$	$C_{ies}$		0.88		nF
Reverse transfer capacitance		$C_{res}$		0.04		
Collector-emitter cut-off current	$V_{CE} = 1200V, V_{GE} = 0V \quad T_{vj} = 25^\circ C$	$I_{CES}$			1	mA
Gate-emitter leakage current	$V_{CE} = 0V, V_{GE} = 20V \quad T_{vj} = 25^\circ C$	$I_{GES}$			100	nA
Turn-on delay time	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	$t_{d\ on}$		46	
					42	
					44	
Rise time	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	$t_r$		38	
					41	
					39	
Turn-off delay time	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	$t_{d\ off}$		215	ns
					249	
					259	
Fall time	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	$t_f$		196	
					221	
					203	
Turn-on energy loss per pulse	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	$E_{on}$		1.57	mJ
					2.12	
					2.25	
Turn-off energy loss per pulse	$I_C = 15A, V_{CE} = 600V$ $V_{GE} = \pm 15V, R_G = 40\Omega$ (inductive load)	$T_{vj} = 25^\circ C$ $T_{vj} = 125^\circ C$ $T_{vj} = 150^\circ C$	$E_{off}$		0.89	
					1.07	
					1.16	
SC data	$V_{GE} \leq 15V, V_{cc} = 800V$ $V_{CEmax} = V_{CES} - L_{sCE} \cdot di/dt \quad t_p \leq 8\mu s, T_{vj} = 25^\circ C$	$I_{sc}$		71		A
Thermal resistance, junction to case	per IGBT	$R_{thJC}$		1.05	1.15	K/W
Temperature under switching conditions		$T_{vj\ op}$	-40		150	$^\circ C$

## Diode, Inverter

### Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	$T_{vj} = 25^\circ C$	$V_{RRM}$	1200	V
Continuous DC forward current		$I_F$	15	A
Repetitive peak forward current	$t_p = 1ms$	$I_{FRM}$	30	A
$I^2t$ -value	$t_p = 10ms, \sin 180^\circ, T_{vj} = 125^\circ C$	$I^2t$	136	$A^2s$

**Characteristic Values**

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Forward voltage	$I_F=15A, V_{GE}=0V$ $T_{vj}=25^{\circ}C$	$V_F$		1.60	2.10	V
	$I_F=15A, V_{GE}=0V$ $T_{vj}=125^{\circ}C$			1.75		
	$I_F=15A, V_{GE}=0V$ $T_{vj}=150^{\circ}C$			1.78		
Peak reverse recovery current	$I_F=15A,$ $-di_F/dt=251A/\mu s(T_{vj}=150^{\circ}C)$ $V_R=600V, V_{GE}=-15V$ $T_{vj}=25^{\circ}C$	$I_{RM}$		13		A
	$T_{vj}=125^{\circ}C$			15		
	$T_{vj}=150^{\circ}C$			17		
Recovered charge	$I_F=15A,$ $-di_F/dt=251A/\mu s(T_{vj}=150^{\circ}C)$ $V_R=600V, V_{GE}=-15V$ $T_{vj}=25^{\circ}C$	$Q_r$		1.87		$\mu C$
	$T_{vj}=125^{\circ}C$			3.33		
	$T_{vj}=150^{\circ}C$			3.82		
Reverse recovered energy	$I_F=15A,$ $-di_F/dt=251A/\mu s(T_{vj}=150^{\circ}C)$ $V_R=600V, V_{GE}=-15V$ $T_{vj}=25^{\circ}C$	$E_{rec}$		0.70		mJ
	$T_{vj}=125^{\circ}C$			1.28		
	$T_{vj}=150^{\circ}C$			1.45		
Thermal resistance, junction to case	per diode	$R_{thJC}$		1.75	1.90	K/W
Temperature under switching conditions		$T_{vj op}$	-40		150	$^{\circ}C$

**Diode, Rectifier**
**Maximum Ratings**

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	$T_{vj}=25^{\circ}C$	$V_{RRM}$	1600	V
Non-Repetitive peak reverse voltage	$T_{vj}=25^{\circ}C$	$V_{RSM}$	1800	V
Maximum Average Forward Current		$I_{F(AV)}$	16	A
Surge forward current	$t_p=10ms, \sin 180^{\circ}, T_{vj}=25^{\circ}C$	$I_{FSM}$	190	A
$I^2t$ -value	$t_p=10ms, \sin 180^{\circ}, T_{vj}=125^{\circ}C$	$I^2t$	381	$A^2s$

**Characteristic Values**

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Forward voltage	$I_F=16A, T_j=25^{\circ}C$	$V_F$		0.95		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	$T_C=100^{\circ}\text{C}$ , $T_{vj\text{ max}}=175^{\circ}\text{C}$	$I_{C\text{ nom}}$	15	A
Repetitive peak collector current	$t_p=1\text{ ms}$	$I_{CRM}$	30	A
Total power dissipation	$T_C = 25^{\circ}\text{C}$ , $T_{vj\text{ max}} = 175^{\circ}\text{C}$	$P_{\text{tot}}$	130	W
Gate emitter voltage		$V_{GE}$	$\pm 20$	V

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit	
			Min.	Typ.	Max.		
Collector-Emitter saturation voltage	$V_{GE}=15\text{V}$ , $I_C=15\text{A}$ $V_{GE}=15\text{V}$ , $I_C=15\text{A}$ $V_{GE}=15\text{V}$ , $I_C=15\text{A}$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$V_{C\text{esat}}$		2.08 2.37 2.45	2.50	V
Gate-Emitter threshold voltage	$I_C=0.48\text{mA}$ , $V_{GE}=V_{CE}$	$T_{vj}=25^{\circ}\text{C}$	$V_{GE(\text{th})}$	5.10	5.70	6.30	
Gate charge	$V_{GE}=-15\text{V}\dots+15\text{V}$		$Q_G$		0.11		$\mu\text{C}$
Internal gate resistor			$R_{G\text{int}}$		None		$\Omega$
Input capacitance	$f=1\text{MHz}$ , $V_{CE}=25\text{V}$ , $V_{GE}=0\text{V}$	$T_{vj}=25^{\circ}\text{C}$	$C_{\text{ies}}$		0.86		nF
Reverse transfer capacitance			$C_{\text{res}}$		0.02		
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	$I_C=15\text{A}$ , $V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}$ , $R_G=40\Omega$ (inductive load)	$T_{vj}=25^{\circ}\text{C}$	$t_{d\text{ on}}$		51		ns
Rise time		$T_{vj}=125^{\circ}\text{C}$			47		
		$T_{vj}=150^{\circ}\text{C}$			40		
	$I_C=15\text{A}$ , $V_{CE}=600\text{V}$ $V_{GE}=\pm 15\text{V}$ , $R_G=40\Omega$ (inductive load)	$T_{vj}=25^{\circ}\text{C}$	$t_r$		44		ns
		$T_{vj}=125^{\circ}\text{C}$			48		
		$T_{vj}=150^{\circ}\text{C}$			56		

Turn-off delay time	I <sub>C</sub> =15A, V <sub>CE</sub> =600 V V <sub>GE</sub> =±15 V, R <sub>G</sub> =40Ω (inductive load)	T <sub>vj</sub> =25°C	t <sub>d off</sub>		216		
		T <sub>vj</sub> =125°C			254		
		T <sub>vj</sub> =150°C			262		
Fall time	I <sub>C</sub> =15A, V <sub>CE</sub> =600 V V <sub>GE</sub> =±15 V, R <sub>G</sub> =40Ω (inductive load)	T <sub>vj</sub> =25°C	t <sub>r</sub>		194		
		T <sub>vj</sub> =125°C			213		
		T <sub>vj</sub> =150°C			219		
Turn-on energy loss per pulse	I <sub>C</sub> =15A, V <sub>CE</sub> =600 V V <sub>GE</sub> =±15 V, R <sub>G</sub> =40Ω (inductive load)	T <sub>vj</sub> =25°C	E <sub>on</sub>		0.92		mJ
		T <sub>vj</sub> =125°C			1.21		
		T <sub>vj</sub> =150°C			1.31		
Turn-off energy loss per pulse	I <sub>C</sub> =15A, V <sub>CE</sub> =600 V V <sub>GE</sub> =±15 V, R <sub>G</sub> =40Ω (inductive load)	T <sub>vj</sub> =25°C	E <sub>off</sub>		0.88		
		T <sub>vj</sub> =125°C			1.11		
		T <sub>vj</sub> =150°C			1.15		
Thermal resistance, junction to case	per IGBT		R <sub>thJC</sub>		1.05	1.15	K/W
Temperature under switching conditions			T <sub>vj op</sub>	-40		150	°C

## Diode, Brake-Chopper

### Maximum Ratings

Parameter	Conditions	Symbol	Value	Unit
Repetitive peak reverse voltage	T <sub>vj</sub> =25°C	V <sub>RRM</sub>	1200	V
Continuous DC forward current		I <sub>F</sub>	8	A
Repetitive peak forward current	t <sub>p</sub> =1ms	I <sub>FRM</sub>	16	A
I <sup>2</sup> t-value	V <sub>R</sub> =0V, t <sub>p</sub> =10ms, T <sub>vj</sub> =125°C	I <sup>2</sup> t	25	A <sup>2</sup> t

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit		
			Min.	Typ.	Max.			
Forward voltage	I <sub>F</sub> =8A, V <sub>GE</sub> =0V	V <sub>F</sub>			2.4	V		
							T <sub>vj</sub> =25°C	1.88
							T <sub>vj</sub> =125°C	1.96
Peak reverse recovery current	I <sub>F</sub> =8A, -di <sub>F</sub> /dt=203A/μs(T <sub>vj</sub> =150°C) V <sub>R</sub> =600V, V <sub>GE</sub> =-15V	I <sub>RM</sub>				A		
							T <sub>vj</sub> =25°C	6
							T <sub>vj</sub> =125°C	7
Recovered charge	I <sub>F</sub> =8A, -di <sub>F</sub> /dt=203A/μs(T <sub>vj</sub> =150°C) V <sub>R</sub> =600V, V <sub>GE</sub> =-15V	Q <sub>r</sub>				μC		
							T <sub>vj</sub> =25°C	0.68
							T <sub>vj</sub> =125°C	1.22
Reverse recovered energy	I <sub>F</sub> =8A, -di <sub>F</sub> /dt=203A/μs(T <sub>vj</sub> =150°C) V <sub>R</sub> =600V, V <sub>GE</sub> =-15V	E <sub>rec</sub>				mJ		
							T <sub>vj</sub> =25°C	0.27
							T <sub>vj</sub> =125°C	0.49
Thermal resistance, junction to case	per diode	R <sub>thJC</sub>			1.75	1.90	K/W	
					T <sub>vj</sub> =150°C	0.53		

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		23		g

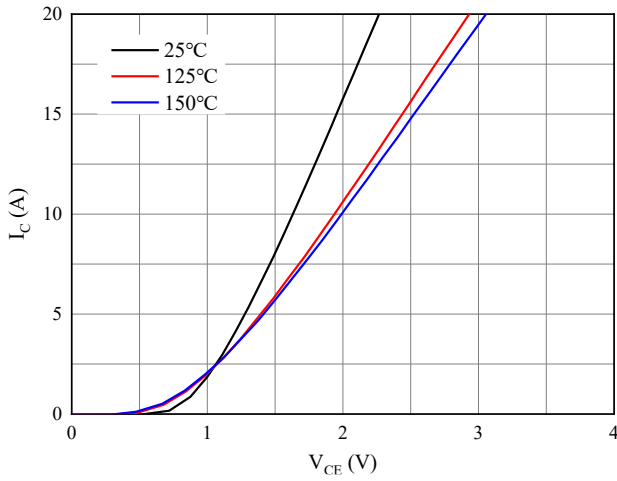


Fig 1. Typical output characteristics ( $V_{GE}=15V$ )

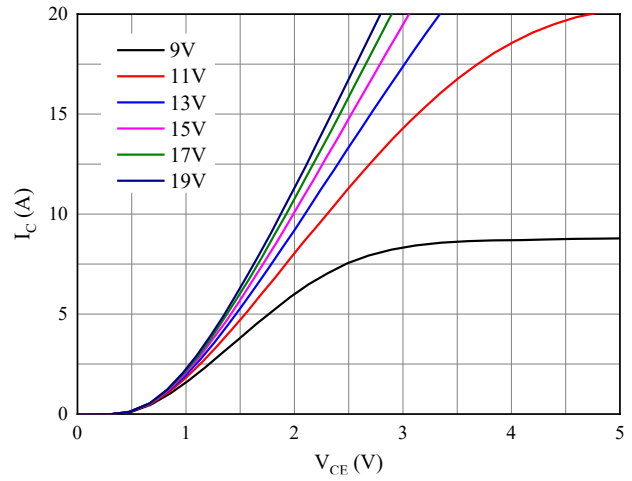


Fig 2. Typical output characteristics ( $T_{vj}=150^{\circ}C$ )

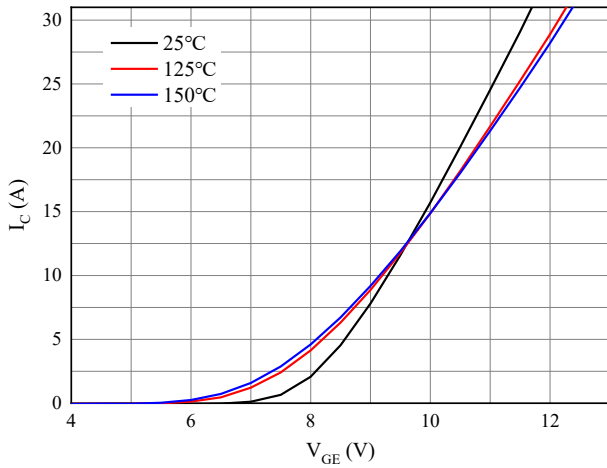


Fig 3. Typical transfer characteristic ( $V_{CE}=20V$ )

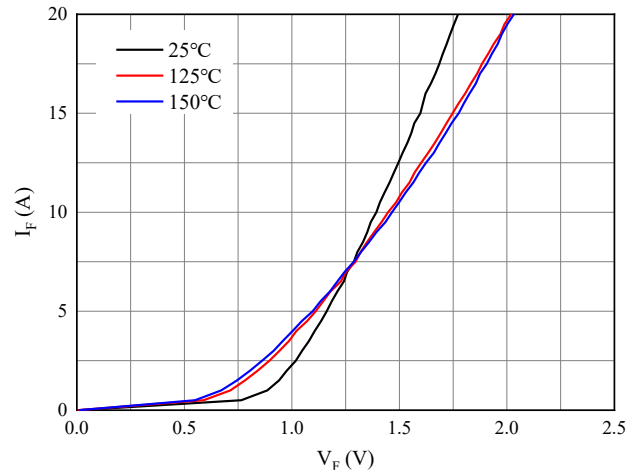


Fig 4. Forward characteristic of Diode

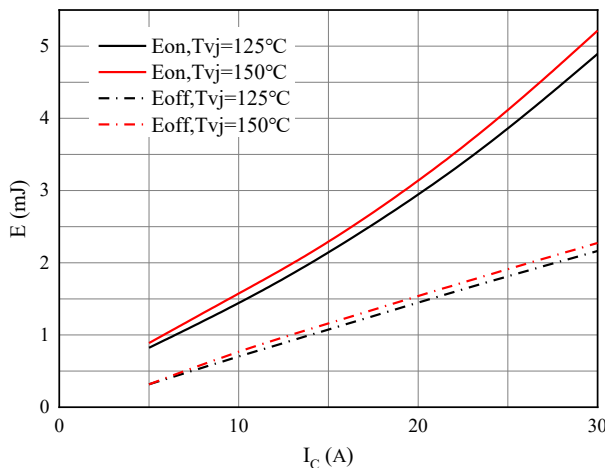


Fig 5. Switching losses of IGBT  
 $V_{GE}=\pm 15V$ ,  $R_{Gon}=40\Omega$ ,  $R_{Goff}=40\Omega$ ,  $V_{CE}=600V$

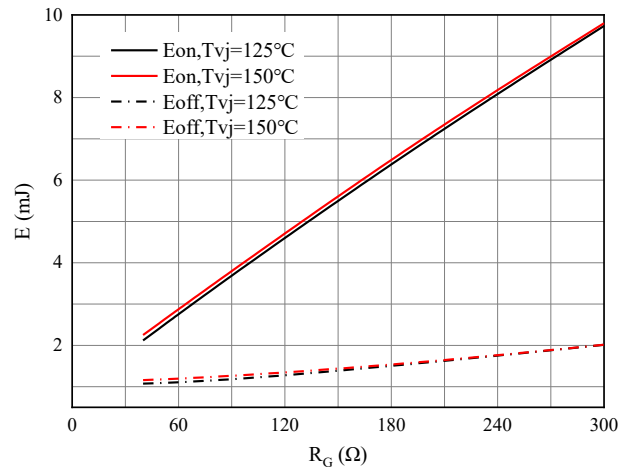
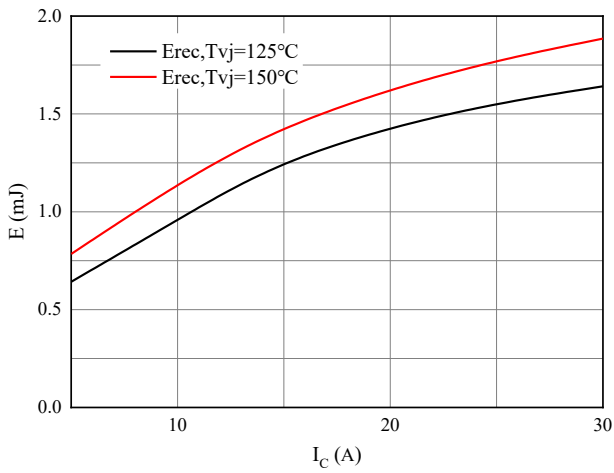
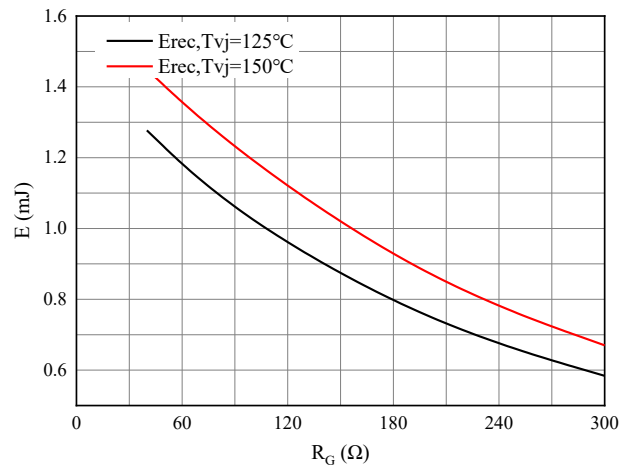


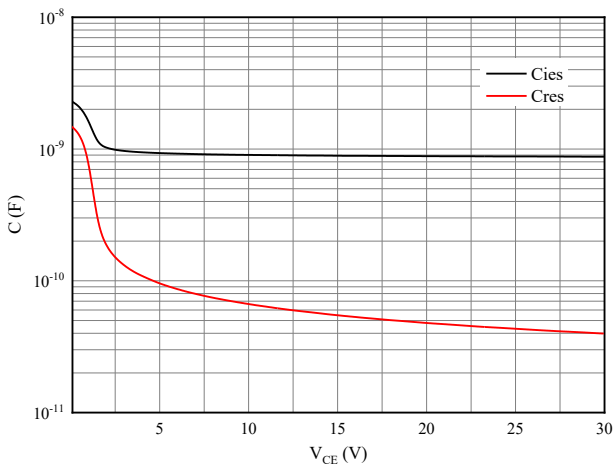
Fig 6. Switching losses of IGBT  
 $V_{GE}=\pm 15V$ ,  $I_C=15A$ ,  $V_{CE}=600V$



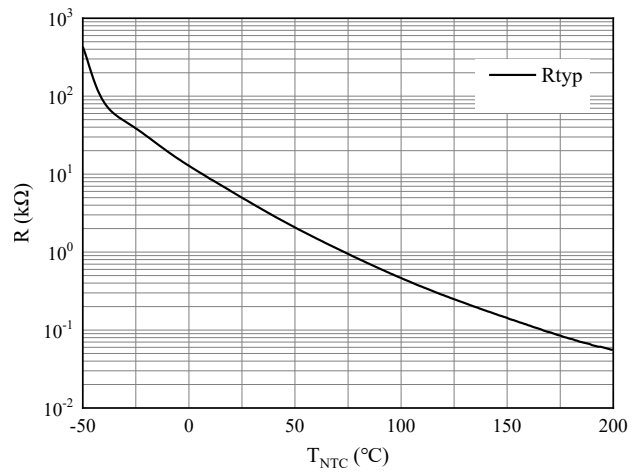
**Fig 7. Switching losses of Diode**  
RGon=40Ω, VCE=600V



**Fig 8. Switching losses of Diode**  
IF=15A, VCE=600V



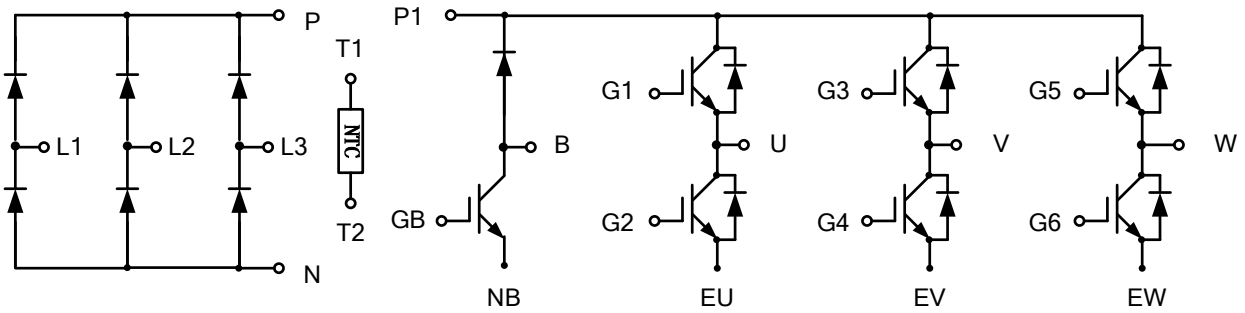
**Fig 9. Capacitance characteristic**



**Fig 10. NTC-Themistor-temperature characteristic**



**Circuit diagram**



**Package outlines**

