

### 3-Level IGBT Module

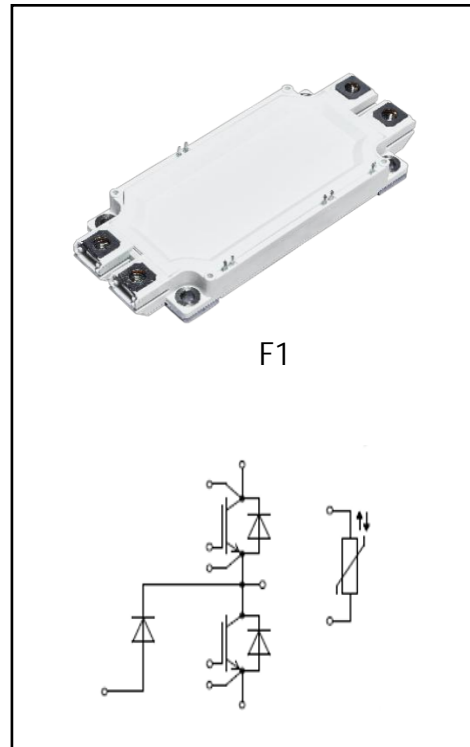
$V_{CES} = 1200V$ ,  $I_{C\ nom} = 450A / I_{CRM} = 900A$

**Electrical characteristics :**

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

**Applications:**

- 3-Level-Applications
- Energy storage inverter
- Annual Performance Factor
- UPS Systems



### 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	$T_C = 100^{\circ}C, T_{vj\ max} = 175^{\circ}C$	$I_{C\ nom}$	450	A
Repetitive peak collector current	$t_p = 1\ ms$	$I_{CRM}$	900	A
Total power dissipation	$T_C = 25^{\circ}C, T_{vj\ max} = 175^{\circ}C$	$P_{tot}$	1250	W
Gate emitter voltage	$t_p \leq 0.5\ \mu s, D < 0.001$	$V_{GE}$	$\pm 20$ 30	V

**Characteristic Values**

Parameter	Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Collector-Emitter saturation voltage	$V_{GE}=15V, I_C=450A$ $T_{vj}=25^{\circ}C$ $V_{GE}=15V, I_C=450A$ $T_{vj}=125^{\circ}C$ $V_{GE}=15V, I_C=450A$ $T_{vj}=150^{\circ}C$	$V_{CE\ sat}$		1.61 1.89 1.96	2.1	V
Gate-Emitter threshold voltage	$I_C=17mA, V_{GE}=V_{CE}$ $T_{vj}=25^{\circ}C$	$V_{GEth}$	5.3	5.8	6.5	
Gate charge	$V_{GE}=-15V...+15V$	$Q_G$		3.12		$\mu C$
Internal gate resistor	$T_{vj}=25^{\circ}C$	$R_{Gint}$		1.9		$\Omega$
Input capacitance	$f=100kHz, V_{CE}=25V,$ $V_{GE}=0V$ $T_{vj}=25^{\circ}C$	$C_{ies}$		34.9		nF
Reverse transfer capacitance		$C_{res}$		1.4		
Collector-emitter cut-off current	$V_{CE}=1200V, V_{GE}=0V$ $T_{vj}=25^{\circ}C$	$I_{CES}$			2	mA
Gate-emitter leakage current	$V_{CE}=0V, V_{GE}=20V$ $T_{vj}=25^{\circ}C$	$I_{GES}$			200	nA
Turn-on delay time	$I_C=450A, V_{CE}=600V$ $T_{vj}=25^{\circ}C$ $V_{GE}=\pm 15V, R_G=2.0\Omega$ $T_{vj}=125^{\circ}C$ (inductive load) $T_{vj}=150^{\circ}C$	$t_{d\ on}$		166 220 250		ns
Rise time	$I_C=450A, V_{CE}=600V$ $T_{vj}=25^{\circ}C$ $V_{GE}=\pm 15V, R_G=2.0\Omega$ $T_{vj}=125^{\circ}C$ (inductive load) $T_{vj}=150^{\circ}C$	$t_r$		91 100 101		
Turn-off delay time	$I_C=450A, V_{CE}=600V$ $T_{vj}=25^{\circ}C$ $V_{GE}=\pm 15V, R_G=2.0\Omega$ $T_{vj}=125^{\circ}C$ (inductive load) $T_{vj}=150^{\circ}C$	$t_{d\ off}$		425 484 500		
Fall time	$I_C=450A, V_{CE}=600V$ $T_{vj}=25^{\circ}C$ $V_{GE}=\pm 15V, R_G=2.0\Omega$ $T_{vj}=125^{\circ}C$ (inductive load) $T_{vj}=150^{\circ}C$	$t_f$		88 156 176		
Turn-on energy loss per pulse	$I_C=450A, V_{CE}=600V,$ $V_{GE}=\pm 15V, R_G=2.0\Omega,$ $di/dt=3500A/\mu s(T_{vj}=150^{\circ}C)$ (inductive load) $T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	$E_{on}$		23.28 31.04 35.09		mJ
Turn-off energy loss per pulse	$I_C=450A, V_{CE}=600V,$ $V_{GE}=\pm 15V, R_G=2.0\Omega,$ $du/dt=4100V/\mu s(T_{vj}=150^{\circ}C)$ (inductive load) $T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	$E_{off}$		35.19 44.73 47.14		mJ
SC data	$V_{GE}\leq 15V, V_{cc}=800V$ $V_{CEmax}=V_{CES}-L_{sCE}\cdot di/dt$ $t_p\leq 10\mu s, T_{vj}=150^{\circ}C$	$I_{sc}$		1700		A
Thermal resistance, junction to case	per IGBT	$R_{thJC}$			0.12	K/W
Temperature under switching conditions		$T_{vj\ op}$	-40		150	$^{\circ}C$

## Diode, Inverter&3-Level

### 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		$I_F$	450	A
Repetitive peak forward current	$t_p=1\text{ms}$	$I_{FRM}$	900	A
I2t-value	$V_R=0\text{V}, t_p=10\text{ms}, T_{vj}=125^{\circ}\text{C}$	I2t	34000	$\text{A}^2\text{s}$

### Characteristic Values

Parameter	Conditions	Symbol	Value			Unit
			Min	Typ.	Max.	
Forward voltage	$I_F=450\text{A}, V_{GE}=0\text{V}$ $T_{vj}=25^{\circ}\text{C}$ $I_F=450\text{A}, V_{GE}=0\text{V}$ $T_{vj}=125^{\circ}\text{C}$ $I_F=450\text{A}, V_{GE}=0\text{V}$ $T_{vj}=150^{\circ}\text{C}$	$V_F$		2.35 2.55 2.45	3.0	V
Peak reverse recovery current	$I_F=450\text{A}, V_R=600\text{V},$ $T_{vj}=25^{\circ}\text{C}$ $V_{GE}=-15\text{V}, R_G=2.0\Omega,$ $T_{vj}=125^{\circ}\text{C}$ $-diF/dt=3500\text{A/us}(T_{vj}=150^{\circ}\text{C})$ $T_{vj}=150^{\circ}\text{C}$	$I_{RM}$		210 296 313		A
Recovered charge	$I_F=450\text{A}, V_R=600\text{V},$ $T_{vj}=25^{\circ}\text{C}$ $V_{GE}=-15\text{V}, R_G=2.0\Omega,$ $T_{vj}=125^{\circ}\text{C}$ $-diF/dt=3500\text{A/us}(T_{vj}=150^{\circ}\text{C})$ $T_{vj}=150^{\circ}\text{C}$	$Q_F$		18.04 42.74 51.26		$\mu\text{C}$
Reverse recovered energy	$I_F=450\text{A}, V_R=600\text{V},$ $T_{vj}=25^{\circ}\text{C}$ $V_{GE}=-15\text{V}, R_G=2.0\Omega,$ $T_{vj}=125^{\circ}\text{C}$ $-diF/dt=3500\text{A/us}(T_{vj}=150^{\circ}\text{C})$ $T_{vj}=150^{\circ}\text{C}$	$E_{rec}$		7.19 18.12 22.18		mJ
Thermal resistance, junction to case	per diode	$R_{thJC}$			0.20	K/W
Temperature under switching conditions		$T_{vj\text{ op}}$	-40		150	$^{\circ}\text{C}$

## 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		$\text{K}\Omega$
B-value	$\pm 2\%$	$B_{25/50}$		3375		K

## Module

Parameter	Conditions	Symbol	Value			Unit
Isolation test voltage	RMS, f=50Hz, t=1min	V <sub>ISOL</sub>	2500			V
Internal isolation			Al <sub>2</sub> O <sub>3</sub>			
Storage temperature		T <sub>stg</sub>	-40		125	°C
Mounting torque for modul mounting		M	3.0		6.0	Nm
Terminal connection torque		M	3.0		6.0	Nm
Weight		W		340		g

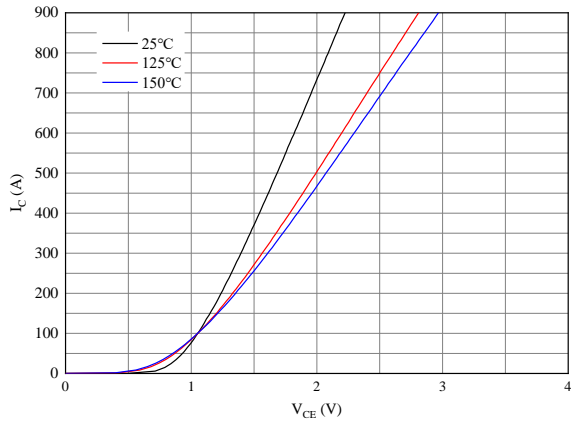


Fig 1. Typical output characteristics ( $V_{GE}=15V$ )

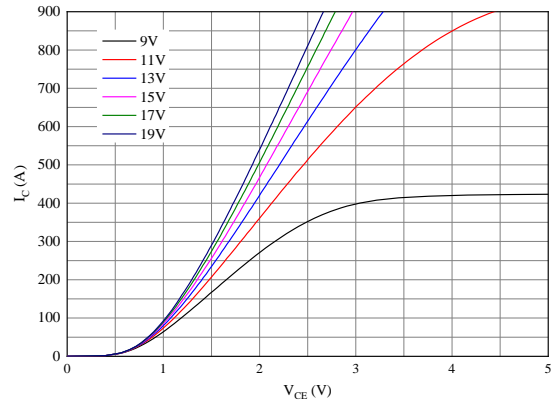


Fig 2. Typical output characteristics ( $T_{vj}=150^{\circ}C$ )

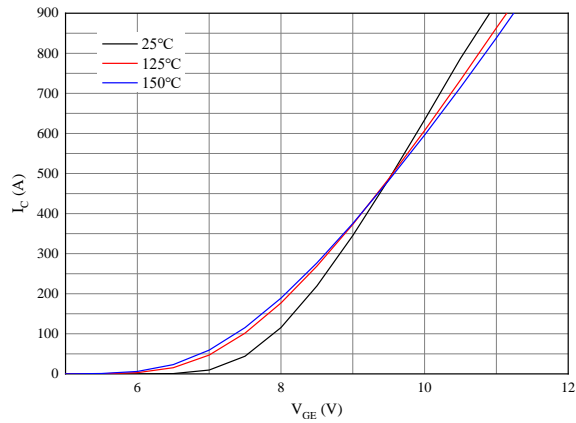


Fig 3. Typical transfer characteristic ( $V_{CE}=20V$ )

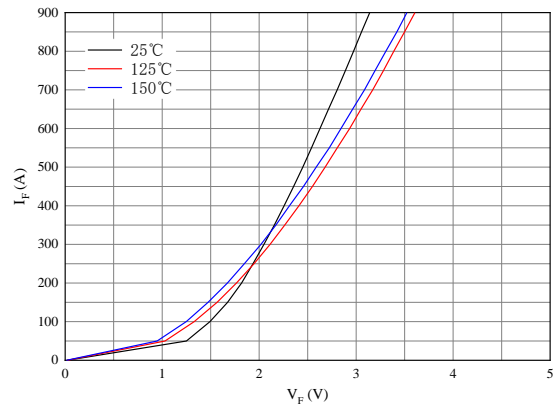


Fig 4. Forward characteristic of Diode

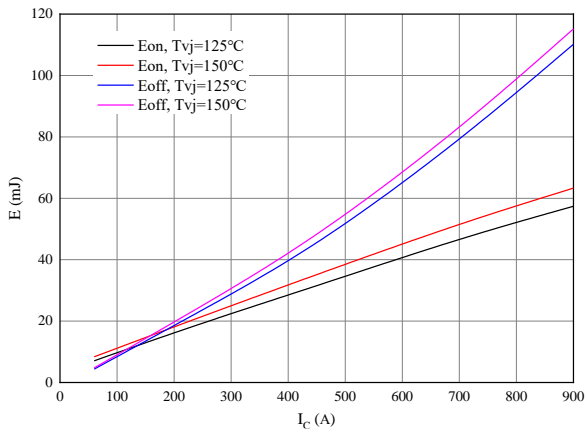


Fig 5. Switching losses of IGBT  
 $V_{GE}=\pm 15V$ ,  $R_{Gon}=2.0\Omega$ ,  $R_{Goff}=2.0\Omega$ ,  $V_{CE}=600V$

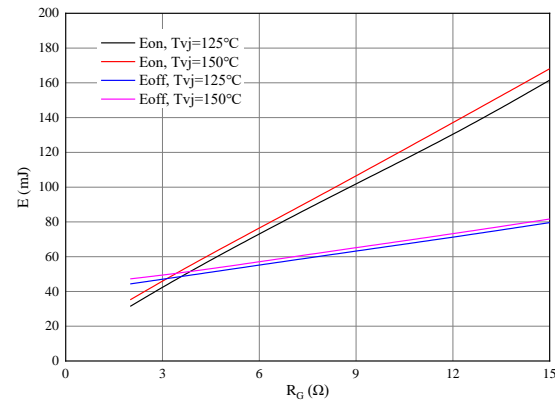
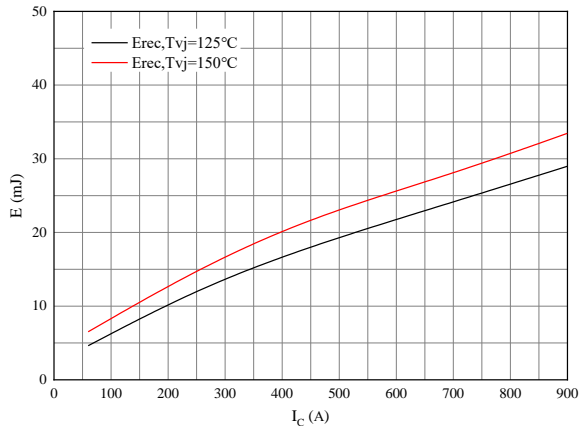
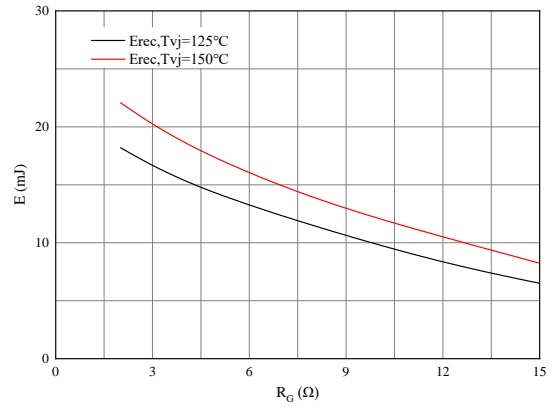


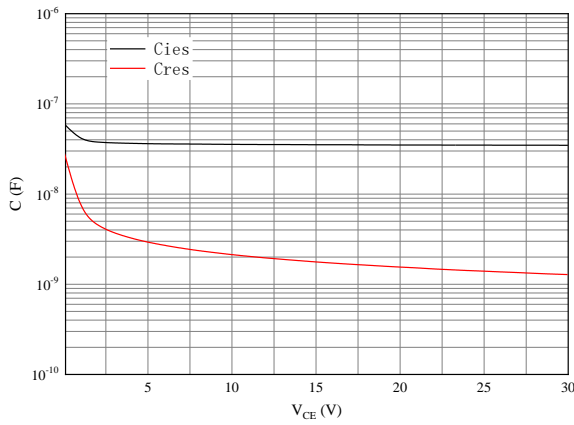
Fig 6. Switching losses of IGBT  
 $V_{GE}=\pm 15V$ ,  $I_C=450A$ ,  $V_{CE}=600V$



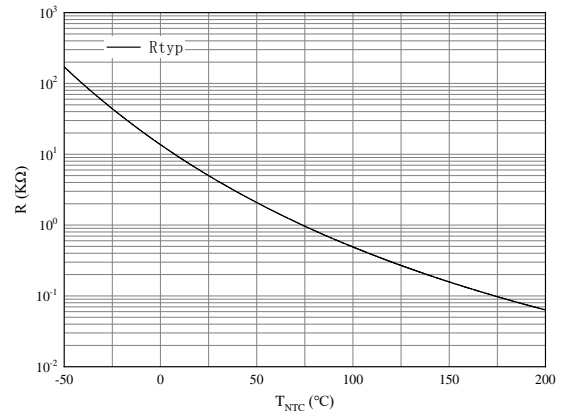
**Fig 7. Switching losses of Diode**  
 $R_{Gon}=2.0\Omega, V_{CE}=600V$



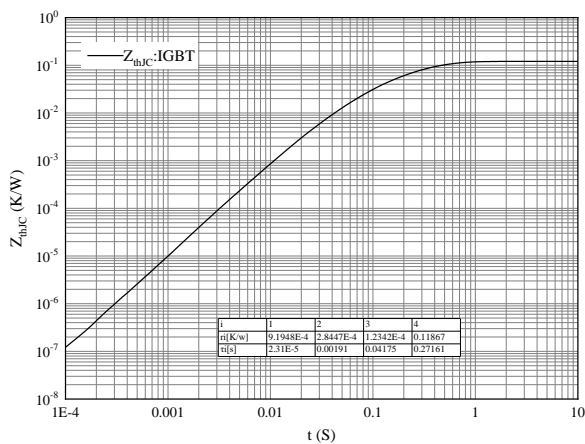
**Fig 8. Switching losses of Diode**  
 $I_C=450A, V_{CE}=600V$



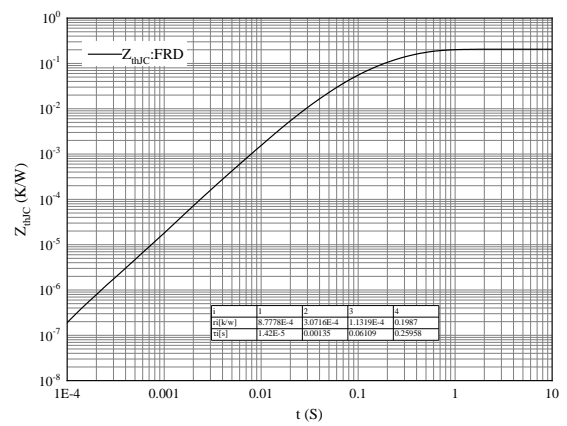
**Fig 9. Capacitance characteristic**



**Fig 10. NTC-Thermistor-temperaturecharacteristic**

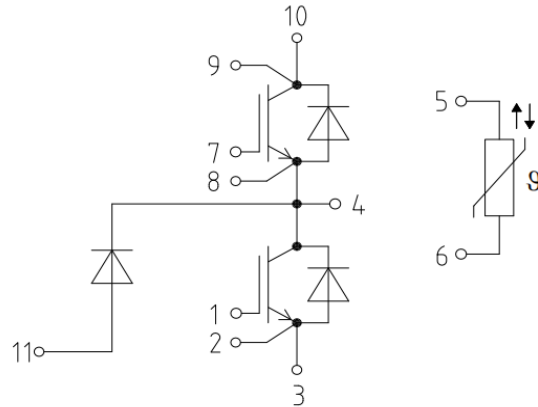


**Fig11. Transient thermal impedance IGBT,Inverter**  
 $Z_{thJC}=f(t)$



**Fig12. Transient thermal impedance FRD ,Inverter**  
 $Z_{thJC}=f(t)$

**Circuit diagram**



**Package outlines**

