

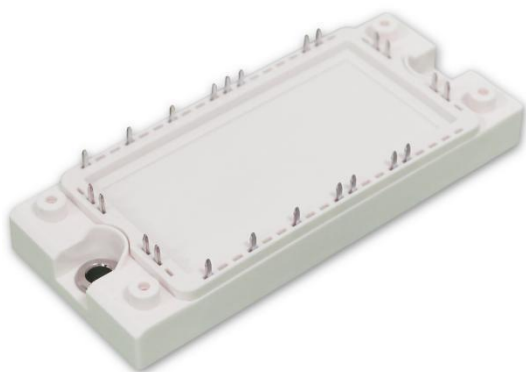
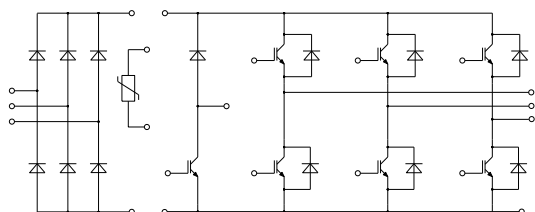
## Features

- Low Switching Losses
- Low  $V_{ce(sat)}$  with Positive Temperature Coefficient
- Including Fast & Soft Recovery Anti-parallel FWD
- Low Inductance Case
- High Short Circuit Capability(10 $\mu$ s)
- Maximum Junction Temperature 175°C
- Epoxy Meets UL 94 V-0 Flammability Rating
- Lead Free Finish/RoHS Compliant ("P" Suffix Designates RoHS Compliant. See Ordering Information)

## Applications

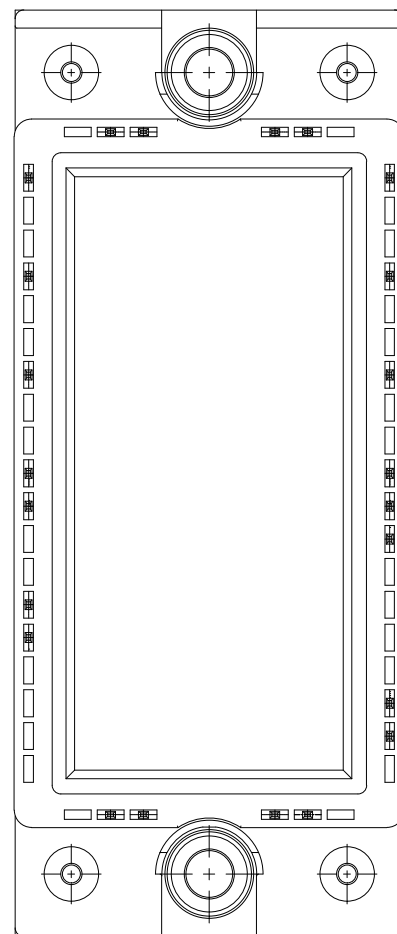
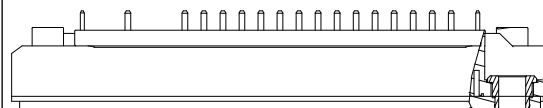
- Motor Drivers
- AC and DC Servo Drive Amplifier
- UPS (Uninterruptible Power Supplies)

## Circuit Diagram



# IGBT Modules 1200V 50A

E1A



● IGBT- Inverter

Maximum Ratings

Parameter	Symbol	Test Conditions	Rating	Unit
Collector-Emitter Voltage	$V_{CES}$	$V_{GE}=0V, I_C=1mA, T_{vj}=25^{\circ}C$	1200	V
Continuous Collector Current	$I_C$	$T_C=100^{\circ}C, T_{vjmax}=175^{\circ}C$	50	A
Repetitive Peak Collector Current	$I_{CRM}$	$t_p=1ms$	100	A
Gate-Emitter Voltage	$V_{GES}$	$T_{vj}=25^{\circ}C$	$\pm 20$	V
Total Power Dissipation	$P_{tot}$	$T_C=25^{\circ}C, T_{vjmax}=175^{\circ}C$	288	W

Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}, I_C=1.7mA, T_{vj}=25^{\circ}C$	5.2	5.8	6.4	V	
Collector-Emitter Cut-off Current	$I_{CES}$	$V_{CE}=1200V, V_{GE}=0V, T_{vj}=25^{\circ}C$			1	mA	
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=50A, V_{GE}=15V, T_{vj}=25^{\circ}C$		1.9	2.3	V	
		$I_C=50A, V_{GE}=15V, T_{vj}=125^{\circ}C$		2.2		V	
		$I_C=50A, V_{GE}=15V, T_{vj}=150^{\circ}C$		2.3		V	
Gate Charge	$Q_g$			0.35		$\mu C$	
Input Capacitance	$C_{ies}$	$V_{CE}=25V, V_{GE}=0V, f=1MHz$		2.6		nF	
Reverse Transfer Capacitance	$C_{res}$			0.1			
Internal Gate Resistance	$R_{gint}$			5		$\Omega$	
Gate-Emitter leakage current	$I_{GES}$	$V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$			400	nA	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE}=600V, I_C=50A, V_{GE}=\pm 15V, R_G=15\Omega, T_{vj}=25^{\circ}C$		168		ns	
Rise Time	$t_r$			34			
Turn-Off Delay Time	$t_{d(off)}$			320			
Fall Time	$t_f$			78			
Turn-On Energy	$E_{on}$			5.42			mJ
Turn-Off Energy	$E_{off}$			4.15			
Turn-On Delay Time	$t_{d(on)}$	$V_{CE}=600V, I_C=50A, V_{GE}=\pm 15V, R_G=15\Omega, T_{vj}=125^{\circ}C$		175		ns	
Rise Time	$t_r$			42			
Turn-Off Delay Time	$t_{d(off)}$			426			
Fall Time	$t_f$			148			
Turn-On Energy	$E_{on}$			7.26			mJ
Turn-Off Energy	$E_{off}$			5.8			
SC Data	$I_{SC}$	$T_p \leq 10\mu s, V_{GE}=15V, T_{vj}=150^{\circ}C, V_{CC}=900V, V_{CEM} \leq 1200V$		260		A	

## ● Diode- Inverter

### Maximum Ratings

Parameter	Symbol	Test Conditions	Rating	Unit
Repetitive Peak Reverse Voltage	$V_{RRM}$	$T_{vj}=25^{\circ}C$	1200	V
Continuous DC Forward Current	$I_F$		50	A
Repetitive Peak Forward Current	$I_{FRM}$	$t_p=1ms$	100	A
$I^2t$ -value	$I^2t$	$V_R=0, t_p=10ms, T_{vj}=125^{\circ}C$	560	A <sup>2</sup> s
		$V_R=0, t_p=10ms, T_{vj}=150^{\circ}C$	480	

### Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Forward Voltage	$V_F$	$I_F=50A, T_{vj}=25^{\circ}C$		2.1	2.5	V
		$I_F=50A, T_{vj}=125^{\circ}C$		2.15		V
		$I_F=50A, T_{vj}=150^{\circ}C$		2.15		V
Recovered Charge	$Q_{rr}$	$I_F=50A, V_R=600V,$ $-di_F/dt=1500A/\mu s, T_{vj}=25^{\circ}C$		5.8		$\mu C$
Peak Reverse Recovery Current	$I_{rr}$			56		A
Reverse Recovery Energy	$E_{rec}$			1.85		mJ
Recovered Charge	$Q_{rr}$	$I_F=50A, V_R=600V,$ $-di_F/dt=1500A/\mu s, T_{vj}=125^{\circ}C$		9.1		$\mu C$
Peak Reverse Recovery Current	$I_{rr}$			58		A
Reverse Recovery Energy	$E_{rec}$			3.3		mJ

## ● IGBT- Brake-chopper

### Maximum Ratings

Parameter	Symbol	Test Conditions	Rating	Unit
Collector-Emitter Voltage	$V_{CES}$	$V_{GE}=0V, I_C=1mA, T_{vj}=25^{\circ}C$	1200	V
Continuous Collector Current	$I_C$	$T_C=100^{\circ}C, T_{vjmax}=175^{\circ}C$	25	A
Repetitive Peak Collector Current	$I_{CRM}$	$t_p=1ms$	50	A
Gate-Emitter Voltage	$V_{GES}$	$T_{vj}=25^{\circ}C$	$\pm 20$	V
Total Power Dissipation	$P_{tot}$	$T_C=25^{\circ}C, T_{vjmax}=175^{\circ}C$	166	W

### Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit		
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}, I_C=0.8mA, T_{vj}=25^{\circ}C$	5.2	6.0	6.8	V		
Collector-Emitter Cut-off Current	$I_{CES}$	$V_{CE}=1200V, V_{GE}=0V, T_{vj}=25^{\circ}C$			1	mA		
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C=25A, V_{GE}=15V, T_{vj}=25^{\circ}C$		1.9	2.3	V		
		$I_C=25A, V_{GE}=15V, T_{vj}=125^{\circ}C$		2.2		V		
		$I_C=25A, V_{GE}=15V, T_{vj}=150^{\circ}C$		2.3		V		
Gate Charge	$Q_g$			0.24		$\mu C$		
Input Capacitance	$C_{ies}$	$V_{CE}=25V, V_{GE}=0V, f=1MHz$		1.6		nF		
Reverse Transfer Capacitance	$C_{res}$			0.07				
Gate-Emitter leakage current	$I_{GES}$	$V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$			100	nA		
Turn-On Delay Time	$t_{d(on)}$	$V_{CE}=600V, I_C=25A, V_{GE}=\pm 15V, R_G=18\Omega, T_{vj}=25^{\circ}C$		175		ns		
Rise Time	$t_r$			38				
Turn-Off Delay Time	$t_{d(off)}$			420				
Fall Time	$t_f$			65				
Turn-On Energy	$E_{on}$			1.95			mJ	
Turn-Off Energy	$E_{off}$			1.2				
Turn-On Delay Time	$t_{d(on)}$	$V_{CE}=600V, I_C=25A, V_{GE}=\pm 15V, R_G=18\Omega, T_{vj}=125^{\circ}C$		185		ns		
Rise Time	$t_r$			43				
Turn-Off Delay Time	$t_{d(off)}$			510				
Fall Time	$t_f$			120				
Turn-On Energy	$E_{on}$			2.6			mJ	
Turn-Off Energy	$E_{off}$			2.0				
SC Data	$I_{SC}$		$T_p \leq 10\mu s, V_{GE}=15V, T_{vj}=150^{\circ}C, V_{CC}=900V, V_{CEM} \leq 1200V$		135			A

## ● Diode- Brake-chopper

### Maximum Ratings

Parameter	Symbol	Test Conditions	Rating	Unit
Repetitive Peak Reverse Voltage	$V_{RRM}$	$T_{vj}=25^{\circ}C$	1200	V
Continuous DC Forward Current	$I_F$		15	A
Repetitive Peak Forward Current	$I_{FRM}$	$t_p=1ms$	30	A
$I^2t$ -value	$I^2t$	$V_R=0, t_p=10ms, T_{vj}=125^{\circ}C$	48	$A^2s$
		$V_R=0, t_p=10ms, T_{vj}=150^{\circ}C$	42	

### Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Forward Voltage	$V_F$	$I_F=15A, T_{vj}=25^{\circ}C$		2		V
		$I_F=15A, T_{vj}=125^{\circ}C$		2.1		V
		$I_F=15A, T_{vj}=150^{\circ}C$		2.1		V
Recovered Charge	$Q_{rr}$	$I_F=15A, V_R=600V,$ $-di_F/dt=550A/\mu s, T_{vj}=25^{\circ}C$		1.1		$\mu C$
Peak Reverse Recovery Current	$I_{rr}$			12		A
Reverse Recovery Energy	$E_{rec}$			0.3		mJ
Recovered Charge	$Q_{rr}$	$I_F=15A, V_R=600V,$ $-di_F/dt=550A/\mu s, T_{vj}=125^{\circ}C$		1.9		$\mu C$
Peak Reverse Recovery Current	$I_{rr}$			14		A
Reverse Recovery Energy	$E_{rec}$			0.6		mJ

## ● Diode- Rectifier

### Maximum Ratings

Parameter	Symbol	Test Conditions	Rating	Unit
Repetitive Peak Reverse Voltage	$V_{RRM}$	$T_j=25^{\circ}\text{C}$	1600	V
Average On-state Current 50/60Hz, sine wave	$I_{F(AV)}$	$T_C=100^{\circ}\text{C}$	65	A
Maximum RMS Current at Rectifier Output	$I_{RMSM}$	$T_C=100^{\circ}\text{C}$	110	A
Surge Forward Current	$I_{FSM}$	$V_R=0, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	850	A
$I^2t$ -value	$I^2t$	$V_R=0, t_p=10\text{ms}, T_j=45^{\circ}\text{C}$	3610	$\text{A}^2\text{s}$

### Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Diode Forward Voltage	$V_F$	$I_F=50\text{A}, T_j=150^{\circ}\text{C}$		1		V
Reverse Current	$I_r$	$T_j=125^{\circ}\text{C}, V_R=1600\text{V}$			1.5	mA

## ● NTC-Thermistor

### Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Rated Resistance	$R_{25}$			5		k $\Omega$
Deviation of R100	$\Delta R/R$	$T_C=100, R_{100}=493.3\Omega$	-5		5	%
Power Dissipation	$P_{25}$				20	mW
B-value	$B_{25/50}$	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$		3375		K

● **Module Characteristics**( $T_C=25^{\circ}\text{C}$  unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Isolation voltage	$V_{\text{isol}}$	$t=1\text{min}, f=50\text{Hz}$	2500			V
Maximum Junction Temperature	$T_{\text{jmax}}$	Inverter, brake			175	$^{\circ}\text{C}$
		rectifier			150	
Operating Junction Temperature	$T_{\text{vj op}}$		-40		150	$^{\circ}\text{C}$
Operating Junction Temperature	$T_{\text{stg}}$		-40		125	$^{\circ}\text{C}$
Stray Inductance	$L_{\text{CE}}$			60		nH
Module Lead Resistance , Terminal to Chip	$R_{\text{cc'+EE'}}$	TC=25 $^{\circ}\text{C}$ , per switch		4		m $\Omega$
	$R_{\text{AA'+CC'}}$			3		
Thermal Resistance Junction to Case	$R_{\theta\text{j c}}$	per IGBT-inverter			0.52	K/W
		per Diode-inverter			0.81	
		per IGBT-brake-chopper			0.90	
		per Diode-chopper			1.5	
		per Diode-rectifier			0.75	
Thermal Resistance Case to Sink	$R_{\theta\text{cs}}$	per IGBT-inverter		0.31		K/W
		per Diode-inverter		0.48		
		per IGBT-brake-chopper		0.33		
		per Diode-chopper		0.7		
		per Diode-rectifier		0.36		
		per Module		0.02		
Module-to-Sink Torque	$M_{\text{S}}$		3		6	N·m
Weight of Module	G			180		g

Curve Characteristics

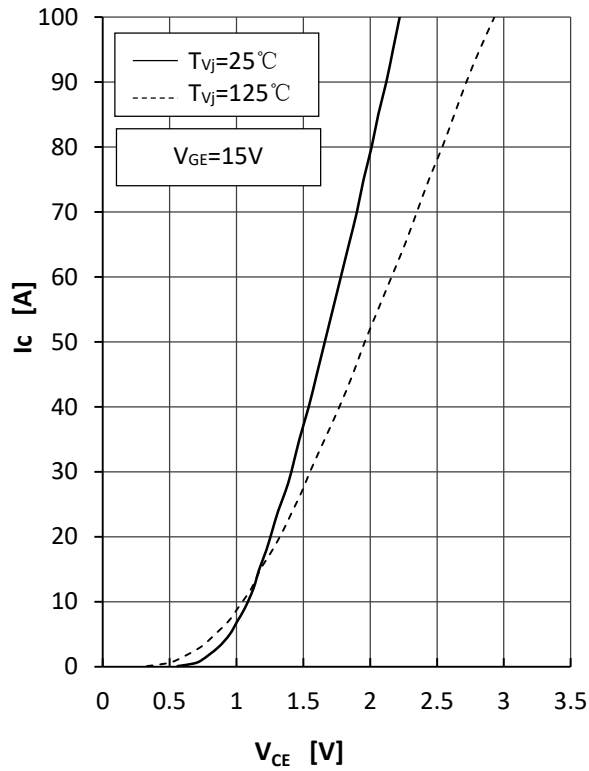


Fig1.IGBT Output Characteristics

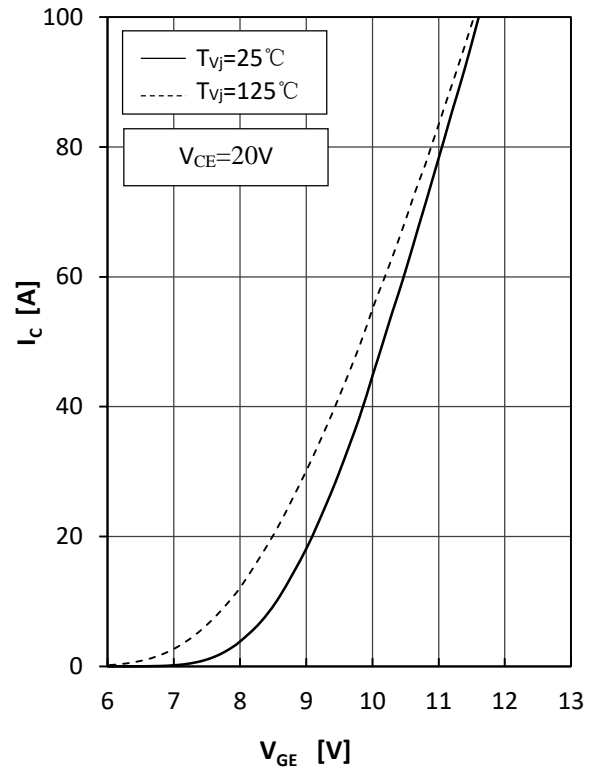


Fig2.IGBT Transfer Characteristics

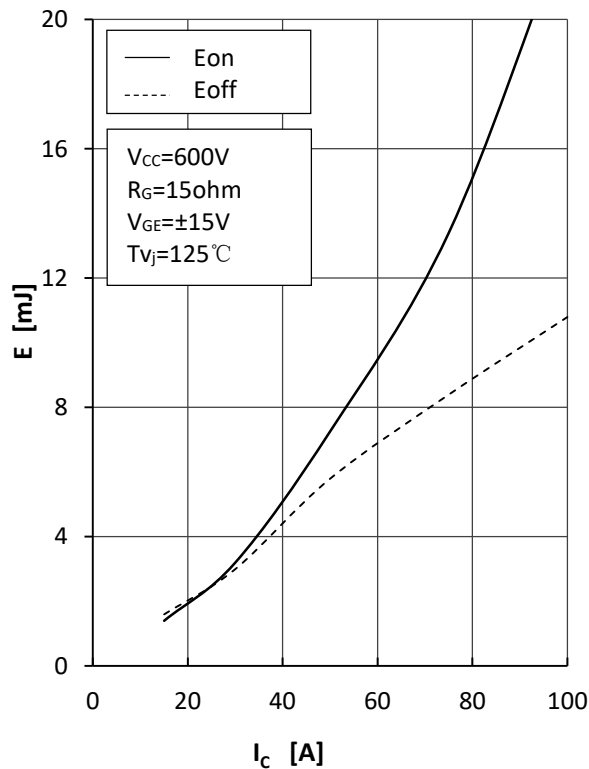


Fig3.IGBT Switching Loss vs.Ic

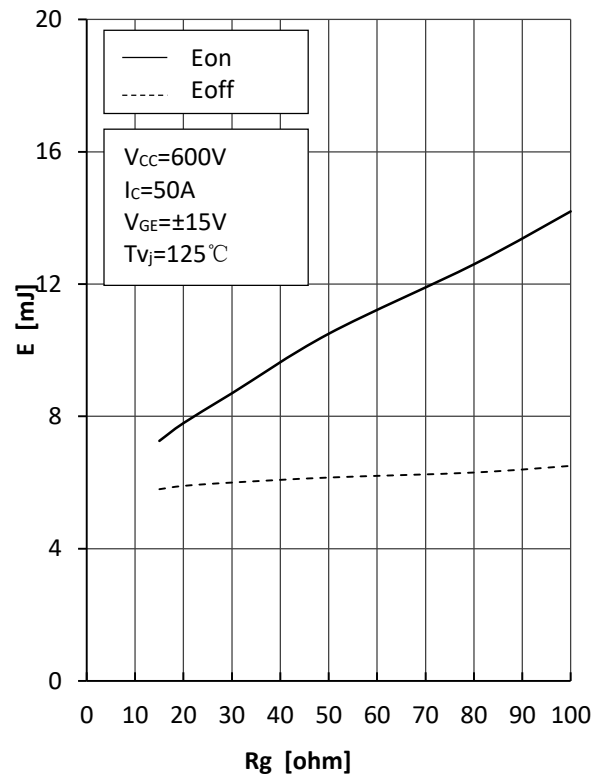
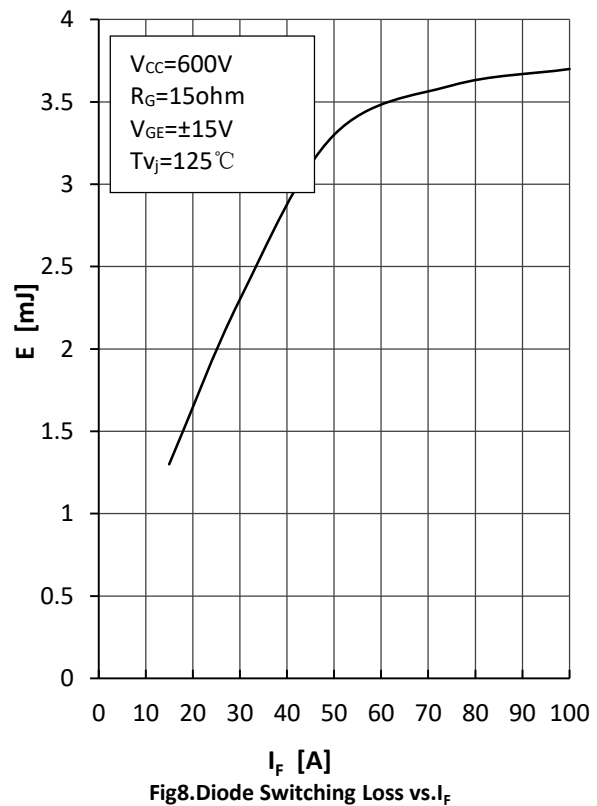
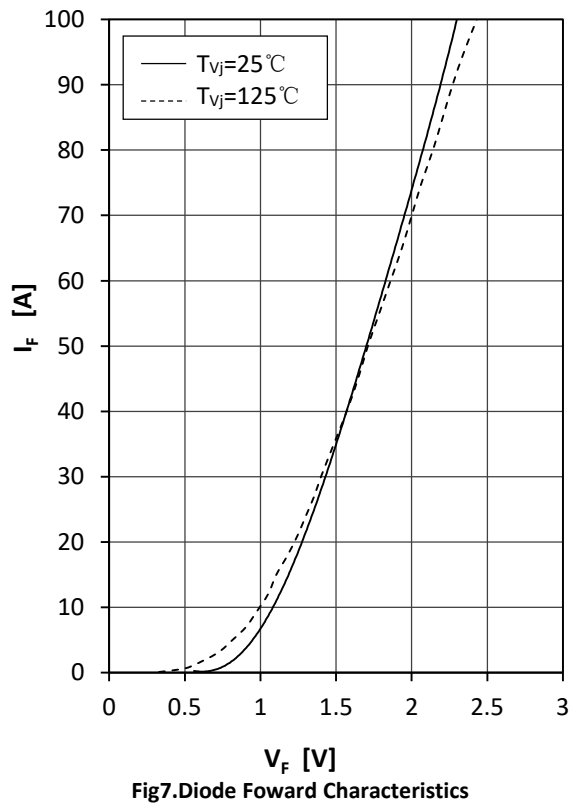
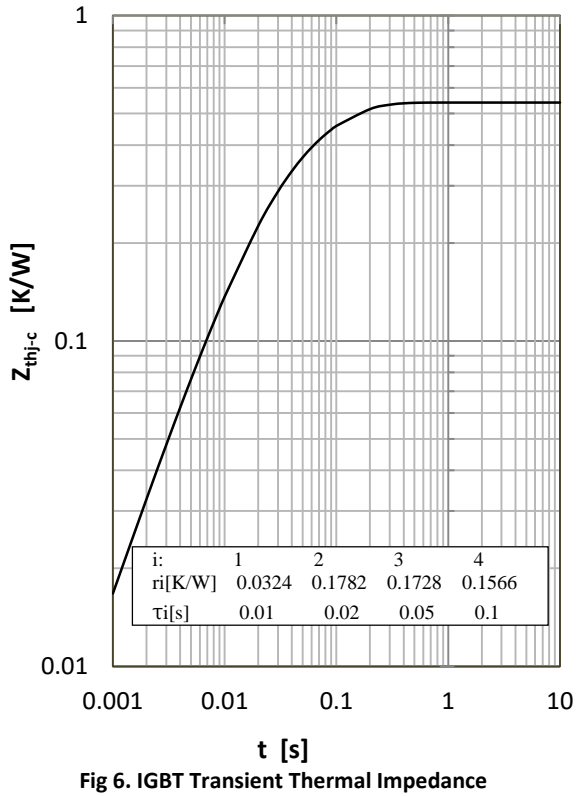
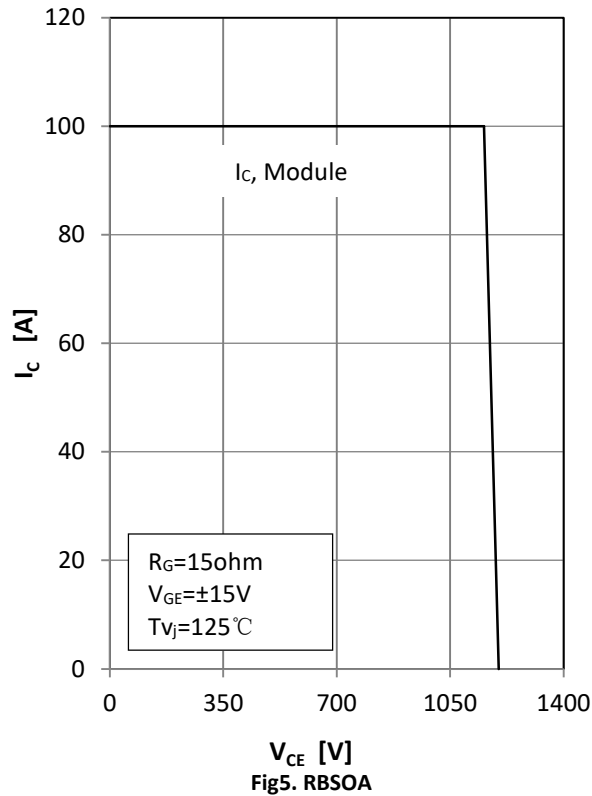


Fig4.IGBT Switching Loss vs.Rg



Curve Characteristics



Curve Characteristics

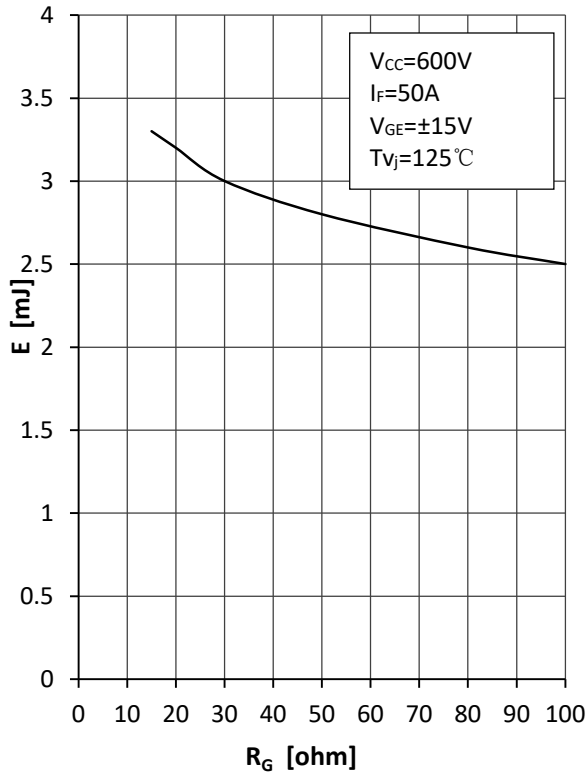


Fig9.Diode Switching Loss vs.Rg

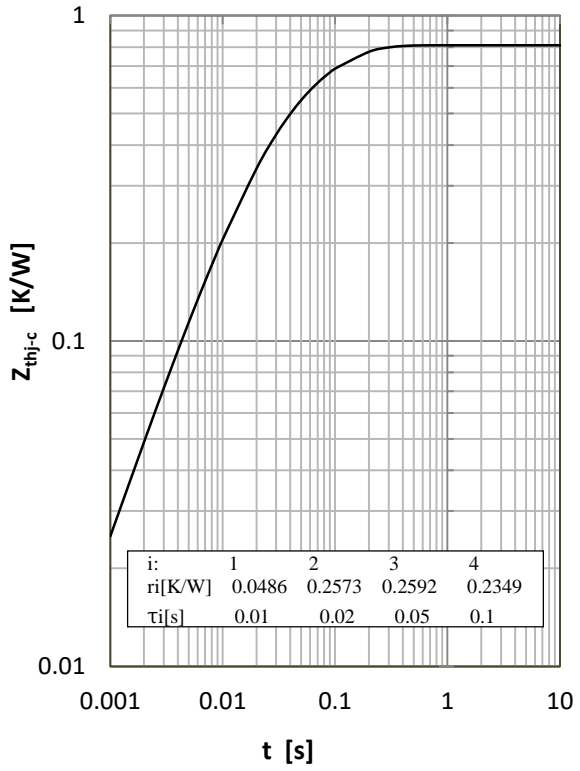


Fig10.Diode Transient Thermal Impedance

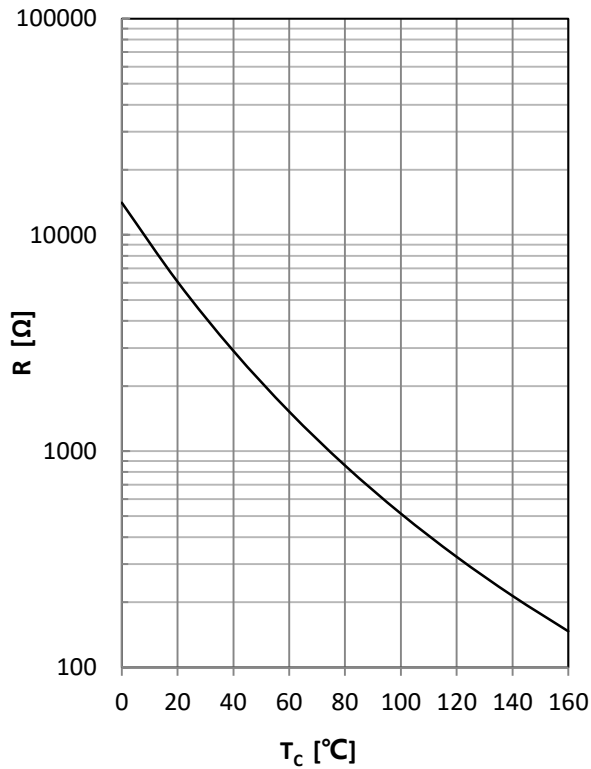
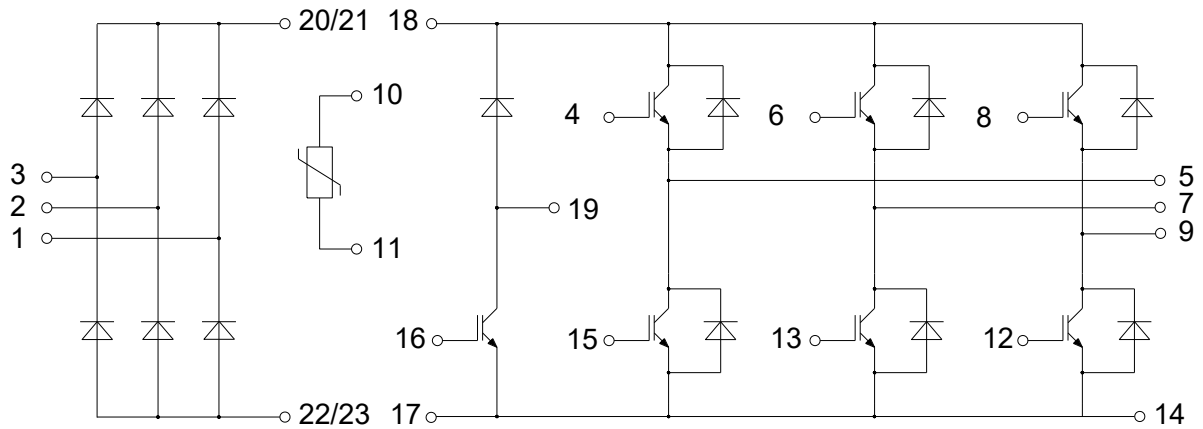


Fig 11. NTC Temperature Characteristic

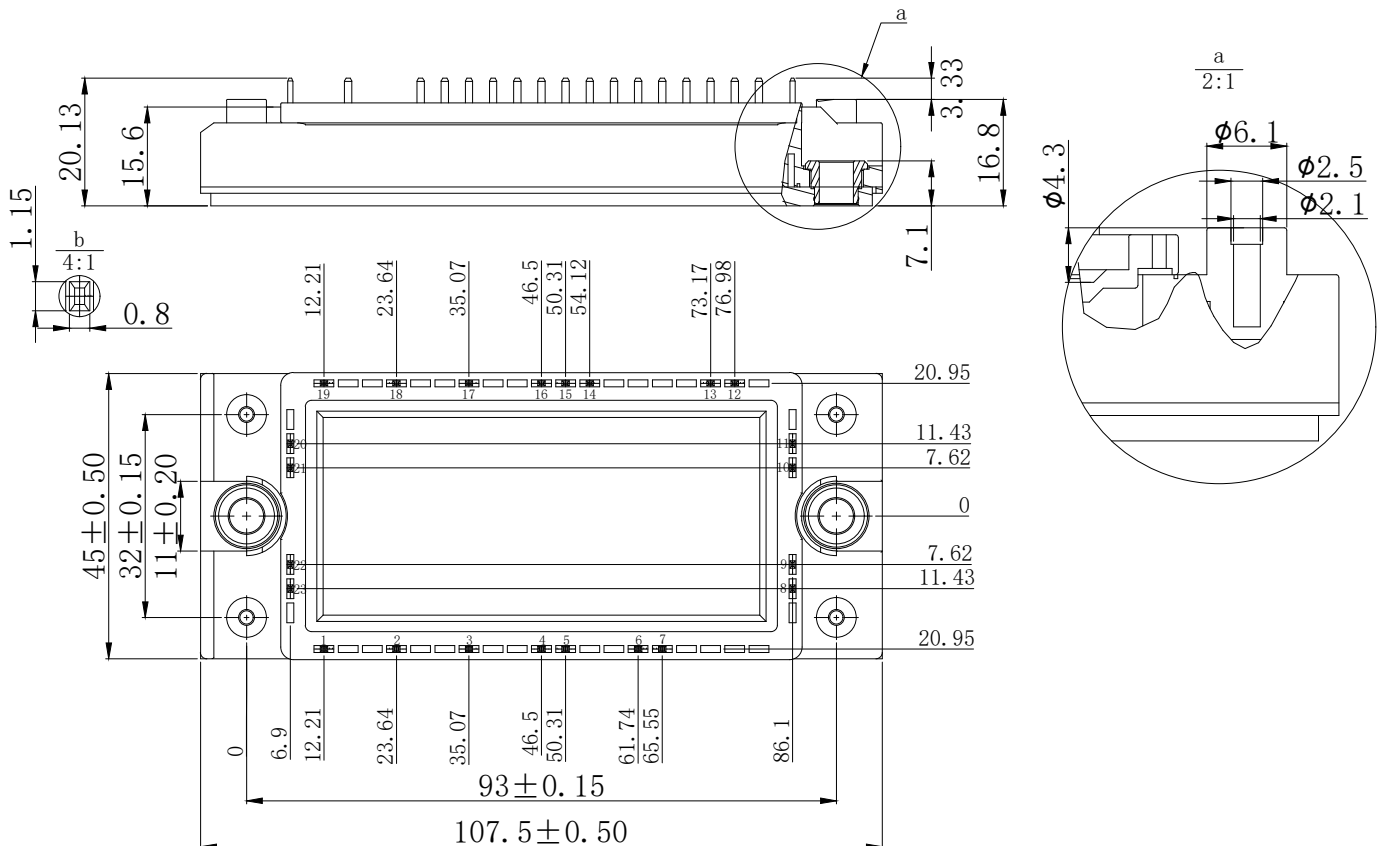
### Circuit Diagram



### Package Dimensions

## E1A

Dimensions in mm



## Ordering Information

Device	Packing
Part Number-BP	Bulk: 10pcs/Box ; 70pcs/Ctn

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