

	<b>E502650</b>
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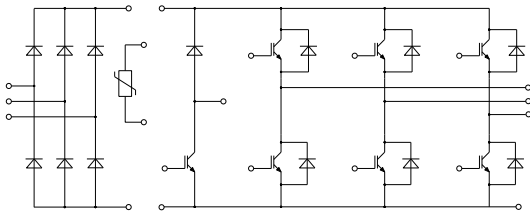
**Features**

- 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 (Note1)("P" Suffix Designates RoHS Compliant. See Ordering Information)

**Applications**

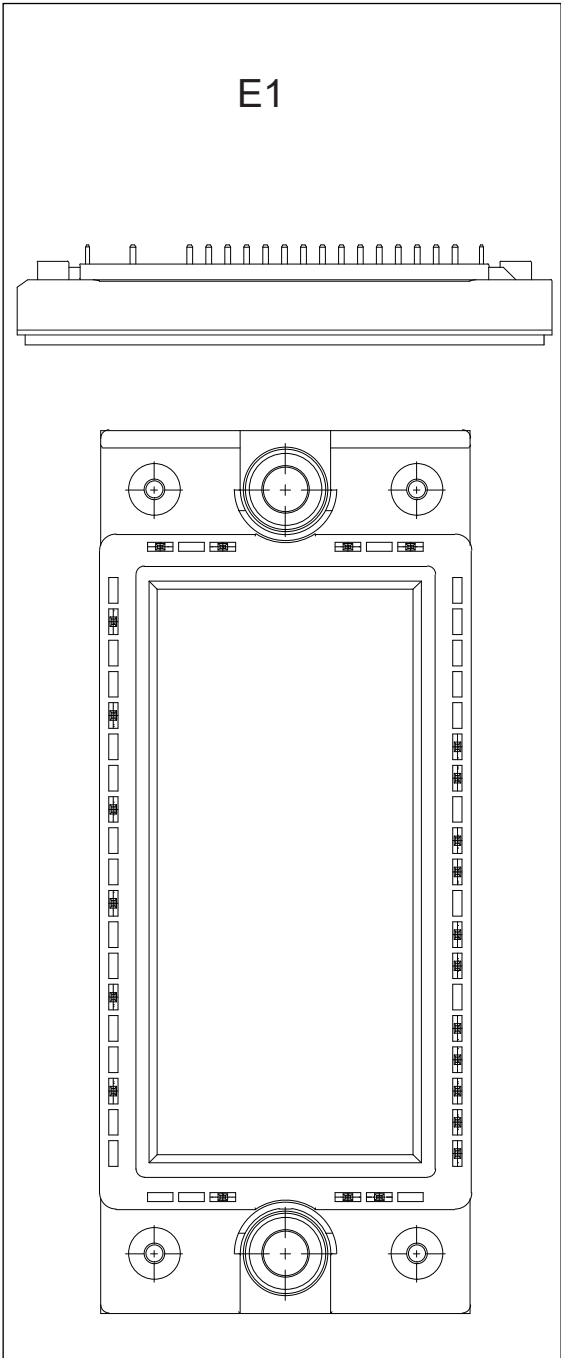
- Motor Drivers
- AC and DC Servo Drive Amplifier
- UPS (Uninterruptible Power Supplies)

**Circuit Diagram**



**Note:**

1. High Temperature Solder Exemptions Applied, see EU Directive Annex 7a.



● 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	$I_C$	$T_C=100^{\circ}C, T_{vjmax}=175^{\circ}C$	15	A
Repetitive Peak Collector Current	$I_{CRM}$	$t_p=1ms$	30	A
Gate-Emitter Voltage	$V_{GES}$	$T_{vj}=25^{\circ}C$	$\pm 20$	V
Total Power Dissipation	$P_{tot}$	$T_C=25^{\circ}C, T_{vjmax}=175^{\circ}C$	142	W

Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}, I_C=0.5mA, T_{vj}=25^{\circ}C$	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	$V_{CE(sat)}$	$I_C=15A, V_{GE}=15V, T_{vj}=25^{\circ}C$		1.85	2.20	V	
		$I_C=15A, V_{GE}=15V, T_{vj}=125^{\circ}C$		2.15		V	
		$I_C=15A, V_{GE}=15V, T_{vj}=150^{\circ}C$		2.25		V	
Gate Charge	$Q_G$			0.15		$\mu C$	
Input Capacitance	$C_{ies}$	$V_{CE}=25V, V_{GE}=0V, f=1MHz, T_{vj}=25^{\circ}C$		1.1		nF	
Reverse Transfer Capacitance	$C_{res}$			0.04			
Gate-Emitter leakage current	$I_{GES}$	$V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$			400	nA	
Turn-On Delay Time	$t_{d(on)}$	$V_{CE}=600V, I_C=15A, V_{GE}=\pm 15V, R_G=39\Omega, T_{vj}=25^{\circ}C$		90		ns	
Rise Time	$t_r$			64			
Turn-Off Delay Time	$t_{d(off)}$			180			
Fall Time	$t_f$			135			
Turn-on Time	$E_{on}$			1.42			mJ
Turn-off Time	$E_{off}$			0.78			
Turn-On Delay Time	$t_{d(on)}$	$V_{CE}=600V, I_C=15A, V_{GE}=\pm 15V, R_G=39\Omega, T_{vj}=125^{\circ}C$		95		ns	
Rise Time	$t_r$			70			
Turn-Off Delay Time	$t_{d(off)}$			260			
Fall Time	$t_f$			180			
Turn-On Energy	$E_{on}$			1.85			mJ
Turn-Off Energy	$E_{off}$			1.13			
SC Data	$I_{SC}$	$t_p \leq 10\mu s, V_{GE}=15V, T_{vj}=150^{\circ}C, V_{CC}=900V, V_{CEM} \leq 1200V$		55		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	$I_F$		15	A
Repetitive Peak Forward Current	$I_{FRM}$	$t_p=1ms$	30	A
$I^2t$ -value	$I^2t$	$V_R=0, t_p=10ms, T_{vj}=125^{\circ}C$	16	$A^2s$
		$V_R=0, t_p=10ms, T_{vj}=150^{\circ}C$	14	

### Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Forward Voltage	$V_F$	$I_F=15A, T_{vj}=25^{\circ}C$		2.00	2.65	V
		$I_F=15A, T_{vj}=125^{\circ}C$		1.75		
		$I_F=15A, T_{vj}=150^{\circ}C$		1.70		
Recovered Charge	$Q_{rr}$	$I_F=15A, V_R=600V,$ $-di_F/dt=600A/\mu s, T_{vj}=25^{\circ}C$		1.20		$\mu C$
Peak Reverse Recovery Current	$I_{rr}$			13.0		A
Reverse Recovery Energy	$E_{rec}$			0.37		mJ
Recovered Charge	$Q_{rr}$	$I_F=15A, V_R=600V,$ $-di_F/dt=600A/\mu s, T_{vj}=125^{\circ}C$		2.05		$\mu C$
Peak Reverse Recovery Current	$I_{rr}$			12		A
Reverse Recovery Energy	$E_{rec}$			0.68		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	$I_C$	$T_C=100^{\circ}C, T_{vjmax}=175^{\circ}C$	15	A
Repetitive Peak Collector Current	$I_{CRM}$	$t_p=1ms$	30	A
Gate-Emitter Voltage	$V_{GES}$	$T_{vj}=25^{\circ}C$	$\pm 20$	V
Total Power Dissipation	$P_{tot}$	$T_C=25^{\circ}C, T_{vjmax}=175^{\circ}C$	155	W

### Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}, I_C=0.5mA, T_{vj}=25^{\circ}C$	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	$V_{CE(sat)}$	$I_C=15A, V_{GE}=15V, T_{vj}=25^{\circ}C$		1.85	2.25	V
		$I_C=15A, V_{GE}=15V, T_{vj}=125^{\circ}C$		2.15		V
		$I_C=15A, V_{GE}=15V, T_{vj}=150^{\circ}C$		2.25		V
Gate Charge	$Q_G$			0.09		$\mu C$
Input Capacitance	$C_{ies}$	$V_{CE}=25V, V_{GE}=0V, f=1MHz, T_{vj}=25^{\circ}C$		1.35		nF
Reverse Transfer Capacitance	$C_{res}$			0.08		
Gate-Emitter leakage current	$I_{GES}$	$V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$			400	nA
Turn-On Delay Time	$t_{d(on)}$	$V_{CE}=600V, I_C=15A, V_{GE}=\pm 15V, R_G=39\Omega, T_{vj}=25^{\circ}C$		46		ns
Rise Time	$t_r$			45		
Turn-Off Delay Time	$t_{d(off)}$			182		
Fall Time	$t_f$			168		
Turn-On Energy	$E_{on}$			0.92		
Turn-Off Energy	$E_{off}$		0.56			
Turn-On Delay Time	$t_{d(on)}$	$V_{CE}=600V, I_C=15A, V_{GE}=\pm 15V, R_G=39\Omega, T_{vj}=125^{\circ}C$		46		ns
Rise Time	$t_r$			63		
Turn-Off Delay Time	$t_{d(off)}$			248		
Fall Time	$t_f$			220		
Turn-On Energy	$E_{on}$			1.37		
Turn-Off Energy	$E_{off}$		0.81			
SC Data	$I_{SC}$	$t_p \leq 10\mu s, V_{GE}=15V, T_{vj}=150^{\circ}C, V_{CC}=900V, V_{CEM} \leq 1200V$		55		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	$I_F$		10	A
Repetitive Peak Forward Current	$I_{FRM}$	$t_p=1ms$	20	A
$I^2t$ -value	$I^2t$	$V_R=0, t_p=10ms, T_{vj}=125^{\circ}C$	16.0	$A^2s$
		$V_R=0, t_p=10ms, T_{vj}=150^{\circ}C$	14	

### Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Forward Voltage	$V_F$	$I_F=10A, T_{vj}=25^{\circ}C$		2.0	2.5	V
		$I_F=10A, T_{vj}=125^{\circ}C$		1.8		V
		$I_F=10A, T_{vj}=150^{\circ}C$		1.75		V
Recovered Charge	$Q_{rr}$	$I_F=10A, V_R=600V,$ $-di_F/dt=500A/\mu s, T_{vj}=25^{\circ}C$		0.9		$\mu C$
Peak Reverse Recovery Current	$I_{rr}$			12.5		A
Reverse Recovery Energy	$E_{rec}$			0.25		mJ
Recovered Charge	$Q_{rr}$	$I_F=10A, V_R=600V,$ $-di_F/dt=500A/\mu s, T_{vj}=125^{\circ}C$		1.7		$\mu C$
Peak Reverse Recovery Current	$I_{rr}$			10.4		A
Reverse Recovery Energy	$E_{rec}$			0.50		mJ

## ● Diode- Rectifier

### Maximum Ratings

Parameter	Symbol	Test Conditions	Value	Unit
Repetitive Peak Reverse Voltage	$V_{RRM}$	$T_{vj}=25^{\circ}C$	1600	V
Average output Current 50/60Hz, sine wave	$I_{F(AV)}$	$T_c=100^{\circ}C$	20	A
Maximum RMS Current at Rectifier Output	$I_{RMSM}$	$T_c=100^{\circ}C$	40	A
Surge Forward Current	$I_{FSM}$	$V_R=0, t_p=10ms, T_{vj}=45^{\circ}C$	270	A
$I^2t$ -value	$I^2t$	$V_R=0, t_p=10ms, T_{vj}=45^{\circ}C$	360	$A^2s$

### Electrical Characteristics

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Diode Forward Voltage	$V_F$	$I_F=15A, T_{vj}=150^{\circ}C$		0.96		V
Reverse Current	$I_R$	$T_j=150^{\circ}C, V_R=1600V$			1.0	mA

## ● NTC-Thermistor

### Electrical Characteristics

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

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Isolation voltage	$V_{iso}$	$t=1\text{min}, f=50\text{Hz}$	2500			V
Maximum Junction Temperature	$T_{jmax}$				175	$^\circ\text{C}$
Operating Junction Temperature	$T_{vjop}$		-40		150	$^\circ\text{C}$
Storage Temperature	$T_{stg}$		-40		125	$^\circ\text{C}$
Stray-inductance-module	$L_{SCE}$			60		nH
Module lead resistance, terminals-chip	$R_{cc'+EE'}$	$T_C=25^\circ\text{C}$ , per switch		4		m $\Omega$
	$R_{AA'+CC'}$			3		
Thermal Resistance Junction to Case	$R_{\theta JC}$	per IGBT-inverter			1.15	K/W
		per Diode-inverter			1.50	
		per IGBT-brake-copper			1.15	
		per Diode-chopper			2.39	
		per Diode-rectifier			1.13	
Thermal Resistance Case-to Sink	$R_{\theta CS}$	per IGBT-inverter		0.41		K/W
		per Diode-inverter		0.51		
		per IGBT-brake-copper		0.51		
		per Diode-chopper		0.77		
		per Diode-rectifier		1.02		
		per Module		0.02		
Mounting Force Per Clamp	F		3		6	N
Weight of Module	G			180		g

## Curve Characteristics

Fig1.IGBT Output Characteristics

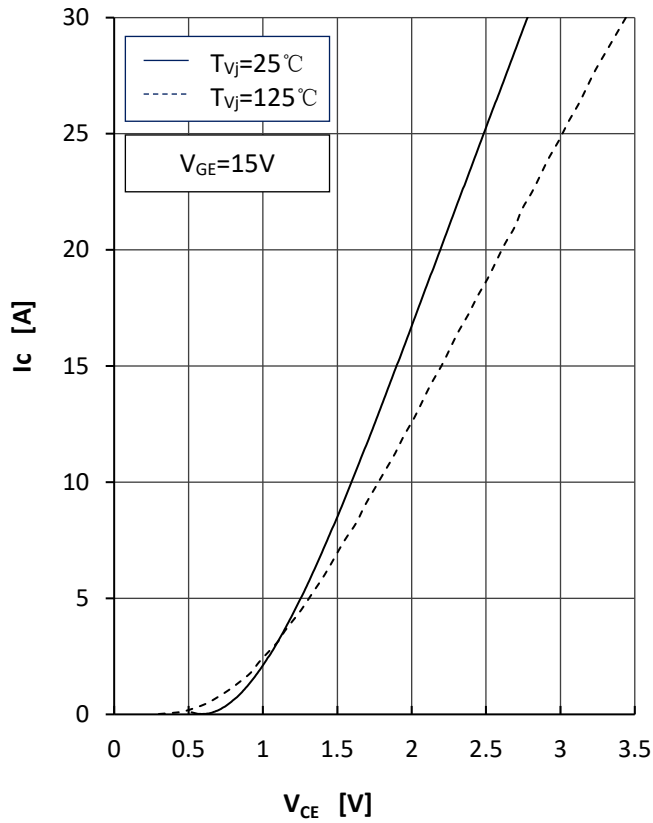


Fig2.IGBT Transfer Characteristics

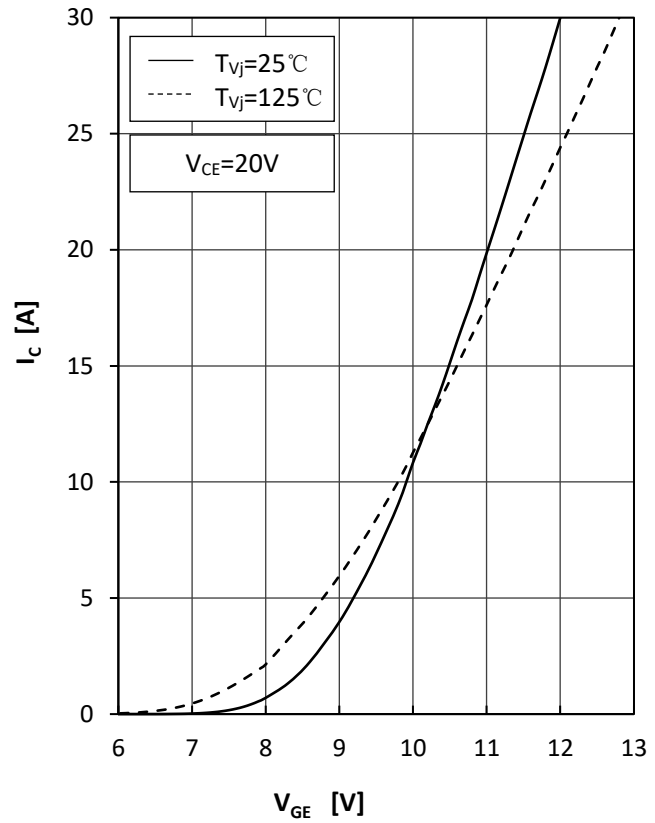


Fig3.IGBT Switching Loss vs.Ic

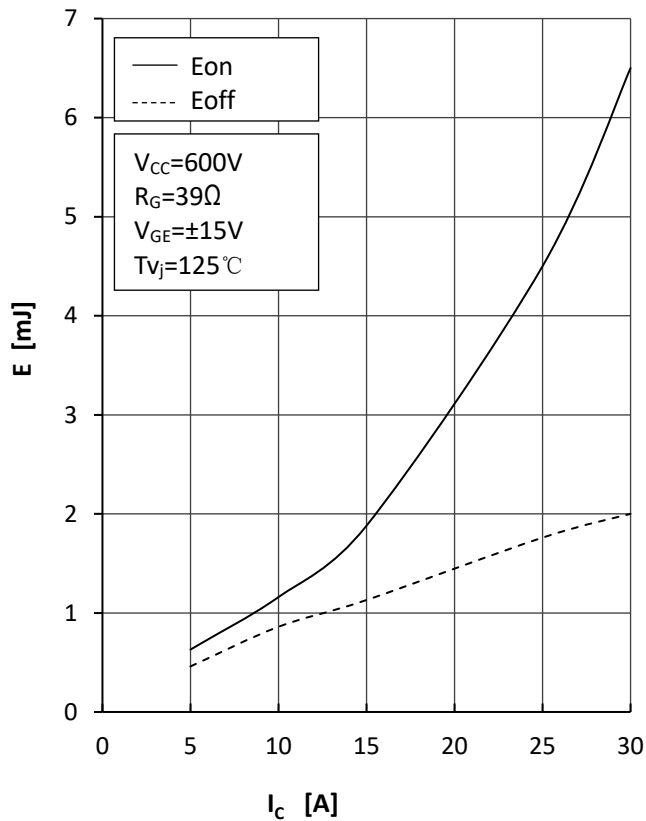
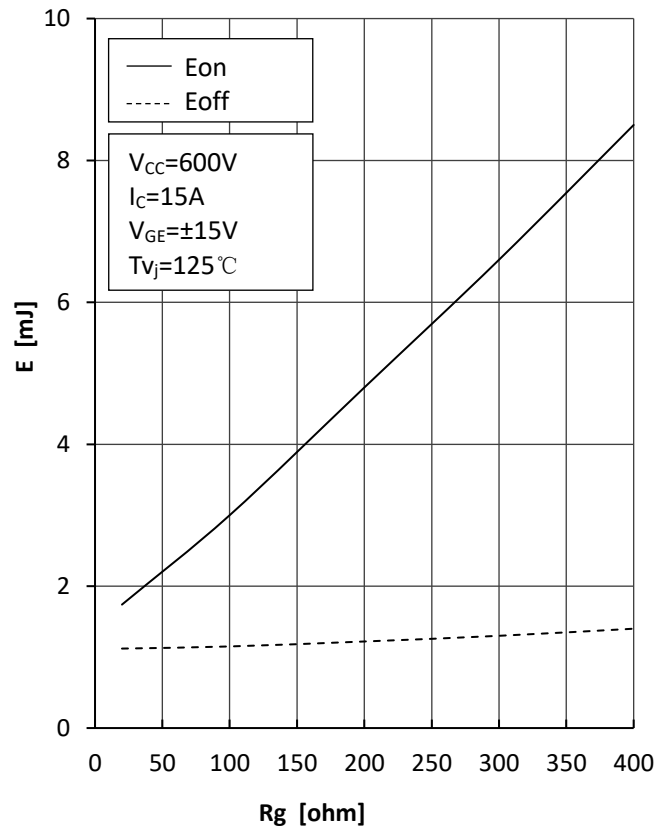


Fig4.IGBT Switching Loss vs.Rg





Curve Characteristics

Fig5. RBSOA

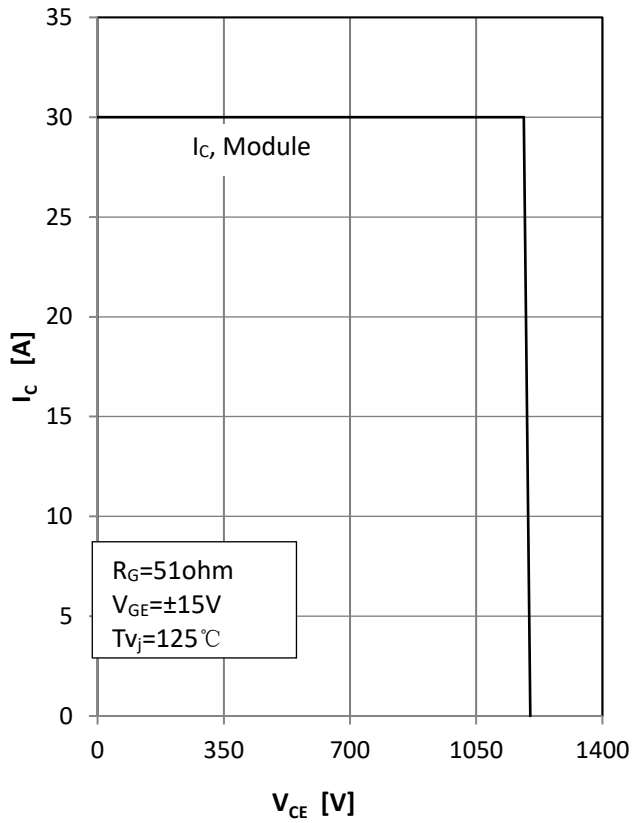


Fig 6. IGBT-invertere Transient Thermal Impedance

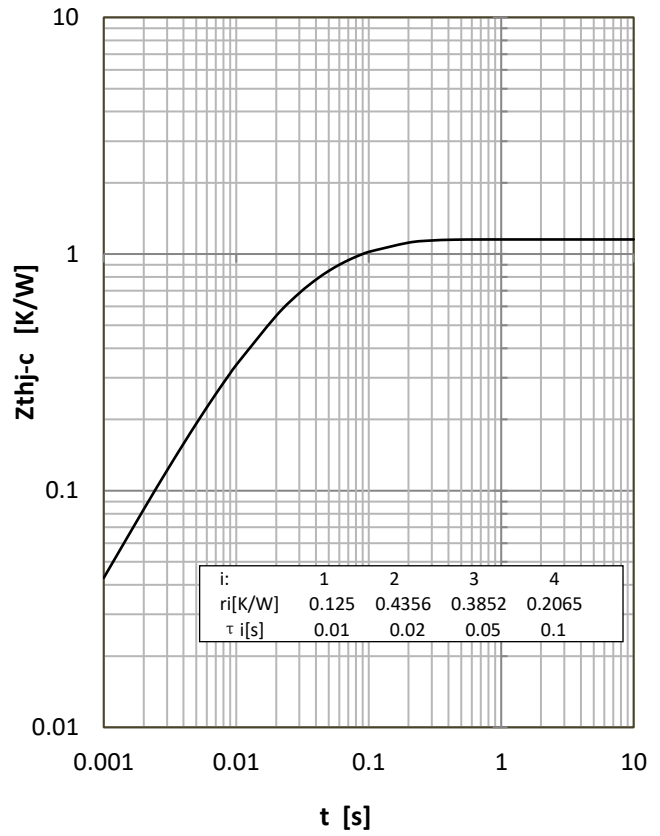


Fig7.Diode Foward Characteristics

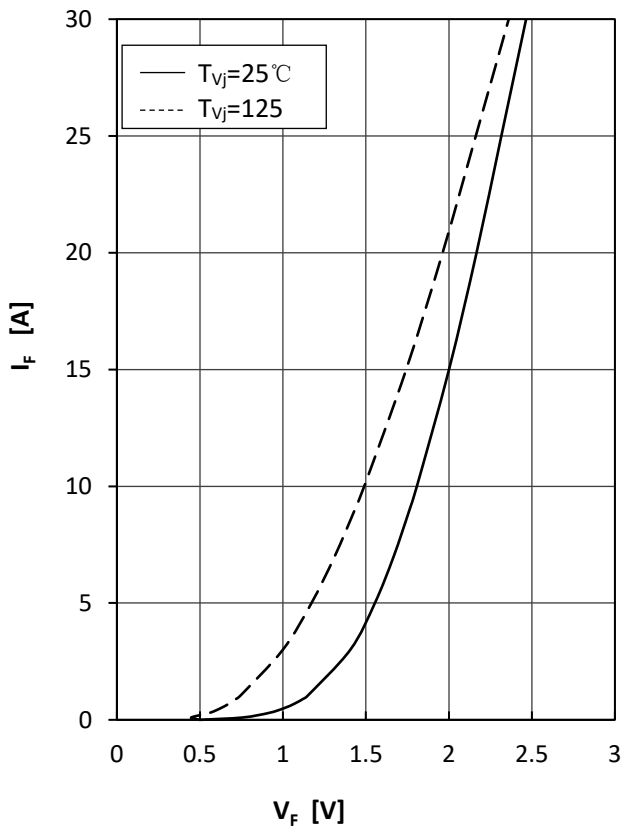
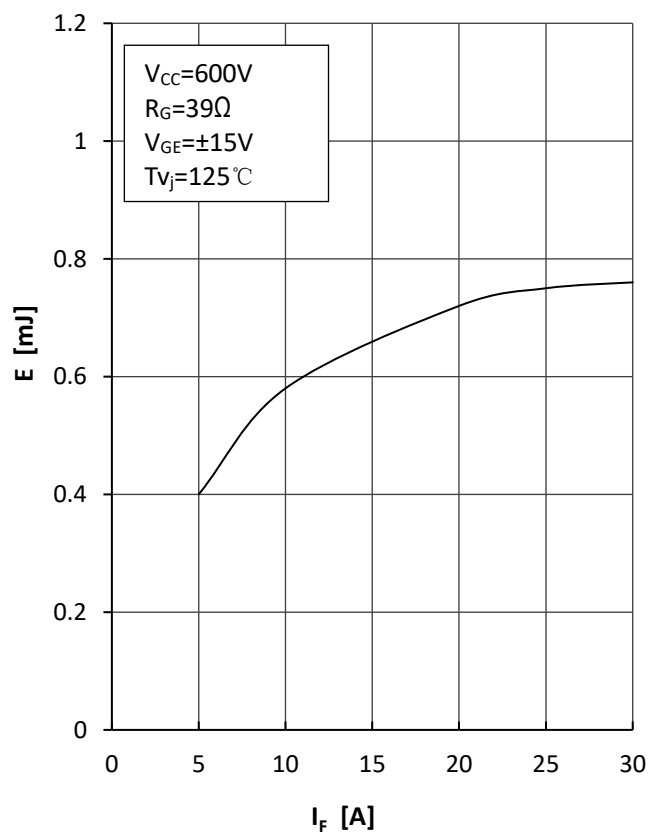


Fig8.Diode Switching Loss(Erec) vs.If



## Curve Characteristics

Fig9. Diode Switching Loss (E<sub>rec</sub>) vs. R<sub>G</sub>

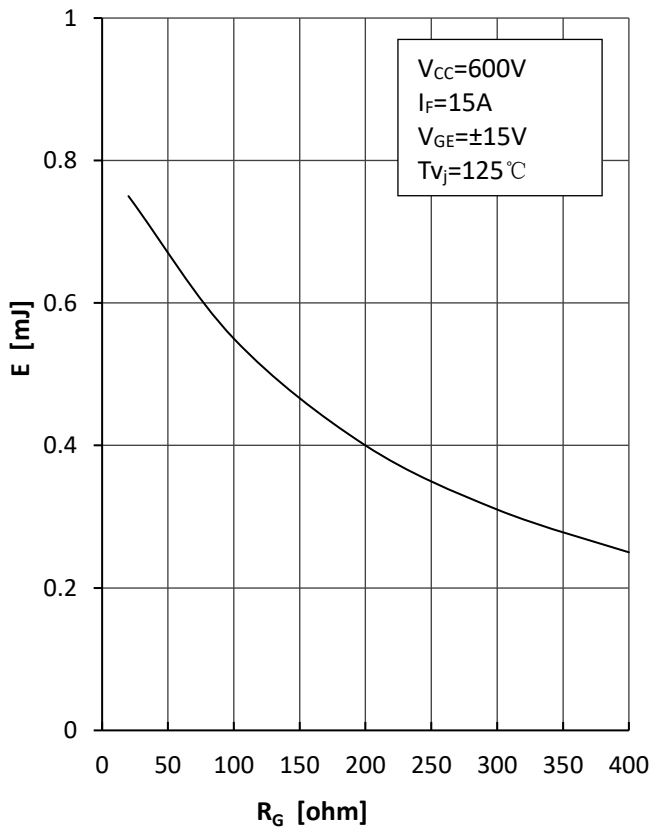


Fig10. Diode Transient Thermal Impedance

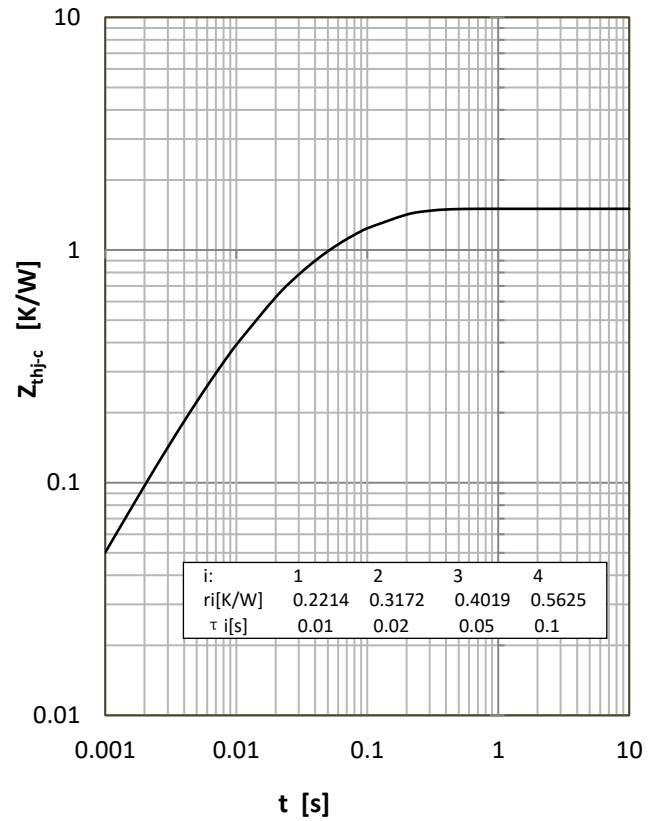


Fig 11. NTC Temperature Characteristic

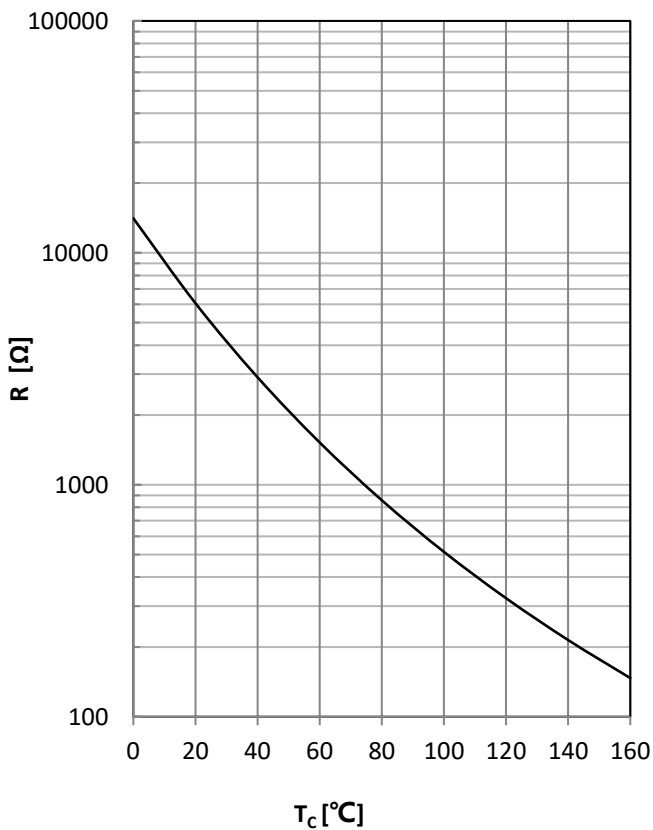
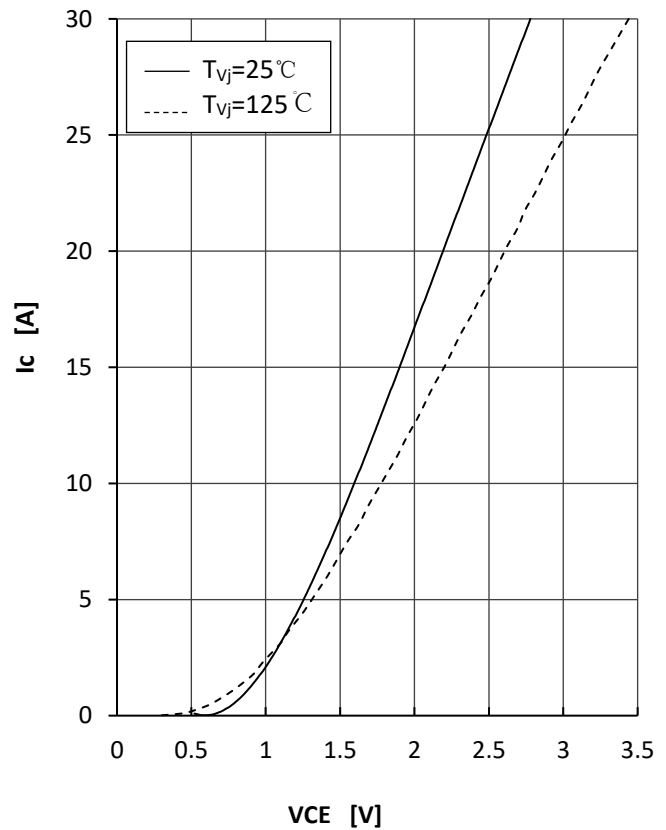
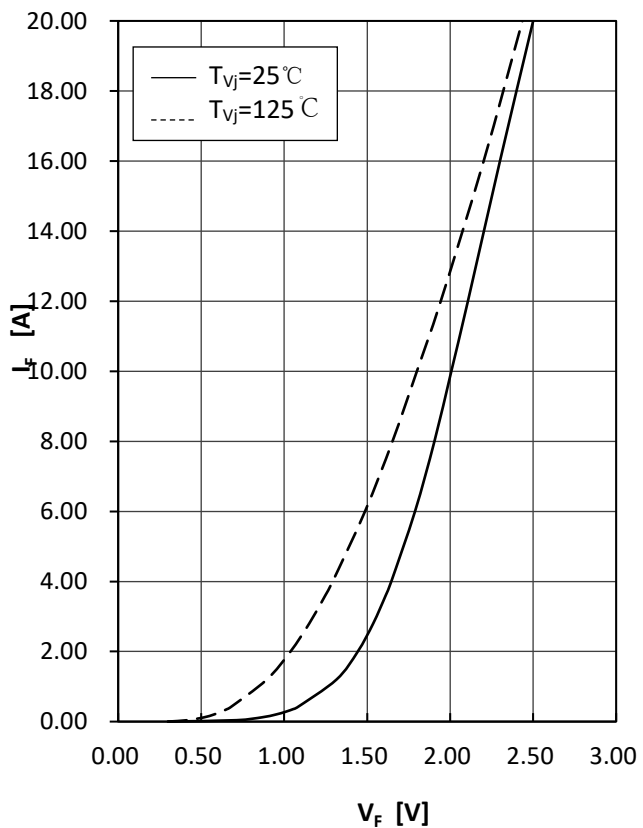


Fig12. IGBT-brake-Chopper output Characteristics

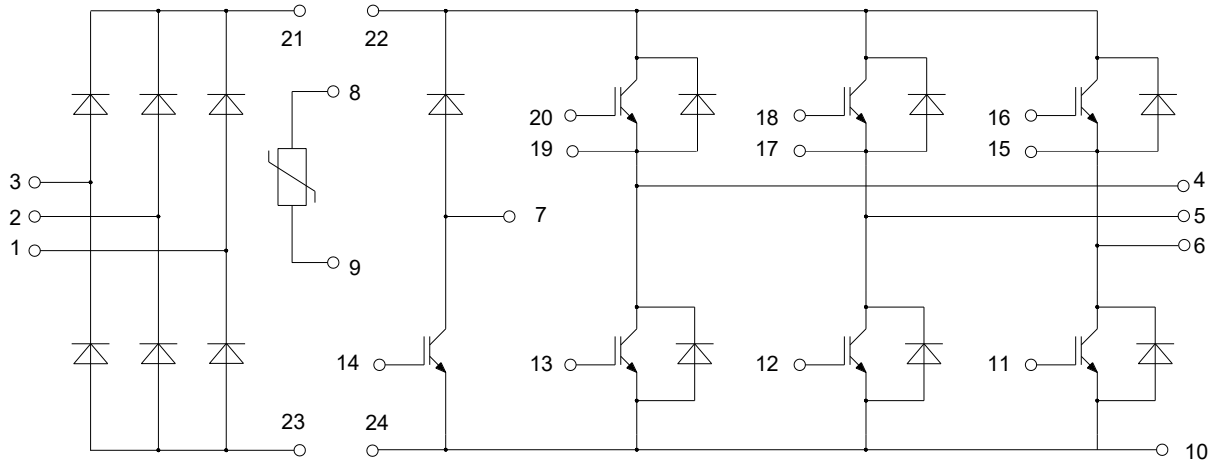


## Curve Characteristics

Fig13.Diode-brake-chopper Foward Characteristics

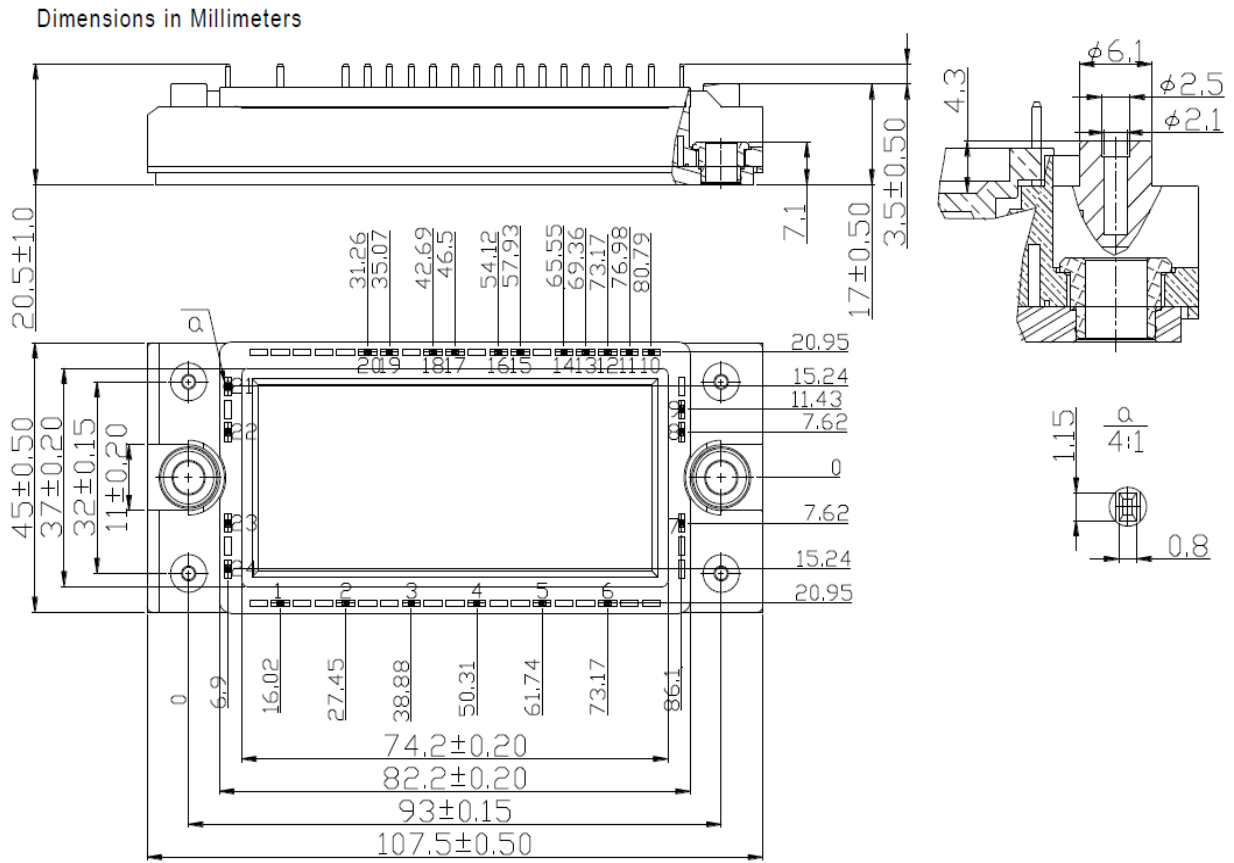


### Circuit Diagram



### Package Dimensions

**E1**



## Ordering Information

Device	Packing
Part Number-BP	Bulk: 8pcs/Box ; 48pcs/Ctn

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