

## 50A 1200V PIM in one-package

### 1 Description

These Insulated Gate Bipolar Transistor used advanced trench and Fieldstop technology design, provided excellent  $V_{CEsat}$  and switching speed ,low gate charge. Which accords with the RoHS standard.

### 2 Features

- Low gate charge
- Excellent switching speed
- Easy paralleling capability due to positive temperature Coefficient in  $V_{CEsat}$
- $Tsc \geq 10\mu s$
- Fast recovery full current anti-parallel diode
- Low  $V_{CEsat}$

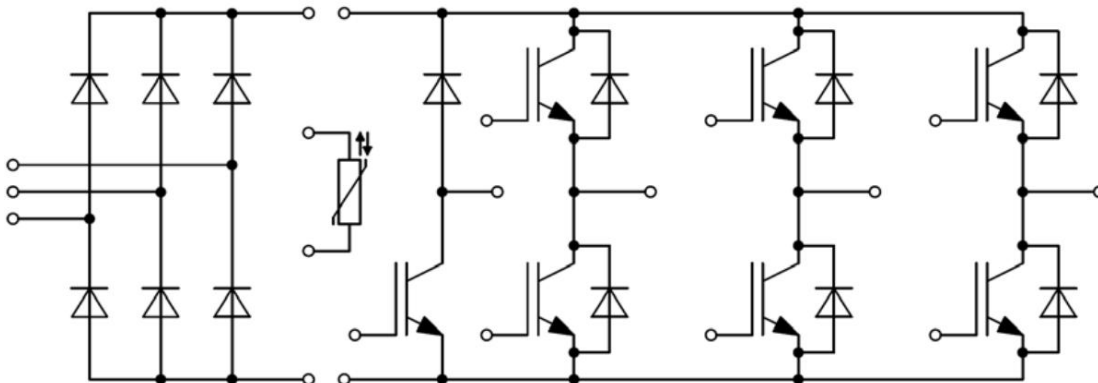
### 3 Applications

- Welding
- UPS
- Three-level Inverter
- AC and DC servo drive amplifier



Type	$V_{CE}$	$I_c$	$V_{CEsat}, T_j=25^\circ C$	$T_{jop}$	Package
DGC50C120M2T	1200V	50A ( $T_j=100^\circ C$ )	1.85V (Typ)	150°C	Econo PIM2

### 4 Equivalent Circuit Schematic



## 5 Electrical Characteristics

### 5.1 Absolute Maximum Ratings (IGBT-inverter) (Tc=25°C, unless otherwise specified)

Parameter	Symbol	Value	Units
Collector-to-Emitter Voltage	V <sub>CE</sub>	1200	V
Gate-to-Emitter Voltage	V <sub>GE</sub>	±30	V
DC Collector current	I <sub>C</sub>	T <sub>J</sub> =25°C	100
		T <sub>J</sub> =100°C	50
Pulsed Collector Current #1	I <sub>CM</sub>	200	A
Maximum Power Dissipation @Tc=25°C	P <sub>D</sub>	568	W
Short circuit withstand time, V <sub>GE</sub> =15V, V <sub>CC</sub> =600V, Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s T <sub>J</sub> =150°C	T <sub>SC</sub>	10	μs

### 5.2 Absolute Maximum Ratings (IGBT-brake) (Tc=25°C, unless otherwise specified)

Parameter	Symbol	Value	Units
Collector-to-Emitter Voltage	V <sub>CE</sub>	1200	V
Gate-to-Emitter Voltage	V <sub>GE</sub>	±30	V
DC Collector current	I <sub>C</sub>	T <sub>J</sub> =25°C	50
		T <sub>J</sub> =100°C	25
Pulsed Collector Current #1	I <sub>CM</sub>	100	A
Maximum Power Dissipation @Tc=25°C	P <sub>D</sub>	211	W
Short circuit withstand time, V <sub>GE</sub> =15V, V <sub>CC</sub> =600V, Allowed number of short circuits < 1000 Time between short circuits: ≥ 1.0s T <sub>J</sub> =150°C	T <sub>SC</sub>	2	μs

Notes: #1 Pulse duration is limited by T<sub>J,max</sub>

### 5.3 Absolute Maximum Ratings (Diode-inverter) (Tc=25°C, unless otherwise specified)

PARAMETER	SYMBOL	VALUE	UNIT
Peak Repetitive Reverse Voltage	V <sub>RRM</sub>	1200	V
DC Blocking Voltage	V <sub>R</sub>	1200	V
Average Rectified Forward Current	I <sub>F(AV)</sub>	40	A
Repetitive Peak Surge Current	I <sub>FRM</sub>	60	A
Nonrepetitive Peak Surge Current(single)	tp=8.3ms I <sub>FSM</sub>	400	A

### 5.4 Absolute Maximum Ratings (Diode-rectifier) (Tc=25°C, unless otherwise specified)

PARAMETER	SYMBOL	VALUE	UNIT
Peak Repetitive Reverse Voltage	V <sub>RRM</sub>	1600	V
Reverse does not repeat peak voltage	I <sub>RRM</sub> =5μA V <sub>RSM</sub>	2000	V
Average Rectified Forward Current	I <sub>F(AV)</sub>	25	A
Nonrepetitive Peak Surge Current(single)	tp=10ms I <sub>FSM</sub>	320	A
I <sup>2</sup> t-value	tp=10ms, sin 180° I <sup>2</sup> t	512	A <sup>2</sup> s

**5.5 Absolute Maximum Ratings (Diode-brake) (Tc=25°C, unless otherwise specified)**

PARAMETER		SYMBOL	VALUE	UNIT
Peak Repetitive Reverse Voltage		$V_{RRM}$	1200	V
DC Blocking Voltage		$V_R$	1200	V
Average Rectified Forward Current		$I_{F(AV)}$	20	A
Repetitive Peak Surge Current		$I_{FRM}$	30	A
Nonrepetitive Peak Surge Current(single)	tp=8.3ms	$I_{FSM}$	300	A

**5.6 IGBT Module**

Parameter	Symbol	VALUE	Units
Junction Temperature Range(inverter/brake)	$T_{jmax}$	-45~175	°C
Junction Temperature Range(Diode-rectifier)	$T_{jmax}$	-45~150	°C
Operating Junction Temperature(Module)	$T_{jop}$	-45~150	°C
Storage Temperature Range	$T_{stg}$	-45~150	°C
Isolation Voltage $R_{MS}, f=50Hz, t=1min$	$V_{ISO}$	2500	V

**5.7 Thermal Characteristics (IGBT Module)**

Parameter		Symbol	Rating	Units
IGBT Thermal Resistance Junction to Case	inverter	$R_{thJC}$	0.42	°C/W
	brake		0.57	
Diode Thermal Resistance Junction to Case-sink	inverter	$R_{thJC}$	1.05	°C/W
	brake		1.1	
	rectifier		0.85	

**5.8 Electrical Characteristics (IGBT-inverter) (Tc=25°C, unless otherwise specified)**

Parameter	Symbol	Conditions	Value			Units
			Min	Typ	Max	
<b>Static Characteristics</b>						
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CES}$	$I_C=250\mu A, V_{GE}=0V, T_j=25^\circ C$	1200	--	--	V
Collector-to-Emitter Leakage Current	$I_{CES}$	$V_{CE}=1200V, V_{GE}=0V, T_j=25^\circ C$	--	--	5.0	$\mu A$
		$V_{CE}=1200V, V_{GE}=0V, T_j=150^\circ C$	--	--	1.0	mA
Gate-to-Emitter Leakage Current	$I_{GES}$	$V_{GE}=\pm 30V, V_{CE}=0V, T_j=25^\circ C$	--	--	$\pm 100$	nA
		$V_{GE}=\pm 30V, V_{CE}=0V, T_j=150^\circ C$	--	--	$\pm 200$	nA
Gate Threshold Voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}, I_C=250\mu A$	4.5	5.5	6.5	V
Collector-emitter saturation voltage		$V_{GE}=15V, I_C=50A, T_j=25^\circ C$	--	1.85	2.25	V
		$V_{GE}=15V, I_C=50A, T_j=150^\circ C$	--	2.15	--	V
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{CE}=25V, V_{GE}=0V, f=1MHz, T_a=25^\circ C$	--	6483	--	pF
Output Capacitance	$C_{oss}$		--	187	--	
Reverse Transfer Capacitance	$C_{rss}$		--	39	--	
<b>IGBT Characteristics</b>						
Turn-on delay time	$t_{d(on)}$	$V_{CE}=600V, I_C=50A, R_G=10\Omega, V_{GE}=15V, \text{感性负载}, T_C=25^\circ C$	--	40	--	nS
Rise time	$t_r$		--	36	--	nS
Turn-off delay time	$t_{d(off)}$		--	372	--	nS

Fall time	$t_f$	$V_{CE}=600V, I_C=50A,$ $R_G=10\Omega, V_{GE}=15V,$ 感性负载, $T_C=150^\circ C$	--	114	--	nS	
Turn-on energy	$E_{on}$		--	0.94	--	mJ	
Turn-off energy	$E_{off}$		--	2.53	--	mJ	
Total switching energy	$E_{ts}$		--	3.47	--	mJ	
Turn-on delay time	$t_{d(on)}$		--	34	--	nS	
Rise time	$t_r$		--	36	--	nS	
Turn-off delay time	$t_{d(off)}$		--	448	--	nS	
Fall time	$t_f$		--	238	--	nS	
Turn-on energy	$E_{on}$		--	1.1	--	mJ	
Turn-off energy	$E_{off}$		--	3.38	--	mJ	
Total switching energy	$E_{ts}$		--	4.48	--	mJ	
Gate charge	$Q_G$		$V_{CE}=600V, I_C=40A, V_{GE}=15V$	--	329	--	nC

### 5.9 Electrical Characteristics (IGBT-brake) ( $T_C=25^\circ C$ , unless otherwise specified)

Parameter	Symbol	Conditions	Value			Units
			Min	Typ	Max	
<b>Static Characteristics</b>						
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CES}$	$I_C=250\mu A, V_{GE}=0V, T_J=25^\circ C$	1200	--	--	V
Collector-to-Emitter Leakage Current	$I_{CES}$	$V_{CE}=1200V, V_{GE}=0V, T_J=25^\circ C$	--	--	10	$\mu A$
		$V_{CE}=1200V, V_{GE}=0V, T_J=150^\circ C$	--	--	1.0	mA
Gate-to-Emitter Leakage Current	$I_{GES}$	$V_{GE}=\pm 30V, V_{CE}=0V, T_J=25^\circ C$	--	--	$\pm 100$	nA
		$V_{GE}=\pm 30V, V_{CE}=0V, T_J=150^\circ C$	--	--	$\pm 200$	nA
Gate Threshold Voltage	$V_{GE(th)}$	$V_{CE}=V_{GE}, I_C=1mA$	4.5	5.0	6.5	V
Collector-emitter saturation voltage		$V_{GE}=15V, I_C=25A, T_J=25^\circ C$	--	2.1	2.4	V
		$V_{GE}=15V, I_C=25A, T_J=150^\circ C$	--	2.9	--	V
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{CE}=25V, V_{GE}=0V,$ $f=1MHz, T_a=25^\circ C$	--	3640	--	pF
Output Capacitance	$C_{oss}$		--	75	--	
Reverse Transfer Capacitance	$C_{rss}$		--	27	--	
<b>IGBT Characteristics</b>						
Turn-on delay time	$t_{d(on)}$	$V_{CE}=600V, I_C=25A,$ $R_G=10\Omega, V_{GE}=15V,$ 感性负载, $T_C=25^\circ C$	--	23.5	--	nS
Rise time	$t_r$		--	29	--	nS
Turn-off delay time	$t_{d(off)}$		--	135	--	nS
Fall time	$t_f$		--	220	--	nS
Turn-on energy	$E_{on}$		--	0.6	--	mJ
Turn-off energy	$E_{off}$		--	1.1	--	mJ
Total switching energy	$E_{ts}$		--	1.7	--	mJ
Turn-on delay time	$t_{d(on)}$	$V_{CE}=600V, I_C=25A,$ $R_G=10\Omega, V_{GE}=15V,$ 感性负载, $T_C=150^\circ C$	--	22.5	--	nS
Rise time	$t_r$		--	26	--	nS
Turn-off delay time	$t_{d(off)}$		--	164.5	--	nS
Fall time	$t_f$		--	286.5	--	nS
Turn-on energy	$E_{on}$		--	0.7	--	mJ
Turn-off energy	$E_{off}$		--	1.6	--	mJ
Total switching energy	$E_{ts}$		--	2.3	--	mJ
Gate charge	$Q_G$	$V_{CE}=600V, I_C=25A, V_{GE}=15V$	--	116	--	nC

**5.10 Electrical Characteristics (Diode-inverter)(Tc=25°C, unless otherwise specified)**

Parameter	Symbol	Conditions	Value			Units
			Min	Typ	Max	
Diode forward voltage	V <sub>F</sub>	I <sub>F</sub> =40A, T <sub>J</sub> =25°C	--	3.3	4.5	V
		I <sub>F</sub> =40A, T <sub>J</sub> =150°C	--	2.6	3.6	V
Diode reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> =0.5A, I <sub>R</sub> =1.0A, I <sub>rr</sub> =0.25A	--	45	--	ns
Diode reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> =40A,	--	106	--	ns
Diode peak reverse recovery curre	I <sub>rrm</sub>	di/dt=200A/uS,	--	7.8	--	A
Diode reverse recovery charge	Q <sub>rr</sub>	V <sub>R</sub> =400V	--	380	--	nC
Maximum Instantaneous Reverse	I <sub>R</sub>	V <sub>R</sub> = 1200V	--	--	5.0	uA
		V <sub>R</sub> = 1200V, T <sub>C</sub> = 150°C	--	--	1.0	mA

**5.11 Electrical Characteristics (Diode-brake)(Tc=25°C, unless otherwise specified)**

Parameter	Symbol	Conditions	Value			Units
			Min	Typ	Max	
Diode forward voltage	V <sub>F</sub>	I <sub>F</sub> =20A, T <sub>J</sub> =25°C	--	1.8	2.5	V
		I <sub>F</sub> =20A, T <sub>J</sub> =150°C	--	--	1.3	V
Diode reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> =0.5A, I <sub>R</sub> =1.0A, I <sub>rr</sub> =0.25A	--	50	--	ns
Diode reverse recovery time	t <sub>rr</sub>	I <sub>F</sub> =20A,	--	120	--	ns
Diode peak reverse recovery curre	I <sub>rrm</sub>	di/dt=200A/uS,	--	10	--	A
Diode reverse recovery charge	Q <sub>rr</sub>	V <sub>R</sub> =400V	--	700	--	nC
Maximum Instantaneous Reverse	I <sub>R</sub>	V <sub>R</sub> = 1200V	--	--	5.0	uA
		V <sub>R</sub> = 1200V, T <sub>C</sub> = 150°C	--	--	1.0	mA

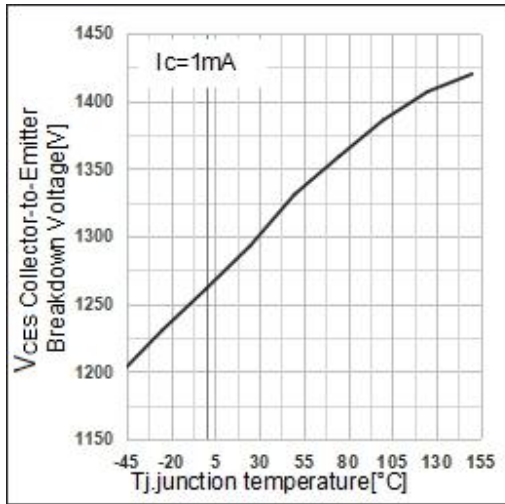
**5.12 Electrical Characteristics (Diode-rectifier)(Tc=25°C, unless otherwise specified)**

Parameter	Symbol	Conditions	Value			Units
			Min	Typ	Max	
Diode forward voltage	V <sub>F</sub>	I <sub>F</sub> =25A, T <sub>J</sub> =25°C	--	0.95	1.2	V
		I <sub>F</sub> =25A, T <sub>J</sub> =150°C	--	0.85	--	V
Maximum Instantaneous Reverse	I <sub>R</sub>	V <sub>R</sub> = 1600V	--	--	5.0	uA
		V <sub>R</sub> = 1600V, T <sub>C</sub> = 150°C	--	--	1.0	mA

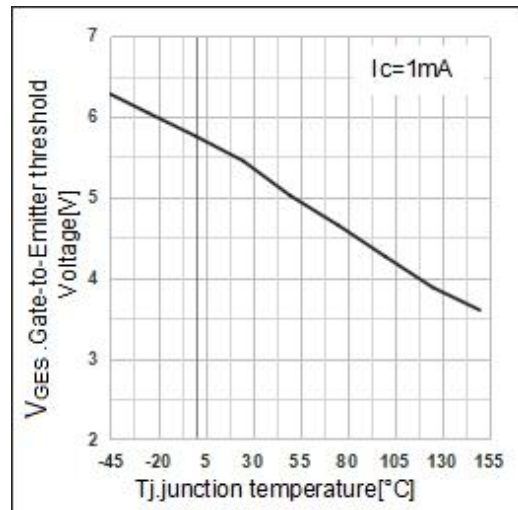
**5.13 Electrical Characteristics (NTC)(Tc=25°C, unless otherwise specified)**

Parameter	Symbol	Conditions	Value	Units
Rated Resistance	R <sub>25°C</sub>	Ta=25±0.05°C Power of	5KΩ±5%	kΩ
B-value	B <sub>25/50</sub>	B=[(Ta×Tb)/(Tb-Ta)]×ln(Ra/Rb)	3380±1%	k
Resistance to insulation	--	100V/DC 1min	≥500	MΩ
Operating Junction Temperatu	T <sub>jop</sub>		-50°C~250°C	°C

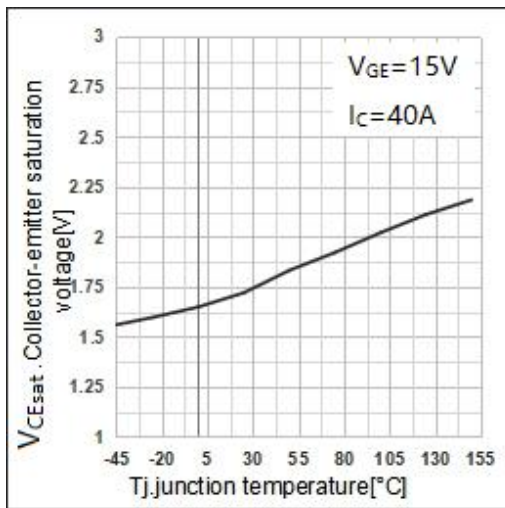
**6 Typical Characteristic Curves**



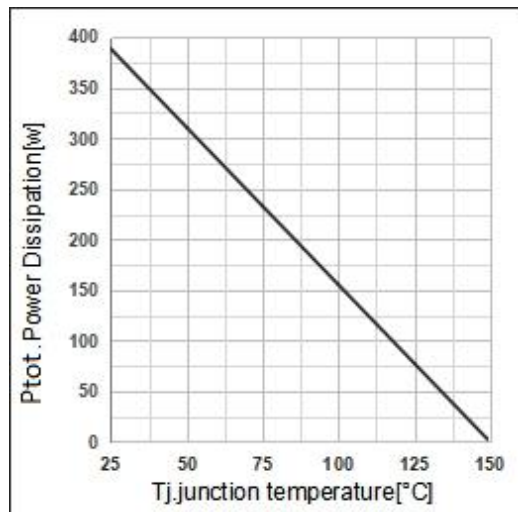
**Fig1. Collector-to-Emitter Breakdown Voltage of temperature characteristic**



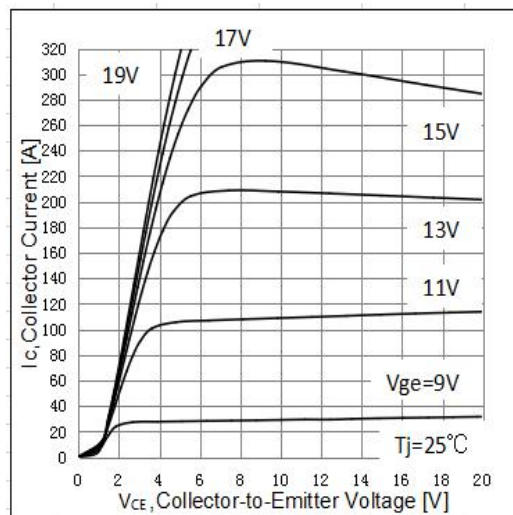
**Fig2. Gate-to-Emitter Threshold Voltage of temperature characteristic**



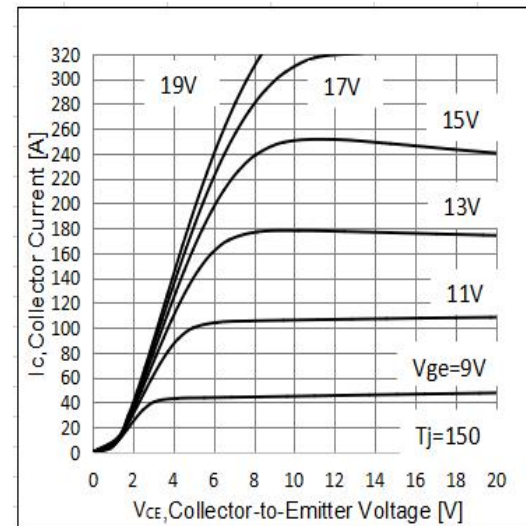
**Fig3. Collector-emitter saturation voltage of temperature characteristic**



**Fig4. Power Dissipation**

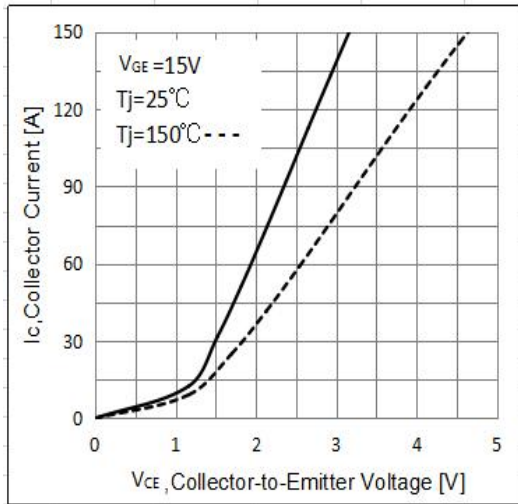


**Fig5. Typical output characteristic**

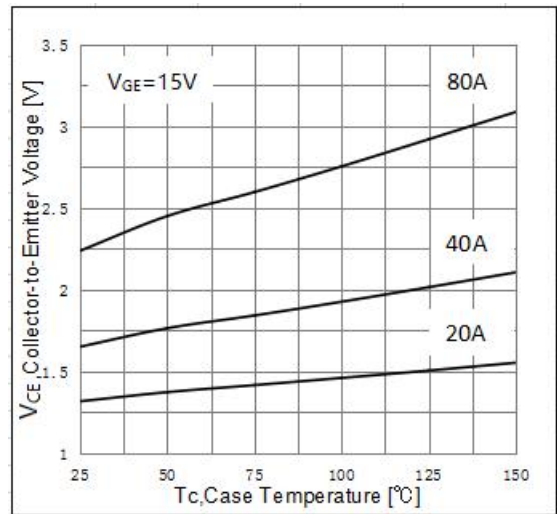


**Fig6. Typical output characteristic**

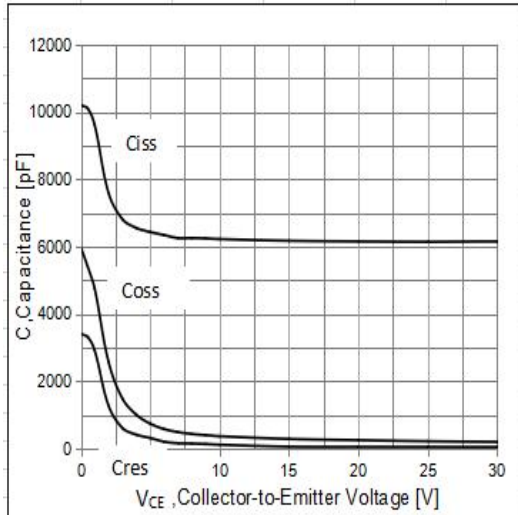




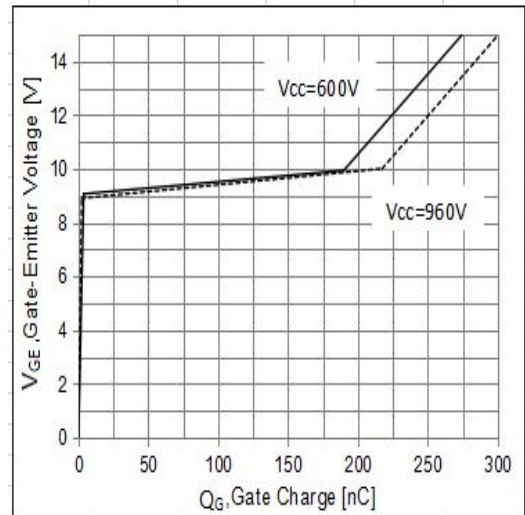
**Fig7. Collector-emitter saturation voltage Characteristic**



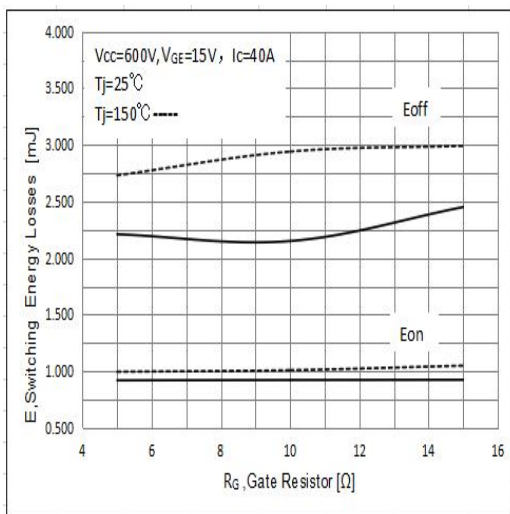
**Fig8. Collector-emitter saturation voltage Temperature Characteristic**



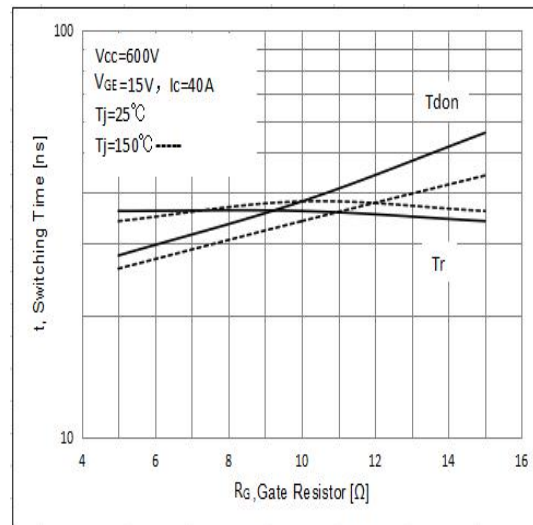
**Fig9. Typical capacitance as a function of collector-emitter voltage**



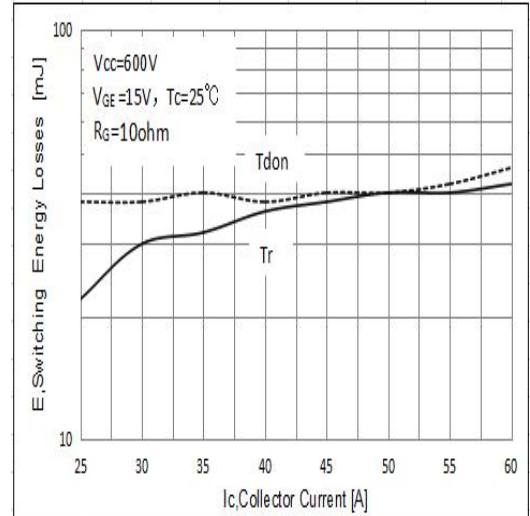
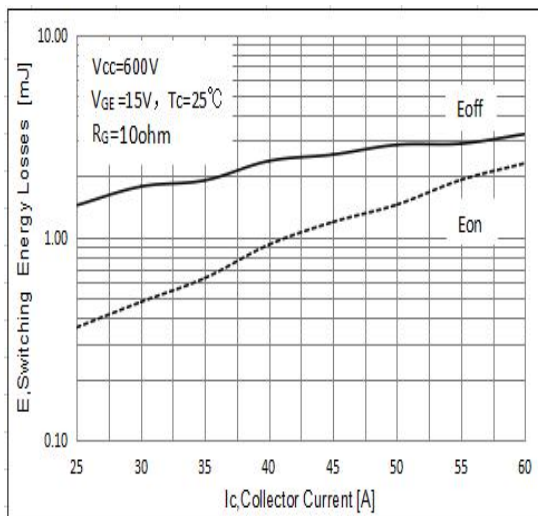
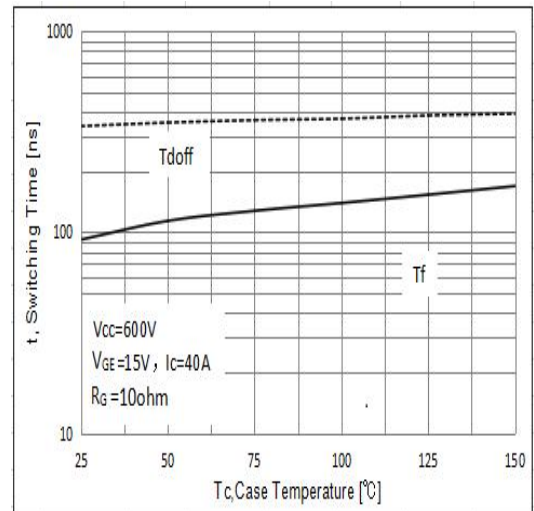
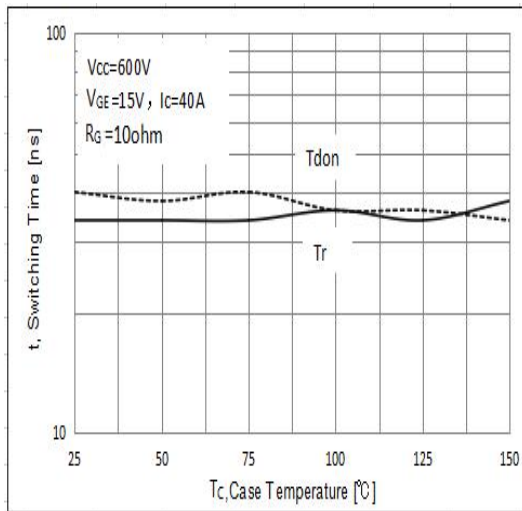
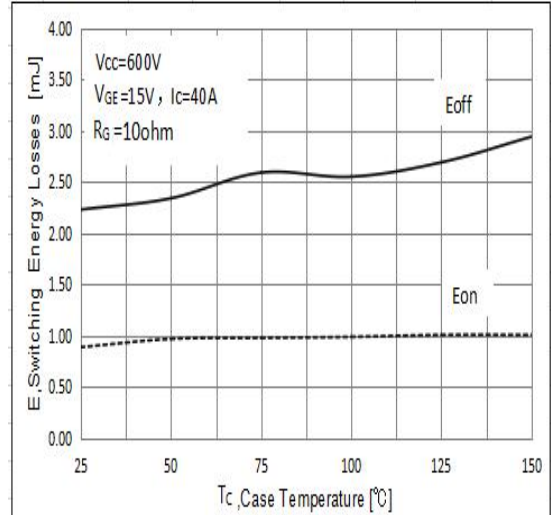
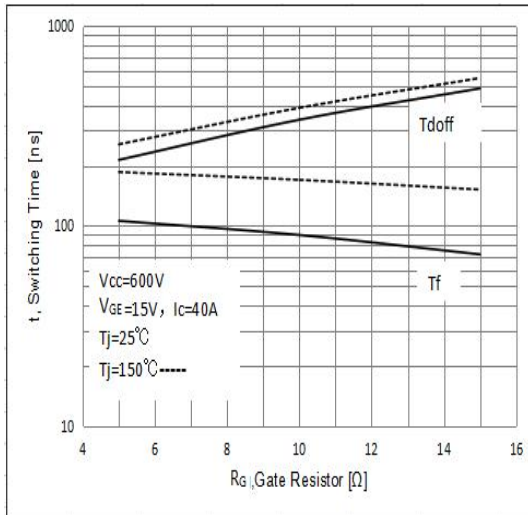
**Fig10. Typical gate charge**



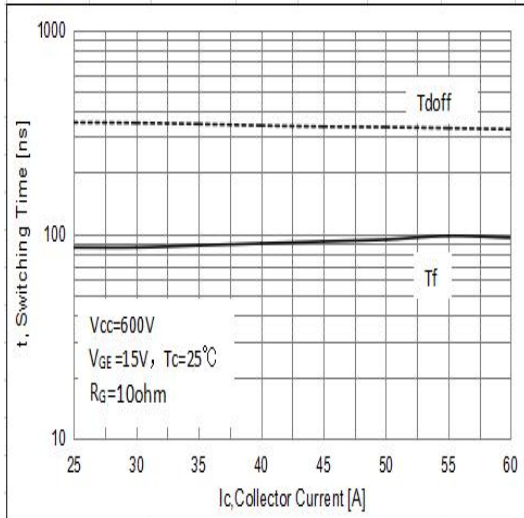
**Fig11. Typical switching energy losses as a function of gate resistor**



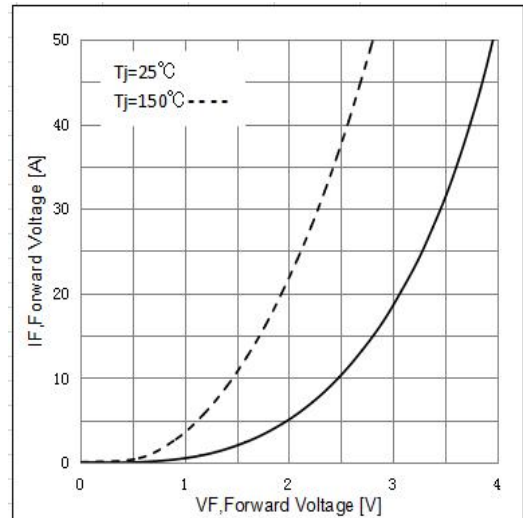
**Fig12. Typical switching times as a function of gate resistor**



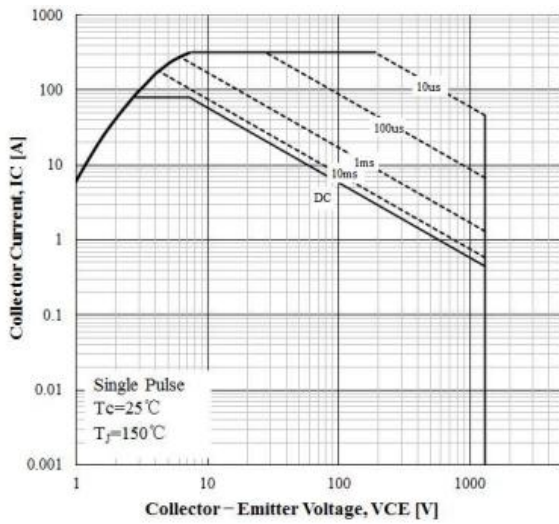




**Fig19. Typical switching times as a function of Collector Current**

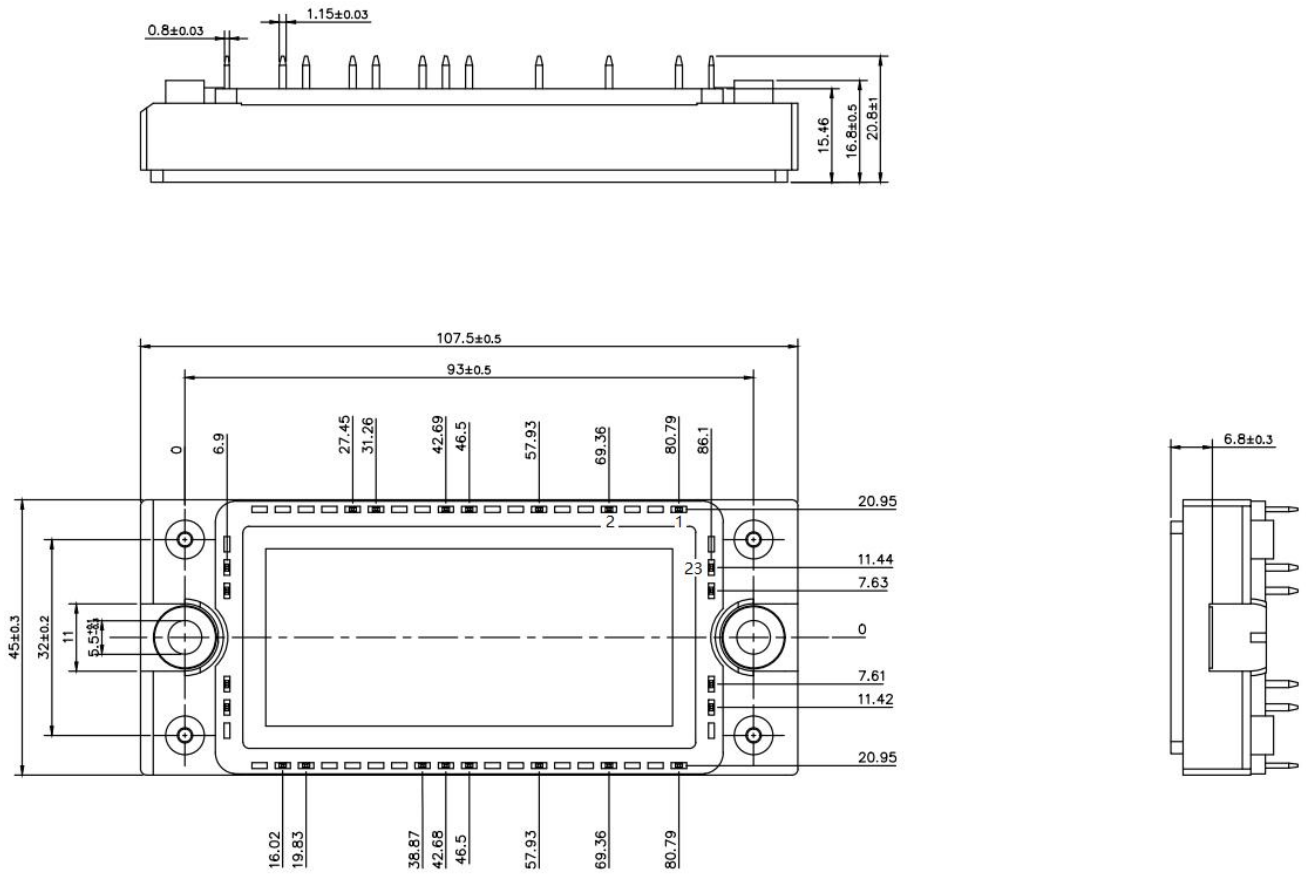


**Fig20. Typical diode forward current as a function of forward voltage**

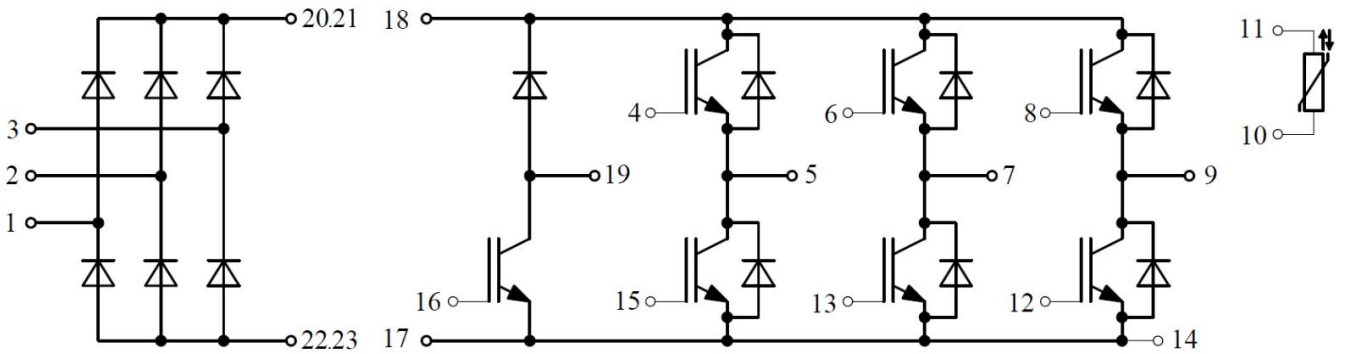


**Fig21. Forward bias safe operating area**

**7 Dimensions**



**7.1 Circuit Schematic**



## 8 Attentions

- Jiangsu Donghai Semiconductor Technology CO.,LTD. reserves the right to change the specification without prior notice! The customer should obtain the latest version of the information before making the order and verify that the information is complete and up to date.
- It is the responsibility of the purchaser for any failure or failure of any semiconductor product under certain conditions. It is the responsibility of the purchaser to comply with safety standards and to take safety measures in the system design and machine manufacturing of Donghai products in order to avoid potential risk of failure. Injury or property damage.
- Product promotion is endless, our company will be dedicated to provide customers with better products.

## 9 Appendix

Revision history:

Date	REV.	Description	Page
2024.5.24	1.0	Original	