

IGBT Module

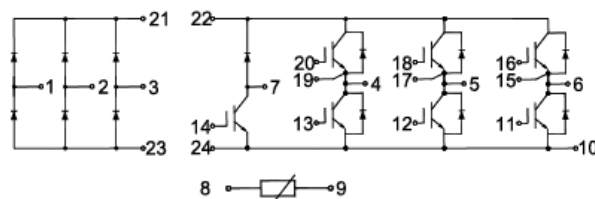
Features:

- $V_{CES}=1200V$ $I_C=40A$ Trench & Field Stop IGBT Module
- Short Circuit Capability
- Low Saturation Voltage
- Low Switching Loss
- 100% RBSOA Tested($2 \times I_C$)
- Low Stray Inductance
- Lead Free, Compliant with RoHS Requirement

Applications:

- Auxiliary Inverters
- Servo Applications
- Motor Drives

Circuit Diagram



Type	Package	Marking
GT40PI120T5H	T5	GT40PI120T5H

IGBT, Inverter

Maximum Rated Values($T_C=25^\circ C$ unless otherwise specified)

V_{CES}	Collector-Emitter Blocking Voltage	$T_J=25^\circ C$	1200	V
V_{GES}	Gate-Emitter Voltage		± 20	V
I_C	Continuous Collector Current Limited by T_{Jmax}	$T_C=100^\circ C$	40	A
		$T_C=25^\circ C$	80	A
I_{CM}	Peak Collector Current Repetitive	T_p limited by T_{Jmax}	80	A
P_D	Maximum Power Dissipation (IGBT)	$T_C=25^\circ C$ $T_{Jmax}=175^\circ C$	250	W

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Electrical Characteristic values($T_C=25^{\circ}\text{C}$ unless otherwise specified)

Static Characteristics

Symbol	Description	Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.0\text{mA}$, $V_{CE}=V_{GE}$, $T_J=25^{\circ}\text{C}$	5.0	5.9	6.8	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=40\text{A}$, $V_{GE}=15\text{V}$	$T_J=25^{\circ}\text{C}$	1.85	2.30	V
			$T_J=125^{\circ}\text{C}$	2.42		
			$T_J=175^{\circ}\text{C}$	2.62		
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}$, $V_{CE}=1200$, $T_J=25^{\circ}\text{C}$			1	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=20\text{V}$, $V_{CE}=0\text{V}$, $T_J=25^{\circ}\text{C}$			200	nA
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}$, $V_{GE}=0\text{V}$, $f=100\text{kHz}$, $T_J=25^{\circ}\text{C}$		2.35		nF
C_{oes}	Output Capacitance			0.54		
C_{res}	Reverse Transfer Capacitance			0.05		

Switching Characteristics

t _{d(on)}	Turn-on Delay Time	V _{CC} =600V, I _C =40A, R _{Gon} =20Ω, V _{GE} =±15V, Inductive Load	T _J =25°C		47		ns
			T _J =125°C		45		
			T _J =175°C		43		
t _r	Rise Time		T _J =25°C		29		ns
			T _J =125°C		31		
			T _J =175°C		36		
t _{d(off)}	Turn-off Delay Time	V _{CC} =600V, I _C =40A, R _{Goff} =20Ω, V _{GE} =±15V, Inductive Load	T _J =25°C		182		ns
			T _J =125°C		203		
			T _J =175°C		217		
t _f	Fall Time		T _J =25°C		167		ns
			T _J =125°C		178		
			T _J =175°C		262		
E _{on}	Turn-on Switching Loss	V _{CC} =600V, I _C =40A, R _{Gon} =20Ω, V _{GE} =±15V, di/dt=880A/μs(T _J =175°C), Inductive Load	T _J =25°C		4.3		mJ
			T _J =125°C		5.1		
			T _J =175°C		5.6		



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E _{off}	Turn-off Switching Loss	V _{CC} =600V, I _C =40A, R _{Goff} =20Ω, V _{GE} =±15V, du/dt=6000V/μs(T _J =175°C), Inductive Load	T _J =25°C		2.6		mJ
			T _J =125°C		3.1		
			T _J =175°C		3.5		
Q _g	Total Gate Charge	V _{GE} =-15V...+15V	T _J =25°C		211		nC
T _{SC}	V _{CC} =600V, V _{GE} =±15V, T _J =175°C ^{note1}					10	us
R _{θJC}	Thermal Resistance: Junction-to-Case (per IGBT)					0.500	°C/W
R _{θCS}	IGBT Thermal Resistance: Case-to-Sink (per IGBT) (per IGBT, λ _{grease} = 1 W/(m • K))				0.337		°C/W

note1: Short circuit withstand time cannot exceed 10us under specified condition

Diode, Inverter

Maximum Rated Values (T_C=25°C unless otherwise specified)

V _{RRM}	Repetitive Peak Reverse Voltage	T _J =25°C	1200	V
I _F	Diode Continuous Forward Current		40	A
I _{FM}	Peak FWD Current Repetitive	t _p =1ms	80	A

Electrical Characteristic Values (T_C=25°C unless otherwise specified)

Symbol	Description	Conditions		Min.	Typ.	Max.	Units
V _{FM}	Forward Voltage	I _F =40A	T _J =25°C		1.60	1.95	V
			T _J =125°C		1.74		
			T _J =175°C		1.66		
I _{rr}	Peak Reverse Recovery Current	I _F =40A, -di/dt=1000A/μs(T _J =175°C), V _R =600V, V _{GE} =-15V	T _J =25°C		38		A
			T _J =125°C		39		
			T _J =175°C		41		
t _{rr}	Reverse Recovery Time		T _J =25°C		291		ns
			T _J =125°C		395		
			T _J =175°C		475		
Q _{rr}	Reverse Recovery Charge		T _J =25°C		3.9		μC
			T _J =125°C		6.4		
			T _J =175°C		8.0		



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E _{rec}	Reverse Recovery Energy	I _F =40A, -di/dt=1000A/μs(T _J =175°C), V _R =600V, V _{GE} =-15V	T _J =25°C		1.2		mJ
			T _J =125°C		2.2		
			T _J =175°C		2.9		
R _{θJC}	Thermal Resistance: Junction-to-Case (per Diode)					0.774	°C/W
R _{θCS}	Diode Thermal Resistance: Case-to-Sink (per Diode, λ _{grease} = 1 W/(m • K))				0.523		°C/W

IGBT, Brake-Chopper

Maximum Rated Values ($T_C=25^\circ C$ unless otherwise specified)

V_{CES}	Collector-Emitter Blocking Voltage		1200	V
V_{GES}	Gate-Emitter Voltage		± 20	V
I_C	Continuous Collector Current Limited by T_{Jmax}	$T_C=100^\circ C$	15	A
		$T_C=25^\circ C$	30	A
I_{CM}	Peak Collector Current Repetitive	T_p limited by T_{Jmax}	30	A
P_D	Maximum Power Dissipation (IGBT)	$T_C=25^\circ C$ $T_{Jmax}=175^\circ C$	170	W

Electrical Characteristic values

Static Characteristics

Symbol	Description	Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.48mA$, $V_{CE}=V_{GE}$, $T_J=25^\circ C$	5.0	5.8	6.6	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=15A$, $V_{GE}=15V$	$T_J=25^\circ C$	1.80	2.15	V
			$T_J=125^\circ C$	2.31		
			$T_J=175^\circ C$	2.45		
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0V$, $V_{CE}=1200$, $T_J=25^\circ C$			1	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=20V$, $V_{CE}=0V$, $T_J=25^\circ C$			200	nA
C_{ies}	Input Capacitance	$V_{CE}=25V$, $V_{GE}=0V$, $f=100kHz$, $T_J=25^\circ C$		965		pF
C_{oes}	Output Capacitance			163		
C_{res}	Reverse Transfer Capacitance			8		



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Switching Characteristics

t _{d(on)}	Turn-on Delay Time	V _{CC} =600V, I _C =15A, R _{Gon} =47Ω, V _{GE} =±15V, Inductive Load	T _J =25°C		43		ns
			T _J =125°C		42		
			T _J =175°C		39		
t _r	Rise Time		T _J =25°C		26		ns
			T _J =125°C		29		
			T _J =175°C		32		
t _{d(off)}	Turn-off Delay Time	V _{CC} =600V, I _C =15A, R _{Goff} =47Ω, V _{GE} =±15V, Inductive Load	T _J =25°C		160		ns
			T _J =125°C		178		
			T _J =175°C		182		
t _f	Fall Time		T _J =25°C		126		ns
			T _J =125°C		141		
			T _J =175°C		144		
E _{on}	Turn-on Switching Loss	V _{CC} =600V, I _C =15A, R _{Gon} =47Ω, V _{GE} =±15V, di/dt=375A/μs (T _J =175°C) Inductive Load	T _J =25°C		1.2		mJ
			T _J =125°C		1.4		
			T _J =175°C		1.5		
E _{off}	Turn-off Switching Loss	V _{CC} =600V, I _C =15A, R _{Goff} =47Ω, V _{GE} =±15V, du/dt=7400V/μs (T _J =175°C) Inductive Load	T _J =25°C		0.8		mJ
			T _J =125°C		1.0		
			T _J =175°C		1.1		
Q _g	Total Gate Charge	V _{GE} =-15V...+15V	T _J =25°C		81		nC
T _{SC}	V _{CC} =600V, V _{GE} =±15V, T _J =175°C ^{note2}					10	us
R _{θJC}	Thermal Resistance: Junction-to-Case (per IGBT)					0.873	°C/W
R _{θCS}	IGBT Thermal Resistance: Case-to-Sink (per IGBT) (per IGBT, λ _{grease} = 1 W/(m • K))				0.590		°C/W

note2: Short circuit withstand time cannot exceed 10us under specified condition

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Diode, Brake-Chopper

Maximum Rated Values ($T_C=25^{\circ}\text{C}$ unless otherwise specified)

V_{RRM}	Repetitive Peak Reverse Voltage		1200	V
I_F	Diode Continuous Forward Current		10	A
I_{FM}	Repetitive Peak Forward Current	$t_p=1\text{ms}$	20	A

Electrical Characteristic values ($T_C=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Description	Conditions		Min.	Typ.	Max.	Units	
V _{FM}	Forward Voltage	I _F =10A	T _J =25°C		1.70	2.05	V	
			T _J =125°C		1.78			
			T _J =175°C		1.73			
t _{rr}	Reverse Recovery Time	I _F =10A, -diF/dt=450A/μs(T _J =175°C) V _R =600V, V _{GE} =-15V	T _J =25°C		218		ns	
			T _J =125°C		370			
			T _J =175°C		440			
I _{rr}	Peak Reverse Recovery Current		T _J =25°C		9		A	
			T _J =125°C		10			
			T _J =175°C		11			
Q _{rr}	Reverse Recovery Charge		T _J =25°C		0.8		μC	
			T _J =125°C		1.4			
			T _J =175°C		1.7			
E _{rec}	Reverse Recovery Energy		T _J =25°C		0.3		mJ	
			T _J =125°C		0.5			
			T _J =175°C		0.7			
R _{θJC}	Thermal Resistance: Junction-To-Case (per Diode)					1.850	°C/W	
R _{θCS}	Diode Thermal Resistance: Case-to-Sink (per Diode, λ _{grease} = 1 W/(m • K))				1.250		°C/W	

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Diode, Rectifier

Maximum Rated Values ($T_C=25^\circ\text{C}$ unless otherwise specified)

V_{RRM}	Repetitive Peak Reverse Voltage	$T_J=25^\circ\text{C}$	1600	V
I_{FRMSM}	Maximum RMS Forward Current per Chip	$T_J=25^\circ\text{C}$	55	A
I_{RMSM}	Maximum RMS Forward Current at Rectifier Output	$T_J=80^\circ\text{C}$	80	A
I_{FSM}	Surge Current @ $t_p=10\text{ms}$	$T_J=25^\circ\text{C}$	630	A
		$T_J=150^\circ\text{C}$	500	
I^2t	I^2t - value	$T_J=25^\circ\text{C}$	1980	A^2s
		$T_J=150^\circ\text{C}$	1250	

Electrical Characteristic values ($T_C=25^\circ\text{C}$ unless otherwise specified)

Symbol	Description	Conditions		Min.	Typ.	Max.	Units
V_F	Forward Voltage	$I_F=40\text{A}$	$T_J=25^\circ\text{C}$		1.21		V
			$T_J=150^\circ\text{C}$		1.18		
I_R	Reverse Current	$V_R=1600\text{V}$	$T_J=25^\circ\text{C}$			1	mA
$R_{\theta JC}$	Thermal Resistance: Junction-to-Case (per Diode)					0.559	$^\circ\text{C}/\text{W}$
$R_{\theta CS}$	Diode Thermal Resistance: Case-to-Sink (per Diode, $\lambda_{\text{grease}} = 1 \text{ W}/(\text{m} \cdot \text{K})$)				0.377		$^\circ\text{C}/\text{W}$

Internal NTC-Thermistor Characteristics

Symbol	Conditions	Min.	Typ.	Max.	Units.
R_{25}	$T_C=25^\circ\text{C}$		5		$\text{k}\Omega$
$\Delta R/R$	$T_C=100^\circ\text{C}$, $R_{100}=465\Omega$	-5		+5	%
P_{25}	$T_C=25^\circ\text{C}$			10	mW
$B_{25/50}$	$R_2=R_{25} \exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$		3380		K
$B_{25/80}$	$R_2=R_{25} \exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$		3440		K
$B_{25/100}$	$R_2=R_{25} \exp[B_{25/100}(1/T_2-1/(298.15\text{K}))]$		3545		K

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Module

Symbol	Description		Min.	Typ.	Max.	Units
V _{iso}	Isolation Voltage (All Terminals Shorted)	RMS, f=50Hz, 60s	2500			V
T _J	Maximum Junction Temperature		-40		175	°C
T _{JOP}	Maximum Operating Junction Temperature Range ^{note3}		-40		150	°C
T _{stg}	Storage Temperature		-40		125	°C
CTI	Comparative Tracking Index		200			
T	Mounting Screw:M5		3.0		6.0	N·m
G	Weight			190		g

note3: T_{JOP}> 150°C is only allowed for operation at overload conditions.

Ordering Information Table

Device code	G	T	40	PI	120	T5	H
	①	②	③	④	⑤	⑥	⑦

- ① - IGBT Module
- ② - Trench & Field Stop IGBT
- ③ - Rated Current (40=40A)
- ④ - Circuit Configuration: PI (Power Integrated)
- ⑤ - Rated Voltage (120=1200V)
- ⑥ - Package Type
- ⑦ - Test Level (Pass the Important Reliability Test-Industrial Grade)



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Characteristic diagram

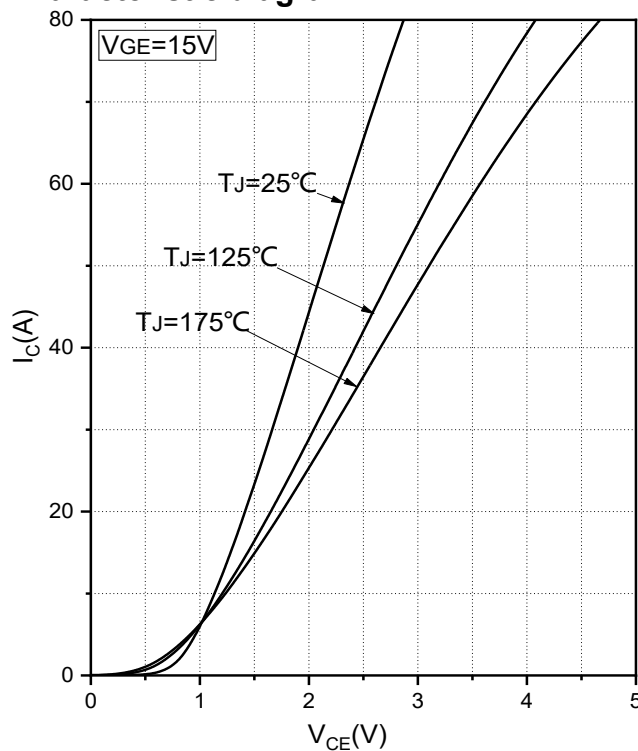


Fig.1 Typical Saturation Voltage Characteristics (Inverter)

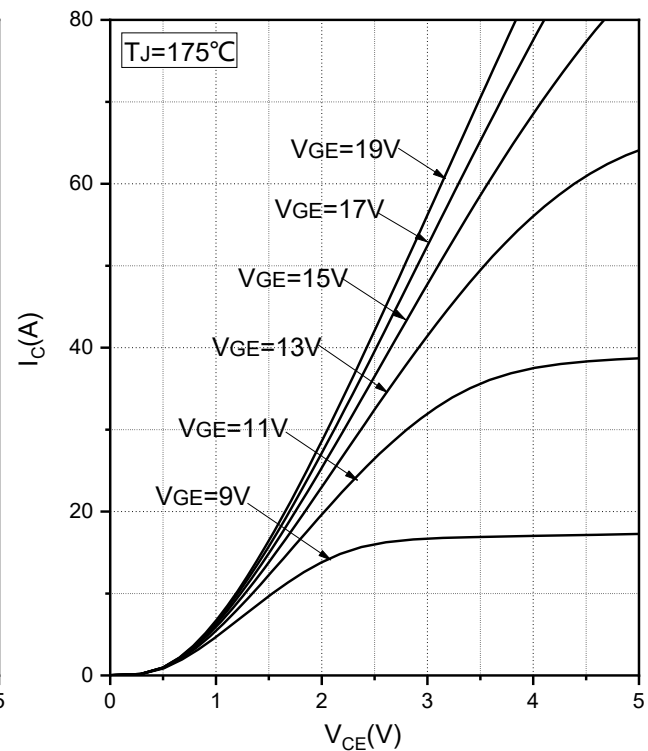


Fig.2 Typical Output Characteristics (Inverter)

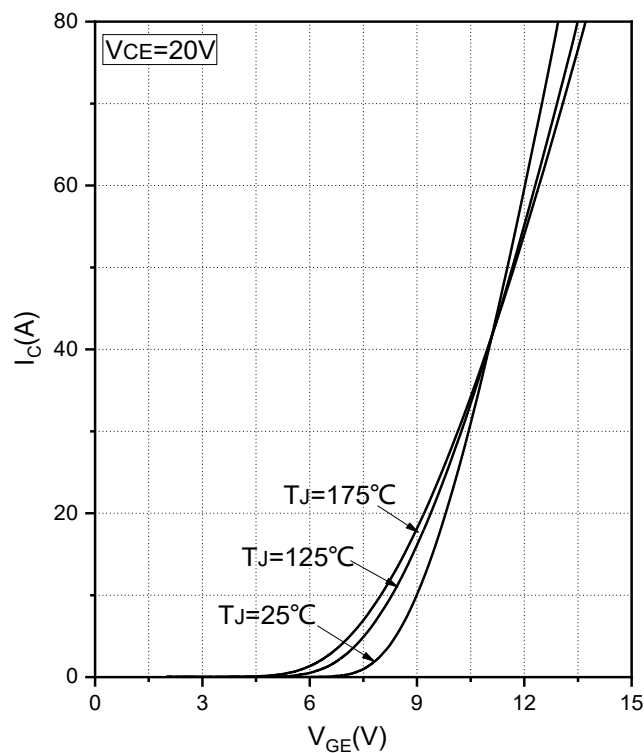


Fig.3 Transfer Characteristics(Inverter)

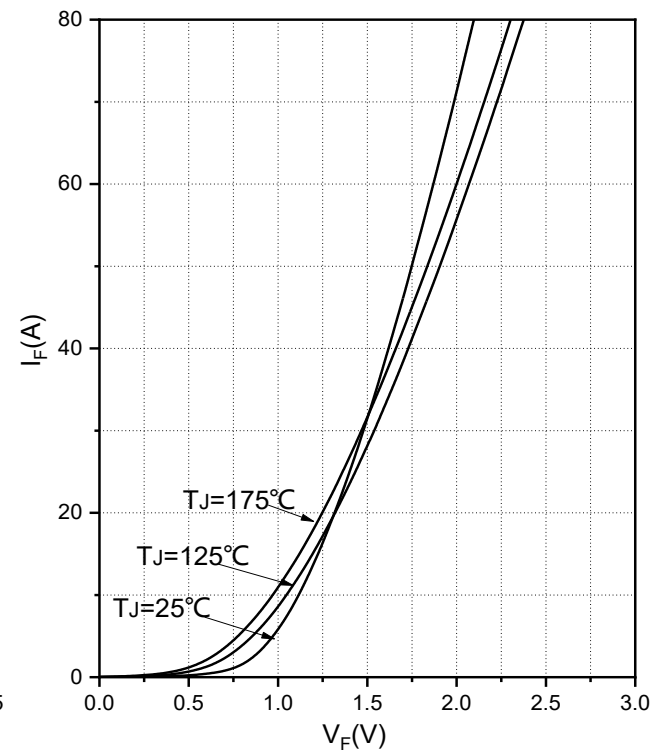


Fig.4 Forward Characteristics of Diode(Inverter)

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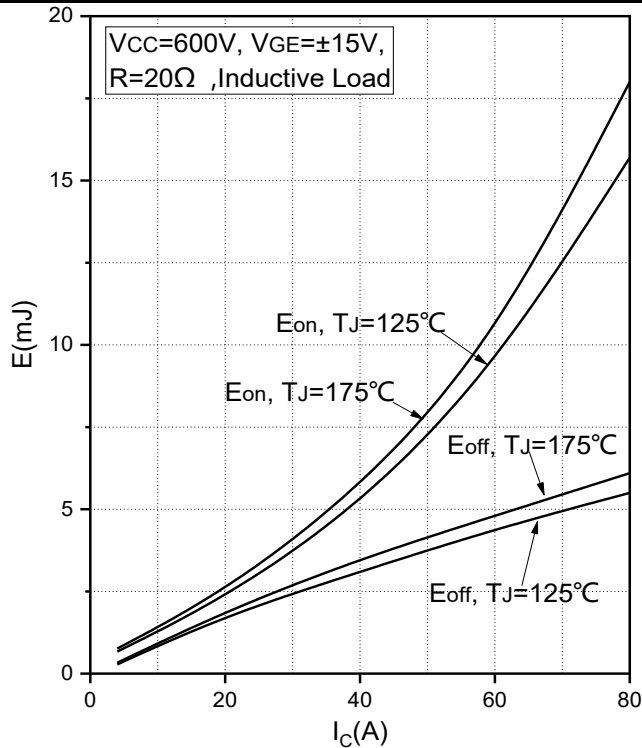


Fig.5 Typical Switching Loss vs. Collector Current(Inverter)

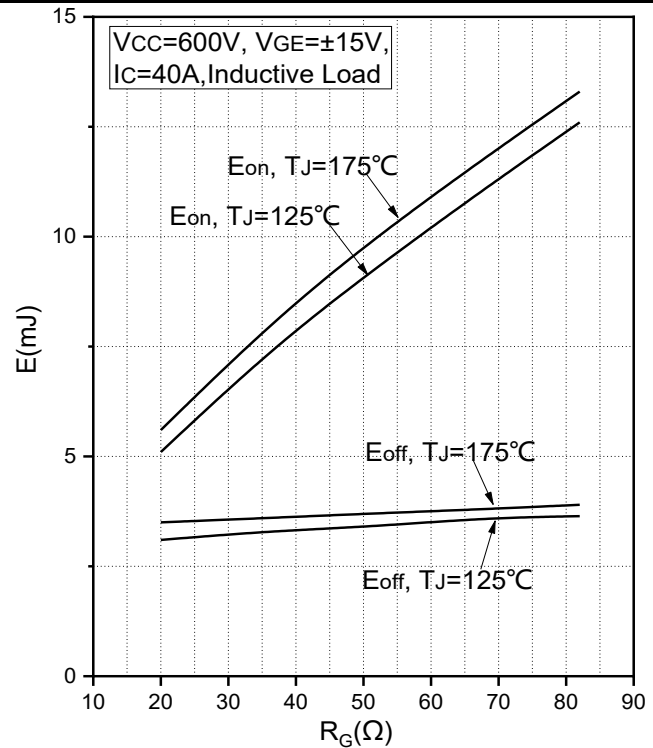


Fig.6 Typical Switching Loss vs. Gate Resistance(Inverter)

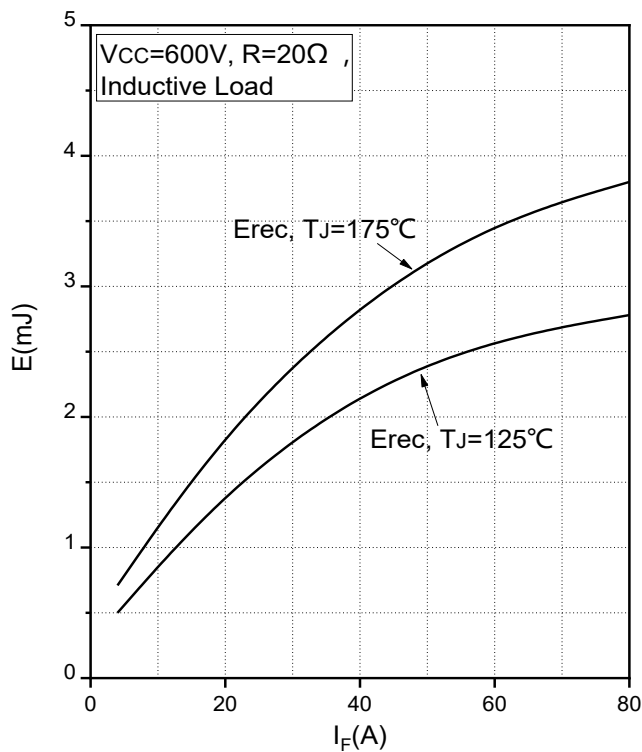


Fig.7 Typical Switching Loss vs. Forward Current(Inverter)

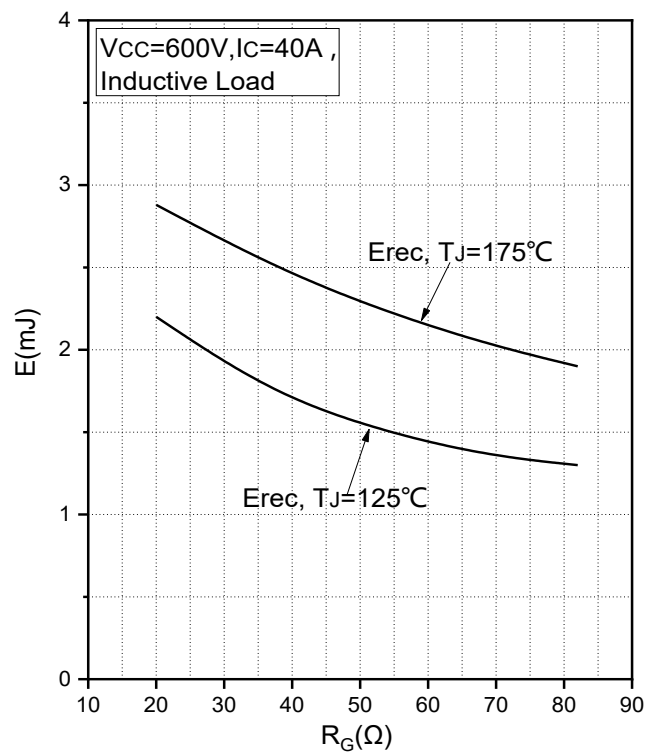


Fig.8 Typical Switching Loss vs. Gate Resistance(Inverter)



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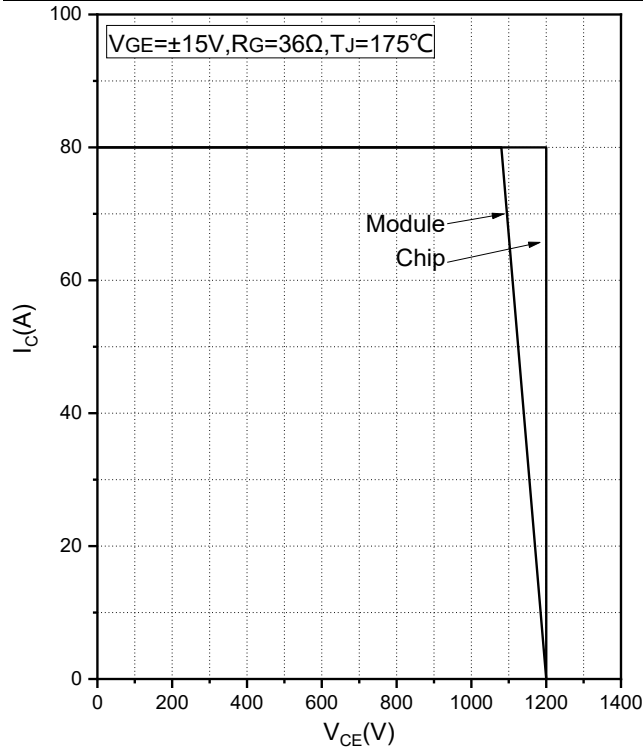


Fig.9 Reverse Bias Safe Operation Area (RBSOA) (Inverter)

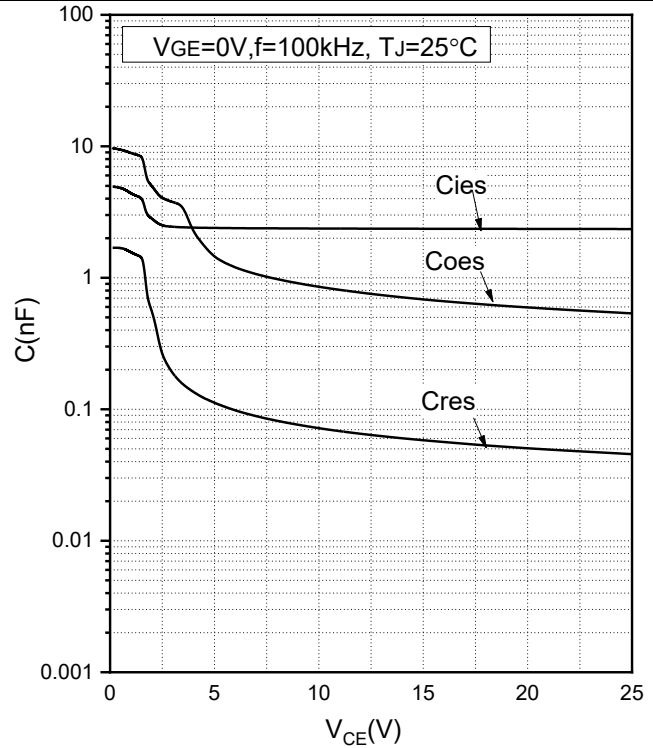


Fig.10 Capacitance Characteristics(Inverter)

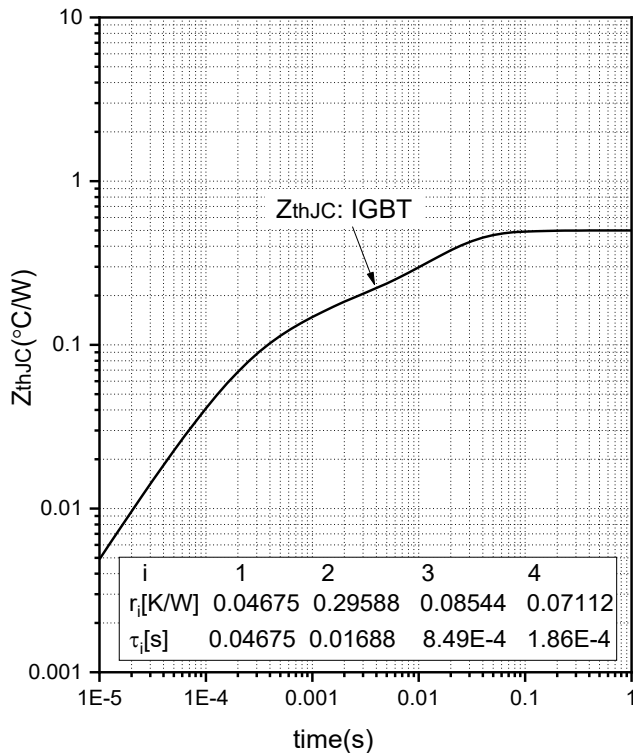


Fig.11 Transient Thermal Impedance (Inverter-IGBT)

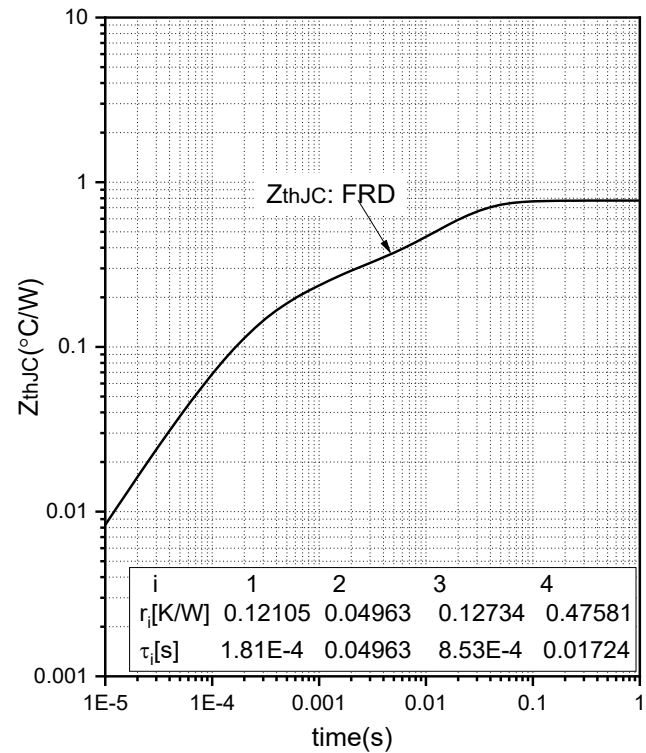


Fig.12 Transient Thermal Impedance (Inverter-FRD)

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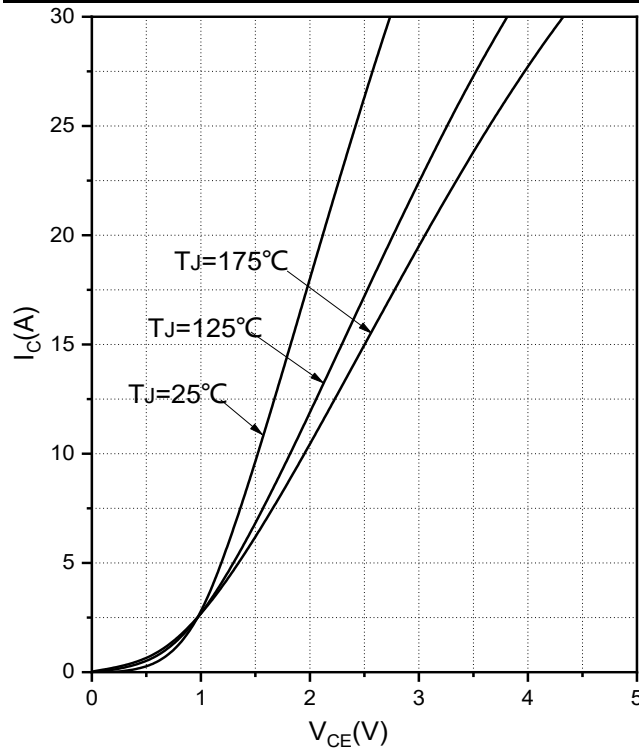


Fig.13 Typical Saturation Voltage Characteristics (Chopper)

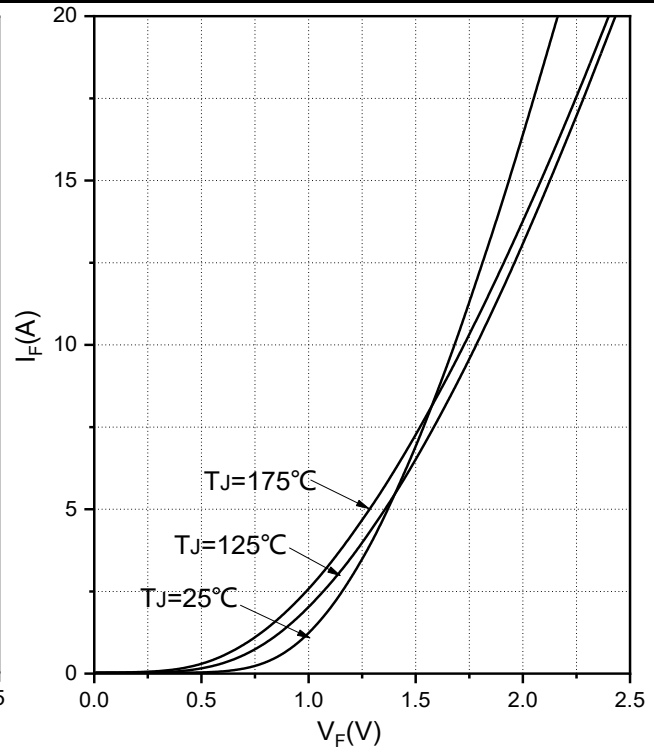


Fig.14 Forward Characteristics of Diode(Chopper)

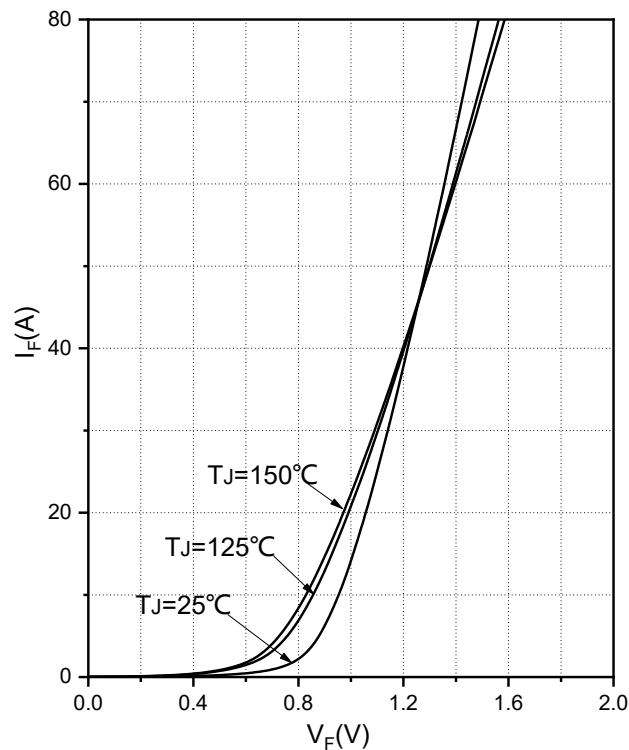


Fig.15 Forward Characteristics of Diode (Rectifier)

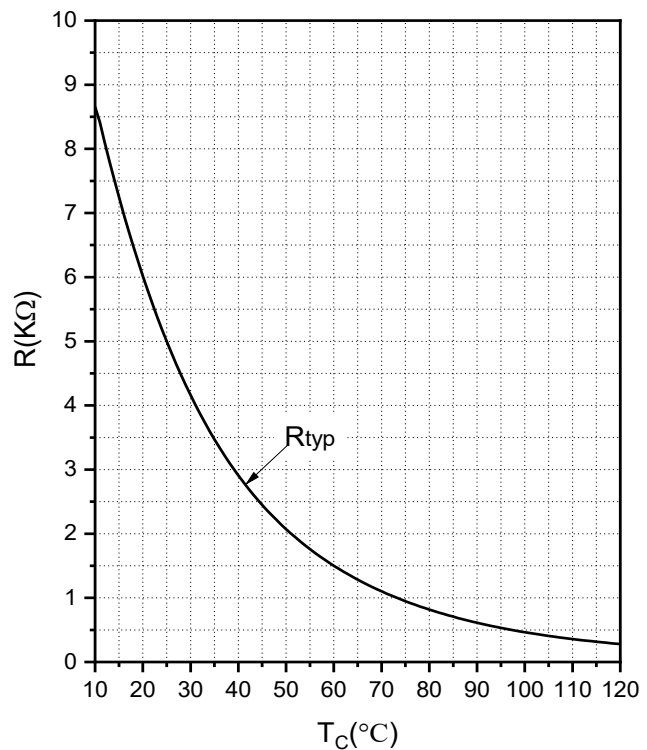


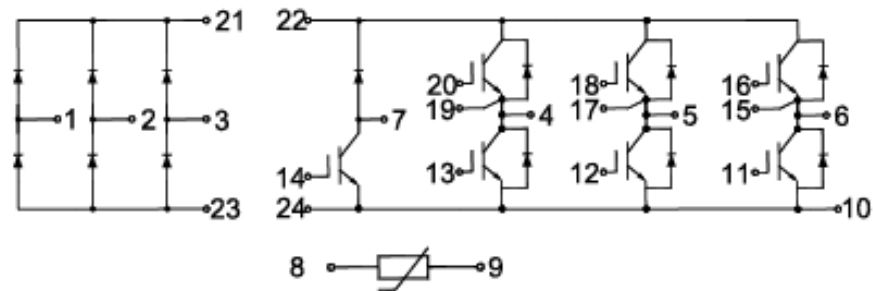
Fig.16 NTC Temperature Characteristics



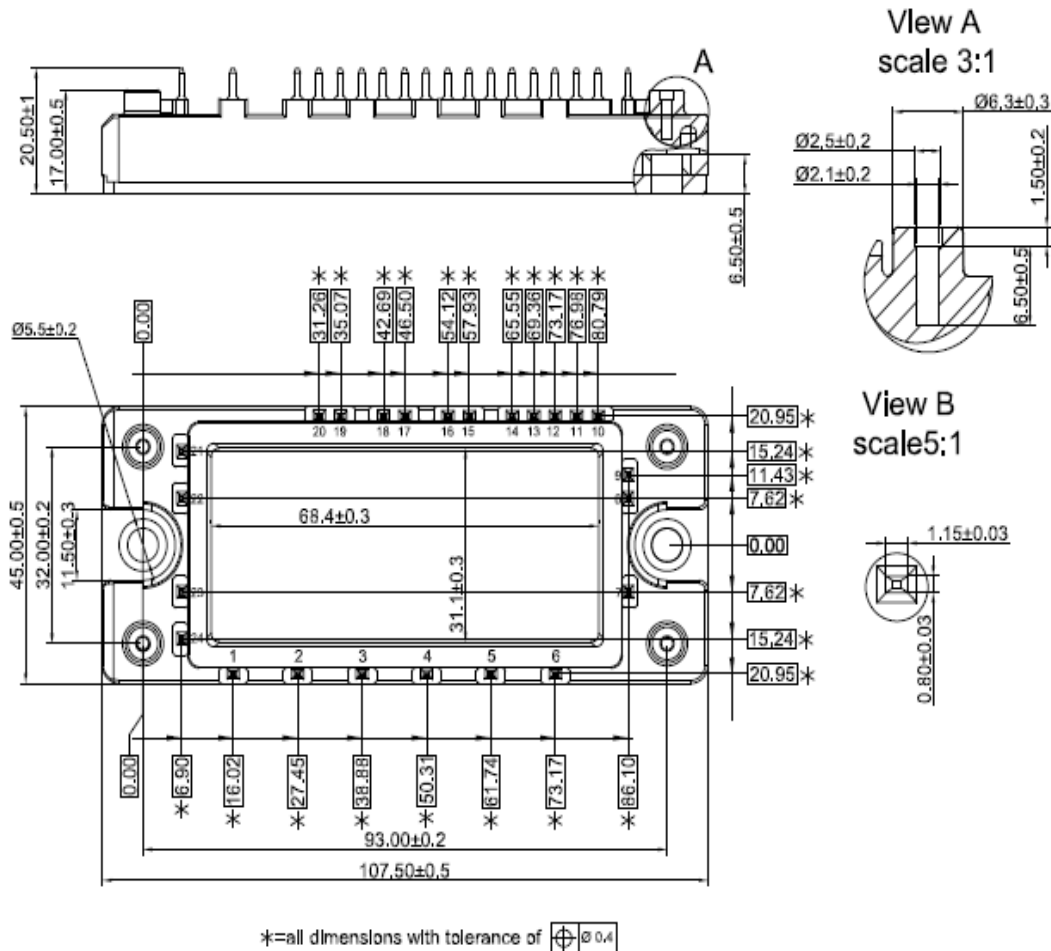
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Internal Circuit



Package Outline (Unit: mm):



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Revision	Notes
A	Fina Datasheet Initial Release

Announcement

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The released datasheet would be issued with “REV.” + “alphabet characters”.