



GT40PI120T6H-T4

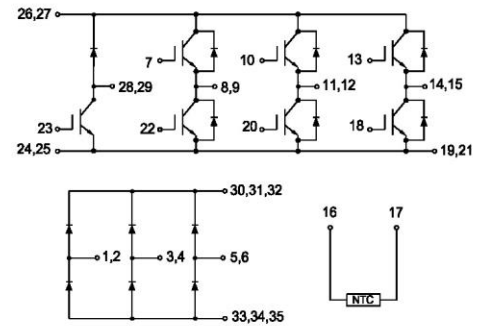
IGBT Module

Preliminary Data

Features:

- Field Stop Trench Gate IGBT
- Short Circuit Rated >10 μ s
- Low Saturation Voltage
- Low Switching Loss
- 100% RBSOA Tested (2 $\times$ I_C)
- Low Stray Inductance
- Lead Free, Compliant with RoHS Requirement

Circuit Diagram



Applications:

- Industrial Inverters
- Servo Applications

IGBT, Inverter

Maximum Rated Values

V _{CES}	Collector-Emitter Blocking Voltage	T _J =25°C	1200	V
V _{GES}	Gate-Emitter Voltage		±20	V
I _C	Continuous Collector Current	T _C =100°C	40	A
		T _C =25°C	80	A
I _{CM}	Peak Collector Current Repetitive	t _p =1ms	80	A
P _D	Maximum Power Dissipation per IGBT	T _C =25°C T _{Jmax} =175°C	300	W



Electrical Characteristics of IGBT

Static Characteristics

Symbol	Description	Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1mA, V_{CE}=V_{GE}, T_J=25^{\circ}C$	5.0	5.8	6.5	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=40A, V_{GE}=15V$	$T_J=25^{\circ}C$	1.80	2.10	V
			$T_J=125^{\circ}C$	2.10		V
			$T_J=150^{\circ}C$	2.20		V
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0V, V_{CE}=V_{CES}, T_J=25^{\circ}C$			1	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=\pm 20V, V_{CE}=0V, T_J=25^{\circ}C$			± 100	nA
C_{ies}	Input Capacitance	$V_{CE}=25V, V_{GE}=0V, f=100kHz, T_J=25^{\circ}C$		3.44		nF
C_{oes}	Output Capacitance			0.51		nF
C_{res}	Reverse Transfer Capacitance			0.32		nF

Switching Characteristics

t _{d(on)}	Turn-on Delay Time	V _{CC} =600V, I _C =40A, R _{Gon} =15Ω, V _{GE} =±15V, Inductive Load	T _J =25℃		92		ns	
			T _J =125℃		93			
			T _J =150℃		94			
t _r	Rise Time		T _J =25℃		46		ns	
			T _J =125℃		50			
			T _J =150℃		50			
t _{d(off)}	Turn-off Delay Time		V _{CC} =600V, I _C =40A, R _{Goff} =15Ω, V _{GE} =±15V, Inductive Load	T _J =25℃		183		ns
				T _J =125℃		185		
				T _J =150℃		189		
t _f	Fall Time	T _J =25℃			258		ns	
		T _J =125℃			310			
		T _J =150℃			315			
E _{on}	Turn-on Switching Loss	V _{CC} =600V, I _C =40A, R _{Gon} =15Ω, V _{GE} =±15V, di/dt=720A/μs(T _J =150℃), Inductive Load		T _J =25℃		2.48		mJ
		T _J =125℃			2.68			
		T _J =150℃			3.05			



E _{off}	Turn-off Switching Loss	V _{CC} =600V, I _C =40A, R _{Goff} =15Ω, V _{GE} =±15V, du/dt=2880V/μs(T _J =150°C), Inductive Load	T _J =25°C		3.21		mJ
			T _J =125°C		3.77		
			T _J =150°C		3.97		
Q _g	Total Gate Charge	V _{GE} =-15V...+15V	T _J =25°C		457		nC
R _{g internal}	Internal Gate Resistance		T _J =25°C		0		Ω
RBSOA	I _C =80A, V _{CC} =1050V, V _p =1200V, R _G =15Ω, V _{GE} =+15V to 0V, T _J =150°C			Trapezoid			
I _{SC}	V _{CC} =600V, V _{GE} = ±15V, tp=10us, R _{Gon} =56Ω, R _{Goff} =56Ω, T _J =25°C				175		A
R _{θJC}	IGBT Thermal Resistance: Junction-To-Case (per leg)					0.499	°C/W

Diode, Inverter Maximum Rated Values

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

Electrical Characteristics of FWD

Symbol	Description	Conditions		Min.	Typ.	Max.	Units
V _{FM}	Forward Voltage	I _F =40A	T _J =25°C		1.80	2.10	V
			T _J =125°C		1.90		
			T _J =150°C		1.90		
t _{rr}	Reverse Recovery Time	I _F =40A, -diF/dt=830A/μs,(T _J =150°C) V _{rr} =600V, V _{GE} =-15V	T _J =25°C		164		ns
			T _J =125°C		186		
			T _J =150°C		186		
I _{rr}	Peak Reverse Recovery Current		T _J =25°C		53.7		A
			T _J =125°C		62.5		
			T _J =150°C		63.8		
Q _{rr}	Reverse Recovery Charge		T _J =25°C		4.53		μC
			T _J =125°C		6.31		
			T _J =150°C		6.54		



E _{rec}	Reverse Recovery Energy	I _F =40A, -diF/dt=830A/μs,(T _J =150℃) V _{rr} =600V, V _{GE} =-15V	T _J =25℃		1.56		mJ
			T _J =125℃		2.14		
			T _J =150℃		2.45		
R _{θJC}	Diode Thermal Resistance: Junction-To-Case (per leg)					0.682	℃/W

IGBT, Brake-Chopper

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	$T_C=100^\circ C$	25	A
		$T_C=25^\circ C$	50	A
I_{CM}	Peak Collector Current Repetitive	$t_p=1ms$	50	A
P_D	Maximum Power Dissipation (IGBT)	$T_C=25^\circ C$ $T_{Jmax}=175^\circ C$	235	W

Electrical Characteristics of IGBT ($T_C=25^\circ C$ unless otherwise specified)

Static Characteristics

Symbol	Description	Conditions		Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1mA$, $V_{CE}=V_{GE}$, $T_J=25^\circ C$		5.00	5.60	6.50	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=25A$, $V_{GE}=15V$	$T_J=25^\circ C$		1.70	1.90	V
			$T_J=125^\circ C$		1.95		
			$T_J=150^\circ C$		2.00		
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0V$, $V_{CE}=V_{CES}$, $T_J=25^\circ C$				1	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=\pm 20V$, $V_{CE}=0V$, $T_J=25^\circ C$				± 100	nA
C_{ies}	Input Capacitance	$V_{CE}=25V$, $V_{GE}=0V$, $f=100kHz$, $T_J=25^\circ C$			2.42		nF
C_{oes}	Output Capacitance				0.17		
C_{res}	Reverse Transfer Capacitance				0.02		



Switching Characteristics

t _{d(on)}	Turn-on Delay Time	V _{CC} =600V, I _C =25A, R _{Gon} =20Ω, V _{GE} =±15V, Inductive Load	T _J =25℃		102		ns
			T _J =125℃		99		
			T _J =150℃		99		
t _r	Rise Time		T _J =25℃		39		ns
			T _J =125℃		39		
			T _J =150℃		37		
t _{d(off)}	Turn-off Delay Time		T _J =25℃		138		ns
			T _J =125℃		147		
			T _J =150℃		145		
t _f	Fall Time	T _J =25℃		494		ns	
		T _J =125℃		723			
		T _J =150℃		728			
E _{on}	Turn-on Switching Loss	T _J =25℃		2.14		mJ	
		T _J =125℃		2.76			
		T _J =150℃		2.97			
E _{off}	Turn-off Switching Loss	T _J =25℃		1.97		mJ	
		T _J =125℃		3.22			
		T _J =150℃		3.54			
Q _g	Total Gate Charge	V _{GE} =+15V...-15V	T _J =25℃		129		nC
R _{g internal}	Internal Gate Resistance		T _J =25℃		0		Ω
RBSOA	I _C =50A, V _{CC} =1050V, V _p =1200V, R _{Goff} =20Ω, V _{GE} =+15V to 0V, T _J =150℃			Trapezoid			
SCSOA	V _{CC} =600V, V _{GE} =+/-15V, R _{Gon} =20Ω, R _{Goff} =20Ω, T _J =125℃			10			μs
R _{θJC}	Thermal Resistance: Junction-to-Case (per IGBT)					0.633	℃/W

Diode, Brake-Chopper

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

V_{RRM}	Repetitive Peak Reverse Voltage	$T_J=25^\circ C$	1200	V
I_F	Diode Continuous Forward Current		15	A
I_{FM}	Peak FWD Current Repetitive	$t_p=1ms$	30	A



Electrical Characteristics of Diode ($T_C=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Description	Conditions		Min.	Typ.	Max.	Units
V _{FM}	Forward Voltage	I _F =15A	T _J =25℃		1.90		V
			T _J =125℃		2.00		
			T _J =150℃		2.00		
t _{rr}	Reverse Recovery Time	I _F =15A, -diF/dt=252A/μs(T _J =150℃) V _R = 600V, V _{GE} =-15V	T _J =25℃		215		ns
			T _J =125℃		293		
			T _J =150℃		409		
I _{rr}	Peak Reverse Recovery Current		T _J =25℃		8.40		A
			T _J =125℃		9.10		
			T _J =150℃		9.70		
Q _{rr}	Reverse Recovery Charge		T _J =25℃		1.34		μC
			T _J =125℃		2.14		
			T _J =150℃		2.33		
E _{rec}	Reverse Recovery Energy		T _J =25℃		0.37		mJ
			T _J =125℃		0.70		
			T _J =150℃		0.80		
R _{θJC}	Thermal Resistance: Junction-to-Case (per Diode)					1.282	℃/W

Diode, Rectifier Maximum Rated Values

V_{RRM}	Repetitive Peak Reverse Voltage	$T_J=25^{\circ}\text{C}$	1800	V
I_{FRMSM}	Maximum RMS Forward Current per Chip	$T_J=80^{\circ}\text{C}$	50	A
I_{RMSM}	Maximum RMS Current at Rectifier Output	$T_J=80^{\circ}\text{C}$	60	A
I_{FSM}	Surge Current @ $t_p=10\text{ ms}$	$T_J=25^{\circ}\text{C}$	420	A
		$T_J=150^{\circ}\text{C}$	350	
I^2t	I^2t - value	$T_J=25^{\circ}\text{C}$	900	A^2s
		$T_J=150^{\circ}\text{C}$	650	



Electrical Characteristics of Diode

Symbol	Description	Conditions	Min.	Typ.	Max.	Units
V _F	Forward Voltage	I _F =40A	T _J =25°C	1.20		V
			T _J =125°C	1.15		
			T _J =150°C	1.15		
I _R	Reverse Current	V _R =1600V	T _J =25°C		1	mA
R _{θJC}	Diode Thermal Resistance: Junction-To-Case				0.822	°C/W

Internal NTC-Thermistor Characteristics

Symbol	Conditions	Min.	Typ.	Max.	Units
R ₂₅	T _C =25°C		5		kΩ
ΔR/R	T _C =100°C, R ₁₀₀ =465Ω	-5		+5	%
P ₂₅	T _C =25°C			10	mW
B _{25/50}	$R_2=R_{25} \exp[B_{25/50}(1/T_2-1/(298.15K))]$		3380		K
B _{25/80}	$R_2=R_{25} \exp[B_{25/80}(1/T_2-1/(298.15K))]$		3440		K
B _{25/100}	$R_2=R_{25} \exp[B_{25/100}(1/T_2-1/(298.15K))]$		3545		K

Module

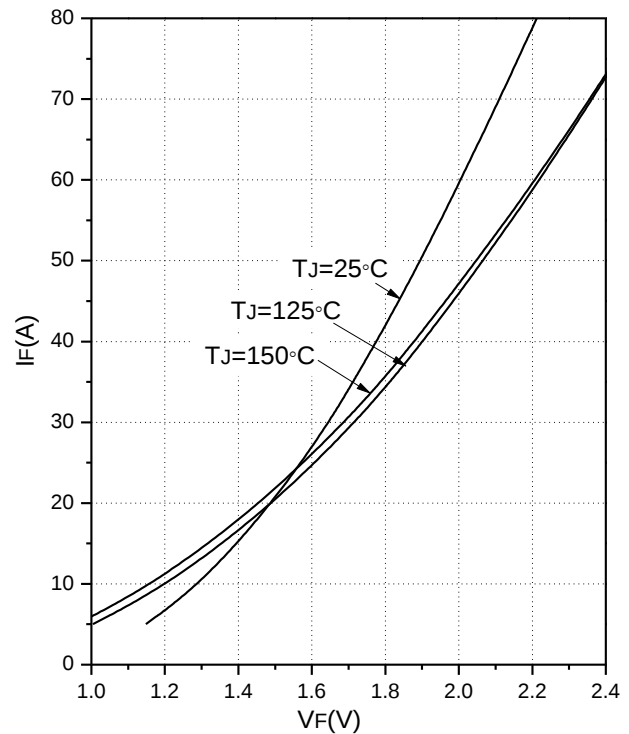
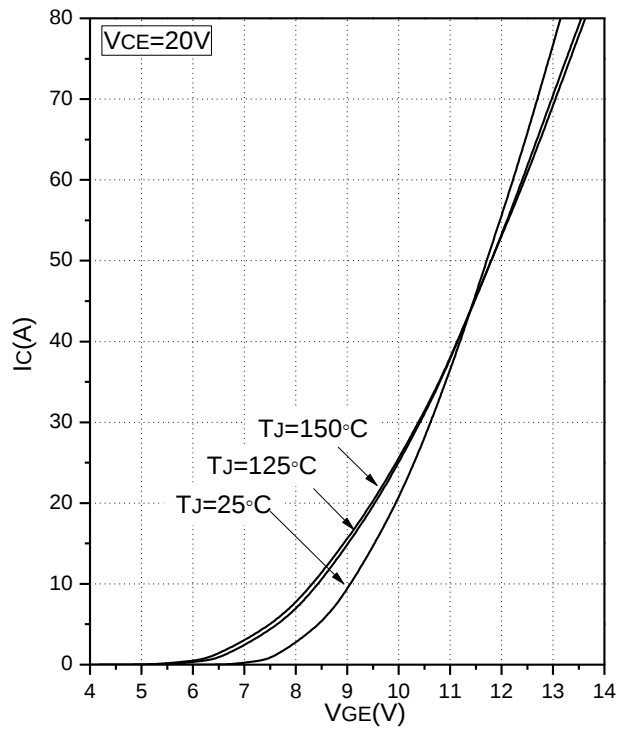
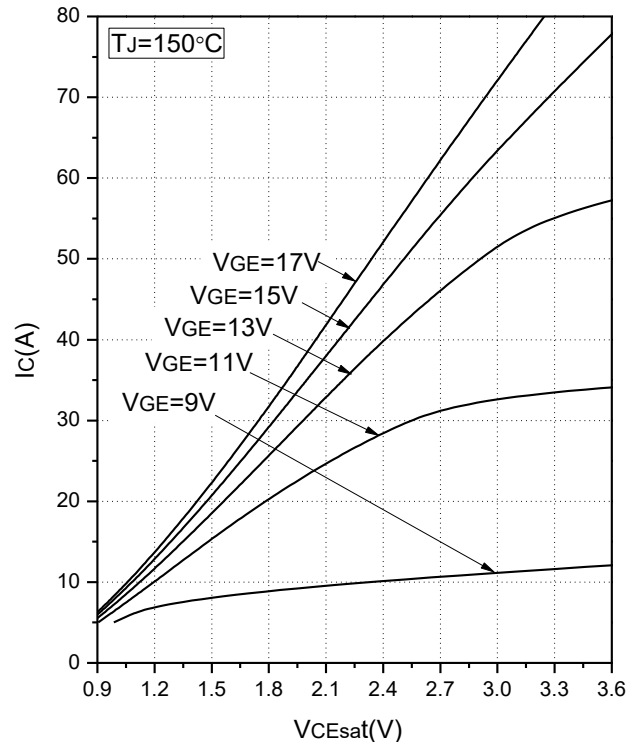
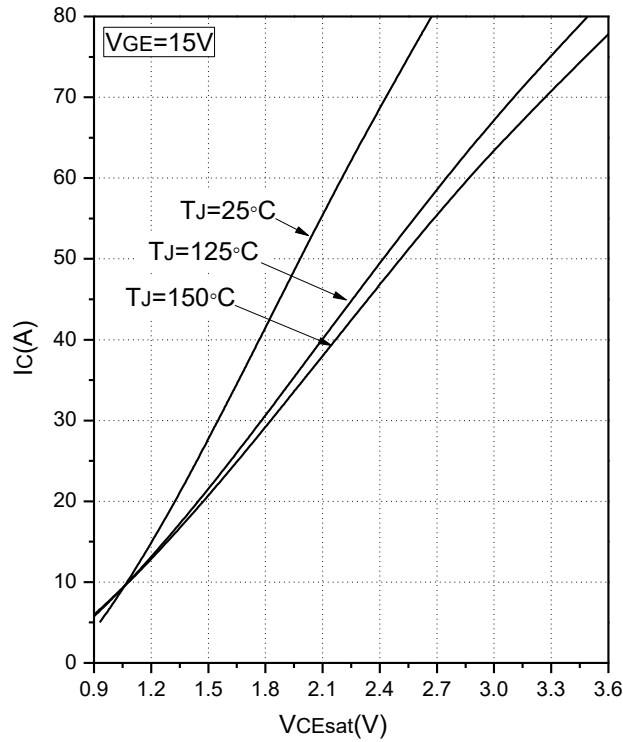
Symbol	Description	Conditions	Min.	Typ.	Max.	Units
V _{iso}	Isolation Voltage (All Terminals Shorted)	RMS, f=50Hz, 30s	4500			V
T _J	Maximum Junction Temperature				175	°C
T _{JOP}	Maximum Operating Junction Temperature Range		-40		+150	°C
T _{stg}	Storage Temperature		-40		+150	°C
CTI	Comparative Tracking Index		200			
R _{θCS}	Case-To-Sink Thermally (Conductive Grease Applied)				0.03	°C/W
M	Mounting Torque for Module Mounting	Screw M5--Mounting according to valid application note	3.0		6.0	N·m
G	Weight			300		g



Ordering Information Table

Device code	G	T	40	PI	120	T6	H	—	T4
	①	②	③	④	⑤	⑥	⑦		⑧

- ① - IGBT Module
- ② - Trench, Low Switching Losses 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)
- ⑧ - Internal Code



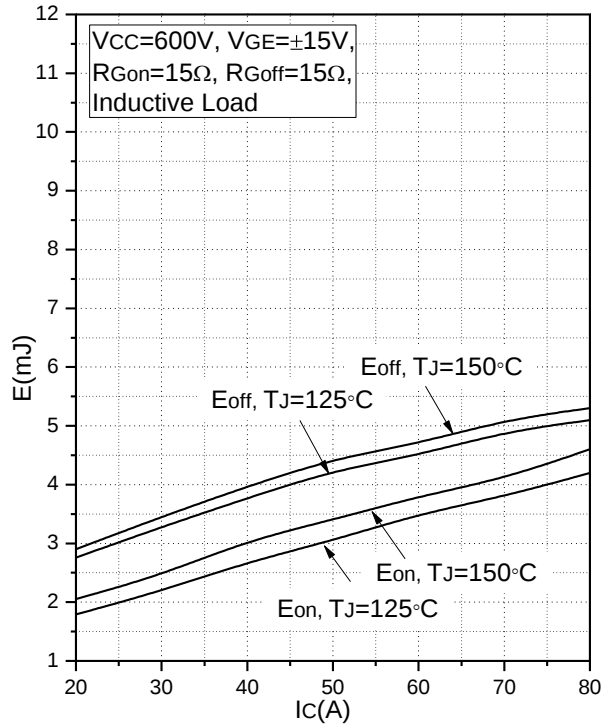


Fig.5 Typical Switching Loss vs. Collector Current (Inverter)

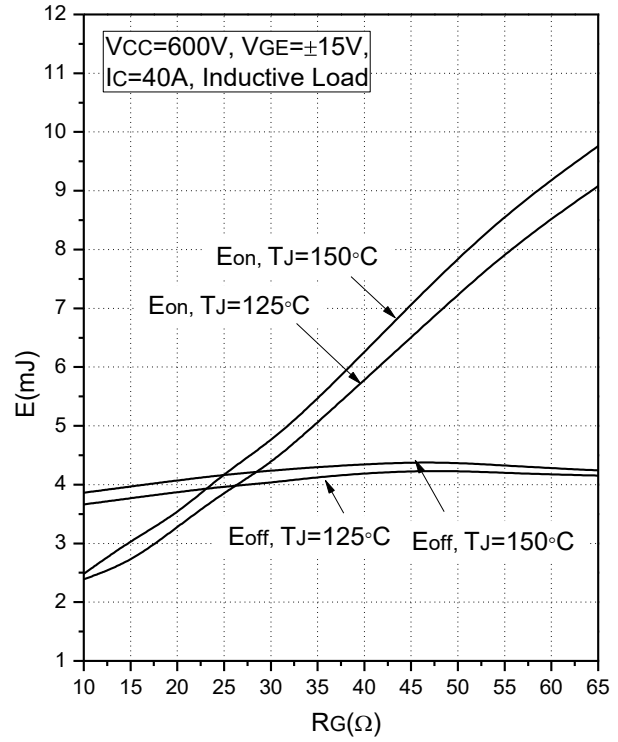


Fig.6 Typical Switching Loss vs. Gate Resistance (Inverter)

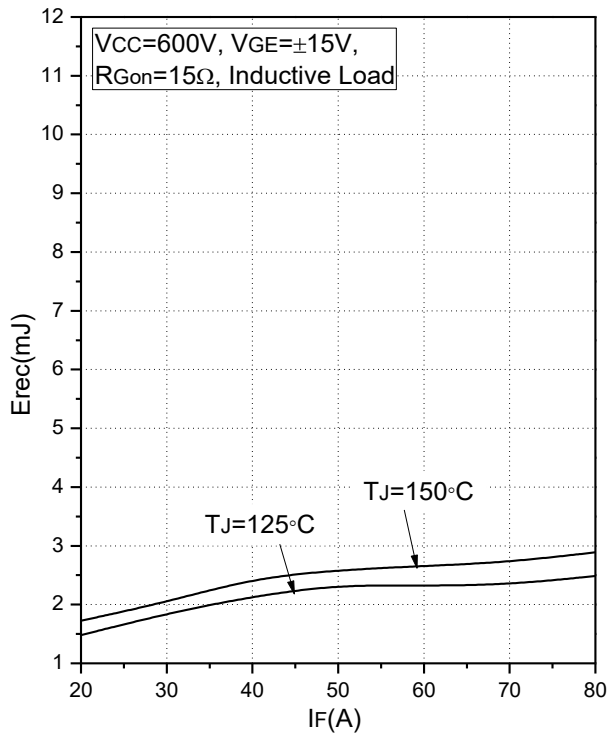


Fig.7 Typical Switching Loss vs. Forward Current (Inverter)

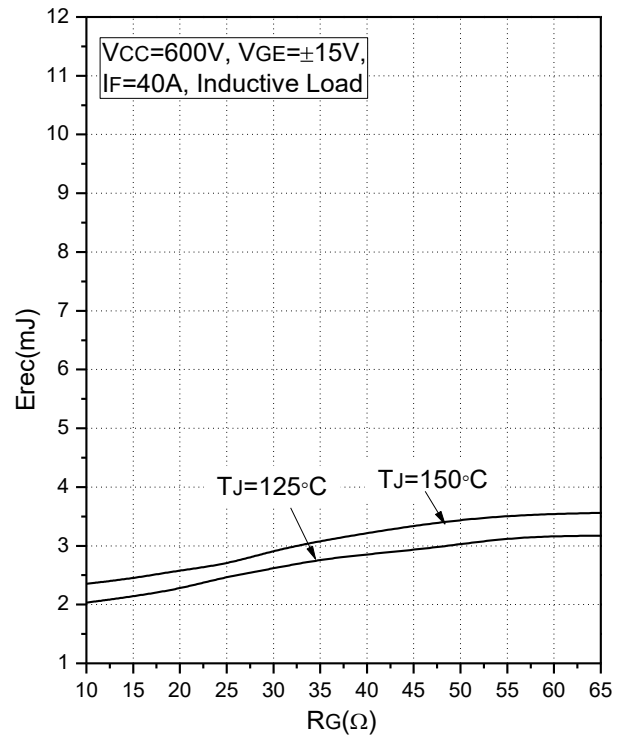


Fig.8 Typical Switching Loss vs. Gate Resistance (Inverter)

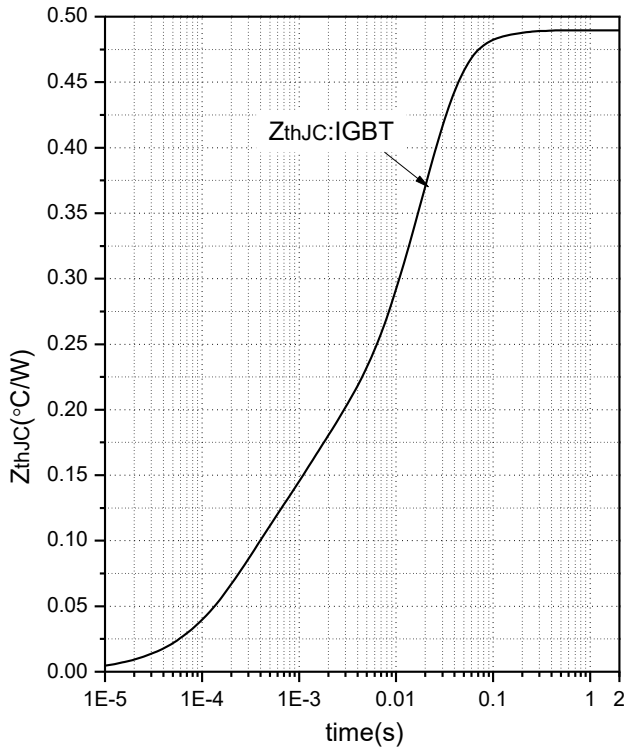


Fig.9 Transient Thermal Impedance (Inverter-IGBT)

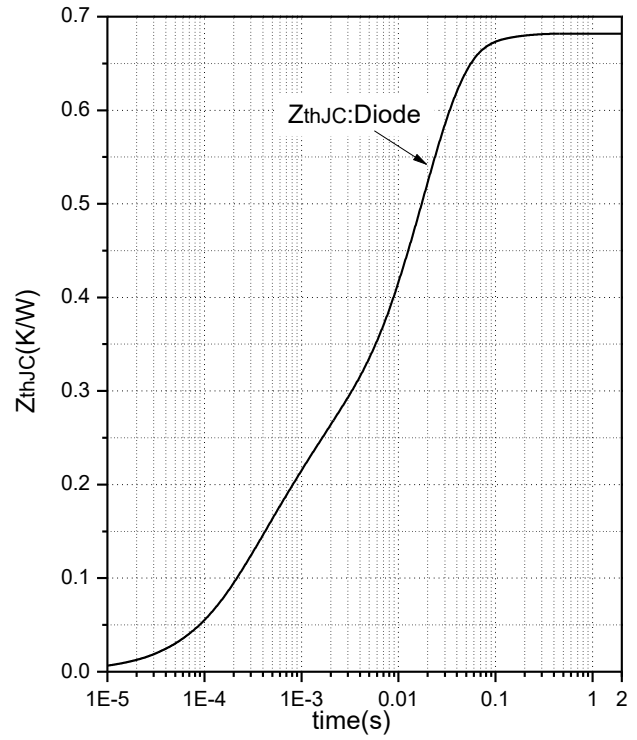


Fig.10 Transient Thermal Impedance (Inverter-Diode)

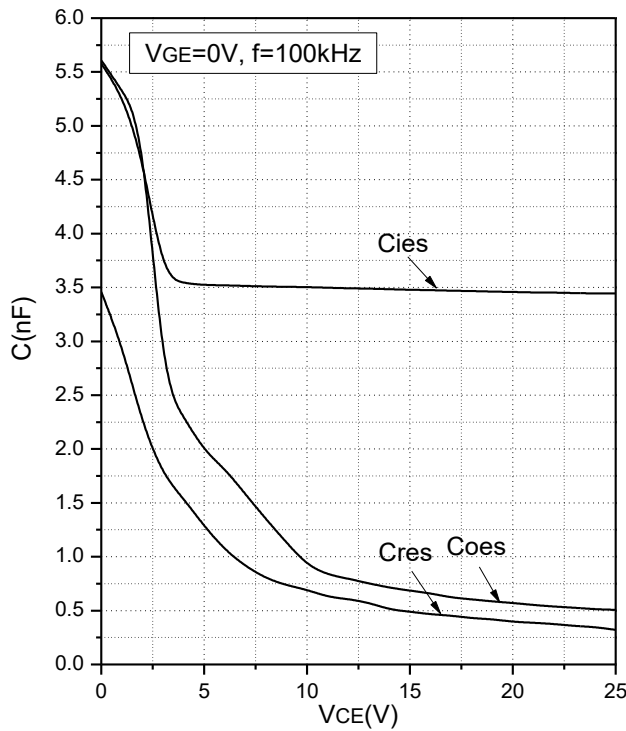


Fig.11 Capacitance Characteristics (Inverter)

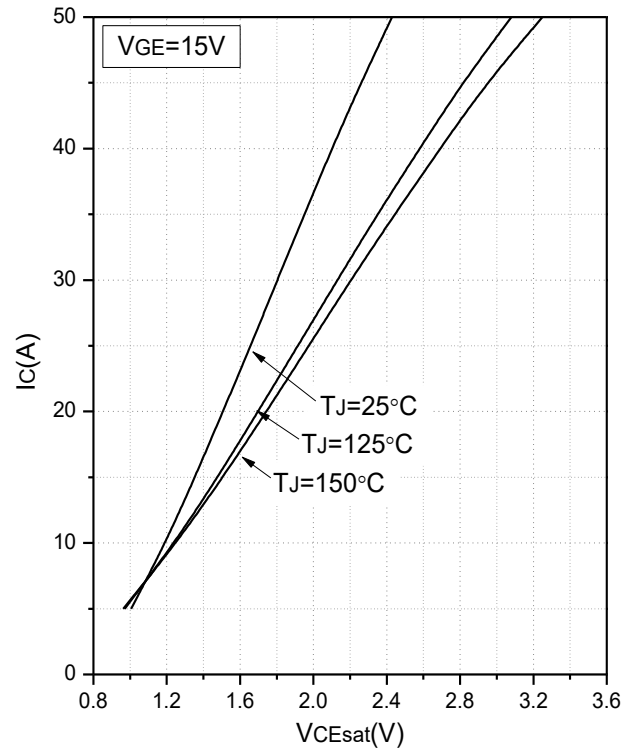


Fig.12 Typical Saturation Voltage Characteristics(Brake-Chopper)

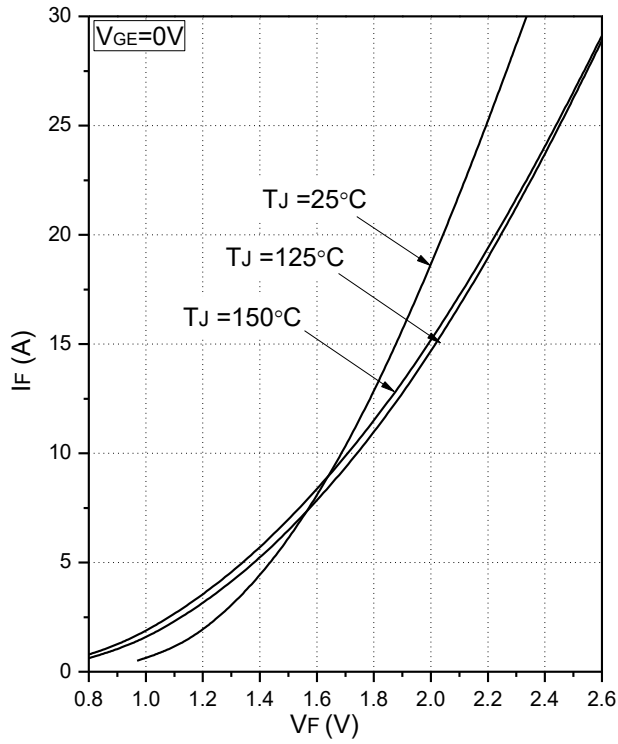


Fig.13 Forward Characteristics of Diode (Brake-Chopper)

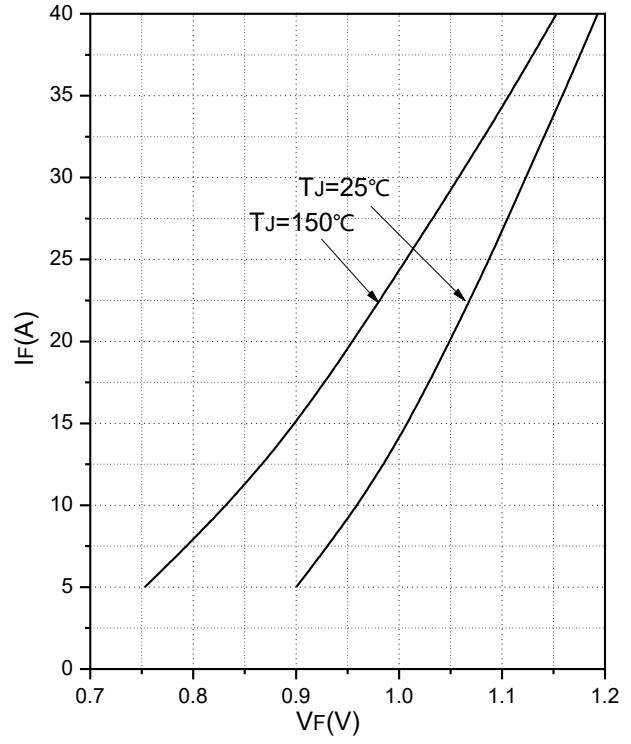


Fig.14 Forward Characteristics of Diode (Rectifier)

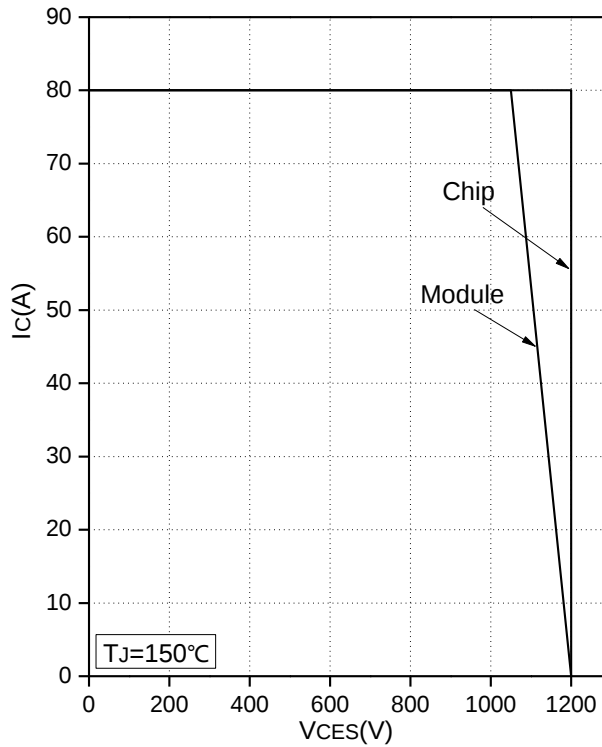


Fig.15 Reverse Bias Safe Operation Area (RBSOA)

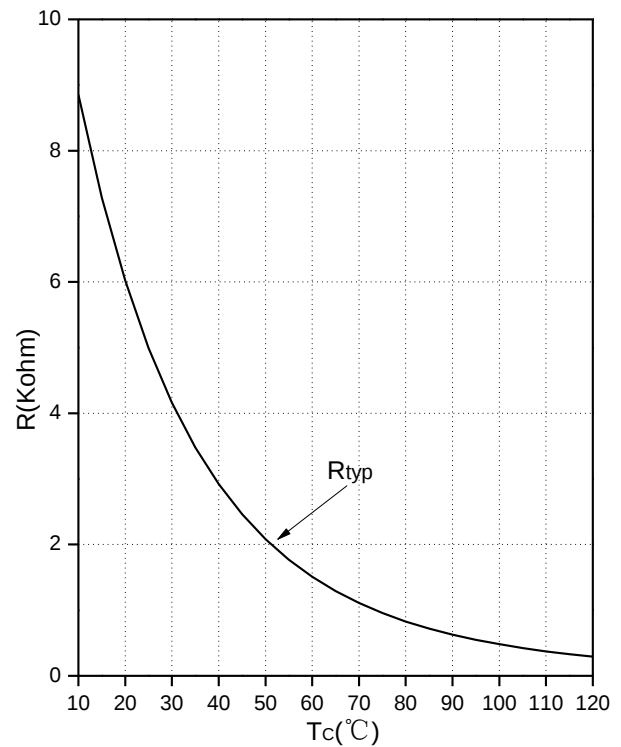
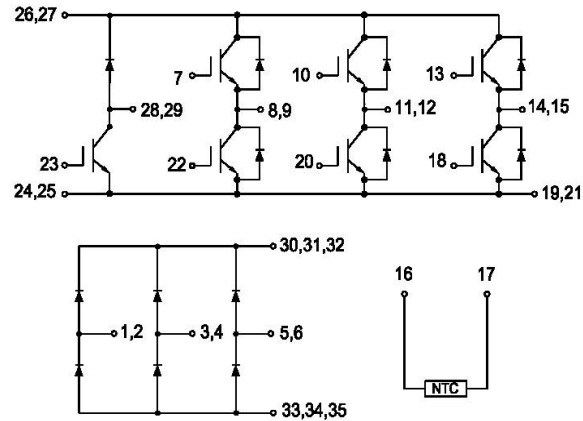


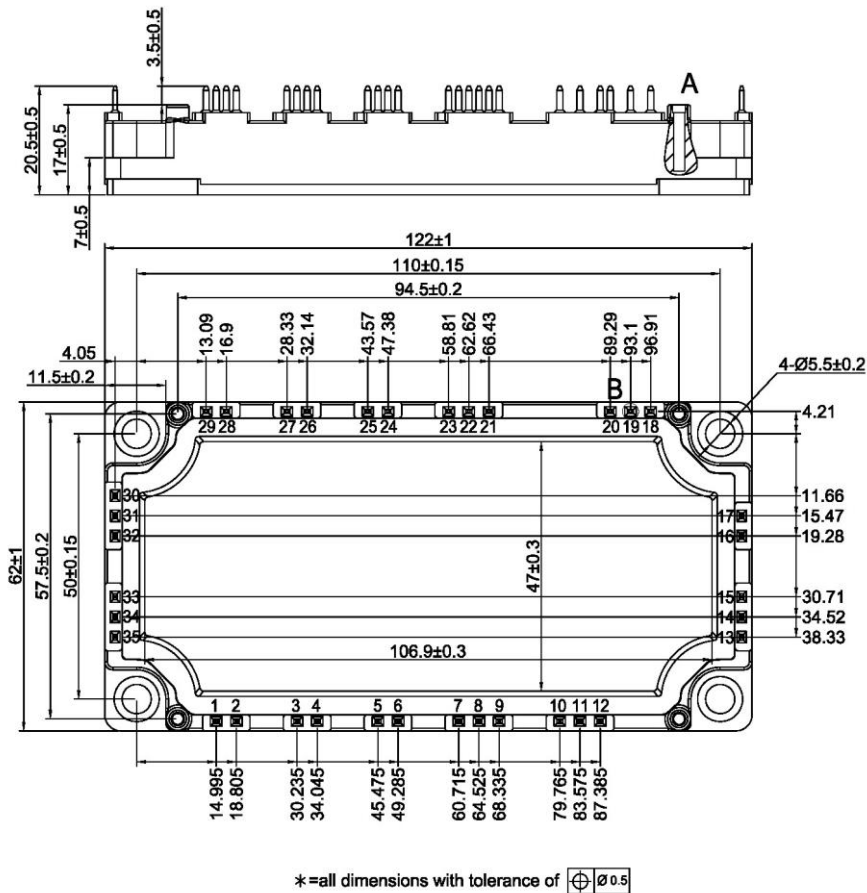
Fig.16 NTC Temperature Characteristics



Internal Circuit:



Package Outline (Unit: mm):





Date	Revision	Notes
03/15/2024	01	Initial Release

Announcement

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