

GT225TL120P4H

IGBT Module

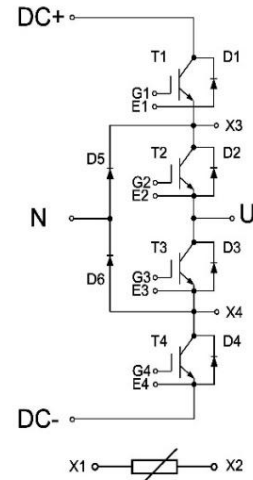
Features:

- $V_{CES}=1200V$ $I_C=225A$ Trench & Field Stop IGBT Module
- Maximum Junction Temperature $-40 - +175^{\circ}C$
- Low Switching Loss
- 100% RBSOA Tested($2 \times I_C$)
- Low Stray Inductance
- Lead Free, Compliant with RoHS Requirement

Applications:

- 3-Level-Application
- Solar Application

Circuit Diagram



Type	Package	Marking
GT225TL120P4H	P4	GT225TL120P4H

IGBT, Buck Switch(T1/T4)

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

Symbol	Description	Value	Units
V_{CES}	Collector-Emitter Blocking Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Continuous Collector Current, limited by T_{Jmax}	$T_C=90^{\circ}C$	225
		$T_C=25^{\circ}C$	450
I_{CM}	Peak Collector Current Repetitive	t_p limited by T_{Jmax}	450
P_D	Maximum Power Dissipation (IGBT)	$T_C=25^{\circ}C, T_{Jmax}=175^{\circ}C$	2300



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

Static Characteristics

Symbol	Description	Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=7.8\text{mA}$, $V_{CE}=V_{GE}$	4.0	4.8	6.0	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=225\text{A}$, $V_{GE}=15\text{V}$	$T_J=25^\circ\text{C}$	1.53	1.85	V
			$T_J=125^\circ\text{C}$	1.89		V
			$T_J=175^\circ\text{C}$	2.10		V
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}$, $V_{CE}=1200\text{V}$, $T_J=25^\circ\text{C}$			1	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=20\text{V}$, $V_{CE}=0\text{V}$, $T_J=25^\circ\text{C}$			400	nA
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}$, $V_{GE}=0\text{V}$, $f=100\text{kHz}$		37.85		nF
C_{oes}	Output Capacitance			1.35		nF
C_{res}	Reverse Transfer Capacitance			0.37		nF

Switching Characteristics

$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600V, I_C=225A,$ $R_{Gon}=2\Omega, R_{Goff}=2\Omega$ $V_{GE}=\pm 15V,$ Inductive Load	$T_J=25^{\circ}C$		38		ns
			$T_J=125^{\circ}C$		30		
			$T_J=175^{\circ}C$		36		
t_r	Rise Time		$T_J=25^{\circ}C$		19		ns
			$T_J=125^{\circ}C$		22		
			$T_J=175^{\circ}C$		22		
$t_{d(off)}$	Turn-off Delay Time		$T_J=25^{\circ}C$		178		ns
			$T_J=125^{\circ}C$		209		
			$T_J=175^{\circ}C$		220		
t_f	Fall Time	$T_J=25^{\circ}C$		100		ns	
		$T_J=125^{\circ}C$		115			
		$T_J=175^{\circ}C$		175			
E_{on}	Turn-on Switching Loss	$V_{CC}=600V, I_C=225A,$ $R_{Gon}=2\Omega, R_{Goff}=2\Omega$ $V_{GE}=\pm 15V,$ $di/dt=8250A/\mu s(T_J=175^{\circ}C)$ Inductive Load	$T_J=25^{\circ}C$		5.7		mJ
		$T_J=125^{\circ}C$		8.2			
		$T_J=175^{\circ}C$		10.6			

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E _{off}	Turn-off Switching Loss	V _{CC} =600V, I _C =225A, R _{Goff} =2Ω, R _{Goff} =2Ω V _{GE} =±15V, du/dt=6600V/μs(T _J =175°C) Inductive Load	T _J =25°C		9.6		mJ
			T _J =125°C		13.1		
			T _J =175°C		14.9		
Q _g	Total Gate Charge	V _{GE} =+15V...-15V	T _J =25°C		2.03		μC
R _{G (int)}	Internal Gate Resistance		T _J =25°C		1		Ω
R _{θJC}	IGBT Thermal Resistance: Junction-to-Case (per IGBT)					0.065	°C/W
R _{θCS}	IGBT Thermal Resistance: Case-to-Sink (per IGBT) (per IGBT, λ _{grease} = 1 W/(m · K))				0.116		°C/W

Buck Diode(D5/D6)

Maximum Rated Values of Diode (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		300	A
I _{FM}	Diode Maximum Forward Current	t _p =1ms	600	A

Electrical Characteristics of Diode (T_C=25°C unless otherwise specified)

Symbol	Description	Conditions		Min.	Typ.	Max.	Units
V _{FM}	Forward Voltage	I _F =300A	T _J =25°C		1.74	2.10	V
			T _J =125°C		1.90		
			T _J =175°C		1.92		
t _{rr}	Reverse Recovery Time	I _F =225A, -diF/dt=11600A/μs(T _J =175°C), V _R =600V, V _{GE} =-15V	T _J =25°C		180		ns
			T _J =125°C		300		
			T _J =175°C		378		
I _{rr}	Peak Reverse Recovery Current		T _J =25°C		402		A
			T _J =125°C		444		
			T _J =175°C		480		
Q _{rr}	Reverse Recovery Charge		T _J =25°C		24.0		μC
			T _J =125°C		39.2		
			T _J =175°C		49.3		

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E _{rec}	Reverse Recovery Energy	I _F =225A, -diF/dt=11600A/μs(T _J =175°C), V _R =600V, V _{GE} =-15V	T _J =25°C		11.4		mJ
			T _J =125°C		19.2		
			T _J =175°C		24.4		
R _{θJC}	Diode Thermal Resistance: Junction-to-Case (per Diode)					0.114	°C/W
R _{θCS}	Diode Thermal Resistance: Case-to-Sink (per Diode, λ _{grease} = 1 W/(m • K))				0.205		°C/W

IGBT, Boost Switch(T2/T3)

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

Symbol	Description		Value	Units
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 =90°C	225	A
		T _C =25°C	450	A
I _{CM}	Peak Collector Current Repetitive	T _p limited by T _{Jmax}	450	A
P _D	Maximum Power Dissipation (IGBT)	T _C =25°C, T _{Jmax} =175°C	2300	W

Electrical Characteristics of IGBT (T_C=25°C unless otherwise specified)

Static Characteristics

Symbol	Description	Conditions	Min.	Typ.	Max.	Units
V _{GE(th)}	Gate-Emitter Threshold Voltage	I _C =7.8mA, V _{CE} =V _{GE}	4.0	4.8	6.0	V
V _{CE(sat)}	Collector-Emitter Saturation Voltage	I _C =225A, V _{GE} =15V	T _J =25°C	1.53	1.85	V
			T _J =125°C	1.89		V
			T _J =175°C	2.10		V
I _{CES}	Collector-Emitter Leakage Current	V _{GE} =0V, V _{CE} =1200V, T _J =25°C			1	mA
I _{GES}	Gate-Emitter Leakage Current	V _{GE} =20V, V _{CE} =0V, T _J =25°C			400	nA
C _{ies}	Input Capacitance	V _{CE} =25V, V _{GE} =0V, f=100kHz		37.85		nF
C _{oes}	Output Capacitance			1.35		nF
C _{res}	Reverse Transfer Capacitance			0.37		nF

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Switching Characteristics

t _{d(on)}	Turn-on Delay Time	V _{CC} =600V, I _C =225A, R _{Gon} =2Ω, R _{Goff} =2Ω V _{GE} =±15V, Inductive Load	T _J =25°C		36		ns
			T _J =125°C		35		
			T _J =175°C		37		
t _r	Rise Time		T _J =25°C		22		ns
			T _J =125°C		23		
			T _J =175°C		24		
t _{d(off)}	Turn-off Delay Time		T _J =25°C		180		ns
			T _J =125°C		211		
			T _J =175°C		225		
t _f	Fall Time	T _J =25°C		87		ns	
		T _J =125°C		130			
		T _J =175°C		143			
E _{on}	Turn-on Switching Loss	V _{CC} =600V, I _C =225A, R _{Gon} =2Ω, R _{Goff} =2Ω V _{GE} =±15V, di/dt=7430A/μs(T _J =175°C) Inductive Load	T _J =25°C		6.7		mJ
		T _J =125°C		9.4			
		T _J =175°C		10.9			
E _{off}	Turn-off Switching Loss	V _{CC} =600V, I _C =225A, R _{Goff} =2Ω, R _{Goff} =2Ω V _{GE} =±15V, du/dt=6500V/μs(T _J =175°C) Inductive Load	T _J =25°C		10.0		mJ
		T _J =125°C		14.0			
		T _J =175°C		16.2			
Q _g	Total Gate Charge	V _{GE} =+15V...-15V	T _J =25°C		2.03		μC
R _{G (int)}	Internal Gate Resistance		T _J =25°C		1		Ω
R _{θJC}	IGBT Thermal Resistance: Junction-to-Case (per IGBT)					0.065	°C/W
R _{θCS}	IGBT Thermal Resistance: Case-to-Sink (per IGBT) (per IGBT, λ _{grease} = 1 W/(m • K))				0.116		°C/W

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Boost Diode(D1/D4)

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

V_{RRM}	Repetitive Peak Reverse Voltage	$T_J=25^{\circ}\text{C}$	1200	V
I_F	Diode Continuous Forward Current		300	A
I_{FM}	Diode Maximum Forward Current	$t_p=1\text{ms}$	600	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 =300A	T _J =25°C		1.74	2.10	V	
			T _J =125°C		1.90			
			T _J =175°C		1.92			
t _{rr}	Reverse Recovery Time	I _F =225A, -diF/dt=10400A/μs(T _J =175°C), V _R =600V, V _{GE} =-15V	T _J =25°C		180		ns	
			T _J =125°C		290			
			T _J =175°C		380			
I _{rr}	Peak Reverse Recovery Current		T _J =25°C		354		A	
			T _J =125°C		384			
			T _J =175°C		396			
Q _{rr}	Reverse Recovery Charge		T _J =25°C		23.2		μC	
			T _J =125°C		36.9			
			T _J =175°C		46.9			
E _{rec}	Reverse Recovery Energy		T _J =25°C		10.8		mJ	
			T _J =125°C		18.0			
			T _J =175°C		22.9			
R _{θJC}	Diode Thermal Resistance: Junction-to-Case (per Diode)					0.114	°C/W	
R _{θCS}	Diode Thermal Resistance: Case-to-Sink (per Diode, λ _{grease} = 1 W/(m • K))				0.205		°C/W	

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Boost Switch Inverter Diode(D2/D3)

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

V_{RRM}	Repetitive Peak Reverse Voltage	$T_J=25^{\circ}\text{C}$	1200	V
I_F	Diode Continuous Forward Current		300	A
I_{FM}	Diode Maximum Forward Current	$t_p=1\text{ms}$	600	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 =300A	T _J =25°C		1.74	2.10	V
			T _J =125°C		1.90		
			T _J =175°C		1.92		
R _{θJC}	Diode Thermal Resistance: Junction-to-Case (per Diode)					0.114	°C/W
R _{θCS}	Diode Thermal Resistance: Case-to-Sink (per Diode, λ _{grease} = 1 W/(m • K))				0.205		°C/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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Symbol	Description	Conditions	Min.	Typ.	Max.	Units
V _{iso}	Isolation Voltage (All Terminals Shorted)	RMS,f=50Hz,60s	3400			V
T _J	Maximum Junction Temperature		-40		175	°C
T _{JOP}	Maximum Operating Junction Temperature Range ^{note1}		-40		150	°C
T _{stg}	Storage Temperature		-40		125	°C
CTI	Comparative Tracking Index		200			
T	Mounting Screw:M5		2.5		4.0	N·m
G	Weight			162		g

note1: T_{JOP}> 150°C is only allowed for operation at overload conditions.

Ordering Information Table

Device code

G	T	225	TL	120	P4	H
①	②	③	④	⑤	⑥	⑦

- ① - IGBT Module
- ② - Trench, Low Switching Losses IGBT
- ③ - Rated Current (225=225A)
- ④ - Circuit Configuration (Three Level, I Type)
- ⑤ - Rated Voltage (120=1200V)
- ⑥ - Package Type
- ⑦ - Test Level (Pass the Important Reliability Test-Industrial Grade)



Characteristic diagram

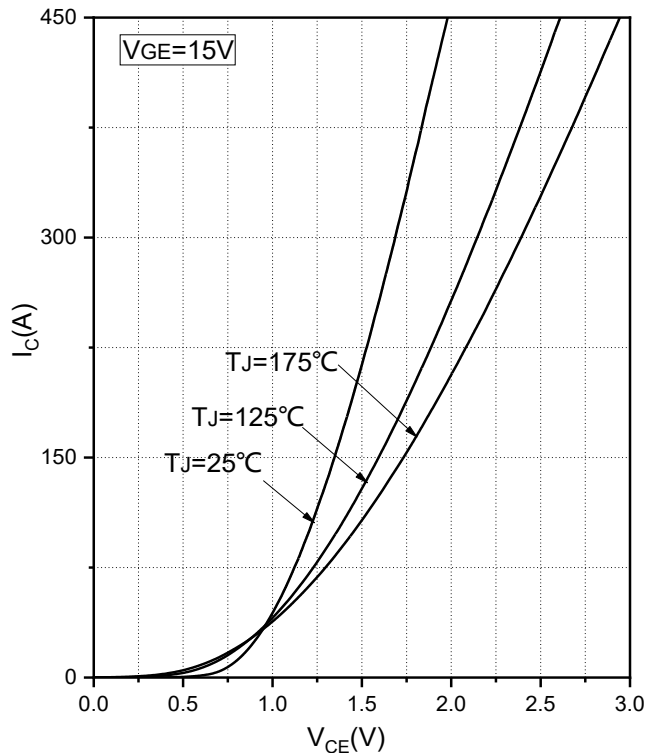


Fig.1 Typical Saturation Voltage Characteristics(T1,T4)

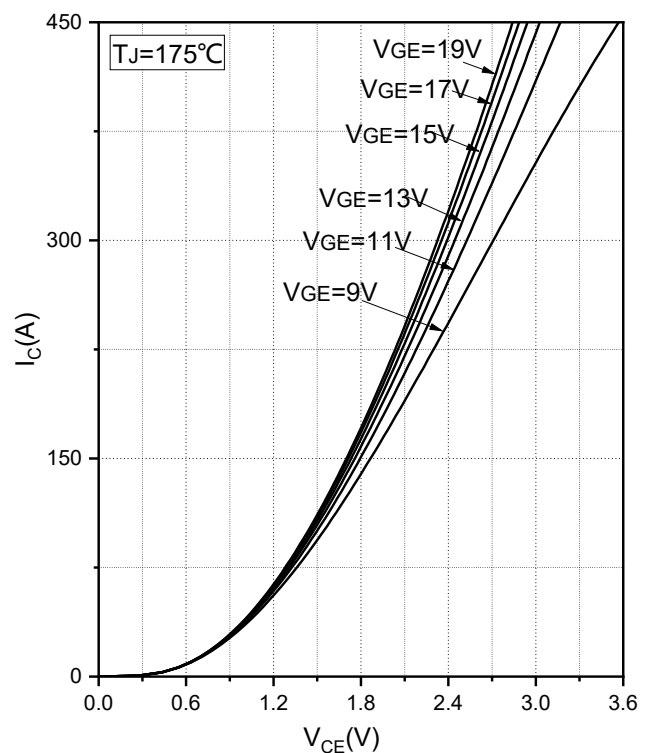


Fig.2 Typical Output Characteristics(T1,T4)

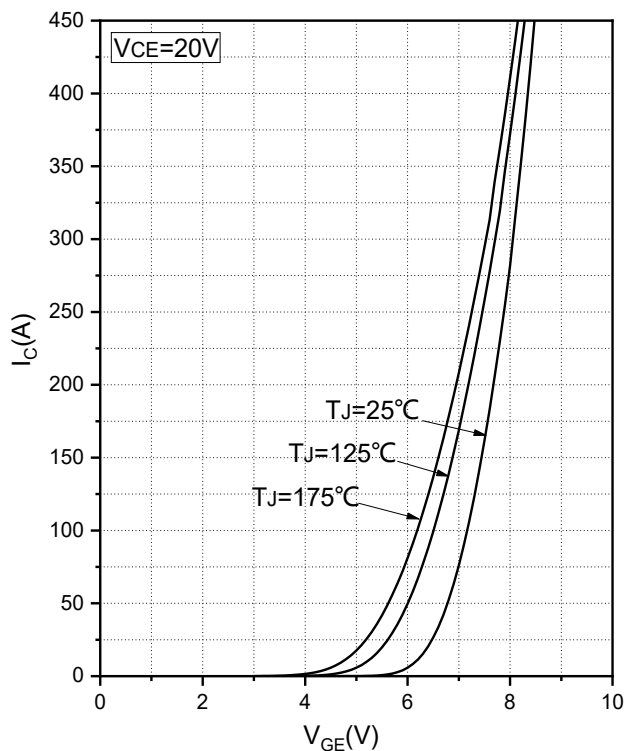


Fig.3 Transfer Characteristic(T1,T4)

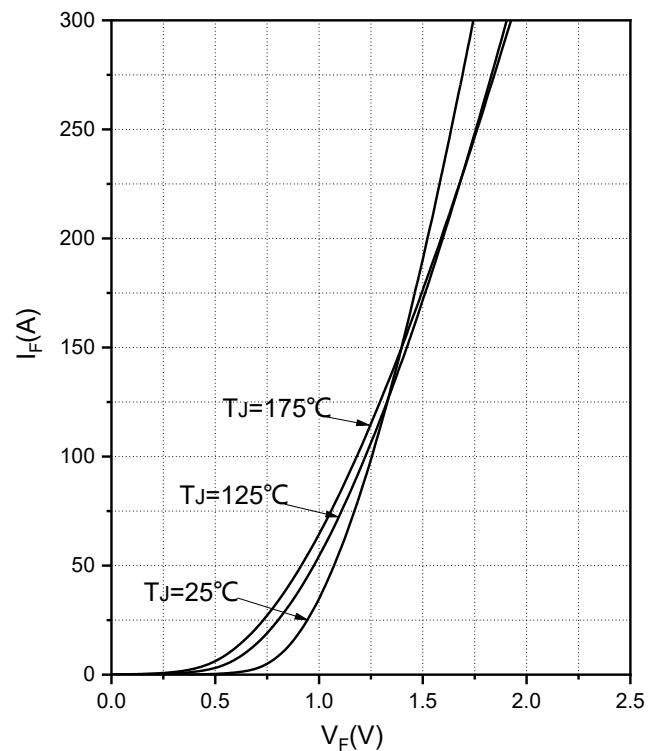


Fig.4 Forward Characteristics of Diode(D1,D4)

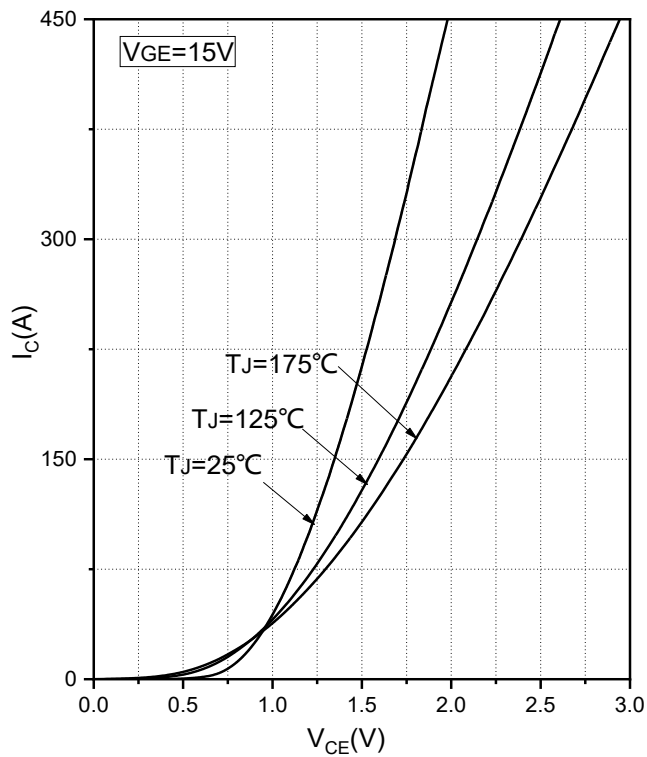


Fig.5 Typical Saturation Voltage Characteristics(T2,T3)

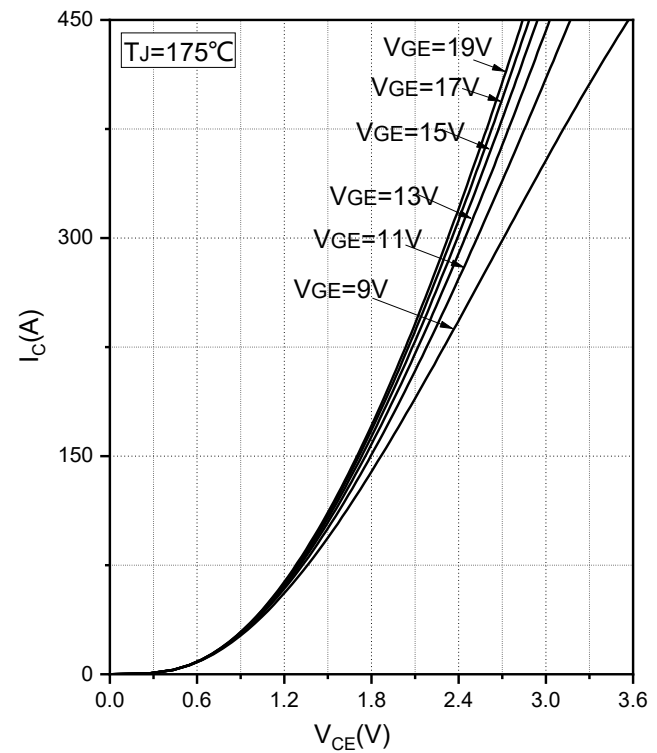


Fig.6 Typical Output Characteristics(T2,T3)

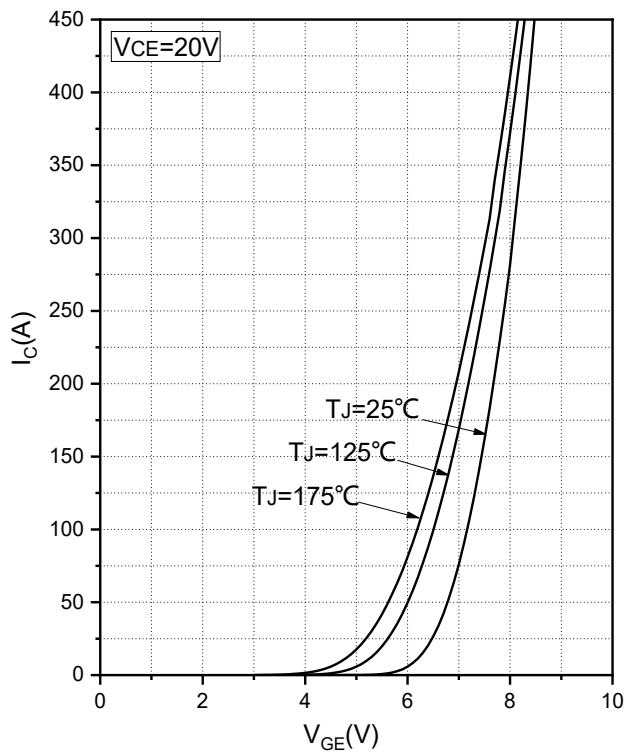


Fig.7 Transfer Characteristic(T2,T3)

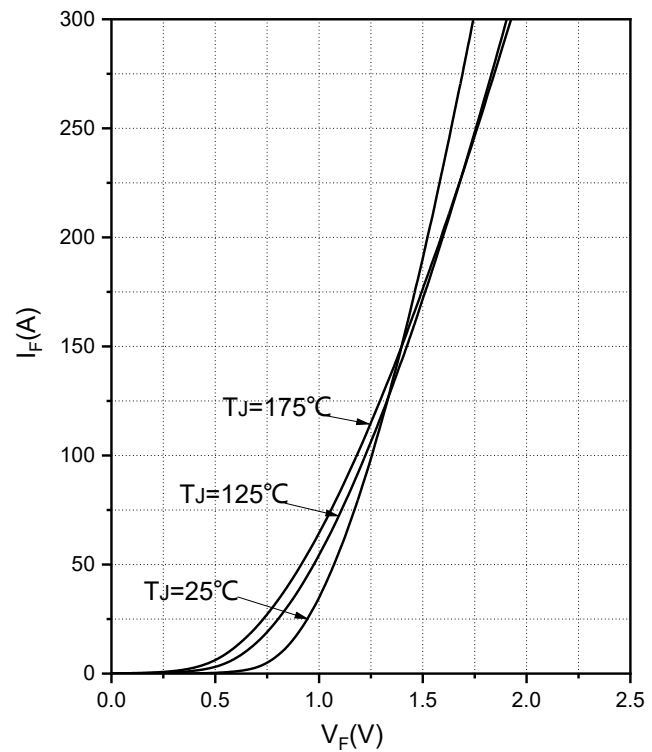


Fig.8 Forward Characteristics of Diode(D2,D3)

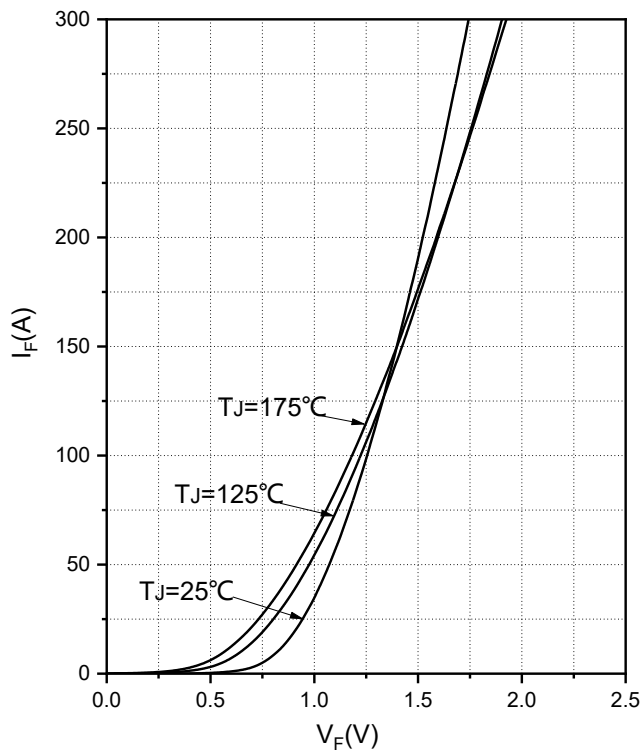


Fig.9 Forward Characteristics of Diode(D5,D6)

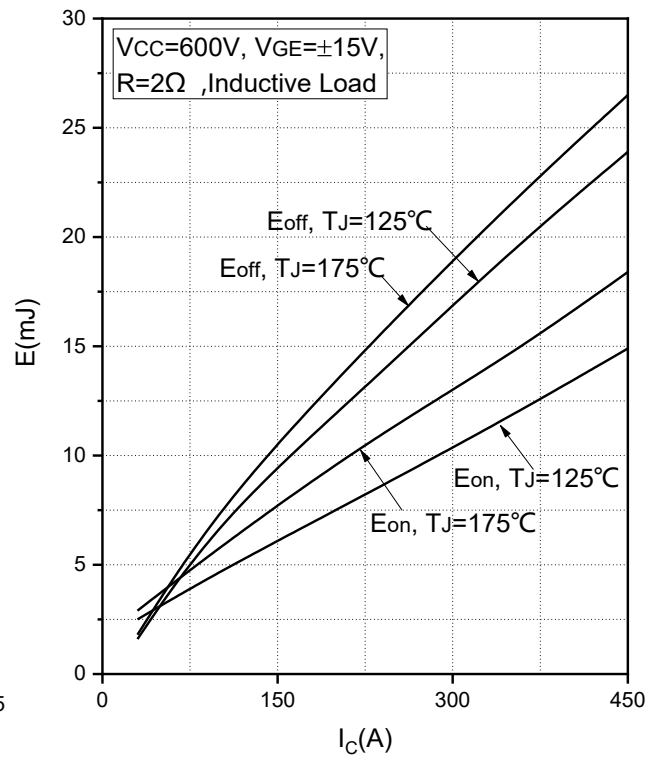


Fig.10 Typical Switching Loss vs. Collector Current(T1,T4)

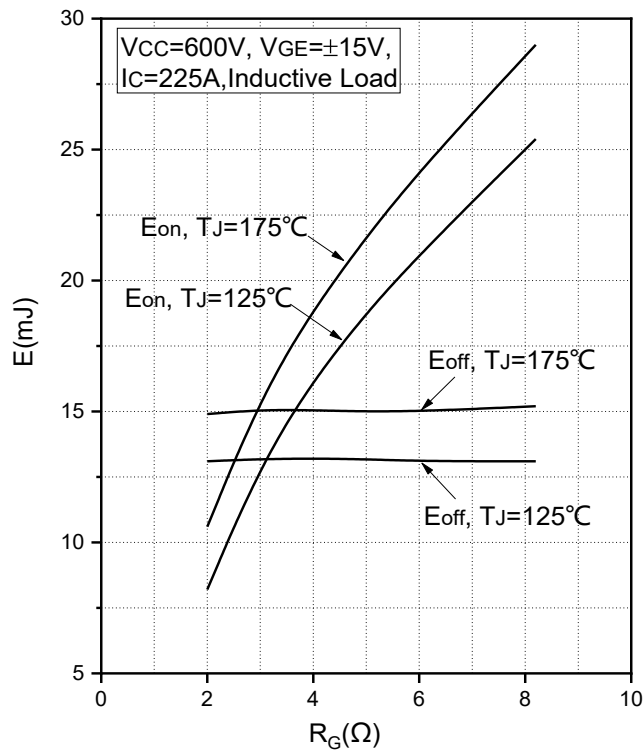


Fig.11 Typical Switching Loss vs. Gate Resistance(T1,T4)

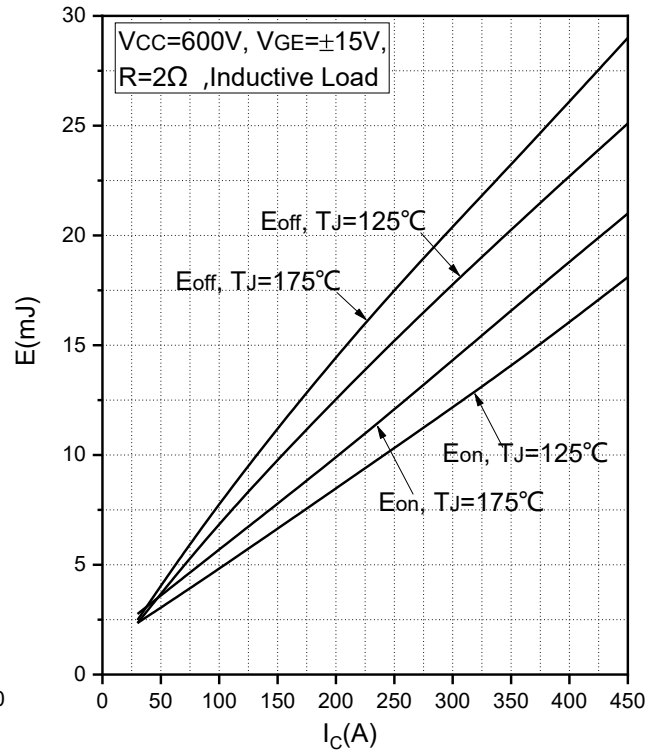
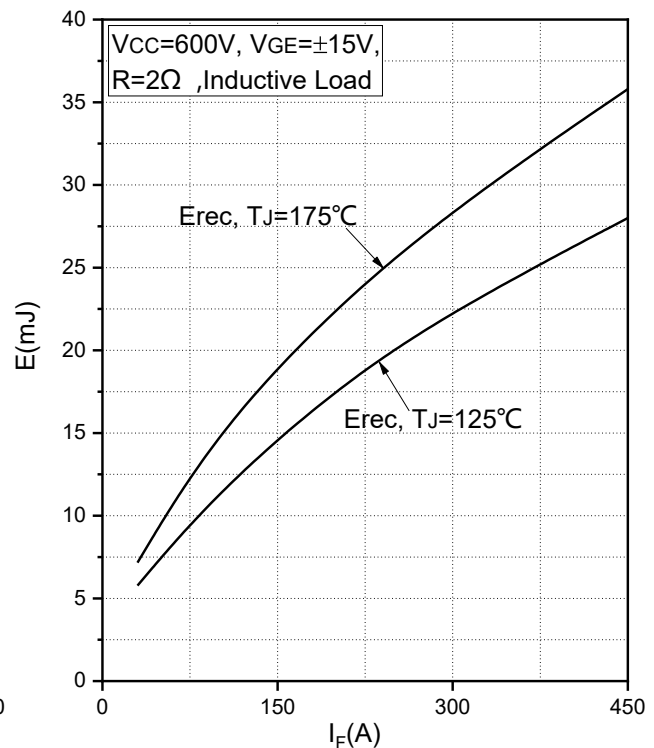
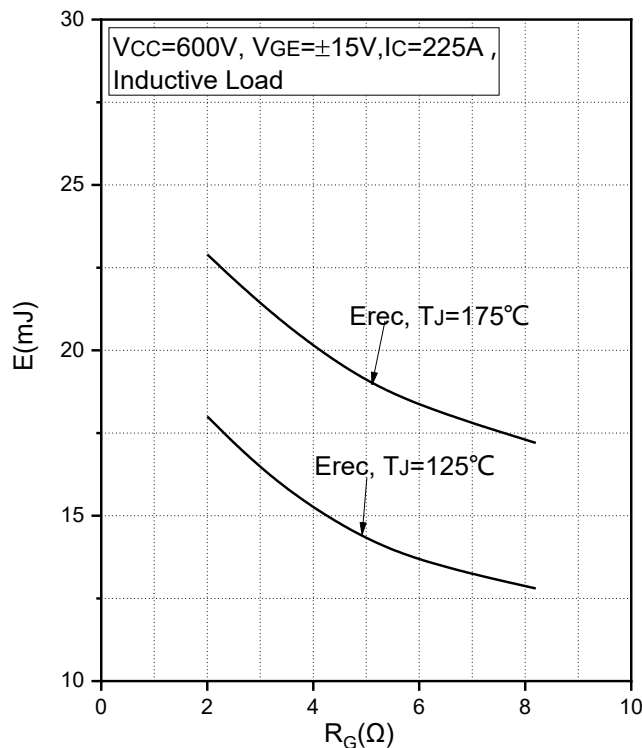
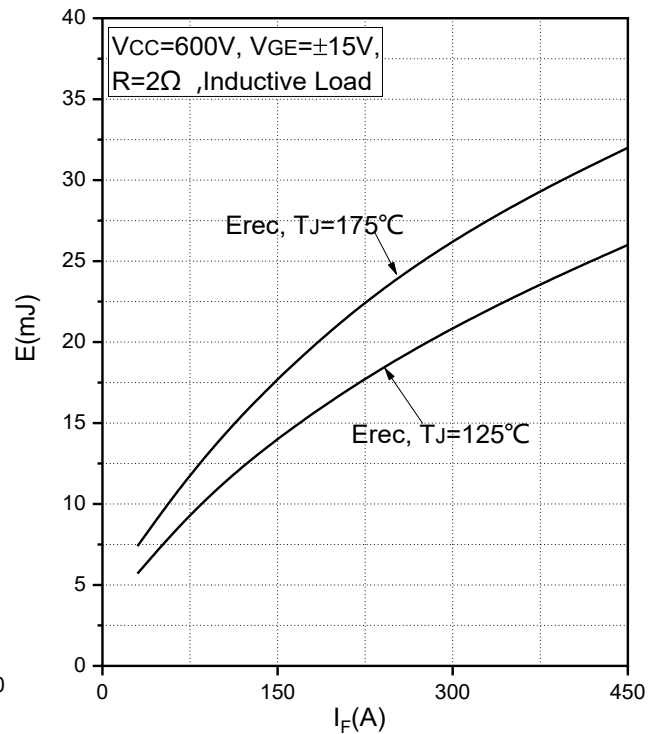
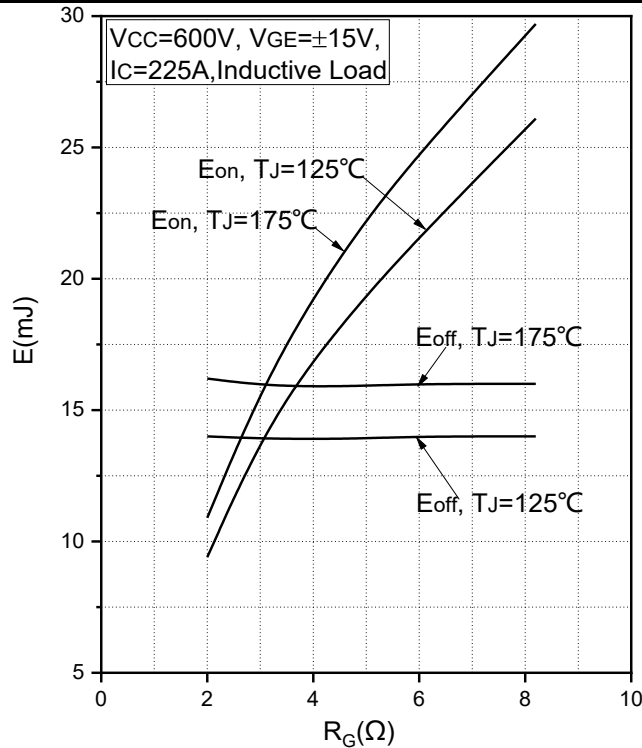
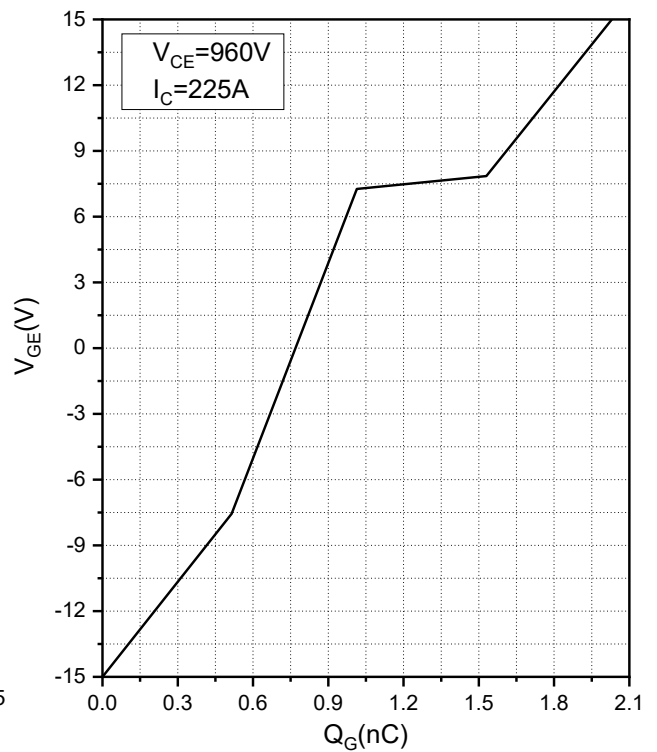
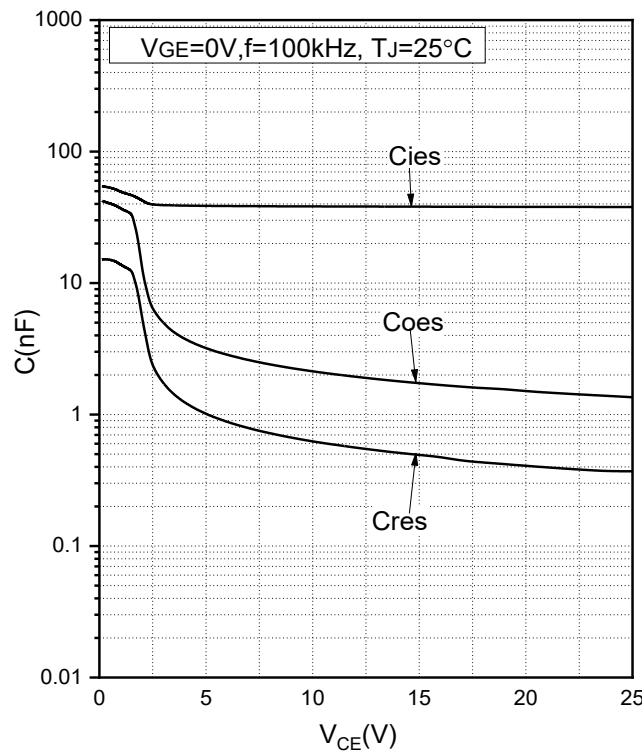
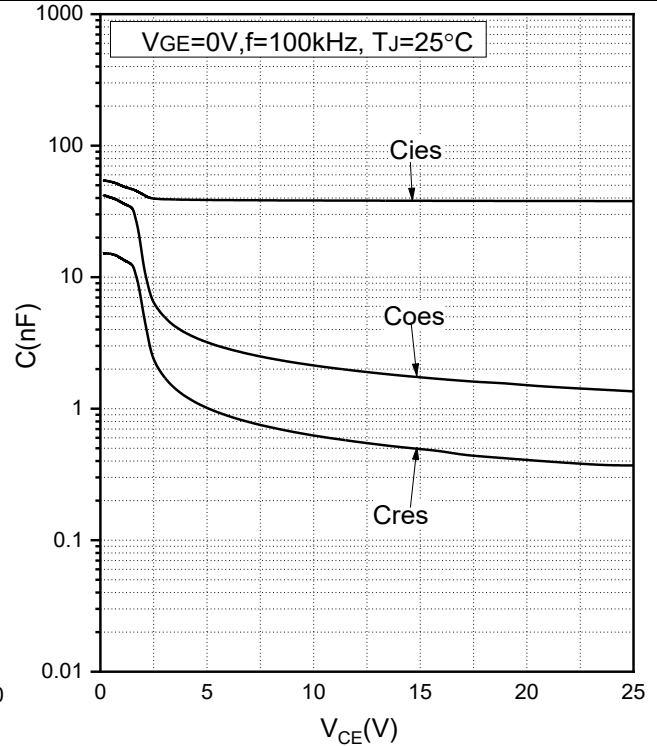
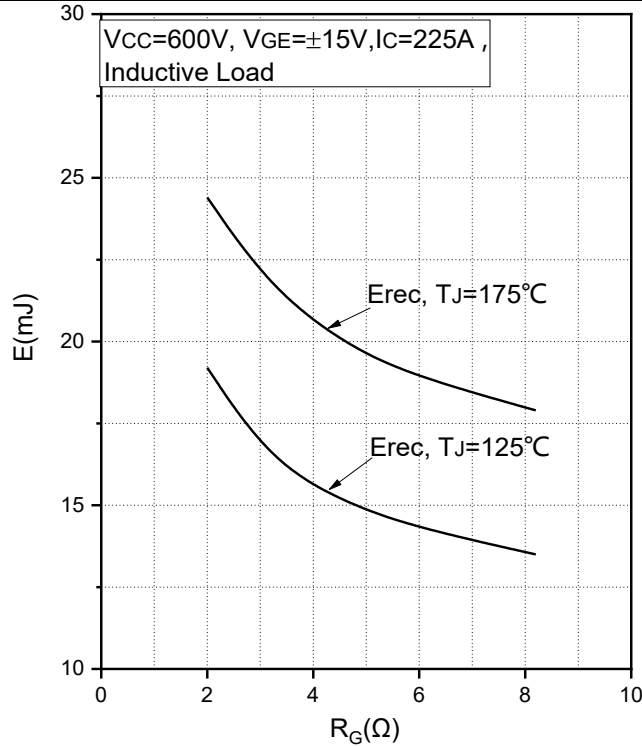


Fig.12 Typical Switching Loss vs. Collector Current(T2,T3)



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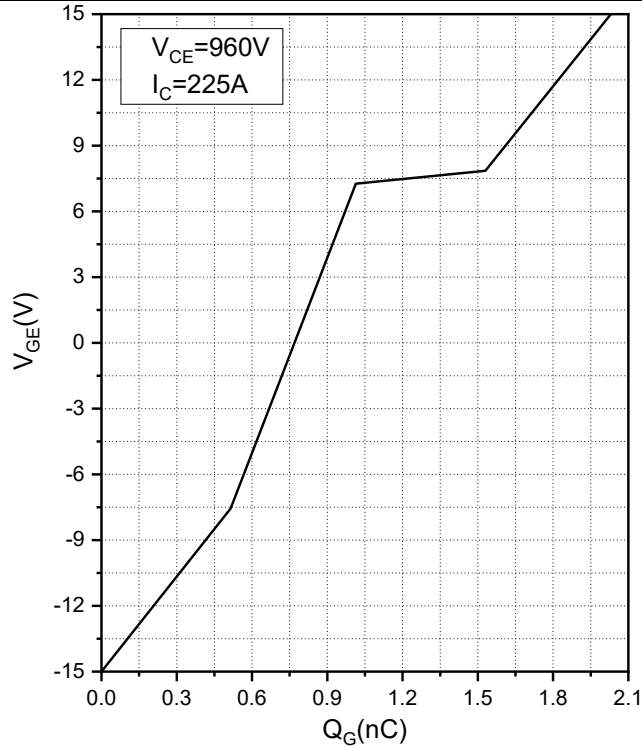


Fig.21 Gate Charge Characteristics(T2,T3)

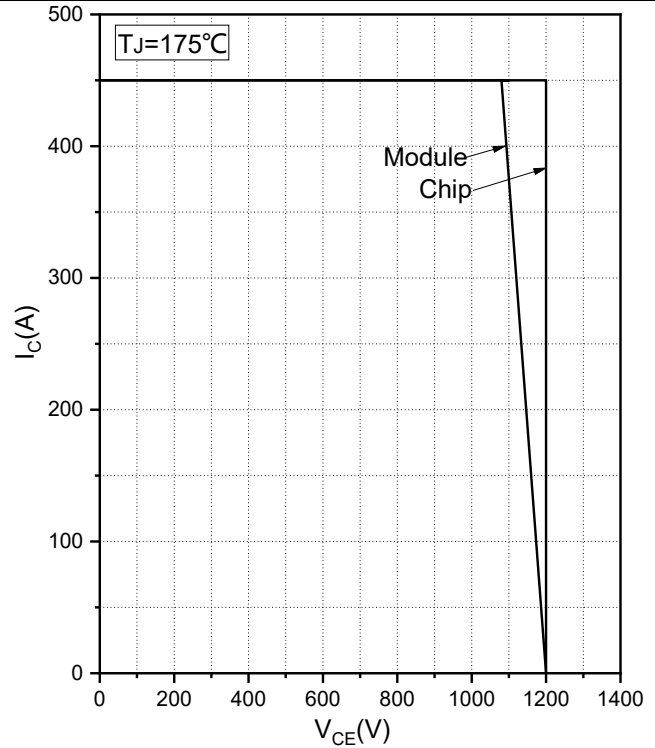


Fig.22 Reverse Bias Safe Operation Area (RBSOA)(T1,T4)

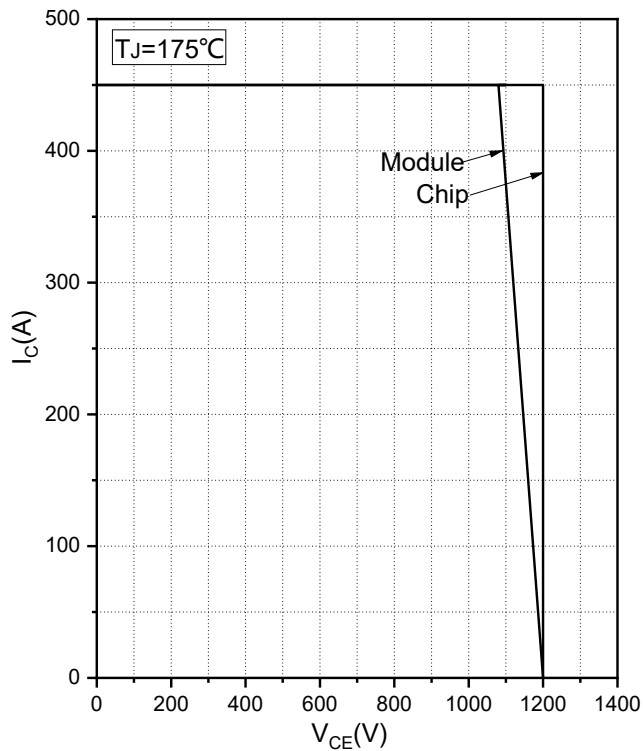


Fig.23 Reverse Bias Safe Operation Area (RBSOA)(T2,T3)

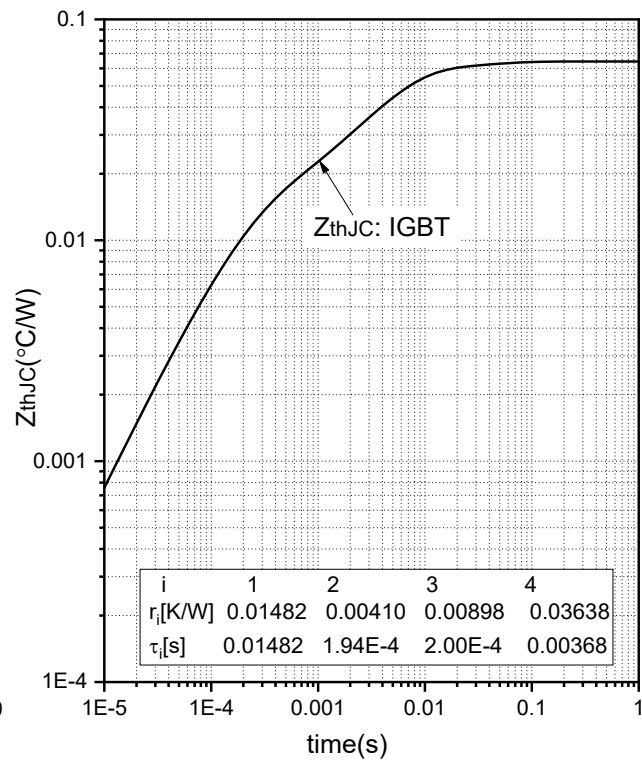


Fig.24 Transient Thermal Impedance (T1,T2,T3,T4)

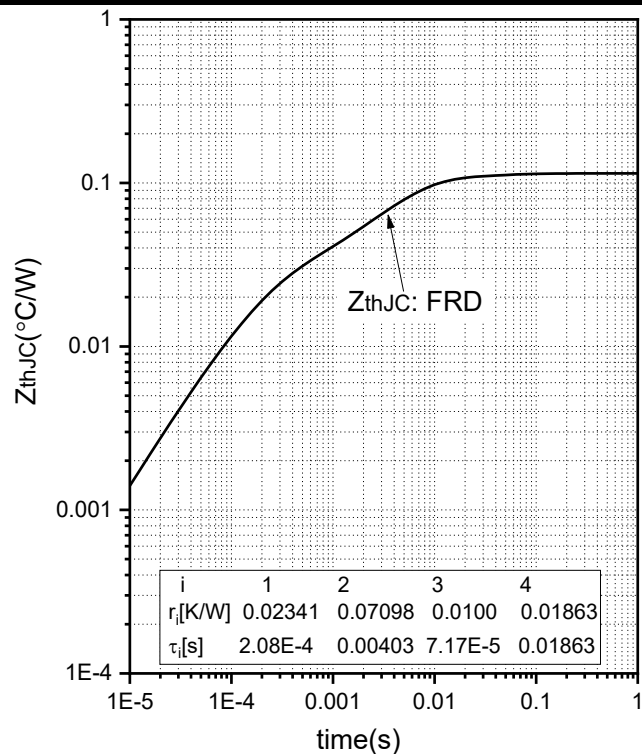


Fig.25 Transient Thermal Impedance (D1,D2,D3,D4,D5,D6)

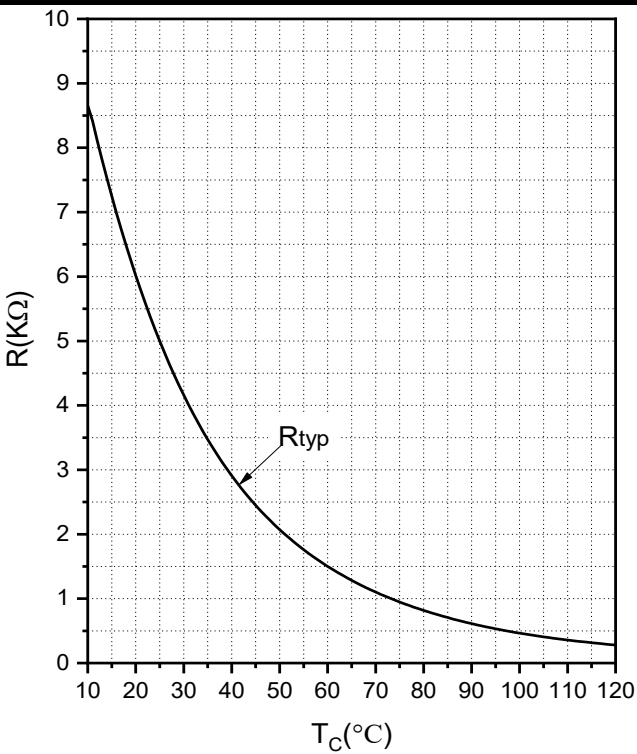
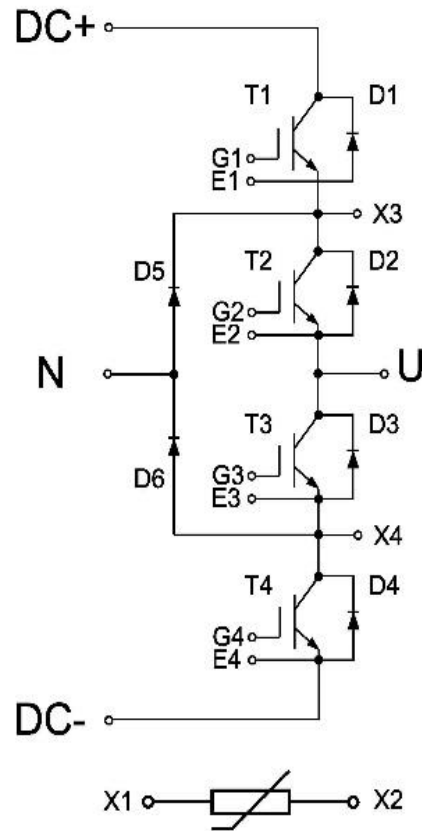


Fig.26 NTC Temperature Characteristics



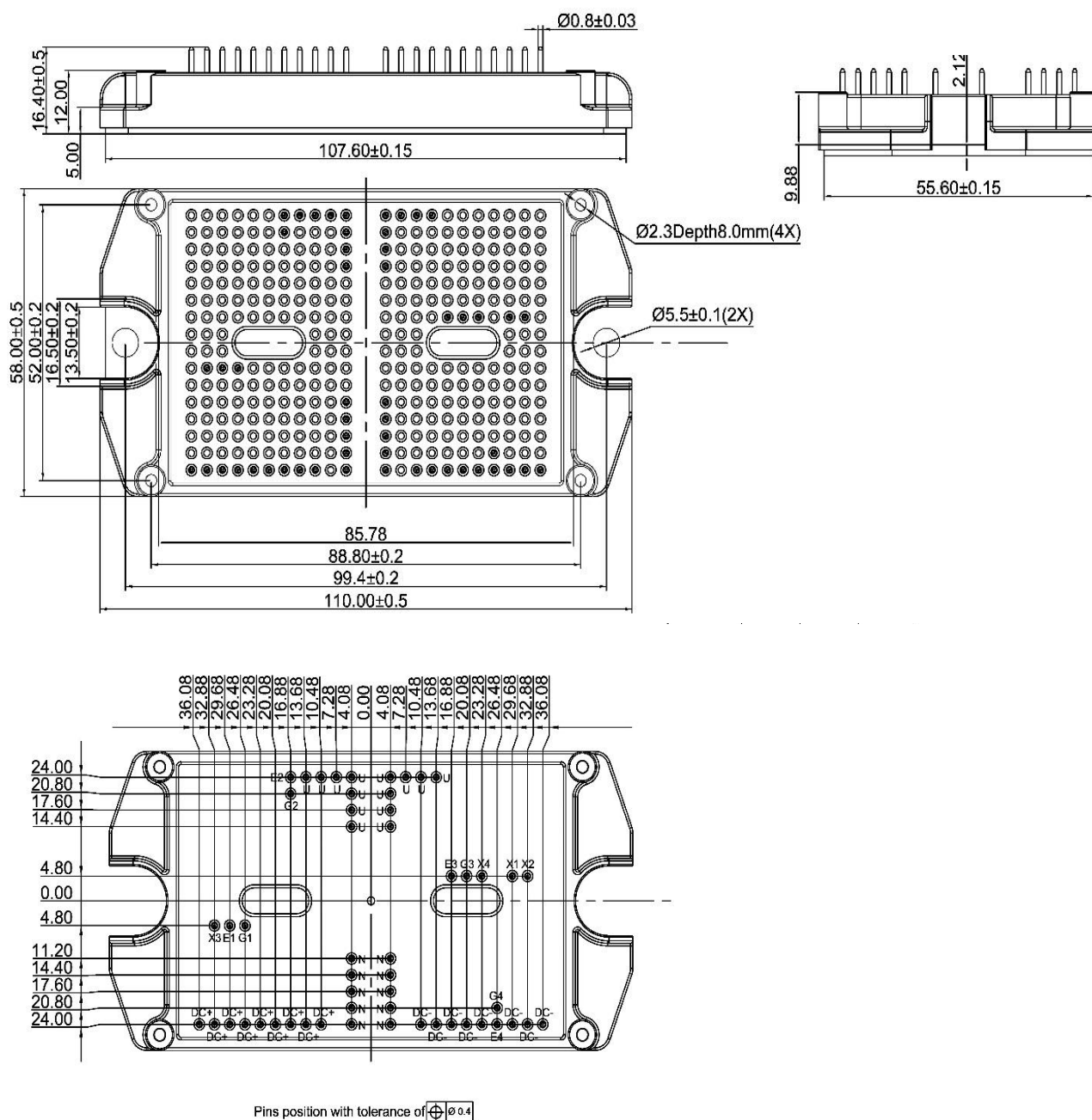
Internal Circuit:



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Package Outline (Unit: mm):





Revision	Notes
A	Final Datasheet Initial Release

Announcement

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The datasheet with “REV.” + “Arabic numerals” is based on engineering data for initial reference purpose only.

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