

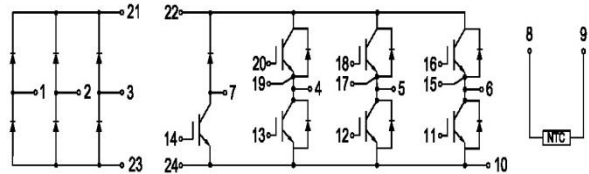


GK10PI60T5H

IGBT Module

Features:

- Non Punch Through (NPT) Technology
- Short Circuit Rated >10μs
- Low Saturation Voltage
- Low Switching Loss
- 100% RBSOA Tested(2xIc)
- Low Stray Inductance
- Lead Free, Compliant with RoHS Requirement



Applications:

- Industrial Inverters

IGBT, Inverter

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

V _{CES}	Collector-Emitter Blocking Voltage		600	V
V _{GES}	Gate-Emitter Voltage		±20	V
I _C	Continuous Collector Current	T _C =80°C	10	A
		T _C =25°C	20	A
I _{CM}	Repetitive Peak Collector Current	T _J =150°C	20	A
t _{SC}	Short Circuit Withstand Time		>10	μs
P _D	Maximum Power Dissipation per IGBT	T _C =25°C T _{Jmax} =150°C	84	W



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

Static Characteristics

Symbol	Description	Conditions	Min	Typ	Max	Unit
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1\text{mA}$, $V_{CE}=V_{GE}$	4.5	5.0	6.0	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=10\text{A}$, $V_{GE}=15\text{V}$	$T_J=25^\circ\text{C}$	2.10		V
			$T_J=125^\circ\text{C}$	2.50		V
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}$, $V_{CE}=V_{CES}$, $T_J=25^\circ\text{C}$			1	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=\pm 20\text{V}$, $V_{CE}=0\text{V}$, $T_J=25^\circ\text{C}$			200	nA
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}$, $V_{GE}=0\text{V}$, $f=100\text{kHz}$		0.52		nF
C_{oes}	Output Capacitance			0.08		nF
C_{res}	Reverse Transfer Capacitance			0.02		nF

Switching Characteristics

$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=300\text{V}$, $I_C=10\text{A}$, $R_{Gon}=36\Omega$, $V_{GE}=\pm 15\text{V}$, Inductive Load	$T_J=25^\circ\text{C}$	54		ns
			$T_J=125^\circ\text{C}$	57		
t_r	Rise Time		$T_J=25^\circ\text{C}$	24		ns
			$T_J=125^\circ\text{C}$	25		
$t_{d(off)}$	Turn-off Delay Time	$V_{CC}=300\text{V}$, $I_C=10\text{A}$, $R_{Goff}=36\Omega$, $V_{GE}=\pm 15\text{V}$, Inductive Load	$T_J=25^\circ\text{C}$	98		ns
			$T_J=125^\circ\text{C}$	99		
t_f	Fall Time		$T_J=25^\circ\text{C}$	210		ns
			$T_J=125^\circ\text{C}$	215		
E_{on}	Turn-on Switching Loss	$V_{CC}=300\text{V}$, $I_C=10\text{A}$, $R_{Gon}=36\Omega$, $V_{GE}=\pm 15\text{V}$, $di/dt=323\text{A}/\mu\text{s}$ ($T_J=125^\circ\text{C}$) Inductive Load	$T_J=25^\circ\text{C}$	0.39		mJ
			$T_J=125^\circ\text{C}$	0.43		
E_{off}	Turn-off Switching Loss		$T_J=25^\circ\text{C}$	0.13		mJ
			$T_J=125^\circ\text{C}$	0.20		
Q_g	Total Gate Charge	$V_{GE}=+15\text{V}\dots-15\text{V}$	$T_J=25^\circ\text{C}$	35		nC
RBSOA	$I_C=20\text{A}$, $V_{CC}=480\text{V}$, $V_p=600\text{V}$, $R_{Goff}=36\Omega$, $V_{GE}=+15\text{V}$ to 0V , $T_J=125^\circ\text{C}$			Trapezoid		
SCSOA	$V_{CC}=300\text{V}$, $V_{GE}=15\text{V}$, $T_J=125^\circ\text{C}$			10		μs
$R_{\theta JC}$	IGBT Thermal Resistance: Junction-To-Case(Per Leg)				1.49	$^\circ\text{C}/\text{W}$



Diode, Inverter

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

V_{RRM}	Repetitive Peak Reverse Voltage	600	V
I_F	Diode Continuous Forward Current	10	A
I_{FM}	Diode Maximum Forward Current	20	A

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

Symbol	Description	Conditions	Min	Typ	Max	Unit	
V_{FM}	Forward Voltage	$I_F=10\text{A}$	$T_J=25^\circ\text{C}$	1.55		V	
			$T_J=125^\circ\text{C}$	1.55			
t_{rr}	Reverse Recovery Time	$I_F=10\text{A}$, $-diF/dt = 1066\text{A}/\mu\text{s}(T_J=125^\circ\text{C})$, $V_{rr} = 300\text{V}$, $V_{GE} = -15\text{V}$	$T_J=25^\circ\text{C}$	109		ns	
			$T_J=125^\circ\text{C}$	119			
I_{rr}	Peak Reverse Recovery Current		$T_J=25^\circ\text{C}$	26.9		A	
			$T_J=125^\circ\text{C}$	28.4			
Q_{rr}	Reverse Recovery Charge		$T_J=25^\circ\text{C}$	0.47		μC	
			$T_J=125^\circ\text{C}$	0.67			
E_{rec}	Reverse Recovery Energy		$T_J=25^\circ\text{C}$	0.05		mJ	
			$T_J=125^\circ\text{C}$	0.10			
$R_{\theta JC}$	Diode Thermal Resistance: Junction-To-Case(Per Leg)				2.13	$^\circ\text{C}/\text{W}$	

IGBT, Brake-Chopper

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

V_{CES}	Collector-Emitter Blocking Voltage		600	V
V_{GES}	Gate-Emitter Voltage		± 20	V
I_C	Continuous Collector Current	$T_C=80^\circ\text{C}$	10	A
		$T_C=25^\circ\text{C}$	20	A
I_{CM}	Repetitive Peak Collector Current	$T_J=150^\circ\text{C}$	20	A
t_{sc}	Short Circuit Withstand Time		>10	μs
P_D	Maximum Power Dissipation per IGBT	$T_C=25^\circ\text{C}$ $T_{Jmax}=150^\circ\text{C}$	84	W



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

Static Characteristics

Symbol	Description	Conditions	Min	Typ	Max	Unit
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1\text{mA}$, $V_{CE}=V_{GE}$	4.5	5.0	6.0	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=10\text{A}$, $V_{GE}=15\text{V}$	$T_J=25^\circ\text{C}$	2.10		V
			$T_J=125^\circ\text{C}$	2.50		V
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}$, $V_{CE}=V_{CES}$, $T_J=25^\circ\text{C}$			1	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=\pm 20\text{V}$, $V_{CE}=0\text{V}$, $T_J=25^\circ\text{C}$			200	nA
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}$, $V_{GE}=0\text{V}$, $f=100\text{kHz}$		0.52		nF
C_{oes}	Output Capacitance			0.08		nF
C_{res}	Reverse Transfer Capacitance			0.02		nF

Switching Characteristics

$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=300\text{V}$, $I_C=10\text{A}$, $R_{Gon}=36\Omega$, $V_{GE}=\pm 15\text{V}$, Inductive Load	$T_J=25^\circ\text{C}$	54		ns
			$T_J=125^\circ\text{C}$	57		
t_r	Rise Time	$V_{CC}=300\text{V}$, $I_C=10\text{A}$, $R_{Gon}=36\Omega$, $V_{GE}=\pm 15\text{V}$, Inductive Load	$T_J=25^\circ\text{C}$	24		ns
			$T_J=125^\circ\text{C}$	25		
$t_{d(off)}$	Turn-off Delay Time	$V_{CC}=300\text{V}$, $I_C=10\text{A}$, $R_{Goff}=36\Omega$, $V_{GE}=\pm 15\text{V}$, Inductive Load	$T_J=25^\circ\text{C}$	98		ns
			$T_J=125^\circ\text{C}$	99		
t_f	Fall Time	$V_{CC}=300\text{V}$, $I_C=10\text{A}$, $R_{Goff}=36\Omega$, $V_{GE}=\pm 15\text{V}$, Inductive Load	$T_J=25^\circ\text{C}$	210		ns
			$T_J=125^\circ\text{C}$	215		
E_{on}	Turn-on Switching Loss	$V_{CC}=300\text{V}$, $I_C=10\text{A}$, $R_{Gon}=36\Omega$, $V_{GE}=\pm 15\text{V}$, $di/dt=323\text{A}/\mu\text{s}$ ($T_J=125^\circ\text{C}$) Inductive Load	$T_J=25^\circ\text{C}$	0.39		mJ
			$T_J=125^\circ\text{C}$	0.43		
E_{off}	Turn-off Switching Loss	$V_{CC}=300\text{V}$, $I_C=10\text{A}$, $R_{Goff}=36\Omega$, $V_{GE}=\pm 15\text{V}$, $du/dt=1945\text{V}/\mu\text{s}$ ($T_J=125^\circ\text{C}$) Inductive Load	$T_J=25^\circ\text{C}$	0.13		mJ
			$T_J=125^\circ\text{C}$	0.20		
Q_g	Total Gate Charge	$V_{GE}=+15\text{V}\dots-15\text{V}$	$T_J=25^\circ\text{C}$	35		nC
RBSOA	$I_C=20\text{A}$, $V_{CC}=480\text{V}$, $V_p=600\text{V}$, $R_{Goff}=36\Omega$, $V_{GE}=+15\text{V}$ to 0V , $T_J=125^\circ\text{C}$			Trapezoid		
SCSOA	$V_{CC}=300\text{V}$, $V_{GE}=15\text{V}$, $T_J=125^\circ\text{C}$			10		μs
$R_{\theta JC}$	IGBT Thermal Resistance: Junction-To-Case(Per Leg)				1.49	$^\circ\text{C}/\text{W}$



Diode, Brake-Chopper

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

V_{RRM}	Repetitive Peak Reverse Voltage	600	V
I_F	Diode Continuous Forward Current	10	A
I_{FM}	Diode Maximum Forward Current	20	A

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

Symbol	Description	Conditions	Min	Typ	Max	Unit	
V_{FM}	Forward Voltage	$I_F=10\text{A}$	$T_J=25^\circ\text{C}$	1.55		V	
			$T_J=125^\circ\text{C}$	1.55			
t_{rr}	Reverse Recovery Time	$I_F=10\text{A}$, $-diF/dt = 1066\text{A}/\mu\text{s}(T_J=125^\circ\text{C})$, $V_{rr}=300\text{V}$, $V_{GE}=-15\text{V}$	$T_J=25^\circ\text{C}$	109		ns	
			$T_J=125^\circ\text{C}$	119			
I_{rr}	Peak Reverse Recovery Current		$T_J=25^\circ\text{C}$	26.9		A	
			$T_J=125^\circ\text{C}$	28.4			
Q_{rr}	Reverse Recovery Charge		$T_J=25^\circ\text{C}$	0.47		μC	
			$T_J=125^\circ\text{C}$	0.67			
E_{rec}	Reverse Recovery Energy		$T_J=25^\circ\text{C}$	0.05		mJ	
			$T_J=125^\circ\text{C}$	0.10			
$R_{\theta JC}$	Diode Thermal Resistance: Junction-To-Case(Per Leg)				2.13	$^\circ\text{C}/\text{W}$	

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	$T_J=80^\circ\text{C}$	20	A
I_{RMSM}	Maximum RMS Current at Rectifier Output	$T_J=80^\circ\text{C}$	30	A
I_{FSM}	Surge Current @ $t_p=10\text{ms}$	$T_J=25^\circ\text{C}$	300	A
		$T_J=150^\circ\text{C}$	250	



I ² t	I ² t - value	T _J =25°C	450	A ² s
		T _J =150°C	300	

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

Symbol	Description	Conditions		Min	Typ	Max	Unit
V _F	Forward Voltage	I _F =10 A	T _J =25°C		1.10		V
			T _J =150°C		1.00		
I _R	Reverse Current	V _R =1200V	T _J =25°C			50	uA
R _{θJC}	Diode Thermal Resistance: Junction-To-Case					1.02	°C/W

Internal NTC-Thermistor Characteristics

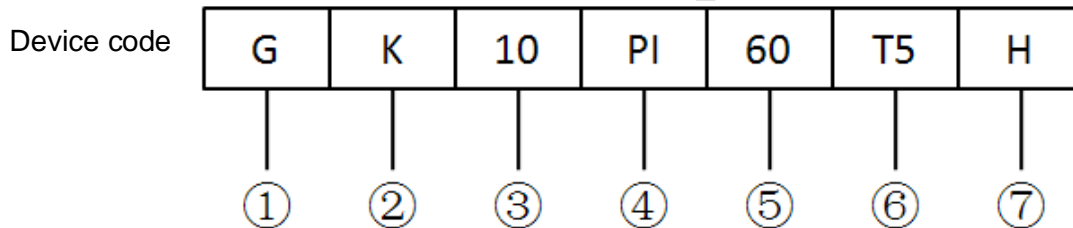
Symbol	Description		Min.	Typ.	Max.	Units.
R ₂₅	Rated Resistance	T _C =25°C		5		kΩ
ΔR/R	Deviation of R ₁₀₀	T _C =100°C, R ₁₀₀ =481Ω	-5		5	%
P ₂₅	Power Dissipation	T _C =25°C			10	mW
B _{25/50}	B-Value	$R_2=R_{25} \exp[B_{25/50}(1/T_2-1/(298.15K))]$		3380		K
B _{25/80}	B-Value	$R_2=R_{25} \exp[B_{25/80}(1/T_2-1/(298.15K))]$		3440		K



Module

Symbol	Description		Min	Typ	Max	Unit
V_{iso}	Isolation Voltage (All Terminals Shorted)	RMS, f=50Hz, 1minute	2500			V
L_{sCE}	Stray Inductance Module			60		nH
T_J	Maximum Junction Temperature				150	°C
T_{JOP}	Maximum Operating Junction Temperature Range		-40		+150	°C
T_{stg}	Storage Temperature		-40		+125	°C
CTI	Comparative Tracking Index		200			
$R_{\theta CS}$	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		5.0	N·m
G	Weight			190		g

Ordering Information Table



- ① - IGBT Module
- ② - Non Punch Through (NPT) Technology
- ③ - Rated Current (10=10A)
- ④ - Circuit Configuration (Power Integrated)
- ⑤ - Rated Voltage (60=600V)
- ⑥ - Package Type
- ⑦ - Test Level (Pass the Important Reliability Test-Industrial Grade)

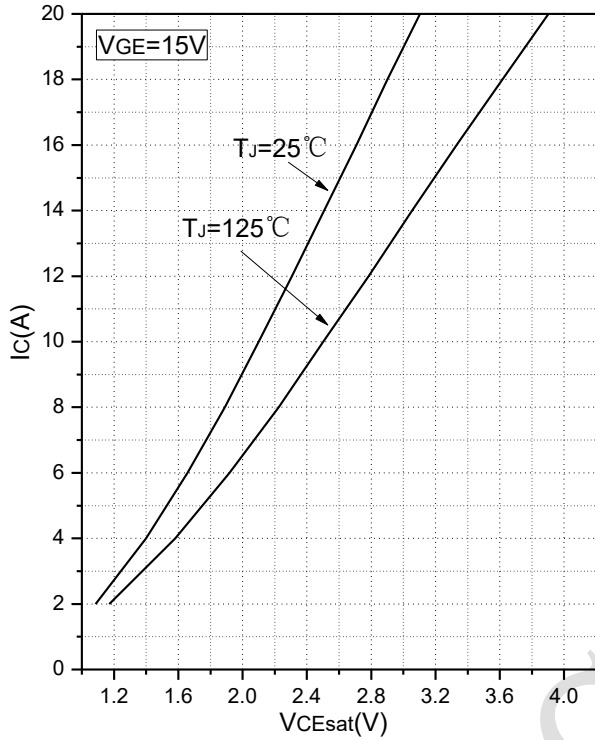


Fig.1 Typical Saturation Voltage Characteristics

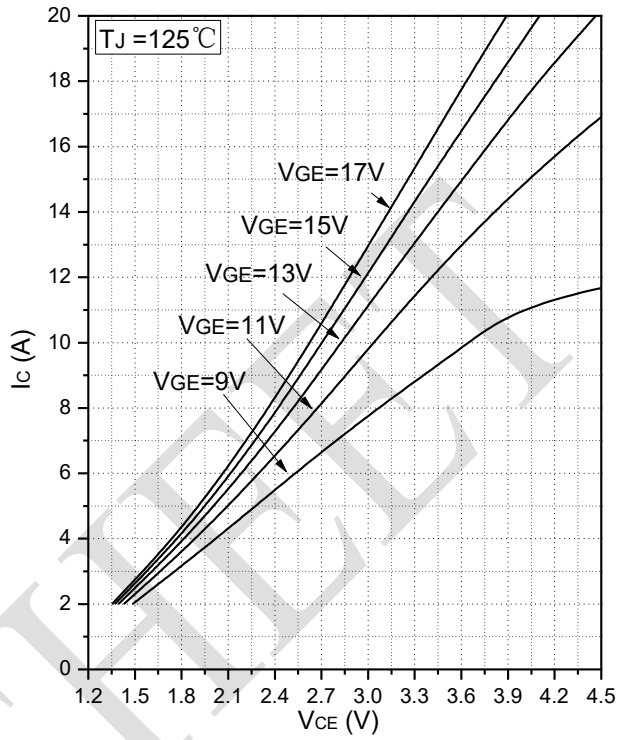


Fig.2 Typical Output Characteristics

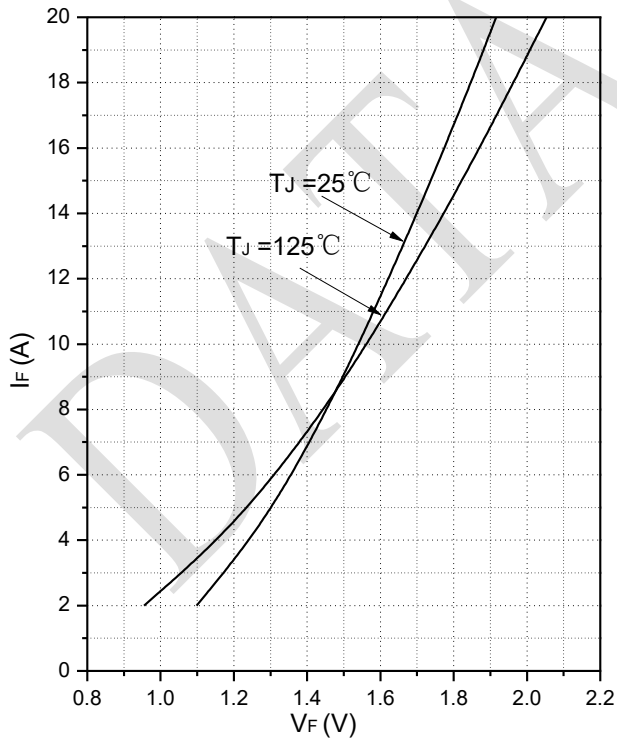


Fig.3 Forward Characteristics of Diode

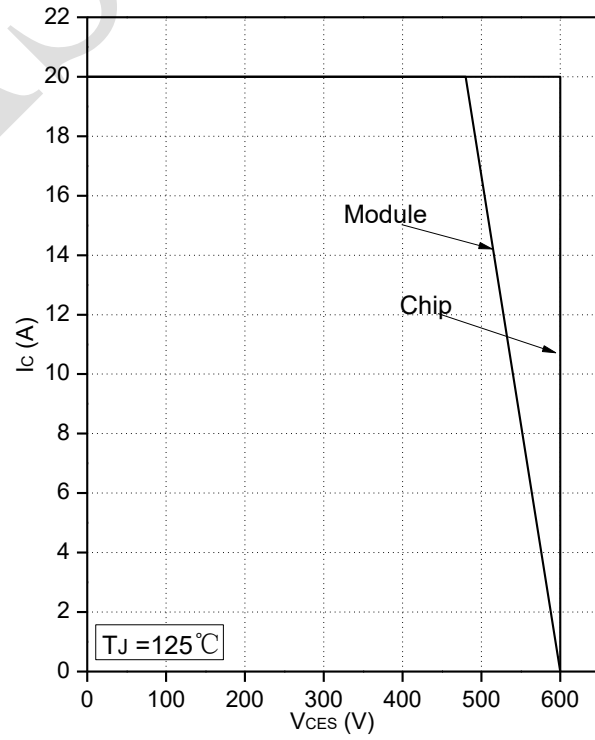


Fig.4 Reverse Bias Safe Operation Area (RBSOA)

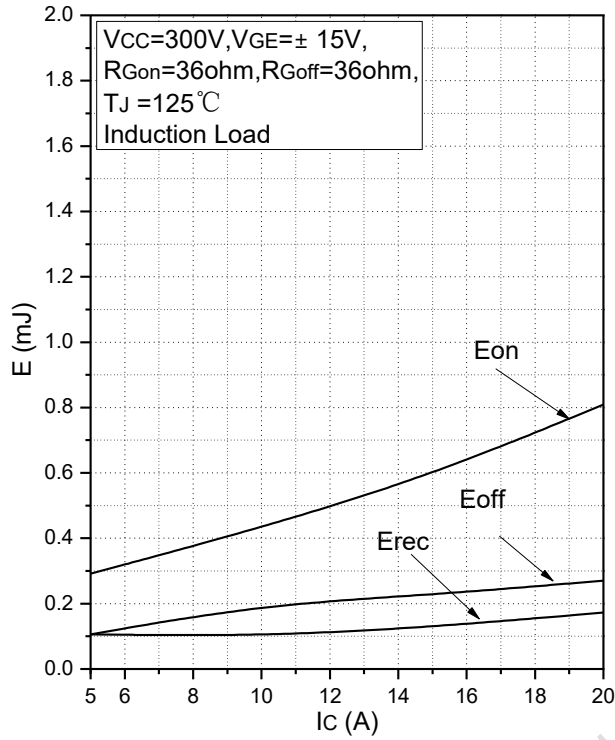


Fig.5 Typical Switching Loss vs. Collector Current

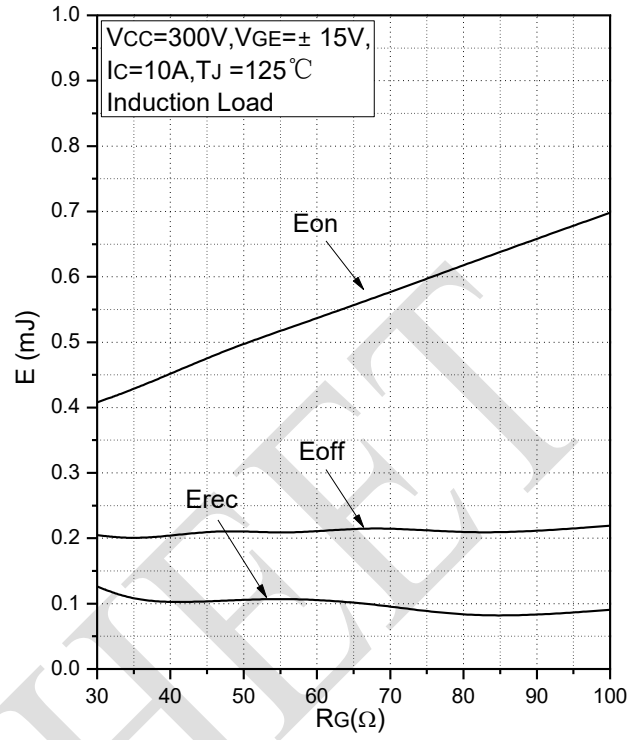


Fig.6 Typical Switching Loss vs. Gate Resistance

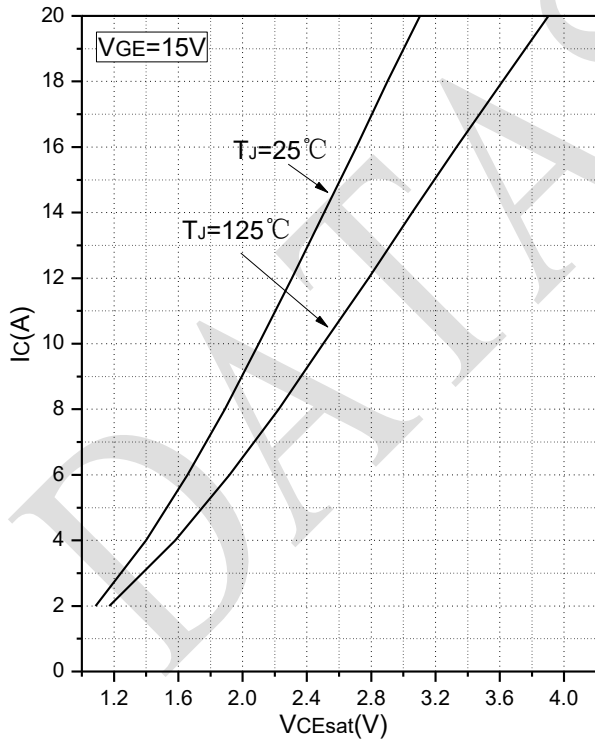


Fig.7 Typical Saturation Voltage Characteristics (Brake-Chopper)

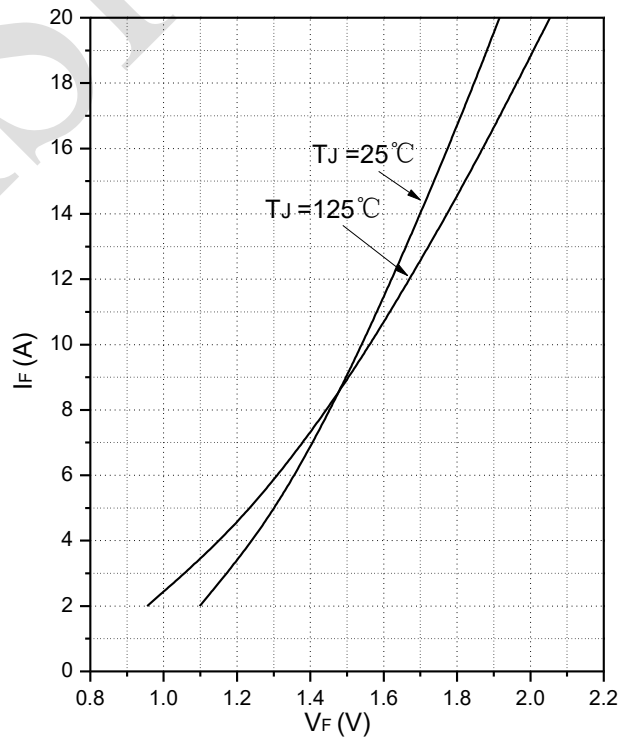


Fig.8 Forward Characteristics of Diode (Brake-Chopper)

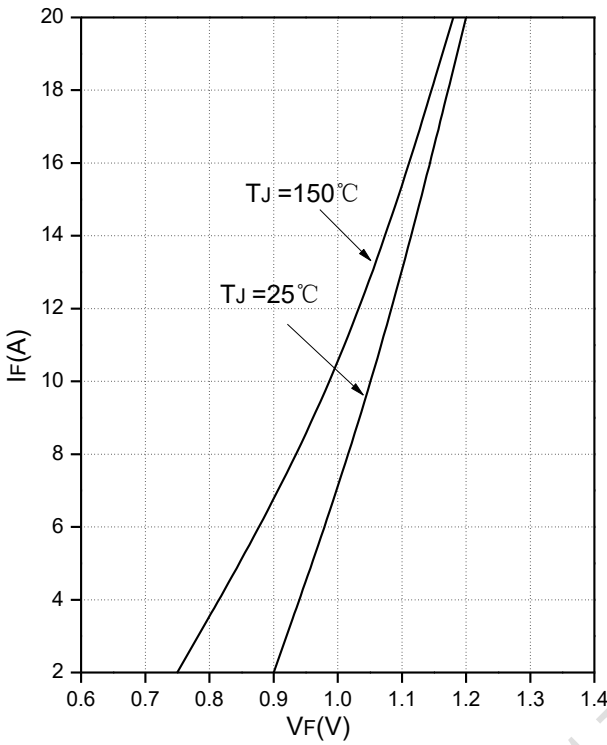


Fig.9 Forward Characteristics of Diode (Rectifier)

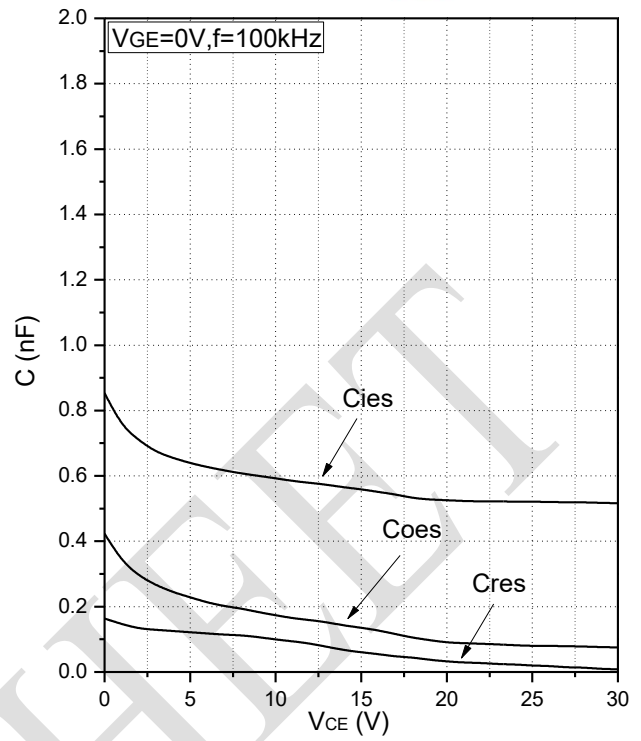


Fig.10 Capacitance Characteristics

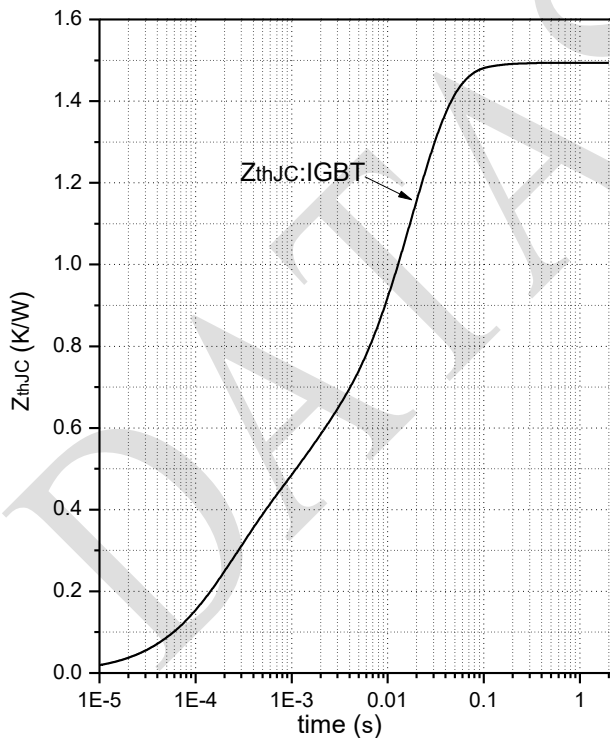


Fig.11 Transient Thermal Impedance IGBT (Inverter)

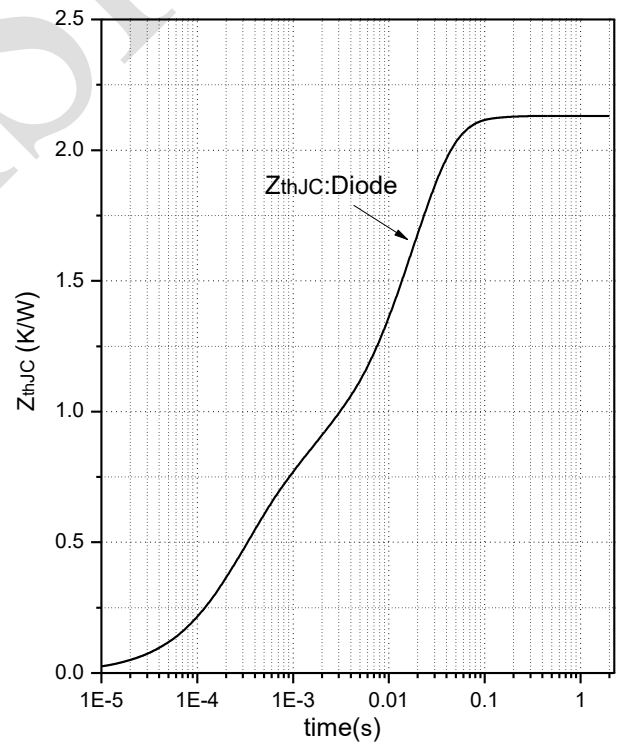


Fig.12 Transient Thermal Impedance Diode (Inverter)

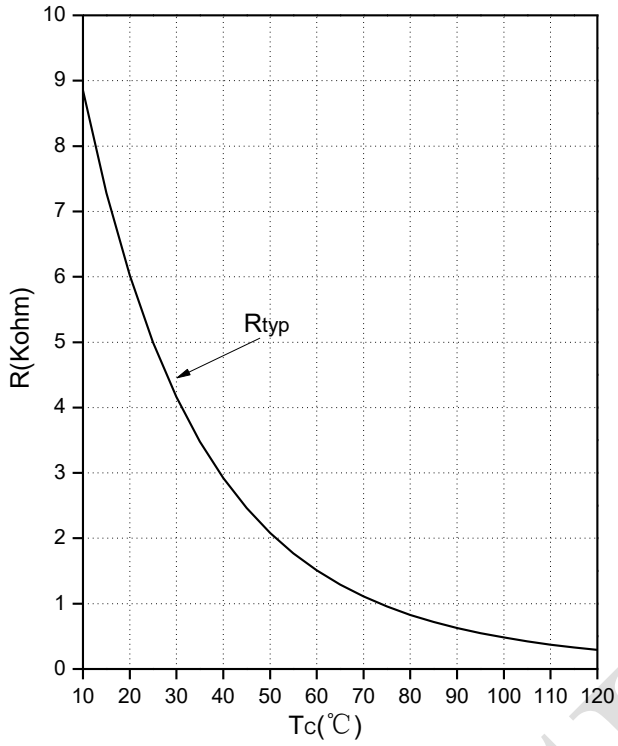
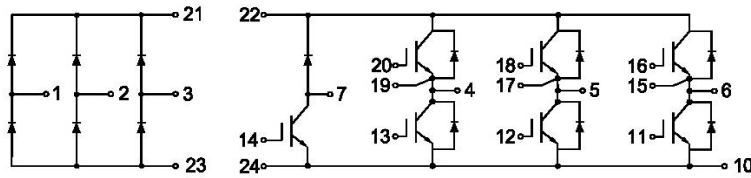


Fig.13 NTC Temperature Characteristics

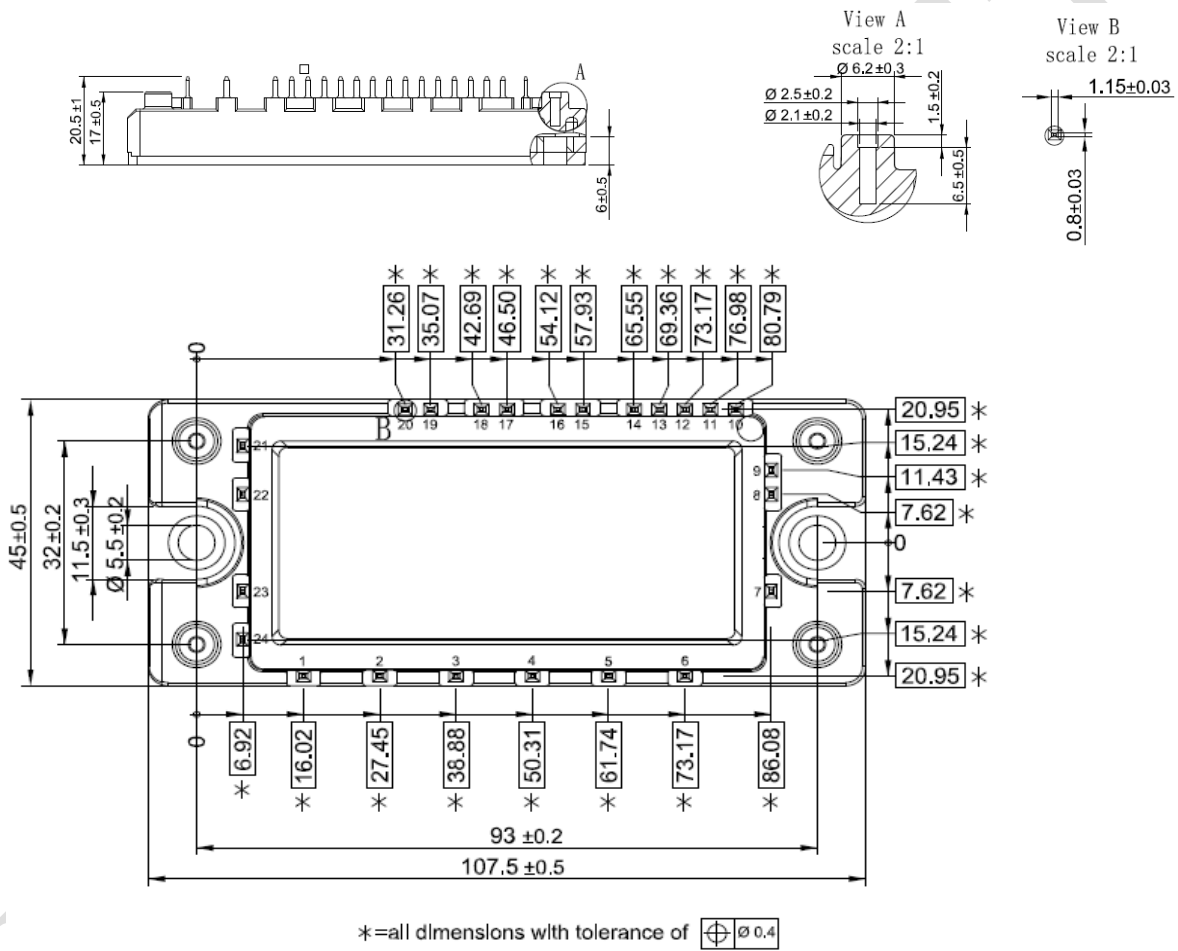
DATA SHEET



Internal Circuit



Package Outline (Unit: mm):





Date	Revision	Notes
01/18/2022	01	Initial Release
02/22/2022	A	Final Version
02/24/2022	B	Updated $V_{CE(sat)}$ and Qg Values

Announcement

Information in this document is believed to be accurate and reliable. However, NJSME does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information.

Right to Make Changes

NJSME reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

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”.