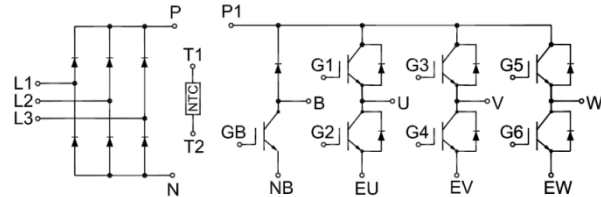


# GK20PI60B3H

## IGBT Module

### Features:

- Non Punch Through (NPT) Technology
- Short Circuit Rated  $>10\mu\text{s}$
- Low Saturation Voltage
- Low Switching Loss
- 100% RBSOA Tested( $2\times I_c$ )
- Low Stray Inductance
- Lead Free, Compliant with RoHS Requirement



### Applications:

- Industrial Inverters
- Servo Applications

### IGBT, Inverter

#### 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		$\pm 20$	V
$I_C$	Continuous Collector Current	$T_C=80^\circ\text{C}$	20	A
		$T_C=25^\circ\text{C}$	40	A
$I_{CM}$	Repetitive Peak Collector Current	$T_J=150^\circ\text{C}$	40	A
$t_{SC}$	Short Circuit Withstand Time		$>10$	$\mu\text{s}$
$P_D$	Maximum Power Dissipation per IGBT	$T_C=25^\circ\text{C}$ $T_{Jmax}=150^\circ\text{C}$	148	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	$I_C=1\text{mA}$ , $V_{CE}=V_{GE}$	4.0	4.8	5.8	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=20\text{A}$ , $V_{GE}=15\text{V}$	$T_J=25^\circ\text{C}$	2.00		V
			$T_J=125^\circ\text{C}$		2.15	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	$V_{CE}=25\text{V}$ , $V_{GE}=0\text{V}$ , $f=100\text{kHz}$		1.33		nF
$C_{oes}$	Output Capacitance			0.16		nF
$C_{res}$	Reverse Transfer Capacitance			0.04		nF

### Switching Characteristics

$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=300\text{V}$ , $I_C=20\text{A}$ , $R_{Gon}=30\Omega$ , $V_{GE}=\pm 15\text{V}$ , Inductive Load	$T_J=25^\circ\text{C}$		88	ns	
			$T_J=125^\circ\text{C}$		96		
$t_r$	Rise Time		$T_J=25^\circ\text{C}$		28	ns	
			$T_J=125^\circ\text{C}$		29		
$t_{d(off)}$	Turn-off Delay Time		$T_J=25^\circ\text{C}$		158	ns	
			$T_J=125^\circ\text{C}$		164		
$t_f$	Fall Time	$T_J=25^\circ\text{C}$		129	ns		
		$T_J=125^\circ\text{C}$		167			
$E_{on}$	Turn-on Switching Loss	$V_{CC}=300\text{V}$ , $I_C=20\text{A}$ , $R_{Gon}=30\Omega$ , $V_{GE}=\pm 15\text{V}$ , $di/dt=559\text{A}/\mu\text{s}$ ( $T_J=125^\circ\text{C}$ ) Inductive Load	$T_J=25^\circ\text{C}$		0.48	mJ	
			$T_J=125^\circ\text{C}$		0.56		
$E_{off}$	Turn-off Switching Loss		$T_J=25^\circ\text{C}$		0.22	mJ	
			$T_J=125^\circ\text{C}$		0.36		
$Q_g$	Total Gate Charge		$V_{GE}=+15\text{V}\dots-15\text{V}$	$T_J=25^\circ\text{C}$		121	nC
RBSOA	$I_C=40\text{A}$ , $V_{CC}=480\text{V}$ , $V_p=600\text{V}$ , $R_G=30\Omega$ , $V_{GE}=+15\text{V}$ to $0\text{V}$ , $T_J=125^\circ\text{C}$			Trapezoid			
SCSOA	$V_{CC}=300\text{V}$ , $V_{GE}=15\text{V}$ , $T_J=125^\circ\text{C}$			10		$\mu\text{s}$	
$R_{\theta JC}$	IGBT Thermal Resistance: Junction-To-Case(Per Leg)				0.84	$^\circ\text{C}/\text{W}$	

### 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	20	A
$I_{FM}$	Diode Maximum Forward Current	40	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	$I_F=20\text{A}$	$T_J=25^\circ\text{C}$	1.50		V
			$T_J=125^\circ\text{C}$	1.55		
$I_{rr}$	Peak Reverse Recovery Current	$I_F=20\text{A}$ , $-diF/dt=227\text{A}/\mu\text{s}(T_J=125^\circ\text{C})$ , $V_{rr}=300\text{V}$ , $V_{GE}=-15\text{V}$	$T_J=25^\circ\text{C}$	15.3		A
			$T_J=125^\circ\text{C}$	18.4		
$Q_{rr}$	Reverse Recovery Charge		$T_J=25^\circ\text{C}$	0.94		$\mu\text{C}$
			$T_J=125^\circ\text{C}$	1.41		
$E_{rec}$	Reverse Recovery Energy		$T_J=25^\circ\text{C}$	0.14		mJ
			$T_J=125^\circ\text{C}$	0.31		
$R_{\theta JC}$	Diode Thermal Resistance: Junction-To-Case(Per Leg)				1.89	$^\circ\text{C}/\text{W}$

### 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		$\pm 20$	V
$I_C$	Continuous Collector Current	$T_C=80^\circ\text{C}$	20	A
		$T_C=25^\circ\text{C}$	40	A
$I_{CM}$	Repetitive Peak Collector Current	$T_J=150^\circ\text{C}$	40	A
$t_{SC}$	Short Circuit Withstand Time		$>10$	$\mu\text{s}$
$P_D$	Maximum Power Dissipation per IGBT	$T_C=25^\circ\text{C}$ $T_{Jmax}=150^\circ\text{C}$	148	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	$I_C=1\text{mA}, V_{CE}=V_{GE}$	4.0	4.8	5.8	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=20\text{A}, V_{GE}=15\text{V}$	$T_J=25^\circ\text{C}$	2.00		V
			$T_J=125^\circ\text{C}$		2.15	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	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}$		1.33		nF
$C_{oes}$	Output Capacitance			0.16		nF
$C_{res}$	Reverse Transfer Capacitance			0.04		nF

### Switching Characteristics

$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_{Gon}=30\Omega, V_{GE}=\pm 15\text{V}, \text{Inductive Load}$	$T_J=25^\circ\text{C}$		88	ns
			$T_J=125^\circ\text{C}$		96	
$t_r$	Rise Time		$T_J=25^\circ\text{C}$		28	ns
			$T_J=125^\circ\text{C}$		29	
$t_{d(off)}$	Turn-off Delay Time	$V_{CC}=300\text{V}, I_C=20\text{A}, R_{Goff}=30\Omega, V_{GE}=\pm 15\text{V}, \text{Inductive Load}$	$T_J=25^\circ\text{C}$		158	ns
			$T_J=125^\circ\text{C}$		164	
$t_f$	Fall Time		$T_J=25^\circ\text{C}$		129	ns
			$T_J=125^\circ\text{C}$		167	
$E_{on}$	Turn-on Switching Loss	$V_{CC}=300\text{V}, I_C=20\text{A}, R_{Gon}=30\Omega, V_{GE}=\pm 15\text{V}, di/dt=559\text{A}/\mu\text{s} (T_J=125^\circ\text{C}) \text{ Inductive Load}$	$T_J=25^\circ\text{C}$		0.48	mJ
			$T_J=125^\circ\text{C}$		0.56	
$E_{off}$	Turn-off Switching Loss		$T_J=25^\circ\text{C}$		0.22	mJ
			$T_J=125^\circ\text{C}$		0.36	
$Q_g$	Total Gate Charge	$V_{GE}=+15\text{V}\dots-15\text{V}$	$T_J=25^\circ\text{C}$		121	nC
RBSOA	$I_C=40\text{A}, V_{CC}=480\text{V}, V_p=600\text{V}, R_G=30\Omega, V_{GE}=+15\text{V to } 0\text{V}, T_J=125^\circ\text{C}$			Trapezoid		
SCSOA	$V_{CC}=300\text{V}, V_{GE}=15\text{V}, T_J=125^\circ\text{C}$			10		$\mu\text{s}$
$R_{\theta JC}$	IGBT Thermal Resistance: Junction-To-Case(Per Leg)				0.84	$^\circ\text{C}/\text{W}$

### 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		
$I_{rr}$	Peak Reverse Recovery Current	$I_F=10\text{A}$ , $-diF/dt = 1066\text{A}/\mu\text{s}(T_J=125^\circ\text{C})$ , $V_{rr}=300\text{V}$ , $V_{GE}=-15\text{V}$	$T_J=25^\circ\text{C}$	26.9		A
			$T_J=125^\circ\text{C}$	28.4		
$Q_{rr}$	Reverse Recovery Charge		$T_J=25^\circ\text{C}$	0.47		$\mu\text{C}$
			$T_J=125^\circ\text{C}$	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)				2.31	$^\circ\text{C}/\text{W}$

### 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	
$I^2t$	$I^2t$ - value	$T_J=25^\circ\text{C}$	450	$\text{A}^2\text{s}$
		$T_J=150^\circ\text{C}$	300	

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

Symbol	Description	Conditions		Min	Typ	Max	Unit
$V_F$	Forward Voltage	$I_F=20\text{ A}$	$T_J=25^\circ\text{C}$		1.20		V
			$T_J=150^\circ\text{C}$		1.20		
$I_R$	Reverse Current	$V_R=1200\text{V}$	$T_J=25^\circ\text{C}$			50	$\mu\text{A}$
$R_{\theta JC}$	Diode Thermal Resistance: Junction-To-Case					1.08	$^\circ\text{C}/\text{W}$

### Internal NTC-Thermistor Characteristics

$R_{25}$	$T_C = 25^\circ\text{C}$	5		$\text{k}\Omega$
$\Delta R/R$	$T_C = 100^\circ\text{C}$ , $R_{100} = 481\Omega$		$\pm 5$	%
$P_{25}$	$T_C = 25^\circ\text{C}$	50		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

### Module

Symbol	Description		Min	Typ	Max	Unit
$V_{iso}$	Isolation Voltage (All Terminals Shorted)	$f = 50\text{Hz}$ , 1minute	2500			V
$L_{sCE}$	Stray Inductance Module			30		nH
$T_J$	Maximum Junction Temperature				150	$^\circ\text{C}$
$T_{JOP}$	Maximum Operating Junction Temperature Range		-40		+150	$^\circ\text{C}$
$T_{stg}$	Storage Temperature		-40		+125	$^\circ\text{C}$
CTI	Comparative Tracking Index		200			
$R_{\theta CS}$	Case-To-Sink Thermally (Conductive Grease Applied)				0.1	$^\circ\text{C}/\text{W}$
T	Mounting Screw:M4		1.5		1.8	N·m
G	Weight			24		g

## Ordering Information Table

Device code	G	K	20	PI	60	B3	H
	①	②	③	④	⑤	⑥	⑦

- ① - IGBT Module
- ② - Non Punch Through (NPT) Technology
- ③ - Rated Current (20=20A)
- ④ - Circuit Configuration (PI=Power Integrated)
- ⑤ - Rated Voltage (60=600V)
- ⑥ - Package Type
- ⑦ - Test Level (Pass the Important Reliability Test-Industrial Grade)

SilverMicro

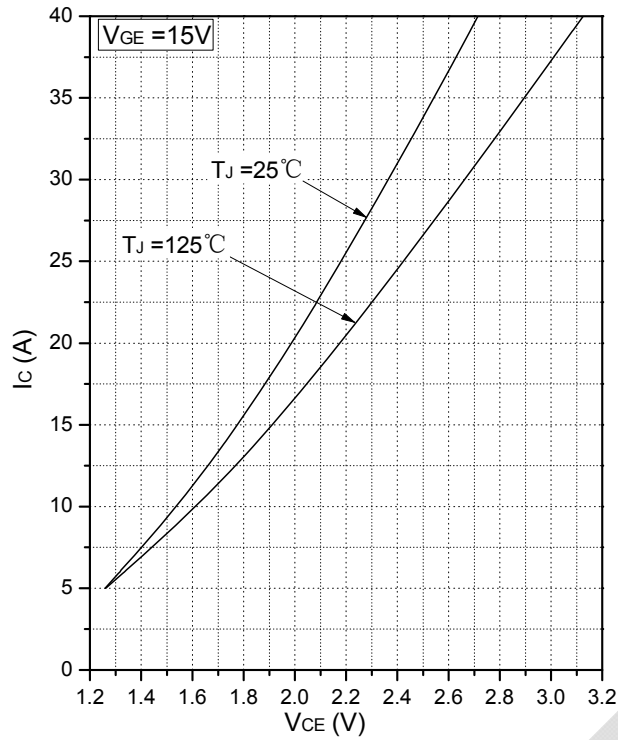


Fig.1 Typical Saturation Voltage Characteristics

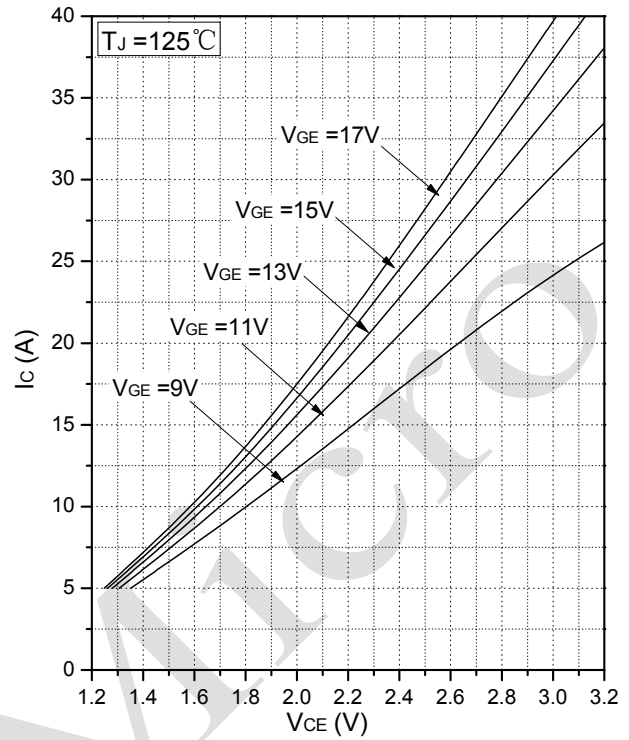


Fig.2 Typical Output Characteristics

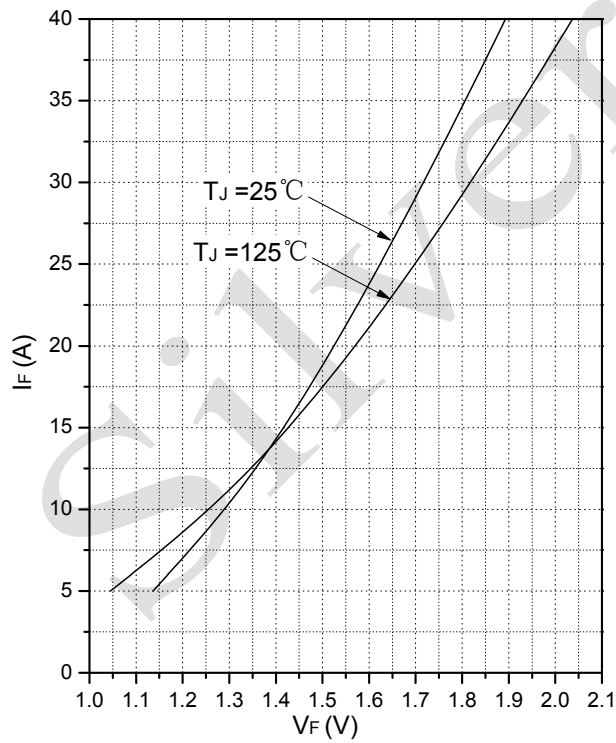


Fig.3 Forward Characteristics of Diode

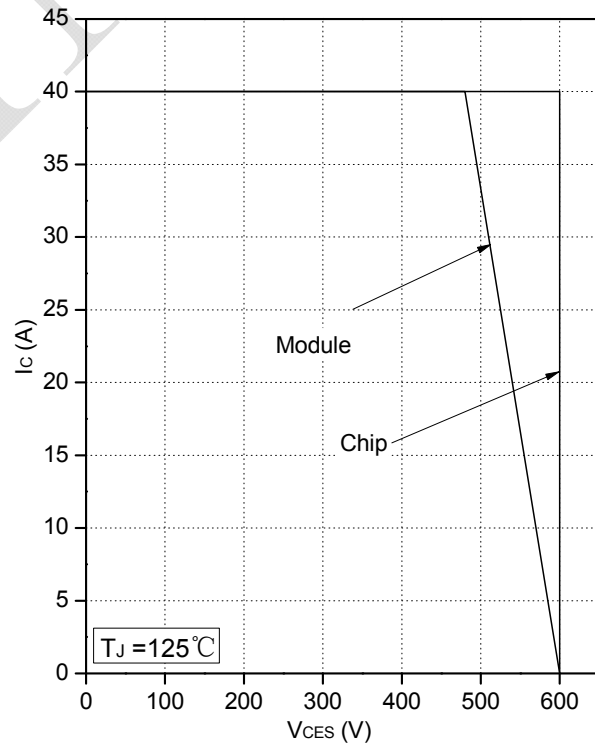


Fig.4 Reverse Bias Safe Operation Area (RBSOA)



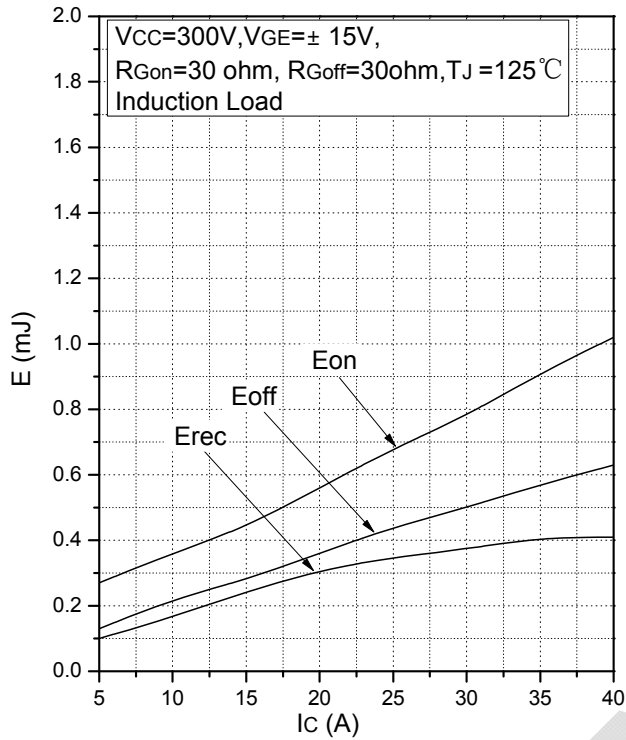


Fig.5 Typical Switching Loss vs. Collector Current

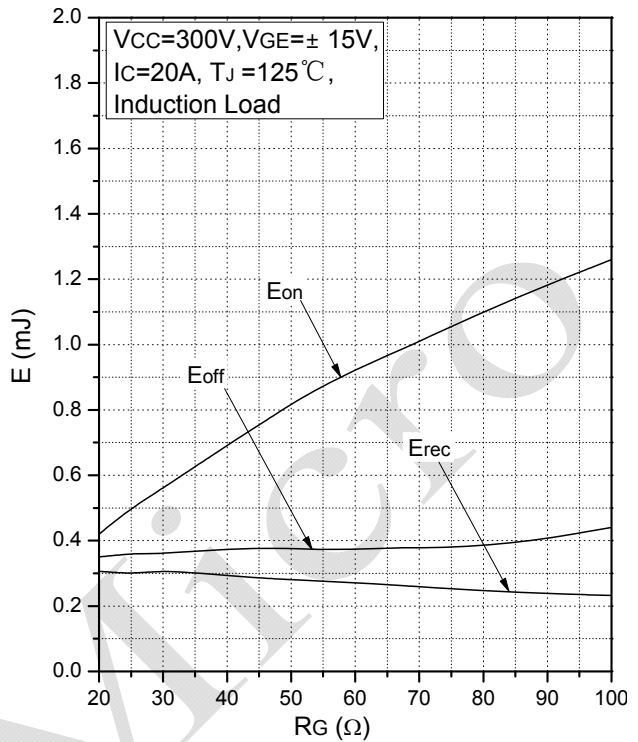


Fig.6 Typical Switching Loss vs. Gate Resistance

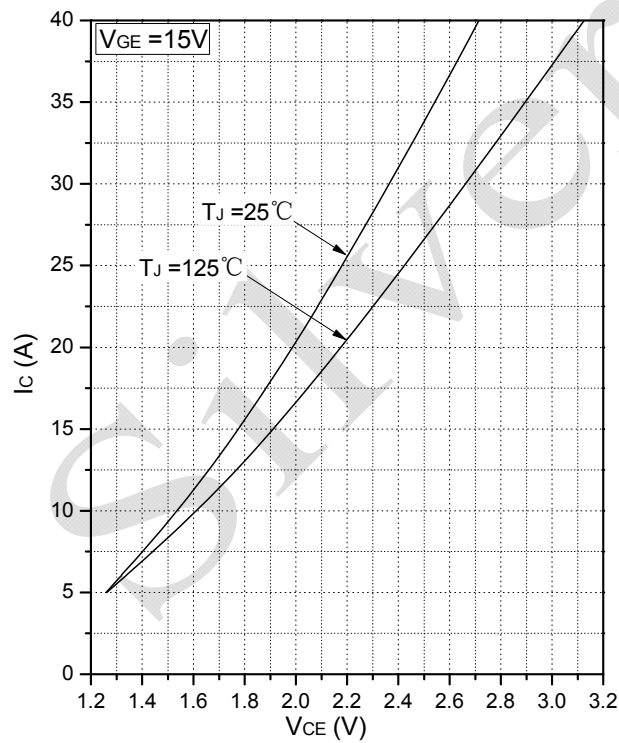


Fig.7 Typical Saturation Voltage Characteristics (Brake-Chopper)

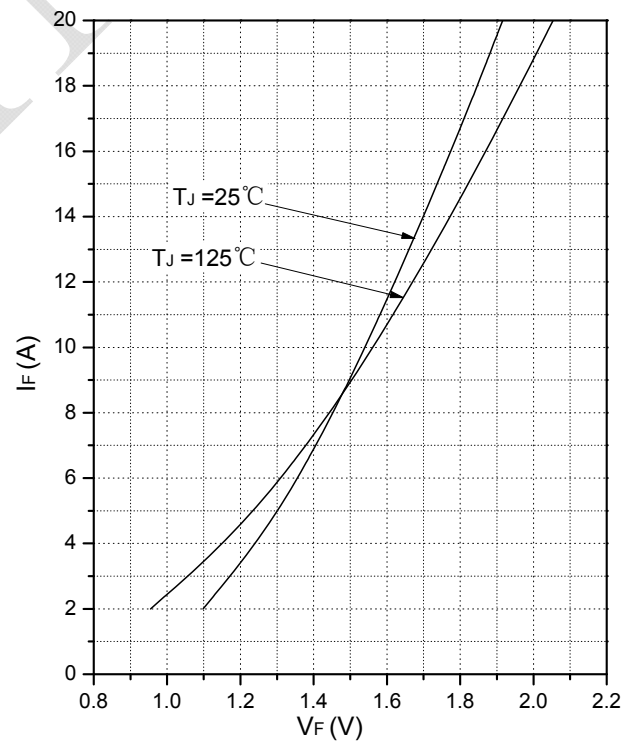


Fig.8 Forward Characteristics of Diode (Brake-Chopper)

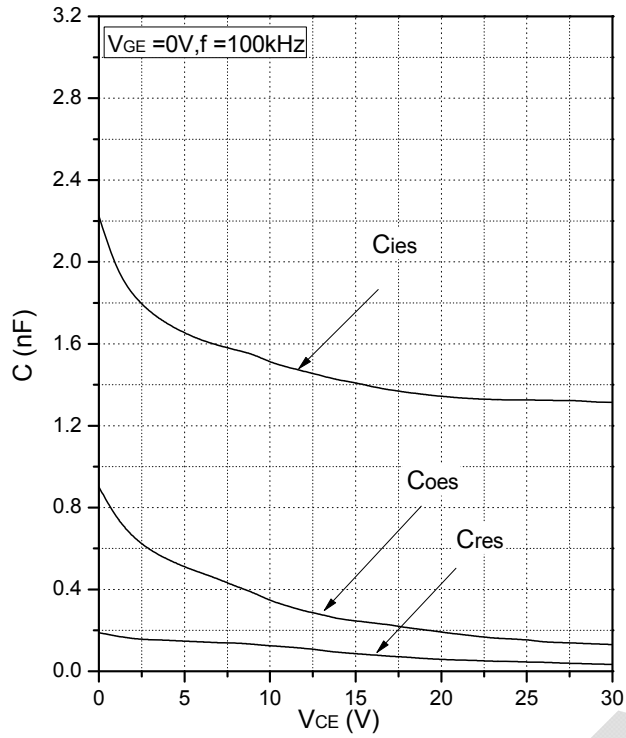


Fig.9 Capacitance Characteristics

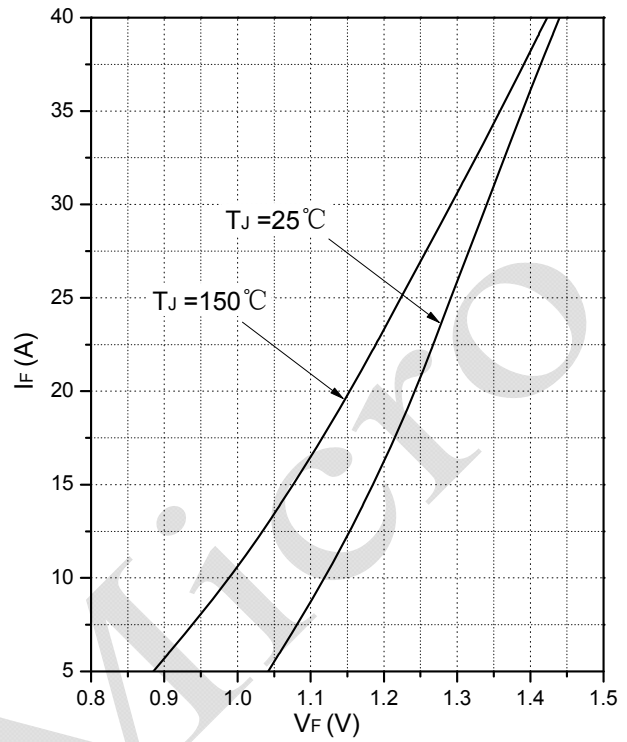


Fig.10 Forward Characteristics of Diode (Rectifier)

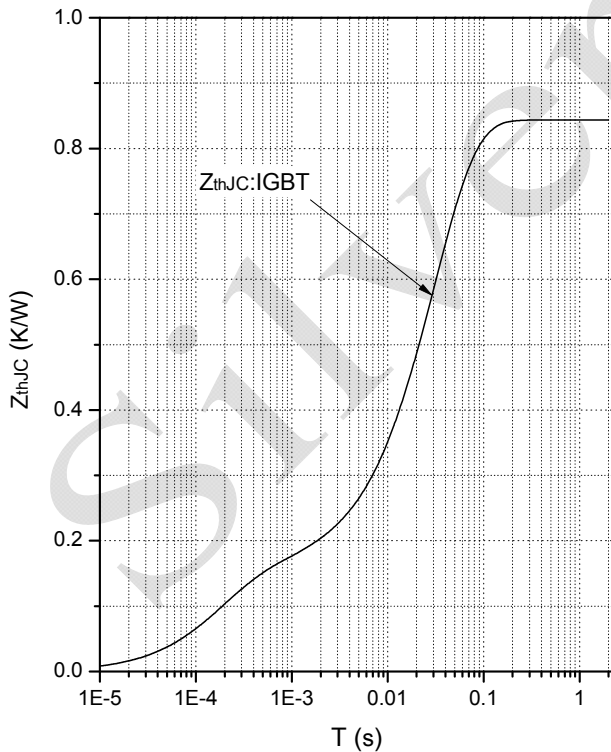


Fig.11 Transient Thermal Impedance IGBT (Inverter)

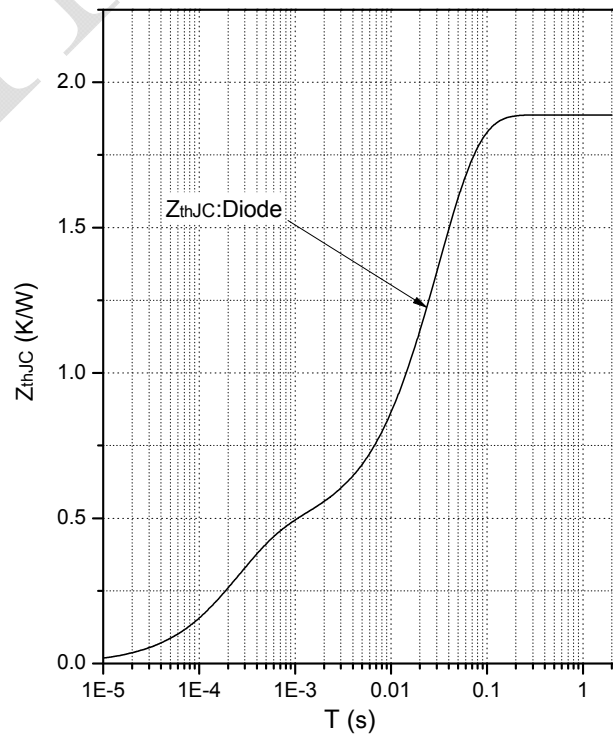


Fig.12 Transient Thermal Impedance Diode (Inverter)

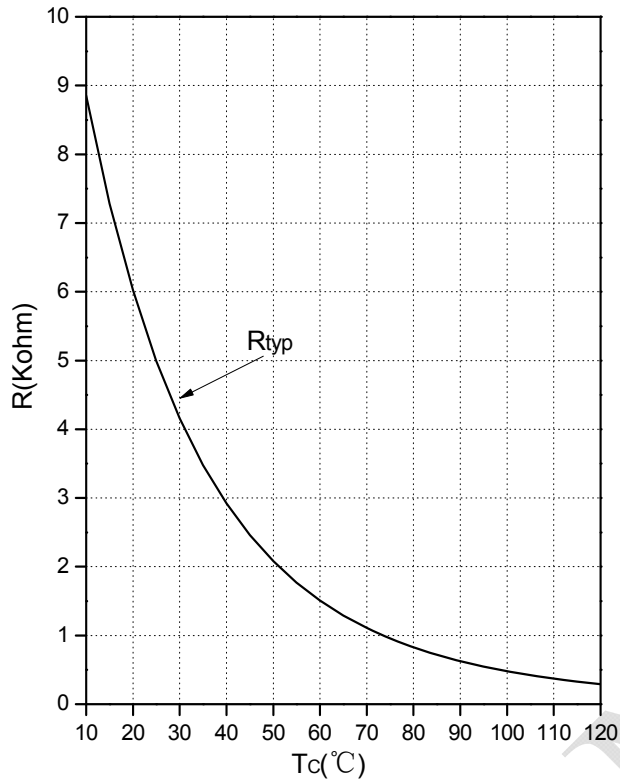
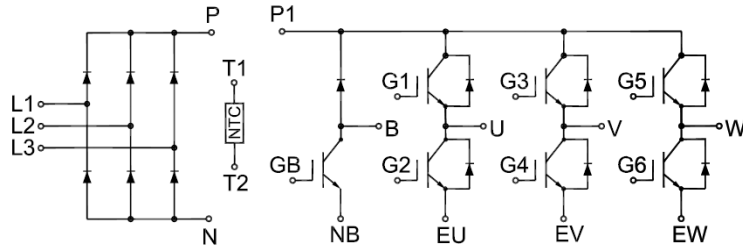
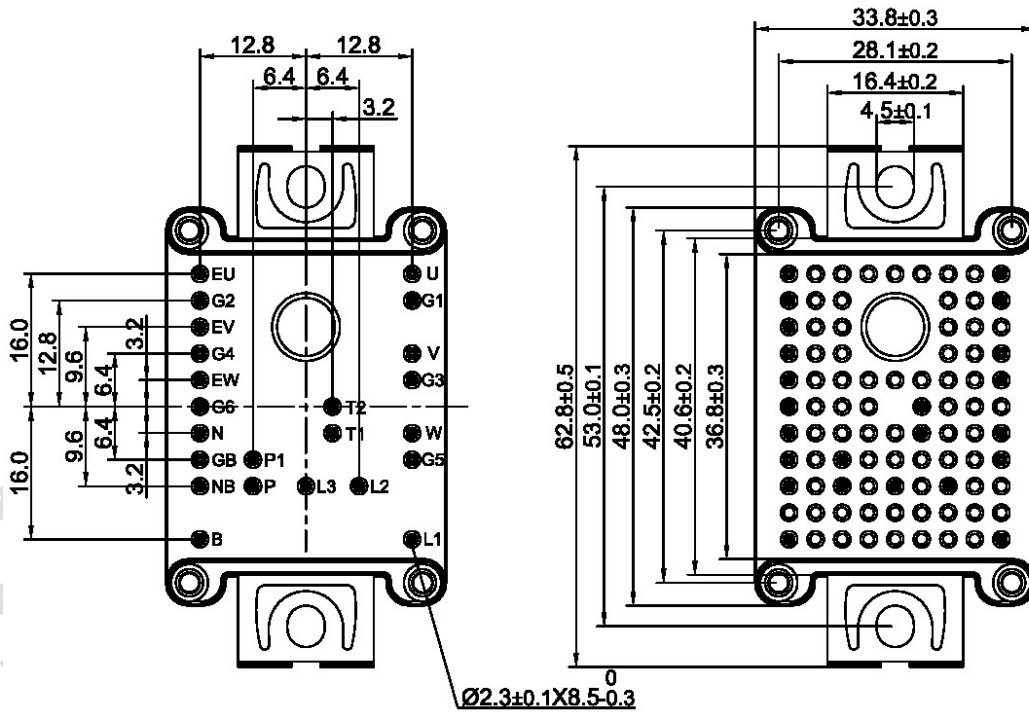
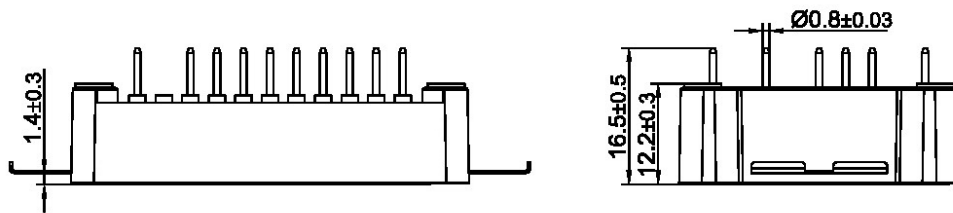


Fig.13 NTC Temperature Characteristics

### Internal Circuit



### Package Outlines (Unit: mm)



Pinpositions with tolerance of  $\pm \text{Ø} 0.4$

Date	Revision	Notes
03/18/2022	A	Final Version

## Announcement

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