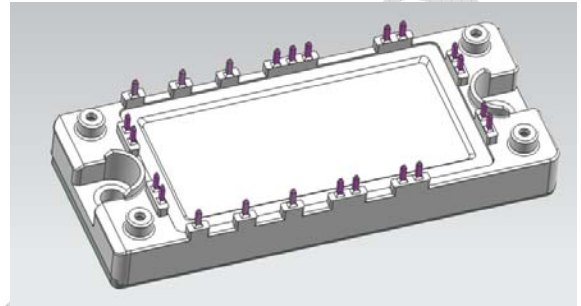


# GK35PI60T5H-T4

## IGBT Module

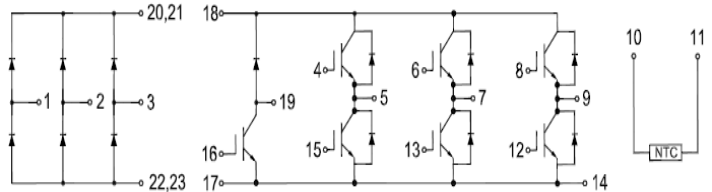
### Features:

- Short Circuit Rated > 10 $\mu$ s
- Low Saturation Voltage:  $V_{CE(sat)} = 1.80V @ I_C = 35A, T_C = 25^\circ C$
- 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 ( $T_C = 25^\circ C$ unless otherwise specified)

$V_{CES}$	Collector-Emitter Blocking Voltage		600	V
$V_{GES}$	Gate-Emitter Voltage		$\pm 20$	V
$I_C$	Continuous Collector Current	$T_C = 80^\circ C,$	35	A
		$T_C = 25^\circ C$	50	A
$I_{CM}$	Peak Collector Current Repetitive	$T_J = 150^\circ C$	70	A
$t_{SC}$	Short Circuit Withstand Time		>10	$\mu$ s
$P_D$	Maximum Power Dissipation per IGBT	$T_C = 25^\circ C$ $T_{Jmax} = 150^\circ C$	190	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	$I_C = 1 \text{ mA}, V_{CE} = V_{GE}$	3.0	4.5	5.0	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 35\text{A}, V_{GE} = 15\text{V}$	$T_J = 25^\circ\text{C}$	1.80	2.10	V
			$T_J = 125^\circ\text{C}$	2.00		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	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$		1.90		nF
$C_{res}$	Output Capacitance			0.30		nF

### Switching Characteristics

$t_{d(on)}$	Turn-on Delay Time	$V_{CC} = 300\text{V}, I_C = 35\text{A}, R_G = 20\Omega, V_{GE} = \pm 15\text{V},$ Inductive Load	$T_J = 25^\circ\text{C}$	70		ns
			$T_J = 125^\circ\text{C}$	60		
$t_r$	Rise Time		$T_J = 25^\circ\text{C}$	50		ns
			$T_J = 125^\circ\text{C}$	50		
$t_{d(off)}$	Turn-off Delay Time		$T_J = 25^\circ\text{C}$	128		ns
			$T_J = 125^\circ\text{C}$	130		
$t_f$	Fall Time		$T_J = 25^\circ\text{C}$	90		ns
			$T_J = 125^\circ\text{C}$	110		
$E_{on}$	Turn-on Switching Loss		$T_J = 25^\circ\text{C}$	0.29		mJ
			$T_J = 125^\circ\text{C}$	0.42		
$E_{off}$	Turn-off Switching Loss	$T_J = 25^\circ\text{C}$	0.31		mJ	
		$T_J = 125^\circ\text{C}$	0.50			
$Q_g$	Total Gate Charge	$T_J = 25^\circ\text{C}$	160		nC	
RBSOA	Reverse Bias Safe Operation Area	$I_C=70\text{A}, V_{CC}=480\text{V}, V_p=600\text{V}, R_g = 20\Omega, V_{GE}=\pm 15\text{V to } 0\text{V}, T_J = 150^\circ\text{C}$	Trapezoid			
SCSOA	Short Circuit Safe Operation Area	$V_{CC} = 300\text{V}, V_{GE} = 15\text{V}, T_J = 150^\circ\text{C}$	10			$\mu\text{s}$
$R_{\theta JC}$	IGBT Thermal Resistance: Junction-To-Case			0.67		$^\circ\text{C/W}$

**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	35	A
$I_{FM}$	Repetitive Peak Forward Current	70	A

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

Symbol	Description	Conditions	Min	Typ	Max	Unit
$V_{FM}$	Forward Voltage	$I_F = 35\text{A}$ , $V_{GE} = 0\text{V}$	$T_J = 25^\circ\text{C}$	1.40	1.60	V
			$T_J = 125^\circ\text{C}$	1.40		
$I_{rr}$	Peak Reverse Recovery Current		$T_J = 25^\circ\text{C}$	18		A
			$T_J = 125^\circ\text{C}$	22		
$Q_{rr}$	Reverse Recovery Charge	$I_F = 35\text{A}$ , $di/dt = 960\text{A}/\mu\text{s}$ , $V_{rr} = 300\text{V}$ , $V_{GE} = -15\text{V}$	$T_J = 25^\circ\text{C}$	2.76		$\mu\text{C}$
			$T_J = 125^\circ\text{C}$	2.43		
$E_{rec}$	Reverse Recovery Energy		$T_J = 25^\circ\text{C}$	0.14		mJ
			$T_J = 125^\circ\text{C}$	0.34		
$R_{\theta JC}$	Diode Thermal Resistance: Junction-To-Case			1.63		$^\circ\text{C}/\text{W}$

**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	$T_C = 80^\circ\text{C}$ ,	35	A
		$T_C = 25^\circ\text{C}$	70	A
$I_{CM}$	Peak Collector Current Repetitive	$T_J = 150^\circ\text{C}$	70	A
$t_{SC}$	Short Circuit Withstand Time		>10	$\mu\text{s}$
$P_D$	Maximum Power Dissipation (IGBT)	$T_C = 25^\circ\text{C}$ $T_{Jmax} = 150^\circ\text{C}$	260	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	$I_C = 1 \text{ mA}, V_{CE} = V_{GE}$	3.0	4.5	5.0	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 35\text{A}, V_{GE} = 15\text{V}$	$T_J = 25^\circ\text{C}$	1.80	2.10	V
			$T_J = 125^\circ\text{C}$	2.00		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	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$		1.90		nF
$C_{oes}$	Output Capacitance			0.30		nF

### Switching Characteristics

$t_{d(on)}$	Turn-on Delay Time	$V_{CC} = 300\text{V}, I_C = 35\text{A}, R_G = 20\Omega, V_{GE} = \pm 15\text{V},$ Inductive Load	$T_J = 25^\circ\text{C}$		70		ns
			$T_J = 125^\circ\text{C}$		60		
$t_r$	Rise Time		$T_J = 25^\circ\text{C}$		50		ns
			$T_J = 125^\circ\text{C}$		50		
$t_{d(off)}$	Turn-off Delay Time		$T_J = 25^\circ\text{C}$		128		ns
			$T_J = 125^\circ\text{C}$		130		
$t_f$	Fall Time		$T_J = 25^\circ\text{C}$		90		ns
			$T_J = 125^\circ\text{C}$		110		
$E_{on}$	Turn-on Switching Loss		$T_J = 25^\circ\text{C}$		0.29		mJ
			$T_J = 125^\circ\text{C}$		0.42		
$E_{off}$	Turn-off Switching Loss	$T_J = 25^\circ\text{C}$		0.31		mJ	
		$T_J = 125^\circ\text{C}$		0.50			
$Q_g$	Total Gate Charge	$T_J = 25^\circ\text{C}$		160		nC	
RBSOA	Reverse Bias Safe Operation Area	$I_C=70\text{A}, V_{CC}=480\text{V}, V_p=600\text{V}, R_g = 20\Omega, V_{GE}=\pm 15\text{V to } 0\text{V}, T_J = 150^\circ\text{C}$	Trapezoid				
SCSOA	Short Circuit Safe Operation Area	$V_{CC} = 300\text{V}, V_{GE} = 15\text{V}, T_J = 150^\circ\text{C}$	10			$\mu\text{s}$	
$R_{\theta JC}$	IGBT Thermal Resistance: Junction-To-Case			0.67		$^\circ\text{C/W}$	

**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	35	A
$I_{FM}$	Repetitive Peak Forward Current	70	A

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

Symbol	Description	Conditions	Min	Typ	Max	Unit
$V_{FM}$	Forward Voltage	$I_F = 35\text{ A}$ , $V_{GE} = 0\text{V}$	$T_J = 25^\circ\text{C}$	1.40	1.60	V
			$T_J = 125^\circ\text{C}$	1.40		
$I_{rr}$	Peak Reverse Recovery Current		$T_J = 25^\circ\text{C}$	30		A
			$T_J = 125^\circ\text{C}$	35		
$Q_{rr}$	Reverse Recovery Charge	$I_F = 35\text{A}$ , $di/dt = 960\text{A}/\mu\text{s}$ , $V_{rr} = 300\text{V}$ , $V_{GE} = -15\text{V}$	$T_J = 25^\circ\text{C}$	1.51		$\mu\text{C}$
			$T_J = 125^\circ\text{C}$	2.43		
$E_{rec}$	Reverse Recovery Energy		$T_J = 25^\circ\text{C}$	0.14		mJ
			$T_J = 125^\circ\text{C}$	0.34		
$R_{\theta JC}$	Diode Thermal Resistance: Junction-To-Case			1.63		$^\circ\text{C}/\text{W}$

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

$V_{RRM}$	Repetitive Peak Reverse Voltage	$T_J = 25^\circ\text{C}$	1200	V
$I_{FRMSM}$	Maximum RMS Forward Current per Chip	$T_J = 80^\circ\text{C}$	35	A
$I_{RMSM}$	Maximum RMS Current at Rectifier Output	$T_J = 80^\circ\text{C}$	35	A
$I_{FSM}$	Surge Current @ $t_p=10\text{ ms}$	$T_J = 25^\circ\text{C}$	300	A
		$T_J = 150^\circ\text{C}$	450	
$I^2t$	$I^2t$ - 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)**

$V_F$	Forward Voltage	$I_F = 35 \text{ A}$	$T_J = 25^\circ\text{C}$	1.10			V
			$T_J = 150^\circ\text{C}$	1.00			
$I_R$	Reverse Current	$V_R=1200\text{V}$	$T_J = 25^\circ\text{C}$			1	mA
$R_{\theta JC}$	Diode Thermal Resistance: Junction-To-Case				0.89		$^\circ\text{C}/\text{W}$

**Internal NTC-Thermistor Characteristics**

$R_{25}$	$T_C = 25^\circ\text{C}$	5		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
$T_J$	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	$^\circ\text{C}$
$R_{\theta CS}$	Case-To-Sink Thermally (Conductive Grease Applied)		0.1		$^\circ\text{C}/\text{W}$
M	Mounting Screw:M5	3.0		5.0	N·m
G	Weight		200		g

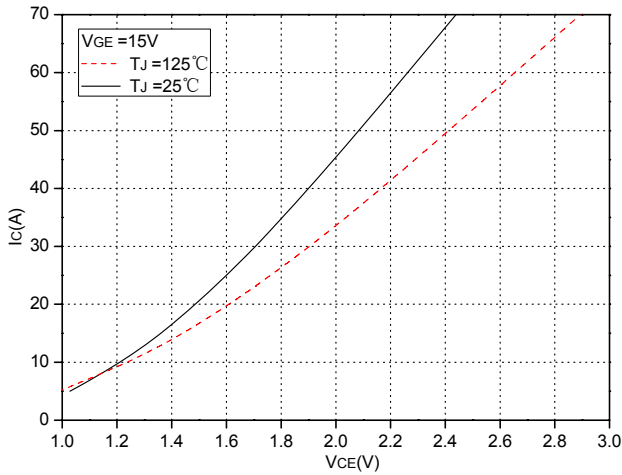


Fig.1 Typical Saturation Voltage Characteristics

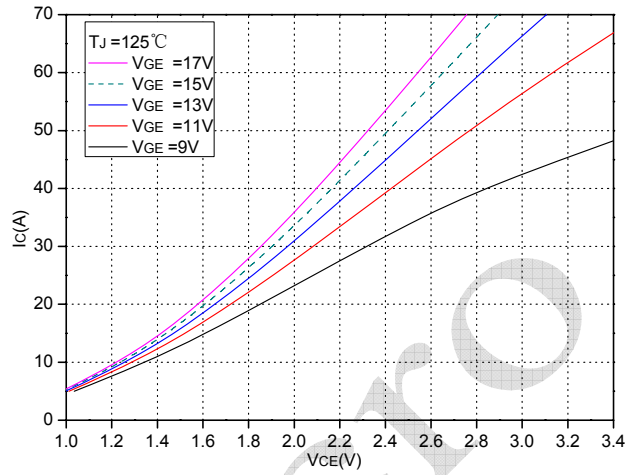


Fig.2 Typical Output Characteristics

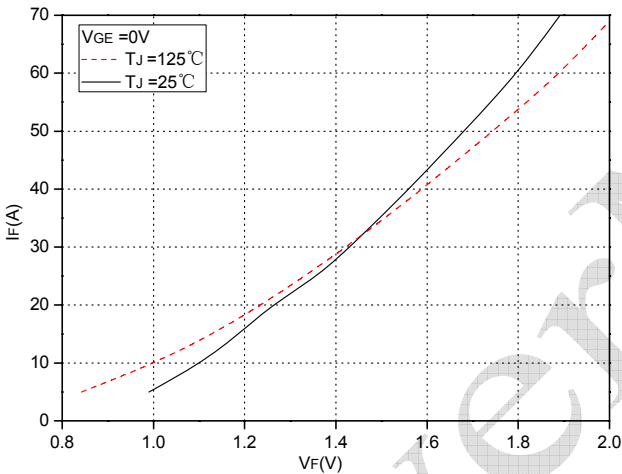


Fig.3 Forward Characteristics of FWD

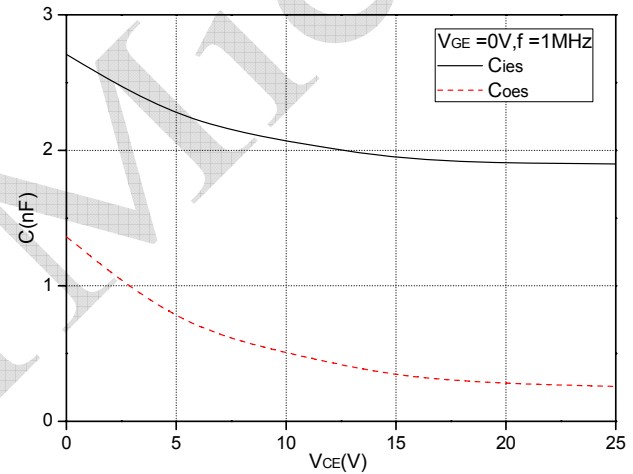


Fig.4 Capacitance Characteristics

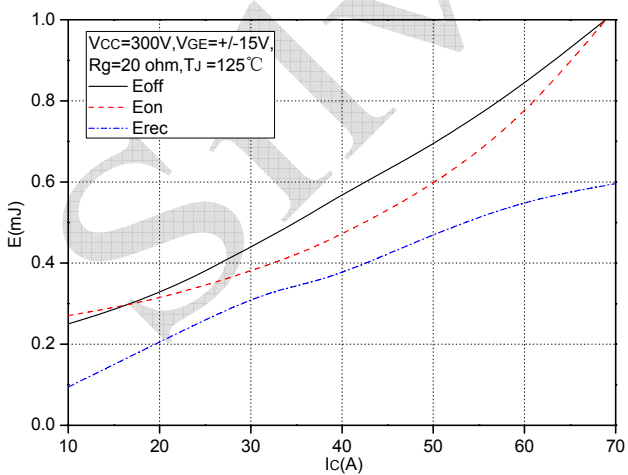


Fig.5 Typical Switching Loss vs. Collector Current

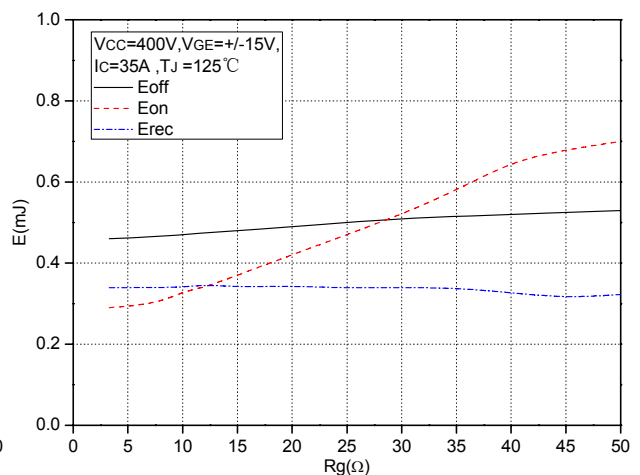


Fig.6 Typical Switching Loss vs. Gate Resistance

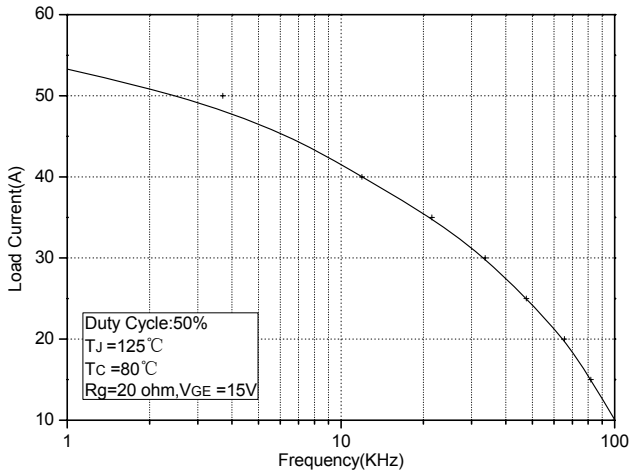


Fig.7 Typical Load Current vs. Frequency

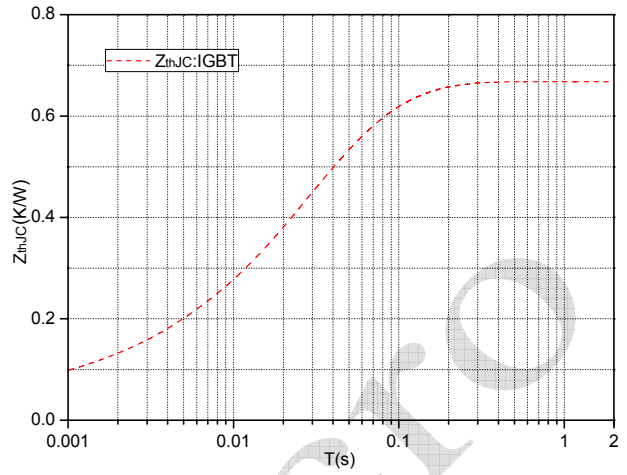


Fig.8 Transient thermal impedance (IGBT)

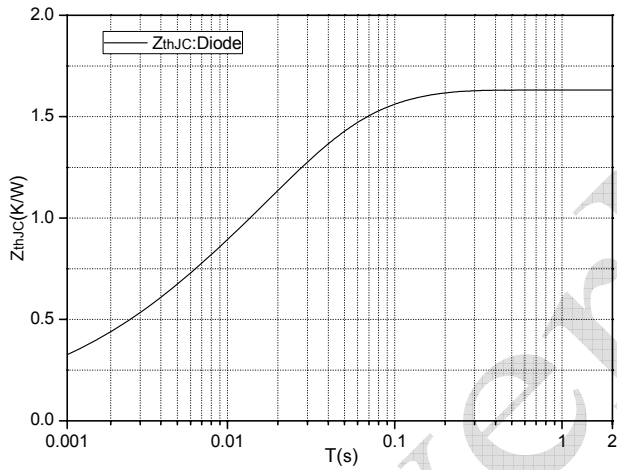


Fig.9 Transient thermal impedance Diode

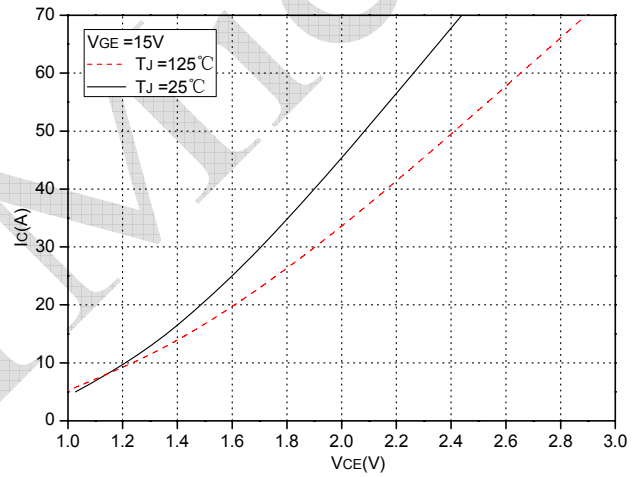


Fig.10 Typical Saturation Voltage Characteristics (Brake-Chopper)

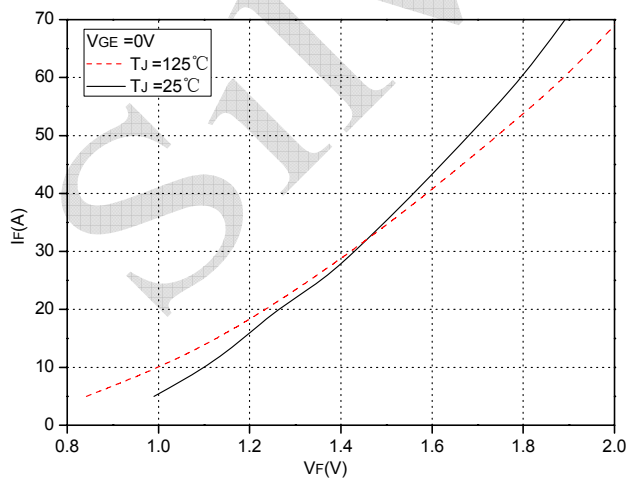


Fig.11 Forward Characteristics of FWD (Brake-Chopper)

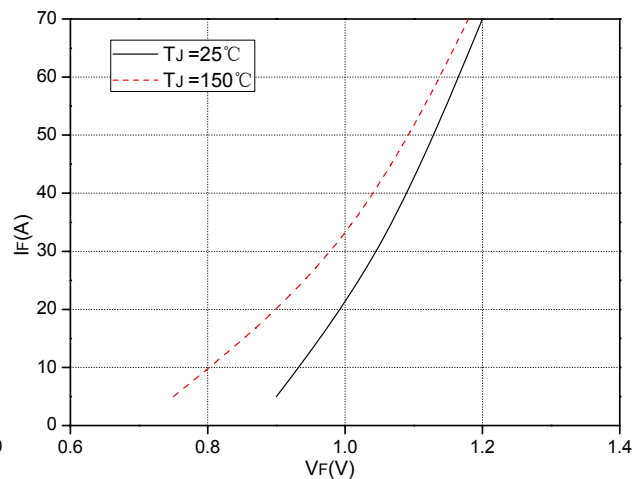


Fig.12 Forward Characteristics of Diode (Rectifier)



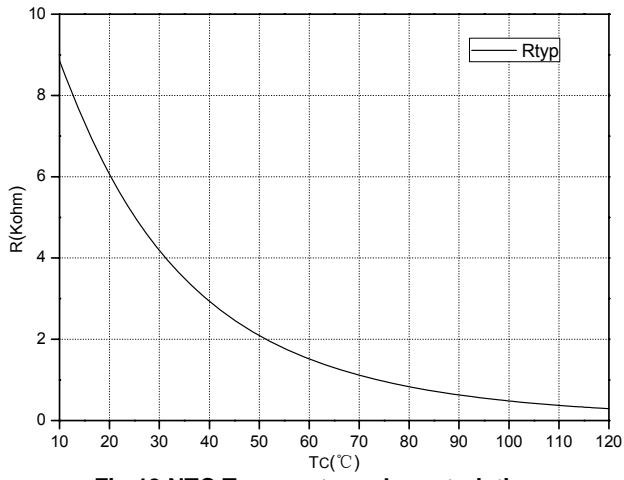


Fig.13 NTC Temperature characteristics

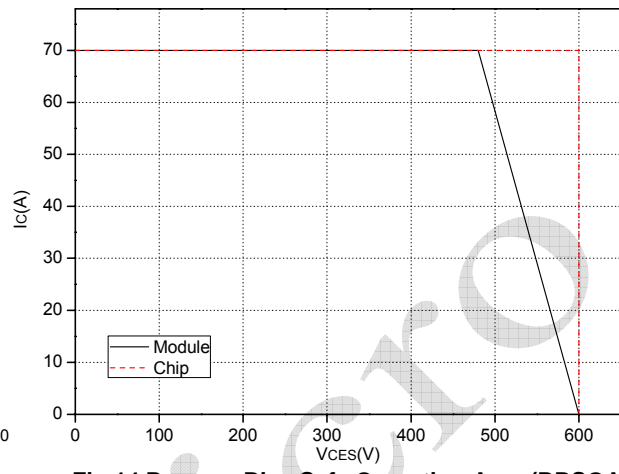
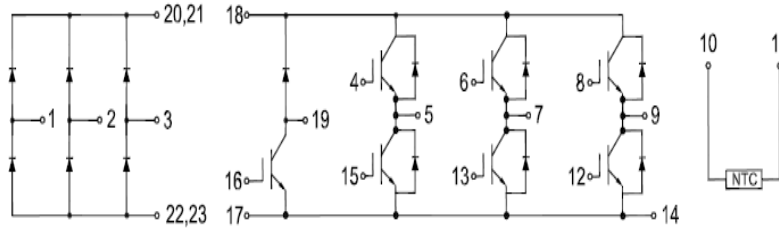


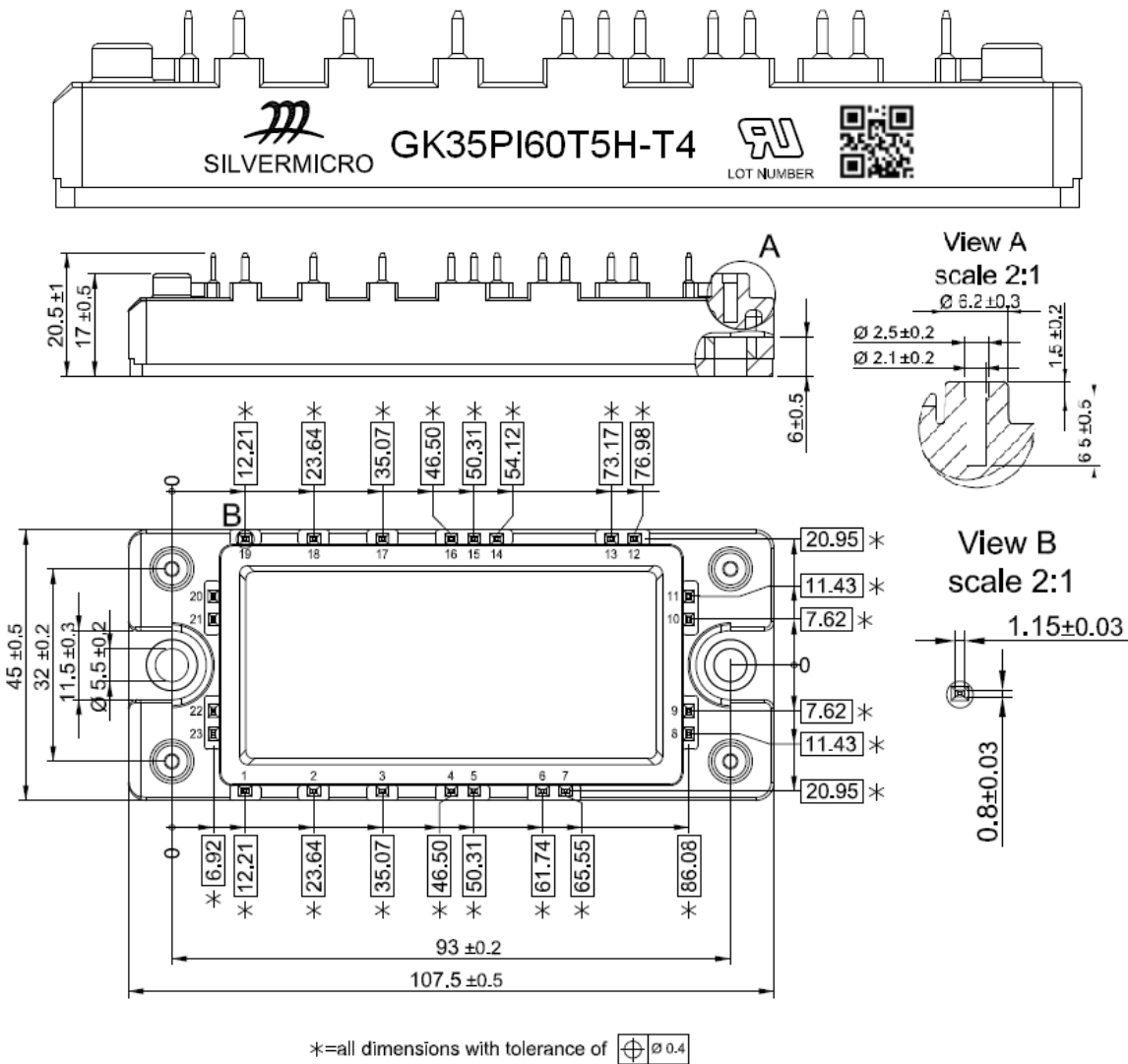
Fig.14 Reverse Bias Safe Operation Area (RBSOA)

SilverMicro

**Internal Circuit:**



**Package Outline (Unit: mm):**





Date	Revision	Notes
07/07/2019	A	Final Version

## Announcement

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