

1200V 35A PIM IGBT Module

Features

- Trench Field Stop technology
- Low saturation voltage
- 10 μ s Short Circuit current
- Low turn-off losses
- Positive temperature coefficient

Applications

- AC Motor Drives
- Motion / Servo Drives
- Inverter and Power supplies



■ Absolute Maximum Ratings $T_j = 25^\circ\text{C}$ unless otherwise noted

Item	Symbol	Parameter	Conditions	Value	Units
Diode Rectifier	VRRM	Repetitive Peak Reverse Voltage		1600	V
	IFAV	Forward Current per Diode		35	A
	IFSM	Surge Forward Current (Chip level)	@ $t_P = 10$ ms, half sine wave	320	A
	I _{2t}	I _{2t} - Value (Chip level)	@ $t_P = 10$ ms, half sine wave	648	A ² S
	T _j	Operating Junction Temperature *(1)	-	-40 ~ 150	°C
IGBT Inverter	VCES	Collector-Emitter Breakdown Voltage	-	1200	V
	VGES	Gate-Emitter Peak Voltage	-	± 20	V
	IC	DC Collector Current	@ $T_j = 150^\circ\text{C}$, $T_C = 100^\circ\text{C}$	35	A
			@ $T_j = 150^\circ\text{C}$, $T_C = 25^\circ\text{C}$	70	A
	ICM	Repetitive Peak Forward Current	$t_P = 1$ ms	70	A
	PD	Maximum Power Dissipation	@ $T_j = 175^\circ\text{C}$, $T_C = 80^\circ\text{C}$	250	W
	T _j	Operating Junction Temperature *(2)	-	-40 ~ 175	°C
Diode Inverter	VRRM	Repetitive Peak Reverse Voltage	-	1200	V
	IF	DC Forward Current		35	A
	IFRM	Repetitive Peak Forward Current	@ $t_P = 1$ ms	70	A
	I _{2t}		@ $T_j = 125^\circ\text{C}$, $t = 10$ ms, $V_R = 0$ V	110	A ² S
	T _j	Operating Junction Temperature *(1)	-	-40 ~ 175	°C
IGBT Brake	VCES	Collector-Emitter Breakdown Voltage	-	1200	V
	VGES	Gate-Emitter Peak Voltage	-	± 20	V
	IC	DC Collector Current	@ $T_j = 150^\circ\text{C}$, $T_C = 100^\circ\text{C}$	35	A
	I _{cpulse}	Repetitive Peak Collector Current	@ $t_P = 1$ ms	50	A
	PD	Maximum Power Dissipation	@ $T_j = 150^\circ\text{C}$, $T_C = 25^\circ\text{C}$	250	W
	T _j	Operating Junction Temperature *(2)	-	-40 ~ 175	°C
Diode Brake	VRRM	Repetitive Peak Reverse Voltage	-	1200	V
	IF	DC Forward Current		20	A
	IFRM	Repetitive Peak Forward Current	@ $t_P = 1$ ms	40	A
	I _{2t}		@ $T_j = 125^\circ\text{C}$, $t = 10$ ms, $V_R = 0$ V	70	A ² S
	T _j	Operating Junction Temperature *(1)	-	-40 ~ 175	°C
Module	T _{stg}	Storage Temperature	-	-40~125	°C
	V _{iso}	Isolation Voltage	@ AC 1minute	2500	V
	W	Weight	-	39	g

Electrical Characteristics of IGBT and Diode $T_j = 25^\circ\text{C}$ unless otherwise noted

IGBT-Inverter Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
BV _{CES}	C-E Breakdown Voltage	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	1200	-		
I _{CES}	C-E Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$	-	-	1	mA
I _{GES}	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$	-	-	± 400	nA
V _{GE(th)}	G-E Threshold Voltage	$V_{GE} = V_{CE}, I_C = 1.0\text{ mA}$	6.0	-	7.0	V
R _{gint}	Internal Gate Resistance		-	3.6	-	Ω
V _{CE(sat)}	Collector to Emitter Saturation Voltage	$I_C = 35\text{ A}, V_{GE} = 15\text{ V}, T_j = 25^\circ\text{C}$	1.70	2.10	2.50	V
		$I_C = 35\text{ A}, V_{GE} = 15\text{ V}, T_j = 125^\circ\text{C}$	-	-	-	V
C _{ies}	Input Capacitance	$V_{CE} = 25\text{ V}, V_{GE} = 0\text{ V}$ $f = 1\text{ MHz}, T_j = 25^\circ\text{C}$	-	1.45	-	nF
C _{oes}	Output Capacitance		-	-	-	nF
C _{res}	Reverse Transfer Capacitance		-	0.05	-	nF
t _{d(on)}	Turn-On Delay Time	$T_j = 25^\circ\text{C}, R_G = 12\text{ }\Omega$ $V_{DC} = 600\text{ V}$ $V_{GE} = 15\text{ V} \sim -15\text{ V}$ $I_C = 35\text{ A}$	-	60	-	ns
t _r	Rise Time		-	38	-	ns
t _{d(off)}	Turn-Off Delay Time		-	265	-	ns
t _f	Fall Time		-	130	-	ns
E _{on}	Turn-On Switching Loss		-	2.05	-	mJ
E _{off}	Turn-Off Switching Loss		-	2.12	-	mJ
t _{d(on)}	Turn-On Delay Time	$T_j = 125^\circ\text{C}, R_G = 12\text{ }\Omega$ $V_{DC} = 600\text{ V}$ $V_{GE} = 15\text{ V} \sim -15\text{ V}$ $I_C = 35\text{ A}$	-	61	-	ns
t _r	Rise Time		-	41	-	ns
t _{d(off)}	Turn-Off Delay Time		-	311	-	ns
t _f	Fall Time		-	190	-	ns
E _{on}	Turn-On Switching Loss		-	3.04	-	mJ
E _{off}	Turn-Off Switching Loss		-	3.02	-	mJ
t _{d(on)}	Turn-On Delay Time	$T_j = 150^\circ\text{C}, R_G = 12\text{ }\Omega$ $V_{DC} = 600\text{ V}$ $V_{GE} = 15\text{ V} \sim -15\text{ V}$ $I_C = 35\text{ A}$	-	62	-	ns
t _r	Rise Time		-	42	-	ns
t _{d(off)}	Turn-Off Delay Time		-	315	-	ns
t _f	Fall Time		-	220	-	ns
E _{on}	Turn-On Switching Loss		-	3.42	-	mJ
E _{off}	Turn-Off Switching Loss		-	3.32	-	mJ
ISC	Short Current	$V_{GE} \leq 15\text{ V}, V_{CC} = 900\text{ V}$ $V_{CE} \leq V_{CES}, T_j = 150^\circ\text{C}, TP \leq 10\text{ }\mu\text{s}$	-	140	-	A

Diode-Inverter Characteristics

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units	
VF	Diode Forward Voltage	IF = 35 A VGE = 0V	TJ = 25 °C	1.6	2.0	2.45	V	
			TJ = 125 °C	-	-	-		
trr	Diode Reverse Recovery Time	IF= 35 A diF/dt = 700 A/μs VR = 600 V VGE = 15 V	TJ = 25 °C	-	133	-	ns	
			TJ = 125 °C	-	-	-		
I _{RRM}	Diode Peak Reverse Recovery Current		TJ = 25 °C	-	20	-	A	
			TJ = 125 °C	-	-	-		
Q _{rr}	Diode Reverse Recovery Charge		TJ = 25 °C	-	1.4	-	μC	
			TJ = 125 °C	-	-	-		
Err	Diode Reverse Recovery Energy		TJ = 25 °C	-	0.25	-	mJ	
			TJ = 125 °C	-	-	-		

Electrical Characteristics of IGBT and Diode $T_J = 25^\circ\text{C}$ unless otherwise noted

Diode Rectifier Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Forward Voltage	$I_F = 35\text{A}$, $T_J = 25^\circ\text{C}$	-	1.1	1.5	V
		$I_F = 35\text{A}$, $T_J = 150^\circ\text{C}$	-	-	-	V
I_R	Reverse Leakage Current	$V_R = 1600\text{V}$, $T_J = 25^\circ\text{C}$	-	-	100	μA
		$V_R = 1600\text{V}$, $T_J = 150^\circ\text{C}$	-	-	1	mA

IGBT-Brake Chopper Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
BV_{CES}	C-E Breakdown Voltage	$V_{GE} = 0\text{V}$, $I_C = 250\mu\text{A}$	1200	-	-	V
I_{CES}	C-E Cut-Off Current	$V_{CE} = V_{CES}$, $V_{GE} = 0\text{V}$	-	-	1	mA
I_{GES}	G-E Leakage Current	$V_{GE} = V_{GES}$, $V_{CE} = 0\text{V}$	-	-	± 400	nA
$V_{GE(th)}$	G-E Threshold Voltage	$V_{GE} = V_{CE}$, $I_C = 1.0\text{mA}$	6.0	-	7.0	V
R_{gint}	Internal Gate Resistance		-	3.6	-	Ω
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 35\text{A}$, $V_{GE} = 15\text{V}$, $T_J = 25^\circ\text{C}$	1.70	2.10	2.50	V
		$I_C = 35\text{A}$, $V_{GE} = 15\text{V}$, $T_J = 125^\circ\text{C}$	-	-	-	V
C_{ies}	Input Capacitance	$V_{CE} = 25\text{V}$, $V_{GE} = 0\text{V}$ $f = 1\text{MHz}$, $T_J = 25^\circ\text{C}$	-	1.45	-	nF
C_{oes}	Output Capacitance		-	-	-	nF
C_{res}	Reverse Transfer Capacitance		-	0.05	-	nF
$t_{d(on)}$	Turn-On Delay Time	$T_J = 25^\circ\text{C}$, $R_G = 12\Omega$ $V_{DC} = 600\text{V}$ $V_{GE} = 15\text{V} \sim -15\text{V}$ $I_C = 35\text{A}$	-	60	-	ns
t_r	Rise Time		-	38	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	265	-	ns
t_f	Fall Time		-	130	-	ns
E_{on}	Turn-On Switching Loss		-	2.05	-	mJ
E_{off}	Turn-Off Switching Loss		-	2.12	-	mJ
$t_{d(on)}$	Turn-On Delay Time	$T_J = 125^\circ\text{C}$, $R_G = 12\Omega$ $V_{DC} = 600\text{V}$ $V_{GE} = 15\text{V} \sim -15\text{V}$ $I_C = 35\text{A}$	-	61	-	ns
t_r	Rise Time		-	41	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	311	-	ns
t_f	Fall Time		-	190	-	ns
E_{on}	Turn-On Switching Loss		-	3.04	-	mJ
E_{off}	Turn-Off Switching Loss		-	3.02	-	mJ
$t_{d(on)}$	Turn-On Delay Time	$T_J = 150^\circ\text{C}$, $R_G = 12\Omega$ $V_{DC} = 600\text{V}$ $V_{GE} = 15\text{V} \sim -15\text{V}$ $I_C = 35\text{A}$	-	62	-	ns
t_r	Rise Time		-	42	-	ns
$t_{d(off)}$	Turn-Off Delay Time		-	315	-	ns
t_f	Fall Time		-	220	-	ns
E_{on}	Turn-On Switching Loss		-	3.42	-	mJ
E_{off}	Turn-Off Switching Loss		-	3.32	-	mJ
I_{SC}	Short Current	$V_{GE} \leq 15\text{V}$, $V_{CC} = 900\text{V}$ $V_{CE} \leq V_{CES}$, $T_J = 150^\circ\text{C}$, $T_P \leq 10\mu\text{s}$	-	140	-	A

□ Diode-Brake Chopper Characteristics

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
VF	Diode Forward Voltage	IF = 35 A VGE = 0V	TJ = 25 °C	1.6	2.0	2.45	V
			TJ = 125 °C	-	-	-	
trr	Diode Reverse Recovery Time	IF= 35 A diF/dt = 700 A/μs VR = 600 V VGE = 15 V	TJ = 25 °C	-	133	-	ns
			TJ = 125 °C	-	-	-	
I _{RRM}	Diode Peak Reverse Recovery Current		TJ = 25 °C	-	20	-	A
			TJ = 125 °C	-	-	-	
Q _{rr}	Diode Reverse Recovery Charge		TJ = 25 °C	-	1.4	-	μC
			TJ = 125 °C	-	-	-	
Err	Diode Reverse Recovery Energy		TJ = 25 °C	-	0.25	-	mJ
			TJ = 125 °C	-	-	-	

□ NTC Thermistor Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
R25	Rated resistance	TC = 25 °C	-	5.00	-	kΩ
ΔR/R	Deviation of R100	TC = 10 °C, R100 = 493 Ω	-5	-	5	%
P25	Power Dissipation	TC = 25 °C	-	-	20.0	mW
B _{25/50}	B-Value	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298.15K))]$	-	3375	-	K
B _{25/80}		$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298.15K))]$	-	3411	-	K
B _{25/100}		$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298.15K))]$	-	3433	-	K

□ Module Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Ls	Stray Inductance		-	30	-	nH
RCC'+EE' RAA'+CC'	Module Lead Resistance	Terminal to chip	-	5.00 6.00	-	mΩ
Rth(J-C)	Thermal Resistance (J-C)	Junction-to-Case(per IGBT-Inverter)	-	0.55	0.60	K/W
	Thermal Resistance (J-C)	Junction-to-Case(per Diode-Inverter)	-	0.79	0.89	K/W
	Thermal Resistance (J-C)	Junction-to-Case(per Diode-Rectifier)	-	0.95	1.10	K/W
	Thermal Resistance (J-C)	Junction-to-Case(per IGBT-Brake)	-	0.55	0.60	K/W
	Thermal Resistance (J-C)	Case-to-Heatsink(per Diode-Brake)	-	0.79	0.89	K/W
F	Mounting force per Clamp		40	-	80	N
G	Weight		-	39	-	g

Figure 1. Typical Output Characteristics IGBT-inverter

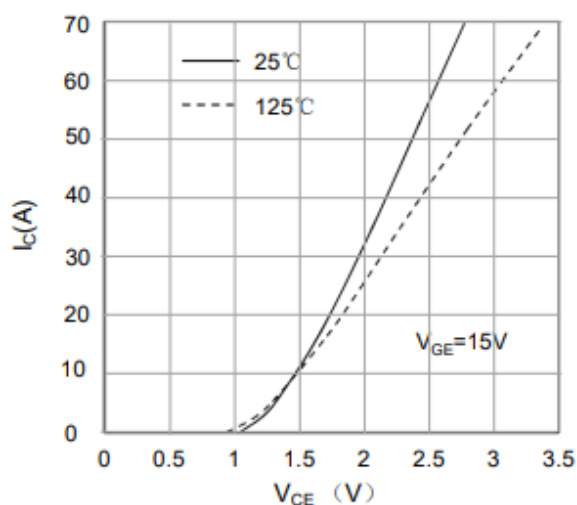


Figure 2. Typical Output Characteristics IGBT-inverter

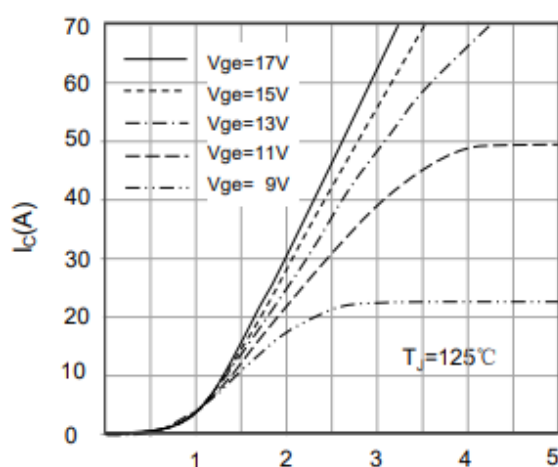


Figure 3. Typical Transfer characteristics IGBT-inverter

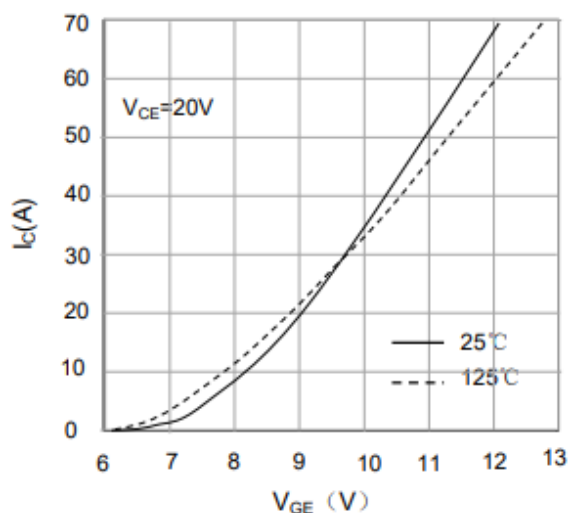


Figure 4. Switching Energy vs Gate Resistor IGBT-inverter

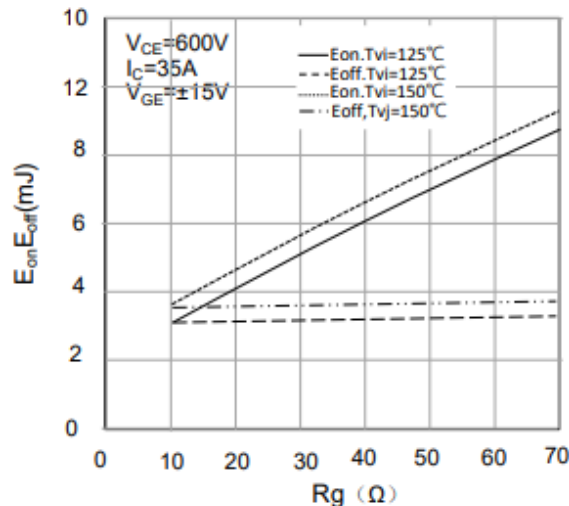


Figure 5. Switching Energy vs Collector Current IGBT-inverter

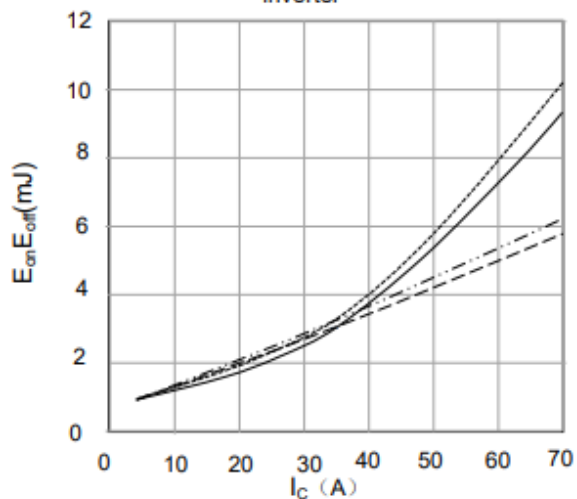


Figure 6. Reverse Biased Safe Operating Area IGBT-inverter

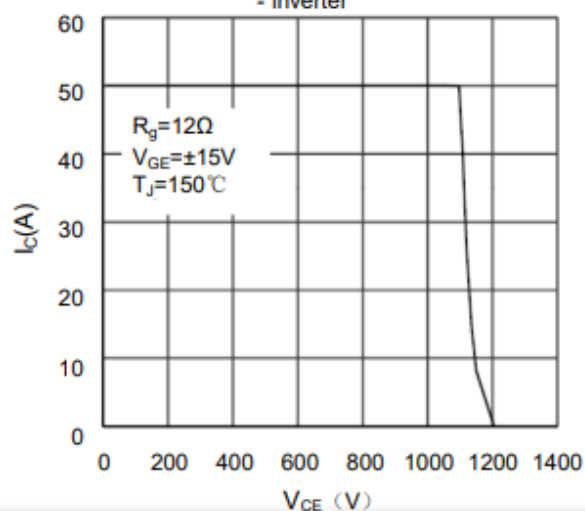


Figure 7. Diode Forward Characteristics Diode -inverter

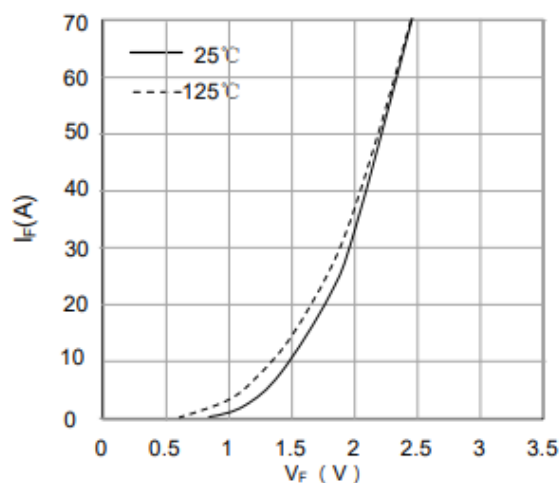


Figure 8. Switching Energy vs Gate Resistor Diode -inverter

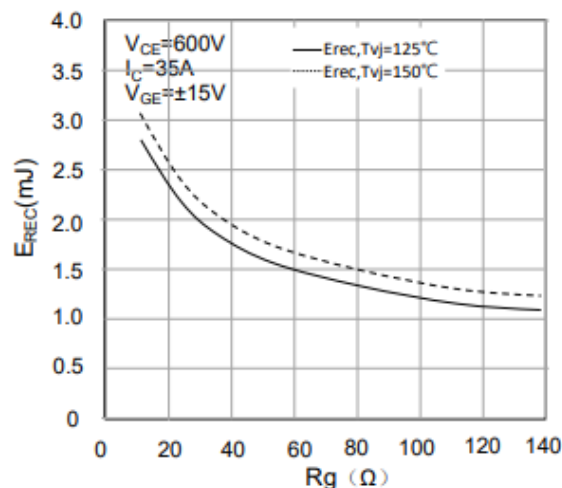


Figure 9. Switching Energy vs Forward Current Diode -inverter

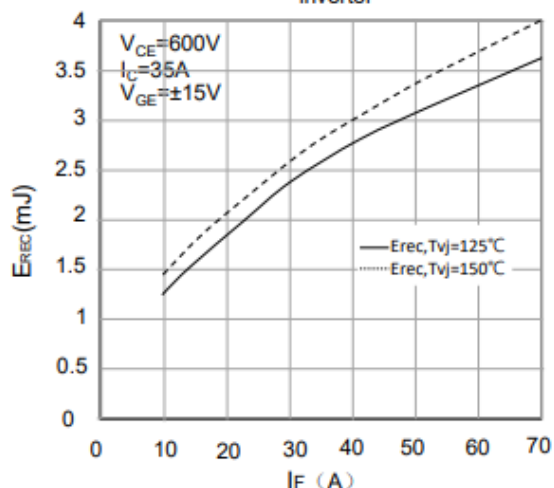


Figure 10. Transient Thermal Impedance of Diode and IGBT -inverter

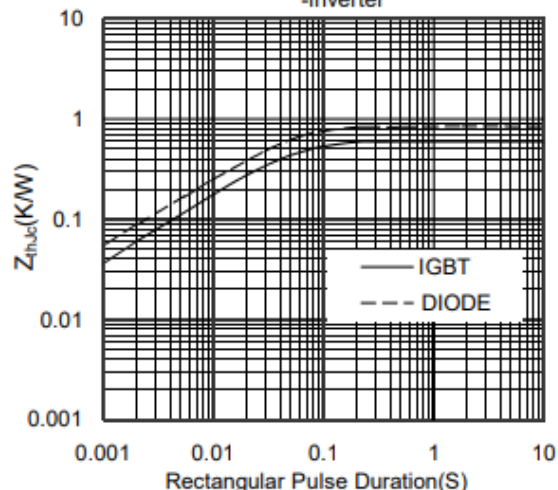


Figure 11. Diode Forward Characteristics Diode - rectifier

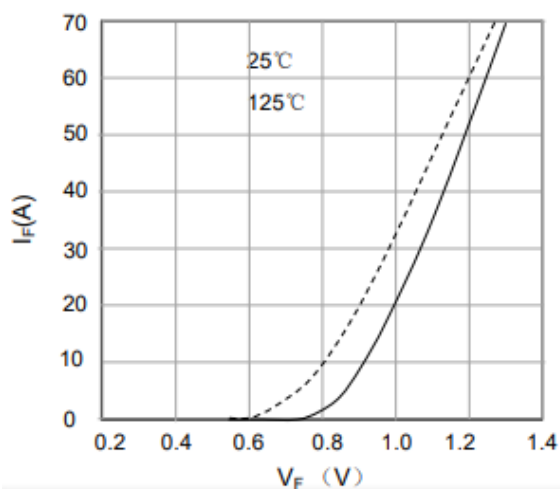


Figure 12. Typical Output Characteristics IGBT - brake chopper

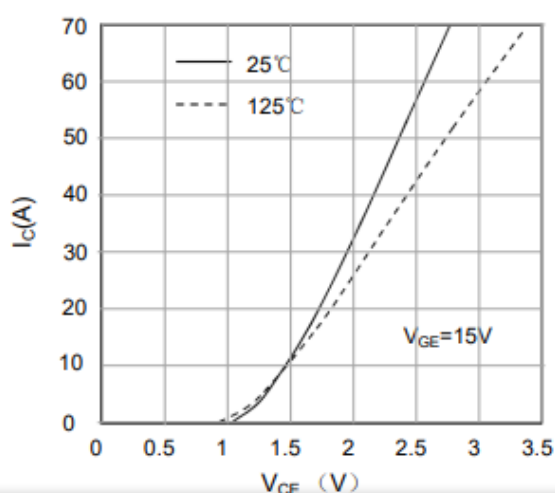


Figure 13. Diode Forward Characteristics Diode
- brake chopper

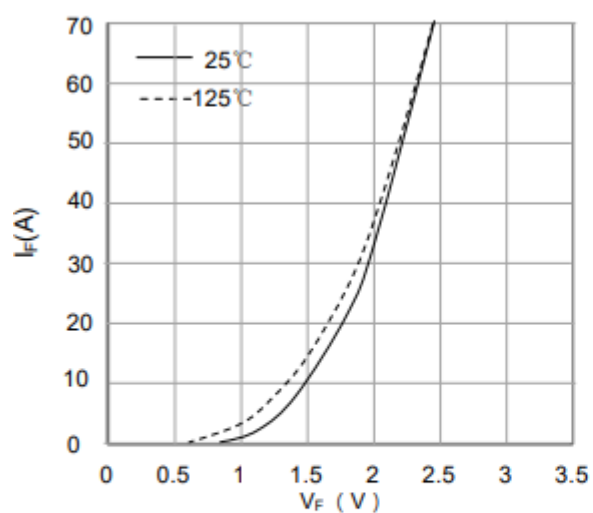
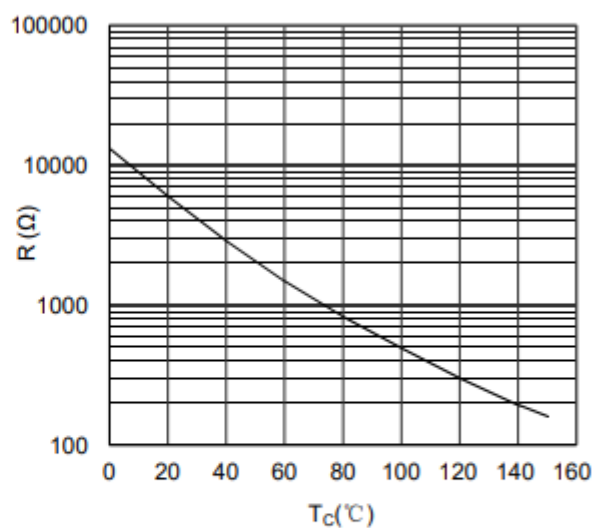
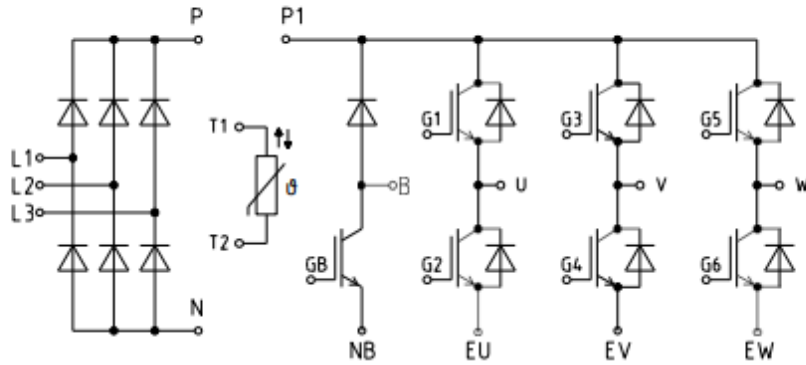


Figure 14. NTC Characteristics



Internal Circuit Diagram



Package Dimension (Dimension in mm)

