

**Key Parameters**

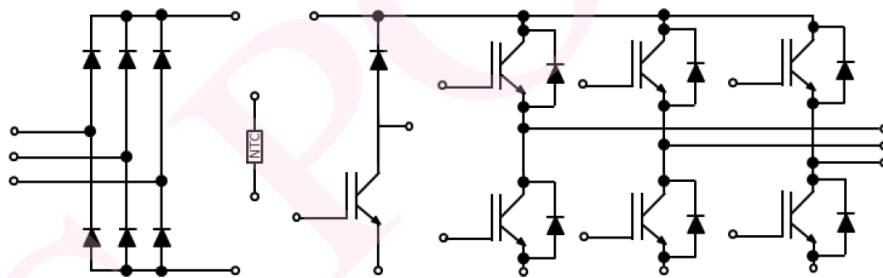
$V_{CES}$  = 1200V  
 $I_c$  = 50A

**Features**

- Low  $V_{ce(sat)}$
- Fast switching
- High ruggedness
- High short circuit capability

**Applications**

- Inverter for motor drive
- Frequency converters
- UPS
- General purpose Inverters



Equivalent Circuit Schematic

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<b>Absolute Maximum Ratings: IGBT, Inverter</b>						
<b>Symbol</b>	<b>Characteristic</b>	<b>Value</b>	<b>Unit</b>			
V <sub>CES</sub>	Collector-Emitter Voltage	1200	V			
I <sub>CDC</sub>	Continuous DC Collector Current ( T <sub>C</sub> =100°C, T <sub>J</sub> =175°C)	50	A			
I <sub>CRM</sub>	Peak Collector Current ( tp=1ms)	100	A			
V <sub>GES</sub>	Gate-Emitter Voltage	±20	V			
<b>IGBT Characteristics</b>						
<b>Symbol</b>	<b>Characteristic</b>	<b>Conditions</b>	<b>Value</b>			<b>Unit</b>
			<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	
BV <sub>CES</sub>	Collector-Emitter breakdown Voltage	V <sub>GE</sub> =0V, I <sub>C</sub> =250μA, T <sub>vj</sub> =25°C	1200			V
I <sub>CES</sub>	Collector-Emitter leakage Current	V <sub>CE</sub> =1200V, V <sub>GE</sub> =0V, T <sub>vj</sub> =25°C			1.0	mA
I <sub>GES</sub>	Gate-Emitter leakage Current	V <sub>CE</sub> =0V, V <sub>GE</sub> =±20V, T <sub>vj</sub> =25°C			100	ηA
V <sub>GE(th)</sub>	Gate-emitter Threshold Voltage	V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> =1.5mA, T <sub>vj</sub> =25°C	5.5	6.5	7.5	V
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	I <sub>C</sub> =50A, V <sub>GE</sub> =15V, T <sub>vj</sub> =25°C		1.70	2.0	V
		I <sub>C</sub> =50A, V <sub>GE</sub> =15V, T <sub>vj</sub> =125°C		2.05		V
		I <sub>C</sub> =50A, V <sub>GE</sub> =15V, T <sub>vj</sub> =150°C		2.15		V
Q <sub>G</sub>	Gate Charge	V <sub>CC</sub> =600V, V <sub>GE</sub> =15V, I <sub>C</sub> =50A T <sub>vj</sub> =25°C		220		ηC
C <sub>iss</sub>	Input Capacitance	V <sub>CE</sub> =25V, V <sub>GE</sub> =0V, f=1MHz, T <sub>vj</sub> =25°C		4150		pF
C <sub>oss</sub>	Output Capacitance			230		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			54		pF
t <sub>d(on)</sub>	Turn-on Delay Time	I <sub>C</sub> =50A		84		ηs
t <sub>r</sub>	Rise Time	V <sub>CE</sub> = 600 V		88		ηs
t <sub>d(off)</sub>	Turn-off Delay Time	V <sub>GE</sub> =0/15V		360		ηs
t <sub>f</sub>	Fall Time	R <sub>G</sub> = 10Ω		103		ηs
E <sub>on</sub>	Energy Dissipation During Turn-on Time	T <sub>vj</sub> =25°C , L <sub>load</sub> =0.82mH		4.8		mJ
E <sub>off</sub>	Energy Dissipation During Turn-off Time	Energy loss include tail and diode reverse recovery		2.4		mJ
t <sub>d(on)</sub>	Turn-on Delay Time	I <sub>C</sub> =50A		85		ηs
t <sub>r</sub>	Rise Time	V <sub>CE</sub> = 600 V		100		ηs
t <sub>d(off)</sub>	Turn-off Delay Time	V <sub>GE</sub> =0/15V		420		ηs
t <sub>f</sub>	Fall Time	R <sub>G</sub> = 10Ω		160		ηs
E <sub>on</sub>	Energy Dissipation During Turn-on Time	T <sub>vj</sub> =150°C , L <sub>load</sub> =0.82mH		7.3		mJ
E <sub>off</sub>	Energy Dissipation During Turn-off Time	Energy loss include tail and diode reverse recovery		3.5		mJ
I <sub>C(SC)</sub>	SC Data	t <sub>sc</sub> ≤10μs, V <sub>GE</sub> =15V, T <sub>vj</sub> =25°C, V <sub>CC</sub> ≤600V,		195		A
<b>Absolute Maximum Ratings: Diode, Inverter</b>						
<b>Symbol</b>	<b>Characteristic</b>	<b>Value</b>	<b>Unit</b>			
V <sub>RRM</sub>	Repetitive peak reverse voltage	1200	V			
I <sub>F</sub>	Continuous DC forward current ( T <sub>C</sub> =100°C, T <sub>J</sub> =150°C)	50	A			
I <sub>FRM</sub>	Repetitive peak forward current (tp=1ms)	100	A			
<b>Diode Characteristics</b>						
<b>Symbol</b>	<b>Characteristic</b>	<b>Conditions</b>	<b>Value</b>			<b>Unit</b>
			<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	
V <sub>F</sub>	Forward Voltage	I <sub>F</sub> =50A, T <sub>vj</sub> =25°C		2.0	2.45	V
		I <sub>F</sub> =50A, T <sub>vj</sub> =125°C		1.75		V
		I <sub>F</sub> =50A, T <sub>vj</sub> =150°C		1.7		V
Q <sub>rr</sub>	Recovered Charge	I <sub>F</sub> =50A		1.86		μC
I <sub>rrm</sub>	Peak Reverse Recovery Current	V <sub>R</sub> =600V		16.5		A
E <sub>rr</sub>	Reverse Recovery Energy	-di <sub>F</sub> /dt =450A/μs T <sub>vj</sub> =25°C		0.55		mJ
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Absolute Maximum Ratings: IGBT, Break-Chopper						
Symbol	Characteristic	Value	Unit			
V <sub>CEs</sub>	Collector-Emitter Voltage	1200	V			
I <sub>CDc</sub>	Continuous DC Collector Current ( T <sub>C</sub> =100°C, T <sub>J</sub> =175°C)	35	A			
I <sub>CRM</sub>	Peak Collector Current ( tp=1ms)	70	A			
V <sub>GES</sub>	Gate-Emitter Voltage	±20	V			
IGBT Characteristics						
Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
BV <sub>CEs</sub>	Collector-Emitter breakdown Voltage	V <sub>GE</sub> =0V, I <sub>C</sub> =250μA, T <sub>vj</sub> =25°C	1200			V
I <sub>CEs</sub>	Collector-Emitter leakage Current	V <sub>CE</sub> =1200V, V <sub>GE</sub> =0V, T <sub>vj</sub> =25°C			1.0	mA
I <sub>GES</sub>	Gate-Emitter leakage Current	V <sub>CE</sub> =0V, V <sub>GE</sub> =±20V, T <sub>vj</sub> =25°C			100	ηA
V <sub>GE(th)</sub>	Gate-emitter Threshold Voltage	V <sub>GE</sub> =V <sub>CE</sub> , I <sub>C</sub> =1.5mA, T <sub>vj</sub> =25°C	5.5	6.5	7.5	V
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	I <sub>C</sub> =35A, V <sub>GE</sub> =15V, T <sub>vj</sub> =25°C		1.65	2.0	V
		I <sub>C</sub> =35A, V <sub>GE</sub> =15V, T <sub>vj</sub> =125°C		2.0		V
		I <sub>C</sub> =35A, V <sub>GE</sub> =15V, T <sub>vj</sub> =150°C		2.15		V
Q <sub>G</sub>	Gate Charge	V <sub>CC</sub> =600V, V <sub>GE</sub> =15V, I <sub>C</sub> =35A T <sub>vj</sub> =25°C		148		ηC
C <sub>iss</sub>	Input Capacitance	V <sub>CE</sub> =25V, V <sub>GE</sub> =0V, f=1MHz, T <sub>vj</sub> =25°C		3460		pF
C <sub>oss</sub>	Output Capacitance			154		pF
C <sub>rss</sub>	Reverse Transfer Capacitance			41		pF
t <sub>d(on)</sub>	Turn-on Delay Time	I <sub>C</sub> =35A V <sub>CE</sub> = 600 V V <sub>GE</sub> =0/15V R <sub>G</sub> = 10Ω T <sub>vj</sub> =25°C , L <sub>load</sub> =0.82mH Energy loss include tail and diode reverse recovery		55		ηs
t <sub>r</sub>	Rise Time			58		ηs
t <sub>d(off)</sub>	Turn-off Delay Time			300		ηs
t <sub>f</sub>	Fall Time			110		ηs
E <sub>on</sub>	Energy Dissipation During Turn-on Time			2.8		mJ
E <sub>off</sub>	Energy Dissipation During Turn-off Time			1.6		mJ
t <sub>d(on)</sub>	Turn-on Delay Time		I <sub>C</sub> =35A V <sub>CE</sub> = 600 V V <sub>GE</sub> =0/15V R <sub>G</sub> = 10Ω T <sub>vj</sub> =150°C , L <sub>load</sub> =0.82mH Energy loss include tail and diode reverse recovery		57	
t <sub>r</sub>	Rise Time			60		ηs
t <sub>d(off)</sub>	Turn-off Delay Time			320		ηs
t <sub>f</sub>	Fall Time			136		ηs
E <sub>on</sub>	Energy Dissipation During Turn-on Time			4.95		mJ
E <sub>off</sub>	Energy Dissipation During Turn-off Time			2.15		mJ
Absolute Maximum Ratings: Diode, Break-Chopper						
Symbol	Characteristic	Value	Unit			
V <sub>RRM</sub>	Repetitive peak reverse voltage	1200	V			
I <sub>F</sub>	Continuous DC forward current ( T <sub>C</sub> =100°C, T <sub>J</sub> =150°C)	15	A			
I <sub>FRM</sub>	Repetitive peak forward current (tp=1ms)	30	A			
Diode Characteristics						
Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
V <sub>F</sub>	Forward Voltage	I <sub>F</sub> =15A, T <sub>vj</sub> =25°C		2.0	2.40	V
		I <sub>F</sub> =15A, T <sub>vj</sub> =125°C		1.75		V
		I <sub>F</sub> =15A, T <sub>vj</sub> =150°C		1.65		V
Q <sub>rr</sub>	Recovered Charge	I <sub>F</sub> =15A		1.2		μC
I <sub>rrm</sub>	Peak Reverse Recovery Current	V <sub>R</sub> =600V		14.5		A
E <sub>rr</sub>	Reverse Recovery Energy	-di <sub>F</sub> /dt =600A/μs T <sub>vj</sub> =25°C		0.4		mJ
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Absolute Maximum Ratings: Diode, Rectifier						
Symbol	Characteristic	Value				Unit
V <sub>RRM</sub>	Repetitive peak reverse voltage	1600				V
I <sub>F(AV)</sub>	Average output current 50/60Hz, sine wave (T <sub>C</sub> =100°C)	35				A
I <sub>RMSM</sub>	Maximum RMS current at rectifier output (T <sub>C</sub> =100°C)	60				A
I <sub>FSM</sub>	Surge forward current (V <sub>R</sub> =0V, t <sub>p</sub> =10msec)	320				A
I <sup>2</sup> t	I <sup>2</sup> t value (V <sub>R</sub> =0V, t <sub>p</sub> =10msec)	510				A <sup>2</sup> s
Diode Characteristics						
Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
V <sub>F</sub>	Forward Voltage	I <sub>F</sub> =35A, T <sub>vj</sub> =150°C		1.12		V
I <sub>R</sub>	Diode reverse current	V <sub>R</sub> =1600V, T <sub>j</sub> =150°C			2.0	mA
Module Characteristics						
Symbol	Characteristic	Conditions	Value			Unit
			Min.	Typ.	Max.	
V <sub>isol</sub>	Isolation voltage	t=1min, f=50Hz	2500			V
T <sub>jmax</sub>	Maximum Junction Temperature				175	°C
T <sub>vj op</sub>	Operating Junction Temperature		-40		150	°C
T <sub>stg</sub>	Storage Temperature		-40		150	°C
R <sub>CC'+EE'</sub>	Module lead resistance terminal to chip			5.0		mΩ
R <sub>AA'+CC'</sub>	Module lead resistance terminal to chip			6.0		mΩ
L <sub>SCE</sub>	Stray Inductance, Module			30		nH
R <sub>θjc</sub>	Junction-to Case	per IGBT-inverter		0.48		°C/W
		per Diode-inverter		0.75		°C/W
		per IGBT-Break Chopper		0.60		°C/W
		per Diode- Break Chopper		1.30		°C/W
		per Diode- Rectifier		0.90		°C/W
R <sub>θcs</sub>	Case to Sink	per IGBT-inverter		0.6		°C/W
		per Diode-inverter		0.75		°C/W
		per IGBT-Break Chopper		0.6		°C/W
		per Diode- Break Chopper		1.05		°C/W
		per Diode- Rectifier		0.95		°C/W
		per Module		0.037		°C/W
M <sub>t</sub>	Mounting force per clamp		30		80	N
G	Weight of Module			45		g
NTC thermistors Characteristics						
Symbol	Characteristic	Conditions	Min.	Typ.	Max.	Unit
R <sub>25</sub>	Rated resistance			5.0		kΩ
ΔR/R	Deviation of R100	T <sub>C</sub> =100°C, R <sub>100</sub> =493.3Ω	-5		5	%
P <sub>25</sub>	Power Dissipation				20.0	mW
B <sub>25/50</sub>	B-value	R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/50</sub> (1/T <sub>2</sub> -1/(298.15K))]		3375		K
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• Typical Electrical Characteristics

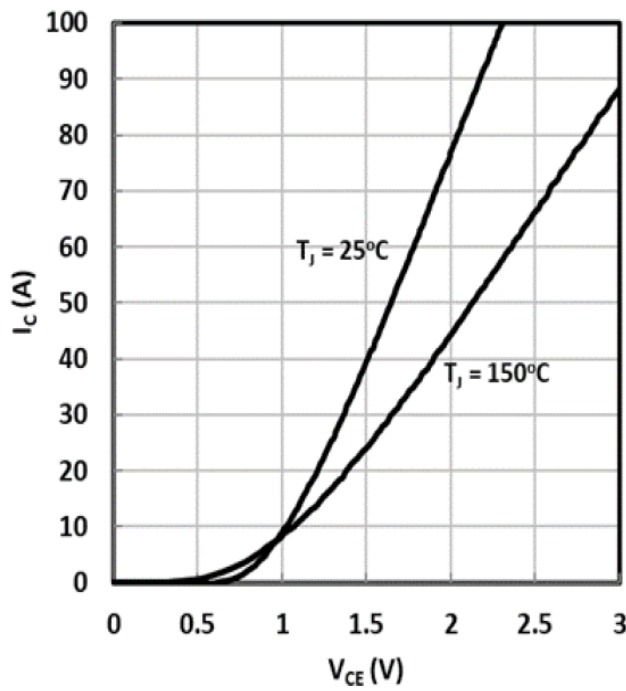


Fig. 1 IGBT (Inverter) Output Characteristics

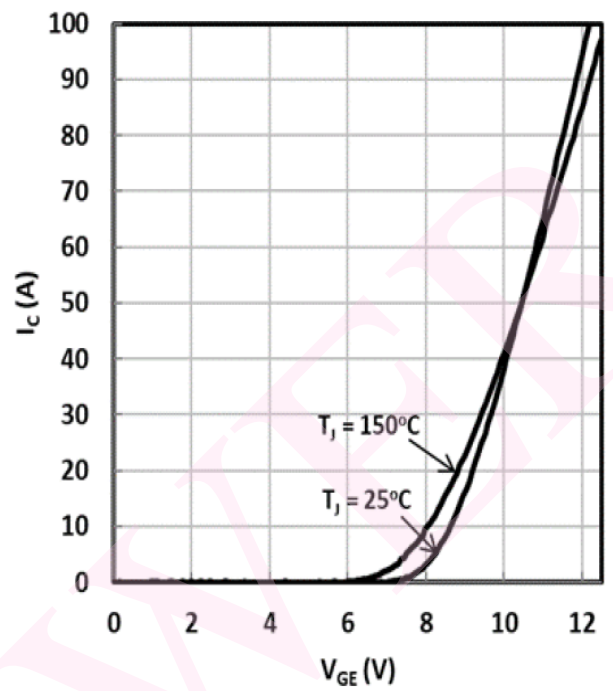


Fig. 2 IGBT (Inverter) Transfer Characteristics

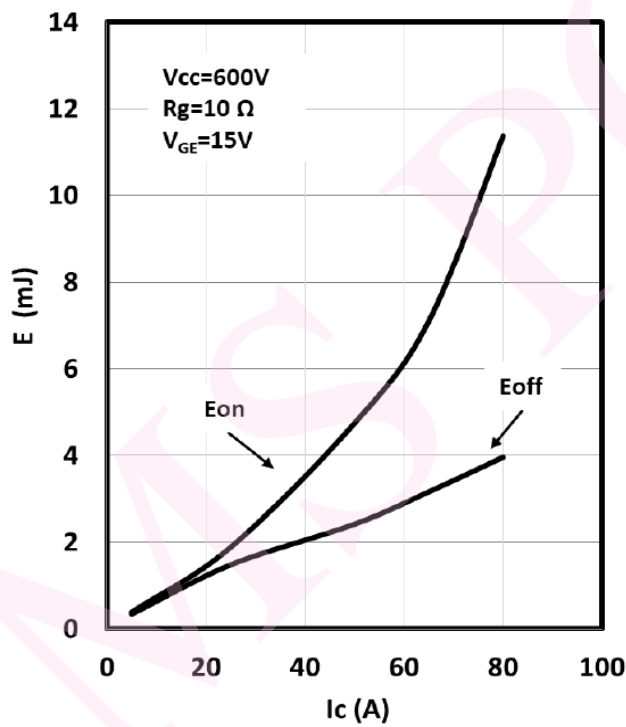


Fig. 3 IGBT (Inverter) Switching Loss vs. Ic

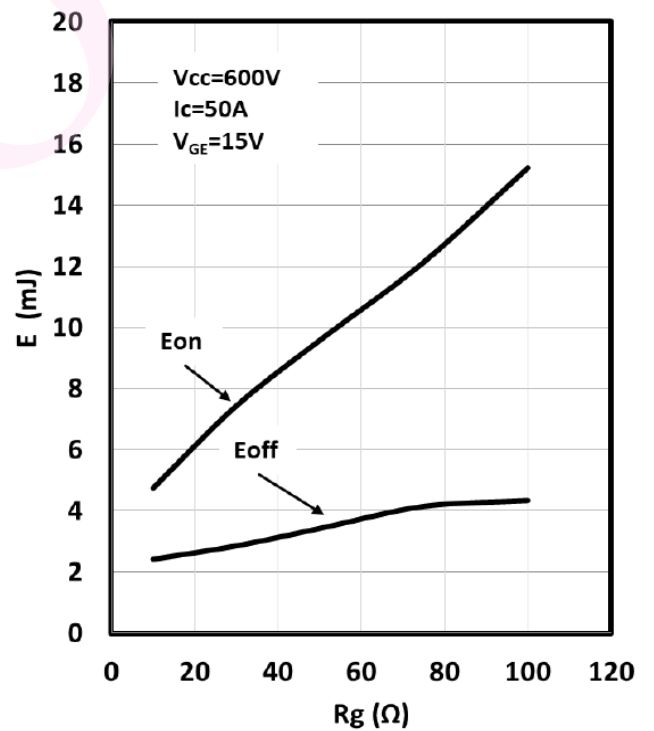
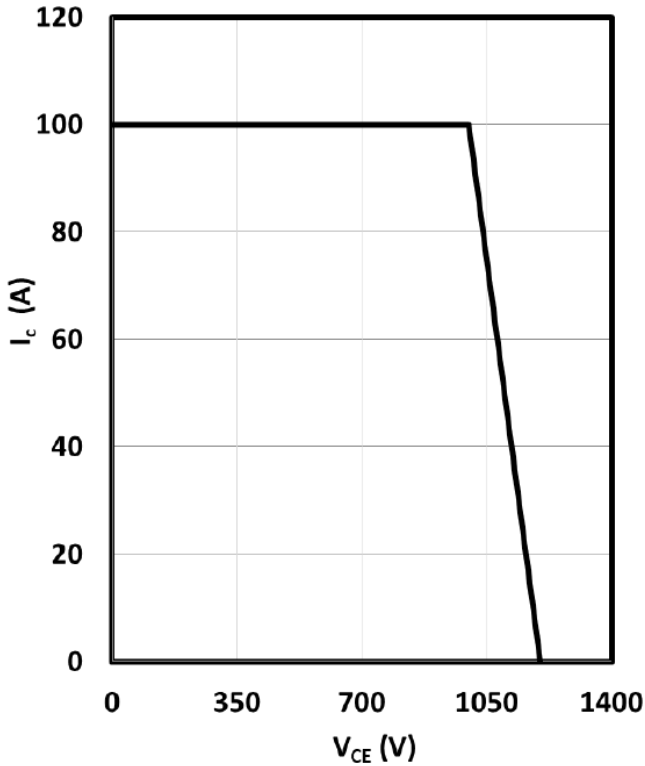
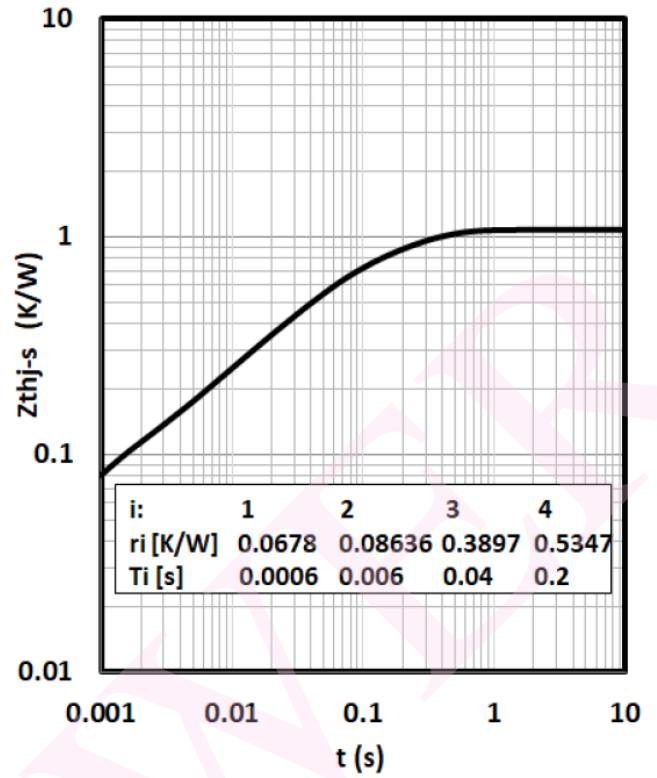


Fig. 4 IGBT (Inverter) Switching Loss vs. Rg

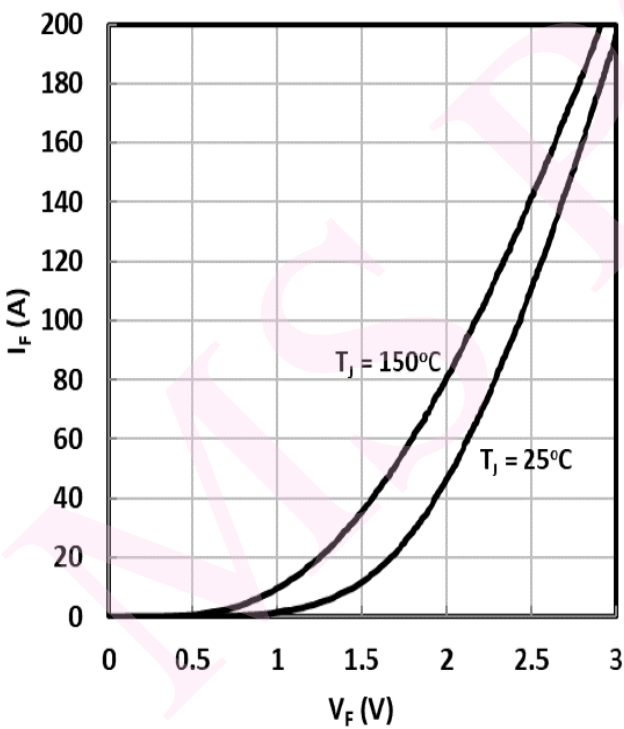
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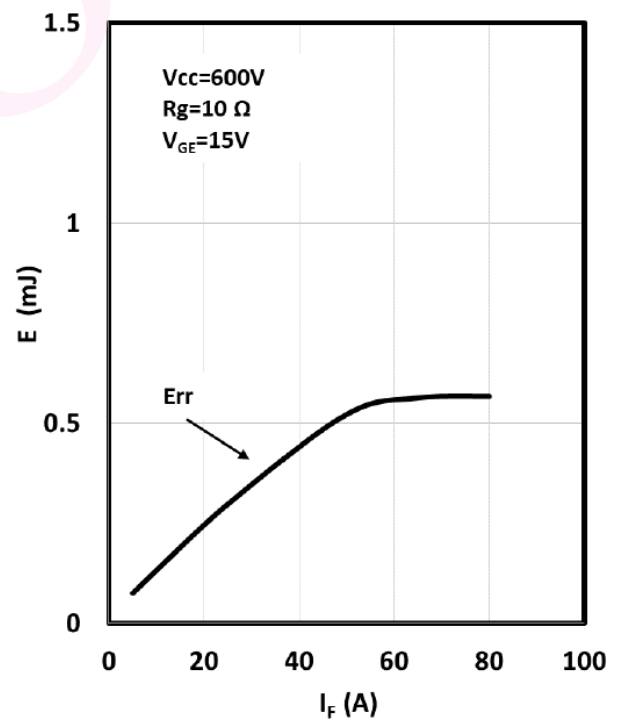
**Fig. 5 RBSOA**



**Fig. 6 IGBT (Inverter) Transient Thermal Impedance**



**Fig. 7 Diode (Inverter) Forward Characteristics**



**Fig. 8 Diode (Inverter) Switching Loss ( $E_{rec}$ ) vs.  $I_F$**

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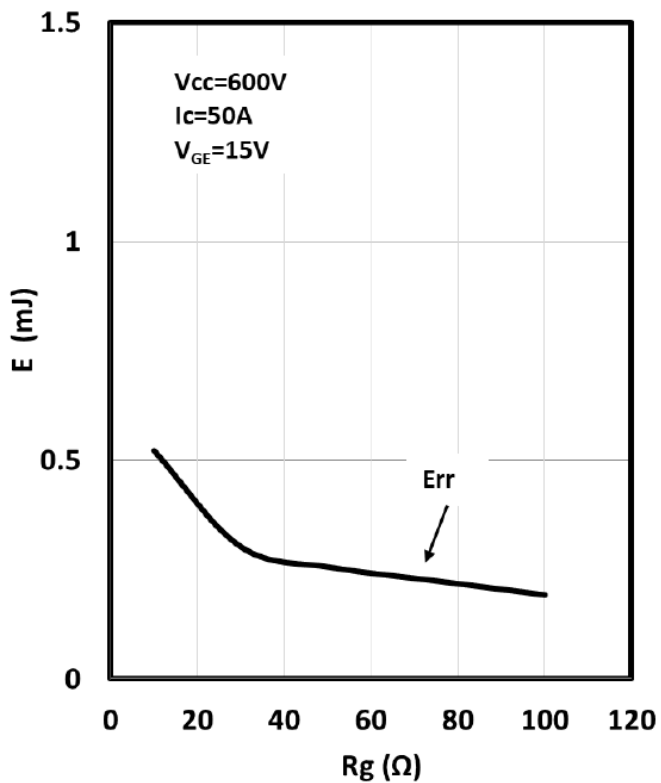


Fig. 9 Diode (Inverter) Reverse-Recovery Loss vs. Rg

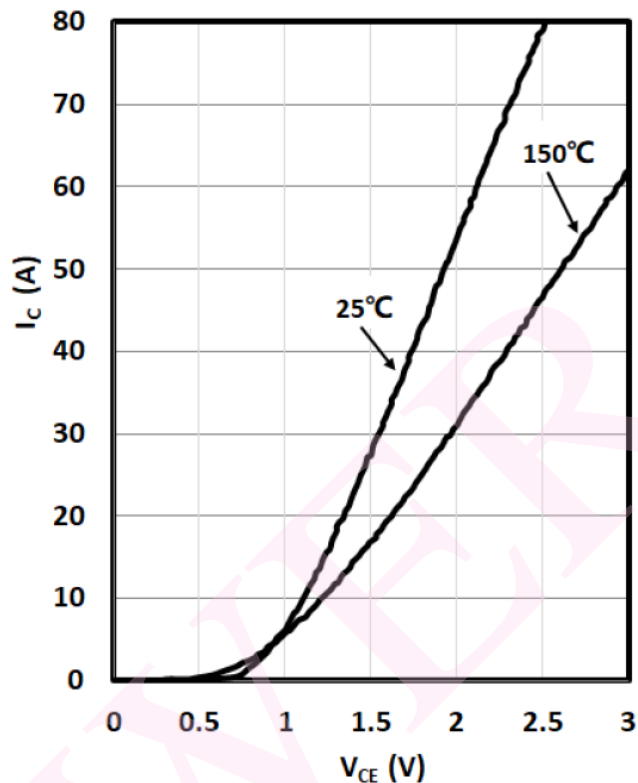


Fig. 10 IGBT (Break-Chopper) Output Characteristics

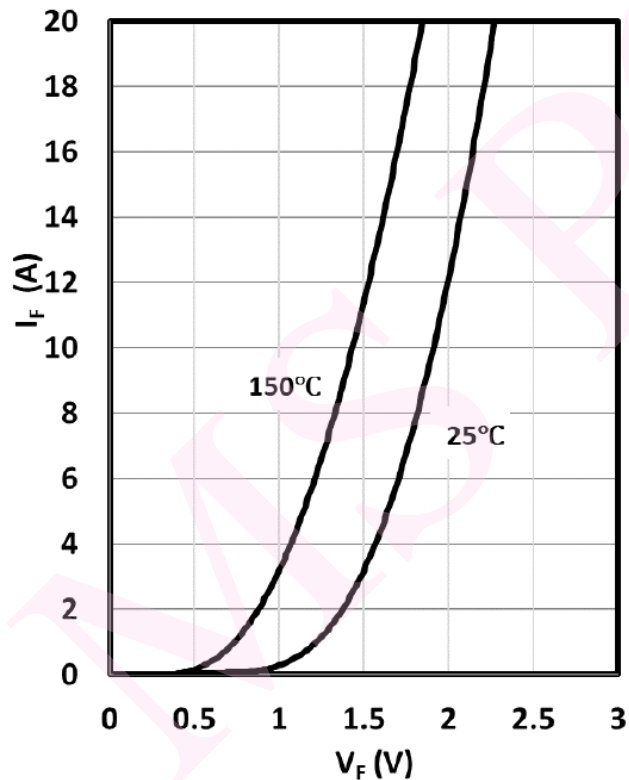


Fig. 11 Diode (Brake-Chopper) Output Characteristics

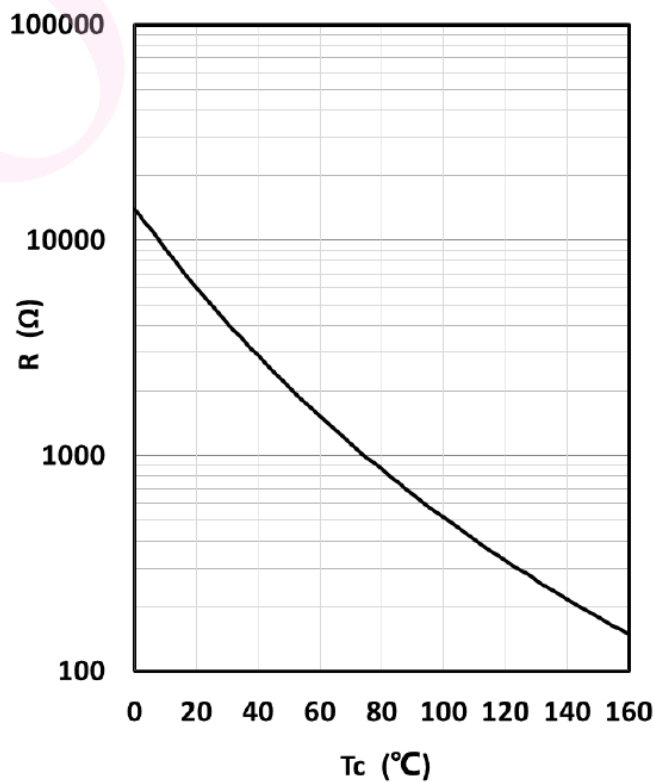
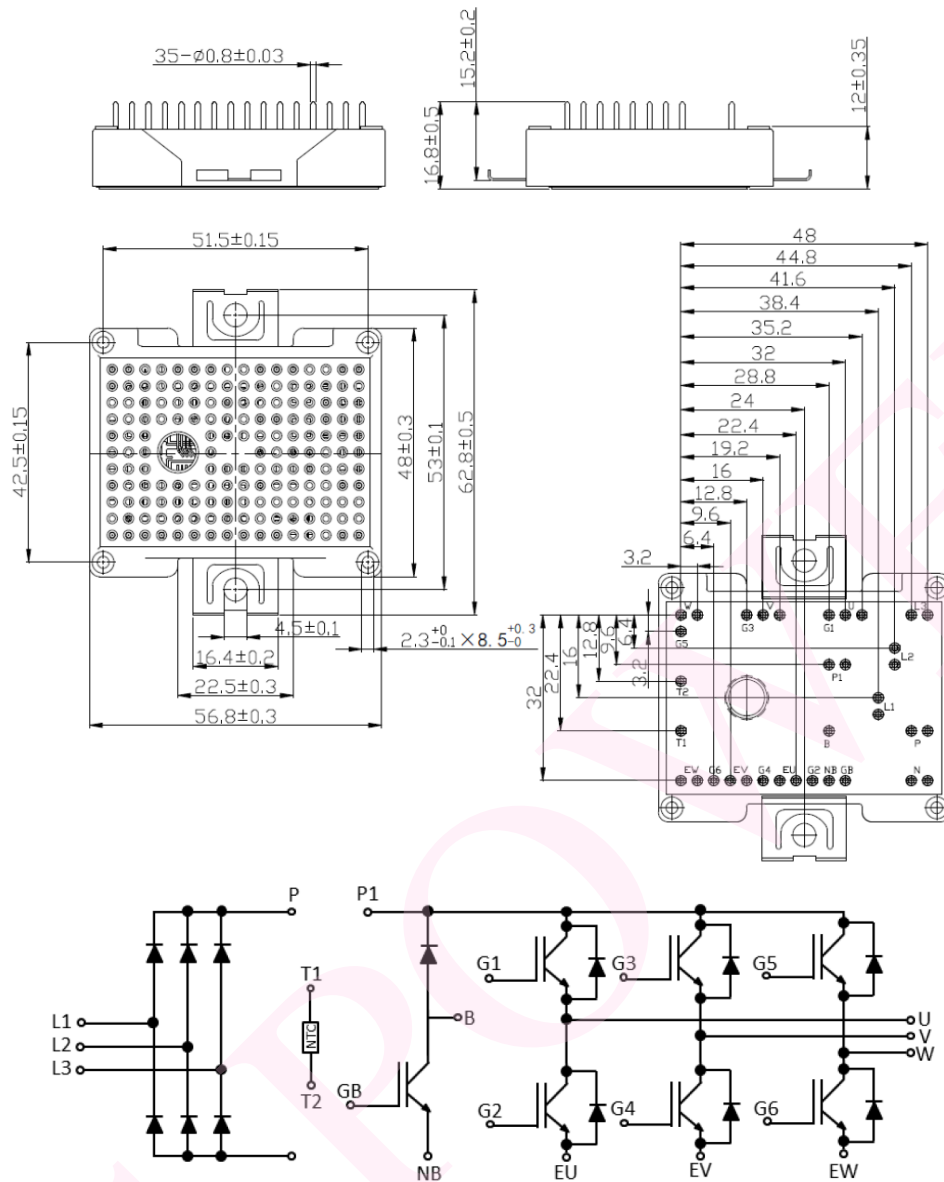


Fig. 12 NTC Temperature Characteristics

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