

### Electrical Features

- Trench/Fieldstop IGBT
- $V_{CEsat}$  with positive Temperature Coefficient
- Low  $V_{CEsat}$

### Typical Applications

- Auxiliary inverters
- Motor drives
- Servo drives



### Mechanical Features

- High power density
- Integrated NTC temperature sensor
- Copper base plate
- Solder contact technology
- Standard housing

### IGBT, Inverter

Maximum Rated Values							
Symbol	Item	Conditions	Rating	Unit			
IGBT							
$V_{CES}$	Collector-emitter voltage	$T_{vj}=25^{\circ}C$	1200	V			
$V_{GES}$	Gate-emitter voltage	-	$\pm 20$	V			
$I_C$	Collector current,DC	$T_C=100^{\circ}C, T_{vj}=175^{\circ}C$	50	A			
$I_{CRM}$	Repetitive peak collector current	$t_p=1ms$	100	A			
$P_{tot}$	Total power dissipation	$T_C=25^{\circ}C, T_{vj}=175^{\circ}C$	217	W			
Characteristics Values							
Symbol	Item	Conditions	Values			Unit	
			Min.	Typ.	Max.		
$I_{CES}$	Collector-emitter cut-off current	$V_{CE}=1200V, V_{GE}=0V, T_{vj}=25^{\circ}C$	-	-	1	mA	
$I_{GES}$	Gate leakage current	$V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$	-	-	400	nA	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=1.5mA, V_{CE}=V_{GE}, T_{vj}=25^{\circ}C$	5.2	5.72	6.5	V	
$V_{CEsat}$	Collector-emitter saturation voltage	$I_C=50A$ $V_{GE}=15V$	$T_{vj}=25^{\circ}C$	-	1.88	2.3	V
			$T_{vj}=125^{\circ}C$	-	2.13	-	
			$T_{vj}=150^{\circ}C$	-	2.24	-	
$C_{ies}$	Input capacitance	$V_{CE}=25V, V_{GE}=0V$ $f=1MHz, T_{vj}=25^{\circ}C$	-	3.535	-	nF	
$C_{oes}$	Output capacitance		-	0.231	-		
$C_{res}$	Reverse transfer capacitance		-	0.119	-		
$Q_G$	Gate charge	$V_{CC}=600V, I_C=50A$ $V_{GE}=-15...+15V, T_{vj}=25^{\circ}C$	-	0.201	-	$\mu C$	
$R_g$	Internal gate resistance	$T_{vj}=25^{\circ}C$	-	4	-	$\Omega$	

$t_{d(on)}$	Turn-on delay time	$V_{CC}=600V$ $I_C=50A$ $V_{GE}=\pm 15V$ $R_{G(on)}=39\Omega$ $R_{G(off)}=39\Omega$	$T_{vj}=25^\circ C$	-	187.7	-	ns
			$T_{vj}=125^\circ C$	-	168.1	-	
			$T_{vj}=150^\circ C$	-	162.6	-	
$t_r$	Rise time		$T_{vj}=25^\circ C$	-	149.3	-	
			$T_{vj}=125^\circ C$	-	156.8	-	
			$T_{vj}=150^\circ C$	-	160.5	-	
$t_{d(off)}$	Turn-off delay time		$T_{vj}=25^\circ C$	-	497.6	-	
			$T_{vj}=125^\circ C$	-	536.1	-	
			$T_{vj}=150^\circ C$	-	568.2	-	
$t_f$	Fall time		$T_{vj}=25^\circ C$	-	248.1	-	
		$T_{vj}=125^\circ C$	-	536.7	-		
		$T_{vj}=150^\circ C$	-	632.8	-		
$E_{on}$	Turn-on energy (per pulse)	$V_{CC}=600V, I_C=50A$ $V_{GE}=\pm 15V, R_{G(on)}=39\Omega$ $di/dt=1000A/\mu s(T_{vj}=150^\circ C)$	$T_{vj}=25^\circ C$	-	13.31	-	mJ
			$T_{vj}=125^\circ C$	-	16.13	-	
			$T_{vj}=150^\circ C$	-	16.82	-	
$E_{off}$	Turn-off energy (per pulse)		$T_{vj}=25^\circ C$	-	3.41	-	
			$T_{vj}=125^\circ C$	-	4.01	-	
			$T_{vj}=150^\circ C$	-	4.23	-	
SC data	Short-circuit current	$V_{CC}=600V, V_{GE}\leq 15V, T_{vj}=25^\circ C$ $V_{CES}\leq 1200V, t_p\leq 10\mu s$	-	350	-	A	
$R_{thJC}$	Thermal resistance, junction to case	Per IGBT	-	-	0.69	K/W	
$R_{thCH}$	Thermal resistance, case to heatsink	Per IGBT / $\lambda_{grease}=1W/(m\cdot K)$	-	0.135	-	K/W	
$T_{vjop}$	Temperature under switching conditions		-40		150	$^\circ C$	

**Diode, Inverter**

**Maximum Rated Values**

Symbol	Item	Conditions	Rating	Unit
$V_{RRM}$	Repetitive peak reverse voltage	$T_{vj}=25^\circ C$	1200	V
$I_F$	Forward current, DC		50	A
$I_{FRM}$	Repetitive peak forward current	$t_p=1ms$	100	A
$I^2t$	$I^2t$ -value	$V_R=0V, t_p=10ms, T_{vj}=25^\circ C$	1800	$A^2s$

**Characteristic Values**

			Min.	Typ.	Max.		
$V_F$	Continuous forward voltage	$I_F=50A$ $V_{GE}=0V$	$T_{vj}=25^\circ C$	-	2.15	2.4	V
			$T_{vj}=125^\circ C$	-	1.87	-	
			$T_{vj}=150^\circ C$	-	1.77	-	
$I_{RM}$	Peak reverse recovery current	$V_R=600V$ $I_F=50A$ $V_{GE}=-15V$ $-di_F/dt=880A/\mu s$ ( $T_{vj}=150^\circ C$ )	$T_{vj}=25^\circ C$	-	22.9	-	A
			$T_{vj}=125^\circ C$	-	30.1	-	
			$T_{vj}=150^\circ C$	-	32.1	-	
$t_{rr}$	Reverse recovery time		$T_{vj}=25^\circ C$	-	82.3	-	ns
			$T_{vj}=125^\circ C$	-	248.1	-	
			$T_{vj}=150^\circ C$	-	295.5	-	
$Q_r$	Recovered charge	$T_{vj}=25^\circ C$	-	1.03	-	$\mu C$	
		$T_{vj}=125^\circ C$	-	9.17	-		
		$T_{vj}=150^\circ C$	-	11.17	-		

E <sub>rec</sub>	Reverse recovery energy		T <sub>vj</sub> =25°C	-	0.06	-	mJ
			T <sub>vj</sub> =125°C	-	2.91	-	
			T <sub>vj</sub> =150°C	-	3.63	-	
R <sub>thJC</sub>	Thermal resistance, junction to case	per diode	-	-	1.13		K/W
R <sub>thCH</sub>	Thermal resistance, case to heatsink	per diode / λ <sub>grease</sub> =1 W/(m • K)	-	0.2	-		K/W
T <sub>vjop</sub>	Temperature under switching conditions		-40		150		°C

**Diode, Rectifier**

Maximum Rated Values							
Symbol	Item	Conditions		Rating			Unit
V <sub>RRM</sub>	Repetitive peak reverse voltage	T <sub>vj</sub> =25°C		1800			V
I <sub>FRMSM</sub>	Maximum RMS forward current per chip	T <sub>C</sub> =80°C		50			A
I <sub>RMSM</sub>	Maximum RMS current at rectifier output	T <sub>C</sub> = 80°C		60			A
I <sub>FSM</sub>	Surge forward current	tp = 10 ms, T <sub>vj</sub> =150°C		420			A
I <sup>2</sup> t	I <sup>2</sup> t-value	V <sub>R</sub> =0V, t <sub>p</sub> =10ms, T <sub>vj</sub> =150°C		882			A <sup>2</sup> s

Characteristic Values							
Symbol	Item	Conditions	Values			Unit	
			Min.	Typ.	Max.		
V <sub>F</sub>	Continuous forward voltage	I <sub>F</sub> =50A V <sub>GE</sub> =0V	T <sub>vj</sub> =25°C	-	1.17	1.4	V
			T <sub>vj</sub> =125°C	-	1.16	-	
			T <sub>vj</sub> =150°C	-	1.16	-	
I <sub>R</sub>	Reverse current	V <sub>R</sub> =1800V	T <sub>vj</sub> =25°C	-	-	10	uA
			T <sub>vj</sub> =125°C	-	-	-	
			T <sub>vj</sub> =150°C	-	-	-	
T <sub>vjop</sub>	Temperature under switching conditions		-40		150		°C

**IGBT, Brake-Chopper**

Maximum Rated Values							
Symbol	Item	Conditions		Values			Unit
V <sub>CES</sub>	Collector-emitter voltage	T <sub>vj</sub> =25°C		1200			V
V <sub>GES</sub>	Gate-emitter voltage	-		±20			V
I <sub>C</sub>	Collector current,DC	T <sub>C</sub> =100°C, T <sub>vj</sub> =175°C		40			A
I <sub>CRM</sub>	Repetitive peak collector current	t <sub>p</sub> =1ms		80			A
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25°C, T <sub>vj</sub> =175°C		147			W

Characteristic Values							
Symbol	Item	Conditions	Values			Unit	
			Min.	Typ.	Max.		
IGBT							
I <sub>CES</sub>	Collector-emitter cut-off current	V <sub>CE</sub> =1200V, V <sub>GE</sub> =0V, T <sub>vj</sub> =25°C		-	-	1	mA
I <sub>GES</sub>	Gate leakage current	V <sub>CE</sub> =0V, V <sub>GE</sub> =20V, T <sub>vj</sub> =25°C		-	-	400	nA
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	I <sub>C</sub> =1.5mA, V <sub>CE</sub> =V <sub>GE</sub> , T <sub>vj</sub> =25°C		5.2	5.5	6.5	V

$V_{CEsat}$	Collector-emitter saturation voltage	$I_C=40A$ $V_{GE}=15V$	$T_{vj}=25^{\circ}C$	-	1.89	2.3	
			$T_{vj}=125^{\circ}C$	-	2.20	-	
			$T_{vj}=150^{\circ}C$	-	2.31	-	
$C_{ies}$	Input capacitance	$V_{CE}=25V, V_{GE}=0V$ $f=1MHz, T_{vj}=25^{\circ}C$		-	3.13	-	nF
$C_{oes}$	Output capacitance			-	0.17	-	
$C_{res}$	Reverse transfer capacitance			-	0.09	-	
$Q_G$	Gate charge	$V_{CC}=600V, I_C=40A$ $V_{GE}=-15...+15V, T_{vj}=25^{\circ}C$		-	0.24	-	$\mu C$
$R_g$	Internal gate resistance	$T_{vj}=25^{\circ}C$		-	-	-	$\Omega$
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600V$ $I_C=40A$ $V_{GE}=\pm 15V$ $R_{G(on)}=39\Omega$ $R_{G(off)}=39\Omega$	$T_{vj}=25^{\circ}C$	-	136.1	-	ns
			$T_{vj}=125^{\circ}C$	-	118.1	-	
			$T_{vj}=150^{\circ}C$	-	104.2	-	
$t_r$	Rise time		$T_{vj}=25^{\circ}C$	-	120.0	-	
			$T_{vj}=125^{\circ}C$	-	123.2	-	
			$T_{vj}=150^{\circ}C$	-	128.3	-	
$t_{d(off)}$	Turn-off delay time		$T_{vj}=25^{\circ}C$	-	251.2	-	
			$T_{vj}=125^{\circ}C$	-	345.6	-	
			$T_{vj}=150^{\circ}C$	-	396.8	-	
$t_f$	Fall time	$T_{vj}=25^{\circ}C$	-	243.2	-		
		$T_{vj}=125^{\circ}C$	-	300.8	-		
		$T_{vj}=150^{\circ}C$	-	316.8	-		
$E_{on}$	Turn-on energy (per pulse)	$T_{vj}=25^{\circ}C$	-	7.67	-	mJ	
		$T_{vj}=125^{\circ}C$	-	9.23	-		
		$T_{vj}=150^{\circ}C$	-	9.54	-		
$E_{off}$	Turn-off energy (per pulse)	$T_{vj}=25^{\circ}C$	-	2.24	-		
		$T_{vj}=125^{\circ}C$	-	2.83	-		
		$T_{vj}=150^{\circ}C$	-	2.86	-		
SC data	Short-circuit current	$V_{CC}=600V, V_{GE}\leq 15V, T_{vj}=25^{\circ}C$ $V_{CES}\leq 1200V, t_p\leq 10\mu s$		-	280	-	A
$R_{thJC}$	Thermal resistance, junction to case	Per IGBT		-	-	1.02	K/W
$R_{thCH}$	Thermal resistance, case to heatsink	Per IGBT / $\lambda_{grease}=1W/(m\cdot K)$		-	0.235	-	K/W
$T_{vjop}$	Temperature under switching conditions			-40		150	$^{\circ}C$
<b>Diode, Brake-Chopper</b>							
<b>Maximum Rated Values</b>							
Symbol	Item	Conditions			Rating		Unit
$V_{RRM}$	Repetitive peak reverse voltage	$T_{vj}=25^{\circ}C$			1200		V
$I_F$	Forward current, DC				15		A
$I_{FRM}$	Repetitive peak forward current	$t_p=1ms$			30		A
$I^2t$	$I^2t$ -value	$V_R=0V, t_p=10ms, T_{vj}=25^{\circ}C$			166		$A^2s$
<b>Characteristic Values</b>				Min.	Typ.	Max.	
$V_F$	Continuous forward voltage	$I_F=15A$ $V_{GE}=0V$	$T_{vj}=25^{\circ}C$	-	1.97	2.3	V
			$T_{vj}=125^{\circ}C$	-	1.69	-	
			$T_{vj}=150^{\circ}C$	-	1.59	-	

I <sub>RM</sub>	Peak reverse recovery current	V <sub>R</sub> =600V I <sub>F</sub> =40A V <sub>GE</sub> =-15V -di <sub>F</sub> /dt=750A/us (T <sub>vj</sub> =150°C)	T <sub>vj</sub> =25°C	-	15.8	-	A
			T <sub>vj</sub> =125°C	-	18.2	-	
			T <sub>vj</sub> =150°C	-	21.6	-	
t <sub>rr</sub>	Reverse recovery time		T <sub>vj</sub> =25°C	-	71.5	-	ns
			T <sub>vj</sub> =125°C	-	789.9	-	
			T <sub>vj</sub> =150°C	-	989.2	-	
Q <sub>r</sub>	Recovered charge		T <sub>vj</sub> =25°C	-	0.58	-	μC
			T <sub>vj</sub> =125°C	-	6.30	-	
			T <sub>vj</sub> =150°C	-	7.32	-	
E <sub>rec</sub>	Reverse recovery energy	T <sub>vj</sub> =25°C	-	0.04	-	mJ	
		T <sub>vj</sub> =125°C	-	2.42	-		
		T <sub>vj</sub> =150°C	-	2.83	-		
R <sub>thJC</sub>	Thermal resistance, junction to case	per diode	-	-	1.65	K/W	
R <sub>thCH</sub>	Thermal resistance, case to heatsink	per diode / λ <sub>grease</sub> =1 W/(m • K)	-	0.37	-	K/W	
T <sub>vjop</sub>	Temperature under switching conditions		-40		150	°C	

Note:

IGBT electrical characteristics according to IEC 60747 – 9

Diode electrical characteristics according to IEC 60747 – 2

### NTC Thermistor Characteristics

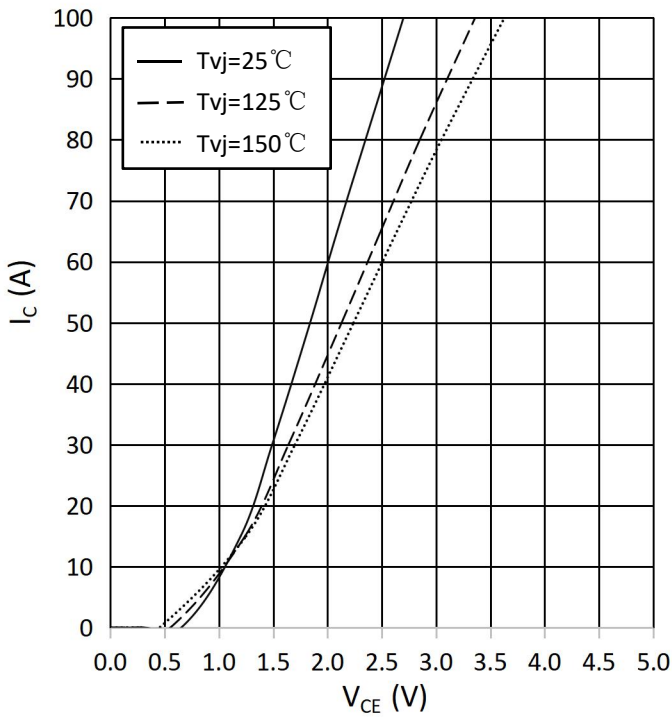
Symbol	Item	Conditions	Values			Unit
			Min.	Typ.	Max.	
R <sub>25</sub>	Rated resistance	T <sub>C</sub> =25°C	-	5	-	kΩ
ΔR/R	Deviation of resistance	T <sub>C</sub> =100°C, R <sub>100</sub> =493Ω	-5	-	5	%
P <sub>25</sub>	Power dissipation	T <sub>C</sub> =25°C	-	-	20	mW
B <sub>25/50</sub>	B-constant	R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/50</sub> (1/T <sub>2</sub> -1/(298.15K))]	-	3375	-	K
B <sub>25/80</sub>	B-constant	R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/80</sub> (1/T <sub>2</sub> -1/(298.15K))]	-	3411	-	
B <sub>25/100</sub>	B-constant	R <sub>2</sub> =R <sub>25</sub> exp[B <sub>25/100</sub> (1/T <sub>2</sub> -1/(298.15K))]	-	3433	-	

### Module

Symbol	Item	Conditions	Rating			Unit
			Min.	Typ.	Max.	
V <sub>ISOL</sub>	Isolation voltage	Terminals to baseplate, RMS, f=50Hz, t=1min	2500			V
T <sub>vj max</sub>	Maximum junction temperature	-	175			°C
T <sub>vj op</sub>	Operating junction temperature	Continuous operation(underswitching)	-40~150			°C
T <sub>stg</sub>	Storage temperature	-	-40~125			°C
Symbol	Item	Conditions	Values			Unit
			Min.	Typ.	Max.	
M	Mounting torque for module mounting	-	3	-	6	Nm
ds	Creepage distance	Terminal to terminal	-	-	-	mm
		Terminal to base plate	-	10	-	
da	Clearance	Terminal to terminal	-	-	-	mm
		Terminal to base plate	-	7.5	-	
m	Weight	-	-	290	-	g

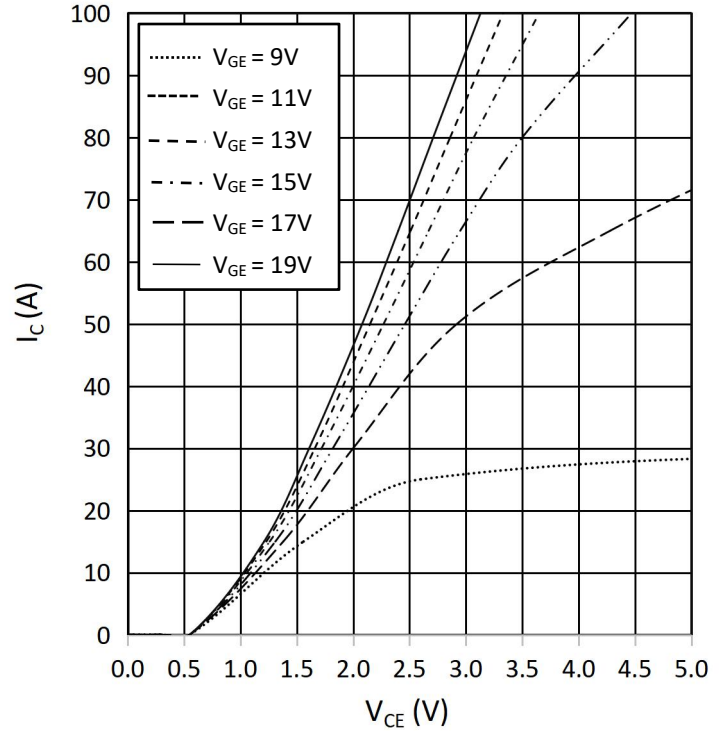
**output characteristic IGBT,Inverter (typical)**

$I_C = f(V_{CE})$   
 $V_{GE} = 15V$



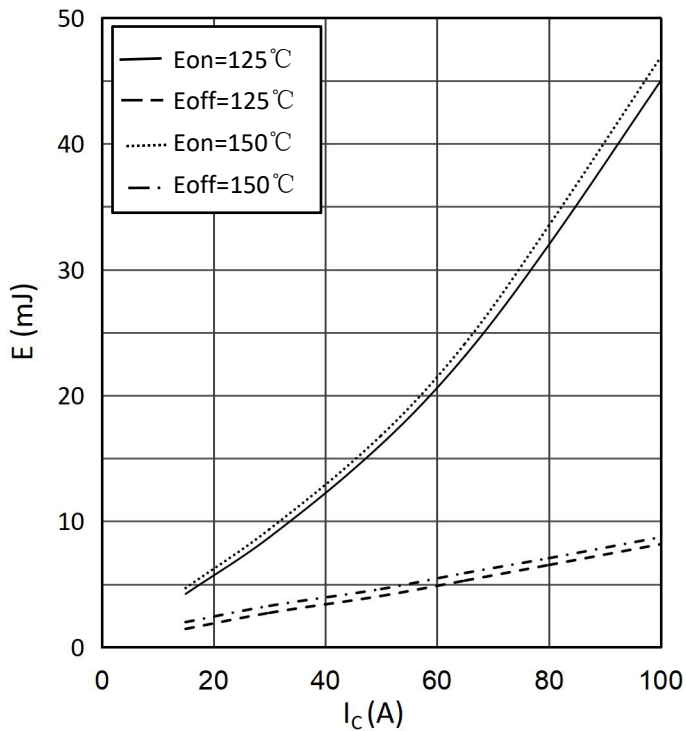
**output characteristic IGBT,Inverter (typical)**

$I_C = f(V_{CE})$   
 $T_{vj} = 150^{\circ}C$



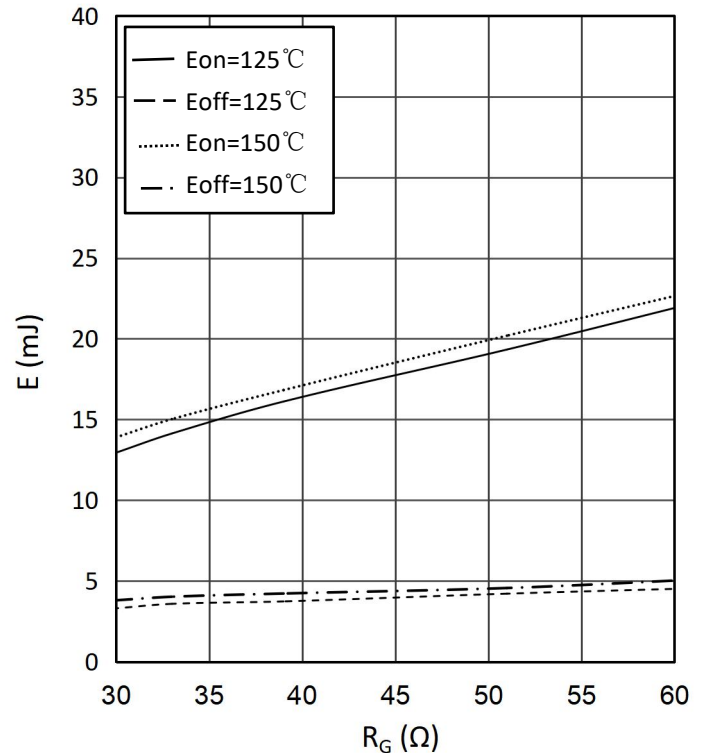
**switching losses IGBT,Inverter (typical)**

$E_{on} = f(I_C), E_{off} = f(I_C)$   
 $V_{GE} = \pm 15V, R_{Gon} = 39\Omega, R_{Goff} = 39\Omega, V_{CE} = 600V$



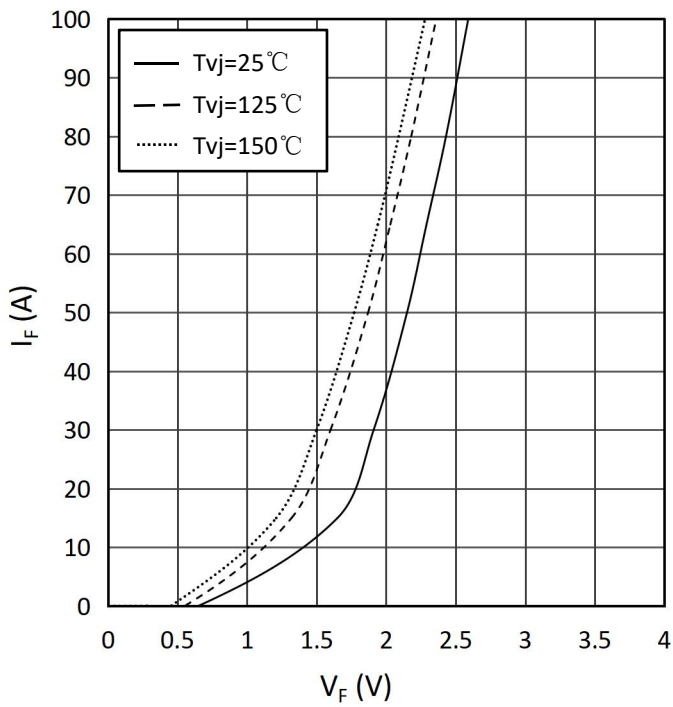
**switching losses IGBT,Inverter (typical)**

$E_{on} = f(R_G), E_{off} = f(R_G)$   
 $V_{GE} = \pm 15V, I_C = 50A, V_{CE} = 600V$



**forward characteristic of Diode, Inverter (typical)**

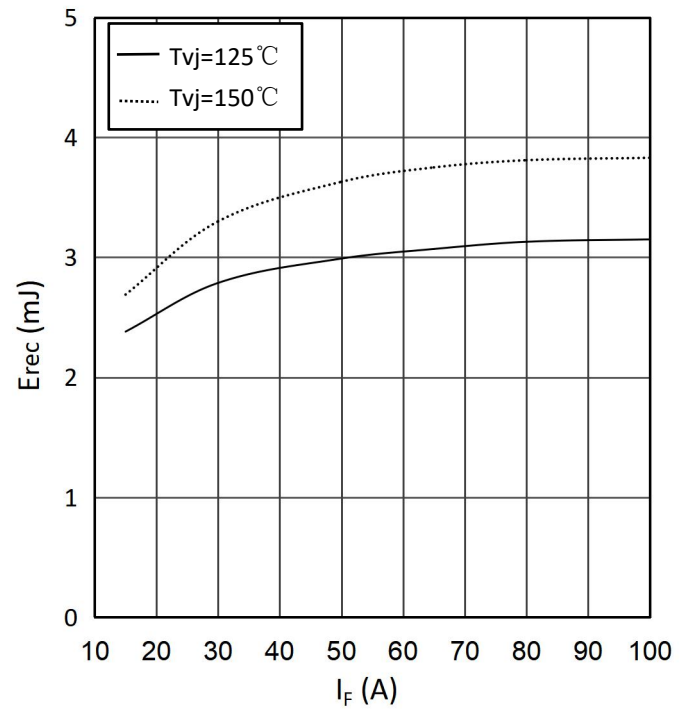
$I_F = f(V_F)$



**switching losses Diode, Inverter (typical)**

$E_{rec} = f(I_F)$

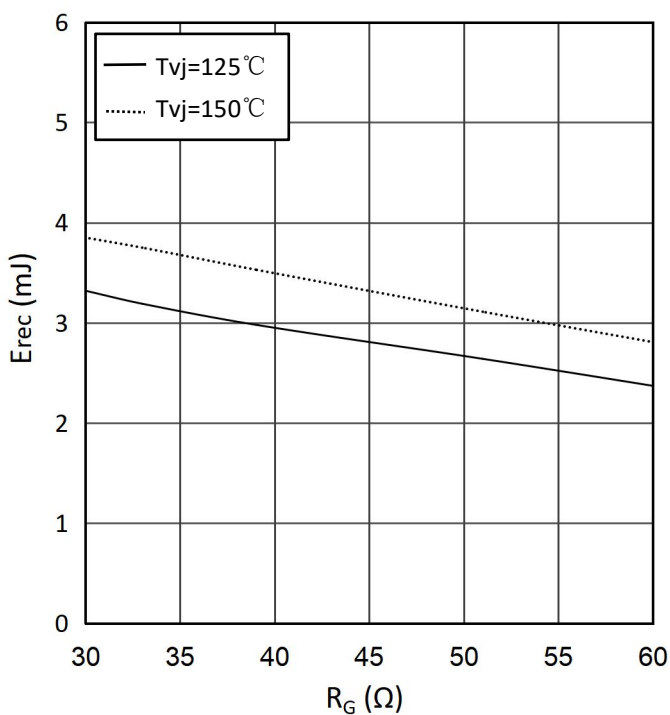
$R_{Gon} = 39\Omega, V_{CE} = 600\text{ V}$



**switching losses Diode, Inverter (typical)**

$E_{rec} = f(R_G)$

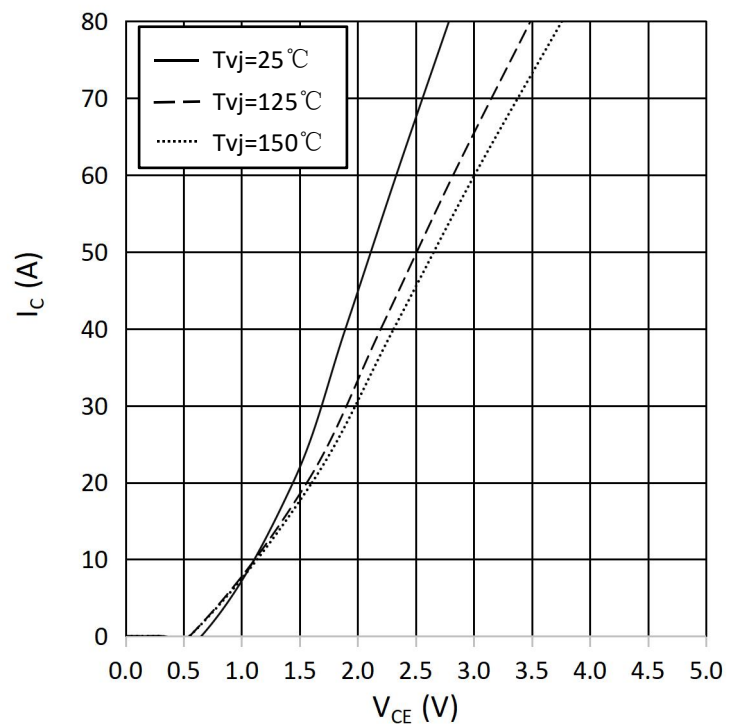
$I_F = 50\text{A}, V_{CE} = 600\text{V}$



**output characteristic IGBT, Brake-Chopper (typical)**

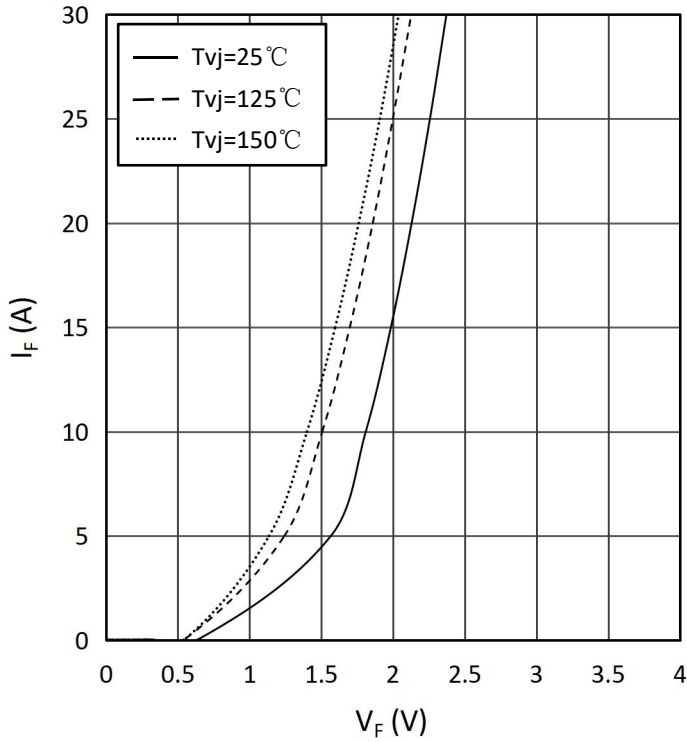
$I_C = f(V_{CE})$

$V_{GE} = 15\text{V}$



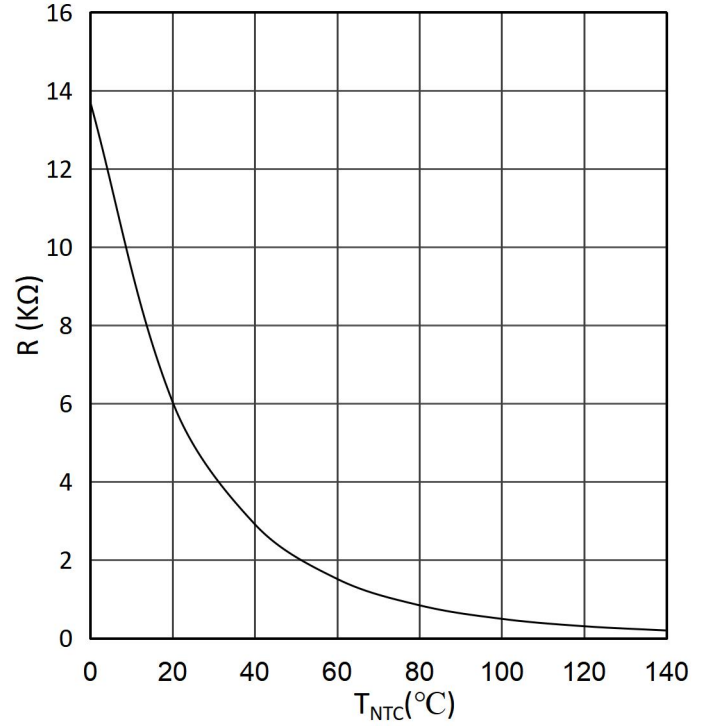
**forward characteristic of Diode, Brake-Chopper (typical)**

$I_F = f(V_F)$



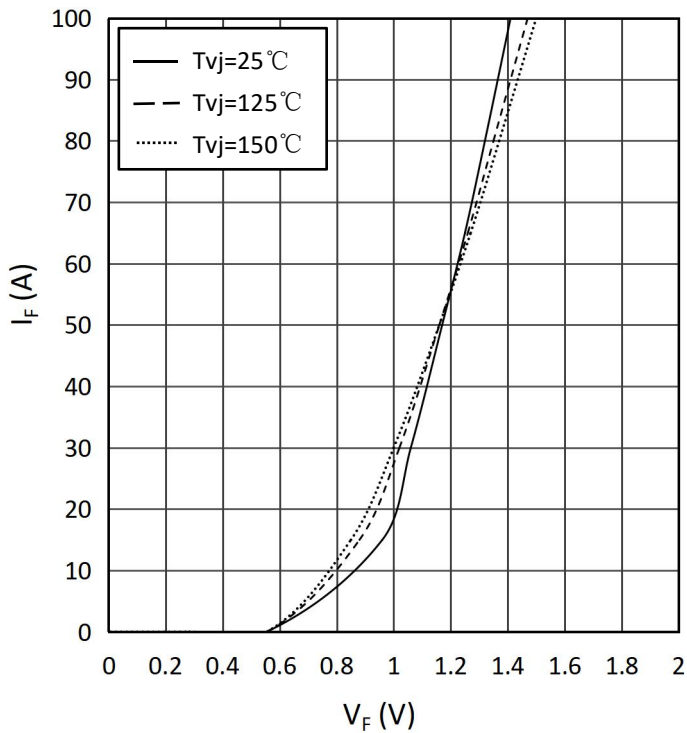
**NTC-Thermistor-temperature characteristic(typical)**

$R=f(T)$



**Forward characteristic of Diode, Rectifier (typical)**

$I_F = f(V_F)$







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