

### Electrical Features

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

### Typical Applications

- Motor Drives
- Servo Drives
- Auxiliary Inverters

### 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	$T_C=80^{\circ}C, T_{vj}=175^{\circ}C$	50	A		
$I_{CRM}$	Repetitive peak collector current	$t_p=1ms$	100	A		
$P_{tot}$	Total power dissipation	$T_C=25^{\circ}C, T_{vj}=175^{\circ}C$	278	W		
Characteristics Values						
Symbol	Item	Conditions	Values			Unit
IGBT			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	$V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$	-	-	100	nA
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=1.5mA, V_{CE}=V_{GE}, T_{vj}=25^{\circ}C$	5.2	5.7	6.6	V
$V_{CEsat}$	Collector-emitter saturation voltage	$I_C=50A$ $V_{GE}=15V$ $T_{vj}=25^{\circ}C$	-	2.25	2.55	
		$T_{vj}=125^{\circ}C$	-	2.82	-	
		$T_{vj}=150^{\circ}C$	-	2.93	-	
$C_{ies}$	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	$T_{vj}=25^{\circ}C$	-	-	-	$\Omega$

t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =600V I <sub>C</sub> =50A V <sub>GE</sub> =±15V R <sub>G(on)</sub> =51Ω R <sub>G(off)</sub> =51Ω	T <sub>vj</sub> =25°C	-	205.9	-	ns
			T <sub>vj</sub> =125°C	-	240.5	-	
			T <sub>vj</sub> =150°C	-	250.9	-	
t <sub>r</sub>	Rise time		T <sub>vj</sub> =25°C	-	163.9	-	
			T <sub>vj</sub> =125°C	-	177.9	-	
			T <sub>vj</sub> =150°C	-	179.6	-	
t <sub>d(off)</sub>	Turn-off delay time		T <sub>vj</sub> =25°C	-	445.0	-	
			T <sub>vj</sub> =125°C	-	748.8	-	
			T <sub>vj</sub> =150°C	-	760.4	-	
t <sub>f</sub>	Fall time	T <sub>vj</sub> =25°C	-	203.9	-		
		T <sub>vj</sub> =125°C	-	328.5	-		
		T <sub>vj</sub> =150°C	-	335.6	-		
E <sub>on</sub>	Turn-on energy (per pulse)	V <sub>CC</sub> =600V, I <sub>C</sub> =50A V <sub>GE</sub> =±15V, R <sub>G(on)</sub> =51Ω di/dt=480A/μs(T <sub>vj</sub> =150°C)	T <sub>vj</sub> =25°C	-	15.17	-	mJ
			T <sub>vj</sub> =125°C	-	20.44	-	
			T <sub>vj</sub> =150°C	-	21.26	-	
E <sub>off</sub>	Turn-off energy (per pulse)		T <sub>vj</sub> =25°C	-	3.09	-	
			T <sub>vj</sub> =125°C	-	4.96	-	
			T <sub>vj</sub> =150°C	-	5.71	-	
SC data	Short-circuit current	V <sub>CC</sub> =600V, V <sub>GE</sub> ≤15V, T <sub>vj</sub> =125°C V <sub>CES</sub> ≤1200V, t <sub>p</sub> ≤10μs	-	200	-	A	
R <sub>thJC</sub>	Thermal resistance, junction to case	Per IGBT	-	-	0.54	K/W	
R <sub>thCH</sub>	Thermal resistance, case to heatsink	Per IGBT λgrease=1W/(m·K)	-	0.295	-	K/W	
T <sub>vjop</sub>	Temperature under switching conditions		-40		150	°C	
<b>Diode, Inverter</b>							
<b>Maximum Rated Values</b>							
Symbol	Item	Conditions			Rating	Unit	
V <sub>RRM</sub>	Repetitive peak reverse voltage	T <sub>vj</sub> =25°C			1200	V	
I <sub>F</sub>	Forward current, DC	T <sub>C</sub> =80°C, T <sub>vj</sub> =175°C			50	A	
I <sub>FRM</sub>	Repetitive peak forward current	t <sub>p</sub> =1ms			100	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> =125°C			667	A <sup>2</sup> s	
<b>Characteristic Values</b>							
V <sub>F</sub>	Continuous forward voltage	I <sub>F</sub> =50A V <sub>GE</sub> =0V	T <sub>vj</sub> =25°C	-	2.60	3.0	V
			T <sub>vj</sub> =125°C	-	2.34	-	
			T <sub>vj</sub> =150°C	-	2.26	-	
I <sub>RM</sub>	Peak reverse recovery current	V <sub>R</sub> =600V I <sub>F</sub> =50A V <sub>GE</sub> =-15V -di <sub>F</sub> /dt=480A/μs (T <sub>vj</sub> =150°C)	T <sub>vj</sub> =25°C	-	16.5	-	A
			T <sub>vj</sub> =125°C	-	22.2	-	
			T <sub>vj</sub> =150°C	-	24.0	-	
t <sub>rr</sub>	Reverse recovery time		T <sub>vj</sub> =25°C	-	95.48	-	ns
			T <sub>vj</sub> =125°C	-	950.2	-	
			T <sub>vj</sub> =150°C	-	992.8	-	
Q <sub>r</sub>	Recovered charge	T <sub>vj</sub> =25°C	-	1.74	-	μC	
		T <sub>vj</sub> =125°C	-	8.32	-		
		T <sub>vj</sub> =150°C	-	9.99	-		

E <sub>rec</sub>	Reverse recovery energy		T <sub>vj</sub> =25°C	-	0.99	-	mJ
			T <sub>vj</sub> =125°C	-	2.32	-	
			T <sub>vj</sub> =150°C	-	2.81	-	
R <sub>thJC</sub>	Thermal resistance, junction to case	per diode	-	-	0.81	K/W	
R <sub>thCH</sub>	Thermal resistance, case to heatsink	Per diode, λ <sub>grease</sub> =1 W/(m • K)	-	0.44	-	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	t <sub>p</sub> = 10ms, T <sub>vj</sub> =150°C	420			A
I <sup>2</sup> t	I <sup>2</sup> t-value	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	-	1.43	-	V
			T <sub>vj</sub> =125°C	-	1.35	-	
			T <sub>vj</sub> =150°C	-	1.31	-	
I <sub>R</sub>	Reverse current	V <sub>R</sub> =1800V	T <sub>vj</sub> =25°C	-	-	10	μA
			T <sub>vj</sub> =125°C	-	-	-	
			T <sub>vj</sub> =150°C	-	-	-	
R <sub>thJC</sub>	Thermal resistance, junction to case	per diode	-	-	0.85	K/W	
R <sub>thCH</sub>	Thermal resistance, case to heatsink	Per diode, λ <sub>grease</sub> =1 W/(m • K)	-	0.465	-	K/W	
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	25			A
I <sub>CRM</sub>	Repetitive peak collector current	t <sub>p</sub> =1ms	50			A
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25°C, T <sub>vj</sub> =175°C	151			W

Characteristic Values						
Symbol	Item	Conditions	Values			Unit
			Min.	Typ.	Max.	
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	-	-	100	nA
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	I <sub>C</sub> =0.5mA, V <sub>CE</sub> =V <sub>GE</sub> , T <sub>vj</sub> =25°C	5.5	5.9	6.6	V

$V_{CEsat}$	Collector-emitter saturation voltage	$I_C=25A$ $V_{GE}=15V$	$T_{vj}=25^{\circ}C$	-	1.90	2.3	V
			$T_{vj}=125^{\circ}C$	-	2.30	-	
			$T_{vj}=150^{\circ}C$	-	2.49	-	
$C_{ies}$	Input capacitance	$V_{CE}=25V, V_{GE}=0V$ $f=1MHz, T_{vj}=25^{\circ}C$	-	1.77	-	nF	
$C_{oes}$	Output capacitance		-	0.17	-		
$C_{res}$	Reverse transfer capacitance		-	0.06	-		
$Q_G$	Gate charge	$V_{CC}=600V, I_C=25A$ $V_{GE}=-15...+15V, T_{vj}=25^{\circ}C$	-	0.171	-	$\mu C$	
$R_g$	Internal gate resistance	$T_{vj}=25^{\circ}C$	-	-	-	$\Omega$	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600V$ $I_C=25A$ $V_{GE}=\pm 15V$ $R_{G(on)}=51\Omega$ $R_{G(off)}=51\Omega$	$T_{vj}=25^{\circ}C$	-	96.6	-	ns
			$T_{vj}=125^{\circ}C$	-	152.1	-	
			$T_{vj}=150^{\circ}C$	-	159.6	-	
$t_r$	Rise time		$T_{vj}=25^{\circ}C$	-	53.6	-	
			$T_{vj}=125^{\circ}C$	-	80.2	-	
			$T_{vj}=150^{\circ}C$	-	86.0	-	
$t_{d(off)}$	Turn-off delay time		$T_{vj}=25^{\circ}C$	-	101.8	-	
			$T_{vj}=125^{\circ}C$	-	308.6	-	
			$T_{vj}=150^{\circ}C$	-	326.1	-	
$t_f$	Fall time		$T_{vj}=25^{\circ}C$	-	359.1	-	
			$T_{vj}=125^{\circ}C$	-	531.4	-	
			$T_{vj}=150^{\circ}C$	-	681.2	-	
$E_{on}$	Turn-on energy (per pulse)	$T_{vj}=25^{\circ}C$	-	2.22	-	mJ	
		$T_{vj}=125^{\circ}C$	-	6.12	-		
		$T_{vj}=150^{\circ}C$	-	7.21	-		
$E_{off}$	Turn-off energy (per pulse)	$T_{vj}=25^{\circ}C$	-	0.72	-		
		$T_{vj}=125^{\circ}C$	-	2.32	-		
		$T_{vj}=150^{\circ}C$	-	2.40	-		
SC data	Short-circuit current	$V_{CC}=600V, V_{GE}\leq 15V, T_{vj}=125^{\circ}C$ $V_{CES}\leq 1200V, t_p\leq 10\mu s$	-	90	-	A	
$R_{thJC}$	Thermal resistance, junction to case	Per IGBT	-	-	0.95	K/W	
$R_{thCH}$	Thermal resistance, case to heatsink	Per IGBT $\lambda_{grease}=1W/(m\cdot K)$	-	0.52	-	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	$T_C=80^{\circ}C, T_{vj}=175^{\circ}C$		15		A	
$I_{FRM}$	Repetitive peak forward current	$t_p=1ms$		30		A	
$I^2t$	$I^2t$ -value	$V_R=0V, t_p=10ms, T_{vj}=125^{\circ}C$		166		$A^2s$	
<b>Characteristic Values</b>							
$V_F$	Continuous forward voltage	$I_F=15A$ $V_{GE}=0V$	$T_{vj}=25^{\circ}C$	Min.	Typ.	Max.	V
			$T_{vj}=125^{\circ}C$	-	2.13	2.69	
			$T_{vj}=150^{\circ}C$	-	1.82	-	
			$T_{vj}=150^{\circ}C$	-	1.78	-	

I <sub>RM</sub>	Peak reverse recovery current	V <sub>R</sub> =600V I <sub>F</sub> =25A V <sub>GE</sub> =-15V -di <sub>F</sub> /dt=440A/us (T <sub>vj</sub> =150°C)	T <sub>vj</sub> =25°C	-	13.6	-	A
			T <sub>vj</sub> =125°C	-	14.7	-	
			T <sub>vj</sub> =150°C	-	14.8	-	
t <sub>rr</sub>	Reverse recovery time		T <sub>vj</sub> =25°C	-	99.9	-	ns
			T <sub>vj</sub> =125°C	-	539.1	-	
			T <sub>vj</sub> =150°C	-	603.2	-	
Q <sub>r</sub>	Recovered charge		T <sub>vj</sub> =25°C	-	0.38	-	μC
			T <sub>vj</sub> =125°C	-	5.45	-	
			T <sub>vj</sub> =150°C	-	5.81	-	
E <sub>rec</sub>	Reverse recovery energy	T <sub>vj</sub> =25°C	-	0.03	-	mJ	
		T <sub>vj</sub> =125°C	-	1.92	-		
		T <sub>vj</sub> =150°C	-	2.07	-		
R <sub>thJC</sub>	Thermal resistance, junction to case	per diode	-	-	1.5	K/W	
R <sub>thCH</sub>	Thermal resistance, case to heatsink	Per diode, λ <sub>grease</sub> =1 W/(m • K)	-	0.82	-	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	-	

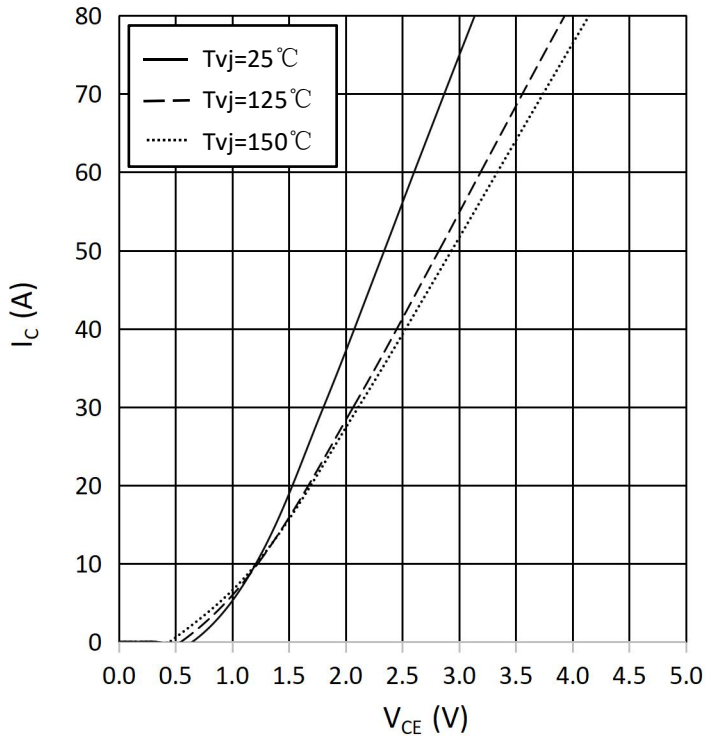
**Module**

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>vjmax</sub>	Maximum junction temperature	-	175			°C
T <sub>vjop</sub>	Operating junction temperature	Continuous operationg(under switching)	-40~150			°C
T <sub>stg</sub>	Storage temperature	-	-40~125			°C
Symbol	Item	Conditions	Values			Unit
			Min.	Typ.	Max.	
Ms	Mounting torque	Mounting to heat sink, M5 screw	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	-	-	175	-	g

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

$I_C = f(V_{CE})$

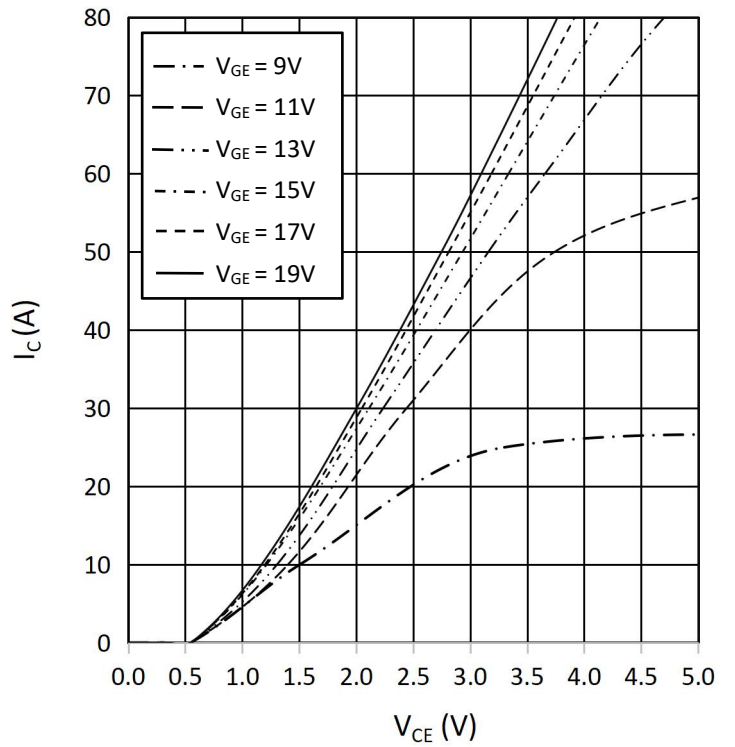
$V_{GE} = 15V$



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

$I_C = f(V_{CE})$

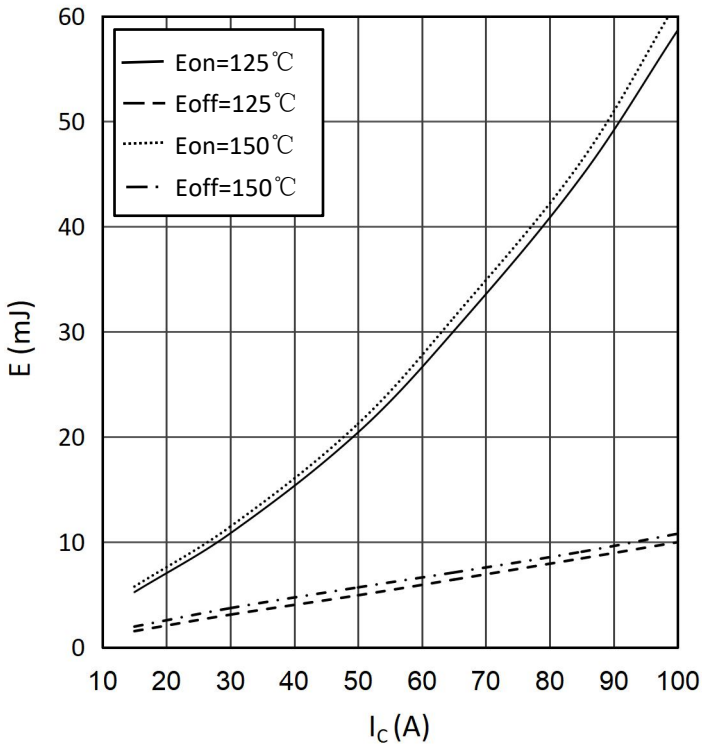
$T_{vj} = 150^{\circ}C$



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

$E_{on} = f(I_C), E_{off} = f(I_C)$

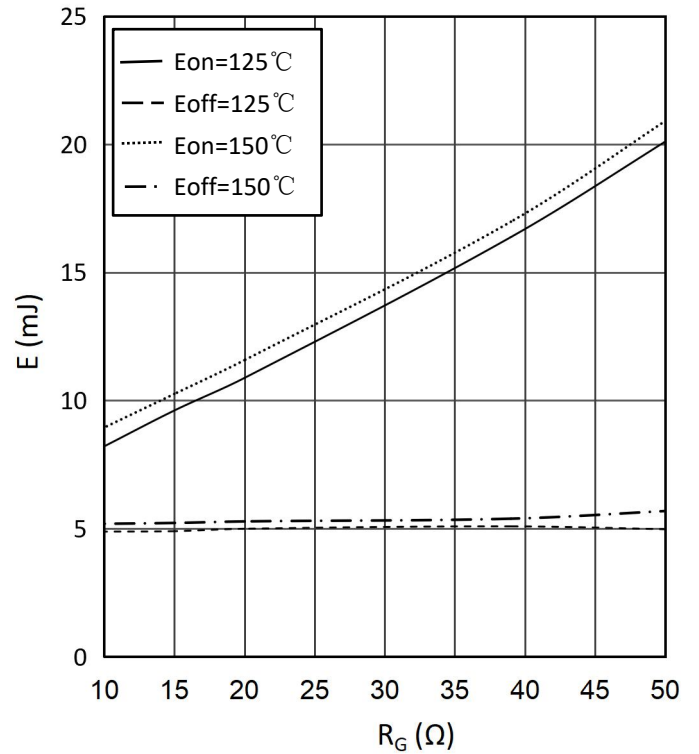
$V_{GE} = \pm 15V, R_{Gon} = 51\Omega, R_{Goff} = 51\Omega, V_{CE} = 600V$



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

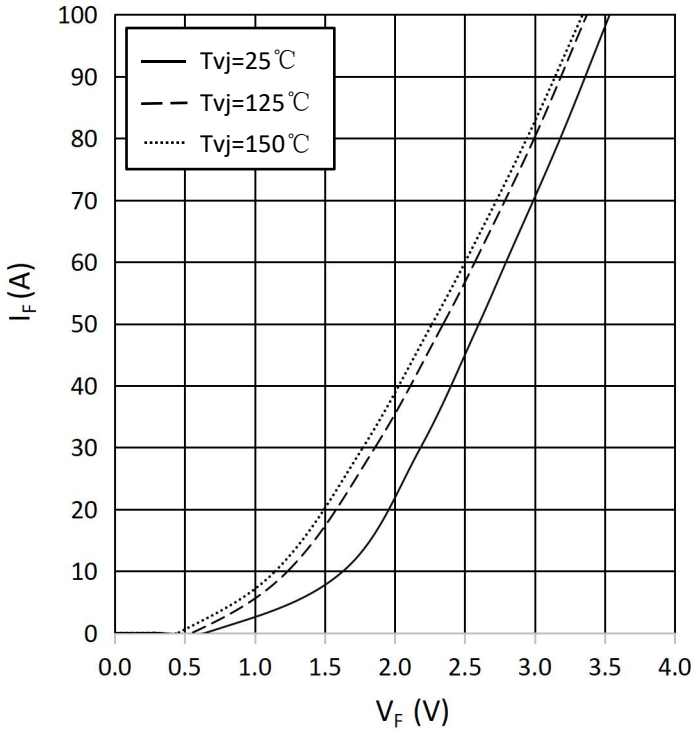
$E_{on} = f(R_G), E_{off} = f(R_G)$

$V_{GE} = \pm 15V, I_C = 50A, V_{CE} = 600V$



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

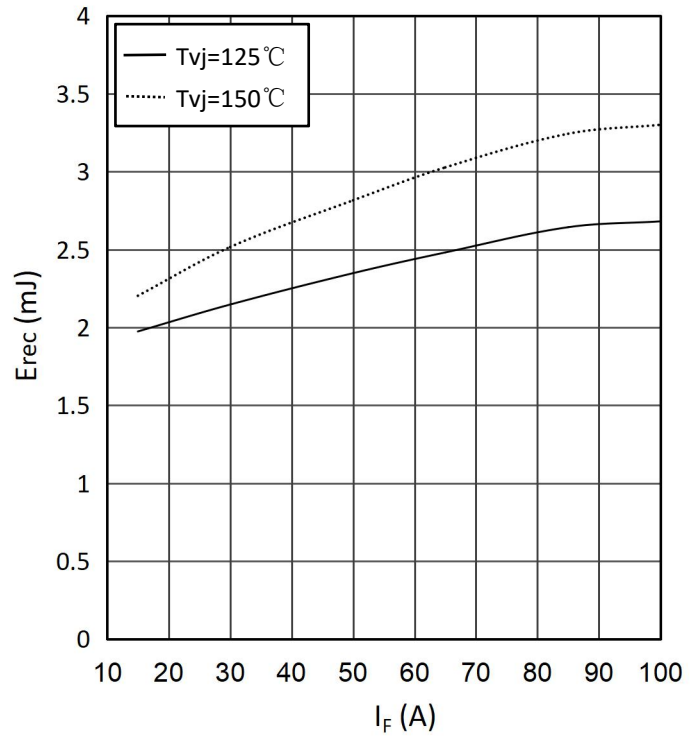
$I_F = f(V_F)$



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

$E_{rec} = f(I_F)$

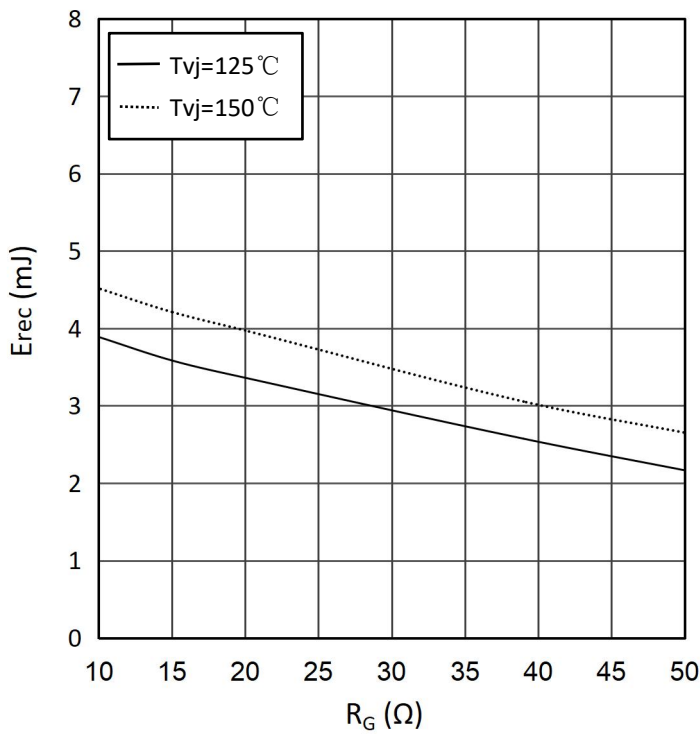
$R_{Gon} = 51\Omega, V_{CE} = 600\text{ V}$



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

$E_{rec} = f(R_G)$

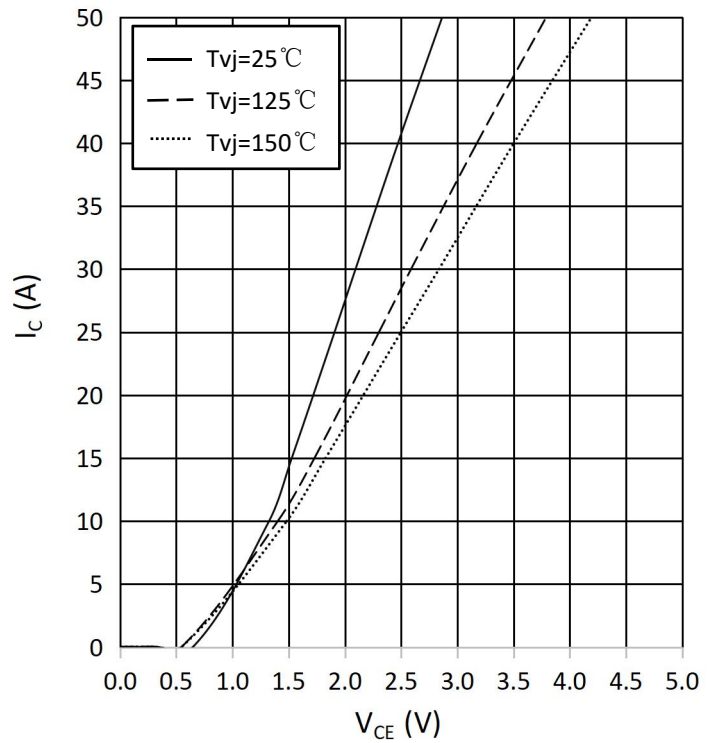
$I_F = 50\text{A}, V_{CE} = 600\text{V}$



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

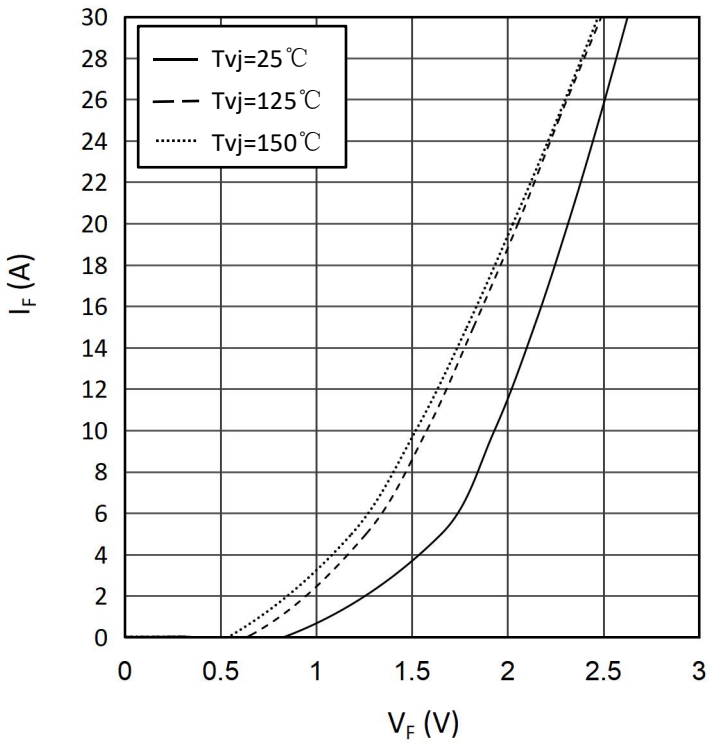
$I_C = f(V_{CE})$

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



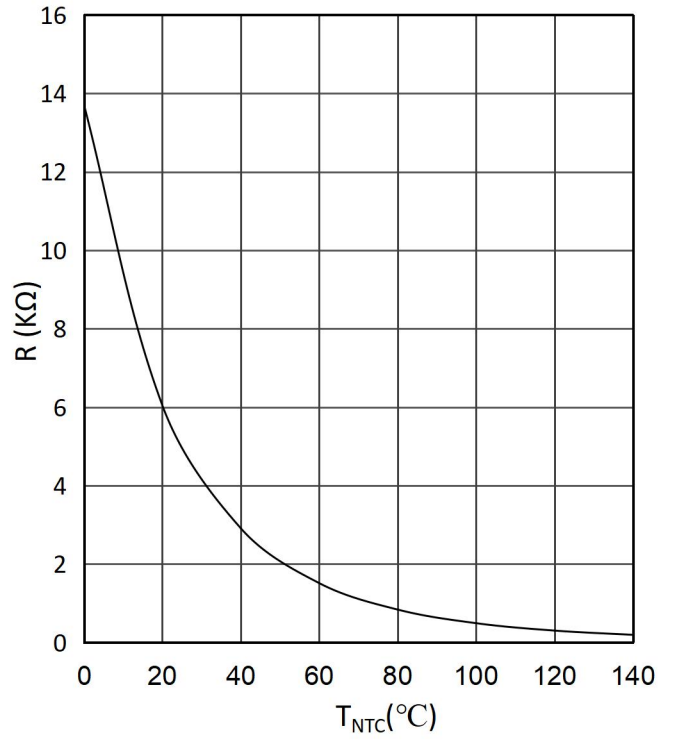
**forward characteristic of Diode, Brake-Chopper (typical)**

$I_F = f(V_F)$



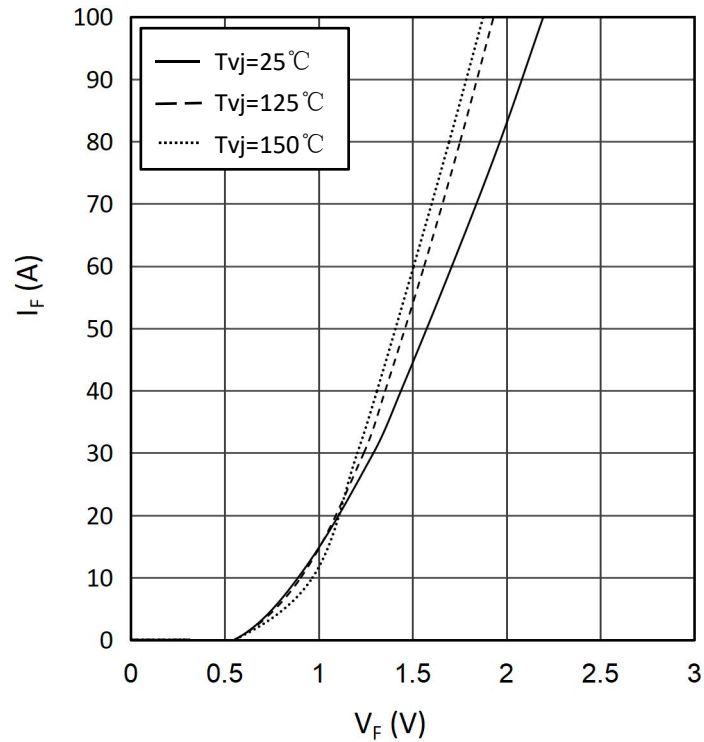
**NTC-Thermistor-temperature characteristic(typical)**

$R=f(T)$



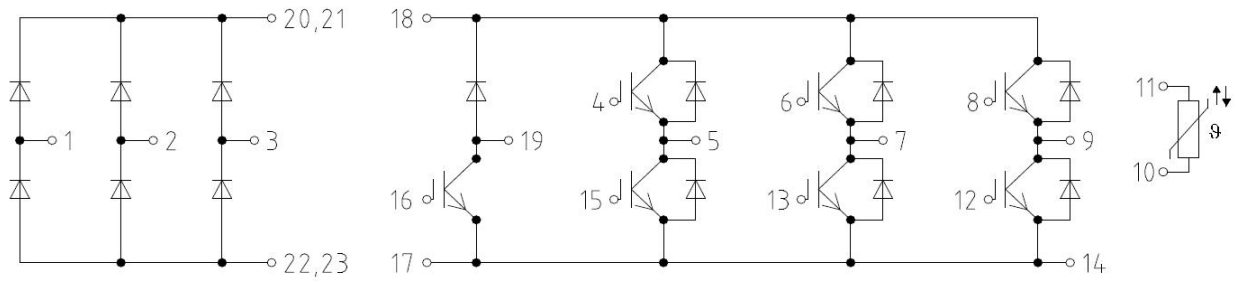
**Forward characteristic of Diode, Rectifier(typical)**

$I_F = f(V_F)$

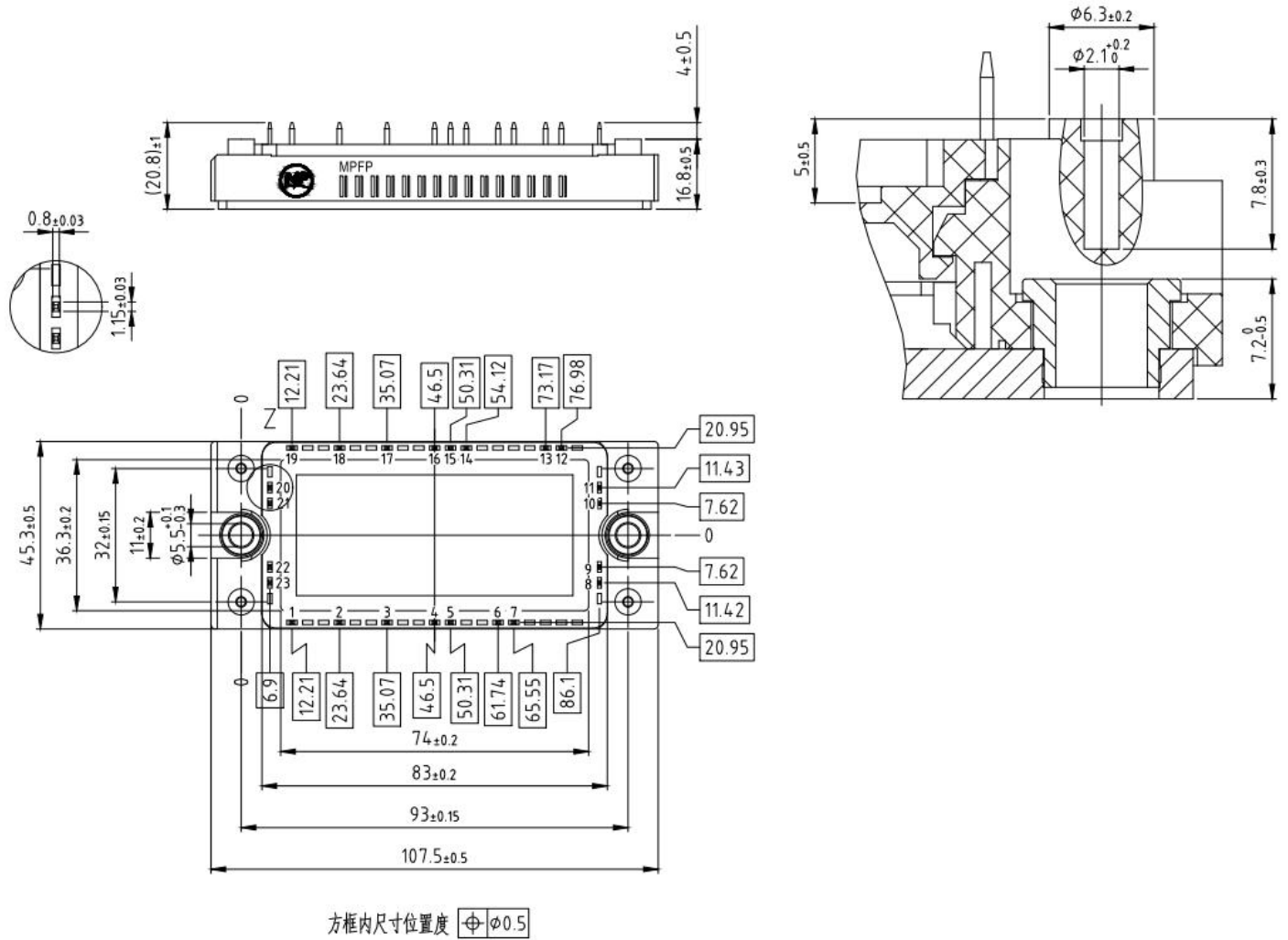




Circuit Diagram



Package Outlines



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