PIM with Trench Field-Stop IGBT, Emitter Controlled Diode and NTC

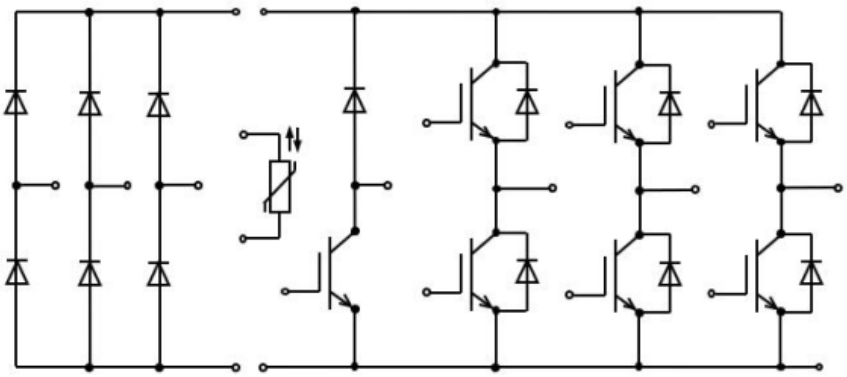
Features

- V_{CE}=1200V I_C=25A
- Low $V_{CE(sat)}$ with Positive Temperature Coefficient
- Maximum junction temperature 150℃

Applications

- The inverter
- Motor control and drives

Equivalent Circuit Schematic



IGBT - Inverter

Maximum Rated Values

Symbol	Description	Conditions	Values	Unit
V_{CES}	Collector-Emitter Voltage	T_{vj}=25℃	1200	V
V_{GES}	Gate-Emitter Peak Voltage	T_{vj}=25℃	±30	V
I_C	Continuous DC Collector Current	T_C=100℃	25	A
I_{CRM}	Repetitive Peak Collector Current	t_P=1ms	50	A
P_{tot}	Total Power Dissipation	T_C=25℃, $T_{vj\ max}$=150℃	87	W

Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE}=15V, I_C=25A, T_{vj}=25℃	1.7	1.85	2.5	V
		V_{GE}=15V, I_C=25A, T_{vj}=125℃	---	2.53	2.7	V
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE}=V_{CE}, I_C=5.0mA	5.2	6.0	6.5	V
I_{CES}	Collector-Emitter Cut-Off Current	V_{CE}=1200V, V_{GE}=0V	---	---	20	uA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=20V, V_{CE}=0V	---	---	200	nA
C_{ies}	Input capacitance	f=1MHz, V_{CE}=25V V_{GE}=0V, T_{Vj}=25℃	---	---	2.15	nF
C_{res}	Reverse Transfer capacitance		---	---	72.3	nF
$t_{d(on)}$	Turn-on Delay Time	V_{CC}=600V V_{GE}=±15V I_C=25A R_G=20Ω Inductive Load T_{vj}=25℃	---	138	---	ns
t_r	Turn-on Rise Time		---	94	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	220	---	ns
t_f	Turn-off Fall Time		---	152	---	ns
E_{on}	Turn-on Switching Loss		---	3.53	---	mJ
E_{off}	Turn-off Switching Loss		---	1.23	---	mJ
I_{SC}	Short Circuit data	V_{GE}=15V, V_{CC}=600V t_P=10μs, T_{vj}=125°C	---	100	---	A
R_{thJC}	Thermal Resistance, Junction to Case	Per IGBT	---	---	1.45	K/W
$T_{VJ\ OP}$	Virtual Junction Temperature	Under Switching	-40	---	125	℃

Diode - Inverter

Maximum Rated Values

Symbol	Description	Conditions	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	T_{vj}=25℃	1200	V
I_F	Continuous DC Forward Current	T_C=100℃	25	A
I_{FRM}	Repetitive Peak Collector Current	t_P=1ms	50	A
I^2t	I^2t Value	t_P=10ms, V_R=0V, T_j=125℃	220	A^2s

Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
V_F	Forward Voltage	I_F=25A, V_{GE}=0V, T_{vj}=25℃	---	1.85	2.5	V
		I_F=25A, V_{GE}=0V, T_{vj}=125℃	---	1.85	2.5	V
t_{rr}	Reverse Recovery Time	I_F=25A, -di/dt=100A/us V_R=600V, V_{GE}=-15V T_{vj}=25℃	---	170	---	ns
Q_r	Recovered Charge		---	0.98	---	uC
E_{rec}	Reverse Recovery Energy		---	0.35	---	mJ
R_{thJC}	Thermal Resistance, Junction to Case	Per Diode	---	---	1.0	K/W
$T_{VJ\ OP}$	Virtual Junction Temperature	Under Switching	-40	---	125	℃

Diode - Rectifier

Maximum Rated Values

Symbol	Description	Conditions	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	T_{vj}=25℃	1600	V
I_{FRMSM}	Maximum RMS forward current Per chip	T_{vj}=80℃	25	A
I_{RMSM}	Maximum RMS current at Rectifier output	T_{vj}=80℃	50	A
I_{FSM}	Surge Forward Current	t_P=10ms, sin180°, T_j=25℃	300	A
I^2t	I^2t Value	t_P=10ms, sin180°, T_j=25℃	450	A^2s

Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
V_F	Forward Voltage	I_F=25A, T_{vj}=25℃	---	1.1	---	V
I_R	Recovery Current	V_R=1600V	---	1.1	---	mA
R_{thJC}	Thermal Resistance, Junction to Case	Per Diode	---	---	1.1	K/W
$T_{VJ\ OP}$	Virtual Junction Temperature	Under Switching	-40	---	125	℃

IGBT – Brake

Maximum Rated Values

Symbol	Description	Conditions	Values	Unit
V_{CES}	Collector-Emitter Voltage	T_{vj}=25℃	1200	V
V_{GES}	Gate-Emitter Peak Voltage	T_{vj}=25℃	±20	V
I_C	Continuous DC Collector Current	T_C=100℃	15	A
I_{CRM}	Repetitive Peak Collector Current	t_P=1ms	30	A
P_{tot}	Total Power Dissipation	T_C=25℃, $T_{vj\ max}$=150℃	108.7	W

Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE}=15V, I_C=15A, T_{vj}=25℃	---	1.85	2.5	V
		V_{GE}=15V, I_C=15A, T_{vj}=125℃	---	2.0	2.7	V
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE}=V_{CE}, I_C=5.0mA	5.2	6.0	6.5	V
I_{CES}	Collector-Emitter Cut-Off Current	V_{CE}=1200V, V_{GE}=0V	---	---	1	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=15V, V_{CE}=0V	---	---	410	nA
$t_{d(on)}$	Turn-on Delay Time	V_{CC}=600V V_{GE}=±15V I_C=15A R_G=35Ω Inductive Load T_{vj}=25℃	---	94	---	ns
t_r	Turn-on Rise Time		---	52	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	243	---	ns
t_f	Turn-off Fall Time		---	190	---	ns
E_{on}	Turn-on Switching Loss		---	1.95	---	mJ
E_{off}	Turn-off Switching Loss		---	0.81	---	mJ
R_{thJC}	Thermal Resistance, Junction to Case	Per IGBT	---	---	1.15	K/W
$T_{VJ\ OP}$	Virtual Junction Temperature	Under Switching	-40	---	150	℃

Diode - Brake

Maximum Rated Values

Symbol	Description	Conditions	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	T_{vj}=25℃	1200	V
I_F	Continuous DC Forward Current	T_C=100℃	15	A
I_{FRM}	Repetitive Peak Collector Current	t_P=1ms	30	A

Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
V_F	Forward Voltage	I_F=15A, V_{GE}=0V, T_{vj}=25℃	---	1.9	2.5	V
		I_F=15A, V_{GE}=0V, T_{vj}=125℃	---	1.9	2.5	V
t_{rr}	Peak Reverse Recovery Current	I_F=15A, -di/dt=300A/us V_R=600V, V_{GE}=-15V T_{vj}=25℃	---	220	---	ns
Q_r	Recovered Charge		---	0.8	---	uC
E_{rec}	Reverse Recovery Energy		---	0.2	---	mJ
R_{thJC}	Thermal Resistance, Junction to Case	Per Diode	---	---	1.45	K/W
$T_{VJ\ OP}$	Virtual Junction Temperature	Under Switching	-40	---	125	℃

NTC-Thermistor

Characteristic Values

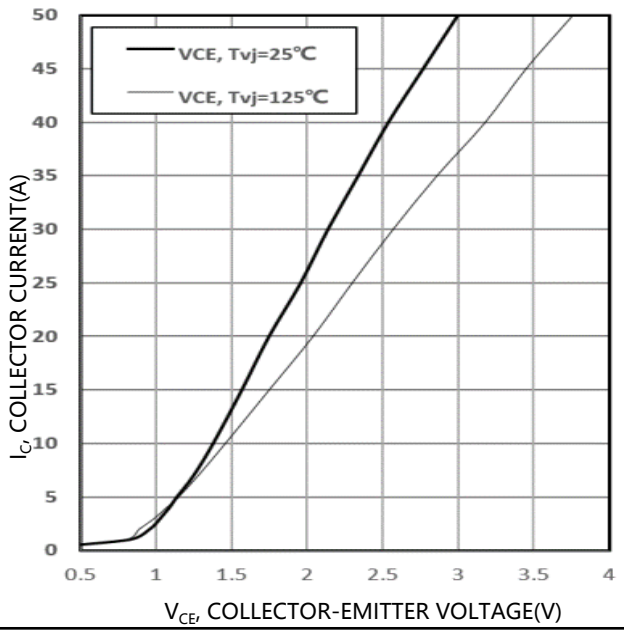
Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
R_{25}	Rated Resistance	T_C=25℃	---	5	---	KΩ
$B_{25/50}$	B Value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 – 1/(298\ K))]$	---	3380	---	K

Module

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
V_{ISOL}	Isolation Test Voltage	RMS, f=50Hz, t=1min	2500	---	---	V
T_{stg}	Storage Temperature		-40	---	150	℃
F	Mounting Fource per Clamp		3	---	6	Nm
G	Weight		---	180	---	g

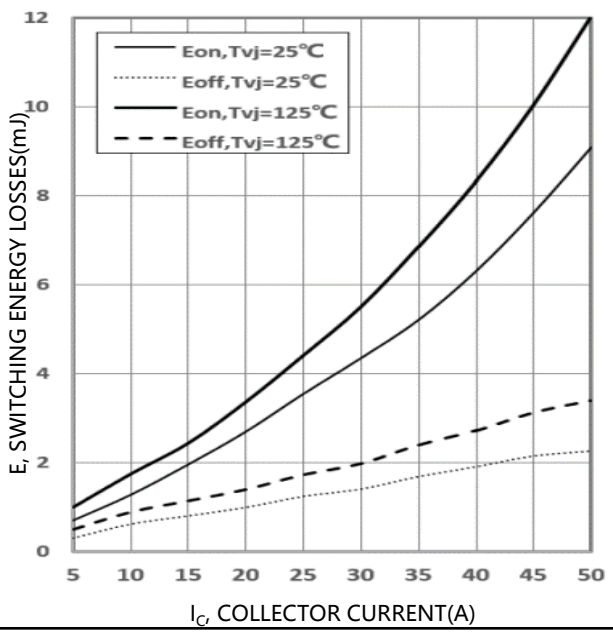
Typical Characteristics

Fig. 1



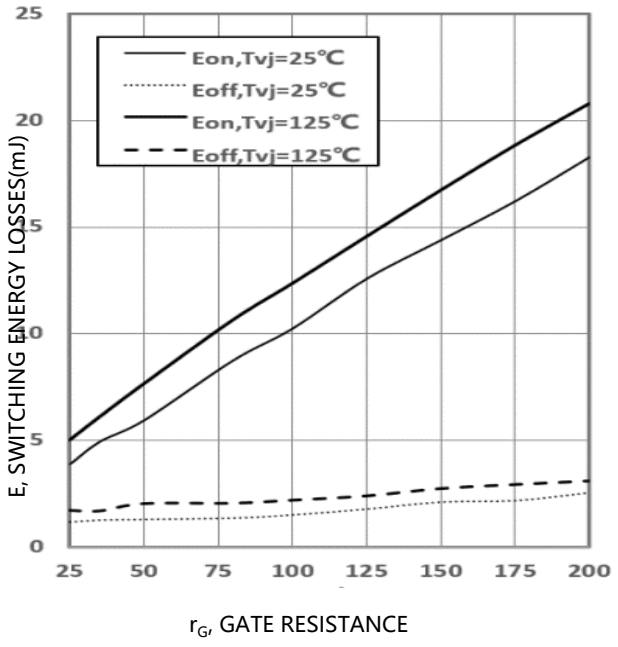
Transfer characteristic IGBT-Inverter (typical)
$I_C=f(V_{GE})$ at V_{CE}=15V

Fig. 2



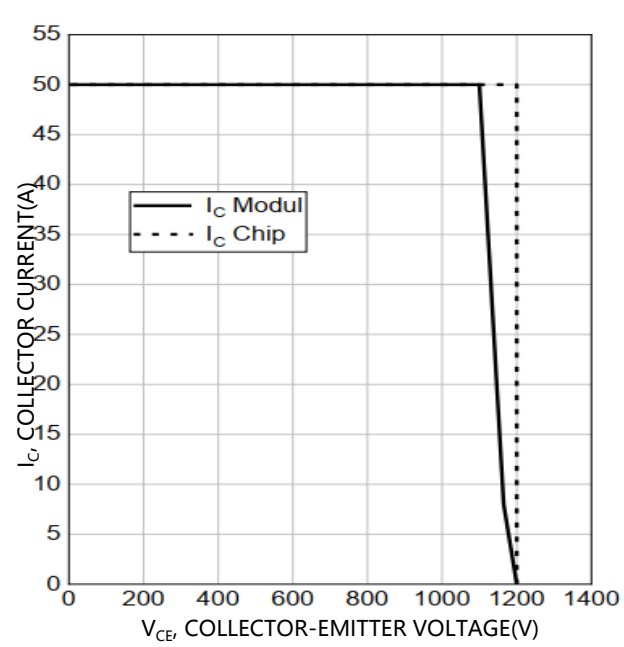
Switching losses IGBT-Inverter (typical)
$E_{on}=f(I_C)$, $E_{off}=f(I_C)$ at $V_{GE}=\pm15V$, $R_G=20\Omega$ and $V_{CE}=600V$

Fig. 3



Switching losses IGBT-Inverter (typical)
Eon=f(RG), Eoff=f(RG) at VGE=±15V, IC=25A and VCE=600V

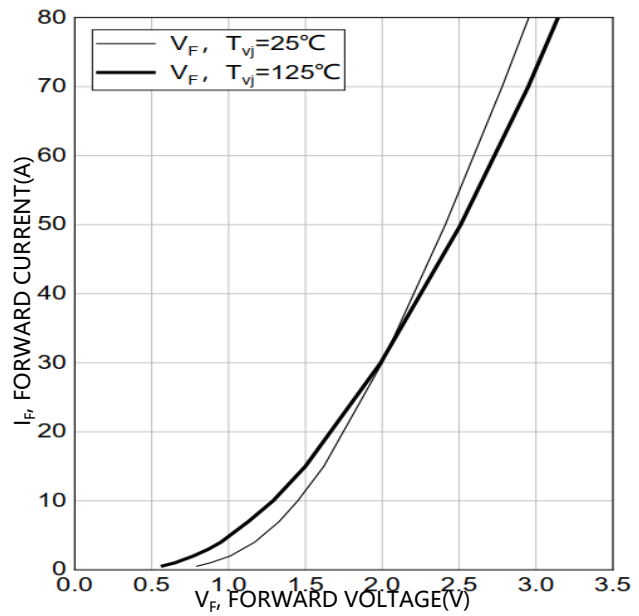
Fig. 4



Reverse Bias Safe Operating Area IGBT-Inverter (RBSOA), IC=f(VCE)

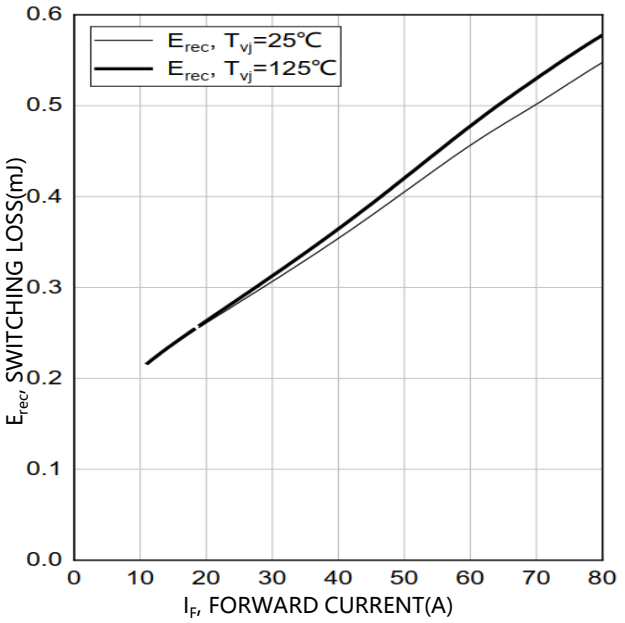
Typical Characteristics

Fig. 5



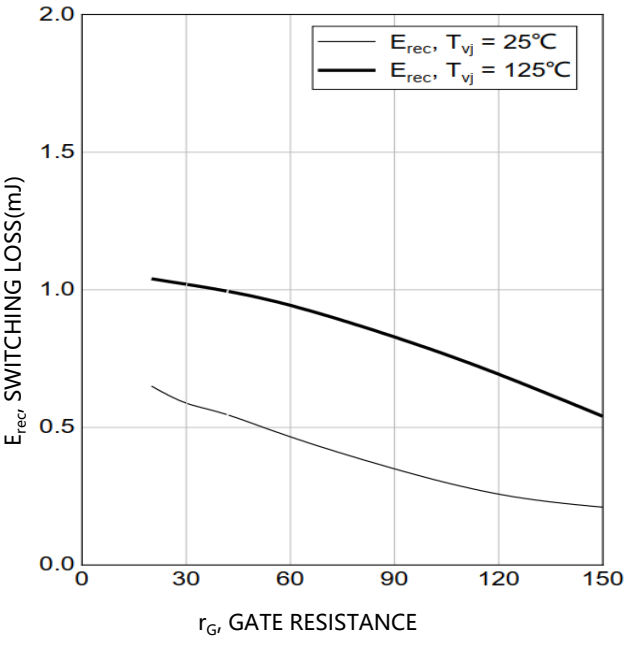
Forward characteristic of Diode-Inverter (typical)
$I_F=f(V_F)$

Fig. 6



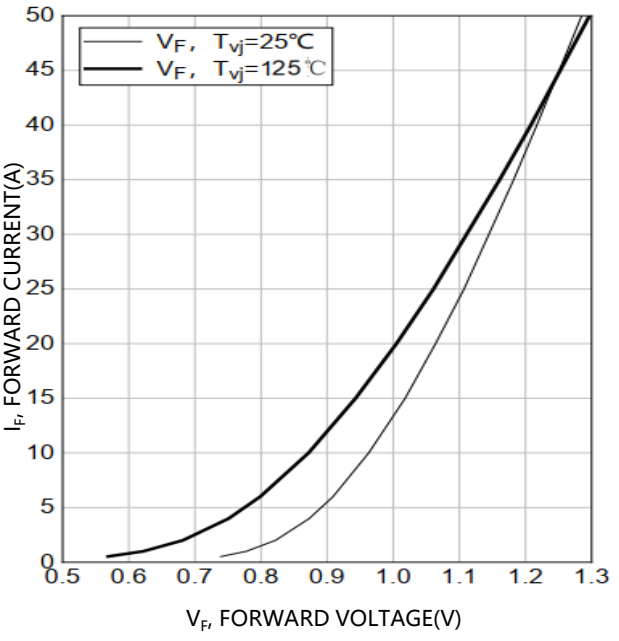
Switching losses Diode-Inverter (typical)
$E_{rec}=f(I_F)$ at R_G=20Ω and V_{CE}=600V

Fig. 7



Switching Losses Diode-Inverter (typical)
$E_{rec}=f(R_G)$ at I_F=25A and V_{CE}=600V

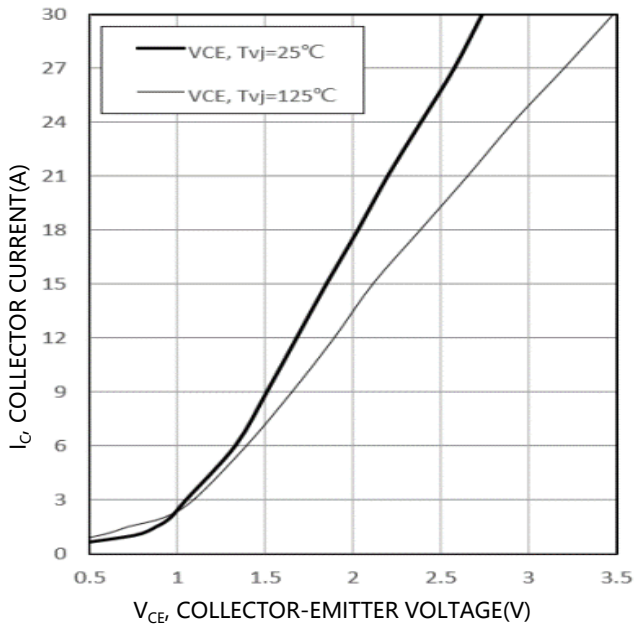
Fig. 8



Forward Characteristic of Diode-Rectifier (typical)
$I_F=f(V_F)$

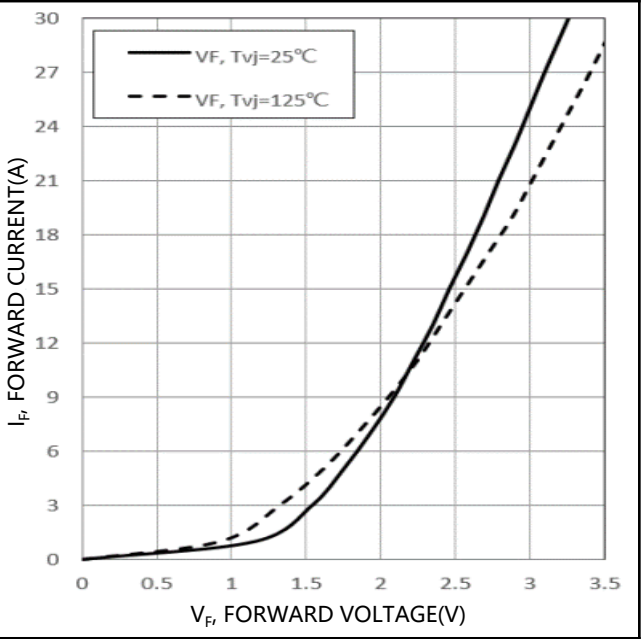
Typical Characteristics

Fig. 9



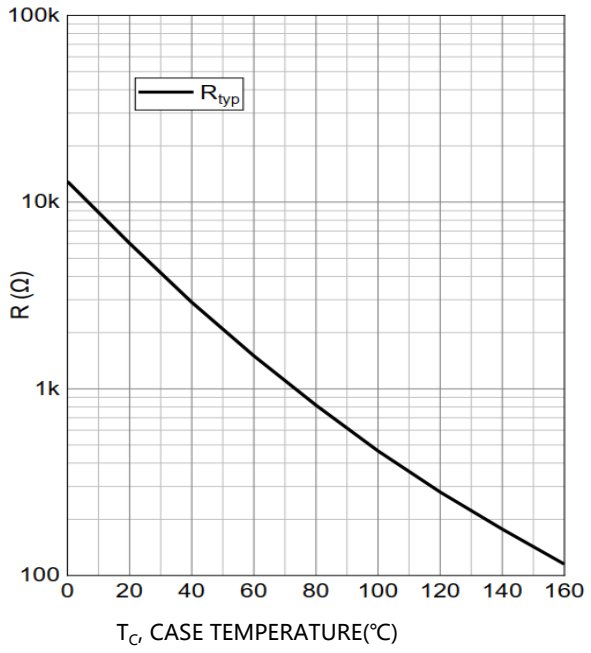
Output Characteristic IGBT-Brake (typical)
$I_C=f(V_{CE})$ at VGE=15V

Fig. 10



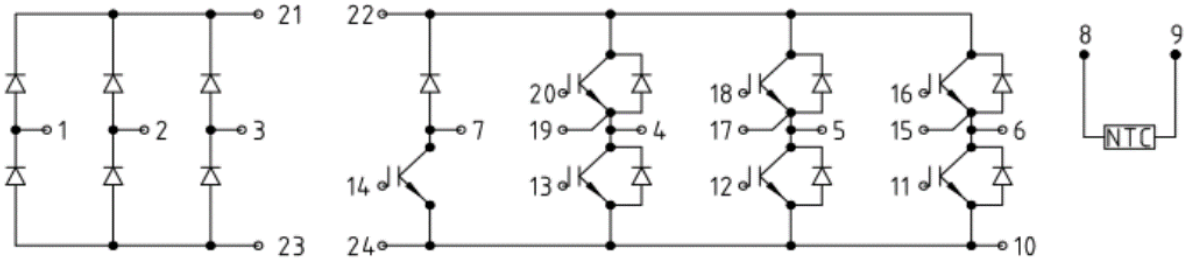
Forward characteristic of Diode-Brake (typical)
$I_F=f(V_F)$

Fig. 11



NTC-Thermistor-Temperature Characteristic (typical), R=f(T)

Circuit Diagram



Package Outlines (mm)