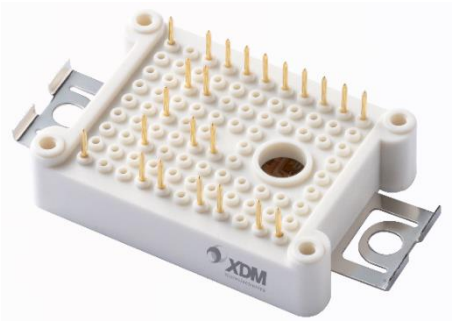
PIM with Trench Field-Stop IGBT, Emitter Controlled Diode and NTC

Features

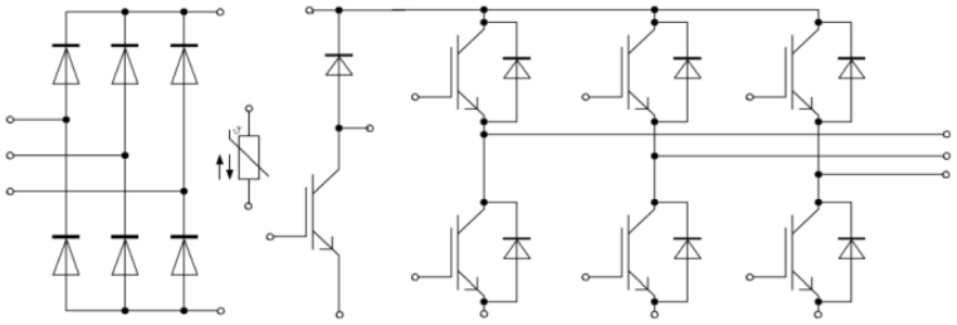
- Trench+ Field Stop Technology
- 1200V Trench Field-Stop IGBT
- Low $V_{CE(sat)}$ with Low Switching Losses



Applications

- Frequency Coverters
- Motor Drives
- Auxiliary Inverters

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℃	±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℃, $T_{vj\ max}$=175℃	130	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℃	---	1.9	2.2	V
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE}=V_{CE}, I_C=1mA	3.5	---	5.5	V
I_{CES}	Collector-Emitter Cut-Off Current	V_{CE}=1200V, V_{GE}=0V	---	---	1	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=20V, V_{CE}=0V	---	---	400	nA
C_{ies}	Input Capacitance	V_{CE}=25V, V_{GE}=0V, f=1MHz	---	880	---	pF
C_{oes}	Output Capacitance		---	90	---	pF
C_{res}	Reverse Transfer Capacitance		---	48	---	pF
$t_{d(on)}$	Turn-on Delay Time	V_{CE}=600V V_{GE}=±15V I_C=15A R_G=39Ω Inductive Load T_{vj}=25℃	---	54	---	ns
t_r	Turn-on Rise Time		---	19	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	250	---	ns
t_f	Turn-off Fall Time		---	155	---	ns
E_{on}	Turn-on Switching Loss		---	1.8	---	mJ
E_{off}	Turn-off Switching Loss		---	1.2	---	mJ
I_{SC}	Short Circuit data	V_{GE}=15V, V_{CC}=600V t_P=10μs, T_{vj}=25°C	---	60	---	A
R_{thJC}	Thermal Resistance, Junction to Case	Per IGBT	---	---	1.15	K/W
$T_{VJ\ OP}$	Virtual Junction Temperature	Under Switching	-40	---	150	℃

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℃	15	A
I_{FRM}	Repetitive peak forward current	t_P=1 ms	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	2.4	V
I_{rr}	Peak Reverse Recovery Current	I_F=15A, di/dt=1700A/us, V_R=600V, V_{GE}=-15V T_{vj}=25℃	---	24.8	---	A
Q_{rr}	Recovered Charge		---	1.3	---	nC
E_{rec}	Reverse Recovery Energy		---	0.5	---	mJ
$T_{VJ\ OP}$	Virtual Junction Temperature	Under Switching	-40	---	150	℃

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℃	16	A
I_{RMSM}	Maximum RMS current at Rectifier output	T_{vj}=80℃	32	A
I_{FSM}	Surge Forward Current	t_P=10ms, sin180°, T_j=25℃	250	A
I^2t	I^2t Value	t_P=10ms, sin180°, T_j=25℃	312.5	A^2s

Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
V_F	Forward Voltage	I_F=16A, V_{GE}=0V, T_{vj}=25℃	---	---	1.2	V
I_R	Recovery Current	V_R=1600V, T_{vj}=25℃	---	---	5	uA
$T_{VJ\ OP}$	Virtual Junction Temperature	Under Switching	-40	---	150	℃

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

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℃	---	1.9	2.2	V
$V_{GE(th)}$	Gate Threshold Voltage	V_{GE}=V_{CE}, I_C=1mA	4.0	---	5.2	V
I_{CES}	Collector-Emitter Cut-Off Current	V_{CE}=1200V, V_{GE}=0V	---	---	1	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=20V, V_{CE}=0V	---	---	400	nA
C_{ies}	Input Capacitance	V_{CE}=25V, V_{GE}=0V, f=1MHz	---	880	---	pF
C_{oes}	Output Capacitance		---	90	---	pF
C_{res}	Reverse Transfer Capacitance		---	48	---	pF
$t_{d(on)}$	Turn-on Delay Time	V_{CC}=600V V_{GE}=±15V I_C=15A R_G=39Ω Inductive Load T_{vj}=25℃	---	35	---	ns
t_r	Turn-on Rise Time		---	22	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	212	---	ns
t_f	Turn-off Fall Time		---	152	---	ns
E_{on}	Turn-on Switching Loss		---	1.6	---	mJ
E_{off}	Turn-off Switching Loss		---	1.2	---	mJ
$T_{VJ\ OP}$	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℃	8	A
I_{FRM}	Repetitive Peak Collector Current	t_P=1ms	16	A

Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
V_F	Forward Voltage	I_F=15A, V_{GE}=0V, T_{vj}=25℃	---	2.3	2.6	V
		I_F=15A, V_{GE}=0V, T_{vj}=125℃	---	2.6	---	V
I_{RM}	Peak Reverse Recovery Current	I_F=15A,di/dt=550A/us V_R=600V, V_{GE}=-15V T_{vj}=25℃	---	10.8	---	A
Q_{rr}	Recovered Charge		---	705	---	nC
E_{rec}	Reverse Recovery Energy		---	0.22	---	mJ
$T_{VJ\ OP}$	Virtual Junction Temperature	Under Switching	-40	---	150	℃

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	$R_2 = R_{25}\ \exp\ [B_{25/50}(1/T_2 - 1/(298\ K))]$	---	3375	---	K

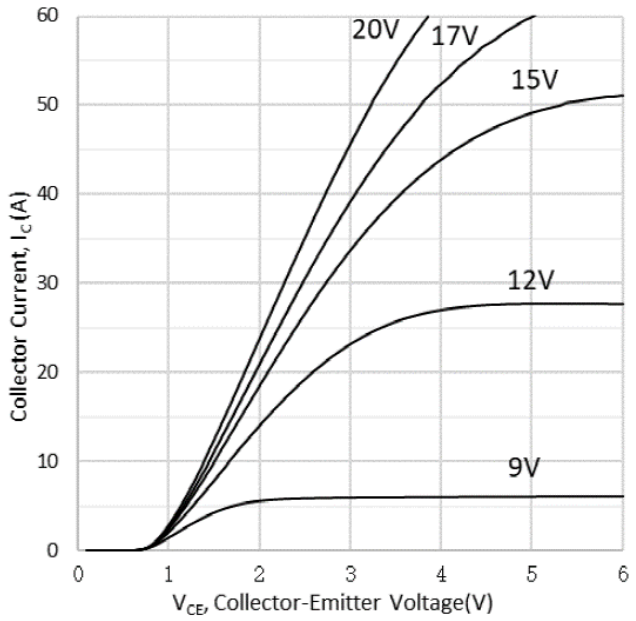
Module

Symbol	Description	Conditions	Values	Unit
V_{ISOL}	Isolation Test Voltage	RMS, f=50Hz, t=1min	2.5	KV
	Internal Isolation	Basic Insulation (Class 1, IEC 61140)	Al_2O_3	
	Creepage Distance	Terminal to Heatsink Terminal to Terminal	11.8 6	mm
	Clearance	Terminal to Heatsink Terminal to Terminal	10.2 5.1	mm
CTI	Comparative Tracking Index		> 200	

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
L_{SCE}	Stray Inductance Module		---	30	---	nH
T_{stg}	Storage Temperature		-40	---	125	℃
$R_{CC'+EE'}$	Module lead resistance, terminals-chip		---	8.0	---	mΩ
G	Weight		---	23.8	---	g

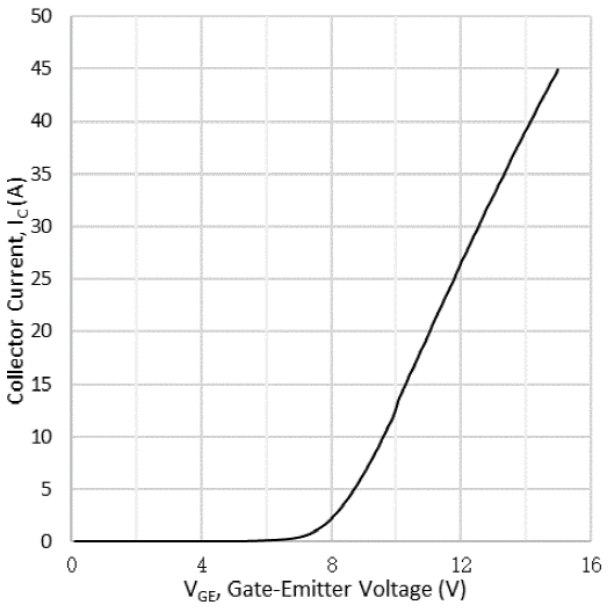
Typical Characteristics

Fig. 1



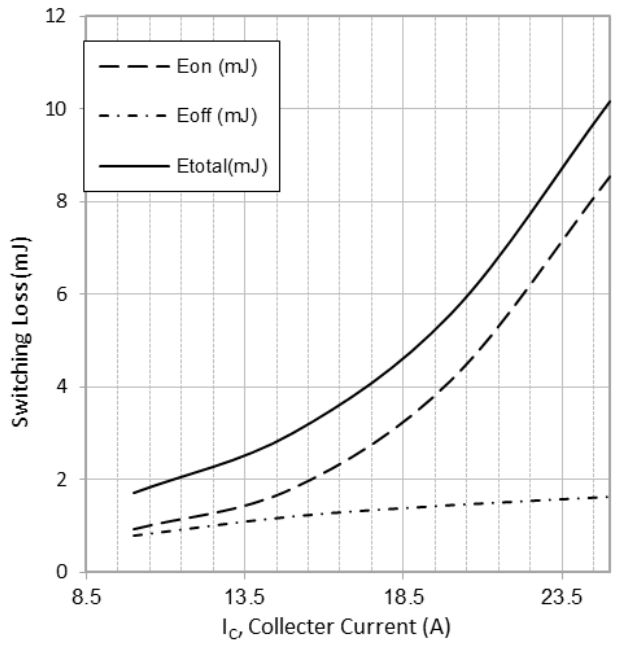
Output characteristic IGBT-Inverter (typical)
$I_C=f(V_{CE})$ at T_{vj}=25℃

Fig. 2



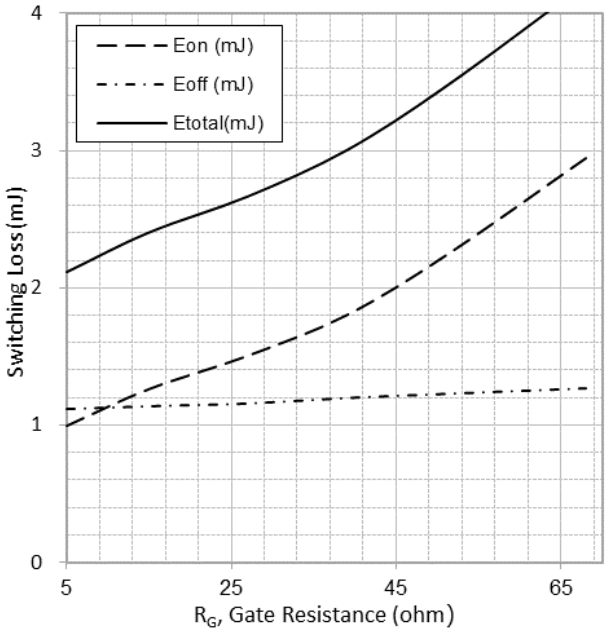
Transfer characteristic IGBT-Inverter (typical)
$I_C=f(V_{GE})$ at V_{CE}=20V and T_{vj}=25℃

Fig. 3



Switching losses IGBT-Inverter (typical)
$E_{on}=f(I_C)$, $E_{off}=f(I_C)$ at V_{GE}=±15V , R_G=39Ω and V_{CE}=600V

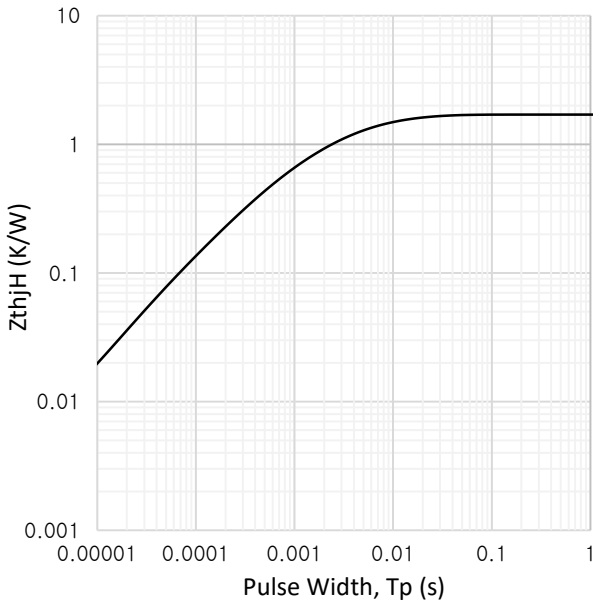
Fig. 4



Switching losses IGBT-Inverter (typical)
$E_{on}=f(R_G)$, $E_{off}=f(R_G)$ at V_{GE}=±15V, I_C=15A and V_{CE}=600V

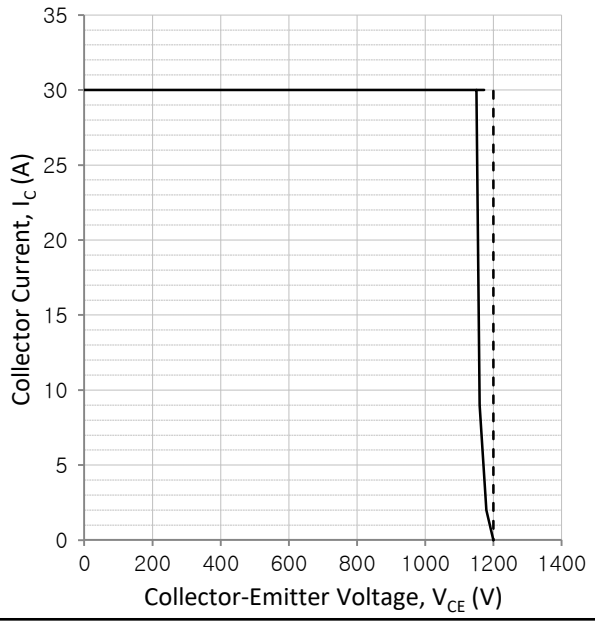
Typical Characteristics

Fig. 5



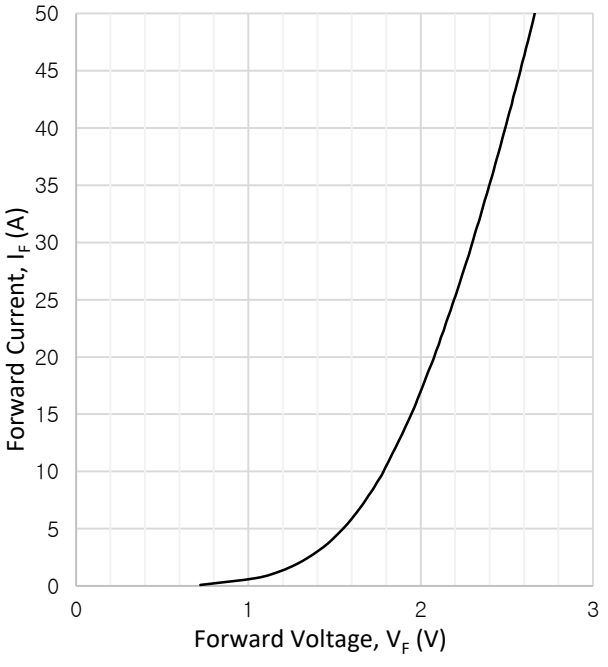
Transient Thermal Impedance IGBT-Inverter
$Z_{thJH}=f(t)$

Fig. 6



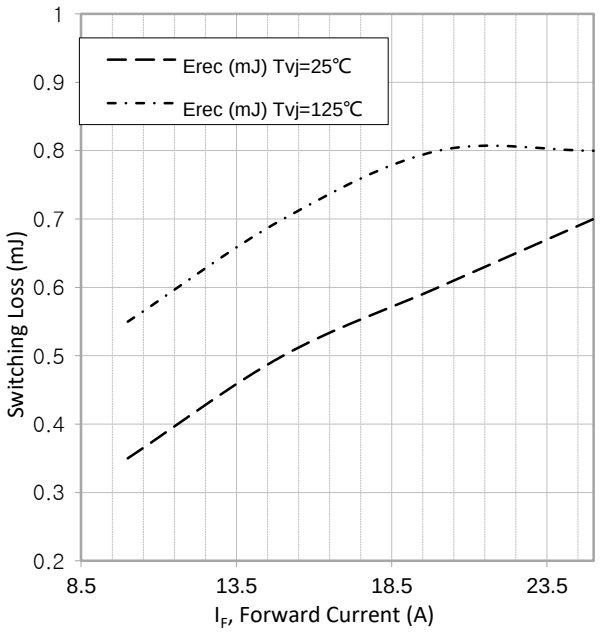
Reverse Bias Safe Operating Area IGBT-Inverter (RBSOA), $I_C=f(V_{CE})$

Fig. 7



Forward characteristic of Diode-Inverter (typical)
$I_F=f(V_F)$ at $T_{vj}=25℃$

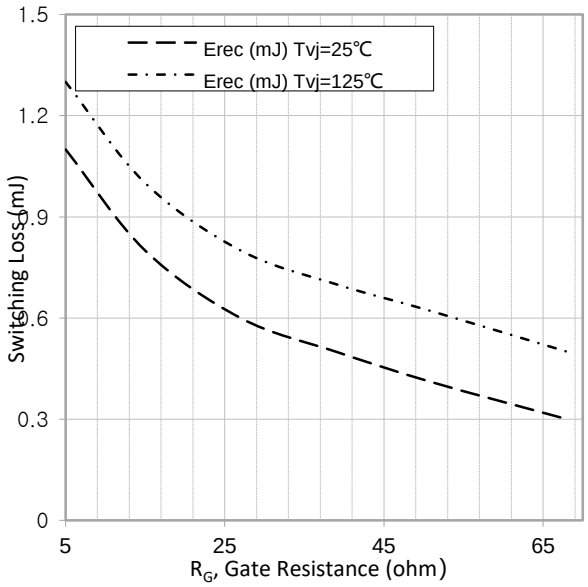
Fig. 8



Switching losses Diode-Inverter (typical)
$E_{rec}=f(I_F)$ at $R_G=39Ω$ and $V_{CE}=600V$

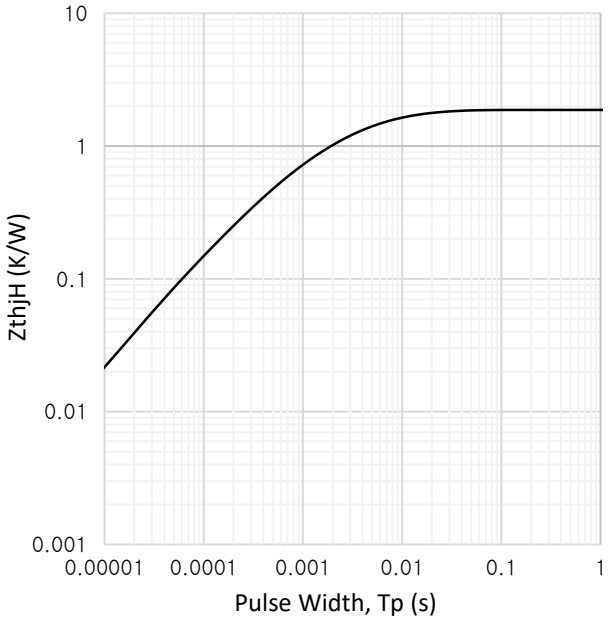
Typical Characteristics

Fig. 9



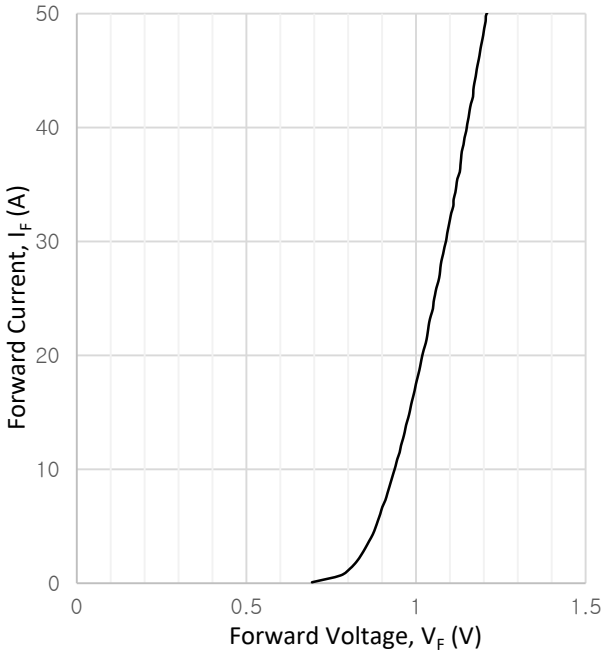
Switching Losses Diode-Inverter (typical)
$E_{rec}=f(R_G)$ at I_F=15A and V_{CE}=600V

Fig. 10



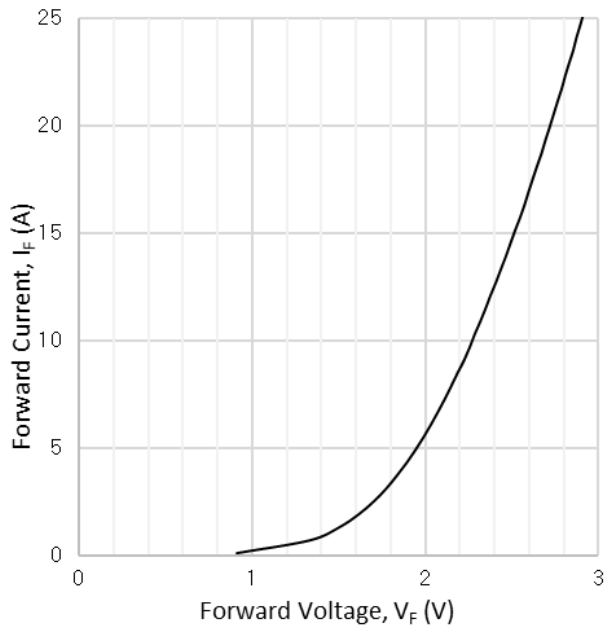
Transient Thermal Impedance Diode-Inverter
$Z_{thJH}=f(t)$

Fig. 11



Forward Characteristic of Diode-Rectifier (typical)
$I_F=f(V_F)$ at T_{vj}=25℃

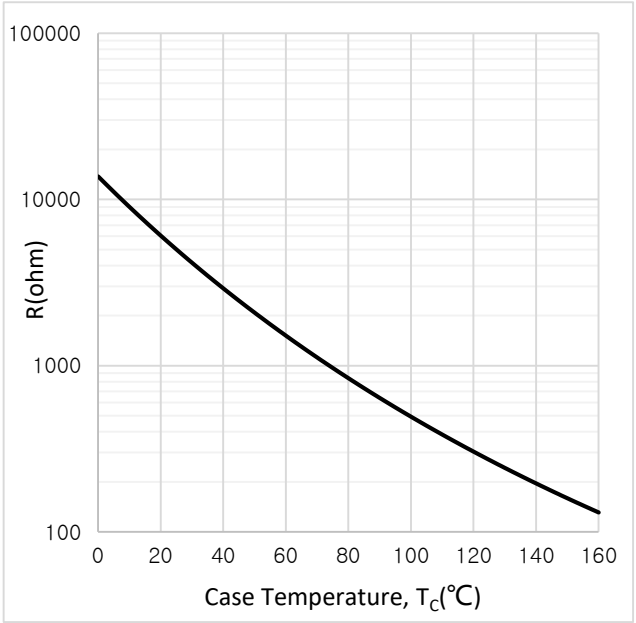
Fig. 12



Forward characteristic of Diode-Brake (typical)
$I_F=f(V_F)$ at T_{vj}=25℃

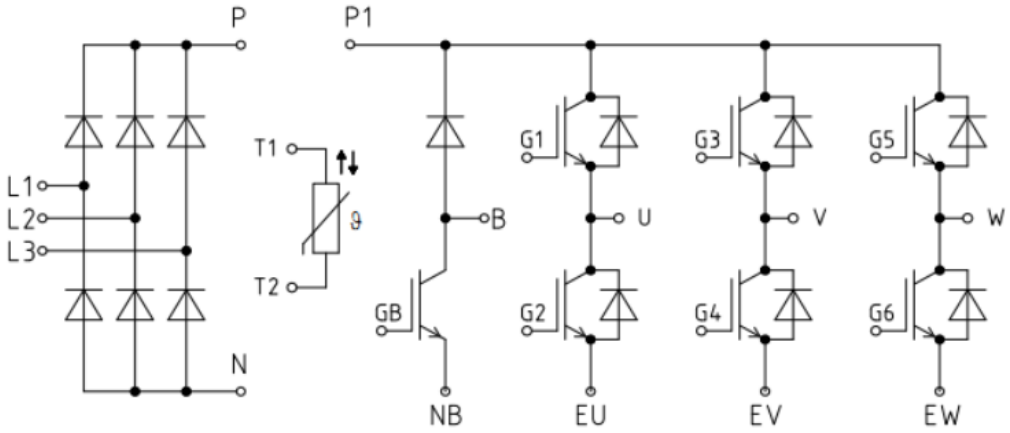
Typical Characteristics

Fig. 13



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

Circuit Diagram



Package Outlines (mm)