

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

### Features

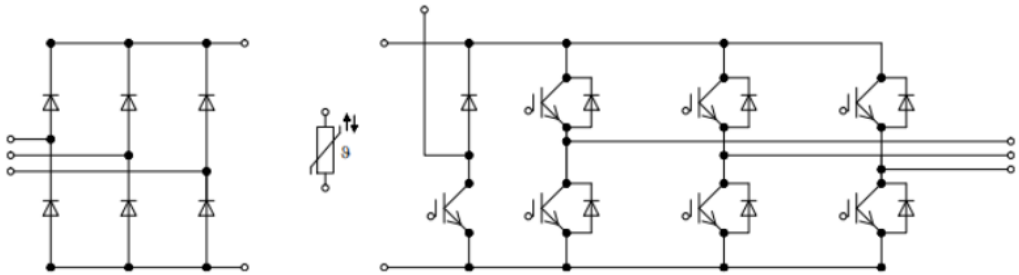
- $V_{CE}=1200V$   $I_C=100A$
- Low  $V_{CE(sat)}$  with Positive Temperature Coefficient
- Trench+ Field Stop Technology



### Applications

- The inverter
- Motor control and drives
- Auxiliary Inverters

### Equivalent Circuit Schematic



## IGBT - Inverter

### Maximum Rated Values

Symbol	Description	Conditions	Values	Unit
$V_{CES}$	Collector-Emitter Voltage	$T_{vj}=25^{\circ}C$	1200	V
$V_{GES}$	Gate-Emitter Peak Voltage	$T_{vj}=25^{\circ}C$	$\pm 20$	V
$I_C$	Continuous DC Collector Current	$T_C=100^{\circ}C$	100	A
$I_{CRM}$	Repetitive Peak Collector Current	$t_p=1ms$	200	A
$P_{tot}$	Total Power Dissipation	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	600	W

**Characteristic Values**

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=100A, T_{vj}=25^{\circ}C$	---	2.20	--	V
		$V_{GE}=15V, I_C=100A, T_{vj}=125^{\circ}C$	---	2.65	--	V
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=2mA$	5.0	---	7.0	V
$I_{CES}$	Collector-Emitter Cut-Off Current	$V_{CE}=1200V, V_{GE}=0V$	---	---	1.0	mA
$I_{GES}$	Gate-Emitter Leakage Current	$V_{GE}=20V, V_{CE}=0V$	---	---	600	nA
$R_{Gint}$	Internal Gate Resistor	$T_{vj}=25^{\circ}C$	---	7.5	---	$\Omega$
$C_{ies}$	Input Capacitance	$V_{CE}=25V, V_{GE}=0V, f=1MHz$	---	6670	---	pF
$C_{res}$	Reverse Transfer Capacitance		---	1600	---	pF
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600V$ $V_{GE}=\pm 15V$ $I_C=100A$ $R_G=5.6\Omega$ Inductive Load $T_{vj}=25^{\circ}C$	---	170	---	ns
$t_r$	Turn-on Rise Time		---	90	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	380	---	ns
$t_f$	Turn-off Fall Time		---	85	---	ns
$E_{on}$	Turn-on Switching Loss		---	9.8	---	mJ
$E_{off}$	Turn-off Switching Loss		---	5.7	---	mJ
$I_{SC}$	Short Circuit data	$V_{GE}\leq 15V, V_{CC}=600V$ $t_p\leq 10\mu s, T_{vj}=25^{\circ}C$	---	470	---	A
$R_{thJC}$	Thermal Resistance, Junction to Case	Per IGBT	---	---	0.25	K/W
$T_{VJOP}$	Virtual Junction Temperature	Under Switching	-40	---	150	$^{\circ}C$

**Diode - Inverter  
Maximum Rated Values**

Symbol	Description	Conditions	Values	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	$T_{vj}=25^{\circ}C$	1200	V
$I_F$	Continuous DC Forward Current		100	A
$I_{FRM}$	Repetitive Peak Collector Current	$t_p=1ms$	200	A

**Characteristic Values**

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
V <sub>F</sub>	Forward Voltage	I <sub>F</sub> =100A, V <sub>GE</sub> =0V, T <sub>vj</sub> =25°C	---	1.65	---	V
		I <sub>F</sub> =100A, V <sub>GE</sub> =0V, T <sub>vj</sub> =125°C	---	1.64	---	V
I <sub>RM</sub>	Peak Reverse Recovery Current	I <sub>F</sub> =100A, V <sub>R</sub> =600V, V <sub>GE</sub> =-15V T <sub>vj</sub> =25°C	---	112	---	A
Q <sub>r</sub>	Recovered Charge		---	12	---	uC
E <sub>rec</sub>	Reverse Recovery Energy		---	5.4	---	mJ
T <sub>VJ OP</sub>	Virtual Junction Temperature	Under Switching	-40	---	150	°C

**Diode - Rectifier  
Maximum Rated Values**

Symbol	Description	Conditions	Values	Unit
V <sub>RRM</sub>	Repetitive Peak Reverse Voltage	T <sub>vj</sub> =25°C	1600	V
I <sub>F</sub>	Continuous DC forward current	T <sub>vj</sub> =80°C	70	A
I <sub>FRM</sub>	Repetitive peak forward current	t <sub>p</sub> =1ms	140	A
I <sup>2</sup> t	I <sup>2</sup> t Value	t <sub>p</sub> =10ms, sin180°, T <sub>J</sub> =25°C	10600	A <sup>2</sup> s

**Characteristic Values**

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
V <sub>F</sub>	Forward Voltage	I <sub>F</sub> =70A, T <sub>vj</sub> =25°C	---	1.1	---	V
I <sub>R</sub>	Recovery Current	V <sub>R</sub> =1800V, T <sub>vj</sub> =25°C	---	1	---	mA
T <sub>VJ OP</sub>	Virtual Junction Temperature	Under Switching	-40	---	150	°C

## IGBT – Brake

### Maximum Rated Values

Symbol	Description	Conditions	Values	Unit
$V_{CES}$	Collector-Emitter Voltage	$T_{vj}=25^{\circ}\text{C}$	1200	V
$V_{GES}$	Gate-Emitter Peak Voltage	$T_{vj}=25^{\circ}\text{C}$	$\pm 20$	V
$I_C$	Continuous DC Collector Current	$T_C=100^{\circ}\text{C}$	50	A
$I_{CRM}$	Repetitive Peak Collector Current	$t_p=1\text{ms}$	100	A

### Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15\text{V}, I_C=50\text{A}, T_{vj}=25^{\circ}\text{C}$	---	1.9	--	V
		$V_{GE}=15\text{V}, I_C=50\text{A}, T_{vj}=125^{\circ}\text{C}$	---	2.4	--	V
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=2\text{mA}$	5.0	---	7.0	V
$I_{CES}$	Collector-Emitter Cut-Off Current	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}$	---	---	1	mA
$I_{GES}$	Gate-Emitter Leakage Current	$V_{GE}=15\text{V}, V_{CE}=0\text{V}$	---	---	600	nA
$R_{Gint}$	Internal gate resistor	$T_{vj}=25^{\circ}\text{C}$	---	1.36	---	$\Omega$
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$	---	5522	---	pF
$C_{res}$	Reverse Transfer Capacitance		---	1800	---	pF
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600\text{V}$ $V_{GE}=\pm 15\text{V}$ $I_C=50\text{A}$ $R_G=15\Omega$ Inductive Load $T_{vj}=25^{\circ}\text{C}$	---	50	---	ns
$t_r$	Turn-on Rise Time		---	165	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	210	---	ns
$t_f$	Turn-off Fall Time		---	140	---	ns
$E_{on}$	Turn-on Switching Loss		---	3.2	---	mJ
$E_{off}$	Turn-off Switching Loss		---	9.7	---	mJ
$T_{VJ OP}$	Virtual Junction Temperature	Under Switching	-40	---	150	$^{\circ}\text{C}$

## Diode - Brake

### Maximum Rated Values

Symbol	Description	Conditions	Values	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	$T_{vj}=25^{\circ}\text{C}$	1200	V
$I_F$	Continuous DC Forward Current		25	A
$I_{FRM}$	Repetitive Peak Collector Current	$t_p=1\text{ms}$	50	A

### Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_F$	Forward Voltage	$I_F=25\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$	---	1.9	---	V
		$I_F=25\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$	---	1.85	---	V
$I_{RM}$	Peak Reverse Recovery Current	$I_F=25\text{A}, V_R=600\text{V}, V_{GE}=-15\text{V}$ $T_{vj}=25^{\circ}\text{C}$	---	20	---	A
$Q_r$	Recovered Charge		---	2.4	---	$\mu\text{C}$
$E_{rec}$	Reverse Recovery Energy		---	1.1	---	mJ
$T_{VJOP}$	Virtual Junction Temperature	Under Switching	-40	---	150	$^{\circ}\text{C}$

## NTC-Thermistor

### Characteristic Values

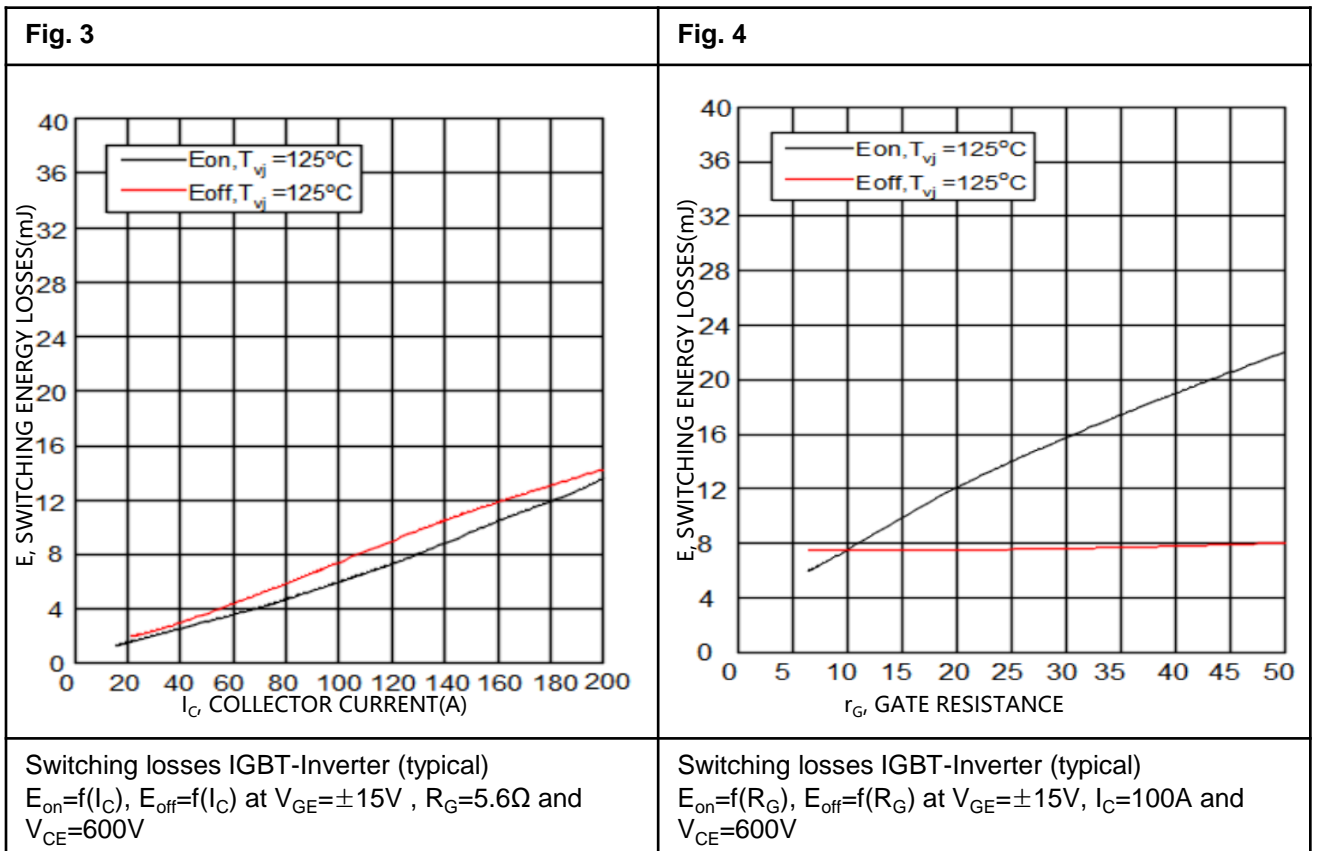
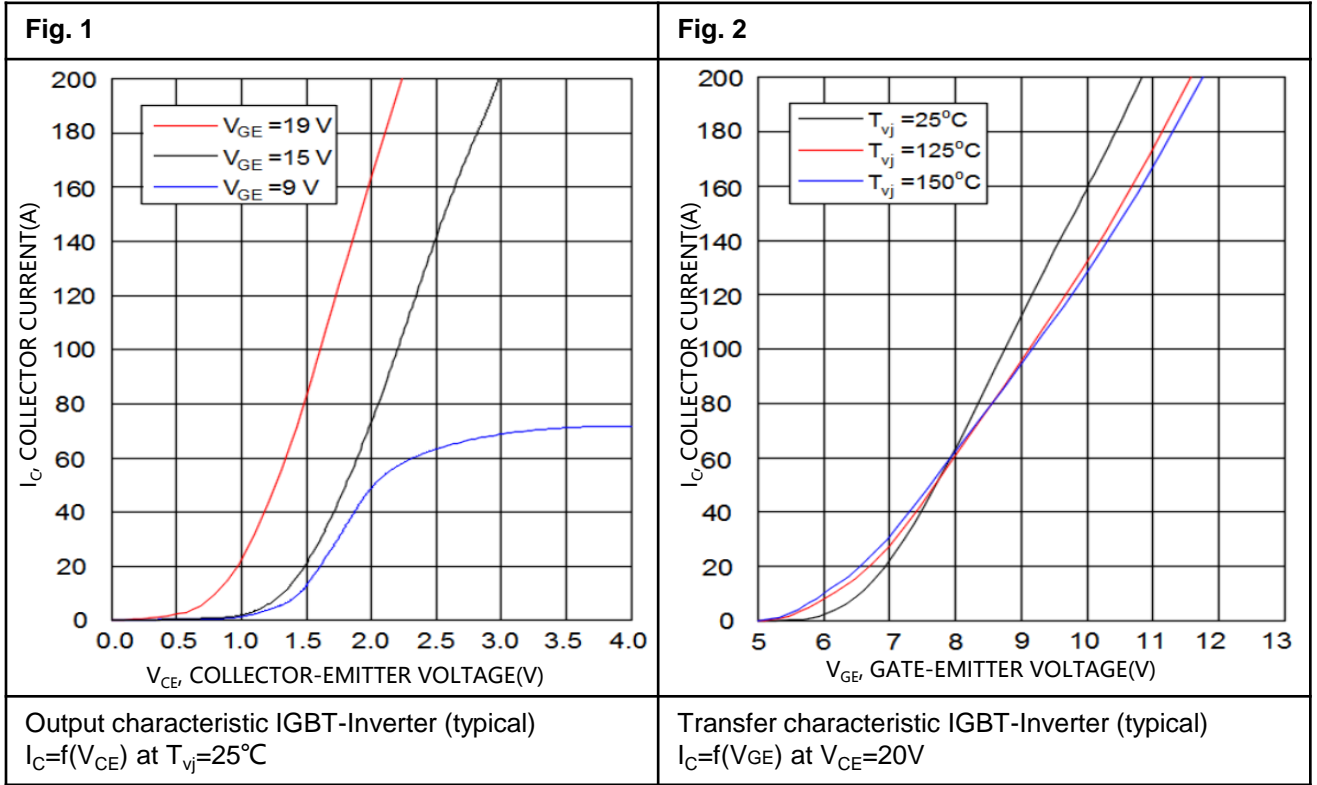
Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$R_{25}$	Rated Resistance	$T_C=25^{\circ}\text{C}$	---	5	---	$\text{K}\Omega$
$B_{25/50}$	B Value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298 \text{ K}))]$	---	3380	---	K

**Module**

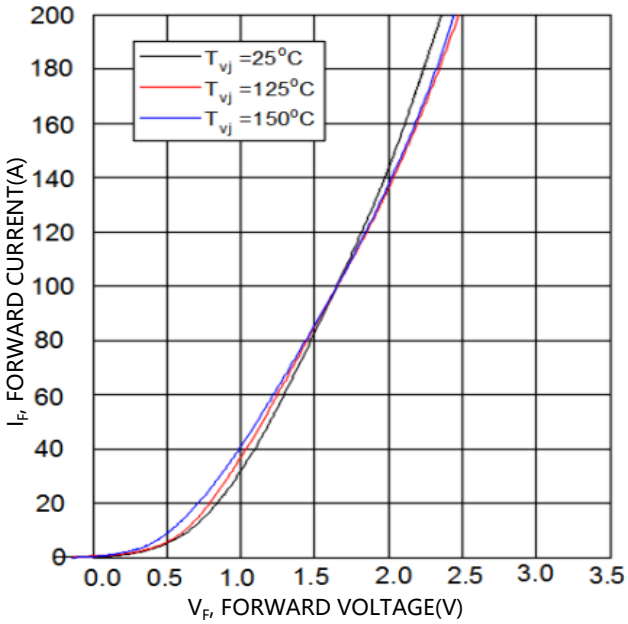
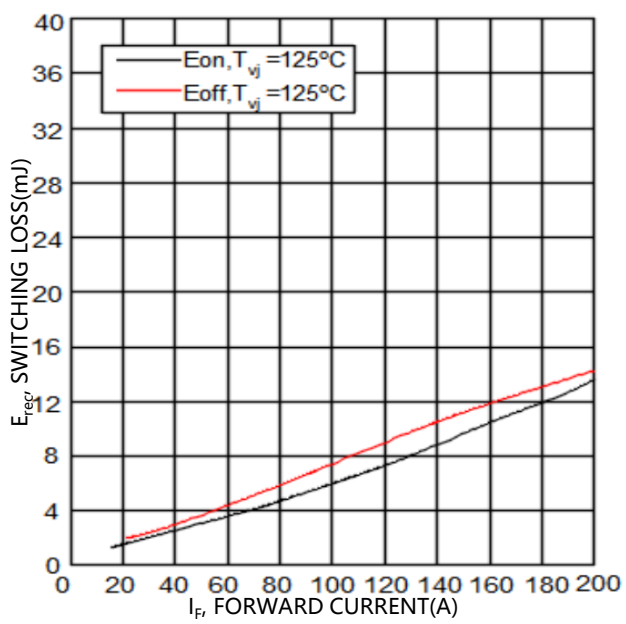
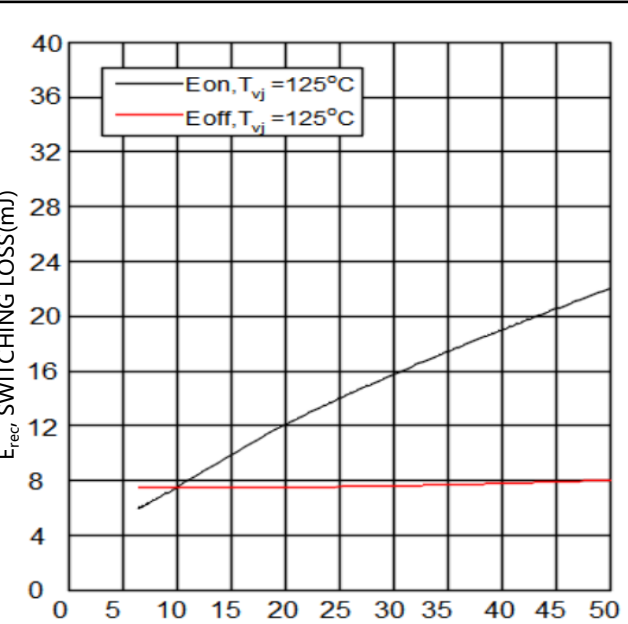
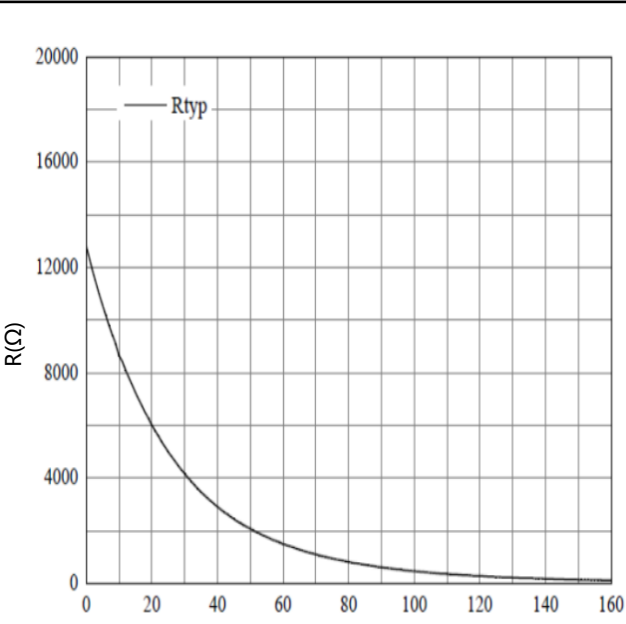
Symbol	Description	Conditions	Values	Unit
$V_{ISOL}$	Isolation Test Voltage	RMS, f=50Hz, t=1min	4	KV
	Internal Isolation	Basic Insulation (Class 1, IEC 61140)	$Al_2O_3$	
	Creepage Distance	Terminal to Heatsink Terminal to Terminal	10	mm
	Clearance	Terminal to Heatsink Terminal to Terminal	7.5	mm

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$L_{sCE}$	Stray Inductance Module		---	40	---	nH
$T_{stg}$	Storage Temperature		-40	---	125	°C
G	Weight		---	300	---	g

## Typical Characteristics

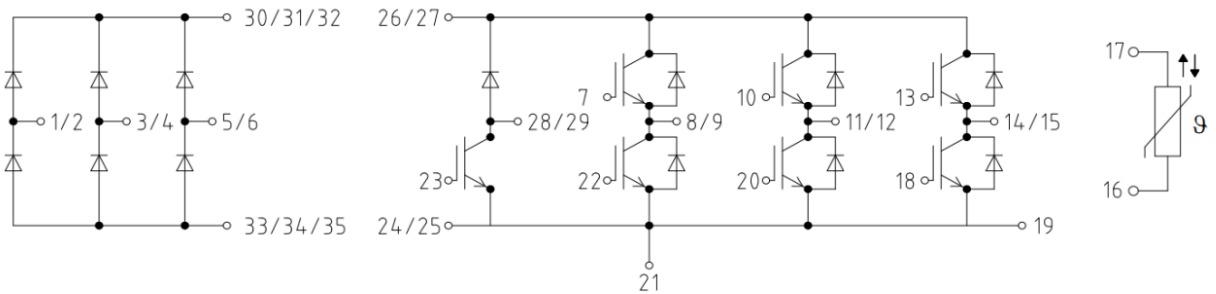


## Typical Characteristics

<p><b>Fig. 5</b></p>  <p>Forward characteristic of Diode-Inverter (typical)  <math>I_F=f(V_F)</math></p>	<p><b>Fig. 6</b></p>  <p>Switching losses Diode-Inverter (typical)  <math>E_{rec}=f(I_F)</math> at <math>R_G=5.6\Omega</math> and <math>V_{CE}=600V</math></p>
<p><b>Fig. 7</b></p>  <p>Switching losses Diode-Inverter (typical)  <math>E_{rec}=f(I_F)</math> at <math>I_F=100A</math> and <math>V_{CE}=600V</math></p>	<p><b>Fig. 8</b></p>  <p>NTC-Thermistor-Temperature Characteristic (typical), <math>R=f(T)</math></p>



## Circuit Diagram



## Package Outlines (mm)

