

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

### Features

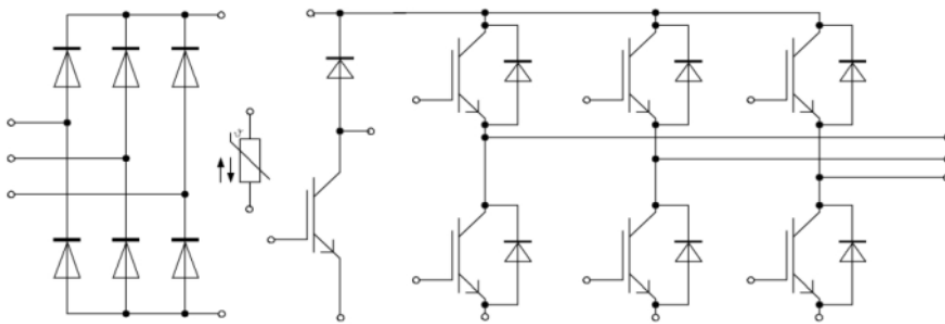
- Trench+ Field Stop Technology
- 1200V Trench Field-Stop IGBT
- Low  $V_{CE(sat)}$  with Low Switching Losses

### Applications

- Frequency Converters
- Motor Drives
- Auxiliary Inverters



### Equivalent Circuit Schematic



### IGBT - Inverter

#### Maximum Rated Values

Symbol	Description	Conditions	Values	Unit
$V_{CES}$	Collector-Emitter Voltage	$T_{vj}=25^{\circ}C$	1200	V
$V_{GES}$	Gate-Emitter Peak Voltage	$T_{vj}=25^{\circ}C$	$\pm 20$	V
$I_C$	Continuous DC Collector Current	$T_C=100^{\circ}C$	35	A
$I_{CRM}$	Repetitive Peak Collector Current	$t_p=1ms$	105	A
$P_{tot}$	Total Power Dissipation	$T_C=25^{\circ}C, T_{vj\ max}=175^{\circ}C$	154	W

**Characteristic Values**

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=35A, T_{vj}=25^{\circ}C$	---	1.8	2.1	V
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=1mA$	5.2	6.0	6.8	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	$V_{CE}=25V, V_{GE}=0V, f=1MHz$	---	3818	---	pF
$C_{oes}$	Output Capacitance		---	184	---	pF
$C_{res}$	Reverse Transfer Capacitance		---	40	---	pF
$t_{d(on)}$	Turn-on Delay Time	$V_{CE}=600V$ $V_{GE}=\pm 15V$ $I_C=35A$ $R_G=20\Omega$ Inductive Load $T_{vj}=25^{\circ}C$	---	106	---	ns
$t_r$	Turn-on Rise Time		---	36	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	228	---	ns
$t_f$	Turn-off Fall Time		---	92	---	ns
$E_{on}$	Turn-on Switching Loss		---	1.27	---	mJ
$E_{off}$	Turn-off Switching Loss		---	2.60	---	mJ
$I_{SC}$	Short Circuit data	$V_{GE}\leq 15V, V_{CC}=800V$ $t_p\leq 10\mu s, T_{vj}=150^{\circ}C$	---	200	---	A
$R_{thJC}$	Thermal Resistance, Junction to Case	Per IGBT	---	---	0.49	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		30	A
$I_{FRM}$	Repetitive Peak Collector Current	$t_p=1ms$	120	A

**Characteristic Values**

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_F$	Forward Voltage	$I_F=35A, V_{GE}=0V, T_{vj}=25^{\circ}C$	---	1.9	2.3	V
$I_{RM}$	Peak Reverse Recovery Current	$I_F=35A, V_R=1200V, V_{GE}=-15V$ $di/dt=200A/us, T_{vj}=25^{\circ}C$	---	50	---	A
$Q_r$	Recovered charge		---	0.32	---	$\mu C$
$T_{rr}$	Reverse Recovery Time		---	55	---	ns
$T_{VJOP}$	Virtual Junction Temperature	Under Switching	-40	---	150	$^{\circ}C$

**Diode - Rectifier**  
**Maximum Rated Values**

Symbol	Description	Conditions	Values	Unit
$V_{RRM}$	Repetitive Peak Reverse Voltage	$T_{vj}=25^{\circ}C$	1600	V
$I_{F(AV)}$	Average Output Current	$T_{vj}=25^{\circ}C$	35	A
$I_{FSM}$	Surge Forward Current	$t_p=10ms, \sin 180^{\circ}, T_j=25^{\circ}C$	360	A
$I^2t$	$I^2t$ Value	$t_p=10ms, \sin 180^{\circ}, T_j=25^{\circ}C$	648	$A^2s$

**Characteristic Values**

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_F$	Forward Voltage	$I_F=35A, V_{GE}=0V, T_{vj}=25^{\circ}C$	---	---	1.2	V
$I_R$	Recovery Current	$V_R=1600V, T_{vj}=25^{\circ}C$	---	---	5	$\mu A$
$T_{VJOP}$	Virtual Junction Temperature	Under Switching	-40	---	150	$^{\circ}C$

## 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	$T_C=100^{\circ}\text{C}$	25	A
$I_{CRM}$	Repetitive Peak Collector Current	$t_p=1\text{ms}$	75	A

### Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15\text{V}, I_C=25\text{A}, T_{vj}=25^{\circ}\text{C}$	---	2	2.3	V
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=1\text{mA}$	4.0	4.5	5.0	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	$V_{GE}=20\text{V}, V_{CE}=0\text{V}$	---	---	400	nA
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$	---	903	---	pF
$C_{oes}$	Output Capacitance		---	94	---	pF
$C_{res}$	Reverse Transfer Capacitance		---	48	---	pF
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600\text{V}$ $V_{GE}=\pm 15\text{V}$ $I_C=25\text{A}$ $R_G=20\Omega$ Inductive Load $T_{vj}=25^{\circ}\text{C}$	---	72	---	ns
$t_r$	Turn-on Rise Time		---	27	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	250	---	ns
$t_f$	Turn-off Fall Time		---	148	---	ns
$E_{on}$	Turn-on Switching Loss		---	1.05	---	mJ
$E_{off}$	Turn-off Switching Loss		---	2.58	---	mJ
$T_{VJOP}$	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	$T_C=115^{\circ}\text{C}$	15	A
$I_{FSM}$	Single Pulse Forward Current	$T_C=25^{\circ}\text{C}$	200	A

### Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_F$	Forward Voltage	$I_F=15\text{A}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$	---	2.0	2.5	V
$I_{RM}$	Peak Reverse Recovery Current	$I_F=15\text{A}, V_R=1200\text{V}, di/dt=200\text{A}/\mu\text{s}, T_{vj}=25^{\circ}\text{C}$	---	18	---	A
$t_{rr}$	Reverse recovery time		---	50	---	ns
$E_{rec}$	Reverse Recovery Energy		---	0.2	---	mJ
$T_{VJOP}$	Virtual Junction Temperature	Under Switching	-40	---	150	$^{\circ}\text{C}$

## NTC-Thermistor

### Characteristic Values

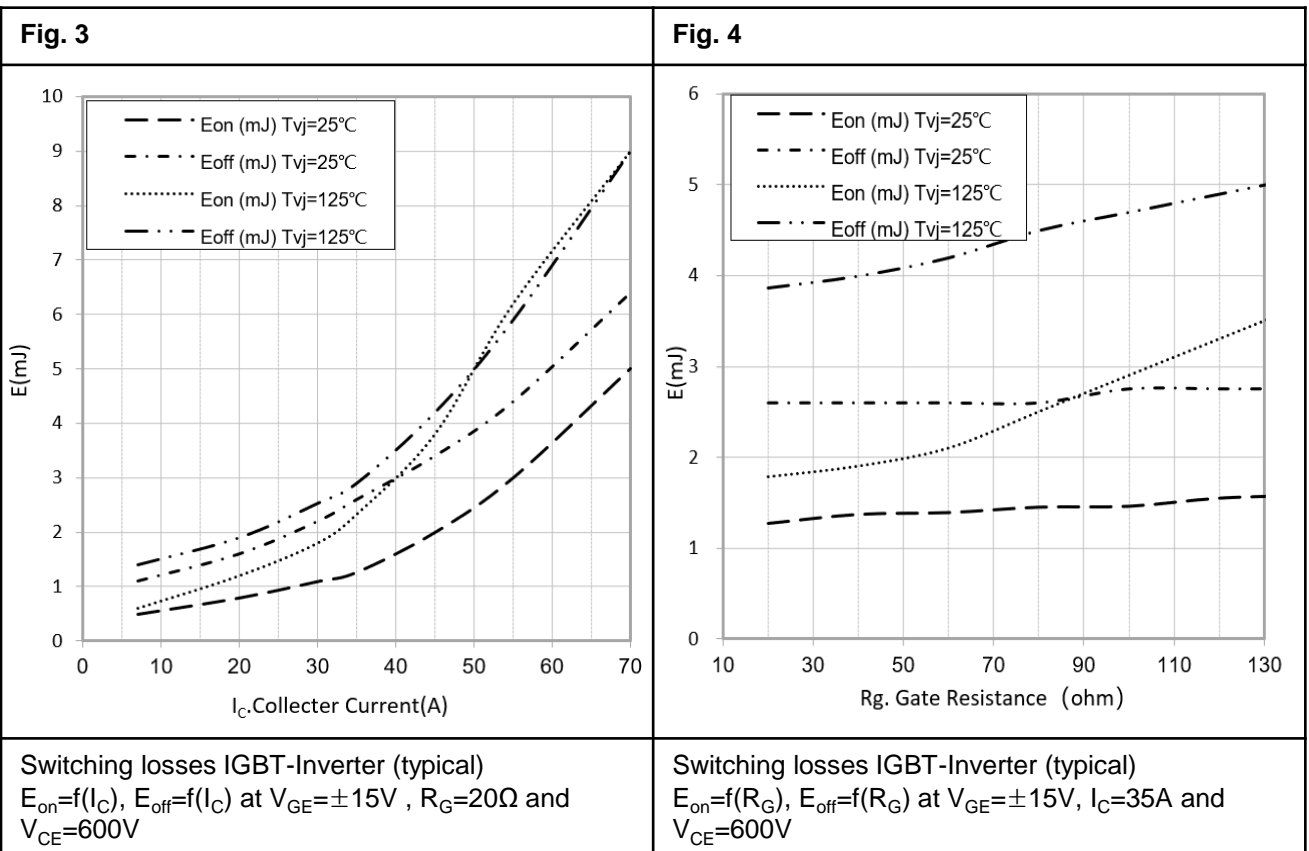
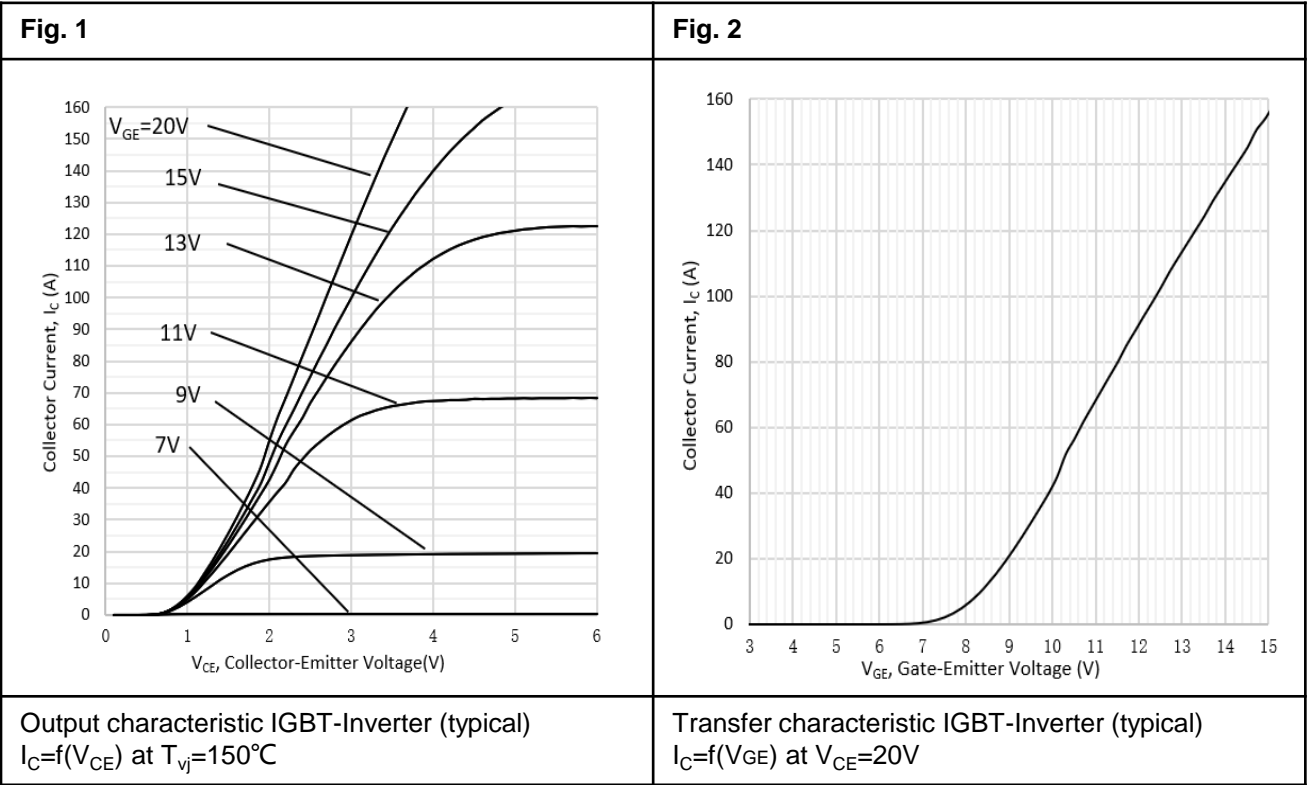
Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$R_{25}$	Rated Resistance	$T_C=25^{\circ}\text{C}$	---	5	---	$\text{K}\Omega$
$B_{25/50}$	B Value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298 \text{ K}))]$	---	3375	---	K

**Module**

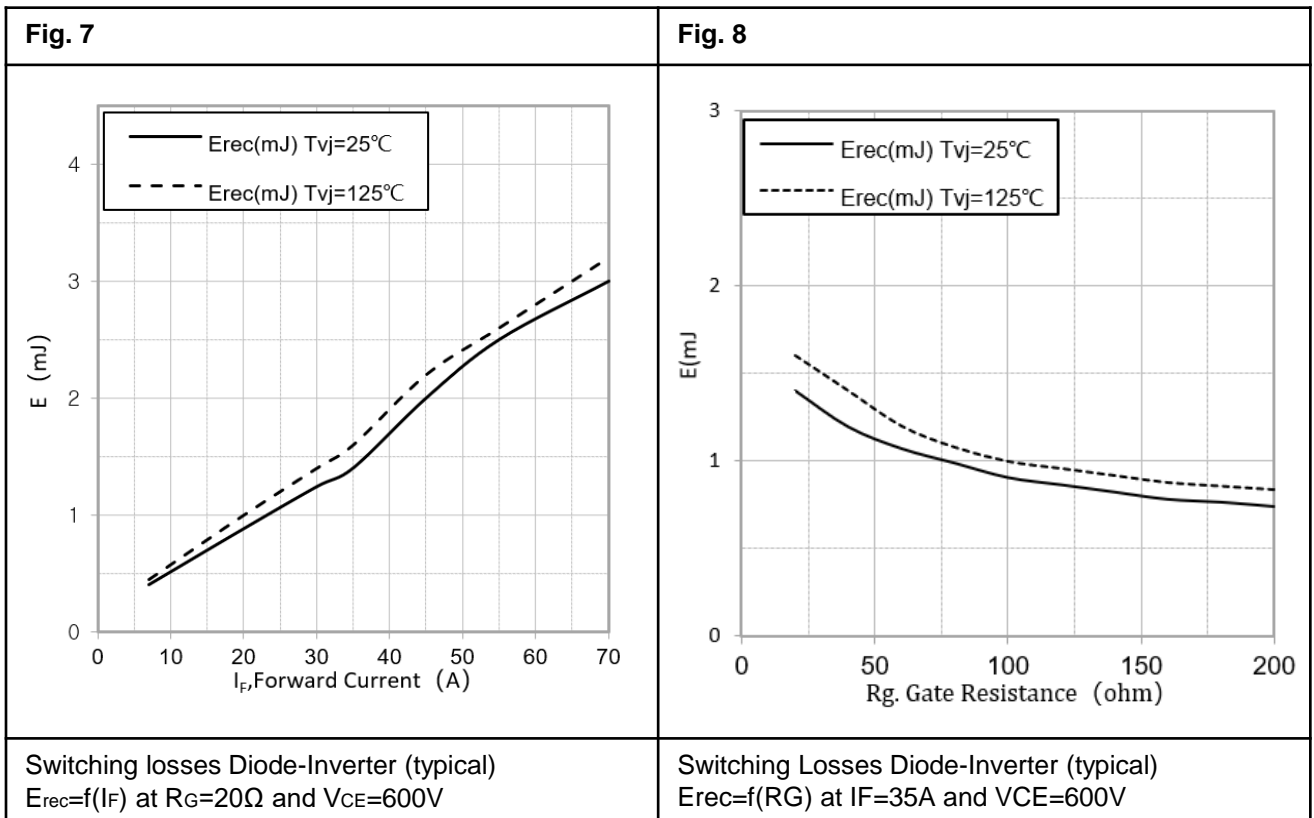
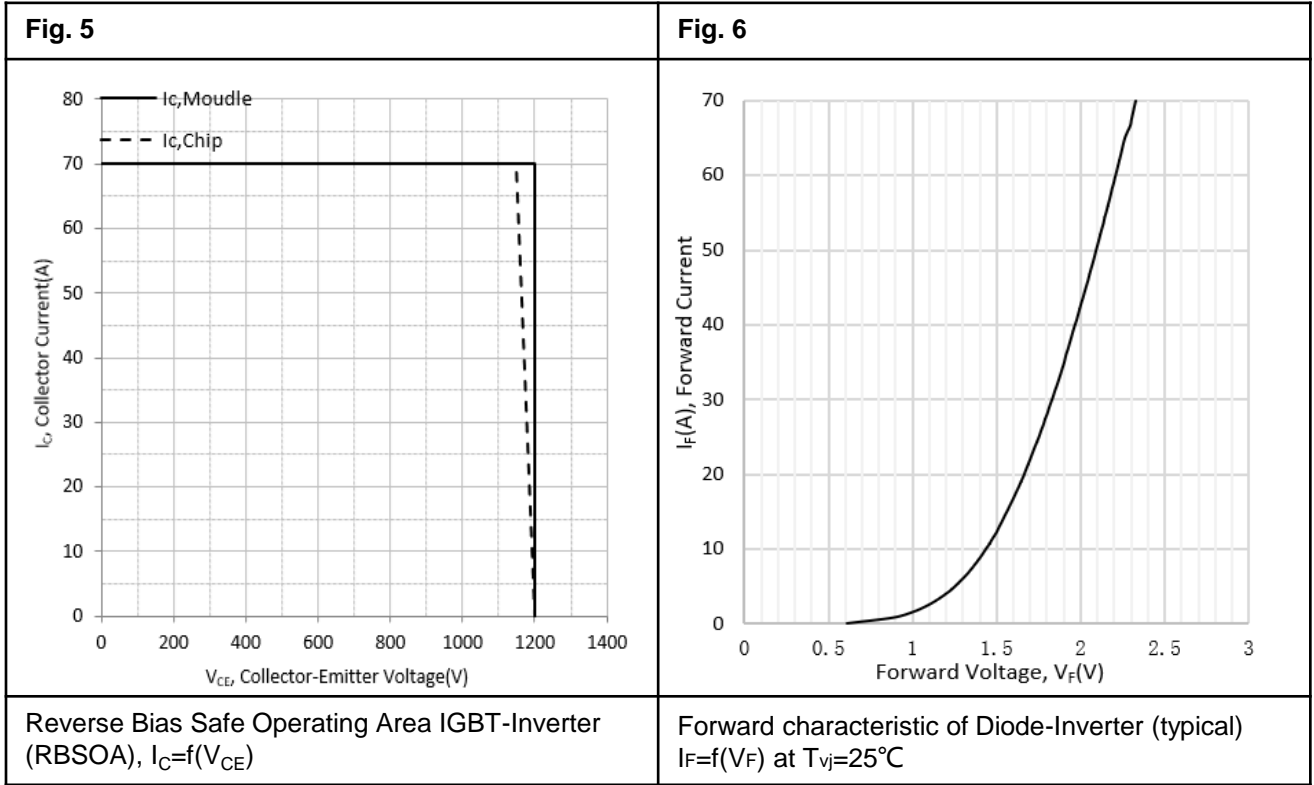
Symbol	Description	Conditions	Values	Unit
$V_{ISOL}$	Isolation Test Voltage	RMS, f=50Hz, t=1min	3	KV
	Internal Isolation	Basic Insulation (Class 1, IEC 61140)	$Al_2O_3$	
	Creepage Distance	Terminal to Heatsink	11.8	mm
		Terminal to Terminal	6	
	Clearance	Terminal to Heatsink	10.2	mm
		Terminal to Terminal	5.1	

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

# Typical Characteristics

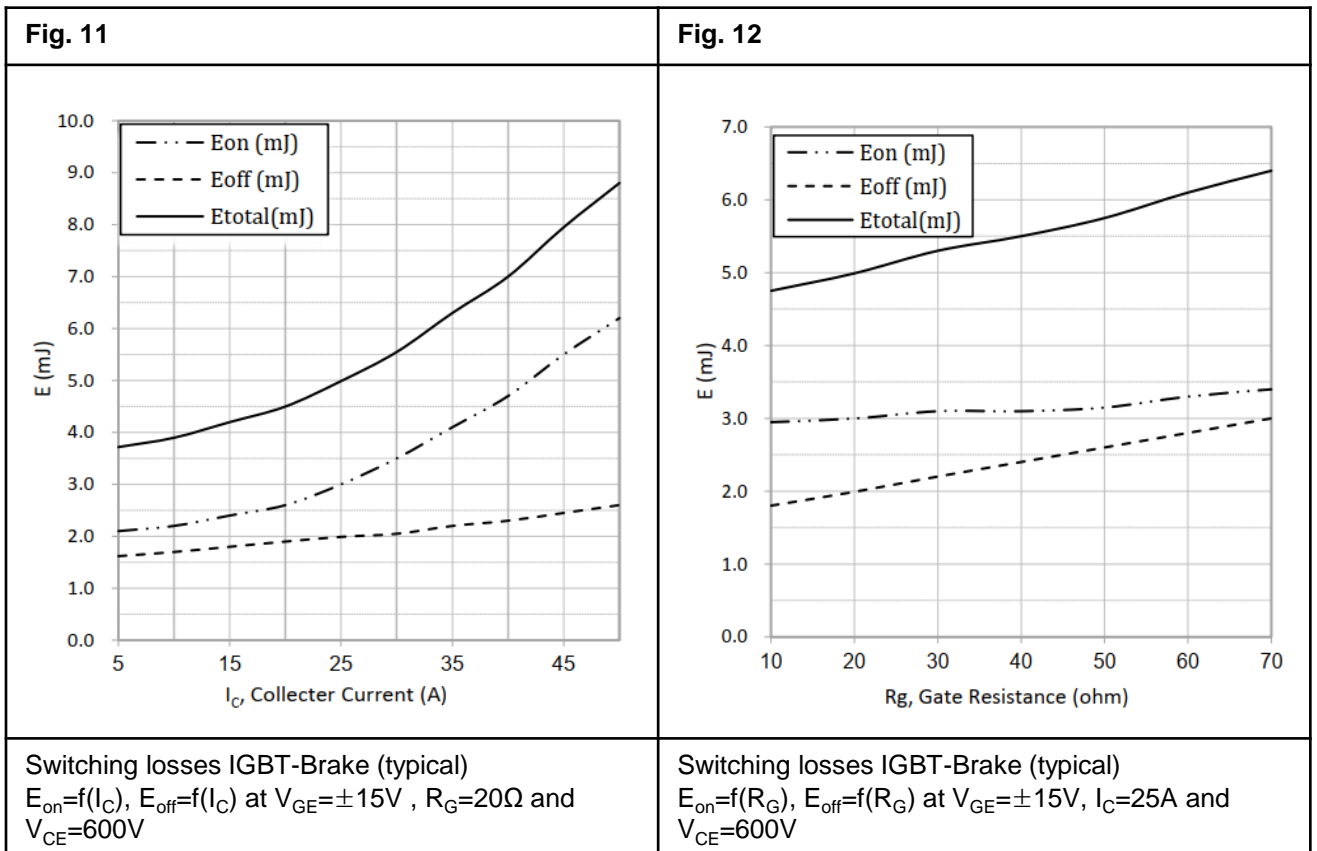
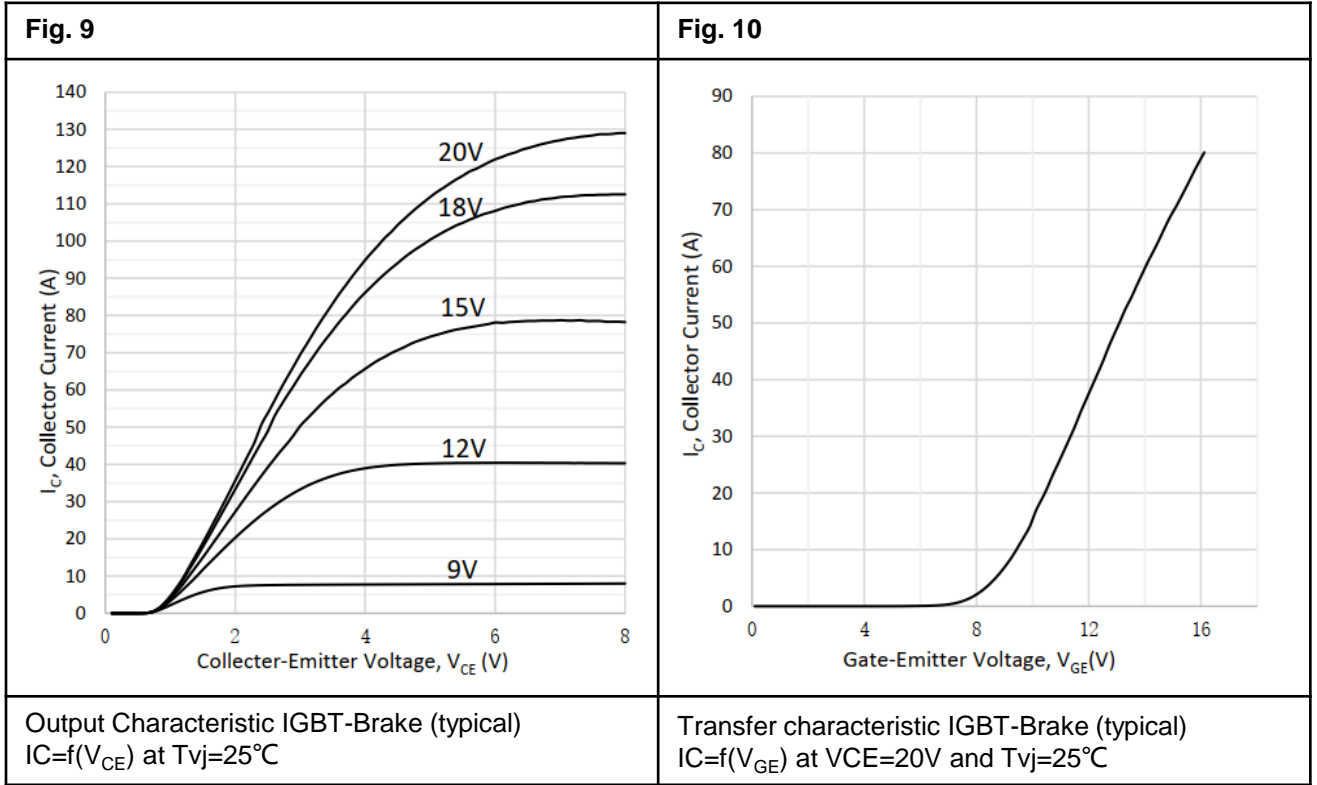


# Typical Characteristics

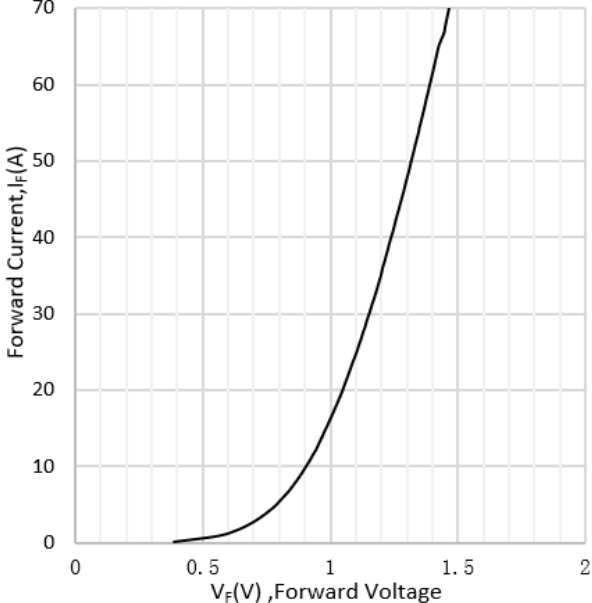
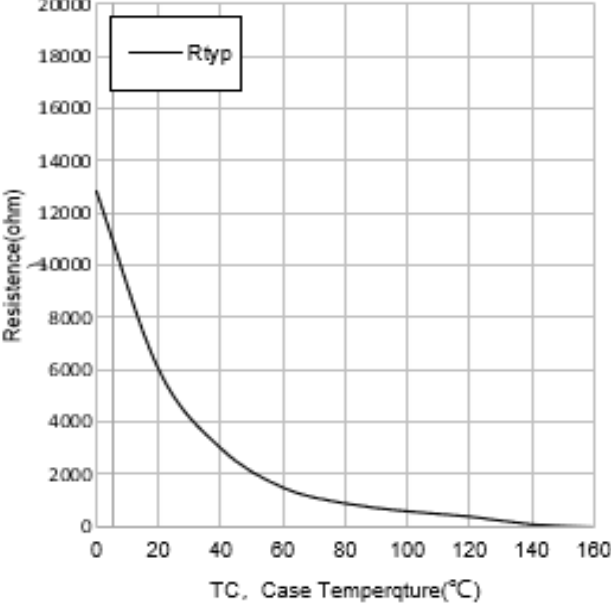




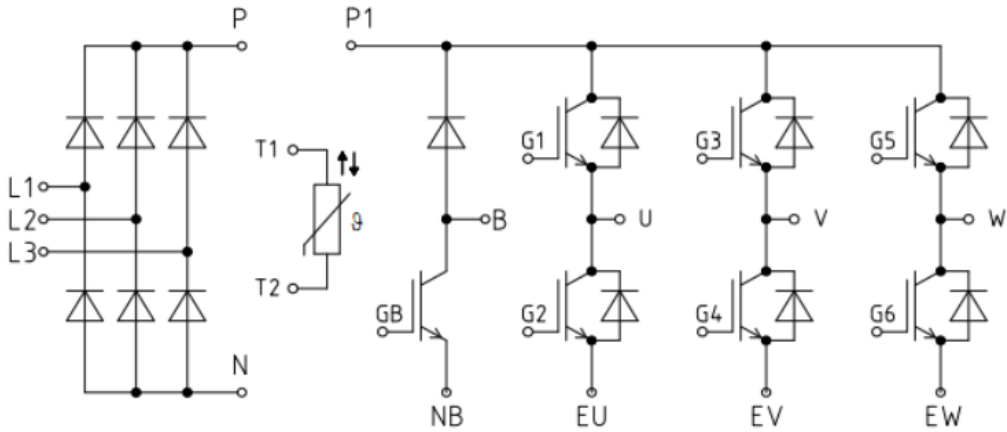
## Typical Characteristics



## Typical Characteristics

<p><b>Fig. 13</b></p>  <p>The graph shows the forward current <math>I_F</math> (A) on the y-axis (0 to 70) versus the forward voltage <math>V_F</math> (V) on the x-axis (0 to 2). The curve shows an exponential relationship, starting near zero at 0.5V and rising sharply to approximately 70A at 1.5V.</p>	<p><b>Fig. 14</b></p>  <p>The graph shows the resistance (ohm) on the y-axis (0 to 20000) versus the case temperature <math>T_C</math> (°C) on the x-axis (0 to 160). The curve, labeled <math>R_{typ}</math>, shows a non-linear decrease in resistance as temperature increases, starting at approximately 13000 ohms at 0°C and reaching near zero at 160°C.</p>
<p>Forward Characteristic of Diode-Rectifier (typical)  <math>I_F=f(V_F)</math> at <math>T_{vj}=25^{\circ}C</math></p>	<p>NTC-Thermistor-Temperature Characteristic (typical), <math>R=f(T)</math></p>

## Circuit Diagram



## Package Outlines (mm)

