

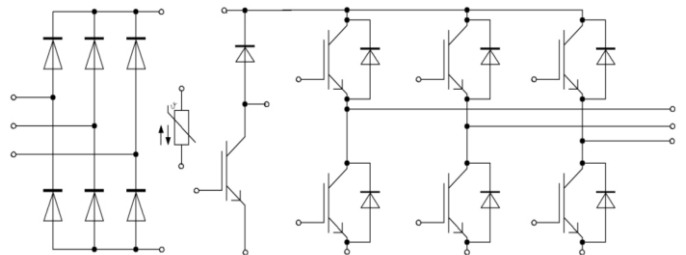
## PIM with Trench Field-Stop IGBT, Emitter Controlled Diode and NTC

### Features

- Low Switching Losses
- 1200V Trench Field-Stop IGBT
- Low  $V_{CE(sat)}$  with Positive Temperature Coefficient

### Typical Applications

- Auxiliary Inverters
- Air Conditioning
- Motor Drives
- Uninterruptive Power Supply (UPS)



### 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 Voltage	$T_{vj}=25^{\circ}C$	$\pm 20$	V
$I_C$	Continuous DC Collector Current	$T_C=25^{\circ}C$	50	A
	Continuous DC Collector Current	$T_C=100^{\circ}C$	25	A
$I_{CRM}$	Repetitive Peak Collector Current	$t_p=1ms$	50	A
$P_{tot}$	Total Power Dissipation	$T_C=25^{\circ}C, T_{vj,max}=175^{\circ}C$	190	W

## Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=25A, T_{vj}=25^{\circ}C$	---	1.90	2.25	V
		$V_{GE}=15V, I_C=25A, T_{vj}=125^{\circ}C$	---	2.40	--	V
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=480\mu A$	5.2	5.8	6.4	V
$I_{CES}$	Collector-Emitter Leakage Current	$V_{CE}=1200V, V_{GE}=0V$	---	---	1	mA
$I_{GES}$	Gate Leakage Current	$V_{GE}=\pm 20V, V_{CE}=0V$	---	---	$\pm 400$	nA
$Q_G$	Total Gate Charge	$V_{CC}=960V, V_{GE}=15V, I_C=25A$	---	117	---	nC
$C_{ies}$	Input Capacitance	$V_{CE}=25V, V_{GE}=0V, f=1MHz$	---	1468	---	pF
$C_{res}$	Reverse Transfer Capacitance		---	82	---	pF
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600V$ $V_{GE}=\pm 15V$ $I_C=25A$ $R_G=20\Omega$ Inductive Load $T_{vj}=25^{\circ}C$	---	20	---	ns
$t_r$	Turn-on Rise Time		---	20	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	136	---	ns
$t_f$	Turn-off Fall Time		---	300	---	ns
$E_{on}$	Turn-on Switching Loss		---	5.61	---	mJ
$E_{off}$	Turn-off Switching Loss		---	1.70	---	mJ
$t_{d(on)}$	Turn-on Delay Time		---	12	---	ns
$t_r$	Turn-on Rise Time		---	24	---	ns
$t_{d(off)}$	Turn-off Delay Time		---	192	---	ns
$t_f$	Turn-off Fall Time		---	436	---	ns
$E_{on}$	Turn-on Switching Loss	---	7.88	---	mJ	
$E_{off}$	Turn-off Switching Loss	---	2.53	---	mJ	
$I_{SC}$	SC data	$V_{GE}\leq 15V, V_{CC}=600V$ $t_p\leq 10\mu s, T_{vj}=25^{\circ}C$	---	62	---	A
$R_{thJC}$	Thermal Resistance, Junction to Case	per IGBT	---	0.8	0.9	K/W
$R_{thCH}$	Thermal Resistance, Case to Heatsink	per IGBT $\lambda_{Paste}=1W/(m\cdot k), \lambda_{Grease}=1W/(m\cdot k)$	---	0.8	---	K/W
$T_{VJ OP}$	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
$I_F$	Gate-Emitter Voltage		25	A
$I_{FRM}$	Repetitive Peak Collector Current	$t_p=1ms$	50	A

## Characteristic Values

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
V <sub>F</sub>	Forward Voltage	I <sub>F</sub> =25A, V <sub>GE</sub> =0V, T <sub>vj</sub> =25°C	---	2.0	2.4	V
		I <sub>F</sub> =25A, V <sub>GE</sub> =0V, T <sub>vj</sub> =125°C	---	1.6	---	V
I <sub>RM</sub>	Peak Reverse Recovery Current	I <sub>F</sub> =25A, di/dt=250A/us V <sub>R</sub> =600V, V <sub>GE</sub> =-15V T <sub>vj</sub> =25°C	---	46	---	A
Q <sub>r</sub>	Recovered Charge		---	1.33	---	uC
E <sub>rec</sub>	Reverse Recovery Energy		---	0.17	---	mJ
I <sub>RM</sub>	Peak Reverse Recovery Current	I <sub>F</sub> =25A, di/dt=250A/us V <sub>R</sub> =600V, V <sub>GE</sub> =-15V T <sub>vj</sub> =125°C	---	56	---	A
Q <sub>r</sub>	Recovered Charge		---	2.21	---	uC
E <sub>rec</sub>	Reverse Recovery Energy		---	0.30	---	mJ
R <sub>thJC</sub>	Thermal Resistance, Junction to Case	per Diode	---	0.90	1.05	K/W
R <sub>thCH</sub>	Thermal Resistance, Case to Heatsink	per IGBT λ <sub>Paste</sub> =1W/(m·k), λ <sub>Grease</sub> =1W/(m·k)	---	0.82	---	K/W
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(AV)</sub>	Average Output Current	T <sub>vj</sub> =25°C	25	A
I <sub>FSM</sub>	Surge Forward Current	t <sub>p</sub> =10ms, sin180°, T <sub>j</sub> =25°C	300	A
I <sup>2</sup> t	I <sup>2</sup> t Value	t <sub>p</sub> =10ms, sin180°, T <sub>j</sub> =25°C	450	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> =25A, V <sub>GE</sub> =0V, T <sub>vj</sub> =25°C	---	1.0	1.2	V
I <sub>R</sub>	Recovery Current	V <sub>R</sub> =1600V	---	---	1	mA
R <sub>thJC</sub>	Thermal Resistance, Junction to Case	per Diode	---	1.1	1.2	K/W
R <sub>thCH</sub>	Thermal Resistance, Case to Heatsink	per Diode λ <sub>Paste</sub> =1W/(m·k), λ <sub>Grease</sub> =1W/(m·k)	---	1	---	K/W
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 Voltage	$T_{vj}=25^{\circ}\text{C}$	$\pm 20$	V
$I_C$	Continuous DC Collector Current	$T_C=25^{\circ}\text{C}$	50	A
	Continuous DC Collector Current	$T_C=100^{\circ}\text{C}$	25	A
$I_{CRM}$	Repetitive Peak Collector Current	$t_p=1\text{ms}$	50	A
$P_{tot}$	Total Power Dissipation	$T_C=25^{\circ}\text{C}, T_{vj\text{max}}=175^{\circ}\text{C}$	190	W

## Characteristic Values

Symbol	Description	Conditions	Values			Unit	
			Min.	Typ.	Max.		
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15\text{V}, I_C=25\text{A}, T_{vj}=25^{\circ}\text{C}$	---	1.90	2.25	V	
		$V_{GE}=15\text{V}, I_C=25\text{A}, T_{vj}=125^{\circ}\text{C}$	---	2.40	--	V	
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=480\mu\text{A}$	5.2	5.8	6.4	V	
$I_{CES}$	Collector-Emitter Leakage Current	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}$	---	---	1	mA	
$I_{GES}$	Gate Leakage Current	$V_{GE}=\pm 20\text{V}, V_{CE}=0\text{V}$	---	---	$\pm 400$	nA	
$Q_G$	Total Gate Charge	$V_{CC}=960\text{V}, V_{GE}=15\text{V}, I_C=25\text{A}$	---	117	---	nC	
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$	---	1468	---	pF	
$C_{res}$	Reverse Transfer Capacitance		---	82	---	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 $T_{vj}=25^{\circ}\text{C}$	---	20	---	ns	
$t_r$	Turn-on Rise Time		---	20	---	ns	
$t_{d(off)}$	Turn-off Delay Time		---	136	---	ns	
$t_f$	Turn-off Fall Time		---	300	---	ns	
$E_{on}$	Turn-on Switching Loss		---	5.61	---	mJ	
$E_{off}$	Turn-off Switching Loss		---	1.70	---	mJ	
$t_{d(on)}$	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 $T_{vj}=125^{\circ}\text{C}$	---	12	---	ns
$t_r$	Turn-on Rise Time			---	24	---	ns
$t_{d(off)}$	Turn-off Delay Time	---		192	---	ns	
$t_f$	Turn-off Fall Time	---		436	---	ns	
$E_{on}$	Turn-on Switching Loss	---		7.88	---	mJ	
$E_{off}$	Turn-off Switching Loss	---		2.53	---	mJ	
$I_{SC}$	SC data	$V_{GE}\leq 15\text{V}, V_{CC}=600\text{V}$ $t_p\leq 10\mu\text{s}, T_{vj}=25^{\circ}\text{C}$		---	62	---	A
$R_{thJC}$	Thermal Resistance, Junction to Case	per IGBT		---	0.8	0.9	K/W
$R_{thCH}$	Thermal Resistance, Case to Heatsink	per IGBT $\lambda_{Paste}=1\text{W}/(\text{m}\cdot\text{k}), \lambda_{Grease}=1\text{W}/(\text{m}\cdot\text{k})$	---	0.8	---	K/W	
$T_{VJ\text{OP}}$	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
$I_F$	Gate-Emitter Voltage		15	A
$I_{FRM}$	Repetitive Peak Collector Current	$t_p=1\text{ms}$	30	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	2.4	V
		$I_F=15\text{A}, V_{GE}=0\text{V}, T_{vj}=125^{\circ}\text{C}$	---	1.6	---	V
$I_{RM}$	Peak Reverse Recovery Current	$I_F=15\text{A}, di/dt=200\text{A/us}$ $V_R=600\text{V}, V_{GE}=-15\text{V}$ $T_{vj}=25^{\circ}\text{C}$	---	22.62	---	A
$Q_r$	Recovered Charge		---	0.76	---	$\mu\text{C}$
$E_{rec}$	Reverse Recovery Energy		---	0.30	---	mJ
$I_{RM}$	Peak Reverse Recovery Current	$I_F=15\text{A}, di/dt=200\text{A/us}$ $V_R=600\text{V}, V_{GE}=-15\text{V}$ $T_{vj}=125^{\circ}\text{C}$	---	22.96	---	A
$Q_r$	Recovered Charge		---	0.85	---	$\mu\text{C}$
$E_{rec}$	Reverse Recovery Energy		---	0.35	---	mJ
$R_{thJC}$	Thermal Resistance, Junction to Case	per Diode	---	1.68	1.80	K/W
$R_{thCH}$	Thermal Resistance, Case to Heatsink	per IGBT $\lambda_{Paste}=1\text{W}/(\text{m}\cdot\text{k}), \lambda_{Grease}=1\text{W}/(\text{m}\cdot\text{k})$	---	1.2	---	K/W
$T_{VJ OP}$	Virtual Junction Temperature	under Switching	-40	---	150	$^{\circ}\text{C}$

## NTC-Thermistor Characteristic Values

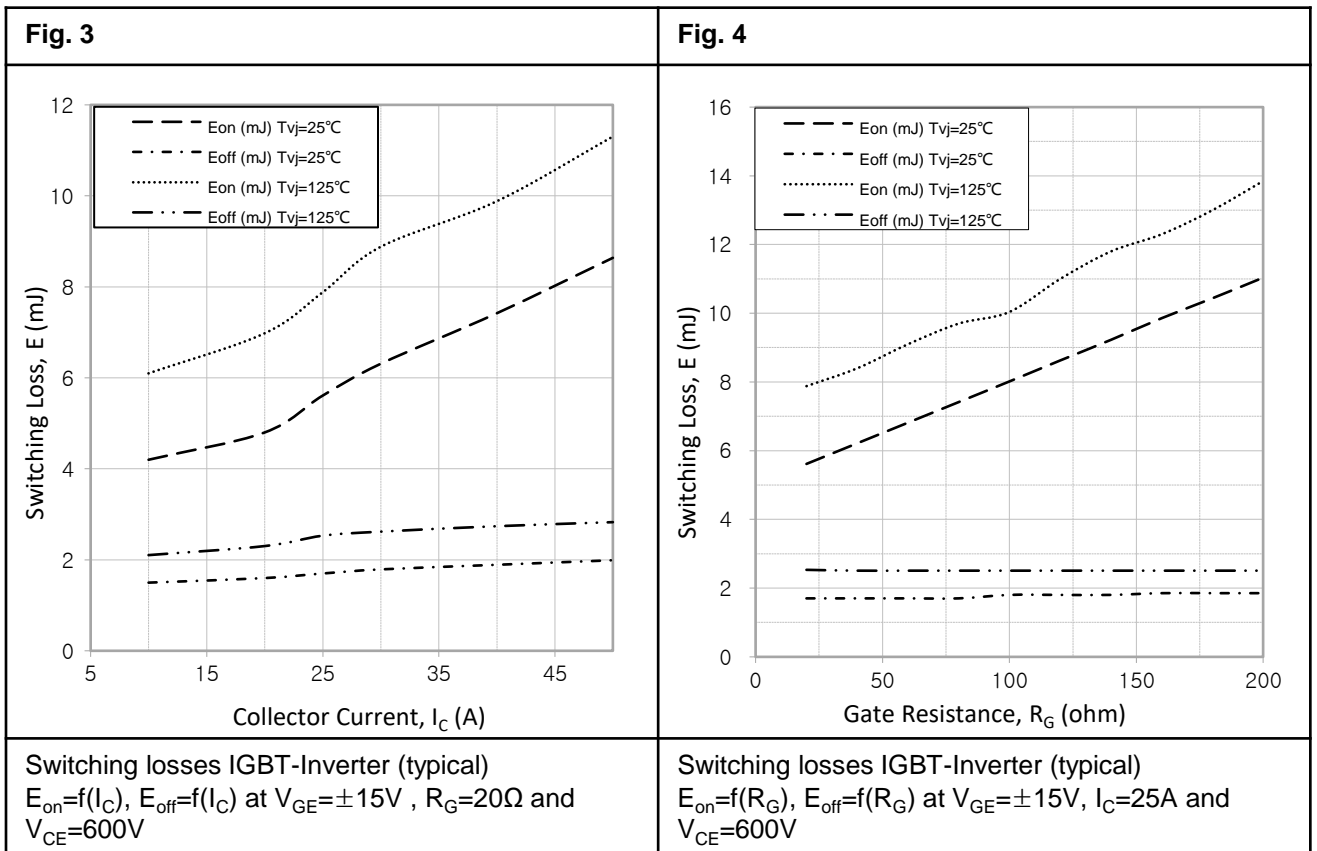
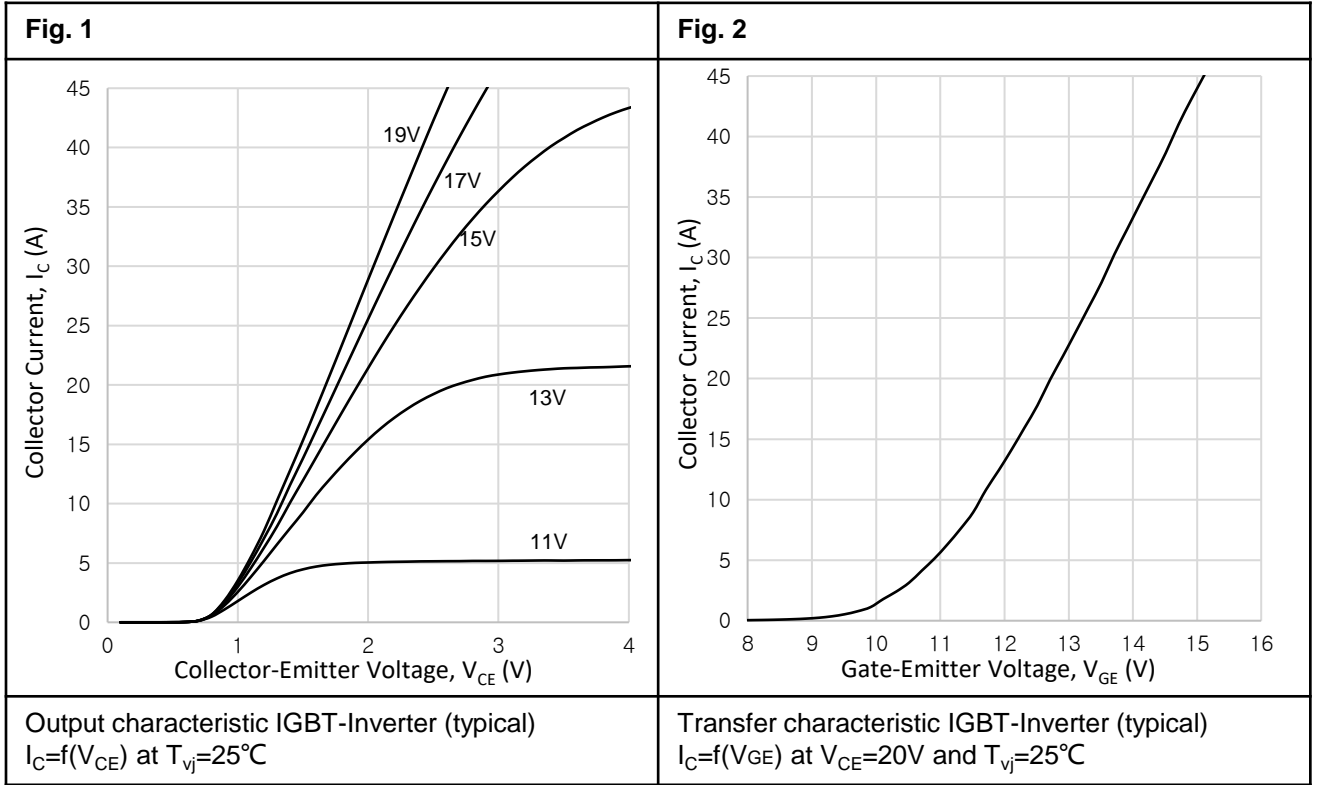
Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$R_{25}$	Rated Resistance	$T_C=25^{\circ}\text{C}$	---	5	---	K $\Omega$
$B_{25/50}$	B Value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298 \text{ K}))]$	---	3380	---	K

## Module

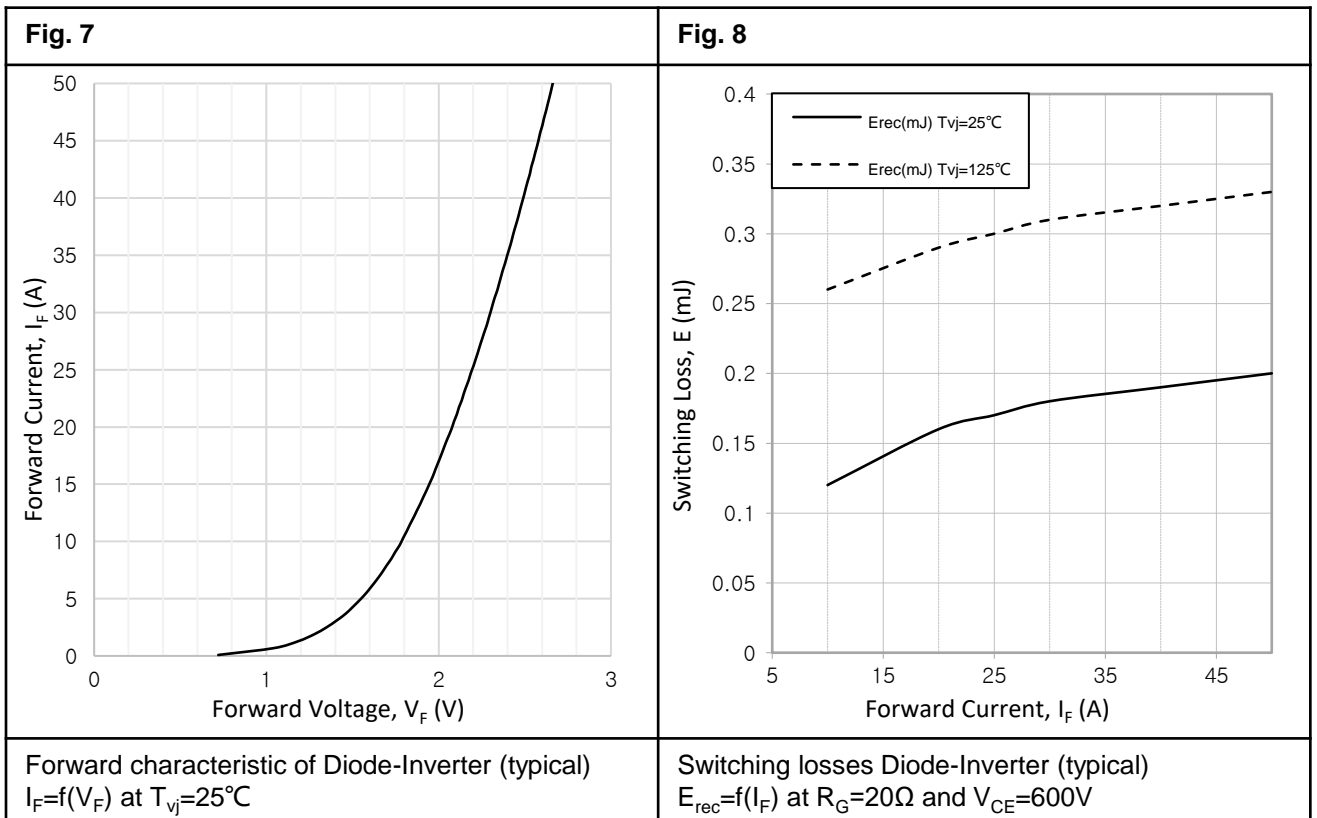
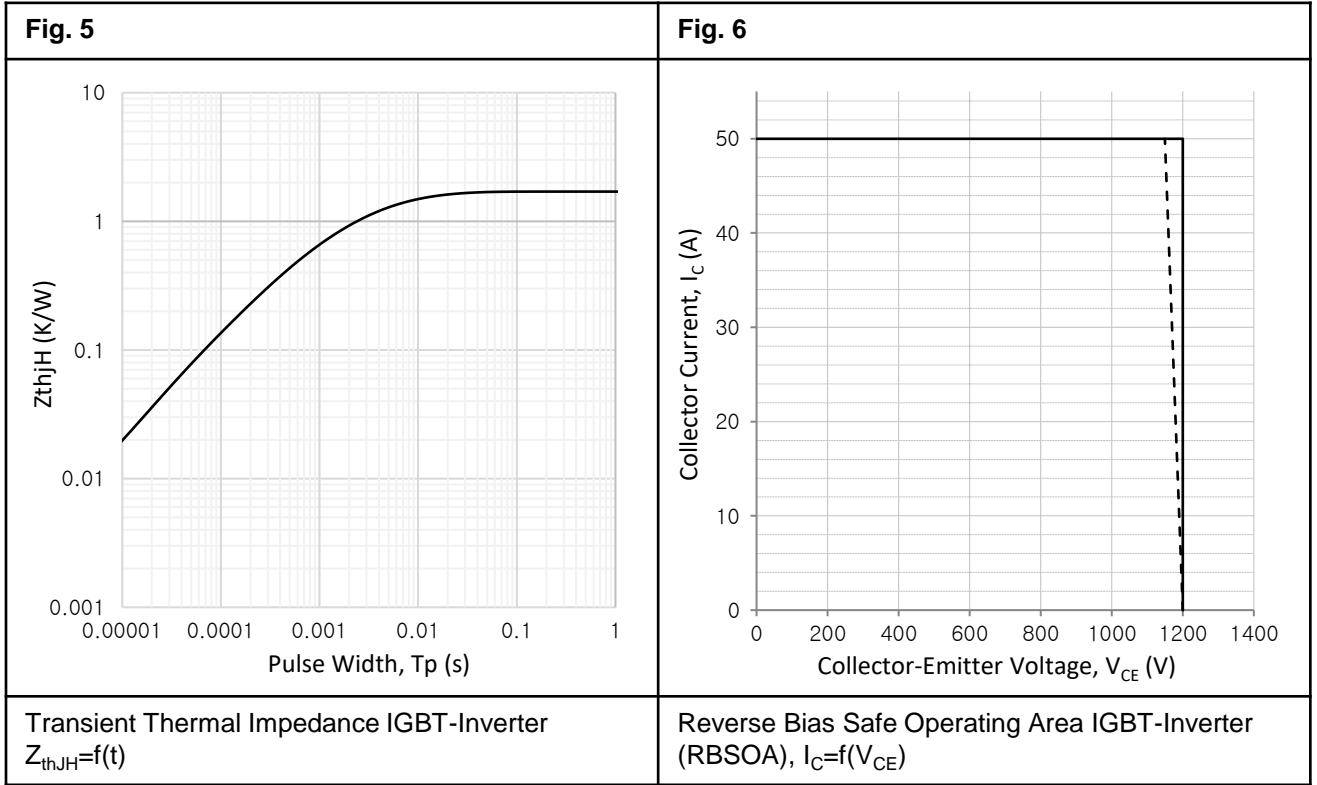
Symbol	Description	Conditions	Values	Unit
$V_{ISOL}$	Isolation Test Voltage	RMS, f=50Hz, t=1min	2.5	KV
	Internal Isolation	Basic Insulation (Class 1, IEC 61140)	$Al_2O_3$	
	Creepage Distance	Terminal to Heatsink Terminal to Terminal	11.5 6.3	mm
	Clearance	Terminal to Heatsink Terminal to Terminal	10 5	mm
CTI	Comparative Tracking Index		> 200	

Symbol	Description	Conditions	Values			Unit
			Min.	Typ.	Max.	
$L_{SCE}$	Stray Inductance Module		---	30	---	nH
$R_{CC'+EE'}$ $R_{AA'+CC'}$	Module Lead Resistance, Terminals – Chip	$T_C=25^\circ C$ , per Switch	---	5 6	---	m $\Omega$
$T_{stg}$	Storage Temperature		-40	---	125	$^\circ C$
F	Mounting Force per Clamp		40	---	80	N
G	Weight		---	39	---	g

## Typical Characteristics

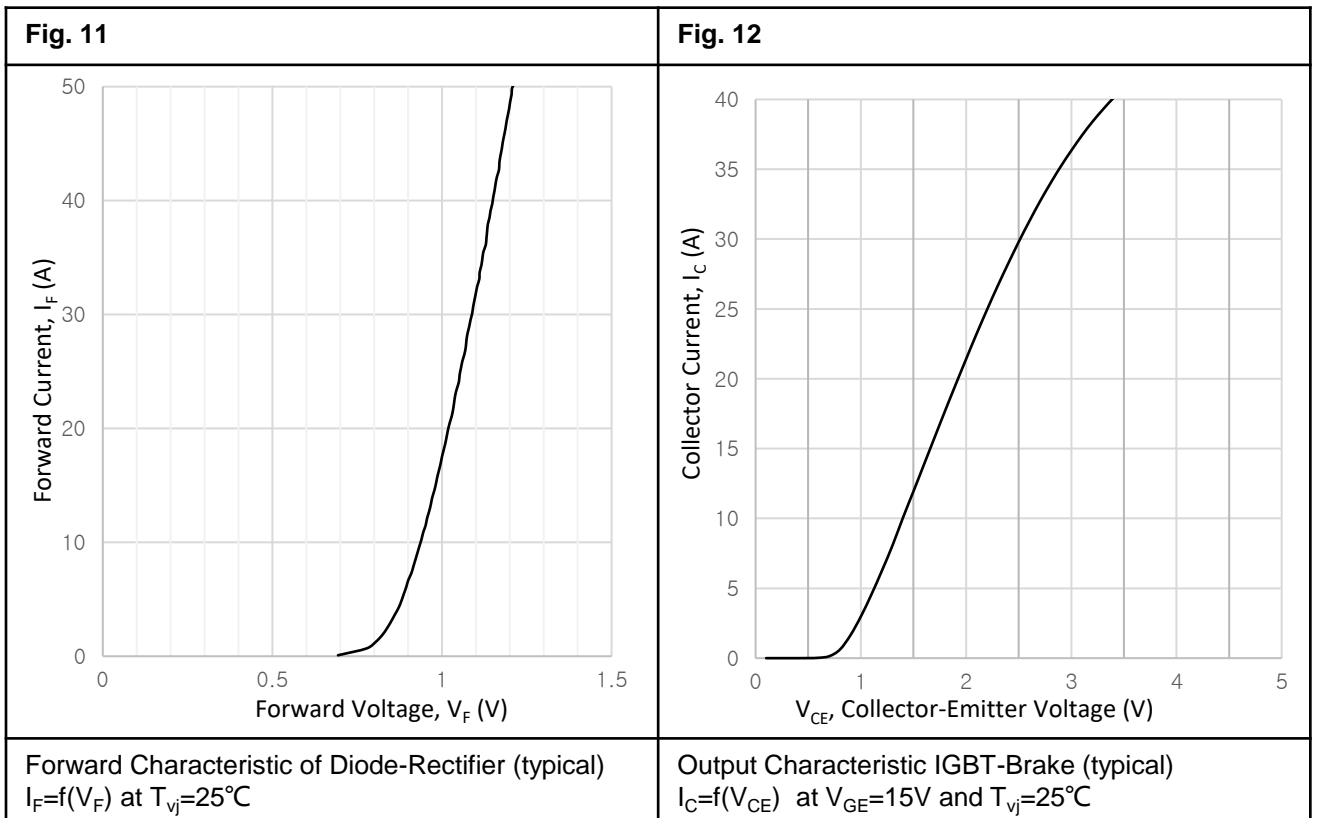
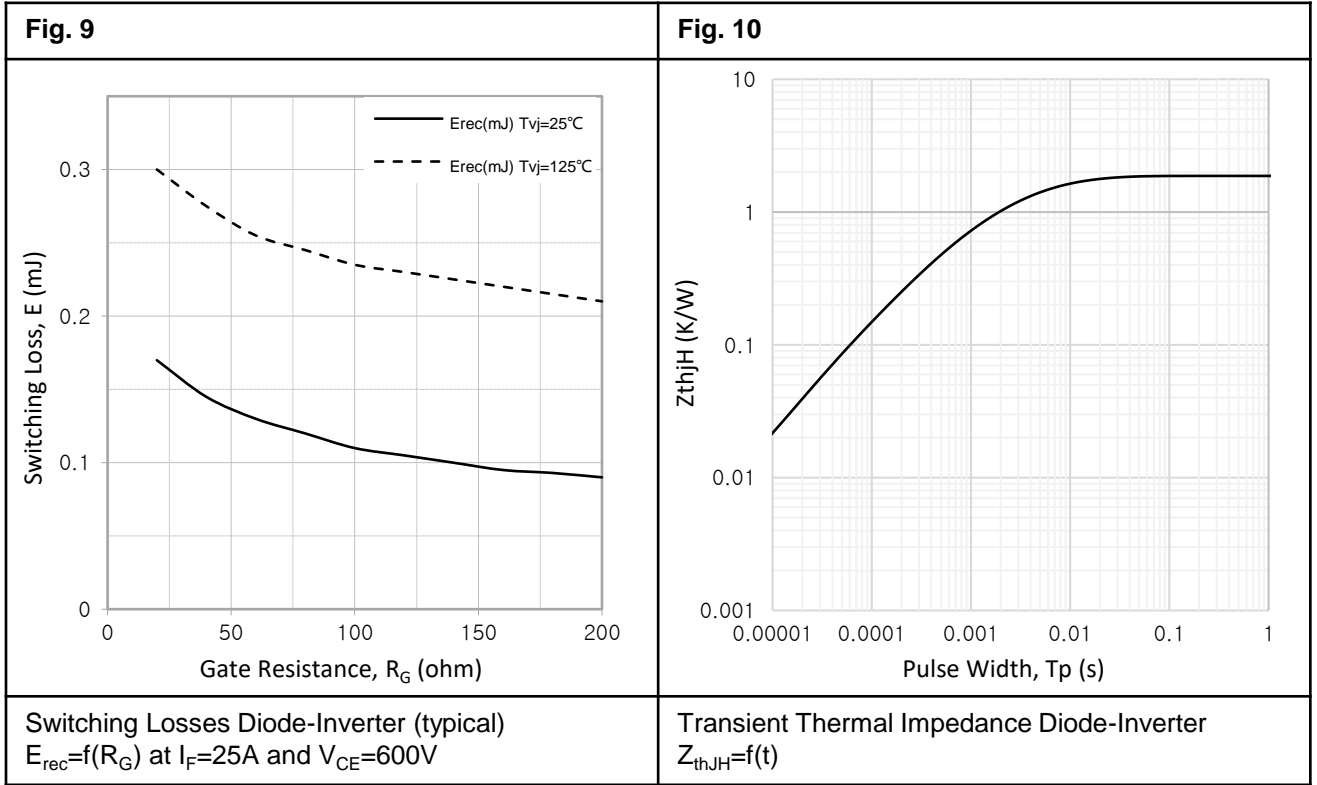


## Typical Characteristics

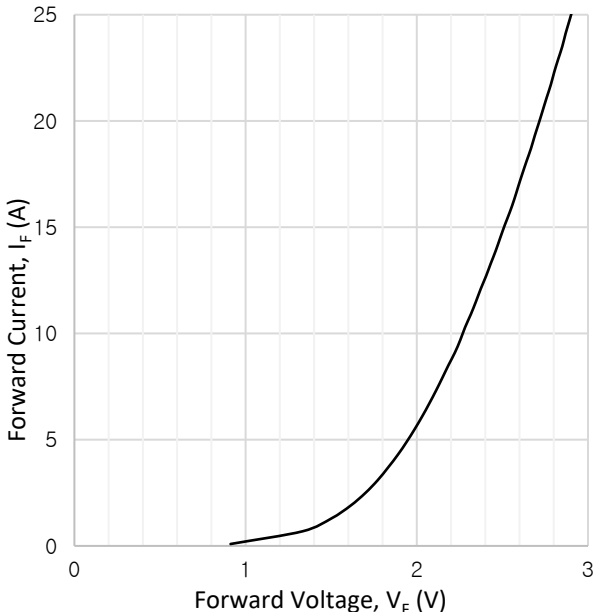
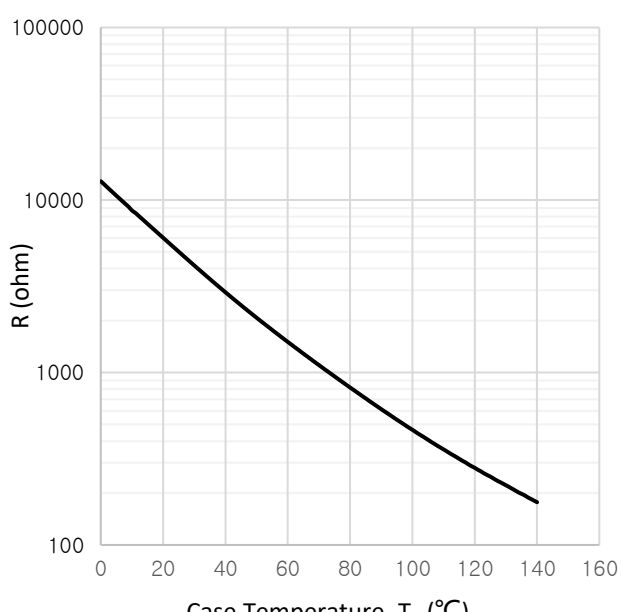




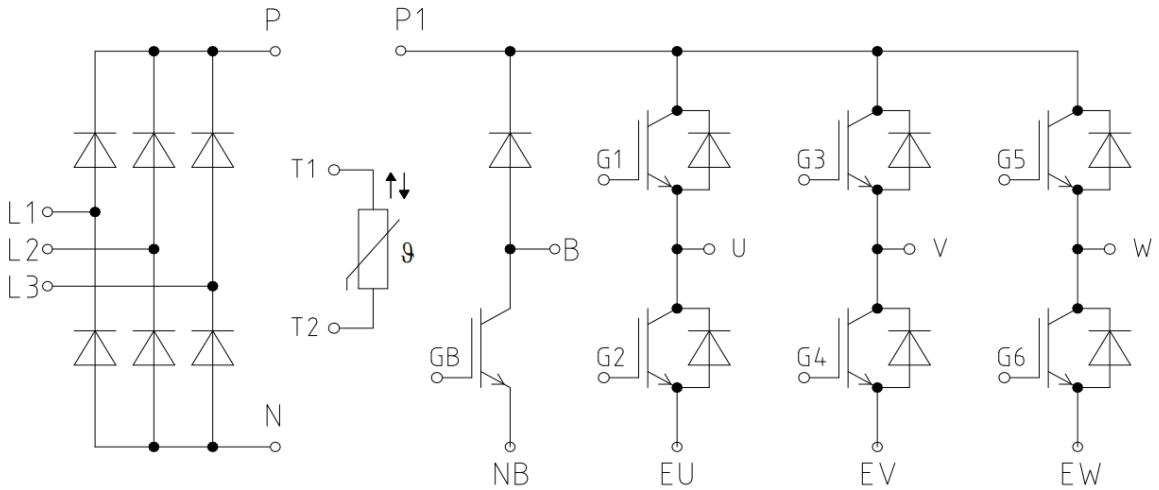
## Typical Characteristics



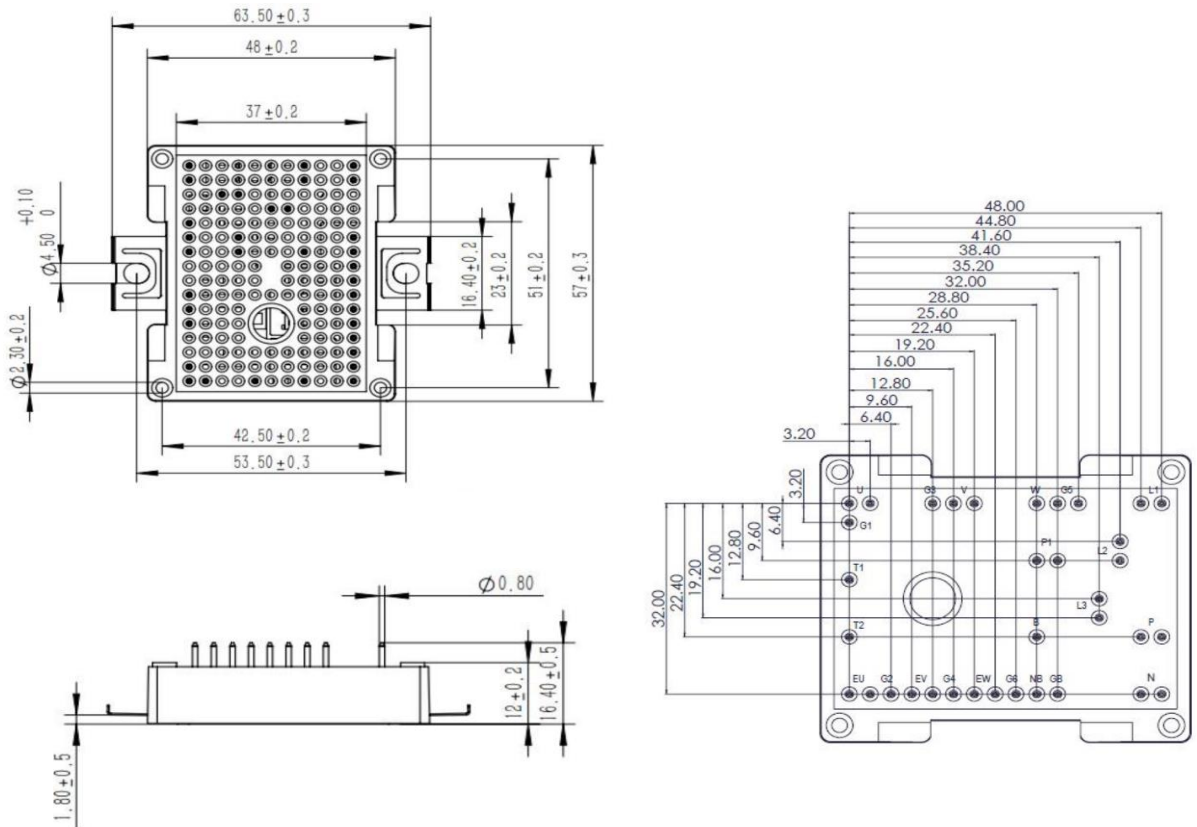
## Typical Characteristics

<p><b>Fig. 13</b></p>  <p>Forward Current, <math>I_F</math> (A)</p> <p>Forward Voltage, <math>V_F</math> (V)</p>	<p><b>Fig. 14</b></p>  <p>R (ohm)</p> <p>Case Temperature, <math>T_c</math> (°C)</p>
<p>Forward characteristic of Diode-Brake (typical)  <math>I_F=f(V_F)</math> at <math>T_{vj}=25^\circ\text{C}</math></p>	<p>NTC-Thermistor-Temperature Characteristic          (typical), <math>R=f(T)</math></p>

## Circuit Diagram



## Package Outlines (mm)



## Revision History

Ver.	Date	Change Notice
1.0	2020/11/10	Released