

STARPOWER

SEMICONDUCTOR

IGBT

GD25PIT120C5S

Molding Type Module**1200V/25A PIM in one-package**

General Description

STARPOWER IGBT Power Module provides ultra low conduction loss as well as short circuit ruggedness. They are designed for the applications such as general inverters and UPS.



Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 10 μ s short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175 °C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology

Typical Applications

- Inverter for motor drive
- AC and DC servo drive amplifier
- Uninterruptible power supply

IGBT-inverter $T_C=25^\circ\text{C}$ unless otherwise noted**Maximum Rated Values**

Symbol	Description	GD25PIT120C5S	Units
V_{CES}	Collector-Emitter Voltage @ $T_j=25^\circ\text{C}$	1200	V
V_{GES}	Gate-Emitter Voltage @ $T_j=25^\circ\text{C}$	± 30	V
I_C	Collector Current @ $T_C=25^\circ\text{C}$ @ $T_C=100^\circ\text{C}$	50 25	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	50	A
P_{tot}	Total Power Dissipation @ $T_j=175^\circ\text{C}$	212	W

Off Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$T_j=25^\circ\text{C}$	1200			V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V},$ $T_j=25^\circ\text{C}$			5.0	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V},$ $T_j=25^\circ\text{C}$			400	nA

On Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.2\text{mA}, V_{CE}=V_{GE},$ $T_j=25^\circ\text{C}$	5.0	5.5	7.5	V
$V_{CE(sat)}$ (chip)	Collector to Emitter Saturation Voltage	$I_C=25\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		1.90	2.35	V
		$I_C=25\text{A}, V_{GE}=15\text{V},$ $T_j=125^\circ\text{C}$		2.30		
		$I_C=25\text{A}, V_{GE}=15\text{V},$ $T_j=150^\circ\text{C}$		2.40		
$V_{CE(sat)}$ (terminal)	Collector to Emitter Saturation Voltage	$I_C=25\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		2.10	2.55	V

Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600V, I_C=25A,$ $R_G=33\Omega, V_{GE}=\pm 15V,$ $T_j=25^\circ C$		233		ns
t_r	Rise Time			66		ns
$t_{d(off)}$	Turn-Off Delay Time			184		ns
t_f	Fall Time			208		ns
E_{on}	Turn-On Switching Loss			3.06		mJ
E_{off}	Turn-Off Switching Loss			1.16		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600V, I_C=25A,$ $R_G=33\Omega, V_{GE}=\pm 15V,$ $T_j=125^\circ C$		310		ns
t_r	Rise Time			86		ns
$t_{d(off)}$	Turn-Off Delay Time			217		ns
t_f	Fall Time			324		ns
E_{on}	Turn-On Switching Loss			3.50		mJ
E_{off}	Turn-Off Switching Loss			1.78		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600V, I_C=25A,$ $R_G=33\Omega, V_{GE}=\pm 15V,$ $T_j=150^\circ C$		221		ns
t_r	Rise Time			68		ns
$t_{d(off)}$	Turn-Off Delay Time			225		ns
t_f	Fall Time			347		ns
E_{on}	Turn-On Switching Loss			4.45		mJ
E_{off}	Turn-Off Switching Loss			2.02		mJ
C_{ies}	Input Capacitance	$V_{CE}=30V, f=1Mhz,$ $V_{GE}=0V$		3.43		nF
C_{oes}	Output Capacitance			0.13		nF
C_{res}	Reverse Transfer Capacitance			0.08		nF
Q_G	Gate Charge	$V_{CC}=600V, I_C=25A,$ $V_{GE}=15V$		160		nC
I_{sc}	SC Data	$t_p \leq 10\mu s, V_{GE}=15V,$ $T_j=125^\circ C, V_{CC}=900V,$ $V_{CEM} \leq 1200V$		225		A

Diode-inverter $T_C=25^\circ\text{C}$ unless otherwise noted**Maximum Rated Values**

Symbol	Description	GD25PIT120C5S	Units
V_{RRM}	Repetitive Peak Reverse Voltage @ $T_j=25^\circ\text{C}$	1200	V
I_F	DC Forward Current	25	A
I_{FRM}	Repetitive Peak Forward Current $t_p=1\text{ms}$	50	A

Characteristics Values

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F (chip)	Diode Forward Voltage	$I_F=25\text{A}$, $V_{GE}=0\text{V}$	$T_j=25^\circ\text{C}$	1.78	2.18	V
			$T_j=125^\circ\text{C}$	1.88		
			$T_j=150^\circ\text{C}$	1.91		
V_F (terminal)	Diode Forward Voltage	$I_F=25\text{A}$, $V_{GE}=0\text{V}$	$T_j=25^\circ\text{C}$	2.00	2.45	V
Q_r	Recovered Charge	$I_F=25\text{A}$, $V_R=600\text{V}$, $R_G=33\Omega$, $V_{GE}=-15\text{V}$	$T_j=25^\circ\text{C}$	1.1		μC
			$T_j=125^\circ\text{C}$	3.2		
			$T_j=150^\circ\text{C}$	4.5		
I_{RM}	Peak Reverse Recovery Current	$I_F=25\text{A}$, $V_R=600\text{V}$, $R_G=33\Omega$, $V_{GE}=-15\text{V}$	$T_j=25^\circ\text{C}$	17		A
			$T_j=125^\circ\text{C}$	21		
			$T_j=150^\circ\text{C}$	28		
E_{rec}	Reverse Recovery Energy	$I_F=25\text{A}$, $V_R=600\text{V}$, $R_G=33\Omega$, $V_{GE}=-15\text{V}$	$T_j=25^\circ\text{C}$	0.80		mJ
			$T_j=125^\circ\text{C}$	1.38		
			$T_j=150^\circ\text{C}$	1.96		

Diode-rectifier $T_C=25^\circ\text{C}$ unless otherwise noted**Maximum Rated Values**

Symbol	Description	GD25PIT120C5S	Units
V_{RRM}	Repetitive Peak Reverse Voltage @ $T_j=25^\circ\text{C}$	1600	V
$I_{F(AV)}$	Average On-state Current @ $T_C=100^\circ\text{C}$	31	A
I_{RMSM}	Maximum RMS Current At Rectifier Output @ $T_C=80^\circ\text{C}$	60	A
I_{FSM}	Surge Forward Current $V_R=0\text{V}$, $t_p=10\text{ms}$, $T_j=45^\circ\text{C}$	320	A
I^2t	I^2t -value, $V_R=0\text{V}$, $t_p=10\text{ms}$, $T_j=45^\circ\text{C}$	510	A^2s

Characteristics Values

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F (chip)	Diode Forward Voltage	$I_F=25\text{A}$ $T_j=150^\circ\text{C}$		1.05		V
V_F (terminal)	Diode Forward Voltage	$I_F=25\text{A}$ $T_j=25^\circ\text{C}$		1.30	1.75	V
I_R	Reverse Current	$T_j=150^\circ\text{C}$, $V_R=1600\text{V}$			2.0	mA

IGBT-brake-chopper $T_C=25^\circ\text{C}$ unless otherwise noted**Maximum Rated Values**

Symbol	Description	GD25PIT120C5S	Units
V_{CES}	Collector-Emitter Voltage @ $T_j=25^\circ\text{C}$	1200	V
V_{GES}	Gate-Emitter Voltage @ $T_j=25^\circ\text{C}$	± 20	V
I_C	Collector Current @ $T_C=25^\circ\text{C}$ @ $T_C=100^\circ\text{C}$	30 15	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	30	A
P_{tot}	Total Power Dissipation @ $T_j=175^\circ\text{C}$	152	W

Off Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	$T_j=25^\circ\text{C}$	1200			V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V},$ $T_j=25^\circ\text{C}$			5.0	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V},$ $T_j=25^\circ\text{C}$			400	nA

On Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=600\mu\text{A}, V_{CE}=V_{GE},$ $T_j=25^\circ\text{C}$	5.0	5.8	6.5	V
$V_{CE(sat)}$ (chip)	Collector to Emitter Saturation Voltage	$I_C=15\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		1.70	2.15	V
		$I_C=15\text{A}, V_{GE}=15\text{V},$ $T_j=125^\circ\text{C}$		2.00		
		$I_C=15\text{A}, V_{GE}=15\text{V},$ $T_j=150^\circ\text{C}$		2.10		
$V_{CE(sat)}$ (terminal)	Collector to Emitter Saturation Voltage	$I_C=15\text{A}, V_{GE}=15\text{V},$ $T_j=25^\circ\text{C}$		2.10	2.55	V

Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600V, I_C=15A,$ $R_G=75\Omega, V_{GE}=\pm 15V,$ $T_j=25^\circ C$		84		ns
t_r	Rise Time			31		ns
$t_{d(off)}$	Turn-Off Delay Time			420		ns
t_f	Fall Time			65		ns
E_{on}	Turn-On Switching Loss			1.51		mJ
E_{off}	Turn-Off Switching Loss			1.27		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600V, I_C=15A,$ $R_G=75\Omega, V_{GE}=\pm 15V,$ $T_j=125^\circ C$		91		ns
t_r	Rise Time			45		ns
$t_{d(off)}$	Turn-Off Delay Time			522		ns
t_f	Fall Time			90		ns
E_{on}	Turn-On Switching Loss			2.12		mJ
E_{off}	Turn-Off Switching Loss			1.48		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600V, I_C=15A,$ $R_G=75\Omega, V_{GE}=\pm 15V,$ $T_j=150^\circ C$		91		ns
t_r	Rise Time			46		ns
$t_{d(off)}$	Turn-Off Delay Time			550		ns
t_f	Fall Time			110		ns
E_{on}	Turn-On Switching Loss			2.43		mJ
E_{off}	Turn-Off Switching Loss			1.64		mJ
C_{ies}	Input Capacitance	$V_{CE}=25V, f=1Mhz,$ $V_{GE}=0V$		1.10		nF
C_{oes}	Output Capacitance			0.06		nF
C_{res}	Reverse Transfer Capacitance			0.05		nF
Q_G	Gate Charge	$V_{CC}=600V, I_C=15A,$ $V_{GE}=-15 \dots +15V$		150		nC
I_{SC}	SC Data	$t_p \leq 10\mu s, V_{GE}=15V,$ $T_j=150^\circ C, V_{CC}=900V,$ $V_{CEM} \leq 1200V$		60		A

Diode-brake-chopper $T_C=25^\circ\text{C}$ unless otherwise noted**Maximum Rated Values**

Symbol	Description	GD25PIT120C5S	Units
V_{RRM}	Repetitive Peak Reverse Voltage @ $T_j=25^\circ\text{C}$	1200	V
I_F	DC Forward Current	15	A
I_{FRM}	Repetitive Peak Forward Current $t_p=1\text{ms}$	30	A

Characteristics Values

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F (chip)	Diode Forward Voltage	$I_F=15\text{A}, V_{GE}=0\text{V}$	$T_j=25^\circ\text{C}$	2.05	2.50	V
			$T_j=125^\circ\text{C}$	2.20		
			$T_j=150^\circ\text{C}$	2.24		
V_F (terminal)	Diode Forward Voltage	$I_F=15\text{A}, V_{GE}=0\text{V}$	$T_j=25^\circ\text{C}$	2.35	2.80	V
Q_r	Recovered Charge	$I_F=15\text{A}, V_R=600\text{V}, R_G=68\Omega, V_{GE}=-15\text{V}$	$T_j=25^\circ\text{C}$	0.6		μC
			$T_j=125^\circ\text{C}$	2.1		
			$T_j=150^\circ\text{C}$	3.0		
I_{RM}	Peak Reverse Recovery Current	$I_F=15\text{A}, V_R=600\text{V}, R_G=68\Omega, V_{GE}=-15\text{V}$	$T_j=25^\circ\text{C}$	10		A
			$T_j=125^\circ\text{C}$	12		
			$T_j=150^\circ\text{C}$	16		
E_{rec}	Reverse Recovery Energy	$I_F=15\text{A}, V_R=600\text{V}, R_G=68\Omega, V_{GE}=-15\text{V}$	$T_j=25^\circ\text{C}$	0.47		mJ
			$T_j=125^\circ\text{C}$	0.86		
			$T_j=150^\circ\text{C}$	1.22		

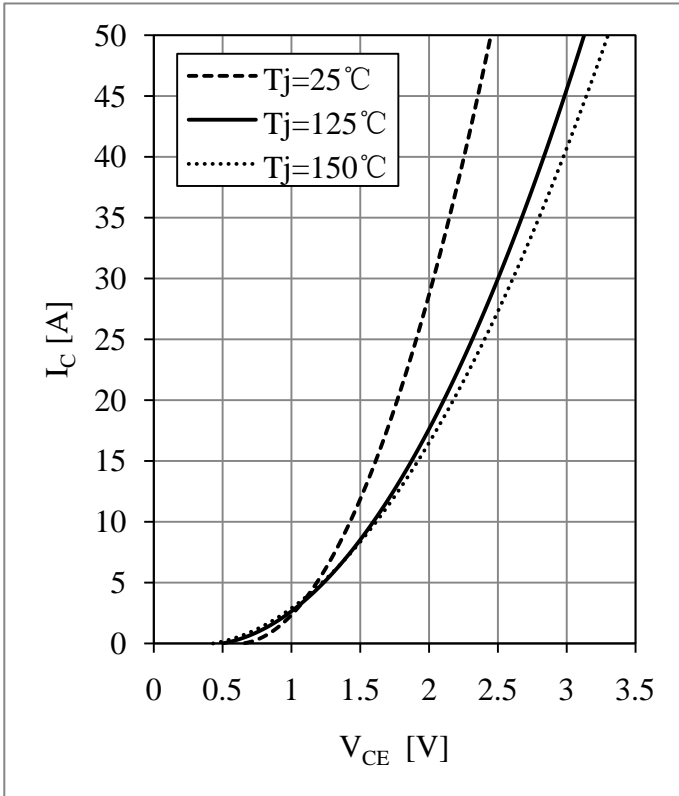
Electrical Characteristics of NTC $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
R_{25}	Rated Resistance			5.0		k Ω
$\Delta R/R$	Deviation of R_{100}	$T_C=100^\circ\text{C}, R_{100}=493.3\Omega$	-5		5	%
P_{25}	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$		3375		K

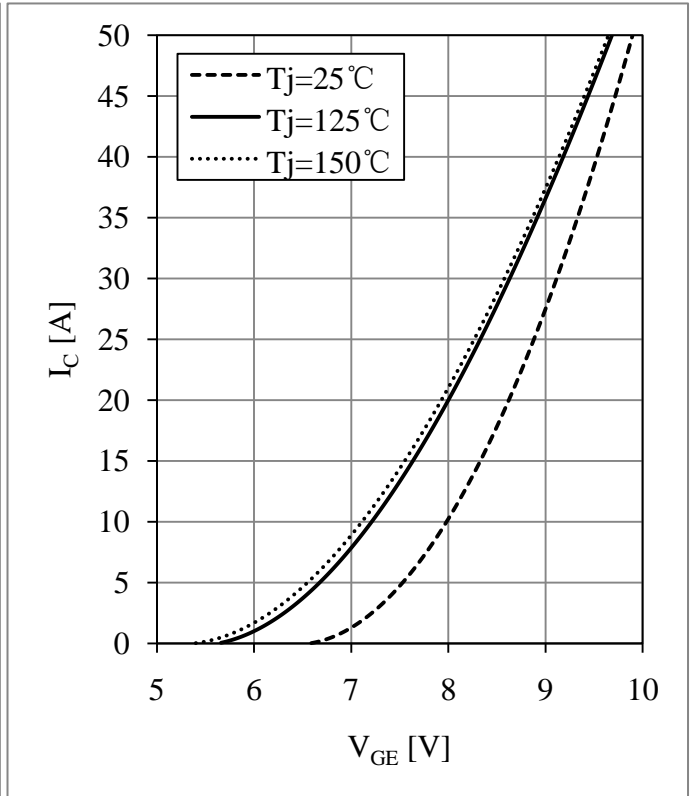
IGBT Module

Symbol	Parameter	Min.	Typ.	Max.	Units
V_{ISO}	Isolation Voltage RMS, $f=50\text{Hz}$, $t=1\text{min}$	2500			V
L_{CE}	Stray Inductance		60		nH
$R_{CC'+EE'}$ $R_{AA'+CC'}$	Module Lead Resistance, Terminal to Chip @ $T_C=25^\circ\text{C}$		4.00 2.00		m Ω
$R_{\theta JC}$	Junction-to-Case (per IGBT-inverter) Junction-to-Case (per Diode-inverter) Junction-to-Case (per Diode-rectifier) Junction-to-Case (per IGBT-brake-chopper) Junction-to-Case (per Diode-brake-chopper)			0.708 0.975 1.151 0.987 1.684	K/W
$R_{\theta CS}$	Case-to-Sink (per IGBT-inverter) Case-to-Sink (per Diode-inverter) Case-to-Sink (per Diode-rectifier) Case-to-Sink (per IGBT-brake-chopper) Case-to-Sink (per Diode-brake-chopper)		0.304 0.418 0.494 0.423 0.722		
$R_{\theta CS}$	Case-to-Sink (Conductive grease applied)		0.02		K/W
T_{jmax}	Maximum Junction Temperature (inverter, brake) Maximum Junction Temperature(rectifier)			175 150	$^\circ\text{C}$
T_{jop}	Operating Junction Temperature (inverter, brake) Operating Junction Temperature(rectifier)	-40 -40		150 125	$^\circ\text{C}$
T_{STG}	Storage Temperature Range	-40		125	$^\circ\text{C}$
Mounting Torque	Mounting Screw:M5	3.0		6.0	N.m
G	Weight of Module		180		g

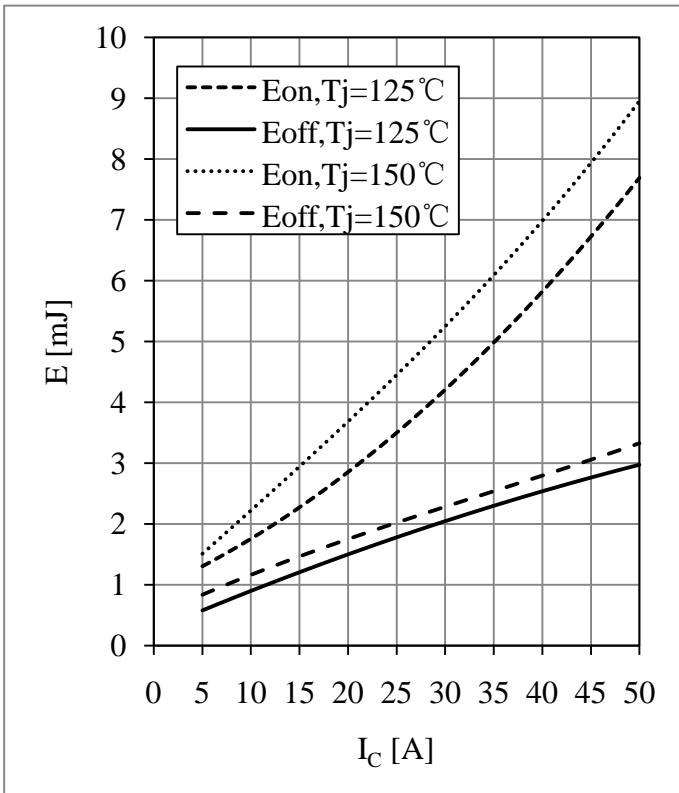
IGBT-inverter Output Characteristics
 $V_{GE}=15V$



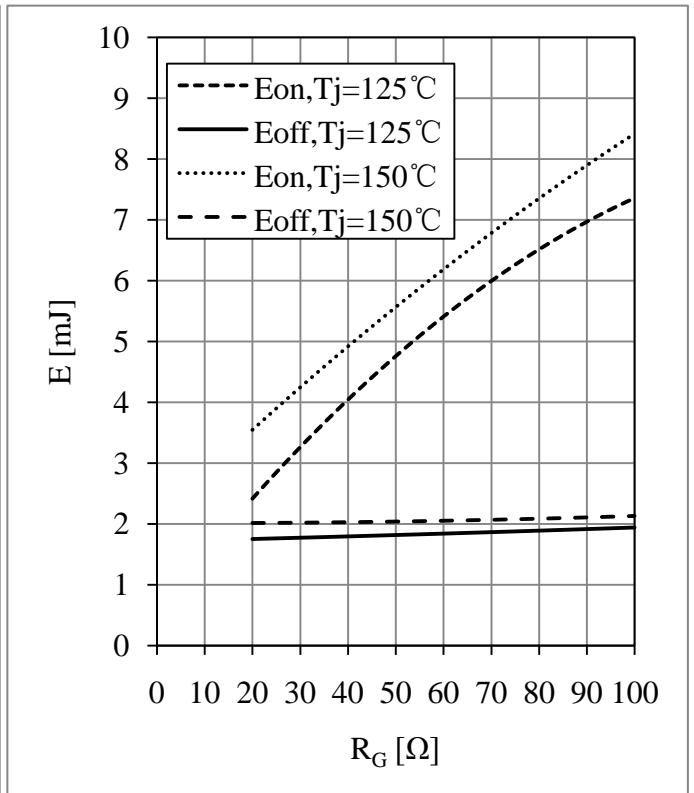
IGBT-inverter Transfer Characteristics
 $V_{CE}=20V$



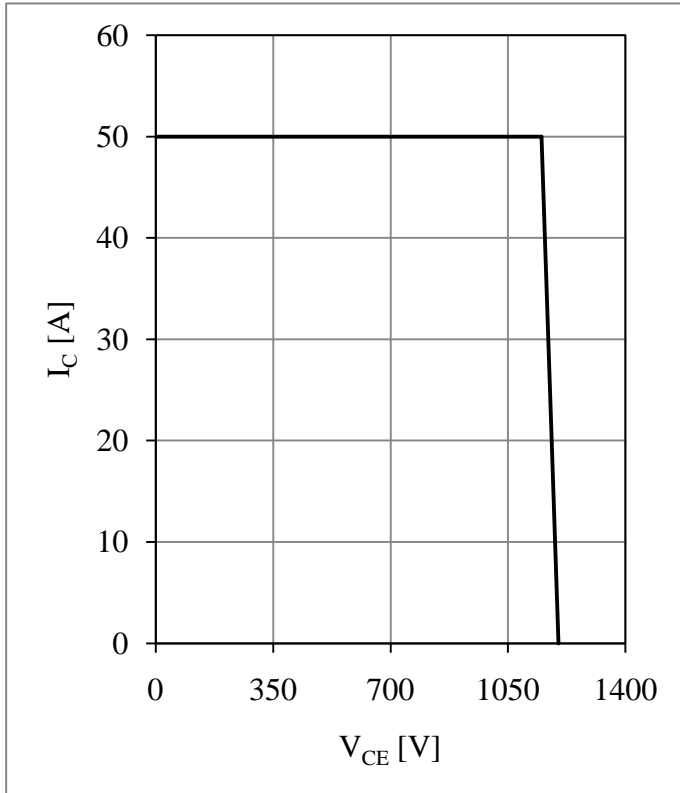
IGBT-inverter Switching Loss vs. I_C
 $V_{CC}=600V, R_G=33\Omega, V_{GE}=\pm 15V$



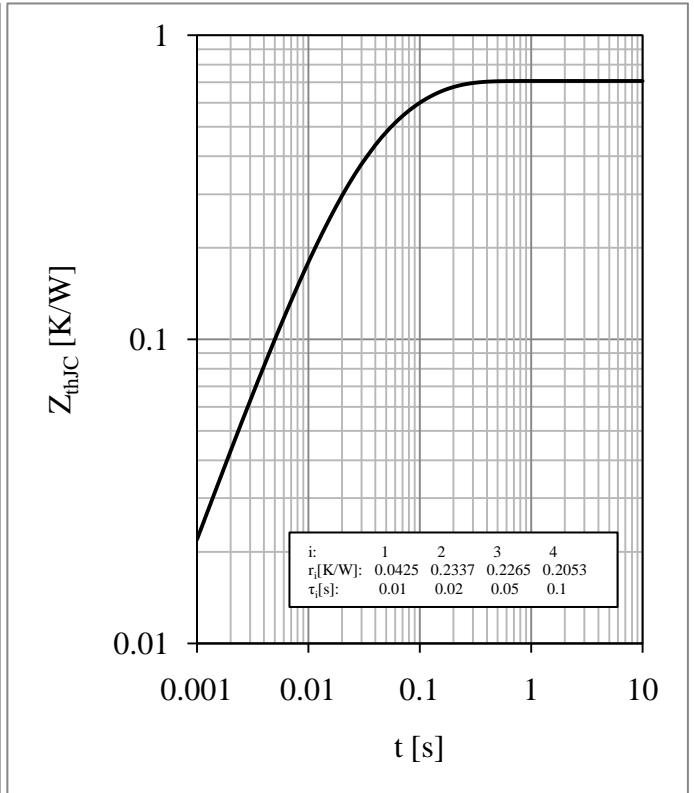
IGBT-inverter Switching Loss vs. R_G
 $V_{CC}=600V, I_C=25A, V_{GE}=\pm 15V$



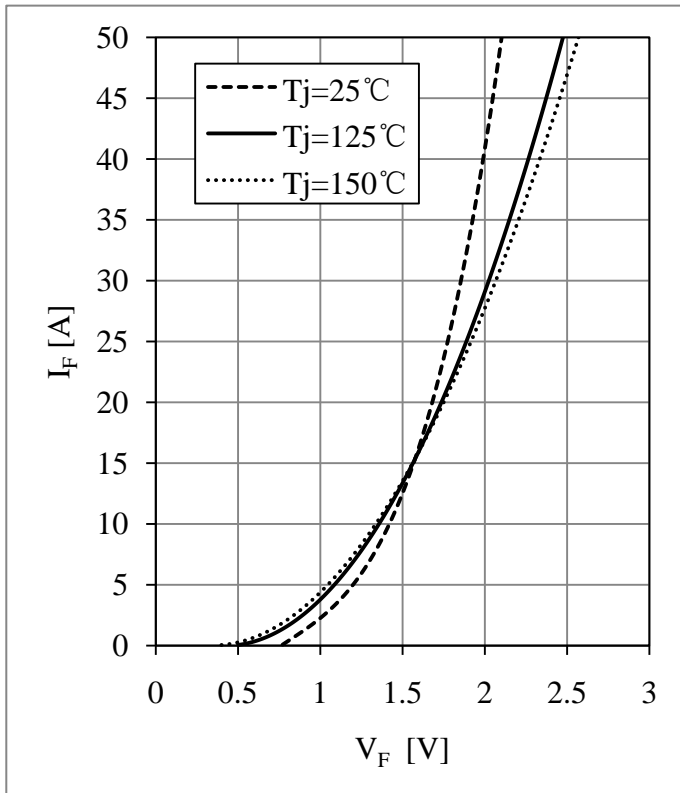
IGBT-inverter RBSOA
Module, $R_G=33\Omega, V_{GE}=\pm 15V, T_j=150^\circ C$



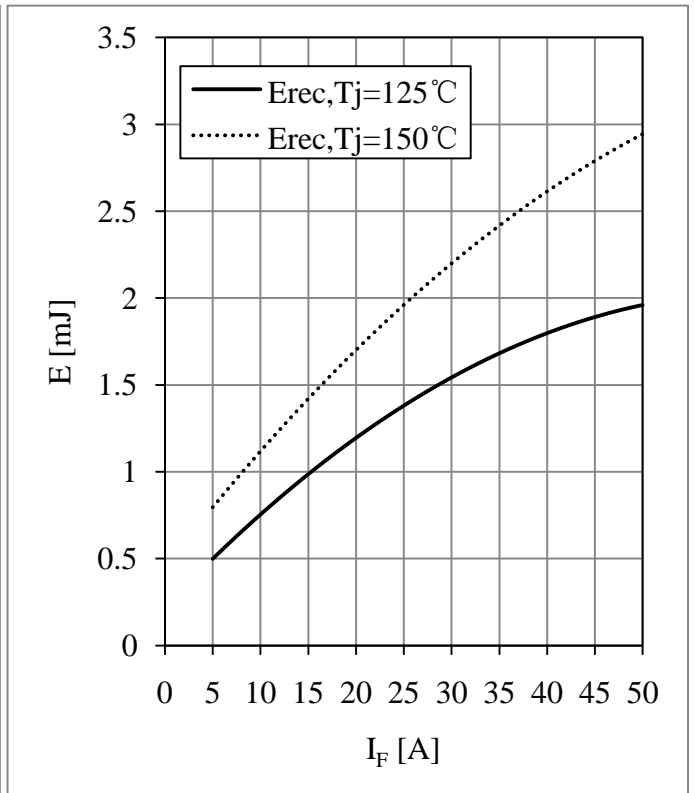
IGBT-inverter Transient Thermal Impedance



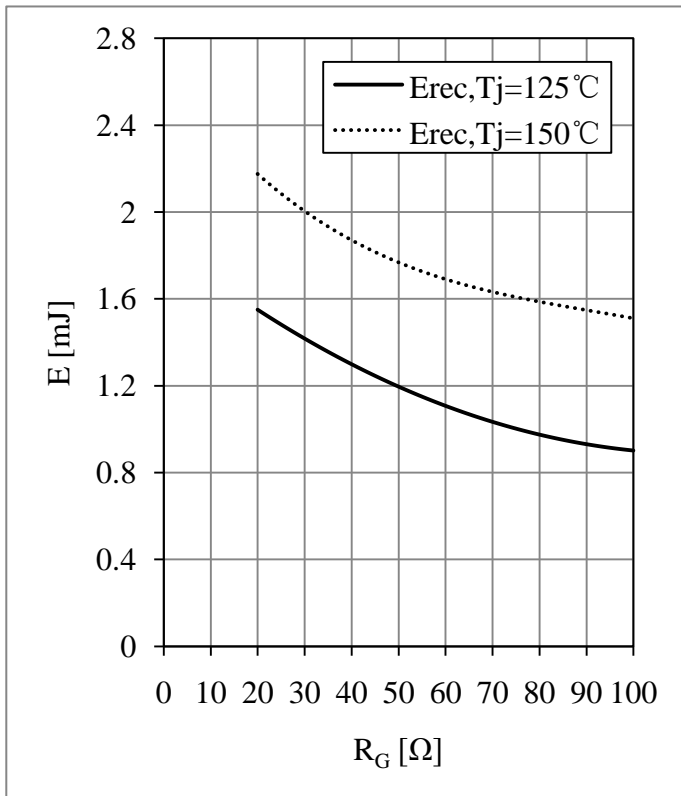
Diode-inverter Forward Characteristics



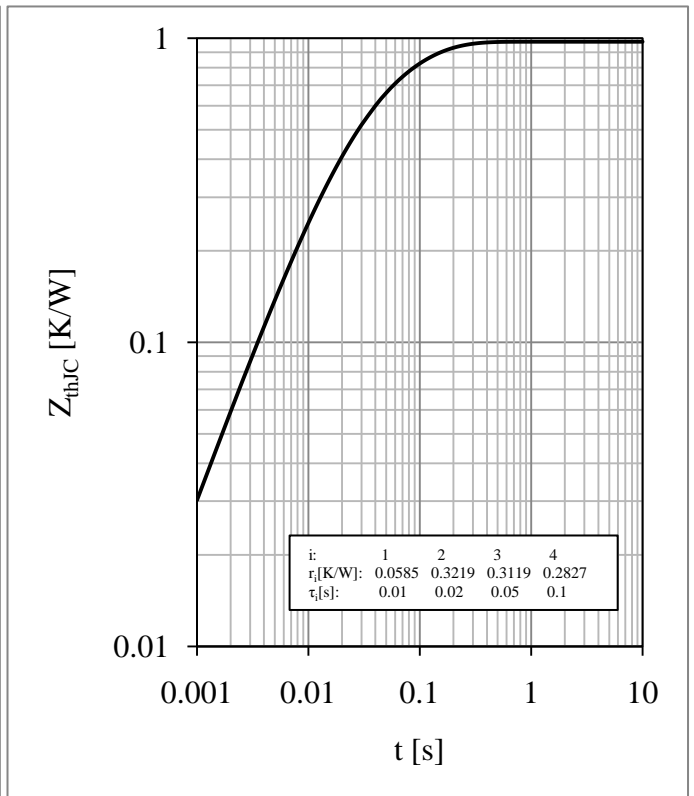
Diode-inverter Switching Loss vs. I_F
 $V_{CC}=600V, R_G=33\Omega$



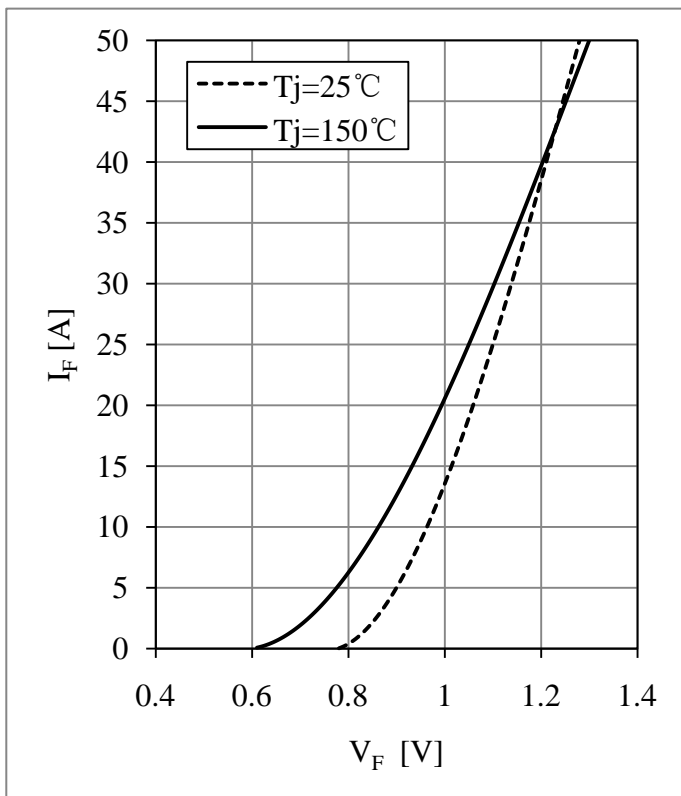
Diode-inverter Switching Loss vs. R_G
 $V_{CC}=600V, I_F=25A$



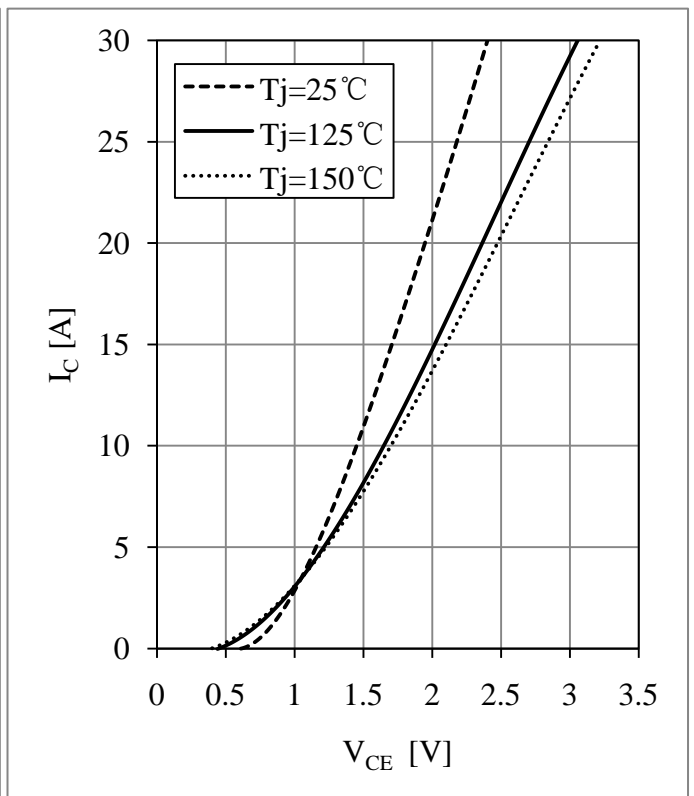
Diode-inverter Transient Thermal Impedance



Diode-rectifier Forward Characteristics

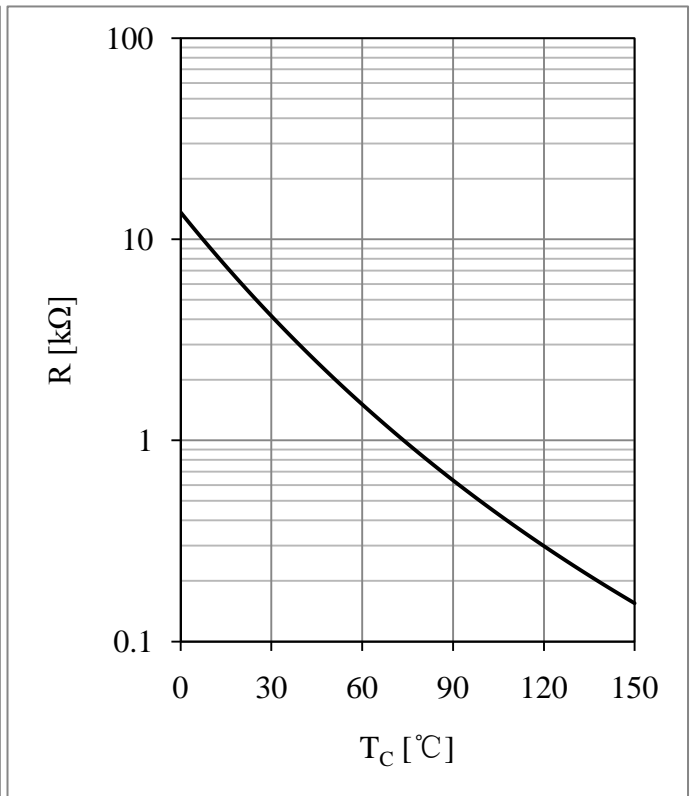
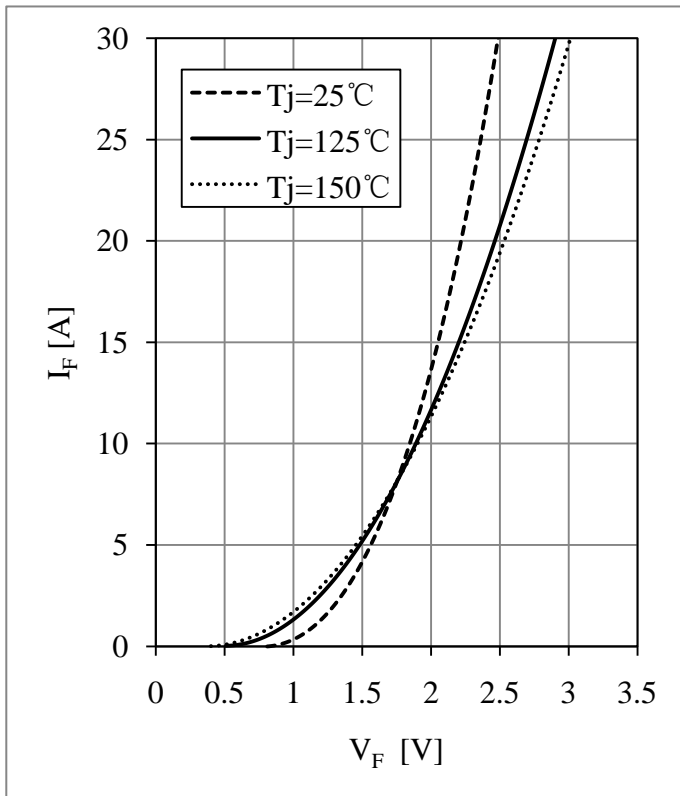


IGBT-brake-chopper Output Characteristics
 $V_{GE}=15V$

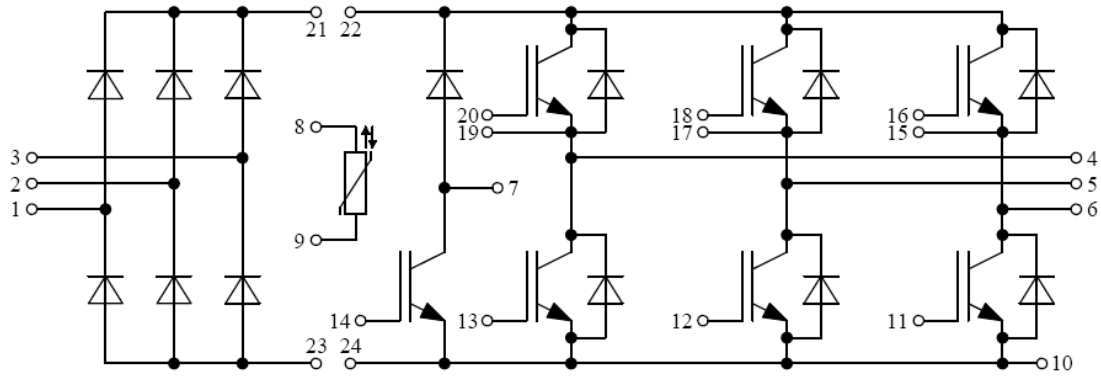


Diode-brake-chopper Forward Characteristics

NTC Temperature Characteristic

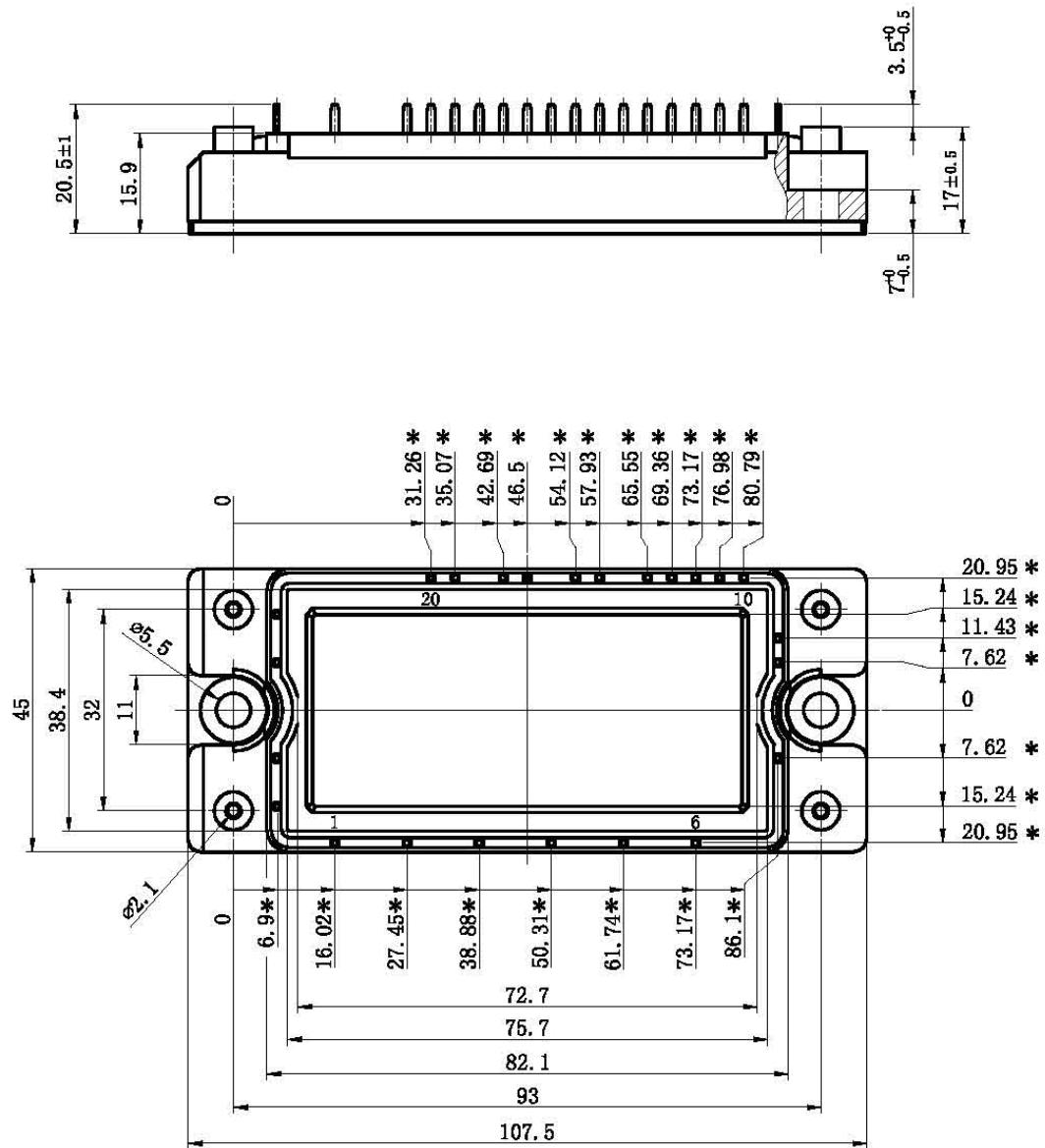


Equivalent Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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