STARPOWER

SEMICONDUCTOR **IGBT**

GD40PIT120C5S

Molding Type Module

1200V/40A 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
- 10μs short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175℃
- 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℃ unless otherwise noted

Maximum Rated Values

Symbol	Description	GD40PIT120C5S	Units
V_{CES}	Collector-Emitter Voltage @ T_j=25℃	1200	V
V_{GES}	Gate-Emitter Voltage @ T_j=25℃	±30	V
I_C	Collector Current @ T_C=25℃ @ T_C=100℃	80 40	A
I_{CM}	Pulsed Collector Current t_p=1ms	80	A
P_{tot}	Total Power Dissipation @ T_j=175℃	314	W

Off Characteristics

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

On Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=2.4mA,V_{CE}=V_{GE}, T_j=25℃	5.0	6.1	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=40A,V_{GE}=15V, T_j=25℃		1.80	2.25	V
		I_C=40A,V_{GE}=15V, T_j=125℃		2.00		
		I_C=40A,V_{GE}=15V, T_j=150℃		2.05		

Switching Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=40A, R_G=24Ω,V_{GE}=±15V, T_j=25℃		370		ns
t_r	Rise Time			84		ns
$t_{d(off)}$	Turn-Off Delay Time			334		ns
t_f	Fall Time			276		ns
E_{on}	Turn-On Switching Loss			5.45		mJ
E_{off}	Turn-Off Switching Loss			2.21		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=40A, R_G=24Ω,V_{GE}=±15V, T_j=125℃		375		ns
t_r	Rise Time			87		ns
$t_{d(off)}$	Turn-Off Delay Time			350		ns
t_f	Fall Time			328		ns
E_{on}	Turn-On Switching Loss			6.05		mJ
E_{off}	Turn-Off Switching Loss			3.45		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=600V,I_C=40A, R_G=24Ω,V_{GE}=±15V, T_j=150℃		376		ns
t_r	Rise Time			92		ns
$t_{d(off)}$	Turn-Off Delay Time			350		ns
t_f	Fall Time			338		ns
E_{on}	Turn-On Switching Loss			6.30		mJ
E_{off}	Turn-Off Switching Loss			3.70		mJ
C_{ies}	Input Capacitance	V_{CE}=30V,f=1Mhz, V_{GE}=0V		6.24		nF
C_{oes}	Output Capacitance			0.23		nF
C_{res}	Reverse Transfer Capacitance			0.15		nF
Q_G	Gate Charge	V_{CC}=600V,I_C=40A, V_{GE}=15V		232		nC
I_{SC}	SC Data	t_P≤10μs,V_{GE}=15V, T_j=125℃,V_{CC}=900V, V_{CEM}≤1200V		500		A

Diode-inverter T_C=25℃ unless otherwise noted

Maximum Rated Values

Symbol	Description	GD40PIT120C5S	Units
V_{RRM}	Repetitive Peak Reverse Voltage @ T_j=25℃	1200	V
I_F	DC Forward Current	40	A
I_{FRM}	Repetitive Peak Forward Current t_p=1ms	80	A

Characteristics Values

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	I_F=40A,V_{GE}=0V	T_j=25℃		2.10	2.50	V
			T_j=125℃		2.00		
			T_j=150℃		1.97		
Q_r	Recovered Charge	I_F=40A, V_R=600V, R_G=24Ω, V_{GE}=-15V	T_j=25℃		2.5		μC
			T_j=125℃		4.8		
			T_j=150℃		5.0		
I_{RM}	Peak Reverse Recovery Current		T_j=25℃		22		A
			T_j=125℃		26		
			T_j=150℃		28		
E_{rec}	Reverse Recovery Energy		T_j=25℃		1.28		mJ
			T_j=125℃		2.40		
			T_j=150℃		2.50		

Diode-rectifier T_C=25℃ unless otherwise noted

Maximum Rated Values

Symbol	Description	GD40PIT120C5S	Units
V_{RRM}	Repetitive Peak Reverse Voltage @ T_j=25℃	1600	V
I_O	Average Output Current 50Hz/60Hz,sine wave	40	A
I_{FSM}	Surge Forward Current V_R=0V,t_p=10ms,T_j=45℃	600	A
I^2t	I^2t-value,V_R=0V,t_p=10ms,T_j=45℃	1800	A^2s

Characteristics Values

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	I_F=40A	T_j=150℃		1.06		V
I_R	Reverse Current	T_j=150℃,V_R=1600V				3.0	mA

IGBT-brake-chopper T_C=25℃ unless otherwise noted

Maximum Rated Values

Symbol	Description	GD40PIT120C5S	Units
V_{CES}	Collector-Emitter Voltage @ T_j=25℃	1200	V
V_{GES}	Gate-Emitter Voltage @ T_j=25℃	±30	V
I_C	Collector Current @ T_C=25℃ @ T_C=100℃	30 15	A
I_{CM}	Pulsed Collector Current t_p=1ms	30	A
P_{tot}	Total Power Dissipation @ T_j=175℃	158	W

Off Characteristics

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

On Characteristics

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

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=75Ω,V_{GE}=±15V, T_j=25℃		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=75Ω,V_{GE}=±15V, T_j=125℃		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=75Ω,V_{GE}=±15V, T_j=150℃		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…+15V		150		nC
I_{SC}	SC Data	t_P≤10μs,V_{GE}=15V, T_j=150℃,V_{CC}=900V, V_{CEM}≤1200V		60		A

Diode-brake-chopper T_C=25℃ unless otherwise noted

Maximum Rated Values

Symbol	Description	GD40PIT120C5S	Units
V_{RRM}	Repetitive Peak Reverse Voltage @ T_j=25℃	1200	V
I_F	DC Forward Current	15	A
I_{FRM}	Repetitive Peak Forward Current t_p=1ms	30	A

Characteristics Values

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

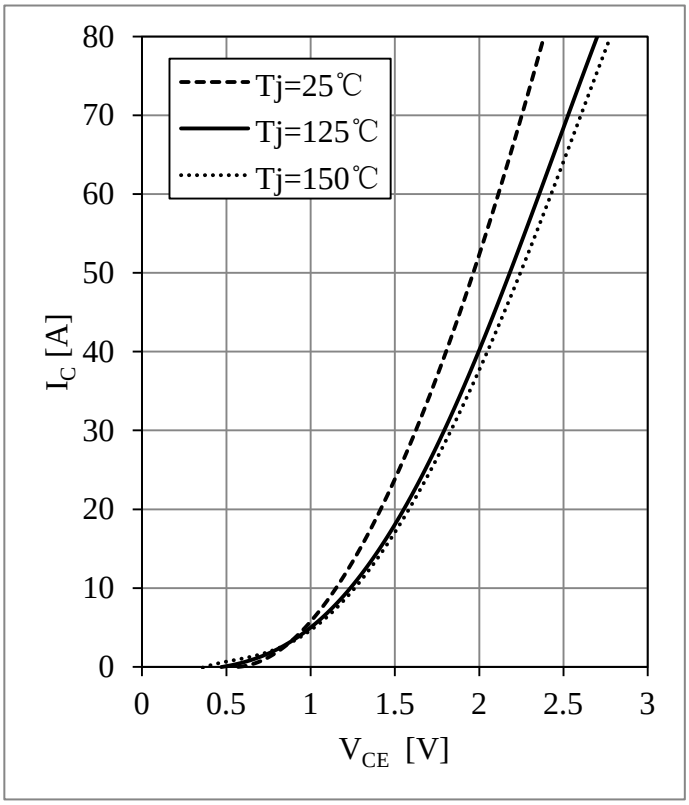
Electrical Characteristics of NTC T_C=25℃ unless otherwise noted

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

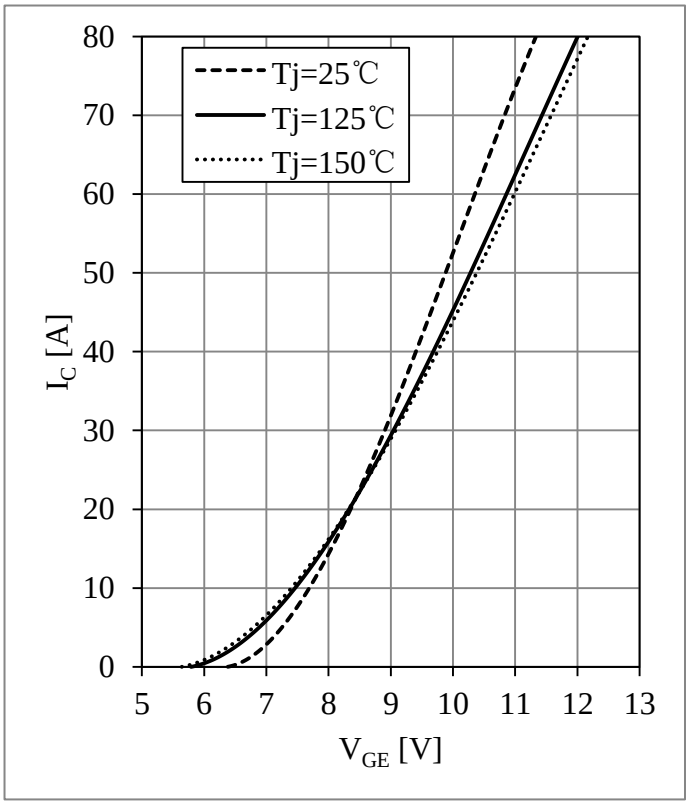
IGBT Module

Symbol	Parameter	Min.	Typ.	Max.	Units
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	2500			V
L_{CE}	Stray Inductance		60		nH
$R_{CC'+EE'}$ $R_{AA'+CC'}$	Module Lead Resistance,Terminal to Chip @ T_C=25℃		4.00 2.00		mΩ
$R_{\theta JC}$	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)			0.477 1.082 0.955 0.951 1.760	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)		0.248 0.563 0.497 0.495 0.916		
$R_{\theta CS}$	Case-to-Sink (Conductive grease applied)		0.02		K/W
T_{jmax}	Maximum Junction Temperature (inverter, brake) Maximum Junction Temperature(rectifier)			175 150	℃
T_{jop}	Operating Junction Temperature	-40		150	℃
T_{STG}	Storage Temperature Range	-40		125	℃
Mounting Torque	Mounting Screw:M5	3.0		6.0	N.m
G	Weight of Module		200		g

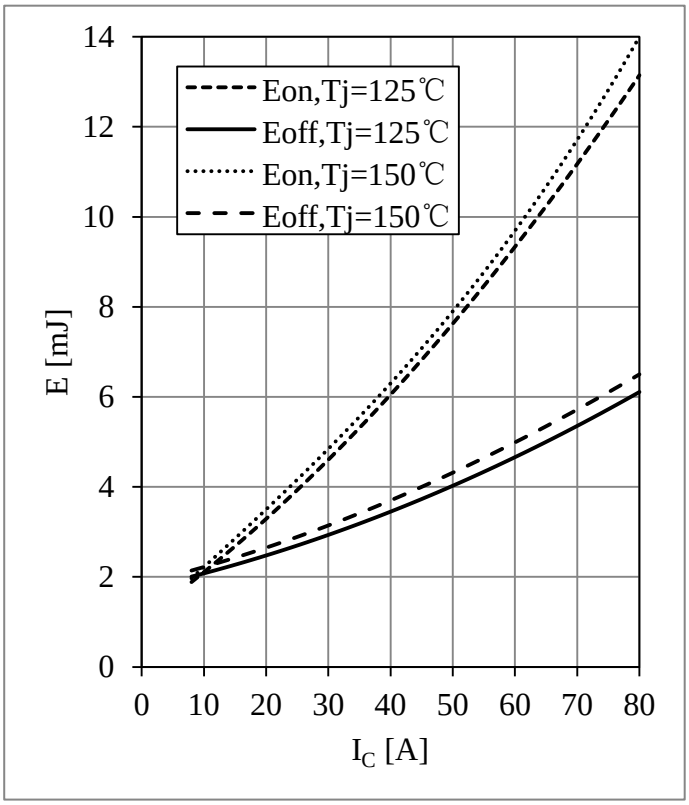
IGBT-inverter Output Characteristics
V_{GE}=15V



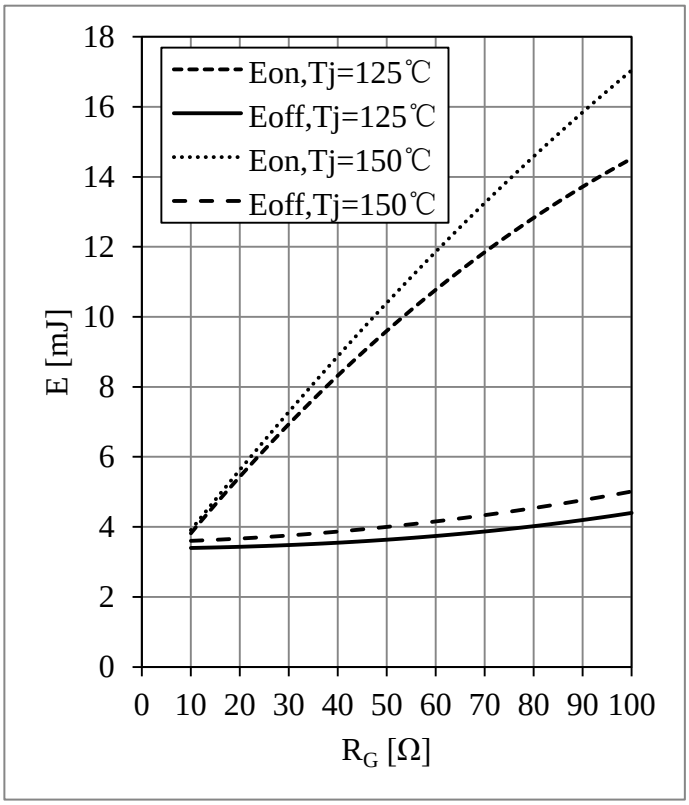
IGBT-inverter Transfer Characteristics
V_{CE}=20V



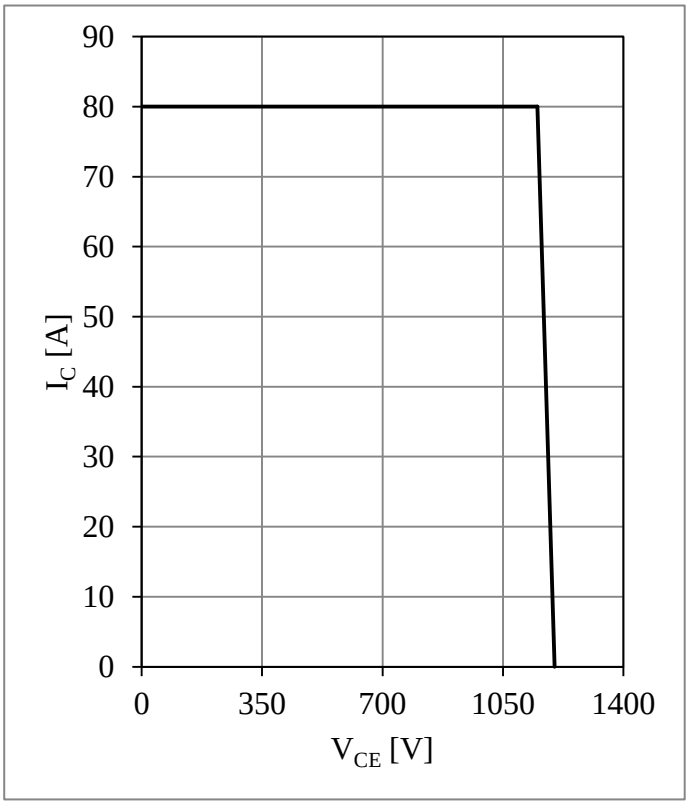
IGBT-inverter Switching Loss vs. I_C
V_{CC}=600V,R_G=24Ω,V_{GE}=±15V



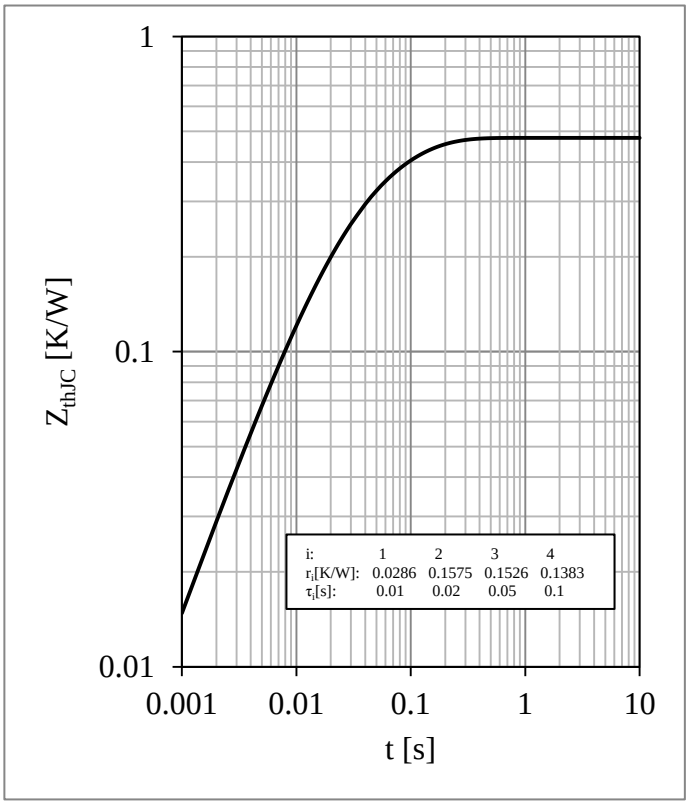
IGBT-inverter Switching Loss vs. R_G
V_{CC}=600V,I_C=40A,V_{GE}=±15V



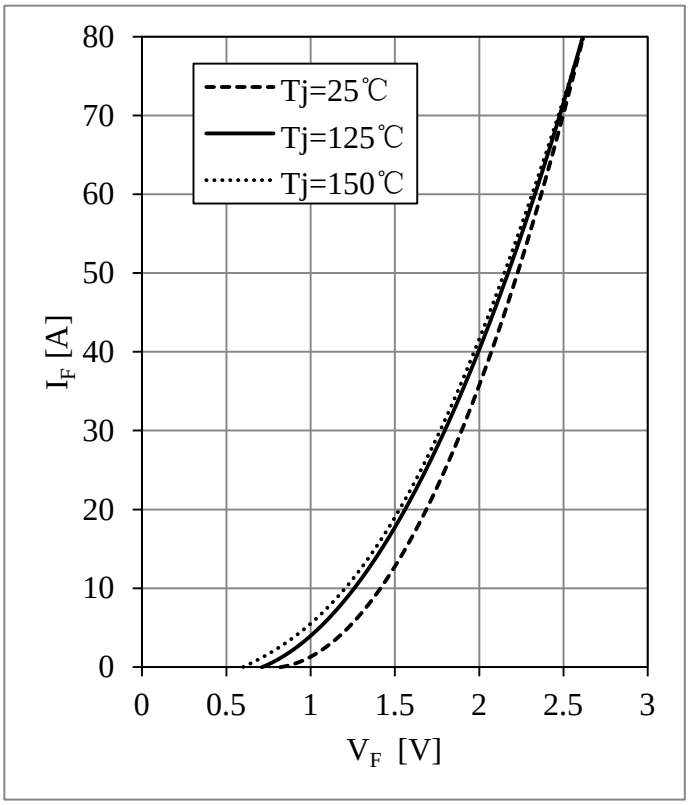
IGBT-inverter RBSOA
Module, R_G=24Ω,V_{GE}= ±15V,T_j=150℃



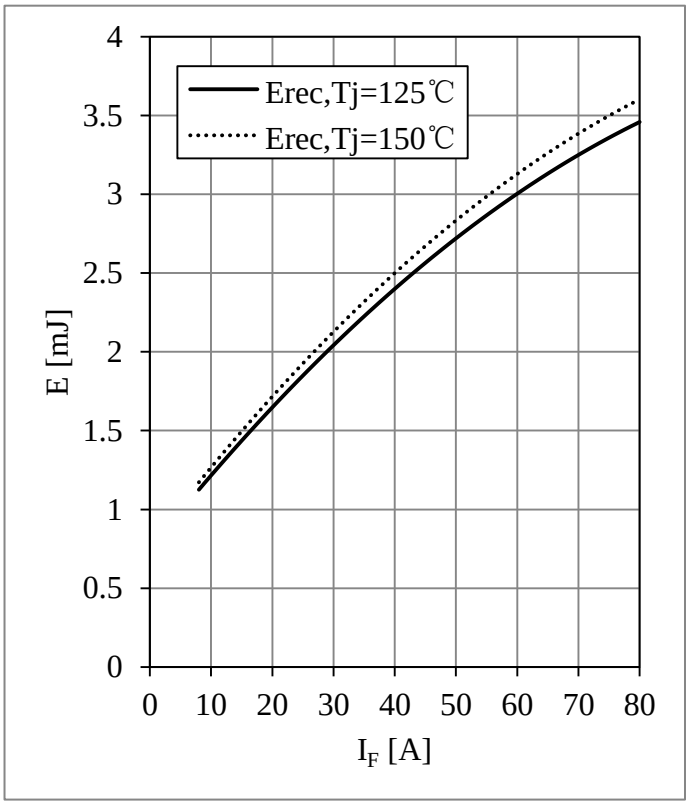
IGBT-inverter Transient Thermal Impedance



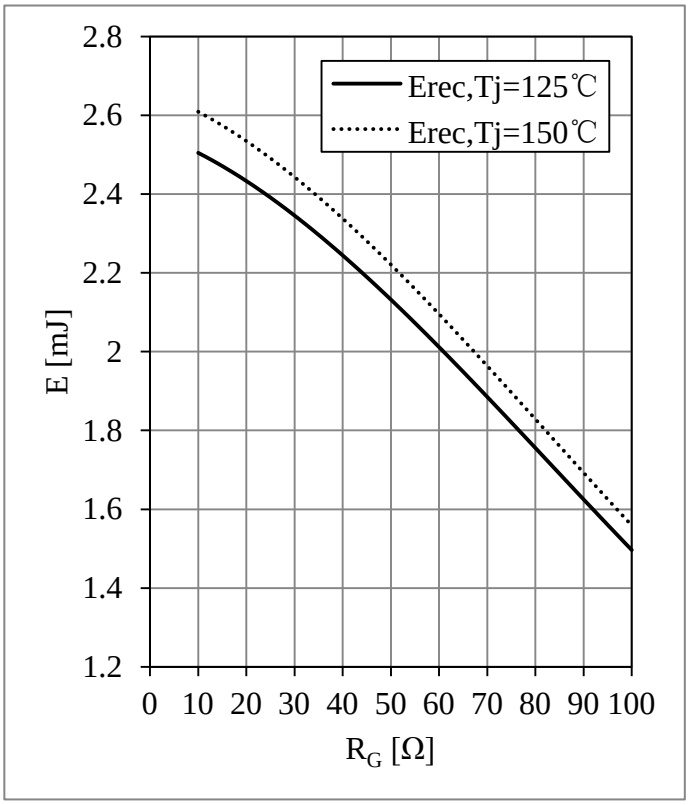
Diode-inverter Forward Characteristics



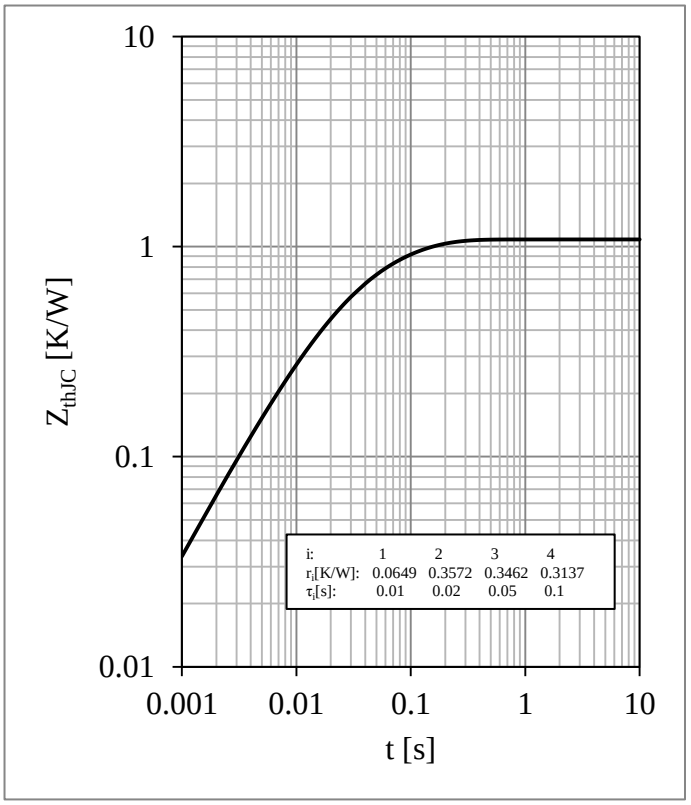
Diode-inverter Switching Loss vs. I_F
V_{CC}=600V,R_G=24Ω



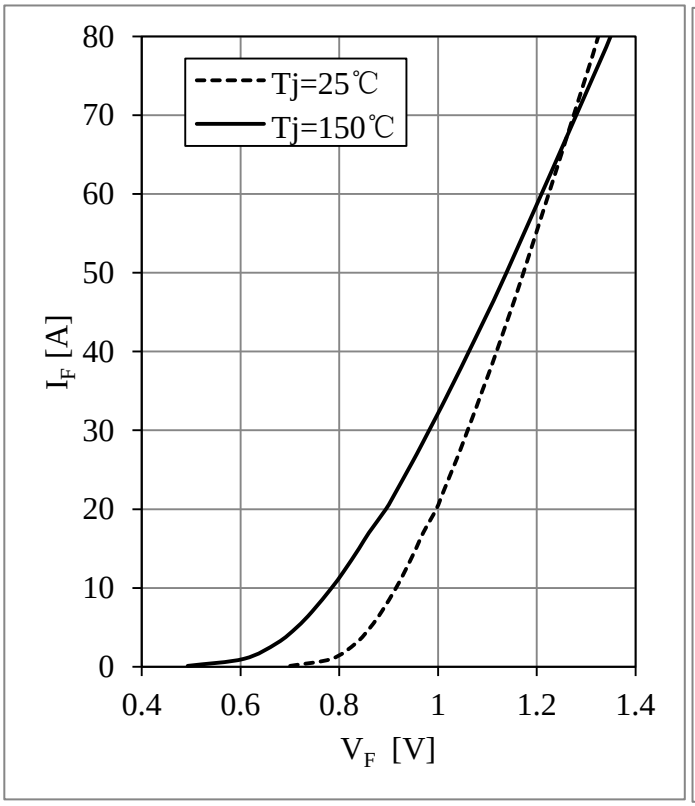
Diode-inverter Switching Loss vs. R_G
V_{CC}=600V,I_F=40A



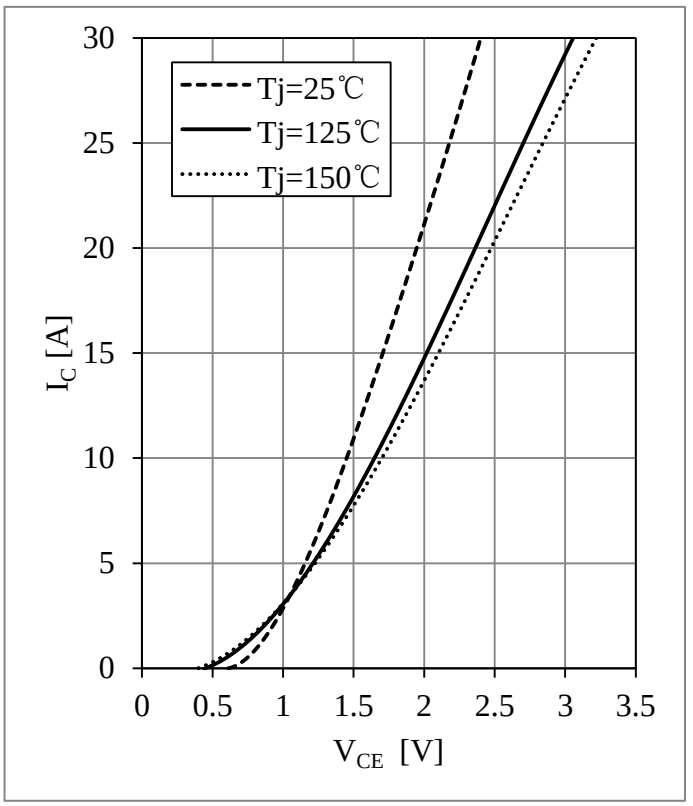
Diode-inverter Transient Thermal Impedance



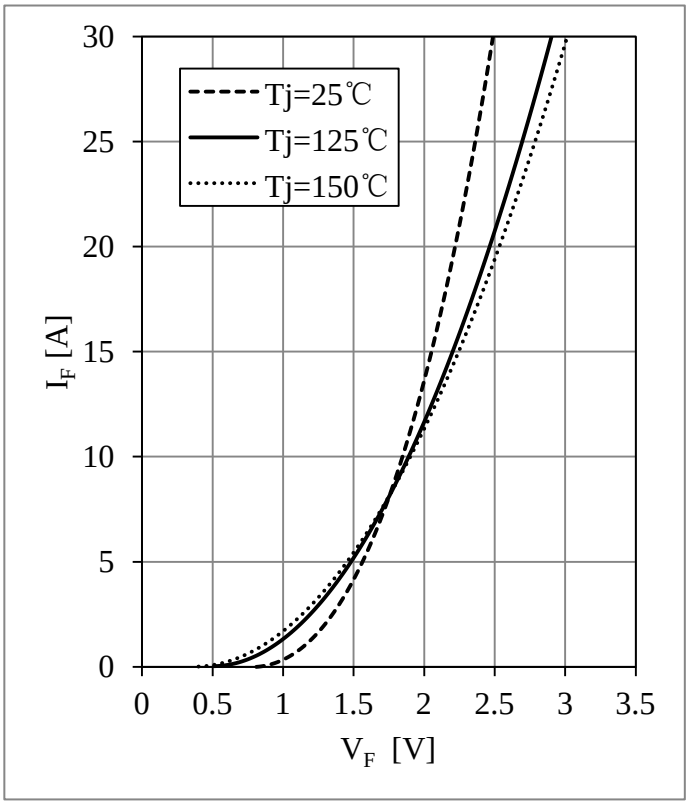
Diode-rectifier Forward Characteristics



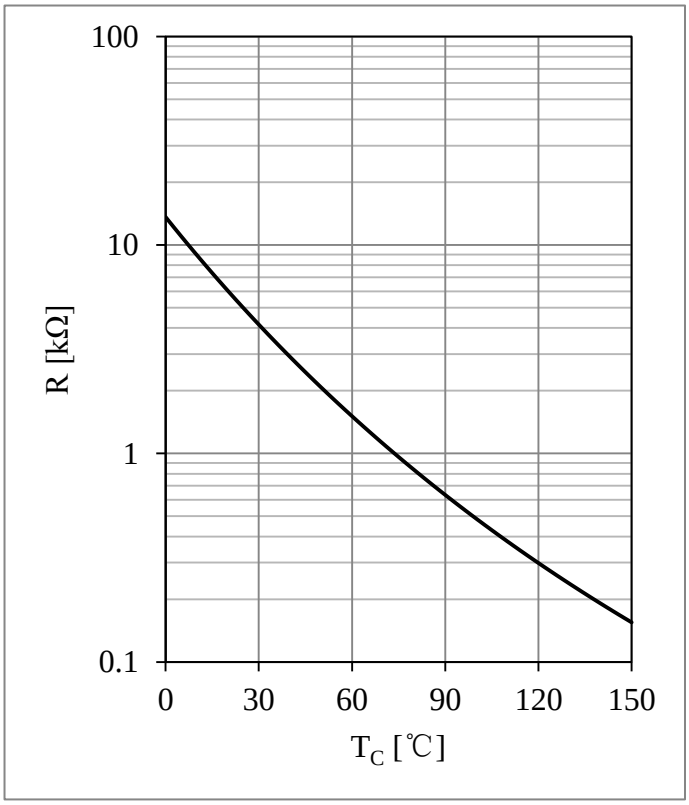
IGBT-brake-chopper Output Characteristics
V_{GE}=15V



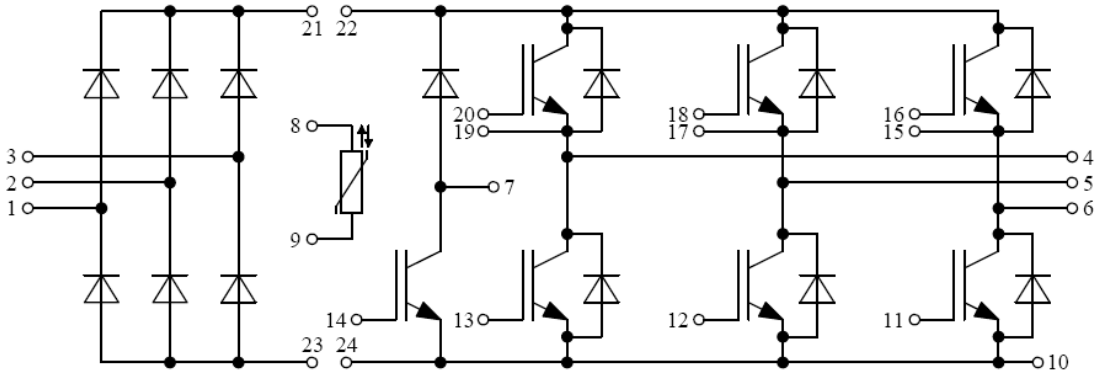
Diode-brake-chopper Forward Characteristics



NTC Temperature Characteristic

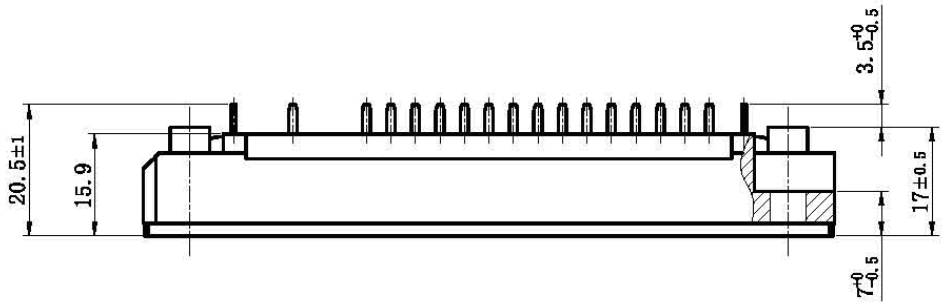


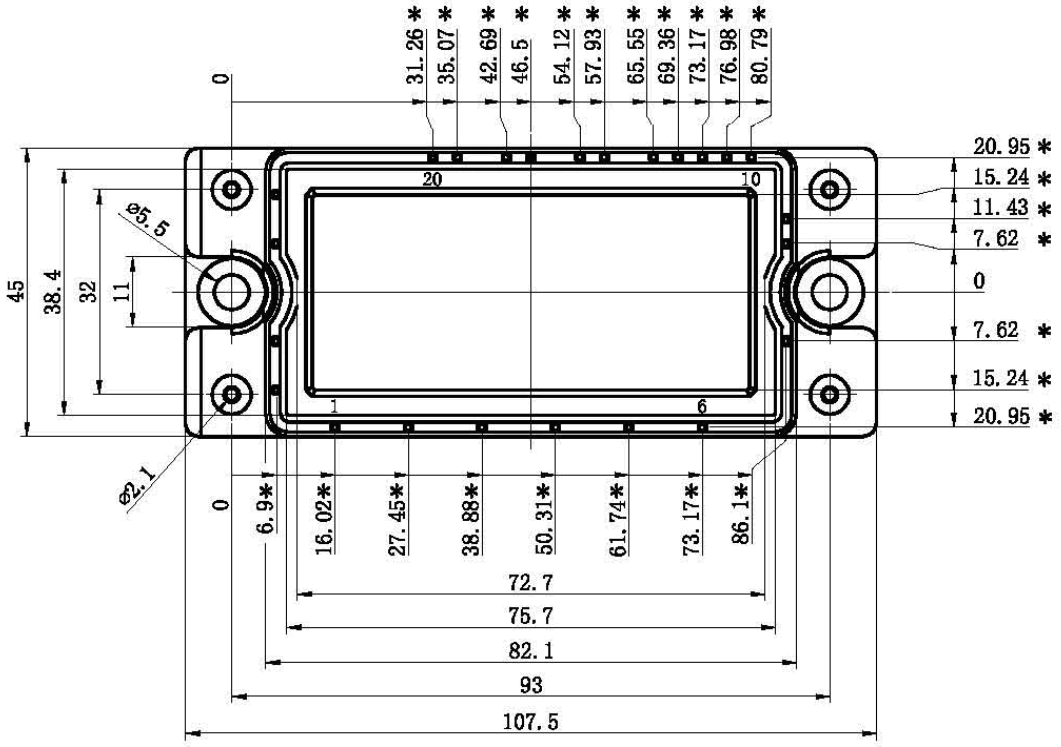
Equivalent Circuit Schematic



Package Dimensions

Dimensions in Millimeters





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