

STARPOWER

SEMICONDUCTOR

IGBT

GD40PIX120C5S

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.

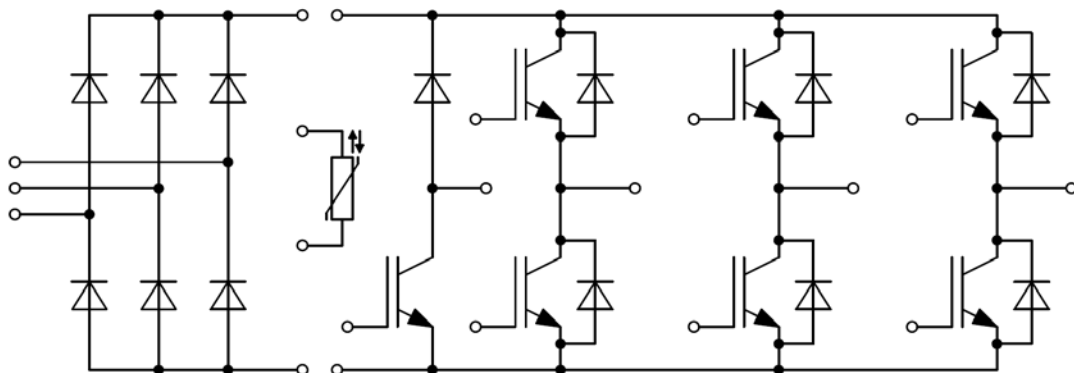
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 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

Equivalent Circuit Schematic



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

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	65	A
		40	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	80	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	232	W

Diode-inverter

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	40	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	80	A

Diode-rectifier

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1600	V
I_O	Average Output Current 50Hz/60Hz,sine wave	40	A
I_{FSM}	Surge Forward Current $t_p=10\text{ms}$ @ $T_j=25^{\circ}\text{C}$ @ $T_j=150^{\circ}\text{C}$	450	A
		370	
I^2t	I^2t -value, $t_p=10\text{ms}$ @ $T_j=25^{\circ}\text{C}$ @ $T_j=150^{\circ}\text{C}$	1000	A^2s
		685	

IGBT-brake

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	30	A
		15	
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	30	A
P_D	Maximum Power Dissipation @ $T_j=175^{\circ}\text{C}$	146	W

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	10	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	20	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature(inverter,brake)	175	$^{\circ}\text{C}$
	Maximum Junction Temperature (rectifier)	150	
T_{jop}	Operating Junction Temperature	-40 to +150	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	2500	V

IGBT-inverter Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.90	2.35	V	
		$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.15			
		$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.20			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=1.40\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.6	6.2	6.8	V	
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			1.0	mA	
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^\circ\text{C}$			400	nA	
R_{Gint}	Internal Gate Resistance			0		Ω	
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		3.62		nF	
C_{res}	Reverse Transfer Capacitance				0.10		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.27		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=40\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		150		ns	
t_r	Rise Time			28		ns	
$t_{d(off)}$	Turn-Off Delay Time			355		ns	
t_f	Fall Time			86		ns	
E_{on}	Turn-On Switching Loss			3.67		mJ	
E_{off}	Turn-Off Switching Loss			2.26		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=40\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		160		ns
t_r	Rise Time				38		ns
$t_{d(off)}$	Turn-Off Delay Time			495		ns	
t_f	Fall Time			162		ns	
E_{on}	Turn-On Switching Loss			4.88		mJ	
E_{off}	Turn-Off Switching Loss			3.42		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=40\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			160		ns
t_r	Rise Time				38		ns
$t_{d(off)}$	Turn-Off Delay Time			485		ns	
t_f	Fall Time			183		ns	
E_{on}	Turn-On Switching Loss			5.44		mJ	
E_{off}	Turn-Off Switching Loss			3.80		mJ	
I_{SC}	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		160		A

Diode-inverter Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=40\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.95	2.40	V
		$I_F=40\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		2.00		
		$I_F=40\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		2.10		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=40\text{A},$ $-di/dt=1200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		3.5		μC
I_{RM}	Peak Reverse Recovery Current			36		A
E_{rec}	Reverse Recovery Energy			1.13		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=40\text{A},$ $-di/dt=1200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		6.5		μC
I_{RM}	Peak Reverse Recovery Current			40		A
E_{rec}	Reverse Recovery Energy			2.32		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=40\text{A},$ $-di/dt=1200\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		7.3		μC
I_{RM}	Peak Reverse Recovery Current			41		A
E_{rec}	Reverse Recovery Energy			2.64		mJ

Diode-rectifier Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=40\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		0.90		V
I_R	Reverse Current	$T_j=150^\circ\text{C}, V_R=1600\text{V}$			3.0	mA

IGBT-brake Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=25^\circ\text{C}$		1.75	2.20	V	
		$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=125^\circ\text{C}$		2.00			
		$I_C=15\text{A}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}$		2.05			
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=0.60\text{mA}, V_{CE}=V_{GE}, T_j=25^\circ\text{C}$	5.6	6.2	6.8	V	
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$			1.0	mA	
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^\circ\text{C}$			400	nA	
R_{Gint}	Internal Gate Resistance			0		Ω	
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		1.55		nF	
C_{res}	Reverse Transfer Capacitance				0.04		nF
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.12		μC	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=39\Omega, V_{GE}=\pm 15\text{V}, T_j=25^\circ\text{C}$		47		ns	
t_r	Rise Time			50		ns	
$t_{d(off)}$	Turn-Off Delay Time			191		ns	
t_f	Fall Time			142		ns	
E_{on}	Turn-On Switching Loss			1.11		mJ	
E_{off}	Turn-Off Switching Loss			0.81		mJ	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=39\Omega, V_{GE}=\pm 15\text{V}, T_j=125^\circ\text{C}$		47		ns
t_r	Rise Time				56		ns
$t_{d(off)}$	Turn-Off Delay Time			269		ns	
t_f	Fall Time			186		ns	
E_{on}	Turn-On Switching Loss			1.50		mJ	
E_{off}	Turn-Off Switching Loss			1.18		mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=15\text{A}, R_G=39\Omega, V_{GE}=\pm 15\text{V}, T_j=150^\circ\text{C}$			47		ns
t_r	Rise Time				56		ns
$t_{d(off)}$	Turn-Off Delay Time			274		ns	
t_f	Fall Time			210		ns	
E_{on}	Turn-On Switching Loss			1.67		mJ	
E_{off}	Turn-Off Switching Loss			1.32		mJ	
I_{SC}	SC Data		$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^\circ\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		60		A

Diode-brake Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=25^\circ\text{C}$		1.85	2.30	V
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=125^\circ\text{C}$		1.90		
		$I_F=10\text{A}, V_{GE}=0\text{V}, T_j=150^\circ\text{C}$		1.95		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=490\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=25^\circ\text{C}$		1.0		μC
I_{RM}	Peak Reverse Recovery Current			14		A
E_{rec}	Reverse Recovery Energy			0.24		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=490\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=125^\circ\text{C}$		2.0		μC
I_{RM}	Peak Reverse Recovery Current			12		A
E_{rec}	Reverse Recovery Energy			0.51		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=10\text{A},$ $-di/dt=490\text{A}/\mu\text{s}, V_{GE}=-15\text{V}$ $T_j=150^\circ\text{C}$		2.2		μC
I_{RM}	Peak Reverse Recovery Current			9		A
E_{rec}	Reverse Recovery Energy			0.58		mJ

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated Resistance			5.0		$\text{k}\Omega$
$\Delta R/R$	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
$B_{25/80}$	B-value	$R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$		3411		K
$B_{25/100}$	B-value	$R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15\text{K}))]$		3433		K

Module Characteristics $T_c=25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		60		nH
$R_{CC'+EE'}$ $R_{AA'+CC'}$	Module Lead Resistance, Terminal to Chip		4.00 3.00		m Ω
R_{thJC}	Junction-to-Case (per IGBT-inverter) Junction-to-Case (per Diode-inverter) Junction-to-Case (per Diode-rectifier) Junction-to-Case (per IGBT-brake) Junction-to-Case (per Diode-brake)			0.647 0.967 0.895 1.028 1.850	K/W
R_{thCH}	Case-to-Heatsink (per IGBT-inverter) Case-to-Heatsink (per Diode-inverter) Case-to-Heatsink (per Diode-rectifier) Case-to-Heatsink (per IGBT-brake) Case-to-Heatsink (per Diode-brake) Case-to-Heatsink (per Module)		0.307 0.458 0.424 0.487 0.877 0.020		K/W
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		200		g

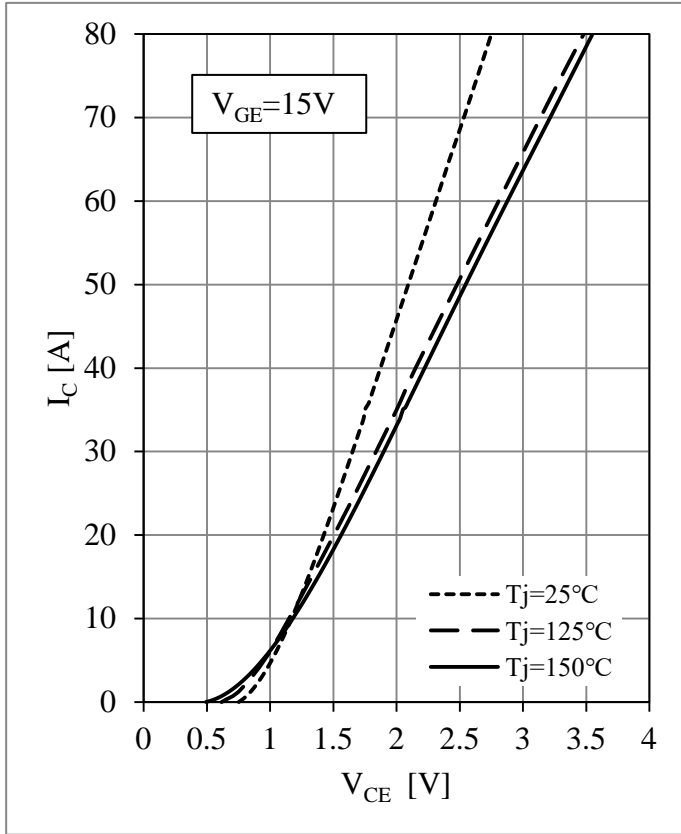


Fig 1. IGBT-inverter Output Characteristics

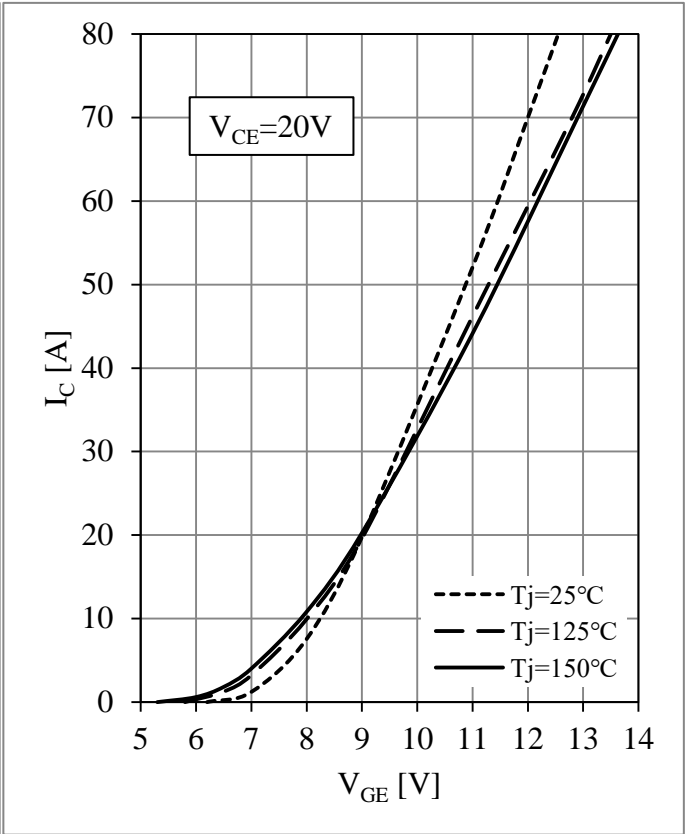


Fig 2. IGBT-inverter Transfer Characteristics

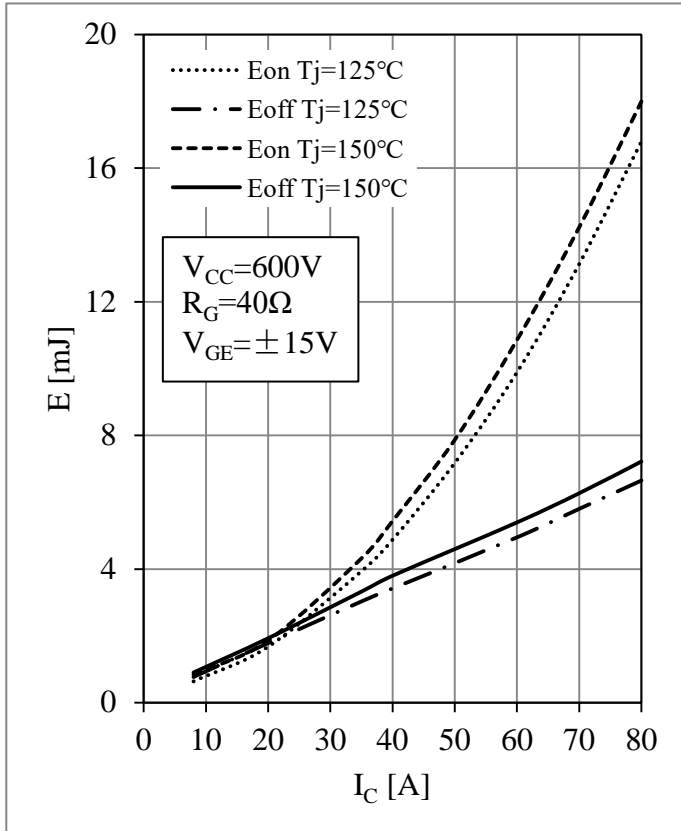


Fig 3. IGBT-inverter Switching Loss vs. I_C

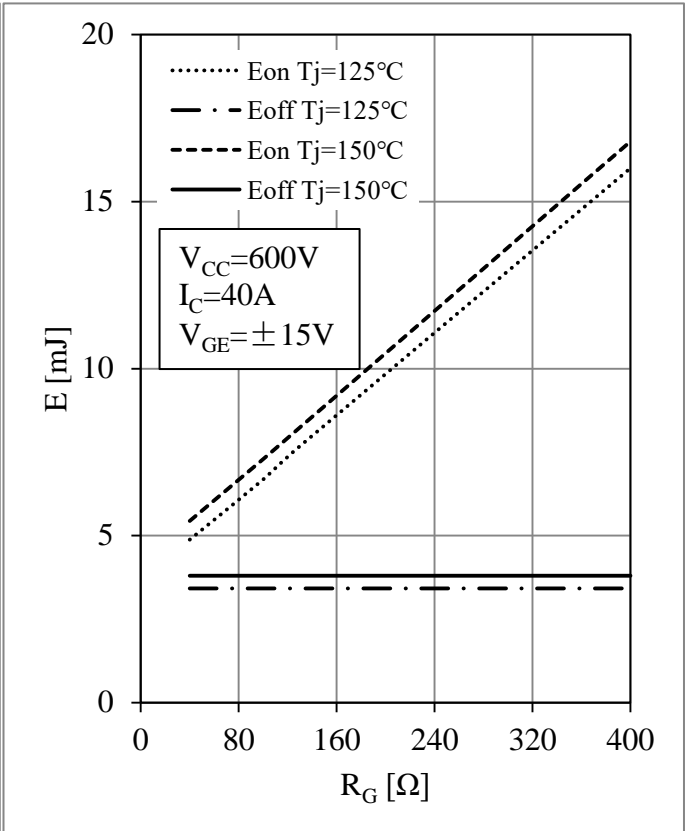


Fig 4. IGBT-inverter Switching Loss vs. R_G

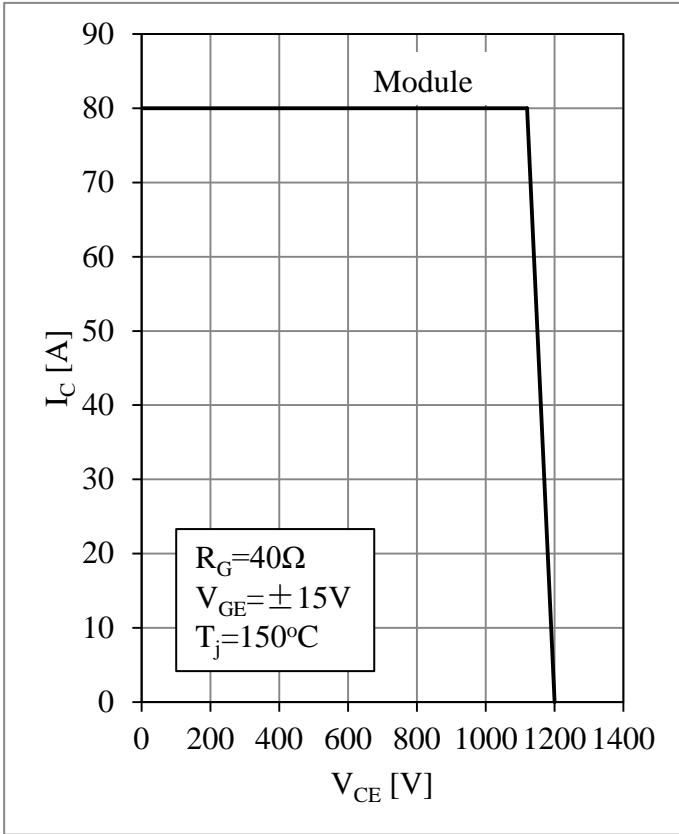


Fig 5. IGBT-inverter RBSOA

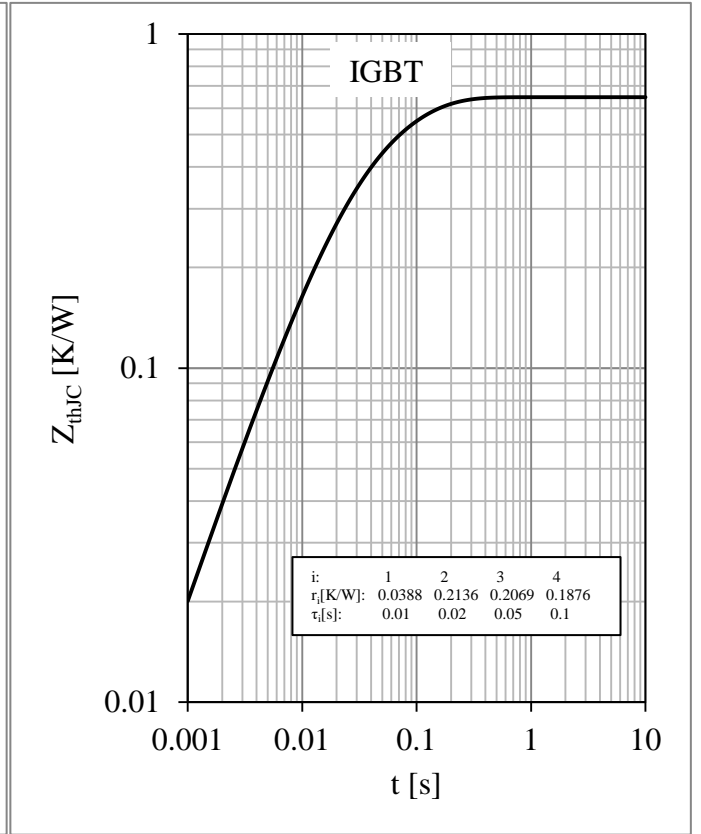


Fig 6. IGBT-inverter Transient Thermal Impedance

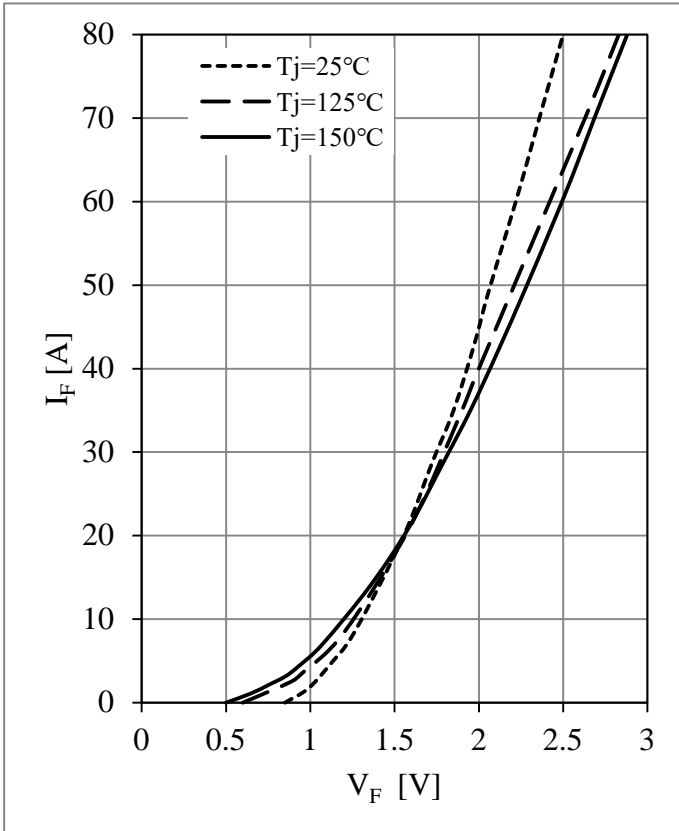


Fig 7. Diode-inverter Forward Characteristics

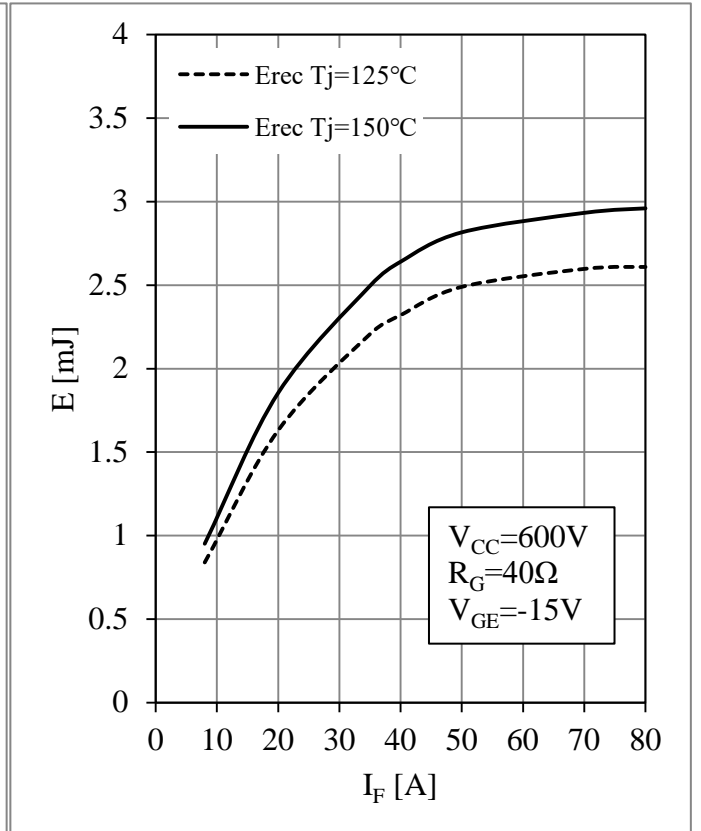


Fig 8. Diode-inverter Switching Loss vs. I_F

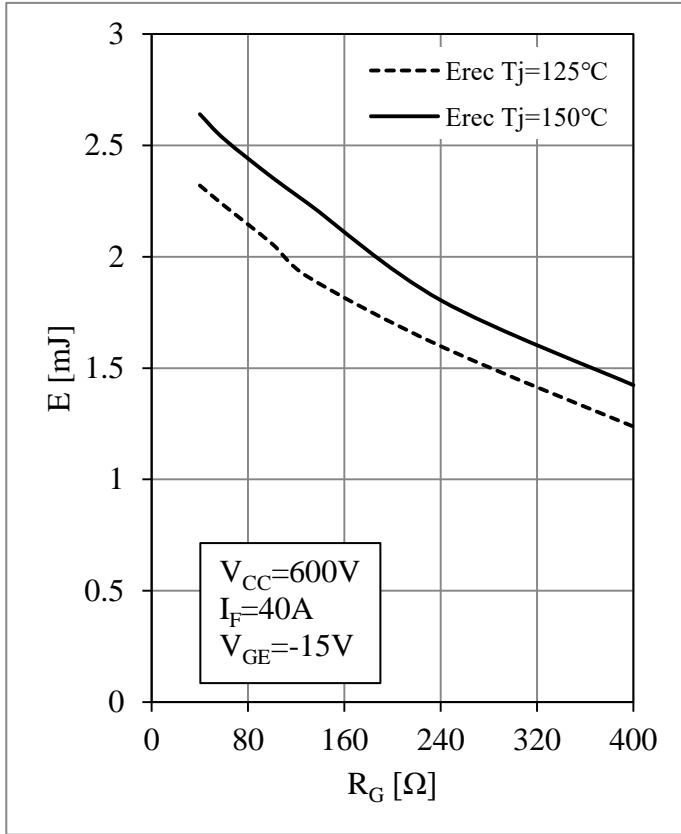


Fig 9. Diode-inverter Switching Loss vs. R_G

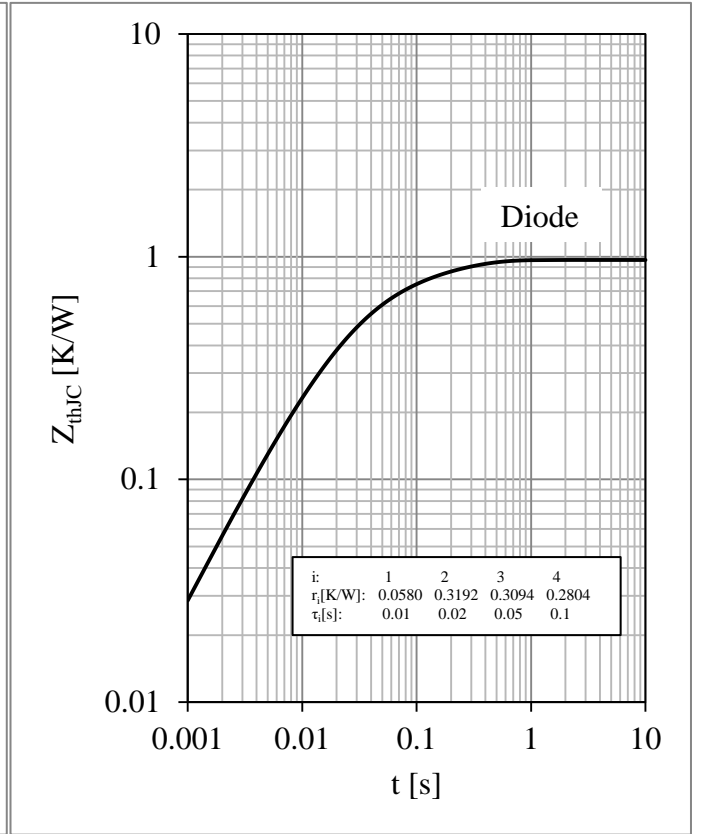


Fig 10. Diode-inverter Transient Thermal Impedance

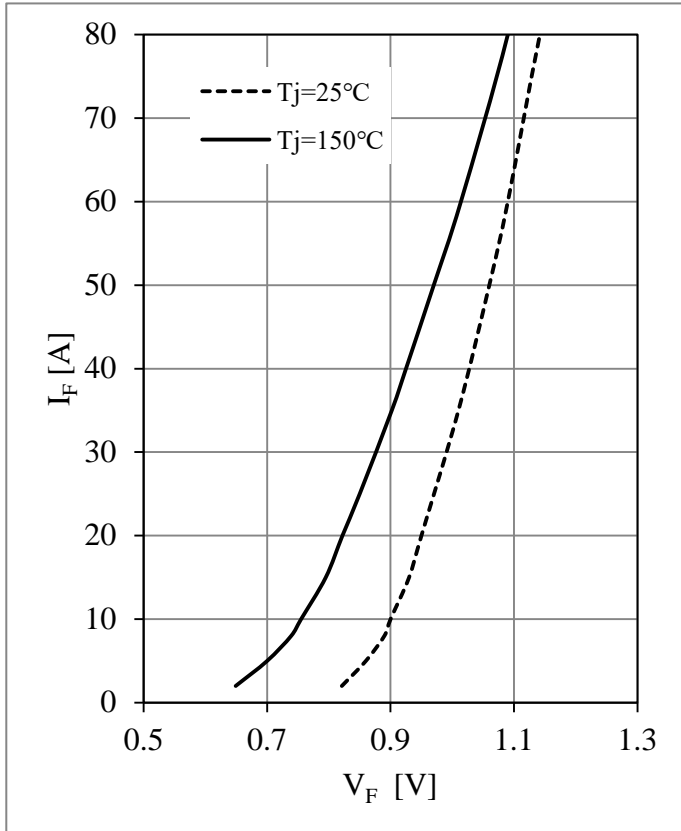


Fig 11. Diode-rectifier Forward Characteristics

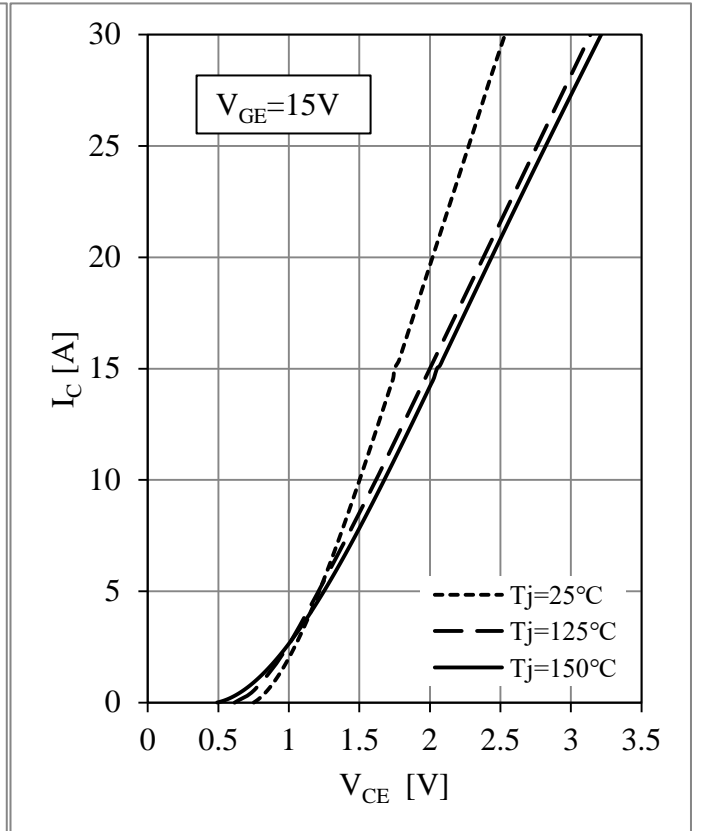


Fig 12. IGBT-brake-chopper Output Characteristics

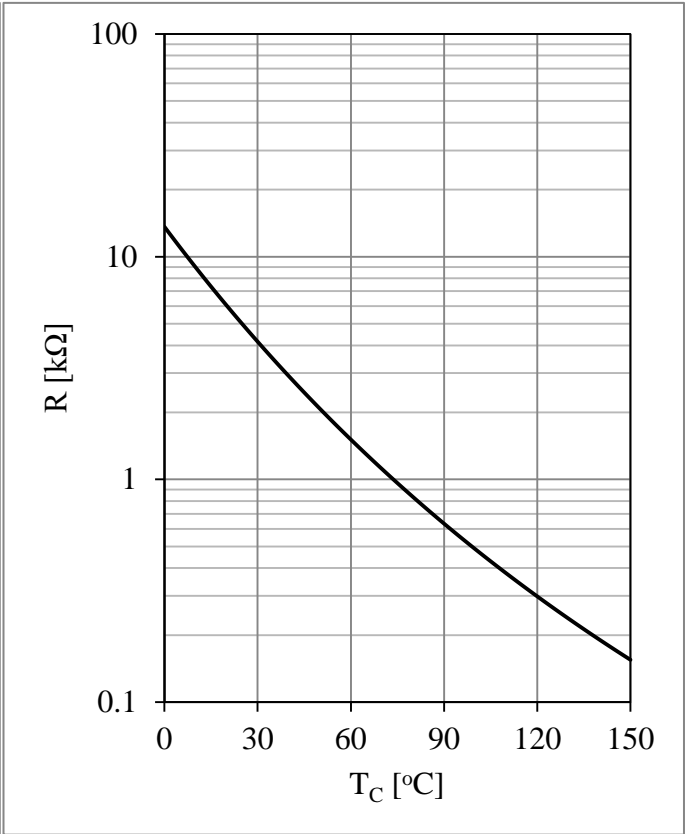
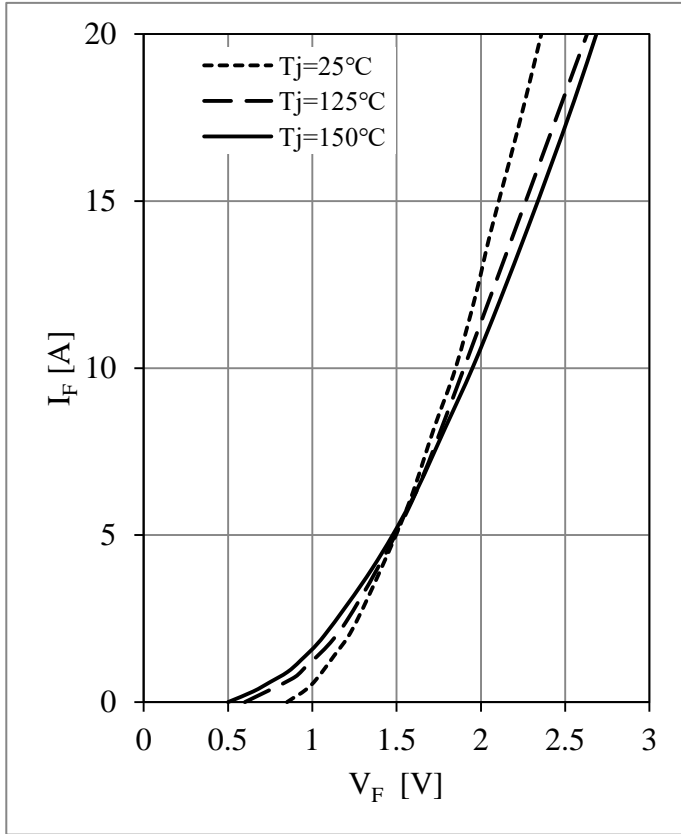
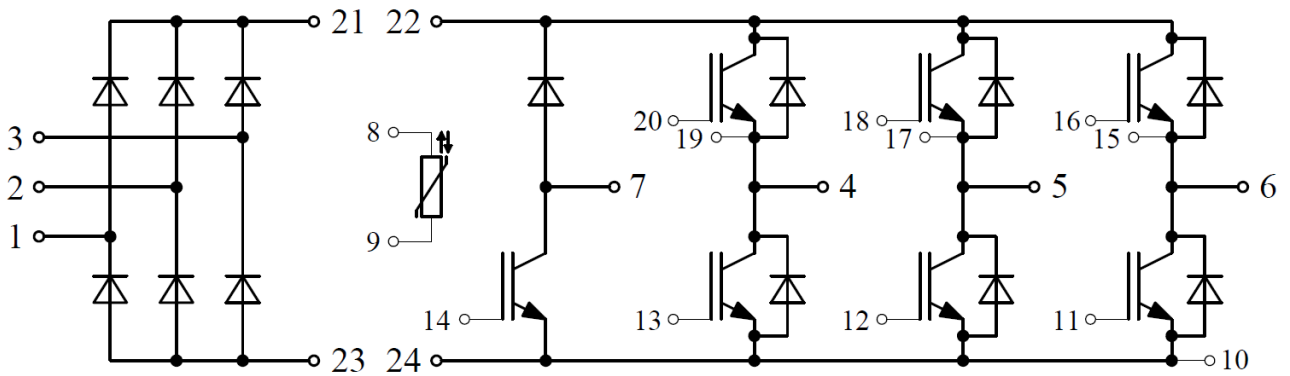


Fig 13. Diode-brake-chopper Forward Characteristics

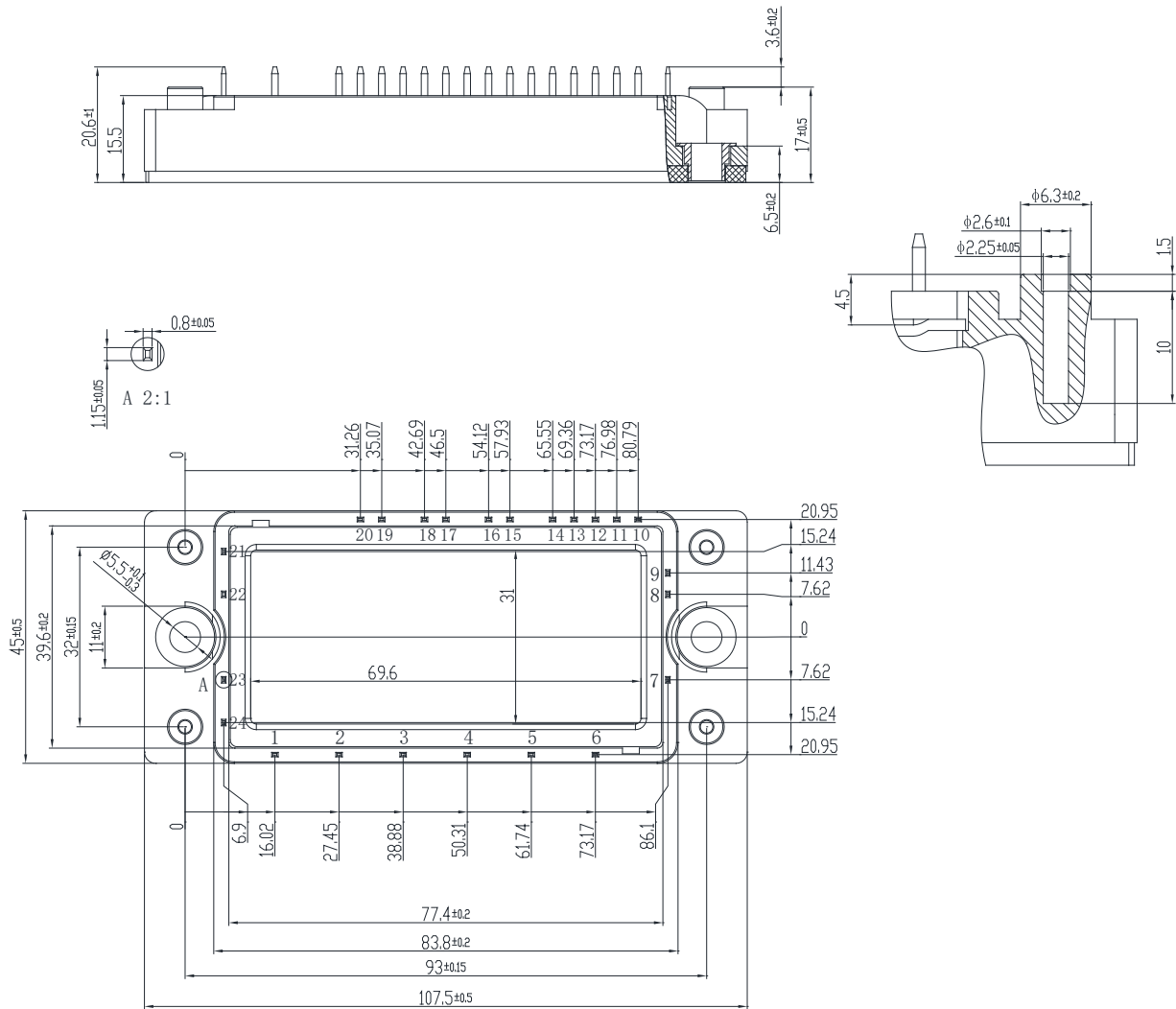
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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