

STARPOWER

SEMICONDUCTOR

IGBT

GD150PIA120C6SN

1200V/150A 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.

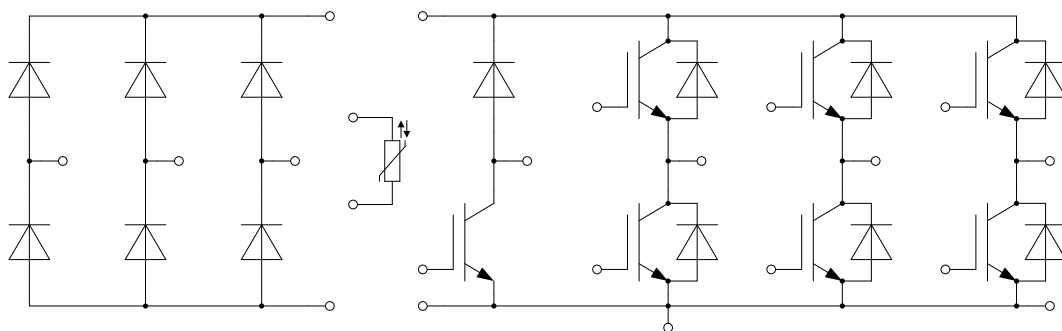
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 8 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 @ $T_C=95^{\circ}\text{C}$	150	A
I_{CRM}	Repetitive Peak Collector Current tp limited by T_{vjop}	300	A

Diode-inverter

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	150	A
I_{FRM}	Repetitive Peak Forward Current tp limited by T_{vjop}	300	A

Diode-rectifier

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1600	V
I_{FRMSM}	Maximum RMS Forward Current per Chip @ $T_C=100^{\circ}\text{C}$	150	A
I_{RMSM}	Maximum RMS Current at Rectifier Output @ $T_C=100^{\circ}\text{C}$	150	A
I_{FSM}	Surge Forward Current $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	1665	A
		1323	
I^2t	I^2t -value, $t_p=10\text{ms}$ @ $T_{vj}=25^{\circ}\text{C}$ @ $T_{vj}=150^{\circ}\text{C}$	13861	A^2s
		8751	

IGBT-brake

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=100^{\circ}\text{C}$	100	A
I_{CRM}	Repetitive Peak Collector Current tp limited by T_{vjop}	200	A

Diode-brake

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	50	A
I_{FRM}	Repetitive Peak Forward Current tp limited by T_{vjop}	100	A

Module

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

Note: $T_{vjop} > 150^{\circ}\text{C}$ is allowed for operation at overload conditions.

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	$I_C=150\text{A}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$		1.50	1.95	V
		$I_C=150\text{A}, V_{GE}=15\text{V}, T_{vj}=125^\circ\text{C}$		1.70		
		$I_C=150\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$		1.80		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=3.0\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^\circ\text{C}$	5.4	6.2	7.0	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$			50	μA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_{vj}=25^\circ\text{C}$			100	nA
R_{Gint}	Internal Gate Resistance			0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		13.3		nF
C_{res}	Reverse Transfer Capacitance				0.12	
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.96		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=3.3\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=25^\circ\text{C}$		59		ns
t_r	Rise Time			65		ns
$t_{d(off)}$	Turn-Off Delay Time			289		ns
t_f	Fall Time			179		ns
E_{on}	Turn-On Switching Loss			12.5		mJ
E_{off}	Turn-Off Switching Loss			11.7		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=3.3\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=125^\circ\text{C}$		66		ns
t_r	Rise Time			70		ns
$t_{d(off)}$	Turn-Off Delay Time			344		ns
t_f	Fall Time			283		ns
E_{on}	Turn-On Switching Loss			16.3		mJ
E_{off}	Turn-Off Switching Loss			16.0		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=150\text{A}, R_G=3.3\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$		69		ns
t_r	Rise Time			72		ns
$t_{d(off)}$	Turn-Off Delay Time			356		ns
t_f	Fall Time			301		ns
E_{on}	Turn-On Switching Loss			18.0		mJ
E_{off}	Turn-Off Switching Loss			16.8		mJ
I_{SC}	SC Data	$t_p \leq 8\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}, V_{CC}=600\text{V}, V_{CEM} \leq 1200\text{V}$		450		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	$I_F=150\text{A}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$		1.60	2.05	V
		$I_F=150\text{A}, V_{GE}=0\text{V}, T_{vj}=125^\circ\text{C}$		1.65		
		$I_F=150\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$		1.65		
Q_r	Recovered Charge			8.28		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=3371\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=25^\circ\text{C}$		106		A
E_{rec}	Reverse Recovery Energy			2.77		mJ
Q_r	Recovered Charge			15.6		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=2856\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=125^\circ\text{C}$		113		A
E_{rec}	Reverse Recovery Energy			5.45		mJ
Q_r	Recovered Charge			17.8		μC
I_{RM}	Peak Reverse Recovery Current	$V_R=600\text{V}, I_F=150\text{A},$ $-di/dt=2701\text{A}/\mu\text{s}, L_S=35\text{nH},$ $V_{GE}=-15\text{V}, T_{vj}=150^\circ\text{C}$		114		A
E_{rec}	Reverse Recovery Energy			6.19		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	$I_F=150\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$		0.95		V
I_R	Reverse Current	$T_{vj}=150^\circ\text{C}, V_R=1600\text{V}$			2.0	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	$I_C=100\text{A}, V_{GE}=15\text{V}, T_{vj}=25^\circ\text{C}$		1.50	1.95	V
		$I_C=100\text{A}, V_{GE}=15\text{V}, T_{vj}=125^\circ\text{C}$		1.70		
		$I_C=100\text{A}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}$		1.80		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=2.0\text{mA}, V_{CE}=V_{GE}, T_{vj}=25^\circ\text{C}$	5.4	6.2	7.0	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$			50	μA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_{vj}=25^\circ\text{C}$			100	nA
R_{Gint}	Internal Gate Resistance			0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		8.84		nF
C_{res}	Reverse Transfer Capacitance				0.08	
Q_G	Gate Charge	$V_{GE}=-15\dots+15\text{V}$		0.64		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=100\text{A}, R_G=3.9\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=25^\circ\text{C}$		62		ns
t_r	Rise Time			26		ns
$t_{d(off)}$	Turn-Off Delay Time			275		ns
t_f	Fall Time			175		ns
E_{on}	Turn-On Switching Loss			3.81		mJ
E_{off}	Turn-Off Switching Loss			8.67		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=100\text{A}, R_G=3.9\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=125^\circ\text{C}$		66		ns
t_r	Rise Time			29		ns
$t_{d(off)}$	Turn-Off Delay Time			331		ns
t_f	Fall Time			279		ns
E_{on}	Turn-On Switching Loss			5.57		mJ
E_{off}	Turn-Off Switching Loss			11.6		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=100\text{A}, R_G=3.9\Omega, L_S=35\text{nH}, V_{GE}=\pm 15\text{V}, T_{vj}=150^\circ\text{C}$		67		ns
t_r	Rise Time			30		ns
$t_{d(off)}$	Turn-Off Delay Time			341		ns
t_f	Fall Time			306		ns
E_{on}	Turn-On Switching Loss			6.00		mJ
E_{off}	Turn-Off Switching Loss			12.1		mJ
I_{SC}	SC Data	$t_p \leq 8\mu\text{s}, V_{GE}=15\text{V}, T_{vj}=150^\circ\text{C}, V_{CC}=600\text{V}, V_{CEM} \leq 1200\text{V}$		300		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	$I_F=50\text{A}, V_{GE}=0\text{V}, T_{vj}=25^\circ\text{C}$		1.60	2.05	V
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_{vj}=125^\circ\text{C}$		1.65		
		$I_F=50\text{A}, V_{GE}=0\text{V}, T_{vj}=150^\circ\text{C}$		1.65		

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		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
$B_{25/80}$	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		40		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)			0.225	K/W
	Junction-to-Case (per Diode-inverter)			0.376	
	Junction-to-Case (per Diode-rectifier)			0.291	
	Junction-to-Case (per IGBT-brake)			0.285	
	Junction-to-Case (per Diode-brake)			0.772	
R_{thCH}	Case-to-Sink (per IGBT-inverter)		0.148		K/W
	Case-to-Sink (per Diode-inverter)		0.162		
	Case-to-Sink (per Diode-rectifier)		0.161		
	Case-to-Sink (per IGBT-brake)		0.159		
	Case-to-Sink (per Diode-brake)		0.179		
M	Mounting Torque, Screw:M5	3.0		6.0	N.m
G	Weight of Module		300		g

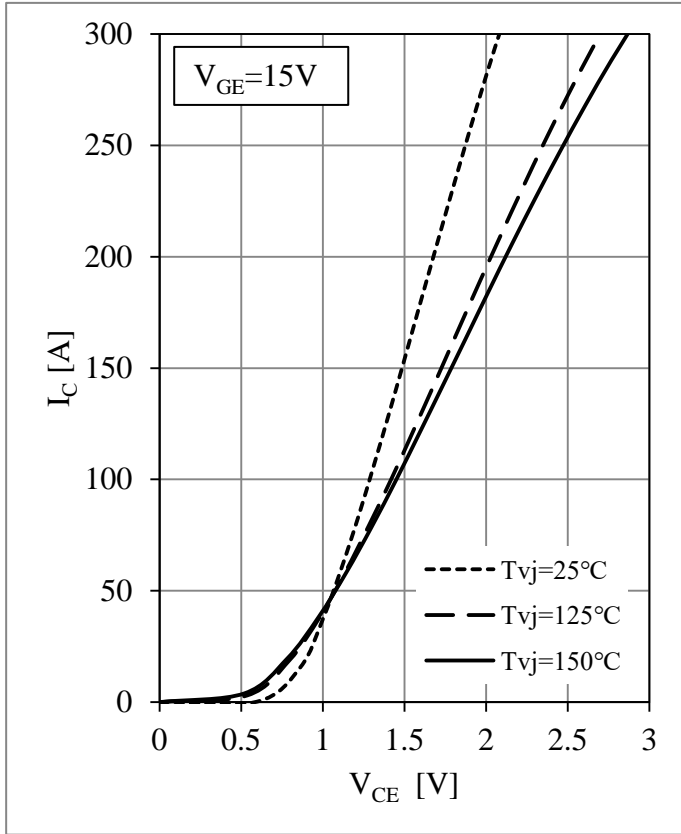


Fig 1. IGBT-inverter Output Characteristics

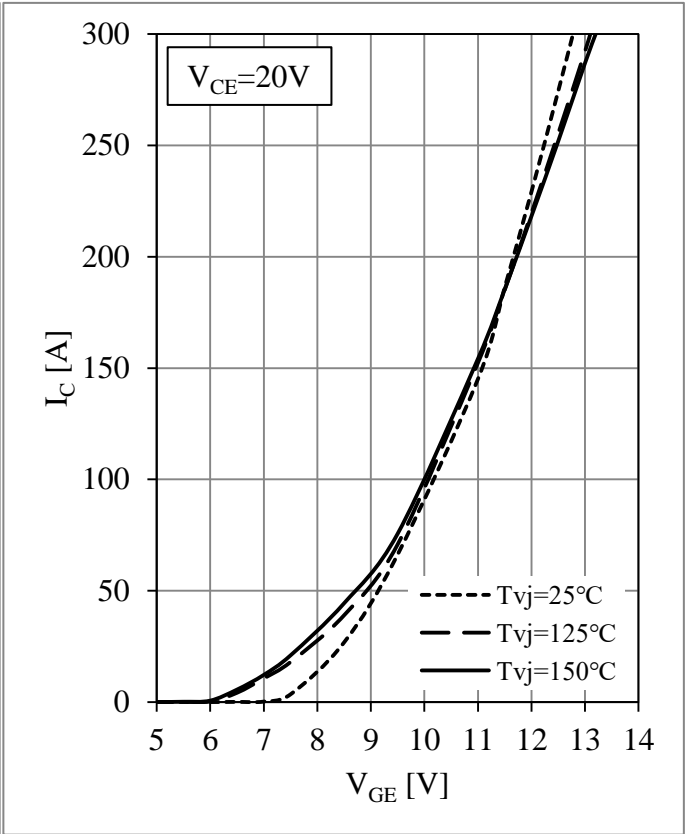


Fig 2. IGBT-inverter Transfer Characteristics

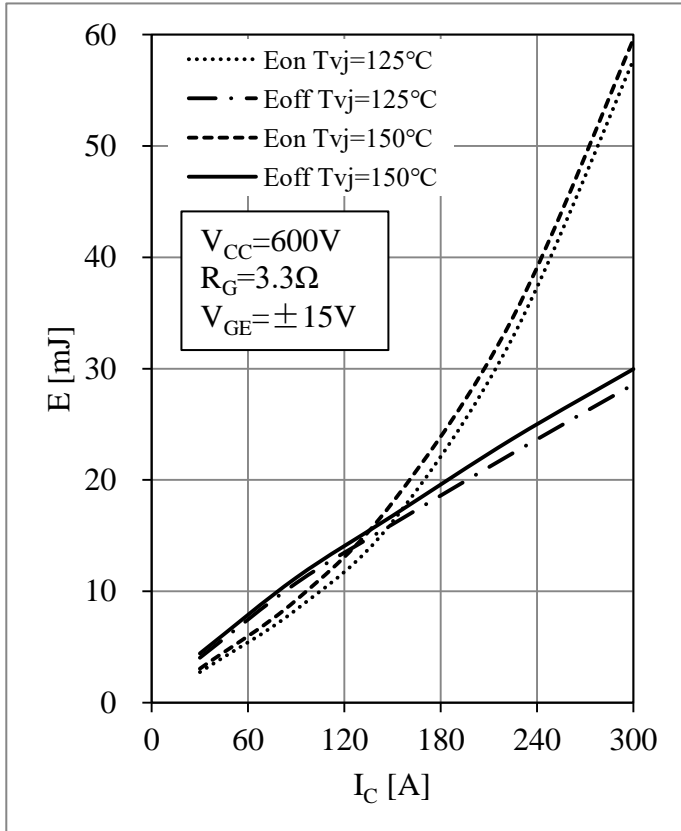


Fig 3. IGBT-inverter Switching Loss vs. I_C

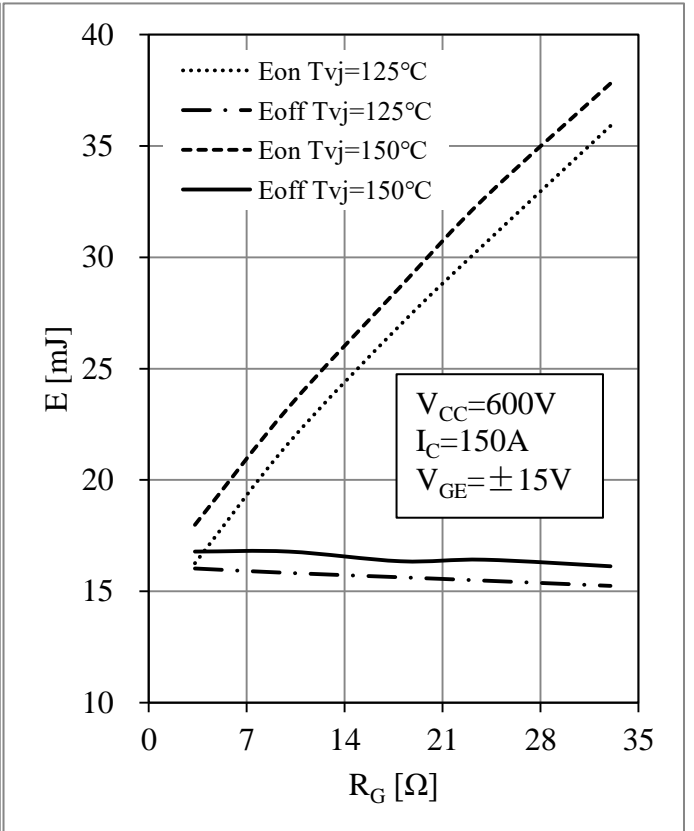


Fig 4. IGBT-inverter Switching Loss vs. R_G

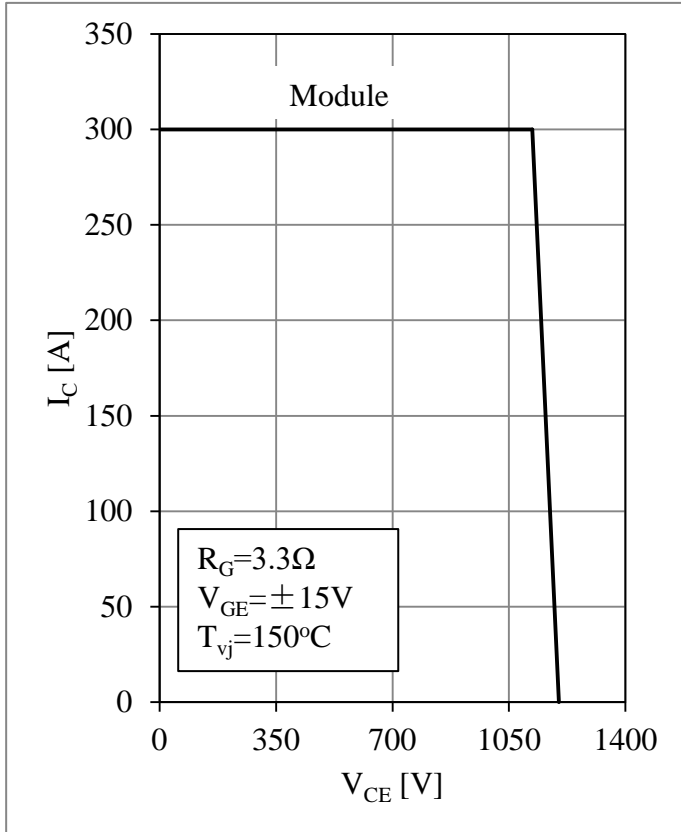


Fig 5. IGBT-inverter RBSOA

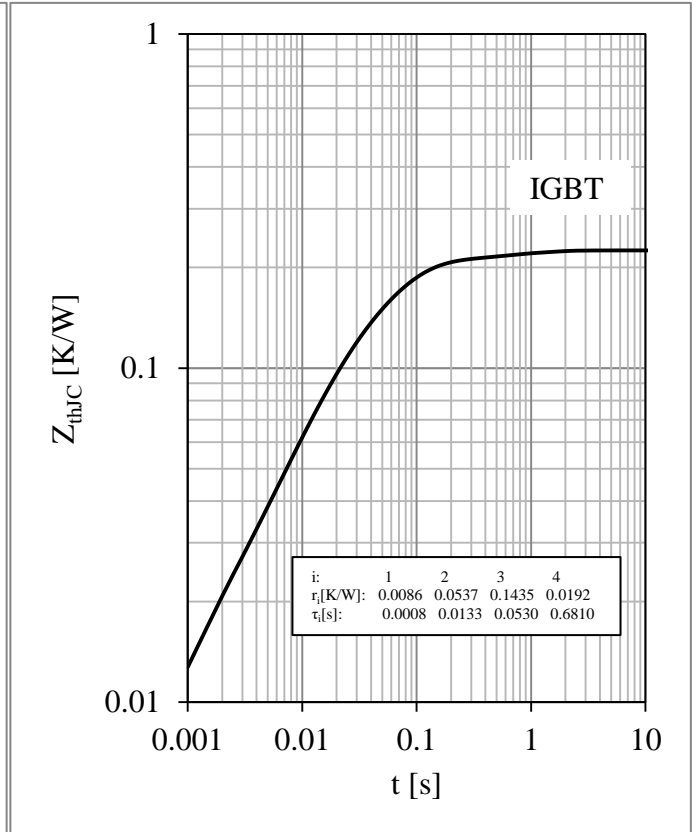


Fig 6. IGBT-inverter Transient Thermal Impedance

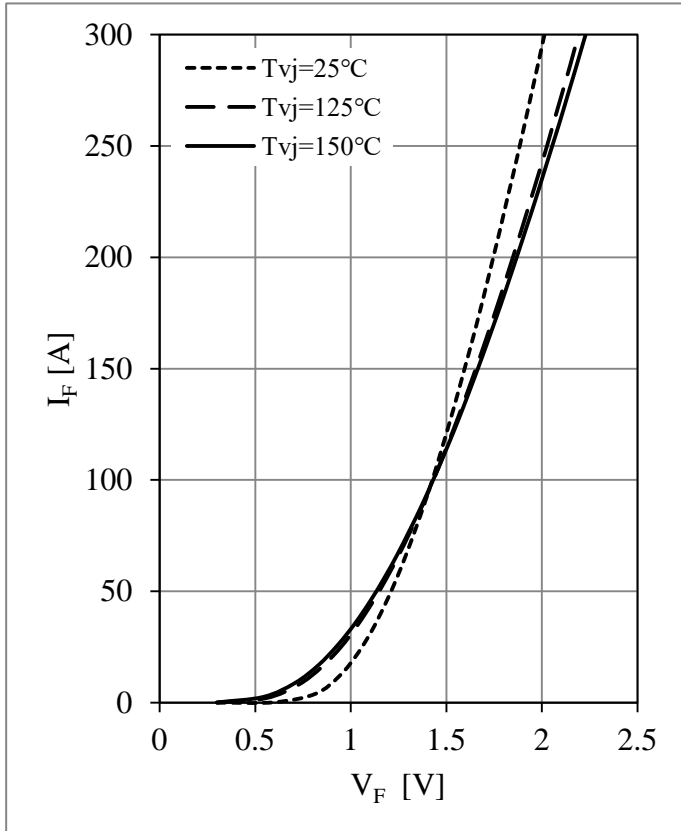


Fig 7. Diode-inverter Forward Characteristics

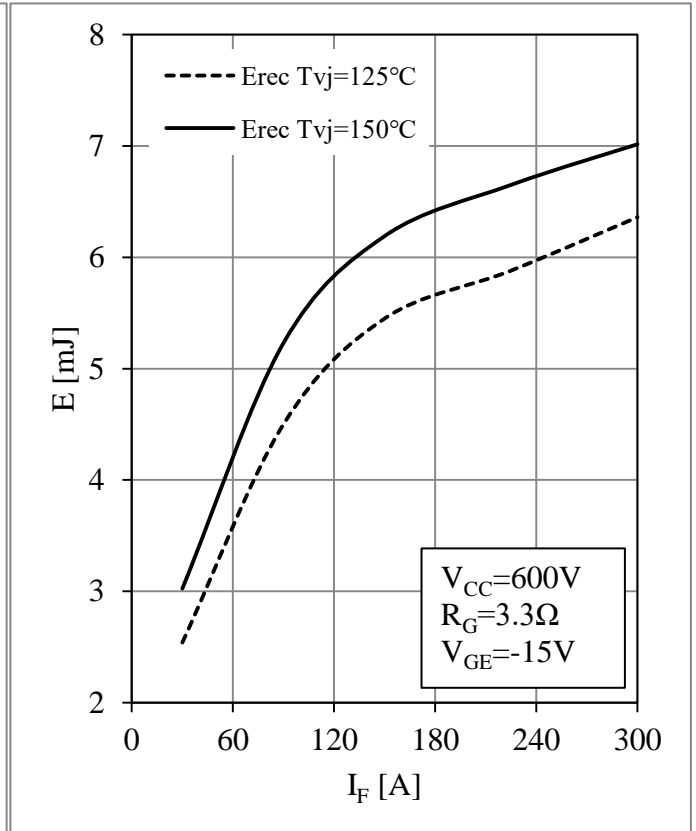


Fig 8. Diode-inverter Switching Loss vs. I_F

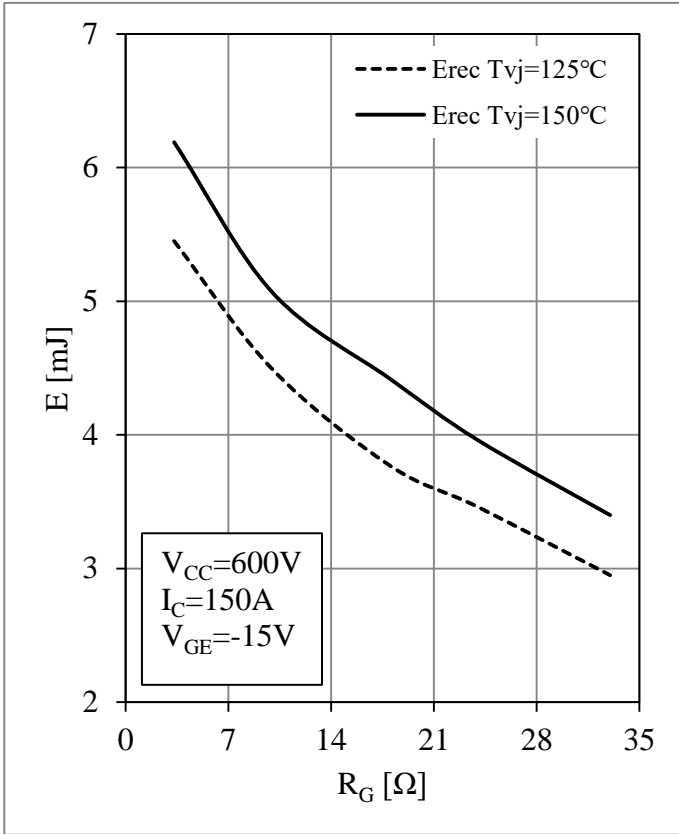


Fig 9. Diode-inverter Switching Loss vs. R_G

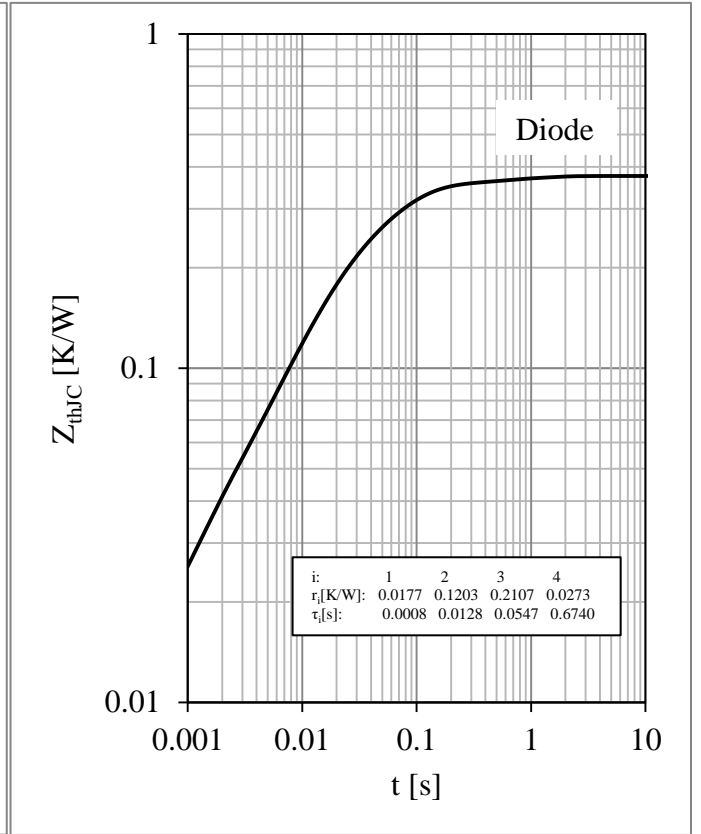


Fig 10. Diode-inverter Transient Thermal Impedance

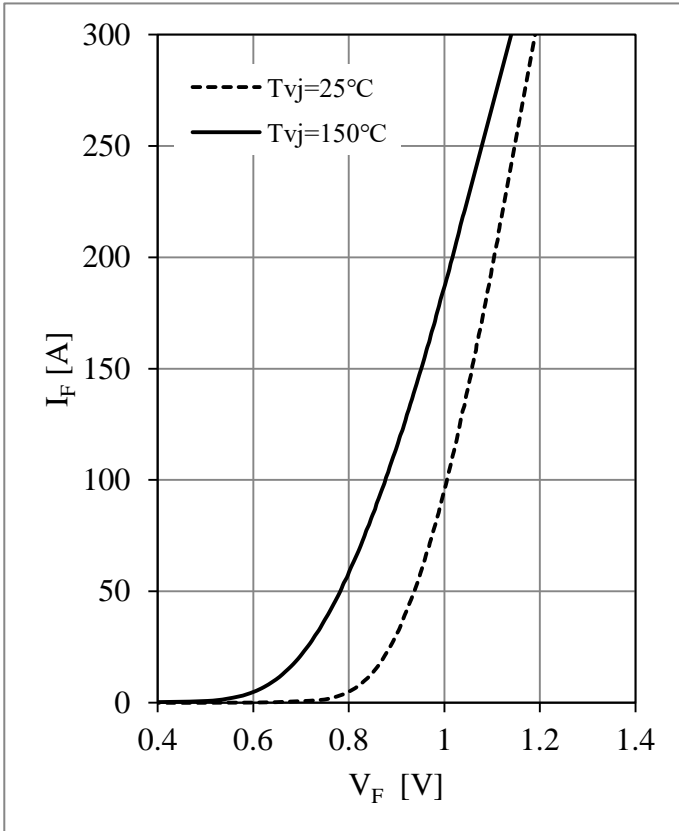


Fig 11. Diode-rectifier Forward Characteristics

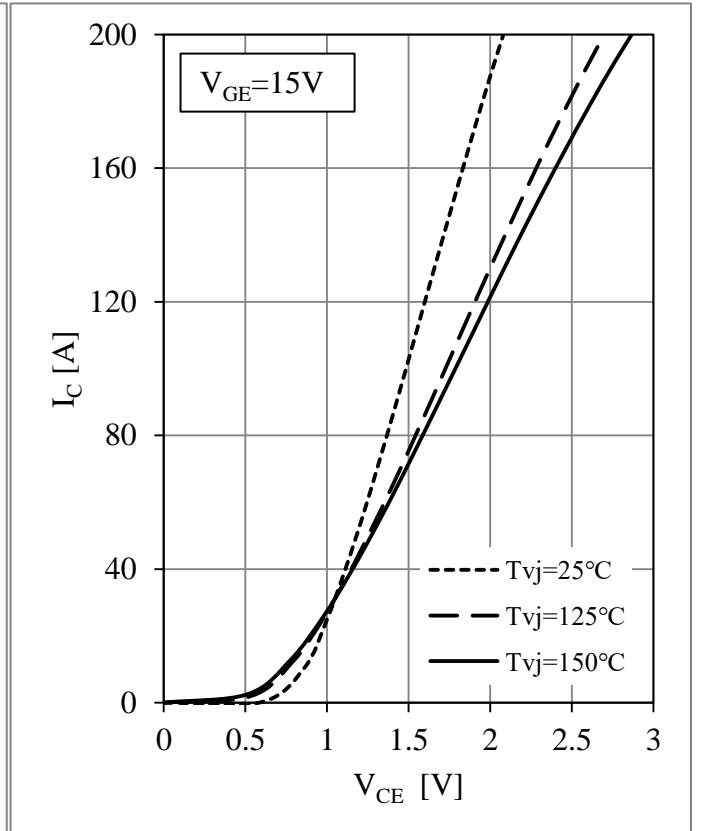


Fig 12. IGBT-brake-chopper Output Characteristics

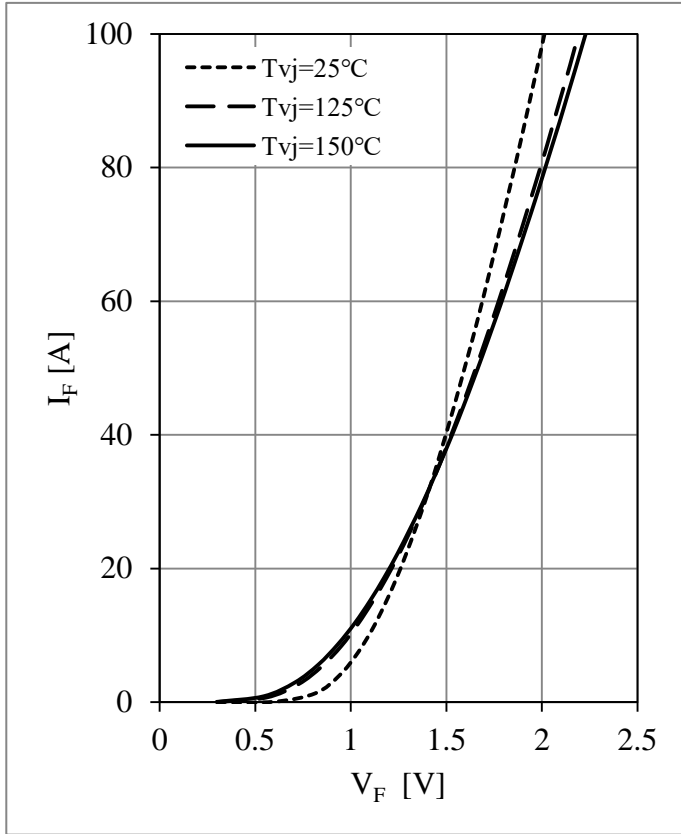


Fig 13. Diode-brake-chopper Forward Characteristics

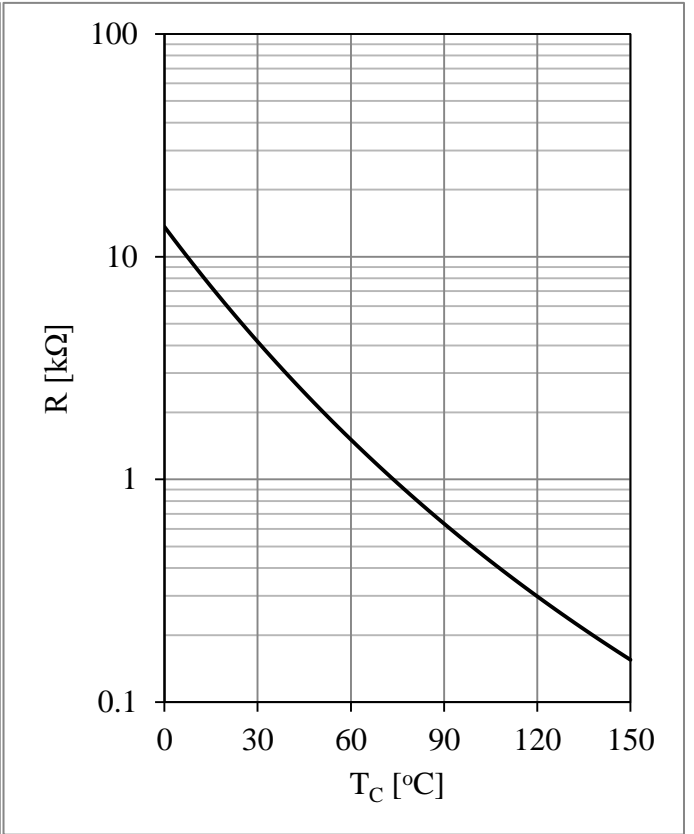
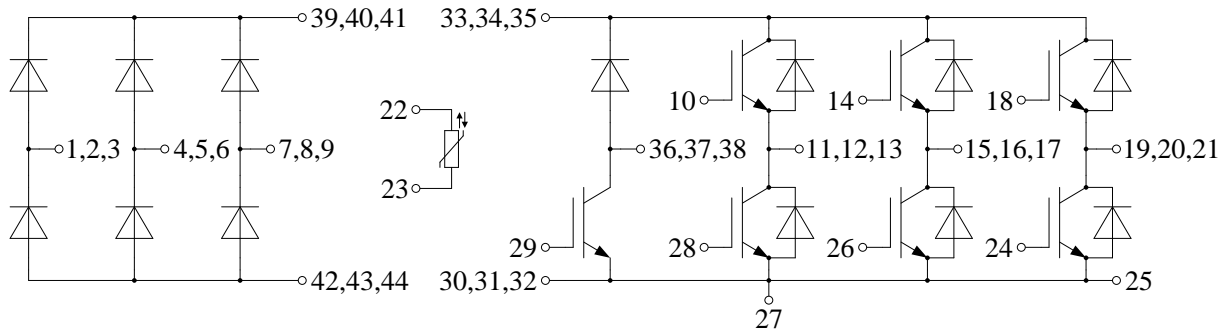


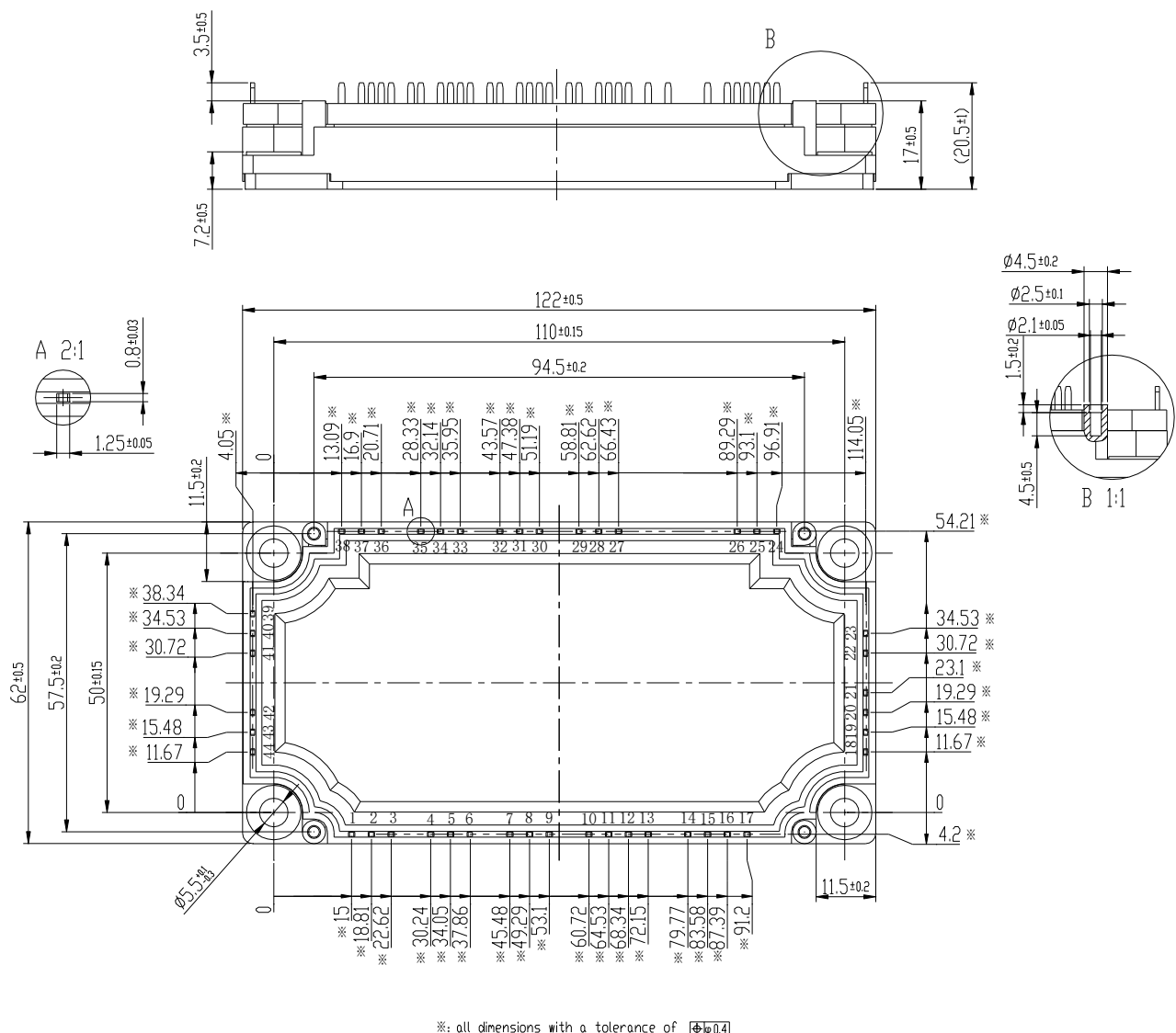
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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