STARPOWER

SEMICONDUCTOR **IGBT**

GD400CFX65C5S

650V/400A 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 inverter and UPS.

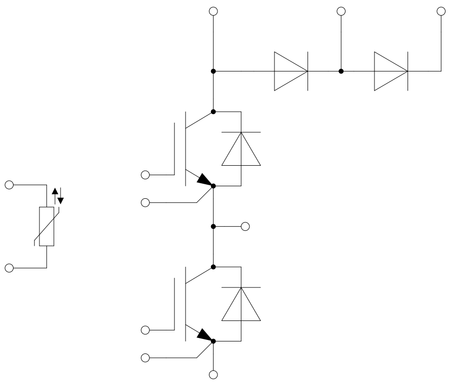
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- 6μs short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175^{o}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°C unless otherwise noted

T1,T2 IGBT

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	650	V
V_{GES}	Gate-Emitter Voltage	±20	V
I_C	Collector Current @ T_C=25°C @ T_C=45°C	445 400	A
I_{CM}	Pulsed Collector Current t_p=1ms	800	A
P_D	Maximum Power Dissipation @ T_j=175°C	1048	W

D1,D2 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	V
I_F	Diode Continuous Forward Current	400	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	800	A

D3,D4 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	650	V
I_F	Diode Continuous Forward Current	150	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	300	A

Module

Symbol	Description	Value	Unit
T_{jmax}	Maximum Junction Temperature	175	°C
T_{jop}	Operating Junction Temperature	-40 to +150	°C
T_{STG}	Storage Temperature Range	-40 to +125	°C
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	2500	V

T1,T2 IGBT Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=400A,V_{GE}=15V, T_j=25°C		1.45	1.90	V
		I_C=400A,V_{GE}=15V, T_j=125°C		1.60		
		I_C=400A,V_{GE}=15V, T_j=150°C		1.70		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=6.4mA,V_{CE}=V_{GE}, T_j=25°C	5.1	5.8	6.5	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_j=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_j=25°C			400	nA
R_{Gint}	Internal Gate Resistance			1.0		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=1MHz, V_{GE}=0V		22.2		nF
C_{res}	Reverse Transfer Capacitance			0.66		nF
Q_G	Gate Charge	V_{GE}=-15V…+15V		3.87		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=300V,I_C=400A, R_G=1.5Ω,V_{GE}=±15V, T_j=25°C		95		ns
t_r	Rise Time			47		ns
$t_{d(off)}$	Turn-Off Delay Time			295		ns
t_f	Fall Time			50		ns
E_{on}	Turn-On Switching Loss			1.9		mJ
E_{off}	Turn-Off Switching Loss			12.5		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=300V,I_C=400A, R_G=1.5Ω,V_{GE}=±15V, T_j=125°C		111		ns
t_r	Rise Time			59		ns
$t_{d(off)}$	Turn-Off Delay Time			311		ns
t_f	Fall Time			65		ns
E_{on}	Turn-On Switching Loss			2.3		mJ
E_{off}	Turn-Off Switching Loss			15.4		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=300V,I_C=400A, R_G=1.5Ω,V_{GE}=±15V, T_j=150°C		121		ns
t_r	Rise Time			65		ns
$t_{d(off)}$	Turn-Off Delay Time			317		ns
t_f	Fall Time			67		ns
E_{on}	Turn-On Switching Loss			2.8		mJ
E_{off}	Turn-Off Switching Loss			16.1		mJ
I_{SC}	SC Data	t_P≤6μs,V_{GE}=15V, T_j=150°C,V_{CC}=360V, V_{CEM}≤600V		2000		A

D1,D2 Diode Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=400A,V_{GE}=0V,T_j=25°C		1.55	2.00	V
		I_F=400A,V_{GE}=0V,T_j=125°C		1.50		
		I_F=400A,V_{GE}=0V,T_j=150°C		1.50		
Q_r	Recovered Charge	V_R=300V,I_F=400A, -di/dt=6050A/μs,V_{GE}=-15V T_j=25°C		20.0		μC
I_{RM}	Peak Reverse Recovery Current			226		A
E_{rec}	Reverse Recovery Energy			3.94		mJ
Q_r	Recovered Charge	V_R=300V,I_F=400A, -di/dt=6050A/μs,V_{GE}=-15V T_j=125°C		33.0		μC
I_{RM}	Peak Reverse Recovery Current			303		A
E_{rec}	Reverse Recovery Energy			7.97		mJ
Q_r	Recovered Charge	V_R=300V,I_F=400A, -di/dt=6050A/μs,V_{GE}=-15V T_j=150°C		38.2		μC
I_{RM}	Peak Reverse Recovery Current			330		A
E_{rec}	Reverse Recovery Energy			9.10		mJ

D3,D4 Diode Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	I_F=150A,V_{GE}=0V,T_j=25°C		1.55	2.00	V
		I_F=150A,V_{GE}=0V,T_j=125°C		1.50		
		I_F=150A,V_{GE}=0V,T_j=150°C		1.50		
Q_r	Recovered Charge	V_R=300V,I_F=150A, -di/dt=5400A/μs,V_{GE}=-15V T_j=25°C		7.0		μC
I_{RM}	Peak Reverse Recovery Current			150		A
E_{rec}	Reverse Recovery Energy			1.93		mJ
Q_r	Recovered Charge	V_R=300V,I_F=150A, -di/dt=5400A/μs,V_{GE}=-15V T_j=125°C		13.0		μC
I_{RM}	Peak Reverse Recovery Current			182		A
E_{rec}	Reverse Recovery Energy			3.50		mJ
Q_r	Recovered Charge	V_R=300V,I_F=150A, -di/dt=5400A/μs,V_{GE}=-15V T_j=150°C		14.7		μC
I_{RM}	Peak Reverse Recovery Current			181		A
E_{rec}	Reverse Recovery Energy			3.92		mJ

NTC Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated Resistance			5.0		kΩ
ΔR/R	Deviation of R_{100}	T_C=100 °C,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
$B_{25/80}$	B-value	$R_2=R_{25}exp[B_{25/80}(1/T_2-1/(298.15K))]$		3411		K
$B_{25/100}$	B-value	$R_2=R_{25}exp[B_{25/100}(1/T_2-1/(298.15K))]$		3433		K

Module Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
R_{thJC}	Junction-to-Case (per T1,T2 IGBT) Junction-to-Case (per D1,D2 Diode) Junction-to-Case (per D3,D4 Diode)			0.143 0.238 0.623	K/W
R_{thCH}	Case-to-Heatsink (per T1,T2 IGBT) Case-to-Heatsink (per D1,D2 Diode) Case-to-Heatsink (per D3,D4 Diode) Case-to-Heatsink (per Module)		0.073 0.122 0.319 0.020		K/W
M	Mounting Torque, Screw M5	2.5		5.0	N.m
G	Weight of Module		200		g

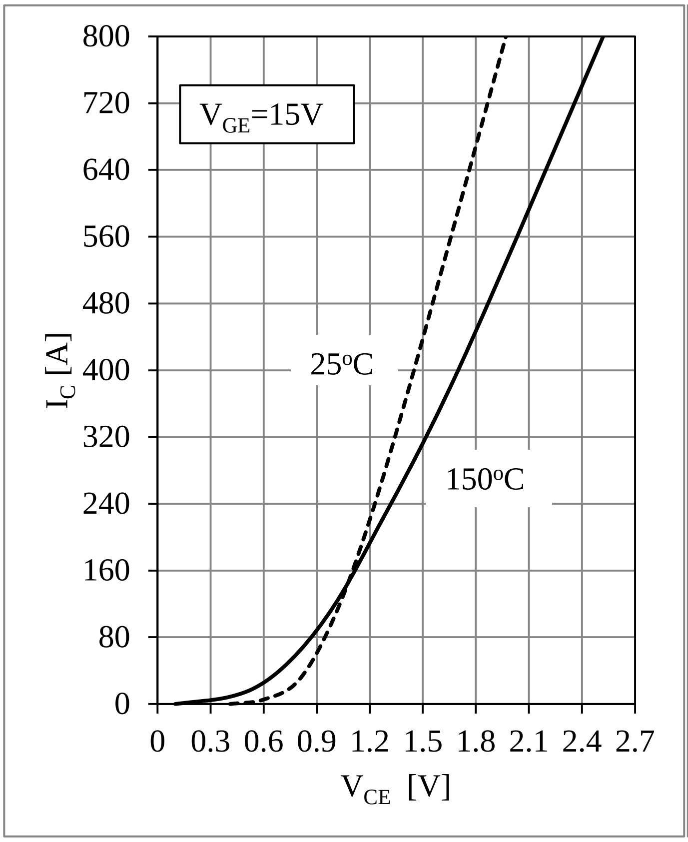


Fig 1. T1,T2 IGBT Output Characteristics

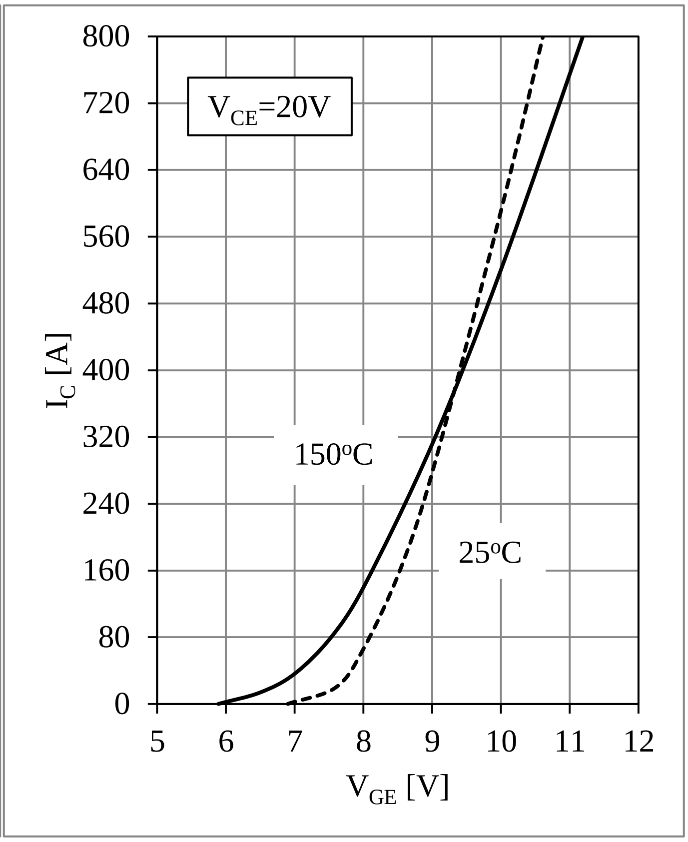


Fig 2. T1,T2 IGBT Transfer Characteristics

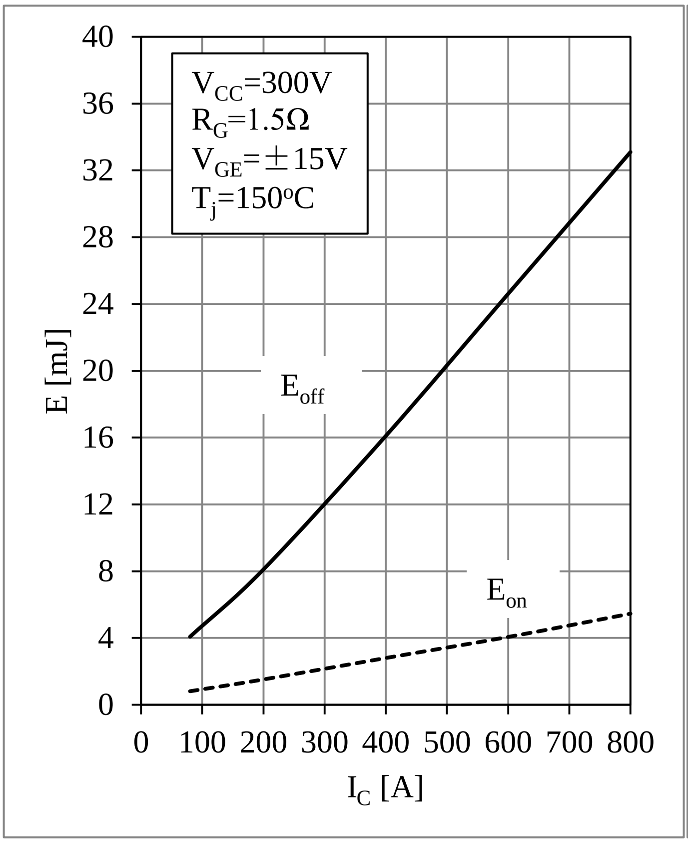


Fig 3. T1,T2 IGBT Switching Loss vs. I_C

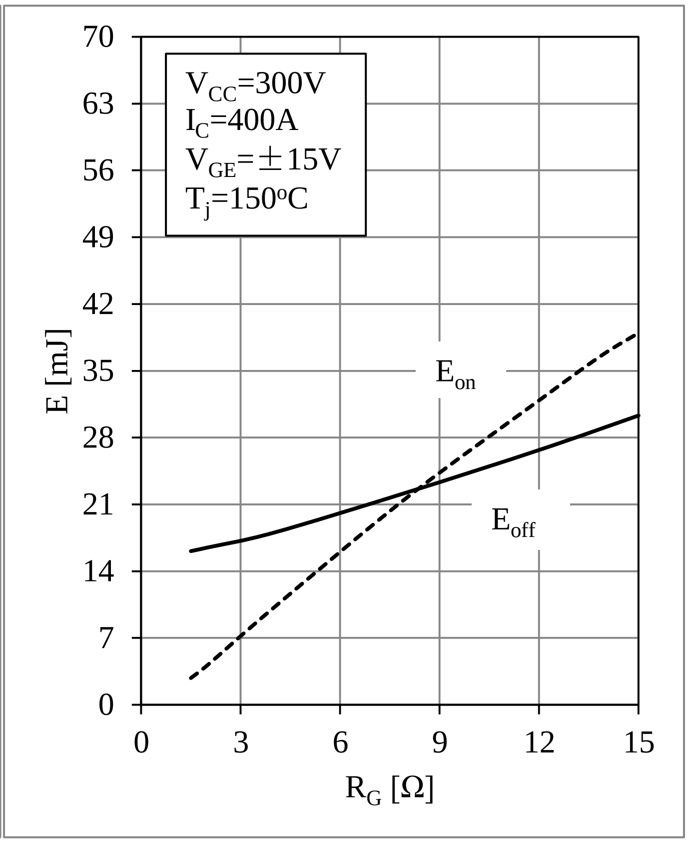


Fig 4. T1,T2 IGBT Switching Loss vs. R_G

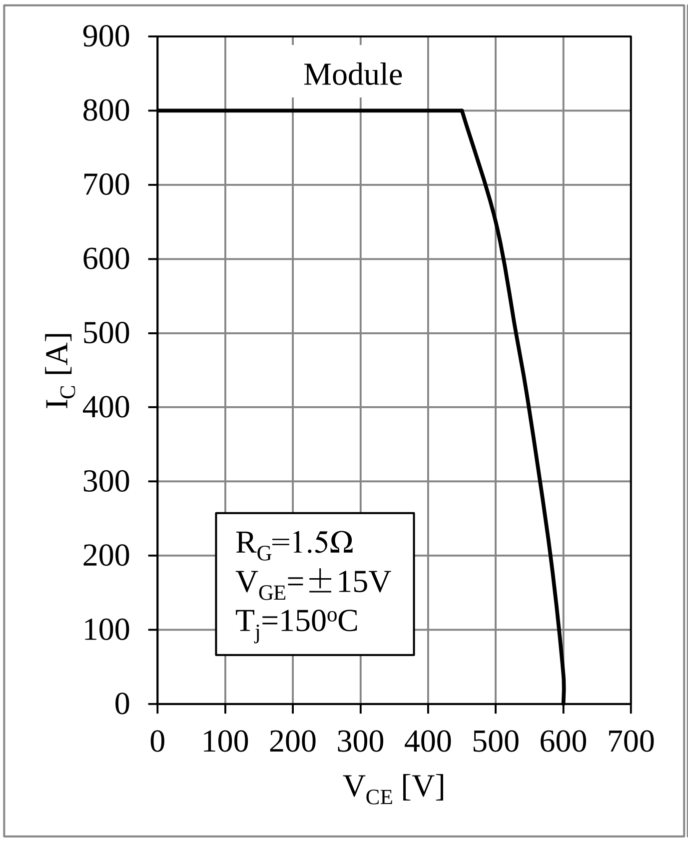


Fig 5. T1,T2 IGBT RBSOA

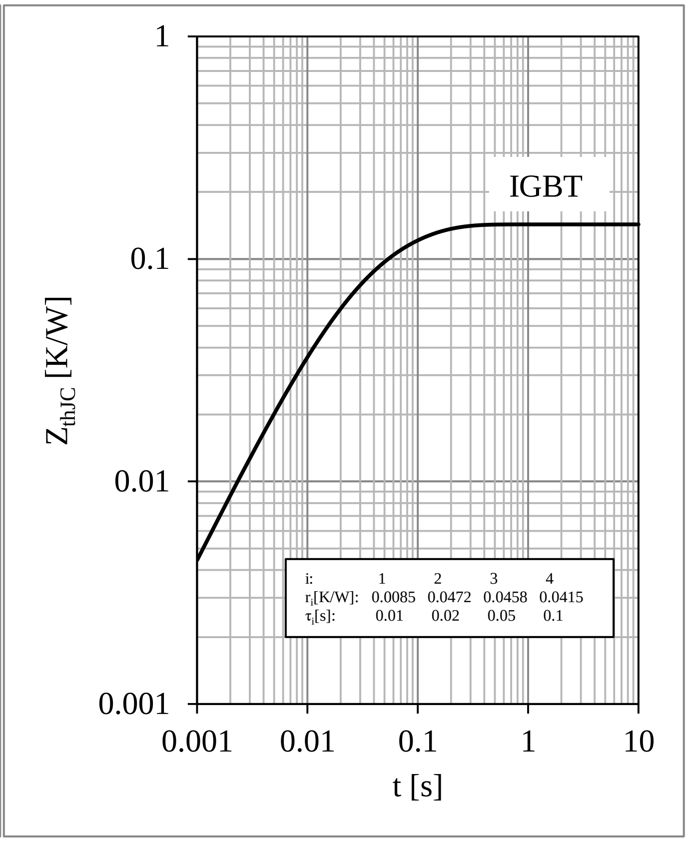


Fig 6. T1,T2 IGBT Transient Thermal Impedance

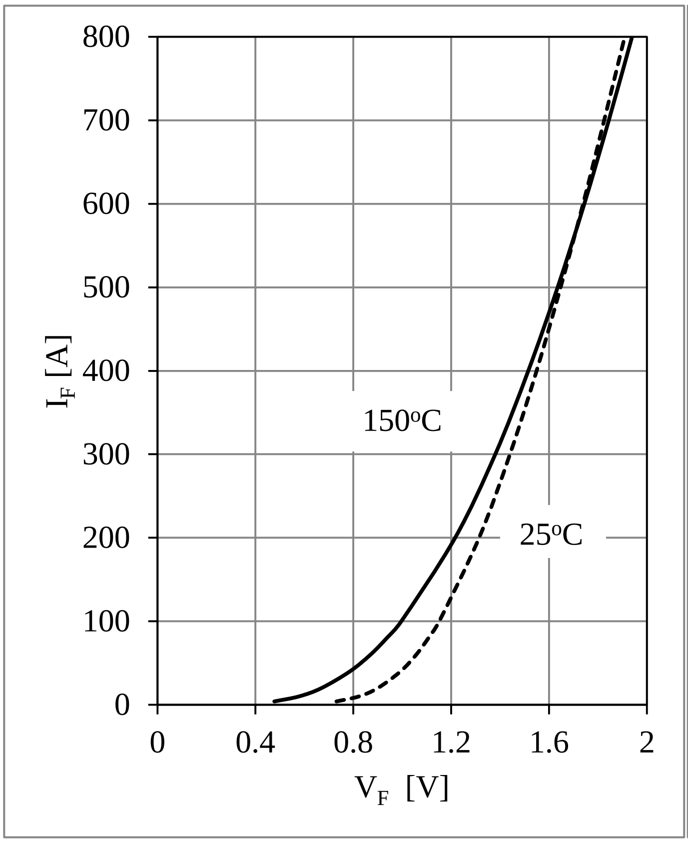


Fig 7. D1,D2 Diode Forward Characteristics

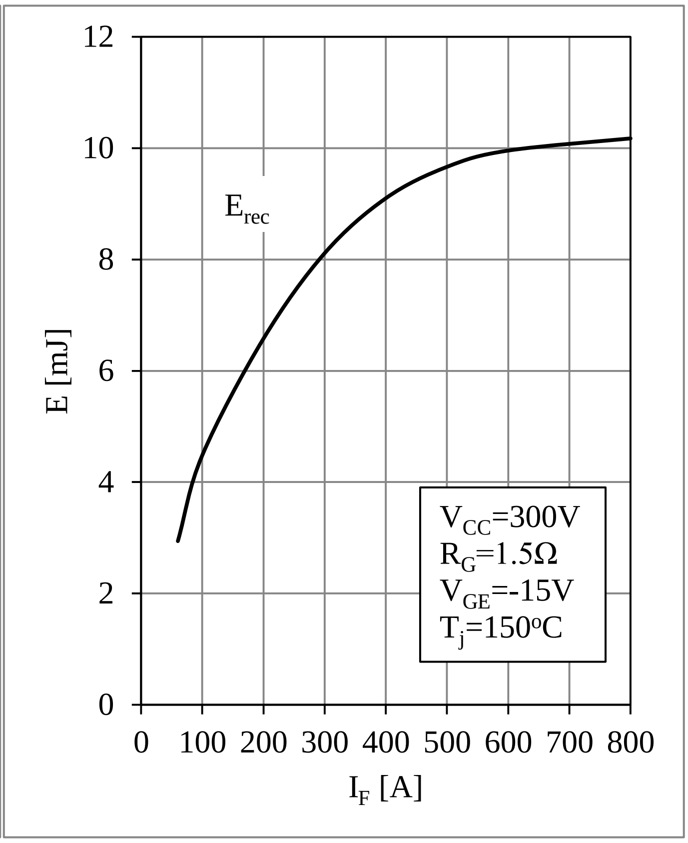


Fig 8. D1,D2 Diode Switching Loss vs. I_F

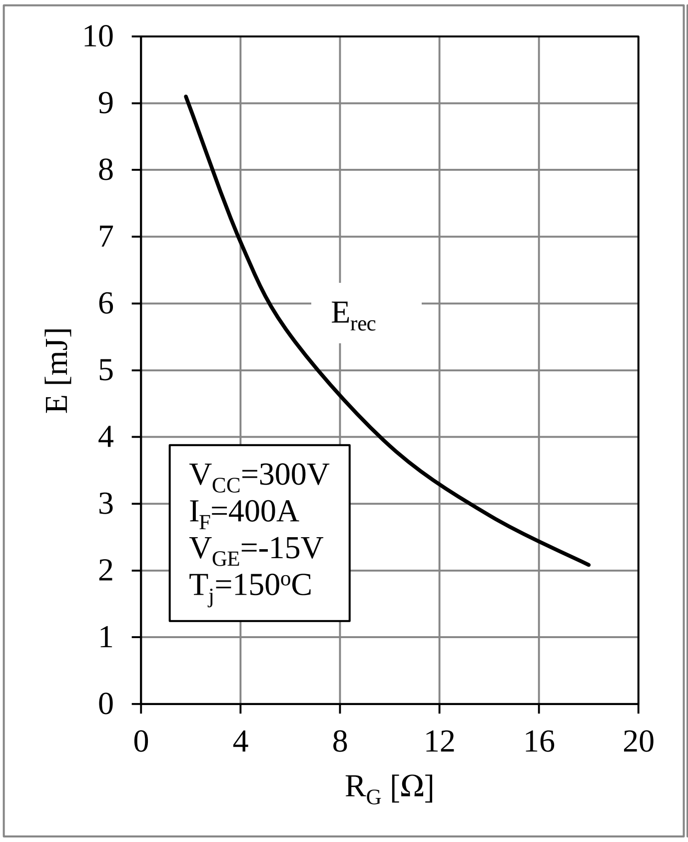


Fig 9. D1,D2 Diode Switching Loss vs. R_G

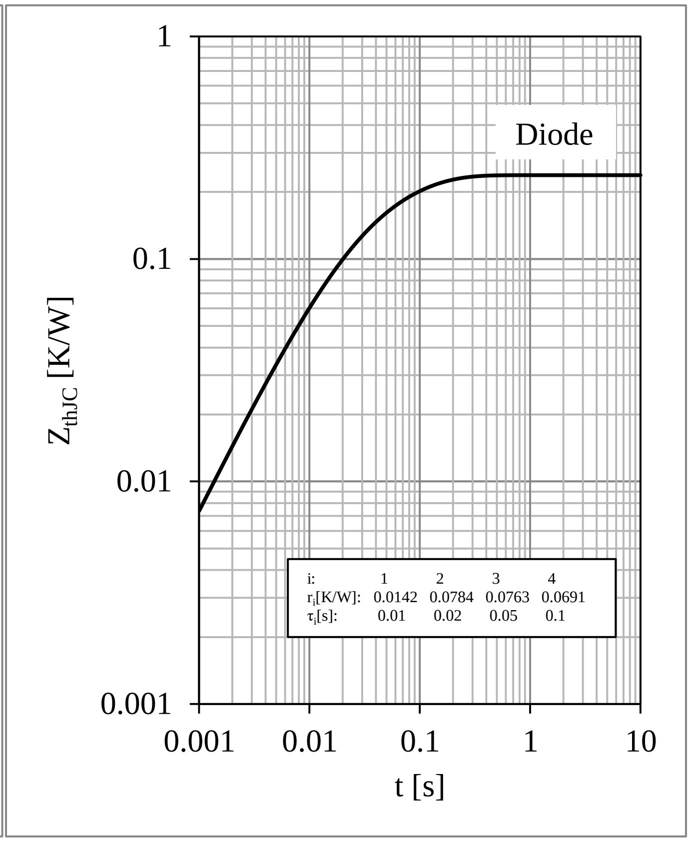


Fig 10. D1,D2 Diode Transient Thermal Impedance

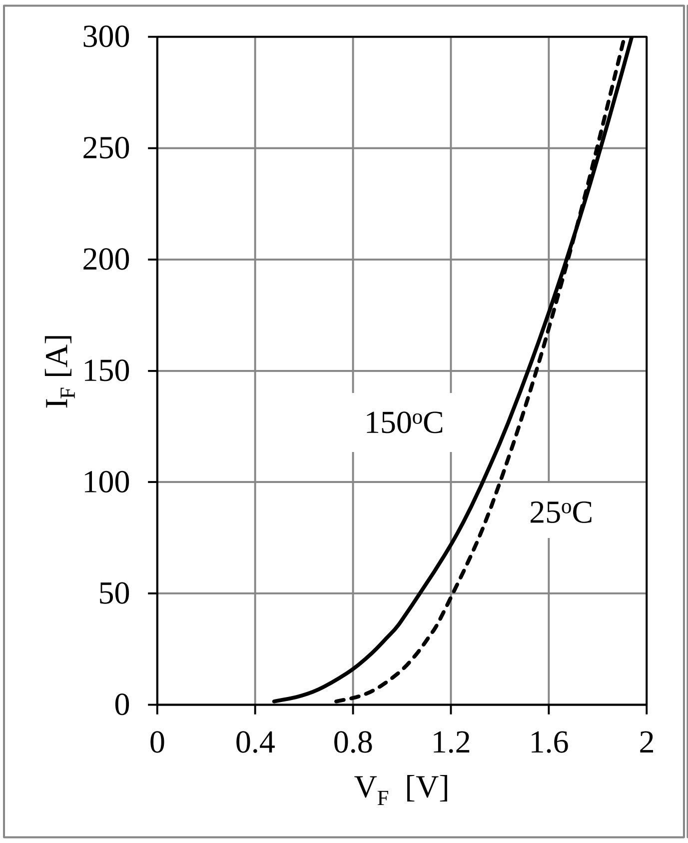


Fig 11. D3,D4 Diode Forward Characteristics

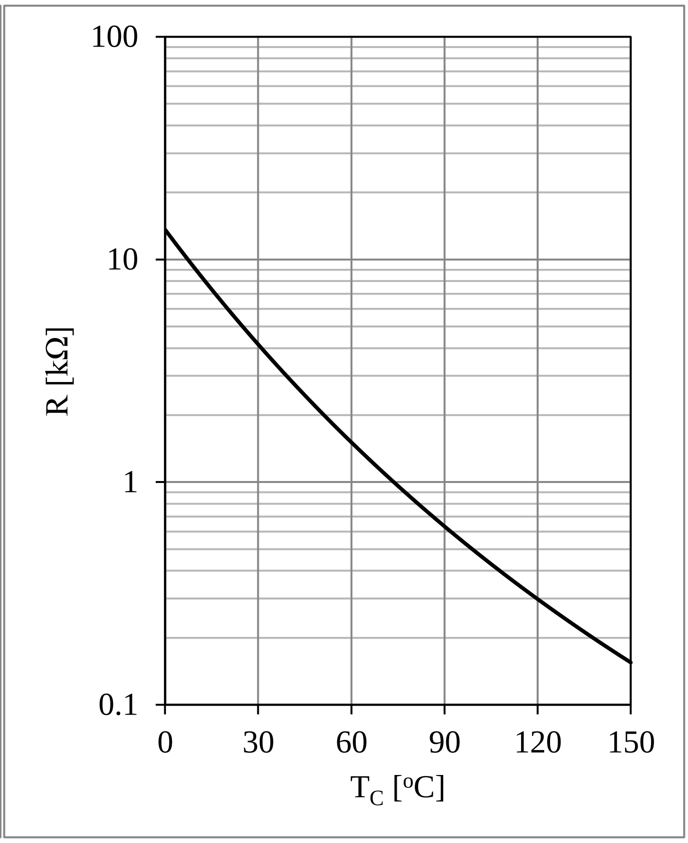
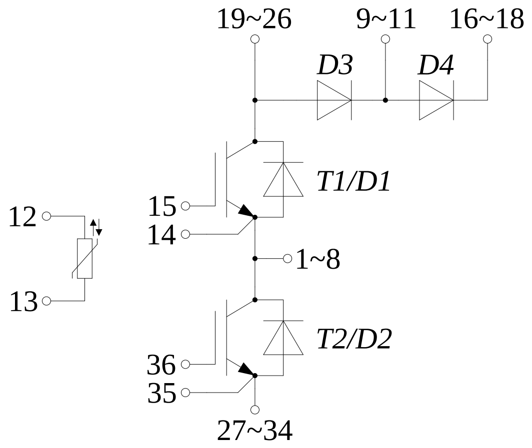


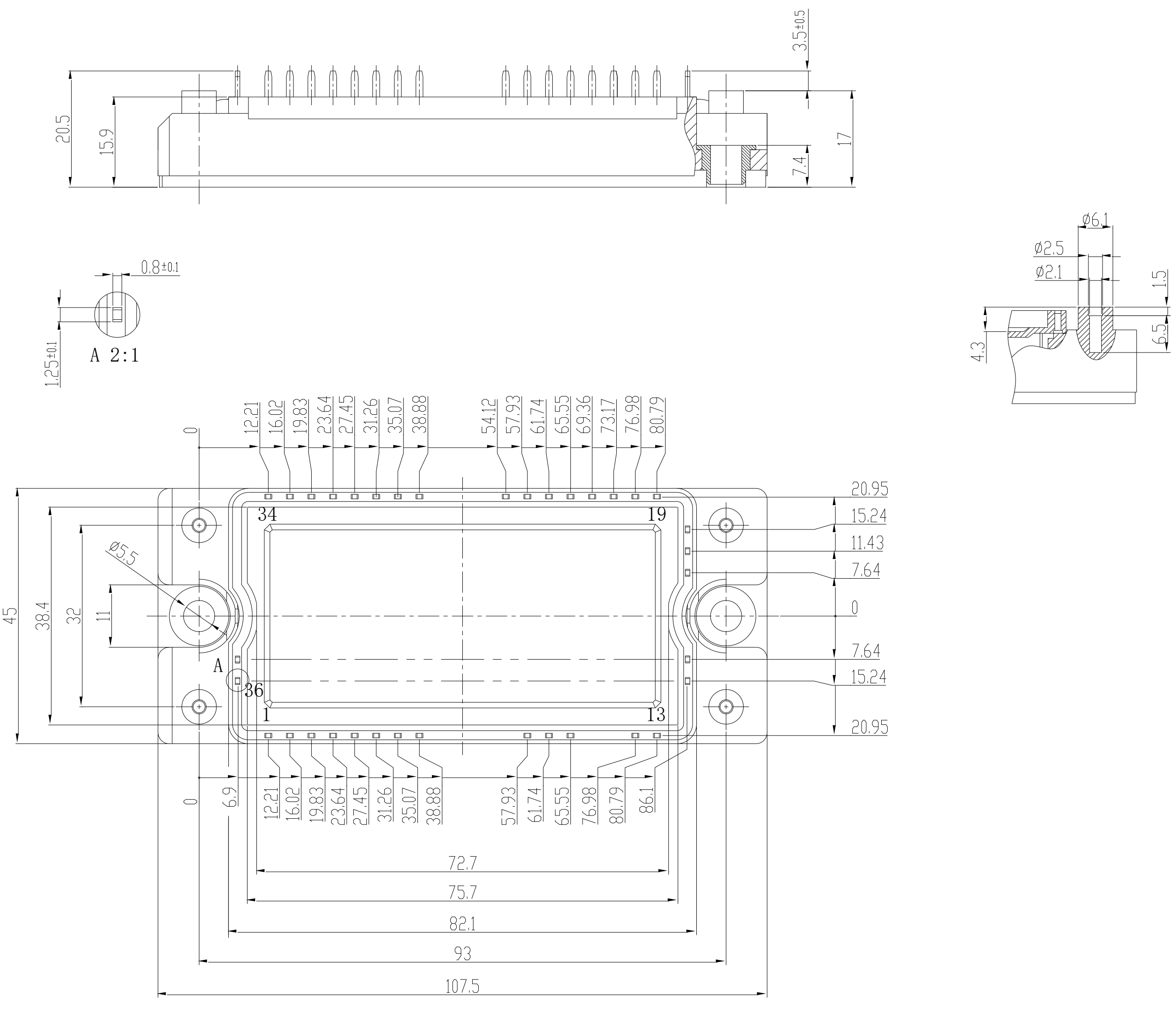
Fig 12. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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