STARPOWER

SEMICONDUCTOR **IGBT**

GD650MJA100L6Q

1000V/650A 3-level 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 3-level-application.

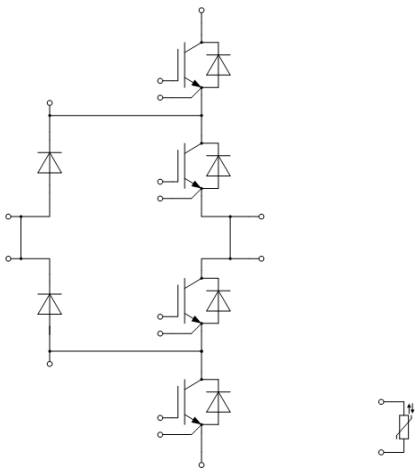
Features

- Low $V_{CE(sat)}$ Trench IGBT technology
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175 ^{o}C
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology

Typical Applications

- Solar power
- 3-level-application

Equivalent Circuit Schematic



Absolute Maximum Ratings T_C=25°C unless otherwise noted

T1,T4 IGBT

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1050	V
V_{GES}	Gate-Emitter Voltage Transient Gate-Emitter Voltage	±23 ±30	V
I_{CN}	Implemented Collector Current	650	A
I_C	Collector Current @ T_C=100°C	441	A
I_{CM}	Pulsed Collector Current t_p=1ms	1300	A

T2,T3 IGBT

Symbol	Description	Value	Unit
V_{CES}	Collector-Emitter Voltage	1050	V
V_{GES}	Gate-Emitter Voltage Transient Gate-Emitter Voltage	±23 ±30	V
I_{CN}	Implemented Collector Current	650	A
I_C	Collector Current @ T_C=100°C	441	A
I_{CM}	Pulsed Collector Current t_p=1ms	1300	A

D1-D4 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1050	V
I_{FN}	Implemented Forward Current	300	A
I_F	Diode Continuous Forward Current@ T_C=65°C	240	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	600	A

D5,D6 Diode

Symbol	Description	Value	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1050	V
I_{FN}	Implemented Forward Current	400	A
I_F	Diode Continuous Forward Current@ T_C=65°C	320	A
I_{FM}	Diode Maximum Forward Current t_p=1ms	800	A

Module

Symbol	Description	Value	Unit
T_{vjmax}	Maximum Junction Temperature	175	°C
T_{vjop}	Operating Junction Temperature(T1-T4, D1-D6)	-40 to +150	°C
T_{STG}	Storage Temperature Range	-40 to +125	°C
V_{ISO}	Isolation Voltage RMS,f=50Hz,t=1min	3200	V
CTI	Comperative tracking index	>600	
RTI	RTI Elec,housing	130	°C

T1,T4 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=600A,V_{GE}=15V, T_{vj}=25°C		1.60	2.05	V
		I_C=600A,V_{GE}=15V, T_{vj}=125°C		1.95		
		I_C=600A,V_{GE}=15V, T_{vj}=150°C		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=12.00mA,V_{CE}=V_{GE}, T_{vj}=25°C	3.50	4.60	5.70	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_{vj}=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_{vj}=25°C			400	nA
R_{Gint}	Internal Gate Resistance			0.5		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=100kHz, V_{GE}=0V		39.5		nF
C_{oes}	Onput Capacitance			1.19		nF
C_{res}	Reverse Transfer Capacitance			0.15		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		2.14		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=650V,I_C=200A, R_{Gon}=2.4Ω,R_{Goff}=24Ω, L_S=17nH, V_{GE}=-8V/+15V, T_{vj}=25°C		68		ns
t_r	Rise Time			50		ns
$t_{d(off)}$	Turn-Off Delay Time			1731		ns
t_f	Fall Time			75		ns
E_{on}	Turn-On Switching Loss			10.6		mJ
E_{off}	Turn-Off Switching Loss			11.6		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=650V,I_C=200A, R_{Gon}=2.4Ω,R_{Goff}=24Ω, L_S=17nH, V_{GE}=-8V/+15V, T_{vj}=125°C		72		ns
t_r	Rise Time			54		ns
$t_{d(off)}$	Turn-Off Delay Time			1945		ns
t_f	Fall Time			76		ns
E_{on}	Turn-On Switching Loss			16.3		mJ
E_{off}	Turn-Off Switching Loss			15.3		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=650V,I_C=200A, R_{Gon}=2.4Ω,R_{Goff}=24Ω, L_S=17nH, V_{GE}=-8V/+15V, T_{vj}=150°C		70		ns
t_r	Rise Time			55		ns
$t_{d(off)}$	Turn-Off Delay Time			2009		ns
t_f	Fall Time			78		ns
E_{on}	Turn-On Switching Loss			17.5		mJ
E_{off}	Turn-Off Switching Loss			16.2		mJ

T2,T3 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=600A,V_{GE}=15V, T_{vj}=25°C		1.60	2.05	V
		I_C=600A,V_{GE}=15V, T_{vj}=125°C		1.95		
		I_C=600A,V_{GE}=15V, T_{vj}=150°C		2.00		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	I_C=12.00mA,V_{CE}=V_{GE}, T_{vj}=25°C	3.50	4.60	5.70	V
I_{CES}	Collector Cut-Off Current	V_{CE}=V_{CES},V_{GE}=0V, T_{vj}=25°C			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=V_{GES},V_{CE}=0V, T_{vj}=25°C			400	nA
R_{Gint}	Internal Gate Resistance			0.5		Ω
C_{ies}	Input Capacitance	V_{CE}=25V,f=100kHz, V_{GE}=0V		39.5		nF
C_{oes}	Onput Capacitance			1.19		nF
C_{res}	Reverse Transfer Capacitance			0.15		nF
Q_G	Gate Charge	V_{GE}=-15…+15V		2.14		μC
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=650V,I_C=200A, R_{Gon}=5.1Ω,R_{Goff}=30Ω, L_S=27nH, V_{GE}=-8V/+15V, T_{vj}=25°C		148		ns
t_r	Rise Time			68		ns
$t_{d(off)}$	Turn-Off Delay Time			1992		ns
t_f	Fall Time			129		ns
E_{on}	Turn-On Switching Loss			16.8		mJ
E_{off}	Turn-Off Switching Loss			15.9		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=650V,I_C=200A, R_{Gon}=5.1Ω,R_{Goff}=30Ω, L_S=27nH, V_{GE}=-8V/+15V, T_{vj}=125°C		112		ns
t_r	Rise Time			78		ns
$t_{d(off)}$	Turn-Off Delay Time			2180		ns
t_f	Fall Time			102		ns
E_{on}	Turn-On Switching Loss			19.8		mJ
E_{off}	Turn-Off Switching Loss			17.7		mJ
$t_{d(on)}$	Turn-On Delay Time	V_{CC}=650V,I_C=200A, R_{Gon}=5.1Ω,R_{Goff}=30Ω, L_S=27nH, V_{GE}=-8V/+15V, T_{vj}=150°C		118		ns
t_r	Rise Time			73		ns
$t_{d(off)}$	Turn-Off Delay Time			2184		ns
t_f	Fall Time			99		ns
E_{on}	Turn-On Switching Loss			20.1		mJ
E_{off}	Turn-Off Switching Loss			18.0		mJ

D1-D4 Diode Characteristics T_C=25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Diode Forward Voltage	I_F=300A,V_{GE}=0V,T_{vj}=25°C		2.25	2.70	V
		I_F=300A,V_{GE}=0V,T_{vj}=125°C		2.30		
		I_F=300A,V_{GE}=0V,T_{vj}=150°C		2.30		

D5,D6 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_{vj}=25°C		2.25	2.70	V
		I_F=400A,V_{GE}=0V,T_{vj}=125°C		2.30		
		I_F=400A,V_{GE}=0V,T_{vj}=150°C		2.30		
Q_r	Recovered Charge	V_R=650V,I_F=200A, -di/dt=4930A/μs,V_{GE}=-8V L_S=17nH,T_{vj}=25°C		19.3		μC
I_{RM}	Peak Reverse Recovery Current			316		A
E_{rec}	Reverse Recovery Energy			5.97		mJ
Q_r	Recovered Charge	V_R=650V,I_F=200A, -di/dt=4850A/μs,V_{GE}=-8V L_S=17nH,T_{vj}=125°C		30.1		μC
I_{RM}	Peak Reverse Recovery Current			359		A
E_{rec}	Reverse Recovery Energy			10.9		mJ
Q_r	Recovered Charge	V_R=650V,I_F=200A, -di/dt=4510A/μs,V_{GE}=-8V L_S=17nH,T_{vj}=150°C		33.2		μC
I_{RM}	Peak Reverse Recovery Current			368		A
E_{rec}	Reverse Recovery Energy			12.2		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
L_{CE}	Stray Inductance		15		nH
R_{thJC}	Junction-to-Case (per T1,T4 IGBT) Junction-to-Case (per T2,T3 IGBT) Junction-to-Case (per D1-D4 Diode) Junction-to-Case (per D5,D6 Diode)			0.074 0.074 0.178 0.136	K/W
R_{thCH}	Case-to-Heatsink (per T1,T4 IGBT) Case-to-Heatsink (per T2,T3 IGBT) Case-to-Heatsink (per D1-D4 Diode) Case-to-Heatsink (per D5,D6 Diode)		0.030 0.030 0.045 0.037		K/W
M	Mounting Torque, Screw:M5	3.0		5.0	N.m
G	Weight of Module		250		g

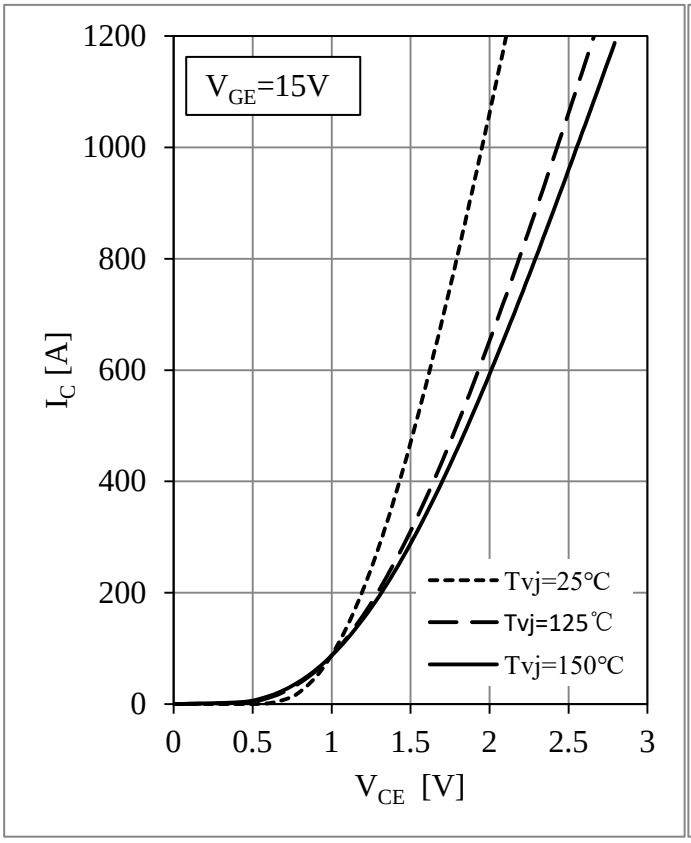


Fig 1. T1,T4 IGBT Output Characteristics

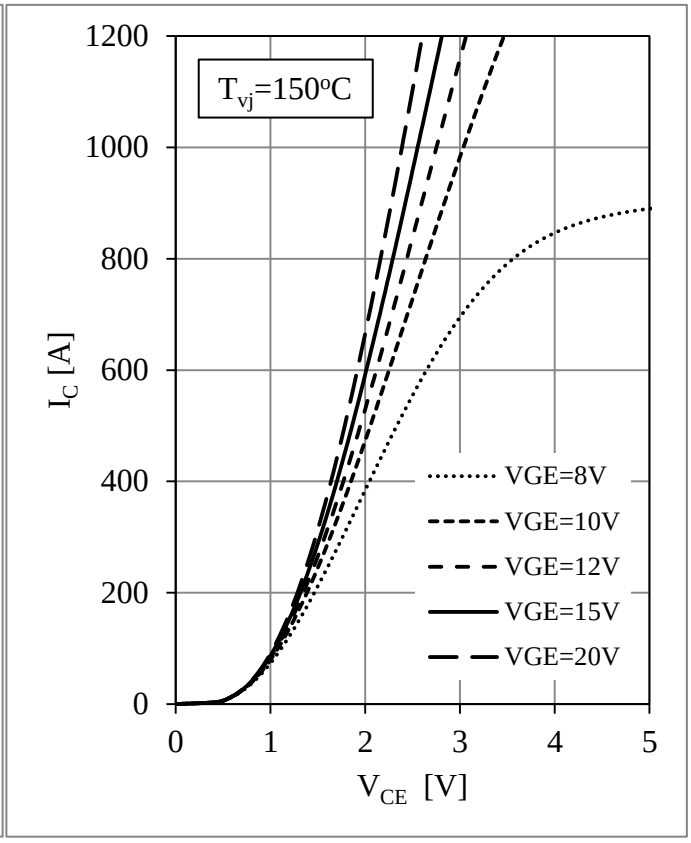


Fig 2. T1,T4 IGBT Output Characteristics

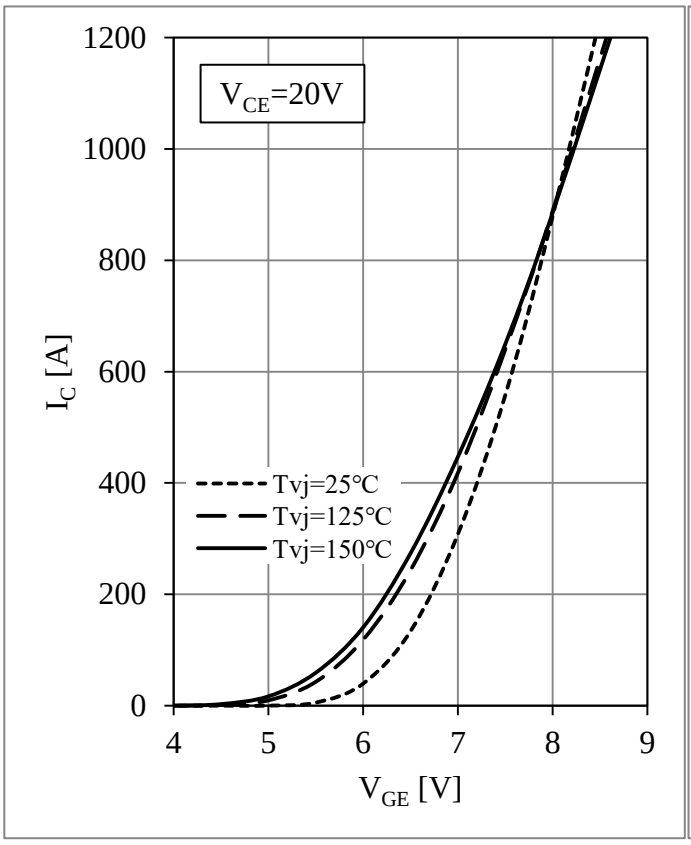


Fig 3. T1,T4 IGBT Transfer Characteristics

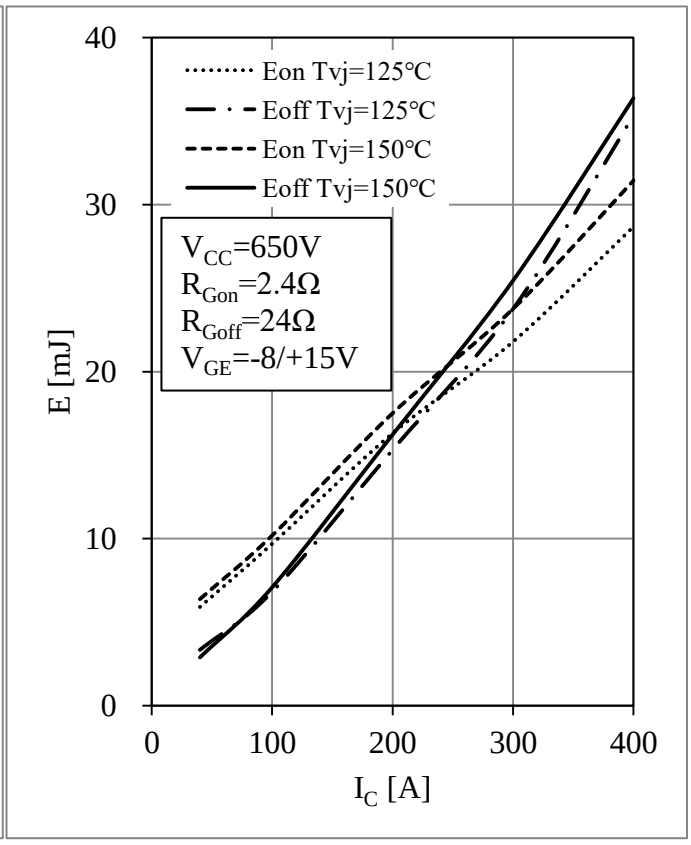


Fig 4. T1,T4 IGBT Switching Loss vs. I_C

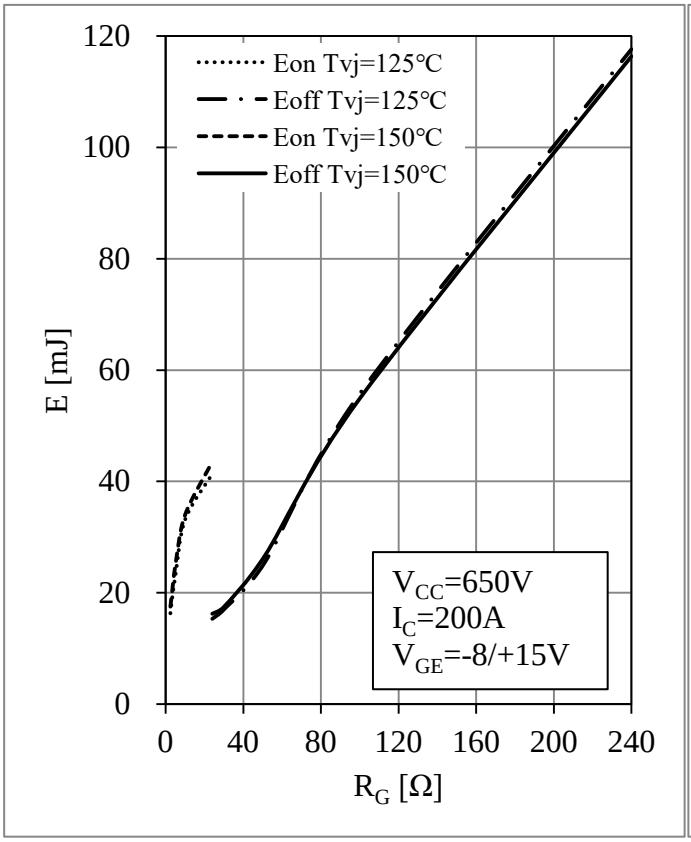


Fig 5. T1,T4 IGBT Switching Loss vs. R_G

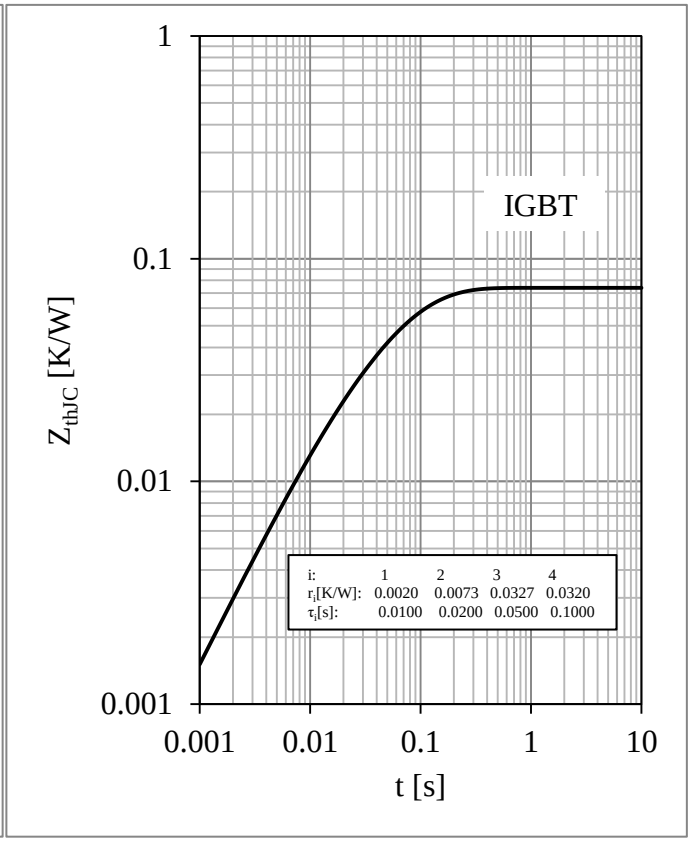


Fig 6. T1,T4 IGBT Transient Thermal Impedance

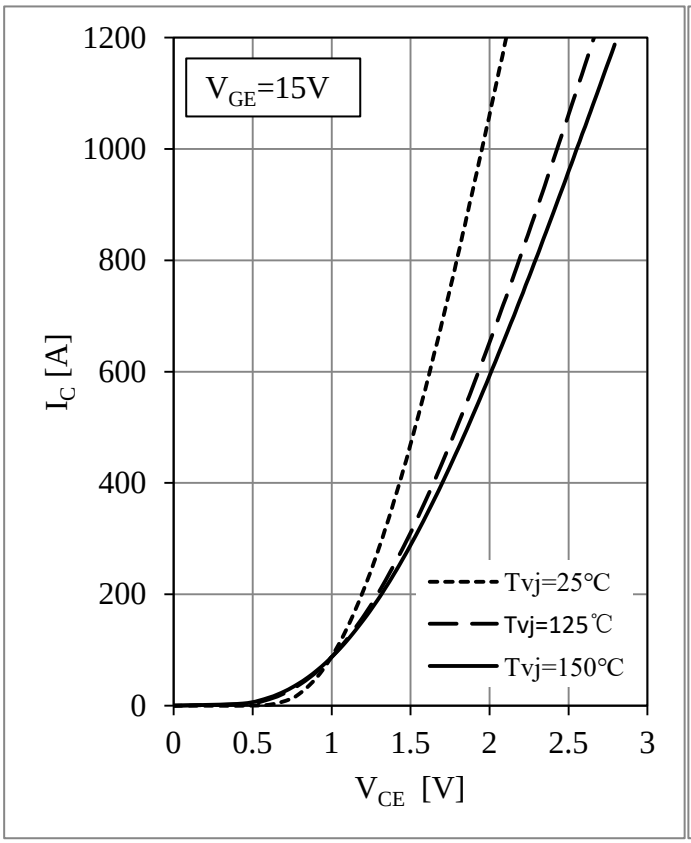


Fig 7. T2,T3 IGBT Output Characteristics

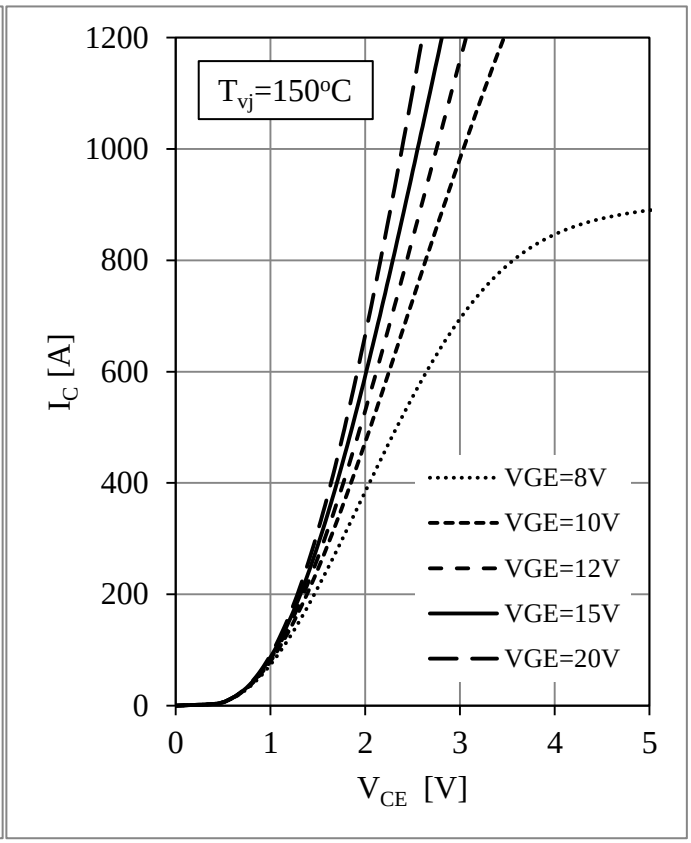


Fig 8. T2,T3 IGBT Output Characteristics

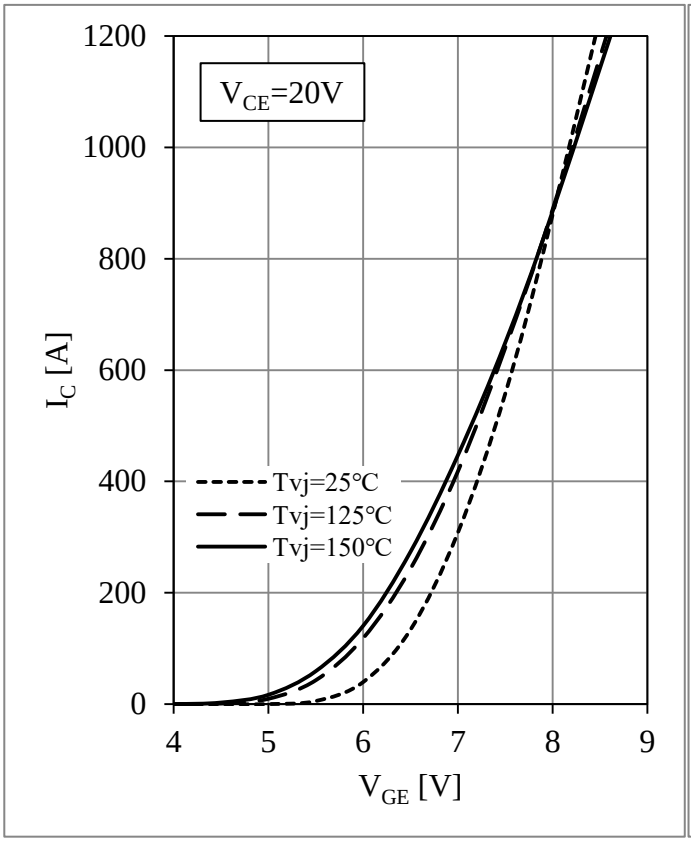


Fig 9. T2,T3 IGBT Transfer Characteristics

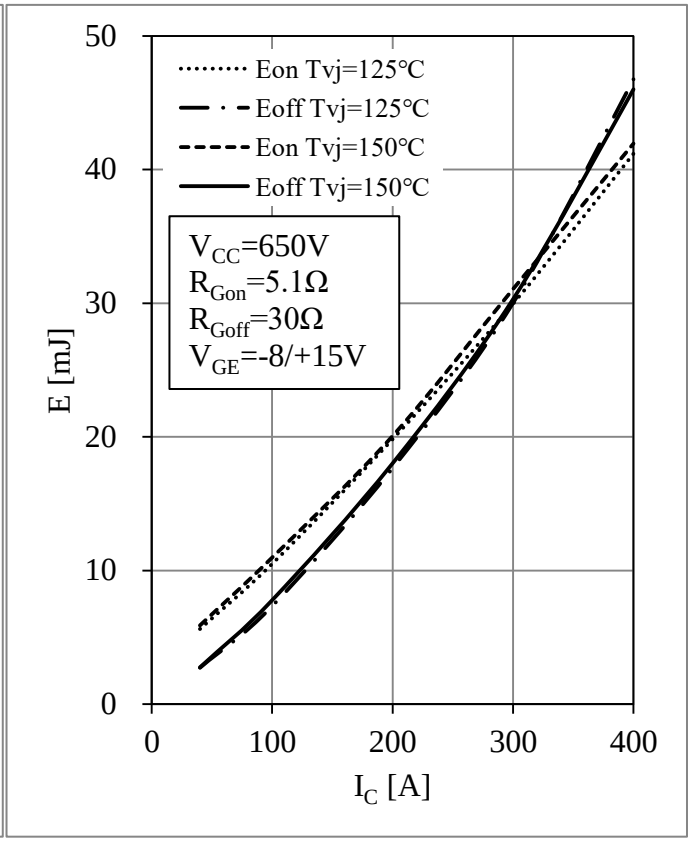


Fig 10. T2,T3 IGBT Switching Loss vs. I_C

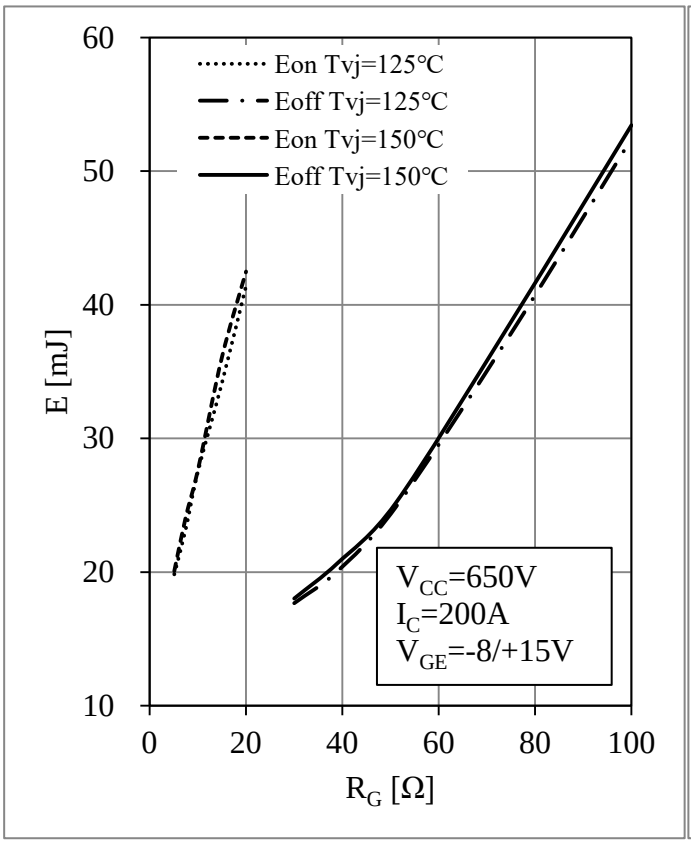


Fig 11. T2,T3 IGBT Switching Loss vs. R_G

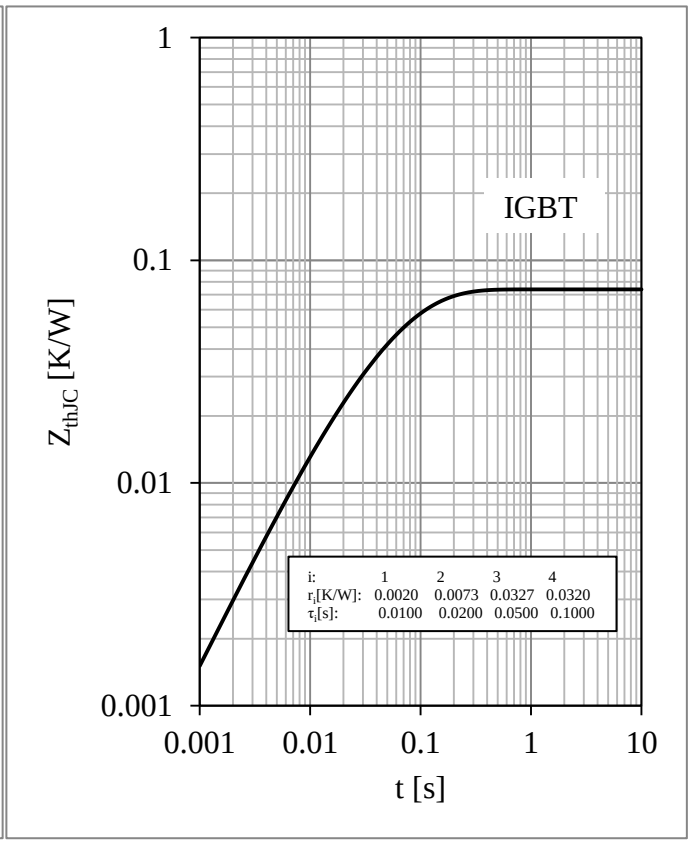


Fig 12. T2,T3 IGBT Transient Thermal Impedance

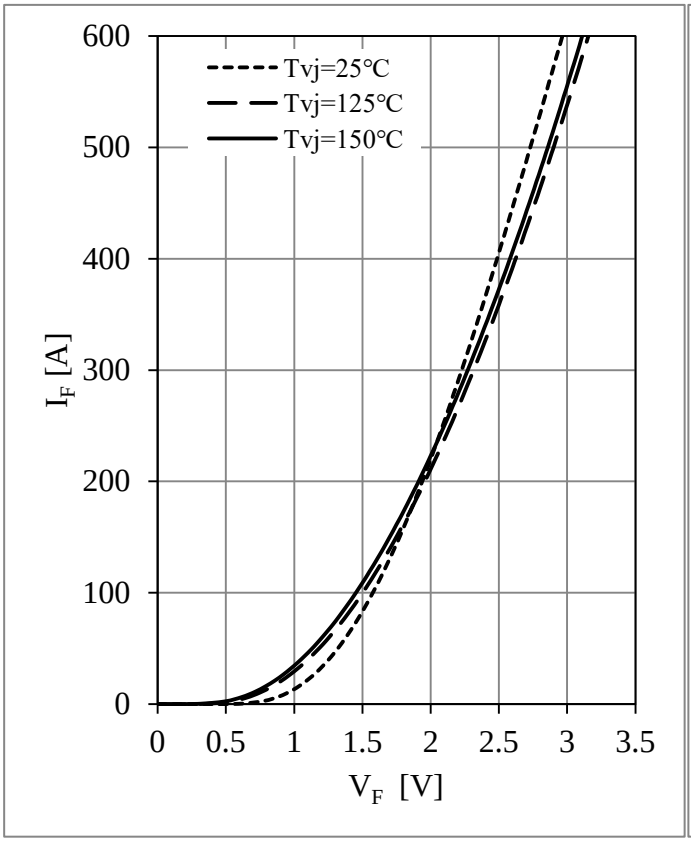


Fig 13. D1-D4 Diode Forward Characteristics

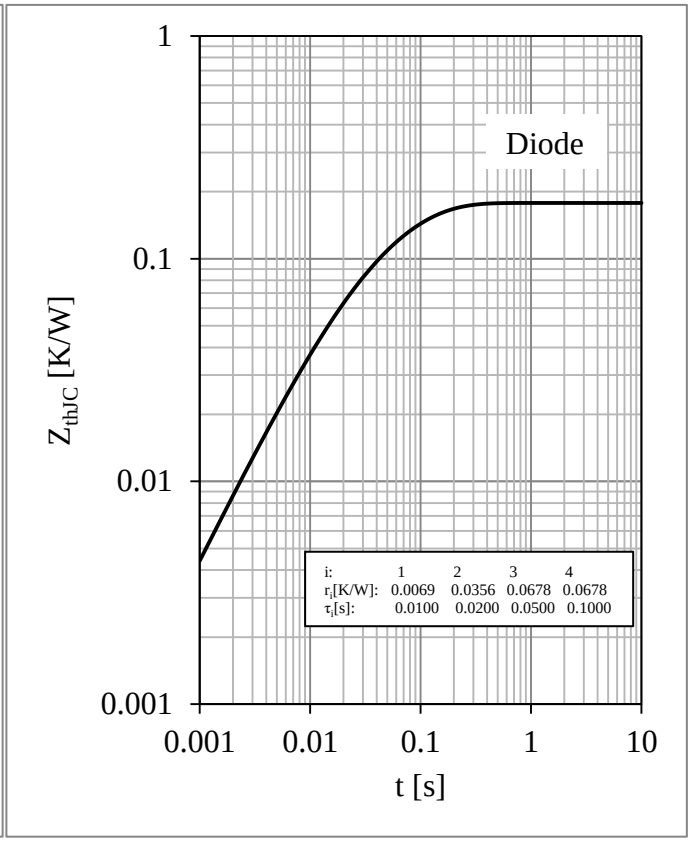


Fig 14. D1-D4 Diode Transient Thermal Impedance

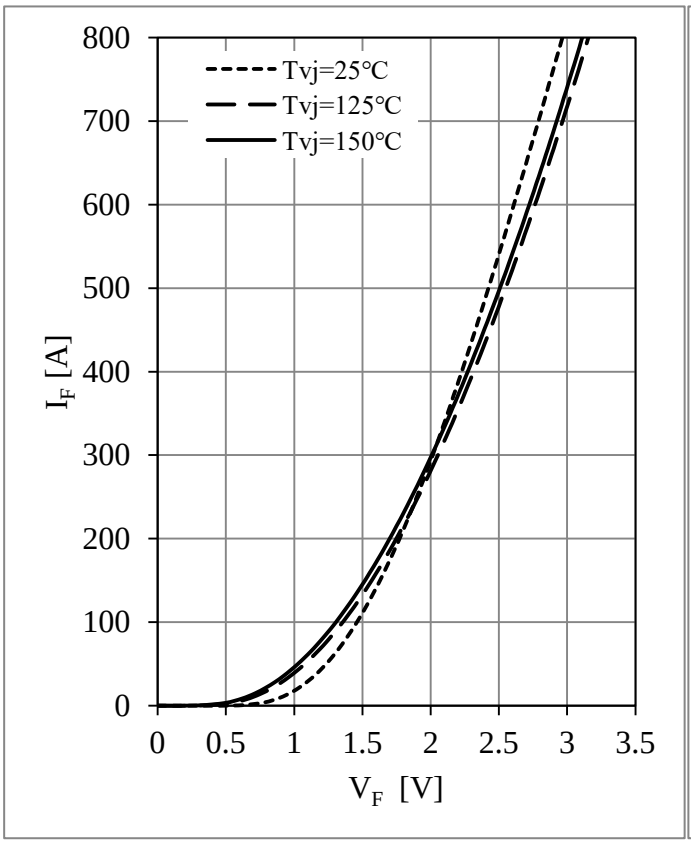


Fig 15. D5,D6 Diode Forward Characteristics

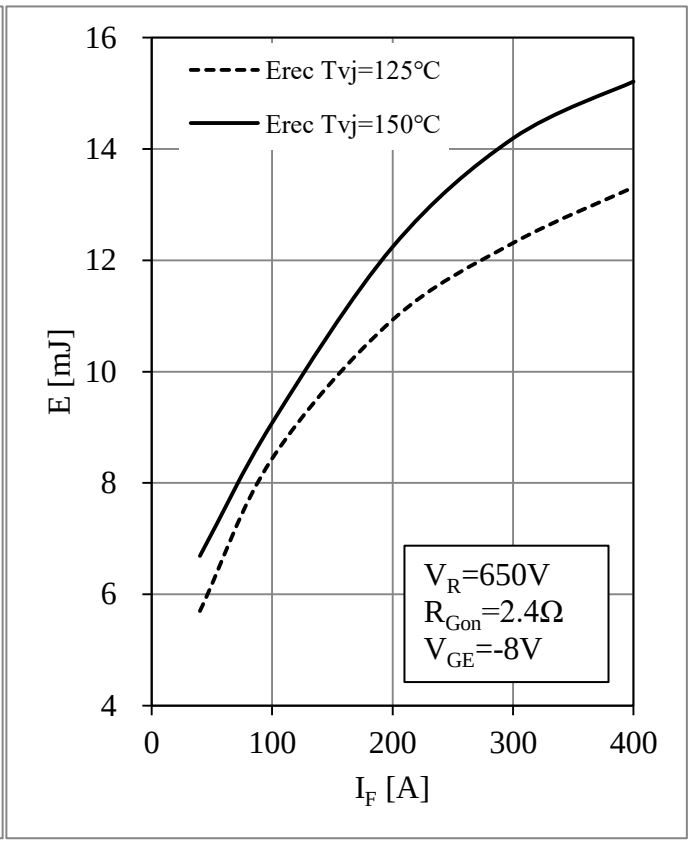


Fig 16. D5,D6 Diode Switching Loss vs. I_F

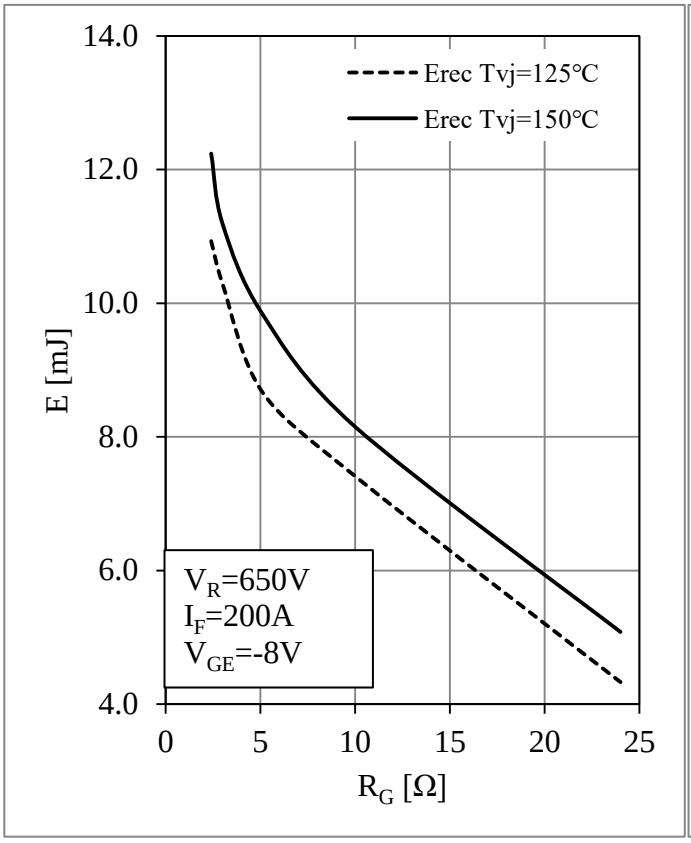


Fig 17. D5,D6 Diode Switching Loss vs. R_G

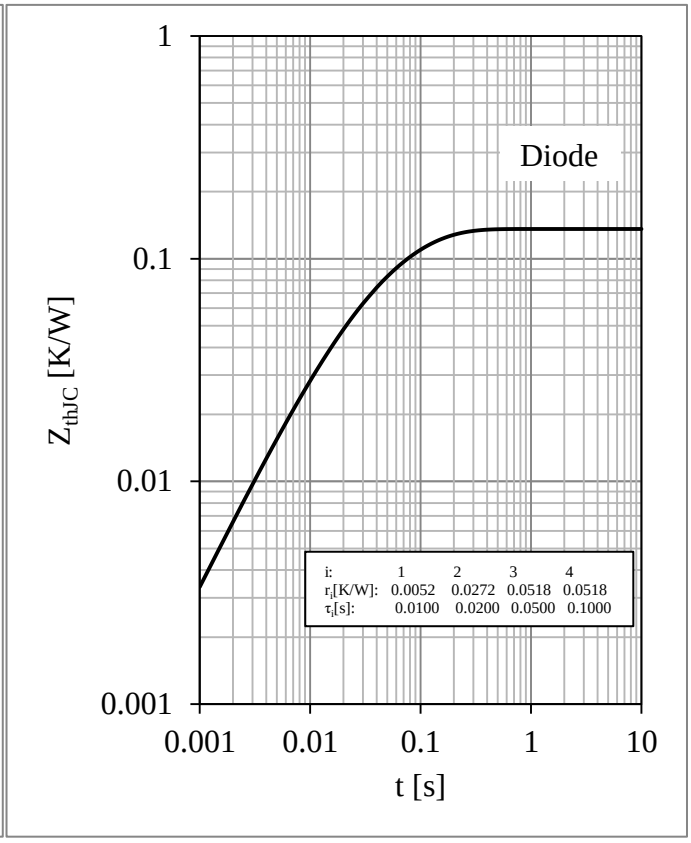
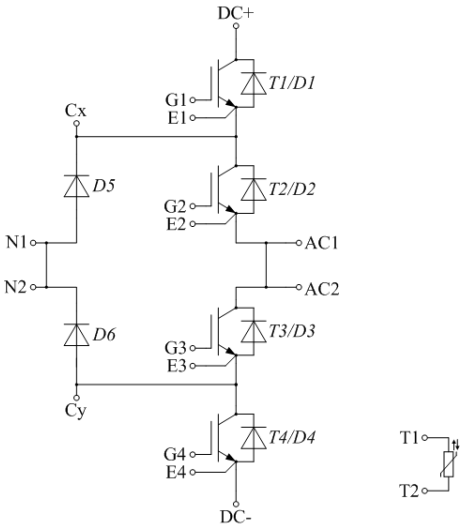


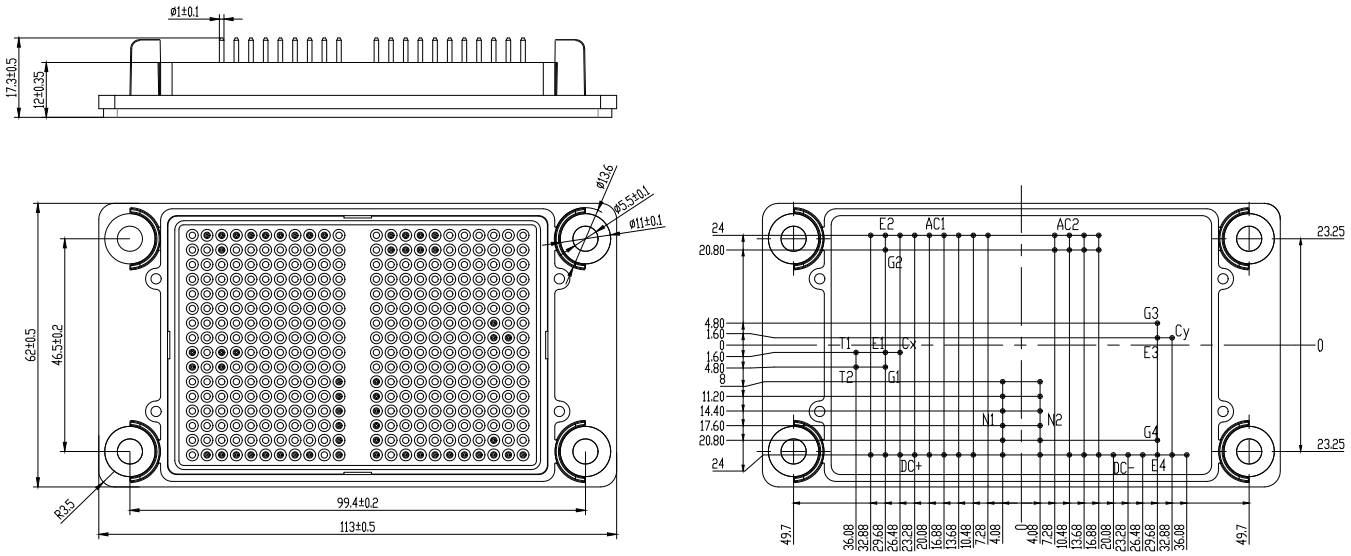
Fig 18. D5,D6 Diode Transient Thermal Impedance

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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