1200V SiC ED3 Power Module

ADPR30B12CSNF

DATASHEET

V1.0, 2025/Nov.

Applications

- Automotive Applications
- Electrical Vehicles (xEV)
- Commercial Agriculture Vehicles
- All-Terrain Vehicles
- Motor Drives
- Servo Drives
- UPS Drives

Features

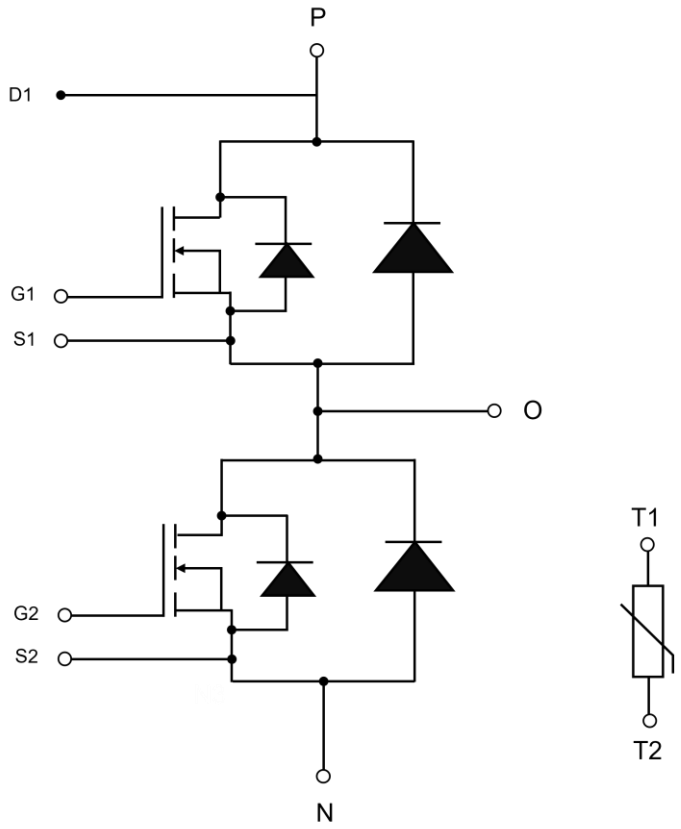
Electrical Features

- $T_{j,op}$ = 150°C
- Low $R_{DS(on)}$
- Blocking Voltage 1200V
- Low Switching Losses
- Low Inductance Design
- SiC High Performance Chip

Mechanical Features

- UL 94 Module Frame
- Temperature Sensor Included
- Pb-free Device and RoHS Compliant
- Guiding Elements for PCB and Cooler Assembly

Circuit Diagram



MOSEFT

Maximum Rated Values

Parameter	Conditions	Symbol	Values	Unit
Drain-source voltage	T_j = 25°C	V_{DSS}	1200	V
Gate-source voltage		V_{GS}	-10/+23	V
DC drain current	V_{GS} = 18V, T_C = 25°C, $T_{j\,max}$ = 175°C	$I_{D\,nom}$	600	A
Pulsed drain current	Verified by design, t_p limited by $T_{j\,max}$	$I_{D\,pulse}$	1200	A
Max junction temperature		$T_{j,\,max}$	175	°C

Characteristics Values

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit
Drain-source on resistance	I_D = 600 A, V_{GS} = 18 V	T_j = 25°C	$R_{DS(on)}$		3.0	4.1	mΩ
	I_D = 600 A, V_{GS} = 18 V	T_j = 150°C			4.5		
	I_D = 600 A, V_{GS} = 18 V	T_j = 175°C			5.2		
Gate threshold voltage	I_D = 175 mA, V_{GS} = V_{DS}	T_j = 25°C	$V_{GS,th}$	2.0	2.6	3.2	V
	I_D = 175 mA, V_{GS} = V_{DS}	T_j = 150°C			1.9		
	I_D = 175 mA, V_{GS} = V_{DS}	T_j = 175°C			1.8		
Internal gate resistance	f = 1MHz	T_j = 25°C	$R_{G,int}$		1.6		Ω
Drain-source leakage current	V_{DS} = 1200 V, V_{GS} = 0 V	T_j = 25°C	I_{DSS}			100	μA
	V_{DS} = 1200 V, V_{GS} = 0 V	T_j = 150°C				1	mA
	V_{DS} = 1200 V, V_{GS} = 0 V	T_j = 175°C				5	mA
Gate-source leakage current	V_{DS} = 0 V, V_{GS} = 20 V	T_j = 25°C	I_{GSS}			400	nA
Gate charge	I_D = 600 A V_{GS} = -5 V / + 18 V V_{DS} = 600V	T_j = 25°C	Q_g		1.6		μC
Input capacitance	f = 100 kHz, V_{DS} = 600 V V_{GS} = 0V	T_j = 25°C	C_{iss}		36.1		nF
Output capacitance	f = 100 kHz, V_{DS} = 600 V V_{GS} = 0V	T_j = 25°C	C_{oss}		3.9		nF
Reverse transfer capacitance	f = 100 kHz, V_{DS} = 600 V V_{GS} = 0V	T_j = 25°C	C_{rss}		0.1		nF
Turn-on delay time, inductive load	I_D = 600 A, V_{DS} = 600 V V_{GS} = -5 V / + 18 V $R_{G,on}$ = 5.1 Ω	T_j = 25°C T_j = 175°C	$t_{d(on)}$		124 95		ns

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit
Rise time, inductive load	I_D = 600 A, V_{DS} = 600 V V_{GS} = -5 V / + 18 V $R_{G,on}$ = 5.1 Ω	T_j = 25°C T_j = 175°C	t_r		307 218		ns
Turn-on energy loss per pulse	I_D = 600 A, V_{DS} = 600 V L_S = 30 nH V_{GS} = -5 V / + 18 V $R_{G,on}$ = 5.1 Ω di/dt= 4.1 A/ns (25°C) di/dt= 4.7 A/ns (175°C)	T_j = 25°C T_j = 175°C	E_{on}		28.4 22.6		mJ
Turn-off delay time, inductive load	I_D = 600 A, V_{DS} = 600 V V_{GS} = -5 V / + 18 V $R_{G,off}$ = 5.1 Ω	T_j = 25°C T_j = 175°C	$t_{d(off)}$		400 497		ns
Fall time, inductive load	I_D = 600 A, V_{DS} = 600 V V_{GS} = -5 V / + 18 V $R_{G,off}$ = 5.1 Ω	T_j = 25°C T_j = 175°C	t_f		91 95		ns
Turn-off energy loss per pulse	I_D = 600 A, V_{DS} = 600 V L_S = 30 nH V_{GS} = -5 V / + 18 V $R_{G,off}$ = 5.1 Ω dV/dt= 6.6 V/ns (25°C) dV/dt= 5.5 V/ns (175°C)	T_j = 25°C T_j = 175°C	E_{off}		21.4 24.1		mJ
Short circuit current	V_{GS} = -5 V / + 18 V V_{DD} = 800 V $R_{G,on}$ = 5.1 Ω $R_{G,off}$ = 5.1 Ω t_{sc} = 3 µs	T_j = 25°C T_j = 150°C	I_{SC}		4900 4700		A
Thermal resistance, junction to case	Per MOSFET		$R_{th,JC}$		0.070		K/W
Operated temperature condition			$T_{j,op}$	-40		150	°C

Diode

Maximum Rated Values

Parameter	Conditions	Symbol	Values	Unit
DC diode forward current	V_{GS} = -5V, T_C = 25°C, $T_{j,max}$=175°C	I_F	600	A
Pulsed diode current	Verified by design, t_p limited by $T_{j,max}$	$I_{F,\ pulse}$	1200	A

Characteristics Values

Parameter	Conditions		Symbol	Typ.	Max.	Unit
Forward voltage	I_F = 600 A, V_{GS} = -5 V	T_j = 25°C T_j = 175°C	V_F	1.45 2.25	2.00	V
Peak reverse recovery current	I_F = 600 A, V_R = 600 V V_{GS} = -5 V -di_F/dt = 4.2 A/ns (25°C) -di_F/dt = 4.7 A/ns (175°C)	T_j = 25°C T_j = 175°C	I_{RM}	67 86		A
Recovered charge	I_F = 600 A, V_R = 600 V V_{GS} = -5 V -di_F/dt = 4.2 A/ns (25°C) -di_F/dt = 4.7 A/ns (175°C)	T_j = 25°C T_j = 175°C	Q_{rr}	2.2 2.8		µC
Reverse recovery energy	I_F = 600 A, V_R = 600 V V_{GS} = -5 V -di_F/dt = 4.2 A/ns (25°C) -di_F/dt = 4.7 A/ns (175°C)	T_j = 25°C T_j = 175°C	E_{rec}	0.6 0.9		mJ
Thermal resistance, junction to case	Per Diode		$R_{th,JC}$	0.075		K/W

NTC-Thermistor

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Rated resistance	T_c = 25°C	R_{25}		5.0		kΩ
Resistance tolerance	T_c = 100°C	∆R/R	- 5		5	%
B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298\ K))]$	$B_{25/50}$		3375		K
B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298\ K))]$	$B_{25/80}$		3411		K
B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298\ K))]$	$B_{25/100}$		3433		K

Module

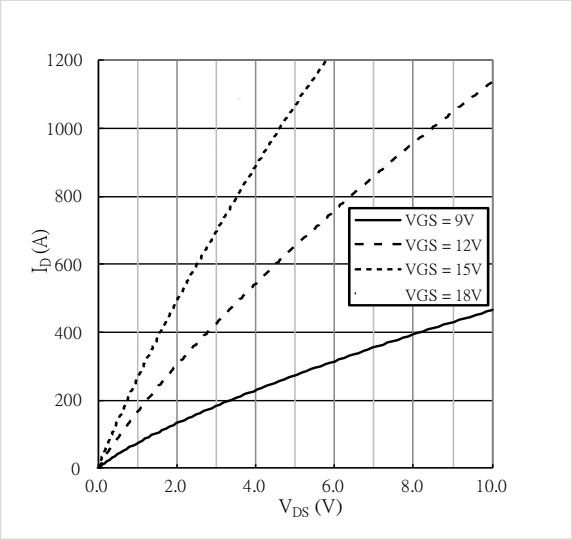
Parameter	Conditions	Symbol	Value	Unit
Isolation test voltage	RMS, f = 0 Hz, t = 1 min	V_{ISOL}	2.5	kV
Module baseplate material			Cu + Ni	
Module internal isolation material	Basic isolation (class 1, IEC 61140)		Si_3N_4	
Creepage distance	Terminal to heatsink	$d_{Creep,TH}$	14.5	mm
Creepage distance	Terminal to terminal	$d_{Creep,TT}$	13.0	mm
Clearance distance	Terminal to heatsink	$d_{Clear,TH}$	12.5	mm
Clearance distance	Terminal to terminal	$d_{Clear,TT}$	10.0	mm
Comparative tracking index [1)]		CTI	> 200	

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Module stray inductance		L_s		18		nH
Storage temperature		T_{stg}	-40		125	°C
Mounting torque for module mounting	Screw M5 - Mounting according to valid application note	M	3		6	Nm
Terminal connection torque	Screw M6 - Mounting according to valid application note	M	3		6	Nm
Weight		G		340		g

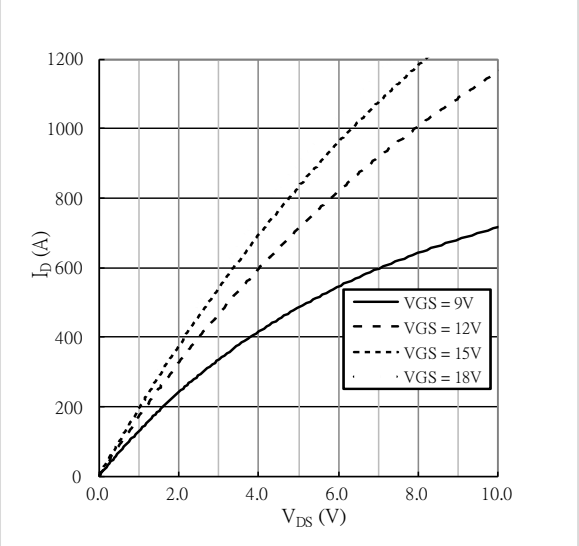
1) Extracted by following UL 746A

Characteristics Diagrams

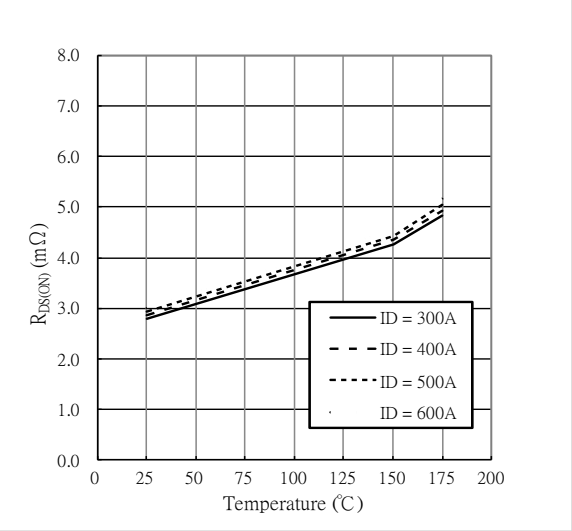
MOSFET, Output Characteristics
T_j = 25°C, $I_D = f(V_{DS})$



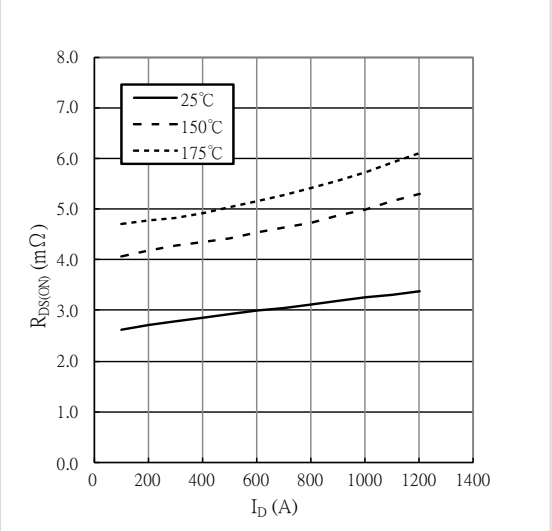
MOSFET, Output Characteristics
T_j = 175°C, $I_D = f(V_{DS})$



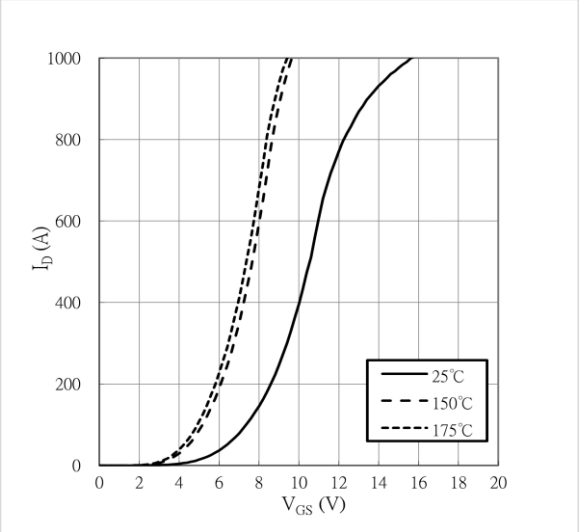
Typical temperature dependence of $R_{DS(on)}$,
V_{GS} = 18V, $R_{DS(on)} = f(T_j)$



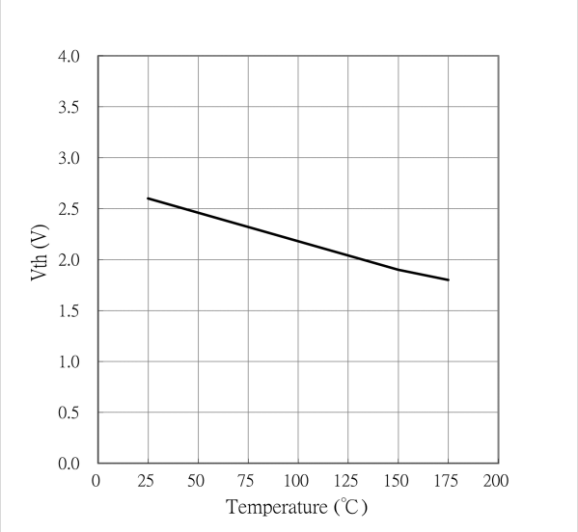
Typical I_D dependence of $R_{DS(on)}$,
V_{GS} = 18V, $R_{DS(on)} = f(I_D)$



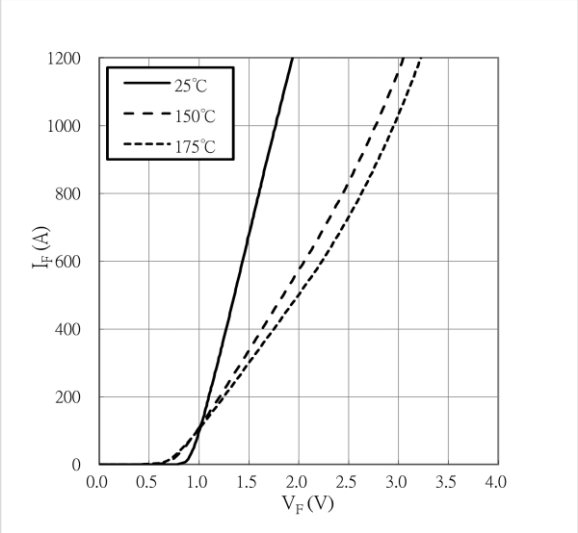
MOSFET, Transfer Characteristics
$I_D = f(V_{GS})$



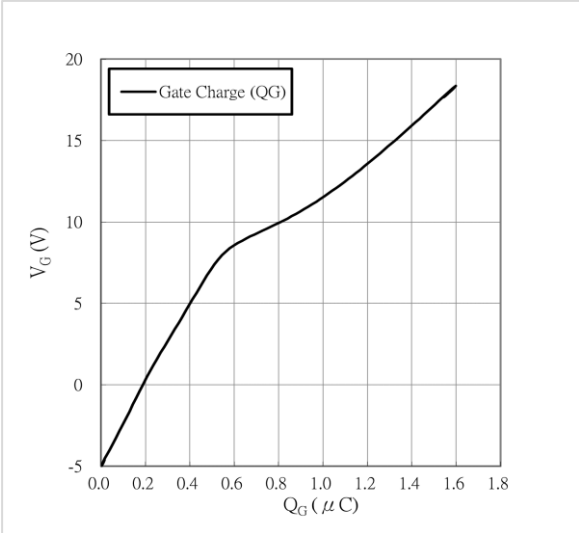
Typical temperature dependence of threshold voltage, $V_{GS,th} = f(T_j)$



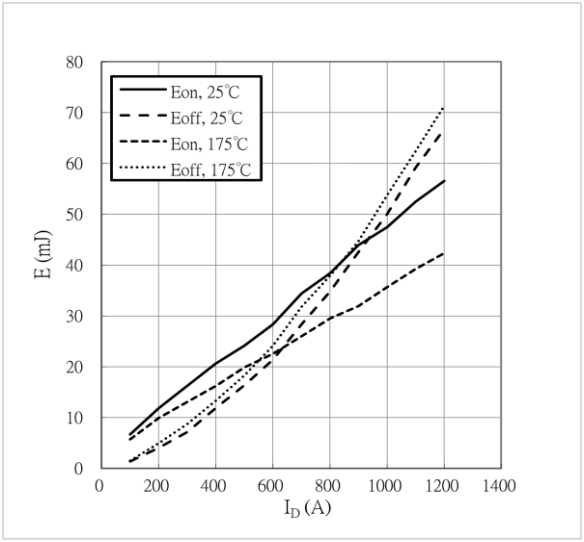
Diode, Forward characteristics
V_{GS} = -5V, $I_F = f(V_F)$



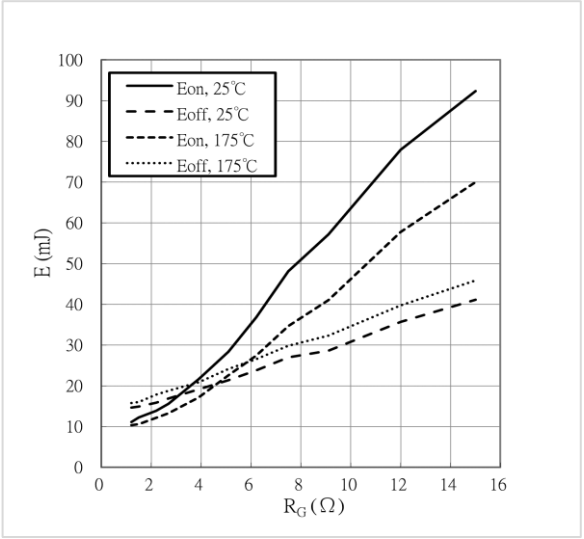
MOSFET, Total Gate charge characteristics
V_{DS} = 600V, I_D = 600A, T_j = 25°C
$V_{GS} = f(Q_G)$



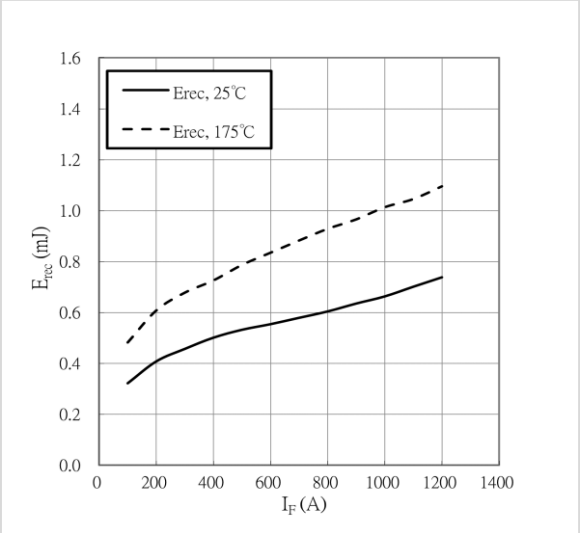
MOSFET, Switching losses vs. I_D
V_{GS} = -5V / +18V, $R_{G,on}$ = 5.1Ω, $R_{G,off}$ = 5.1Ω,
V_{DS} = 600V, E_{on} & E_{off} = f(I_D)



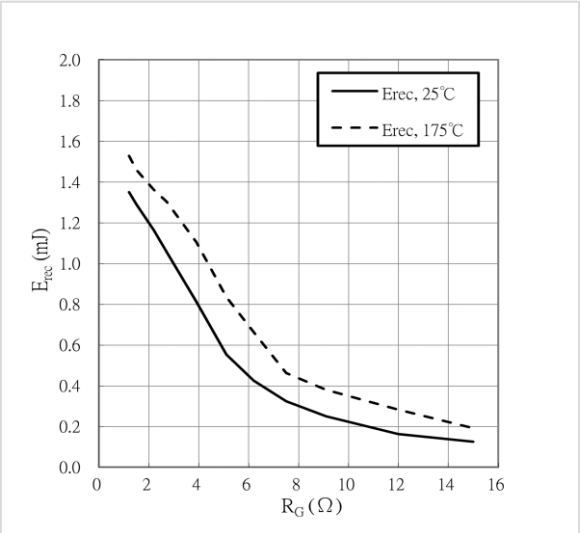
MOSFET, Switching losses vs. R_G
V_{GS} = -5V / +18V, V_{DS} = 600V, I_D = 600A,
E_{on} & E_{off} = f(R_G)



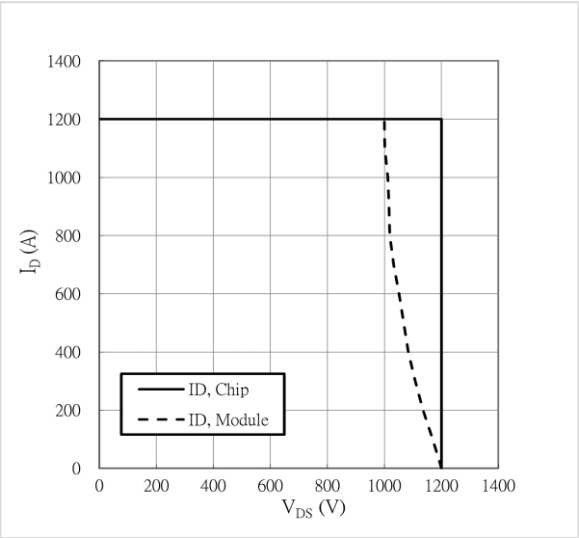
Diode, Switching losses vs. I_F
V_{GS} = -5V / +18V, $R_{G,on}$ = 5.1Ω, $R_{G,off}$ = 5.1Ω,
V_{DS} = 600V, E_{rec} = f(I_F)



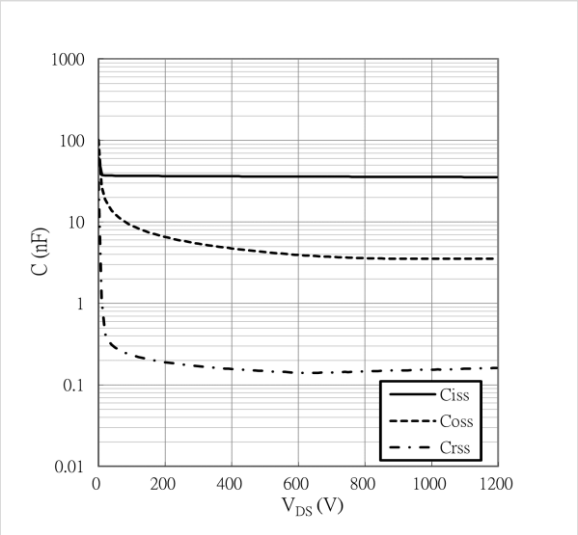
Diode, Switching losses vs. R_G
V_{GS} = -5V / +18V, V_{DS} = 600V, I_F = 600A,
E_{rec} = f(R_G)



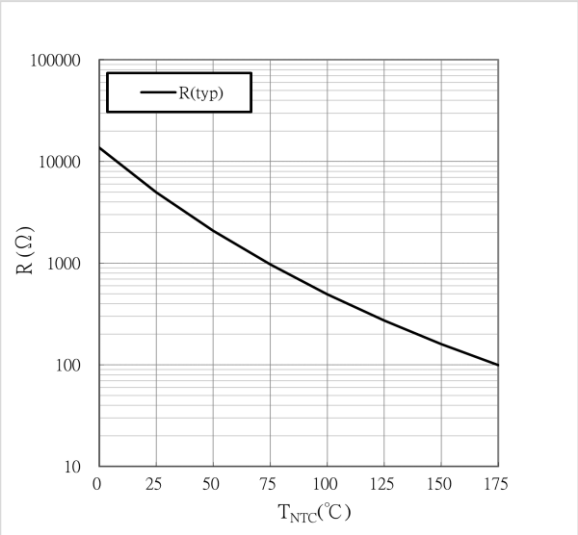
MOSFET, Reverse bias safe operating area (RBSOA) , V_{GS} = -5V / +18V, $R_{G,on}$ = 5.1Ω $R_{G,off}$ = 5.1Ω, T_j = 175°C, I_D = f(V_D)



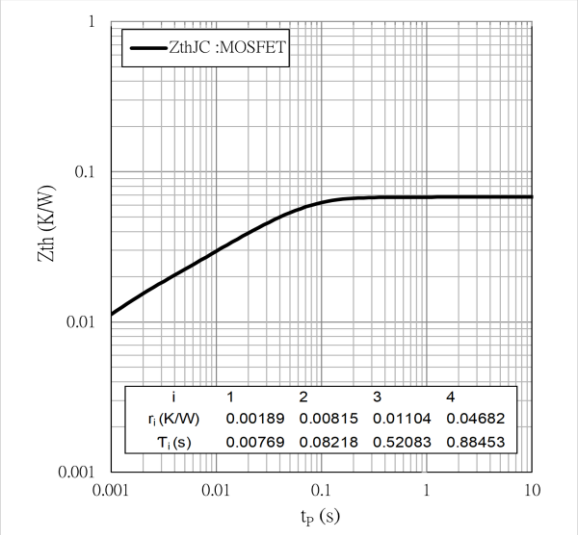
MOSFET, Capacitance characteristics V_{GS} = 0V, T_j = 25°C, f = 100kHz, C = f(V_{DS})



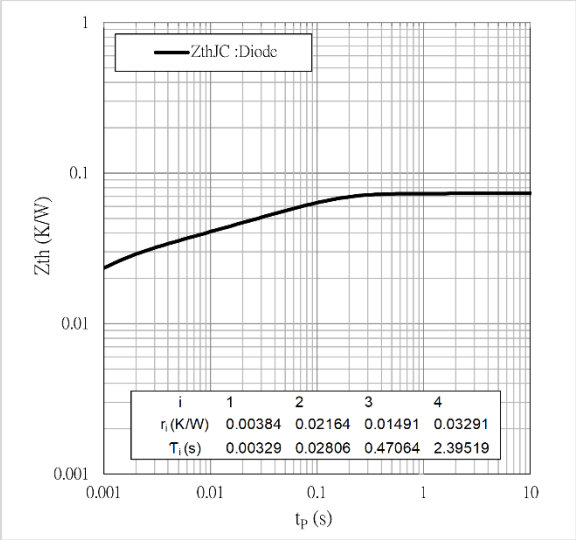
NTC-Thermistor-temperature characteristics R = f(T_{NTC})



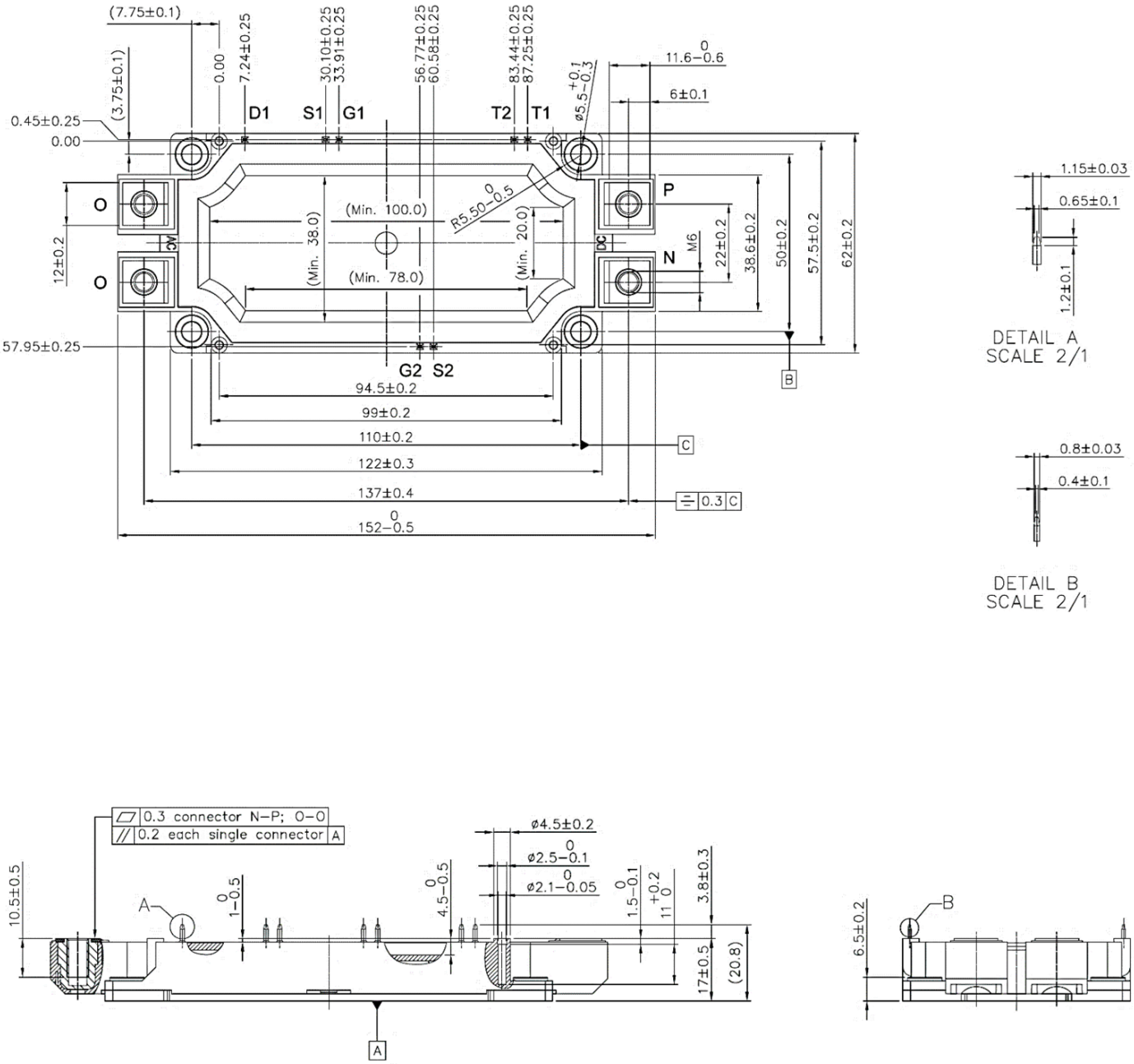
MOSFET, Transient thermal impedance Z_{thJC} = f(t_P)



Diode, Transient thermal impedance
$Z_{thJC} = f(t_P)$



Package Outlines



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