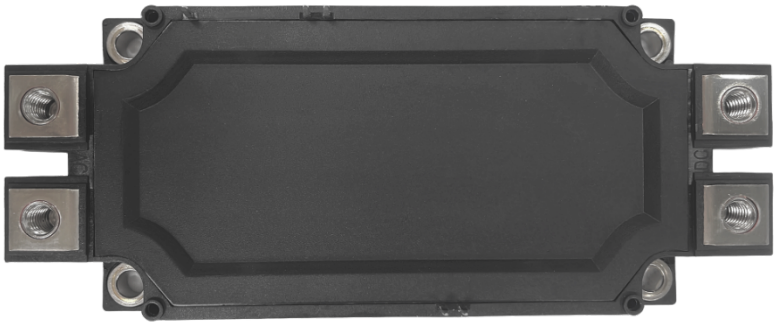
1200V SiC ED3 Power Module

ADPR30B12CSNT

PRELIMINARY
DATASHEET

V0.1, 2023/12



Applications

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

Electrical Features

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

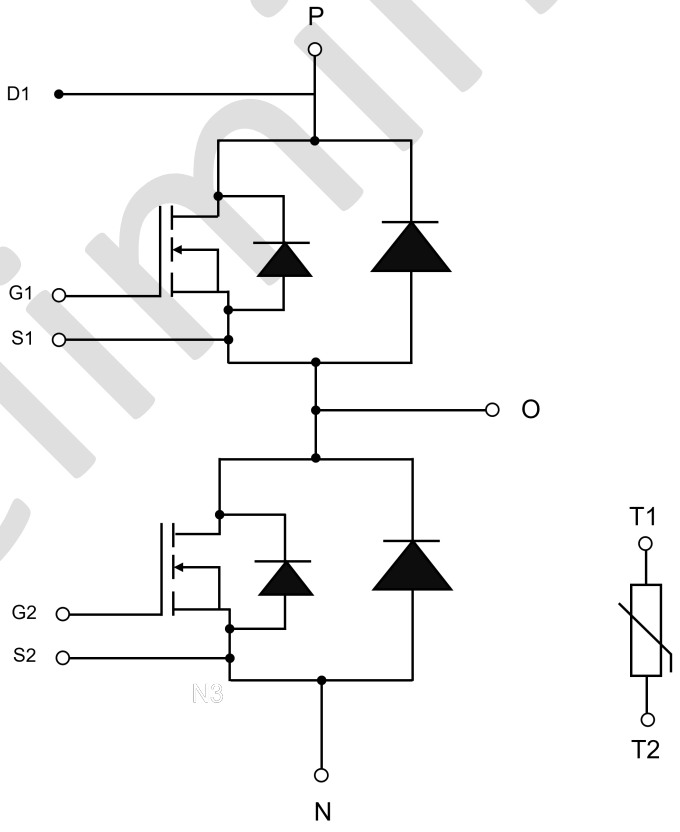
Mechanical Features

- Compact design
- UL 94 Module frame
- Temperature sensor included
- Pb-free device and RoHS compliant
- Guiding elements for PCB and cooler assembly
- Sintered Ag Die attachment

FEATURES

- High speed, low loss SiC module
- High reliability, high durability module

Inner 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}	-5/+20	V
DC drain current	V_{GS} = 15 V, T_C = 70°C, T_j = 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

Characteristics Values

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit
Drain-source on resistance	I_D = 600 A, V_{GS} = 15 V	T_j = 25°C	$R_{DS(on)}$		3.0	5.9	mΩ
	I_D = 600 A, V_{GS} = 15 V	T_j = 150°C			4.5		
	I_D = 600 A, V_{GS} = 15 V	T_j = 175°C			5.4		
Gate threshold voltage	I_D = 175 mA, V_{GS} = V_{DS}	T_j = 25°C	V_{GSth}	2.2	3.2	4.2	V
	I_D = 175 mA, V_{GS} = V_{DS}	T_j = 150°C			2.7		
	I_D = 175 mA, V_{GS} = V_{DS}	T_j = 175°C			2.6		
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
Input capacitance	f = 100 kHz, V_{DS} = 100 V V_{GS} = 0 V	T_j = 25°C	C_{iss}		37		nF
Output capacitance	f = 100 kHz, V_{DS} = 100 V V_{GS} = 0 V	T_j = 25°C	C_{oss}		7.9		nF
Reverse transfer capacitance	f = 100 kHz, V_{DS} = 100 V V_{GS} = 0 V	T_j = 25°C	C_{rss}		0.03		nF
Turn-on delay time, inductive load	I_D = 600 A, V_{DS} = 600 V V_{GS} = -5 V / + 15 V R_G = 5.0 Ω	T_j = 25°C T_j = 175°C	$t_{d(on)}$		49 27		ns
Rise time, inductive load	I_D = 600 A, V_{DS} = 600 V V_{GS} = -5 V / + 15 V R_G = 5.0 Ω	T_j = 25°C T_j = 175°C	t_r		116 85		ns

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit
Turn-on energy loss per pulse	I_D = 600 A, V_{DS} = 600 V L_S = 30nH V_{GS} = -5 V / + 15 V R_G = 5.0 Ω, di/dt= 4250 A/µs (25°C) di/dt= 6000 A/µs (175°C)	T_j = 25°C T_j = 175°C	E_{on}		27.5 20.5		mJ
Turn-off delay time, inductive load	I_D = 600 A, V_{DS} = 600 V V_{GS} = -5 V / + 15 V R_G = 5.0 Ω	T_j = 25°C T_j = 175°C	$t_{d(off)}$		235 275		ns
Fall time, inductive load	I_D = 600 A, V_{DS} = 600 V V_{GS} = -5 V / + 15 V R_G = 5.0 Ω	T_j = 25°C T_j = 175°C	t_f		76 77		ns
Turn-off energy loss per pulse	I_D = 600 A, V_{DS} = 600 V L_S = 30nH V_{GS} = -5 V / + 15 V R_G = 5.0 Ω, dV/dt= 11.5 kV/µs (25°C) dV/dt= 12.0 kV/µs (175°C)	T_j = 25°C T_j = 175°C	E_{off}		15.5 16.0		mJ
Thermal resistance, junction to case	Per MOSFET; ΔV/ΔT = 10 dm³/min, T_F = 60°C		R_{thJC}		0.095		K/W
Thermal resistance, junction to case	Per Diode; ΔV/ΔT = 10 dm³/min, T_F = 60°C		R_{thJC}		0.07		K/W

Diode

Maximum Rated Values

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

Characteristics Values

Parameter	Conditions		Symbol	Typ.	Max.	Unit
Forward voltage	I_{SD} = 600 A, V_{GS} = -5 V	T_j = 25°C	V_{SD}	1.9	2.5	V
Peak reverse recovery current	I_F = 600A, V_R = 600V, V_{GE} = -5V, -di_F/dt = 5700 A/µs (25°C) -di_F/dt = 6400 A/µs (150°C)	T_j = 25°C T_j = 175°C	I_{RM}	115 140		A
Recovered charge	I_F = 600A, V_R = 600V, V_{GE} = -5V, -di_F/dt = 5700 A/µs (25°C) -di_F/dt = 6400 A/µs (150°C)	T_j = 25°C T_j = 175°C	Q_{rr}	3.5 4.3		µC
Reverse recovery energy	I_F = 600A, V_R = 600V, V_{GE} = -5V, -di_F/dt = 5700 A/µs (25°C) -di_F/dt = 6400 A/µs (150°C)	T_j = 25°C T_j = 175°C	E_{rec}	0.45 0.68		mJ

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	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15\ K))$	$B_{25/50}$		3375		K
B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298.15\ K))$	$B_{25/80}$		3411		K
B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298.15\ K))$	$B_{25/100}$		3433		K

Module

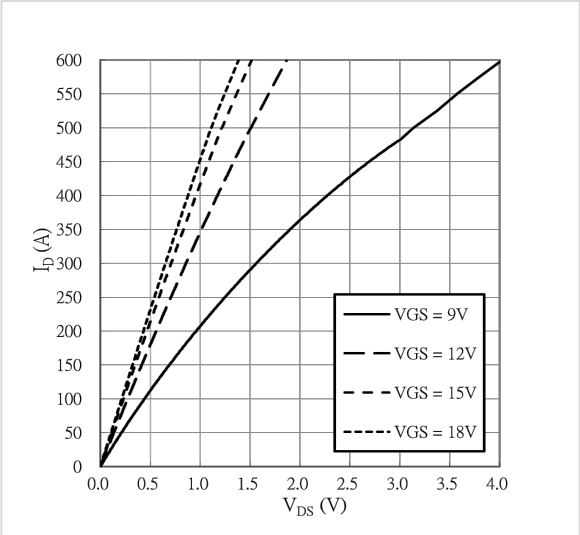
Parameter	Conditions	Symbol	Value	Unit
Module baseplate material			Cu + Ni	
Module internal isolation material			Si_3N_4	
Comparative tracking index [1)]		CTI	200	

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Module stray inductance		L_s		18		nH
Storage temperature		T_{stg}	-40		125	°C
Weight		G		350		g

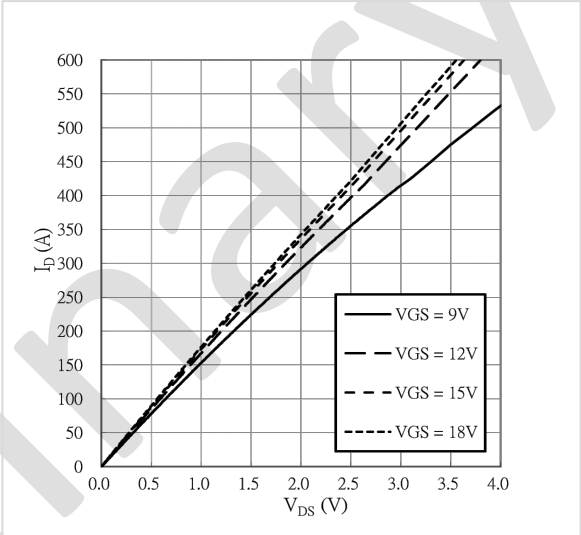
1) Extracted by following UL 746A

Characteristics Diagrams

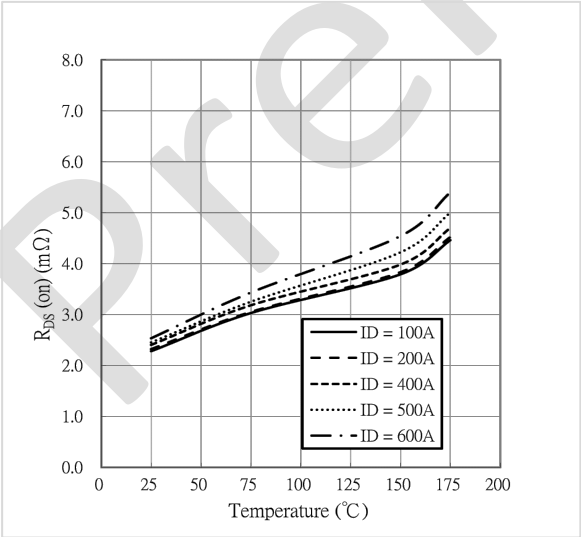
Output Characteristics MOSFET, Inverter
T_j = 25°C, I_D = f(V_{DS})



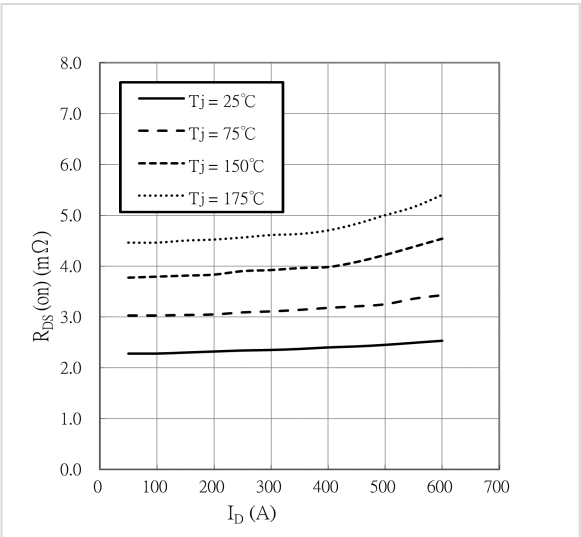
Output Characteristics MOSFET, Inverter
T_j = 175°C, I_D = f(V_{DS})



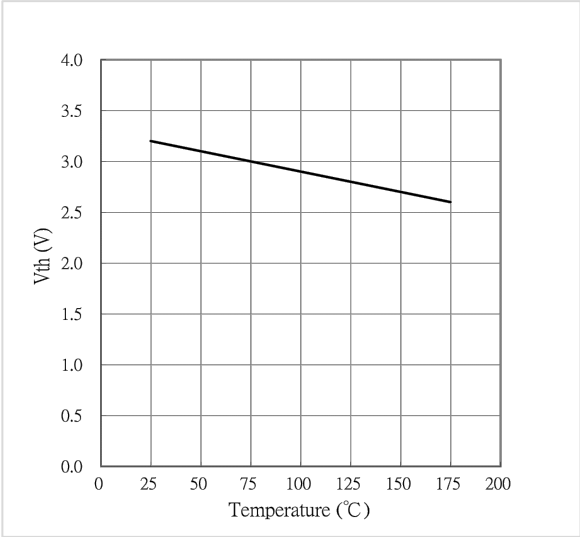
Typical temperature dependence of $R_{DS(on)}$,
V_{GS} = 15V, I_D = 600A, $R_{DS(on)}$ = f(T_j)



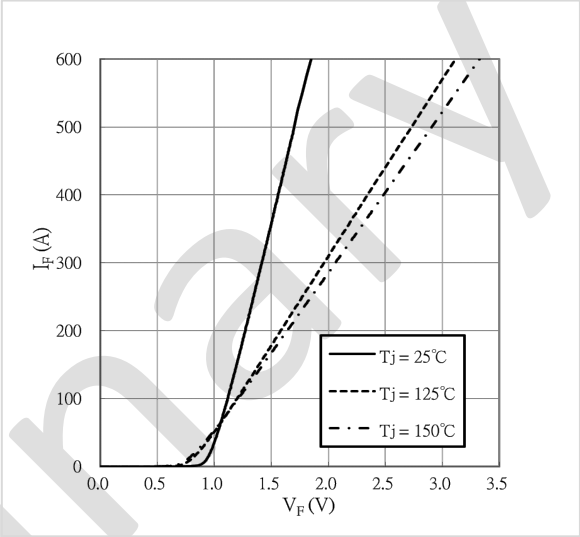
Typical ID dependence of $R_{DS(on)}$,
V_{GS} = 15V, $R_{DS(on)}$ = f(I_D)



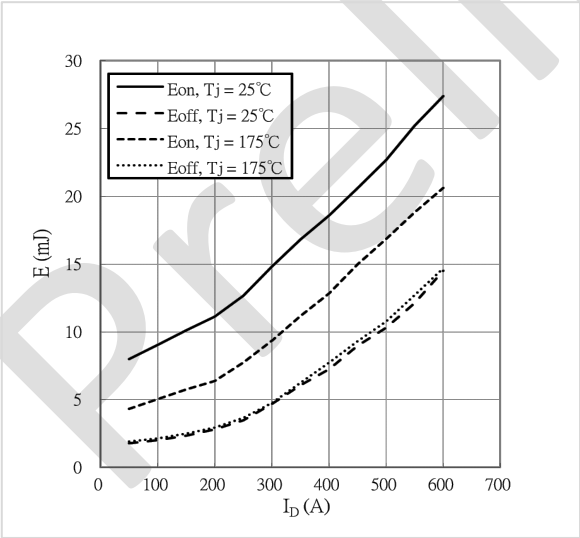
Typical temperature dependence of threshold voltage, Vth = f(T_j)



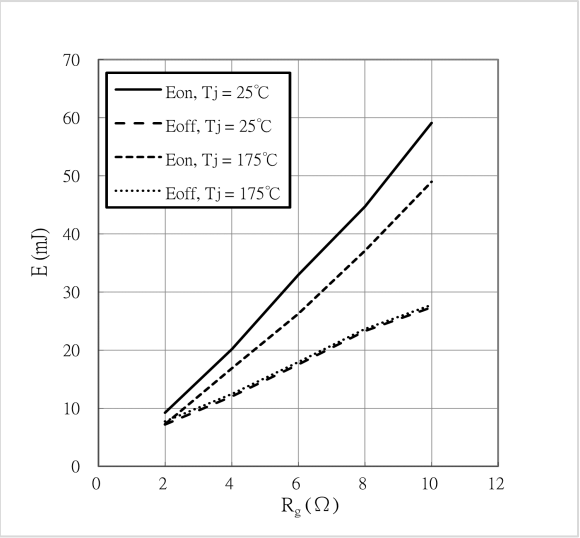
Forward characteristics of Diode, Inverter
V_{GS} = -5V, I_F = f(V_F)



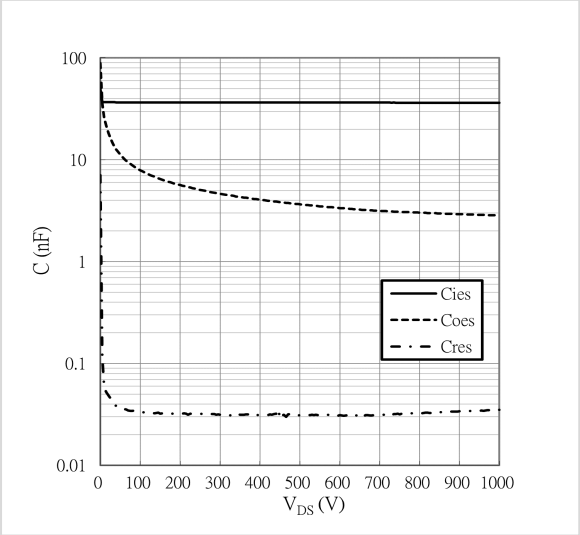
Switching loss MOSFET, Inverter
V_{GS} = -5V/+15V, R_{GON} = 5.0Ω, R_{Goff} = 5.0Ω,
V_{DS} = 600V, E_{on} & E_{off} = f(I_D)



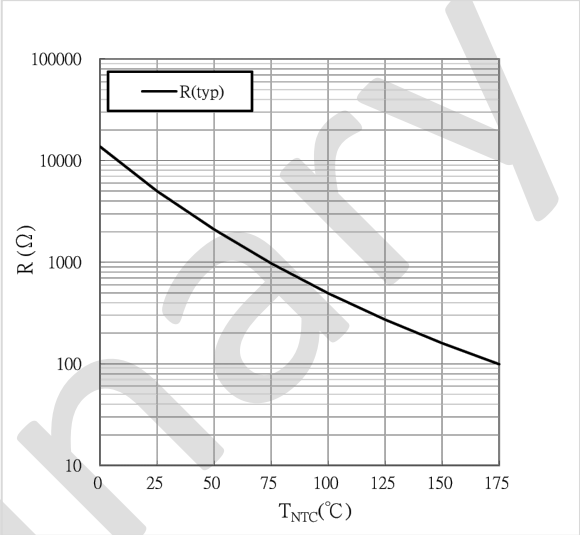
Switching loss MOSFET, Inverter
V_{GS} = -5V/+15V, V_{DS} = 600V, I_D = 600A,
E_{on} & E_{off} = f(R_g)



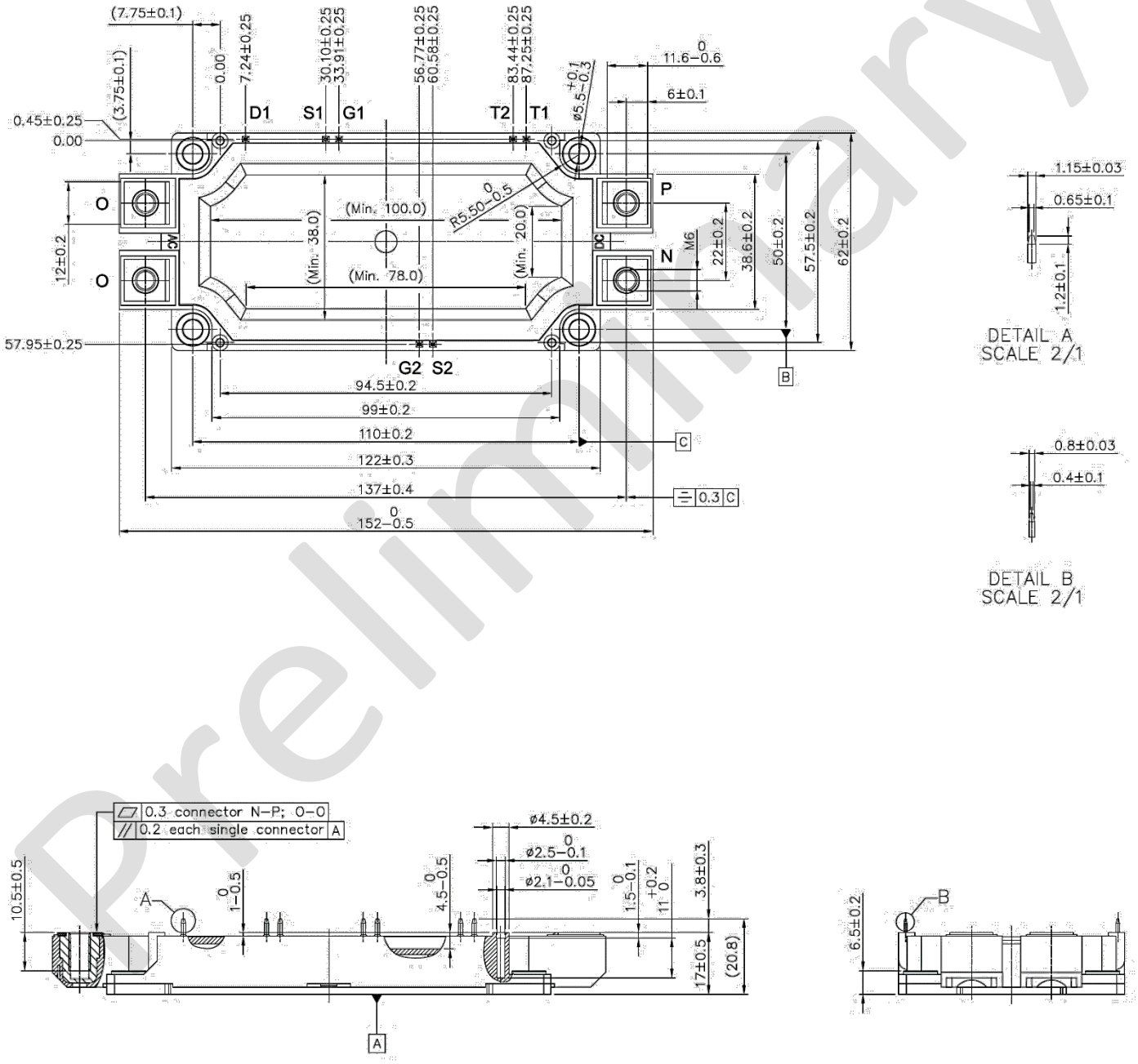
Capacitance characteristics MOSFET, inverter
V_{GS} = 0V, T_j = 25°C, f = 100KHz, C = f(V_{DS})



NTC-Thermistor-temperature characteristics



Package Outlines



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