



1200V SSC Power Module

ATSR20B12C1WT

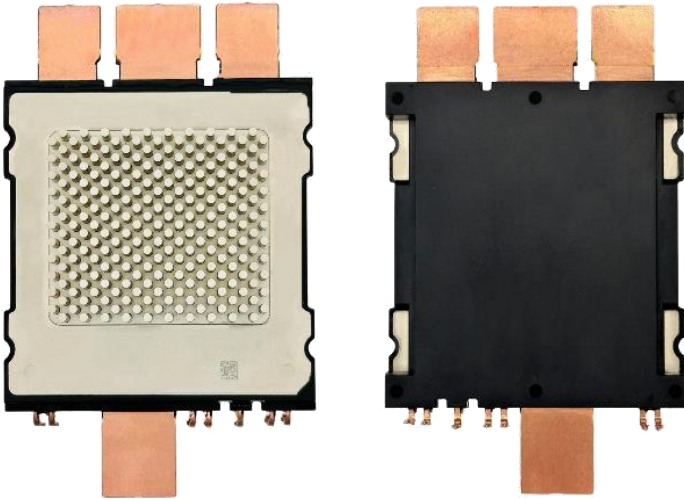
**PRELIMINARY
DATASHEET**

V0.3, 2025/01



ACTRON TECHNOLOGY CORP.

ATSR20B12C1WT SiC SSC Power Module



Applications

- Motor Drives
- Automotive Applications
- Molded Package Optimized for EV Application
- PinFin Structure for Lowest Thermal Resistance

Features

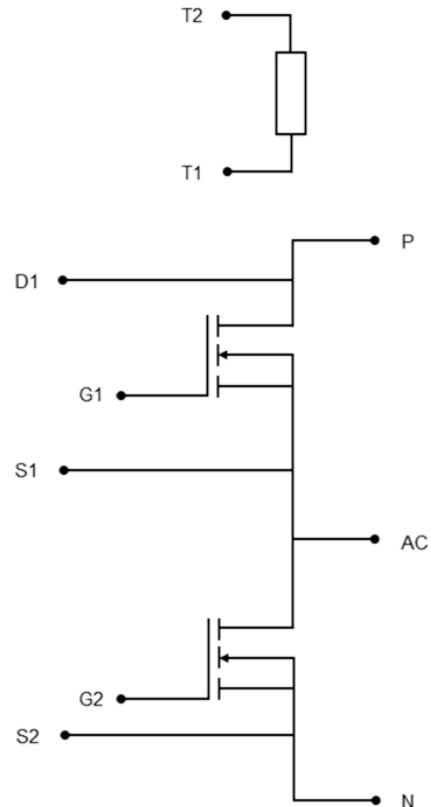
Electrical Features

- Low $R_{DS(on)}$
- $T_{j,op,max} = 175^{\circ}C$
- Blocking Voltage 1200V
- DC Drain Current 600A
- Low Switching Losses
- Low Inductive Design
- SiC MOSFET Technology

Mechanical Features

- Compact Design
- Sintered Ag Technology
- Si_3N_4 Ceramic Substrate
- NTC Temperature Sensor Included
- Comparative Tracking Index (CTI) > 600
- Press-Fit Pin Connection
- Direct Liquid Cooled PinFin Baseplate
- Pb-Free and RoHS Compliant

Circuit Diagram





MOSFET

Maximum Rated Values

Parameter	Conditions	Symbol	Values	Unit
Drain-source voltage	$T_j = 25^\circ\text{C}$	V_{DS}	1200	V
Gate-source voltage		V_{GS}	-10/+23	V
	Recommended operating values	V_{GS}	-5/+18	V
DC drain current	$V_{GS} = 18\text{V}$, $T_F = 65^\circ\text{C}$, $T_{j,max} = 175^\circ\text{C}$	$I_{D,nom}$	600	A
Pulsed drain current	t_p limited by $T_{j,max}$	$I_{D,pulse}$	1200	A
Maximum junction temperature		$T_{j,max}$	175	$^\circ\text{C}$

Characteristics Values

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Drain-source on resistance	$I_D = 600\text{A}$, $V_{GS} = 18\text{V}$ $T_j = 25^\circ\text{C}$	$R_{DS(on)}$		2.0	2.6	$\text{m}\Omega$
	$I_D = 600\text{A}$, $V_{GS} = 18\text{V}$ $T_j = 150^\circ\text{C}$			3.1		
	$I_D = 600\text{A}$, $V_{GS} = 18\text{V}$ $T_j = 175^\circ\text{C}$			3.5		
Gate threshold voltage	$I_D = 215\text{mA}$, $V_{GS} = V_{DS}$ $T_j = 25^\circ\text{C}$	$V_{GS,th}$	1.80	2.50	3.30	V
	$I_D = 215\text{mA}$, $V_{GS} = V_{DS}$ $T_j = 150^\circ\text{C}$			1.90		
	$I_D = 215\text{mA}$, $V_{GS} = V_{DS}$ $T_j = 175^\circ\text{C}$			1.80		
Drain-source leakage current	$V_{DS} = 1200\text{V}$, $V_{GS} = 0\text{V}$ $T_j = 25^\circ\text{C}$	I_{DSS}			100	μA
	$V_{DS} = 1200\text{V}$, $V_{GS} = 0\text{V}$ $T_j = 150^\circ\text{C}$				1	mA
	$V_{DS} = 1200\text{V}$, $V_{GS} = 0\text{V}$ $T_j = 175^\circ\text{C}$				5	mA
Gate-source leakage current	$V_{DS} = 0\text{V}$, $V_{GS} = 20\text{V}$ $T_j = 25^\circ\text{C}$	I_{GSS}			400	nA
Gate charge	$V_{GS} = -5\text{V} / +18\text{V}$ $V_{DS} = 800\text{V}$, $I_D = 600\text{A}$ $T_j = 25^\circ\text{C}$	Q_G		2.0		μC
Input capacitance	$f = 100\text{kHz}$, $V_{DS} = 800\text{V}$ $V_{GS} = 0\text{V}$ $T_j = 25^\circ\text{C}$	C_{iss}		52.1		nF
Output capacitance	$f = 100\text{kHz}$, $V_{DS} = 800\text{V}$ $V_{GS} = 0\text{V}$ $T_j = 25^\circ\text{C}$	C_{oss}		2.5		nF
Reverse transfer capacitance	$f = 100\text{kHz}$, $V_{DS} = 800\text{V}$ $V_{GS} = 0\text{V}$ $T_j = 25^\circ\text{C}$	C_{rss}		0.24		nF
Turn-on delay time inductive load	$I_D = 600\text{A}$, $V_{DS} = 800\text{V}$ $V_{GS} = -5\text{V} / +18\text{V}$ $R_{G,on} = 2.2\ \Omega$ $T_j = 25^\circ\text{C}$	$t_{d(on)}$		85		ns
	$I_D = 600\text{A}$, $V_{DS} = 800\text{V}$ $V_{GS} = -5\text{V} / +18\text{V}$ $R_{G,on} = 2.2\ \Omega$ $T_j = 175^\circ\text{C}$			70		
Rise time, inductive load	$I_D = 600\text{A}$, $V_{DS} = 800\text{V}$ $V_{GS} = -5\text{V} / +18\text{V}$ $R_{G,on} = 2.2\ \Omega$ $T_j = 25^\circ\text{C}$	t_r		83		ns
	$I_D = 600\text{A}$, $V_{DS} = 800\text{V}$ $V_{GS} = -5\text{V} / +18\text{V}$ $R_{G,on} = 2.2\ \Omega$ $T_j = 175^\circ\text{C}$			80		



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Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Turn-on energy loss per pulse	$I_D = 600A$, $V_{DS} = 800V$ $L_S = 30\text{ nH}$ $V_{GS} = -5V / +18V$ $R_{G,on} = 2.2\ \Omega$ $di/dt = 8.4\text{ A/ns}$ (25°C) $di/dt = 9.1\text{ A/ns}$ (175°C)	$T_j = 25^\circ\text{C}$ $T_j = 175^\circ\text{C}$	E_{on}	33.5 32.0		mJ
Turn-off delay time Inductive load	$I_D = 600A$, $V_{DS} = 800V$ $V_{GS} = -5V / +18V$ $R_{G,off} = 1.5\ \Omega$	$T_j = 25^\circ\text{C}$ $T_j = 175^\circ\text{C}$	$t_{d(off)}$	360 375		ns
Fall time, inductive load	$I_D = 600A$, $V_{DS} = 800V$ $V_{GS} = -5V / +18V$ $R_{G,off} = 1.5\ \Omega$	$T_j = 25^\circ\text{C}$ $T_j = 175^\circ\text{C}$	t_f	54 61		ns
Turn-off energy loss per pulse	$I_D = 600A$, $V_{DS} = 800V$ $L_S = 30\text{ nH}$ $V_{GS} = -5V / +18V$ $R_{G,off} = 1.5\ \Omega$ $dv/dt = 10.4\text{ V/ns}$ (25°C) $dv/dt = 10.2\text{ V/ns}$ (175°C)	$T_j = 25^\circ\text{C}$ $T_j = 175^\circ\text{C}$	E_{off}	48.9 49.0		mJ
Short circuit current	$V_{DD} = 800V$ $V_{GS} = -5V / +18V$ $R_{G,on} = 2.2\ \Omega$ $R_{G,off} = 1.5\ \Omega$ $t_{sc} \leq 1.5\ \mu\text{s}$	$T_j = 175^\circ\text{C}$	I_{sc}	8000		A
Thermal resistance Junction to cooling fluid	Per MOSFETs $\Delta V/\Delta t = 10\text{ dm}^3/\text{min}$ $T_F = 65^\circ\text{C}$		$R_{th,JF}$	0.074		K/W
Operated temperature condition		$T_{j,op}$	-40		175	°C



Body diode

Maximum Rated Values

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

Characteristics Values

Parameter	Conditions	Symbol	Typ.	Max.	Unit
Forward voltage	$I_{SD} = 600A, V_{GS} = -5V$	$T_j = 25^{\circ}C$	5.50		V
		$T_j = 150^{\circ}C$	5.05		
		$T_j = 175^{\circ}C$	4.95		
Peak reverse recovery current	$I_{SD} = 600A, V_R = 800V$ $V_{GS} = -5V$	$T_j = 25^{\circ}C$	145		A
		$T_j = 175^{\circ}C$	295		
Recovered charge	$I_{SD} = 600A, V_R = 800V$ $V_{GS} = -5V$	$T_j = 25^{\circ}C$	3.5		μC
		$T_j = 175^{\circ}C$	14.6		
Reverse recovery energy	$I_{SD} = 600A, V_R = 800V$ $V_{GS} = -5V$ $-di/dt = 9.3 A/ns (25^{\circ}C)$ $-di/dt = 8.4 A/ns (175^{\circ}C)$	$T_j = 25^{\circ}C$	3.3		mJ
		$T_j = 175^{\circ}C$	10.0		

NTC-Thermistor

Characteristics Values

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Rated resistance	$T_c = 25^{\circ}C$	R_{25}		5.0		k Ω
Resistance tolerance	$T_c = 100^{\circ}C$	$\Delta R/R$	-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
Dimensions	Terminal (AC) to Terminal (DC)	L	110	mm
	Mold body width	W	69	mm
	Mold body length	L	74	mm
	Baseplate surface to the pressfit pinis(inserted in the PCB)	H	17.35	mm
Module baseplate material			Cu + Ni	
Module internal isolation material	Basic isolation (class 1, IEC 61140)		Si ₃ N ₄	
Creepage distance	Terminal to baseplate	d _{Creep,TH}	8.5	mm
Creepage distance	Terminal to terminal	d _{Creep,TT}	8	mm
Clearance distance	Terminal to baseplate	d _{Clear,TH}	6.9	mm
Clearance distance	Terminal to terminal	d _{Clear,TT}	3.3	mm

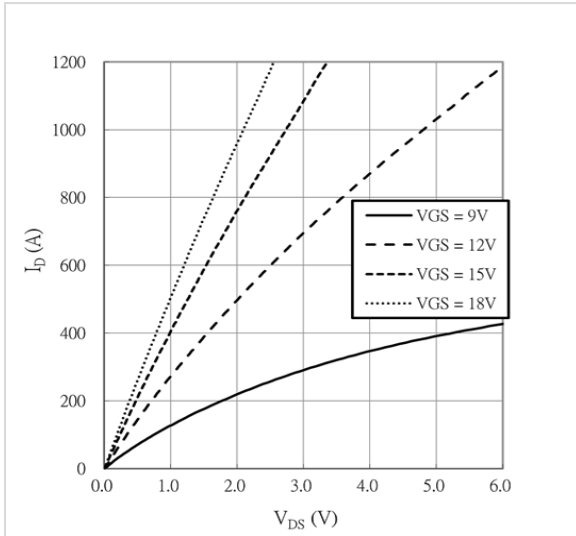
Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit
Module stray inductance		L _{sDS}		< 6		nH
Comparative tracking index ¹⁾		CTI		> 600		
Storage temperature		T _{stg}	-40		150	°C
Weight		G		290		g

¹⁾ Extracted by following UL 746A

Characteristics Diagrams

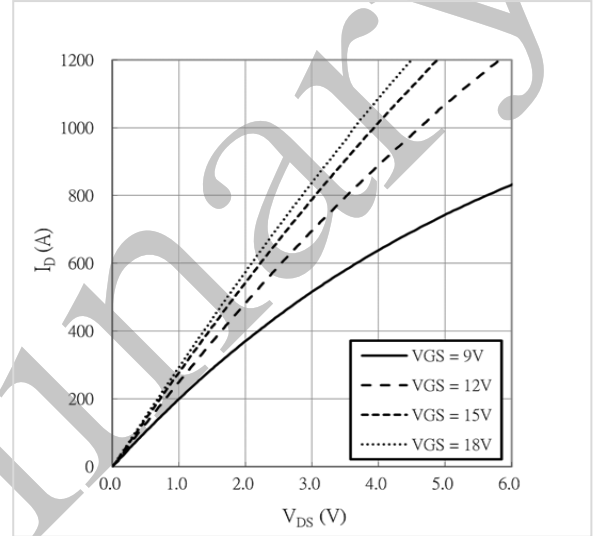
MOSFET, Output characteristics

$T_j = 25^\circ\text{C}$, $I_D = f(V_{DS})$



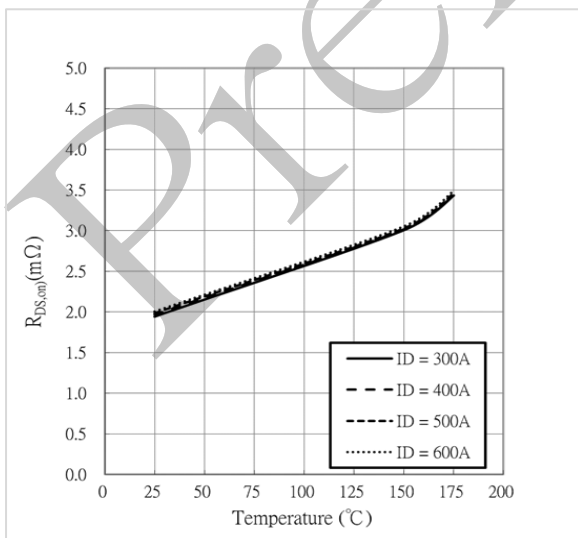
MOSFET, Output characteristics

$T_j = 175^\circ\text{C}$, $I_D = f(V_{DS})$



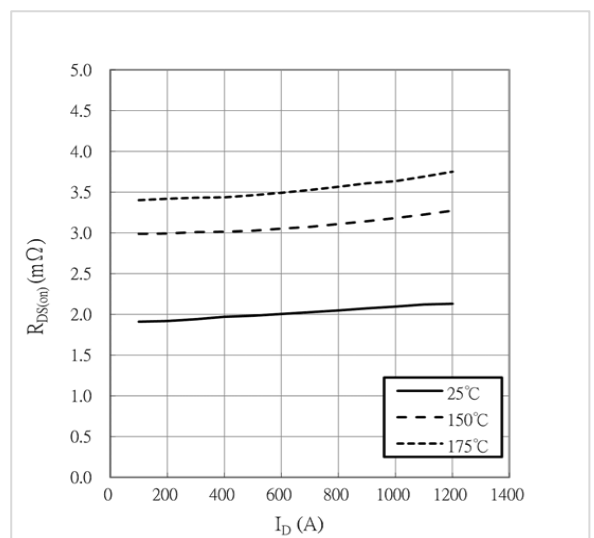
Typical temperature dependence of $R_{DS(on)}$

$V_{GS} = 18\text{V}$, $R_{DS(on)} = f(T_j)$



Typical I_D dependence of $R_{DS(on)}$

$V_{GS} = 18\text{V}$, $R_{DS(on)} = f(I_D)$

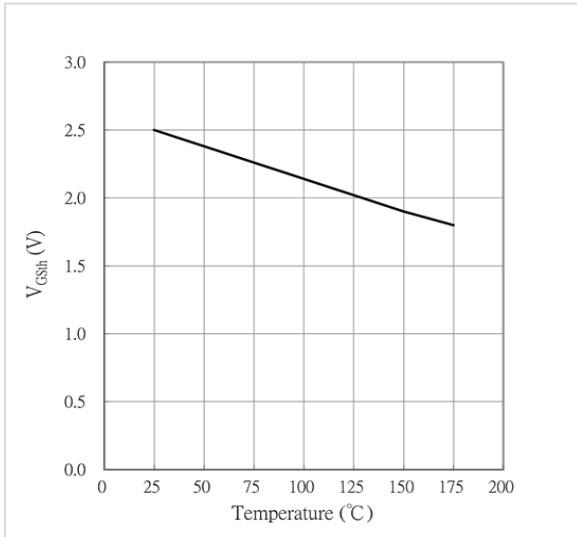




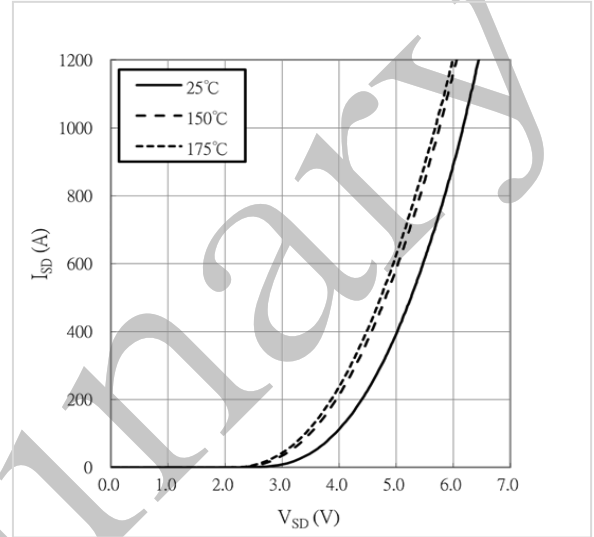
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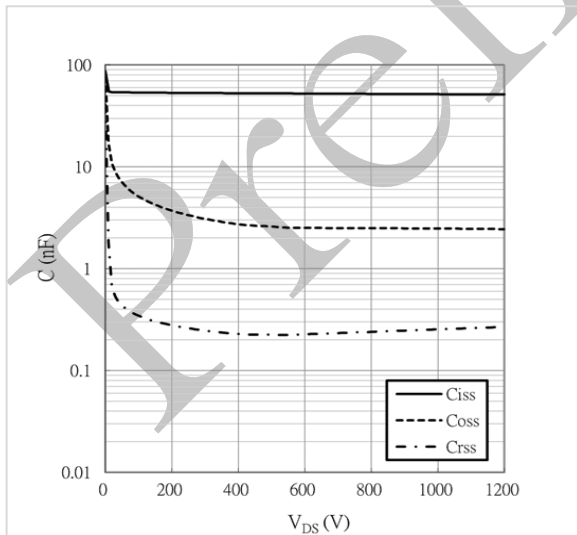
Typical temperature dependence of
threshold voltage, $V_{GS,th} = f(T_j)$



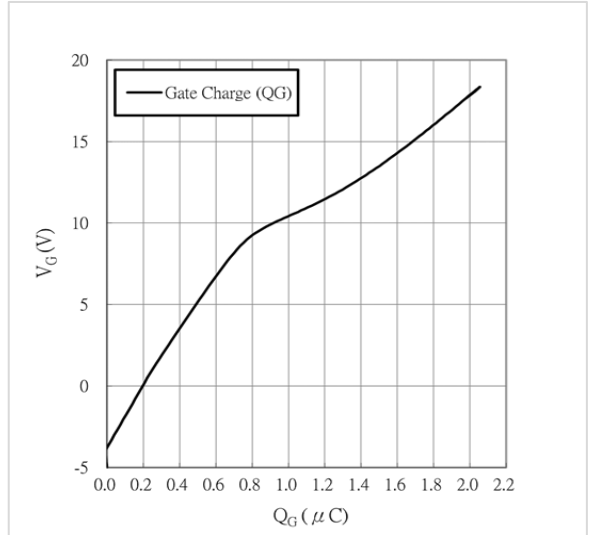
Body diode, Forward characteristics
 $V_{GS} = -5V$, $I_{SD} = f(V_{SD})$



MOSFET, Capacitance characteristics
 $V_{GS} = 0V$, $T_j = 25^\circ C$, $f = 100\text{ kHz}$, $C = f(V_{DS})$



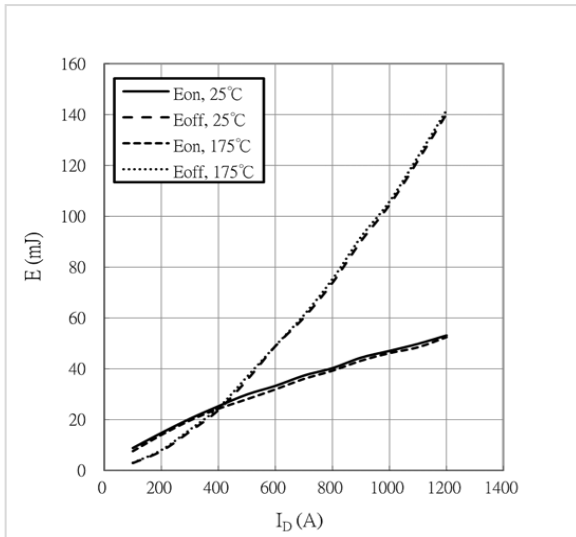
MOSFET, Total gate charge characteristics
 $V_{DS} = 800V$, $I_D = 600A$, $T_j = 25^\circ C$, $V_{GS} = f(Q_G)$



MOSFET, Switching losses VS. I_D

$V_{GS} = -5V / +18V$, $R_{G,on} = 2.2\Omega$, $R_{G,off} = 1.5\Omega$

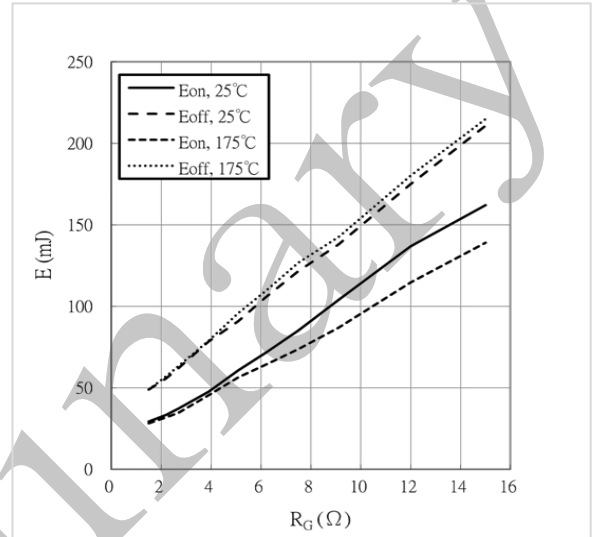
$V_{DS} = 800V$, E_{on} & $E_{off} = f(I_D)$



MOSFET, Switching losses VS. R_G

$V_{GS} = -5V / +18V$, $V_{DS} = 800V$, $I_D = 600A$

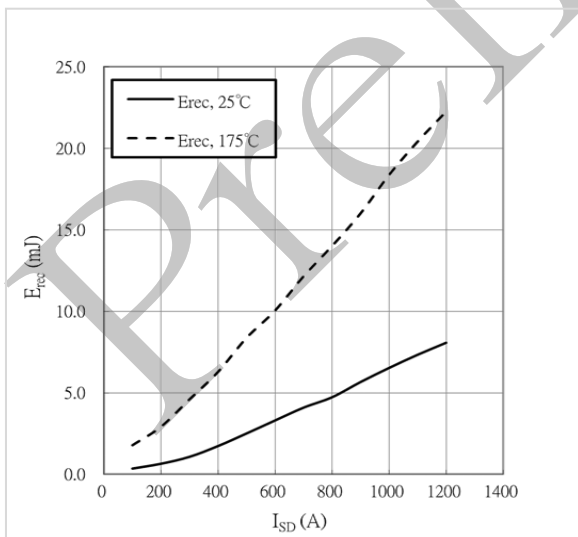
E_{on} & $E_{off} = f(R_G)$



Body diode, Switching losses VS. I_{SD}

$V_{GS} = -5V / +18V$, $R_{G,on} = 2.2\Omega$, $R_{G,off} = 1.5\Omega$

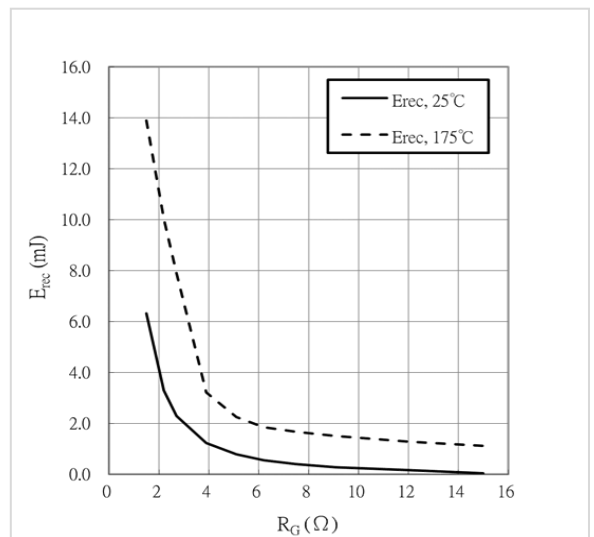
$V_{DS} = 800V$, $E_{rec} = f(I_{SD})$



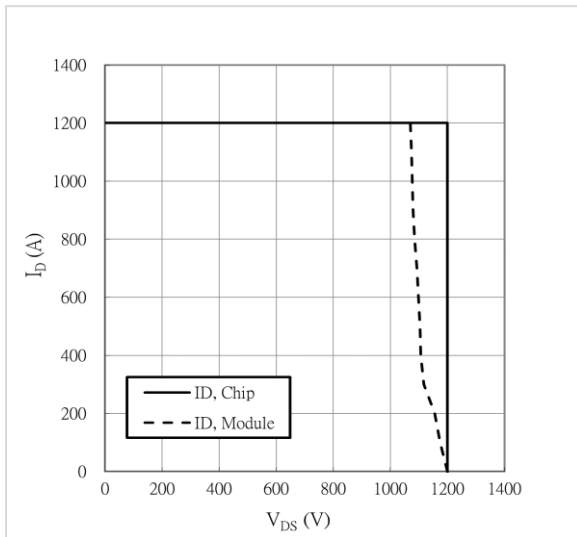
Body diode, Switching losses VS. R_G

$V_{GS} = -5V / +18V$, $V_{DS} = 800V$, $I_{SD} = 600A$

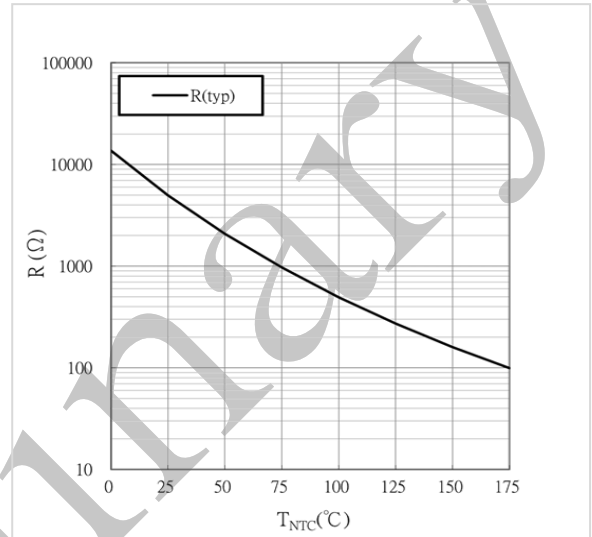
$E_{rec} = f(R_G)$



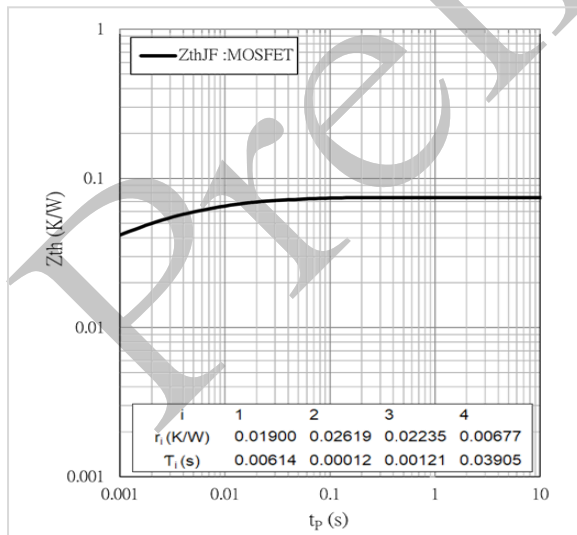
MOSFET, Reverse bias safe operating area
(RBSOA) $V_{GS} = -5V / +18V$, $R_{G,on} = 2.2\Omega$
 $R_{G,off} = 1.5\Omega$, $T_j = 175^\circ\text{C}$, $I_D = f(V_{DS})$



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

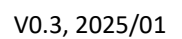


MOSFET, Transient thermal impedance
 $Z_{thJF} = f(t_p)$
 $\Delta V / \Delta t = 10 \text{ dm}^3/\text{min}$, $T_F = 65^\circ\text{C}$





Package Outlines



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