

1200V/4.1mΩ Half Bridge SiC MOSFET Module

Description

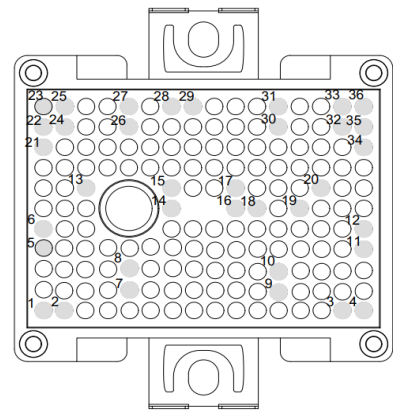
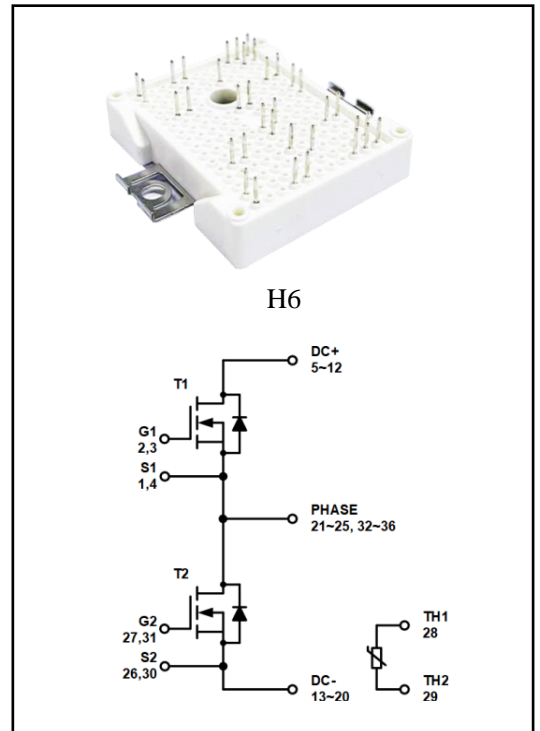
The AKM2CM004N120-MC is a Half Bridge SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as Solar Inverter and Uninterruptible Power Supplies.

Features

- ◆ Blocking voltage 1200V
- ◆ $R_{DS(on)} = 4.1m\Omega$
- ◆ Low thermal resistance with Si₃N₄ AMB
- ◆ 175°C maximum junction temperature
- ◆ Thermistor inside
- ◆ Low Switching Losses

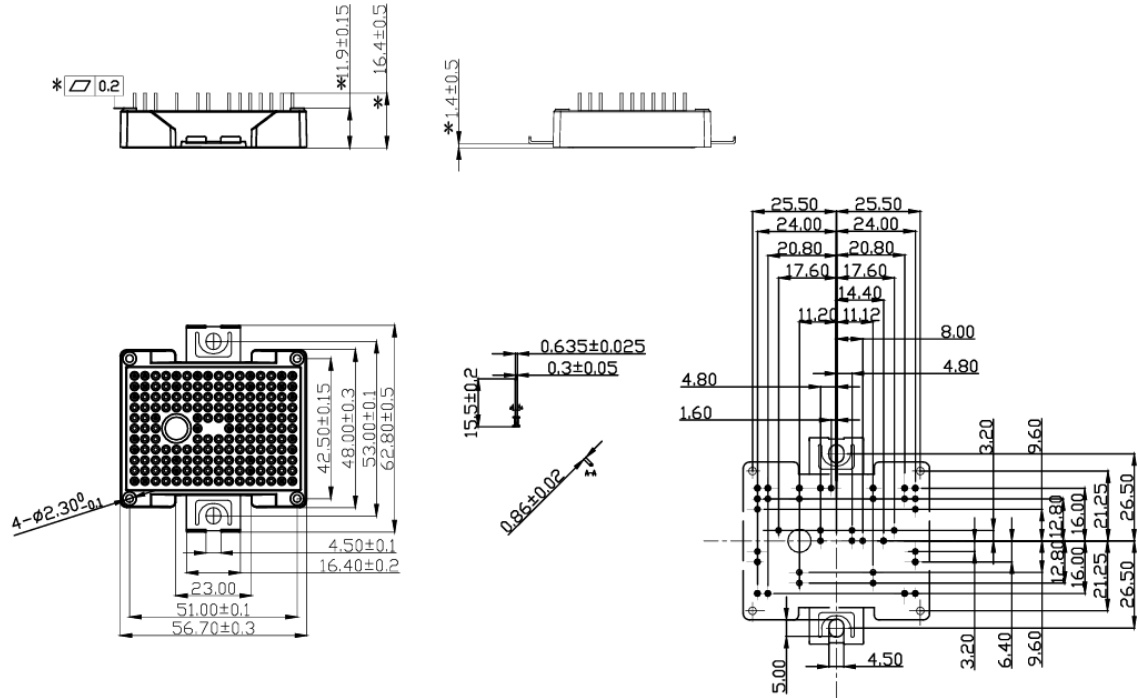
Applications

- ◆ Solar Inverter
- ◆ Uninterruptible Power Supplies
- ◆ Electric Vehicle Charging Stations
- ◆ Energy Storage Systems



Key performance and package parameters

Type	V _{DS}	I _{DS} (T _C =100°C)	R _{DS(ON)} (V _{GS} =18V, I _D =200A, T _J =25°C)	Q _g	Marking	Package
AKM2CM004N120-MC	1200V	320A	4.1mΩ	760nC	AKM2CM004N120-MC	H6

Package outlines


PIN No.	Symbol	Description
1,4	S1	T1 Kelvin Emitter(High the switch)
2,3	G1	T1 Gate(High the switch)
5-12	DC+	DC + Bus connection
13-20	DC-	DC - Bus connection
21-25,32-36	PHASE	Output terminal of half bridge
26,30	S2	T2 Kelvin Emitter(Low the switch)
27,31	G2	T2 Gate(Low the switch)
28	TH1	Thermistor connection 1
29	TH2	Thermistor connection 2

Module

Symbol	Description	Value	Unit	Note
V _{ISO}	Isolation Voltage ,RMS, f =50Hz, t =1min	3.6	kV	
Baseplate	Material of Module Baseplate	Cu	-	
AMB	Substrate Ceramic Material	Si ₃ N ₄		
Creepage Distance	terminal to heatsink Creepage Distance	11.5	mm	
	terminal to terminal Creepage Distance	6.0		
Clearance	terminal to heatsink Clearance	10.0	mm	
	terminal to terminal Clearance	5.0		
T _M	Screws to Heatsink mounting torque	2.0	N·m	
CTI	Comperative tracking index	>200	-	
W	Weight	40	g	

Maximum Ratings (T_j =25°C unless otherwise specified)

Symbol	Parameter	Conditions	Value	Unit	Note
V _{DSS}	Drain-Source Voltage	G-S Short	1200	V	
V _{GSS}	Gate-Source Voltage	D-S Short, AC frequency ≥1Hz, Note 1	-10 to 22	V	
I _{DS}	DC Continuous Drain Current	T _C =25°C, V _{GS} =18V(T _J =175°C)	430	A	
I _{DS}	DC Continuous Drain Current	T _C =100°C, V _{GS} =18V(T _J =175°C)	320	A	
I _{SD}	Source (Body Diode) Current	T _C =100°C	320	A	
I _{DSM}	Pulse Forward Current	Pulse width limited by T _{Jmax}	800	A	
P _{tot}	Total Power Dissipation	T _J =175°C	1500	W	
T _{Jmax}	Max Junction Temperature	-	175	°C	
T _{stg}	Storage Temperature	-	-40 to 150	°C	

Note1: Recommended Operating Value: +18V/-4V

MOSFET Electrical Characteristics

Symbol	Item	Conditions	Value			Unit	Note	
			Min.	Typ.	Max.			
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=1200V, V_{GS}=0V$	-	1	-	μA		
$V_{GS(th)}$	Gate-Source Threshold Voltage	$I_D=84mA$ $V_{DS}=V_{GS}$	$T_j=25^\circ C$	2.0	2.8	4.0	V	Fig.10
			$T_j=175^\circ C$	-	1.9	-	V	
I_{GSS}	Gate-Source Leakage Current	$V_{GS}=18V, V_{DS}=0V, T_j=25^\circ C$	-	-	1	μA		
$R_{DS(on)}$ (Chip)	Static Drain-Source On-State Resistance	$I_D=200A, V_{GS}=+18V$	$T_j=25^\circ C$	-	4.10	-	m Ω	Fig. 7,8
			$T_j=175^\circ C$	-	7.23	-	m Ω	
		$I_D=200A, V_{GS}=+15V$	$T_j=25^\circ C$	-	5.01	-	m Ω	
C_{iss}	Input Capacitance	$V_D=800V, V_{GS}=0V$ $f=100kHz$	-	18031	-	pF	Fig.12	
C_{oss}	Output Capacitance		-	930	-	pF		
C_{rss}	Reverse Transfer Capacitance		-	59	-	pF		
E_{oss}	Coss Stored energy		-	388	-	μJ	Fig.11	
$R_{G(int)}$	Internal Gate Resistor	$f=100kHz$	-	1.14	-	Ω		
Q_g	Total Gate Charge	$V_{DS}=800V, I_D=200A, V_{GS}=+18/-4V$	-	760	-	nC	Fig.9	
Q_{gs}	Gate to Source Charge		-	178	-	nC		
Q_{gd}	Gate to Drain Charge		-	145	-	nC		
$t_{d(on)}$	Turn-On Delay Time	$V_{DD}=600V$ $I_D=200A$ $V_{GS}=+18/-4V$ $R_{gon}/R_{goff}=1.0/1.0\Omega$	$T_j=25^\circ C$	-	56	-	ns	Fig. 13-16
			$T_j=150^\circ C$	-	53	-	ns	
t_r	Rise Time		$T_j=25^\circ C$	-	17	-	ns	
			$T_j=150^\circ C$	-	15	-	ns	
$t_{d(off)}$	Turn-Off Delay Time		$T_j=25^\circ C$	-	85	-	ns	
			$T_j=150^\circ C$	-	98	-	ns	
t_f	Fall Time		$T_j=25^\circ C$	-	19	-	ns	
			$T_j=150^\circ C$	-	21	-	ns	
E_{on}	Turn-On Power Dissipation		$T_j=25^\circ C$	-	1.28	-	mJ	
E_{off}	Turn-Off Power Dissipation		$T_j=150^\circ C$	-	1.42	-	mJ	
			$T_j=25^\circ C$	-	1.08	-	mJ	
E_{off}	Turn-Off Power Dissipation		$T_j=150^\circ C$	-	1.16	-	mJ	
		$T_j=25^\circ C$	-	1.16	-	mJ		
$R_{th(j-c)}$	Thermal Resistance	Junction to Case	-	0.07	-	$^\circ C/W$	Fig.18	
$R_{th(c-f)}$	Contact Thermal Resistance	With thermal conductive grease, $\lambda_{grease}=2.8W/(m \cdot K)$	-	0.12	-	$^\circ C/W$		

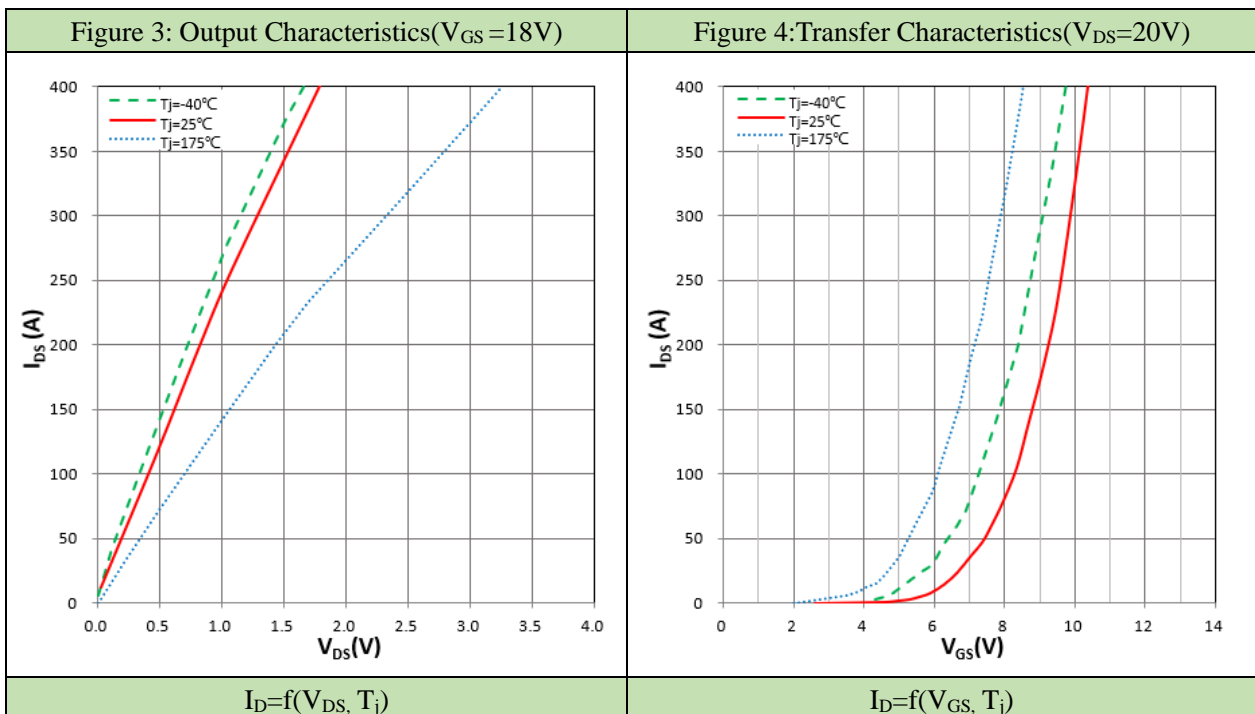
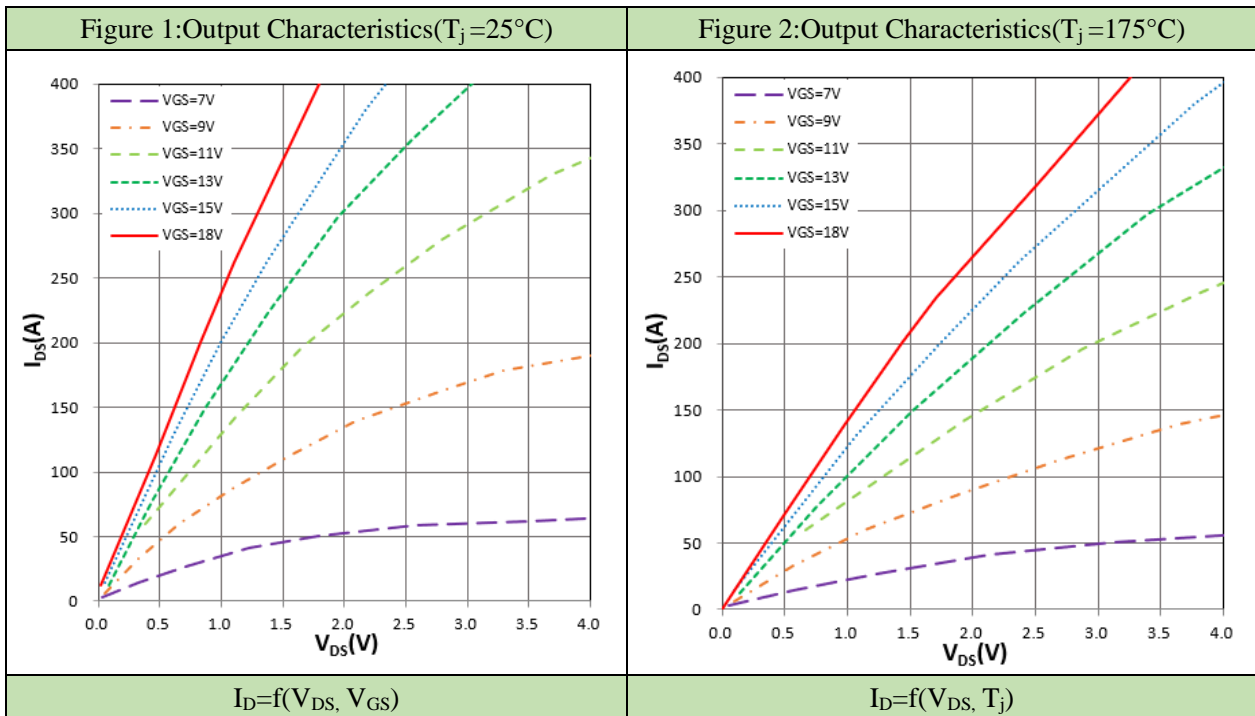
Body Diode Electrical Characteristics

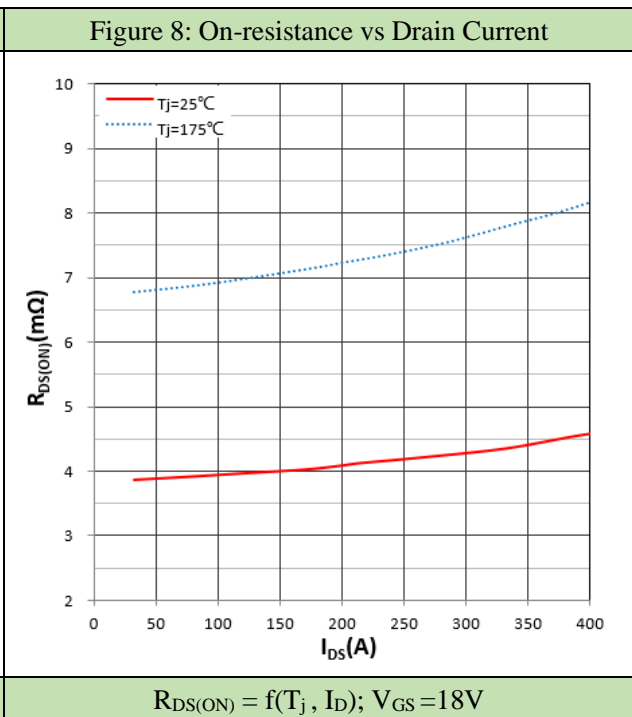
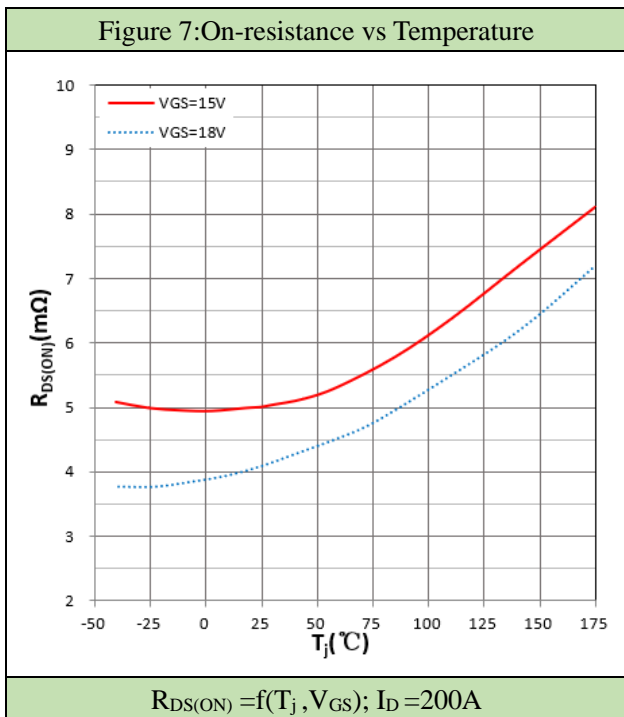
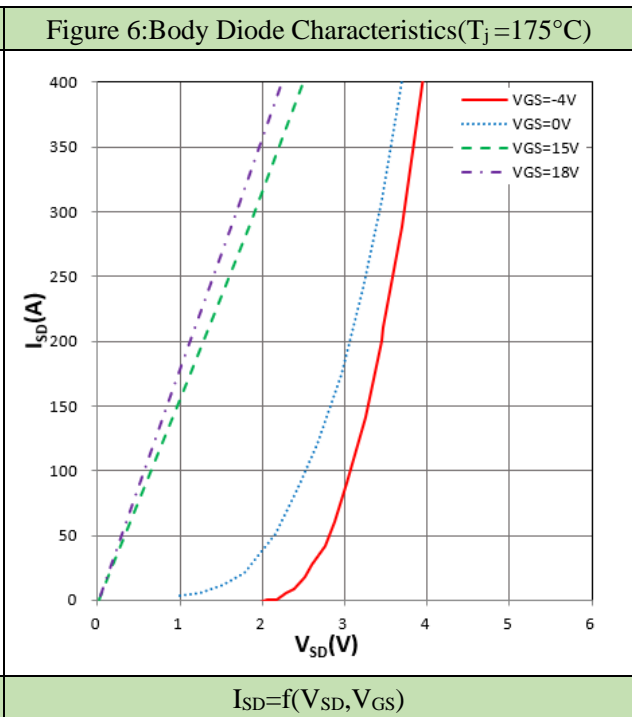
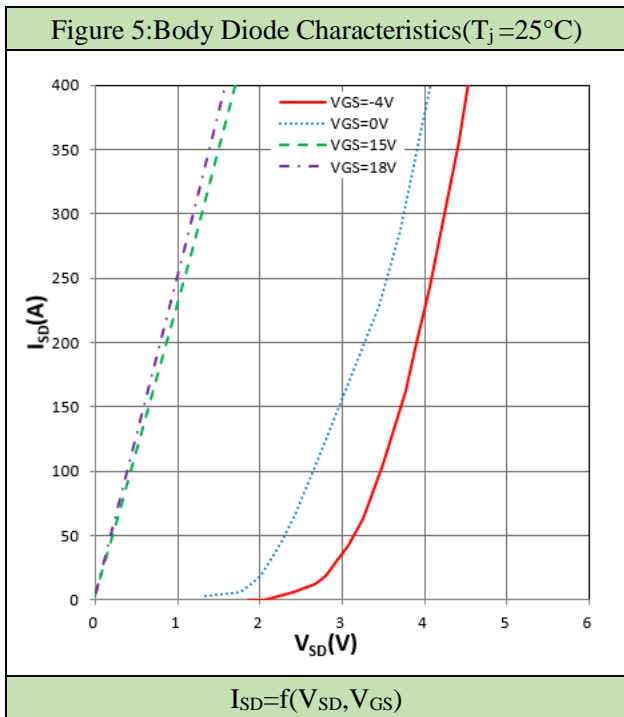
Symbol	Item	Conditions	Value			Unit	Note	
			Min.	Typ.	Max.			
V _{SD}	Body Diode Forward Voltage	V _{GS} = -4V I _{SD} = 200A	T _j = 25°C	-	3.95	-	V	Fig.5,6
			T _j = 175°C	-	3.47	-		
T _{rr}	Reverse Recovery Time	V _R = 600V I _{SD} = 200A	T _j = 25°C	-	23	-	ns	
			T _j = 150°C	-	35	-		
Q _{rr}	Reverse Recovery Charge	V _{GS} = +18/-4V R _{gon} /R _{goff} = 1.0/1.0Ω	T _j = 25°C	-	1.81	-	μC	
			T _j = 150°C	-	4.02	-		
I _{rrm}	Peak Reverse Recovery Current		T _j = 25°C	-	138	-	A	
			T _j = 150°C	-	196	-		

NTC Characteristics

Symbol	Parameter	Conditions	Value			Unit	Note
			Min.	Typ.	Max.		
R ₂₅	Resistance	T _C = 25°C	-	5	-	kΩ	Fig.17
ΔR/R	Deviation of R ₁₀₀	T _C = 100°C, R ₁₀₀ = 493Ω	-5	-	5	%	
P ₂₅	Power Dissipation	T _C = 25°C	-	-	60	mW	
B _{25/50}	B-Value	R ₂ = R ₂₅ exp [B _{25/50} (1/T ₂ - 1/(298,15 K))]	-	3375	-	K	
B _{25/80}	B-Value	R ₂ = R ₂₅ exp [B _{25/80} (1/T ₂ - 1/(298,15 K))]	-	3425	-	K	
B _{25/100}	B-Value	R ₂ = R ₂₅ exp [B _{25/100} (1/T ₂ - 1/(298,15 K))]	-	3443	-	K	

Typical Performance





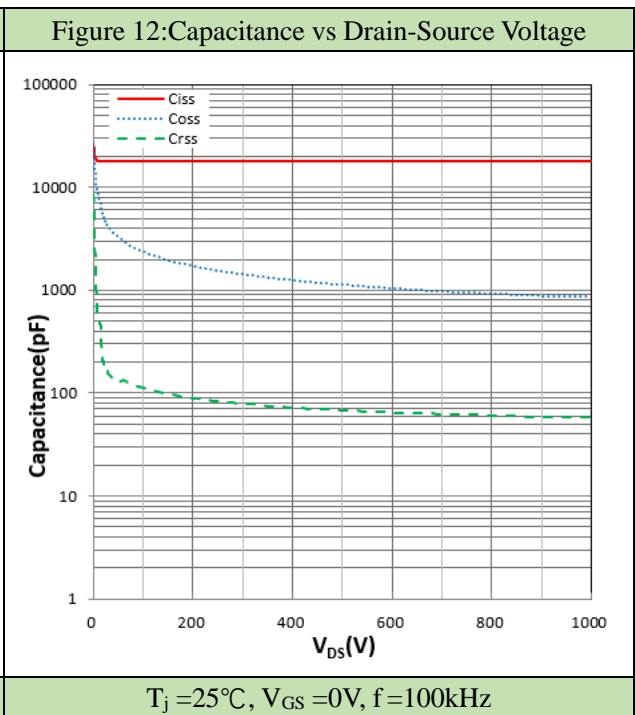
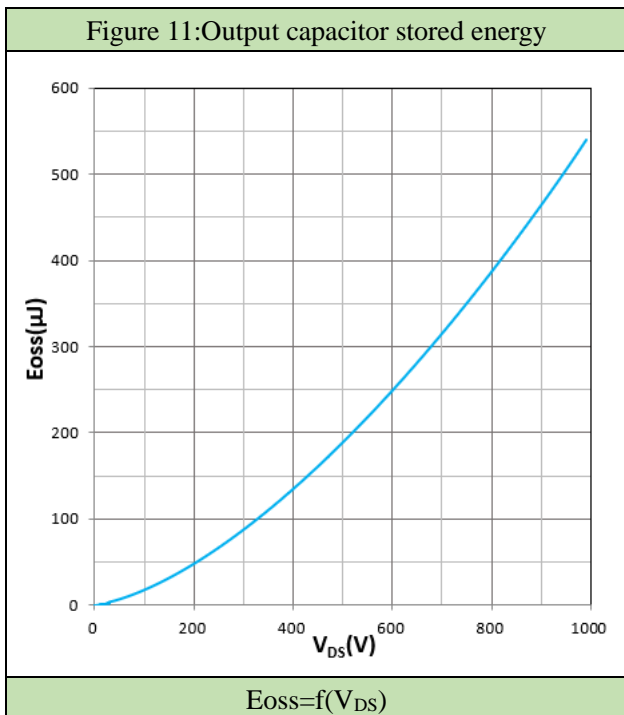
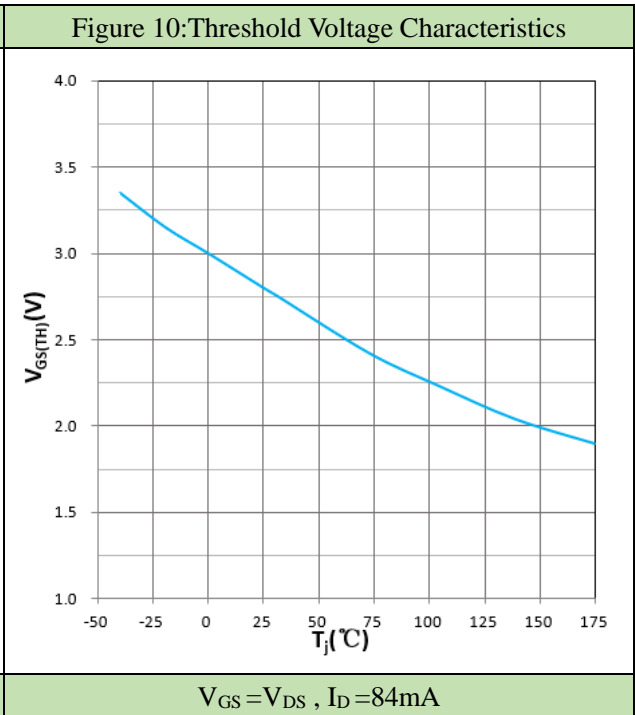
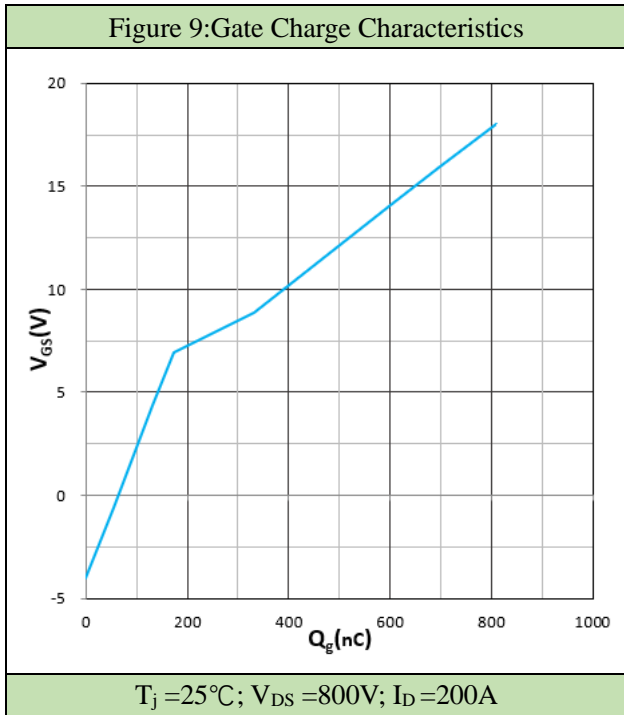
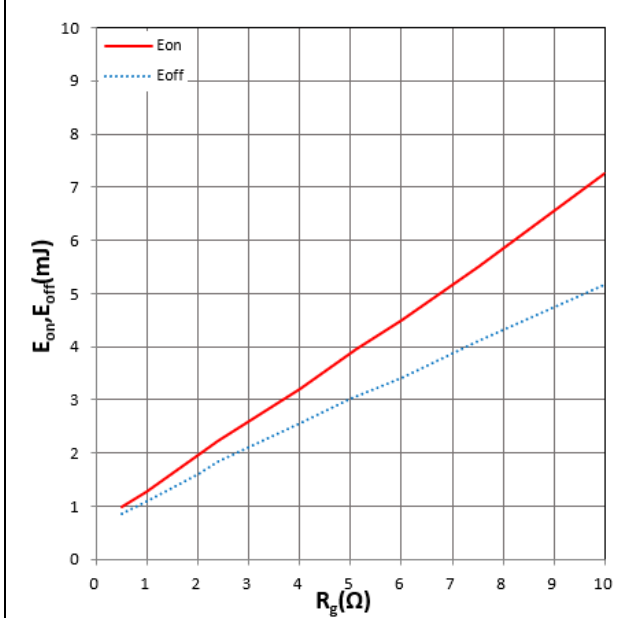
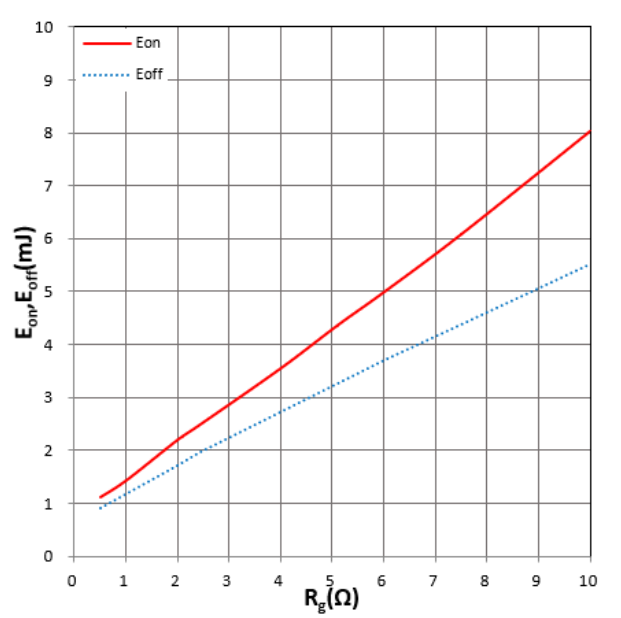


Figure 13: Inductive Switching Energy vs $R_{g(ext)}$ ($T_j = 25^\circ\text{C}$)



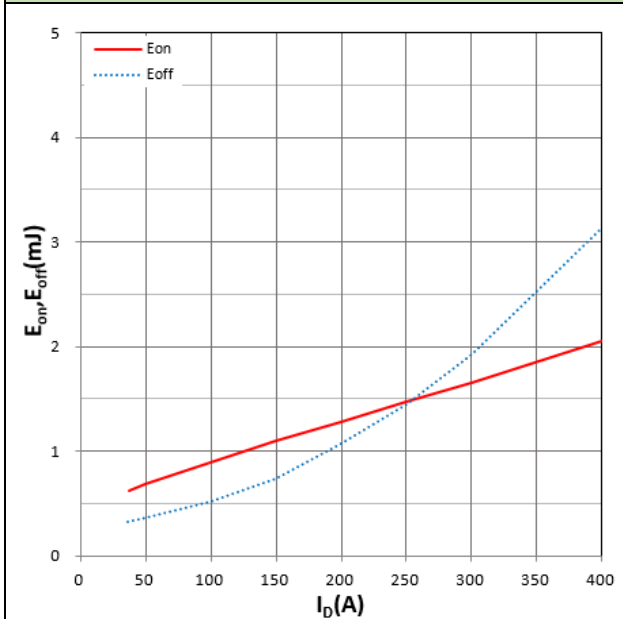
$V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$, $I_D = 200\text{A}$
Inductive Load

Figure 14: Inductive Switching Energy vs $R_{g(ext)}$ ($T_j = 150^\circ\text{C}$)



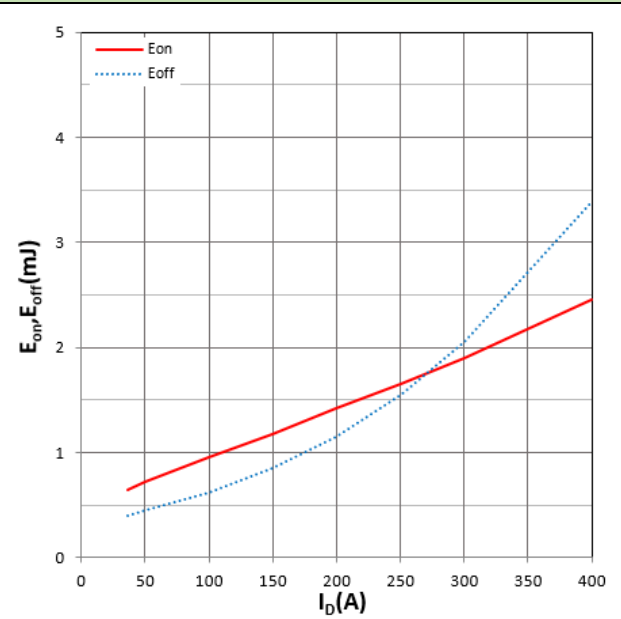
$V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$, $I_D = 200\text{A}$
Inductive Load

Figure 15: Inductive Switching Energy vs Drain Current ($T_j = 25^\circ\text{C}$)

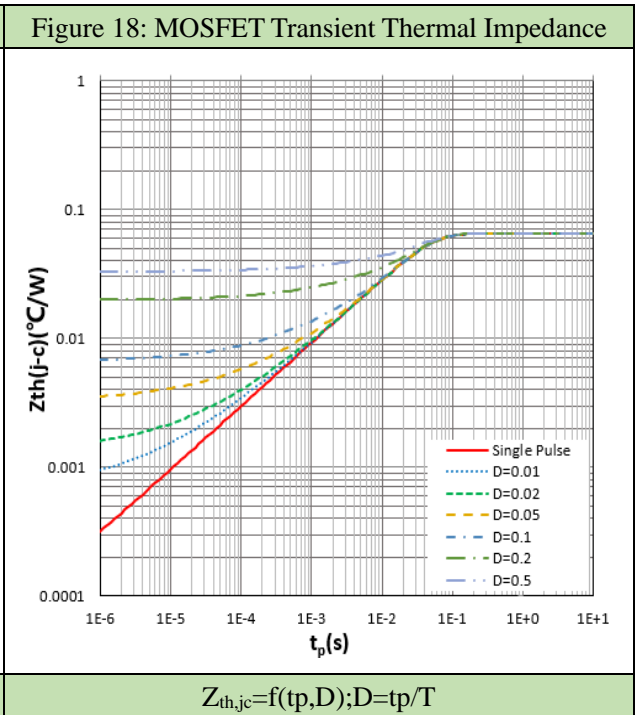
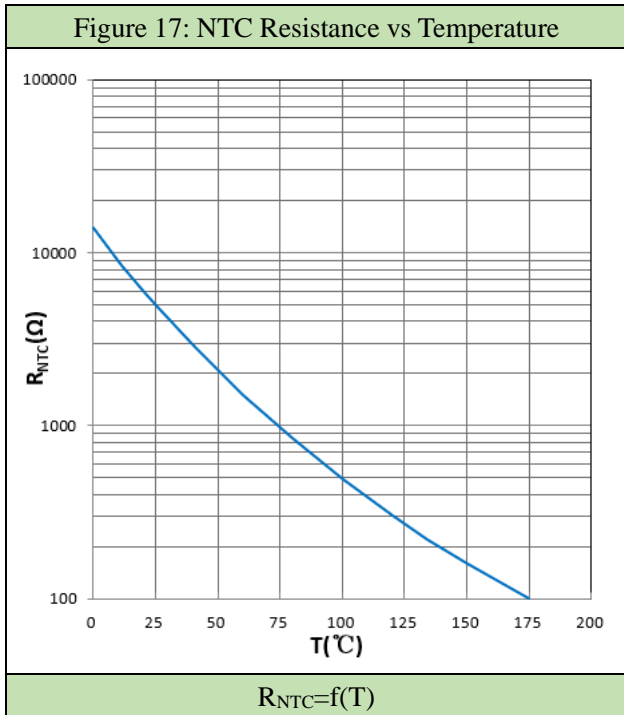


$V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$,
 $R_{gon}/R_{goff} = 1.0/1.0\Omega$, Inductive Load

Figure 16: Inductive Switching Energy vs Drain Current ($T_j = 150^\circ\text{C}$)



$V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$,
 $R_{gon}/R_{goff} = 1.0/1.0\Omega$, Inductive Load



Test definitions

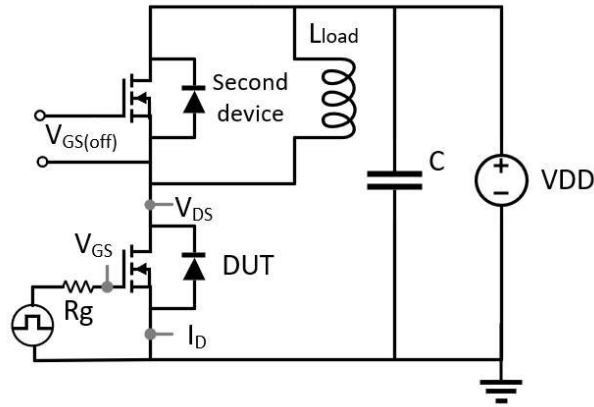


Figure A. Switching characteristics measurement circuit

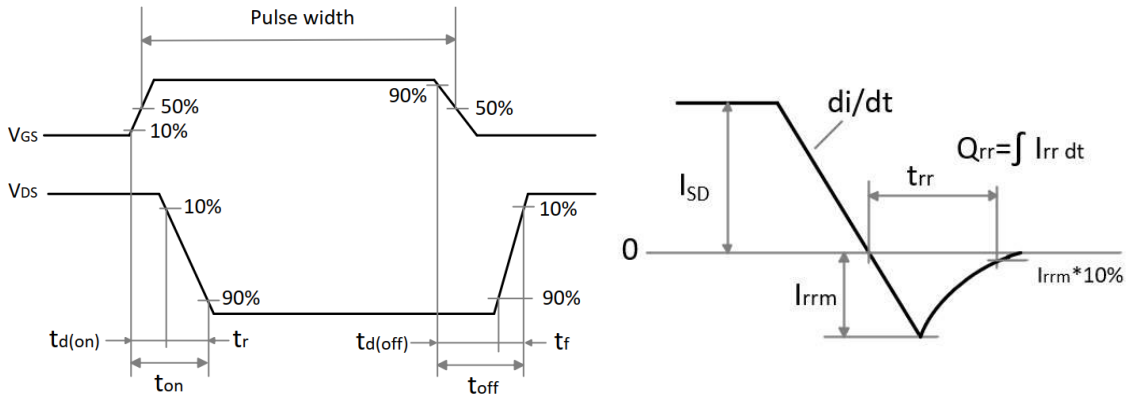


Figure B. Switching time definition

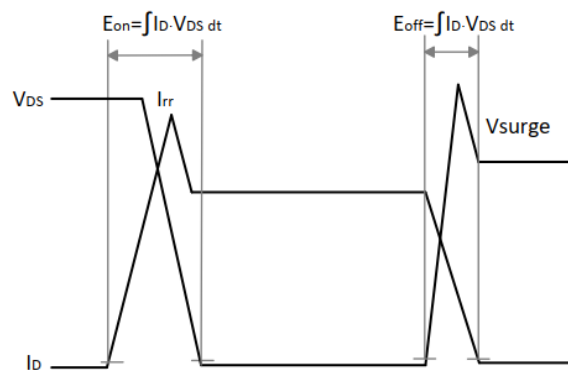


Figure C. Switching energy loss