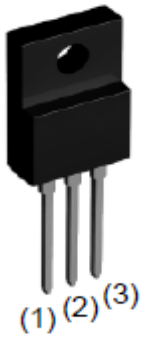
CMS6509AENX

Nch 650V/9A Super Junction Power MOSFET

V_{DSS}	650V
$R_{DS(on)}$ (Max.)	0.68Ω
I_D	9A
P_D	48W

Outline

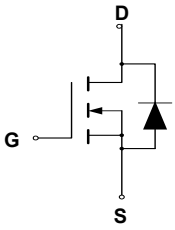
TO-220FP
Front View



FEATURES

- Low on-resistance
- Fast switching speed
- Gate-source voltage (V_{GSS}) guaranteed to be ±20V
- Drive circuits can be simple
- Parallel use is easy
- Pb-free lead plating ; RoHs compliant

Inner circuit



(1) Gate
(2) Drain
(3) Source

Application

- Switching Power Supply

Packaging specificationa

Type	Packaging	Bulk
	Reel size (mm)	-
	Tape width (mm)	-
	Basic ordering unit (pcs)	1000
	Taping code	-
	Marking	CMS6509A

ORDERING INFORMATION

Part Number	Temperature Range	Package
CMS6509AENX	-55℃ to 150℃	TO-220FP

*Note :

AE*Series

N*:N-ch Mosfet

X*TO-220FP

ABSOLUTE MAXIMUM RATINGS (Ta=25℃)

Parameter		Symbol	Value	Unit
Drain-Source Voltage		V_{DSS}	650	V
Continuous drain current	Tc=25℃	I_D *1	±9	A
	Tc=100℃	I_D *1	±4.9	A
Pulsed drain current		$I_{D,\ pulse}$ *2	±27	A
Gate-Source Voltage		V_{GSS}	±20	V
Avalanche energy, single pulse		E_{AS} *3	153	mJ
Avalanche energy, repetitive		E_{AR} *3	0.23	mJ
Avalanche current, repetitive		I_{AR}	1.4	A
Power Dissipation (Tc=25℃)		P_D	48	W
Junction temperature		T_J	150	℃
Range of storage temperature		T_{stg}	-55 to +150	℃
Reverse diode dv/dt		Dv/dt *4	15	V/ns
Drain-Source Voltage Slope	V_{DS}=480V ; Tj=25℃	Dv/dt	50	V/ns

THERMAL RESISTANCE

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Thermal resistance , junction-case	R_{thJC}	-	-	2.6	℃/W
Thermal resistance , junction-ambient	R_{thJA}	-	-	70	℃/W
Soldering temperature , wavesoldering for 10s	T_{sold}	-	-	265	℃

ELECTRICAL CHARACTERISTICS (Ta=25℃)

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Drain-Source breakdown voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 250uA	650	-	-	V
Zero gate voltage drain current	I_{DSS}	V_{DS} = 600V, V_{GS} = 0V				uA
		T_j = 25℃	-	0.1	100	
		T_j = 125℃	-	-	1000	
Gate-Source leakage current	I_{GSS}	V_{GS} = ±20V, V_{DS} = 0V	-	-	±100	nA
Gate threshold voltage	$V_{GS(th)}$	V_{DS} = 10V, I_D = 1mA	2	-	4	V
Static drain-source on-state resistance	$R_{DS(on)}$ *5	V_{GS} = 10V, I_D = 2.8A				Ω
		T_j = 25℃	-	0.520	0.68	
		T_j = 125℃	-	1.00	-	
Gate input resistance	R_G	F = 1MHz, open drain	-	9.6	-	Ω

ELECTRICAL CHARACTERISTICS (Ta=25℃)

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Transconductance	G_{fs} *5	V_{DS} = 10V, I_D = 4.5A	2.2	4.4	-	S
Input capacitance	C_{iss}	V_{GS} = 0V V_{DS} = 25V F = 1MHZ	-	430	-	pF
Output capacitance	C_{oss}		-	470	-	
Reverse transfer capacitance	C_{rss}		-	55	-	
Effective output capacitance, energy related	$C_{o(er)}$	V_{GS} = 0V V_{DS} = 0V to 480V	-	23	-	pF
Effective output capacitance, time related	$C_{o(tr)}$		-	100	-	
Turn-on delay time	$T_{d(on)}$ *5	V_{DD}～300V, V_{GS} = 10V I_D = 4.5A R_L = 66.6Ω R_G = 10Ω	-	25	-	ns
Rise time	T_r *5		-	35	-	
Turn-off delay time	$T_{d(off)}$ *5		-	75	-	
Fall time	T_f *5		-	30	-	

GATE CHARACTERISTICS (Ta=25℃)

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Gate plateau voltage	$V_{(plateau)}$	V_{DD}～300V, I_D = 9A	-	6.4	-	V
Total gate charge	Q_g *5	V_{DD}～300V I_D = 9A V_{GS} = 10V	-	23	-	nC
Gate-Source charge	Q_{gs} *5		-	4	-	
Gate Drain charge	Q_{gd} *5		-	15	-	

*1 : Limit only by maximum temperature allowed

*2 : Pw≦10us, Duty cycle≦1%

*3 : I_D = 1.4A, V_{DD} = 50V

*4 : Reference measurement circuits Fig.5-1

*5 : Pulsed

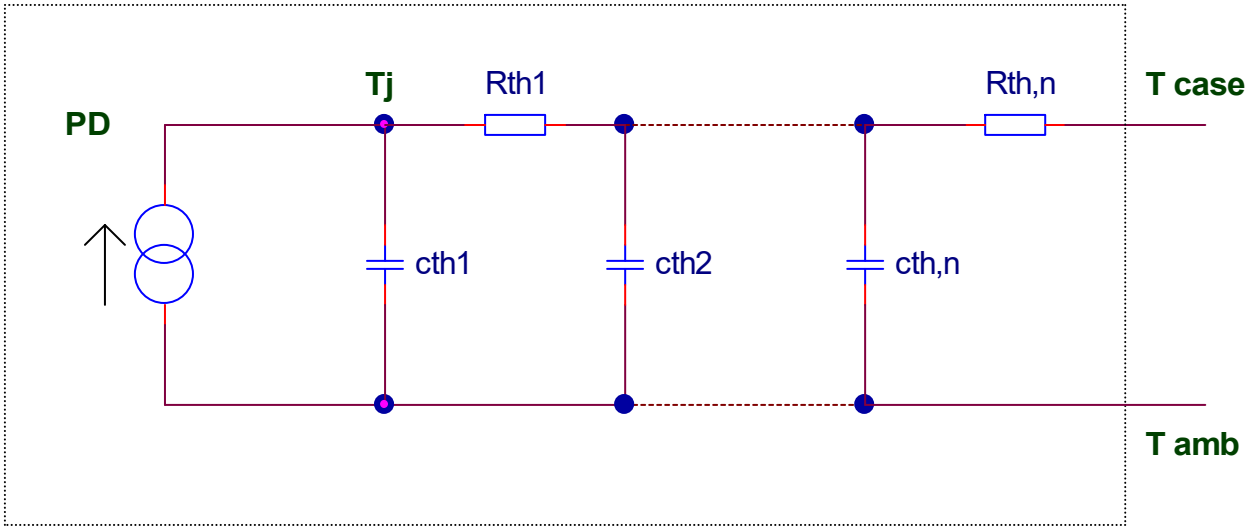
BODY DIODE ELECTRICAL CHARACTERISTICS (Source-Drain) (Ta=25℃)

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	I_S *1	Tc=25℃	-	-	9	A
Inverse diode direct current, pulsed	I_{SM} *2		-	-	27	A
Forward Voltage	V_{SD} *5	V_{GS} = 0V, I_S = 9A	-	-	1.5	V
Reverse recovery time	T_{rr} *5	I_S = 9A Di/dt = 100A/us	-	380	-	ns
Reverse recovery charge	Q_{rr} *5		-	3.8	-	uC
Peak reverse recovery current	I_{rrm} *5		-	20	-	A

TYPICAL TRANSIENT THERMAL CHARACTERISTICS

Symbol	Value	Unit
R_{th1}	0.344	K/W
R_{th2}	1.15	
R_{th3}	2.2	
C_{th1}	0.00137	Ws/K
C_{th2}	0.0145	
C_{th3}	0.451	

Application Circuit



●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

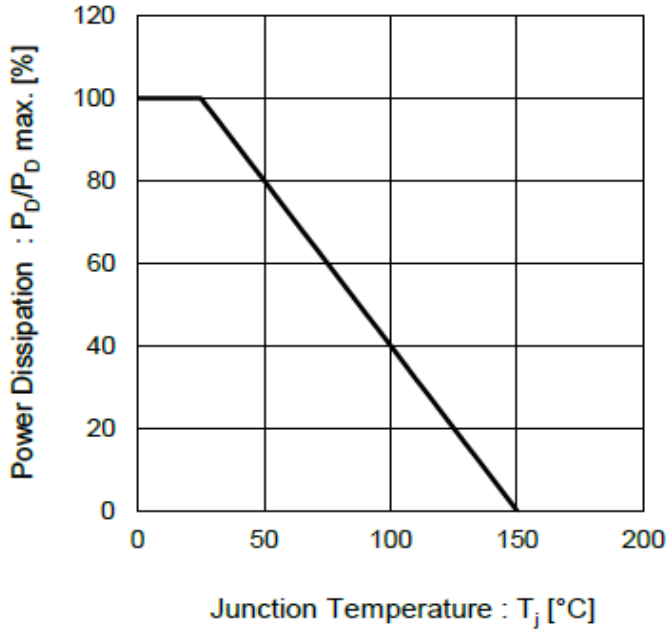


Fig.2 Maximum Safe Operating Area

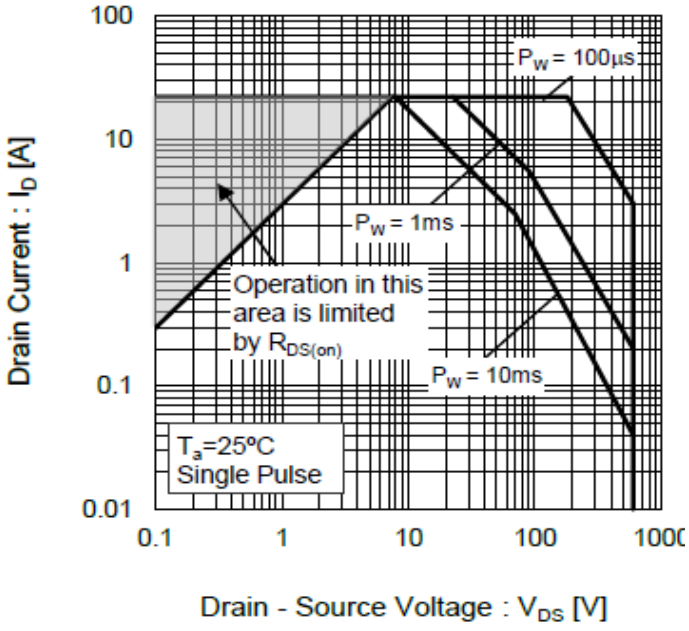


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width

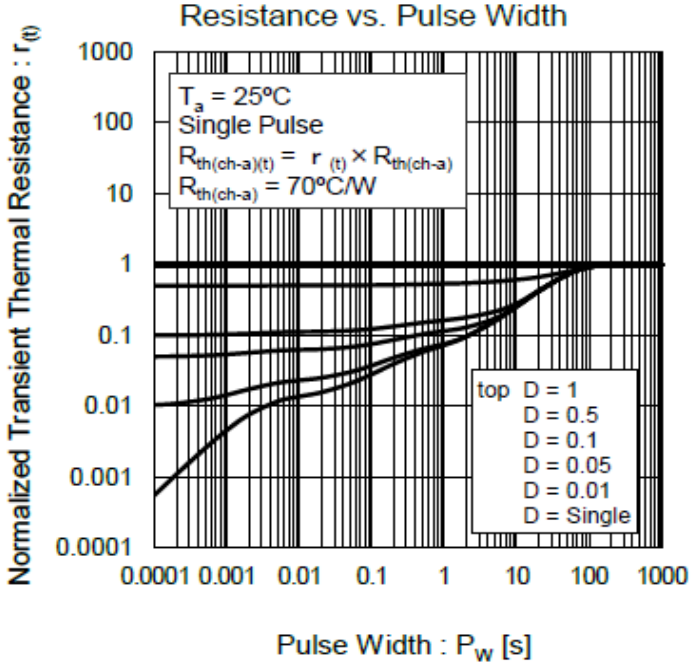
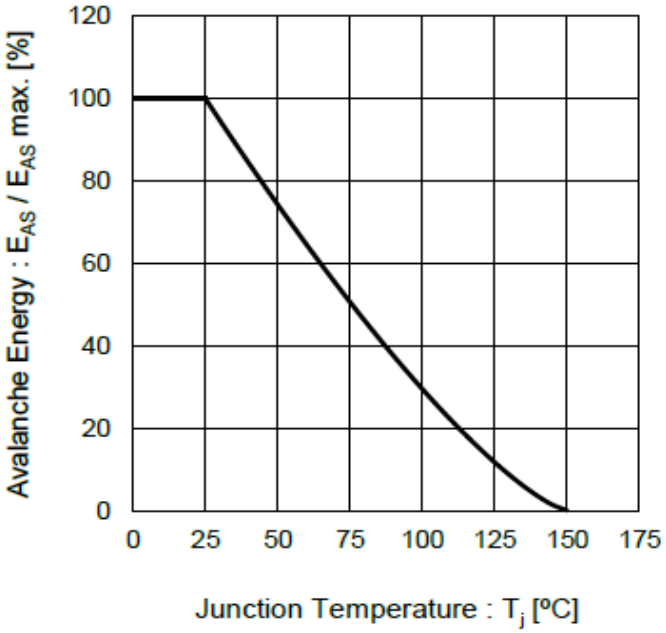


Fig.4 Avalanche Energy Derating Curve vs Junction Temperature



●Electrical characteristic curves

Fig.5 Typical Output Characteristics(I)

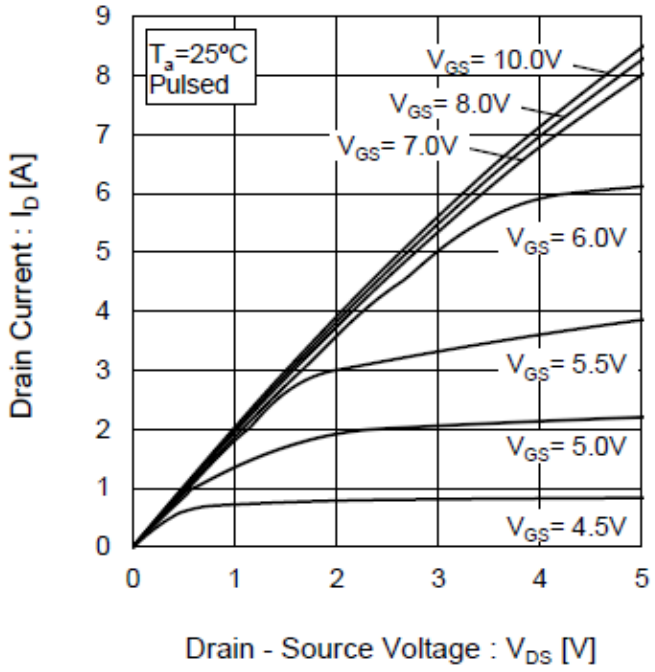


Fig.6 Typical Output Characteristics(II)

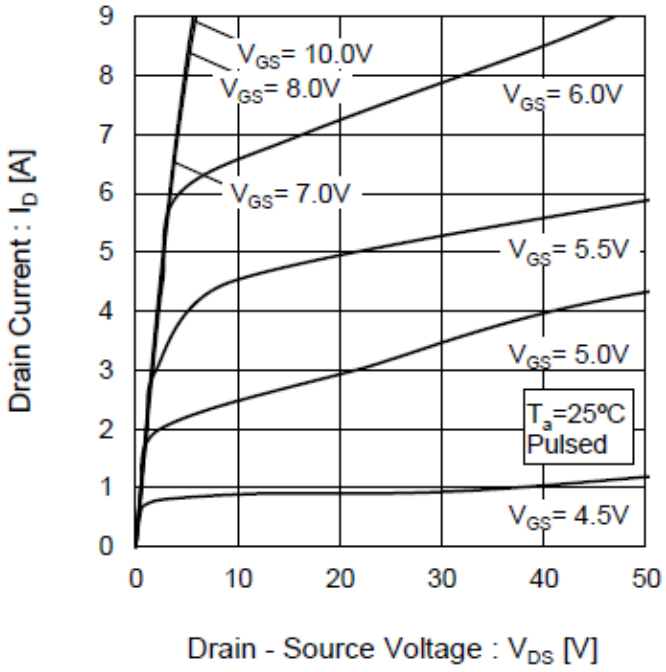


Fig.7 T_j = 150°C Typical Output Characteristics(I)

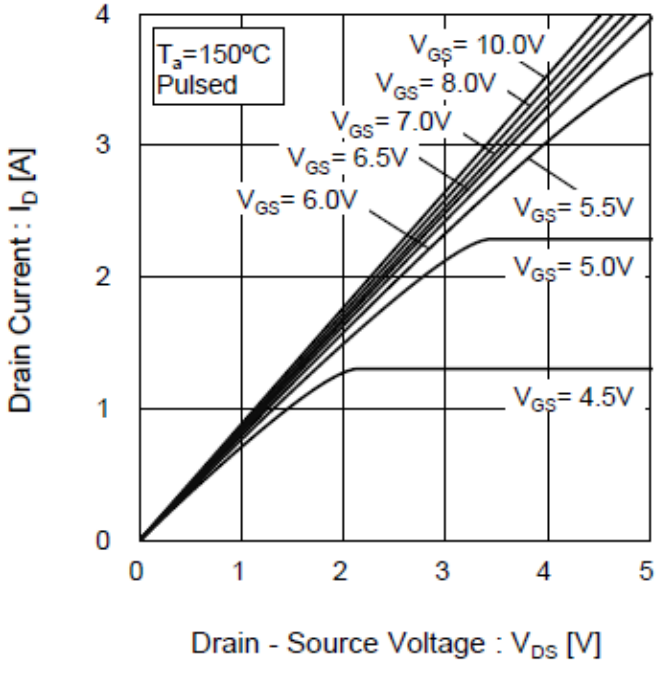
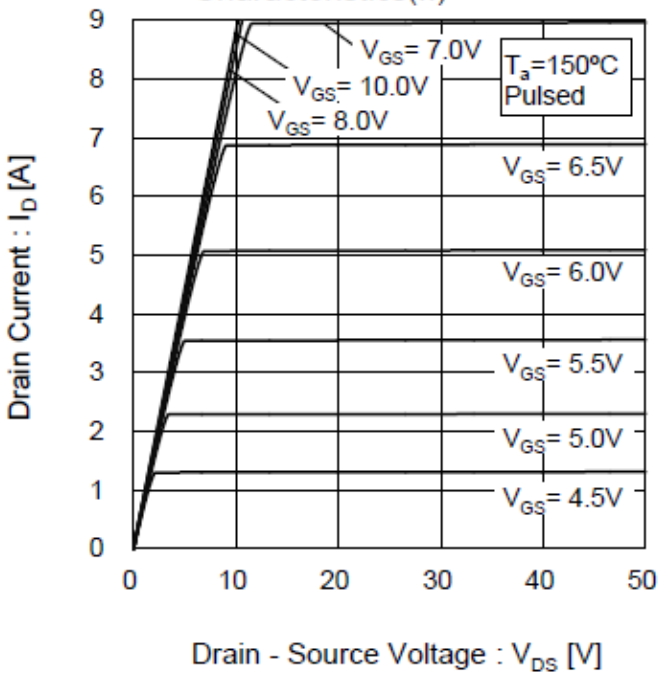


Fig.8 T_j = 150°C Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.9 Breakdown Voltage vs. Junction Temperature

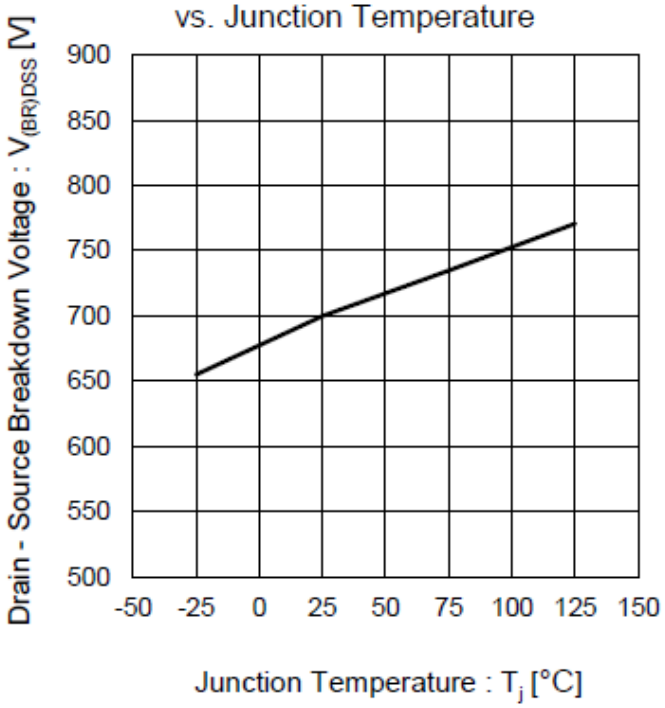


Fig.10 Typical Transfer Characteristics

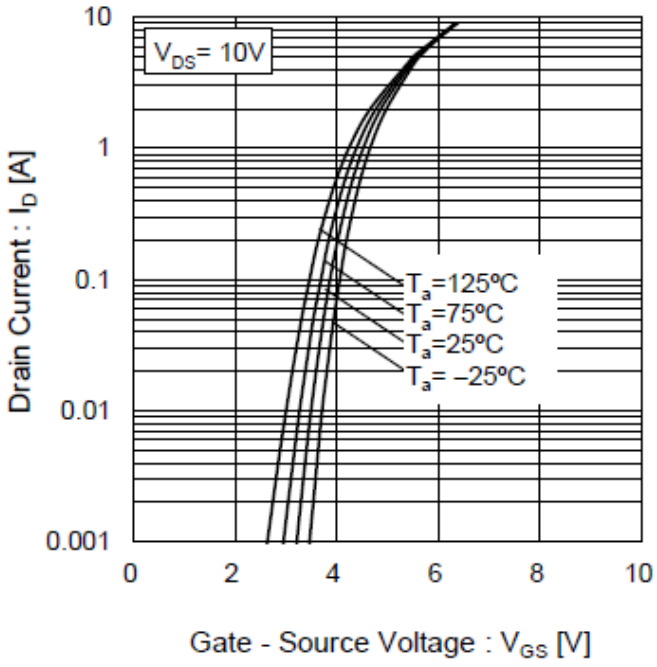


Fig.11 Gate Threshold Voltage vs. Junction Temperature

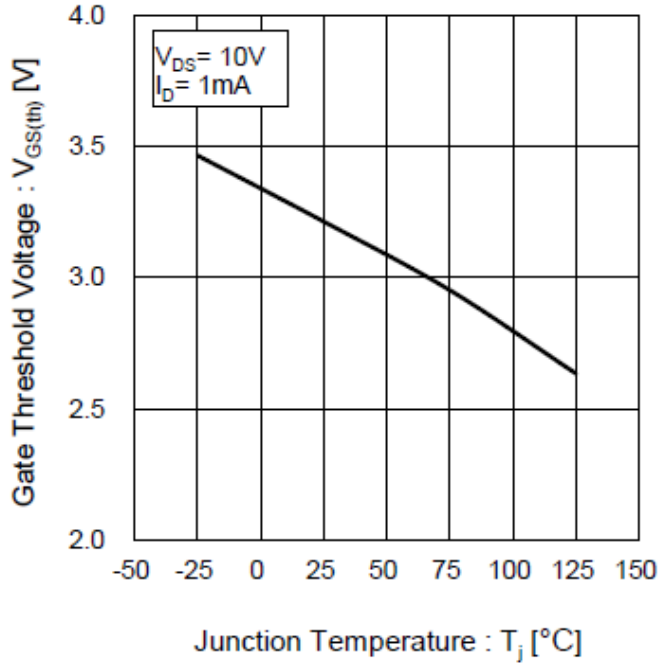
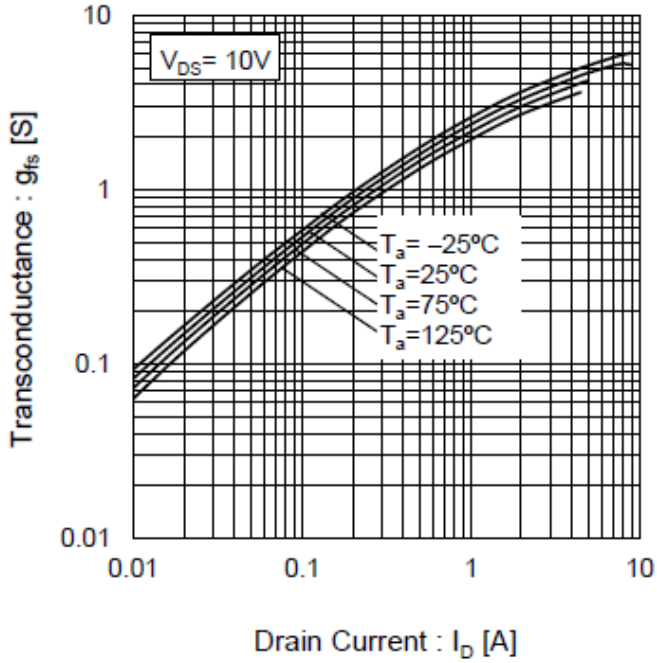


Fig.12 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.13 Static Drain - Source On - State Resistance vs. Gate Source Voltage

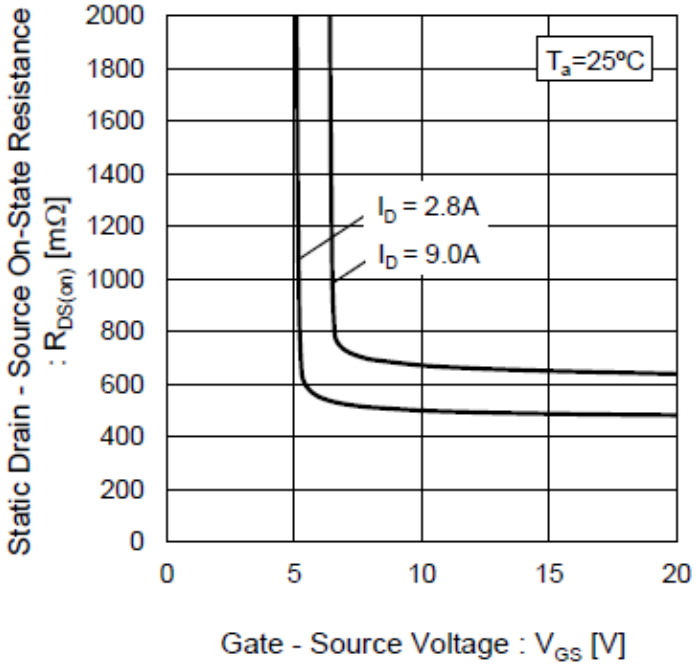


Fig.14 Static Drain - Source On - State Resistance vs. Junction Temperature

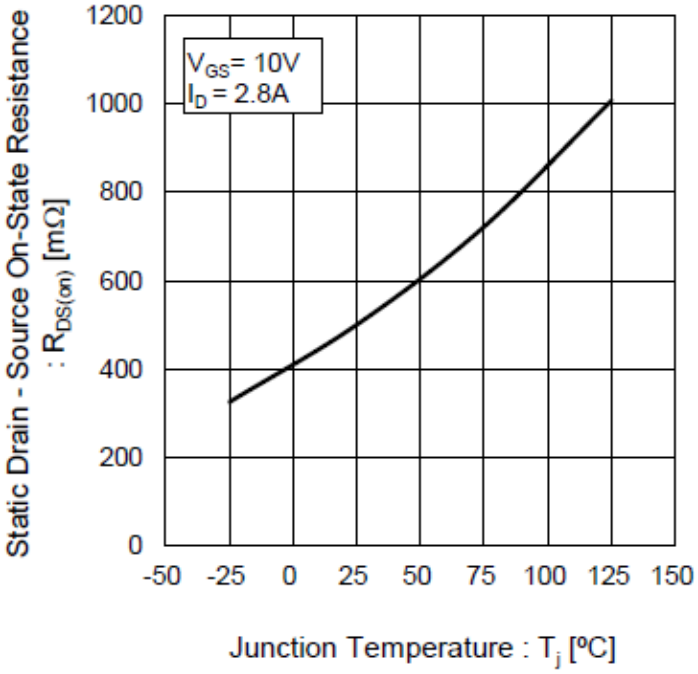


Fig.15 Static Drain - Source On - State Resistance vs. Drain Current

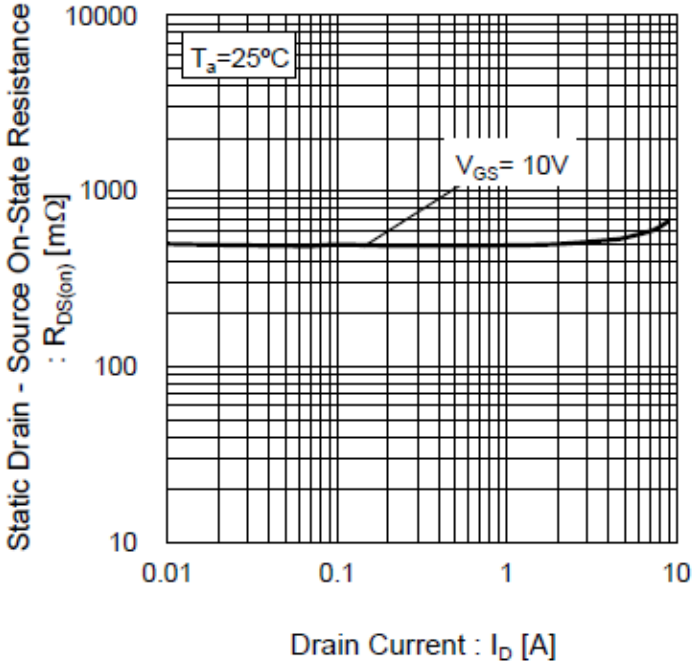
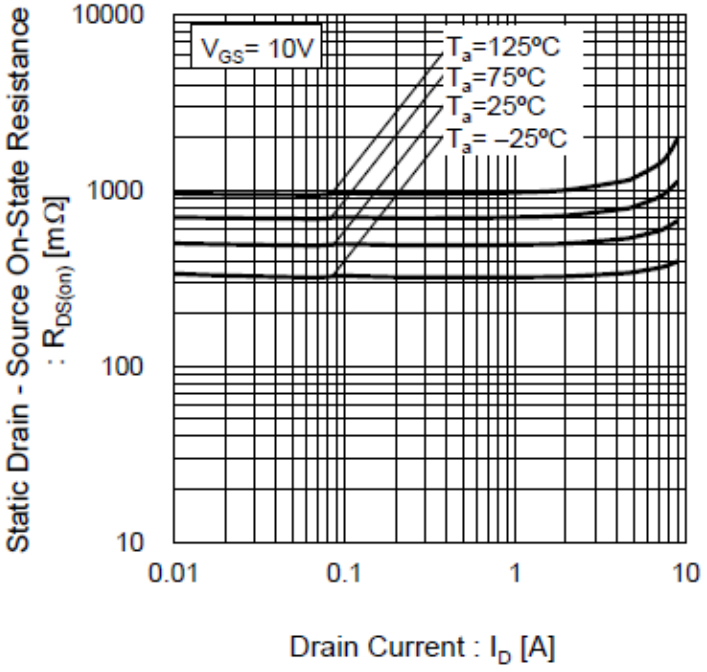


Fig.16 Static Drain - Source On - State Resistance vs. Drain Current



●Electrical characteristic curves

Fig.17 Typical Capacitance vs. Drain - Source Voltage

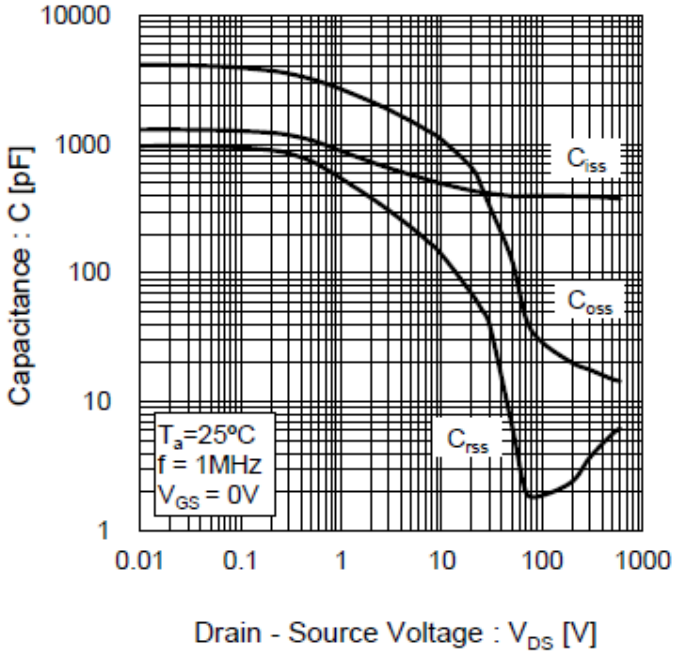


Fig.18 Coss Stored Energy

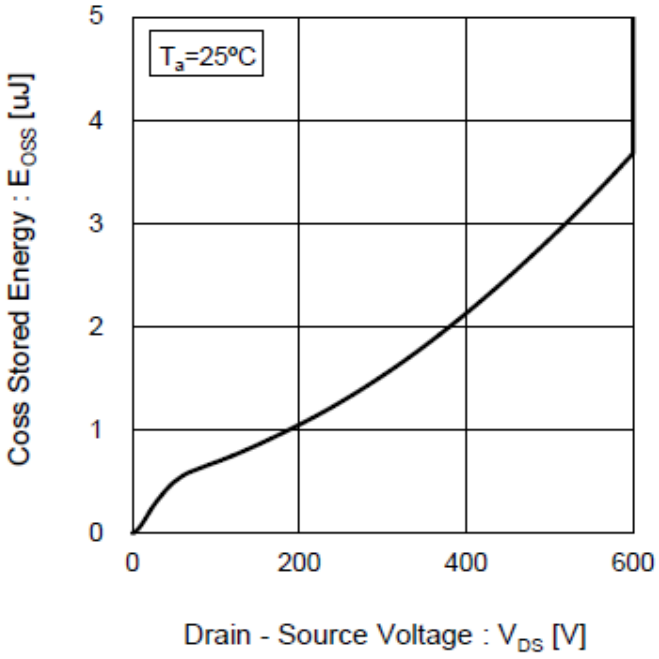


Fig.19 Switching Characteristics

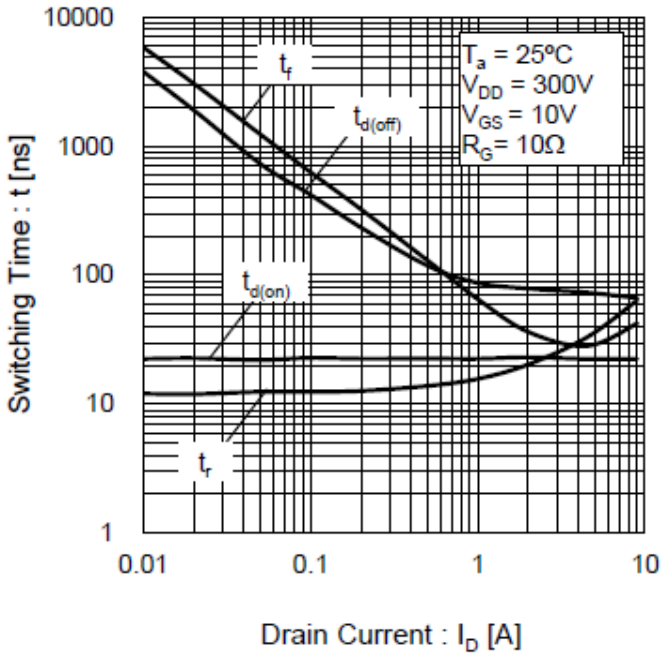
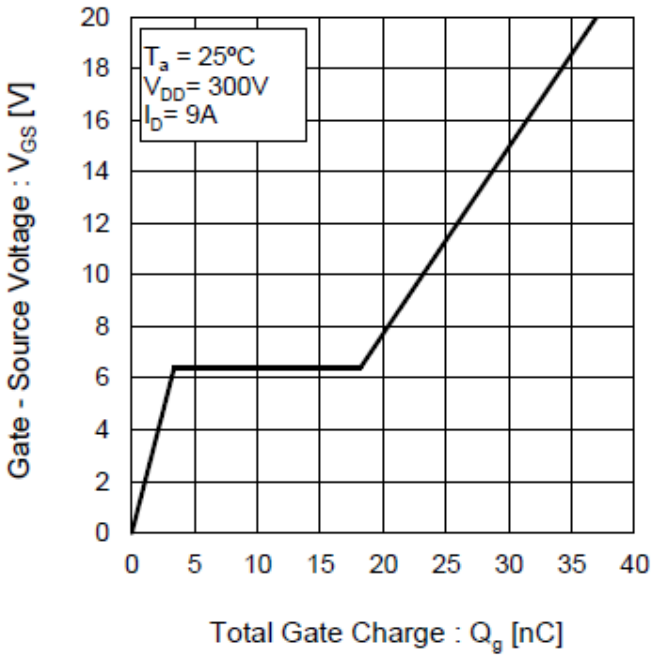


Fig.20 Dynamic Input Characteristics



●Electrical characteristic curves

Fig.21 Inverse Diode Forward Current vs. Source - Drain Voltage

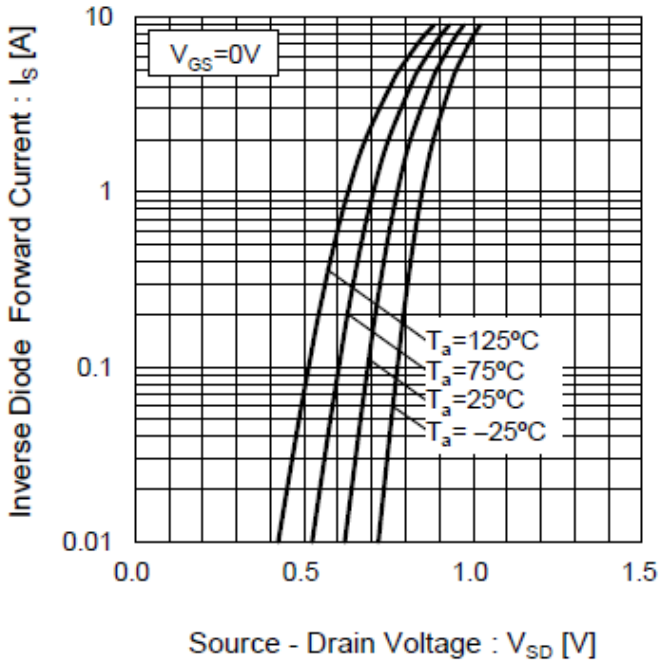
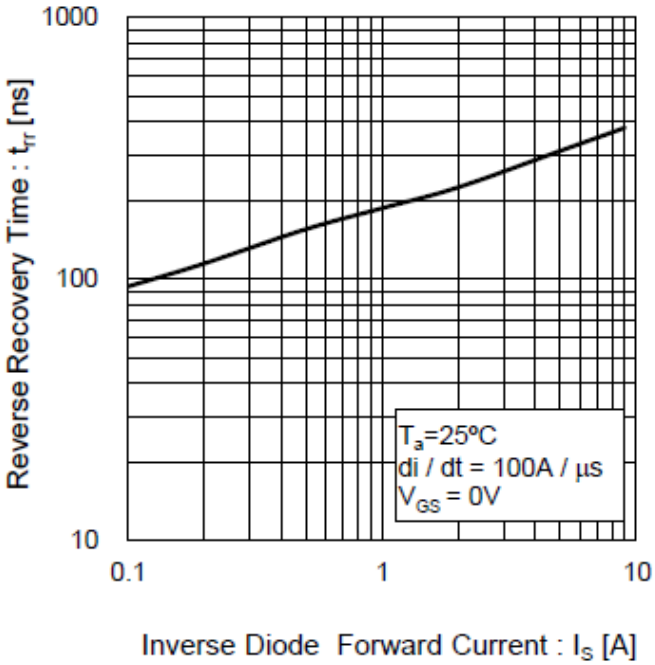
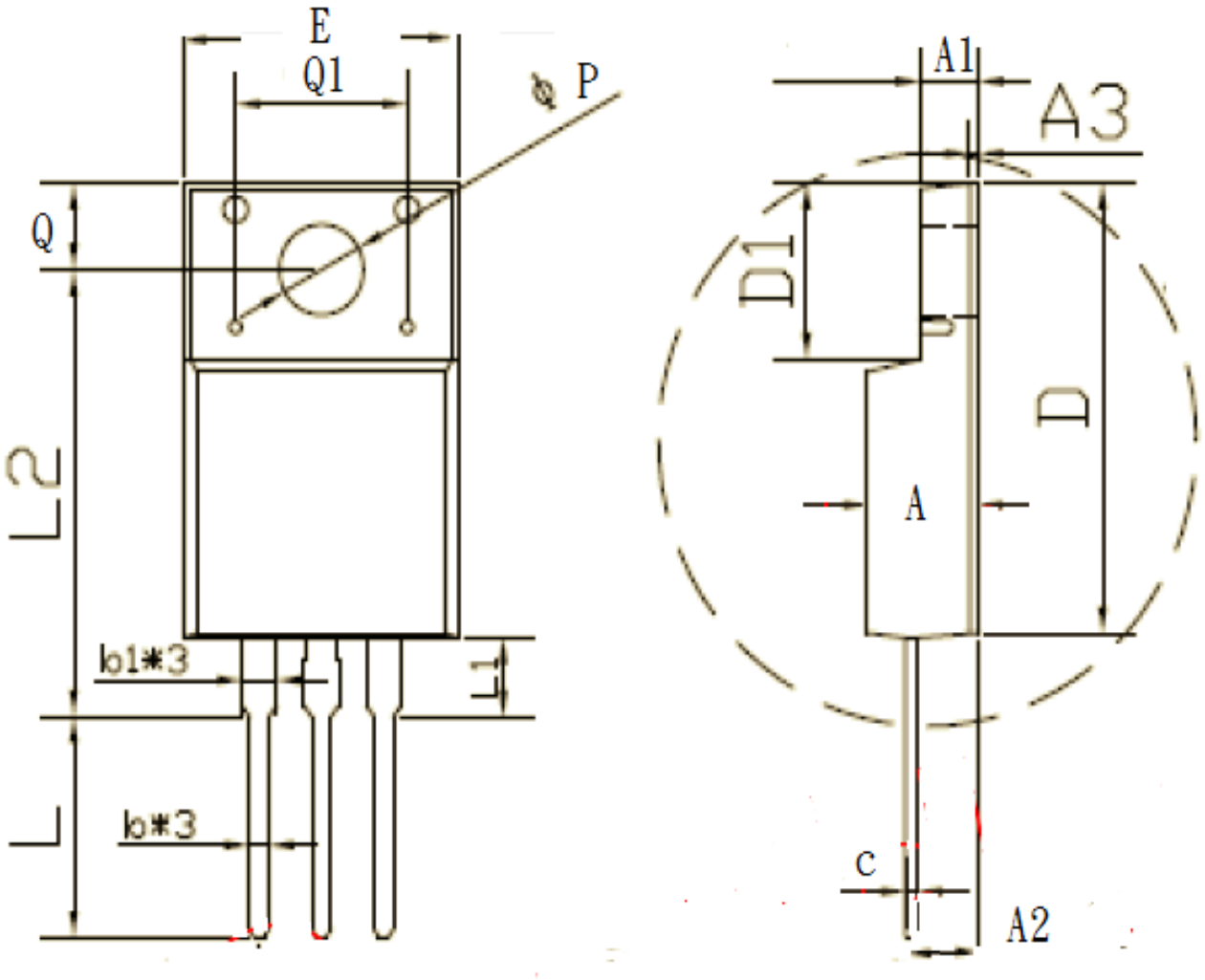


Fig.22 Reverse Recovery Time vs.Inverse Diode Forward Current





Dimension	Millimeters		Dimension	Millimeters	
	Min.	Max.		Min.	Max.
A	4.68	4.73	E	9.95	10.22
A1	2.45	2.55	e	5.08 Ref	
A2	2.80	2.90	L	9.45	10.65
A3	0.60	0.75	L1	2.79	3.30
b	0.75	0.85	L2	15.60	16.00
b1	1.33	1.40	Q	3.20	3.40
c	0.45	0.55	Q1	6.90	7.10
D	15.8	16.0	P	3.5 Ref	
D1	6.67	6.77			

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