General Description

The WSD4048DN56 is the highest performance trench N-ch and P-ch MOSFET with extreme high cell density , which provide excellent RDSON and gate charge for most of the synchronous buck converter applications .

The WSD4048DN56 meet the RoHS and Green Product requirement 100% EAS guaranteed with full function reliability approved.

Features

- Advanced high cell density Trench technology
- Super Low Gate Charge
- Excellent CdV/dt effect decline
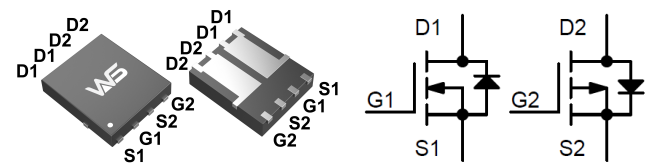- 100% EAS Guaranteed
- Green Device Available

Product Summery

BVDSS	RDSON	ID
40V	14mΩ	34A
-40V	32mΩ	-24A

Applications

- High Frequency Point-of-Load Synchronous Buck Converter for MB/NB/UMPC/VGA
- Networking DC-DC Power System
- CCFL Back-light Inverter

DFN5X6C-8-EP2 Pin Configuration

Absolute Maximum Ratings

Symbol	Parameter	Rating		Units
		N-Ch	P-Ch	
V_{DS}	Drain-Source Voltage	40	-40	V
V_{GS}	Gate-Source Voltage	±20	±20	V
I_D@T_C=25℃	Continuous Drain Current, V_{GS} @ 10V[1]	34	-24	A
I_D@T_C=70℃	Continuous Drain Current, V_{GS} @ 10V[1]	22	-18	A
I_{DM}	Pulsed Drain Current[2]	46	-40	A
EAS	Single Pulse Avalanche Energy[3]	28	66	mJ
I_{AS}	Avalanche Current	17.8	-27.2	A
P_D@T_C=25℃	Total Power Dissipation[4]	25	31.3	W
T_{STG}	Storage Temperature Range	-55 to 150	-55 to 150	℃
T_J	Operating Junction Temperature Range	-55 to 150	-55 to 150	℃

Thermal Data

Symbol	Parameter	Typ.	Max.	Unit
$R_{θJA}$	Thermal Resistance Junction-Ambient [1]	---	62	℃/W
$R_{θJC}$	Thermal Resistance Junction-Case[1]	---	5	℃/W

N-Channel Electrical Characteristics (T$_J$=25 ℃, unless otherwise noted)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
BV$_{DSS}$	Drain-Source Breakdown Voltage	V$_{GS}$=0V , I$_D$=250uA	40	---	---	V
△BV$_{DSS}$/△T$_J$	BVDSS Temperature Coefficient	Reference to 25℃ , I$_D$=1mA	---	0.034	---	V/℃
R$_{DS(ON)}$	Static Drain-Source On-Resistance[2]	V$_{GS}$=10V , I$_D$=10A	---	14	21	mΩ
		V$_{GS}$=4.5V , I$_D$=5A	---	18	25	
V$_{GS(th)}$	Gate Threshold Voltage	V$_{GS}$=V$_{DS}$, I$_D$ =250uA	1.5	2.0	2.5	V
△V$_{GS(th)}$	V$_{GS(th)}$ Temperature Coefficient		---	-4.56	---	mV/℃
I$_{DSS}$	Drain-Source Leakage Current	V$_{DS}$=32V , V$_{GS}$=0V , T$_J$=25℃	---	---	1	uA
		V$_{DS}$=32V , V$_{GS}$=0V , T$_J$=55℃	---	---	5	
I$_{GSS}$	Gate-Source Leakage Current	V$_{GS}$=±20V , V$_{DS}$=0V	---	---	±100	nA
gfs	Forward Transconductance	V$_{DS}$=5V , I$_D$=10A	---	15	---	S
R$_g$	Gate Resistance	V$_{DS}$=0V , V$_{GS}$=0V , f=1MHz	---	2.5	5.2	Ω
Q$_g$	Total Gate Charge (4.5V)	V$_{DS}$=20V , V$_{GS}$=4.5V , I$_D$=12A	---	9.5	---	nC
Q$_{gs}$	Gate-Source Charge		---	1.25	---	
Q$_{gd}$	Gate-Drain Charge		---	2.5	---	
T$_{d(on)}$	Turn-On Delay Time	V$_{DD}$=20V , V$_{GS}$=10V , R$_G$=3.3Ω I$_D$=1A	---	8.9	---	ns
T$_r$	Rise Time		---	2.2	---	
T$_{d(off)}$	Turn-Off Delay Time		---	41	---	
T$_f$	Fall Time		---	2.7	---	
C$_{iss}$	Input Capacitance	V$_{DS}$=15V , V$_{GS}$=0V , f=1MHz	---	810	---	pF
C$_{oss}$	Output Capacitance		---	90	---	
C$_{rss}$	Reverse Transfer Capacitance		---	60	---	

Guaranteed Avalanche Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
EAS	Single Pulse Avalanche Energy[5]	V$_{DD}$=25V , L=0.5mH , I$_{AS}$=10A	10	---	---	mJ

Diode Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I$_S$	Continuous Source Current[1,6]	V$_G$=V$_D$=0V , Force Current	---	---	23	A
I$_{SM}$	Pulsed Source Current[2,6]		---	---	46	A
V$_{SD}$	Diode Forward Voltage[2]	V$_{GS}$=0V , I$_S$=1A , T$_J$=25℃	---	---	1.2	V

Note :
1. The data tested by surface mounted on a 1 inch[2] FR-4 board with 2OZ copper.
2. The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%
3. The EAS data shows Max. rating .
4. The power dissipation is limited by 150℃ junction temperature
5. The Min. value is 100% EAS tested guarantee.
6. The data is theoretically the same as I$_D$ and I$_{DM}$, in real applications , should be limited by total power dissipation.

P-Channel Electrical Characteristics (T$_J$=25 ℃ , unless otherwise noted)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
BV$_{DSS}$	Drain-Source Breakdown Voltage	V$_{GS}$=0V , I$_D$=-250uA	-40	---	---	V
△BV$_{DSS}$/△T$_J$	BV$_{DSS}$ Temperature Coefficient	Reference to 25℃ , I$_D$=-1mA	---	-0.012	---	V/℃
R$_{DS(ON)}$	Static Drain-Source On-Resistance[2]	V$_{GS}$=-10V , I$_D$=-10A	---	32	38	mΩ
		V$_{GS}$=-4.5V , I$_D$=-4A	---	46	62	
V$_{GS(th)}$	Gate Threshold Voltage	V$_{GS}$=V$_{DS}$, I$_D$ =-250uA	-1.5	-2.0	-2.5	V
△V$_{GS(th)}$	V$_{GS(th)}$ Temperature Coefficient		---	4.32	---	mV/℃
I$_{DSS}$	Drain-Source Leakage Current	V$_{DS}$=-32V , V$_{GS}$=0V , T$_J$=25℃	---	---	1	uA
		V$_{DS}$=-32V , V$_{GS}$=0V , T$_J$=55℃	---	---	5	
I$_{GSS}$	Gate-Source Leakage Current	V$_{GS}$=±20V , V$_{DS}$=0V	---	---	±100	nA
gfs	Forward Transconductance	V$_{DS}$=-5V , I$_D$=-8A	---	12.6	---	S
R$_g$	Gate Resistance	V$_{DS}$=0V , V$_{GS}$=0V , f=1MHz	---	13	16	Ω
Q$_g$	Total Gate Charge (-4.5V)	V$_{DS}$=-20V , V$_{GS}$=-4.5V , I$_D$=-12A	---	9	---	nC
Q$_{gs}$	Gate-Source Charge		---	2.54	---	
Q$_{gd}$	Gate-Drain Charge		---	3.1	---	
T$_{d(on)}$	Turn-On Delay Time	V$_{DD}$=-15V , V$_{GS}$=-10V , R$_G$=3.3Ω, I$_D$=-1A	---	19.2	---	ns
T$_r$	Rise Time		---	12.8	---	
T$_{d(off)}$	Turn-Off Delay Time		---	48.6	---	
T$_f$	Fall Time		---	4.6	---	
C$_{iss}$	Input Capacitance	V$_{DS}$=-15V , V$_{GS}$=0V , f=1MHz	---	1904	--	pF
-C$_{oss}$	Output Capacitance		---	108	---	
C$_{rss}$	Reverse Transfer Capacitance		---	80	---	

Guaranteed Avalanche Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
EAS	Single Pulse Avalanche Energy[5]	V$_{DD}$=-25V , L=0.1mH , I$_{AS}$=-10A	20	---	---	mJ

Diode Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I$_S$	Continuous Source Current[1,6]	V$_G$=V$_D$=0V , Force Current	---	---	-20	A
I$_{SM}$	Pulsed Source Current[2,6]		---	---	-40	A
V$_{SD}$	Diode Forward Voltage[2]	V$_{GS}$=0V , I$_S$=-1A , T$_J$=25℃	---	---	-1	V

Note :
1.The data tested by surface mounted on a 1 inch^2 FR-4 board with 2OZ copper.
2.The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%
3.The EAS data shows Max. rating .
4.The power dissipation is limited by 150℃ junction temperature
5.The Min. value is 100% EAS tested guarantee.
6.The data is theoretically the same as I$_D$ and I$_{DM}$, in real applications , should be limited by total power dissipation.

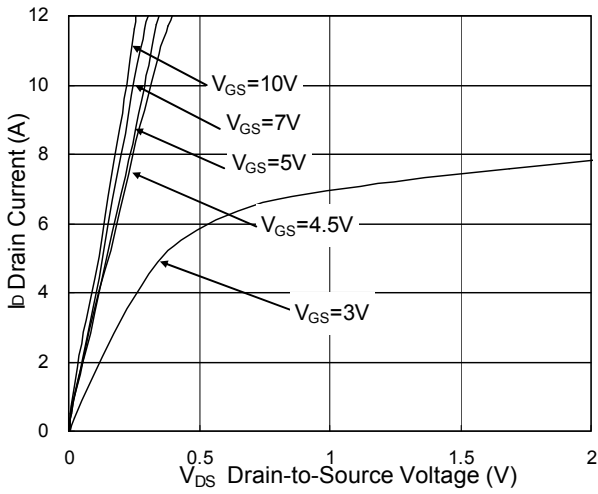## N-Channel Typical Characteristics
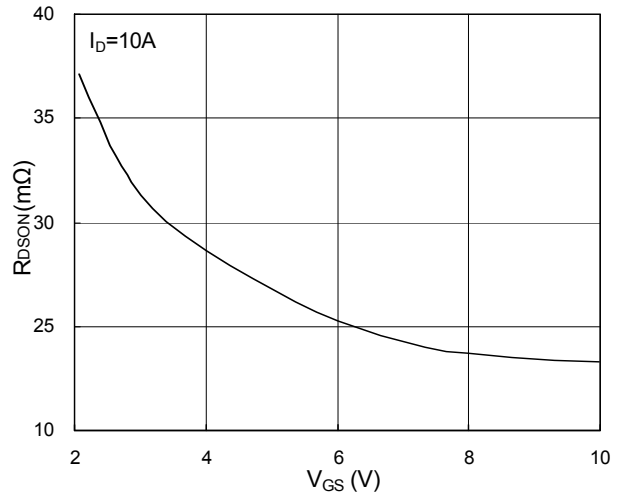

Fig.1 Typical Output Characteristics
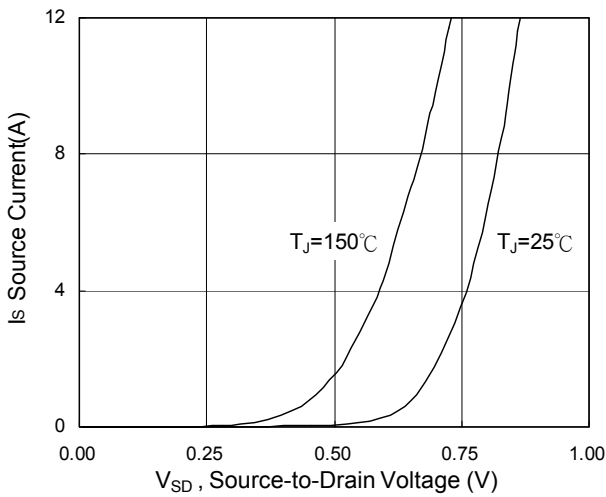

Fig.2 On-Resistance vs. G-S Voltage

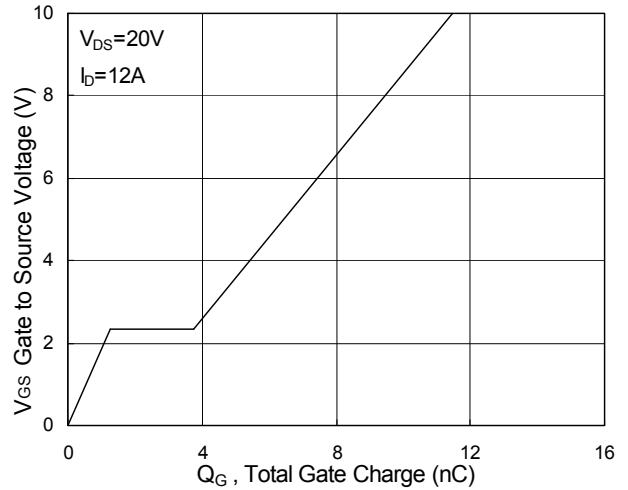**Fig.3 Forward Characteristics of Reverse**
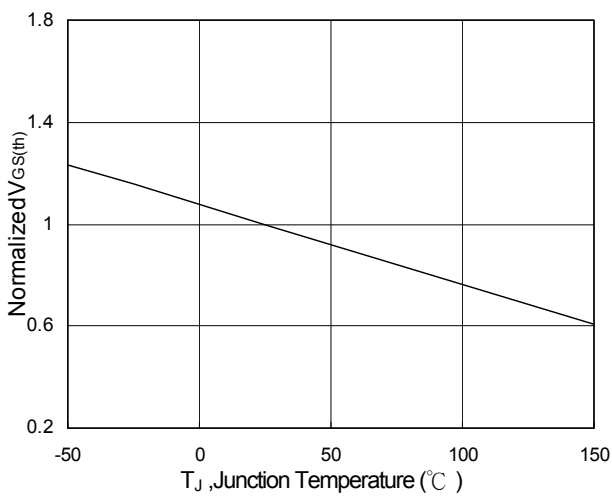
Fig.4 Gate-Charge Characteristics

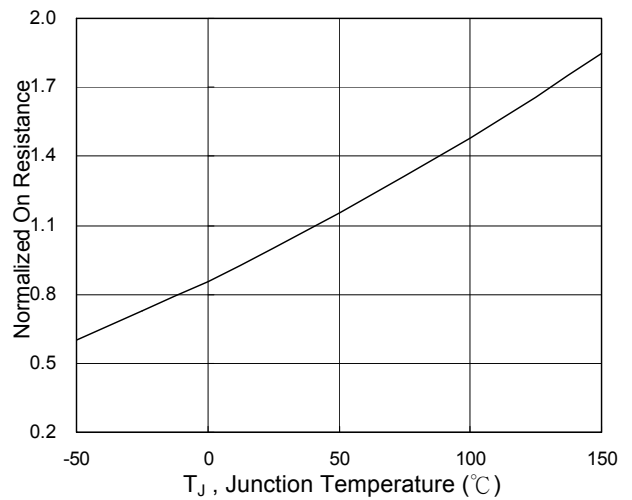**Fig.5 Normalized V$_{GS(th)}$ vs. T$_J$**
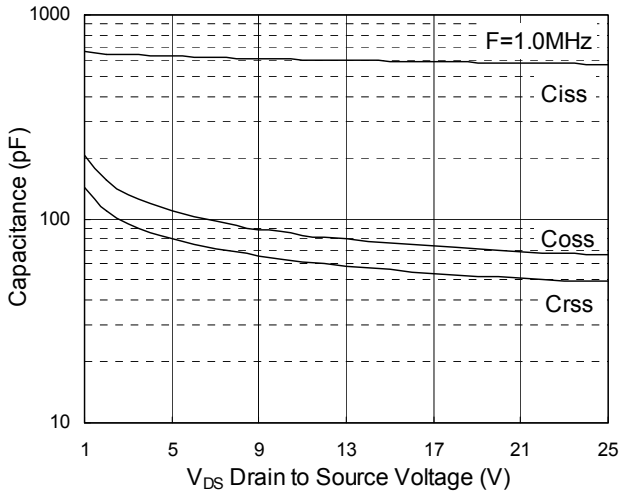

Fig.6 Normalized R$_{DSON}$ vs. T$_J$
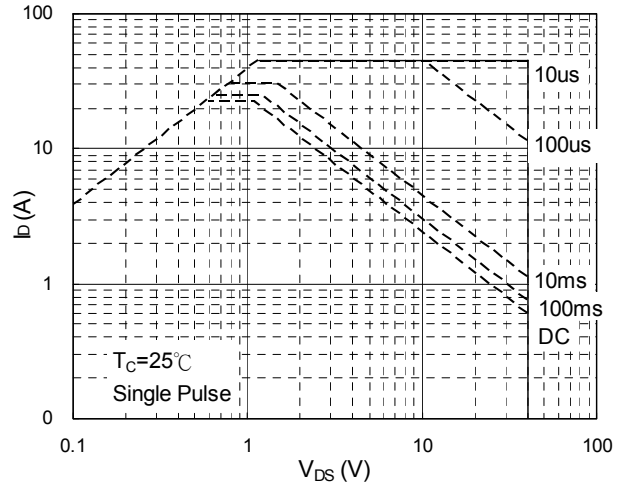
Fig.7 Capacitance

Fig.8 Safe Operating Area
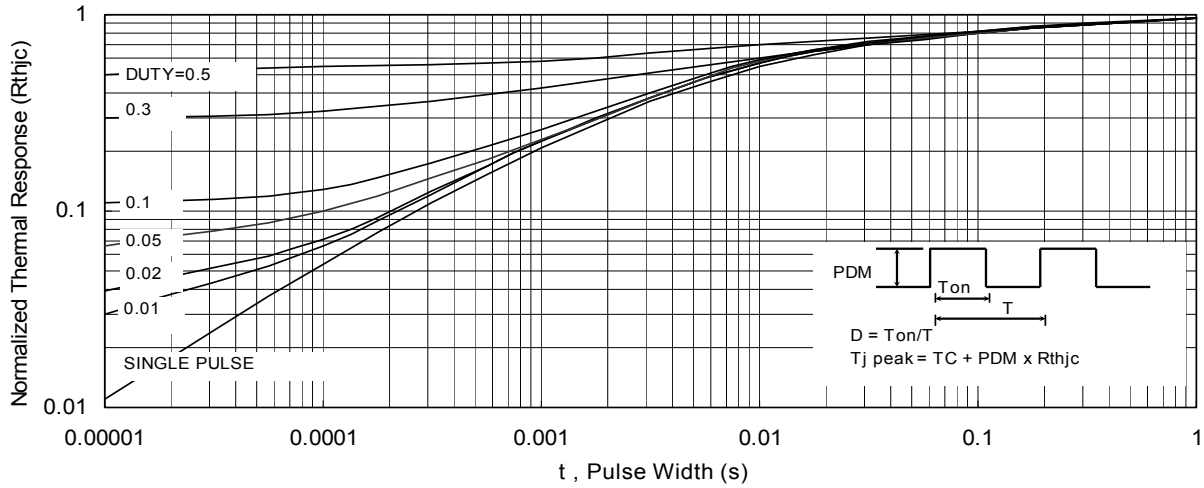
Fig.9 Normalized Maximum Transient Thermal Impedance
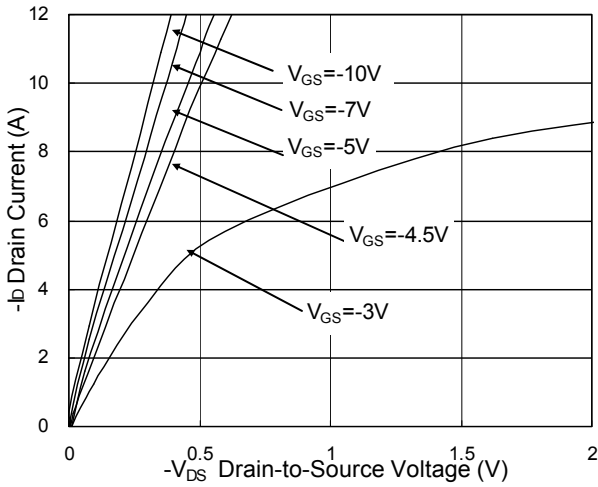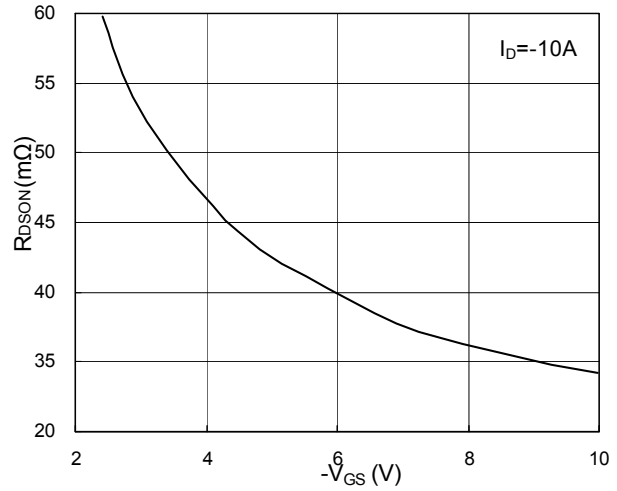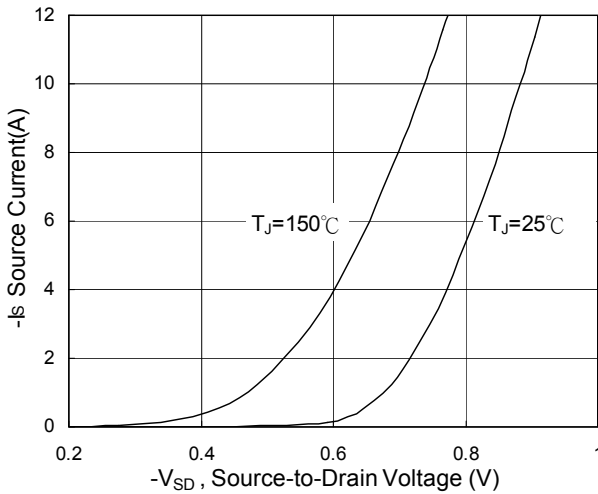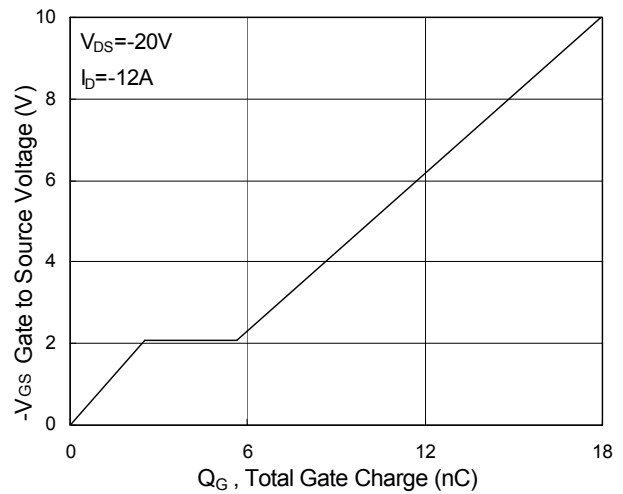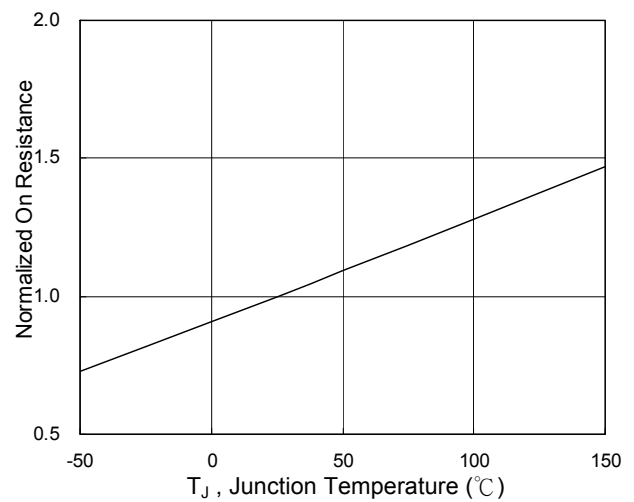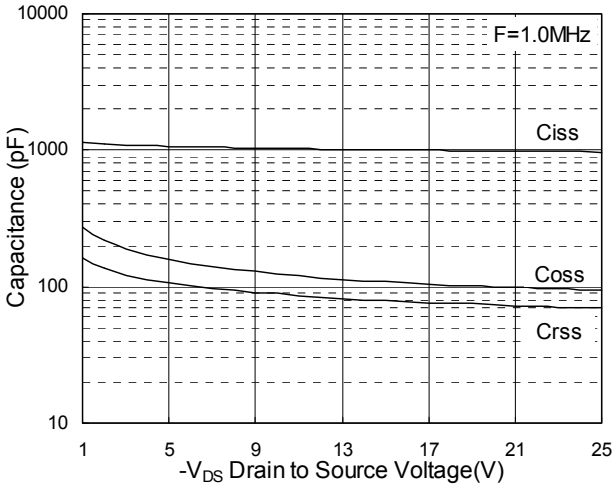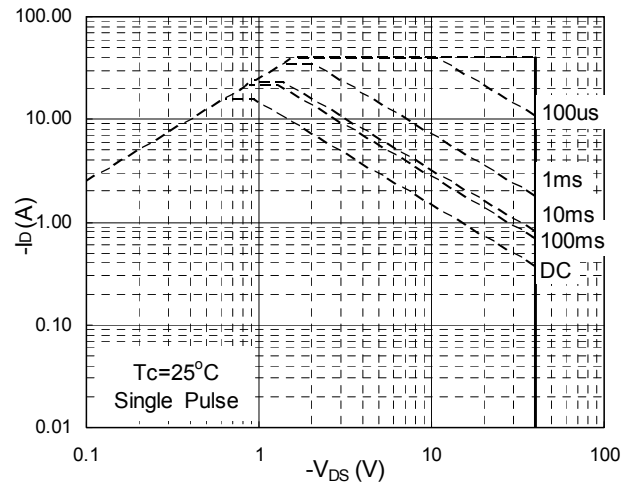

Fig.10 Switching Time Waveform

$$EAS= \frac{1}{2}L \times I_{AS}^2 \times \frac{BV_{DSS}}{BV_{DSS}-V_{DD}}$$
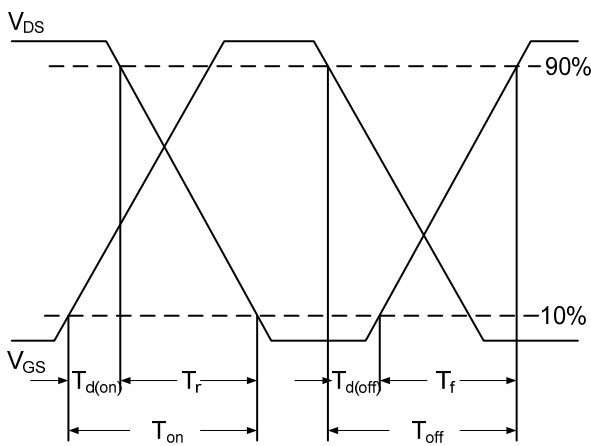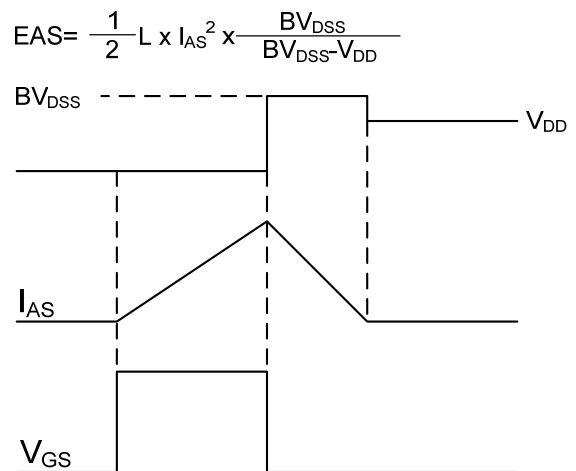
Fig.11 Unclamped Inductive Switching Wave

P-Channel Typical Characteristics

Fig.1 Typical Output Characteristics

Fig.2 On-Resistance v.s Gate-Source

Fig.3 Forward Characteristics of Reverse

Fig.4 Gate-Charge Characteristics

Fig.5 Normalized $V_{GS(th)}$ v.s T_J

Fig.6 Normalized R_{DSON} v.s T_J

Fig.7 Capacitance

Fig.8 Safe Operating Area

Fig.9 Normalized Maximum Transient Thermal Impedance

$$T_J peak = T_C + P_{DM} \times R_{\theta JC}$$

$$D = T_{ON}/T$$

Fig.10 Switching Time Waveform

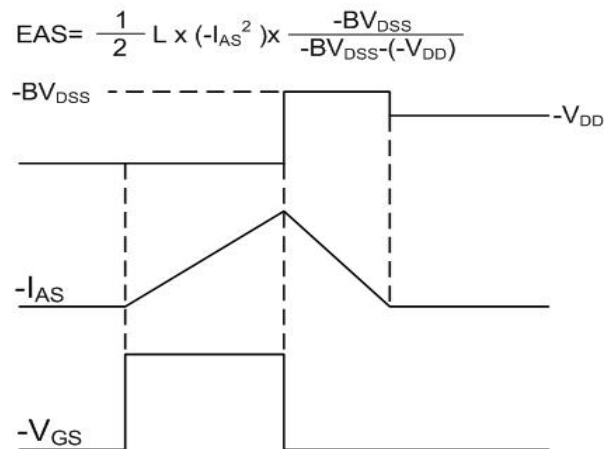$$EAS = \frac{1}{2} L \times (-I_{AS}^2) \times \frac{-BV_{DSS}}{-BV_{DSS} - (-V_{DD})}$$
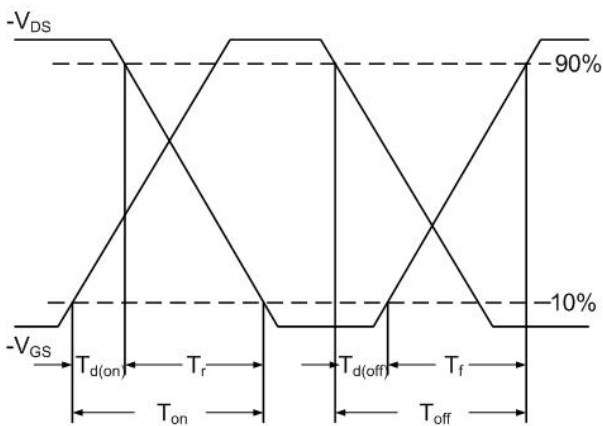
Fig.11 Unclamped Inductive Waveform