40V N+P-Channel Enhancement Mode MOSFET

Description

The XPX4012FX uses advanced trench technology

to provide excellent $R_{DS(ON)}$, low gate charge and

operation with gate voltages as low as 4.5V. This

device is suitable for use as a

Battery protection or in other Switching application.

Pin Description

Top View of TO-252-4

Features

- **N Channel**

    40V/20A,
    $R_{DS(ON)}$ = 16mΩ (typ.) @ V_{GS} = 10V
    $R_{DS(ON)}$ = 25mΩ (typ.) @ V_{GS} = 4.5V

- **P Channel**

    -40V/-20A,
    $R_{DS(ON)}$ = 30mΩ (typ.) @ V_{GS} =-10V
    $R_{DS(ON)}$ = 62mΩ (typ.) @ V_{GS} =-4.5V

- 100% UIS Tested

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- Reliable and Rugged

    Lead Free Available (RoHS Compliant)

Applications

- For Fan Pre-driver H-Bridge.

- Motor Control.

- Synchronous Rectification.
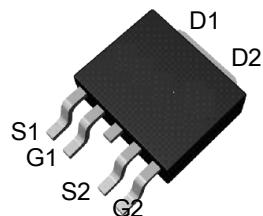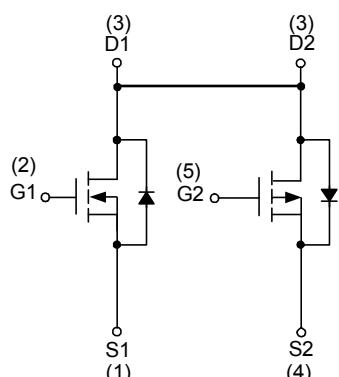
N-Channel MOSFET   P-Channel MOSFET

Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
XPX4012FX	XPX4012FX	TO-252-4	-	-	

Absolute Maximum Ratings (T_A = 25°C unless otherwise noted)

Symbol	Parameter		N Channel	P Channel	Unit
Common Ratings					
V_{DSS}	Drain-Source Voltage		40	-40	V
V_{GSS}	Gate-Source Voltage		±20	±20	
T_J	Maximum Junction Temperature		175		°C
T_{STG}	Storage Temperature Range		-55 to 175		
I_S	Diode Continuous Forward Current	T_C=25°C	10	-10	A
I_D	Continuous Drain Current	T_C=25°C	20*	-20*	
		T_C=100°C	20*	-15.3	
I_{DM}[a]	Pulsed Drain Current	T_C=25°C	80*	-80*	
P_D	Maximum Power Dissipation	T_C=25°C	39.4	39.4	W
		T_C=100°C	19.7	19.7	
$R_{\theta JC}$	Thermal Resistance-Junction to Case		3.8	3.8	°C/W
I_D	Continuous Drain Current	T_A=25°C	12.2	-8.4	A
		T_A=70°C	10.2	-7	
P_D	Power Dissipation	T_A=25°C	6	6	W
		T_A=70°C	4.2	4.2	
$R_{\theta JA}$	Thermal Resistance-Junction to Ambient	t ≤ 10s	25	25	°C/W
		Steady State [c]	60	60	
I_{AS}[b]	Avalanche Current, Single pulse	L=0.5mH	10	-10	A
E_{AS}[b]	Avalanche Energy, Single pulse	L=0.5mH	25	25	mJ

Note * ：Limited by package.

Note a ：Pulse width limited by max. junction temperature.

Note b ：UIS tested and pulse width limited by maximum junction temperature 175°C (initial temperature Tj=25°C).

Note c ：Surface Mounted on 1in^2 pad area, t =999sec.

40V N+P-Channel Enhancement Mode MOSFET

N Channel Electrical Characteristics $(T_A = 25°C$ unless otherwise noted)

Symbol	Parameter	Test Conditions	N Channel			Unit
			Min.	Typ.	Max.	
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0V$, $I_{DS}=250\mu A$	40	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=32V$, $V_{GS}=0V$	-	-	1	μA
		$T_J=85°C$	-	-	30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_{DS}=250\mu A$	1.5	2	2.5	V
I_{GSS}	Gate Leakage Current	$V_{GS}=\pm20V$, $V_{DS}=0V$	-	-	±100	nA
$R_{DS(ON)}$ d	Drain-Source On-state Resistance	$V_{GS}=10V$, $I_{DS}=10A$	-	16	21	$m\Omega$
		$V_{GS}=4.5V$, $I_{DS}=5A$	-	18	25	
Diode Characteristics						
V_{SD} d	Diode Forward Voltage	$I_{SD}=1A$, $V_{GS}=0V$	-	0.75	1.1	V
t_{rr}	Reverse Recovery Time	$I_{DS}=10A$, $dI_{SD}/dt=100A/\mu s$	-	13	-	ns
Q_{rr}	Reverse Recovery Charge		-	8.7	-	nC
Dynamic Characteristics e						
R_G	Gate Resistance	$V_{GS}=0V$,$V_{DS}=0V$,F=1MHz	-	2.5	-	Ω
C_{iss}	Input Capacitance	$V_{GS}=0V$, $V_{DS}=20V$, Frequency=1.0MHz	-	815	-	pF
C_{oss}	Output Capacitance		-	95	-	
C_{rss}	Reverse Transfer Capacitance		-	60	-	
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=20V$, $R_L=20\Omega$, $I_{DS}=1A$, $V_{GEN}=10V$, $R_G=6\Omega$	-	7.8	-	ns
t_r	Turn-on Rise Time		-	6.9	-	
$t_{d(OFF)}$	Turn-off Delay Time		-	22.4	-	
t_f	Turn-off Fall Time		-	4.8	-	
Gate Charge Characteristics e						
Q_g	Total Gate Charge	$V_{DS}=20V$, $V_{GS}=10V$, $I_{DS}=10A$	-	15.7	22	nC
Q_g	Total Gate Charge	$V_{DS}=20V$, $V_{GS}=4.5V$, $I_{DS}=10A$	-	7.5	10.5	
Q_{gth}	Threshold Gate Charge		-	1.85	-	
Q_{gs}	Gate-Source Charge		-	3.24	-	
Q_{gd}	Gate-Drain Charge		-	2.75	-	

Note d：Pulse test ; pulse width≤300µs, duty cycle≤2%.
Note e：Guaranteed by design, not subject to production testing.
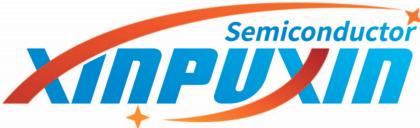
# P Channel Electrical Characteristics $(T_A = 25°C$ unless otherwise noted)

Symbol	Parameter	Test Conditions	P Channel			Unit
			Min.	Typ.	Max.	
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_{DS}=-250\mu A$	-40	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=-32V, V_{GS}=0V$	-	-	-1	μA
		$T_J=85°C$	-	-	-30	mA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=-250\mu A$	-1.5	-2	-2.5	V
I_{GSS}	Gate Leakage Current	$V_{GS}=\pm20V, V_{DS}=0V$	-	-	±100	nA
$R_{DS(ON)}{}^d$	Drain-Source On-state Resistance	$V_{GS}=-10V, I_{DS}=-10A$	-	30	38	$m\Omega$
		$V_{GS}=-4.5V, I_{DS}=-5A$	-	46	62	
Diode Characteristics						
$V_{SD}{}^d$	Diode Forward Voltage	$I_{SD}=-1A, V_{GS}=0V$	-	-0.75	-1	V
t_{rr}	Reverse Recovery Time	$I_{DS}=-10A, dI_{SD}/dt=100A/\mu s$	-	15	-	ns
Q_{rr}	Reverse Recovery Charge		-	8	-	nC
Dynamic Characteristics [e]						
R_G	Gate Resistance	$V_{GS}=0V, V_{DS}=0V, F=1MHz$	-	8	-	Ω
C_{iss}	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=-20V,$ Frequency=1.0MHz	-	668	-	pF
C_{oss}	Output Capacitance		-	98	-	
C_{rss}	Reverse Transfer Capacitance		-	72	-	
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=-20V, R_L=20\Omega,$ $I_{DS}=-1A, V_{GEN}=-10V,$ $R_G=6\Omega$	-	8.7	-	ns
t_r	Turn-on Rise Time		-	7	-	
$t_{d(OFF)}$	Turn-off Delay Time		-	31	-	
t_f	Turn-off Fall Time		-	17	-	
Gate Charge Characteristics [e]						
Q_g	Total Gate Charge	$V_{DS}=-20V, V_{GS}=-10V,$ $I_{DS}=-10A$	-	15	-	nC
Q_g	Total Gate Charge	$V_{DS}=-20V, V_{GS}=-4.5V,$ $I_{DS}=-10A$	-	7.5	-	
Q_{gth}	Threshold Gate Charge		-	1.4	-	
Q_{gs}	Gate-Source Charge		-	2.4	-	
Q_{gd}	Gate-Drain Charge		-	3.5	-	

Note d：Pulse test; pulse width≤300μs, duty cycle≤2%.
Note e：Guaranteed by design, not subject to production testing.

N Channel Typical Operating Characteristics

Power Dissipation

P_{tot} - Power (W)

T_C=25°C

T_j - Junction Temperature (°C)

Drain Current

I_D - Drain Current (A)

T_C=25°C,V_G=10V

T_j - Junction Temperature (°C)

Safe Operation Area

I_D - Drain Current (A)

Rds(on) Limit

100μs

1ms

10ms

DC

T_C=25°C

V_{DS} - Drain - Source Voltage (V)

Thermal Transient Impedance

Normalized Transient Thermal Resistance

Duty = 0.5

0.2

0.1

0.05

0.02

0.01

Single Pulse

$R_{\theta JC}$:3.8^{o}C/W

Square Wave Pulse Duration (sec)

N Channel Typical Operating Characteristics (Cont.)

Output Characteristics

V_{GS}=5,6,7,8,9,10V

4V

3.5V

3V

I_D- Drain Current (A)

V_{DS}- Drain - Source Voltage (V)

Drain-Source On Resistance

V_{GS}=4.5V

V_{GS}=10V

$R_{DS(ON)}$ - On - Resistance (mΩ)

I_D- Drain Current (A)

Gate-Source On Resistance

I_{DS}=10A

$R_{DS(ON)}$ - On - Resistance (mΩ)

V_{GS} - Gate - Source Voltage (V)

Gate Threshold Voltage

I_{DS} =250μA

Normalized Threshold Vlotage

T_j - Junction Temperature (°C)

N Channel Typical Operating Characteristics (Cont.)

Drain-Source On Resistance

V_{GS} = 10V
I_{DS} = 10A

Normalized On Resistance

R_{ON}@T_j=25°C: 16mΩ

T_j- Junction Temperature (°C)

Source-Drain Diode Forward

I_S - Source Current (A)

T_j=150°C

T_j=25°C

V_{SD} - Source - Drain Voltage (V)

Capacitance

Frequency=1MHz

C - Capacitance (pF)

Ciss

Coss

Crss

V_{DS} - Drain - Source Voltage (V)

Gate Charge

V_{DS}=20V
I_{DS}=10A

V_{GS} - Gate-source Voltage (V)

Q_G - Gate Charge (nC)

P Channel Typical Operating Characteristics

Power Dissipation

$T_C=25^{\circ}C$

P_{tot} - Power (W)

T_j - Junction Temperature (°C)

Drain Current

$T_C=25^{\circ}C, V_G=-10V$

$-I_D$ - Drain Current (A)

T_j - Junction Temperature (°C)

Safe Operation Area

$-I_D$ - Drain Current (A)

Rds(on) Limit

100μs

1ms

10ms

DC

$T_C=25^{\circ}C$

$-V_{DS}$ - Drain - Source Voltage (V)

Thermal Transient Impedance

Normalized Transient Thermal Resistance

Duty = 0.5

0.2

0.1

0.05

0.02

0.01

Single Pulse

$R_{\theta JC}$:3.8°C/W

Square Wave Pulse Duration (sec)

P Channel Typical Operating Characteristics (Cont.)

Output Characteristics

**Drain-Source On Resistance**
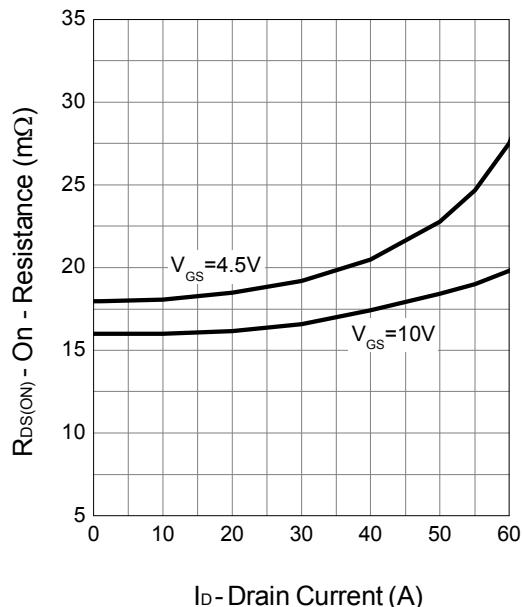
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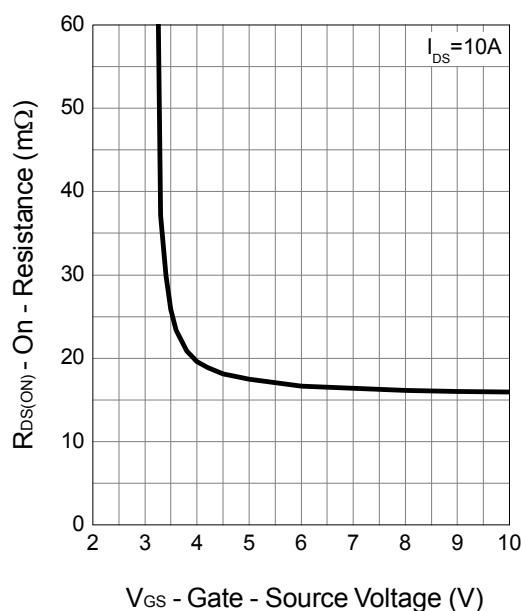
Gate Threshold Voltage
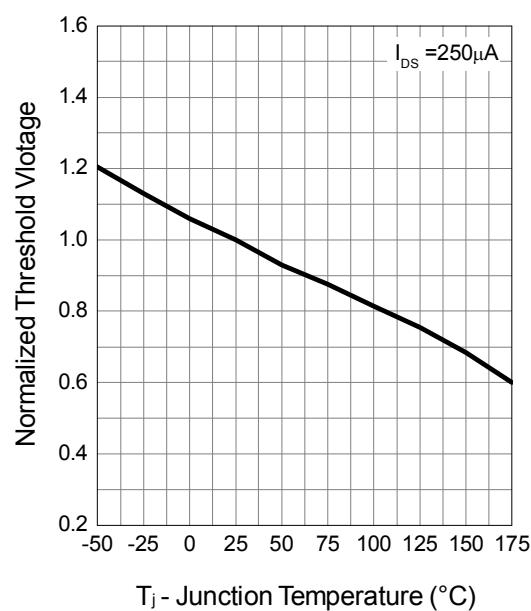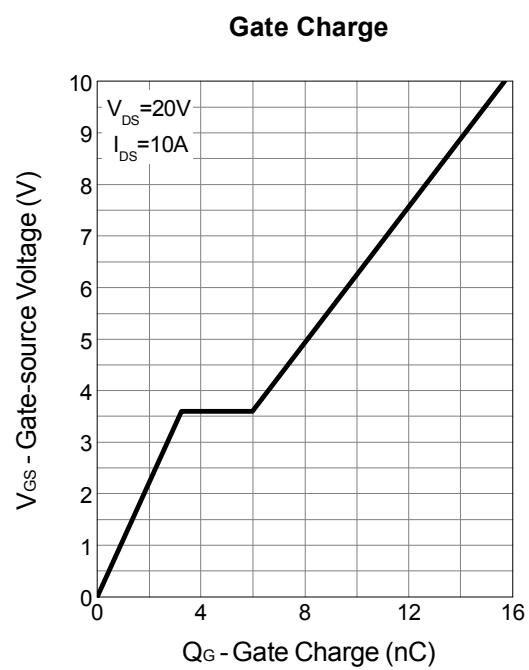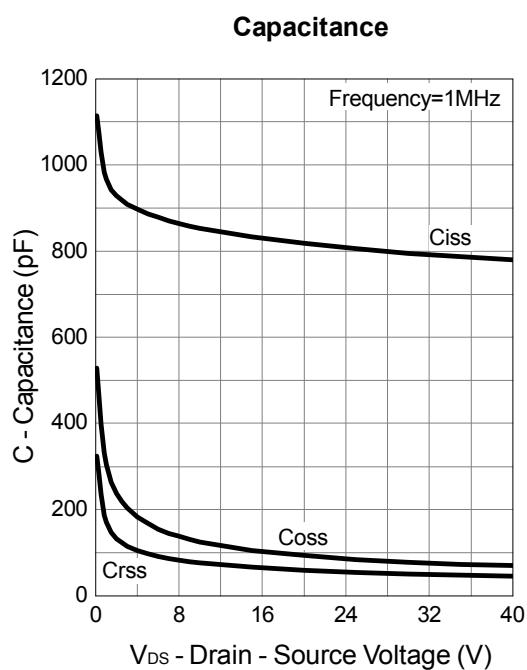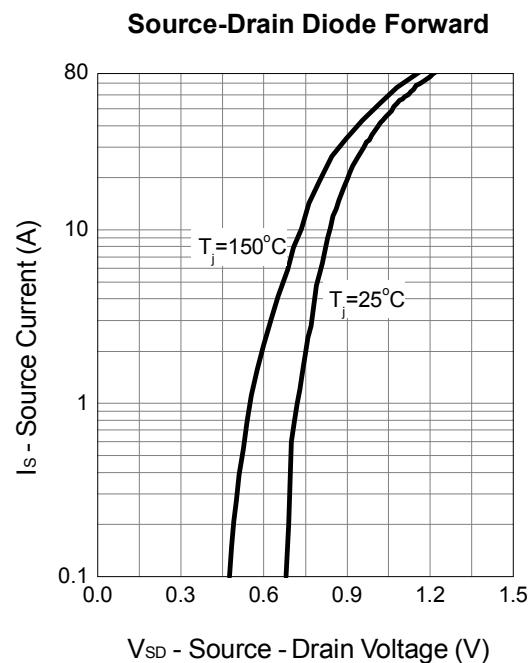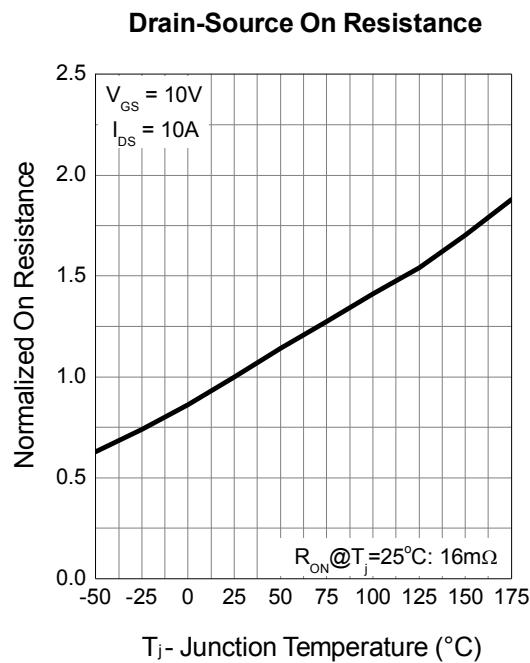
P Channel Typical Operating Characteristics (Cont.)

Drain-Source On Resistance

V_{GS} = -10V

I_{DS} = -10A

Normalized On Resistance

R_{ON}@T_j=25°C: 30mΩ

T_j- Junction Temperature (°C)

Source-Drain Diode Forward

-I_S - Source Current (A)

T_j=150°C

T_j=25°C

-V_{SD} - Source - Drain Voltage (V)

Capacitance

Frequency=1MHz

C - Capacitance (pF)

Ciss

Coss

Crss

-V_{DS} - Drain - Source Voltage (V)

Gate Charge

V_{DS}=-20V

I_{DS}=-10A

-V_{GS} - Gate-source Voltage (V)

Q_G - Gate Charge (nC)
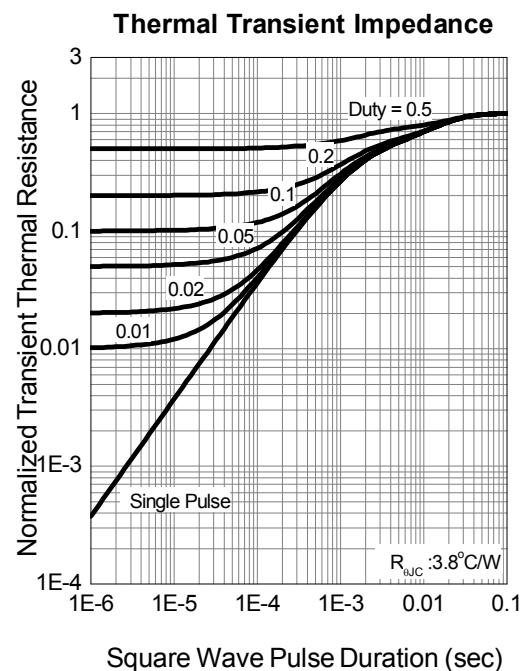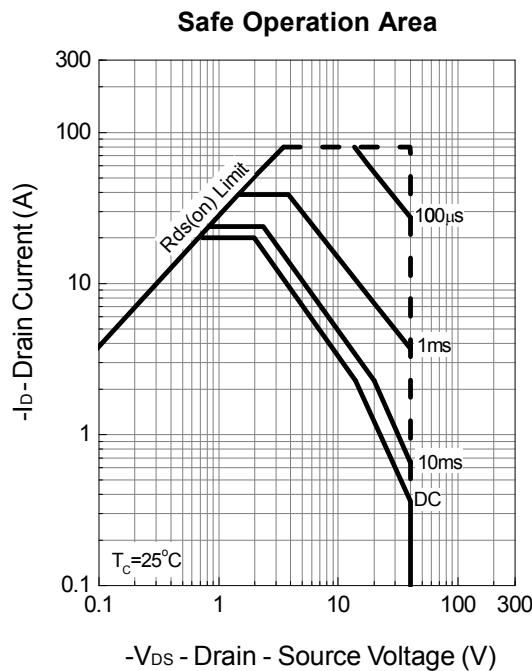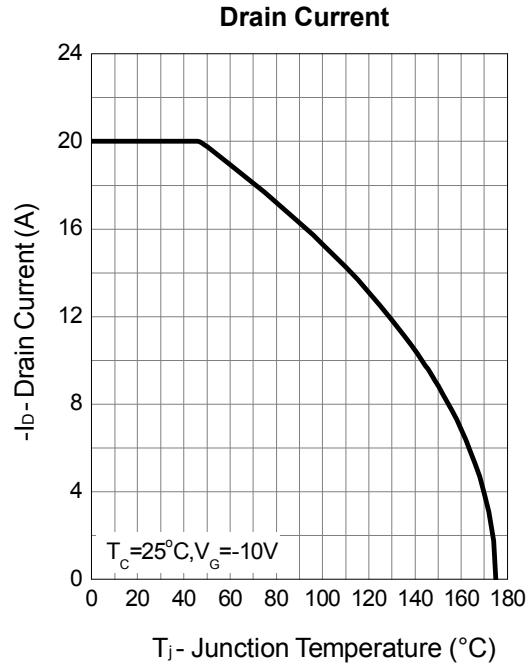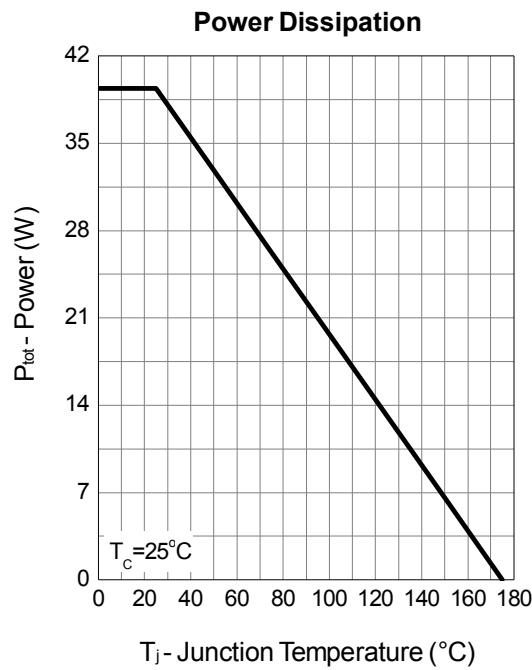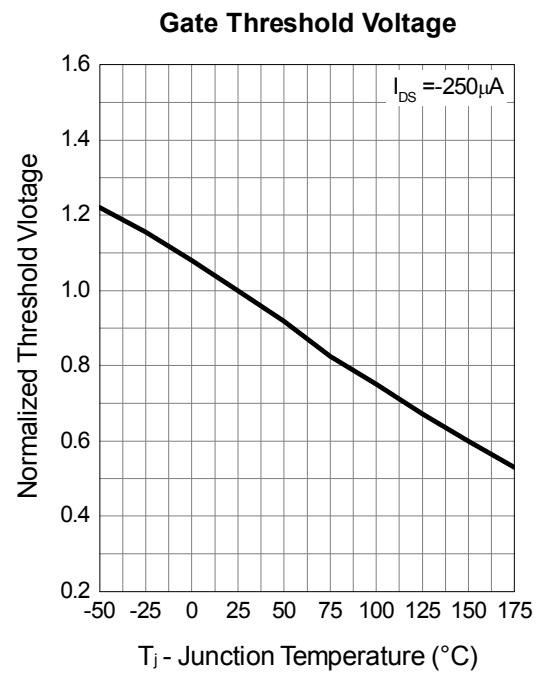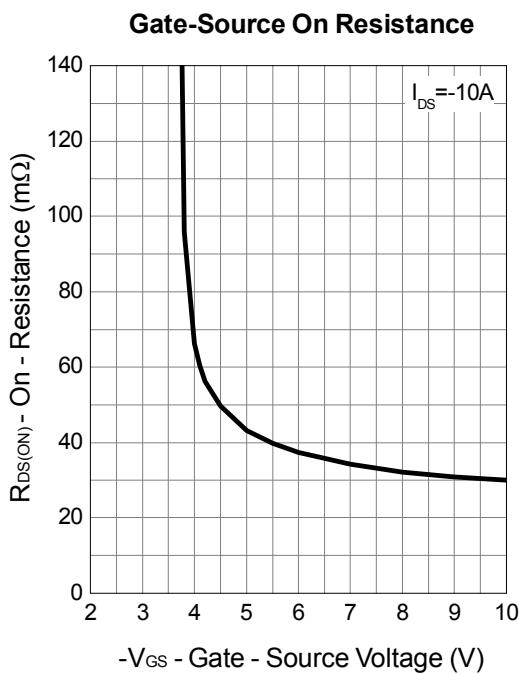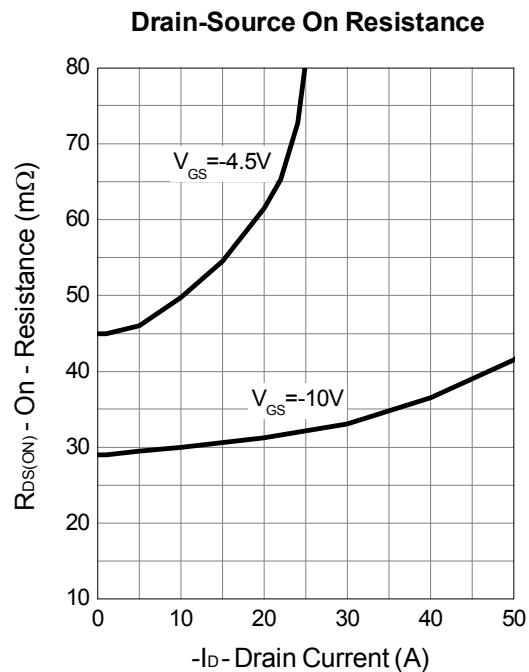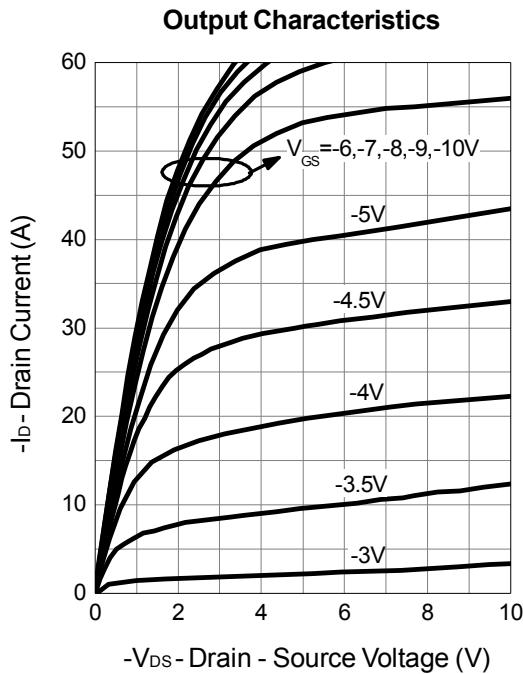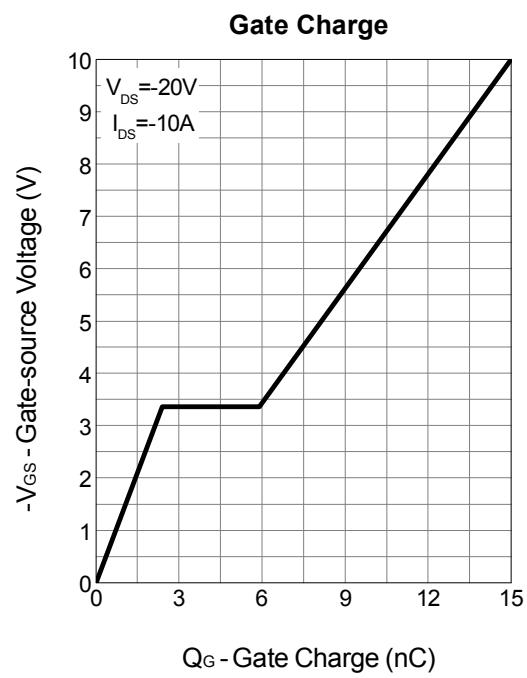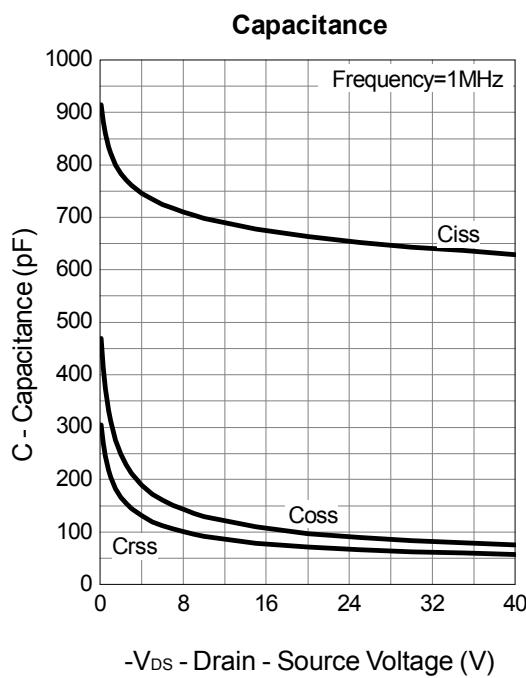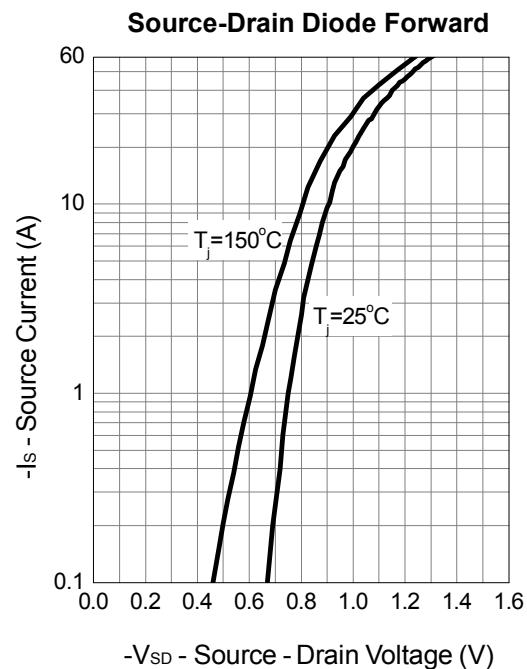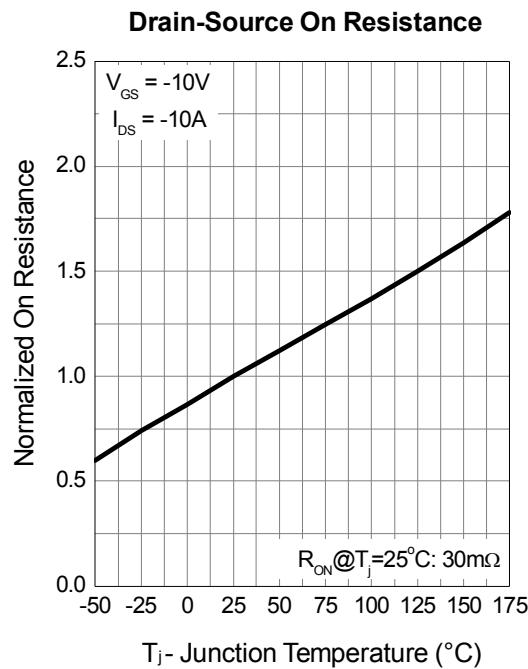
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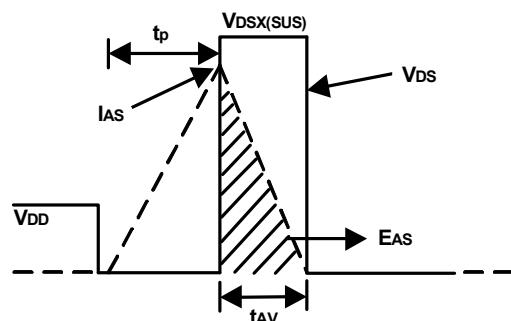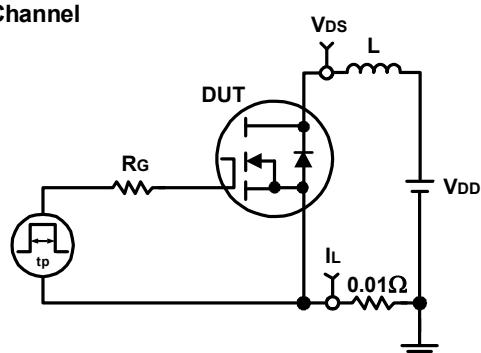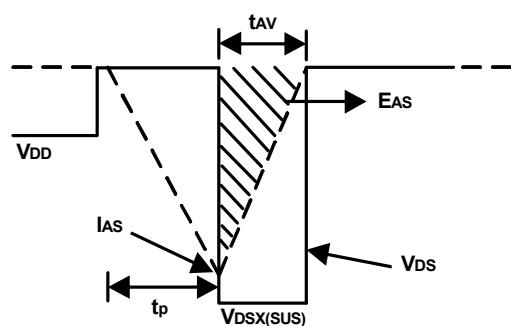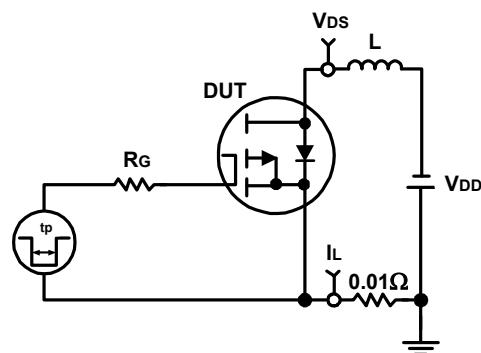
N Channel

P Channel

Switching Time Test Circuit and Waveforms

N Channel

P Channel