

### Product Summary

$V_{(BR)DSS}$	$R_{DS(on)TYP}$	$I_D$
40V	13mΩ@10V	9A
	18mΩ@4.5V	
-40V	26mΩ@-10V	-7A
	35mΩ@-4.5V	

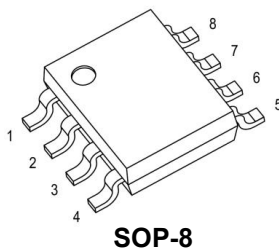
### Feature

- N-Channel  
 $V_{DS} = 40V, I_D = 9A$   
 $R_{DS(ON)} < 18m\Omega @ V_{GS} = 10V$   
 $R_{DS(ON)} < 25m\Omega @ V_{GS} = 4.5V$
- P-Channel  
 $V_{DS} = -40V, I_D = -7A$   
 $R_{DS(ON)} < 35m\Omega @ V_{GS} = -10V$   
 $R_{DS(ON)} < 45m\Omega @ V_{GS} = -4.5V$
- High power and current handling capability
- Surface mount package

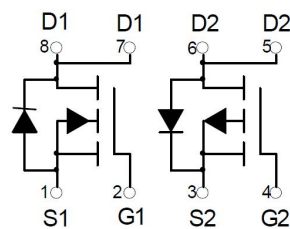
### Application

- Load Switch
- Battery Switch
- Power Management

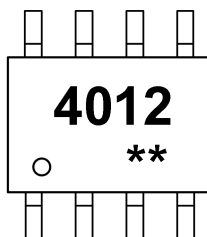
### Package



### Circuit diagram



### Marking



4012 : Product code  
 \*\* : Week code.

**Absolute maximum ratings (Ta=25°C unless otherwise noted)**

Parameter	Symbol	Value		Unit
		N-Channel	P-Channel	
Drain-Source Voltage	$V_{DS}$	40	-40	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V
Continuous Drain Current	$I_D$	9	-7	A
Pulsed Drain Current <sup>(1)</sup>	$I_{DM}$	36	-28	A
Maximum Power Dissipation	$P_D$	2.0	2.0	W
Thermal Resistance from Junction to Ambient( $t \leq 10s$ )	$R_{\theta JA}$	62.5		$^{\circ}C/W$
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	-55 To 150	$^{\circ}C$

**N-Channel Electrical characteristics (T<sub>A</sub>=25 °C, unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Static Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	40	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 32V, V_{GS} = 0V$	-	-	1	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	-	$\pm 100$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	1	1.5	2.5	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 7A$	-	13	18	m $\Omega$
		$V_{GS} = 4.5V, I_D = 4A$	-	18	25	
Forward Transconductance	$g_{FS}$	$V_{DS} = 5V, I_D = 7A$	-	32	-	S
<b>Dynamic Characteristics<sup>(3)</sup></b>						
Input Capacitance	$C_{iss}$	$V_{DS} = 15V, V_{GS} = 0V, f = 1MHz$	-	1013	-	PF
Output Capacitance	$C_{oss}$		-	107	-	
Reverse Transfer Capacitance	$C_{rss}$		-	76	-	
<b>Switching Characteristics<sup>(3)</sup></b>						
Turn-on Delay Time	$t_d(on)$	$V_{DD} = 20V, V_{GS} = 10V, R_G = 3.3\Omega, I_D = 7A$	-	2.8	-	nS
Turn-on Rise Time	$t_r$		-	40.4	-	
Turn-Off Delay Time	$t_d(off)$		-	22.8	-	
Turn-Off Fall Time	$t_f$		-	6.4	-	
Total Gate Charge	$Q_g$	$V_{DS} = 32V, V_{GS} = 4.5V, I_D = 7A$	-	9.8	-	nC
Gate-Source Charge	$Q_{gs}$		-	2.8	-	
Gate-Drain Charge	$Q_{gd}$		-	3.9	-	
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage <sup>(2)</sup>	$V_{SD}$	$V_{GS} = 0V, I_S = 1A, T_J = 25^{\circ}C$	-	-	1.2	V

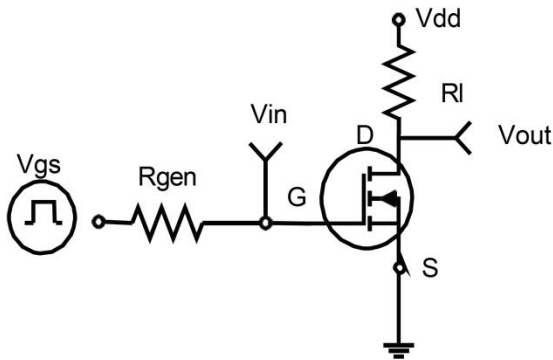
**P-Channel Electrical characteristics (T<sub>A</sub>=25 °C, unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Static Characteristics</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = -250μA	-40	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = -40V, V <sub>GS</sub> = 0V	-	-	-1	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V	-	-	±100	nA
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA	-1.0	-1.5	-2.5	V
Drain-Source On-State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = -10V, I <sub>D</sub> = -5A	-	26	35	mΩ
		V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -4A	-	35	45	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = -5V, I <sub>D</sub> = -8A	20	-	-	S
<b>Dynamic Characteristics <sup>(3)</sup></b>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = -15V, V <sub>GS</sub> = 0V, f = 1MHz	-	1415	-	PF
Output Capacitance	C <sub>oss</sub>		-	134	-	
Reverse Transfer Capacitance	C <sub>rss</sub>		-	102	-	
<b>Switching Characteristics <sup>(3)</sup></b>						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> = -15V, V <sub>GS</sub> = -10V, R <sub>G</sub> = 3.3 Ω, I <sub>D</sub> = -1A	-	22	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	15.7	-	
Turn-Off Delay Time	t <sub>d(off)</sub>		-	59	-	
Turn-Off Fall Time	t <sub>f</sub>		-	5.5	-	
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> = -15V, V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -1A	-	11.5	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	3.5	-	
Gate-Drain Charge	Q <sub>gd</sub>		-	3.3	-	
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage <sup>(2)</sup>	V <sub>SD</sub>	V <sub>GS</sub> = 0V, I <sub>S</sub> = -1A, T <sub>J</sub> = 25°C	-	-	-1.2	V

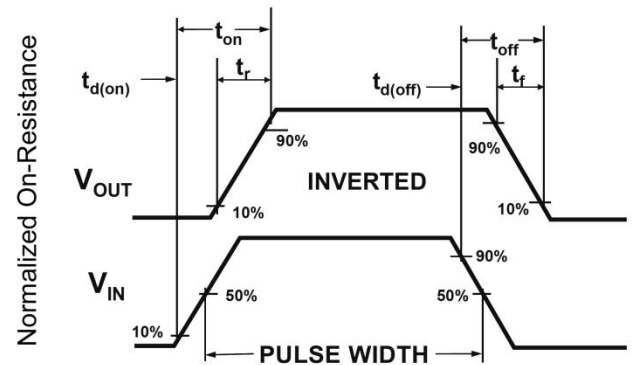
**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
3. Guaranteed by design, not subject to production

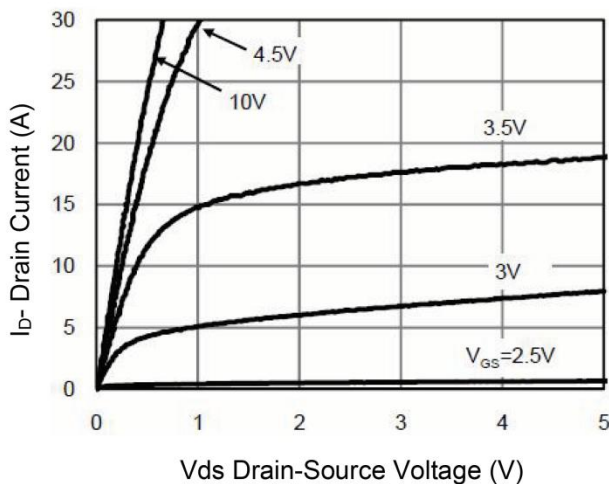
**N-Channel Typical Characteristics**



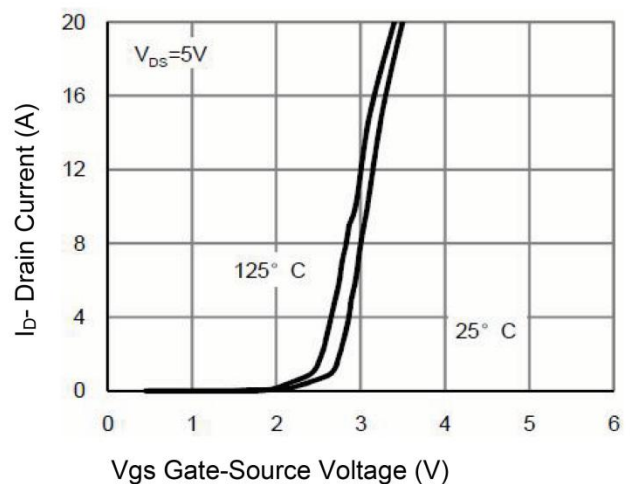
**Figure 1: Switching Test Circuit**



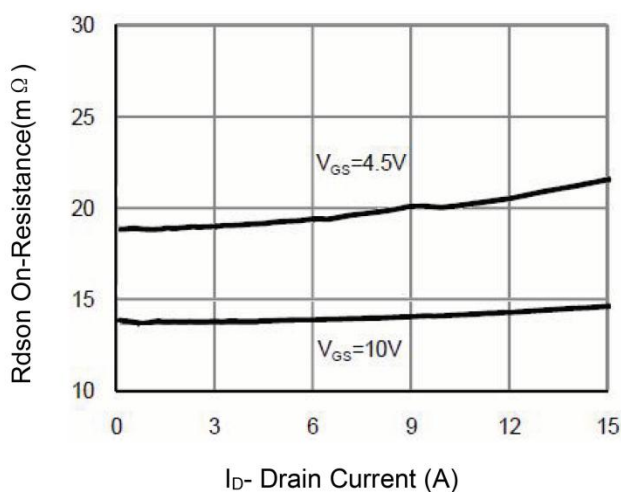
**Figure 2: Switching Waveforms**



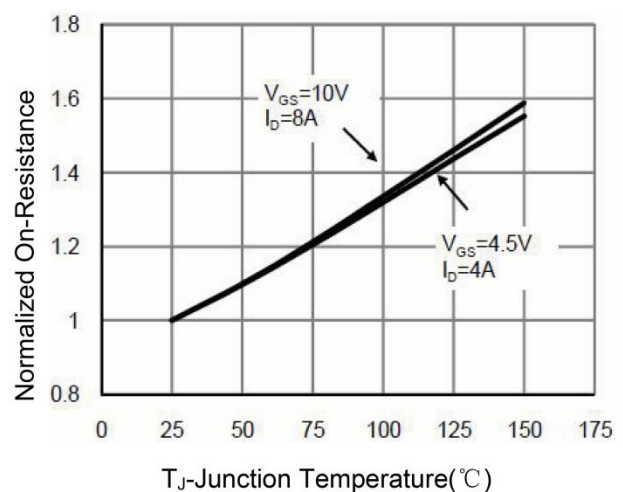
**Figure 3 Output Characteristics**



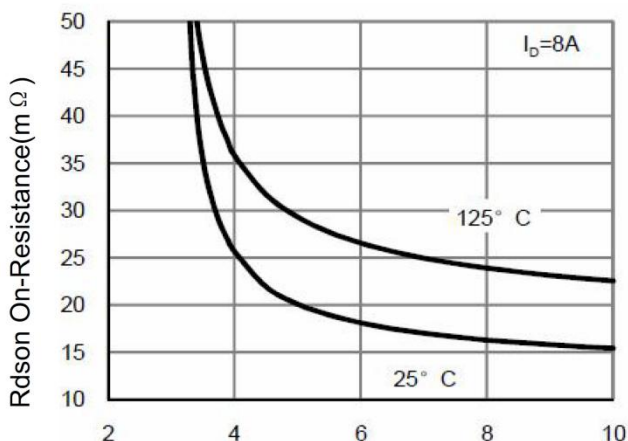
**Figure 4 Transfer Characteristics**



**Figure 5 Drain-Source On-Resistance**

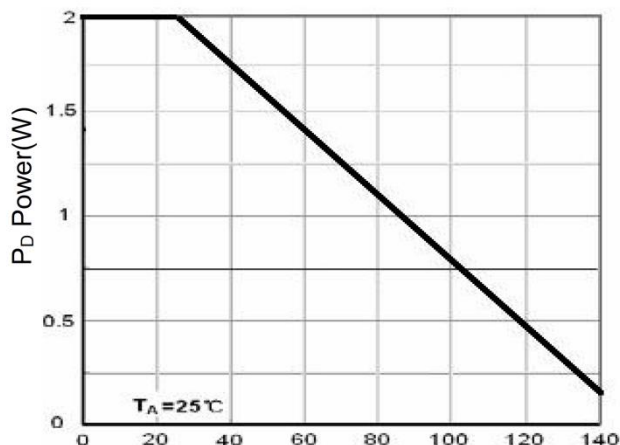


**Figure 6 Drain-Source On-Resistance**



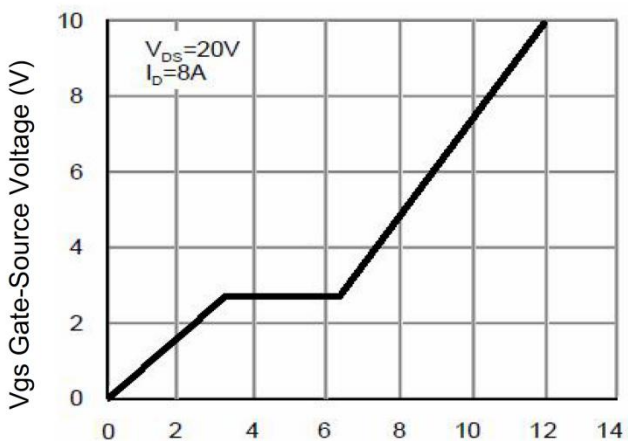
Vgs Gate-Source Voltage (V)

Figure 7 Rdson vs Vgs



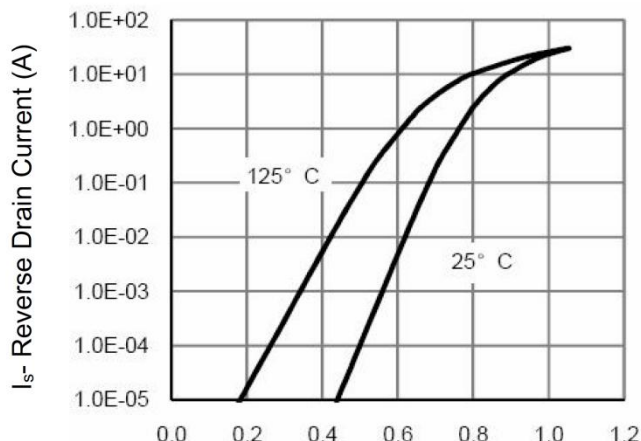
T<sub>J</sub>-Junction Temperature(°C)

Figure 8 Power Dissipation



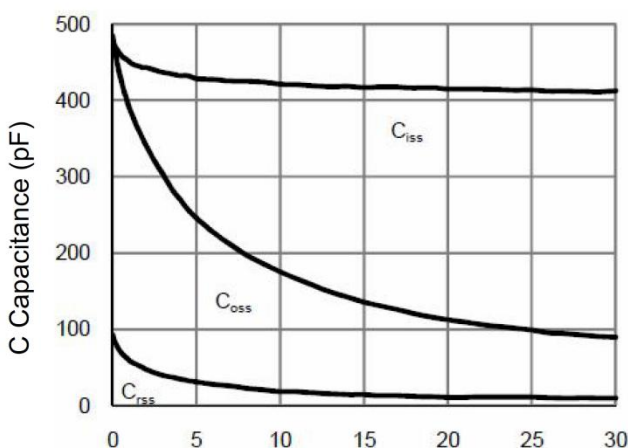
Qg Gate Charge (nC)

Figure 9 Gate Charge



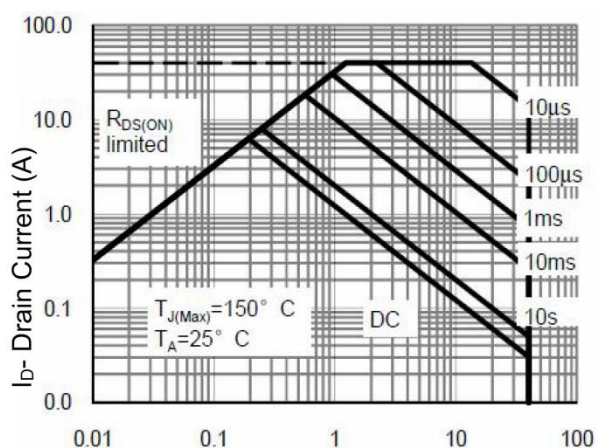
Vds Drain-Source Voltage (V)

Figure 10 Source- Drain Diode Forward



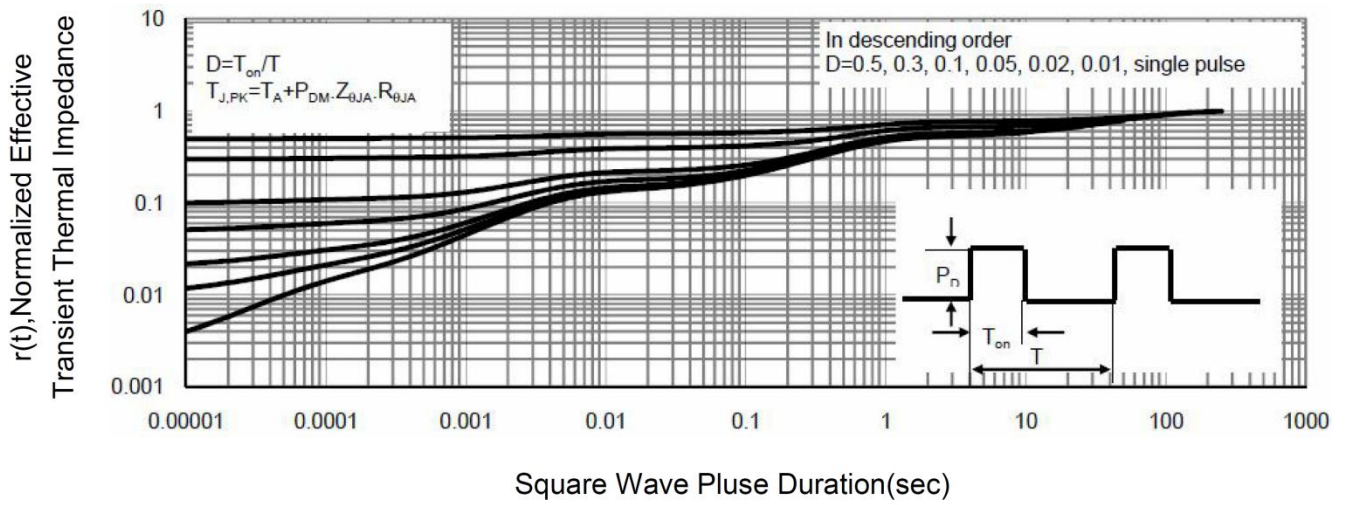
Vds Drain-Source Voltage (V)

Figure 11 Capacitance vs Vds



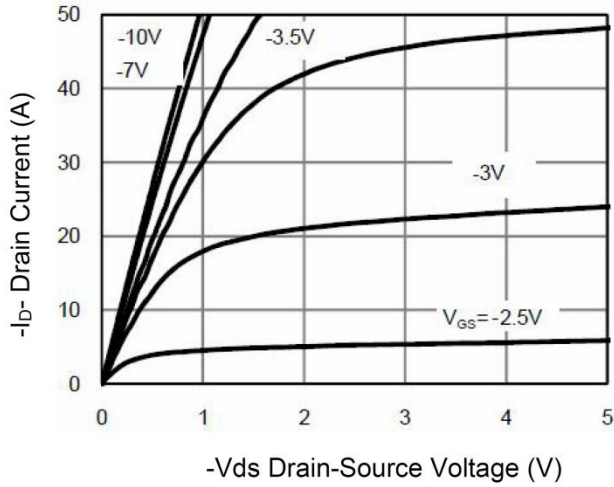
Vds Drain-Source Voltage (V)

Figure 12 Safe Operation Area

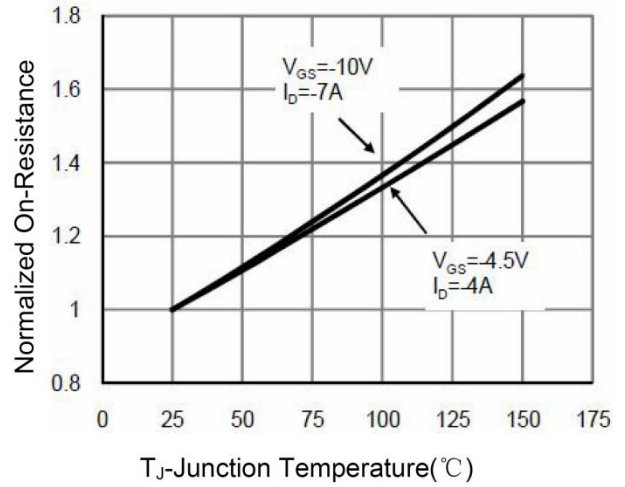


**Figure 13 Normalized Maximum Transient Thermal Impedance**

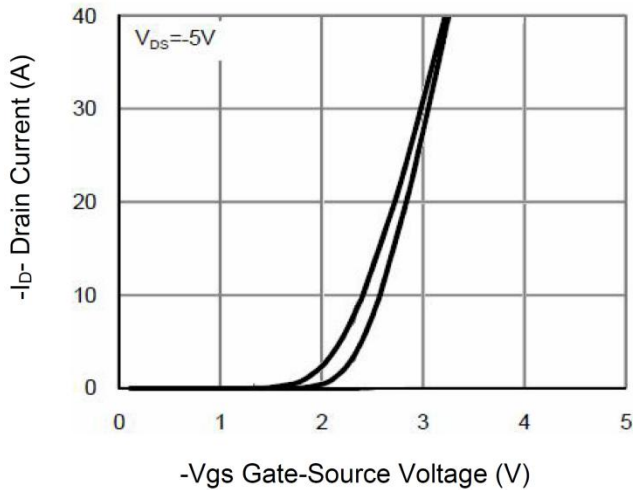
**P-Channel Typical Characteristics**



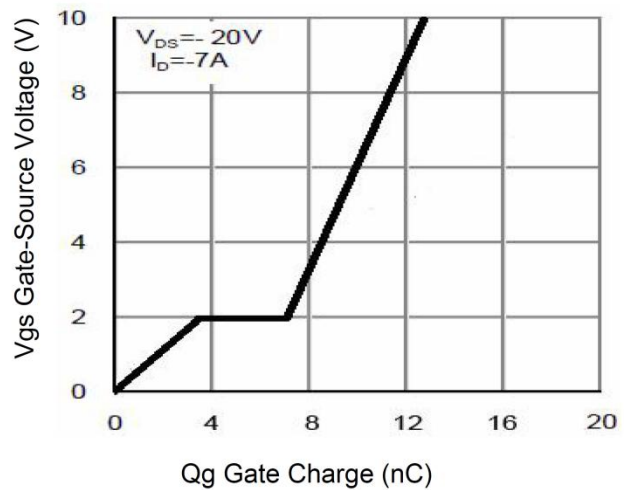
**Figure 1 Output Characteristics**



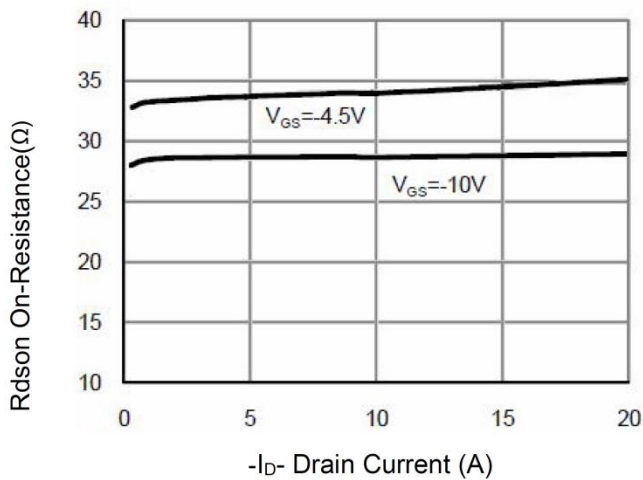
**Figure 4 Rdson-Junction Temperature**



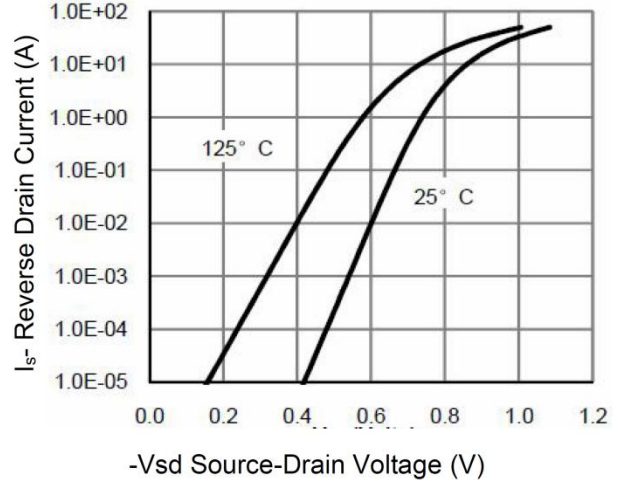
**Figure 2 Transfer Characteristics**



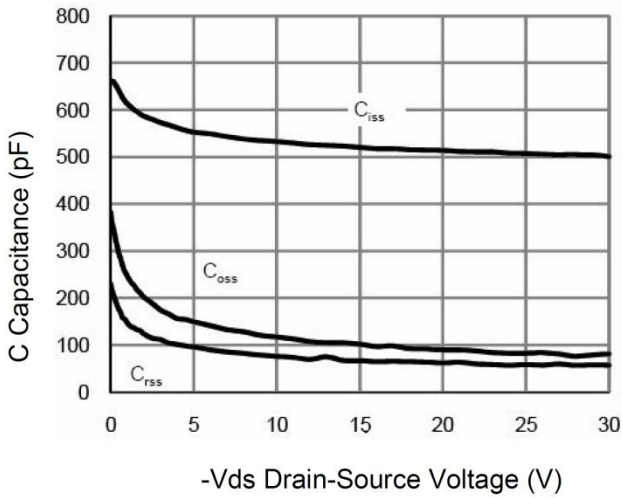
**Figure 5 Gate Charge**



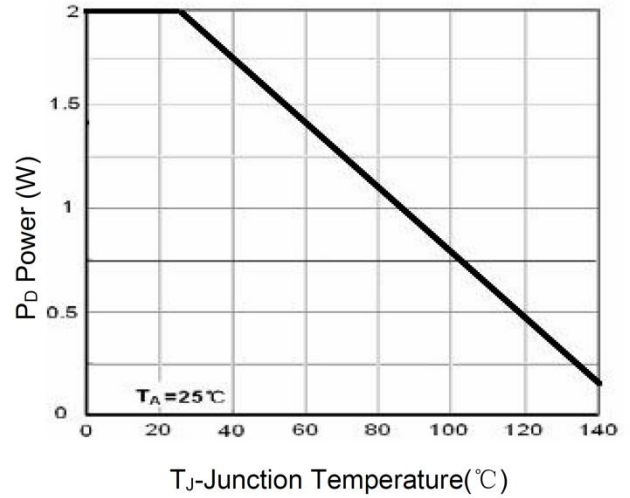
**Figure 3 Rdson- Drain Current**



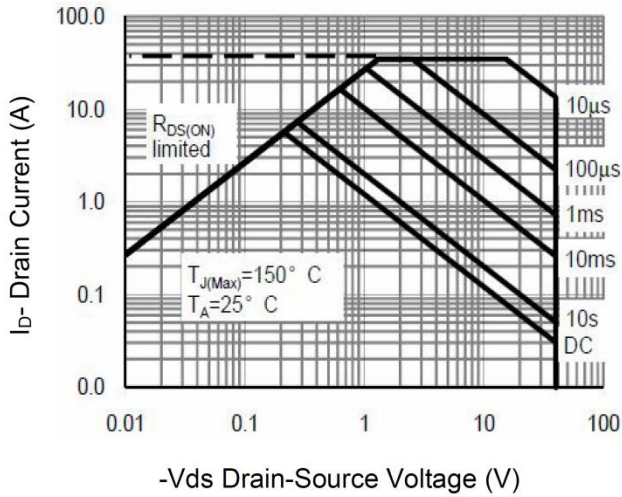
**Figure 6 Source- Drain Diode Forward**



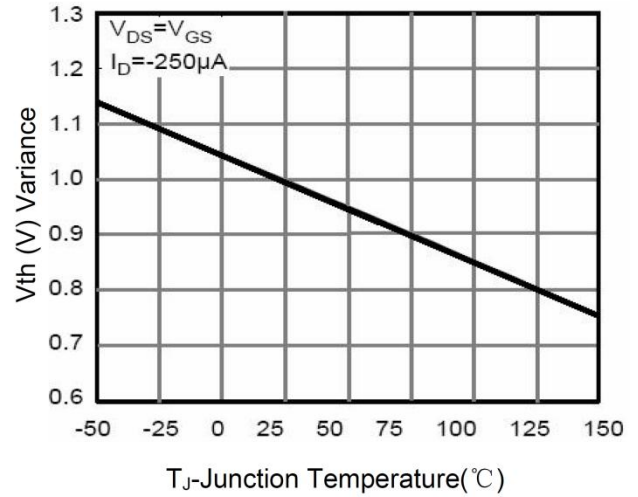
**Figure 7 Capacitance vs Vds**



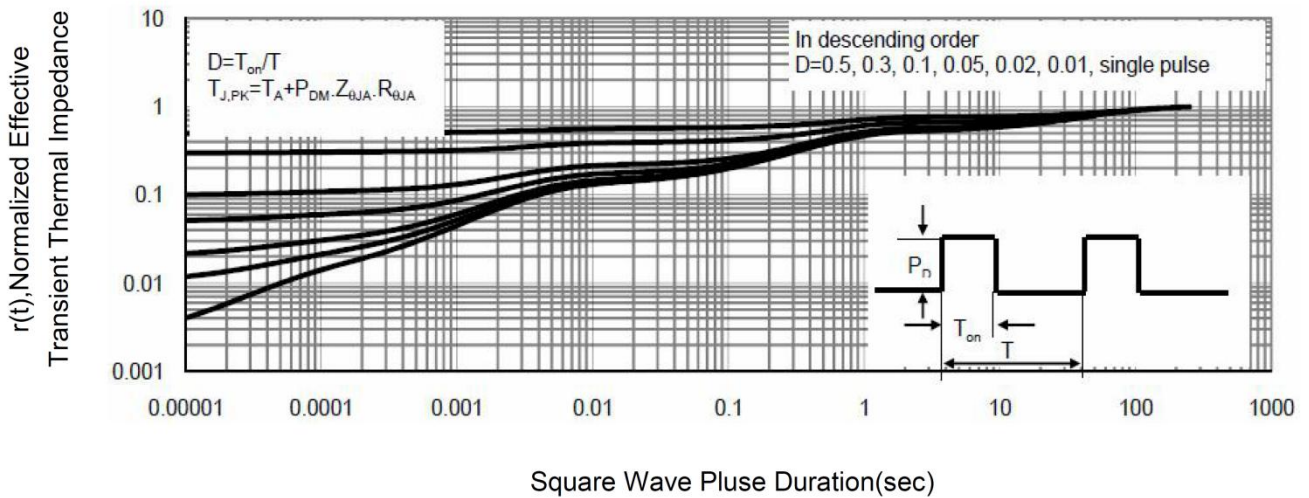
**Figure 9 Power Dissipation**



**Figure 8 Safe Operation Area**

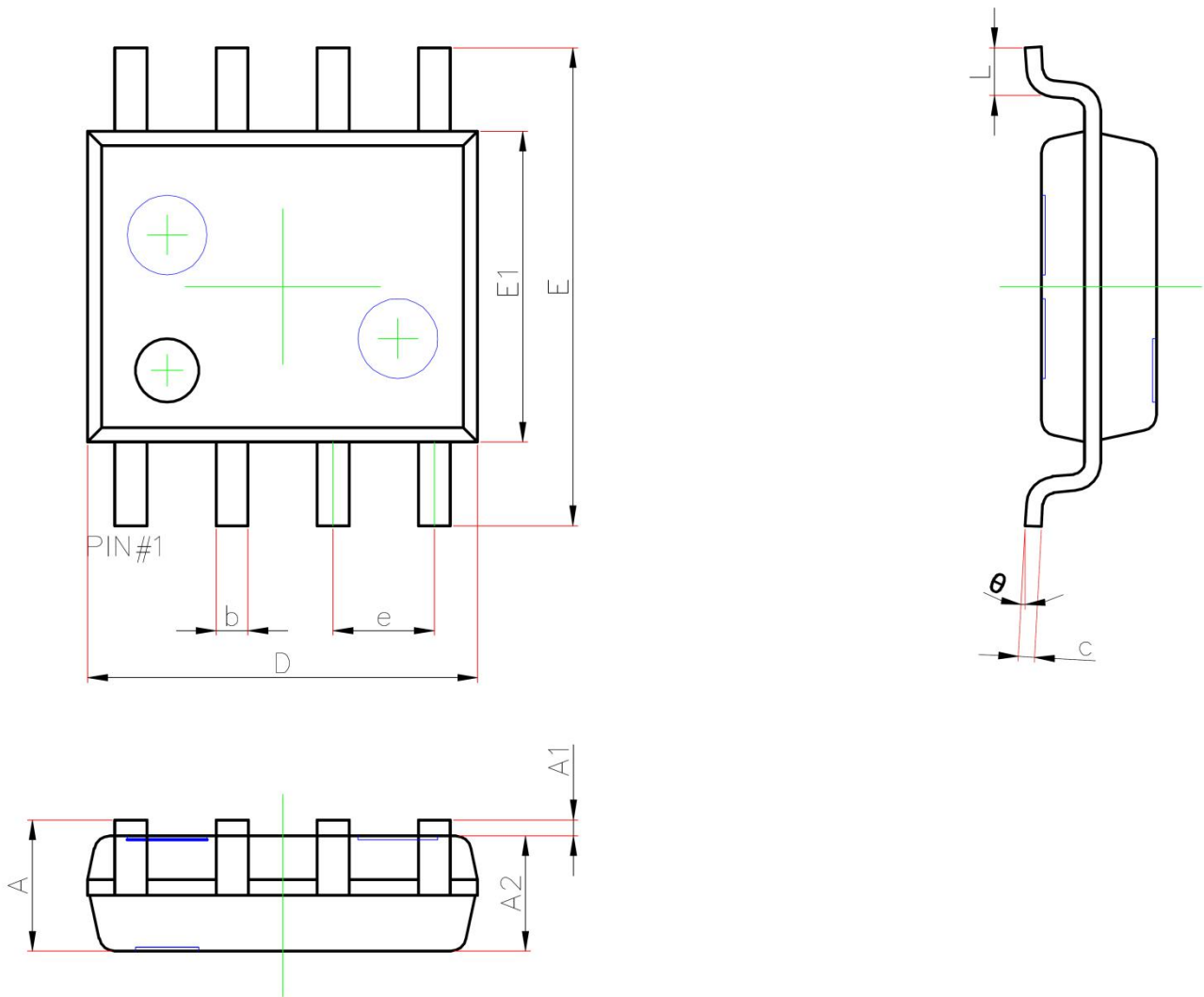


**Figure 10 V<sub>GS(th)</sub> vs Junction Temperature**



**Figure 11 Normalized Maximum Transient Thermal Impedance**



**SOP-8 Package Information**


Symbol	Dimensions In Millimeters	
	Min.	Max.
A	1.35	1.75
A1	0.10	0.25
A2	1.35	1.55
b	0.33	0.51
c	0.17	0.25
D	4.80	5.00
e	1.27 REF.	
E	5.80	6.20
E1	3.80	4.00
L	0.40	1.27
$\theta$	0°	8°

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