




# Power MOSFETS


## DATASHEET


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**LM60110NAK8A**

N-Channel  
Enhancement Mode MOSFET

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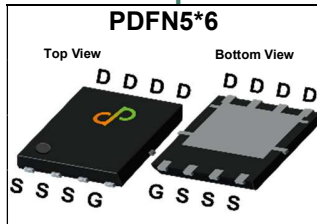


Quality Management Systems

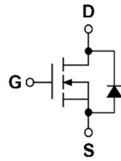
ISO 9001:2015 Certificate

## N-Channel Enhancement Mode MOSFET

### Pin Description



### Symbol



### Product Summary

Symbol	N-Channel	Unit
V <sub>DSS</sub>	60	V
R <sub>DS(ON)-Max</sub>	11	mΩ
I <sub>D</sub>	65	A

### Feature

- Fast switching speed
- Reliable and Rugged
- ROHS Compliant & Halogen-Free
- 100% UIS and Rg Tested

### Applications

- Power Management in DC/DC Converters
- USB Power Delivery (USB PD)

### Ordering Information

Orderable Part Number	Package Type	Form	Shipping	Marking
LM60110NAK8A	PDFN5*6	Tape & Reel	5000 / Tape & Reel	60110 □□□□□□

Note : □□□□□□ = Lot Code

### Absolute Maximum Ratings (T<sub>J</sub>=25°C Unless Otherwise Noted)

Symbol	Parameter	N-Channel	Unit	
V <sub>DSS</sub>	Drain-Source Voltage	60	V	
V <sub>GSS</sub>	Gate-Source Voltage	±20		
T <sub>J</sub>	Maximum Junction Temperature	150	°C	
T <sub>STG</sub>	Storage Temperature Range	-55 to 150	°C	
I <sub>S</sub>	Diode Continuous Forward Current	T <sub>C</sub> =25°C	42	A
I <sub>DM</sub> <sup>①</sup>	Pulse Drain Current Tested	T <sub>C</sub> =25°C	162	A
I <sub>D</sub>	Continuous Drain Current	T <sub>C</sub> =25°C	65	A
		T <sub>C</sub> =100°C	41	
P <sub>D</sub>	Maximum Power Dissipation	T <sub>C</sub> =25°C	46	W
		T <sub>C</sub> =100°C	19	
I <sub>D</sub>	Continuous Drain Current	T <sub>A</sub> =25°C	15	A
		T <sub>A</sub> =70°C	12	
P <sub>D</sub>	Maximum Power Dissipation	T <sub>A</sub> =25°C	2.5	W
		T <sub>A</sub> =70°C	1.6	
I <sub>AS</sub> <sup>②</sup>	Avalanche Current, Single pulse	L=0.1mH	24	A
		L=0.5mH	13	
E <sub>AS</sub> <sup>②</sup>	Avalanche Energy, Single pulse	L=0.1mH	29	mJ
		L=0.5mH	42	

### Thermal Characteristics

Symbol	Parameter	Rating	Unit	
R <sub>θJC</sub>	Thermal Resistance-Junction to Case	Steady State	2.7	°C/W
R <sub>θJA</sub> <sup>③</sup>	Thermal Resistance-Junction to Ambient	Steady State	50	°C/W

Note ① : Max. current is limited by junction temperature

Note ② : UIS tested and pulse width are limited by maximum junction temperature 150°C

Note ③ : Surface Mounted on 1in<sup>2</sup> FR-4 board with 1oz

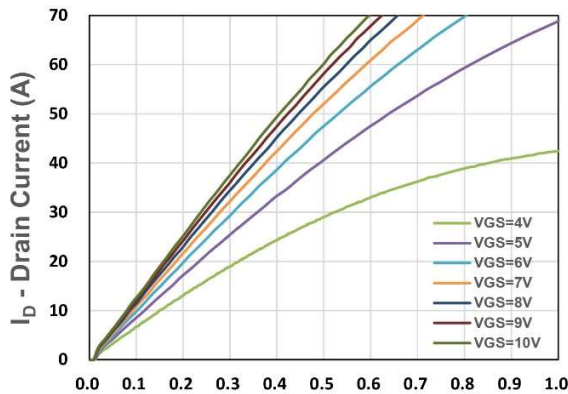
## N-Channel Electrical Characteristics (T<sub>J</sub>=25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static Electrical Characteristics</b>						
<b>BV<sub>DSS</sub></b>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>DS</sub> =250uA	60	-	-	V
<b>I<sub>DSS</sub></b>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =48V, V <sub>GS</sub> =0V	-	-	1	uA
<b>V<sub>GS(th)</sub></b>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250uA	1	1.8	2.5	V
<b>I<sub>GSS</sub></b>	Gate Leakage Current	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA
<b>R<sub>DS(ON)</sub></b> <sup>④</sup>	Drain-Source On-state Resistance	V <sub>GS</sub> =10V, I <sub>DS</sub> =20A	-	8.5	11	mΩ
		V <sub>GS</sub> =4.5V, I <sub>DS</sub> =10A	-	13	17	
<b>gfs</b>	Forward Transconductance	V <sub>DS</sub> =5V, I <sub>DS</sub> =10A	-	16.8	-	S
<b>Dynamic Characteristics</b> <sup>⑤</sup>						
<b>R<sub>G</sub></b>	Gate Resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, Freq.=1MHz	-	1	-	Ω
<b>C<sub>iss</sub></b>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =30V, Freq.=1MHz	-	1227	-	pF
<b>C<sub>oss</sub></b>	Output Capacitance		-	317	-	
<b>C<sub>rss</sub></b>	Reverse Transfer Capacitance		-	46	-	
<b>td(ON)</b>	Turn-on Delay Time	V <sub>GS</sub> =10V, V <sub>DS</sub> =30V, I <sub>D</sub> =1A, R <sub>GEN</sub> =1Ω	-	8.8	-	nS
<b>t<sub>r</sub></b>	Turn-on Rise Time		-	19.6	-	
<b>t<sub>d(OFF)</sub></b>	Turn-off Delay Time		-	25.8	-	
<b>t<sub>f</sub></b>	Turn-off Fall Time		-	29	-	
<b>Q<sub>g</sub></b>	Total Gate Charge	V <sub>GS</sub> =4.5V, V <sub>DS</sub> =30V, I <sub>D</sub> =20A	-	11.2	-	nC
<b>Q<sub>g</sub></b>	Total Gate Charge	V <sub>GS</sub> =10V, V <sub>DS</sub> =30V, I <sub>D</sub> =20A	-	22.3	-	
<b>Q<sub>gs</sub></b>	Gate-Source Charge		-	4.9	-	
<b>Q<sub>gd</sub></b>	Gate-Drain Charge		-	4.8	-	
<b>Source-Drain Characteristics</b>						
<b>V<sub>SD</sub></b> <sup>④</sup>	Diode Forward Voltage	I <sub>SD</sub> =10A, V <sub>GS</sub> =0V	-	0.8	1.1	V
<b>t<sub>rr</sub></b>	Reverse Recovery Time	I <sub>F</sub> =10A, V <sub>R</sub> =48V	-	22.2	-	nS
<b>Q<sub>rr</sub></b>	Reverse Recovery Charge	dI <sub>F</sub> /dt=100A/μs	-	11.1	-	nC

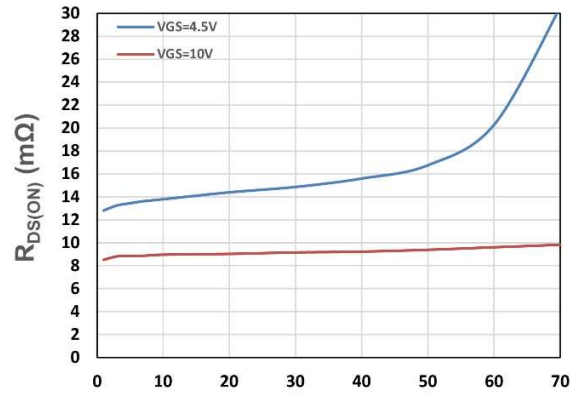
Note ④ : Pulse test (pulse width≤300us, duty cycle≤2%).

Note ⑤ : Guaranteed by design, not subject to production testing.

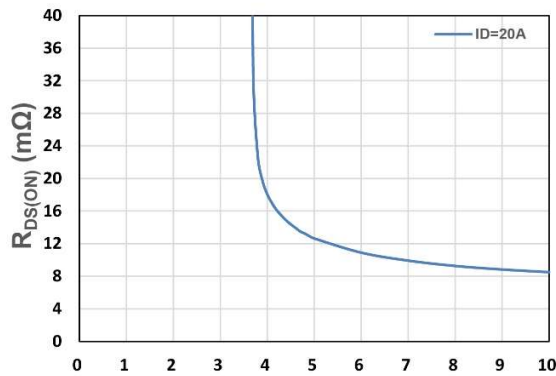
## N-Channel Typical Characteristics



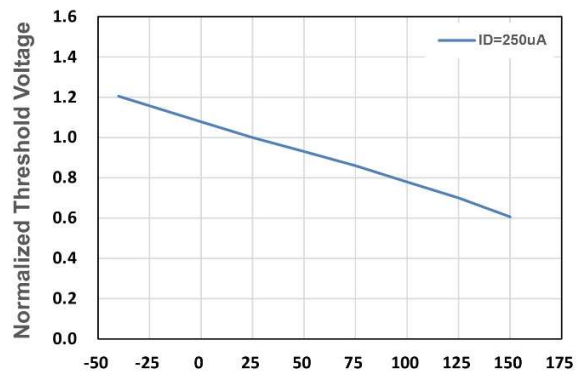
$V_{DS}$  - Drain - Source Voltage (V)  
Figure 1. Output Characteristics



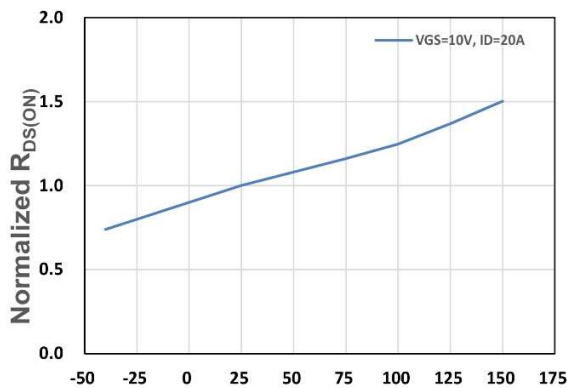
$I_D$ - Drain Current (A)  
Figure 2. On-Resistance vs. ID



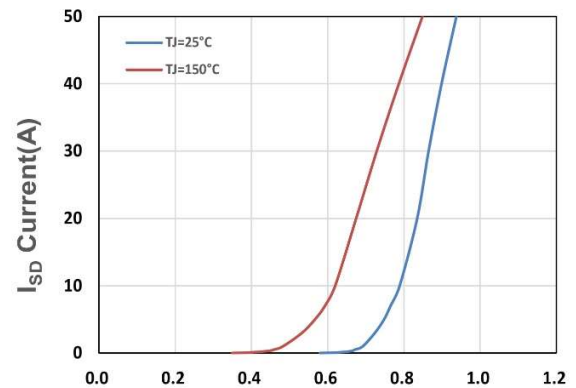
$V_{GS}$  - Gate - Source Voltage (V)  
Figure 3. On-Resistance vs. VGS



$T_j$ , Junction Temperature( $^{\circ}C$ )  
Figure 4. Gate Threshold Voltage

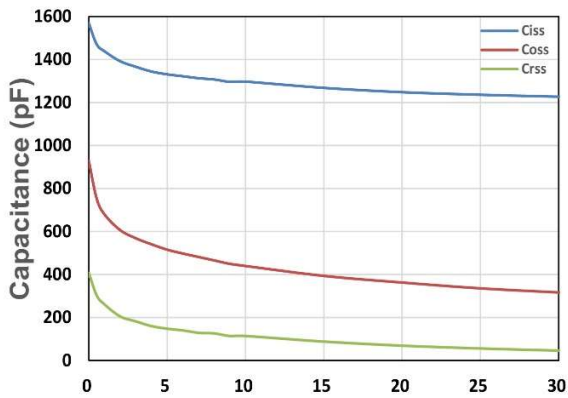


$T_j$ , Junction Temperature( $^{\circ}C$ )  
Figure 5. Drain-Source On Resistance

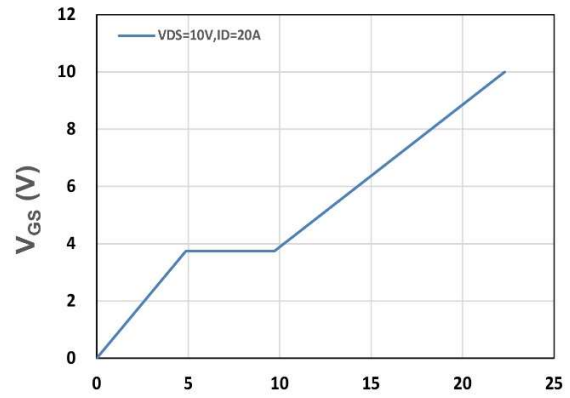


$V_{SD}$ , Source-Drain Voltage(V)  
Figure 6. Source-Drain Diode Forward

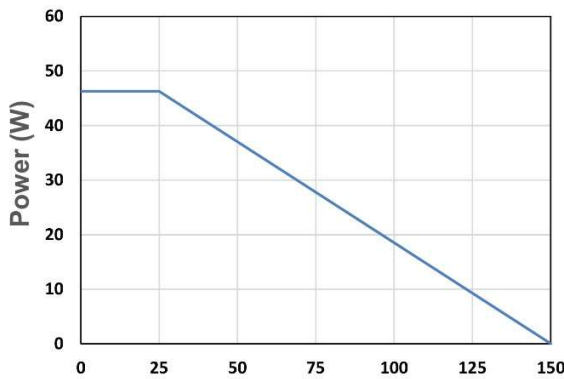
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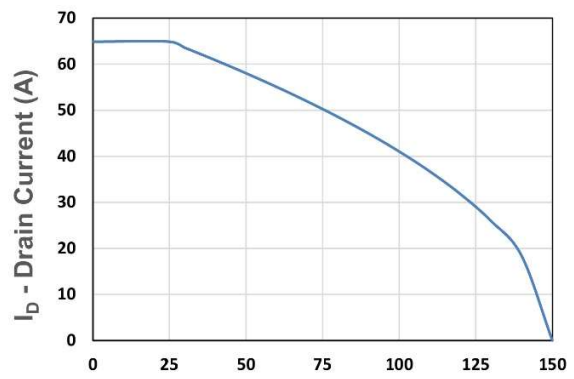
$V_{DS}$  - Drain - Source Voltage (V)  
Figure 7. Capacitance



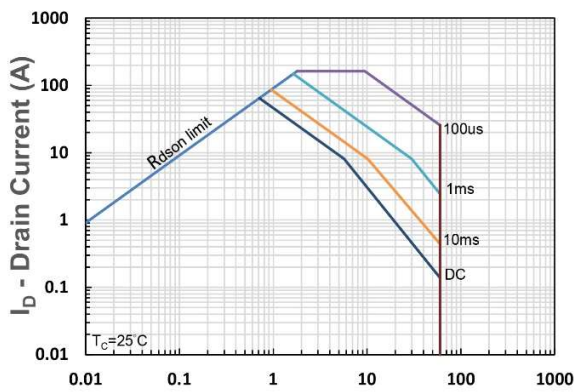
$Q_g$ , Total Gate Charge (nC)  
Figure 8. Gate Charge Characteristics



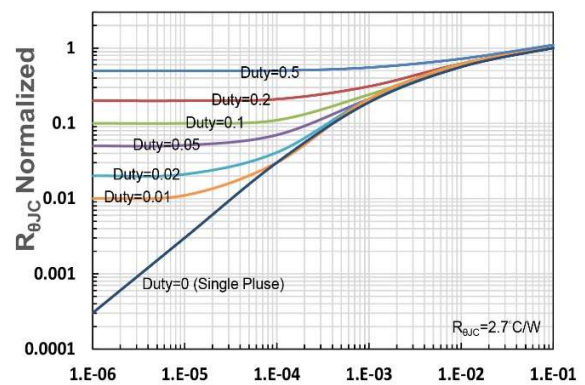
$T_c$  - Case Temperature (°C)  
Figure 9. Power Dissipation



$T_c$  - Case Temperature (°C)  
Figure 10. Drain Current



$V_{DS}$  - Drain-Source Voltage (V)  
Figure 11. Safe Operating Area



$t_1$ , Square Wave Pulse Duration(s)  
Figure 12.  $R_{\theta JC}$  Transient Thermal Impedance