



Power MOSFETS

DATASHEET

LM40013NAK8A

N-Channel
Enhancement Mode MOSFET



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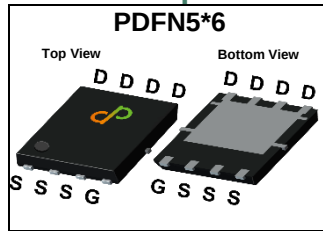


Quality Management Systems

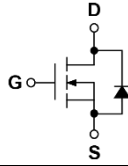
ISO 9001:2015 Certificate

N-Channel Enhancement Mode MOSFET

Pin Description



Symbol



Product Summary

Symbol	N-Channel	Unit
V_{DSS}	40	V
$R_{DS(ON)-Max}$	1.4	mΩ
I_D	190	A

Feature

- Fast switching speed
- Reliable and Rugged
- ROHS Compliant & Halogen-Free
- 100% UIS and Rg Tested
- Moisture Sensitivity Level MSL1

Applications

- DC-to-DC converters
- Switch Mode Power Supply
- Brushless DC motor control

Ordering Information

Orderable Part Number	Package Type	Form	Shipping	Marking
LM40013NAK8A	PDFN5*6	Tape & Reel	5000 / Tape & Reel	40013 □□□□□□

Note : □□□□□□ = Lot Code

Absolute Maximum Ratings ($T_J=25^\circ\text{C}$ Unless Otherwise Noted)

Symbol	Parameter	N-Channel	Unit
V_{DSS}	Drain-Source Voltage	40	V
V_{GSS}	Gate-Source Voltage	± 20	
T_J	Maximum Junction Temperature	150	$^\circ\text{C}$
T_{STG}	Storage Temperature Range	-55 to 150	$^\circ\text{C}$
I_S	Diode Continuous Forward Current	$T_C=25^\circ\text{C}$ 75	A
I_{DM}	Pulse Drain Current Tested	$T_C=25^\circ\text{C}$ 400 ^①	A
I_D	Continuous Drain Current	$T_C=25^\circ\text{C}$ 190	A
		$T_C=100^\circ\text{C}$ 118	
P_D	Maximum Power Dissipation	$T_C=25^\circ\text{C}$ 89	W
		$T_C=100^\circ\text{C}$ 36	
I_D	Continuous Drain Current	$T_A=25^\circ\text{C}$ 29	A
		$T_A=70^\circ\text{C}$ 23	
P_D	Maximum Power Dissipation	$T_A=25^\circ\text{C}$ 2.1	W
		$T_A=70^\circ\text{C}$ 1.3	
$I_{AS}^{②}$	Avalanche Current, Single pulse	$L=0.1\text{mH}$ 48	A
		$L=0.5\text{mH}$ 25	
$E_{AS}^{③}$	Avalanche Energy, Single pulse	$L=0.1\text{mH}$ 115	mJ
		$L=0.5\text{mH}$ 156	

Thermal Characteristics

Symbol	Parameter	Rating	Unit
$R_{\theta JC}$	Thermal Resistance-Junction to Case	Steady State	1.3
$R_{\theta JA}^{③}$	Thermal Resistance-Junction to Ambient	Steady State	60

Note ① : Max. current is limited by bonding

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

Note ③ : Surface Mounted on 1in^2 FR-4 board with 1oz

N-Channel Electrical Characteristics (T_J=25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Electrical Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =250uA	40	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =32V, V _{GS} =0V	-	-	1	uA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =250uA	1	1.7	2.3	V
I _{GSS}	Gate Leakage Current	V _{GS} =±20V, V _{DS} =0V	-	-	±100	nA
R _{DS(ON)} ④	Drain-Source On-state Resistance	V _{GS} =10V, I _{DS} =20A	-	1.1	1.4	mΩ
		V _{GS} =4.5V, I _{DS} =10A	-	1.7	2.2	
gfs	Forward Transconductance	V _{DS} =5V, I _{DS} =10A	-	46	-	S
Dynamic Characteristics ⑥						
R _G	Gate Resistance	V _{GS} =0V, V _{DS} =0V, Freq.=1MHz	-	1.3	-	Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =20V, Freq.=1MHz	-	4935	-	pF
C _{oss}	Output Capacitance		-	2000	-	
C _{rss}	Reverse Transfer Capacitance		-	68	-	
td(ON)	Turn-on Delay Time	V _{GS} =10V, V _{DS} =20V, I _D =20A, R _{GEN} =3Ω	-	10.7	-	nS
tr	Turn-on Rise Time		-	25.5	-	
td(OFF)	Turn-off Delay Time		-	65.5	-	
tf	Turn-off Fall Time		-	54	-	
Qg	Total Gate Charge	V _{GS} =10V, V _{DS} =20V, I _D =20A	-	70	-	nC
Qgs	Gate-Source Charge		-	16.5	-	
Qgd	Gate-Drain Charge		-	10	-	
Source-Drain Characteristics						
VSD④	Diode Forward Voltage	ISD=10A, VGS=0V	-	0.8	1.1	V
trr	Reverse Recovery Time	IF=20A, VR=20V	-	49	-	nS
Qrr	Reverse Recovery Charge	dIF/dt=100A/μs	-	36	-	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

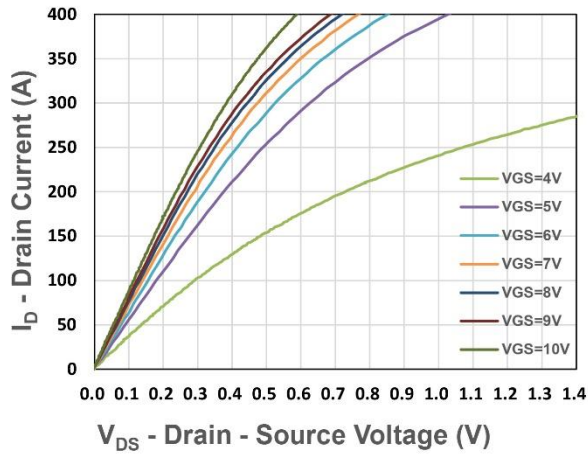


Figure 1. Output Characteristics

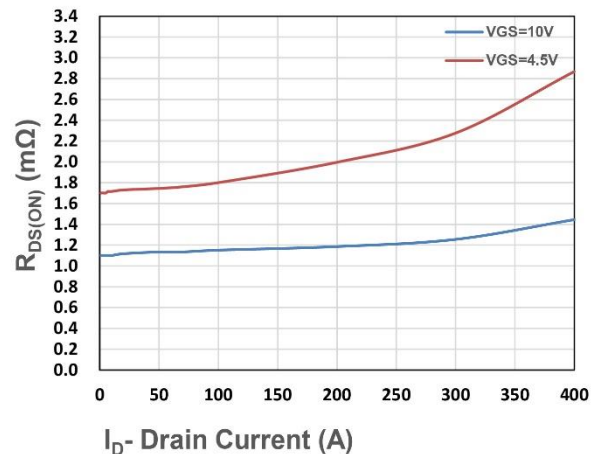


Figure 2. On-Resistance vs. ID

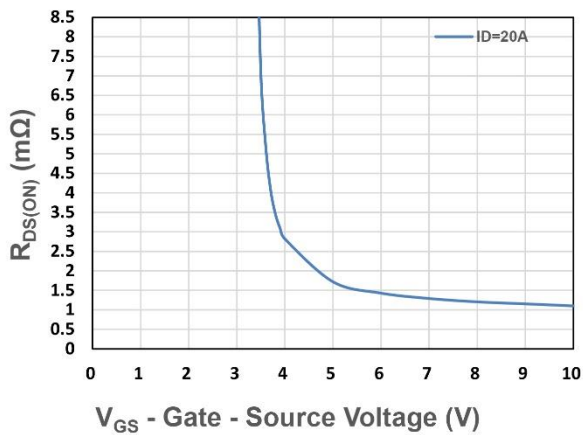


Figure 3. On-Resistance vs. VGS

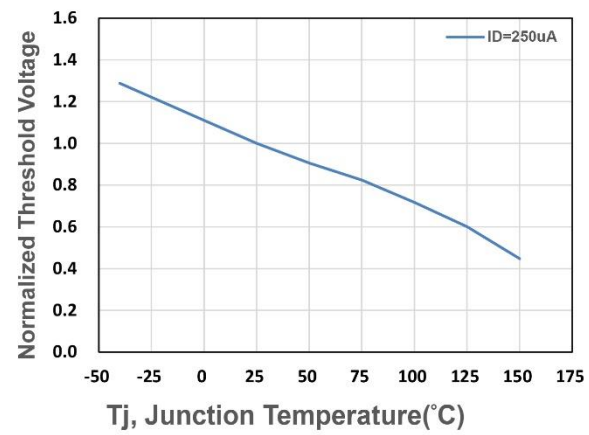


Figure 4. Gate Threshold Voltage

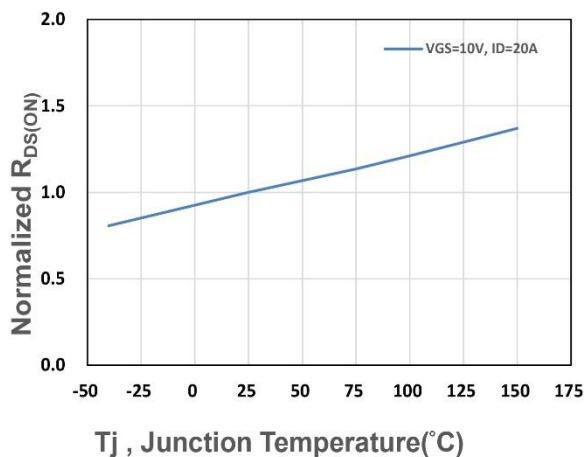


Figure 5. Drain-Source On Resistance

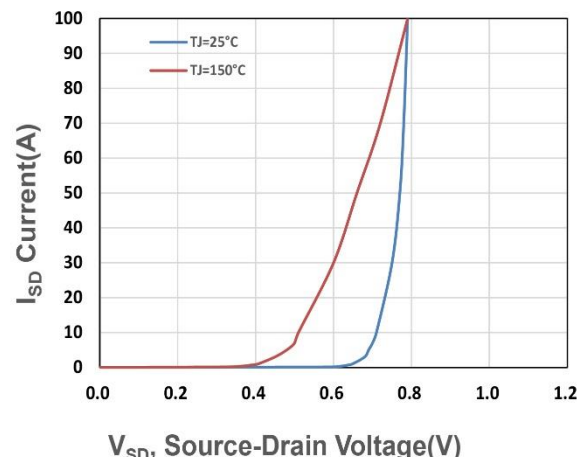
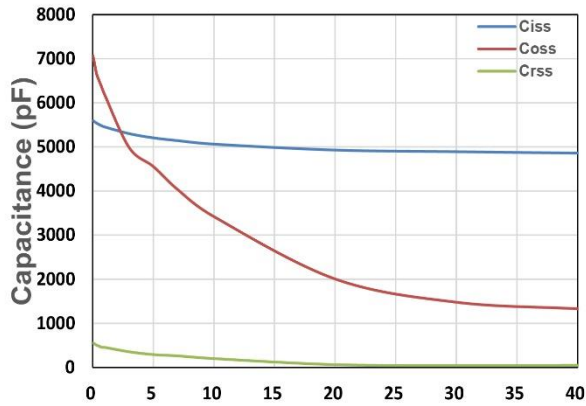
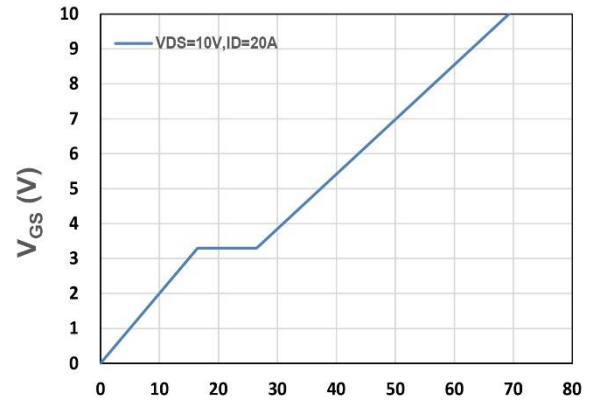


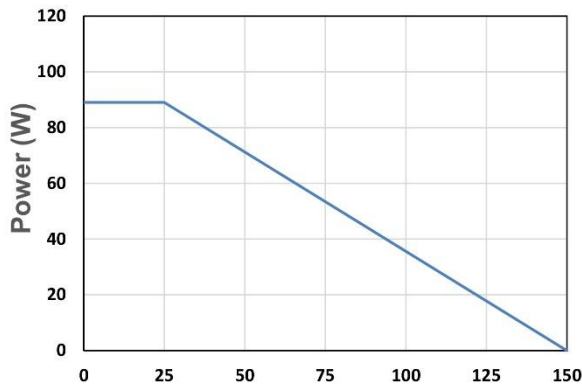
Figure 6. Source-Drain Diode Forward



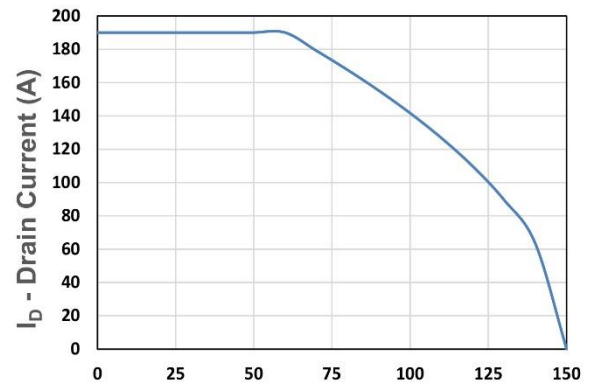
V_{DS} - Drain - Source Voltage (V)
Figure 7. Capacitance



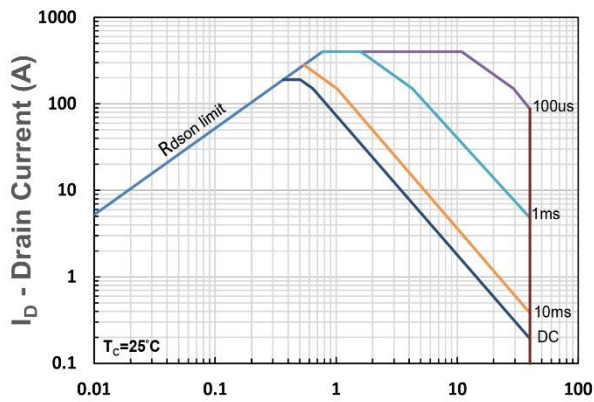
Q_g , Total Gate Charge (nC)
Figure 8. Gate Charge Characteristics



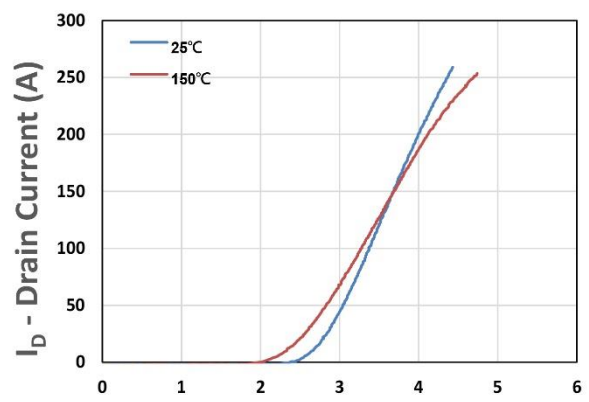
T_c - Case Temperature (°C)
Figure 9. Power Dissipation



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



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



V_{GS} - Gate - Source Voltage (V)
Figure 12. Transfer Characteristics

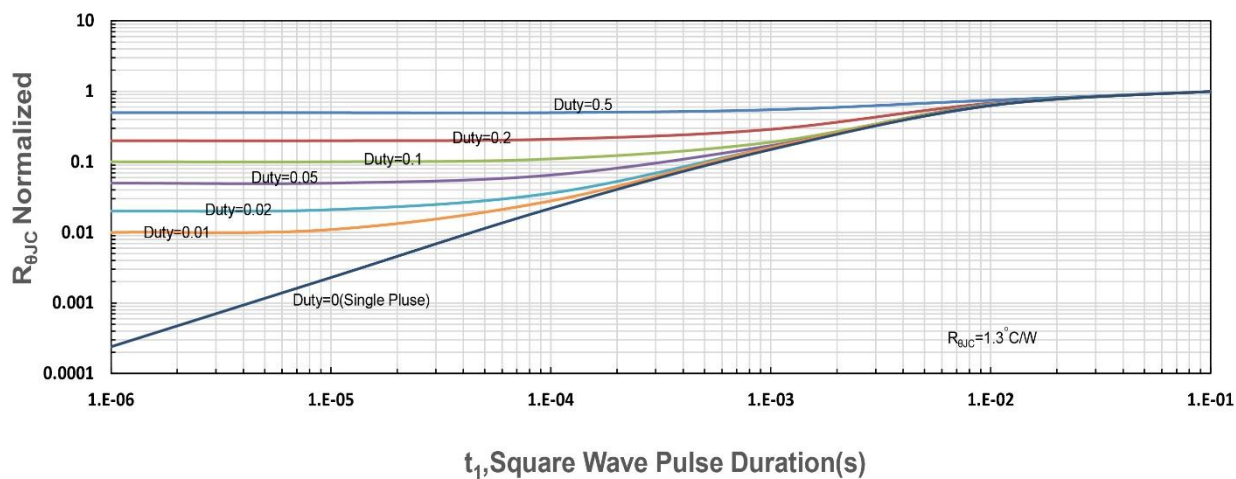


Figure 13. $R_{\theta JC}$ Transient Thermal Impedance