NIF9N05CL

Protected Power MOSFET

2.6 A, 52 V, N−Channel, Logic Level, Clamped MOSFET w/ ESD Protection in a SOT−223 Package

ON Semiconductor®

http://onsemi.com

Benefits

- High Energy Capability for Inductive Loads
- Low Switching Noise Generation

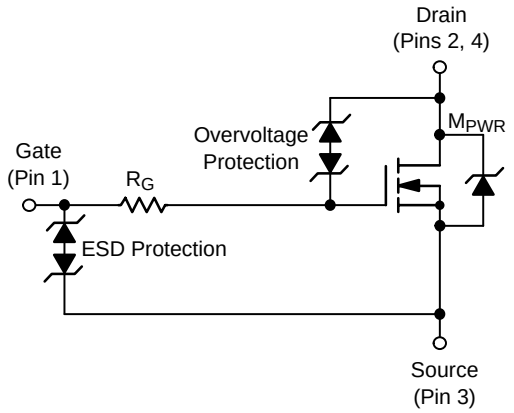
Features

- Diode Clamp Between Gate and Source
- ESD Protection − HBM 5000 V
- Active Over−Voltage Gate to Drain Clamp
- Scalable to Lower or Higher $R_{DS(on)}$
- Internal Series Gate Resistance

Applications

- Automotive and Industrial Markets:
  Solenoid Drivers, Lamp Drivers, Small Motor Drivers

V_{DSS} (Clamped)	$R_{DS(ON)}$ TYP	I_D MAX
52 V	107 mΩ	2.6 A



MAXIMUM RATINGS (T_J = 25°C unless otherwise noted)

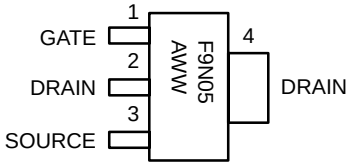
Rating	Symbol	Value	Unit
Drain−to−Source Voltage Internally Clamped	V_{DSS}	52−59	V
Gate−to−Source Voltage − Continuous	V_{GS}	±15	V
Drain Current − Continuous @ T_A = 25°C − Single Pulse (t_p = 10 μs) (Note 1)	I_D I_{DM}	2.6 10	A
Total Power Dissipation @ T_A = 25°C (Note 1)	P_D	1.69	W
Operating and Storage Temperature Range	T_J, T_{stg}	−55 to 150	°C
Single Pulse Drain−to−Source Avalanche Energy (V_{DD} = 50 V, $I_{D(pk)}$ = 1.17 A, V_{GS} = 10 V, L = 160 mH, R_G = 25 Ω)	E_{AS}	110	mJ
Thermal Resistance − Junction−to−Ambient (Note 1) − Junction−to−Ambient (Note 2)	 $R_{\theta JA}$ $R_{\theta JA}$	 74 169	°C/W
Maximum Lead Temperature for Soldering Purposes, 1/8″ from Case for 10 s	T_L	260	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. When surface mounted to an FR4 board using 1″ pad size, (Cu area 1.127 in^2)
2. When surface mounted to an FR4 board using minimum recommended pad size, (Cu area 0.412 in^2)

SOT−223
CASE 318E
STYLE 3

MARKING DIAGRAM



(Top View)

F9N05 = Specific Device Code
A = Assembly Location
WW = Work Week

ORDERING INFORMATION

Device	Package	Shipping†
NIF9N05CLT1	SOT−223	1000/Tape & Reel
NIF9N05CLT3	SOT−223	4000/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

MOSFET ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Drain−to−Source Breakdown Voltage (Note 3) (V_{GS} = 0 V, I_D = 1.0 mA, T_J = 25°C) (V_{GS} = 0 V, I_D = 1.0 mA, T_J = −40°C to 125°C) Temperature Coefficient (Negative)	$V_{(BR)DSS}$	 52 50.8	 55 54 −9.3	 59 59.5	 V V mV/°C
Zero Gate Voltage Drain Current (V_{DS} = 40 V, V_{GS} = 0 V) (V_{DS} = 40 V, V_{GS} = 0 V, T_J = 125°C)	I_{DSS}			 10 25	μA
Gate−Body Leakage Current (V_{GS} = ±8 V, V_{DS} = 0 V) (V_{GS} = ±14 V, V_{DS} = 0 V)	I_{GSS}		 ±22	±10	μA
ON CHARACTERISTICS (Note 3)					
Gate Threshold Voltage (Note 3) (V_{DS} = V_{GS}, I_D = 100 μA) Threshold Temperature Coefficient (Negative)	$V_{GS(th)}$	1.3	1.75 −4.1	2.5	V mV/°C
Static Drain−to−Source On−Resistance (Note 3) (V_{GS} = 3.5 V, I_D = 0.6 A) (V_{GS} = 4.0 V, I_D = 1.5 A) (V_{GS} = 10 V, I_D = 2.6 A)	$R_{DS(on)}$		 190 165 107	 380 200 125	mΩ
Forward Transconductance (Note 3) (V_{DS} = 15 V, I_D = 2.6 A)	g_{FS}		3.8		Mhos
DYNAMIC CHARACTERISTICS					
Input Capacitance	V_{DS} = 35 V, V_{GS} = 0 V, f = 10 kHz	C_{iss}		155	250	pF
Output Capacitance		C_{oss}		60	100	
Transfer Capacitance		C_{rss}		25	40	
Input Capacitance	V_{DS} = 25 V, V_{GS} = 0 V, f = 10 kHz	C_{iss}		170		pF
Output Capacitance		C_{oss}		70		
Transfer Capacitance		C_{rss}		30		

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
4. Switching characteristics are independent of operating junction temperatures.

MOSFET ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Characteristic		Symbol	Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS (Note 4)						
Turn−On Delay Time	V_{GS} = 4.5 V, V_{DD} = 40 V, I_D = 2.6 A, R_D = 15.4 Ω	$t_{d(on)}$		275	465	ns
Rise Time		t_r		1418	2400	
Turn−Off Delay Time		$t_{d(off)}$		780	1320	
Fall Time		t_f		1120	1900	
Turn−On Delay Time	V_{GS} = 4.5 V, V_{DD} = 40 V, I_D = 1.0 A, R_D = 40 Ω	$t_{d(on)}$		242		ns
Rise Time		t_r		1165		
Turn−Off Delay Time		$t_{d(off)}$		906		
Fall Time		t_f		1273		
Turn−On Delay Time	V_{GS} = 10 V, V_{DD} = 15 V, I_D = 2.6 A, R_D = 5.8 Ω	$t_{d(on)}$		107		ns
Rise Time		t_r		290		
Turn−Off Delay Time		$t_{d(off)}$		1540		
Fall Time		t_f		1000		
Gate Charge	V_{GS} = 4.5 V, V_{DS} = 40 V, I_D = 2.6 A (Note 3)	Q_T		4.5	7.0	nC
		Q_1		0.9		
		Q_2		2.6		
Gate Charge	V_{GS} = 4.5 V, V_{DS} = 15 V, I_D = 1.5 A (Note 3)	Q_T		3.9		nC
		Q_1		1.0		
		Q_2		1.7		
SOURCE−DRAIN DIODE CHARACTERISTICS						
Forward On−Voltage	I_S = 2.6 A, V_{GS} = 0 V (Note 3) I_S = 2.6 A, V_{GS} = 0 V, T_J = 125°C	V_{SD}		0.81 0.66	1.5	V
Reverse Recovery Time	I_S = 1.5 A, V_{GS} = 0 V, dI_S/dt = 100 A/μs (Note 3)	t_{rr}		730		ns
		t_a		200		
		t_b		530		
Reverse Recovery Stored Charge		Q_{RR}		6.3		μC
ESD CHARACTERISTICS						
Electro−Static Discharge Capability	Human Body Model (HBM)	ESD	5000			V
	Machine Model (MM)		500			

3. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
4. Switching characteristics are independent of operating junction temperatures.

TYPICAL PERFORMANCE CURVES

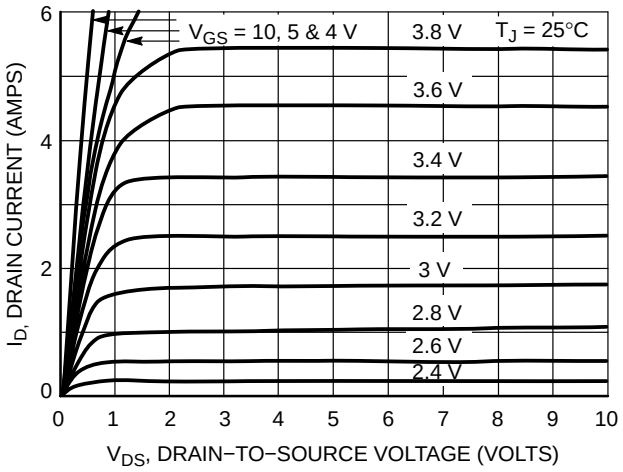


Figure 1. On−Region Characteristics

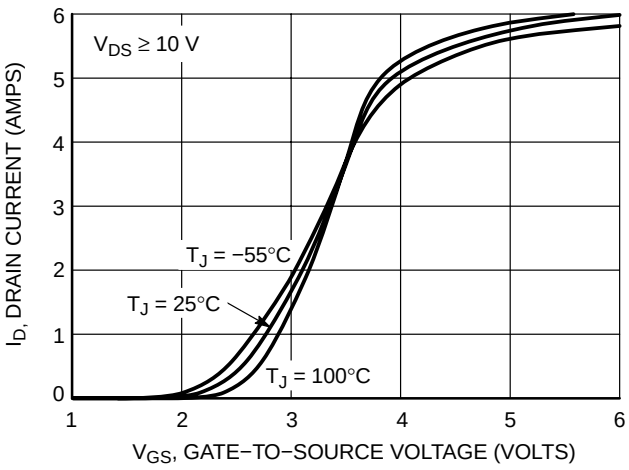


Figure 2. Transfer Characteristics

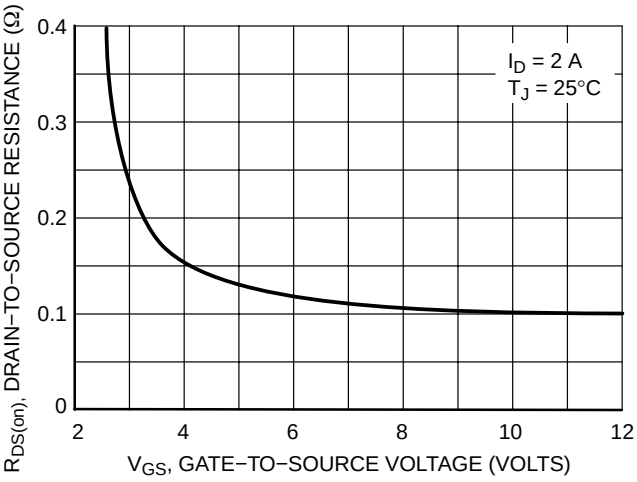


Figure 3. On−Resistance vs. Gate−to−Source Voltage

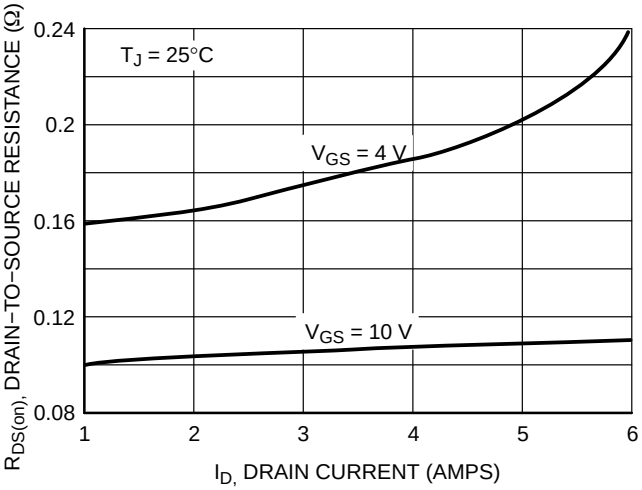


Figure 4. On−Resistance vs. Drain Current and Gate Voltage

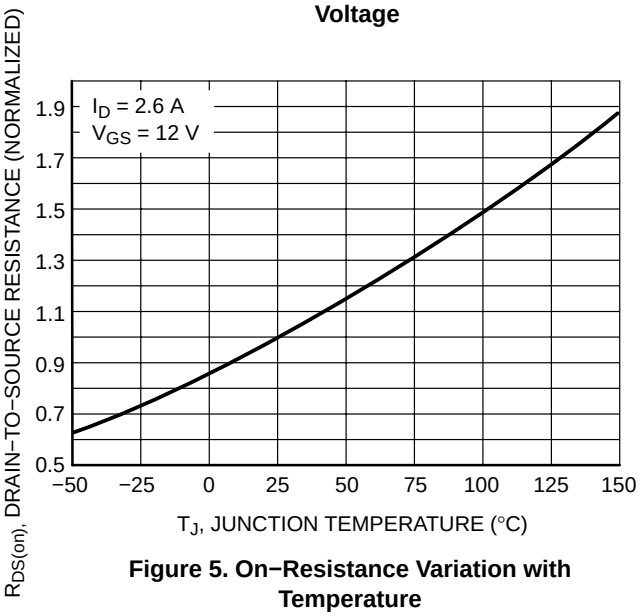


Figure 5. On−Resistance Variation with Temperature

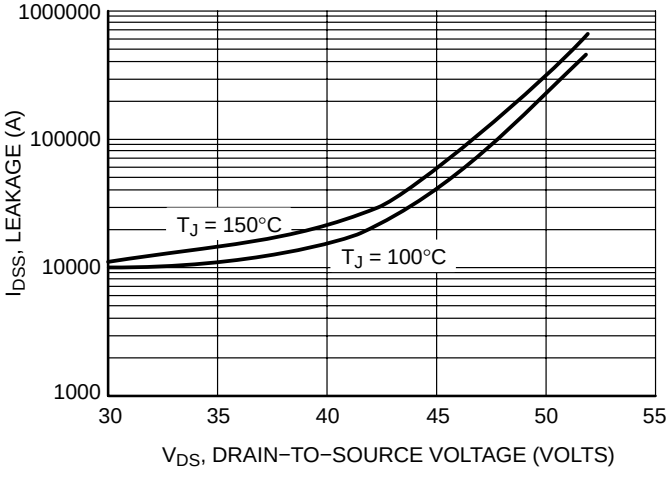


Figure 6. Drain−to−Source Leakage Current vs. Voltage

TYPICAL PERFORMANCE CURVES

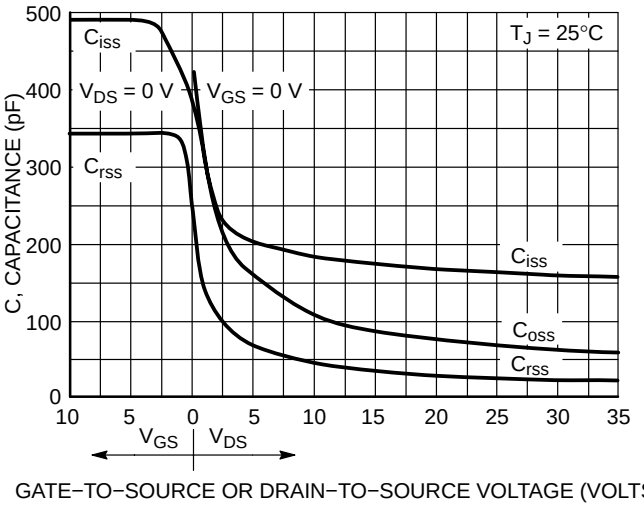


Figure 7. Capacitance Variation

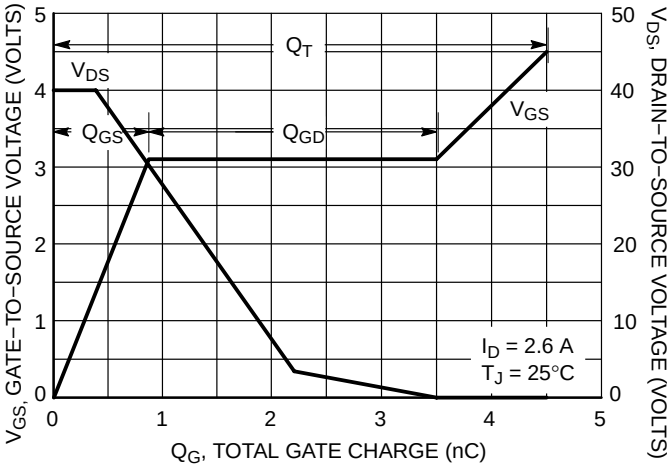


Figure 8. Gate−to−Source Voltage vs. Total Gate Charge

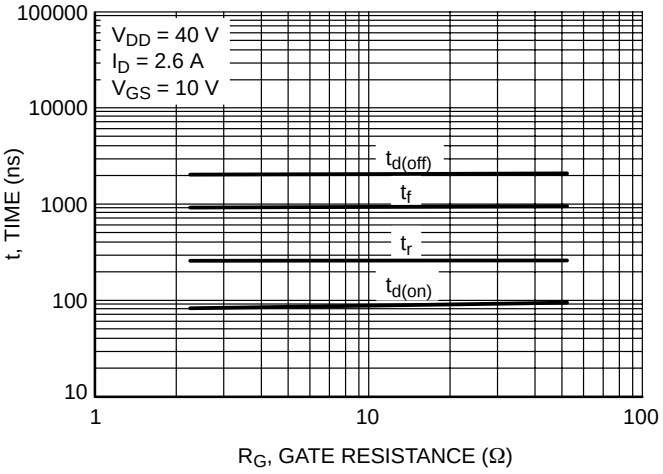


Figure 9. Resistance Switching Time Variation vs. Gate Resistance

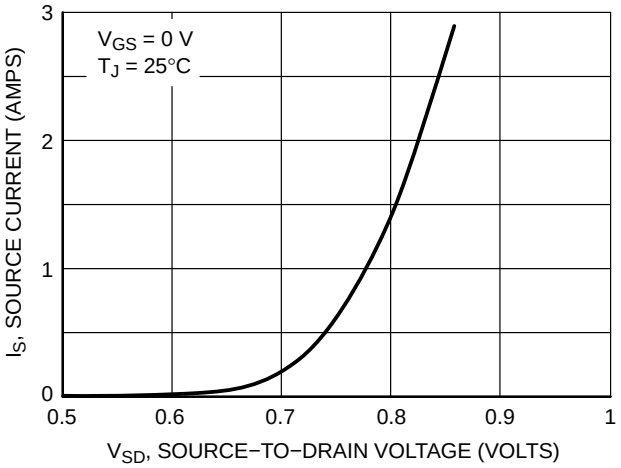
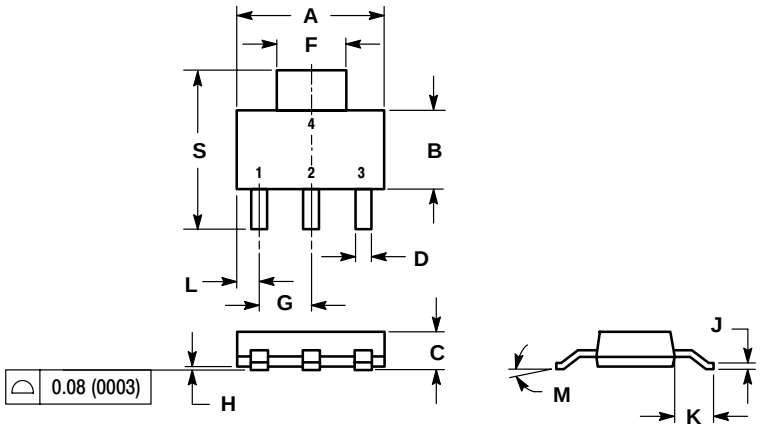


Figure 10. Diode Forward Voltage vs. Current

PACKAGE DIMENSIONS

SOT−223
CASE 318E−04
ISSUE K



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.249	0.263	6.30	6.70
B	0.130	0.145	3.30	3.70
C	0.060	0.068	1.50	1.75
D	0.024	0.035	0.60	0.89
F	0.115	0.126	2.90	3.20
G	0.087	0.094	2.20	2.40
H	0.0008	0.0040	0.020	0.100
J	0.009	0.014	0.24	0.35
K	0.060	0.078	1.50	2.00
L	0.033	0.041	0.85	1.05
M	0 °	10 °	0 °	10 °
S	0.264	0.287	6.70	7.30

STYLE 3:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
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