

## FR12N25D-VB Datasheet

### N-Channel 250 V (D-S) 175 °C MOSFET

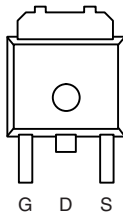
PRODUCT SUMMARY		
$V_{DS}$ (V)	250	
$R_{DS(on)}$ ( $\Omega$ )	$V_{GS} = 10\text{ V}$	0.176
$Q_g$ max. (nC)	68	
$Q_{gs}$ (nC)	11	
$Q_{gd}$ (nC)	35	
Configuration	Single	

#### FEATURES

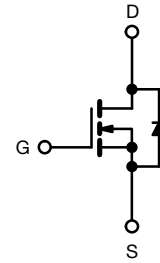
- Dynamic dV/dt rating
- Repetitive avalanche rated
- Fast switching
- Ease of paralleling
- Simple drive requirements



TO-252



Top View



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS (T <sub>C</sub> = 25 °C, unless otherwise noted)					
PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V <sub>DS</sub>	250	V
Gate-Source Voltage			V <sub>GS</sub>	± 20	
Continuous Drain Current	V <sub>GS</sub> at 10 V	T <sub>C</sub> = 25 °C	I <sub>D</sub>	17	A
		T <sub>C</sub> = 100 °C		11	
Pulsed Drain Current <sup>a</sup>			I <sub>DM</sub>	56	
Linear Derating Factor				1.0	W/°C
Single Pulse Avalanche Energy <sup>b</sup>			E <sub>AS</sub>	550	mJ
Repetitive Avalanche Current <sup>a</sup>			I <sub>AR</sub>	17	A
Repetitive Avalanche Energy <sup>a</sup>			E <sub>AR</sub>	13	mJ
Maximum Power Dissipation	T <sub>C</sub> = 25 °C		P <sub>D</sub>	125	W
Peak Diode Recovery dV/dt <sup>c</sup>			dV/dt	4.8	V/ns
Operating Junction and Storage Temperature Range			T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C
Soldering Recommendations (Peak temperature) <sup>d</sup>	for 10 s			300	
Mounting Torque	6-32 or M3 screw			10	lbf · in
				1.1	N · m

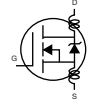

#### Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
 b.  $V_{DS} = 50\text{ V}$ , starting  $T_J = 25\text{ }^{\circ}\text{C}$ ,  $L = 4.5\text{ mH}$ ,  $R_g = 25\text{ }\Omega$ ,  $I_{AS} = 14\text{ A}$  (see fig. 12).  
 c.  $I_{SD} \leq 14\text{ A}$ ,  $dI/dt \leq 150\text{ A}/\mu\text{s}$ ,  $V_{DD} \leq V_{DS}$ ,  $T_J \leq 150\text{ }^{\circ}\text{C}$ .  
 d. 1.6 mm from case.

**THERMAL RESISTANCE RATINGS**

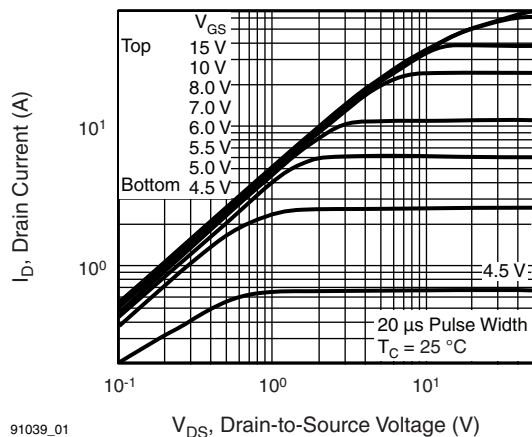
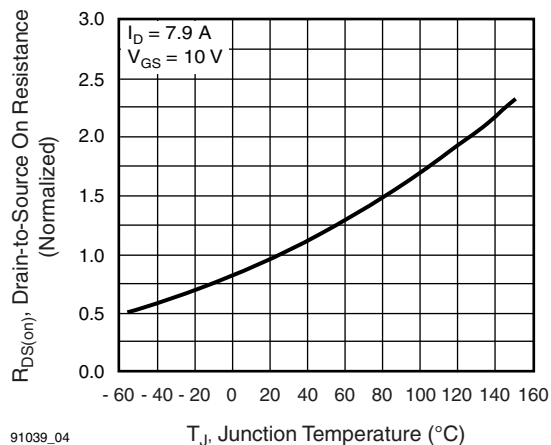
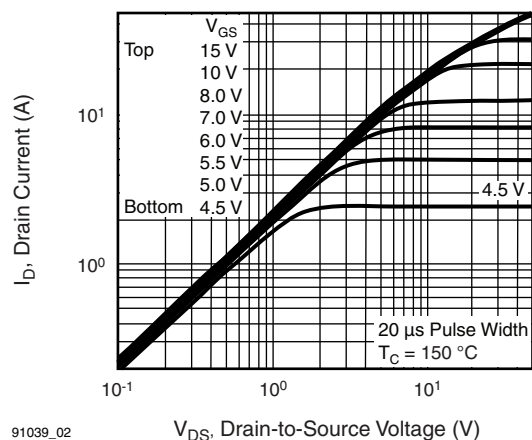
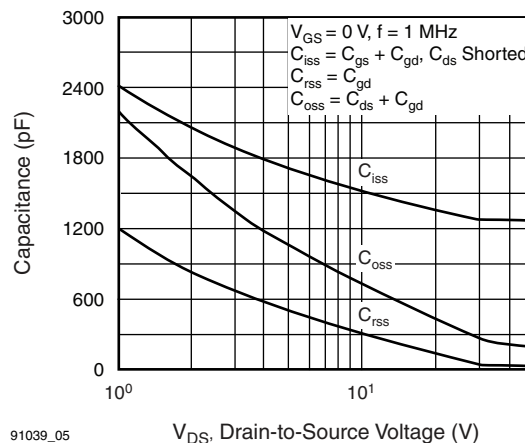
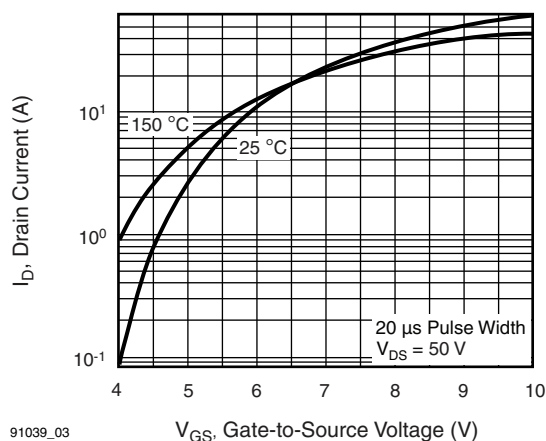
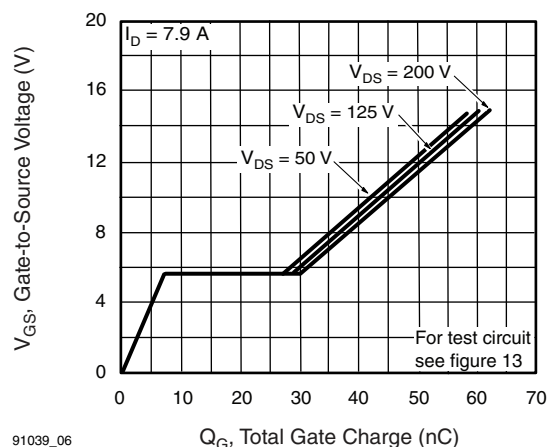
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	62	°C/W
Case-to-Sink, Flat, Greased Surface	$R_{thCS}$	0.50	-	
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	1.0	

**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$	250	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^{\circ}\text{C}$ , $I_D = 1\text{ mA}$	-	0.34	-	V/ $^{\circ}\text{C}$
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2.0	-	4.0	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$	-	-	$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 250\text{ V}$ , $V_{GS} = 0\text{ V}$	-	-	25	$\mu\text{A}$
		$V_{DS} = 200\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^{\circ}\text{C}$	-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$ , $I_D = 8.4\text{ A}^b$	-	0.176	-	$\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 50\text{ V}$ , $I_D = 8.4\text{ A}^b$	6.7	-	-	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1.0\text{ MHz}$ , see fig. 5	-	1300	-	pF
Output Capacitance	$C_{oss}$		-	330	-	
Reverse Transfer Capacitance	$C_{rss}$		-	85	-	
Total Gate Charge	$Q_g$	$V_{GS} = 10\text{ V}$ , $I_D = 7.9\text{ A}$ , $V_{DS} = 200\text{ V}$ , see fig. 6 and 13 <sup>b</sup>	-	-	68	nC
Gate-Source Charge	$Q_{gs}$		-	-	11	
Gate-Drain Charge	$Q_{gd}$		-	-	35	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 125\text{ V}$ , $I_D = 7.9\text{ A}$ , $R_g = 9.1\text{ }\Omega$ , $R_D = 8.7\text{ }\Omega$ , see fig. 10 <sup>b</sup>	-	11	-	ns
Rise Time	$t_r$		-	24	-	
Turn-Off Delay Time	$t_{d(off)}$		-	53	-	
Fall Time	$t_f$		-	49	-	
Internal Drain Inductance	$L_D$	Between lead, 6 mm (0.25") from package and center of die contact 	-	4.5	-	nH
Internal Source Inductance	$L_S$		-	7.5	-	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}$ , open drain	0.3	-	1.2	$\Omega$
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	14	A
Pulsed Diode Forward Current <sup>a</sup>	$I_{SM}$		-	-	56	
Body Diode Voltage	$V_{SD}$	$T_J = 25\text{ }^{\circ}\text{C}$ , $I_S = 14\text{ A}$ , $V_{GS} = 0\text{ V}^b$	-	-	1.8	V
Body Diode Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^{\circ}\text{C}$ , $I_F = 7.9\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}^b$	-	250	500	ns
Body Diode Reverse Recovery Charge	$Q_{rr}$		-	2.3	4.6	$\mu\text{C}$
Forward Turn-On Time	$t_{on}$	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S$ and $L_D$ )				

**Notes**

- a. Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).  
 b. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; duty cycle  $\leq 2\%$ .

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

**Fig. 1 - Typical Output Characteristics,  $T_C = 25^\circ\text{C}$** 

**Fig. 4 - Normalized On-Resistance vs. Temperature**

**Fig. 2 - Typical Output Characteristics,  $T_C = 150^\circ\text{C}$** 

**Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage**

**Fig. 3 - Typical Transfer Characteristics**

**Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage**

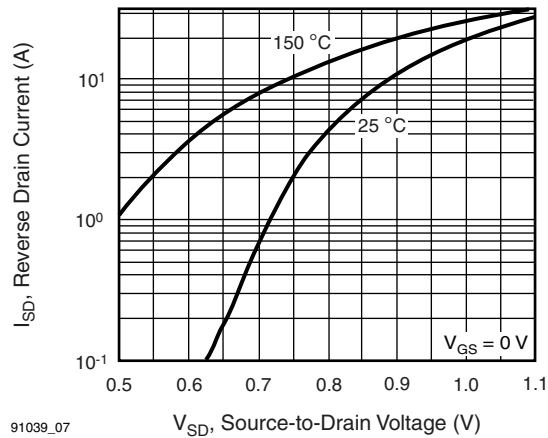


Fig. 7 - Typical Source-Drain Diode Forward Voltage

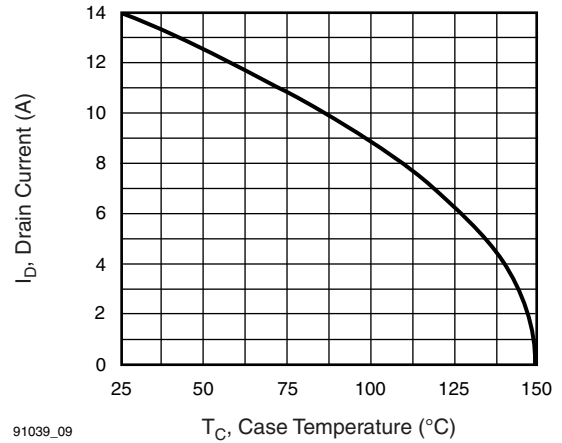


Fig. 9 - Maximum Drain Current vs. Case Temperature



Fig. 8 - Maximum Safe Operating Area

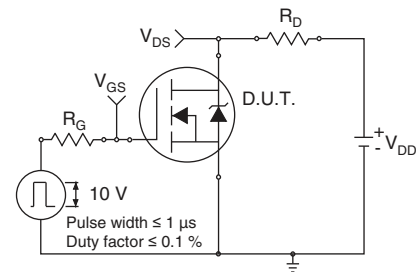


Fig. 10a - Switching Time Test Circuit

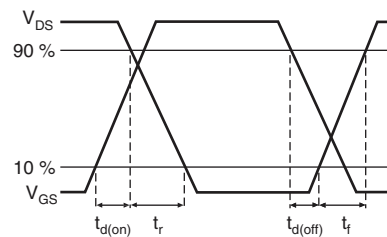


Fig. 10b - Switching Time Waveforms

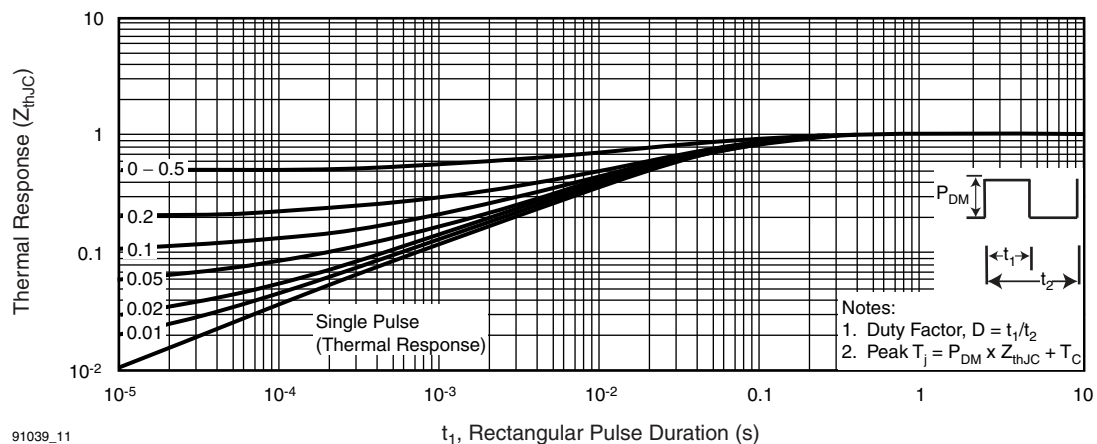


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



Fig. 12a - Unclamped Inductive Test Circuit



Fig. 12b - Unclamped Inductive Waveforms

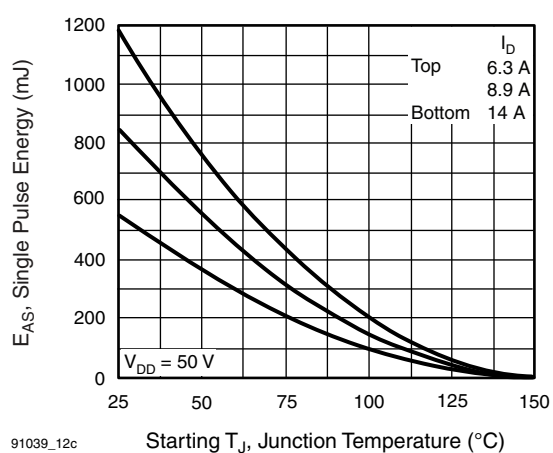


Fig. 12c - Maximum Avalanche Energy vs. Drain Current

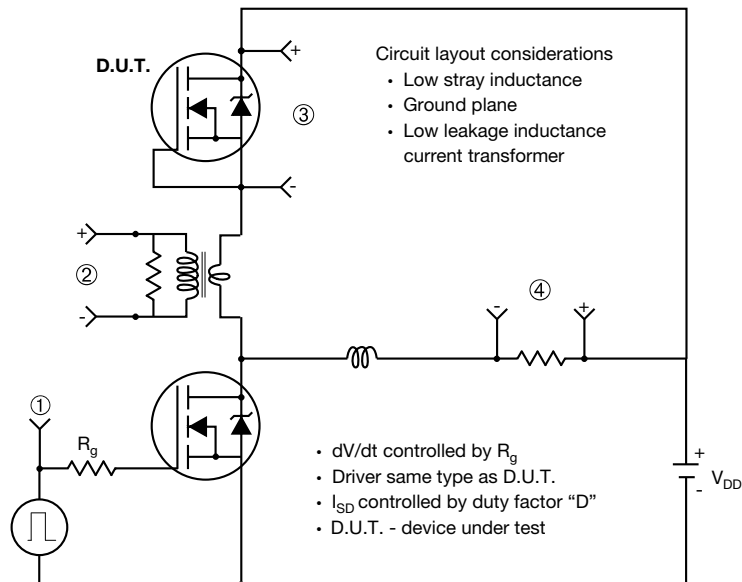


Fig. 13a - Basic Gate Charge Waveform



Fig. 13b - Gate Charge Test Circuit

### Peak Diode Recovery $dV/dt$ Test Circuit



#### Note

a.  $V_{GS} = 5 V$  for logic level devices

**Fig. 14 - For N-Channel**

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