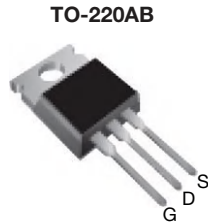


24NM65N-VB TO220 Datasheet N-Channel 60 V(D-S) MOSFET

PRODUCT SUMMARY		
V_{DS} (V)	60	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10\text{ V}$	0.072
Q_g max. (nC)	25	
Q_{gs} (nC)	5.8	
Q_{gd} (nC)	11	
Configuration	Single	

FEATURES

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



N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted)					
PARAMETER		SYMBOL	LIMIT	UNIT	
Drain-Source Voltage		V_{DS}	60	V	
Gate-Source Voltage		V_{GS}	± 20		
Continuous Drain Current	V_{GS} at 10 V	I_D	$T_C = 25\text{ }^\circ\text{C}$	20	A
			$T_C = 100\text{ }^\circ\text{C}$	12	
Pulsed Drain Current ^a		I_{DM}	68		
Linear Derating Factor			0.40	W/ $^\circ\text{C}$	
Single Pulse Avalanche Energy ^b		E_{AS}	100	mJ	
Maximum Power Dissipation	$T_C = 25\text{ }^\circ\text{C}$	P_D	60	W	
Peak Diode Recovery dV/dt ^c		dV/dt	4.5	V/ns	
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55 to +175	$^\circ\text{C}$	
Soldering Recommendations (Peak temperature) ^d	for 10 s		300		
Mounting Torque	6-32 or M3 screw		10	lbf · in	
			1.1	N · m	

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- $V_{DD} = 25\text{ V}$, starting $T_J = 25\text{ }^\circ\text{C}$, $L = 403\text{ }\mu\text{H}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 17\text{ A}$ (see fig. 12).
- $I_{SD} \leq 17\text{ A}$, $dI/dt \leq 140\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 175\text{ }^\circ\text{C}$.
- 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}	-	2.5	

SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted)							
PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-Source Breakdown Voltage	V_{DS}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		60	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$		-	0.061	-	V/°C
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$		1.0	-	3.0	V
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 60\text{ V}, V_{GS} = 0\text{ V}$		-	-	25	μA
		$V_{DS} = 48\text{ V}, V_{GS} = 0\text{ V}, T_J = 150\text{ }^\circ\text{C}$		-	-	250	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 10\text{ A}^b$	-	0.072	-	Ω
Forward Transconductance	g_{fs}	$V_{DS} = 25\text{ V}, I_D = 10\text{ A}$		5.5	-	-	S
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V},$ $V_{DS} = 25\text{ V},$ $f = 1.0\text{ MHz},$ see fig. 5		-	640	-	pF
Output Capacitance	C_{oss}			-	360	-	
Reverse Transfer Capacitance	C_{rss}			-	79	-	
Total Gate Charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 17\text{ A}, V_{DS} = 48\text{ V},$ see fig. 6 and 13 ^b	-	-	25	nC
Gate-Source Charge	Q_{gs}			-	-	5.8	
Gate-Drain Charge	Q_{gd}			-	-	11	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 30\text{ V}, I_D = 17\text{ A},$ $R_g = 18\text{ }\Omega, R_D = 1.7\text{ }\Omega,$ see fig. 10 ^b		-	13	-	ns
Rise Time	t_r			-	58	-	
Turn-Off Delay Time	$t_{d(off)}$			-	25	-	
Fall Time	t_f			-	42	-	
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	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	20	A
Pulsed Diode Forward Current ^a	I_{SM}			-	-	68	
Body Diode Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 17\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	1.5	V
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = 17\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		-	88	180	ns
Body Diode Reverse Recovery Charge	Q_{rr}			-	0.29	0.64	μC
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 $\leq 2\text{ }\%$.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



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



Fig. 4 - Normalized On-Resistance vs. Temperature



Fig. 2 - Typical Output Characteristics, $T_C = 175\text{ }^\circ\text{C}$



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

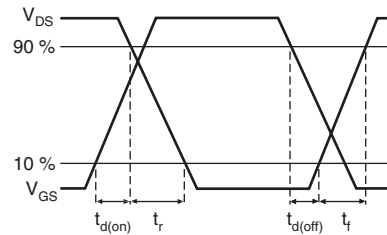


Fig. 10b - Switching Time Waveforms



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

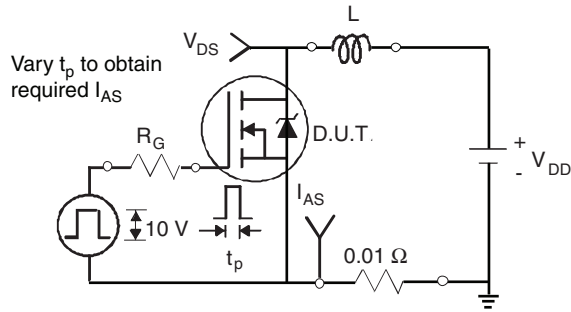


Fig. 12a - Unclamped Inductive Test Circuit



Fig. 12b - Unclamped Inductive Waveforms



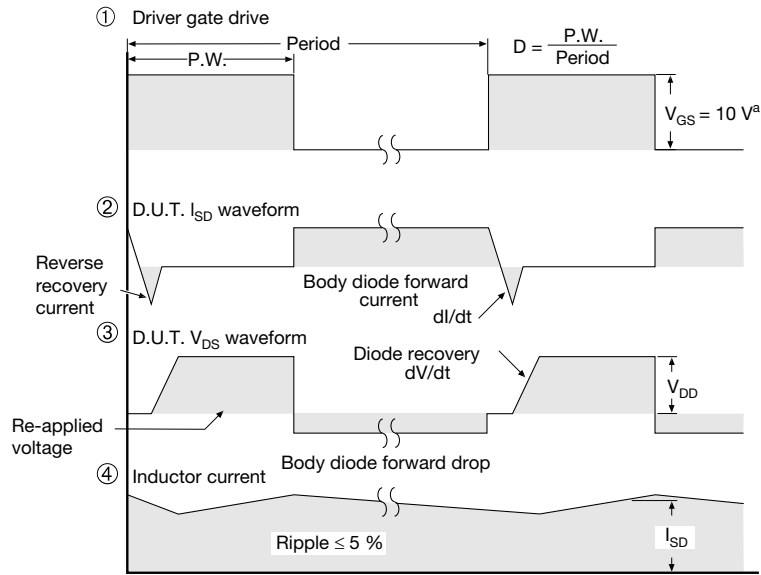
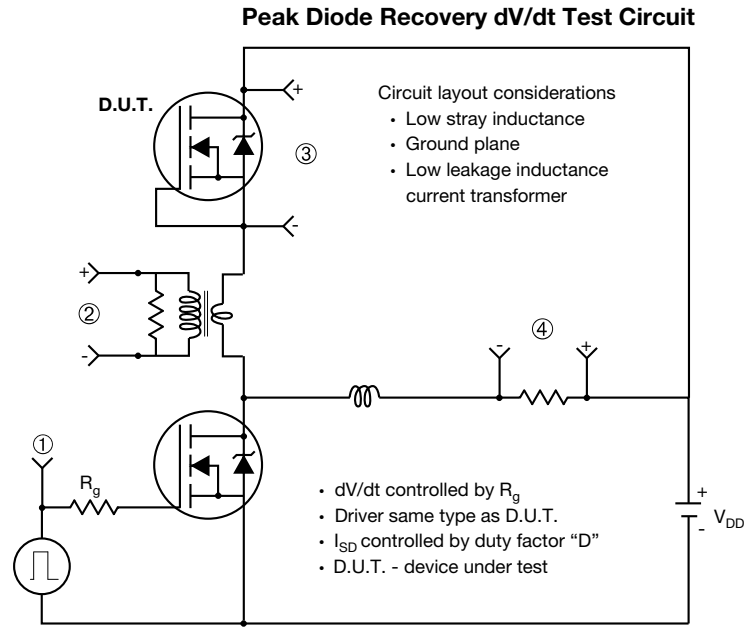
Fig. 12c - Maximum Avalanche Energy vs. Drain Current



Fig. 13a - Basic Gate Charge Waveform



Fig. 13b - Gate Charge Test



Note

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

Fig. 14 - For N-Channel

TO-220



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.24	4.65	0.167	0.183
b	0.69	1.02	0.027	0.040
b(1)	1.14	1.78	0.045	0.070
c	0.36	0.61	0.014	0.024
D	14.33	15.85	0.564	0.624
E	9.96	10.52	0.392	0.414
e	2.41	2.67	0.095	0.105
e(1)	4.88	5.28	0.192	0.208
F	1.14	1.40	0.045	0.055
H(1)	6.10	6.71	0.240	0.264
J(1)	2.41	2.92	0.095	0.115
L	13.36	14.40	0.526	0.567
L(1)	3.33	4.04	0.131	0.159
$\varnothing P$	3.53	3.94	0.139	0.155
Q	2.54	3.00	0.100	0.118

ECN: X15-0364-Rev. C, 14-Dec-15
DWG: 6031

Note

- M^* = 0.052 inches to 0.064 inches (dimension including protrusion), heatsink hole for HVM

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