

K4013-VB Datasheet

N-Channel 800V (D-S) Super Junction Power MOSFET

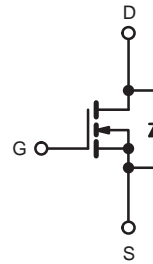
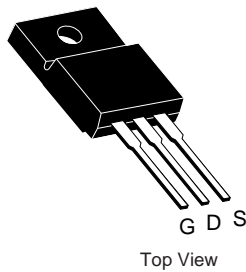
PRODUCT SUMMARY		
V_{DS} (V)	800	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10\text{ V}$	1.2
Q_g (Max.) (nC)	200	
Q_{gs} (nC)	24	
Q_{gd} (nC)	110	
Configuration	Single	

FEATURES

- Dynamic dV/dt Rating
- Repetitive Avalanche Rated
- Isolated Central Mounting Hole
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
- Compliant to RoHS Directive 2002/95/EC



TO-220 FULLPAK



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}	800	V	
Gate-Source Voltage	V_{GS}	± 30		
Continuous Drain Current	V_{GS} at 10 V	$T_C = 25\text{ }^\circ\text{C}$	A	
		$T_C = 100\text{ }^\circ\text{C}$		
Pulsed Drain Current ^a	I_{DM}	21		
Linear Derating Factor		1.5	$\text{W}/^\circ\text{C}$	
Single Pulse Avalanche Energy ^b	E_{AS}	770	mJ	
Repetitive Avalanche Current ^a	I_{AR}	7.8	A	
Repetitive Avalanche Energy ^a	E_{AR}	19	mJ	
Maximum Power Dissipation	$T_C = 25\text{ }^\circ\text{C}$	P_D	190	W
Peak Diode Recovery dV/dt^c		dV/dt	2.0	V/ns
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to + 150	$^\circ\text{C}$	
Soldering Recommendations (Peak Temperature)	for 10 s			300 ^d
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).
- $V_{DD} = 50\text{ V}$, starting $T_J = 25\text{ }^\circ\text{C}$, $L = 23\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 7.8\text{ A}$ (see fig. 12).
- $I_{SD} \leq 7.8\text{ A}$, $dI/dt \leq 140\text{ A}/\mu\text{s}$, $V_{DD} \leq 600\text{ V}$, $T_J \leq 150\text{ }^\circ\text{C}$.
- 1.6 mm from case.

* Pb containing terminations are not RoHS compliant, exemptions may apply

THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	R_{thJA}	-	40	°C/W
Case-to-Sink, Flat, Greased Surface	R_{thCS}	0.24	-	
Maximum Junction-to-Case (Drain)	R_{thJC}	-	0.65	

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}	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$		800	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$		-	0.98	-	V/°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}	$V_{GS} = \pm 20\text{ V}$		-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}$		-	-	100	μA
		$V_{DS} = 640\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$		-	-	500	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 3.7\text{ A}^b$	-	1.2	-	Ω
Forward Transconductance	g_{fs}	$V_{DS} = 100\text{ V}, I_D = 3.7\text{ A}^b$		5.6	-	-	S
Dynamic							
Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V},$ $V_{DS} = 25\text{ V},$ $f = 1.0\text{ MHz}$, see fig. 5		-	3100	-	pF
Output Capacitance	C_{oss}			-	800	-	
Reverse Transfer Capacitance	C_{riss}			-	490	-	
Total Gate Charge	Q_g	$V_{GS} = 10\text{ V}$	$I_D = 3.8\text{ A}, V_{DS} = 400\text{ V},$ see fig. 6 and 13 ^b	-	-	200	nC
Gate-Source Charge	Q_{gs}			-	-	24	
Gate-Drain Charge	Q_{gd}			-	-	110	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 400\text{ V}, I_D = 3.8\text{ A},$ $R_g = 6.2\text{ }\Omega, R_D = 52\text{ }\Omega$ see fig. 10 ^b		-	19	-	ns
Rise Time	t_r			-	38	-	
Turn-Off Delay Time	$t_{d(off)}$			-	120	-	
Fall Time	t_f			-	39	-	
Internal Drain Inductance	L_D	Between lead, 6 mm (0.25") from package and center of die contact		-	5.0	-	nH
Internal Source Inductance	L_S			-	13	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	5.0	A
Pulsed Diode Forward Current ^a	I_{SM}			-	-	21	
Body Diode Voltage	V_{SD}	$T_J = 25\text{ }^\circ\text{C}, I_S = 3.8\text{ A}, V_{GS} = 0\text{ V}^b$		-	-	1.8	V
Body Diode Reverse Recovery Time	t_{rr}	$T_J = 25\text{ }^\circ\text{C}, I_F = 3.8\text{ A},$ $di/dt = 100\text{ A}/\mu\text{s}^b$		-	650	980	ns
Body Diode Reverse Recovery Charge	Q_{rr}			-	3.8	5.7	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 $\leq 2\%$.

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



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

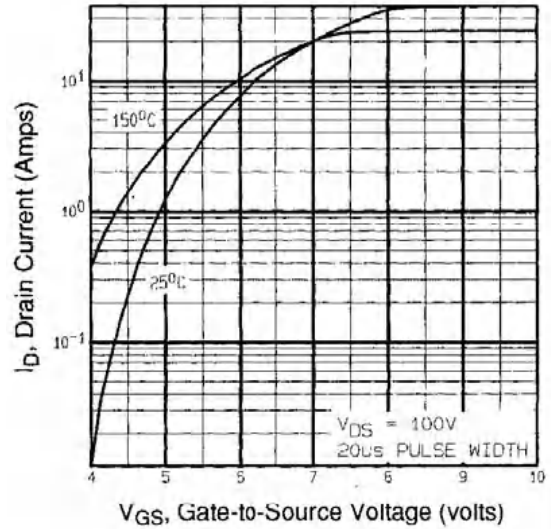


Fig. 3 - Typical Transfer Characteristics



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

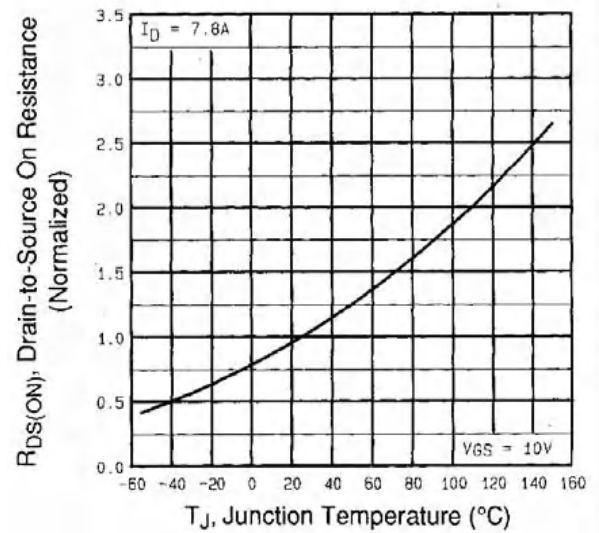


Fig. 4 - Normalized On-Resistance vs. Temperature



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



Fig. 7 - Typical Source-Drain Diode Forward Voltage



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



Fig. 8 - Maximum Safe Operating Area



Fig. 9 - Maximum Drain Current vs. Case Temperature

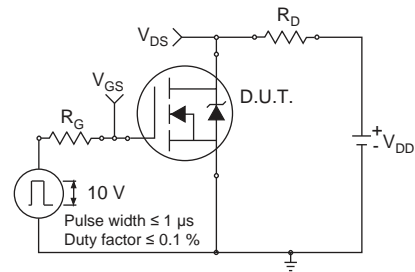


Fig. 10a - Switching Time Test Circuit

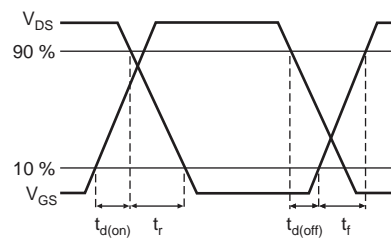


Fig. 10b - Switching Time Waveforms

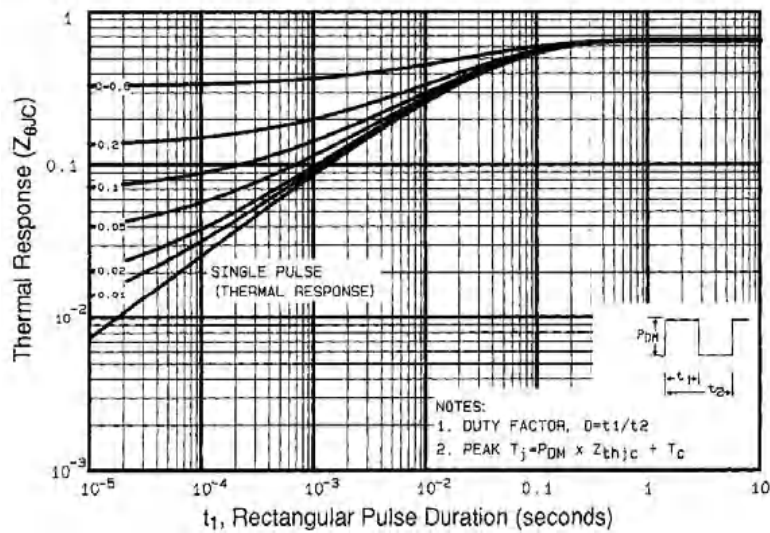


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

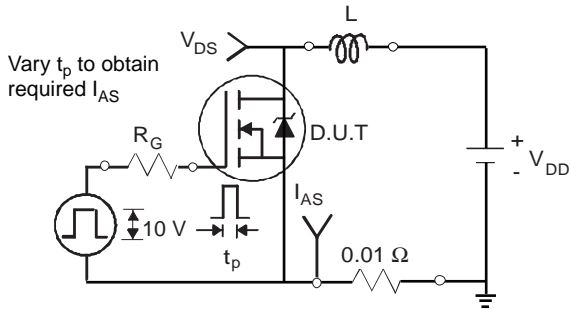


Fig. 12a - Unclamped Inductive Test Circuit



Fig. 12b - Unclamped Inductive Waveforms



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

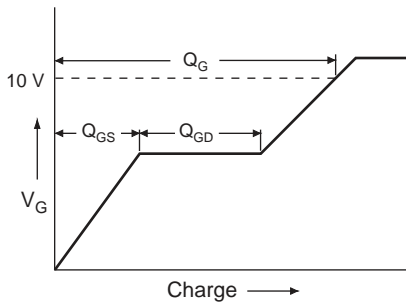


Fig. 13a - Basic Gate Charge Waveform

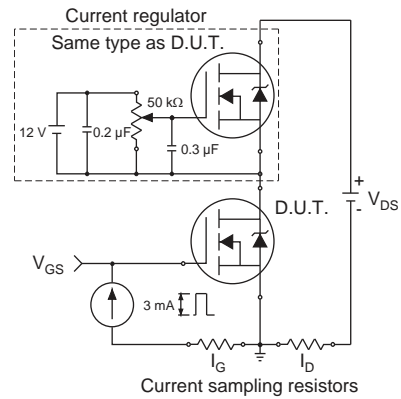
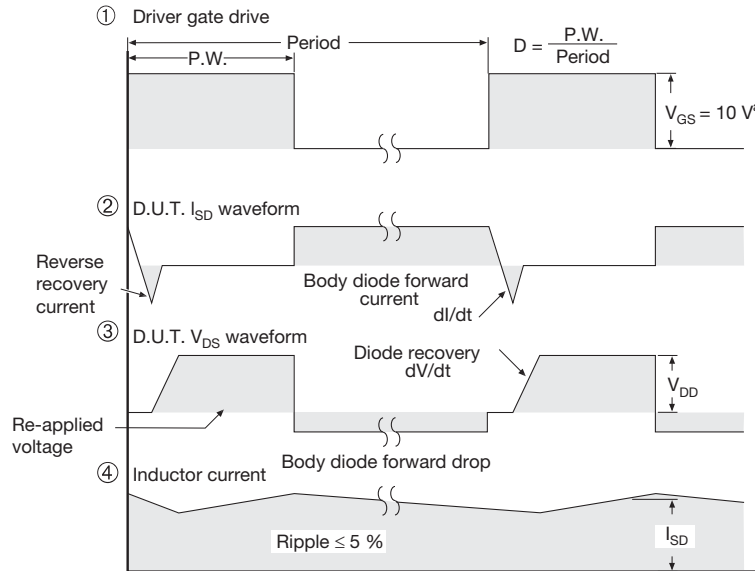
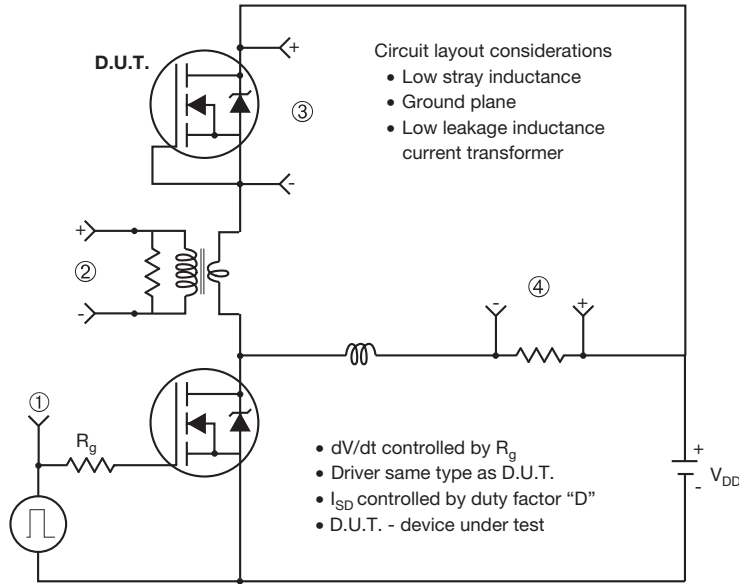


Fig. 13b - Gate Charge Test Circuit

Peak Diode Recovery dV/dt Test Circuit

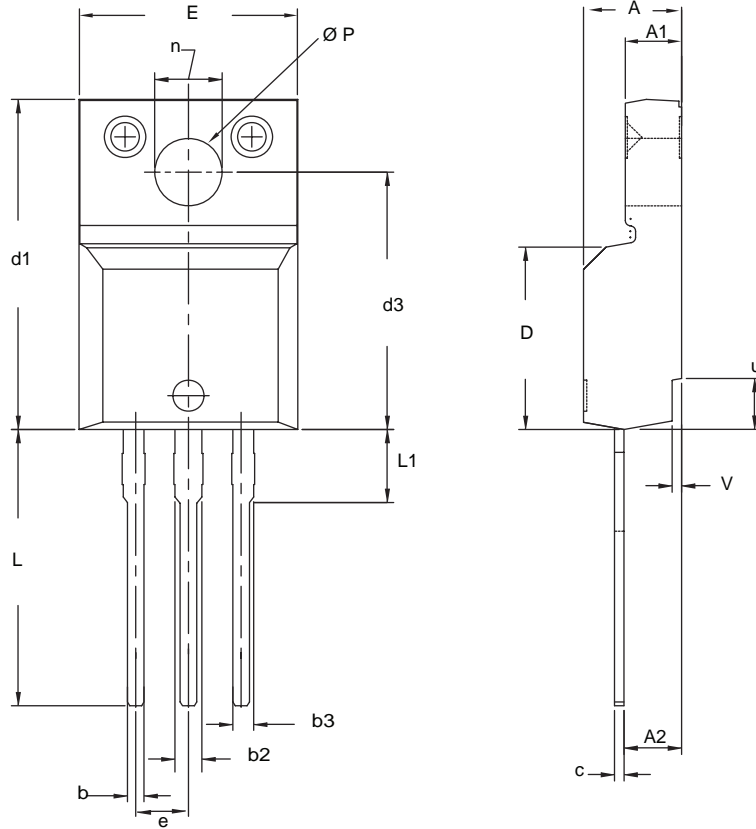


Note

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

Fig. 14 - For N-Channel

TO-220 FULLPAK (HIGH VOLTAGE)



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.570	4.830	0.180	0.190
A1	2.570	2.830	0.101	0.111
A2	2.510	2.850	0.099	0.112
b	0.622	0.890	0.024	0.035
b2	1.229	1.400	0.048	0.055
b3	1.229	1.400	0.048	0.055
c	0.440	0.629	0.017	0.025
D	8.650	9.800	0.341	0.386
d1	15.88	16.120	0.622	0.635
d3	12.300	12.920	0.484	0.509
E	10.360	10.630	0.408	0.419
e	2.54 BSC		0.100 BSC	
L	13.200	13.730	0.520	0.541
L1	3.100	3.500	0.122	0.138
n	6.050	6.150	0.238	0.242
Ø P	3.050	3.450	0.120	0.136
u	2.400	2.500	0.094	0.098
v	0.400	0.500	0.016	0.020

ECN: X09-0126-Rev. B, 26-Oct-09
DWG: 5972

Notes

1. To be used only for process drawing.
2. These dimensions apply to all TO-220, FULLPAK leadframe versions 3 leads.
3. All critical dimensions should C meet $C_{pk} > 1.33$.
4. All dimensions include burrs and plating thickness.
5. No chipping or package damage.

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