

PHW13N40E-VB Datasheet

N-Channel 500V(D-S) Super Junction Power MOSFET

PRODUCT SUMMARY

V_{DS} (V)	500	
$R_{DS(on)}$ (Ω)	$V_{GS} = 10\text{ V}$	0.080
Q_g (Max.) (nC)	350	
Q_{gs} (nC)	85	
Q_{gd} (nC)	180	
Configuration	Single	

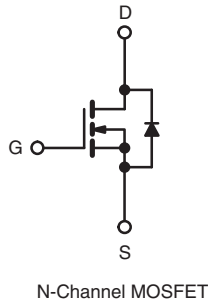
FEATURES

- Low Gate Charge Q_g Results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Low $R_{DS(on)}$
- Compliant to RoHS Directive 2002/95/EC



APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits

ABSOLUTE MAXIMUM RATINGS ($T_C = 25\text{ }^\circ\text{C}$, unless otherwise noted)

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-Source Voltage			V _{DS}	500	V
Gate-Source Voltage			V _{GS}	± 30	
Continuous Drain Current	V _{GS} at 10 V	T _C = 25 °C	I _D	40	A
		T _C = 100 °C		25	
Pulsed Drain Current ^a			I _{DM}	180	
Linear Derating Factor				4.3	W/°C
Single Pulse Avalanche Energy ^b			E _{AS}	910	mJ
Repetitive Avalanche Current ^a			I _{AR}	40	A
Repetitive Avalanche Energy ^a			E _{AR}	51	mJ
Maximum Power Dissipation	T _C = 25 °C		P _D	530	W
Peak Diode Recovery dV/dt ^c			dV/dt	9.0	V/ns
Operating Junction and Storage Temperature Range			T _J , T _{stg}	- 55 to + 150	°C
Soldering Recommendations (Peak Temperature)	for 10 s			300 ^d	

Notes

- Repetitive rating; pulse width limited by maximum junction temperature (see fig. 11).
- Starting $T_J = 25\text{ }^\circ\text{C}$, $L = 0.82\text{ mH}$, $R_g = 25\text{ }\Omega$, $I_{AS} = 47\text{ A}$ (see fig. 12c).
- $I_{SD} \leq 47\text{ A}$, $dI/dt \leq 230\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{DS}$, $T_J \leq 150\text{ }^\circ\text{C}$.
- 1.6 mm from case.

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}	-	0.23	

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 V, I _D = 250 μA		500	-	-	V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	Reference to 25 °C, I _D = 1 mA		-	0.60	-	V/°C
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		3.0	-	5.0	V
Gate-Source Leakage	I _{GSS}	V _{GS} = ± 30 V		-	-	± 100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 500 V, V _{GS} = 0 V		-	-	50	μA
		V _{DS} = 400 V, V _{GS} = 0 V, T _J = 125 °C		-	-	250	
Drain-Source On-State Resistance	R _{DS(on)}	V _{GS} = 10 V	I _D = 28 A ^b	-	0.080	-	Ω
Forward Transconductance	g _{fs}	V _{DS} = 50 V, I _D = 28 A		23	-	-	S
Dynamic							
Input Capacitance	C _{iss}	V _{GS} = 0 V, V _{DS} = 25 V, f = 1.0 MHz, see fig. 5		-	8310	-	pF
Output Capacitance	C _{oss}			-	960	-	
Reverse Transfer Capacitance	C _{rss}			-	120	-	
Output Capacitance	C _{oss}	V _{GS} = 0 V	V _{DS} = 1.0 V, f = 1.0 MHz	-	10170	-	
			V _{DS} = 400 V, f = 1.0 MHz	-	240	-	
Effective Output Capacitance	C _{oss eff.}		V _{DS} = 0 V to 400 V ^c	-	440	-	
Total Gate Charge	Q _g		I _D = 47 A, V _{DS} = 400 V, see fig. 6 and 13 ^b	-	-	350	nC
Gate-Source Charge	Q _{gs}			-	-	85	
Gate-Drain Charge	Q _{gd}			-	-	180	
Turn-On Delay Time	t _{d(on)}	V _{GS} = 10 V	V _{DD} = 250 V, I _D = 47 A, R _G = 1.0 Ω, see fig. 10 ^b	-	25	-	ns
Rise Time	t _r			-	140	-	
Turn-Off Delay Time	t _{d(off)}			-	55	-	
Fall Time	t _f			-	74	-	
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I _S	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	47	A
Pulsed Diode Forward Current ^a	I _{SM}			-	-	190	
Body Diode Voltage	V _{SD}	T _J = 25 °C, I _S = 47 A, V _{GS} = 0 V ^b		-	-	1.5	V
Body Diode Reverse Recovery Time	t _{rr}	T _J = 25 °C, I _F = 47 A, dI/dt = 100 A/μs ^b		-	620	940	ns
Body Diode Reverse Recovery Charge	Q _{rr}			-	14	21	μC
Body Diode Recovery Current	I _{RRM}			-	38	-	A
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 $\leq 400\text{ }\mu\text{s}$; duty cycle $\leq 2\%$.
 c. $C_{oss\text{ eff.}}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DS} .

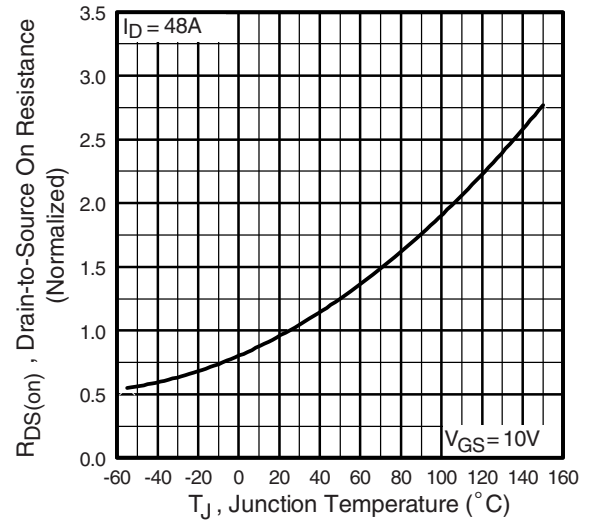
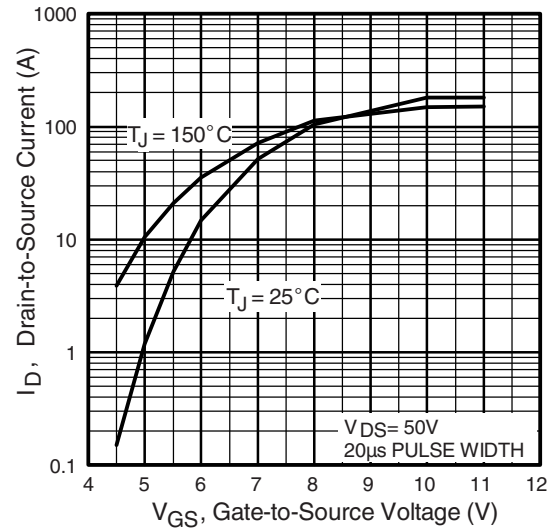
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)




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

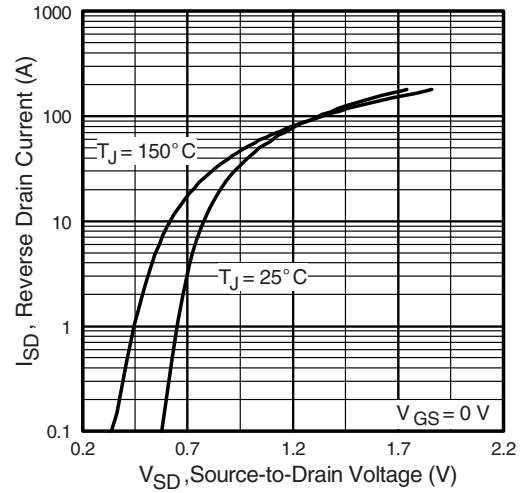


Fig. 7 - Typical Source-Drain Diode Forward Voltage

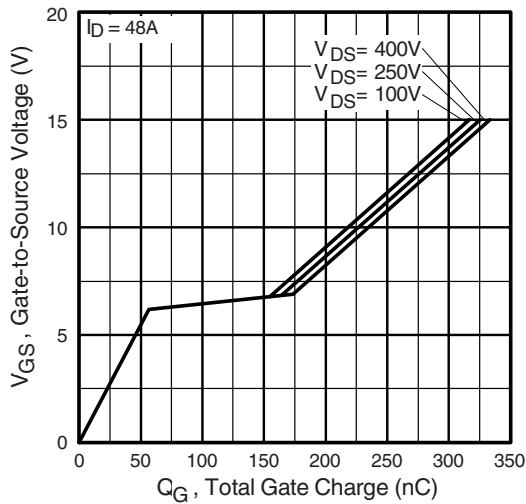


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage



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

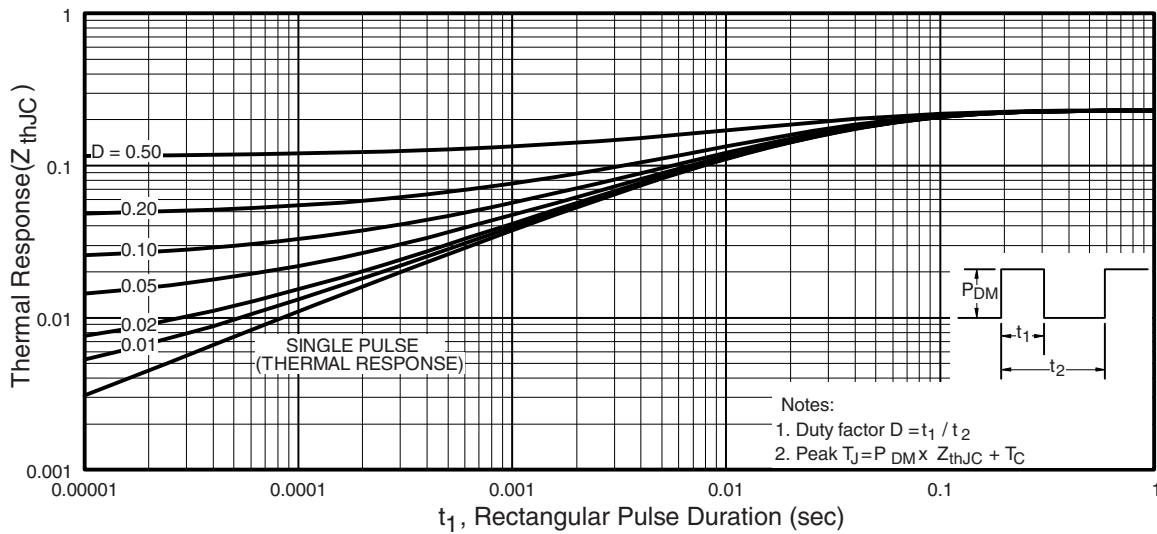


Fig. 11 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



Fig. 12a - Unclamped Inductive Test Circuit



Fig. 12b - Unclamped Inductive Waveforms



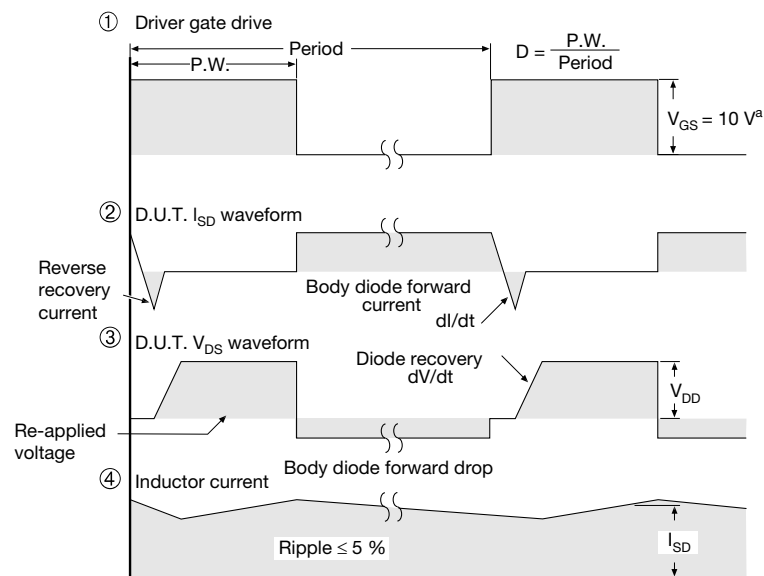
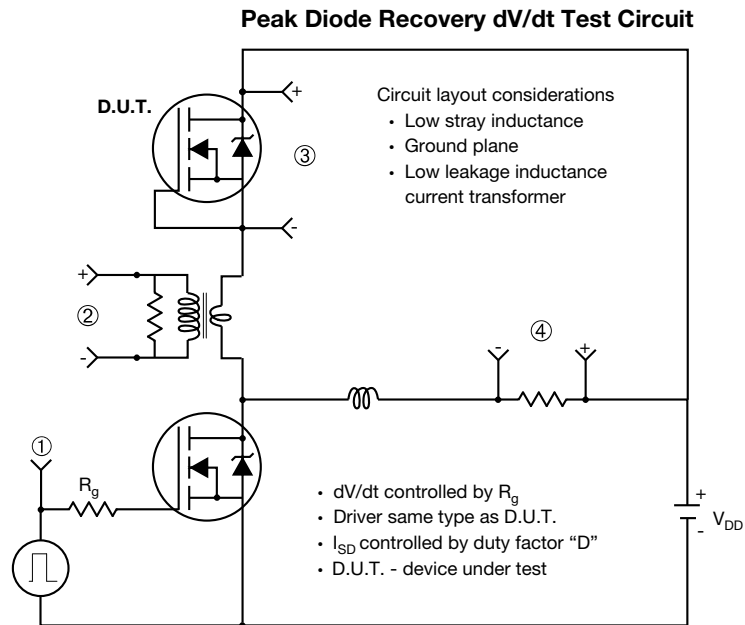
Fig. 12c - Maximum Avalanche Energy vs. Drain Current



Fig. 13a - Basic Gate Charge Waveform



Fig. 13b - Gate Charge Test Circuit



Note

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

Fig. 14 - For N-Channel

TO-274AA (High Voltage)



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.70	5.30	0.185	0.209
A1	1.50	2.50	0.059	0.098
A2	2.25	2.65	0.089	0.104
b	1.30	1.60	0.051	0.063
b2	1.80	2.20	0.071	0.087
b4	3.00	3.25	0.118	0.128
c ⁽¹⁾	0.38	0.89	0.015	0.035
D	19.80	20.80	0.780	0.819

DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
D1	15.50	16.10	0.610	0.634
D2	0.70	1.30	0.028	0.051
E	15.10	16.10	0.594	0.634
E1	13.30	13.90	0.524	0.547
e	5.45 BSC		0.215 BSC	
L	13.70	14.70	0.539	0.579
L1	1.00	1.60	0.039	0.063
R	2.00	3.00	0.079	0.118

ECN: X17-0056-Rev. B, 27-Mar-17
 DWG: 5975

Notes

- Dimensioning and tolerancing per ASME Y14.5M-1994
- Dimension D and E do not include mold flash. Mold flash shall not exceed 0.127 mm (0.005") per side. These dimensions are measured at the outer extremes of the plastic body
- Outline conforms to JEDEC® outline to TO-274AA

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