

Product Summary

$V_{(BR)DSS}$	$R_{DS(on)TYP}$	I_D
60V	13m Ω @10V	45A
	17m Ω @4.5V	

Feature

- $V_{DS} = 60V, I_D = 45A$
- $R_{DS(ON)} < 18m\Omega @ V_{GS} = 10V$
- High density cell design for ultra low R_{dson}
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high EAS
- Excellent package for good heat dissipation

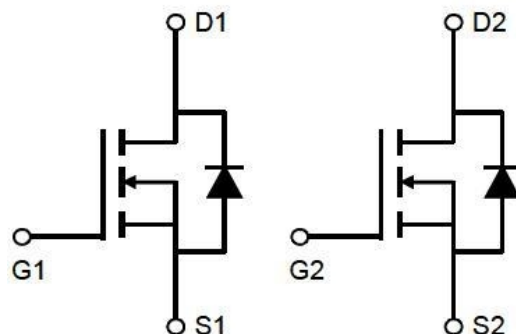
Applications

- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply

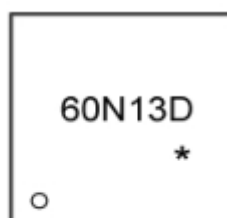
Package



Circuit diagram



Marking



60N13D : Product code
* : Month code.

Absolute maximum ratings

(T_a=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V _{DS}	60	V
Gate-Source Voltage	V _{GS}	±20	V
Drain Current-Continuous	I _D	45	A
Pulsed Drain Current	I _{DM}	180	A
Maximum Power Dissipation	P _D	85	W
Derating factor		0.57	W/°C
Single pulse avalanche energy ^(Note 5)	E _{AS}	300	mJ
Thermal Resistance,Junction-to-Case ^(Note 2)	R _{θJC}	1.8	°C/W
Operating Junction and Storage Temperature Range	T _{STG} , T _J	-55 To 175	°C

Electrical characteristics

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

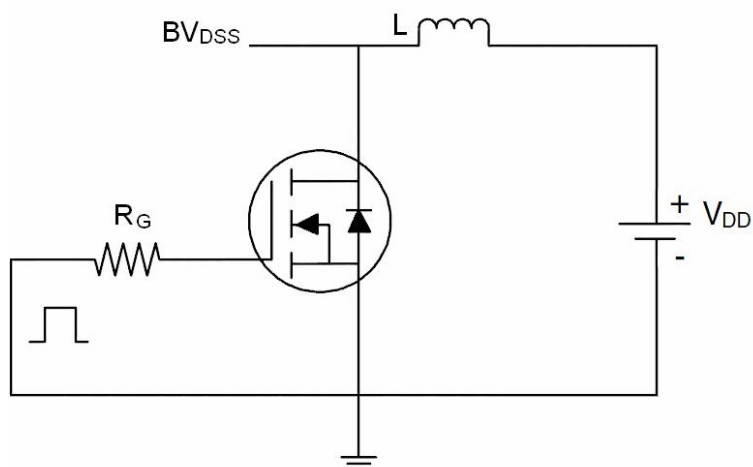
Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Static Characteristics						
Drain-Source Breakdown Voltage	$BV_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	60			V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 60V, V_{GS} = 0V$			1	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS} = \pm 20V, V_{DS} = 0V$			± 100	μA
On Characteristics (Note 3)						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	1	1.6	2.5	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 20A$		12	16	m Ω
		$V_{GS} = 4.5V, I_D = 20A$		15	22	
Forward Transconductance	g_{FS}	$V_{DS} = 5V, I_D = 20A$	18			S
Dynamic and Switching Characteristics(Note4)						
Input capacitance	C_{iss}	$V_{DS} = 30V, V_{GS} = 0V, f = 1MHz$		2050		pF
Output capacitance	C_{oss}			158		
Reverse transfer capacitance	C_{rss}			120		
Switching Characteristics(Note4)						
Turn-on Delay Time	$T_{d(on)}$	$V_{DD} = 30V, R_L = 6.7\Omega, V_{GS} = 10V, R_G = 3\Omega$		7.4		nS
Turn-on Rise Time	T_r			5.1		
Turn-Off Delay Time	$T_{d(off)}$			28.2		
Turn-Off Fall Time	t_f			5.5		
Total Gate Charge	Q_g	$V_{DS} = 30V, I_D = 20A, V_{GS} = 10V$		50		pF
Gate-Source Charge	Q_{gs}			6		
Gate-Drain Charge	Q_{gd}			15		
Drain-Source Body Diode Characteristics						
Diode Forward Voltage (Note 3)	V_{SD}	$V_{GS} = 0V, I_S = 1A$			1.2	V
Diode Forward Current (Note 2)	I_S				50	A
Reverse Recovery Time	t_{rr}	$T_J = 25^{\circ}C, I_F = 20A$		28		nS
Reverse Recovery Charge	Q_{rr}	$di/dt = 100A/\mu s$ (Note3)		40		nC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Note:

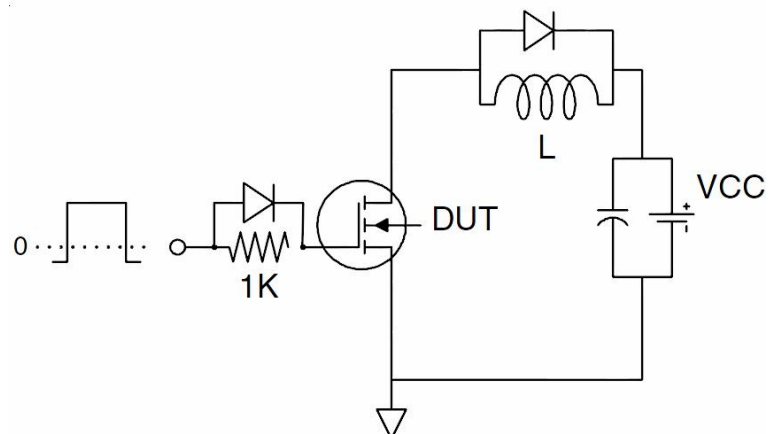
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, $t \leq 10$ sec.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production
5. E_{AS} condition : $T_J = 25^{\circ}\text{C}, V_{DD} = 30V, V_G = 10V, L = 0.5mH, R_G = 25\Omega$

Test Circuits

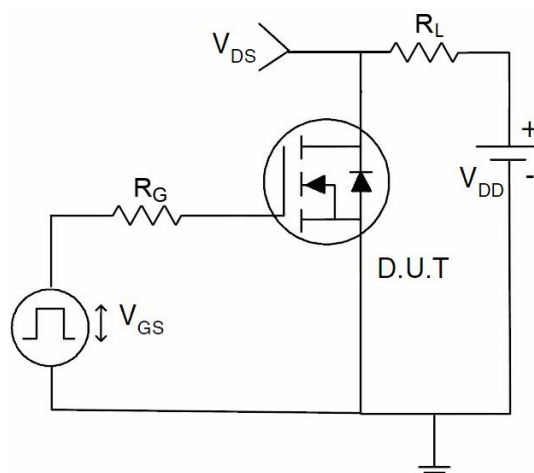
- EAS Test Circuits



- Gate Charge Test Circuit



- Switch Time Test Circuit



Typical Characteristics

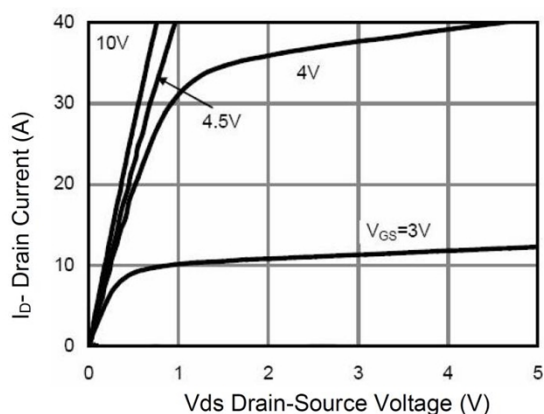


Figure 1 Output Characteristics

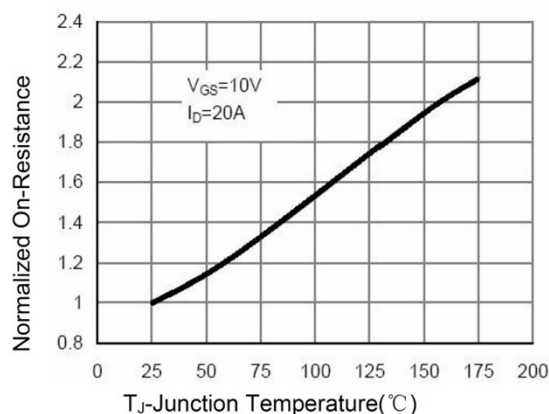


Figure 4 $R_{DS(on)}$ -Junction Temperature

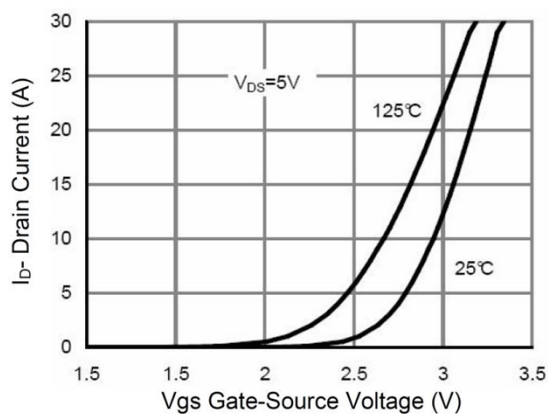


Figure 2 Transfer Characteristics

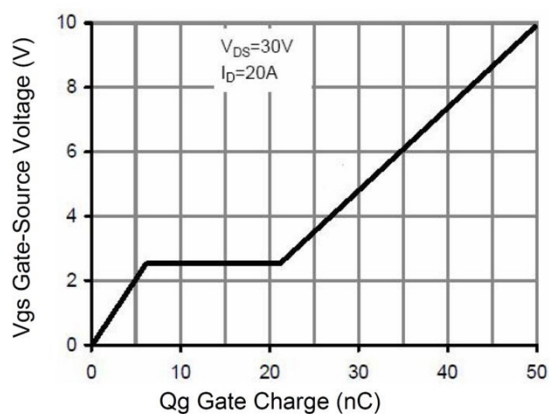


Figure 5 Gate Charge

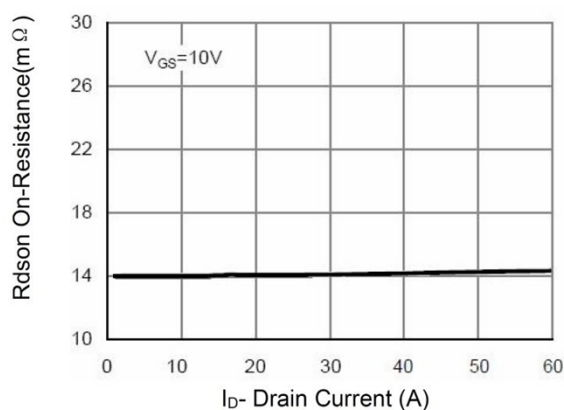


Figure 3 $R_{DS(on)}$ - Drain Current

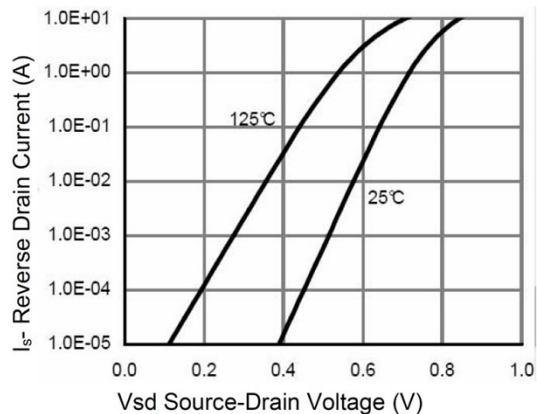


Figure 6 Source- Drain Diode Forward

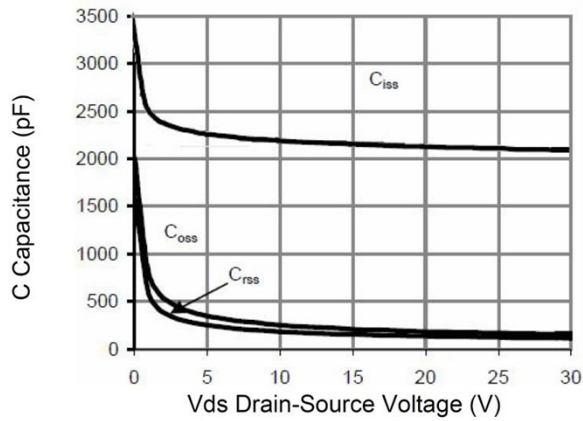


Figure 7 Capacitance vs Vds

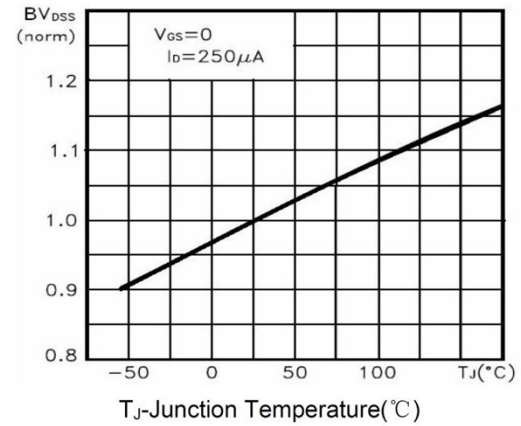


Figure 9 BV_{DSS} vs Junction Temperature

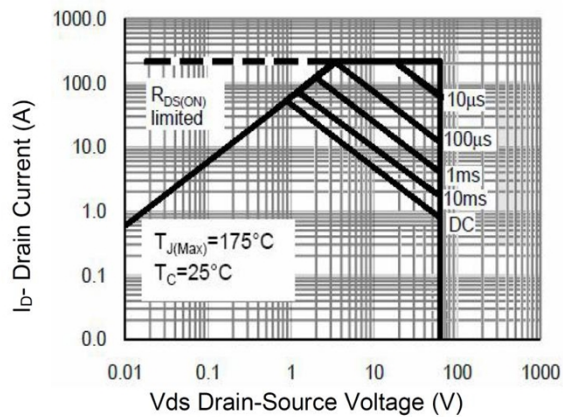


Figure 8 Safe Operation Area

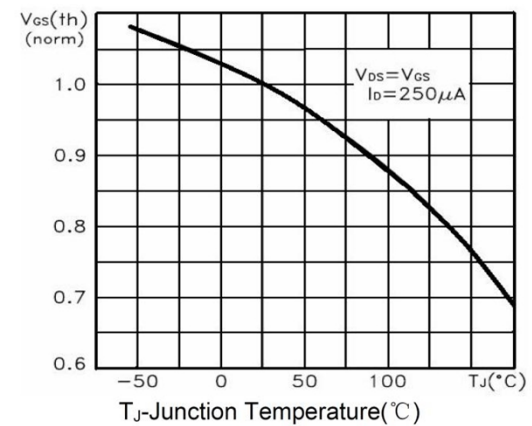


Figure 10 $V_{GS(th)}$ vs Junction Temperature

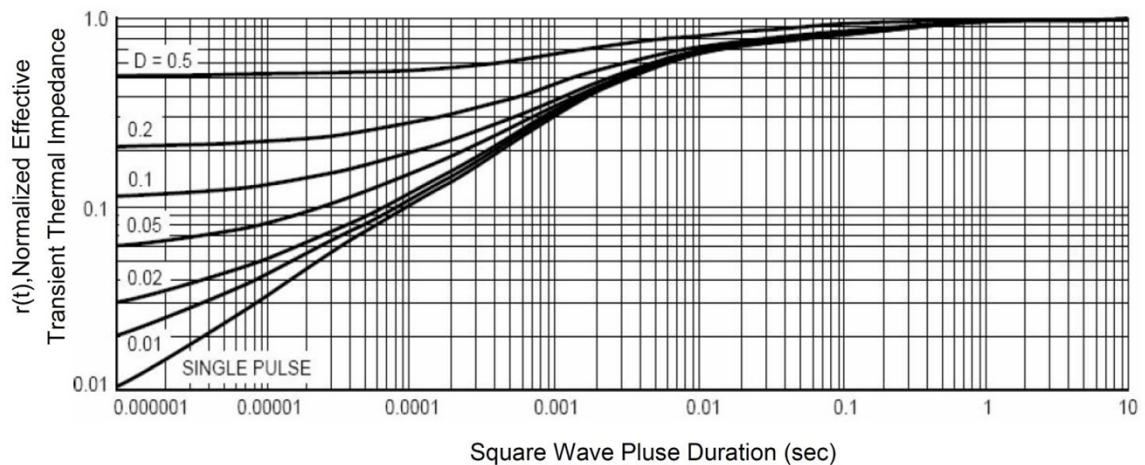
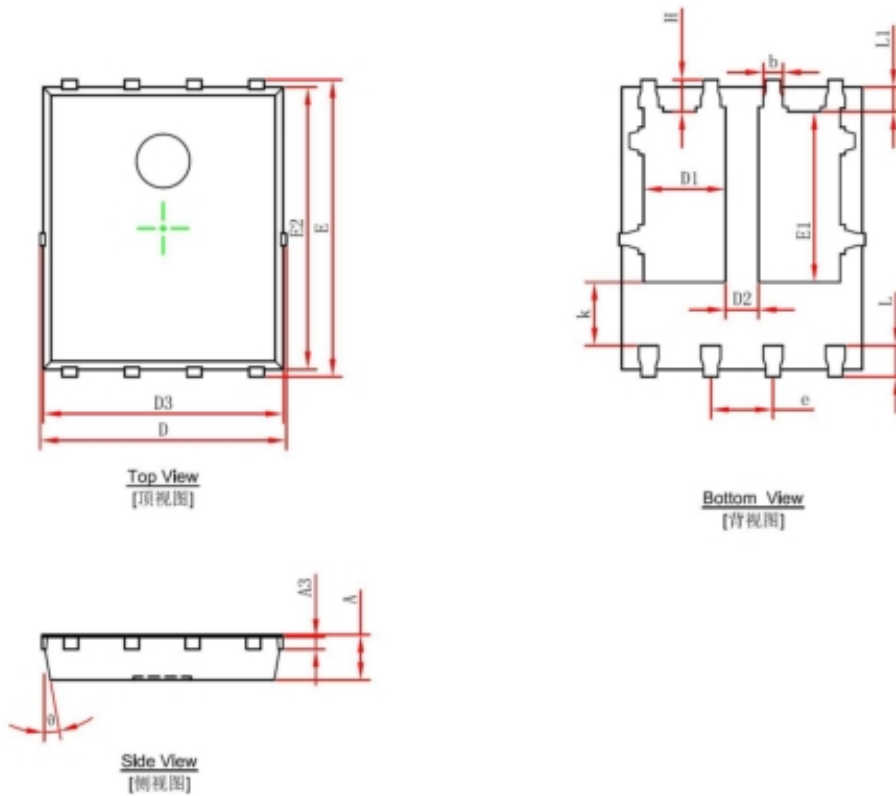


Figure 11 Normalized Maximum Transient Thermal Impedance

PDFNWB5X6-8L-A Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.000	0.035	0.039
A3	0.254 REF.		0.010 REF.	
D	4.944	5.096	0.195	0.201
E	5.974	6.126	0.235	0.241
D1	1.470	1.870	0.058	0.074
D2	0.470	0.870	0.019	0.034
E1	3.375	3.575	0.133	0.141
D3	4.824	4.976	0.190	0.196
E2	5.674	5.826	0.223	0.229
k	1.190	1.390	0.047	0.055
b	0.350	0.450	0.014	0.018
e	1.270 TYP.		0.050 TYP.	
L	0.559	0.711	0.022	0.028
L1	0.424	0.576	0.017	0.023
H	0.574	0.726	0.023	0.029
θ	10°	12°	10°	12°