

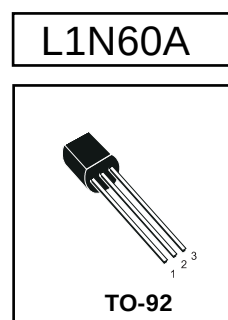
N-CHANNEL MOSFET

600V - 13Ω - 0.8A

General features

Type	V _{DSS}	R _{DS(on)}	I _D	P _w
L1N60A	600V	<15Ω	0.3A	3W

- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- New high voltage benchmark



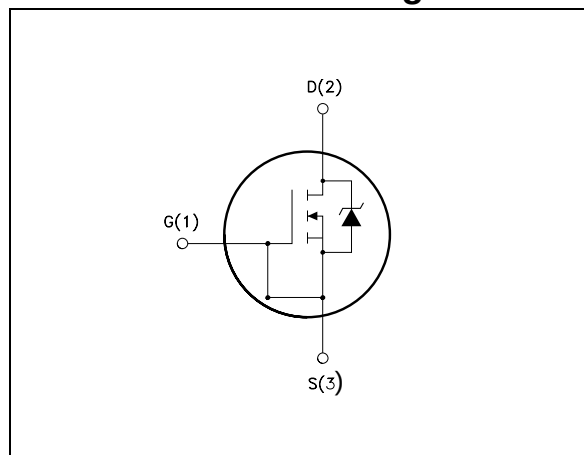
Description

The L1N60A is a high voltage MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance.

Applications

- Switching application

Internal schematic diagram



L1N60A

Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
		TO-92	
V_{DS}	Drain-Source Voltage ($V_{GS} = 0$)	600	V
V_{DGR}	Drain-Gate Voltage ($R_{GS} = 20K\Omega$)	600	V
V_{GS}	Gate-Source Voltage	± 30	V
I_D	Drain Current (continuous) at $T_C = 25^\circ C$	0.3	A
I_D	Drain Current (continuous) at $T_C = 100^\circ C$	0.189	A
$I_{DM}^{(1)}$	Drain Current (pulsed)	1.2	A
P_{TOT}	Total Dissipation at $T_C = 25^\circ C$	3	W
	Derating Factor	0.25	W/ $^\circ C$
$V_{ESD(G-D)}$	Gate source ESD(HBM-C=100pF, R=1.5K Ω)	800	V
$dv/dt^{(2)}$	Peak Diode Recovery voltage slope	4.5	V/ns
T_J T_{stg}	Operating Junction Temperature Storage Temperature	-55 to 150	$^\circ C$

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 0.3A$, $di/dt \leq 200A/\mu s$, $V_{DD} = 80\%V_{(BR)DSS}$

Table 2. Thermal resistance

Symbol	Parameter	Value	Unit
		TO-92	
$R_{thj-case}$	Thermal resistance junction-case Max	--	$^\circ C/W$
R_{thj-a}	Thermal resistance junction-ambient Max	120	$^\circ C/W$
$R_{thj-lead}$	Thermal resistance junction-lead Max	40	$^\circ C/W$
T_I	Maximum lead temperature for soldering purpose	260	$^\circ C$

1. When mounted on 1 inch² FR-4 board, 2 Oz Cu

Table 3. Avalanche data

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche Curent, Repetitive or Noy-Repetitive (pulse width limited by T_J Max)	0.8	A
E_{AS}	Single pulse avalanche Energy (starting $T_J = 25^\circ C$, $I_d = I_{ar}$, $V_{dd} = 50V$)	60	mJ

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Electrical characteristics

(T_{CASE}=25°C unless otherwise specified)

Table 4. On/off states

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Drain-Source Breakdown Voltage	I _D = 1mA, V _{GS} = 0	600			V
I _{DSS}	Zero Gate Voltage Drain Current (V _{GS} = 0)	V _{DS} = Max Rating, V _{DS} = MaxRating @125°C			1 50	μA μA
I _{GSS}	Gate Body Leakage Current (V _{DS} = 0)	V _{GS} = ±20V			±10	μA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 50μA	3	3.75	4.5	V
R _{DS(on)}	Static Drain-Source On Resistance	V _{GS} = 10V, I _D = 0.4A		13	15	Ω

Table 5. Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g _{fs} ⁽¹⁾	Forward Transconductance	V _{DS} = 15V, I _D = 0.4A		0.5		S
C _{iss} C _{oss} C _{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V _{DS} = 25V, f = 1 MHz, V _{GS} = 0		94 17.6 2.8		pF pF pF
C _{oss eq} ⁽²⁾	Equivalent Output Capacitance	V _{GS} = 0, V _{DS} = 0V to 480V		11		pF
Q _g Q _{gs} Q _{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V _{DD} = 480V, I _D = 0.8A V _{GS} = 10V (see Figure 11)		4.9 1 2.7	6.9	nC nC nC

1. Pulsed: pulse duration=300μs, duty cycle 1.5%
2. C_{oss eq} is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

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Table 6. Switching times

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{DD}=300\text{ V}$, $I_D=0.4\text{ A}$, $R_G=4.7\Omega$, $V_{GS}=10\text{ V}$ (see Figure 19)		5.5		ns
t_r	Rise Time			5		ns
$t_{d(off)}$	Turn-off Delay Time			13		ns
t_f	Fall Time			28		ns

Table 7. Source drain diode

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain Current				0.8	A
$I_{SDM}^{(1)}$	Source-drain Current (pulsed)				2.4	A
$V_{SD}^{(2)}$	Forward on Voltage	$I_{SD}=0.8\text{ A}$, $V_{GS}=0$			1.6	V
t_{rr}	Reverse Recovery Time	$I_{SD}=0.8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=20\text{ V}$, $T_j=25^\circ\text{C}$		135		ns
Q_{rr}	Reverse Recovery Charge			216		nC
I_{RRM}	Reverse Recovery Current			3.2		A
t_{rr}	Reverse Recovery Time	$I_{SD}=0.8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD}=20\text{ V}$, $T_j=150^\circ\text{C}$		140		ns
Q_{rr}	Reverse Recovery Charge			224		nC
I_{RRM}	Reverse Recovery Current			3.2		A

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration=300 μs , duty cycle 1.5%

Table 8. Gate-source zener diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$BV_{GSO}^{(1)}$	Gate-source Braekdown Voltage	$I_{gs}=\pm 1\text{ mA}$ (Open Drain)	30			V

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Electrical characteristics (curves)

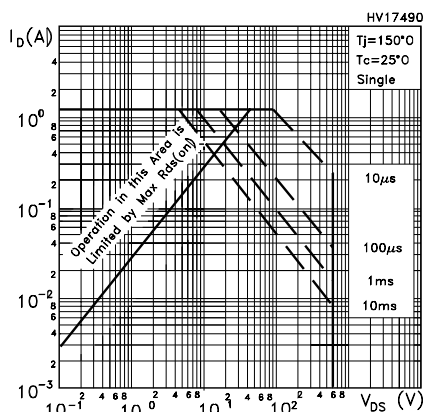


Figure 1. Safe operating area for TO-92

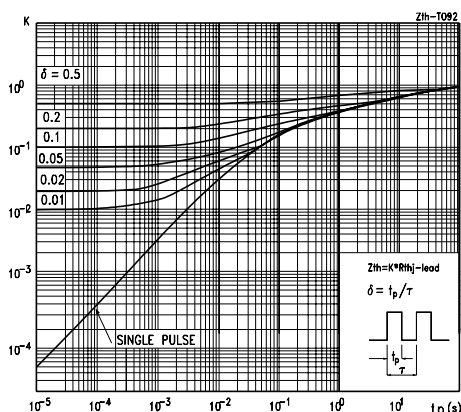


Figure 2. Thermal impedance for TO-92

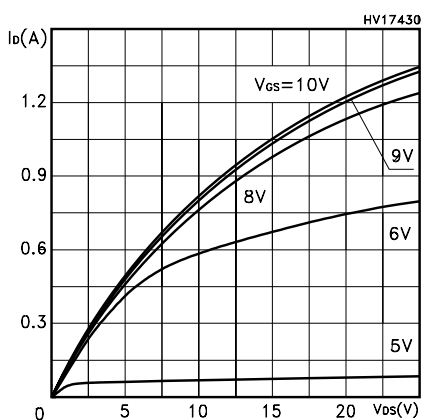


Figure 3. Output characteristics

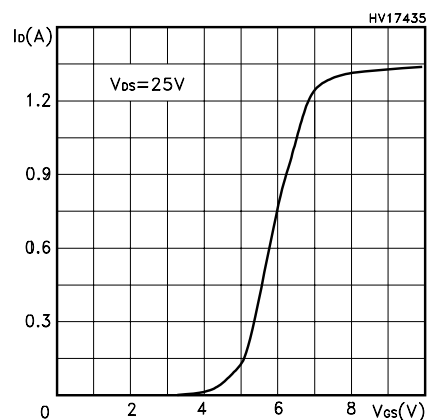


Figure 4. Transfer characteristics

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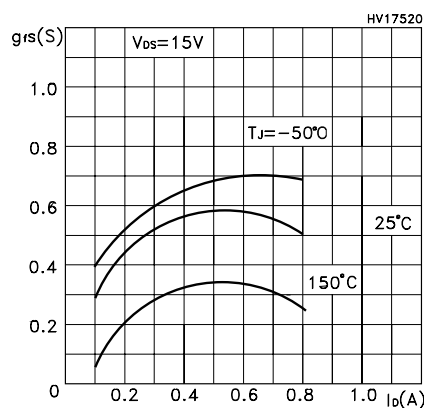


Figure 5. Transconductance

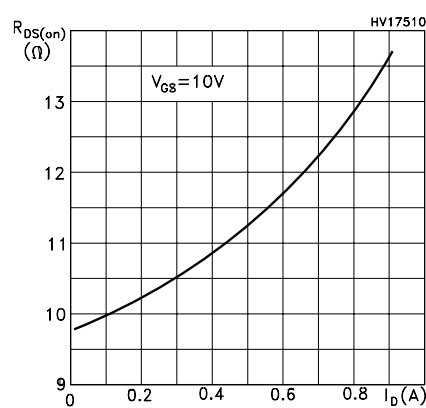


Figure 6. Static drain-source on resistance

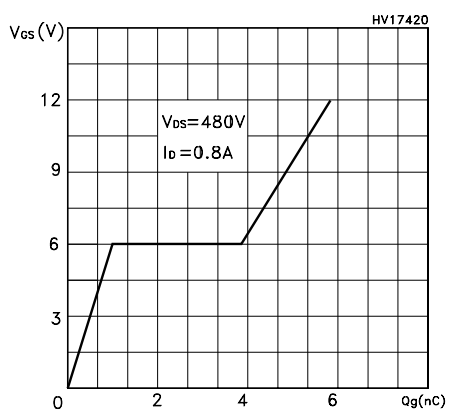


Figure 7. Gate charge vs gate-source voltage

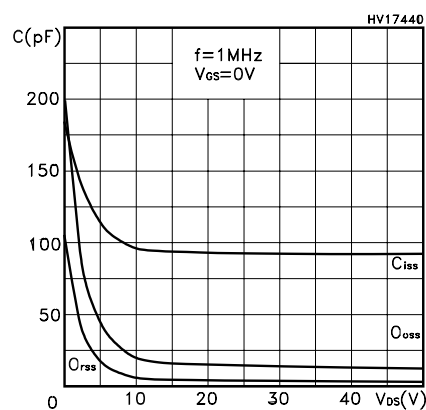


Figure 8. Capacitance variations

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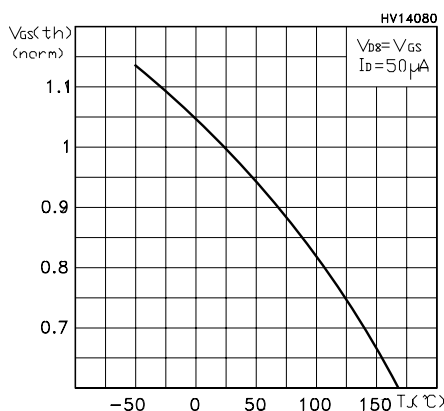


Figure 9. Normalized gate threshold voltage vs temperature

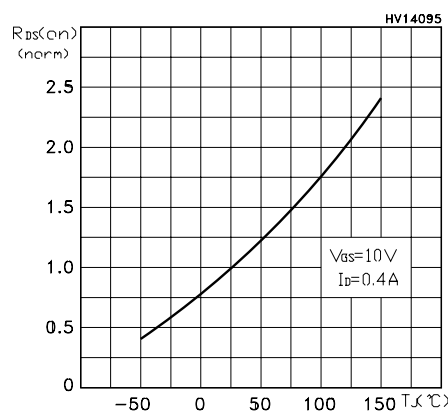


Figure 10. Normalized on resistance vs temperature

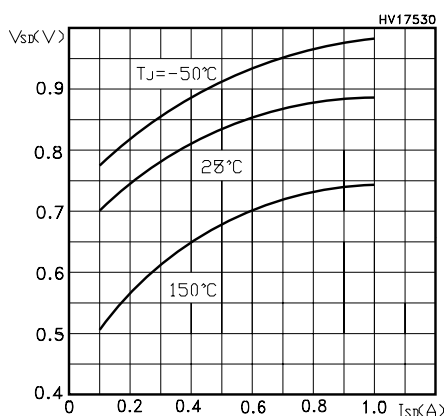


Figure 11. Source-drain diode forward characteristics

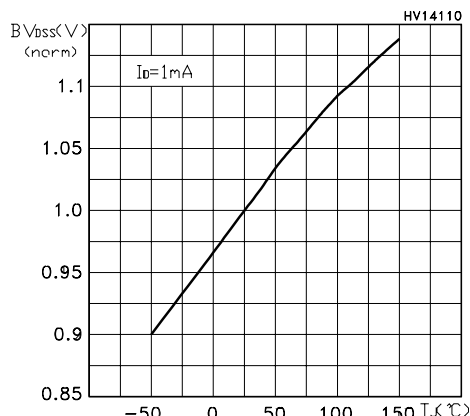


Figure 12. Normalized $B_{V_{DS}}$ vs temperature

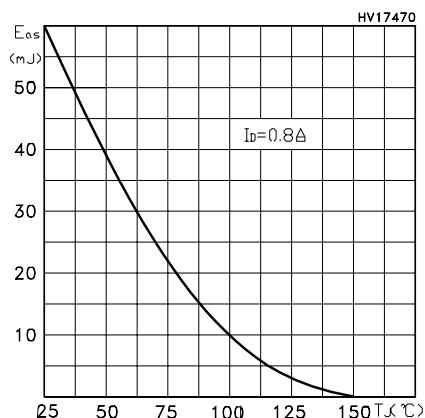


Figure 13. Maximum avalanche energy vs temperature

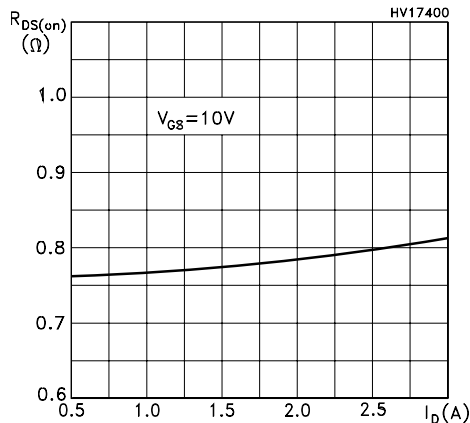


Figure 14. Max I_d Current vs T_c

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Test circuit

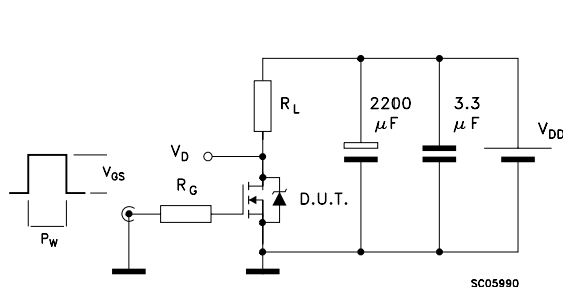


Figure 15. Switching times test circuit for resistive load

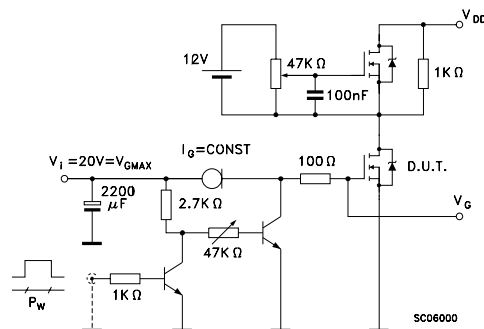


Figure 16. Gate charge test circuit

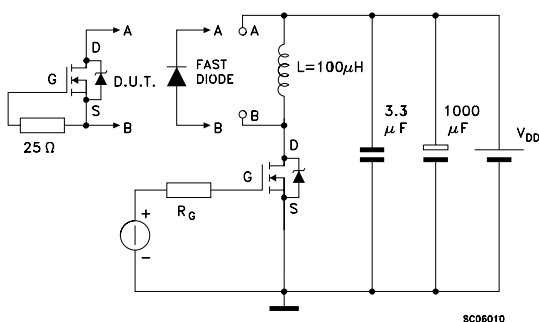


Figure 17. Test circuit for inductive load switching and diode recovery times

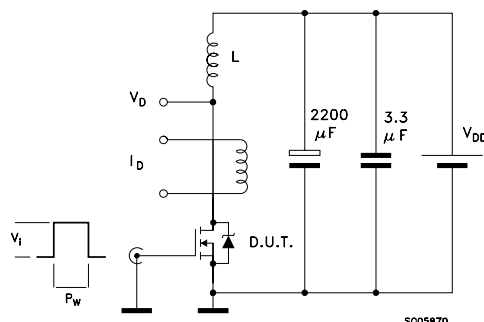


Figure 18. Unclamped Inductive load test circuit

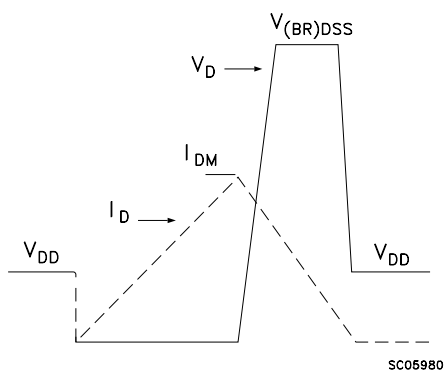


Figure 19. Unclamped inductive waveform

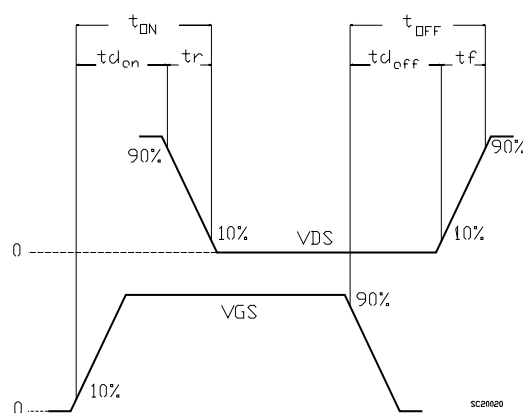


Figure 20. Switching time waveform

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TO-92 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.32		4.95	0.170		0.194
b	0.36		0.51	0.014		0.020
D	4.45		4.95	0.175		0.194
E	3.30		3.94	0.130		0.155
e	2.41		2.67	0.094		0.105
e1	1.14		1.40	0.044		0.055
L	12.70		15.49	0.50		0.610
R	2.16		2.41	0.085		0.094
S1	0.92		1.52	0.036		0.060
W	0.41		0.56	0.016		0.022
V		5°			5°	

