



# STQ2LN60K3-AP

N-channel 600 V, 4  $\Omega$  typ., 0.6 A SuperMESH3™ Power MOSFET  
in TO-92 package

Datasheet — production data

## Features

Order code	V <sub>DSS</sub>	R <sub>DS(on) max</sub>	I <sub>D</sub>	P <sub>TOT</sub>
STQ2LN60K3-AP	600 V	< 4.5 $\Omega$	0.6 A	2.5 W

- 100% avalanche tested
- Extremely high dv/dt capability
- Very low intrinsic capacitance
- Improved diode reverse recovery characteristics
- Zener-protected

## Applications

- Switching applications

## Description

This SuperMESH3™ Power MOSFET is the result of improvements applied to STMicroelectronics' SuperMESH™ technology, combined with a new optimized vertical structure. This device boasts an extremely low on-resistance, superior dynamic performance and high avalanche capability, rendering it suitable for the most demanding applications.

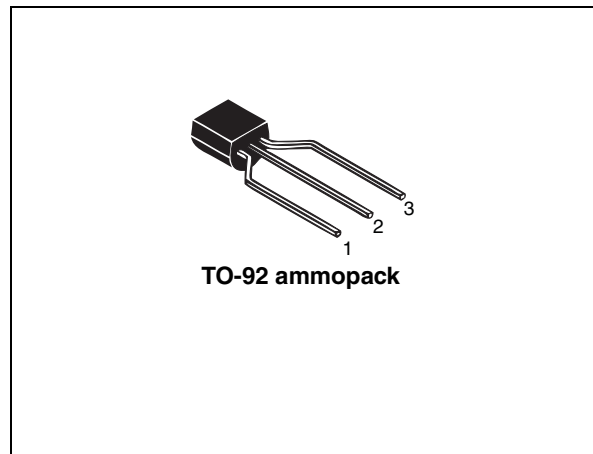


Figure 1. Internal schematic diagram

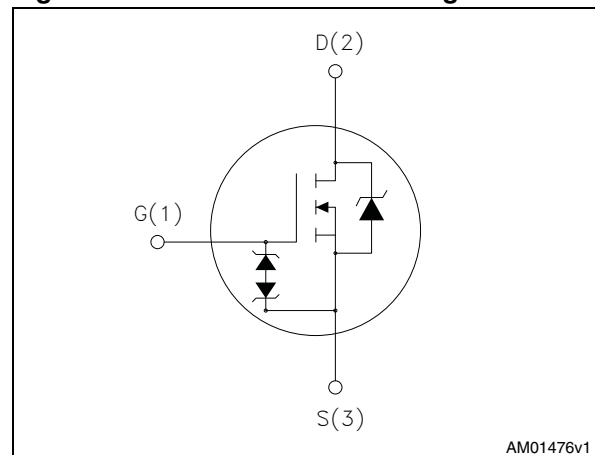


Table 1. Device summary

Order codes	Marking	Package	Packaging
STQ2LN60K3-AP	2LN60K3	TO-92	Ampack

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{DS}$	Drain-source voltage	600	V
$V_{GS}$	Gate- source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	0.6	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	0.38	A
$I_{DM}^{(1)}$	Drain current (pulsed)	2.4	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	2.5	W
	Derating factor	0.02	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate source ESD (HBM-C = 100 pF, R = 1.5 k $\Omega$ )	2500	V
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	12	V/ns
$T_{stg}$	Storage temperature	-55 to 150	$^\circ\text{C}$
$T_j$	Max. operating junction temperature	150	$^\circ\text{C}$

1. Pulse width limited by safe operating area

2.  $I_{SD} \leq 0.6\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ , peak  $V_{DS} < V_{(BR)DSS}$

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	50	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb max	120	$^\circ\text{C}/\text{W}$

**Table 4. Avalanche characteristics**

Symbol	Parameter	Max value	Unit
$I_{AR}$	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)	2	A
$E_{AS}$	Single pulse avalanche energy (starting $T_j = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	80	mJ

## 2 Electrical characteristics

( $T_C = 25\text{ °C}$  unless otherwise specified)

**Table 5. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0$	600			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 600\text{ V}$ $V_{DS} = 600\text{ V}$ , $T_C = 125\text{ °C}$			1 50	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 50\text{ }\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 1\text{ A}$		4	4.5	$\Omega$

**Table 6. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	235	-	pF
$C_{oss}$	Output capacitance			22		pF
$C_{rss}$	Reverse transfer capacitance			3.5		pF
$C_{o(tr)}^{(1)}$	Eq. capacitance time related	$V_{GS} = 0$ , $V_{DS} = 0\text{ to }480\text{ V}$	-	14	-	pF
$C_{o(er)}^{(2)}$	Eq. capacitance energy related			10		pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	7	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}$ , $I_D = 1\text{ A}$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 16</a> )	-	12	-	nC
$Q_{gs}$	Gate-source charge			1.8		nC
$Q_{gd}$	Gate-drain charge			7.7		nC

1.  $C_{oss\text{ eq}}$ . time related is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

2.  $C_{oss\text{ eq}}$ . energy related is defined as a constant equivalent capacitance giving the same stored energy as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

**Table 7. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$ , $I_D = 1\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 15</a> )	-	10	-	ns
$t_r$	Rise time		-	8.5	-	ns
$t_{d(off)}$	Turn-off-delay time		-	23.5	-	ns
$t_f$	Fall time		-	21	-	ns

**Table 8. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		0.6	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		2.4	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 2\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 2\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 20</a> )	-	200		ns
$Q_{rr}$	Reverse recovery charge		-	800		nC
$I_{RRM}$	Reverse recovery current		-	8		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 2\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 20</a> )	-	230		ns
$Q_{rr}$	Reverse recovery charge		-	950		nC
$I_{RRM}$	Reverse recovery current		-	8.5		A

1. Pulse width limited by safe operating area.
2. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Table 9. Gate-source Zener diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$BV_{GSO}^{(1)}$	Gate-source breakdown voltage	$I_{gs} = \pm 1\text{ mA}$ (open drain)	30	-	-	V

1. The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

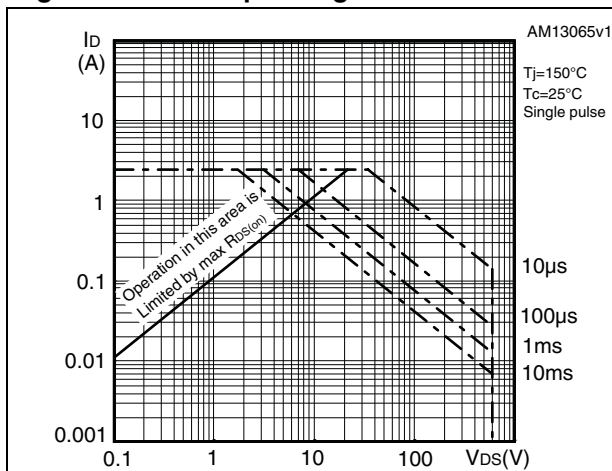


Figure 3. Thermal impedance

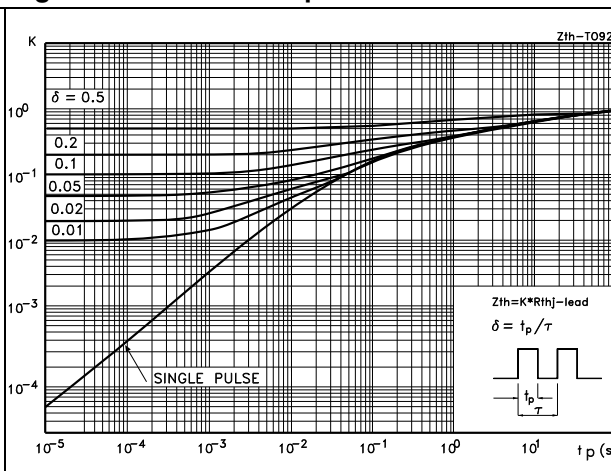


Figure 4. Output characteristics

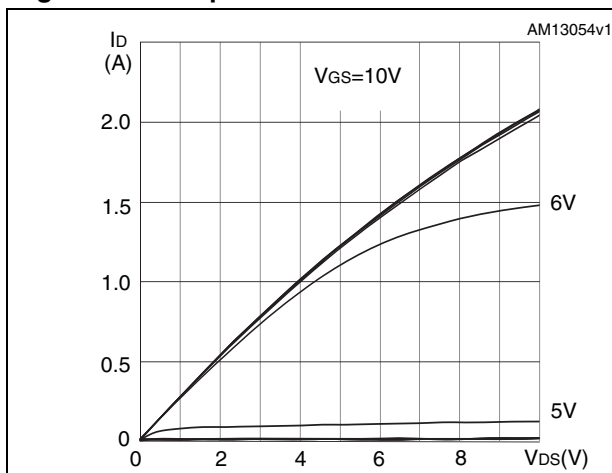


Figure 5. Transfer characteristics

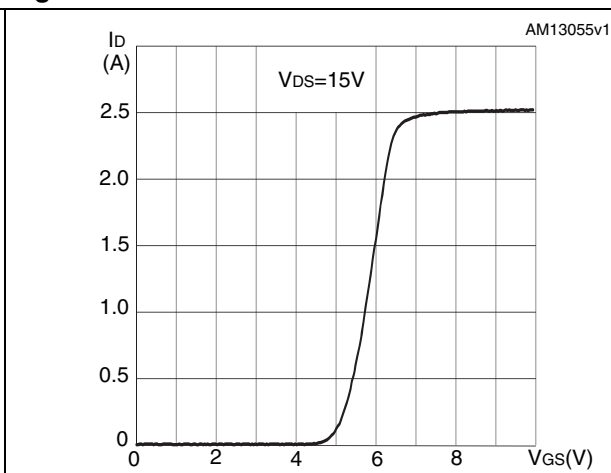


Figure 6. Gate charge vs gate-source voltage

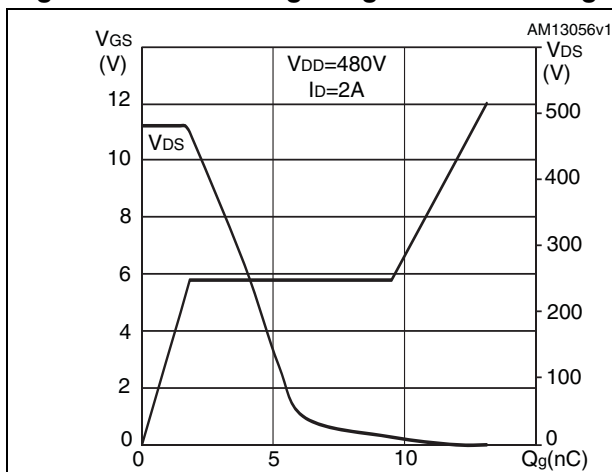


Figure 7. Static drain-source on-resistance

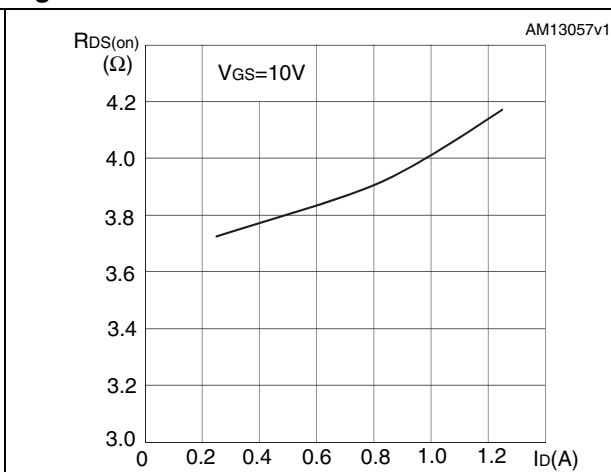


Figure 8. Capacitance variations

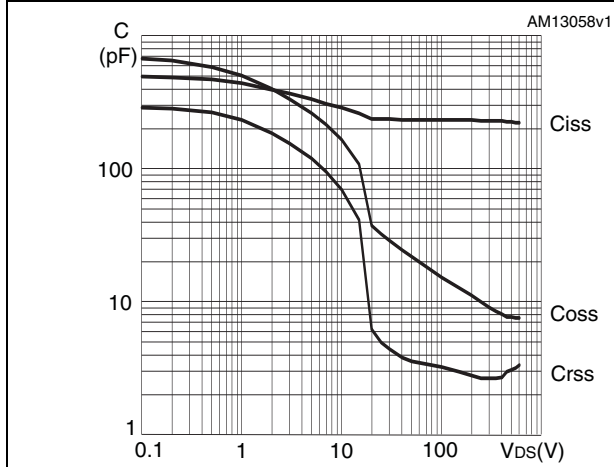


Figure 9. Output capacitance stored energy

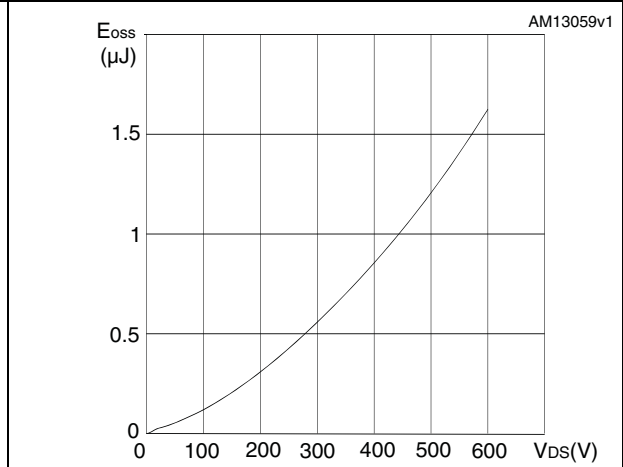


Figure 10. Normalized gate threshold voltage vs temperature

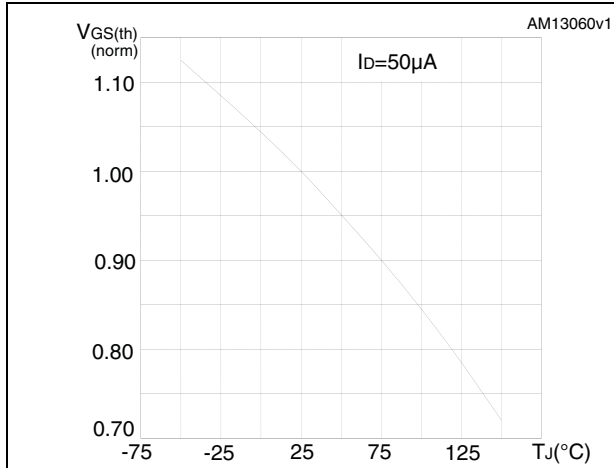


Figure 11. Normalized on-resistance vs temperature

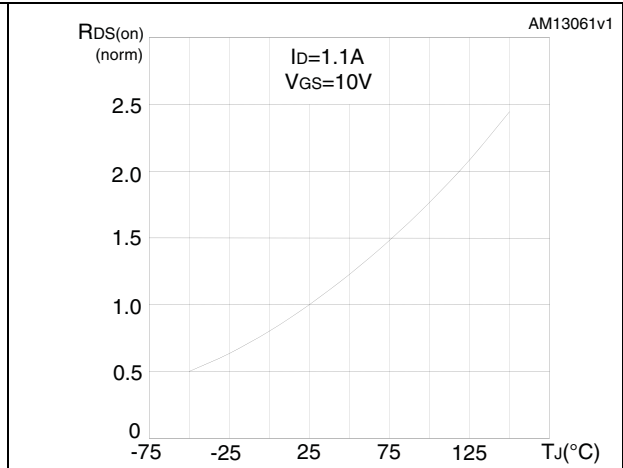


Figure 12. Normalized BV<sub>DSS</sub> vs temperature

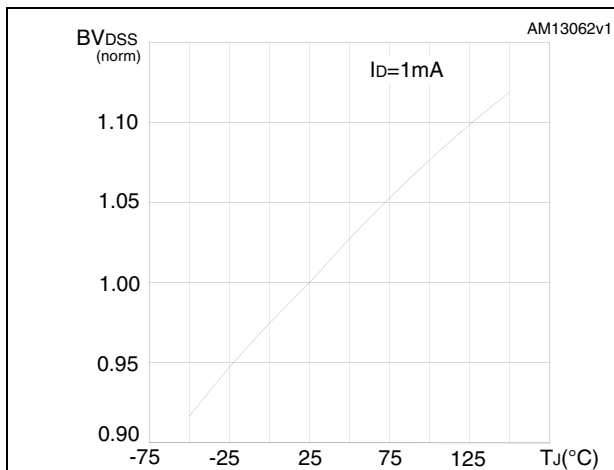


Figure 13. Source-drain diode forward characteristics

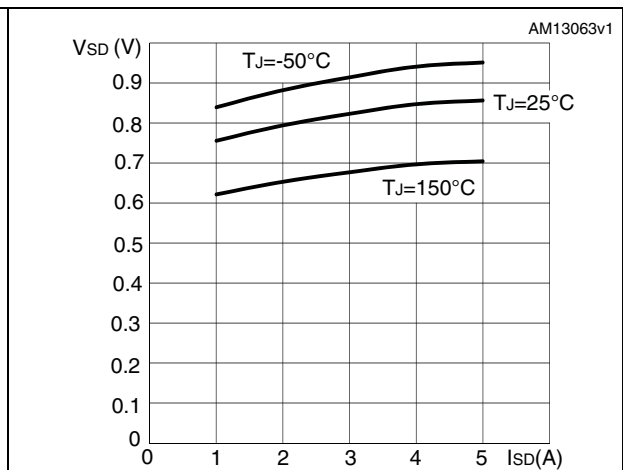
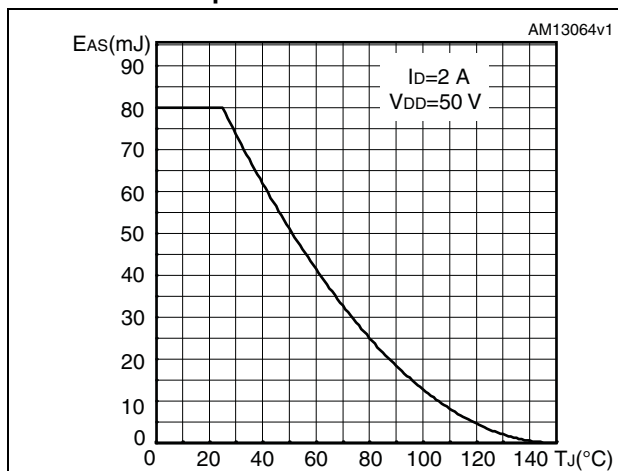


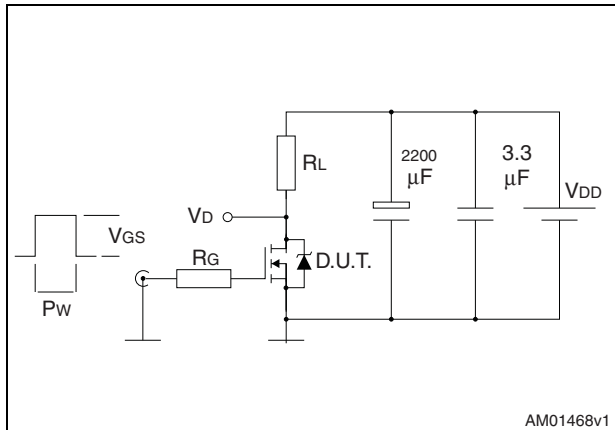
Figure 14. Maximum avalanche energy vs temperature





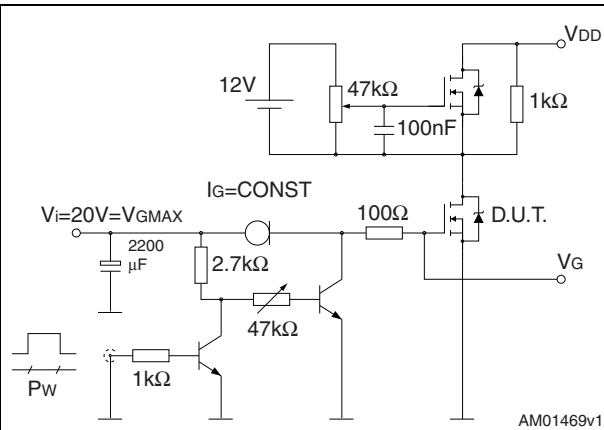
### 3 Test circuits

Figure 15. Switching times test circuit for resistive load



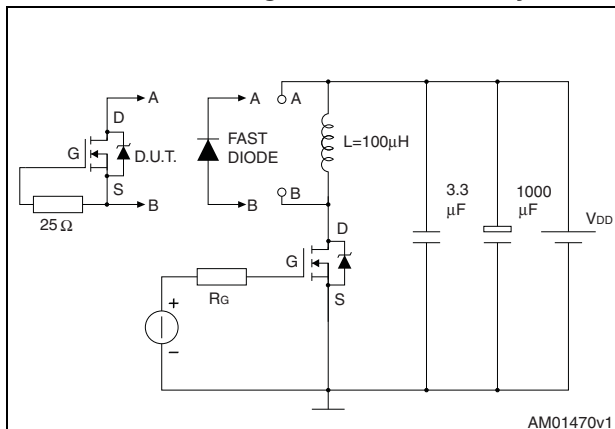
AM01468v1

Figure 16. Gate charge test circuit



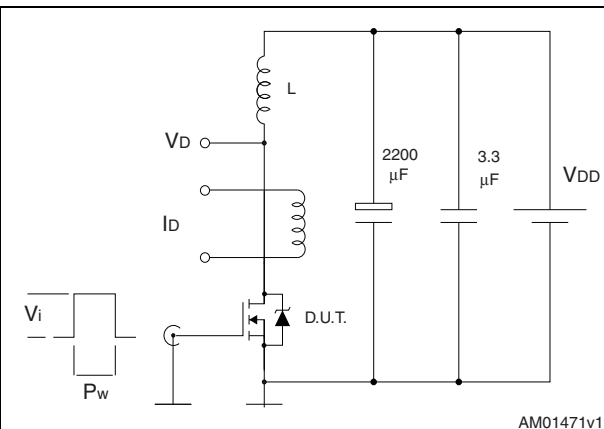
AM01469v1

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



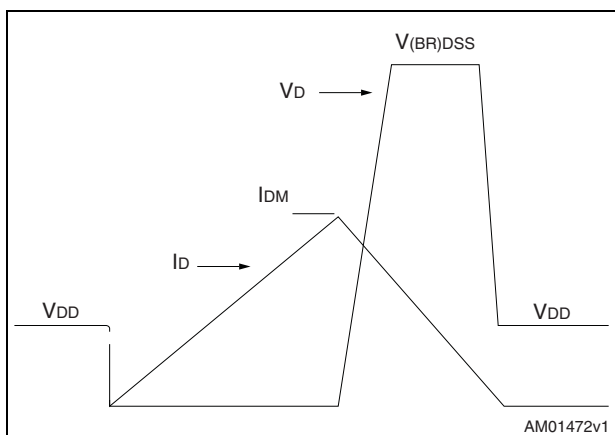
AM01470v1

Figure 18. Unclamped Inductive load test circuit



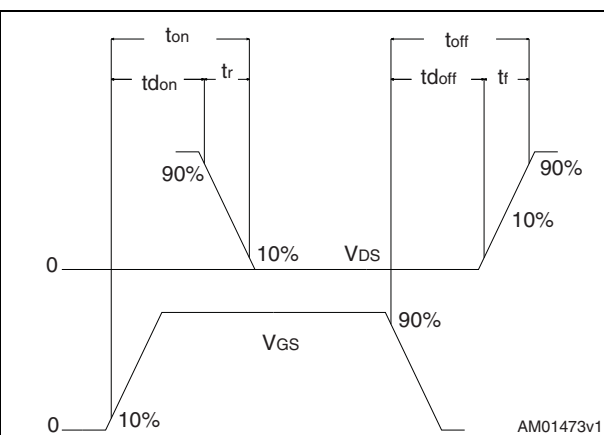
AM01471v1

Figure 19. Unclamped inductive waveform



AM01472v1

Figure 20. Switching time waveform



AM01473v1

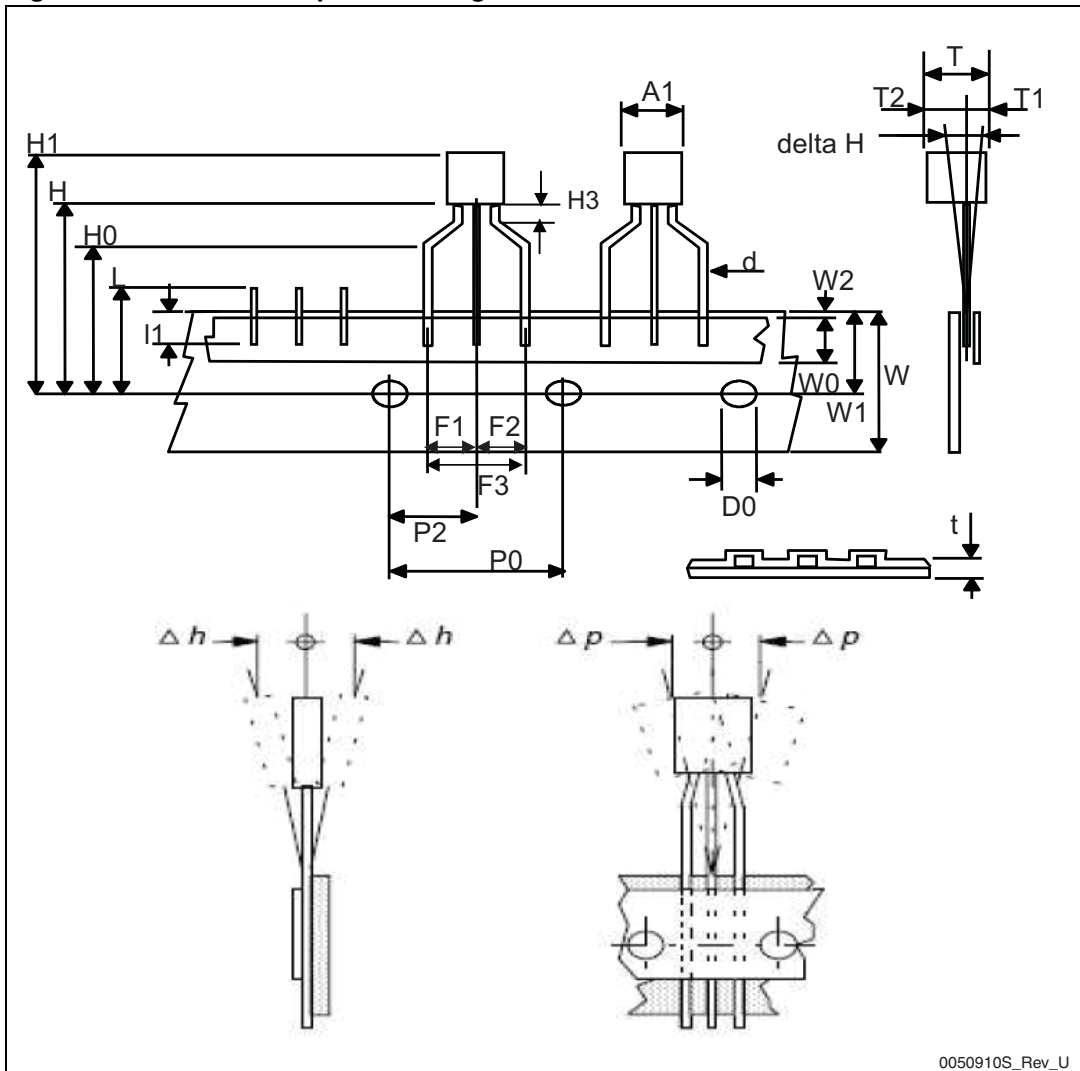
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

Table 10. TO-92 ammopack mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A1			4.80
T			3.80
T1			1.60
T2			2.30
d	0.45	0.47	0.48
P0	12.50	12.70	12.90
P2	5.65	6.35	7.05
F1, F2	2.40	2.50	2.94
F3	4.98	5.08	5.48
delta H	-2.00		2.00
W	17.50	18.00	19.00
W0	5.50	6.00	6.50
W1	8.50	9.00	9.25
W2			0.50
H		18.50	21.00
H0	15.50	16.00	18.20
H1		25.00	27.00
H3	0.50	1.00	2.00
D0	3.80	4.00	4.20
t			0.90
L			11.00
l1	3.00		
delta P	-1.00		1.00

Figure 21. TO-92 ammopack drawing



0050910S\_Rev\_U

## 5 Revision history

Table 11. Document revision history

Date	Revision	Changes
19-Jul-2012	1	First release.

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