

## N-channel 800 V, 0.8 $\Omega$ typ., 6 A MDmesh™ K5 Power MOSFET in TO-220FP and I<sup>2</sup>PAKFP packages

Datasheet – production data

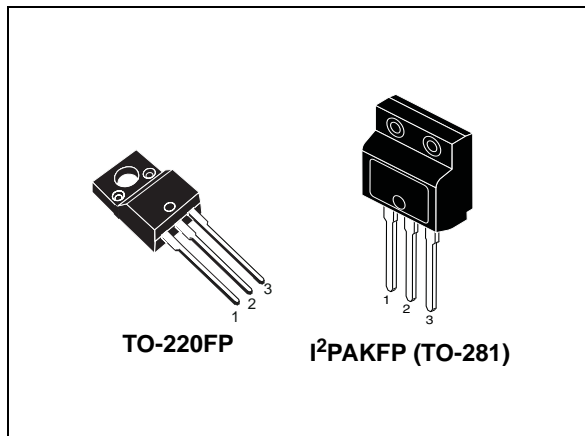
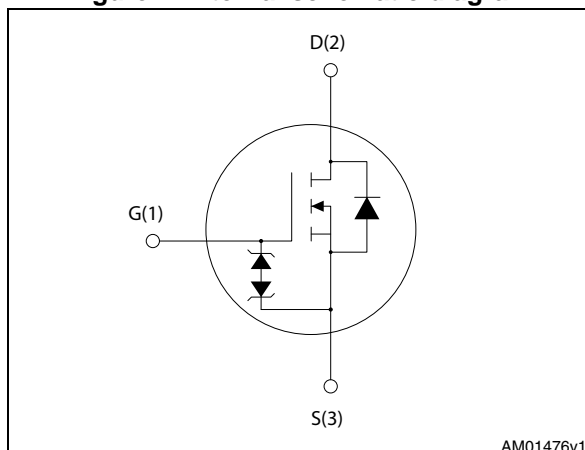


Figure 1. Internal schematic diagram



### Features

Order codes	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STF8N80K5	800 V	0.95 $\Omega$	6 A	25 W
STFI8N80K5				

- Industry's lowest R<sub>DS(on)</sub> x area
- Industry's best figure of merit (FoM)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

These very high voltage N-channel Power MOSFETs are designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STF8N80K5	8N80K5	TO-220FP	Tube
STFI8N80K5		I <sup>2</sup> PAKFP (TO-281)	

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D$	Drain current $T_C = 25\text{ }^\circ\text{C}$	6 <sup>(1)</sup>	A
$I_D$	Drain current $T_C = 100\text{ }^\circ\text{C}$	4 <sup>(1)</sup>	A
$I_{DM}$ <sup>(2)</sup>	Drain current (pulsed)	24 <sup>(1)</sup>	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	25	W
$I_{AR}$ <sup>(3)</sup>	Max current during repetitive or single pulse avalanche	2	A
$E_{AS}$ <sup>(4)</sup>	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AS}$ , $V_{DD} = 50\text{ V}$ )	114	mJ
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t = 1\text{ s}$ ; $T_C = 25\text{ }^\circ\text{C}$ )	2500	V
$dv/dt$ <sup>(5)</sup>	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt$ <sup>(6)</sup>	MOSFET $dv/dt$ ruggedness	50	V/ns
$T_j$	Operating junction temperature	-55 to 150	$^\circ\text{C}$
$T_{stg}$	Storage temperature		$^\circ\text{C}$

- Limited by package.
- Pulse width limited by safe operating area.
- Pulse width limited by  $T_{Jmax}$ .
- Starting  $T_J = 25\text{ }^\circ\text{C}$ ,  $I_D = I_{AS}$ ,  $V_{DD} = 50\text{ V}$
- $I_{SD} \leq 6\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{DS(peak)} \leq V_{(BR)DSS}$
- $V_{DS} \leq 640\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max.	5	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-amb max.	62.5	$^\circ\text{C}/\text{W}$

## 2 Electrical characteristics

(T<sub>CASE</sub> = 25 °C unless otherwise specified)

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0	800			V
I <sub>DSS</sub>	Zero gate voltage drain current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = 800 V,			1	μA
		V <sub>DS</sub> = 800 V, T <sub>C</sub> = 125 °C			50	μA
I <sub>GSS</sub>	Gate body leakage current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 20 V			±10	μA
V <sub>GS(th)</sub>	Gate threshold voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 100 μA	3	4	5	V
R <sub>DS(on)</sub>	Static drain-source on-resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 3 A		0.8	0.95	Ω

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C <sub>iss</sub>	Input capacitance	V <sub>DS</sub> = 100 V, f = 1 MHz, V <sub>GS</sub> = 0	-	450	-	pF
C <sub>oss</sub>	Output capacitance		-	50	-	pF
C <sub>rss</sub>	Reverse transfer capacitance		-	1	-	pF
C <sub>o(tr)</sub> <sup>(1)</sup>	Equivalent capacitance time related	V <sub>GS</sub> = 0, V <sub>DS</sub> = 0 to 640 V	-	57	-	pF
C <sub>o(er)</sub> <sup>(2)</sup>	Equivalent capacitance energy related		-	24	-	pF
R <sub>G</sub>	Intrinsic gate resistance	f = 1 MHz open drain	-	6	-	Ω
Q <sub>g</sub>	Total gate charge	V <sub>DD</sub> = 640 V, I <sub>D</sub> = 6 A V <sub>GS</sub> = 10 V (see <a href="#">Figure 16</a> )	-	16.5	-	nC
Q <sub>gs</sub>	Gate-source charge		-	3.2	-	nC
Q <sub>gd</sub>	Gate-drain charge		-	11	-	nC

1. Time related is defined as a constant equivalent capacitance giving the same charging time as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>
2. Energy related is defined as a constant equivalent capacitance giving the same stored energy as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit	
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$ , $I_D = 3\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 18</a> )	-	12	-	ns	
$t_r$	Rise time			14	-	ns	
$t_{d(off)}$	Turn-off delay time				32	-	ns
$t_f$	Fall time				20	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		6	A
$I_{SDM}$	Source-drain current (pulsed)				24	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 6\text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 6\text{ A}$ , $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , (see <a href="#">Figure 17</a> )	-	300		ns
$Q_{rr}$	Reverse recovery charge				3	$\mu\text{C}$
$I_{RRM}$	Reverse recovery current				20	A
$t_{rr}$	Reverse recovery time	$I_{SD} = 6\text{ A}$ , $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , $T_J = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 17</a> )	-	415		ns
$Q_{rr}$	Reverse recovery charge				3.8	$\mu\text{C}$
$I_{RRM}$	Reverse recovery current				18	A

1. Pulsed: pulse duration = 300 $\mu\text{s}$ , duty cycle 1.5%

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$ , $I_D = 0$	30	-	-	V

The built-in back-to-back Zener diodes have been specifically designed to enhance the ESD capability of the device. The Zener voltage is appropriate for efficient and cost-effective intervention to protect the device integrity. These integrated Zener diodes thus eliminate the need for external components.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

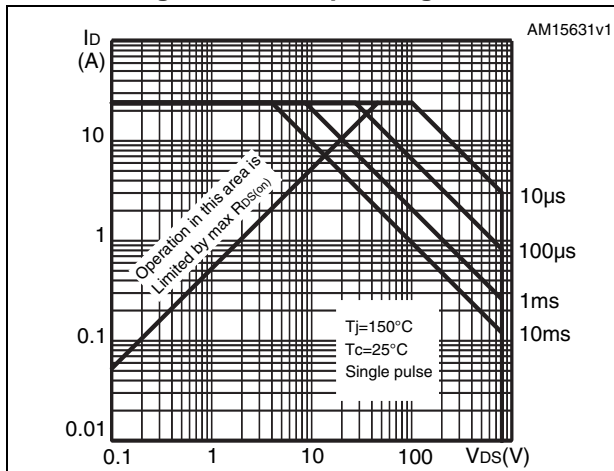


Figure 3. Thermal impedance

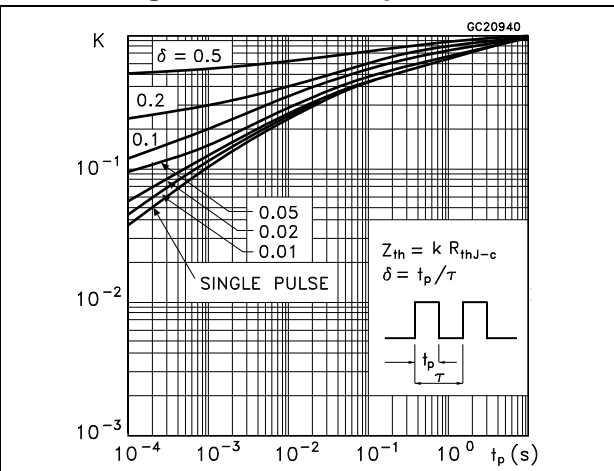


Figure 4. Output characteristics

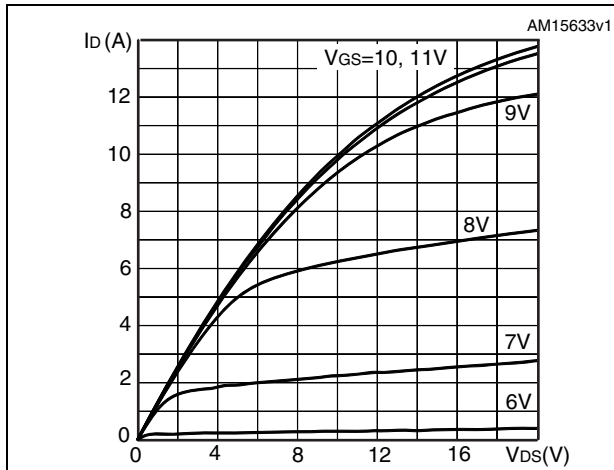


Figure 5. Transfer characteristics

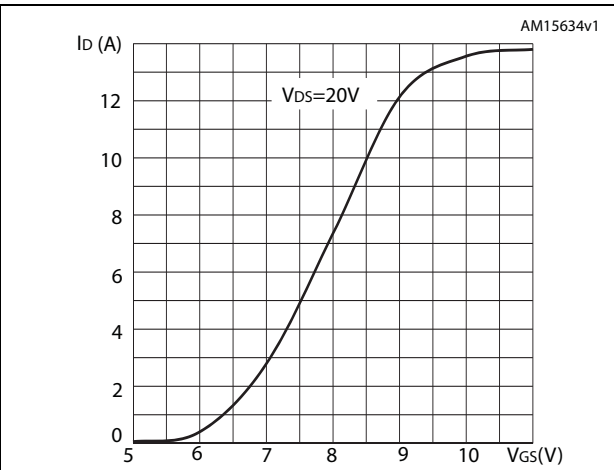


Figure 6. Gate charge vs gate-source voltage

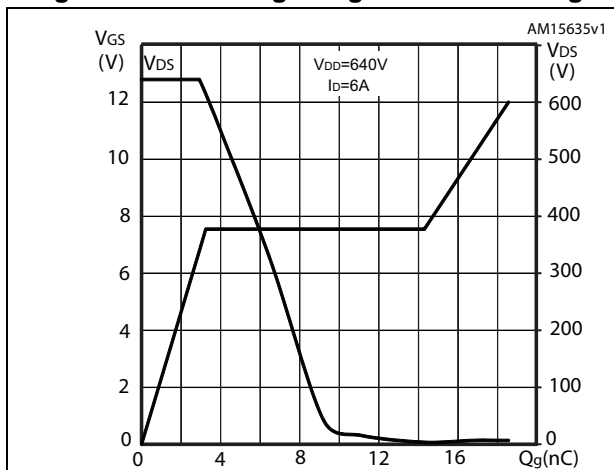


Figure 7. Static drain-source on-resistance

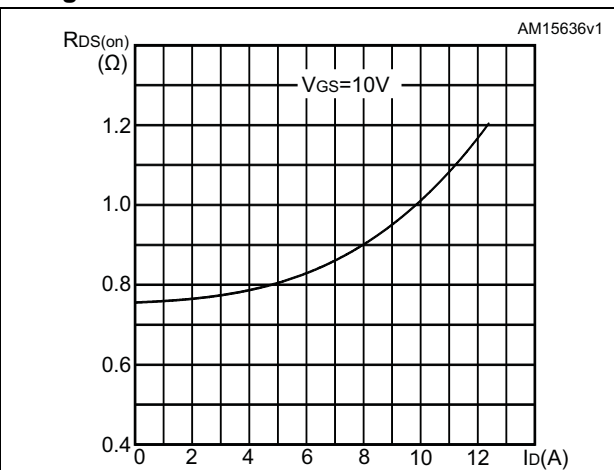


Figure 8. Capacitance variations

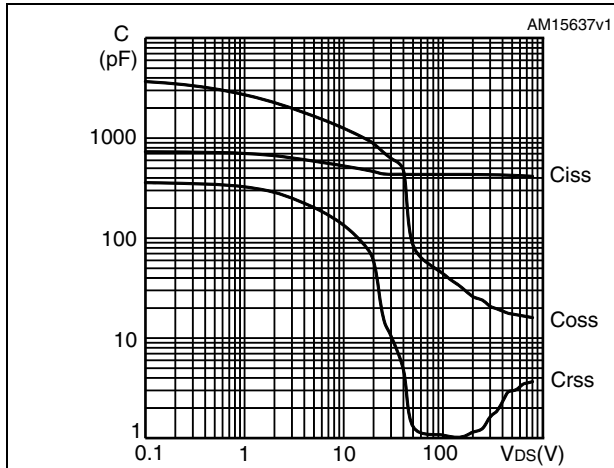


Figure 9. Output capacitance stored energy

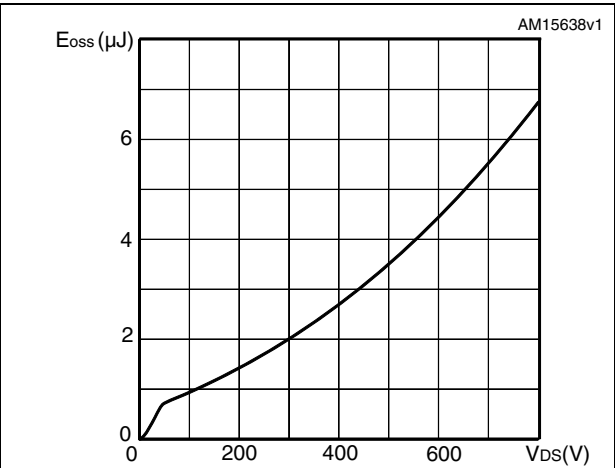


Figure 10. Normalized gate threshold voltage vs. temperature

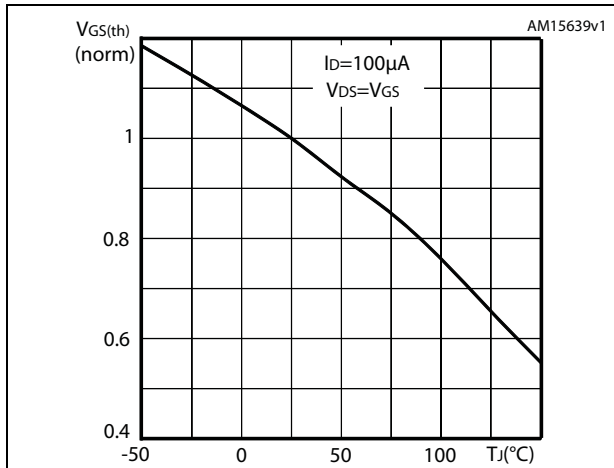


Figure 11. Normalized on-resistance vs. temperature

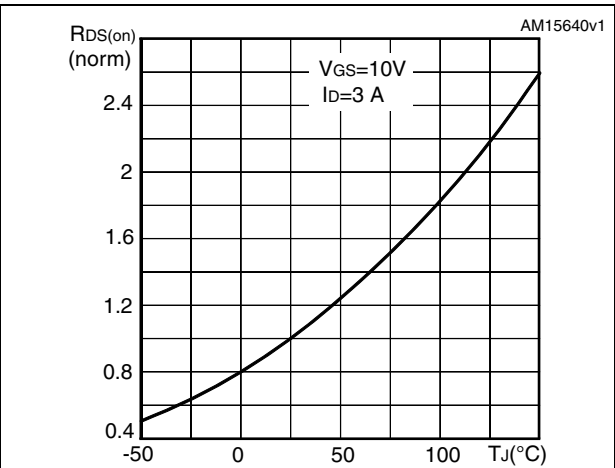


Figure 12. Drain-source diode forward characteristics

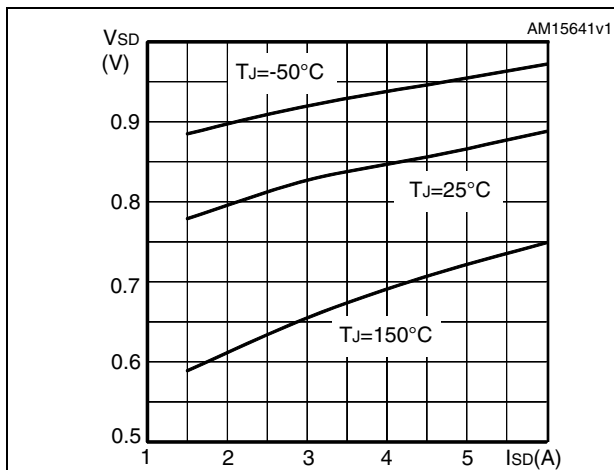


Figure 13. Normalized V<sub>DS</sub> vs. temperature

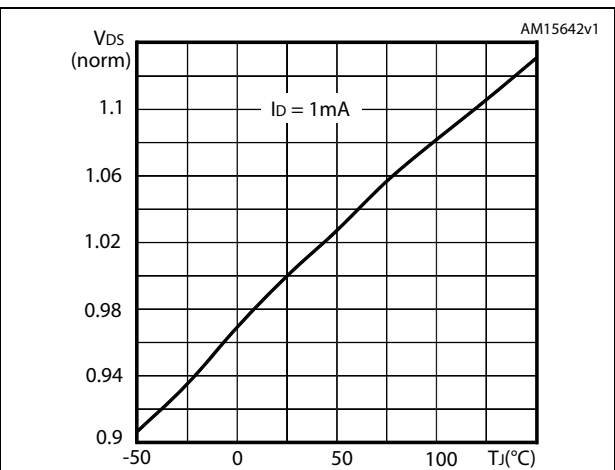
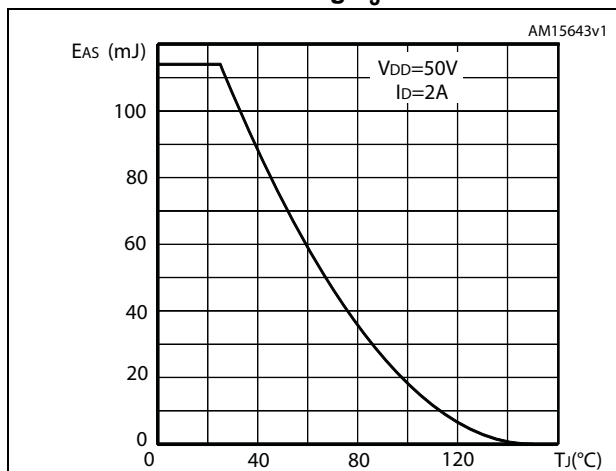


Figure 14. Maximum avalanche energy vs. starting  $T_J$





### 3 Test circuits

Figure 15. Switching times test circuit for resistive load

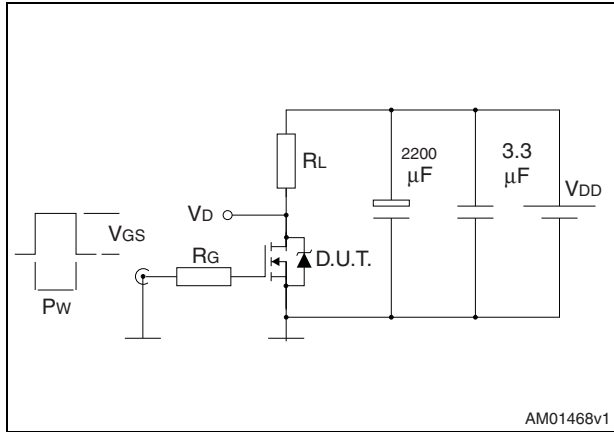


Figure 16. Gate charge test circuit

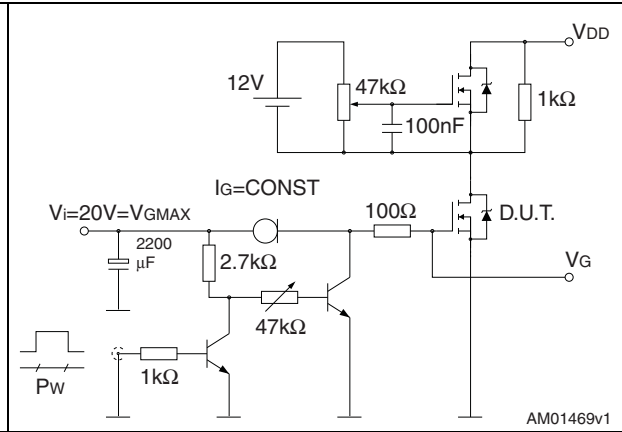


Figure 17. Test circuit for inductive load switching and diode recovery times

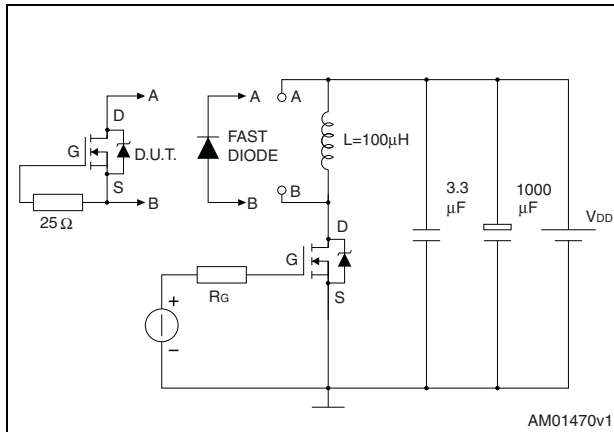


Figure 18. Unclamped inductive load test circuit

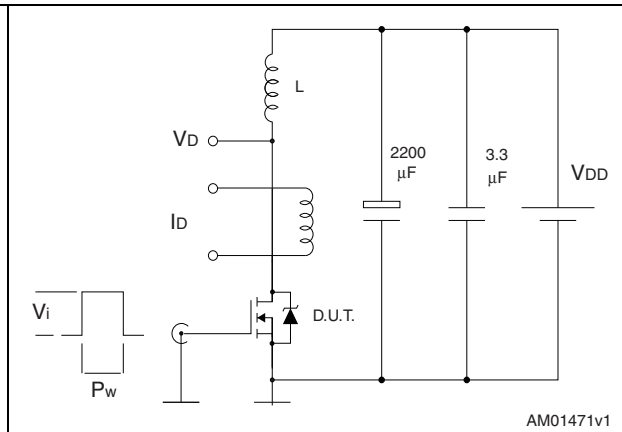


Figure 19. Unclamped inductive waveform

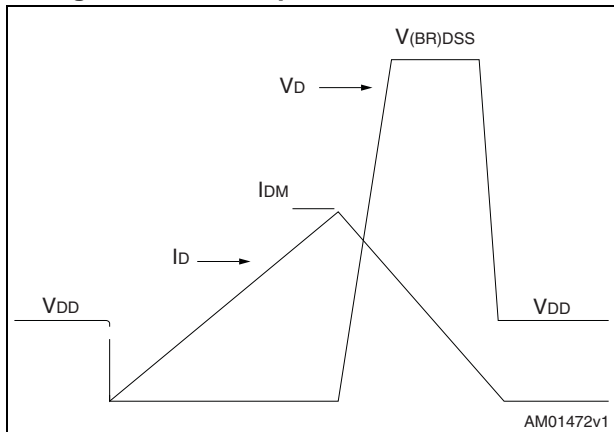
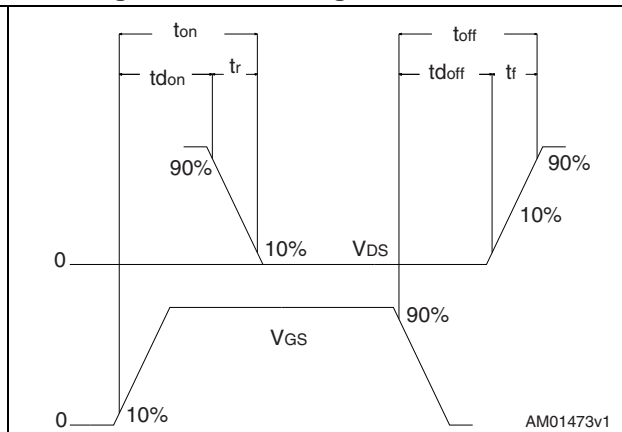


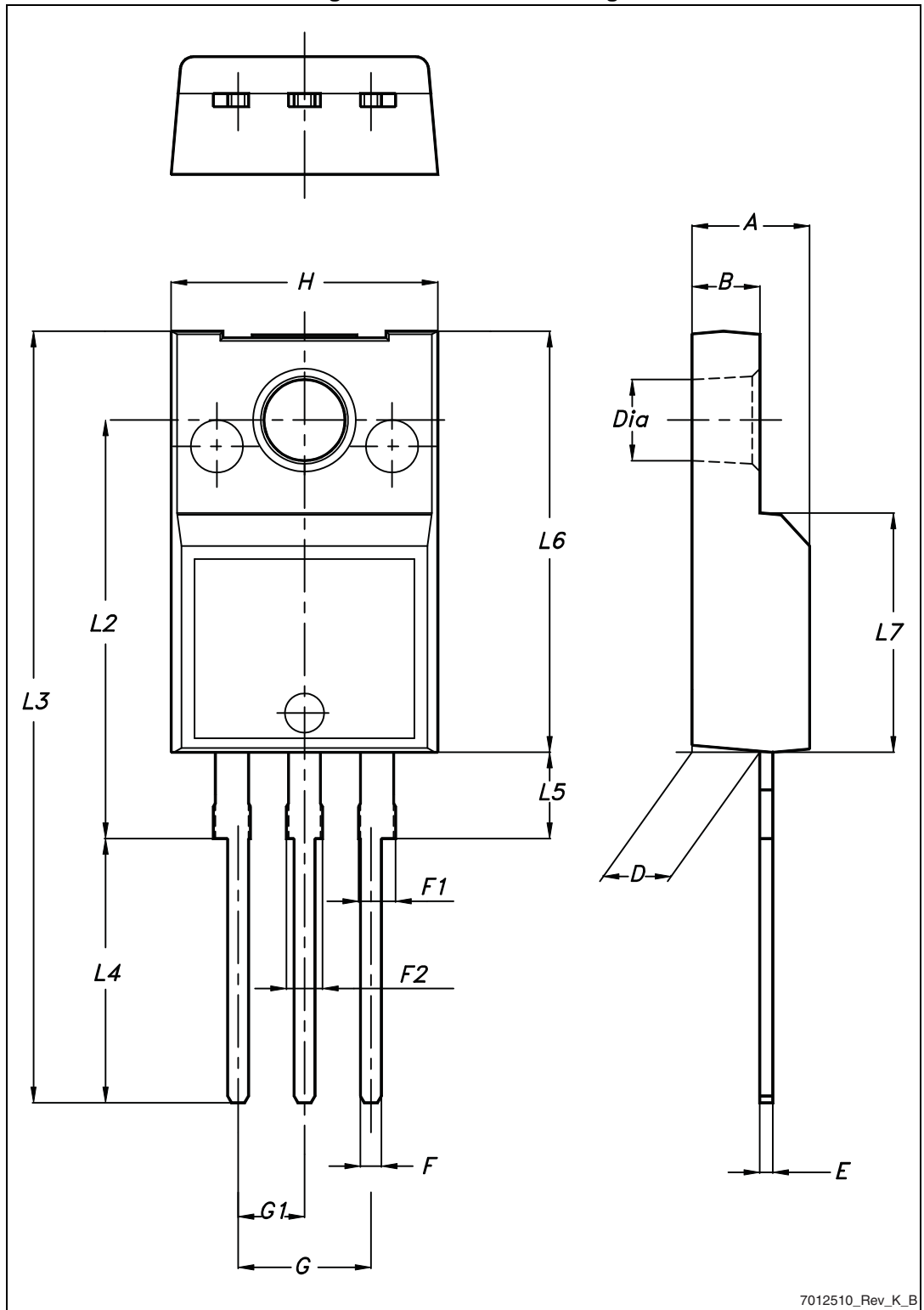
Figure 20. Switching time waveform



## 4 Package mechanical data

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

Figure 21. TO-220FP drawing



7012510\_Rev\_K\_B

Table 9. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 22. I<sup>2</sup>PAKFP (TO-281) drawing

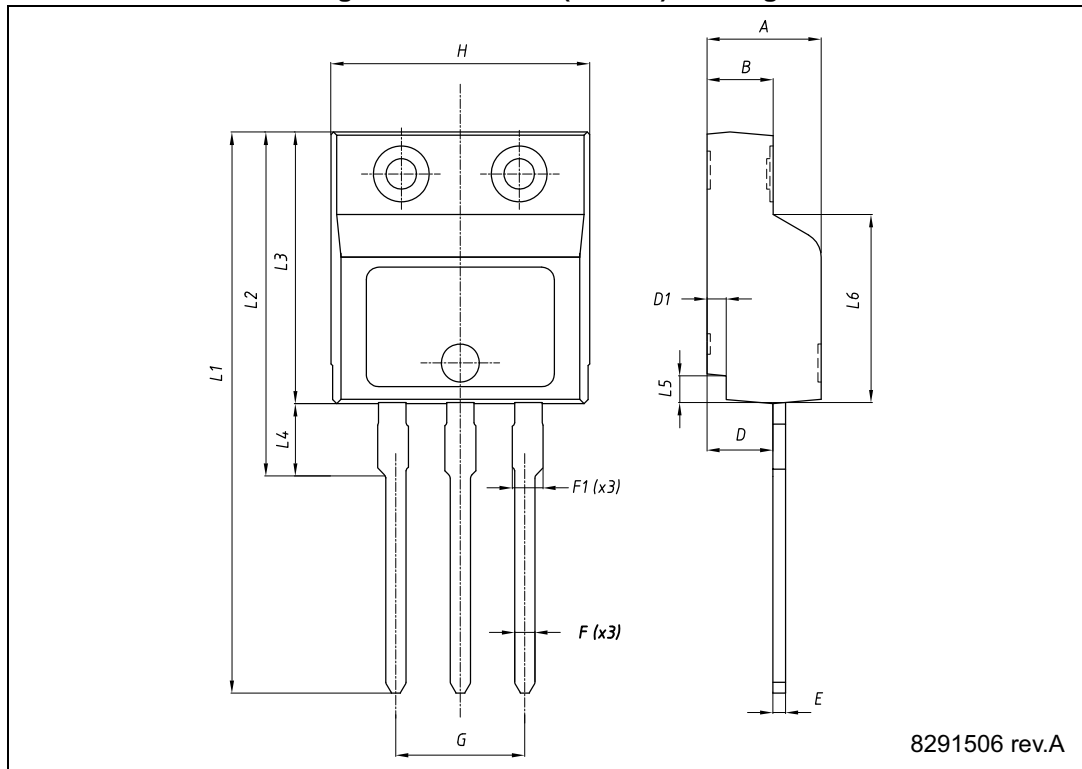


Table 10. I<sup>2</sup>PAKFP (TO-281) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
D1	0.65		0.85
E	0.45		0.70
F	0.75		1.00
F1			1.20
G	4.95	-	5.20
H	10.00		10.40
L1	21.00		23.00
L2	13.20		14.10
L3	10.55		10.85
L4	2.70		3.20
L5	0.85		1.25
L6	7.30		7.50

## 5 Revision history

**Table 11. Document revision history**

Date	Revision	Changes
25-Mar-2012	1	First release. Part numbers previously included in datasheet DM00062075
27-Mar-2013	2	Added: MOSFET dv/dt ruggedness on <a href="#">Table 2</a>
28-Oct-2014	3	Updated title with "MDmesh™ K5" nomenclature Document status promoted from preliminary data to production data Updated cover page <a href="#">Features</a> list Updated cover page <a href="#">Description</a> Updated zener diode descriptions in <a href="#">Section 2: Electrical characteristics</a> Updated <a href="#">Figure 7: Static drain-source on-resistance</a> Reordered drawings and tables in <a href="#">Section 4: Package mechanical data</a>

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