STF13NM60N-H

N-channel 600 V, 0.28 Ω, 11 A MDmesh™ II Power MOSFET in TO-220FP

Features

Type	V_{DSS} (@Tjmax)	$R_{DS(on)}$ max	I_D
STF13NM60N-H	650 V	< 0.36 Ω	11 A

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Application

- Switching applications

Description

This series of devices implements second generation MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.
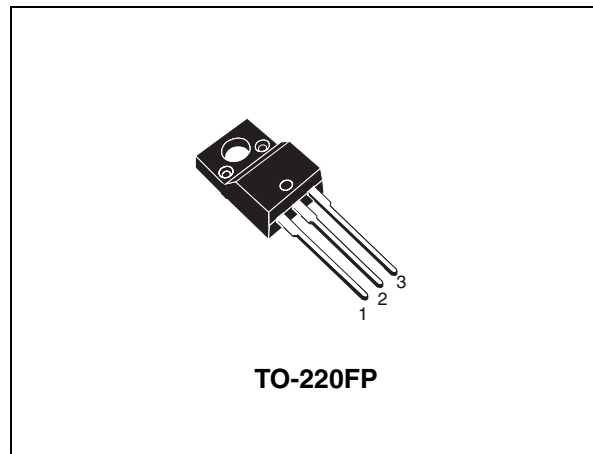

TO-220FP
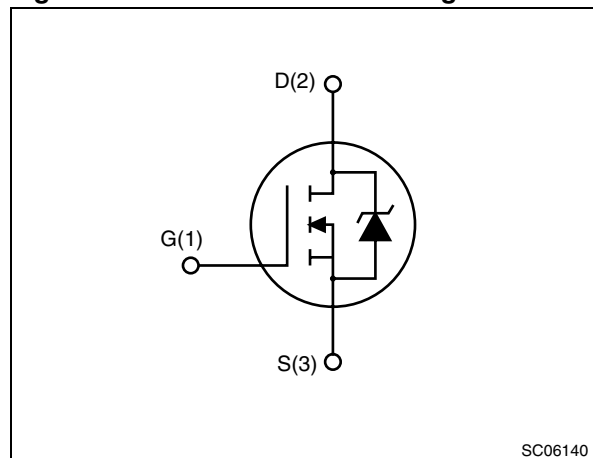
Figure 1. Internal schematic diagram

SC06140

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STF13NM60N-H[1]	13NM60N	TO-220FP	Tube

1. The device meets ECOPACK® standards, an environmentally-friendly grade of products commonly referred to as "halogen-free" . See *Section 4: Package mechanical data*.

Contents

1 Electrical ratings

Table 2.   Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage (V_{GS} = 0)	600	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at T_C = 25 °C	11[1]	A
I_D	Drain current (continuous) at T_C = 100 °C	6.93 [1]	A
I_{DM} [2]	Drain current (pulsed)	44 [1]	A
P_{TOT}	Total dissipation at T_C = 25 °C	25	W
dv/dt [3]	Peak diode recovery voltage slope	15	V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s;T_C=25 °C)	2500	V
T_{stg}	Storage temperature	−55 to 150	°C
T_j	Max. operating junction temperature	150	°C

1. Limited only by maximum temperature allowed

2. Pulse width limited by safe operating area

3. I_{SD} ≤11 A, di/dt ≤400 A/µs, V_{DD} ≤ 80% $V_{(BR)DSS}$

Table 3.   Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5	°C/W
T_l	Maximum lead temperature for soldering purpose	300	°C

Table 4.   Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by Tj max)	3.5	A
E_{AS}	Single pulse avalanche energy (starting T_J=25 °C, I_D=I_{AS}, V_{DD}=50 V)	200	mJ

2 Electrical characteristics

(T_{CASE} = 25 °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 mA, V_{GS} = 0	600			V
dv/dt [1]	Drain source voltage slope	V_{DD}=480 V, I_D = 9 A, V_{GS}=10 V		45		V/ns
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = Max rating V_{DS} = Max rating, @125 °C			1 10	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 20 V			0.1	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 5.5 A		0.28	0.36	Ω

1. Characteristic value at turn off on inductive load

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} [1]	Forward transconductance	V_{DS}=15 V, I_D = 5.5 A	-	7	-	S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	790 60 3.6	-	pF pF pF
$C_{oss\ eq.}$ [2]	Equivalent output capacitance	V_{GS} = 0, V_{DS} = 0 to 480 V	-	135	-	pF
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 480 V, I_D = 11 A, V_{GS} = 10 V, *(see Figure 17)*	-	30 15 4	-	nC nC nC
R_G	Gate input resistance	f=1 MHz Gate DC Bias=0 Test signal level = 20 mV open drain	-	4.7	-	Ω

1. Pulsed: Pulse duration = 300 µs, 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_{DS}

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 5.5 A R_G = 4.7 Ω V_{GS} = 10 V *(see Figure 16)*	-	3	-	ns
t_r	Rise time			8		ns
$t_{d(off)}$	Turn-off delay time			30		ns
t_f	Fall time			10		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD}	Source-drain current		-		11	A
I_{SDM} [1]	Source-drain current (pulsed)				44	A
V_{SD} [2]	Forward on voltage	I_{SD} = 11 A, V_{GS} = 0	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 9 A, di/dt = 100 A/µs V_{DD} = 100 V *(see Figure 18)*	-	230		ns
Q_{rr}	Reverse recovery charge			2		µC
I_{RRM}	Reverse recovery current			18		A
t_{rr}	Reverse recovery time	I_{SD} = 9 A, di/dt = 100 A/µs V_{DD} = 100 V, T_j = 150 °C *(see Figure 18)*	-	290		ns
Q_{rr}	Reverse recovery charge			190		µC
I_{RRM}	Reverse recovery current			17		A

1. Pulse width limited by safe operating area

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

2.1 Electrical characteristics (curves)

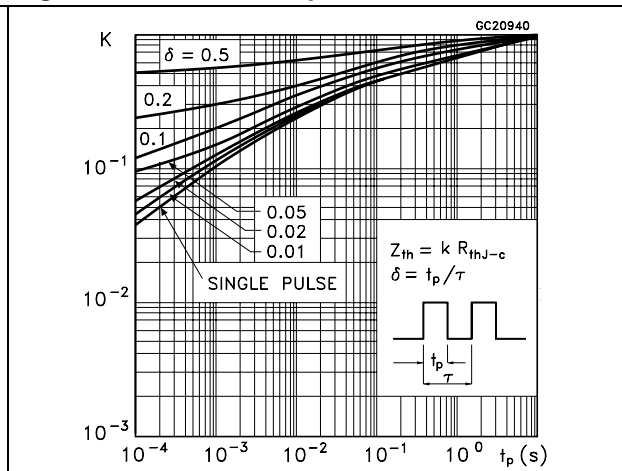**Figure 2. Safe operating area**
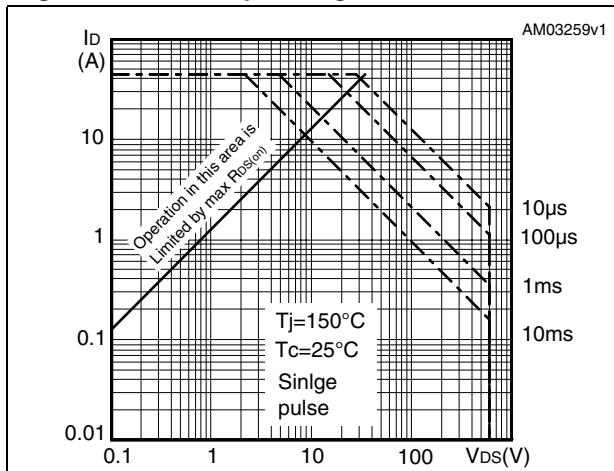
Figure 3. Thermal impedance

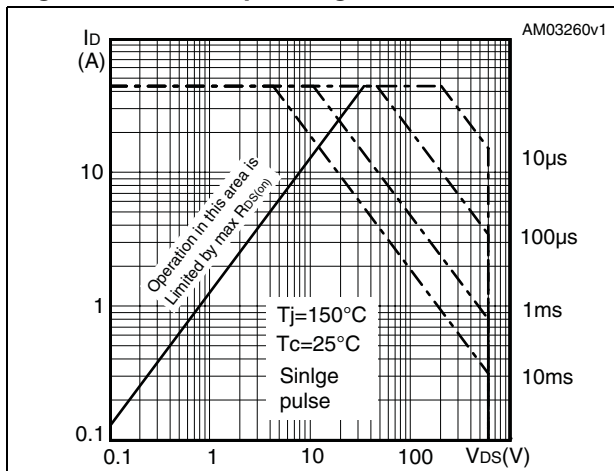**Figure 4. Safe operating area for DPAK**

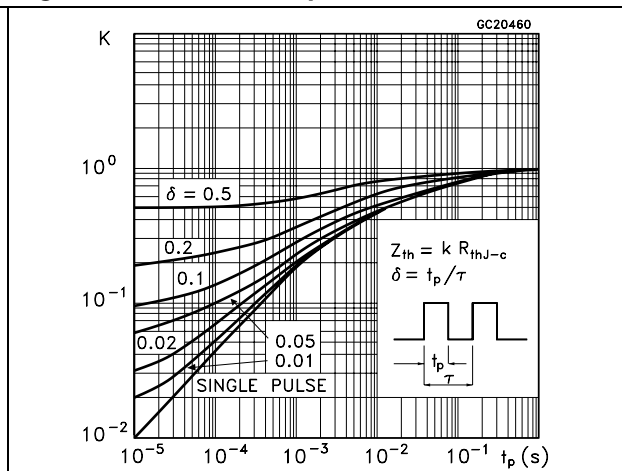**Figure 5. Thermal impedance for DPAK**

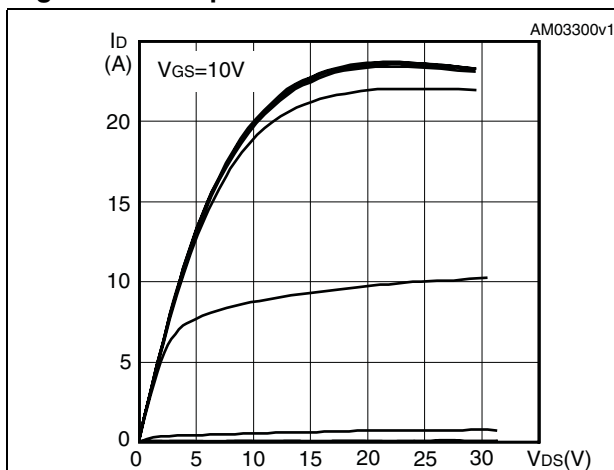**Figure 6. Output characteristics**

Figure 7. Transfer characteristics
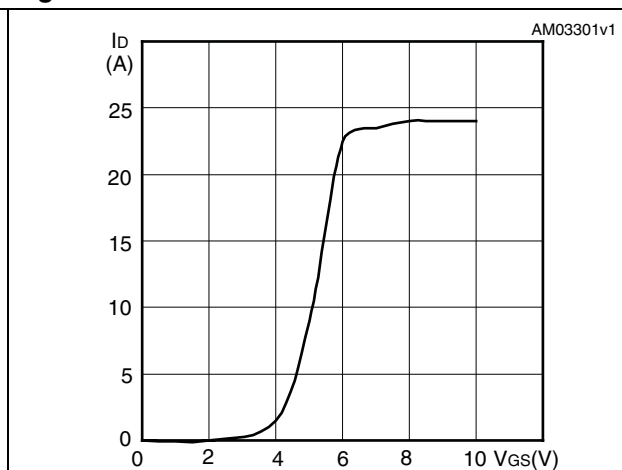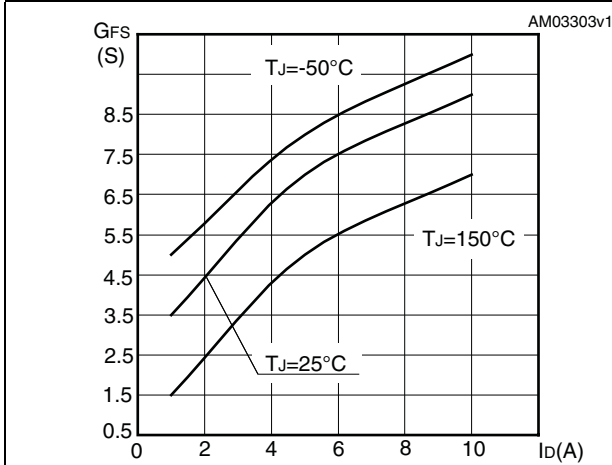
Figure 8.   Transconductance

Figure 9.   Static drain-source on resistance
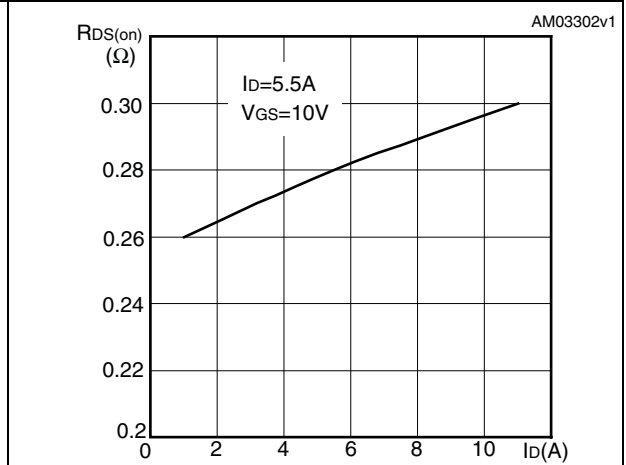
Figure 10.   Gate charge vs gate-source voltage
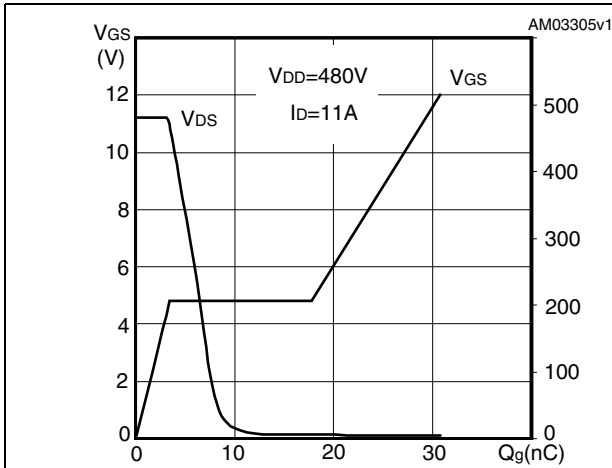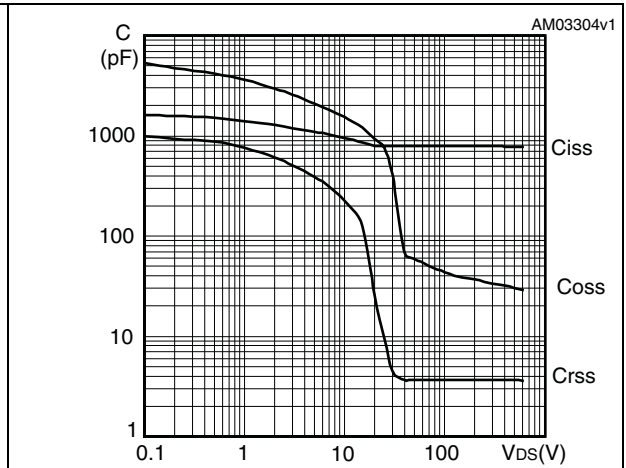

Figure 11.   Capacitance variations

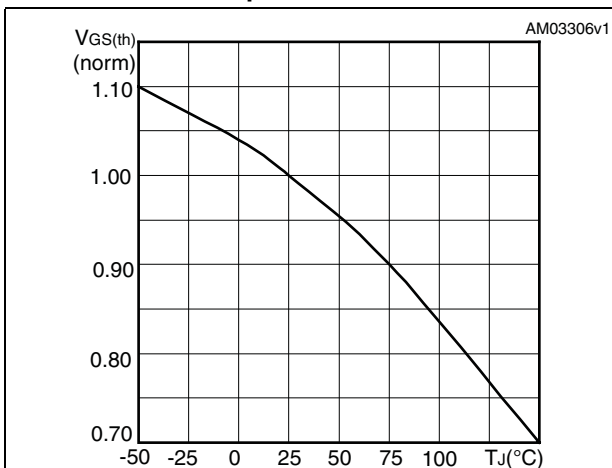**Figure 12.   Normalized gate threshold voltage vs temperature**

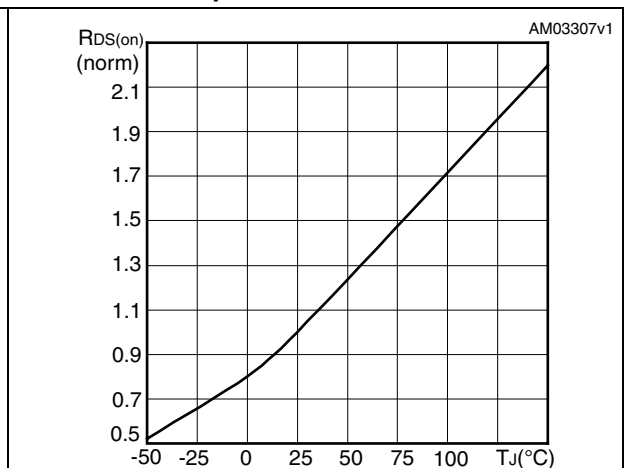**Figure 13.   Normalized on resistance vs temperature**

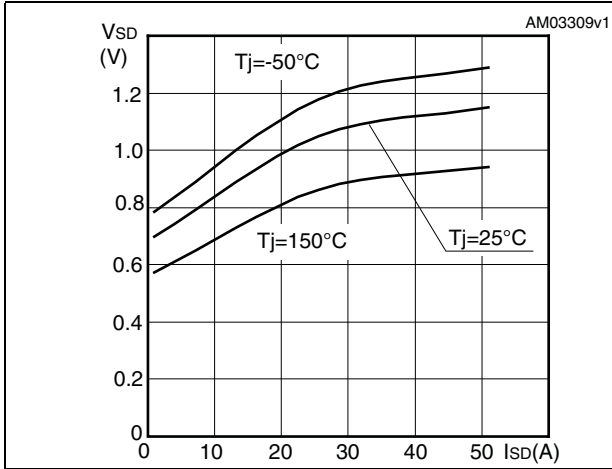**Figure 14. Source-drain diode forward characteristics**
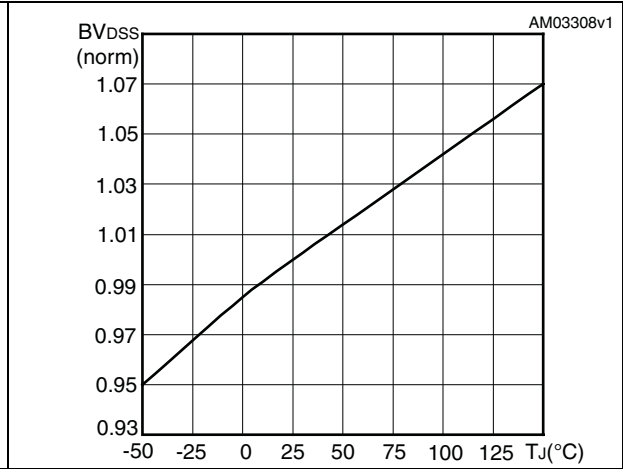

Figure 15. Normalized B_VDSS vs temperature

3   Test circuits
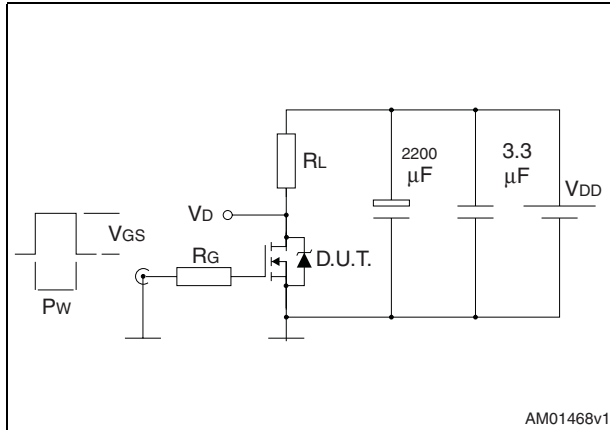
Figure 16.   Switching times test circuit for resistive load

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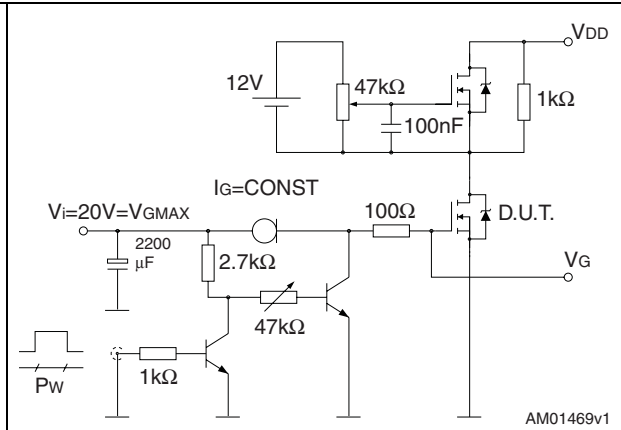**Figure 17.   Gate charge test circuit**

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Figure 18.   Test circuit for inductive load switching and diode recovery times
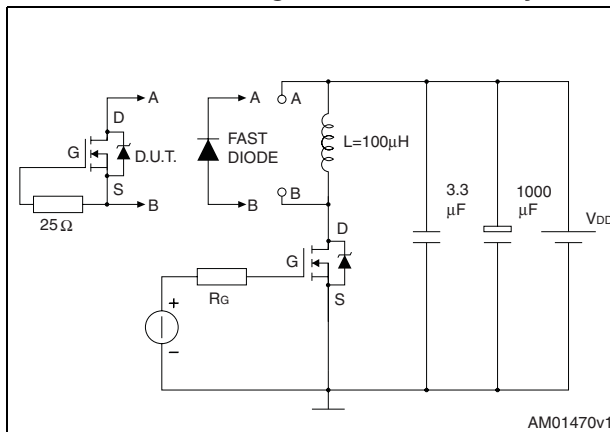

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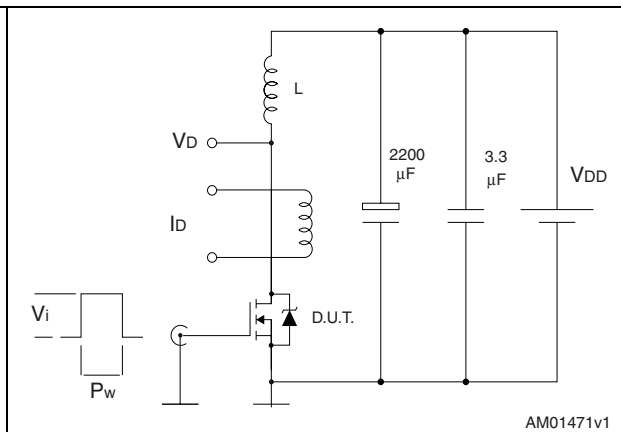
Figure 19.   Unclamped inductive load test circuit

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Figure 20.   Unclamped inductive waveform
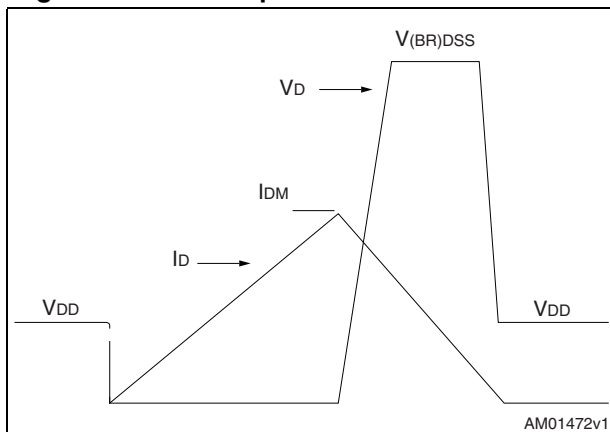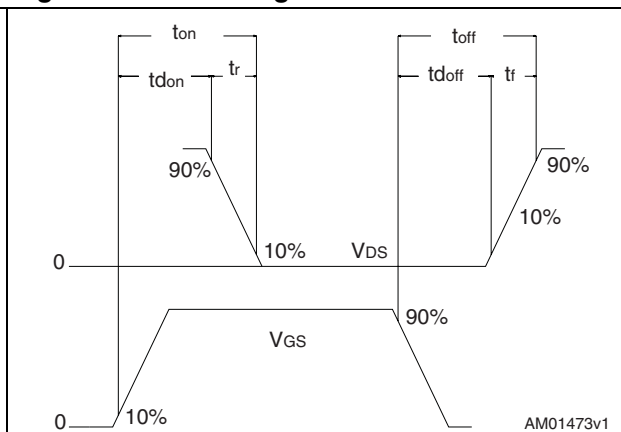

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**Figure 21.   Switching time waveform**

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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. ECOPACK is an ST trademark.

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.   TO-220FP drawing

7012510_Rev_K
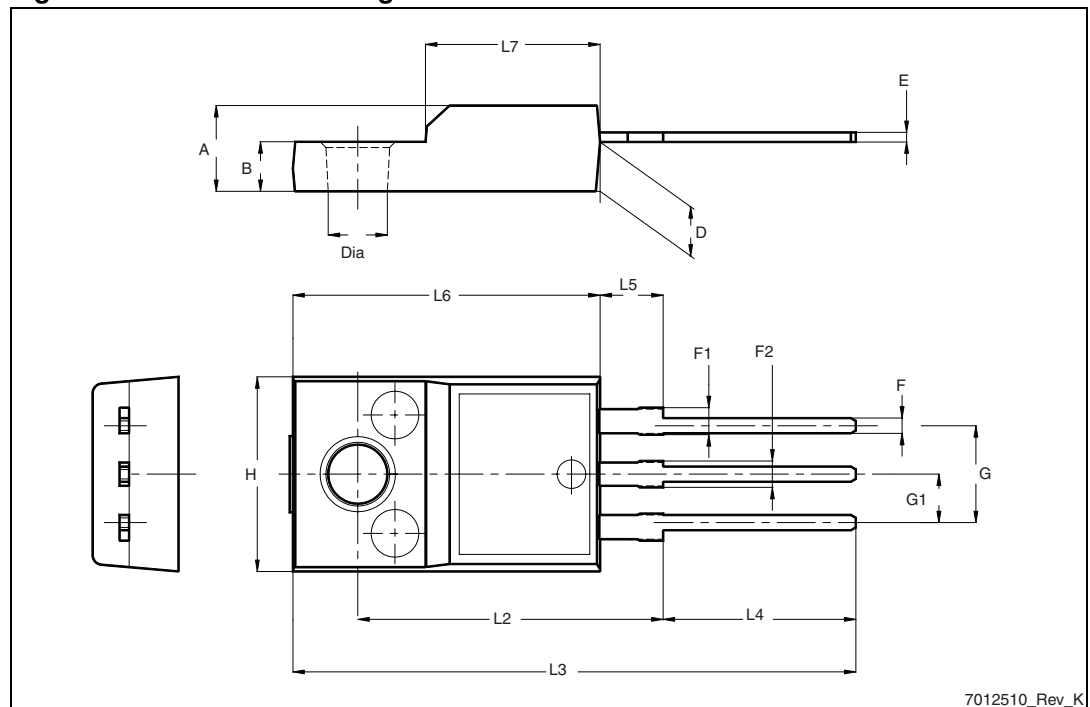
5 Revision history

Table 10.   Document revision history

Date	Revision	Changes
08-Jan-2010	1	First release

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