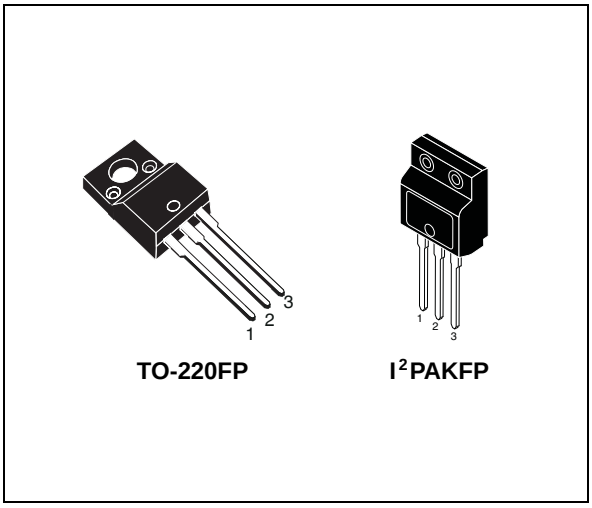
STF10N60M2, STFI10N60M2

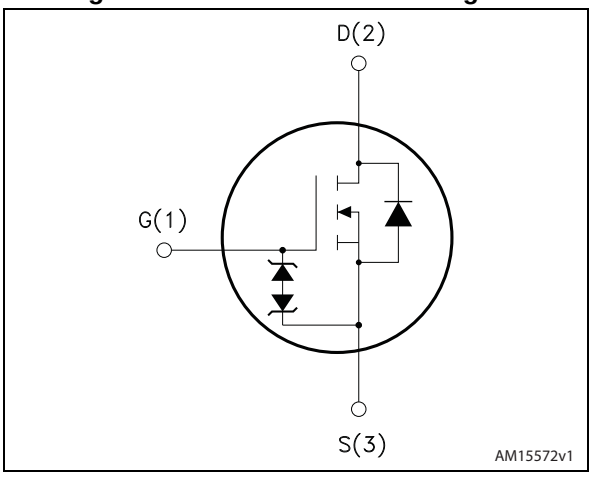
N-channel 600 V, 0.550 Ω typ., 7.5 A MDmesh II Plus™ low Q_g Power MOSFETs in TO-220FP and I²PAKFP packages

Datasheet – production data



TO-220FP **I²PAKFP**

Figure 1. Internal schematic diagram



Features

Order codes	V_{DS} @ T_{Jmax}	$R_{DS(on)}$ max	I_D
STF10N60M2	650 V	0.6 Ω	7.5 A
STFI10N60M2			

- Extremely low gate charge
- Lower $R_{DS(on)}$ x area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using a new generation of MDmesh™ technology: MDmesh II Plus™ low Q_g. These revolutionary Power MOSFETs associate a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. They are therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STF10N60M2	10N60M2	TO-220FP	Tube
STFI10N60M2		I²PAKFP (TO281)	

This is information on a product in full production. www.st.com

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at T_C = 25 °C	7.5(1)	A
I_D	Drain current (continuous) at T_C = 100 °C	4.9(1)	A
I_{DM} (1)	Drain current (pulsed)	30(1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	25	W
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
dv/dt(3)	MOSFET dv/dt ruggedness	50	
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		

1. Pulse width limited by safe operating area
2. $I_{SD} \leq 7.5$ A, di/dt ≤ 400 A/μs; $V_{DS\ peak} < V_{(BR)DSS}$, V_{DD}=400 V
3. $V_{DS} \leq 480$ V

Table 3. Thermal data

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

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	2.5	A
E_{AS}	Single pulse avalanche energy (starting T_j=25°C, I_D= I_{AR}; V_{DD}=50)	110	mJ

2 Electrical characteristics

(T_C = 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
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 600 V V_{DS} = 600 V, T_C=125 °C			1 100	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 V			±10	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 = 3 A		0.550	0.6	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0	-	400	-	pF
C_{oss}	Output capacitance		-	22	-	pF
C_{rss}	Reverse transfer capacitance		-	0.84	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0	-	83	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	6.4	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 7.5 A, V_{GS} = 10 V (see *Figure 15*)	-	13.5	-	nC
Q_{gs}	Gate-source charge		-	2.1	-	nC
Q_{gd}	Gate-drain charge		-	7.2	-	nC

1. $C_{oss\ eq.}$ 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}

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 = 3.75 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 14* and *Figure 19*)	-	8.8	-	ns
t_r	Rise time		-	8	-	ns
$t_{d(off)}$	Turn-off delay time		-	32.5	-	ns
t_f	Fall time		-	13.2	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		7.5	A
I_{SDM} (1)	Source-drain current (pulsed)		-		30	A
V_{SD} (2)	Forward on voltage	I_{SD} = 7.5 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 7.5 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 16*)	-	270		ns
Q_{rr}	Reverse recovery charge		-	2		µC
I_{RRM}	Reverse recovery current		-	14.4		A
t_{rr}	Reverse recovery time	I_{SD} = 7.5 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see *Figure 16*)	-	376		ns
Q_{rr}	Reverse recovery charge		-	2.8		µC
I_{RRM}	Reverse recovery current		-	15		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

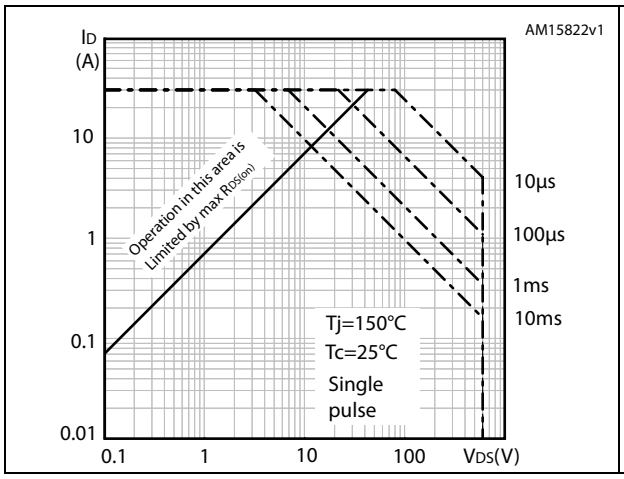


Figure 3. Thermal impedance

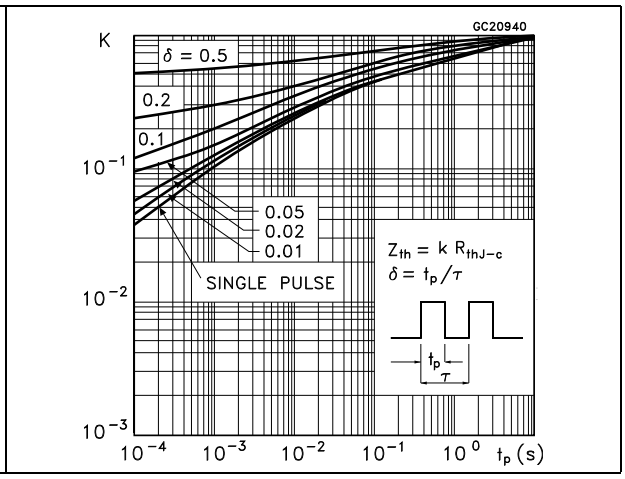


Figure 4. Output characteristics

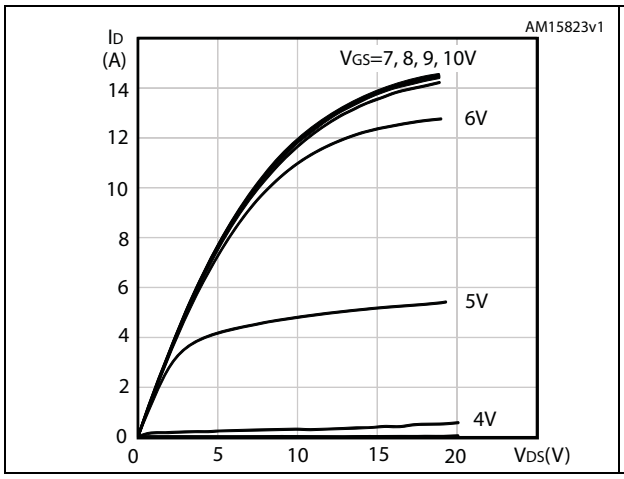


Figure 5. Transfer characteristics

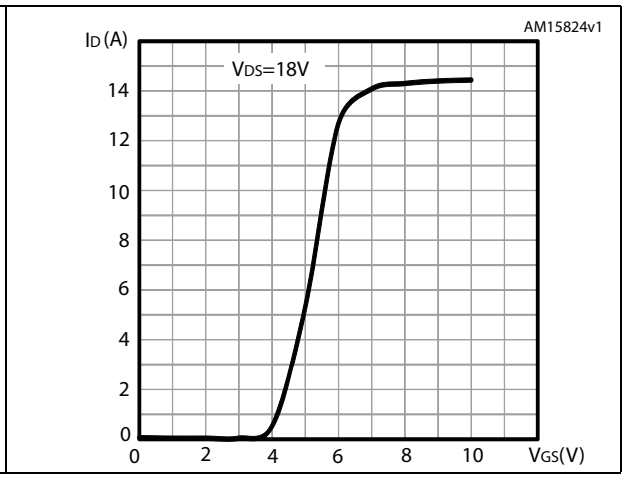


Figure 6. Gate charge vs gate-source voltage

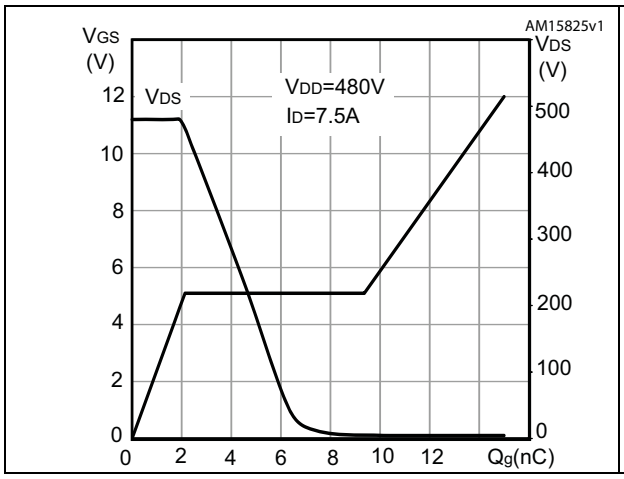


Figure 7. Static drain-source on-resistance

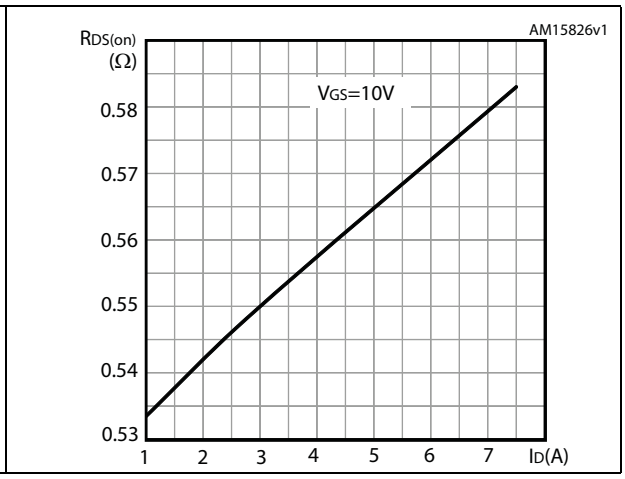


Figure 8. Capacitance variations

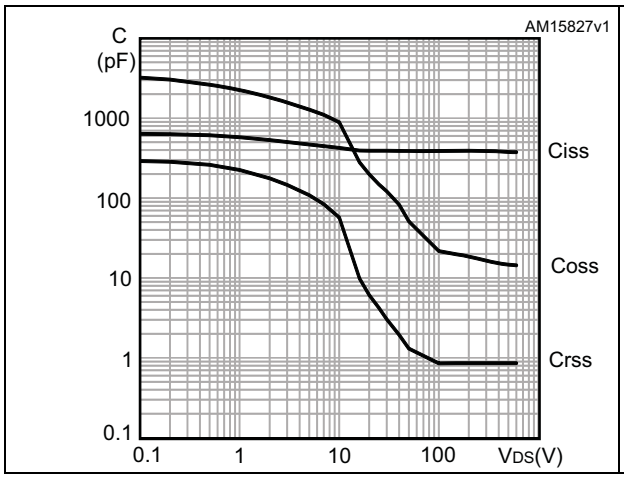


Figure 9. Normalized gate threshold voltage vs. temperature

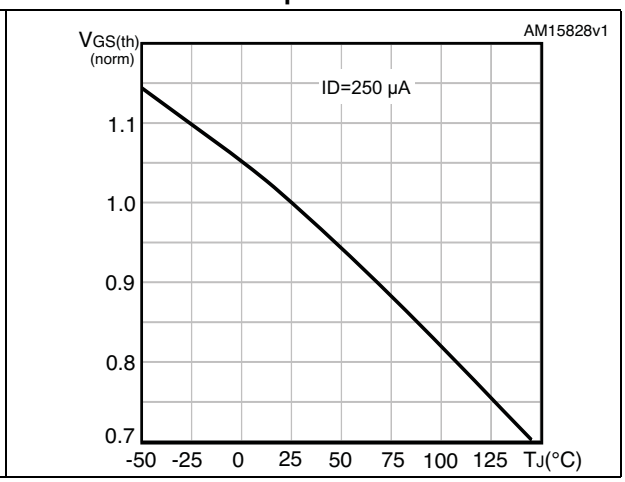


Figure 10. Normalized on-resistance vs temperature

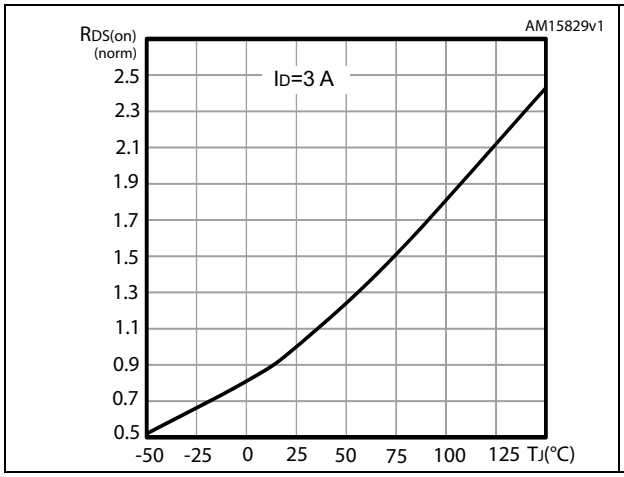


Figure 11. Source-drain diode forward characteristics

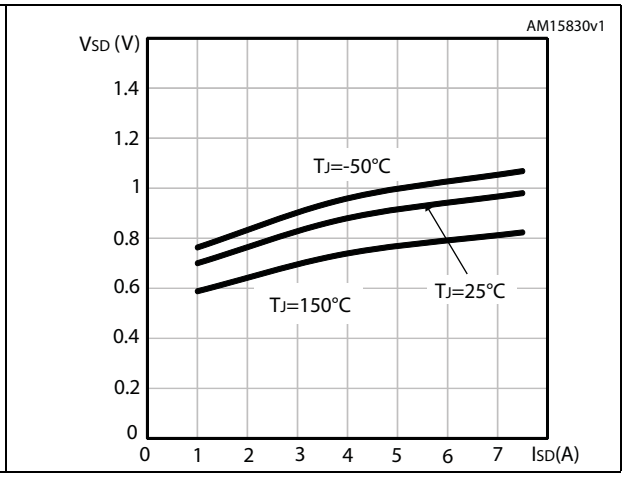


Figure 12. Normalized V_{DS} vs temperature

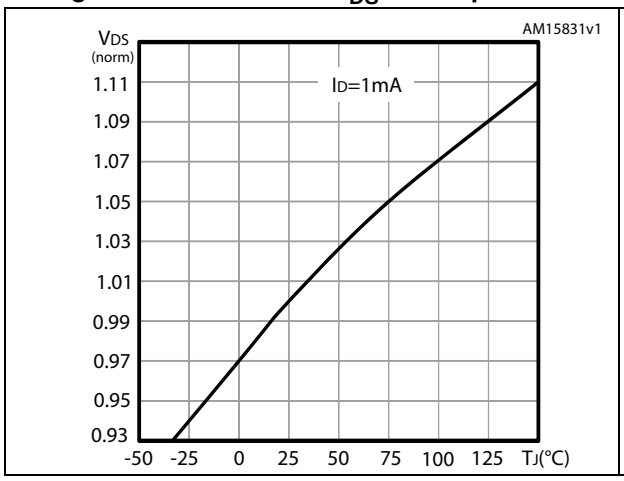
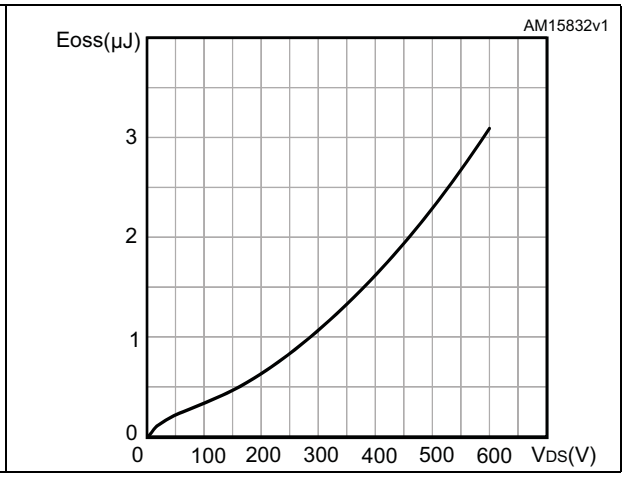


Figure 13. Output capacitance stored energy



3 Test circuits

Figure 14. Switching times test circuit for resistive load

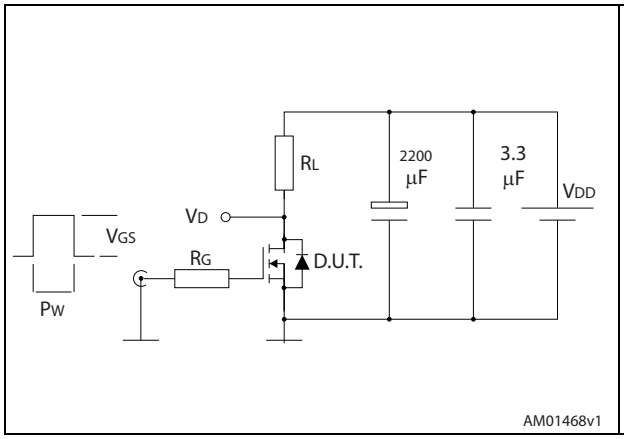


Figure 15. Gate charge test circuit

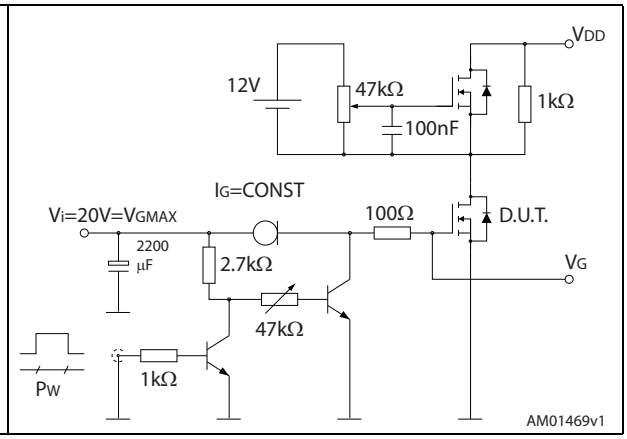


Figure 16. Test circuit for inductive load switching and diode recovery times

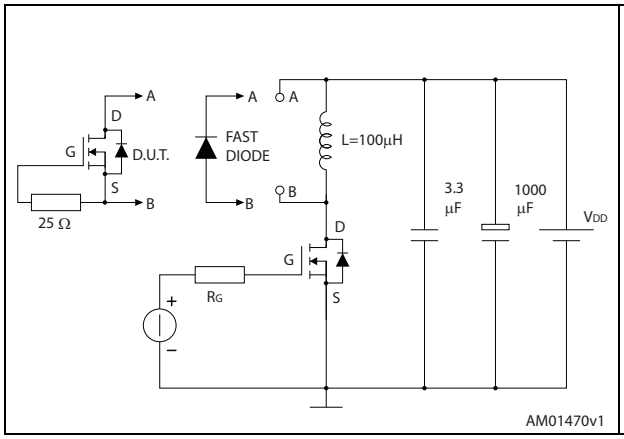


Figure 17. Unclamped inductive load test circuit

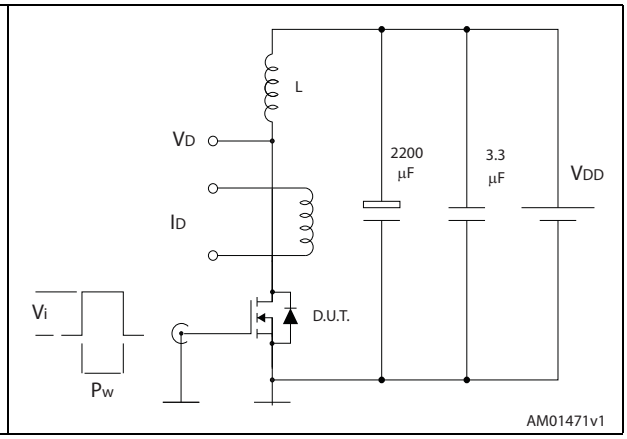


Figure 18. Unclamped inductive waveform

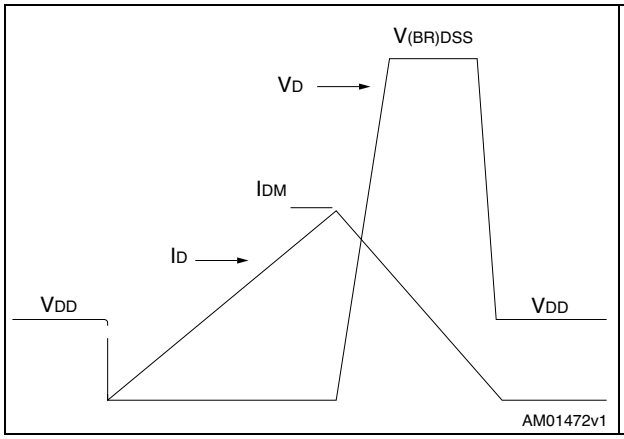
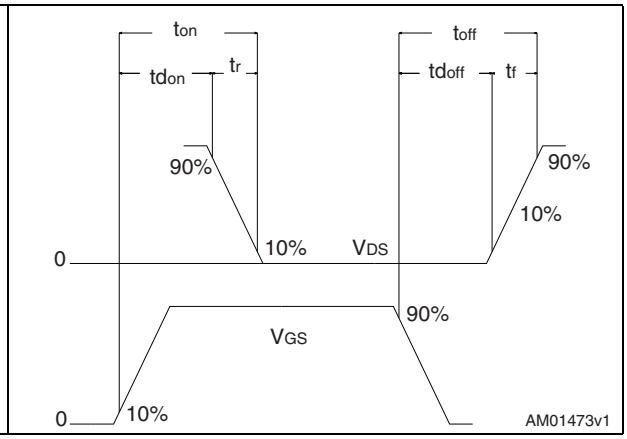


Figure 19. Switching time waveform



4 Package mechanical data

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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 20. TO-220FP drawing

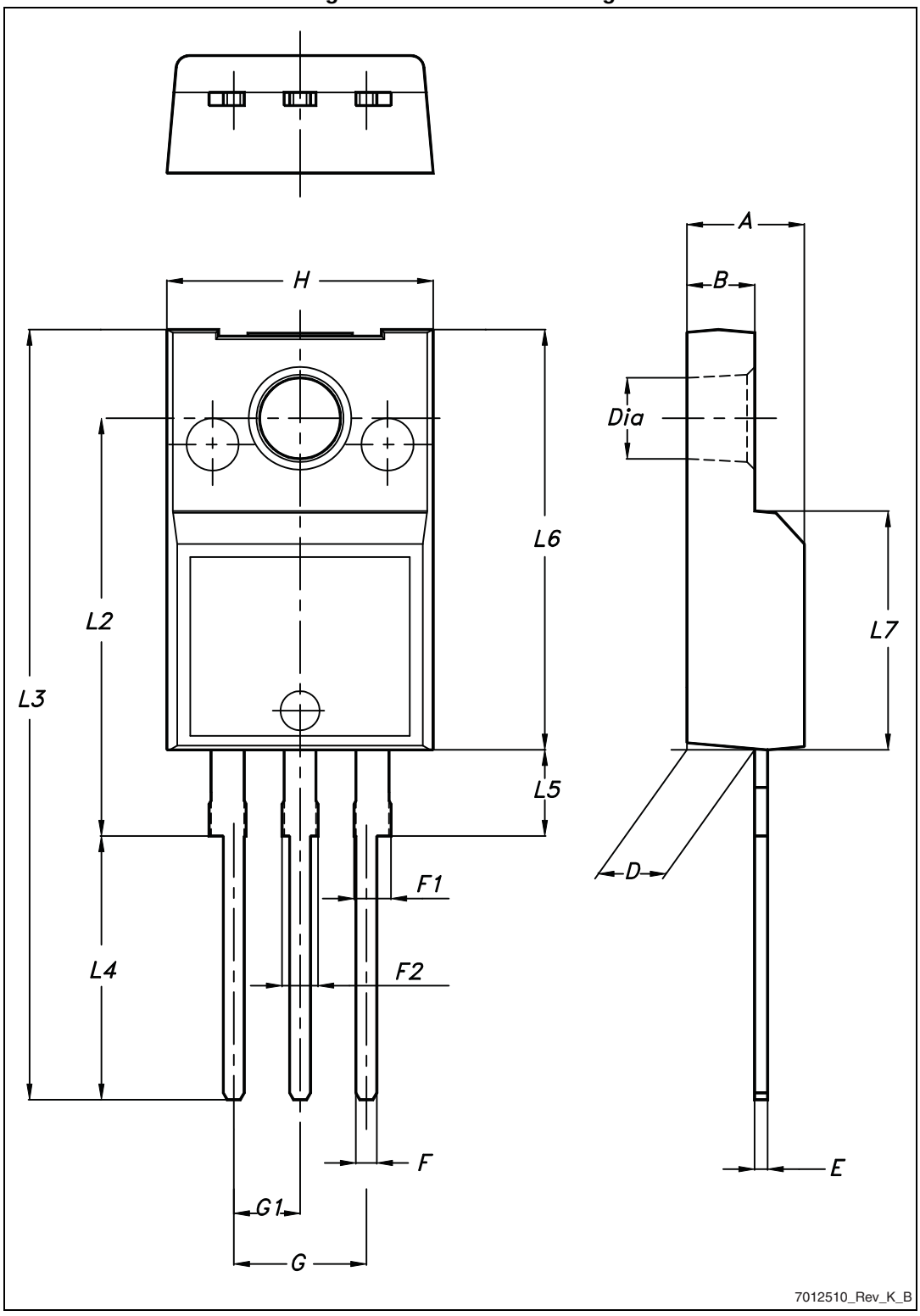
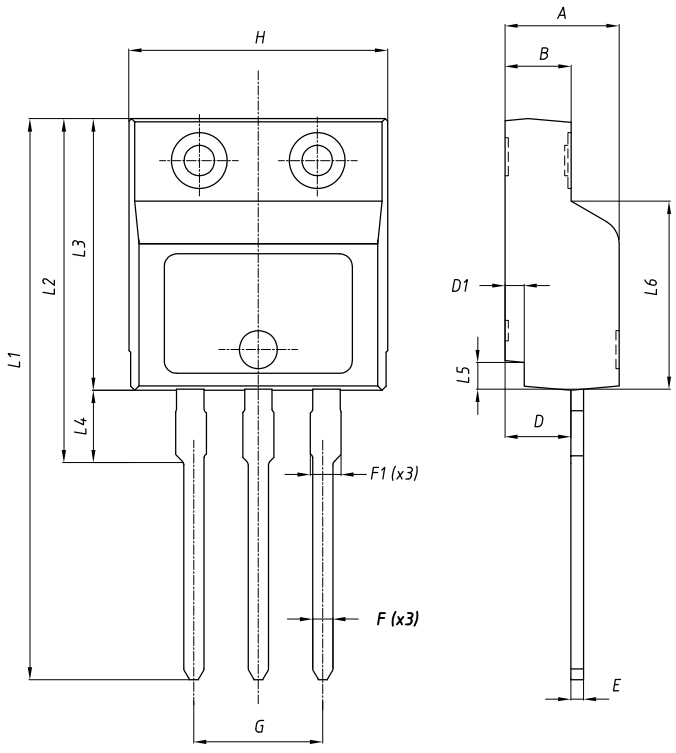


Table 10. I^2PAKFP (TO-281) mechanical data

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

Figure 21. I^2PAKFP (TO-281) drawing



5 Revision history

Table 11. Document revision history

Date	Revision	Changes
29-May-2013	1	First release.
14-Oct-2013	2	– Modified: R_G value in *Table 6* – Minor text changes
06-Dec-2013	3	– Added: I^2PAKFP package – Modified: title – Modified: $R_{DS(on)}$ typical values in *Table 5* – Modified: R_G value in *Table 6* – Modified: *Figure 7* and I_D value in *Figure 10* – Added: *Table 10*, and *Figure 21* – Minor text changes

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