STF15NM65N, STFI15NM65N, STP15NM65N

N-channel 650 V, 0.35 Ω typ., 12 A MDmesh™ II Power MOSFETs in TO-220FP, I²PAKFP and TO-220 packages

Datasheet - production data

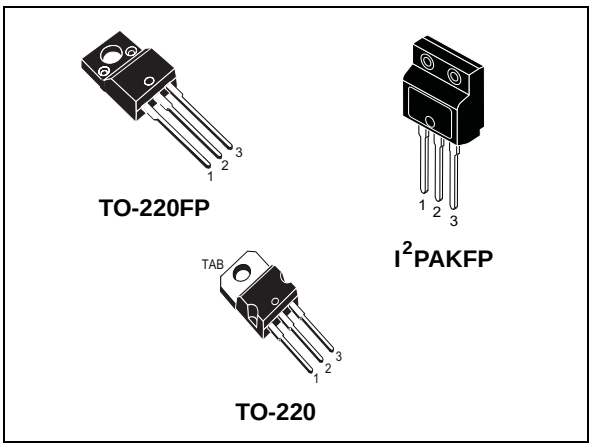
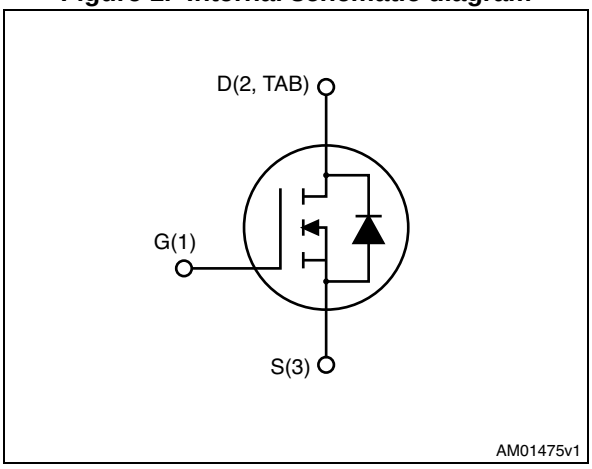


Figure 1. Internal schematic diagram



Features

Order codes	V_{DSS} @T_{jmax}	$R_{DS(on)}$ max.	I_D
STF15NM65N	710 V	0.38 Ω	12 A
STFI15NM65N			
STP15NM65N			

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

Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a 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.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STF15NM65N	15NM65N	TO-220FP	Tube
STFI15NM65N		I²PAKFP (TO-281)	
STP15NM65N		TO-220	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220FP, I^2PAKFP	TO-220	
V_{DS}	Drain source voltage	650		V
V_{GS}	Gate source voltage	± 25		V
I_D	Drain current continuous Tc=25 °C	12(1)	12	A
I_D	Drain current continuous Tc=100 °C	7.56	7.56	A
I_{DM} (2)	Drain current pulsed	48	48	A
P_{TOT}	Total dissipation at Tc=25 °C	30	125	W
dv/dt (3)	Peak diode recovery voltage slope	15		V/ns
V_{iso}	Insulation withstand voltage (RMS from all three leads to external heatsink (t=1 s; T_C=25 °C)	2500		V
T_J	Operating junction temperature	-55 to 150		°C
T_{sg}	Storage temperature			°C

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 12$ A, di/dt ≤ 400 A/µs, $V_{DSpeak} \leq V_{(BR)DSS}$, V_{DD} = 80 % $V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameters	Value		Unit
		TO-220FP, I^2PAKFP	TO-220	
R_{thjc}	Thermal resistance junction-case	4.17	1.0	°C/W
R_{thja}	Thermal resistance junction-ambient	62.5		°C/W

Table 4. Avalanche characteristics

Symbol	Parameters	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_{jmax})	3	A
E_{AS}	Single pulse avalanche energy (starting T_J=25 °C, I_D=I_{AR}, V_{DD}=50 V)	187	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, V_{GS} = 0	I_D = 1 mA	650			V
I_{DSS}	Zero gate voltage drain current (V_{GS}=0)	V_{DD} = 650 V			1	µA
		V_{DD} = 650 V, T_C = 125 °C			100	µA
I_{GSS}	Gate body leakage (V_{DS}=0)	V_{GS}= ±25 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	I_D=250 µA, $V_{GS=}V_{DS}$	2	3	4	V
$R_{DS(on)}$	Static $R_{DS(on)}$-resistance	I_D=6 A, V_{GS}=10V		0.35	0.38	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS}=50 V, f=1MHz, V_{GS}=0	-	983	-	pF
C_{oss}	Output capacitance		-	57	-	pF
C_{rss}	Reverse capacitance		-	4.5	-	pF
C_{osseq} (1)	Equivalent out. capacitance	V_{DS}=0 V to V_{GS}=0	-	146	-	pF
R_g	Intrinsic gate resistance	f=1MHz open drain	-	4.6	-	Ω
Q_g	Total gate charge	V_{DD}=520 V, I_D=12 A, V_{GS}=10 V	-	33.3	-	nC
Q_{gs}	Gate source charge		-	5.7	-	nC
Q_{gd}	Gate-drain charge		-	17	-	nC

1. Cross eq: 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}=325 V, I_D=6 A R_g=4.7 Ω, V_{GS}=10 V	-	55.5	-	ns
t_r	Rise time		-	8.5	-	ns
$t_{d(off)}$	Turn-off-delay time		-	14	-	ns
t_f	Fall time		-	11.4	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source drain current		-		12	A
I_{SDM}(1)	Source drain current (pulsed)		-		48	A
V_{SD}(2)	Forward on voltage	I_{SD} = 12 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 12 A, di/dt = 100 A/µs V_{DD} = 60 V	-	428		ns
Q_{rr}	Reverse recovery charge		-	4.7		nC
I_{RRM}	Reverse recovery current		-	21.5		A
t_{rr}	Reverse recovery time	I_{SD}=12 A, di/dt=100 A/µs V_{DD}=60 V, T_j=150 °C	-	570		ns
Q_{rr}	Reverse recovery charge		-	6.2		nC
I_{RRM}	Reverse recovery current		-	22		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 for TO-220FP and I^2PAKFP

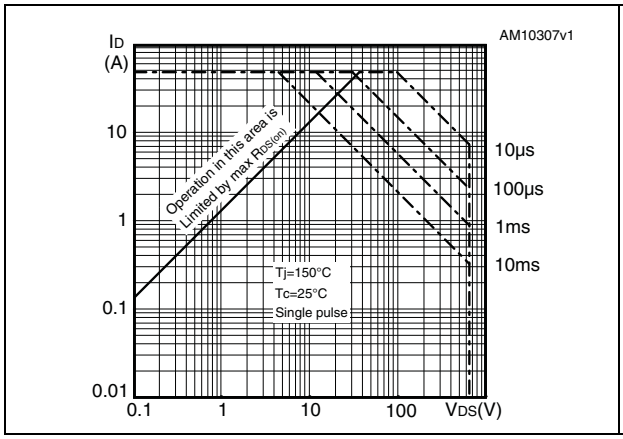


Figure 3. Thermal impedance for TO-220FP and I^2PAKFP

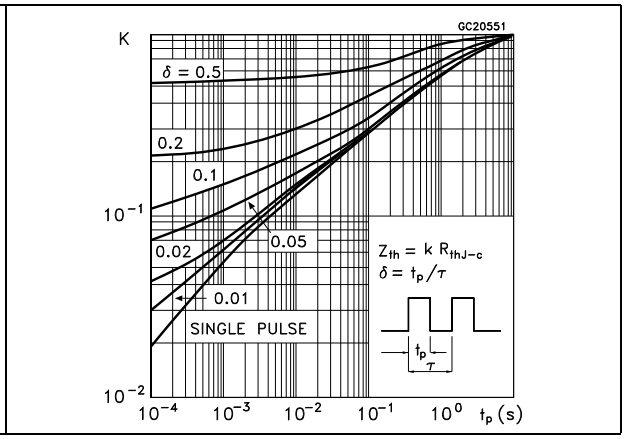


Figure 4. Safe operating area for TO-220

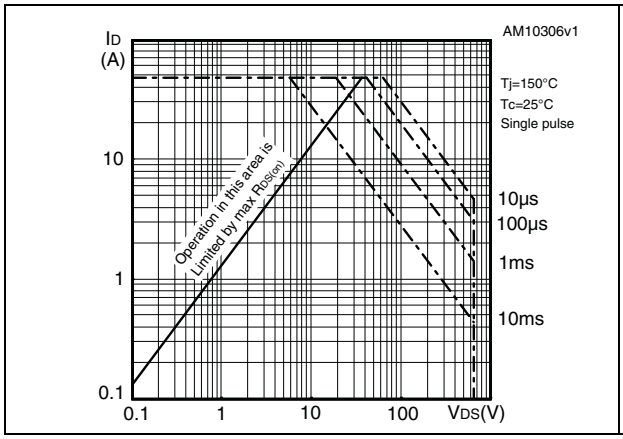


Figure 5. Thermal impedance for TO-220

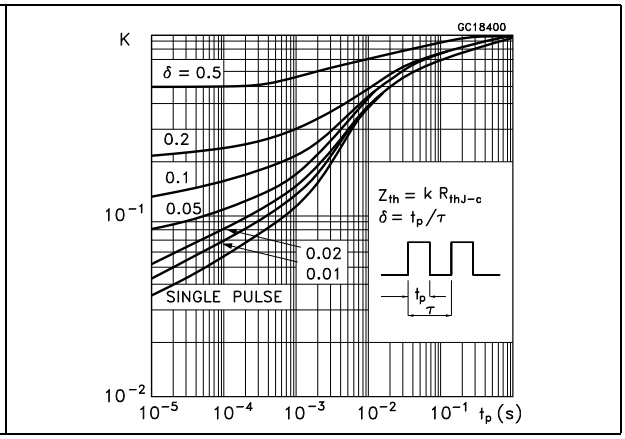


Figure 6. Output characteristics

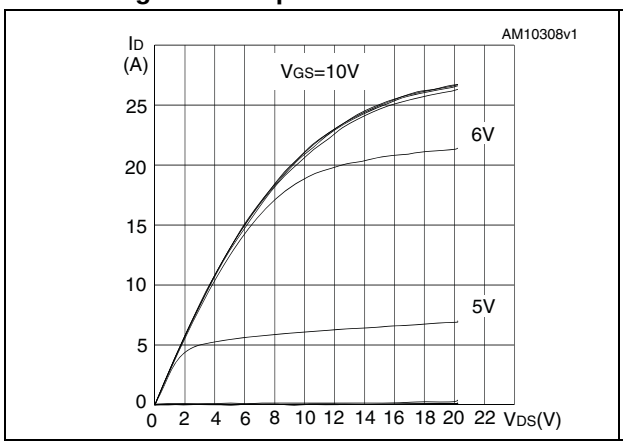


Figure 7. Transfer characteristics

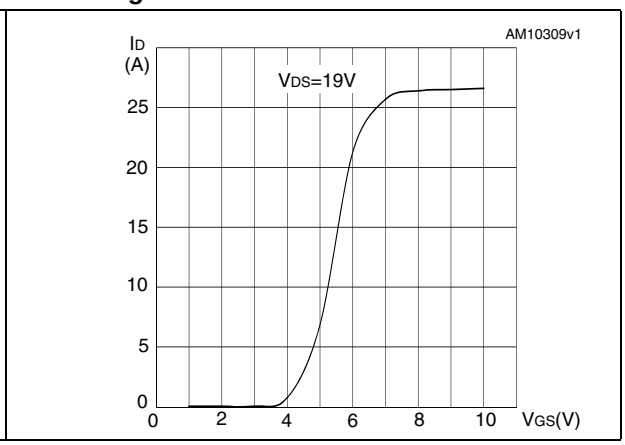


Figure 8. Static drain-source on-resistance

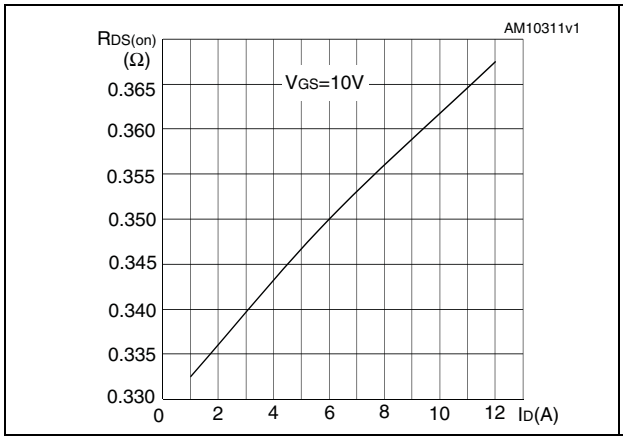


Figure 9. Gate charge vs gate-source voltage

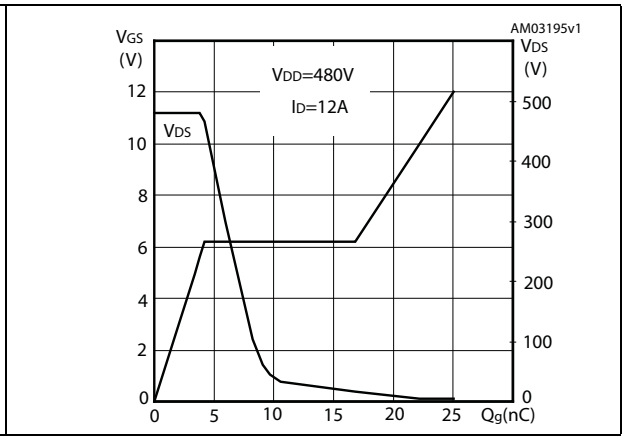


Figure 10. Capacitance variations

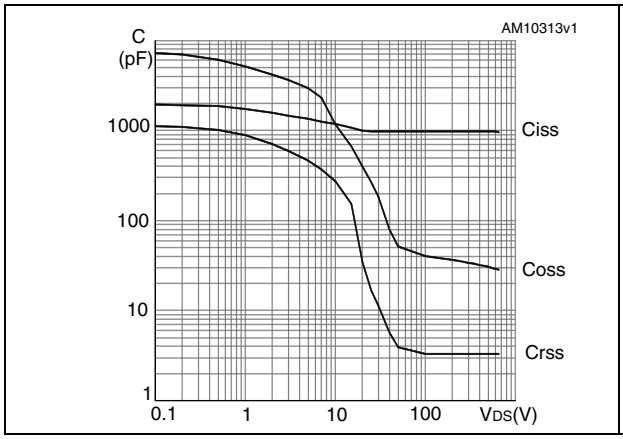


Figure 11. Normalized gate threshold voltage vs temperature

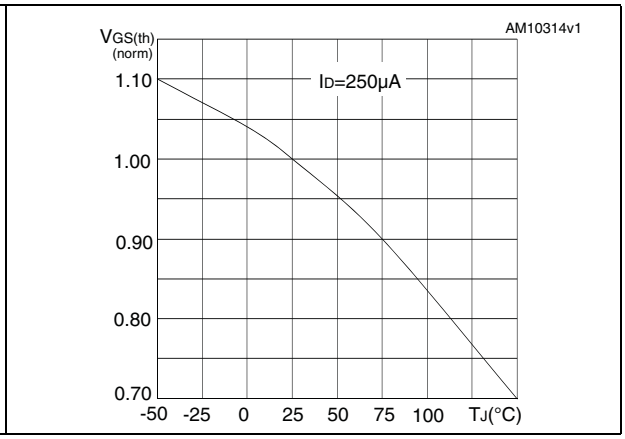


Figure 12. Normalized on-resistance vs temperature

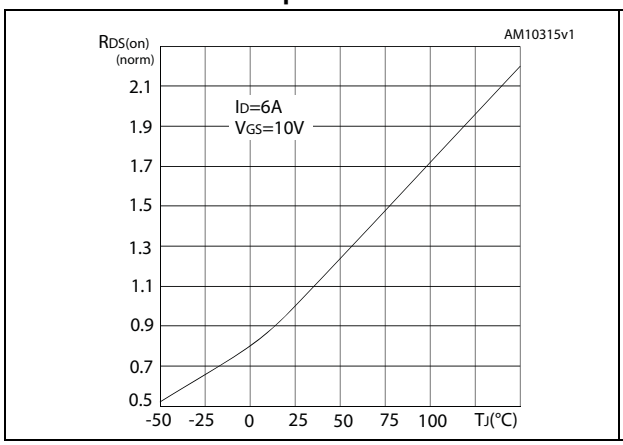


Figure 13. Source-drain diode forward characteristics

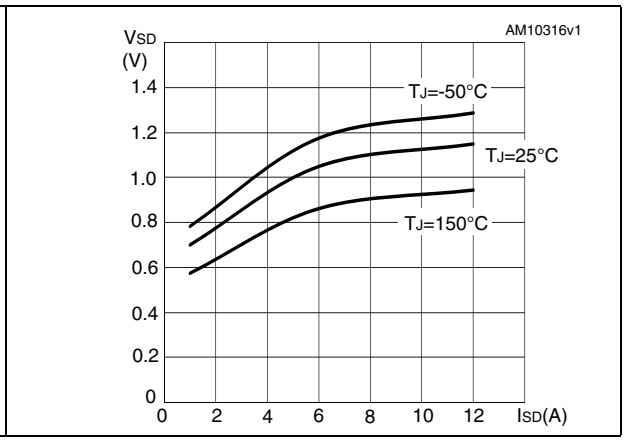
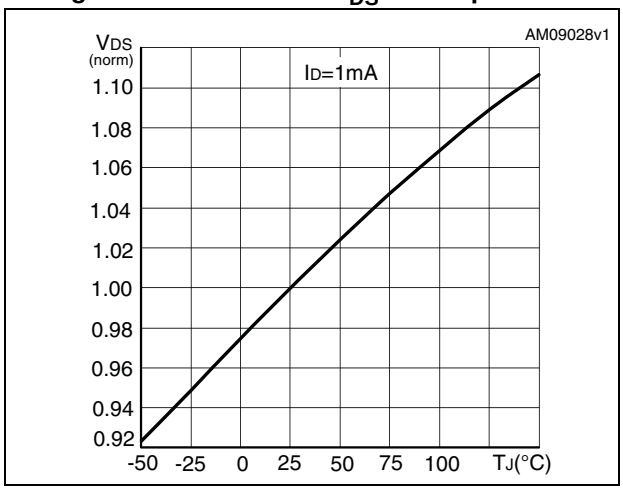


Figure 14. Normalized V_{DS} vs temperature



3 Test circuits

Figure 15. Switching times test circuit for resistive load

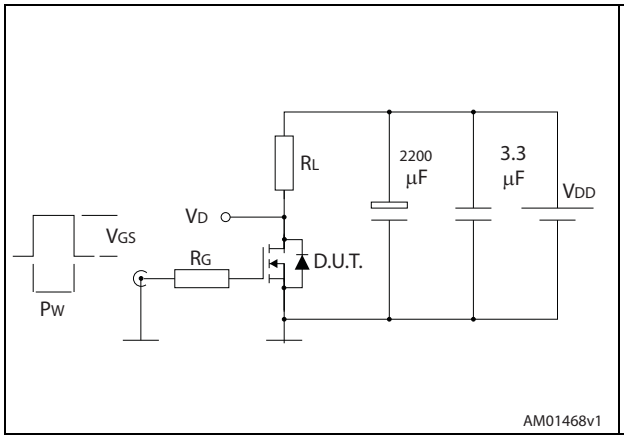


Figure 16. Gate charge test circuit

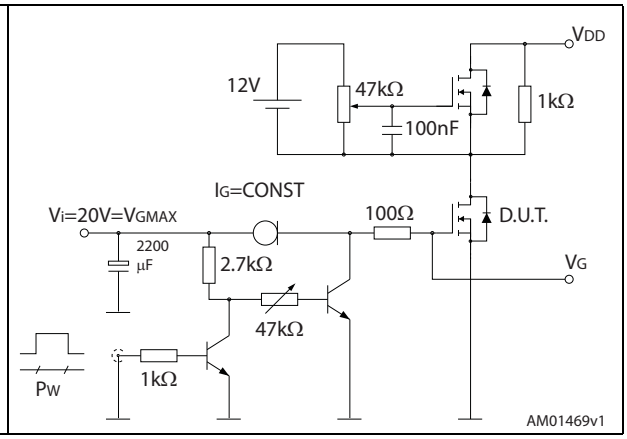


Figure 17. Test circuit for inductive load switching and diode recovery times

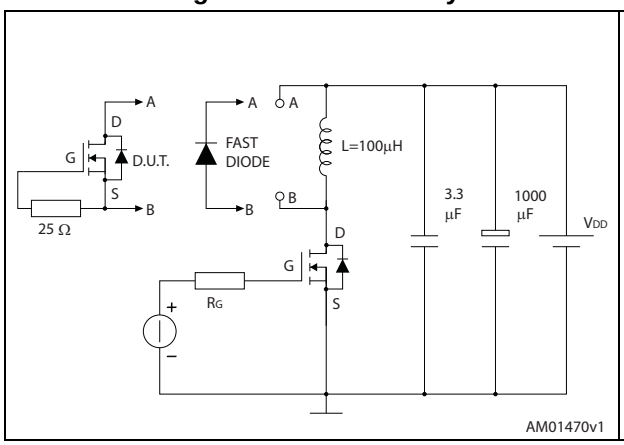


Figure 18. Unclamped inductive load test circuit

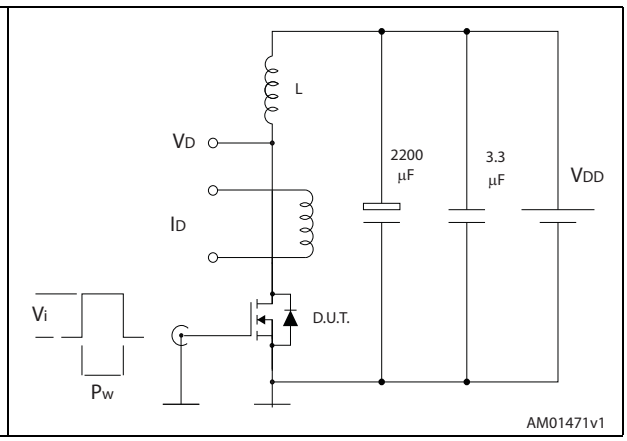


Figure 19. Unclamped inductive waveform

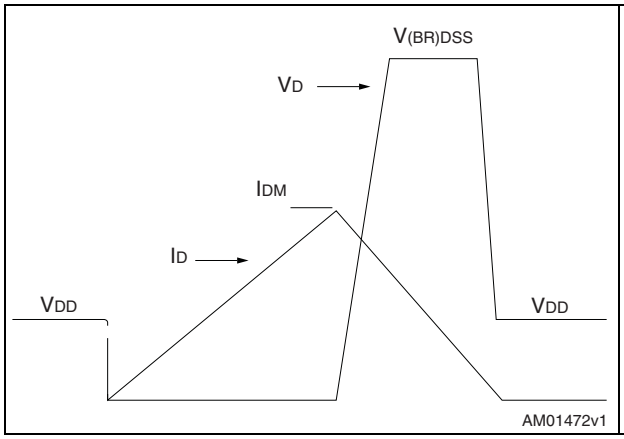
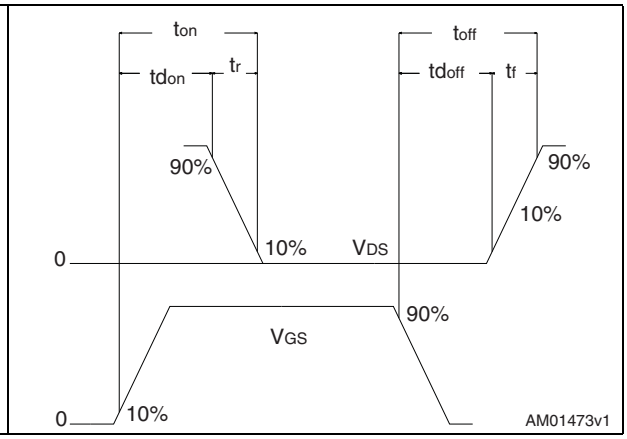


Figure 20. Switching time waveform



4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® 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 21. TO-220FP drawing

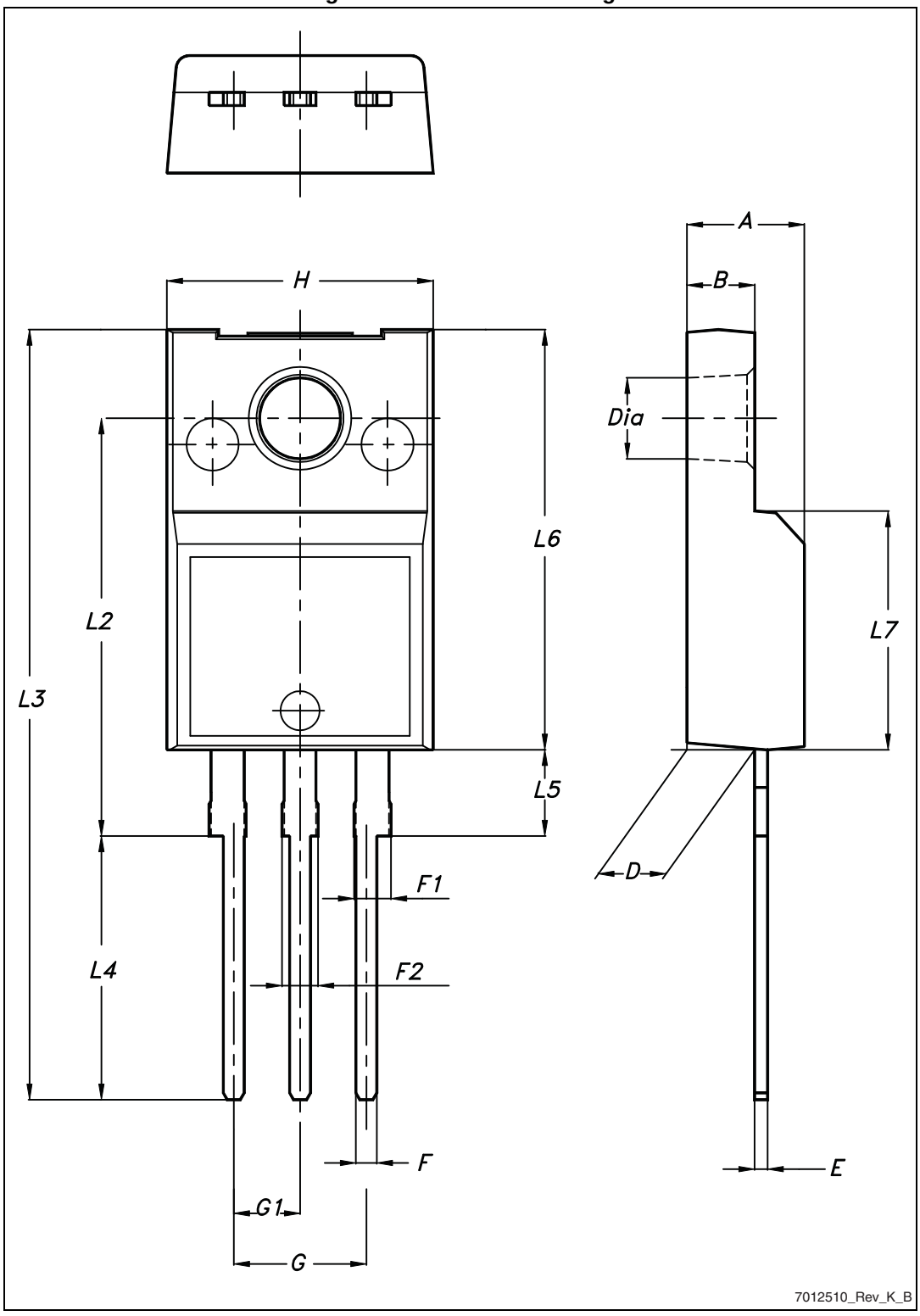


Table 10. I^2PAKFP (TO-281) mechanical data

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 22. I^2PAKFP (TO-281) drawing

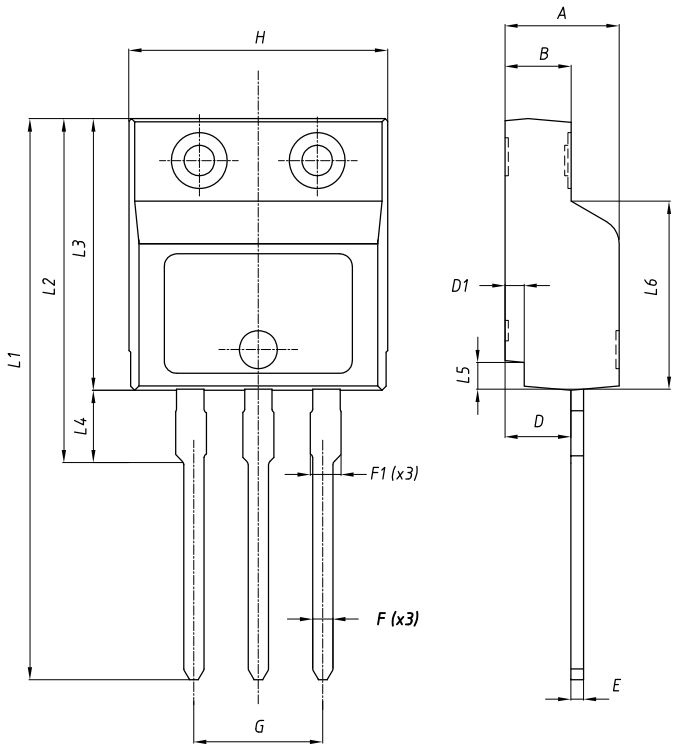
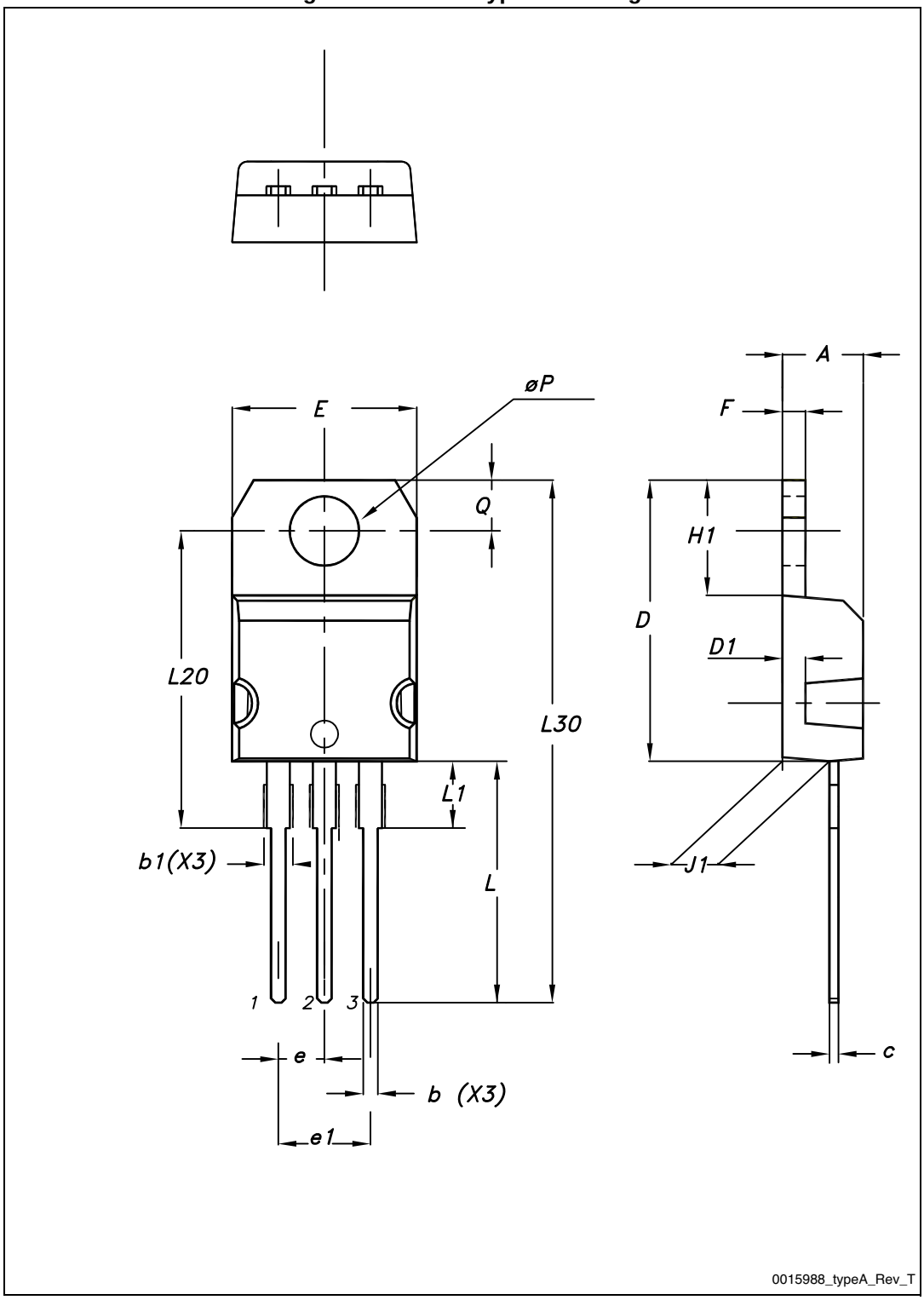


Table 11. TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95

Figure 23. TO-220 type A drawing



5 Revision history

Table 12. Document revision history

Date	Revision	Changes
11-May-2011	1	Initial release.
21-Jun-2011	2	Document status promoted form preliminary data to datasheet, added *Section 2.1: Electrical characteristics (curves)*.
17-Jul-2013	3	– Added: I^2PAKFP package – Added: *Table 10* and *Figure 22* – Updated: *Section 4: Package mechanical data* – Minor text changes

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