

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

Datasheet - production data

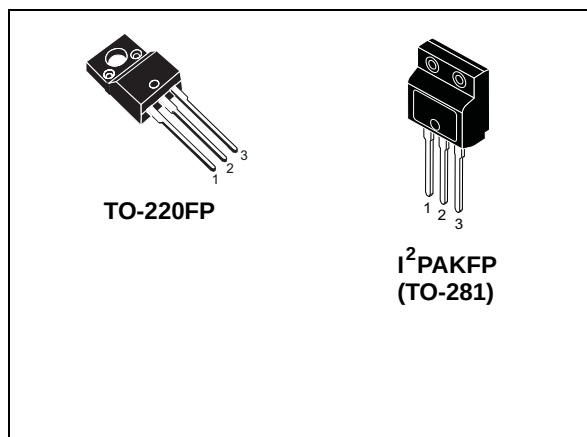
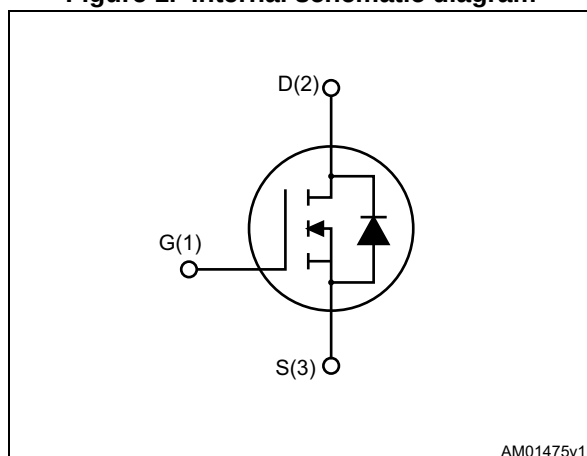


Figure 1. Internal schematic diagram



Features

Order code	V _{DSS} @T _{jmax}	R _{DS(on)} max.	I _D
STF15NM65N	710 V	0.38 Ω	12 A
STFI15NM65N			

- 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 MOSFETs 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 code	Marking	Packages	Packing
STF15NM65N	15NM65N	TO-220FP	Tube
STFI15NM65N		I ² PAKFP (TO-281)	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220FP	I ² PAKFP	
V _{DS}	Drain source voltage	650		V
V _{GS}	Gate source voltage	± 25		V
I _D	Drain current continuous T _c = 25 °C	12 ⁽¹⁾		A
I _D	Drain current continuous T _c = 100 °C	7.56		A
I _{DM} ⁽²⁾	Drain current pulsed	48		A
P _{TOT}	Total dissipation at T _c = 25 °C	30		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 range	-55 to 150		°C
T _{stg}	Storage temperature range			

1. Limited by maximum junction temperature.

2. Pulse width limited by safe operating area.

3. I_{SD} ≤ 12 A, di/dt ≤ 400 A/μs, V_{DSpeak} ≤ V_{(BR)DSS}, V_{DD} = 80 % V_{(BR)DSS}

Table 3. Thermal data

Symbol	Parameters	Value		Unit
		TO-220FP	I ² PAKFP	
R _{thjc}	Thermal resistance junction-case	4.17		°C/W
R _{thj-amb}	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

($T_{CASE} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified).

Table 5. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0, I_D = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{DD} = 650\text{ V}, V_{GS} = 0$			1	μA
		$V_{DD} = 650\text{ V}, V_{GS} = 0$ $T_C = 125\text{ }^{\circ}\text{C}^{(1)}$			100	μA
I_{GSS}	Gate body leakage	$V_{GS} = \pm 25\text{ V}, V_{DS} = 0\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$I_D = 250\text{ }\mu\text{A}, V_{GS} = V_{DS}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$I_D = 6\text{ A}, V_{GS} = 10\text{ V}$		0.35	0.38	Ω

1. Defined by design, not subject to production test

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Ma.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}, f = 1\text{ MHz},$ $V_{GS} = 0\text{ V}$	-	983	-	pF
C_{oss}	Output capacitance		-	57	-	pF
C_{rss}	Reverse capacitance		-	4.5	-	pF
$C_{osseq}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ V to } 520\text{ V}, V_{GS} = 0\text{ V}$	-	146	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz } I_D = 0\text{ A}$	-	4.6	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}, I_D = 12\text{ A},$ $V_{GS} = 10\text{ V}$ (see Figure 13: Gate charge test circuit)	-	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	$V_{DD} = 325\text{ V}, I_D = 6\text{ A}$ $R_g = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$ (see Figure 12: Switching times test circuit for resistive load and Figure 17: Switching time waveform)	-	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	$I_{SD} = 12\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 14: Test circuit for inductive load switching and diode recovery times)	-	428		ns
Q_{rr}	Reverse recovery charge		-	4.7		μC
I_{RRM}	Reverse recovery current		-	21.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 14: Test circuit for inductive load switching and diode recovery times)	-	570		ns
Q_{rr}	Reverse recovery charge		-	6.2		μC
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)

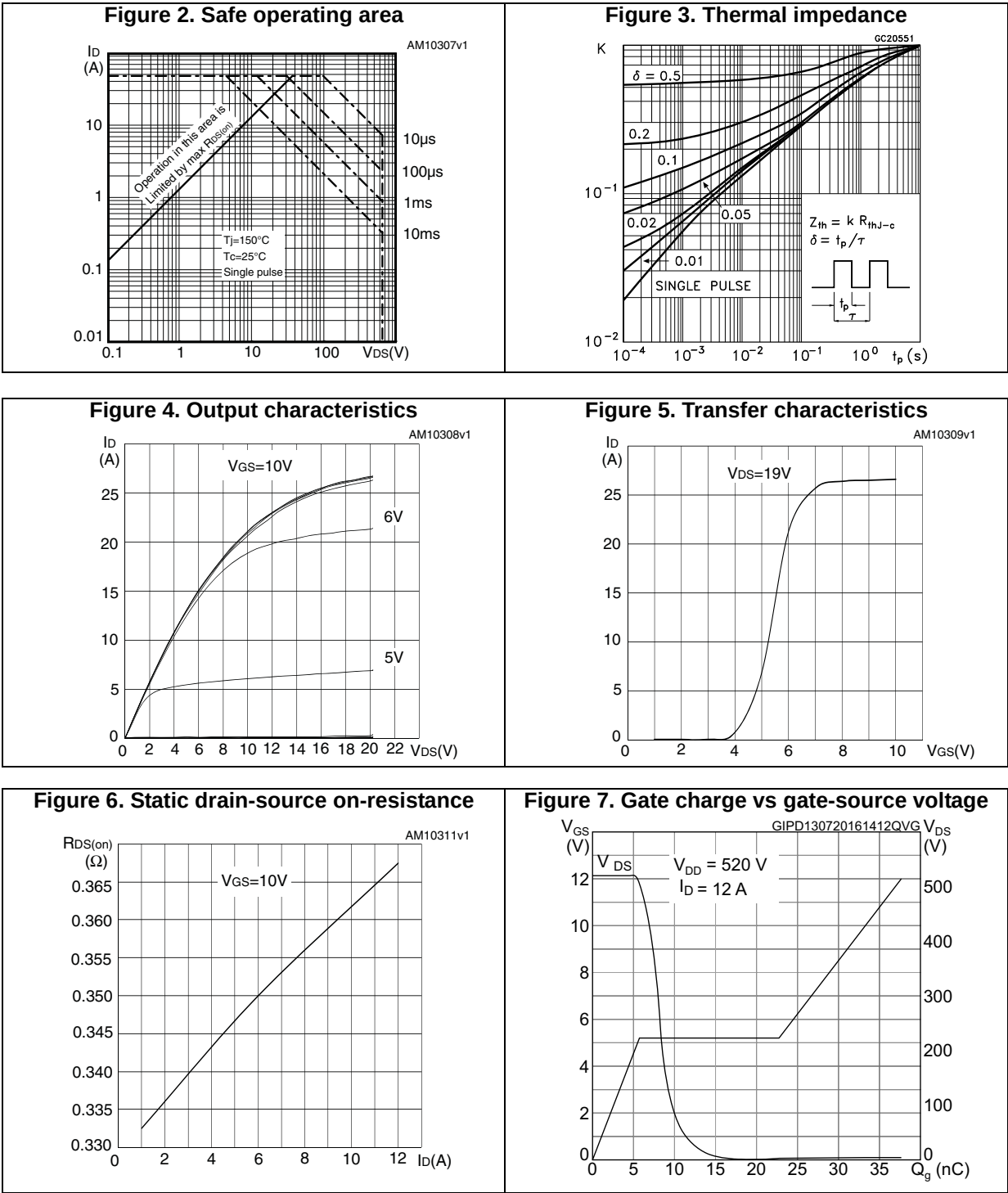


Figure 8. Capacitance variations

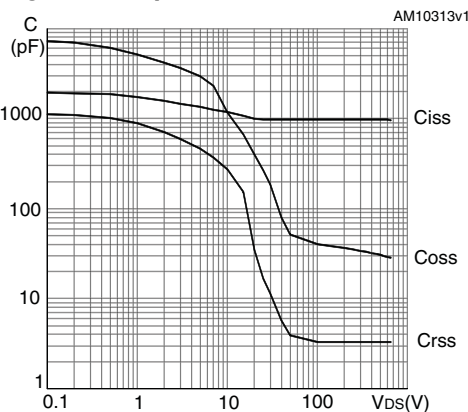


Figure 9. Normalized gate threshold voltage vs temperature

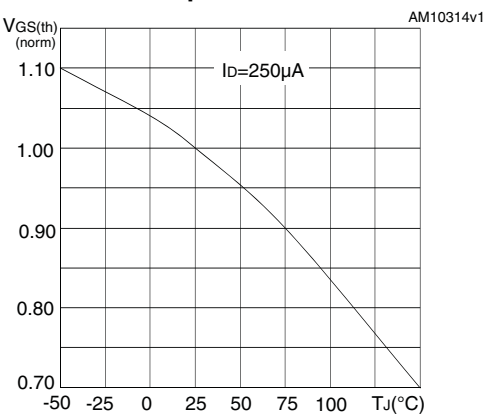
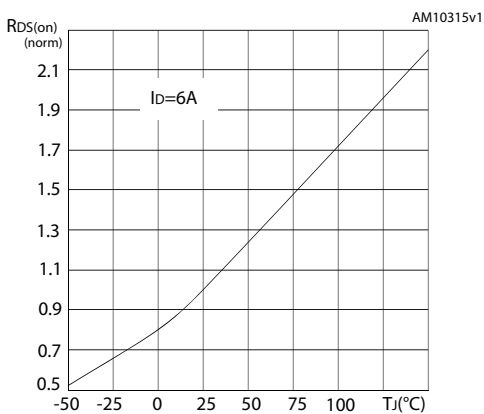


Figure 10. Normalized on-resistance vs temp.



Source-drain diode forward characteristics

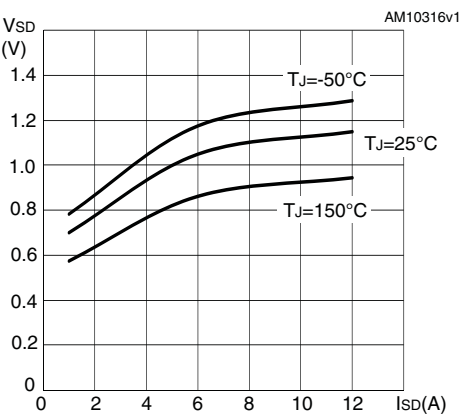
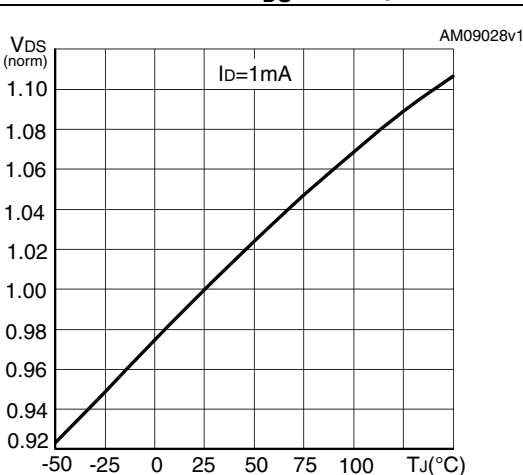
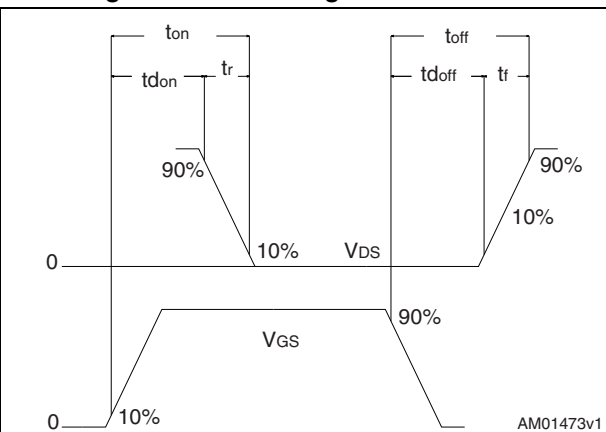
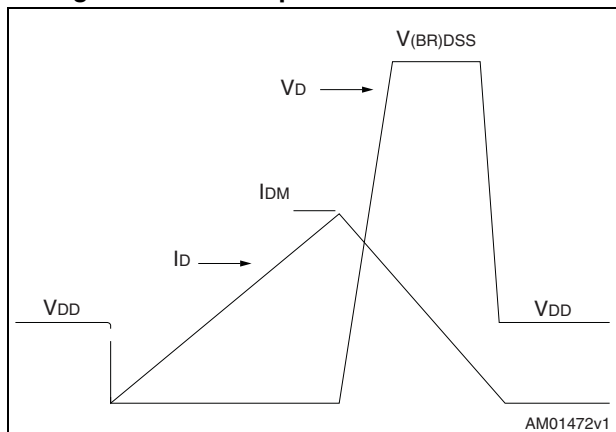
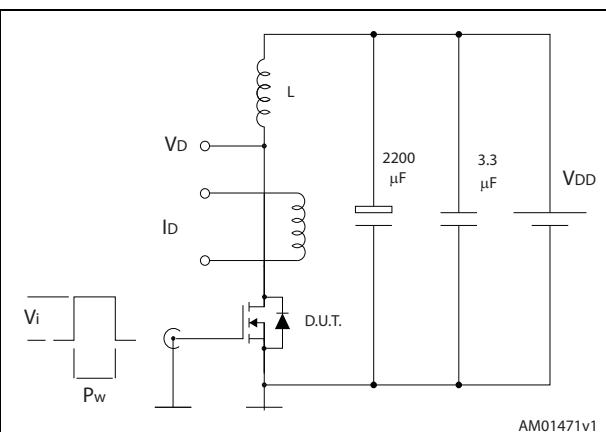
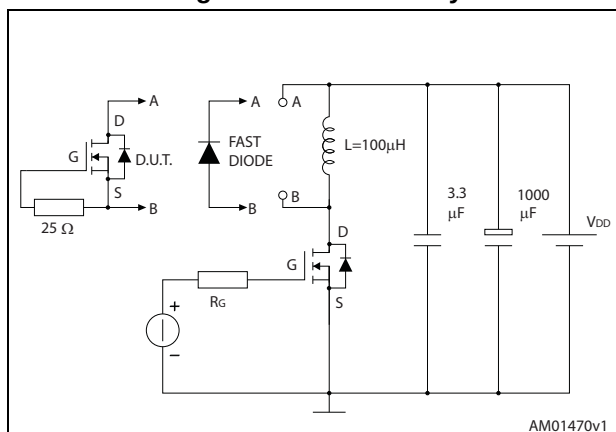
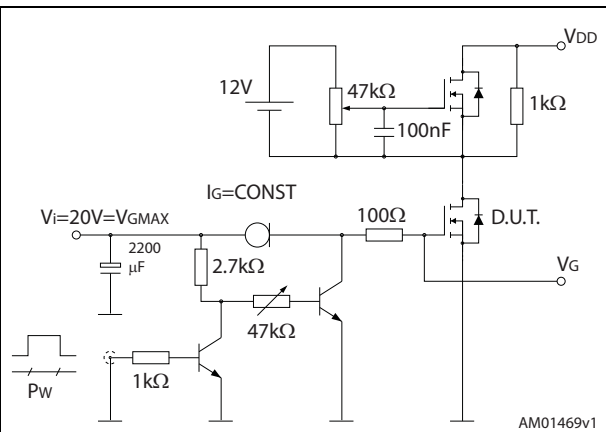
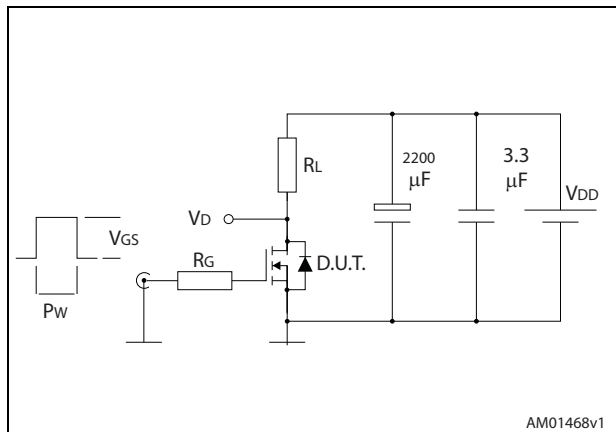


Figure 11. Normalized V_{DS} vs temperature





4 Package information

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.

4.1 TO-220FP package information

Figure 18. TO-220FP package outline

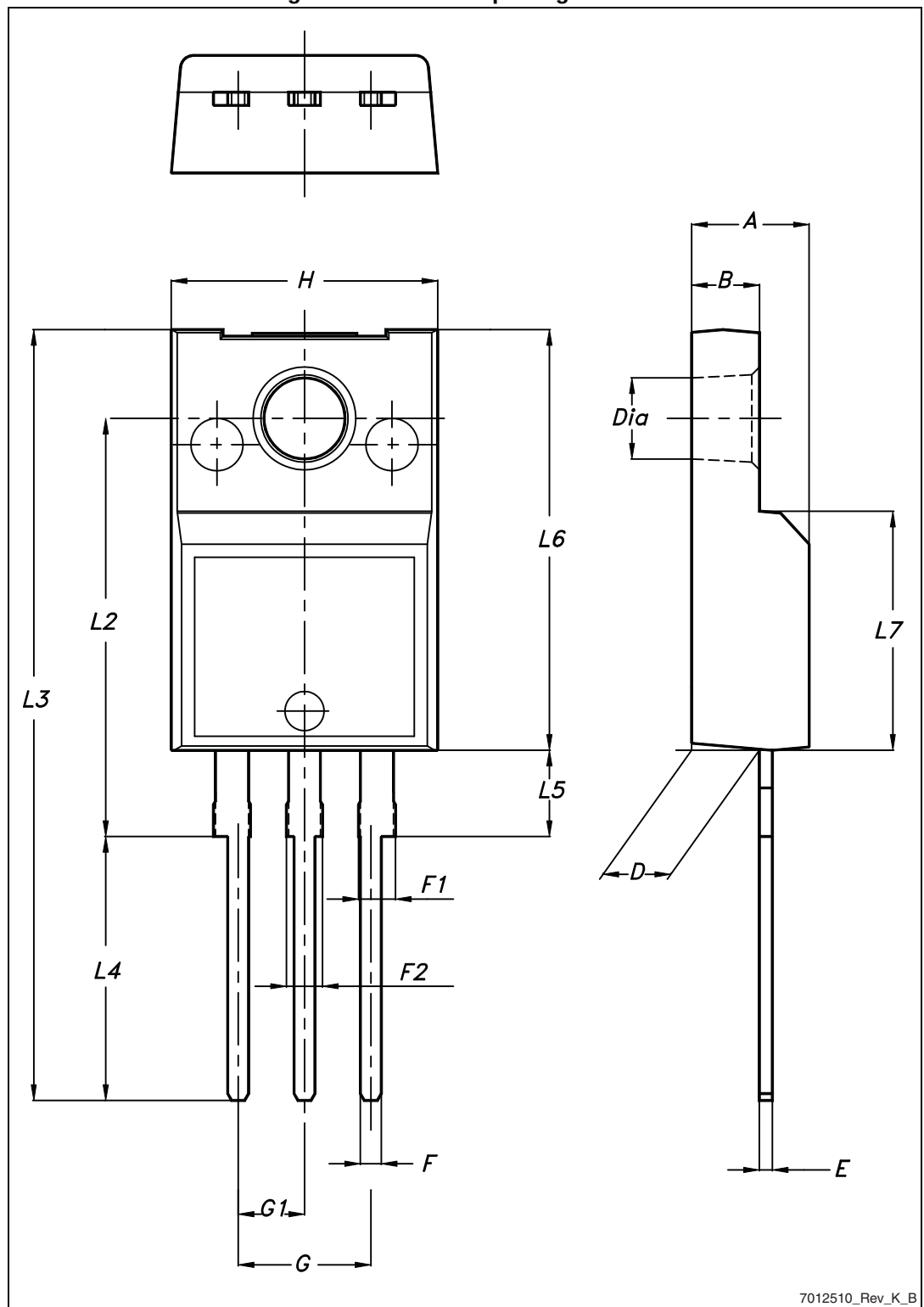


Table 9. TO-220FP package mechanical data

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

4.2 I²PAKFP (TO-281) package information

Figure 19. I²PAKFP (TO-281) package outline

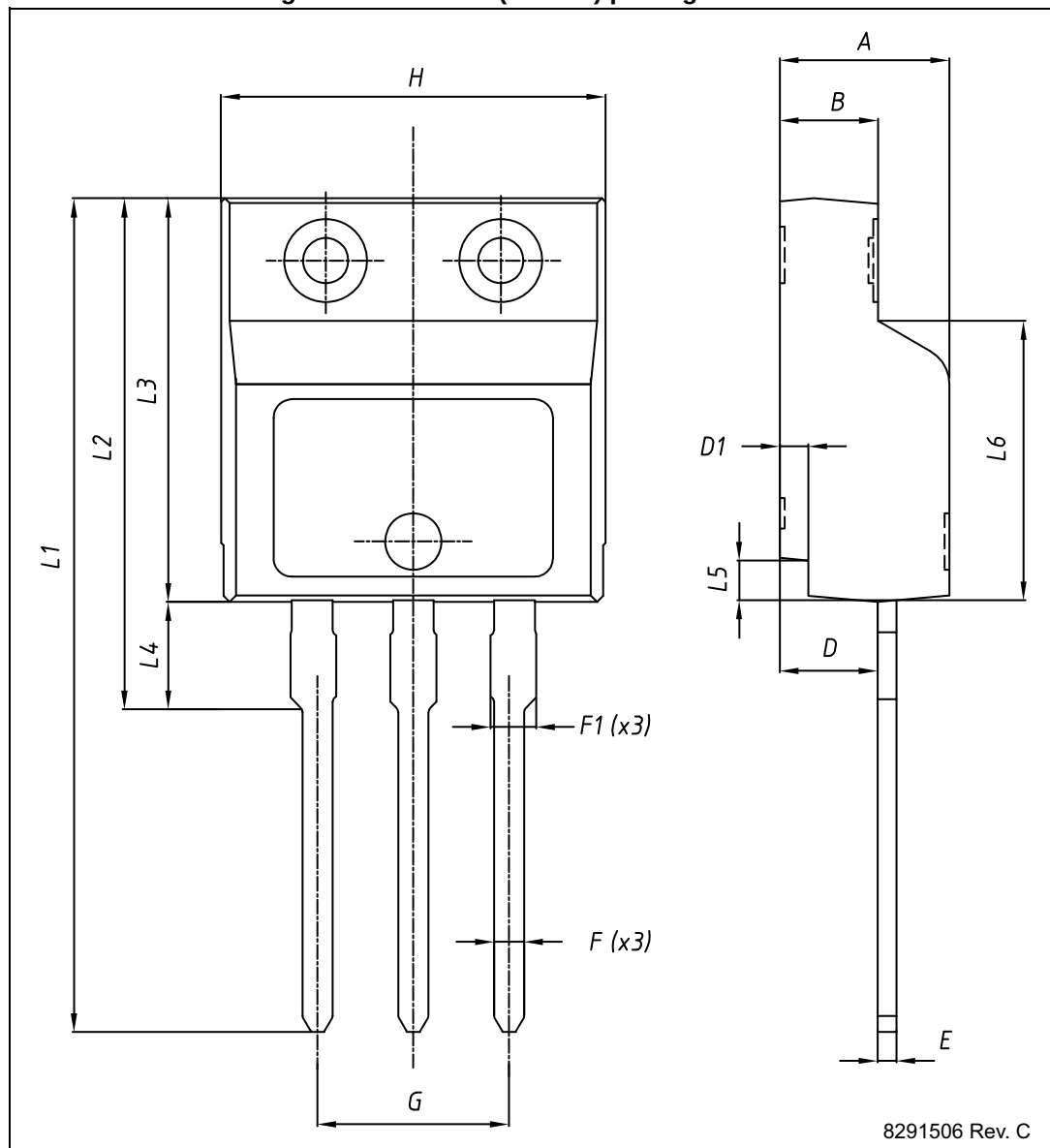


Table 10. I²PAKFP (TO-281) package mechanical data

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	7.50	7.60	7.70

5 Revision history

Table 11. Document revision history

Date	Revision	Changes
11-May-2011	1	Initial release.
21-Jun-2011	2	Document status promoted from preliminary data to datasheet, added Section 2.1: Electrical characteristics (curves).
17-Jul-2013	3	– Added: I²PAKFP package – Added: <i>Table 10</i> and <i>Figure 22</i> – Updated: <i>Section 4: Package information</i> – Minor text changes.
25-Jul-2016	4	The part number STF15NM65N has been moved to a separate datasheet. Minor text changes.

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