

STF13N65M2, **STFI13N65M2**

N-channel 650 V, 0.37 Ω typ., 10 A MDmesh™ M2 Power MOSFETs in TO-220FP and I²PAKFP packages

Datasheet - production data

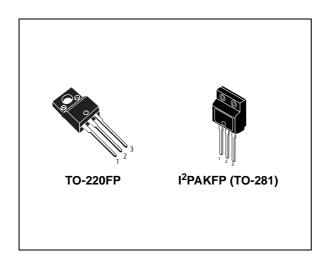
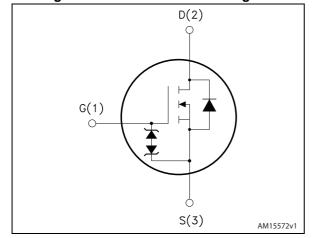


Figure 1. Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max	I _D
STF13N65M2	650 V	0.43 Ω	10A
STFI13N65M2	000 V	0.40 12	10/4

- · Extremely low gate charge
- Excellent output capacitance (Coss) profile
- 100% avalanche tested
- Zener-protected

Applications

· Switching applications

Description

These devices are N-channel Power MOSFETs developed using MDmesh™ M2 technology. Thanks to their strip layout and improved vertical structure, the devices exhibit low on-resistance and optimized switching characteristics, rendering them suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order code	Marking	Package	Packaging
STF13N65M2	- 13N65M2	TO-220FP	Tube
STFI13N65M2	TONODIVIZ	I ² PAKFP (TO-281)	rube

December 2014 DocID026893 Rev 2 1/15

Contents

Contents

1	Electrical ratings
2	Electrical characteristics
3	Test circuits
4	Package mechanical data
	4.1 TO-220FP, STF13N65M2
	4.2 I ² PAKFP (TO-281), STFI13N65M2
5	Revision history



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	10 ⁽¹⁾	Α
I _D	Drain current (continuous) at T _C = 100 °C	6.3 ⁽¹⁾	Α
I _{DM} ⁽²⁾	Drain current (pulsed)	40 ⁽¹⁾	Α
P _{TOT}	Total dissipation at T _C = 25 °C	25	W
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C = 25$ °C)	2500	V
dv/dt (3)	Peak diode recovery voltage slope	15	V/ns
dv/dt ⁽⁴⁾	MOSFET dv/dt ruggedness	50	V/115
T _{stg}	Storage temperature	- 55 to 150	°C
T _j	Max. operating junction temperature	150	

- 1. Limited by maximum junction temperature..
- 2. Pulse width limited by safe operating area.
- 3. $I_{SD} \leq$ 10 A, di/dt \leq 400 A/ μ s; $V_{DS peak} < V_{(BR)DSS}$, V_{DD} =400 V
- 4. $V_{DS} \leq 520 V$

Table 3. Thermal data

Symbol	Symbol Parameter		Unit
R _{thj-case}	Thermal resistance junction-case max	5	°C/W
R _{thj-amb}	R _{thj-amb} Thermal resistance junction-ambient max		°C/W

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	1.8	А
E _{AS}	Single pulse avalanche energy (starting $T_j = 25^{\circ}C$, $I_D = I_{AR}$; $V_{DD} = 50 \text{ V}$)	350	mJ

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified)

Table 5. On /off states

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V _{(BR)DSS}	Drain-source breakdown voltage	I _D = 1 mA, V _{GS} = 0 V	650			V
1	Zero gate voltage	V _{DS} = 650 V			1	μΑ
IDSS	drain current (V _{GS} = 0)	V _{DS} = 650 V, T _C = 125 °C			100	μA
I _{GSS}	Gate-body leakage current (V _{DS} = 0)	V _{GS} = ± 25 V			±10	μΑ
V _{GS(th)}	Gate threshold voltage	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	2	3	4	V
R _{DS(on)}	Static drain-source on-resistance	V _{GS} = 10 V, I _D = 5 A		0.37	0.43	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C _{iss}	Input capacitance		-	590	-	pF
C _{oss}	Output capacitance	V _{DS} = 100 V, f = 1 MHz,	1	27.5	ı	pF
C _{rss}	Reverse transfer capacitance	V _{GS} = 0 V	-	1.1	-	pF
Coss eq. (1)	Equivalent output capacitance	V _{DS} = 0 to 520 V, V _{GS} = 0 V	-	168.5	-	pF
R _G	Intrinsic gate resistance	f = 1 MHz open drain	-	6.5	-	Ω
Qg	Total gate charge		-	17	-	nC
Q _{gs}	Gate-source charge	$V_{DD} = 520 \text{ V, } I_{D} = 10 \text{ A,}$ $V_{GS} = 10 \text{ V, (see Figure 15)}$	-	3.3	-	nC
Q _{gd}	Gate-drain charge	7, 3	-	7	-	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.	Тур.	Max.	Unit
t _{d(on)}	Turn-on delay time		-	11	-	ns
t _r	Rise time	$V_{DD} = 325 \text{ V}, I_D = 5 \text{ A},$	-	7.8	-	ns
t _{d(off)}	Turn-off delay time	$R_G = 4.7 \Omega$, $V_{GS} = 10 V$ (see <i>Figure 14</i> and <i>Figure 19</i>)	-	38	-	ns
t _f	Fall time		-	12	-	ns

4/15 DocID026893 Rev 2

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I _{SD}	Source-drain current		-		10	Α
I _{SDM} ⁽¹⁾	Source-drain current (pulsed)		-		40	Α
V _{SD} (2)	Forward on voltage	I _{SD} = 10 A, V _{GS} = 0 V	-		1.6	V
t _{rr}	Reverse recovery time		-	312		ns
Q _{rr}	Reverse recovery charge	$I_{SD} = 10 \text{ A}, \text{ di/dt} = 100 \text{ A/}\mu\text{s}, V_{DD} = 60 \text{ V (see } Figure 16)$	-	2.7		μC
I _{RRM}	Reverse recovery current	Top or receiving and roy	-	17.5		Α
t _{rr}	Reverse recovery time	I _{SD} = 10 A, di/dt = 100 A/μs,	-	464		ns
Q _{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}, T_i = 150 \text{ °C},$	-	4.1		μC
I _{RRM}	Reverse recovery current	(see Figure 16)	-	17.5		Α

^{1.} Pulse width limited by safe operating area.



^{2.} Pulsed: pulse duration = $300 \mu s$, duty cycle 1.5%

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

Figure 3. Thermal impedance

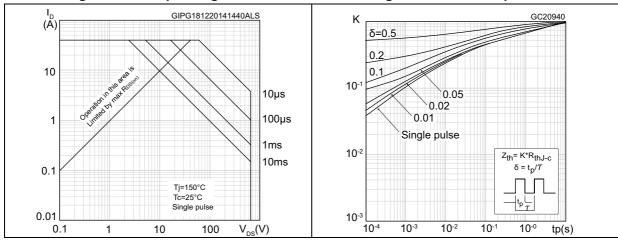


Figure 4. Output characteristics

Figure 5. Transfer characteristics

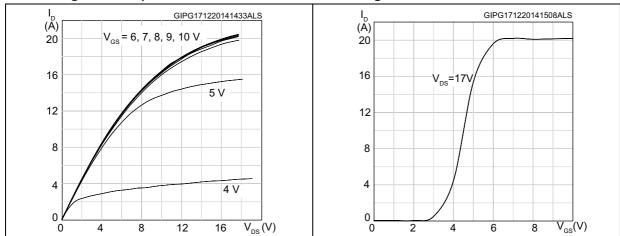
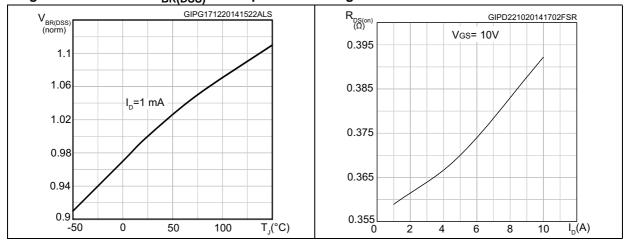


Figure 6. Normalized $V_{BR(DSS)}$ vs temperature

Figure 7. Static drain-source on-resistance



6/15 DocID026893 Rev 2

Figure 8. Gate charge vs gate-source voltage

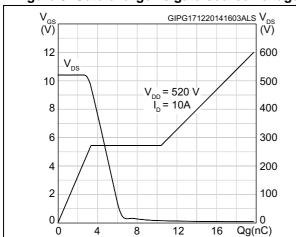


Figure 9. Capacitance variations

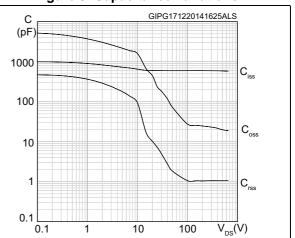
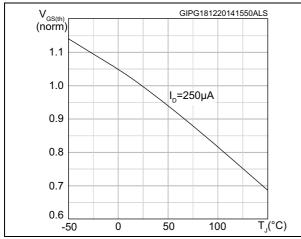


Figure 10. Normalized gate threshold voltage vs temperature

Figure 11. Normalized on-resistance vs temperature



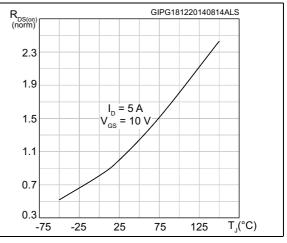
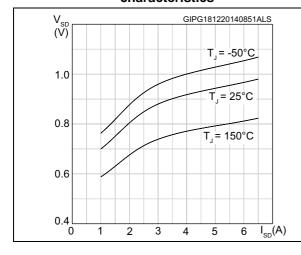
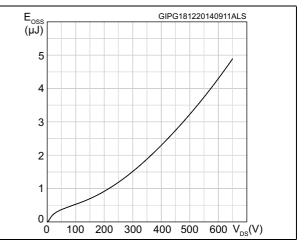


Figure 12. Source-drain diode forward characteristics

Figure 13. Output capacitance stored energy





57/

3 Test circuits

Figure 14. Switching times test circuit for resistive load

Figure 15. Gate charge test circuit

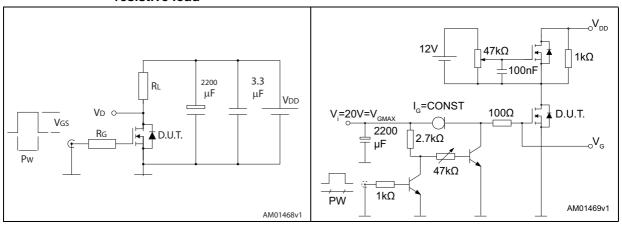


Figure 16. Test circuit for inductive load switching and diode recovery times

Figure 17. Unclamped inductive load test circuit

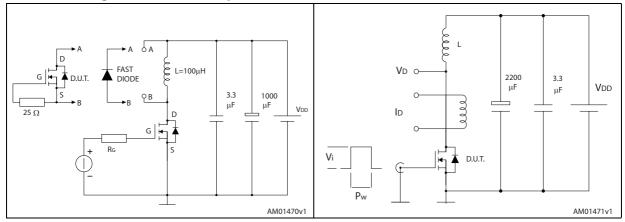
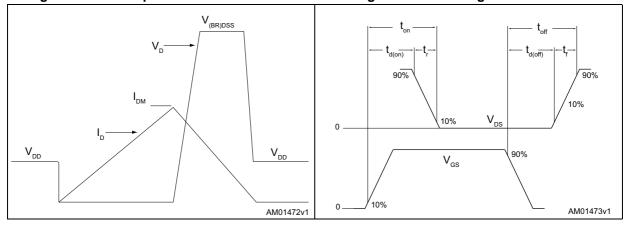


Figure 18. Unclamped inductive waveform

Figure 19. Switching time waveform



57

8/15

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.



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4.1 TO-220FP, STF13N65M2

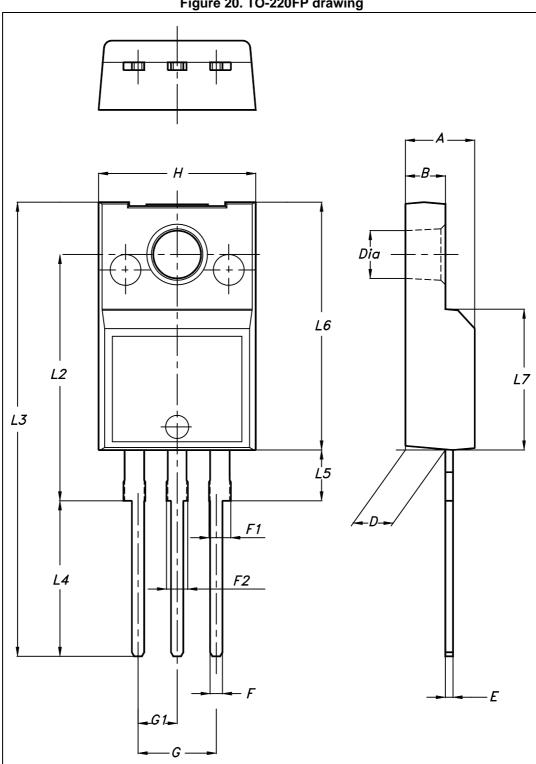


Figure 20. TO-220FP drawing

10/15 DocID026893 Rev 2

Table 9. TO-220FP mechanical data

	mm				
Dim.			1		
	Min.	Тур.	Max.		
А	4.4		4.6		
В	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		
Н	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		
Ø	3		3.2		



4.2 I²PAKFP (TO-281), STFI13N65M2

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Figure 21. I²PAKFP (TO-281) drawing

577

Table 10. I²PAKFP (TO-281) mechanical data

		mm	
Dim.	Min.	Тур.	Max.
	Willi.	īyβ.	Wax.
Α	4.40	-	4.60
В	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
Н	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
15-Oct-2014	1	Initial release
18-Dec-2014	2	Text edits throughout document Updated Section 1: Electrical ratings Updated Section 2: Electrical characteristics Added Section 2.1: Electrical characteristics (curves) Updated Section 4.2: PPAKFP (TO-281), STFI13N65M2



14/15 DocID026893 Rev 2

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DocID026893 Rev 2

15/15