

STF6N65M2, STP6N65M2, STU6N65M2

N-channel 650 V, 1.2 Ω typ., 4 A MDmesh™ M2 Power MOSFETs in TO-220FP, TO-220 and IPAK packages

Datasheet - preliminary data

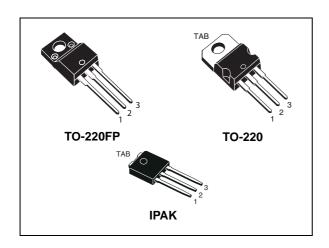
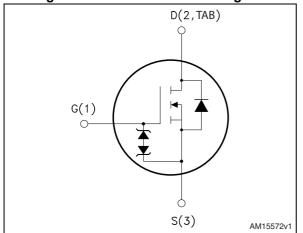


Figure 1. Internal schematic diagram



Features

Order codes	V _{DS}	R _{DS(on)} max	I _D
STF6N65M2			
STP6N65M2	650 V	1.35 Ω	4 A
STU6N65M2			

- Extremely low gate charge
- Excellent output capacitance (C_{OSS}) 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 codes	Marking	Package	Packaging
STF6N65M2		TO-220FP	
STP6N65M2	6N65M2	TO-220	Tube
STU6N65M2		IPAK	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Va	Unit	
Symbol	Farameter	TO-220FP	TO-220, IPAK	Onn
V _{GS}	Gate-source voltage	±	25	V
I _D	Drain current (continuous) at T _C = 25 °C	4 (1)	4	Α
I _D	Drain current (continuous) at T _C = 100 °C	2.5 ⁽¹⁾ 2.5		Α
I _{DM} ⁽²⁾	Drain current (pulsed)	16 ⁽¹⁾ 16		Α
P _{TOT}	Total dissipation at T _C = 25 °C	20	60	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	1	5	Mas
dv/dt ⁽⁴⁾	MOSFET dv/dt ruggedness	50		V/ns
T _{stg}	Storage temperature	- 55 to 150		°C
Tj	Max. operating junction temperature	- 55 (.0 150	

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

Table 3. Thermal data

Symbol	Parameter		Unit		
Symbol	raiametei	TO-220FP	TO-220	IPAK	
R _{thj-case}	Thermal resistance junction-case max	6.25 2.08)8	°C/W
R _{thj-amb}	Thermal resistance junction-ambient max	62.5		100	°C/W

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T _{jmax})	0.5	Α
E _{AS}	Single pulse avalanche energy (starting T _j =25°C, I _D = I _{AR} ; V _{DD} =50)	100	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	$V_{GS} = 0, I_D = 1 \text{ mA}$	650			٧
	Zero gate voltage drain current	$V_{GS} = 0, V_{DS} = 650 \text{ V}$			1	μΑ
I _{DSS}		$V_{GS} = 0$, $V_{DS} = 650$ V, $T_C = 125$ °C			100	μΑ
I _{GSS}	Gate-body leakage current	$V_{DS} = 0, V_{GS} = \pm 25 \text{ V}$			±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 = 2 A		1.2	1.35	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C _{iss}	Input capacitance		-	226	-	pF
C _{oss}	Output capacitance	$V_{GS} = 0, V_{DS} = 100 \text{ V},$	-	12.8	-	pF
C _{rss}	Reverse transfer capacitance	f = 1 MHz	-	0.65	-	pF
C _{oss eq.} ⁽¹⁾	Equivalent output capacitance	$V_{GS} = 0$, $V_{DS} = 0$ to 520 V	-	114	-	pF
R_{G}	Intrinsic gate resistance	f = 1 MHz open drain	-	6.5	-	Ω
Qg	Total gate charge	V _{DD} = 520 V, I _D = 4 A,	-	9.8	-	nC
Q _{gs}	Gate-source charge	V _{GS} = 10 V	-	1.7	-	nC
Q_{gd}	Gate-drain charge	(see Figure 8)	-	4	-	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		-	19	-	ns
t _r	Rise time	$V_{DD} = 325 \text{ V}, I_D = 2 \text{ A},$	-	7	-	ns
t _{d(off)}	Turn-off delay time	$R_G = 4.7 \Omega$, $V_{GS} = 10 V$ (see <i>Figure 15</i> and <i>Figure 20</i>)	-	6.5	-	ns
t _f	Fall time		-	20	-	ns



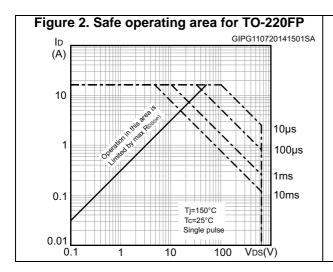
Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I _{SD}	Source-drain current		-		4	Α
I _{SDM} ⁽¹⁾	Source-drain current (pulsed)		-		16	Α
V _{SD} (2)	Forward on voltage	I _{SD} = 4 A, V _{GS} = 0	-		1.6	V
t _{rr}	Reverse recovery time		-	260		ns
Q _{rr}	Reverse recovery charge	I _{SD} = 4 A, di/dt = 100 A/μs V _{DD} = 60 V (see <i>Figure 17</i>)	-	1.2		μC
I _{RRM}	Reverse recovery current	God rigano rry	-	9.2		Α
t _{rr}	Reverse recovery time	I _{SD} = 4 A, di/dt = 100 A/μs	-	400		ns
Q _{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}, T_j = 150 ^{\circ}\text{C}$	-	1.84		μC
I _{RRM}	Reverse recovery current	(see Figure 17)	-	9.1		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)



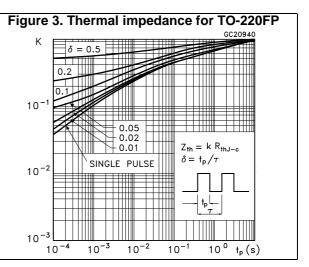
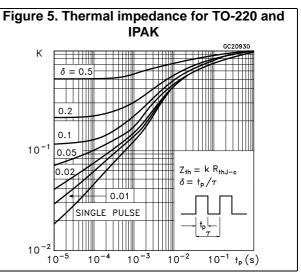
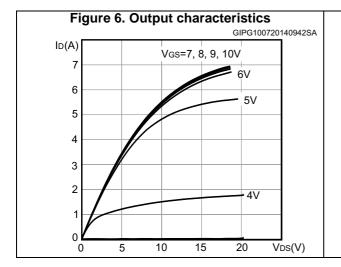


Figure 4. Safe operating area for TO-220 and **IPAK** GIPG110720141521SA ΙD (A) 10 10µs 100µs 1ms 10ms 0.1 Tj=150°C Tc=25°C Single pulse 0.01 10 100 V_Ds(V)





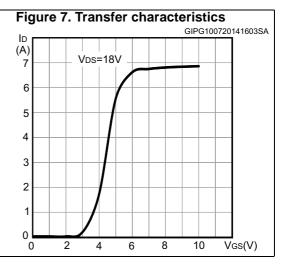


Figure 8. Gate charge vs gate-source voltage GIPG100720141638SA VDS (V) (V) Vos VDD=520V 12 ID=4A 500 450 10 400 350 8 300 6 250 200 4 150 100 2 50 0 Q_g(nC) 2 6 8 10

Figure 9. Static drain-source on-resistance

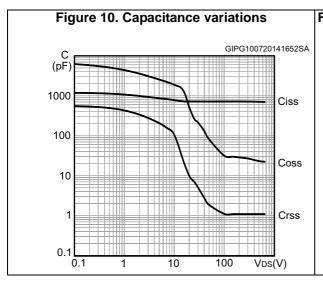
RDS(on) (Ω) VGS=10V

1.26

1.18

1.14

0 1 2 3 4 ID(A)



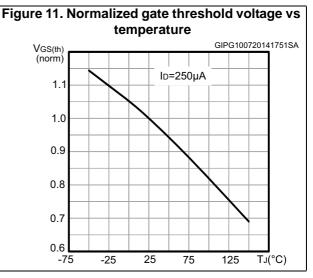
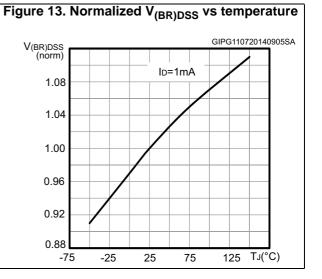
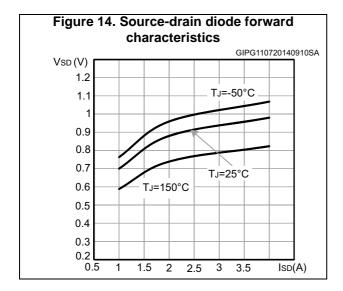


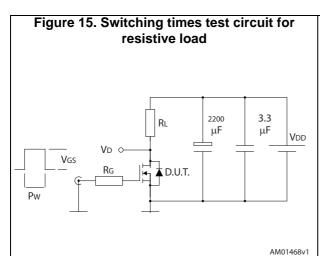
Figure 12. Normalized on-resistance vs temperature GIPG110720140859SA RDS(on) (norm) Vgs=10V 2.2 1.8 1.4 0.6 0.2 -75 -25 25 75 125 T_J(°C)

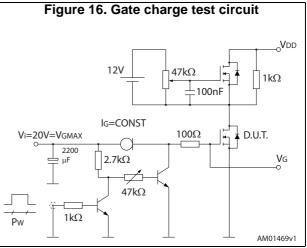


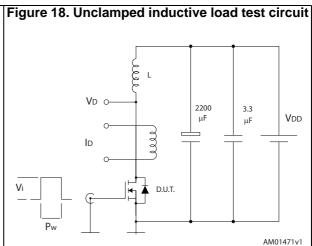


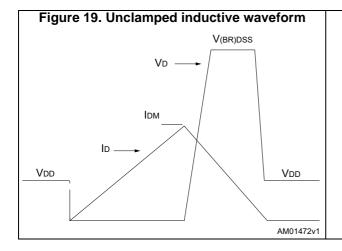
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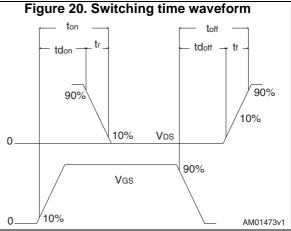
3 Test circuits











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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.

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4.1 TO-220FP, STF6N65M2

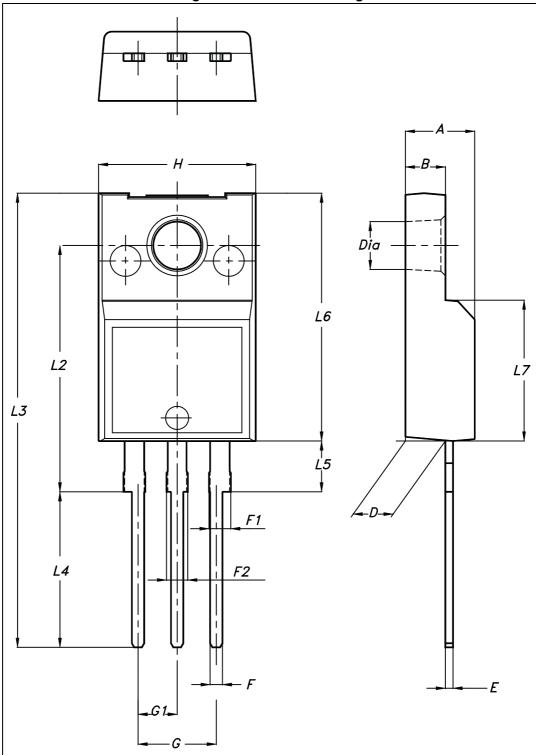


Figure 21. TO-220FP drawing

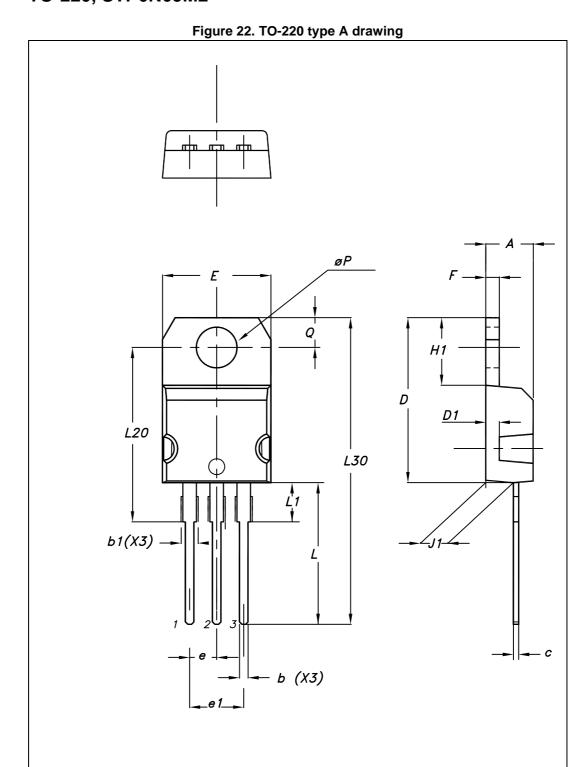
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7012510_Rev_K_B

Table 9. TO-220FP mechanical data

mm				
Dim.		mm	I	
	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 TO-220, STP6N65M2



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0015988_typeA_Rev_T

Table 10. TO-220 type A mechanical data

Dim		mm	
Dim.	Min.	Тур.	Max.
А	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
С	0.48		0.70
D	15.25		15.75
D1		1.27	
Е	10		10.40
е	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	
ØP	3.75		3.85
Q	2.65		2.95

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IPAK, STU6N65M2 4.3

Figure 23. IPAK (TO-251) drawing E-L2 , L1 F *b2 (3x)* b (3x) -*B5*

0068771_K

Table 11. IPAK (TO-251) mechanical data

	mm.		
DIM	min.	typ.	max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
С	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
е		2.28	
e1	4.40		4.60
Н		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

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5 Revision history

Table 12. Document revision history

Date	Revision	Changes
04-Aug-2014	1	First release.



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