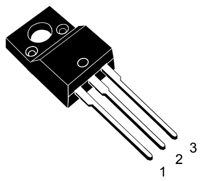
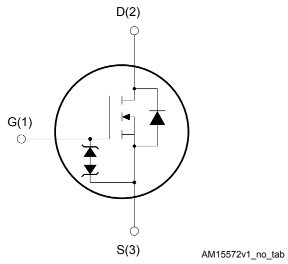
N-channel 600 V, 0.55 Ω typ., 7.5 A MDmesh M2 Power MOSFET in a TO-220FP package



TO-220FP



Features

Order code	V_{DS} at $T_{Jmax.}$	$R_{DS(on)}$ max.	I_D
STF10N60M2	650 V	0.60 Ω	7.5 A

- Extremely low gate charge
- Excellent output capacitance (C_{OSS}) profile
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using MDmesh M2 technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance and optimized switching characteristics, rendering it suitable for the most demanding high efficiency converters.

Product status link
STF10N60M2

Product summary	
Order code	STF10N60M2
Marking	10N60M2
Package	TO-220FP
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±25	V
I_D (1)	Drain current (continuous) at T_C = 25 °C	7.5	A
	Drain current (continuous) at T_C = 100 °C	4.9	
I_{DM} (2)	Drain current (pulsed)	30	A
P_{TOT}	Total power dissipation at T_C = 25 °C	25	W
dv/dt(3)	Peak diode recovery voltage slope	15	V/ns
dv/dt(4)	MOSFET dv/dt ruggedness	50	
V_{ISO} (5)	Insulation withstand voltage (RMS) from all three leads to external heat sink	2500	V
T_{stg}	Storage temperature range	-55 to 150	°C
T_j	Operating junction temperature range		

1. *Limited by package.*
2. *Pulse limited by safe operating area.*
3. *I_{SD} ≤ 7.5 A, di/dt ≤ 400 A/µs; V_{DS} peak < $V_{(BR)DSS}$, V_{DD} = 400 V*
4. *V_{DS} ≤ 480 V.*
5. *t = 1 s; T_C = 25 °C.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	5	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	62.5	

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR} (1)	Avalanche current, repetitive or not repetitive	1.5	A
E_{AS} (2)	Single pulse avalanche energy	110	mJ

1. *Pulse width limited by T_{jmax}.*
2. *Starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V.*

2 Electrical characteristics

(T_{case} = 25 °C unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_{case} = 125 °C[(1)]			100	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, 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		0.55	0.60	Ω

1. *Defined by design, not subject to production test.*

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	400	-	pF
C_{oss}	Output capacitance		-	22	-	
C_{rss}	Reverse transfer capacitance		-	0.84	-	
$C_{oss\ eq.}$ [(1)]	Equivalent output capacitance	V_{DS} = 0 to 480 V, V_{GS} = 0 V	-	83	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	6.4	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 7.5 A, V_{GS} = 0 to 10 V (see) Figure 14. Test circuit for gate charge behavior	-	13.5	-	nC
Q_{gs}	Gate-source charge		-	2.1	-	
Q_{gd}	Gate-drain charge		-	7.2	-	

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 6. 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 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	8.8	-	ns
t_r	Rise time		-	8	-	
$t_{d(off)}$	Turn-off delay time		-	32.5	-	
t_f	Fall time		-	13.2	-	

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} (1)	Source-drain current		-		7.5	A
I_{SDM} (2)	Source-drain current (pulsed)		-		30	A
V_{SD} (3)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 7.5 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 7.5 A, di/dt = 100 A/μs, V_{DD} = 60 V (see) Figure 15. Test circuit for inductive load switching and diode recovery times	-	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 15. Test circuit for inductive load switching and diode recovery times	-	376		ns
Q_{rr}	Reverse recovery charge		-	2.8		μC
I_{RRM}	Reverse recovery current		-	15		A

1. *Limited by package.*
2. *Pulse width is limited by safe operating area.*
3. *Pulse test: pulse duration = 300 μs, duty cycle 1.5%.*

2.1 Electrical characteristics curves

Figure 1. Safe operating area

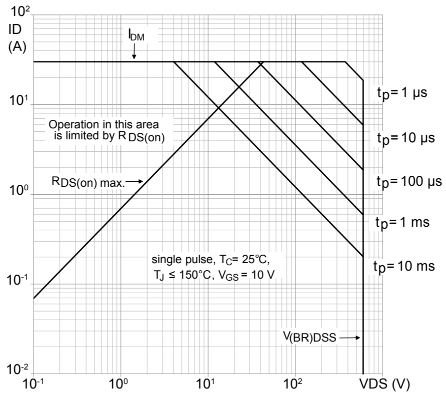


Figure 2. Maximum transient thermal impedance

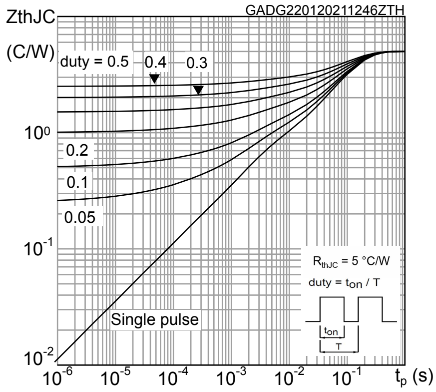


Figure 3. Output characteristics

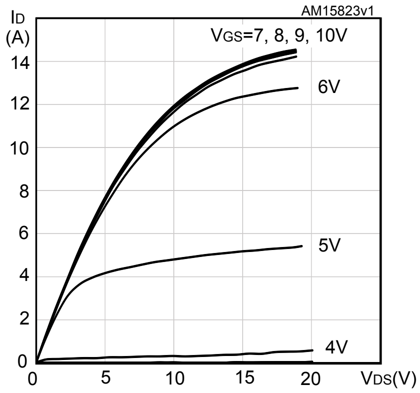


Figure 4. Transfer characteristics

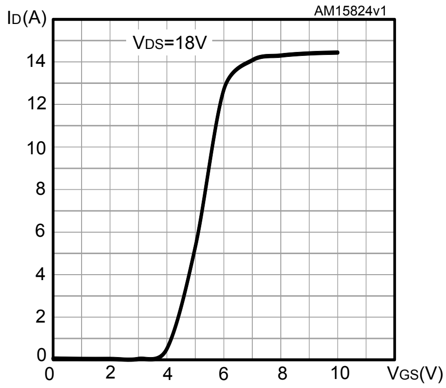


Figure 5. Gate charge vs gate-source voltage

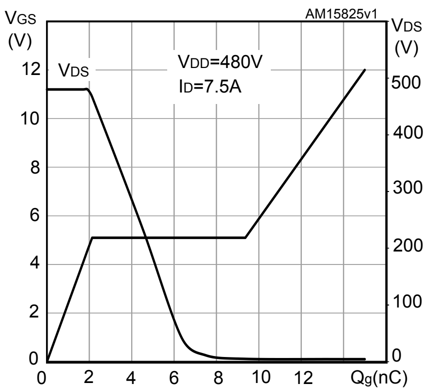


Figure 6. Static drain-source on-resistance

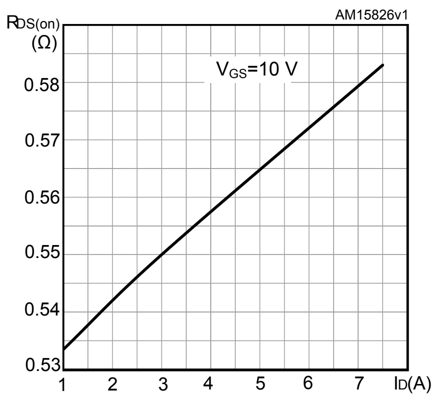


Figure 7. Capacitance variations

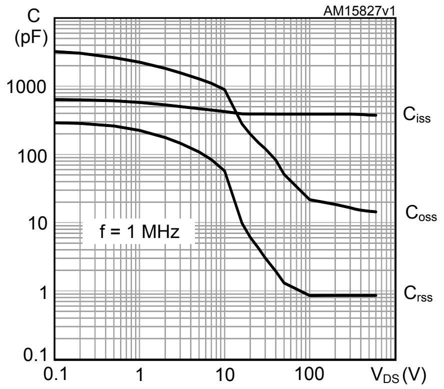


Figure 8. Normalized gate threshold voltage vs temperature

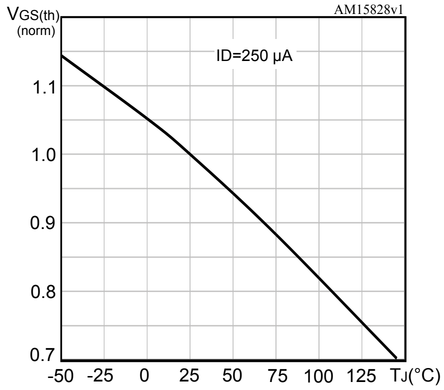


Figure 9. Normalized on-resistance vs temperature

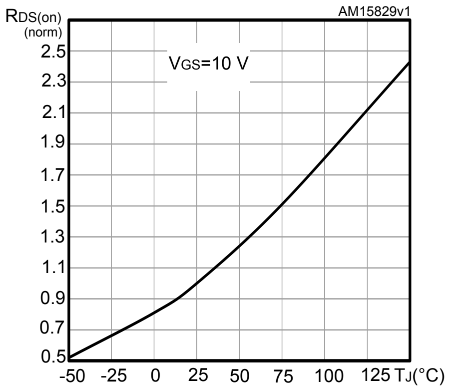


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

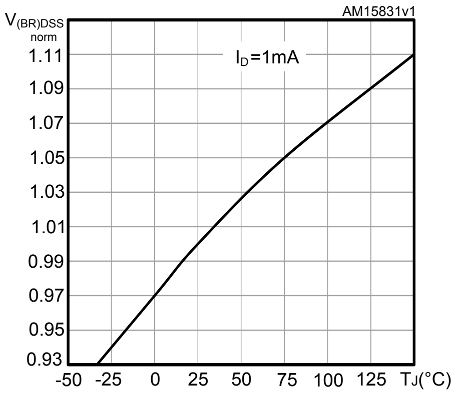


Figure 11. Source-drain diode forward characteristics

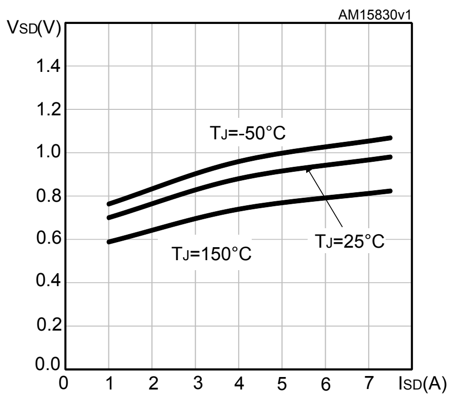
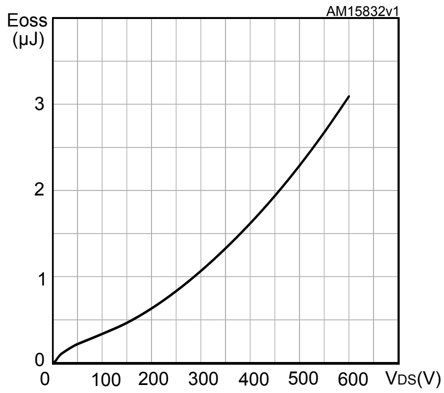


Figure 12. Output capacitance stored energy



3 Test circuits

Figure 13. Test circuit for resistive load switching times

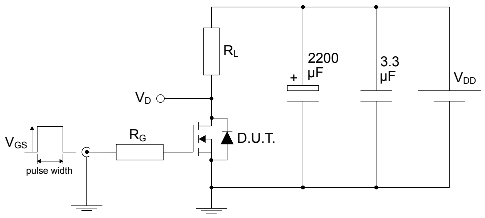


Figure 14. Test circuit for gate charge behavior

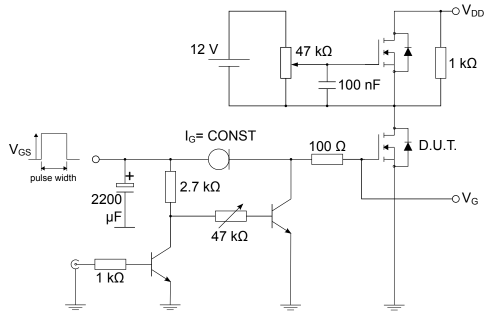


Figure 15. Test circuit for inductive load switching and diode recovery times

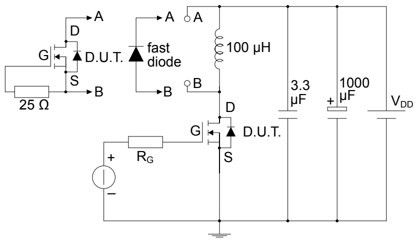


Figure 16. Unclamped inductive load test circuit

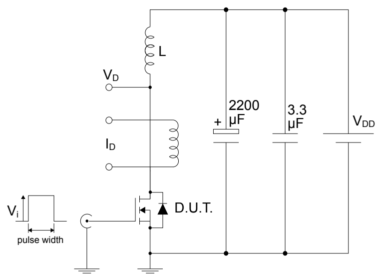


Figure 17. Unclamped inductive waveform

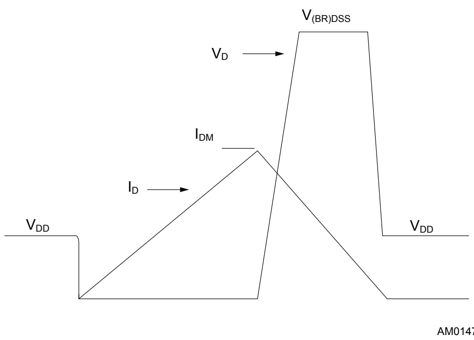
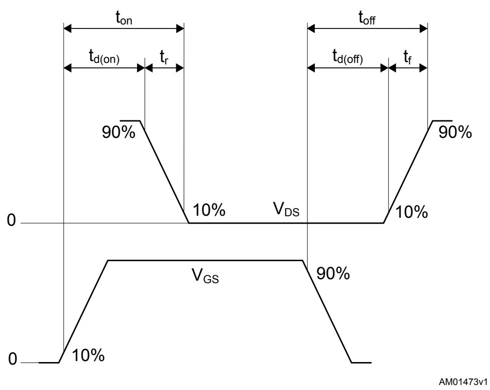


Figure 18. Switching time waveform



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 19. TO-220FP package outline

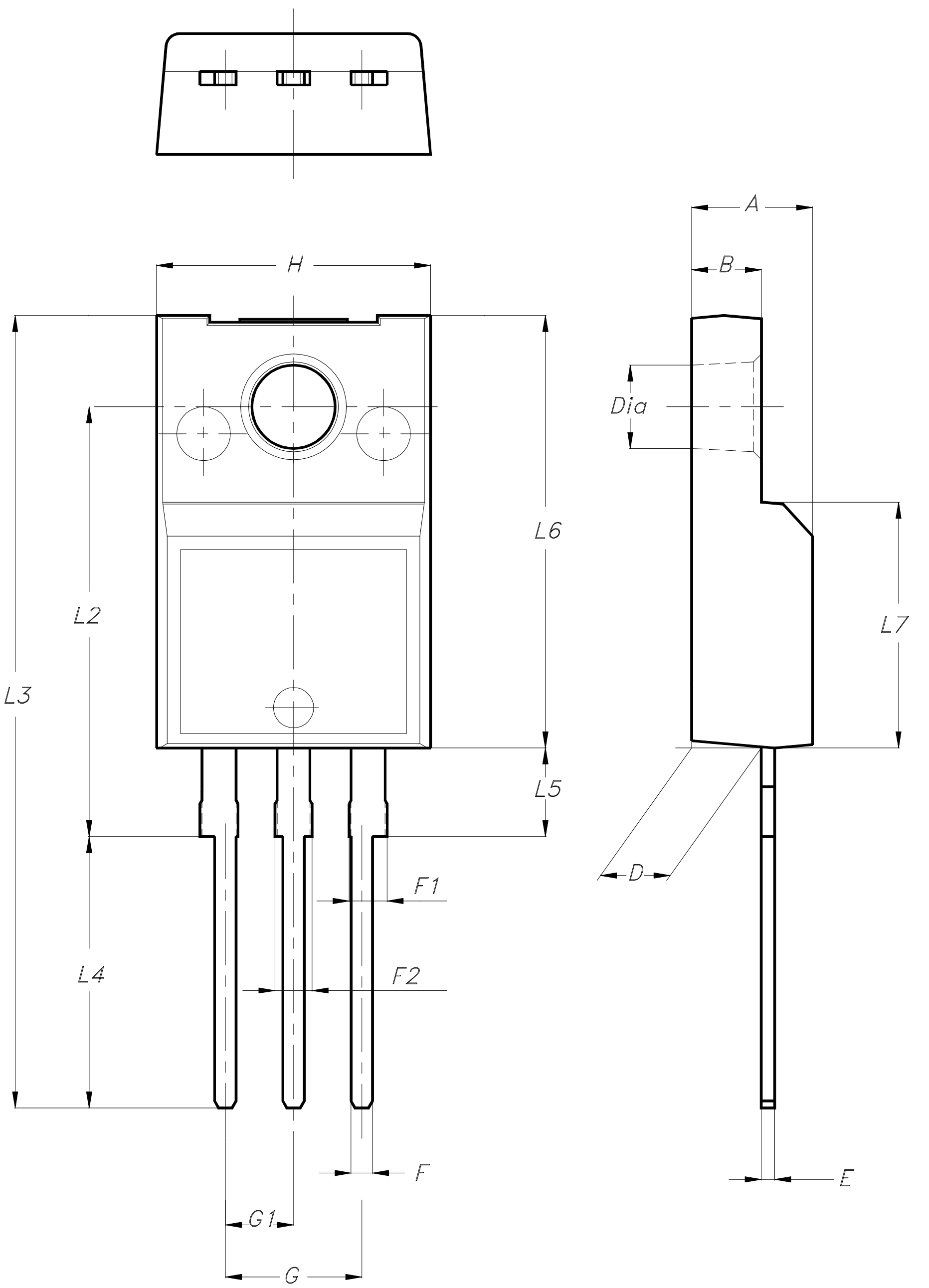


Table 8. **TO-220FP package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

Revision history

Table 9. **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
09-Mar-2017	4	The part number STFI10N60M2 has been moved to a separate datasheet and this document has been updated accordingly. Updated the title and the description in cover page. Updated Table 3. Avalanche characteristics. Minor text changes.
01-Feb-2021	5	Updated Figure 1 and Figure 2. Minor text changes.

Contents