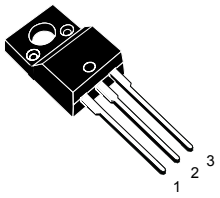
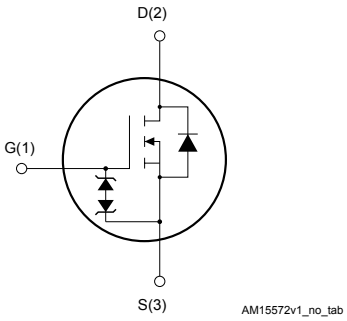
N-channel 600 V, 520 mΩ typ., 6.4 A MDmesh M6 Power MOSFET in a TO-220FP package



TO-220FP



Features

Order code	V_{DS} @ T_{Jmax}	$R_{DS(on)}$ max.	I_D
STF10N60M6	650 V	600 mΩ	6.4 A

- Reduced switching losses
- Lower $R_{DS(on)}$ per area vs previous generation
- Low gate input resistance
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications
- LLC converters, resonant converters
- Boost PFC converters

Description

The new MDmesh M6 technology incorporates the most recent advancements to the well-known and consolidated MDmesh family of SJ MOSFETs. STMicroelectronics builds on the previous generation of MDmesh devices through its new M6 technology, which combines excellent $R_{DS(on)}$ per area improvement with one of the most effective switching behaviors available, as well as a user-friendly experience for maximum end-application efficiency.

Product status link
STF10N60M6

Product summary	
Order code	STF10N60M6
Marking	10N60M6
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	6.4	A
I_D (1)	Drain current (continuous) at T_C = 100 °C	4	A
I_{DM} (2) (1)	Drain current (pulsed)	16.6	A
P_{TOT}	Total power dissipation at T_C = 25 °C	20	W
dv/dt (3)	Peak diode recovery voltage slope	15	V/ns
dv/dt (4)	MOSFET dv/dt ruggedness	100	V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)	2.5	kV
T_{stg}	Storage temperature range	- 55 to 150	°C
T_j	Operating junction temperature range		

1. *Limited by package.*
2. *Pulse width limited by package.*
3. *I_{SD} ≤ 6.4 A, di/dt ≤ 400 A/µs; $V_{DS\ (peak)}$ < $V_{(BR)DSS}$, V_{DD} = 400 V*
4. *V_{DS} ≤ 480 V*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	6.25	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	62.5	°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	1.4	A
E_{AS}	Single pulse avalanche energy (starting T_j=25 °C, I_D= I_{AR}; V_{DD}=50 V)	120	mJ

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified)

Table 4. On /off states

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_C=125 °C (1)			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±5	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 3.2 A		520	600	mΩ

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	-	338	-	pF
C_{oss}	Output capacitance		-	26.2	-	pF
C_{rss}	Reverse transfer capacitance		-	3.88	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS}= 0 to 480 V, V_{GS}= 0 V	-	59	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D=0 A	-	7	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 6.4 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	8.8	-	nC
Q_{gs}	Gate-source charge		-	2.7	-	nC
Q_{gd}	Gate-drain charge		-	4.8	-	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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 3.2 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)	-	11	-	ns
t_r	Rise time		-	8	-	ns
$t_{d(off)}$	Turn-off delay time		-	23	-	ns
t_f	Fall time		-	10	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} (1)	Source-drain current		-		6.4	A
I_{SDM} (2) (1)	Source-drain current (pulsed)		-		16.6	A
V_{SD} (3)	Forward on voltage	I_{SD} = 6.4 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 6.4 A, di/dt = 100 A/µs	-	155		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	0.813		µC
I_{RRM}	Reverse recovery current		-	10.5		A
t_{rr}	Reverse recovery time	I_{SD} = 6.4 A, di/dt = 100 A/µs	-	250		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, T_j = 150 °C	-	1.35		µC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	10.8		A

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

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

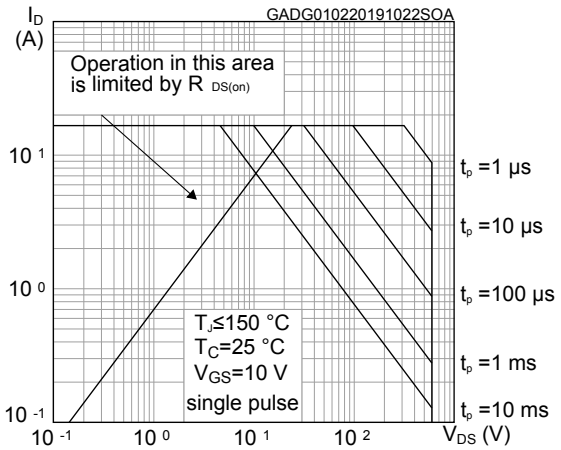


Figure 2. Thermal impedance

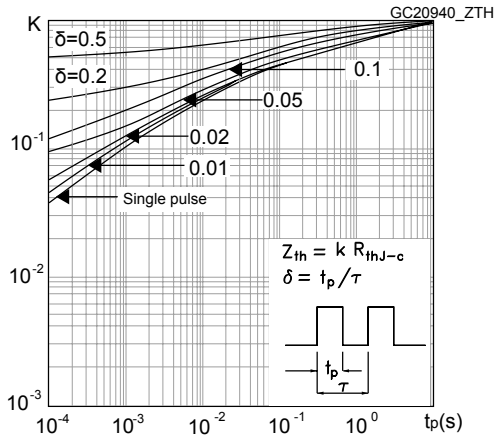


Figure 3. Output characteristics

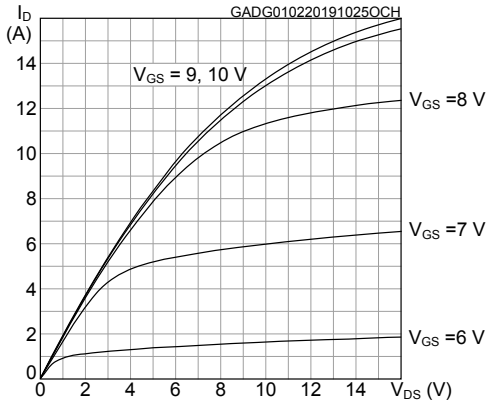


Figure 4. Transfer characteristics

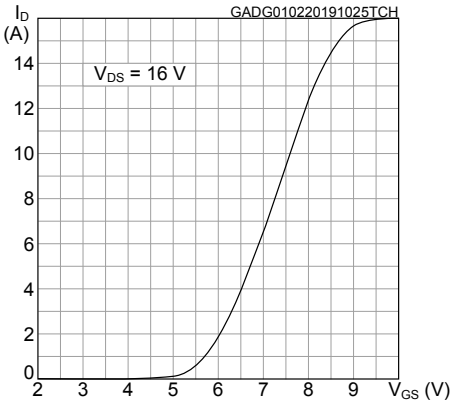


Figure 5. Gate charge vs gate-source voltage

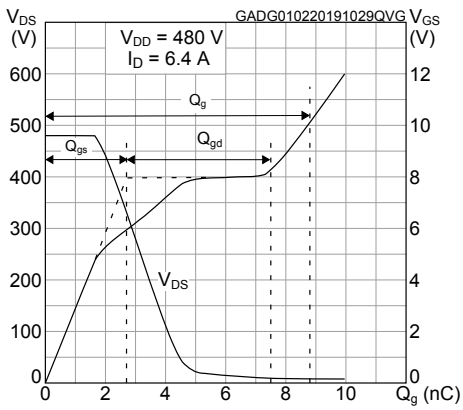


Figure 6. Static drain-source on-resistance

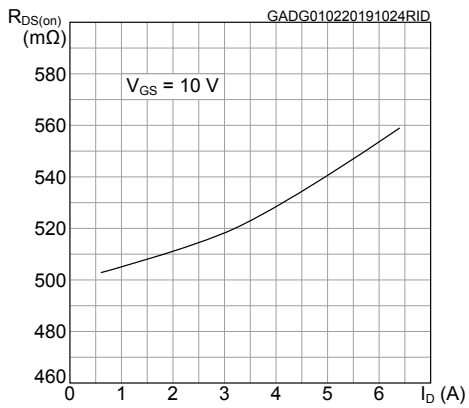


Figure 7. Capacitance variations

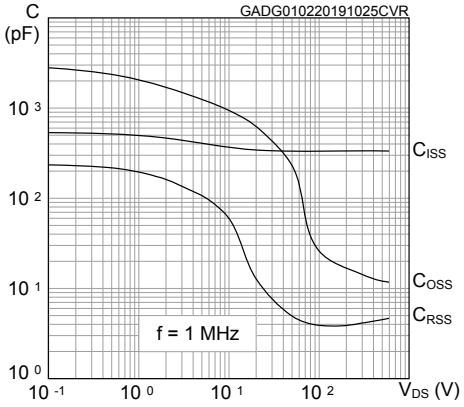


Figure 8. Normalized gate threshold voltage vs. temperature

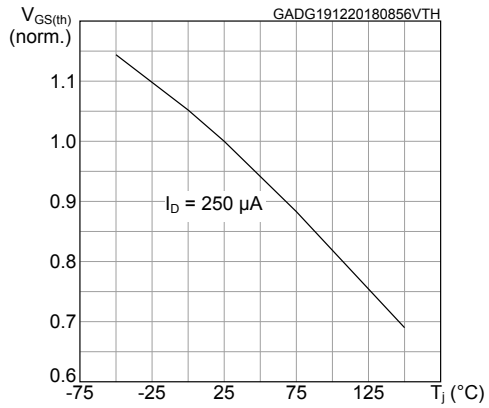


Figure 9. Normalized on-resistance vs temperature

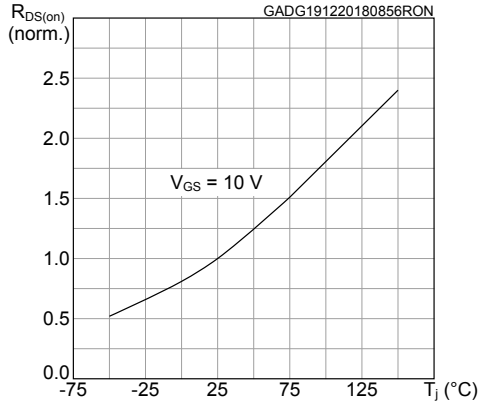


Figure 10. Source-drain diode forward characteristics

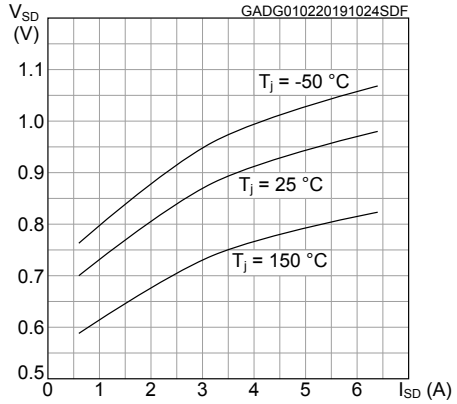


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

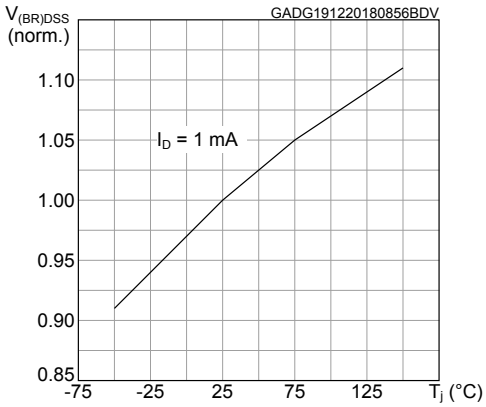
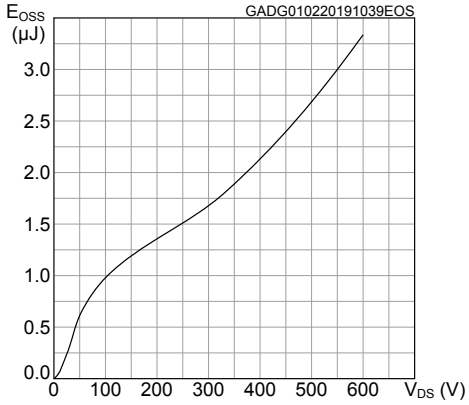


Figure 12. Output capacitance stored energy



3 Test circuits

Figure 13. Test circuit for resistive load switching times

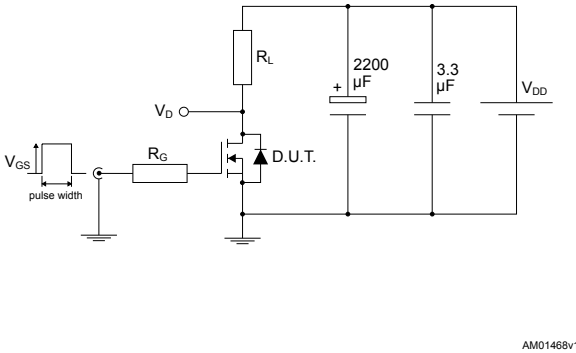


Figure 14. Test circuit for gate charge behavior

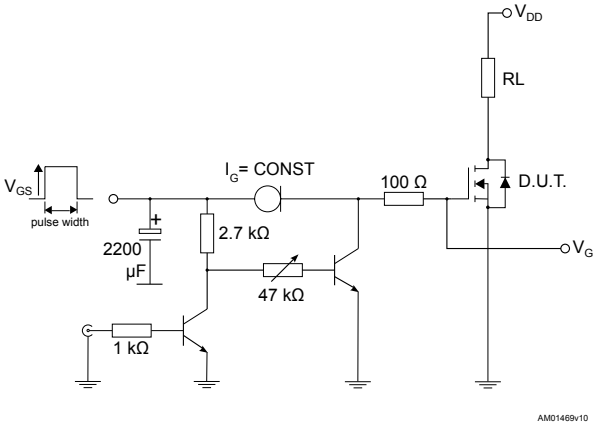


Figure 15. Test circuit for inductive load switching and diode recovery times

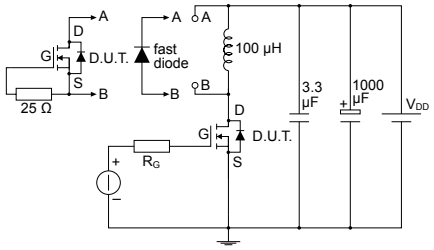


Figure 16. Unclamped inductive load test circuit

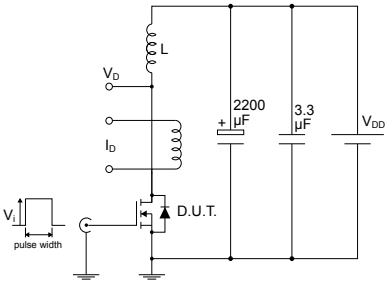


Figure 17. Unclamped inductive waveform

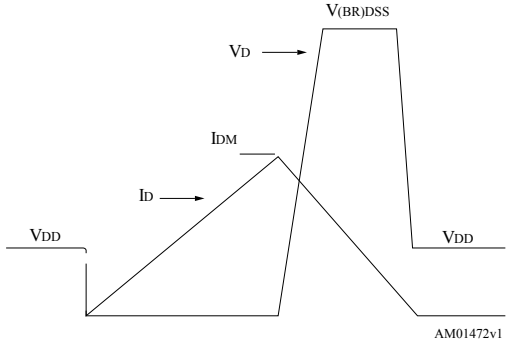
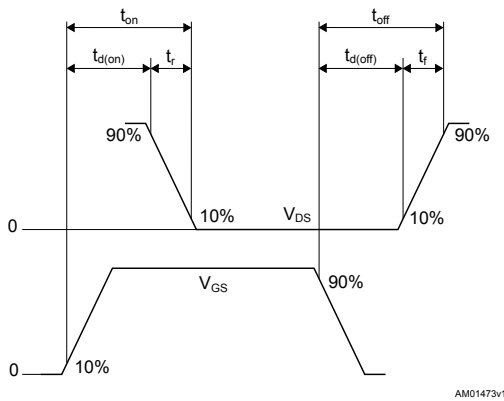


Figure 18. Switching time waveform



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**

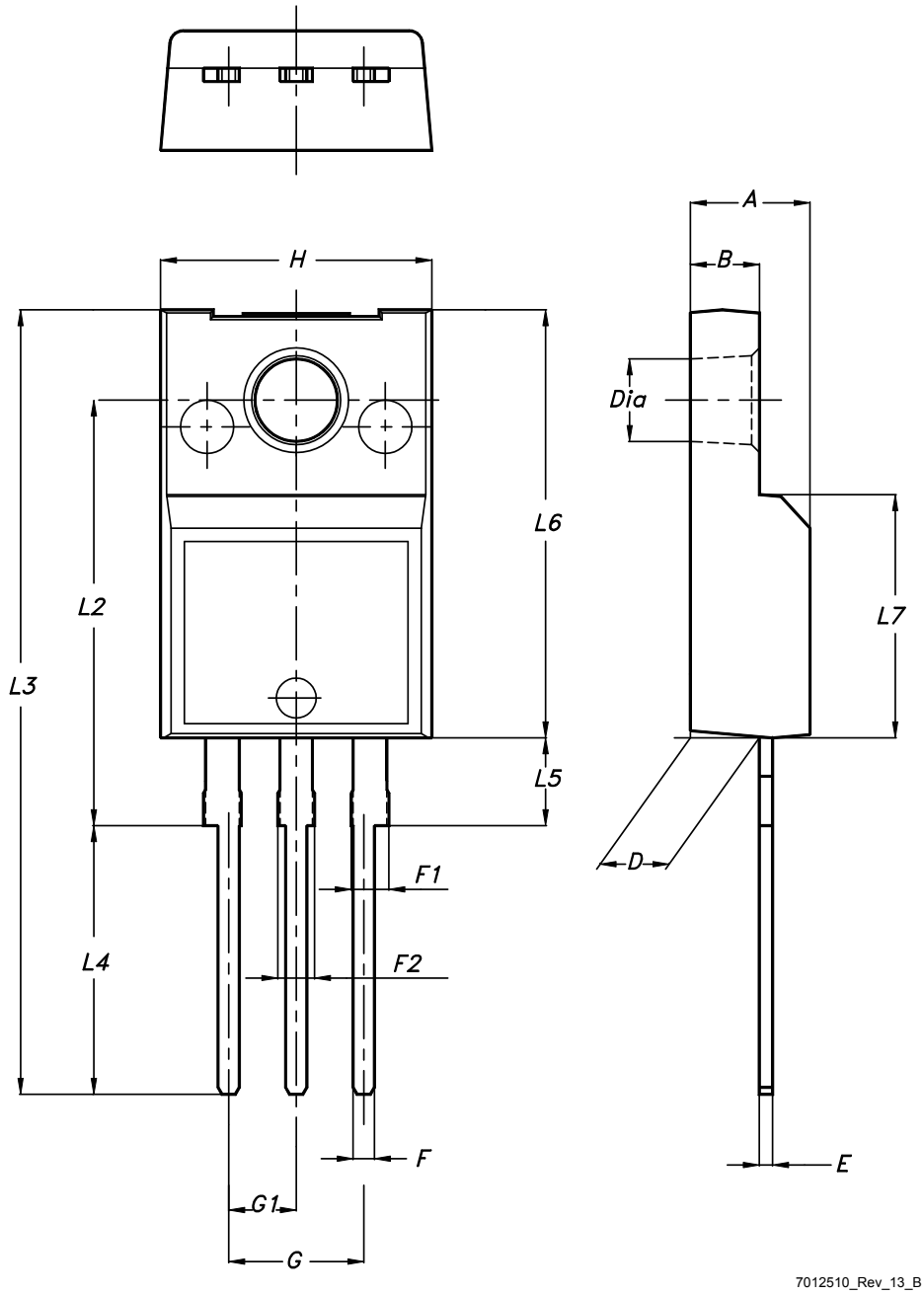


Table 8. **TO-220FP package mechanical data**

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
11-Apr-2019	1	First release.
21-Jun-2019	2	Updated Section Description, Section 2 Electrical characteristics and Section 2.1 Electrical characteristics (curves). Minor text changes.

Contents

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