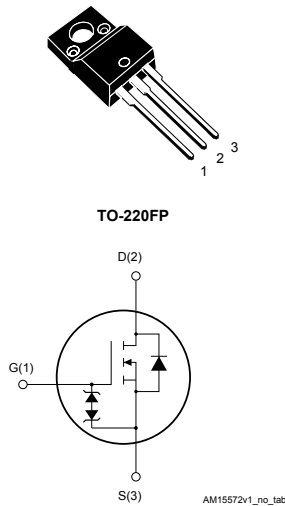


# N-channel 600 V, 0.55 $\Omega$ typ., 7.5 A MDmesh M2 Power MOSFET in a TO-220FP package



## Features

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



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### Product status link

[STF10N60M2](#)

### Product summary

<b>Order code</b>	STF10N60M2
<b>Marking</b>	10N60M2
<b>Package</b>	TO-220FP
<b>Packing</b>	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 $T_C = 25\text{ °C}$	7.5	A
	Drain current (continuous) at $T_C = 100\text{ °C}$	4.9	
$I_{DM}^{(2)}$	Drain current (pulsed)	30	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	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		

- Limited by package.
- Pulse limited by safe operating area.
- $I_{SD} \leq 7.5\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD} = 400\text{ V}$
- $V_{DS} \leq 480\text{ V}$ .
- $t = 1\text{ s}$ ;  $T_C = 25\text{ °C}$ .

**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

- Pulse width limited by  $T_{jmax}$ .
- Starting  $T_j = 25\text{ °C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

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## 2 Electrical characteristics

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

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = 1\text{ mA}$	600			V
$I_{\text{DSS}}$	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 600\text{ V}$			1	$\mu\text{A}$
		$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 600\text{ V}$ , $T_{\text{case}} = 125\text{ }^{\circ}\text{C}^{(1)}$			100	
$I_{\text{GSS}}$	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$ , $V_{\text{GS}} = \pm 25\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{\text{GS}(\text{th})}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$ , $I_{\text{D}} = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{\text{DS}(\text{on})}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 3\text{ A}$		0.55	0.60	$\Omega$

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

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{\text{iss}}$	Input capacitance	$V_{\text{DS}} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{\text{GS}} = 0\text{ V}$	-	400	-	$\mu\text{F}$
$C_{\text{oss}}$	Output capacitance		-	22	-	
$C_{\text{riss}}$	Reverse transfer capacitance		-	0.84	-	
$C_{\text{oss eq.}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }480\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$	-	83	-	$\mu\text{F}$
$R_{\text{G}}$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_{\text{D}} = 0\text{ A}$	-	6.4	-	$\Omega$
$Q_{\text{g}}$	Total gate charge	$V_{\text{DD}} = 480\text{ V}$ , $I_{\text{D}} = 7.5\text{ A}$ , $V_{\text{GS}} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	13.5	-	nC
$Q_{\text{gs}}$	Gate-source charge		-	2.1	-	
$Q_{\text{gd}}$	Gate-drain charge		-	7.2	-	

1.  $C_{\text{oss eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{\text{oss}}$  when  $V_{\text{DS}}$  increases from 0 to 80%  $V_{\text{DSS}}$ .

**Table 6. Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{\text{d}(\text{on})}$	Turn-on delay time	$V_{\text{DD}} = 300\text{ V}$ , $I_{\text{D}} = 3.75\text{ A}$ , $R_{\text{G}} = 4.7\text{ }\Omega$ , $V_{\text{GS}} = 10\text{ V}$ (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	8.8	-	ns
$t_{\text{r}}$	Rise time		-	8	-	
$t_{\text{d}(\text{off})}$	Turn-off delay time		-	32.5	-	
$t_{\text{f}}$	Fall time		-	13.2	-	

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**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	$V_{GS} = 0\text{ V}, I_{SD} = 7.5\text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 7.5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_{DD} = 60\text{ V}$ (see ) Figure 15. Test circuit for inductive load switching and diode recovery times	-	270		ns
$Q_{rr}$	Reverse recovery charge		-	2		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	14.4		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 7.5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_{DD} = 60\text{ V}, T_j = 150\text{ }^\circ\text{C}$ (see ) Figure 15. Test circuit for inductive load switching and diode recovery times	-	376		ns
$Q_{rr}$	Reverse recovery charge		-	2.8		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	15		A

1. Limited by package.
2. Pulse width is limited by safe operating area.
3. Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

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## 2.1 Electrical characteristics curves

Figure 1. Safe operating area

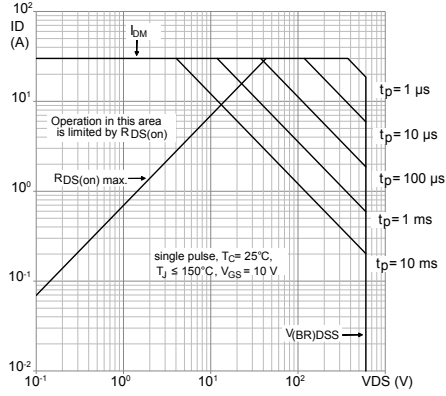


Figure 2. Maximum transient thermal impedance

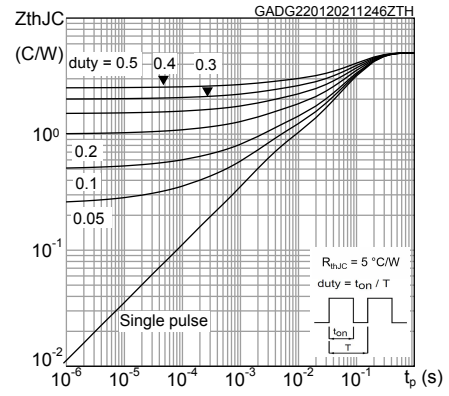


Figure 3. Output characteristics

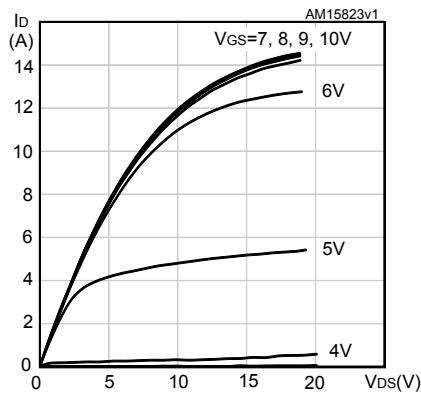


Figure 4. Transfer characteristics

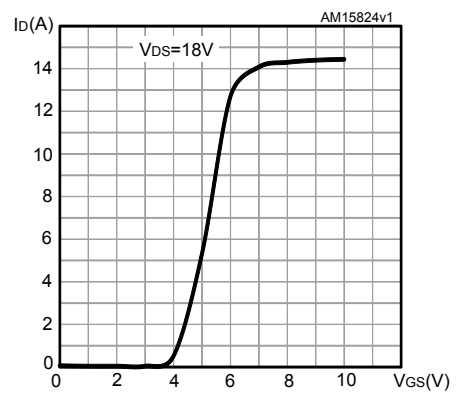


Figure 5. Gate charge vs gate-source voltage

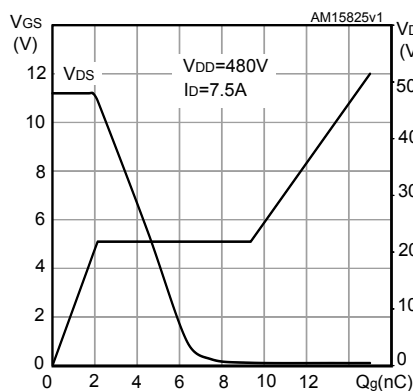
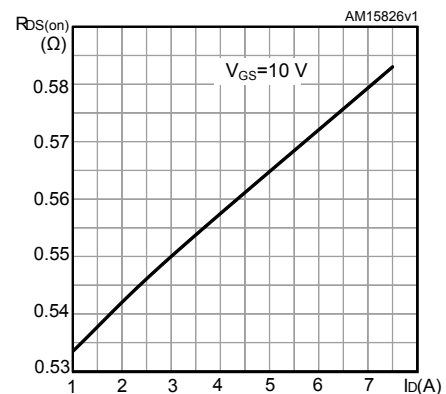
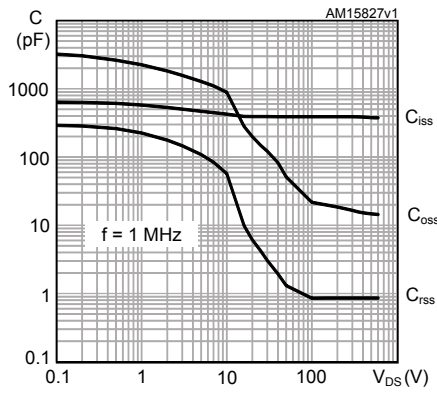


Figure 6. Static drain-source on-resistance

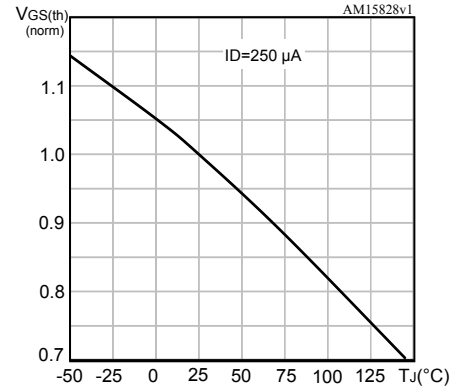


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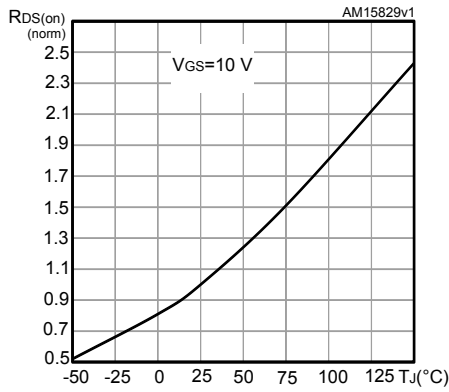
**Figure 7. Capacitance variations**



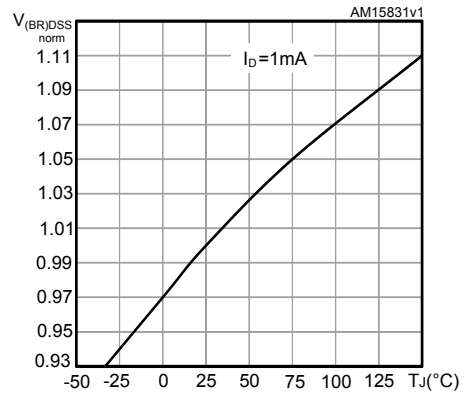
**Figure 8. Normalized gate threshold voltage vs temperature**



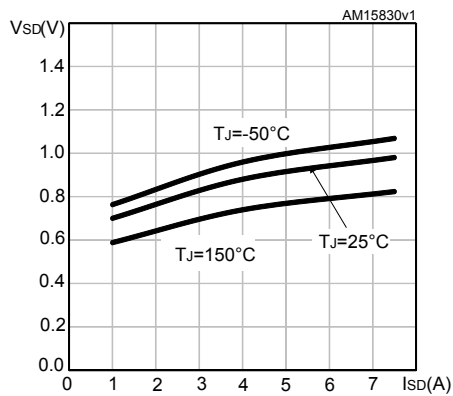
**Figure 9. Normalized on-resistance vs temperature**



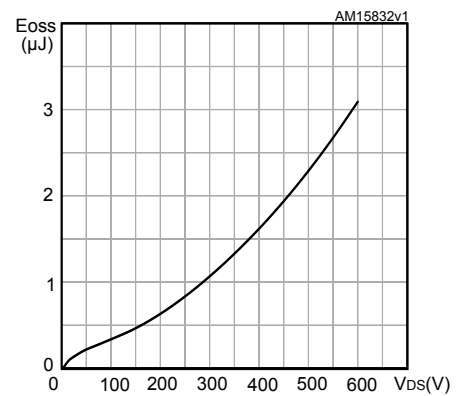
**Figure 10. Normalized V<sub>(BR)DSS</sub> vs temperature**



**Figure 11. Source-drain diode forward characteristics**

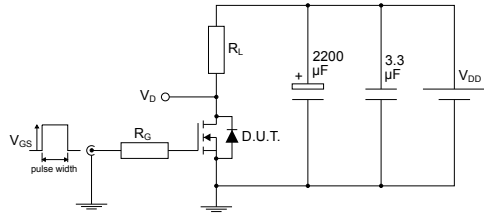


**Figure 12. Output capacitance stored energy**

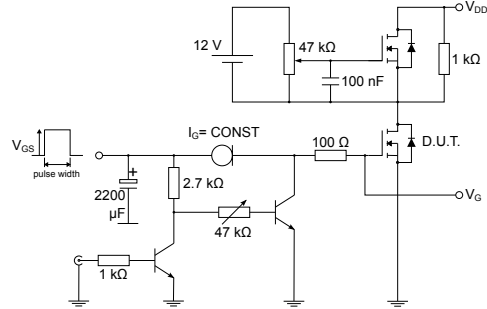


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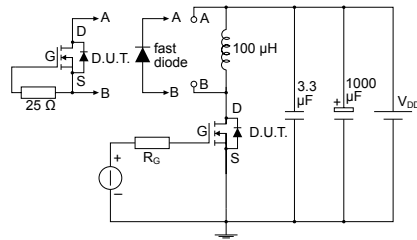
### 3 Test circuits

**Figure 13. Test circuit for resistive load switching times**


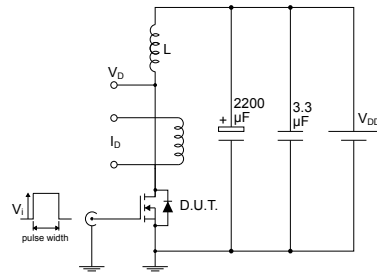
AM01468v1

**Figure 14. Test circuit for gate charge behavior**


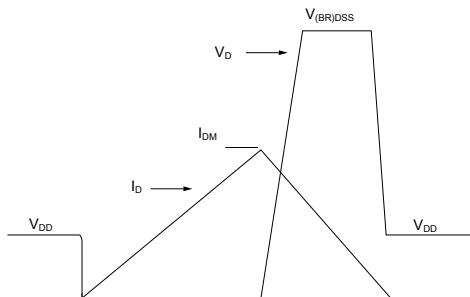
AM01469v1

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


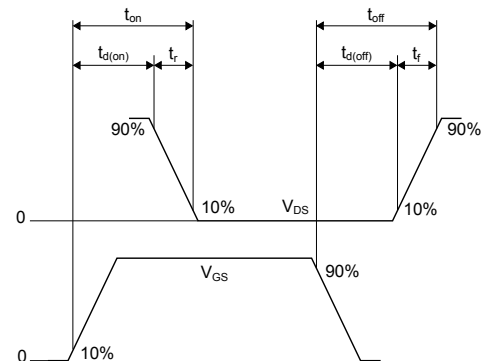
AM01470v1

**Figure 16. Unclamped inductive load test circuit**


AM01471v1

**Figure 17. Unclamped inductive waveform**


AM01472v1

**Figure 18. Switching time waveform**


AM01473v1

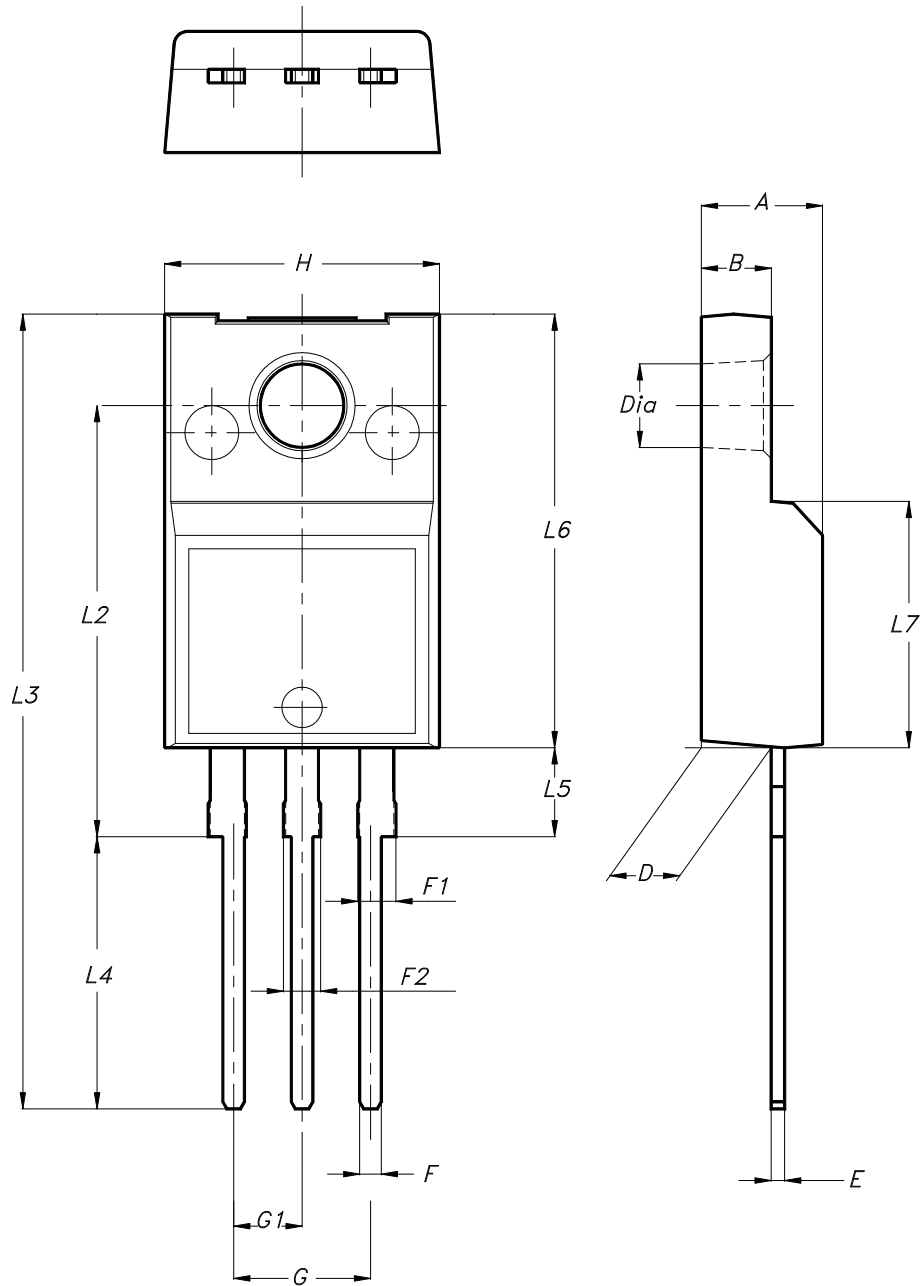
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## 4 Package information

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](http://www.st.com). ECOPACK is an ST trademark.

### 4.1 TO-220FP package information

Figure 19. TO-220FP package outline



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**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

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## 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 <i>Table 6</i> Minor text changes
06-Dec-2013	3	Added: I <sup>2</sup> PAKFP package – Modified: title – Modified: $R_{DS(on)}$ typical values in <i>Table 5</i> – Modified: $R_G$ value in <i>Table 6</i> – Modified: <i>Figure 7</i> and $I_D$ value in <i>Figure 10</i> – Added: <i>Table 10</i> , and <i>Figure 21</i> – Minor text changes
09-Mar-2017	4	The part number STF10N60M2 has been moved to a separate datasheet and this document has been updated accordingly. Updated the title and the description in cover page. Updated <i>Table 3. Avalanche characteristics</i> . Minor text changes.
01-Feb-2021	5	Updated <i>Figure 1</i> and <i>Figure 2</i> . Minor text changes.

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