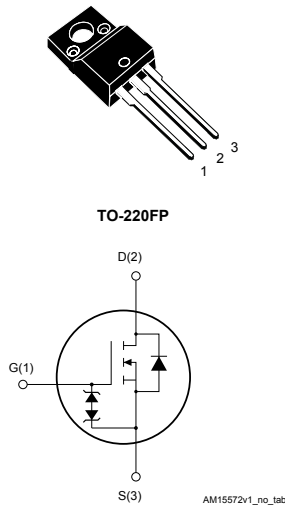


# N-channel 600 V, 0.55 $\Omega$ typ., 7.5 A MDmesh M2 Power MOSFET in a TO-220FP package



## 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.



### 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  $T_j = 25\text{ °C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

## 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	-	
$C_{\text{rSS}}$	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	-	

**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%.

## 2.1 Electrical characteristics curves

Figure 1. Safe operating area

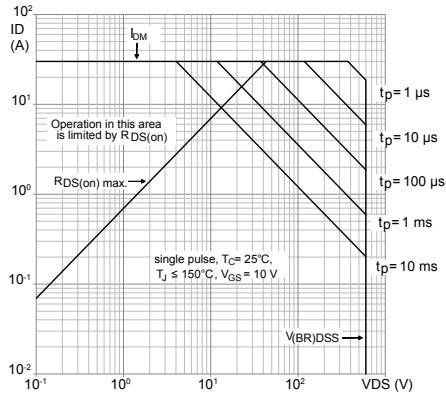


Figure 2. Maximum transient thermal impedance

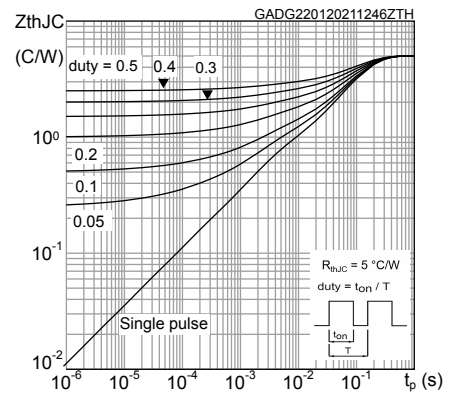


Figure 3. Output characteristics

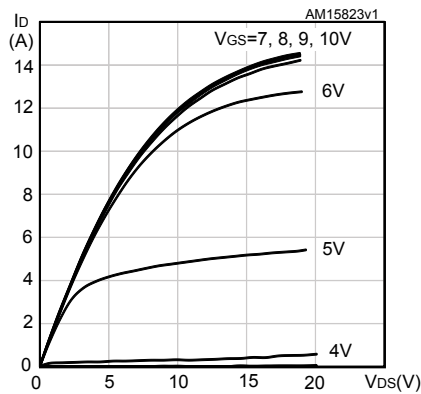


Figure 4. Transfer characteristics

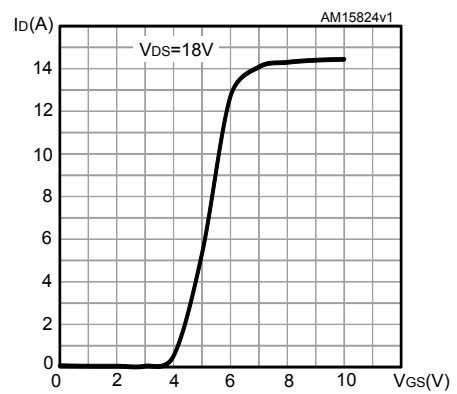


Figure 5. Gate charge vs gate-source voltage

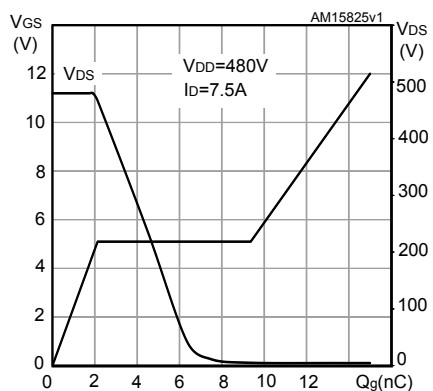


Figure 6. Static drain-source on-resistance

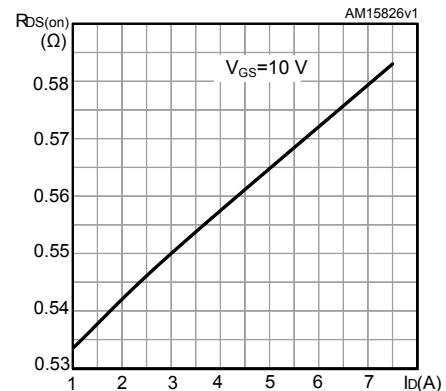


Figure 7. Capacitance variations

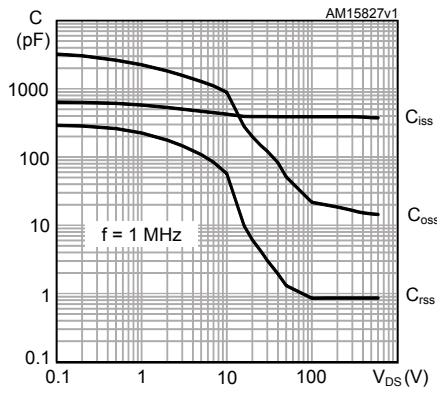


Figure 8. Normalized gate threshold voltage vs temperature

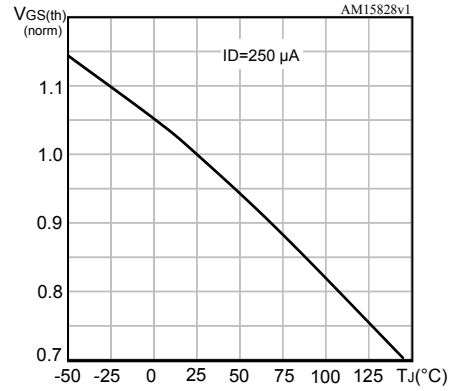


Figure 9. Normalized on-resistance vs temperature

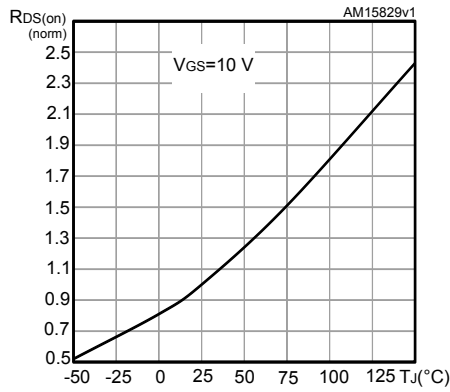


Figure 10. Normalized V<sub>(BR)DSS</sub> vs temperature

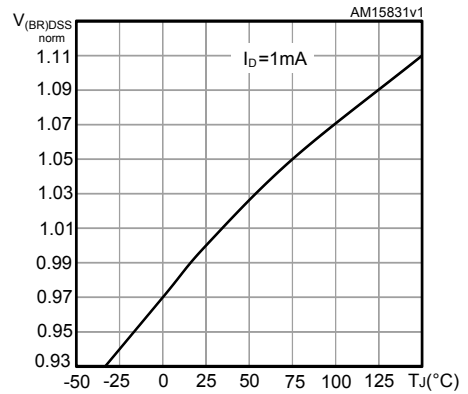


Figure 11. Source-drain diode forward characteristics

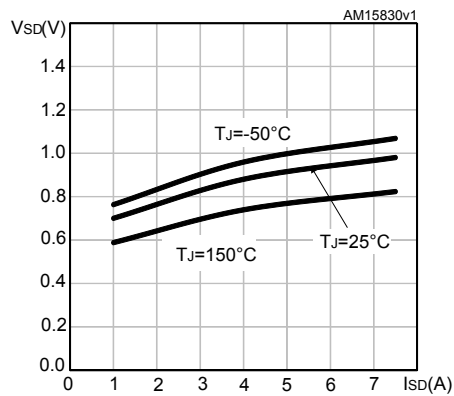
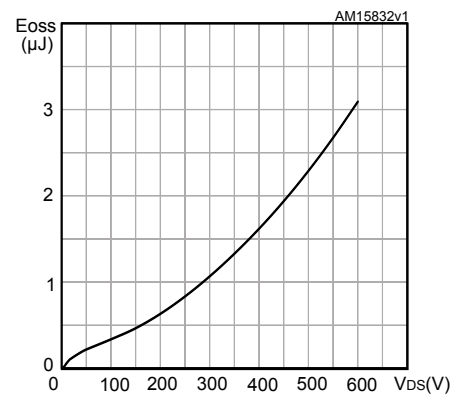
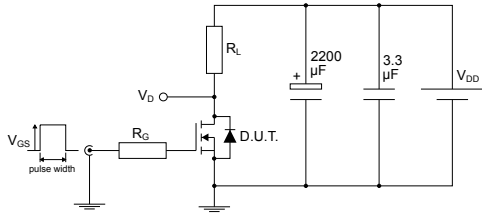


Figure 12. Output capacitance stored energy



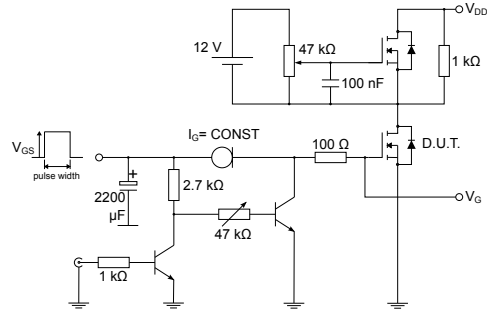
### 3 Test circuits

Figure 13. Test circuit for resistive load switching times



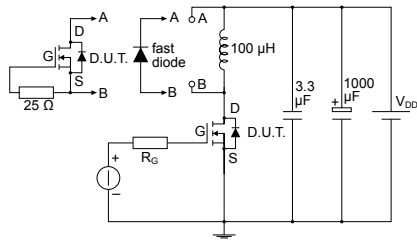
AM01468v1

Figure 14. Test circuit for gate charge behavior



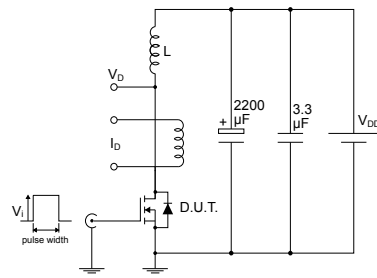
AM01469v1

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



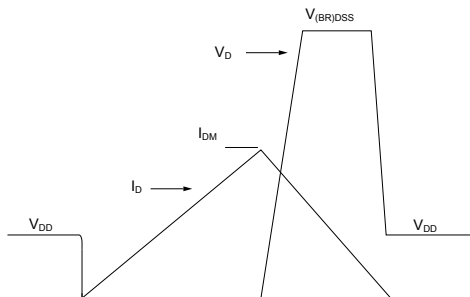
AM01470v1

Figure 16. Unclamped inductive load test circuit



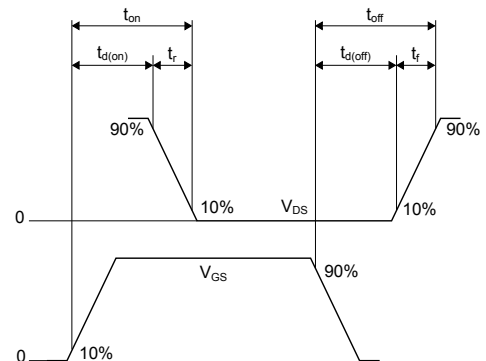
AM01471v1

Figure 17. Unclamped inductive waveform



AM01472v1

Figure 18. Switching time waveform



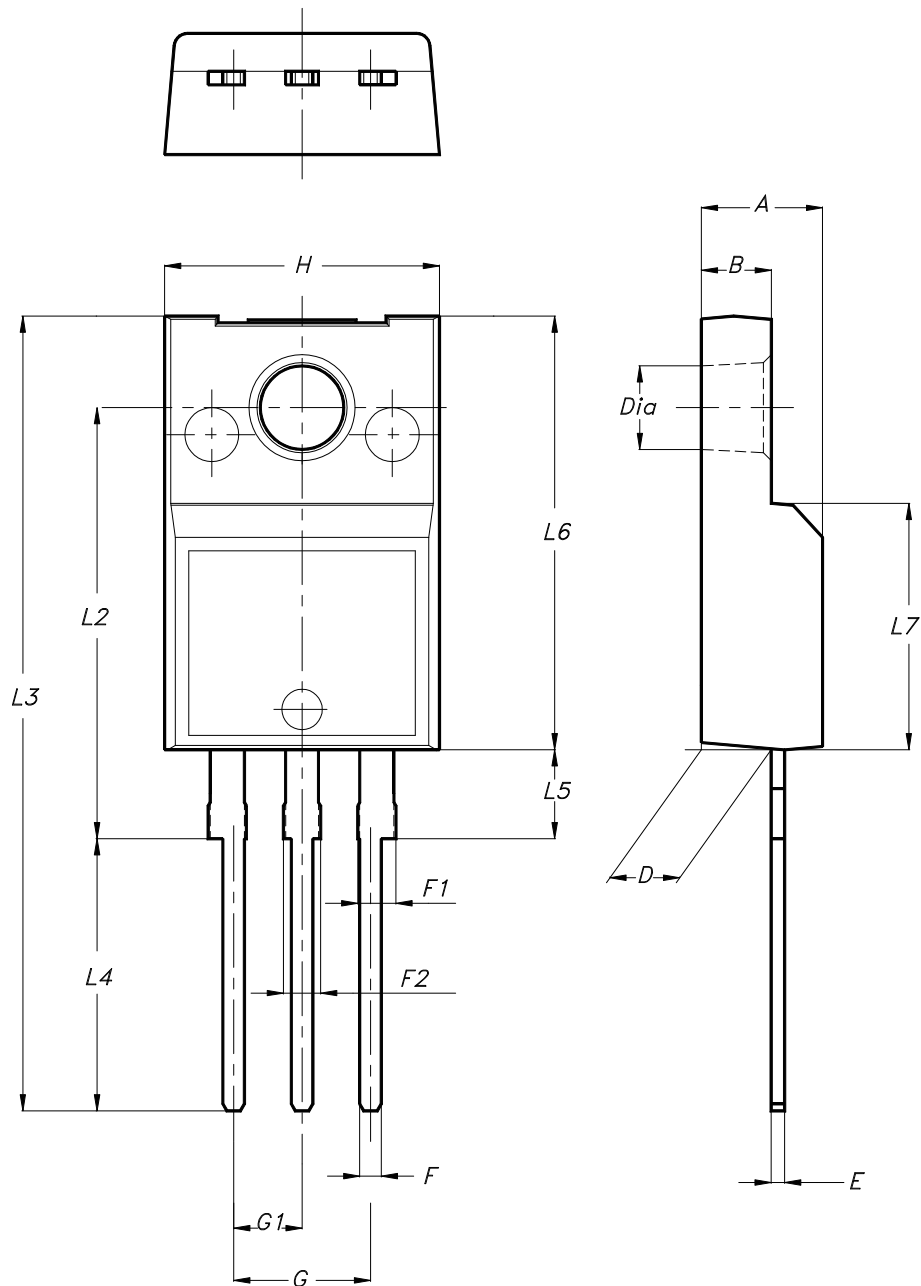
AM01473v1

## 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



7012510\_Rev\_13\_B



**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 <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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