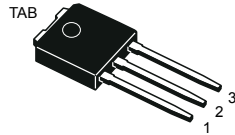
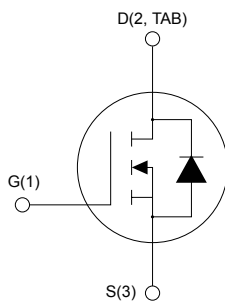


N-channel 600 V, 280 Ω typ., 11 A MDmesh II Power MOSFET in an IPAK package


IPAK


AM01475v1_noZen


Product status link
[STU13NM60N](#)
Product summary

Order code	STU13NM60N
Marking	13NM60N
Package	IPAK
Packing	Tube

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STU13NM60N	600 V	360 m Ω	11 A

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using the second generation of MDmesh technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	600	V
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	11	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	6.9	
$I_{DM}^{(1)}$	Drain current (pulsed)	44	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	90	W
I_{AR}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_J max)	3.5	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	200	mJ
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature range	-55 to 150	$^\circ\text{C}$
T_J	Operating junction temperature range		$^\circ\text{C}$

1. Pulse width limited by safe operating area.

2. $I_{SD} \leq 11\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DS}(\text{peak}) \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	1.39	$^\circ\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-ambient	100	$^\circ\text{C}/\text{W}$

2 Electrical characteristics

$T_C = 25\text{ °C}$ unless otherwise specified.

Table 3. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_C = 125\text{ °C}$ ⁽¹⁾			100	
I_{GSS}	Gate body leakage current	$V_{GS} = \pm 25\text{ V}$, $V_{DS} = 0\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 5.5\text{ A}$		280	360	m Ω

1. Specified by design, not tested in production.

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	790	-	pF
C_{oss}	Output capacitance		-	60	-	pF
C_{riss}	Reverse transfer capacitance		-	3.6	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ to }480\text{ V}$	-	135	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	4.7	-	Ω
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 11\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 13. Test circuit for gate charge behavior)	-	27	-	nC
Q_{gs}	Gate-source charge		-	4	-	nC
Q_{gd}	Gate-drain charge		-	14	-	nC

1. $C_{oss\text{ eq.}}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 V to the stated value.

Table 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 5.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 12. Test circuit for resistive load switching times and Figure 17. Switching time waveform)	-	3	-	ns
t_r	Rise time		-	8	-	ns
$t_{d(off)}$	Turn-off delay time		-	30	-	ns
t_f	Fall time		-	10	-	ns

Table 6. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		11	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		44	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 11\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$	-	230		ns
Q_{rr}	Reverse recovery charge	(see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	2		μC
I_{RRM}	Reverse recovery current		-	18		A
t_{rr}	Reverse recovery time	$I_{SD} = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 100\text{ V}$,	-	290		ns
Q_{rr}	Reverse recovery charge	$T_J = 150\text{ }^\circ\text{C}$ (see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	2.5		μC
I_{RRM}	Reverse recovery current		-	17		A

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

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

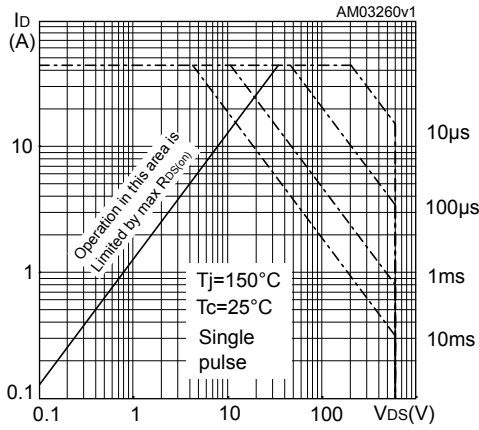


Figure 2. Normalized transient thermal impedance

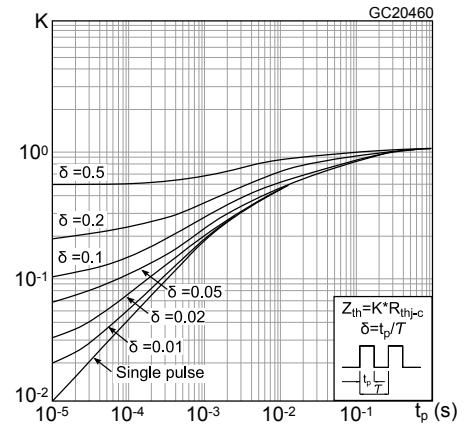


Figure 3. Typical output characteristics

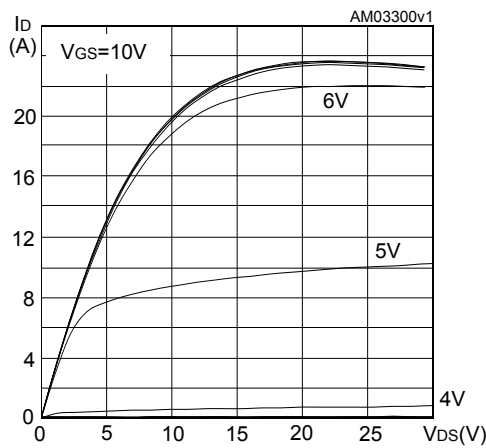


Figure 4. Typical transfer characteristics

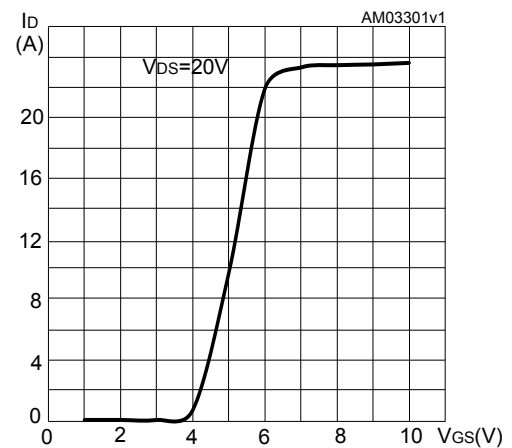


Figure 5. Normalized gate threshold vs temperature

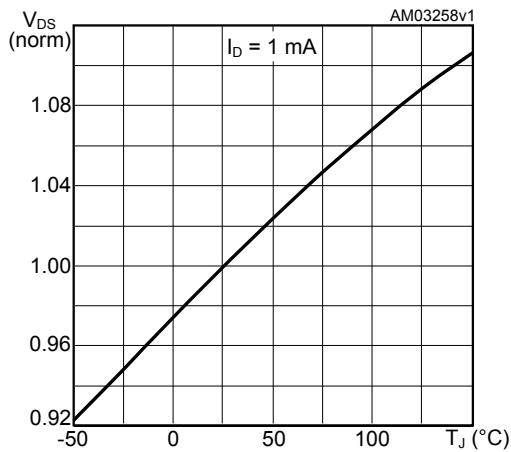


Figure 6. Typical drain-source on-resistance

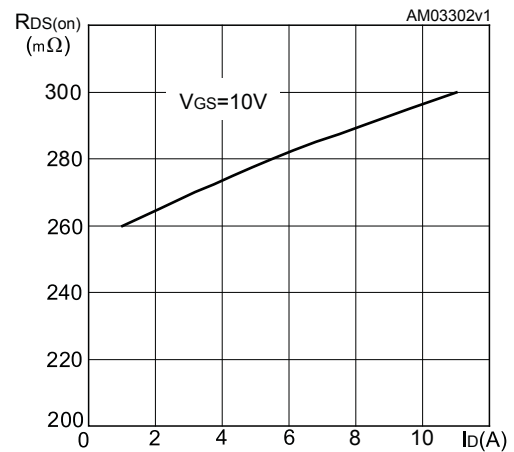


Figure 7. Typical gate charge characteristics

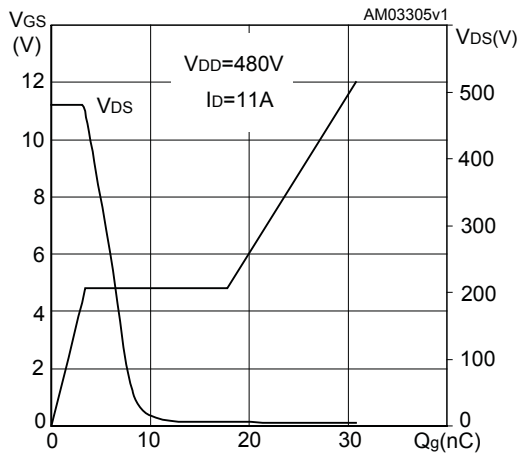


Figure 8. Typical capacitance characteristics

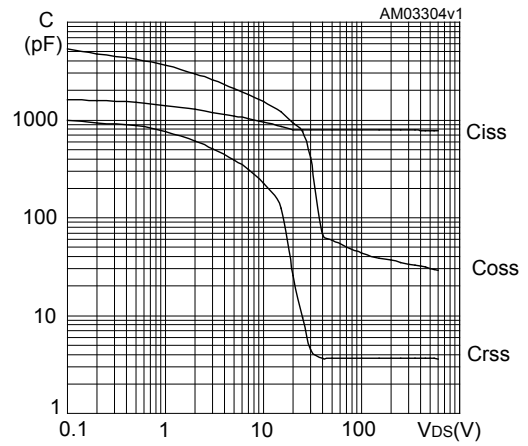


Figure 9. Normalized gate threshold vs temperature

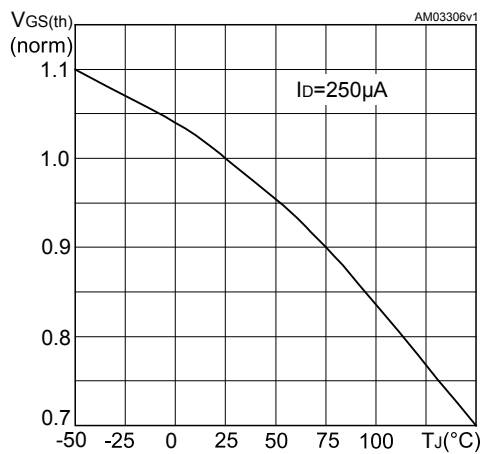


Figure 10. Normalized on-resistance vs temperature

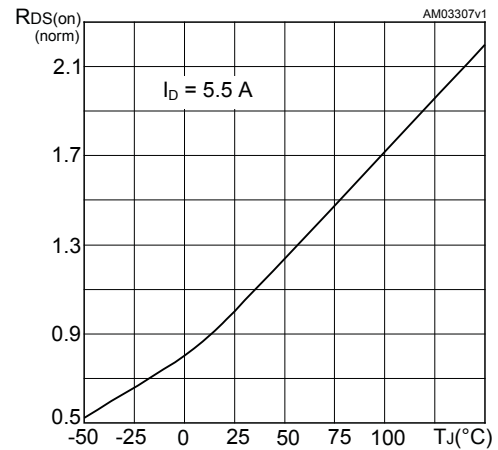
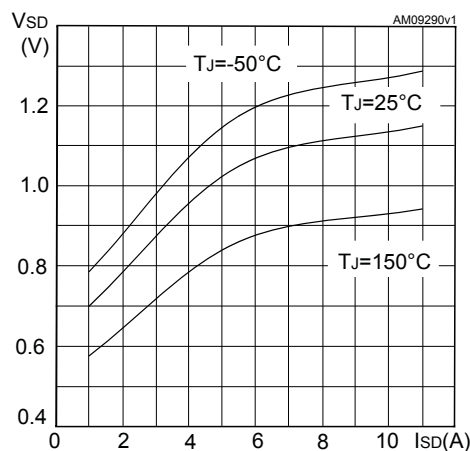


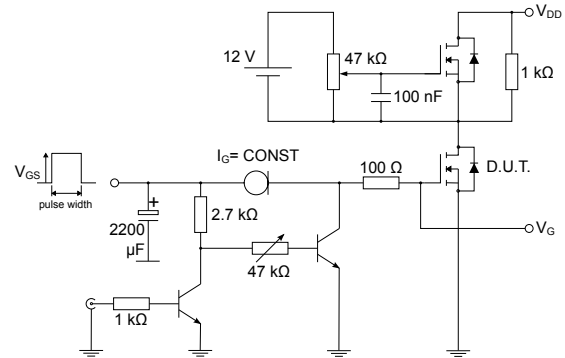
Figure 11. Typical reverse diode forward characteristics



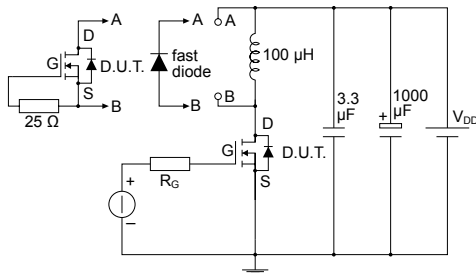
3 Test circuits

Figure 12. Test circuit for resistive load switching times

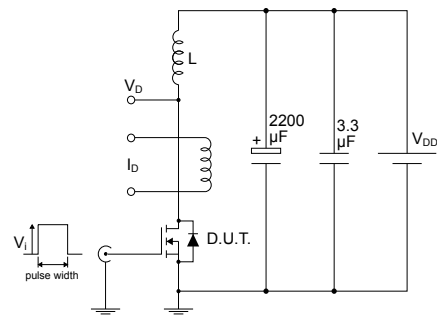

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Figure 13. Test circuit for gate charge behavior


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Figure 14. Test circuit for inductive load switching and diode recovery times


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Figure 15. Unclamped inductive load test circuit


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Figure 16. Unclamped inductive waveform


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Figure 17. Switching time waveform

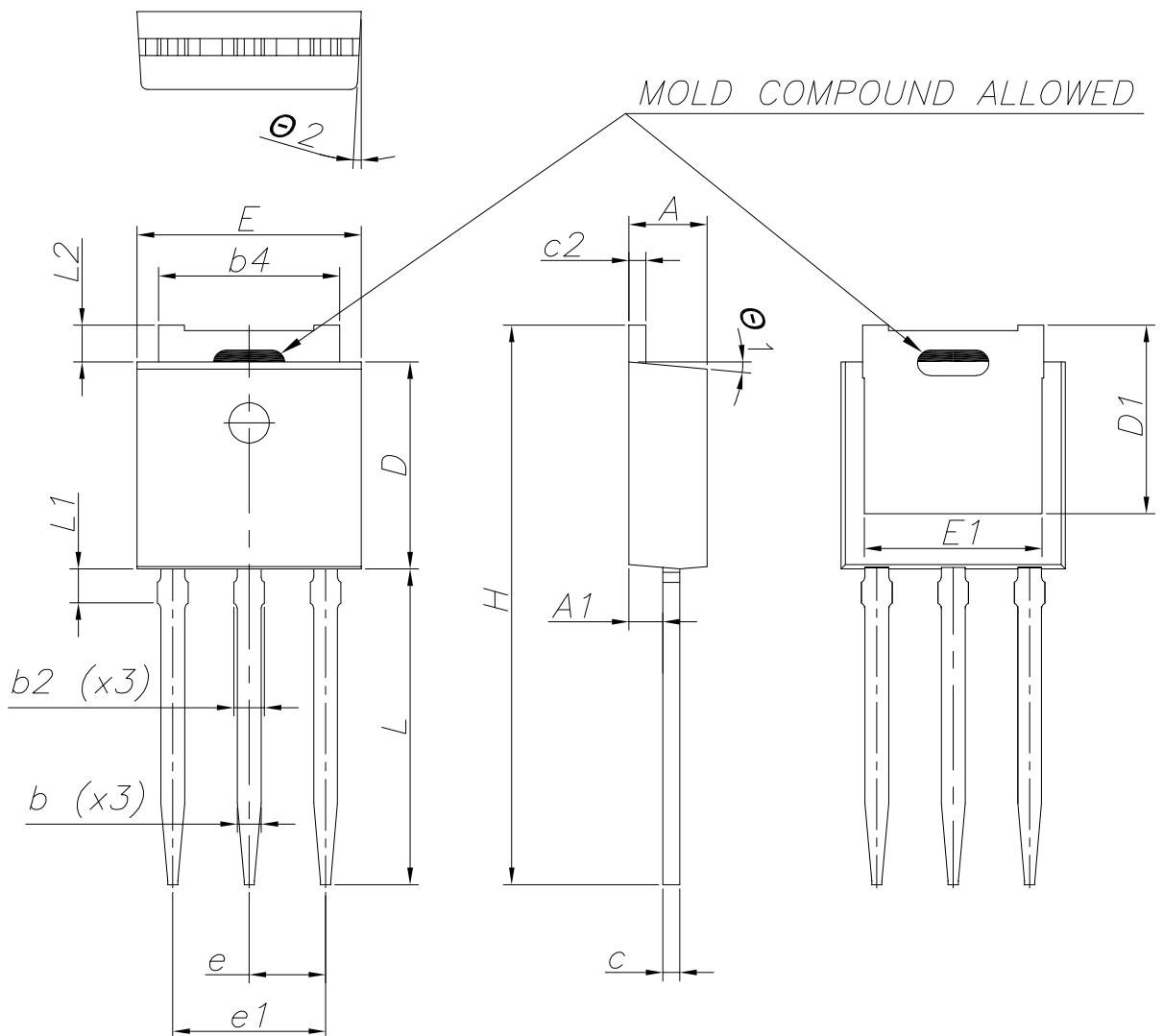

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4 Package information

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. ECOPACK is an ST trademark.

4.1 IPAK (TO-251) type E package information

Figure 18. IPAK (TO-251) type E package outline



0068771_E_rev.16

Table 7. IPAK (TO-251) type E package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.35
A1	0.90	1.00	1.10
b	0.66		0.79
b2			0.90
b4	5.23	5.33	5.43
c	0.46		0.59
c2	0.46		0.59
D	6.00	6.10	6.20
D1	5.30	5.53	5.75
E	6.50	6.60	6.70
E1	5.05	5.23	5.40
e	2.20	2.25	2.30
e1	4.40	4.50	4.60
H	16.18	16.48	16.78
L	9.00	9.30	9.60
L1	0.80	1.00	1.20
L2	0.90	1.08	1.25
Ø1	3°	5°	7°
Ø2	1°	3°	5°

Revision history

Table 8. Document revision history

Date	Revision	Changes
29-Feb-2009	1	First release
13-Jan-2010	2	<ul style="list-style-type: none"> – Added new package, mechanical data: TO-247 – Added new package, mechanical data: D²PAK
08-Nov-2010	3	<ul style="list-style-type: none"> – Modified <i>Figure 4</i> – Added new package, mechanical data: I²PAK
18-Jan-2012	4	<ul style="list-style-type: none"> – Added new package, mechanical data: IPAK – Minor text changes
14-Nov-2012	5	<p>The part numbers STB13NM60N and STD13NM60N have been moved to a separate datasheet.</p> <p><i>Section 4: Package mechanical data</i> has been updated.</p>
26-Oct-2020	6	<p>The part number STW13NM60N have been moved to a separate datasheet and the document has been updated accordingly.</p> <p>Updated cover page.</p> <p>Updated <i>Section 1 Electrical ratings</i>.</p> <p>Updated <i>Table 4. Static</i> and <i>Table 7. Source-drain diode</i>.</p> <p>Updated <i>Section 4 Package information</i>.</p> <p>Added <i>Section 5 Ordering information</i>.</p> <p>Minor text changes.</p>
18-Sep-2023	7	<p>The part numbers STF13NM60N, STI13NM60N and STP13NM60N have been moved to separate datasheets and the document has been updated accordingly.</p> <p>Updated <i>Section 4 Package information</i>.</p> <p>Minor text changes.</p>

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