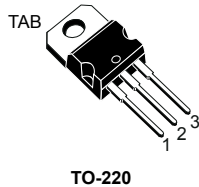
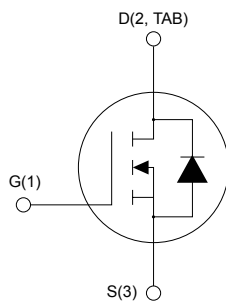


## N-channel 600 V, 325 mΩ typ., 11 A FDmesh II Power MOSFET in a TO-220 package



TO-220



AM01475v1\_noZen


**Product status link**
[STP13NM60ND](#)
**Product summary**

<b>Order code</b>	STP13NM60ND
<b>Marking</b>	13NM60ND
<b>Package</b>	TO-220
<b>Packing</b>	Tube

### Features

Order code	$V_{DS}$ at $T_J$ max.	$R_{DS(on)}$ max.	$I_D$
STP13NM60ND	650 V	380 mΩ	11 A

- Fast-recovery body diode
- Low gate charge and input capacitance
- Low on-resistance  $R_{DS(on)}$
- 100% avalanche tested
- High dv/dt ruggedness

### Applications

- Switching applications

### Description

This FDmesh II Power MOSFET with fast-recovery body diode is produced using MDmesh II technology. Utilizing a new strip-layout vertical structure, this device features low on-resistance and superior switching performance. It is ideal for bridge topologies and ZVS phase-shift 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 $T_C = 25\text{ °C}$	11	A
	Drain current (continuous) at $T_C = 100\text{ °C}$	6.93	
$I_{DM}^{(1)}$	Drain current (pulsed)	44	A
$P_{TOT}$	Total power dissipation at $T_C = 25\text{ °C}$	109	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	40	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	40	V/ns
$T_{stg}$	Storage temperature range	-55 to 150	°C
$T_J$	Maximum operating junction temperature	150	°C

1. Pulse width is limited by safe operating area.
2.  $I_{SD} \leq 11\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS}(\text{peak}) < V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ .
3.  $V_{DS} \leq 480\text{ V}$ .

**Table 2. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thJC}$	Thermal resistance, junction-to-case	1.15	°C/W
$R_{thJA}$	Thermal resistance, junction-to-ambient	62.5	°C/W

**Table 3. Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AS}$	Avalanche current, repetitive or non-repetitive (pulse width limited by $T_J$ max.)	3	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ °C}$ , $I_D = I_{AS}$ , $V_{DD} = 50\text{ V}$ )	162	mJ

## 2 Electrical characteristics

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

**Table 4. On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ , $T_C = 125\text{ °C}^{(1)}$			100	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$			$\pm 100$	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 5.5\text{ A}$		325	380	m $\Omega$

1. Specified by design, not tested in production.

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	845	-	pF
$C_{oss}$	Output capacitance		-	47	-	pF
$C_{rSS}$	Reverse transfer capacitance		-	2.5	-	pF
$C_{oss\ eq.}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$ , $V_{DS} = 0\text{ to }480\text{ V}$	-	121	-	pF
$R_G$	Gate input resistance	$f = 1\text{ MHz}$ , Gate DC bias = 0 V, test signal level = 20 mV, open drain	-	4.3	-	$\Omega$
$Q_g$	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)	-	24.5	-	nC
$Q_{gs}$	Gate-source charge		-	4.8	-	nC
$Q_{gd}$	Gate-drain charge		-	17	-	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	$V_{DD} = 300\text{ V}$ , $I_D = 5.5\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	46.5	-	ns
$t_r$	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 12. Test circuit for resistive load switching times and Figure 17. Switching time waveform)	-	9.6	-	ns
$t_f$	Fall time		-	15.4	-	ns

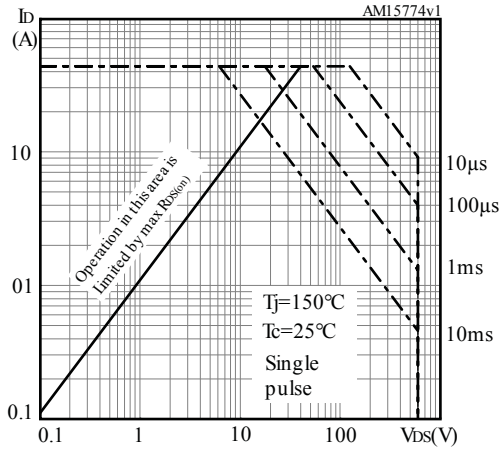
**Table 7. Source-drain diode**

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	$I_{SD} = 11\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 11\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	150		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100\text{ V}$	-	755		nC
$I_{RRM}$	Reverse recovery current	(see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	12		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 11\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,	-	187		ns
$Q_{rr}$	Reverse recovery charge	$V_{DD} = 100\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$	-	1271		nC
$I_{RRM}$	Reverse recovery current	(see Figure 14. Test circuit for inductive load switching and diode recovery times)	-	13.6		A

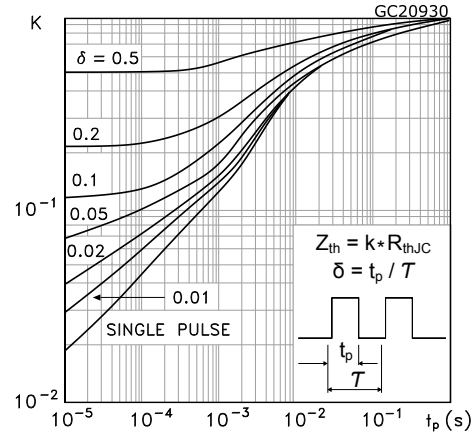
1. Pulse width is limited by safe operating area.
2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)

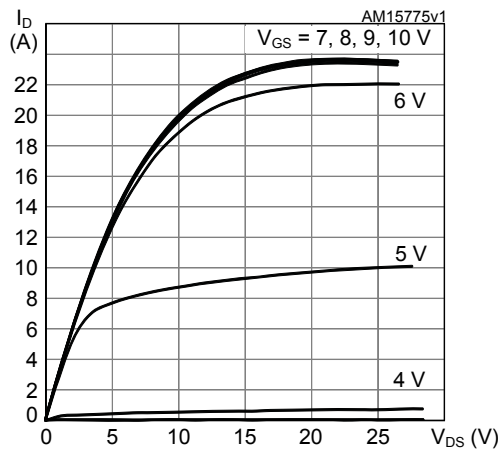
**Figure 1. Safe operating area**



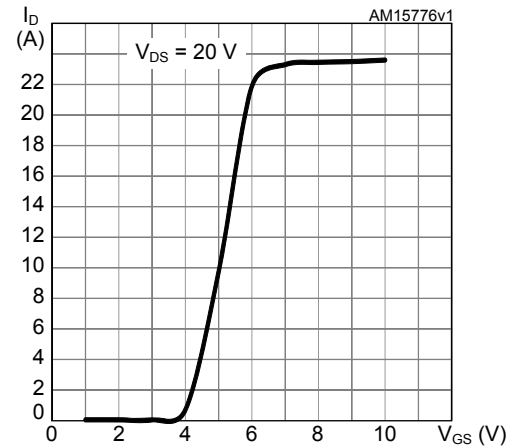
**Figure 2. Normalized transient thermal impedance**



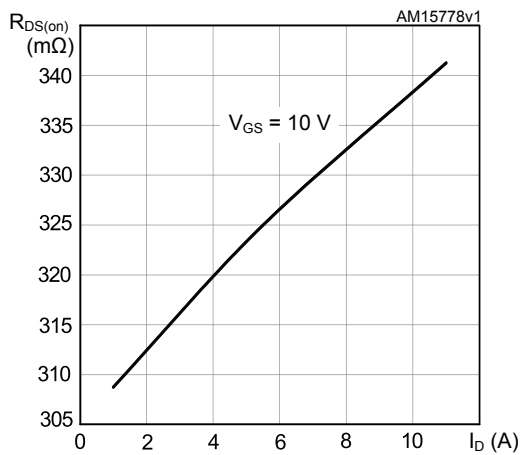
**Figure 3. Output characteristics**



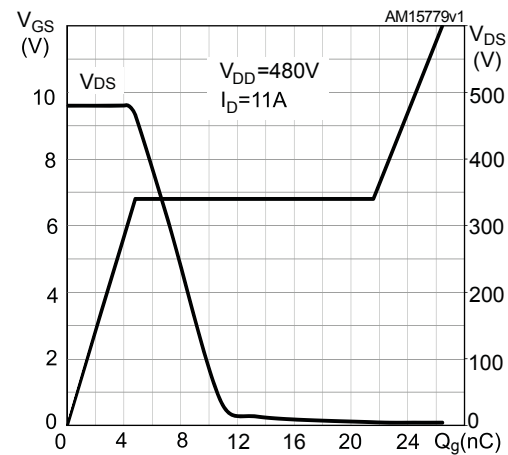
**Figure 4. Transfer characteristics**



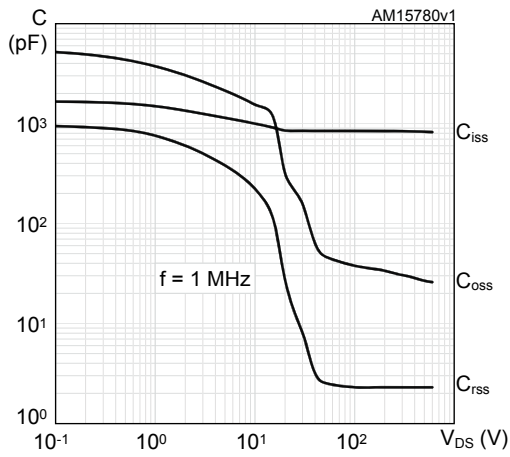
**Figure 5. Static drain-source on resistance**



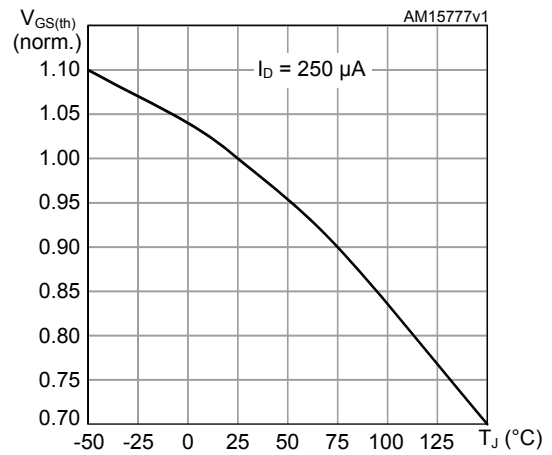
**Figure 6. Gate charge vs gate-source voltage**



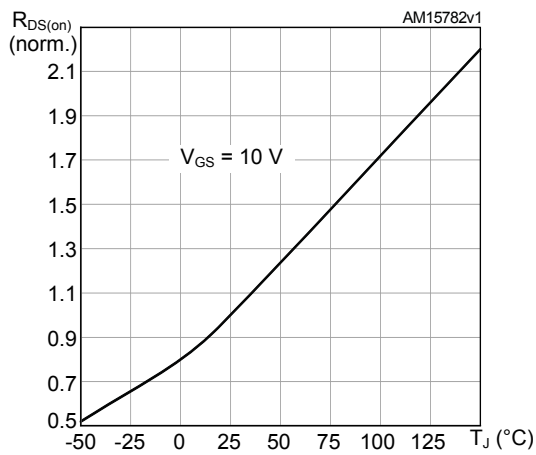
**Figure 7. Capacitance variations**



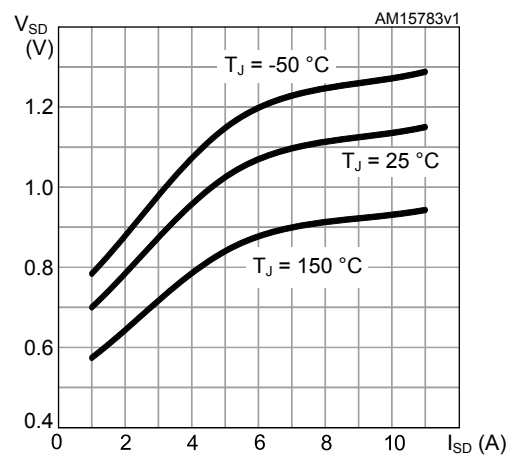
**Figure 8. Normalized gate threshold voltage vs temperature**



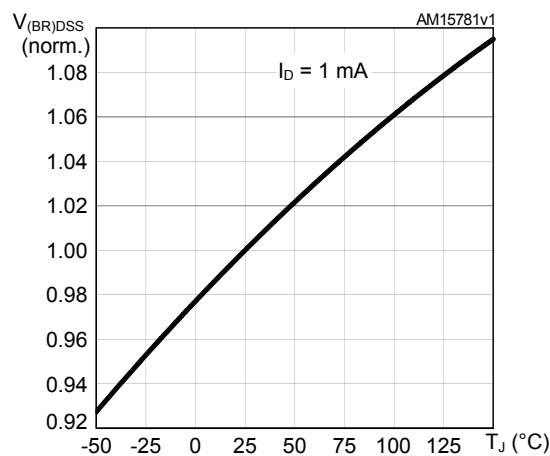
**Figure 9. Normalized on resistance vs temperature**



**Figure 10. Source-drain diode forward characteristics**



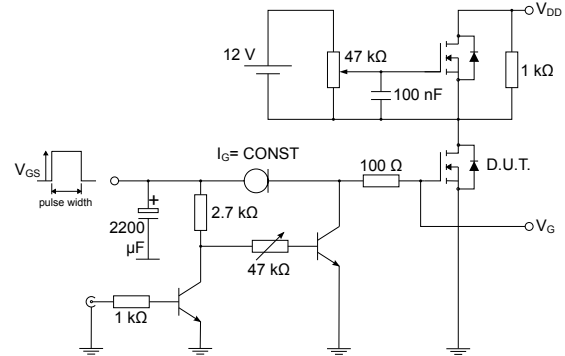
**Figure 11. Normalized breakdown voltage vs temperature**



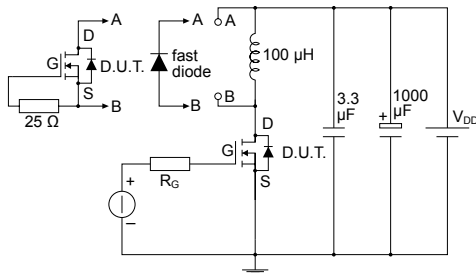
### 3 Test circuits

**Figure 12. Test circuit for resistive load switching times**


AM01468v1

**Figure 13. Test circuit for gate charge behavior**


AM01469v1

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


AM01470v1

**Figure 15. Unclamped inductive load test circuit**


AM01471v1

**Figure 16. Unclamped inductive waveform**


AM01472v1

**Figure 17. Switching time waveform**

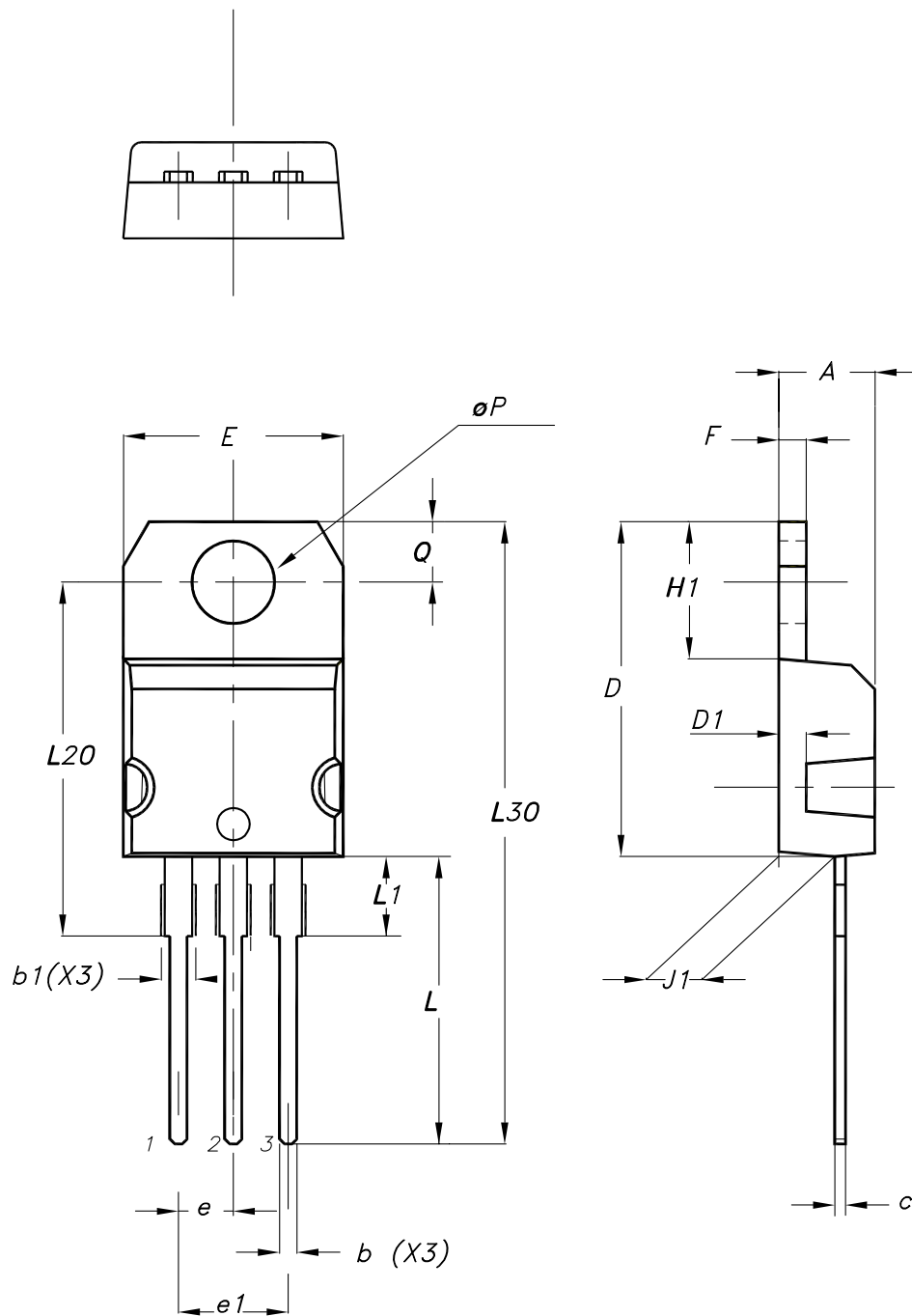

AM01473v1

## 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-220 type A package information

Figure 18. TO-220 type A package outline



0015988\_typeA\_Rev\_23



**Table 8. TO-220 type A package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95
Slug flatness		0.03	0.10

## Revision history

**Table 9. Document revision history**

Date	Revision	Changes
24-May-2023	1	First release. The part number STP13NM60ND was previously inserted in the DS9668.

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