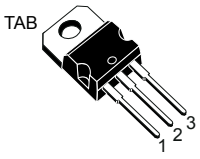
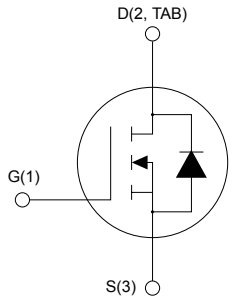
N-channel 600 V, 325 mΩ typ., 11 A FDmesh II Power MOSFET in a TO-220 package



TO-220



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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.

Product status link
STP13NM60ND

Product summary	
Order code	STP13NM60ND
Marking	13NM60ND
Package	TO-220
Packing	Tube

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 °C	11	A
	Drain current (continuous) at T_C = 100 °C	6.93	
I_{DM}(1)	Drain current (pulsed)	44	A
P_{TOT}	Total power dissipation at T_C = 25 °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} ≤ 11 A, di/dt ≤ 400 A/µs, V_{DS} (peak) < $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.*
3. *V_{DS} ≤ 480 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 °C, I_D = I_{AS}, V_{DD} = 50 V)	162	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} = ±20 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 5.5 A		325	380	mΩ

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 V, f = 1 MHz, V_{GS} = 0 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 V, V_{DS} = 0 to 480 V	-	121	-	pF
R_G	Gate input resistance	f = 1 MHz, Gate DC bias = 0 V, test signal level = 20 mV, open drain	-	4.3	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 11 A, V_{GS} = 0 to 10 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 V, I_D = 5.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 12. Test circuit for resistive load switching times and Figure 17. Switching time waveform)	-	46.5	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time		-	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 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 11 A, di/dt = 100 A/µs,	-	150		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 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 A, di/dt = 100 A/µs,	-	187		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V, T_J = 150 °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 µs, duty cycle 1.5%.*

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

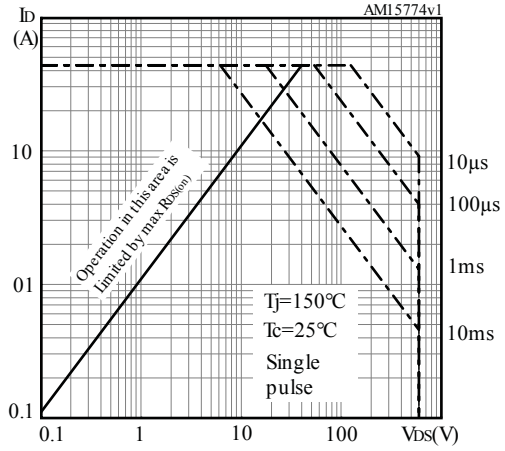


Figure 2. Normalized transient thermal impedance

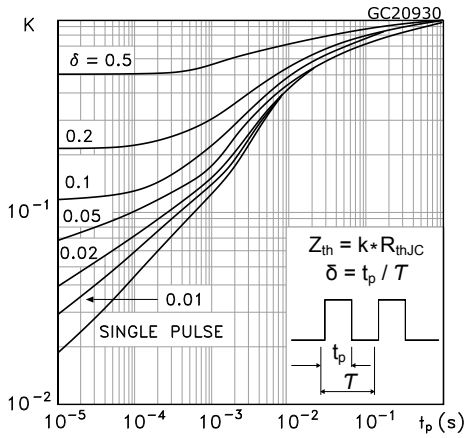


Figure 3. Output characteristics

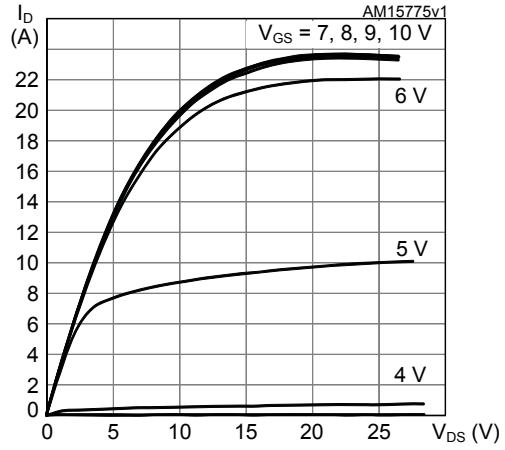


Figure 4. Transfer characteristics

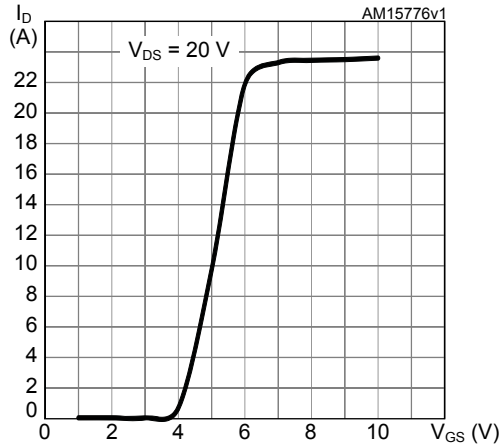


Figure 5. Static drain-source on resistance

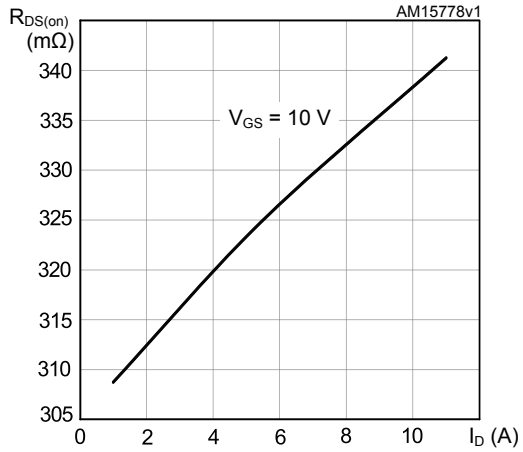


Figure 6. Gate charge vs gate-source voltage

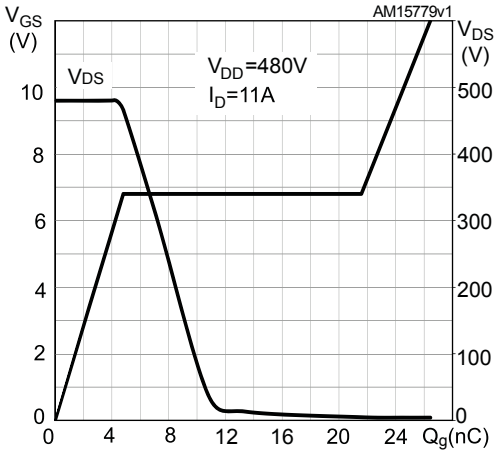


Figure 7. Capacitance variations

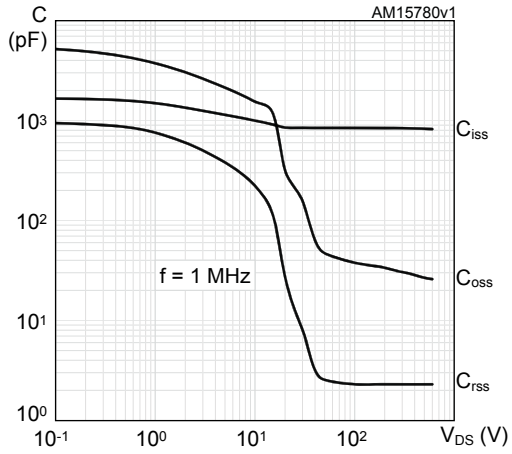


Figure 8. Normalized gate threshold voltage vs temperature

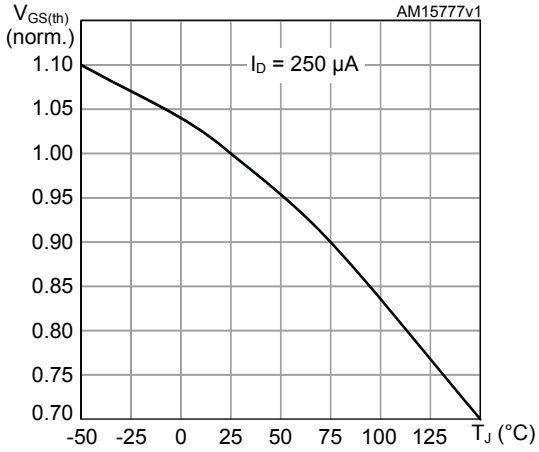


Figure 9. Normalized on resistance vs temperature

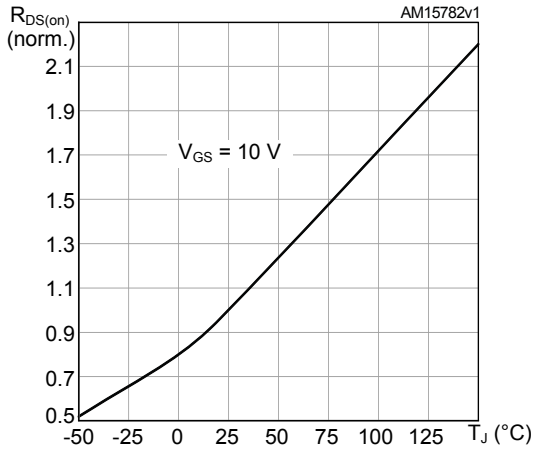


Figure 10. Source-drain diode forward characteristics

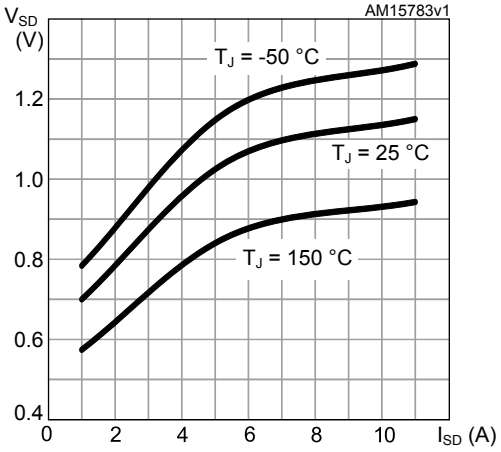
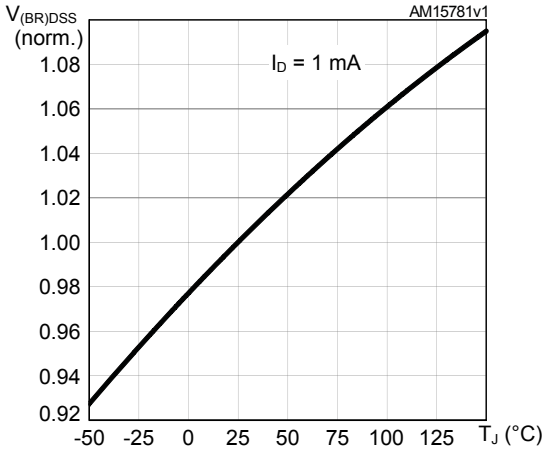


Figure 11. Normalized breakdown voltage vs temperature



3 Test circuits

Figure 12. Test circuit for resistive load switching times

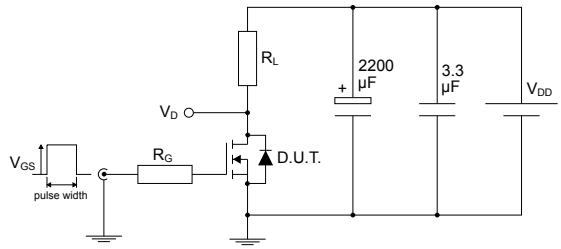


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Figure 13. Test circuit for gate charge behavior

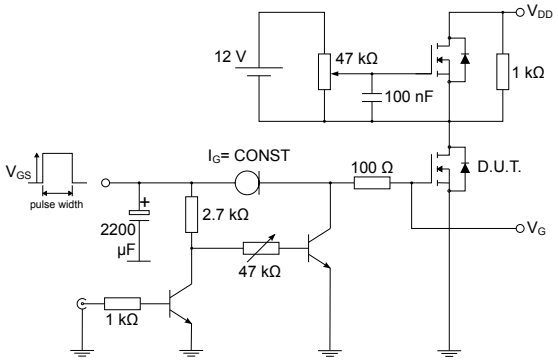

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Figure 14. Test circuit for inductive load switching and diode recovery times

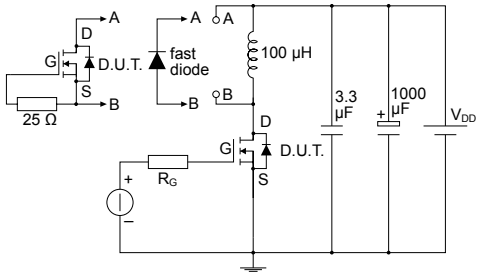

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Figure 15. Unclamped inductive load test circuit

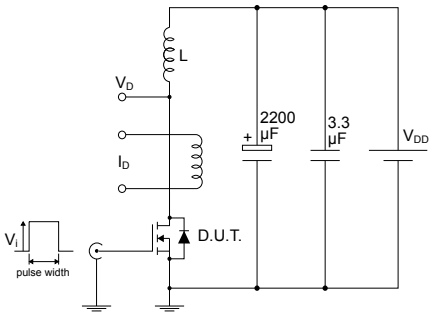

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Figure 16. Unclamped inductive waveform

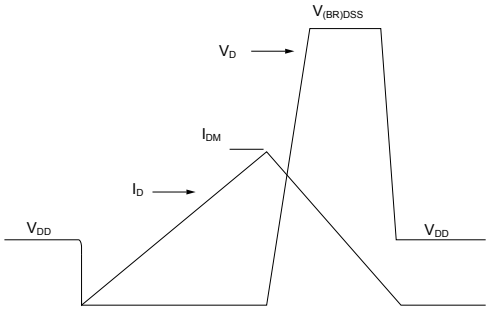

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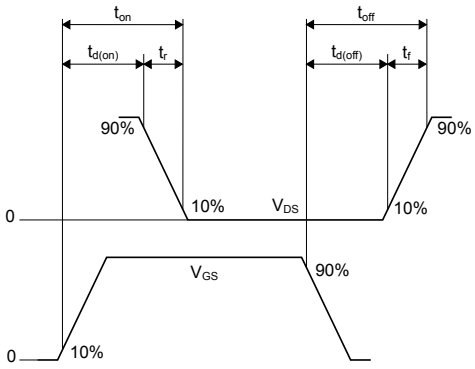
Figure 17. Switching time waveform



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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 TO-220 type A package information

Figure 18. TO-220 type A package outline

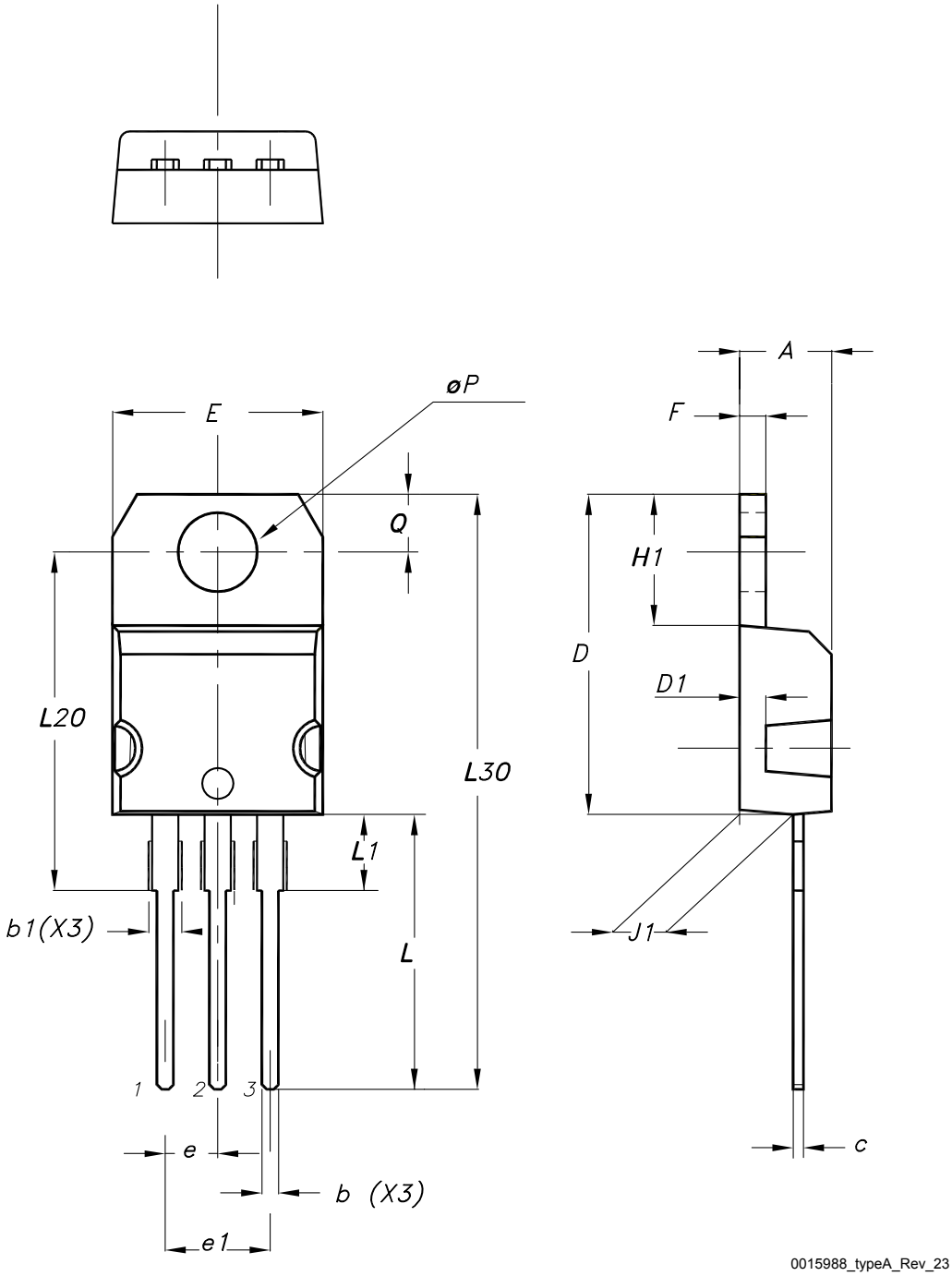

Table 8. **TO-220 type A package mechanical data**

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.

Contents