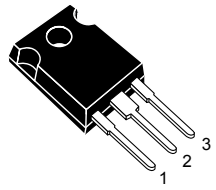
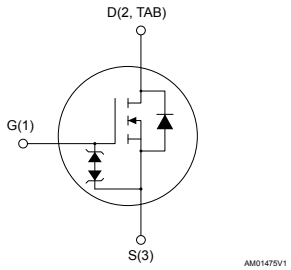
N-channel 600 V, 60 mΩ typ., 42 A MDmesh M2 Power MOSFET in a TO-247 package



TO-247



Features

Order code	V_{DS} @ $T_{Jmax.}$	$R_{DS(on)}$ max.	I_D
STW48N60M2	650 V	70 mΩ	42 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
STW48N60M2

Device summary	
Order code	STW48N60M2
Marking	48N60M2
Package	TO-247
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±25	V
I_D	Drain current (continuous) at T_C = 25 °C	42	A
I_D	Drain current (continuous) at T_C = 100 °C	26	A
I_{DM} (1)	Drain current (pulsed)	168	A
P_{TOT}	Total power dissipation at T_C = 25 °C	300	W
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
dv/dt (3)	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature range	- 55 to 150	°C
T_j	Operating junction temperature range		

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 42 A, di/dt ≤ 400 A/µs; $V_{DS(peak)}$ < $V_{(BR)DSS}$, V_{DD} = 400 V*
3. *V_{DS} ≤ 480 V*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	0.42	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	50	°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by $T_{jmax.}$)	7	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}; V_{DD} = 50 V)	1	J

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} = ±25 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 21 A		60	70	mΩ

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{GS} = 0 V, V_{DS} = 100 V, f = 1 MHz	-	3060	-	pF
C_{oss}	Output capacitance		-	143	-	pF
C_{rss}	Reverse transfer capacitance		-	4.3	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 to 480 V	-	630	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	4.6	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 42 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	70	-	nC
Q_{gs}	Gate-source charge		-	10.5	-	nC
Q_{gd}	Gate-drain charge		-	31	-	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 = 21 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	18.5	-	ns
t_r	Rise time		-	17	-	ns
$t_{d(off)}$	Turn-off delay time		-	119	-	ns
t_f	Fall time		-	13	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		42	A
I_{SDM} (1)	Source-drain current (pulsed)		-		168	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 21 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 42 A, di/dt = 100 A/µs V_{DD} = 60 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	487		ns
Q_{rr}	Reverse recovery charge		-	9.1		µC
I_{RRM}	Reverse recovery current		-	37.5		A
t_{rr}	Reverse recovery time	I_{SD} = 42 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	605		ns
Q_{rr}	Reverse recovery charge		-	12.5		µC
I_{RRM}	Reverse recovery current		-	41.5		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

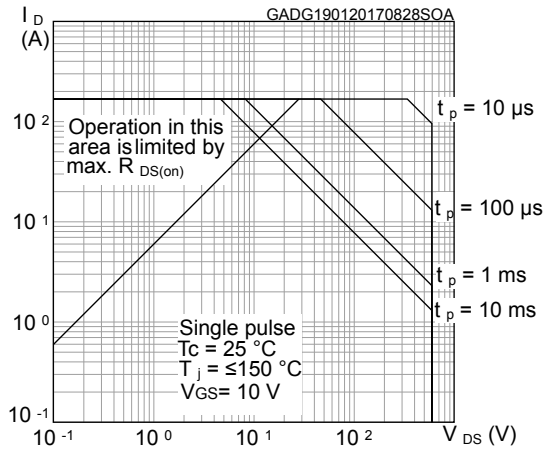


Figure 2. Thermal impedance

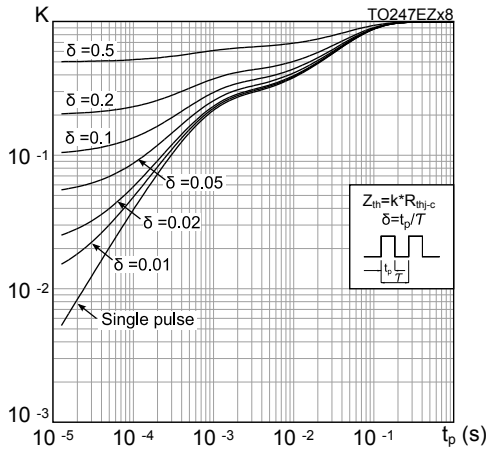


Figure 3. Output characteristics

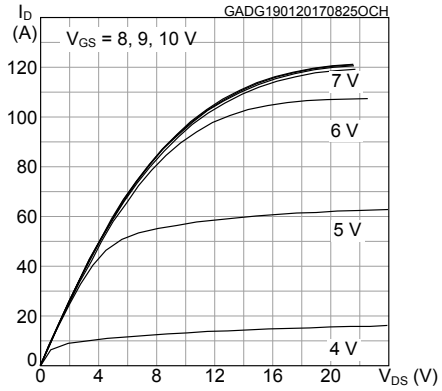


Figure 4. Transfer characteristics

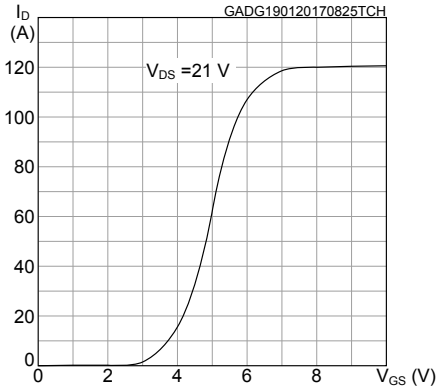


Figure 5. Gate charge vs gate-source voltage

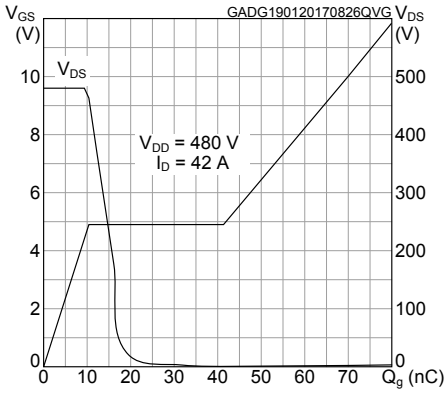


Figure 6. Static drain-source on-resistance

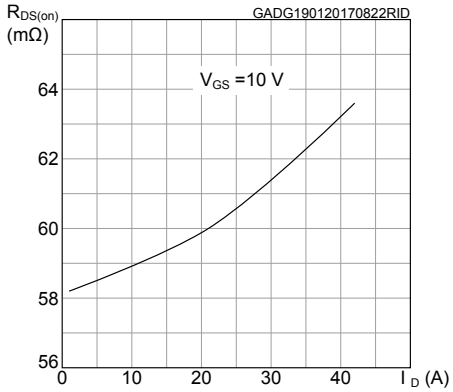


Figure 7. Capacitance variations

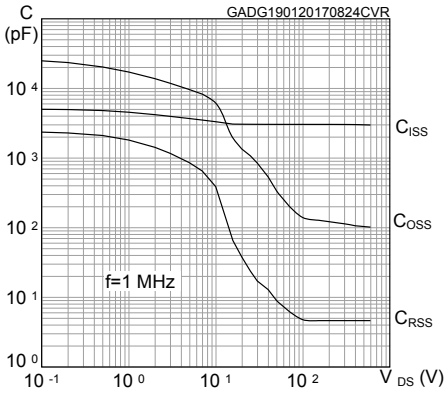


Figure 8. Output capacitance stored energy

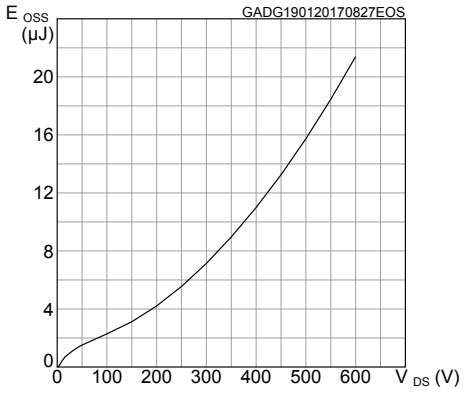


Figure 9. Normalized gate threshold voltage vs temperature

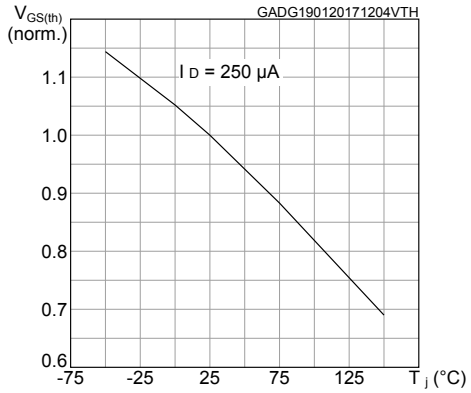


Figure 10. Normalized on-resistance vs temperature

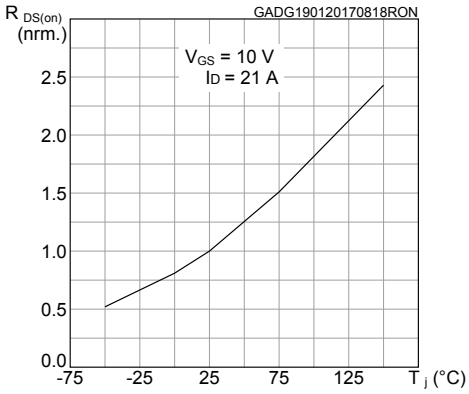


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

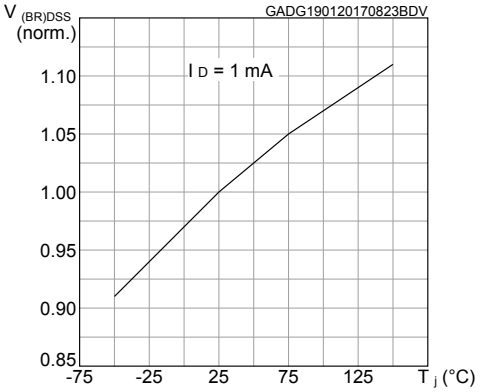
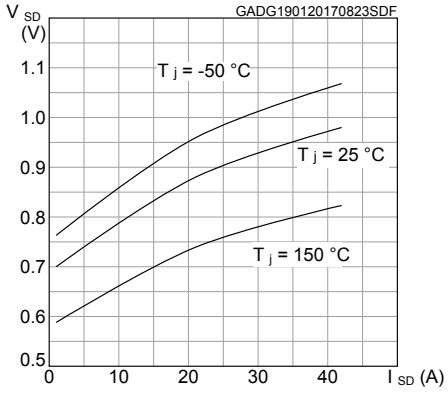


Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Test circuit for resistive load switching times

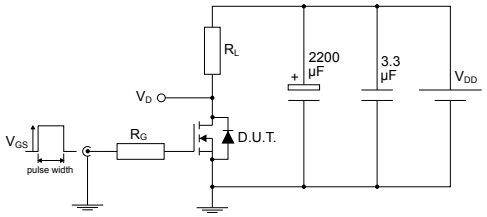


Figure 14. Test circuit for gate charge behavior

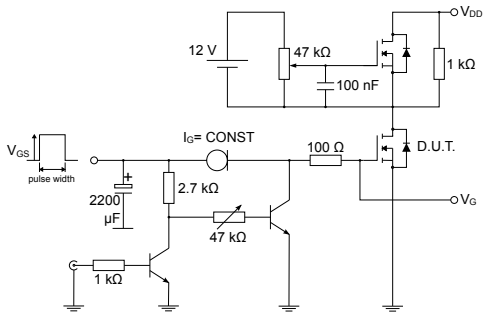


Figure 15. Test circuit for inductive load switching and diode recovery times

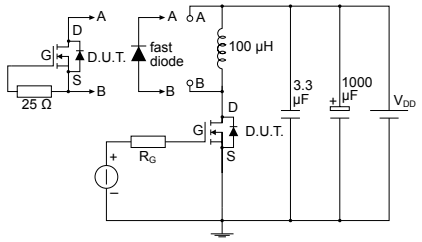


Figure 16. Unclamped inductive load test circuit

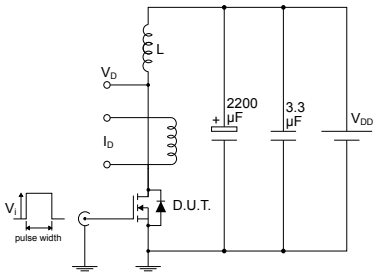


Figure 17. Unclamped inductive waveform

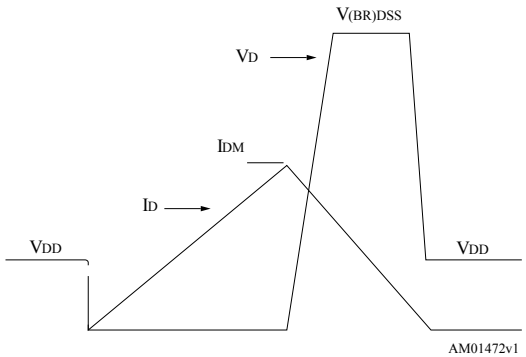
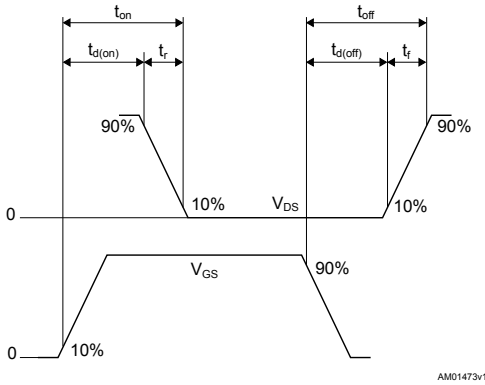


Figure 18. Switching time waveform



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-247 package information

Figure 19. TO-247 package outline

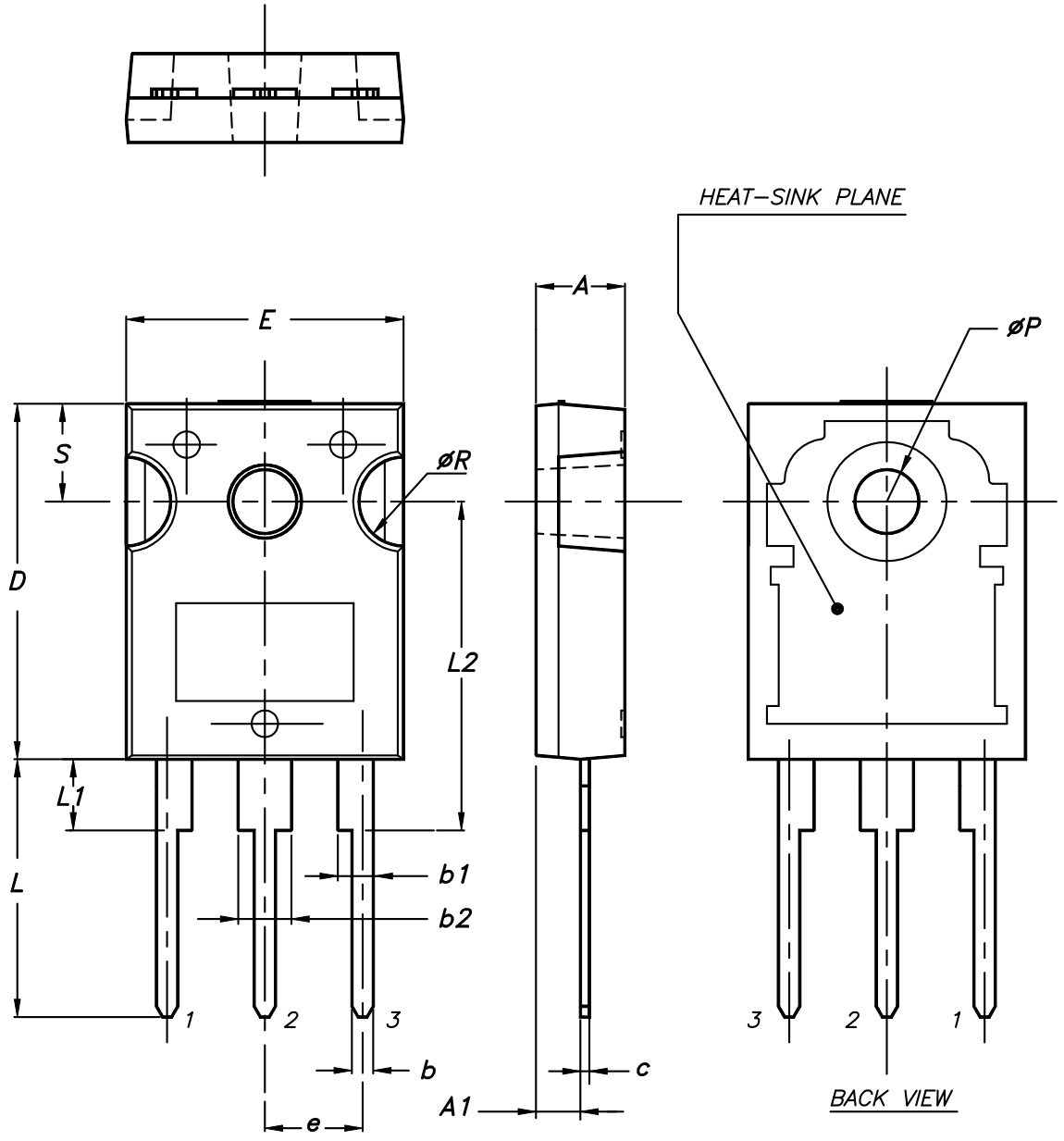


Table 8. **TO-247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
09-Jun-2014	1	First release.
01-Sep-2014	2	Document status promoted from preliminary to production data. Added *Section 2.1: "Electrical characteristics curves"*. Minor text changes.
19-Jan-2017	3	Updated *Table 1. Absolute maximum ratings*, *Table 3. Avalanche characteristics*, *Table 4. On /off-states* and *Table 6. Switching times*. Updated *Section 2.1 Electrical characteristics (curves)*.
19-Mar-2020	4	Updated Table 6. Switching times. Minor text changes.

Contents