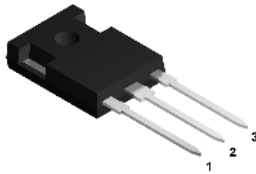
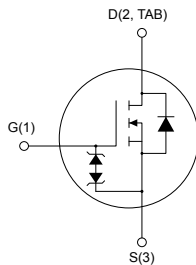


N-channel 600 V, 60 mΩ typ., 42 A MDmesh M2 Power MOSFET in a TO-247 long leads package



TO-247 long leads



AM01475V1

Features

Order code	$V_{DS} @ T_{Jmax.}$	$R_{DS(on)}$ max.	I_D
STWA48N60M2	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

STWA48N60M2

Device summary

Order code	STWA48N60M2
Marking	48N60M2
Package	TO-247 long leads
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 $T_C = 25\text{ }^\circ\text{C}$	42	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	26	A
$I_{DM}^{(1)}$	Drain current (pulsed)	168	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	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	$^\circ\text{C}$
T_j	Operating junction temperature range		

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

Table 2. Thermal data

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

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 $T_j = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$; $V_{DD} = 50\text{ V}$)	1	J

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	μA
		$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}, T_C = 125\text{ °C}^{(1)}$			100	μA
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}, V_{GS} = \pm 25\text{ V}$			± 10	μA
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}, I_D = 21\text{ A}$		60	70	m Ω

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$	-	3060	-	pF
C_{oss}	Output capacitance		-	143	-	pF
C_{rss}	Reverse transfer capacitance		-	4.3	-	pF
$C_{oss\ eq.}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ to }480\text{ V}$	-	630	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	4.6	-	Ω
Q_g	Total gate charge	$V_{DD} = 480\text{ V}, I_D = 42\text{ A},$	-	70	-	nC
Q_{gs}	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$	-	10.5	-	nC
Q_{gd}	Gate-drain charge	(see Figure 14. Test circuit for gate charge behavior)	-	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	$V_{DD} = 300\text{ V}, I_D = 21\text{ A},$	-	18.5	-	ns
t_r	Rise time	$R_G = 4.7\text{ }\Omega, V_{GS} = 10\text{ V}$	-	17	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	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	$V_{GS} = 0\text{ V}$, $I_{SD} = 21\text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 42\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	487		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	9.1		μC
I_{RRM}	Reverse recovery current		-	37.5		A
t_{rr}	Reverse recovery time	$I_{SD} = 42\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$	-	605		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	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

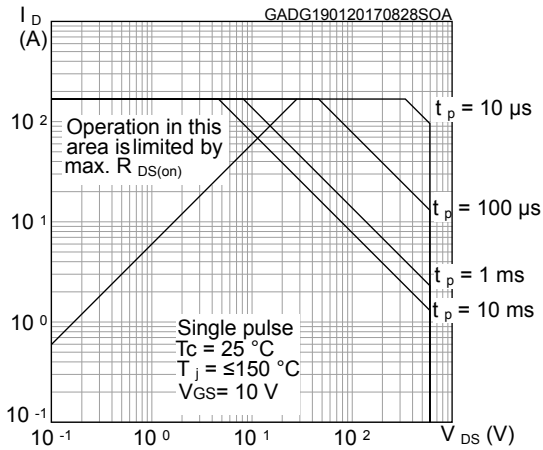


Figure 2. Thermal impedance

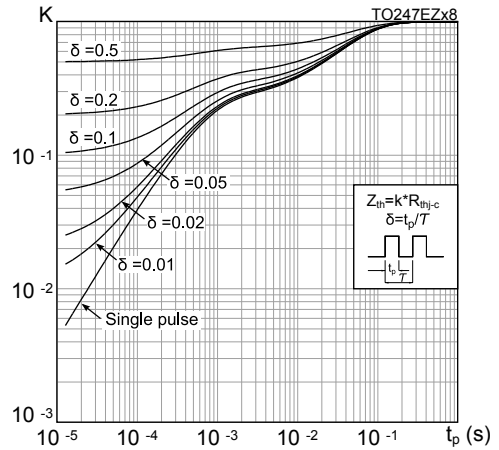


Figure 3. Output characteristics

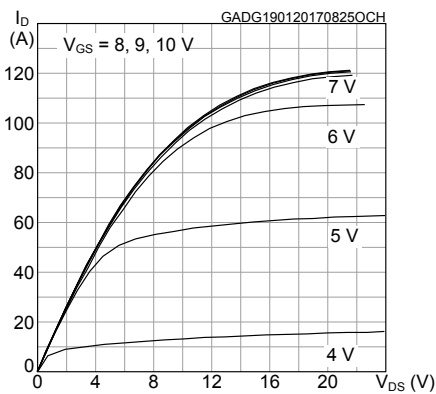


Figure 4. Transfer characteristics

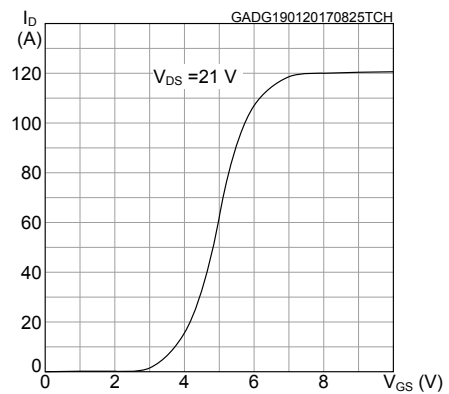


Figure 5. Gate charge vs gate-source voltage

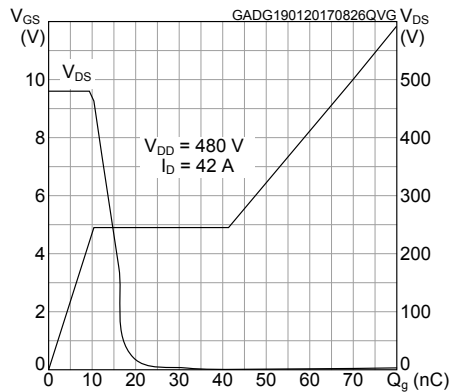


Figure 6. Static drain-source on-resistance

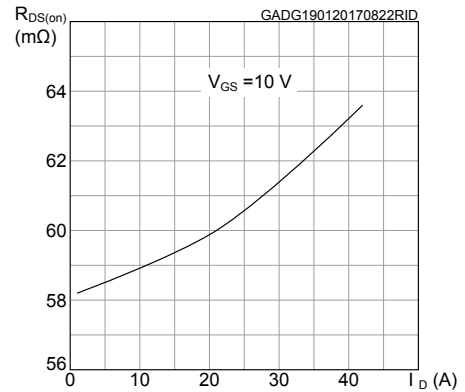


Figure 7. Capacitance variations

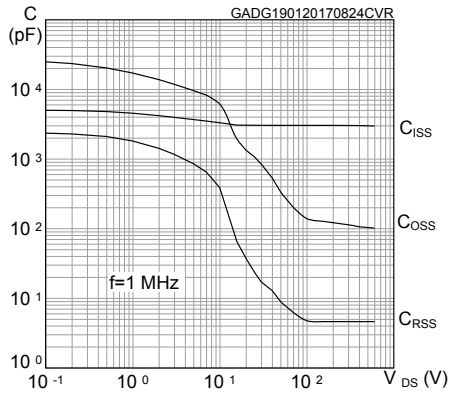


Figure 8. Output capacitance stored energy

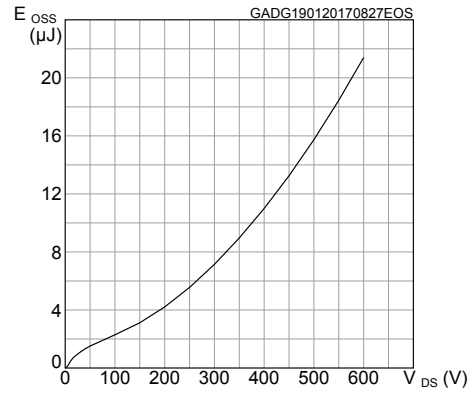


Figure 9. Normalized gate threshold voltage vs temperature

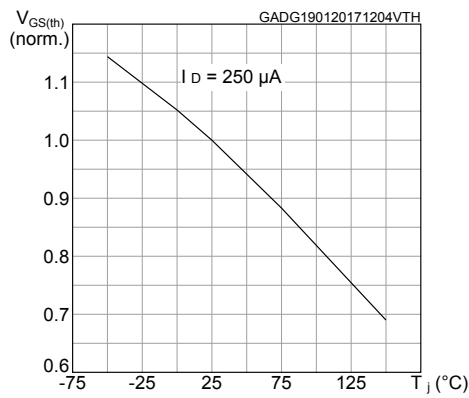


Figure 10. Normalized on-resistance vs temperature

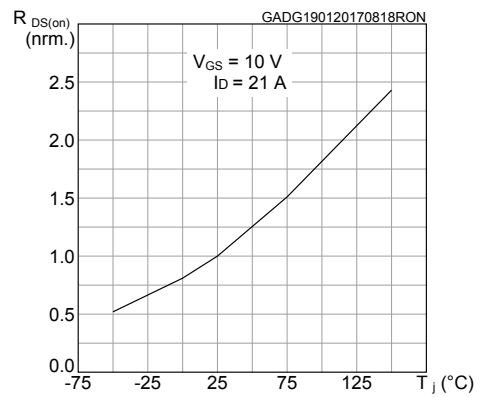


Figure 11. Normalized $V_{(BR)DSS}$ vs temperature

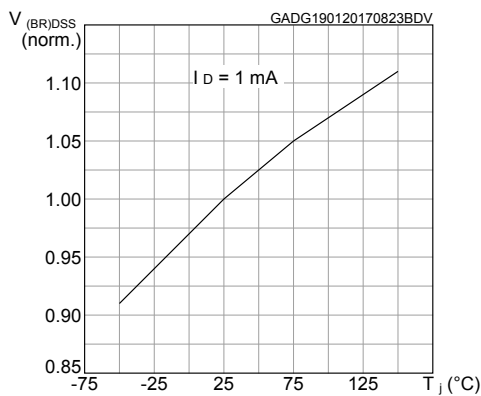
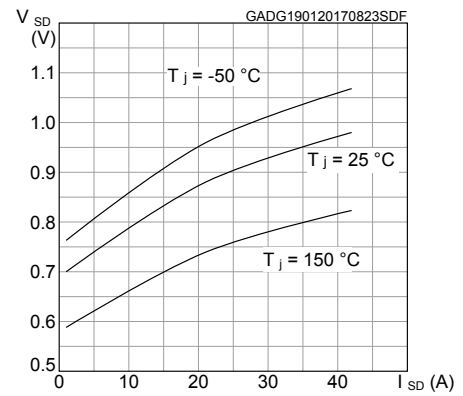
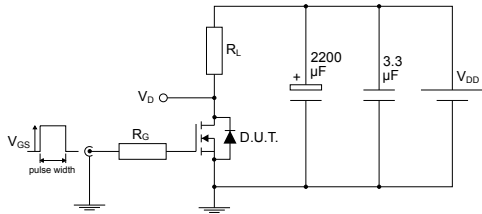


Figure 12. Source-drain diode forward characteristics



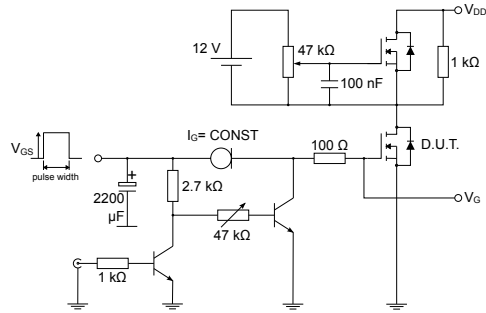
3 Test circuits

Figure 13. Test circuit for resistive load switching times



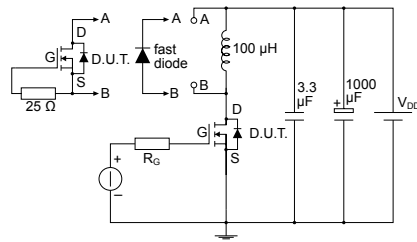
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Figure 14. Test circuit for gate charge behavior



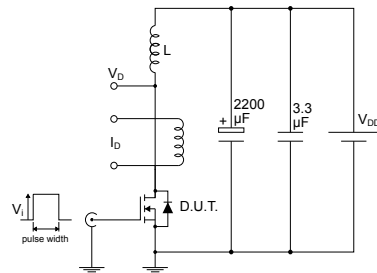
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Figure 15. Test circuit for inductive load switching and diode recovery times



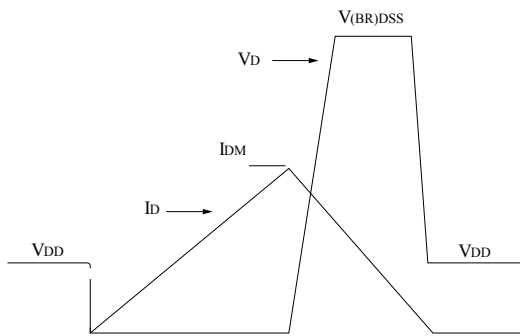
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Figure 16. Unclamped inductive load test circuit



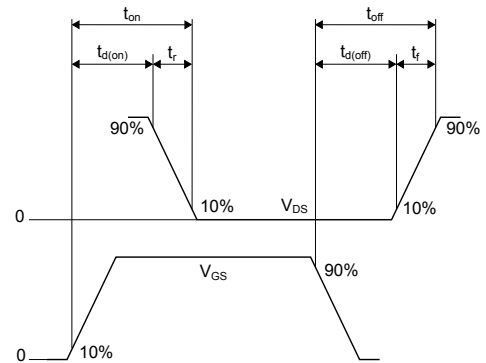
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Figure 17. Unclamped inductive waveform



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Figure 18. Switching time waveform



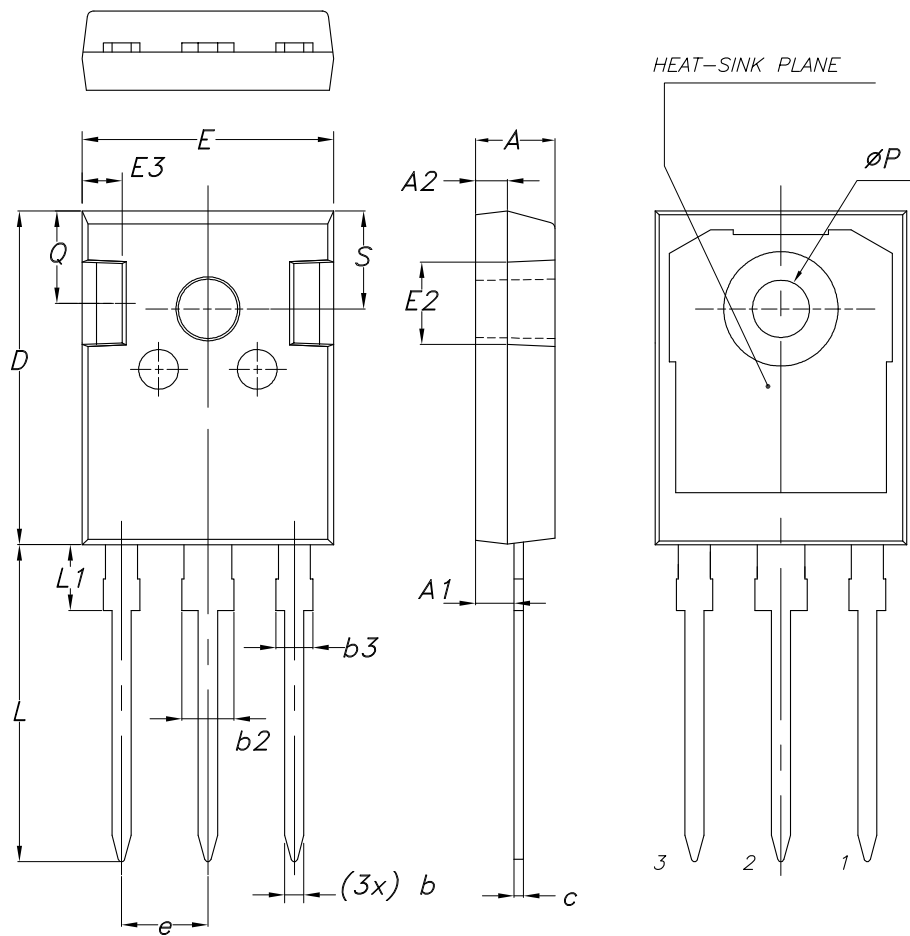
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4 Package information

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-247 long leads package information

Figure 19. TO-247 long leads package outline



8463846_2_F

Table 8. TO-247 long leads package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
c	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25

Revision history

Table 9. Document revision history

Date	Revision	Changes
01-Dec-2015	1	First release.
20-Jan-2017	2	Updated <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 4: "Avalanche characteristics"</i> , <i>Table 5: "On /off-states"</i> , <i>Table 6: "Dynamic"</i> and <i>Table 7: "Switching times"</i> . Updated <i>Section 2.2: "Electrical characteristics (curves)"</i> .
19-Mar-2020	3	Updated <i>Table 6. Switching times</i> . Minor text changes.

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