

N-channel 600 V, 0.052 Ω typ., 50 A MDmesh™ DM2 Power MOSFET in a TO-247 package

Datasheet - production data

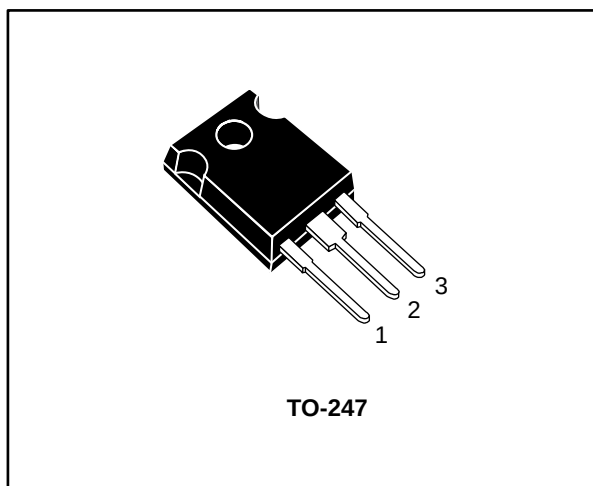
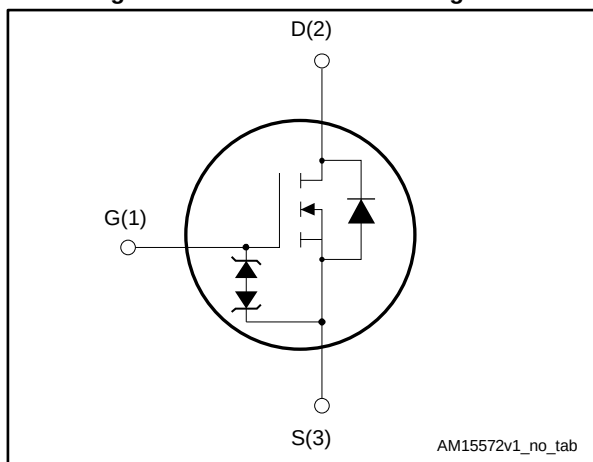


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D	P _{TOT}
STW56N60DM2	600 V	0.060 Ω	50 A	360 W

- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

This high voltage N-channel Power MOSFET is part of the MDmesh™ DM2 fast recovery diode series. It offers very low recovery charge (Q_{rr}) and time (t_{rr}) combined with low $R_{DS(on)}$, rendering it suitable for the most demanding high efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STW56N60DM2	56N60DM2	TO-247	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves).....	6
3	Test circuits	8
4	Package information	9
	4.1 TO-247 package information.....	9
5	Revision history	11

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_{case} = 25\text{ }^{\circ}\text{C}$	50	A
	Drain current (continuous) at $T_{case} = 100\text{ }^{\circ}\text{C}$	31	
$I_{DM}^{(1)}$	Drain current (pulsed)	200	A
P_{TOT}	Total dissipation at $T_{case} = 25\text{ }^{\circ}\text{C}$	360	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	50	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	
T_{stg}	Storage temperature	-55 to 150	$^{\circ}\text{C}$
T_j	Operating junction temperature		

Notes:

⁽¹⁾ Pulse width is limited by safe operating area.

⁽²⁾ $I_{SD} \leq 50\text{ A}$, $di/dt=900\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

⁽³⁾ $V_{DS} \leq 480\text{ V}$.

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.35	$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	50	

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
$I_{AS}^{(1)}$	Avalanche current, repetitive or not repetitive	12	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	800	mJ

Notes:

⁽¹⁾ Pulse width limited by T_{jmax} .

⁽²⁾ starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$.

2 Electrical characteristics

($T_{\text{case}} = 25\text{ }^{\circ}\text{C}$ unless otherwise specified)

Table 5: Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$, $I_{\text{D}} = 1\text{ mA}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 600\text{ V}$			10	μA
		$V_{\text{GS}} = 0\text{ V}$, $V_{\text{DS}} = 600\text{ V}$, $T_{\text{case}} = 125\text{ }^{\circ}\text{C}$			100	
I_{GSS}	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$, $V_{\text{GS}} = \pm 25\text{ V}$			± 5	μA
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$, $I_{\text{D}} = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$, $I_{\text{D}} = 25\text{ A}$		0.052	0.060	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{\text{DS}} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{\text{GS}} = 0\text{ V}$	-	4100	-	pF
C_{oss}	Output capacitance		-	190	-	
C_{rss}	Reverse transfer capacitance		-	3.2	-	
$C_{\text{oss eq.}}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }480\text{ V}$, $V_{\text{GS}} = 0\text{ V}$	-	325	-	pF
R_{G}	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_{\text{D}} = 0\text{ A}$	-	4.2	-	Ω
Q_{g}	Total gate charge	$V_{\text{DD}} = 480\text{ V}$, $I_{\text{D}} = 50\text{ A}$, $V_{\text{GS}} = 10\text{ V}$ (see Figure 15: "Gate charge test circuit")	-	90	-	nC
Q_{gs}	Gate-source charge		-	18	-	
Q_{gd}	Gate-drain charge		-	44	-	

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 300\text{ V}$, $I_{\text{D}} = 25\text{ A}$ $R_{\text{G}} = 4.7\text{ }\Omega$ (see Figure 14: "Switching times test circuit for resistive load" and Figure 19: "Switching time waveform")	-	24	-	ns
t_{r}	Rise time		-	60	-	
$t_{\text{d(off)}}$	Turn-off delay time		-	130	-	
t_{f}	Fall time		-	12	-	

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		50	A
I_{SDM}	Source-drain current (pulsed)		-		200	A
$V_{SD}^{(1)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 50\text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 50\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see Figure 16 : "Test circuit for inductive load switching and diode recovery times")	-	140		ns
Q_{rr}	Reverse recovery charge		-	0.7		μC
I_{RRM}	Reverse recovery current		-	10.6		A
t_{rr}	Reverse recovery time	$I_{SD} = 50\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 16 : "Test circuit for inductive load switching and diode recovery times")	-	245		ns
Q_{rr}	Reverse recovery charge		-	2.6		μC
I_{RRM}	Reverse recovery current		-	21		A

Notes:

⁽¹⁾ Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

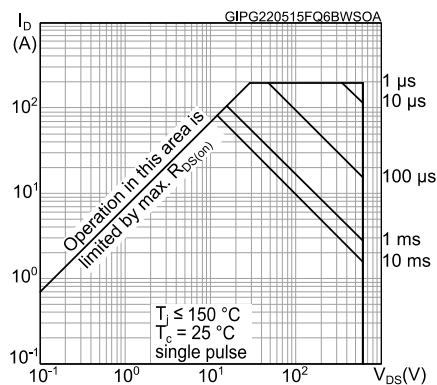


Figure 3: Thermal impedance

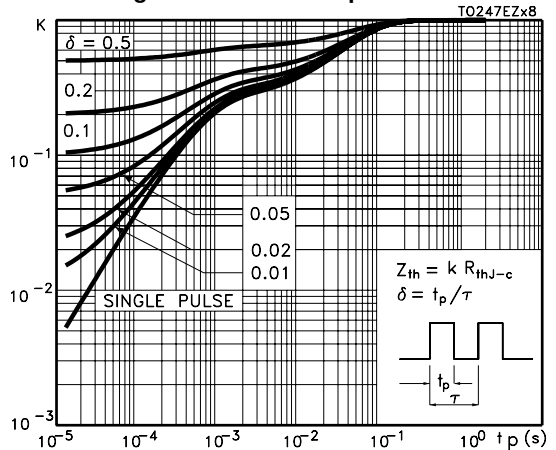


Figure 4: Output characteristics

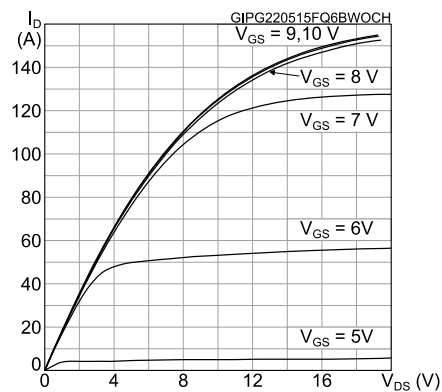


Figure 5: Transfer characteristics

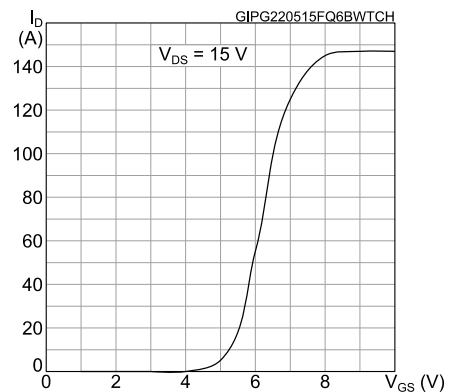


Figure 6: Gate charge vs gate-source voltage

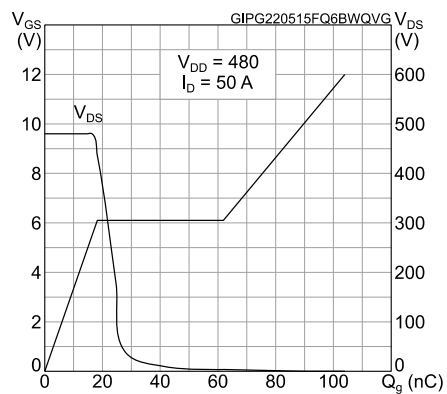


Figure 7: Static drain-source on-resistance

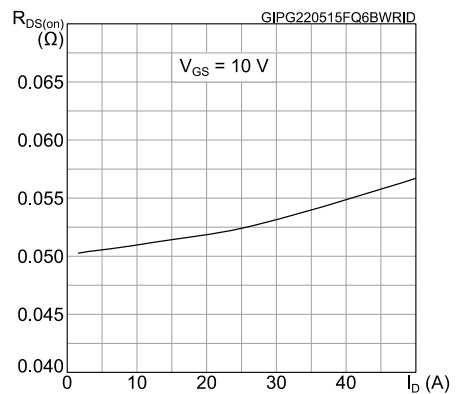


Figure 8: Capacitance variations

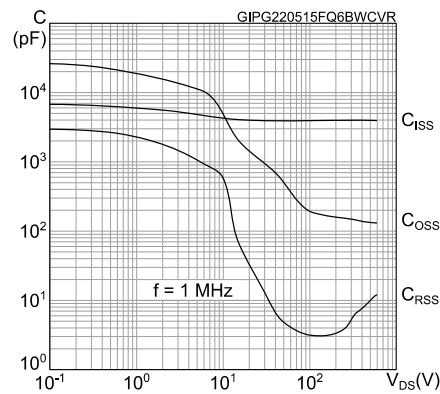


Figure 9: Normalized gate threshold voltage vs temperature

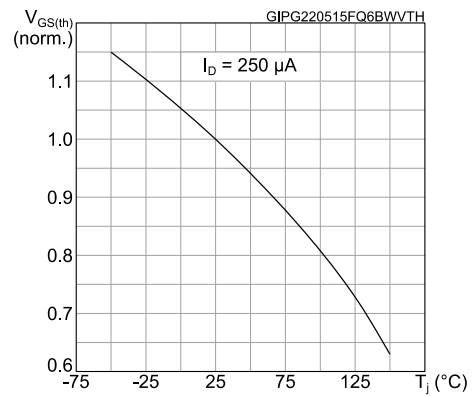


Figure 10: Normalized on-resistance vs temperature

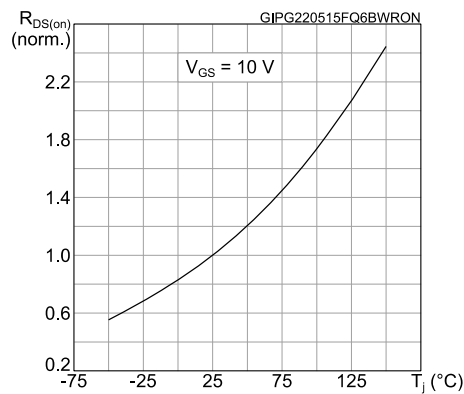
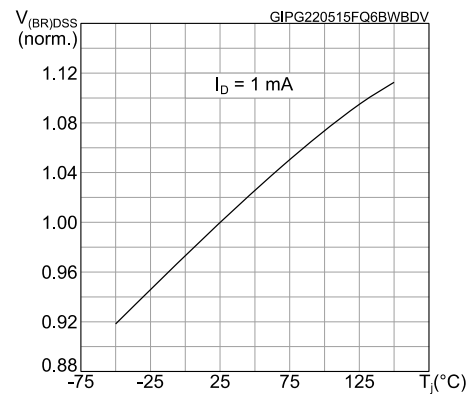
Figure 11: Normalized $V_{(BR)DSS}$ vs temperature

Figure 12: Output capacitance stored energy

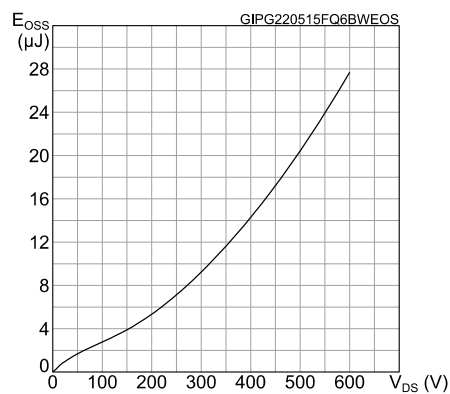
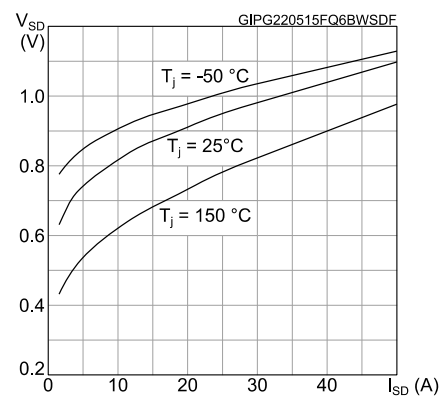


Figure 13: Source-drain diode forward characteristics



AM01468v1

AM01469v1

AM01470v1

AM01471v1

AM01472v1

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. ECOPACK® is an ST trademark.

4.1 TO-247 package information

Figure 20: TO-247 package outline

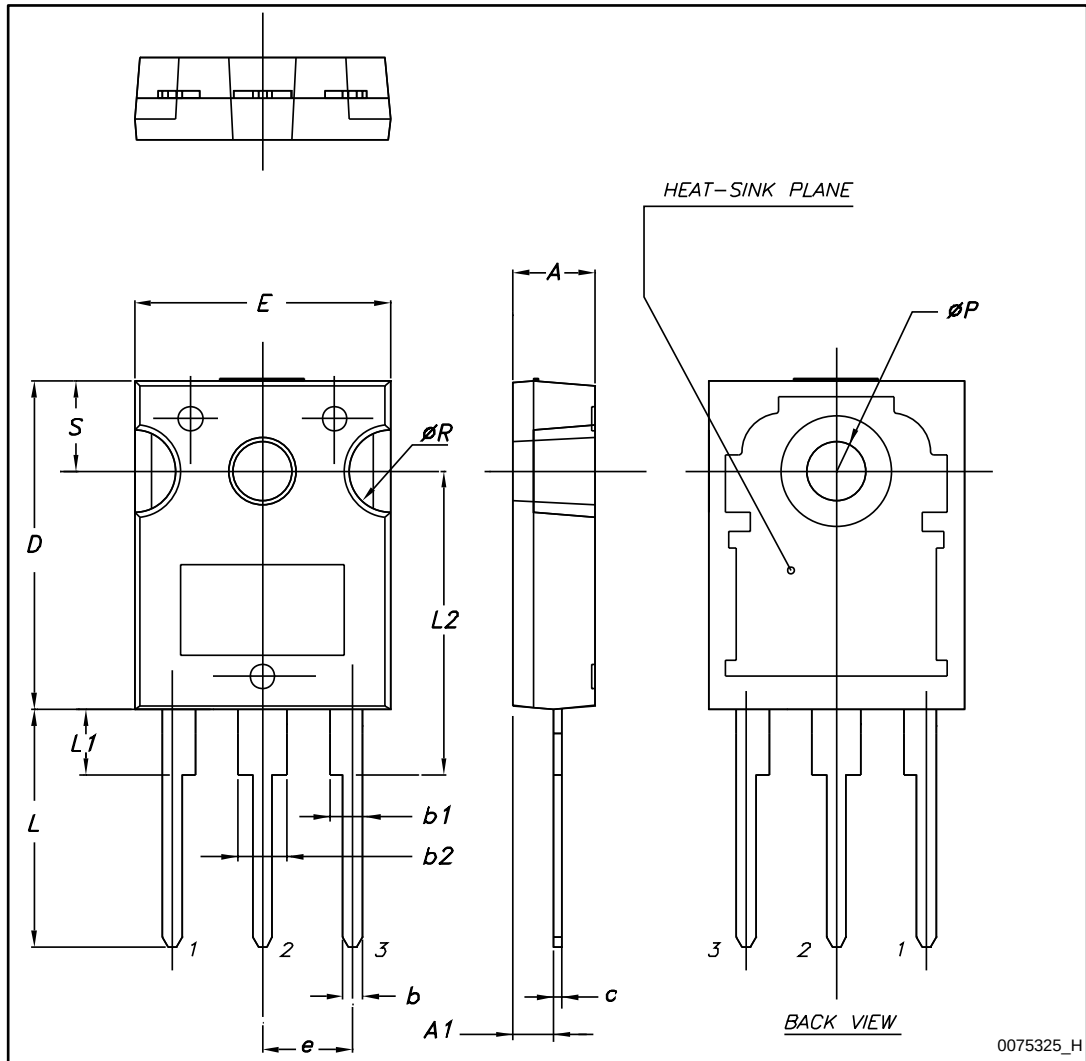


Table 9: TO-247 package mechanical data

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

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
08-Oct-2014	1	First release.
09-Jun-2015	2	Text and formatting changes throughout document. On cover page: - updated title description and features In Section 1 Electrical ratings: - updated Table 2. Absolute maximum ratings - updated Table 4. Avalanche characteristics In Section 2 Electrical characteristics: - updated and renamed Table 5. Static (was On /off states) - updated Table 6. Dynamic - updated Table 7. Switching times - updated Table 8. Source drain diode Added Section 2.1 Electrical characteristics (curves)
15-Jun-2015	3	Datasheet promoted from preliminary data to production data

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2015 STMicroelectronics – All rights reserved