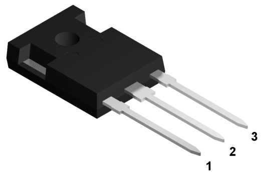
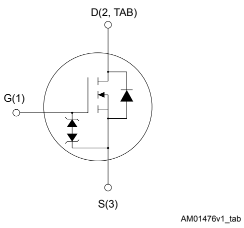
Automotive-grade N-channel 650 V, 42 mΩ typ., 60 A MDmesh DM2 Power MOSFET in a TO-247 long leads package



TO-247 long leads



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STWA65N65DM2AG	650 V	50 mΩ	60 A	446 W

- AEC-Q101 qualified
- 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.

Product status link
STWA65N65DM2AG

Product summary	
Order code	STWA65N65DM2AG
Marking	65N65DM2
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_{case} = 25 °C	60	A
	Drain current (continuous) at T_{case} = 100 °C	38	
I_{DM} (1)	Drain current (pulsed)	240	A
P_{TOT}	Total power dissipation at T_{case} = 25 °C	446	W
dv/dt(2)	Peak diode recovery voltage slope	100	V/ns
di/dt (2)	Peak diode recovery current slope	1000	A/µs
dv/dt(3)	MOSFET dv/dt ruggedness	100	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_j	Operating junction temperature range		

1. *Pulse width is limited by safe operating area.*
2. *I_{SD} ≤ 60 A, V_{DS} peak < $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.*
3. *V_{DS} ≤ 520 V.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	0.28	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	50	

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive	8	A
E_{AS} (1)	Single pulse avalanche energy	1100	mJ

1. *starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V.*

2 Electrical characteristics

(T_{case} = 25 °C unless otherwise specified).

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	650			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 650 V			10	µA
		V_{GS} = 0 V, V_{DS} = 650 V, T_{case} = 125 °C (1)			100	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±5	µA
$V_{GS(th)}$	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 = 30 A		42	50	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_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	5500	-	pF
C_{oss}	Output capacitance		-	210	-	
C_{rss}	Reverse transfer capacitance		-	3	-	
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 520 V, V_{GS} = 0 V	-	456	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	3.3	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 60 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	120	-	nC
Q_{gs}	Gate-source charge		-	27	-	
Q_{gd}	Gate-drain charge		-	58	-	

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} = 325 V, I_D = 30 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)	-	33	-	ns
t_r	Rise time		-	13.5	-	
$t_{d(off)}$	Turn-off delay time		-	114	-	
t_f	Fall time		-	11.5	-	

Table 7. **Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		60	A
I_{SDM} (1)	Source-drain current (pulsed)		-		240	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 60 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 60 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	154		ns
Q_{rr}	Reverse recovery charge		-	0.94		µC
I_{RRM}	Reverse recovery current		-	12.2		A
t_{rr}	Reverse recovery time	I_{SD} = 60 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)	-	288		ns
Q_{rr}	Reverse recovery charge		-	3.65		µC
I_{RRM}	Reverse recovery current		-	25.4		A

1. *Pulse width is limited by safe operating area.*
2. *Pulse test: pulse duration = 300 µs, duty cycle 1.5%.*

2.1 Electrical characteristics (curves)

Figure 1. **Safe operating area**

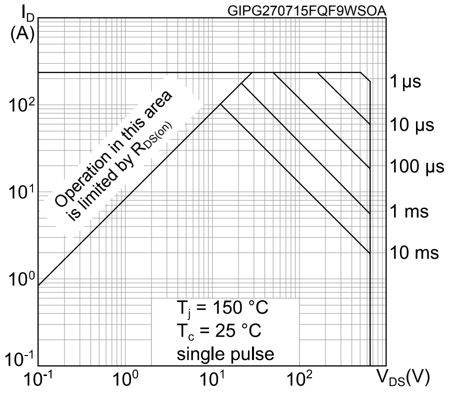


Figure 2. **Thermal impedance**

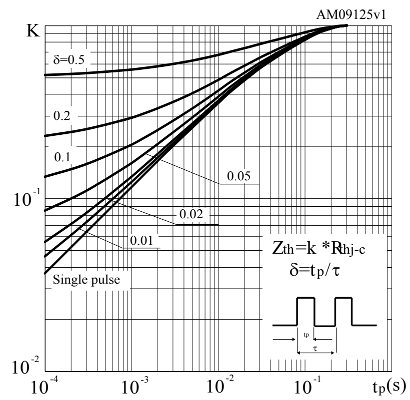


Figure 3. **Output characteristics**

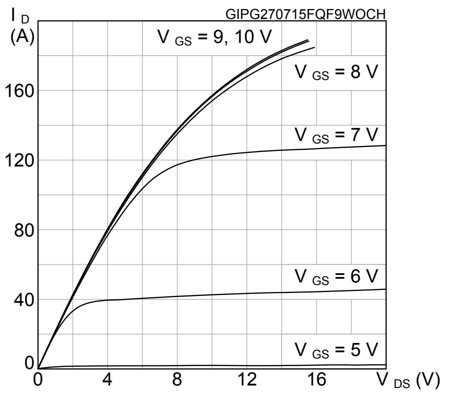


Figure 4. **Transfer characteristics**

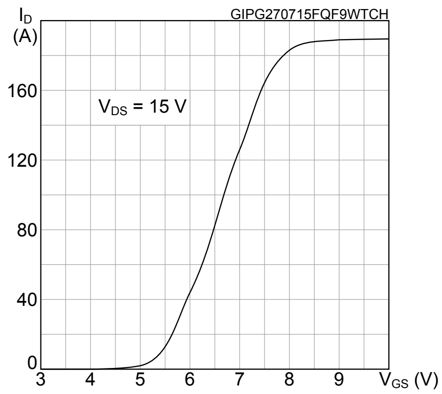


Figure 5. **Gate charge vs gate-source voltage**

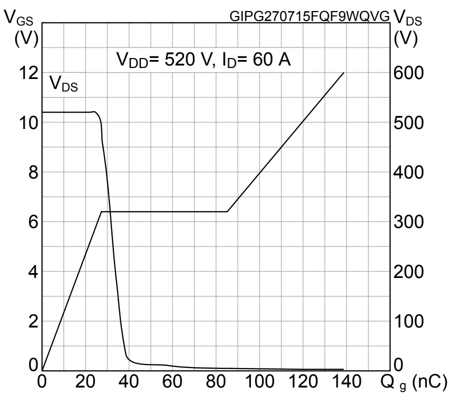


Figure 6. **Static drain-source on-resistance**

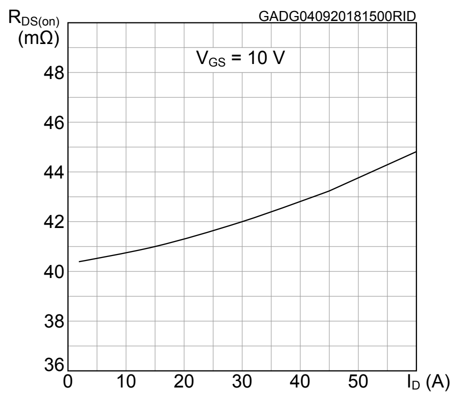


Figure 7. Capacitance variations

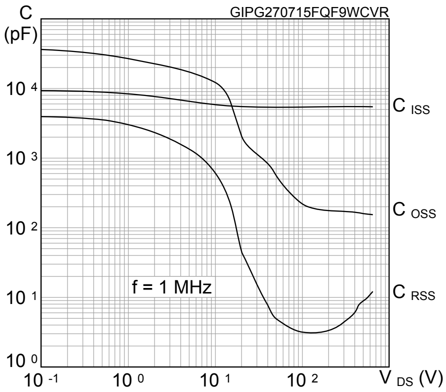


Figure 8. Normalized gate threshold voltage vs temperature

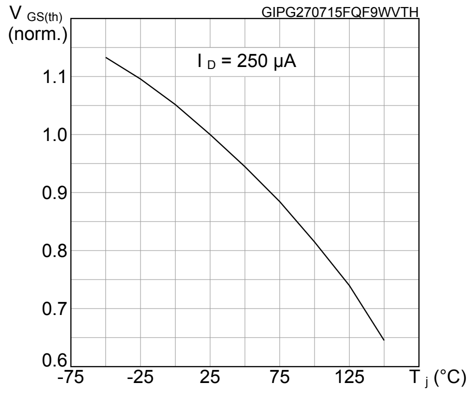


Figure 9. Normalized on-resistance vs temperature

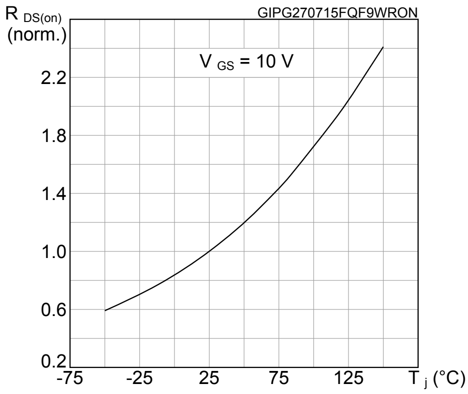


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

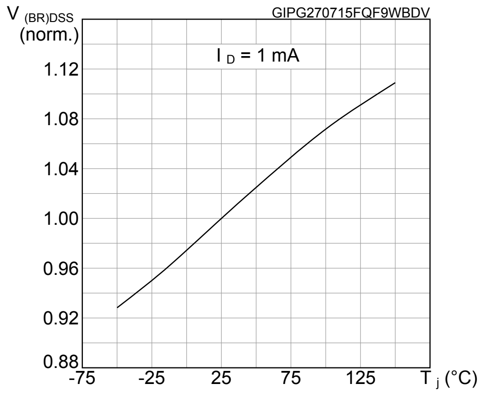


Figure 11. Output capacitance stored energy

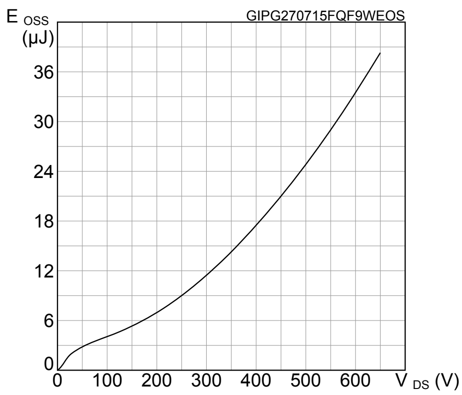
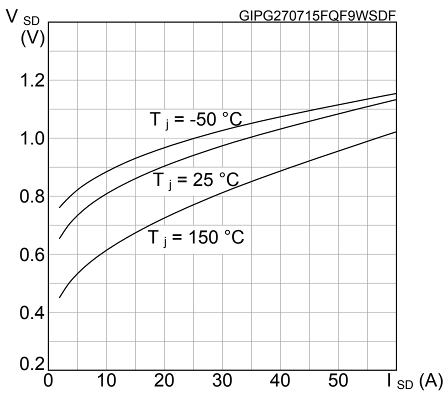


Figure 12. Source- drain diode forward characteristics



3 Test circuits

Figure 13. Test circuit for resistive load switching times

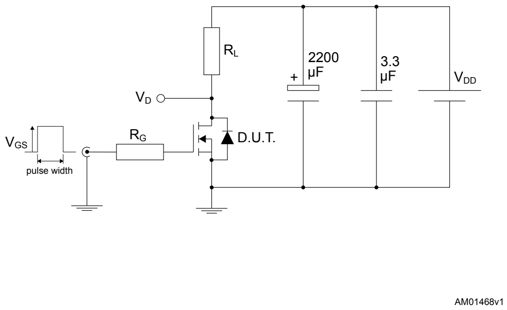


Figure 14. Test circuit for gate charge behavior

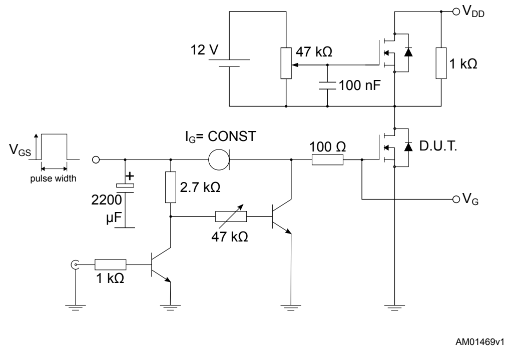


Figure 15. Test circuit for inductive load switching and diode recovery times

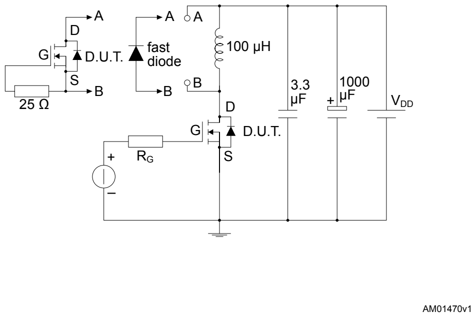


Figure 16. Unclamped inductive load test circuit

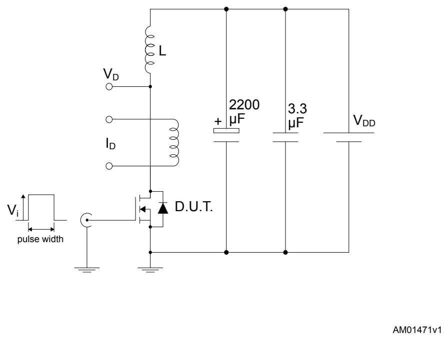


Figure 17. Unclamped inductive waveform

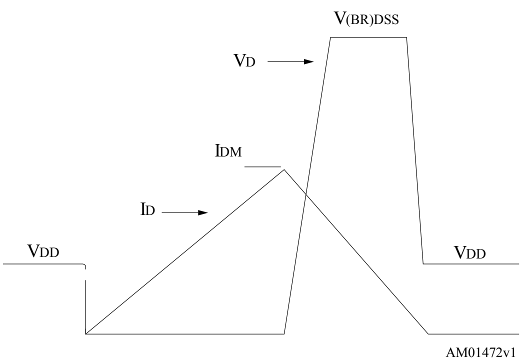
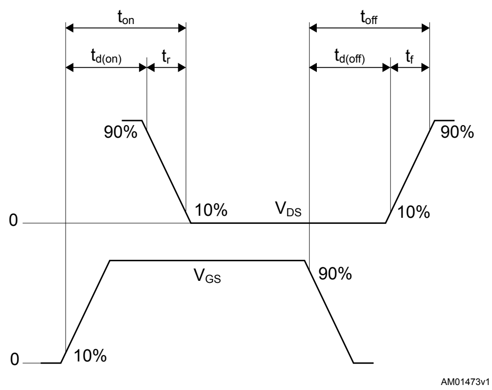


Figure 18. Switching time waveform



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 long leads package information

Figure 19. TO-247 long leads package outline

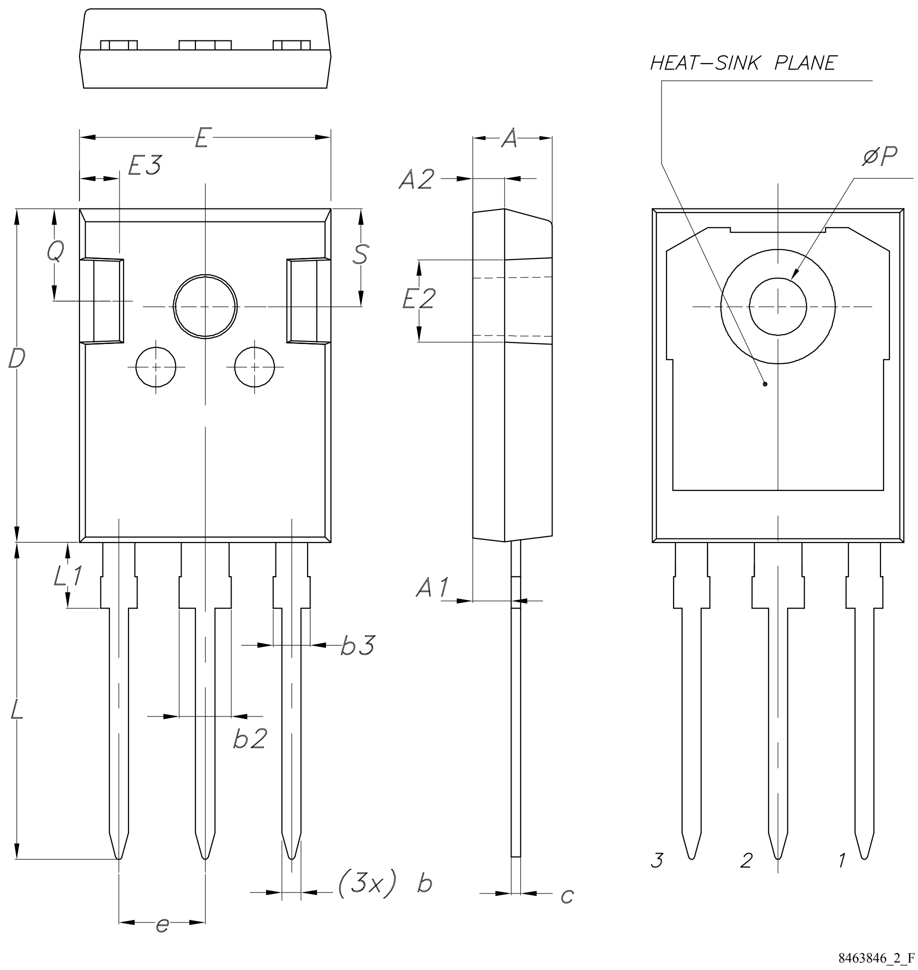


Table 8. TO-247 long leads package mechanical data

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
04-Sep-2018	1	Initial release.
03-Oct-2018	2	Modified Table 1. Absolute maximum ratings, Table 3. Avalanche characteristics and Table 7. Source-drain diode. Updated Figure 1. Safe operating area. Minor text changes.
25-May-2020	3	Updated Table 1. Absolute maximum ratings.

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