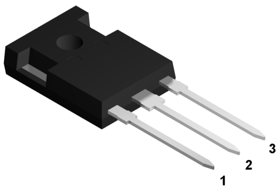
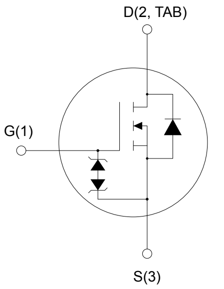
STWA70N65DM6

Datasheet

N-channel 650 V, 36 mΩ typ., 68 A MDmesh DM6 Power MOSFET in a TO-247 long leads package



TO-247 long leads



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STWA70N65DM6	650 V	40 mΩ	68 A

- Fast-recovery body diode
- Lower $R_{DS(on)}$ per area vs previous generation
- Low gate charge, input capacitance and 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 DM6 fast-recovery diode series. Compared with the previous MDmesh fast generation, DM6 combines very low recovery charge (Q_{rr}), recovery time (t_{rr}) and excellent improvement in $R_{DS(on)}$ per area with one of the most effective switching behaviors available in the market for the most demanding high-efficiency bridge topologies and ZVS phase-shift converters.

Product status link
STWA70N65DM6

Product summary	
Order code	STWA70N65DM6
Marking	70N65DM6
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 °C	68	A
I_D	Drain current (continuous) at T_C = 100 °C	43	A
I_{DM} (1)	Drain current (pulsed)	260	A
P_{TOT}	Total power dissipation at T_C = 25 °C	450	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		°C

1. *Pulse width limited by safe operating area.*
2. $I_{SD} \leq 68$ *A,* $V_{DS\ (peak)} < V_{(BR)DSS}$*,* $V_{DD} = 400$ *V.*
3. $V_{DS} \leq 520$ *V.*

Table 2. **Thermal data**

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.28	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

Table 3. **Avalanche characteristics**

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (t_p limited by T_J max)	8	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}; V_{DD} = 50 V)	1.8	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	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_C = 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	3.25	4	4.75	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 34 A		36	40	mΩ

1. *Specified by design, not tested in production.*

Table 5. **Dynamic characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	4900	-	pF
C_{oss}	Output capacitance		-	280	-	
C_{rss}	Reverse transfer capacitance		-	3	-	
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 520 V, V_{GS} = 0 V	-	859	-	
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	2.3	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 68 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	125	-	nC
Q_{gs}	Gate-source charge		-	33	-	
Q_{gd}	Gate-drain charge		-	56	-	

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 = 34 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)	-	30.4	-	ns
t_r	Rise time		-	52	-	ns
$t_{d(off)}$	Turn-off delay time		-	107	-	ns
t_f	Fall time		-	10.8	-	ns

Table 7. **Source-drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		68	A
I_{SDM} (1)	Source-drain current (pulsed)		-		260	A
V_{SD} (2)	Forward on voltage	V_{GS} = 0 V, I_{SD} = 68 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 68 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	170	-	ns
Q_{rr}	Reverse recovery charge		-	1.08	-	µC
I_{RRM}	Reverse recovery current		-	12.7	-	A
t_{rr}	Reverse recovery time	I_{SD} = 68 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)	-	308	-	ns
Q_{rr}	Reverse recovery charge		-	4.16	-	µC
I_{RRM}	Reverse recovery current		-	27	-	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**

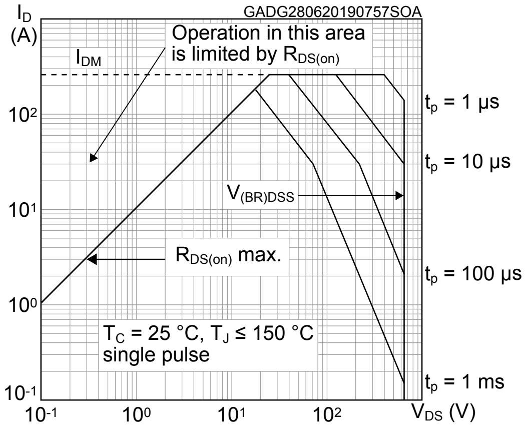


Figure 2. **Maximum transient thermal impedance**

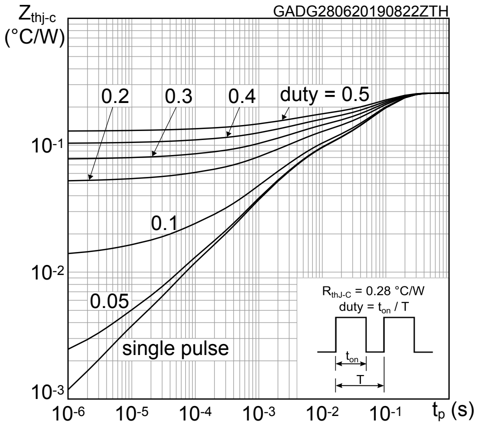


Figure 3. **Typical output characteristics**

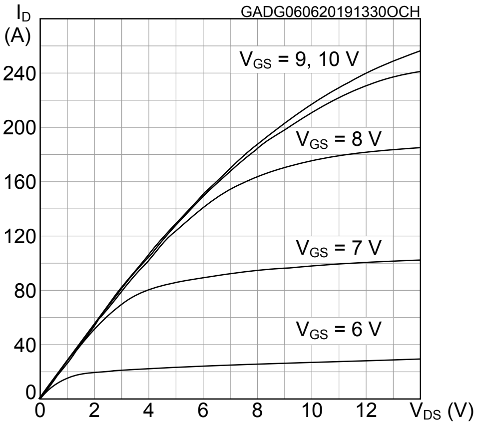


Figure 4. **Typical transfer characteristics**

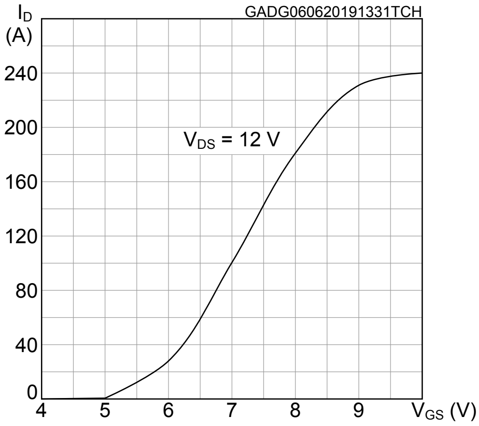


Figure 5. **Typical gate charge characteristics**

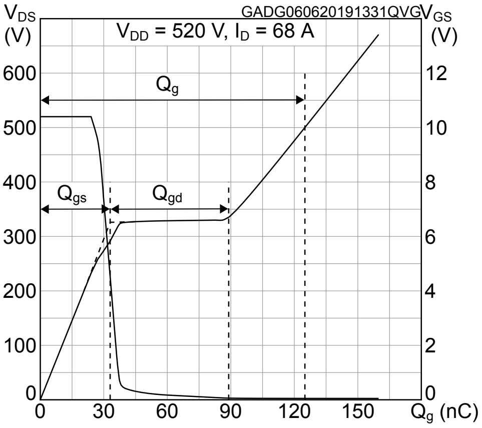


Figure 6. **Typical drain-source on-resistance**

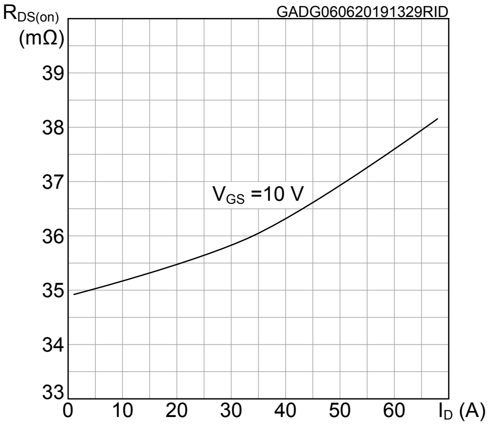


Figure 7. Typical capacitance characteristics

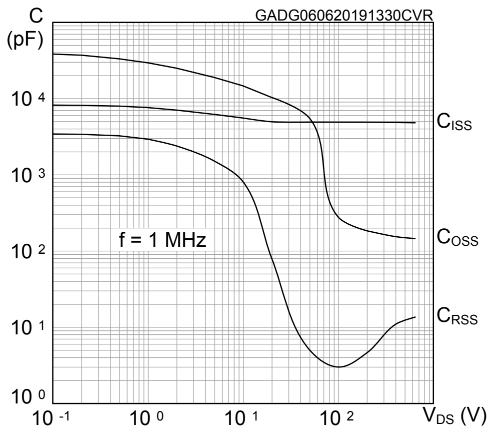


Figure 8. Typical output capacitance stored energy

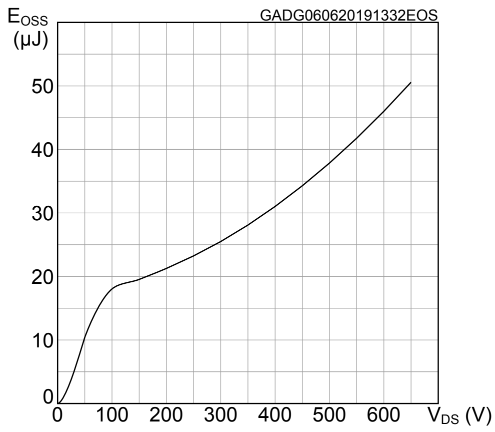


Figure 9. Normalized gate threshold vs temperature

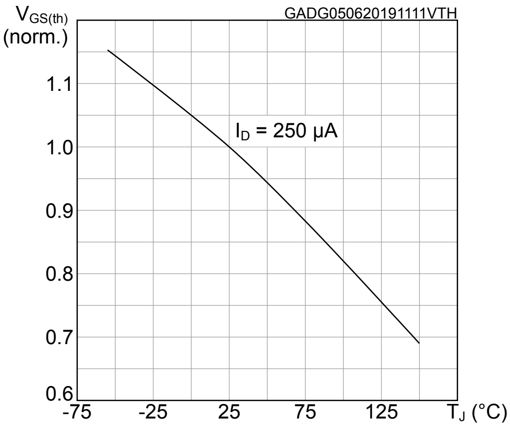


Figure 10. Normalized on-resistance vs. temperature

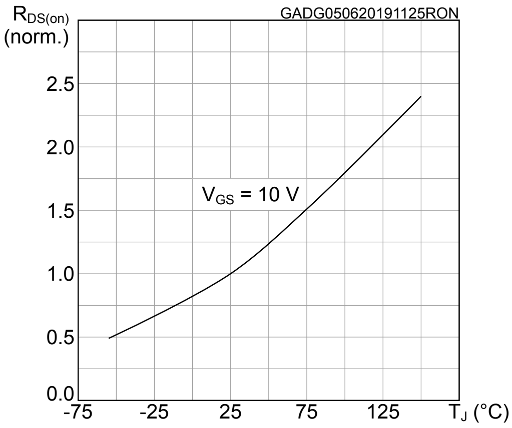


Figure 11. Normalized breakdown voltage vs temperature

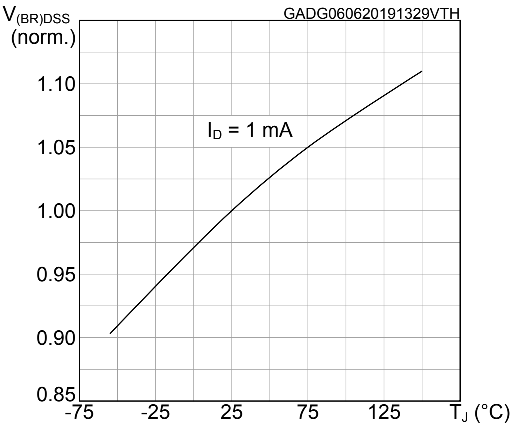
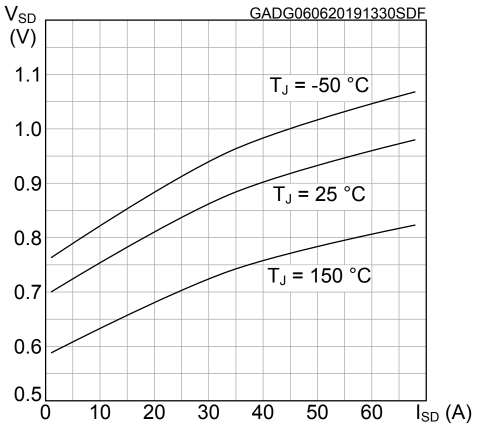


Figure 12. Typical reverse diode forward characteristics



3 Test circuits

Figure 13. Test circuit for resistive load switching times

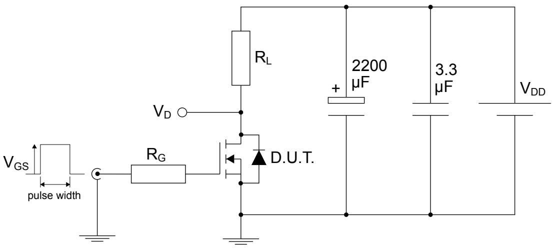


Figure 14. Test circuit for gate charge behavior

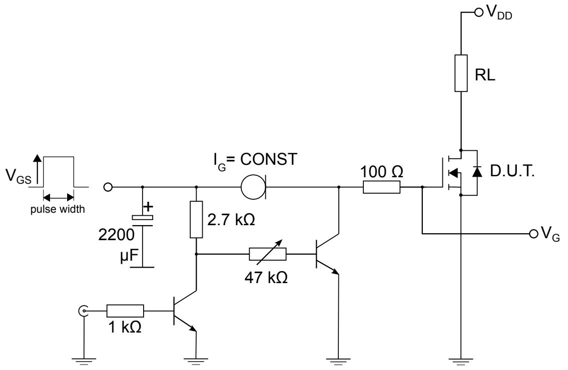


Figure 15. Test circuit for inductive load switching and diode recovery times

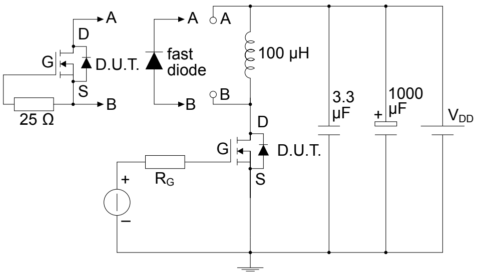


Figure 16. Unclamped inductive load test circuit

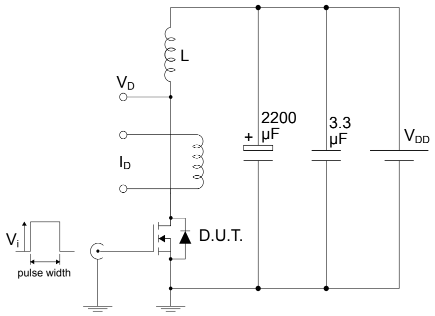


Figure 17. Unclamped inductive waveform

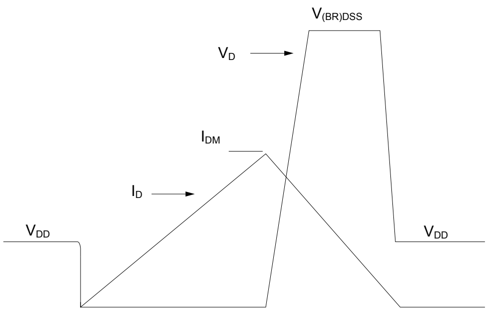
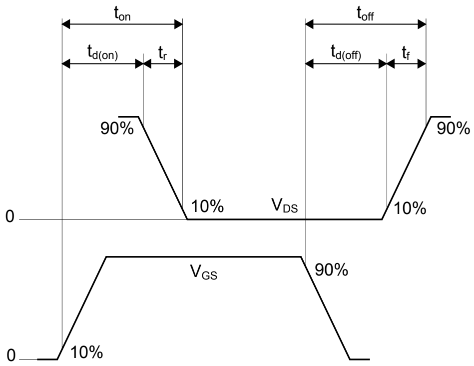


Figure 18. Switching time waveform



4 Package information

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

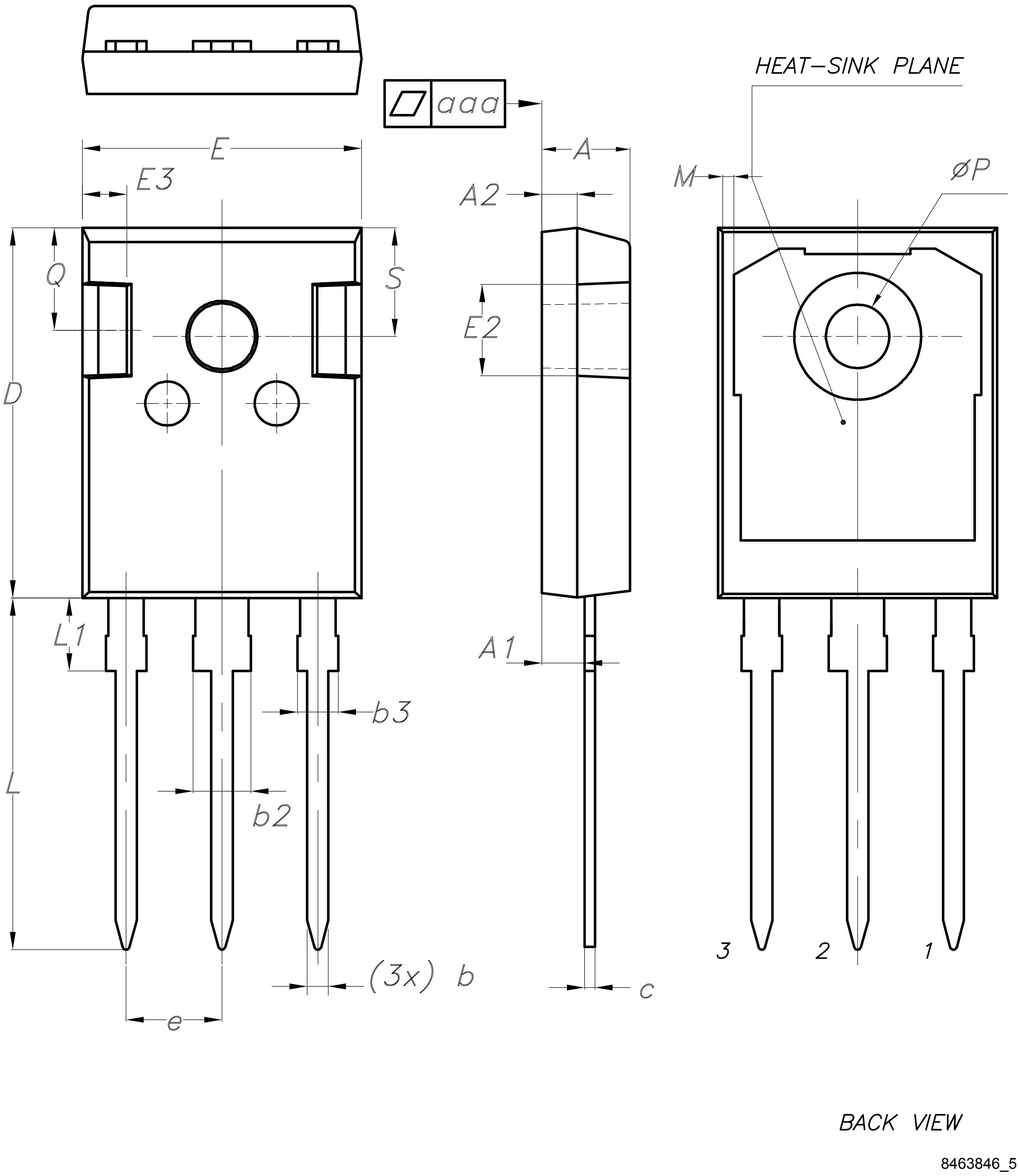


Figure 19. TO-247 long leads package outline

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
M	0.35		0.95
P	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25
aaa		0.04	0.10

Revision history

Table 9. **Document revision history**

Date	Version	Changes
06-Dec-2017	1	Initial release.
09-Jul-2019	2	Update *Table 1, Table 3, Table 4, Table 5, Table 6* and *Table 7*. Added *Section 2.1* Update *Figure 14*.
21-Feb-2020	3	The part number STW70N65DM6 have been moved to a separate datasheet and the document has been updated accordingly.
16-Mar-2020	4	Updated Table 7. Source-drain diode.
02-Jul-2020	5	Updated *Table 1. Absolute maximum ratings.*
03-Nov-2024	6	Updated Section 4.1: TO-247 long leads package information. Minor text changes.

Contents

IMPORTANT NOTICE – 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 acknowledgment.

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. For additional information about ST trademarks, refer to www.st.com/trademarks. 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.

© 2024 STMicroelectronics – All rights reserved

Downloaded from Arrow.com.