

## Automotive-grade N-channel 650 V, 0.070 $\Omega$ typ., 38 A Power MOSFET MDmesh™ DM2 in TO-247 long leads package

Datasheet - production data

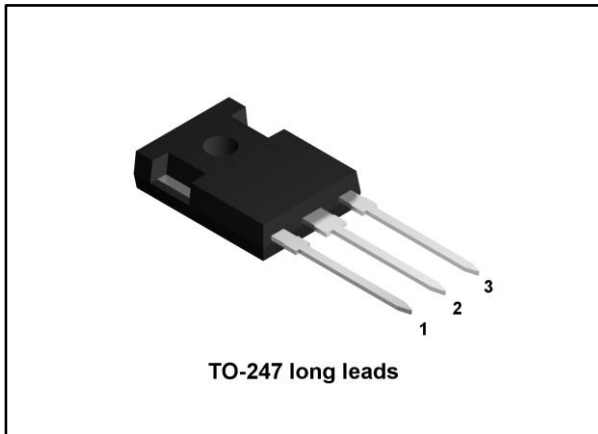
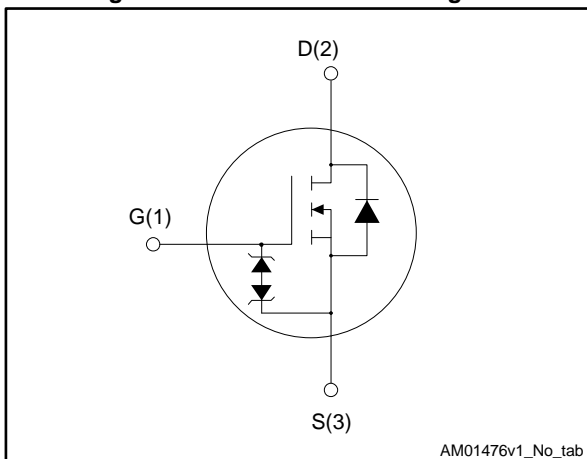


Figure 1: Internal schematic diagram



### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max.	$I_D$	$P_{TOT}$
STWA50N65DM2AG	650 V	0.087 $\Omega$	38 A	300 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.

Table 1: Device summary

Order code	Marking	Package	Packing
STWA50N65DM2AG	50N65DM2	TO-247 long leads	Tube



The HTRB test was performed at 80%  $V_{(BR)DSS}$  in compliance with AEC-Q101 rev. C. All the other tests were performed according to rev. D.

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 25$	V
$I_D$	Drain current (continuous) at $T_{case} = 25\text{ °C}$	38	A
	Drain current (continuous) at $T_{case} = 100\text{ °C}$	24	
$I_{DM}^{(1)}$	Drain current (pulsed)	110	A
$P_{TOT}$	Total dissipation at $T_{case} = 25\text{ °C}$	300	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	50	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50	
$T_{stg}$	Storage temperature range	-55 to 150	°C
$T_j$	Operating junction temperature range		

**Notes:**

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

(2)  $I_{SD} \leq 38\text{ A}$ ,  $di/dt=800\text{ A}/\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ .

(3)  $V_{DS} \leq 520\text{ V}$ .

**Table 3: Thermal data**

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

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}$	Avalanche current, repetitive or not repetitive	5	A
$E_{AS}^{(1)}$	Single pulse avalanche energy	850	mJ

**Notes:**

(1) starting  $T_j = 25\text{ °C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

## 2 Electrical characteristics

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

**Table 5: Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = 1\text{ mA}$	650			V
$I_{\text{DSS}}$	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 650\text{ V}$			10	$\mu\text{A}$
		$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 650\text{ V}$ , $T_{\text{case}} = 125\text{ °C}$ <sup>(1)</sup>			100	
$I_{\text{GSS}}$	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$ , $V_{\text{GS}} = \pm 25\text{ V}$			$\pm 5$	$\mu\text{A}$
$V_{\text{GS(th)}}$	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	$V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 19\text{ A}$		0.070	0.087	$\Omega$

**Notes:**

<sup>(1)</sup> Defined by design, not subject to production test

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{\text{iss}}$	Input capacitance	$V_{\text{DS}} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{\text{GS}} = 0\text{ V}$	-	3200	-	$\text{pF}$
$C_{\text{oss}}$	Output capacitance		-	130	-	
$C_{\text{riss}}$	Reverse transfer capacitance		-	3	-	
$C_{\text{oss eq.}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }520\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$	-	256	-	$\text{pF}$
$R_{\text{G}}$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_{\text{D}} = 0\text{ A}$	-	4	-	$\Omega$
$Q_{\text{g}}$	Total gate charge	$V_{\text{DD}} = 520\text{ V}$ , $I_{\text{D}} = 38\text{ A}$ , $V_{\text{GS}} = 0\text{ to }10\text{ V}$ (see <a href="#">Figure 15: "Test circuit for gate charge behavior"</a> )	-	69	-	$\text{nC}$
$Q_{\text{gs}}$	Gate-source charge		-	18	-	
$Q_{\text{gd}}$	Gate-drain charge		-	34	-	

**Notes:**

<sup>(1)</sup>  $C_{\text{oss eq.}}$  is defined as a constant equivalent capacitance giving the same charging time as  $C_{\text{oss}}$  when  $V_{\text{DS}}$  increases from 0 to 80%  $V_{\text{DSS}}$ .

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325 \text{ V}$ , $I_D = 19 \text{ A}$ $R_G = 4.7 \text{ } \Omega$ , $V_{GS} = 10 \text{ V}$ (see <a href="#">Figure 14: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 19: "Switching time waveform"</a> )	-	22.5	-	ns
$t_r$	Rise time		-	21	-	
$t_{d(off)}$	Turn-off delay time		-	89	-	
$t_f$	Fall time		-	10.5	-	

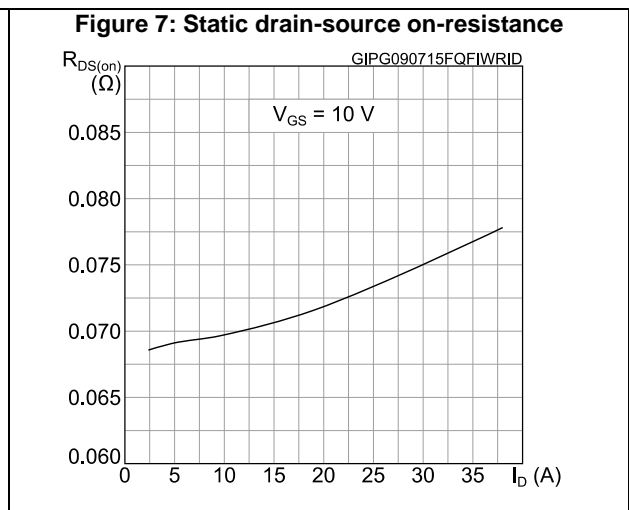
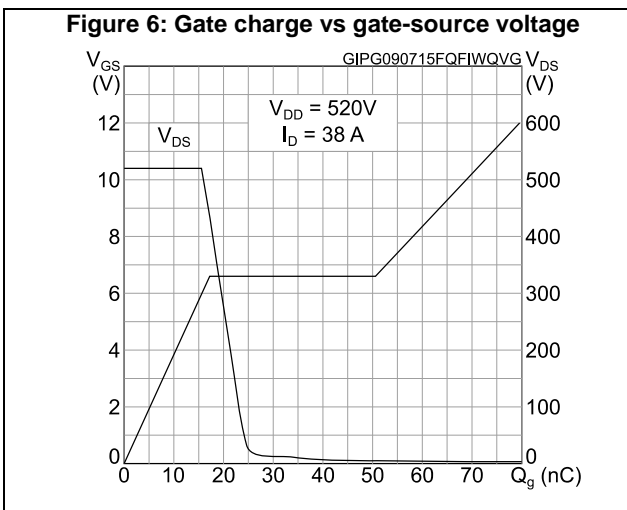
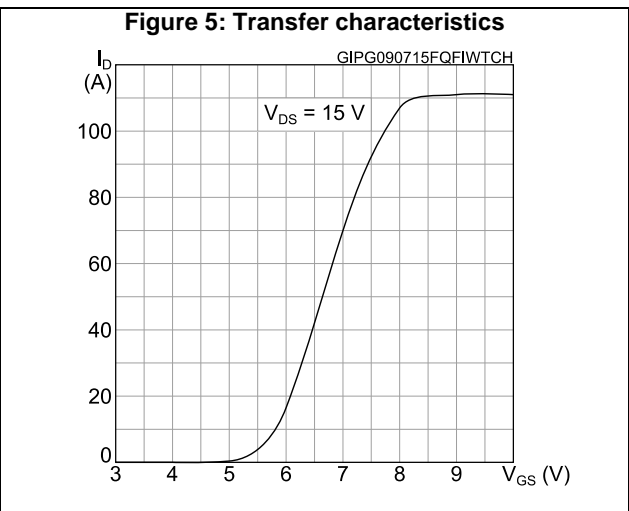
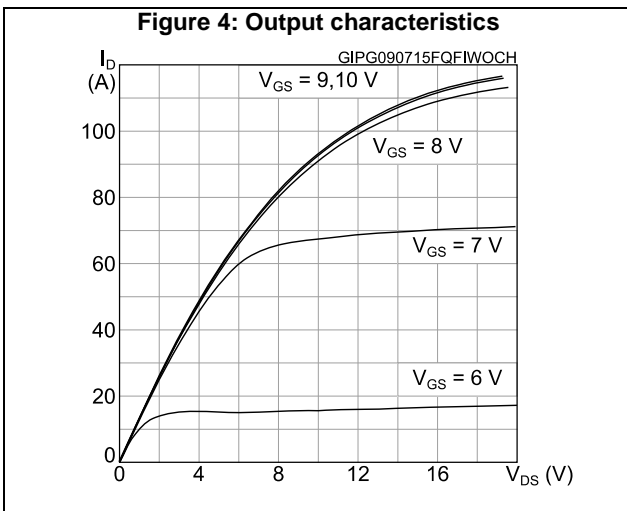
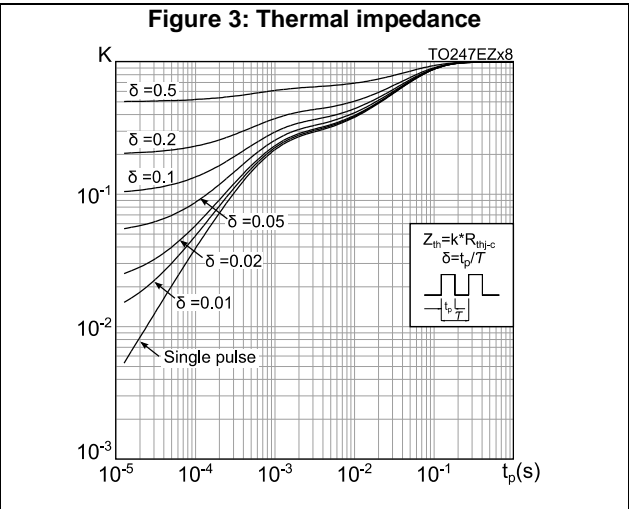
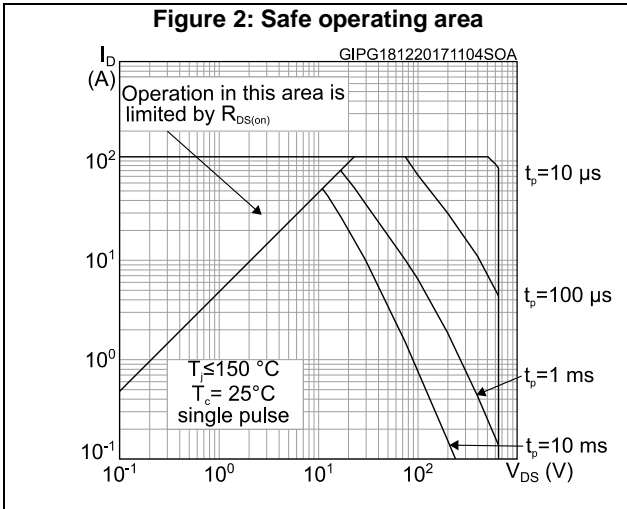
Table 8: Source-drain diode

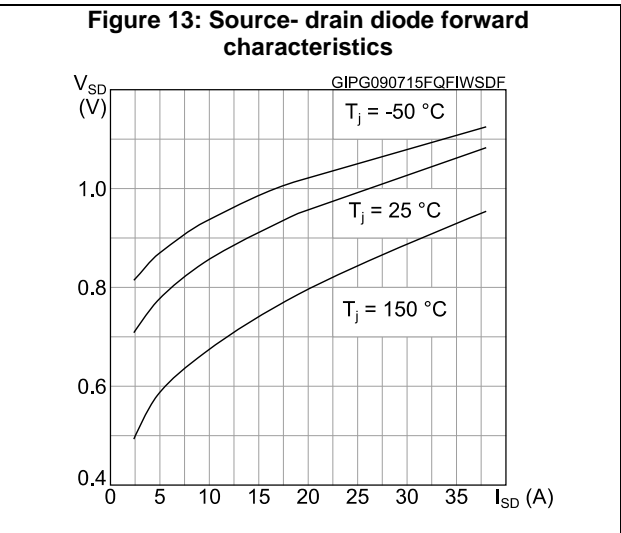
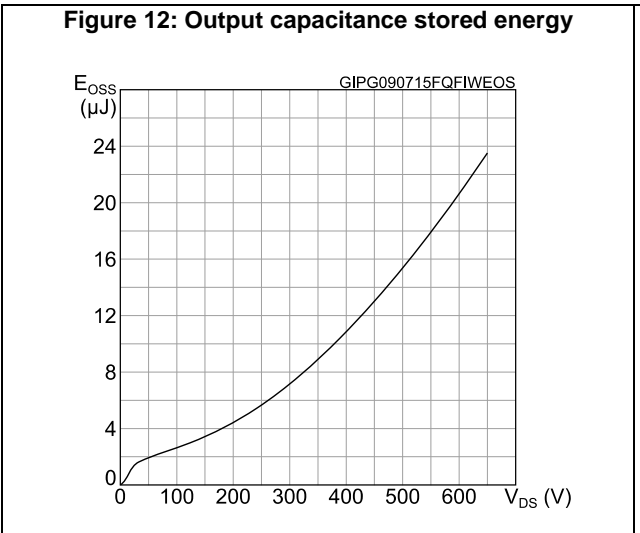
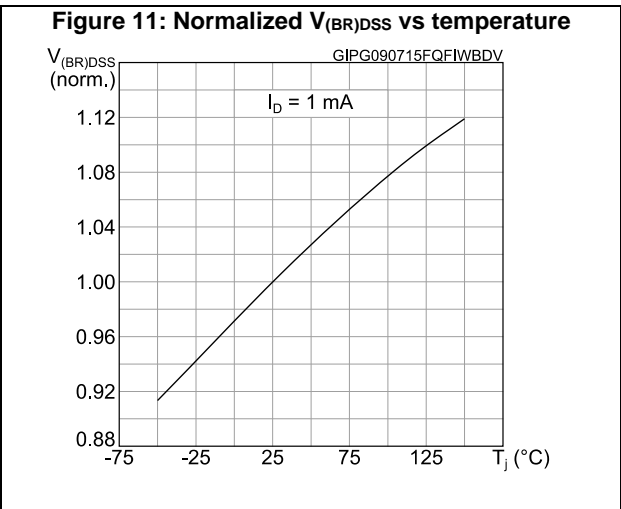
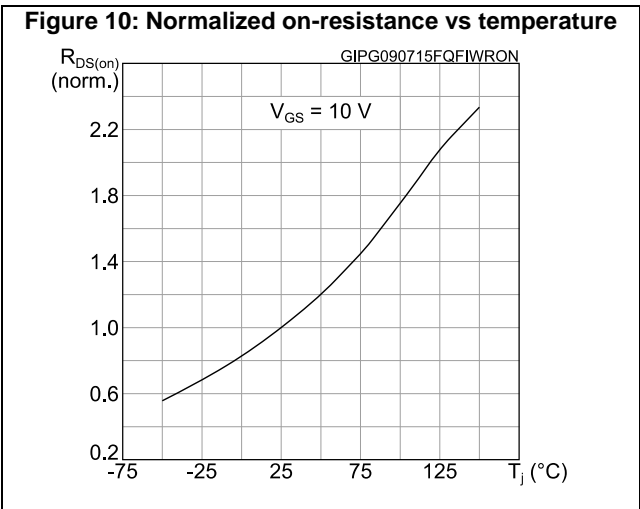
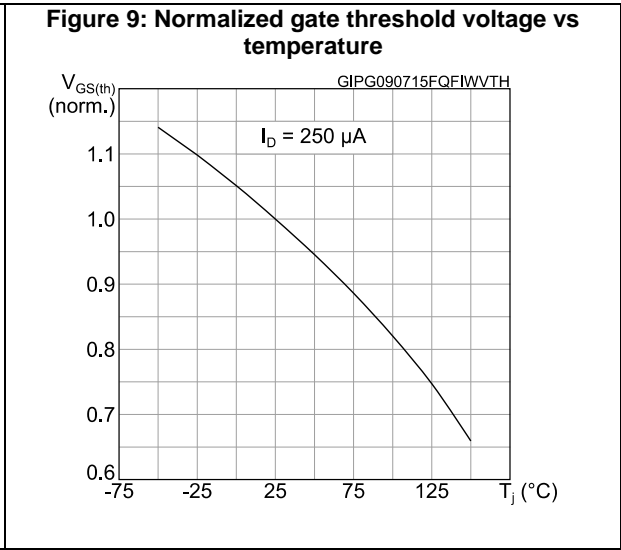
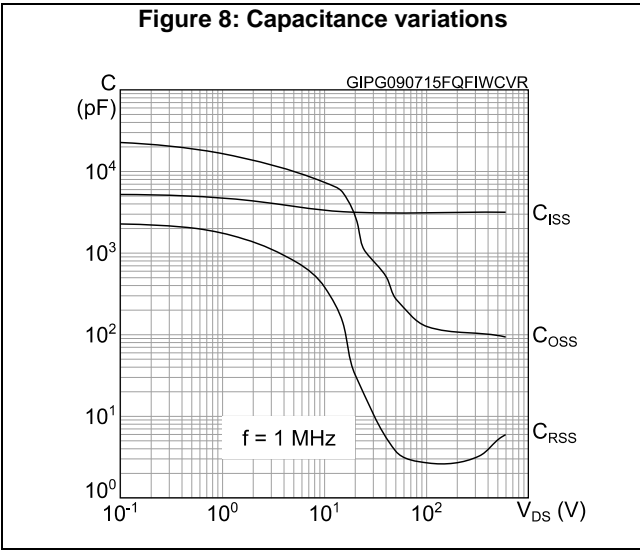
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		38	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		110	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0 \text{ V}$ , $I_{SD} = 38 \text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 38 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ , $V_{DD} = 60 \text{ V}$ (see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> )	-	150		ns
$Q_{rr}$	Reverse recovery charge		-	0.96		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	12.8		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 38 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ , $V_{DD} = 60 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$ (see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> )	-	245		ns
$Q_{rr}$	Reverse recovery charge		-	2.7		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	22		A

**Notes:**

- (1) Pulse width is limited by safe operating area.  
(2) Pulse test: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)





### 3 Test circuits

**Figure 14: Test circuit for resistive load switching times**



AM01468v1

**Figure 15: Test circuit for gate charge behavior**



AM01469v1

**Figure 16: Test circuit for inductive load switching and diode recovery times**



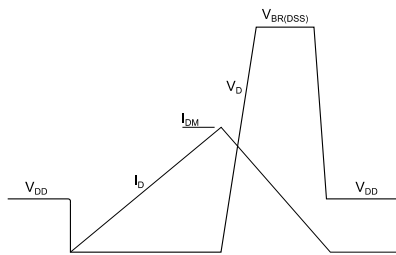
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**Figure 17: Unclamped inductive load test circuit**



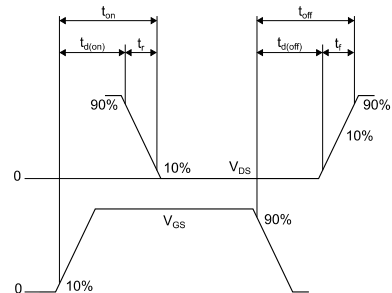
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**Figure 18: Unclamped inductive waveform**



AM01472v1

**Figure 19: Switching time waveform**



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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 TO-247 long leads package information

Figure 20: TO-247 long leads package outline

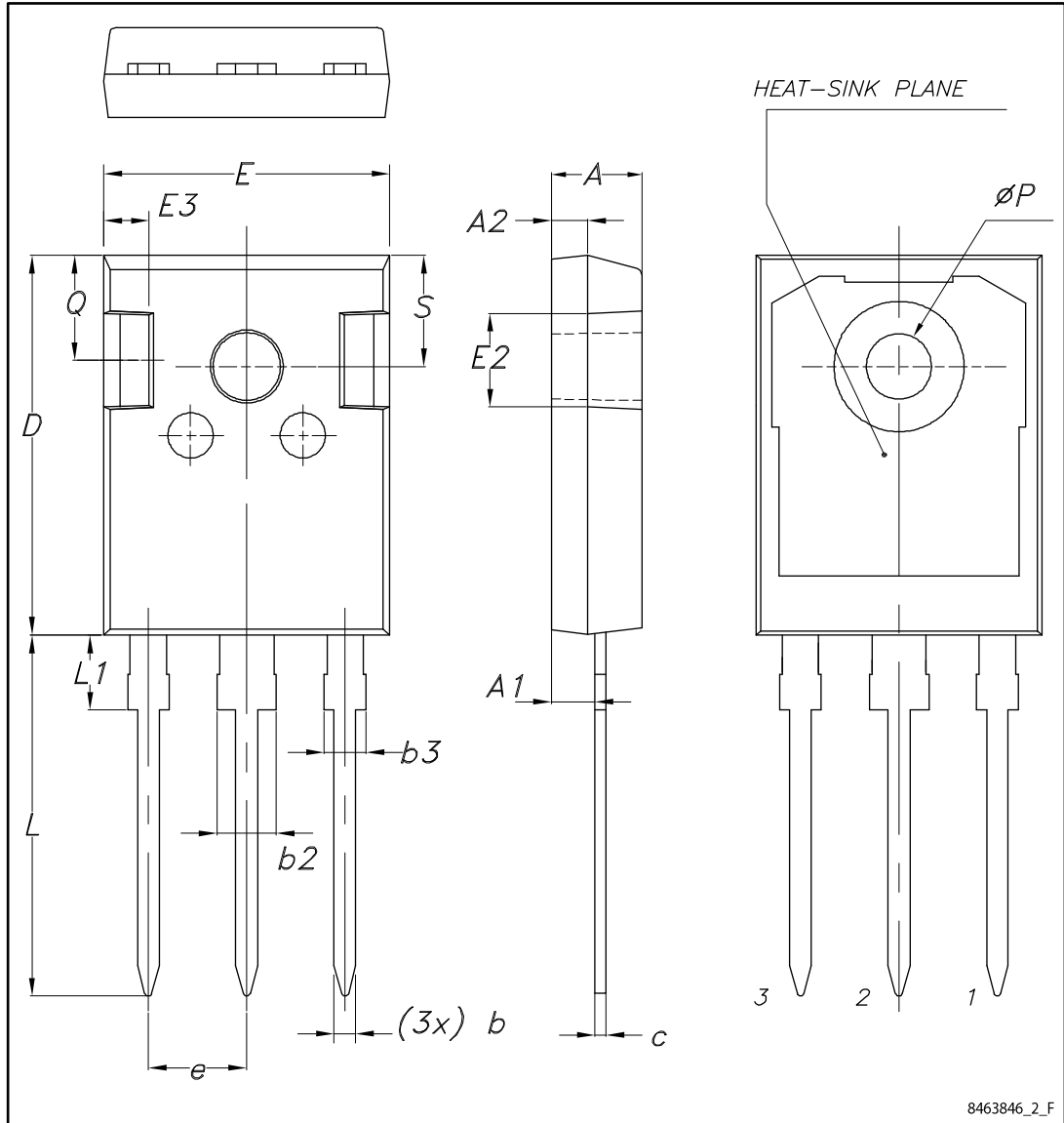


Table 9: TO-247 long leads package mechanical data

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

## 5 Revision history

**Table 10: Document revision history**

Date	Revision	Changes
10-Jan-2017	1	Initial release
18-Dec-2017	2	Datasheet promoted from preliminary data to production data. Modified <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 4: "Avalanche characteristics"</i> , <i>Table 6: "Dynamic"</i> and <i>Table 8: "Source-drain diode"</i> . Modified <i>Figure 2: "Safe operating area"</i> . Minor text changes.

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