

## N-channel 950 V, 0.275 $\Omega$ typ., 18 A, MDmesh™ DK5 Power MOSFETs in TO-247 and TO-247 long leads packages

Datasheet - production data

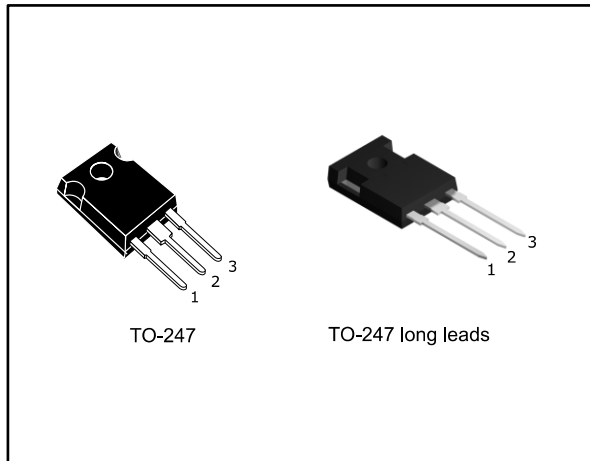
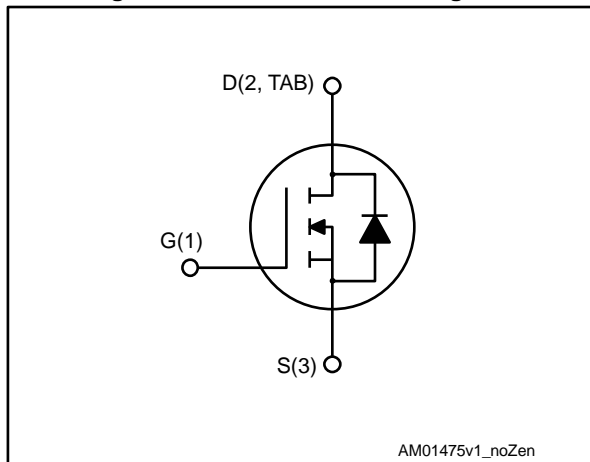


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STW20N95DK5	950 V	0.330 $\Omega$	18 A
STWA20N95DK5			

- Fast-recovery body diode
- Best R<sub>DS(on)</sub> x area
- Low gate charge, input capacitance and resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness

### Applications

- Switching applications

### Description

These very high voltage N-channel Power MOSFETs are part of the MDmesh™ DK5 fast recovery diode series. The MDmesh™ DK5 combines very low recovery charge (Q<sub>rr</sub>) and recovery time (t<sub>rr</sub>) with an excellent improvement in R<sub>DS(on)</sub> \* area and one of the most effective switching behaviors, ideal for half bridge and full bridge converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STW20N95DK5	20N95DK5	TO-247	Tube
STWA20N95DK5		TO-247 long leads	

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	$\pm 30$	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ }^\circ\text{C}$	18	V
$I_D$	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	11	A
$I_{DM}^{(1)}$	Drain current (pulsed)	72	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ }^\circ\text{C}$	250	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	50	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		

**Notes:**

(1) Pulse width limited by safe operating area

(2)  $I_{SD} \leq 8.5\text{ A}$ ,  $di/dt \leq 400\text{ A}/\mu\text{s}$ ,  $V_{DS\text{ peak}} \leq V_{(BR)DSS}$ ,  $V_{DD} = 475\text{ V}$

(3)  $V_{DS} \leq 760\text{ V}$

**Table 3: Avalanche characteristics**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.5	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	50	$^\circ\text{C}/\text{W}$

**Table 4: Thermal data**

Symbol	Parameter	Value	Unit
$I_{AR}$	Maximum current during repetitive or single pulse avalanche	6	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{ V}$ )	520	mJ

## 2 Electrical characteristics

(T<sub>CASE</sub> = 25 °C unless otherwise specified)

**Table 5: On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0 V	950			V
I <sub>DSS</sub>	Zero gate voltage drain current	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 950 V			10	μA
		V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 950 V, T <sub>C</sub> = 125 °C <sup>(1)</sup>			100	μA
I <sub>GSS</sub>	Gate source leakage current	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V			±2	μA
V <sub>GS(th)</sub>	Gate threshold voltage	V <sub>DD</sub> = V <sub>GS</sub> , I <sub>D</sub> = 100 μA	3	4	5	V
R <sub>DS(on)</sub>	Static drain-source on-resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 9 A		0.275	0.330	Ω

**Notes:**

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

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C <sub>iss</sub>	Input capacitance	V <sub>DS</sub> = 100 V, f = 1 MHz, V <sub>GS</sub> = 0 V	-	1600	-	pF
C <sub>oss</sub>	Output capacitance		-	76	-	pF
C <sub>rss</sub>	Reverse transfer capacitance		-	5	-	pF
C <sub>o(tr)</sub> <sup>(1)</sup>	Time-related equivalent capacitance	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 0 to 760 V	-	169	-	pF
C <sub>o(er)</sub> <sup>(2)</sup>	Energy-related equivalent capacitance		-	60	-	pF
R <sub>g</sub>	Intrinsic gate resistance	f = 1 MHz, I <sub>D</sub> = 0 A	-	4	-	Ω
Q <sub>g</sub>	Total gate charge	V <sub>DD</sub> = 760 V, I <sub>D</sub> = 18 A, V <sub>GS</sub> = 0 to 10 V (see <a href="#">Figure 16: "Test circuit for gate charge behavior"</a> )	-	50.7	-	nC
Q <sub>gs</sub>	Gate source charge		-	7.8	-	nC
Q <sub>gd</sub>	Gate drain charge		-	34.2	-	nC

**Notes:**

<sup>(1)</sup>C<sub>o(tr)</sub> is defined as the constant equivalent capacitance giving the same charging time as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>.

<sup>(2)</sup>C<sub>o(er)</sub> is defined as the constant equivalent capacitance giving the same stored energy as C<sub>oss</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>.

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DS} = 475\text{ V}$ , $I_D = 9\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 15: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 20: "Switching time waveform"</a> )	-	23	-	ns
$t_r$	Rise time		-	23	-	ns
$t_{d(off)}$	Turn-off delay time		-	74	-	ns
$t_f$	Fall time		-	25.4	-	ns

Table 8: Source-drain diode

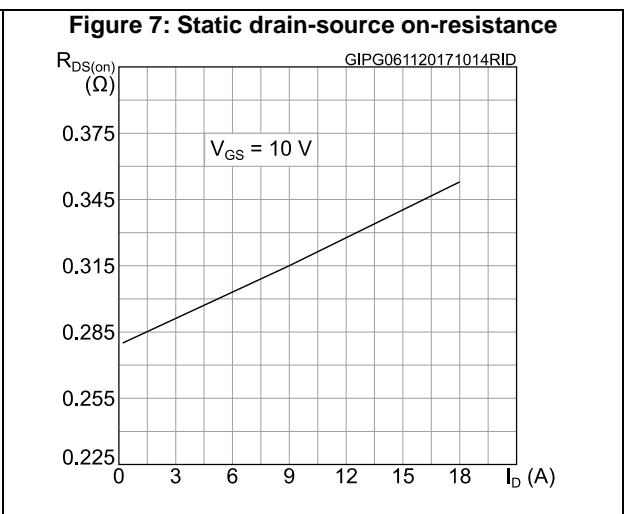
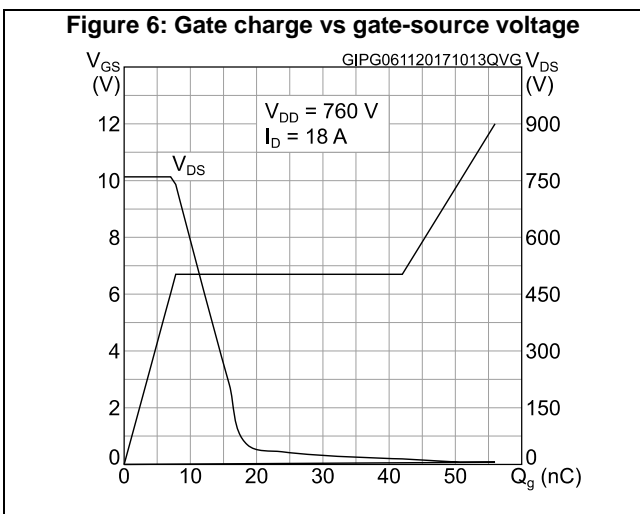
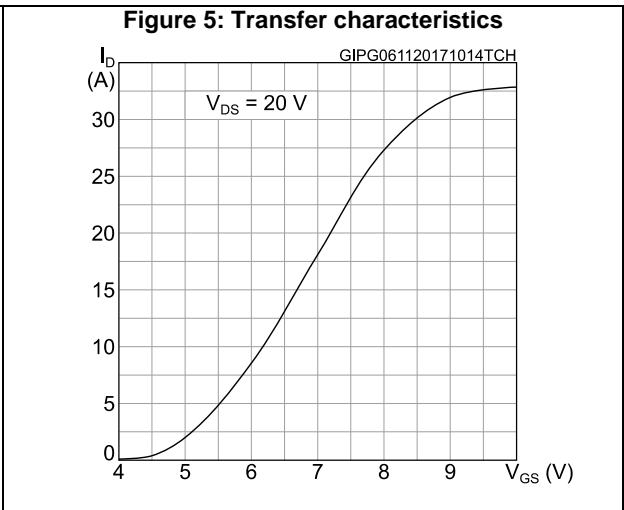
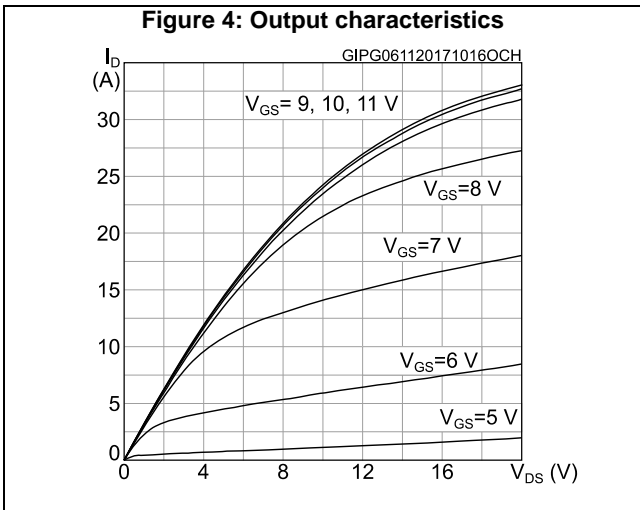
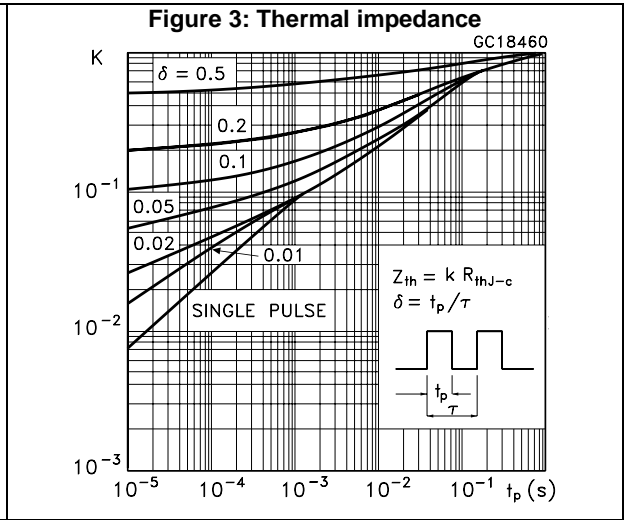
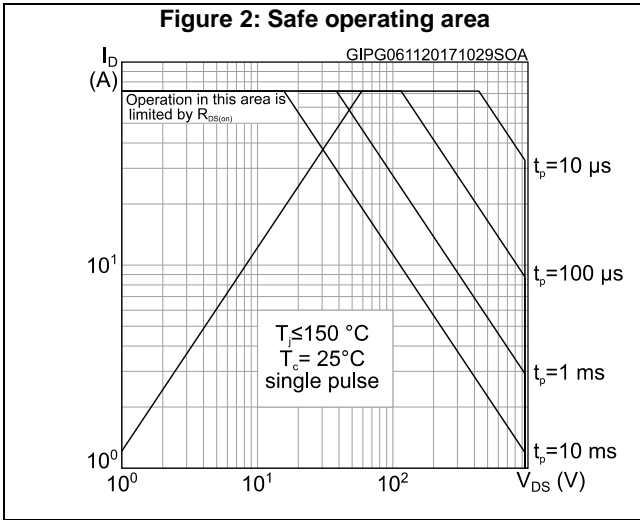
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		18	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		72	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 18\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 9\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 17: "Test circuit for inductive load switching and diode recovery times"</a> )	-	150		ns
$Q_{rr}$	Reverse recovery charge		-	1		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	13.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 9\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 17: "Test circuit for inductive load switching and diode recovery times"</a> )	-	264		ns
$Q_{rr}$	Reverse recovery charge		-	2.9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	22		A

**Notes:**

(1)Pulse width limited by safe operating area

(2)Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

## 2.1 Electrical characteristics (curves)



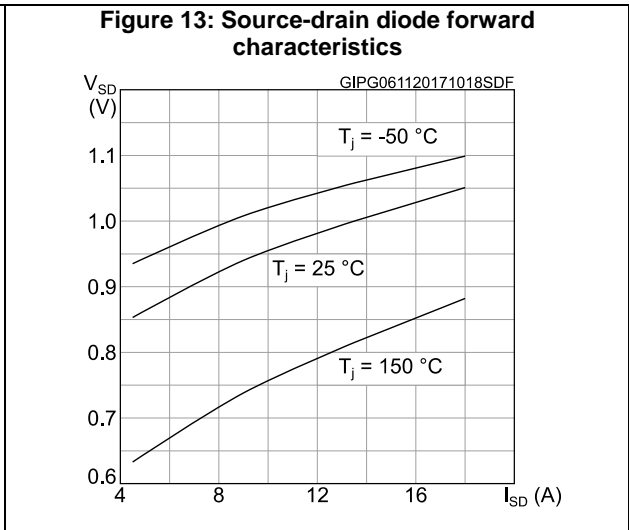
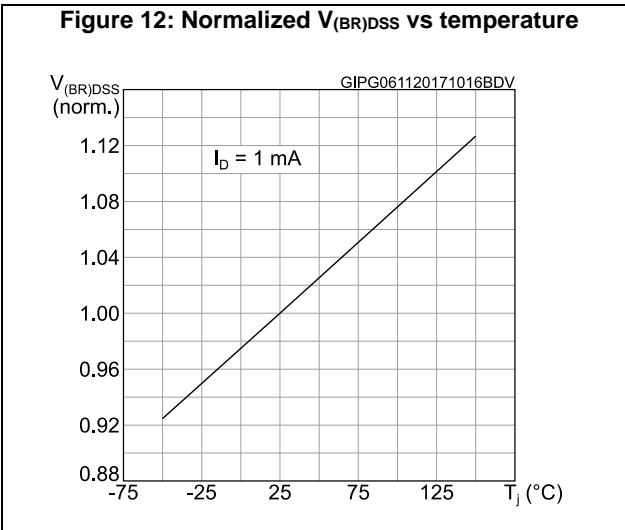
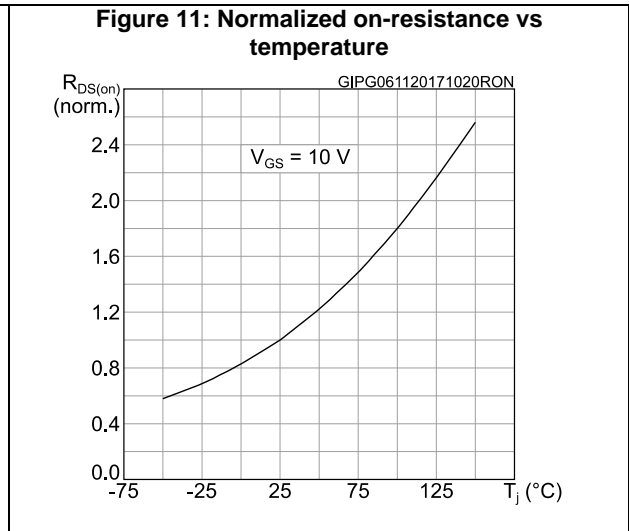
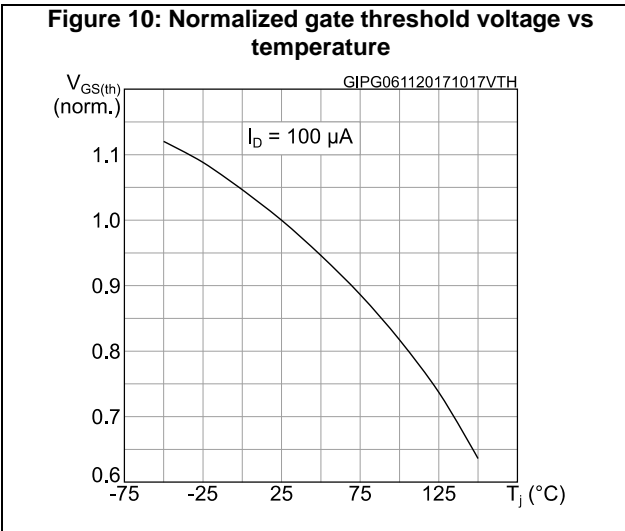
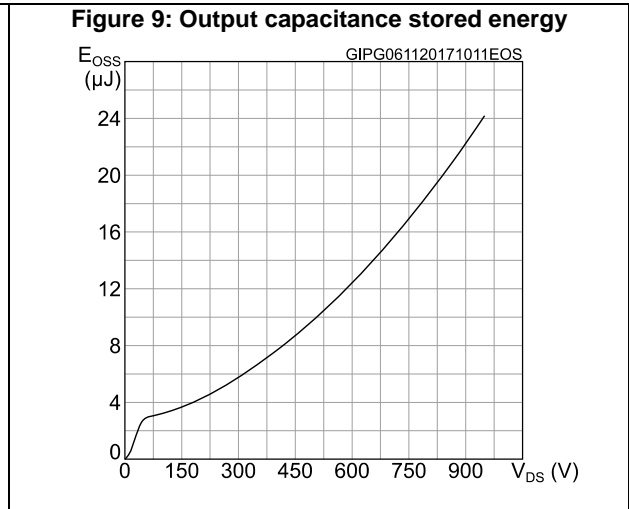
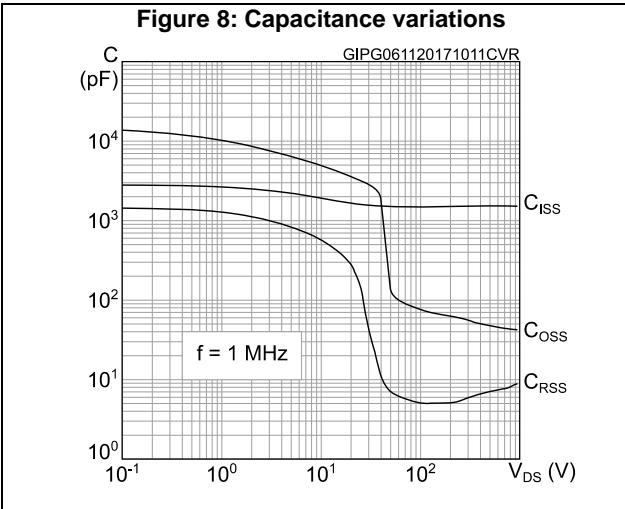
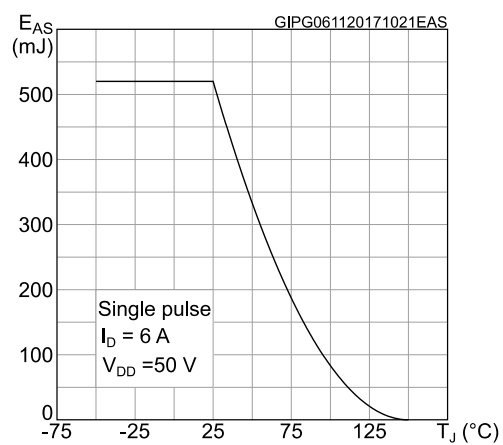


Figure 14: Maximum avalanche energy vs starting  $T_J$





### 3 Test circuits

**Figure 15: Test circuit for resistive load switching times**



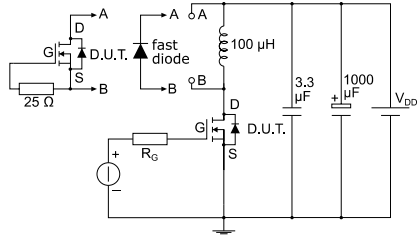
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**Figure 16: Test circuit for gate charge behavior**



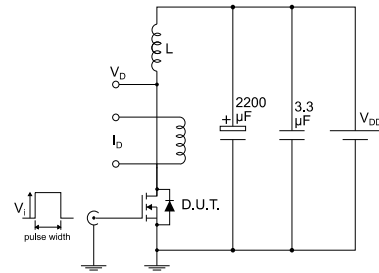
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**Figure 17: Test circuit for inductive load switching and diode recovery times**



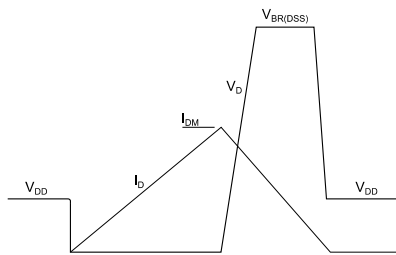
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**Figure 18: Unclamped inductive load test circuit**



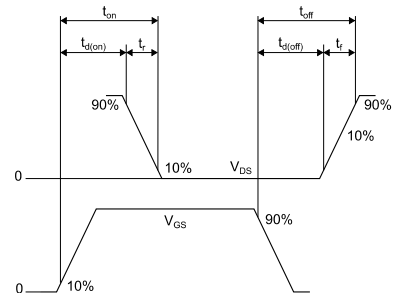
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**Figure 19: Unclamped inductive waveform**



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**Figure 20: 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 package information

Figure 21: TO-247 package outline

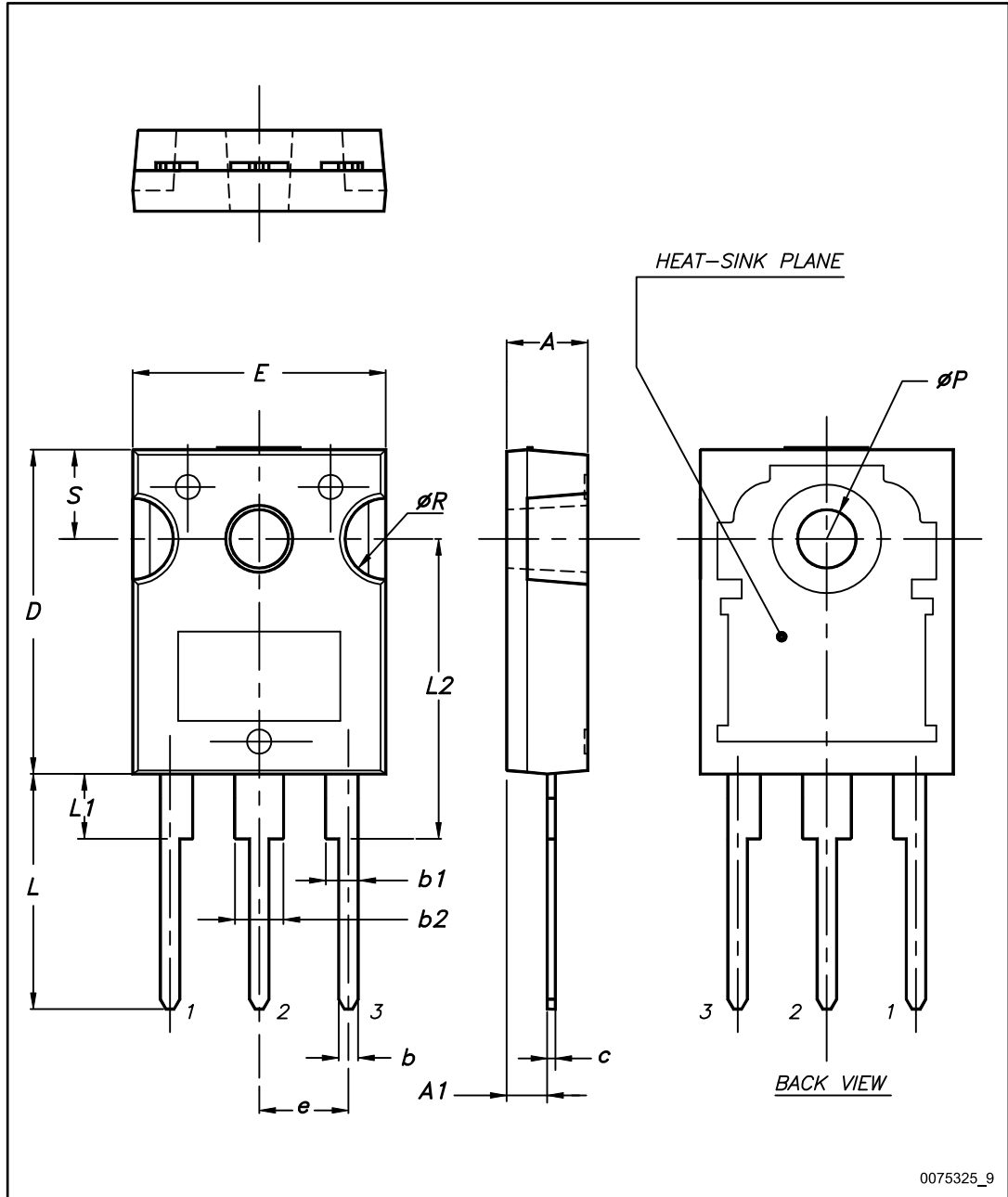
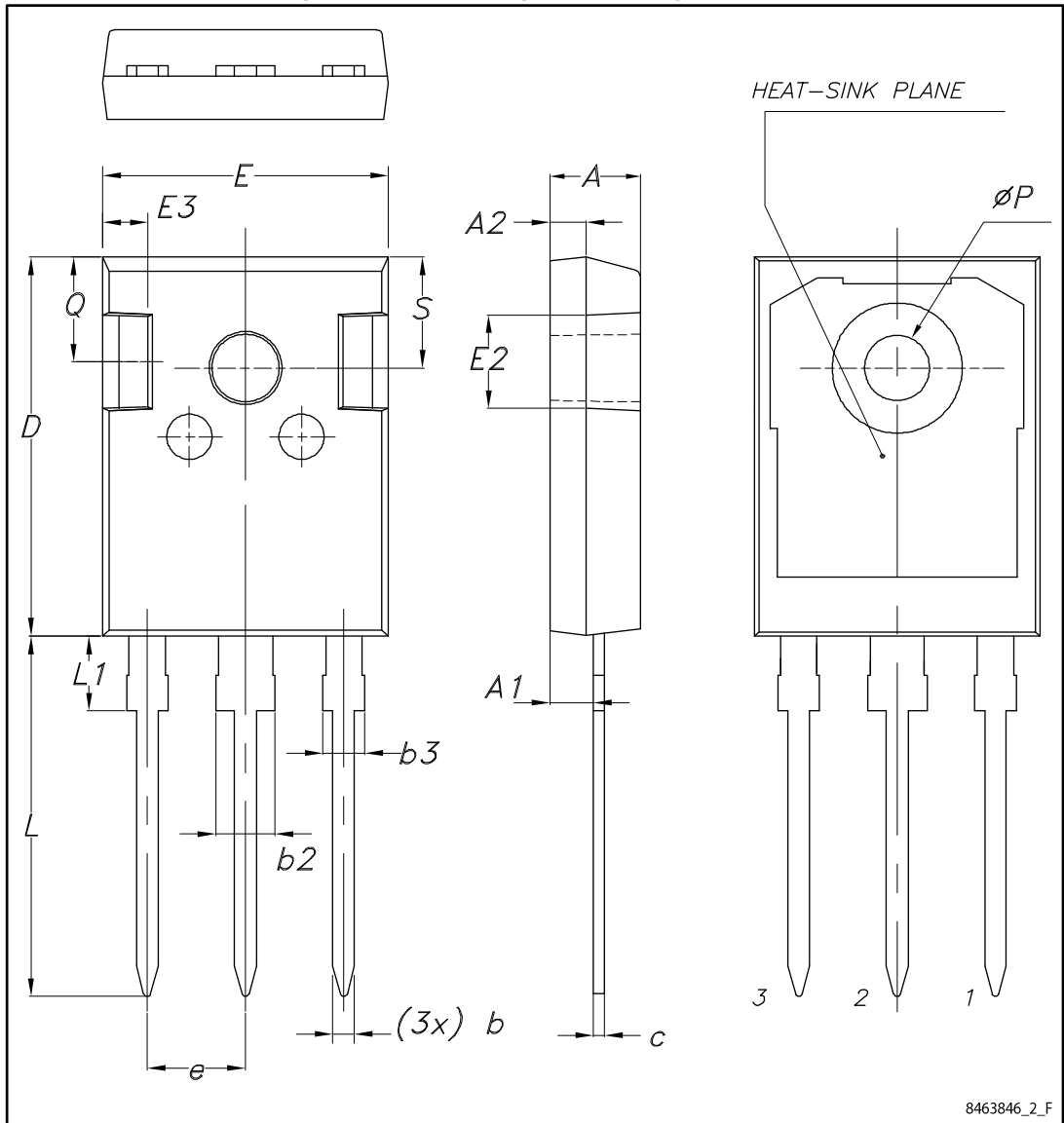


Table 9: TO-247 package mechanical data

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

### 4.2 TO-247 long leads package information

Figure 22: TO-247 long leads package outline



8463846\_2\_F

Table 10: 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 11: Document revision history

Date	Revision	Changes
10-May-2017	1	Initial release
06-Nov-2017	2	Datasheet promoted from preliminary data to production data. Modified title and features table on cover page Modified <a href="#">Table 2: "Absolute maximum ratings"</a> , <a href="#">Table 4: "Thermal data"</a> , <a href="#">Table 5: "On/off states"</a> , <a href="#">Table 6: "Dynamic"</a> , <a href="#">Table 7: "Switching times"</a> and <a href="#">Table 8: "Source-drain diode"</a> . Added <a href="#">Section 2.1: "Electrical characteristics (curves)"</a> . Minor text changes.

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