

## N-channel 850 V, 0.2 $\Omega$ typ., 19 A MDmesh™ K5 Power MOSFET in a TO-247 package

Datasheet - production data

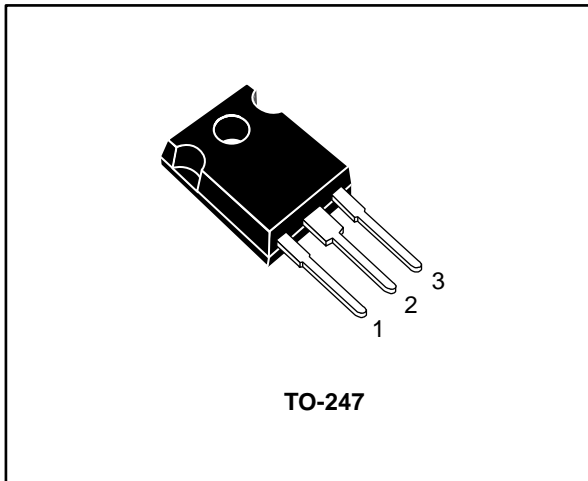
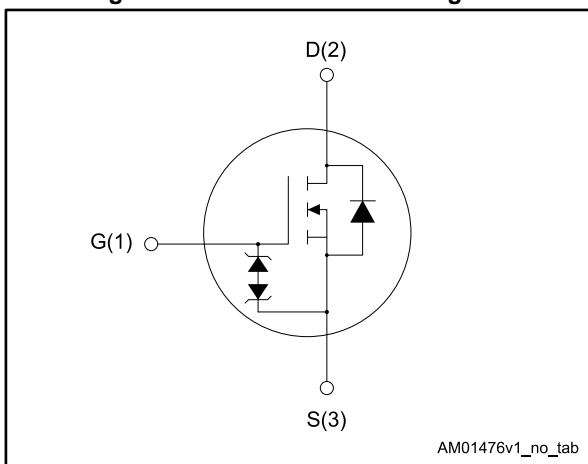


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STW23N85K5	850 V	0.275 $\Omega$	19 A	250 W

- Industry's lowest R<sub>DS(on)</sub> x area
- Industry's best figure of merit (FoM)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This very high voltage N-channel Power MOSFET is designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1: Device summary

Order code	Marking	Package	Packing
STW23N85K5	23N85K5	TO-247	Tube

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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 $T_{case} = 25\text{ }^\circ\text{C}$	19	A
	Drain current (continuous) at $T_{case} = 100\text{ }^\circ\text{C}$	12.4	
$I_{DM}^{(1)}$	Drain current (pulsed)	250	A
$P_{TOT}$	Total dissipation at $T_{case} = 25\text{ }^\circ\text{C}$	250	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	6	V/ns
$T_{stg}$	Storage temperature	-55 to 150	$^\circ\text{C}$
$T_j$	Operating junction temperature		

**Notes:**

<sup>(1)</sup> Pulse width is limited by safe operating area.

<sup>(2)</sup>  $I_{SD} \leq 19\text{ A}$ ,  $di/dt = 100\text{ A}/\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ .

**Table 3: Thermal data**

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	45	

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not repetitive	6	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	200	mJ

**Notes:**

<sup>(1)</sup> Pulse width limited by  $T_{jmax}$ .

<sup>(2)</sup> starting  $T_j = 25\text{ }^\circ\text{C}$ ,  $I_D = I_{AR}$ ,  $V_{DD} = 50\text{ V}$ .

## 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	$V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = 1\text{ mA}$	850			V
$I_{\text{DSS}}$	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 850\text{ V}$			10	$\mu\text{A}$
		$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 850\text{ V}$ , $T_{\text{case}} = 125\text{ °C}$			50	
$I_{\text{GSS}}$	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$ , $V_{\text{GS}} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$ , $I_{\text{D}} = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 9.5\text{ A}$		0.2	0.275	$\Omega$

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{\text{iss}}$	Input capacitance	$V_{\text{DS}} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{\text{GS}} = 0\text{ V}$	-	1650	-	$\text{pF}$
$C_{\text{oss}}$	Output capacitance		-	115	-	
$C_{\text{rss}}$	Reverse transfer capacitance		-	2	-	
$C_{\text{oss eq.}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }680\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$	-	185	-	$\text{pF}$
$R_{\text{G}}$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_{\text{D}} = 0\text{ A}$	-	3.5	-	$\Omega$
$Q_{\text{g}}$	Total gate charge	$V_{\text{DD}} = 520\text{ V}$ , $I_{\text{D}} = 60\text{ A}$ , $V_{\text{GS}} = 10\text{ V}$ (see <a href="#">Figure 17</a> : "Gate charge test circuit")	-	38	-	$\text{nC}$
$Q_{\text{gs}}$	Gate-source charge		-	11	-	
$Q_{\text{gd}}$	Gate-drain charge		-	20	-	

**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
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 400\text{ V}$ , $I_{\text{D}} = 9.5\text{ A}$ $R_{\text{G}} = 4.7\text{ }\Omega$ , $V_{\text{GS}} = 10\text{ V}$ (see <a href="#">Figure 16</a> : "Switching times test circuit for resistive load" and <a href="#">Figure 21</a> : "Switching time waveform")	-	22	-	$\text{ns}$
$t_{\text{r}}$	Rise time		-	14	-	
$t_{\text{d(off)}}$	Turn-off delay time		-	55	-	
$t_{\text{f}}$	Fall time		-	8	-	

Table 8: Source-drain diode

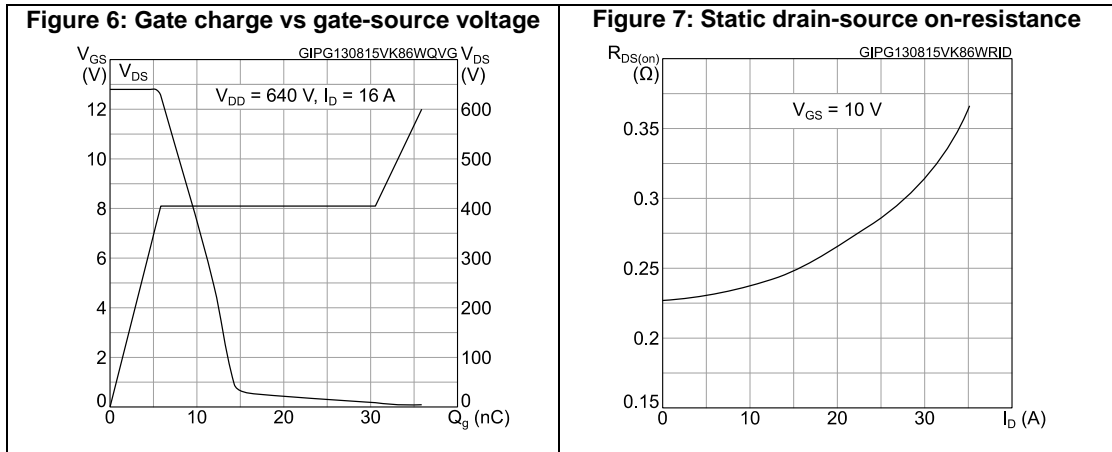
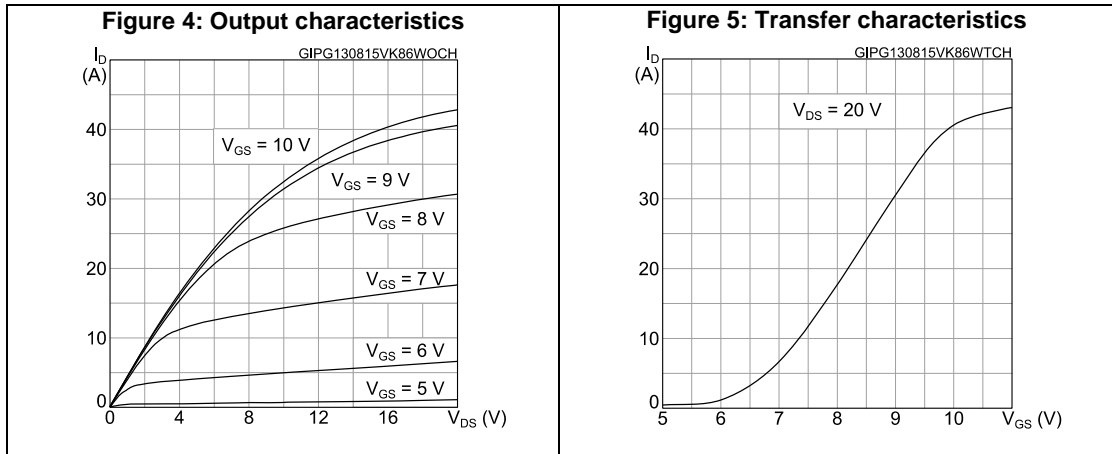
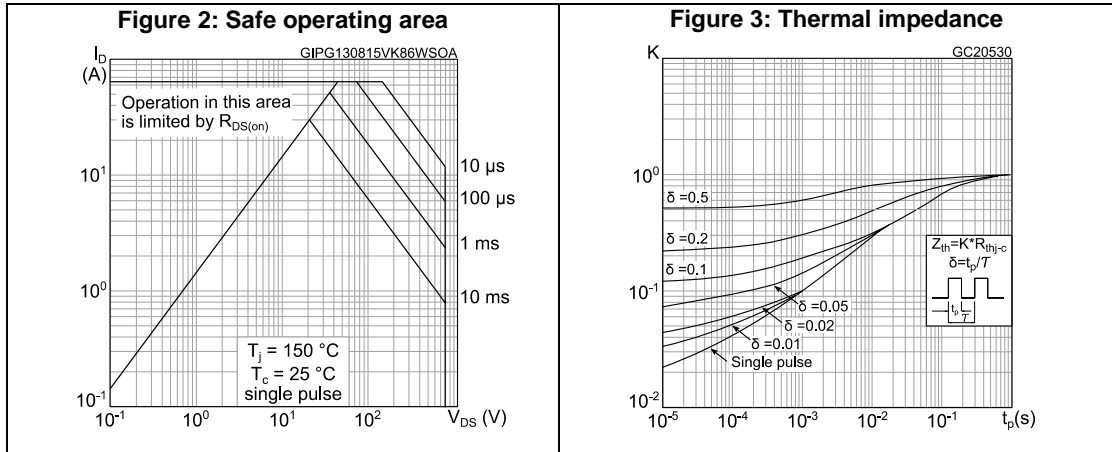
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		19	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		76	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 19\text{ A}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 19\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 18: "Test circuit for inductive load switching and diode recovery times"</a> )	-	510		ns
$Q_{rr}$	Reverse recovery charge		-	11		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	43		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 19\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 18: "Test circuit for inductive load switching and diode recovery times"</a> )	-	684		ns
$Q_{rr}$	Reverse recovery charge		-	14		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	41		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)



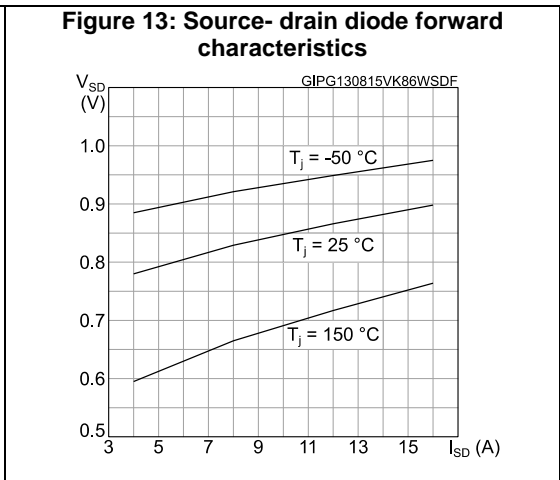
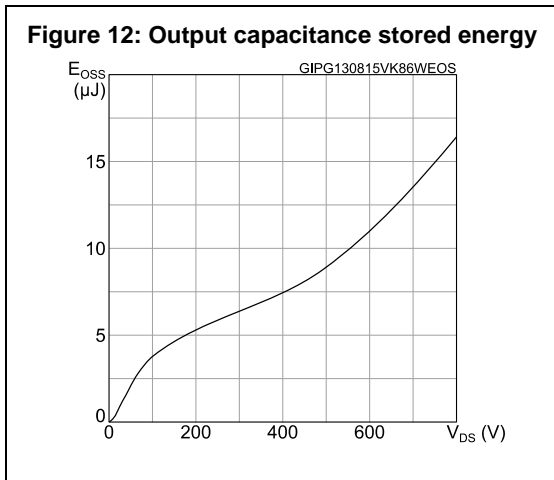
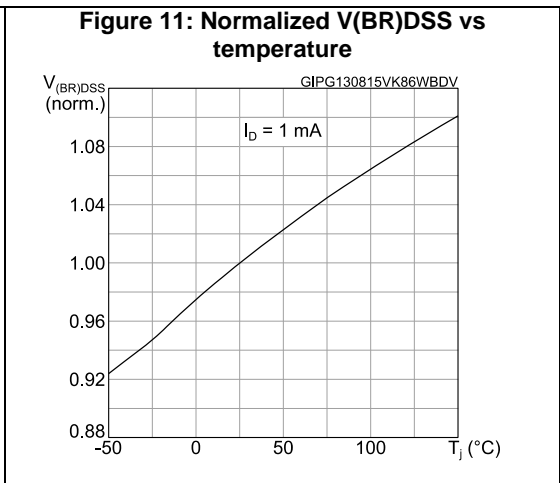
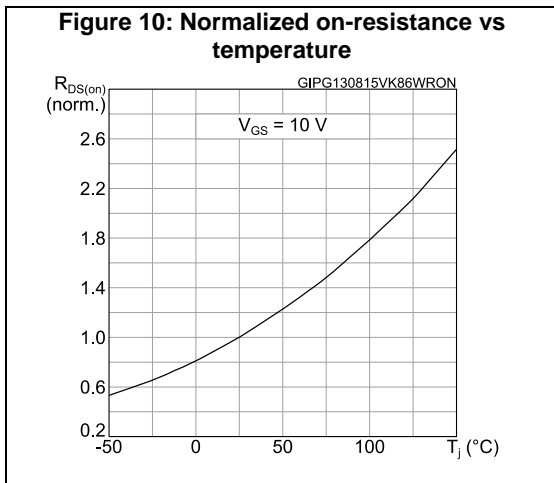
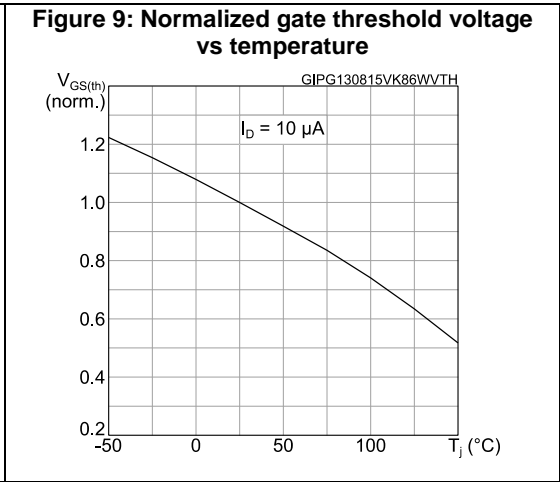
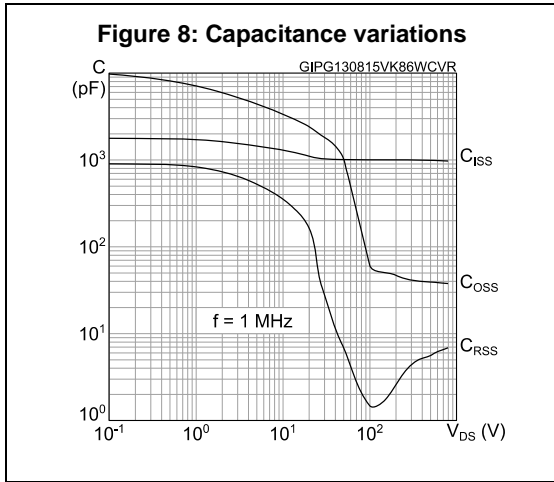


Figure 14: Maximum avalanche energy vs temperature (ID = 3.5 A)

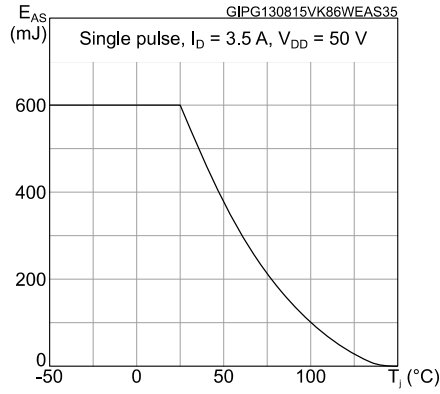
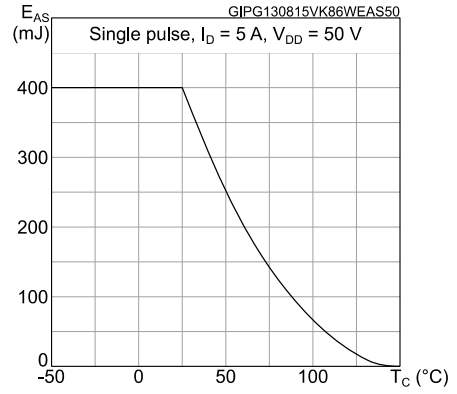
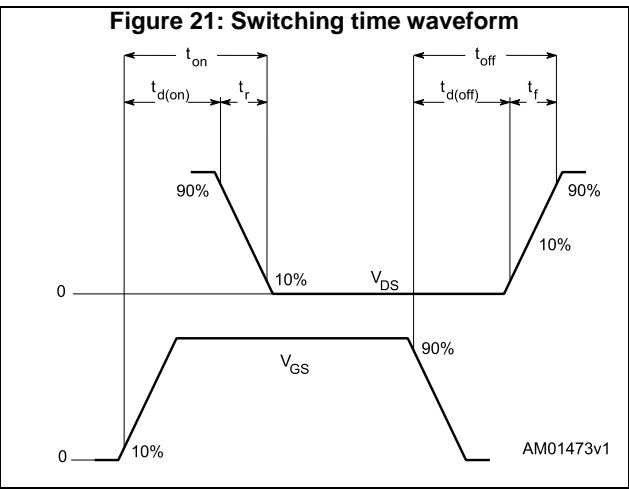
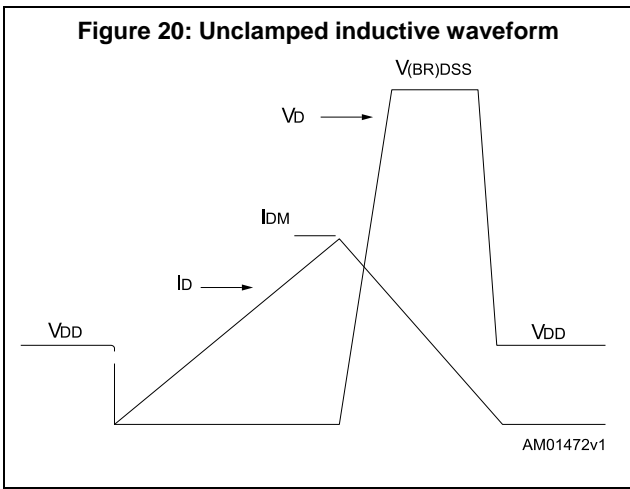
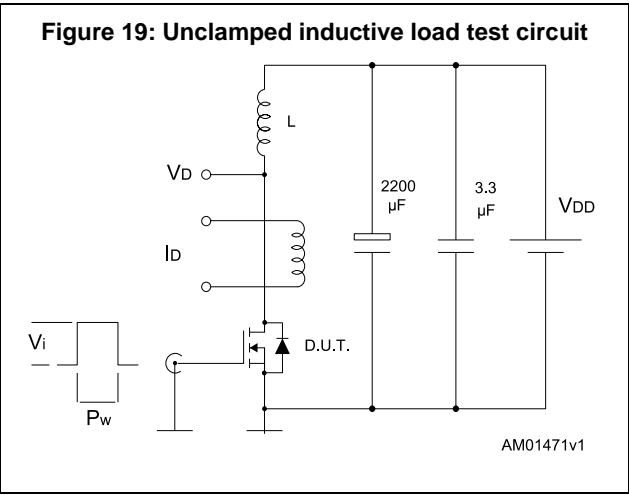
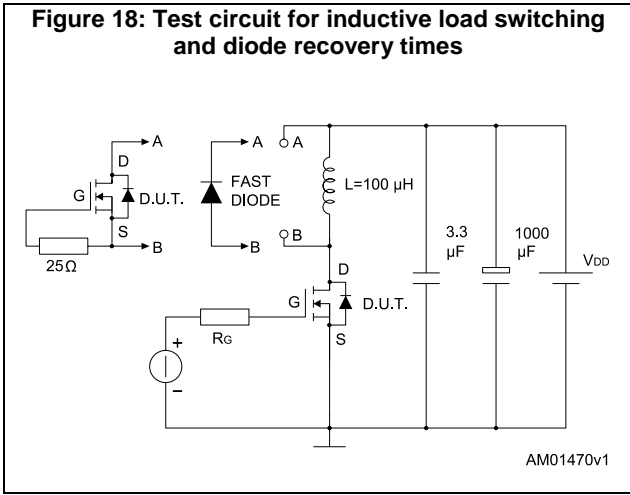
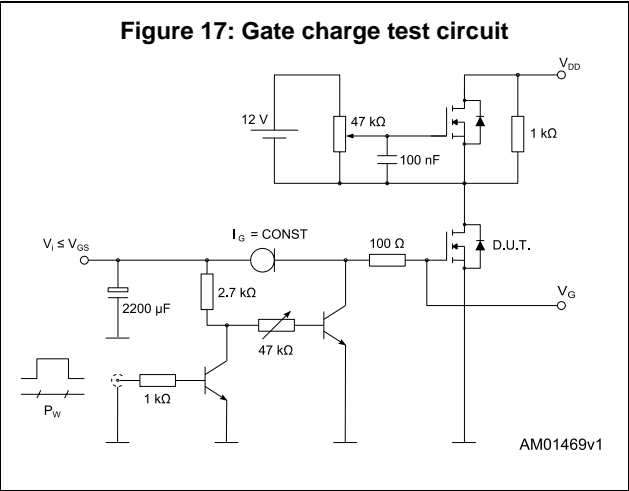
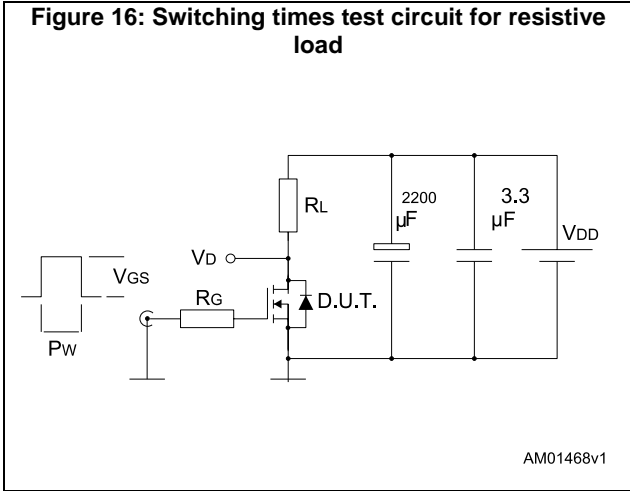


Figure 15: Maximum avalanche energy vs temperature (ID = 5.0 A)





### 3 Test circuits



## 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 22: TO-247 package outline

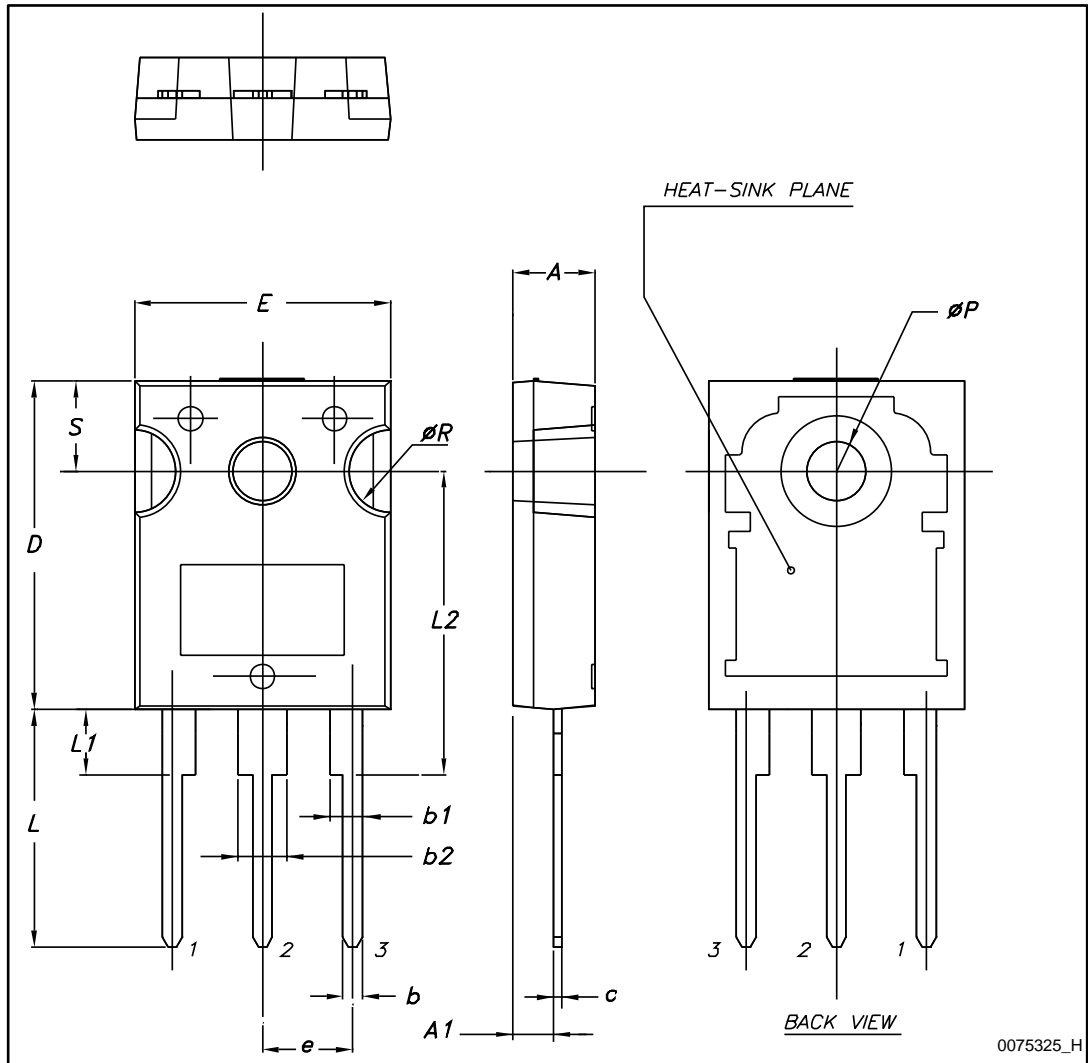


Table 9: TO-247 package mechanical data

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
06-Aug-2012	1	First release.
21-Jan-2014	2	Document status promoted from preliminary to production data. Added Figure 12: Maximum avalanche energy vs temperature.
13-Aug-2015	3	Text and formatting changes throughout document. On cover page: - updated <i>Title, Features and Description</i> Updated Section <i>Electrical characteristics</i> Updated Section <i>Electrical characteristics (curves)</i> Updated and renamed Section <i>Package information</i> (was Package mechanical data)

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