

## N-channel 950 V, 0.110 $\Omega$ typ., 38 A MDmesh™ K5 Power MOSFET in a TO-247 package

Datasheet - production data

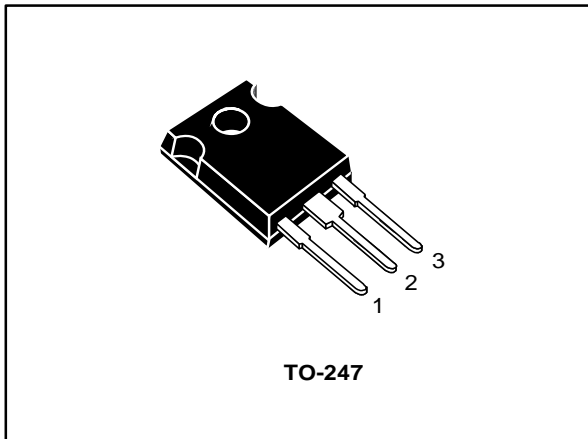
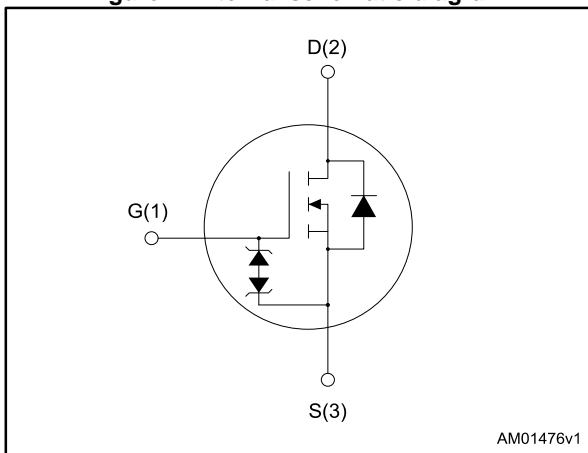


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>	P <sub>TOT</sub>
STW40N95K5	950 V	0.130 $\Omega$	38 A	450 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	Packaging
STW40N95K5	40N95K5	TO-247	Tube

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V <sub>GS</sub>	Gate- source voltage	± 30	V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	38	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	24	A
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	152	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	450	W
I <sub>AR</sub>	Max current during repetitive or single pulse avalanche	13	A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>J</sub> = 25 °C, I <sub>D</sub> = 13 A, V <sub>DD</sub> = 50 V)	700	mJ
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	4.5	V/ns
dv/dt <sup>(3)</sup>	MOSFET dv/dt ruggedness	50	V/ns
T <sub>j</sub> T <sub>stg</sub>	Operating junction temperature Storage temperature	-55 to 150	°C

**Notes:**

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

<sup>(2)</sup>I<sub>SD</sub> ≤ 19 A, di/dt ≤ 100 A/μs, V<sub>DS(peak)</sub> ≤ V<sub>(BR)DSS</sub>.

<sup>(3)</sup>V<sub>DS</sub> ≤ 760 V

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case max	0.28	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-amb max	50	°C/W

## 2 Electrical characteristics

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

**Table 4: On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0, I_{\text{D}} = 1\text{ mA}$	950			V
$I_{\text{DSS}}$	Zero gate voltage drain current	$V_{\text{GS}} = 0, V_{\text{DS}} = 950\text{ V}$			1	$\mu\text{A}$
		$V_{\text{GS}} = 0, V_{\text{DS}} = 950\text{ V}, T_{\text{C}} = 125\text{ °C}$			50	$\mu\text{A}$
$I_{\text{GSS}}$	Gate-body leakage current	$V_{\text{DS}} = 0, V_{\text{GS}} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{\text{GS(th)}}$	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	$V_{\text{GS}} = 10\text{ V}, I_{\text{D}} = 19\text{ A}$		0.110	0.130	$\Omega$

**Table 5: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{\text{ISS}}$	Input capacitance	$V_{\text{GS}} = 0, V_{\text{DS}} = 100\text{ V}, f = 1\text{ MHz}$	-	3300	-	pF
$C_{\text{OSS}}$	Output capacitance		-	250	-	pF
$C_{\text{RSS}}$	Reverse transfer capacitance		-	2	-	pF
$C_{\text{O(tr)}^{(1)}}$	Equivalent capacitance time related	$V_{\text{GS}} = 0, V_{\text{DS}} = 0\text{ to }760\text{ V}$	-	398	-	pF
$C_{\text{O(er)}^{(2)}}$	Equivalent capacitance energy related		-	142	-	pF
$R_{\text{G}}$	Intrinsic gate resistance	$f = 1\text{ MHz}, I_{\text{D}} = 0$	-	5	-	$\Omega$
$Q_{\text{g}}$	Total gate charge	$V_{\text{DD}} = 760\text{ V}, I_{\text{D}} = 38\text{ A}$	-	93	-	nC
$Q_{\text{gs}}$	Gate-source charge	$V_{\text{GS}} = 10\text{ V}$	-	18.7	-	nC
$Q_{\text{gd}}$	Gate-drain charge	(see <a href="#">Figure 16: "Gate charge test circuit"</a> )	-	63.4	-	nC

**Notes:**

<sup>(1)</sup>Time related 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%  $V_{\text{DSS}}$

<sup>(2)</sup>energy related is defined as a constant equivalent capacitance giving the same stored energy as  $C_{\text{OSS}}$  when  $V_{\text{DS}}$  increases from 0 to 80%  $V_{\text{DSS}}$

**Table 6: Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 475\text{ V}, I_{\text{D}} = 19\text{ A}, R_{\text{G}} = 4.7\text{ }\Omega, V_{\text{GS}} = 10\text{ V}$ (see <a href="#">Figure 15: "Switching times test circuit for resistive load"</a> )	-	33.5	-	ns
$t_{\text{r}}$	Rise time		-	51	-	ns
$t_{\text{d(off)}}$	Turn-off-delay time		-	91.5	-	ns
$t_{\text{f}}$	Fall time		-	10	-	ns

Table 7: 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)		-		152	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 38 \text{ A}$ , $V_{GS} = 0$	-		1.5	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 18: "Unclamped inductive load test circuit"</a> )	-	706		ns
$Q_{rr}$	Reverse recovery charge		-	22		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	62		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 18: "Unclamped inductive load test circuit"</a> )	-	886		ns
$Q_{rr}$	Reverse recovery charge		-	28.2		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	64		A

**Notes:**

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

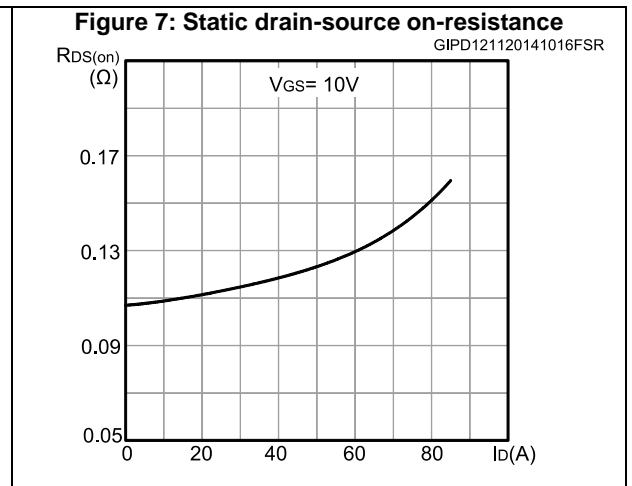
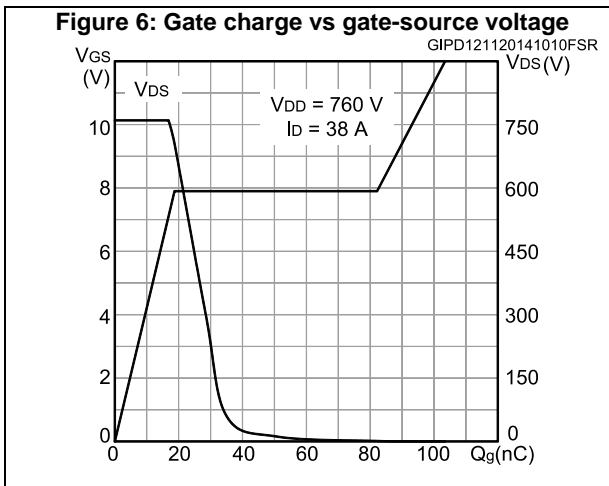
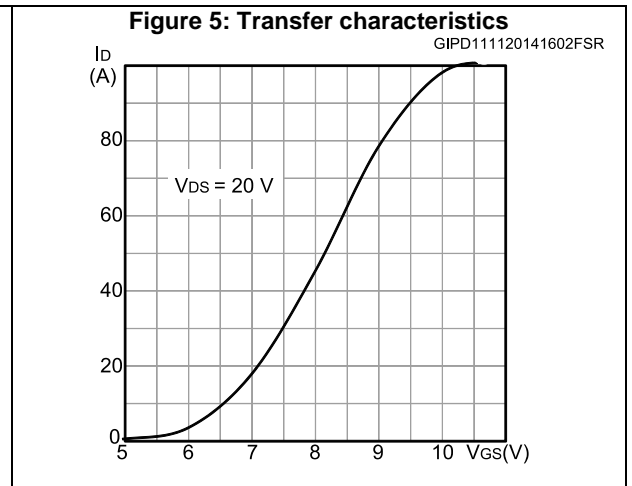
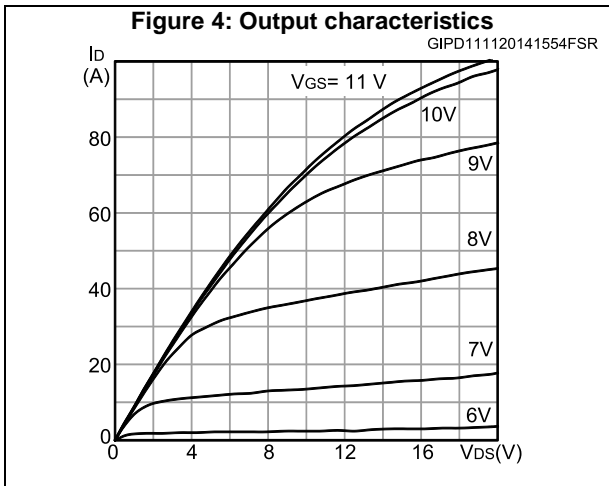
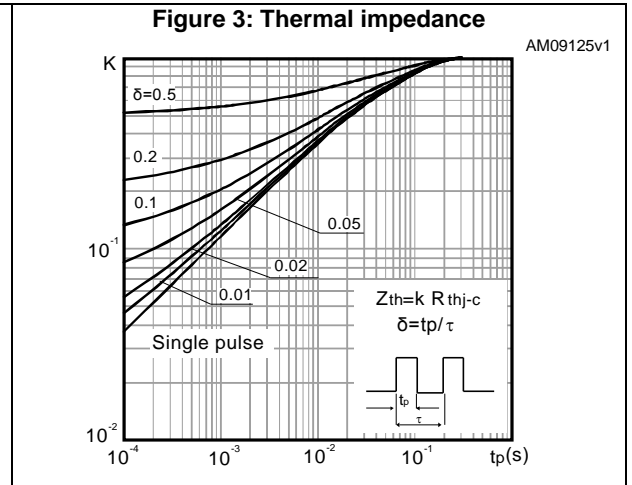
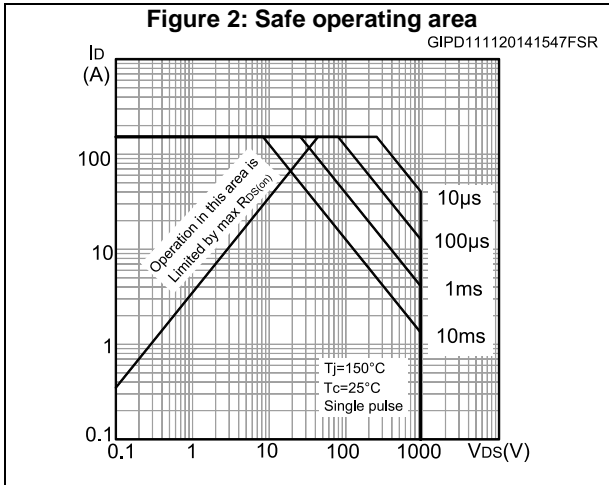
<sup>(2)</sup>Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

Table 8: Gate-source Zener diode

Symbol	Parameter	Test conditions	Min	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1 \text{ mA}$ , $I_D = 0$	30	-	-	V

The built-in back-to-back Zener diodes have specifically been designed to enhance the device's ESD capability. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

## 2.1 Electrical characteristics (curves)



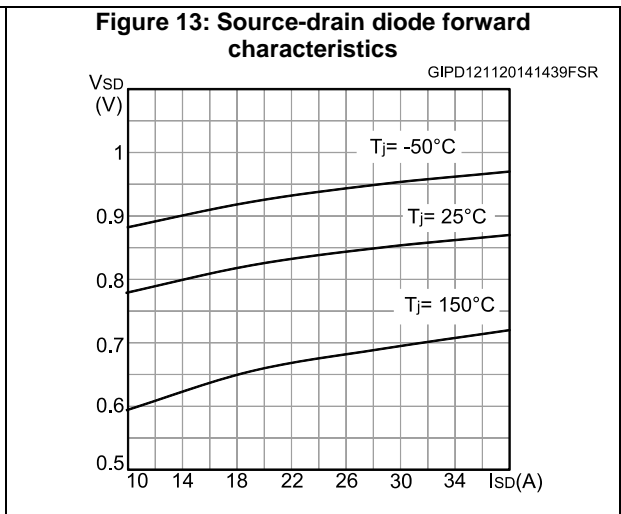
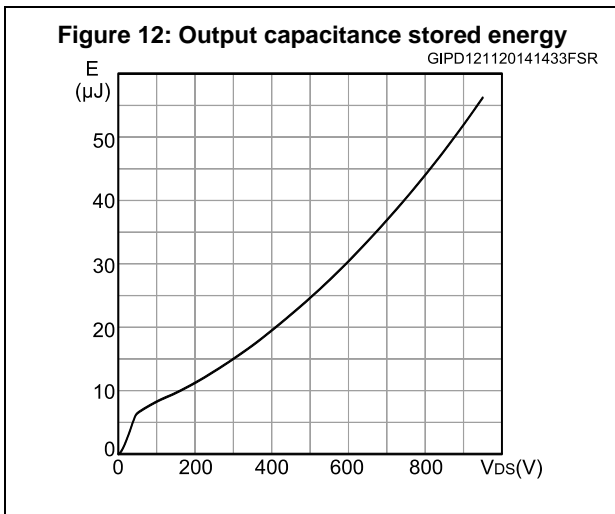
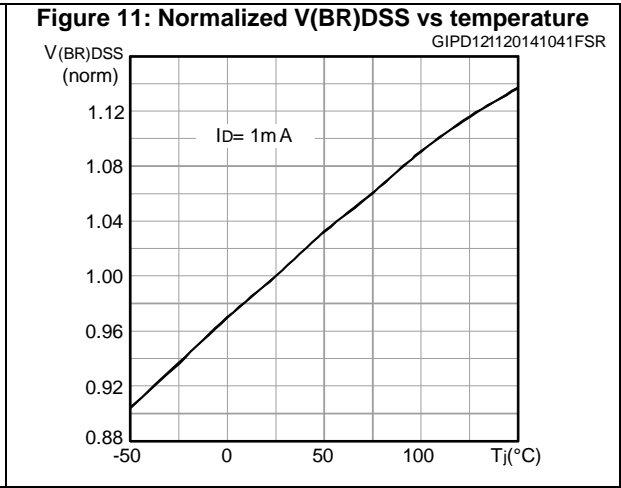
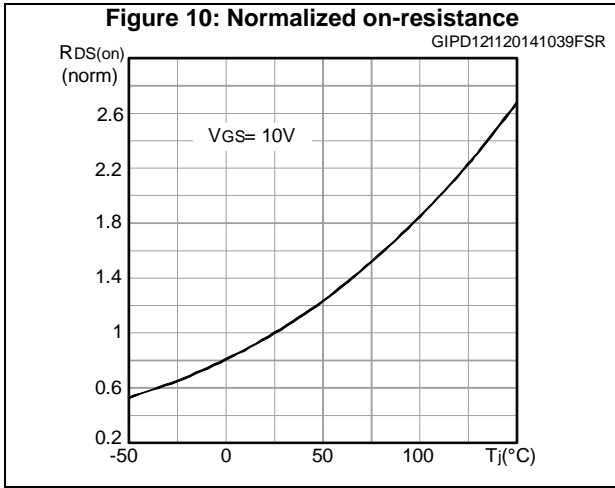
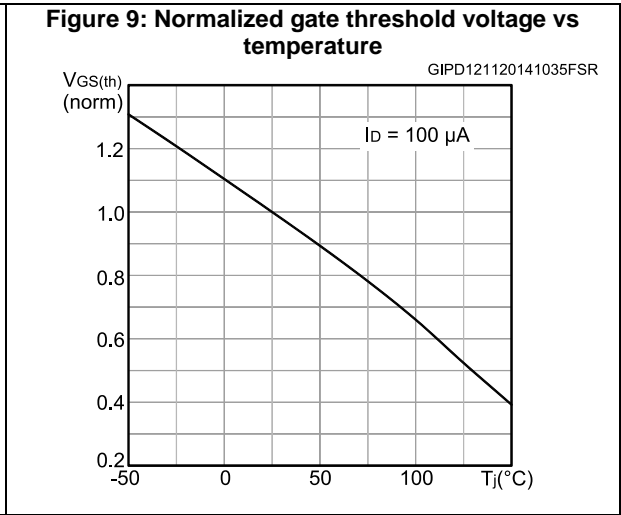
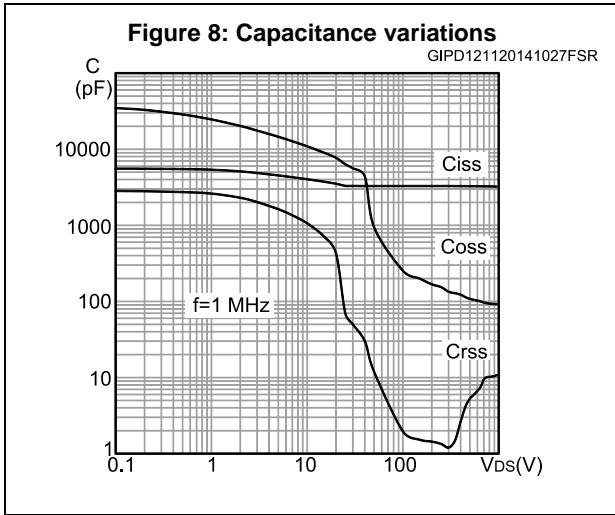
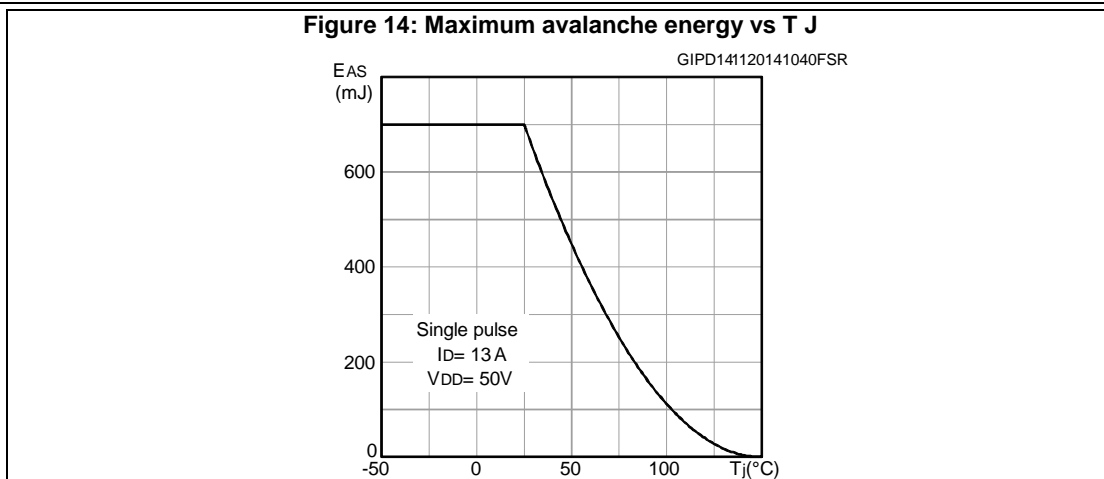


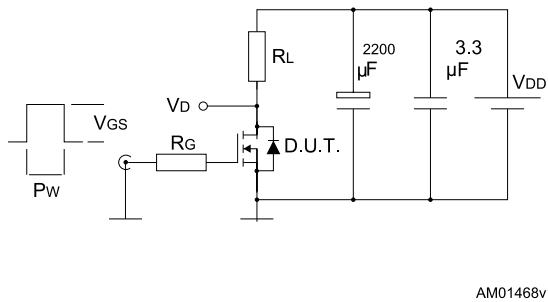
Figure 14: Maximum avalanche energy vs T J



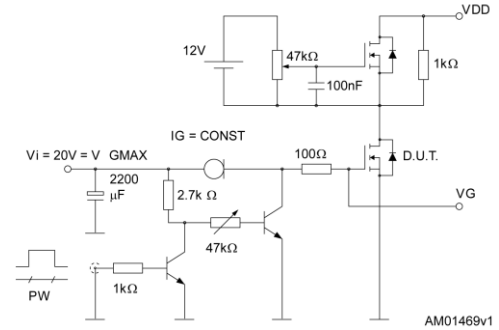


### 3 Test circuits

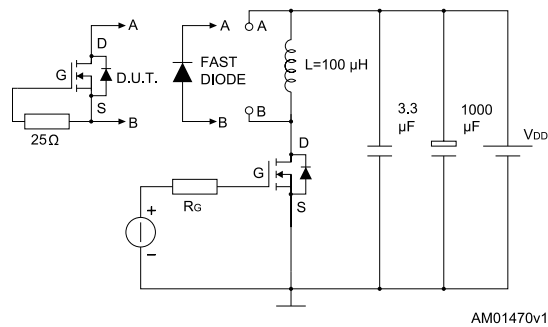
**Figure 15: Switching times test circuit for resistive load**



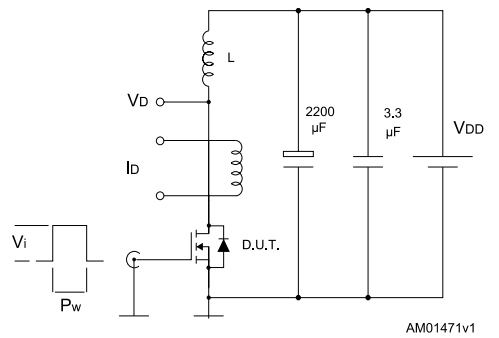
**Figure 16: Gate charge test circuit**



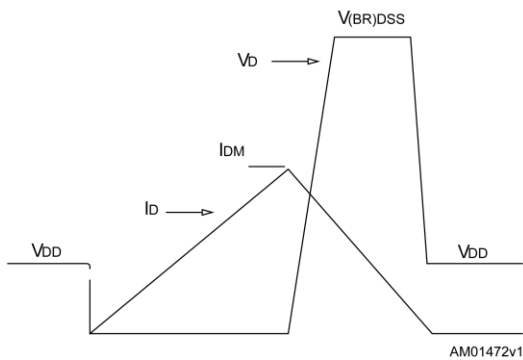
**Figure 17: Test circuit for inductive load switching and diode recovery times**



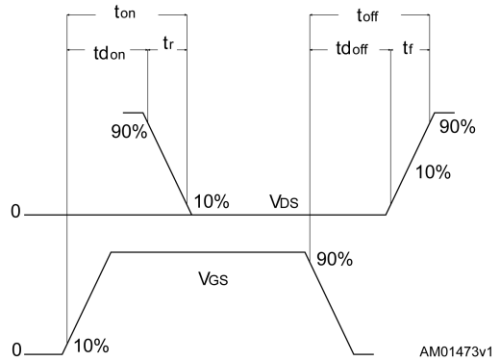
**Figure 18: Unclamped inductive load test circuit**



**Figure 19: Unclamped inductive waveform**



**Figure 20: Switching time waveform**



## 4 Package mechanical data

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 drawing

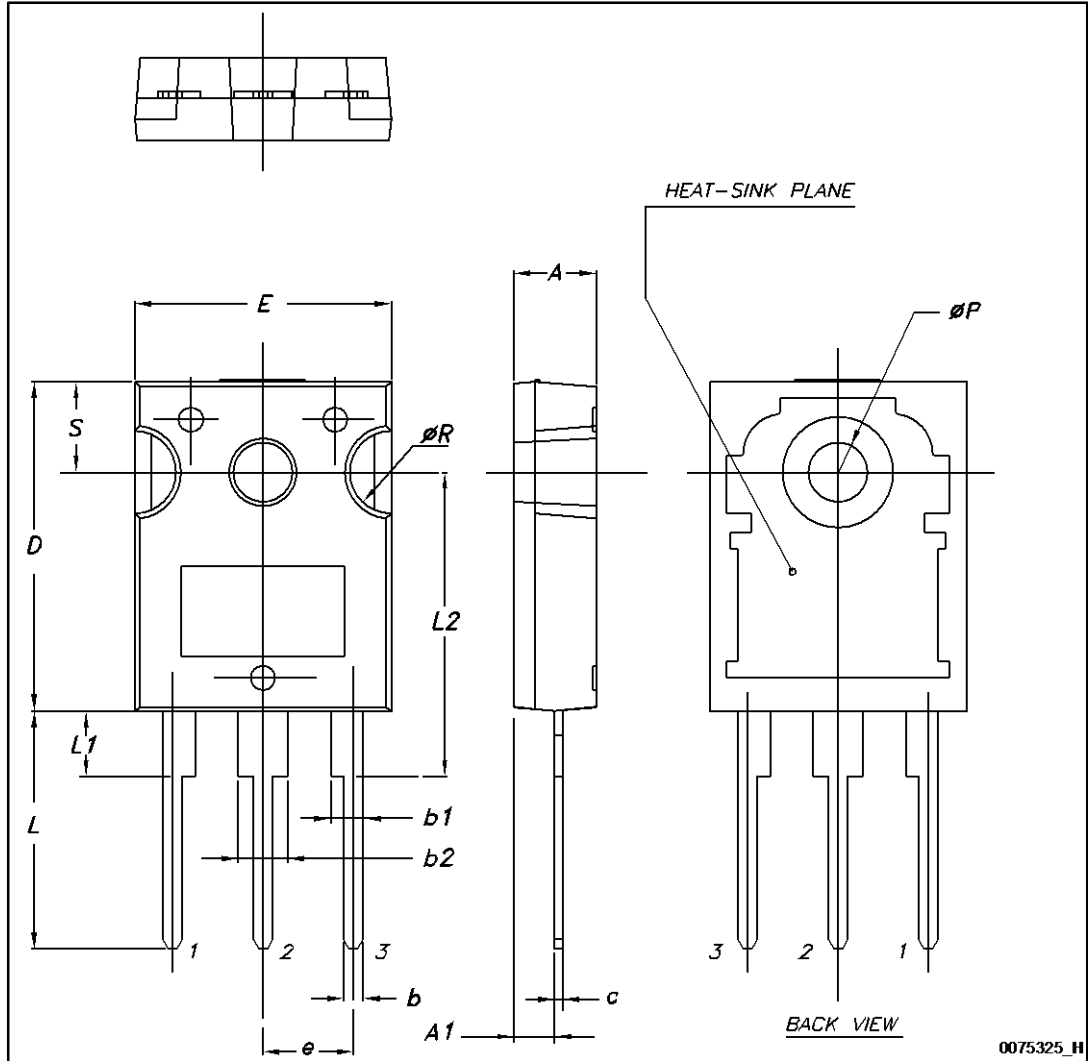


Table 9: TO-247 mechanical data

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
03-Jun-2014	1	First release.
14-Nov-2014	2	Document status promoted from preliminary to production data. Added <a href="#">Section 2.1: "Electrical characteristics (curves)"</a> .

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