

## N-channel 800 V, 0.07 $\Omega$ typ., 46 A MDmesh™ K5 Power MOSFET in a TO-247 package

Datasheet - production data

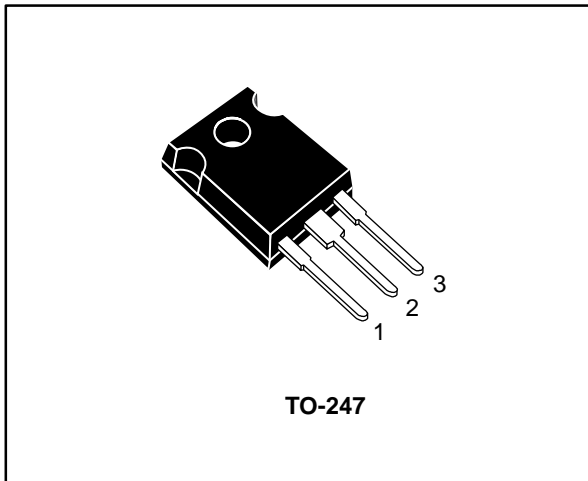
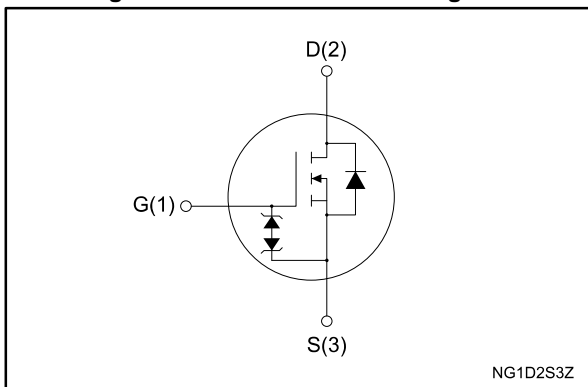


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STW65N80K5	800 V	0.08 $\Omega$	46 A	446 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
STW65N80K5	65N80K5	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 $T_{case} = 25\text{ }^\circ\text{C}$	46	A
	Drain current (continuous) at $T_{case} = 100\text{ }^\circ\text{C}$	30	
$I_{DM}^{(1)}$	Drain current (pulsed)	184	A
$P_{TOT}$	Total dissipation at $T_{case} = 25\text{ }^\circ\text{C}$	446	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50	
$T_{stg}$	Storage temperature	-55 to 150	$^\circ\text{C}$
$T_j$	Operating junction temperature		

**Notes:**

- (1) Pulse width is limited by safe operating area.  
 (2)  $I_{SD} \leq 46\text{ A}$ ,  $di/dt = 100\text{ A}/\mu\text{s}$ ;  $V_{DS\text{ peak}} < V_{(BR)DSS}$ ,  $V_{DD} = 80\% V_{(BR)DSS}$ .  
 (3)  $V_{DS} \leq 640\text{ V}$

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case	0.28	$^\circ\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient	50	

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
$I_{AR}^{(1)}$	Avalanche current, repetitive or not repetitive	16	A
$E_{AS}^{(2)}$	Single pulse avalanche energy	700	mJ

**Notes:**

- (1) Pulse width limited by  $T_{jmax}$ .  
 (2) 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	$V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = 1\text{ mA}$	800			V
$I_{\text{DSS}}$	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 800\text{ V}$			1	$\mu\text{A}$
		$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 800\text{ V}$ , $T_{\text{case}} = 125\text{ °C}$			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	$V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 23\text{ A}$		0.07	0.08	$\Omega$

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{\text{iss}}$	Input capacitance	$V_{\text{DS}} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{\text{GS}} = 0\text{ V}$	-	3230	-	$\mu\text{F}$
$C_{\text{oss}}$	Output capacitance		-	310	-	
$C_{\text{rss}}$	Reverse transfer capacitance		-	3	-	
$C_{\text{oss(eq)}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }640\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$	-	734	-	$\mu\text{F}$
$R_{\text{G}}$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_{\text{D}} = 0\text{ A}$	-	1.9	-	$\Omega$
$Q_{\text{g}}$	Total gate charge	$V_{\text{DD}} = 640\text{ V}$ , $I_{\text{D}} = 46\text{ A}$ , $V_{\text{GS}} = 10\text{ V}$ (see <a href="#">Figure 14</a> : "Test circuit for gate charge behavior")	-	92	-	nC
$Q_{\text{gs}}$	Gate-source charge		-	18	-	
$Q_{\text{gd}}$	Gate-drain charge		-	65	-	

**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	$V_{\text{DD}} = 400\text{ V}$ , $I_{\text{D}} = 23\text{ A}$ $R_{\text{G}} = 4.7\text{ }\Omega$ , $V_{\text{GS}} = 10\text{ V}$ (see <a href="#">Figure 13</a> : "Test circuit for resistive load switching times" and <a href="#">Figure 18</a> : "Switching time waveform")	-	34	-	ns
$t_{\text{r}}$	Rise time		-	30	-	
$t_{\text{d(off)}}$	Turn-off delay time		-	90	-	
$t_{\text{f}}$	Fall time		-	10	-	

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		46	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		184	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$ , $I_{SD} = 46\text{ A}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 46\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ (see <a href="#">Figure 15</a> : "Test circuit for inductive load switching and diode recovery times")	-	650		ns
$Q_{rr}$	Reverse recovery charge		-	20		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	60		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 46\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 15</a> : "Test circuit for inductive load switching and diode recovery times")	-	845		ns
$Q_{rr}$	Reverse recovery charge		-	28		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	66		A

**Notes:**

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

Table 9: Gate-source Zener diode

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

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

## 2.1 Electrical characteristics (curves)

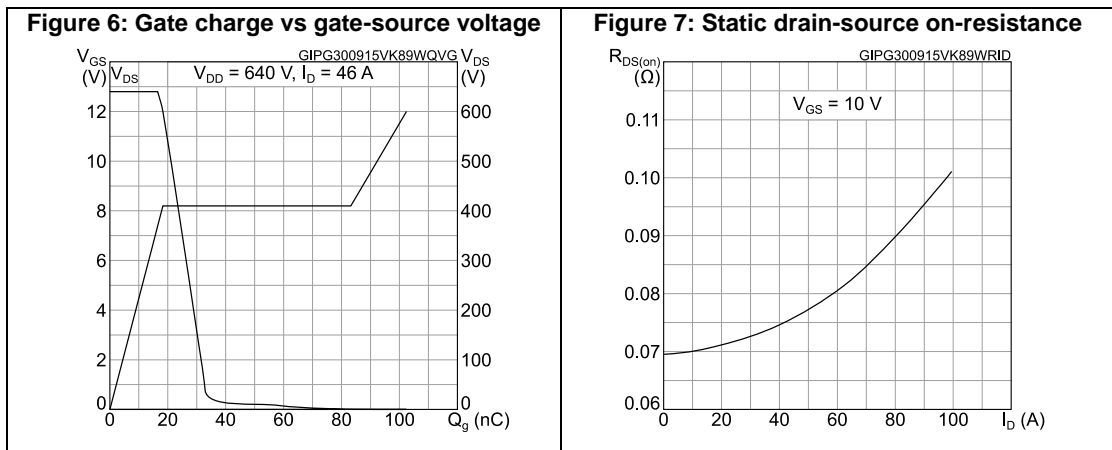
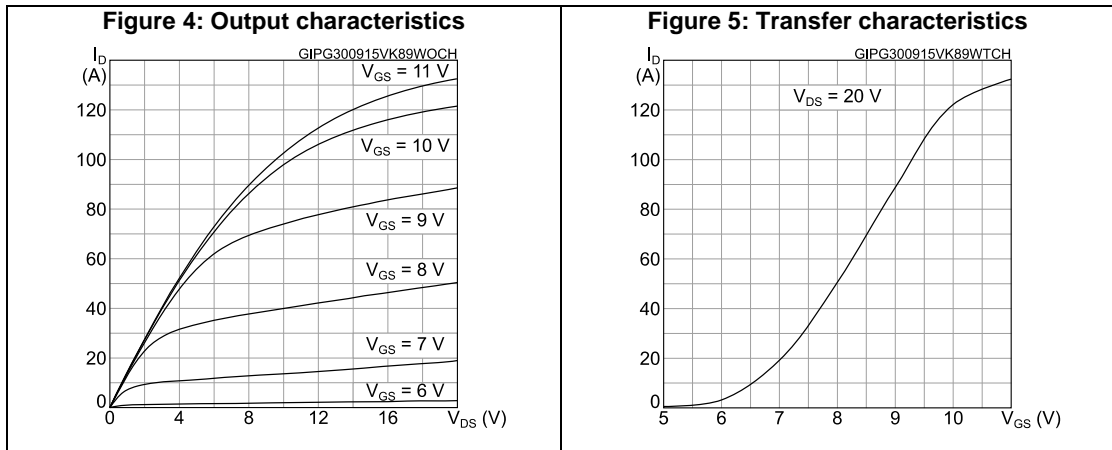
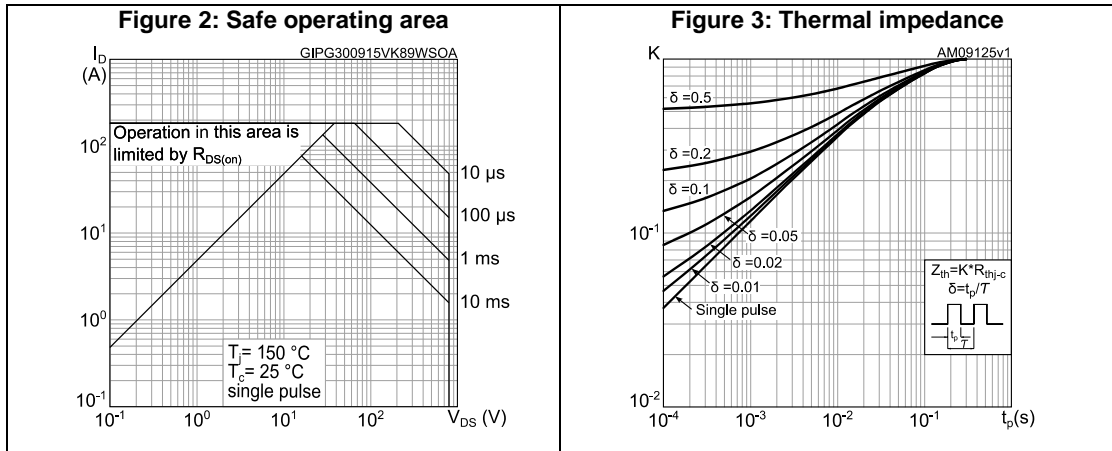


Figure 8: Capacitance variations

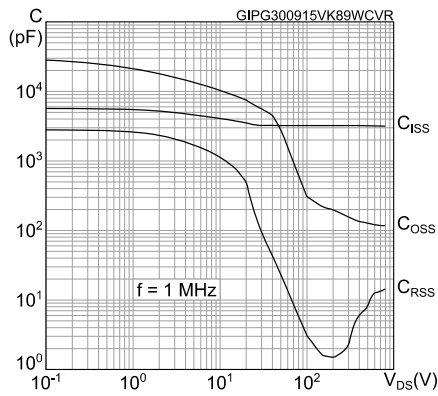


Figure 9: Normalized gate threshold voltage vs temperature

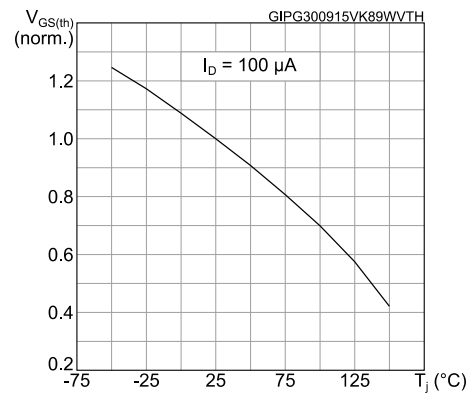


Figure 10: Normalized on-resistance vs temperature

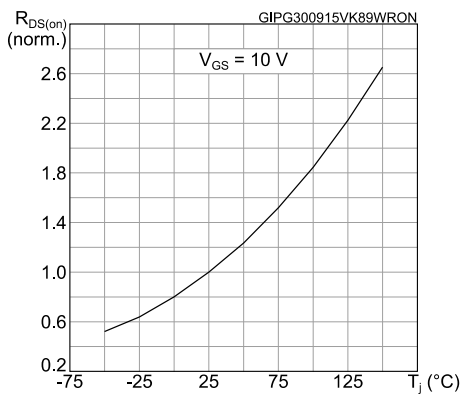


Figure 11: Normalized V(BR)DSS vs temperature

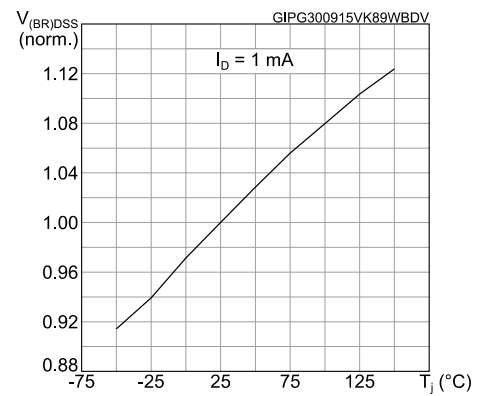
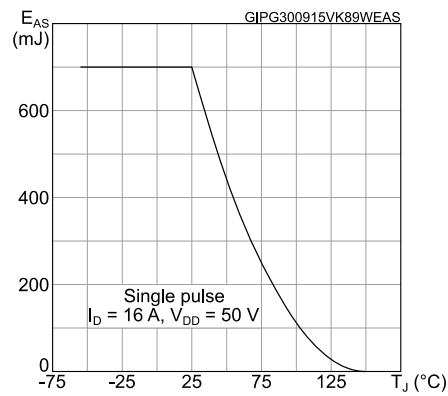
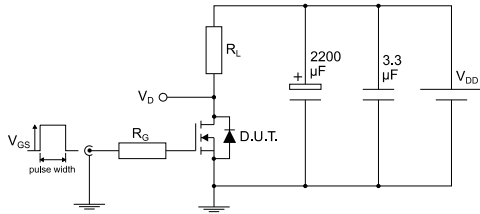


Figure 12: Maximum avalanche energy vs temperature



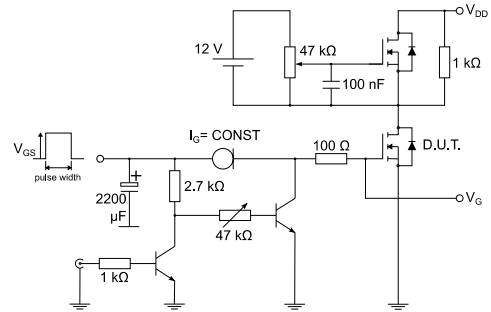
### 3 Test circuits

**Figure 13: Test circuit for resistive load switching times**



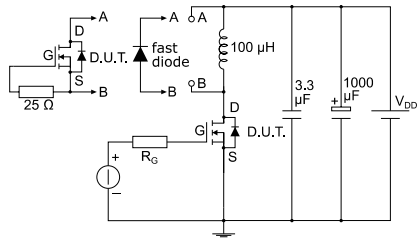
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**Figure 14: Test circuit for gate charge behavior**



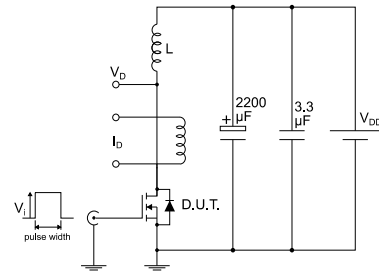
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**Figure 15: Test circuit for inductive load switching and diode recovery times**



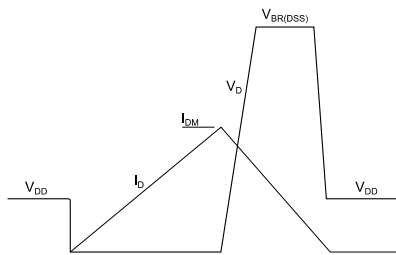
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**Figure 16: Unclamped inductive load test circuit**



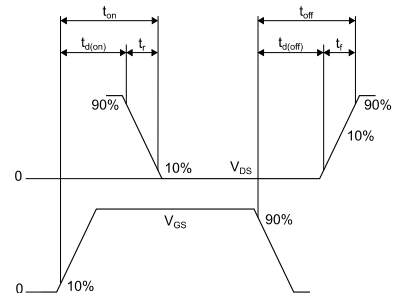
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**Figure 17: Unclamped inductive waveform**



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**Figure 18: Switching time waveform**



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## 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 19: TO-247 package outline

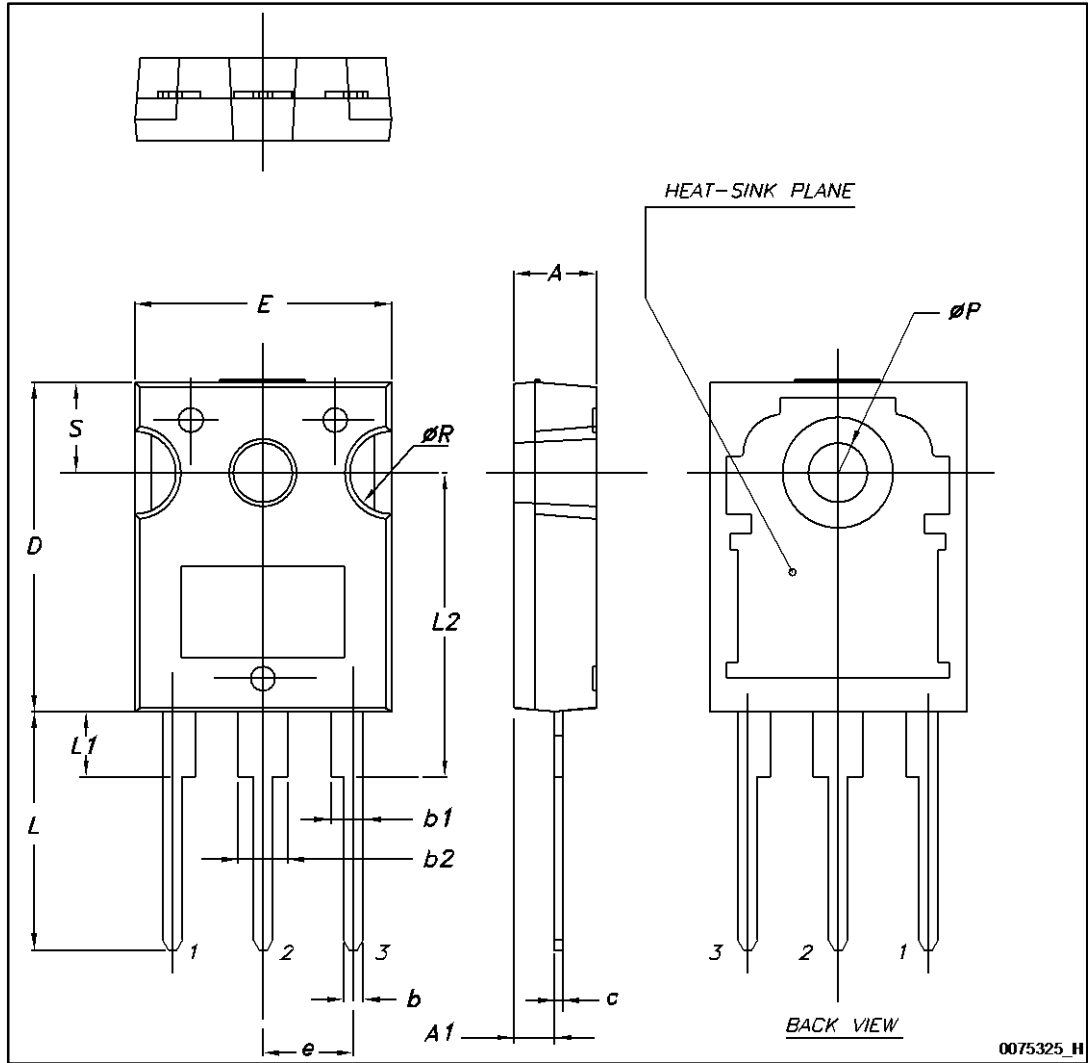


Table 10: TO-247 package mechanical data

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 11: Document revision history

Date	Revision	Changes
21-May-2015	1	First release.
02-Oct-2015	2	Text and formatting changes throughout document. Datasheet status promoted from preliminary to production data. On cover page: - updated title description and Features table. Updated sections - Electrical ratings and Electrical characteristics. Added section - Electrical characteristics (curves).

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