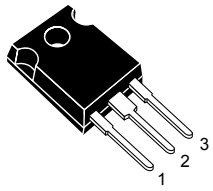
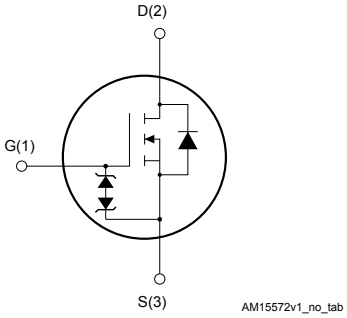
N-channel 850 V, 235 mΩ typ., 19 A MDmesh K5 Power MOSFET in a TO-247 package



TO-247



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STW23N85K5	850 V	275 mΩ	19 A

- Ultra-low gate charge
- Very low FoM (figure of merit)
- Zener-protected
- 100% avalanche tested

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.

Product status link
STW23N85K5

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

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±30	V
I_D	Drain current (continuous) at T_C = 25 °C	19	A
	Drain current (continuous) at T_C = 100 °C	12.4	
I_{DM} (1)	Drain current (pulsed)	250	A
P_{TOT}	Total power dissipation at T_C = 25 °C	250	W
dv/dt (2)	Peak diode recovery voltage slope	6	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		

1. *Pulse width is limited by safe operating area.*
2. *I_{SD} ≤ 19 A, di/dt = 100 A/µs, $V_{DS(peak)}$ < $V_{(BR)DSS}$, V_{DD} = 680 V.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.5	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	50	

Table 3. 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

1. *Pulse width limited by T_J max.*
2. *Starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V.*

2 Electrical characteristics

T_C = 25 °C unless otherwise specified.

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	850			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 850 V			1	µA
		V_{GS} = 0 V, V_{DS} = 850 V, T_C = 125 °C (1)			50	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 9.5 A		235	275	mΩ

1. *Specified by design, not tested in production.*

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	1650	-	pF
C_{oss}	Output capacitance		-	115	-	
C_{rss}	Reverse transfer capacitance		-	2	-	
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 680 V, V_{GS} = 0 V	-	185	-	pF
R_g	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	3.5	-	Ω
Q_g	Total gate charge	V_{DD} = 520 V, I_D = 60 A, V_{GS} = 10 V (see Figure 15. Test circuit for gate charge behavior)	-	38	-	nC
Q_{gs}	Gate-source charge		-	11	-	
Q_{gd}	Gate-drain charge		-	20	-	

1. *$C_{oss\ eq.}$ is defined as a constant equivalent capacitance giving the same charging time as C_{OSS} when V_{DS} increases from 0 to 80% V_{DSS}.*

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 400 V, I_D = 9.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	22	-	ns
t_r	Rise time		-	14	-	
$t_{d(off)}$	Turn-off delay time		-	55	-	
t_f	Fall time		-	8	-	

Table 7. 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 V, I_{SD} = 19 A	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 19 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	510		ns
Q_{rr}	Reverse recovery charge		-	11		µC
I_{RRM}	Reverse recovery current		-	43		A
t_{rr}	Reverse recovery time	I_{SD} = 19 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_J = 150 °C (see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	684		ns
Q_{rr}	Reverse recovery charge		-	14		µC
I_{RRM}	Reverse recovery current		-	41		A

1. *Pulse width is limited by safe operating area.*
2. *Pulse test: pulse duration = 300 µs, duty cycle 1.5%.*

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

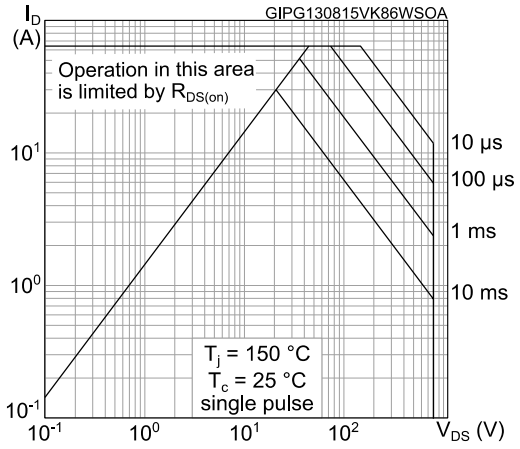


Figure 2. Normalized transient thermal impedance

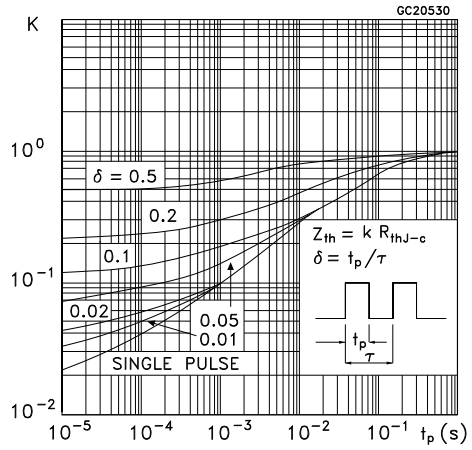


Figure 3. Typical output characteristics

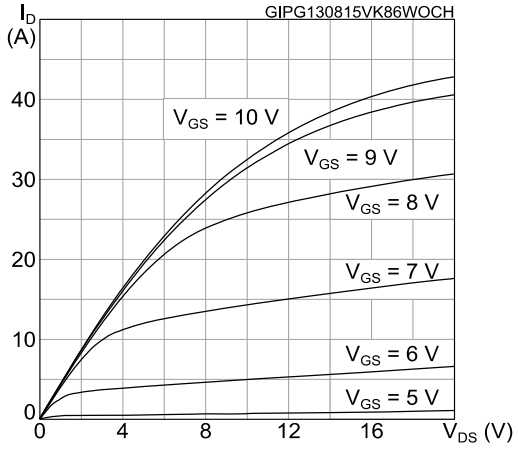


Figure 4. Typical transfer characteristics

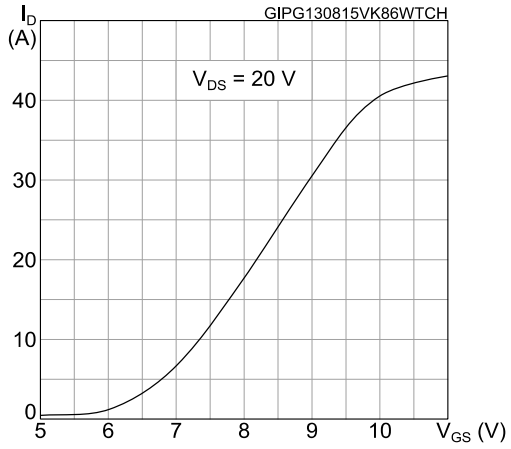


Figure 5. Typical gate charge characteristics

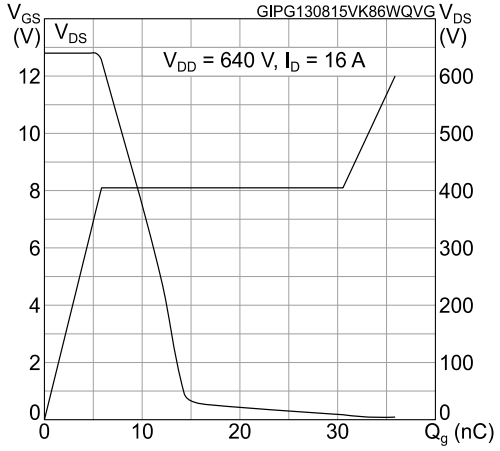


Figure 6. Typical drain-source on-resistance

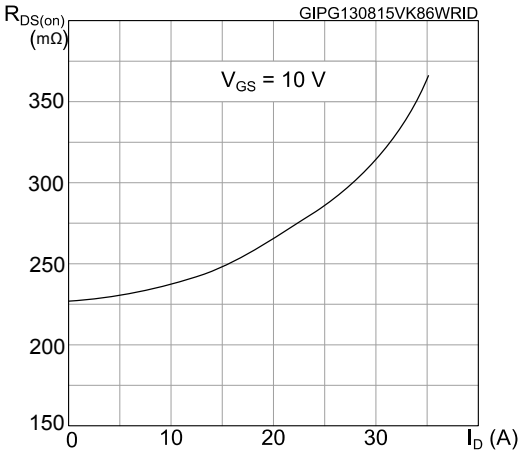


Figure 7. Typical capacitance characteristics

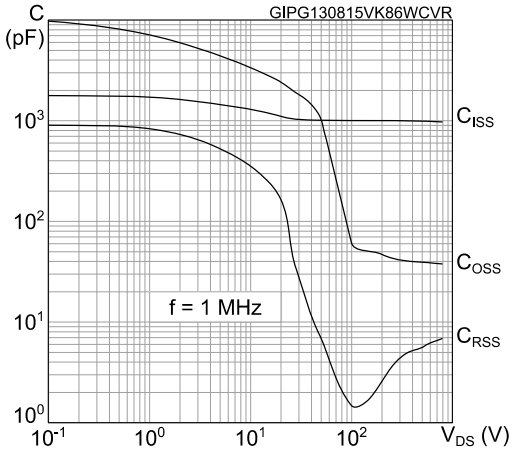


Figure 8. Normalized gate threshold vs temperature

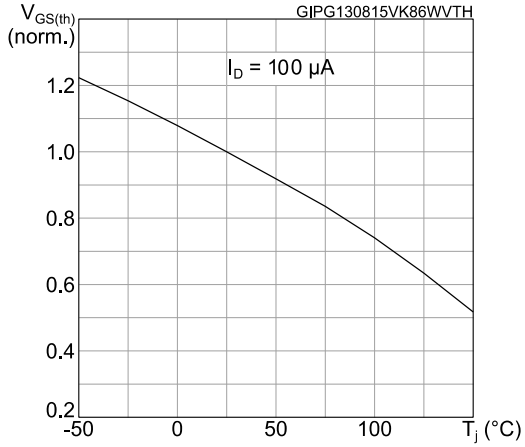


Figure 9. Normalized on-resistance vs temperature

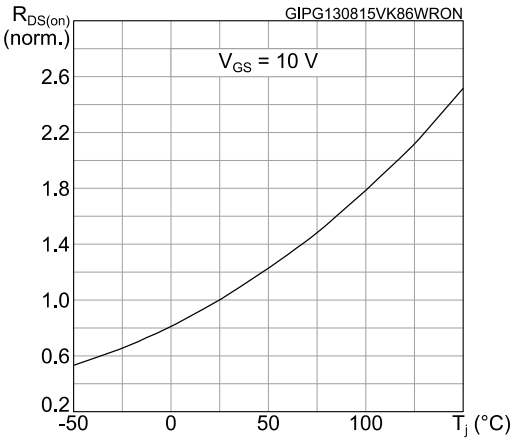


Figure 10. Normalized breakdown voltage vs temperature

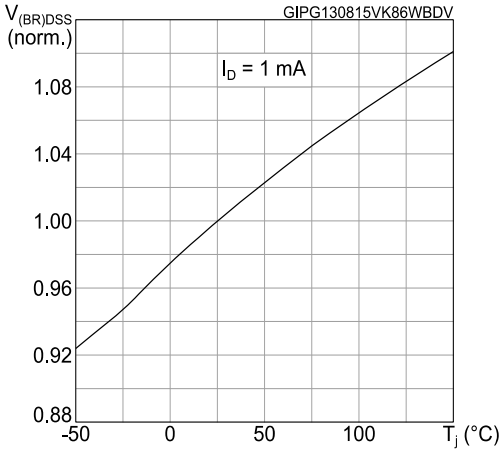


Figure 11. Typical output capacitance stored energy

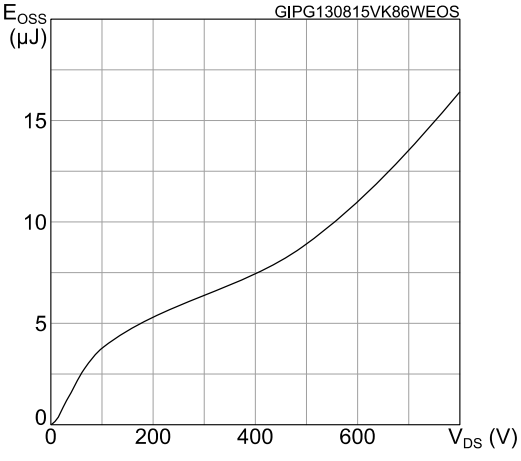


Figure 12. Typical reverse diode forward characteristics

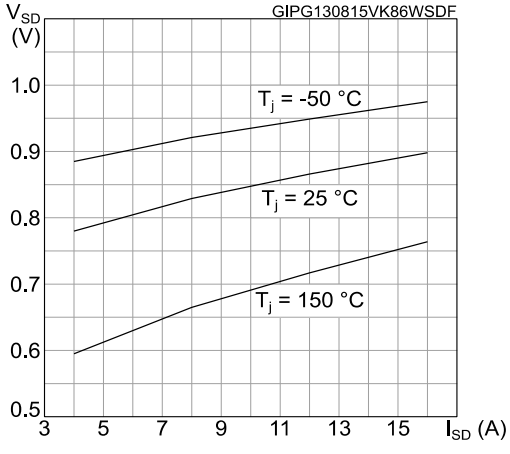
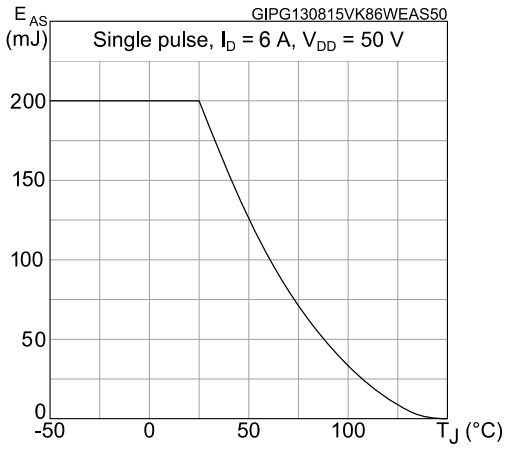
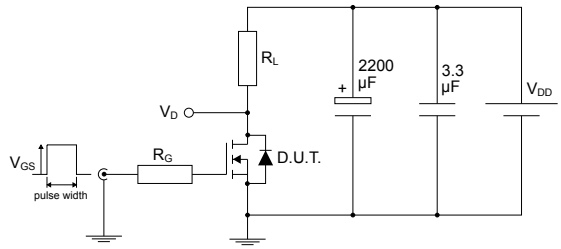


Figure 13. **Maximum avalanche energy vs temperature**



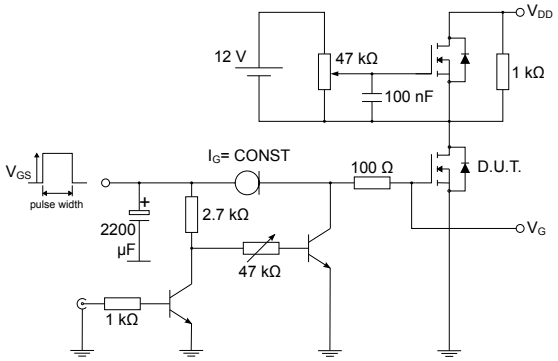
3 Test circuits

Figure 14. Test circuit for resistive load switching times



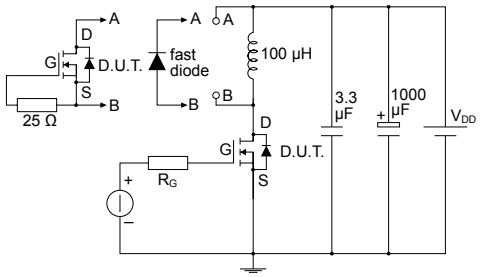
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Figure 15. Test circuit for gate charge behavior



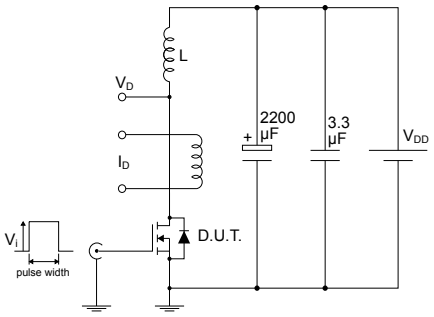
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Figure 16. Test circuit for inductive load switching and diode recovery times



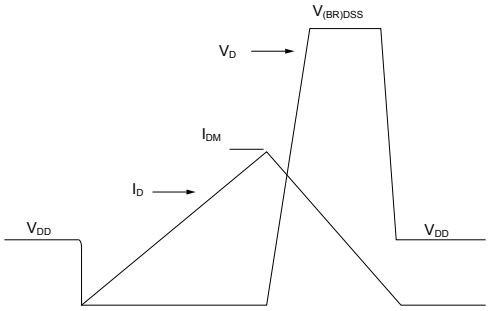
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Figure 17. Unclamped inductive load test circuit



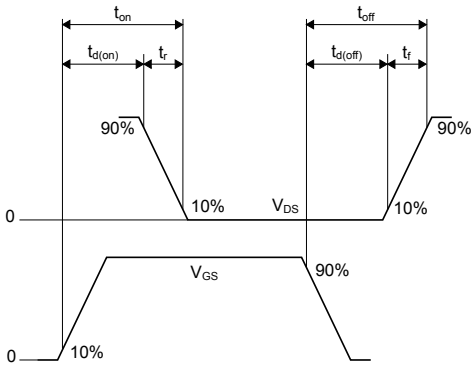
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Figure 18. Unclamped inductive waveform



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Figure 19. Switching time waveform



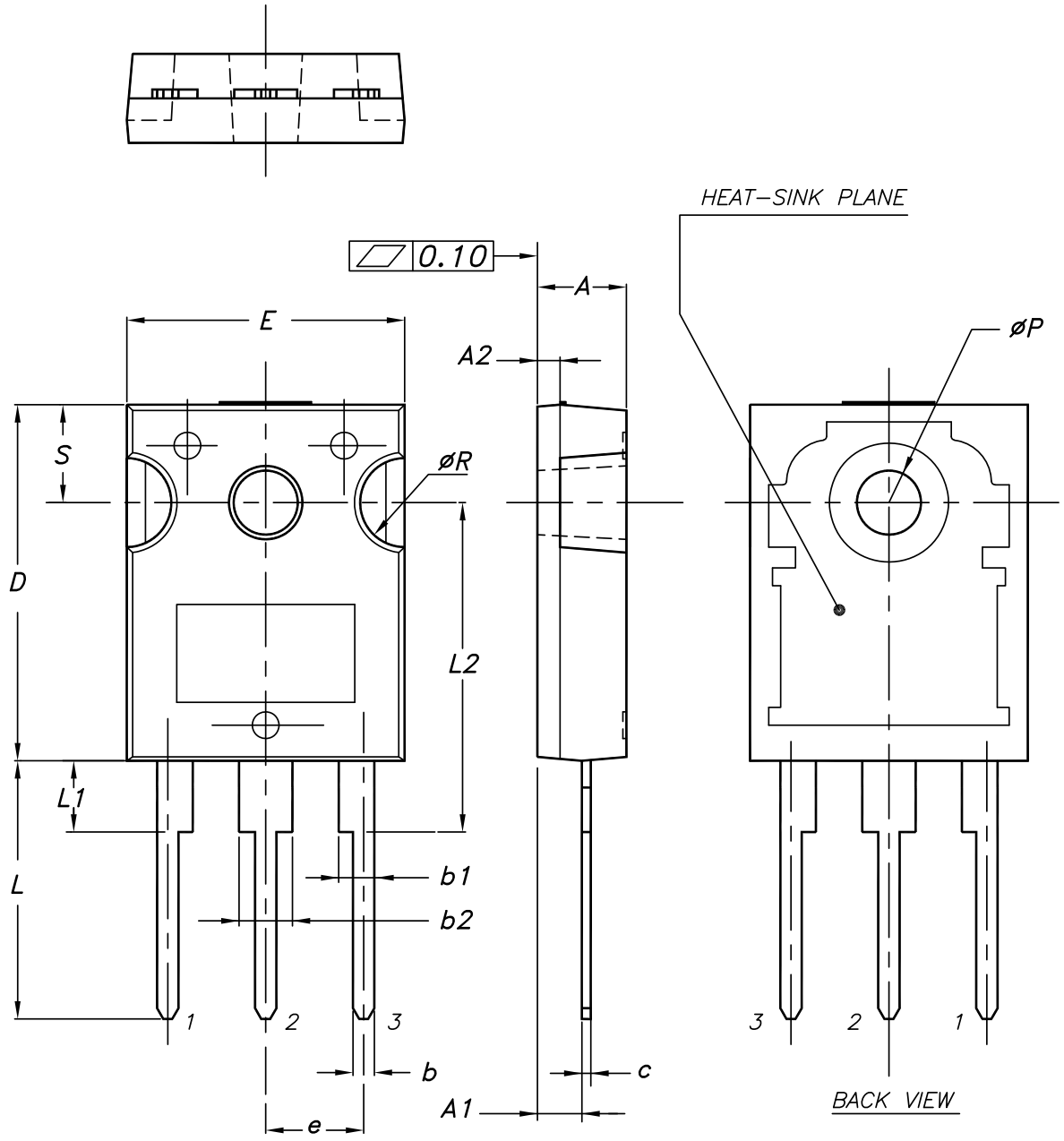
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4 Package information

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. ECOPACK is an ST trademark.

4.1 TO-247 package information

Figure 20. **TO-247 package outline**



0075325_11

Table 8. **TO-247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
A2		1.27	
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

Revision history

Table 9. **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 *Title*, *Features* and *Description* Updated Section *Electrical characteristics* Updated Section *Electrical characteristics (curves)* Updated and renamed Section *Package information* (was Package mechanical data)
03-Dec-2025	4	Updated Section 4: Package information. Minor text changes.

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