

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

Datasheet - production data

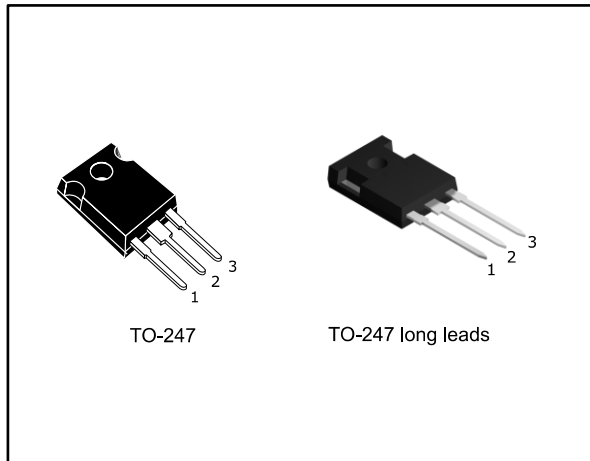
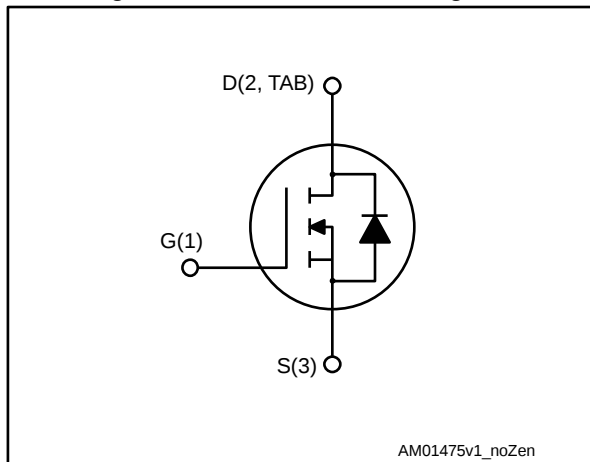


Figure 1: Internal schematic diagram



Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STW20N95DK5	950 V	0.330 Ω	18 A
STWA20N95DK5			

- Fast-recovery body diode
- Best R_{DS(on)} 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_{rr}) and recovery time (t_{rr}) with an excellent improvement in R_{DS(on)} * 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	± 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_{CASE} = 25 °C unless otherwise specified)

Table 5: On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V _{(BR)DSS}	Drain-source breakdown voltage	I _D = 1 mA, V _{GS} = 0 V	950			V
I _{DSS}	Zero gate voltage drain current	V _{GS} = 0 V, V _{DS} = 950 V			10	μA
		V _{GS} = 0 V, V _{DS} = 950 V, T _C = 125 °C ⁽¹⁾			100	μA
I _{GSS}	Gate source leakage current	V _{DS} = 0 V, V _{GS} = ± 20 V			±2	μA
V _{GS(th)}	Gate threshold voltage	V _{DD} = 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 A		0.275	0.330	Ω

Notes:

⁽¹⁾Defined by design, not subject to production test

Table 6: Dynamic

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

Notes:

⁽¹⁾C_{o(tr)} is defined as the constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}.

⁽²⁾C_{o(er)} is defined as the constant equivalent capacitance giving the same stored energy as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}.

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 Figure 15: "Test circuit for resistive load switching times" and Figure 20: "Switching time waveform")	-	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 Figure 17: "Test circuit for inductive load switching and diode recovery times")	-	150		ns
Q_{rr}	Reverse recovery charge		-	1		μC
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 Figure 17: "Test circuit for inductive load switching and diode recovery times")	-	264		ns
Q_{rr}	Reverse recovery charge		-	2.9		μC
I_{RRM}	Reverse recovery current		-	22		A

Notes:

(1) Pulse width limited by safe operating area

(2) Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

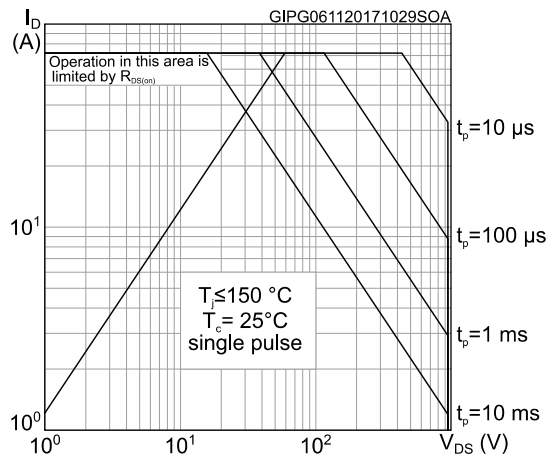


Figure 3: Thermal impedance

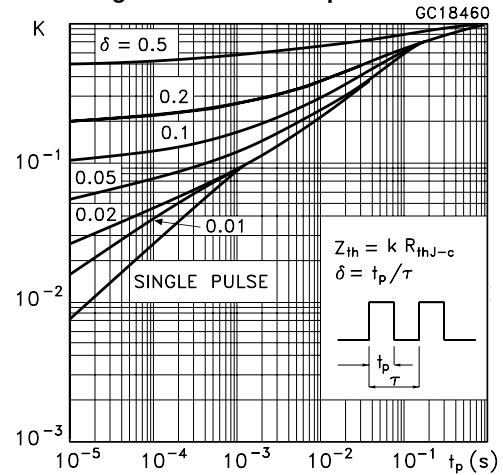


Figure 4: Output characteristics

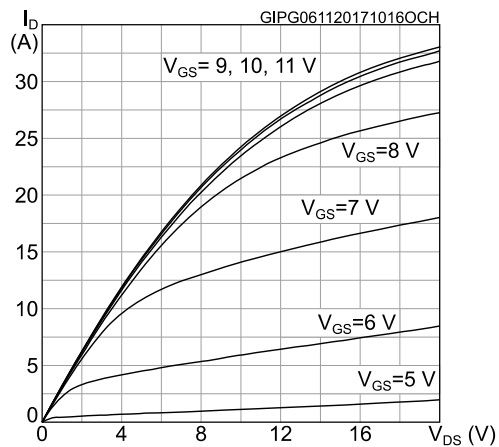


Figure 5: Transfer characteristics

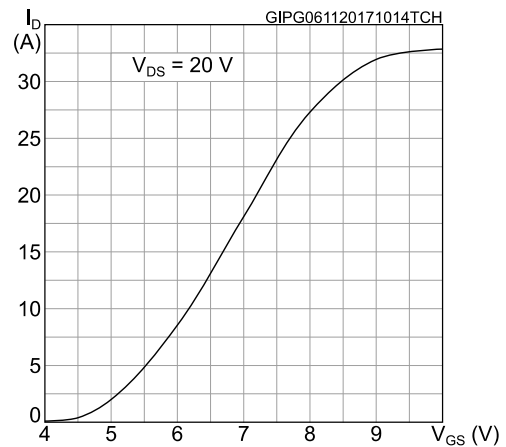


Figure 6: Gate charge vs gate-source voltage

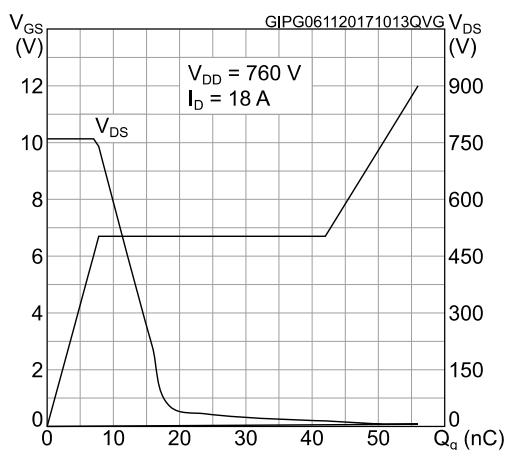


Figure 7: Static drain-source on-resistance

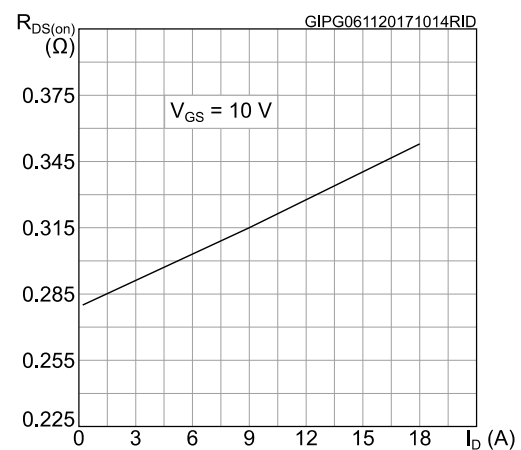


Figure 8: Capacitance variations

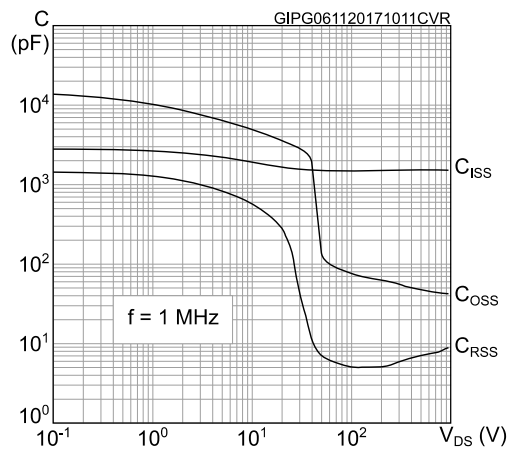


Figure 9: Output capacitance stored energy

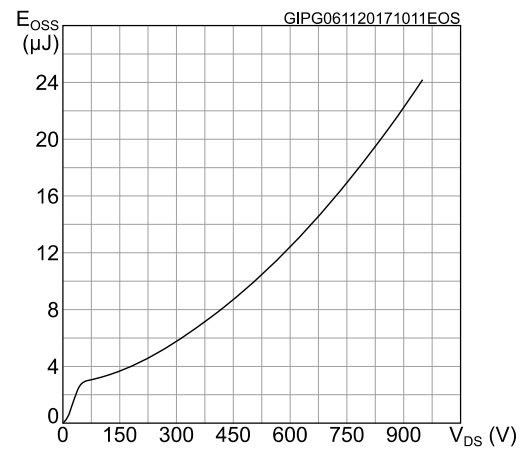


Figure 10: Normalized gate threshold voltage vs temperature

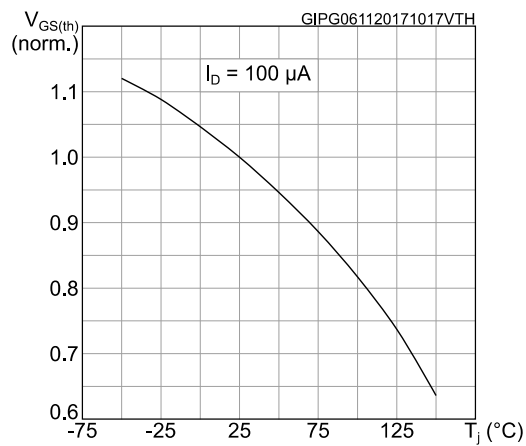


Figure 11: Normalized on-resistance vs temperature

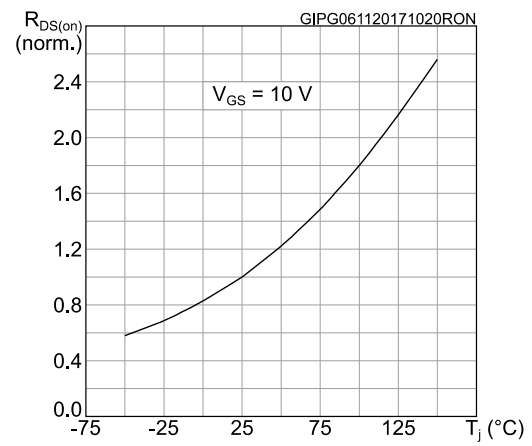
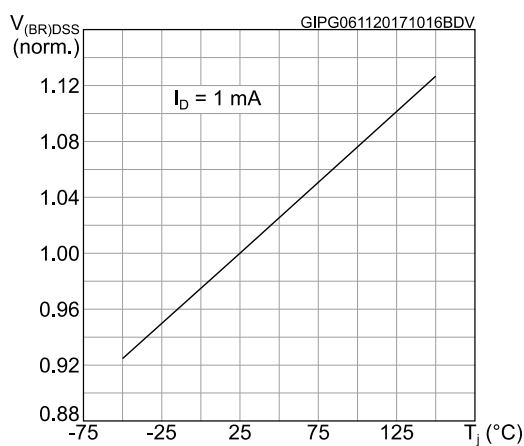
Figure 12: Normalized $V_{(BR)DSS}$ vs temperature

Figure 13: Source-drain diode forward characteristics

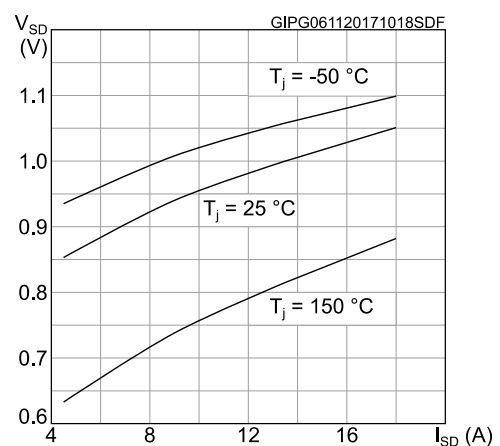
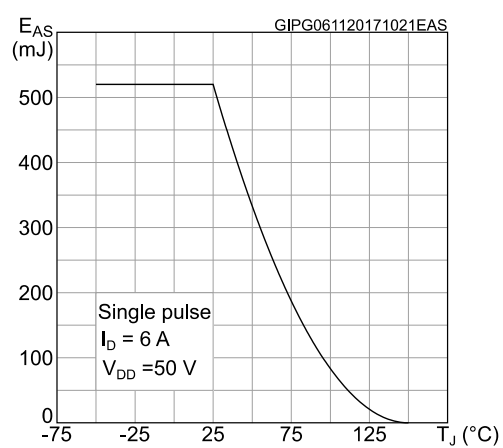
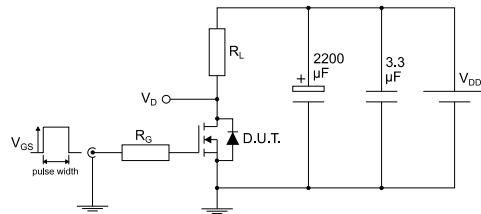


Figure 14: Maximum avalanche energy vs starting T_J 

3 Test circuits

Figure 15: Test circuit for resistive load switching times



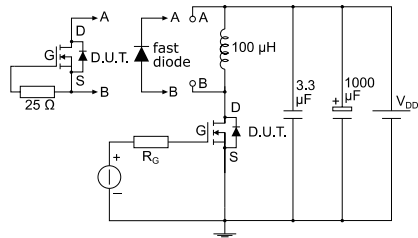
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Figure 16: Test circuit for gate charge behavior



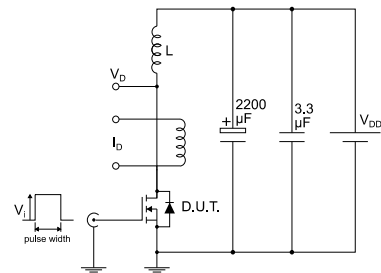
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Figure 17: Test circuit for inductive load switching and diode recovery times



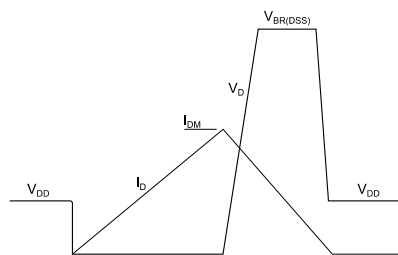
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Figure 18: Unclamped inductive load test circuit



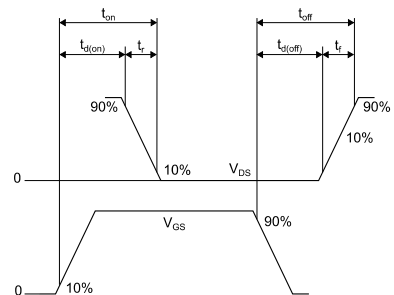
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Figure 19: Unclamped inductive waveform



AM01472v1

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. ECOPACK® is an ST trademark.

4.1 TO-247 package information

Figure 21: TO-247 package outline

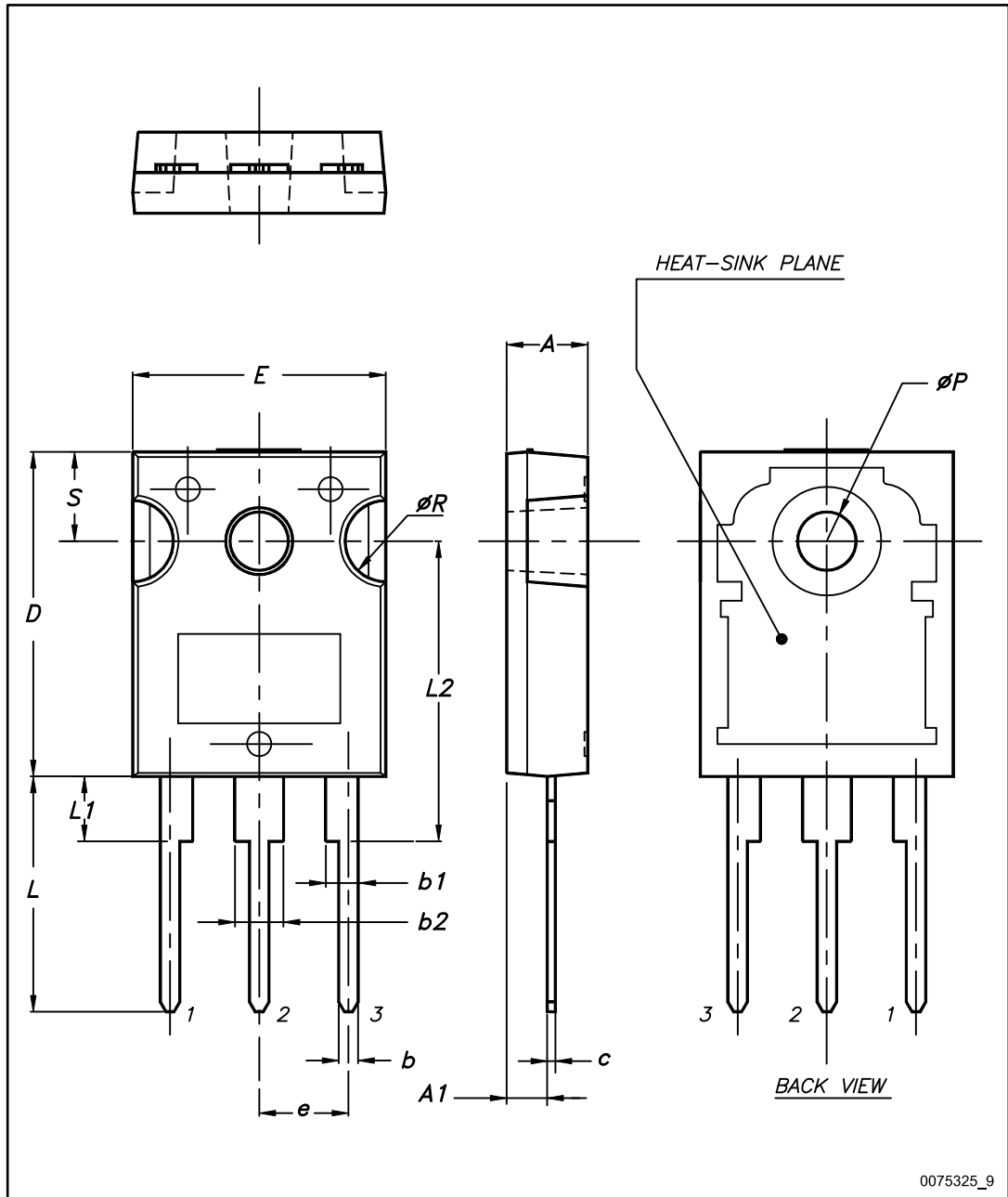


Table 9: TO-247 package mechanical data

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

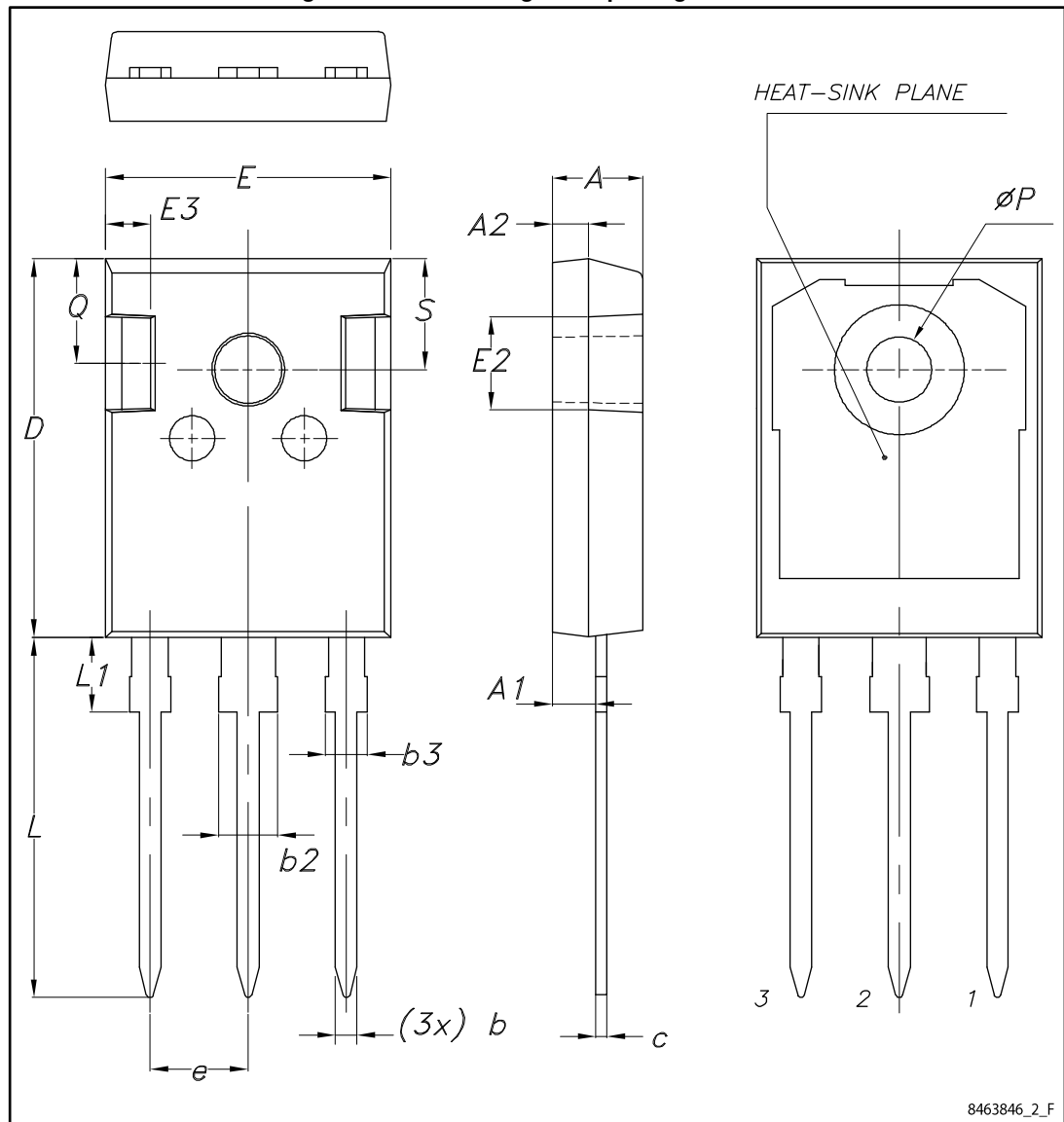


Table 10: TO-247 long leads package mechanical data

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 Table 2: "Absolute maximum ratings" , Table 4: "Thermal data" , Table 5: "On/off states" , Table 6: "Dynamic" , Table 7: "Switching times" and Table 8: "Source-drain diode" . Added Section 2.1: "Electrical characteristics (curves)" . Minor text changes.

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