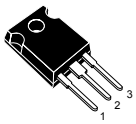
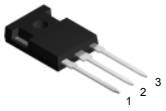
STW40N95DK5, STWA40N95DK5

Datasheet

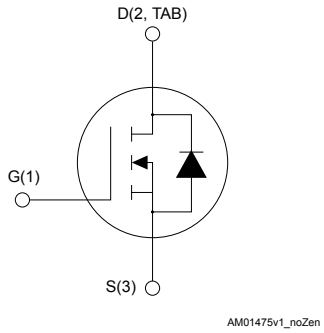
N-channel 950 V, 120 mΩ typ., 38 A, MDmesh DK5 Power MOSFETs in TO-247 and TO-247 long leads packages



TO-247



TO-247 long leads



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STW40N95DK5	950 V	130 mΩ	38 A
STWA40N95DK5			

- 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.

Product status links
STW40N95DK5
STWA40N95DK5

Product summary	
Order code	**STW40N95DK5**
Marking	40N95DK5
Package	TO-247
Packing	Tube
Order code	**STWA40N95DK5**
Marking	40N95DK5
Package	TO-247 long leads
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	38	A
	Drain current (continuous) at T_C = 100 °C	24	
I_{DM}(1)	Drain current (pulsed)	152	A
P_{TOT}	Total power dissipation at T_C = 25 °C	450	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	°C
T_J	Operating junction temperature range		°C

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 38 A, di/dt ≤ 400 A/µs, V_{DS} (peak) ≤ $V_{(BR)DSS}$, V_{DD} = 760 V.*
3. *V_{DS} ≤ 760 V.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.28	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Maximum current during repetitive or single pulse avalanche	13	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	730	mJ

2 Electrical characteristics

T_C = 25 °C unless otherwise specified.

Table 4. 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			1	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			±10	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 = 19 A		120	130	mΩ

1. *Defined by design, not subject to production test.*

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	-	3480	-	pF
C_{oss}	Output capacitance		-	235	-	pF
C_{rss}	Reverse transfer capacitance		-	2.3	-	pF
$C_{o(tr)}$(1)	Equivalent capacitance time related	V_{GS} = 0 V, V_{DS} = 0 to 760 V	-	371	-	pF
$C_{o(er)}$(2)	Equivalent capacitance energy related		-	134	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	2	-	Ω
Q_g	Total gate charge	V_{DD} = 760 V, I_D = 38 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	100	-	nC
Q_{gs}	Gate source charge		-	19.5	-	nC
Q_{gd}	Gate drain charge		-	67.6	-	nC

1. *$C_{o(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.*
2. *$C_{o(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising 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_{DS} = 475 V, I_D= 19 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	30	-	ns
t_r	Rise time		-	15	-	ns
$t_{d(off)}$	Turn-off delay time		-	82	-	ns
t_f	Fall time		-	11	-	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 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 19 A, di/dt = 100 A/µs,	-	170		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V	-	1.4		µC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	15		A
t_{rr}	Reverse recovery time	I_{SD} = 19 A, di/dt = 100 A/µs,	-	340		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, T_J = 150 °C	-	5		µC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	30		A

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

2.1 Electrical characteristics (curves)

Figure 1. Forward bias safe operating area

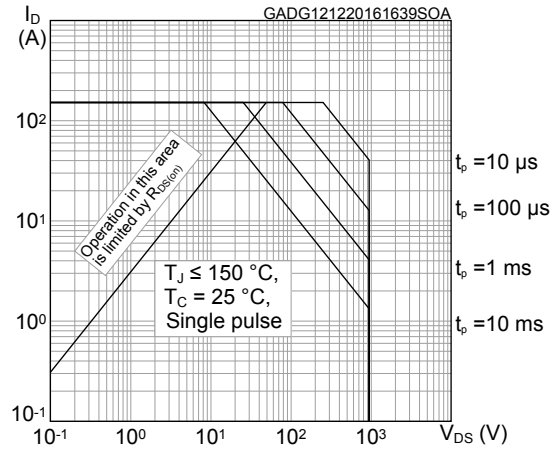


Figure 2. Thermal impedance

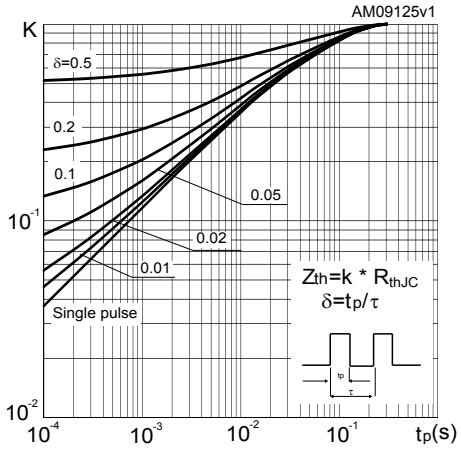


Figure 3. Output characteristics

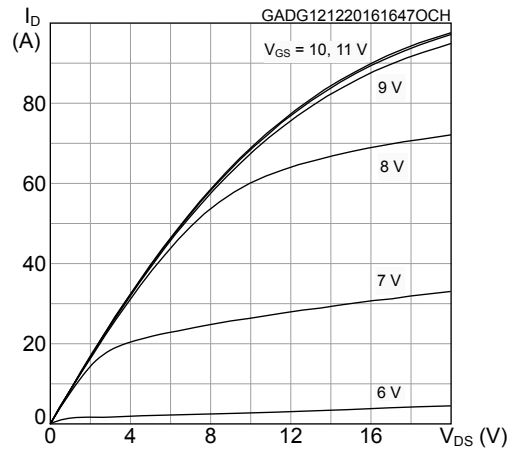


Figure 4. Transfer characteristics

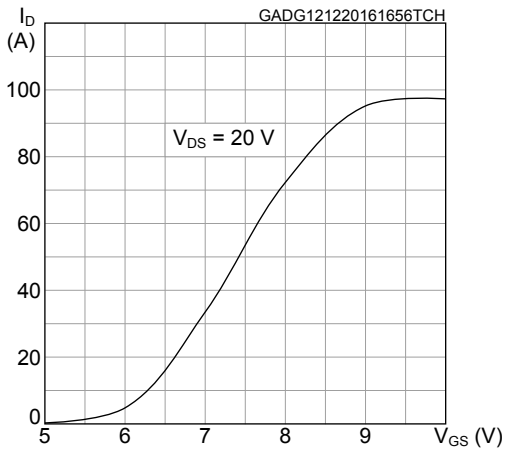


Figure 5. Gate charge vs gate-source voltage

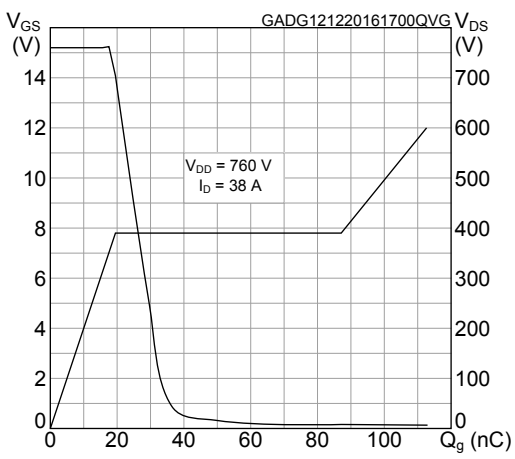


Figure 6. Static drain-source on-resistance

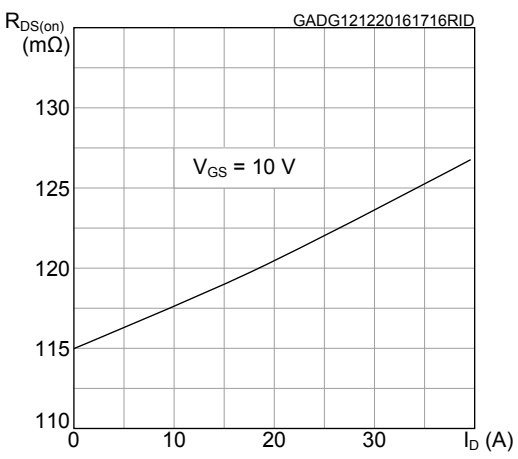


Figure 7. Capacitance variations

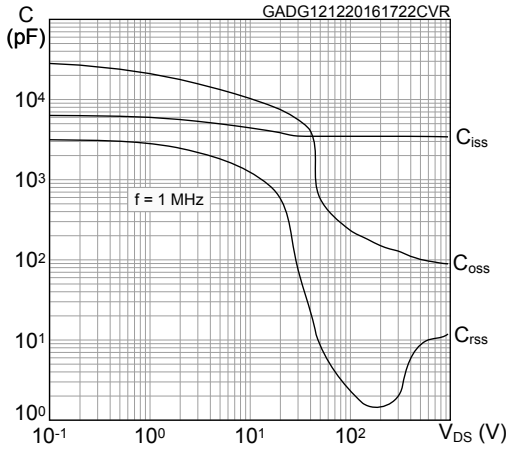


Figure 8. Normalized gate threshold voltage vs temperature

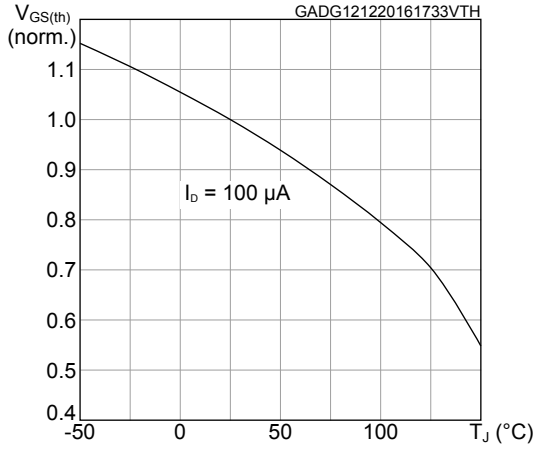


Figure 9. Normalized on-resistance vs temperature

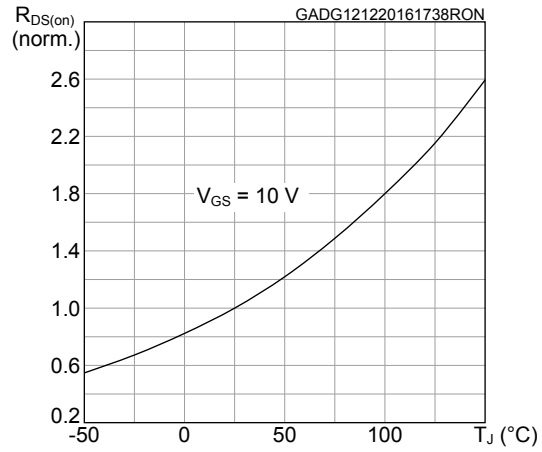


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

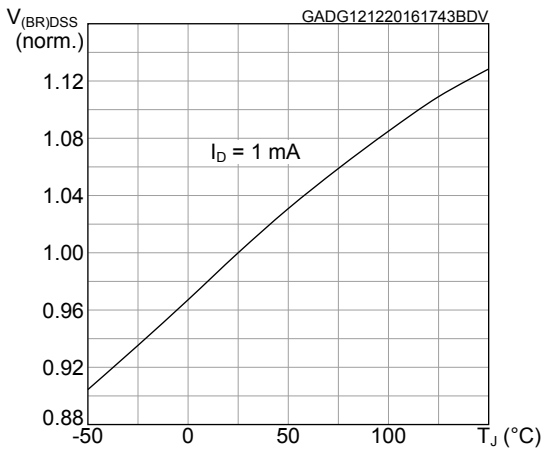


Figure 11. Source-drain diode forward characteristics

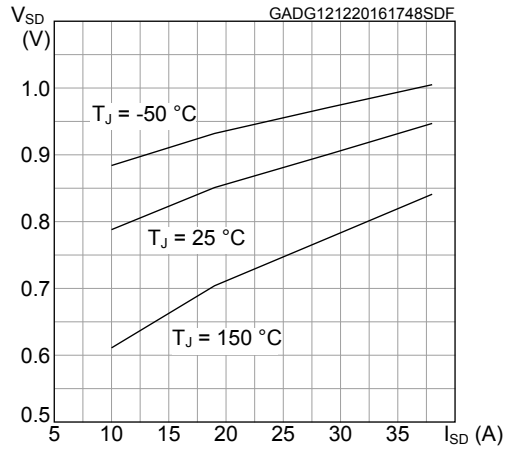
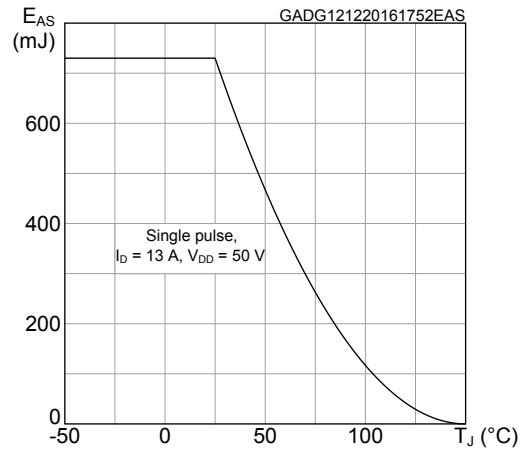


Figure 12. Maximum avalanche energy vs starting T_J



3 Test circuits

Figure 13. Test circuit for resistive load switching times

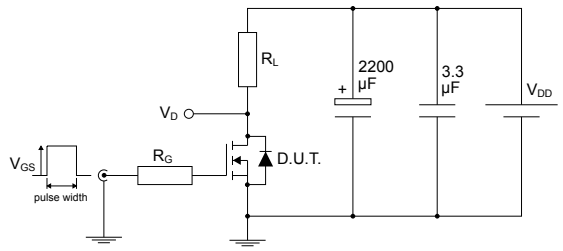


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Figure 14. Test circuit for gate charge behavior

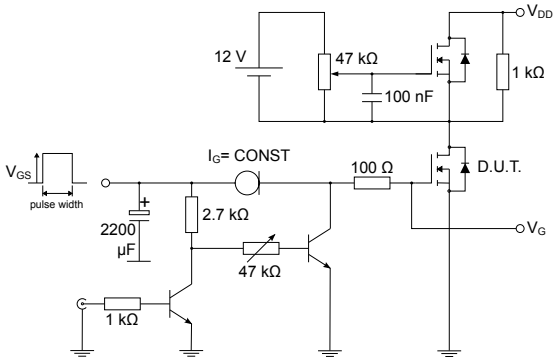

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Figure 15. Test circuit for inductive load switching and diode recovery times

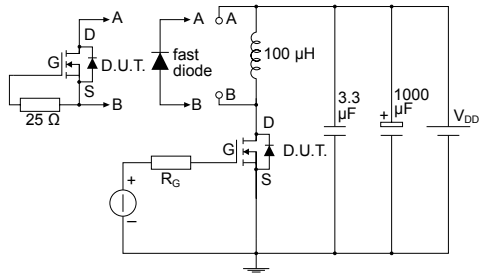

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Figure 16. Unclamped inductive load test circuit

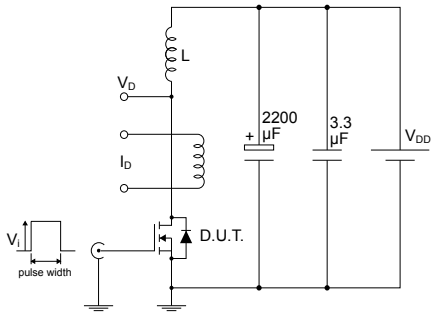

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Figure 17. Unclamped inductive waveform

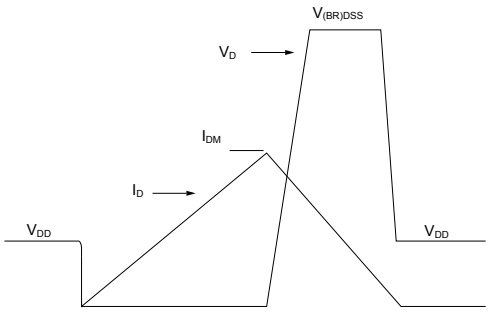

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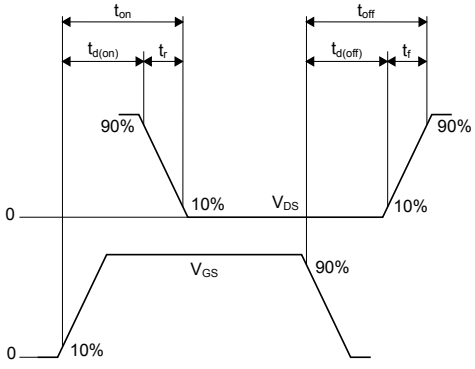
Figure 18. Switching time waveform



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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. ECOPACK is an ST trademark.

4.1 TO-247 package information

Figure 19. TO-247 package outline

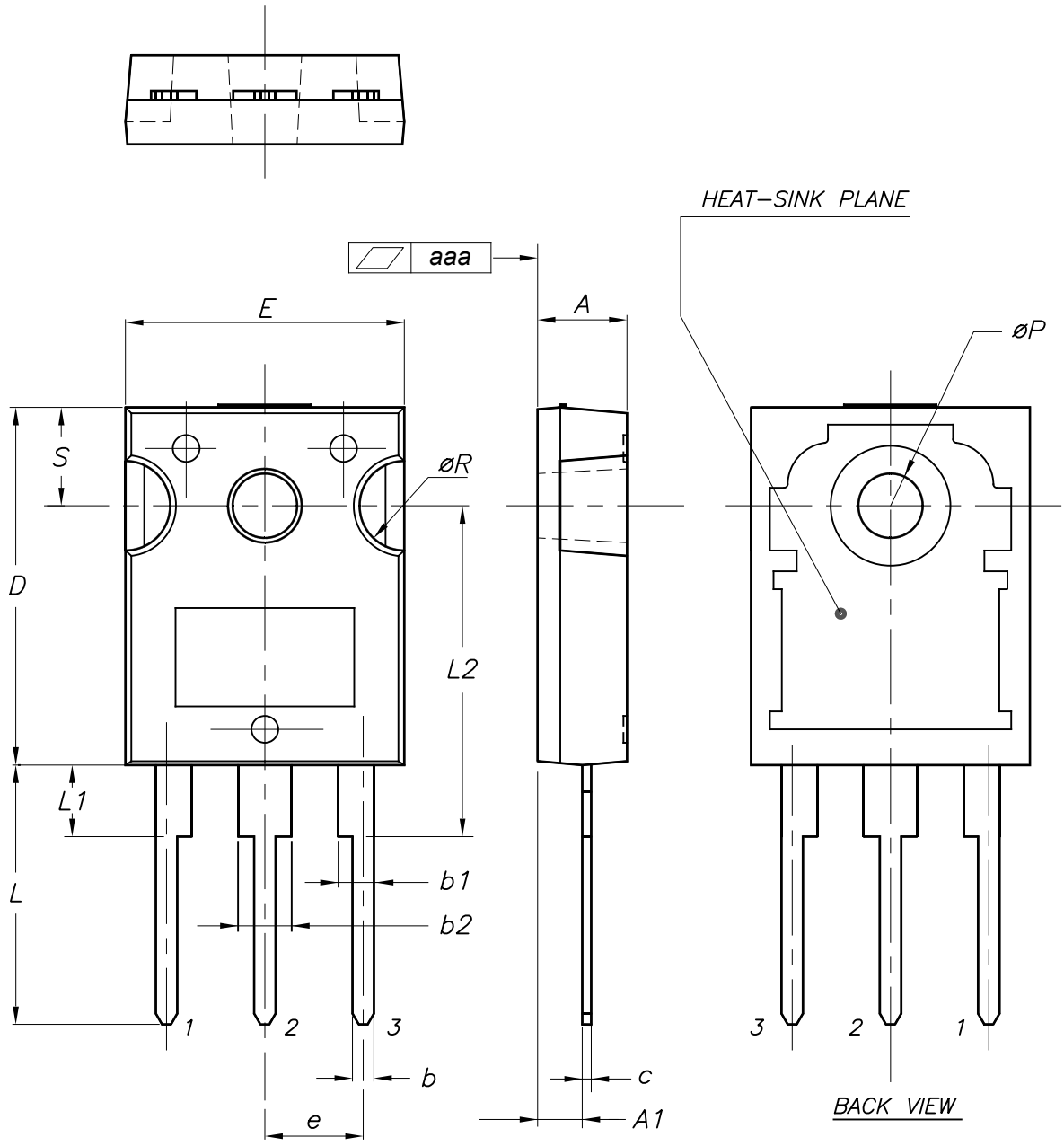

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Table 8. **TO-247 package mechanical data**

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
aaa		0.04	0.10

4.2 TO-247 long leads package information

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

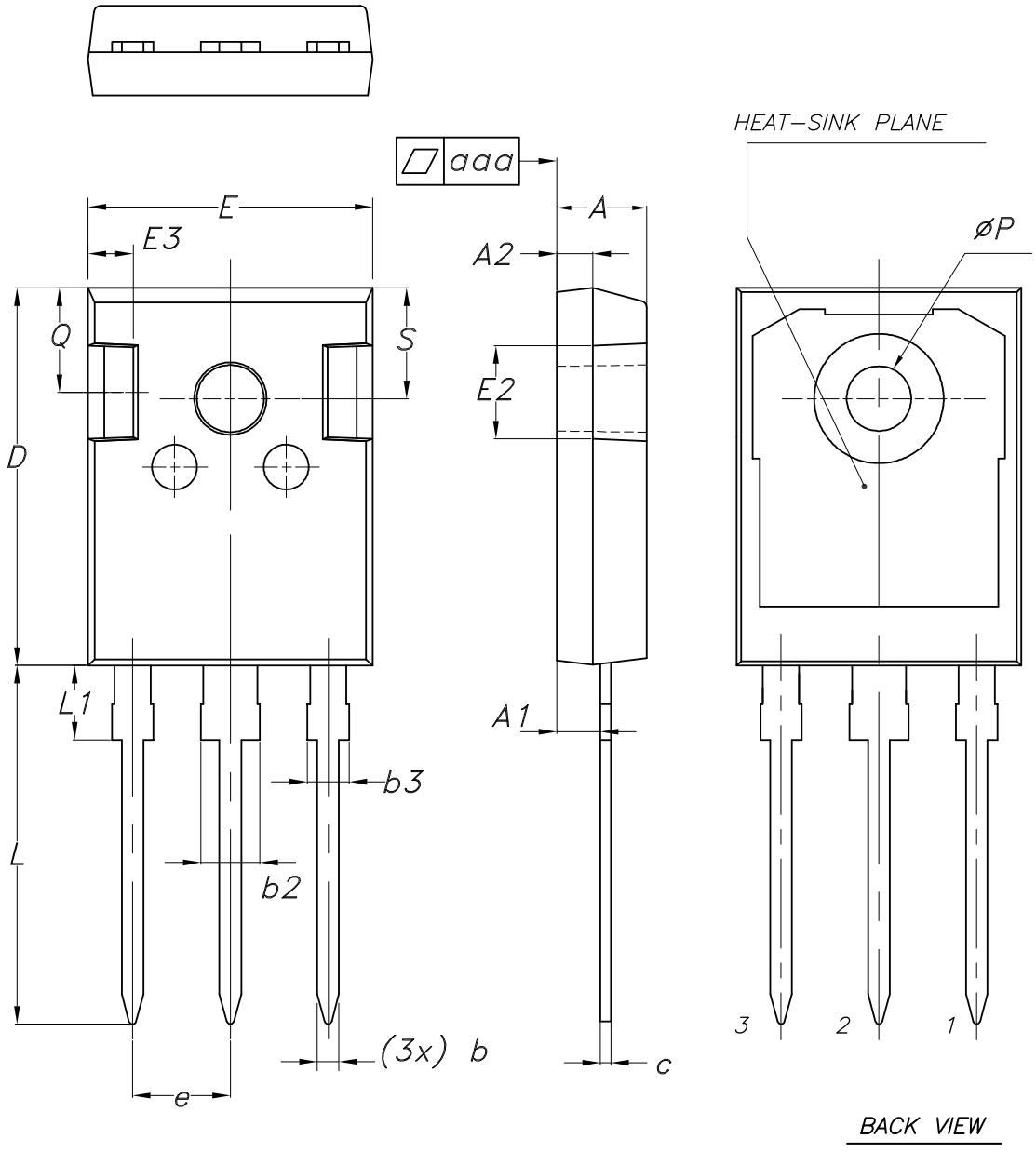

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Table 9. **TO-247 long leads package mechanical data**

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
aaa		0.04	0.10

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
19-Sep-2013	1	First release.
13-Nov-2015	2	Updated title, features and description in cover page. Updated Section 10 : "Electrical characteristics" and Section 12.1:"TO-247 package information" Minor text changes.
12-Apr-2016	3	Updated title,silhouette and description in cover page. Updated *Table 2: "Absolute maximum ratings"*. Updated *Section 10: "Electrical characteristics"* . Added *Figure 21: "TO-247 long lead package outline"*. Minor text changes
12-Dec-2016	4	Datasheet status promoted from preliminary to production data. Updated document title on cover page. Updated *Table 2: "Absolute maximum ratings"*, *Table 4: "Thermal data"*, *Table 5: "On/off states"*, *Table 6: "Dynamic"* and *Table 8: "Source-drain diode"*. Added *Section 2.1: "Electrical characteristics (curves)"*. Minor text changes
11-Aug-2021	5	Updated Table 1. Absolute maximum ratings. Updated Section 4 Package information. Minor text changes.

Contents