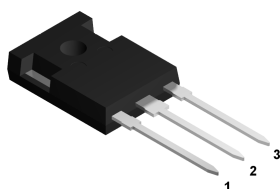
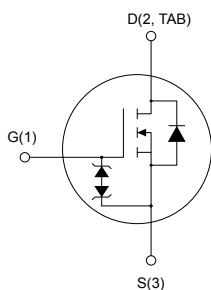


Automotive-grade N-channel 650 V, 70 mΩ typ., 38 A MDmesh DM2 Power MOSFET in a TO-247 long leads package



TO-247 long leads



AM01476v1_tab



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STWA50N65DM2AG	650 V	87 mΩ	38 A

- AEC-Q101 qualified 
- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

Applications

- Switching applications

Description

This high-voltage N-channel Power MOSFET is part of the MDmesh DM2 fast-recovery diode series. It offers very low recovery charge (Q_{rr}) and time (t_{rr}) combined with low $R_{DS(on)}$, rendering it suitable for the most demanding high-efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Product status link

[STWA50N65DM2AG](#)

Product summary ⁽¹⁾

Order code	STWA50N65DM2AG
Marking	50N65DM2
Package	TO-247 long leads
Packing	Tube

1. The HTRB test was performed at 80% $V_{(BR)DSS}$ in compliance with AEC-Q101 rev. C. All the other tests were performed according to rev. D.

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	38	A
	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	24	
$I_{DM}^{(1)}$	Drain current (pulsed)	110	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	300	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		$^{\circ}\text{C}$

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq 38\text{ A}$, $V_{DS} (\text{peak}) < V_{(BR)DSS}$, $di/dt = 800\text{ A}/\mu\text{s}$, $V_{DD} = 520\text{ V}$.
3. $V_{DD} = 520\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.42	$^{\circ}\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-ambient	50	$^{\circ}\text{C}/\text{W}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_J max.)	5	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	850	mJ

2 Electrical characteristics

$T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 4. On/off-states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	650			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$			10	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 650\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$ ⁽¹⁾			100	
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 5	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 19\text{ A}$		70	87	m Ω

1. Specified by design, not tested in production.

Table 5. Dynamic characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ kHz}$, $V_{GS} = 0\text{ V}$	-	3200	-	pF
C_{oss}	Output capacitance		-	130	-	pF
C_{rss}	Reverse transfer capacitance		-	3	-	pF
$C_{oss\text{ eq}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }520\text{ V}$, $V_{GS} = 0\text{ V}$	-	256	-	pF
R_g	Intrinsic gate resistance	$f = 250\text{ kHz}$, $I_D = 0\text{ A}$	-	4	-	Ω
Q_g	Total gate charge	$V_{DD} = 520\text{ V}$, $I_D = 38\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	69	-	nC
Q_{gs}	Gate-source charge		-	18	-	nC
Q_{gd}	Gate-drain charge		-	34	-	nC

1. $C_{oss\text{ eq}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to stated value.

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325\text{ V}$, $I_D = 19\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	22.5	-	ns
t_r	Rise time		-	21	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	89	-	ns
t_f	Fall time		-	10.5	-	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)		-		110	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0\text{ V}$, $I_{SD} = 38\text{ A}$	-		1.6	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 Figure 15. Test circuit for inductive load switching and diode recovery times)	-	150		ns
Q_{rr}	Reverse recovery charge		-	0.96		μC
I_{RRM}	Reverse recovery current		-	12.8		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 Figure 15. Test circuit for inductive load switching and diode recovery times)	-	245		ns
Q_{rr}	Reverse recovery charge		-	2.7		μC
I_{RRM}	Reverse recovery current		-	22		A

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

2.1 Electrical characteristics (curves)

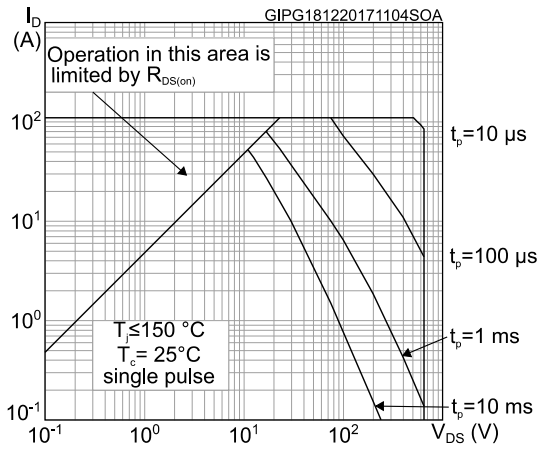
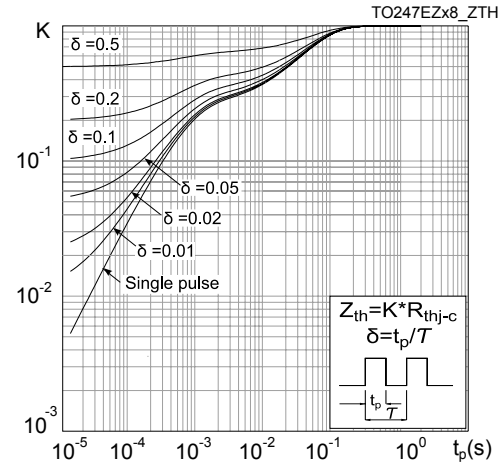
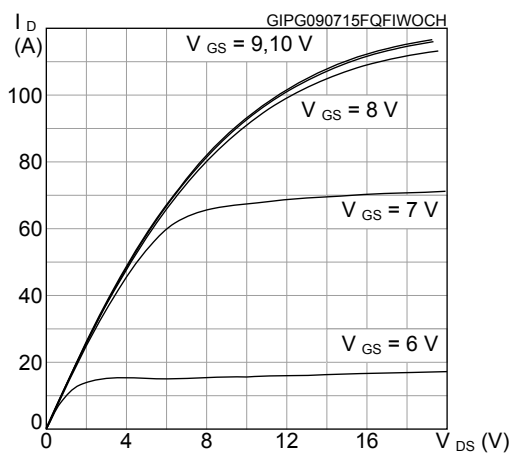
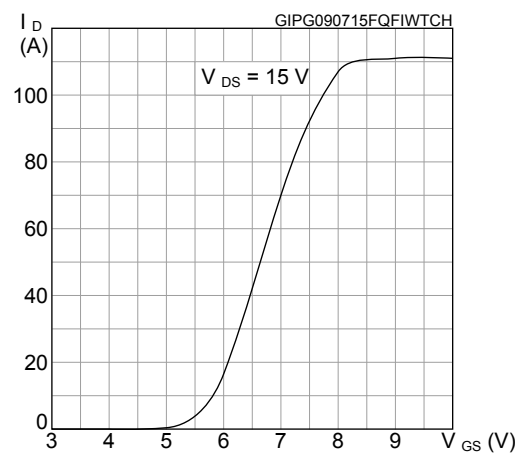
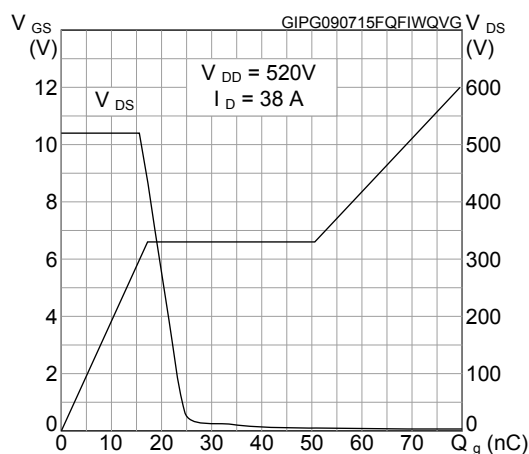
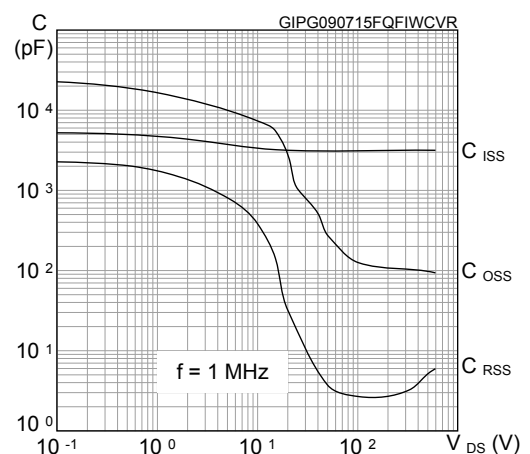
Figure 1. Safe operating area

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 capacitance characteristics


Figure 7. Typical drain-source on-resistance

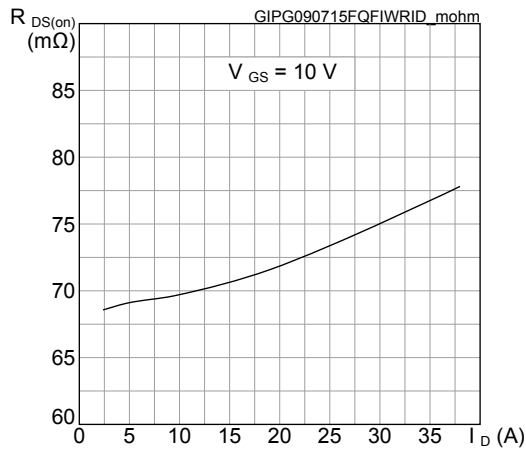


Figure 8. Normalized on-resistance vs temperature

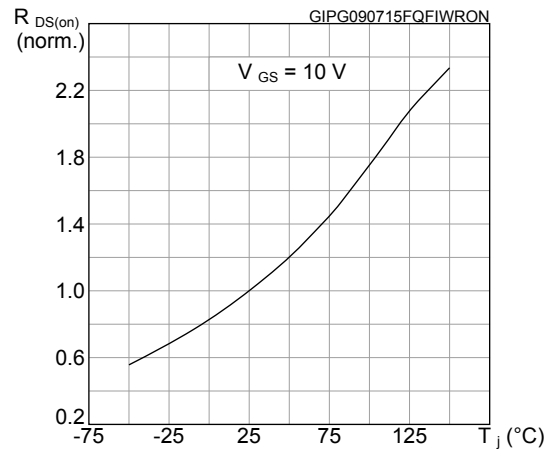


Figure 9. Normalized gate threshold vs temperature

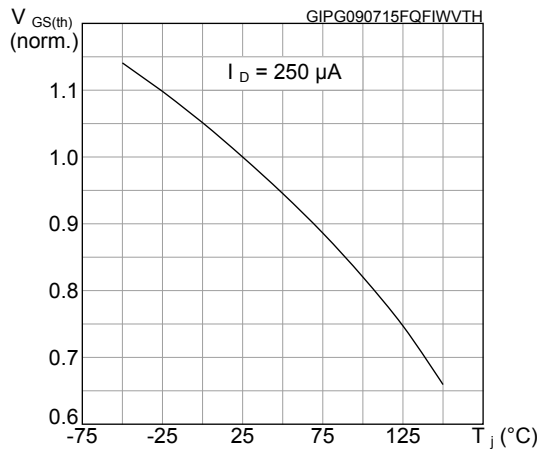


Figure 10. Normalized breakdown voltage vs temperature

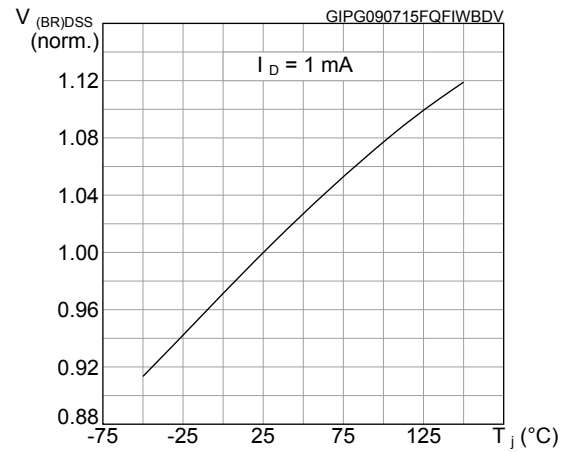


Figure 11. Typical reverse diode forward characteristics

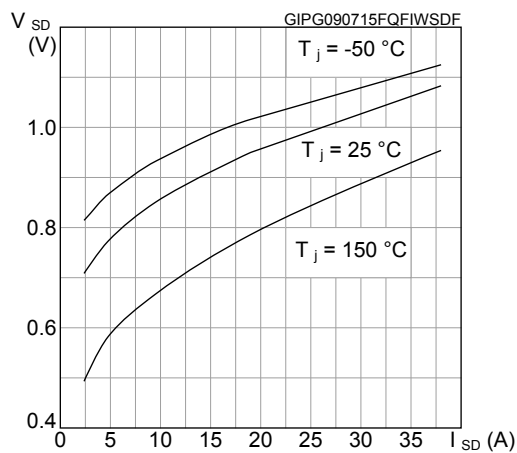
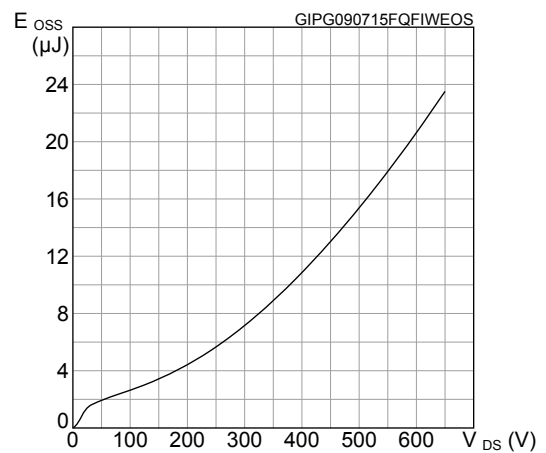


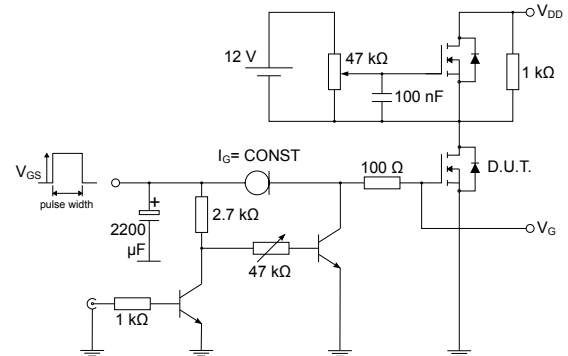
Figure 12. Typical output capacitance stored energy



3 Test circuits

Figure 13. Test circuit for resistive load switching times


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Figure 14. Test circuit for gate charge behavior


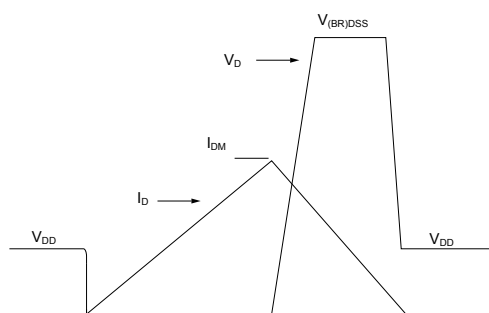
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Figure 15. Test circuit for inductive load switching and diode recovery times


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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

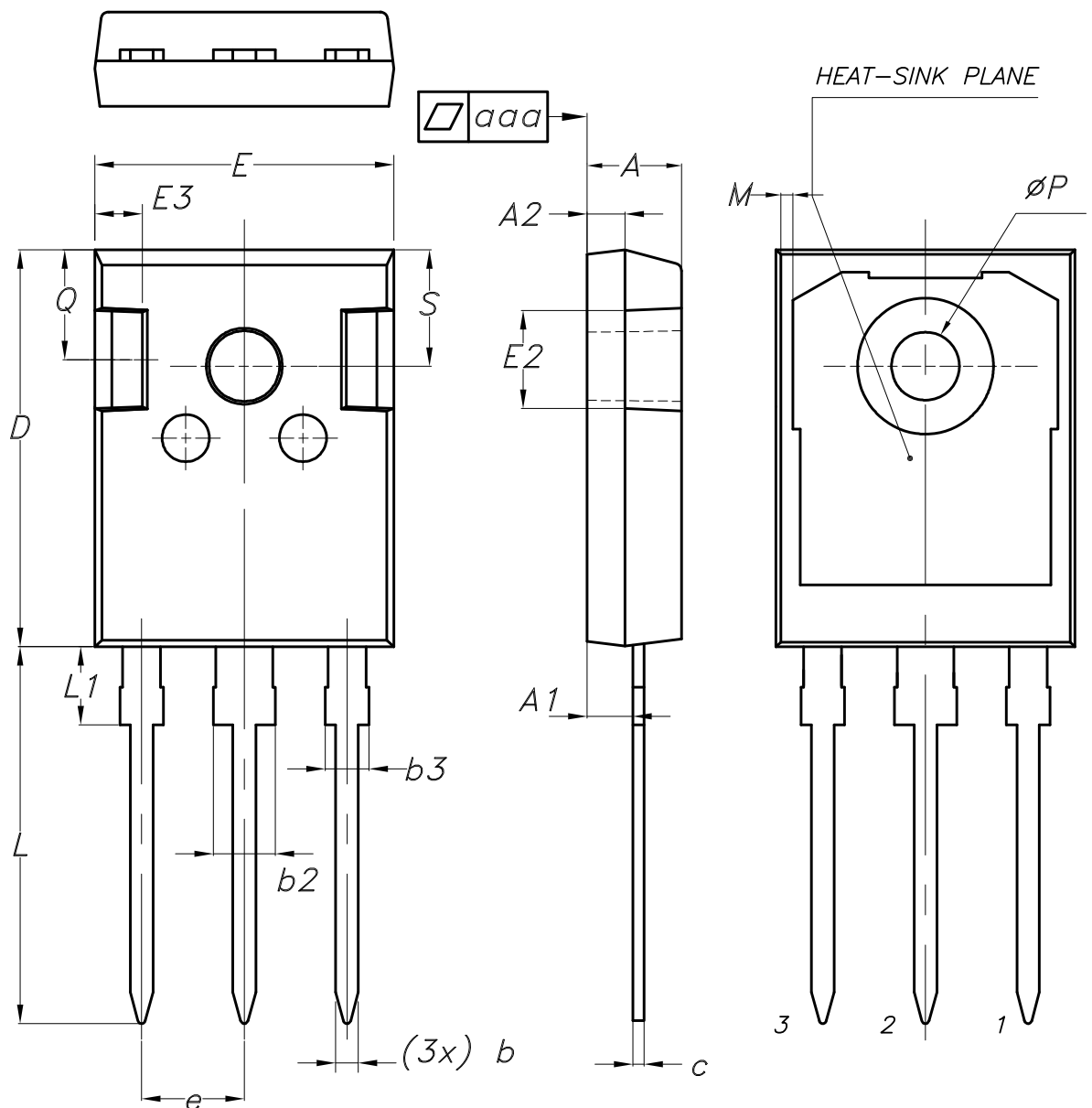

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4 Package information

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 long leads package information

Figure 19. TO-247 long leads package outline



BACK VIEW

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Table 8. 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
M	0.35		0.95
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 9. Document revision history

Date	Revision	Changes
10-Jan-2017	1	Initial release.
18-Dec-2017	2	Datasheet promoted from preliminary data to production data. Modified <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 4: "Avalanche characteristics"</i> , <i>Table 6: "Dynamic"</i> and <i>Table 8: "Source-drain diode"</i> . Modified <i>Figure 2: "Safe operating area"</i> . Minor text changes.
10-Mar-2025	3	Updated Section 4.1: TO-247 long leads package information . Minor text changes.

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