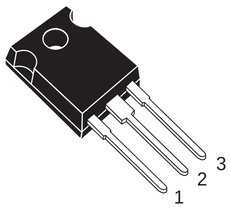
STW60NM50N

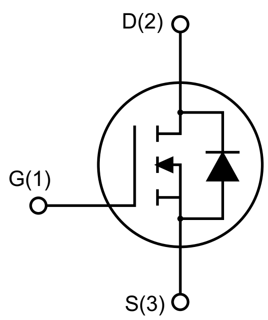
N-channel 500 V, 0.035 Ω, 68 A, MDmesh™ II Power MOSFET in a TO-247 package

Datasheet - production data



TO-247

Figure 1. Internal schematic diagram



Features

Order code	V_{DSS} (@T_{jmax})	$R_{DS(on)}$ max	I_D
STW60NM50N	550 V	<0.043 Ω	68 A

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

This device is an N-channel Power MOSFET developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company’s strip layout to yield one of the world’s lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order codes	Marking	Packages	Packaging
STW60NM50N	60NM50N	TO-247	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate- source voltage	±25	V
I_D	Drain current (continuous) at T_C = 25 °C	68	A
I_D	Drain current (continuous) at T_C = 100 °C	43	A
I_{DM} (1)	Drain current (pulsed)	272	A
P_{TOT}	Total dissipation at T_C = 25 °C	446	W
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature	–55 to 150	°C
T_j	Max. operating junction temperature	150	°C

1. Pulse width limited by safe operating area.
2. $I_{SD} \leq$ 68 A, di/dt $\leq$ 400 A/µs, V_{DD} =80% $V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	0.28	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	°C/W

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_{j\ Max}$)	11	A
E_{AS}	Single pulse avalanche energy (starting Tj=25 °C, I_D=I_{AS}, V_{DD}=50 V)	551	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	V_{GS} = 0, I_D = 1 mA	500			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 500 V V_{GS} = 0, V_{DS} = 500 V, T_j = 125 °C			1 100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0, V_{GS} = ± 20 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 34 A		0.035	0.043	Ω

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	-	5790	-	pF
C_{oss}	Output capacitance		-	365	-	pF
C_{rss}	Reverse transfer capacitance		-	14	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0V to 480 V	-	1008	-	pF
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 68 A, V_{GS} = 10 V *(see Figure 14)*	-	178	-	nC
Q_{gs}	Gate-source charge		-	28	-	nC
Q_{gd}	Gate-drain charge		-	95	-	nC
R_g	Gate input resistance	f=1 MHz gate DC bias=0 Test signal level = 20 mV open drain	-	2	-	Ω

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_{DS}

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} =300 V, I_D = 32.5 A R_G = 4.7 Ω V_{GS} = 10 V *(see Figure 13)*	-	206	-	ns
t_r	Rise time		-	36	-	ns
$t_{d(off)}$	Turn-off delay time		-	40	-	ns
t_f	Fall time		-	27.5	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current Source-drain current (pulsed)		-		68	A
I_{SDM} (1)	Source-drain current (pulsed)		-		272	A
V_{SD} (2)	Forward on voltage	I_{SD} = 68 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 68 A, di/dt = 100 A/µs V_{DD} = 100 V *(see Figure 15)*	-	476		ns
Q_{rr}	Reverse recovery charge		-	10.5		nC
I_{RRM}	Reverse recovery current		-	44		A
t_{rr}	Reverse recovery time	I_{SD} = 68 A, di/dt = 100 A/µs V_{DD} = 100 V, T_j = 150 °C *(see Figure 15)*	-	586		ns
Q_{rr}	Reverse recovery charge		-	15		nC
I_{RRM}	Reverse recovery current		-	51		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 2. Safe operating area

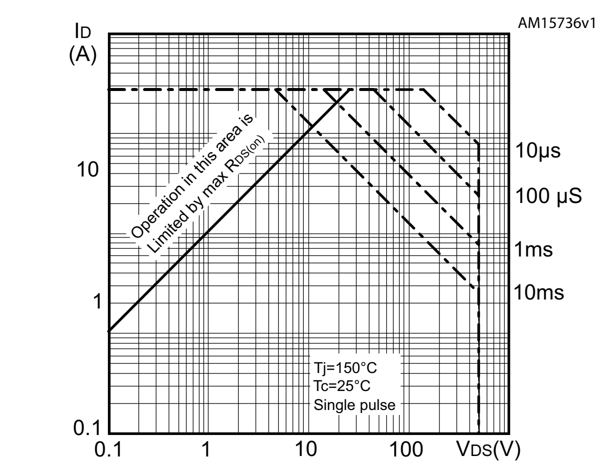


Figure 3. Thermal impedance

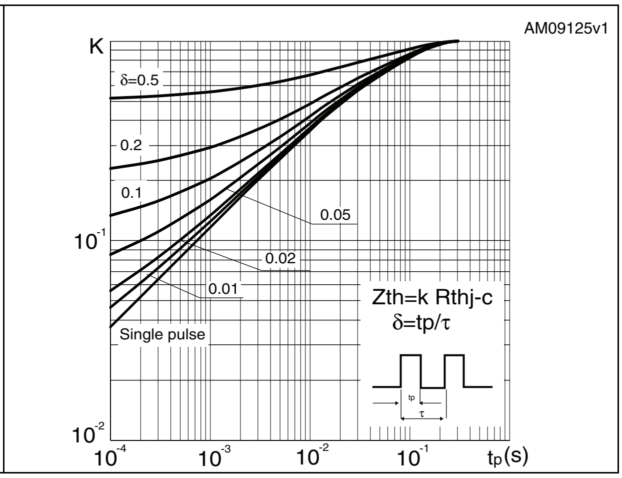


Figure 4. Output characteristics

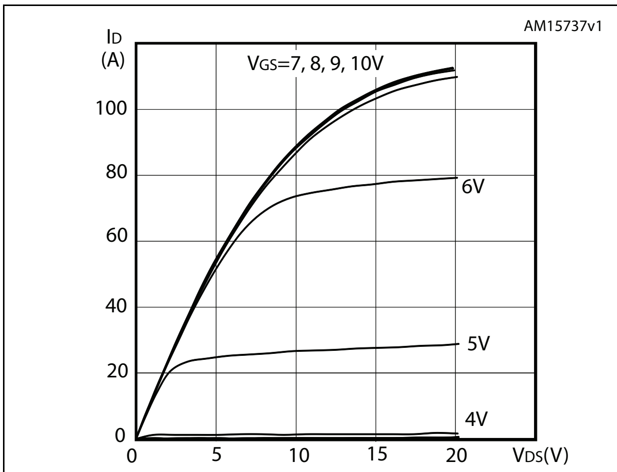


Figure 5. Transfer characteristics

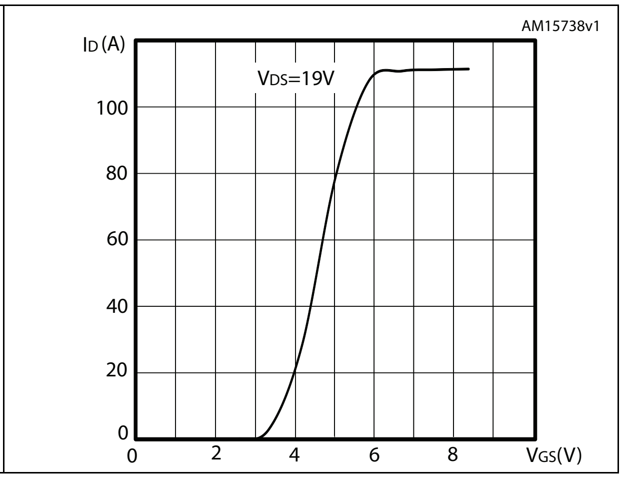


Figure 6. Normalized $V_{(BR)DSS}$ vs temperature

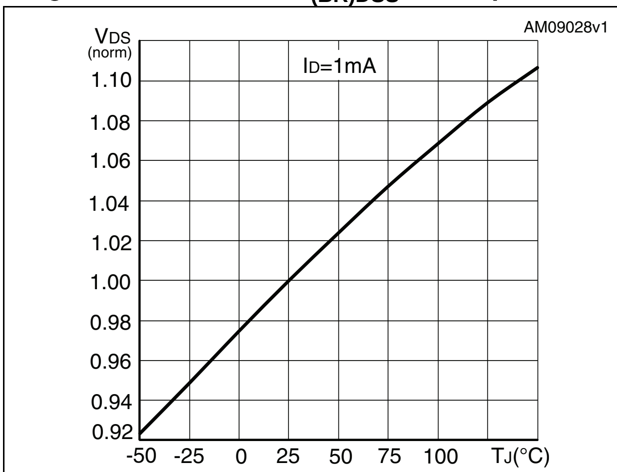


Figure 7. Static drain-source on-resistance

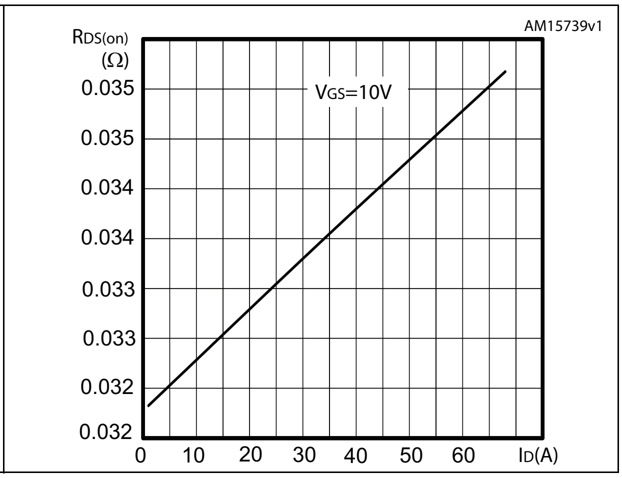


Figure 8. Gate charge vs gate-source voltage

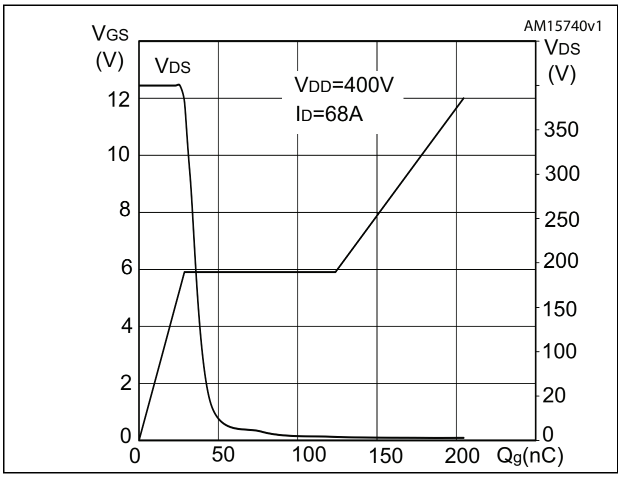


Figure 9. Capacitance variations

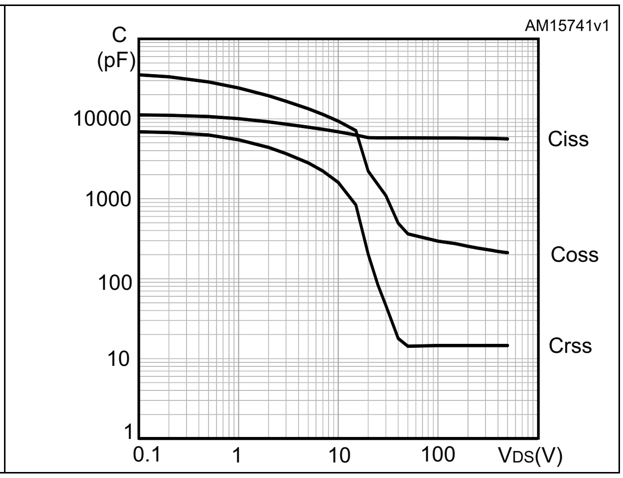


Figure 10. Normalized gate threshold voltage vs temperature

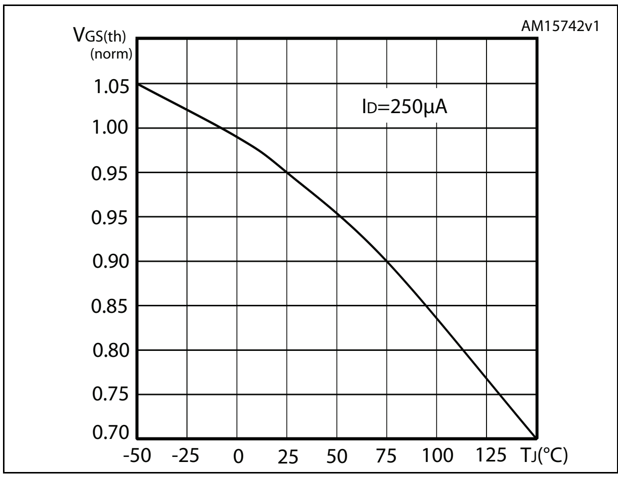


Figure 11. Normalized on-resistance vs temperature

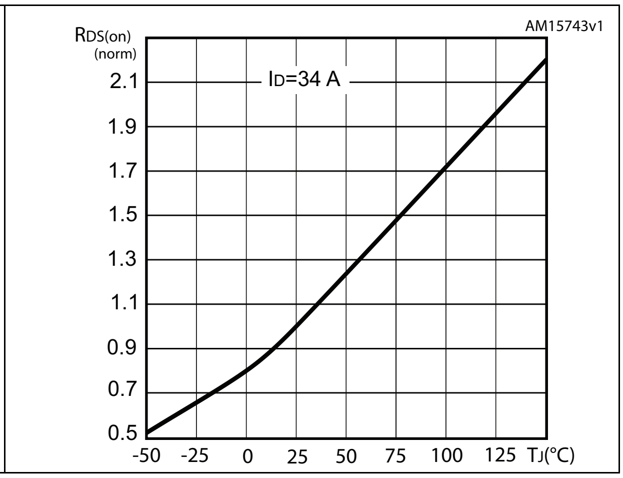
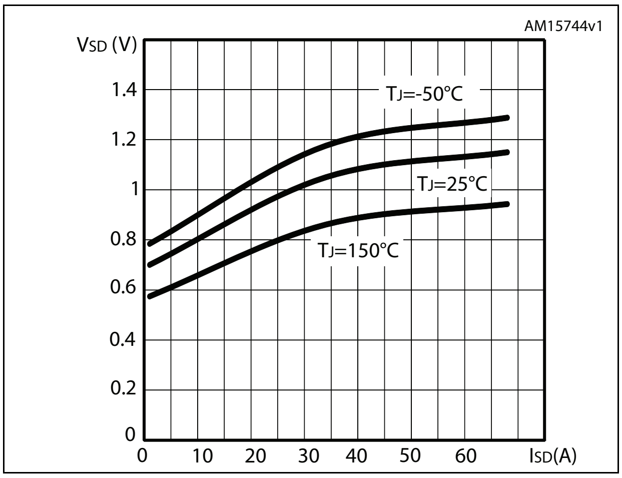


Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Switching times test circuit for resistive load

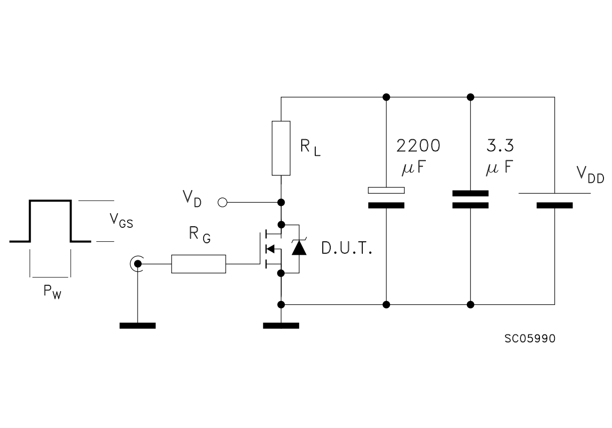


Figure 14. Gate charge test circuit

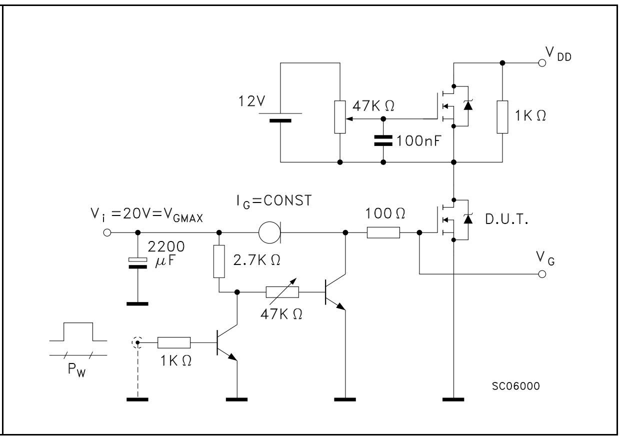


Figure 15. Test circuit for inductive load switching and diode recovery times

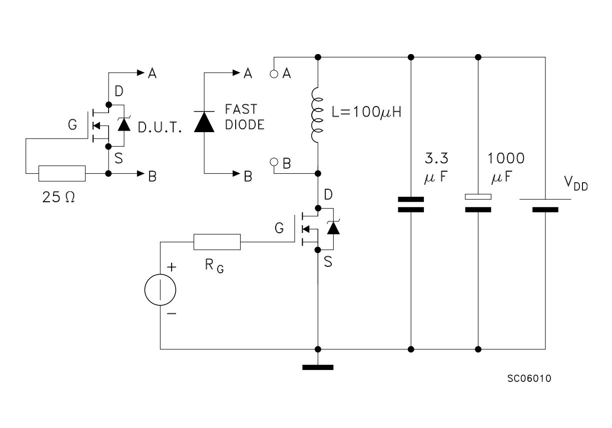


Figure 16. Unclamped Inductive load test circuit

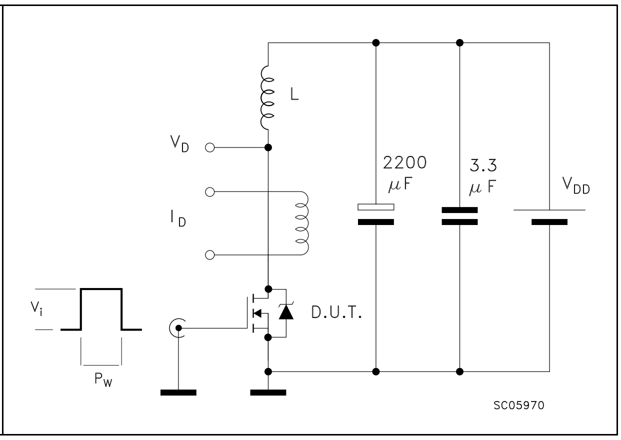


Figure 17. Unclamped inductive waveform

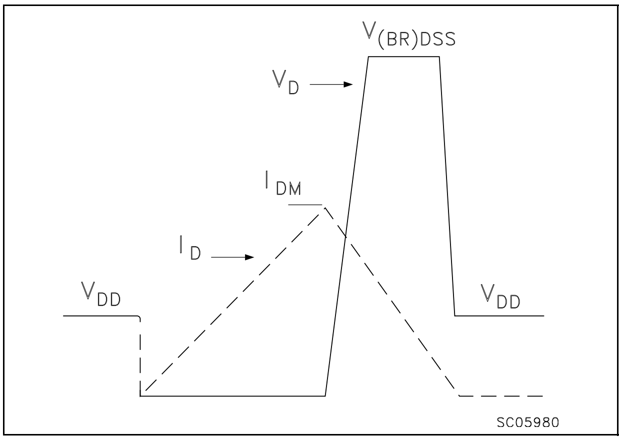
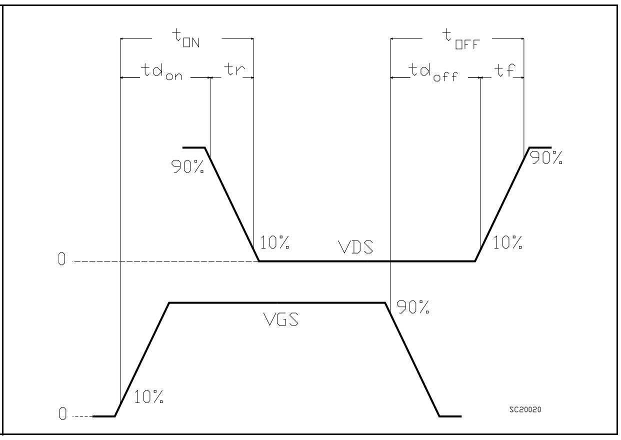


Figure 18. Switching time waveform



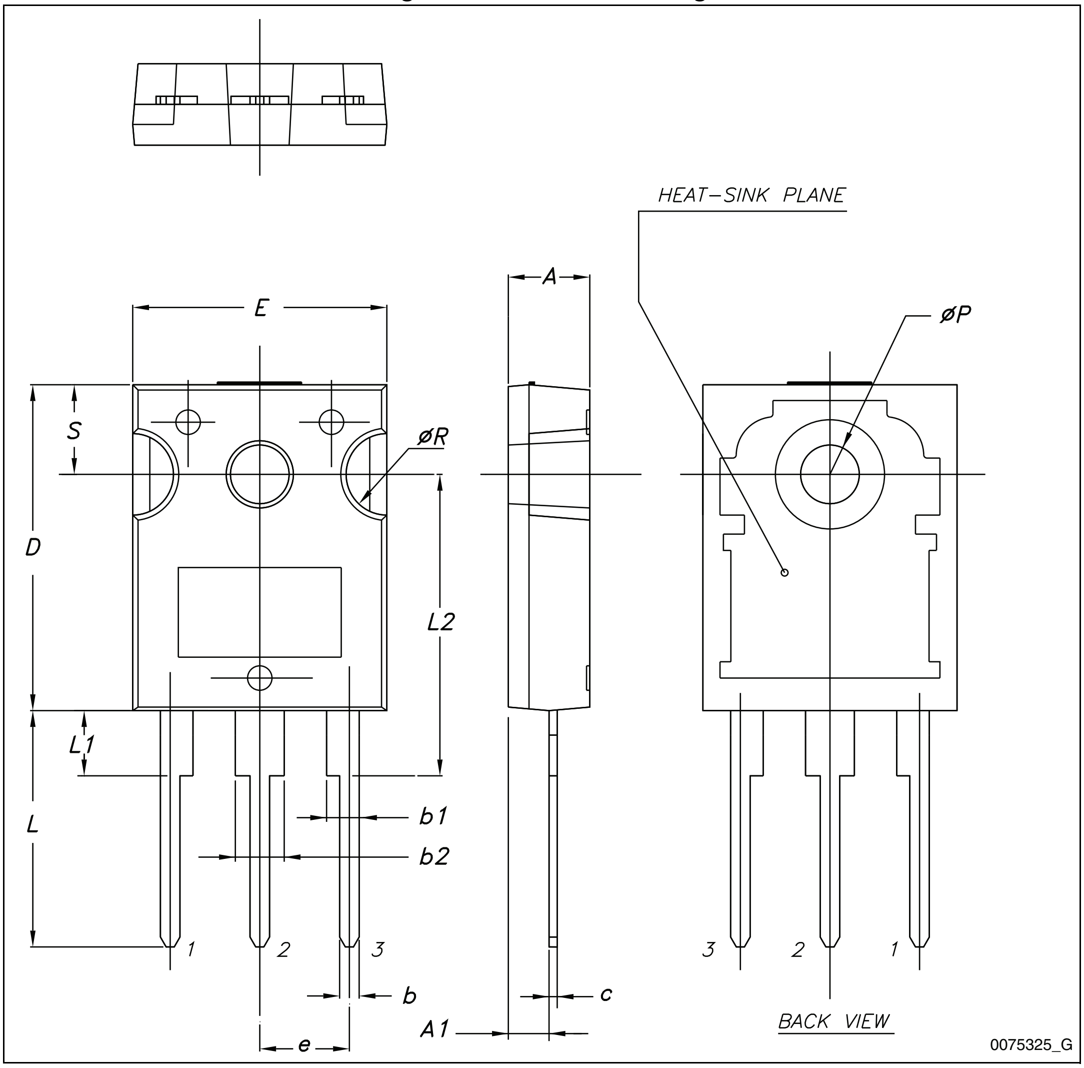
4 Package mechanical data

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.

Table 9. TO-247 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	
∅P	3.55		3.65
∅R	4.50		5.50
S	5.30	5.50	5.70

Figure 19. TO-247 drawing



5 Revision history

Table 10. Document revision history

Date	Revision	Changes
26-Apr-2012	1	First release.
16-Apr-2013	2	– Inserted: *Section 2.1: Electrical characteristics (curves)* – Modified: I_{AS} value on *Table 4* – Minor text changes

Please Read Carefully: