STW54NM65ND

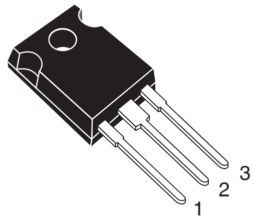
N-channel 650 V, 0.055 Ω typ., 49 A FDmesh™ II Power MOSFET (with fast diode) in a TO-247 package

Datasheet — production data

Features

Order code	V_{DSS} (@Tjmax)	$R_{DS(on)}$ max.	I_D
STW54NM65ND	710 V	< 0.065 Ω	49 A

- The worldwide best $R_{DS(on)}$ * area amongst the fast recovery diode devices
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- Extremely high dv/dt and avalanche capabilities



TO-247

Application

Switching applications

Description

The device is an N-channel FDmesh™ II Power MOSFET that belongs to the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout and associates all advantages of reduced on-resistance and fast switching with an intrinsic fast-recovery body diode. It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

Figure 1. Internal schematic diagram

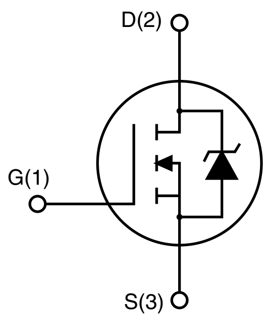


Table 1. Device summary

Order code	Marking	Package	Packaging
STW54NM65ND	54NM65ND	TO-247	Tube

This is information on a product in full production. www.st.com

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	650	V
V_{GS}	Gate- source voltage	± 25	V
I_D	Drain current (continuous) at T_C = 25 °C	49	A
I_D	Drain current (continuous) at T_C = 100 °C	31	A
I_{DM} (1)	Drain current (pulsed)	196	A
P_{TOT}	Total dissipation at T_C = 25 °C	350	W
dv/dt (2)	Peak diode recovery voltage slope	40	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. $I_{SD} \leq 49$ A, di/dt $\leq$ 600 A/μs, V_{DD} = 80% $V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case max	0.36	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	50	°C/W
T_l	Maximum lead temperature for soldering purpose	300	°C

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	15	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D= I_{AS}, V_{DD} = 50 V)	850	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	650			V
dv/dt(1)	Drain source voltage slope	V_{DD} = 480 V, I_D = 49 A, V_{GS} = 10 V		30		V/ns
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 650 V V_{DS} = 650 V, T_C = 125 °C			10 100	µA 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	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 24.5 A		0.055	0.065	Ω

1. Characteristic value at turn off on inductive load.

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	6200 218 10	-	pF pF pF
$C_{oss\ eq.}$(1)	Output equivalent capacitance	V_{DS}=0 to 200 V V_{GS}=0	-	850	-	pF
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 520 V, I_D = 49 A, V_{GS} = 10 V, *(see Figure 14)*	-	188 32 100	-	nC nC nC
t_c t_r $t_{d(off)}$ t_f	Crossing time Rise time Turn-off delay time Fall time	V_{DD} = 520 V, I_D = 49 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 17*), (see *Figure 13*)	-	33 59 152 98	-	ns ns ns ns
R_g	Gate input resistance	f=1 MHz gate DC bias=0 Test signal level = 20 mV open drain	-	1.9	-	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. Source drain diode

Symbol	Parameter	Test conditions	Min	Typ.	Max	Unit
I_{SD} I_{SDM} (1)	Source-drain current Source-drain current (pulsed)		-		49 196	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 49 A, V_{GS} = 0	-		1.3	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 49 A, di/dt = 100 A/µs V_{DD} = 60 V *Figure 15*	-	212 2 19		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 49 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C *Figure 15*	-	296 4 28		ns µC 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

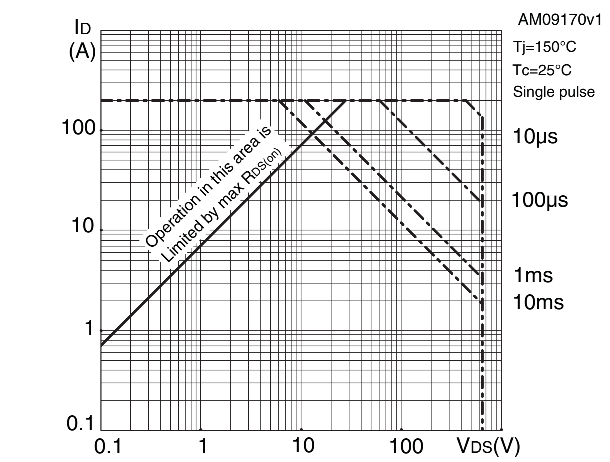


Figure 3. Thermal impedance

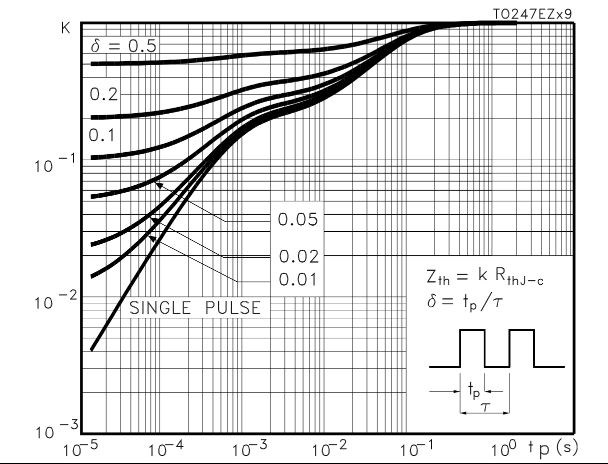


Figure 4. Output characteristics

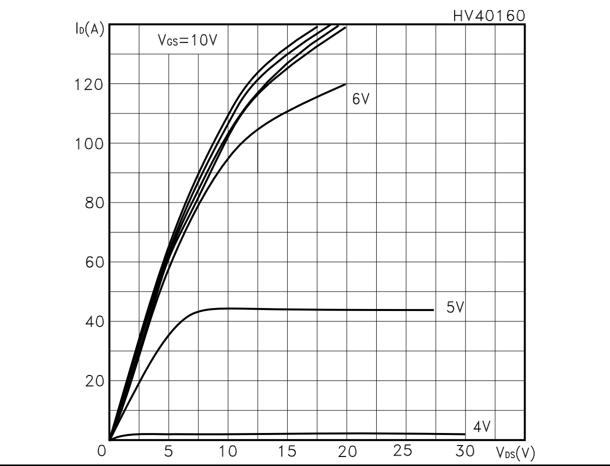


Figure 5. Transfer characteristics

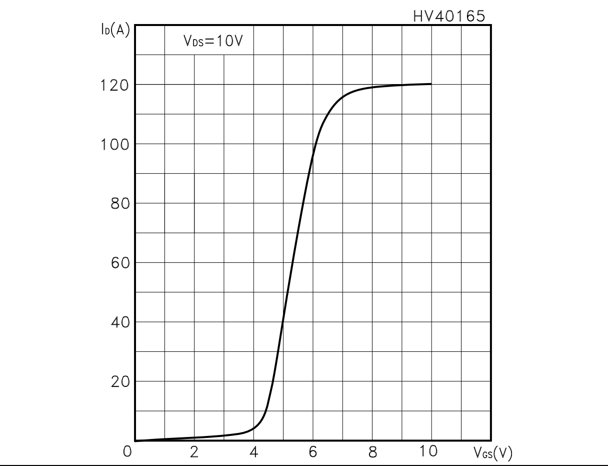


Figure 6. Normalized B_{VDSS} vs temperature

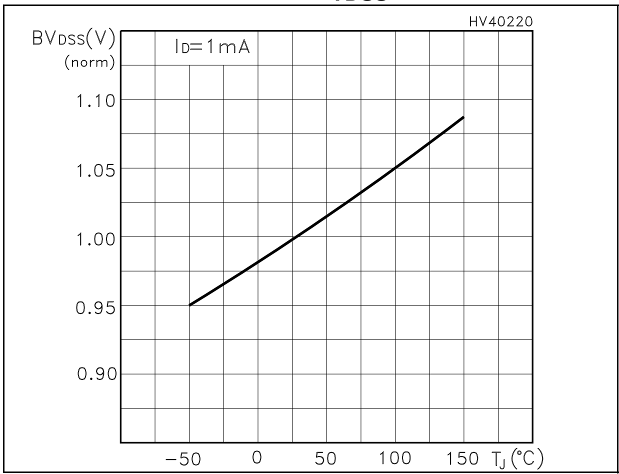


Figure 7. Static drain-source on-resistance

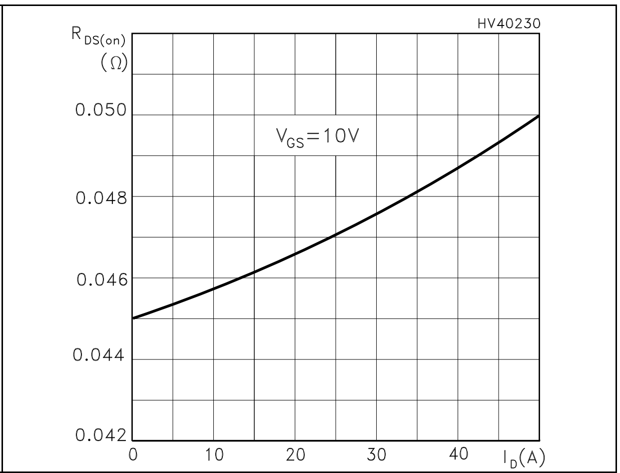


Figure 8. Gate charge vs gate-source voltage

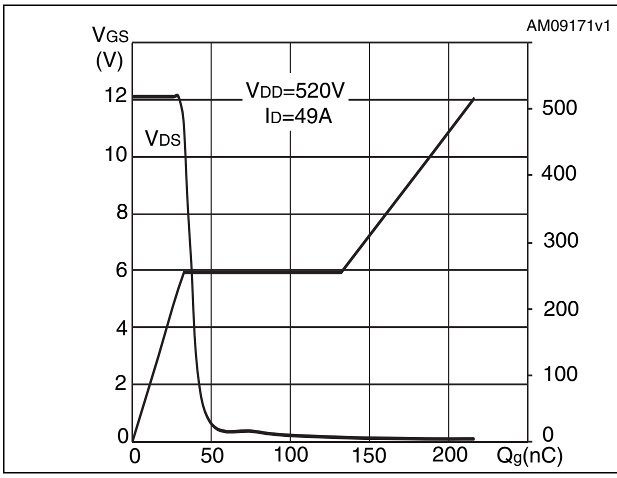


Figure 9. Capacitance variations

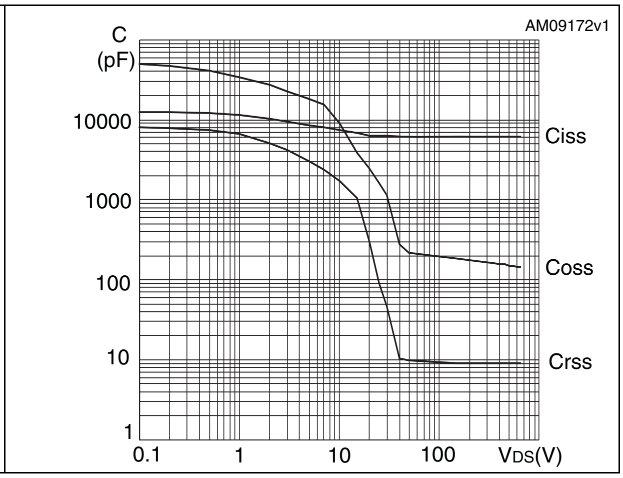


Figure 10. Normalized gate threshold voltage vs temperature

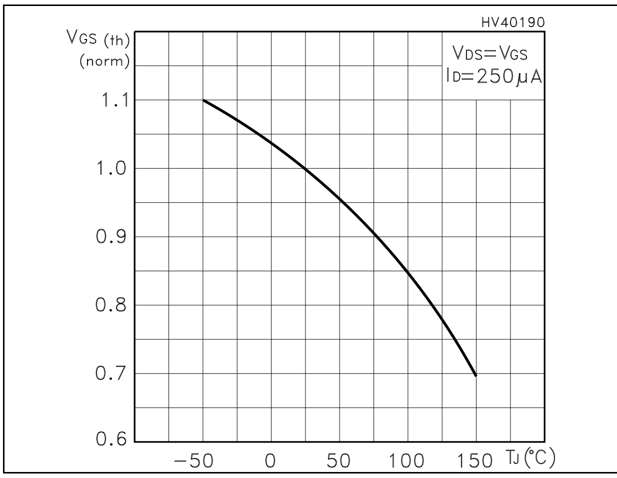


Figure 11. Normalized on resistance vs temperature

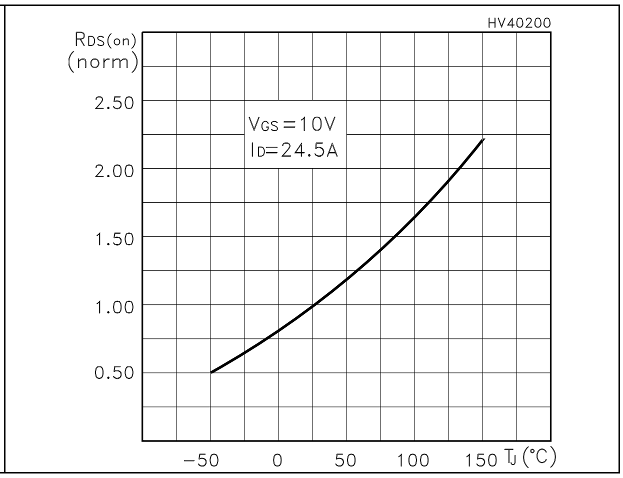
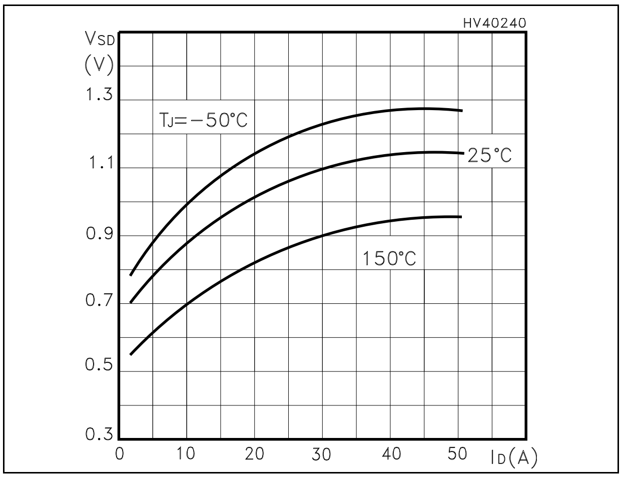


Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Switching times test circuit for resistive load

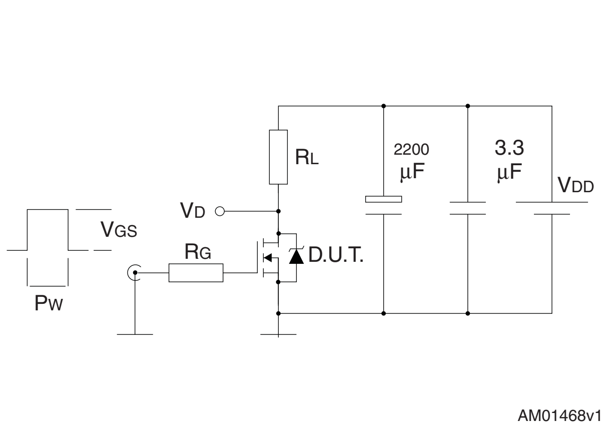


Figure 14. Gate charge test circuit

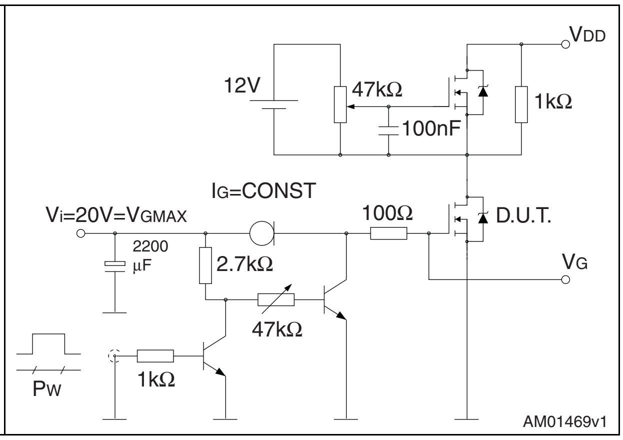


Figure 15. Test circuit for inductive load switching and diode recovery times

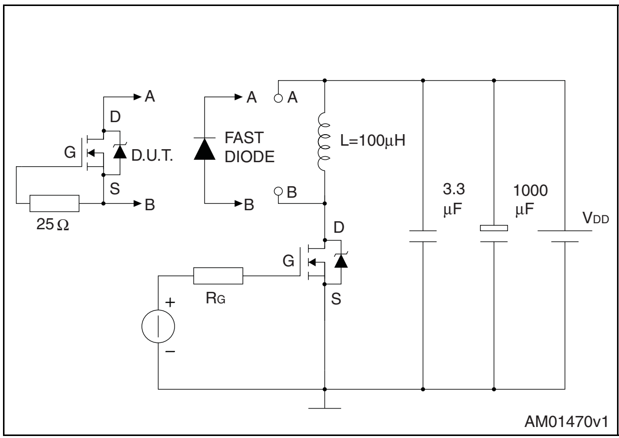


Figure 16. Unclamped inductive load test circuit

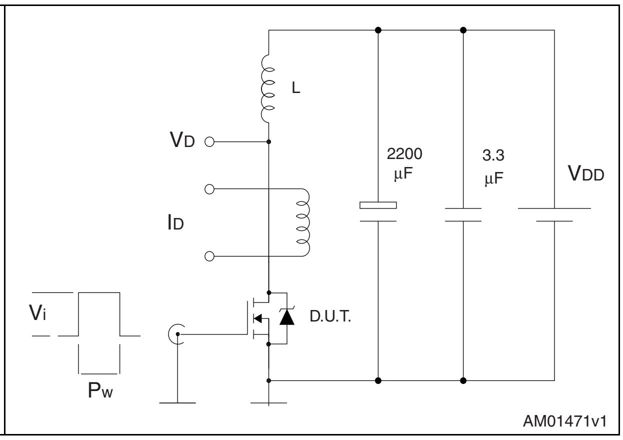


Figure 17. Unclamped inductive waveform

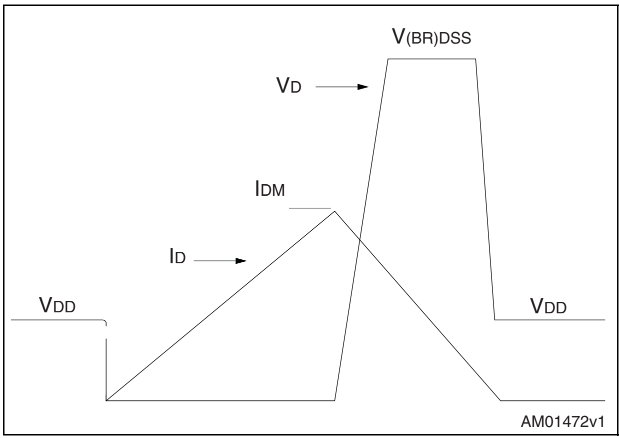
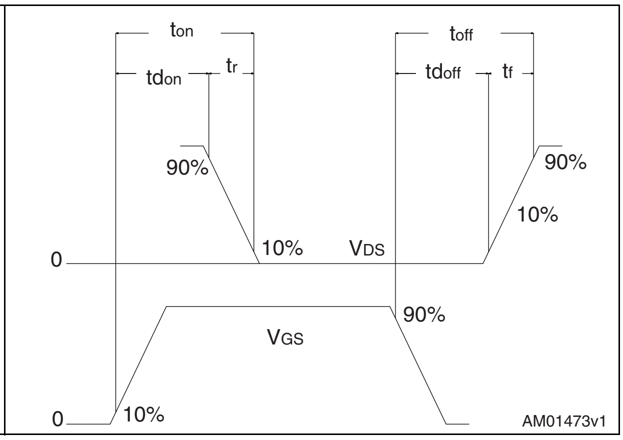


Figure 18. Switching time waveform



4 Package mechanical data

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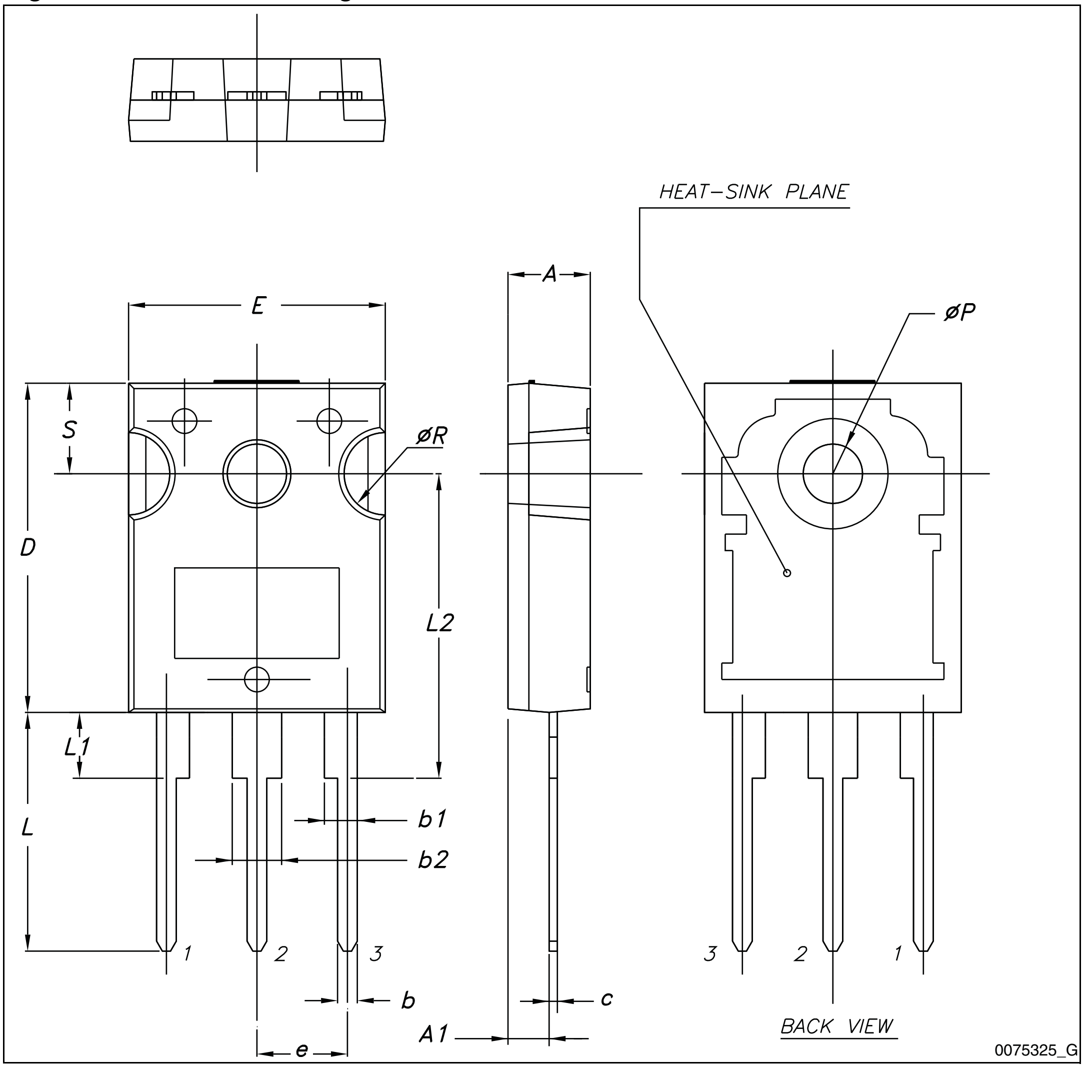
Table 8. TO-247 mechanical data

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 9. Document revision history

Date	Revision	Changes
03-Jun-2011	1	Initial release
19-Dec-2012	2	Updated title on the cover page. Inserted dv/dt parameter in *Table 5.* Updated *Section 4: Package mechanical data*.

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