STW55NM60ND

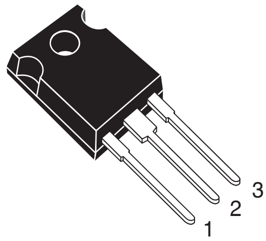
N-channel 600 V, 0.047 Ω typ., 51 A FDmesh™ II Power MOSFET (with fast diode) in a TO-247 package

Datasheet — production data

Features

Type	V_{DSS} (@$T_J$max)	$R_{DS(on)}$ max	I_D
STW55NM60ND	650 V	< 0.060 Ω	51 A

- The worldwide best $R_{DS(on)}$ amongst the fast recovery diode devices in TO-247
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- High dv/dt and avalanche capabilities



TO-247

Application

- Switching applications

Description

This FDmesh™ II Power MOSFET with intrinsic fast-recovery body diode is produced using the second generation of MDmesh™ technology. Utilizing a new strip-layout vertical structure, this revolutionary device features extremely low on-resistance and superior switching performance. It is ideal for bridge topologies and ZVS phase-shift converters.

Figure 1. Internal schematic diagram

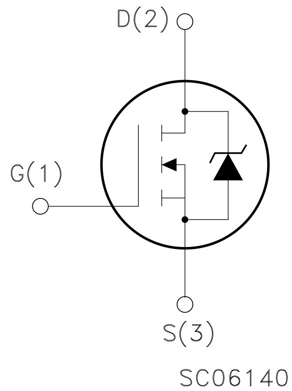


Table 1. Device summary

Order code	Marking	Package	Packaging
STW55NM60ND	55NM60ND	TO-247	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage	600	V
V_{GS}	Gate- source voltage	±25	V
I_D	Drain current (continuous) at T_C = 25 °C	51	A
I_D	Drain current (continuous) at T_C = 100 °C	32	A
I_{DM} (1)	Drain current (pulsed)	204	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. $I_{SD} \leq 51$ 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	Max 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)	1600	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	600			V
dv/dt [(1)]	Drain source voltage slope	V_{DD}=480 V, I_D= 51 A, V_{GS} =10 V		30		V/ns
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 600 V V_{DS} = 600 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 = 25.5 A		0.047	0.060	Ω

1. Characteristic value at turn off on inductive load.

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
g_{fs} [(1)]	Forward transconductance	V_{DS} = 15 V, I_D = 25.5 A		45		S
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0		5800 300 30		pF pF pF
$C_{oss\ eq.}$ [(2)]	Equivalent output capacitance	V_{GS} = 0, V_{DS} = 0 to 480 V		900		pF
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Turn-off delay time Fall time	V_{DD} = 300 V, I_D = 25.5 A R_G = 4.7 Ω, V_{GS} = 10 V *(see Figure 19),* *(see Figure 14)*		33 68 188 96		ns ns ns ns
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 480 V, I_D = 51 A, V_{GS} = 10 V, *(see Figure 15)*		190 30 90		nC nC nC
R_g	Gate input resistance	f=1 MHz Gate DC Bias = 0 Test signal level = 20 mV Open drain		2.5		Ω

1. Pulsed: pulse duration= 300 µs, duty cycle 1.5%
2. $C_{oss\ eq.}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}

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)				51 204	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 51 A, V_{GS} = 0			1.3	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 51 A, V_{DD} = 60 V di/dt = 100 A/µs *(see Figure 16)*		200 1.8 18		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 51 A,V_{DD} = 60 V di/dt = 100 A/µs, T_j = 150 °C *(see Figure 16)*		280 3.4 24		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

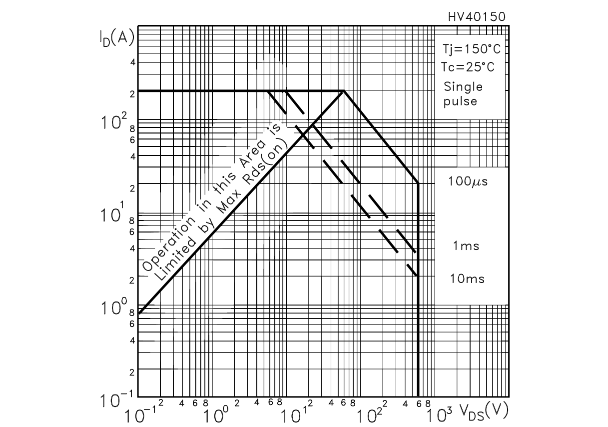


Figure 3. Thermal impedance

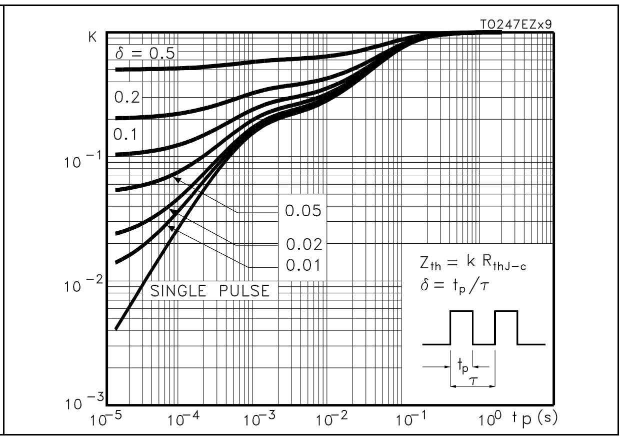


Figure 4. Output characteristics

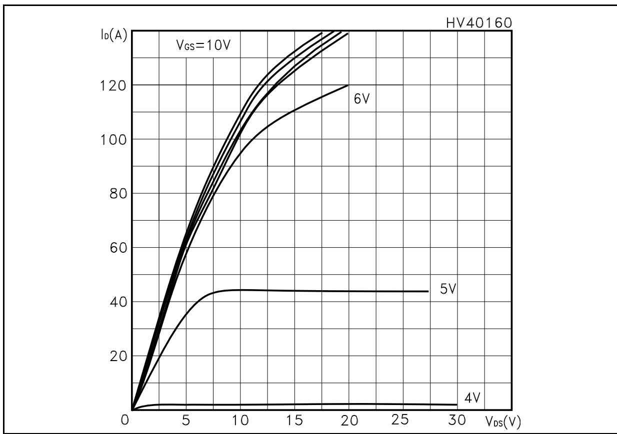


Figure 5. Transfer characteristics

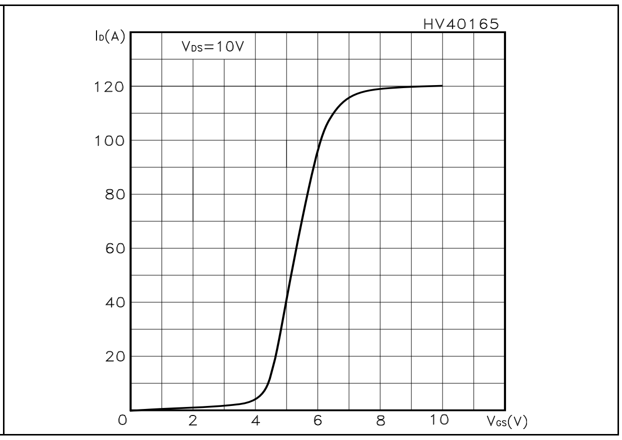


Figure 6. Transconductance

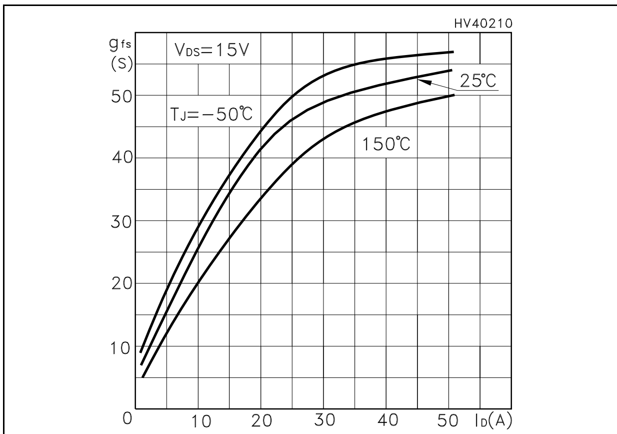


Figure 7. Static drain-source on-resistance

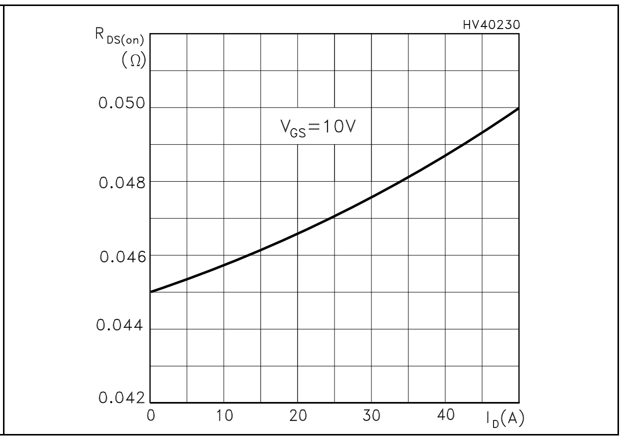


Figure 8. Gate charge vs gate-source voltage

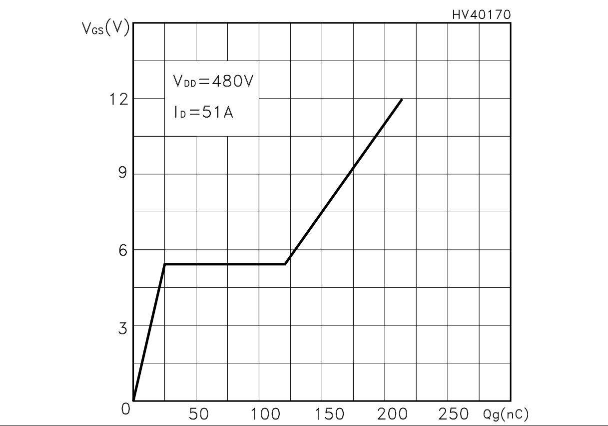


Figure 9. Capacitance variations

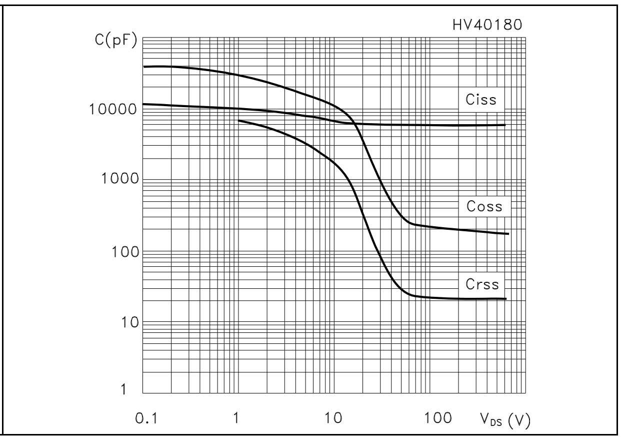


Figure 10. Normalized gate threshold voltage vs temperature

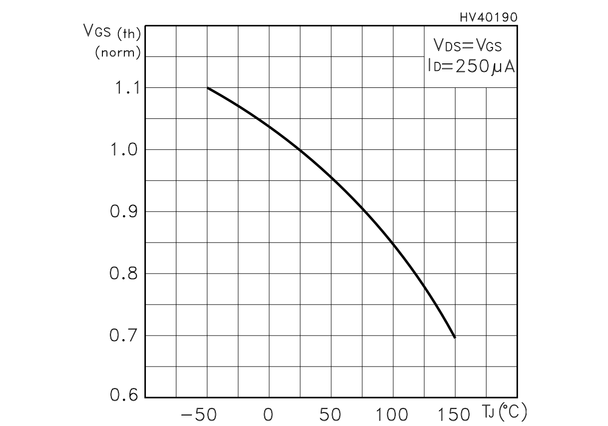


Figure 11. Normalized on resistance vs temperature

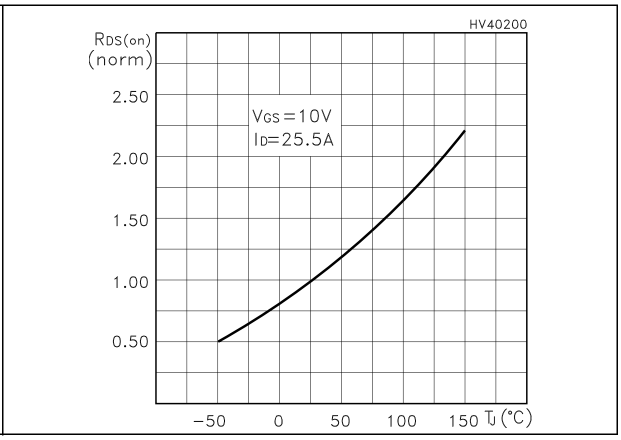


Figure 12. Source-drain diode forward characteristics

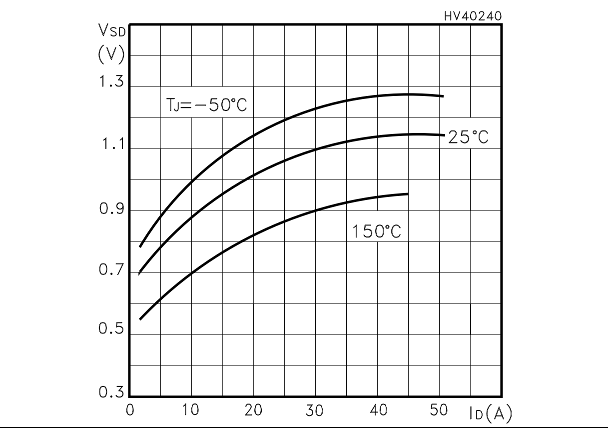
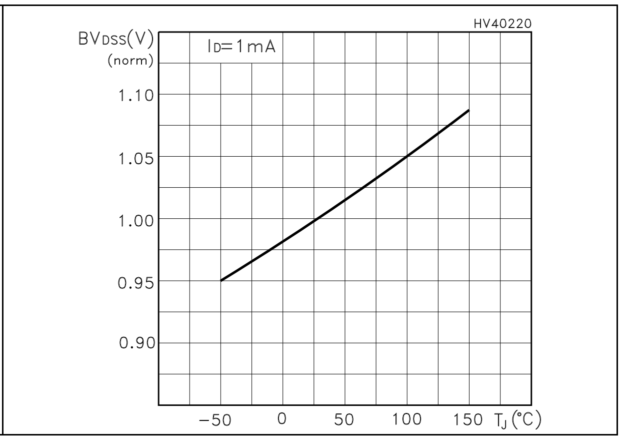


Figure 13. Normalized B_{VDSS} vs temperature



3 Test circuits

Figure 14. Switching times test circuit for resistive load

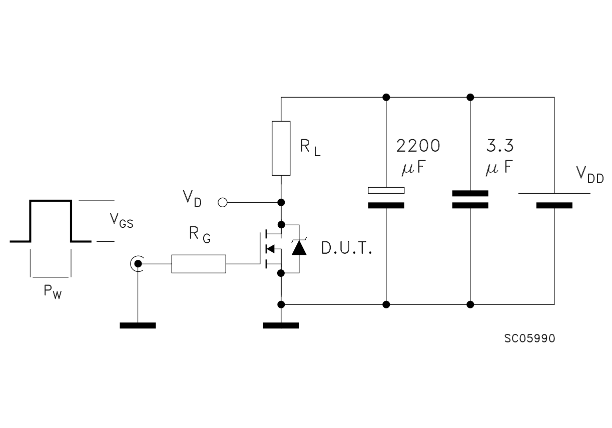


Figure 15. Gate charge test circuit

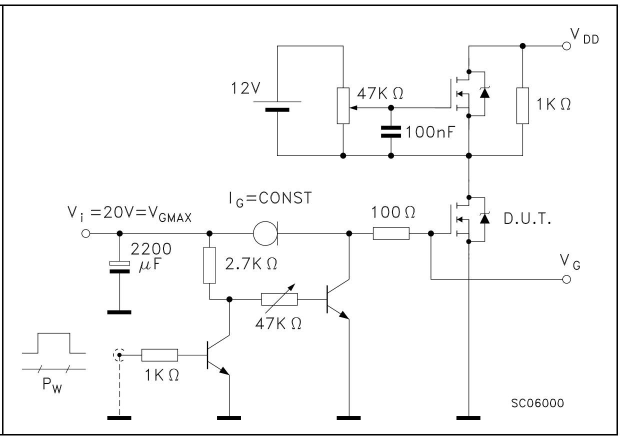


Figure 16. Test circuit for inductive load switching and diode recovery times

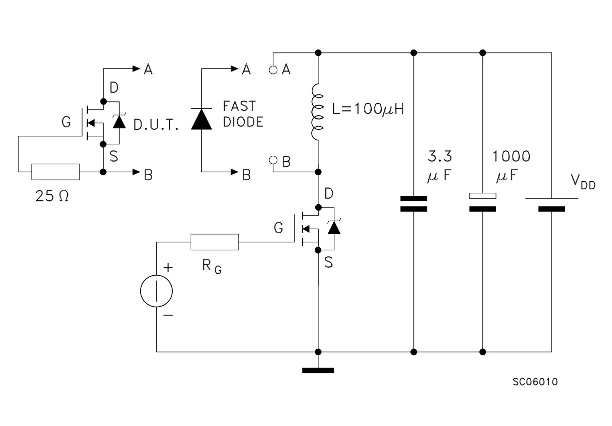


Figure 17. Unclamped Inductive load test circuit

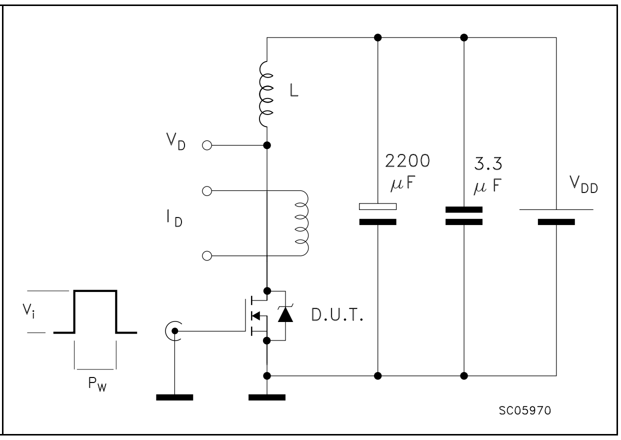


Figure 18. Unclamped inductive waveform

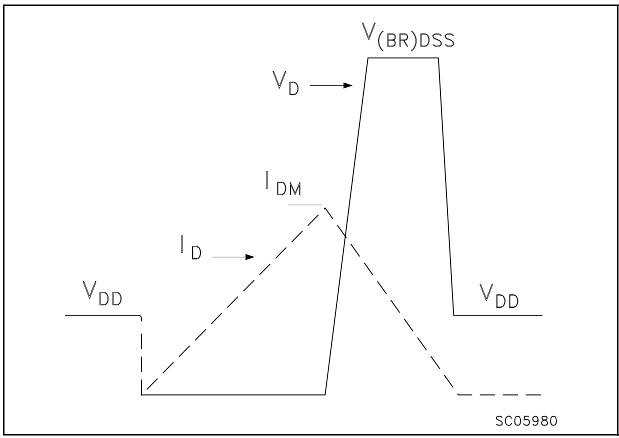
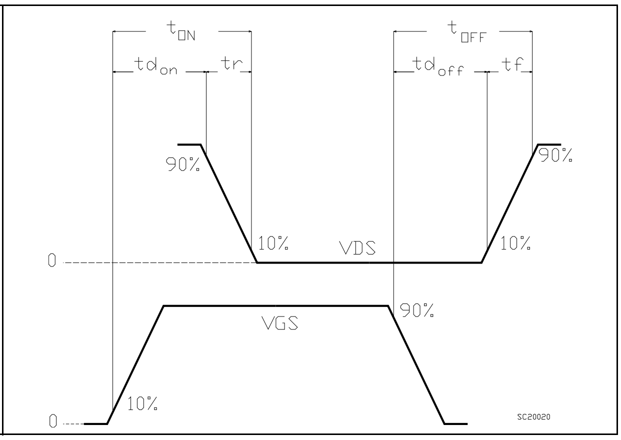


Figure 19. Switching time waveform



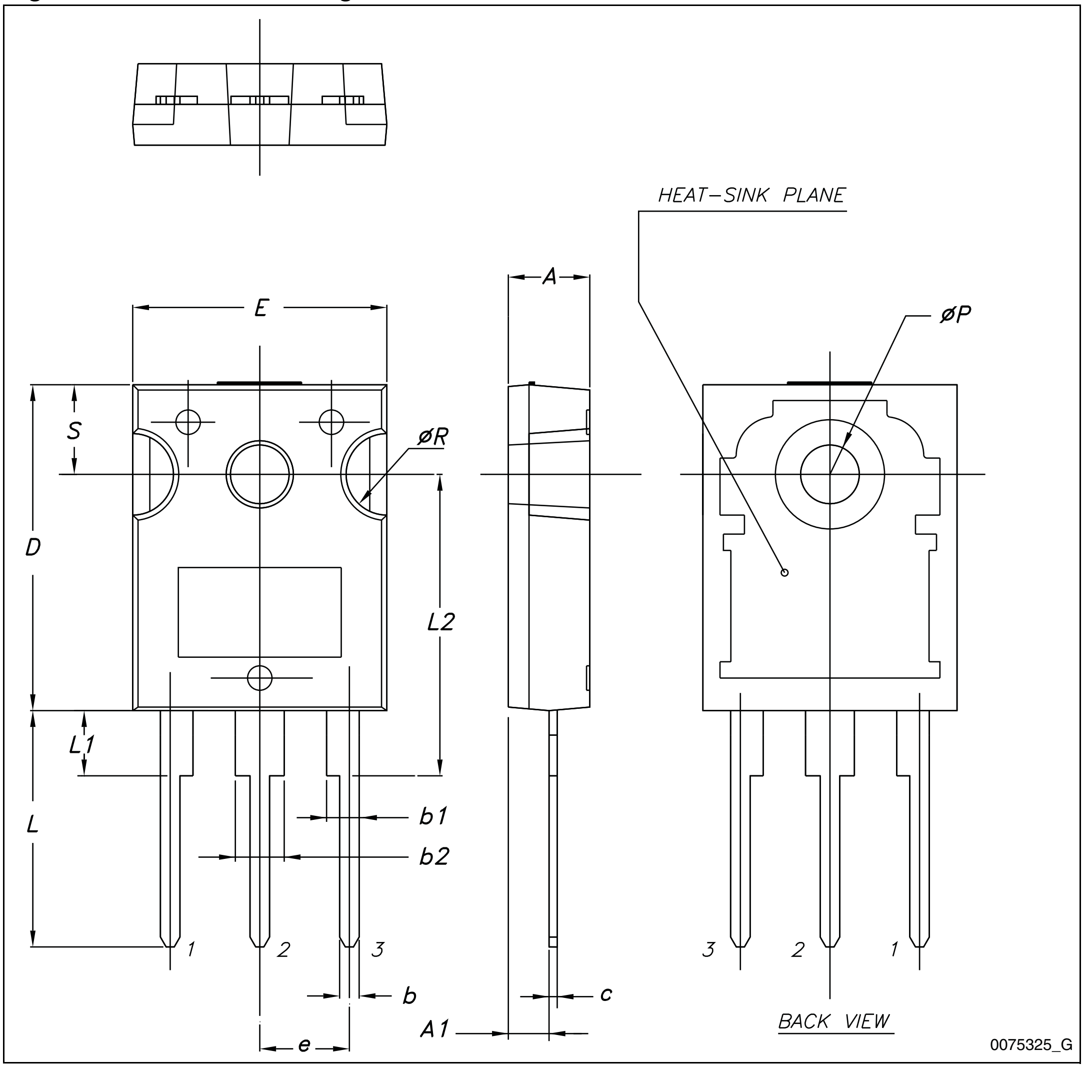
4 Package mechanical data

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 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 20. TO-247 drawing



5 Revision history

Table 9. Document revision history

Date	Revision	Changes
16-Nov-2007	1	First release.
22-Apr-2008	2	Document status promoted from preliminary data to datasheet.
19-Dec-2012	3	Title changed on the cover page. Minor text changes. Updated *Section 4: Package mechanical data*.