



Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



N-channel 600 V, 0.110 Ω typ., 24 A MDmesh™ DM2
Power MOSFET in D²PAK, TO-220 and TO-247 packages

Datasheet - production data

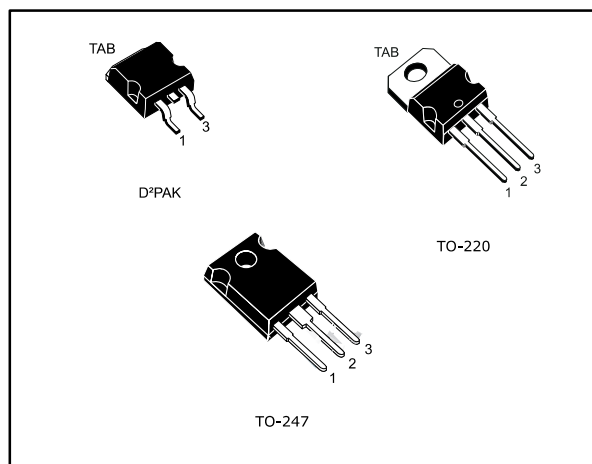
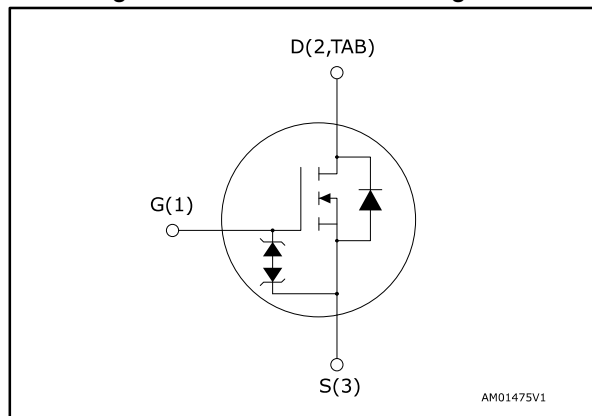


Figure 1: Internal schematic diagram



Features

Order code	V _{DS} @ T _{Jmax.}	R _{DS(on)} max.	I _D
STB33N60DM2	650 V	0.130 Ω	24 A
STP33N60DM2	650 V	0.130 Ω	24 A
STW33N60DM2	650 V	0.130 Ω	24 A

- 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

These high voltage N-channel Power MOSFETs are part of the MDmesh™ DM2 fast recovery diode series. They offer very low recovery charge (Q_{rr}) and time (t_{rr}) combined with low $R_{DS(on)}$, rendering them suitable for the most demanding high efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STB33N60DM2	33N60DM2	D ² PAK	Tape and reel
STP33N60DM2	33N60DM2	TO-220	Tube
STW33N60DM2	33N60DM2	TO-247	Tube

Contents

1	Electrical ratings	3
2	Electrical characteristics	4
	2.1 Electrical characteristics (curves).....	6
3	Test circuits	9
4	Package information	10
	4.1 D ² PAK package information.....	10
	4.2 D ² PAK packing information	13
	4.3 TO-220 type A package information.....	15
	4.4 TO-247 package information.....	17
5	Revision history	19

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 $T_{case} = 25\text{ °C}$	24	A
	Drain current (continuous) at $T_{case} = 100\text{ °C}$	15.5	
$I_{DM}^{(1)}$	Drain current (pulsed)	96	A
P_{TOT}	Total dissipation at $T_{case} = 25\text{ °C}$	190	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	50	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	
T_{stg}	Storage temperature	-55 to 150	°C
T_j	Operating junction temperature		

Notes:

(1) Pulse width is limited by safe operating area.

(2) $I_{SD} \leq 24\text{ A}$, $di/dt=900\text{ A}/\mu\text{s}$; $V_{DS\text{ peak}} < V_{(BR)DSS}$, $V_{DD} = 400\text{ V}$.

(3) $V_{DS} \leq 480\text{ V}$.

Table 3: Thermal data

Symbol	Parameter	Value			Unit
		D ² PAK	TO-220	TO-247	
$R_{thj-case}$	Thermal resistance junction-case	0.66			°C/W
$R_{thj-pcb}$	Thermal resistance junction-pcb ⁽¹⁾	30			
$R_{thj-amb}$	Thermal resistance junction-ambient		62.5	50	

Notes:

(1) When mounted on 1 inch² FR-4, 2 Oz copper board.

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (Pulse width limited by T_{jmax})	5.5	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	570	mJ

2 Electrical characteristics

($T_{\text{case}} = 25\text{ °C}$ unless otherwise specified)

Table 5: Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$			1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_{\text{case}} = 125\text{ °C}$			100	
I_{GSS}	Gate-body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$			± 10	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	$V_{GS} = 10\text{ V}$, $I_D = 12\text{ A}$		0.110	0.130	Ω

Table 6: Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1870	-	pF
C_{oss}	Output capacitance		-	87	-	
C_{rss}	Reverse transfer capacitance		-	2	-	
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DD} = 480\text{ V}$, $V_{GS} = 0\text{ V}$	-	157	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$, $I_D = 0\text{ A}$	-	4.5	-	Ω
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 24\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 19: "Test circuit for gate charge behavior" and Figure 23: "Switching time waveform")	-	43	-	nC
Q_{gs}	Gate-source charge		-	9.8	-	
Q_{gd}	Gate-drain charge		-	21	-	

Notes:

⁽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 80% V_{DSS} .

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 12\text{ A}$ $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 18: "Test circuit for resistive load switching times" and)	-	17	-	ns
t_r	Rise time		-	8	-	
$t_{d(off)}$	Turn-off delay time		-	62	-	
t_f	Fall time		-	9	-	

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		24	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		96	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0 \text{ V}$, $I_{SD} = 24 \text{ A}$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 24 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$ (see Figure 20 : "Test circuit for inductive load switching and diode recovery times")	-	150		ns
Q_{rr}	Reverse recovery charge		-	0.5		μC
I_{RRM}	Reverse recovery current		-	8.8		A
t_{rr}	Reverse recovery time	$I_{SD} = 24 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, $T_j = 150 \text{ }^\circ\text{C}$ (see Figure 20 : "Test circuit for inductive load switching and diode recovery times")	-	316		ns
Q_{rr}	Reverse recovery charge		-	2.85		μC
I_{RRM}	Reverse recovery current		-	18		A

Notes:

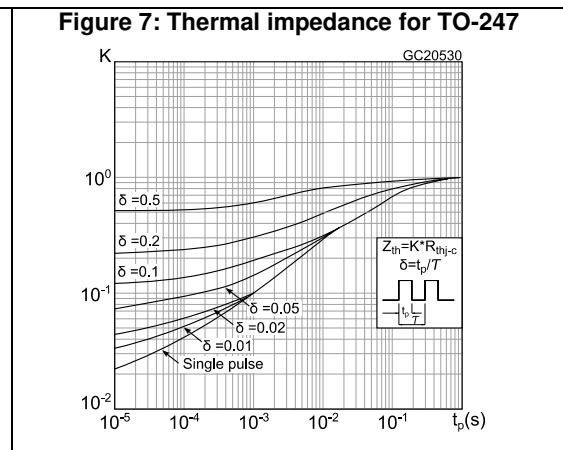
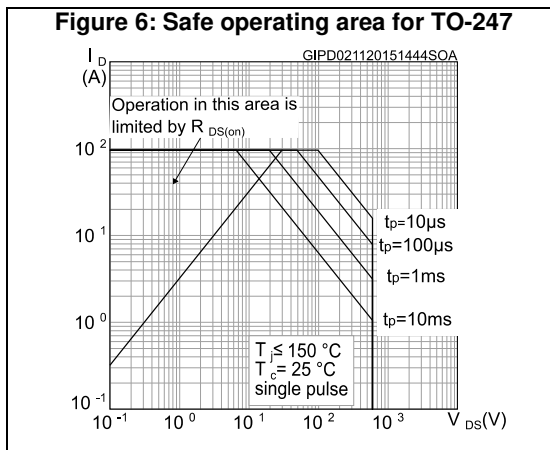
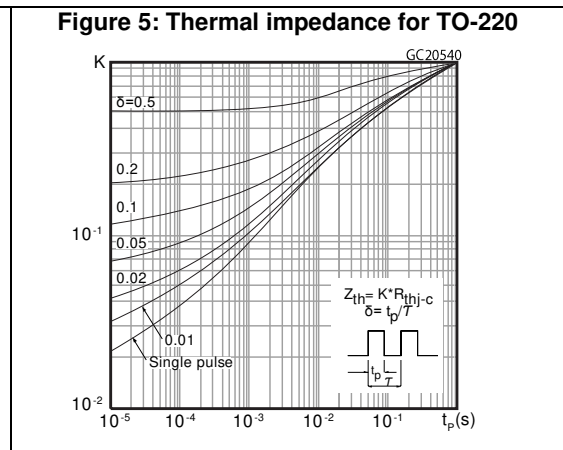
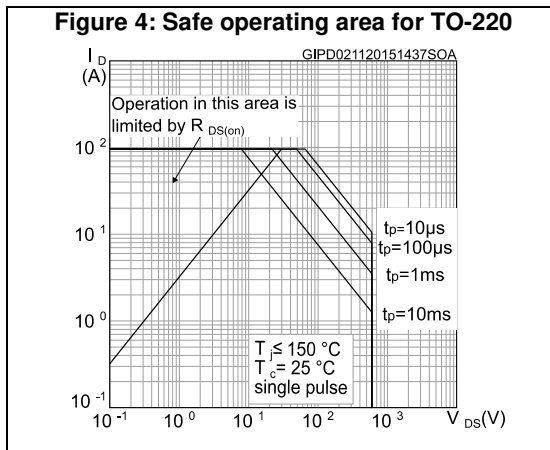
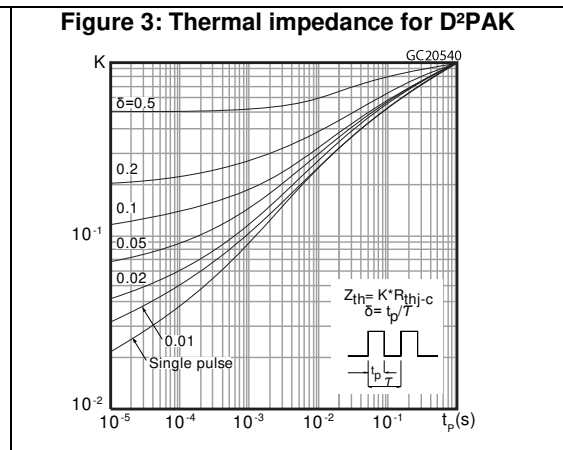
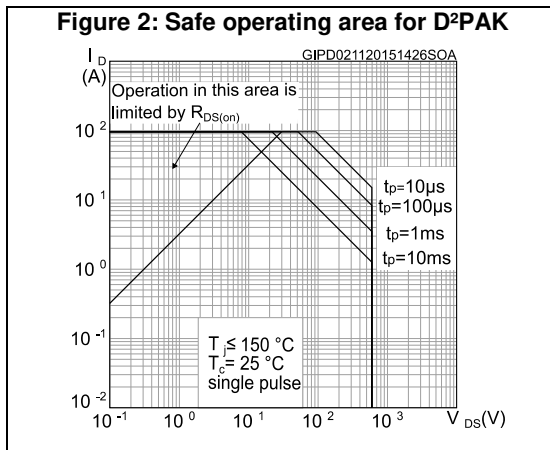
(1) Pulse width is limited by safe operating area.

(2) Pulse test: pulse duration = 300 μs , duty cycle 1.5%.

Table 9: Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 250 \mu\text{A}$, $I_D = 0 \text{ A}$	± 30	-	-	V

2.1 Electrical characteristics (curves)



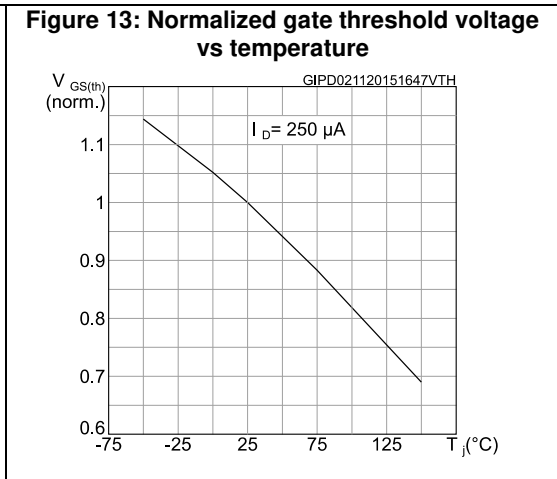
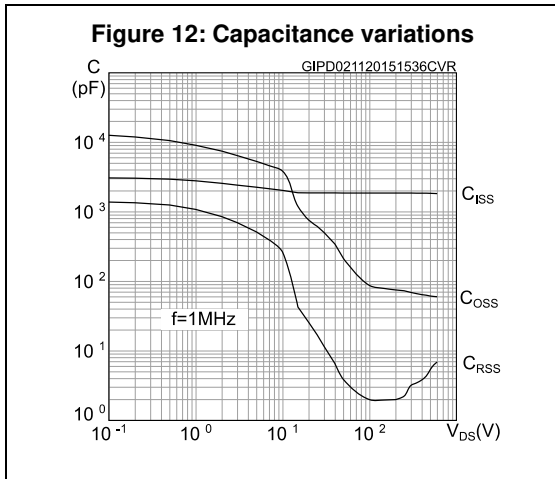
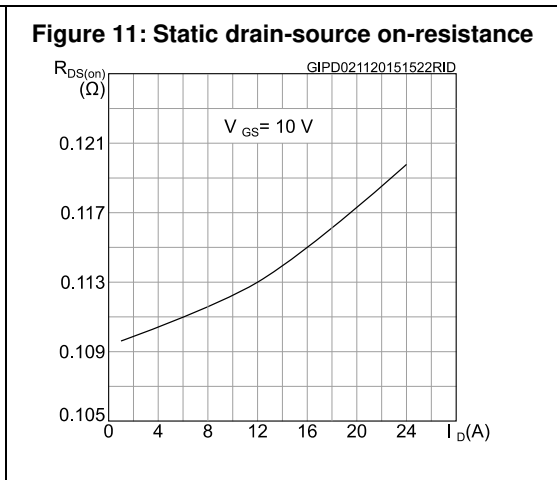
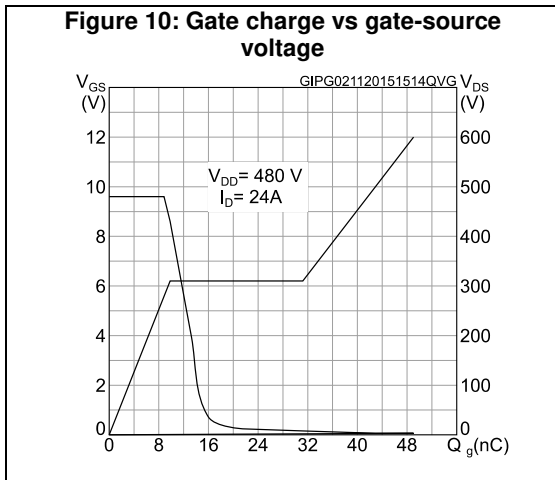
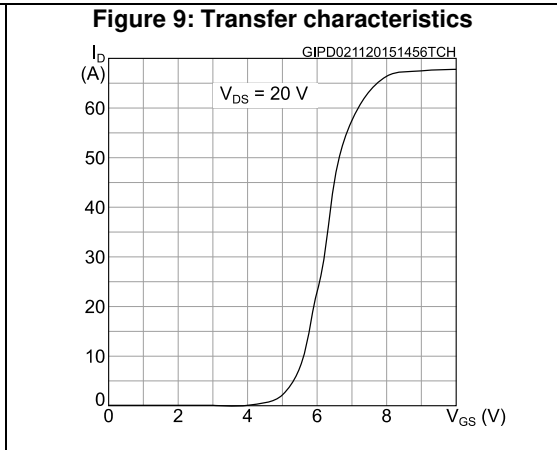
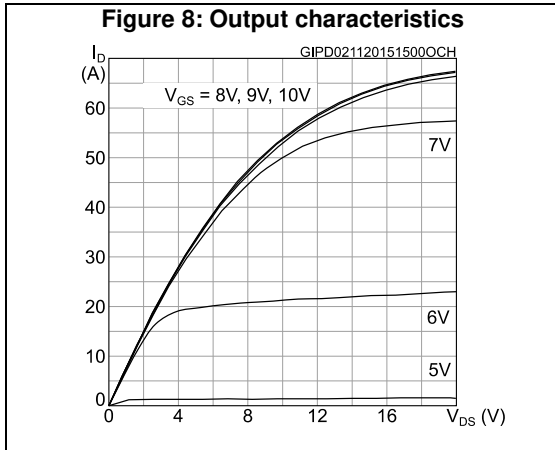


Figure 14: Normalized on-resistance vs temperature

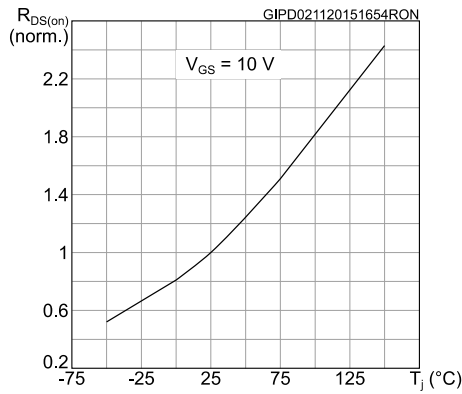


Figure 15: Normalized $V(BR)_{DSS}$ vs temperature

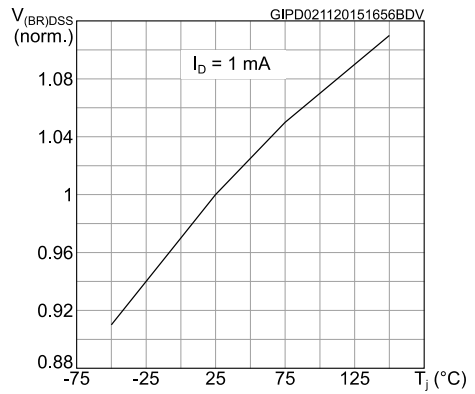


Figure 16: Output capacitance stored energy

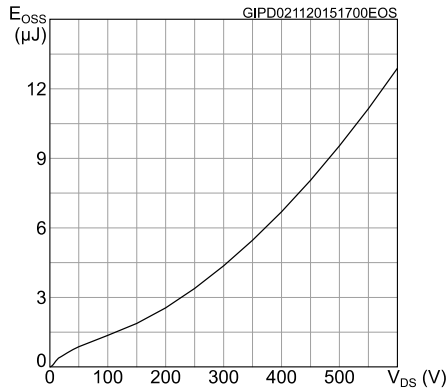
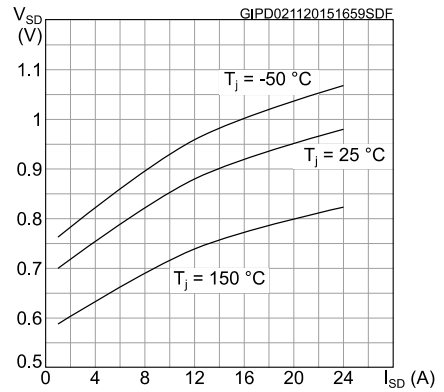
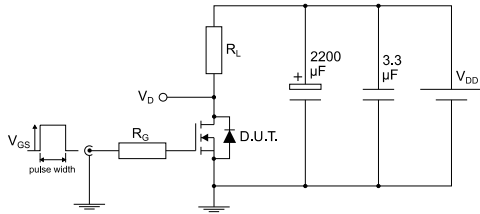


Figure 17: Source-drain diode forward characteristics



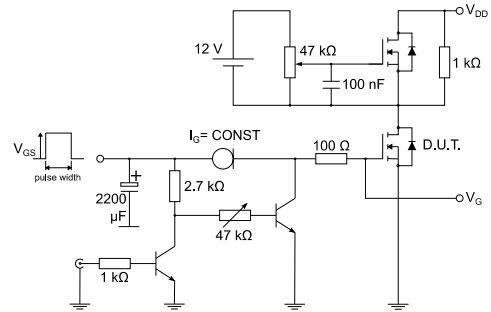
3 Test circuits

Figure 18: Test circuit for resistive load switching times



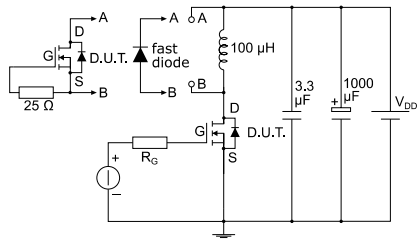
AM01468v1

Figure 19: Test circuit for gate charge behavior



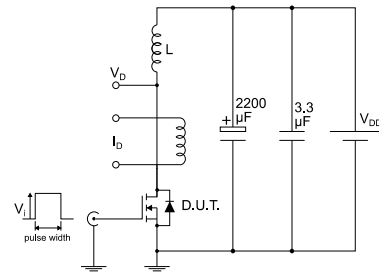
AM01469v1

Figure 20: Test circuit for inductive load switching and diode recovery times



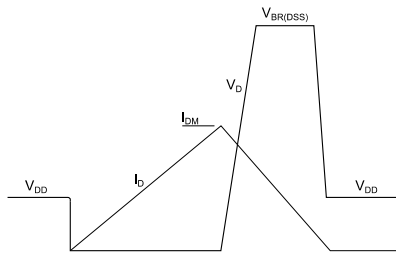
AM01470v1

Figure 21: Unclamped inductive load test circuit



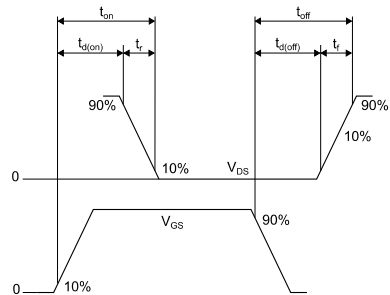
AM01471v1

Figure 22: Unclamped inductive waveform



AM01472v1

Figure 23: Switching time waveform



AM01473v1

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 D²PAK package information

Figure 24: D²PAK (TO-263) type A package outline

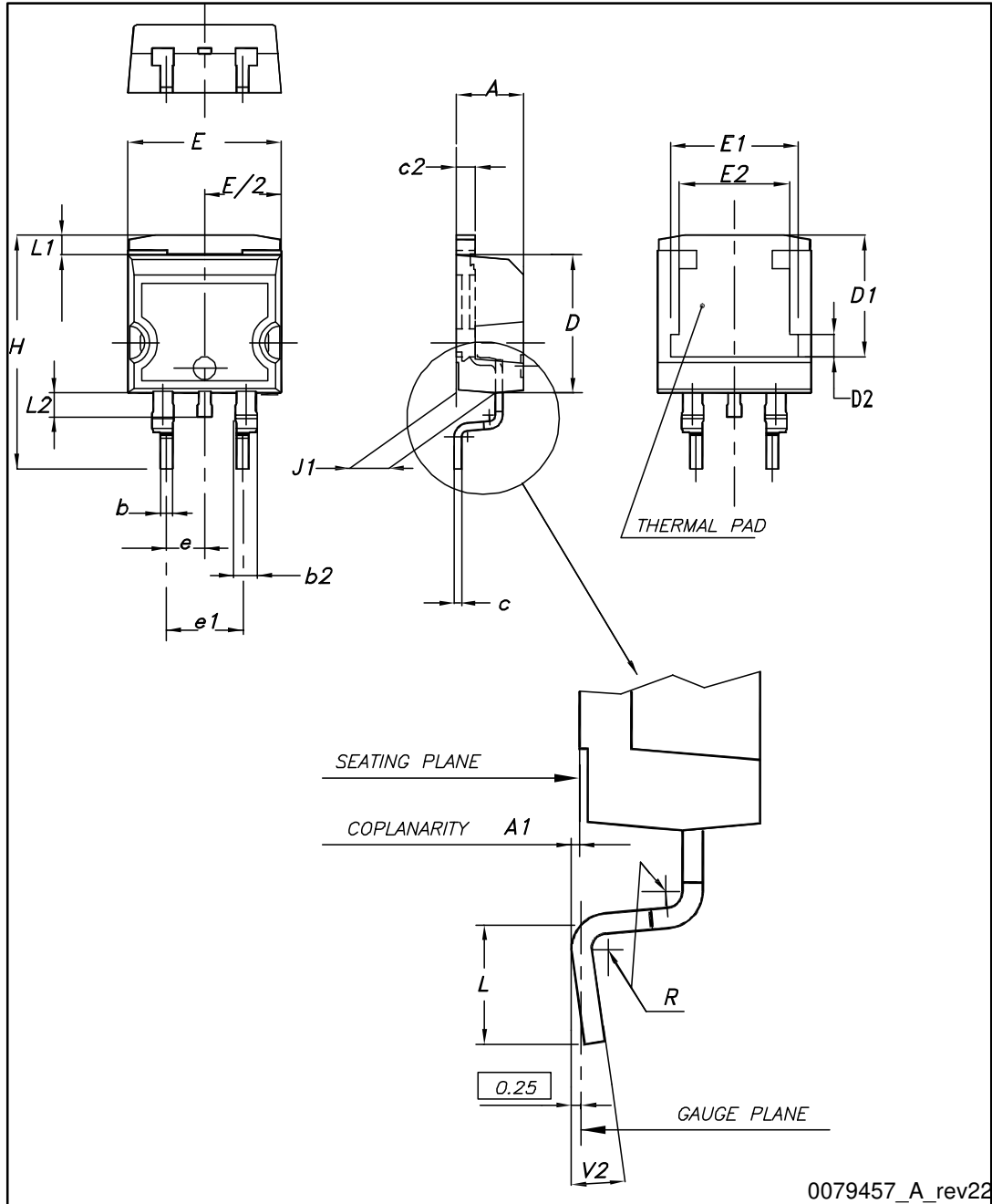
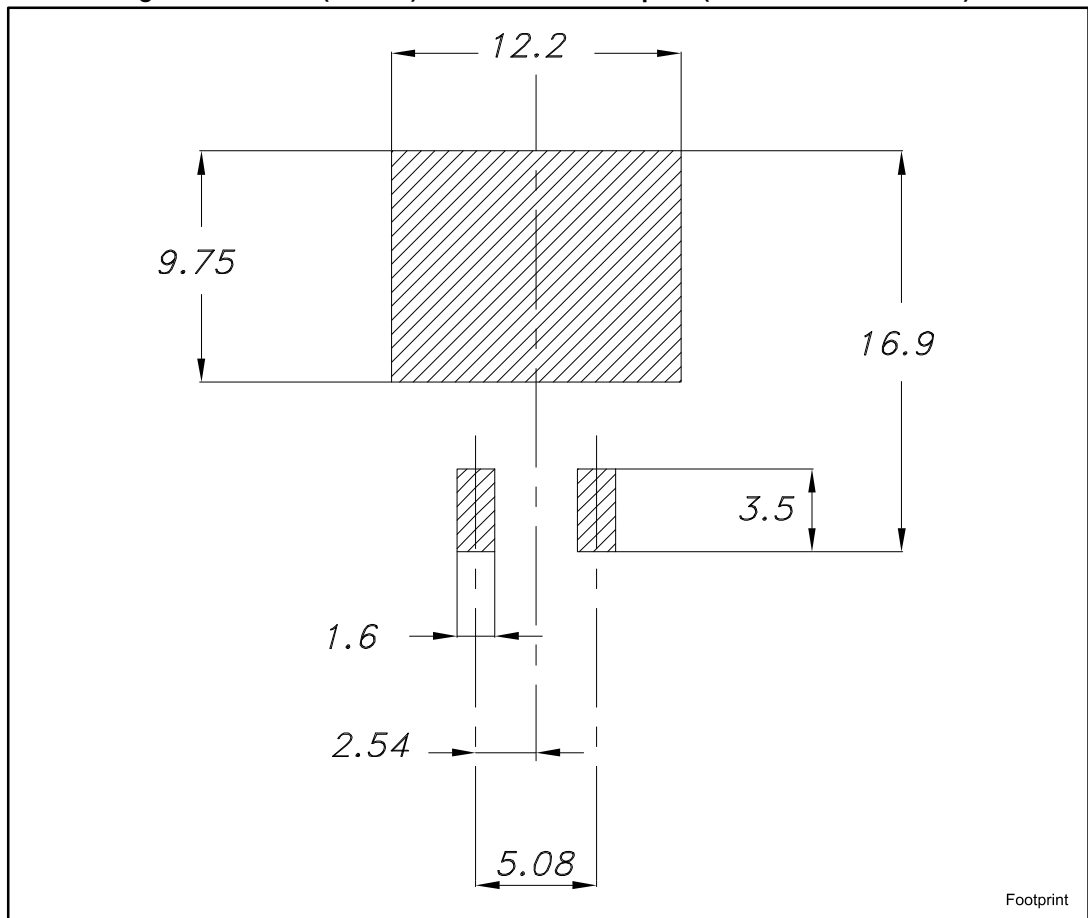


Table 10: D²PAK (TO-263) type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10		10.40
E1	8.50	8.70	8.90
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

Figure 25: D²PAK (TO-263) recommended footprint (dimensions are in mm)



4.2 D²PAK packing information

Figure 26: Tape outline

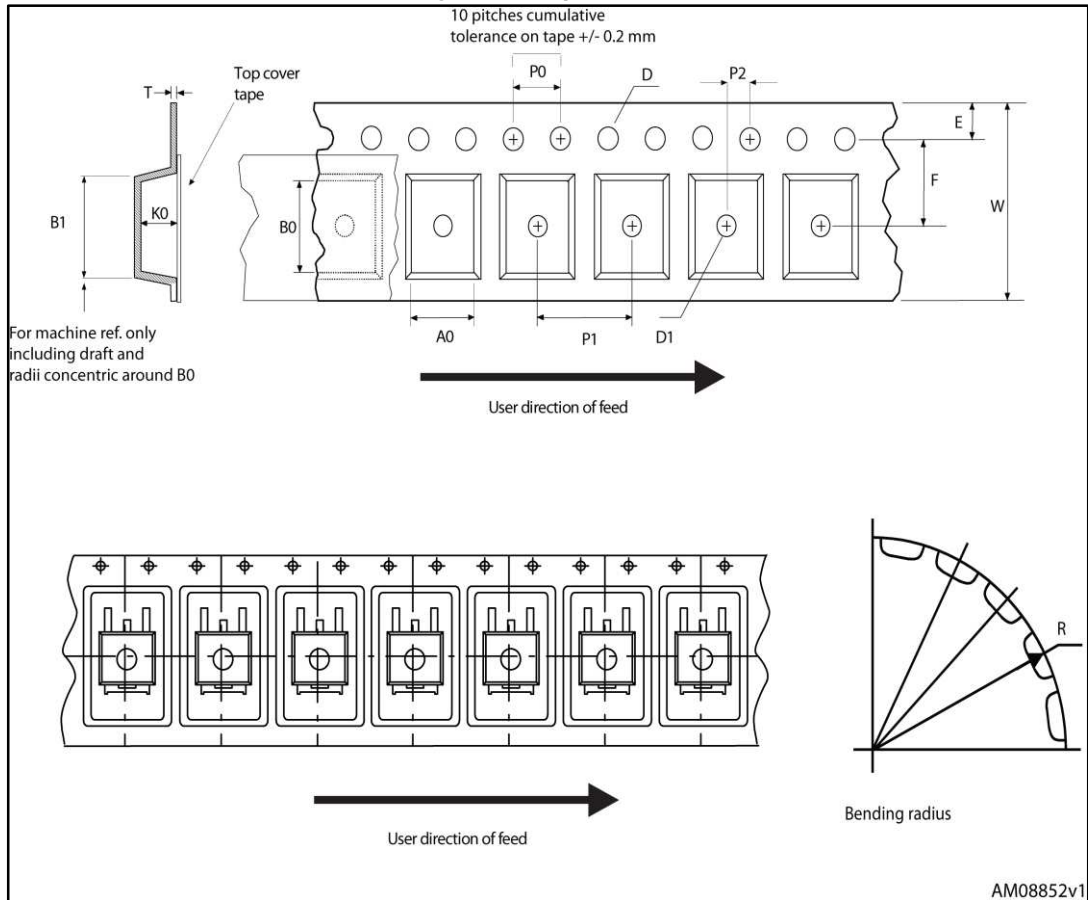


Figure 27: Reel outline

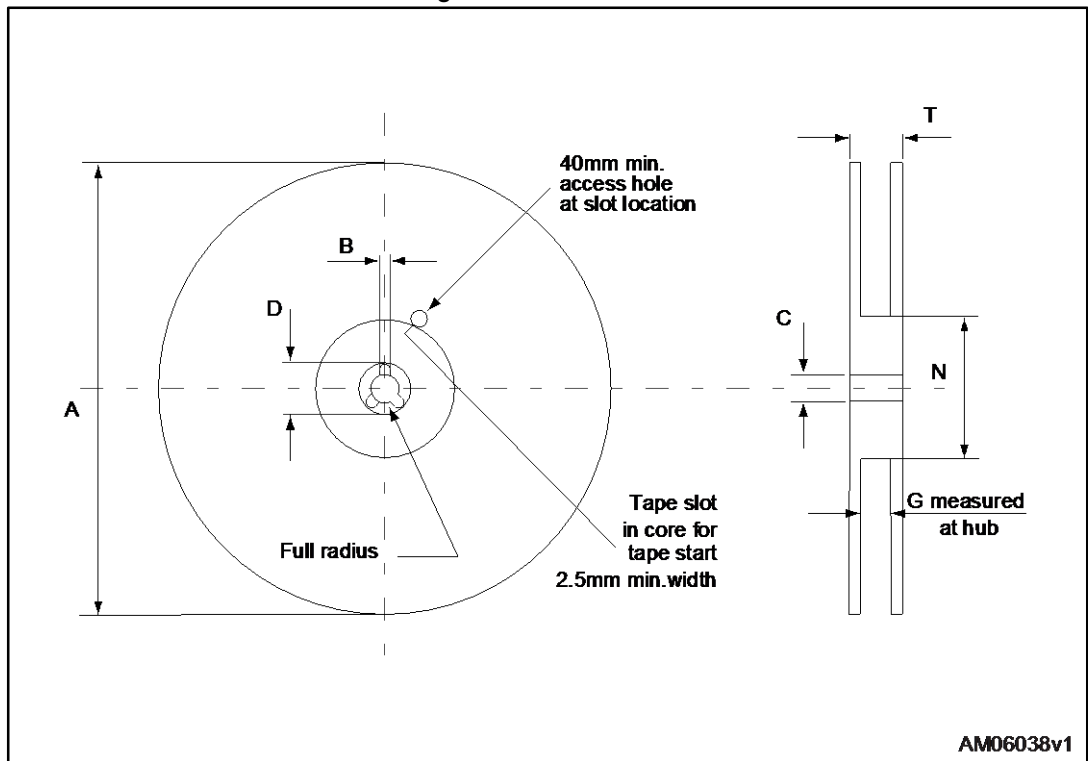


Table 11: D²PAK tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

4.3 TO-220 type A package information

Figure 28: TO-220 type A package outline

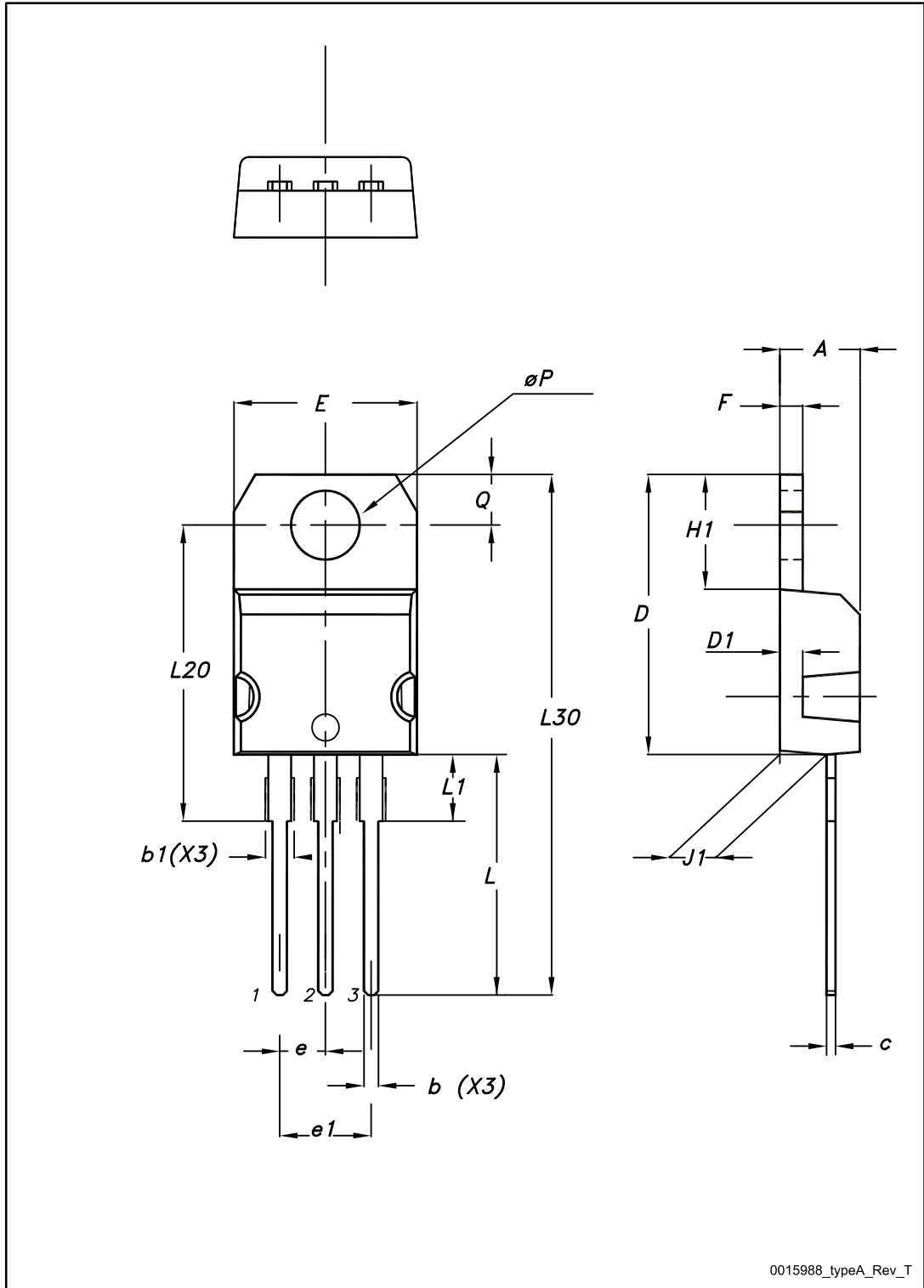


Table 12: TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

4.4 TO-247 package information

Figure 29: TO-247 package outline

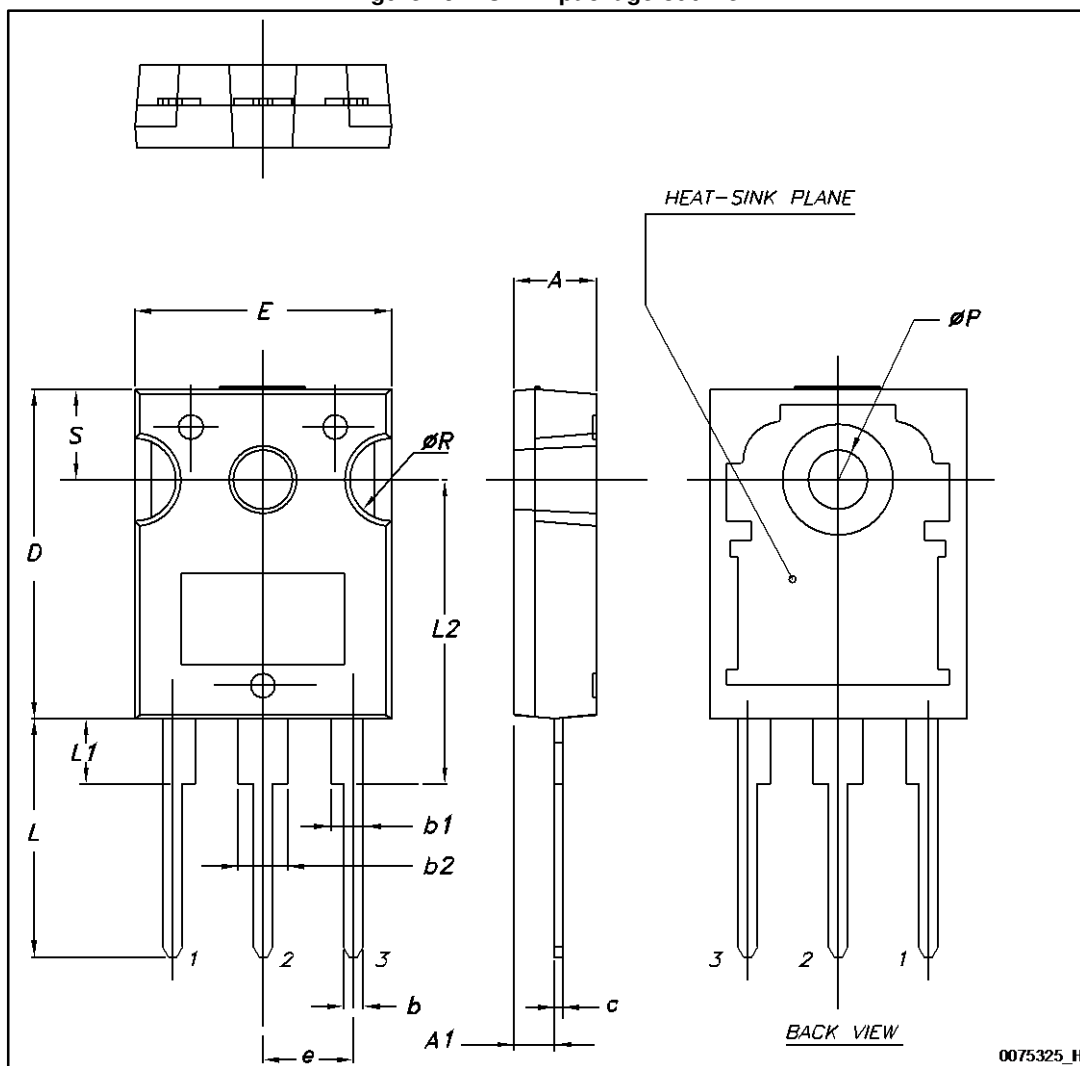


Table 13: TO-247 package mechanical data

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

5 Revision history

Table 14: Document revision history

Date	Revision	Changes
16-Oct-2014	1	First release.
02-Nov-2015	2	Document status promoted from preliminary to production data. Updated title and features in cover page. Updated <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 4: "Avalanche characteristics"</i> , <i>Table 5: "Static"</i> , <i>Table 6: "Dynamic"</i> , <i>Table 7: "Switching times"</i> and <i>Table 8: "Source-drain diode"</i> . Added <i>Section 2.1 Electrical characteristics (curves)</i> .

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2015 STMicroelectronics – All rights reserved