STDLED623, STULED623

N-channel 620 V, 3.0 Ω typ., 3.0 A Power MOSFET in DPAK and IPAK packages

Datasheet - production data

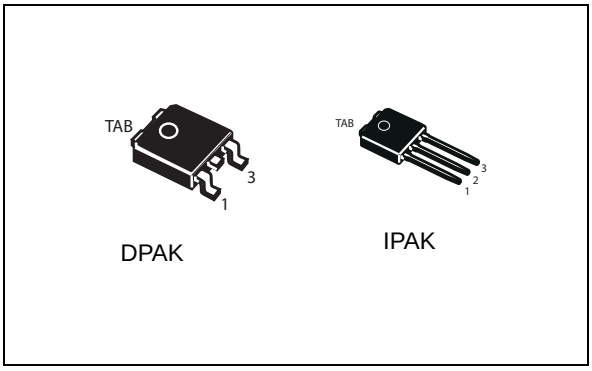
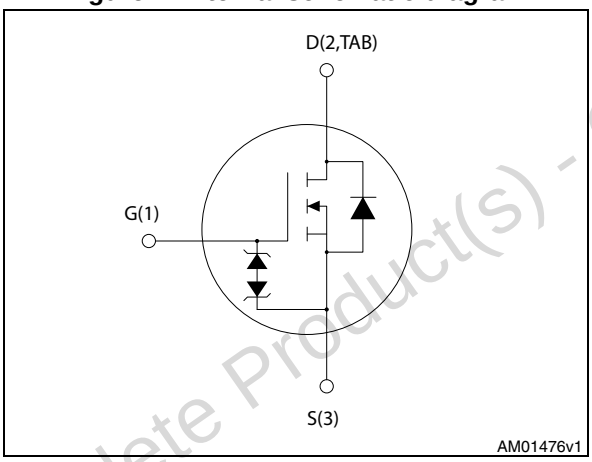


Figure 1. Internal schematic diagram



Features

Order codes	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STDLED623	620 V	< 3.6 Ω	3.0 A	45 W
STULED623				

- 100% avalanche tested
- Extremely high dv/dt capability
- Very low intrinsic capacitance
- Improved diode reverse recovery characteristics
- Zener-protected

Applications

- LED lighting applications

Description

These Power MOSFETs boast extremely low on-resistance, superior dynamic performance and high avalanche capability, making them suitable for the buck-boost and flyback topology.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STDLED623	LED623	DPAK	Tape and reel
STULED623		IPAK	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source voltage (V_{GS} = 0)	620	V
V_{GS}	Gate-source voltage	± 30	V
I_D	Drain current (continuous) at T_C = 25 °C	3.0	A
I_D	Drain current (continuous) at T_C = 100 °C	3.0	A
I_{DM}(1)	Drain current (pulsed)	12	A
P_{TOT}	Total dissipation at T_C = 25 °C	45	W
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max.)	0.36	W/°C
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, VDD = 50 V)	85	kV
dv/dt(2)	Peak diode recovery voltage slope	12	V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)		V
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} ≤ 2.2 A, di/dt ≤ 400 A/µs, V_{DS} peak ≤ $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value		Unit
		DPAK	IPAK	
$R_{thj\text{-}case}$	Thermal resistance junction-case max.	2.78	6.25	°C/W
$R_{thj\text{-}pcb}$(1)	Thermal resistance junction-pcb max.	50		°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-amb max.		100	°C/W

1. When mounted on 1 inch² FR-4 board, 2 oz Cu.

Table 4. Avalanche characteristics

Symbol	Parameter	Max. value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max.)	2.7	A
E_{AS}	Single pulse avalanche energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	100	mJ

2 Electrical characteristics

(T_C = 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	620			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 620 V V_{DS} = 620 V, T_C = 125 °C			1 50	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 20 V			± 10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 50 µA	3	3.6	4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 1.1 A		3	3.6	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	350	-	pF
C_{oss}	Output capacitance		-	27	-	pF
C_{rss}	Reverse transfer capacitance		-	4.4	-	pF
$C_{o(tr)}$(1)	Equivalent capacitance time related	V_{GS} = 0, V_{DS} = 0 to 496 V	-	17	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	5	-	Ω
Q_g	Total gate charge	V_{DD} = 496 V, I_D = 2.7 A, V_{GS} = 10 V (see *Figure 16*)	-	15.5	-	nC
Q_{gs}	Gate-source charge		-	3.2	-	nC
Q_{gd}	Gate-drain charge		-	9.8	-	nC

1. Time related 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} = 310 V, I_D =1.1 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 15*)	-	8	-	ns
t_r	Rise time		-	4.4	-	ns
$t_{d(off)}$	Turn-off-delay time		-	21	-	ns
t_f	Fall time		-	22	-	ns

Table 8. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		2.2	A
I_{SDM}(1)	Source-drain current (pulsed)		-		8.8	A
V_{SD}(2)	Forward on voltage	I_{SD} = 2.2 A, V_{GS} = 0	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 2.2 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 20*)	-	200		ns
Q_{rr}	Reverse recovery charge		-	900		nC
I_{RRM}	Reverse recovery current		-	9		A
t_{rr}	Reverse recovery time	I_{SD} = 2.2 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see *Figure 20*)	-	240		ns
Q_{rr}	Reverse recovery charge		-	1150		nC
I_{RRM}	Reverse recovery current		-	10		A

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

Table 9. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
BV_{GSO}	Gate-source breakdown voltage	I_{GS} = ± 1 mA (open drain)	30	-	-	V

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for DPAK and IPAK

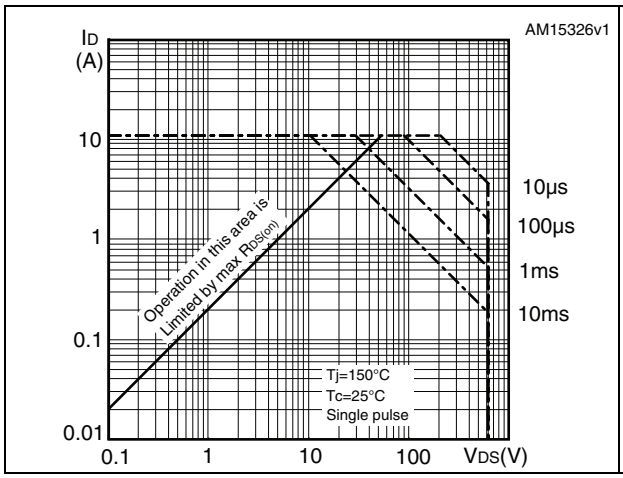


Figure 3. Thermal impedance for DPAK and IPAK

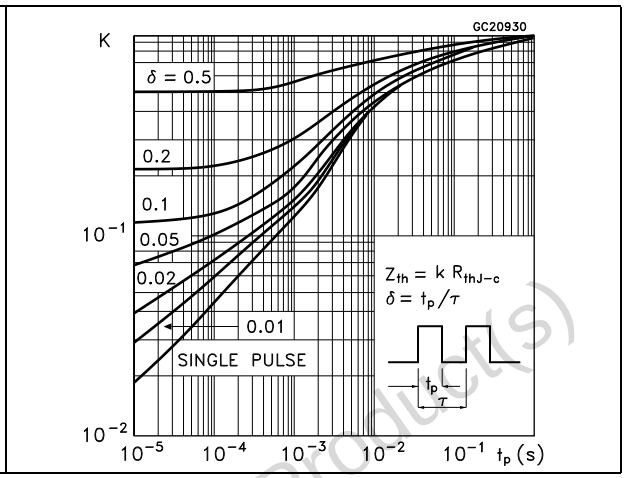


Figure 4. Output characteristics

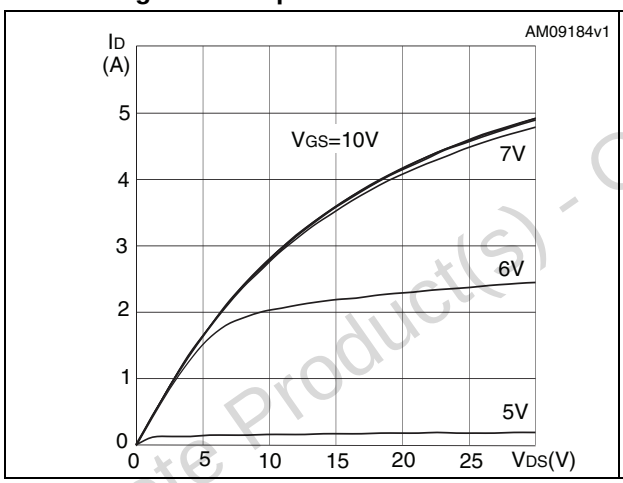


Figure 5. Transfer characteristics

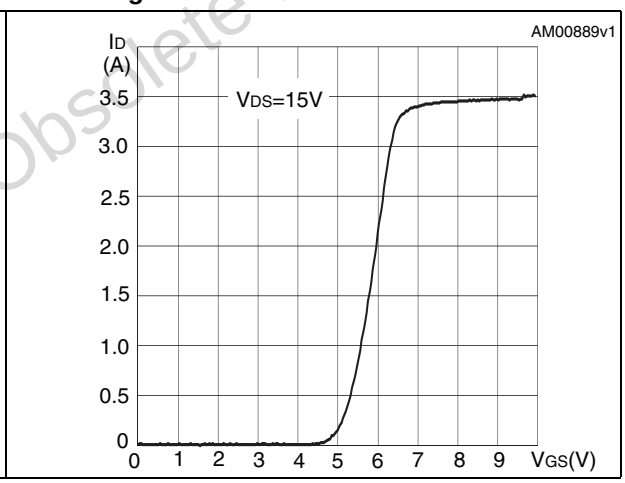


Figure 6. Gate charge vs gate-source voltage

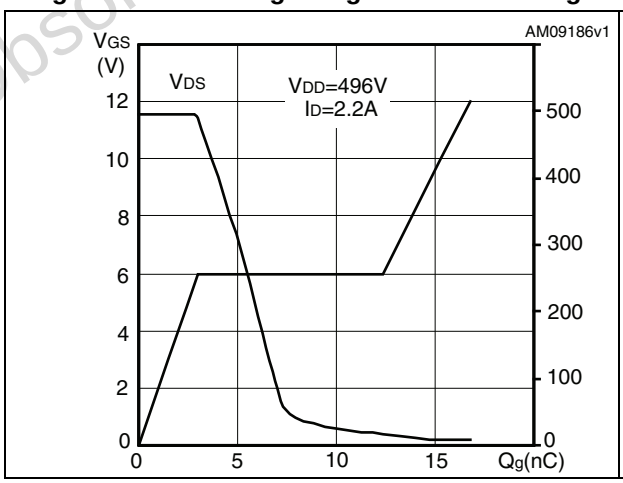


Figure 7. Static drain-source on-resistance

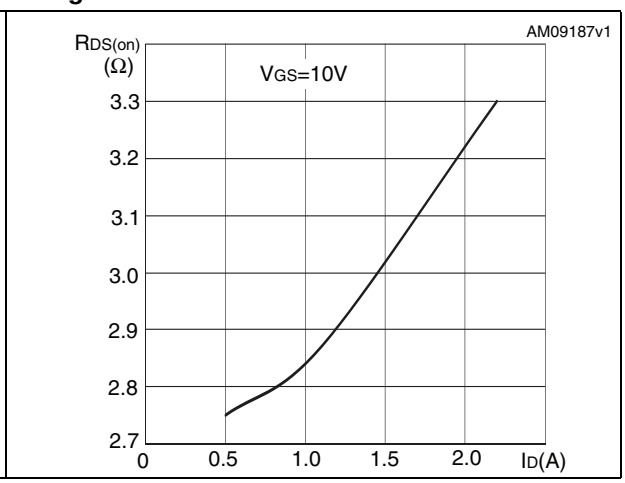


Figure 8. Capacitance variations

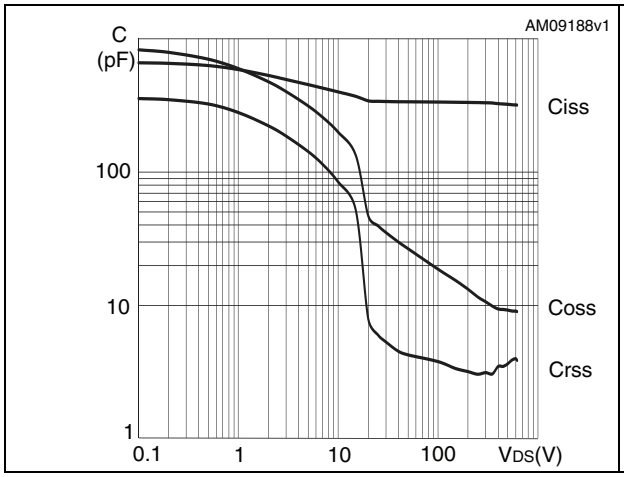


Figure 9. Output capacitance stored energy

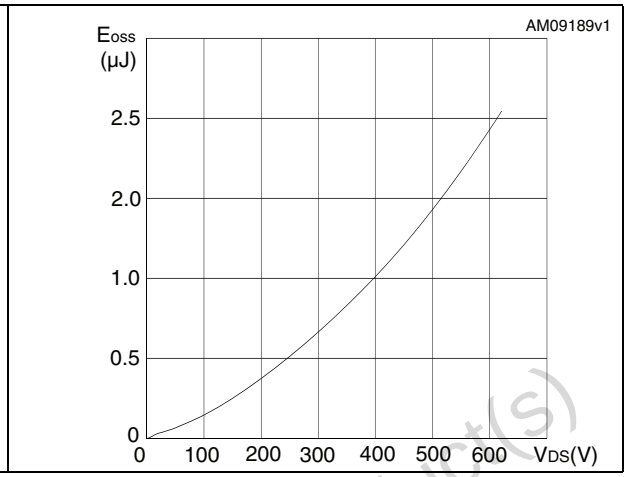


Figure 10. Normalized gate threshold voltage vs temperature

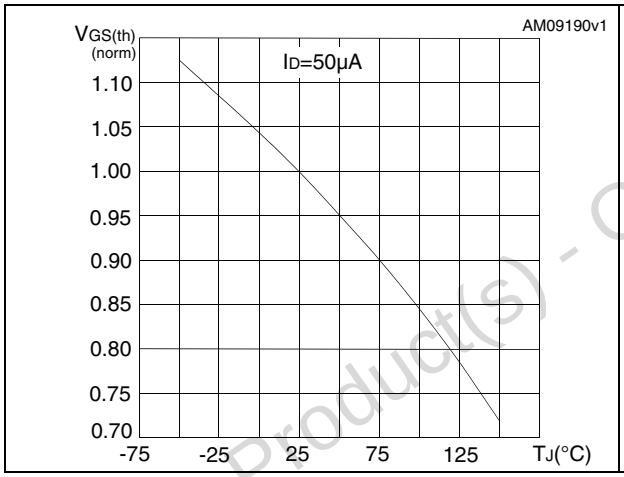


Figure 11. Normalized on-resistance vs temperature

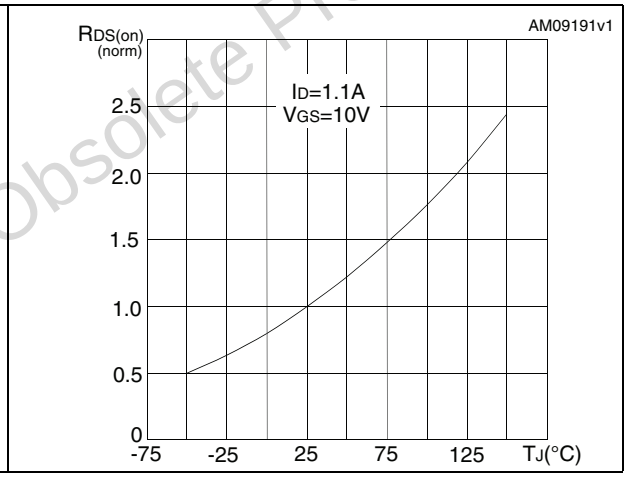


Figure 12. Source-drain diode forward characteristics

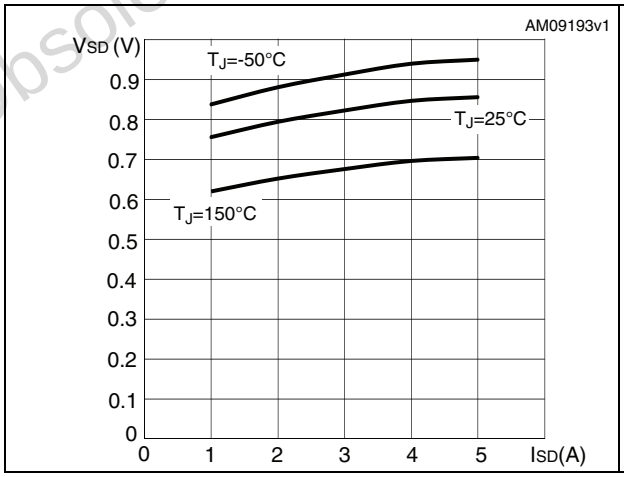


Figure 13. Maximum avalanche energy vs temperature

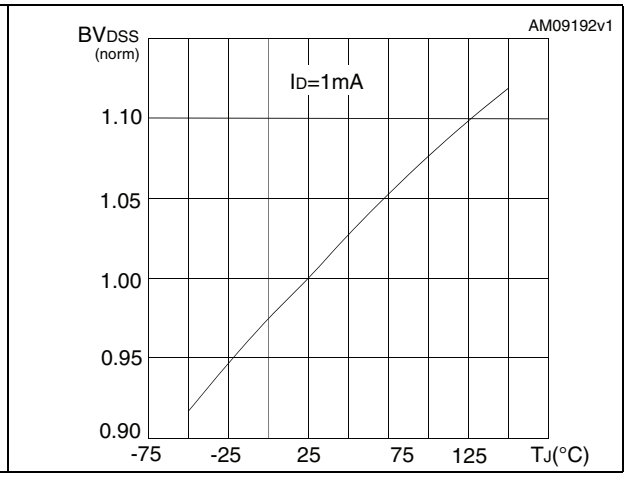
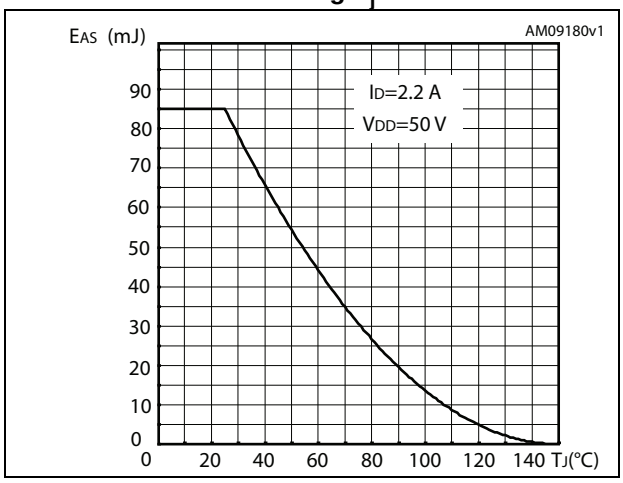


Figure 14. Maximum avalanche energy vs starting T_j



3 Test circuits

Figure 15. Switching times test circuit for resistive load

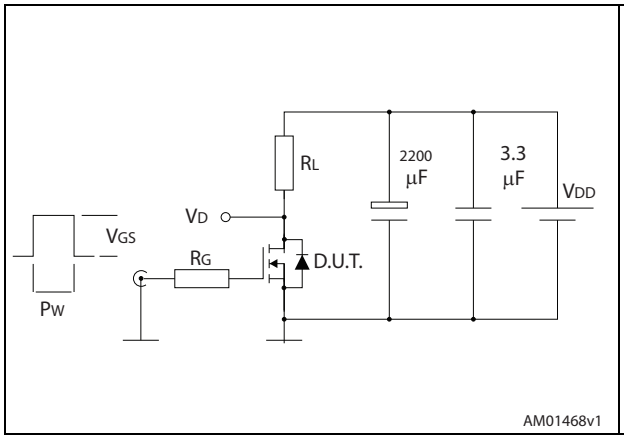


Figure 16. Gate charge test circuit

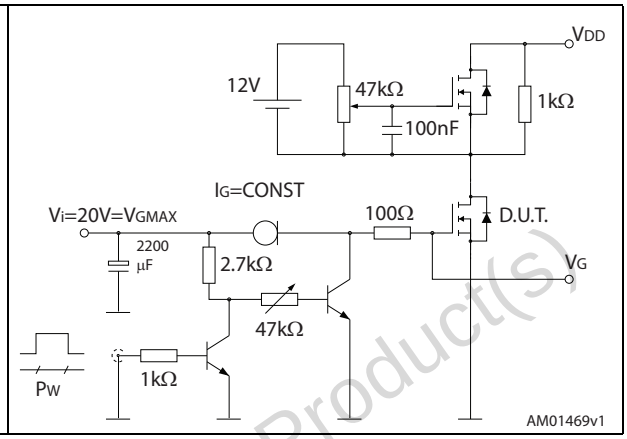


Figure 17. Test circuit for inductive load switching and diode recovery times

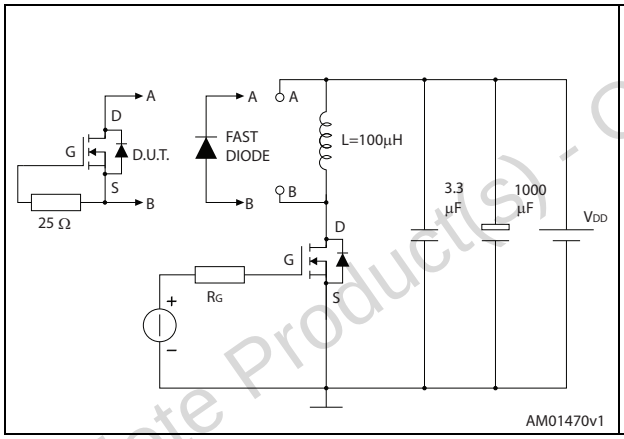


Figure 18. Unclamped Inductive load test circuit

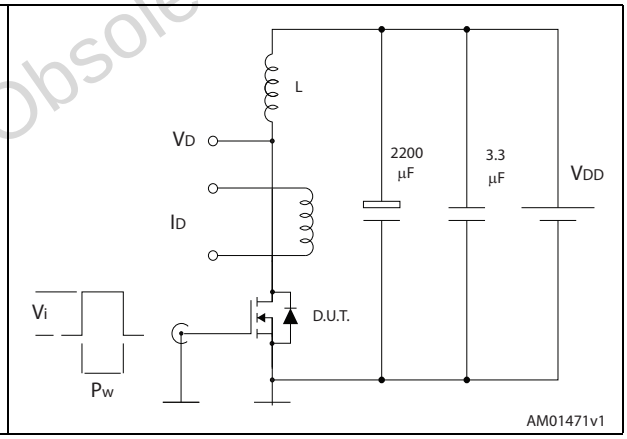


Figure 19. Unclamped inductive waveform

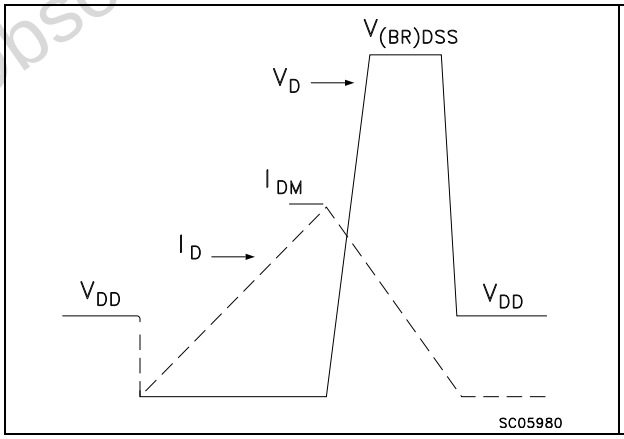
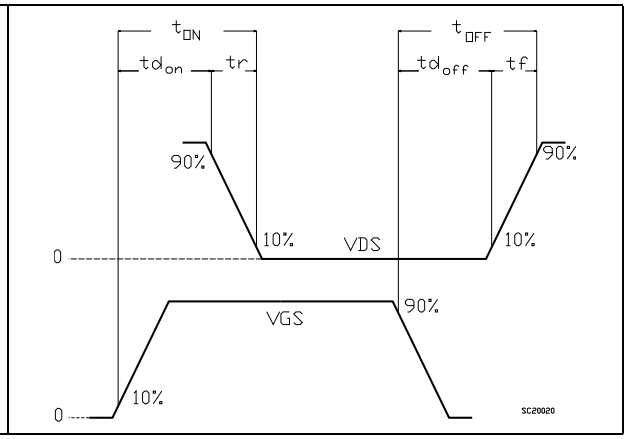


Figure 20. Switching time waveform



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 10. DPAK (TO-252) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
A2	0.03		0.23
b	0.64		0.90
b4	5.20		5.40
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
D1		5.10	
E	6.40		6.60
E1		4.70	
e		2.28	
e1	4.40		4.60
H	9.35		10.10
L	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 21. DPAK (TO-252) drawings

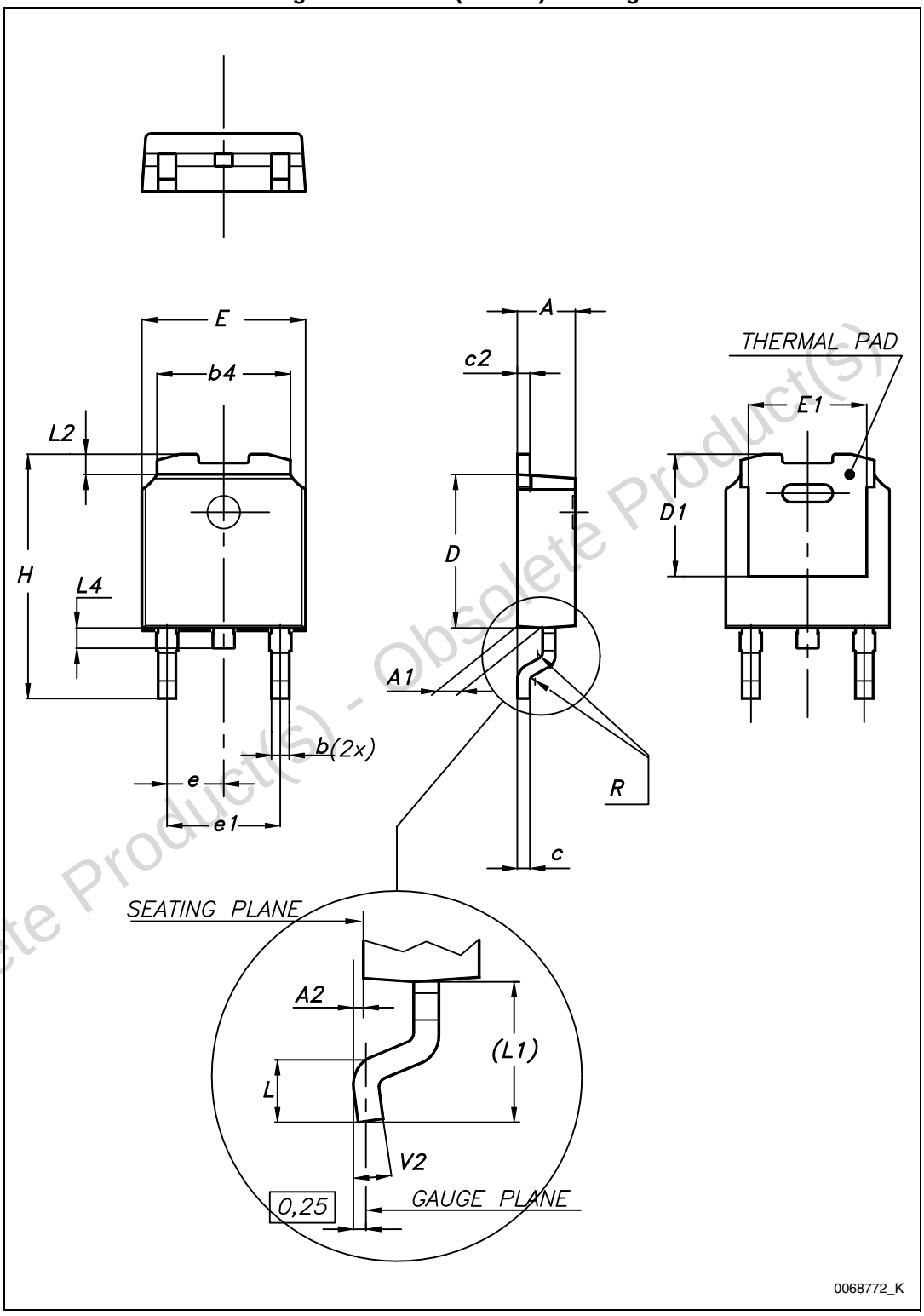
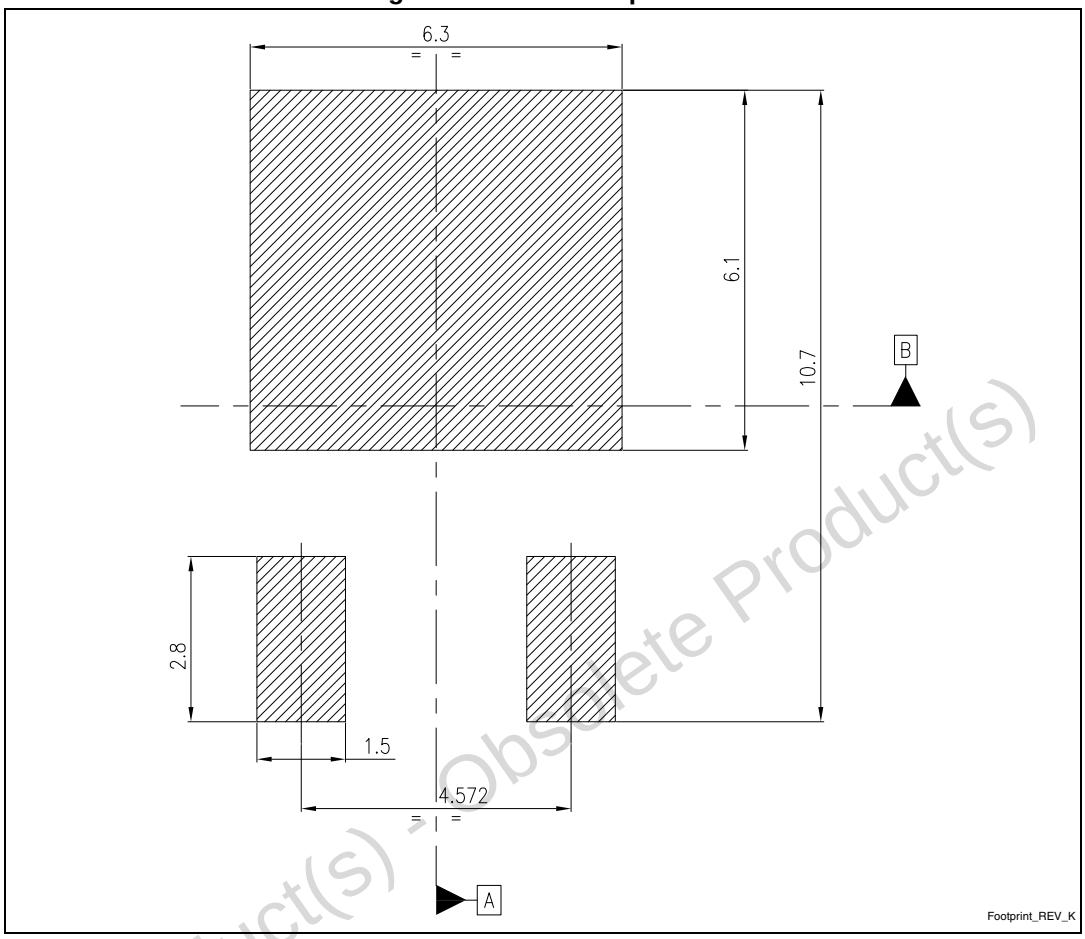


Figure 22. DPAK footprint [(a)]

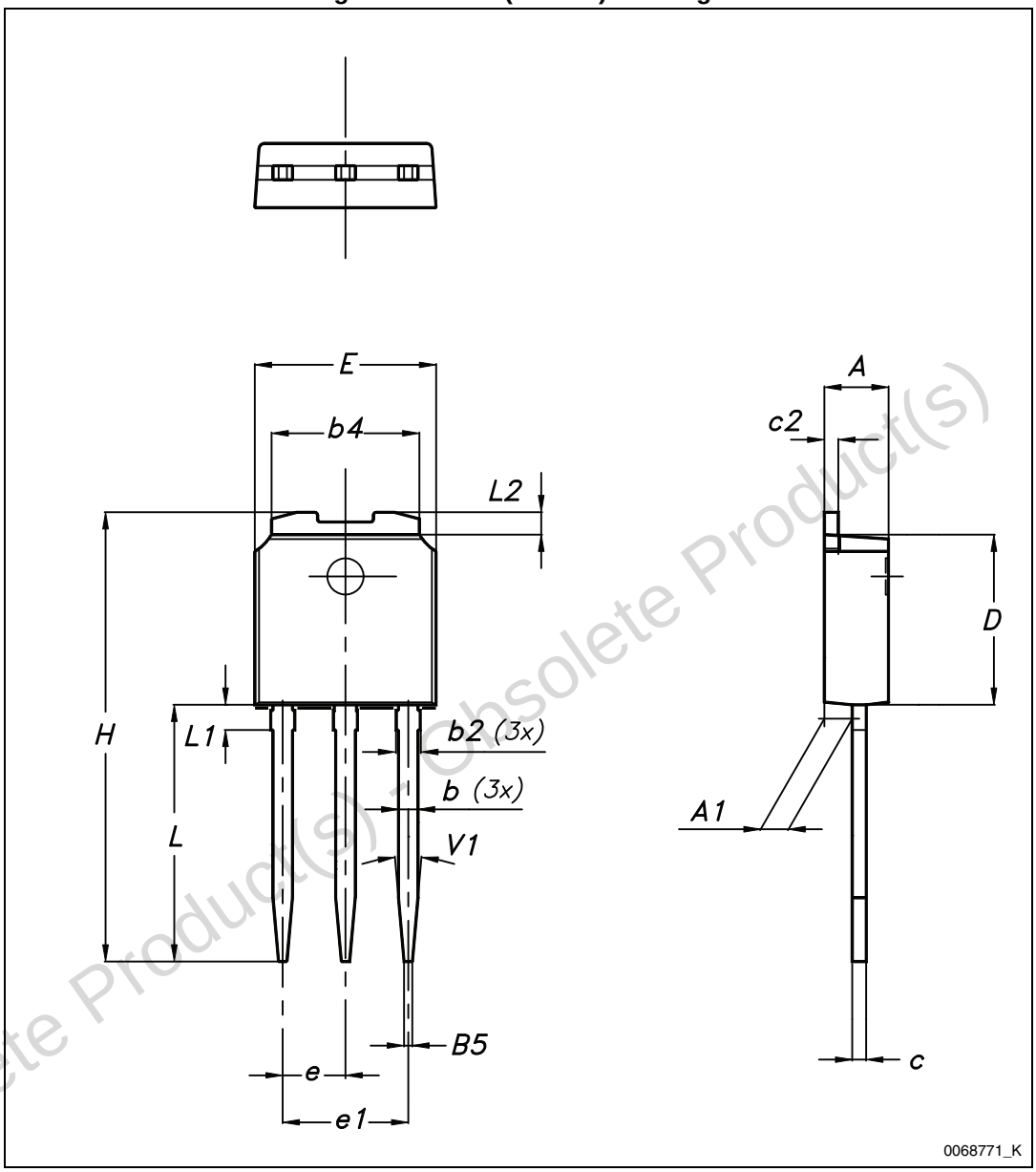


a. All dimensions are in millimeters.

Table 11. IPAK (TO-251) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20		2.40
A1	0.90		1.10
b	0.64		0.90
b2			0.95
b4	5.20		5.40
B5		0.30	
c	0.45		0.60
c2	0.48		0.60
D	6.00		6.20
E	6.40		6.60
e		2.28	
e1	4.40		4.60
H		16.10	
L	9.00		9.40
L1	0.80		1.20
L2		0.80	1.00
V1		10°	

Figure 23. IPAK (TO-251) drawings



5 Packaging mechanical data

Table 12. DPAK (TO-252) tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	6.8	7	A		330
B0	10.4	10.6	B	1.5	
B1		12.1	C	12.8	13.2
D	1.5	1.6	D	20.2	
D1	1.5		G	16.4	18.4
E	1.65	1.85	N	50	
F	7.4	7.6	T		22.4
K0	2.55	2.75			
P0	3.9	4.1	Base qty.		2500
P1	7.9	8.1	Bulk qty.		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

Figure 24. Tape for DPAK (TO-252)

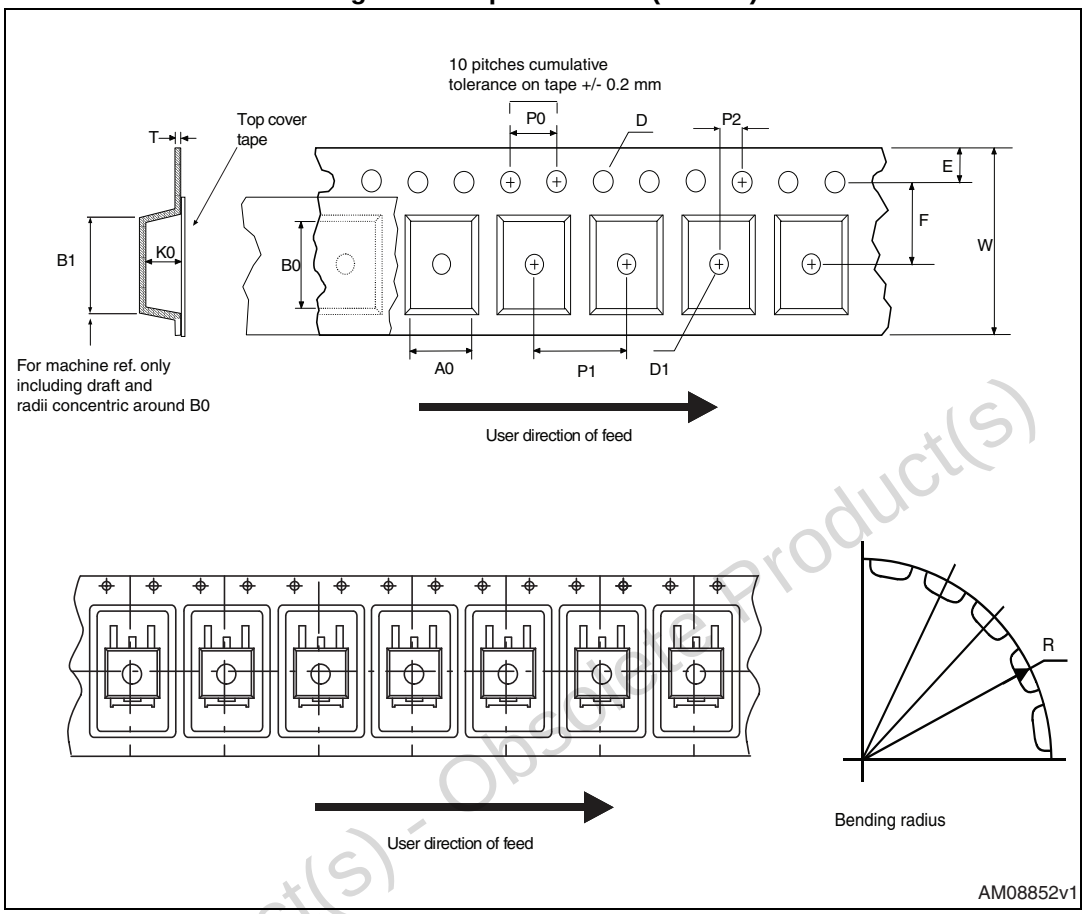
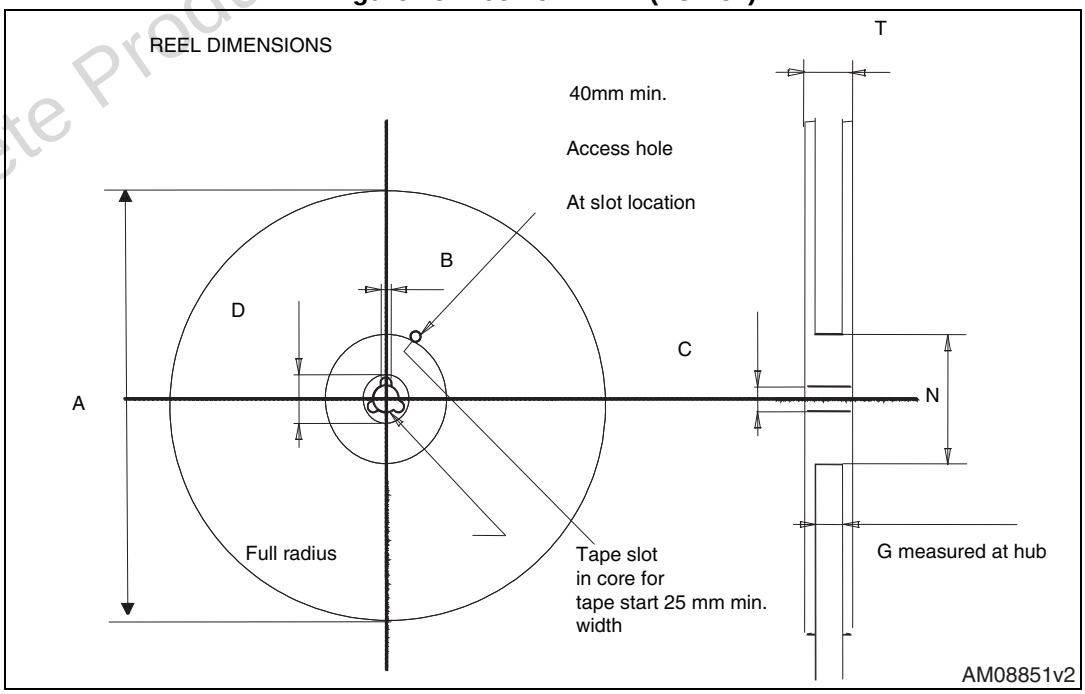


Figure 25. Reel for DPAK (TO-252)



6 Revision history

Table 13. Document revision history

Date	Revision	Changes
03-Sep-2013	1	First release.

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