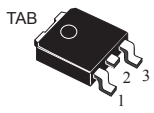
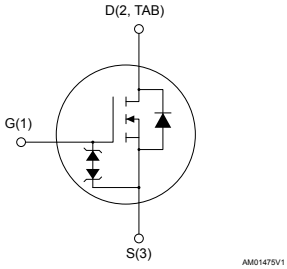
N-channel 525 V, 1 Ω typ., 6.5 A MDmesh™ K3 Power MOSFET in DPAK package



DPAK



Features

Order codes	V_{DS}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STD6N52K3	525 V	1.2 Ω	5 A	70 W

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

Applications

- Switching applications

Description

This MDmesh™ K3 Power MOSFET is the result of improvements applied to STMicroelectronics' MDmesh™ technology, combined with a new optimized vertical structure. This device boasts an extremely low on-resistance, superior dynamic performance and high avalanche capability, rendering it suitable for the most demanding applications.

Product status link
STD6N52K3

Product summary	
Order code	STD6N52K3
Marking	6N52K3
Package	DPAK
Packing	Tape and reel

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate- source voltage	±30	V
I_D	Drain current (continuous) at T_C = 25 °C	5	A
I_D	Drain current (continuous) at T_C = 100 °C	3	A
I_{DM} (1)	Drain current (pulsed)	20	A
P_{TOT}	Total dissipation at T_C = 25 °C	70	W
I_{AR}	Avalanche current, repetitive or not-repetitive	2.5	A
E_{AS} (2)	Single pulse avalanche energy	110	mJ
dv/dt (3)	Peak diode recovery voltage slope	12	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_j	Operating junction temperature range		

1. *Pulse width limited by safe operating area.*
2. *Starting Tj = 25 °C, $I_D = I_{AR}$, V_{DD} = 50 V.*
3. *$I_{SD} \leq 5$ A, di/dt ≤ 400 A/µs, V_{DD} = 80% $V_{(BR)DSS}$, $V_{DS\ peak} \leq V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	1.79	°C/W
$R_{thj\text{-}pcb}$ (1)	Thermal resistance junction-pcb	50	°C/W

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

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified)

Table 3. 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 V	525			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 525 V			1	µA
		V_{GS} = 0 V, V_{DS} = 525 V T_C = 125 °C (1)			50	µA
I_{GSS}	Gate body leakage current	V_{GS} = ±20 V, V_{DS} = 0 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 50 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	V_{GS} = 10 V, I_D = 2.5 A		1	1.2	Ω

1. *Defined by design, not subject to production test.*

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0 V	-	670	-	pF
C_{oss}	Output capacitance			54		
C_{rss}	Reverse transfer capacitance			10		
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{GS} = 0 V, V_{DS} = 0 to 420 V		40		pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	-	4	-	Ω
Q_g	Total gate charge	V_{DD} = 420 V, I_D = 5 A, V_{GS} = 0 to 10 V (see Figure 15. Test circuit for gate charge behavior)	-	26	-	nC
Q_{gs}	Gate-source charge			4		
Q_{gd}	Gate-drain charge			15		

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_{DSS}.*

Table 5. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 260 V, I_D = 2.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	10	-	ns
t_r	Rise time			11		
$t_{d(off)}$	Turn-off delay time			31		
t_f	Fall time			18		

Table 6. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5	A
I_{SDM} (1)	Source-drain current (pulsed)				20	
V_{SD} (2)	Forward on voltage	I_{SD} = 5 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs	-	206		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V (see Figure 16. Test circuit for inductive load switching and diode recovery times)		1.4		µC
I_{RRM}	Reverse recovery current			14		A
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs	-	233		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, T_j = 150 °C (see Figure 16. Test circuit for inductive load switching and diode recovery times)		1.7		µC
I_{RRM}	Reverse recovery current			15		A

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

Table 7. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	I_D = 0 A, I_{GS} = ±1 mA	±30	-		V

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

2.1 Electrical characteristics curves

Figure 1. Safe operating area

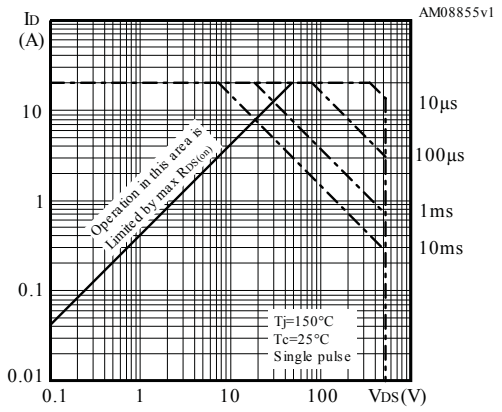


Figure 2. Thermal impedance

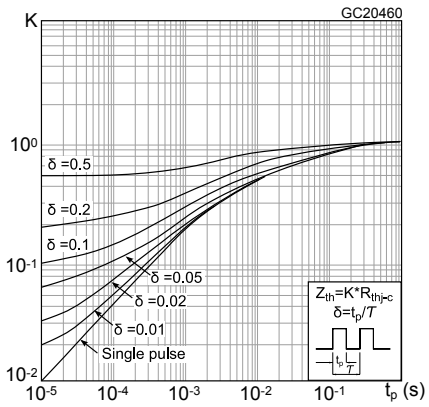


Figure 3. Output characteristics

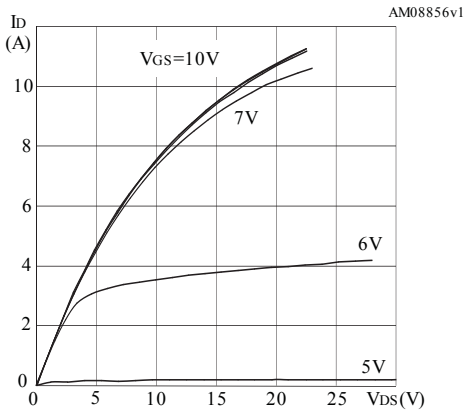


Figure 4. Transfer characteristics

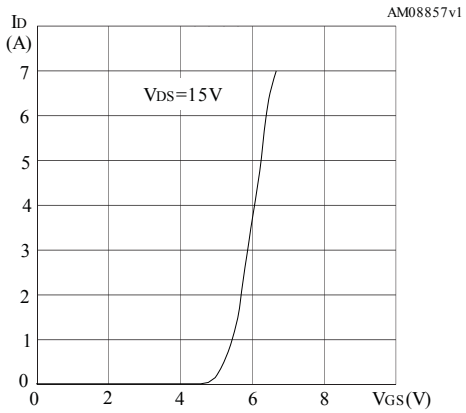


Figure 5. Gate charge vs gate-source voltage

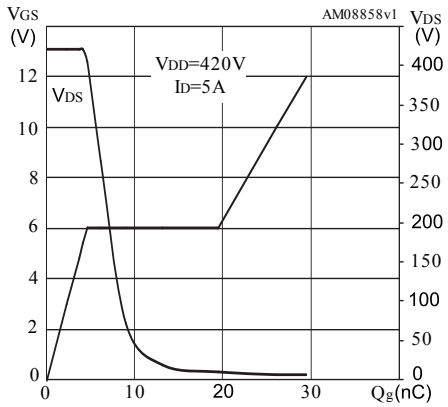


Figure 6. Static drain-source on resistance

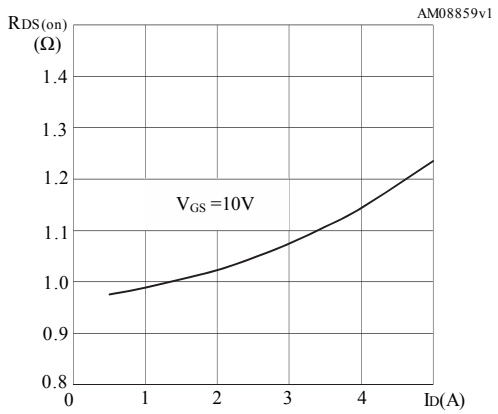


Figure 7. Capacitance variations

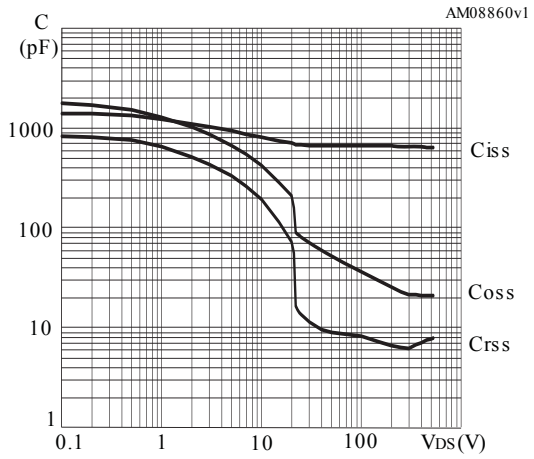


Figure 8. Output capacitance stored energy

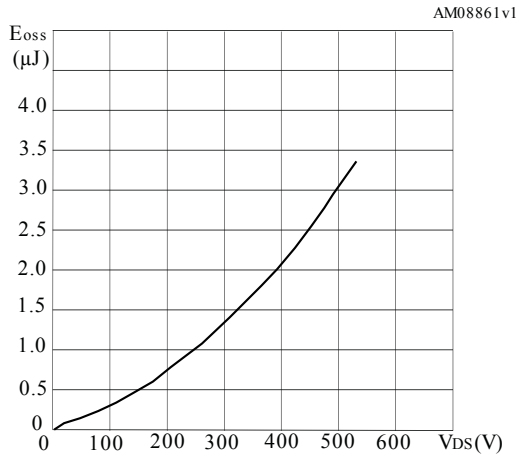


Figure 9. Normalized gate threshold voltage vs temperature

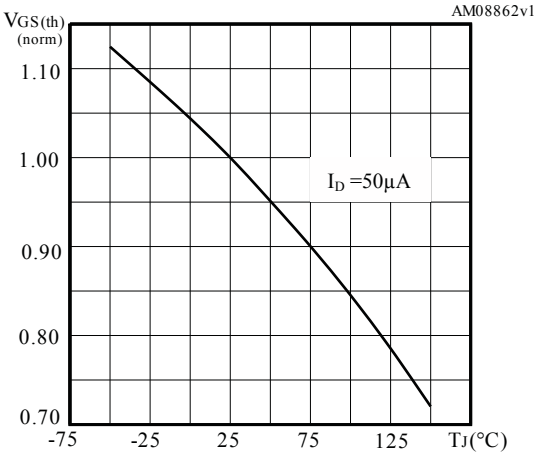


Figure 10. Normalized on resistance vs temperature

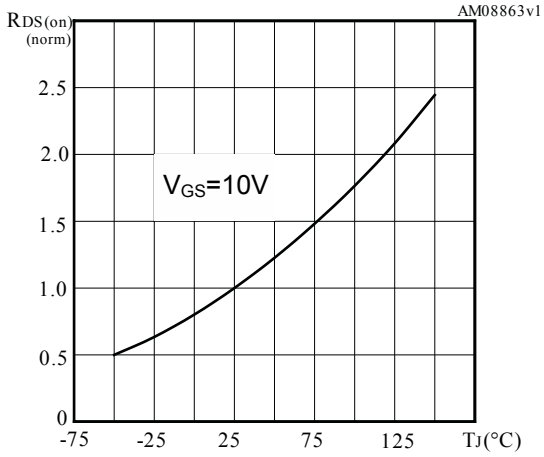


Figure 11. Source-drain diode forward characteristics

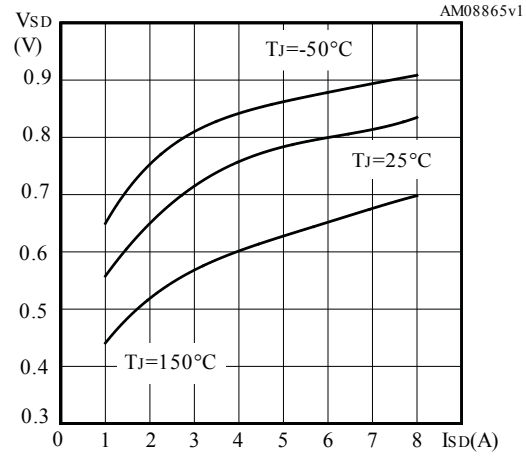


Figure 12. Normalized $V_{(BR)DSS}$ vs temperature

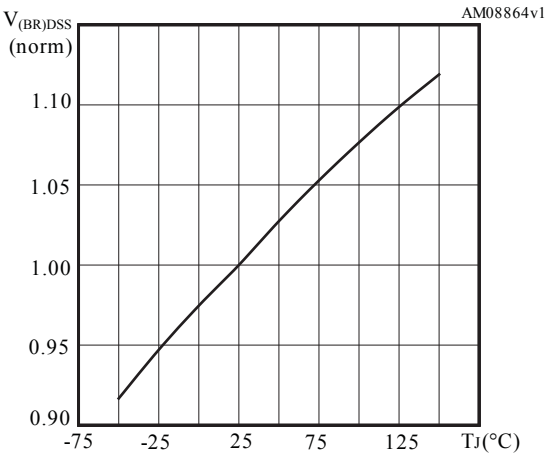
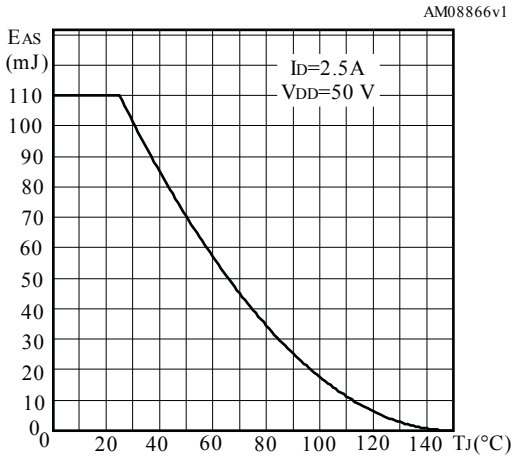


Figure 13. Maximum avalanche energy vs temperature



3 Test circuits

Figure 14. Test circuit for resistive load switching times

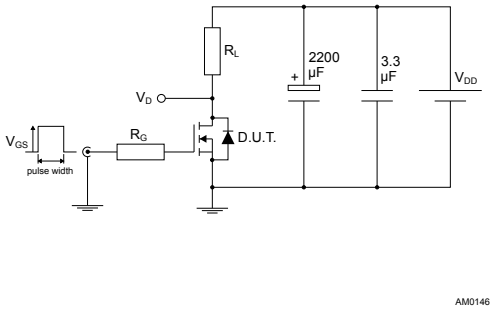


Figure 15. Test circuit for gate charge behavior

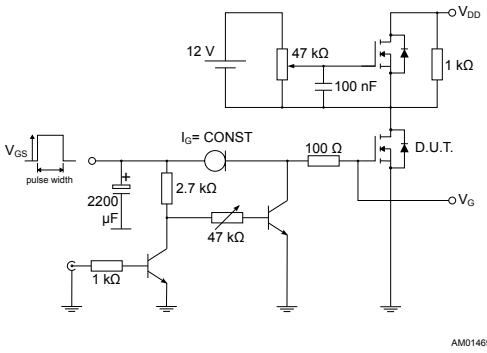


Figure 16. Test circuit for inductive load switching and diode recovery times

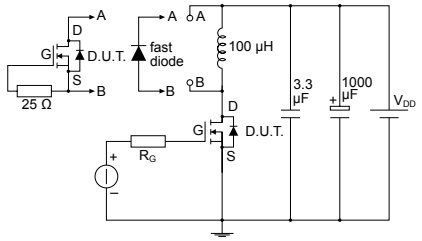


Figure 17. Unclamped inductive load test circuit

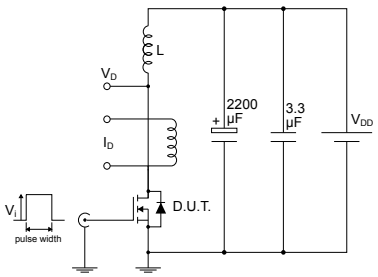


Figure 18. Unclamped inductive waveform

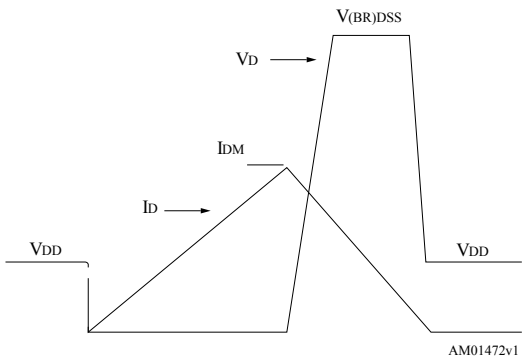
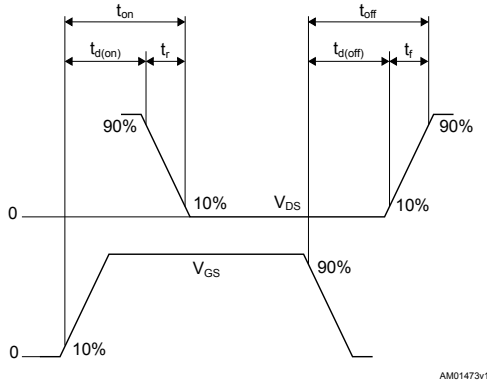


Figure 19. Switching time waveform

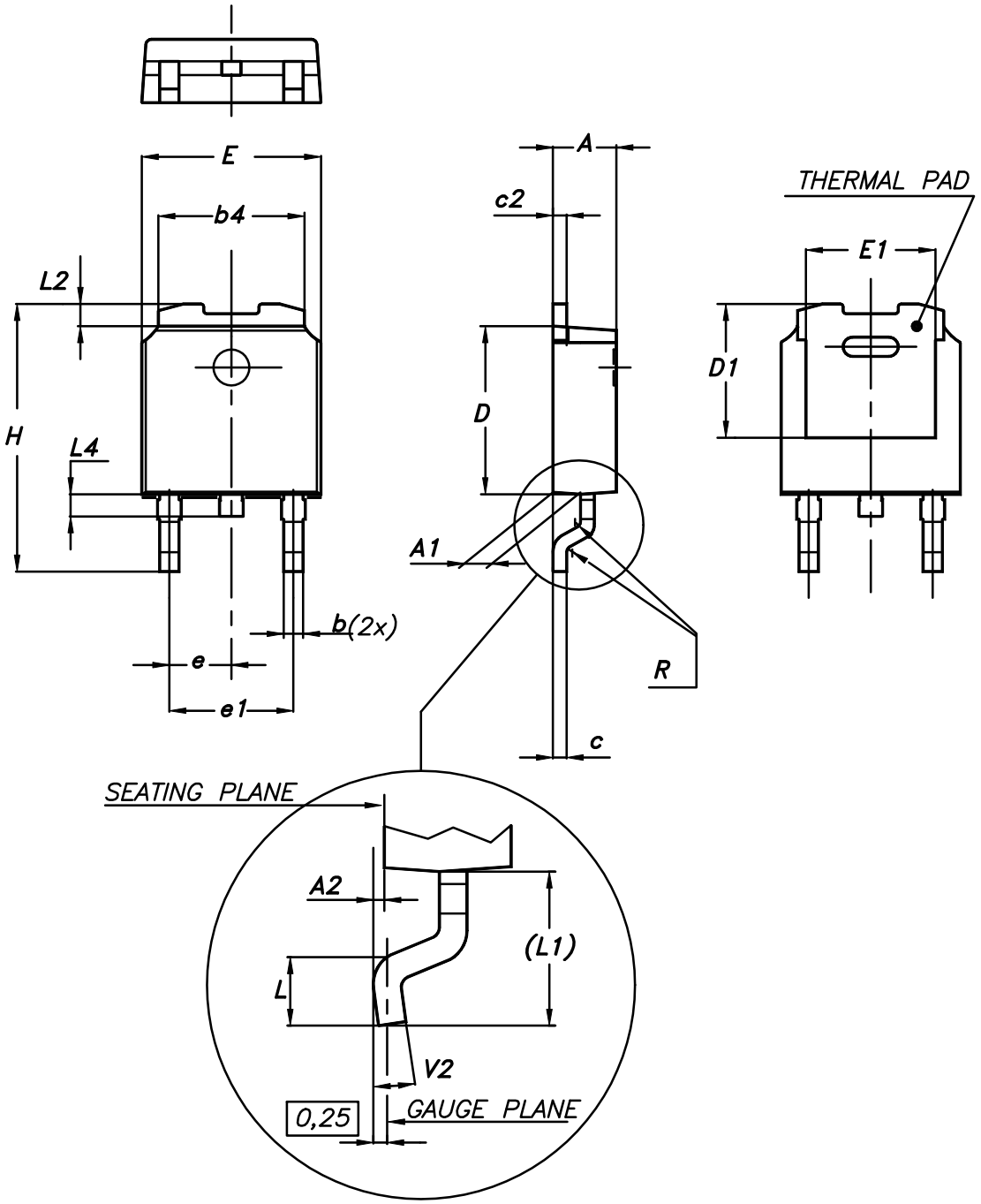


4 Package information

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 DPAK (TO-252) type A package information

Figure 20. **DPAK (TO-252) type A package outline**



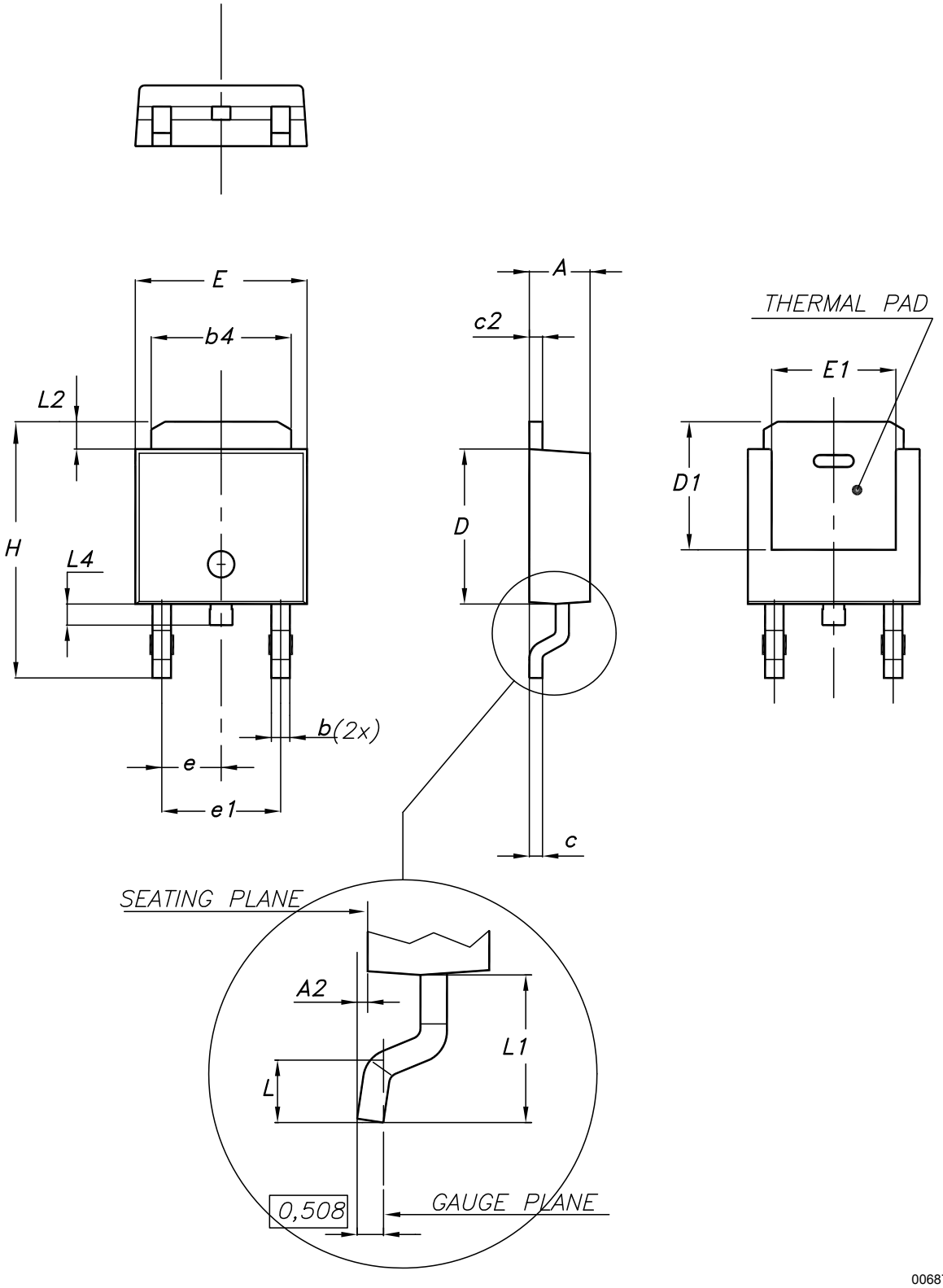
0068772_A_25

Table 8. **DPAK (TO-252) type A 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	4.95	5.10	5.25
E	6.40		6.60
E1	4.60	4.70	4.80
e	2.159	2.286	2.413
e1	4.445	4.572	4.699
H	9.35		10.10
L	1.00		1.50
(L1)	2.60	2.80	3.00
L2	0.65	0.80	0.95
L4	0.60		1.00
R		0.20	
V2	0°		8°

4.2 DPAK (TO-252) type E package information

Figure 21. **DPAK (TO-252) type E package outline**

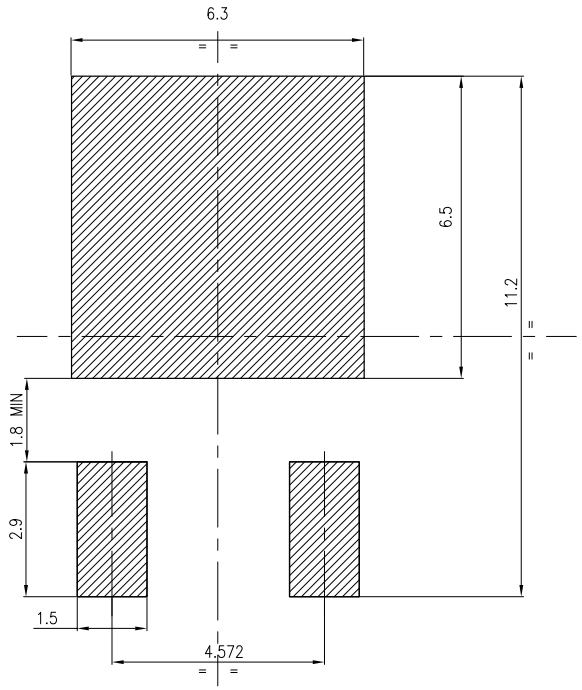


0068772_type-E_rev.25

Table 9. **DPAK (TO-252) type E mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
c	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
e		2.286	
e1		4.572	
H	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

Figure 22. **DPAK (TO-252) recommended footprint (dimensions are in mm)**



FP_0068772_25

4.3 DPAK (TO-252) packing information

Figure 23. **DPAK (TO-252) tape outline**

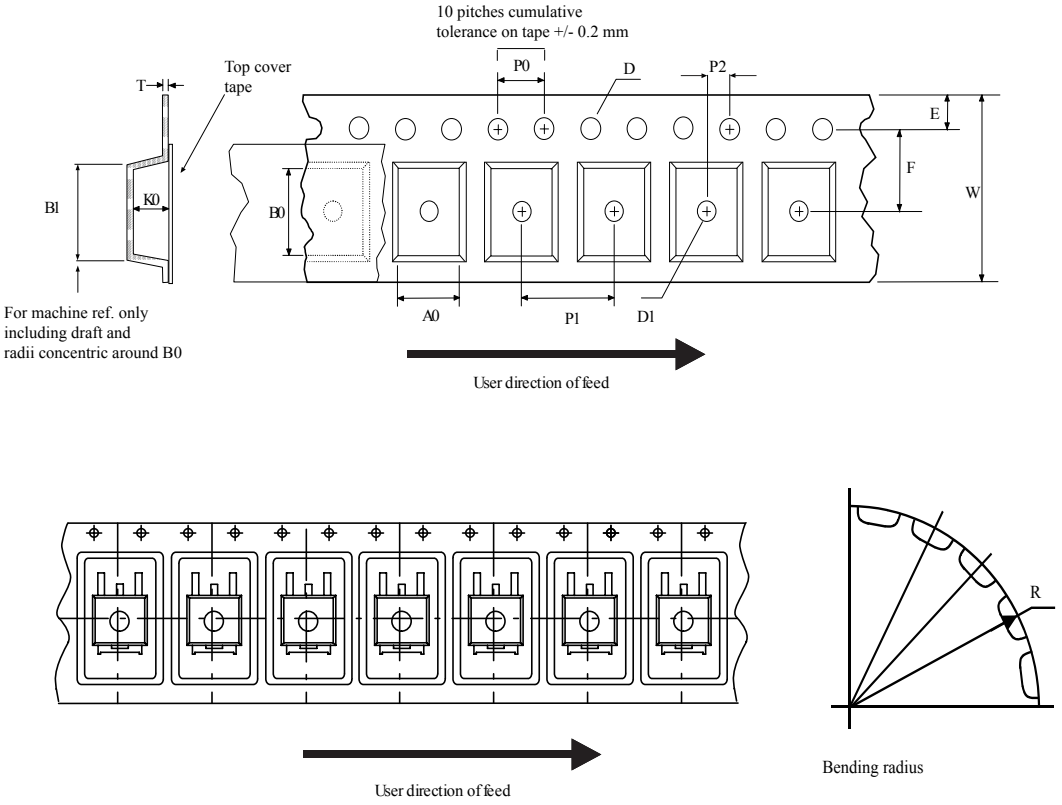
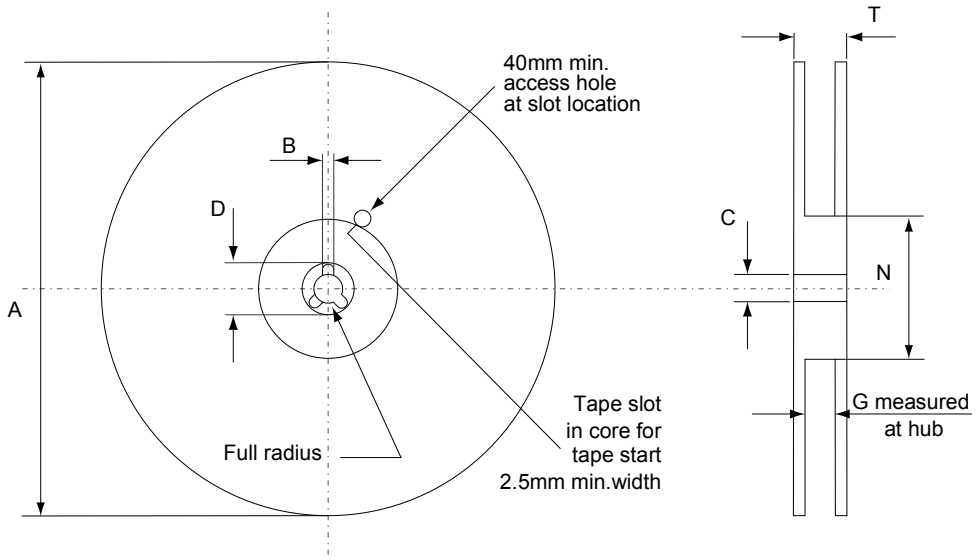


Figure 24. **DPAK (TO-252) reel outline**



AM06038v1

Table 10. **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			

Revision history

Table 11. **Document revision history**

Date	Revision	Changes
03-Sep-2008	1	Initial release.
21-Feb-2011	2	– Added new package, mechanical data: D²PAK; – Added new package, mechanical data: TO-220; – Document status promoted from preliminary data to datasheet.
05-Sep-2018	3	The part numbers STB6N52K3, STF6N52K3 and STP6N52K3 have been moved to a separate datasheet. Removed maturity status indication from cover page. The document status is production data. Updated title and features in cover page. Updated Section 1 Electrical ratings, Section 2 Electrical characteristics and Section 4 Package information. Minor text changes.

Contents