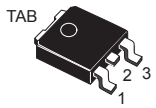
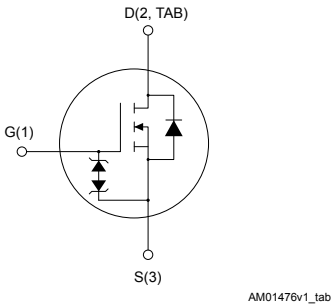
N-channel 525 V, 1.25 Ω typ., 4.4 A, UltraFASTmesh Power MOSFET in a DPAK package



DPAK



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STD5N52U	525 V	1.50 Ω	4.4 A

- Outstanding dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitances
- Very low $R_{DS(on)}$
- Extremely low t_{rr}

Applications

- Switching applications

Description

This device is N-channel Power MOSFET developed using UltraFASTmesh technology, which combines the advantages of reduced on resistance, Zener gate protection and very high dv/dt capability with an enhanced fast body-drain recovery diode.

Product status link
STD5N52U

Product summary	
Order code	STD5N52U
Marking	5N52U
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	4.4	A
	Drain current (continuous) at T_C= 100 °C	2.8	
I_{DM} (1)	Drain current (pulsed)	17.6	A
P_{TOT}	Total power dissipation at T_C = 25 °C	70	W
dv/dt	Peak diode recovery voltage slope	20	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		
ESD	Gate-source human body model (R = 1.5 kΩ, C = 100 pF)	2.8	kV

1. *Pulse width limited by safe operating area.*
2. *I_{SD} ≤ 4.4 A, di/dt ≤ 400 A/µs, V_{DS} (peak) < $V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	1.79	°C/W
R_{thJA}(1)	Thermal resistance, junction-to-ambient	50	

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

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_J max)	4.4	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	170	mJ

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified).

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	525			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 525 V			10	µA
		V_{GS} = 0 V, V_{DS} = 525 V, T_C = 125 °C(1)			500	
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±20 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 = 2.2 A		1.25	1.50	Ω

1. *Specified by design, not tested in production.*

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS}= 25 V, f = 1 MHz, V_{GS} = 0 V	-	529	-	pF
C_{oss}	Output capacitance		-	71	-	pF
C_{rss}	Reverse transfer capacitance		-	13.4	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 V to 420 V, V_{GS} = 0 V	-	11	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0 A	-	6	-	Ω
Q_g	Total gate charge	V_{DD} = 416 V, I_D = 4.4 A, V_{GS} = 0 to 10 V (see Figure 14. Test circuit for gate charge behavior)	-	16.9	-	nC
Q_{gs}	Gate-source charge		-	4.2	-	nC
Q_{gd}	Gate-drain charge		-	8.4	-	nC

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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 260 V, I_D = 2.2 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	11.4	-	ns
t_r	Rise time		-	13.6	-	ns
$t_{d(off)}$	Turn-off delay time		-	23.1	-	ns
t_f	Fall time		-	15	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		4.4	A
I_{SDM}(1)	Source-drain current (pulsed)		-		17.6	A
V_{SD}	Forward on voltage	V_{GS} = 0 V, I_{SD} = 4.4 A	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 4.4 A, di/dt = 100 A/µs,	-	55		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V	-	95		nC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	3.5		A
t_{rr}	Reverse recovery time	I_{SD} = 4.4 A, di/dt = 100 A/µs,	-	120		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 60 V, T_j = 150 °C	-	266		nC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	4.5		A

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

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

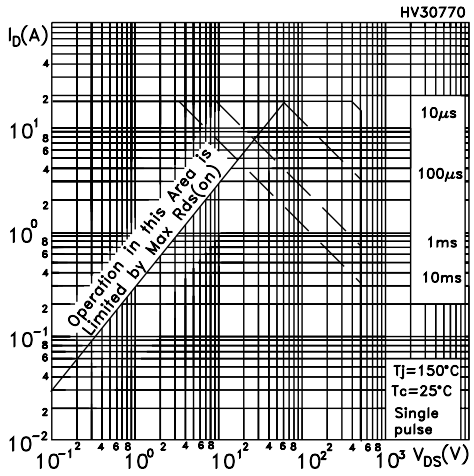


Figure 2. Normalized transient thermal impedance

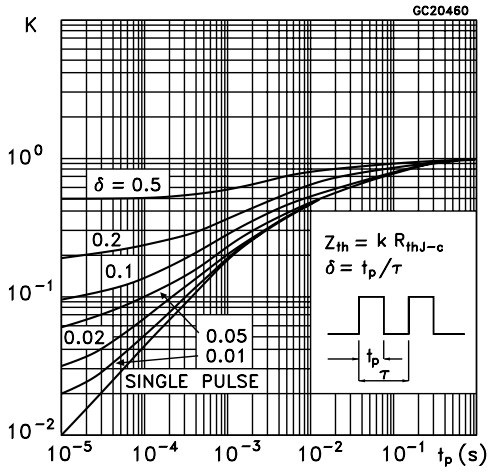


Figure 3. Typical output characteristics

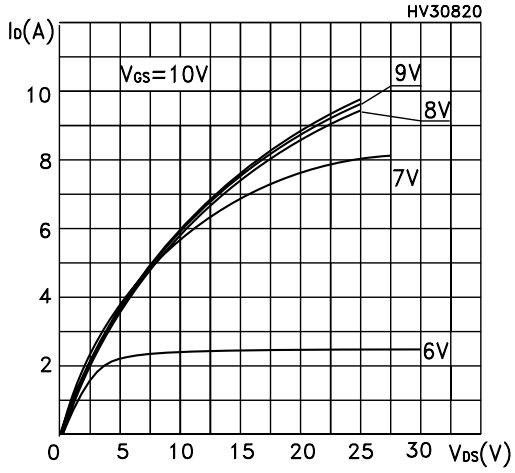


Figure 4. Typical transfer characteristics

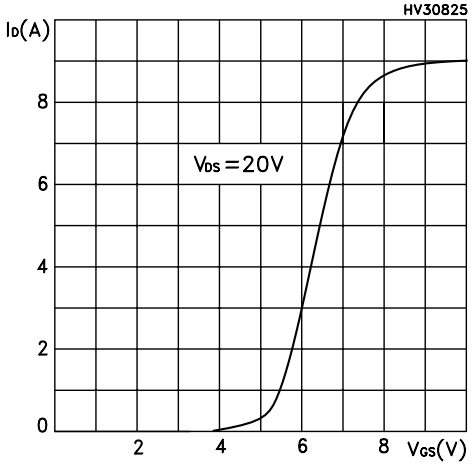


Figure 5. Normalized breakdown voltage vs temperature

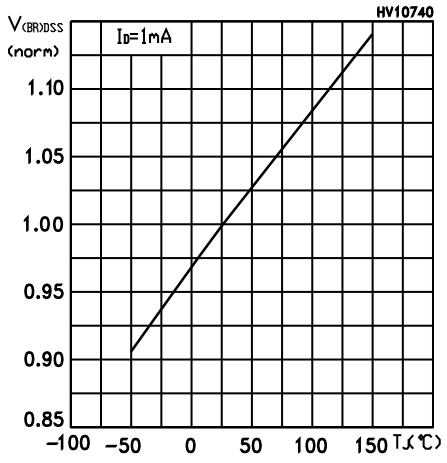


Figure 6. Typical drain-source on-resistance

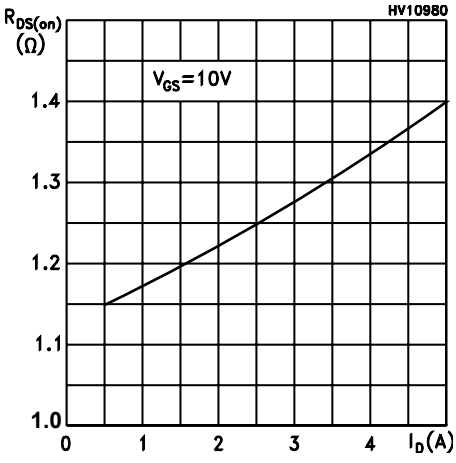


Figure 7. Typical gate charge vs gate-source voltage

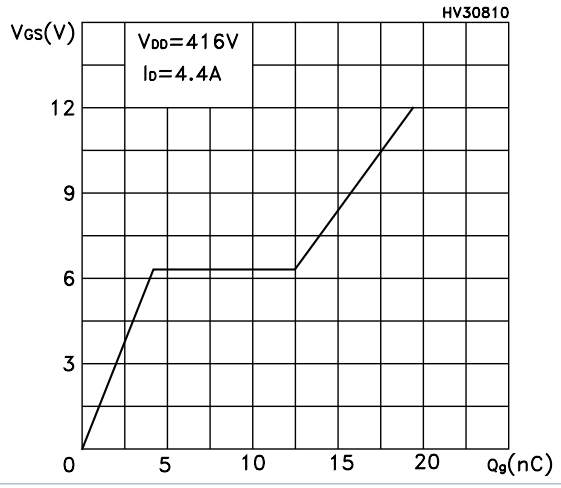


Figure 8. Typical capacitance characteristics

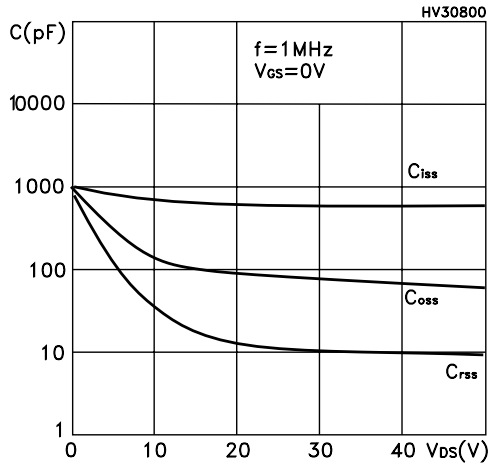


Figure 9. Normalized gate threshold vs temperature

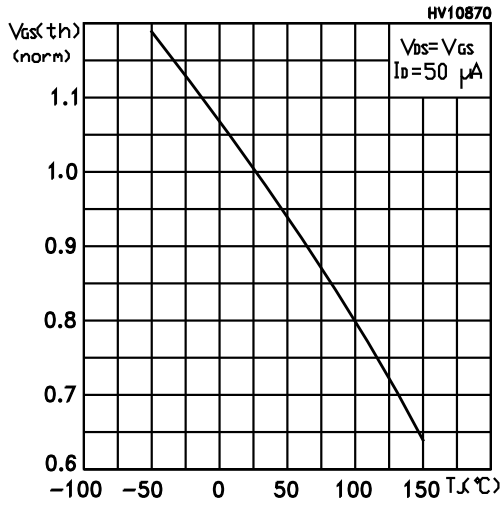


Figure 10. Normalized on-resistance vs temperature

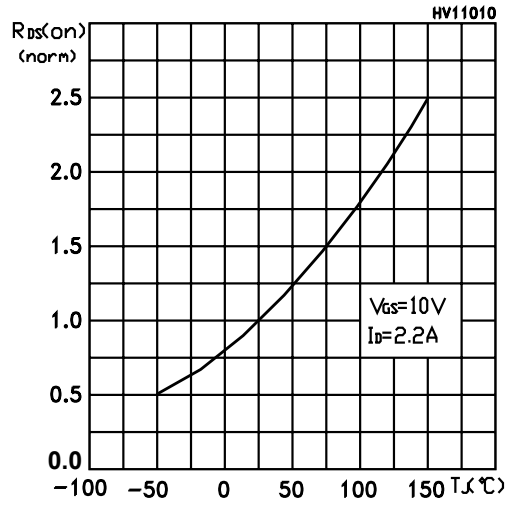


Figure 11. Typical reverse diode forward characteristics

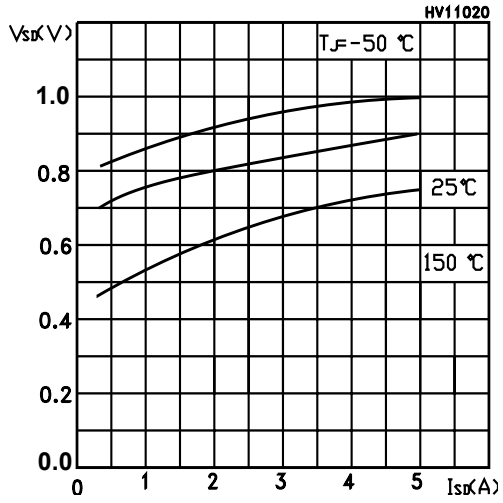
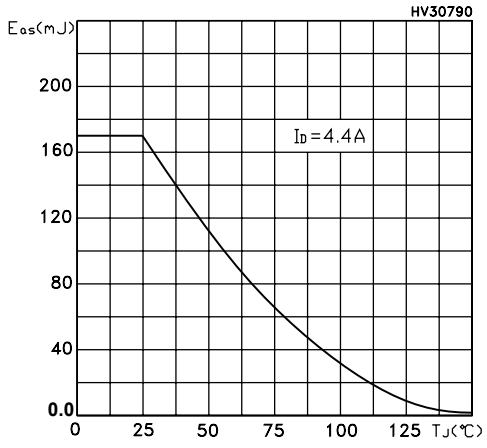
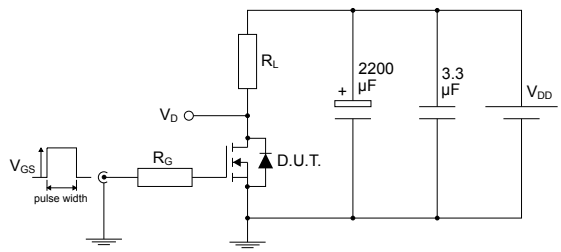


Figure 12. Maximum avalanche energy vs temperature



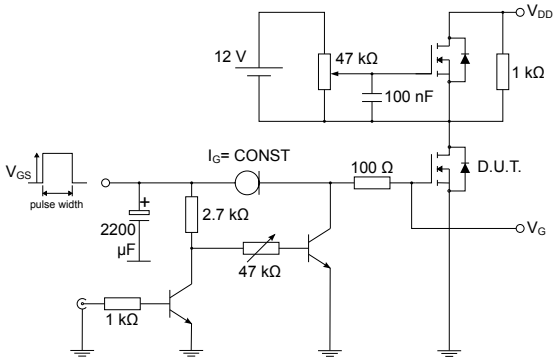
3 Test circuits

Figure 13. Test circuit for resistive load switching times



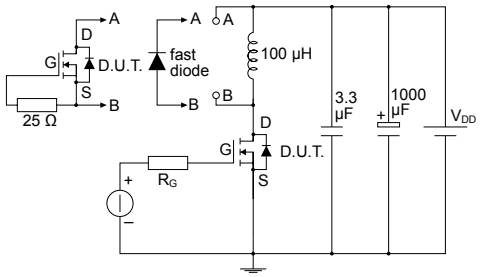
AM01468v1

Figure 14. Test circuit for gate charge behavior



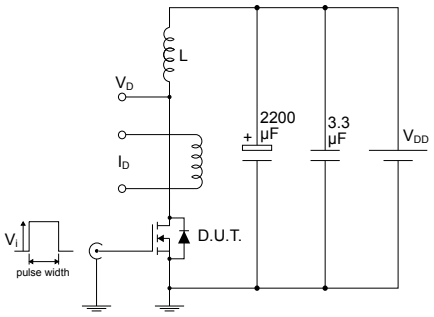
AM01469v1

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



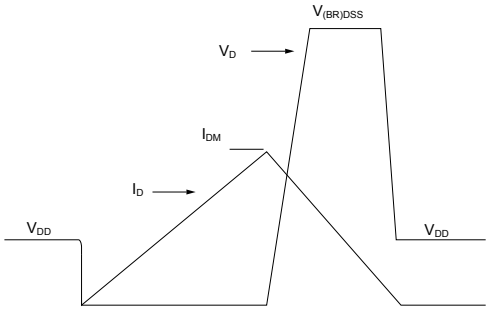
AM01470v1

Figure 16. Unclamped inductive load test circuit



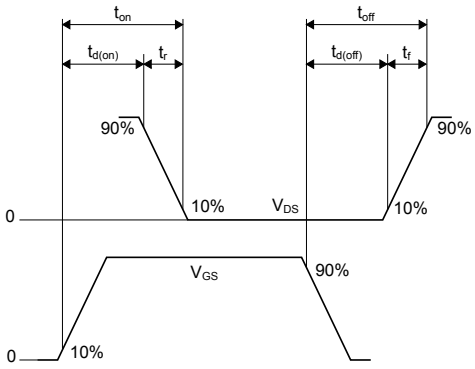
AM01471v1

Figure 17. Unclamped inductive waveform



AM01472v1

Figure 18. Switching time waveform



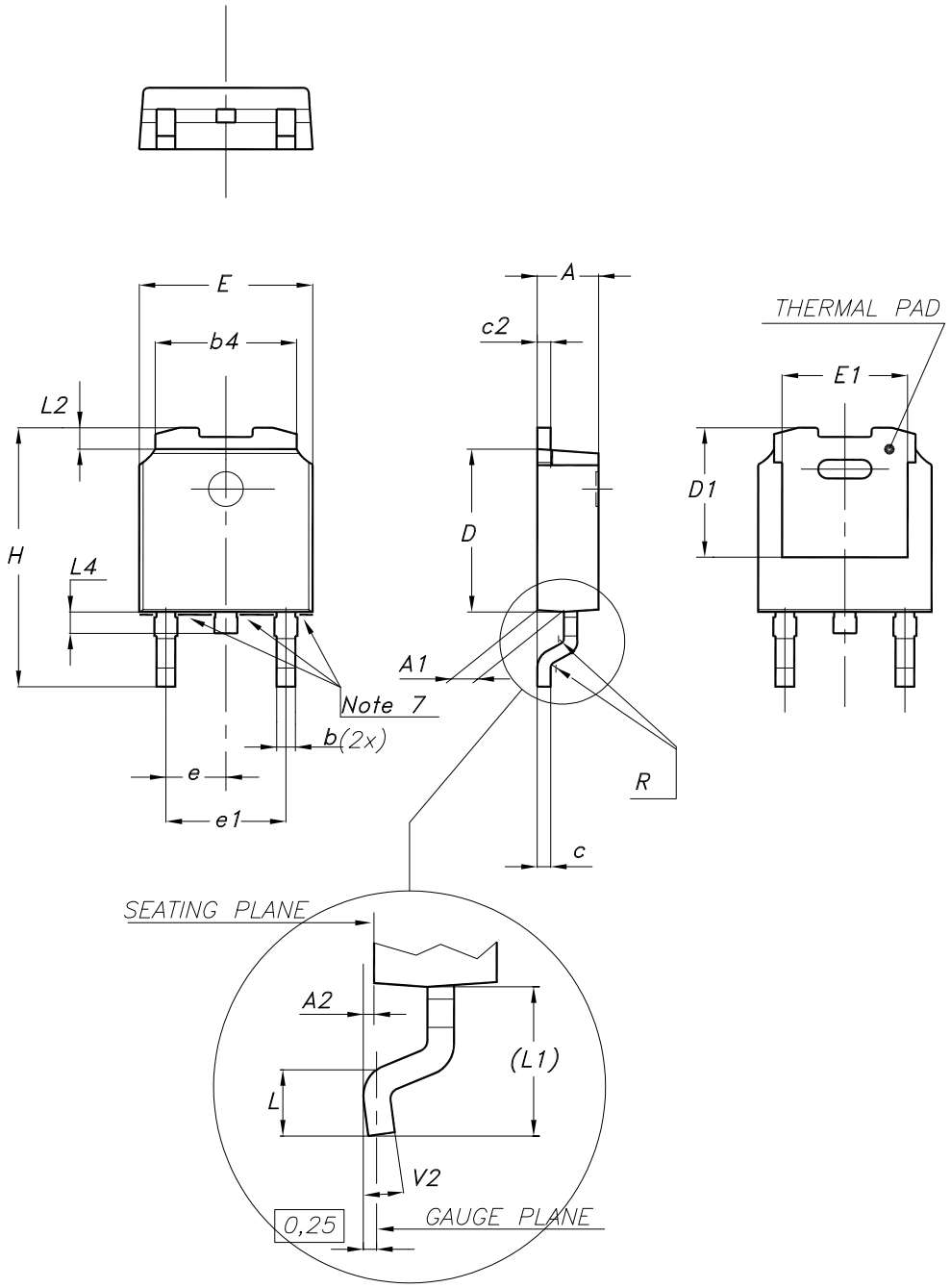
AM01473v1

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 DPAK (TO-252) type A package information

Figure 19. DPAK (TO-252) type A package outline



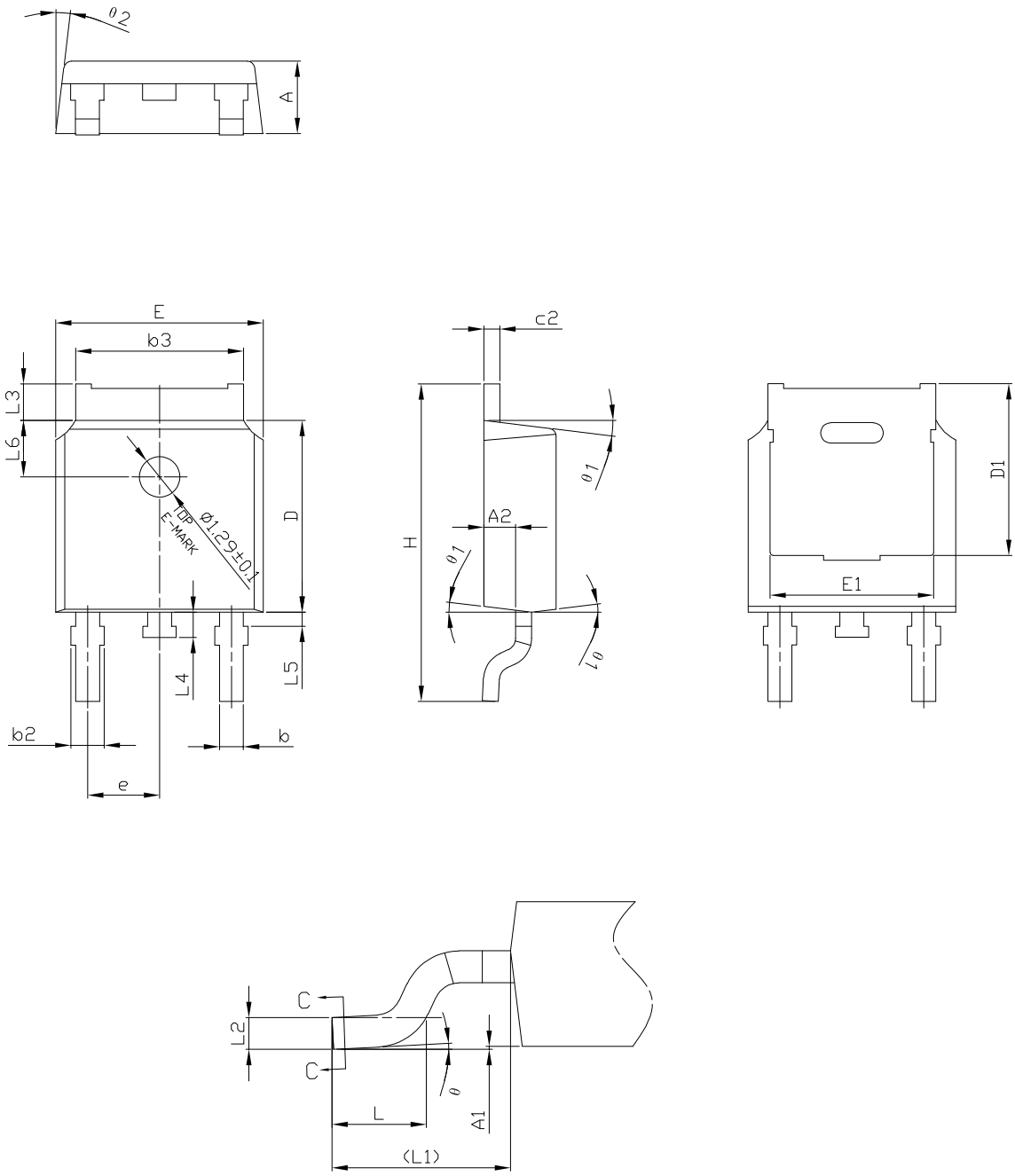
0068772_A_34

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 C3 package information

Figure 20. **DPAK (TO-252) type C3 package outline**



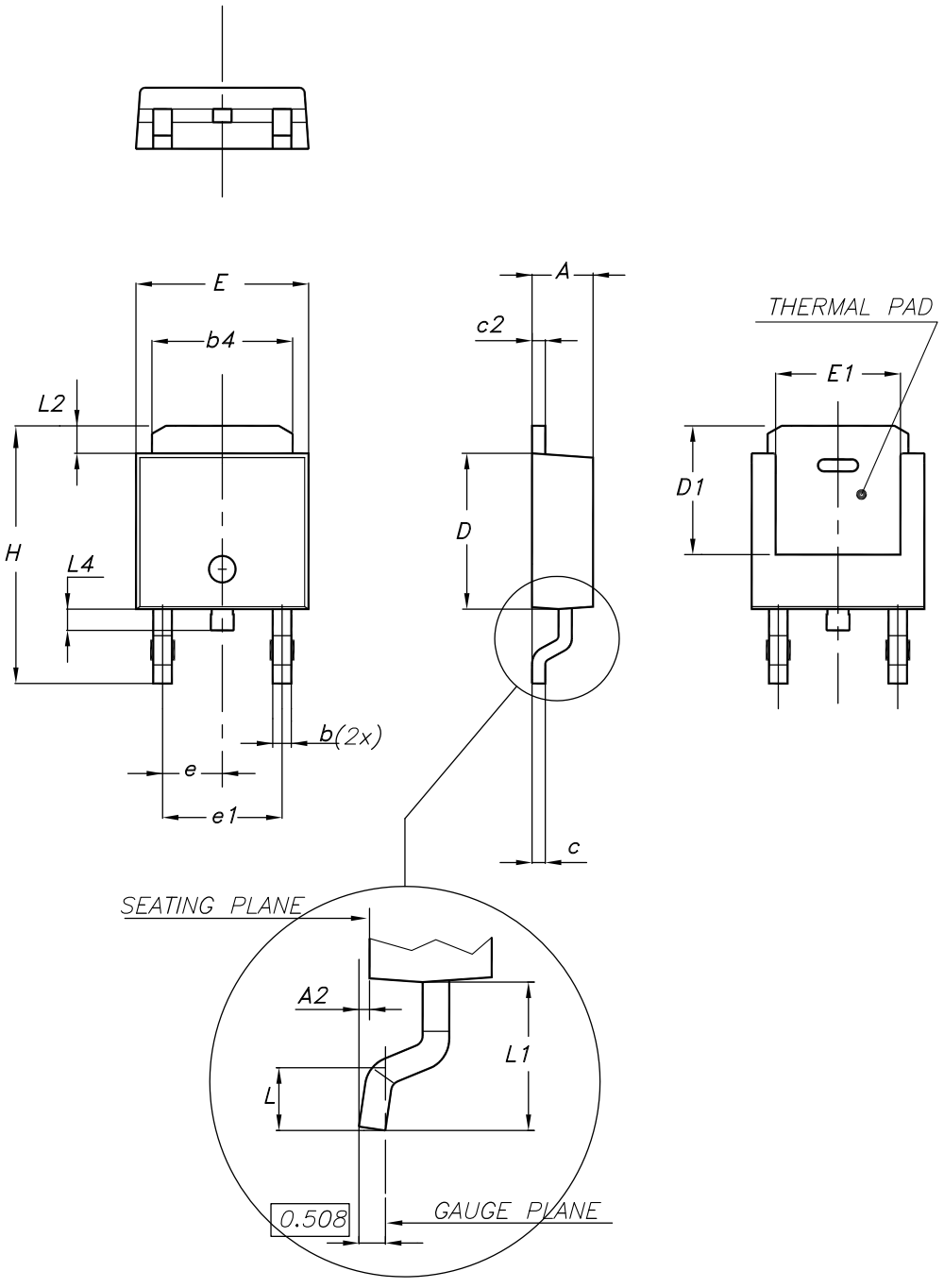
0068772_type-C3_rev34

Table 9. **DPAK (TO-252) type C3 mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.00		0.10
A2	0.90	1.01	1.10
b	0.72		0.85
b2	0.72		1.10
b3	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.20	5.45	5.70
E	6.50	6.60	6.70
E1	5.00	5.20	5.40
e	2.186	2.286	2.386
H	9.80	10.10	10.40
L	1.40	1.50	1.70
L1	2.90 REF		
L2	0.51 BSC		
L3	0.90		1.25
L4	0.60	0.80	1.00
L5	0.15		0.75
L6	1.80 REF		
θ	0°		8°
θ1	5°	7°	9°
θ2	5°	7°	9°

4.3 DPAK (TO-252) type E package information

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

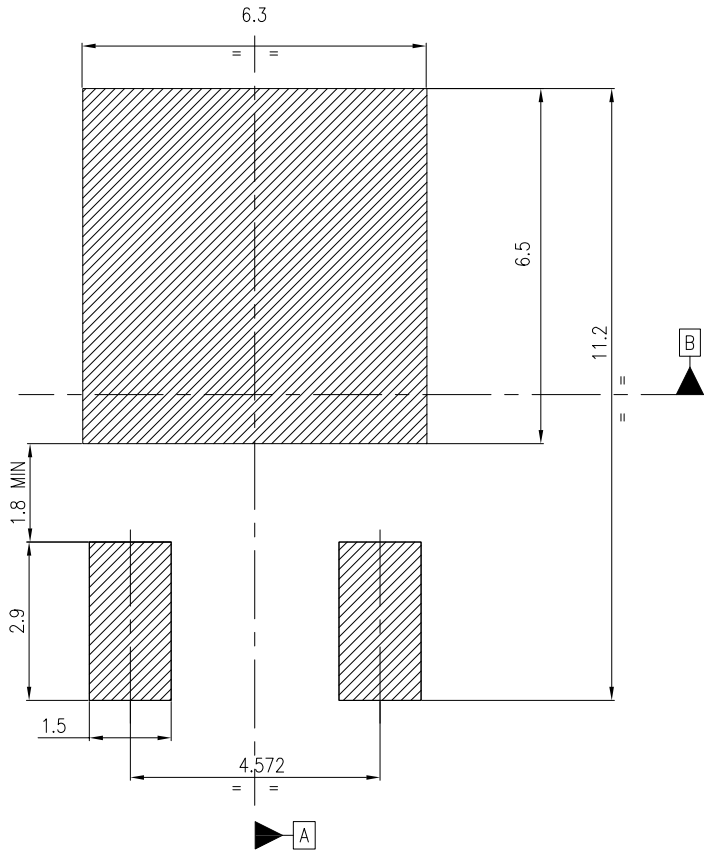


0068772_typeE_rev.34

Table 10. **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)



Notes:

1) This footprint is able to ensure insulation up to 630 Vrms (according to CEI IEC 664−1)

2) The device must be positioned within ⌖ 0.05 A B

FP_0068772_34

4.4 DPAK (TO-252) packing information

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

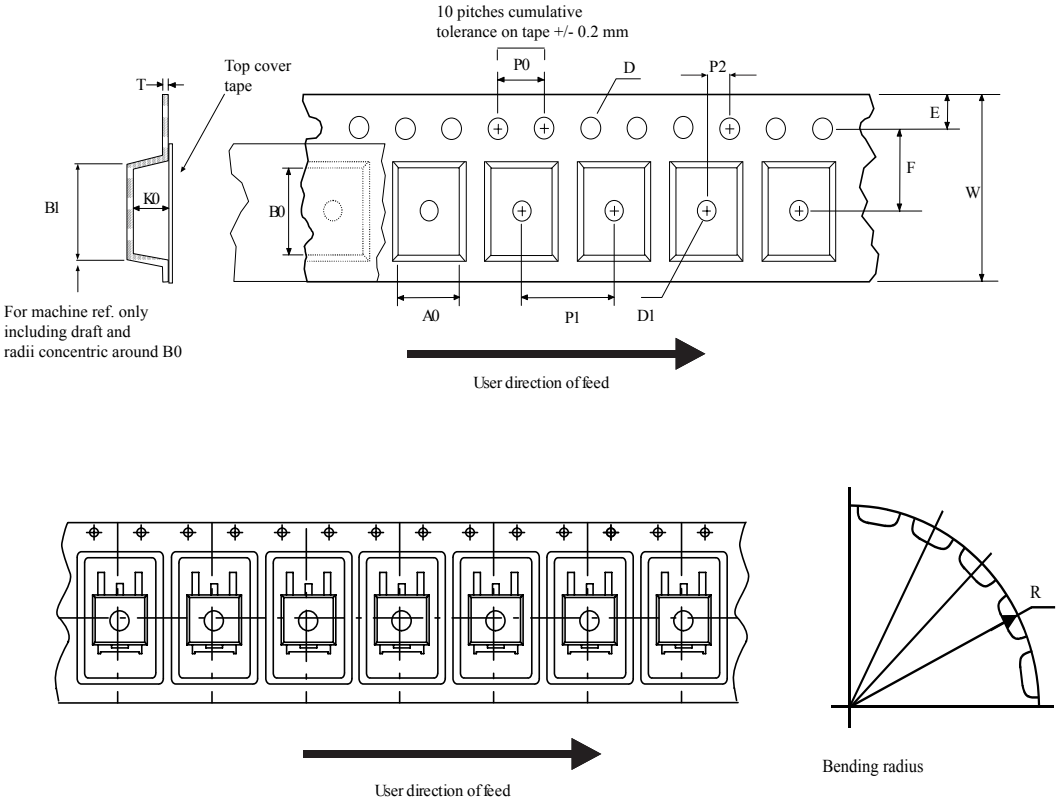
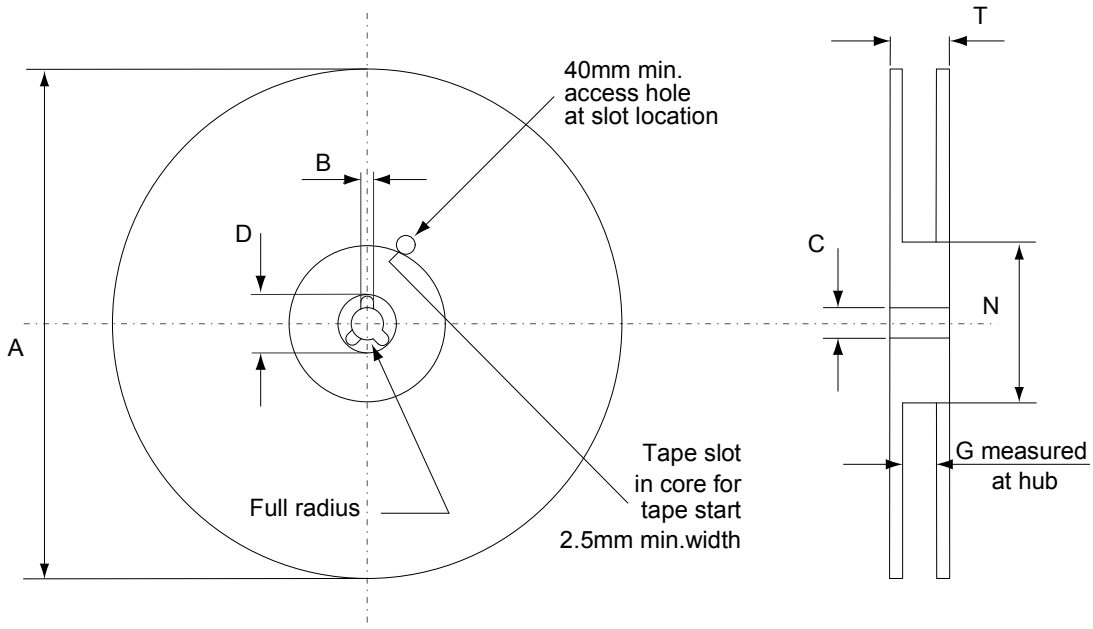


Figure 24. **DPAK (TO-252) reel outline**



AM06038v1

Table 11. **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 12. **Document revision history**

Date	Version	Changes
06-May-2009	1	First release.
28-Sep-2011	2	Inserted new device in I2PAK. Updated tables 1, 2 and 3 with the new package. Updated Section 4: Package mechanical data with the new package and Section 5: Packaging mechanical data. Minor text changes.
24-Apr-2014	3	Updated Section 4.1: DPAK, STD5N52U. Modified: Q_{rr} unit in Table 7. Modified: Figure 8 and 11. The part number STI5N52U has been moved to a separate datasheet.
10-Dec-2018	4	Part number STF5N52U was moved to a separate datasheet and the document was updated accordingly.
15-Jun-2023	5	Updated the entire Section 4 Package information Minor text changes.

Contents