

N-channel 800 V, 0.95  $\Omega$  typ., 6 A MDmesh™ K5 Power MOSFETs in DPAK, TO-220 and IPAK packages

Datasheet - production data

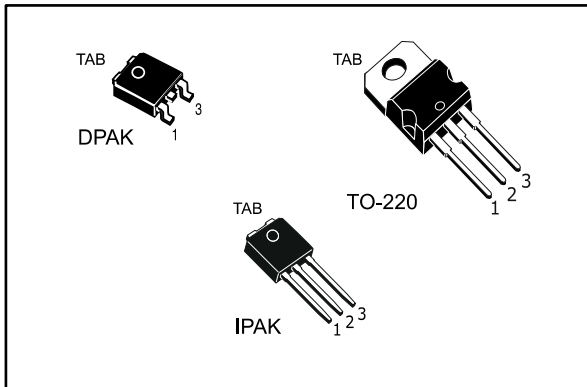
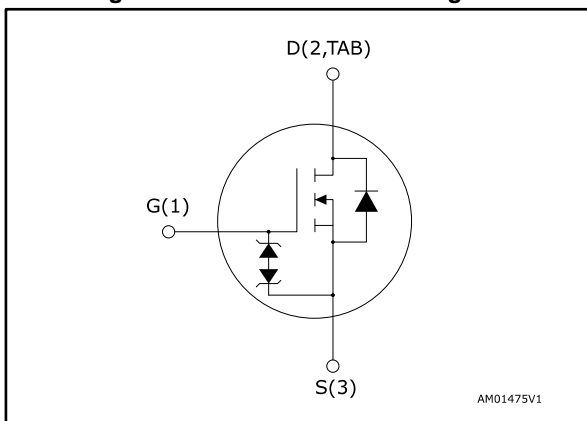


Figure 1: Internal schematic diagram



## Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>	P <sub>TOT</sub>
STD7N80K5	800 V	1.2 $\Omega$	6 A	110 W
STP7N80K5				
STU7N80K5				

- Industry's lowest R<sub>DS(on)</sub> x area
- Industry's best FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

## Applications

- Switching applications

## Description

This very high voltage N-channel Power MOSFET is designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1: Device summary

Order code	Marking	Package	Packaging
STD7N80K5	7N80K5	DPAK	Tape and reel
STP7N80K5		TO-220	Tube
STU7N80K5		IPAK	

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# 1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V <sub>GS</sub>	Gate- source voltage	± 30	V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	6	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	3.8	A
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	24	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	110	W
I <sub>AR</sub>	Max current during repetitive or single pulse avalanche (pulse width limited by T <sub>Jmax</sub> )	2	A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>J</sub> = 25 °C, I <sub>D</sub> =I <sub>AS</sub> , V <sub>DD</sub> = 50 V)	88	mJ
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	4.5	V/ns
dv/dt <sup>(3)</sup>	MOSFET dv/dt ruggedness	50	V/ns
T <sub>j</sub>	Operating junction temperature range	-55 to 150	°C
T <sub>stg</sub>	Storage temperature range		°C

**Notes:**

<sup>(1)</sup>Pulse width limited by safe operating area.

<sup>(2)</sup>I<sub>SD</sub> ≤ 6 A, di/dt ≤ 100 A/μs, V<sub>DS(peak)</sub> ≤ V<sub>(BR)DSS</sub>

<sup>(3)</sup>V<sub>DS</sub> ≤ 640 V

Table 3: Thermal data

Symbol	Parameter	Value			Unit
		DPAK	TO-220	IPAK	
R <sub>thj-case</sub>	Thermal resistance junction-case	1.14			°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-amb		62.5	100	°C/W
R <sub>thj-pcb</sub> <sup>(1)</sup>	Thermal resistance junction-pcb	50			°C/W

**Notes:**

<sup>(1)</sup>When mounted on 1 inch<sup>2</sup> FR-4, 2 Oz copper board.

## 2 Electrical characteristics

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

**Table 4: On/off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}; I_D = 1\text{ mA}$	800			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}; V_{DS} = 800\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}; V_{DS} = 800\text{ V}, T_C = 125\text{ °C}$ <sup>(1)</sup>			50	$\mu\text{A}$
$I_{GSS}$	Gate body leakage current	$V_{DS} = 0\text{ V}; V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}, I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}, I_D = 3\text{ A}$		0.95	1.2	$\Omega$

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test.

**Table 5: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}, f = 1\text{ MHz}, V_{GS} = 0\text{ V}$	-	360	-	pF
$C_{oss}$	Output capacitance		-	30	-	pF
$C_{rss}$	Reverse transfer capacitance		-	1	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0\text{ V}, V_{DS} = 0\text{ to }640\text{ V}$	-	47	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	20	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}, I_D = 0\text{ A}$	-	6	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 640\text{ V}, I_D = 6\text{ A}$	-	13.4	-	nC
$Q_{gs}$	Gate-source charge	$V_{GS} = 0\text{ to }10\text{ V}$	-	3.7	-	nC
$Q_{gd}$	Gate-drain charge	(see <a href="#">Figure 18: "Test circuit for gate charge behavior"</a> )	-	7.5	-	nC

**Notes:**

<sup>(1)</sup>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%  $V_{DSS}$

<sup>(2)</sup>Energy related is defined as a constant equivalent capacitance giving the same stored energy 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	$V_{DD} = 400\text{ V}$ , $I_D = 3\text{ A}$ , $R_G = 4.7\ \Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 17: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 22: "Switching time waveform"</a> )	-	11.3	-	ns
$t_r$	Rise time		-	8.3	-	ns
$t_{d(off)}$	Turn-off delay time		-	23.7	-	ns
$t_f$	Fall time		-	20.2	-	ns

Table 7: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		6	A
$I_{SDM}$	Source-drain current (pulsed)		-		24	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 6\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 6\text{ A}$ , $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , (see <a href="#">Figure 19: "Test circuit for inductive load switching and diode recovery times"</a> )	-	315		ns
$Q_{rr}$	Reverse recovery charge		-	2.8		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	17.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 6\text{ A}$ , $V_{DD} = 60\text{ V}$ $di/dt = 100\text{ A}/\mu\text{s}$ , $T_j = 150\text{ }^\circ\text{C}$ (see <a href="#">Figure 19: "Test circuit for inductive load switching and diode recovery times"</a> )	-	480		ns
$Q_{rr}$	Reverse recovery charge		-	3.8		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	16		A

Notes:

(1) Pulsed: pulse duration = 300 $\mu\text{s}$ , duty cycle 1.5%

Table 8: Gate-source Zener diode

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

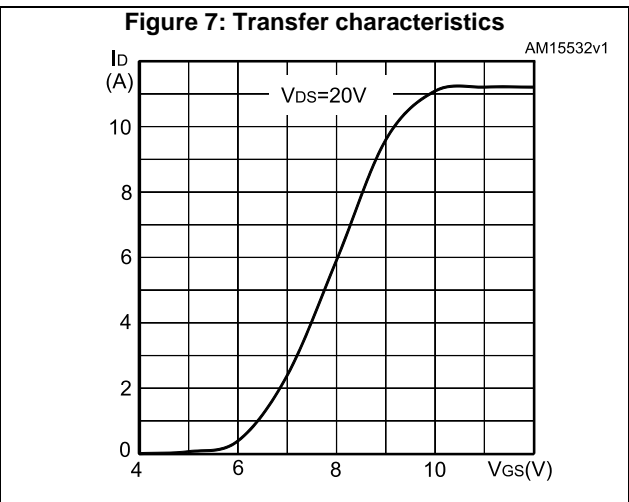
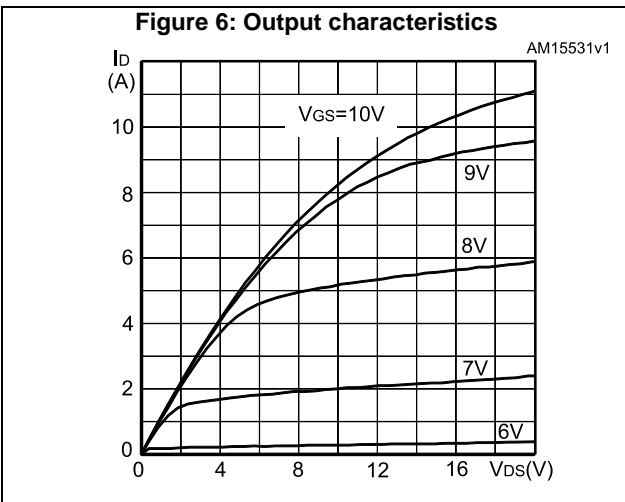
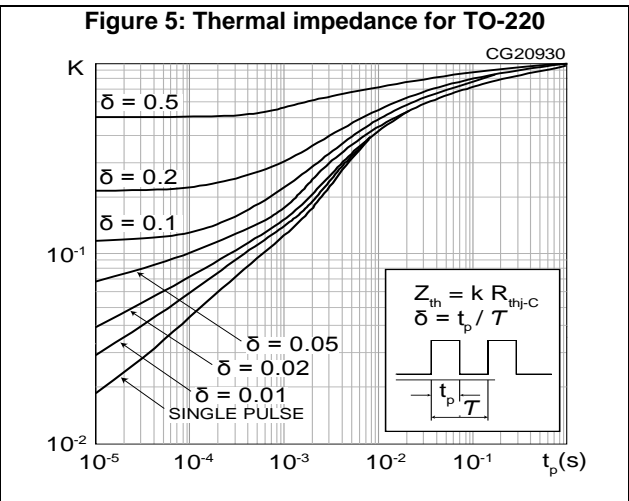
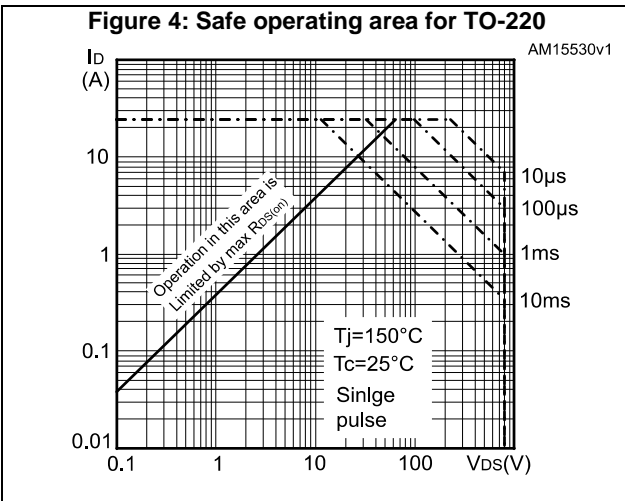
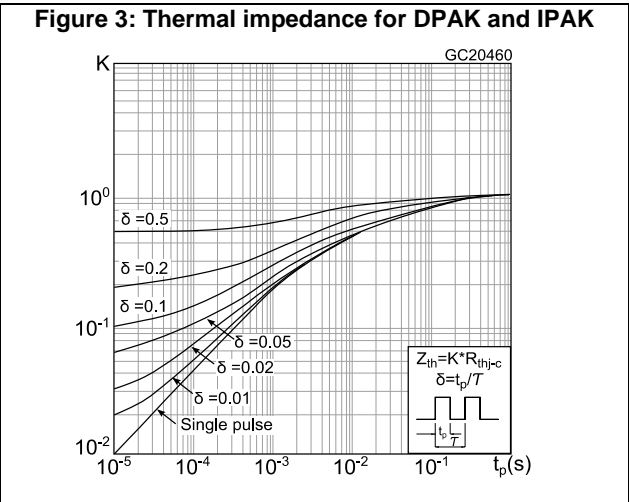
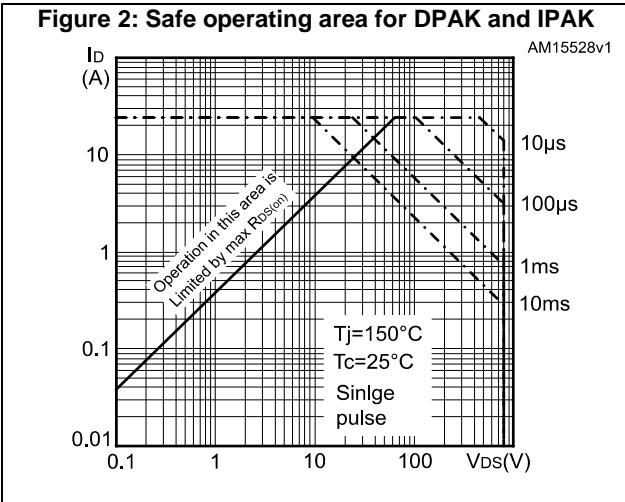


Figure 8: Gate charge vs gate-source voltage

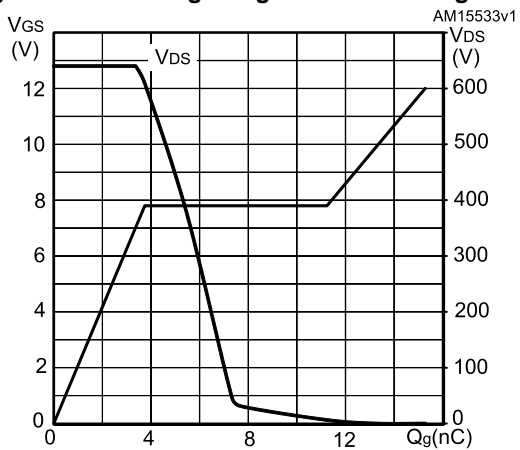


Figure 9: Static drain-source on-resistance

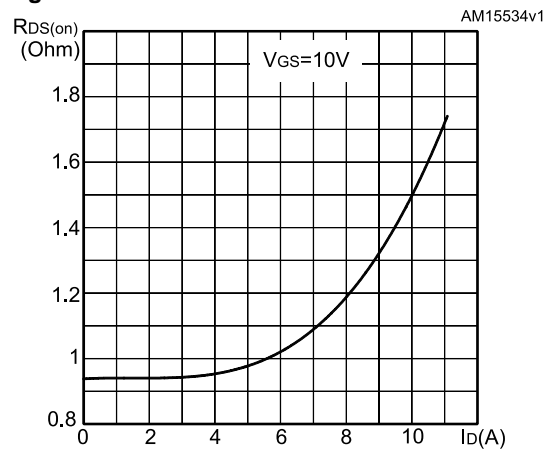


Figure 10: Capacitance variations

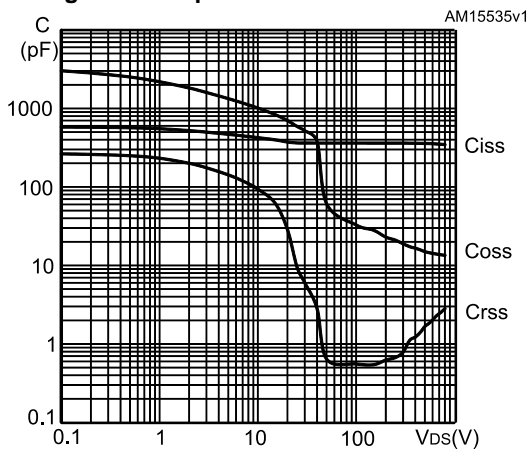


Figure 11: Output capacitance stored energy

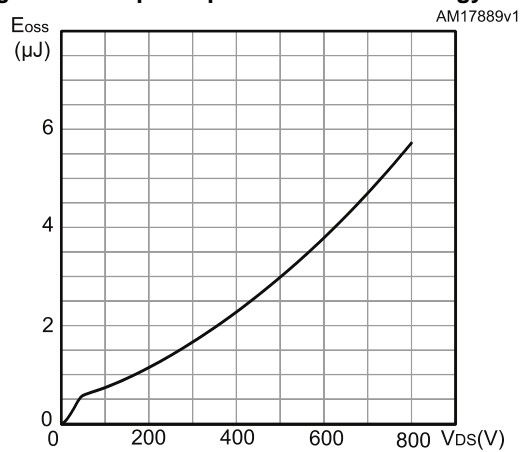


Figure 12: Normalized gate threshold voltage vs temperature

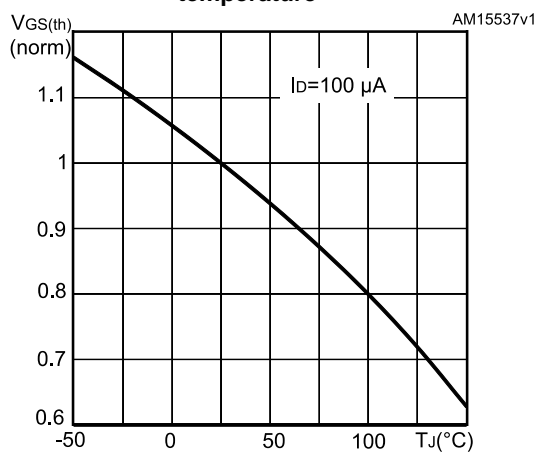


Figure 13: Normalized on-resistance vs temperature

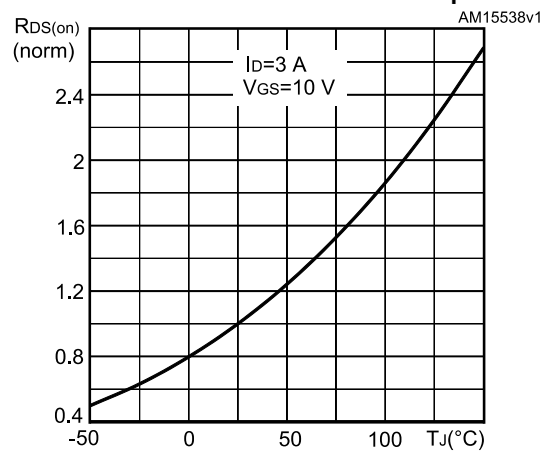


Figure 14: Maximum avalanche energy vs starting  $T_J$

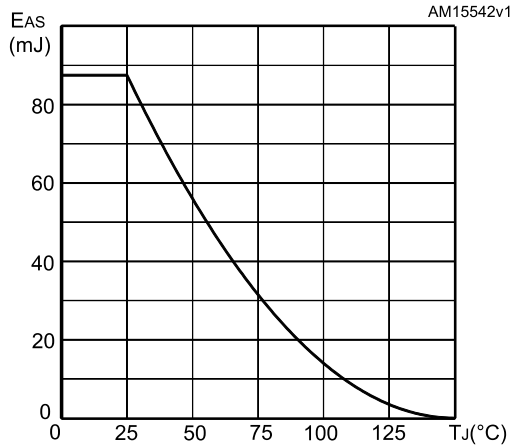


Figure 15: Normalized  $V_{(BR)DSS}$  vs temperature

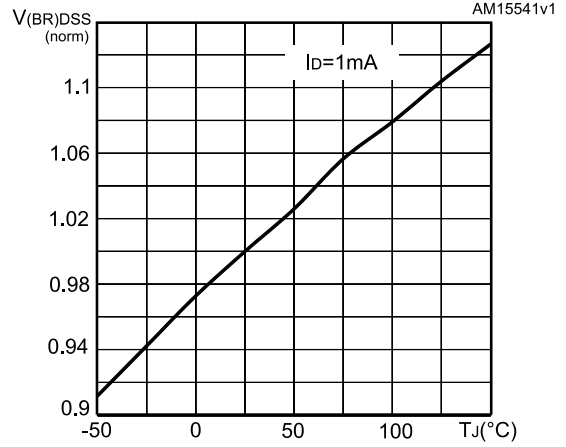
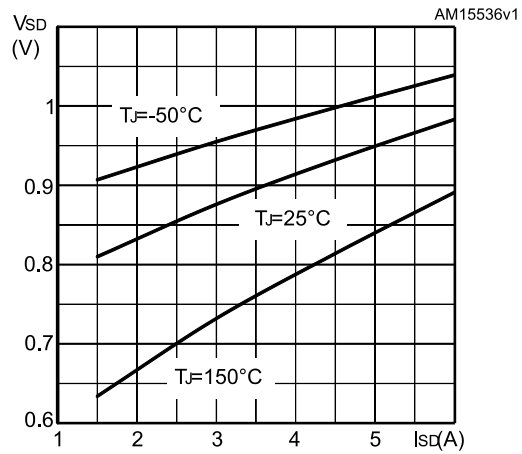


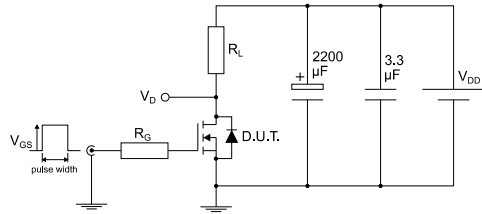
Figure 16: Source-drain diode forward characteristics





### 3 Test circuits

**Figure 17: Test circuit for resistive load switching times**



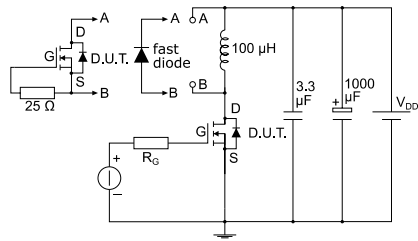
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**Figure 18: Test circuit for gate charge behavior**



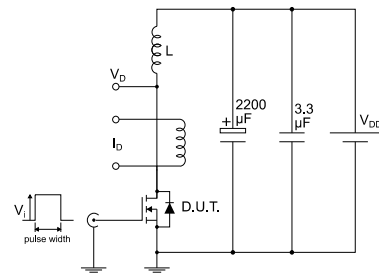
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**Figure 19: Test circuit for inductive load switching and diode recovery times**



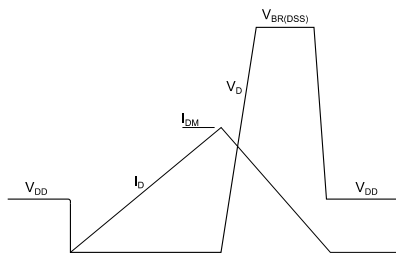
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**Figure 20: Unclamped inductive load test circuit**



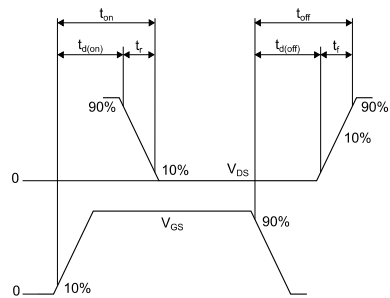
AM01471v1

**Figure 21: Unclamped inductive waveform**



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**Figure 22: Switching time waveform**



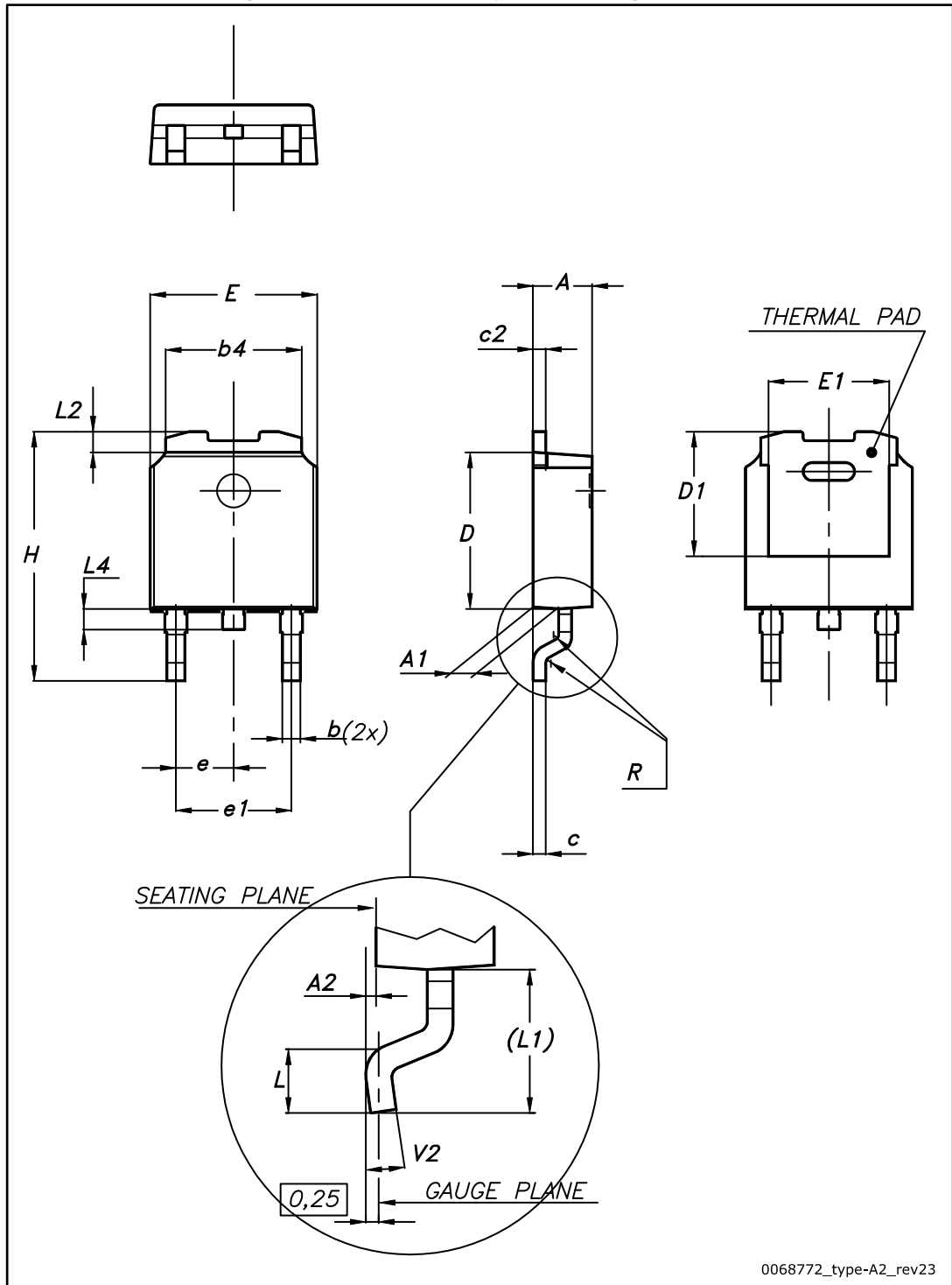
AM01473v1

## 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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 DPAK type A2 package information

Figure 23: DPAK (TO-252) type A2 package outline

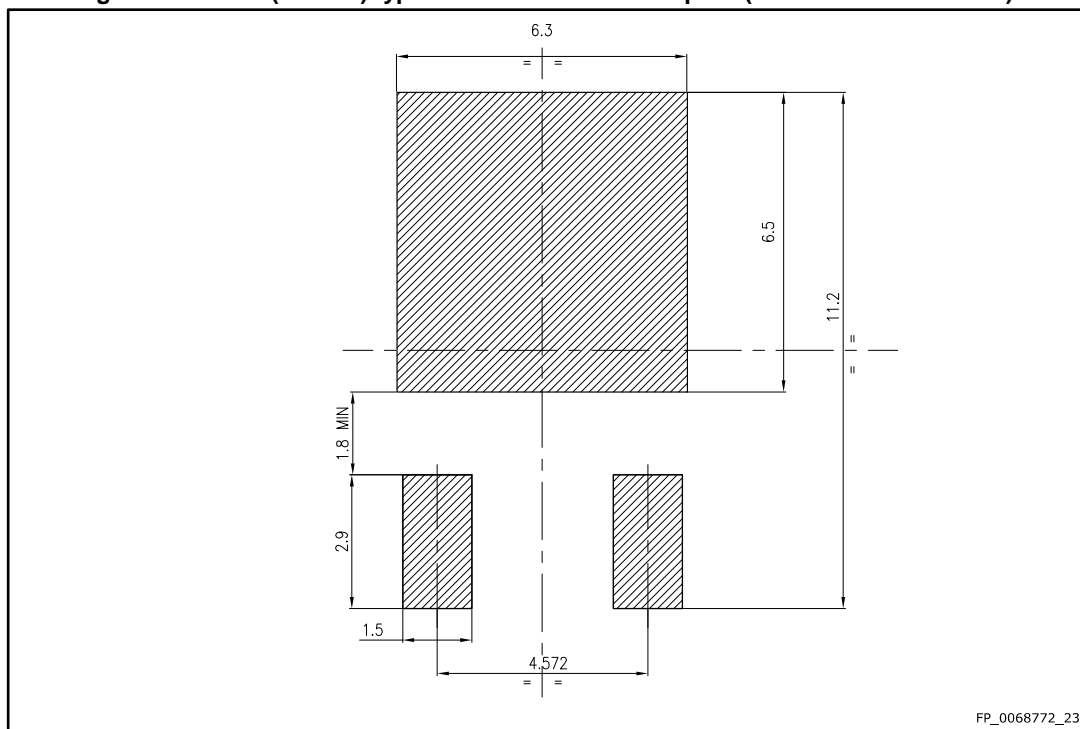


0068772\_type-A2\_rev23

Table 9: DPAK (TO-252) type A2 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	5.10	5.20	5.30
e	2.16	2.28	2.40
e1	4.40		4.60
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°

Figure 24: DPAK (TO-252) type A2 recommended footprint (dimensions are in mm)



## 4.2 DPAK type C2 package information

Figure 25: DPAK (TO-252) type C2 package outline

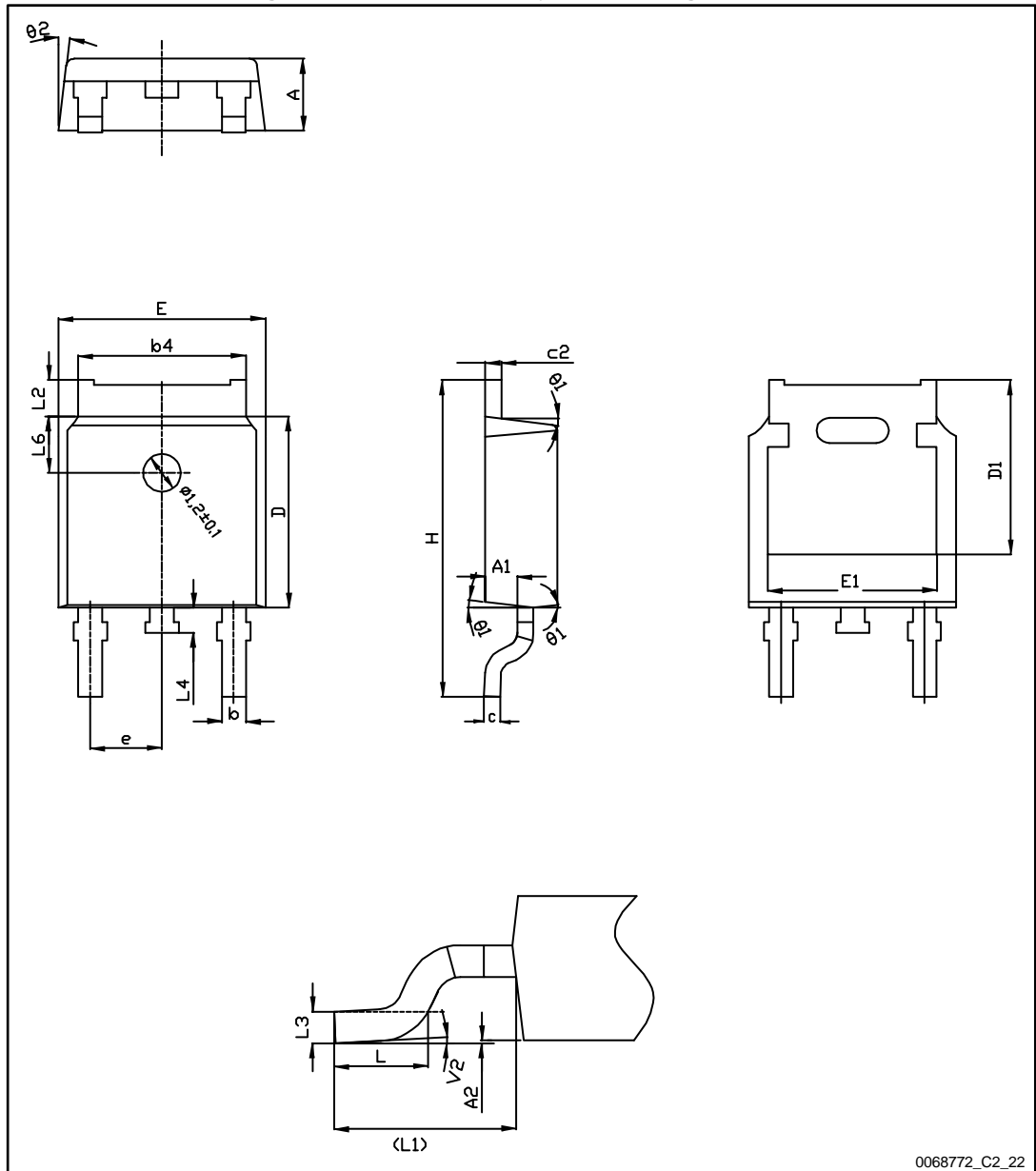
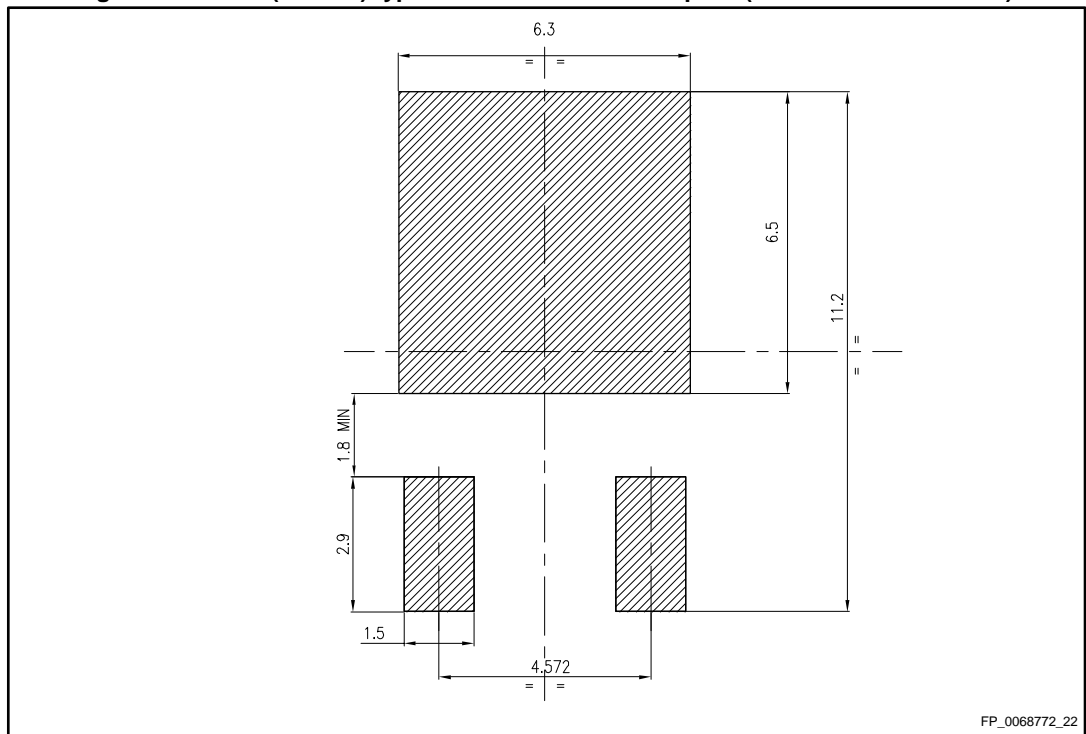


Table 10: DPAK (TO-252) type C2 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.38
A1	0.90	1.01	1.10
A2	0.00		0.10
b	0.72		0.85
b4	5.13	5.33	5.46
c	0.47		0.60
c2	0.47		0.60
D	6.00	6.10	6.20
D1	5.10		5.60
E	6.50	6.60	6.70
E1	5.20		5.50
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	0.90		1.25
L3	0.51 BSC		
L4	0.60	0.80	1.00
L6	1.80 BSC		
θ1	5°	7°	9°
θ2	5°	7°	9°
V2	0°		8°

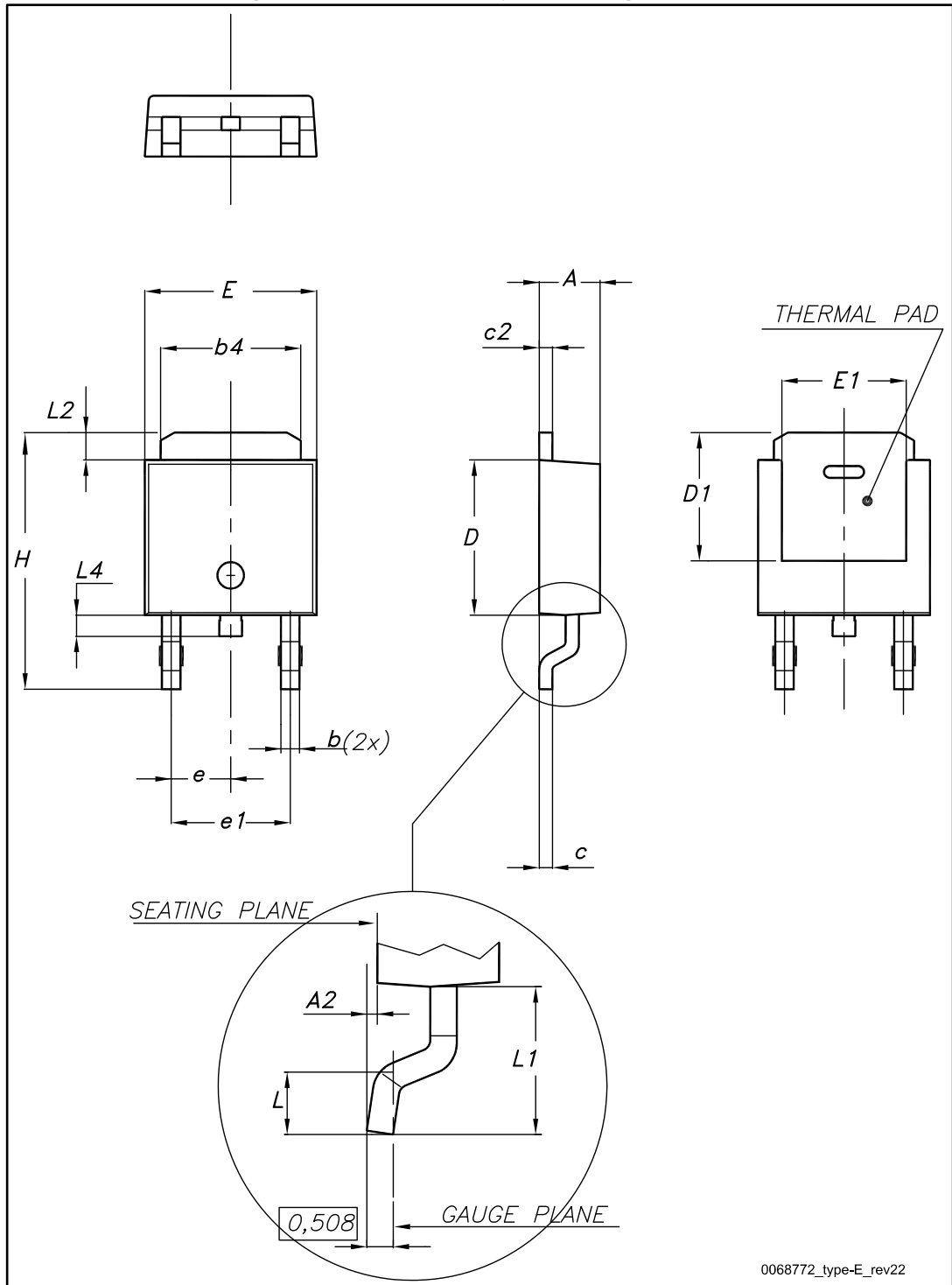
Figure 26: DPAK (TO-252) type C2 recommended footprint (dimensions are in mm)





### 4.3 DPAK type E package information

Figure 27: DPAK (TO-252) type E package outline

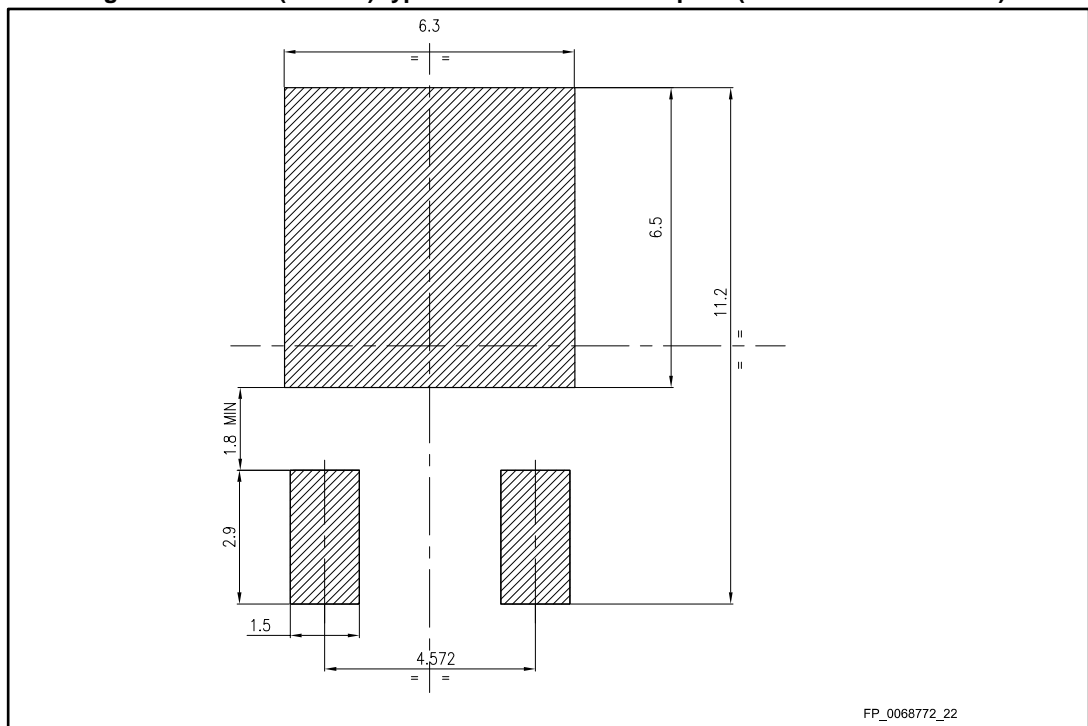


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Table 11: DPAK (TO-252) type E mechanical data

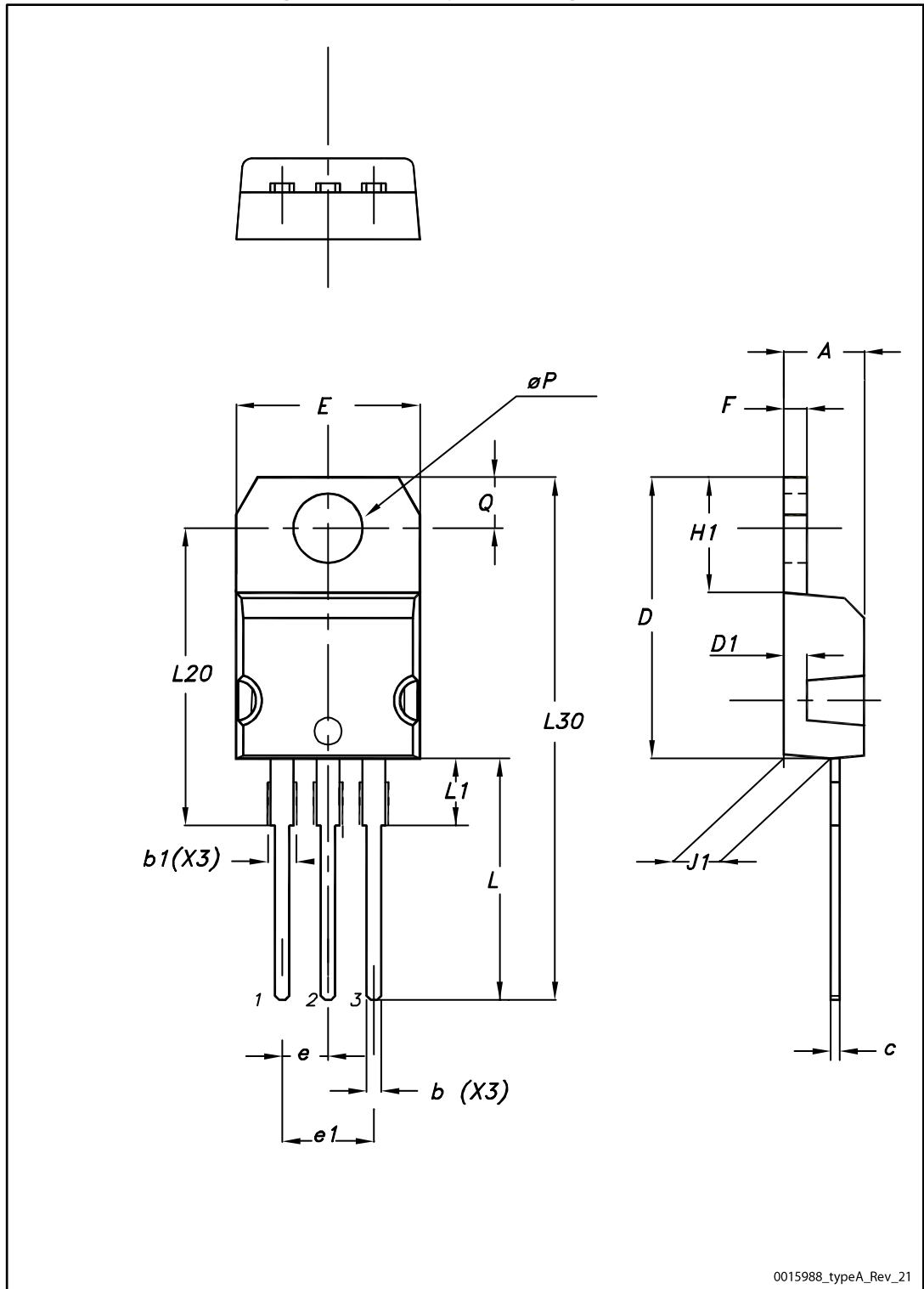
Dim.	mm		
	Min.	Typ.	Max.
A	2.18		2.39
A2			0.13
b	0.65		0.884
b4	4.95		5.46
c	0.46		0.61
c2	0.46		0.60
D	5.97		6.22
D1	5.21		
E	6.35		6.73
E1	4.32		
e		2.286	
e1		4.572	
H	9.94		10.34
L	1.50		1.78
L1		2.74	
L2	0.89		1.27
L4			1.02

Figure 28: DPAK (TO-252) type E recommended footprint (dimensions are in mm)



### 4.4 TO-220 package information

Figure 29: TO-220 type A package outline



0015988\_typeA\_Rev\_21

Table 12: TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		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	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

### 4.5 IPAK type A package information

Figure 30: IPAK (TO-251) type A package outline

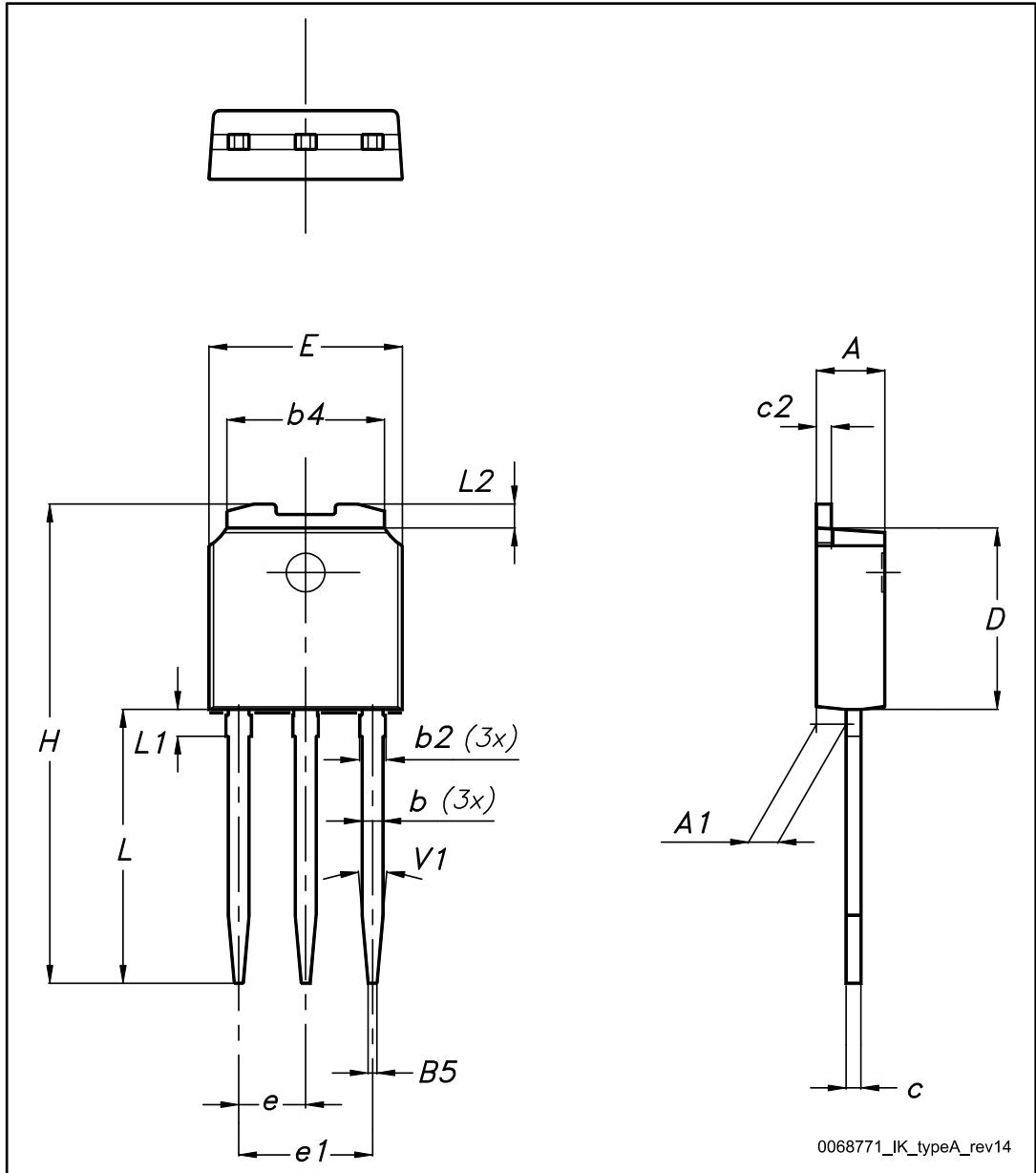
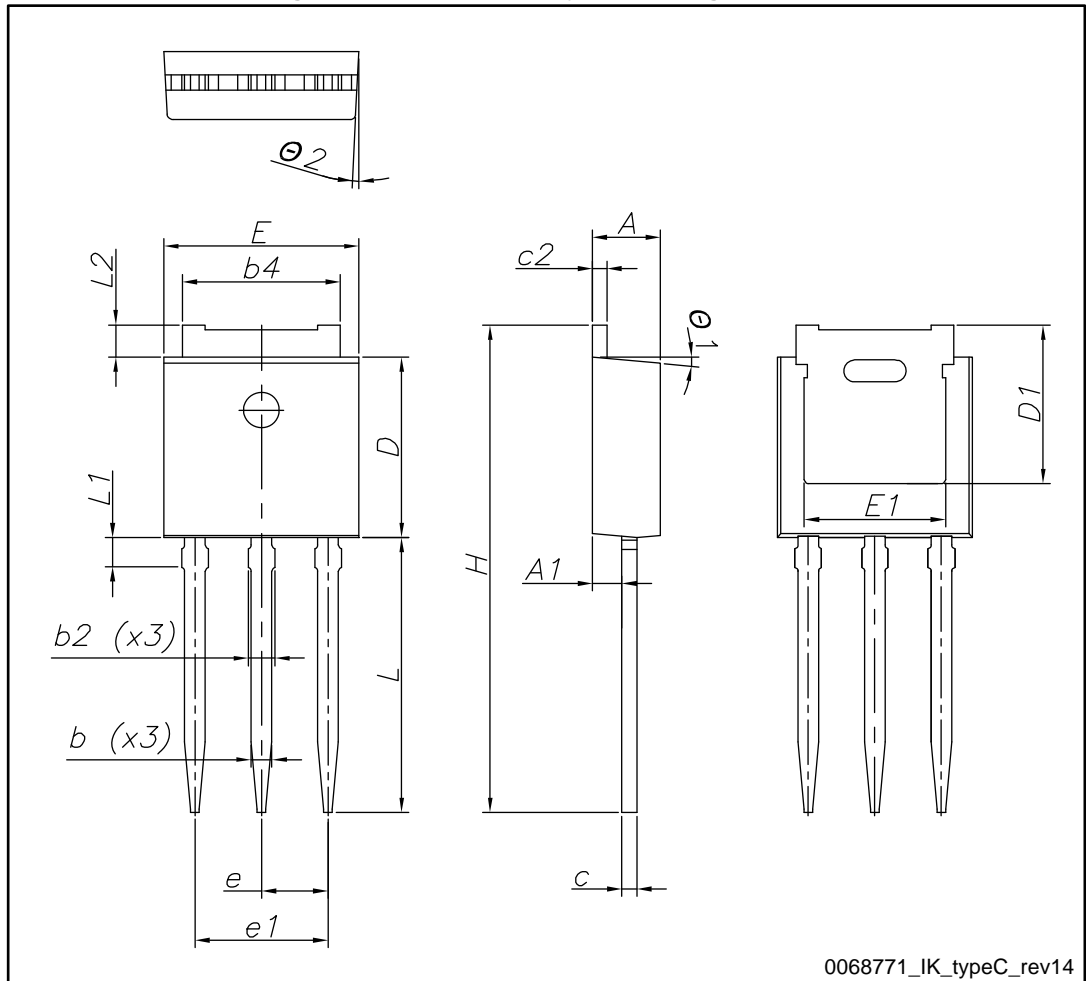


Table 13: IPAK (TO-251) type A package mechanical data

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°	

### 4.6 IPAK type C package information

Figure 31: IPAK (TO-251) type C package outline



0068771\_IK\_typeC\_rev14

Table 14: IPAK (TO-251) type C package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.35
A1	0.90	1.00	1.10
b	0.66		0.79
b2			0.90
b4	5.23	5.33	5.43
c	0.46		0.59
c2	0.46		0.59
D	6.00	6.10	6.20
D1	5.20	5.37	5.55
E	6.50	6.60	6.70
E1	4.60	4.78	4.95
e	2.20	2.25	2.30
e1	4.40	4.50	4.60
H	16.18	16.48	16.78
L	9.00	9.30	9.60
L1	0.80	1.00	1.20
L2	0.90	1.08	1.25
$\theta 1$	3°	5°	7°
$\theta 2$	1°	3°	5°



# 5 Packing mechanical data

Figure 32: DPAK (TO-252) tape outline

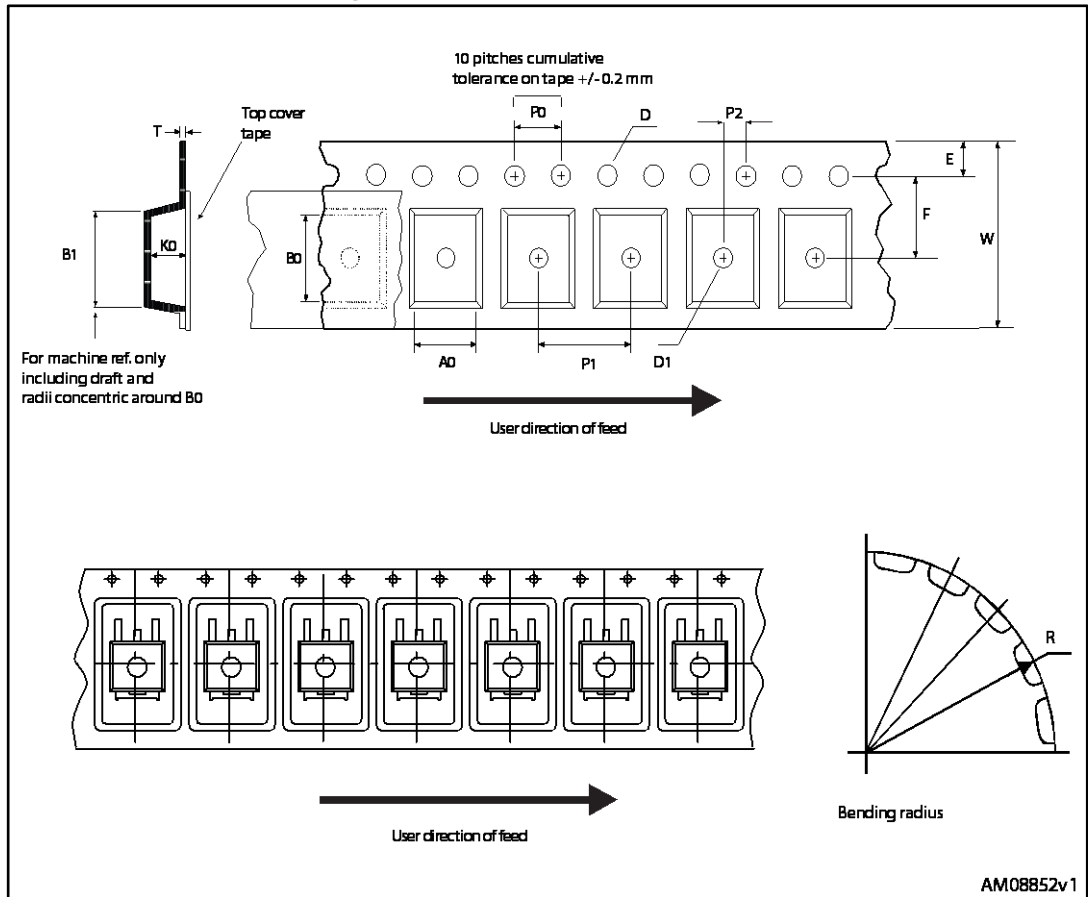
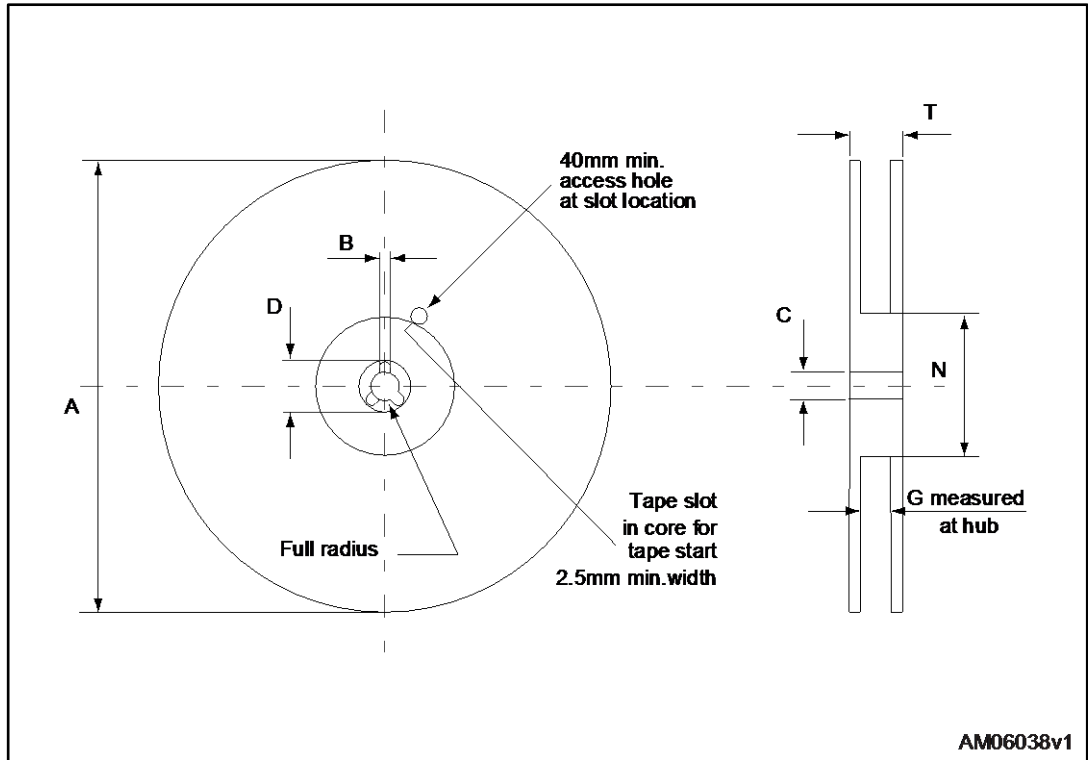


Figure 33: DPAK (TO-252) reel outline



AM06038v1

Table 15: 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			

## 6 Revision history

Table 16: Document revision history

Date	Revision	Changes
17-Jul-2012	1	First release.
17-Oct-2012	2	Minor text changes in cover page Modified: title and I <sub>D</sub> value in cover page
19-Dec-2012	3	Minor text changes Added: IPAK package Updated: Section 4: Package mechanical data for IPAK
18-Mar-2013	4	Modified: I <sub>AR</sub> value on Table 2 Updated: Section 4: Package mechanical data only for DPAK package
09-Oct-2013	5	The part number STF7N80K5 has been moved to a separate datasheet Minor text changes
19-May-2017	6	Updated title, description and features in cover page. Updated <a href="#">Table 2: "Absolute maximum ratings"</a> and <a href="#">Table 4: "On/off states"</a> . Updated <a href="#">Section 4: "Package information"</a> . Minor text changes.

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