STB8N65M5, STD8N65M5, STF8N65M5, STI8N65M5, STP8N65M5, STU8N65M5

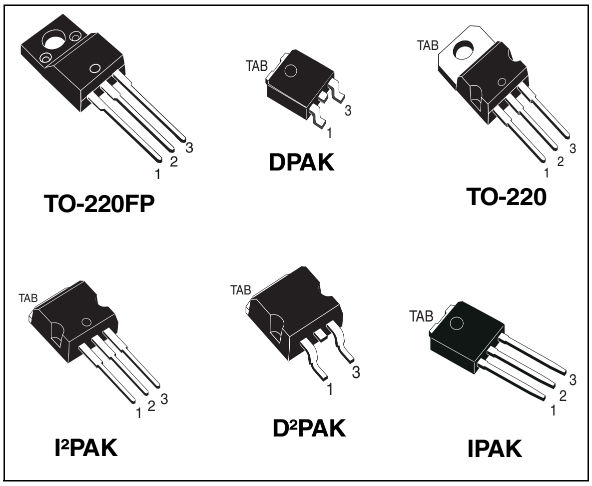
N-channel 650 V, 0.56 Ω typ., 7 A MDmesh™ V Power MOSFET in D²PAK, I²PAK, TO-220, TO-220FP, DPAK and IPAK packages

Datasheet — production data

Features

Type	V_{DSS} @ T_{Jmax}	$R_{DS(on)}$ max.	I_D	P_{TOT}
STB8N65M5	710 V	< 0.6 Ω	7 A	70 W
STD8N65M5				70 W
STF8N65M5				25 W
STI8N65M5				70 W
STP8N65M5				70 W
STU8N65M5				70 W

- Worldwide best $R_{DS(on)}$ * area
- Higher V_{DSS} rating
- High dv/dt capability
- Excellent switching performance
- Easy to drive
- 100% avalanche tested



Applications

- Switching applications

Description

These devices are N-channel MDmesh™ V Power MOSFETs based on an innovative proprietary vertical process technology, which is combined with STMicroelectronics' well-known PowerMESH™ horizontal layout structure. The resulting product has extremely low on-resistance, which is unmatched among silicon-based Power MOSFETs, making it especially suitable for applications which require superior power density and outstanding efficiency.

Figure 1. Internal schematic diagram

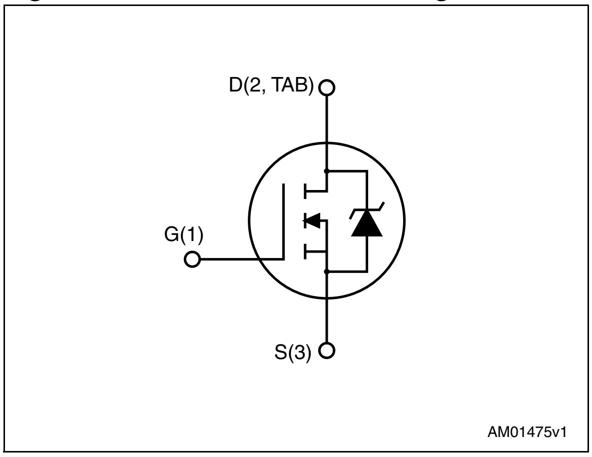


Table 1. Device summary

Order codes	Marking	Package	Packaging
STB8N65M5	8N65M5	D²PAK	Tape and reel
STD8N65M5		DPAK	Tape and reel
STF8N65M5		TO-220FP	Tube
STI8N65M5		I²PAK	Tube
STP8N65M5		TO-220	Tube
STU8N65M5		IPAK	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220 D²PAK I²PAK	IPAK DPAK,	TO-220FP	
V_{GS}	Gate- source voltage	± 25			V
I_D	Drain current (continuous) at T_C = 25 °C	7		7 (1)	A
I_D	Drain current (continuous) at T_C = 100 °C	4.4		4.4 (1)	A
I_{DM} (2)	Drain current (pulsed)	28		28 (1)	A
P_{TOT}	Total dissipation at T_C = 25 °C	70		25	W
I_{AR}	Max current during repetitive or single pulse avalanche (pulse width limited by T_{JMAX})	2			A
E_{AS}	Single pulse avalanche energy (starting T_j = 25°C, I_D = I_{AR}, V_{DD} = 50V)	120			mJ
dv/dt (3)	Peak diode recovery voltage slope	15			V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T_C = 25 °C)			2500	V
T_{stg}	Storage temperature	-55 to 150			°C
T_j	Max. operating junction temperature	150			°C

1. Limited by maximum junction temperature
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 7$ A, di/dt ≤ 400 A/µs, $V_{DD} \leq 400$ V, $V_{DS(peak)} < V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value						Unit
		DPAK	IPAK	TO-220	I²PAK	D²PAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max	1.79					5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max		100	62.5			62.5	°C/W
$R_{thj-pcb}$ (1)	Thermal resistance junction-pcb max	50				30		°C/W

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

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	I_D = 1 mA, V_{GS} = 0	650			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 650 V V_{DS} = 650 V, T_C=125 °C			1 100	µA µA
I_{GSS}	Gate-body leakage current (V_{DS} = 0)	V_{GS} = ± 25 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 3.5 A		0.56	0.60	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0	-	690 18 2	-	pF pF pF
$C_{o(er)}$ (1)	Equivalent output capacitance energy related	V_{GS} = 0, V_{DS} = 0 to 520 V	-	17	-	pF
$C_{o(tr)}$ (2)	Equivalent output capacitance time related	V_{GS} = 0, V_{DS} = 0 to 520 V	-	52	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz open drain	2	4	6	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 520 V, I_D = 3.5 A, V_{GS} = 10 V (see *Figure 19*)	-	15 3.6 6	-	nC nC nC

1. $C_{o(er)}$ is a constant capacitance value that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}
2. $C_{o(tr)}$ is a constant capacitance value that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$ $t_{r(V)}$ $t_{c(off)}$ $t_{f(i)}$	Turn-off delay time Rise time Cross time Fall time	V_{DD} = 400 V, I_D = 4A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 20*) (see *Figure 23*)	-	50 14 20 11	-	ns ns ns ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM} (1)	Source-drain current Source-drain current (pulsed)		-		7 28	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 7 A, V_{GS} = 0	-		1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 7 A, di/dt = 100 A/µs V_{DD} = 100 V (see *Figure 20*)	-	200 1.6 16		ns µC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 7 A, di/dt = 100 A/µs V_{DD} = 100 V, T_j = 150 °C (see *Figure 20*)	-	263 1.9 15		ns µC A

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

2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for TO-220, I²PAK, D²PAK

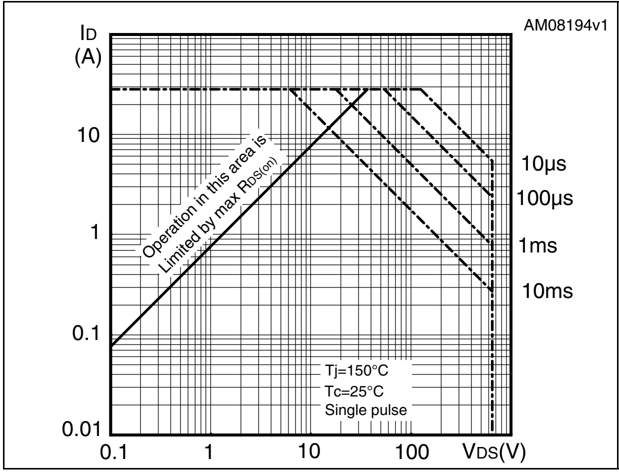


Figure 3. Thermal impedance for TO-220, I²PAK, D²PAK

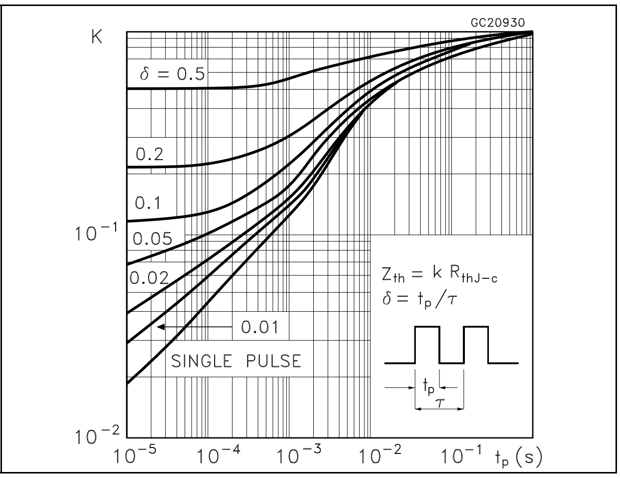


Figure 4. Safe operating area for DPAK, IPAK

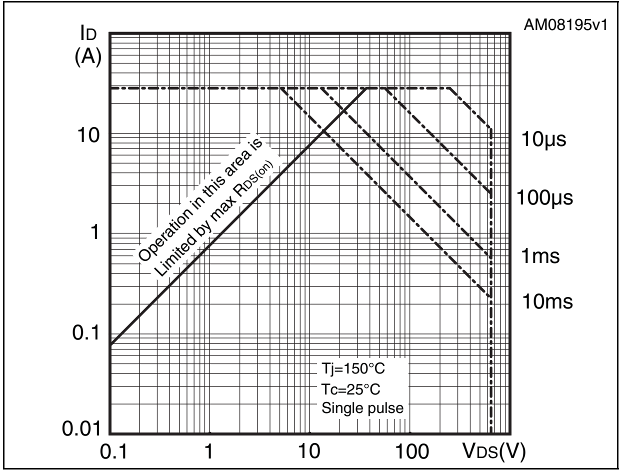


Figure 5. Thermal impedance for DPAK, IPAK

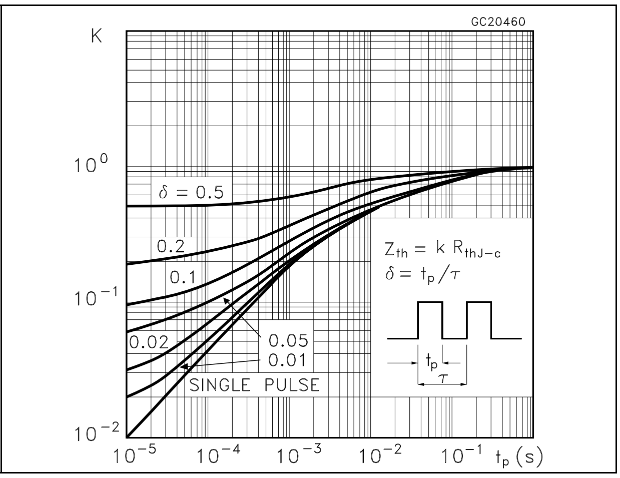


Figure 6. Safe operating area for TO-220FP

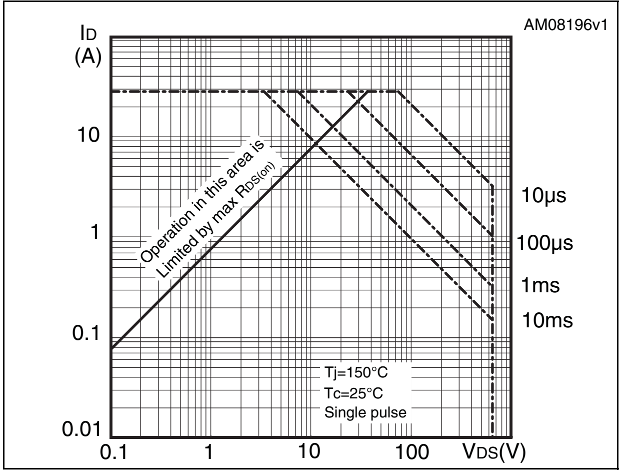


Figure 7. Thermal impedance for TO-220FP

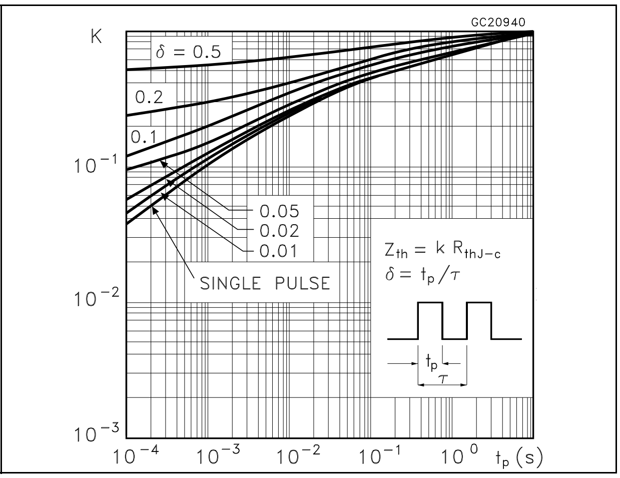


Figure 8. Output characteristics

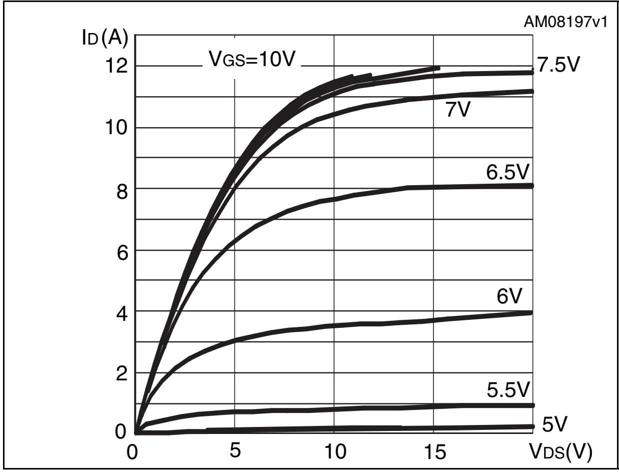


Figure 9. Transfer characteristics

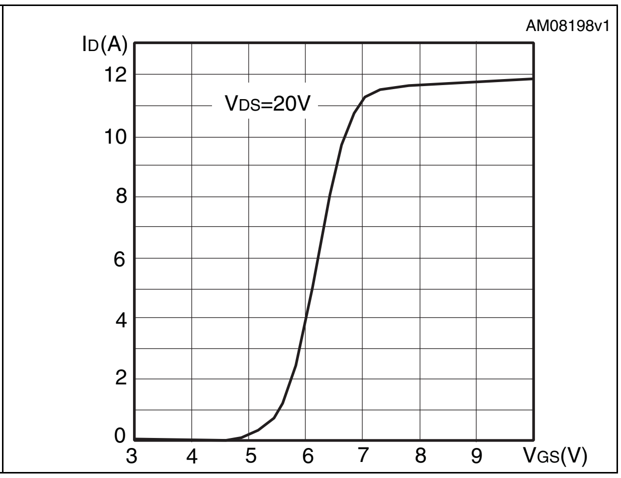


Figure 10. Gate charge vs gate-source voltage

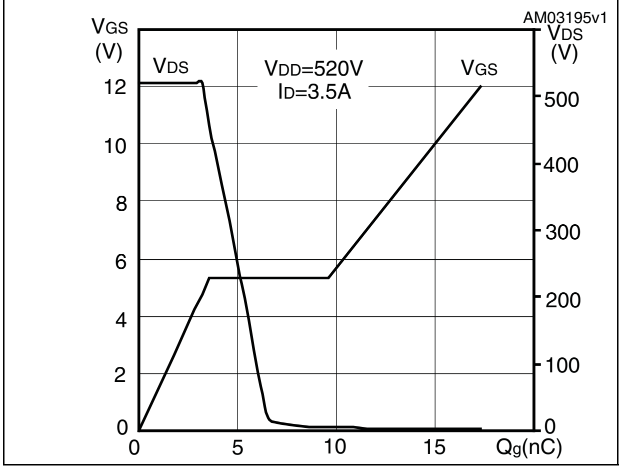


Figure 11. Static drain-source on-resistance

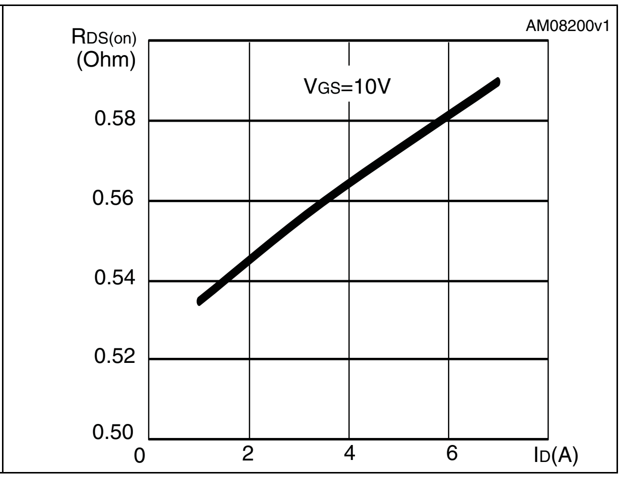


Figure 12. Capacitance variations

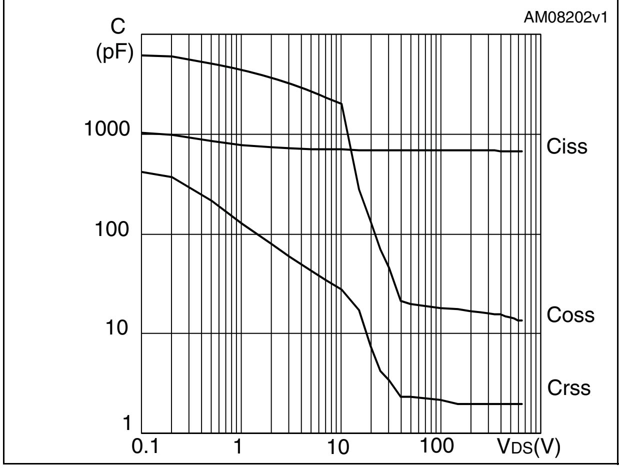


Figure 13. Output capacitance stored energy

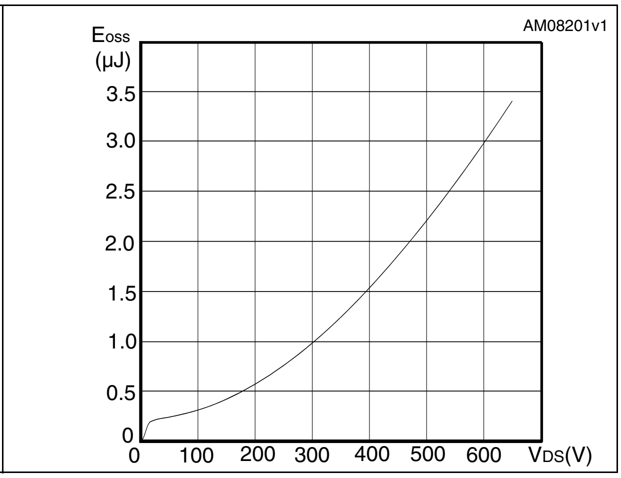


Figure 14. Normalized gate threshold voltage vs temperature

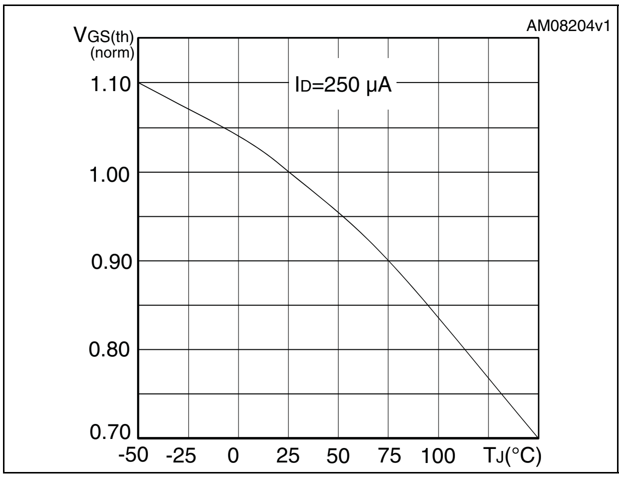


Figure 15. Normalized on-resistance vs temperature

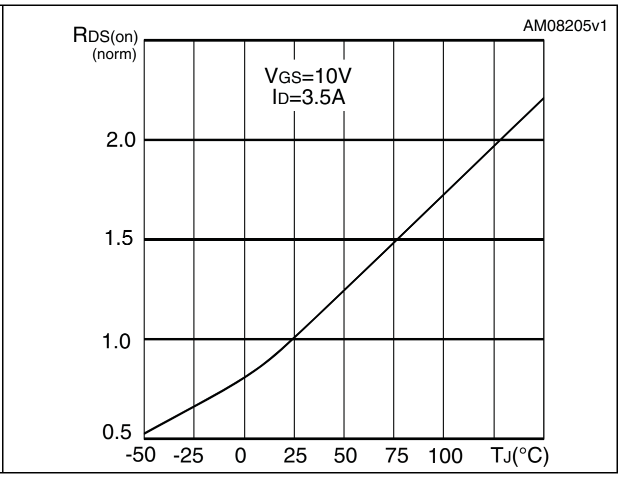


Figure 16. Switching losses vs gate resistance (1)

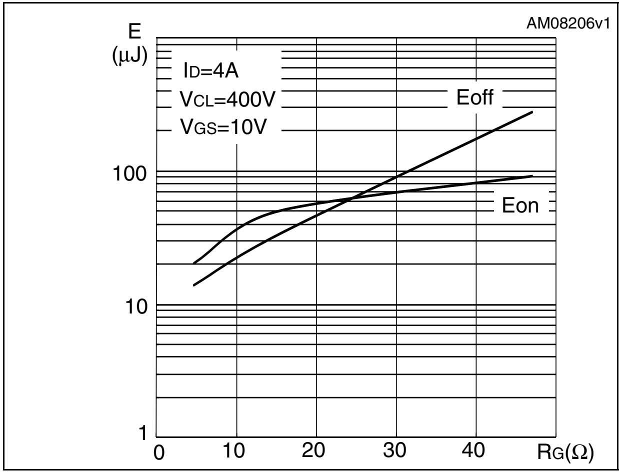
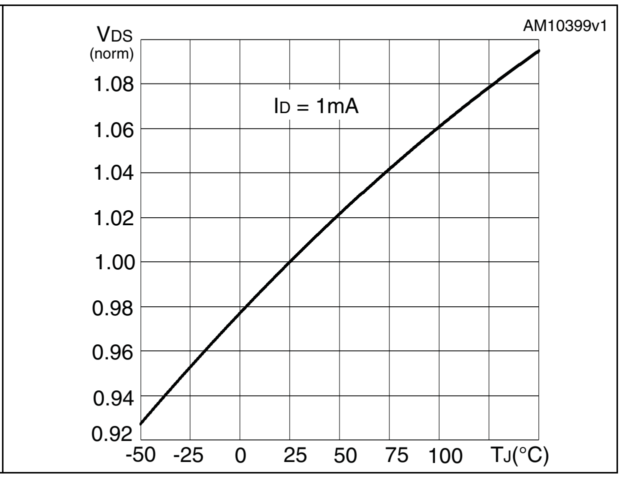


Figure 17. Normalized B_{VDSS} vs temperature



1. Eon including reverse recovery of a SiC diode

3 Test circuits

Figure 18. Switching times test circuit for resistive load

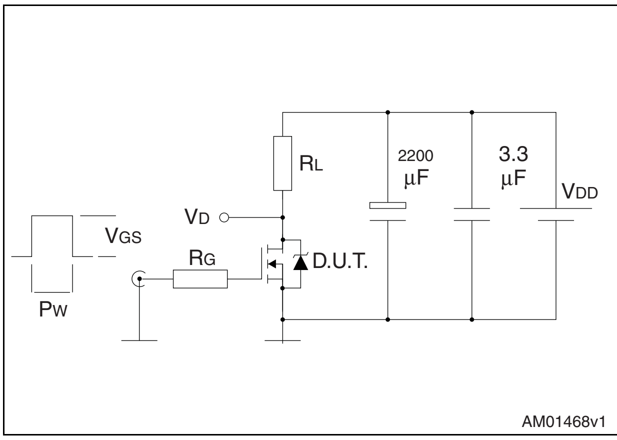


Figure 19. Gate charge test circuit

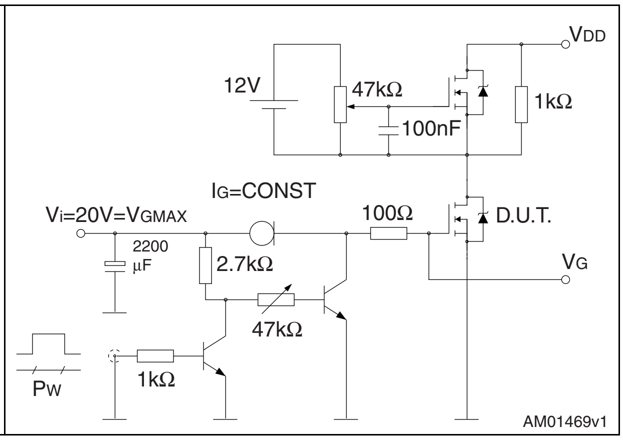


Figure 20. Test circuit for inductive load switching and diode recovery times

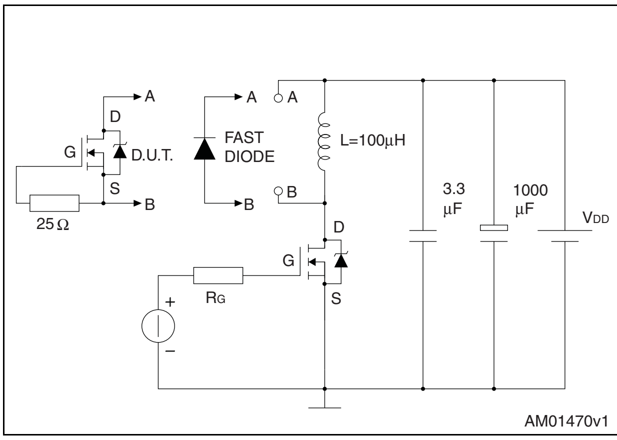


Figure 21. Unclamped inductive load test circuit

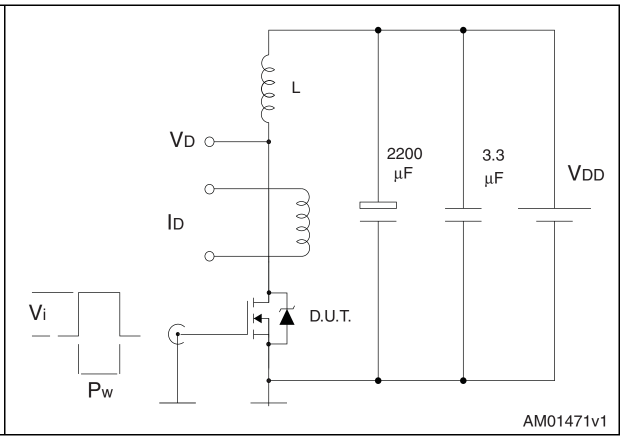


Figure 22. Unclamped inductive waveform

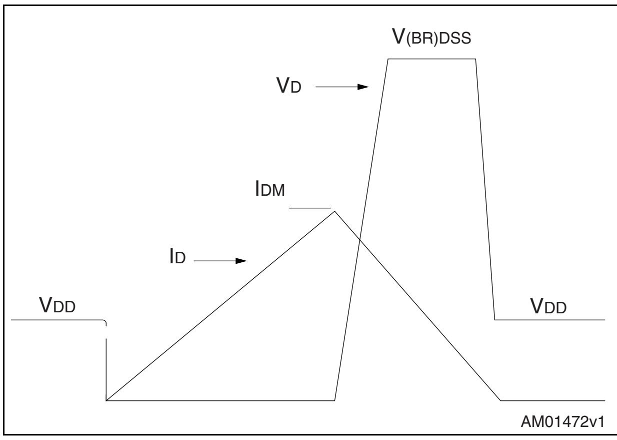
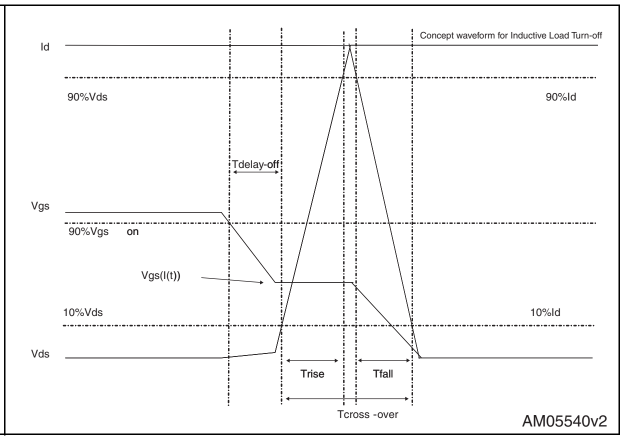


Figure 23. Switching time waveform



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 8. D^2PAK (TO-263) 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		
E	10		10.40
E1	8.50		
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 24. D²PAK (TO-263) drawing

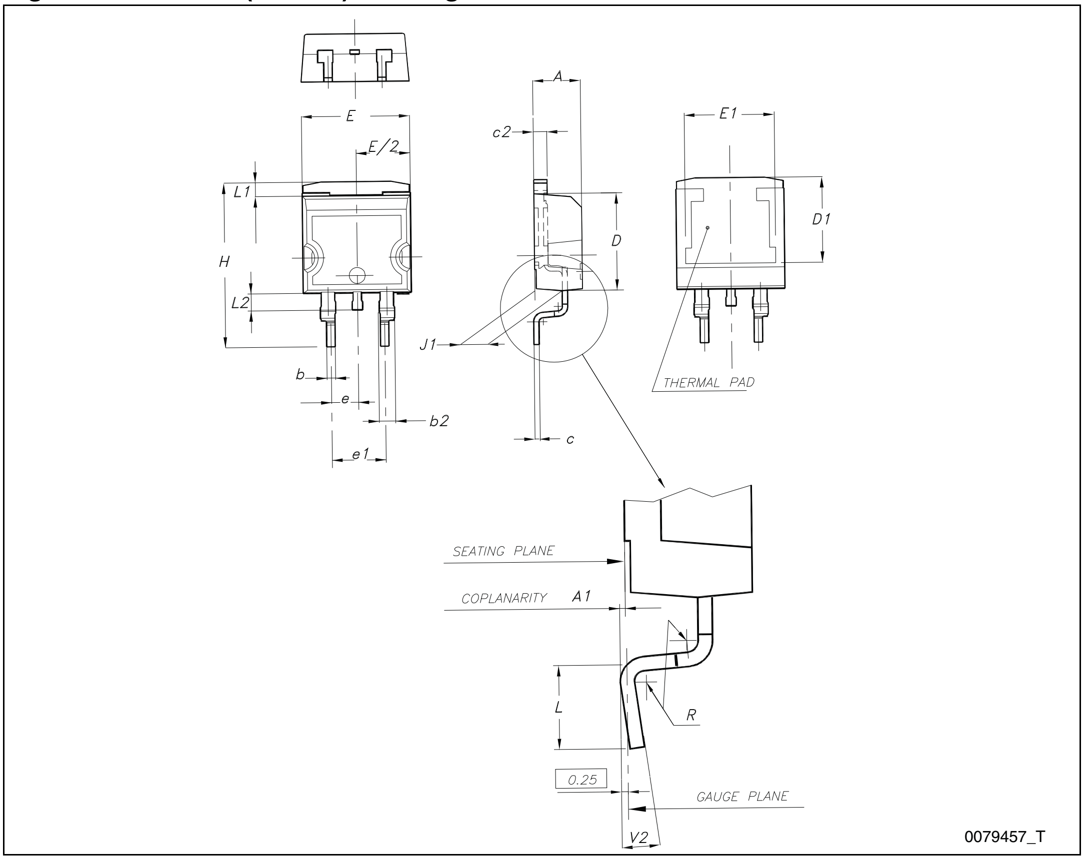
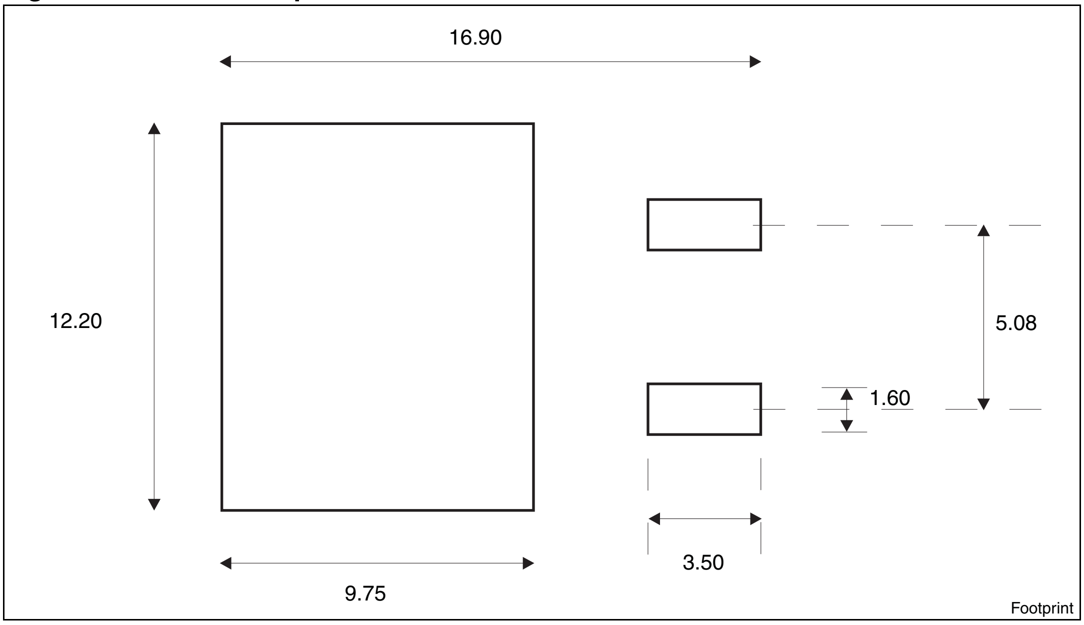


Figure 25. D²PAK footprint[(a)]



a. All dimension are in millimeters

Table 9. 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		
L1		2.80	
L2		0.80	
L4	0.60		1
R		0.20	
V2	0°		8°

Figure 26. DPAK (TO-252) drawing

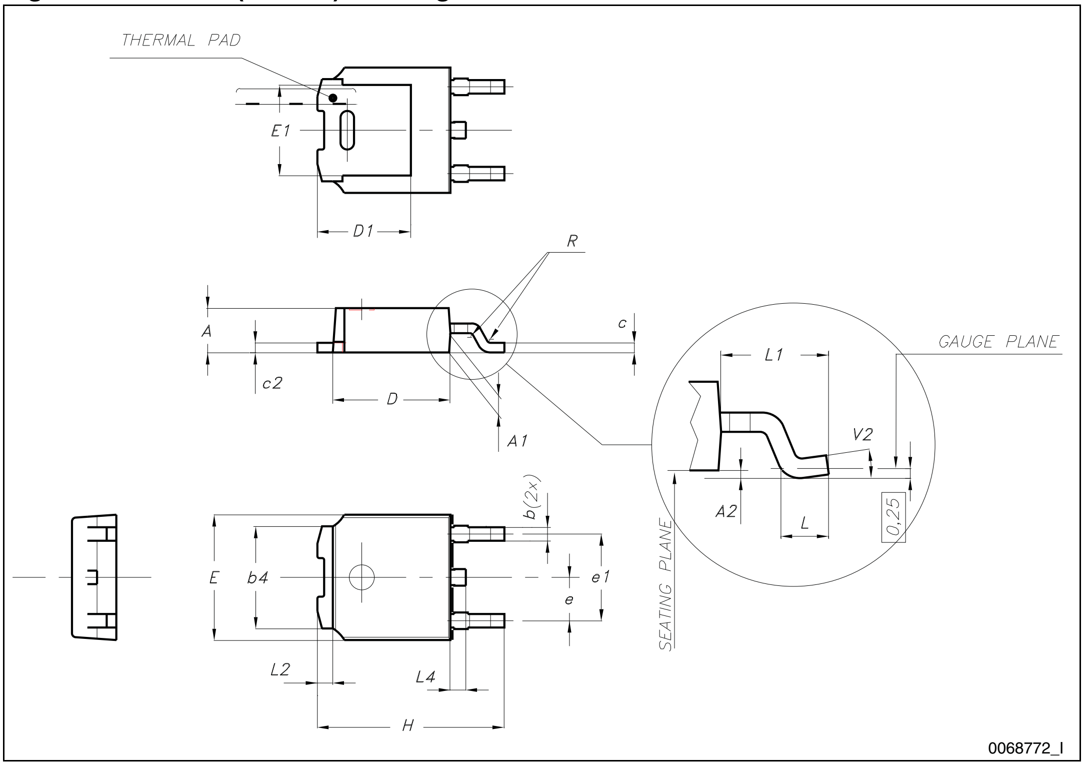
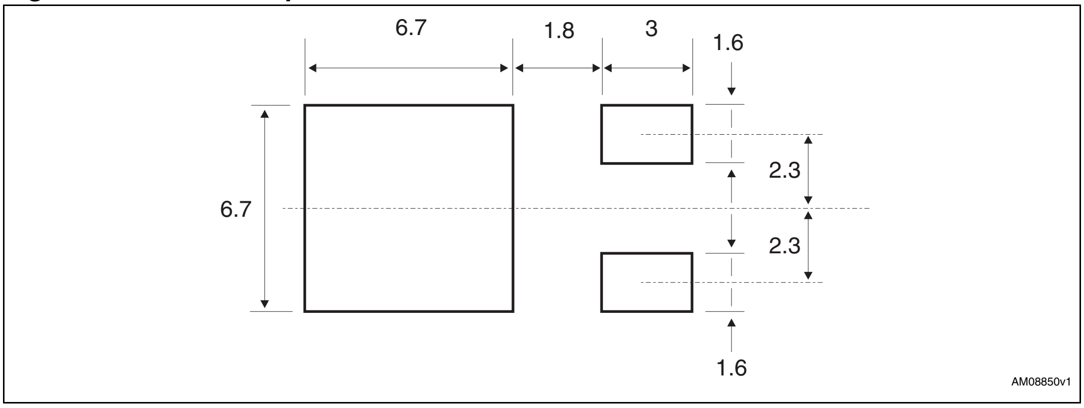


Figure 27. DPAK footprint(b)



b. All dimensions are in millimeters.

Table 10. TO-220FP mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

Figure 28. TO-220FP drawing

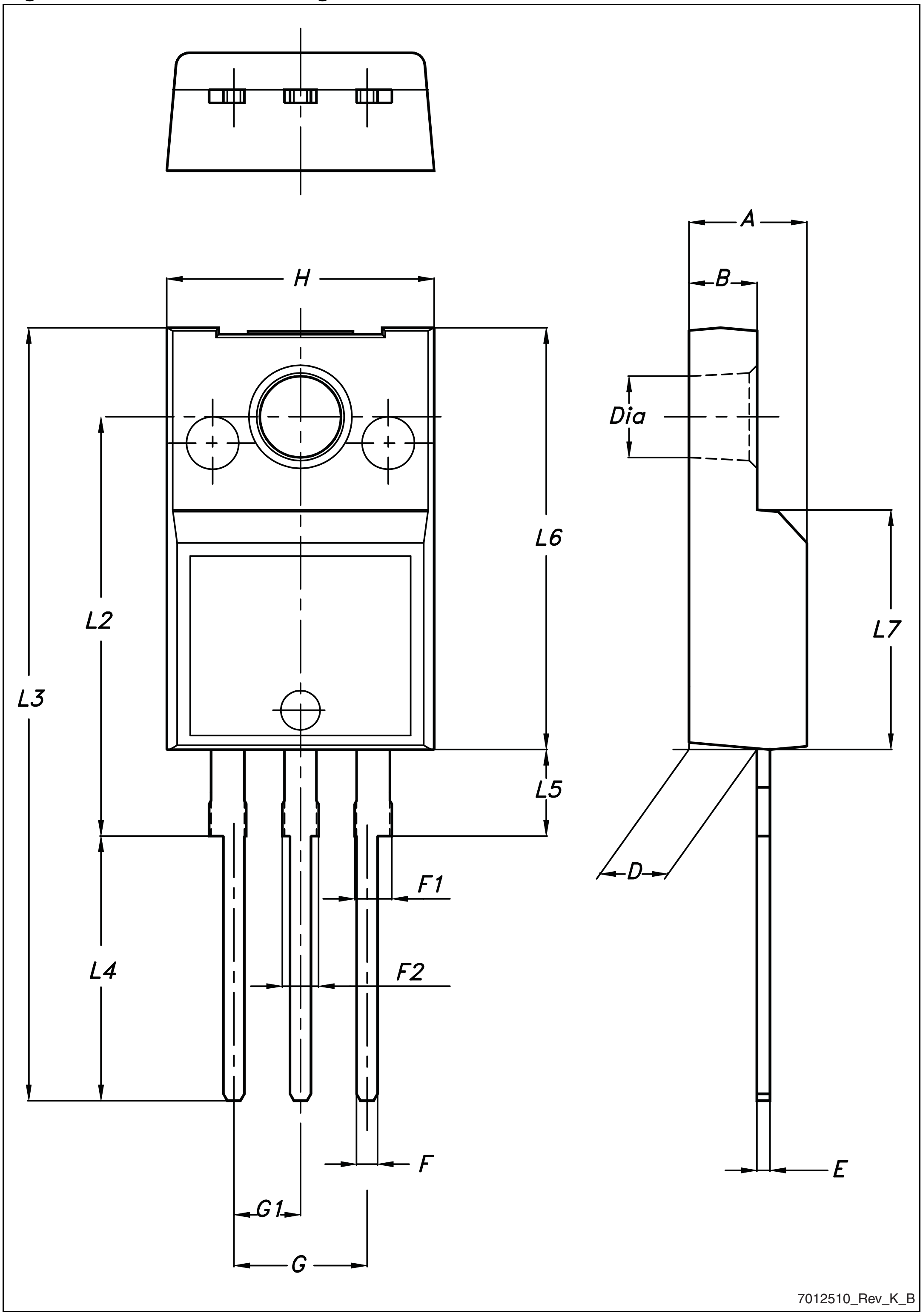


Table 11. I²PAK (TO-262) mechanical data

DIM.	mm.		
	min.	typ	max.
A	4.40		4.60
A1	2.40		2.72
b	0.61		0.88
b1	1.14		1.70
c	0.49		0.70
c2	1.23		1.32
D	8.95		9.35
e	2.40		2.70
e1	4.95		5.15
E	10		10.40
L	13		14
L1	3.50		3.93
L2	1.27		1.40

Figure 29. I²PAK (TO-262) drawing

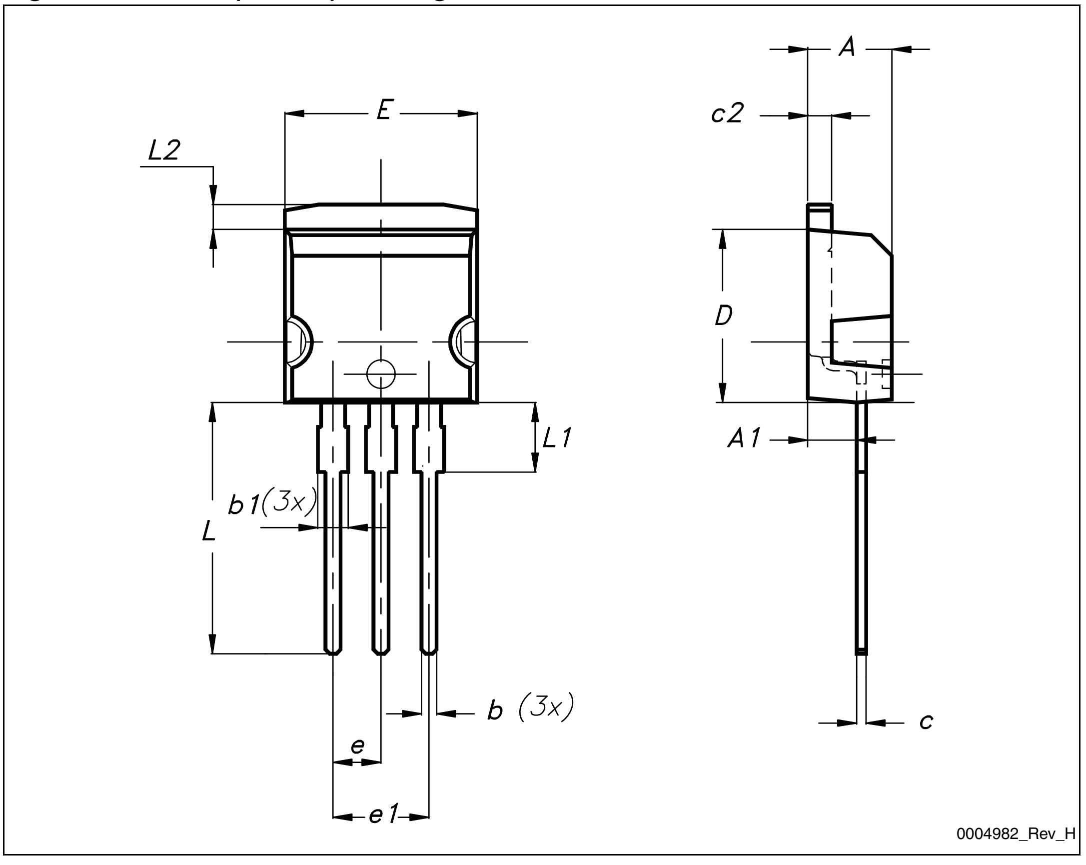


Table 12. TO-220 type A mechanical data

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	
∅P	3.75		3.85
Q	2.65		2.95

Figure 30. TO-220 type A drawing

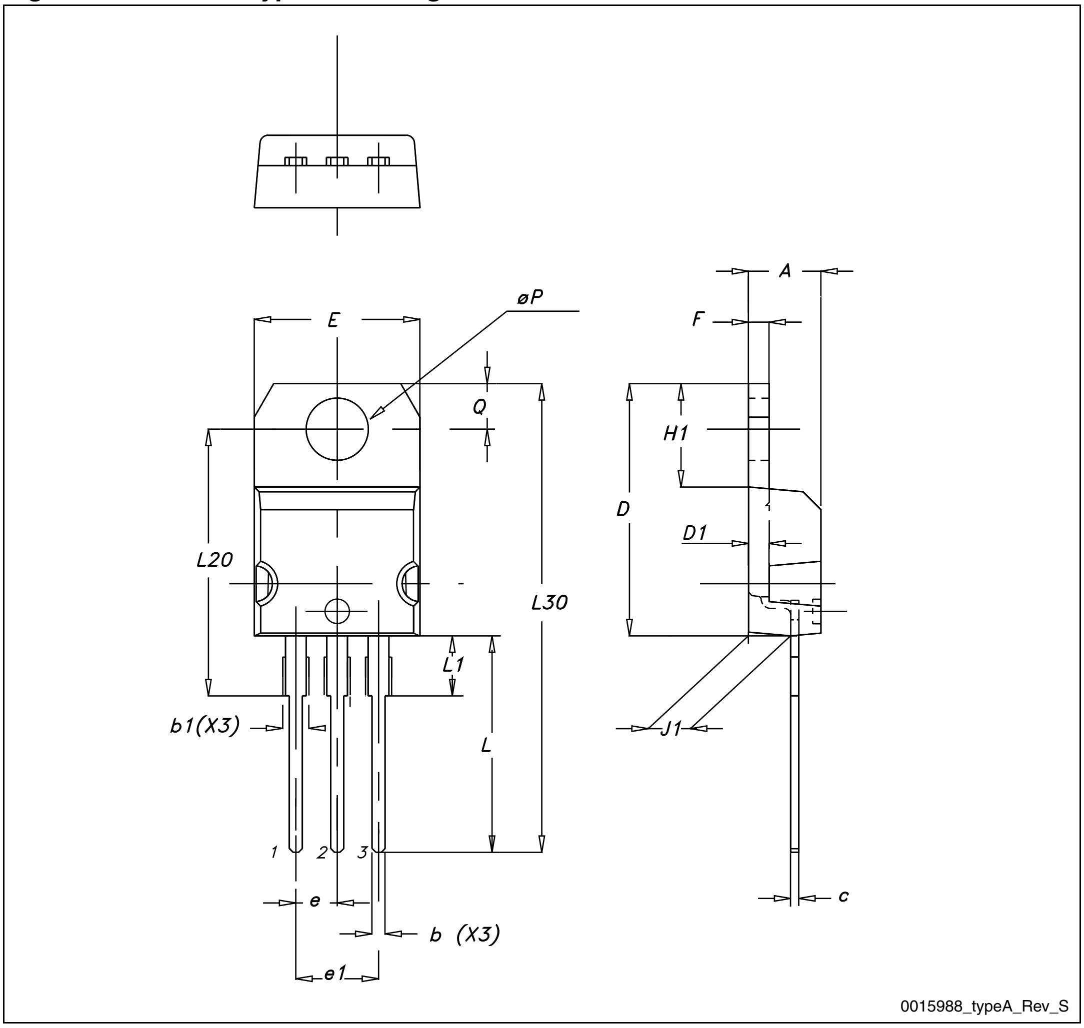


Table 13. IPAK (TO-251) mechanical data

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°	

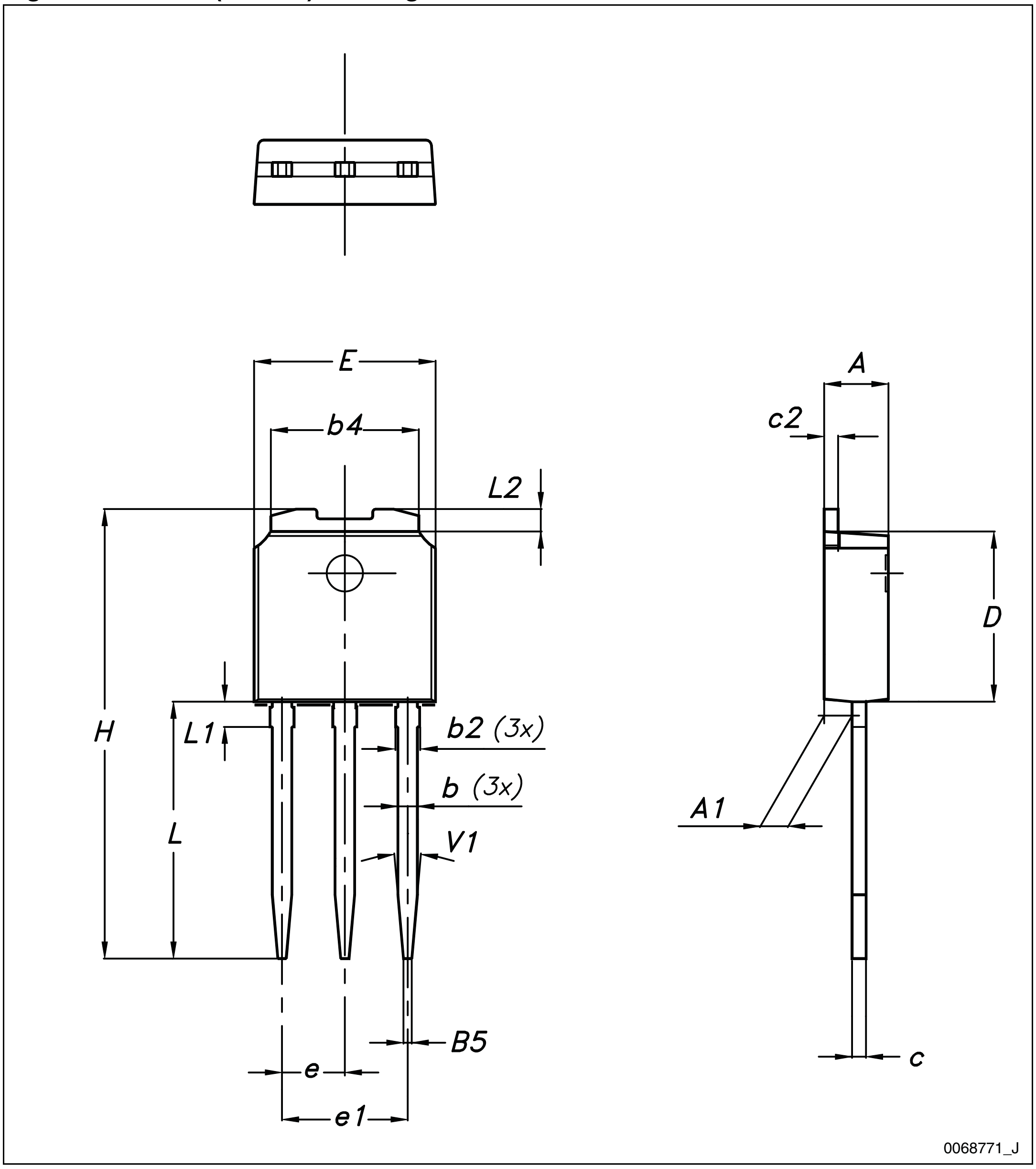


Figure 31. IPAK (TO-251) drawing

5 Packaging mechanical data

Table 14. D^2PAK (TO-263) 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 qty		1000
P2	1.9	2.1	Bulk qty		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

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			

Figure 32. Tape for DPAK and D²PAK

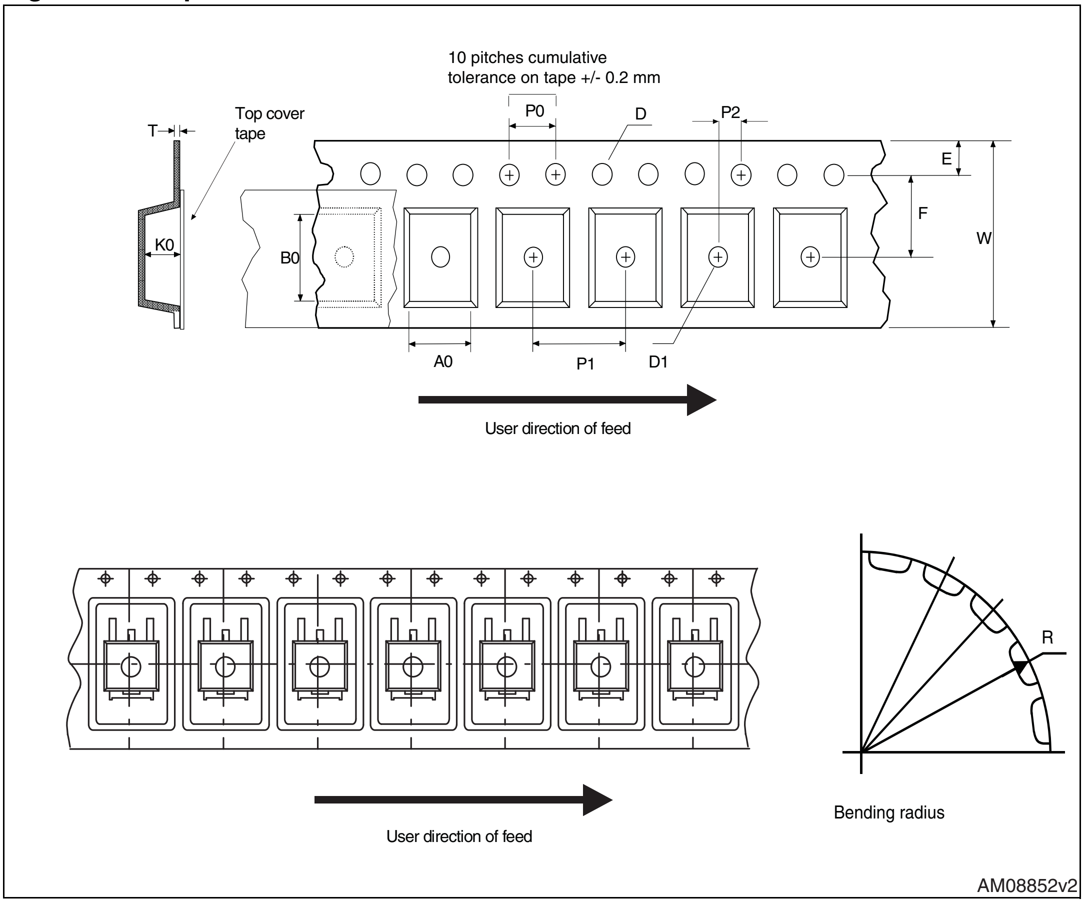
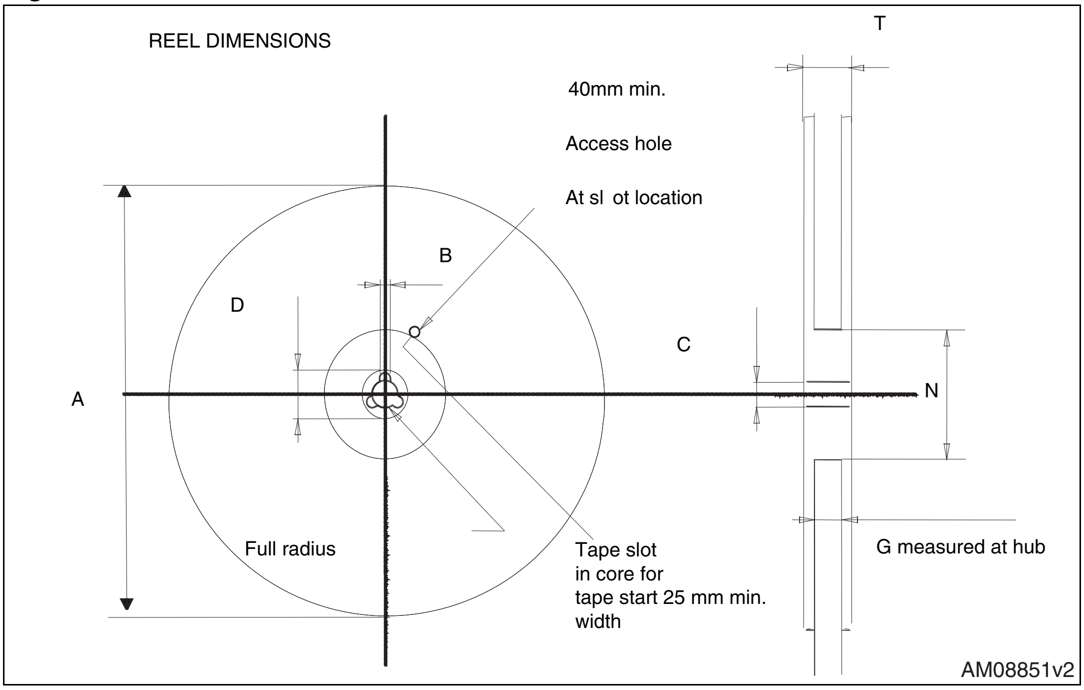


Figure 33. Reel for DPAK and D²PAK



6 Revision history

Table 16. Document revision history

Date	Revision	Changes
23-Oct-2009	1	First release
14-Oct-2010	2	Document status promoted from preliminary data to datasheet.
05-Jul-2011	3	*Table 7: Source drain diode* has been updated.
04-Oct-2012	4	– Updated: *Figure 1*, *10*, *14* and *17*. – Updated: note *1* and *3* below the *Table 2* – Updated the entire *Section 4: Package mechanical data*. – Updated title and description on the cover page.
29-Oct-2012	5	– Updated R_G values in *Table 5*.