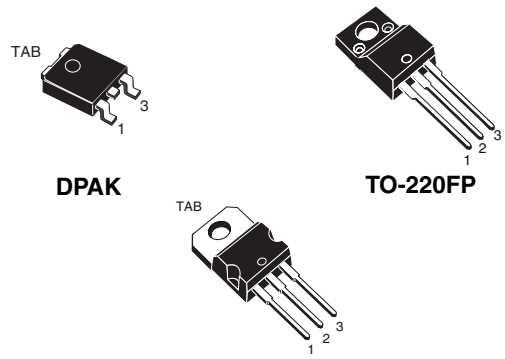
STD10NM60ND, STF10NM60ND STP10NM60ND

N-channel 600 V, 0.57 Ω, 8 A, DPAK, TO-220FP, TO-220 FDmesh™ II Power MOSFET (with fast diode)

Features

Order codes	V_{DSS} @$T_J$max	$R_{DS(on)}$ max.	I_D	P_{TOT}
STD10NM60ND	650 V	< 0.6 Ω	8 A	70 W
STF10NM60ND				25 W
STP10NM60ND				70 W

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- Extremely high dv/dt avalanche capabilities



Applications

- Switching applications

Description

This FDmesh™ II Power MOSFET with intrinsic fast-recovery body diode is produced using the second generation of MDmesh™ technology. Utilizing a new strip-layout vertical structure, this revolutionary device features extremely low on-resistance and superior switching performance. It is ideal for bridge topologies and ZVS phase-shift converters.

Figure 1. Internal schematic diagram

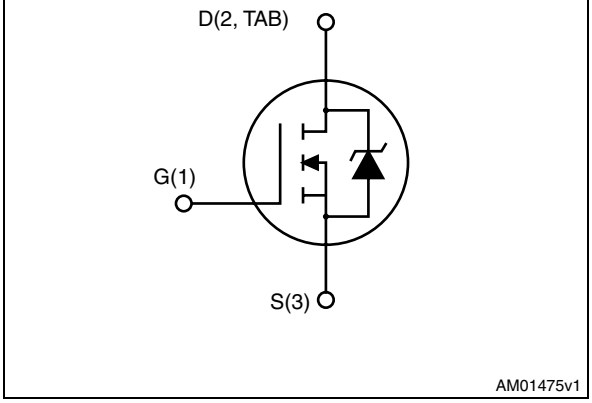


Table 1. Device summary

Order codes	Marking	Package	Packaging
STD10NM60ND	10NM60ND	DPAK	Tape and reel
STF10NM60ND		TO-220FP	Tube
STP10NM60ND		TO-220	

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2.1 Electrical characteristics (curves) 6

3 Test circuits 9

4 Package mechanical data 10

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		DPAK	TO-220FP	TO-220	
V_{DS}	Drain-source voltage	600			V
V_{GS}	Gate- source voltage	± 25			V
I_D	Drain current (continuous) at T_C = 25 °C	8	8 (1)	8	A
I_D	Drain current (continuous) at T_C = 100 °C	5	5 (1)	5	A
I_{DM} (2)	Drain current (pulsed)	32	32 (1)	32	A
P_{TOT}	Total dissipation at T_C = 25 °C	70	25	70	W
dv/dt(3)	Peak diode recovery voltage slope	40			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_J T_{stg}	Operating junction temperature Storage temperature	- 55 to 150			°C

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 8$ A, di/dt ≤400 A/µs, V_{DS} peak $\leq V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		DPAK	TO-220FP	TO-220	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	1.79	5	1.79	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.50	62.50		°C/W
$R_{thj\text{-}pcb}$	Thermal resistance junction-pcb max	50			°C/W
T_J	Maximum lead temperature for soldering purpose		300		°C/W

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by Tj Max)	2.5	A
E_{AS}	Single pulse avalanche energy (starting T_J=25 °C, I_D=I_{AS}, V_{DD}=50 V)	130	mJ

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2 Electrical characteristics

(Tcase =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 (V_{GS} = 0)	I_D = 1 mA	600			V
I_{DSS}	Zero gate voltage drain current (V_{GS} = 0)	V_{DS} = 600 V V_{DS} = 600 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 = 4 A		0.57	0.6	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	577 32.4 1.76	-	pF pF pF
$C_{oss\ eq}$ (1)	Equivalent capacitance time related	V_{DS} = 0 to 480 V, V_{GS} = 0	-	138	-	pF
R_g	Gate input resistance	f=1 MHz open drain	-	6	-	Ω
Q_g Q_{gs} Q_{gd}	Total gate charge Gate-source charge Gate-drain charge	V_{DD} = 480 V, I_D = 8 A, V_{GS} = 10 V *(see Figure 19)*	-	20 4.3 11.6	-	nC nC nC

1. $C_{oss\ eq}$ 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
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on delay time Rise time Turn-off-delay time Fall time	V_{DD} = 300 V, I_D = 4 A, R_G = 4.7 Ω, V_{GS} = 10 V *(see Figure 18)*	-	9.2 10 32 9.8	-	ns ns ns ns

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Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
I_{SD} I_{SDM} (1)	Source-drain current Source-drain current (pulsed)		-		8 32	A A
V_{SD} (2)	Forward on voltage	I_{SD} = 8 A, V_{GS} = 0	-		1.5	V
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 8 A, di/dt = 100 A/µs V_{DD}= 60 V *(see Figure 20)*	-	118 680 11		ns nC A
t_{rr} Q_{rr} I_{RRM}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_{SD} = 8 A, di/dt = 100 A/µs V_{DD}= 60 V T_J = 150 °C *(see Figure 20)*	-	150 918 12		ns nC A

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

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2.1 Electrical characteristics (curves)

Figure 2. Safe operating area for DPAK

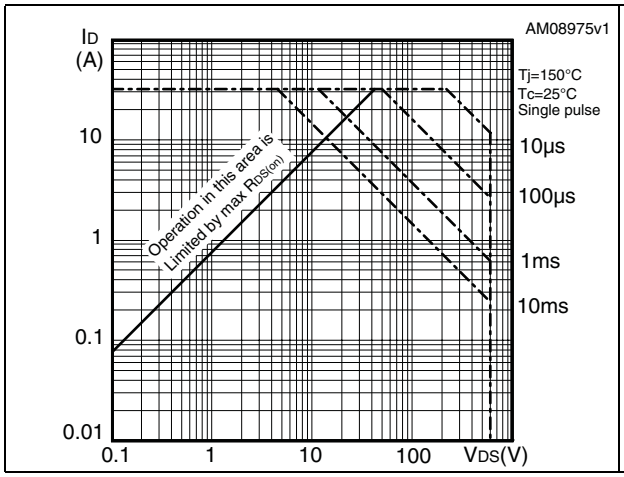


Figure 3. Thermal impedance for DPAK

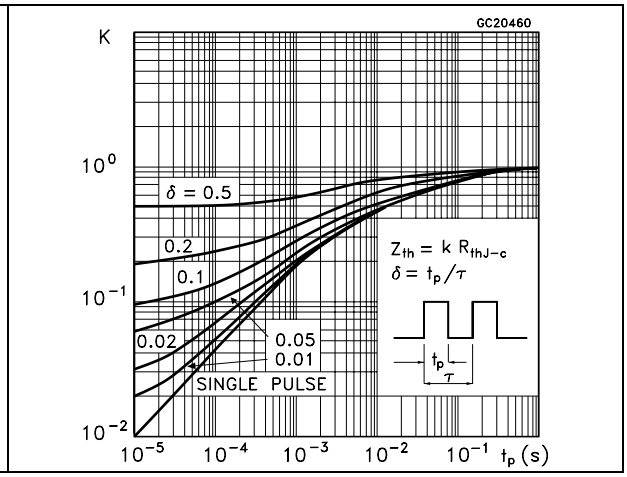


Figure 4. Safe operating area for TO-220FP

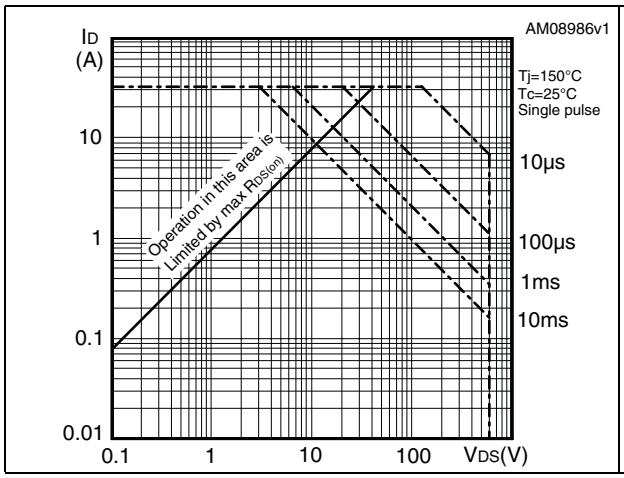


Figure 5. Thermal impedance for TO-220FP

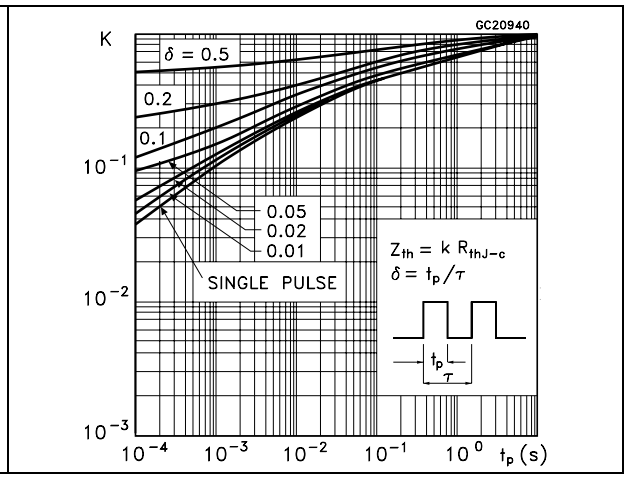


Figure 6. Safe operating area for TO-220

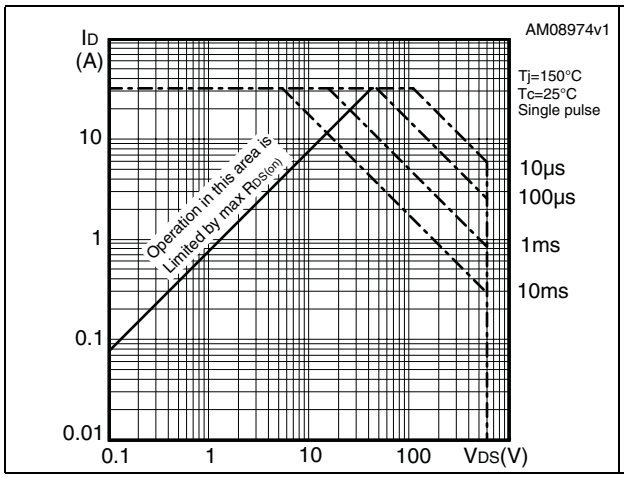
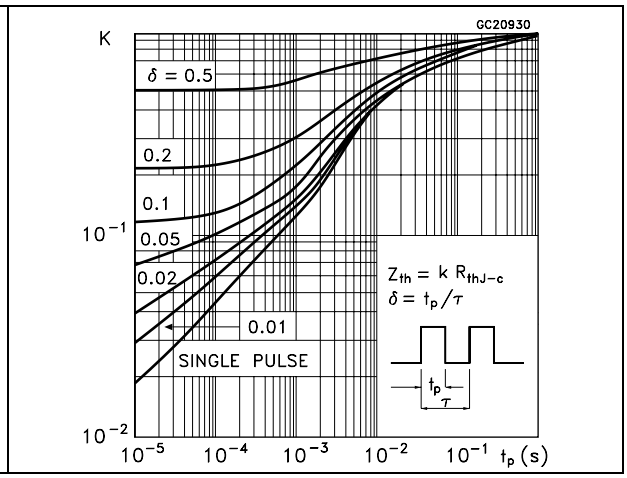


Figure 7. Thermal impedance for TO-220



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Figure 8. Output characteristics

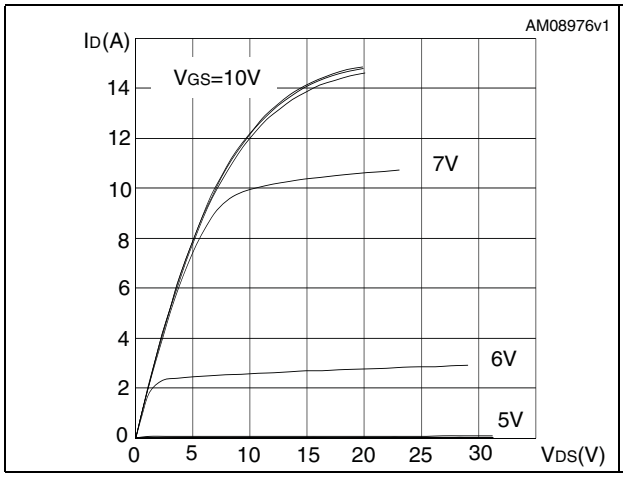


Figure 9. Transfer characteristics

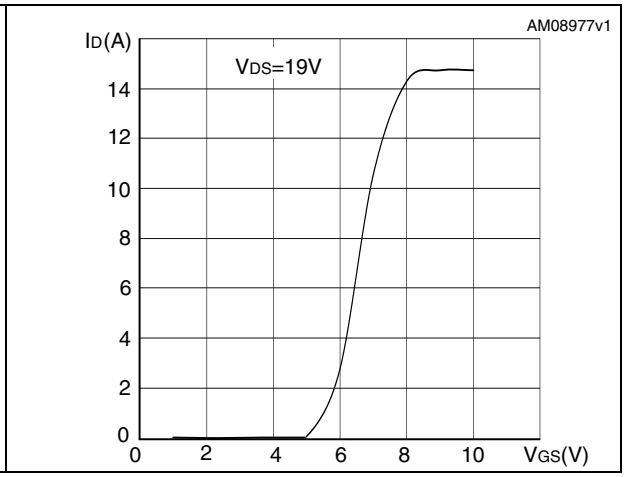


Figure 10. Gate charge vs gate-source voltage

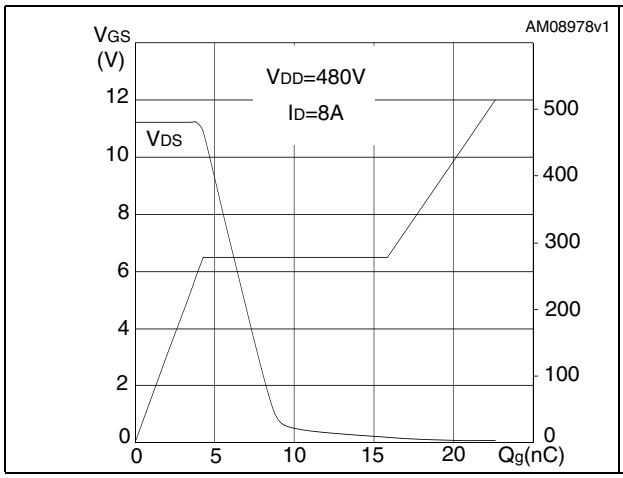


Figure 11. Static drain-source on resistance

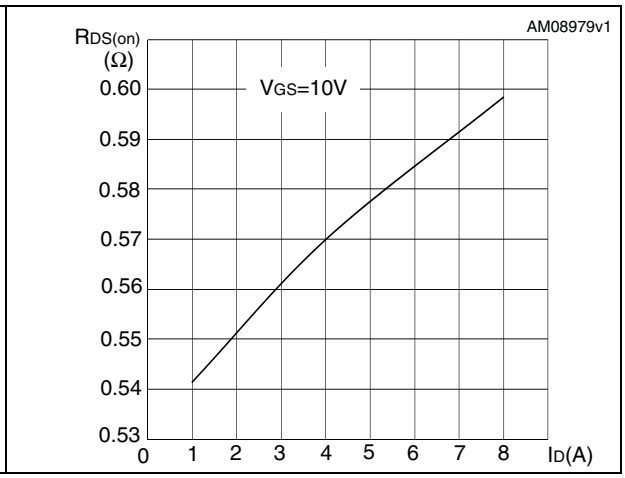


Figure 12. Capacitance variations

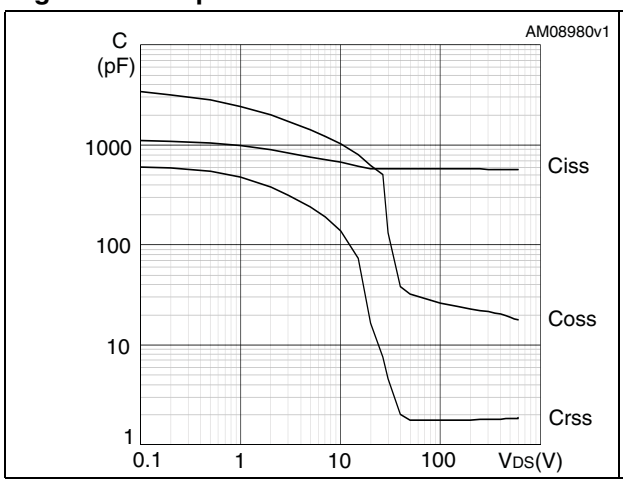
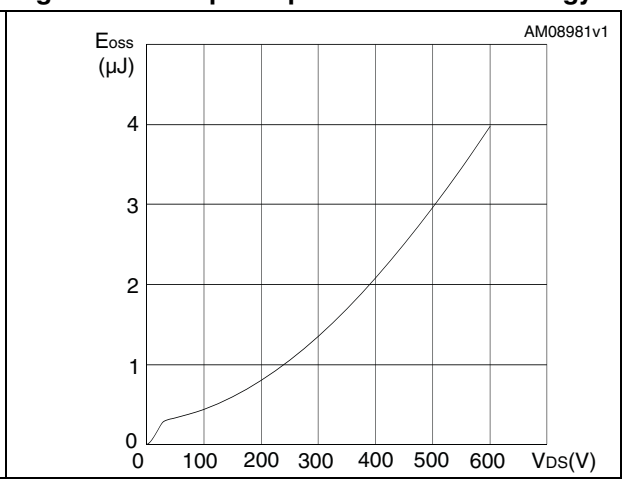


Figure 13. Output capacitance stored energy



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Figure 14. Normalized gate threshold voltage vs temperature

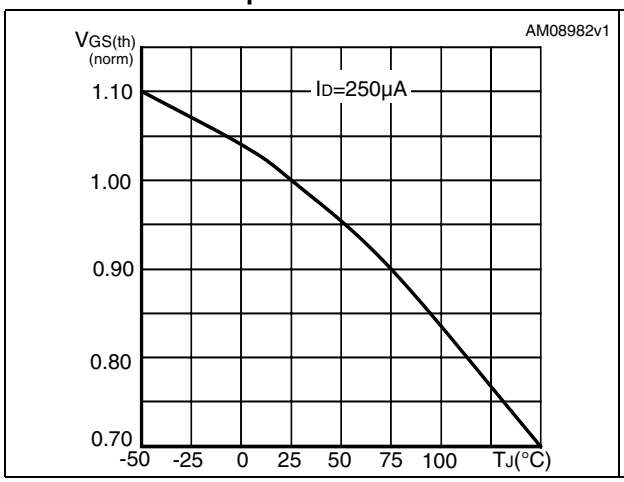


Figure 15. Normalized on resistance vs temperature

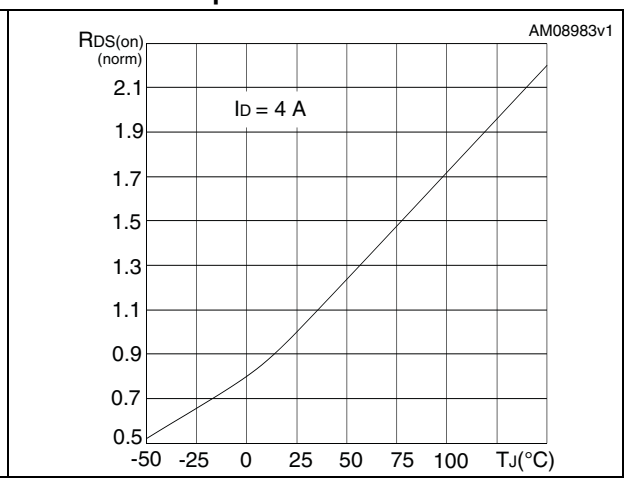


Figure 16. Source-drain diode forward characteristics

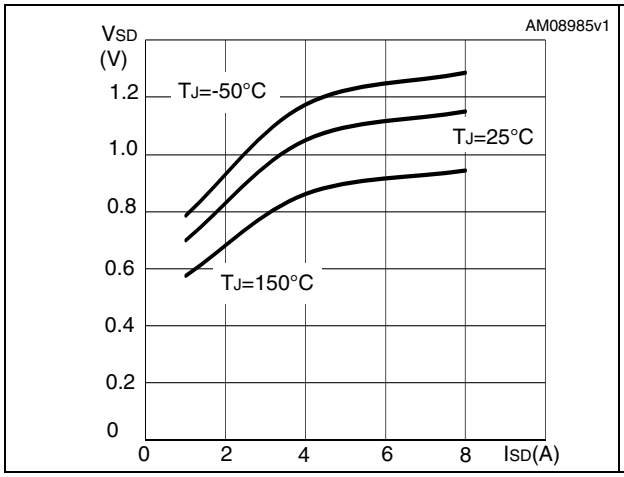
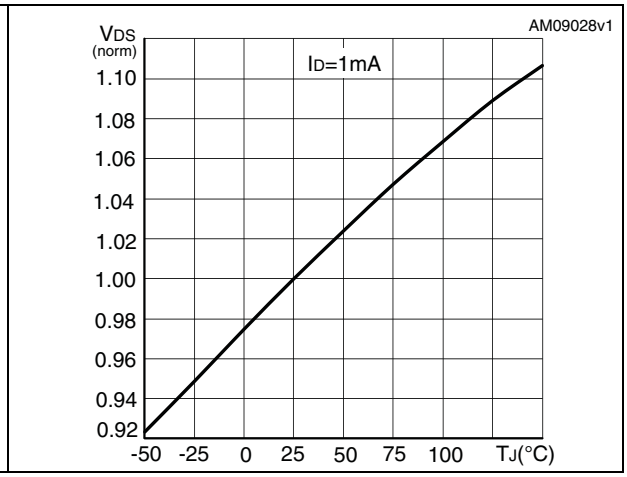


Figure 17. Normalized V_{DS} vs temperature



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3 Test circuits

Figure 18. Switching times test circuit for resistive load

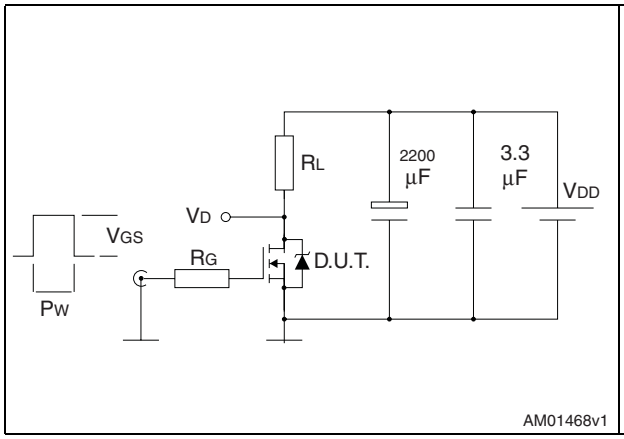


Figure 19. Gate charge test circuit

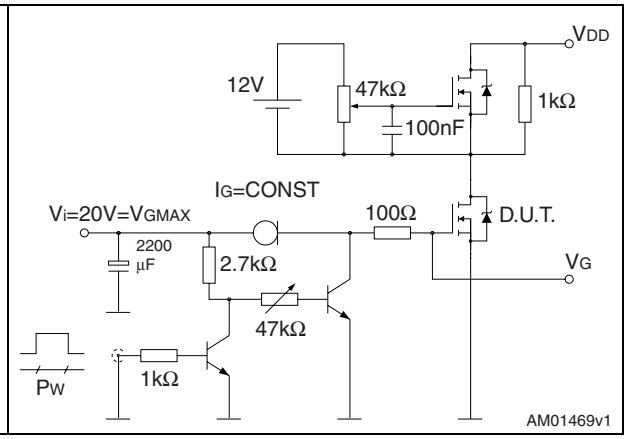


Figure 20. Test circuit for inductive load switching and diode recovery times

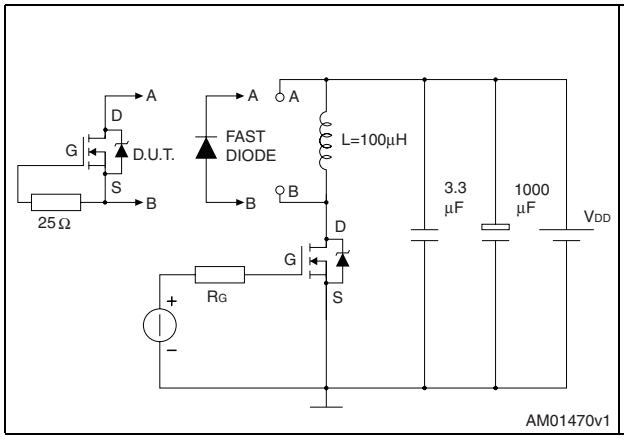


Figure 21. Unclamped inductive load test circuit

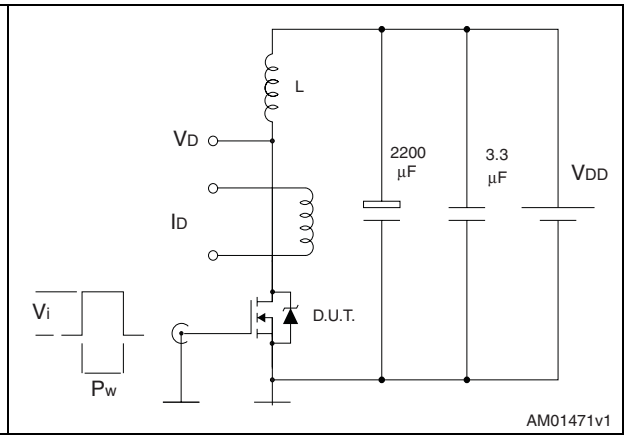


Figure 22. Unclamped inductive waveform

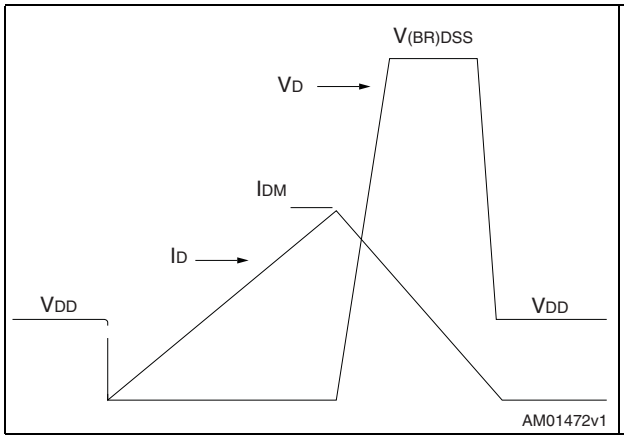
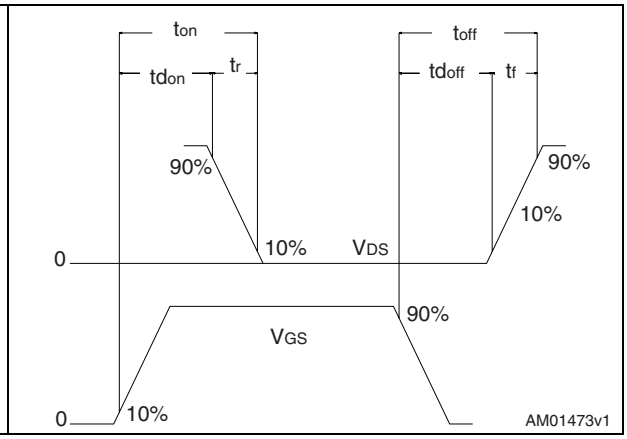


Figure 23. Switching time waveform



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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.

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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°

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Figure 24. DPAK (TO-252) drawing

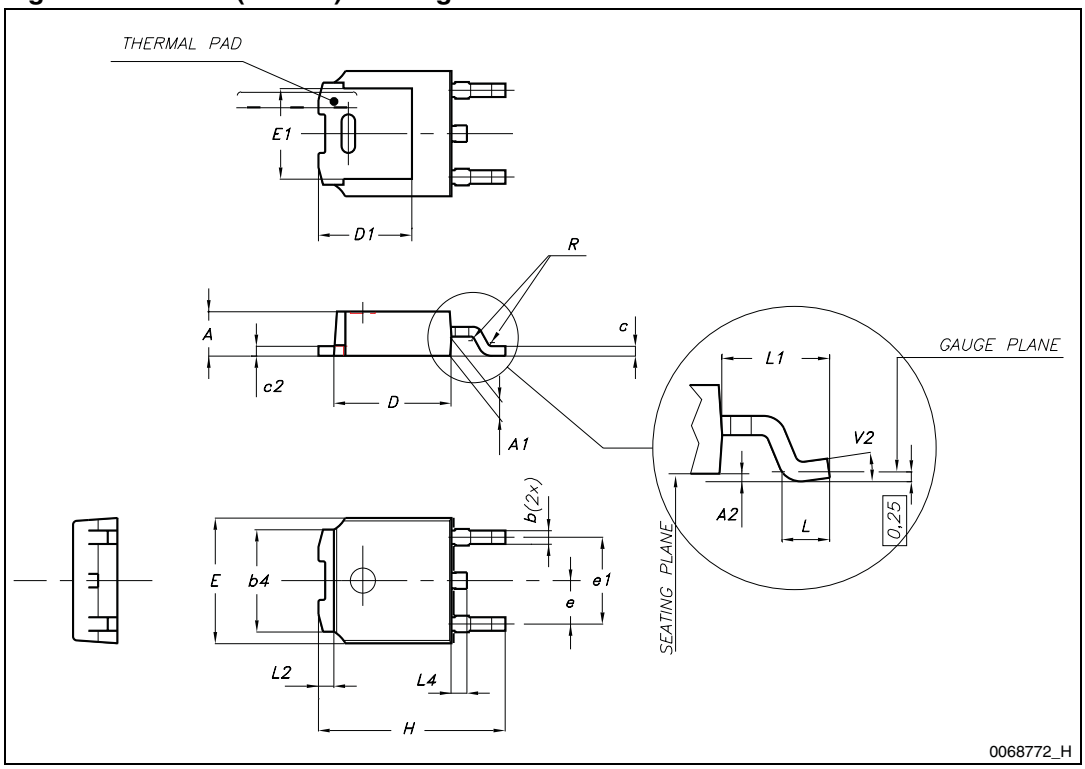
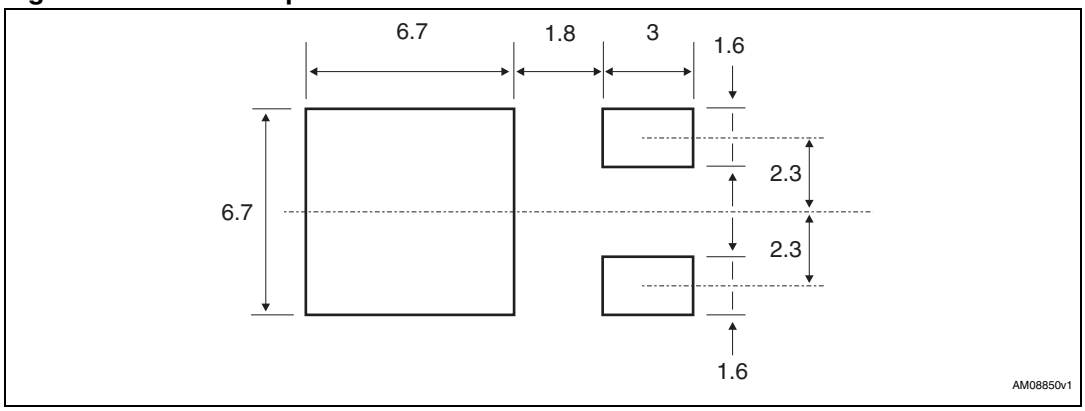


Figure 25. DPAK footprint[a]



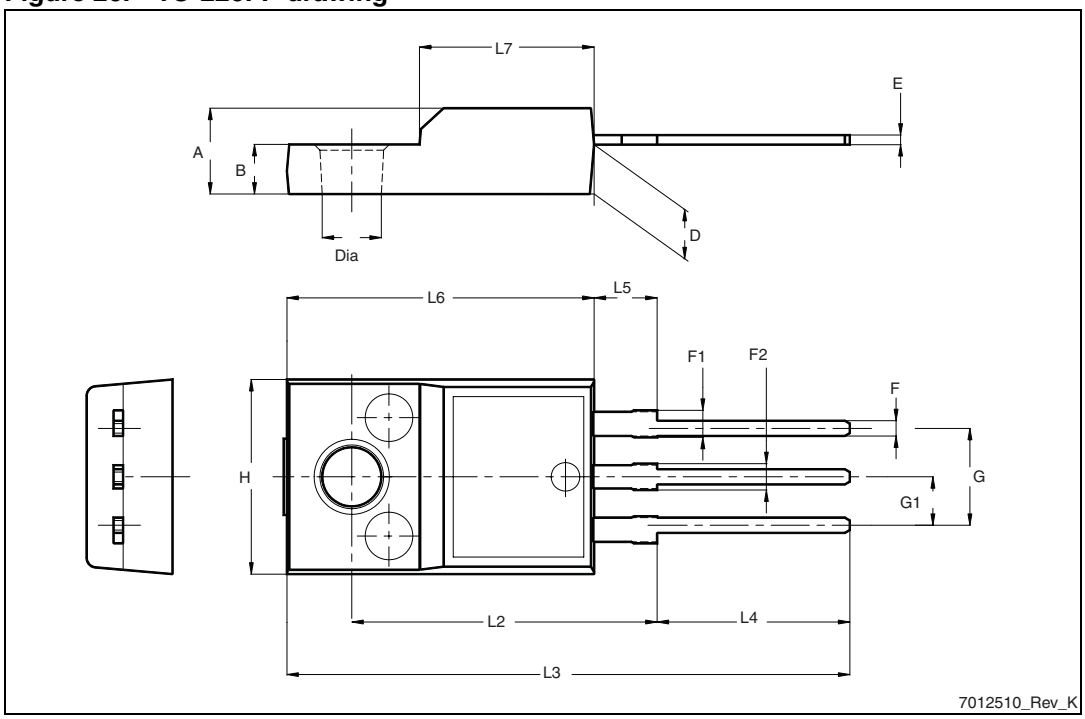
a. All dimension are in millimeters

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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 26. TO-220FP drawing



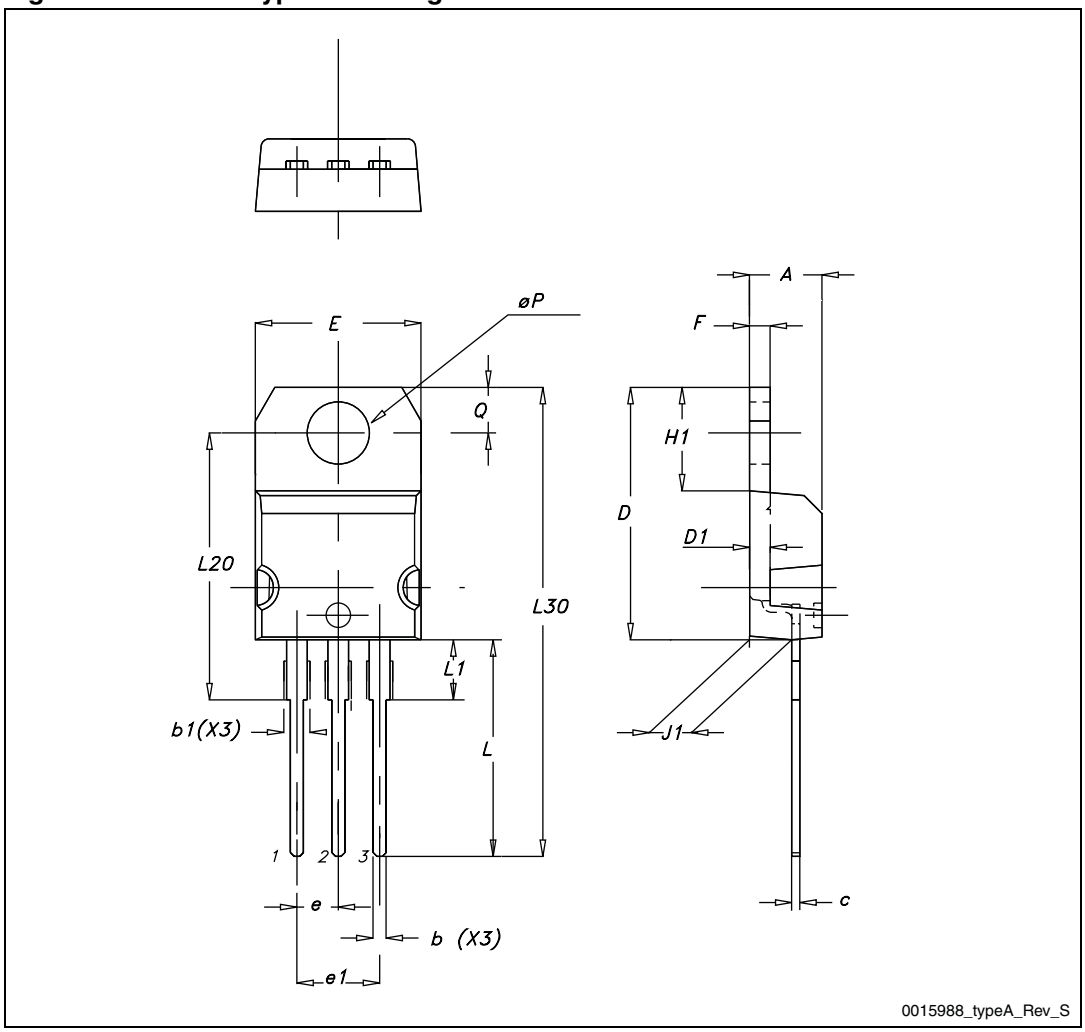
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Table 11. TO-220 type A mechanical data

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

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Figure 27. TO-220 type A drawing



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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			

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Figure 28. Tape for DPAK (TO-252)

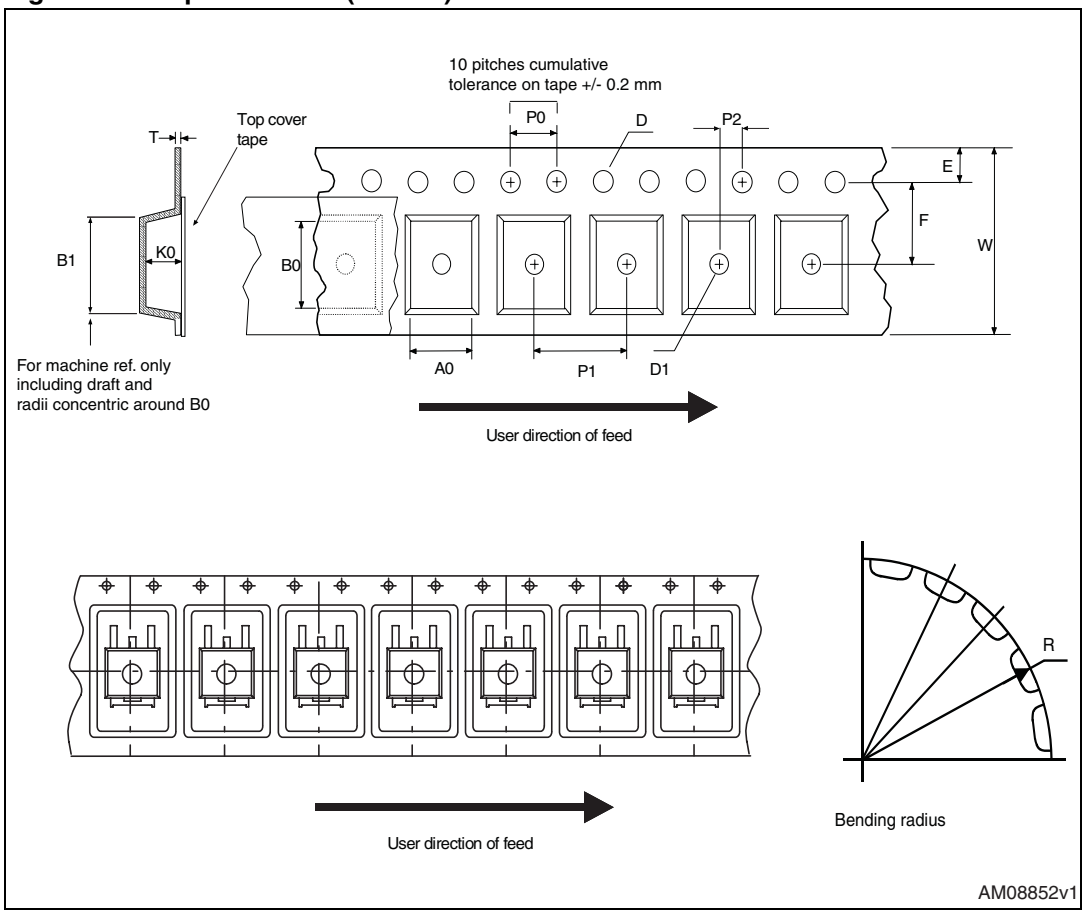
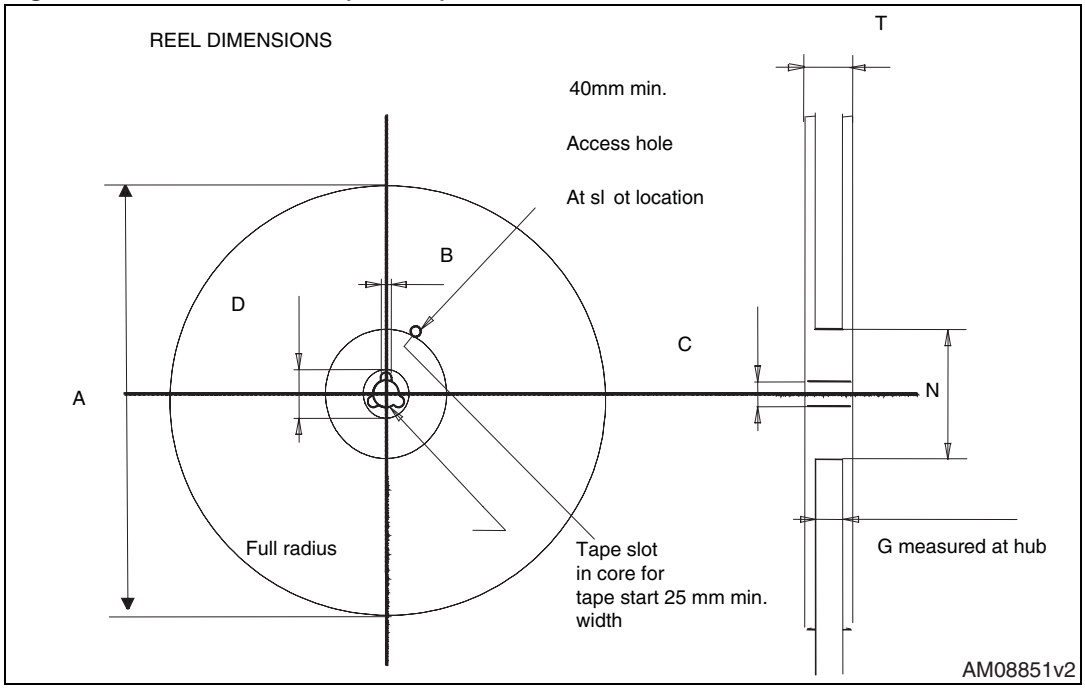


Figure 29. Reel for DPAK (TO-252)



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6 Revision history

Table 13. Document revision history

Date	Revision	Changes
10-Feb-2011	1	First release.
17-Nov-2011	2	Updated features in table and description in cover page. Updated *Table 2: Absolute maximum ratings*, *Table 5: On /off states*, *Table 15: Normalized on resistance vs temperature*, *Figure 17: Normalized V_{DS} vs temperature* and *Section 4: Package mechanical data*.

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