STD16NF25, STF16NF25, STP16NF25

N-channel 250 V, 0.195 Ω, 14 A STripFET™ II Power MOSFET in DPAK, TO-220FP and TO-220 packages

Datasheet — production data

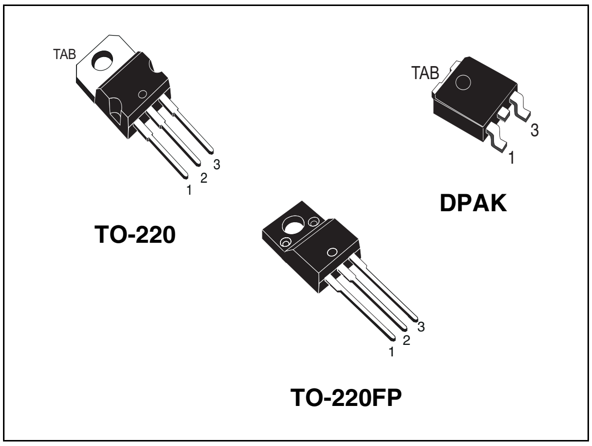
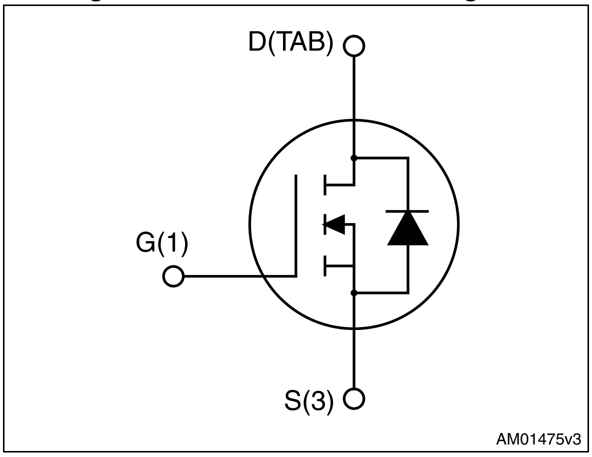


Figure 1. Internal schematic diagram



Features

Order codes	V_{DS}	$R_{DS(on)}$ max	I_D	P_{TOT}
STD16NF25	250 V	0.235 Ω	14 A	100 W
STF16NF25			14 A(1)	25 W
STP16NF25			14 A	100 W

1. Limited by maximum junction temperature

- Exceptional dv/dt capability
- 100% avalanche tested
- Application oriented characterization

Applications

- Switching applications

Description

These Power MOSFETs have been developed using STMicroelectronics' unique STripFET process, which is specifically designed to minimize input capacitance and gate charge. This renders the devices suitable for use as primary switch in advanced high-efficiency isolated DC-DC converters for telecom and computer applications, and applications with low gate charge driving requirements.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STD16NF25	16NF25	DPAK	Tape and reel
STF16NF25		TO-220FP	Tube
STP16NF25		TO-220	

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		DPAK TO-220	TO-220FP	
V_{DS}	Drain-source voltage	250		V
V_{GS}	Gate- source voltage	± 20		V
I_D	Drain current (continuous) at $T_C = 25$ °C	14	14(1)	A
I_D	Drain current (continuous) at $T_C = 100$ °C	8.8	8.8 (1)	A
I_{DM}(2)	Drain current (pulsed)	56	56(1)	A
P_{TOT}	Total dissipation at $T_C = 25$ °C	85	25	W
	Derating factor	0.68	0.2	W/°C
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;Tc = 25 °C)		2500	V
T_{stg}	Storage temperature	-55 to 150		°C
T_j	Max. operating junction temperature			

1. Limited by maximum junction temperature
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 13A$, $di/dt \leq 300A/\mu s$, $V_{DD} \leq 80\% \; V_{(BR)DSS}$, $Tj \leq T_{JMAX}$

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		TO-220	DPAK	TO-220FP	
$R_{thj\text{-}case}$	Thermal resistance junction-case max	1.47		5	°C/W
$R_{thj\text{-}pcb}$	Thermal resistance junction to pcb max		50		°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient max	62.5		62.5	°C/W

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_{j\ max}$)	13	A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25$ °C, $I_{AR} = 13$ A, $V_{DD} = 50$ V)	100	mJ

2 Electrical characteristics

(T_C = 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	250			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0, V_{DS} = 250 V			1	µA
		V_{GS} = 0, V_{DS} = 250 V, T_C=125 °C			10	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0, V_{GS} = ±20 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 6.5 A		0.195	0.235	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0	-	680	-	pF
C_{oss}	Output capacitance		-	125	-	pF
C_{rss}	Reverse transfer capacitance		-	20	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 200 V, V_{GS} = 0	-	48	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D = 0	-	2.1	-	Ω
Q_g	Total gate charge	V_{DD} = 200 V, I_D = 13 A, V_{GS} = 10 V (see *Figure 19*)	-	18	-	nC
Q_{gs}	Gate-source charge		-	3	-	nC
Q_{gd}	Gate-drain charge		-	8	-	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 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 125 V, I_D = 6.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 18*)	-	9	-	ns
t_r	Rise time		-	17	-	ns
$t_{d(off)}$	Turn-off delay time		-	35	-	ns
t_f	Fall time		-	17	-	ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	-	14	A
I_{SDM} (1)	Source-drain current (pulsed)		-	-	56	A
V_{SD} (2)	Forward on voltage	I_{SD} = 13 A, V_{GS} = 0	-	-	1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 13 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 20*)	-	133		ns
Q_{rr}	Reverse recovery charge		-	651		nC
I_{RRM}	Reverse recovery current		-	10		A
t_{rr}	Reverse recovery time	I_{SD} = 13 A, di/dt = 100 A/µs V_{DD} = 60 V, T_J=150 °C (see *Figure 20*)	-	157		ns
Q_{rr}	Reverse recovery charge		-	895		nC
I_{RRM}	Reverse recovery current		-	11		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

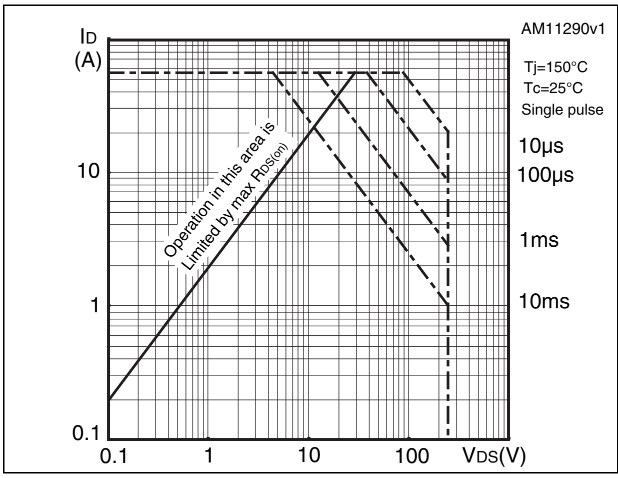


Figure 3. Thermal impedance for TO-220

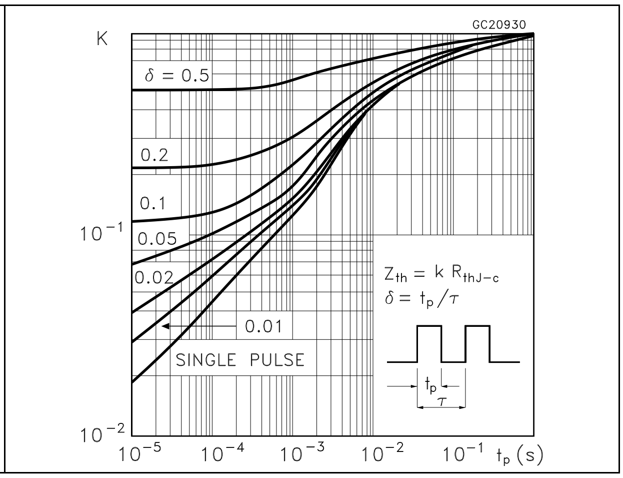


Figure 4. Safe operating area for TO-220FP

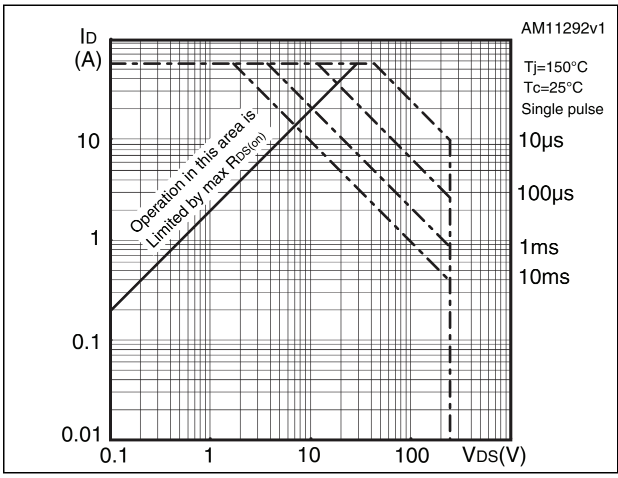


Figure 5. Thermal impedance for TO-220FP

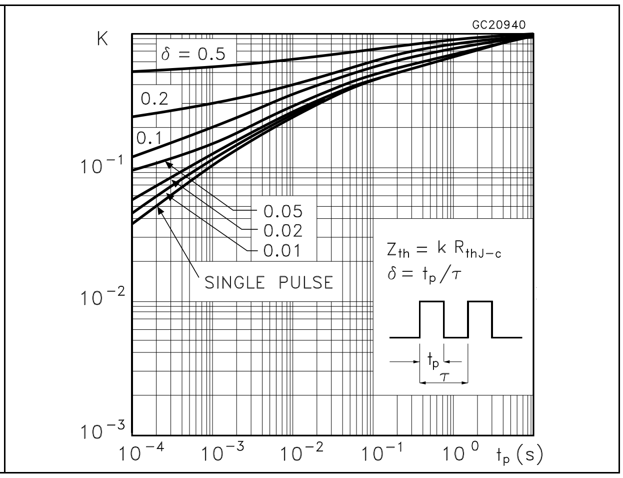


Figure 6. Safe operating area for DPAK

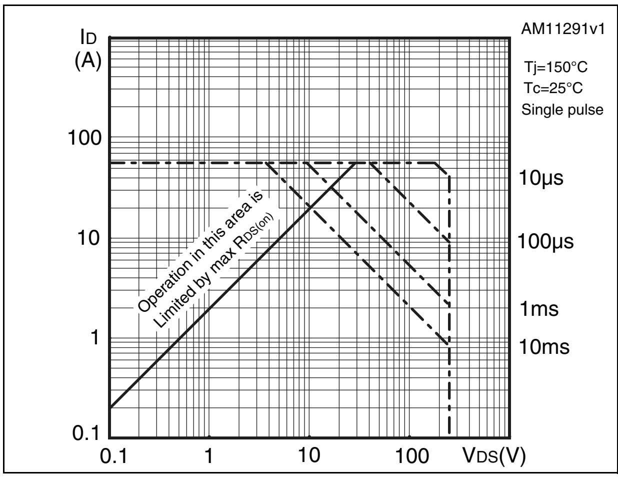


Figure 7. Thermal impedance for DPAK

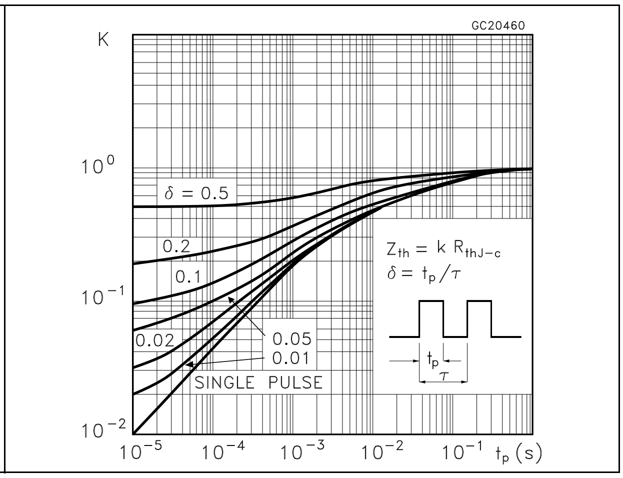


Figure 8. Output characteristics

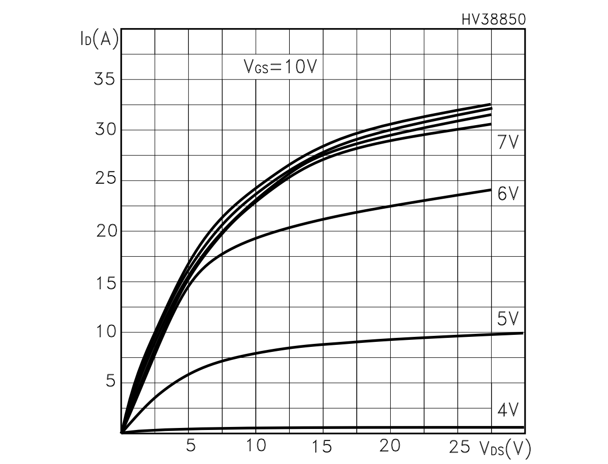


Figure 9. Transfer characteristics

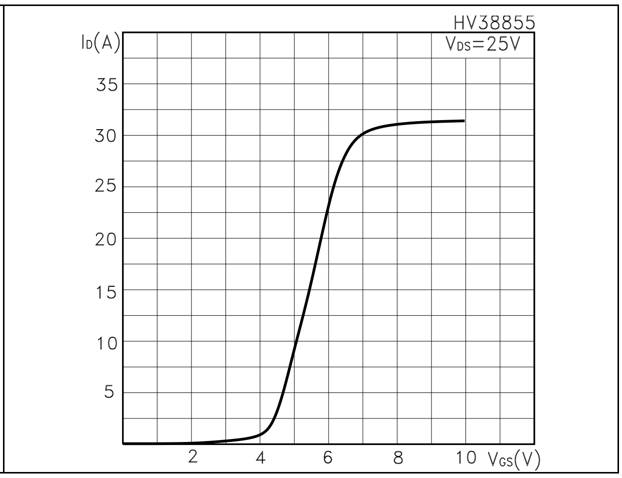


Figure 10. Normalized BV_{DSS} vs temperature

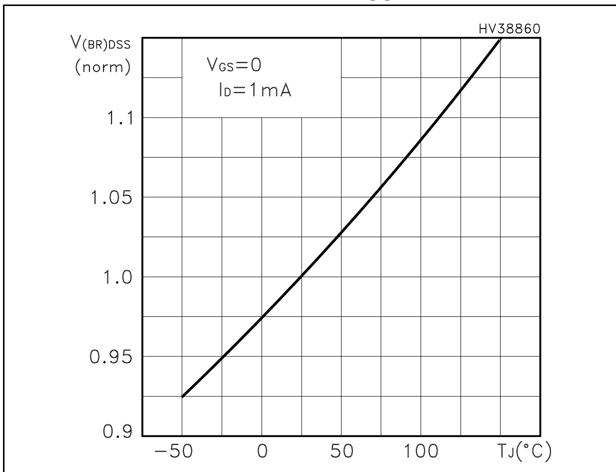


Figure 11. Static-drain source on-resistance

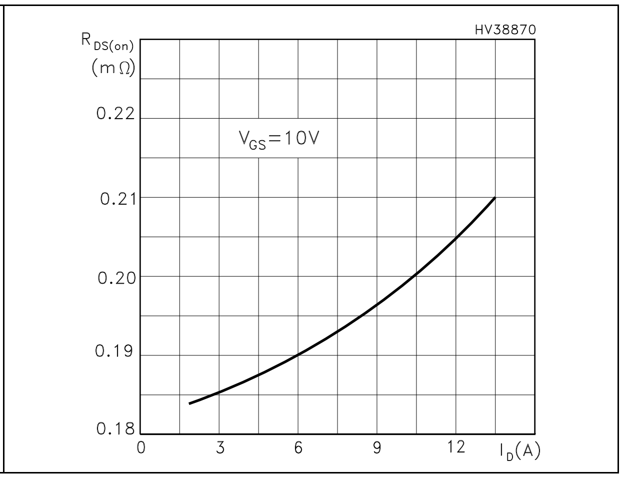


Figure 12. Gate charge vs gate-source voltage

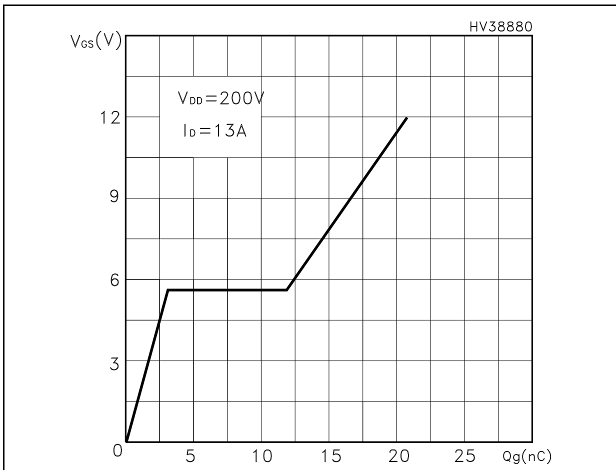


Figure 13. Capacitance variations

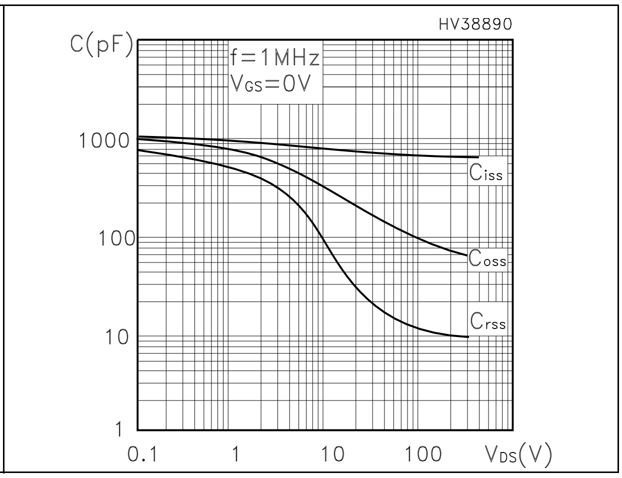


Figure 14. Normalized gate threshold voltage vs temperature

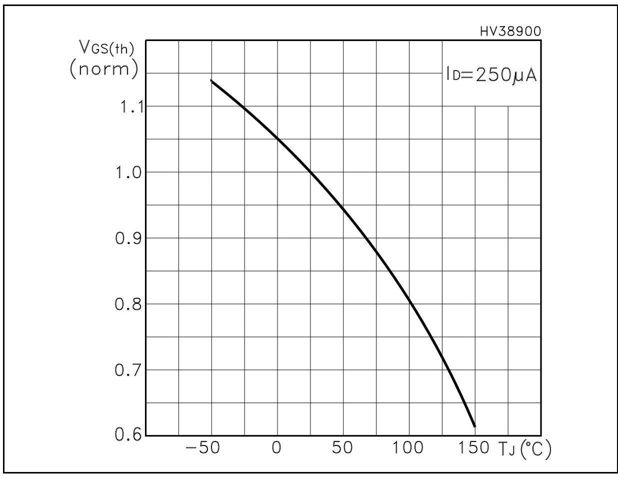


Figure 15. Normalized on-resistance vs temperature

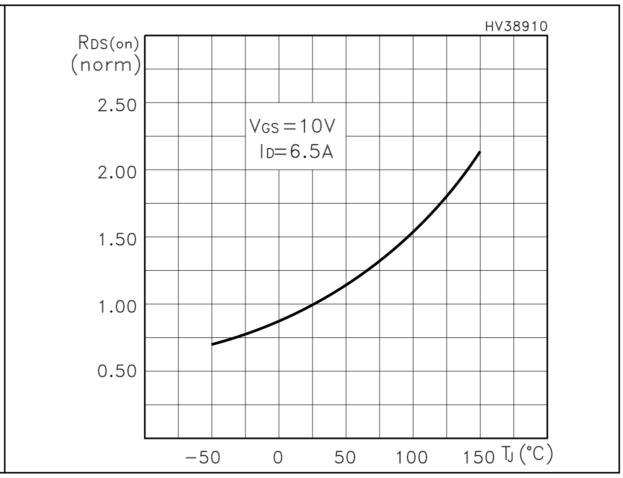


Figure 16. Source-drain diode forward characteristics

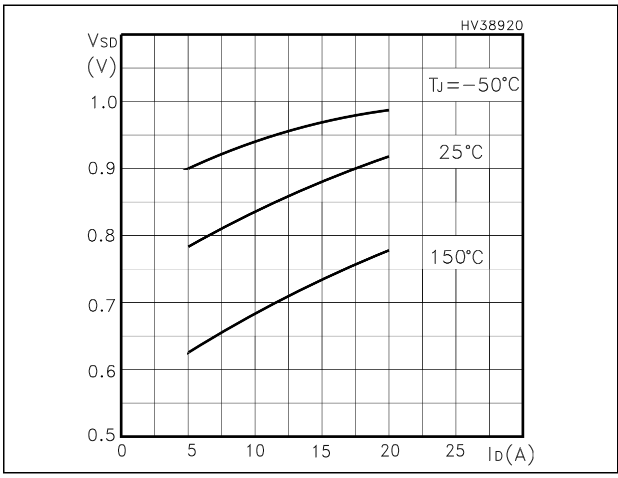
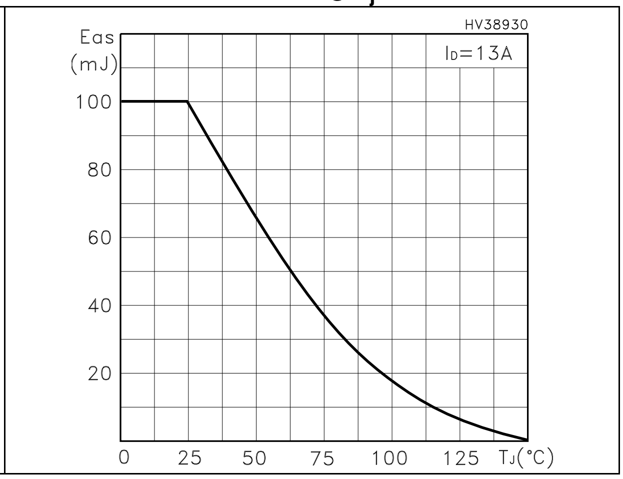


Figure 17. Maximum avalanche energy vs starting T_j



3 Test circuit

Figure 18. Switching times test circuit for resistive load

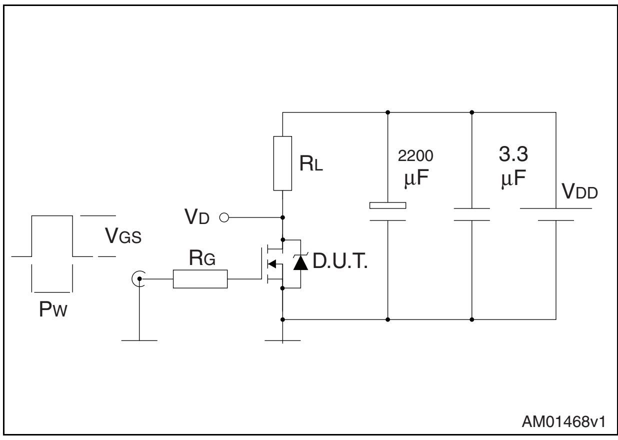


Figure 19. Gate charge test circuit

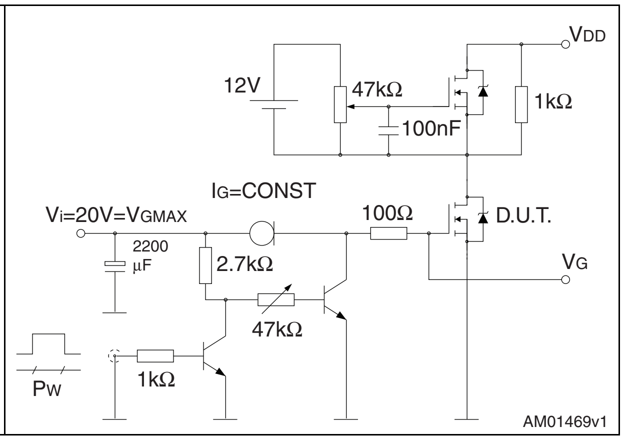


Figure 20. Test circuit for inductive load switching and diode recovery times

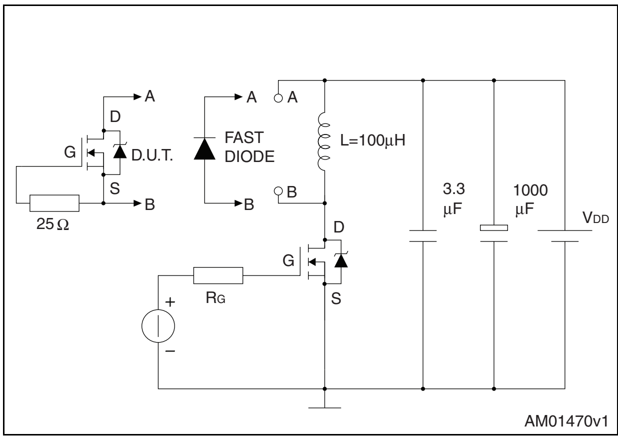


Figure 21. Unclamped inductive load test circuit

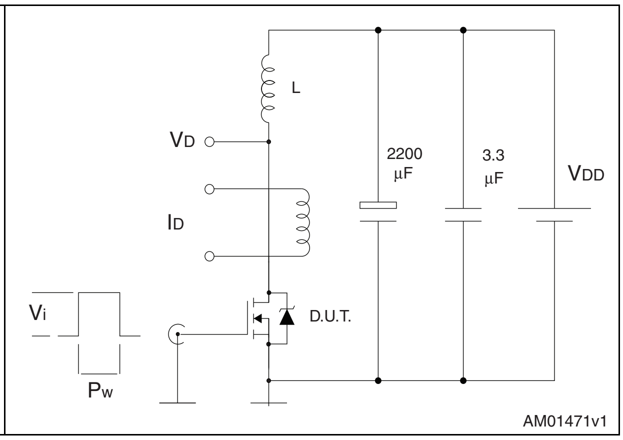


Figure 22. Unclamped inductive waveform

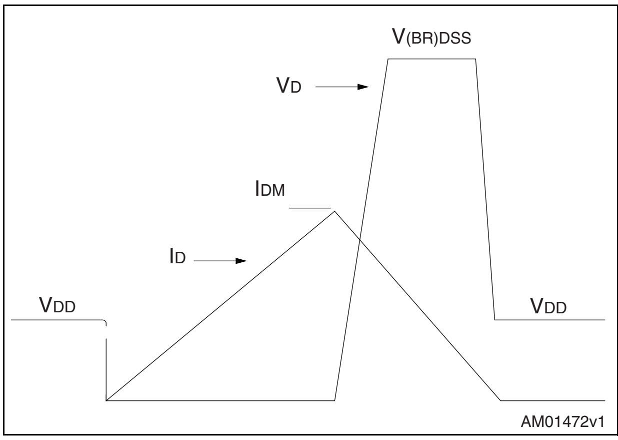
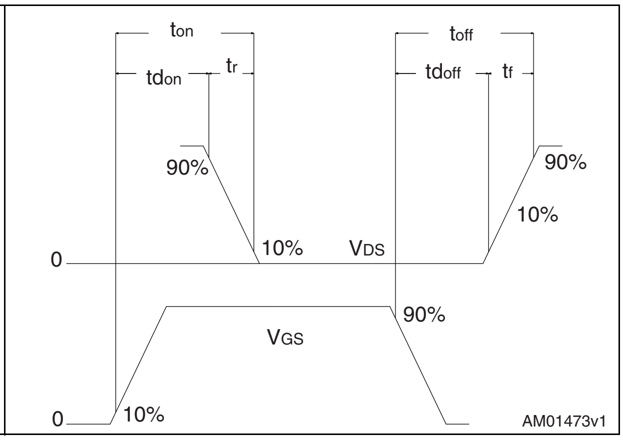


Figure 23. Switching time waveform



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 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	1.00		1.50
(L1)		2.80	
L2		0.80	
L4	0.60		1.00
R		0.20	
V2	0°		8°

Figure 24. DPAK (TO-252) drawing

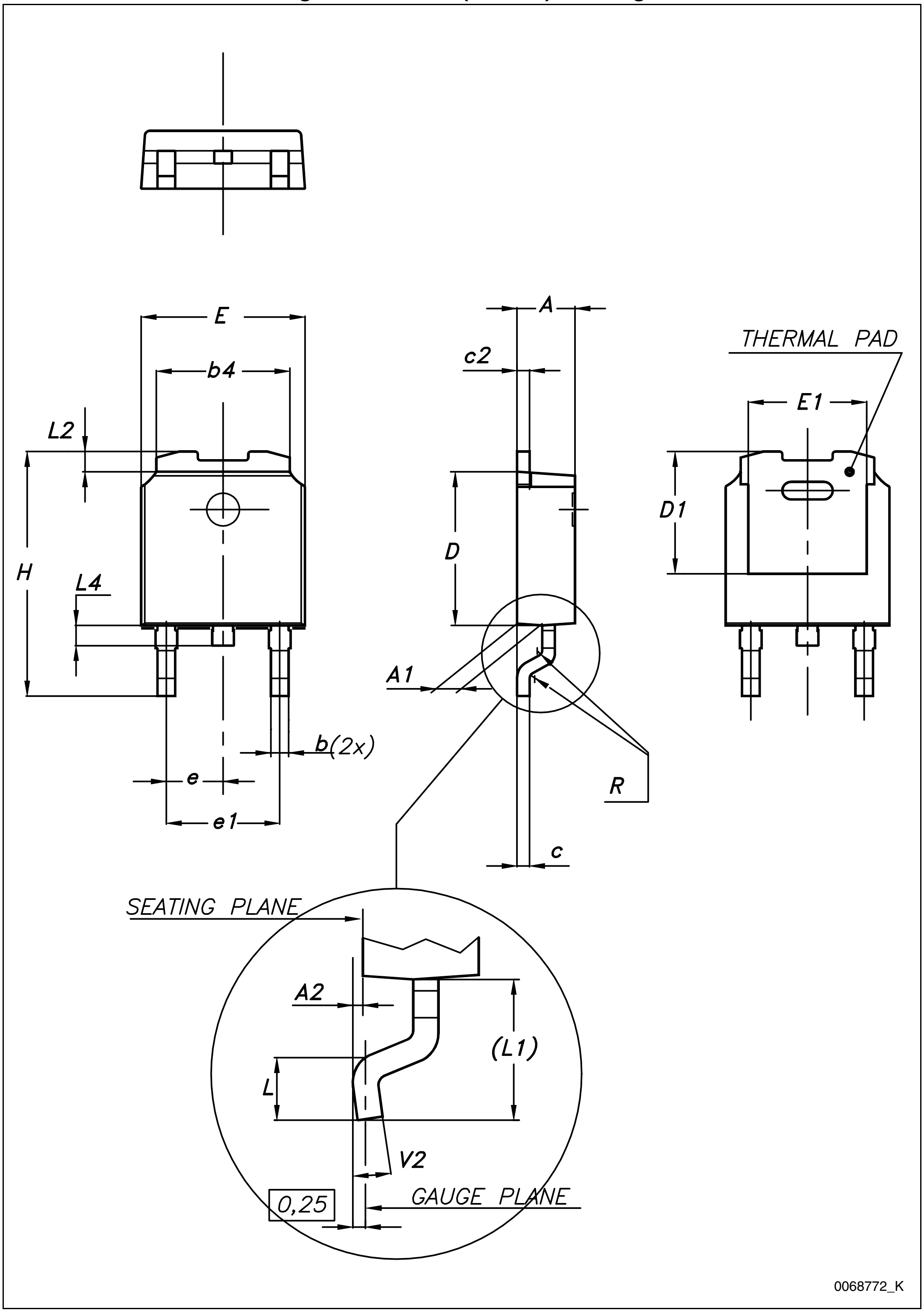
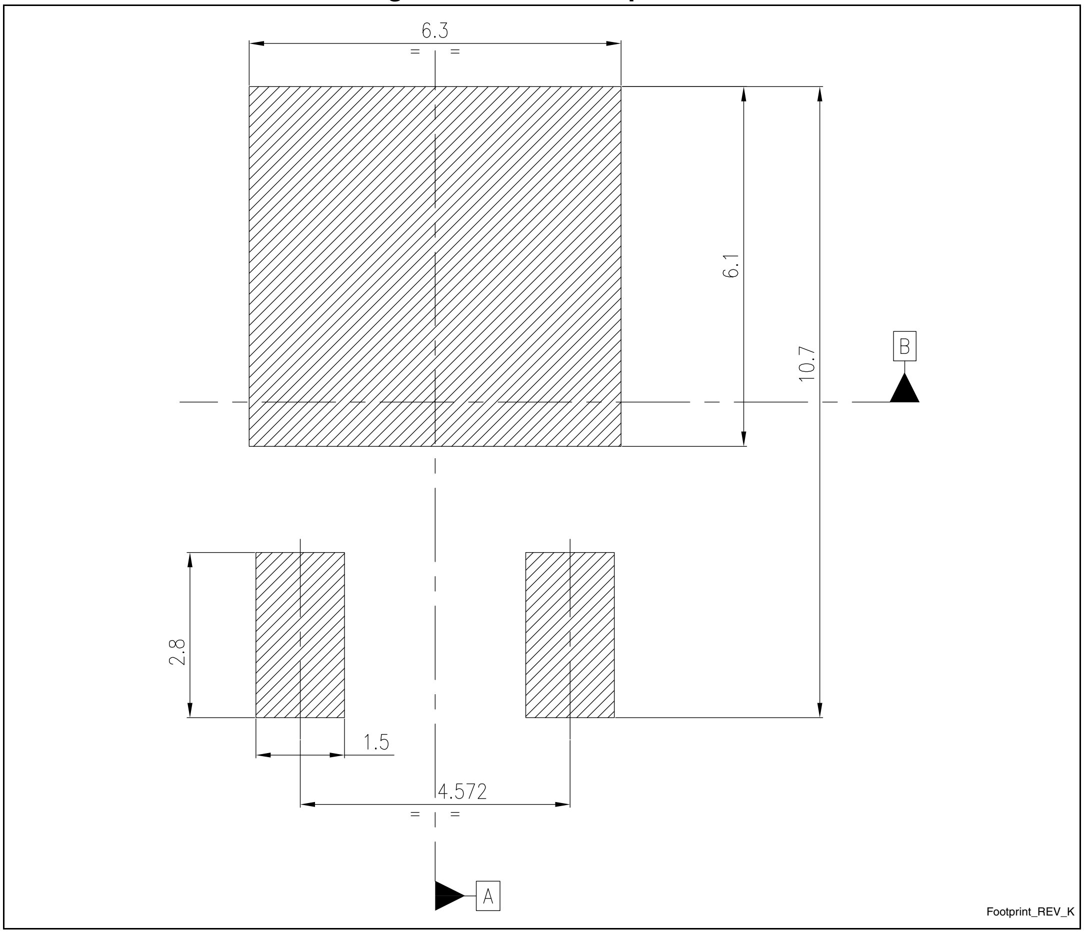


Figure 25. DPAK footprint [(a)]



a. 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 26. TO-220FP drawing

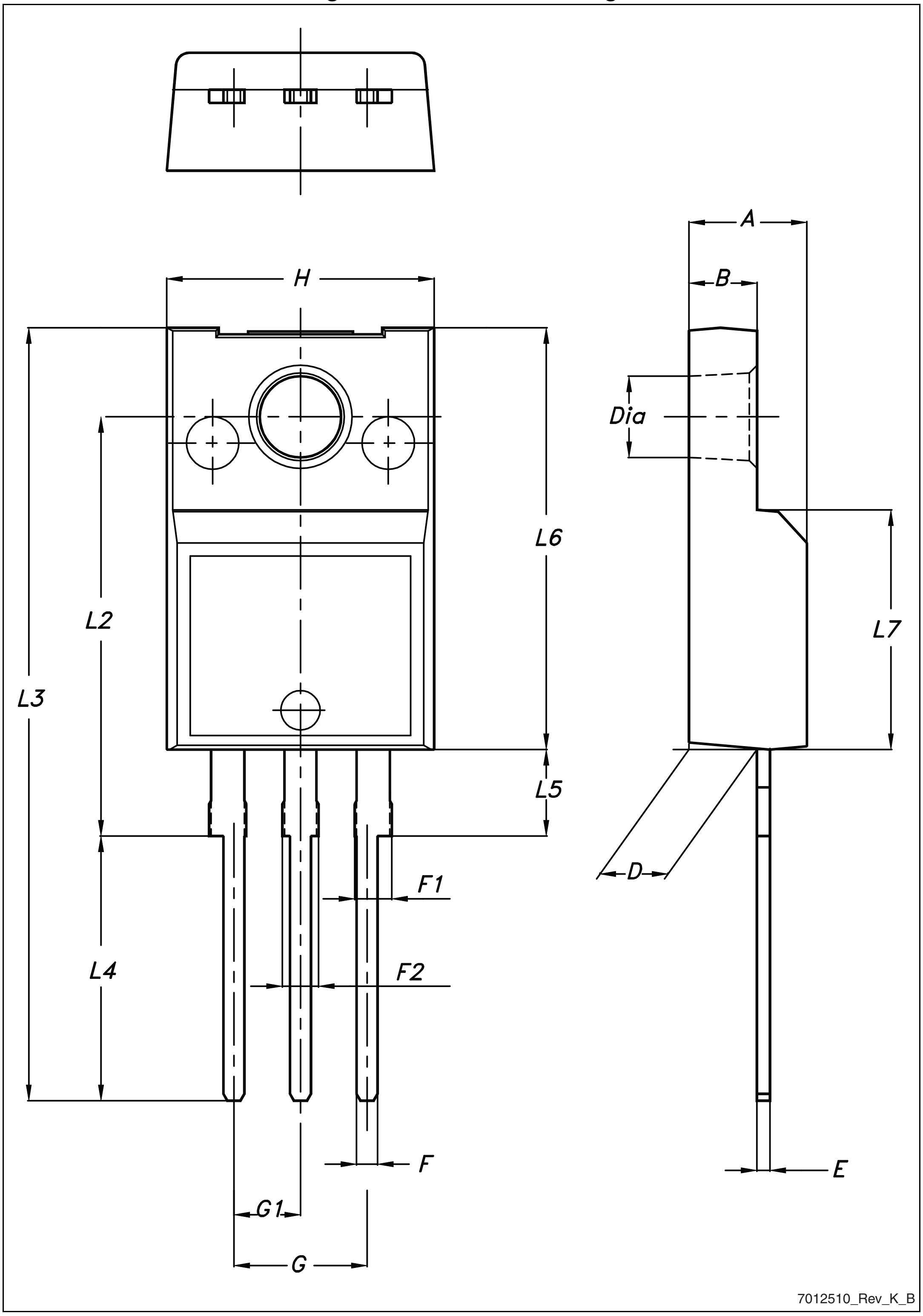
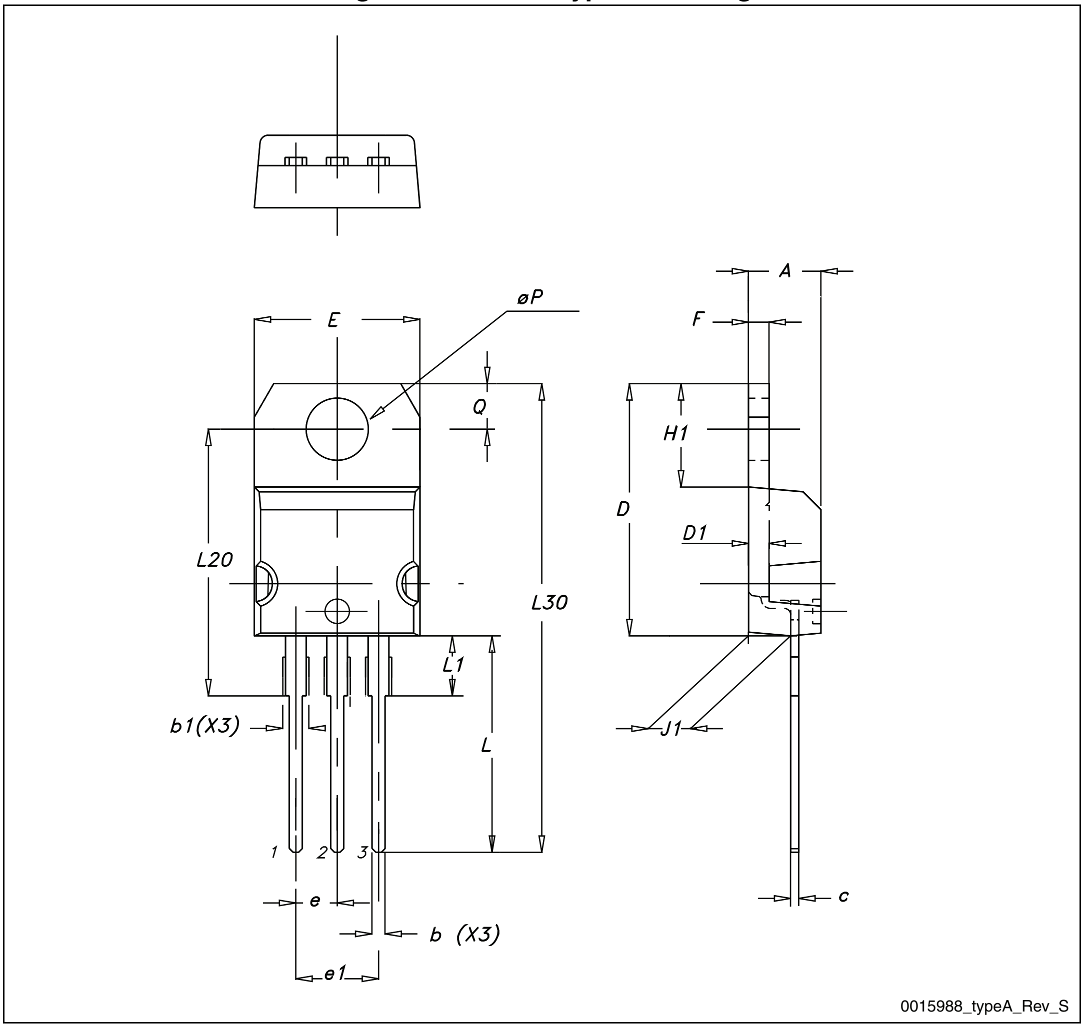


Table 11. TO-220 type A mechanical data

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

Figure 27. TO-220 type A drawing



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			

Figure 28. Tape for DPAK (TO-252)

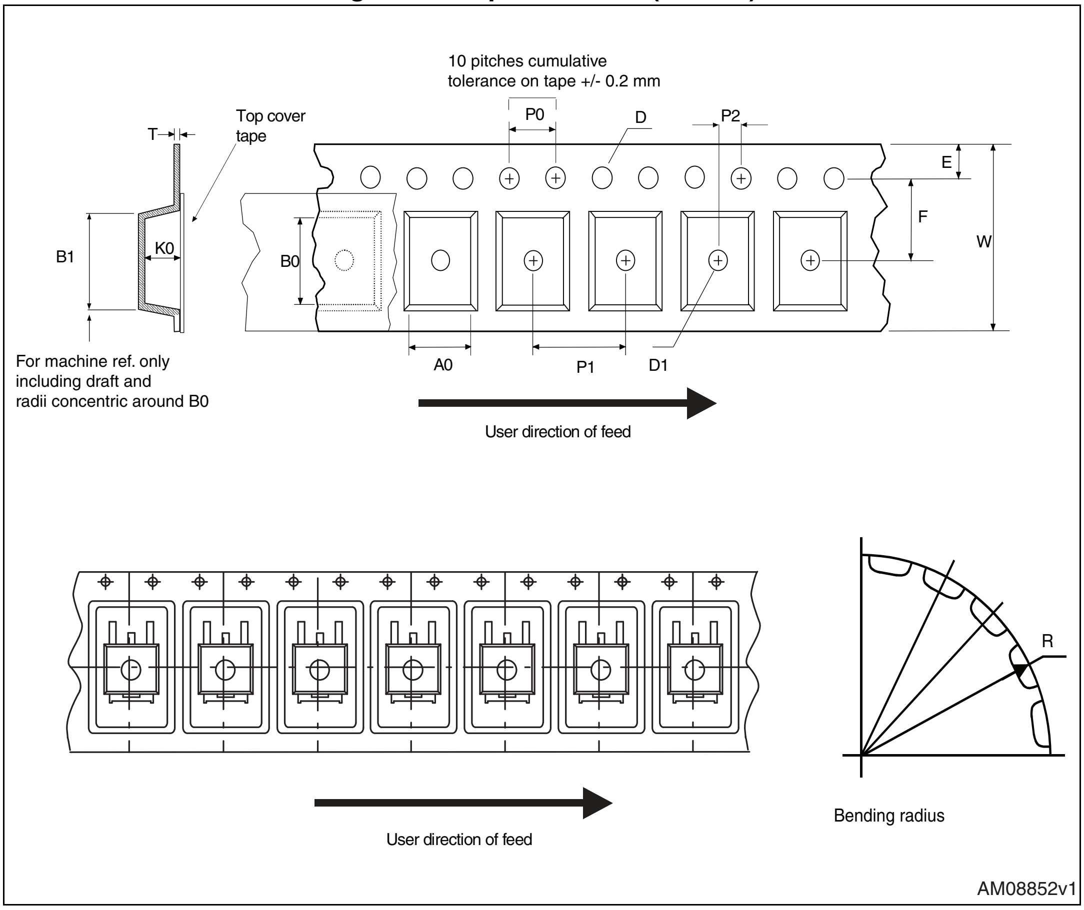
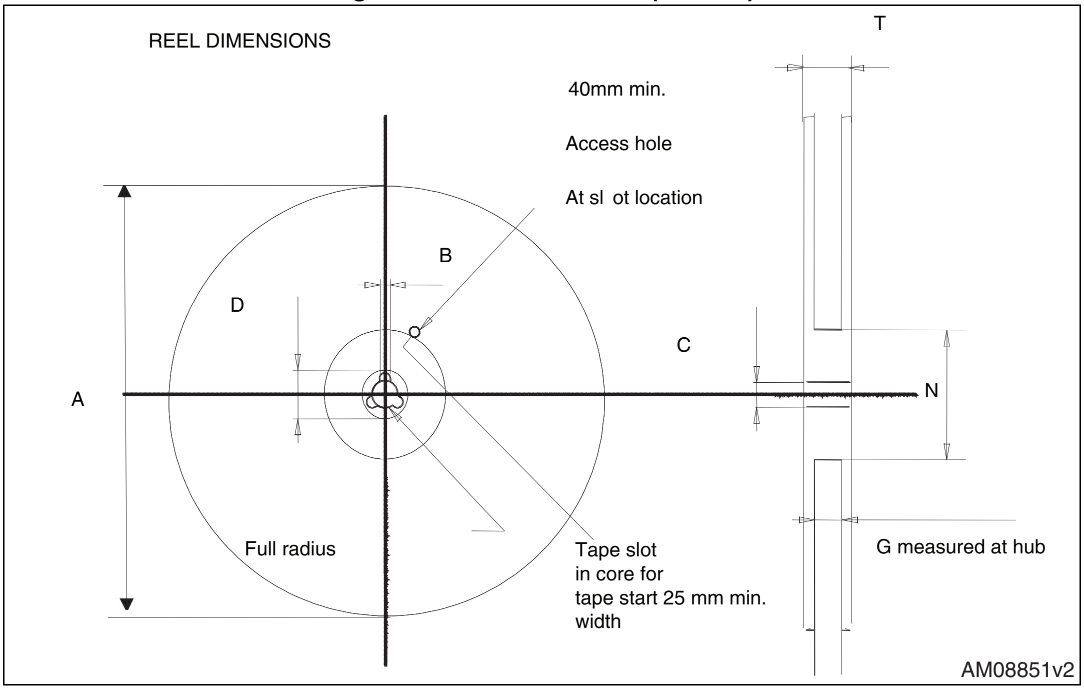


Figure 29. Reel for DPAK (TO-252)



6 Revision history

Table 13. Document revision history

Date	Revision	Changes
12-Oct-2007	1	Initial release.
13-Nov-2007	2	Modified: *Figure 13: Capacitance variations*.
29-Mar-2012	3	*Figure 2: Safe operating area for TO-220*, *Figure 4: Safe operating area for TO-220FP* and *Figure 6: Safe operating area for DPAK* have been updated. *Section 4: Package mechanical data* and *Section 5: Packaging mechanical data* have been updated. Minor text changes
06-Mar-2013	4	– Modified: P_{TOT}, derating factor values, note *1* on *Table 2*, $R_{thj-case}$, $R_{thj-amb}$ only for TO-220 and DPAK – Updated: *Section 4: Package mechanical data* – Minor text changes