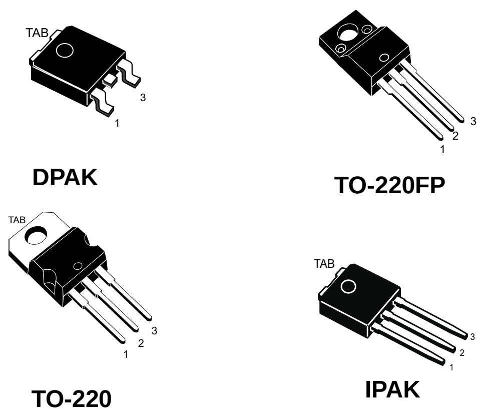
STD10NM60N, STF10NM60N, STP10NM60N, STU10NM60N

N-channel 600 V, 0.53 Ω typ., 10 A MDmesh™ II Power MOSFET in DPAK, TO-220FP, TO-220 and IPAK packages

Datasheet - production data

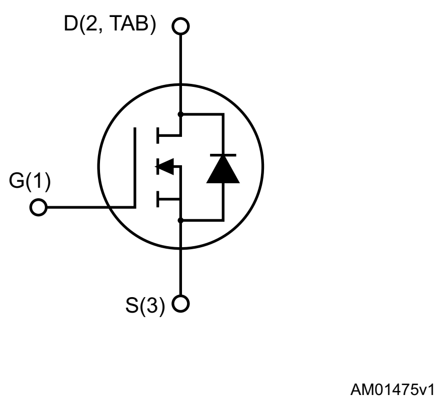


Features

Order code	V_{DS} @T_J max.	$R_{DS(on)}$ max.	I_D	P_{TOT}
STD10NM60N	650 V	0.55 Ω	10 A	70 W
STF10NM60N				25 W
STP10NM60N				70 W
STU10NM60N				

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Figure 1. Internal schematic diagram



Applications

- Switching applications

Description

These devices are N-channel Power MOSFETs developed using the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a vertical structure to the company's strip layout to yield one of the world's lowest on-resistance and gate charge. It is therefore suitable for the most demanding high efficiency converters.

Table 1. Device summary

Order code	Marking	Package	Packing
STD10NM60N	10NM60N	DPAK	Tape and reel
STF10NM60N	10NM60N	TO-220FP	Tube
STP10NM60N	10NM60N	TO-220	Tube
STU10NM60N	10NM60N	IPAK	Tube

Contents

1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value				Unit
		TO-220	TO-220FP	IPAK	DPAK	
V_{GS}	Gate- source voltage	± 25				V
I_D	Drain current (continuous) at T_C = 25 °C	10	10 (1)	10		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	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_J	Operating junction temperature	- 55 to 150				°C
T_{stg}	Storage temperature					

1. Limited by maximum junction temperature.
2. Pulse width limited by safe operating area.
3. $I_{SD} \leq 10$ A, di/dt $\leq$ 400 A/µs, V_{DS} peak $\leq V_{(BR)DSS}$, V_{DD} = 80% $V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		TO-220	TO-220FP	IPAK	DPAK	
$R_{thj-case}$	Thermal resistance junction-case max.	1.79	5	1.79		°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max.	62.50		100		°C/W
$R_{thj-pcb}$	Thermal resistance junction-pcb max.				50	°C/W

Table 4. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max.)	4	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AS}, V_{DD} = 50 V)	200	mJ

2 Electrical characteristics

(T_{case} = 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	I_D = 1 mA, V_{GS} = 0	600			V
		I_D = 1 mA, V_{GS} = 0, T_C = 150 °C		650		
I_{DSS}	Zero-gate voltage drain current (V_{GS} = 0)	V_{DS} = 600 V			1	µA
		V_{DS} = 600 V, T_C = 125 °C			100	
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	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 4 A		0.53	0.55	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0	-	540	-	pF
C_{oss}	Output capacitance		-	44	-	pF
C_{rss}	Reverse transfer capacitance		-	1.2	-	pF
$C_{oss\ eq}$[(1)]	Equivalent capacitance time related	V_{DS} = 0 to 480 V, V_{GS} = 0	-	110	-	pF
R_g	Gate input resistance	f=1 MHz open drain	-	6	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 8 A, V_{GS} = 10 V (see *Figure 17*)	-	19	-	nC
Q_{gs}	Gate-source charge		-	3	-	nC
Q_{gd}	Gate-drain charge		-	10	-	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
$t_{d(on)}$	Turn-on delay time	V_{DD} = 300 V, I_D = 4 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 16*)	-	10	-	ns
t_r	Rise time		-	12	-	ns
$t_{d(off)}$	Turn-off-delay time		-	32	-	ns
t_f	Fall time		-	15	-	ns

Table 8. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		8	A
I_{SDM}(1)	Source-drain current (pulsed)				32	A
V_{SD}(2)	Forward on voltage	I_{SD} = 8 A, V_{GS} = 0	-		1.3	V
t_{rr}	Reverse recovery time	I_{SD} = 8 A, di/dt = 100 A/µs V_{DD}= 60 V *(see Figure 18)*	-	250		ns
Q_{rr}	Reverse recovery charge		-	2.12		µC
I_{RRM}	Reverse recovery current			17		A
t_{rr}	Reverse recovery time	I_{SD} = 8 A, di/dt = 100 A/µs V_{DD}= 60 V T_J = 150 °C (see *Figure 18*)	-	315		ns
Q_{rr}	Reverse recovery charge			2.6		µC
I_{RRM}	Reverse recovery current			16.5		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

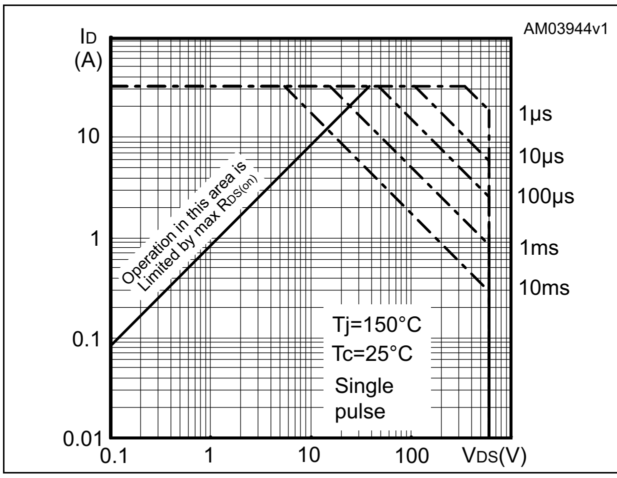


Figure 3. Thermal impedance for TO-220

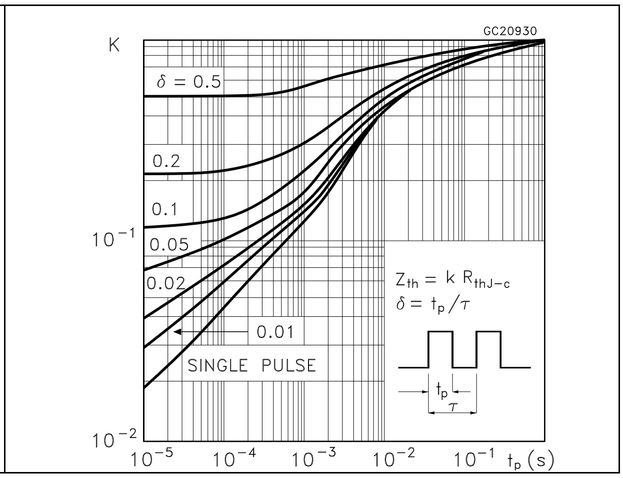


Figure 4. Safe operating area for TO-220FP

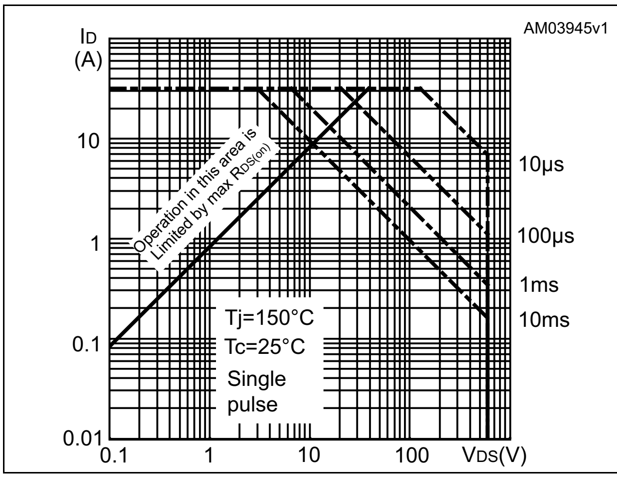


Figure 5. Thermal impedance for TO-220FP

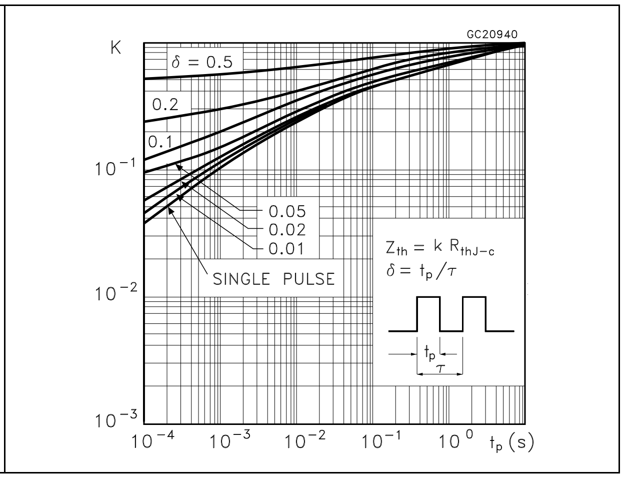


Figure 6. Safe operating area for DPAK, IPAK

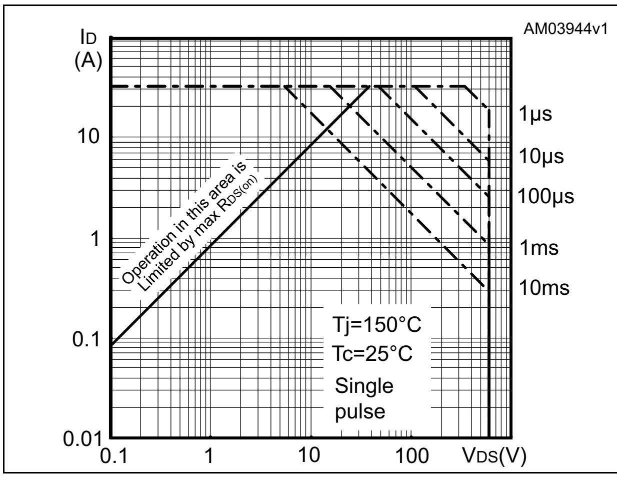
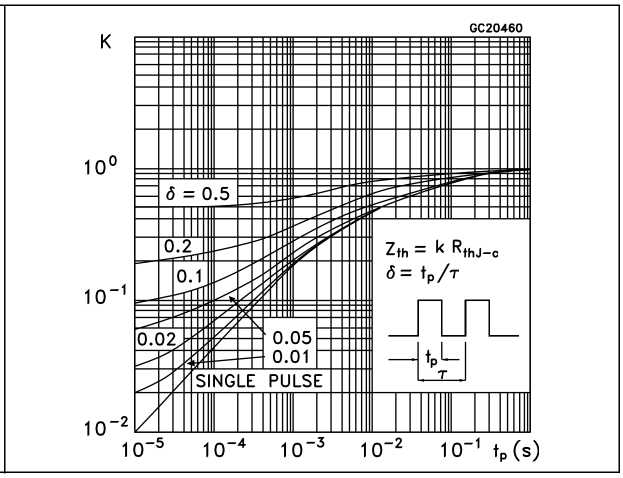


Figure 7. Thermal impedance for DPAK, IPAK



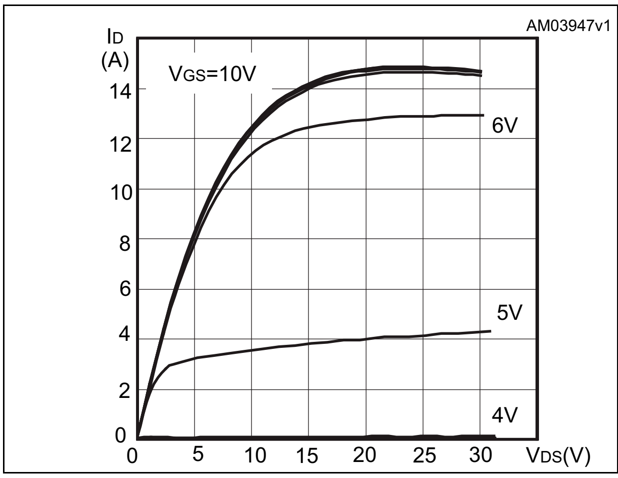


Figure 8. Output characteristics

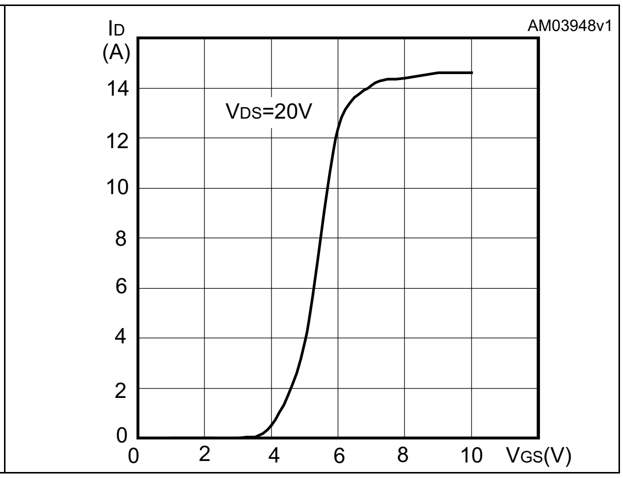


Figure 9. Transfer characteristics

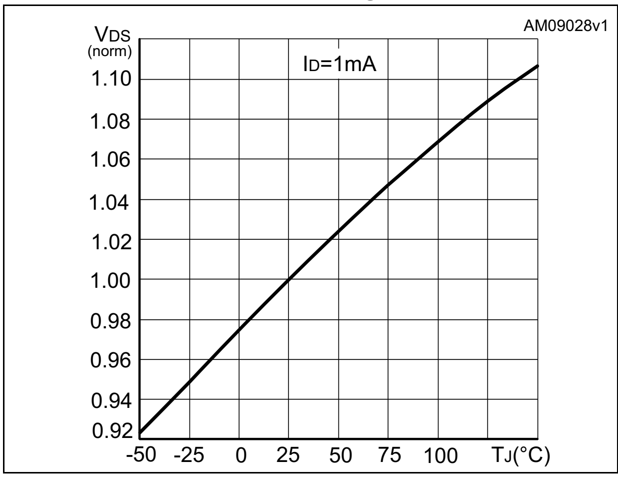


Figure 10. Normalized V_{DS} vs. temperature

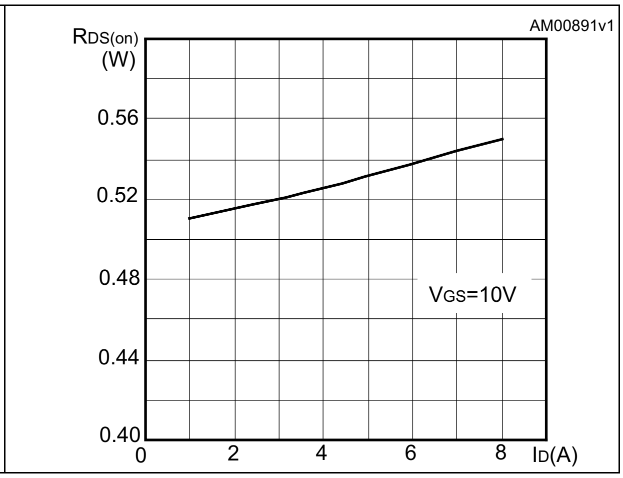


Figure 11. Static drain-source on-resistance

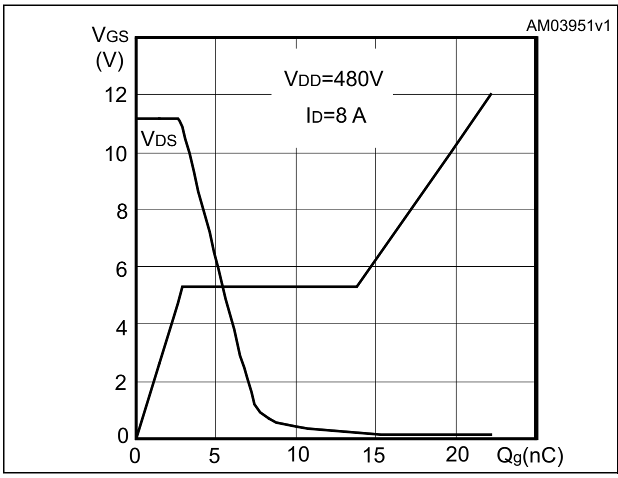


Figure 12. Gate charge vs. gate-source voltage

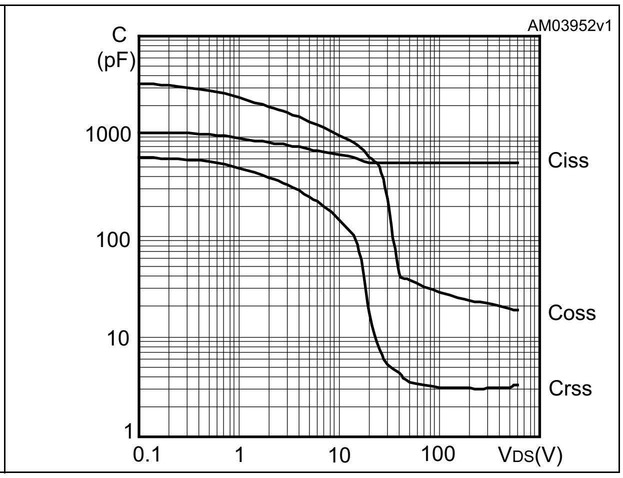


Figure 13. Capacitance variations

Figure 14. Normalized gate threshold voltage vs. temperature

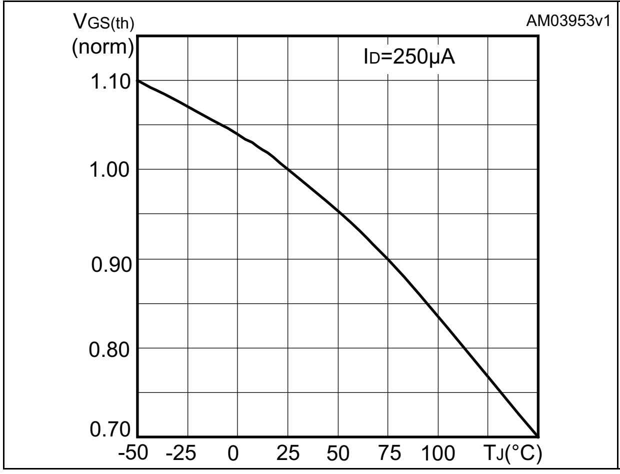
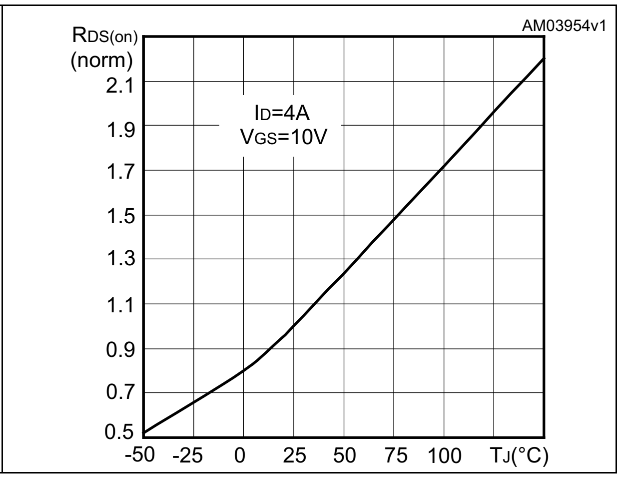


Figure 15. Normalized on-resistance vs. temperature



3 Test circuits

Figure 16. Switching times test circuit for resistive load

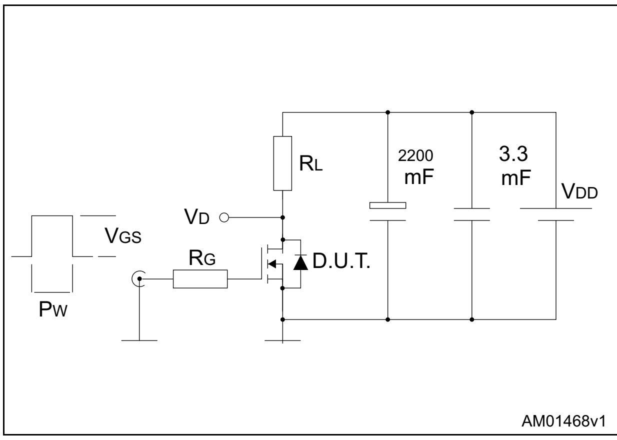


Figure 17. Gate charge test circuit

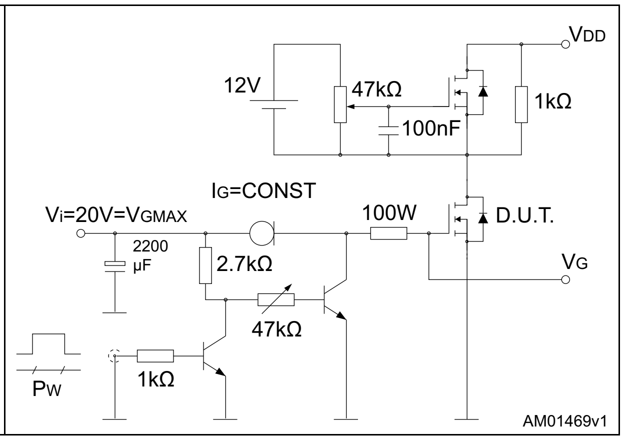


Figure 18. Test circuit for inductive load switching and diode recovery times

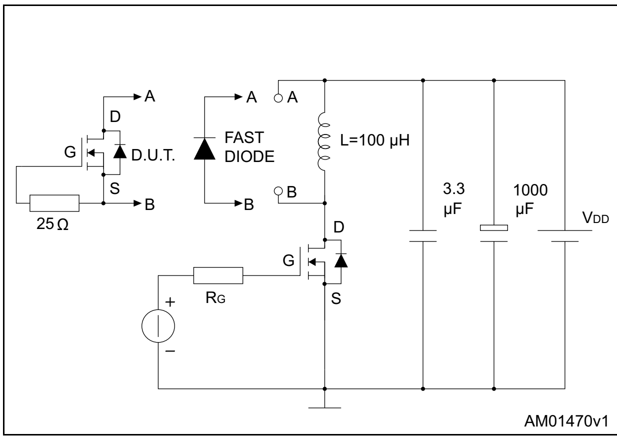


Figure 19. Unclamped inductive load test circuit

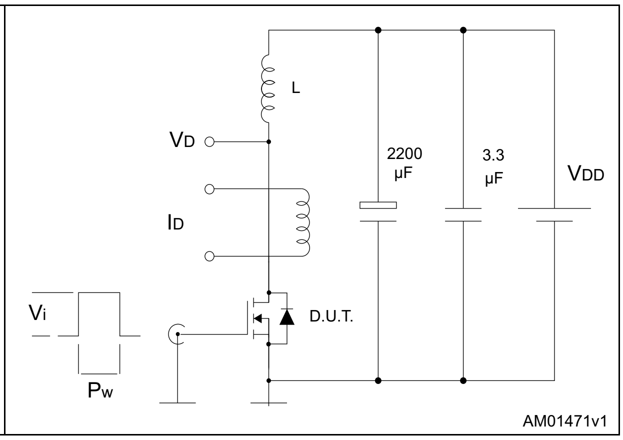


Figure 20. Unclamped inductive waveform

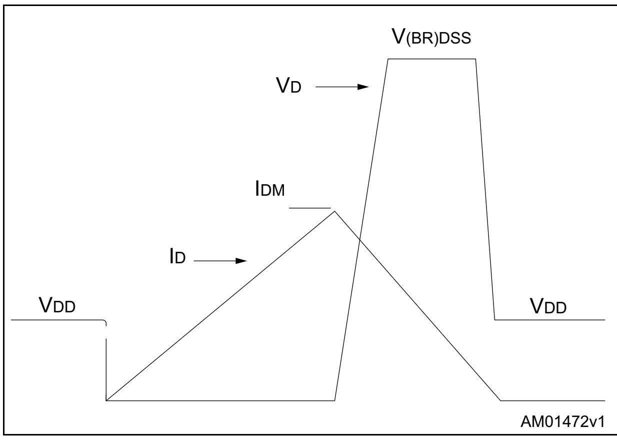
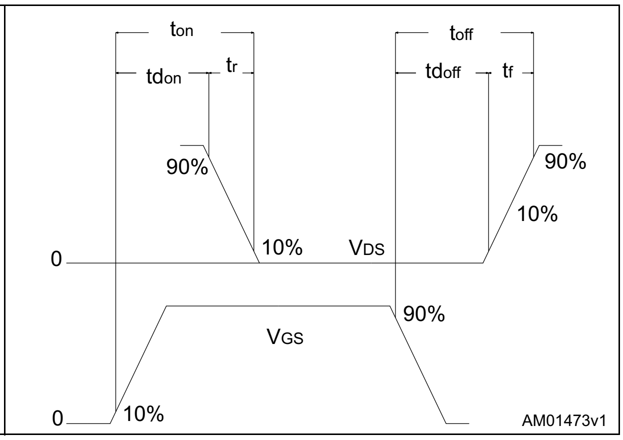


Figure 21. Switching time waveform



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 STD10NM60N, DPAK (TO-252) package information

Figure 22. DPAK (TO-252) type A package outline

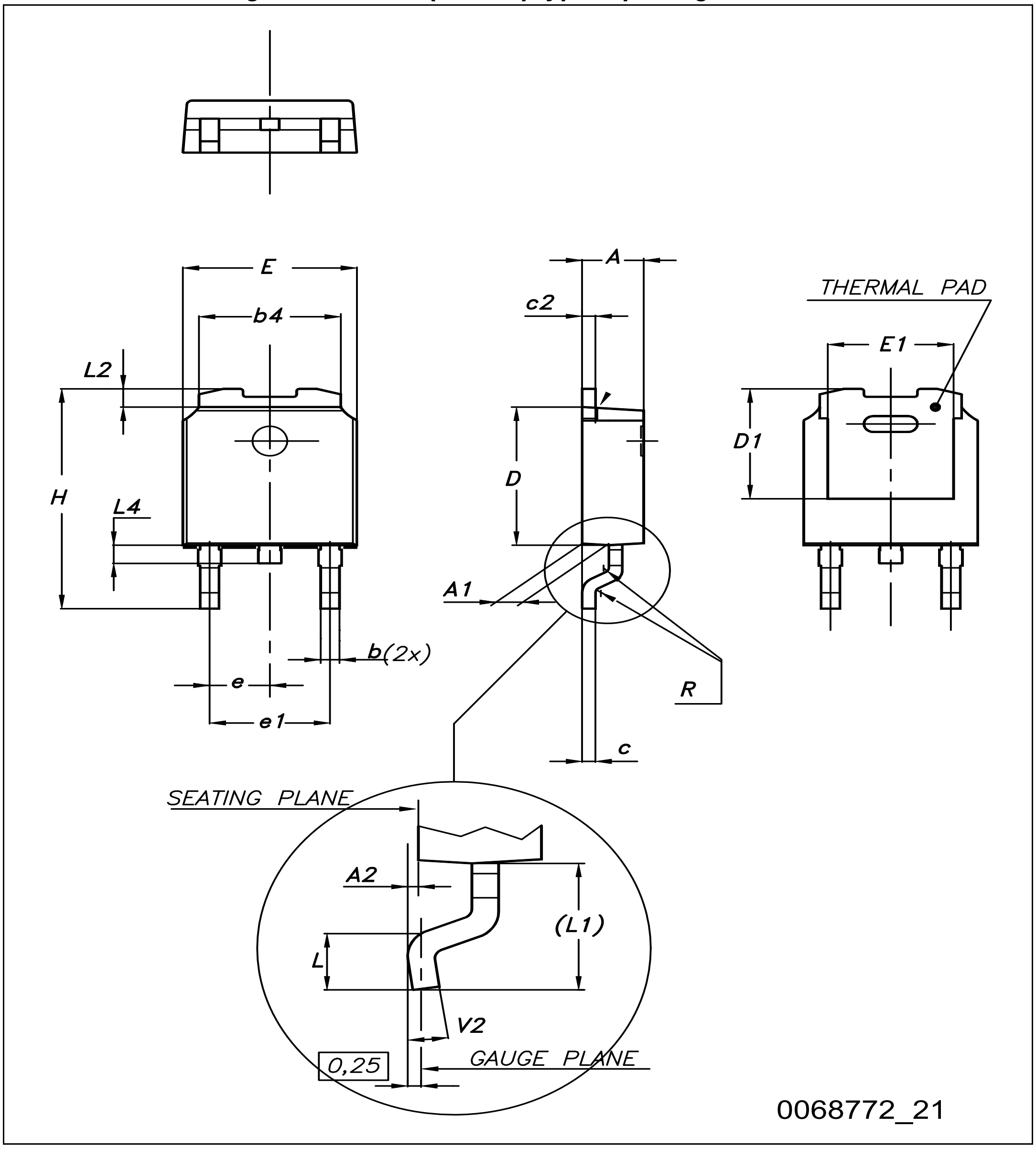


Table 9. DPAK (TO-252) type A mechanical data

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	2.16	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 23. DPAK (TO-252) type C2 outline

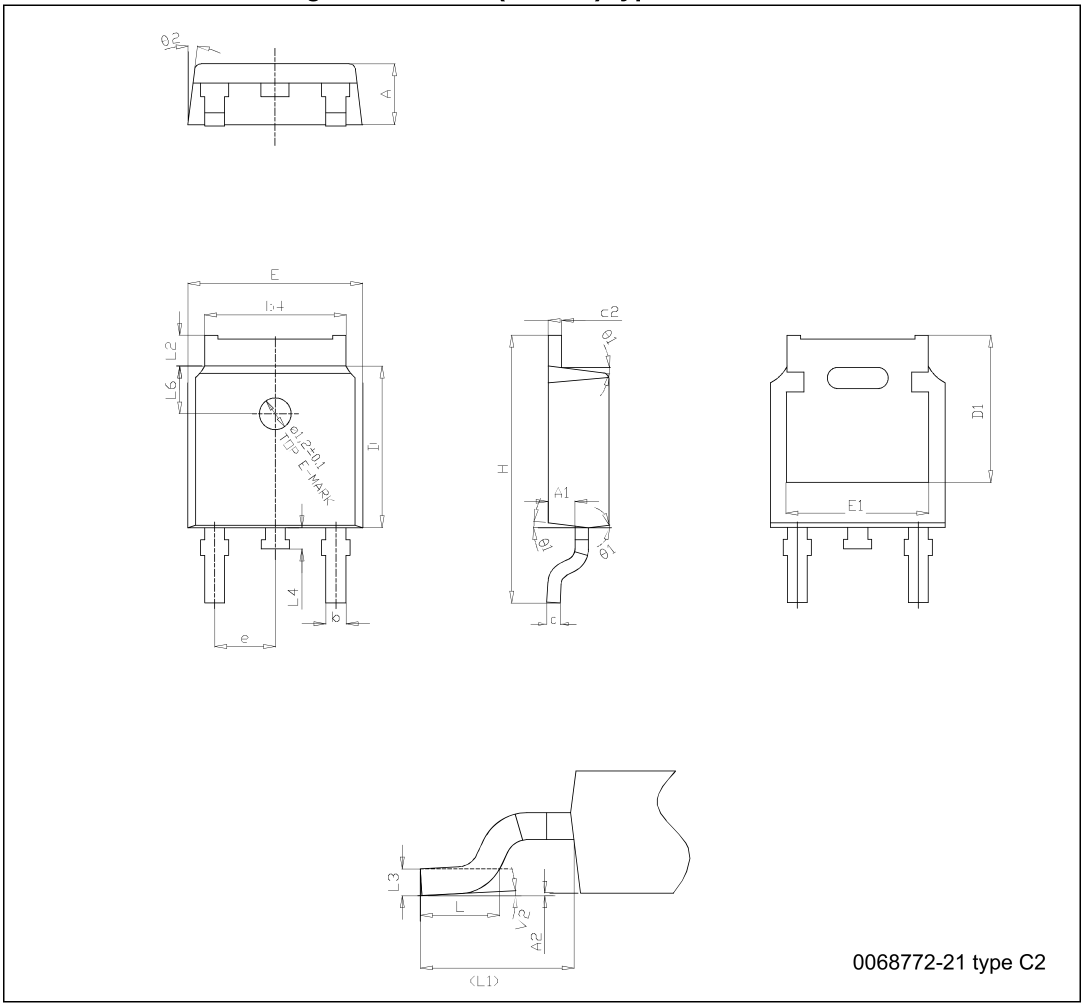


Table 10. DPAK (TO-252) type C2 package mechanical data

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 24. DPAK (TO-252) type E package outline

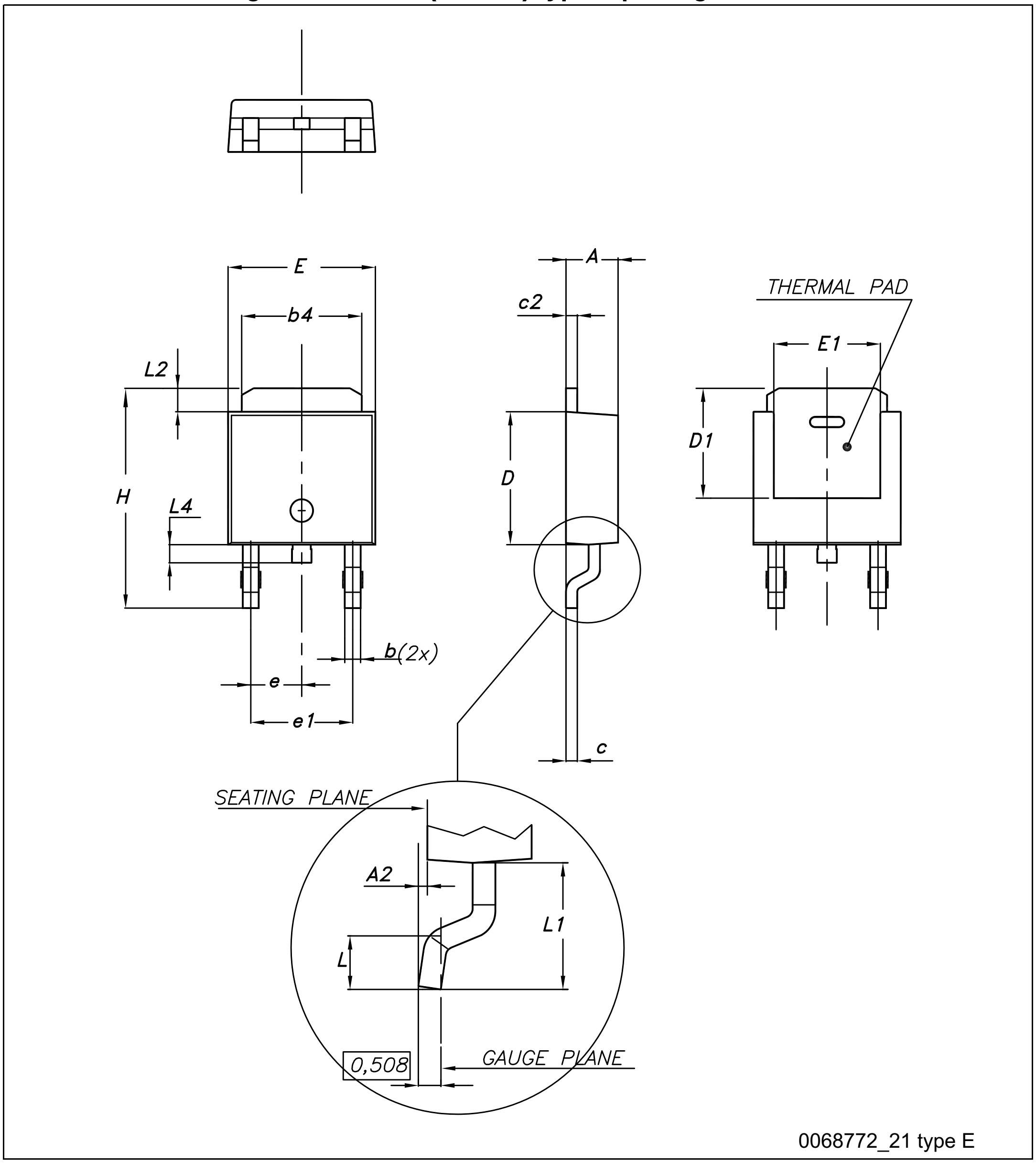
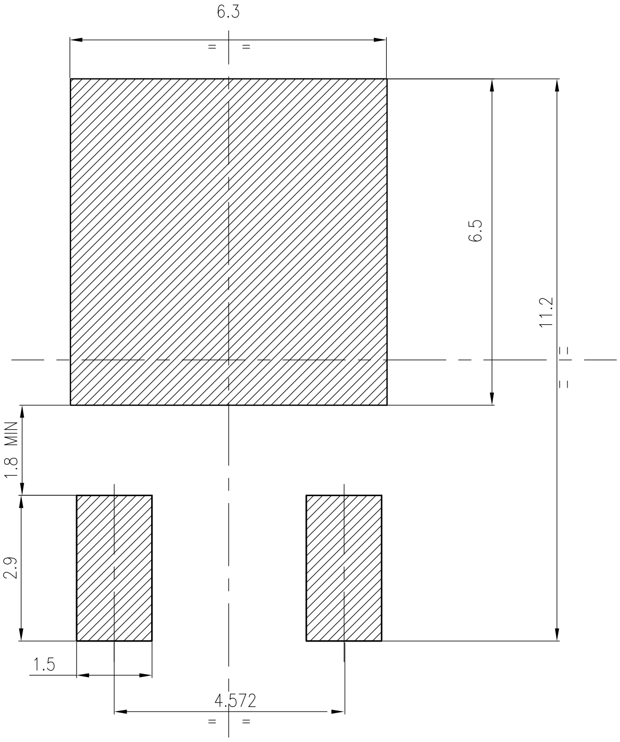


Table 11. DPAK (TO-252) type E mechanical data

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 25. DPAK (TO-252) type A, C2, E recommended footprint [a]



a. All dimensions are in millimeters

4.2 STF10NM60N, TO-220FP package information

Figure 26. TO-220FP package outline

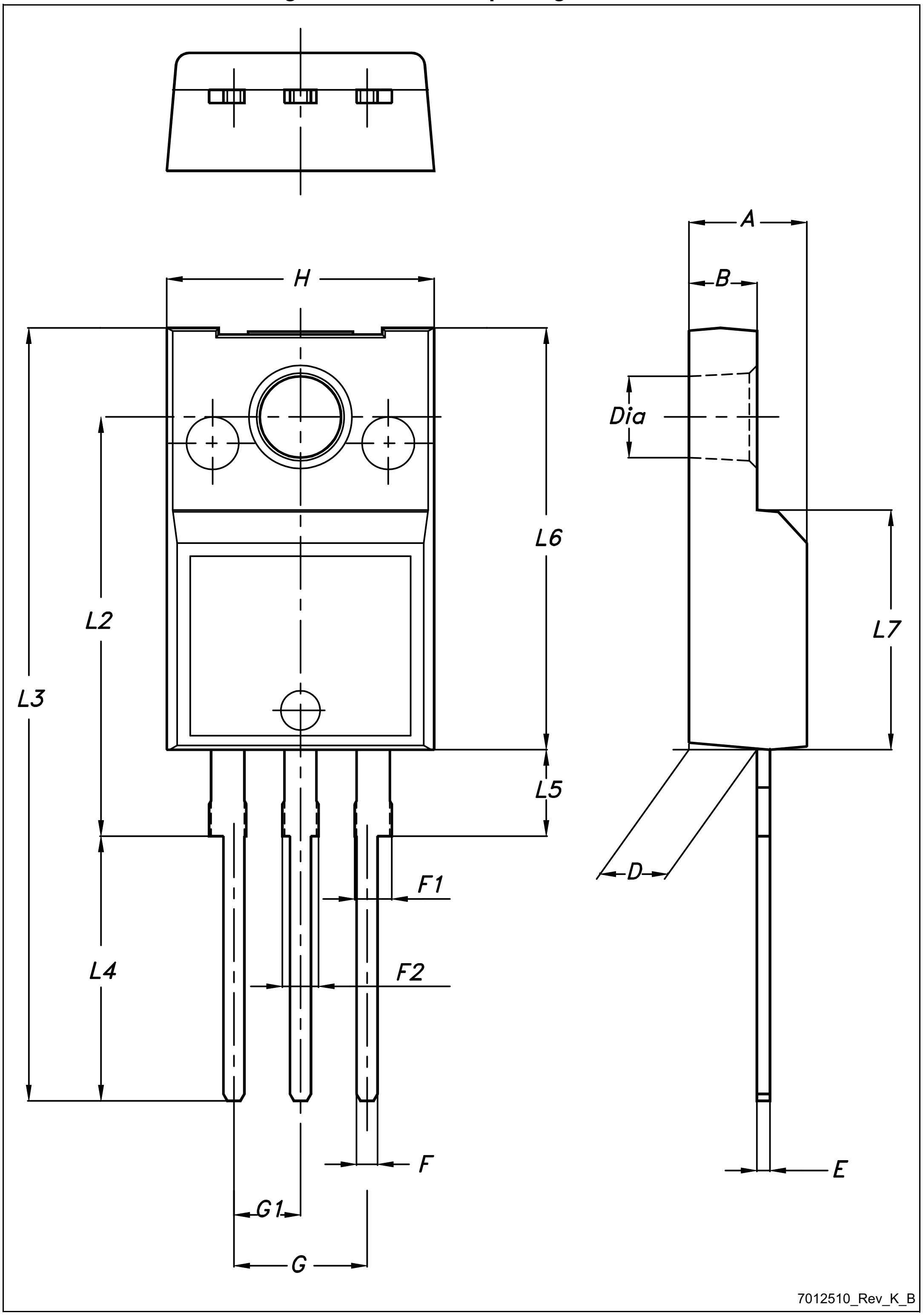


Table 12. TO-220FP package mechanical data

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

4.3 STP10NM60N, TO-220 package information

Figure 27. TO-220 type A package outline

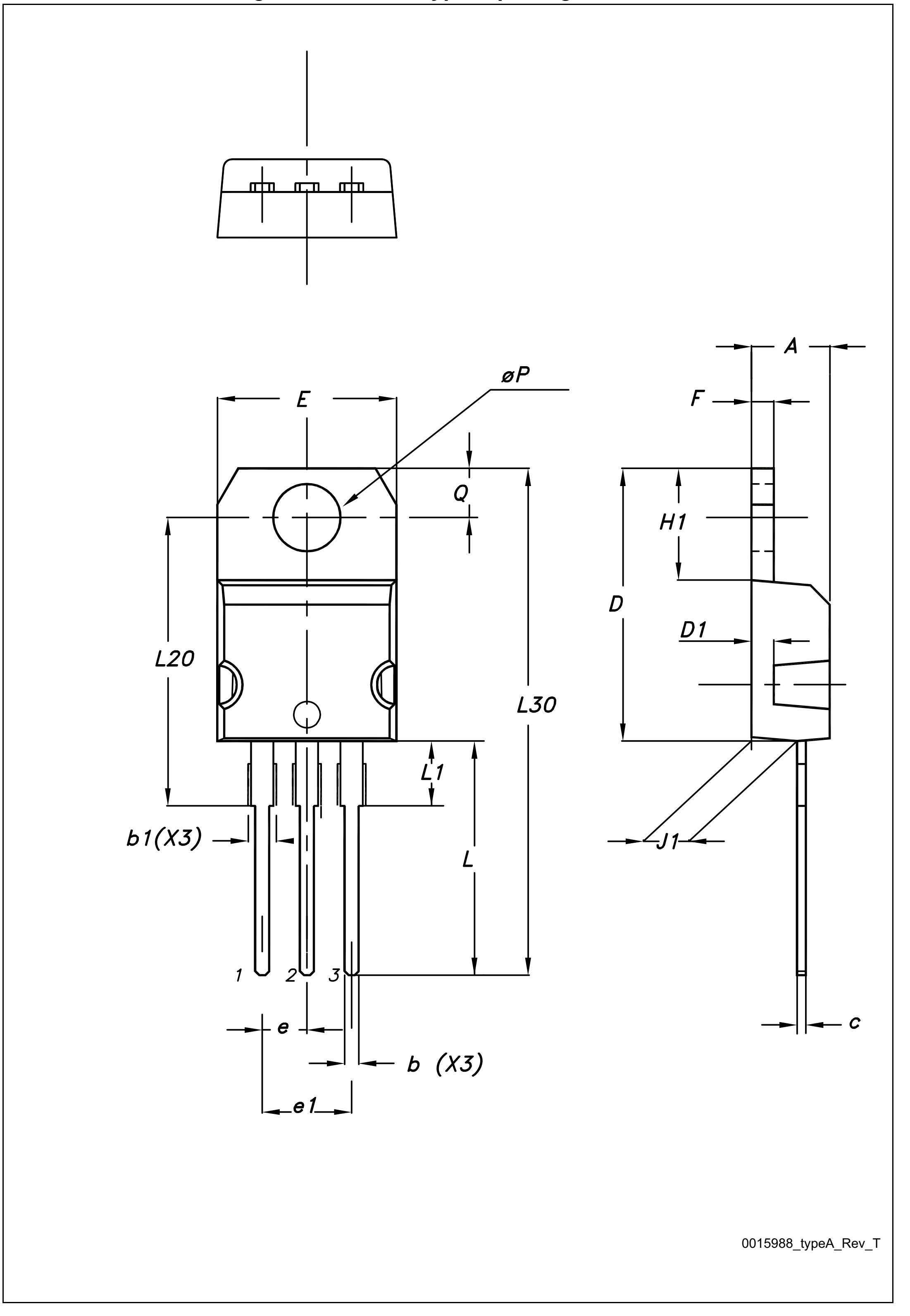


Table 13. TO-220 type A mechanical data

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	
øP	3.75		3.85
Q	2.65		2.95

4.4 STU10NM60N, IPAK (TO-251)

Figure 28. IPAK (TO-251) type A outline

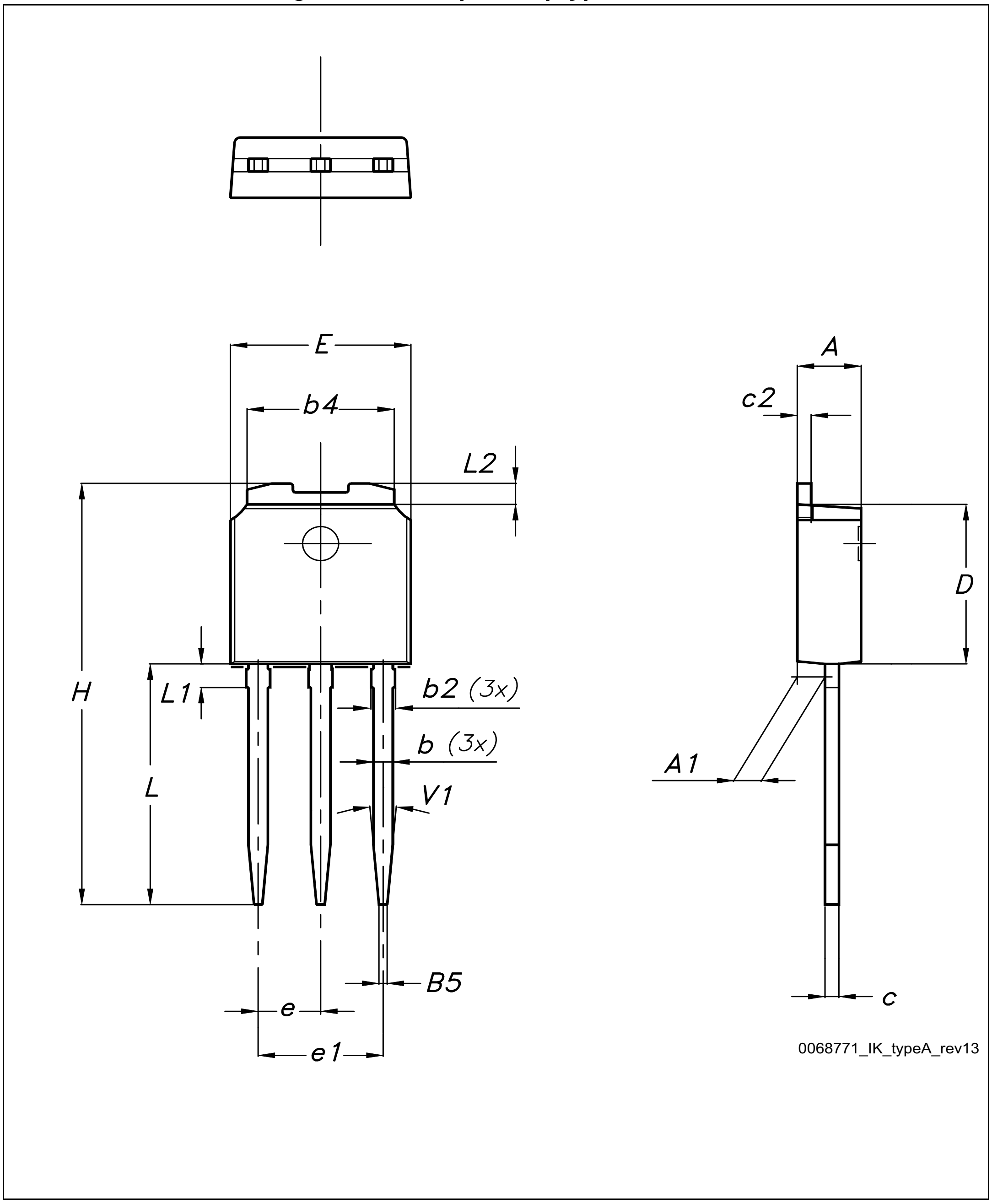


Table 14. IPAK (TO-251) type A mechanical data

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 29. IPAK (TO-251) type C package outline

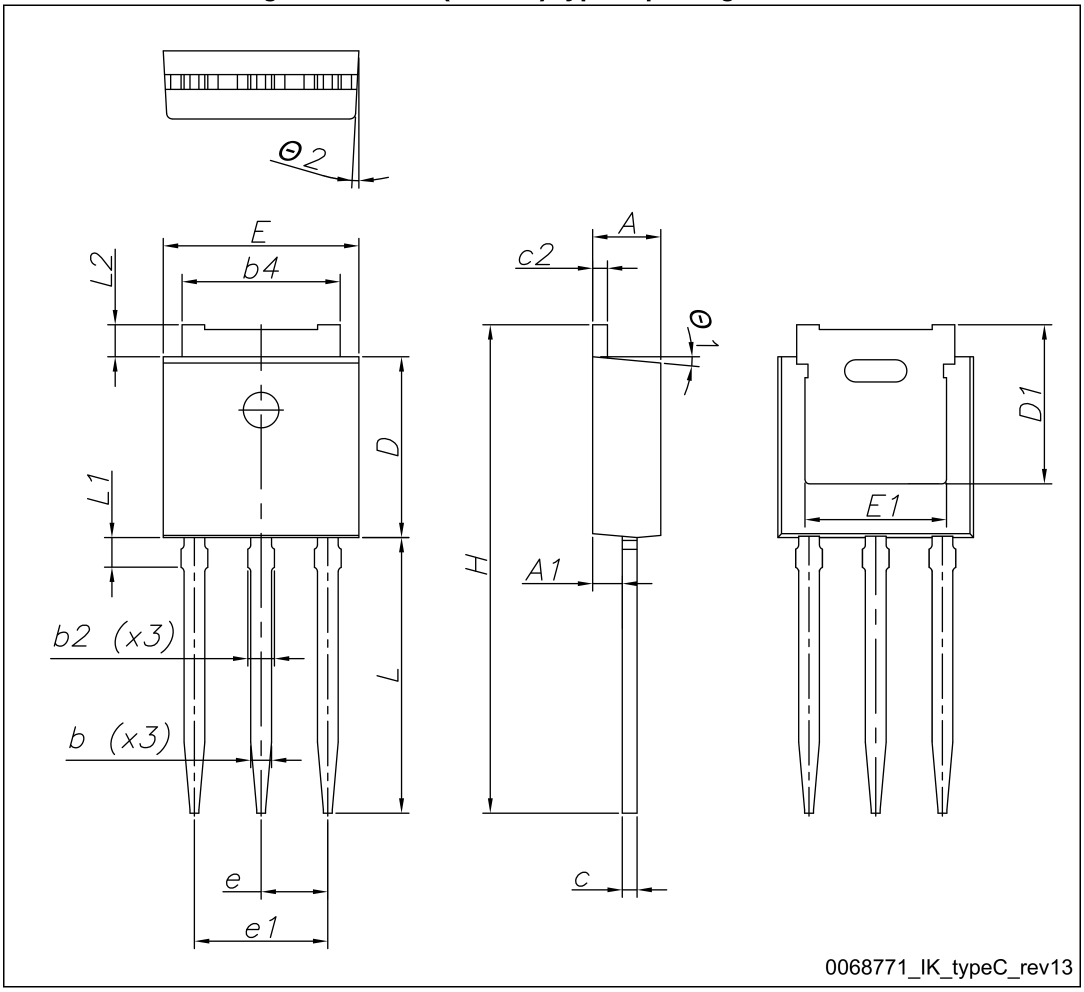


Table 15. IPAK (TO-251) type C package mechanical data

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	0.90	1.00	1.20
L2	0.90	1.08	1.25
Ɵ1	3°	5°	7°
Ɵ2	1°	3°	5°

5 Packing information

Figure 30. Tape for DPAK (TO-252)

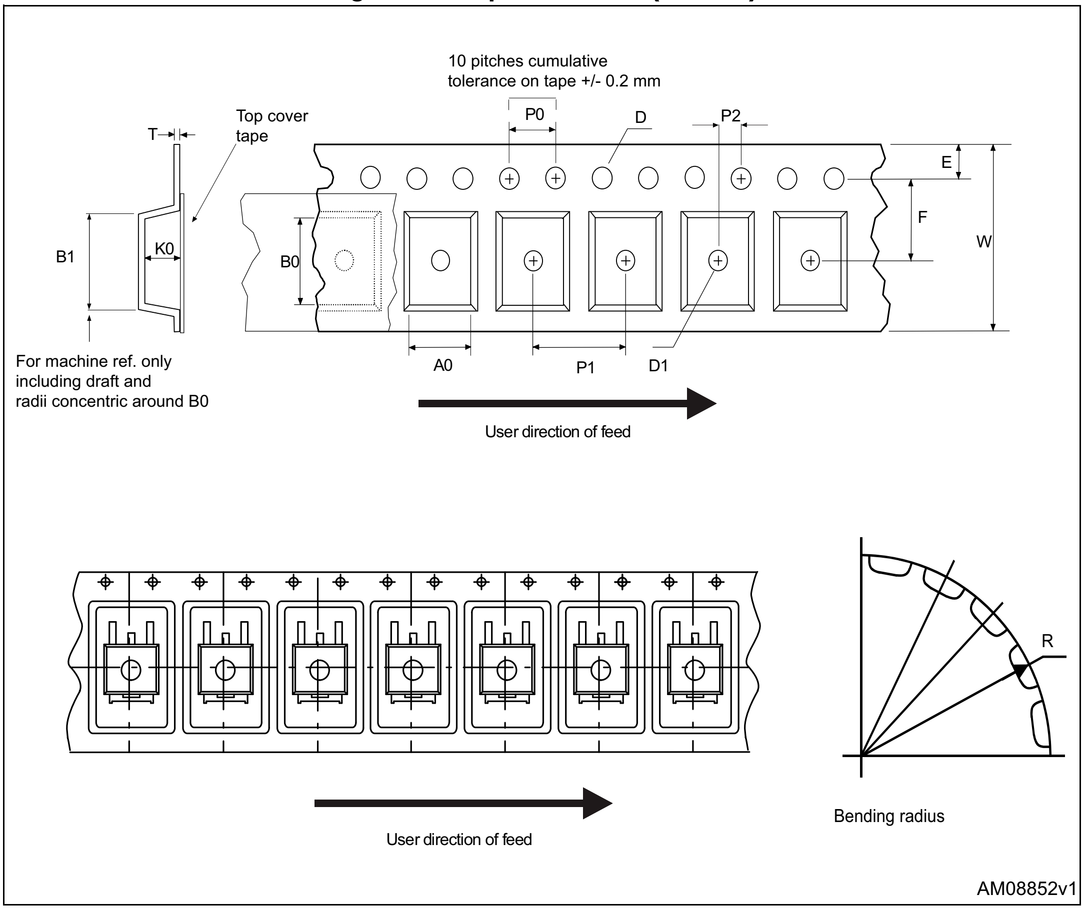


Figure 31. Reel for DPAK (TO-252)

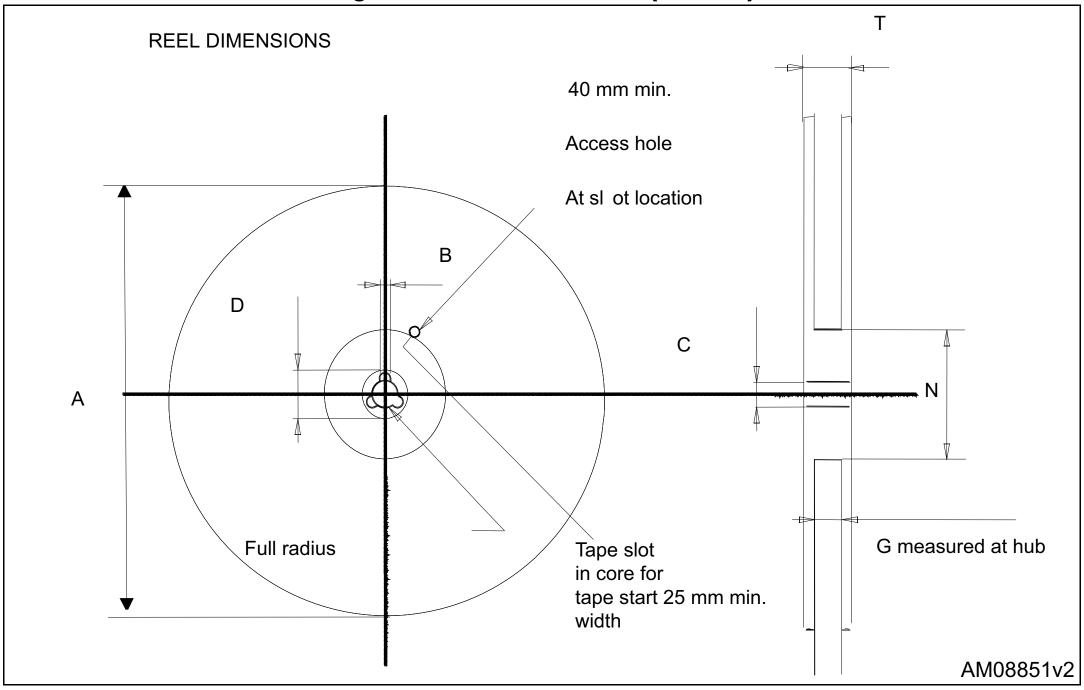


Table 16. DPAK (TO-252) tape and reel mechanical data

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 quantity		2500
P1	7.9	8.1	Bulk quantity		2500
P2	1.9	2.1			
R	40				
T	0.25	0.35			
W	15.7	16.3			

6 Revision history

Table 17. Document revision history

Date	Revision	Changes
04-Dec-2015	1	First release. Part numbers previously included in the datasheet with DocID15764.