



STF4N62K3, STI4N62K3 STP4N62K3, STU4N62K3

N-channel 620 V, 1.7 Ω , 3.8 A SuperMESH3™ Power MOSFET
TO-220FP, I²PAK, TO-220, I²PAK

Features

Order codes	V _{DSS}	R _{DS(on)} max	I _D	P _w
STF4N62K3	620 V	< 2 Ω	3.8 A	25 W
STI4N62K3				70 W
STP4N62K3				70 W
STU4N62K3				70 W

- 100% avalanche tested
- Extremely high dv/dt capability
- Gate charge minimized
- Very low intrinsic capacitance
- Improved diode reverse recovery characteristics
- Zener-protected

Application

Switching applications

Description

These devices are made using the SuperMESH3™ Power MOSFET technology that is obtained via improvements applied to STMicroelectronics' SuperMESH™ technology combined with a new optimized vertical structure. The resulting product has an extremely low on resistance, superior dynamic performance and high avalanche capability, making it especially suitable for the most demanding applications.

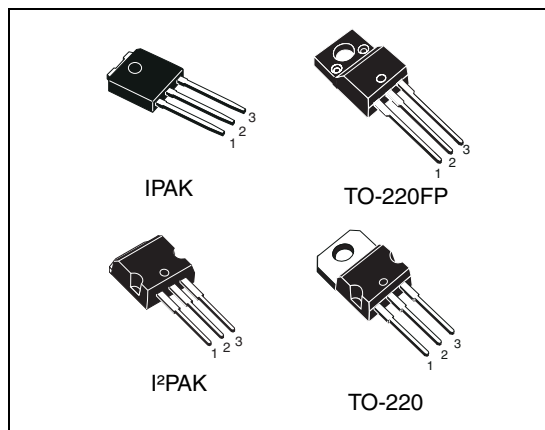


Figure 1. Internal schematic diagram

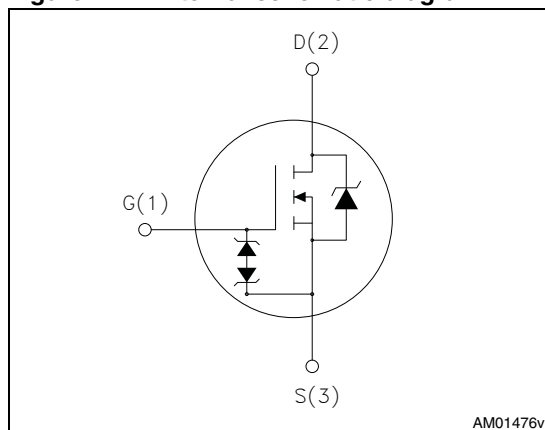


Table 1. Device summary

Order codes	Marking	Package	Packaging
STF4N62K3 STI4N62K3 STP4N62K3 STU4N62K3	4N62K3	TO-220FP I ² PAK TO-220 IPAK	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value			Unit
		TO-220 IPAK	IPAK	TO-220FP	
V_{DS}	Drain-source voltage ($V_{GS} = 0$)	620			V
V_{GS}	Gate- source voltage	± 30			V
I_D	Drain current (continuous) at $T_C = 25\text{ }^{\circ}\text{C}$	3.8		3.8 ⁽¹⁾	A
I_D	Drain current (continuous) at $T_C = 100\text{ }^{\circ}\text{C}$	2		2 ⁽¹⁾	A
I_{DM} ⁽²⁾	Drain current (pulsed)	15.2		15.2 ⁽¹⁾	A
P_{TOT}	Total dissipation at $T_C = 25\text{ }^{\circ}\text{C}$	70		25	W
I_{AR}	Avalanche current, repetitive or not-repetitive (pulse width limited by T_j max)	3.8			A
E_{AS}	Single pulse avalanche energy (starting $T_j = 25\text{ }^{\circ}\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{V}$)	115			mJ
$V_{ESD(G-S)}$	Gate source ESD(HBM-C = 100 pF, R = 1.5 k Ω)	2500			V
dv/dt ⁽³⁾	Peak diode recovery voltage slope	12			V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink ($t = 1\text{ s}$; $T_C = 25\text{ }^{\circ}\text{C}$)			2500	V
T_{stg}	Storage temperature	- 55 to 150			$^{\circ}\text{C}$
T_j	Max. operating junction temperature	150			$^{\circ}\text{C}$

1. Limited by maximum temperature allowed.

2. Pulse width limited by safe operating area.

3. $I_{SD} \leq 3.8\text{ A}$, $di/dt = 400\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$, $V_{DS\text{ peak}} \leq V_{(BR)DSS}$.

Table 3. Thermal data

Symbol	Parameter	Value				Unit
		TO-220	IPAK	IPAK	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max	1.79			5	$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal resistance junction-ambient max	62.5				$^{\circ}\text{C}/\text{W}$
T_I	Maximum lead temperature for soldering purpose	300				$^{\circ}\text{C}$

2 Electrical characteristics

($T_C = 25\text{ °C}$ unless otherwise specified)

Table 4. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	620			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = \text{Max rating}$ $V_{DS} = \text{Max rating}$, $T_C = 125\text{ °C}$			1 50	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 50\text{ }\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10\text{ V}$, $I_D = 1.9\text{ A}$		1.7	2	Ω

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	550	-	pF
C_{oss}	Output capacitance			42		pF
C_{rss}	Reverse transfer capacitance			7		pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }496\text{ V}$, $V_{GS} = 0$	-	27	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	5	-	Ω
Q_g	Total gate charge	$V_{DD} = 496\text{ V}$, $I_D = 3.8\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 20)	-	22	-	nC
Q_{gs}	Gate-source charge			4		nC
Q_{gd}	Gate-drain charge			13		nC

1. $C_{oss\text{ eq.}}$ 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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 1.9\text{ A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\text{ V}$ (see Figure 19)	-	10	-	ns
t_r	Rise time			9		ns
$t_{d(off)}$	Turn-off-delay time			29		ns
t_f	Fall time			19		ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		3.8	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				15.2	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 3.8\text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 3.8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$ (see Figure 24)	-	220		ns
Q_{rr}	Reverse recovery charge			1.4		μC
I_{RRM}	Reverse recovery current			13		A
t_{rr}	Reverse recovery time	$I_{SD} = 3.8\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 60\text{ V}$, $T_j = 150\text{ }^\circ\text{C}$ (see Figure 24)	-	270		ns
Q_{rr}	Reverse recovery charge			1.9		μC
I_{RRM}	Reverse recovery current			14		A

1. Pulse width limited by safe operating area

2. Pulsed: Pulse duration = 300 μs , duty cycle 1.5%

Table 8. Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
BV_{GSO}	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$ (open drain)	30	-		V

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

2.1 Electrical characteristics (curves)

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

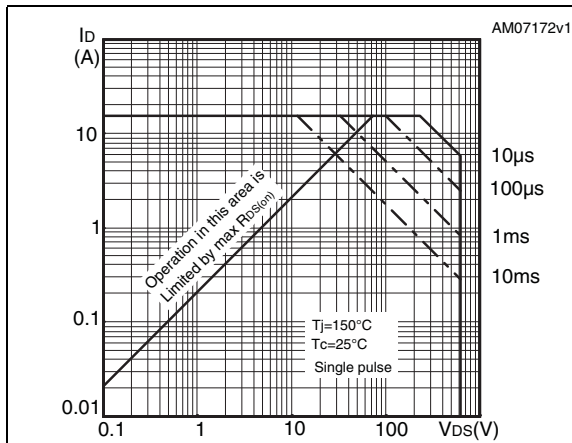


Figure 3. Thermal impedance for TO-220, I²PAK

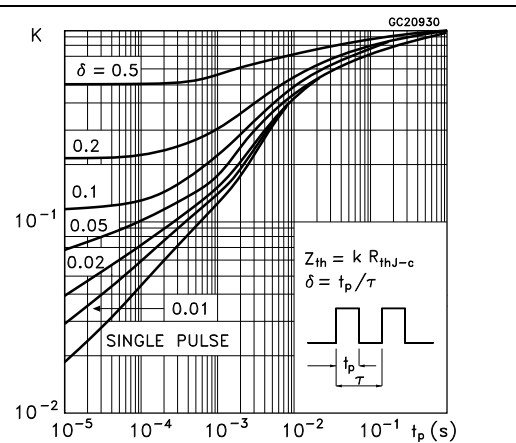


Figure 4. Safe operating area for TO-220FP

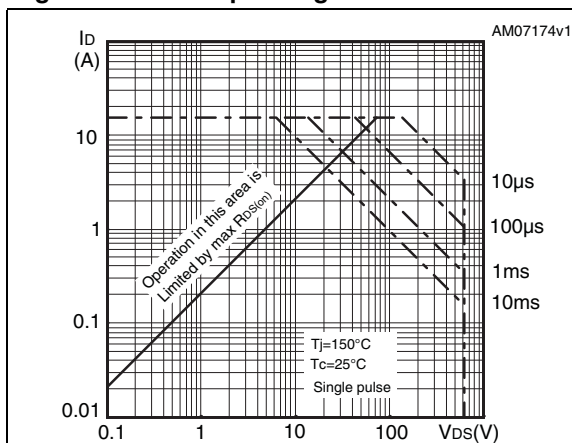


Figure 5. Thermal impedance for TO-220FP

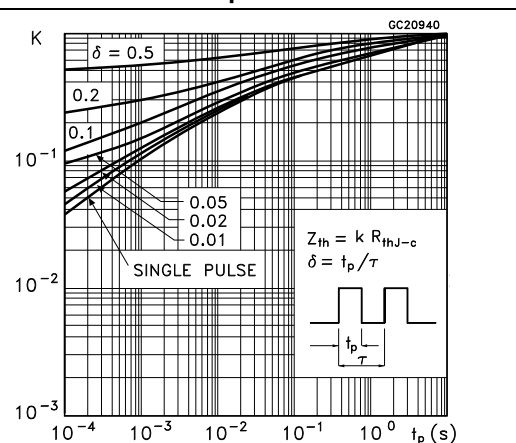


Figure 6. Safe operating area for IPAK

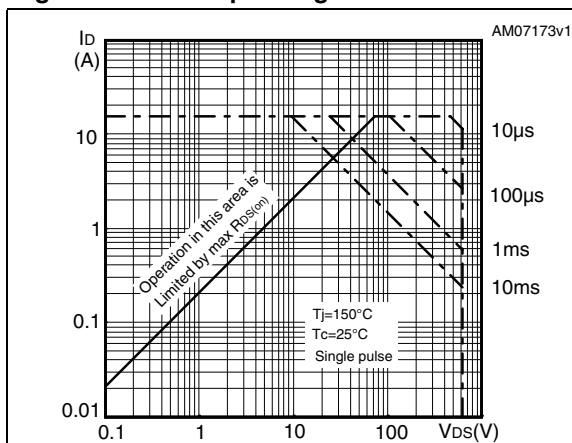


Figure 7. Thermal impedance for IPAK

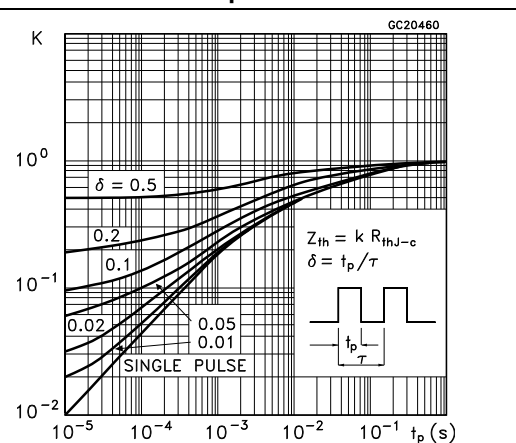


Figure 8. Output characteristics

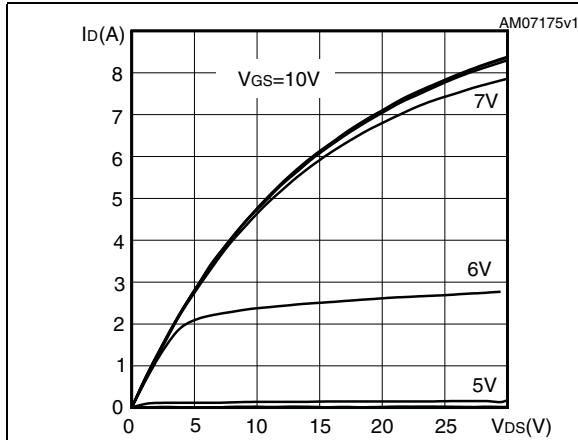


Figure 9. Transfer characteristics

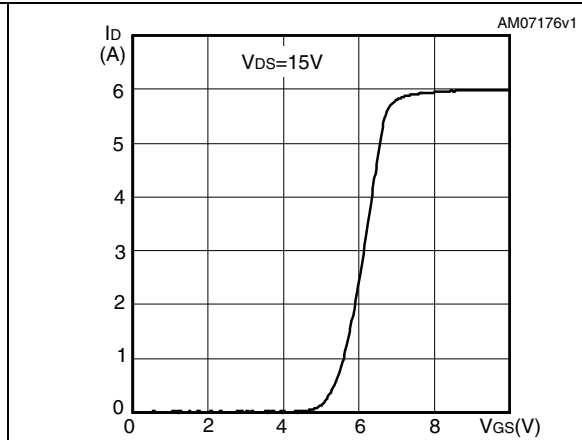


Figure 10. Gate charge vs gate-source voltage

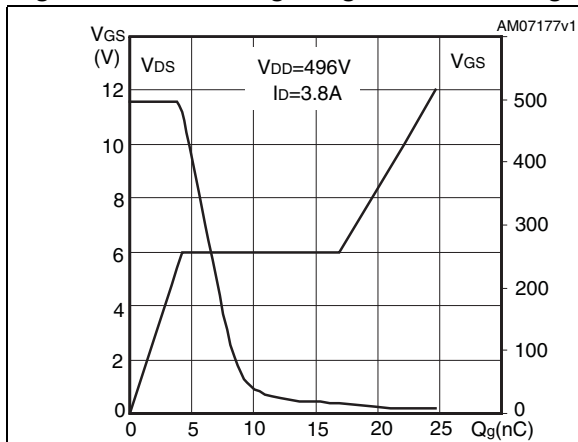


Figure 11. Static drain-source on resistance

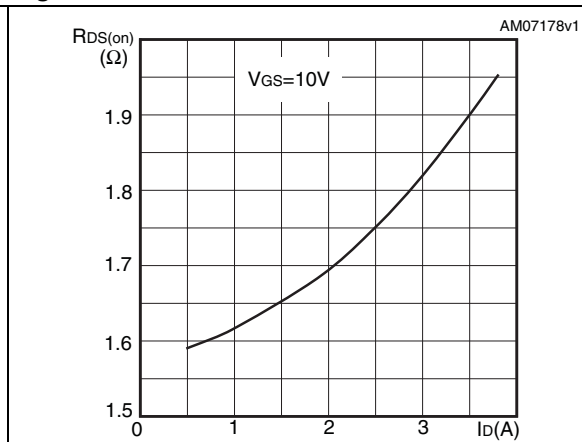


Figure 12. Capacitance variations

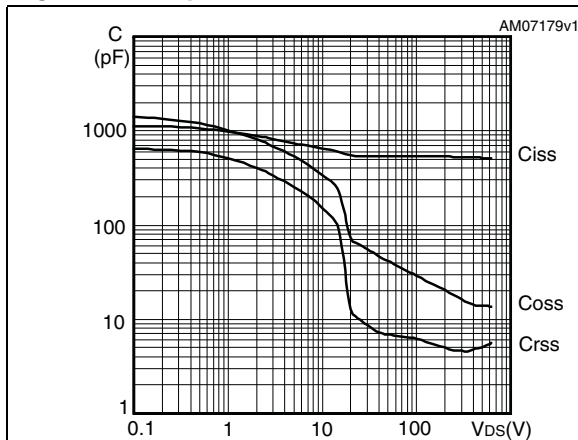


Figure 13. Output capacitance stored energy

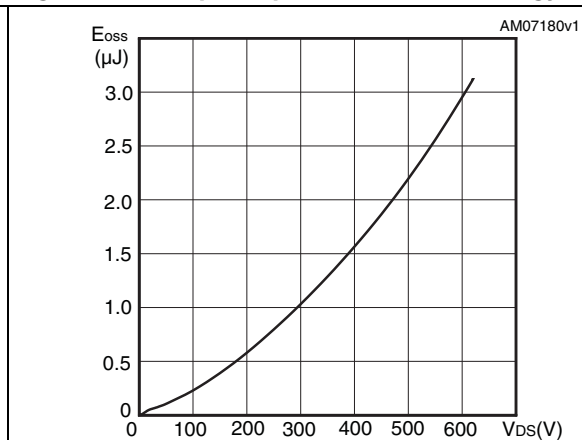
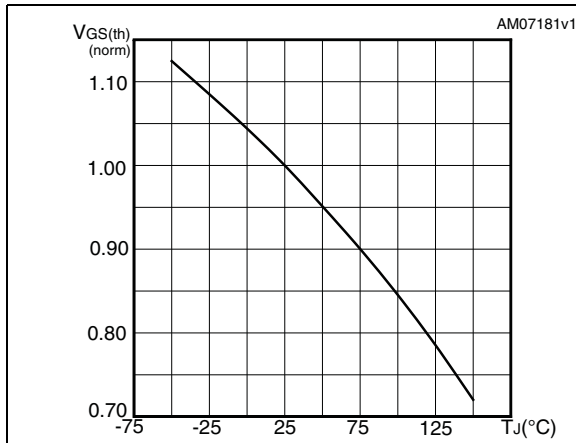
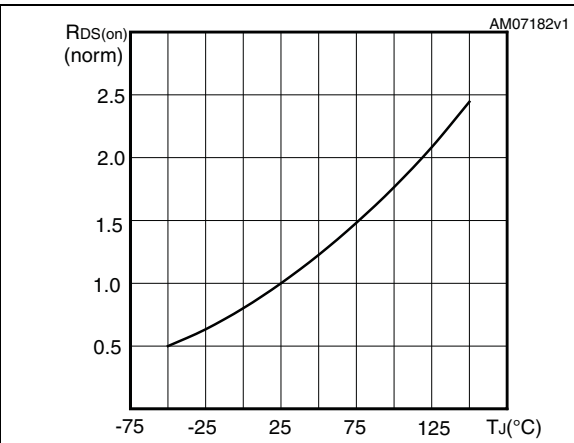
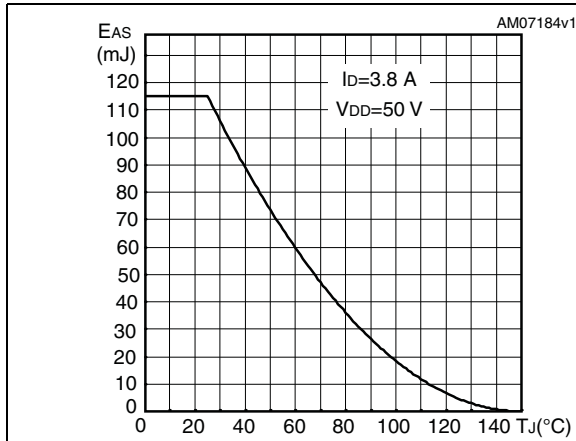
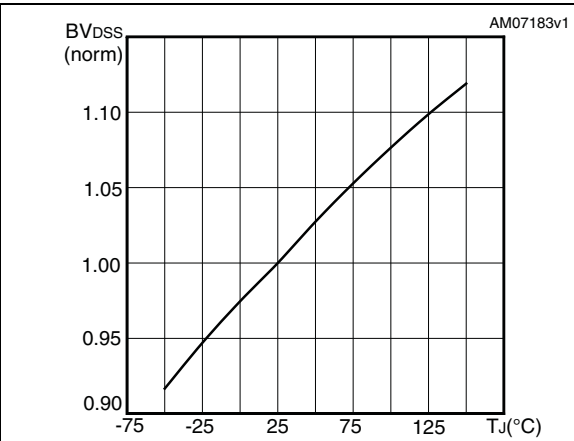
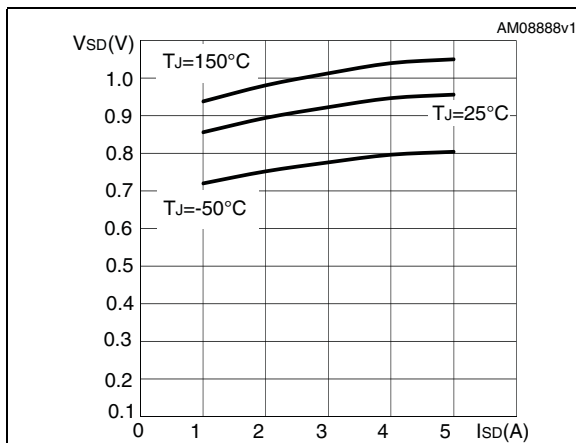


Figure 14. Normalized gate threshold voltage vs temperature**Figure 15. Normalized on resistance vs temperature****Figure 16. Maximum avalanche energy vs starting Tj****Figure 17. Normalized B_{VDS} vs temperature****Figure 18. Source-drain diode forward characteristics**

3 Test circuits

Figure 19. Switching times test circuit for resistive load

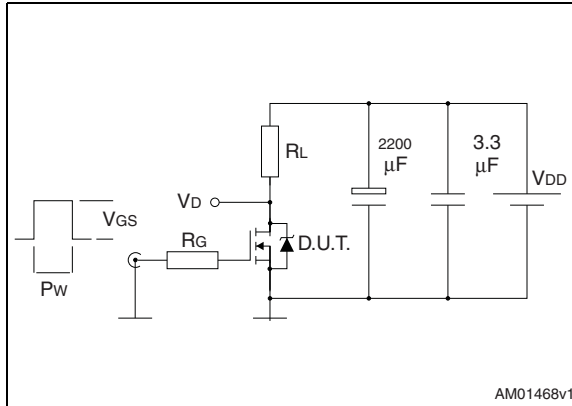


Figure 20. Gate charge test circuit

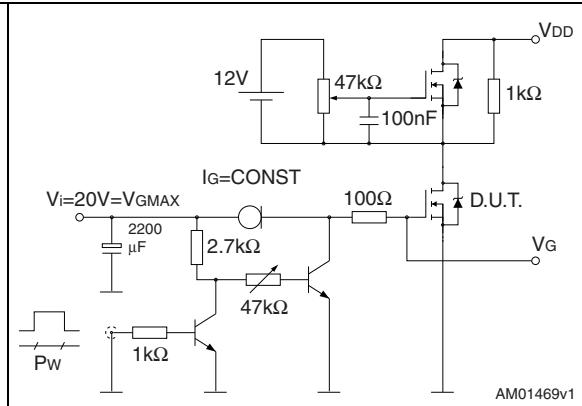


Figure 21. Test circuit for inductive load switching and diode recovery times

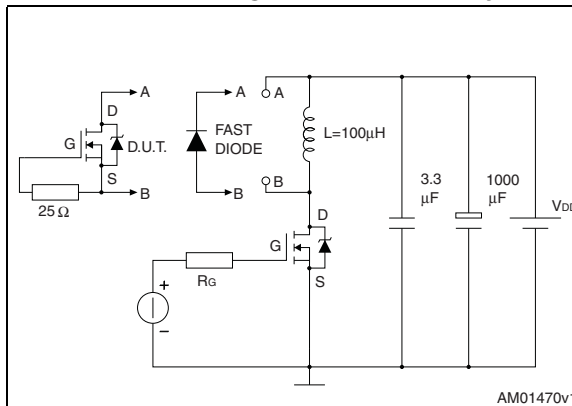


Figure 22. Unclamped Inductive load test circuit

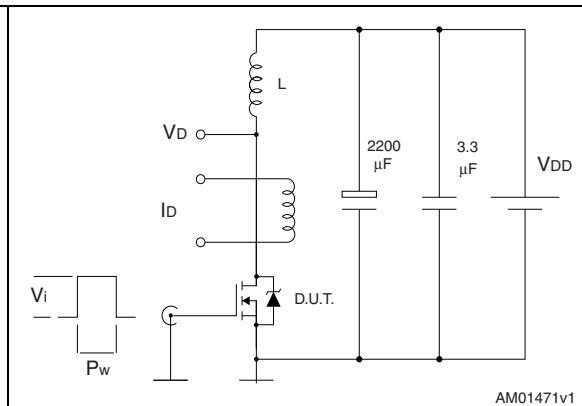


Figure 23. Unclamped inductive waveform

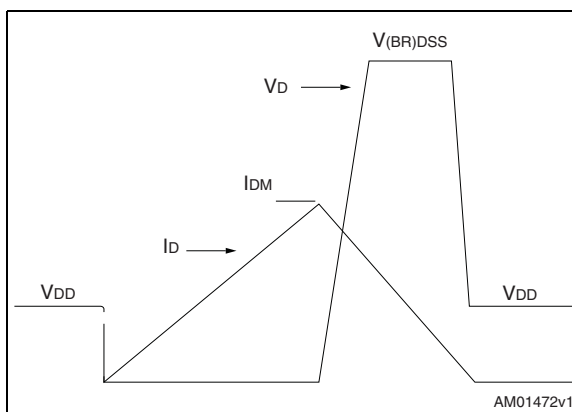
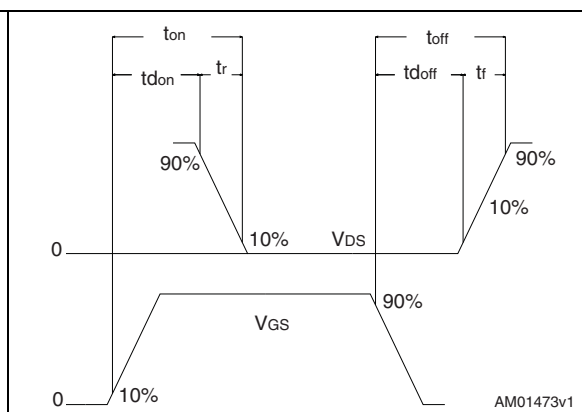


Figure 24. Switching time waveform



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. 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 25. TO-220FP drawing

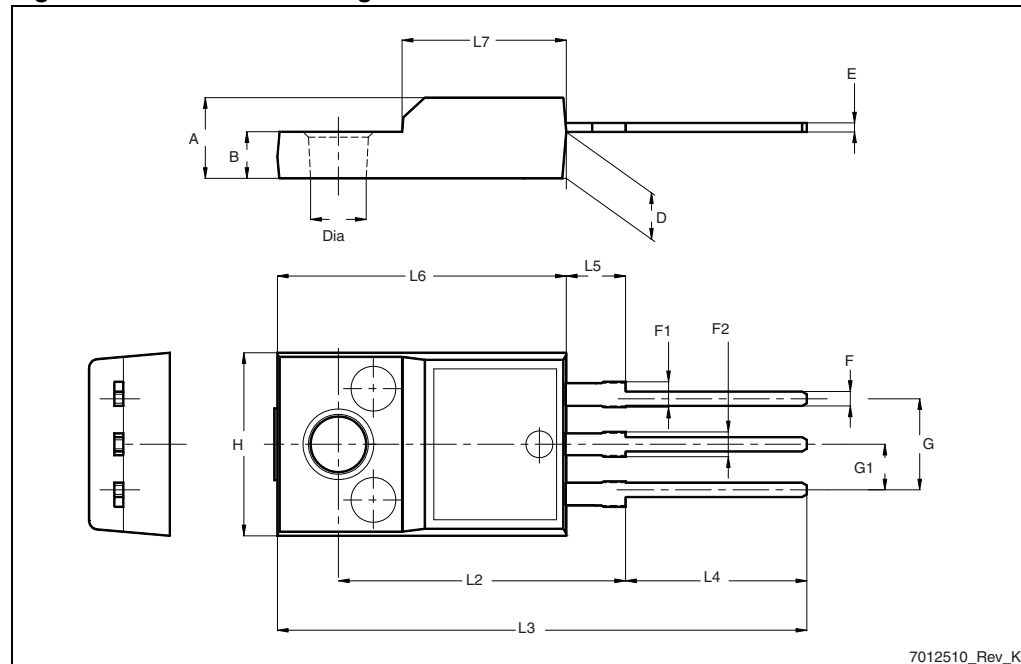


Table 10. IPAK (TO-251) mechanical data

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		0.3	
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 26. IPAK (TO-251) drawing

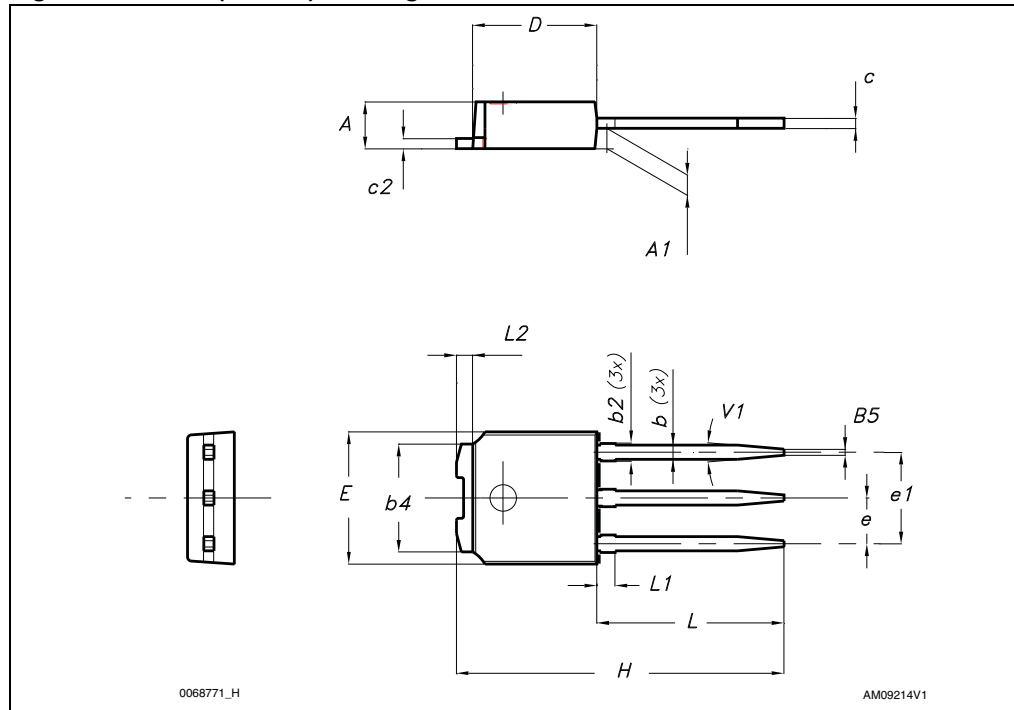


Table 11. TO-220 type A mechanical data

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	
ØP	3.75		3.85
Q	2.65		2.95

Figure 27. TO-220 type A drawing

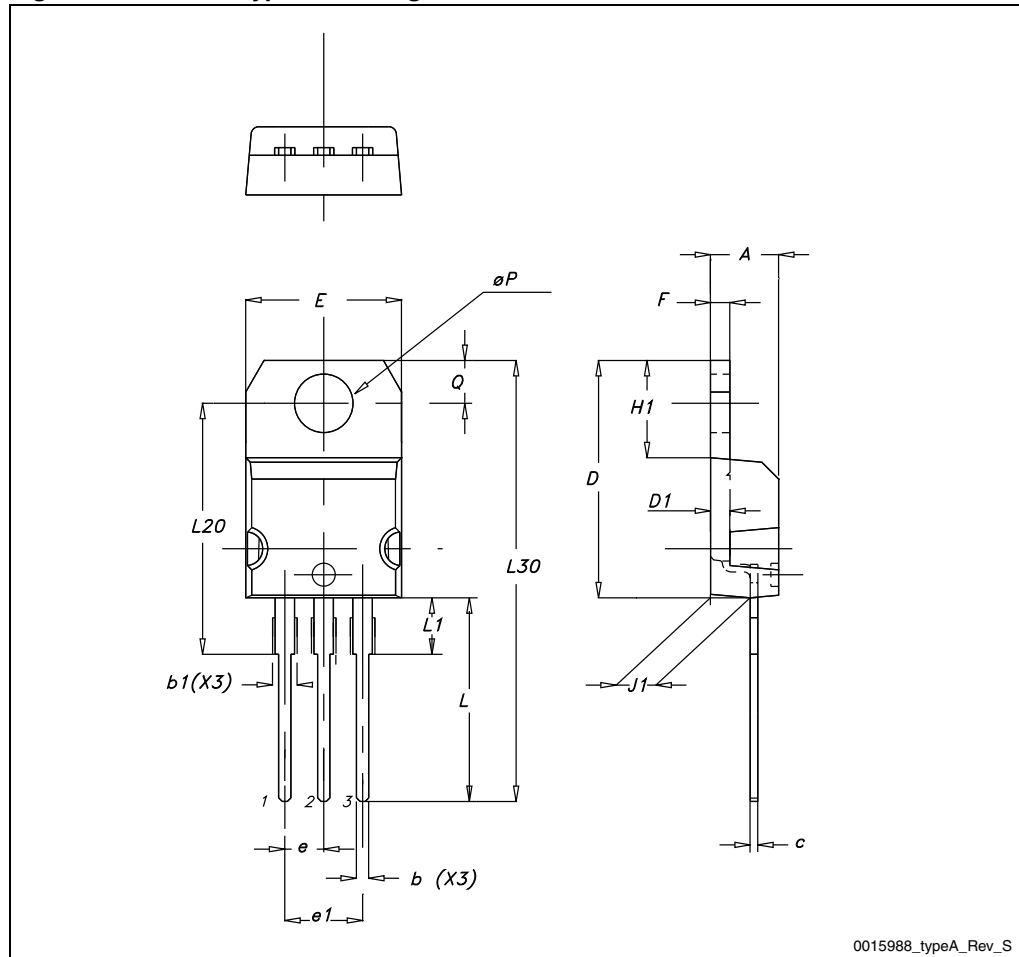
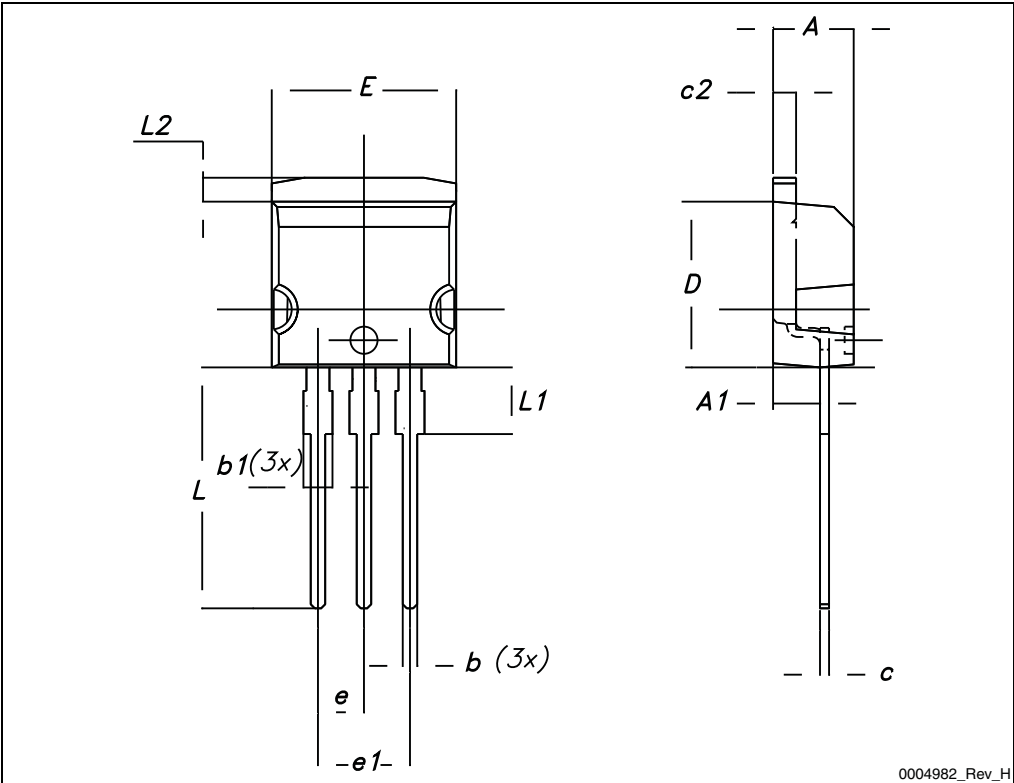


Table 12. I²PAK (TO-262) mechanical data

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 28. I²PAK (TO-262) drawing



5 Revision history

Table 13. Document revision history

Date	Revision	Changes
05-May-2010	1	First release
16-Dec-2010	2	Document status promoted from preliminary data to datasheet.

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