



# STF6N62K3, STFI6N62K3, STI6N62K3, STP6N62K3, STU6N62K3

N-channel 620 V, 0.95  $\Omega$  typ., 5.5 A SuperMESH3™ Power MOSFET in TO-220FP, I<sup>2</sup>PAKFP, I<sup>2</sup>PAK, TO-220, IPAK packages

Datasheet – production data

## Features

Order codes	V <sub>DSS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STF6N62K3	620 V	< 1.2 $\Omega$	5.5 A	30 W
STFI6N62K3				30 W
STI6N62K3				90 W
STP6N62K3				90 W
STU6N62K3				90 W

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

## Applications

- Switching applications

## Description

These SuperMESH3™ Power MOSFETs are the result of improvements applied to STMicroelectronics' SuperMESH™ technology, combined with a new optimized vertical structure. These devices boast an extremely low on-resistance, superior dynamic performance and high avalanche capability, rendering them suitable for the most demanding applications.

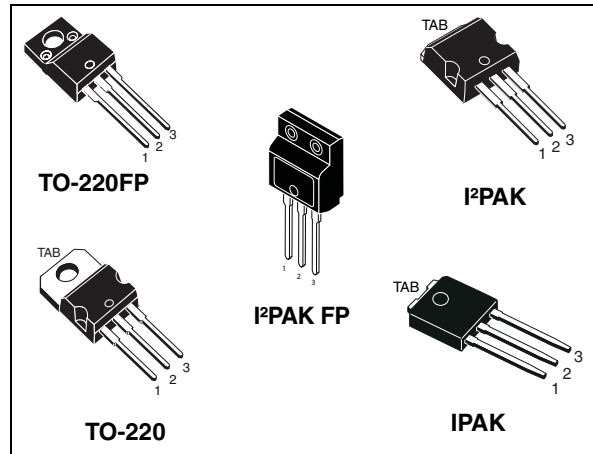


Figure 1. Internal schematic diagram

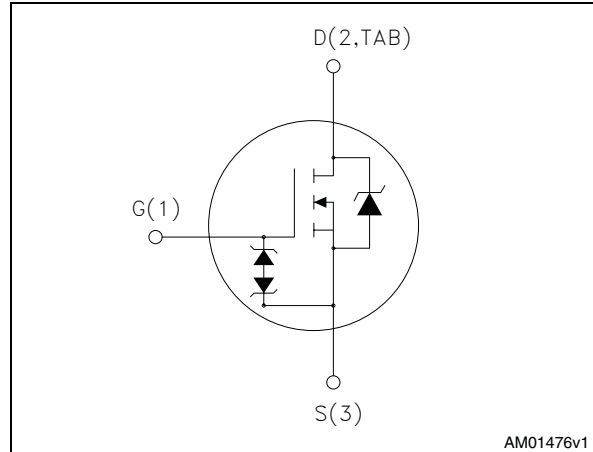


Table 1. Device summary

Order codes	Marking	Package	Packaging
STF6N62K3	6N62K3	TO-220FP	Tube
STFI6N62K3		I <sup>2</sup> PAKFP	
STI6N62K3		I <sup>2</sup> PAK	
STP6N62K3		TO-220	
STU6N62K3		IPAK	

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value			Unit
		TO-220FP I <sup>2</sup> PAKFP	I <sup>2</sup> PAK TO-220	IPAK	
V <sub>DS</sub>	Drain-source voltage	620			V
V <sub>GS</sub>	Gate- source voltage	± 30			V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	5.5 <sup>(1)</sup>	5.5		A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	3 <sup>(1)</sup>	3		A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	22 <sup>(1)</sup>	22		A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	30	90		W
I <sub>AR</sub> <sup>(3)</sup>	Avalanche current, repetitive or not-repetitive	5.5			A
E <sub>AS</sub> <sup>(4)</sup>	Single pulse avalanche energy	140			mJ
ESD	Gate-source human body model (R=1.5 kΩ, C=100 pF)	2.5			kV
dv/dt <sup>(5)</sup>	Peak diode recovery voltage slope	12			V/ns
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T <sub>C</sub> = 25 °C)	2500			V
T <sub>stg</sub>	Storage temperature	-55 to 150			°C
T <sub>j</sub>	Max. operating junction temperature	150			°C

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- Pulse width limited by T<sub>j</sub> max.
- Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = I<sub>AR</sub>, V<sub>DD</sub> = 50 V.
- I<sub>SD</sub> ≤ 5.5 A, di/dt ≤ 400 A/μs, V<sub>DD</sub> = 80% V<sub>(BR)DSS</sub>, V<sub>DSpeak</sub> ≤ V<sub>(BR)DSS</sub>.

**Table 3. Thermal data**

Symbol	Parameter	TO-220FP I <sup>2</sup> PAKFP	I <sup>2</sup> PAK TO-220	IPAK	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case max.	4.17	1.39		°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max.	62.5		100	°C/W

## 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 ( $V_{GS} = 0$ )	$V_{DS} = 620\text{ V}$ $V_{DS} = 620\text{ V}$ , $T_C = 125\text{ °C}$			0.8 50	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{ V}$			$\pm 9$	$\mu\text{A}$
$V_{GS(th)}$	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	$V_{GS} = 10\text{ V}$ , $I_D = 2.8\text{ A}$		0.95	1.2	$\Omega$

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 50\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$	-	875	-	pF
$C_{oss}$	Output capacitance			100		pF
$C_{rss}$	Reverse transfer capacitance			17		pF
$C_{oss(er)}^{(1)}$	Equivalent output capacitance energy related	$V_{GS} = 0$ , $V_{DS} = 0\text{ to }480\text{ V}$	-	28	-	pF
$C_{oss(tr)}^{(2)}$	Equivalent output capacitance time related			63		pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	3.5	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 496\text{ V}$ , $I_D = 5.5\text{ A}$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 20</a> )	-	34	-	nC
$Q_{gs}$	Gate-source charge			4		nC
$Q_{gd}$	Gate-drain charge			22		nC

1. Is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$

2. Is defined as a constant equivalent capacitance giving the same storage energy 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	$V_{DD} = 310 \text{ V}$ , $I_D = 2.75 \text{ A}$ , $R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$ (see <a href="#">Figure 19</a> )		22		ns
$t_r$	Rise time			12		ns
$t_{d(off)}$	Turn-off-delay time			49		ns
$t_f$	Fall time			20		ns

**Table 7. Source drain diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current				5.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		27	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 5.5 \text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 5.5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ (see <a href="#">Figure 24</a> )		290		ns
$Q_{rr}$	Reverse recovery charge			1.9		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			13.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 5.5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ , $T_j = 150 \text{ }^\circ\text{C}$ (see <a href="#">Figure 24</a> )		335		ns
$Q_{rr}$	Reverse recovery charge			2.4		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			14.5		A

1. Pulse width limited by safe operating area

2. Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

**Table 8. Gate-source Zener diode**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage ( $I_D = 0$ )	$I_{gs} = \pm 1 \text{ mA}$	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, I<sup>2</sup>PAK

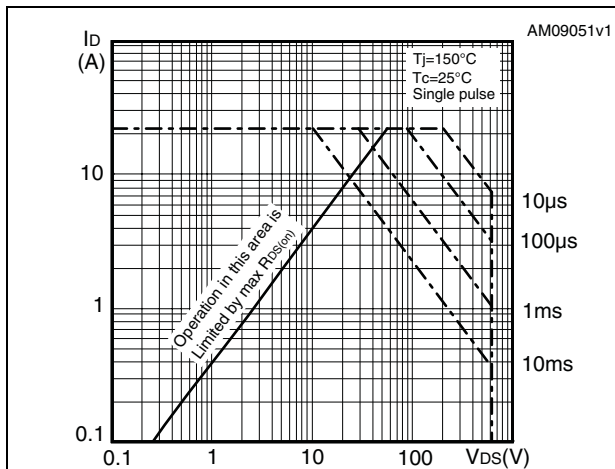


Figure 3. Thermal impedance for TO-220, I<sup>2</sup>PAK

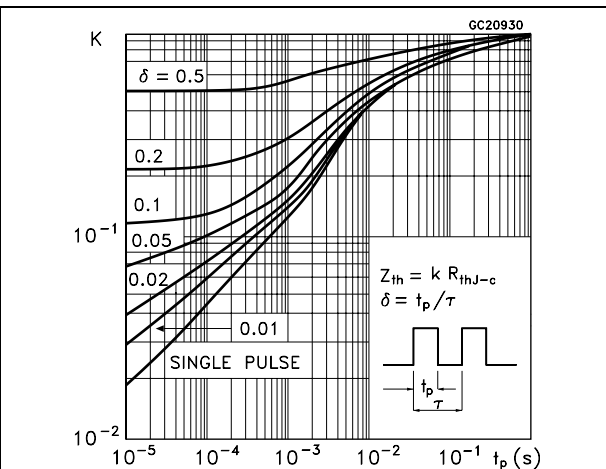


Figure 4. Safe operating area for TO-220FP, I<sup>2</sup>PAKFP

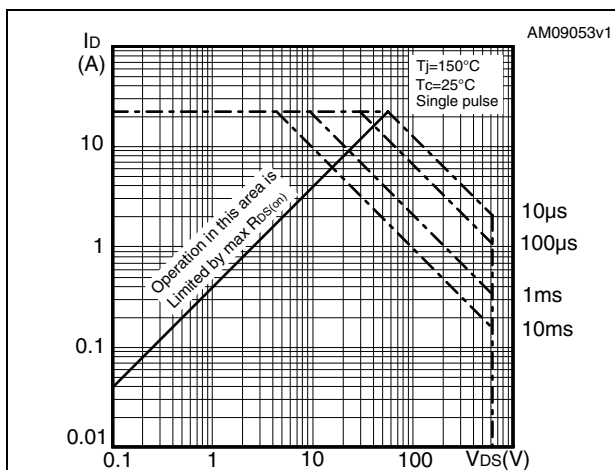


Figure 5. Thermal impedance for TO-220FP, I<sup>2</sup>PAKFP

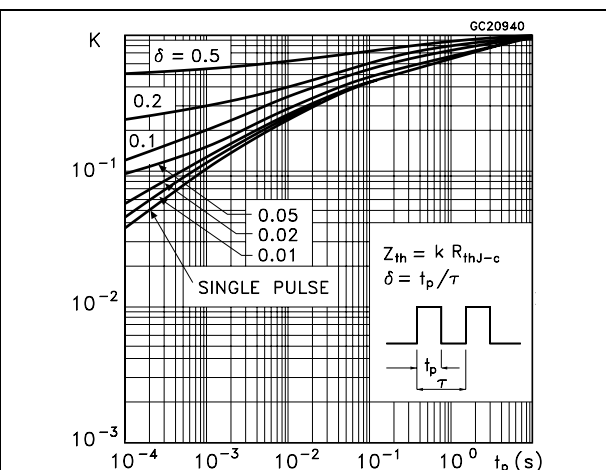


Figure 6. Safe operating area for IPAK

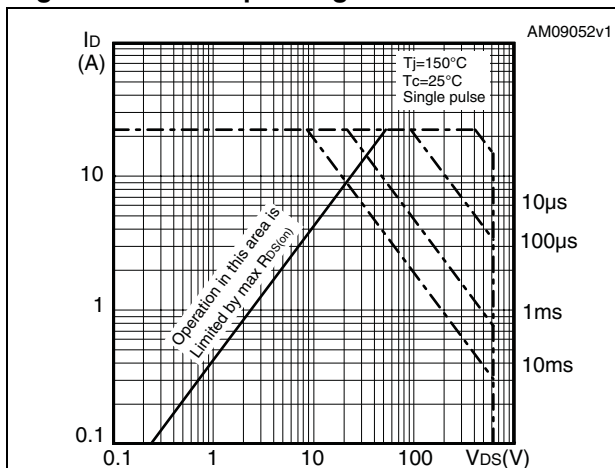


Figure 7. Thermal impedance for IPAK

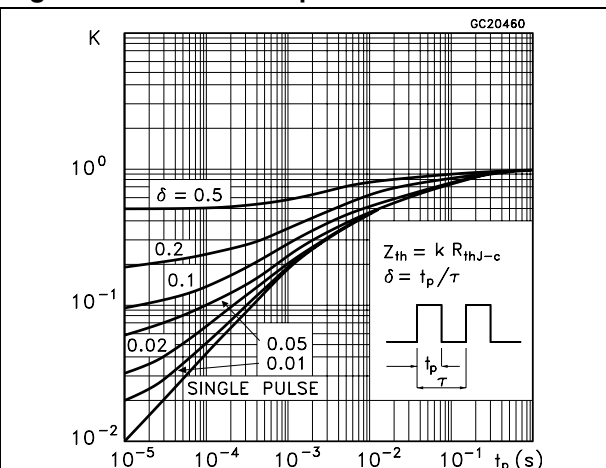


Figure 8. Output characteristics

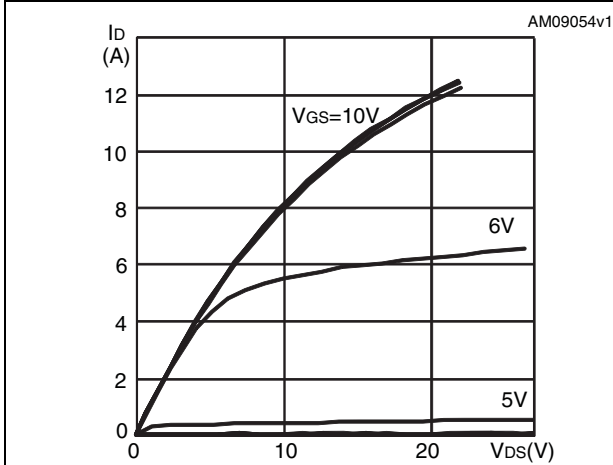


Figure 9. Transfer characteristics

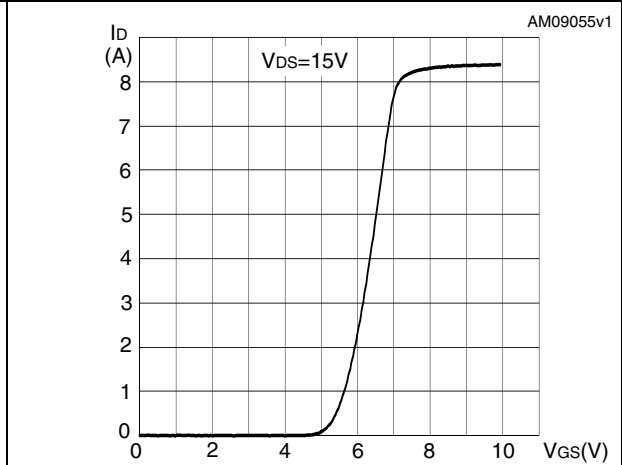


Figure 10. Gate charge vs gate-source voltage Figure 11. Static drain-source on-resistance

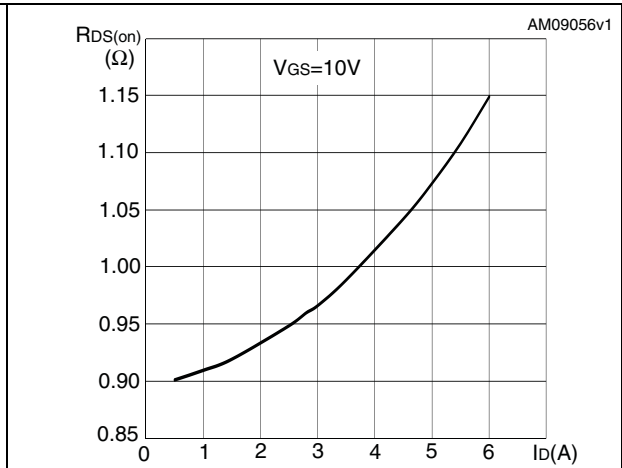
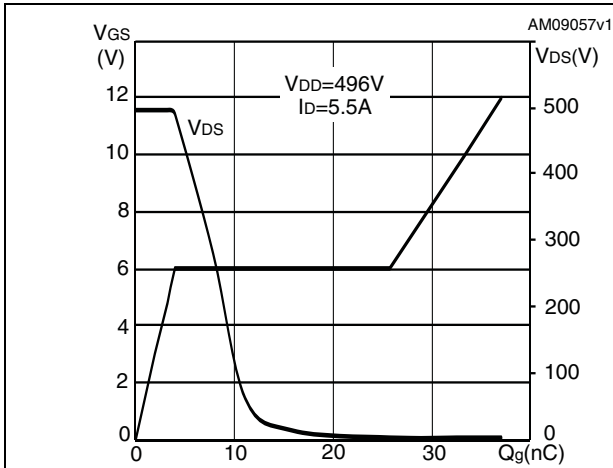


Figure 12. Capacitance variations

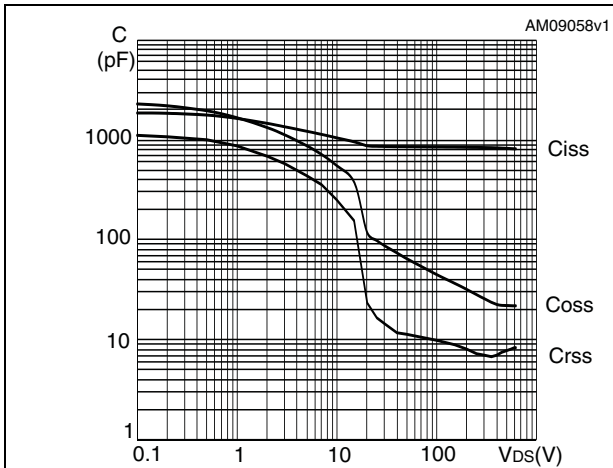


Figure 13. Output capacitance stored energy

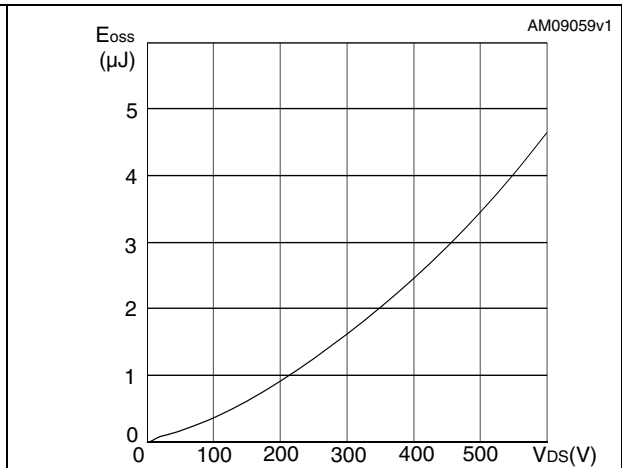


Figure 14. Normalized gate threshold voltage vs temperature

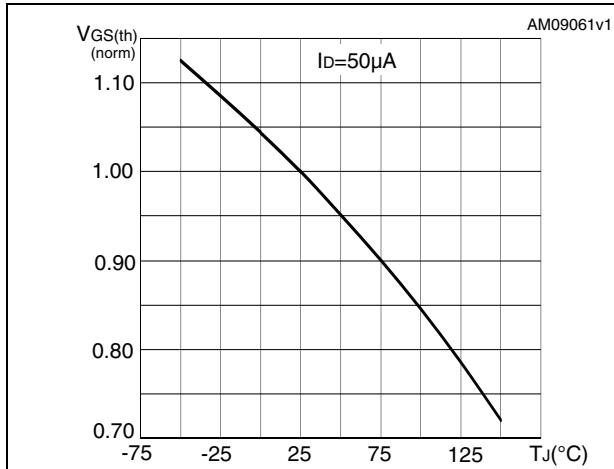


Figure 15. Normalized on-resistance vs temperature

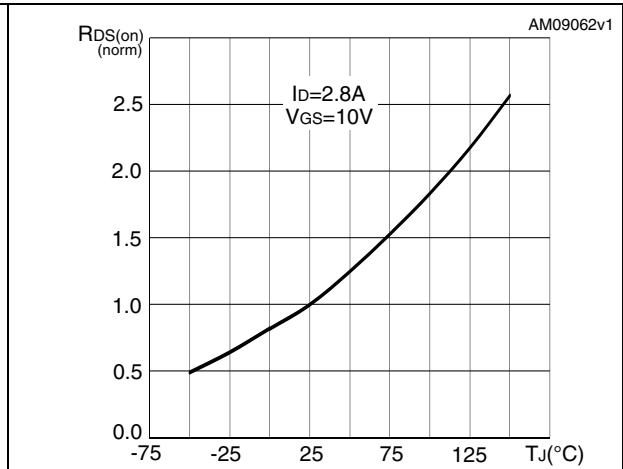


Figure 16. Normalized B<sub>V</sub>DSS vs temperature

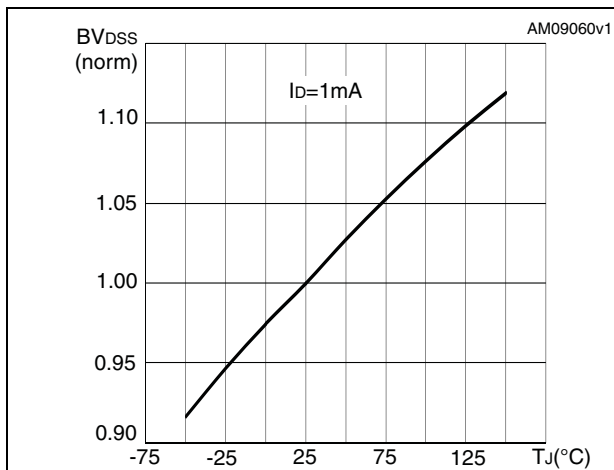


Figure 17. Source-drain diode forward characteristics

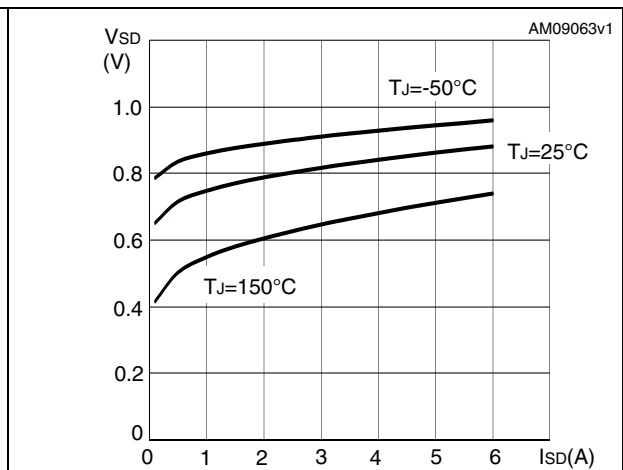
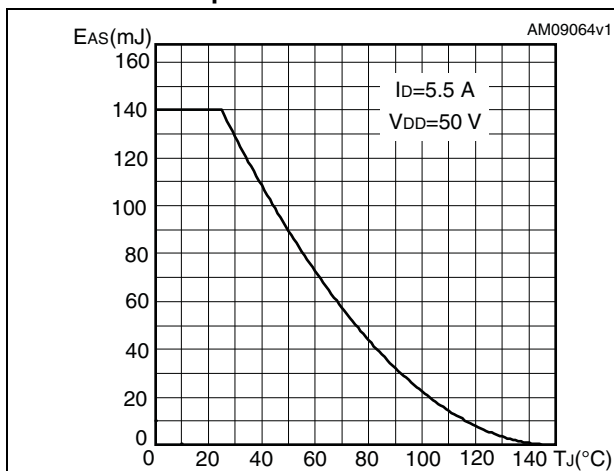


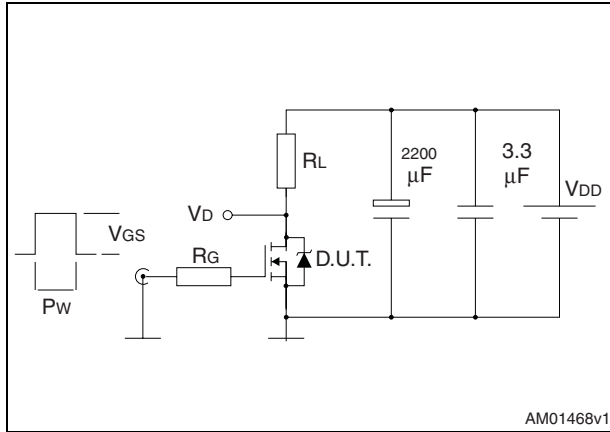
Figure 18. Maximum avalanche energy vs temperature





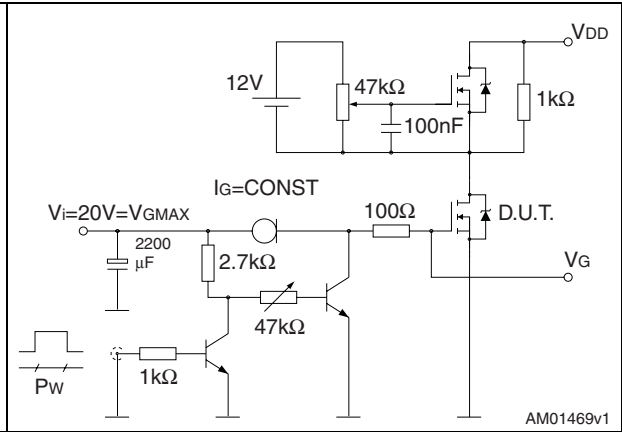
### 3 Test circuits

**Figure 19. Switching times test circuit for resistive load**



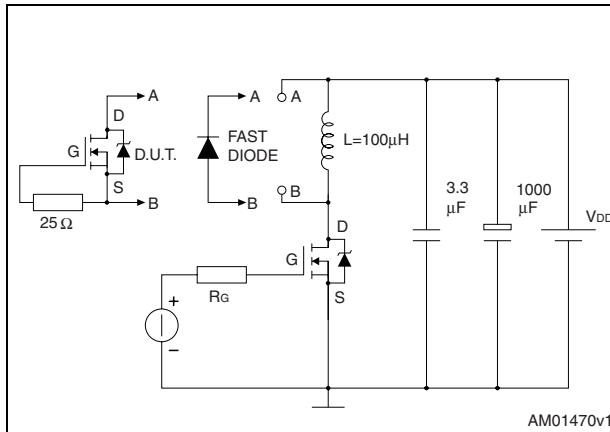
AM01468v1

**Figure 20. Gate charge test circuit**



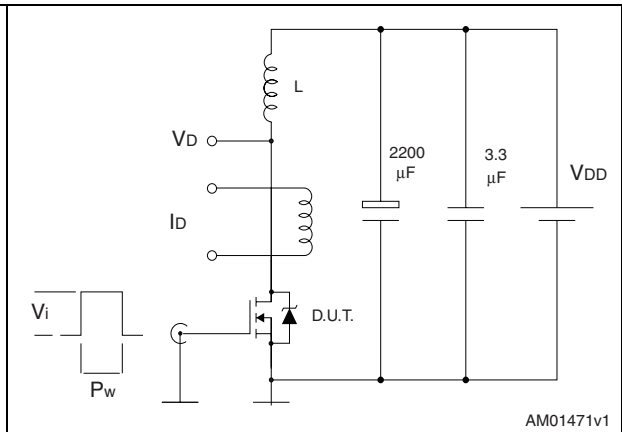
AM01469v1

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



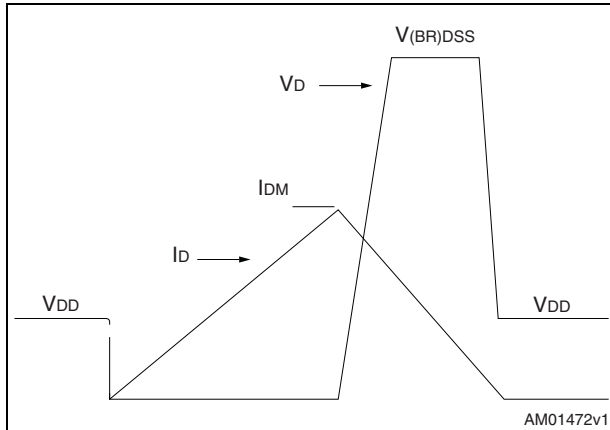
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**Figure 22. Unclamped Inductive load test circuit**



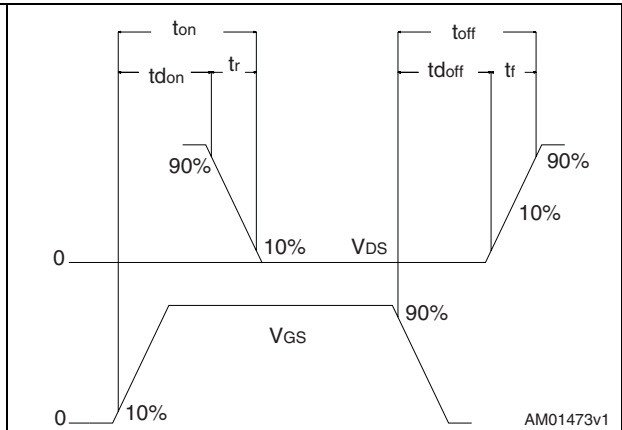
AM01471v1

**Figure 23. Unclamped inductive waveform**



AM01472v1

**Figure 24. Switching time waveform**



AM01473v1

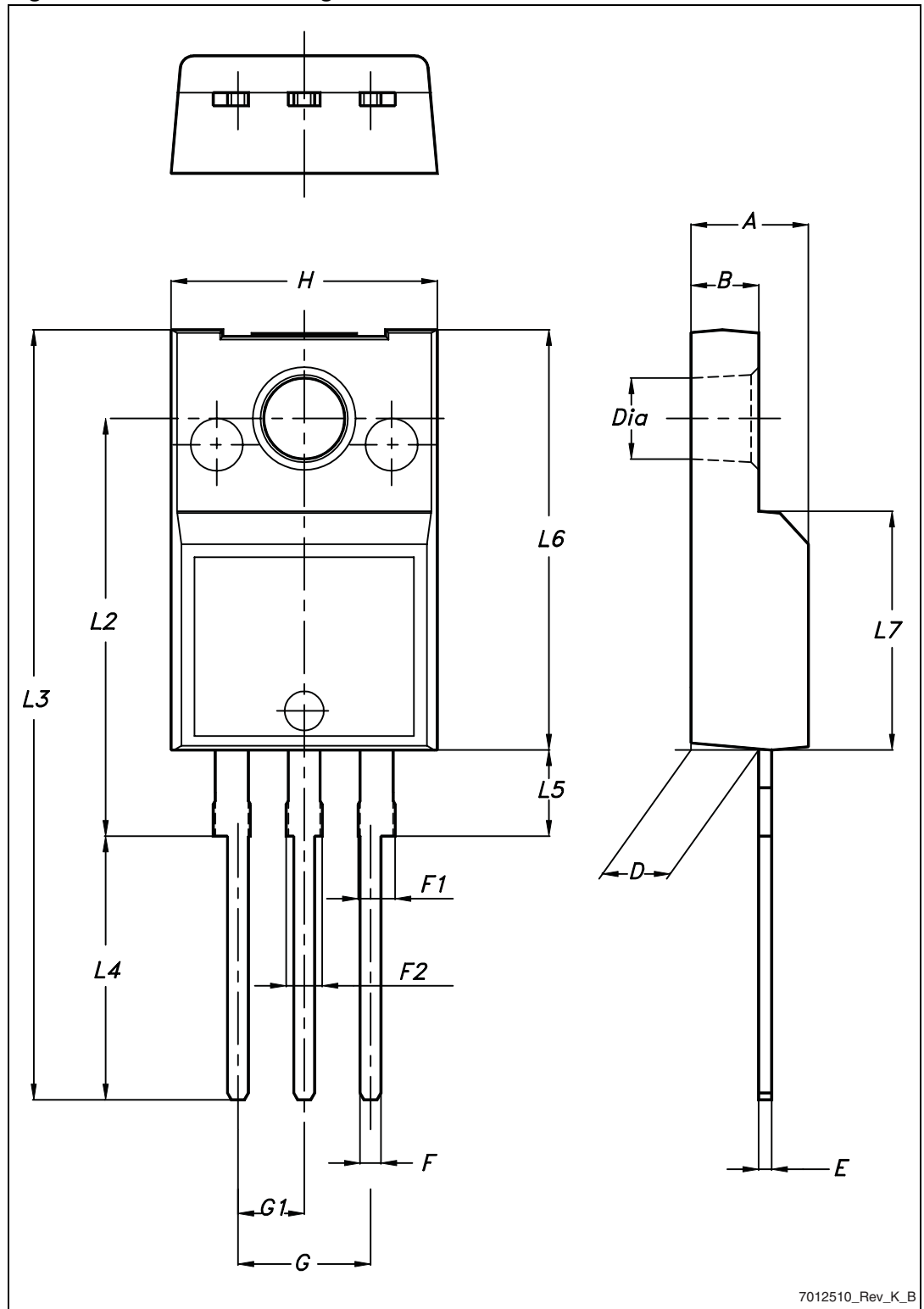
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://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

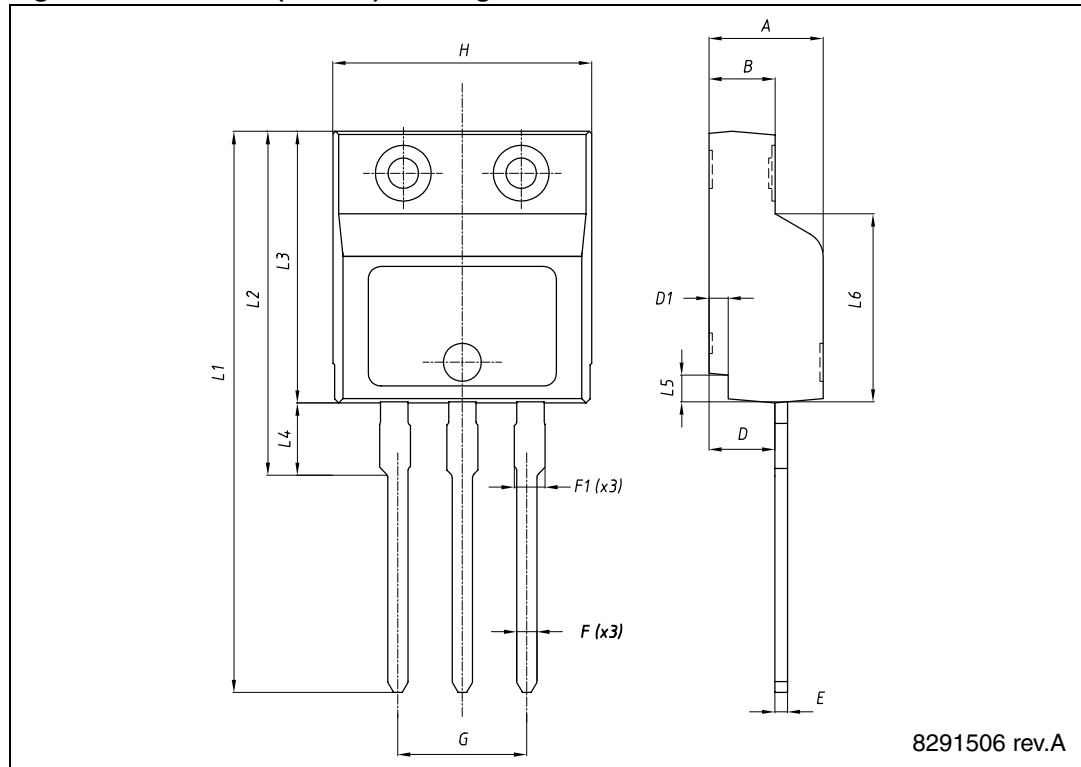


7012510\_Rev\_K\_B

Table 10. I<sup>2</sup>PAKFP (TO-281) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40	-	4.60
B	2.50		2.70
D	2.50		2.75
D1	0.65		0.85
E	0.45		0.70
F	0.75		1.00
F1			1.20
G	4.95		5.20
H	10.00		10.40
L1	21.00		23.00
L2	13.20		14.10
L3	10.55		10.85
L4	2.70		3.20
L5	0.85		1.25
L6	7.30		7.50

Figure 26. I<sup>2</sup>PAKFP (TO-281) drawing

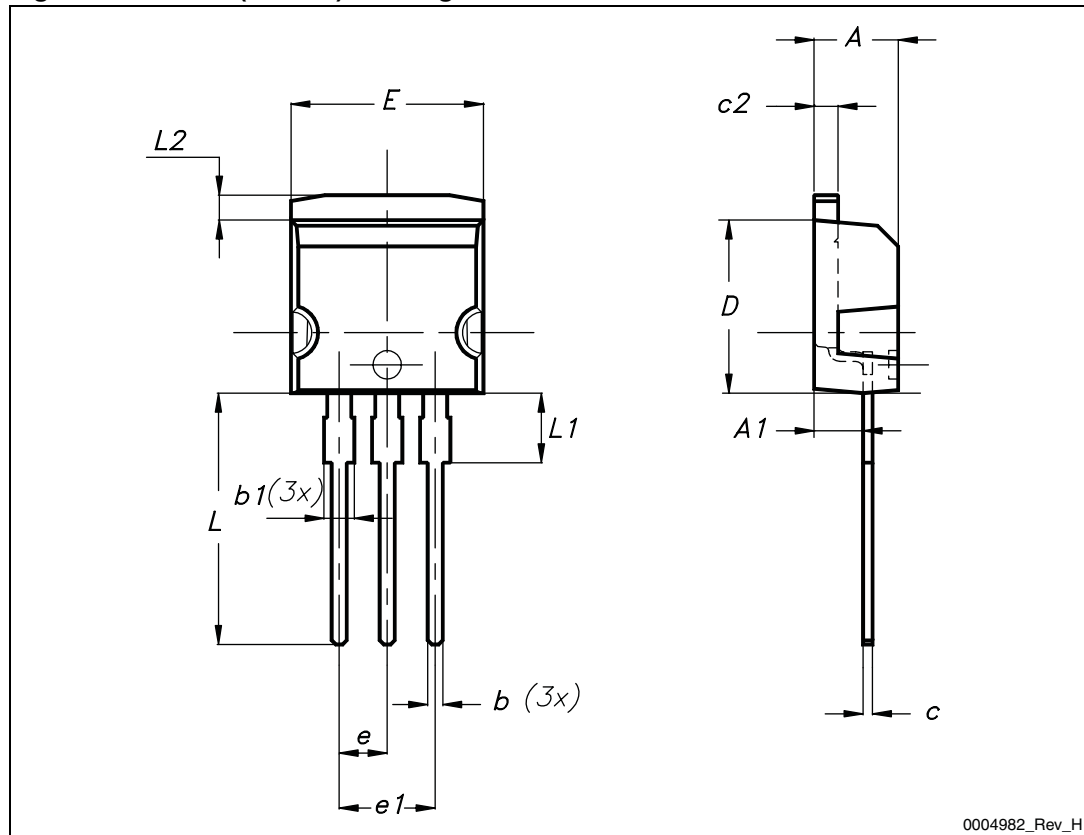


8291506 rev.A

Table 11. I<sup>2</sup>PAK (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 27. I<sup>2</sup>PAK (TO-262) drawing



0004982\_Rev\_H

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	
ØP	3.75		3.85
Q	2.65		2.95

Figure 28. TO-220 type A drawing

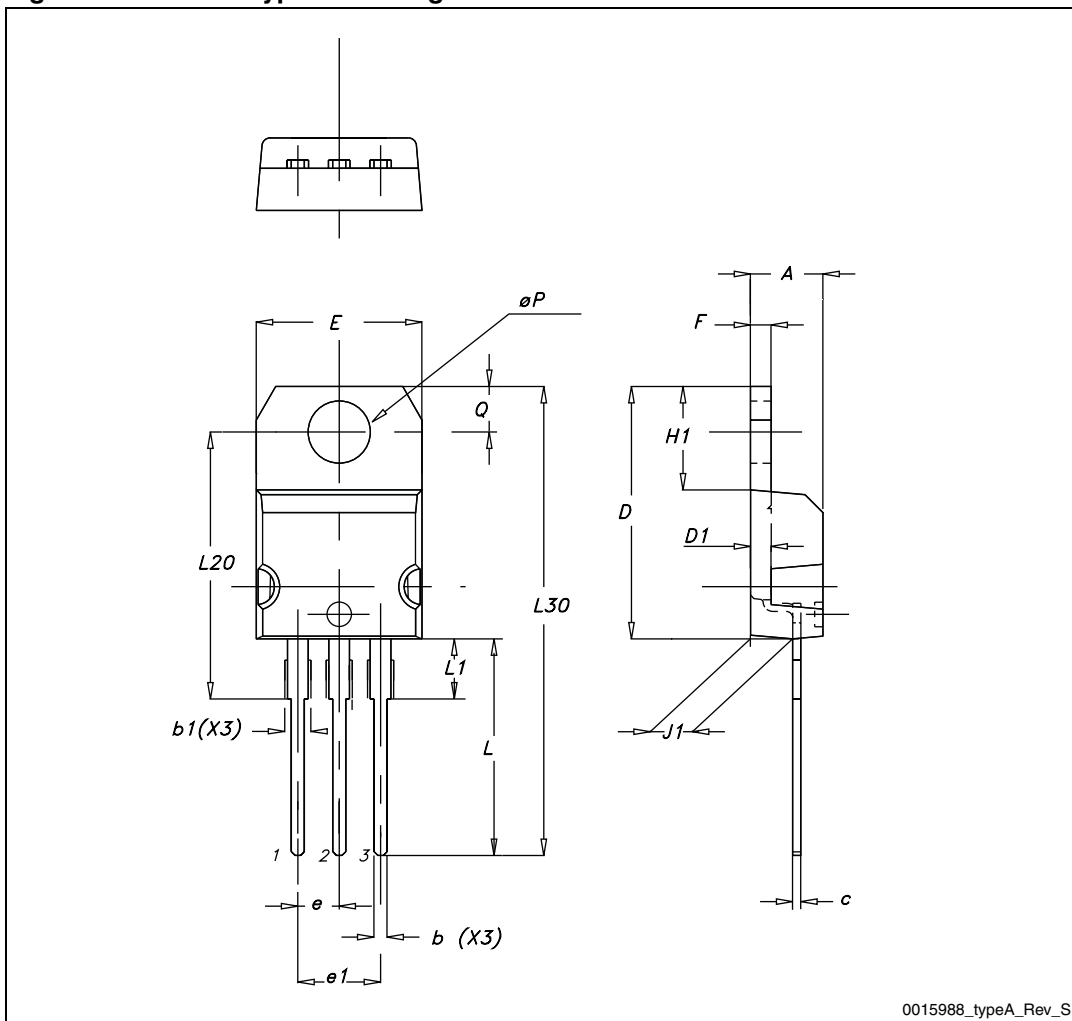
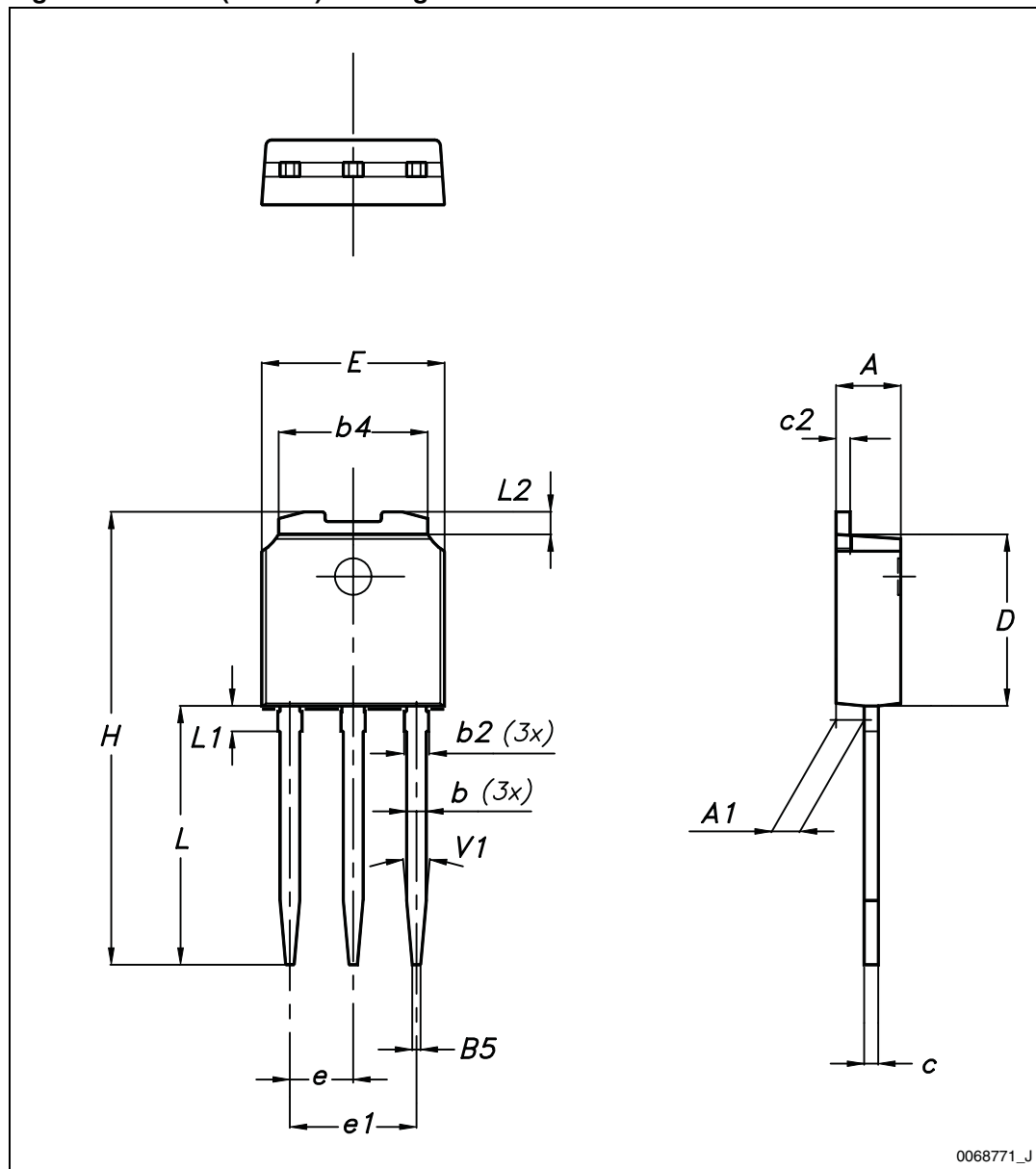


Table 13. IPAK (TO-251) mechanical data

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 29. IPAK (TO-251) drawing



## 5 Revision history

Table 14. Document revision history

Date	Revision	Changes
19-May-2006	1	First release.
02-May-2011	2	R <sub>G</sub> value has been updated.
06-Dec-2011	3	Removed p/n STD6N62K3 in DPAK.
03-Aug-2012	4	Added package, mechanical data: I <sup>2</sup> PAKFP Updated <a href="#">Table 1: Device summary</a> , <a href="#">Table 2: Absolute maximum ratings</a> , <a href="#">Table 3: Thermal data</a> , <a href="#">Table 4: On /off states</a> , <a href="#">Table 13: IPAK (TO-251) mechanical data</a> and <a href="#">Figure 29: IPAK (TO-251) drawing</a> Minor text changes.

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