

N-channel 650 V, 1.7 Ω typ., 4.5 A Power MOSFET
in I²PAKFP, TO-220 and IPAK packages

Datasheet – production data

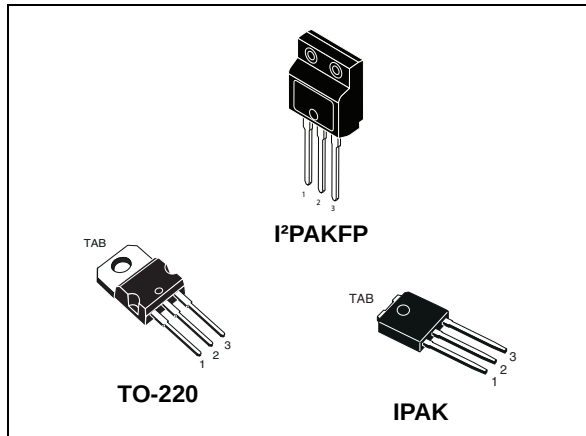
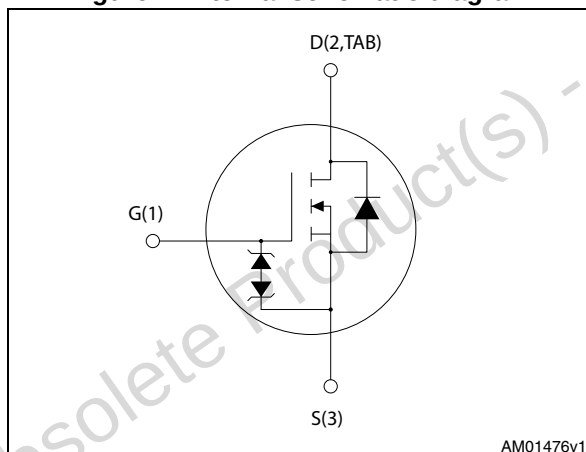


Figure 1. Internal schematic diagram



Features

Order codes	V _{DS}	R _{DS(on)} max	I _D	P _{TOT}
STFILED625H	620 V	2 Ω	6.0 A	25 W
STPLED625H				70 W
STULED625H				

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

Applications

- LED lighting applications

Description

These Power MOSFETs boast extremely low on-resistance and very good dv/dt capability, rendering them suitable for buck-boost and flyback topologies.

Table 1. Device summary

Order codes	Marking	Package	Packaging
STFILED625H	LED625H	I ² PAKFP (TO-281)	Tube
STPLED625H		TO-220	
STULED625H		IPAK	

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Obsolete Product(s) - Obsolete Product(s)



1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		I ² PAKFP	TO-220, IPAK	
V _{DS}	Drain- source voltage	620		V
V _{GS}	Gate- source voltage	±30		V
I _D	Drain current (continuous) at T _C = 25 °C	4.5 ⁽¹⁾	4.5	A
I _D	Drain current (continuous) at T _C = 100 °C	2.3 ⁽¹⁾	2.3	A
I _{DM} ⁽²⁾	Drain current (pulsed)	18.0 ⁽¹⁾	18.0	A
P _{TOT}	Total dissipation at T _C = 25 °C	25	70	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 °C, I _D = I _{AR} , V _{DD} = 50 V)	115		mJ
ESD	Gate-source human body model (C=100 pF, R=1.5 kΩ)	2.5		kV
dv/dt ⁽³⁾	Peak diode recovery voltage slope	12		V/ns
V _{ISO}	Insulation withstand voltage (AC)	2500		V
T _{stg}	Storage temperature	- 55 to 150		°C
T _J	Operating junction temperature	150		°C

1. Limited only by maximum temperature allowed

2. Pulse width limited by safe operating area

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

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		I ² PAKFP	TO-220	IPAK	
R _{thj-case}	Thermal resistance junction-case max.	5	1.79		°C/W
R _{thj-amb}	Thermal resistance junction-ambient max	62.5			°C/W

2 Electrical characteristics

(T_{case} = 25 °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 ($V_{GS} = 0$)	$V_{DS} = 620 \text{ V}$ $V_{DS} = 620 \text{ V}$, $T_C = 125 \text{ °C}$			1 50	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20 \text{ V}$; $V_{DS} = 0$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 50 \text{ }\mu\text{A}$	3	3.6	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	$V_{DS} = 50 \text{ V}$, $f = 1 \text{ MHz}$, $V_{GS} = 0$		560		pF
C_{oss}	Output capacitance			43		pF
C_{rss}	Reverse transfer capacitance			7.5		pF
$C_{oss \text{ eq.}}^{(1)}$	Equivalent capacitance energy related	$V_{DS} = 0 \text{ to } 496 \text{ V}$, $V_{GS} = 0$		27		pF
R_g	Gate input resistance	$f = 1 \text{ MHz}$ open drain	2	5	10	Ω
Q_g	Total gate charge	$V_{DD} = 496 \text{ V}$, $I_D = 3.8 \text{ A}$, $V_{GS} = 10 \text{ V}$ (see Figure 18)	-	23		nC
Q_{gs}	Gate-source charge			4		nC
Q_{gd}	Gate-drain charge			13		nC

1. $C_{oss \text{ eq.}}$ energy related is defined as a constant equivalent capacitance giving the same stored 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	$V_{DD} = 300 \text{ V}$, $I_D = 1.9 \text{ A}$, $R_G = 4.7 \text{ }\Omega$, $V_{GS} = 10 \text{ V}$ (see Figure 18)	-	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	$I_{SD} = 5.4 \text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 5.4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$	-	220		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}$	-	1.4		μC
I_{RRM}	Reverse recovery current	(see Figure 22)	-	13		A
t_{rr}	Reverse recovery time	$I_{SD} = 5.4 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$	-	270		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}$, $T_J = 150 \text{ }^\circ\text{C}$	-	1.9		μC
I_{RRM}	Reverse recovery current	(see Figure 22)	-	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
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1 \text{ mA}$, $I_D = 0$	30	-	-	V

The built-in back-to-back Zener diodes have been specifically designed to enhance not only the device's ESD capability, but also to make them capable of safely absorbing any voltage transients that may occasionally be applied from gate to source. In this respect, the Zener voltage is appropriate to achieve efficient and cost-effective protection of device integrity. The integrated Zener diodes thus eliminate the need for external components.

2.1 Electrical characteristics (curves)

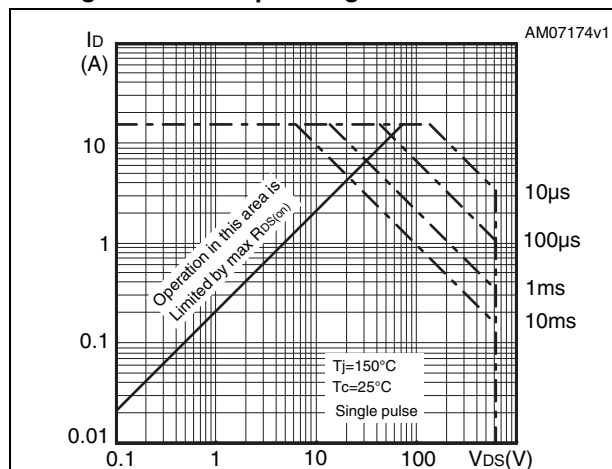
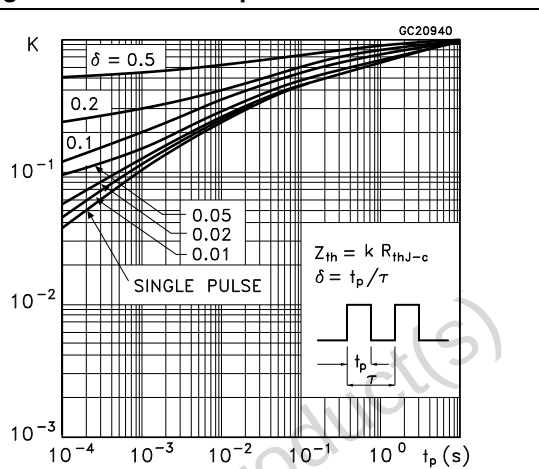
Figure 2. Safe operating area for I²PAKFPFigure 3. Thermal impedance for I²PAKFP

Figure 4. Safe operating area for TO-220

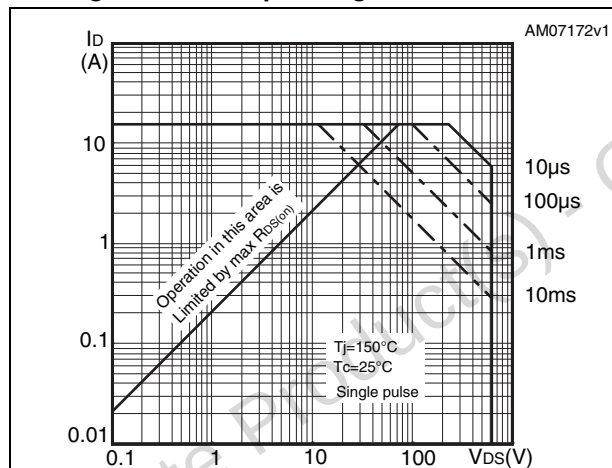


Figure 5. Thermal impedance for TO-220

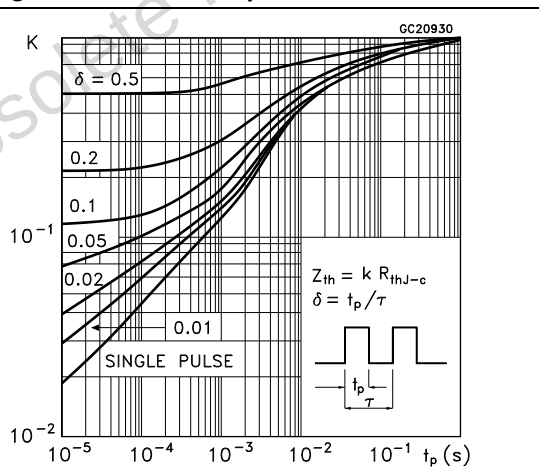


Figure 6. Safe operating area for IPAK

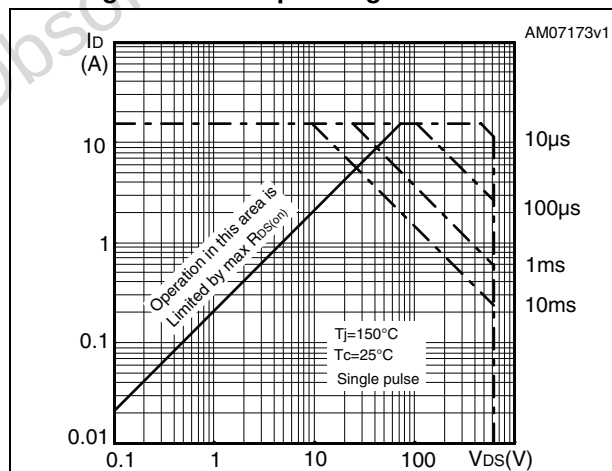


Figure 7. Thermal impedance for IPAK

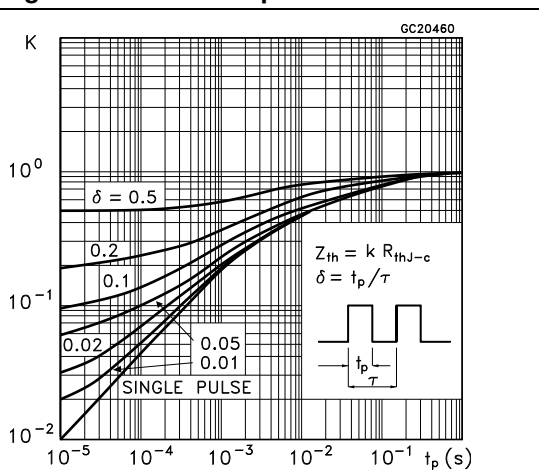


Figure 8. Output characteristics

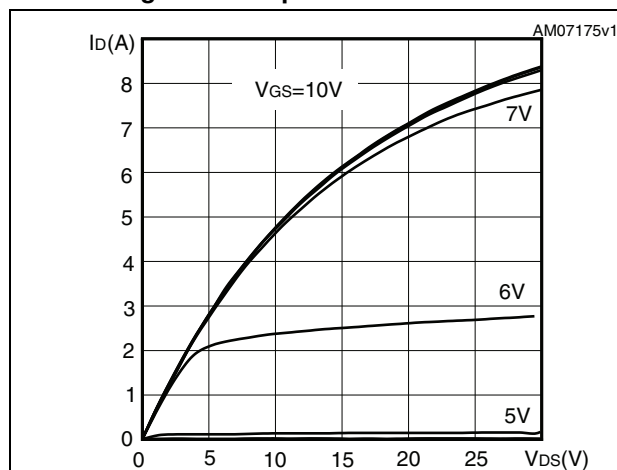


Figure 9. Transfer characteristics

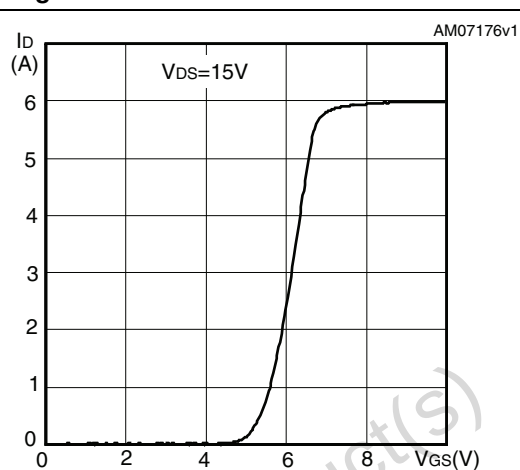


Figure 10. Gate charge vs gate-source voltage

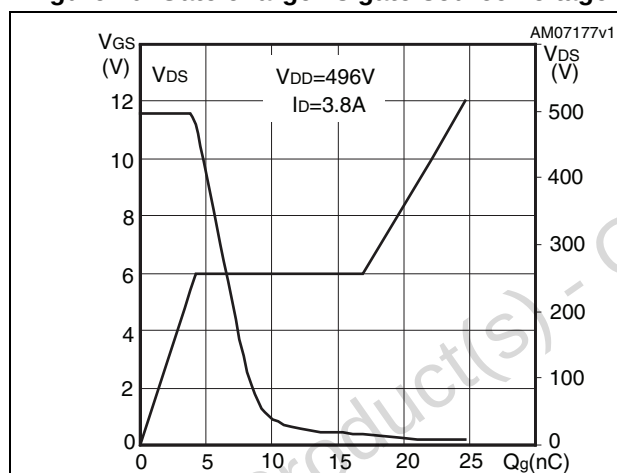


Figure 11. Static drain-source on-resistance

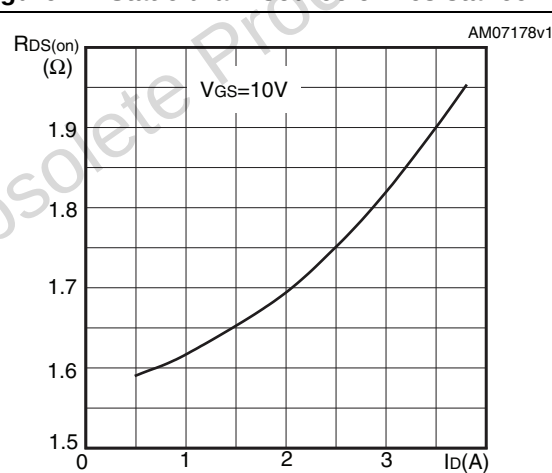


Figure 12. Capacitance variations

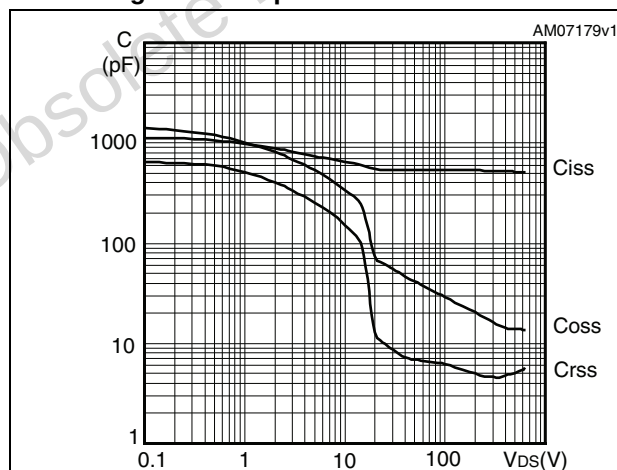


Figure 13. Output capacitance stored energy

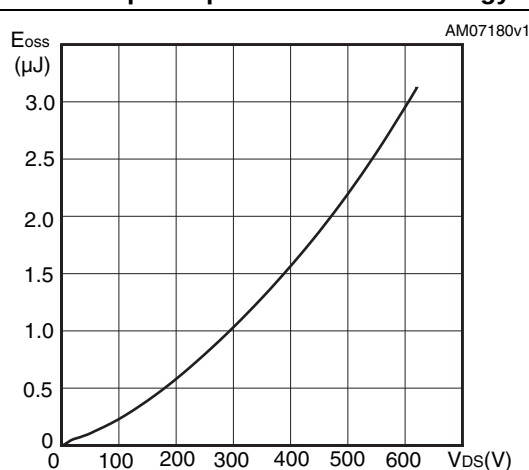


Figure 14. Normalized gate threshold voltage vs temperature

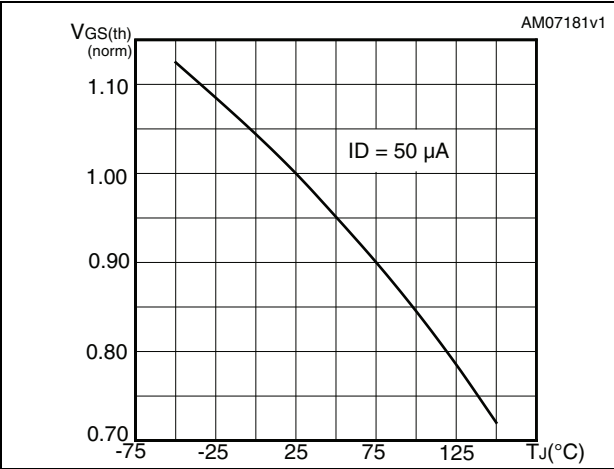


Figure 15. Normalized on-resistance vs temperature

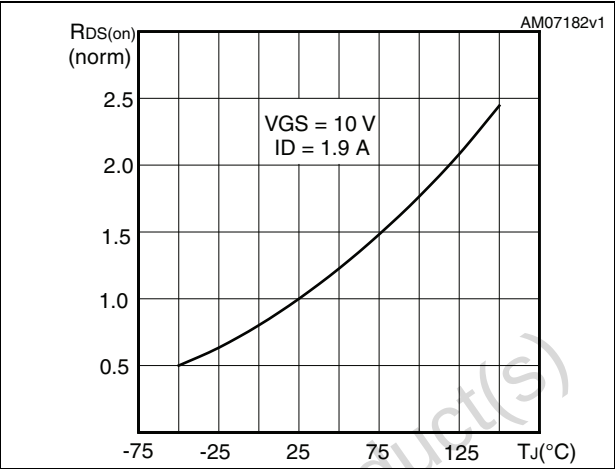


Figure 16. Normalized BV_{DSS} vs temperature

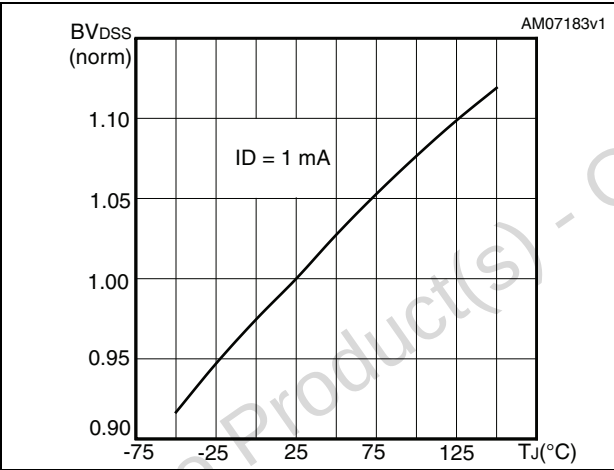
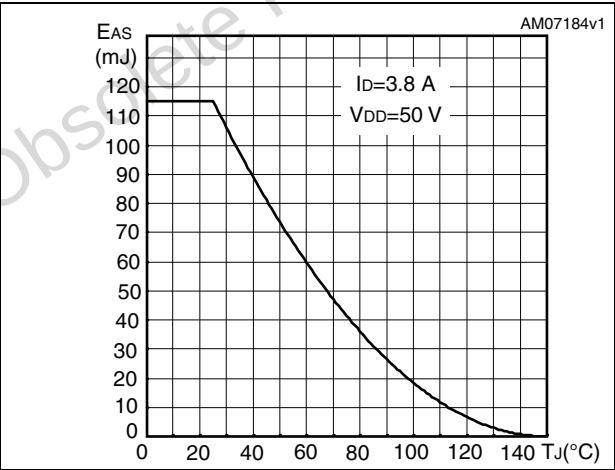


Figure 17. Maximum avalanche energy vs temperature



3 Test circuits

Figure 18. Switching times test circuit for resistive load

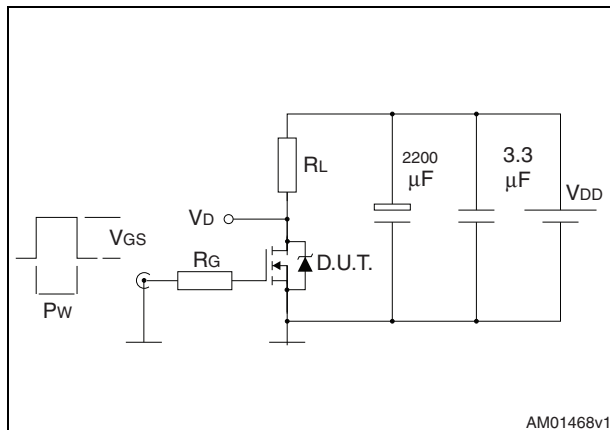


Figure 19. Gate charge test circuit

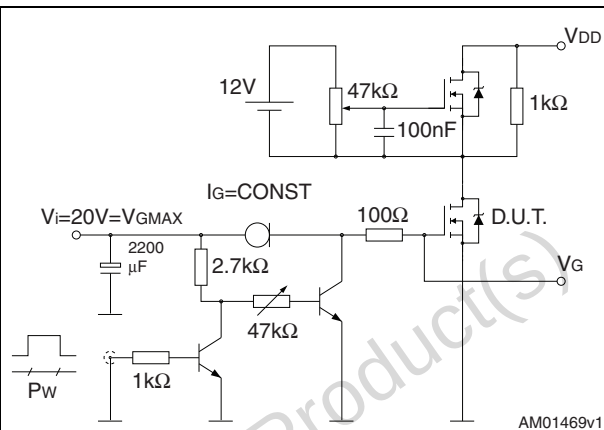


Figure 20. Test circuit for inductive load switching and diode recovery times

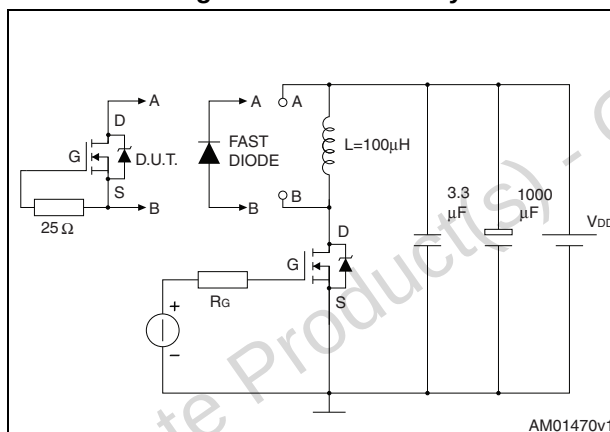


Figure 21. Unclamped inductive load test circuit

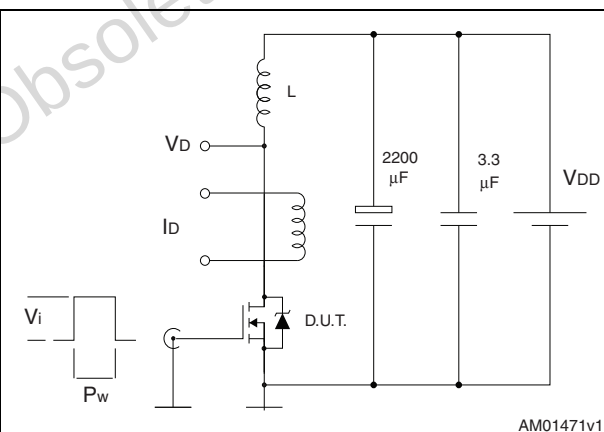


Figure 22. Unclamped inductive waveform

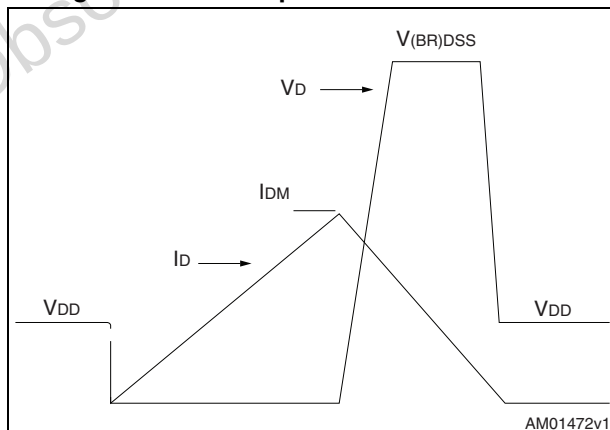
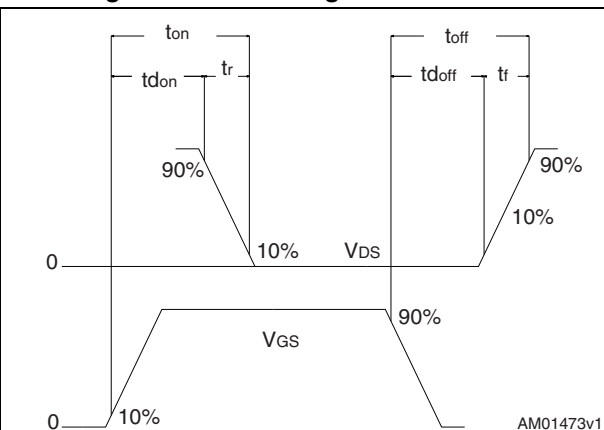


Figure 23. Switching time waveform



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.

Obsolete Product(s) - Obsolete Product(s)

Table 9. I²PAKFP (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 24. I²PAKFP (TO-281) drawing

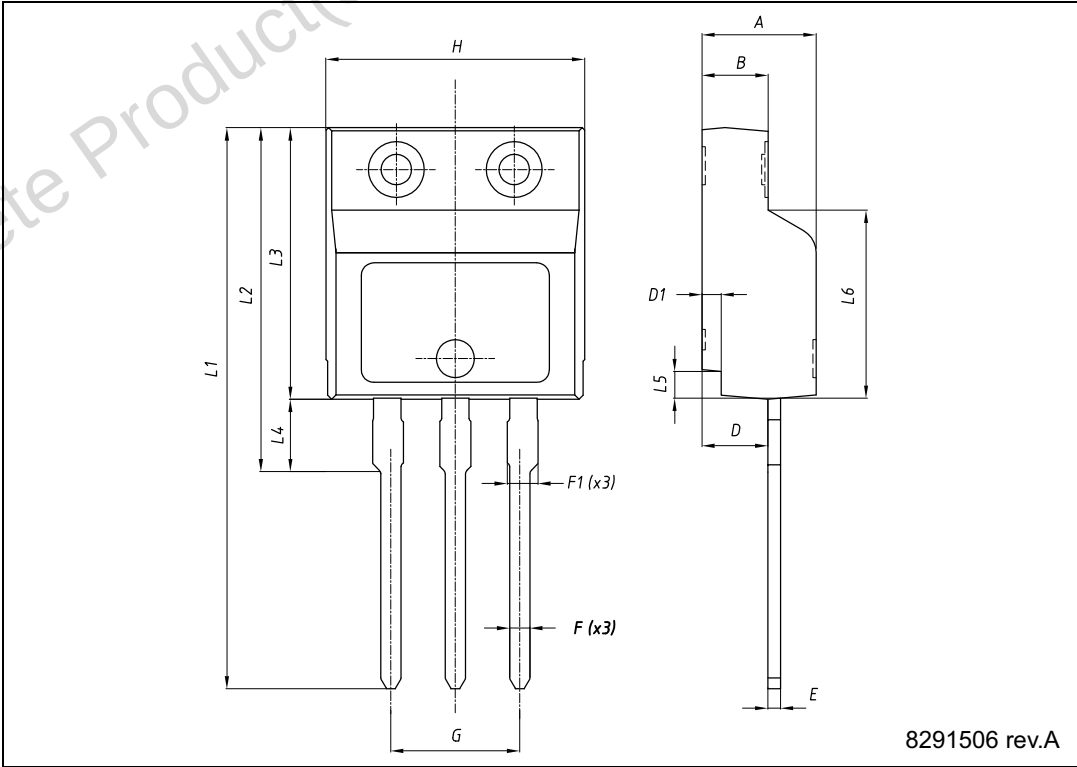


Table 10. TO-220 type A mechanical data

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 25. TO-220 type A drawing

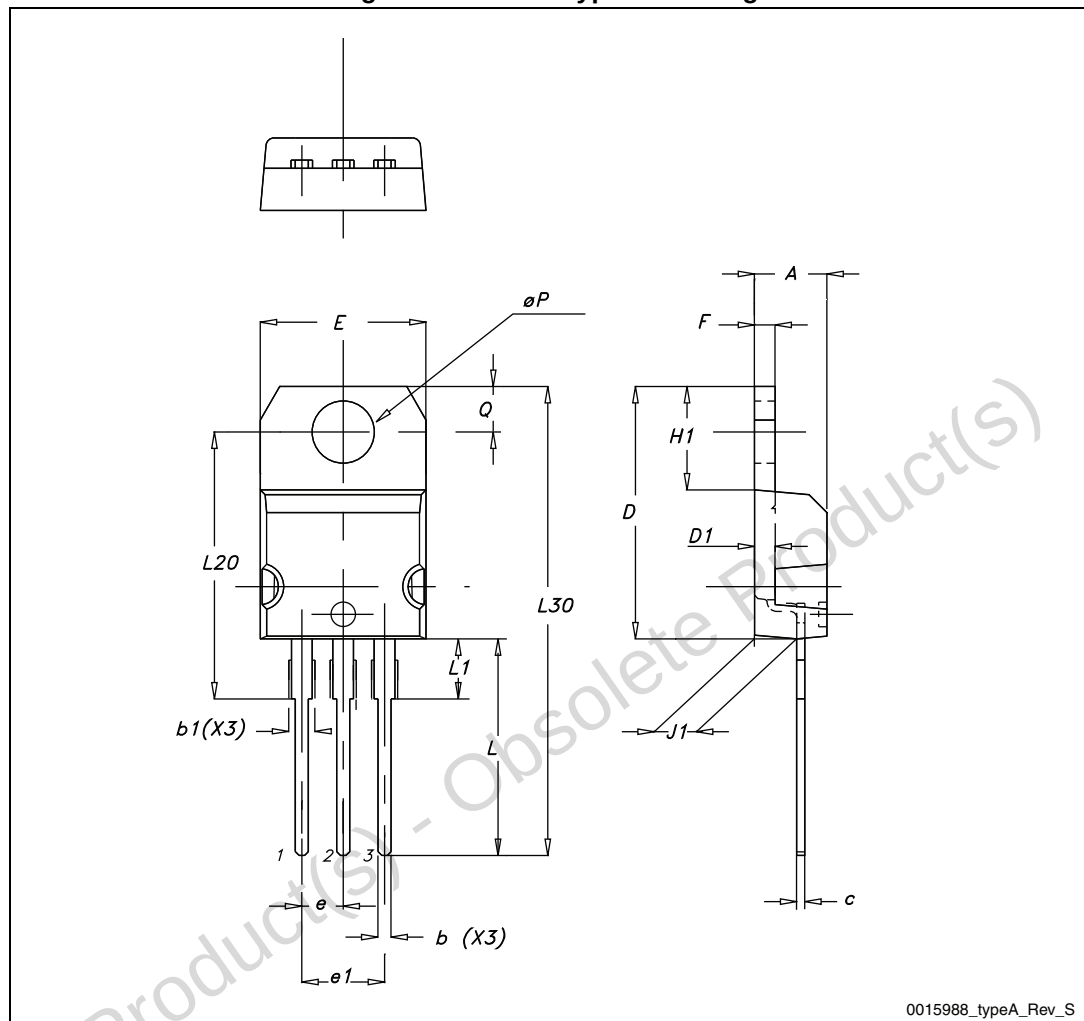
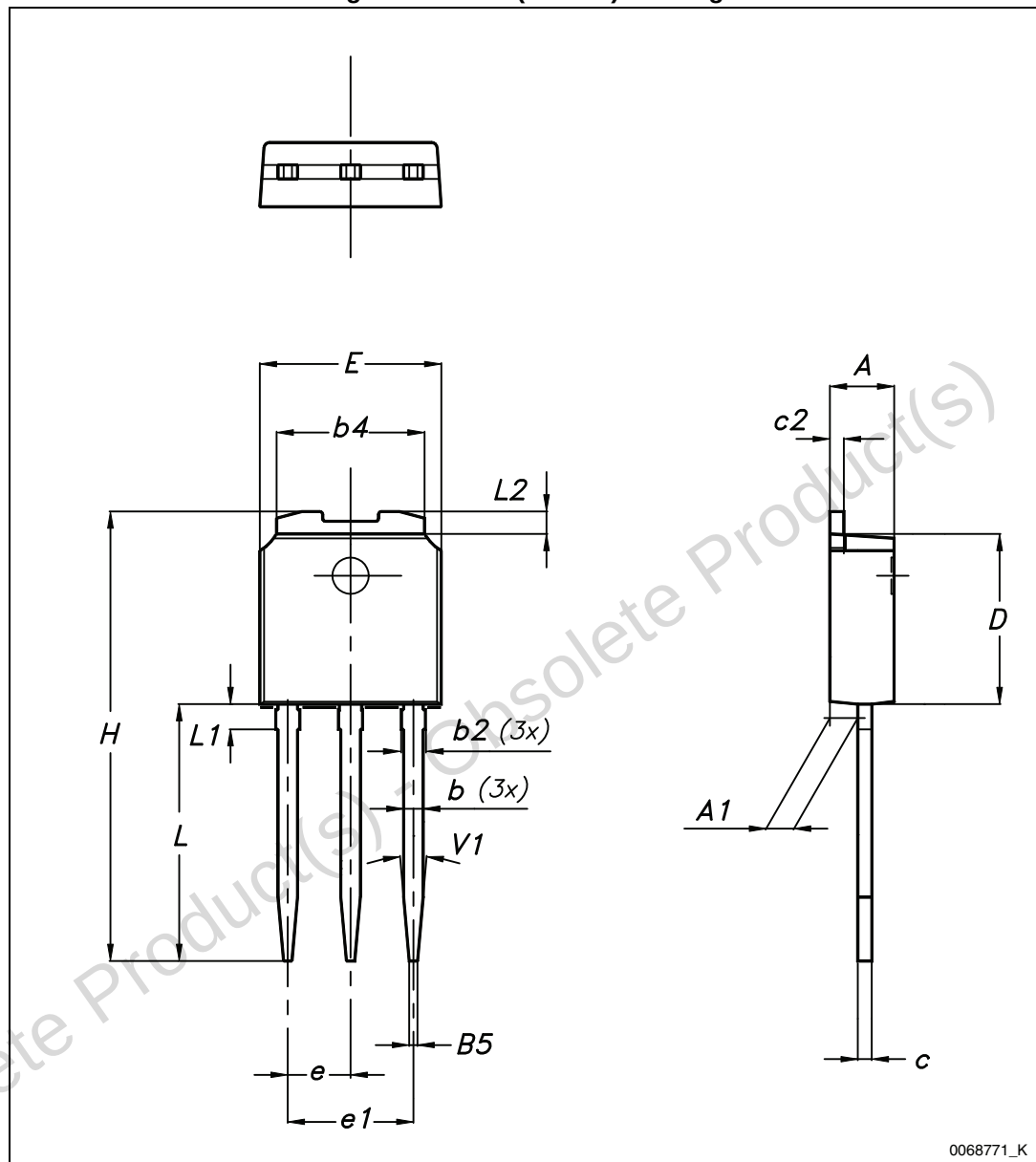


Table 11. IPAK (TO-251) mechanical data

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 26. IPAK (TO-251) drawing



5 Revision history

Table 12. Document revision history

Date	Revision	Changes
08-Apr-2013	1	First release.

Obsolete Product(s) - Obsolete Product(s)

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