

N-channel 500 V, 0.28 Ω typ., 12 A MDmesh™ II Power MOSFETs in TO-220FP, I²PAK and TO-220 packages

Datasheet - production data

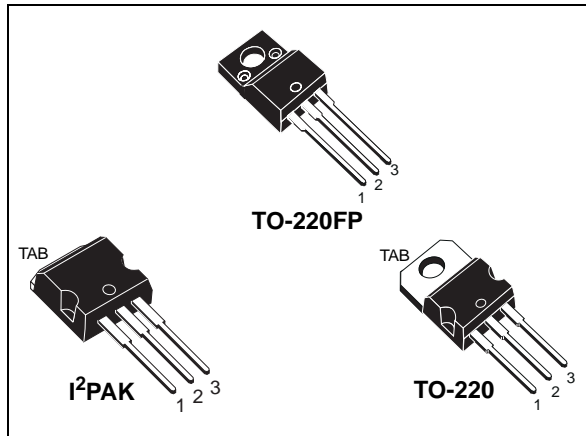
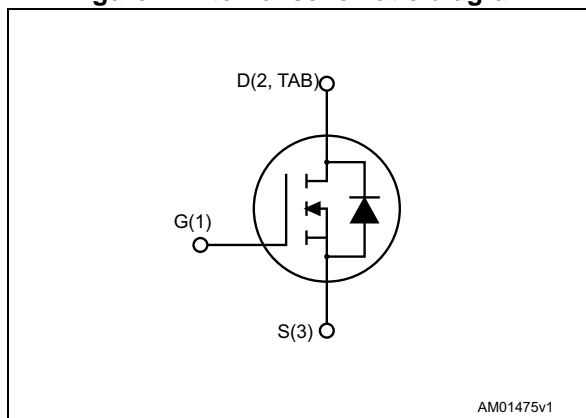


Figure 1. Internal schematic diagram



Features

Order codes	V _{DS} @ T _{Jmax}	R _{DS(on)} max	I _D
STF14NM50N	550 V	0.32 Ω	12 A
STI14NM50N			
STP14NM50N			

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

Applications

- Switching applications

Description

These devices are N-channel Power MOSFET 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 codes	Marking	Package	Packaging
STF14NM50N	14NM50N	TO-220FP	Tube
STI14NM50N		I ² PAK	
STP14NM50N		TO-220	

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		I ² PAK, TO-220	TO-220FP	
V _{DS}	Drain-source voltage	500		V
V _{GS}	Gate-source voltage	± 25		V
I _D	Drain current (continuous) at T _C = 25 °C	12	12 ⁽¹⁾	A
I _D	Drain current (continuous) at T _C = 100 °C	8	8 ⁽¹⁾	A
I _{DM} ⁽²⁾	Drain current (pulsed)	48	48 ⁽¹⁾	A
P _{TOT}	Total dissipation at T _C = 25 °C	90	25	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 _{stg}	Storage temperature	- 55 to 150		°C
T _j	Max. operating junction temperature	150		°C

1. Limited by maximum junction temperature
2. Pulse width limited by safe operating area
3. $I_{SD} \leq 12$ A, $di/dt \leq 400$ A/s, $V_{DS\ peak} \leq V_{(BR)DSS}$, $V_{DD} = 80\% V_{(BR)DSS}$

Table 3. Thermal data

Symbol	Parameter	Value			Unit
		TO-220FP	I ² PAK	TO-220	
R _{thj-case}	Thermal resistance junction-case max	5	1.39		°C/W
R _{thj-amb}	Thermal resistance junction-ambient max	62.5			°C/W

Table 4. Avalanche data

Symbol	Parameter	Value	Unit
I _{AR}	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 _{AR} , V _{DD} = 50 V)	172	mJ

2 Electrical characteristics

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

Table 5. On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	500			V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	$V_{DS} = 500\text{ V}$ $V_{DS} = 500\text{ V}$, $T_C = 125\text{ °C}$			1 100	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 25\text{ V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 6\text{ A}$		0.28	0.32	Ω

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$	-	816	-	pF
C_{oss}	Output capacitance			60		pF
C_{rss}	Reverse transfer capacitance			3		pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }50\text{ V}$, $V_{GS} = 0$	-	157	-	pF
R_G	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	4.5	-	Ω
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 12\text{ A}$, $V_{GS} = 10\text{ V}$ (see Figure 16)	-	27	-	nC
Q_{gs}	Gate-source charge			5		nC
Q_{gd}	Gate-drain charge			15		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_{DS}

Table 7. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$, $I_D = 12\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see Figure 17)	-	12	-	ns
t_r	Rise time			16		ns
$t_{d(off)}$	Turn-off-delay time			42		ns
t_f	Fall time			22		ns

Table 8. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		12	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		48	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 12 \text{ A}$, $V_{GS} = 0$	-		1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 12 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$ (see Figure 20)	-	252		ns
Q_{rr}	Reverse recovery charge			2.8		μC
I_{RRM}	Reverse recovery current			22		A
t_{rr}	Reverse recovery time	$I_{SD} = 12 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 60 \text{ V}$, $T_J = 150 \text{ }^\circ\text{C}$ (see Figure 20)	-	300		ns
Q_{rr}	Reverse recovery charge			3.3		μC
I_{RRM}	Reverse recovery current			22.2		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 I²PAK, TO-220 Figure 3. Thermal impedance for I²PAK, TO-220

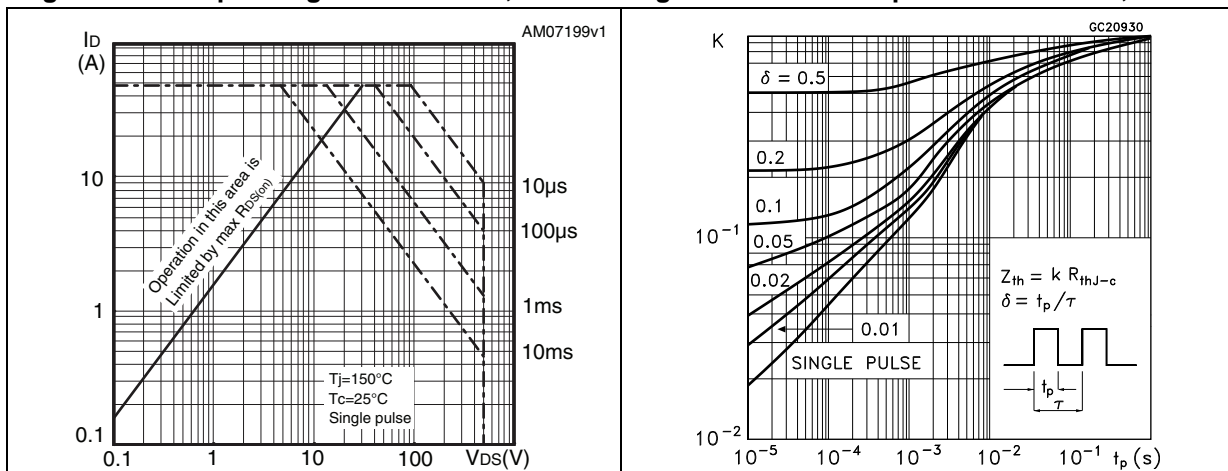


Figure 4. Safe operating area for TO-220FP

Figure 5. Thermal impedance for TO-220FP

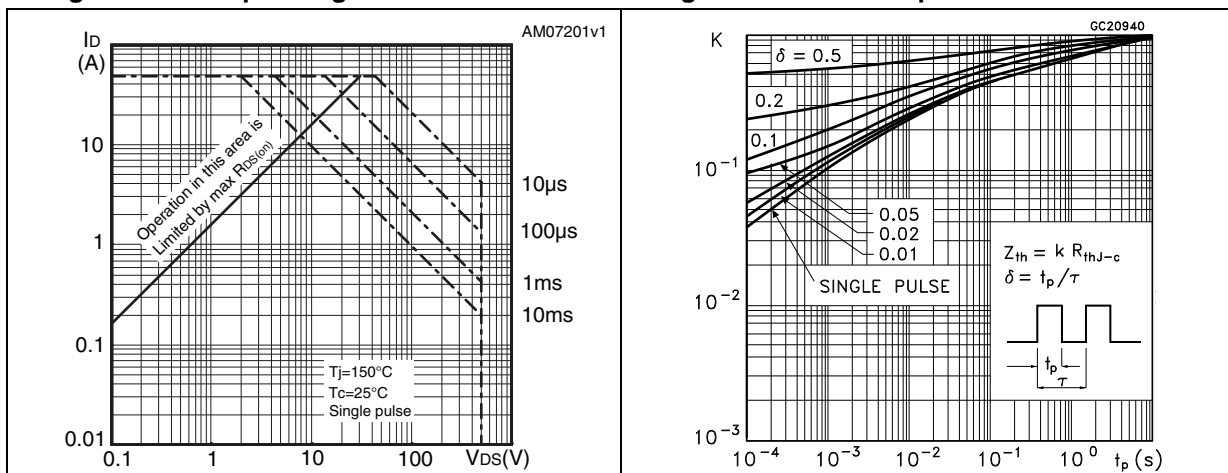


Figure 6. Output characteristics

Figure 7. Transfer characteristics

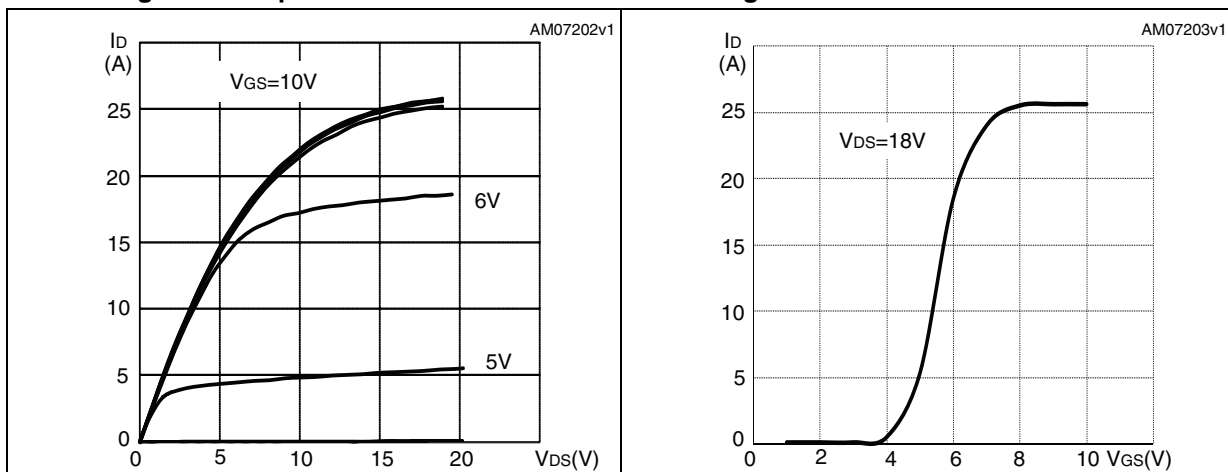


Figure 8. Normalized $V_{(BR)DSS}$ vs temperature

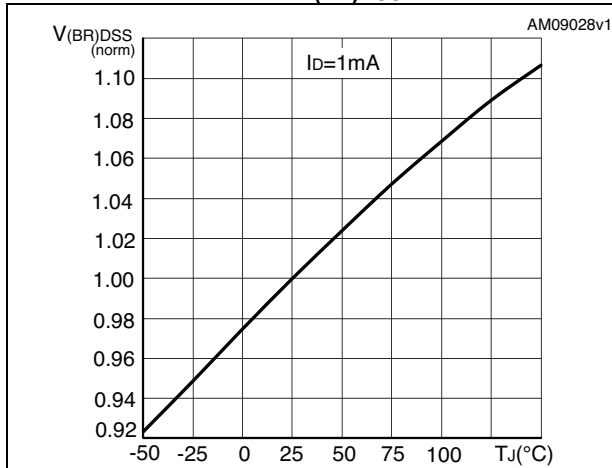


Figure 9. Static drain-source on-resistance

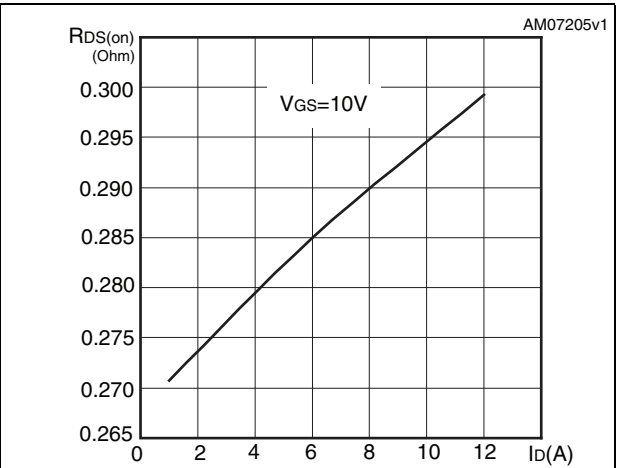


Figure 10. Capacitance variations

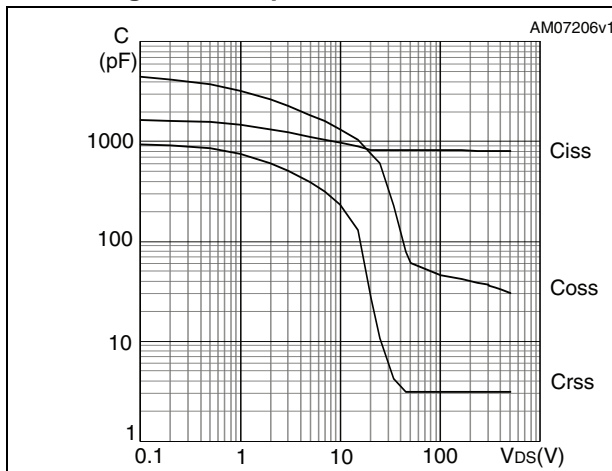


Figure 11. Gate charge vs gate-source voltage

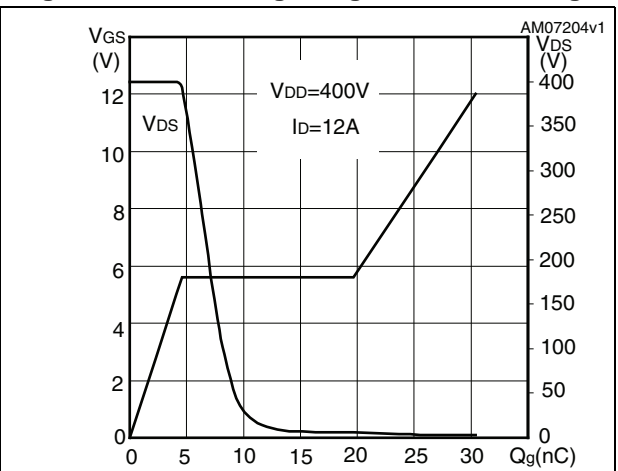


Figure 12. Normalized gate threshold voltage vs temperature

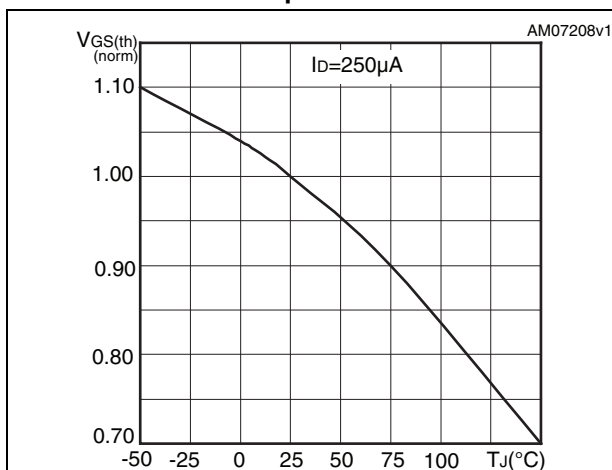


Figure 13. Normalized on-resistance vs temperature

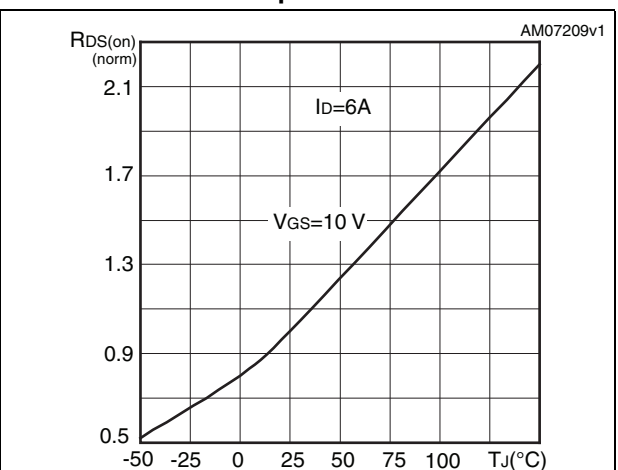
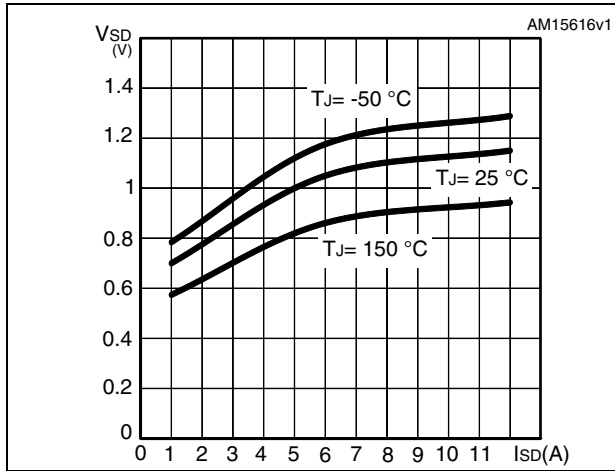


Figure 14. Source-drain diode forward characteristics



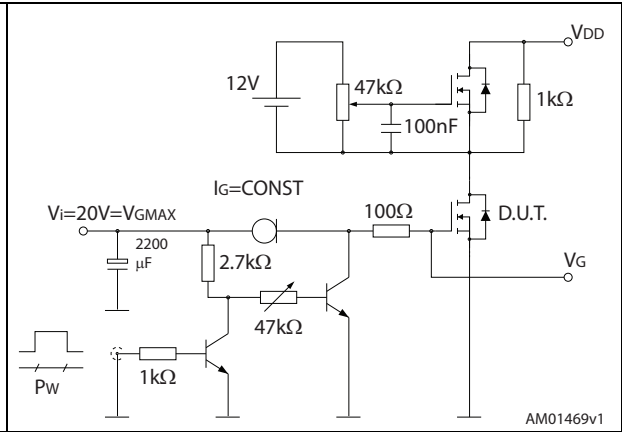
3 Test circuits

Figure 15. Switching times test circuit for resistive load



AM01468v1

Figure 16. Gate charge test circuit



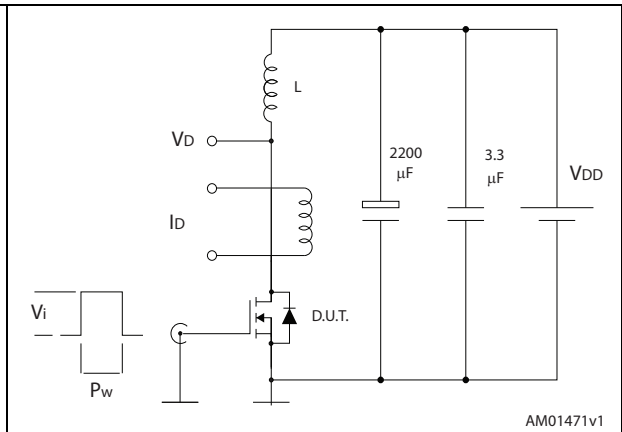
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Figure 17. Test circuit for inductive load switching and diode recovery times



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Figure 18. Unclamped inductive load test circuit



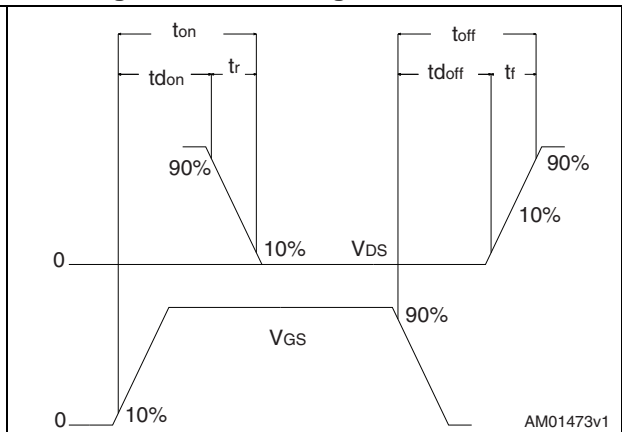
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Figure 19. Unclamped inductive waveform



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Figure 20. Switching time waveform



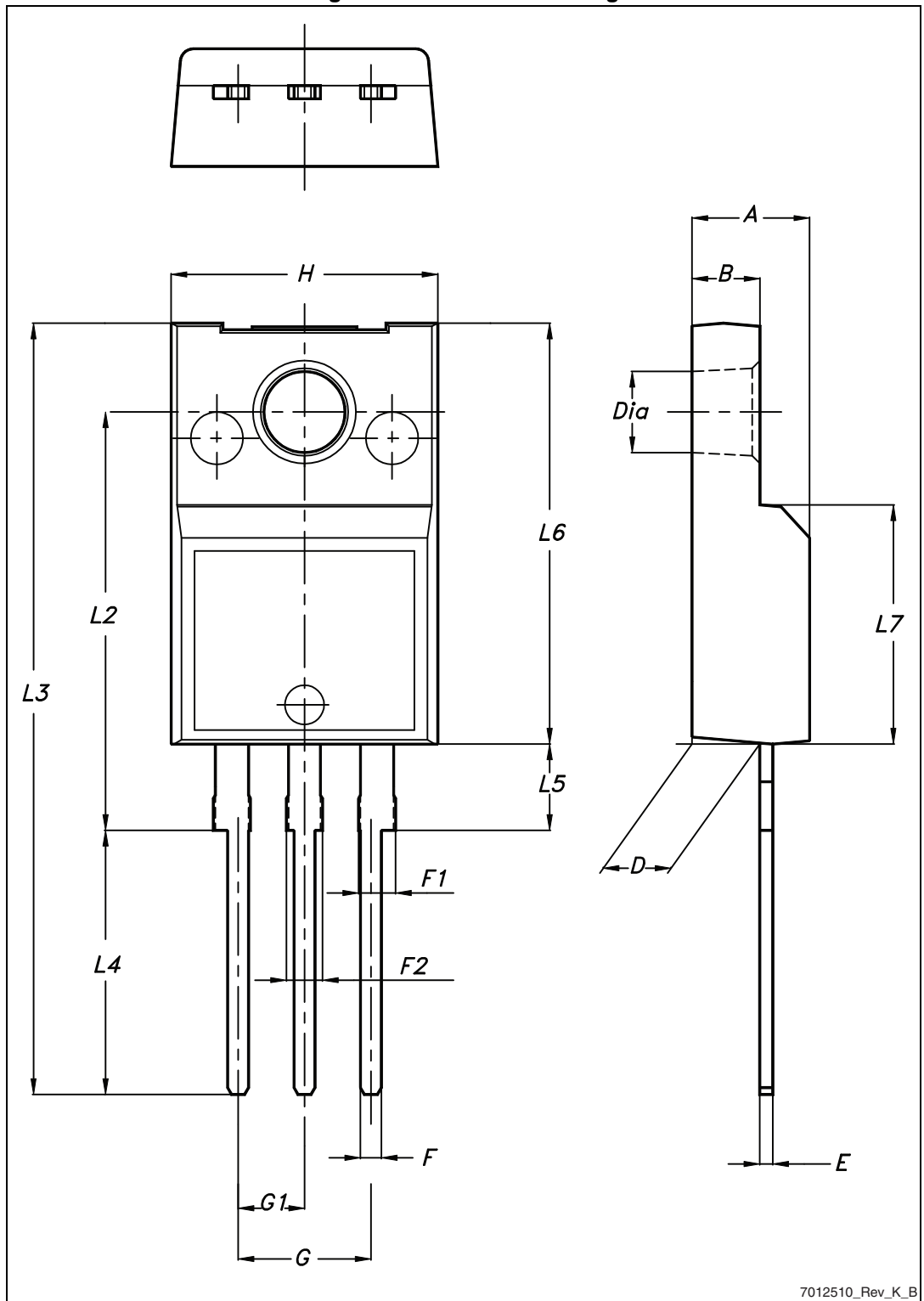
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4 Package mechanical data

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.

4.1 TO-220FP, STF14NM50N

Figure 21. TO-220FP drawing



7012510_Rev_K_B

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

4.2 I²PAK, STI14NM50N

Figure 22. I²PAK (TO-262) drawing

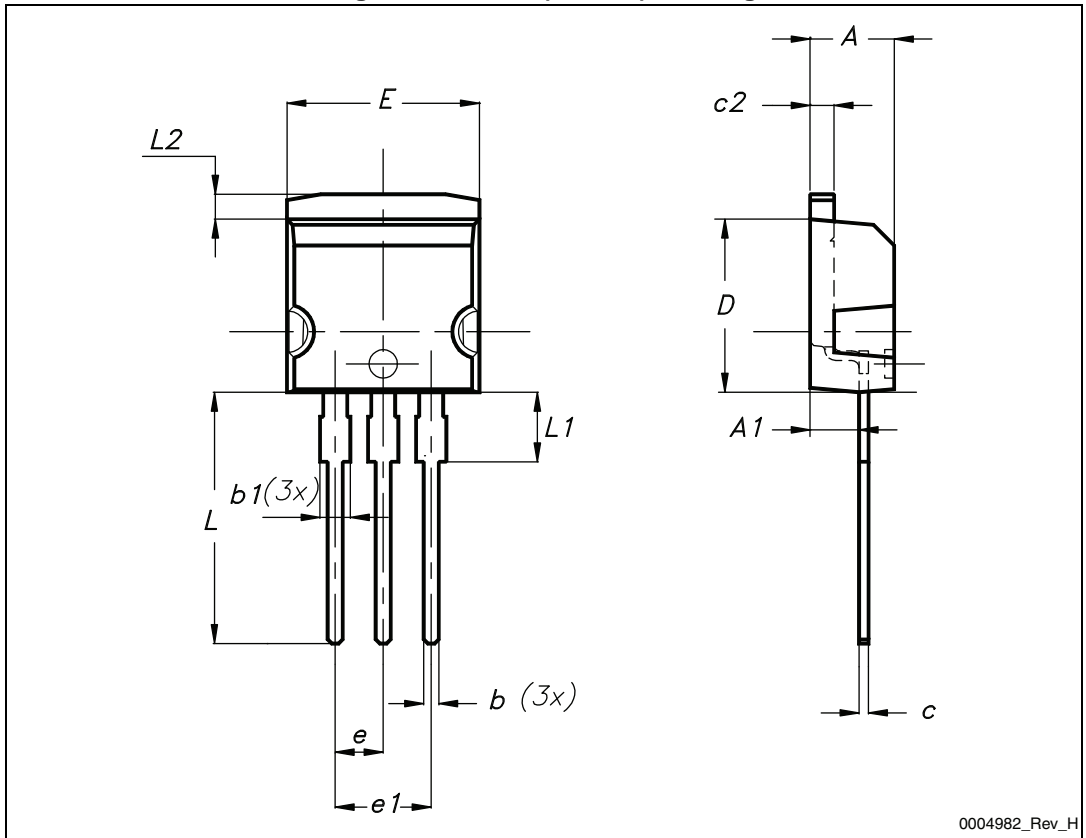


Table 10. I²PAK (TO-262) mechanical data

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

4.3 TO-220, STP14NM50N

Figure 23. TO-220 type A drawing

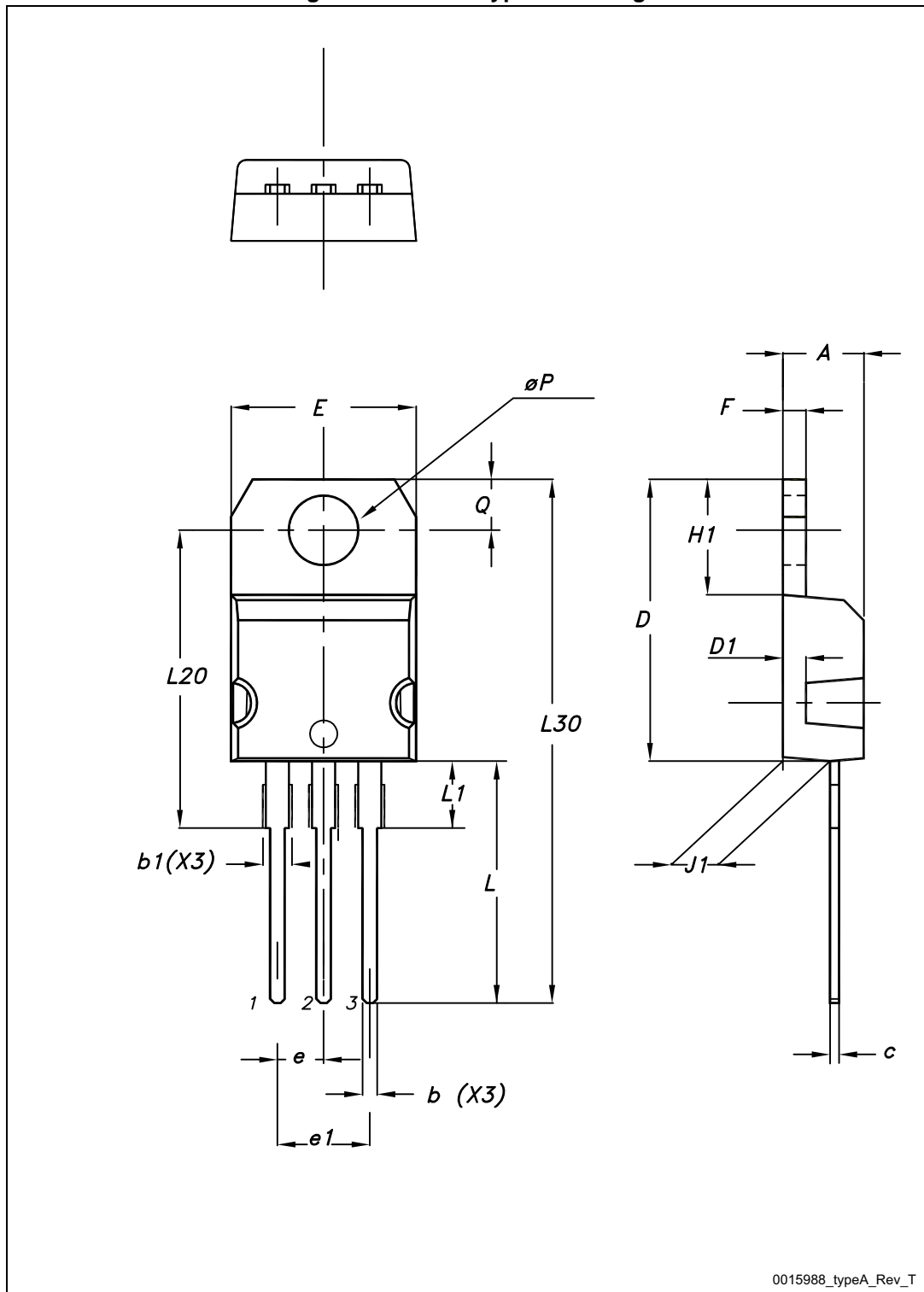


Table 11. TO-220 type A mechanical data

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

5 Revision history

Table 12. Document revision history

Date	Revision	Changes
26-Nov-2009	1	First release.
02-Dec-2009	2	Inserted table footnote Table 3: Thermal data .
22-Jul-2010	3	Document status promoted from preliminary data to datasheet.
06-Apr-2011	4	Updated E_{AS} in Table 2 .
30-Oct-2012	5	Updated Figure 1: Internal schematic diagram , Table 1: Device summary , Table 2: Absolute maximum ratings , Table 3: Thermal data , Table 5: On /off states . Updated Section 4: Package mechanical data . Minor text changes.
07-Feb-2013	6	– Minor text changes – Added: Figure 14 – Updated: Section 4: Package mechanical data only for DPAK package
05-Jun-2014	7	– The root part numbers STB14NM50N and STD14NM50N have been moved to a separate datasheet – Updated Coss eq. in Table 6: Dynamic – Updated: Section 4.3: TO-220, STP14NM50N – Minor text changes

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