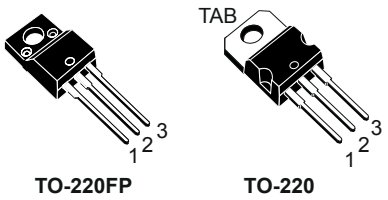
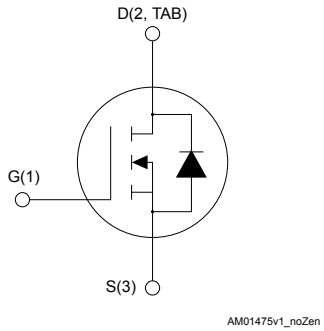
STF14NM50N, STP14NM50N

Datasheet

N-channel 500 V, 285 mΩ typ., 12 A MDmesh II Power MOSFETs in TO-220FP and TO-220 packages



TO-220FP **TO-220**



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STF14NM50N	500 V	320 mΩ	12 A
STP14NM50N			

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

Applications

- Switching applications

Description

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

Product status links
STF14NM50N
STP14NM50N

Product summary	
Order code	**STF14NM50N**
Marking	14NM50N
Package	TO-220FP
Packing	Tube
Order code	**STP14NM50N**
Marking	14NM50N
Package	TO-220
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220FP	TO-220	
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(1)	12	A
	Drain current (continuous) at T_C = 100 °C	8(1)	8	
I_{DM} (2)	Drain current (pulsed)	48(1)	48	A
P_{TOT}	Total power dissipation at T_C = 25 °C	25	90	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)	2.5		kV
T_{stg}	Storage temperature range	-55 to 150		°C
T_J	Operation junction temperature range			°C

1. *Limited by maximum junction temperature.*
2. *Pulse width is limited by safe operating area.*
3. *I_{SD} ≤ 12 A, di/dt ≤ 400 A/µs, V_{DS} (peak) ≤ $V_{(BR)DSS}$, V_{DD} = 400 V.*

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		TO-220FP	TO-220	
R_{thJC}	Thermal resistance, junction-to-case	5	1.39	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	62.5		°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or non-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 °C unless otherwise specified.

Table 4. On/off states

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	I_D = 1 mA, V_{GS} = 0 V	500			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 500 V			1	µA
		V_{GS} = 0 V, V_{DS} = 500 V, T_C = 125 °C(1)			100	
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, 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 = 6 A		285	320	mΩ

1. *Specified by design, not tested in production.*

Table 5. Dynamic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 50 V, f = 1 MHz, V_{GS} = 0 V	-	816	-	pF
C_{oss}	Output capacitance		-	60	-	pF
C_{rss}	Reverse transfer capacitance		-	3	-	pF
$C_{oss\ eq.}$(1)	Equivalent output capacitance	V_{DS} = 0 to 400 V, V_{GS} = 0 V	-	308	-	pF
Q_g	Total gate charge	V_{DD} = 400 V, I_D = 12 A, V_{GS} = 0 to 10 V (see the Figure 15. Test circuit for gate charge behavior)	-	27	-	nC
Q_{gs}	Gate-source charge		-	5	-	nC
Q_{gd}	Gate-drain charge		-	15	-	nC
R_g	Gate input resistance	f = 1 MHz, open drain	-	4.5	-	Ω

1. *$C_{oss\ eq.}$ 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 condition	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD} = 400 V, I_D = 12 A, R_G = 4.7 Ω, V_{GS} = 10 V (see the Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	12	-	ns
t_r	Rise time		-	16	-	ns
$t_{d(off)}$	Turn-off delay time		-	42	-	ns
t_f	Fall time		-	22	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test condition	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 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 12 A, di/dt = 100 A/µs, V_{DD} = 60 V (see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	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 A, di/dt = 100 A/µs, V_{DD} = 60 V, T_J = 150 °C (see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	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 1. Safe operating area for TO-220

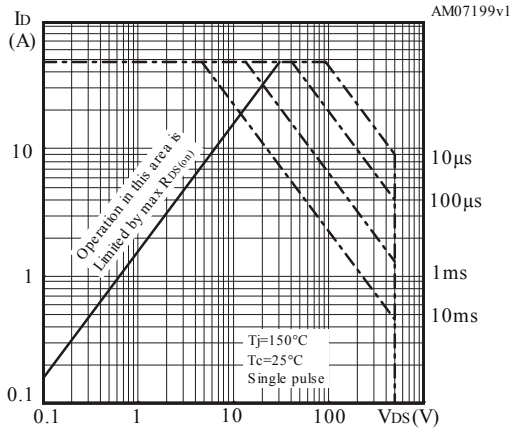


Figure 2. Normalized transient thermal impedance for TO-220

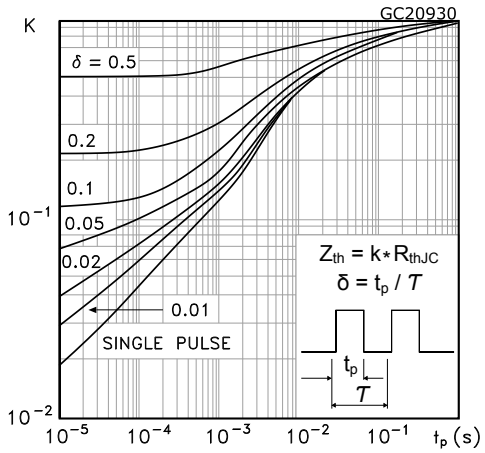


Figure 3. Safe operating area for TO-220FP

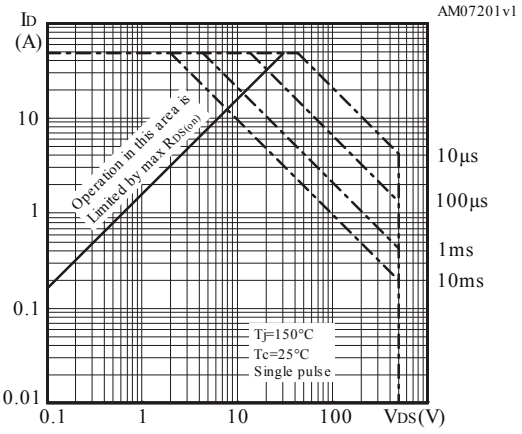


Figure 4. Normalized transient thermal impedance for TO-220FP

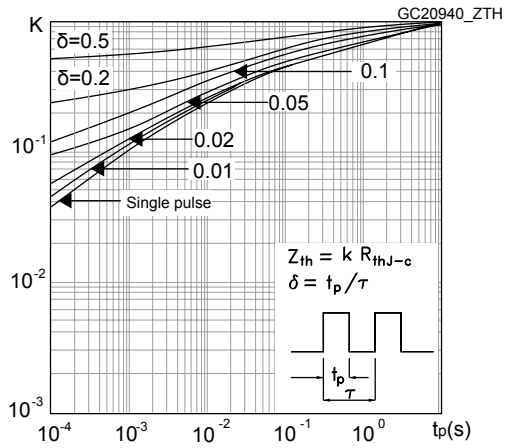


Figure 5. Typical output characteristics

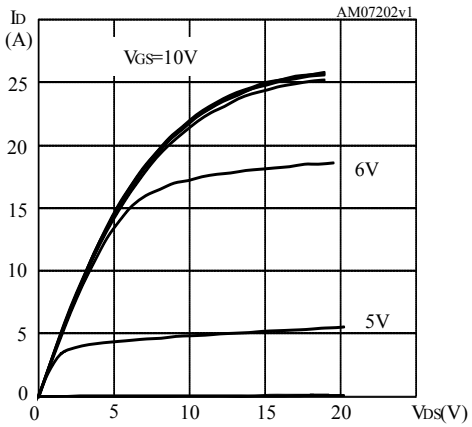


Figure 6. Typical transfer characteristics

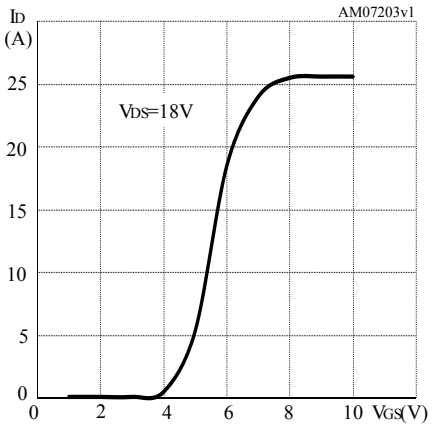


Figure 7. Typical gate charge characteristics

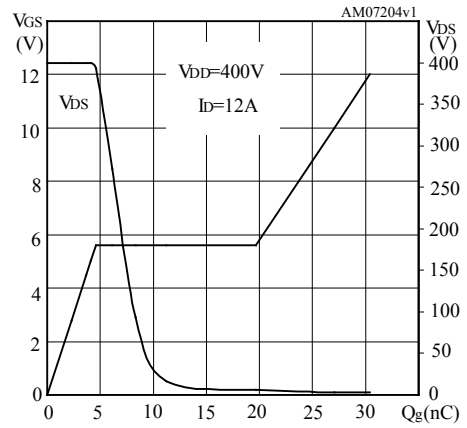


Figure 8. Typical drain-source on-resistance

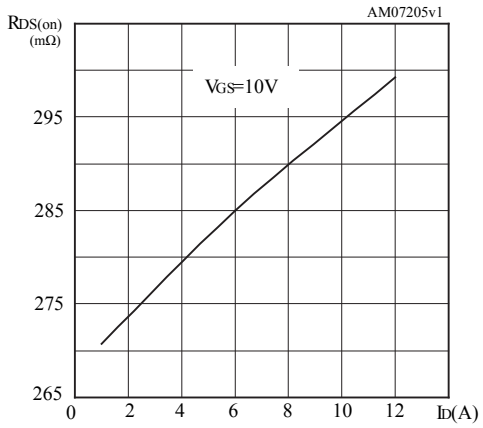


Figure 9. Typical capacitance characteristics

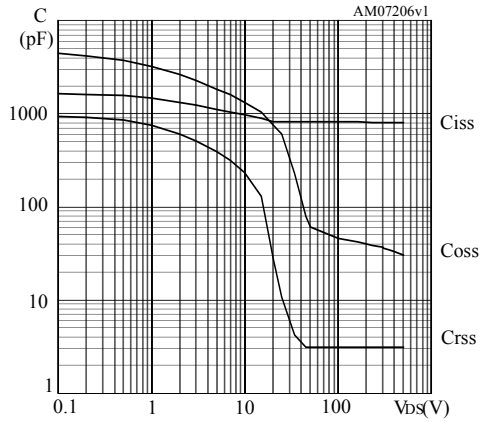


Figure 10. Normalized gate threshold vs temperature

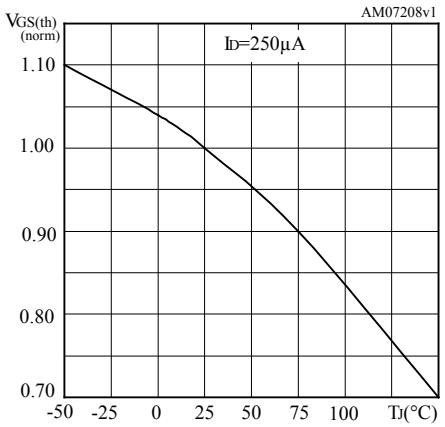


Figure 11. Normalized on-resistance vs temperature

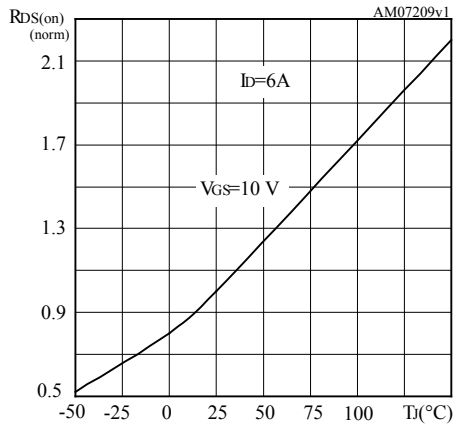


Figure 12. Normalized breakdown voltage vs temperature

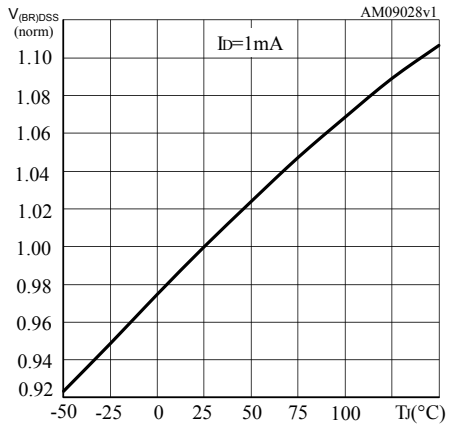
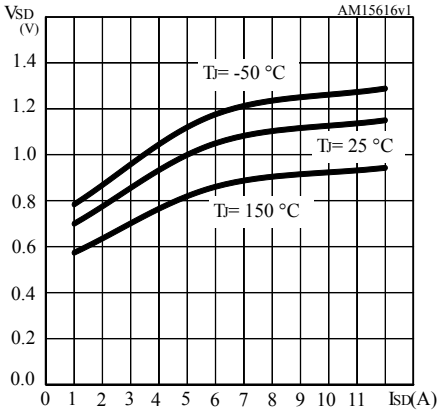


Figure 13. Typical reverse diode forward characteristics



3 Test circuits

Figure 14. Test circuit for resistive load switching times

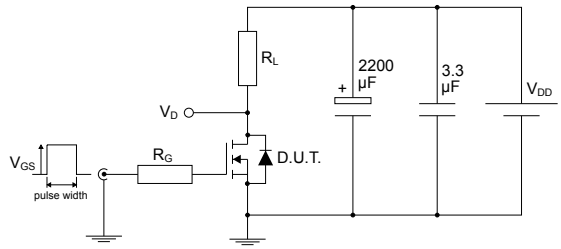


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Figure 15. Test circuit for gate charge behavior

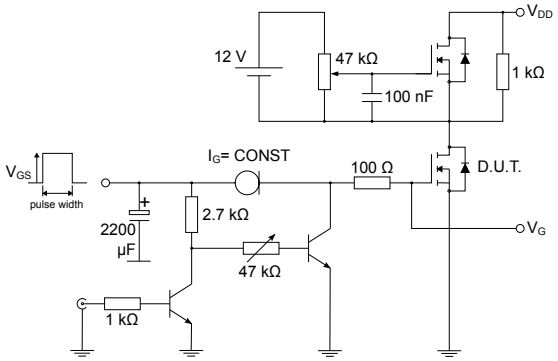

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Figure 16. Test circuit for inductive load switching and diode recovery times

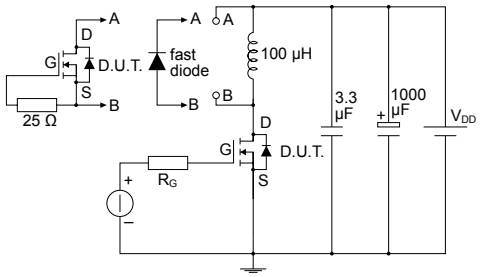

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Figure 17. Unclamped inductive load test circuit

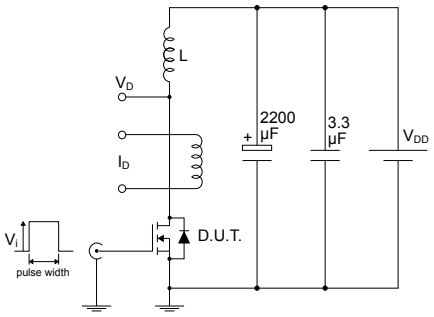

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Figure 18. Unclamped inductive waveform

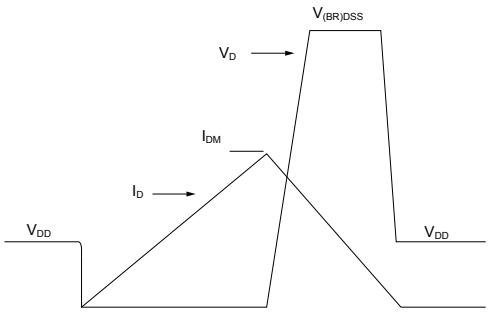

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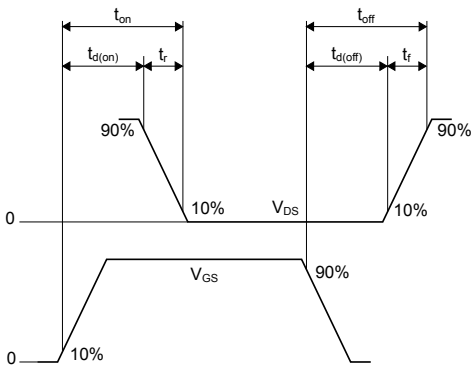
Figure 19. Switching time waveform



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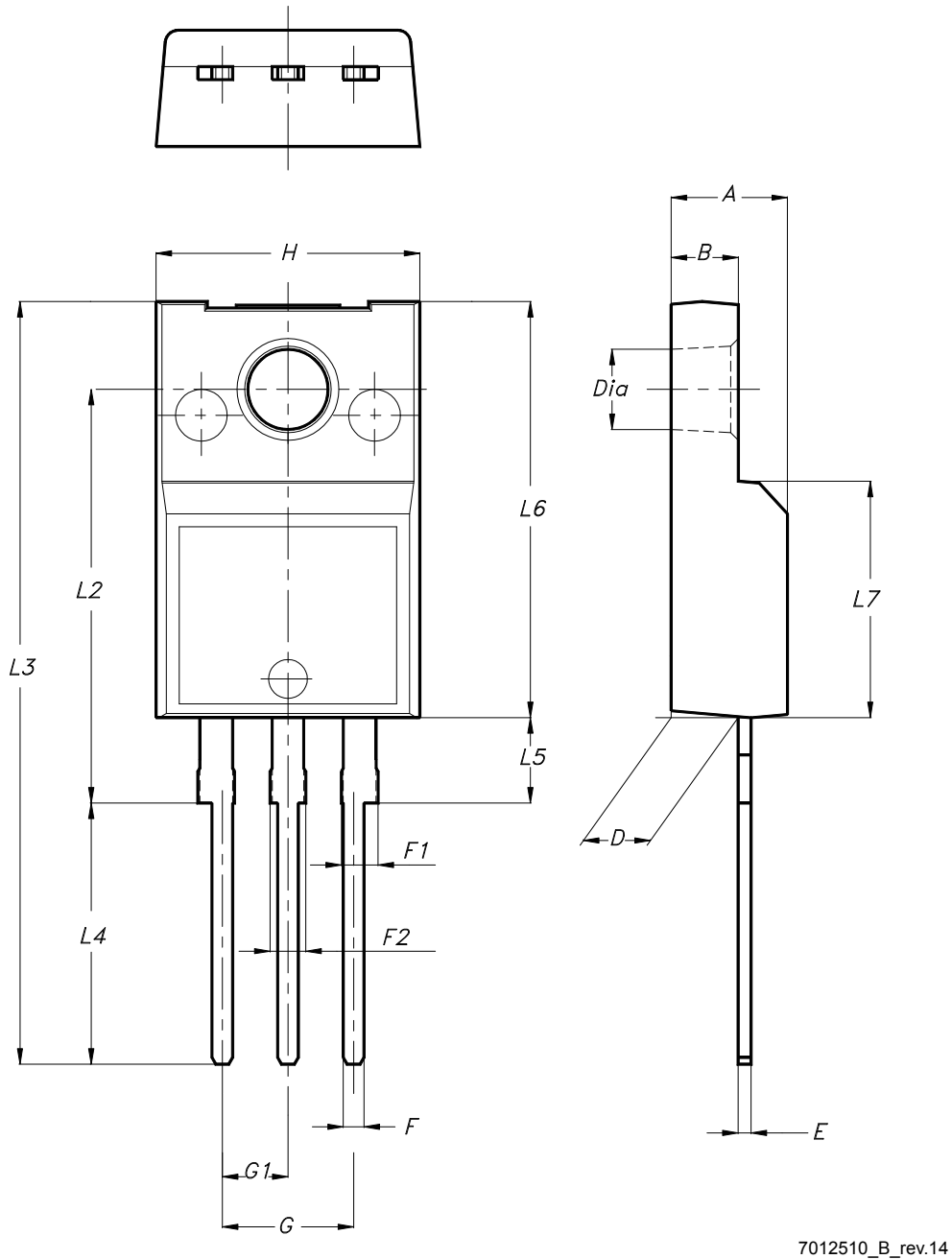
4 Package information

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 type B package information

Figure 20. TO-220FP type B package outline



7012510_B_rev.14

Table 8. **TO-220FP type B package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.70
F	0.75		1.00
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.20
G1	2.40		2.70
H	10.00		10.40
L2		16.00	
L3	28.60		30.60
L4	9.80		10.60
L5	2.90		3.60
L6	15.90		16.40
L7	9.00		9.30
Dia	3.00		3.20

4.2 TO-220 type A package information

Figure 21. **TO-220 type A package outline**

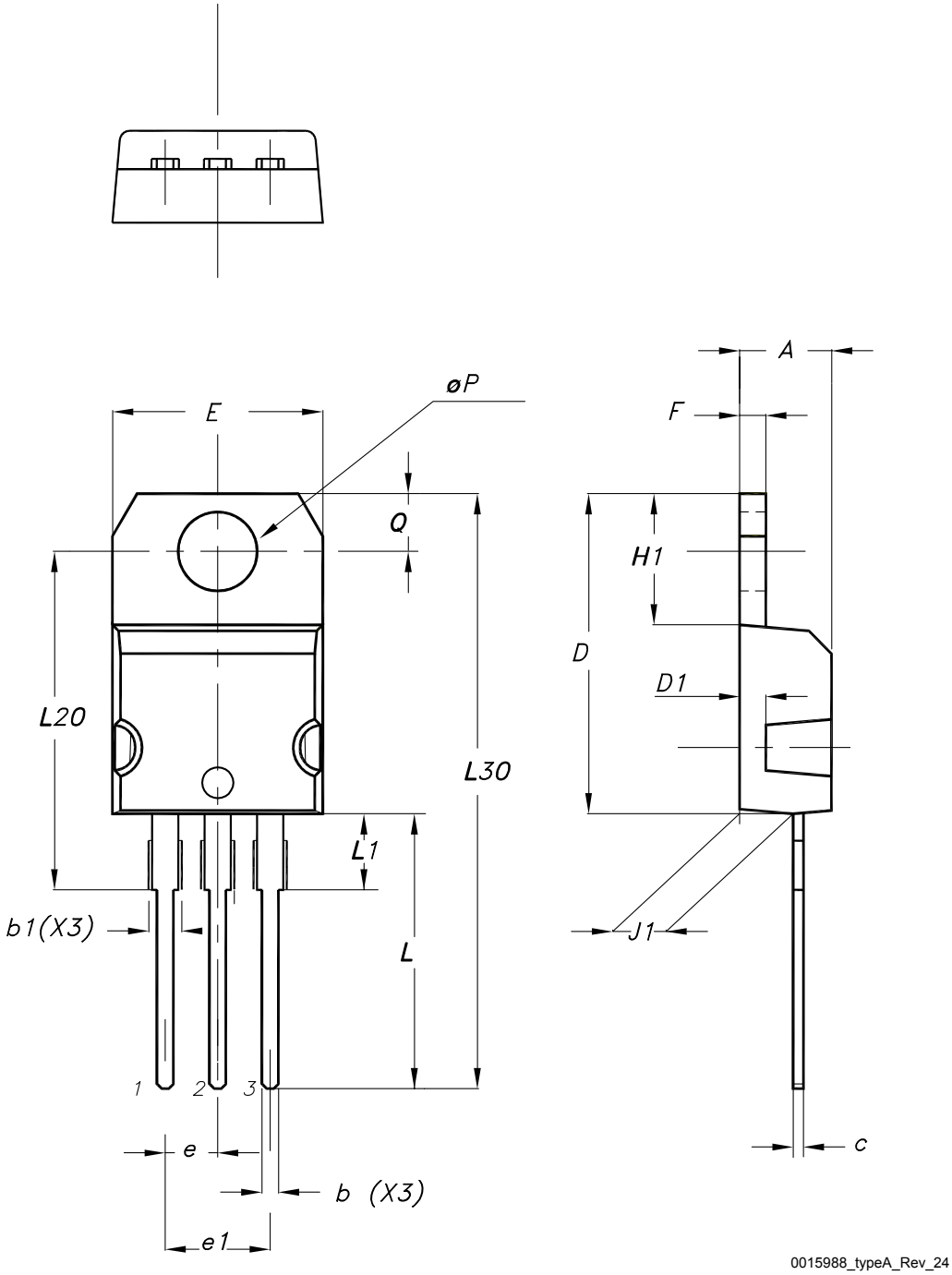


Table 9. **TO-220 type A package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		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	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95
Slug flatness		0.03	0.10

Revision history

Table 10. **Document revision history**

Date	Revision	Changes
26-Nov-2009	1	Preliminary version
02-Dec-2009	2	Complete version
22-Jul-2010	3	Modified value on *Figure 8*
06-Apr-2011	4	New dv/dt value on *Table 5*
30-Oct-2012	5	The document has been reformatted
07-Feb-2013	6	Updated I_D value on *Table 2: Absolute maximum ratings*
05-Jun-2014	7	Inserted dv/dt value in *Table 2: Absolute maximum ratings*
11-Dec-2025	8	The part number STI14NM50N has been removed and the document has been updated accordingly. Updated Section 4: Package information. Minor text changes.

Contents