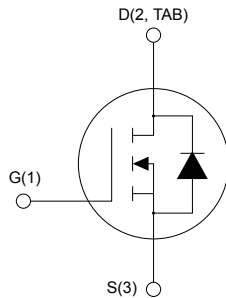
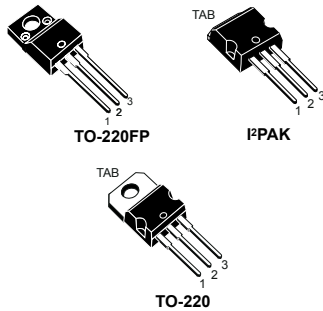




N-channel 600 V, 168 mΩ typ., 17 A MDmesh II Power MOSFET in a TO-220FP, I²PAK and TO-220 packages



AM01475v1_noZen

Features

Order code	V _{DS}	R _{DS(on)} max.	I _D
STF24NM60N	600 V	190 mΩ	17 A
STI24NM60N			
STP24NM60N			

- 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

[STF24NM60N](#)

[STI24NM60N](#)

[STP24NM60N](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		I ² PAK TO-220	TO-220FP	
V _{DS}	Drain-source voltage	600		V
V _{GS}	Gate-source voltage	±30		V
I _D	Drain current (continuous) at T _C = 25 °C	17		A
I _D	Drain current (continuous) at T _C = 100 °C	11		A
I _{DM} ⁽¹⁾	Drain current (pulsed)	68		A
P _{TOT}	Total power dissipation at T _C = 25 °C	125	30	W
V _{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; T _C = 25 °C)	-	2.5	kV
dv/dt ⁽²⁾	Peak diode recovery voltage slope	15		V/ns
T _{stg}	Storage temperature range	-55 to 150		°C
T _J	Operating junction temperature range			°C

1. Pulse width limited by safe operating area.

2. I_{SD} ≤ 17 A, di/dt ≤ 400 A/μs, V_{DS} (peak) ≤ V_{(BR)DSS}, V_{DD} = 480 V.

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		I ² PAK	TO-220	TO-220FP	
R _{thJC}	Thermal resistance, junction-to-case	1		4.17	°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 not-repetitive (pulse width limited by T _J max.)	6	A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AR} , V _{DD} = 50 V)	300	mJ

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	600	-	-	V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$	-	-	1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}^{(1)}$	-	-	100	
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 25\text{ V}$	-	-	± 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	$V_{GS} = 10\text{ V}$, $I_D = 8\text{ A}$	-	168	190	m Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 50\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1330	-	pF
C_{oss}	Output capacitance		-	80	-	pF
C_{rss}	Reverse transfer capacitance		-	3.2	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent capacitance time related	$V_{DS} = 0\text{ to }480\text{ V}$, $V_{GS} = 0\text{ V}$	-	182	-	pF
Q_g	Total gate charge	$V_{DD} = 480\text{ V}$, $I_D = 17\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see the Figure 16. Test circuit for gate charge behavior)	-	44	-	nC
Q_{gs}	Gate-source charge		-	7	-	nC
Q_{gd}	Gate-drain charge		-	24	-	nC
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	5	-	Ω

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	$V_{DD} = 300\text{ V}$, $I_D = 8.5\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	11.5	-	ns
t_r	Rise time		-	16.5	-	ns
$t_{d(off)}$	Turn-off delay time	(see the Figure 15. Test circuit for resistive load switching times and Figure 20. Switching time waveform)	-	73	-	ns
t_f	Fall time		-	37	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	-	17	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-	-	68	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 17\text{ A}$, $V_{GS} = 0\text{ V}$	-	-	1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 17\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$ (see the Figure 17. Test circuit for inductive load switching and diode recovery times)	-	340	-	ns
Q_{rr}	Reverse recovery charge		-	4.6	-	μC
I_{RRM}	Reverse recovery current		-	27	-	A
t_{rr}	Reverse recovery time	$I_{SD} = 17\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$ (see the Figure 17. Test circuit for inductive load switching and diode recovery times)	-	404	-	ns
Q_{rr}	Reverse recovery charge		-	5.7	-	μC
I_{RRM}	Reverse recovery current		-	28	-	A

1. Pulse width limited by safe operating area.

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

2.1 Electrical characteristics (curves)

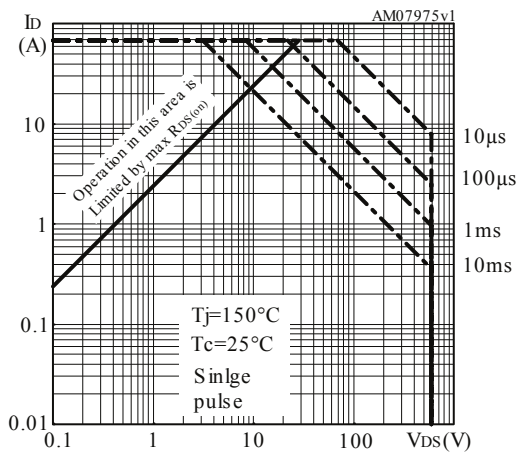
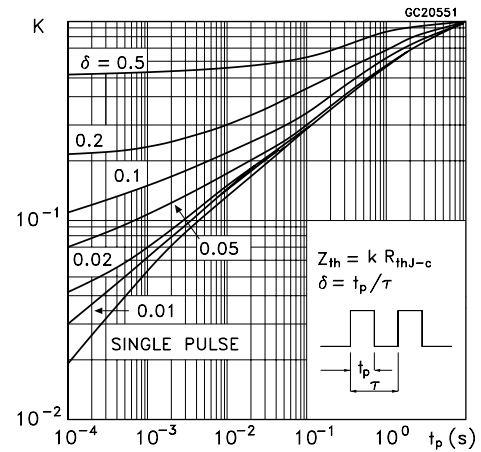
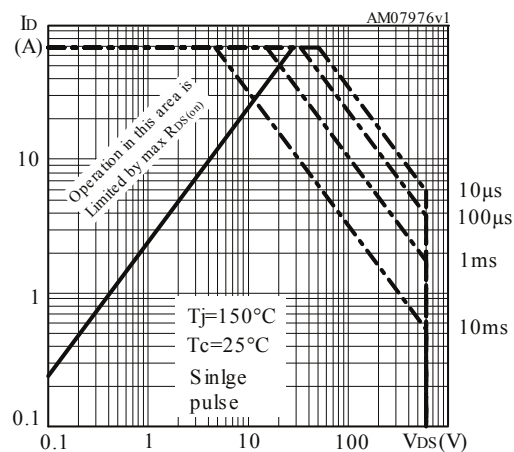
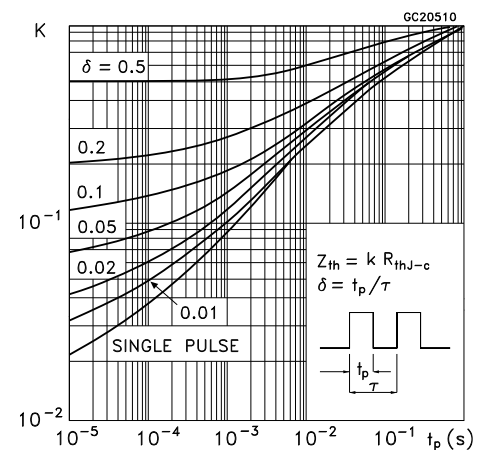
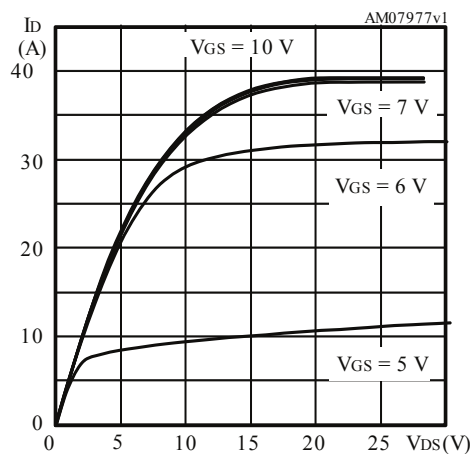
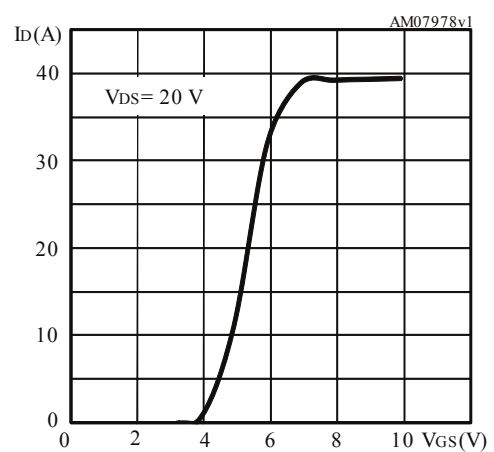
Figure 1. Safe operating area for TO-220FP

Figure 2. Normalized transient thermal impedance for TO-220FP

Figure 3. Safe operating area for I²PAK and TO-220

Figure 4. Normalized transient thermal impedance for I²PAK and TO-220

Figure 5. Typical output characteristics

Figure 6. Typical transfer characteristics


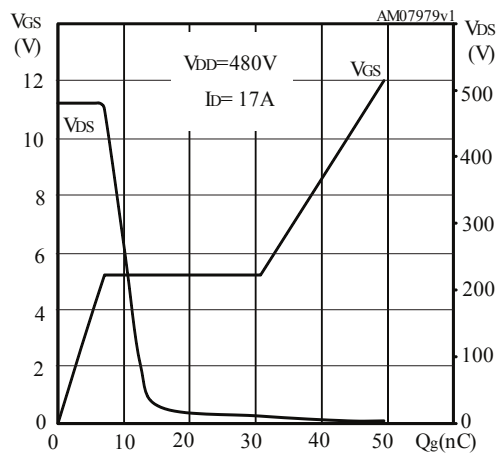
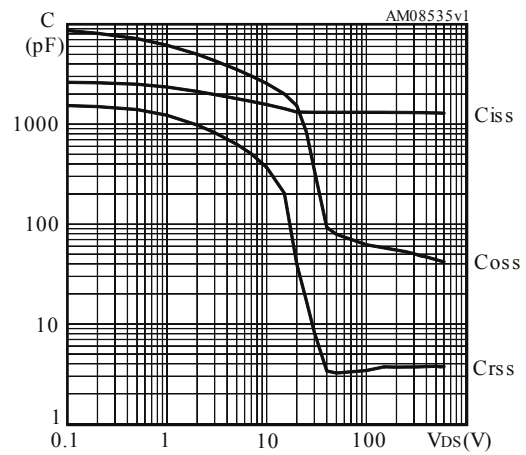
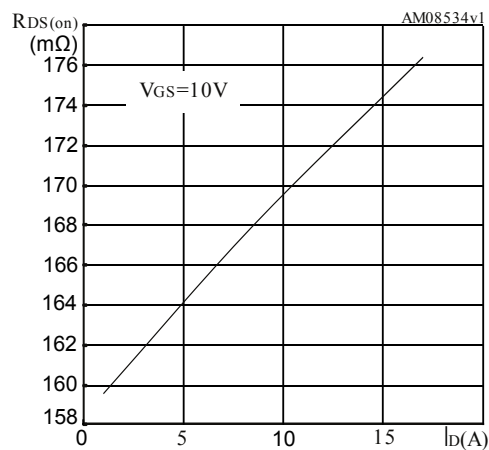
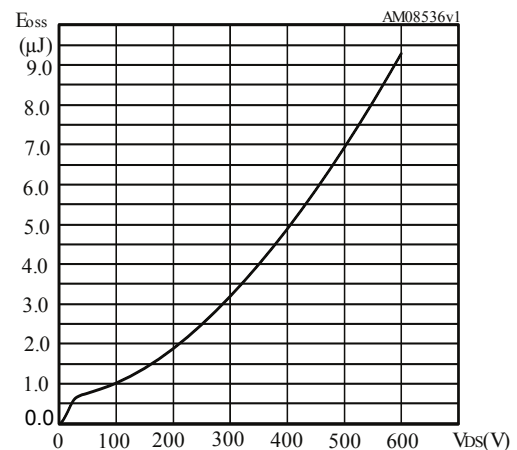
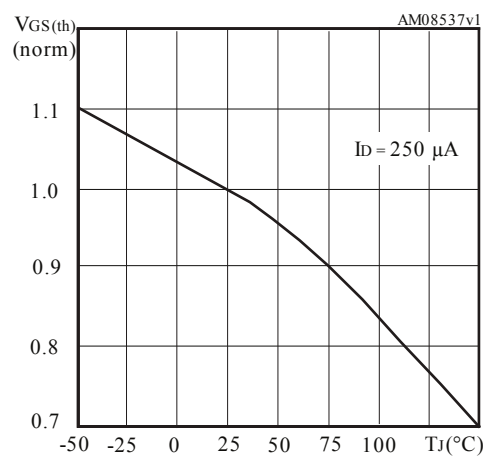
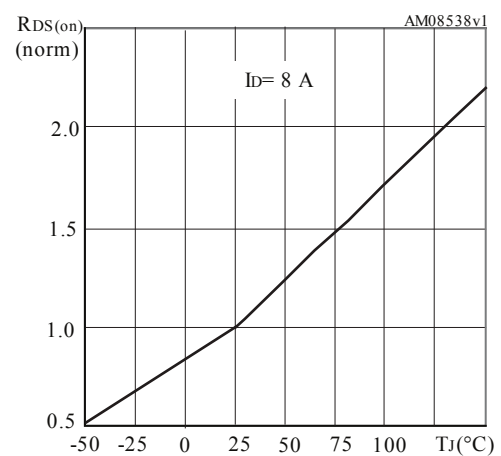
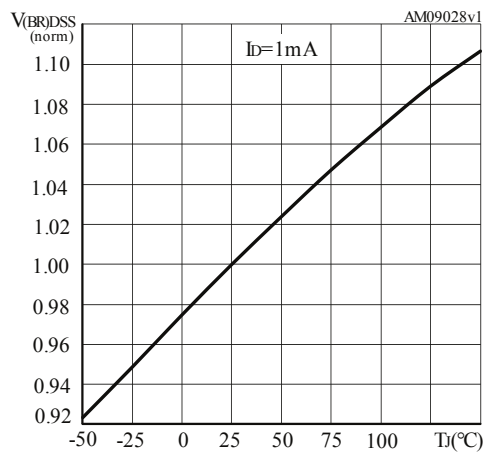
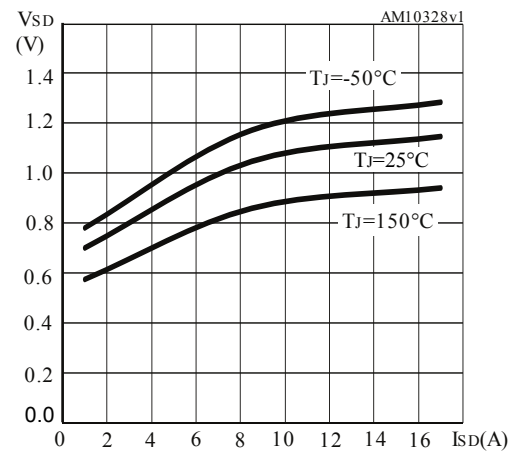
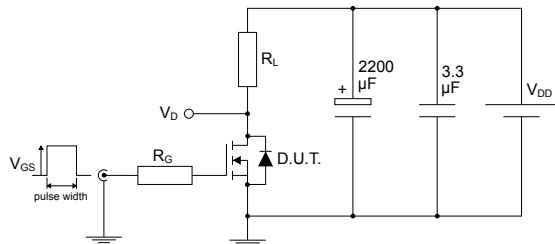
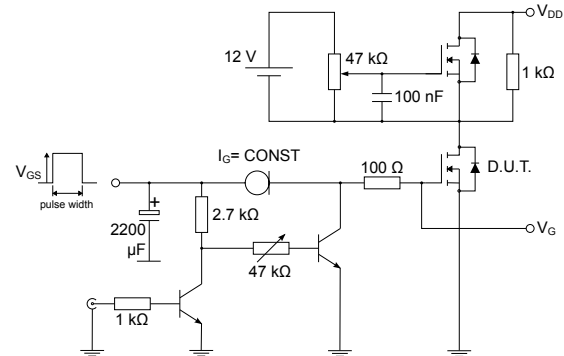
Figure 7. Typical gate charge characteristics

Figure 8. Typical capacitance characteristics

Figure 9. Typical drain-source on-resistance

Figure 10. Typical output capacitance stored energy

Figure 11. Normalized gate threshold vs temperature

Figure 12. Normalized on-resistance vs temperature


Figure 13. Normalized breakdown voltage vs temperature

Figure 14. Typical reverse diode forward characteristics


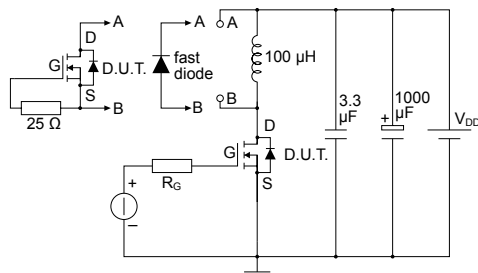
3 Test circuits

Figure 15. Test circuit for resistive load switching times


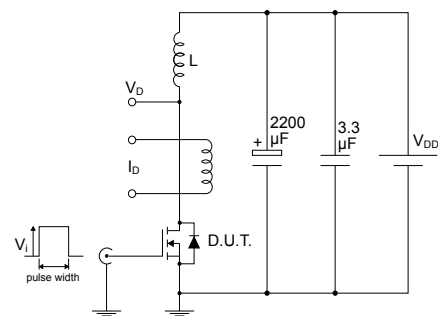
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Figure 16. Test circuit for gate charge behavior


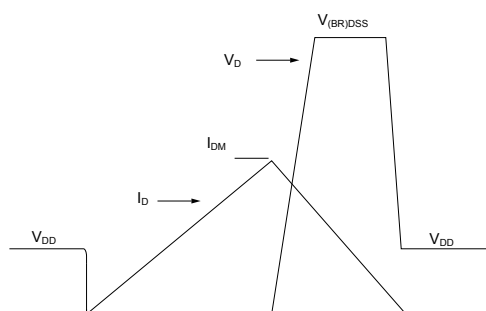
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Figure 17. Test circuit for inductive load switching and diode recovery times


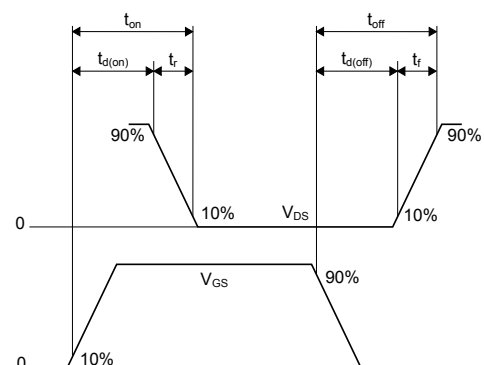
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Figure 18. Unclamped inductive load test circuit


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Figure 19. Unclamped inductive waveform


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Figure 20. Switching time waveform


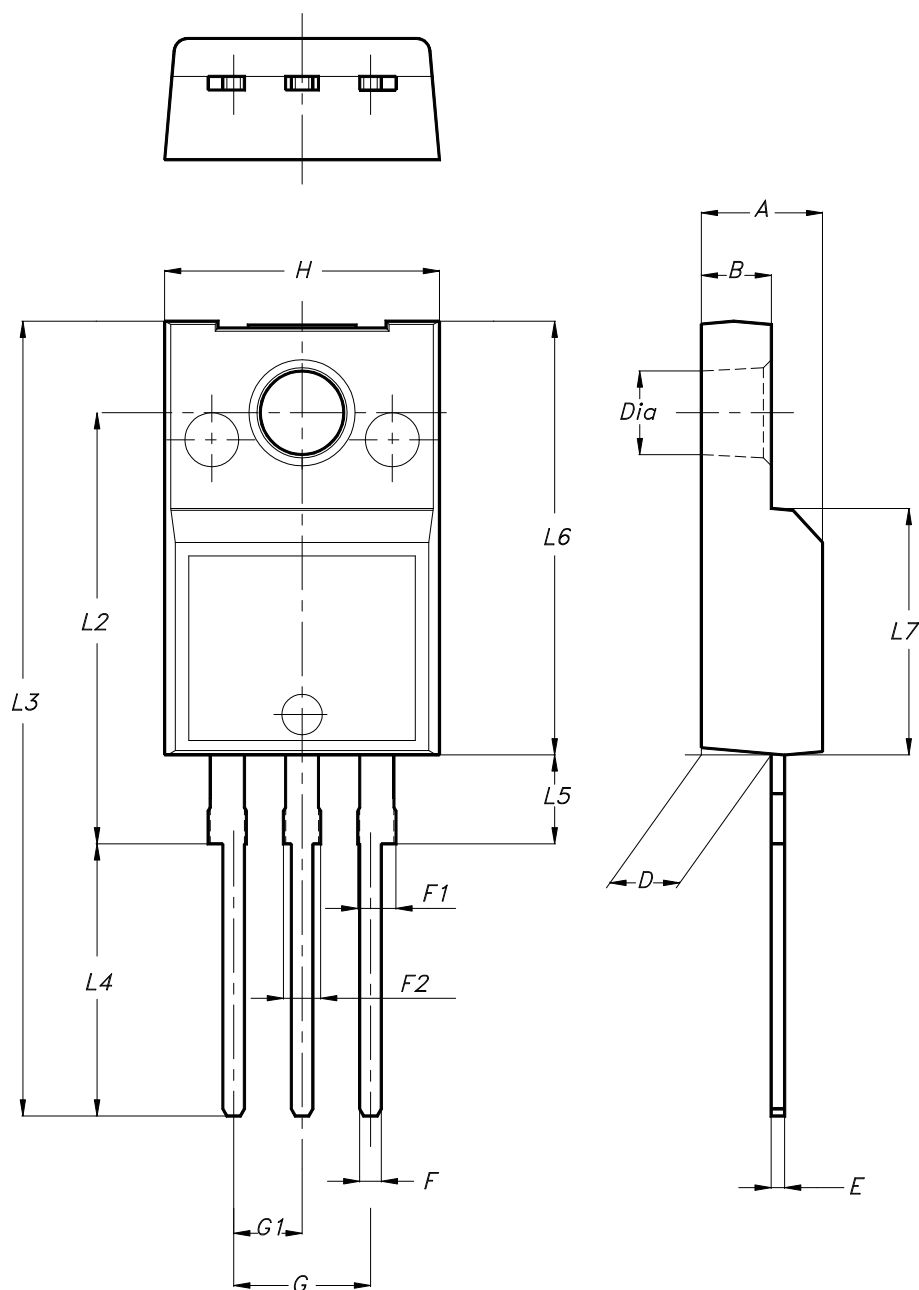
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4 Package information

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 21. TO-220FP type B package outline



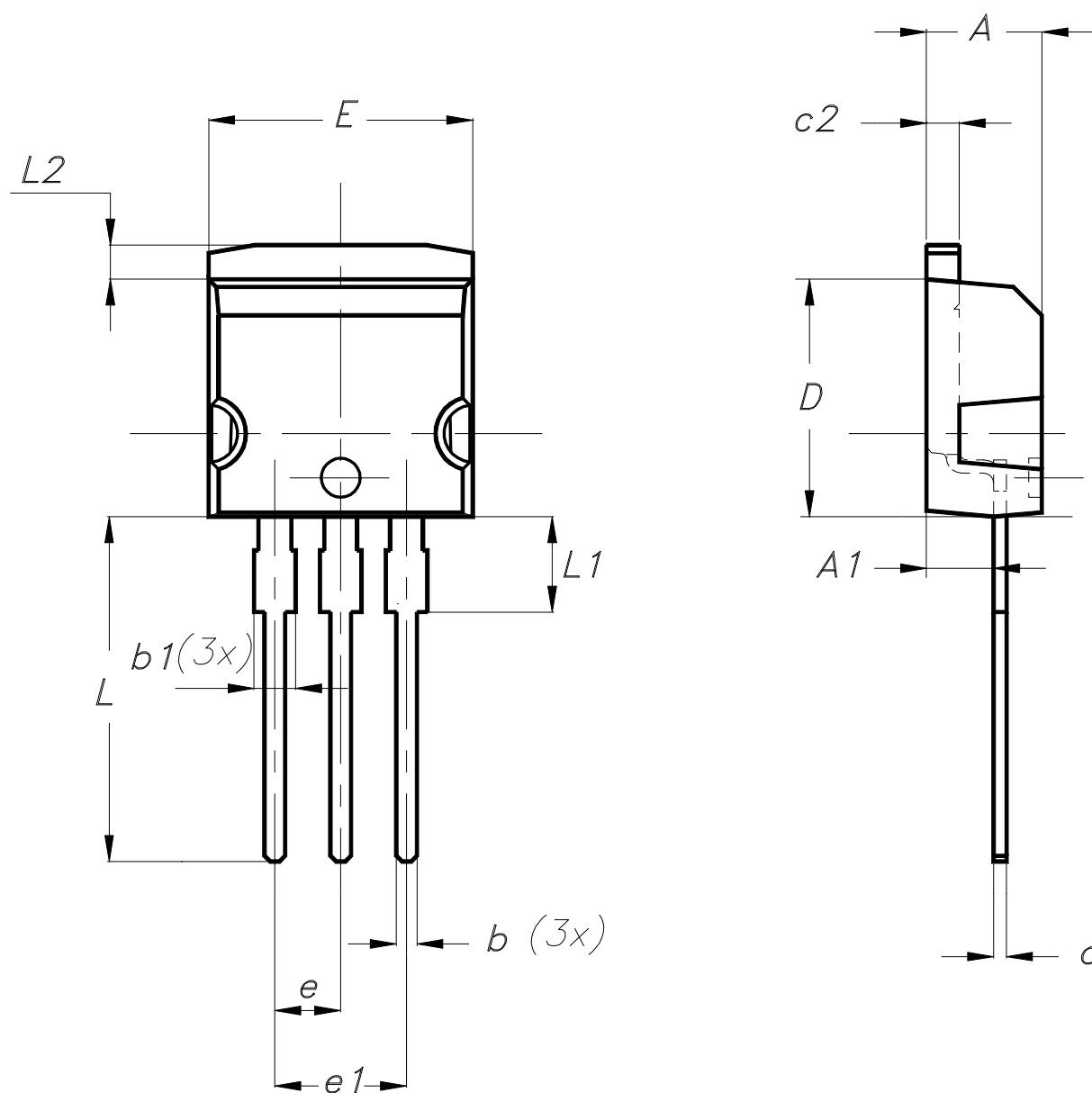
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Table 8. TO-220FP type B package mechanical data

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 I²PAK package information

Figure 22. I²PAK package outline



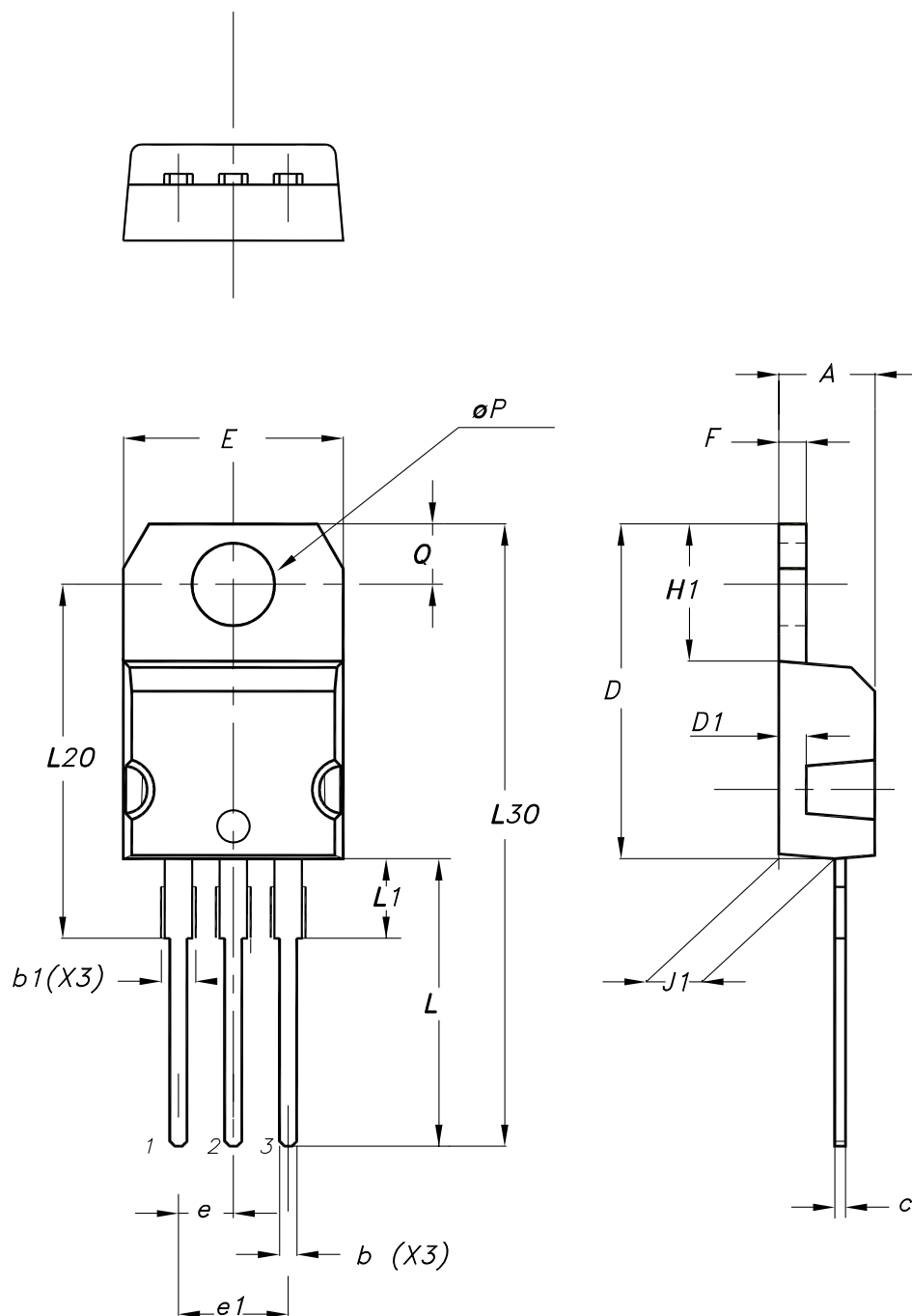
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Table 9. I²PAK package mechanical data

Dim.	mm	
	Min.	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	10.00	10.40
L	13.00	14.00
L1	3.50	3.93
L2	1.27	1.40

4.3 TO-220 type A package information

Figure 23. TO-220 type A package outline



0015988_typeA_Rev_24

Table 10. 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



5 Ordering information

Table 11. Order codes

Order codes	Marking	Package	Packing
STF24NM60N	24NM60N	TO-220FP	Tube
STI24NM60N		I ² PAK	
STP24NM60N		TO-220	

Revision history

Table 12. Document revision history

Date	Revision	Changes
05-Jan-2011	1	First release.
01-Jul-2011	2	Corrected $R_{thj-amb}$ value (see <i>Table 3: Thermal data</i>). Added new package and mechanical data: TO-247.
22-Aug-2011	3	Inserted device in I ² PAK. Updated <i>Table 1: Device summary</i> , <i>Table 2: Absolute maximum ratings</i> and <i>Table 3: Thermal data</i> . Inserted new mechanical data in <i>Section 4: Package mechanical data</i> .
24-Jul-2014	4	Modified: the entire typical values in <i>Table 6</i> . Modified: <i>Figure 12</i> . Updated: <i>Section 4: Package mechanical data</i> . Minor text changes.
13-Jan-2026	5	Removed order code STW24NM60N. Updated <i>Section 4: Package information</i> . Minor text changes.

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