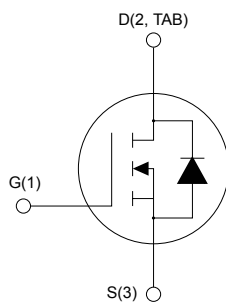
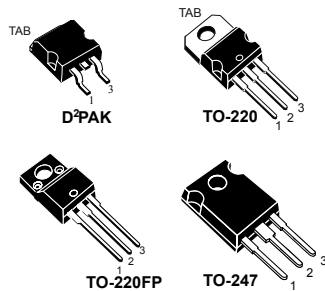




STB20NM60T4, STP20NM60 STP20NM60FP, STW20NM60

Datasheet

N-channel 600 V, 250 mΩ typ., 20 A MDmesh Power MOSFET in D²PAK, TO-220, TO-220FP and TO-247 packages



AM01475v1_noZen



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STB20NM60T4	600 V	290 mΩ	20 A
STP20NM60			
STP20NM60FP			
STW20NM60			

- High dv/dt and avalanche capabilities
- Low input capacitance and gate charge
- Low gate input resistance
- 100% avalanche tested

Applications

- Switching applications

Description

These N-channel Power MOSFETs are developed using STMicroelectronics' revolutionary MDmesh technology, which associates the multiple drain process with the company's PowerMESH horizontal layout. These devices offer extremely low on-resistance, high dv/dt and excellent avalanche characteristics. Utilizing ST's proprietary strip technique, these Power MOSFETs boast an overall dynamic performance which is superior to similar products on the market.

Product status links

[STB20NM60T4](#)

[STP20NM60](#)

[STP20NM60FP](#)

[STW20NM60](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		D ² PAK, TO-220 TO-247	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	20	20 ⁽¹⁾	A
	Drain current (continuous) at T _C = 100 °C	12.6	12.6 ⁽¹⁾	
I _{DM} ⁽²⁾	Drain current (pulsed)	80		A
P _{TOT}	Total power dissipation at T _C = 25 °C	192	45	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	-65 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} ≤ 20 A, di/dt ≤ 400 A/μs, V_{DD} ≤ V_{(BR)DSS}.

Table 2. Thermal data

Symbol	Parameter	Value		Unit
		D ² PAK, TO-220 TO-247	TO-220FP	
R _{thJC}	Thermal resistance, junction-to-case	0.65	2.8	°C/W
R _{thJA}	Thermal resistance, junction-to-ambient	62.5		°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I _{AS}	Avalanche current, repetitive or non-repetitive (pulse width limited by T _J max.)	10	A
E _{AS}	Single pulse avalanche energy (starting T _J = 25 °C, I _D = I _{AS} , V _{DD} = 50 V)	650	mJ

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\text{ }\mu\text{A}$, $V_{GS} = 0\text{ V}$	600	-	-	V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$	-	-	1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 600\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}^{(1)}$	-	-	10	
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 30\text{ V}$	-	-	± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 10\text{ A}$	-	250	290	m Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$g_{fs}^{(1)}$	Forward transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$, $I_D = 20\text{ A}$	-	11	-	S
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1500	-	pF
C_{oss}	Output capacitance		-	350	-	pF
C_{rss}	Reverse transfer capacitance		-	35	-	pF
$C_{oss\text{ eq.}}^{(2)}$	Equivalent output capacitance	$V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ to }480\text{ V}$	-	215	-	pF
Q_g	Total gate charge	$V_{DD} = 400\text{ V}$, $I_D = 20\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see the Figure 15. Test circuit for gate charge behavior)	-	39	54 ⁽³⁾	nC
Q_{gs}	Gate-source charge		-	10	-	nC
Q_{gd}	Gate-drain charge		-	20	-	nC
R_g	Gate input resistance	$f = 1\text{ MHz}$ gate DC bias = 0 test signal level = 20 mV open drain	-	1.6	-	Ω

1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5%.

2. $C_{oss\text{ eq.}}$ 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} .

3. Specified by design, not tested in production.

Table 6. Switching times

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\text{ V}$, $I_D = 10\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	25	-	ns
t_r	Rise time		-	20	-	ns
$t_{d(off)}$	Turn-off delay time	(see the Figure 14. Test circuit for resistive load switching times and Figure 19. Switching time waveform)	-	42	-	ns
t_f	Fall time		-	11	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-	-	20	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		80	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 20\text{ A}$, $V_{GS} = 0\text{ V}$	-	-	1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 20\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$	-	390		ns
Q_{rr}	Reverse recovery charge		-	5		μC
I_{RRM}	Reverse recovery current	(see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	25		A
t_{rr}	Reverse recovery time	$I_{SD} = 20\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_{DD} = 60\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	510		ns
Q_{rr}	Reverse recovery charge		-	6.5		μC
I_{RRM}	Reverse recovery current	(see the Figure 16. Test circuit for inductive load switching and diode recovery times)	-	26		A

1. Pulse width limited by safe operating area.
2. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

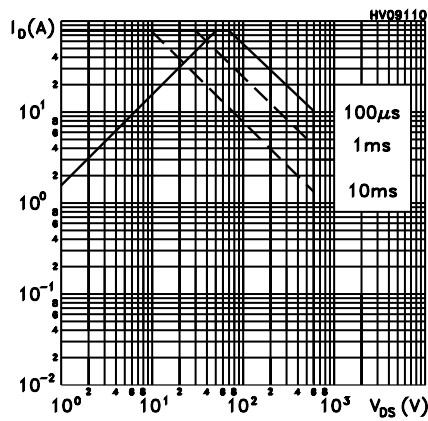
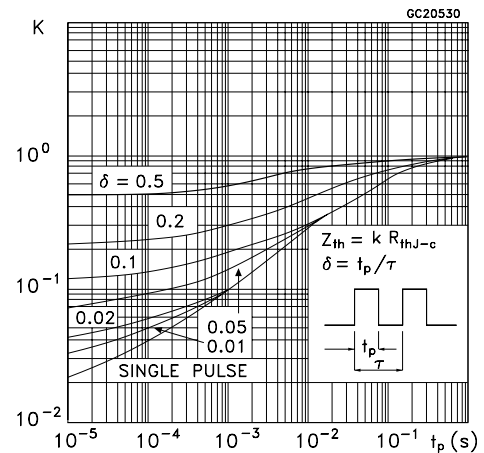
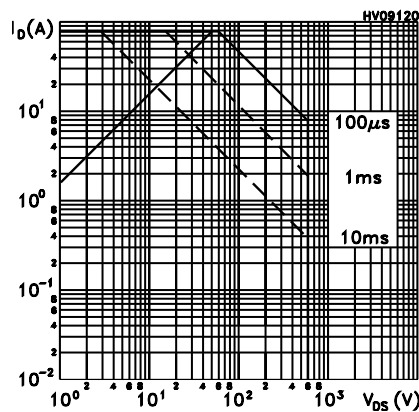
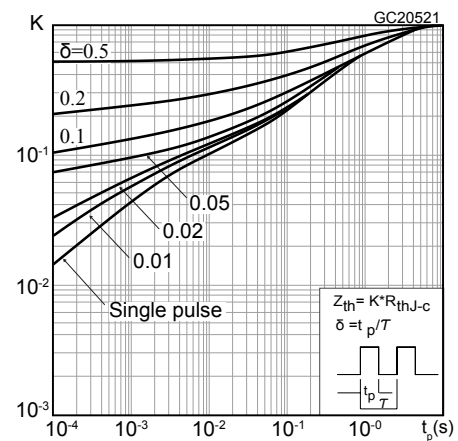
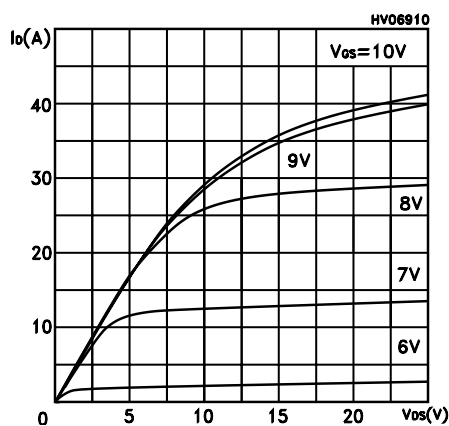
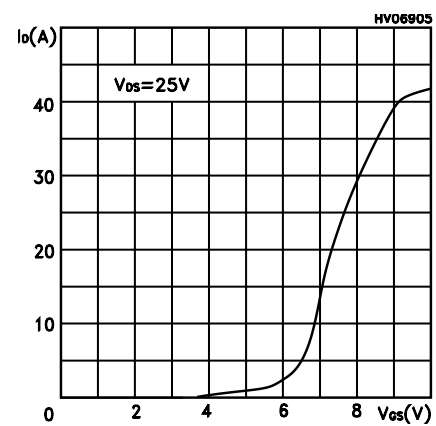
Figure 1. Safe operating area for D²PAK, TO-220 and TO-247

Figure 2. Thermal impedance for D²PAK, TO-220 and TO-247

Figure 3. Safe operating area for TO-220FP

Figure 4. Thermal impedance for TO-220FP

Figure 5. Output characteristics

Figure 6. Transfer characteristics


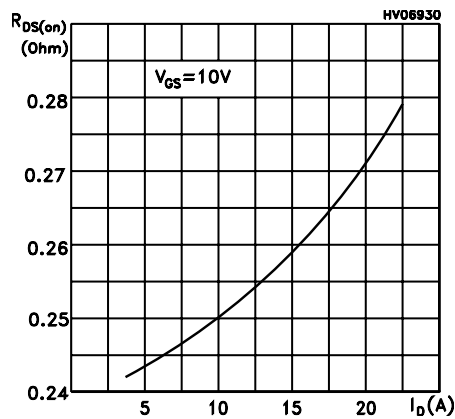
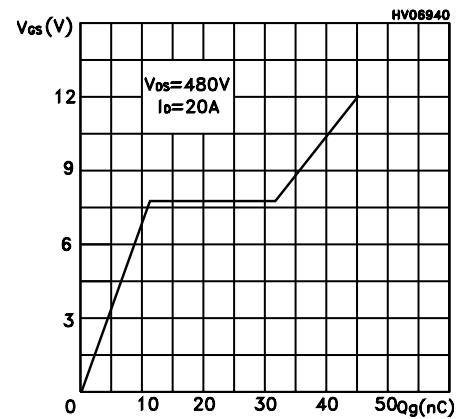
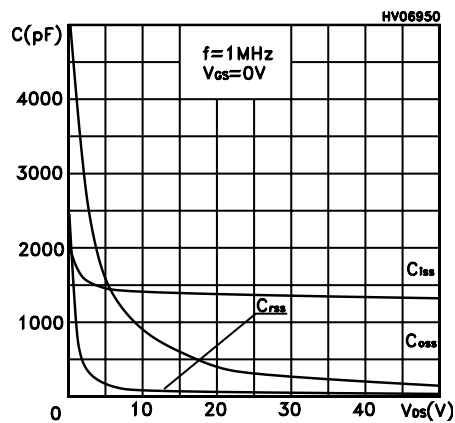
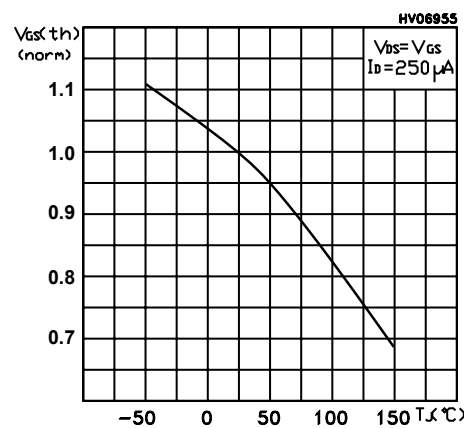
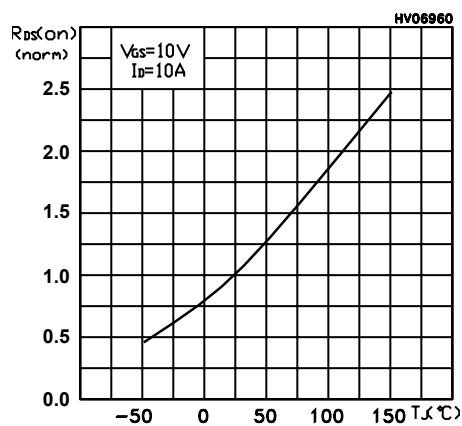
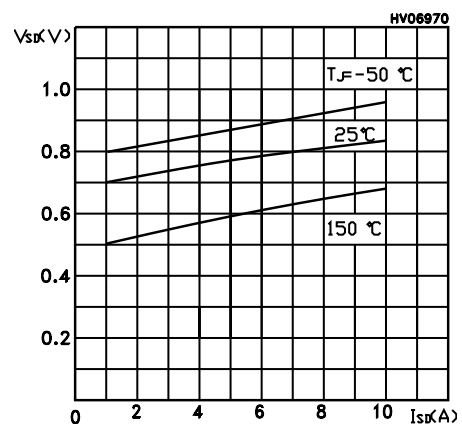
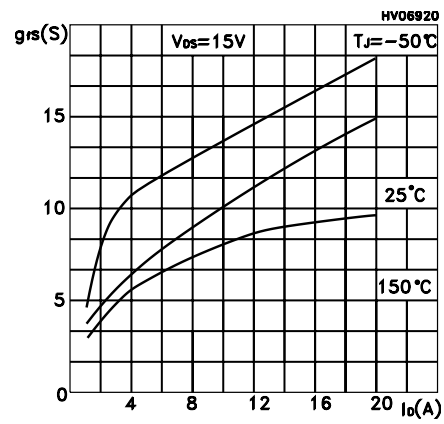
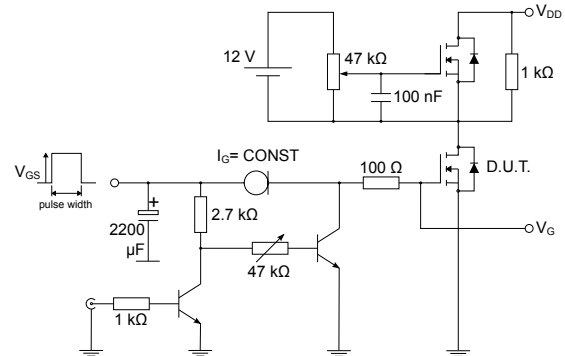
Figure 7. Static drain-source on-resistance

Figure 8. Gate charge vs gate-source voltage

Figure 9. Capacitance variations

Figure 10. Normalized gate threshold voltage vs temperature

Figure 11. Normalized on-resistance vs temperature

Figure 12. Source-drain diode forward characteristics


Figure 13. Transconductance


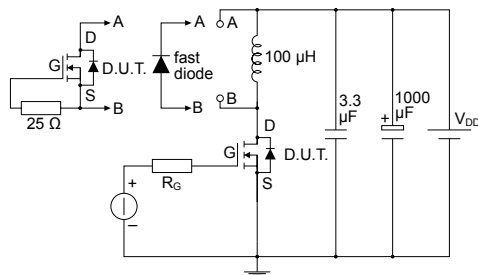
3 Test circuits

Figure 14. Test circuit for resistive load switching times

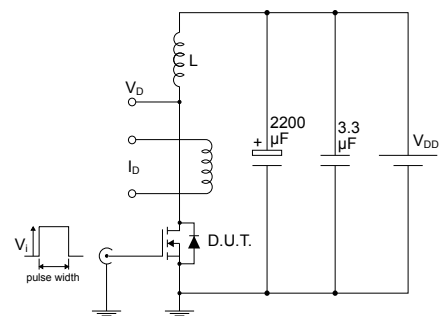

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Figure 15. Test circuit for gate charge behavior


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


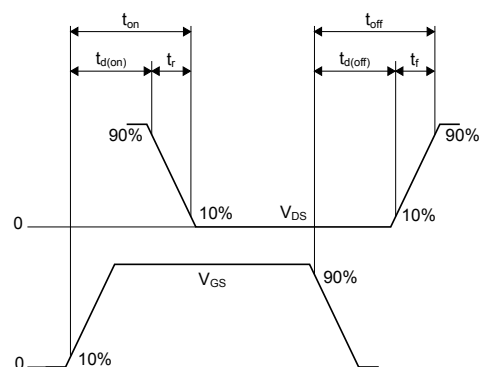
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Figure 17. Unclamped inductive load test circuit


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Figure 18. Unclamped inductive waveform


AM01472v1

Figure 19. Switching time waveform


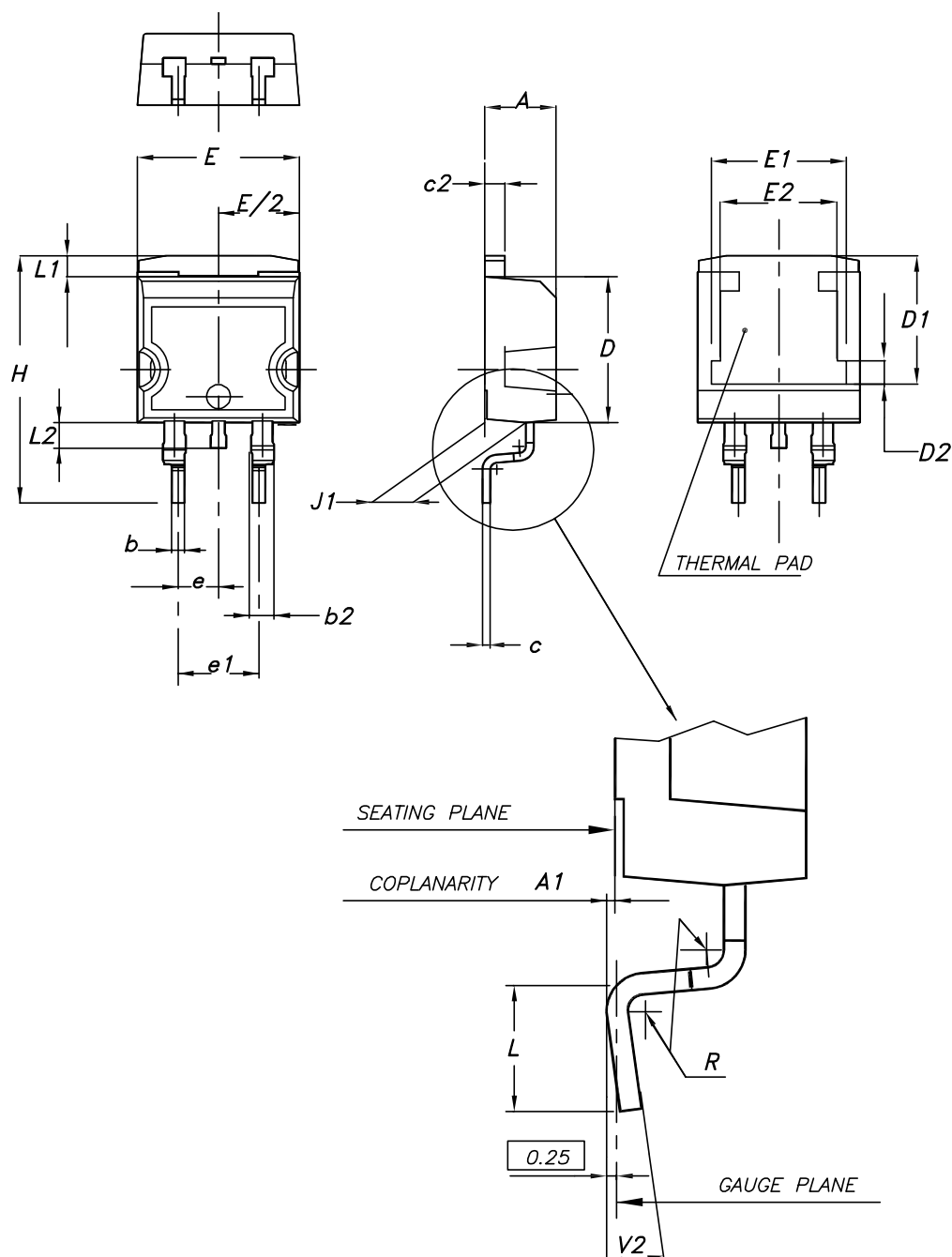
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4 Package information

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 D²PAK (TO-263) type A package information

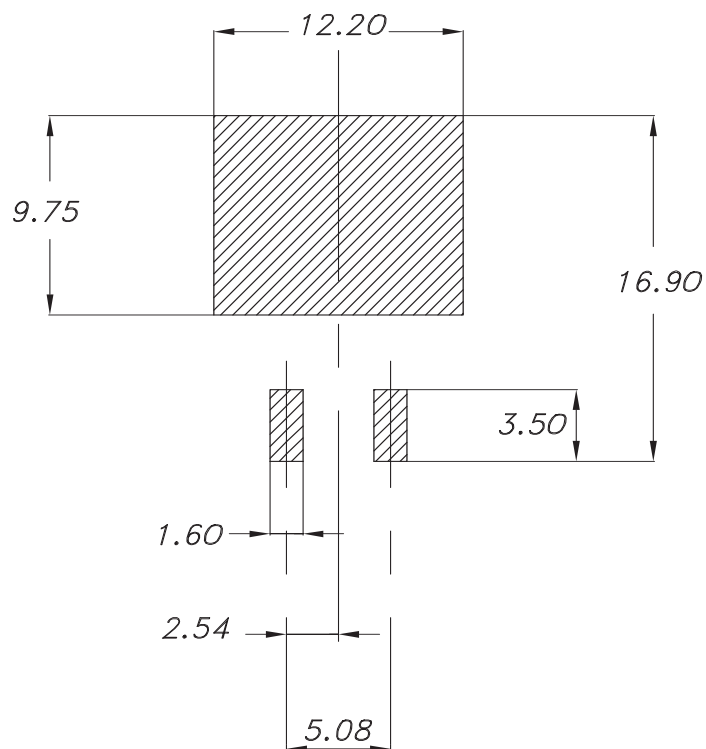
Figure 20. D²PAK (TO-263) type A package outline



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Table 8. D²PAK (TO-263) type A package mechanical data

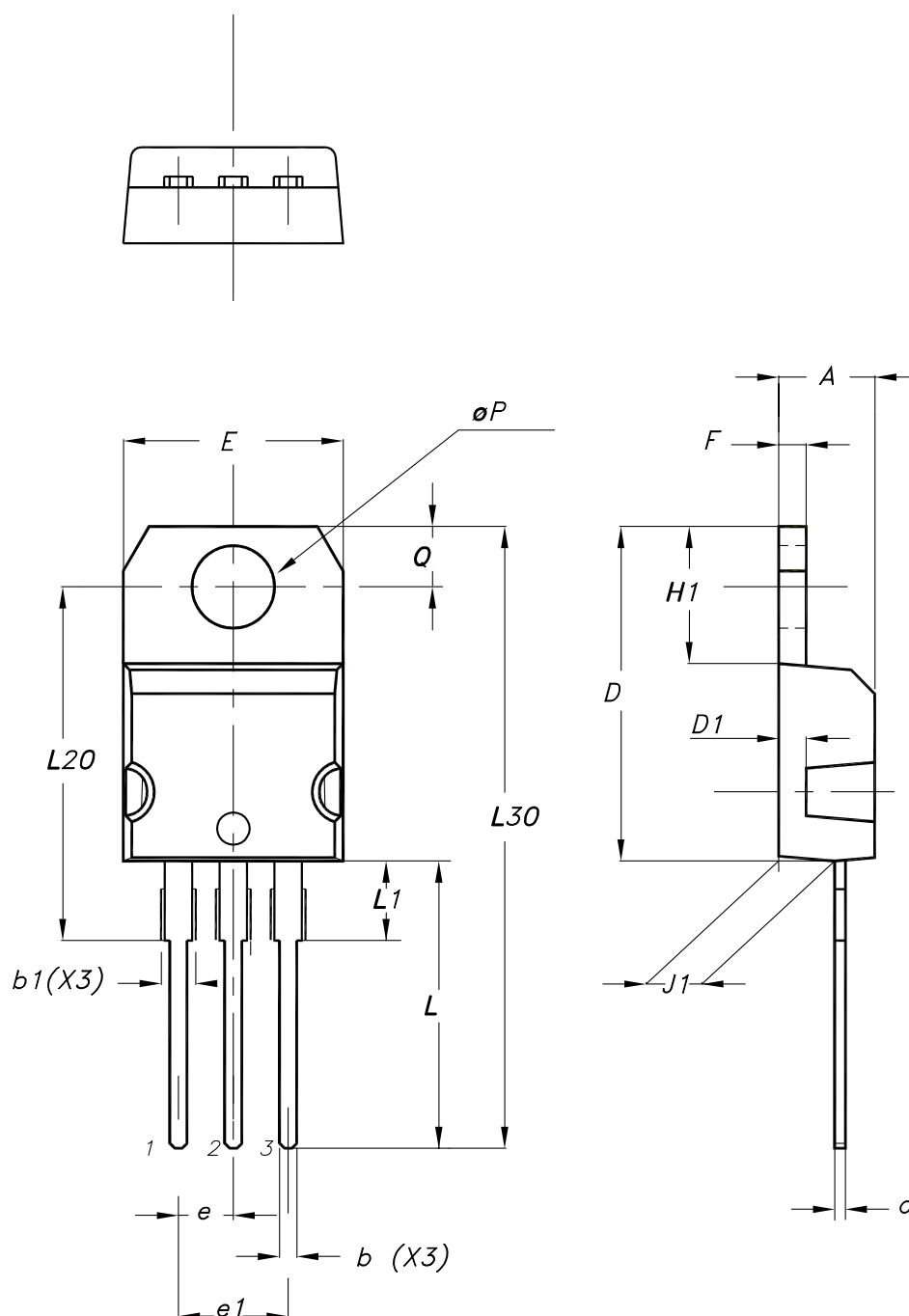
Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50	7.75	8.00
D2	1.10	1.30	1.50
E	10.00		10.40
E1	8.30	8.50	8.70
E2	6.85	7.05	7.25
e		2.54	
e1	4.88		5.28
H	15.00		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.40	
V2	0°		8°

Figure 21. D²PAK (TO-263) recommended footprint (dimensions are in mm)


0079457_Rev27_footprint

4.2 TO-220 type A package information

Figure 22. TO-220 type A package outline



0015988_typeA_Rev_24

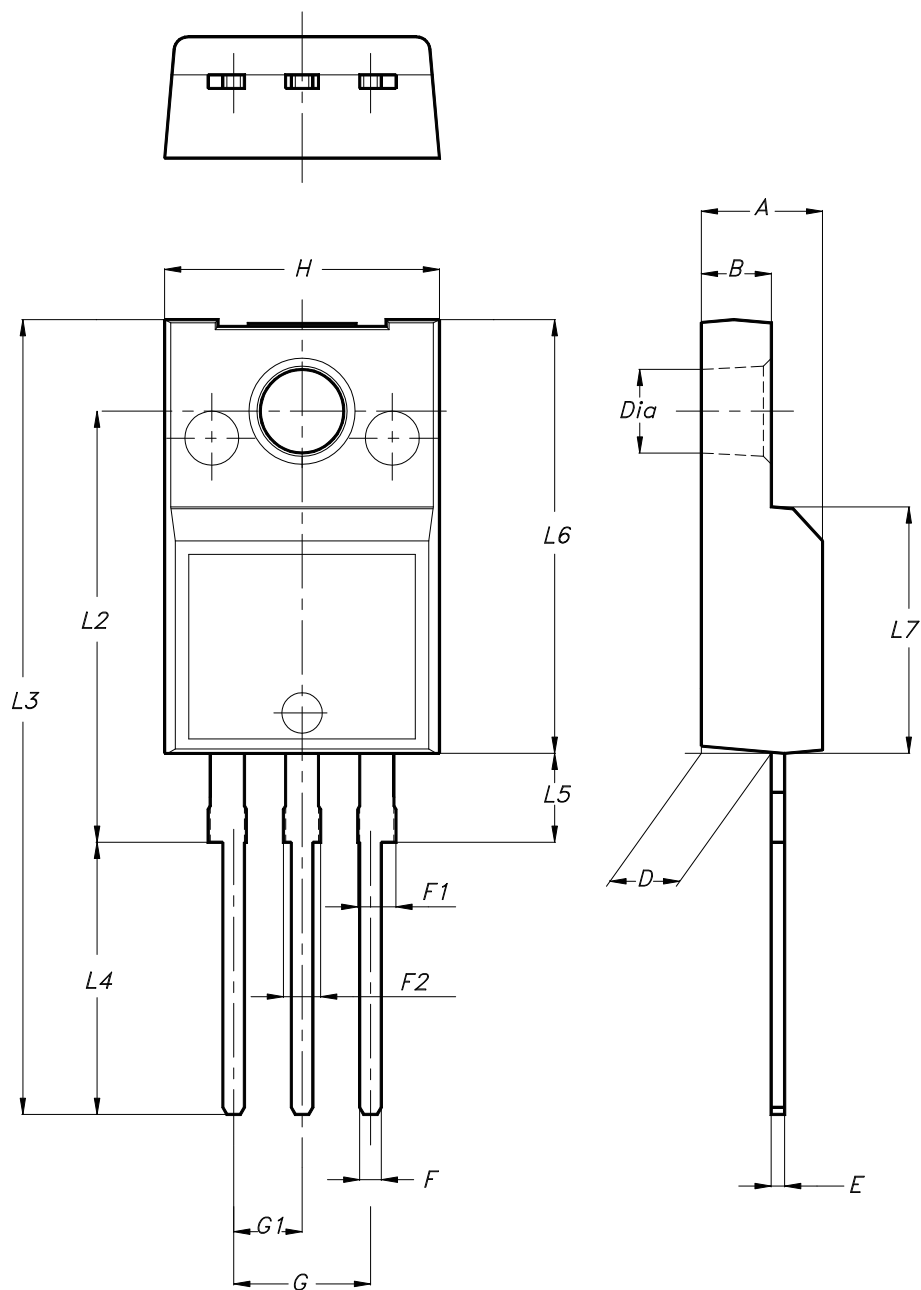


Table 9. TO-220 type A package mechanical data

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

4.3 TO-220FP type B package information

Figure 23. TO-220FP type B package outline



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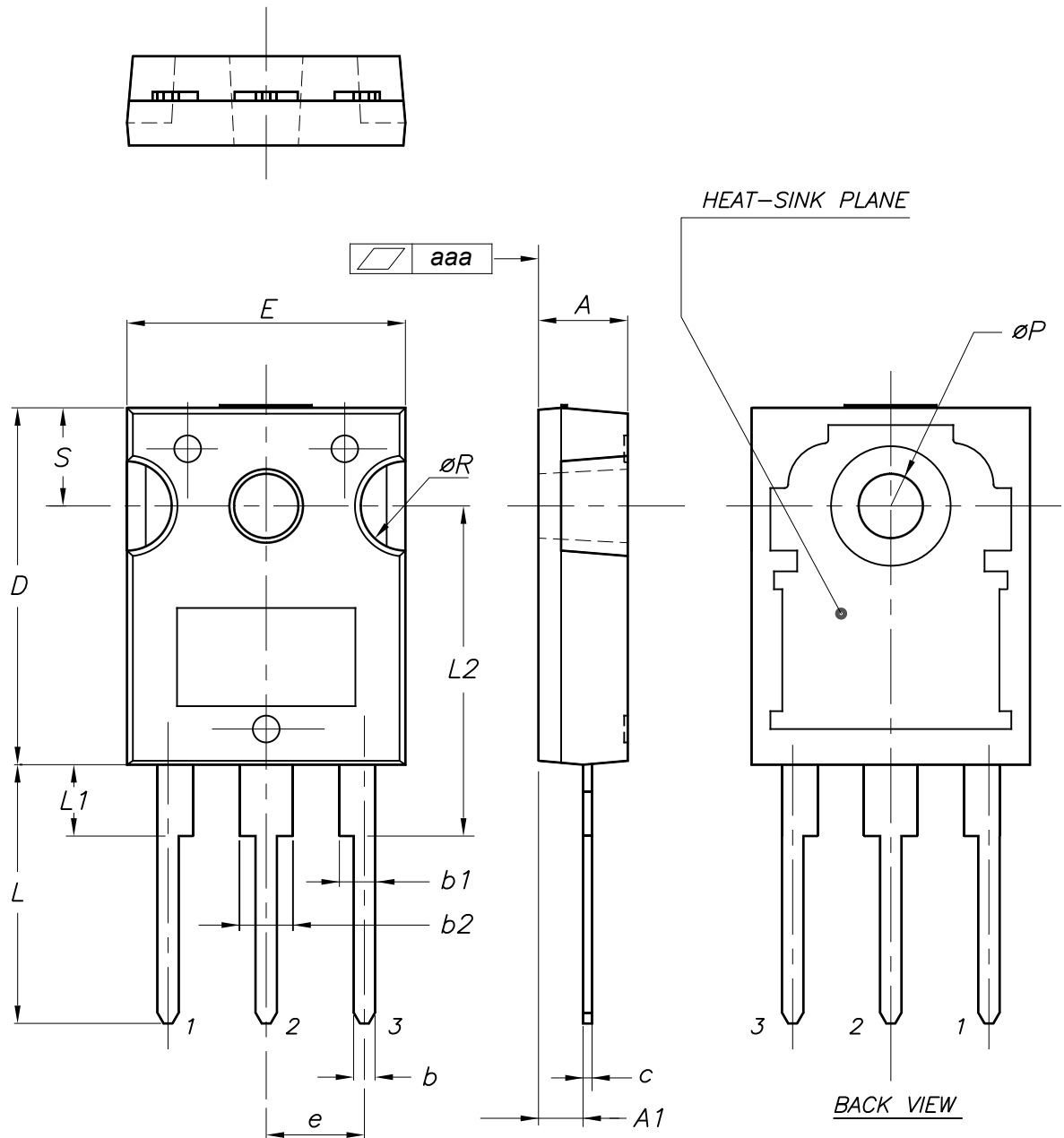


Table 10. TO-220FP type B package mechanical data

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

4.4 TO-247 package information

Figure 24. TO-247 package outline



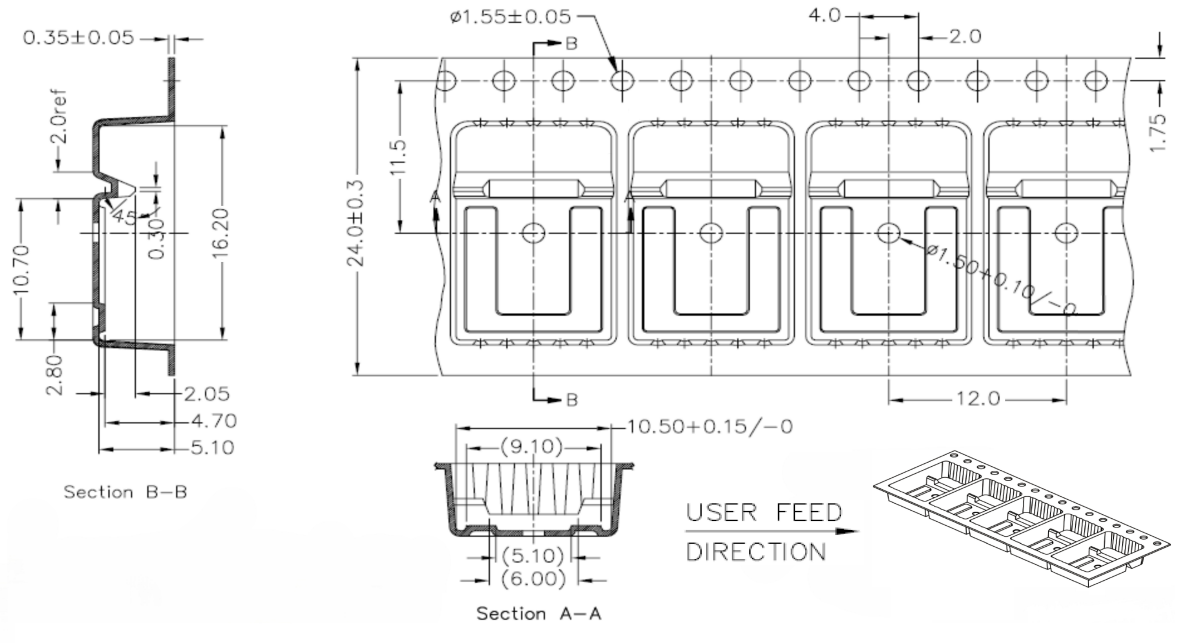
0075325_10

Table 11. TO-247 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	5.30	5.45	5.60
L	14.20		14.80
L1	3.70		4.30
L2		18.50	
ØP	3.55		3.65
ØR	4.50		5.50
S	5.30	5.50	5.70
aaa		0.04	0.10

4.5 D²PAK packing information

Figure 25. D²PAK tape drawing (dimensions are in mm)



DM01095771_2



5 Ordering information

Table 12. Order codes

Order codes	Marking	Package	Packing
STB20NM60T4	B20NM60	D ² PAK	Tape and reel
STP20NM60	P20NM60	TO-220	Tube
STP20NM60FP	P20NM60FP	TO-220FP	
STW20NM60	W20NM60	TO-247	



Revision history

Table 13. Document revision history

Date	Revision	Changes
17-Feb-2005	9	Insert the TO-247 package
25-Oct-2006	10	The document has been reformatted
18-Dec-2006	11	Text updates on <i>Table 5</i> .
27-Aug-2007	12	Updated <i>Figure 2</i> and <i>Figure 4</i> .
30-Jul-2025	13	Removed order code STB20NM60-1. Updated Section 4: Package information . Minor text changes.



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4.2	TO-220 type A package information	12
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