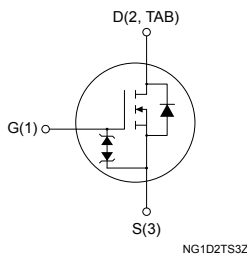
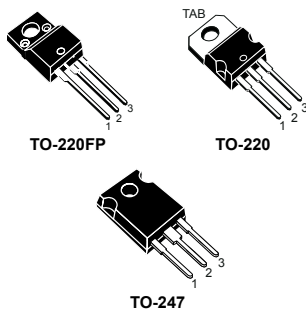




N-channel 1000 V, 2.7 Ω typ., 3.5 A SuperMESH Power MOSFET in a TO-220FP, TO-220 and TO-247 packages



Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STF5NK100Z	1000 V	3.7 Ω	3.5 A
STP5NK100Z			
STW5NK100Z			

- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitance
- Zener-protected

Applications

- Switching applications

Description

These high-voltage devices are Zener-protected N-channel Power MOSFETs developed using the SuperMESH technology by STMicroelectronics, an optimization of the well-established PowerMESH. In addition to a significant reduction in on-resistance, these devices are designed to ensure a high level of dv/dt capability for the most demanding applications.

Product status links

[STF5NK100Z](#)

[STP5NK100Z](#)

[STW5NK100Z](#)

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value		Unit
		TO-220 TO-247	TO-220FP	
V_{DS}	Drain-source voltage	1000		V
V_{GS}	Gate-source voltage	±30		V
I_D	Drain current (continuous) at $T_C = 25\text{ °C}$	3.5	3.5 ⁽¹⁾	A
	Drain current (continuous) at $T_C = 100\text{ °C}$	2.2	2.2 ⁽¹⁾	
$I_{DM}^{(2)}$	Drain current (pulsed)	14	14 ⁽¹⁾	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ °C}$	125	30	W
ESD	Gate-source human body model (C = 100 pF, R = 1.5 kΩ)	4		kV
$dv/dt^{(3)}$	Peak diode recovery voltage slope	4.5		V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; $T_C = 25\text{ °C}$)	-	2.5	kV
T_J	Operating junction temperature range	-55 to 150		°C
T_{stg}	Storage temperature range			

- Limited by maximum junction temperature.
- Pulse width limited by safe operating area.
- $I_{SD} \leq 3.5\text{ A}$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DS}(\text{peak}) < V_{(BR)DSS}$.

Table 2. Thermal data

Symbol	Parameter	Value			Unit
		TO-220FP	TO-220	TO-247	
R_{thJC}	Thermal resistance, junction-to-case	4.2	1		°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	62.5		50	°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.)	3.5	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ °C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	250	mJ

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0\text{ V}$	1000	-	-	V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$, $V_{DS} = 1000\text{ V}$	-	-	1	μA
		$V_{GS} = 0\text{ V}$, $V_{DS} = 1000\text{ V}$, $T_C = 125\text{ °C}^{(1)}$	-	-	50	
I_{GSS}	Gate body leakage current	$V_{DS} = 0\text{ V}$, $V_{GS} = \pm 20\text{ V}$	-	-	± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 100\text{ }\mu\text{A}$	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 1.75\text{ A}$	-	2.7	3.7	$\text{m}\Omega$

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	1154	-	pF
C_{oss}	Output capacitance		-	106	-	pF
C_{riss}	Reverse transfer capacitance		-	21.3	-	pF
$C_{oss\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0$ to 800 V , $V_{GS} = 0\text{ V}$	-	46.8	-	pF
Q_g	Total gate charge	$V_{DD} = 800\text{ V}$, $I_D = 3.5\text{ A}$, $V_{GS} = 0$ to 10 V (see the Figure 17. Test circuit for gate charge behavior)	-	42	59 ⁽²⁾	nC
Q_{gs}	Gate-source charge		-	7.3	-	nC
Q_{gd}	Gate-drain charge		-	21.7	-	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_{DSS} .

2. 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	$V_{DD} = 500\text{ V}$, $I_D = 1.75\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$ (see the Figure 16. Test circuit for resistive load switching times and Figure 21. Switching time waveform)	-	22.5	-	ns
t_r	Rise time		-	7.7	-	ns
$t_{d(off)}$	Turn-off delay time		-	51.5	-	ns
t_f	Fall time		-	19	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current	-	-	-	3.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-	-	14	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 3.5 \text{ A}$, $V_{GS} = 0 \text{ V}$	-	-	1.6	V
t_{rr}	Reverse recovery time	$I_{SD} = 3.5 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 35 \text{ V}$ (see the Figure 18. Test circuit for inductive load switching and diode recovery times)	-	605	-	ns
Q_{rr}	Reverse recovery charge		-	3.09	-	μC
I_{RRM}	Reverse recovery current		-	10.5	-	A
t_{rr}	Reverse recovery time	$I_{SD} = 3.5 \text{ A}$, $di/dt = 100 \text{ A}/\mu\text{s}$, $V_{DD} = 35 \text{ V}$, $T_J = 150 \text{ }^\circ\text{C}$ (see the Figure 18. Test circuit for inductive load switching and diode recovery times)	-	742	-	ns
Q_{rr}	Reverse recovery charge		-	4.2	-	μC
I_{RRM}	Reverse recovery current		-	11.2	-	A

1. Pulse width is 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

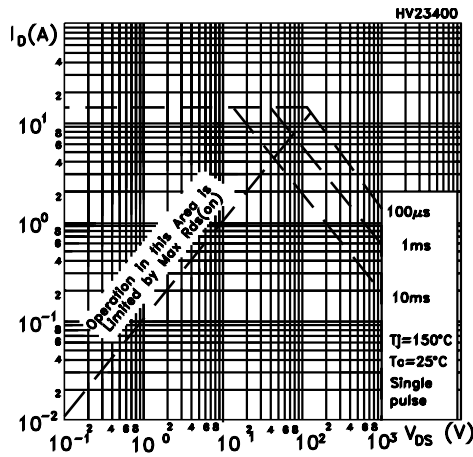


Figure 2. Normalized transient thermal impedance for TO-220 FP

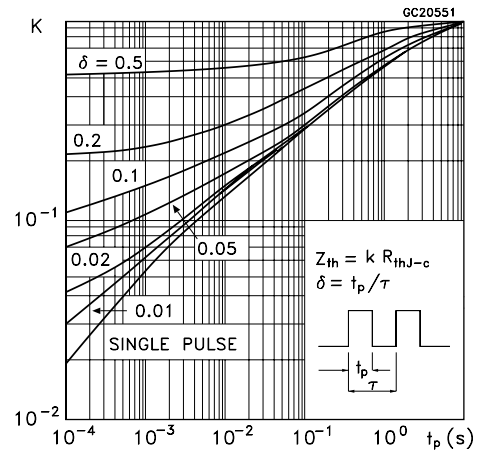


Figure 3. Safe operating area for TO-220

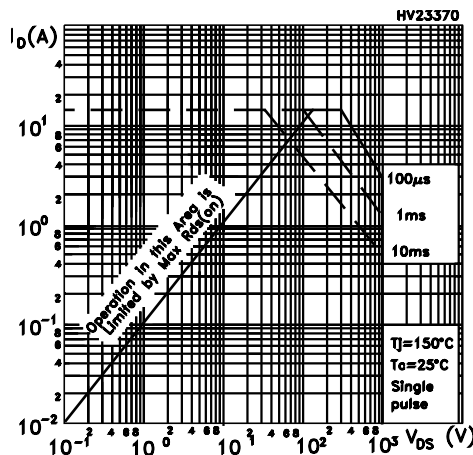


Figure 4. Normalized transient thermal impedance for TO-220

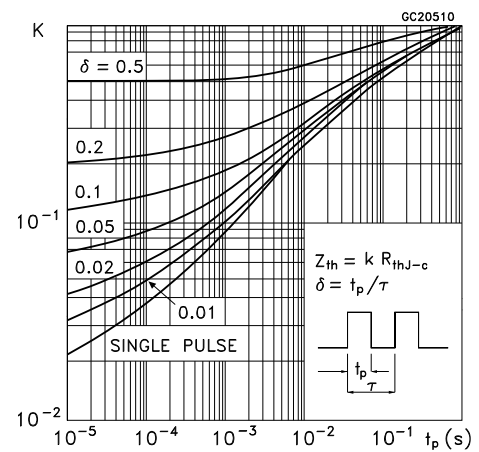


Figure 5. Safe operating area for TO-247

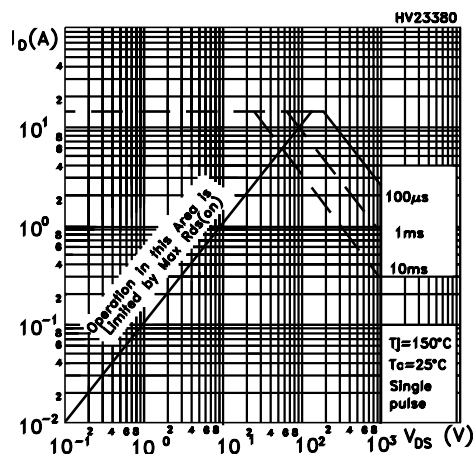


Figure 6. Normalized transient thermal impedance for TO-247

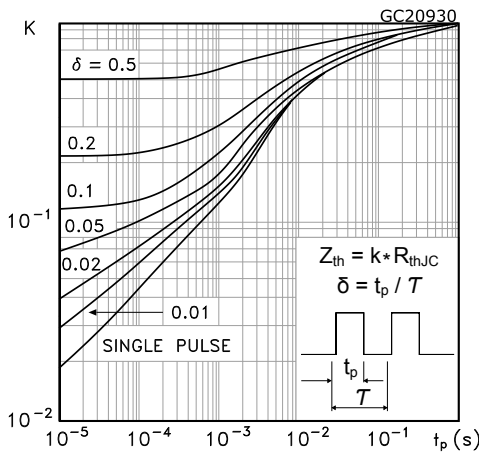


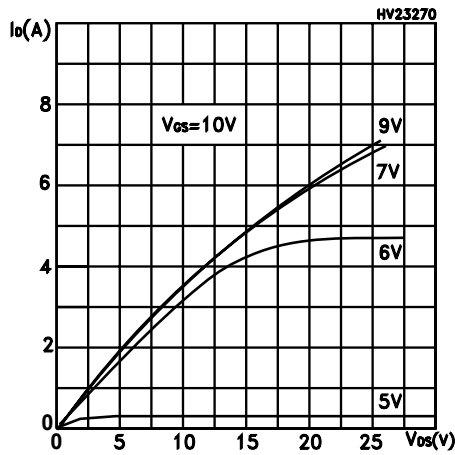
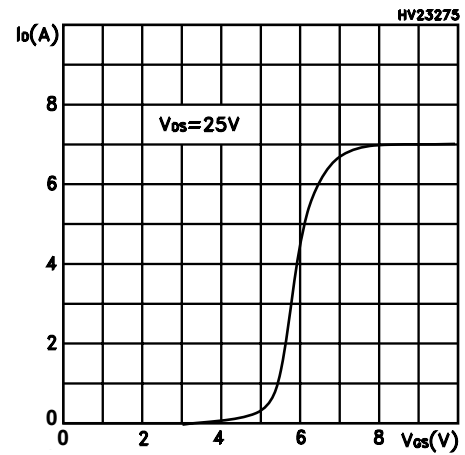
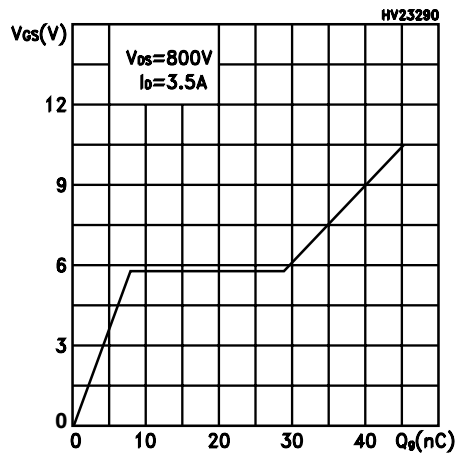
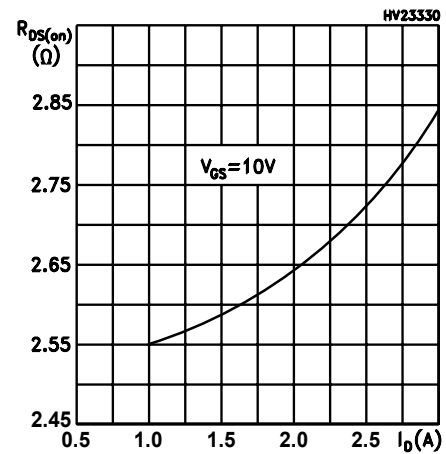
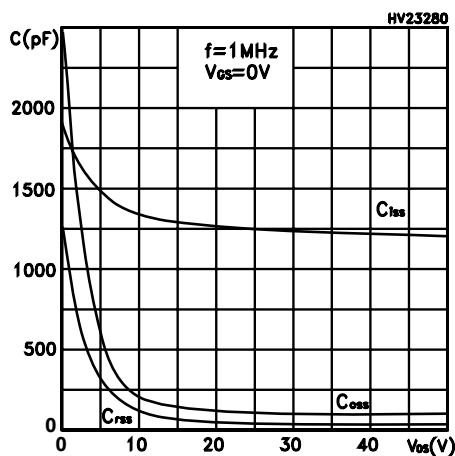
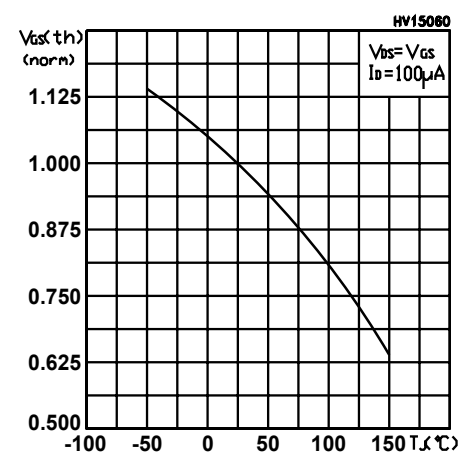
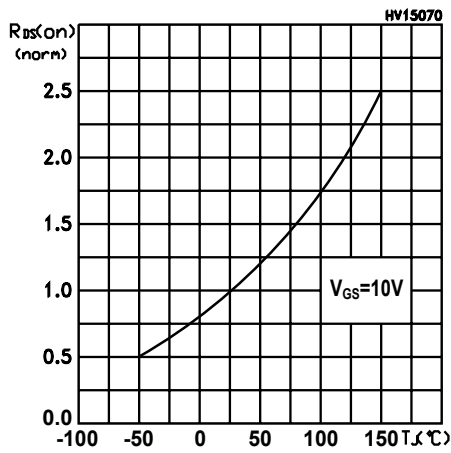
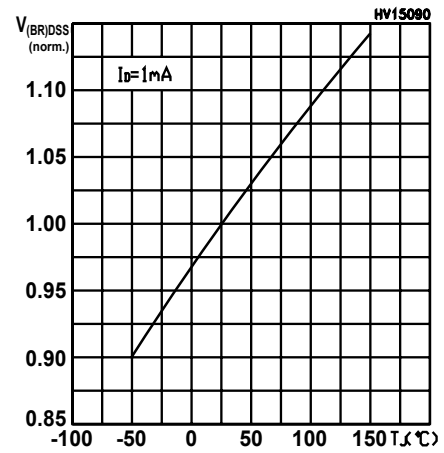
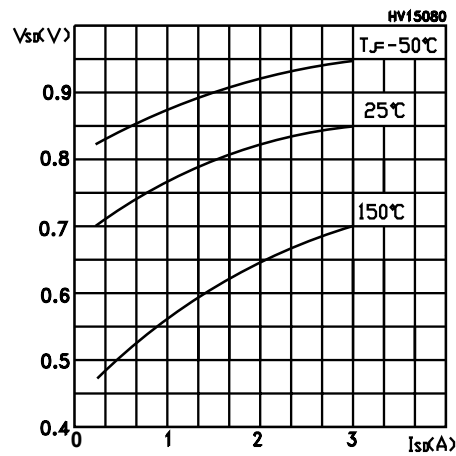
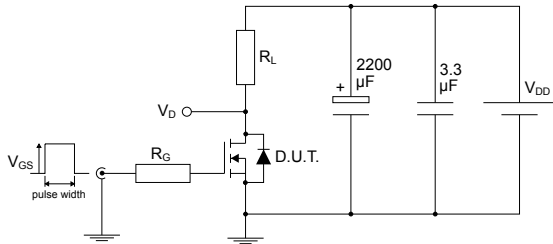
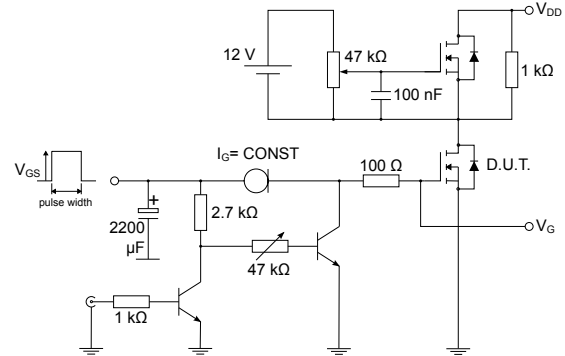
Figure 7. Typical output characteristics

Figure 8. Typical transfer characteristics

Figure 9. Gate charge vs gate-source voltage

Figure 10. Typical drain-source on-resistance

Figure 11. Capacitance variations

Figure 12. Normalized gate threshold vs temperature


Figure 13. Normalized on-resistance vs temperature

Figure 14. Normalized breakdown voltage vs temperature

Figure 15. Typical reverse diode forward characteristics


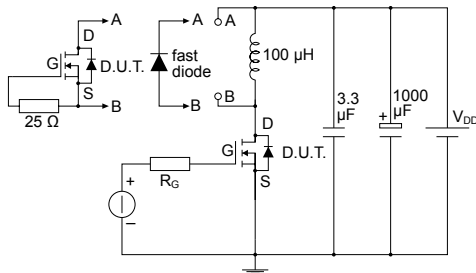
3 Test circuits

Figure 16. Test circuit for resistive load switching times


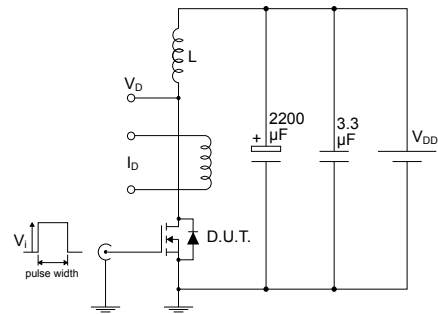
AM01468v1

Figure 17. Test circuit for gate charge behavior


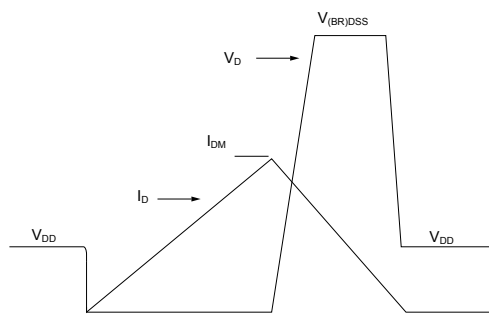
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Figure 18. Test circuit for inductive load switching and diode recovery times


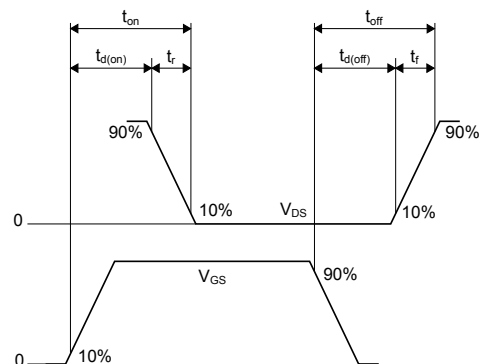
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Figure 19. Unclamped inductive load test circuit


AM01471v1

Figure 20. Unclamped inductive waveform


AM01472v1

Figure 21. Switching time waveform


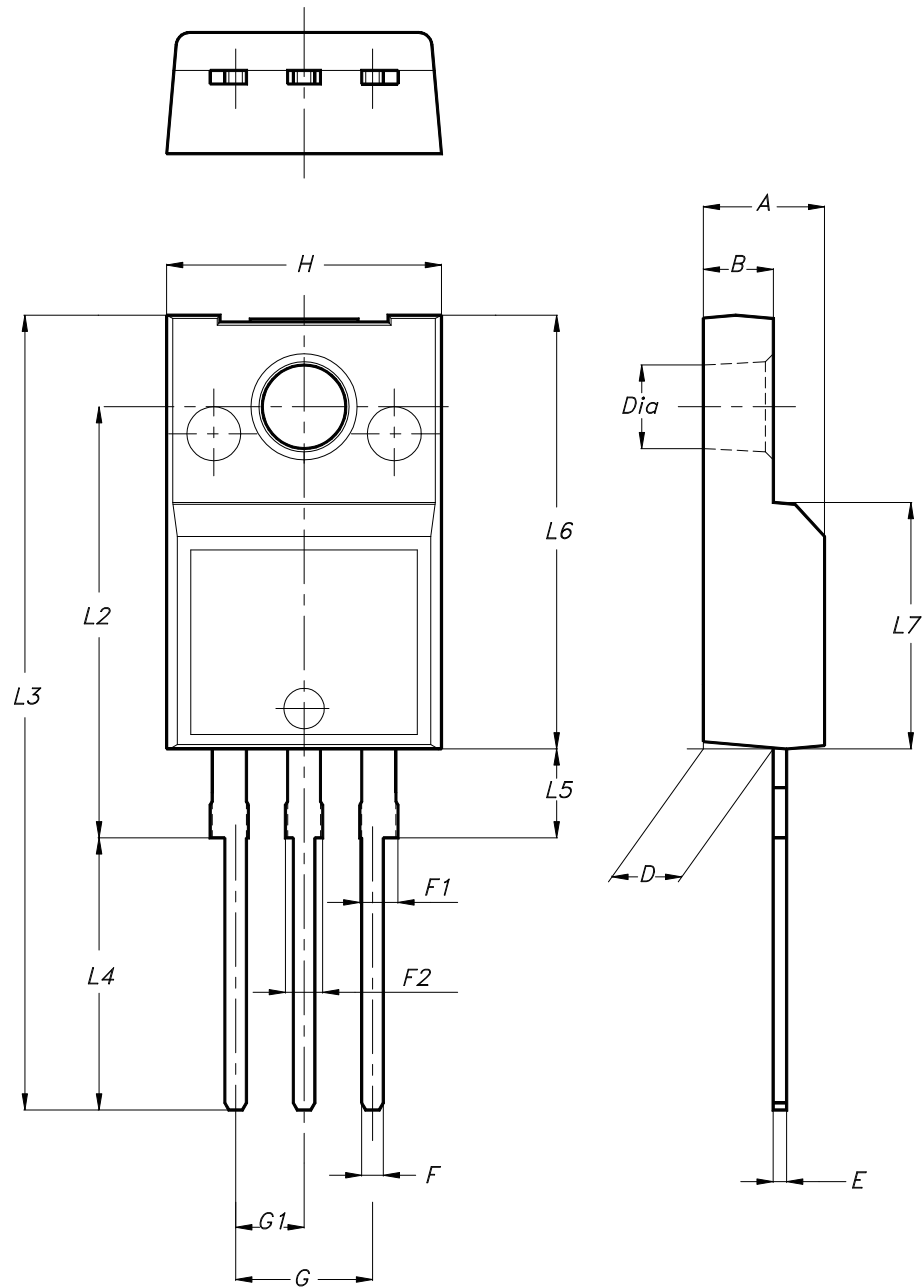
AM01473v1

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 22. TO-220FP type B package outline



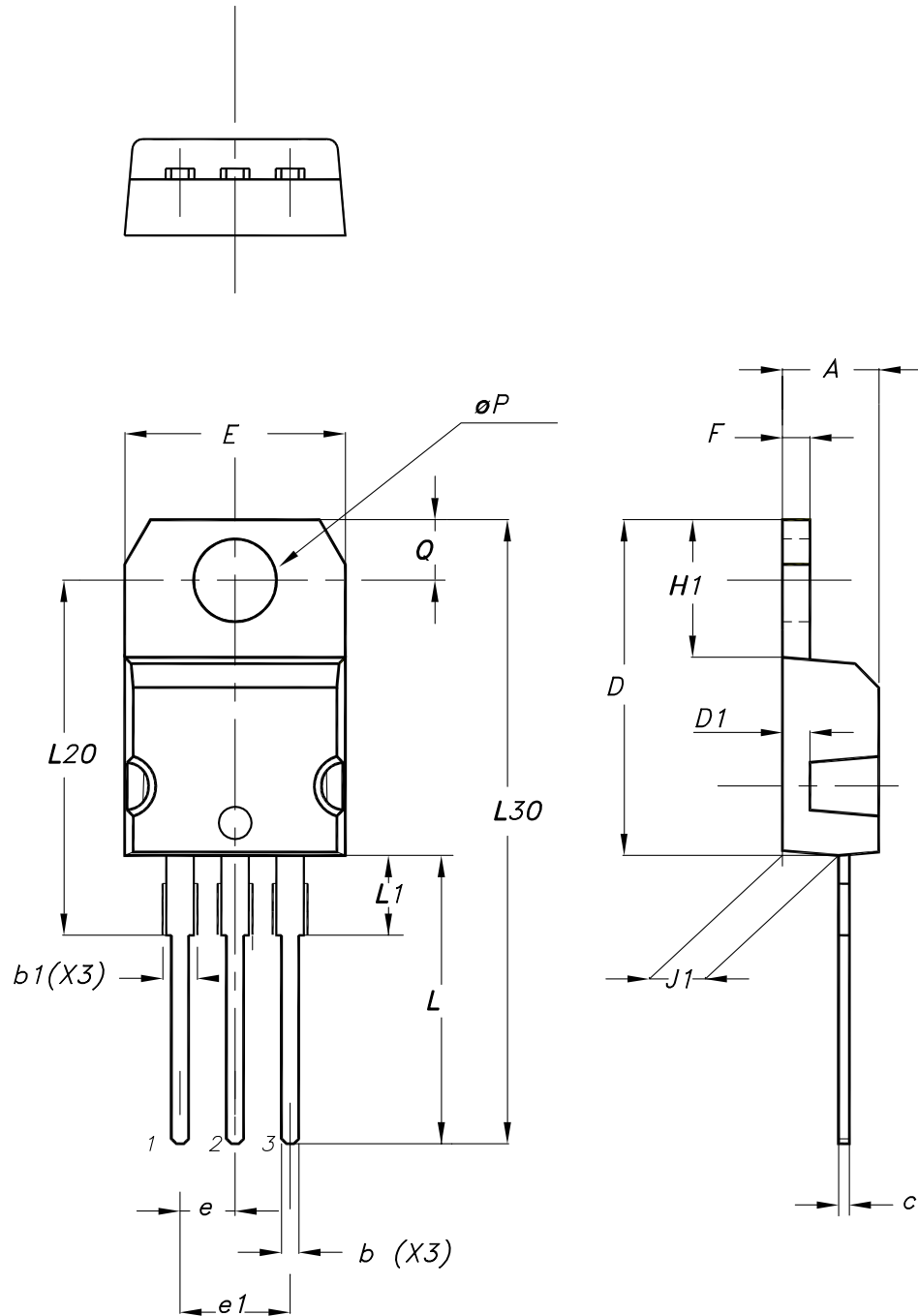
7012510_B_rev.14

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 23. TO-220 type A package outline



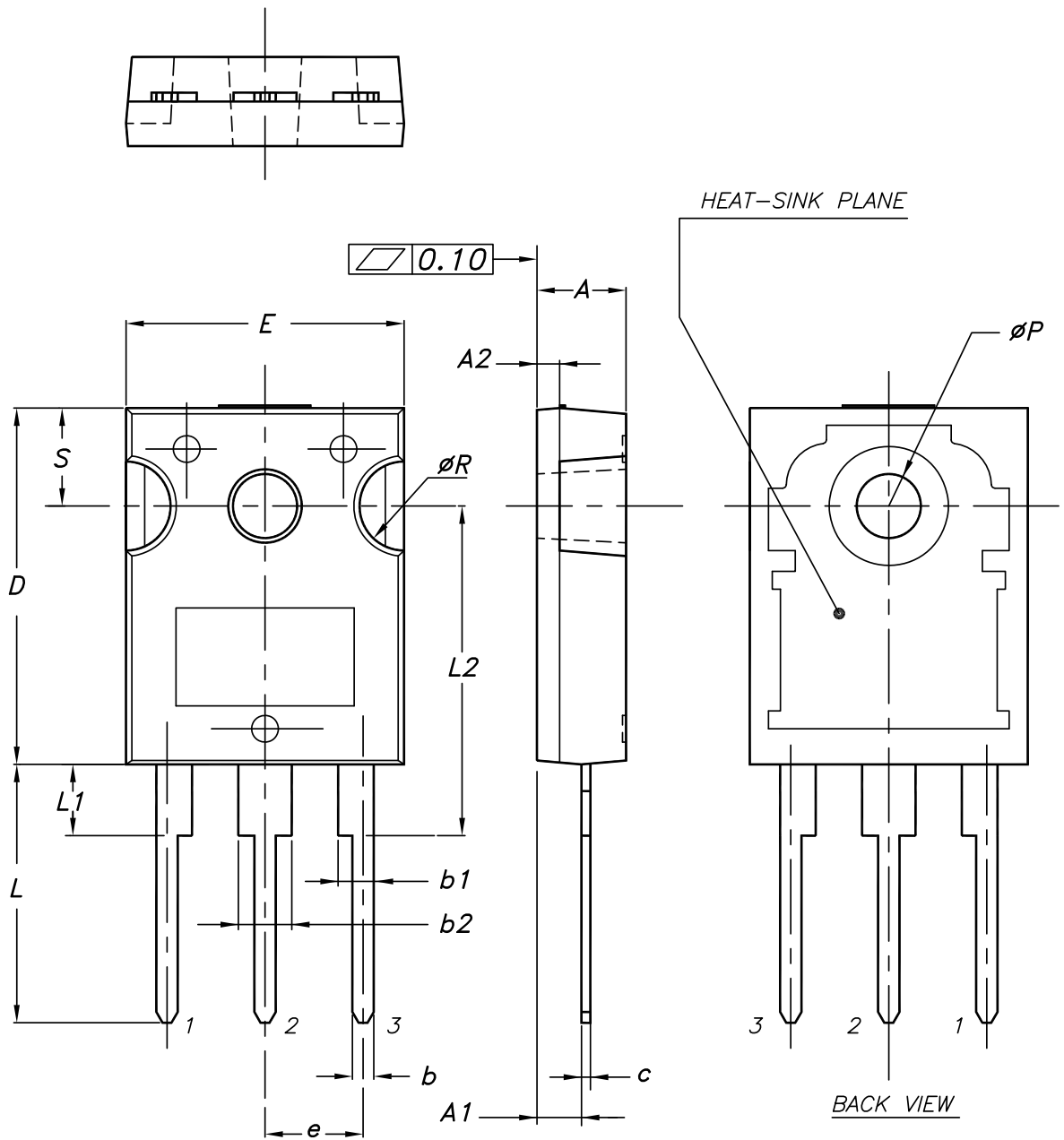
0015988_typeA_Rev_24

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-247 package information

Figure 24. TO-247 package outline



0075325_11

Table 10. TO-247 package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
A2		1.27	
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



5 Ordering information

Table 11. Order codes

Order codes	Marking	Package	Packing
STF5NK100Z	F5NK100Z	TO-220FP	Tube
STP5NK100Z	P5NK100Z	TO-220	
STW5NK100Z	W5NK100Z	TO-247	

Revision history

Table 12. Document revision history

Date	Version	Changes
12-Oct-2004	1	First release.
08-Sep-2005	2	Complete datasheet.
16-Dec-2005	3	Inserted ecopack indication.
16-Aug-2006	4	New template, no content change.
15-May-2009	5	Modified: <i>Section 2.1: Electrical characteristics (curves)</i> .
22-Jan-2026	6	Updated Section 4: Package information . Minor text changes.



Contents

1	Electrical ratings	2
2	Electrical characteristics	3
2.1	Electrical characteristics curves	5
3	Test circuits	8
4	Package information	9
4.1	TO-220FP type B package information	9
4.2	TO-220 type A package information	11
4.3	TO-247 package information	13
5	Ordering information	15
	Revision history	16



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