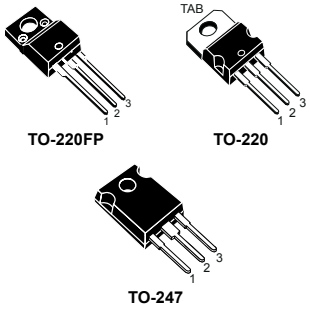
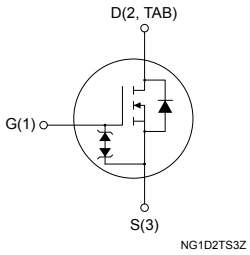
STF5NK100Z, STP5NK100Z, STW5NK100Z

Datasheet

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 °C	3.5	3.5(1)	A
	Drain current (continuous) at T_C = 100 °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 °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 °C)	-	2.5	kV
T_J	Operating junction temperature range	-55 to 150		°C
T_{stg}	Storage temperature range			

1. *Limited by maximum junction temperature.*
2. *Pulse width limited by safe operating area.*
3. *I_{SD} ≤ 3.5 A, di/dt ≤ 200 A/µs, V_{DS} (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 °C, I_D = I_{AR}, V_{DD} = 50 V)	250	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	1000	-	-	V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 1000 V	-	-	1	µA
		V_{GS} = 0 V, V_{DS} = 1000 V, T_C = 125 °C(1)	-	-	50	
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V	-	-	±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 µA	3	3.75	4.5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 1.75 A	-	2.7	3.7	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} = 25 V, f = 1 MHz, V_{GS} = 0 V	-	1154	-	pF
C_{oss}	Output capacitance		-	106	-	pF
C_{rss}	Reverse transfer capacitance		-	21.3	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS} = 0 to 800 V, V_{GS} = 0 V	-	46.8	-	pF
Q_g	Total gate charge	V_{DD} = 800 V, I_D = 3.5 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. *$C_{oss\ eq.}$ 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 V, I_D = 1.75 A, R_G = 4.7 Ω, V_{GS} = 10 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 A, V_{GS} = 0 V	-	-	1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 3.5 A, di/dt = 100 A/µs, V_{DD} = 35 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 A, di/dt = 100 A/µs, V_{DD} = 35 V, T_J = 150 °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

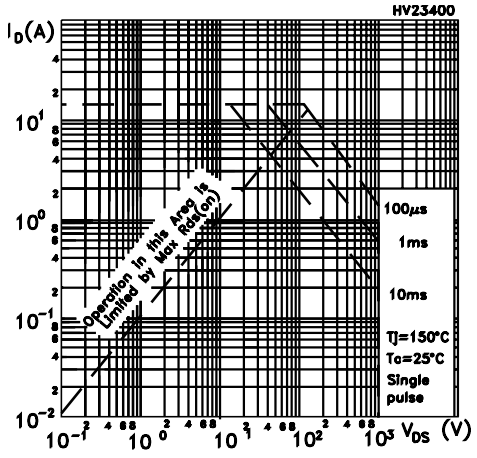


Figure 2. Normalized transient thermal impedance for TO-220 FP

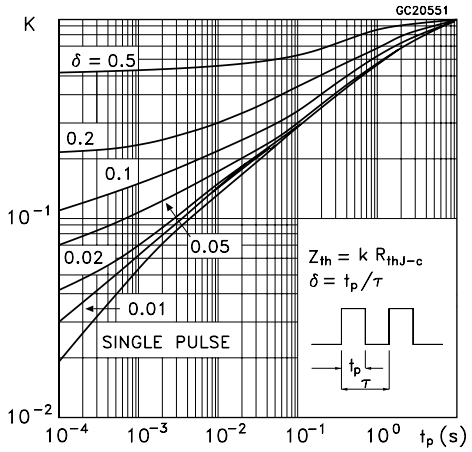


Figure 3. Safe operating area for TO-220

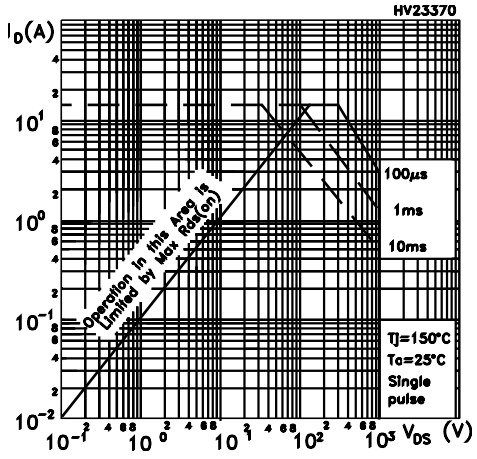


Figure 4. Normalized transient thermal impedance for TO-220

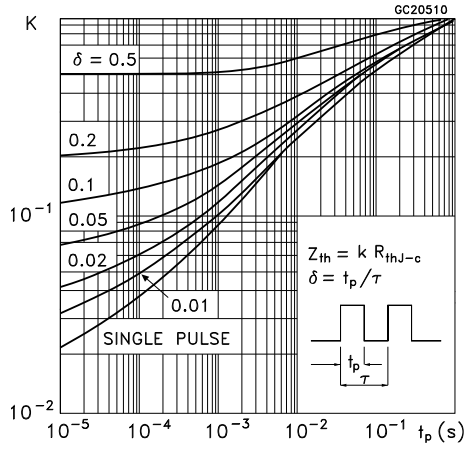


Figure 5. Safe operating area for TO-247

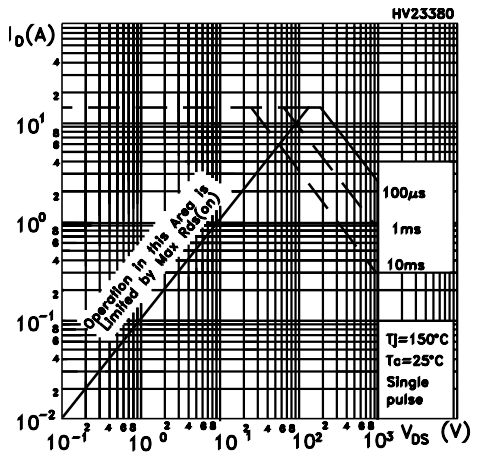


Figure 6. Normalized transient thermal impedance for TO-247

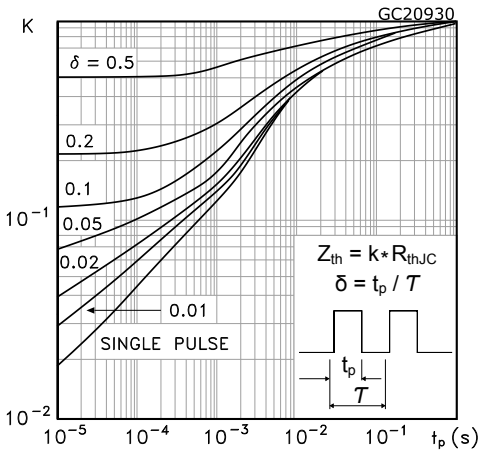


Figure 7. Typical output characterisics

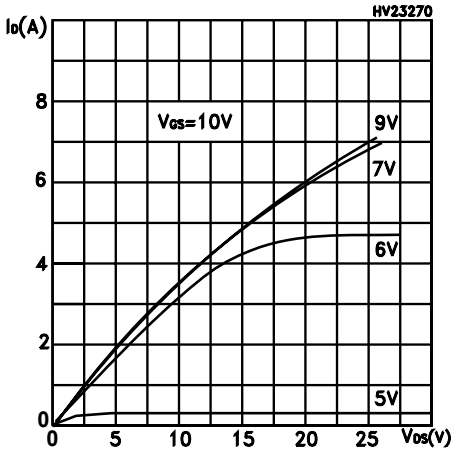


Figure 8. Typical transfer characteristics

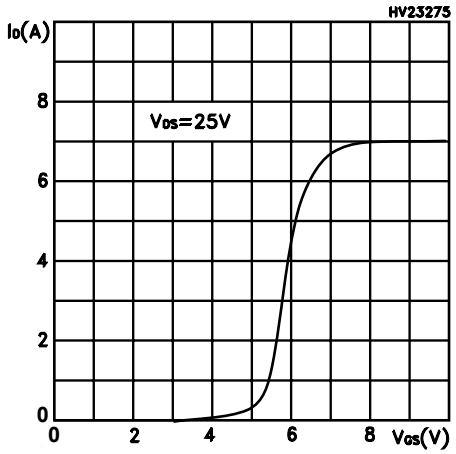


Figure 9. Gate charge vs gate-source voltage

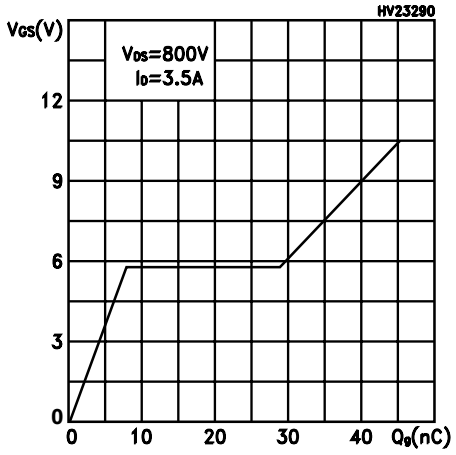


Figure 10. Typical drain-source on-resistance

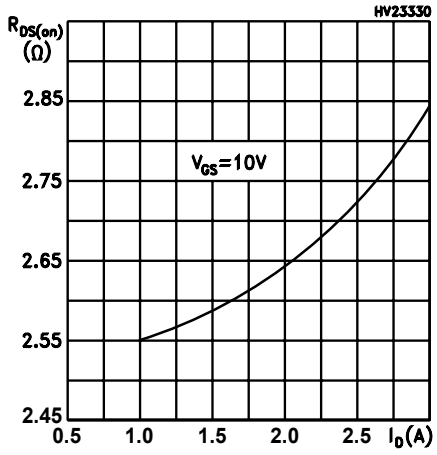


Figure 11. Capacitance variations

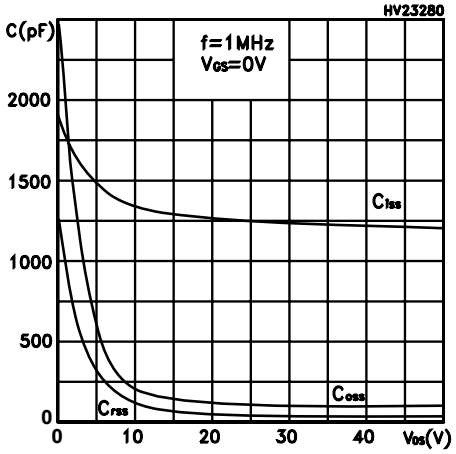


Figure 12. Normalized gate threshold vs temperature

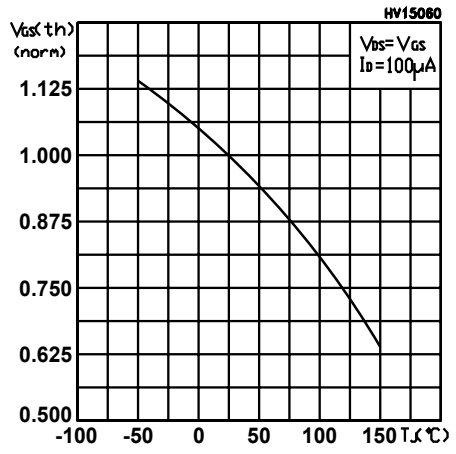


Figure 13. Normalized on-resistance vs temperature

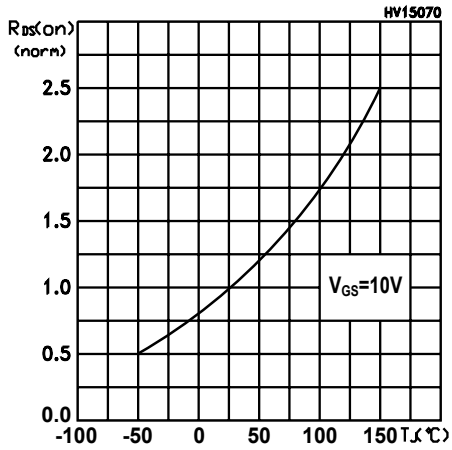


Figure 14. Normalized breakdown voltage vs temperature

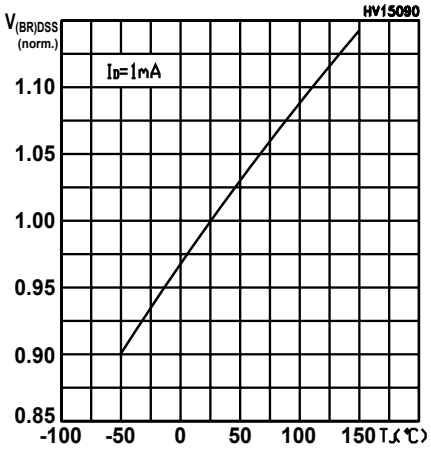
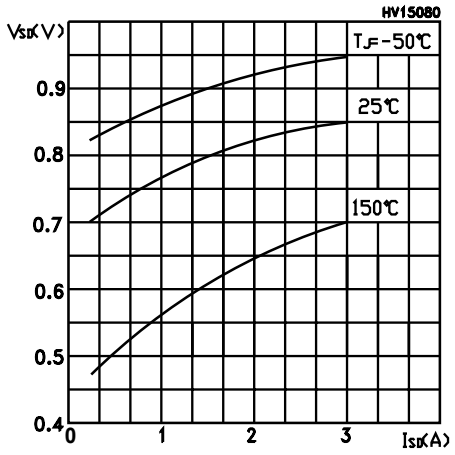


Figure 15. Typical reverse diode forward characteristics



3 Test circuits

Figure 16. Test circuit for resistive load switching times

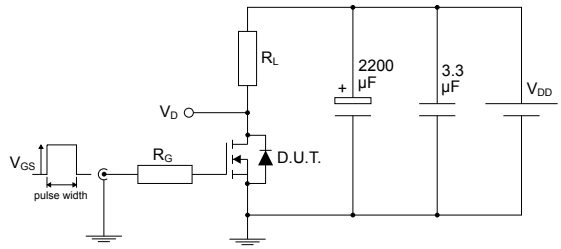


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Figure 17. Test circuit for gate charge behavior

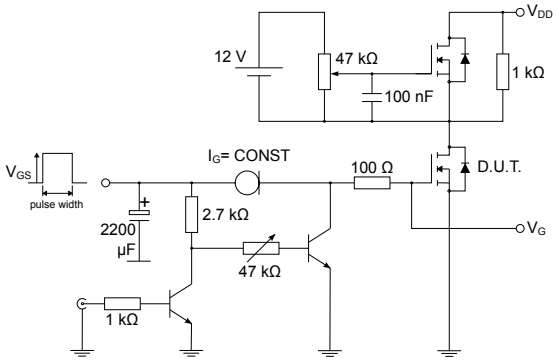

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Figure 18. Test circuit for inductive load switching and diode recovery times

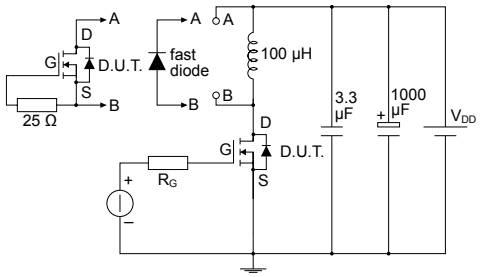

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Figure 19. Unclamped inductive load test circuit

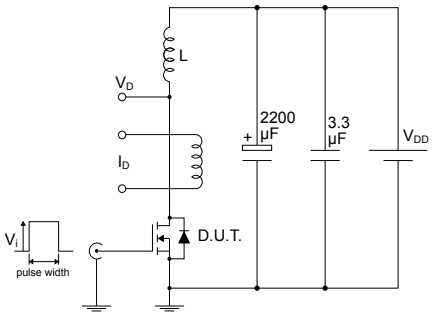

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Figure 20. Unclamped inductive waveform

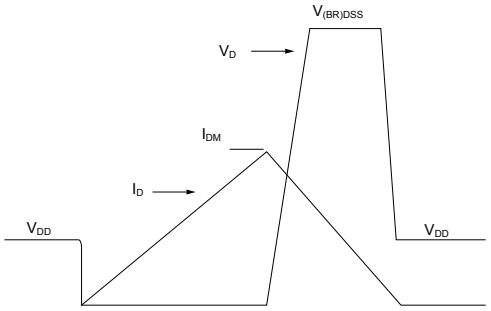

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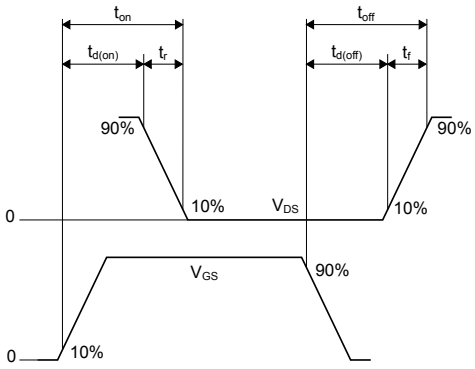
Figure 21. Switching time waveform



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

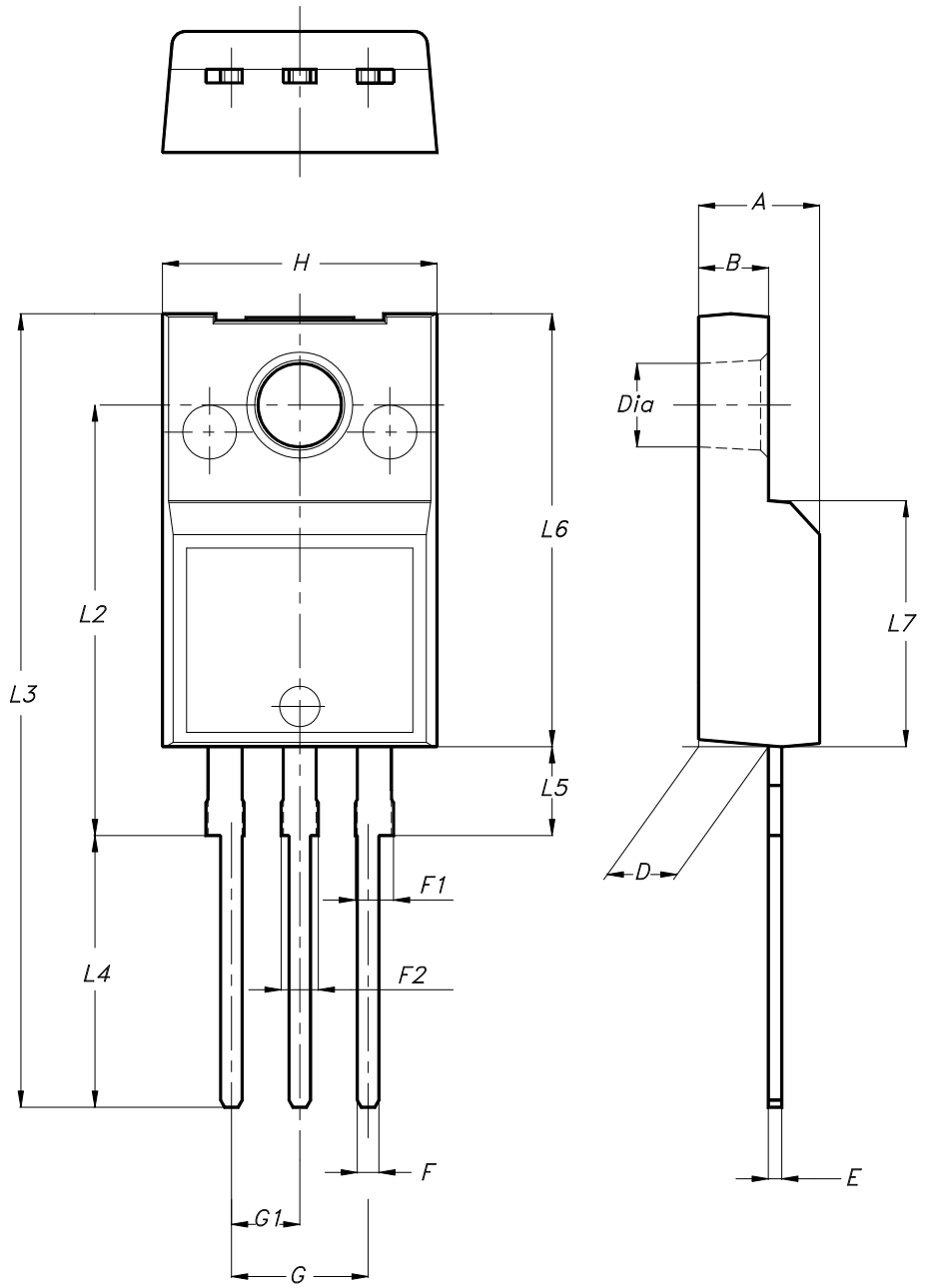


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Table 8. **TO-220FP type B package mechanical data**

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 TO-220 type A package information

Figure 23. **TO-220 type A package outline**

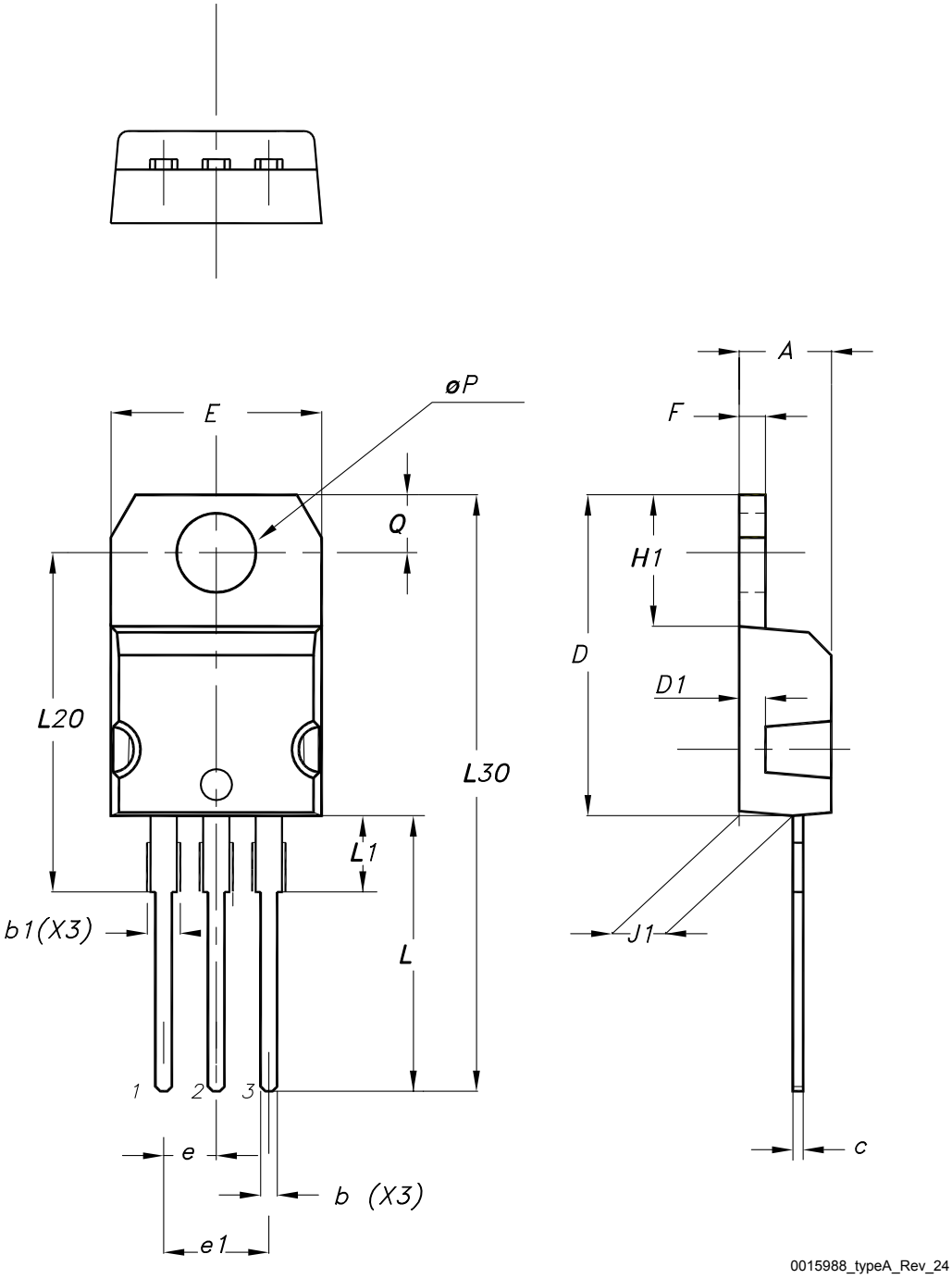
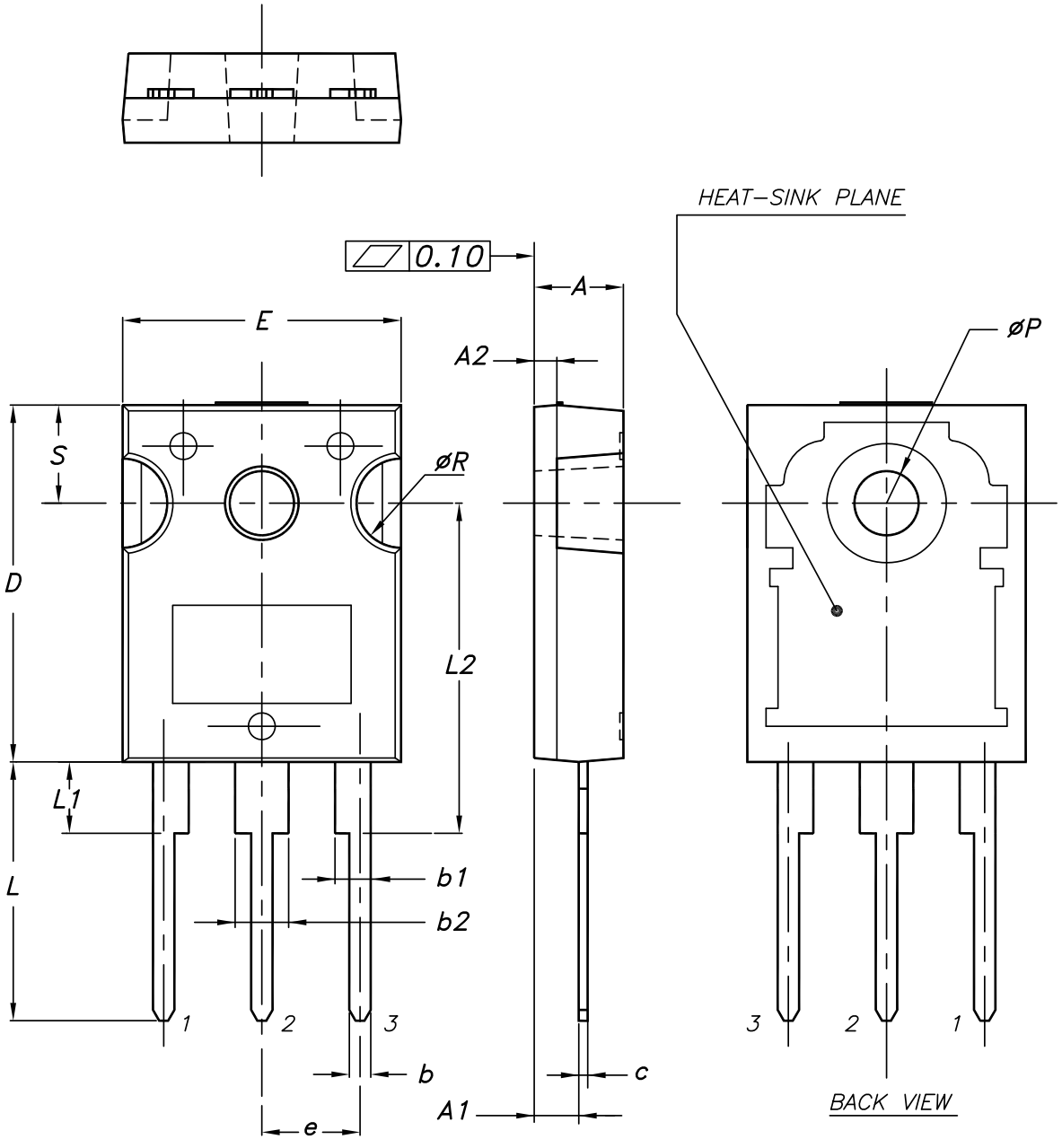


Table 9. **TO-220 type A package mechanical data**

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

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: *Section 2.1: Electrical characteristics (curves)*.
22-Jan-2026	6	Updated Section 4: Package information. Minor text changes.

Contents