

## N-channel 800 V, 1.50 $\Omega$ typ., 4 A MDmesh™ K5 Power MOSFET in a TO-220FP package

Datasheet - production data

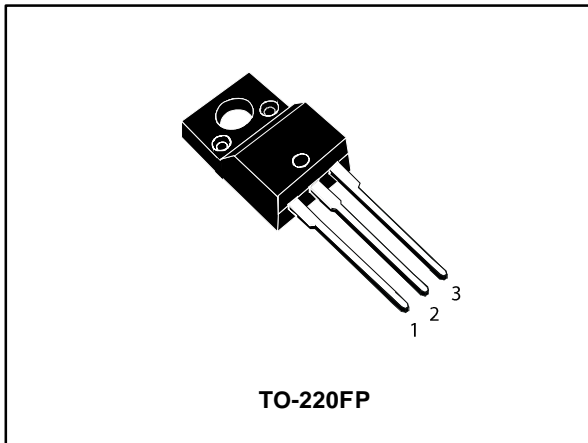
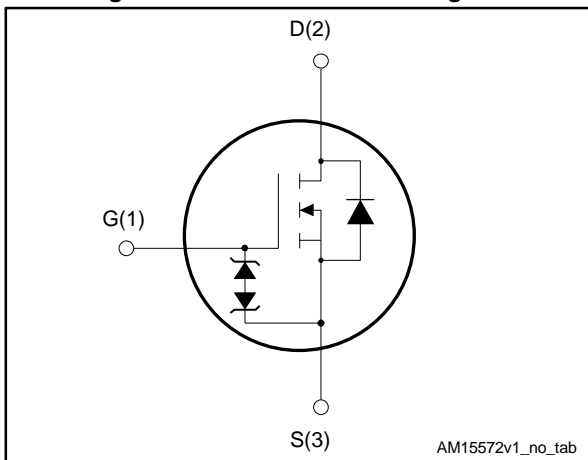


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STF5N80K5	800 V	1.75 $\Omega$	4 A

- Industry's lowest R<sub>DS(on)</sub> x area
- Industry's best FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This very high voltage N-channel Power MOSFET is designed using MDmesh™ K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Table 1: Device summary

Order code	Marking	Package	Packing
STF5N80K5	5N80K5	TO-220FP	Tube

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V <sub>GS</sub>	Gate-source voltage	± 30	V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	4	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	2.3	A
I <sub>D</sub> <sup>(1)</sup>	Drain current (pulsed)	16	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	20	W
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	4.5	V/ns
dv/dt <sup>(3)</sup>	MOSFET dv/dt ruggedness	50	
V <sub>ISO</sub>	Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1 s; T <sub>C</sub> = 25 °C)	2500	V
T <sub>J</sub>	Operating junction temperature range	- 55 to 150	°C
T <sub>stg</sub>	Storage temperature range		

**Notes:**

(1)Pulse width limited by safe operating area

(2)I<sub>SD</sub> ≤ 4 A, di/dt = 100 A/μs; V<sub>DS</sub> peak < V<sub>(BR)DSS</sub>, V<sub>DD</sub> = 640 V

(3)V<sub>DS</sub> ≤ 640 V

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case	6.25	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient	62.5	°C/W

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
I <sub>AR</sub>	Avalanche current, repetitive or not repetitive (pulse width limited by T <sub>jmax</sub> )	1.2	A
E <sub>AS</sub>	Single pulse avalanche energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V)	165	mJ

## 2 Electrical characteristics

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

**Table 5: On/off-state**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	800			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 800\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 800\text{ V}$ $T_C = 125\text{ °C}$ <sup>(1)</sup>			50	$\mu\text{A}$
$I_{GSS}$	Gate body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 20\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DD} = V_{GS}$ , $I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 2\text{ A}$		1.50	1.75	$\Omega$

**Notes:**

<sup>(1)</sup>Defined by design, not subject to production test

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	177	-	pF
$C_{oss}$	Output capacitance		-	15	-	pF
$C_{rss}$	Reverse transfer capacitance		-	0.3	-	pF
$C_{o(tr)}$ <sup>(1)</sup>	Equivalent capacitance time related	$V_{DS} = 0\text{ to }640\text{ V}$ , $V_{GS} = 0\text{ V}$	-	33	-	pf
$C_{o(er)}$ <sup>(2)</sup>	Equivalent capacitance energy related		-	12	-	pf
$R_g$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_D = 0\text{ A}$	-	16	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 640\text{ V}$ , $I_D = 4\text{ A}$ $V_{GS} = 10\text{ V}$ see <a href="#">Figure 15: "Test circuit for gate charge behavior"</a>	-	5	-	nC
$Q_{gs}$	Gate-source charge		-	1.7	-	nC
$Q_{gd}$	Gate-drain charge		-	2.9	-	nC

**Notes:**

<sup>(1)</sup> $C_{o(tr)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

<sup>(2)</sup> $C_{o(er)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

Table 7: Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 400\text{ V}$ , $I_D = 2\text{ A}$ , $R_G = 4.7\ \Omega$ $V_{GS} = 10\text{ V}$ see <a href="#">Figure 14: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 19: "Switching time waveform"</a>	-	12.7	-	ns
$t_r$	Rise time		-	11.7	-	ns
$t_{d(off)}$	Turn-off delay time		-	23	-	ns
$t_f$	Fall time		-	14.8	-	ns

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		4	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		16	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 4\text{ A}$ , $V_{GS} = 0\text{ V}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 4\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a>	-	265		ns
$Q_{rr}$	Reverse recovery charge		-	1.59		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	12		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 4\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ , $V_{DD} = 60\text{ V}$ , $T_J = 150\text{ }^\circ\text{C}$ see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a>	-	386		ns
$Q_{rr}$	Reverse recovery charge		-	2.18		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	11.3		A

**Notes:**

(1)Pulse width limited by safe operating area

(2)Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

Table 9: Gate-source Zener diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)GSO}$	Gate-source breakdown voltage	$I_{GS} = \pm 1\text{ mA}$ , $I_D = 0\text{ A}$	30	-	-	V

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

## 2.1 Electrical characteristics (curves)

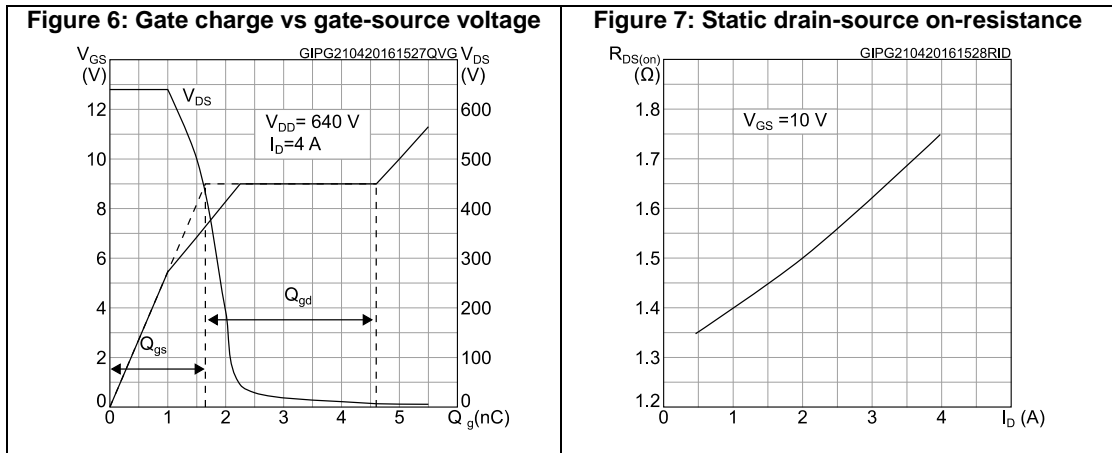
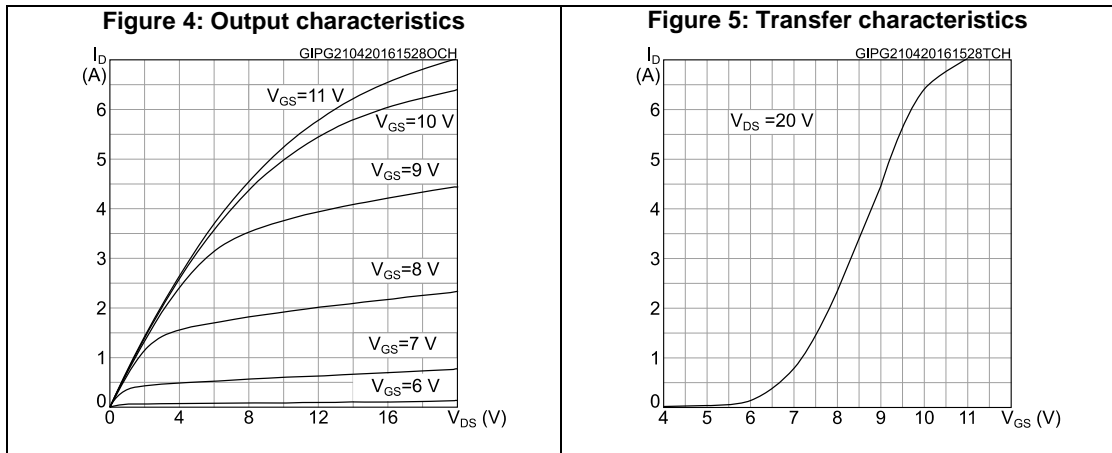
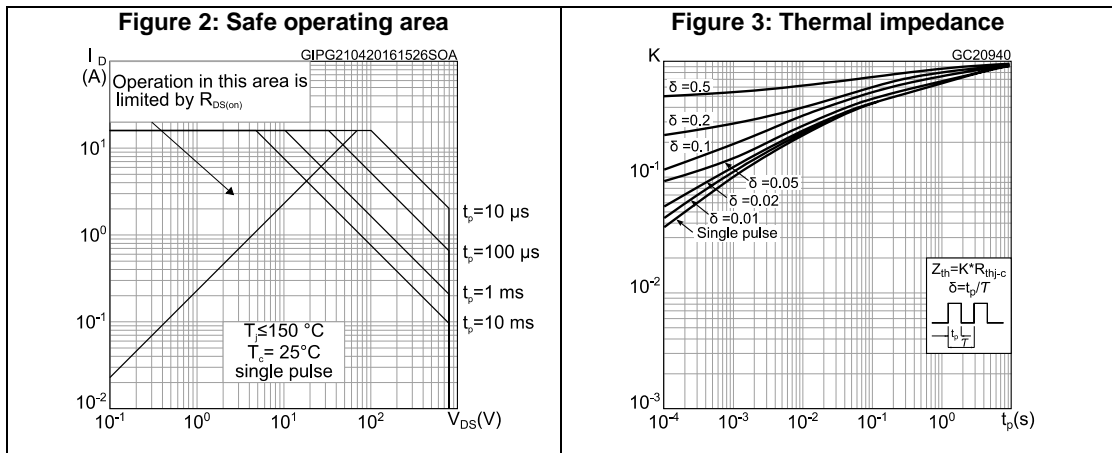


Figure 8: Capacitance variations

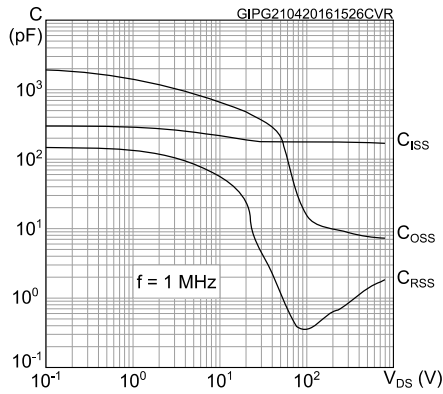


Figure 9: Normalized gate threshold voltage vs temperature

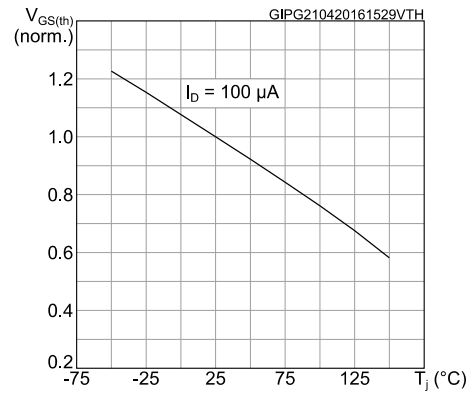


Figure 10: Normalized on-resistance vs temperature

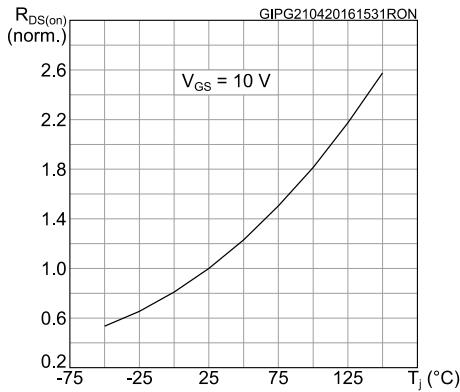


Figure 11: Normalized V(BR)DSS vs temperature

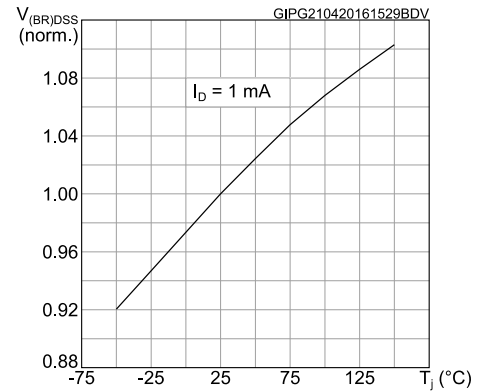


Figure 12: Maximum avalanche energy vs starting T\_J

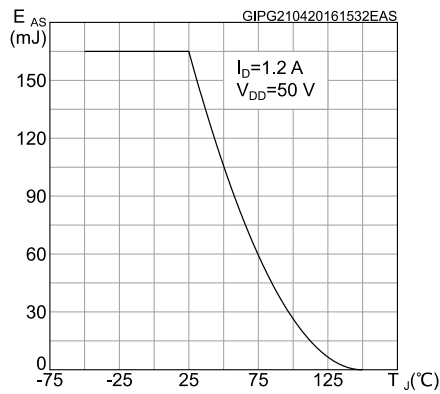
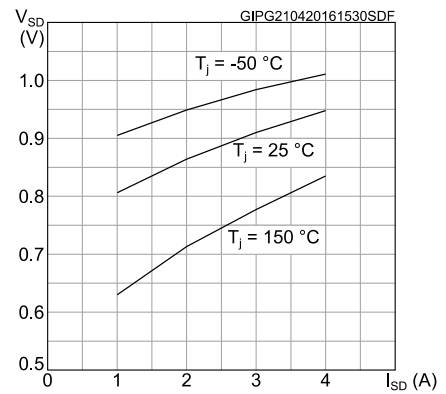
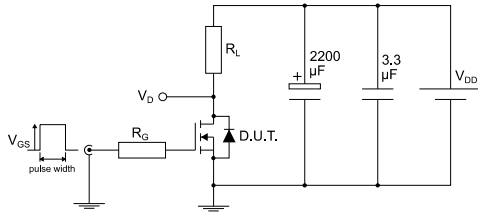


Figure 13: Source-drain diode forward characteristics



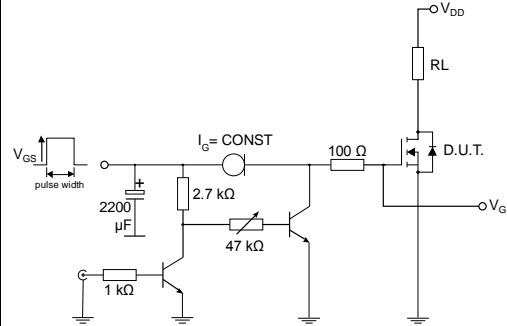
### 3 Test circuits

**Figure 14: Test circuit for resistive load switching times**



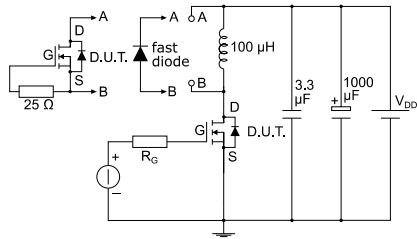
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**Figure 15: Test circuit for gate charge behavior**



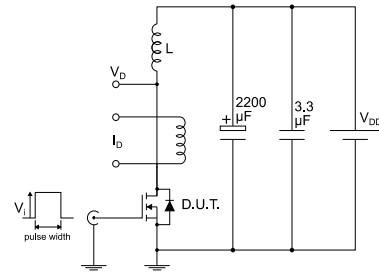
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**Figure 16: Test circuit for inductive load switching and diode recovery times**



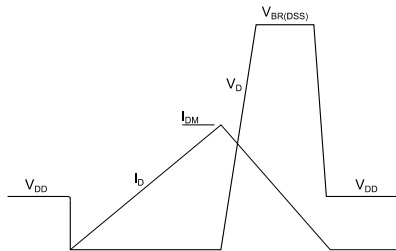
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**Figure 17: Unclamped inductive load test circuit**



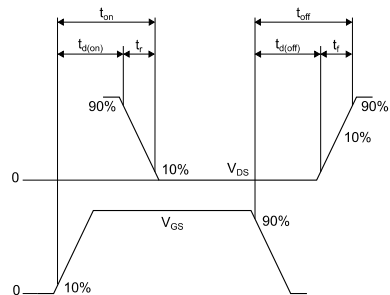
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**Figure 18: Unclamped inductive waveform**



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**Figure 19: Switching time waveform**



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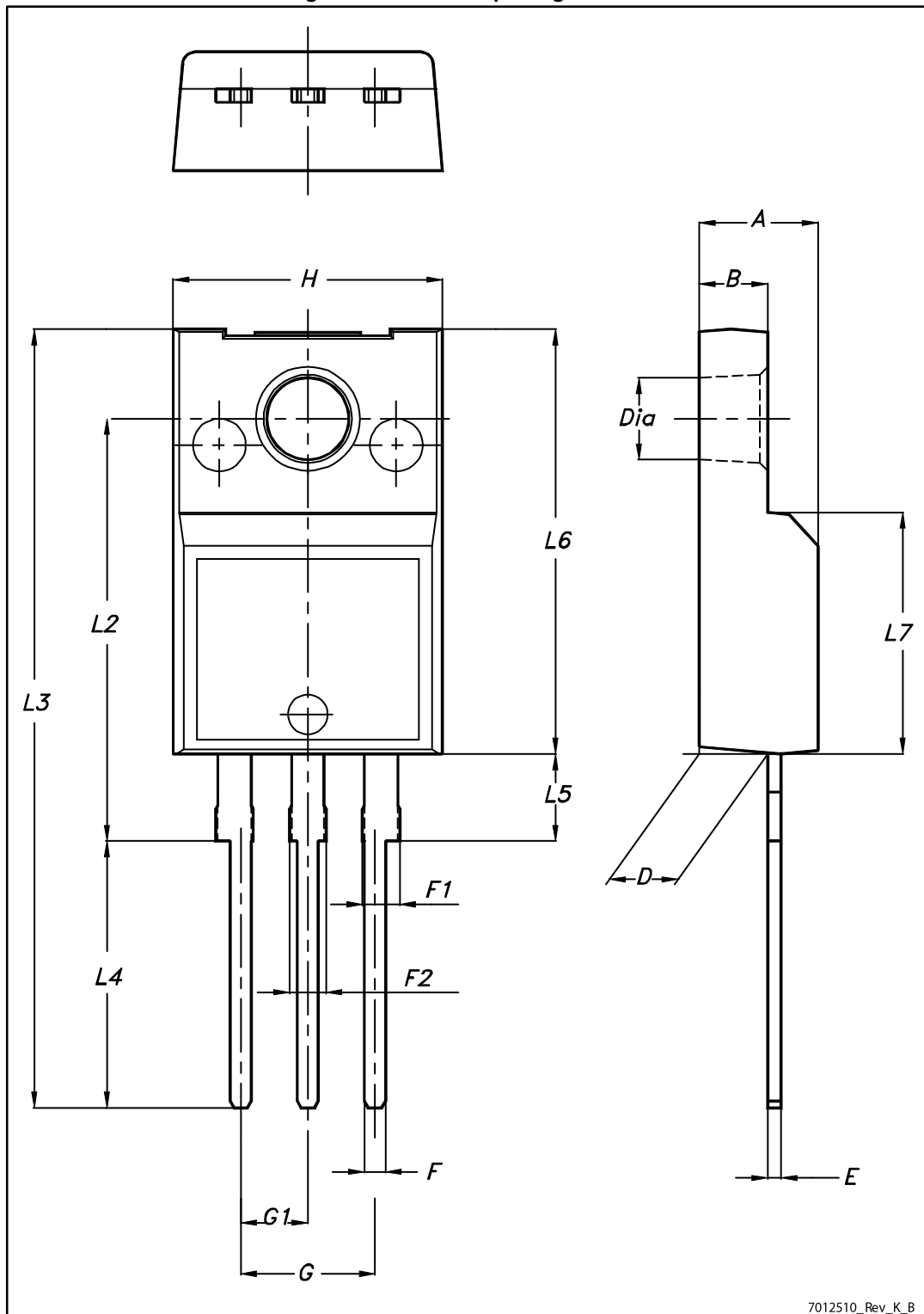


## 4 Package information

In order 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](http://www.st.com). ECOPACK® is an ST trademark.

### 4.1 TO-220FP package information

Figure 20: TO-220FP package outline



7012510\_Rev\_K\_B

Table 10: TO-220FP package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.4		4.6
B	2.5		2.7
D	2.5		2.75
E	0.45		0.7
F	0.75		1
F1	1.15		1.70
F2	1.15		1.70
G	4.95		5.2
G1	2.4		2.7
H	10		10.4
L2		16	
L3	28.6		30.6
L4	9.8		10.6
L5	2.9		3.6
L6	15.9		16.4
L7	9		9.3
Dia	3		3.2

## 5 Revision history

**Table 11: Document revision history**

Date	Revision	Changes
16-Oct-2015	1	First release.
06-Nov-2015	2	Updated title in cover page.
09-May-2016	3	Modified: title <i>Table 2: "Absolute maximum ratings", Table 3: "Thermal data", Table 5: "On/off-state", Table 6: "Dynamic", Table 7: "Switching times", Table 8: "Source-drain diode"</i> Added: <i>Section 3.1: "Electrical characteristics (curves)"</i> Modified: <i>Section 4: "Test circuits"</i> Minor text changes

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