

N-channel 1050 V, 1  $\Omega$  typ., 6 A MDmesh™ K5  
Power MOSFETs in TO-220, TO-220FP and TO-247 packages

Datasheet - production data

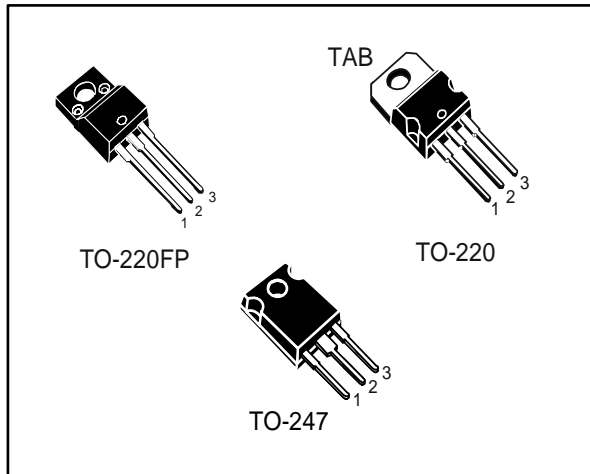
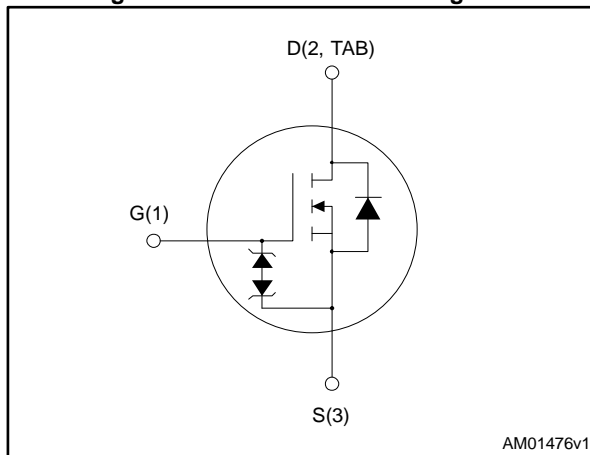


Figure 1: Internal schematic diagram



## Features

Order codes	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STF10N105K5	1050 V	1.3 $\Omega$	6 A	30 W
STP10N105K5				130 W
STW10N105K5				130 W

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

## Applications

- Switching applications

## Description

These very high voltage N-channel Power MOSFETs are 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 codes	Marking	Package	Packaging
STF10N105K5	10N105K5	TO-220FP	Tube
STP10N105K5	10N105K5	TO-220	Tube
STW10N105K5	10N105K5	TO-247	Tube

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value			Unit
		TO-220	TO-247	TO-220FP	
$V_{GS}$	Gate- source voltage	30			V
$I_D$	Drain current (continuous) at $T_C = 25\text{ °C}$	6			A
$I_D$	Drain current (continuous) at $T_C = 100\text{ °C}$	3.78			A
$I_{DM}^{(1)}$	Drain current (pulsed)	24			A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	130		30	W
$I_{AR}$	Max. current during repetitive or single pulse avalanche	2			A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ °C}$ , $I_D = I_{AS}$ , $V_{DD} = 50\text{ V}$ )	140			mJ
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5			V/ns
$dv/dt^{(3)}$	MOSFET $dv/dt$ ruggedness	50			V/ns
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heatsink ( $t = 1\text{ s}$ ; $T_C = 25\text{ °C}$ )			2500	V
$T_j$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150			°C

**Notes:**

<sup>(1)</sup>Pulse width limited by safe operating area.

<sup>(2)</sup> $I_{SD} \leq 6\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{peak} \leq V_{(BR)DSS}$ .

<sup>(3)</sup> $V_{SD} \leq 840$ .

**Table 3: Thermal data**

Symbol	Parameter	Value			Unit
		TO-220	TO-247	TO-220FP	
$R_{thj-case}$	Thermal resistance junction-case max.	0.96			°C/W
	Thermal resistance junction-case max.			4.2	
$R_{thj-amb}$	Thermal resistance junction-ambient max.	62.50			°C/W

## 2 Electrical characteristics

( $T_{\text{case}} = 25\text{ °C}$  unless otherwise specified)

**Table 4: On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0$	1050			V
$I_{DSS}$	Zero gate voltage, drain current ( $V_{GS} = 0$ )	$V_{DS} = 1050\text{ V}$			1	$\mu\text{A}$
		$V_{DS} = 1050\text{ V}$ , $T_C = 125\text{ °C}$			50	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current	$V_{GS} = \pm 20\text{ V}$ ; $V_{DS} = 0$			10	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on- resistance	$V_{GS} = 10\text{ V}$ , $I_D = 3\text{ A}$		1	1.3	$\Omega$

**Table 5: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0$		545		$\mu\text{F}$
$C_{oss}$	Output capacitance			30		$\mu\text{F}$
$C_{riss}$	Reverse transfer capacitance			1.3		$\mu\text{F}$
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0$ , $V_{DS} = 0$ to $840\text{ V}$		65		$\mu\text{F}$
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related			22		$\mu\text{F}$
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain		7		$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 840\text{ V}$ , $I_D = 6\text{ A}$ $V_{GS} = 10\text{ V}$		21.5		nC
$Q_{gs}$	Gate-source charge			3.3		nC
$Q_{gd}$	Gate-drain charge			15.5		nC

**Notes:**

<sup>(1)</sup>Time related is defined as a constant equivalent capacitance giving the same charging time as  $C_{oss}$  when  $V_{DS}$  increases from 0 to 80%  $V_{DSS}$ .

<sup>(2)</sup>Energy related is defined as a constant equivalent capacitance giving the same stored energy 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	$V_{DD} = 525\text{ V}$ , $I_D = 3\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$		19		ns
$t_r$	Rise time			8		ns
$t_{d(off)}$	Turn-off-delay time			50		ns
$t_f$	Fall time			21.5		ns

Table 7: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current				6	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)				24	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 6 \text{ A}$ , $V_{GS} = 0$			1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 6 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$	-	345		ns
$Q_{rr}$	Reverse recovery charge			3.53		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			20.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 6 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ $T_J = 150 \text{ }^\circ\text{C}$		540		ns
$Q_{rr}$	Reverse recovery charge			5.05		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current			18.5		A

**Notes:**

<sup>(1)</sup>Pulse width limited by safe operating area.

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

Table 8: Gate-source Zener diode

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

The built-in back-to-back Zener diodes have been specifically designed to enhance the ESD capability of the device. The Zener voltage is appropriate for efficient and cost-effective intervention to protect the device integrity. These integrated Zener diodes thus eliminate the need for external components.

2.1 Electrical characteristics (curves)

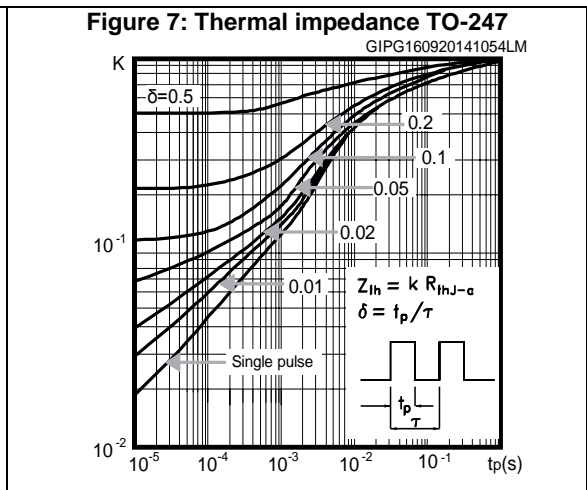
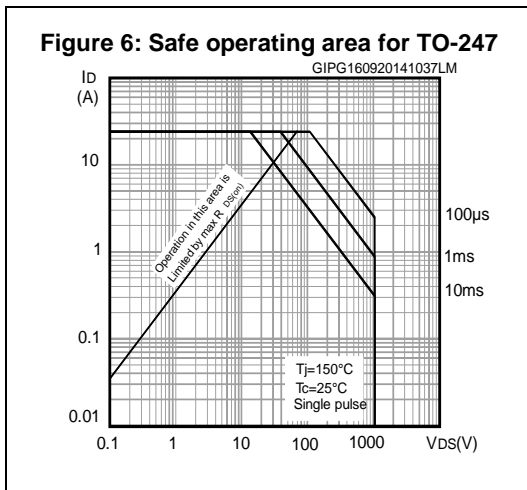
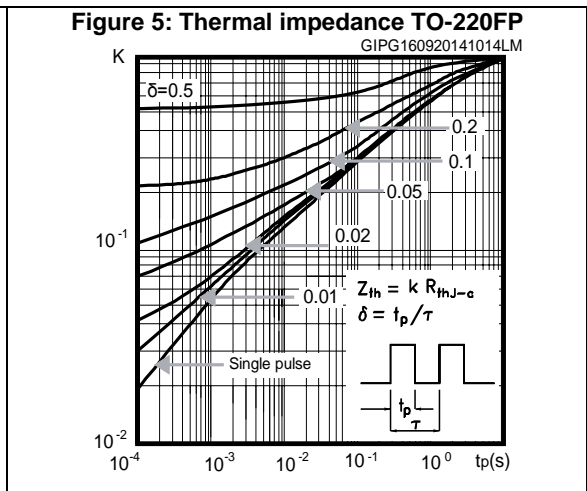
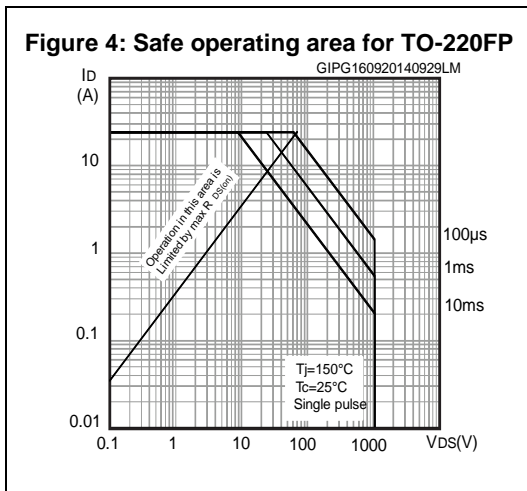
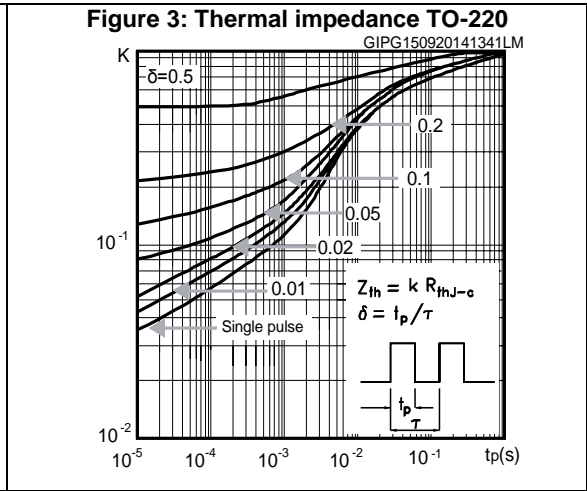
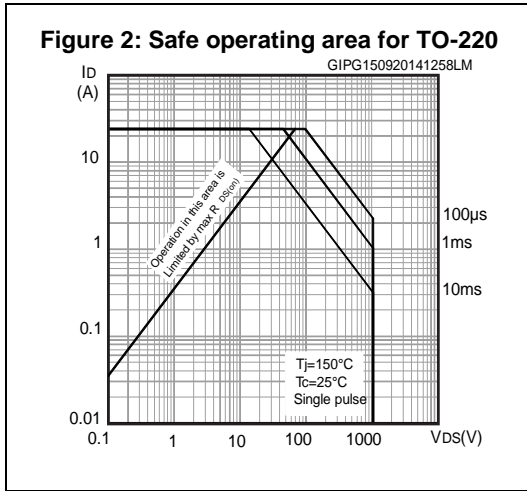


Figure 8: Output characteristics

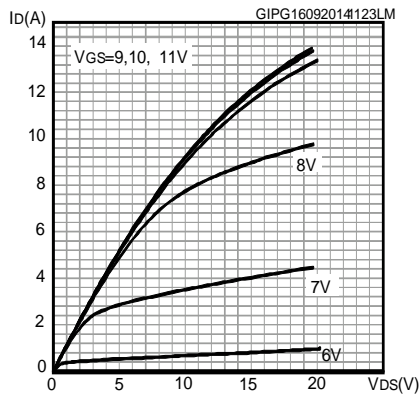


Figure 9: Transfer characteristics

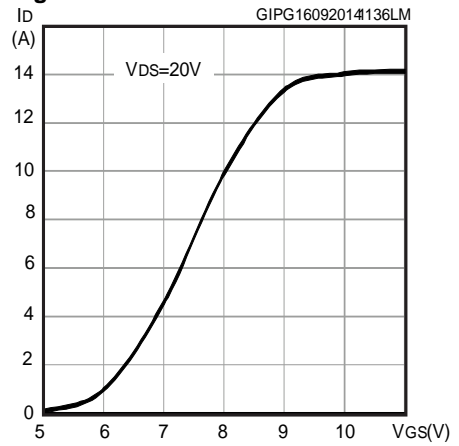


Figure 10: Gate charge vs gate-source voltage

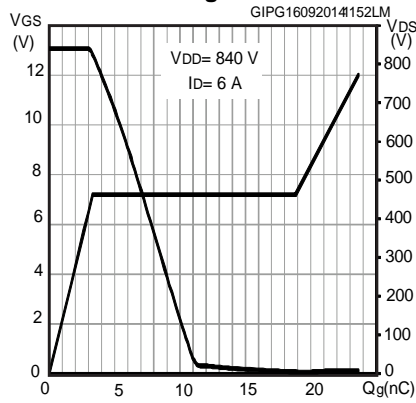


Figure 11: Static drain-source on-resistance

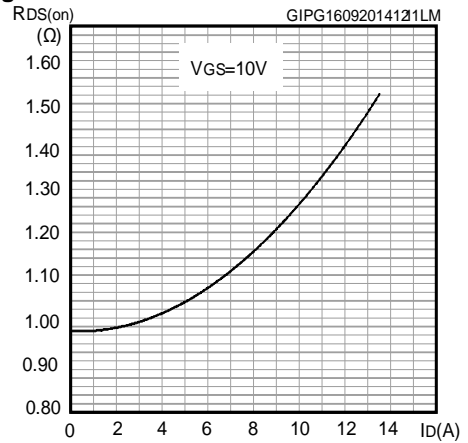


Figure 12: Capacitance variation

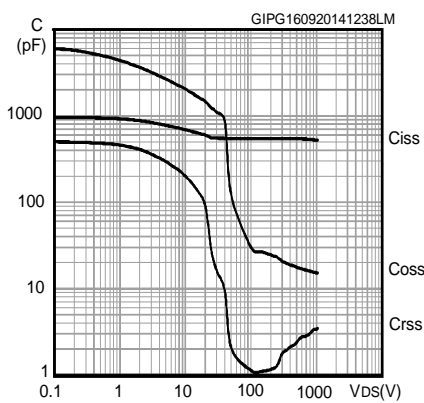
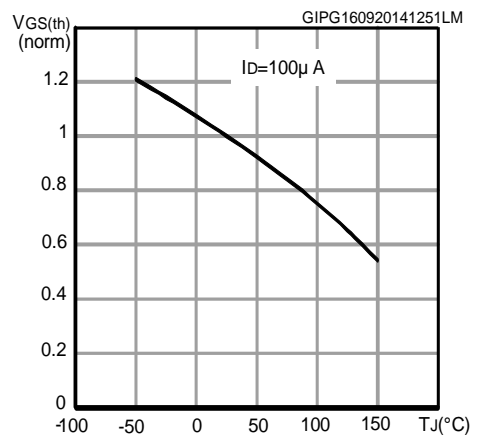
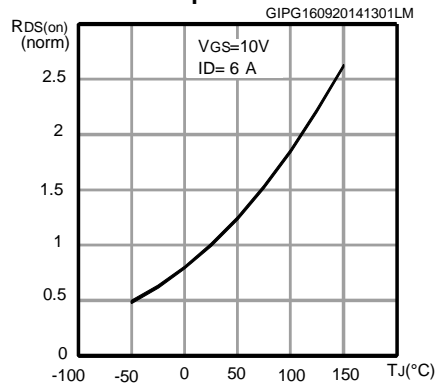


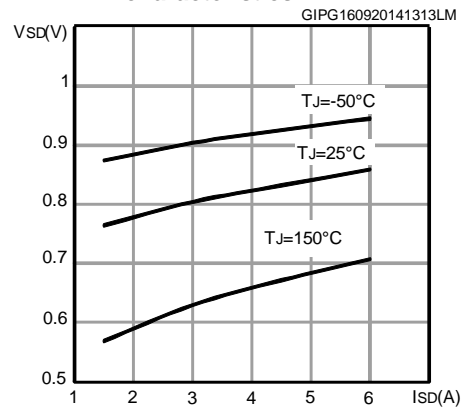
Figure 13: Normalized gate threshold voltage vs temperature



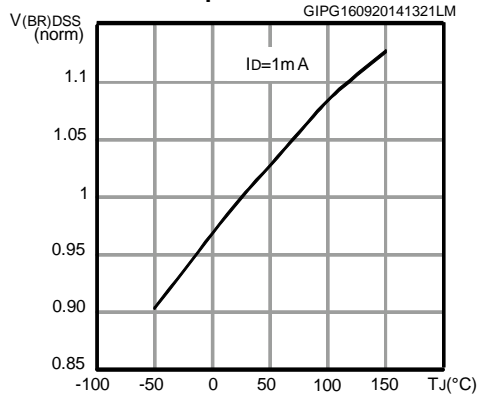
**Figure 14: Normalized on-resistance vs temperature**



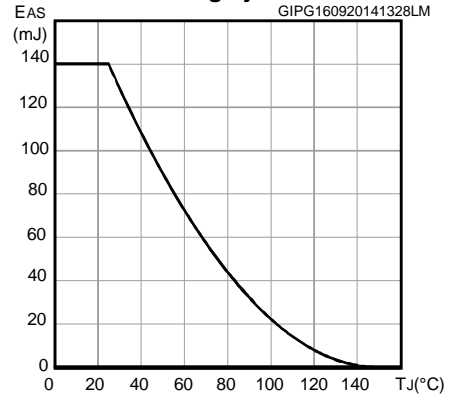
**Figure 15: Source-drain diode forward characteristics**



**Figure 16: Normalized VBR(DSS) vs temperature**

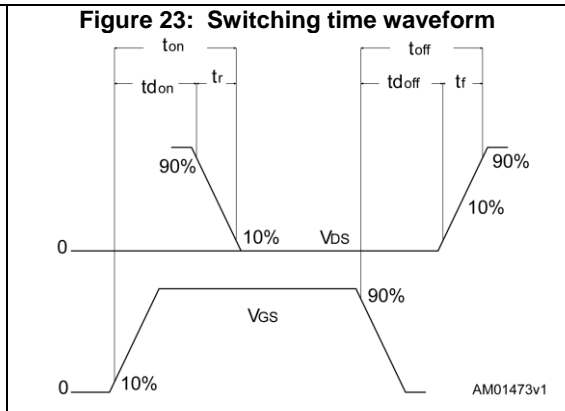
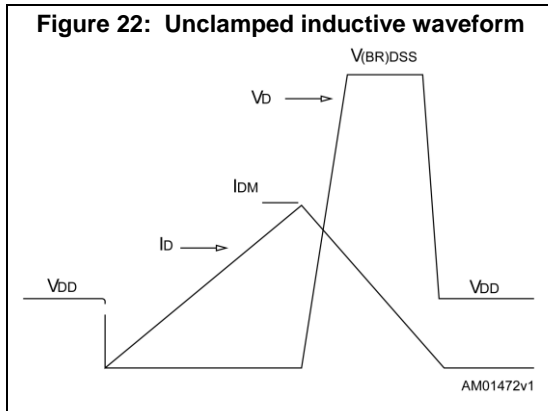
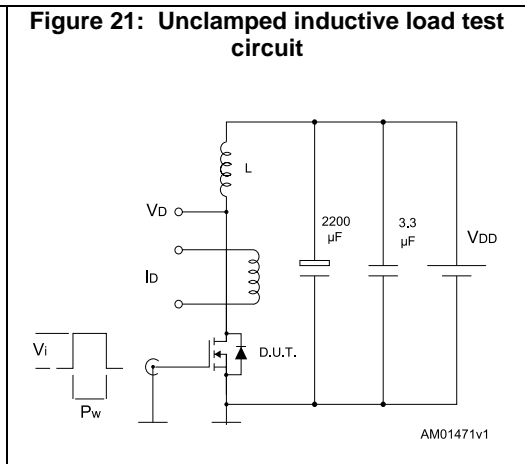
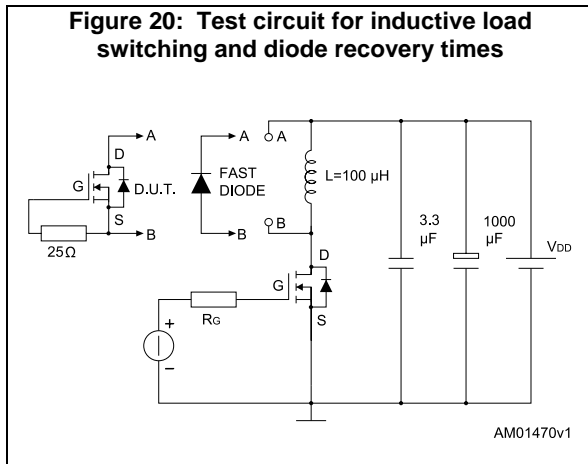
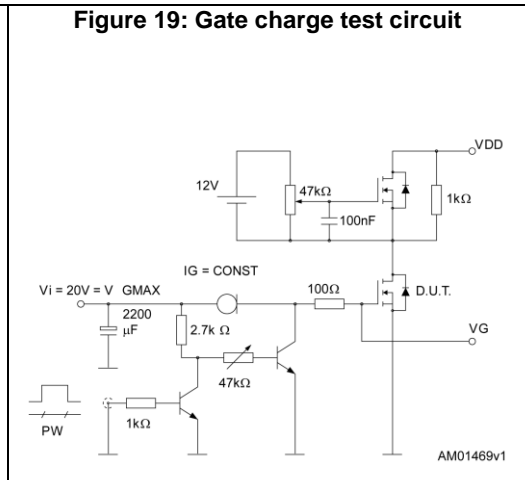
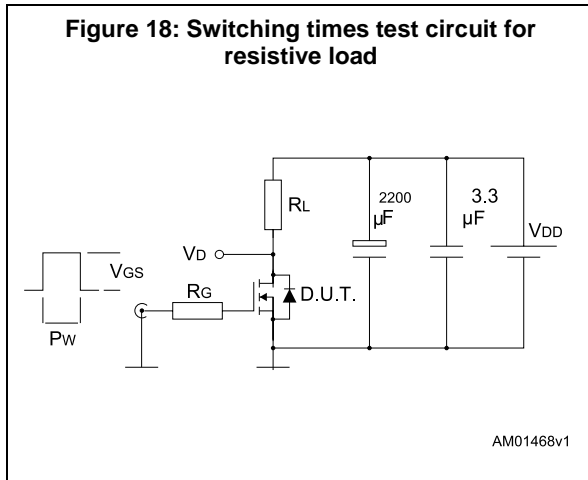


**Figure 17: Maximum avalanche energy vs starting TJ**





### 3 Test circuits



## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

### 4.1 TO-220 package mechanical data

Figure 24: TO-220 type A drawings

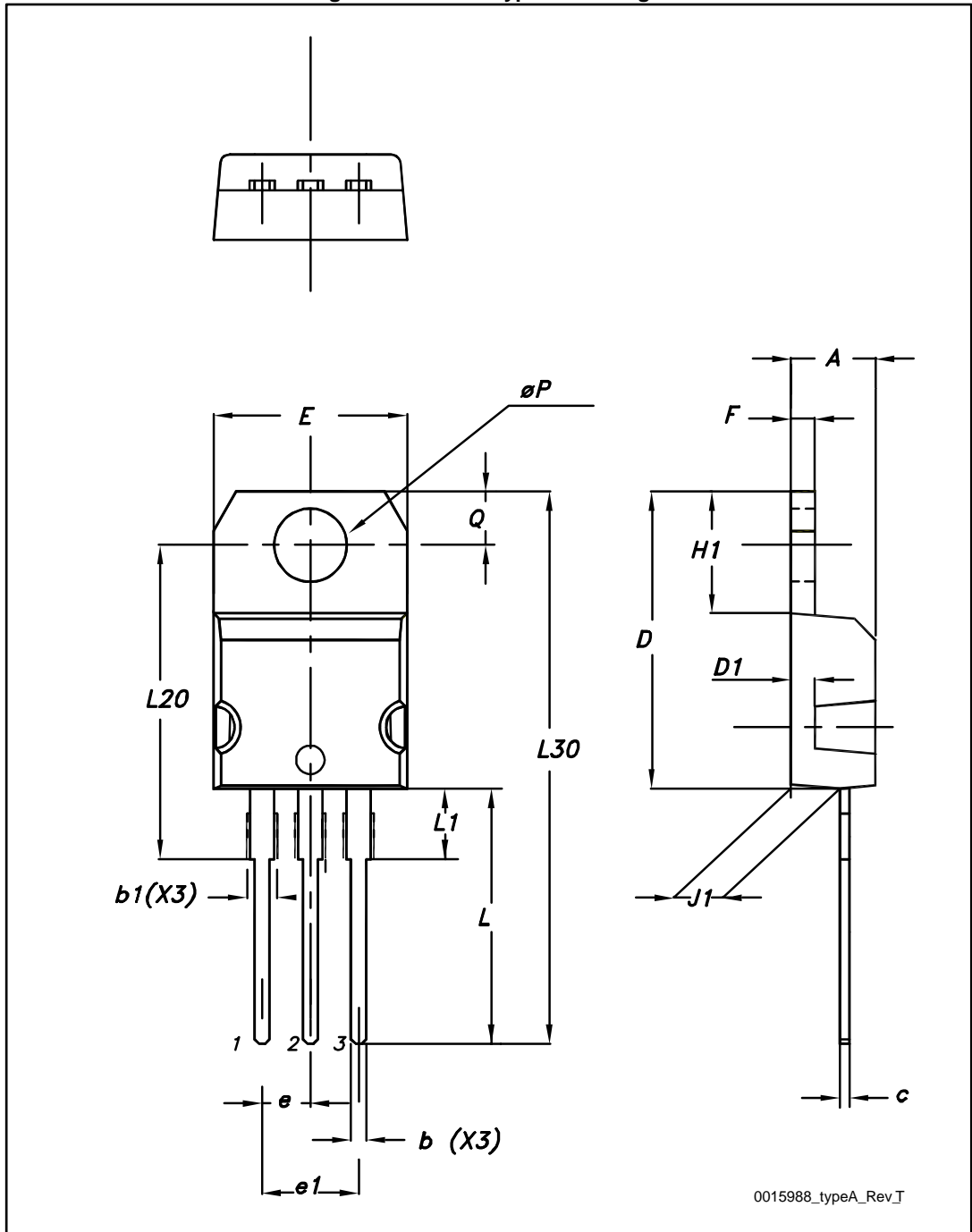


Table 9: TO-220 type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		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		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95

4.2 TO-247 package mechanical data

Figure 25: TO-247 drawings

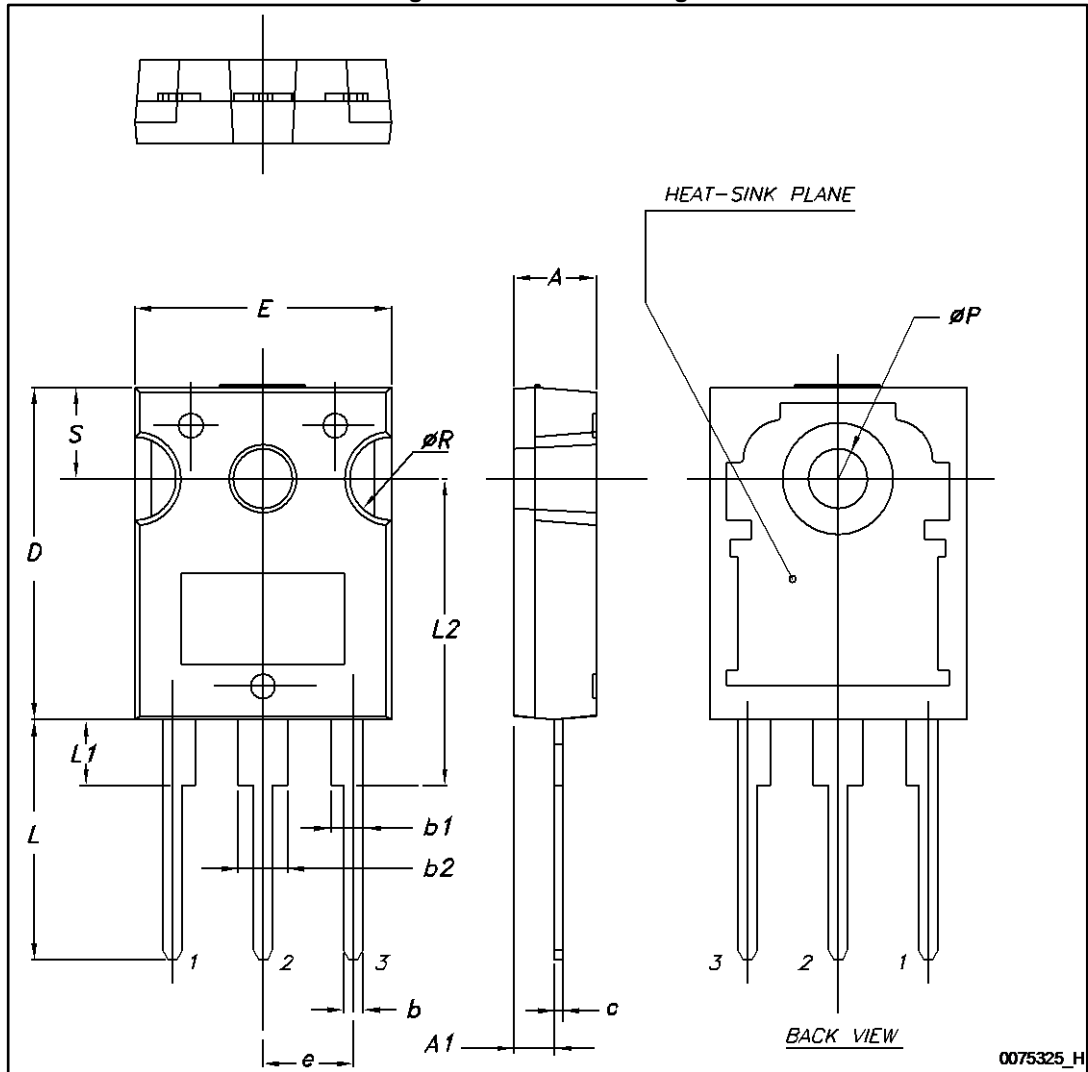


Table 10: TO-247 mechanical data

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

### 4.3 TO-220FP package mechanical data

Figure 26: TO-220FP drawings

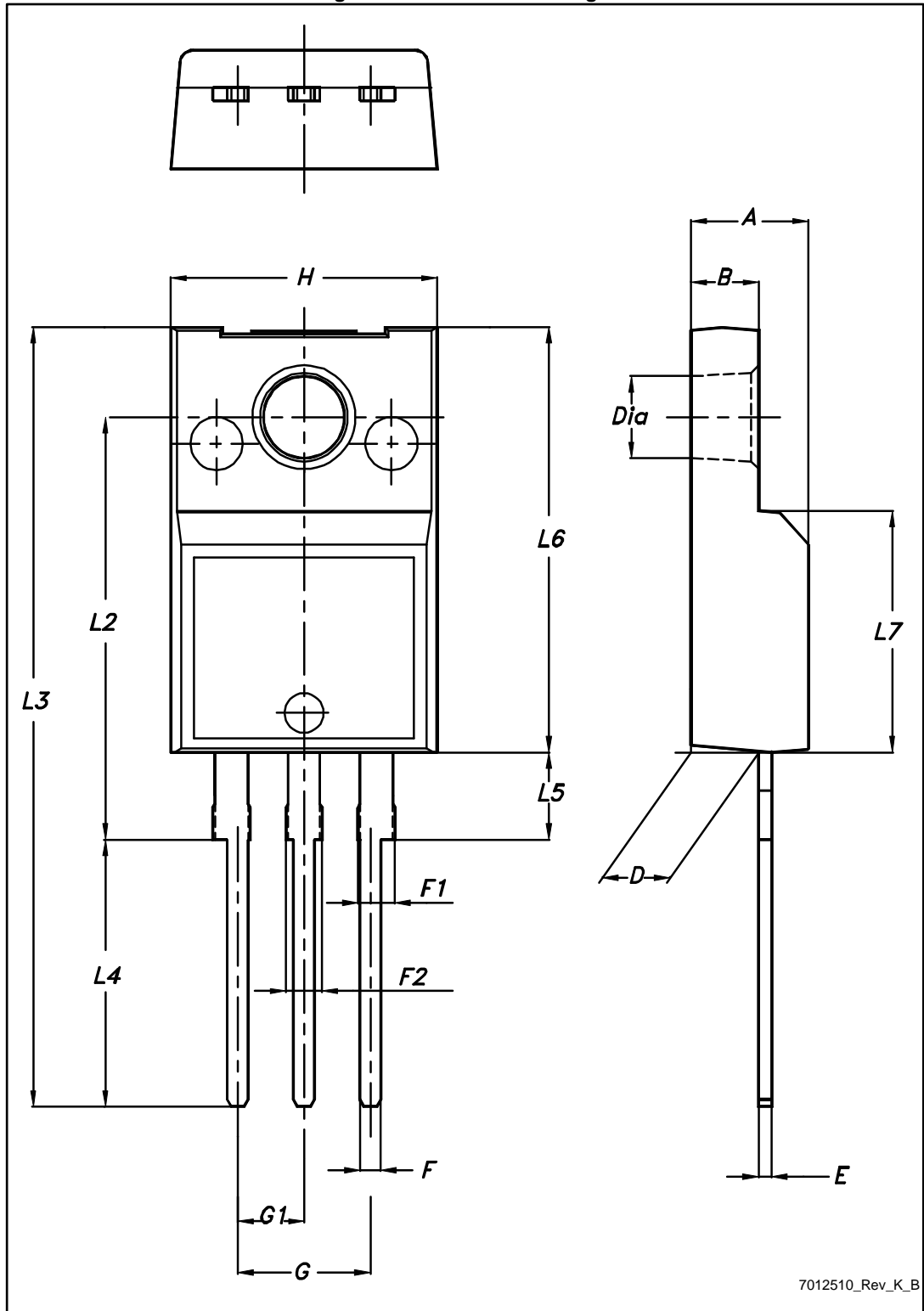


Table 11: TO-220FP mechanical data

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
Ø	3		3.2



## 5 Revision history

Table 12: Document revision history

Date	Revision	Changes
07-Oct-2014	1	First release.
14-Oct-2014	2	Document status promoted from preliminary to production data.

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