

## N-channel 1050 V, 6 $\Omega$ typ., 1.5 A Zener-protected SuperMESH™ 5 Power MOSFET in a TO-3PF package

Datasheet - preliminary data

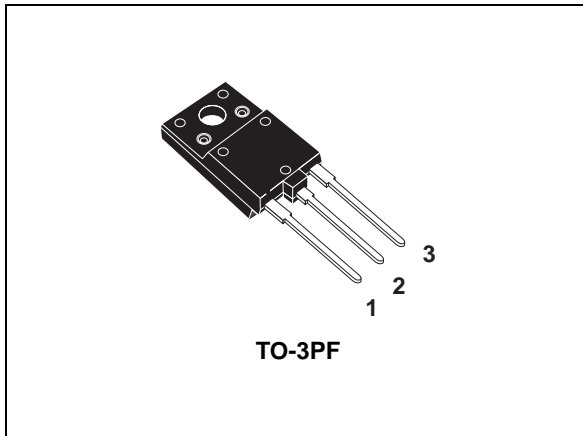
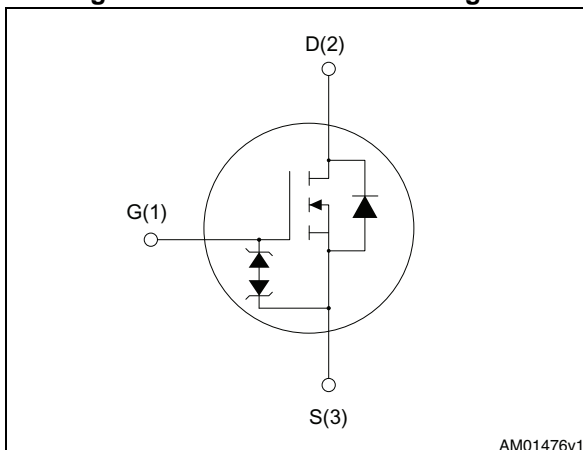


Figure 1. Internal schematic diagram



### Features

Order code	$V_{DS}$	$R_{DS(on)}$ max	$I_D$	$P_{TOT}$
STFW2N105K5	1050 V	8 $\Omega$	1.5 A	30 W

- Worldwide best FOM (figure of merit)
- Ultra low gate charge
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This N-channel Zener-protected Power MOSFET is designed using ST's revolutionary avalanche-rugged very high voltage SuperMESH™ 5 technology, based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance, and ultra-low gate charge for applications which require superior power density and high efficiency.

Table 1. Device summary

Order code	Marking	Package	Packaging
STFW2N105K5	2N105K5	TO-3PF	Tube

# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate- source voltage	30	V
$I_D$	Drain current (continuous) at $T_C = 25\text{ °C}$	2 <sup>(1)</sup>	A
$I_D$	Drain current (continuous) at $T_C = 100\text{ °C}$	1.3 <sup>(1)</sup>	A
$I_{DM}$	Drain current (pulsed)	6	A
$P_{TOT}$	Total dissipation at $T_C = 25\text{ °C}$	30	W
$I_{AR}$	Max current during repetitive or single pulse avalanche	0.5	A
$E_{AS}$	Single pulse avalanche energy (starting $T_J = 25\text{ °C}$ , $I_D = I_{AS}$ , $V_{DD} = 50\text{ V}$ )	90	mJ
$dv/dt$ <sup>(2)</sup>	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt$ <sup>(3)</sup>	MOSFET $dv/dt$ ruggedness	50	V/ns
$V_{ISO}$	Insulation withstand voltage (RMS) from all three leads to external heat sink ( $t=1\text{ s}$ ; $TC=25\text{ °C}$ )	3500	V
$T_j$ $T_{stg}$	Operating junction temperature Storage temperature	-55 to 150	°C

1. Pulse width limited by safe operating area.
2.  $I_{SD} \leq 1.5\text{ A}$ ,  $di/dt \leq 100\text{ A}/\mu\text{s}$ ,  $V_{Peak} \leq V_{(BR)DSS}$ .
3.  $V_{SD} \leq 840\text{ V}$

**Table 3. Thermal data**

Symbol	Parameter	Value	Unit
$R_{thj-case}$	Thermal resistance junction-case max	4.2	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient max	50	°C/W

## 2 Electrical characteristics

(T<sub>case</sub> = 25 °C unless otherwise specified)

**Table 4. On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0	1050			V
I <sub>DSS</sub>	Zero gate voltage, drain current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = 1050 V			1	μA
		V <sub>DS</sub> = 1050 V, T <sub>C</sub> = 125 °C			50	μA
I <sub>GSS</sub>	Gate-body leakage current	V <sub>GS</sub> = ± 20 V; V <sub>DS</sub> = 0			10	μA
V <sub>GS(th)</sub>	Gate threshold voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 100 μA	3	4	5	V
R <sub>DS(on)</sub>	Static drain-source on-resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 0.75 A		6	8	Ω

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C <sub>ISS</sub>	Input capacitance	V <sub>DS</sub> = 100 V, f = 1 MHz, V <sub>GS</sub> = 0	-	115	-	pF
C <sub>OSS</sub>	Output capacitance		-	15	-	pF
C <sub>rSS</sub>	Reverse transfer capacitance		-	0.5	-	pF
C <sub>o(tr)</sub> <sup>(1)</sup>	Equivalent capacitance time related	V <sub>GS</sub> = 0, V <sub>DS</sub> = 0 to 840 V	-	17	-	pF
C <sub>o(er)</sub> <sup>(2)</sup>	Equivalent capacitance energy related		-	6	-	pF
R <sub>G</sub>	Intrinsic gate resistance	f = 1 MHz open drain	-	20	-	Ω
Q <sub>g</sub>	Total gate charge	V <sub>DD</sub> = 840 V, I <sub>D</sub> = 1.5 A V <sub>GS</sub> = 10 V (see <a href="#">Figure 16</a> )	-	10	-	nC
Q <sub>gs</sub>	Gate-source charge		-	1.5	-	nC
Q <sub>gd</sub>	Gate-drain charge		-	8	-	nC

1. Time related is defined as a constant equivalent capacitance giving the same charging time as C<sub>OSS</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>
2. energy related is defined as a constant equivalent capacitance giving the same stored energy as C<sub>OSS</sub> when V<sub>DS</sub> increases from 0 to 80% V<sub>DSS</sub>

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 525 \text{ V}$ , $I_D = 0.75 \text{ A}$ , $R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$ (see Figure 15)	-	14.5	-	ns
$t_r$	Rise time		-	8.5	-	ns
$t_{d(off)}$	Turn-off-delay time		-	35	-	ns
$t_f$	Fall time		-	38.5	-	ns

Table 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max	Unit
$I_{SD}$	Source-drain current		-		1.5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		6	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 1.5 \text{ A}$ , $V_{GS} = 0$	-		1.5	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 1.5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ (see Figure 17)	-	326		ns
$Q_{rr}$	Reverse recovery charge		-	1.19		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	7.3		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 1.5 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 60 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$ (see Figure 17)	-	525		ns
$Q_{rr}$	Reverse recovery charge		-	1.83		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	7		A

1. Pulse width limited by safe operating area

2. 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 specifically been designed to enhance the device's ESD capability. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

## 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

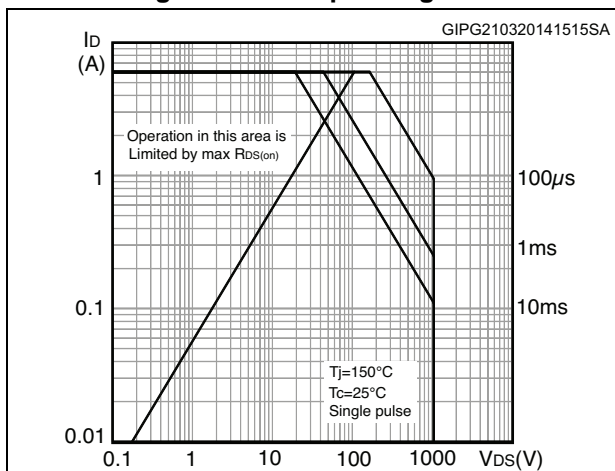


Figure 3. Thermal impedance

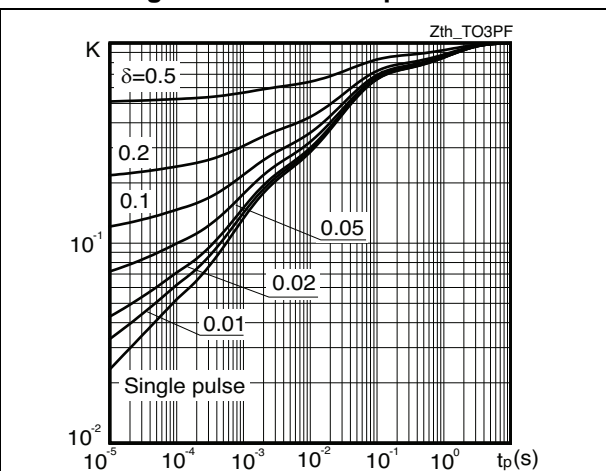


Figure 4. Output characteristics

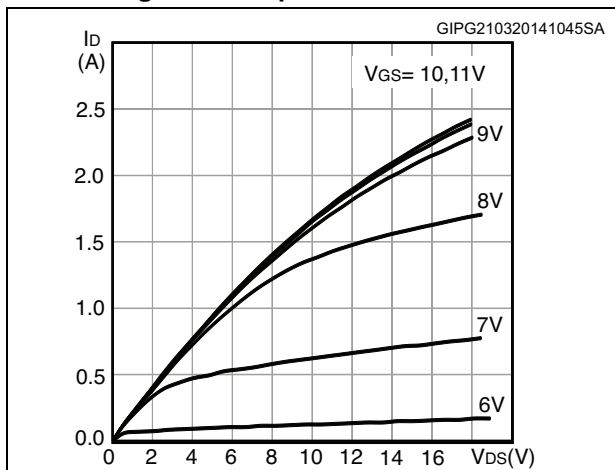


Figure 5. Transfer characteristics

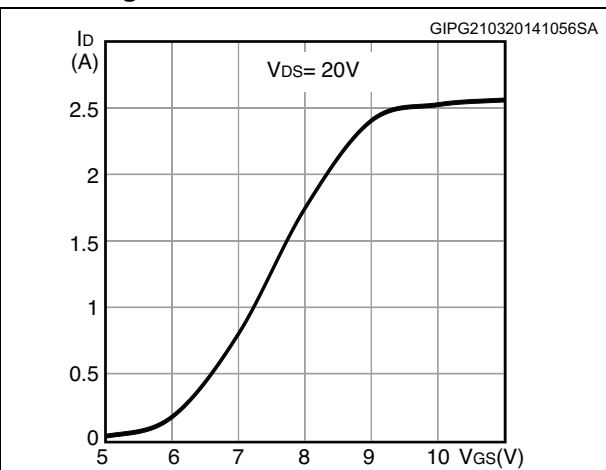


Figure 6. Gate charge vs gate-source voltage

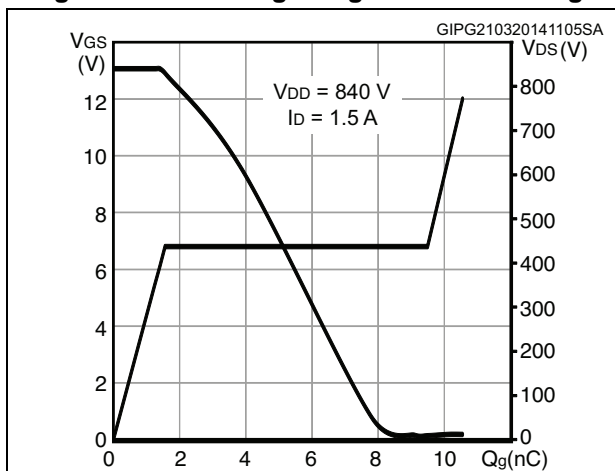


Figure 7. Static drain-source on-resistance

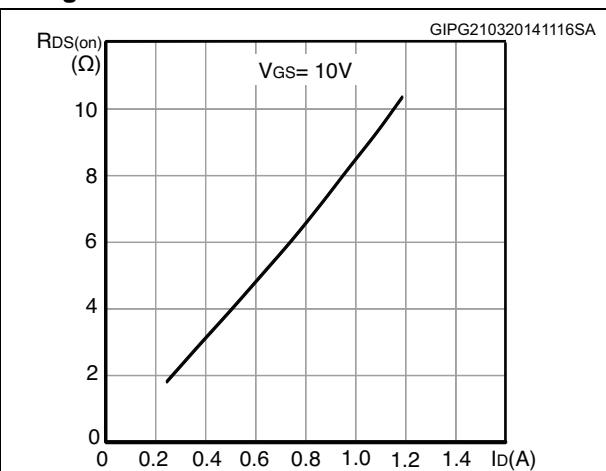


Figure 8. Capacitance variations

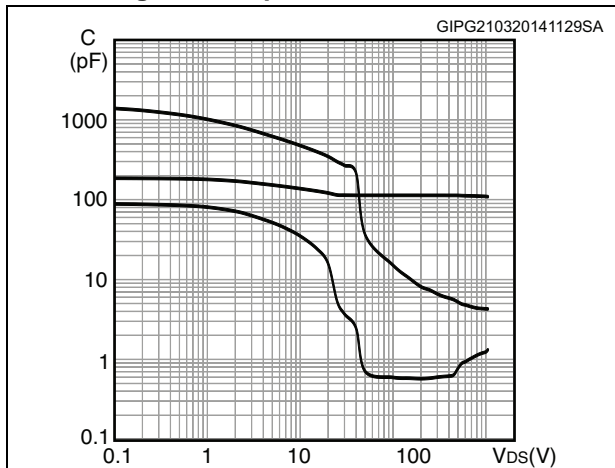


Figure 9. Output capacitance stored energy

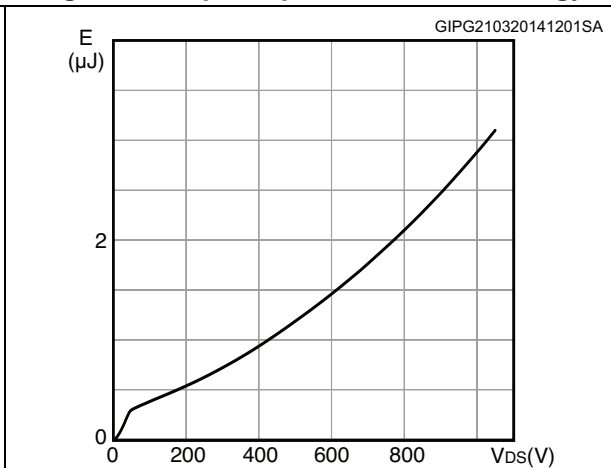


Figure 10. Normalized gate threshold voltage vs temperature

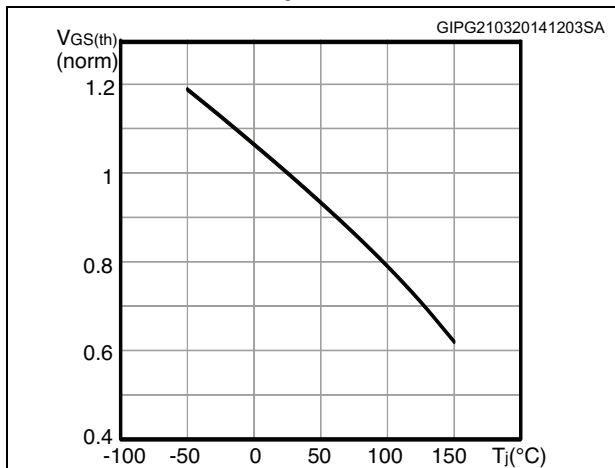


Figure 11. Normalized on-resistance vs temperature

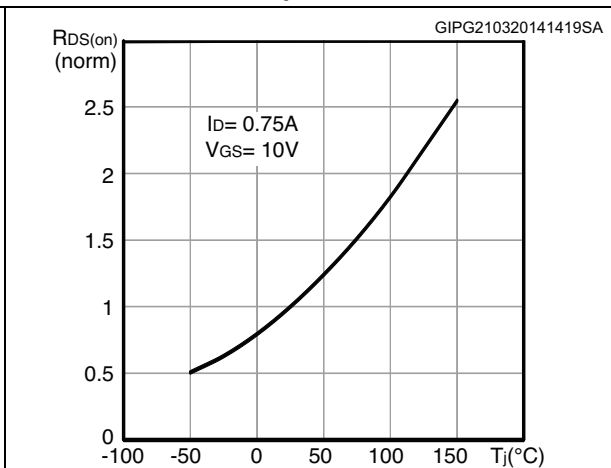


Figure 12. Source-drain diode forward characteristics

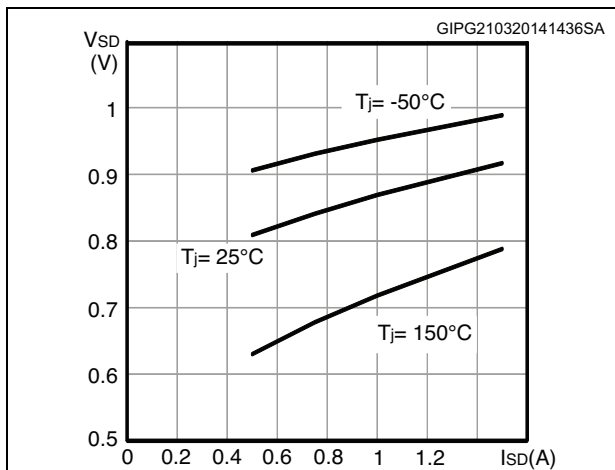


Figure 13. Normalized V(BR)DSS vs temperature

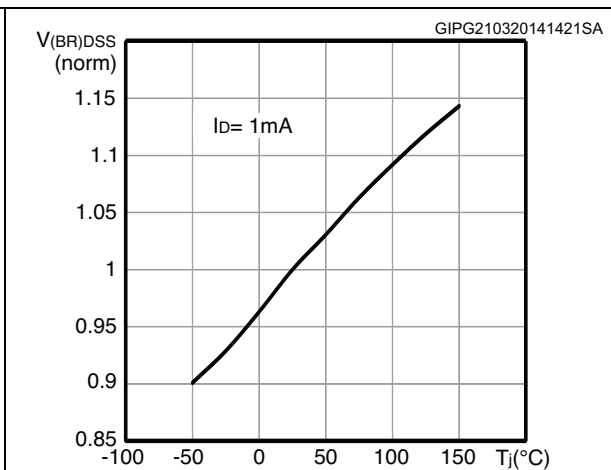
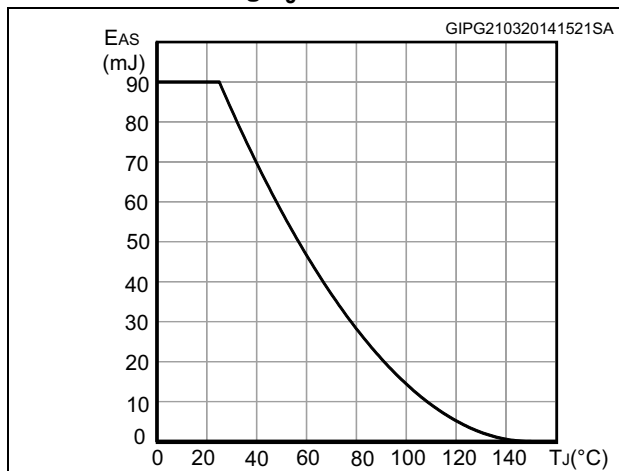


Figure 14. Maximum avalanche energy vs starting  $T_J$





### 3 Test circuits

Figure 15. Switching times test circuit for resistive load



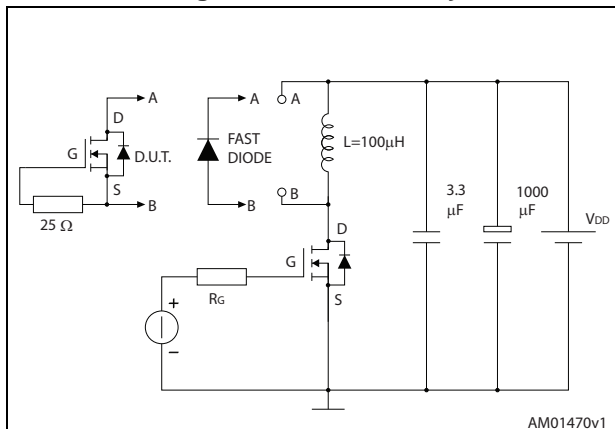
AM01468v1

Figure 16. Gate charge test circuit



AM01469v1

Figure 17. Test circuit for inductive load switching and diode recovery times



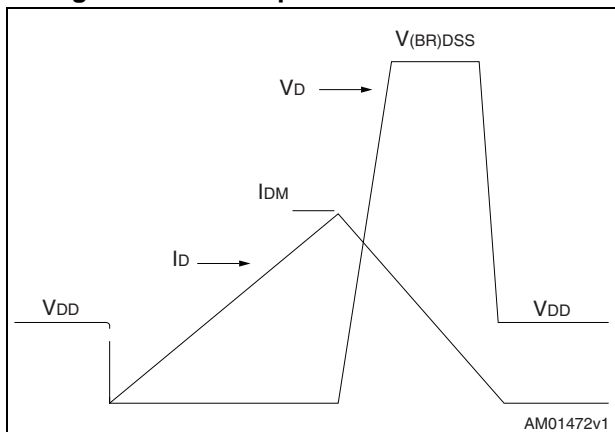
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Figure 18. Unclamped inductive load test circuit



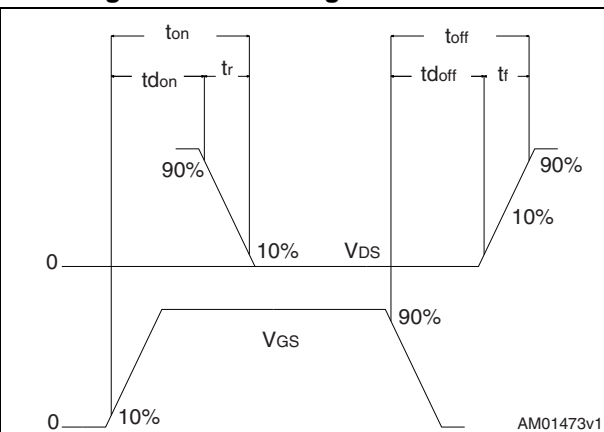
AM01471v1

Figure 19. Unclamped inductive waveform



AM01472v1

Figure 20. Switching time waveform



AM01473v1

## 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.

Figure 21. TO-3PF drawing

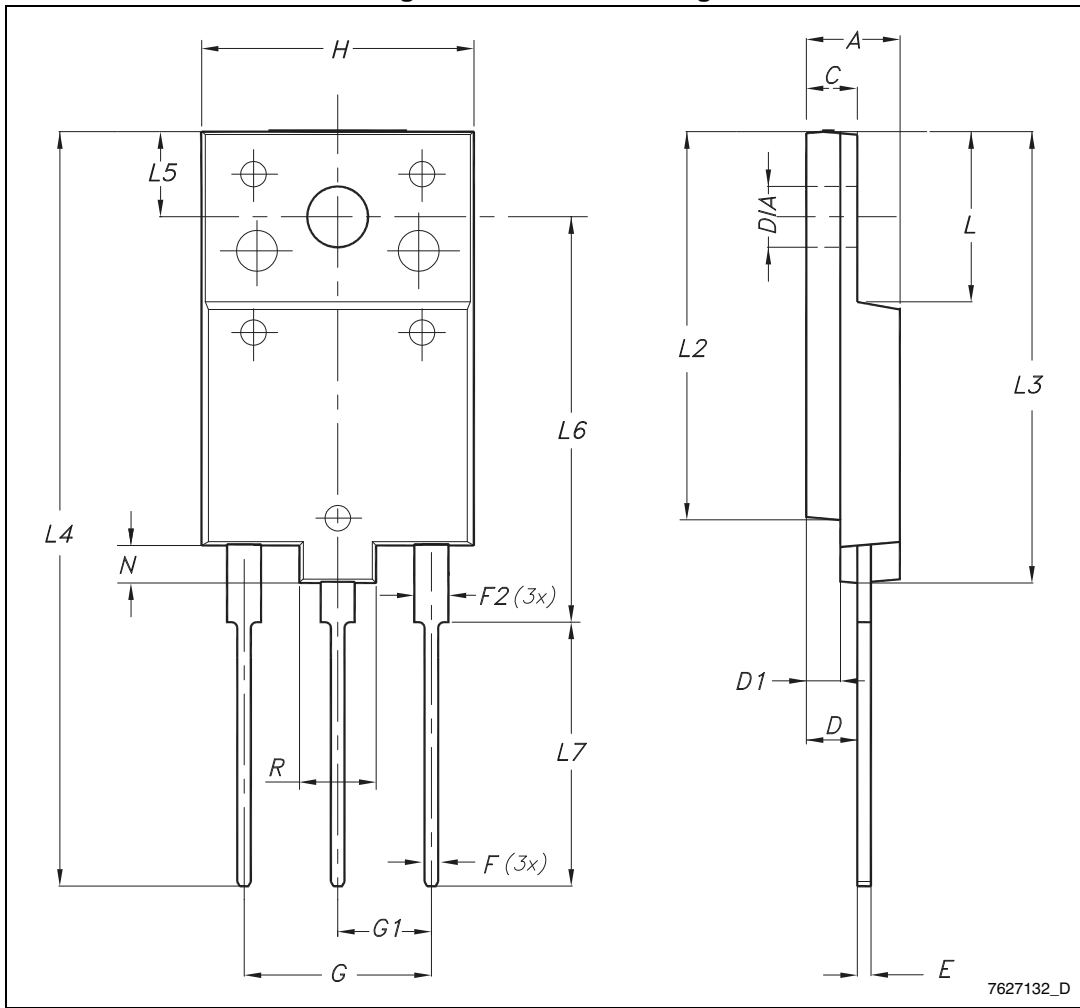


Table 9. TO-3PF mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	5.30		5.70
C	2.80		3.20
D	3.10		3.50
D1	1.80		2.20
E	0.80		1.10
F	0.65		0.95
F2	1.80		2.20
G	10.30		11.50
G1		5.45	
H	15.30		15.70
L	9.80	10	10.20
L2	22.80		23.20
L3	26.30		26.70
L4	43.20		44.40
L5	4.30		4.70
L6	24.30		24.70
L7	14.60		15
N	1.80		2.20
R	3.80		4.20
Dia	3.40		3.80

## 5 Revision history

Table 10. Document revision history

Date	Revision	Changes
08-May-2014	1	First release.

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