

## N-channel 650 V, 0.37 $\Omega$ typ., 10 A MDmesh™ M2 Power MOSFET in a TO-220FP ultra narrow leads package

Datasheet - production data

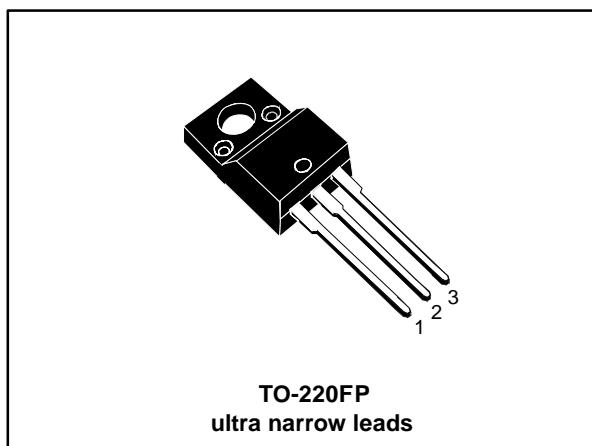
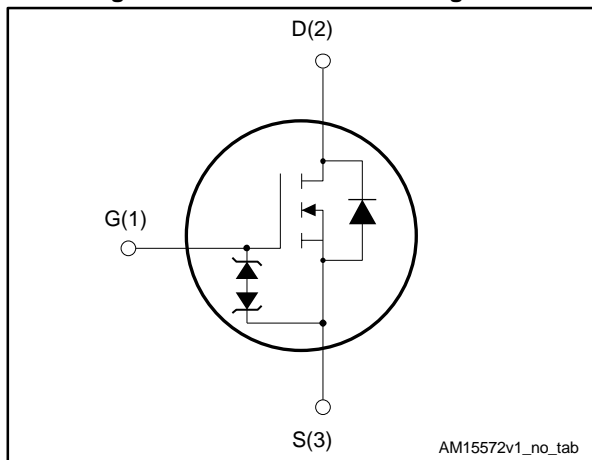


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
STFU13N65M2	650 V	0.43 $\Omega$	10A

- Extremely low gate charge
- Excellent output capacitance (C<sub>oss</sub>) profile
- 100% avalanche tested
- Zener-protected

### Applications

- Switching applications

### Description

This device is an N-channel Power MOSFET developed using MDmesh™ M2 technology. Thanks to its strip layout and an improved vertical structure, the device exhibits low on-resistance and optimized switching characteristics, rendering it suitable for the most demanding high efficiency converters.

Table 1: Device summary

Order code	Marking	Package	Packaging
STFU13N65M2	13N65M2	TO-220FP ultra narrow leads	Tube

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# 1 Electrical ratings

**Table 2: Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V <sub>GS</sub>	Gate-source voltage	± 25	V
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	10 <sup>(1)</sup>	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	6.3 <sup>(1)</sup>	A
I <sub>DM</sub> <sup>(2)</sup>	Drain current (pulsed)	40 <sup>(1)</sup>	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	25	W
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
dv/dt <sup>(3)</sup>	Peak diode recovery voltage slope	15	V/ns
dv/dt <sup>(4)</sup>	MOSFET dv/dt ruggedness	50	
T <sub>stg</sub>	Storage temperature	- 55 to 150	°C
T <sub>j</sub>	Max. operating junction temperature	150	

**Notes:**

<sup>(1)</sup>Limited by maximum junction temperature..

<sup>(2)</sup>Pulse width limited by safe operating area.

<sup>(3)</sup>I<sub>SD</sub> ≤ 10 A, di/dt ≤ 400 A/μs; V<sub>DSpEak</sub> < V<sub>(BR)DSS</sub>, V<sub>DD</sub>=400 V

<sup>(4)</sup>V<sub>DS</sub> ≤ 520 V

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case max	5	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	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> )	1.8	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)	350	mJ

## 2 Electrical characteristics

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

**Table 5: On /off states**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 1\text{ mA}$ , $V_{GS} = 0\text{ V}$	650			V
$I_{DSS}$	Zero gate voltage drain current ( $V_{GS} = 0$ )	$V_{DS} = 650\text{ V}$			1	$\mu\text{A}$
		$V_{DS} = 650\text{ V}$ , $T_C = 125\text{ °C}$			100	$\mu\text{A}$
$I_{GSS}$	Gate-body leakage current ( $V_{DS} = 0$ )	$V_{GS} = \pm 25\text{ V}$			$\pm 10$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 5\text{ A}$		0.37	0.43	$\Omega$

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ISS}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	590	-	pF
$C_{OSS}$	Output capacitance		-	27.5	-	pF
$C_{RSS}$	Reverse transfer capacitance		-	1.1	-	pF
$C_{OSS\text{ eq.}}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }520\text{ V}$ , $V_{GS} = 0\text{ V}$	-	168.5	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	6.5	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 520\text{ V}$ , $I_D = 10\text{ A}$ , $V_{GS} = 10\text{ V}$	-	17	-	nC
$Q_{gs}$	Gate-source charge		-	3.3	-	nC
$Q_{gd}$	Gate-drain charge		-	7	-	nC

**Notes:**

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

**Table 7: Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 325\text{ V}$ , $I_D = 5\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$	-	11	-	ns
$t_r$	Rise time		-	7.8	-	ns
$t_{d(off)}$	Turn-off delay time		-	38	-	ns
$t_f$	Fall time		-	12	-	ns

Table 8: Source drain diode

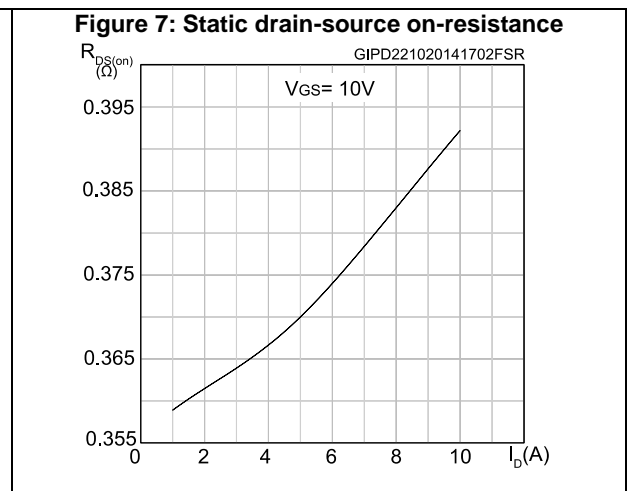
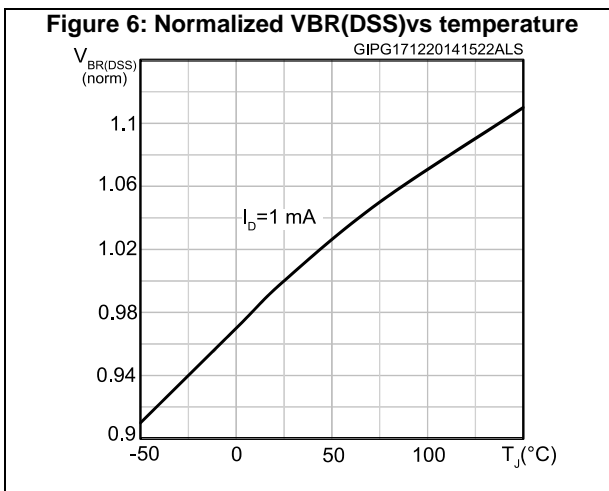
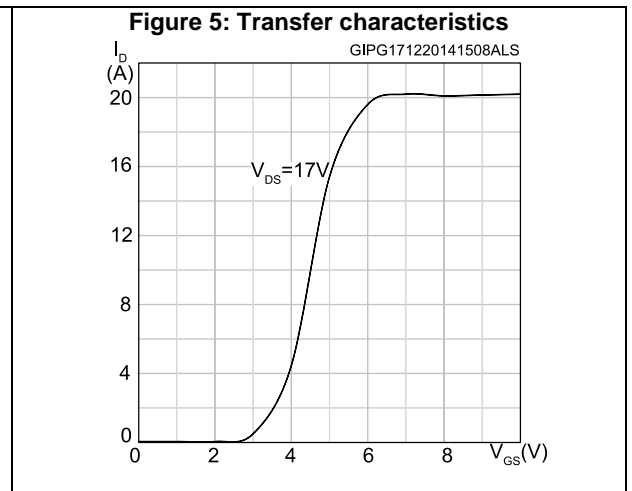
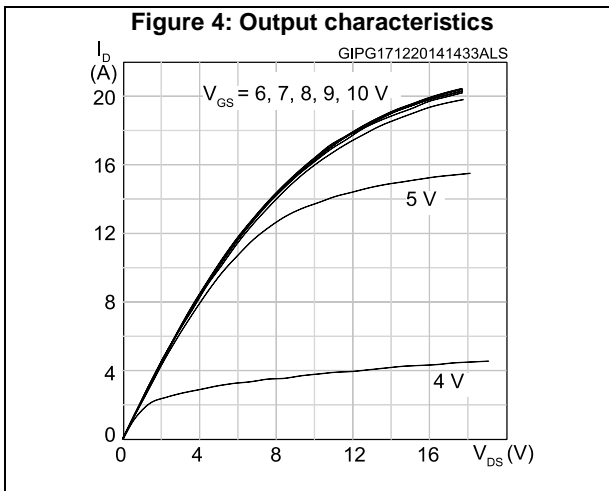
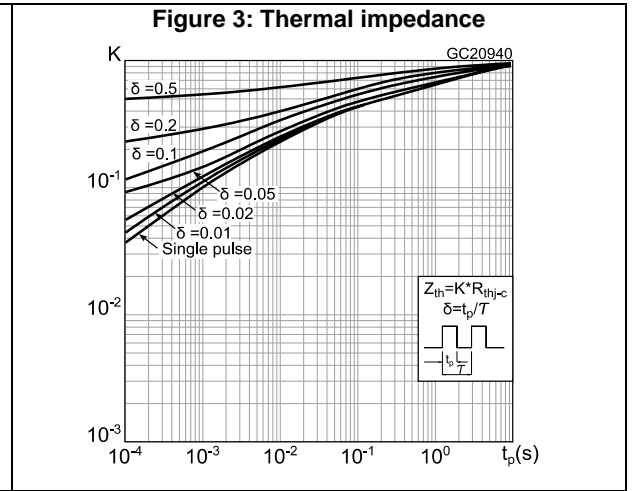
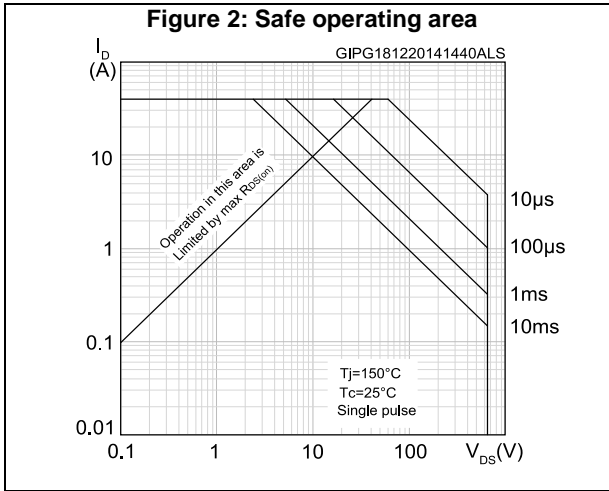
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		10	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		40	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 10 \text{ A}$ , $V_{GS} = 0 \text{ V}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 10 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ , $V_{DD} = 60 \text{ V}$	-	312		ns
$Q_{rr}$	Reverse recovery charge		-	2.7		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	17.5		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 10 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ , $V_{DD} = 60 \text{ V}$ , $T_j = 150 \text{ }^\circ\text{C}$	-	464		ns
$Q_{rr}$	Reverse recovery charge		-	4.1		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	17.5		A

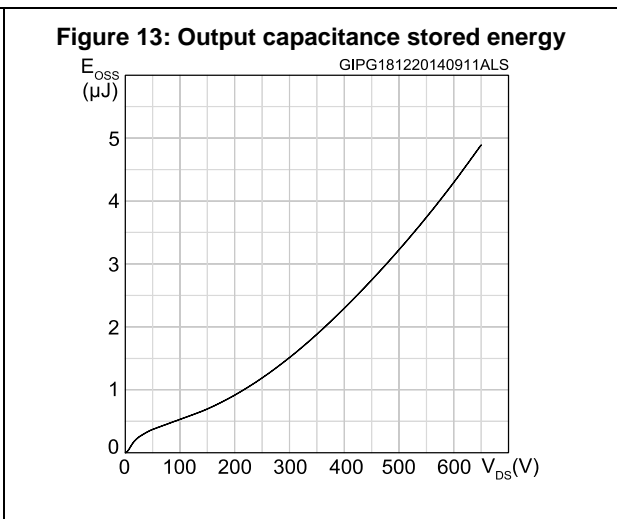
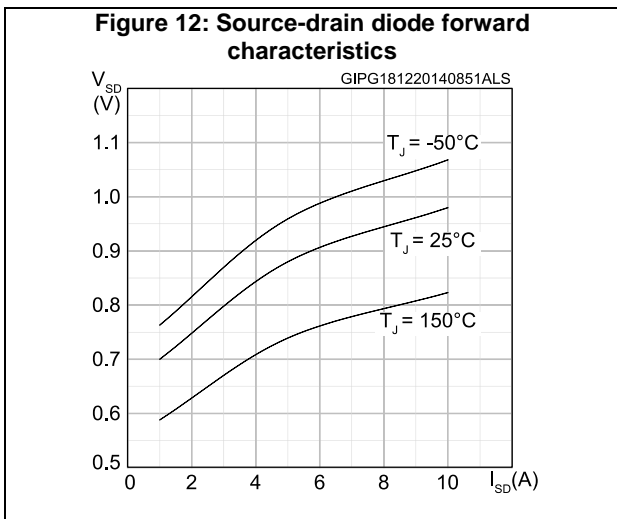
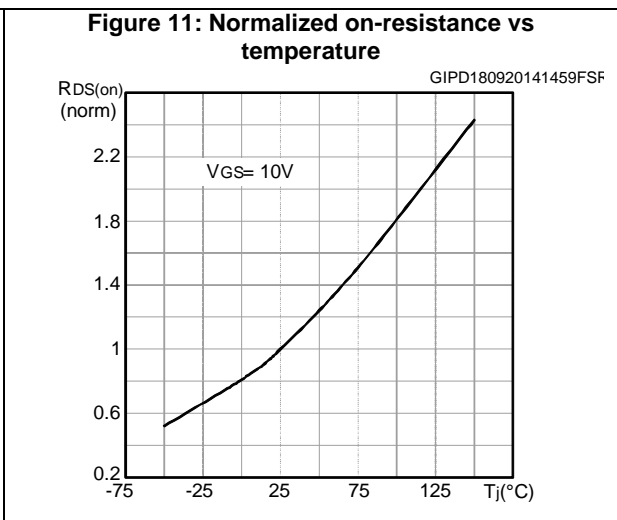
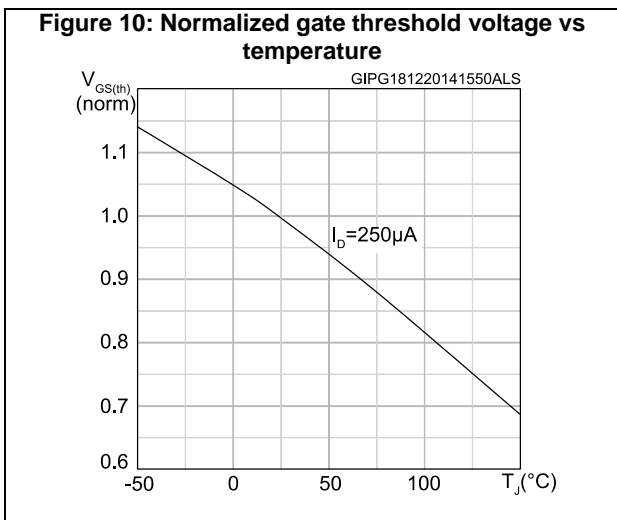
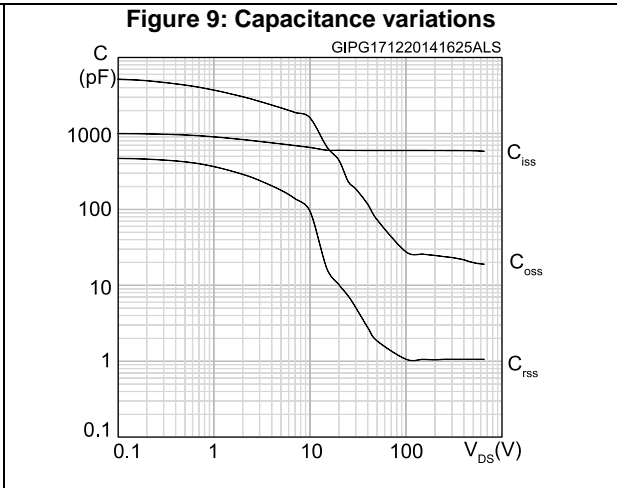
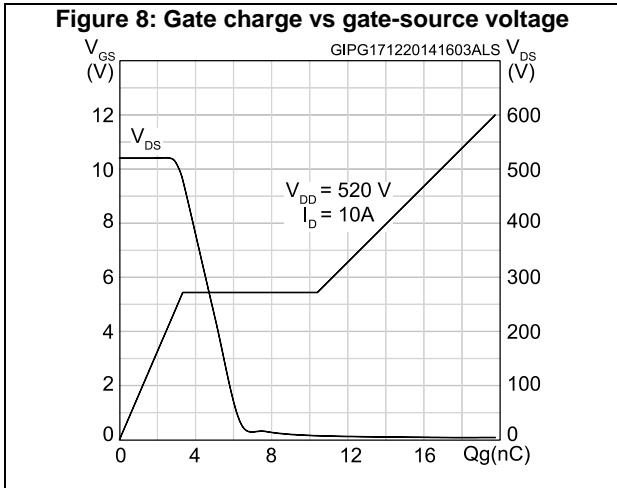
**Notes:**

(1)Pulse width limited by safe operating area.

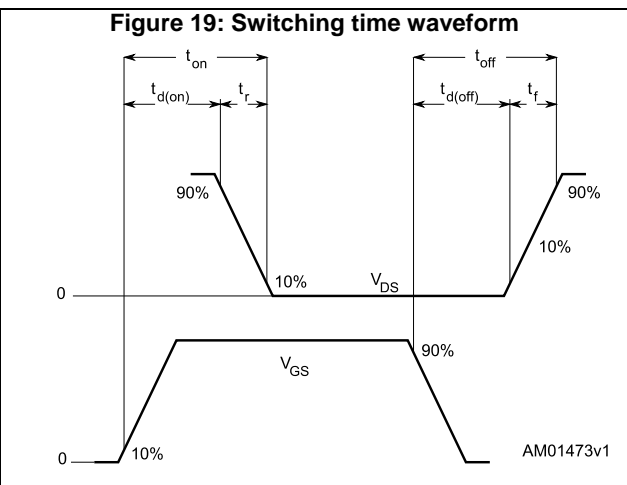
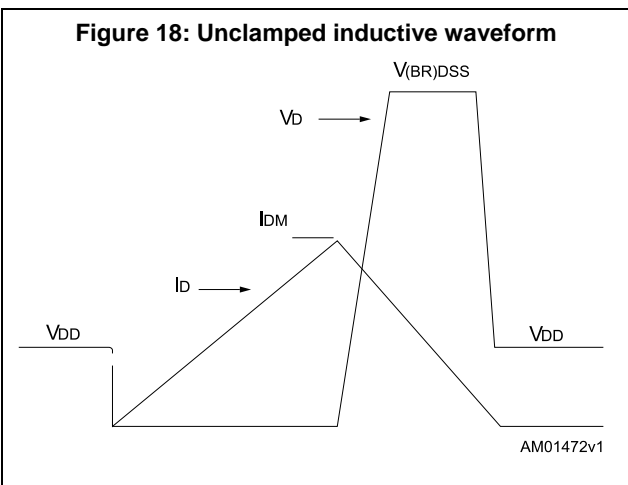
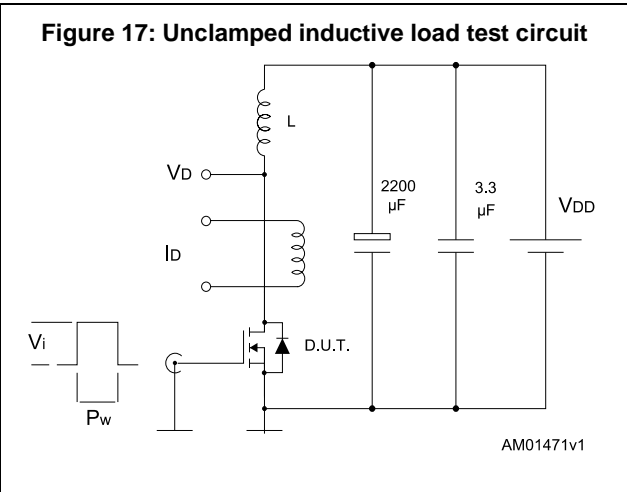
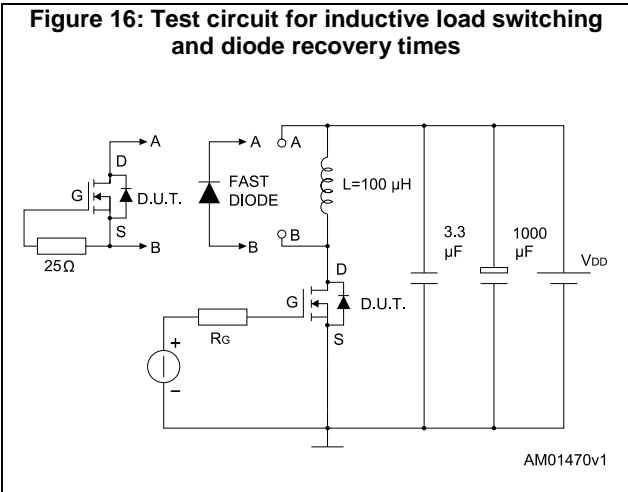
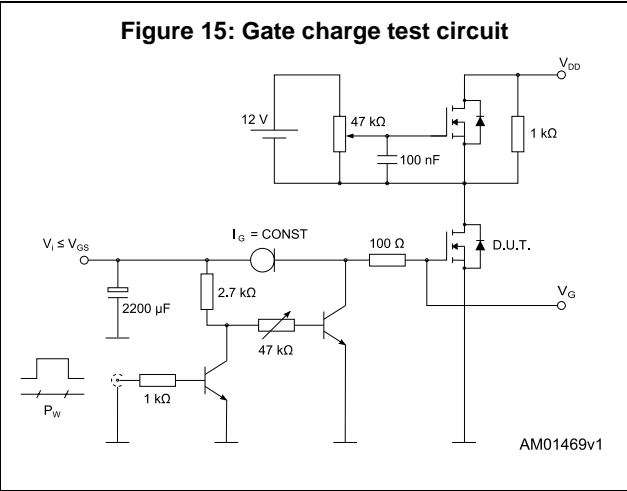
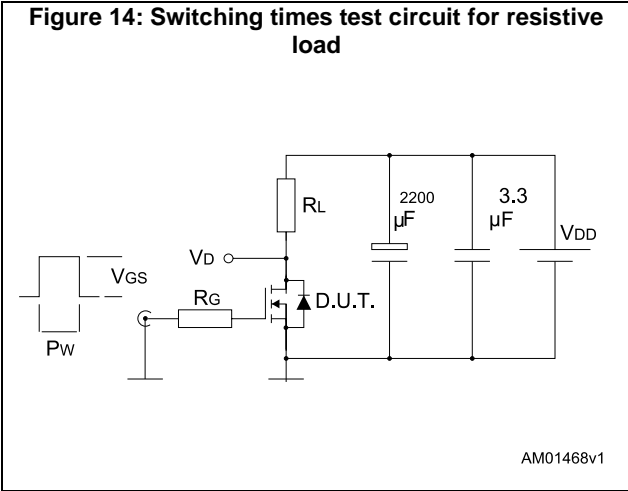
(2)Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%

2.1 Electrical characteristics (curves)





### 3 Test circuit





## 4 Package mechanical data

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 ultra narrow leads package outline

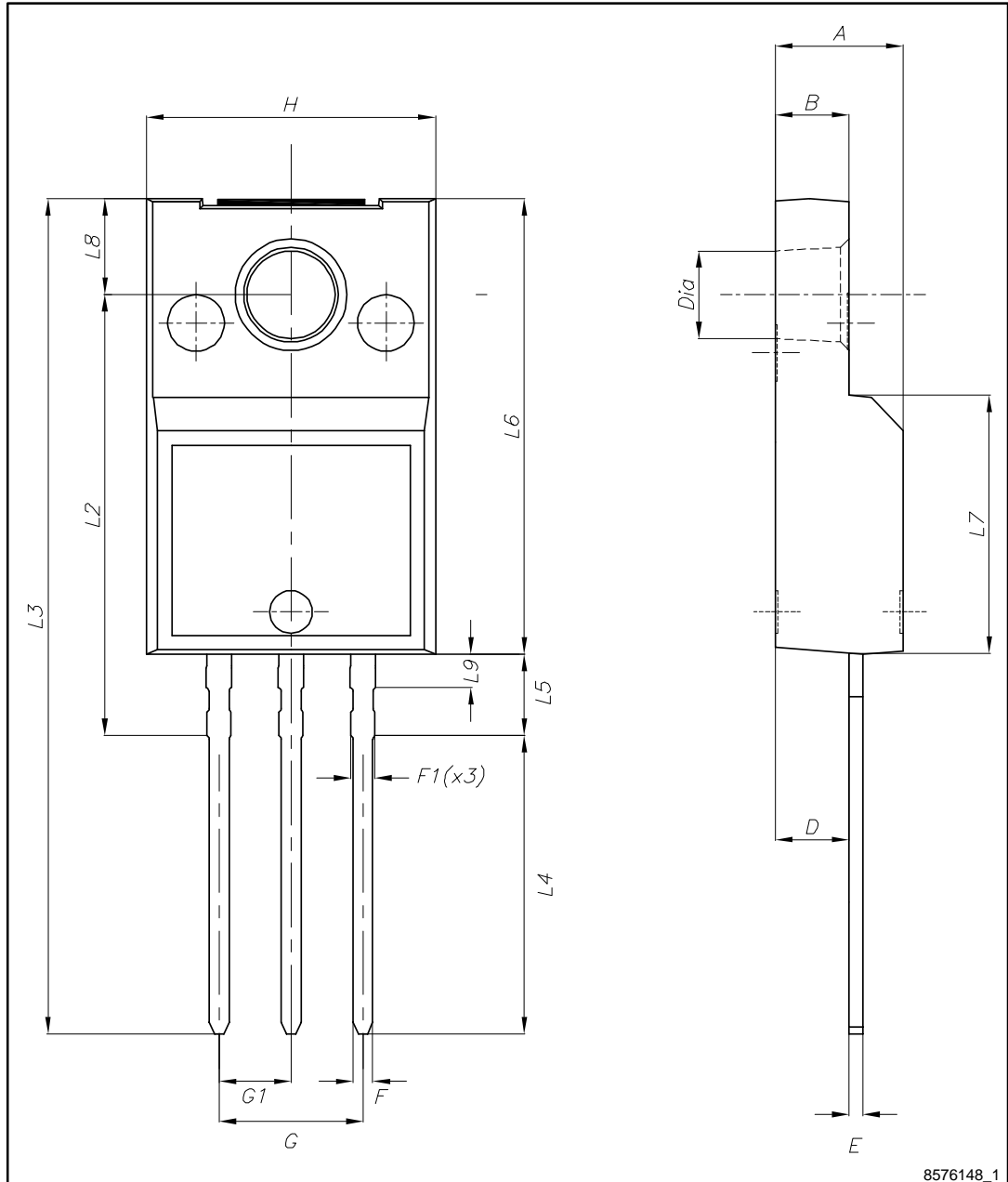


Table 9: TO-220FP ultra narrow leads mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
B	2.50		2.70
D	2.50		2.75
E	0.45		0.60
F	0.65		0.75
F1	-		0.90
G	4.95		5.20
G1	2.40	2.54	2.70
H	10.00		10.40
L2	15.10		15.90
L3	28.50		30.50
L4	10.20		11.00
L5	2.50		3.10
L6	15.60		16.40
L7	9.00		9.30
L8	3.20		3.60
L9	-		1.30
Dia.	3.00		3.20

## 5 Revision history

Table 10: Document revision history

Date	Revision	Changes
26-May-2015	1	Initial release

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