

## N-channel 650 V, 0.093 $\Omega$ typ., 32 A MDmesh™ DM2 Power MOSFET in a TO-220FP package

Datasheet - production data

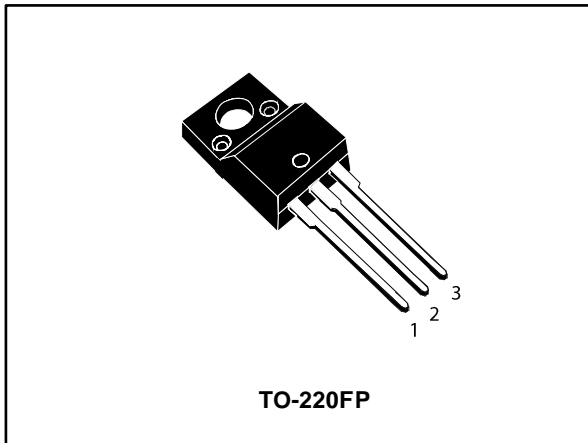
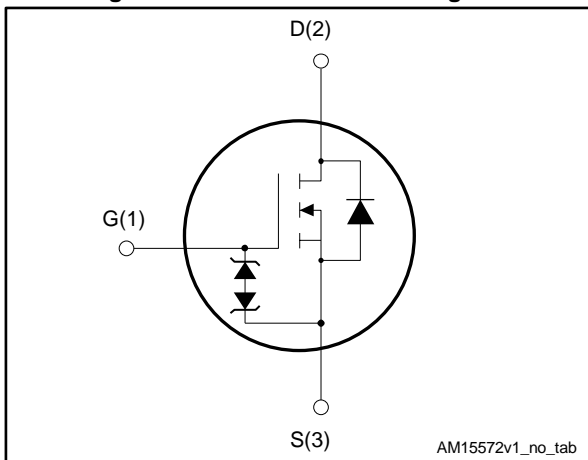


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>	P <sub>TOT</sub>
STF35N65DM2	650 V	0.110 $\Omega$	32 A	40 W

- Fast-recovery body diode
- Extremely low gate charge and input capacitance
- Low on-resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected

### Applications

- Switching applications

### Description

This high voltage N-channel Power MOSFET is part of the MDmesh™ DM2 fast recovery diode series. It offers very low recovery charge ( $Q_{rr}$ ) and time ( $t_{rr}$ ) combined with low  $R_{DS(on)}$ , rendering it suitable for the most demanding high efficiency converters and ideal for bridge topologies and ZVS phase-shift converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STF35N65DM2	35N65DM2	TO-220FP	Tube

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## Contents

<b>1</b>	<b>Electrical ratings .....</b>	<b>3</b>
<b>2</b>	<b>Electrical characteristics .....</b>	<b>4</b>
	2.1 Electrical characteristics (curves).....	6
<b>3</b>	<b>Test circuits .....</b>	<b>8</b>
<b>4</b>	<b>Package information .....</b>	<b>9</b>
	4.1 TO-220FP package information .....	10
<b>5</b>	<b>Revision history .....</b>	<b>12</b>

# 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>case</sub> = 25 °C	32	A
	Drain current (continuous) at T <sub>case</sub> = 100 °C	20	
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	90	A
P <sub>TOT</sub>	Total dissipation at T <sub>case</sub> = 25 °C	40	W
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	50	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)	2.5	kV
T <sub>stg</sub>	Storage temperature range	-55 to 150	°C
T <sub>j</sub>	Operating junction temperature range		

**Notes:**

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

<sup>(2)</sup>I<sub>SD</sub> ≤ 32 A, di/dt=900 A/μs, V<sub>DS</sub> peak < V<sub>(BR)DSS</sub>, V<sub>DD</sub> = 80% V<sub>(BR)DSS</sub>

<sup>(3)</sup>V<sub>DS</sub> ≤ 520 V

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case	3.1	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient	62.5	

**Table 4: Avalanche characteristics**

Symbol	Parameter	Value	Unit
I <sub>AR</sub>	Avalanche current, repetitive or non-repetitive	4	A
E <sub>AS</sub> <sup>(1)</sup>	Single pulse avalanche energy	1150	mJ

**Notes:**

<sup>(1)</sup>Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = I<sub>AR</sub>, V<sub>DD</sub> = 50 V.

## 2 Electrical characteristics

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

**Table 5: Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(\text{BR})\text{DSS}}$	Drain-source breakdown voltage	$V_{\text{GS}} = 0\text{ V}$ , $I_{\text{D}} = 1\text{ mA}$	650			V
$I_{\text{DSS}}$	Zero gate voltage drain current	$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 650\text{ V}$			1	$\mu\text{A}$
		$V_{\text{GS}} = 0\text{ V}$ , $V_{\text{DS}} = 650\text{ V}$ , $T_{\text{case}} = 125\text{ °C}^{(1)}$			100	
$I_{\text{GSS}}$	Gate-body leakage current	$V_{\text{DS}} = 0\text{ V}$ , $V_{\text{GS}} = \pm 25\text{ V}$			$\pm 5$	$\mu\text{A}$
$V_{\text{GS(th)}}$	Gate threshold voltage	$V_{\text{DS}} = V_{\text{GS}}$ , $I_{\text{D}} = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{\text{DS(on)}}$	Static drain-source on-resistance	$V_{\text{GS}} = 10\text{ V}$ , $I_{\text{D}} = 16\text{ A}$		0.093	0.110	$\Omega$

**Notes:**

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

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{\text{iss}}$	Input capacitance	$V_{\text{DS}} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{\text{GS}} = 0\text{ V}$	-	2540	-	$\text{pF}$
$C_{\text{oss}}$	Output capacitance		-	115	-	
$C_{\text{riss}}$	Reverse transfer capacitance		-	2.5	-	
$C_{\text{oss eq.}}^{(1)}$	Equivalent output capacitance	$V_{\text{DS}} = 0\text{ to }520\text{ V}$ , $V_{\text{GS}} = 0\text{ V}$	-	204	-	$\text{pF}$
$R_{\text{G}}$	Intrinsic gate resistance	$f = 1\text{ MHz}$ , $I_{\text{D}} = 0\text{ A}$	-	4.2	-	$\Omega$
$Q_{\text{g}}$	Total gate charge	$V_{\text{DD}} = 520\text{ V}$ , $I_{\text{D}} = 32\text{ A}$ , $V_{\text{GS}} = 0$ to $10\text{ V}$ (see <a href="#">Figure 15: "Test circuit for gate charge behavior"</a> )	-	56.3	-	$\text{nC}$
$Q_{\text{gs}}$	Gate-source charge		-	12.7	-	
$Q_{\text{gd}}$	Gate-drain charge		-	27.6	-	

**Notes:**

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

**Table 7: Switching times**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{\text{d(on)}}$	Turn-on delay time	$V_{\text{DD}} = 325\text{ V}$ , $I_{\text{D}} = 16\text{ A}$ , $R_{\text{G}} = 4.7\text{ }\Omega$ , $V_{\text{GS}} = 10\text{ V}$ (see <a href="#">Figure 14: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 19: "Switching time waveform"</a> )	-	23.4	-	$\text{ns}$
$t_{\text{r}}$	Rise time		-	23	-	
$t_{\text{d(off)}}$	Turn-off delay time		-	72	-	
$t_{\text{f}}$	Fall time		-	10.4	-	

Table 8: Source-drain diode

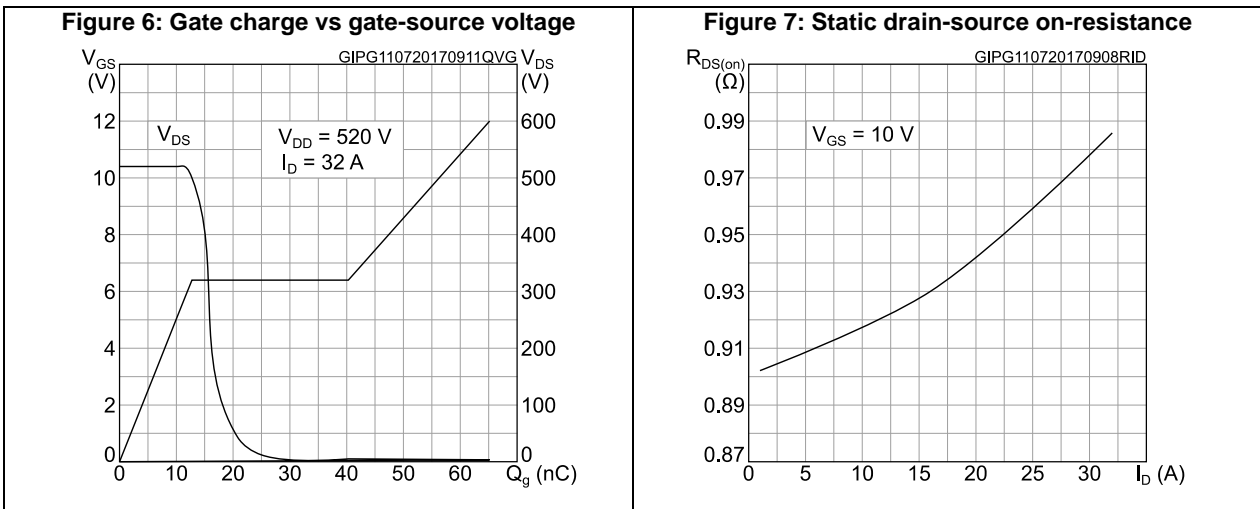
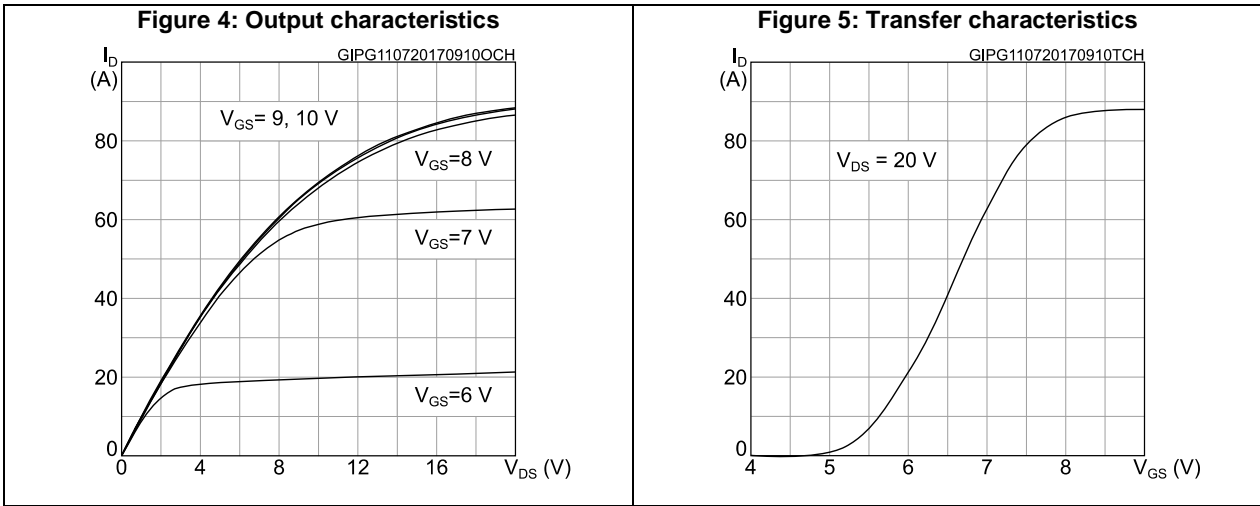
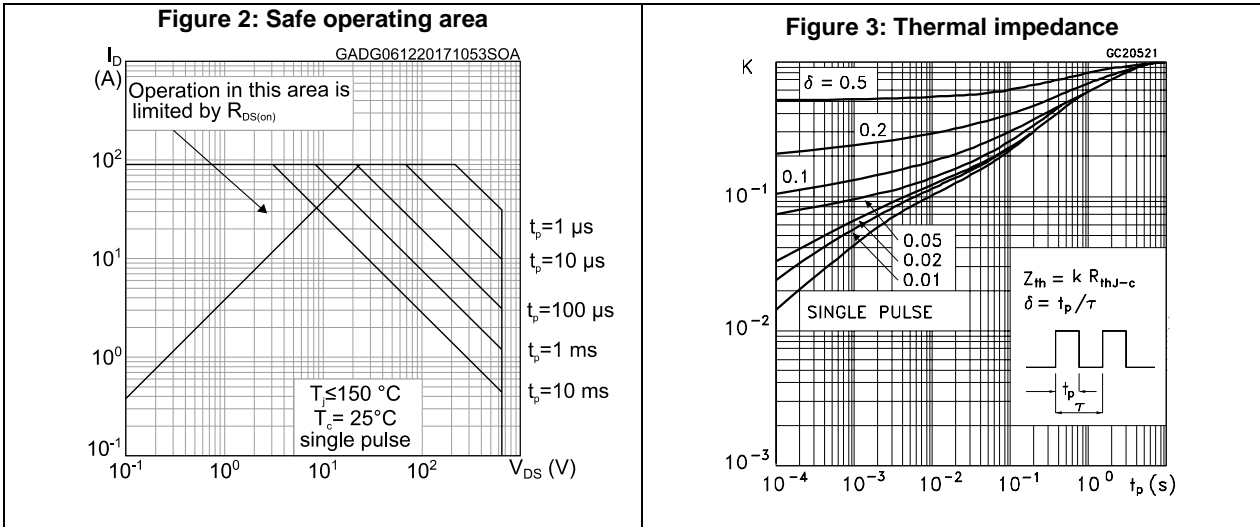
Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		32	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		90	A
$V_{SD}^{(2)}$	Forward on voltage	$V_{GS} = 0 \text{ V}$ , $I_{SD} = 32 \text{ A}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 32 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ , $V_{DD} = 60 \text{ V}$ (see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> )	-	100		ns
$Q_{rr}$	Reverse recovery charge		-	0.42		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	8.4		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 32 \text{ A}$ , $di/dt = 100 \text{ A}/\mu\text{s}$ , $V_{DD} = 60 \text{ V}$ , $T_j = 150 \text{ }^\circ\text{C}$ (see <a href="#">Figure 16: "Test circuit for inductive load switching and diode recovery times"</a> )	-	205		ns
$Q_{rr}$	Reverse recovery charge		-	1.8		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	17.6		A

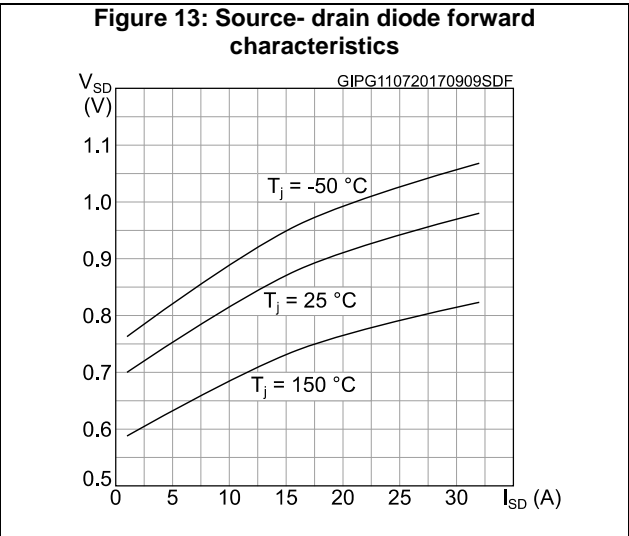
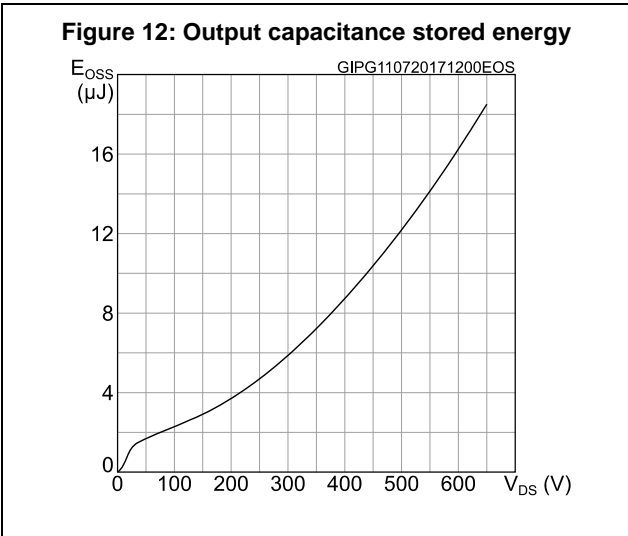
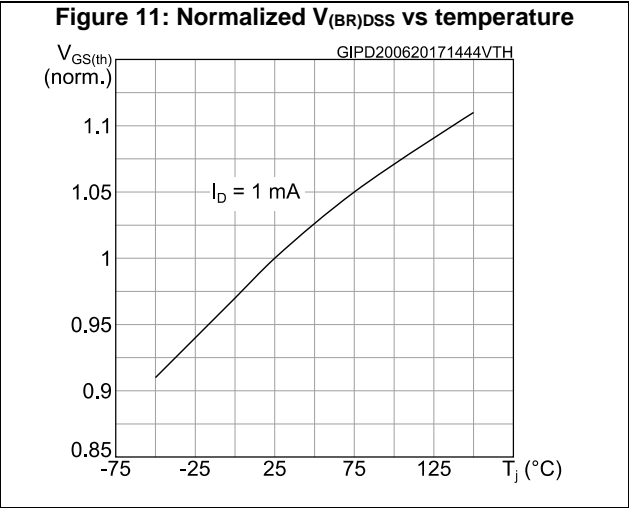
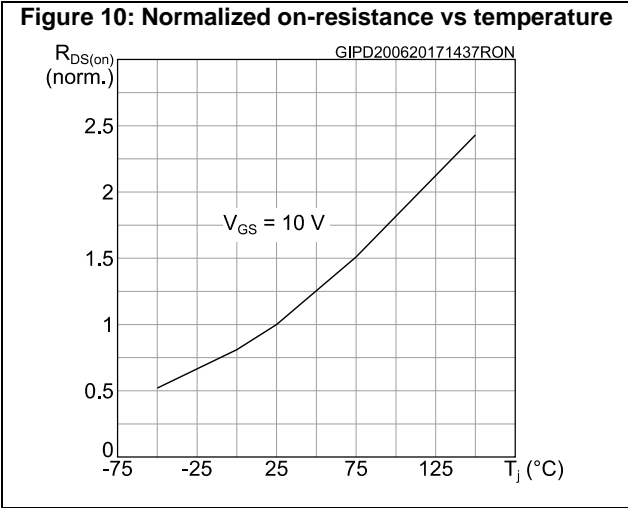
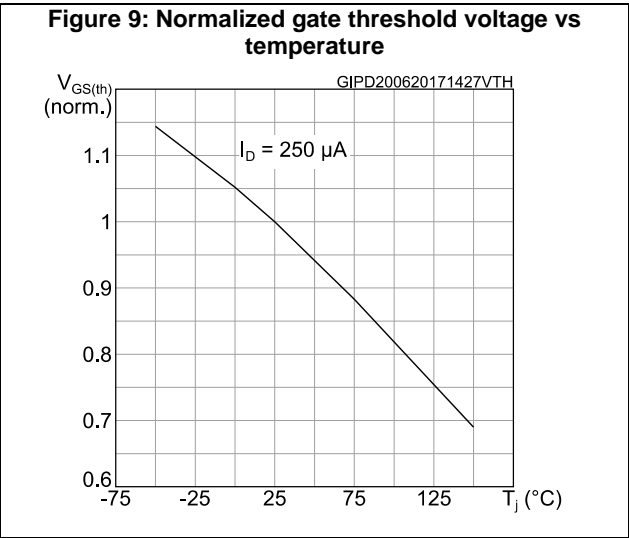
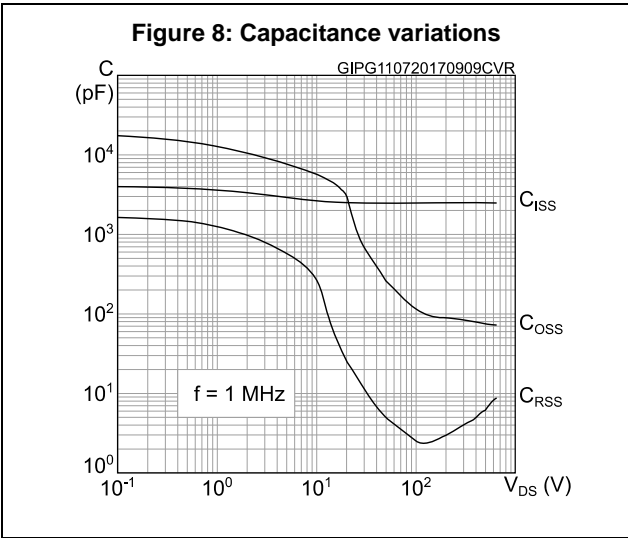
**Notes:**

(1)Pulse width is limited by safe operating area.

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

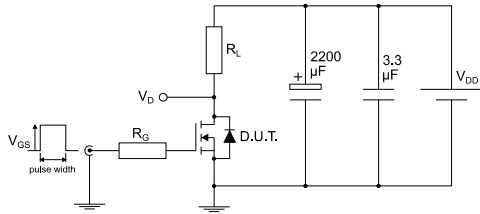
## 2.1 Electrical characteristics (curves)





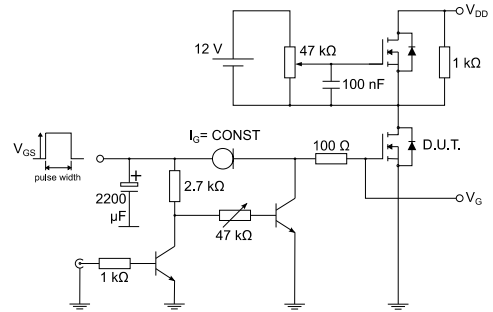
### 3 Test circuits

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



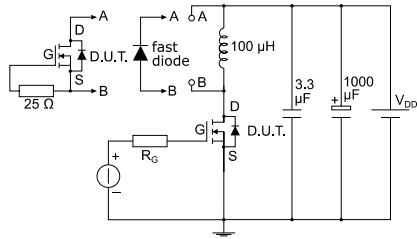
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**Figure 15: Test circuit for gate charge behavior**



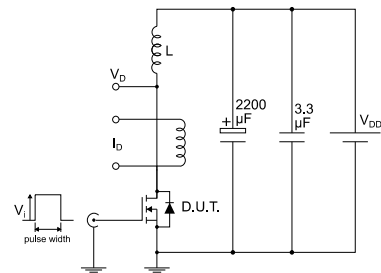
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**Figure 16: Test circuit for inductive load switching and diode recovery times**



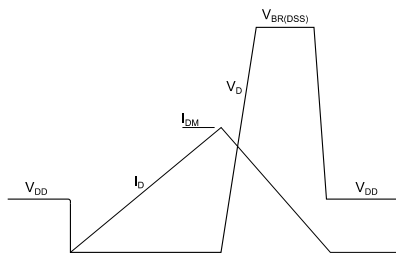
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**Figure 17: Unclamped inductive load test circuit**



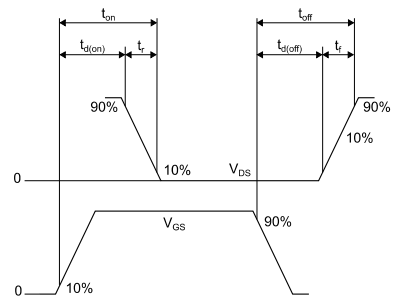
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**Figure 18: Unclamped inductive waveform**



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**Figure 19: Switching time waveform**



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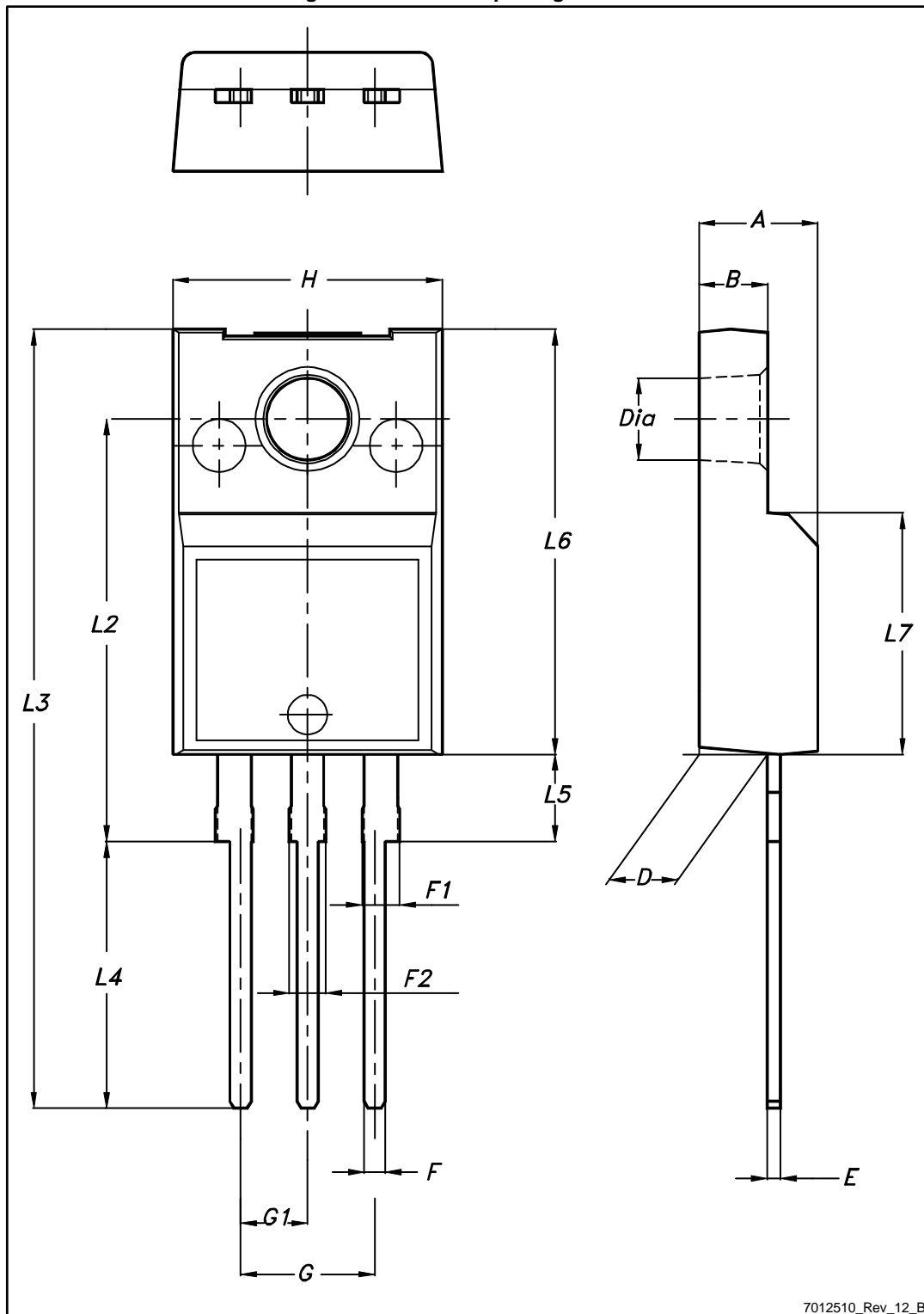


## 4 Package information

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\_12\_B

Table 9: 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 10: Document revision history

Date	Revision	Changes
21-Jul-2017	1	Initial release
04-Dec-2017	2	Document status changed from preliminary to production data. Updated <i>Table 2: "Absolute maximum ratings"</i> and <i>Table 8: "Source-drain diode"</i> . Updated <i>Figure 2: "Safe operating area"</i> . Minor text changes.

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