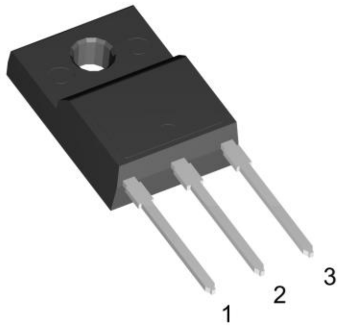
STFH10N60M2

N-channel 600 V, 0.55 Ω typ., 7.5 A MDmesh™ M2 Power MOSFET in a TO-220FP wide creepage package

Datasheet - production data



TO-220FP wide creepage

Features

Order code	V_{DS} @ T_{Jmax}	$R_{DS(on)}$ max	I_D
STFH10N60M2	650 V	0.60 Ω	7.5 A

- Extremely low gate charge
- Excellent output capacitance (C_{OSS}) profile
- 100% avalanche tested
- Zener-protected
- Wide distance of 4.25 mm between the pins

Applications

- Switching applications
- LLC converters, resonant converters

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.

The TO-220FP wide creepage package provides increased surface insulation for Power MOSFETs to prevent failure due to arcing, which can occur in polluted environments.

Figure 1: Internal schematic diagram

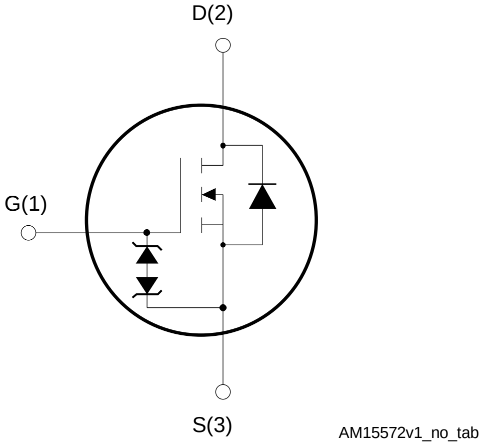


Table 1: Device summary

Order code	Marking	Package	Packing
STFH10N60M2	10N60M2	TO-220FP wide creepage	Tube

Contents

1 Electrical ratings

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	± 25	V
I_D (1)	Drain current (continuous) at T_C = 25 °C	7.5	A
I_D (1)	Drain current (continuous) at T_C = 100 °C	4.9	A
I_{DM} (1)(2)	Drain current (pulsed)	30	A
P_{TOT}	Total dissipation at T_C = 25 °C	25	W
dv/dt (3)	Peak diode recovery voltage slope	15	V/ns
dv/dt (4)	MOSFET dv/dt ruggedness	50	V/ns
V_{ISO}	Insulation withstand voltage (RMS) from all three leads to external heat sink (t = 1 s; TC = 25 °C)	2500	V
T_{stg}	Storage temperature range	- 55 to 150	°C
T_j	Operating junction temperature range		

Notes:

(1)Limited by package.

(2)Pulse width limited by package.

(3)$I_{SD} \leq 7.5$ A, di/dt ≤ 400 A/µs; $V_{DS(peak)} < V_{(BR)DSS}$, V_{DD} = 400 V

(4)$V_{DS} \leq 480$ V

Table 3: Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}case}$	Thermal resistance junction-case	5	°C/W
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient	62.5	°C/W

Table 4: Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_{jmax})	1.5	A
E_{AS}	Single pulse avalanche energy (starting T_j=25 °C, I_D= I_{AR}; V_{DD}=50 V)	110	mJ

2 Electrical characteristics

(T_C = 25 °C unless otherwise specified)

Table 5: On /off states

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C=125 °C (1)			100	µA
I_{GSS}	Gate-body leakage current	V_{DS} = 0 V, V_{GS} = ±25 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 3 A		0.55	0.60	Ω

Notes:

(1)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 V, f = 1 MHz, V_{GS} = 0 V	-	400	-	pF
C_{oss}	Output capacitance		-	22	-	pF
C_{rss}	Reverse transfer capacitance		-	0.84	-	pF
$C_{oss\ eq.}$ (1)	Equivalent output capacitance	V_{DS}= 0 to 480 V, V_{GS}= 0 V	-	83	-	pF
R_G	Intrinsic gate resistance	f = 1 MHz, I_D=0 A	-	6.4	-	Ω
Q_g	Total gate charge	V_{DD} = 480 V, I_D = 7.5 A, V_{GS} = 0 to 10 V (see *Figure 15: "Test circuit for gate charge behavior"*)	-	13.5	-	nC
Q_{gs}	Gate-source charge		-	2.1	-	nC
Q_{gd}	Gate-drain charge		-	7.2	-	nC

Notes:

(1)$C_{oss\ eq.}$ 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} = 300 V, I_D = 3.75 A, R_G = 4.7 Ω, V_{GS} = 10 V (see *Figure 14: "Test circuit for resistive load switching times"* and *Figure 19: "Switching time waveform"*)	-	8.8	-	ns
t_r	Rise time		-	8	-	ns
$t_{d(off)}$	Turn-off delay time		-	32.5	-	ns
t_f	Fall time		-	13.2	-	ns

Table 8: Source drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}(1)	Source-drain current		-		7.5	A
I_{SDM}(1)(2)	Source-drain current (pulsed)		-		30	A
V_{SD}(3)	Forward on voltage	I_{SD} = 7.5 A, V_{GS} = 0 V	-		1.6	V
t_{rr}	Reverse recovery time	I_{SD} = 7.5 A, di/dt = 100 A/µs V_{DD} = 60 V (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*)	-	270		ns
Q_{rr}	Reverse recovery charge		-	2		µC
I_{RRM}	Reverse recovery current		-	14.4		A
t_{rr}	Reverse recovery time	I_{SD} = 7.5 A, di/dt = 100 A/µs V_{DD} = 60 V, T_j = 150 °C (see *Figure 16: "Test circuit for inductive load switching and diode recovery times"*)	-	376		ns
Q_{rr}	Reverse recovery charge		-	2.8		µC
I_{RRM}	Reverse recovery current		-	15		A

Notes:

(1)Limited by package.

(2)Pulse width limited by safe operating area.

(3)Pulsed: pulse duration = 300 µs, duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 2: Safe operating area

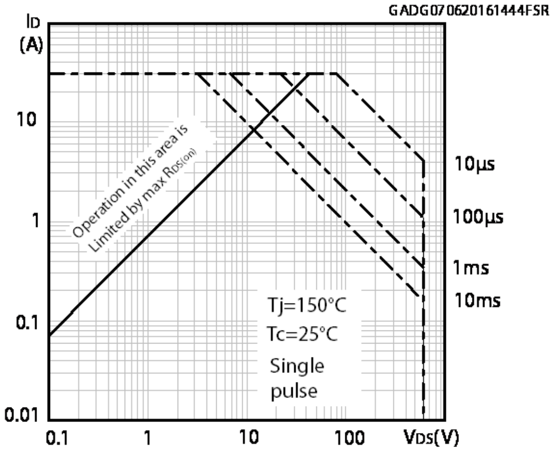


Figure 3: Thermal impedance

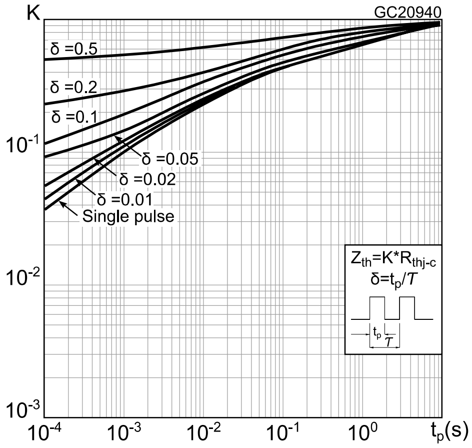


Figure 4: Output characteristics

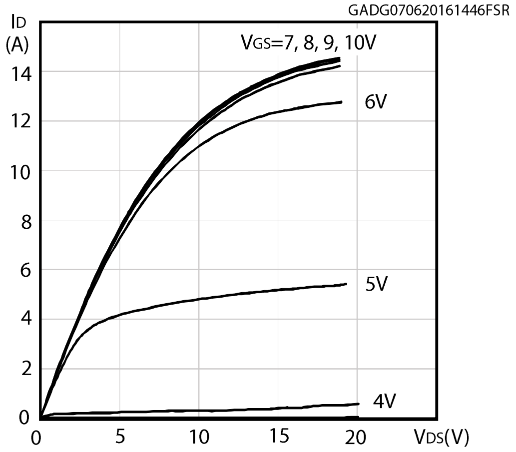


Figure 5: Transfer characteristics

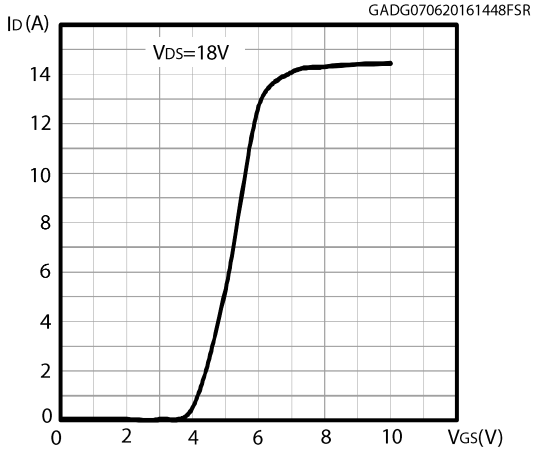


Figure 6: Gate charge vs gate-source voltage

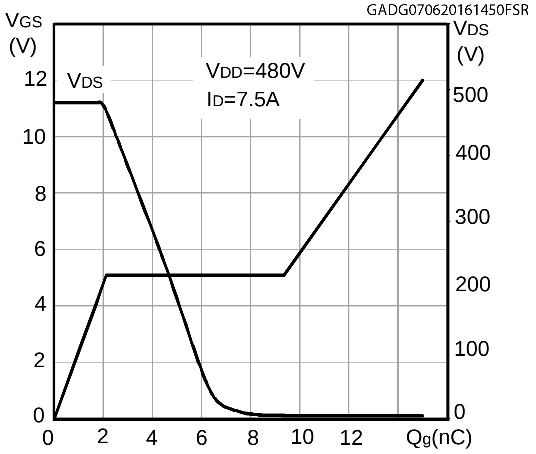


Figure 7: Static drain-source on-resistance

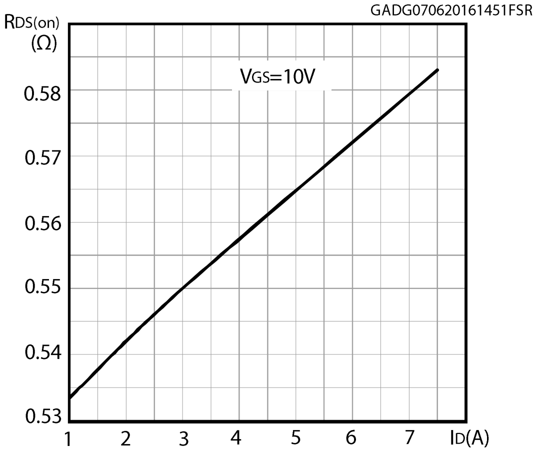


Figure 8: Capacitance variations

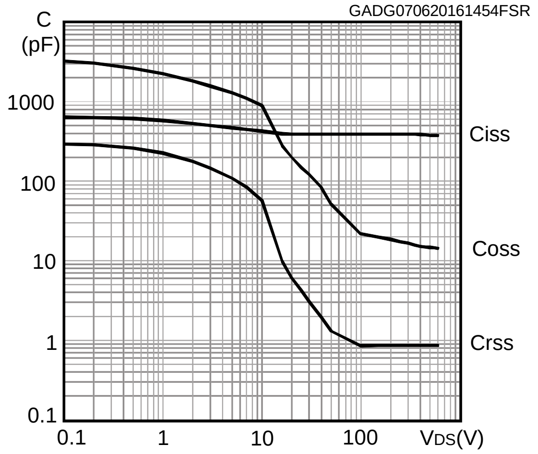


Figure 9: Normalized gate threshold voltage vs. temperature

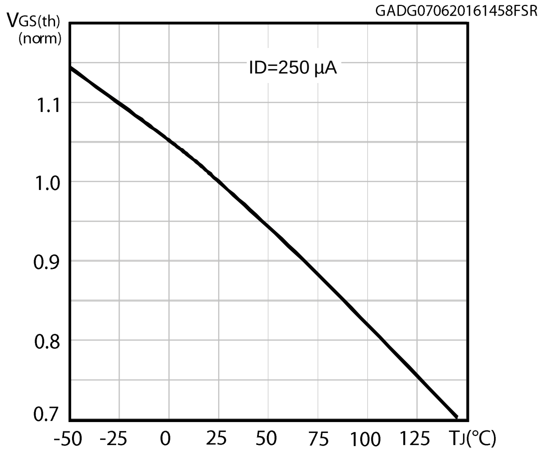


Figure 10: Normalized on-resistance vs temperature

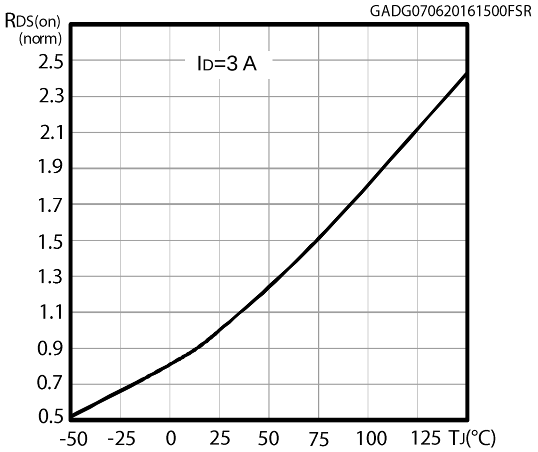


Figure 11: Source-drain diode forward characteristics

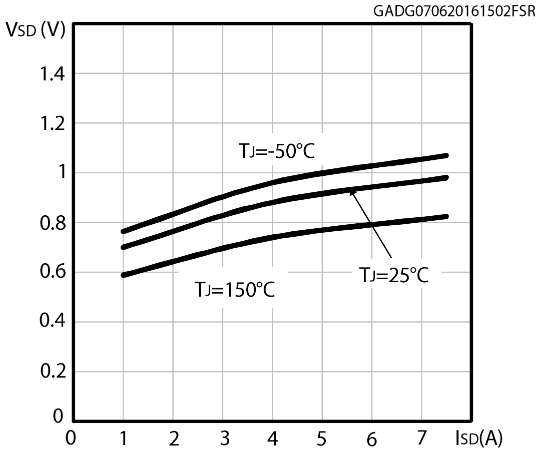


Figure 12: Normalized $V_{(BR)DSS}$ vs temperature

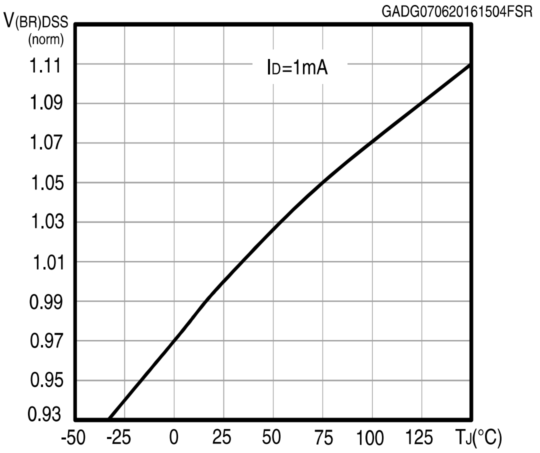
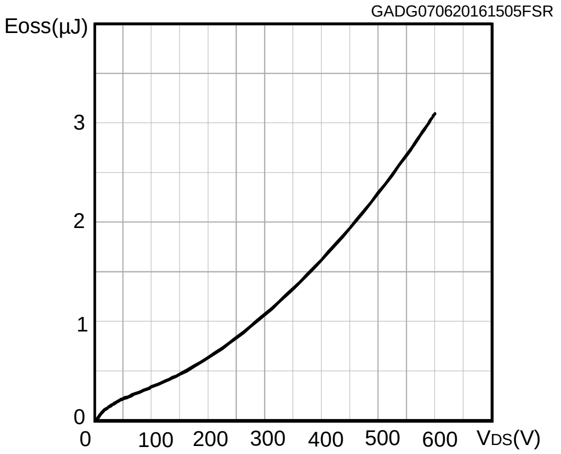


Figure 13: Output capacitance stored energy



3 Test circuits

Figure 14: Test circuit for resistive load switching times

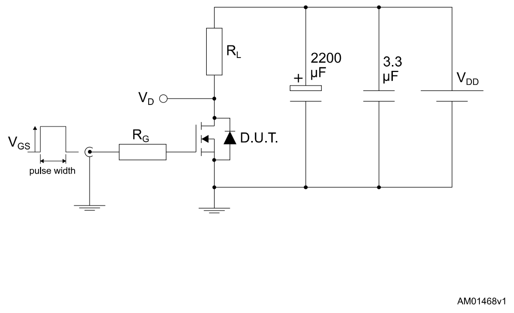


Figure 15: Test circuit for gate charge behavior

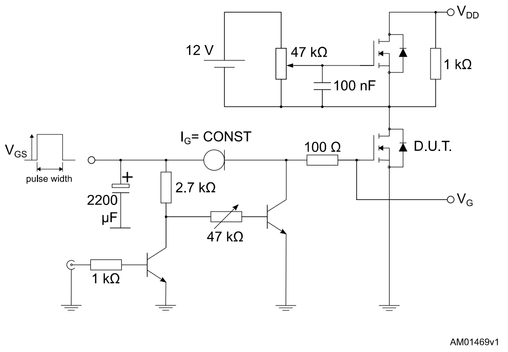


Figure 16: Test circuit for inductive load switching and diode recovery times

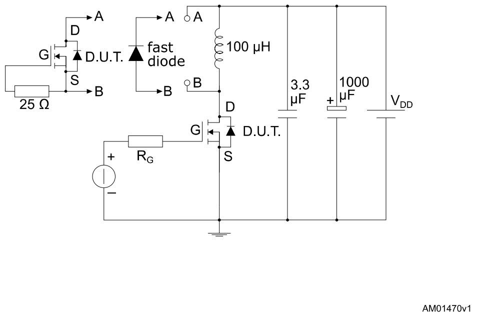


Figure 17: Unclamped inductive load test circuit

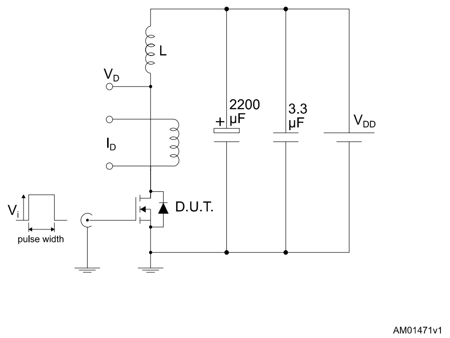


Figure 18: Unclamped inductive waveform

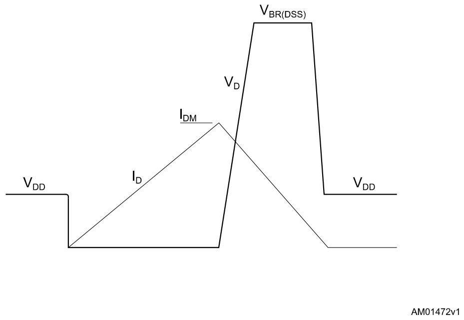
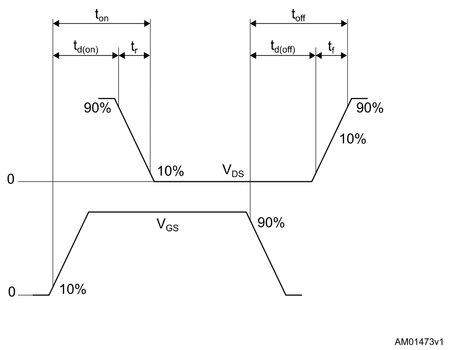


Figure 19: Switching time waveform



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***. ECOPACK® is an ST trademark.

4.1 TO-220FP wide creepage package information

Figure 20: TO-220FP wide creepage package outline

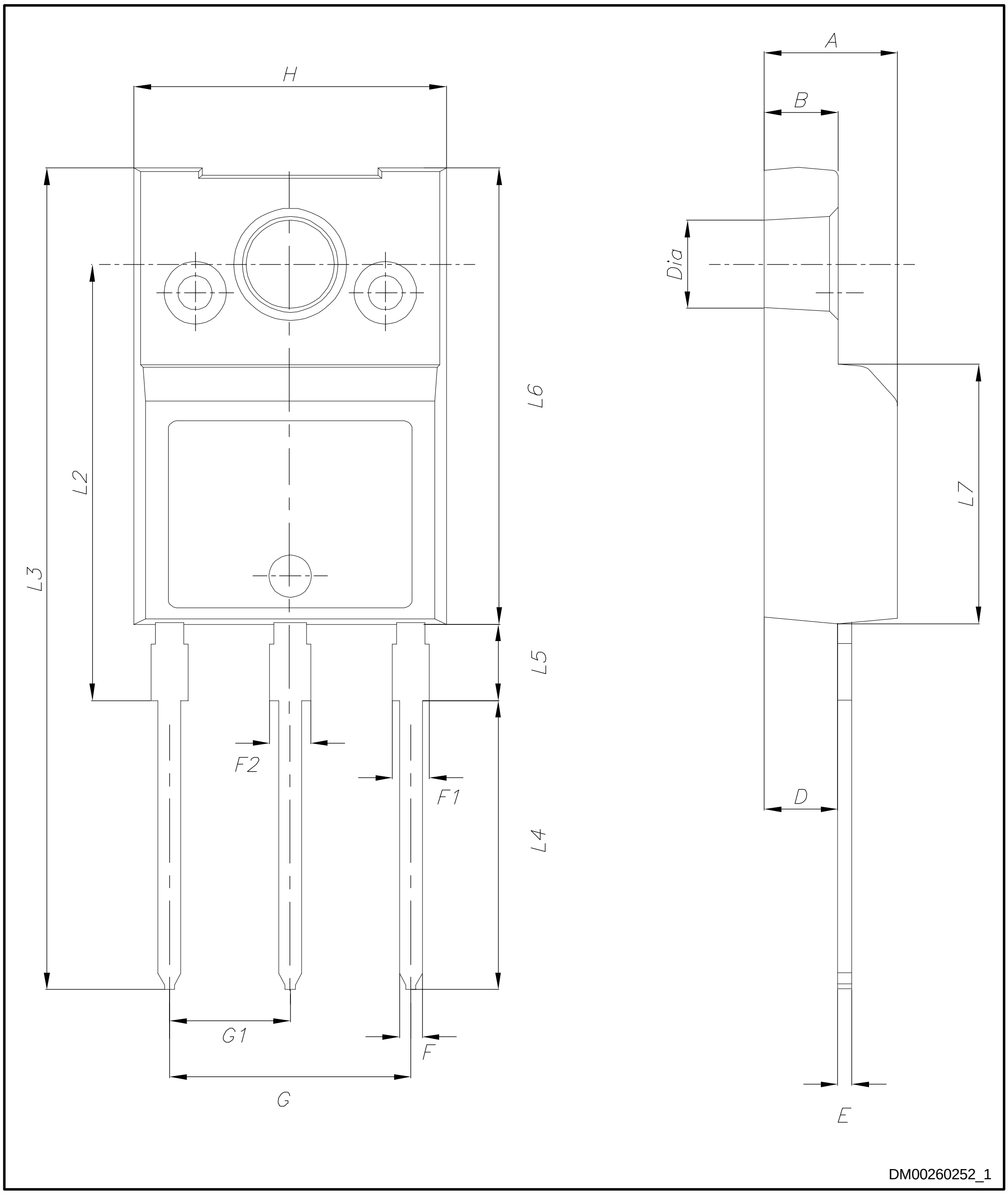


Table 9: TO-220FP wide creepage package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.60	4.70	4.80
B	2.50	2.60	2.70
D	2.49	2.59	2.69
E	0.46		0.59
F	0.76		0.89
F1	0.96		1.25
F2	1.11		1.40
G	8.40	8.50	8.60
G1	4.15	4.25	4.35
H	10.90	11.00	11.10
L2	15.25	15.40	15.55
L3	28.70	29.00	29.30
L4	10.00	10.20	10.40
L5	2.55	2.70	2.85
L6	16.00	16.10	16.20
L7	9.05	9.15	9.25
Dia	3.00	3.10	3.20

5 Revision history

Table 10: Document revision history

Date	Revision	Changes
07-Jun-2016	1	First release.
16-Jun-2016	2	Document status promoted from preliminary data to production data. Minor text changes.
18-Aug-2016	3	Modified: title and $R_{DS(on)}$ in cover page Modified: *Table 5: "On /off states"* and *Table 7: "Switching times"* Minor text changes
08-May-2017	4	Modified features on cover page. Modified *Table 2: "Absolute maximum ratings"* and *Table 4: "Avalanche characteristics"*. Minor text changes.

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