

## N-channel 600 V, 0.084 $\Omega$ typ., 29 A MDmesh™ DM6 Power MOSFET in an H<sup>2</sup>PAK-7 package

Datasheet - preliminary data

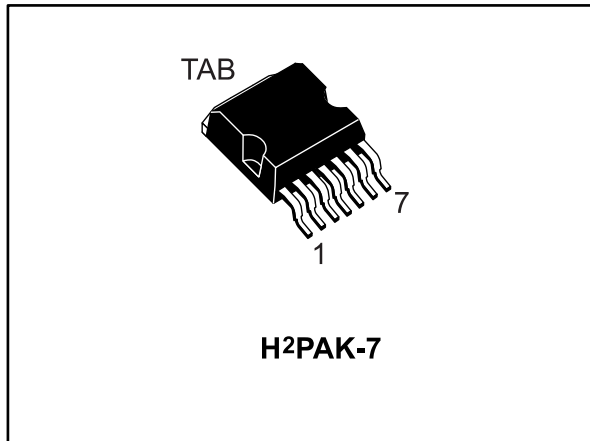
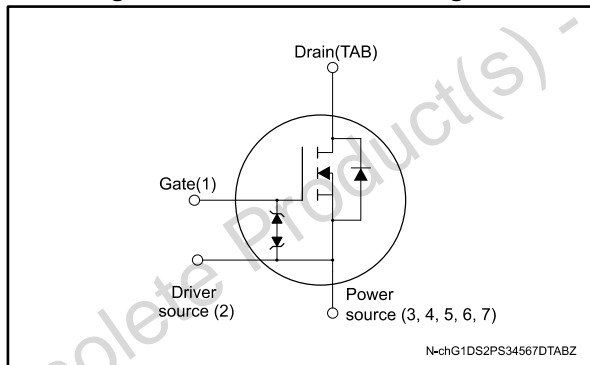


Figure 1: Internal schematic diagram



### Features

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STH45N60DM6-7	600 V	0.099 $\Omega$	29 A

- Fast-recovery body diode
- Lower R<sub>DS(on)</sub> x area vs previous generation
- Low gate charge, input capacitance and resistance
- 100% avalanche tested
- Extremely high dv/dt ruggedness
- Zener-protected
- Excellent switching performance thanks to the extra driving source pin

### Applications

- Switching applications

### Description

This high voltage N-channel Power MOSFET is part of the MDmesh™ DM6 fast recovery diode series. Compared with the previous MDmesh fast recovery diode series, DM6 combines very low recovery charge (Q<sub>rr</sub>), recovery time (t<sub>rr</sub>) and excellent improvement in R<sub>DS(on)</sub> \* area with one of the most effective switching behaviors available in the market for the most demanding high efficiency bridge topologies and ZVS phase-shift converters.

Table 1: Device summary

Order code	Marking	Package	Packing
STH45N60DM6-7	45N60DM6	H <sup>2</sup> PAK-7	Tape and reel

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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 H <sup>2</sup> PAK-7 package information .....	9
	4.2 H <sup>2</sup> PAK-7 packing information .....	12
<b>5</b>	<b>Revision history .....</b>	<b>14</b>

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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	29	A
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	18	A
I <sub>D</sub> <sup>(1)</sup>	Drain current (pulsed)	103	A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	210	W
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	50	V/ns
dv/dt <sup>(3)</sup>	MOSFET dv/dt ruggedness	100	
T <sub>J</sub>	Operating junction temperature range	-55 to 150	°C
T <sub>stg</sub>	Storage temperature range		

**Notes:**

(1)Pulse width limited by safe operating area.

(2)I<sub>SD</sub> ≤ 29 A, di/dt ≤ 800 A/μs; V<sub>DS peak</sub> < V<sub>(BR)DSS</sub>, V<sub>DD</sub> = 480 V

(3)V<sub>DS</sub> ≤ 480 V

**Table 3: Thermal data**

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case	0.6	°C/W
R <sub>thj-pcb</sub>	Thermal resistance junction-pcb <sup>(1)</sup>	30	

**Notes:**

(1)When mounted on 1 inch<sup>2</sup> FR-4, 2 Oz copper board.

**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> )	6	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> = 100 V)	630	mJ

## 2 Electrical characteristics

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

**Table 5: On/off-state**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$ , $I_D = 1\text{ mA}$	600			V
$I_{DSS}$	Zero gate voltage drain current	$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$			1	$\mu\text{A}$
		$V_{GS} = 0\text{ V}$ , $V_{DS} = 600\text{ V}$ , $T_C = 125\text{ °C}^{(1)}$			100	$\mu\text{A}$
$I_{GSS}$	Gate body leakage current	$V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 25\text{ V}$			$\pm 5$	$\mu\text{A}$
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$ , $I_D = 14.5\text{ A}$		0.084	0.099	$\Omega$

**Notes:**

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

**Table 6: Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{iss}$	Input capacitance	$V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GS} = 0\text{ V}$	-	1960	-	pF
$C_{oss}$	Output capacitance		-	140	-	pF
$C_{rss}$	Reverse transfer capacitance		-	2	-	pF
$C_{oss\ eq.}^{(1)}$	Equivalent output capacitance	$V_{DS} = 0\text{ to }480\text{ V}$ , $V_{GS} = 0\text{ V}$	-	335	-	pF
$R_G$	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	1.5	-	$\Omega$
$Q_g$	Total gate charge	$V_{DD} = 480\text{ V}$ , $I_D = 29\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ (see <a href="#">Figure 14: "Test circuit for gate charge behavior"</a> )	-	46	-	nC
$Q_{gs}$	Gate-source charge		-	13	-	nC
$Q_{gd}$	Gate-drain charge		-	22	-	nC

**Notes:**

<sup>(1)</sup> $C_{oss\ eq.}$  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	$V_{DD} = 300\text{ V}$ , $I_D = 14.5\text{ A}$ , $R_G = 4.7\text{ }\Omega$ , $V_{GS} = 10\text{ V}$ (see <a href="#">Figure 13: "Test circuit for resistive load switching times"</a> and <a href="#">Figure 18: "Switching time waveform"</a> )	-	16	-	ns
$t_r$	Rise time		-	5.3	-	ns
$t_{d(off)}$	Turn-off delay time		-	50	-	ns
$t_f$	Fall time		-	7	-	ns

Table 8: Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain current		-		29	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		103	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 29\text{ A}, V_{GS} = 0\text{ V}$	-		1.6	V
$t_{rr}$	Reverse recovery time	$I_{SD} = 29\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_{DD} = 60\text{ V}$ (see <i>Figure 15: "Test circuit for inductive load switching and diode recovery times"</i> )	-	110		ns
$Q_{rr}$	Reverse recovery charge		-	0.5		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	9		A
$t_{rr}$	Reverse recovery time	$I_{SD} = 29\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_{DD} = 60\text{ V}, T_j = 150\text{ }^\circ\text{C}$ (see <i>Figure 15: "Test circuit for inductive load switching and diode recovery times"</i> )	-	215		ns
$Q_{rr}$	Reverse recovery charge		-	2		$\mu\text{C}$
$I_{RRM}$	Reverse recovery current		-	17		A

**Notes:**

(1)Pulse width limited by safe operating area.

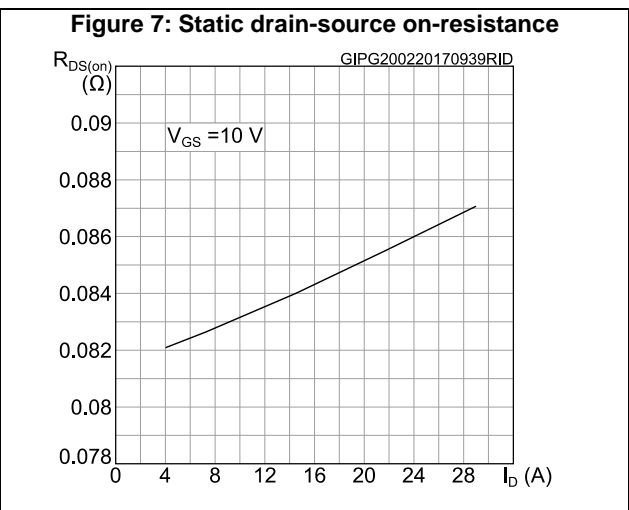
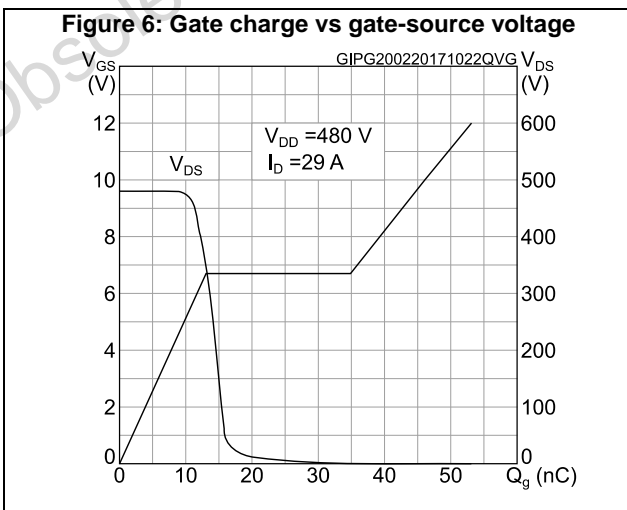
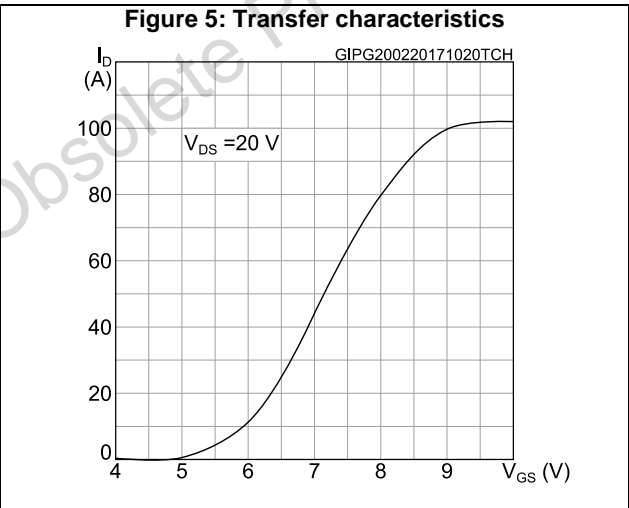
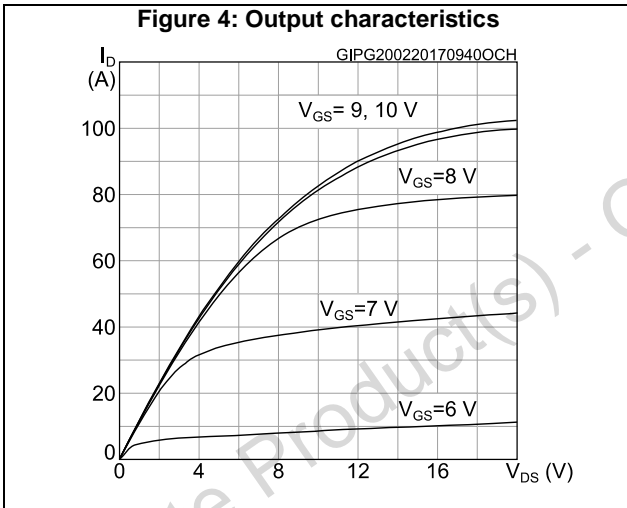
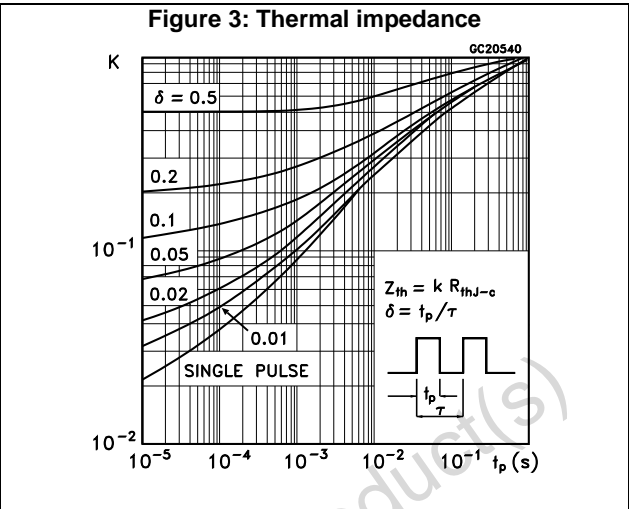
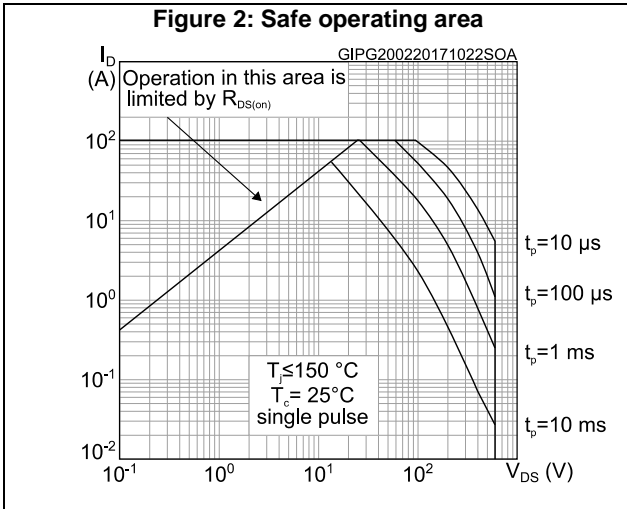
(2)Pulsed: pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5%.

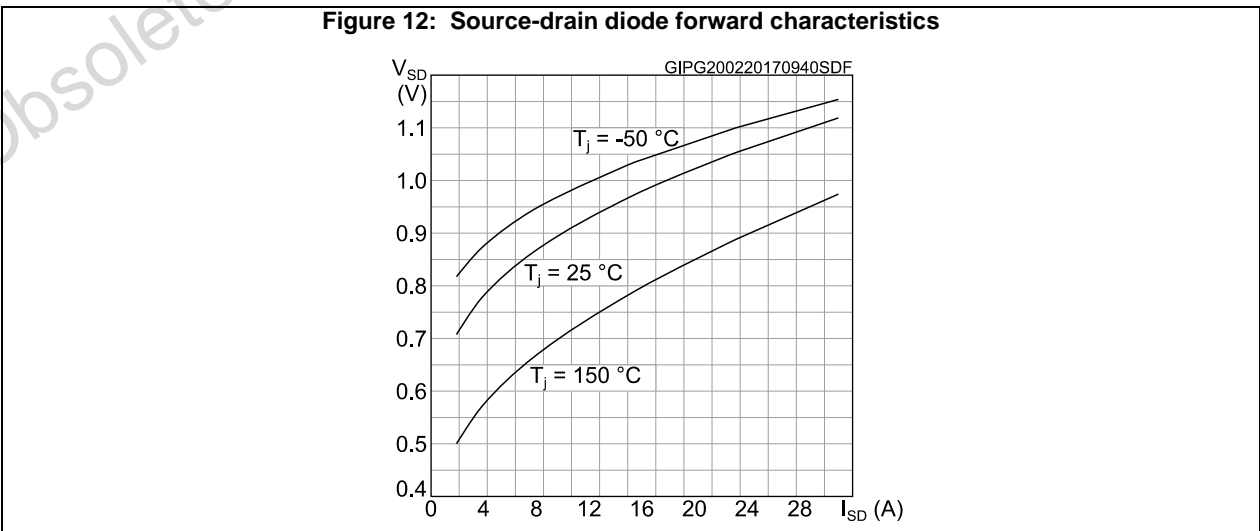
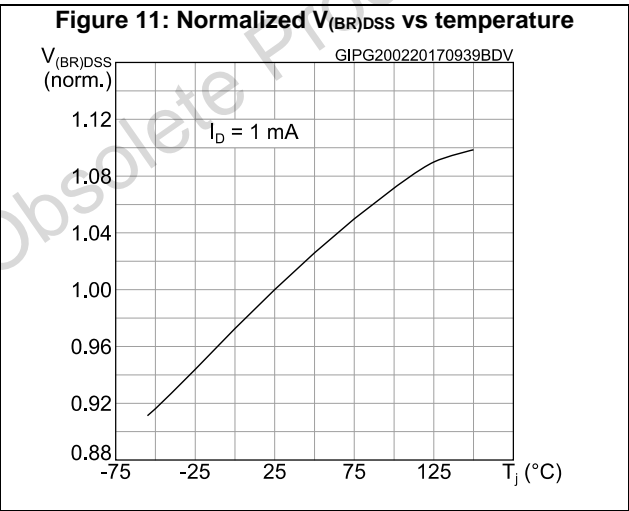
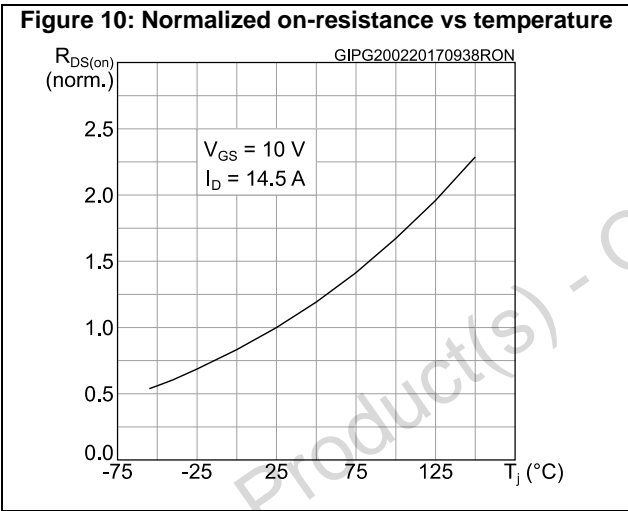
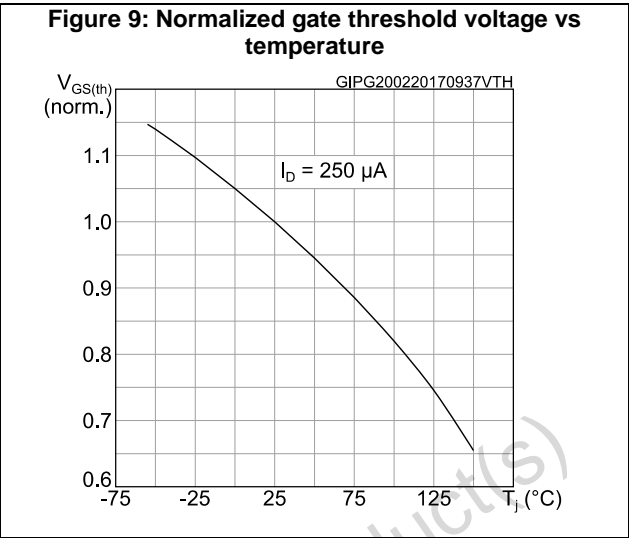
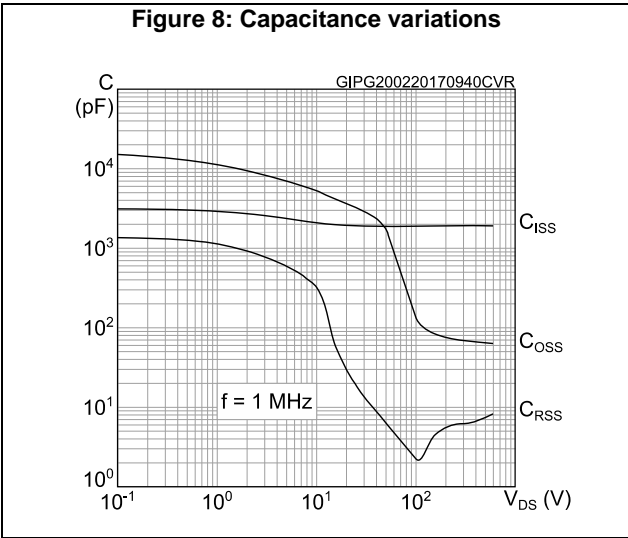
Table 9: Gate-source Zener diode

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

The built-in back-to-back Zener diodes are specifically designed to enhance the ESD performance of the device. The Zener voltage facilitates efficient and cost-effective device integrity protection, thus eliminating the need for additional external componentry.

### 2.1 Electrical characteristics (curves)





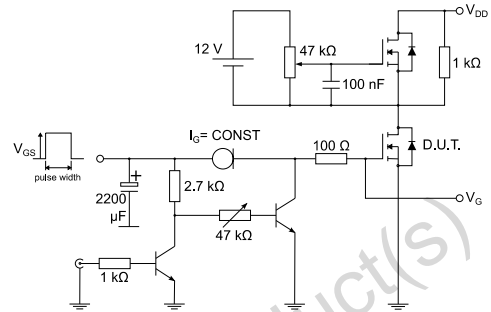
### 3 Test circuits

**Figure 13: Test circuit for resistive load switching times**



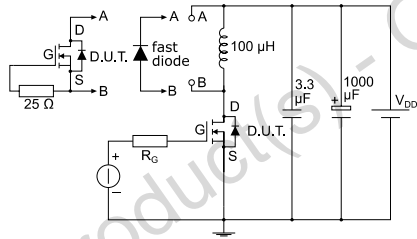
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**Figure 14: Test circuit for gate charge behavior**



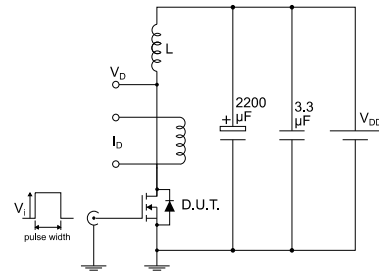
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**Figure 15: Test circuit for inductive load switching and diode recovery times**



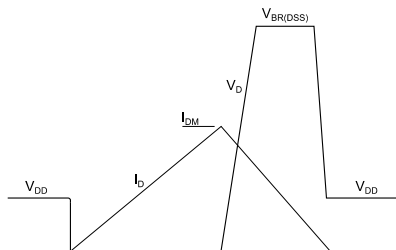
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**Figure 16: Unclamped inductive load test circuit**



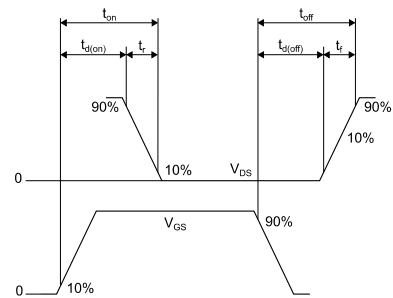
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**Figure 17: Unclamped inductive waveform**



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**Figure 18: Switching time waveform**



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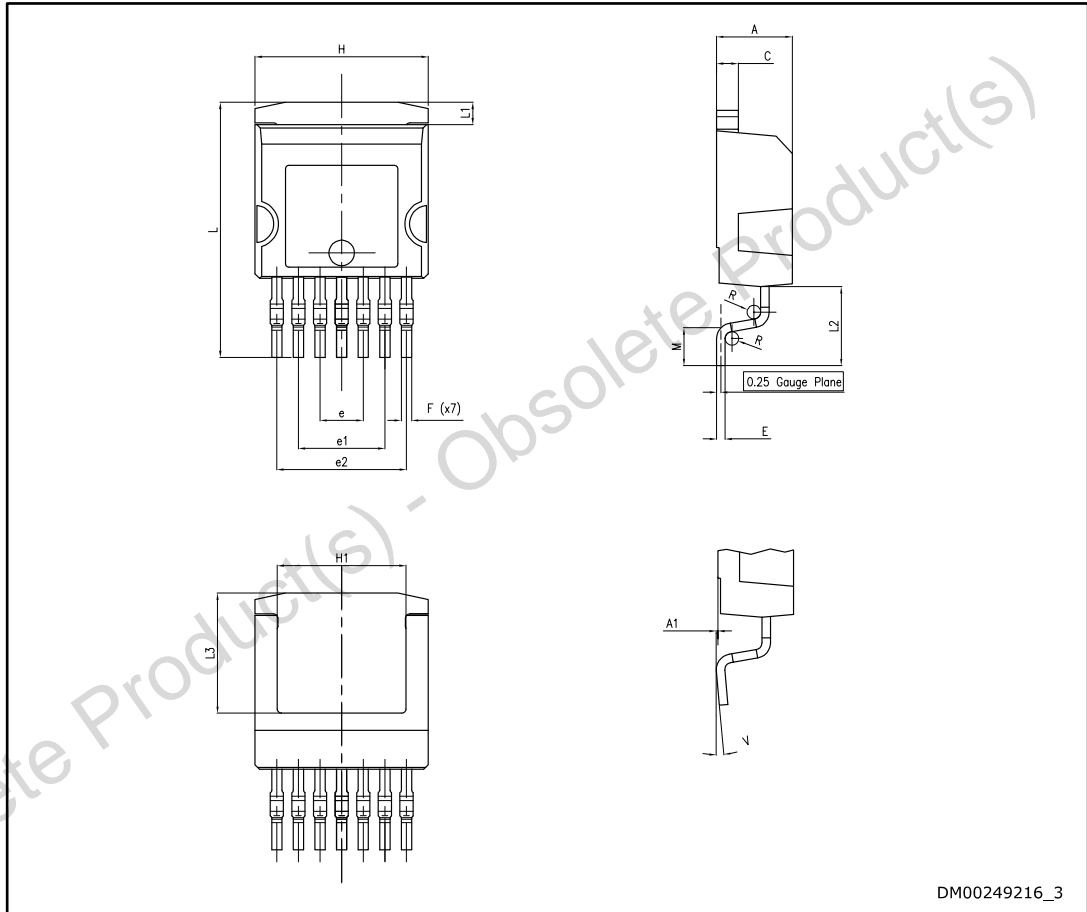


## 4 Package information

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 H<sup>2</sup>PAK-7 package information

Figure 19: H<sup>2</sup>PAK-7 package outline

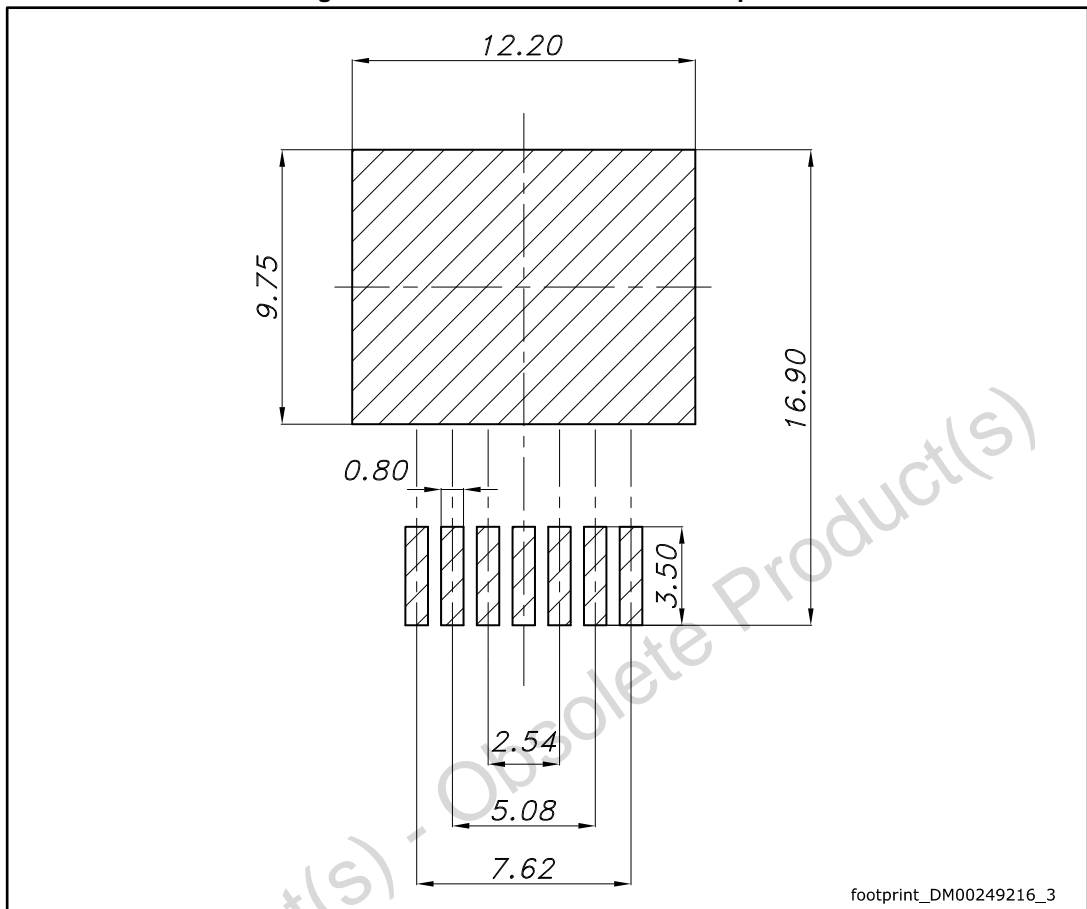


DM00249216\_3

Table 10: H<sup>2</sup>PAK-7 package mechanical data

Dim.	mm	
	Min.	Max.
A	4.30	4.80
A1	0.03	0.20
C	1.17	1.37
e	2.34	2.74
e1	4.88	5.28
e2	7.42	7.82
E	0.45	0.60
F	0.50	0.70
H	10.00	10.40
H1	7.40	7.60
L	14.75	15.25
L1	1.27	1.40
L2	4.35	4.95
L3	6.85	7.25
M	1.90	2.50
R	0.20	0.60
V	0°	8°

Figure 20: H<sup>2</sup>PAK-7 recommended footprint



footprint\_DM00249216\_3



Dimensions are in mm.

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### 4.2 H<sup>2</sup>PAK-7 packing information

Figure 21: Tape outline

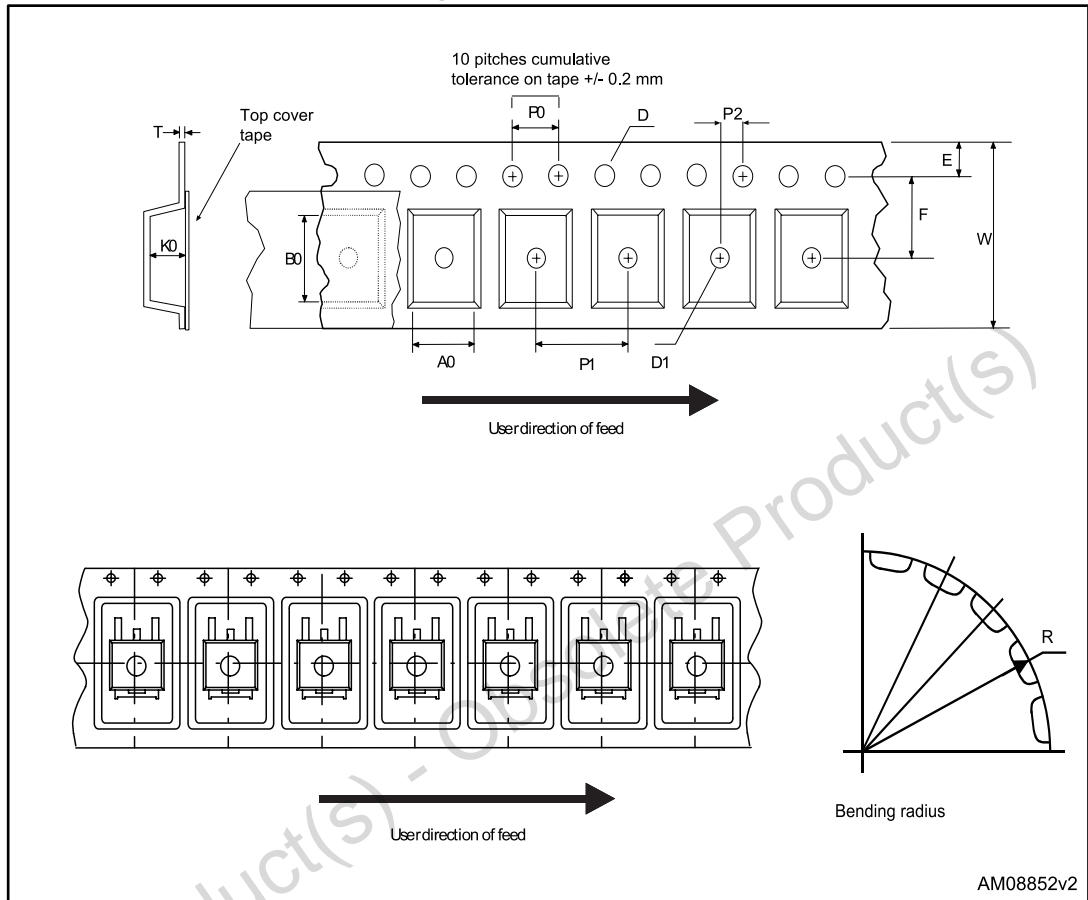


Figure 22: Reel outline

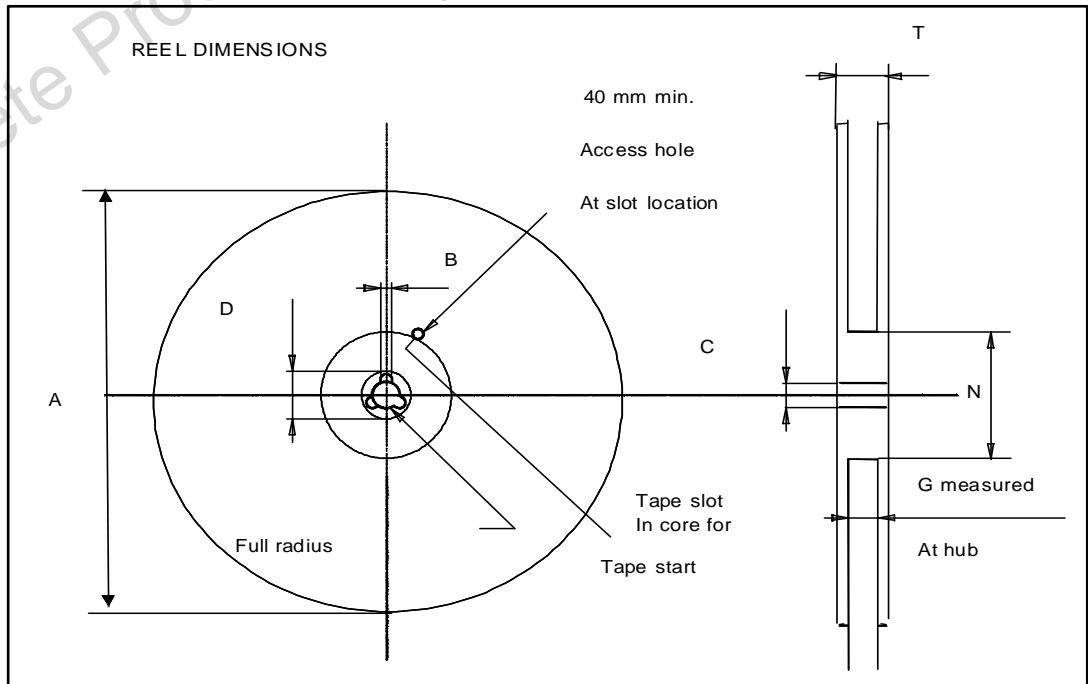


Table 11: Tape and reel mechanical data

Tape			Reel		
Dim.	mm		Dim.	mm	
	Min.	Max.		Min.	Max.
A0	10.5	10.7	A		330
B0	15.7	15.9	B	1.5	
D	1.5	1.6	C	12.8	13.2
D1	1.59	1.61	D	20.2	
E	1.65	1.85	G	24.4	26.4
F	11.4	11.6	N	100	
K0	4.8	5.0	T		30.4
P0	3.9	4.1			
P1	11.9	12.1	Base quantity		1000
P2	1.9	2.1	Bulk quantity		1000
R	50				
T	0.25	0.35			
W	23.7	24.3			

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## 5 Revision history

**Table 12: Document revision history**

Date	Revision	Changes
13-Jun-2017	1	Initial release
23-Feb-2017	2	Modified title and features on cover page. Datasheet promoted from target data to preliminary data. Modified <i>Table 2: "Absolute maximum ratings"</i> , <i>Table 3: "Thermal data"</i> , <i>Table 5: "On/off-state"</i> , <i>Table 6: "Dynamic"</i> , <i>Table 7: "Switching times"</i> and <i>Table 8: "Source-drain diode"</i> . Added <i>Section 2.1: "Electrical characteristics (curves)"</i> . Minor text changes.

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