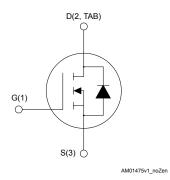


Datasheet

# N-channel 950 V, 275 m $\Omega$ typ., 18 A, MDmesh DK5 Power MOSFETs in TO-247 and TO-247 long leads packages





#### **Features**

Order code	V <sub>DS</sub>	R <sub>DS(on)</sub> max.	I <sub>D</sub>
STW20N95DK5	950 V	330 mΩ	18 A
STWA20N95DK5	930 V	330 1112	10 A

- · Fast-recovery body diode
- Best R<sub>DS(on)</sub> x area
- · Low gate charge, input capacitance and resistance
- 100% avalanche tested
- · Extremely high dv/dt ruggedness

#### **Applications**

· Switching applications

#### **Description**

These very high voltage N-channel Power MOSFETs are part of the MDmesh DK5 fast-recovery diode series. The MDmesh DK5 combines very low recovery charge  $(Q_{rr})$  and recovery time  $(t_{rr})$  with an excellent improvement in  $R_{DS(on)}\,^{*}$  area and one of the most effective switching behaviors, ideal for half bridge and full bridge converters.



Product status links
STW20N95DK5
STWA20N95DK5

Prod	Product summary			
Order code	STW20N95DK5			
Marking 20N95DK5				
Package	TO-247			
Packing	Tube			
Order code	STWA20N95DK5			
Marking	20N95DK5			
Package	TO-247 long leads			
Packing Tube				



# 1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
$V_{GS}$	Gate-source voltage	±30	V
I_	Drain current (continuous) at T <sub>C</sub> = 25 °C	18	
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	11	_ A
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	72	А
P <sub>TOT</sub>	Total power dissipation at T <sub>C</sub> = 25 °C	250	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/ns
T <sub>stg</sub>	Storage temperature range	-55 to 150	°C
TJ	Operating junction temperature range	-55 (0 150	°C

- 1. Pulse width limited by safe operating area.
- 2.  $I_{SD} \le 18$  A,  $di/dt \le 400$  A/ $\mu$ s,  $V_{DS}$  (peak)  $\le V_{(BR)DSS}$ ,  $V_{DD} = 760$  V.
- 3.  $V_{DS} \le 760 \ V$ .

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R <sub>thJC</sub>	Thermal resistance, junction-to-case	0.5	°C/W
R <sub>thJA</sub>	Thermal resistance, junction-to-ambient	50	°C/W

Table 3. Avalanche characteristics

Symbol Parameter		Value	Unit
I <sub>AR</sub>	Maximum current during repetitive or single pulse avalanche	6	Α
E <sub>AS</sub>	Single pulse avalanche energy (starting $T_J = 25$ °C, $I_D = I_{AR}$ , $V_{DD} = 50$ V)	520	mJ

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#### 2 Electrical characteristics

 $T_C$  = 25 °C unless otherwise specified.

Table 4. On/off states

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source breakdown voltage	I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0 V	950			V
l	Zoro goto voltogo droin ourrent	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 950 V			1	μA
I <sub>DSS</sub>	Zero gate voltage drain current	$V_{GS}$ = 0 V, $V_{DS}$ = 950 V, $T_{C}$ = 125 °C <sup>(1)</sup>			100	μA
I <sub>GSS</sub>	Gate source leakage current	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V			±10	μA
V <sub>GS(th)</sub>	Gate threshold voltage	$V_{DD} = V_{GS}$ , $I_D = 100 \mu A$	3	4	5	V
R <sub>DS(on)</sub>	Static drain-source on-resistance	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 9 A		275	330	mΩ

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

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
C <sub>iss</sub>	Input capacitance		-	1600	-	pF
C <sub>oss</sub>	Output capacitance	V <sub>DS</sub> = 100 V, f = 1 MHz, V <sub>GS</sub> = 0 V	-	76	-	pF
C <sub>rss</sub>	Reverse transfer capacitance		-	5	-	pF
C <sub>o(tr)</sub> <sup>(1)</sup>	Equivalent capacitance time related	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 0 to 760 V	-	169	-	pF
C <sub>o(er)</sub> <sup>(2)</sup>	Equivalent capacitance energy related	VGS - 0 V, VDS - 0 to 700 V	-	60	-	pF
$R_{G}$	Intrinsic gate resistance	f = 1 MHz, I <sub>D</sub> = 0 A	-	4	-	Ω
Qg	Total gate charge	V <sub>DD</sub> = 760 V, I <sub>D</sub> = 18 A, V <sub>GS</sub> = 0 to 10 V	-	50.7	-	nC
Q <sub>gs</sub>	Gate source charge	(see Figure 15. Test circuit for gate		7.8	-	nC
Q <sub>gd</sub>	Gate drain charge	charge behavior)	-	34.2	-	nC

<sup>1.</sup>  $C_{o(tr)}$  is a constant capacitance value that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

Table 6. Switching times

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
t <sub>d(on)</sub>	Turn-on delay time	V <sub>DS</sub> = 475 V, I <sub>D</sub> = 9 A,	-	23	-	ns
t <sub>r</sub>	Rise time	$R_G = 4.7 \Omega, V_{GS} = 10 V$	-	23	-	ns
t <sub>d(off)</sub>	Turn-off delay time	(see Figure 14. Test circuit for resistive load switching times and		74	-	ns
t <sub>f</sub>	Fall time	Figure 19. Switching time waveform)	-	25.4	-	ns

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<sup>2.</sup>  $C_{o(er)}$  is a constant capacitance value that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .



Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I <sub>SD</sub>	Source-drain current		-		18	Α
I <sub>SDM</sub> <sup>(1)</sup>	Source-drain current (pulsed)		-		72	Α
V <sub>SD</sub> <sup>(2)</sup>	Forward on voltage	I <sub>SD</sub> = 18 A, V <sub>GS</sub> = 0 V	-		1.5	V
t <sub>rr</sub>	Reverse recovery time	I <sub>SD</sub> = 9 A, di/dt = 100 A/μs,	-	150		ns
Q <sub>rr</sub>	Reverse recovery charge	V <sub>DD</sub> = 60 V	-	1		μC
I <sub>RRM</sub>	Reverse recovery current	(see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	13.5		Α
t <sub>rr</sub>	Reverse recovery time	I <sub>SD</sub> = 9 A, di/dt = 100 A/μs,	-	264		ns
Q <sub>rr</sub>	Reverse recovery charge	V <sub>DD</sub> = 60 V, T <sub>J</sub> = 150 °C	-	2.9		μC
I <sub>RRM</sub>	Reverse recovery current	(see Figure 16. Test circuit for inductive load switching and diode recovery times)	-	22		Α

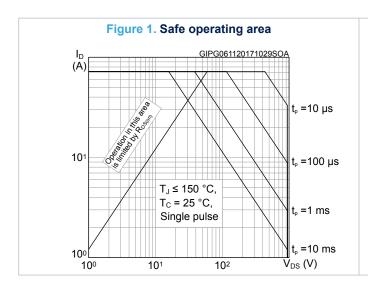
<sup>1.</sup> Pulse width limited by safe operating area.

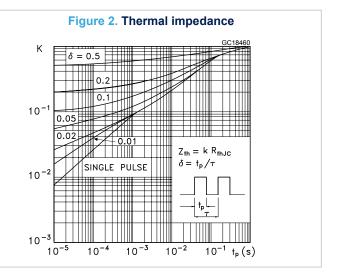
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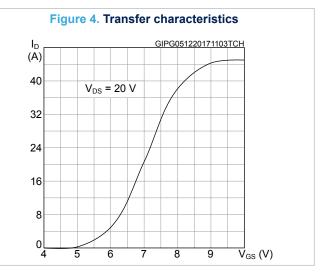
<sup>2.</sup> Pulsed: pulse duration =  $300 \mu s$ , duty cycle 1.5%.

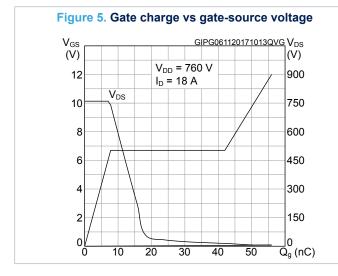


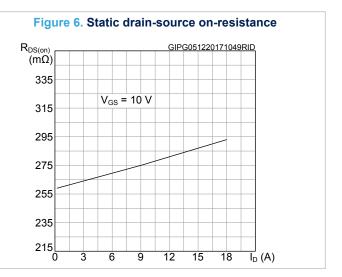
#### 2.1 Electrical characteristics (curves)











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Figure 7. Capacitance variations C (pF) GIPG061120171011CVR 104 Ciss 10<sup>3</sup> 10<sup>2</sup> f = 1 MHz101 100 V<sub>DS</sub> (V)

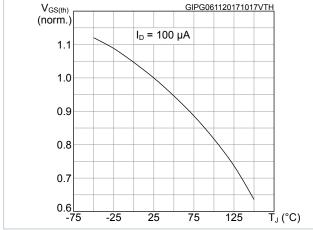
100

Figure 8. Output capacitance stored energy E<sub>OSS</sub> (µJ) GIPG061120171011EOS 24 20 16 12 8 600 750 300 450 900  $\overline{V}_{DS}(V)$ 

Figure 9. Normalized gate threshold voltage vs temperature

10<sup>1</sup>

10<sup>2</sup>



GIPG061120171020RON  $R_{\text{DS}(\text{on})}$ (norm.) 2.4 V<sub>GS</sub> = 10 V 2.0 1.6 1.2

8.0

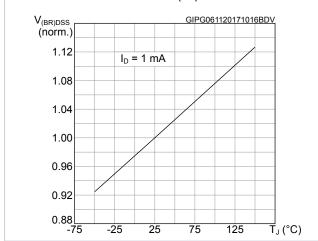
0.4

0.0 -75

-25

Figure 10. Normalized on-resistance vs temperature

Figure 11. Normalized  $V_{(BR)DSS}$  vs temperature



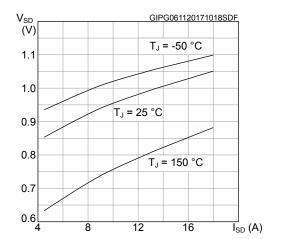


75

125

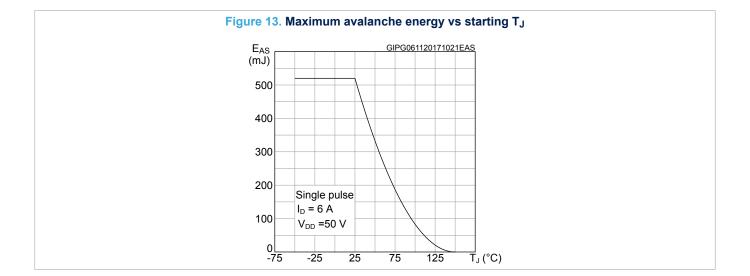
ี่T<sub>J</sub> (°C)

25



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#### 3 Test circuits

Figure 14. Test circuit for resistive load switching times

V<sub>GS</sub>

V<sub>D</sub>

V<sub>D</sub>

D.U.T.

AM01468v1

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

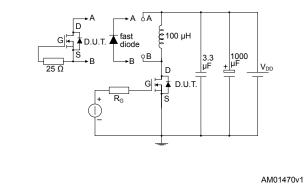


Figure 17. Unclamped inductive load test circuit

Figure 18. Unclamped inductive waveform

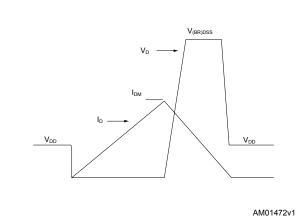
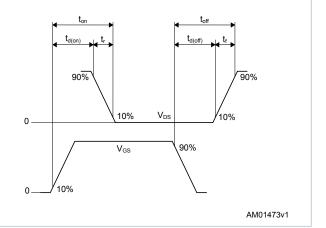


Figure 19. Switching time waveform



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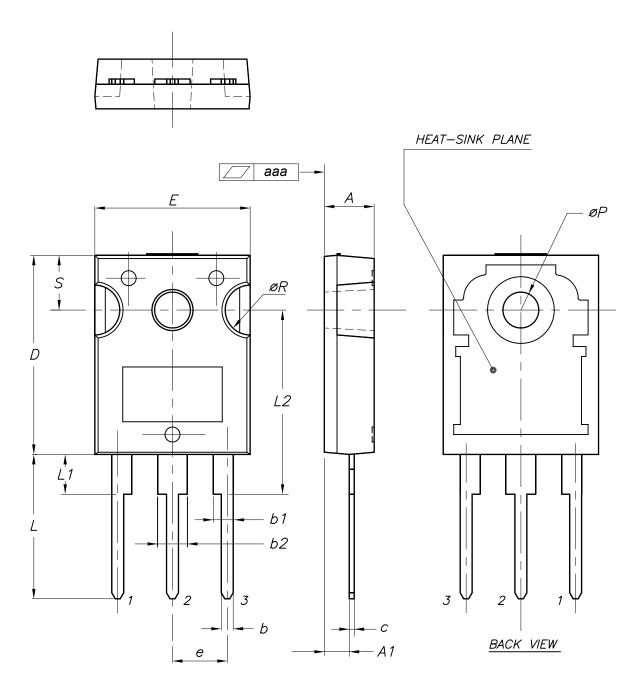


## 4 Package information

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. ECOPACK is an ST trademark.

## 4.1 TO-247 package information

Figure 20. TO-247 package outline



0075325\_10



Table 8. TO-247 package mechanical data

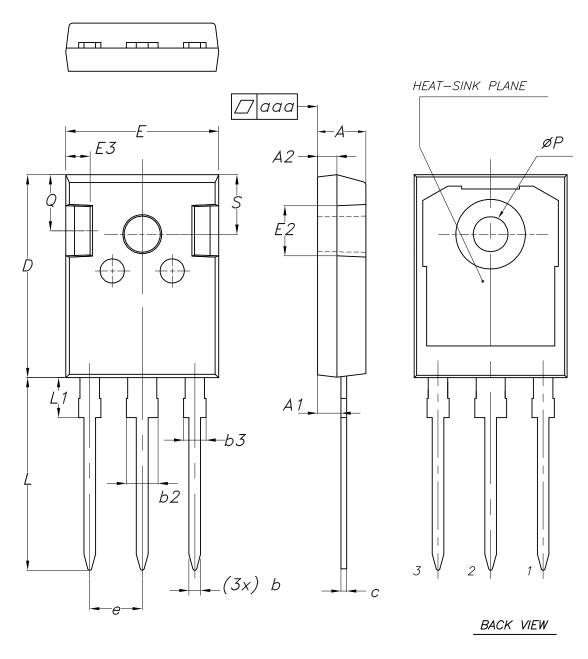
Dim.	mm				
Dim.	Min.	Тур.	Max.		
Α	4.85		5.15		
A1	2.20		2.60		
b	1.0		1.40		
b1	2.0		2.40		
b2	3.0		3.40		
С	0.40		0.80		
D	19.85		20.15		
E	15.45		15.75		
е	5.30	5.45	5.60		
L	14.20		14.80		
L1	3.70		4.30		
L2		18.50			
ØP	3.55		3.65		
ØR	4.50		5.50		
S	5.30	5.50	5.70		
aaa		0.04	0.10		

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## 4.2 TO-247 long leads package information

Figure 21. TO-247 long leads package outline



8463846\_3

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Table 9. TO-247 long leads package mechanical data

Dim.		mm	
Dilli.	Min.	Тур.	Max.
А	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
b	1.16		1.26
b2			3.25
b3			2.25
С	0.59		0.66
D	20.90	21.00	21.10
E	15.70	15.80	15.90
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
е	5.34	5.44	5.54
L	19.80	19.92	20.10
L1			4.30
Р	3.50	3.60	3.70
Q	5.60		6.00
S	6.05	6.15	6.25
aaa		0.04	0.10

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## **Revision history**

Table 10. Document revision history

Date	Revision	Changes
10-May-2017	1	Initial release
	2	Datasheet promoted from preliminary data to production data.  Modified title and features table on cover page
06-Nov-2017		Modified Table 2: "Absolute maximum ratings", Table 4: "Thermal data", Table 5: "On/off states", Table 6: "Dynamic", Table 7: "Switching times" and Table 8: "Source-drain diode".
		Added Section 2.1: "Electrical characteristics (curves)".
		Minor text changes.
	3	Updated Table 1. Absolute maximum ratings.
11-Aug-2021		Updated Figure 3. Output characteristics, Figure 4. Transfer characteristics and Figure 6. Static drain-source on-resistance.
		Updated Section 4 Package information.
		Minor text changes.

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