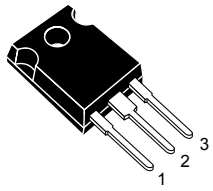
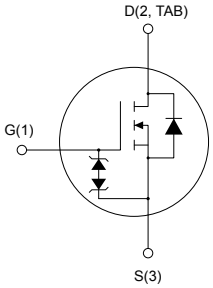
STW20N90K5

Datasheet

N-channel 900 V, 210 mΩ typ., 20 A MDmesh K5 Power MOSFET in a TO-247 package



TO-247



AM01476v1_tab

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STW20N90K5	900 V	250 mΩ	20 A

- Very low FoM (figure of merit)
- Ultra-low gate charge
- 100% avalanche tested
- Zener-protected

Applications

- Switching applications

Description

This very high voltage N-channel Power MOSFET is designed using MDmesh K5 technology based on an innovative proprietary vertical structure. The result is a dramatic reduction in on-resistance and ultra-low gate charge for applications requiring superior power density and high efficiency.

Product status link
STW20N90K5

Product summary	
Order code	STW20N90K5
Marking	20N90K5
Package	TO-247
Packing	Tube

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{GS}	Gate-source voltage	±30	V
I_D	Drain current (continuous) at T_C = 25 °C	20	A
I_D	Drain current (continuous) at T_C = 100 °C	13	A
I_{DM} (1)	Drain current (pulsed)	80	A
P_{TOT}	Total power dissipation at T_C = 25 °C	250	W
dv/dt (2)	Peak diode recovery voltage slope	4.5	V/ns
dv/dt (3)	MOSFET dv/dt ruggedness	50	
T_J	Operating junction temperature range	-55 to 150	°C
T_{stg}	Storage temperature range		

1. *Pulse width limited by safe operating area*
2. *I_{SD} ≤ 20 A, di/dt ≤ 100 A/µs; V_{DS} peak ≤ $V_{(BR)DSS}$, V_{DD}= 450 V*
3. *V_{DD} ≤ 720 V*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	0.5	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	50	°C/W

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or not repetitive (pulse width limited by T_J max.)	6.5	A
E_{AS}	Single pulse avalanche energy (starting T_J = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	500	mJ

2 Electrical characteristics

T_C = 25 °C unless otherwise specified

Table 4. On/off-state

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	V_{GS} = 0 V, I_D = 1 mA	900			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 900 V			1	µA
		V_{GS} = 0 V, V_{DS} = 900 V T_C = 125 °C (1)			50	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V			±10	µA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 100 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 10 A		210	250	mΩ

1. *Specified by design, not tested in production.*

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	V_{DS} = 100 V, f = 1 MHz, V_{GS} = 0 V	-	1500	-	pF
C_{oss}	Output capacitance		-	120	-	pF
C_{rss}	Reverse transfer capacitance		-	1	-	pF
$C_{o(er)}$ (1)	Equivalent capacitance energy related	V_{GS} = 0 V, V_{DS} = 0 to 720 V	-	78	-	pF
$C_{o(tr)}$ (2)	Equivalent capacitance time related			220	-	pF
R_g	Intrinsic gate resistance	f = 1 MHz , I_D = 0 A	-	3.7	-	Ω
Q_g	Total gate charge	V_{DD} = 720 V, I_D = 20 A V_{GS}= 0 to 10 V (see Figure 2)	-	40	-	nC
Q_{gs}	Gate-source charge		-	14	-	nC
Q_{gd}	Gate-drain charge		-	17	-	nC

1. *$C_{o(er)}$ 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}.*
2. *$C_{o(tr)}$ 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.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	V_{DD}= 450 V, I_D = 10 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 1 and Figure 6)	-	20.2	-	ns
t_r	Rise time		-	13.5	-	ns
$t_{d(off)}$	Turn-off delay time		-	64.7	-	ns
t_f	Fall time		-	16	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		20	A
I_{SDM} (1)	Source-drain current (pulsed)		-		80	A
V_{SD} (2)	Forward on voltage	I_{SD} = 20 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 20 A, di/dt = 100 A/µs, V_{DD} = 60 V (see Figure 3)	-	517		ns
Q_{rr}	Reverse recovery charge		-	11.4		µC
I_{RRM}	Reverse recovery current		-	44		A
t_{rr}	Reverse recovery time	I_{SD} = 20 A, di/dt = 100 A/µs V_{DD} = 60 V, T_J = 150 °C (see Figure 3)	-	674		ns
Q_{rr}	Reverse recovery charge		-	14		µC
I_{RRM}	Reverse recovery current		-	41.6		A

1. *Pulse width limited by safe operating area*
2. *Pulsed: pulse duration = 300 µs, duty cycle 1.5%*

2.1 Electrical characteristics curves

Figure 1. Safe operating area

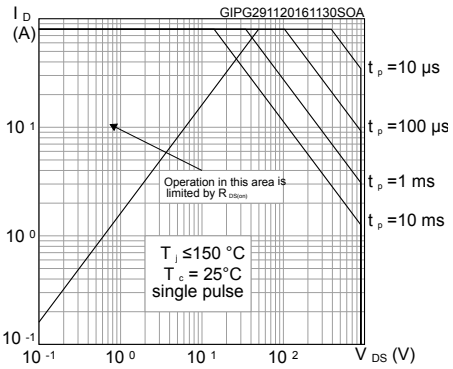


Figure 2. Thermal impedance

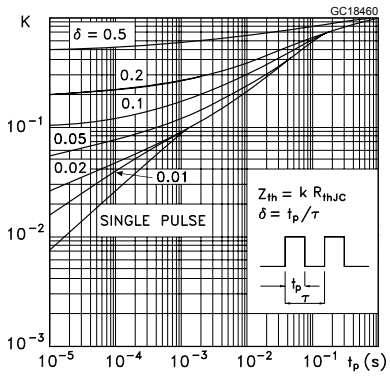


Figure 3. Output characteristics

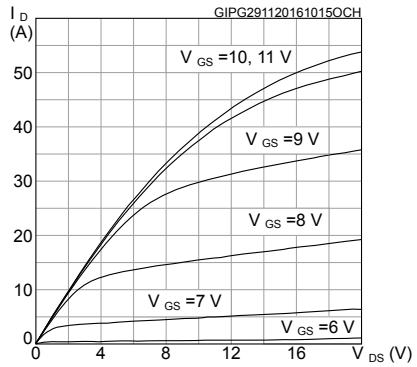


Figure 4. Transfer characteristics

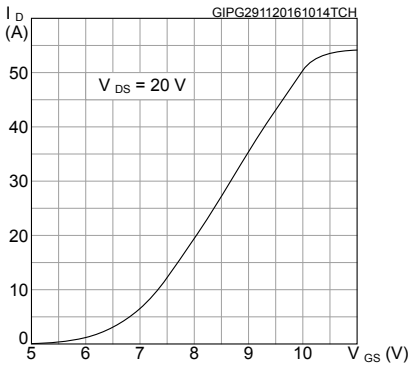


Figure 5. Normalized $V_{(BR)DSS}$ vs temperature

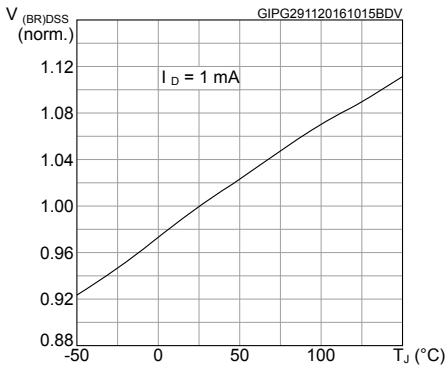


Figure 6. Static drain-source on-resistance

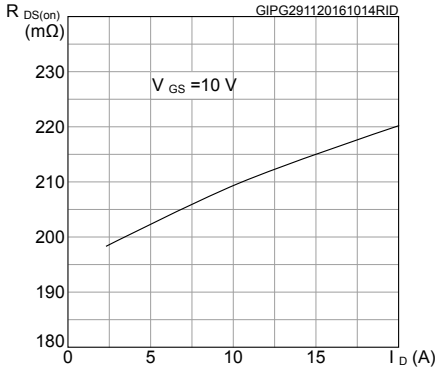


Figure 7. Gate charge vs gate-source voltage

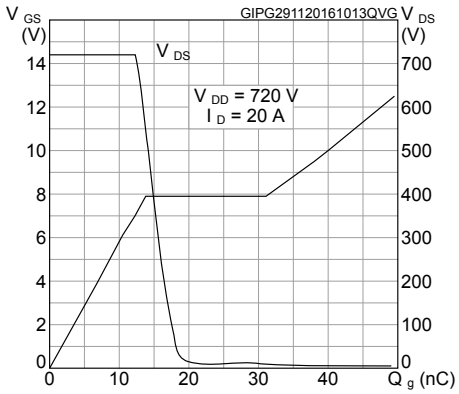


Figure 8. Capacitance variation

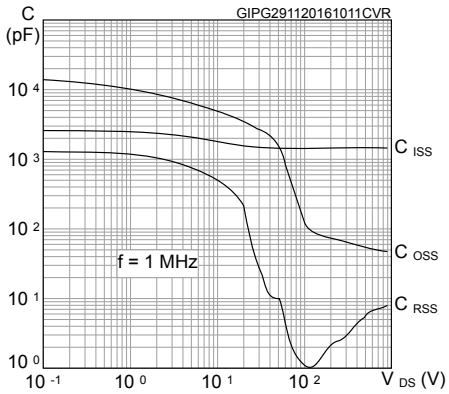


Figure 9. Normalized gate threshold voltage vs temperature

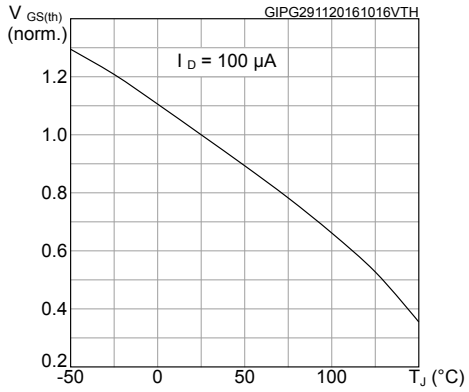


Figure 10. Normalized on-resistance vs temperature

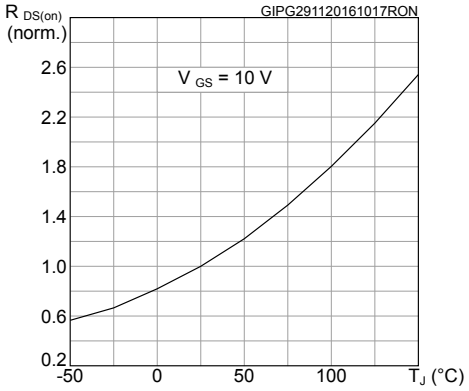


Figure 11. Maximum avalanche energy vs. starting T_J

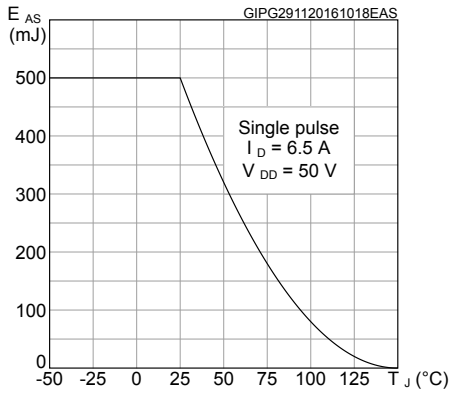
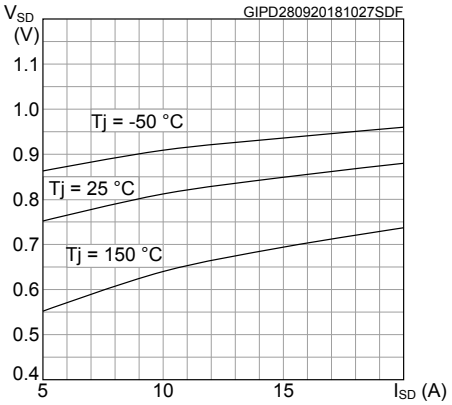
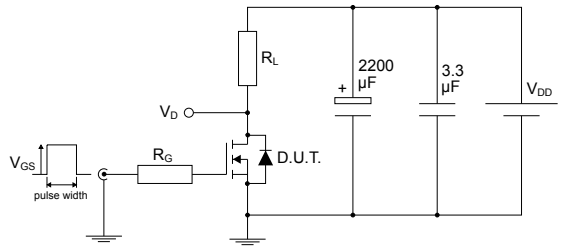


Figure 12. Source-drain diode forward characteristics



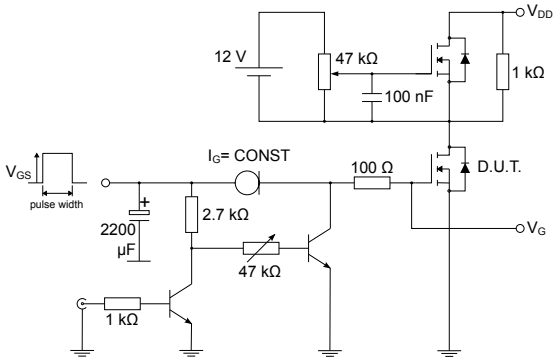
3 Test circuits

Figure 13. Test circuit for resistive load switching times



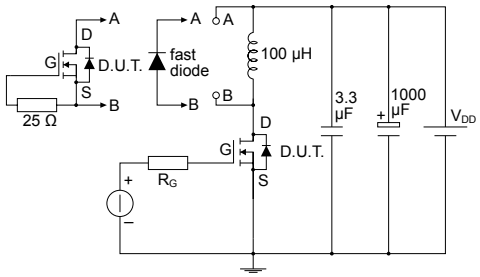
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Figure 14. Test circuit for gate charge behavior



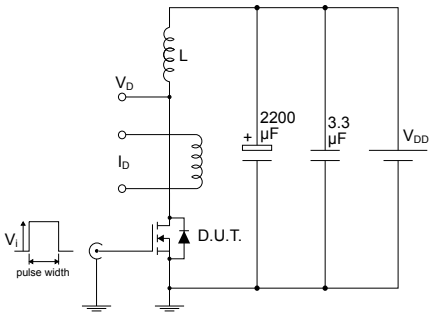
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Figure 15. Test circuit for inductive load switching and diode recovery times



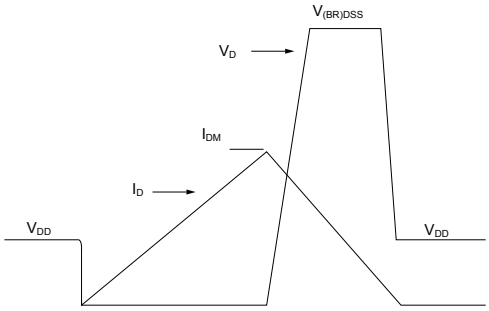
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Figure 16. Unclamped inductive load test circuit



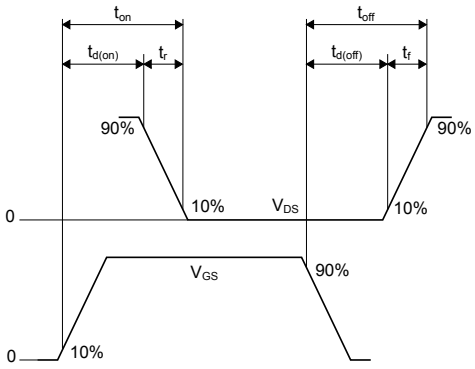
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Figure 17. Unclamped inductive waveform



AM01472v1

Figure 18. Switching time waveform



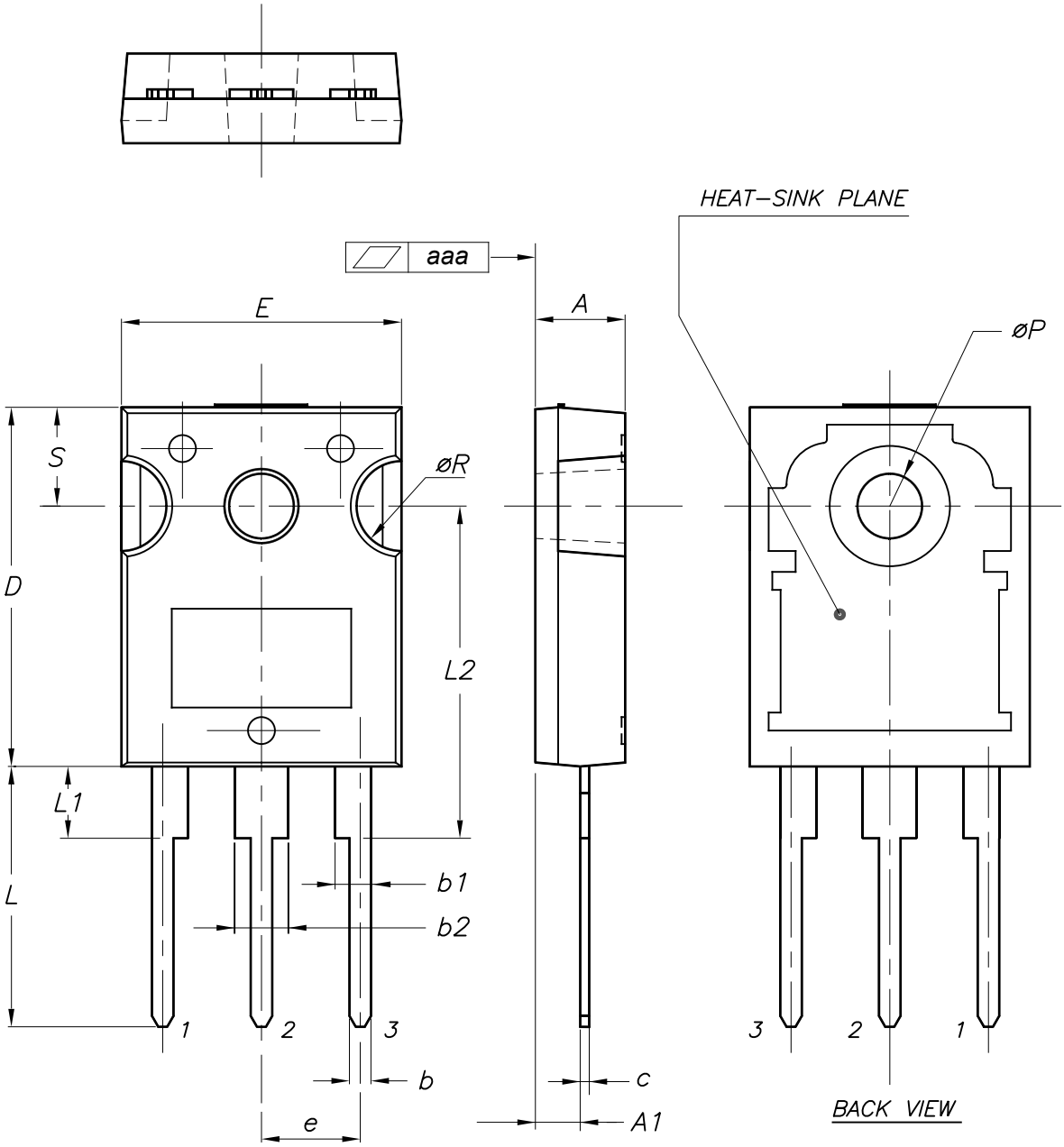
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4 Package information

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 19. TO-247 package outline



0075325_10

Table 8. **TO-247 package mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	4.85		5.15
A1	2.20		2.60
b	1.0		1.40
b1	2.0		2.40
b2	3.0		3.40
c	0.40		0.80
D	19.85		20.15
E	15.45		15.75
e	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

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
19-May-2016	1	First release.
01-Dec-2016	2	Modified: title and $R_{DS(on)}$ value in cover page Modified: *Table 5. Avalanche characteristics Table 6. On/off-state, Table 7. Dynamic, Table 8. Switching times* and *Table 9. Source-drain diode* Added *Section 2.1 Electrical characteristics curves* Modified: *Section 3 Test circuits* Datasheet promoted from preliminary data to production data Minor text changes
01-Oct-2018	3	Removed maturity status indication from cover page. Updated *Figure 12. Source-drain diode forward characteristics.* Minor text changes.
04-Nov-2025	4	Updated Section 3: Test circuits. Updated Section 4: Package information. Minor text changes.

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