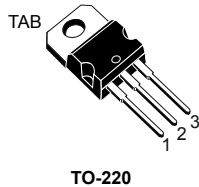
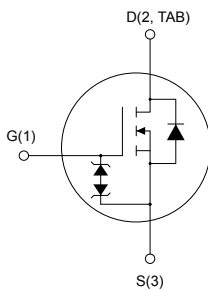


N-channel 950 V, 2.0 Ω typ., 3.5 A MDmesh K5 Power MOSFET in a TO-220 package



TO-220



AM01476v1_tab



Product status link

[STP5N95K5](#)

Product summary

Order code	STP5N95K5
Marking	5N95K5
Package	TO-220
Packing	Tube

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STP5N95K5	950 V	2.5 Ω	3.5 A

- Industry's lowest $R_{DS(on)}$ x area
- Industry's best 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.

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 $T_C = 25\text{ }^\circ\text{C}$	3.5	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	2.2	
$I_{DM}^{(1)}$	Drain current (pulsed)	14	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	70	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	4.5	V/ns
$dv/dt^{(3)}$	MOSFET dv/dt ruggedness	50	V/ns
T_{stg}	Storage temperature range	-55 to 150	$^\circ\text{C}$
T_J	Operating junction temperature range		$^\circ\text{C}$

1. Pulse width is limited by safe operating area.
2. $I_{SD} \leq 3.5\text{ A}$, $di/dt \leq 100\text{ A}/\mu\text{s}$, $V_{DS}(\text{peak}) < V_{(BR)DSS}$.
3. $V_{DS} \leq 640\text{ V}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	1.47	$^\circ\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-ambient	62.5	$^\circ\text{C}/\text{W}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AR}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_J max.)	1	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$)	70	mJ

2 Electrical characteristics

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

Table 4. On/off-state

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$V_{GS} = 0\text{ V}$, $I_D = 1\text{ mA}$	950			V
I_{DSS}	Zero gate voltage drain current	$V_{DS} = 950\text{ V}$, $V_{GS} = 0\text{ V}$			1	μA
		$V_{DS} = 950\text{ V}$, $V_{GS} = 0\text{ V}$, $T_C = 125\text{ °C}^{(1)}$			50	
I_{GSS}	Gate body leakage current	$V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$			± 10	μA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 100\text{ }\mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\text{ V}$, $I_D = 1.5\text{ A}$		2.0	2.5	Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$, $V_{GS} = 0\text{ V}$	-	220	-	pF
C_{oss}	Output capacitance		-	17	-	pF
C_{rss}	Reverse transfer capacitance		-	1	-	pF
$C_{o(tr)}^{(1)}$	Equivalent capacitance time related	$V_{GS} = 0\text{ V}$, $V_{DS} = 0\text{ to }760\text{ V}$	-	30	-	pF
$C_{o(er)}^{(2)}$	Equivalent capacitance energy related		-	11	-	pF
R_g	Intrinsic gate resistance	$f = 1\text{ MHz}$ open drain	-	17	-	Ω
Q_g	Total gate charge	$V_{DD} = 760\text{ V}$, $I_D = 3.5\text{ A}$, $V_{GS} = 0\text{ to }10\text{ V}$ (see Figure 14. Test circuit for gate charge behavior)	-	12.5	-	nC
Q_{gs}	Gate-source charge		-	2	-	nC
Q_{gd}	Gate-drain charge		-	10	-	nC

1. $C_{o(tr)}$ 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} .

2. $C_{o(er)}$ 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 6. Switching times

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 475\text{ V}$, $I_D = 1.75\text{ A}$, $R_G = 4.7\text{ }\Omega$, $V_{GS} = 10\text{ V}$	-	12	-	ns
t_r	Rise time		-	16	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 13. Test circuit for resistive load switching times and Figure 18. Switching time waveform)	-	32	-	ns
t_f	Fall time		-	25	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		3.5	A
I_{SDM}	Source-drain current (pulsed)		-		14	A
$V_{SD}^{(1)}$	Forward on voltage	$I_{SD} = 3.5 \text{ A}, V_{GS} = 0 \text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 3.5 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s},$	-	330		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}$	-	2.2		μC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	13		A
t_{rr}	Reverse recovery time	$I_{SD} = 3.5 \text{ A}, di/dt = 100 \text{ A}/\mu\text{s},$	-	525		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 60 \text{ V}, T_J = 150 \text{ }^\circ\text{C}$	-	3.2		μC
I_{RRM}	Reverse recovery current	(see Figure 15. Test circuit for inductive load switching and diode recovery times)	-	12		A

1. Pulsed: pulse duration = 300 μs , duty cycle 1.5%.

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

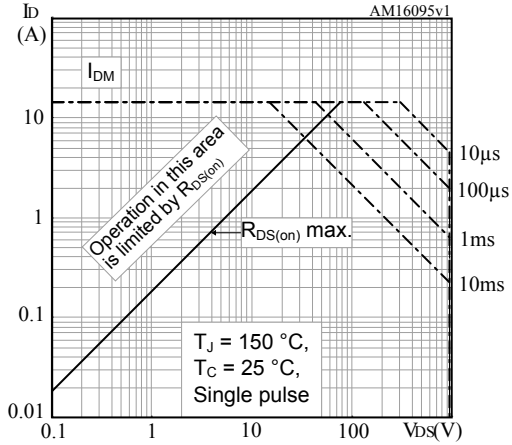


Figure 2. Thermal impedance

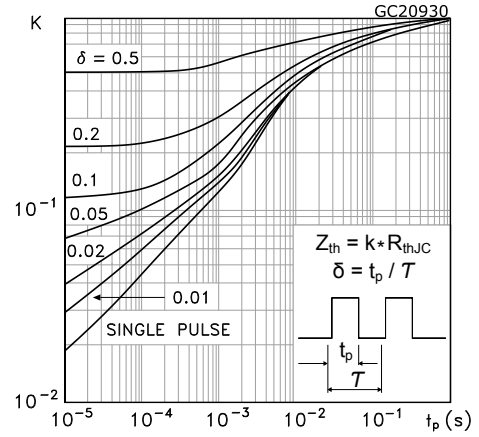


Figure 3. Output characteristics

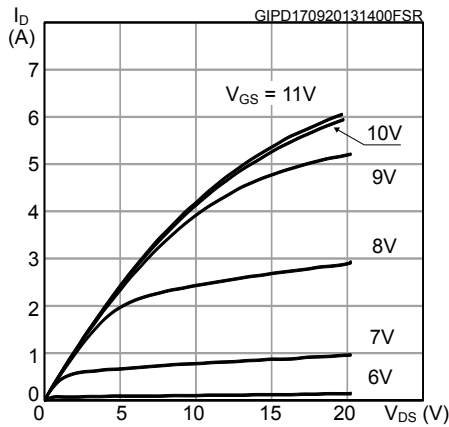


Figure 4. Transfer characteristics

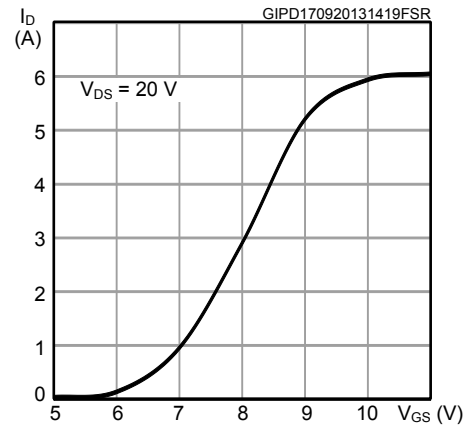


Figure 5. Gate charge vs gate-source voltage

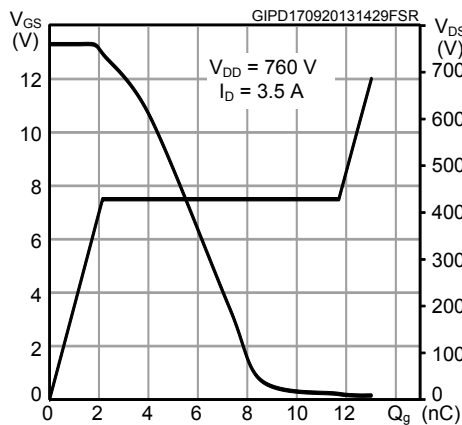


Figure 6. Static drain-source on-resistance

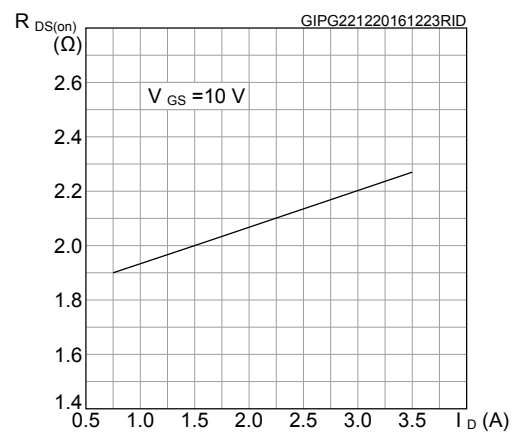


Figure 7. Capacitance variations

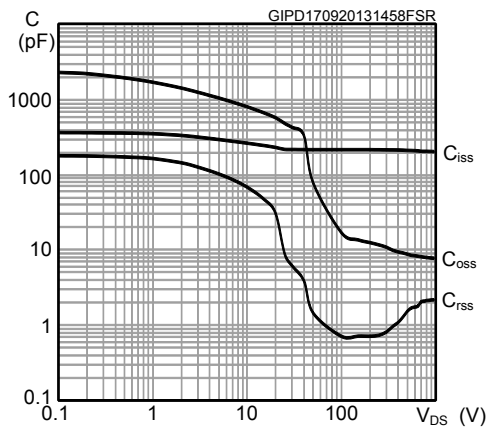


Figure 8. Output capacitance stored energy

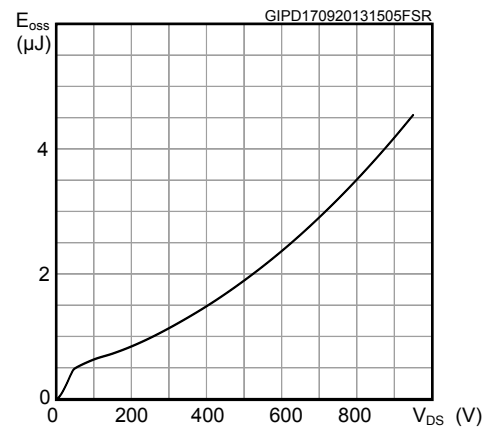


Figure 9. Normalized gate threshold voltage vs temperature

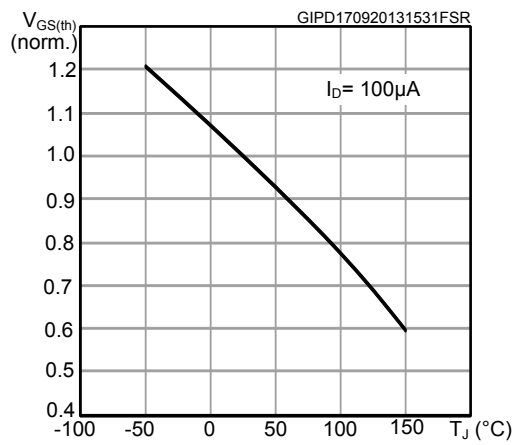


Figure 10. Normalized $V_{(BR)DSS}$ vs temperature

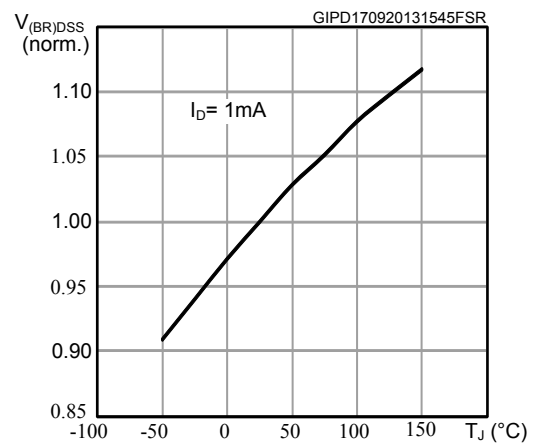


Figure 11. Normalized on-resistance vs temperature

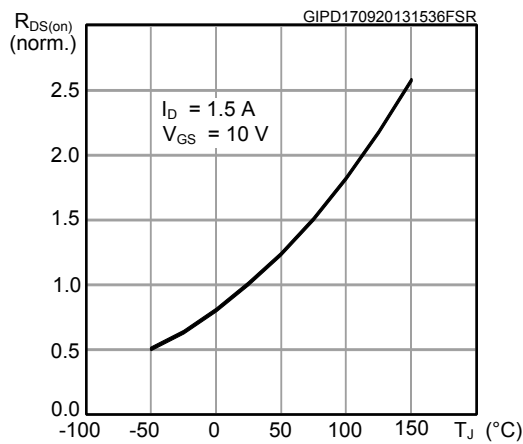
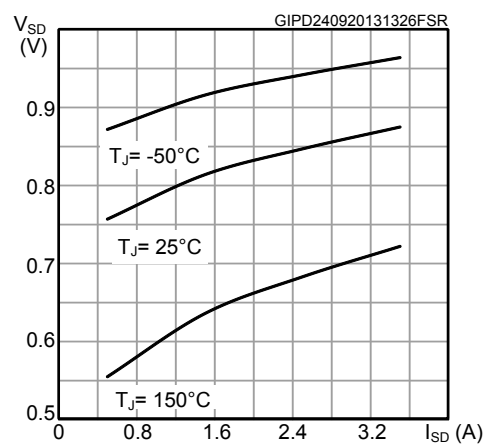


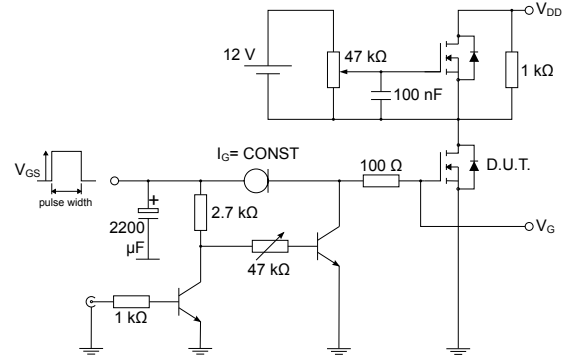
Figure 12. Source-drain diode forward characteristics



3 Test circuits

Figure 13. Test circuit for resistive load switching times

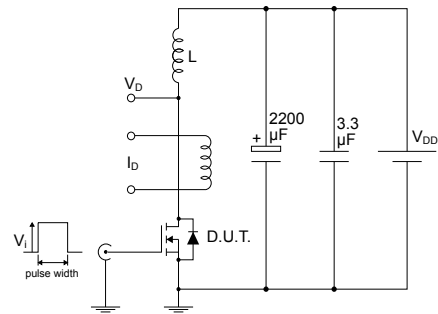

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Figure 14. Test circuit for gate charge behavior


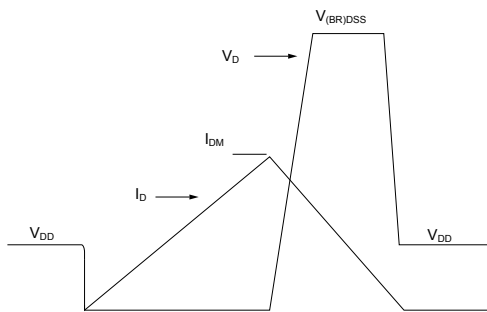
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Figure 15. Test circuit for inductive load switching and diode recovery times


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Figure 16. Unclamped inductive load test circuit


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Figure 17. Unclamped inductive waveform


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Figure 18. Switching time waveform

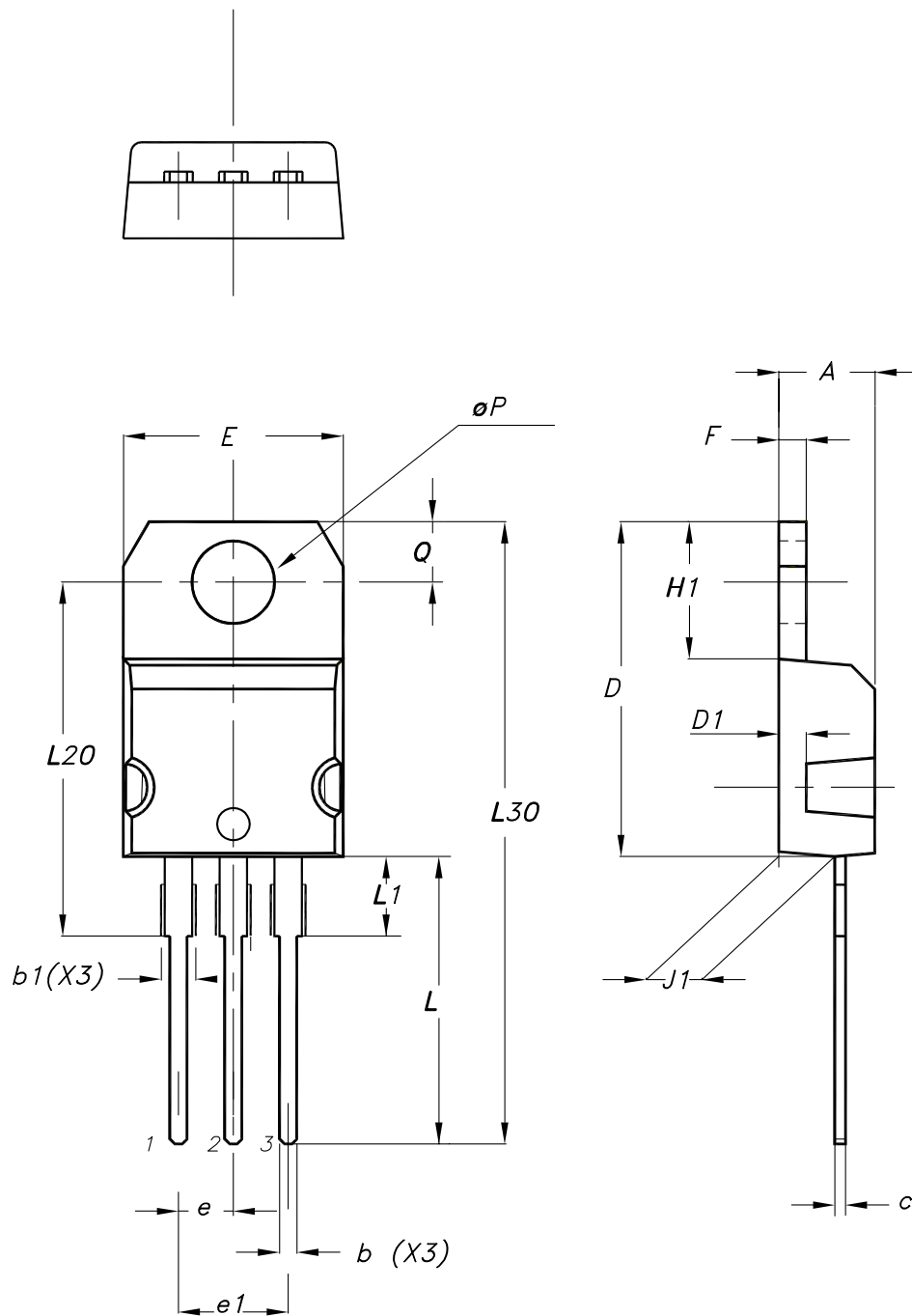

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4 Package information

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. ECOPACK is an ST trademark.

4.1 TO-220 type A package information

Figure 19. TO-220 type A package outline



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Table 8. TO-220 type A package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.55
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10.00		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13.00		14.00
L1	3.50		3.93
L20		16.40	
L30		28.90	
øP	3.75		3.85
Q	2.65		2.95
Slug flatness		0.03	0.10

Revision history

Table 9. Document revision history

Date	Revision	Changes
30-May-2023	1	First release. The part number STP5N95K5 was previously inserted in the DS9663.

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