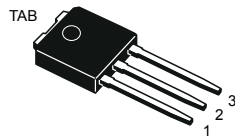
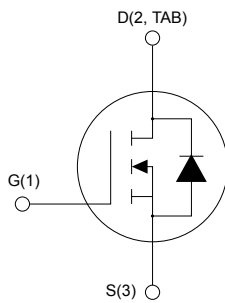


N-channel 600 V, 0.9 Ω typ., 5 A MDmesh Power MOSFET in an IPAK package



IPAK



AM01475v1_noZen


Product status link
[STD5NM60-1](#)
Product summary

Order code	STD5NM60-1
Marking	D5NM60
Package	IPAK
Packing	Tube

Features

Order code	V_{DS}	$R_{DS(on)}$ max.	I_D
STD5NM60-1	600 V	1.0 Ω	5 A

- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance

Applications

- Switching applications

Description

This N-channel Power MOSFET is developed using STMicroelectronics' revolutionary MDmesh technology, which associates the multiple drain process with the company's PowerMESH horizontal layout. This device offers extremely low on-resistance, high dv/dt , and excellent avalanche characteristics. Using STMicroelectronics's proprietary strip technique, this Power MOSFET boasts an overall dynamic performance that is superior to similar products on the market.

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 $T_C = 25\text{ }^\circ\text{C}$	5	A
	Drain current (continuous) at $T_C = 100\text{ }^\circ\text{C}$	3.1	
$I_{DM}^{(1)}$	Drain current (pulsed)	20	A
P_{TOT}	Total power dissipation at $T_C = 25\text{ }^\circ\text{C}$	96	W
$dv/dt^{(2)}$	Peak diode recovery voltage slope	15	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. $I_{SD} \leq 5\text{ A}$, $di/dt \leq 400\text{ A}/\mu\text{s}$, $V_{DD} = 80\% V_{(BR)DSS}$.

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	1.3	$^\circ\text{C}/\text{W}$
R_{thJA}	Thermal resistance, junction-to-ambient	100	$^\circ\text{C}/\text{W}$

Table 3. Avalanche characteristics

Symbol	Parameter	Value	Unit
I_{AS}	Avalanche current, repetitive or non-repetitive (pulse width limited by T_J max.)	2.5	A
E_{AS}	Single pulse avalanche energy (starting $T_J = 25\text{ }^\circ\text{C}$, $I_D = I_{AS}$, $V_{DD} = 50\text{ V}$)	200	mJ

2 Electrical characteristics

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

Table 4. On/off states

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source breakdown voltage	$I_D = 250\ \mu\text{A}$, $V_{GS} = 0\ \text{V}$	600			V
I_{DSS}	Zero gate voltage drain current	$V_{GS} = 0\ \text{V}$, $V_{DS} = 600\ \text{V}$			1	μA
		$V_{GS} = 0\ \text{V}$, $V_{DS} = 600\ \text{V}$, $T_C = 125\text{ °C}^{(1)}$			10	
I_{GSS}	Gate body leakage current	$V_{DS} = 0\ \text{V}$, $V_{GS} = \pm 20\ \text{V}$			± 100	nA
$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	$V_{GS} = 10\ \text{V}$, $I_D = 2.5\ \text{A}$		0.9	1.0	Ω

1. Specified by design, not tested in production.

Table 5. Dynamic

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
C_{iss}	Input capacitance	$V_{DS} = 25\ \text{V}$, $f = 1\ \text{MHz}$, $V_{GS} = 0\ \text{V}$	-	400	-	pF
C_{oss}	Output capacitance		-	100	-	pF
C_{rss}	Reverse transfer capacitance		-	10	-	pF
$C_{oss\ eq.}^{(1)}$	Equivalent output capacitance	$V_{GS} = 0\ \text{V}$, $V_{DS} = 0\ \text{to}\ 480\ \text{V}$	-	50	-	pF
Q_g	Total gate charge	$V_{DD} = 400\ \text{V}$, $I_D = 5\ \text{A}$, $V_{GS} = 0\ \text{to}\ 10\ \text{V}$ (see Figure 12. Test circuit for gate charge behavior)	-	13	-	nC
Q_{gs}	Gate-source charge		-	5	-	nC
Q_{gd}	Gate-drain charge		-	6	-	nC

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 6. Switching times

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on delay time	$V_{DD} = 300\ \text{V}$, $I_D = 2.5\ \text{A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\ \text{V}$	-	14	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time	(see Figure 11. Test circuit for resistive load switching times and Figure 16. Switching time waveform)	-	23	-	ns
t_f	Fall time		-	10	-	ns
$t_{r(voff)}$	Off-voltage rise time	$V_{DD} = 480\ \text{V}$, $I_D = 5\ \text{A}$, $R_G = 4.7\ \Omega$, $V_{GS} = 10\ \text{V}$	-	7	-	ns
t_f	Fall time		-	10	-	ns
t_c	Cross-over time	(see Figure 13. Test circuit for inductive load switching and diode recovery times)	-	17	-	ns

Table 7. Source-drain diode

Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain current		-		5	A
$I_{SDM}^{(1)}$	Source-drain current (pulsed)		-		20	A
$V_{SD}^{(2)}$	Forward on voltage	$I_{SD} = 5\text{ A}$, $V_{GS} = 0\text{ V}$	-		1.5	V
t_{rr}	Reverse recovery time	$I_{SD} = 5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$,	-	300		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 100\text{ V}$	-	1.95		μC
I_{RRM}	Reverse recovery current	(see Figure 13. Test circuit for inductive load switching and diode recovery times)	-	13		A
t_{rr}	Reverse recovery time	$I_{SD} = 5\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$,	-	445		ns
Q_{rr}	Reverse recovery charge	$V_{DD} = 100\text{ V}$, $T_J = 150\text{ }^\circ\text{C}$	-	3		μC
I_{RRM}	Reverse recovery current	(see Figure 13. Test circuit for inductive load switching and diode recovery times)	-	13.5		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

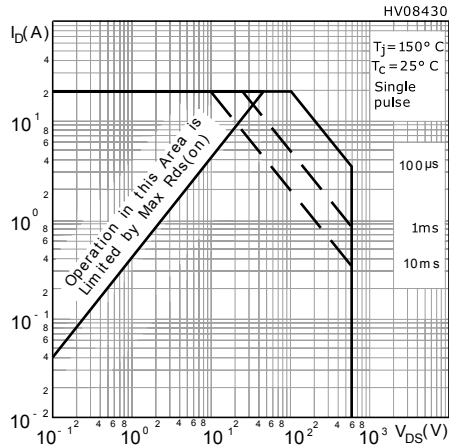


Figure 2. Thermal impedance

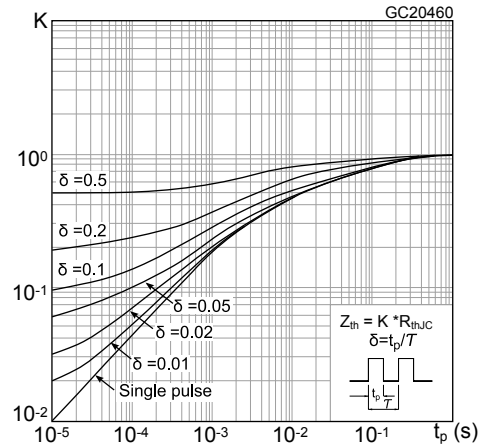


Figure 3. Output characteristics

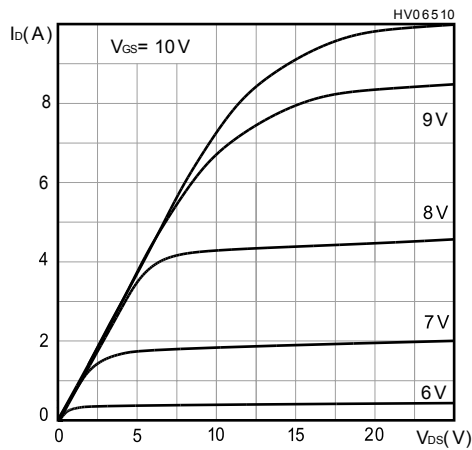


Figure 4. Transfer characteristics

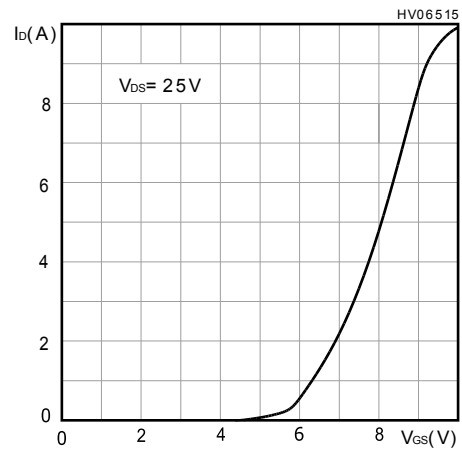


Figure 5. Static drain-source on-resistance

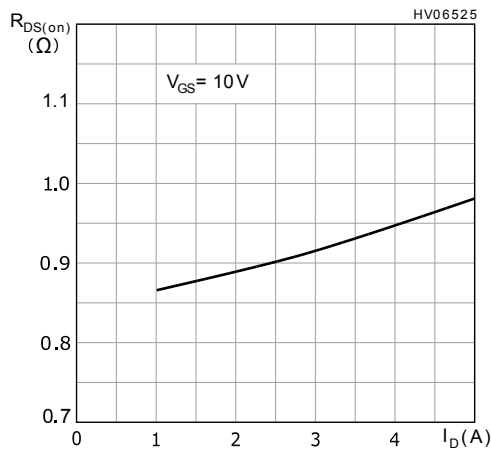


Figure 6. Gate charge vs gate-source voltage

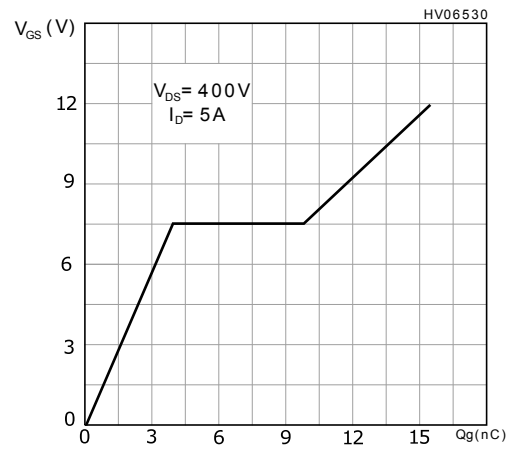


Figure 7. Capacitance variations

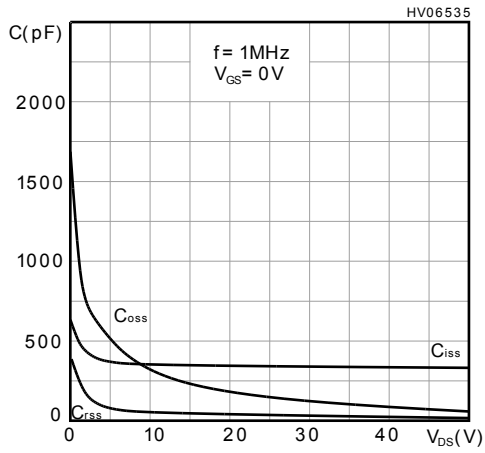


Figure 8. Normalized gate threshold voltage vs temperature

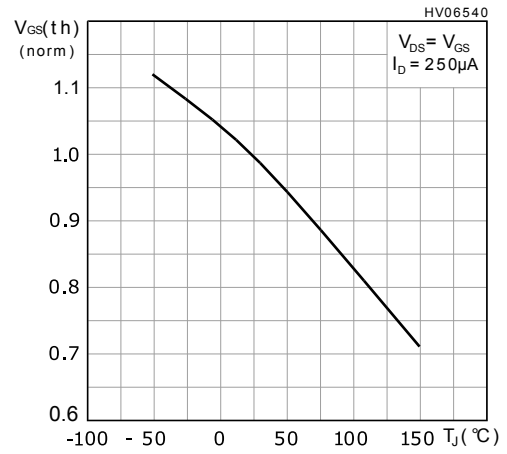


Figure 9. Normalized on-resistance vs temperature

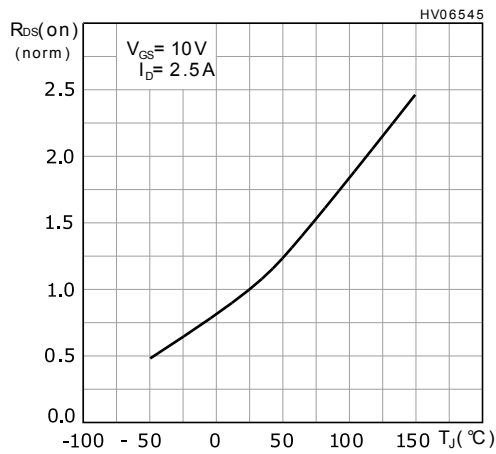
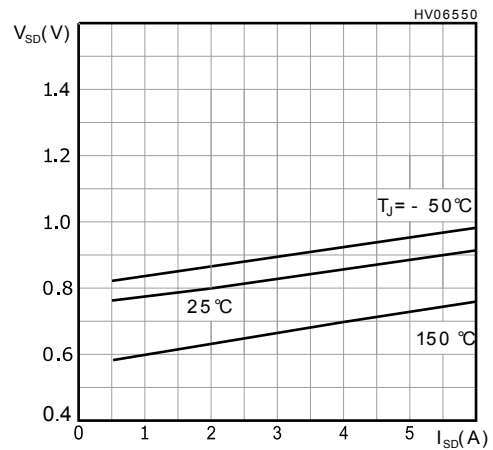


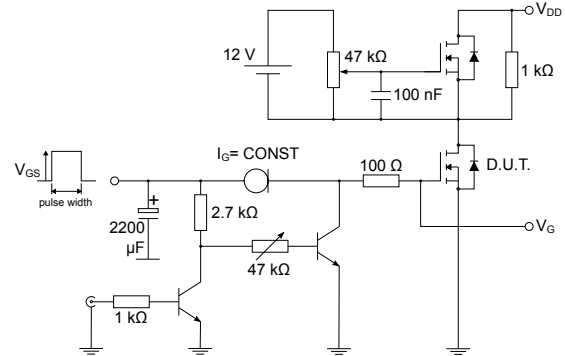
Figure 10. Source-drain diode forward characteristics



3 Test circuits

Figure 11. Test circuit for resistive load switching times


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Figure 12. Test circuit for gate charge behavior


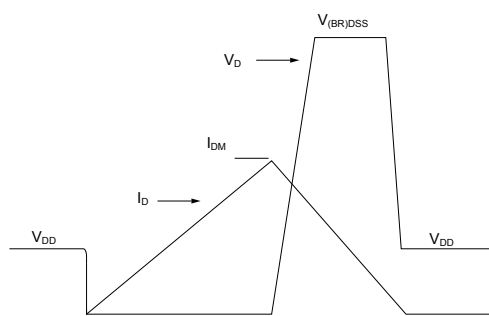
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Figure 13. Test circuit for inductive load switching and diode recovery times


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Figure 14. Unclamped inductive load test circuit


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Figure 15. Unclamped inductive waveform


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Figure 16. Switching time waveform


AM01473v1

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 IPAK (TO-251) type E package information

Figure 17. IPAK (TO-251) type E package outline

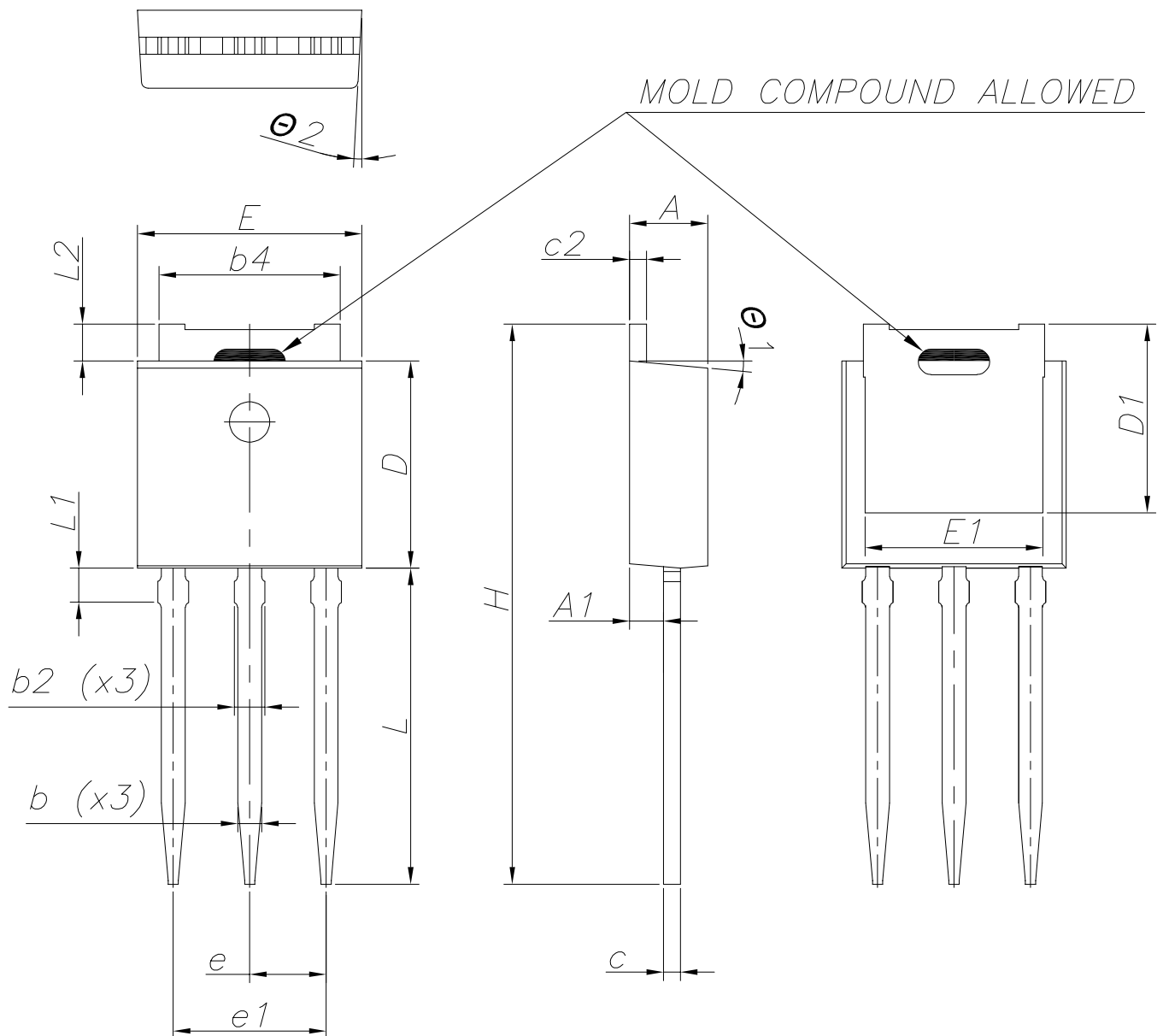


Table 8. IPAK (TO-251) type E package mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	2.20	2.30	2.35
A1	0.90	1.00	1.10
b	0.66		0.79
b2			0.90
b4	5.23	5.33	5.43
c	0.46		0.59
c2	0.46		0.59
D	6.00	6.10	6.20
D1	5.30	5.53	5.75
E	6.50	6.60	6.70
E1	5.05	5.23	5.40
e	2.20	2.25	2.30
e1	4.40	4.50	4.60
H	16.18	16.48	16.78
L	9.00	9.30	9.60
L1	0.80	1.00	1.20
L2	0.90	1.08	1.25
Ø1	3°	5°	7°
Ø2	1°	3°	5°

Revision history

Table 9. Document revision history

Date	Revision	Changes
21-Jun-2023	1	First release. The part number STD5NM60-1 was previously inserted in the DS1949.

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