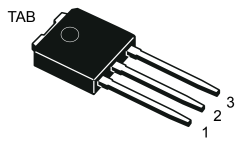
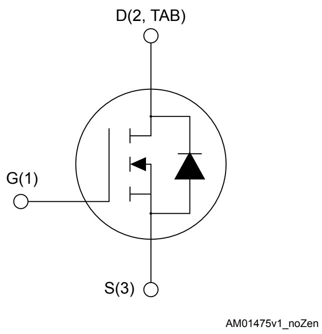
STD5NM60-1

Datasheet

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



IPAK



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.

Product status link
STD5NM60-1

Product summary	
Order code	STD5NM60-1
Marking	D5NM60
Package	IPAK
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	5	A
	Drain current (continuous) at T_C = 100 °C	3.1	
I_{DM} (1)	Drain current (pulsed)	20	A
P_{TOT}	Total power dissipation at T_C = 25 °C	96	W
dv/dt (2)	Peak diode recovery voltage slope	15	V/ns
T_{stg}	Storage temperature range	-55 to 150	°C
T_J	Operating junction temperature range		°C

1. *Pulse width is limited by safe operating area.*
2. *I_{SD} ≤ 5 A, di/dt ≤ 400 A/µs, V_{DD} = 80% $V_{(BR)DSS}$.*

Table 2. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance, junction-to-case	1.3	°C/W
R_{thJA}	Thermal resistance, junction-to-ambient	100	°C/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 °C, I_D = I_{AS}, V_{DD} = 50 V)	200	mJ

2 Electrical characteristics

T_C = 25 °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 µA, V_{GS} = 0 V	600			V
I_{DSS}	Zero gate voltage drain current	V_{GS} = 0 V, V_{DS} = 600 V			1	µA
		V_{GS} = 0 V, V_{DS} = 600 V, T_C = 125 °C[1]			10	µA
I_{GSS}	Gate body leakage current	V_{DS} = 0 V, V_{GS} = ±20 V			±100	nA
$V_{GS(th)}$	Gate threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	3	4	5	V
$R_{DS(on)}$	Static drain-source on-resistance	V_{GS} = 10 V, I_D = 2.5 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 V, f = 1 MHz, V_{GS} = 0 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 V, V_{DS} = 0 to 480 V	-	50	-	pF
Q_g	Total gate charge	V_{DD} = 400 V, I_D = 5 A, V_{GS} = 0 to 10 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 V, I_D = 2.5 A, R_G = 4.7 Ω, V_{GS} = 10 V (see Figure 11. Test circuit for resistive load switching times and Figure 16. Switching time waveform)	-	14	-	ns
t_r	Rise time		-	10	-	ns
$t_{d(off)}$	Turn-off delay time		-	23	-	ns
t_f	Fall time		-	10	-	ns
$t_{r(Voff)}$	Off-voltage rise time	V_{DD}= 480 V, I_D= 5 A, R_G= 4.7 Ω, V_{GS}=10 V (see Figure 13. Test circuit for inductive load switching and diode recovery times)	-	7	-	ns
t_f	Fall time		-	10	-	ns
t_c	Cross-over time		-	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 A, V_{GS} = 0 V	-		1.5	V
t_{rr}	Reverse recovery time	I_{SD} = 5 A, di/dt = 100 A/µs,	-	300		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 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 A, di/dt = 100 A/µs,	-	445		ns
Q_{rr}	Reverse recovery charge	V_{DD} = 100 V, T_J = 150 °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

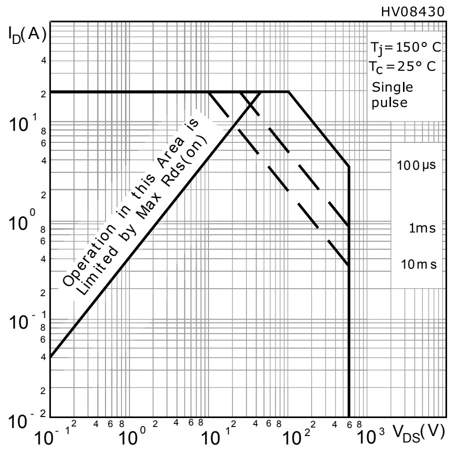


Figure 2. Thermal impedance

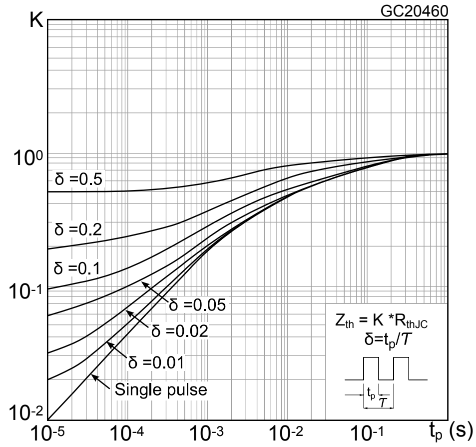


Figure 3. Output characterisics

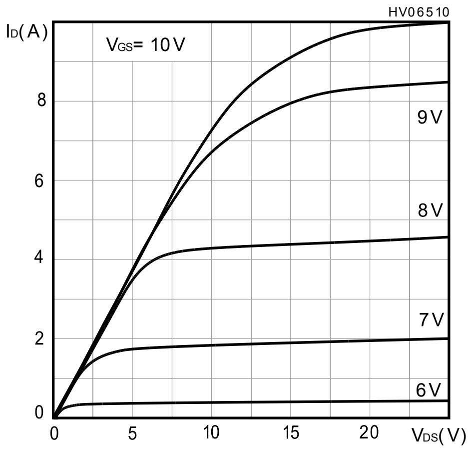


Figure 4. Transfer characteristics

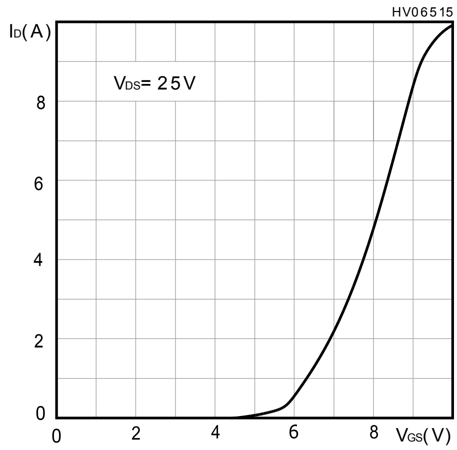


Figure 5. Static drain-source on-resistance

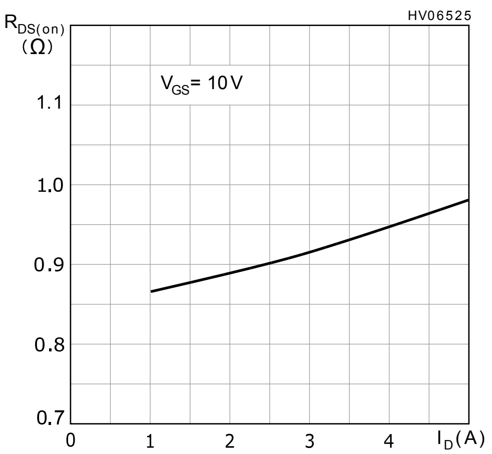


Figure 6. Gate charge vs gate-source voltage

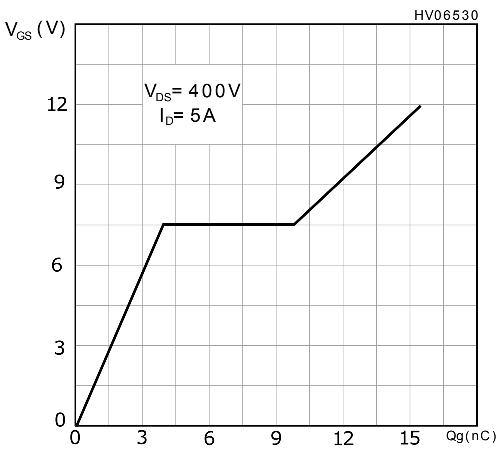


Figure 7. Capacitance variations

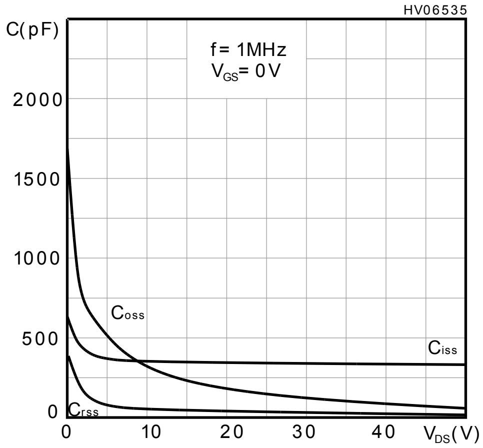


Figure 8. Normalized gate threshold voltage vs temperature

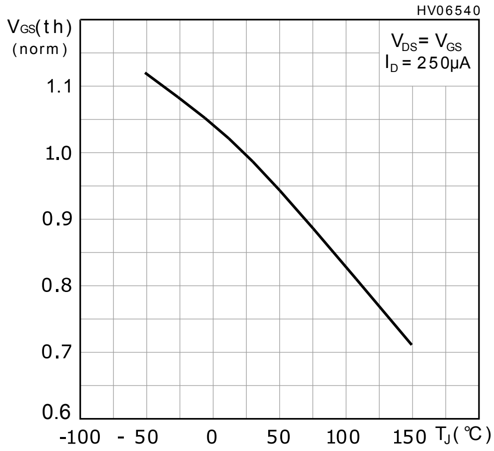


Figure 9. Normalized on-resistance vs temperature

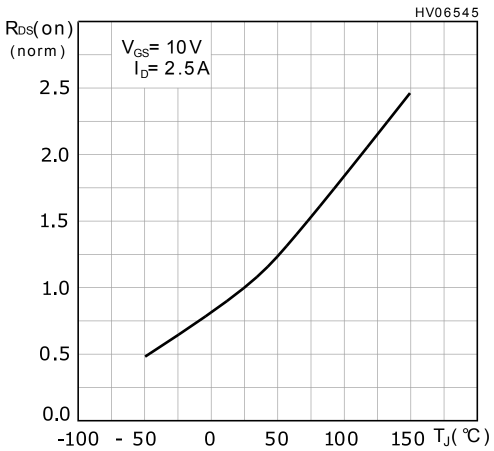
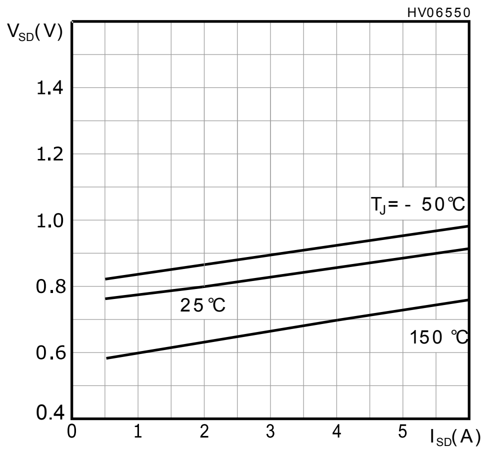


Figure 10. Source-drain diode forward characteristics



3 Test circuits

Figure 11. Test circuit for resistive load switching times

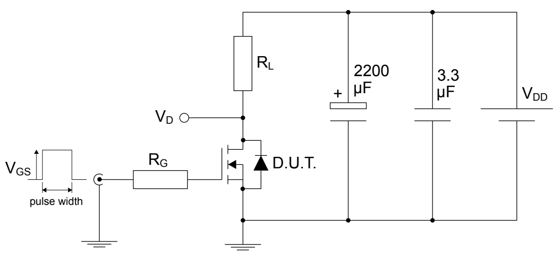


Figure 12. Test circuit for gate charge behavior

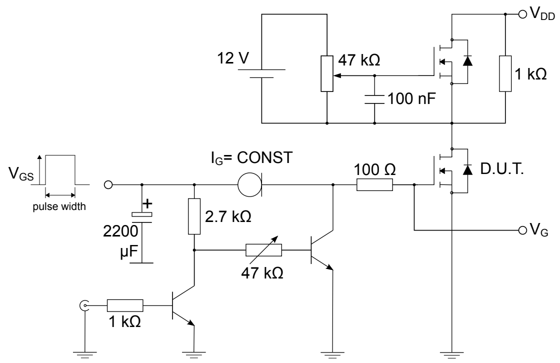


Figure 13. Test circuit for inductive load switching and diode recovery times

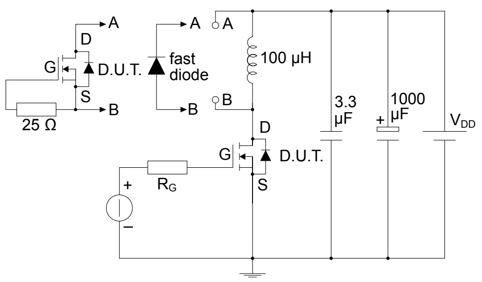


Figure 14. Unclamped inductive load test circuit

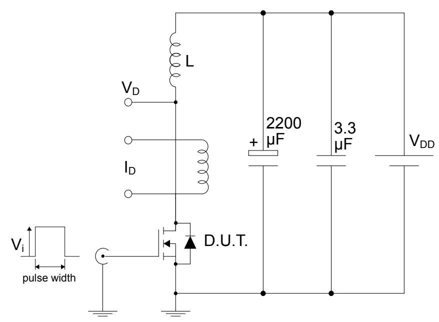


Figure 15. Unclamped inductive waveform

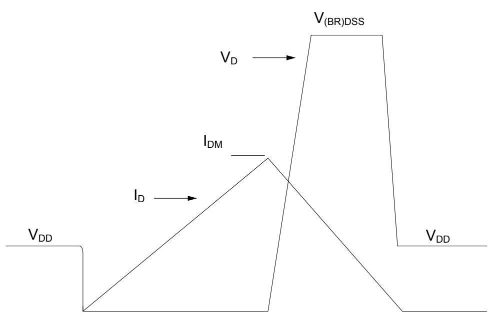
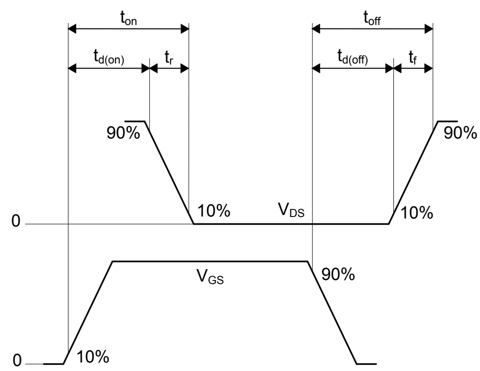


Figure 16. Switching time waveform



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

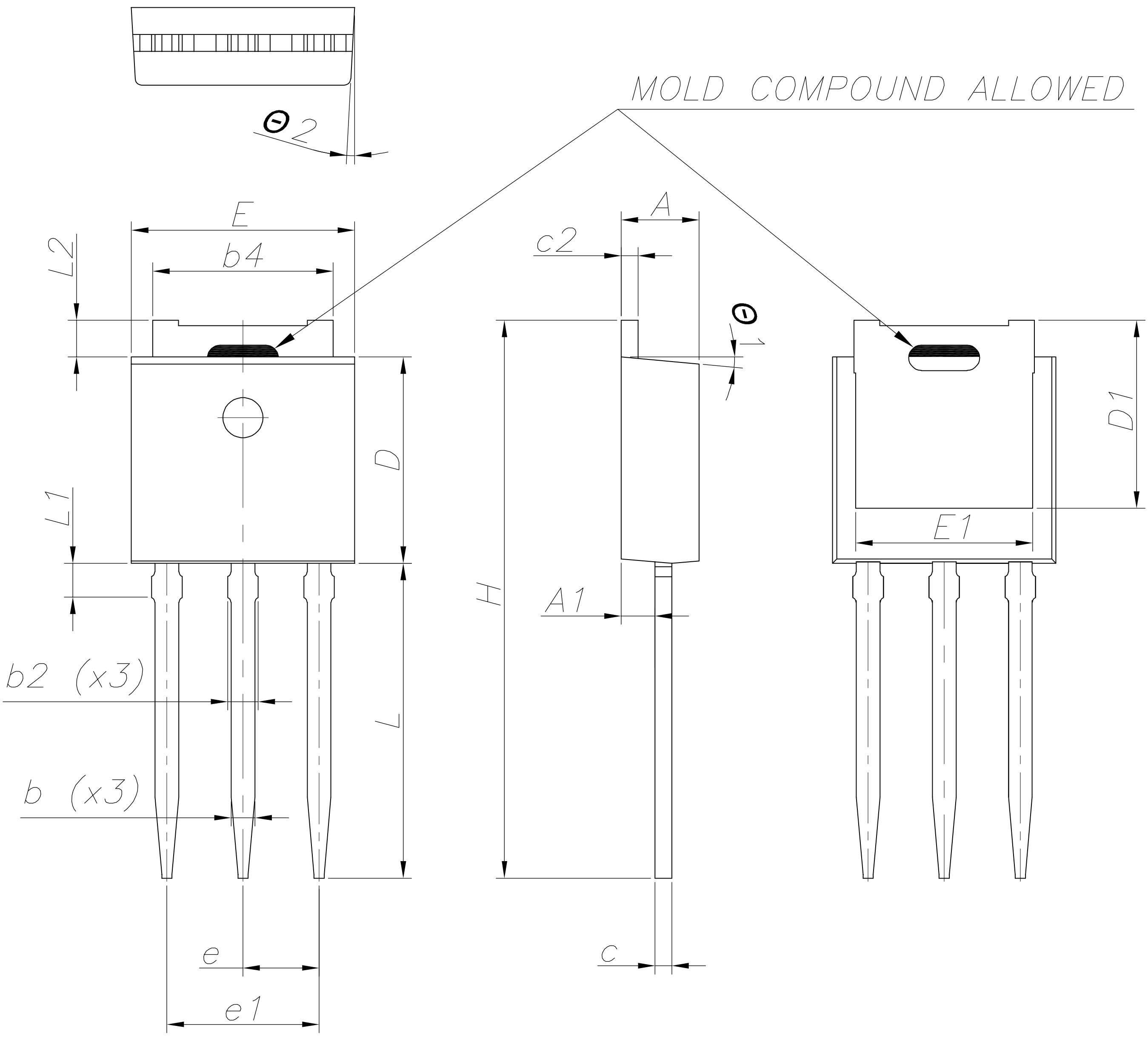


Table 8. IPAK (TO-251) type E package mechanical data

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
Θ1	3°	5°	7°
Θ2	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.

Contents