

#### STW55NM60ND

N-channel 600 V - 0.047 Ω - 51 A TO-247 FDmesh™ II Power MOSFET (with fast diode)

#### **Features**

Туре	V <sub>DSS</sub> (@T <sub>J</sub> max)	R <sub>DS(on)</sub> (max)	I <sub>D</sub>
STW55NM60ND	650 V	< 0.060 Ω	51 A

- The worldwide best R<sub>DS(on)</sub> amongst the fast recovery diode devices in TO-247
- 100% avalanche tested
- Low input capacitance and gate charge
- Low gate input resistance
- High dv/dt and avalanche capabilities



Switching applications

#### **Description**

The FDmesh™ II series belongs to the second generation of MDmesh™ technology. This revolutionary Power MOSFET associates a new vertical structure to the company's strip layout and associates all advantages of reduced onresistance and fast switching with an intrinsic fast-recovery body diode.It is therefore strongly recommended for bridge topologies, in particular ZVS phase-shift converters.

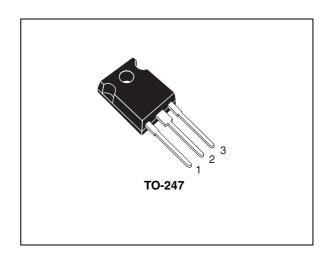


Figure 1. Internal schematic diagram

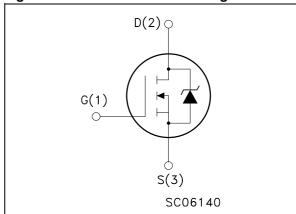


Table 1. Device summary

Order code	Marking	Package	Packaging	
STW55NM60ND	55NM60ND	TO-247	Tube	

Contents STW55NM60ND

## **Contents**

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STW55NM60ND Electrical ratings

# 1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V <sub>DS</sub>	Drain-source voltage (V <sub>GS</sub> = 0)	600	V
$V_{GS}$	Gate- source voltage	±25	٧
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 25 °C	51	Α
I <sub>D</sub>	Drain current (continuous) at T <sub>C</sub> = 100 °C	32	Α
I <sub>DM</sub> <sup>(1)</sup>	Drain current (pulsed)	204	Α
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25 °C	350	W
dv/dt <sup>(2)</sup>	Peak diode recovery voltage slope	40	V/ns
T <sub>stg</sub>	Storage temperature	-55 to 150	°C
Tj	Max. operating junction temperature	150	°C

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

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case max	0.36	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient max	50	°C/W
T <sub>I</sub>	Maximum lead temperature for soldering purpose	300	°C

Table 4. Avalanche characteristics

Symbol	Parameter	Max value	Unit
I <sub>AS</sub>	Avalanche current, repetitive or not-repetitive (pulse width limited by $T_j$ max)	15	Α
E <sub>AS</sub>	Single pulse avalanche energy (starting $T_j = 25$ °C, $I_D = I_{AS}$ , $V_{DD} = 50$ V)	850	mJ

<sup>2.</sup>  $I_{SD} \leq 51$  A, di/dt  $\leq 600$  A/µs,  $V_{DD} = 80\%$   $V_{(BR)DSS}$ 

Electrical characteristics STW55NM60ND

### 2 Electrical characteristics

(T<sub>CASE</sub>=25°C unless otherwise specified)

Table 5. 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	600			V
dv/dt (1)	Drain source voltage slope	$V_{DD}$ =480 V, $I_{D}$ = 51 A, $V_{GS}$ =10 V		30		V/ns
I <sub>DSS</sub>	Zero gate voltage drain current (V <sub>GS</sub> = 0)	$V_{DS}$ = Max rating $V_{DS}$ = Max rating @125 °C			1 100	μ <b>Α</b> μ <b>Α</b>
I <sub>GSS</sub>	Gate-body leakage current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 20 V			100	nA
V <sub>GS(th)</sub>	Gate threshold voltage	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	3	4	5	V
R <sub>DS(on)</sub>	Static drain-source on resistance	$V_{GS} = 10 \text{ V}, I_D = 25.5 \text{ A}$		0.047	0.060	Ω

<sup>1.</sup> Characteristic value at turn off on inductive load

Table 6. Dynamic

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
9 <sub>fs</sub> <sup>(1)</sup>	Forward transconductance	$V_{DS} = 15 V_{,} I_{D} = 25.5 A$		45		S
C <sub>iss</sub> C <sub>oss</sub> C <sub>rss</sub>	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 50 \text{ V, f} = 1 \text{ MHz,}$ $V_{GS} = 0$		5800 300 30		pF pF pF
C <sub>oss eq.</sub> <sup>(2)</sup>	Equivalent output capacitance	V <sub>GS</sub> = 0, V <sub>DS</sub> = 0 to 480 V		900		pF
$\begin{array}{c} t_{d(on)} \\ t_{r} \\ t_{d(off)} \\ t_{f} \end{array}$	Turn-on delay time Rise time Turn-off delay time Fall time	$V_{DD}$ = 300 V, $I_{D}$ = 25.5 A $R_{G}$ = 4.7 $\Omega$ , $V_{GS}$ = 10 V (see Figure 19), (see Figure 14)		33 68 188 96		ns ns ns
Q <sub>g</sub> Q <sub>gs</sub> Q <sub>gd</sub>	Total gate charge Gate-source charge Gate-drain charge	$V_{DD}$ = 480 V, $I_D$ = 51 A, $V_{GS}$ = 10 V, (see Figure 15)		190 30 90		nC nC nC
Rg	Gate input resistance	f=1 MHz Gate DC Bias = 0 Test signal level = 20 mV Open drain		2.5		Ω

<sup>1.</sup> Pulsed: pulse duration= 300  $\mu$ s, duty cycle 1.5%

<sup>2.</sup>  $C_{oss\ eq}$  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 7. Source drain diode

Symbol	Parameter	Test conditions	Min.	Тур.	Max.	Unit
I <sub>SD</sub>	Source-drain current Source-drain current (pulsed)				51 204	A A
V <sub>SD</sub> <sup>(2)</sup>	Forward on voltage	I <sub>SD</sub> = 51 A, V <sub>GS</sub> = 0			1.3	V
t <sub>rr</sub> Q <sub>rr</sub> I <sub>RRM</sub>	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 51 \text{ A}, V_{DD} = 60 \text{ V}$ di/dt = 100 A/ $\mu$ s (see Figure 16)		200 1.8 18		ns µC A
t <sub>rr</sub> Q <sub>rr</sub> I <sub>RRM</sub>	Reverse recovery time Reverse recovery charge Reverse recovery current	$I_{SD} = 51 \text{ A}, V_{DD} = 60 \text{ V}$ di/dt = 100 A/ $\mu$ s, $T_j = 150 ^{\circ}\text{C}$ (see Figure 16)		280 3.4 24		ns µC A

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

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

Electrical characteristics STW55NM60ND

#### 2.1 Electrical characteristics (curves)

Figure 2. Safe operating area

Figure 3. Thermal impedance

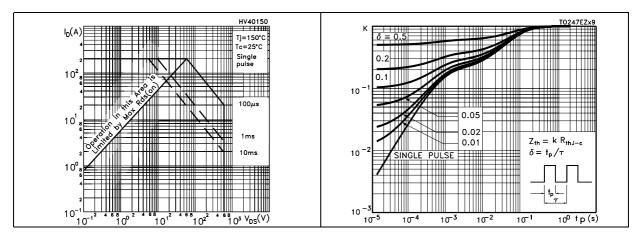


Figure 4. Output characteristics

Figure 5. Transfer characteristics

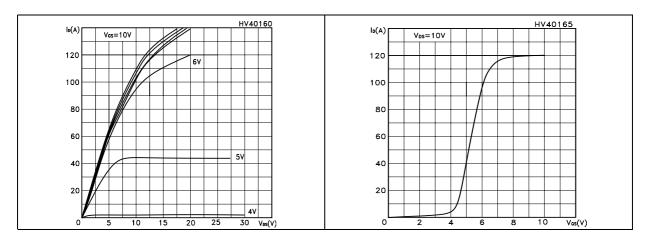
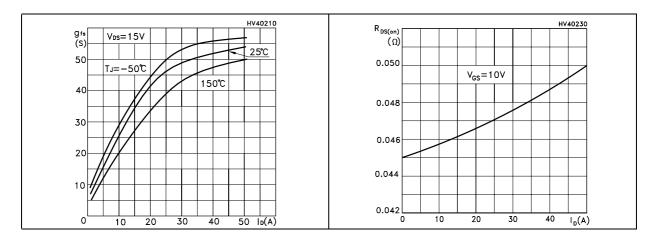


Figure 6. Transconductance

Figure 7. Static drain-source on resistance



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Figure 8. Gate charge vs gate-source voltage Figure 9. Capacitance variations

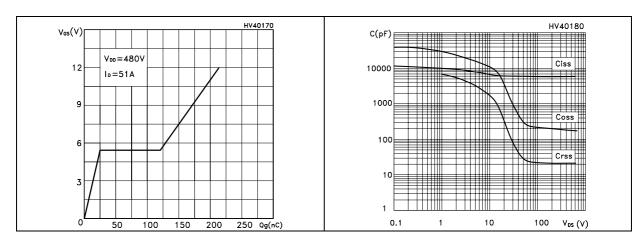


Figure 10. Normalized gate threshold voltage vs temperature

Figure 11. Normalized on resistance vs temperature

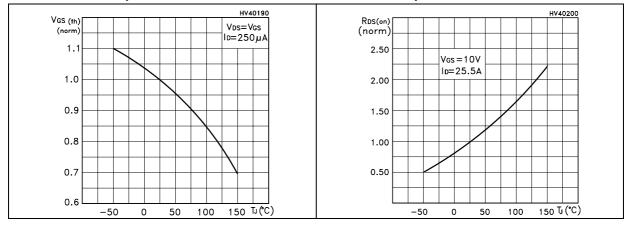
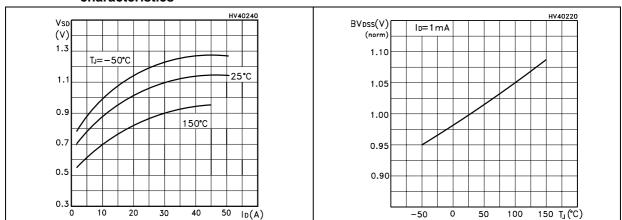


Figure 12. Source-drain diode forward characteristics

Figure 13. Normalized B<sub>VDSS</sub> vs temperature



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Test circuits STW55NM60ND

### 3 Test circuits

Figure 14. Switching times test circuit for resistive load

Figure 15. Gate charge test circuit

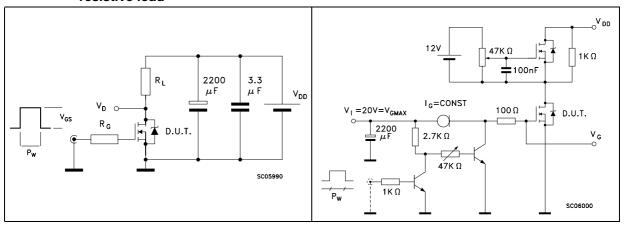


Figure 16. Test circuit for inductive load switching and diode recovery times

Figure 17. Unclamped Inductive load test circuit

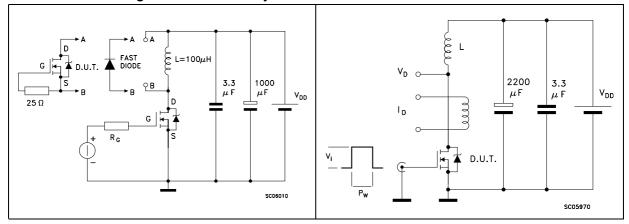
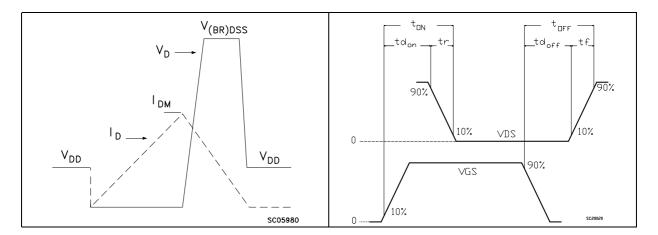


Figure 18. Unclamped inductive waveform

Figure 19. Switching time waveform



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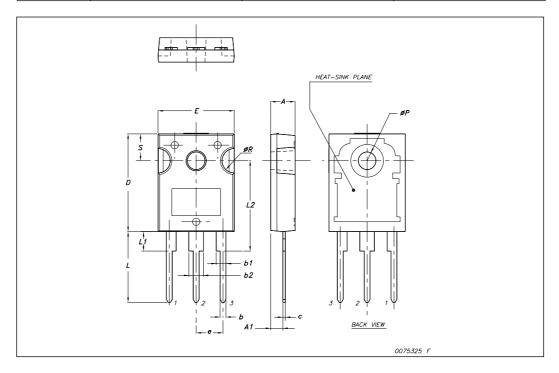
## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: <a href="https://www.st.com">www.st.com</a>.

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Dim.		mm.				
Dilli.	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		5.45				
L	14.20		14.80			
L1	3.70		4.30			
L2		18.50				
øΡ	3.55		3.65			
øR	4.50		5.50			
S		5.50				



STW55NM60ND Revision history

# 5 Revision history

Table 8. Document revision history

Date	Revision	Changes
16-Nov-2007	1	First release.
22-Apr-2008	2	Document status promoted from preliminary data to datasheet.

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