

# **STP40N20 STW40N20**

## N-CHANNEL 200V - 0.038Ω - 40A TO-220/TO-247 LOW GATE CHARGE STripFET™ MOSFET

**Table 1: General Features** 

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	Pw
STP40N20	200 V	< 0.045 Ω		160 W
STW40N20	200 V	< 0.045 Ω		160 W

- TYPICAL  $R_{DS}(on) = 0.038 \Omega$
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATIBILITY
- EXCELLENT FIGURE OF MERIT (R<sub>DS</sub>\*Q<sub>d</sub>)
- 100% AVALANCHE TESTED

#### **DESCRIPTION**

This MOSFET series realized with STMicroelectronics unique STripFET process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters.

#### **APPLICATIONS**

- HIGH CURRENT, HIGH SPEED SWITCHING
- UPS

Figure 1: Package

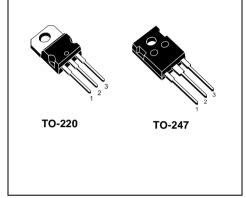


Figure 2: Internal Schematic Diagram

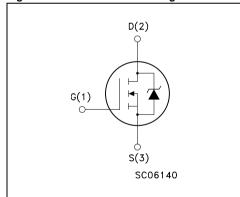


Table 2: Order Codes

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP40N20	P40N20	TO-220	TUBE
STW40N20	STW40N20 W40N20		TUBE

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**Table 3: Absolute Maximum ratings** 

Symbol	Parameter	Value	Unit
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	200	V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)	200	V
$V_{GS}$	Gate- source Voltage	± 20	V
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 25°C	40	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>C</sub> = 100°C	25	A
I <sub>DM</sub> (•)	Drain Current (pulsed)	160	A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	160	W
	Derating Factor	1.28	W/°C
dv/dt (1)	Peak Diode Recovery voltage slope	12	V/ns
T <sub>j</sub> T <sub>stg</sub>	Operating Junction Temperature Storage Temperature	-55 to 150	°C

#### **Table 4: Thermal Data**

		TO-220	TO-247	
Rthj-case	Thermal Resistance Junction-case Max	0.	78	°C/W
Rthj-amb	Thermal Resistance Junction-ambient Max	62.5	50	°C/W
T <sub>I</sub>	Maximum Lead Temperature For Soldering Purpose	300		°C

## **Table 5: Avalanche Characteristics**

Symbol	Parameter	Max Value	Unit
I <sub>AR</sub>	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max)	40	Α
Eas	Single Pulse Avalanche Energy (starting $T_j = 25$ °C, $I_D = I_{AR}$ , $V_{DD} = 50$ V)	230	mJ

<sup>(•)</sup> Pulse width limited by safe operating area (1) I<sub>SD</sub> ≤ 40A, di/dt ≤ 200 A/µs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

## **ELECTRICAL CHARACTERISTICS** (T<sub>CASE</sub> =25°C UNLESS OTHERWISE SPECIFIED)

## Table 6: On/Off

Symbol	Parameter Test Conditions		Min.	Тур.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source Breakdown Voltage	$I_D = 1$ mA, $V_{GS} = 0$	200			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0)	$V_{DS}$ = Max Rating $V_{DS}$ = Max Rating, $T_{C}$ = 125 °C			1 10	μA μA
Igss	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 20V			±100	nA
V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_{D} = 250 \mu A$	2	3	4	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10V, I <sub>D</sub> = 20 A		0.038	0.045	Ω

## Table 7: Dynamic

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
g <sub>fs</sub> (1)	Forward Transconductance	V <sub>DS</sub> = 15 V <sub>,</sub> I <sub>D</sub> =20 A		30		S
C <sub>iss</sub> C <sub>oss</sub> C <sub>rss</sub>	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25V$ , f = 1 MHz, $V_{GS} = 0$		2500 510 78		pF pF pF
t <sub>d(on)</sub> t <sub>r</sub> t <sub>d(off)</sub> t <sub>r</sub>	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	$V_{DD}$ = 100 V, $I_D$ = 20 A, $R_G$ = 4.7 $\Omega$ $V_{GS}$ = 10 V (Resistive Load see, Figure 17)		20 44 74 22		ns ns ns ns
Q <sub>g</sub> Q <sub>gs</sub> Q <sub>gd</sub>	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 160V, I_D = 40 A,$ $V_{GS} = 10V$		75 13.2 35.5		nC nC nC

## **Table 8: Source Drain Diode**

Symbol	Parameter Test Conditions		Min.	Тур.	Max.	Unit
I <sub>SD</sub> I <sub>SDM</sub> (2)	Source-drain Current Source-drain Current (pulsed)				40 160	A A
V <sub>SD</sub> (1)	Forward On Voltage	I <sub>SD</sub> = 20 A, V <sub>GS</sub> = 0			1.5	V
t <sub>rr</sub> Q <sub>rr</sub> I <sub>RRM</sub>	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD}$ = 20 A, di/dt = 100A/µs $V_{DD}$ = 100V, $T_j$ = 25°C (see test circuit, Figure 18)		192 922 9.6		ns nC A
t <sub>rr</sub> Q <sub>rr</sub> I <sub>RRM</sub>	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD}$ = 20 A, di/dt = 100A/µs $V_{DD}$ = 100V, $T_j$ = 150°C (see test circuit, Figure 18)		242 1440 11.9		ns nC A

<sup>(1)</sup> Pulsed: Pulse duration = 300 μs, duty cycle 1.5 %.(2) Pulse width limited by safe operating area.

Figure 3: Safe Operating Area For TO-220

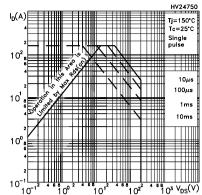


Figure 4: Safe Operating Area For TO-247

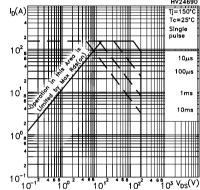


Figure 5: Output Characteristics

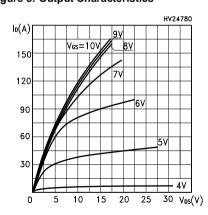


Figure 6: Thermal Impedance For TO-220

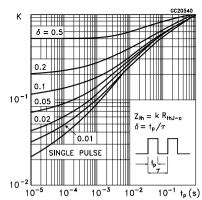


Figure 7: Thermal Impedance For TO-247

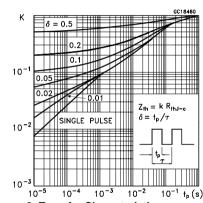
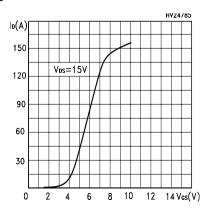


Figure 8: Transfer Characteristics



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Figure 9: Transconductance

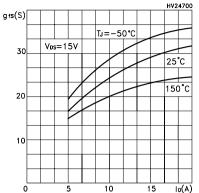


Figure 10: Gate Charge vs Gate-source Voltage

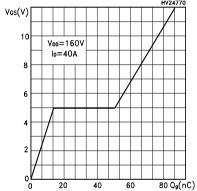


Figure 11: Normalized Gate Threshold Voltage vs Temperature

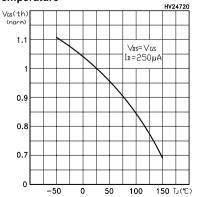


Figure 12: Static Drain-source On Resistance

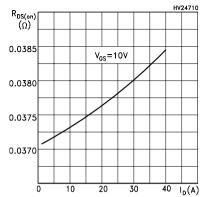


Figure 13: Capacitance Variations

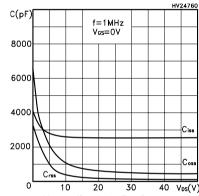


Figure 14: Normalized On Resistance vs Temperature

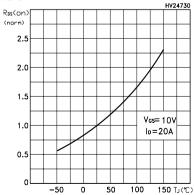


Figure 15: Source-Drain Forward Characteristics

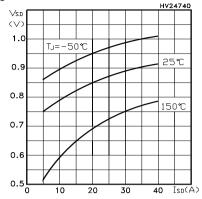


Figure 16: Unclamped Inductive Load Test Circuit

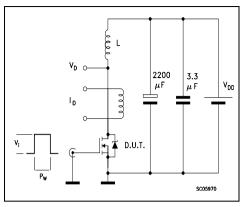


Figure 17: Switching Times Test Circuit For Resistive Load

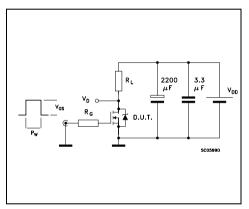


Figure 18: Test Circuit For Inductive Load Switching and Diode Recovery Times

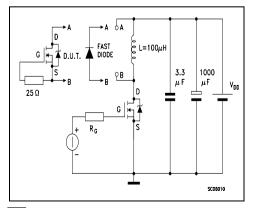


Figure 19: Unclamped Inductive Wafeform

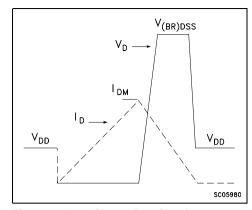
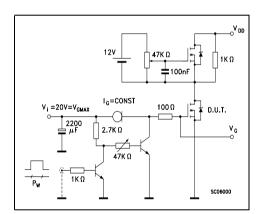
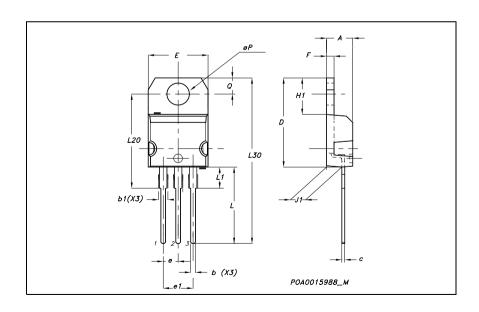


Figure 20: Gate Charge Test Circuit



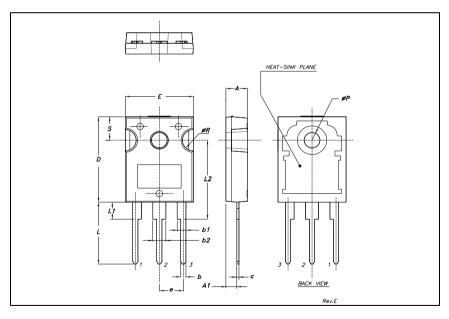
TO-220	ME	CHA	NIC	AL	DATA
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DIM.		mm.		inch		
DIW.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
Α	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
С	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
Е	10		10.40	0.393		0.409
е	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
øΡ	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



## **TO-247 MECHANICAL DATA**

DIM.	mm.			inch			
DIIVI.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.	
Α	4.85		5.15	0.19		0.20	
A1	2.20		2.60	0.086		0.102	
b	1.0		1.40	0.039		0.055	
b1	2.0		2.40	0.079		0.094	
b2	3.0		3.40	0.118		0.134	
С	0.40		0.80	0.015		0.03	
D	19.85		20.15	0.781		0.793	
E	15.45		15.75	0.608		0.620	
е		5.45			0.214		
L	14.20		14.80	0.560		0.582	
L1	3.70		4.30	0.14		0.17	
L2		18.50			0.728		
øΡ	3.55		3.65	0.140		0.143	
øR	4.50		5.50	0.177		0.216	
S		5.50			0.216		



## **Table 9: Revision History**

Date	Revision	Description of Changes
27-Sep-2004	1	First Release.
03-Feb-2005	2	Complete Version

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