# STP40N20
# STW40N20

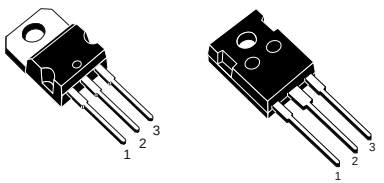
## N-CHANNEL 200V - 0.038Ω - 40A TO-220/TO-247
## LOW GATE CHARGE STripFET™ MOSFET

**Table 1: General Features**

| TYPE | $V_{DSS}$ | $R_{DS(on)}$ | $I_D$ | Pw |
|---|---|---|---|---|
| STP40N20 | 200 V | < 0.045 Ω | 40 A | 160 W |
| STW40N20 | 200 V | < 0.045 Ω | 40 A | 160 W |

- TYPICAL $R_{DS}(on)$ = 0.038 Ω
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATIBILITY
- EXCELLENT FIGURE OF MERIT ($R_{DS}$*$Q_g$)
- 100% AVALANCHE TESTED

**Figure 1: Package**

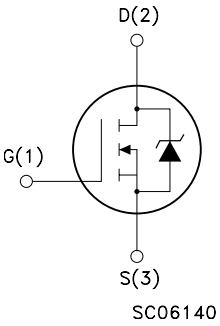



**TO-220** **TO-247**

### 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.

**Figure 2: Internal Schematic Diagram**




### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- UPS

**Table 2: Order Codes**

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|---|---|---|---|
| STP40N20 | P40N20 | TO-220 | TUBE |
| STW40N20 | W40N20 | TO-247 | TUBE |

**Table 3: Absolute Maximum ratings**

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

(•) Pulse width limited by safe operating area
(1) $I_{SD} \leq 40A$, $di/dt \leq 200$ A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX.}$

**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 |
| $T_l$ | Maximum Lead Temperature For Soldering Purpose | 300 | | °C |

**Table 5: Avalanche Characteristics**

| Symbol | Parameter | Max Value | Unit |
|---|---|---|---|
| $I_{AR}$ | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max) | 40 | A |
| $E_{AS}$ | Single Pulse Avalanche Energy (starting $T_j$ = 25 °C, $I_D = I_{AR}$, $V_{DD}$ = 50 V) | 230 | mJ |

**ELECTRICAL CHARACTERISTICS** ($T_{CASE}$ =25°C UNLESS OTHERWISE SPECIFIED)

**Table 6: On/Off**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage | $I_D$ = 1mA, $V_{GS}$ = 0 | 200 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current ($V_{GS}$ = 0) | $V_{DS}$ = Max Rating<br>$V_{DS}$ = Max Rating, $T_C$ = 125 °C | | | 1<br>10 | µA<br>µA |
| $I_{GSS}$ | Gate-body Leakage Current ($V_{DS}$ = 0) | $V_{GS}$ = ± 20V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | 3 | 4 | V |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS}$ = 10V, $I_D$ = 20 A | | 0.038 | 0.045 | Ω |

**Table 7: Dynamic**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $g_{fs}$ (1) | Forward Transconductance | $V_{DS}$ = 15 V, $I_D$=20 A | | 30 | | S |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{DS}$ = 25V, f = 1 MHz, $V_{GS}$ = 0 | | 2500<br>510<br>78 | | pF<br>pF<br>pF |
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_r$ | Turn-on Delay Time<br>Rise Time<br>Turn-off Delay Time<br>Fall Time | $V_{DD}$ = 100 V, $I_D$ = 20 A,<br>$R_G$= 4.7 Ω $V_{GS}$ = 10 V<br>(Resistive Load see, Figure 17) | | 20<br>44<br>74<br>22 | | ns<br>ns<br>ns<br>ns |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD}$ = 160V, $I_D$ = 40 A,<br>$V_{GS}$ = 10V | | 75<br>13.2<br>35.5 | | nC<br>nC<br>nC |

**Table 8: Source Drain Diode**

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

(1) 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**

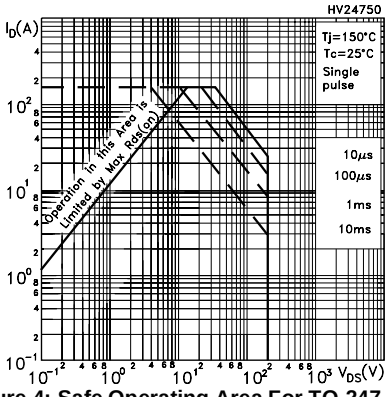



**Figure 4: Safe Operating Area For TO-247**

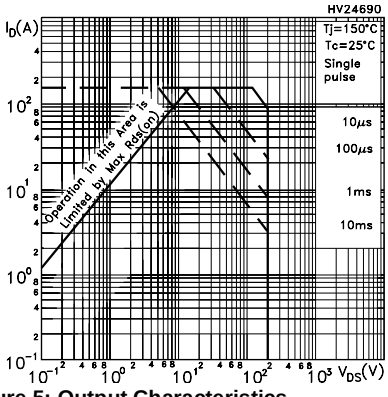



**Figure 5: Output Characteristics**

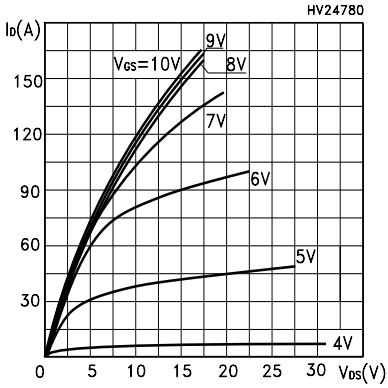



**Figure 6: Thermal Impedance For TO-220**

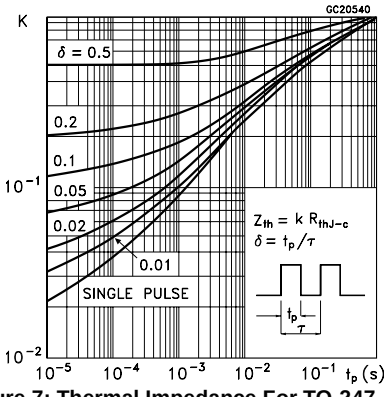



**Figure 7: Thermal Impedance For TO-247**

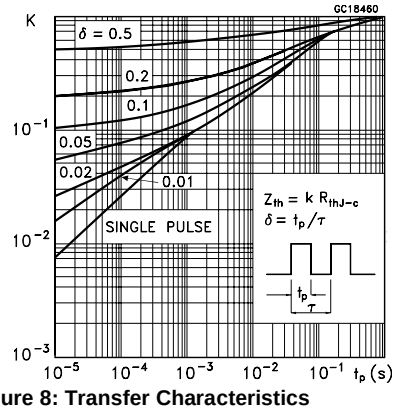



**Figure 8: Transfer Characteristics**

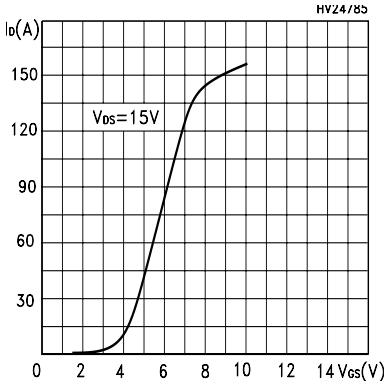


**Figure 9: Transconductance**

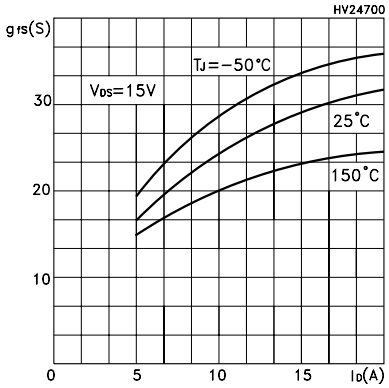



**Figure 10: Gate Charge vs Gate-source Voltage**

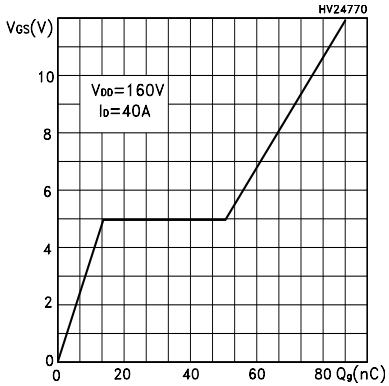



**Figure 11: Normalized Gate Threshold Voltage vs Temperature**

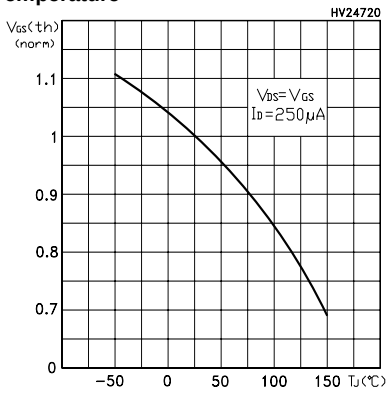



**Figure 12: Static Drain-source On Resistance**

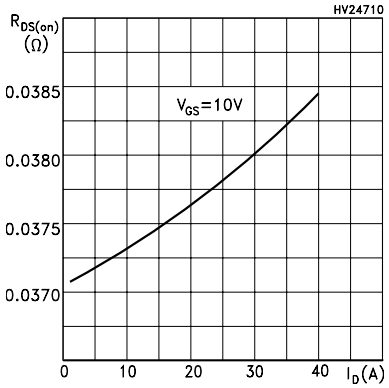



**Figure 13: Capacitance Variations**

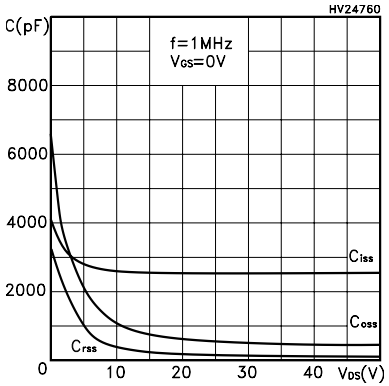



**Figure 14: Normalized On Resistance vs Temperature**

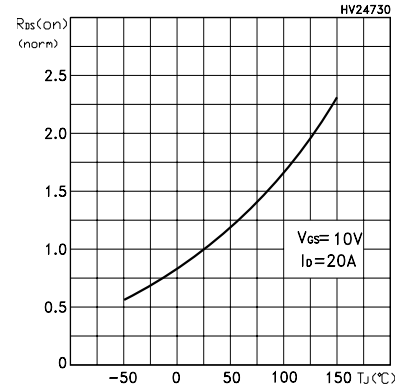


**Figure 15: Source-Drain Forward Characteristics**

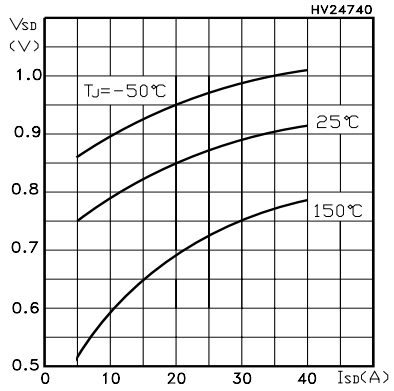


**Figure 16: Unclamped Inductive Load Test Circuit**

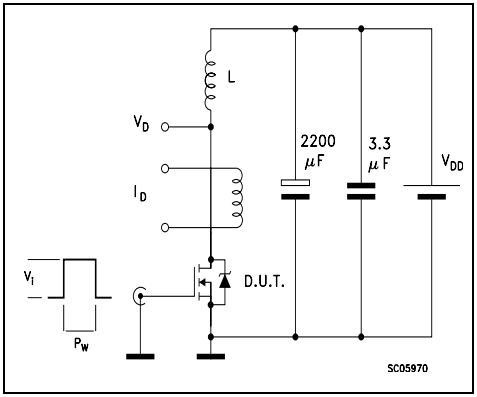



**Figure 17: Switching Times Test Circuit For Resistive Load**

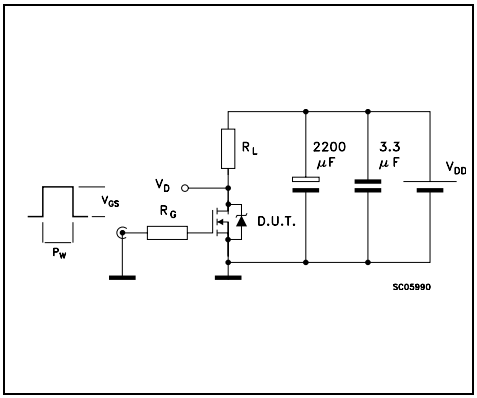



**Figure 18: Test Circuit For Inductive Load Switching and Diode Recovery Times**

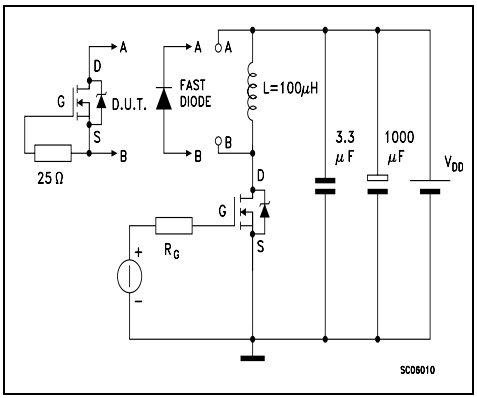



**Figure 19: Unclamped Inductive Wafeform**

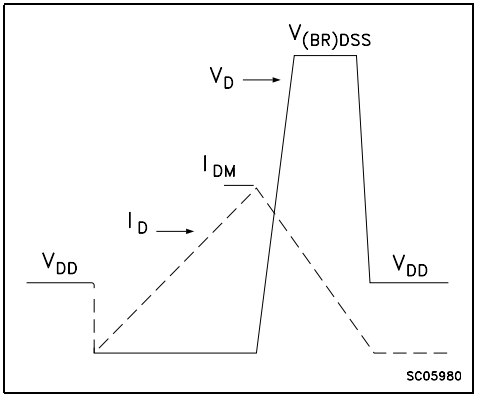
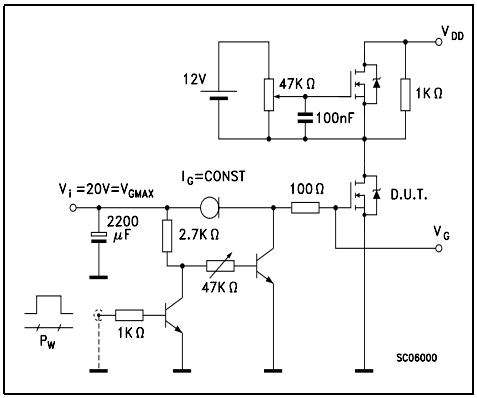
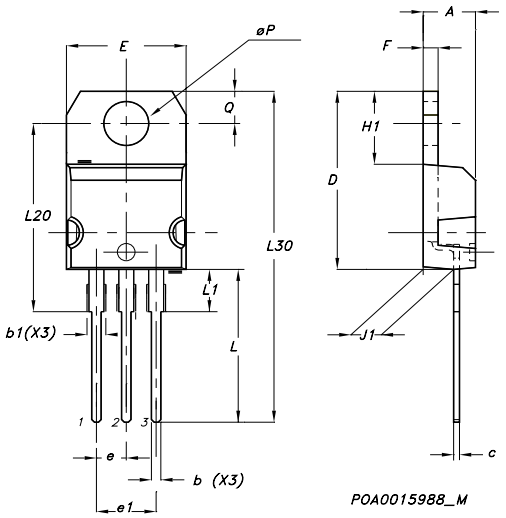



**Figure 20: Gate Charge Test Circuit**



## TO-220 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 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 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.60 | | 0.620 |
| E | 10 | | 10.40 | 0.393 | | 0.409 |
| e | 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 | |
| øP | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |



## TO-247 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 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 |
| c | 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 |
| e | | 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 | |
| øP | 3.55 | | 3.65 | 0.140 | | 0.143 |
| øR | 4.50 | | 5.50 | 0.177 | | 0.216 |
| S | | 5.50 | | | 0.216 | |

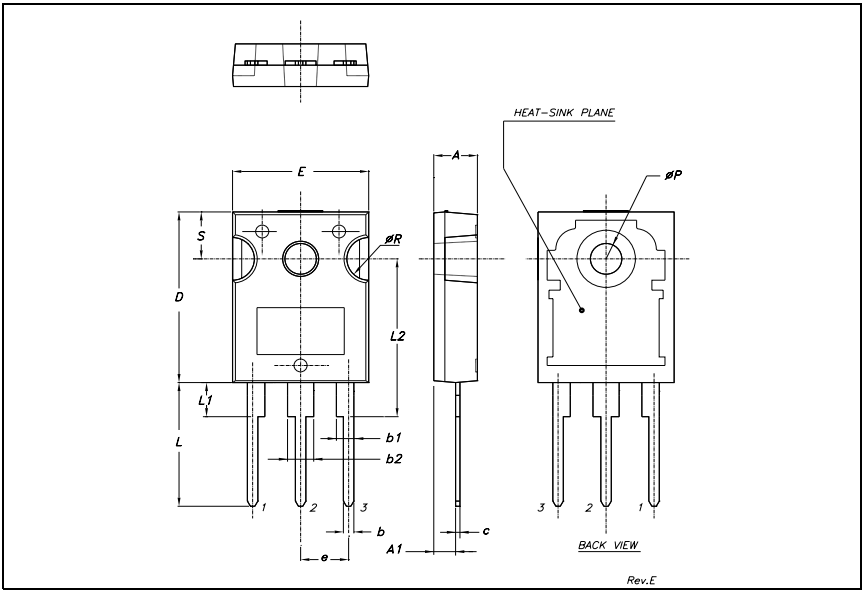


**Table 9: Revision History**

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