# STH165N10F4-2
# STP165N10F4

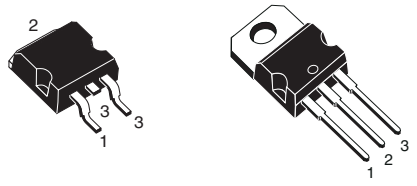
## N-channel 100 V, 4.1 mΩ, 160 A TO-220, H²PAK STripFET™ DeepGATE™ Power MOSFET

**Preliminary data**

## Features

| Type | $V_{DSS}$ | $R_{DS(on)}$ max | $I_D$ |
|---|---|---|---|
| STH165N10F4-2 | 100 V | < 5.1 mΩ | 160 A |
| STP165N10F4 | 100 V | < 5.5 mΩ | 120 A |

- N-channel enhancement mode
- 100% avalanche rated
- Low gate charge
- Very low on-resistance




H²PAK TO-220

## Application

- Switching applications

## Description

This STripFET™ DeepGATE™ Power MOSFET technology is among the latest improvements, which have been especially tailored to minimize on-state resistance, with a new gate structure, providing superior switching performances.

**Figure 1. Internal schematic diagram**

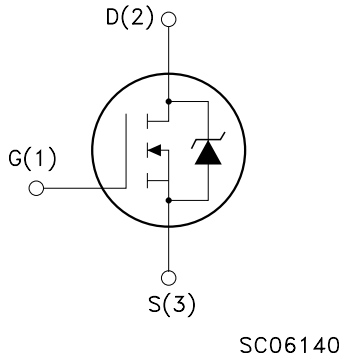



**Table 1. Device summary**

| Order codes | Marking | Package | Packaging |
|---|---|---|---|
| STH165N10F4-2 | 165N10F4 | H²PAK | Tape and reel |
| STP165N10F4 | 165N10F4 | TO-220 | Tube |

# Contents

# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | TO-220 | H²PAK | |
| $V_{DS}$ | Drain-source voltage ($V_{GS}$ = 0) | 100 | | V |
| $V_{GS}$ | Gate- source voltage | ± 20 | | V |
| $I_D$ | Drain current (continuous) at $T_C$ = 25 °C | 120 | 160 | A |
| $I_D$ | Drain current (continuous) at $T_C$ = 100 °C | 110 | 115 | A |
| $I_{DM}$ (1) | Drain current (pulsed) | 480 | 640 | A |
| $P_{TOT}$ | Total dissipation at $T_C$ = 25 °C | 315 | | W |
| | Derating factor | 2.1 | | W/°C |
| $E_{AS}$ (2) | Single pulse avalanche energy | TBD | | J |
| $T_{stg}$ | Storage temperature | – 55 to 175 | | °C |
| $T_j$ | Max. operating junction temperature | 175 | | |

1. Pulse width limited by safe operating area
2. Starting $T_j$ = 25 °C, $I_D$= 45 A, $V_{DD}$= 60 V

**Table 3. Thermal data**

| Symbol | Parameter | Value | | Unit |
|---|---|---|---|---|
| | | TO-220, | H²PAK | |
| $R_{thj\text{-}case}$ | Thermal resistance junction-case max | 0.48 | | °C/W |
| $R_{thj\text{-}pcb}$ | Thermal resistance junction-pcb max | | 35(1) | |
| $R_{thj\text{-}a}$ | Thermal resistance junction-ambient max | 62.5 | | °C/W |
| $T_l$ | Maximum lead temperature for soldering purpose | 315 | | °C |

1. When mounted on FR-4 board of 1 inch², 2 oz Cu

# 2 Electrical characteristics

($T_{CASE}$=25°C unless otherwise specified)

**Table 4. On/off states**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-source Breakdown voltage | $I_D$ = 250 µA, $V_{GS}$ = 0 | 100 | | | V |
| $I_{DSS}$ | Zero gate voltage Drain current ($V_{GS}$ = 0) | $V_{DS}$ = max rating | | | 1 | µA |
| | | $V_{DS}$ = max rating,$T_C$=125 °C | | | 100 | µA |
| $I_{GSS}$ | Gate-body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ± 20 V | | | 100 | nA |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | 2 | | 4 | V |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS}$ = 10 V, $I_D$ = 60 A(1) | | 4.4 | 5.5 | mΩ |
| | | $V_{GS}$ = 10 V, $I_D$ = 80 A(2) | | 4.1 | 5.1 | mΩ |

1. For TO-220
2. For H²PAK

**Table 5. Dynamic**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input capacitance | $V_{DS}$ = 25 V, f = 1 MHz, $V_{GS}$ = 0 | - | 10500 | - | pF |
| $C_{oss}$ | Output capacitance | | | 1170 | | pF |
| $C_{rss}$ | Reverse transfer capacitance | | | 630 | | pF |
| $Q_g$ | Total gate charge | $V_{DD}$ = 50 V, $I_D$ = 120 A, $V_{GS}$ = 10 V *(see Figure 3)* | - | 180 | - | nC |
| $Q_{gs}$ | Gate-source charge | | | TBD | | nC |
| $Q_{gd}$ | Gate-drain charge | | | TBD | | nC |

**Table 6. Switching times**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ = 50 V, $I_D$ = 60 A $R_G$ = 4.7 Ω $V_{GS}$ = 10 V *(see Figure 2)* | - | TBD | - | ns |
| $t_r$ | Rise time | | | TBD | | ns |
| $t_{d(off)}$ | Turn-off-delay time | $V_{DD}$ = 50 V, $I_D$ = 60 A, $R_G$ = 4.7 Ω, $V_{GS}$ = 10 V *(see Figure 2)* | - | TBD | - | ns |
| $t_f$ | Fall time | | | TBD | | ns |

**Table 7. Source drain diode**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{SD}$ | Source-drain current | | - | | 120(1)<br>160(2) | A |
| $I_{SDM}$ (3) | Source-drain current (pulsed) | | - | | 480(1)<br>640(2) | A |
| $V_{SD}$ (4) | Forward on voltage | $I_{SD}$ = 120 A, $V_{GS}$ = 0 | - | | TBD | V |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse recovery time<br>Reverse recovery charge<br>Reverse recovery current | $I_{SD}$ = 120 A,<br>$V_{DD}$ = 25 V<br>di/dt = 100 A/µs,<br>$T_j$ = 150 °C<br>*(see Figure 4)* | - | TBD<br>TBD<br>TBD | | ns<br>nC<br>A |

1. For TO-220
2. For H²PAK
3. Pulse width limited by safe operating area.
4. Pulsed: Pulse duration = 300 µs, duty cycle 1.5%

# 3 Test circuits

**Figure 2. Switching times test circuit for resistive load**

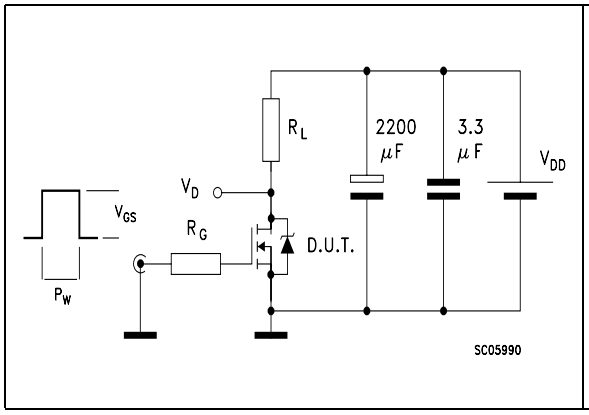



**Figure 3. Gate charge test circuit**

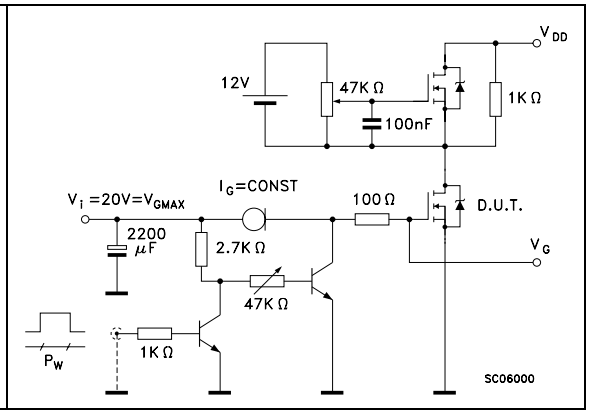



**Figure 4. Test circuit for inductive load switching and diode recovery times**

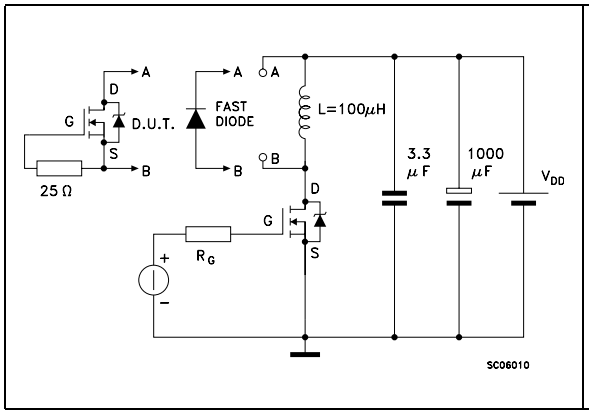



**Figure 5. Unclamped inductive load test circuit**

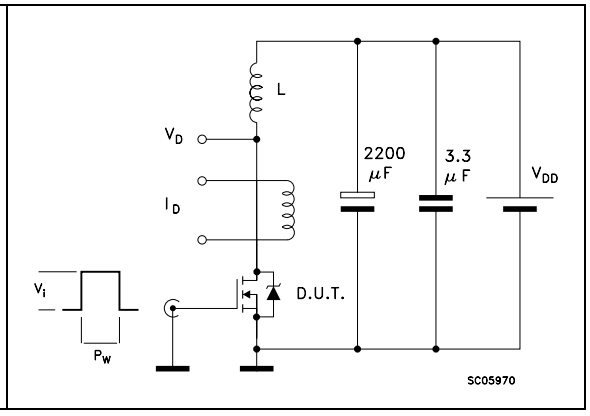



**Figure 6. Unclamped inductive waveform**

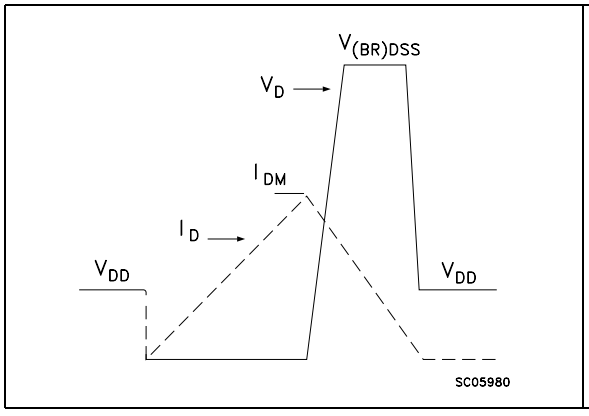
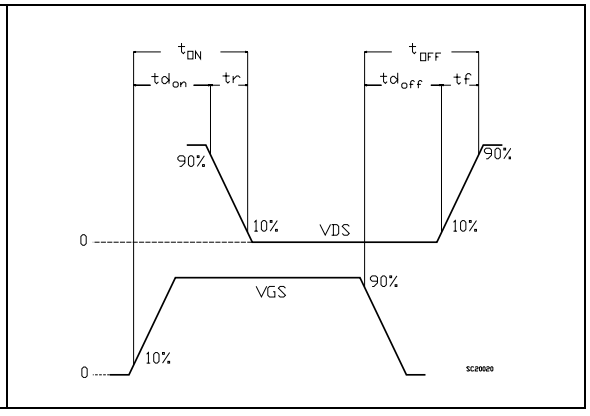



**Figure 7. Switching time waveform**



# 4 Package mechanical data

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## 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 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.48 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.6 | | 0.62 |
| D1 | | 1.27 | | | 0.050 | |
| 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 | | 0.051 |
| 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 | |
| ∅P | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |

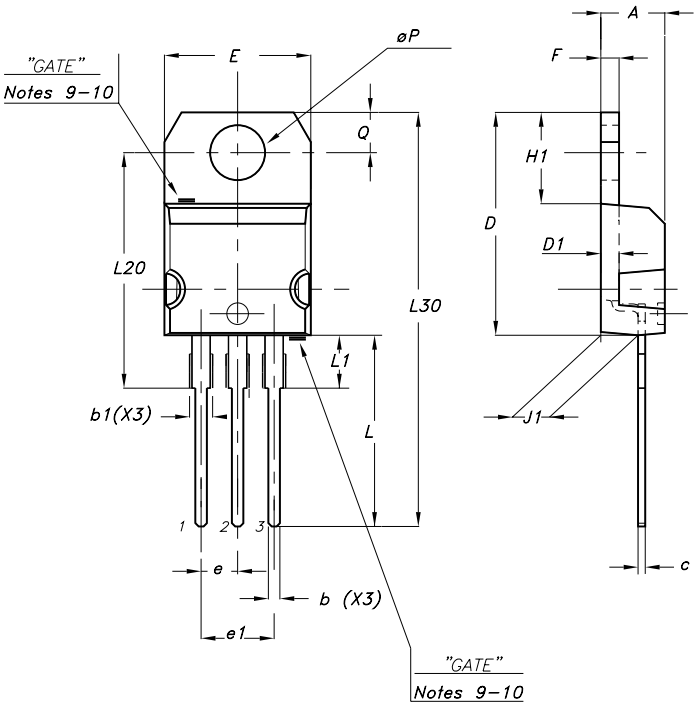


Table 8. H²PAK 2 leads mechanical data

| Dim. | mm | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 4.30 | - | 4.80 |
| A1 | 0.03 | | 0.20 |
| C | 1.17 | | 1.37 |
| e | 4.98 | | 5.18 |
| E | 0.50 | | 0.90 |
| F | 0.78 | | 0.85 |
| H | 10.00 | | 10.40 |
| H1 | 7.171 | | 7.971 |
| L | 15.30 | | 15.80 |
| L1 | 1.27 | | 1.40 |
| L2 | 4.93 | | 5.23 |
| L3 | 7.45 | | 7.85 |
| L4 | 1.5 | | 1.7 |
| M | 2.6 | | 2.9 |
| R | 0.20 | | 0.60 |
| V | 0° | | 8° |

**Figure 8. H²PAK 2 leads drawing**

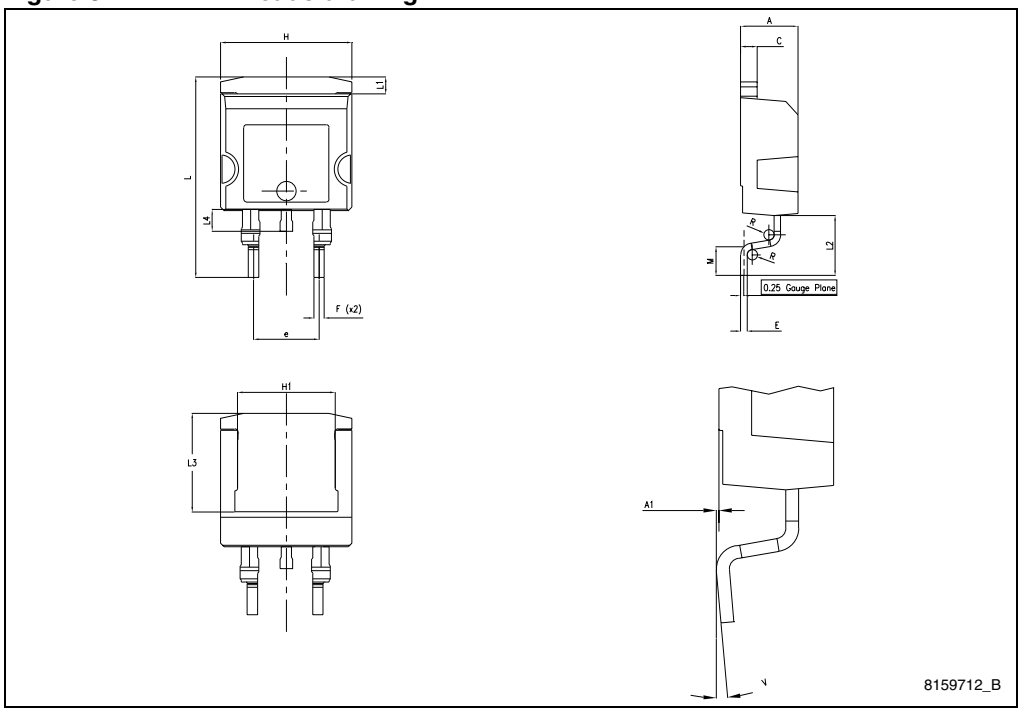
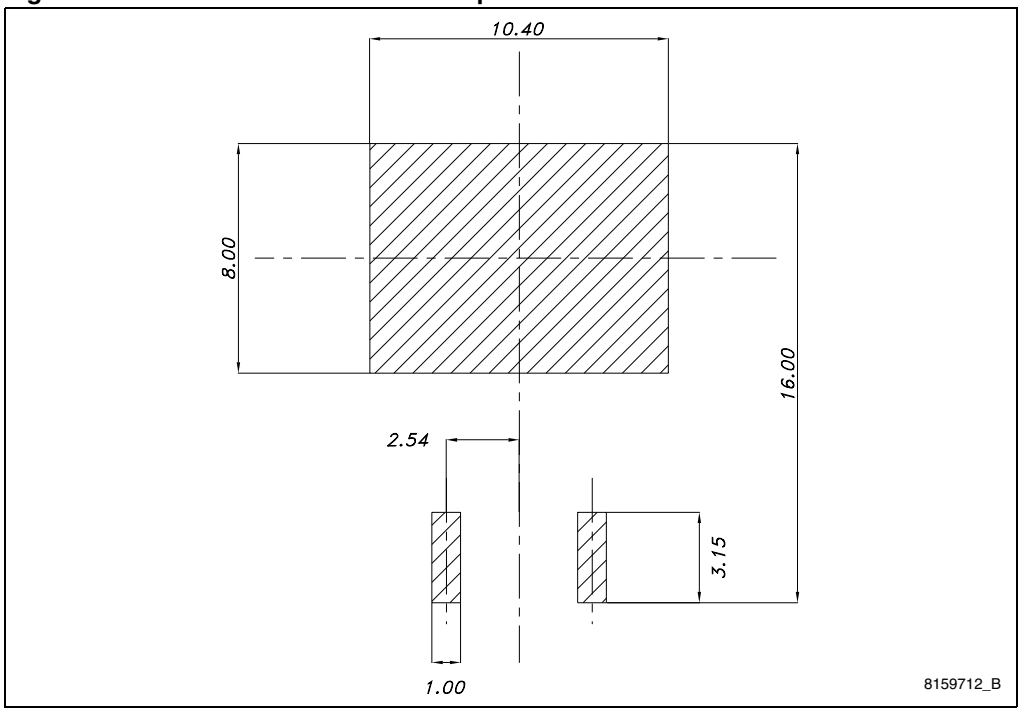



**Figure 9. H²PAK 2 recommended footprint**



# 5 Revision history

Table 9. Document revision history

| Date | Revision | Changes |
|---|---|---|
| 19-May-2009 | 1 | First release |

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