

STW13NK80Z

N-channel 800V - 0.53 Ω - 12A - TO-247 Zener-protected SuperMESH $^{\text{TM}}$ Power MOSFET

General features

| Туре | V _{DSS} | R _{DS(on)} | I _D | p _W |
|------------|------------------|---------------------|----------------|----------------|
| STW13NK80Z | 800V | <0.65Ω | 12A | 230W |

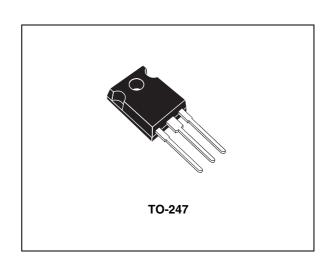
- Extremely high dv/dt capability
- 100% avalanche tested
- Gate charge minimized
- Very low intrinsic capacitances
- Very good manufacturing repeatibility

Description

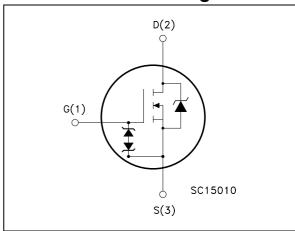
The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

Applications

■ Switching application



Internal schematic diagram



Order codes

| Part n | umber | Marking | Package | Packaging | |
|--------|--------|----------|---------|-----------|--|
| STW13 | BNK80Z | W13NK80Z | TO-247 | Tube | |

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STW13NK80Z Electrical ratings

1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | Unit | |
|--------------------------------|--|--------------|------|--|
| V _{DS} | Drain-source voltage (V _{GS} = 0) | 800 | V | |
| V _{GS} | Gate- source voltage | ± 30 | V | |
| I _D | Drain current (continuous) at T _C = 25°C | 12 | Α | |
| I _D | Drain current (continuous) at T _C = 100°C | 7.6 | Α | |
| I _{DM} ⁽¹⁾ | Drain current (pulsed) | 48 | Α | |
| P _{tot} | Total dissipation at T _C = 25°C | 230 | W | |
| | Derating Factor | 1.85 | W/°C | |
| E _{AS} (2) | Single pulse avalanche energy | 4.5 | mJ | |
| T _{stg} | Storage temperature | EE to 1EO 00 | | |
| T _j | Max. operating junction temperature | 55 to 150 °C | | |

^{1.} Pulse width limited by safe operating area.

Table 2. Thermal data

| Rthj-case | Thermal resistance junction-case max | 0.54 | °C/W |
|-----------|--|------|------|
| Rthj-amb | Thermal resistance junction-ambient max | 50 | °C/W |
| T_J | Maximum lead temperature for soldering purpose | 300 | °C |

Table 3. Avalanche characteristics

| Symbol | Parameter Max value | | | |
|-----------------|---|-----|----|--|
| I _{AR} | Avalanche current, repetitive or not-repetitive (pulse width limited by T _j max) | 12 | Α | |
| E _{AS} | Single pulse avalanche energy (starting $T_j = 25$ °C, $I_D = I_{AR}$, $V_{DD} = 50$ V) | 450 | mJ | |

Table 4. Gate-source zener diode

| Symbol | Parameter | Test conditions | Min. | Тур. | Max. | Unit |
|-------------------|-------------------------------|------------------------|------|------|------|------|
| BV _{GSO} | Gate-source breakdown voltage | Igs=± 1mA (open drain) | 30 | | | V |

^{2.} $I_{SD} \leq 2A$, di/dt $\leq 200A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.

Electrical ratings STW13NK80Z

1.1 Protection features of gate-to-source zener diodes

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

2 Electrical characteristics

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

Table 5. On/off states

| Symbol | Parameter | Test conditions | Min. | Тур. | Max. | Unit |
|----------------------|--|--|------|------|---------|--------------------------|
| V _{(BR)DSS} | Drain-source breakdown voltage | I _D = 1mA, V _{GS} =0 | 800 | | | V |
| I _{DSS} | Zero gate voltage drain current (V _{GS} = 0) | V_{DS} = max rating V_{DS} = max rating, T_{C} = 125°C | | | 1 50 | μ Α μ Α |
| I _{GSS} | Gate-body leakage current (V _{DS} = 0) | V _{GS} = ± 20V | | | ±10 | μА |
| V _{GS(th)} | Gate threshold voltage | $V_{DS} = V_{GS}$, $I_D = 100\mu A$ | 3 | 3.75 | 4.5 | V |
| R _{DS(on)} | Static drain-source on resistance | $V_{GS} = 10V, I_D = 6A$ | | 0.53 | 0.65 | Ω |

Table 6. Dynamic

| Symbol | Parameter | Test conditions | Min. | Тур. | Max. | Unit |
|--|---|---|------|----------------------|------|----------------|
| 9 _{fs} ⁽¹⁾ | Forward transconductance | $V_{DS} = 15V_{,} I_{D} = 6A$ | | 11 | | S |
| C _{iss} C _{oss} C _{rss} | Input capacitance Output capacitance Reverse transfer capacitance | $V_{DS} = 25V, f = 1MHz,$ $V_{GS} = 0$ | | 3480 312 67 | | pF pF pF |
| C _{oss eq} ⁽²⁾ | Equivalent output capacitance | $V_{GS} = 0V, V_{DS} = 0V$ to 720V | | 150 | | pF |
| t _{d(on)} t _r t _{d(off)} t _f | Turn-on delay time Rise time Turn-off delay time Fall time | V_{DD} = 400V, I_{D} = 6A R_{G} = 4.7 Ω V_{GS} = 10V (see <i>Figure 13</i>) | | 33 22 95 55 | | ns ns ns |
| Q _g Q _{gs} Q _{gd} | Total gate charge Gate-source charge Gate-drain charge | $V_{DD} = 640V, I_{D} = 12A,$ $V_{GS} = 10V, R_{G} = 4.7\Omega$ (see <i>Figure 14</i>) | | 115 31 51 | 155 | nC nC nC |

^{1.} Pulsed: Pulse duration = 300 μ s, duty cycle 1.5 %.

^{2.} Coss 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} .

Electrical characteristics STW13NK80Z

Table 7. Source drain diode

| Symbol | Parameter | Test conditions | ons Min. Typ. | | Max. | Unit |
|--------------------------------|--|--|---------------|-----|----------|--------|
| I _{SD} | Source-drain current Source-drain current (pulsed) | | | | 12 48 | A A |
| V _{SD} ⁽²⁾ | Forward on voltage | I _{SD} = 12A, V _{GS} = 0 | | | 1.6 | V |
| t _{rr} | Reverse recovery time | $I_{SD} = 12A$, di/dt = 100A/ μ s, | | 632 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 100V, T_j = 25^{\circ}C$ | | 7.2 | | μС |
| I _{RRM} | Reverse recovery current | (see Figure 15) | | 26 | | Α |
| t _{rr} | Reverse recovery time | $I_{SD} = 12A$, di/dt = 100A/ μ s, | | 805 | | ns |
| Q_{rr} | Reverse recovery charge | $V_{DD} = 100V, T_j = 150^{\circ}C$ | | 10 | | μС |
| I _{RRM} | Reverse recovery current | (see Figure 15) | | 25 | | Α |

^{1.} Pulse width limited by safe operating area.

^{2.} Pulsed: Pulse duration = 300 μ s, duty cycle 1.5 %

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area

Figure 2. Thermal impedance

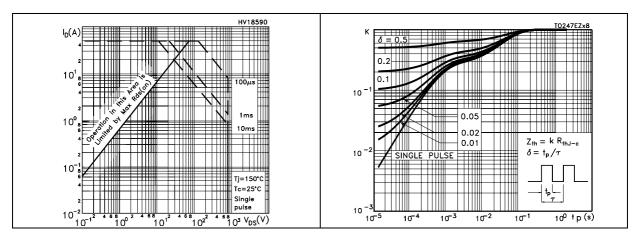


Figure 3. Output characterisics

Figure 4. Transfer characteristics

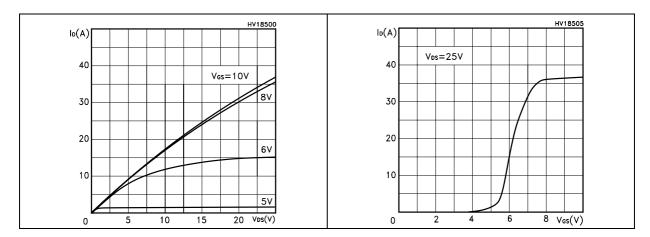
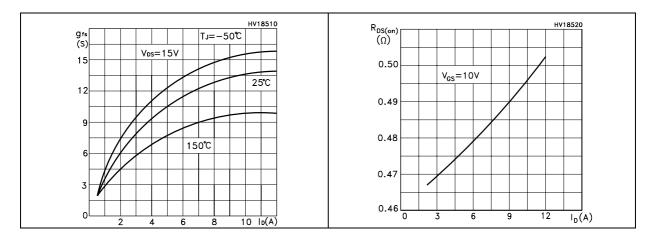


Figure 5. Transconductance

Figure 6. Static drain-source on resistance



Electrical characteristics STW13NK80Z

Figure 7. Gate charge vs gate-source voltage Figure 8. Capacitance variations

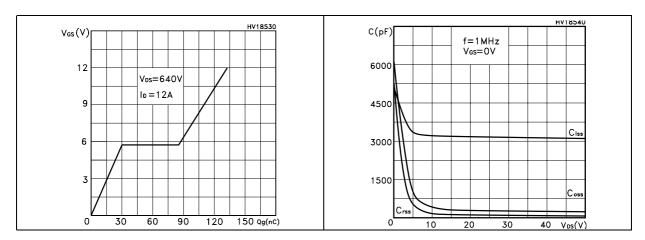


Figure 9. Normalized gate threshold voltage vs temperature

Figure 10. Normalized on resistance vs temperature

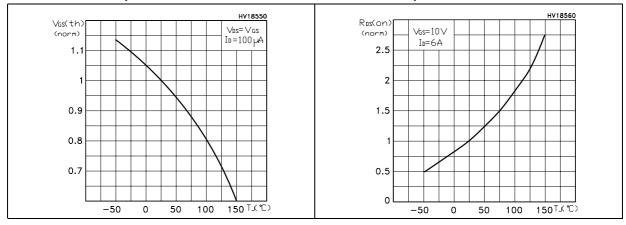
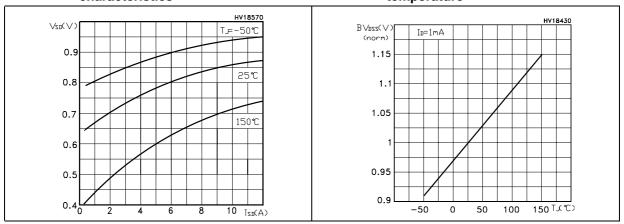


Figure 11. Source-drain diode forward characteristics

Figure 12. Normalized breakdown voltage vs temperature



STW13NK80Z Test circuit

3 Test circuit

Figure 13. Switching times test circuit for resistive load

Figure 14. Gate charge test circuit

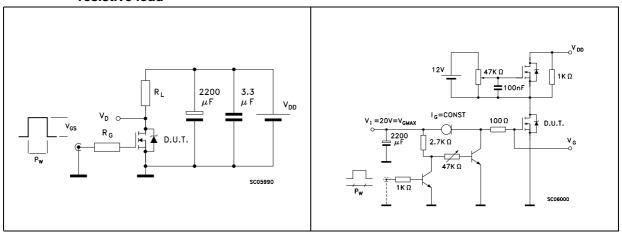
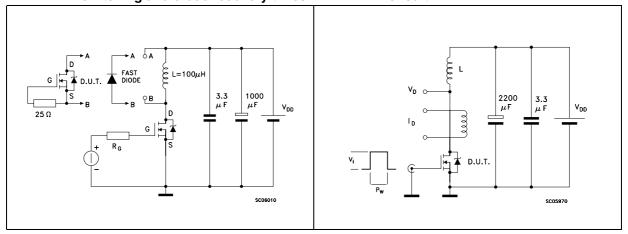


Figure 15. Test circuit for inductive load switching and diode recovery times

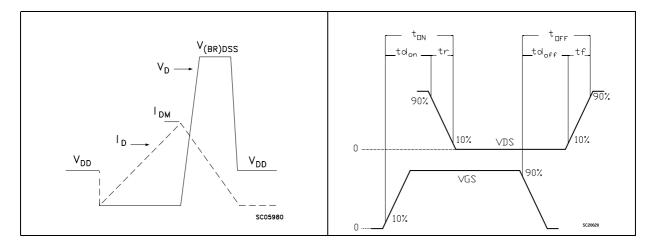
Figure 16. Unclamped Inductive load test circuit



Test circuit STW13NK80Z

Figure 17. Unclamped inductive waveform

Figure 18. Switching time waveform

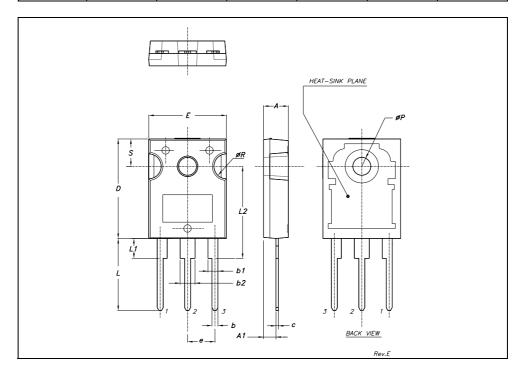


4 Package mechanical data

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: www.st.com

TO-247 MECHANICAL DATA

| DIM. | | mm. | | | inch | |
|-------|-------|-------|-------|-------|-------|-------|
| DINI. | 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 |
| Е | 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 | |



STW13NK80Z Revision history

5 Revision history

Table 8. Revision history

| Date | Revision | Changes |
|-------------|----------|---------------------------------|
| 21-Jun-2004 | 3 | Complete document |
| 17-Oct-2006 | 4 | New template, no content change |

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