

# **STW7NC80Z**

## **N-CHANNEL 800V - 1.5Ω - 6A TO-247**

### **Zener-Protected PowerMESH™III MOSFET**

| TYPE      | V <sub>DSS</sub> | R <sub>D(on)</sub> | I <sub>D</sub> |
|-----------|------------------|--------------------|----------------|
| STW7NC80Z | 800 V            | < 1.8Ω             | 6A             |

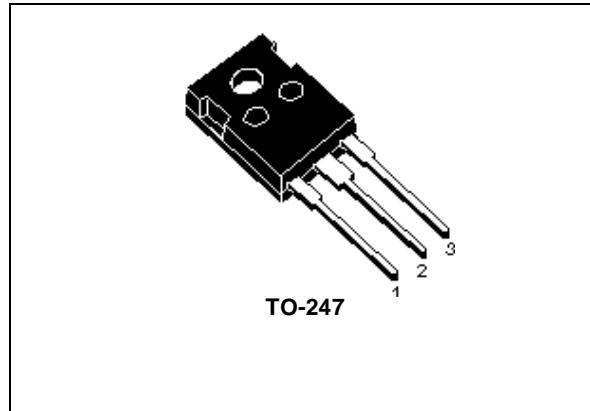
- TYPICAL R<sub>D(on)</sub> = 1.5Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- GATE-TO-SOURCE ZENER DIODES
- 100% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED

#### **DESCRIPTION**

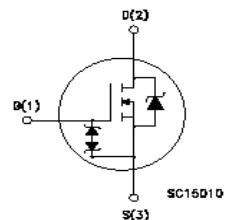
The third generation of MESH OVERLAY™ Power MOSFETs for very high voltage exhibits unsurpassed on-resistance per unit area while integrating back-to-back Zener diodes between gate and source. Such arrangement gives extra ESD capability with higher ruggedness performance as requested by a large variety of single-switch applications.

#### **APPLICATIONS**

- SINGLE-ENDED SMPS IN MONITORS,  
COMPUTER AND INDUSTRIAL APPLICATION
- WELDING EQUIPMENT



**INTERNAL SCHEMATIC DIAGRAM**



#### **ABSOLUTE MAXIMUM RATINGS**

| Symbol                | Parameter   | Value      | Unit |
|-----------------------|---|------------|------|
| V <sub>DS</sub>       | Drain-source Voltage (V <sub>GS</sub> = 0)          | 800        | V    |
| V <sub>DGR</sub>      | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)        | 800        | V    |
| V <sub>GS</sub>       | Gate- source Voltage                                | ±25        | V    |
| I <sub>D</sub>        | Drain Current (continuos) at T <sub>C</sub> = 25°C  | 6          | A    |
| I <sub>D</sub>        | Drain Current (continuos) at T <sub>C</sub> = 100°C | 3.8        | A    |
| I <sub>DM</sub> (•)   | Drain Current (pulsed)                              | 24         | A    |
| P <sub>TOT</sub>      | Total Dissipation at T <sub>C</sub> = 25°C          | 160        | W    |
|                       | Derating Factor                                     | 1.28       | W/°C |
| I <sub>GS</sub>       | Gate-source Current                                 | ±50        | mA   |
| V <sub>ESD(G-S)</sub> | Gate source ESD(HBM-C=100pF, R=15KΩ)                | 3          | kV   |
| dv/dt (1)             | Peak Diode Recovery voltage slope                   | 3          | V/ns |
| T <sub>stg</sub>      | Storage Temperature                                 | -65 to 150 | °C   |
| T <sub>j</sub>        | Max. Operating Junction Temperature                 | 150        | °C   |

(•)Pulse width limited by safe operating area

(1)I<sub>SD</sub> ≤ 6A, di/dt ≤ 100A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>.

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### THERMAL DATA

|                |  |      |      |
|----------------|--|------|------|
| Rthj-case      | Thermal Resistance Junction-case Max           | 0.78 | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient Max        | 30   | °C/W |
| Rthc-sink      | Thermal Resistance Case-sink Typ               | 0.1  | °C/W |
| T <sub>I</sub> | Maximum Lead Temperature For Soldering Purpose | 300  | °C   |

### AVALANCHE CHARACTERISTICS

| Symbol          | Parameter   | Max Value | Unit |
|-----------------|---|-----------|------|
| I <sub>AR</sub> | Avalanche Current, Repetitive or Not-Repetitive<br>(pulse width limited by T <sub>j</sub> max)                                | 6         | A    |
| E <sub>AS</sub> | Single Pulse Avalanche Energy<br>(starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 50 V) | 250       | mJ   |

### ELECTRICAL CHARACTERISTICS (TCASE = 25 °C UNLESS OTHERWISE SPECIFIED) OFF

| Symbol                              | Parameter   | Test Conditions   | Min. | Typ. | Max.    | Unit     |
|-------------------------------------|---|---|------|------|---------|----------|
| V <sub>(BR)DSS</sub>                | Drain-source Breakdown Voltage                        | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0  | 800  |      |         | V        |
| ΔBV <sub>DSS</sub> /ΔT <sub>J</sub> | Breakdown Voltage Temp. Coefficient                   | I <sub>D</sub> = 1 mA, V <sub>GS</sub> = 0  |      | 0.9  |         | V/°C     |
| I <sub>DSS</sub>                    | Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0) | V <sub>DS</sub> = Max Rating<br>V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C |      |      | 1<br>50 | μA<br>μA |
| I <sub>GSS</sub>                    | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ±20V  |      |      | ±10     | μA       |

### ON (1)

| Symbol               | Parameter                         | Test Conditions   | Min. | Typ. | Max. | Unit |
|----------------------|-----------------------------------|---|------|------|------|------|
| V <sub>GS(th)</sub>  | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                               | 3    | 4    | 5    | V    |
| R <sub>DSS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10V, I <sub>D</sub> = 3A  |      | 1.5  | 1.8  | Ω    |
| I <sub>D(on)</sub>   | On State Drain Current            | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DSS(on)max</sub> ,<br>V <sub>GS</sub> = 10V | 6    |      |      | A    |

### DYNAMIC

| Symbol              | Parameter                    | Test Conditions   | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|---|------|------|------|------|
| g <sub>fs</sub> (1) | Forward Transconductance     | V <sub>DS</sub> > I <sub>D(on)</sub> × R <sub>DSS(on)max</sub> ,<br>I <sub>D</sub> = 3A |      | 7    |      | S    |
| C <sub>iss</sub>    | Input Capacitance            |   |      | 1600 |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |   |      | 125  |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance | V <sub>DS</sub> = 25V, f = 1 MHz, V <sub>GS</sub> = 0                                   |      | 12   |      | pF   |

**ELECTRICAL CHARACTERISTICS (CONTINUED)****SWITCHING ON (RESISTIVE LOAD)**

| <b>Symbol</b> | <b>Parameter</b>   | <b>Test Conditions</b>  | <b>Min.</b> | <b>Typ.</b> | <b>Max.</b> | <b>Unit</b> |
|---------------|--------------------|---|-------------|-------------|-------------|-------------|
| $t_{d(on)}$   | Turn-on Delay Time | $V_{DD} = 400V, I_D = 3A$                                       |             | 26          |             | ns          |
| $t_r$         | Rise Time          | $R_G = 4.7\Omega, V_{GS} = 10V$<br>(see test circuit, Figure 3) |             | 10          |             | ns          |
| $Q_g$         | Total Gate Charge  | $V_{DD} = 640V, I_D = 6 A,$                                     |             | 45          |             | nC          |
| $Q_{gs}$      | Gate-Source Charge | $V_{GS} = 10V$  |             | 12          |             | nC          |
| $Q_{gd}$      | Gate-Drain Charge  |   |             | 19          |             | nC          |

**SWITCHING OFF (INDUCTIVE LOAD)**

| <b>Symbol</b> | <b>Parameter</b>      | <b>Test Conditions</b>          | <b>Min.</b> | <b>Typ.</b> | <b>Max.</b> | <b>Unit</b> |
|---------------|-----------------------|---------------------------------|-------------|-------------|-------------|-------------|
| $t_{r(Voff)}$ | Off-voltage Rise Time | $V_{DD} = 640V, I_D = 6 A,$     |             | 11          |             | ns          |
| $t_f$         | Fall Time             | $R_G = 4.7\Omega, V_{GS} = 10V$ |             | 13          |             | ns          |
| $t_c$         | Cross-over Time       | (see test circuit, Figure 5)    |             | 19          |             | ns          |

**SOURCE DRAIN DIODE**

| <b>Symbol</b> | <b>Parameter</b>              | <b>Test Conditions</b>             | <b>Min.</b> | <b>Typ.</b> | <b>Max.</b> | <b>Unit</b> |
|---------------|-------------------------------|------------------------------------|-------------|-------------|-------------|-------------|
| $I_{SD}$      | Source-drain Current          |                                    |             |             | 6           | A           |
| $I_{SDM}(2)$  | Source-drain Current (pulsed) |                                    |             |             | 24          | A           |
| $V_{SD}(1)$   | Forward On Voltage            | $I_{SD} = 6 A, V_{GS} = 0$         |             |             | 1.6         | V           |
| $t_{rr}$      | Reverse Recovery Time         | $I_{SD} = 6 A, di/dt = 100A/\mu s$ |             | 850         |             | ns          |
| $Q_{rr}$      | Reverse Recovery Charge       | $V_{DD} = 100V, T_j = 150^\circ C$ |             | 8.1         |             | $\mu C$     |
| $I_{RRM}$     | Reverse Recovery Current      | (see test circuit, Figure 5)       |             | 19          |             | A           |

**GATE-SOURCE ZENER DIODE**

| <b>Symbol</b> | <b>Parameter</b>              | <b>Test Conditions</b>          | <b>Min.</b> | <b>Typ.</b> | <b>Max.</b> | <b>Unit</b>        |
|---------------|-------------------------------|---------------------------------|-------------|-------------|-------------|--------------------|
| $BV_{GSO}$    | Gate-Source Breakdown Voltage | $I_{GS} = \pm 1mA$ (Open Drain) | 25          |             |             | V                  |
| $\alpha T$    | Voltage Thermal Coefficient   | $T = 25^\circ C$ Note(3)        |             | 1.3         |             | $10^{-4}/^\circ C$ |
| $R_z$         | Dynamic Resistance            | $I_{GS} = 50 mA$                |             | 90          |             | $\Omega$           |

Note: 1. Pulsed: Pulse duration = 300  $\mu s$ , duty cycle 1.5 %.

2. Pulse width limited by safe operating area.

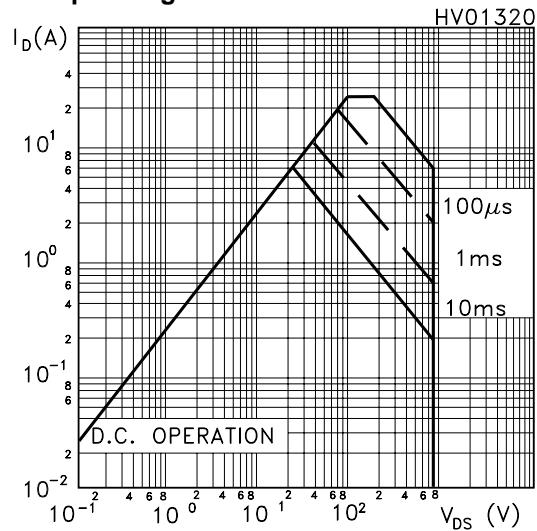
3.  $\Delta V_{BV} = \alpha T (25^\circ - T) BV_{GSO}(25^\circ)$

**PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES**

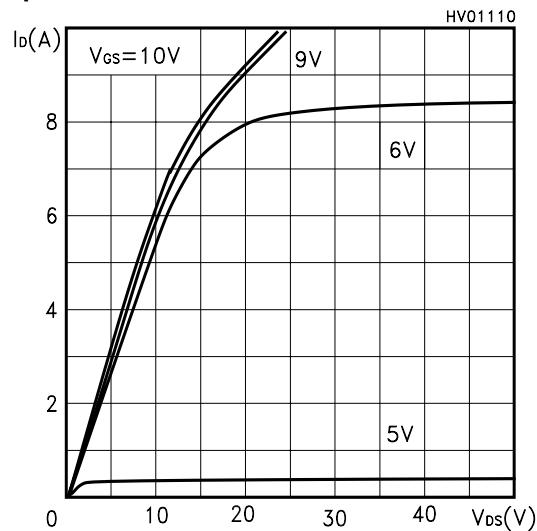
The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the 25V Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

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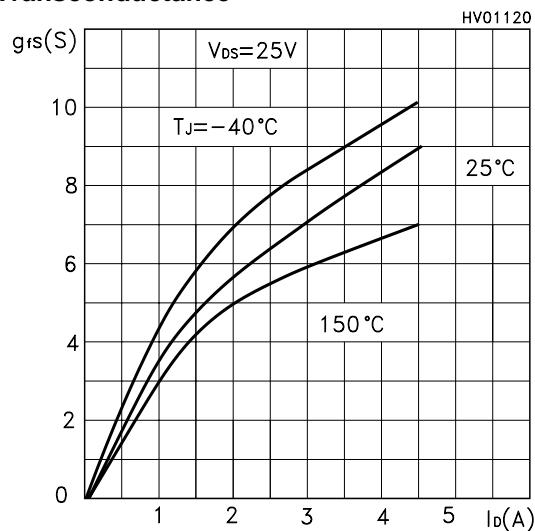
### Safe Operating Area



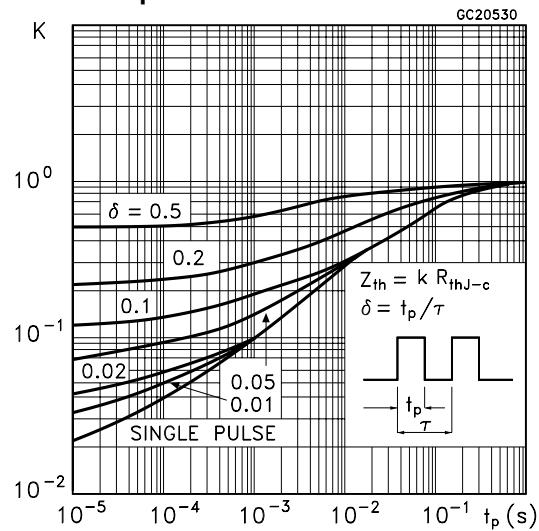
### Output Characteristics



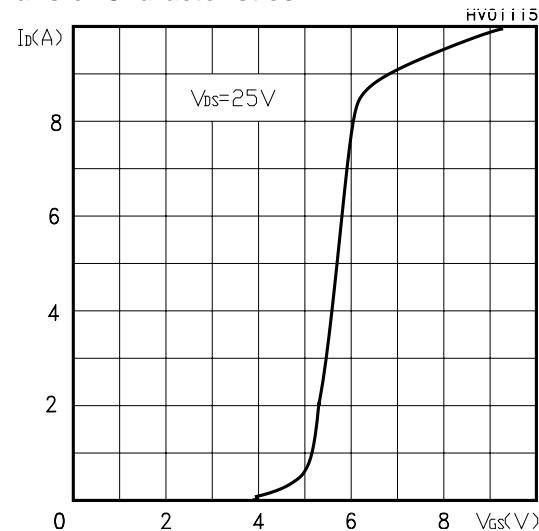
### Transconductance



### Thermal Impedance



### Transfer Characteristics



### Static Drain-source On Resistance

