

## TSC-NSD-XX-YY-ZZZZ

# GaN THz Nano-Schottky Diode Series

### Product Description

The TSC-NSD is a GaN nanoscale Schottky diode fabricated using Teledyne's high-frequency, high-power GaN-on-SiC MMIC process. The scaled Schottky contact offers > 1.5 THz cutoff frequency, while maintaining > 60V reverse break down. Various diode configurations (single, series, anti-parallel, quad, T-shaped) and anode peripheries (10  $\mu\text{m}$  to 720  $\mu\text{m}$ ) are available. The NSD diode has a 0.7 V turn-on voltage and a forward current of 0.6 A/mm at 1.3V with a low series resistance of 0.27 Ohm $\cdot$ mm. Max diode current is above 1 A/mm with a max forward voltage of +4V. The total zero-bias capacitance is 380 fF/mm and a large 3:1 on-off capacitance ratio is achieved from +0.5V forward bias to -10V reverse bias.

### Features

- ◆ Low zero-bias capacitance ( $C_{to}$ ): 3.8 fF (min) – 274 fF (max)
- ◆ Low series resistance ( $R_s$ ): 1.0  $\Omega$  (min) – 53  $\Omega$  (max)
- ◆ High cutoff frequency ( $F_c = 1/2\pi R_s \cdot C_{to}$ ): >1THz
- ◆ High breakdown voltage (BV): >60V
- ◆ Various diode configurations: single, series, anti-parallel, quad, T-shaped
- ◆ Anode peripheries: 10  $\mu\text{m}$  (min) – 720  $\mu\text{m}$  (max)
- ◆ Chip size: 150  $\mu\text{m}$   $\times$  290  $\mu\text{m}$  (min) – 760  $\mu\text{m}$   $\times$  240  $\mu\text{m}$  (max)
- ◆ 10- $\mu\text{m}$ -thick Au bond pads: 50  $\mu\text{m}$   $\times$  75  $\mu\text{m}$  (small), 150  $\mu\text{m}$   $\times$  150  $\mu\text{m}$  (large)
- ◆ Fully passivated with SiN & BCB
- ◆ Flip chip and beamlead geometry
- ◆ MMIC backend process available for integrated passives and vias
- ◆ Diodes can be monolithically integrated with GaN HEMTs.

### Applications (Microwave to Millimeter-wave)

- ◆ Frequency Multipliers
- ◆ Mixers
- ◆ Detectors

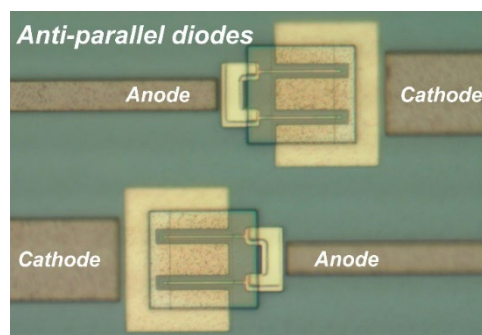



Figure 1 – GaN nano-Schottky diode with anti-parallel configuration.

### Ordering information

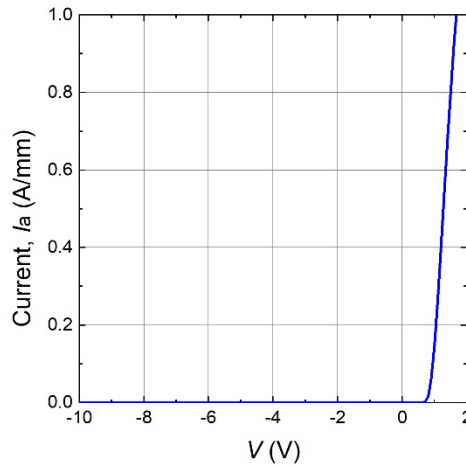
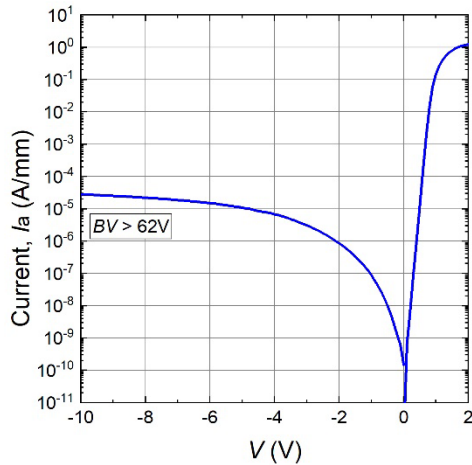
| PART NUMBER        | DESCRIPTION  | <b>CAUTION</b><br>DEVICE SUSCEPTIBLE TO<br>DAMAGE BY ELECTROSTATIC<br>DISCHARGE (ESD)  |
|--------------------|--|---|
| TSC-NSD-SM-S-0105  | Small single diode with 1 $\times$ 5 $\mu\text{m}$ anode     |   |
| TSC-NSD-ST-AP-0215 | Standard antiparallel diode with 2 $\times$ 15 $\mu\text{m}$ |   |

For more information, please contact [TSI.Electronics@teledyne.com](mailto:TSI.Electronics@teledyne.com)

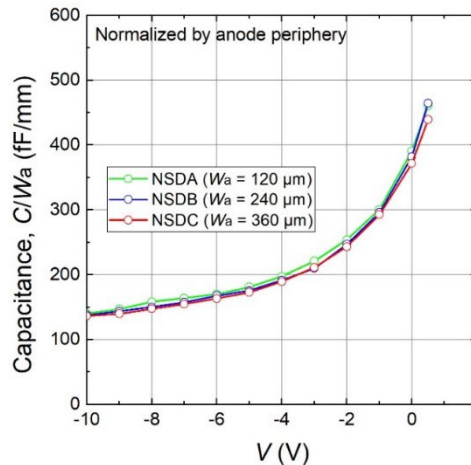
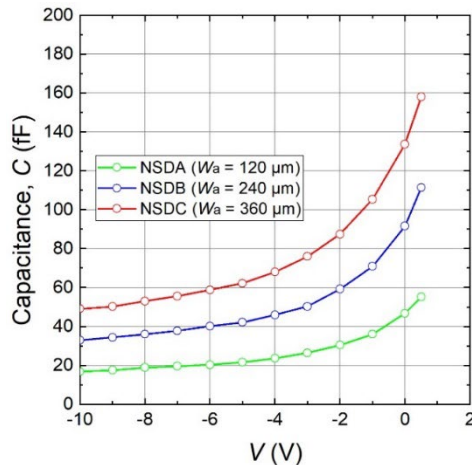
### Typical Device Parameters

| Parameters                           | Test Conditions               | Typ.                | Units                  | Typ. | Units         |
|--------------------------------------|-------------------------------|---------------------|------------------------|------|---------------|
| Anode periphery ( $W_a$ )            |                               | Normalized by $W_a$ |                        | 120  | $\mu\text{m}$ |
| Junction Capacitance ( $C_{jo}$ )    | $V = 0\text{V}$               | 280                 | fF/mm                  | 33.6 | fF            |
| Total Capacitance ( $C_{to}$ )       | $V = 0\text{V}$               | 380                 | fF/mm                  | 45.6 | fF            |
| Capacitance ratio (0V/-10V)          |                               | 2.9                 | NA                     | 2.9  | NA            |
| Series Resistance ( $R_s$ )          | $V = 0\text{V}$               | 0.27                | $\Omega\cdot\text{mm}$ | 2.25 | $\Omega$      |
| Turn-on Voltage ( $V_{on}$ )         | $I = 10\text{ mA/mm}$         | 0.7                 | V                      | 0.7  | V             |
| Reverse Breakdown voltage ( $BV.R$ ) | $I = 1\text{ mA/mm}$          | 62                  | V                      | 62   | V             |
| Forward Breakdown voltage ( $BV.F$ ) |                               | >4                  | V                      | >4   | V             |
| Cutoff Frequency ( $F_c$ )           | $= 1/(2\pi R_s \cdot C_{to})$ | 1.56                | THz                    | 1.56 | THz           |

### Typical I-V Characteristics



### Typical C-V Characteristics



### Available Configurations

|                        | Chip ( $\mu\text{m}$ ) |       | Pads ( $\mu\text{m}$ ) |       | Length ( $\mu\text{m}$ ) | 5 | 15 | 15 | 45 | 15 | 45 | 30 | 45 |
|------------------------|------------------------|-------|------------------------|-------|--------------------------|---|----|----|----|----|----|----|----|
|                        | Length                 | Width | Length                 | Width | Fingers                  | 1 | 1  | 2  | 1  | 4  | 2  | 4  | 4  |
| Small Single           | 290                    | 150   | 50                     | 75    |                          | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Standard Single        | 540                    | 240   | 150                    | 150   |                          |   |    | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Beam Lead Single       | 290                    | 150   | 200                    | 75    |                          | ✓ | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Small Antiparallel     | 290                    | 150   | 50                     | 75    |                          | ✓ | ✓  | ✓  | ✓  |    | ✓  |    |    |
| Standard Antiparallel  | 540                    | 240   | 150                    | 150   |                          |   |    | ✓  | ✓  | ✓  | ✓  |    |    |
| Beam Lead Antiparallel | 290                    | 150   | 200                    | 75    |                          | ✓ | ✓  | ✓  | ✓  |    | ✓  |    |    |
| Small T-shaped         | 470                    | 150   | 50                     | 75    |                          |   | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Standard T-shaped      | 760                    | 240   | 150                    | 150   |                          |   |    | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Small Series           | 470                    | 150   | 50                     | 75    |                          |   | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Standard Series        | 760                    | 240   | 150                    | 150   |                          |   |    | ✓  | ✓  | ✓  | ✓  | ✓  | ✓  |
| Quat (Ring)            | 510                    | 510   | 150                    | 150   |                          |   |    | ✓  |    | ✓  | ✓  |    | ✓  |

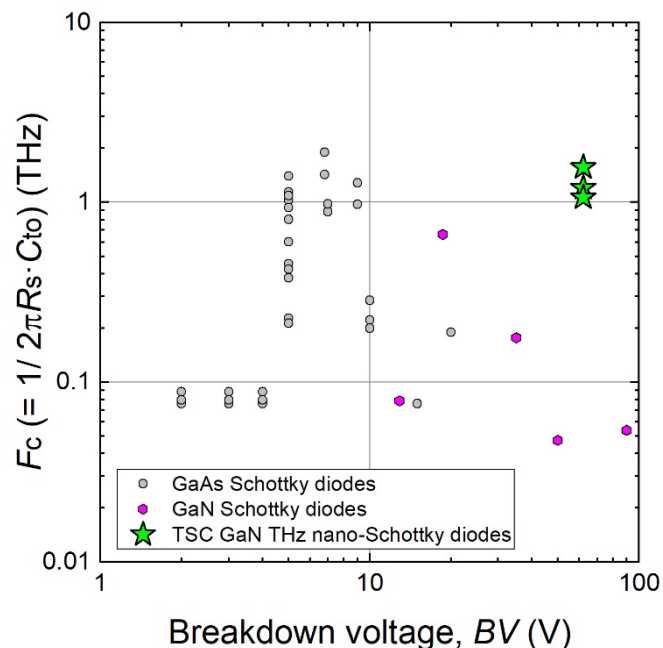
Part number: TSC-NSD-XX-YY-ZZZZ

XX: Small (SM), Standard (ST), Beam Lead (BL)

YY: Single (S), Antiparallel (A), Series (SR), Tee (T), Quad/Ring (Q)

ZZZZ: Finger/Length (i.e. 0115)

### Comparison with Other Technologies



**Model: TSC-NSD-SM-S-0115**

