

# Enhancement Mode Gallium Nitride (GaN) HEMT

650 V, 16 mΩ, 102 A, TOLT

## Preliminary Document NTBT023N65GN1

### Features

- Low  $R_{DS(ON)}$  to Minimize Conduction Losses
- Ultra Low Gate Charge for High Speed Switching
- FOM- $Q_G = 282 \text{ nC}^* \text{ m}\Omega$
- TOLT Top Cool Package
- Pb-Free, Halogen Free and RoHS Compliant

### Typical Applications

- High Density Power Modules
- High Performance PSU for Data Center and Industrial
- Telecom Power Supplies

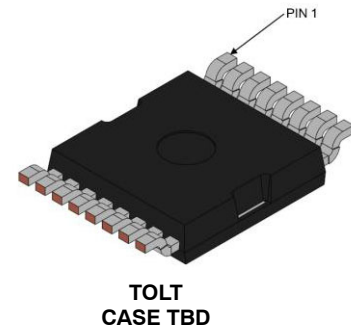
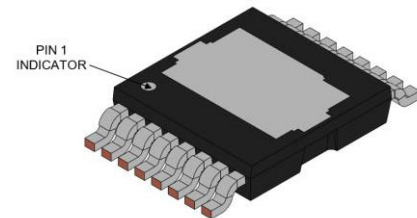
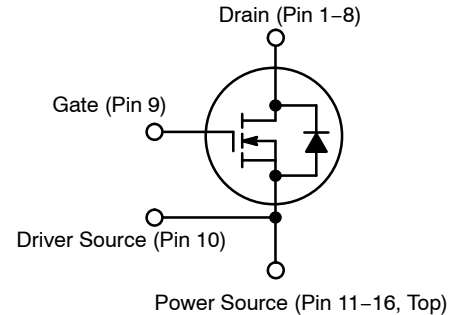
### MAXIMUM RATINGS ( $T_J = 25 \text{ }^\circ\text{C}$ unless otherwise noted)

| Parameter  | Symbol          | Value      | Unit             |
|--|-----------------|------------|------------------|
| Drain-to-Source Voltage  | $V_{DSS}$       | 650        | V                |
| Drain-to-Source Transient Voltage,<br>$t_P < 200 \text{ }\mu\text{s}$  | $V_{DS(TRAN)}$  | 800        | V                |
| Gate-to-Source Voltage   | $V_{GS}$        | -6 to 7    | V                |
| Gate-to-Source Transient Voltage,<br>$t_P = 50 \text{ ns}$ , $f_P = 100 \text{ kHz}$ , open drain                                    | $V_{GS(PULSE)}$ | -20 to 10  | V                |
| Continuous Drain Current,<br>$T_{CASE} = 25 \text{ }^\circ\text{C}$<br>$T_{CASE} = 100 \text{ }^\circ\text{C}$                       | $I_{DS}$        | 102<br>70  | A                |
| Pulsed Drain Current,<br>$t_P < 10 \text{ }\mu\text{s}$ ,<br>$T_J = 25 \text{ }^\circ\text{C}$<br>$T_J = 125 \text{ }^\circ\text{C}$ | $I_{DS(PULSE)}$ | 175<br>104 | A                |
| Power Dissipation, $V_{GS} = 6 \text{ V}$ ,<br>$T_{CASE} = 25 \text{ }^\circ\text{C}$  | $P_{TOT}$       | 480        | W                |
| Operating Junction Temperature   | $T_J$           | -55 to 150 | $^\circ\text{C}$ |
| Storage Temperature  | $T_{STG}$       | -55 to 150 | $^\circ\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

| $V_{(BR)DSS}$ | $R_{DS(ON)}$ TYP | $I_{DS}$ MAX |
|---------------|------------------|--------------|
| 650 V         | 16 mΩ            | 102 A        |

### TOP THERMAL PAD – SOURCE



### ORDERING INFORMATION

See detailed ordering and shipping information on page 3 of this data sheet.

This Preliminary document is for informational purposes only. onsemi may update or withdraw it without notice. Content and referenced products are under development and subject to change.

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## THERMAL CHARACTERISTICS

| Parameter                            | Symbol          | Value | Unit                        |
|--------------------------------------|-----------------|-------|-----------------------------|
| Junction-to-Cases                    | $R_{\theta JC}$ | 0.26  | $^{\circ}\text{C}/\text{W}$ |
| Junction-to-Ambient (Note 1)         | $R_{\theta JA}$ | 48    | $^{\circ}\text{C}/\text{W}$ |
| Maximum Soldering Temperature (MSL3) | $T_{SLD}$       | 260   | $^{\circ}\text{C}$          |

1. Device on 1 in<sup>2</sup>, 2 oz copper pad on single layer FR-4 PCB

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^{\circ}\text{C}$ unless otherwise specified)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|-----------|--------|-----------------|-----|-----|-----|------|
|-----------|--------|-----------------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                   |               |   |     |     |     |               |
|-----------------------------------|---------------|---|-----|-----|-----|---------------|
| Drain-to-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS} = 0\text{ V}$   | 650 |     |     | V             |
| Drain-to-Source Leakage Current   | $I_{DSS}$     | $V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}$                            |     | 10  | TBD | $\mu\text{A}$ |
|                                   |               | $V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}, T_J = 125^{\circ}\text{C}$ |     | 113 |     |               |
| Gate-to-Source Leakage Current    | $I_{GSS}$     | $V_{GS} = 6\text{ V}, V_{DS} = 0\text{ V}$                              |     | 284 | TBD | $\mu\text{A}$ |
|                                   |               | $V_{GS} = 6\text{ V}, V_{DS} = 0\text{ V}, T_J = 125^{\circ}\text{C}$   |     | TBD |     | $\mu\text{A}$ |

### ON CHARACTERISTICS

|                               |              |  |  |     |    |                  |
|-------------------------------|--------------|--|--|-----|----|------------------|
| Drain-to-Source On Resistance | $R_{DS(ON)}$ | $V_{GS} = 6\text{ V}, I_{DS} = 26\text{ A}$                            |  | 16  | 21 | $\text{m}\Omega$ |
|                               |              | $V_{GS} = 6\text{ V}, I_{DS} = 26\text{ A}, T_J = 125^{\circ}\text{C}$ |  | 31  |    |                  |
| Gate Threshold Voltage        | $V_{GS(TH)}$ | $V_{DS} = V_{GS}, I_{DS} = 100\text{ mA}, T_J = 25^{\circ}\text{C}$    |  | 1.6 |    | V                |
|                               |              | $V_{DS} = V_{GS}, I_{DS} = 100\text{ mA}, T_J = 125^{\circ}\text{C}$   |  | 1.5 |    |                  |

### DYNAMIC CHARACTERISTICS

|                                    |               |  |  |      |  |               |
|------------------------------------|---------------|--|--|------|--|---------------|
| Input Capacitance                  | $C_{ISS}$     | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$       |  | 791  |  | $\text{pF}$   |
| Output Capacitance                 | $C_{OSS}$     |  |  | 266  |  |               |
| Reverse Transfer Capacitance       | $C_{RSS}$     |  |  | 2.5  |  |               |
| Output Capacitance, Energy Related | $C_{OSS(ER)}$ | $V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$          |  | 386  |  | $\text{pF}$   |
| Output Capacitance, Time Related   | $C_{OSS(TR)}$ |  |  | 503  |  |               |
| Output Charge                      | $Q_{OSS}$     |  |  | 201  |  | $\text{nC}$   |
| Output Capacitance Stored Energy   | $E_{OSS}$     |  |  | 30.9 |  | $\mu\text{J}$ |
| Gate Resistance                    | $R_G$         | $f = 5\text{ MHz}$   |  | 4    |  | $\Omega$      |
| Gate Charge                        | $Q_G$         | $V_{DS} = 400\text{ V}, I_{DS} = 26\text{ A}, V_{GS} = 0/6\text{ V}$ |  | 17.6 |  | $\text{nC}$   |
| Gate-to-Source Charge              | $Q_{GS}$      |  |  | 1.7  |  |               |
| Gate-to-Drain Charge               | $Q_{GD}$      |  |  | 6.3  |  |               |
| Gate Plateau Voltage               | $V_{PLAT}$    |  |  | 2.1  |  | V             |

### SWITCHING CHARACTERISTICS

|                     |              |   |  |     |  |    |
|---------------------|--------------|---|--|-----|--|----|
| Turn-On Delay Time  | $t_{D(ON)}$  | $V_{DS} = 400\text{ V}, I_{DS} = 26\text{ A}, V_{GS} = 0/6\text{ V}, R_G = 10\ \Omega, R_{G,OFF} = 2.2\ \Omega$ |  | TBD |  | ns |
| Turn-Off Delay Time | $t_{D(OFF)}$ |   |  | TBD |  | ns |
| Turn-On Rise Time   | $t_R$        |   |  | TBD |  | ns |
| Turn-Off Fall Time  | $t_F$        |   |  | TBD |  | ns |

### REVERSE CONDUCTION CHARACTERISTICS

|                                 |          |  |  |     |  |   |
|---------------------------------|----------|--|--|-----|--|---|
| Source-to-Drain Reverse Voltage | $V_{SD}$ | $V_{GS} = -2\text{ V}, I_{SD} = 26\text{ A}$ |  | 4.4 |  | V |
|                                 |          | $V_{GS} = 0\text{ V}, I_{SD} = 26\text{ A}$  |  | 2.4 |  |   |
|                                 |          | $V_{GS} = 6\text{ V}, I_{SD} = 26\text{ A}$  |  | 0.4 |  |   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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## Gate Drive Guidelines

This GaN device utilizes a Schottky gate structure, which behaves similarly to a MOSFET with a purely capacitive input and does not require continuous gate current during the on-state. For optimal performance, apply a low-impedance gate driver with appropriate gate resistance to control switching speed and limit ringing. A typical gate voltage of

6 V is recommended, with optional negative gate bias for hard-switching applications to improve  $dv/dt$  immunity and prevent false turn-on. Minimize gate loop inductance ( $<1$  nH) through careful PCB layout and short connections. For additional robustness, Zener clamps may be used to limit gate voltage in both polarities.

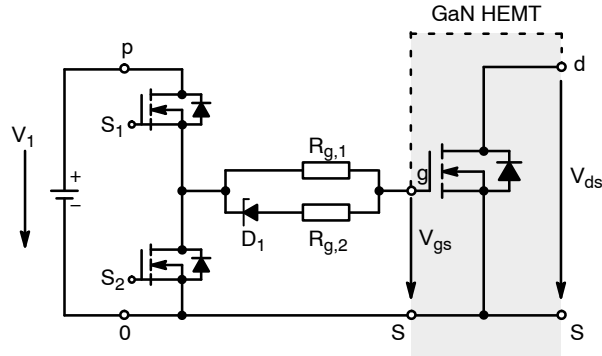


Figure 1. Schottky Gate Conventional Driver Schematic

## ORDERING INFORMATION

| Device Order Number | Package Type  | Shipping |
|---------------------|---------------|----------|
| ENGNTBT023N65GN1TXG | TOLT Top Cool | TBD      |

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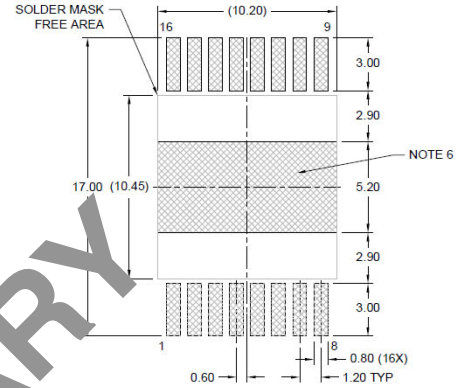
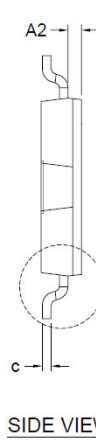
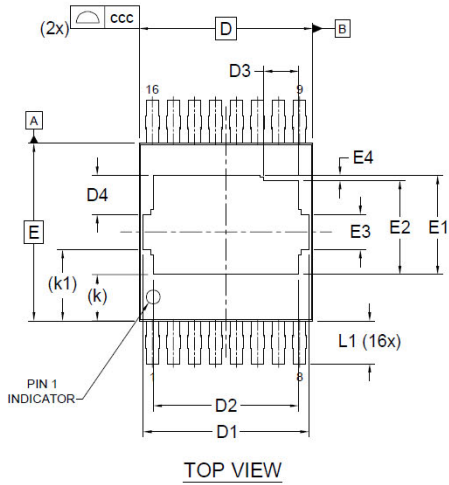
## REVISION HISTORY

| Revision | Description of Changes                | Date     |
|----------|---------------------------------------|----------|
| P0       | Initial Preliminary Document release. | 5/5/2026 |

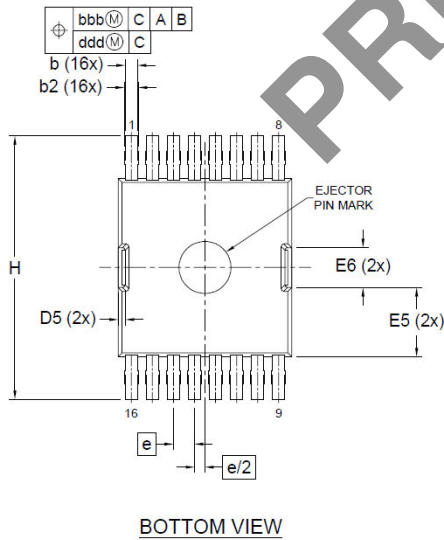
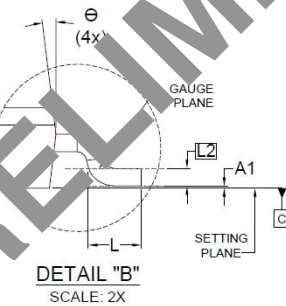
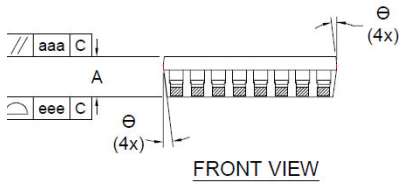
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## PACKAGE DIMENSIONS

PDSOG16 10.15x9.90x2.30, 1.20P  
CASE XXXXX  
ISSUE O



\*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.



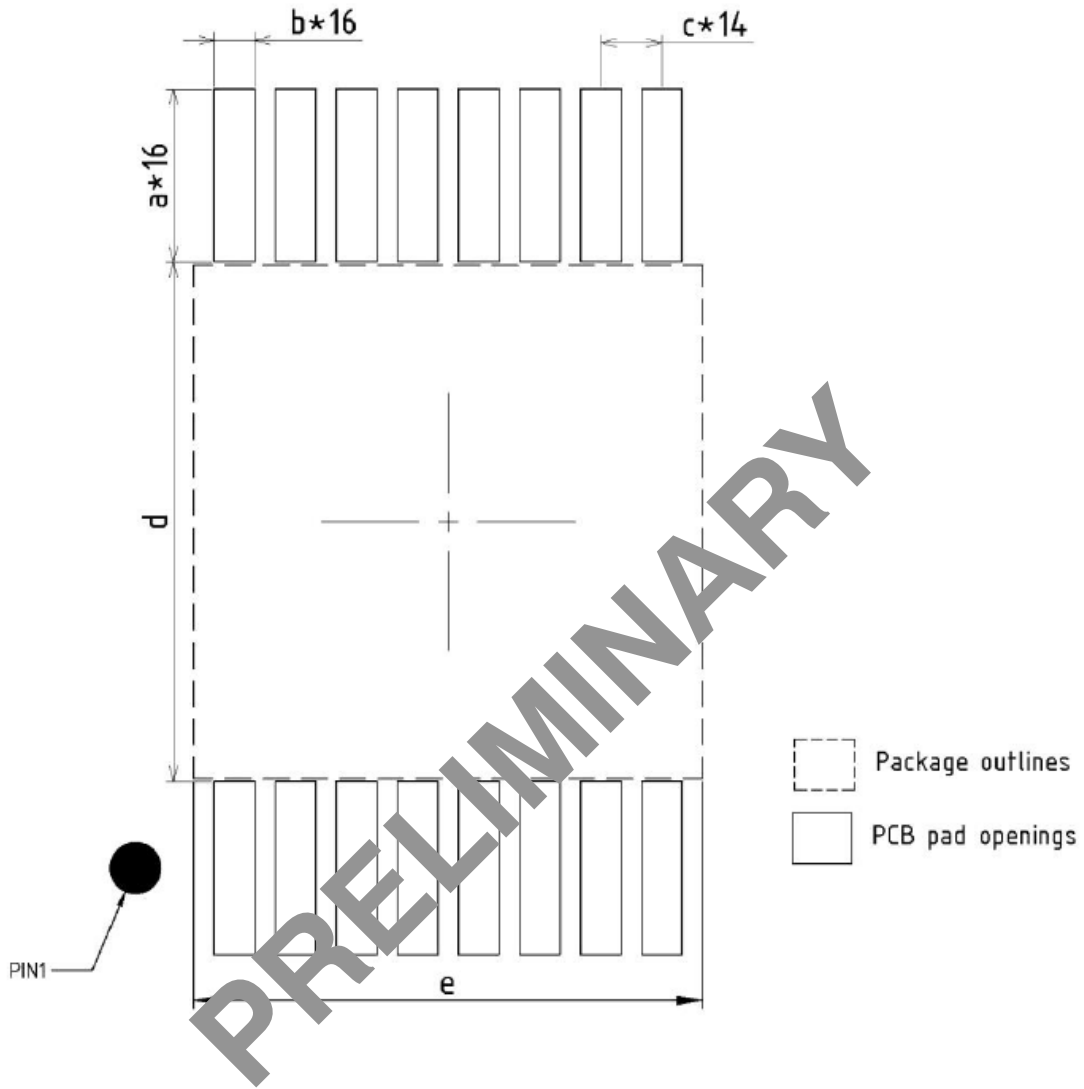
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-2018.
2. UNIT DIMENSION: MILLIMETERS
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.150mm PER SIDE.
4. DIMENSIONS D AND E1 ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. OPTIONAL MOLD FEATURE.
6. LAND PAD UNDER THE PACKAGE BODY IS FOR MECHANICAL SUPPORT ONLY. SOLDER CONNECTION IS NOT REQUIRED.
7. DIMENSION A1 IS THE LEAD STAND-OFF FROM THE BOTTOM SURFACE OF THE PACKAGE BODY.

| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 2.20        | 2.30 | 2.40 |
| A1  | 0.00        | --   | 0.06 |
| A2  | 0.66        | 0.76 | 0.86 |
| b   | 0.60        | 0.70 | 0.80 |
| b2  | 0.70        | 0.80 | 0.90 |
| c   | 0.40        | 0.50 | 0.60 |
| D   | 9.90 BSC    |      |      |
| D1  | 9.36        | 9.46 | 9.56 |
| D2  | 8.20        | 8.30 | 8.40 |
| D3  | 1.90        | 2.00 | 2.10 |
| D4  | 2.14        | 2.24 | 2.34 |
| D5  | 0.30        | 0.40 | 0.50 |
| E   | 10.15 BSC   |      |      |
| E1  | 5.57        | 5.67 | 5.77 |
| E2  | 5.27        | 5.37 | 5.47 |
| E3  | 1.90        | 2.00 | 2.10 |
| E4  | 0.20        | 0.30 | 0.40 |

| DIM   | MILLIMETERS |       |       |
|-------|-------------|-------|-------|
|       | MIN.        | NOM.  | MAX.  |
| E5    | 3.84        | 3.94  | 4.04  |
| E6    | 2.18        | 2.28  | 2.38  |
| e     | 1.20 BSC    |       |       |
| e/2   | 0.60 BSC    |       |       |
| H     | 14.90       | 15.00 | 15.10 |
| k     | 2.65 REF    |       |       |
| k1    | 4.08 REF    |       |       |
| L     | 1.40        | 1.50  | 1.60  |
| L2    | 0.50 BSC    |       |       |
| theta | 10° REF     |       |       |
| aaa   | 0.20        |       |       |
| bbb   | 0.25        |       |       |
| ccc   | 0.20        |       |       |
| ddd   | 0.20        |       |       |
| eee   | 0.10        |       |       |

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| SYMBOL | DIMENSION | SYMBOL | DIMENSION |
|--------|-----------|--------|-----------|
| a      | 3.40      | d      | 10.20     |
| b      | 0.80      | e      | 10.00     |
| c      | 1.20      |        |           |

Notes:

(1) All dimension are in millimeters.  
 (2) Drawing is not to scale.

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