

Enhancement Mode Gallium Nitride (GaN) HEMT

650 V, 39 mΩ, 40 A, TOLL 10x12

Preliminary Document **NTBL050N65GN1**

Features

- Low $R_{DS(ON)}$ to Minimize Conduction Losses
- Ultra Low Gate Charge for High Speed Switching
- FOM- $Q_G = 367 \text{ nC}^* \text{ m}\Omega$
- Small Footprint for High Density PCB Design
- Pb-Free, Halogen Free and RoHS Compliant

Typical Applications

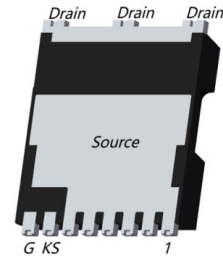
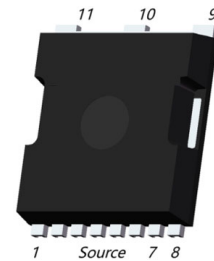
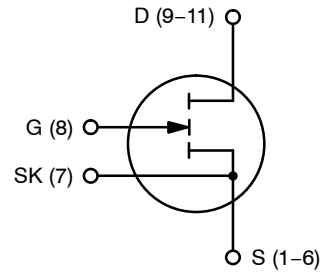
- High Density Power Modules
- High Frequency AC-DC and DC-DC Converters
- High Performance PSU for Datacenter and Industrial
- Resonant Conversion

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, $t_p < 200 \text{ }\mu\text{s}$	$V_{DS(TRAN)}$	800	V
Gate-to-Source Voltage	V_{GS}	-6 to 7	V
Gate-to-Source Transient Voltage, $t_p = 50 \text{ ns}$, $f_p = 100 \text{ kHz}$, open drain	$V_{GS(PULSE)}$	-20 to 10	V
Continuous Drain Current, $T_{CASE} = 25 \text{ }^\circ\text{C}$ $T_{CASE} = 100 \text{ }^\circ\text{C}$	I_{DS}	40 30	A
Pulsed Drain Current, $t_p < 10 \text{ }\mu\text{s}$, $T_J = 25 \text{ }^\circ\text{C}$ $T_J = 125 \text{ }^\circ\text{C}$	$I_{DS(PULSE)}$	77 40	A
Power Dissipation, $V_{GS} = 6 \text{ V}$, $T_{CASE} = 25 \text{ }^\circ\text{C}$	P_{TOT}	250	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	39 mΩ	40 A



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-Case	$R_{\theta JC}$	0.5	$^{\circ}\text{C}/\text{W}$
Junction-to-Ambient (Note 1)	$R_{\theta JA}$	56	$^{\circ}\text{C}/\text{W}$
Maximum Soldering Temperature (MSL3)	T_{SLD}	260	$^{\circ}\text{C}$

1. Device on 1 in², 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
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OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}$	650			V
Drain-to-Source Leakage Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}$		8	TBD	μA
		$V_{GS} = 0\text{ V}, V_{DS} = 650\text{ V}, T_J = 125^{\circ}\text{C}$		20		
Gate-to-Source Leakage Current	I_{GSS}	$V_{GS} = 6\text{ V}, V_{DS} = 0\text{ V}$		250	TBD	μA
		$V_{GS} = 6\text{ V}, V_{DS} = 0\text{ V}, T_J = 125^{\circ}\text{C}$		TBD		μA

ON CHARACTERISTICS

Drain-to-Source On Resistance	$R_{DS(ON)}$	$V_{GS} = 6\text{ V}, I_{DS} = 18\text{ A}$		39	50	$\text{m}\Omega$
		$V_{GS} = 6\text{ V}, I_{DS} = 18\text{ A}, T_J = 125^{\circ}\text{C}$		75		
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS} = V_{GS}, I_{DS} = 50\text{ mA}, T_J = 25^{\circ}\text{C}$		1.7		V
		$V_{DS} = V_{GS}, I_{DS} = 50\text{ mA}, T_J = 125^{\circ}\text{C}$		1.6		

DYNAMIC CHARACTERISTICS

Input Capacitance	C_{ISS}	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$		342		pF
Output Capacitance	C_{OSS}			125		
Reverse Transfer Capacitance	C_{RSS}			1.5		
Output Capacitance, Energy Related	$C_{OSS(ER)}$	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$		189		pF
Output Capacitance, Time Related	$C_{OSS(TR)}$			269		
Output Charge	Q_{OSS}			107		nC
Output Capacitance Stored Energy	E_{OSS}			15		μJ
Gate Resistance	R_G		$f = 5\text{ MHz}$		1.5	
Gate Charge	Q_G	$V_{DS} = 400\text{ V}, I_{DS} = 18\text{ A}, V_{GS} = 0/6\text{ V}$		9.4		nC
Gate-to-Source Charge	Q_{GS}			0.9		
Gate-to-Drain Charge	Q_{GD}			4.0		
Gate Plateau Voltage	V_{PLAT}			2.5		V

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{D(ON)}$	$V_{DS} = 400\text{ V}, I_{DS} = 18\text{ A}, V_{GS} = 0/6\text{ V},$ $R_{G,ON} = 10\ \Omega, R_{G,OFF} = 2.2\ \Omega$		9.6		ns
Turn-Off Delay Time	$t_{D(OFF)}$			10.5		ns
Turn-On Rise Time	t_R			13.3		ns
Turn-Off Fall Time	t_F			9		ns

REVERSE CONDUCTION CHARACTERISTICS

Source-to-Drain Reverse Voltage	V_{SD}	$V_{GS} = -2\text{ V}, I_{SD} = 18\text{ A}$		4.9		V
		$V_{GS} = 0\text{ V}, I_{SD} = 18\text{ A}$		2.9		
		$V_{GS} = 6\text{ V}, I_{SD} = 18\text{ A}$		0.7		

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.

ORDERING INFORMATION

Device Order Number	Package Type	Shipping
ENGNTBL050N65GN1TXG	TOLL 10.0 x 12.0	TBD

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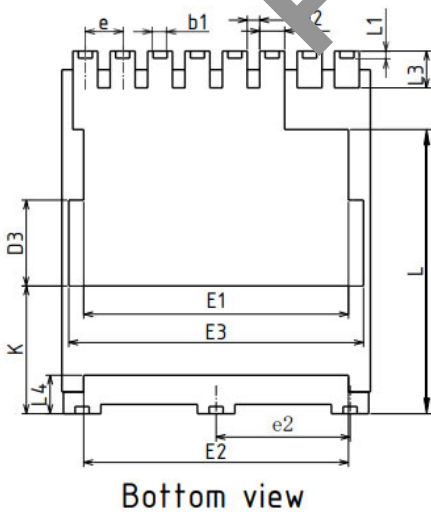
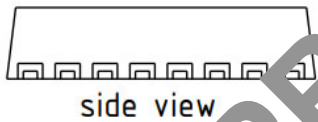
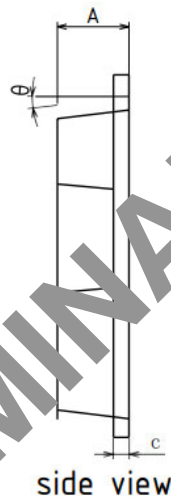
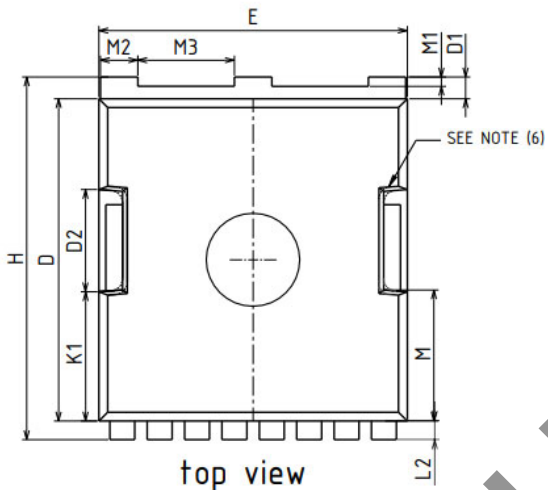
REVISION HISTORY

Revision	Description of Changes	Date
P0	Initial Preliminary Document release.	5/4/2026

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PACKAGE DIMENSIONS

TOLL 10 x 12 mm
CASE TBD
ISSUE O



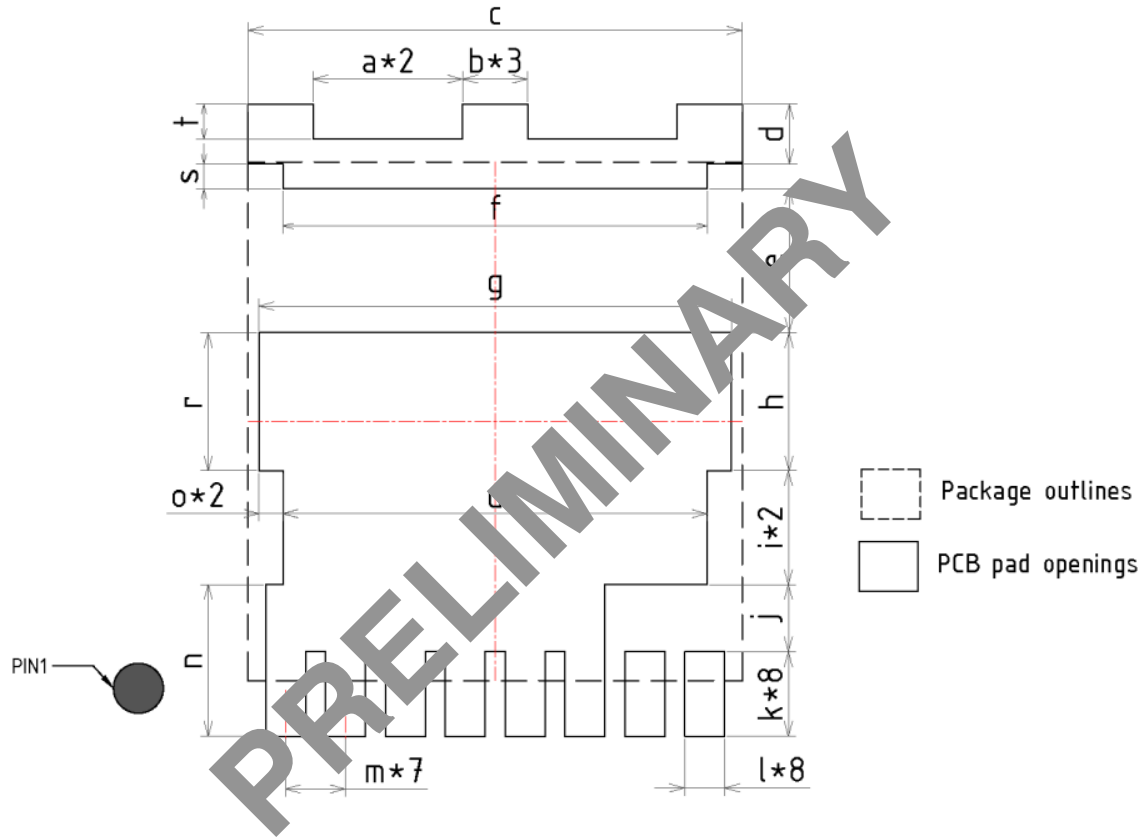
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
	2.15	2.30	2.45
b	0.30	0.40	0.50
b1	0.31	0.43	0.55
b2	0.65	0.80	0.90
c	0.40	0.50	0.60
D	10.18	10.38	10.58
D1	0.50	0.70	0.90
D2	3.30REF		
D3	2.77REF		
E	9.70	9.90	10.10
E1	8.50REF		
E2	8.50REF		
E3	9.46REF		
e	1.10	1.20	1.30
e2	4.20	4.30	4.40
H	11.48	11.68	11.88
K	4.08REF		
K1	4.18REF		
L	9.13REF		
L1	0.23REF		
L2	0.50	0.60	0.70
L3	1.00	1.20	1.40
L4	1.00	1.20	1.40
M	4.18REF		
M1	0.26REF		
M2	1.10	1.20	1.30
M3	3.10REF		
θ	10.00REF		

All Dimensions in mm

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PACKAGE DIMENSIONS

LAND PATTERN



SYMBOL	DIMENSION	SYMBOL	DIMENSION
a	3.00	k	1.70
b	1.30	l	0.80
c	9.90	m	1.20
d	1.20	n	3.05
e	2.88	o	0.48
f	8.50	r	2.77
g	9.46	s	0.50
h	2.77	t	0.70
i	2.28	u	8.50
j	1.35	/	/

All Dimensions in mm

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