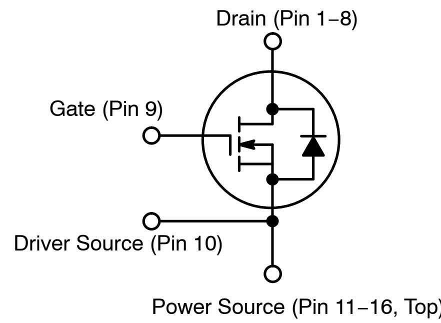
Enhancement Mode Gallium Nitride (GaN) HEMT

650 V, 39 mΩ, 40 A, TOLT 10x15

Preliminary Document

NTBT050N65GN1

$V_{(BR)DSS}$	$R_{DS(ON)}$ TYP	I_{DS} MAX
650 V	39 mΩ	40 A

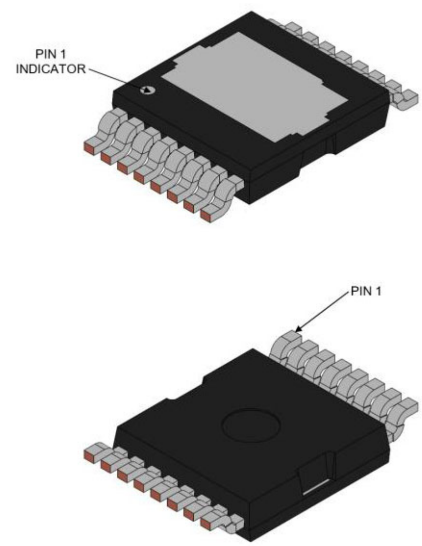


Features

- Low $R_{DS(ON)}$ to Minimize Conduction Losses
- Ultra Low Gate Charge for High Speed Switching
- FOM-Q_G = 367 nC*mΩ
- 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 Data Center and Industrial
- Resonant Conversion



TOLT 10x15 mm
CASE TBD

MAXIMUM RATINGS (T_J = 25 °C unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-to-Source Voltage	V_{DSS}	650	V
Drain-to-Source Transient Voltage, t_P < 200 μs	$V_{DS(TRAN)}$	800	V
Gate-to-Source Voltage	V_{GS}	−6 to 7	V
Gate-to-Source Transient Voltage, t_P = 50 ns, f_P = 100 kHz, open drain	$V_{GS(PULSE)}$	−20 to 10	V
Continuous Drain Current, T_{CASE} = 25 °C T_{CASE} = 100 °C	I_{DS}	40 30	A
Pulsed Drain Current, t_P < 10 μs, T_J = 25 °C T_J = 125 °C	$I_{DS(PULSE)}$	77 40	A
Power Dissipation, V_{GS} = 6 V, T_{CASE} = 25 °C	P_{TOT}	312	W
Operating Junction Temperature	T_J	−55 to 150	°C
Storage Temperature	T_{STG}	−55 to 150	°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.

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.

THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Junction-to-Cases	$R_{\theta JC}$	0.4	°C/W
Junction-to-Ambient (Note 1)	$R_{\theta JA}$	49	°C/W
Maximum Soldering Temperature (MSL3)	T_{SLD}	260	°C

1. Device on 1 in^2, 2 oz copper pad on single layer FR-4 PCB

ELECTRICAL CHARACTERISTICS (T_J = 25 °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 V	650			V
Drain-to-Source Leakage Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = 650 V		8	TBD	μA
		V_{GS} = 0 V, V_{DS} = 650 V, T_J = 125 °C		20		
Gate-to-Source Leakage Current	I_{GSS}	V_{GS} = 6 V, V_{DS} = 0 V		250	TBD	μA
		V_{GS} = 6 V, V_{DS} = 0 V, T_J = 125 °C		TBD		μA
ON CHARACTERISTICS						
Drain-to-Source On Resistance	$R_{DS(ON)}$	V_{GS} = 6 V, I_{DS} = 18 A		39	50	mΩ
		V_{GS} = 6 V, I_{DS} = 18 A, T_J = 125 °C		75		
Gate Threshold Voltage	$V_{GS(TH)}$	V_{DS} = V_{GS}, I_{DS} = 50 mA, T_J = 25 °C		1.7		V
		V_{DS} = V_{GS}, I_{DS} = 50 mA, T_J = 125 °C		1.6		
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ISS}	V_{DS} = 400 V, V_{GS} = 0 V, f = 1 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 V to 400 V, V_{GS} = 0 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 MHz		1.5		Ω
Gate Charge	Q_G	V_{DS} = 400 V, I_{DS} = 18 A, V_{GS} = 0/6 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 V, I_{DS} = 18 A, V_{GS} = 0/6 V, R_G = 10 Ω, $R_{G,OFF}$ = 2.2 Ω		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 V, I_{SD} = 18 A		4.9		V
		V_{GS} = 0 V, I_{SD} = 18 A		2.9		
		V_{GS} = 6 V, I_{SD} = 18 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.

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.

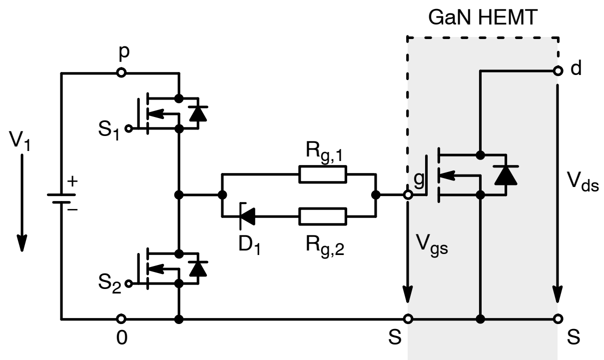


Figure 1. Schottky Gate Conventional Driver Schematic

ORDERING INFORMATION

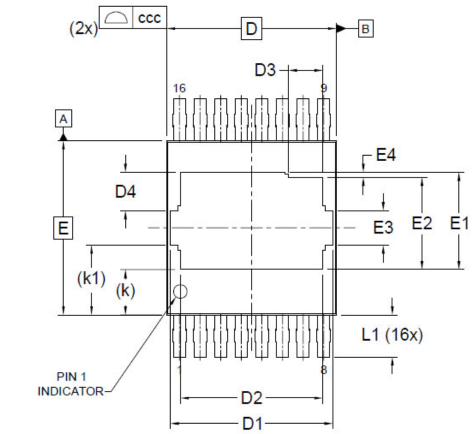
Device Order Number	Package Type	Shipping
ENGNTBT050N65GN1TXG	TOLT 10.0 x 15.0	TBD

REVISION HISTORY

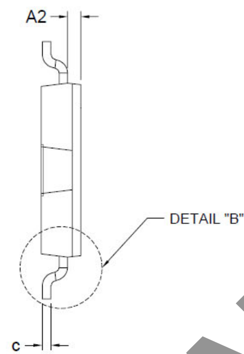
Revision	Description of Changes	Date
P0	Initial Preliminary Document release.	5/5/2026

PACKAGE DIMENSIONS

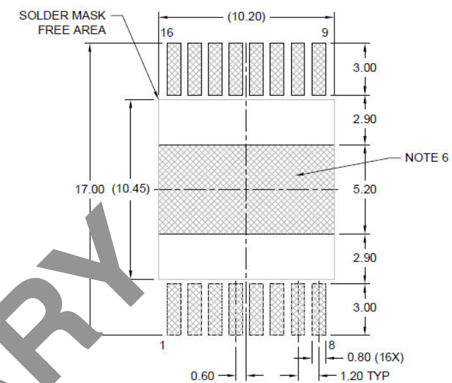
PDSOG16 10.15x9.90x2.30, 1.20P
CASE XXXXX
ISSUE O



TOP VIEW

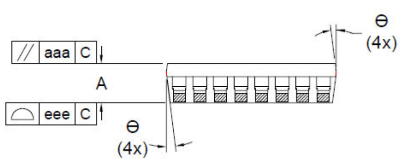


SIDE VIEW

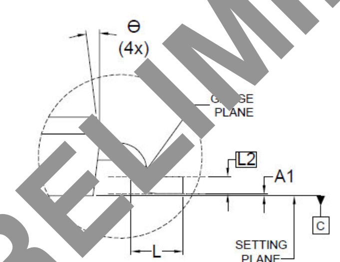


LAND PATTERN RECOMMENDATION

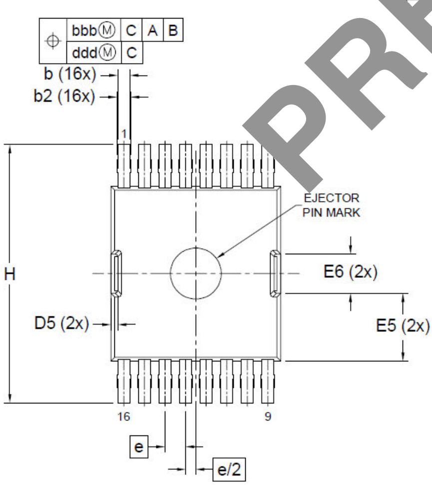
*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.



FRONT VIEW



DETAIL "B"
SCALE: 2X

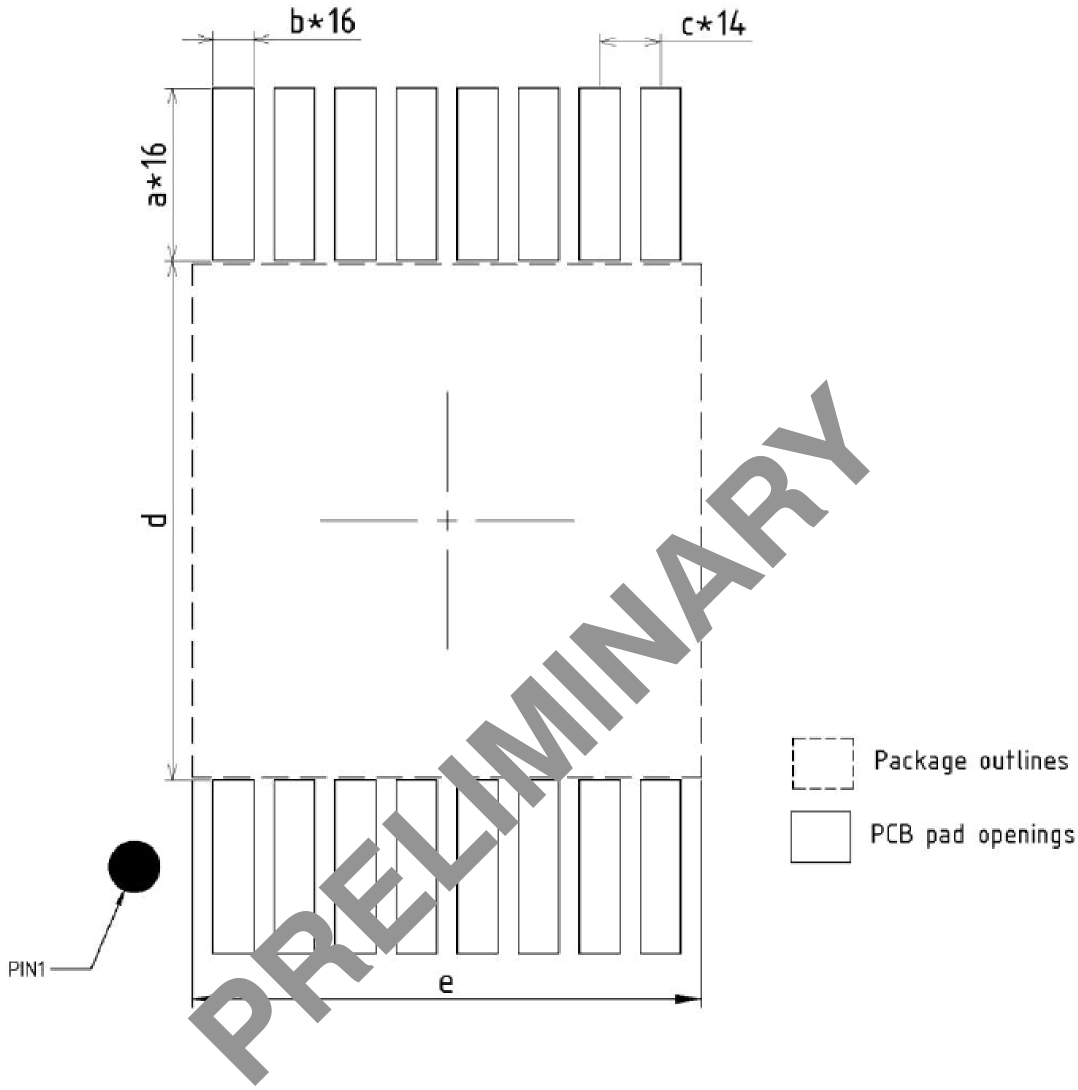


BOTTOM VIEW

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
L1	2.33	2.43	2.53
L2		0.50 BSC	
θ		10° REF	
aaa		0.20	
bbb		0.25	
ccc		0.20	
ddd		0.20	
eee		0.10	



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.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
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