



**THE DATASHEET OF  
NB100LVEP17DTR2**



# 2.5 V/3.3 V Quad Differential Driver/Receiver

## NB100LVEP17

### Description

The NB100LVEP17 is a 4-bit differential line receiver. The design incorporates two stages of gain, internal to the device, making it an excellent choice for use in high bandwidth amplifier applications.

The  $V_{BB}$  pin, an internally generated voltage supply, is available to this device only. For single-ended input conditions, the unused differential input is connected to  $V_{BB}$  as a switching reference voltage.  $V_{BB}$  may also rebias AC coupled inputs. When used, decouple  $V_{BB}$  and  $V_{CC}$  via a 0.01  $\mu$ F capacitor and limit current sourcing or sinking to 0.5 mA. When not used,  $V_{BB}$  should be left open.

Inputs of unused gates can be left open and will not affect the operation of the rest of the device.

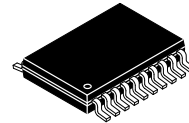
### Features

- Maximum Input Clock Frequency > 2.5 GHz Typical
- Maximum Input Data Rate > 2.5 Gb/s Typical
- 250 ps Typical Propagation Delay
- Low Profile QFN Package
- PECL Mode Operating Range:  $V_{CC} = 2.375$  V to 3.8 V with  $V_{EE} = 0$  V
- NECL Mode Operating Range:  $V_{CC} = 0$  V with  $V_{EE} = -2.375$  V to  $-3.8$  V
- Q Output Will Default LOW with Inputs Open or at  $V_{EE}$
- $V_{BB}$  Output
- These Devices are Pb-Free, Halogen Free and RoHS Compliant

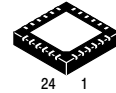


ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

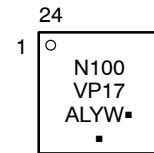
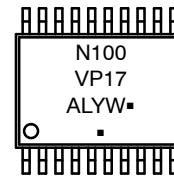


TSSOP-20  
DT SUFFIX  
CASE 948E



24 PIN QFN  
MN SUFFIX  
CASE 485L

### MARKING DIAGRAMS\*



- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

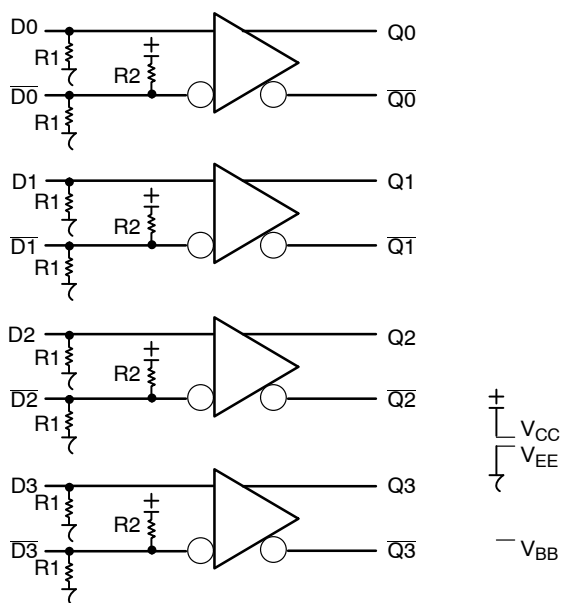
\*For additional marking information, refer to Application Note [AND8002/D](#).

### ORDERING INFORMATION

Device	Package	Shipping†
NB100LVEP17DTR2G	TSSOP-20 (Pb-Free)	2500 / Tape & Reel
NB100LVEP17MNG	QFN-24 (Pb-Free)	92 Units / Tube
NB100LVEP17MNR2G	QFN-24 (Pb-Free)	3000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, [BRD8011/D](#).

## NB100LVEP17



**Figure 1. Logic Diagram**

**Table 1. PIN DESCRIPTION**

Pin		Name	I/O	Default State	Description
TSSOP	QFN				
1,20	13,18,21,22,23	$V_{CC}$	-	-	Positive Supply Voltage. All $V_{CC}$ Pins Must be Externally Connected to Power Supply to Guarantee Proper Operation.
11	10	$V_{EE}$	-	-	Negative Supply Voltage. All $V_{EE}$ Pins Must be Externally Connected to Power Supply to Guarantee Proper Operation.
10	9	$V_{BB}$	-	-	ECL Reference Voltage Output.
2,4,6,8	1,3,5,7	D[0:3]	ECL Input	Low	Noninverted Differential Inputs [0:3]. Internal 75 k $\Omega$ to $V_{EE}$ .
3,5,7,9	2,4,6,8	$\overline{D}$ [0:3]	ECL Input	High	Inverted Differential Inputs [0:3]. Internal 75 k $\Omega$ to $V_{EE}$ and 37 k $\Omega$ to $V_{CC}$ .
19,17,15,13	12,15,17,20	Q[0:3]	ECL Output	-	Noninverted Differential Outputs [0:3]. Typically Terminated with 50 $\Omega$ to $V_{TT} = V_{CC} - 2$ V.
18,16,14,12	11,14,16,19	$\overline{Q}$ [0:3]	ECL Output	-	Inverted Differential Outputs [0:3]. Typically Terminated with 50 $\Omega$ to $V_{TT} = V_{CC} - 2$ V.
N/A	24	NC	-	-	No Connect. The NC Pin is Electrically Connected to the Die and "MUST BE" Left Open.
N/A	-	EP	-	-	Exposed Pad. (Note 1)

1. All  $V_{CC}$  and  $V_{EE}$  pins must be externally connected to Power Supply to guarantee proper operation. The thermally conductive expose pad on the package bottom (see case drawing) must be attached to a heat-sinking conduit.

# NB100LVEP17

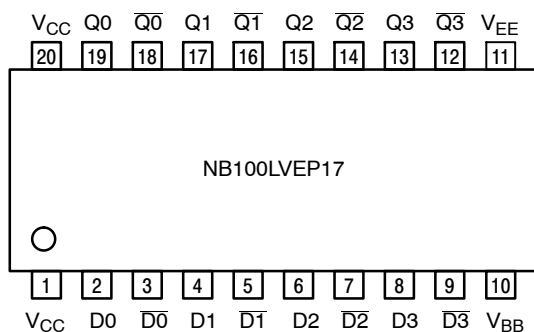


Figure 2. TSSOP-20 Lead Pinout (Top View)

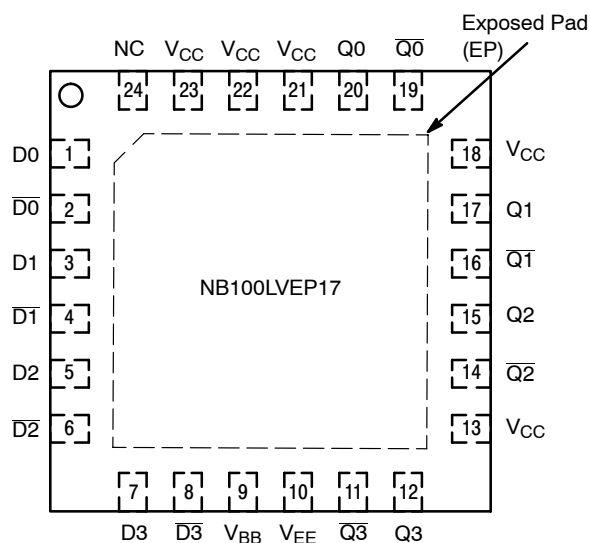


Figure 3. QFN-24 Lead Pinout (Top View)

Table 2. ATTRIBUTES

Characteristics	Value
Internal Input Pulldown Resistor (R1)	75 kΩ
Internal Input Pullup Resistor (R2)	37 kΩ
ESD Protection Human Body Model Machine Model Charged Device Model	> 2 kV > 150 V > 2 kV
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)	Pb-Free Pkg
TSSOP-20 QFN-24	Level 1 Level 1
Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
Transistor Count	274 Devices
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

1. For additional information, see Application Note [AND8003/D](#).

# NB100LVEP17

**Table 3. MAXIMUM RATINGS**

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V <sub>CC</sub>	Positive Mode Power Supply	V <sub>EE</sub> = 0 V		6	V
V <sub>EE</sub>	Negative Mode Power Supply	V <sub>CC</sub> = 0 V		-6	V
V <sub>I</sub>	Positive Mode Input Voltage Negative Mode Input Voltage	V <sub>EE</sub> = 0 V V <sub>CC</sub> = 0 V	V <sub>I</sub> ≤ V <sub>CC</sub> V <sub>I</sub> ≥ V <sub>EE</sub>	6 -6	V V
I <sub>out</sub>	Output Current	Continuous Surge		50 100	mA mA
I <sub>BB</sub>	V <sub>BB</sub> Sink/Source			±0.5	mA
T <sub>A</sub>	Operating Temperature Range			-40 to +85	°C
T <sub>stg</sub>	Storage Temperature Range			-65 to +150	°C
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient) JEDEC 51-3 (1S - Single Layer Test Board)	0 lfpm 500 lfpm	20 TSSOP 20 TSSOP	140 50	°C/W °C/W
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient) JEDEC 51-6 (2S2P Multilayer Test Board) with Filled Thermal Vias	0 lfpm 500 lfpm	24 QFN 24 QFN	37 32	°C/W °C/W
θ <sub>JC</sub>	Thermal Resistance (Junction-to-Case)	Standard Board	20 TSSOP 24 QFN	23 to 41 11	°C/W °C/W
T <sub>sol</sub>	Wave Solder (Pb-Free)			265	°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.

**Table 4. DC CHARACTERISTICS, PECL V<sub>CC</sub> = 2.5 V; V<sub>EE</sub> = 0 V (Note 2)**

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I <sub>EE</sub>	Negative Power Supply Current	30	40	50	30	40	50	30	40	55	mA
V <sub>OH</sub>	Output HIGH Voltage (Note 3)	1355	1480	1605	1355	1480	1605	1355	1480	1605	mV
V <sub>OL</sub>	Output LOW Voltage (Note 3)	505	775	900	505	775	900	505	775	900	mV
V <sub>IH</sub>	Input HIGH Voltage (Single-Ended) (Note 4)	1335		1620	1335		1620	1275		1620	mV
V <sub>IL</sub>	Input LOW Voltage (Single-Ended) (Note 4)	505		875	505		875	505		875	mV
V <sub>IHCMR</sub>	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 5)	1.2		2.5	1.2		2.5	1.2		2.5	V
I <sub>IH</sub>	Input HIGH Current (@ V <sub>IH</sub> )			150			150			150	μA
I <sub>IL</sub>	Input LOW Current (@ V <sub>IL</sub> )	D D	0.5 -150		0.5 -150			0.5 -150			μA

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm.

- Input and output parameters vary 1:1 with V<sub>CC</sub>. V<sub>EE</sub> can vary -0.125 V to +1.3 V.
- All loading with 50 Ω to V<sub>EE</sub> = V<sub>CC</sub> - 2.0 V.
- Do not use V<sub>BB</sub> at V<sub>CC</sub> < 3.0 V.
- V<sub>IHCMR</sub> min varies 1:1 with V<sub>EE</sub>, V<sub>IHCMR</sub> max varies 1:1 with V<sub>CC</sub>. The V<sub>IHCMR</sub> range is referenced to the most positive side of the differential input signal.

# NB100LVEP17

**Table 5. DC CHARACTERISTICS, PECL**  $V_{CC} = 3.3\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 6)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Negative Power Supply Current	30	40	50	30	40	50	30	40	55	mA
$V_{OH}$	Output HIGH Voltage (Note 7)	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
$V_{OL}$	Output LOW Voltage (Note 7)	1305	1575	1700	1305	1575	1700	1305	1575	1700	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	2135		2420	2135		2420	2135		2420	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	1305		1675	1305		1675	1305		1675	mV
$V_{BB}$	ECL Output Reference Voltage (Note 8)	1775	1875	1975	1775	1875	1975	1775	1875	1975	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 9)	1.2		3.3	1.2		3.3	1.2		3.3	V
$I_{IH}$	Input HIGH Current (@ $V_{IH}$ )			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current (@ $V_{IL}$ )	D D	0.5 -150		0.5 -150			0.5 -150			$\mu\text{A}$

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm.

6. Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +0.5 V to -0.3 V.

7. All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .

8. Single ended input operation is limited  $V_{CC} \geq 3.0\text{ V}$  in PECL mode.

9.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ .  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

**Table 6. DC CHARACTERISTICS, NECL**  $V_{CC} = 0\text{ V}$ ,  $V_{EE} = -2.375\text{ V}$  to  $-3.8\text{ V}$  (Note 10)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Negative Power Supply Current	30	40	50	30	40	50	30	40	55	mA
$V_{OH}$	Output HIGH Voltage (Note 11)	-1145	-1020	-895	-1145	-1020	-895	-1145	-1020	-895	mV
$V_{OL}$	Output LOW Voltage (Note 11)	-1995	-1725	-1600	-1995	-1725	-1600	-1995	-1725	-1600	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	-1165		-880	-1165		-880	-1165		-880	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	-1995		-1600	-1995		-1600	-1995		-1600	mV
$V_{BB}$	ECL Output Reference Voltage (Note 12)	-1525	-1425	-1325	-1525	-1425	-1325	-1525	-1425	-1325	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 13)	$V_{EE} + 1.2$		0.0	$V_{EE} + 1.2$		0.0	$V_{EE} + 1.2$		0.0	V
$I_{IH}$	Input HIGH Current (@ $V_{IH}$ )			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current (@ $V_{IL}$ )	D D	0.5 -150		0.5 -150			0.5 -150			$\mu\text{A}$

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm.

10. Input and output parameters vary 1:1 with  $V_{CC}$ .

11. All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .

12. Single ended input operation is limited  $V_{EE} \leq -3.0\text{ V}$  in NECL mode.

13.  $V_{IHCMR}$  min varies 1:1 with  $V_{EE}$ .  $V_{IHCMR}$  max varies 1:1 with  $V_{CC}$ . The  $V_{IHCMR}$  range is referenced to the most positive side of the differential input signal.

# NB100LVEP17

**Table 7. AC CHARACTERISTICS**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -2.375\text{ V}$  to  $-3.8\text{ V}$  or  $V_{CC} = 2.375\text{ V}$  to  $3.8\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 14)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$V_{OUTPP}$	Output Voltage Amplitude (See Figures 4, 5)										
	$f_{in} < 1\text{ GHz}$	600	700		600	700		550	700		mV
	$f_{in} = 2\text{ GHz}$	400	500		325	500		300	500		
	$f_{in} = 2.5\text{ GHz}$	300	400		250	400		200	400		
$t_{PLH}$ , $t_{PHL}$	Propagation Delay to Output Differential D to Q, $\bar{Q}$	200	250	325	200	250	325	225	300	350	ps
$t_{Skew}$	Pulse Skew (Note 15) Within Device Skew (Note 17) Device-to-Device Skew (Note 17)		5	25		5	25		5	25	ps
			5	25		5	25		5	25	
			25	100		25	100		25	100	
$t_{JITTER}$	RMS Random Clock Jitter (Note 18) Peak-to-Peak Data Dependent Jitter (Note 19)		0.5	1		0.5	1		0.5	1	ps
	$f_{in} = 2.5\text{ GHz}$		5	15		5	15		5	15	
	$f_{in} = 1.5\text{ Gb/s}$		5	15		5	15		5	15	
	$f_{in} = 2.5\text{ Gb/s}$		5	15		5	15		5	15	
$V_{INPP}$	Input Voltage Swing (Differential Configuration) (Note 20)	150	800	1200	150	800	1200	150	800	1200	mV
$t_r$ , $t_f$	Output Rise/Fall Times @ 50 MHz (20% – 80%)										ps
	Q, $\bar{Q}$	125	175	225	140	190	240	150	200	250	

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm.

14. Measured using a 750 mV source, 50% duty cycle clock source. All loading with  $50\ \Omega$  to  $V_{CC} - 2.0\text{ V}$ . Input edge rates 150 ps (20% – 80%).

15. Pulse Skew =  $|t_{PLH} - t_{PHL}|$

16. Worst case difference between Q0 and Q1 outputs.

17. Skew is measured between outputs under identical transitions.

18. Additive RMS jitter with 50% Duty Cycle Clock Signal at 2.5 GHz.

19. Peak-to-Peak jitter with input NRZ data at PRBS  $2^{31}-1$  at 2.5 Gb/s with all inputs active.

20. Input voltage swing is a single-ended measurement operating in differential mode, with minimum propagation change of 50 ps.

# NB100LVEP17

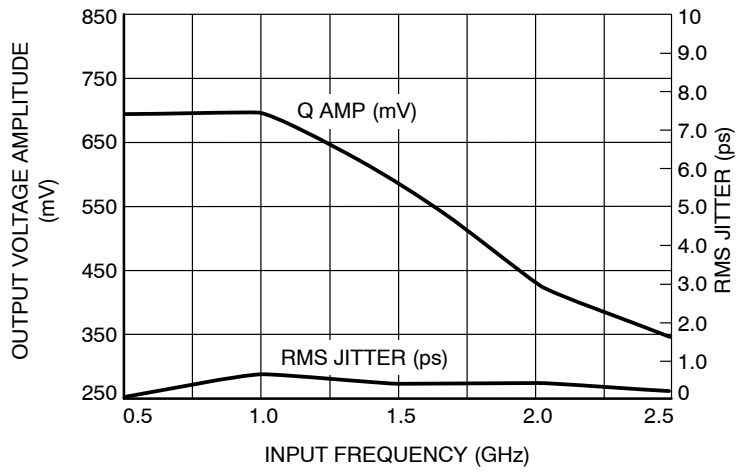


Figure 4. Output Voltage Amplitude ( $V_{OUTPP}$ ) / RMS Jitter vs. Input Frequency ( $f_{in}$ ) at  $V_{CC} = 2.5$  V, Ambient Temperature

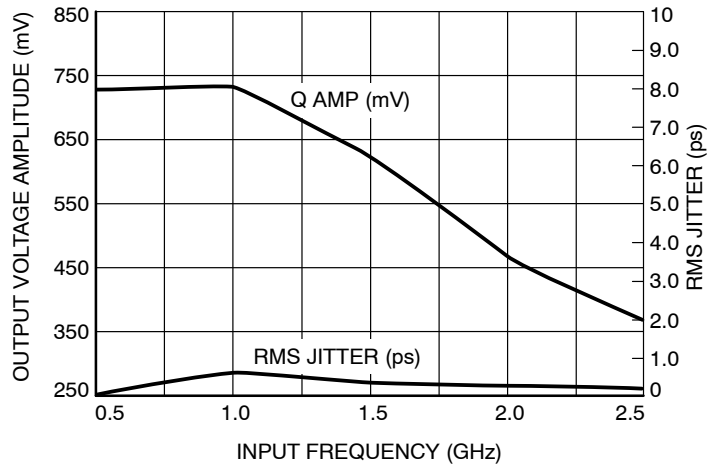


Figure 5. Output Voltage Amplitude ( $V_{OUTPP}$ ) / RMS Jitter vs. Input Frequency ( $f_{in}$ ) at  $V_{CC} = 3.3$  V, Ambient Temperature

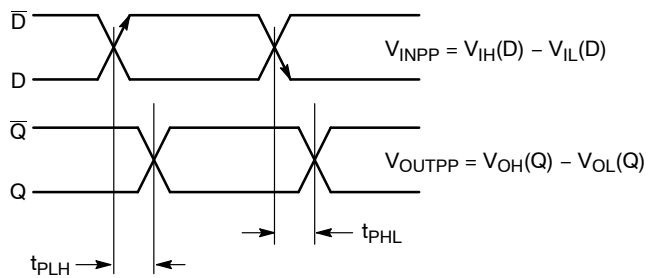
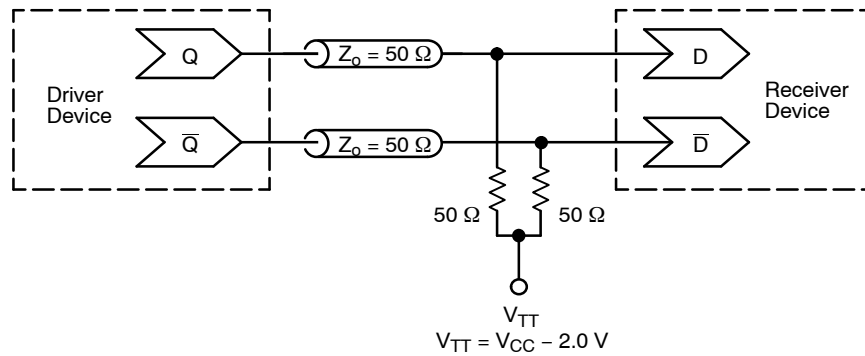


Figure 6. AC Reference Measurement

## NB100LVEP17



**Figure 7. Typical Termination for Output Driver and Device Evaluation**  
(See Application Note [AND8020/D](#) – Termination of ECL Logic Devices.)

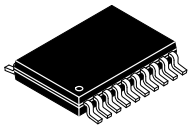
### Resource Reference of Application Notes

- AN1405/D** – ECL Clock Distribution Techniques
- AN1406/D** – Designing with PECL (ECL at +5.0 V)
- AN1503/D** – ECLinPS™ I/O SPiCE Modeling Kit
- AN1504/D** – Metastability and the ECLinPS Family
- AN1568/D** – Interfacing Between LVDS and ECL
- AN1672/D** – The ECL Translator Guide
- AND8001/D** – Odd Number Counters Design
- AND8002/D** – Marking and Date Codes
- AND8020/D** – Termination of ECL Logic Devices
- AND8066/D** – Interfacing with ECLinPS
- AND8090/D** – AC Characteristics of ECL Devices

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

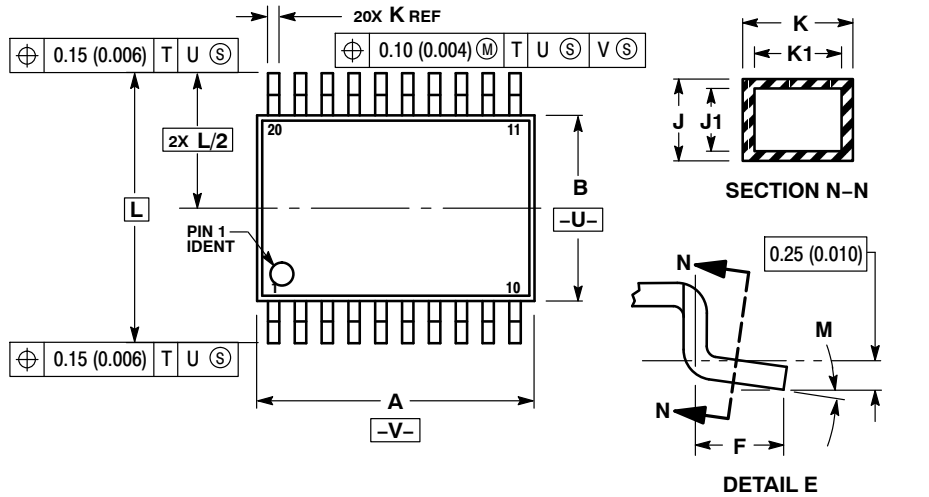
ON Semiconductor®



TSSOP-20 WB  
CASE 948E  
ISSUE D

DATE 17 FEB 2016

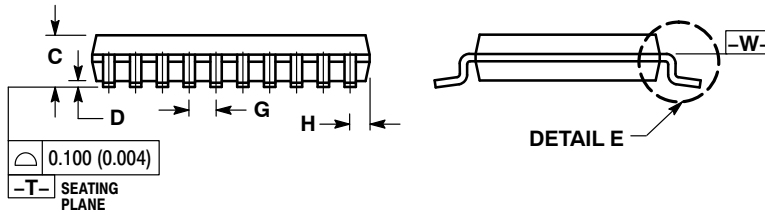
SCALE 2:1



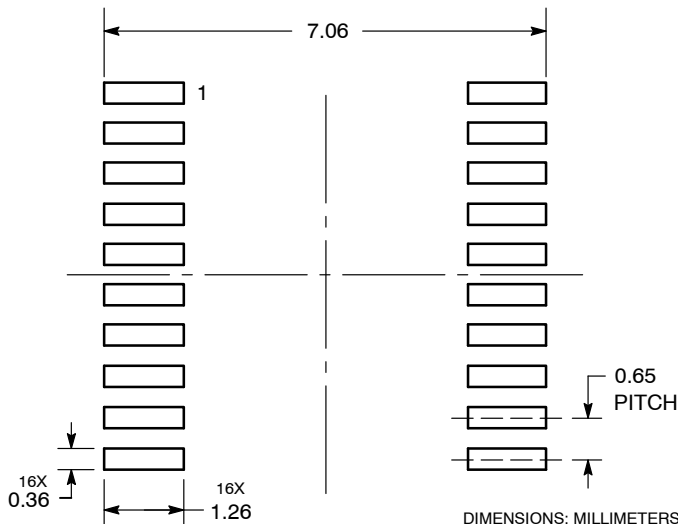
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

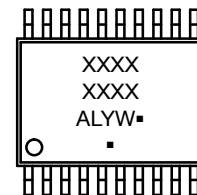
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°



SOLDERING FOOTPRINT



GENERIC MARKING DIAGRAM\*



- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

DOCUMENT NUMBER:	98ASH70169A	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TSSOP-20 WB	PAGE 1 OF 1

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at [www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)



## Looking for pricing, stock, or lifecycle information?

Click below to explore more details on WIN SOURCE:

- ⊖ [View NB100LVEP17DTR2 on WIN SOURCE](#)
- ⊖ [ON Semiconductor Information](#)

## Optimize Your Supply Chain with WIN SOURCE Solutions

- ✓ Global Sourcing Solution
- ✓ Obsolete Management
- ✓ Cost Control Management
- ✓ Shortage Management
- ✓ Alternative Solution
- ✓ Excess Inventory Management