

NB100LVEP17

2.5V / 3.3V Quad Differential Driver/Receiver

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 μ 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

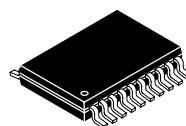
- Maximum Input Clock Frequency > 2.5 GHz Typical
- Maximum Input Data Rate > 2.5 Gb/s Typical
- 250 ps Typical Propagation Delay
- Low Profile QFN Package
- PECL Mode Operating Range: $V_{CC} = 2.375$ V to 3.8 V with $V_{EE} = 0$ V
- NECL Mode Operating Range: $V_{CC} = 0$ V with $V_{EE} = -2.375$ V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



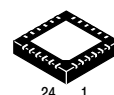
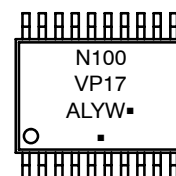
ON Semiconductor®

<http://onsemi.com>

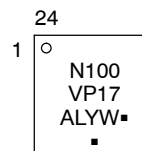
MARKING DIAGRAMS*



TSSOP-20
DT SUFFIX
CASE 948E



24 PIN QFN
MN SUFFIX
CASE 485L



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

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

NB100LVEP17

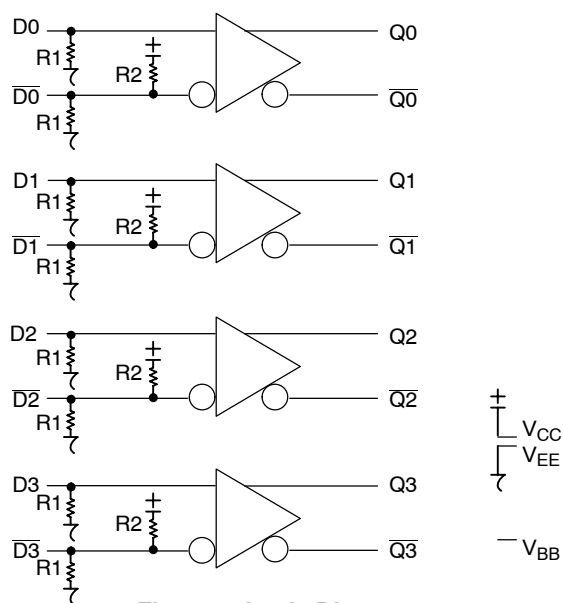


Figure 1. Logic Diagram

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 $75\text{ k}\Omega$ to V_{EE} .
3,5,7,9	2,4,6,8	$\overline{D}[0:3]$	ECL Input	High	Inverted Differential Inputs [0:3]. Internal $75\text{ k}\Omega$ to V_{EE} and $37\text{ k}\Omega$ 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 $V_{TT} = V_{CC} - 2\text{ V}$.
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 $V_{TT} = V_{CC} - 2\text{ V}$.
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

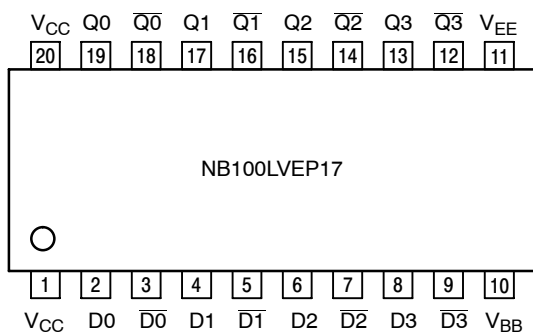


Figure 2. TSSOP-20 Lead Pinout (Top View)

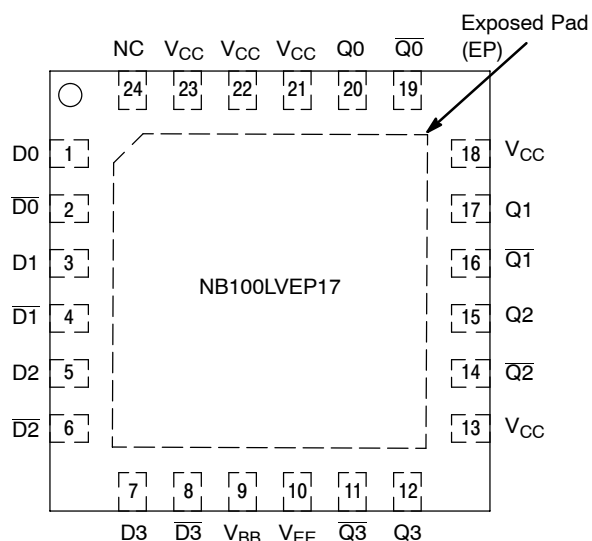


Figure 3. QFN-24 Lead Pinout (Top View)

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 Pkg	Pb-Free Pkg
	TSSOP-20 QFN-24	Level 1 Level 1	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 _{CC}	Positive Mode Power Supply	V _{EE} = 0 V		6	V
V _{EE}	Negative Mode Power Supply	V _{CC} = 0 V		-6	V
V _I	Positive Mode Input Voltage Negative Mode Input Voltage	V _{EE} = 0 V V _{CC} = 0 V	V _I ≤ V _{CC} V _I ≥ V _{EE}	6 -6	V V
I _{out}	Output Current	Continuous Surge		50 100	mA mA
I _{BB}	V _{BB} Sink/Source			±0.5	mA
T _A	Operating Temperature Range			-40 to +85	°C
T _{stg}	Storage Temperature Range			-65 to +150	°C
θ _{JA}	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 _{JA}	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 _{JC}	Thermal Resistance (Junction-to-Case)	Standard Board	20 TSSOP 24 QFN	23 to 41 11	°C/W °C/W
T _{sol}	Wave Solder Pb Pb-Free			265 265	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Table 4. DC CHARACTERISTICS, PECL V_{CC} = 2.5 V; V_{EE} = 0 V (Note 2)

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 3)	1355	1480	1605	1355	1480	1605	1355	1480	1605	mV
V _{OL}	Output LOW Voltage (Note 3)	555	775	900	555	775	900	555	775	900	mV
V _{IH}	Input HIGH Voltage (Single-Ended) (Note 4)	1335		1620	1335		1620	1275		1620	mV
V _{IL}	Input LOW Voltage (Single-Ended) (Note 4)	555		875	555		875	555		875	mV
V _{IHCMR}	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 5)	1.2		2.5	1.2		2.5	1.2		2.5	V
I _{IH}	Input HIGH Current (@ V _{IH})			150			150			150	μA
I _{IL}	Input LOW Current (@ V _{IL})	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. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

2. Input and output parameters vary 1:1 with V_{CC}. V_{EE} can vary -0.125 V to +1.3 V.
3. All loading with 50 Ω to V_{EE} = V_{CC} - 2.0 V.
4. Do not use V_{BB} at V_{CC} < 3.0 V.
5. 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 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)	1355	1575	1700	1355	1575	1700	1355	1575	1700	mV
V_{IH}	Input HIGH Voltage (Single-Ended)	2135		2420	2135		2420	2135		2420	mV
V_{IL}	Input LOW Voltage (Single-Ended)	1355		1675	1355		1675	1355		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	μA
I_{IL}	Input LOW Current (@ V_{IL})	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 lfm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

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 Ω 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 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)	-1945	-1725	-1600	-1945	-1725	-1600	-1945	-1725	-1600	mV
V_{IH}	Input HIGH Voltage (Single-Ended)	-1165		-880	-1165		-880	-1165		-880	mV
V_{IL}	Input LOW Voltage (Single-Ended)	-1945		-1600	-1945		-1600	-1945		-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	μA
I_{IL}	Input LOW Current (@ V_{IL})	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 lfm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

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

11. All loading with 50 Ω 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 V or $V_{CC} = 2.375\text{ V}$ to 3.8 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 5 25	25 25 100		5 5 25	25 25 100		5 5 25	25 25 100	ps
t_{JITTER}	RMS Random Clock Jitter (Note 18) Peak-to-Peak Data Dependent Jitter (Note 19)		0.5 5 5	1 15 15		0.5 5 5	1 15 15		0.5 5 5	1 15 15	ps
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%)	125	175	225	140	190	240	150	200	250	ps

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. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

14. Measured using a 750 mV source, 50% duty cycle clock source. All loading with 50 Ω 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

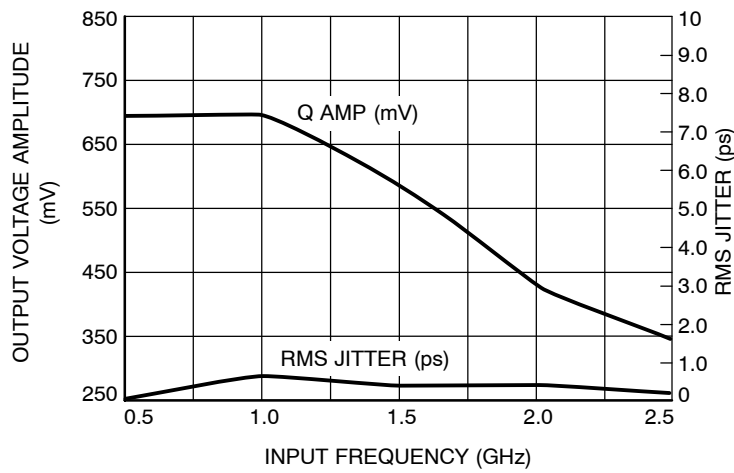


Figure 4. Output Voltage Amplitude (V_{OUTPP}) / RMS Jitter vs. Input Frequency (f_{in}) at $V_{CC} = 2.5$ V, Ambient Temperature

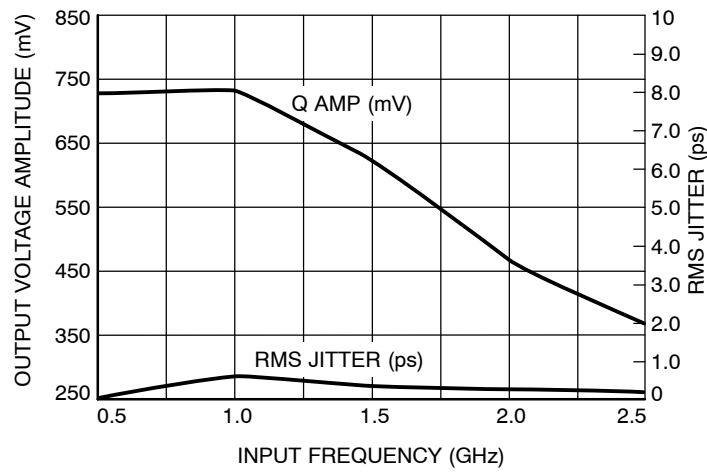


Figure 5. Output Voltage Amplitude (V_{OUTPP}) / RMS Jitter vs. Input Frequency (f_{in}) at $V_{CC} = 3.3$ V, Ambient Temperature

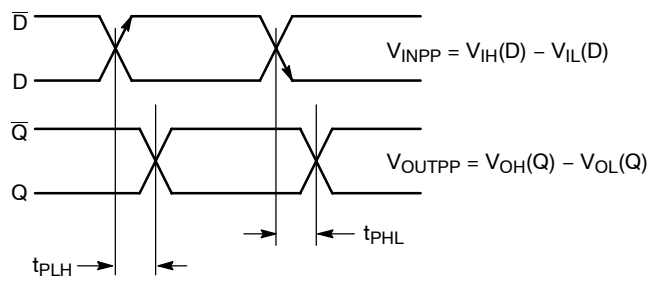


Figure 6. AC Reference Measurement

NB100LVEP17

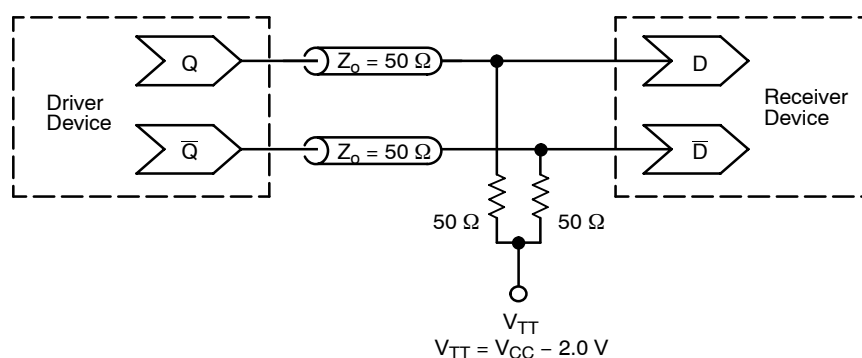


Figure 7. Typical Termination for Output Driver and Device Evaluation
(See Application Note AND8020/D – Termination of ECL Logic Devices.)

ORDERING INFORMATION

Device	Package	Shipping†
NB100LVEP17DT	TSSOP-20*	75 Units / Rail
NB100LVEP17DTG	TSSOP-20*	75 Units / Rail
NB100LVEP17DTR2	TSSOP-20*	2500 Tape & Reel
NB100LVEP17DTR2G	TSSOP-20*	2500 Tape & Reel
NB100LVEP17MN	QFN-24	92 Units / Rail
NB100LVEP17MNG	QFN-24 (Pb-Free)	92 Units / Rail
NB100LVEP17MNR2	QFN-24	3000 Tape & Reel
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.

*This package is inherently Pb-Free.

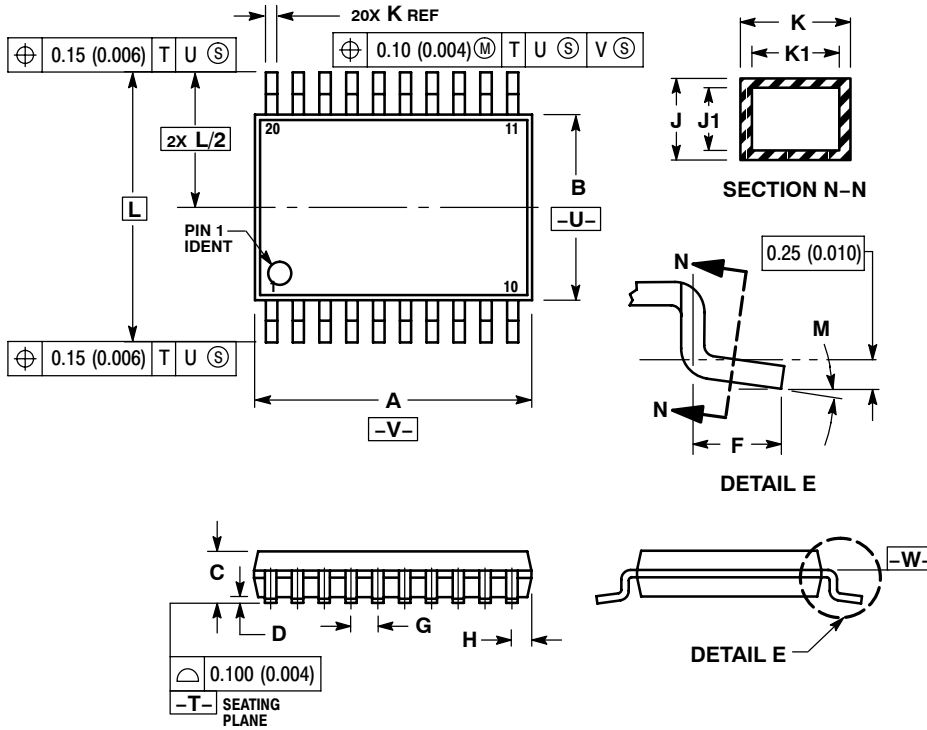
Resource Reference of Application Notes

- 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

NB100LVEP17

PACKAGE DIMENSIONS

TSSOP-20
CASE 948E-02
ISSUE C

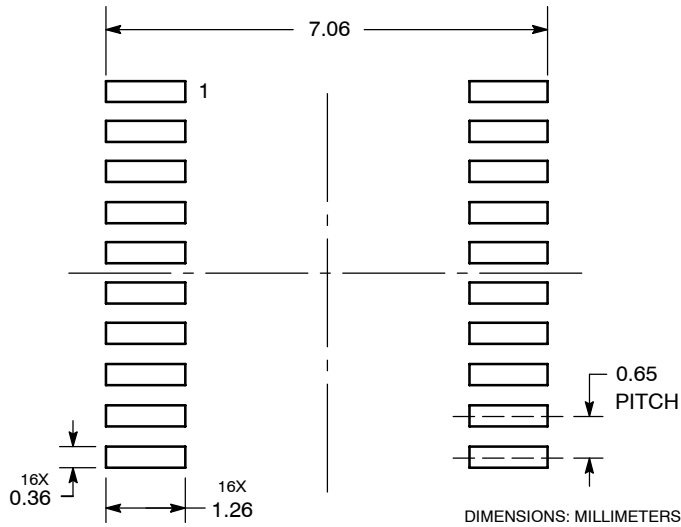


NOTES:

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*

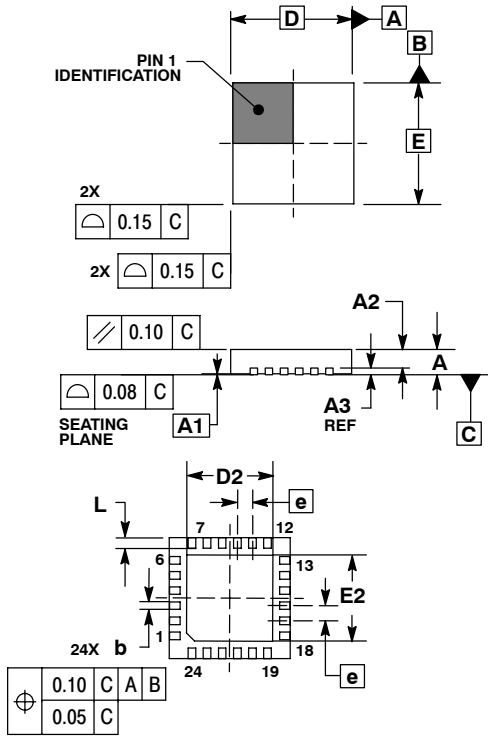


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NB100LVEP17

PACKAGE DIMENSIONS

QFN 24
MN SUFFIX
 24 PIN QFN, 4x4
 CASE 485L-01
 ISSUE O



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

DIM	MILLIMETERS	
	MIN	MAX
A	0.80	1.00
A1	0.00	0.05
A2	0.60	0.80
A3	0.20	REF
b	0.23	0.28
D	4.00	BSC
D2	2.70	2.90
E	4.00	BSC
E2	2.70	2.90
e	0.50	BSC
L	0.35	0.45

ECLinPS is a trademark of Semiconductor Components Industries, LLC (SCILLC).

ON Semiconductor and **ON** are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC 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. "Typical" parameters which may be provided in SCILLC 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. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC 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 SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
 Literature Distribution Center for ON Semiconductor
 P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
 USA/Canada
Europe, Middle East and Africa Technical Support:
 Phone: 421 33 790 2910
Japan Customer Focus Center
 Phone: 81-3-5773-3850

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
 For additional information, please contact your local Sales Representative

Данный компонент на территории Российской Федерации

Вы можете приобрести в компании MosChip.

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru

moschip.ru_4

moschip.ru_6

moschip.ru_9