NB100LVEP17

2.5V / 3.3V Quad Differential Driver/Receiver

ON Semiconductor®

http://onsemi.com

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.

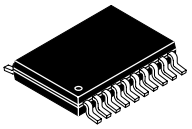
The V_{BB} pin, an internally generated voltage supply, is available to this device only. For single-ended input conditions, the unused differential input is connected to V_{BB} as a switching reference voltage. V_{BB} may also rebias AC coupled inputs. When used, decouple V_{BB} and V_{CC} via a 0.01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

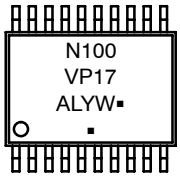
Inputs of unused gates can be left open and will not affect the operation of the rest of the device.

Features

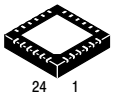
- Maximum Input Clock Frequency > 2.5 GHz Typical
- Maximum Input Data Rate > 2.5 Gb/s Typical
- 250 ps Typical Propagation Delay
- Low Profile QFN Package
- PECL Mode Operating Range: V_{CC} = 2.375 V to 3.8 V with V_{EE} = 0 V
- NECL Mode Operating Range: V_{CC} = 0 V with V_{EE} = −2.375 V to −3.8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

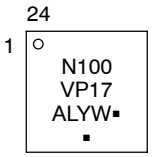
MARKING DIAGRAMS*





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.

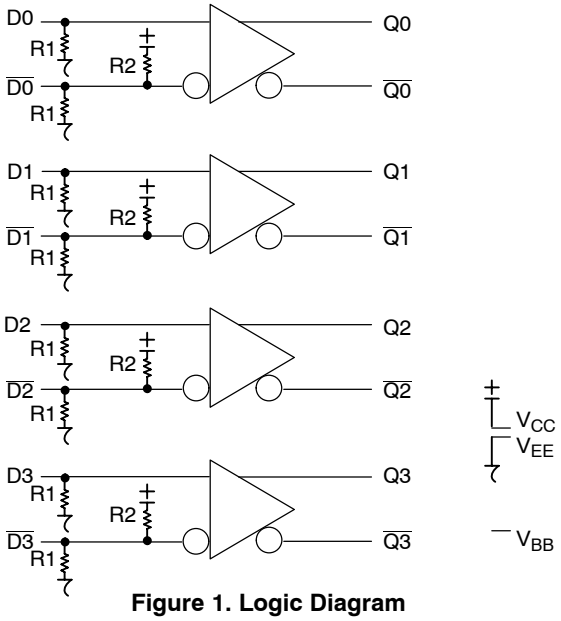


Figure 1. Logic Diagram

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 kΩ 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 kΩ to V_{EE} and 37 kΩ to V_{CC}.
19,17,15,13	12,15,17,2 0	Q[0:3]	ECL Output	–	Noninverted Differential Outputs [0:3]. Typically Terminated with 50 Ω to $V_{TT} = V_{CC} - 2$ V.
18,16,14,12	11,14,16,1 9	$\overline{Q[0:3]}$	ECL Output	–	Inverted Differential Outputs [0:3]. Typically Terminated with 50 Ω 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.

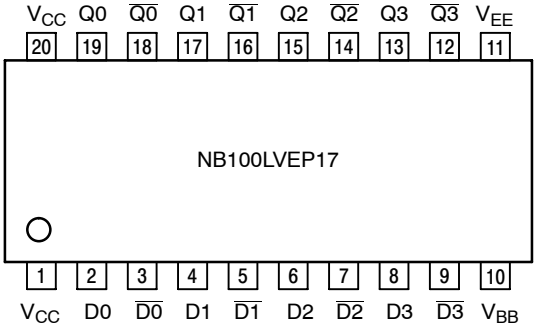


Figure 2. TSSOP−20 Lead Pinout (Top View)

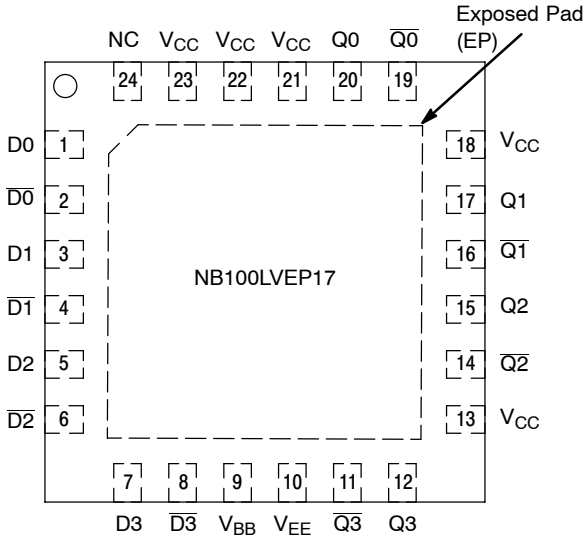


Figure 3. QFN−24 Lead Pinout (Top View)

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.

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	$V_I \le V_{CC}$ $V_I \ge V_{EE}$	6 −6	V V
I_{out}	Output Current	Continuous Surge		50 100	mA mA
I_{BB}	V_{BB} Sink/Source			±0.5	mA
TA	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)

		−40°C			25°C			85°C			
Symbol	Characteristic	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	Unit
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 $\overline{D}$	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.

Table 5. DC CHARACTERISTICS, PECL V_{CC} = 3.3 V; V_{EE} = 0 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 $\overline{D}$	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.

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 V.
8. Single ended input operation is limited $V_{CC} \geq$ 3.0 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 V, V_{EE} = −2.375 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 $\overline{D}$	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.

10. Input and output parameters vary 1:1 with V_{CC}.
11. All loading with 50 Ω to V_{CC} − 2.0 V.
12. Single ended input operation is limited $V_{EE} \leq$ −3.0V 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.

Table 7. AC CHARACTERISTICS V_{CC} = 0 V; V_{EE} = −2.375 V to −3.8 V or V_{CC} = 2.375 V to 3.8 V; V_{EE} = 0 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 GHz f_{in} = 2 GHz f_{in} = 2.5 GHz	600 400 300	700 500 400		600 325 250	700 500 400		550 300 200	700 500 400		mV
t_{PLH}, t_{PHL}	Propagation Delay to Output Differential	D to Q, $\overline{Q}$	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)	f_{in} = 2.5 GHz f_{in} = 1.5 Gb/s f_{in} = 2.5 Gb/s		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%)	Q, $\overline{Q}$	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 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.

14. Measured using a 750 mV source, 50% duty cycle clock source. All loading with 50 Ω to V_{CC} − 2.0 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.

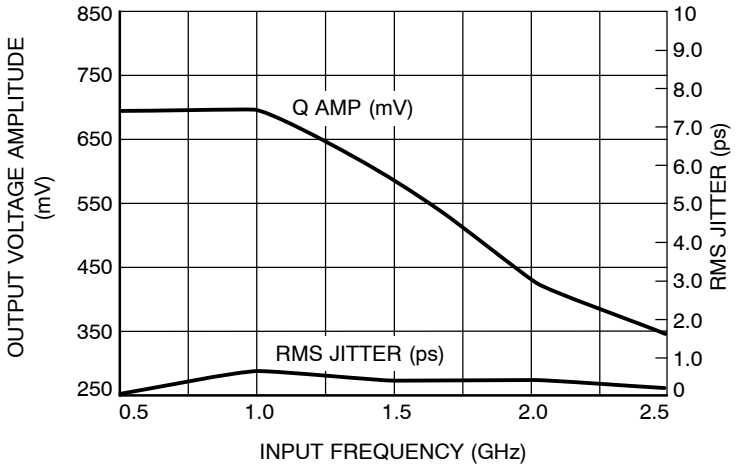


Figure 4. Output Voltage Amplitude (V_{OUTPP}) / RMS Jitter vs. Input Frequency (f_{in}) at V_{CC} = 2.5 V, Ambient Temperature

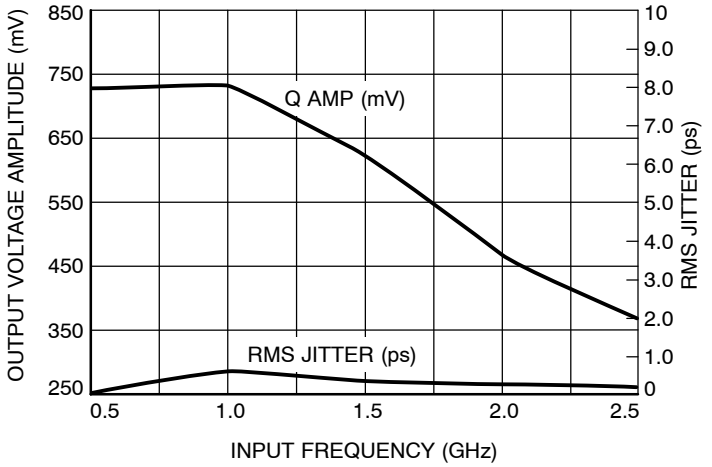


Figure 5. Output Voltage Amplitude (V_{OUTPP}) / RMS Jitter vs. Input Frequency (f_{in}) at V_{CC} = 3.3 V, Ambient Temperature

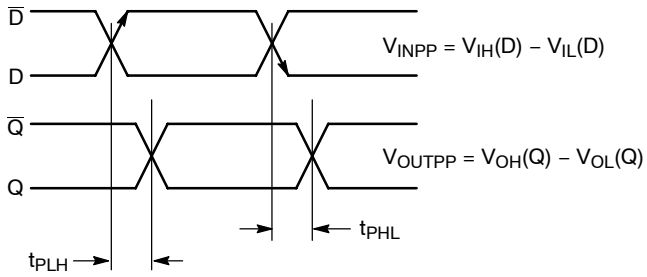


Figure 6. AC Reference Measurement

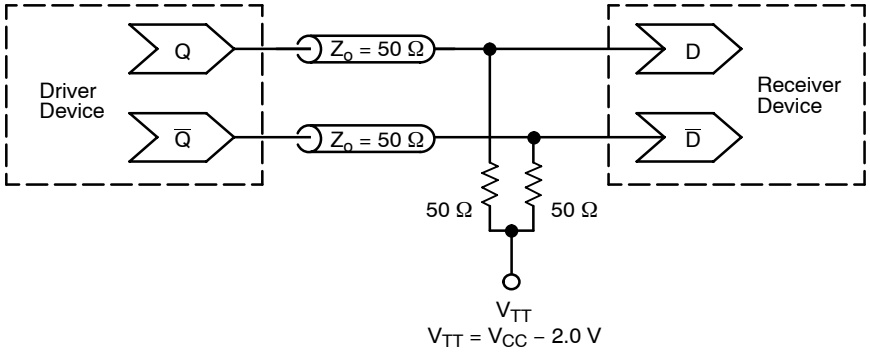


Figure 7. Typical Termination for Output Driver and Device Evaluation (See Application Note AND8020/D – Termination of ECL Logic Devices.)

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

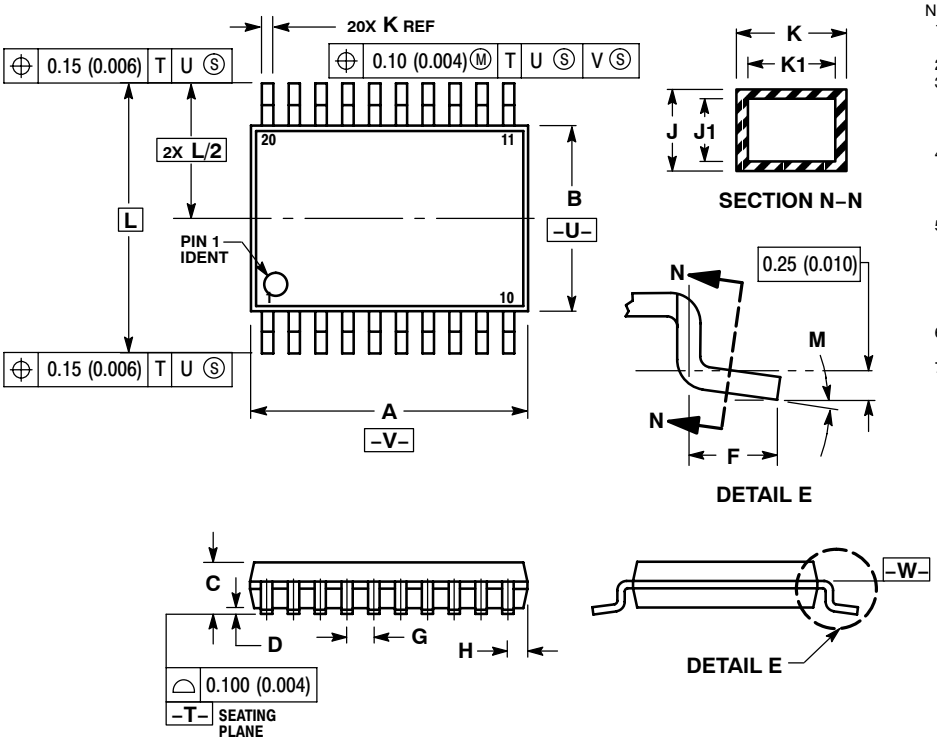
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.
*This package is inherently Pb−Free.

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

PACKAGE DIMENSIONS

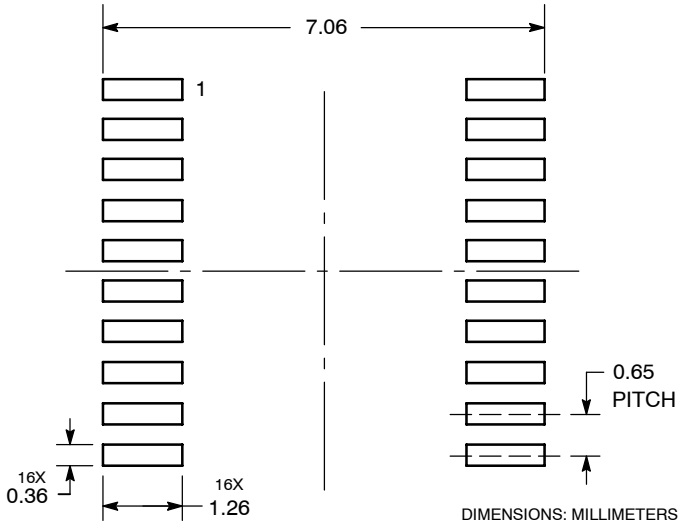
TSSOP−20
CASE 948E−02
ISSUE C



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−.

	MILLIMETERS		INCHES	
DIM	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°

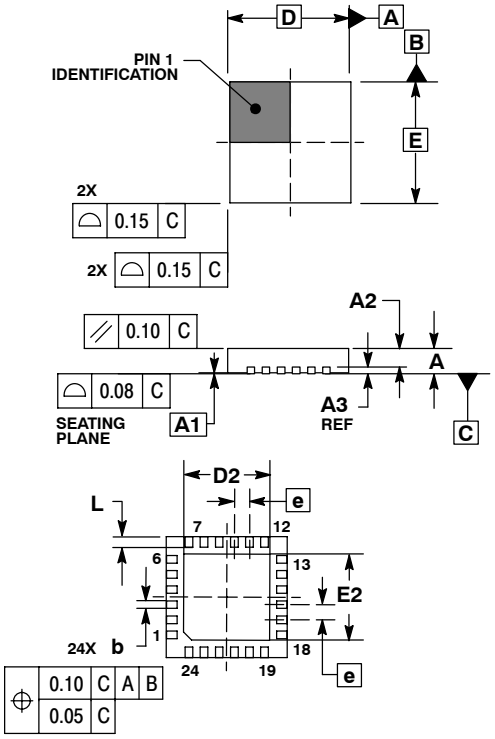
SOLDERING FOOTPRINT*



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

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.

	MILLIMETERS	
DIM	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).

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
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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

NB100LVEP17/D