# **3.3 V / 5 V ECL Differential Receiver/Driver with High and Low Gain**

# Description

The EP16VB is a world-class differential receiver/driver. The device is functionally equivalent to the EP16 and LVEP16 devices but with both high and low gain outputs.  $Q_{HG}$  and  $\overline{Q_{HG}}$  outputs have a DC gain several times larger than the DC gain of an EP16.  $\overline{Q}$  output is provided for feedback purposes.

The V<sub>BB</sub> 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<sub>BB</sub> as a switching reference voltage. V<sub>BB</sub> may also rebias AC coupled inputs. When used, decouple V<sub>BB</sub> and V<sub>CC</sub> via a 0.01  $\mu$ F capacitor and limit current sourcing or sinking to 0.5 mA. When not used, V<sub>BB</sub> should be left open.

Special considerations are required for differential inputs under No Signal conditions to prevent instability.

The 100 Series contains temperature compensation.

# Features

- Gain = > 200
- Maximum Frequency = > 3 GHz Typical
- PECL Mode Operating Range: V<sub>CC</sub> = 3.0 V to 5.5 V with V<sub>EE</sub> = 0 V
- NECL Mode Operating Range: V<sub>CC</sub> = 0 V with V<sub>EE</sub> = -3.0 V to -5.5 V
- V<sub>BB</sub> Output
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant



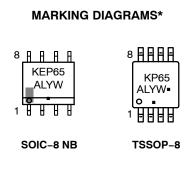
# **ON Semiconductor®**

www.onsemi.com



SOIC-8 NB D SUFFIX CASE 751-07

TSSOP-8 DT SUFFIX CASE 948R-02



- A = Assembly Location
  - = Wafer Lot
  - = Year

Y

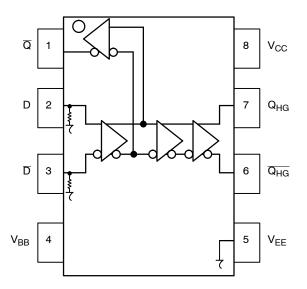
- W = Work Week
- M = Date Code
  - = Pb-Free Package

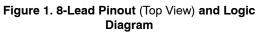
(Note: Microdot may be in either location) \*For additional marking information, refer to Application Note <u>AND8002/D</u>.

## **ORDERING INFORMATION**

Device	Package	Shipping†
MC100EP16VBDG	SOIC-8 NB (Pb-Free)	98 Units / Tube
MC100EP16VBDR2G	SOIC-8 NB (Pb-Free)	2500 Tape & Reel
MC100EP16VBDTG	TSSOP-8 (Pb-Free)	100 Units / Tube
MC100EP16VBDTR2G	TSSOP-8 (Pb-Free)	2500 Tape & Reel

+For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, <u>BRD8011/D</u>.





### Table 2. ATTRIBUTES

# Table 1. PIN DESCRIPTION

Pin	Function
D*, <u>D</u> *	ECL Data Inputs
Q	ECL Data Output
Q <sub>HG</sub> , Q <sub>HG</sub>	ECL High Gain Data Outputs
V <sub>BB</sub>	Reference Voltage Output
V <sub>CC</sub>	Positive Supply
V <sub>EE</sub>	Negative Supply

\*Pins will default LOW when left open.

Characteristics	Value
Internal Input Pulldown Resistor	75 kΩ
Internal Input Pullup Resistor	N/A
ESD Protection Human Body Model Machine Model Charged Device Model	> 4 kV > 200 V > 2 kV
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)	Pb-Free Pkg
SOIC–8 NB TSSOP–8	Level 1 Level 3
Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
Transistor Count	167 Devices
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test	

1. For additional information, see Application Note <u>AND8003/D</u>.

### **Table 3. MAXIMUM RATINGS**

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V <sub>CC</sub>	PECL Mode Power Supply	V <sub>EE</sub> = 0 V		6	V
$V_{EE}$	NECL Mode Power Supply	V <sub>CC</sub> = 0 V		-6	V
VI	PECL Mode Input Voltage NECL Mode Input Voltage	V <sub>EE</sub> = 0 V V <sub>CC</sub> = 0 V	$\begin{array}{l} V_{I} \leq V_{CC} \\ V_{I} \geq V_{EE} \end{array}$	6 -6	V V
l <sub>out</sub>	Output Current	Continuous Surge		50 100	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
$\theta_{JA}$	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	SOIC-8 NB SOIC-8 NB	190 130	°C/W
$\theta_{\text{JC}}$	Thermal Resistance (Junction-to-Case)	Standard Board	SOIC-8 NB	41 to 44	°C/W
$\theta_{JA}$	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	TSSOP-8 TSSOP-8	185 140	°C/W
$\theta_{\text{JC}}$	Thermal Resistance (Junction-to-Case)	Standard Board	TSSOP-8	41 to 44	°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. 100EP DC CHARACTERISTICS, PECL (V<sub>CC</sub> = 3.3 V, V<sub>EE</sub> = 0 V (Note 1))

		-40°C		25°C			85°C				
Symbol	Characteristic	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit
I <sub>EE</sub>	Power Supply Current	27	37	47	22	30	38	24	32	40	mA
V <sub>OH</sub>	Output HIGH Voltage (Note 2)	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
V <sub>OL</sub>	Output LOW Voltage (Note 2)	1305	1430	1555	1305	1400	1555	1305	1380	1555	mV
V <sub>IH</sub>	Input HIGH Voltage (Single-Ended)	2075		2420	2075		2420	2075		2420	mV
V <sub>IL</sub>	Input LOW Voltage (Single-Ended)	1355		1675	1355		1675	1355		1675	mV
V <sub>BB</sub>	Output Voltage Reference	1775	1875	1975	1775	1875	1975	1775	1875	2045	mV
VIHCMR	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 3)	2.0		3.3	2.0		3.3	2.0		3.3	V
I <sub>IH</sub>	Input HIGH Current			150			150			150	μA
۱ <sub>IL</sub>	Input LOW Current	0.5			0.5			0.5			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.

1. Input and output parameters vary 1:1 with V<sub>CC</sub>. V<sub>EE</sub> can vary +0.3 V to -2.2 V.

2. All loading with 50  $\Omega$  to V<sub>CC</sub> – 2.0 V. 3. 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.

		–40°C 25°C									
Symbol	Characteristic	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit
I <sub>EE</sub>	Power Supply Current	27	37	47	22	30	38	24	32	40	mA
V <sub>OH</sub>	Output HIGH Voltage (Note 2)	3855	3980	4105	3855	3980	4105	3855	3980	4105	mV
V <sub>OL</sub>	Output LOW Voltage (Note 2)	3005	3130	3255	3005	3100	3255	3005	3080	3255	mV
V <sub>IH</sub>	Input HIGH Voltage (Single-Ended)	3775		4120	3775		4120	3775		4120	mV
V <sub>IL</sub>	Input LOW Voltage (Single-Ended)	3055		3375	3055		3375	3055		3375	mV
$V_{BB}$	Output Voltage Reference	3475	3575	3675	3475	3575	3675	3475	3575	3675	mV
VIHCMR	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 3)	2.0		5.0	2.0		5.0	2.0		5.0	V
I <sub>IH</sub>	Input HIGH Current			150			150			150	μA
۱ <sub>IL</sub>	Input LOW Current	0.5			0.5			0.5			μA

#### Table 5. 100EP DC CHARACTERISTICS, PECL (V<sub>CC</sub> = 5.0 V, V<sub>EE</sub> = 0 V (Note 1))

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.

1. Input and output parameters vary 1:1 with V<sub>CC</sub>. V<sub>EE</sub> can vary +2.0 V to –0.5 V.

2. All loading with 50  $\Omega$  to V<sub>CC</sub> – 2.0 V.

3. 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.

#### Table 6. 100EP DC CHARACTERISTICS, NECL (V<sub>CC</sub> = 0 V; V<sub>EE</sub> = -5.5 V to -3.0 V (Note 1))

		-40°C			25°C			85°C			
Symbol	Characteristic	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit
I <sub>EE</sub>	Power Supply Current	27	37	47	22	30	38	24	32	40	mA
V <sub>OH</sub>	Output HIGH Voltage (Note 2)	-1145	-1020	-895	-1145	-1020	-895	-1145	-1020	-895	mV
V <sub>OL</sub>	Output LOW Voltage (Note 2)	-1995	-1870	-1745	-1995	-1900	-1745	-1995	-1920	-1745	mV
V <sub>IH</sub>	Input HIGH Voltage (Single-Ended)	-1225		-880	-1225		-880	-1225		-880	mV
V <sub>IL</sub>	Input LOW Voltage (Single-Ended)	-1945		-1625	-1945		-1625	-1945		-1625	mV
V <sub>BB</sub>	Output Voltage Reference	-1525	-1425	-1325	-1525	-1425	-1325	-1525	-1425	-1325	mV
V <sub>IHCMR</sub>	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 3)	V <sub>EE</sub> + 2.0		0.0	V <sub>EE</sub> + 2.0		0.0	V <sub>EE</sub> ·	+ 2.0	0.0	V
I <sub>IH</sub>	Input HIGH Current	150		150			150			150	μA
Ι <sub>IL</sub>	Input LOW Current	0.5			0.5			0.5			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.

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

2. All loading with 50  $\Omega$  to V\_{CC} – 2.0 V.

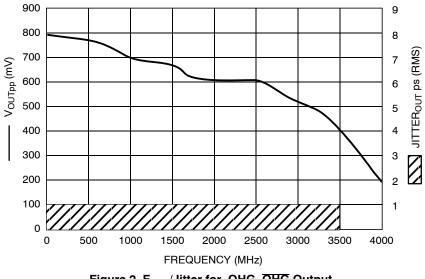
3. V<sub>IHCMR</sub> min varies 1:1 with V<sub>EE</sub>, V<sub>IHCMR</sub> max varies 1:1 with V<sub>CC</sub>. The V<sub>IHCMR</sub> range is referenced to the most positive side of the differential input signal.

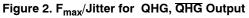
	( 66 ) 1				00		,	,	,,		
			–40°C		25°C						
Symbol	Characteristic	Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	Unit
f <sub>max</sub>	Maximum Frequency (Figure 2)		> 3			> 3			> 3		GHz
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay (Differential) Q (Differential) QHG, QHG (Single-Ended) Q (Single-Ended) QHG, QHG		275 280 325 330	350 350 400 400	250 250 300 300	300 300 350 350	400 400 450 450	275 275 325 325	310 320 360 370	425 425 475 475	ps
t <sub>SKEW</sub>	Duty Cycle Skew (Note 2)		5.0	20		5.0	20		5.0	20	ps
t <sub>JITTER</sub>	Cycle-to-Cycle Jitter (Figure 3)		0.2	< 1		0.2	< 1		0.2	< 1	ps
V <sub>PP</sub>	Input Voltage Swing (Differential) HG (Differential) Q		800 800	1200 1200	25 150	800 800	1200 1200	25 150	800 800	1200 1200	mV
t <sub>r</sub> t <sub>f</sub>	Output Rise/Fall Times $\overline{Q}$ (20%-80%)QHG, $\overline{QHG}$	200 70	270 130	400 220	220 80	300 150	420 240	250 100	310 170	450 270	ps

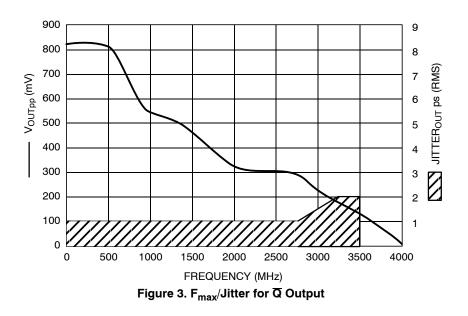
NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional 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.

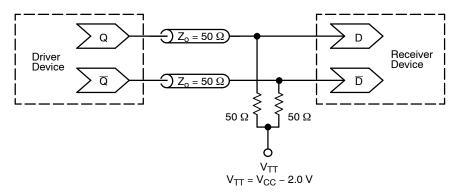
1. Measured using a 750 mV source, 50% duty cycle clock source. All loading with 50  $\Omega$  to V<sub>CC</sub> – 2.0 V.

2. Skew is measured between outputs under identical transitions. Duty cycle skew is defined only for differential operation when the delays are measured from the cross point of the inputs to the cross point of the outputs.









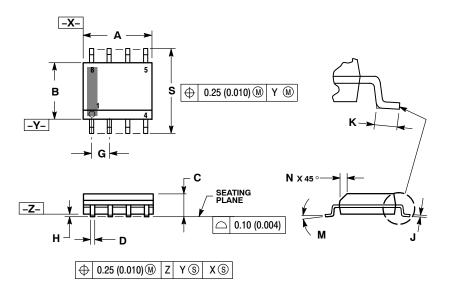


# **Resource Reference of Application Notes**

AN1405/D	-	ECL Clock Distribution Techniques
AN1406/D	-	Designing with PECL (ECL at +5.0 V)
AN1503/D	-	ECLinPS <sup>™</sup> 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

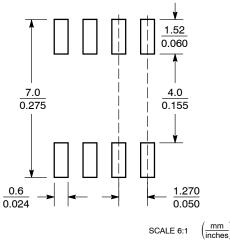
SOIC-8 NB **D SUFFIX** CASE 751-07 **ISSUE AK** 



- NOTES: 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982. 2. CONTROLLING DIMENSION: MILLIMETER.
- З.
- DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE. 4.
- DIMENSION D DOES NOT INCLUDE DAMBAR 5. PROTRUSION ALLOWABLE DAMBAR PROTRUSION ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION. 751-01 THRU 751-06 ARE OBSOLETE. NEW STANDARD IS 751-07.
- 6.

	MILLIN	IETERS	INC	HES		
DIM	MIN	MAX	MIN	MAX		
Α	4.80	5.00	0.189	0.197		
в	3.80	4.00	0.150	0.157		
С	1.35	1.75	0.053	0.069		
D	0.33	0.51	0.013	0.020		
G	1.27	7 BSC	0.050 BSC			
н	0.10	0.25	0.004	0.010		
J	0.19	0.25	0.007	0.010		
к	0.40	1.27	0.016	0.050		
м	0 °	8 °	0 °	8 °		
Ν	0.25	0.50	0.010	0.020		
S	5.80	6.20	0.228	0.244		

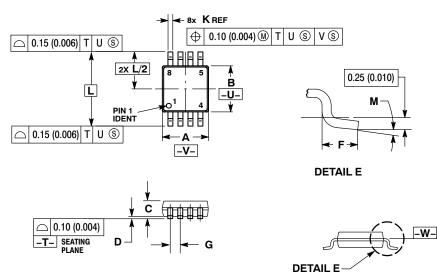
**SOLDERING FOOTPRINT\*** 



\*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

TSSOP-8 **DT SUFFIX** CASE 948R-02 **ISSUE A** 



- DIMENSIONING AND TOLERANCING PER ANSI 1 Y14.5M, 1982. CONTROLLING DIMENSION: MILLIMETER 2. 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. TERMINAL NUMBERS ARE SHOWN FOR 5
- REFERENCE ONLY. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-. 6.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
Α	2.90	3.10	0.114	0.122
В	2.90	3.10	0.114	0.122
С	0.80	1.10	0.031	0.043
D	0.05	0.15	0.002	0.006
F	0.40	0.70	0.016	0.028
G	0.65 BSC		0.026 BSC	
K	0.25	0.40	0.010	0.016
L	4.90 BSC		0.193 BSC	
Μ	0°	6 °	0°	6 °

#### ECLinPS is a trademark of Semiconductor Components Industries, LLC (SCILLC) or its subsidiaries in the United States and/or other countries

ON Semiconductor and mare trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at <a href="http://www.onsemi.com/site/pdf/Patent-Marking.pdf">www.onsemi.com/site/pdf/Patent-Marking.pdf</a>. 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. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typical" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor 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 ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor 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 ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor 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 19521 E. 32nd Pkwy, Aurora, Colorado 80011 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: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative