

## 3.3 V/5 V Hex Differential Line Receiver/Driver

### MC100EP116

#### Description

The MC100EP116 is a 6-bit differential line receiver based on the EP16 device. The 3.0 GHz bandwidth provided by the high frequency outputs makes the device ideal for buffering of very high speed oscillators.

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.

The design incorporates two stages of gain, internal to the device, making it an excellent choice for use in high bandwidth amplifier applications.

The differential inputs have internal clamp structures which will force the Q output of a gate in an open input condition to go to a LOW state. Thus, inputs of unused gates can be left open and will not affect the operation of the rest of the device. Note that the input clamp will take effect only if both inputs fall 2.5 V below  $V_{CC}$ .

The 100 Series contains temperature compensation.

#### Features

- 260 ps Typical Propagation Delay
- Maximum Frequency > 3 GHz Typical
- PECL Mode Operating Range:  $V_{CC} = 3.0$  V to 5.5 V with  $V_{EE} = 0$  V
- NECL Mode Operating Range:  $V_{CC} = 0$  V with  $V_{EE} = -3.0$  V to -5.5 V
- Open Input Default State
- Safety Clamp on Inputs
- Q Output Will Default LOW with Inputs Open or at  $V_{EE}$
- $V_{BB}$  Output
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant



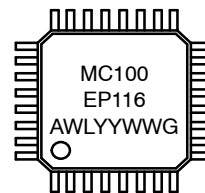
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LQFP-32  
FA SUFFIX  
CASE 561AB

#### MARKING DIAGRAM\*



A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week  
G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

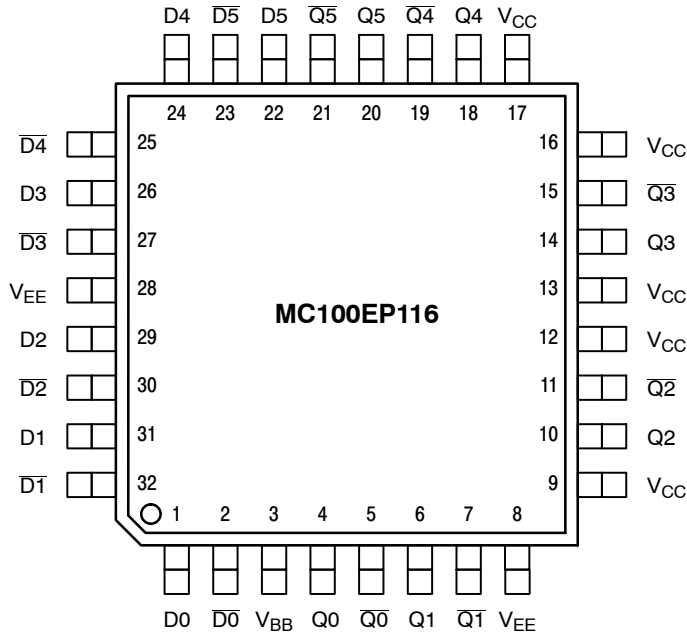
\*For additional marking information, refer to Application Note [AND8002/D](#).

#### ORDERING INFORMATION

Device	Package	Shipping†
MC100EP116FAG	LQFP-32 (Pb-Free)	250 Units / Tray

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

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Warning: All  $V_{CC}$  and  $V_{EE}$  pins must be externally connected to Power Supply to guarantee proper operation.

Figure 1. 32-Lead LQFP Pinout (Top View)

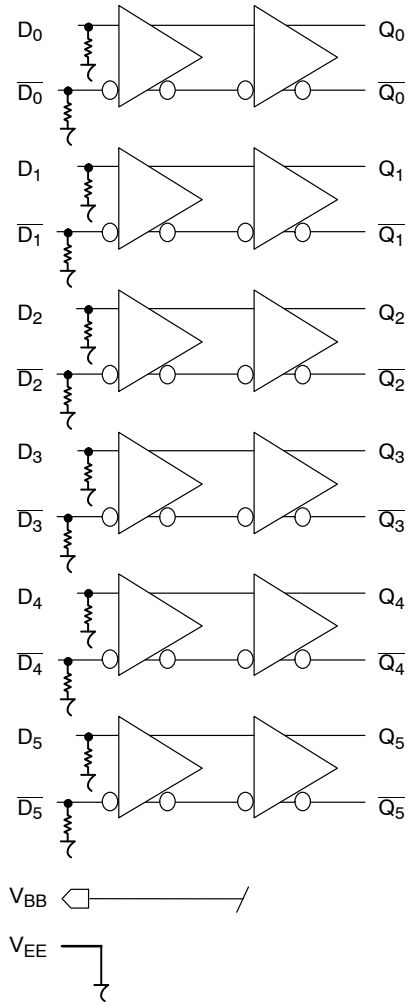


Figure 2. Logic Diagram

Table 1. PIN DESCRIPTION

PIN	FUNCTION
$D[0:5]^*$ , $\bar{D}[0:5]^*$	ECL Differential Data Inputs
$Q[0:5]$ , $\bar{Q}[0:5]$	ECL Differential Data Outputs
$V_{BB}$	Reference Voltage Output
$V_{CC}$	Positive Supply
$V_{EE}$	Negative Supply

\* Pins will default LOW when left open.

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**Table 2. ATTRIBUTES**

Characteristics	Value
Internal Input Pulldown Resistor	75 k $\Omega$
Internal Input Pullup Resistor	N/A
ESD Protection Human Body Model Machine Model Charged Device Model	> 2 kV > 100 V > 2 kV
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)	Pb-Free Pkg
LQFP-32	Level 2
Flammability Rating Oxygen Index: 28 to 34	UL-94 V-0 @ 0.125 in
Transistor Count	729 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	Units
V <sub>CC</sub>	PECL Mode Power Supply	V <sub>EE</sub> = 0 V		6	V
V <sub>EE</sub>	NECL Mode Power Supply	V <sub>CC</sub> = 0 V		-6	V
V <sub>I</sub>	PECL Mode Input Voltage NECL Mode Input Voltage	V <sub>EE</sub> = 0 V V <sub>CC</sub> = 0 V	V <sub>I</sub> $\leq$ V <sub>CC</sub> V <sub>I</sub> $\geq$ V <sub>EE</sub>	6 -6	V
I <sub>out</sub>	Output Current	Continuous Surge		50 100	mA
I <sub>BB</sub>	V <sub>BB</sub> Sink/Source			$\pm$ 0.5	mA
T <sub>A</sub>	Operating Temperature Range			-40 to +85	$^{\circ}$ C
T <sub>stg</sub>	Storage Temperature Range			-65 to +150	$^{\circ}$ C
$\theta_{JA}$	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	32 LQFP 32 LQFP	80 55	$^{\circ}$ C/W
$\theta_{JC}$	Thermal Resistance (Junction-to-Case)	Standard Board	32 LQFP	12 to 17	$^{\circ}$ C/W
T <sub>sol</sub>	Wave Solder Pb-Free			265	$^{\circ}$ 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.

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**Table 4. 100EP DC CHARACTERISTICS, PECL**  $V_{CC} = 3.3\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (Note 2)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	60	75	90	60	80	95	60	85	95	mA
$V_{OH}$	Output HIGH Voltage (Note 3)	2155	2280	2405	2155	2280	2405	2155	2280	2405	mV
$V_{OL}$	Output LOW Voltage (Note 3)	1355	1480	1605	1355	1480	1605	1355	1480	1605	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	2075		2420	2075		2420	2075		2420	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	1355		1675	1490		1675	1490		1675	mV
$V_{BB}$	Output Voltage Reference	1775	1875	1975	1775	1875	1975	1775	1875	1975	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4)	2.0		3.3	2.0		3.3	2.0		3.3	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	0.5			0.5			0.5			$\mu\text{A}$

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 lfp.m.

- Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +0.3 V to -2.2 V.
- All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .
- $V_{IHCMR}$  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. 100EP DC CHARACTERISTICS, PECL**  $V_{CC} = 5.0\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (Note 5)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	60	75	90	60	80	95	60	85	95	mA
$V_{OH}$	Output HIGH Voltage (Note 6)	3855	3980	4105	3855	3980	4105	3855	3980	4105	mV
$V_{OL}$	Output LOW Voltage (Note 6)	3055	3180	3305	3055	3180	3305	3055	3180	3305	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	3775		4120	3775		4120	3775		4120	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	3790		3375	3190		3375	3190		3375	mV
$V_{BB}$	Output Voltage Reference	3475	3575	3675	3475	3575	3675	3475	3575	3675	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 7)	2.0		5.0	2.0		5.0	2.0		5.0	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	0.5			0.5			0.5			$\mu\text{A}$

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 lfp.m.

- Input and output parameters vary 1:1 with  $V_{CC}$ .  $V_{EE}$  can vary +2.0 V to -0.5 V.
- All loading with 50  $\Omega$  to  $V_{CC} - 2.0\text{ V}$ .
- $V_{IHCMR}$  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.

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**Table 6. 100EP DC CHARACTERISTICS, NECL**  $V_{CC} = 0\text{ V}$ ,  $V_{EE} = -5.5\text{ V}$  to  $-3.0\text{ V}$  (Note 8)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$I_{EE}$	Power Supply Current	60	75	90	60	80	95	60	85	95	mA
$V_{OH}$	Output HIGH Voltage (Note 9)	-1145	-1020	-895	-1145	-1020	-895	-1145	-1020	-895	mV
$V_{OL}$	Output LOW Voltage (Note 9)	-1945	-1820	-1695	-1945	-1820	-1695	-1945	-1820	-1695	mV
$V_{IH}$	Input HIGH Voltage (Single-Ended)	-1225		-880	-1225		-880	-1225		-880	mV
$V_{IL}$	Input LOW Voltage (Single-Ended)	-1945		-1625	-1945		-1625	-1945		-1625	mV
$V_{BB}$	Output Voltage Reference	-1525	-1425	-1325	-1525	-1425	-1325	-1525	-1425	-1325	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 10)	$V_{EE}+2.0$		0.0	$V_{EE}+2.0$		0.0	$V_{EE}+2.0$		0.0	V
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	0.5			0.5			0.5			$\mu\text{A}$

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 lpm.

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

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

10.  $V_{IHCMR}$  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**  $V_{CC} = 0\text{ V}$ ;  $V_{EE} = -3.0\text{ V}$  to  $-5.5\text{ V}$  or  $V_{CC} = 3.0\text{ V}$  to  $5.5\text{ V}$ ;  $V_{EE} = 0\text{ V}$  (Note 11)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$f_{max}$	Maximum Frequency (See Figure 3 $F_{max}/\text{JITTER}$ )		> 3			> 3			> 3		GHz
$t_{PLH}$ , $t_{PHL}$	Propagation Delay to Output Differential	160	250	340	160	260	340	190	300	380	ps
$t_{SKEW}$	Duty Cycle Skew (Note 12)		5.0	20		5.0	20		5.0	20	ps
$t_{SKEW}$	Within Device Skew Device to Device Skew (Note 12)			100 180			100 180			100 190	ps
$t_{\text{JITTER}}$	Cycle-to-Cycle Jitter (See Figure 3 $F_{max}/\text{JITTER}$ )		0.2	< 1		0.2	< 1		0.2	< 1	ps
$V_{PP}$	Input Voltage Swing (Differential Configuration)	150	800	1200	150	800	1200	150	800	1200	mV
$t_r$ , $t_f$	Output Rise/Fall Times (20% - 80%) $Q, \bar{Q}$	90	150	220	90	160	240	90	160	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 lpm.

11. Measured using a 750 mV source, 50% duty cycle clock source. All loading with  $50\ \Omega$  to  $V_{CC} - 2.0\text{ V}$ .

12. 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.

# MC100EP116

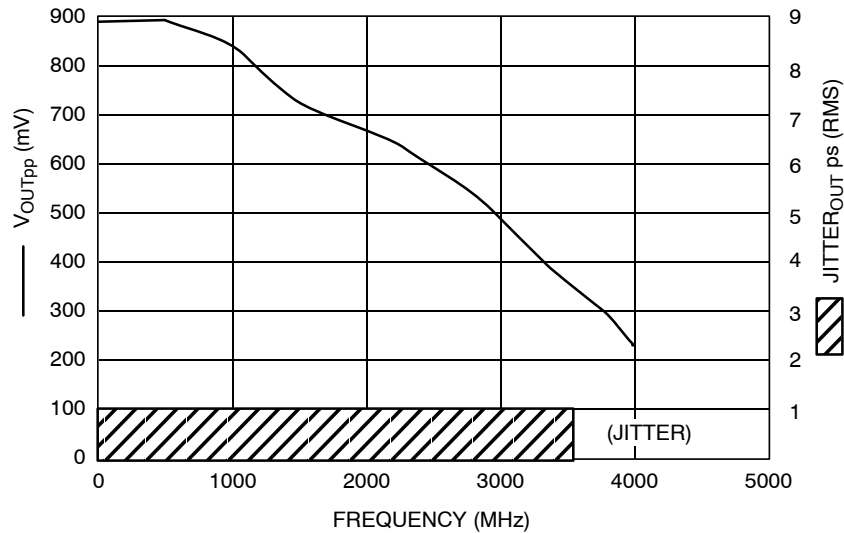


Figure 3. F<sub>max</sub>/Jitter

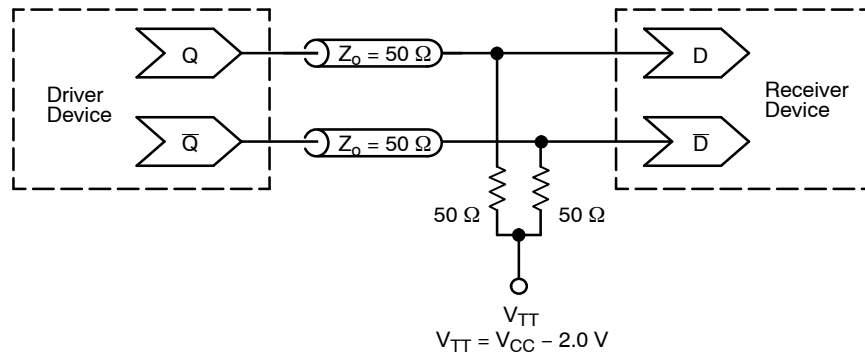


Figure 4. Typical Termination for Output Driver and Device Evaluation  
(See Application Note [AND8020/D](#) – Termination of ECL Logic Devices.)

## 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

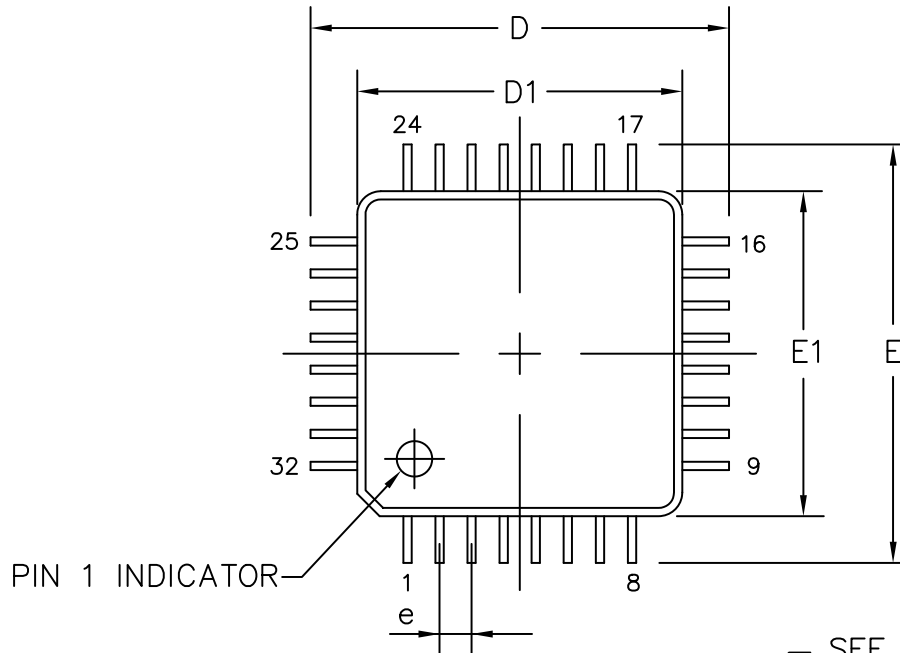
**MECHANICAL CASE OUTLINE**  
**PACKAGE DIMENSIONS**

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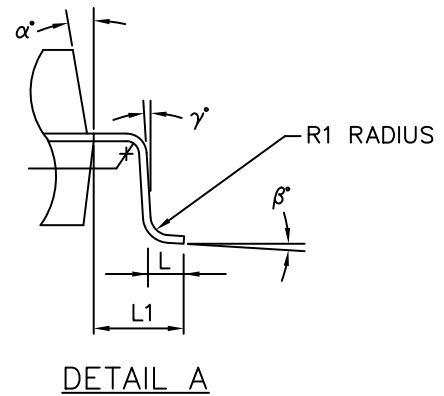
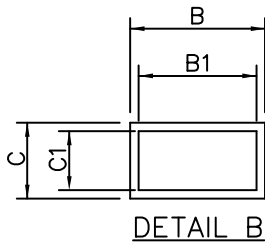
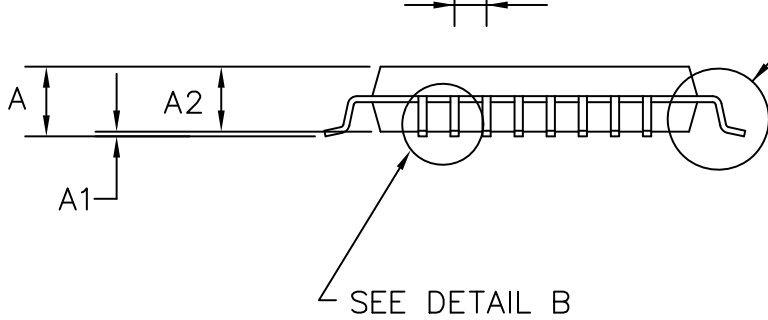


**LQFP-32, 7x7**  
**CASE 561AB-01**  
**ISSUE O**

DATE 19 JUN 2008



SYMBOL	MIN	NOM	MAX
A	—	—	1.60
A1	0.05	—	0.15
A2	1.35	1.40	1.45
B	0.30	0.37	0.45
B1	0.30	0.35	0.40
C	0.09	—	0.20
C1	0.09	—	0.16
D	9.00 BSC		
D1	7.00 BSC		
E	9.00 BSC		
E1	7.00 BSC		
e	0.80 BSC		
L	0.45	0.60	0.75
L1	1.00		
R1	0.08	—	0.20
$\alpha^\circ$	11	—	13
$\beta^\circ$	0	—	7
$\gamma^\circ$	0	—	—



ALL DIMENSIONS IN MM

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