

# MC100EP809

## 3.3V 2:1:9 Differential HSTL/PECL/LVDS to HSTL Clock Driver with LVTTTL Clock Select and Enable

### Description

The MC100EP809 is a low skew 2:1:9 differential clock driver, designed with clock distribution in mind, accepting two clock sources into an input multiplexer. The part is designed for use in low voltage applications which require a large number of outputs to drive precisely aligned low skew signals to their destination. The two clock inputs are one differential HSTL and one differential LVPECL. Both input pairs can accept LVDS levels. They are selected by the CLK\_SEL pin which is LVTTTL. To avoid generation of a runt clock pulse when the device is enabled/disabled, the Output Enable (OE), which is LVTTTL, is synchronous ensuring the outputs will only be enabled/disabled when they are already in LOW state (Figure 9).

The MC100EP809 guarantees low output-to-output skew. The optimal design, layout, and processing minimize skew within a device and from lot to lot. The MC100EP809 output structure uses open emitter architecture and will be terminated with 50  $\Omega$  to ground instead of a standard HSTL configuration (Figure 7). To ensure the tight skew specification is realized, both sides of the differential output need to be terminated identically into 50  $\Omega$  even if only one output is being used. If an output pair is unused, both outputs may be left open (unterminated) without affecting skew.

Designers can take advantage of the EP809's performance to distribute low skew clocks across the backplane of the board. Both clock inputs may be single-end driven by biasing the non-driven pin in an input pair (Figure 8).

### Features

- 100 ps Typical Device-to-Device Skew
- 15 ps Typical within Device Skew
- HSTL Compatible Outputs Drive 50  $\Omega$  to GND with no Offset Voltage
- Maximum Frequency > 750 MHz
- 850 ps Typical Propagation Delay
- Fully Compatible with Micrel SY89809L
- PECL and HSTL Mode Operating Range:  $V_{CCI} = 3\text{ V}$  to 3.6 V with  $GND = 0\text{ V}$ ,  $V_{CCO} = 1.6\text{ V}$  to 2.0 V
- Open Input Default State
- These Devices are Pb-Free and are RoHS Compliant



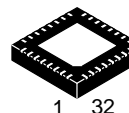
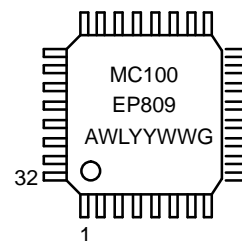
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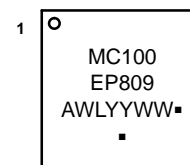
### MARKING DIAGRAMS\*



32-LEAD LQFP  
FA SUFFIX  
CASE 873A



QFN32  
MN SUFFIX  
CASE 488AM



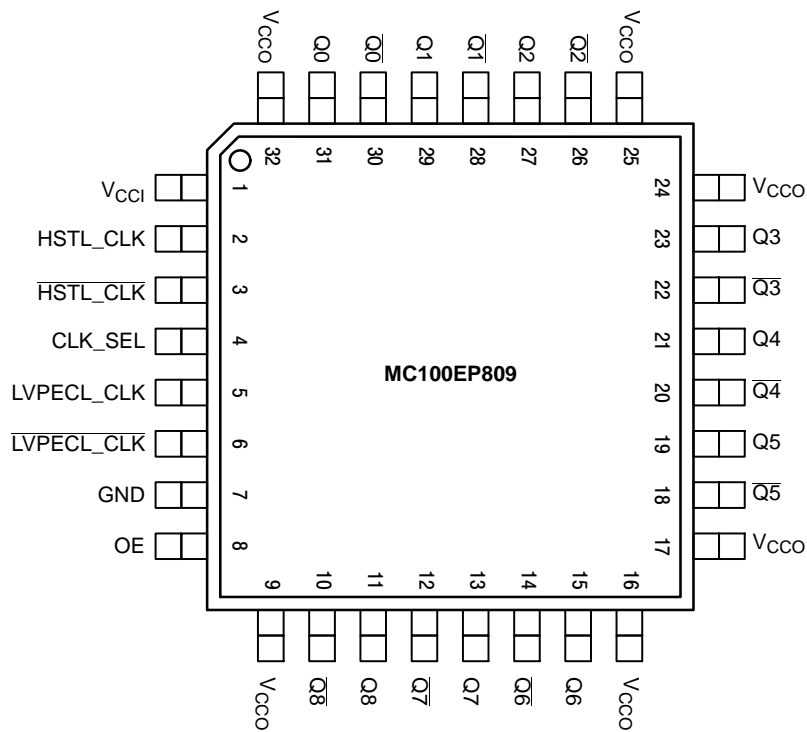
A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G or ■ = Pb-Free Package  
(Note: Microdot may be in either location)

\*For additional marking information, refer to Application Note AND8002/D.

### ORDERING INFORMATION

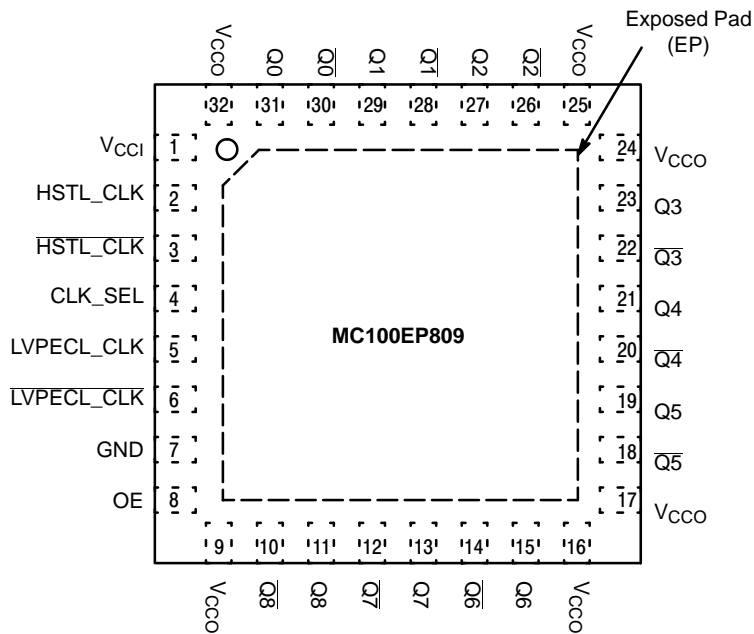
See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

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All V<sub>CCI</sub>, V<sub>CCO</sub>, and GND pins must be externally connected to appropriate Power Supply to guarantee proper operation (V<sub>CCI</sub> ≠ V<sub>CCO</sub>).

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



**Figure 2. 32-Lead QFN Pinout (Top View)**

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**Table 1. PIN DESCRIPTION**

PIN	FUNCTION
HSTL_CLK*, HSTL_CLK**	HSTL or LVDS Differential Inputs
LVPECL_CLK*, LVPECL_CLK**	LVPECL or LVDS Differential Inputs
CLK_SEL**	LVC MOS/LVTTL Input CLK Select
OE**	LVC MOS/LVTTL Output Enable
Q0 – Q8, Q0 – Q8	HSTL Differential Outputs
V <sub>CC1</sub>	Positive Supply_Core (3.0 V – 3.6 V)
V <sub>CC0</sub>	Positive Supply_HSTL Outputs (1.6 V – 2.0 V)
GND	Ground
EP	The exposed pad (EP) on the QFN–32 package bottom is thermally connected to the die for improved heat transfer out of the package. The exposed pad must be attached to a heat-sinking conduit. The pad is electrically connected to GND.

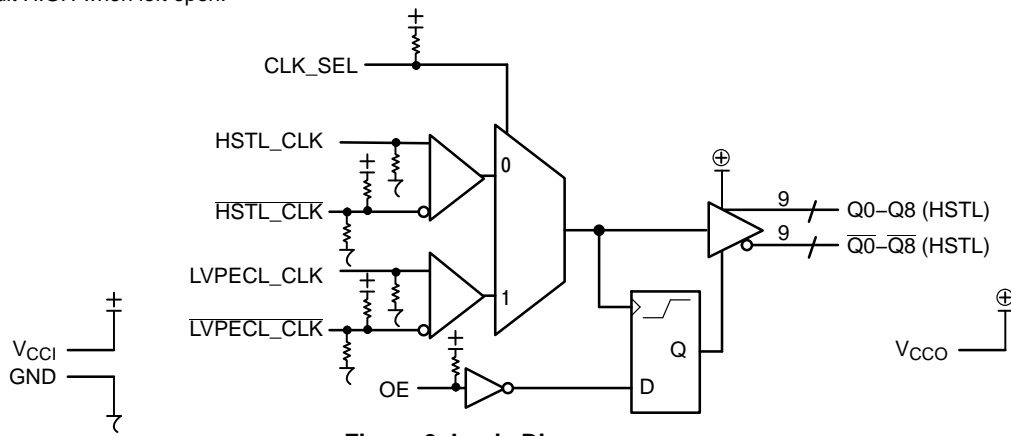
\* Pins will default LOW when left open.

\*\* Pins will default HIGH when left open.

**Table 2. TRUTH TABLE**

OE*	CLK_SEL	Q0 – Q8	$\overline{Q0} - \overline{Q8}$
L	L	L	H
L	H	L	H
H	L	HSTL_CLK	HSTL_CLK
H	H	LVPECL_CLK	LVPECL_CLK

\*The OE (Output Enable) signal is synchronized with the rising edge of the HSTL\_CLK and LVOCL\_CLK signals.



**Figure 3. Logic Diagram**

**Table 3. ATTRIBUTES**

Characteristics		Value	
Internal Input Pulldown Resistor		75 kΩ	
Internal Input Pullup Resistor		37.5 kΩ	
ESD Protection	Human Body Model	> 2 kV	
	Machine Model	> 200 V	
	Charged Device Model	> 2 kV	
Moisture Sensitivity, Indefinite Time Out of Drypack (Note 1)	Pb Pkg	Pb-Free Pkg	
	LQFP–32 QFN–32	Level 2 N/A	Level 2 Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V–0 @ 0.125 in	
Transistor Count	478 Devices		
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test			

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

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**Table 4. MAXIMUM RATINGS**

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V <sub>CC1</sub>	Core Power Supply	GND = 0 V	V <sub>CC0</sub> = 1.6 to 2.0 V	4	V
V <sub>CC0</sub>	HSTL Output Power Supply	GND = 0 V	V <sub>CC1</sub> = 3.0 to 3.6 V	4	V
V <sub>I</sub>	Input Voltage	GND = 0 V	V <sub>I</sub> ≤ V <sub>CC1</sub>	4	V
I <sub>out</sub>	Output Current	Continuous Surge		50 100	mA mA
T <sub>A</sub>	Operating Temperature Range			0 to +85	°C
T <sub>stg</sub>	Storage Temperature Range			-65 to +150	°C
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	LQFP-32 LQFP-32	80 55	°C/W °C/W
θ <sub>JC</sub>	Thermal Resistance (Junction-to-Case)	Standard Board	LQFP-32	12 to 17	°C/W
θ <sub>JA</sub>	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	QFN-32 QFN-32	31 27	°C/W °C/W
θ <sub>JC</sub>	Thermal Resistance (Junction-to-Case)	2S2P	QFN-32	12	°C/W
T <sub>sol</sub>	Wave Solder Pb Pb-Free			265 265	°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 5. LVPECL DC CHARACTERISTICS** V<sub>CC1</sub> = 3.0 V to 3.6 V; V<sub>CC0</sub> = 1.6 V to 2.0 V, GND = 0 V

Symbol	Characteristic	0°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
I <sub>CC</sub>	Core Power Supply Current	75	95	115	75	95	115	75	95	115	mA
V <sub>IH</sub>	Input HIGH Voltage (Single-Ended)	V <sub>CC1</sub> - 1.165		V <sub>CC1</sub> - 0.88	V <sub>CC1</sub> - 1.165		V <sub>CC1</sub> - 0.88	V <sub>CC1</sub> - 1.165		V <sub>CC1</sub> - 0.88	V
V <sub>IL</sub>	Input LOW Voltage (Single-Ended)	V <sub>CC1</sub> - 1.945		V <sub>CC1</sub> - 1.6	V <sub>CC1</sub> - 1.945		V <sub>CC1</sub> - 1.6	V <sub>CC1</sub> - 1.945		V <sub>CC1</sub> - 1.6	V
V <sub>IHCMR</sub>	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 2) (Figure 5) LVPECL_CLK/LVPECL_CLK	1.2		V <sub>CC1</sub>	1.2		V <sub>CC1</sub>	1.2		V <sub>CC1</sub>	V
I <sub>IH</sub>	Input HIGH Current	-150		150	-150		150	-150		150	μA
I <sub>IL</sub>	Input LOW Current	-150		150	-150		150	-150		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.

2. V<sub>IHCMR</sub> max varies 1:1 with V<sub>CC1</sub>. The V<sub>IHCMR</sub> range is referenced to the most positive side of the differential input signal.

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**Table 6. LVTTTL/LVCMOS DC CHARACTERISTICS**  $V_{CCI} = 3.0\text{ V to }3.6\text{ V}$ ;  $V_{CCO} = 1.6\text{ V to }2.0\text{ V}$ ,  $GND = 0\text{ V}$

Symbol	Characteristic	0°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$V_{IH}$	Input HIGH Voltage	2.0			2.0			2.0			V
$V_{IL}$	Input LOW Voltage			0.8			0.8			0.8	V
$I_{IH}$	Input HIGH Current	-150		150	-150		150	-150		150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	-300		300	-300		300	-300		300	$\mu\text{A}$

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.

**Table 7. HSTL DC CHARACTERISTICS**  $V_{CCI} = 3.0\text{ V to }3.6\text{ V}$ ;  $V_{CCO} = 1.6\text{ V to }2.0\text{ V}$ ,  $GND = 0\text{ V}$

Symbol	Characteristic	0°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$V_{OH}$	Output HIGH Voltage (Note 3)	1.0		1.2	1.0		1.2	1.0		1.2	V
$V_{OL}$	Output LOW Voltage (Note 3)	0.1		0.4	0.1		0.4	0.1		0.4	V
$V_{IH}$	Input HIGH Voltage (Figure 6)	$V_X + 0.1$		1.6	$V_X + 0.1$		1.6	$V_X + 0.1$		1.6	V
$V_{IL}$	Input LOW Voltage (Figure 6)	-0.3		$V_X - 0.1$	-0.3		$V_X - 0.1$	-0.3		$V_X - 0.1$	V
$V_X$	HSTL Input Crossover Voltage	0.68	-	0.9	0.68	-	0.9	0.68	-	0.9	V
$I_{IH}$	Input HIGH Current	-150		150	-150		150	-150		150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	-300		300	-300		300	-300		300	$\mu\text{A}$
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4) HSTL_CLK/HSTL_CLK	0.6		$V_{CCI} - 1.2$	0.6		$V_{CCI} - 1.2$	0.6		$V_{CCI} - 1.2$	V V

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.

3. All outputs loaded with 50  $\Omega$  to GND (Figure 7).

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

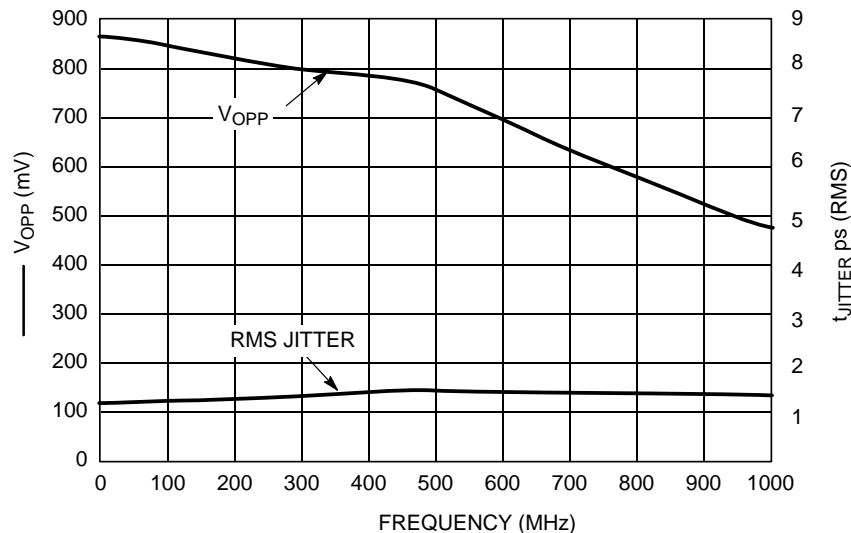
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**Table 8. AC CHARACTERISTICS**  $V_{CCI} = 3.0\text{ V to }3.6\text{ V}$ ;  $V_{CCO} = 1.6\text{ V to }2.0\text{ V}$ ,  $GND = 0\text{ V}$  (Note 5)

Symbol	Characteristic	0°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$V_{Opp}$	Differential Output Voltage (Figure 4) $f_{out} < 100\text{ MHz}$ $f_{out} < 500\text{ MHz}$ $f_{out} < 750\text{ MHz}$	600	850		600	850		600	850		mV mV
		600	750		600	750		600	750		
		450	575		450	575		450	575		
$t_{PLH}$ $t_{PHL}$	Propagation Delay (Differential Configuration) LVPECL_CLK to Q HSTL_CLK to Q	680	800	930	700	820	950	780	920	1070	ps
		690	830	990	700	850	1000	790	950	1110	ps
$t_{skew}$	Within-Device Skew (Note 6) Device-to-Device Skew (Note 7)		15	50		15	50		15	50	ps
			100	200		100	200		100	200	ps
$t_{JITTER}$	Random Clock Jitter (Figure 4) (RMS)		1.4	3.0		1.4	3.0		1.4	3.0	ps
$V_{PP}$	Input Swing (Differential Configuration) (Note 8) (Figure 5) LVPECL HSTL	200			200			200			mV
		200			200			200			mV
$t_S$	OE Set Up Time (Note 9)	0.5			0.5			0.5			ns
$t_H$	OE Hold Time	0.5			0.5			0.5			ns
$t_r/t_f$	Output Rise/Fall Time (20% – 80%)	350		600	350	450	600	350		600	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.

5. Measured with 750 mV (LVPECL) source or 1 V (HSTL) source, 50% duty cycle clock source. All outputs loaded with 50  $\Omega$  to GND (Figure 7).
6. Skew is measured between outputs under identical transitions and conditions on any one device.
7. Device-to-Device skew for identical transitions and conditions.
8.  $V_{PP}$  is the Differential Input Voltage swing required to maintain AC characteristics listed herein.
9. OE Set Up Time is defined with respect to the rising edge of the clock. OE High-to-Low transition ensures outputs remain disabled during the next clock cycle. OE Low-to-High transition enables normal operation of the next input clock (Figure 9).



**Figure 4. Output Frequency ( $F_{OUT}$ ) versus Output Voltage ( $V_{OPP}$ ) and Random Clock Jitter ( $t_{JITTER}$ )**

# MC100EP809

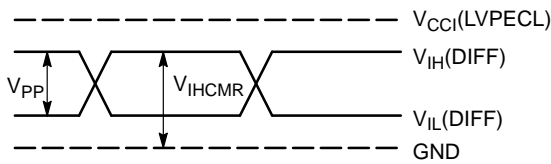


Figure 5. LVPECL Differential Input Levels

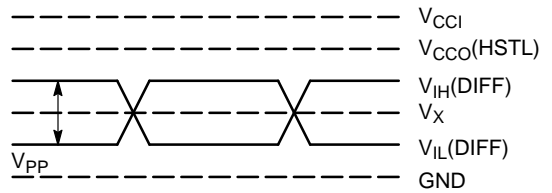


Figure 6. HSTL Differential Input Levels

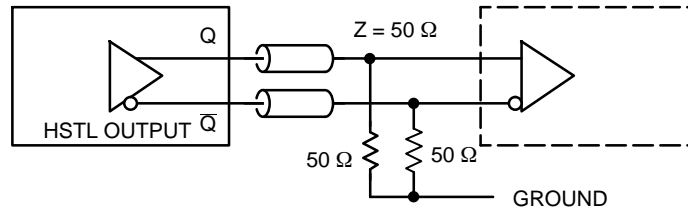
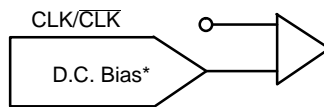


Figure 7. HSTL Output Termination and AC Test Reference



\*Must be CLK/CLK common mode voltage:  $((V_{IH} + V_{IL})/2)$ .

Figure 8. Single-Ended CLK/CLK Input Configuration

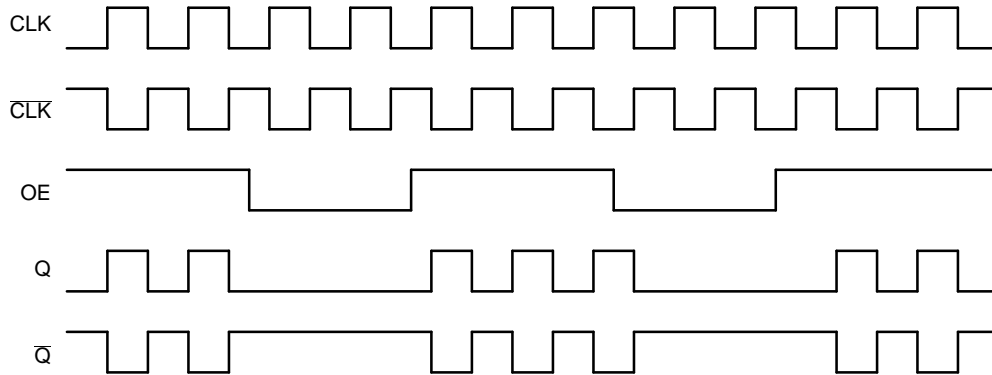


Figure 9. Output Enable (OE) Timing Diagram

# MC100EP809

## ORDERING INFORMATION

Device	Package	Shipping†
MC100EP809FAG	LQFP-32 (Pb-Free)	250 Units / Tray
MC100EP809FAR2G	LQFP-32 (Pb-Free)	2000 / Tape & Reel
MC100EP809MNG	QFN32 (Pb-Free)	74 Units / Rail
MC100EP809MNR4G	QFN32 (Pb-Free)	1000 / 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, BRD8011/D.

### Resource Reference of Application Notes

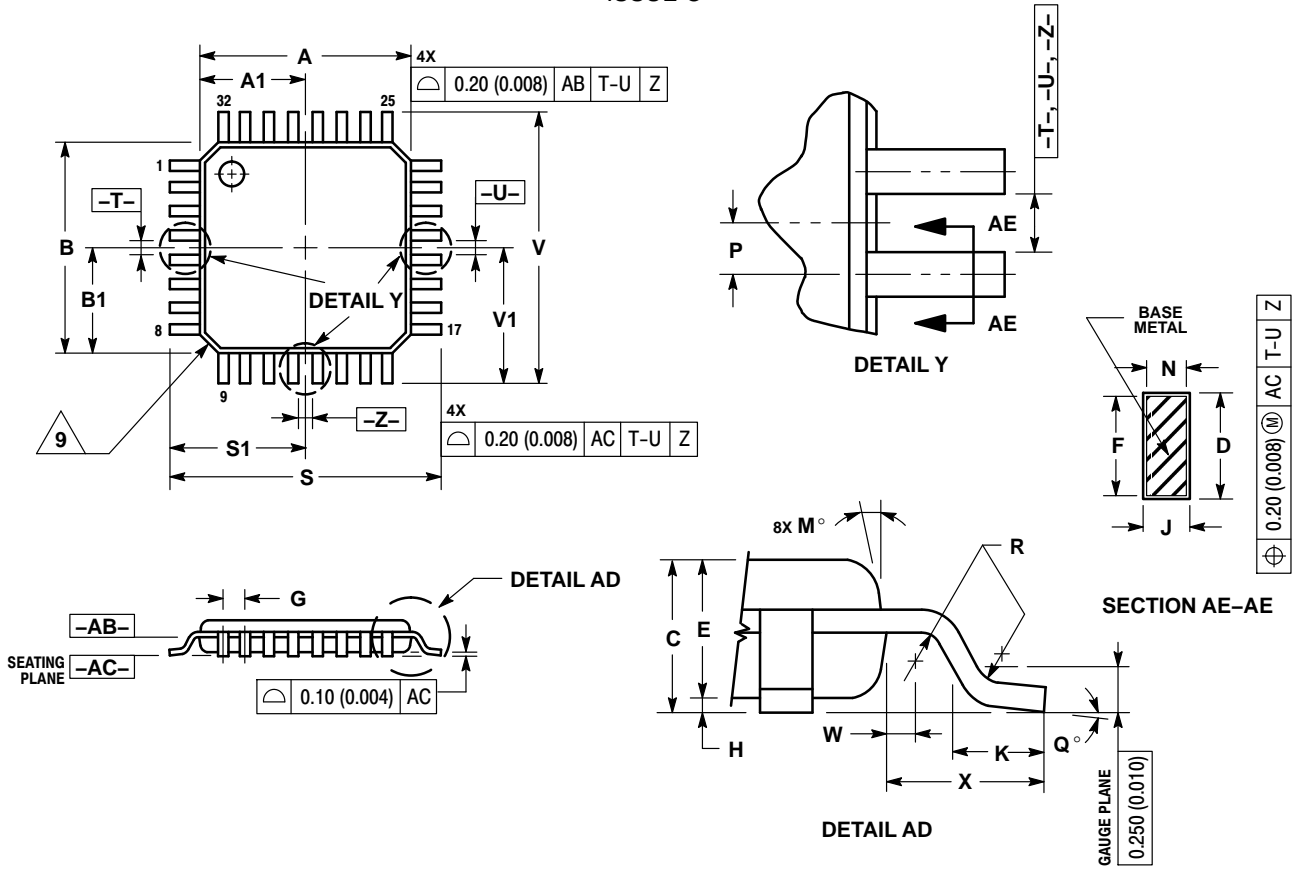
- AN1405/D** – ECL Clock Distribution Techniques
- AN1406/D** – Designing with PECL (ECL at +5.0 V)
- AN1503/D** – ECLinPS™ I/O SPICE Modeling Kit
- AN1504/D** – Metastability and the ECLinPS Family
- AN1568/D** – Interfacing Between LVDS and ECL
- AN1672/D** – The ECL Translator Guide
- AND8001/D** – 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



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## PACKAGE DIMENSIONS

32 LEAD LQFP  
CASE 873A-02  
ISSUE C



**NOTES:**

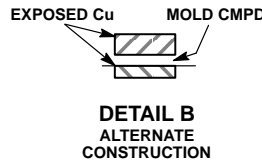
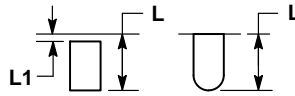
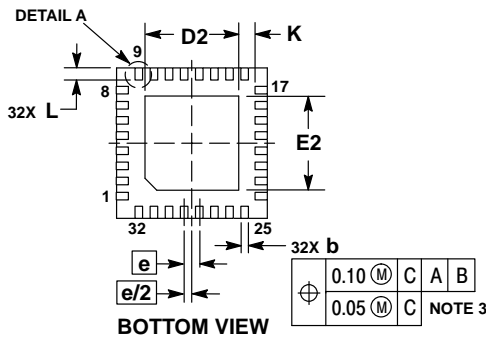
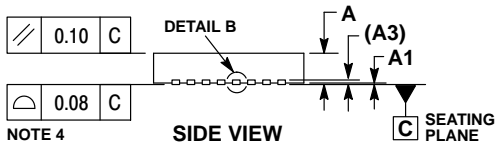
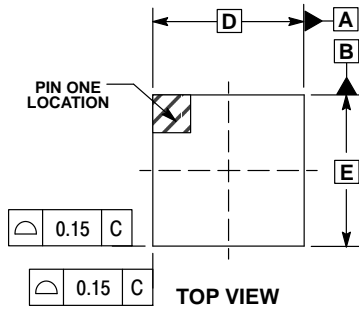
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
- DATUMS -T-, -U-, AND -Z- TO BE DETERMINED AT DATUM PLANE -AB-.
- DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -AC-.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -AB-.
- DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.520 (0.020).
- MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076 (0.0003).
- EXACT SHAPE OF EACH CORNER MAY VARY FROM DEPICTION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	7.000	BSC	0.276	BSC
A1	3.500	BSC	0.138	BSC
B	7.000	BSC	0.276	BSC
B1	3.500	BSC	0.138	BSC
C	1.400	1.600	0.055	0.063
D	0.300	0.450	0.012	0.018
E	1.350	1.450	0.053	0.057
F	0.300	0.400	0.012	0.016
G	0.800	BSC	0.031	BSC
H	0.050	0.150	0.002	0.006
J	0.090	0.200	0.004	0.008
K	0.450	0.750	0.018	0.030
M	12°	REF	12°	REF
N	0.090	0.160	0.004	0.006
P	0.400	BSC	0.016	BSC
Q	1°	5°	1°	5°
R	0.150	0.250	0.006	0.010
S	9.000	BSC	0.354	BSC
S1	4.500	BSC	0.177	BSC
V	9.000	BSC	0.354	BSC
V1	4.500	BSC	0.177	BSC
W	0.200	REF	0.008	REF
X	1.000	REF	0.039	REF

# MC100EP809

## PACKAGE DIMENSIONS

QFN32 5x5, 0.5P  
CASE 488AM  
ISSUE A

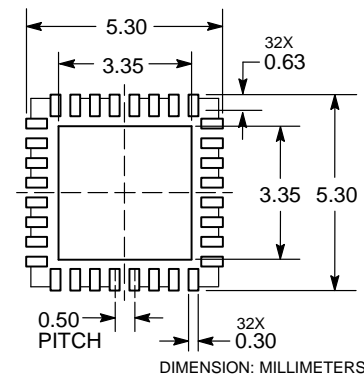


**NOTES:**

1. DIMENSIONS AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.


DIM	MILLIMETERS	
	MIN	MAX
A	0.80	1.00
A1	---	0.05
A3	0.20 REF	
b	0.18	0.30
D	5.00 BSC	
D2	2.95	3.25
E	5.00 BSC	
E2	2.95	3.25
e	0.50 BSC	
K	0.20	---
L	0.30	0.50
L1	---	0.15

**RECOMMENDED  
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.

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

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