

# MC100EP210S

## 2.5V 1:5 Dual Differential LVDS Compatible Clock Driver

### Description

The MC100EP210S is a low skew 1-to-5 dual differential driver, designed with LVDS clock distribution in mind. The LVDS or LVPECL input signals are differential and the signal is fanned out to five identical differential LVDS outputs.

The EP210S specifically guarantees low output-to-output skew. Optimal design, layout, and processing minimize skew within a device and from device to device.

Two internal 50  $\Omega$  resistors are provided across the inputs. For LVDS inputs, VTA and VTB pins should be unconnected. For LVPECL inputs, VTA and VTB pins should be connected to the  $V_{TT}$  ( $V_{CC} - 2.0$  V) supply.

Designers can take advantage of the EP210S performance to distribute low skew LVDS clocks across the backplane or the board.

### Features

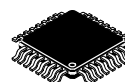
- 20 ps Typical Output-to-Output Skew
- 85 ps Typical Device-to-Device Skew
- 550 ps Typical Propagation Delay
- The 100 Series Contains Temperature Compensation
- Maximum Frequency > 1 GHz Typical
- Operating Range:  $V_{CC} = 2.375$  V to 2.625 V with  $V_{EE} = 0$  V
- Internal 50  $\Omega$  Input Termination Resistors
- LVDS Input/Output Compatible
- These are Pb-Free Devices



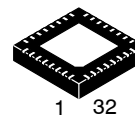
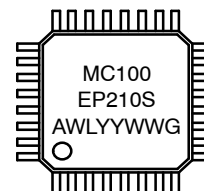
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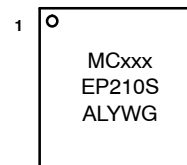
### MARKING DIAGRAM\*



LQFP-32  
FA SUFFIX  
CASE 873A



QFN32  
MN SUFFIX  
CASE 488AM



xxx = 10 or 100  
A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week  
G = Pb-Free Package

\*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 6 of this data sheet.

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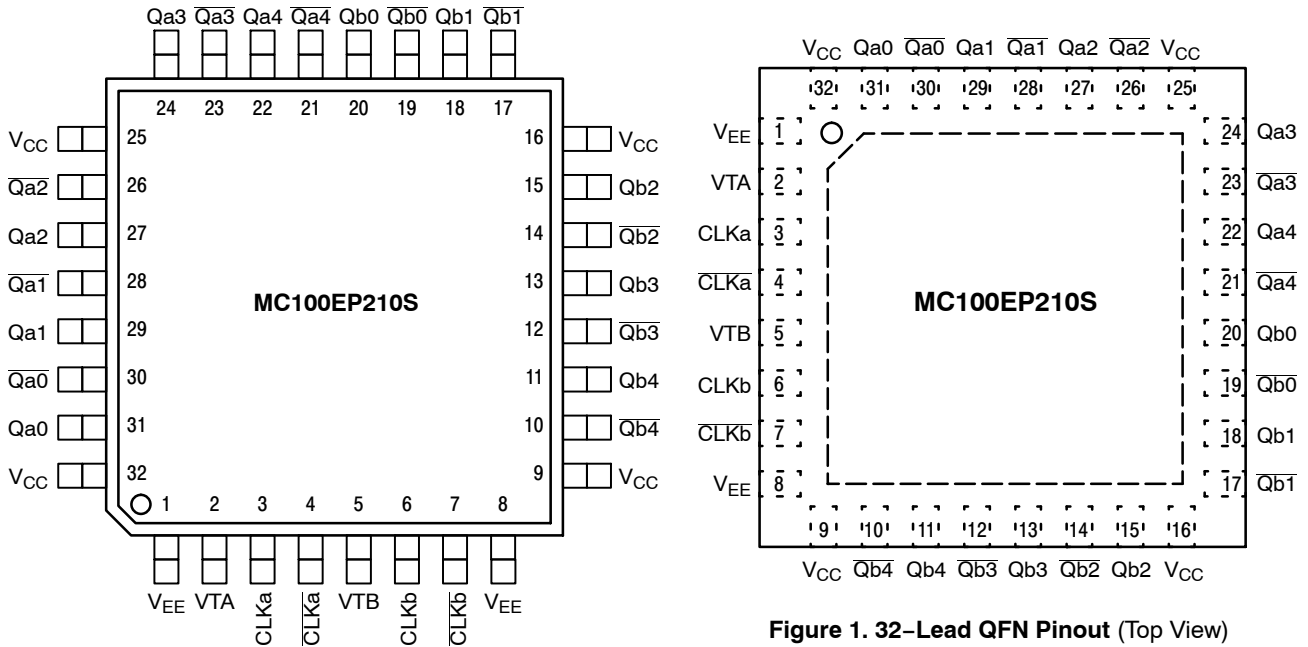


Figure 1. 32-Lead QFN Pinout (Top View)

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)

Table 1. PIN DESCRIPTION

PIN	FUNCTION
CLKn, $\overline{CLKn}$	LVDS, LVPECL CLK Inputs*
Qn0:4, $\overline{Qn0:4}$	LVDS Outputs
VTA	50 $\Omega$ Termination Resistors
VTB	50 $\Omega$ Termination Resistors
$V_{CC}$	Positive Supply
$V_{EE}$	Ground
EP for QFN-32, only	The Exposed Pad (EP) on the QFN-32 package bottom is thermally connected to the die for improved heat transfer out of package. The exposed pad must be attached to a heat-sinking conduit. The pad is electrically connected to $V_{EE}$ .

\*Under open or floating conditions with input pins converging to a common termination bias voltage the device is susceptible to auto oscillation.

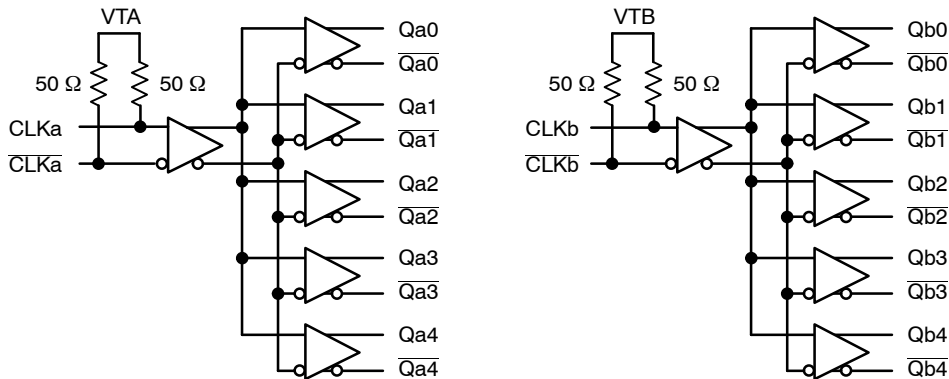


Figure 2. Logic Diagram

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**Table 2. ATTRIBUTES**

Characteristics	Value	
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 Pkg	Pb-Free Pkg
	LQFP-32 QFN-32	Level 2 Level 1
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
Transistor Count	461 Devices	
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test		

1. For additional information, refer to Application Note AND8003/D.

**Table 3. MAXIMUM RATINGS**

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
$V_{CC}$	Power Supply	$V_{EE} = 0\text{ V}$		6	V
$V_{EE}$	Power Supply (GND)	$V_{CC} = 2.5\text{ V}$		-6	V
$V_I$	LVDS, LVPECL Input Voltage	$V_{EE} = 0\text{ V}$	$V_I \leq V_{CC}$	6	V
$I_{out}$	Output Current	Continuous Surge		50 100	mA mA
$T_A$	Operating Temperature Range			-40 to +85	°C
$T_{stg}$	Storage Temperature Range			-65 to +150	°C
$\theta_{JA}$	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	32 LQFP 32 LQFP	80 55	°C/W °C/W
$\theta_{JC}$	Thermal Resistance (Junction-to-Case)	Standard Board	32 LQFP	12 to 17	°C/W
$\theta_{JA}$	Thermal Resistance (Junction-to-Ambient)	0 lfpm 500 lfpm	QFN-32 QFN-32	31 27	°C/W °C/W
$\theta_{JC}$	Thermal Resistance (Junction-to-Case)	2S2P	QFN-32	12	°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.

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**Table 4. DC CHARACTERISTICS**  $V_{CC} = 2.5\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (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		150	200		150	200		150	200	mA
$V_{OH}$	Output HIGH Voltage (Note 3)	1250	1400	1550	1250	1400	1550	1250	1400	1550	mV
$V_{OL}$	Output LOW Voltage (Note 3)	800	950	1100	800	950	1100	800	950	1100	mV
$V_{IHCMR}$	Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 4)	1.2		2.5	1.2		2.5	1.2		2.5	V
$R_T$	Internal Termination Resistor	43		57	43	50	57	43		57	$\Omega$
$I_{IH}$	Input HIGH Current			150			150			150	$\mu\text{A}$
$I_{IL}$	Input LOW Current	CLK CLK	-150 -150	150 150	-150 -150		150 150	-150 -150		150 150	$\mu\text{A}$

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 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.

- Input and output parameters vary 1:1 with  $V_{CC}$ .
- All loading with 100  $\Omega$  across LVDS differential outputs.
- $V_{IHCMR}$  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. AC CHARACTERISTICS**  $V_{CC} = 2.375$  to  $2.625\text{ V}$ ,  $V_{EE} = 0\text{ V}$  (Note 5)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$f_{\text{maxLVDS/LVPECL}}$	Maximum Frequency (See Figure 2. $F_{\text{max/JITTER}}$ )		> 1			> 1			> 1		GHz
$t_{PLH}$ $t_{PHL}$	Propagation Delay	425	525	625	450	550	650	475	575	675	ps
$t_{\text{skew}}$	Within-Device Skew (Note 6) Device-to-Device Skew (Note 7) Duty Cycle Skew (Note 8)		20 85 80	25 160 100		20 85 80	25 160 100		20 85 80	35 160 100	ps
$t_{\text{JITTER}}$	RMS Random Clock Jitter		0.2	< 1		0.2	< 1		0.2	< 1	ps
$V_{PP}$	Minimum Input Swing	150	800	1200	150	800	1200	150	800	1200	mV
$t_r/t_f$	Output Rise/Fall Time (20%–80%)	50	130	200	75	150	225	80	160	230	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.

- Measured with 400 mV source, 50% duty cycle clock source. All loading with 100  $\Omega$  across differential outputs.
- Skew is measured between outputs under identical transitions of similar paths through a device.
- Device-to-Device skew for identical transitions at identical  $V_{CC}$  levels.
- Duty cycle skew guaranteed only for differential operation measured from the cross point of the input to the cross point of the output.

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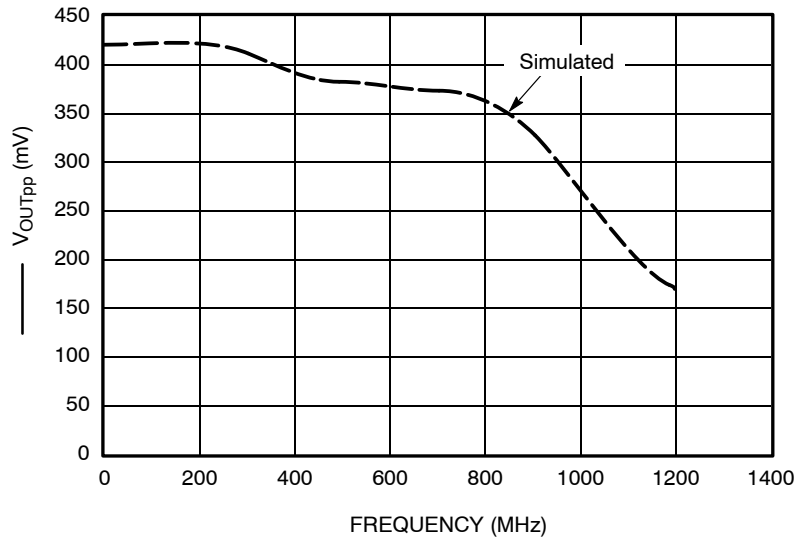


Figure 2.  $F_{max}$

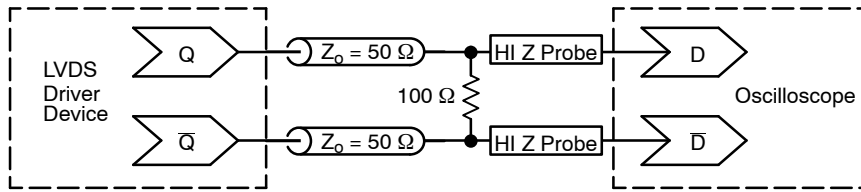


Figure 3. Typical Termination for Output Driver and Device Evaluation

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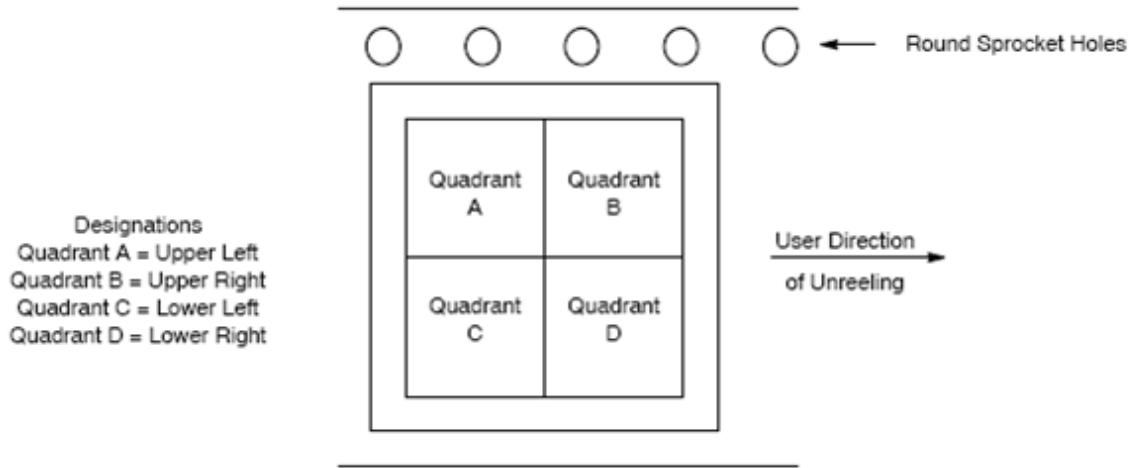


Figure 4. Tape and Reel Pin 1 Quadrant Orientation

## ORDERING INFORMATION

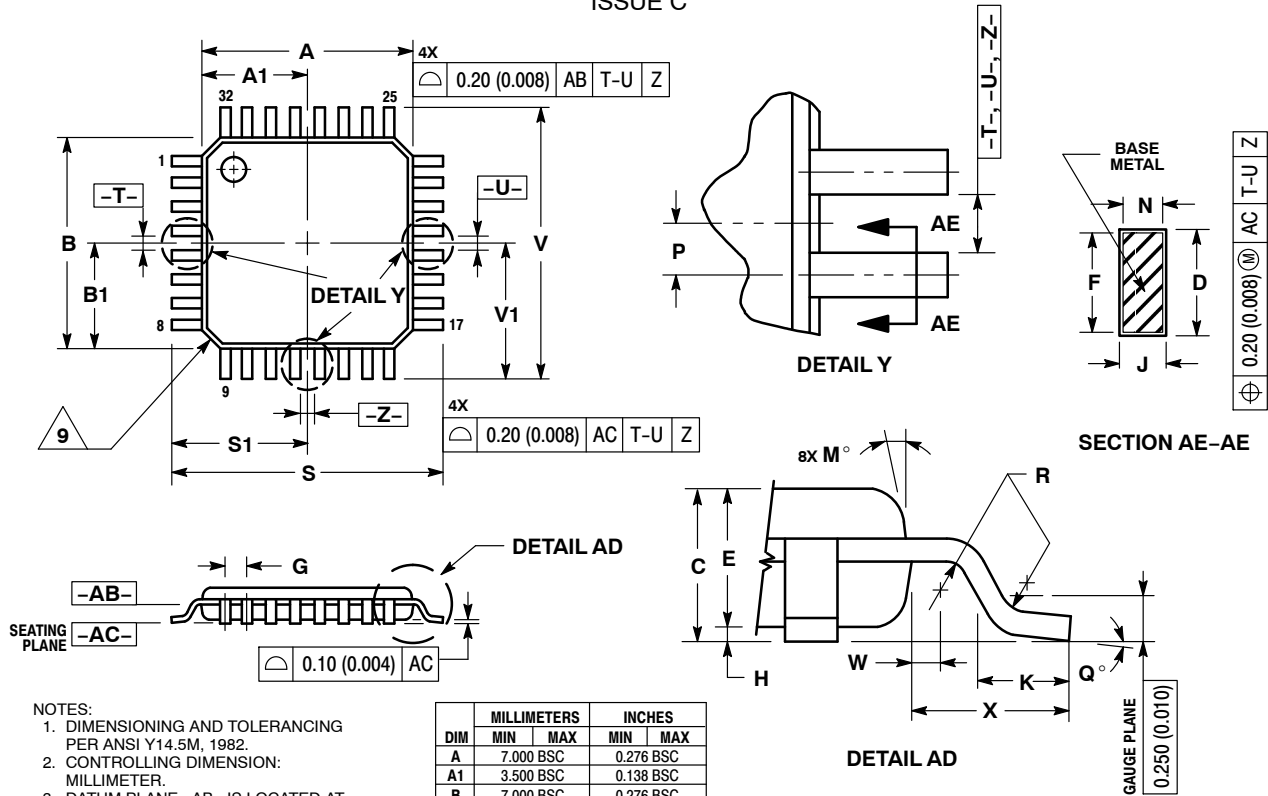
Device	Package	Shipping <sup>†</sup>
MC100EP210SFAG	LQFP-32 (Pb-Free)	250 Units / Tray
MC100EP210SFAR2G	LQFP-32 (Pb-Free)	2000 / Tape & Reel (Pin 1 Orientation in Quadrant B, Figure 4)
MC100EP210SFATWG	LQFP-32 (Pb-Free)	2000 / Tape & Reel (Pin 1 Orientation in Quadrant A, Figure 4)
MC100EP210SMNG	QFN-32 (Pb-Free)	72 Units / Tray
MC100EP210SMNR4G	QFN-32 (Pb-Free)	1000 / Tape & Reel

<sup>†</sup>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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## PACKAGE DIMENSIONS

32 LEAD LQFP  
CASE 873A-02  
ISSUE C



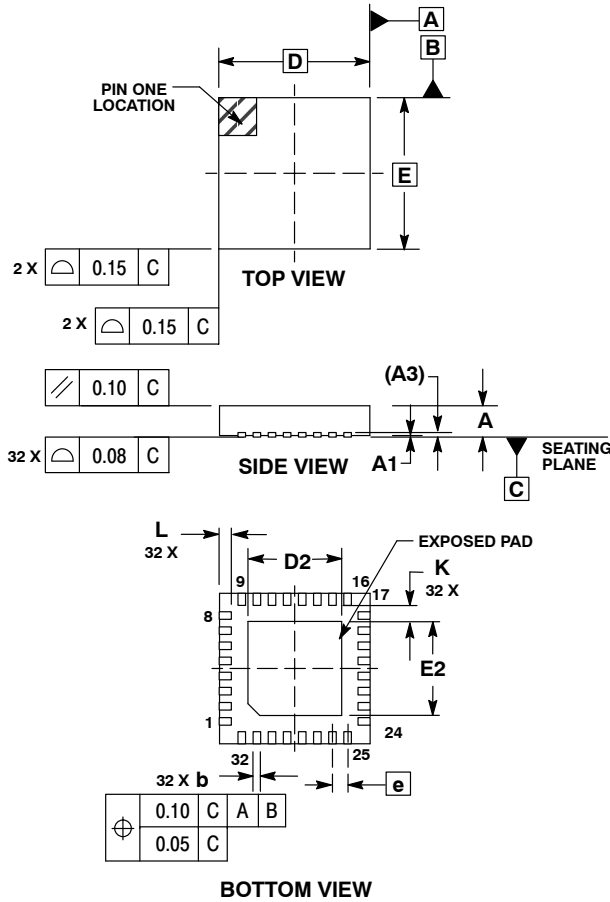
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
  4. DATUMS -T-, -U-, AND -Z- TO BE DETERMINED AT DATUM PLANE -AB-.
  5. DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -AC-.
  6. 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-.
  7. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.520 (0.020).
  8. MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076 (0.0003).
  9. 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	

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## PACKAGE DIMENSIONS

QFN32 5\*5\*1 0.5 P  
CASE 488AM-01  
ISSUE O

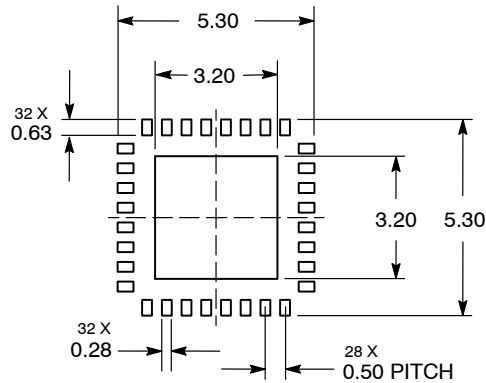


**NOTES:**

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

MILLIMETERS			
DIM	MIN	NOM	MAX
A	0.800	0.900	1.000
A1	0.000	0.025	0.050
A3	0.200 REF		
b	0.180	0.250	0.300
D	5.00 BSC		
D2	2.950	3.100	3.250
E	5.00 BSC		
E2	2.950	3.100	3.250
e	0.500 BSC		
K	0.200	---	---
L	0.300	0.400	0.500

**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.

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