

MC100LVEP210

2.5V / 3.3V 1:5 Dual Differential ECL/PECL/HSTL Clock Driver

Description

The MC100LVEP210 is a low skew 1-to-5 dual differential driver, designed with clock distribution in mind. The ECL/PECL input signals can be either differential or single-ended if the V_{BB} output is used. The signal is fanned out to 5 identical differential outputs. HSTL inputs can be used when the EP210 is operating in PECL mode.

The LVEP210 specifically guarantees low output-to-output skew. Optimal design, layout, and processing minimize skew within a device and from device to device.

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.

The MC100LVEP210, as with most other ECL devices, can be operated from a positive V_{CC} supply in PECL mode. This allows the LVEP210 to be used for high performance clock distribution in +3.3 V or +2.5 V systems. Single-ended CLK input operation is limited to a $V_{CC} \geq 3.0\ \text{V}$ in PECL mode, or $V_{EE} \leq -3.0\ \text{V}$ in ECL mode.

Designers can take advantage of the LVEP210's performance to distribute low skew clocks across the backplane or the board. In a PECL environment, series or Thevenin line terminations are typically used as they require no additional power supplies. For more information on using PECL, designers should refer to Application Note AN1406/D.

Features

- 85 ps Typical Device-to-Device Skew
- 20 ps Typical Output-to-Output Skew
- V_{BB} Output
- Jitter Less than 1 ps RMS
- 350 ps Typical Propagation Delay
- Maximum Frequency > 3 GHz Typical
- The 100 Series Contains Temperature Compensation
- PECL and HSTL Mode Operating Range: $V_{CC} = 2.375\ \text{V}$ to $3.8\ \text{V}$ with $V_{EE} = 0\ \text{V}$
- NECL Mode Operating Range: $V_{CC} = 0\ \text{V}$ with $V_{EE} = -2.375\ \text{V}$ to $-3.8\ \text{V}$
- Open Input Default State
- LVDS Input Compatible
- Fully Compatible with MC100EP210
- These are Pb-Free Devices



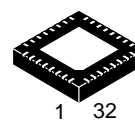
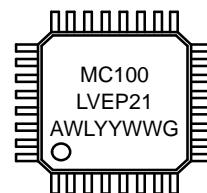
ON Semiconductor®

<http://onsemi.com>

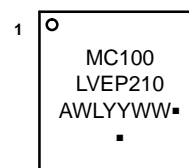
MARKING DIAGRAMS*



32-LEAD LQFP
FA SUFFIX
CASE 873A



1 32
QFN32
MN SUFFIX
CASE 488AM



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

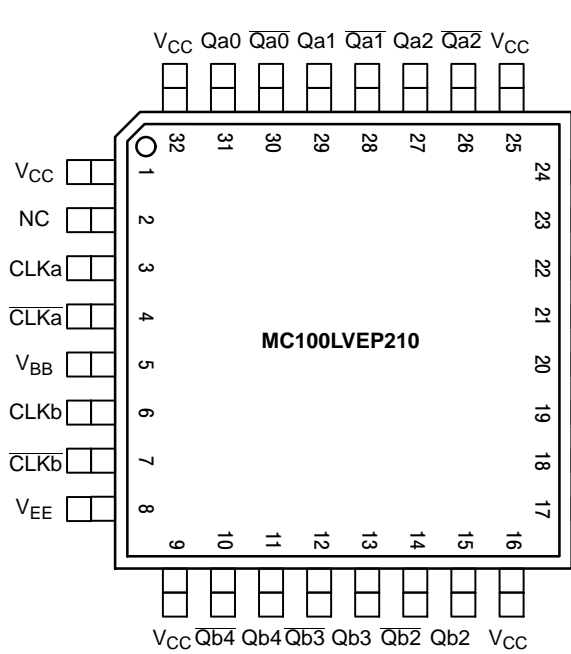
(Note: Microdot may be in either location)

*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 7 of this data sheet.

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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 QFN Pinout (Top View)

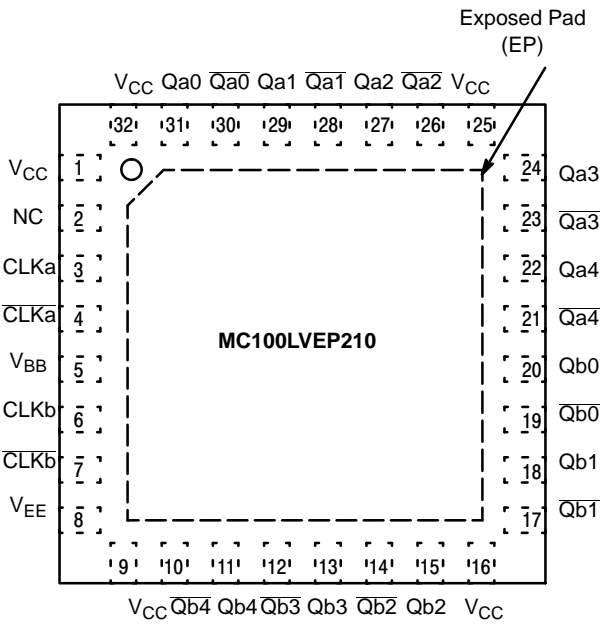


Figure 2. LQFP-32 Pinout (Top View)

Table 1. PIN DESCRIPTION

| PIN | FUNCTION |
|-------------------------------------|--|
| CLK_n^* , \overline{CLK}_n^{**} | ECL/PECL/HSTL CLK Inputs |
| $Q_n0:4$, $\overline{Q}_n0:4$ | ECL/PECL Outputs |
| V_{BB} | Reference Voltage Output |
| V_{CC} | Positive Supply |
| V_{EE} | Negative Supply |
| 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 V_{EE} . |

* Pins will default LOW when left open.

** Pins will default to $V_{CC}/2$ when left open.

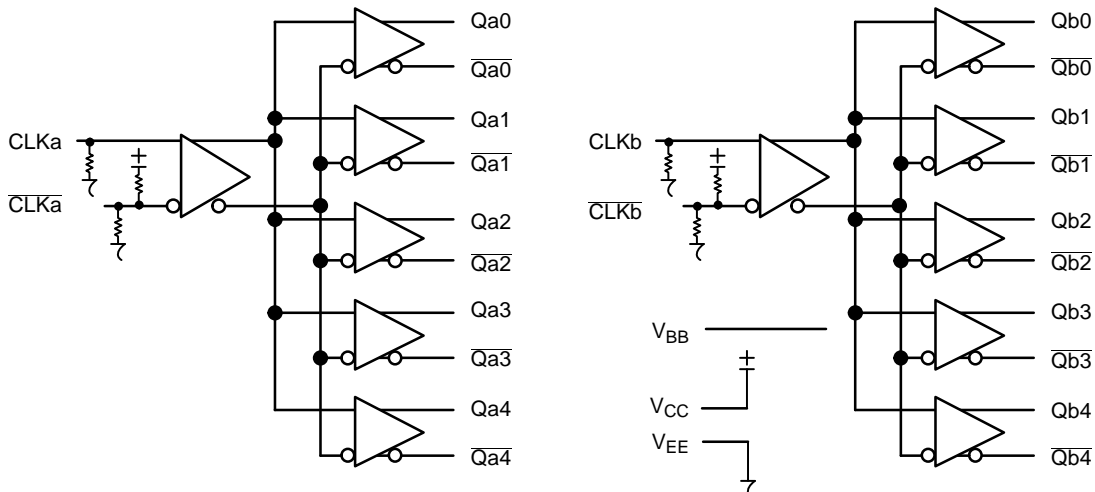


Figure 3. Logic Diagram

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Table 2. ATTRIBUTES

| Characteristics | | Value | |
|--|---|-----------------------------|--------------------------------------|
| Internal Input Pulldown Resistor | | 75 kΩ | |
| Internal Input Pull-up Resistor | | 37.5 kΩ | |
| ESD Protection | Human Body Model Machine Model Charged Device Model | > 2 kV > 100 V > 2 kV | |
| Moisture Sensitivity (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 | | 461 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} | PECL Mode Power Supply | V _{EE} = 0 V | | 6 | V |
| V _{EE} | NECL Mode Power Supply | V _{CC} = 0 V | | -6 | V |
| V _I | PECL Mode Input Voltage NECL Mode Input Voltage | V _{EE} = 0 V V _{CC} = 0 V | V _I ≤ V _{CC} V _I ≥ 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 |
| T _A | Operating Temperature Range | | | -40 to +85 | °C |
| T _{stg} | Storage Temperature Range | | | -65 to +150 | °C |
| θ _{JA} | Thermal Resistance (Junction-to-Ambient) | 0 lfpm 500 lfpm | LQFP-32 LQFP-32 | 80 55 | °C/W °C/W |
| θ _{JC} | Thermal Resistance (Junction-to-Case) | Standard Board | LQFP-32 | 12 to 17 | °C/W |
| θ _{JA} | Thermal Resistance (Junction-to-Ambient) | 0 lfpm 500 lfpm | QFN-32 QFN-32 | 31 27 | °C/W °C/W |
| θ _{JC} | Thermal Resistance (Junction-to-Case) | 2S2P | QFN-32 | 12 | °C/W |
| T _{sol} | Wave Solder | Pb Pb-Free | <2 to 3 sec @ 248°C <2 to 3 sec @ 260°C | 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. PECL 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 | 55 | 70 | 90 | 55 | 70 | 90 | 55 | 70 | 90 | 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) | 505 | 680 | 900 | 505 | 680 | 900 | 505 | 680 | 900 | 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 |
| V_{IL} | Input LOW Voltage (Single-Ended) | 505 | | 900 | 505 | | 900 | 505 | | 900 | mV |
| I_{IH} | Input HIGH Current | | | 150 | | | 150 | | | 150 | μA |
| I_{IL} | Input LOW Current | | | | | | | | | | μA |
| | | CLK | 0.5 | | 0.5 | | | 0.5 | | | μA |
| | | CLK | -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 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} . V_{EE} can vary +0.125 V to -1.3 V.
- All loading with 50 Ω to V_{EE} .
- 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. PECL DC CHARACTERISTICS $V_{CC} = 3.3\text{ V}$; $V_{EE} = 0\text{ V}$ (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 | 55 | 70 | 90 | 55 | 70 | 90 | 55 | 70 | 90 | mA |
| V_{OH} | Output HIGH Voltage (Note 6) | 2155 | 2280 | 2405 | 2155 | 2280 | 2405 | 2155 | 2280 | 2405 | mV |
| V_{OL} | Output LOW Voltage (Note 6) | 1305 | 1480 | 1700 | 1305 | 1480 | 1700 | 1305 | 1480 | 1700 | mV |
| V_{IH} | Input HIGH Voltage (Single-Ended) | 2135 | | 2420 | 2135 | | 2420 | 2135 | | 2420 | mV |
| V_{IL} | Input LOW Voltage (Single-Ended) | 1305 | | 1700 | 1305 | | 1700 | 1305 | | 1700 | mV |
| V_{BB} | Output Reference Voltage (Note 7) | 1775 | 1875 | 1975 | 1775 | 1875 | 1975 | 1775 | 1875 | 1975 | mV |
| V_{IHCMR} | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 8) | 1.2 | | 3.3 | 1.2 | | 3.3 | 1.2 | | 3.3 | V |
| I_{IH} | Input HIGH Current | | | 150 | | | 150 | | | 150 | μA |
| I_{IL} | Input LOW Current | | | | | | | | | | μA |
| | | CLK | 0.5 | | 0.5 | | | 0.5 | | | μA |
| | | CLK | -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 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} . V_{EE} can vary +0.925 V to -0.5 V.
- All loading with 50 Ω to $V_{CC} - 2.0\text{ V}$.
- Single-ended input operation is limited $V_{CC} \geq 3.0\text{ V}$ in PECL mode.
- 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. NECL DC CHARACTERISTICS $V_{CC} = 0\text{ V}$, $V_{EE} = -2.375\text{ V}$ to -3.8 V (Note 9)

| Symbol | Characteristic | -40°C | | | 25°C | | | 85°C | | | Unit |
|-------------|---|---------------------------|-------|-------|----------------|-------|-------|----------------|-------|-------|---------------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| I_{EE} | Power Supply Current | 55 | 70 | 90 | 55 | 70 | 90 | 55 | 70 | 90 | mA |
| V_{OH} | Output HIGH Voltage (Note 10) | -1145 | -1020 | -895 | -1145 | -1020 | -895 | -1145 | -1020 | -895 | mV |
| V_{OL} | Output LOW Voltage (Note 10) | -1995 | -1820 | -1600 | -1995 | -1820 | -1600 | -1995 | -1820 | -1600 | mV |
| V_{IH} | Input HIGH Voltage (Single-Ended) | -1165 | | -880 | -1165 | | -880 | -1165 | | -880 | mV |
| V_{IL} | Input LOW Voltage (Single-Ended) | -1995 | | -1600 | -1995 | | -1600 | -1995 | | -1600 | mV |
| V_{BB} | Output Reference Voltage (Note 11) | -1525 | -1425 | -1325 | -1525 | -1425 | -1325 | -1525 | -1425 | -1325 | mV |
| V_{IHCMR} | Input HIGH Voltage Common Mode Range (Differential Configuration) (Note 12) | $V_{EE} + 1.2$ | | 0.0 | $V_{EE} + 1.2$ | | 0.0 | $V_{EE} + 1.2$ | | 0.0 | V |
| I_{IH} | Input HIGH Current | | | 150 | | | 150 | | | 150 | μA |
| I_{IL} | Input LOW Current | CLK 0.5 CLK -150 | | | 0.5 -150 | | | 0.5 -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 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.

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

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

11. Single-ended input operation is limited $V_{EE} \leq -3.0\text{V}$ in NECL mode.

12. 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. HSTL DC CHARACTERISTICS $V_{CC} = 2.375$ to 3.8 V , $V_{EE} = 0\text{ V}$

| Symbol | Characteristic | -40°C | | | 25°C | | | 85°C | | | Unit |
|----------|-------------------------------------|-------|-----|-----|------|-----|-----|------|-----|-----|------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| V_{IH} | Input HIGH Voltage | 1200 | | | 1200 | | | 1200 | | | mV |
| V_{IL} | Input LOW Voltage | | | 400 | | | 400 | | | 400 | mV |
| V_{CM} | Input Crossover Voltage | 680 | | 900 | 680 | | 900 | 680 | | 900 | mV |
| I_{CC} | Power Supply Current (Outputs Open) | 55 | 70 | 90 | 55 | 70 | 90 | 55 | 70 | 90 | mA |

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.

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Table 8. AC CHARACTERISTICS $V_{CC} = 0\text{ V}$; $V_{EE} = -2.375\text{ to }-3.8\text{ V}$ or $V_{CC} = 2.375\text{ to }3.8\text{ V}$; $V_{EE} = 0\text{ V}$ (Note 13)

| Symbol | Characteristic | -40°C | | | 25°C | | | 85°C | | | Unit |
|---------------------------------|---|------------|--|--|------------|--|--|------------|--|--|------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| $f_{\text{maxPECL/HSTL}}$ | Maximum Frequency (Figure 4) | | 3 | | | 3 | | | 3 | | GHz |
| $t_{\text{PLH}}/t_{\text{PHL}}$ | Propagation Delay @ 2.5 V Propagation Delay @ 3.3 V | 220 220 | 300 300 | 380 380 | 270 270 | 350 350 | 430 430 | 300 330 | 400 410 | 500 490 | ps |
| t_{skew} | Within-Device Skew (Note 14) Device-to-Device Skew (Note 15) | | 20 85 | 25 160 | | 20 85 | 25 160 | | 20 85 | 35 160 | ps |
| t_{JITTER} | CLOCK Random Jitter (RMS) @ $\leq 0.5\text{ GHz}$ @ $\leq 1.0\text{ GHz}$ @ $\leq 1.5\text{ GHz}$ @ $\leq 2.0\text{ GHz}$ @ $\leq 2.5\text{ GHz}$ @ $\leq 3.0\text{ GHz}$ | | 0.184 0.190 0.178 0.196 0.239 0.336 | 0.3 0.3 0.3 0.3 0.4 0.5 | | 0.207 0.200 0.197 0.233 0.301 0.422 | 0.3 0.3 0.3 0.4 0.4 0.5 | | 0.271 0.252 0.259 0.308 0.399 0.572 | 0.4 0.4 0.4 0.5 0.5 0.9 | ps |
| V_{PP} | Minimum Input Swing | 150 | 800 | 1200 | 150 | 800 | 1200 | 150 | 800 | 1200 | mV |
| $t_{\text{r}}/t_{\text{f}}$ | Output Rise/Fall Time (20%–80%) | 100 | 170 | 250 | 120 | 190 | 270 | 150 | 280 | 350 | 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. 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.

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

14. Skew is measured between outputs under identical transitions of similar paths through a device.

15. Device-to-Device skew for identical transitions at identical V_{CC} levels.

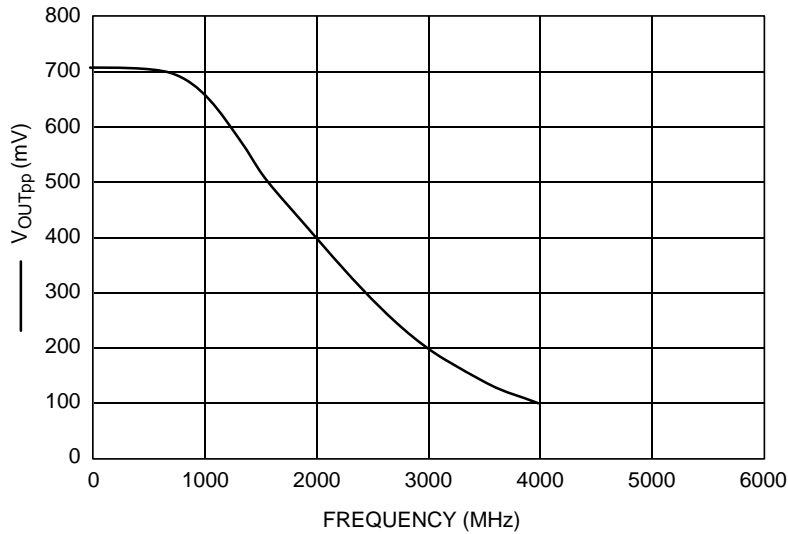
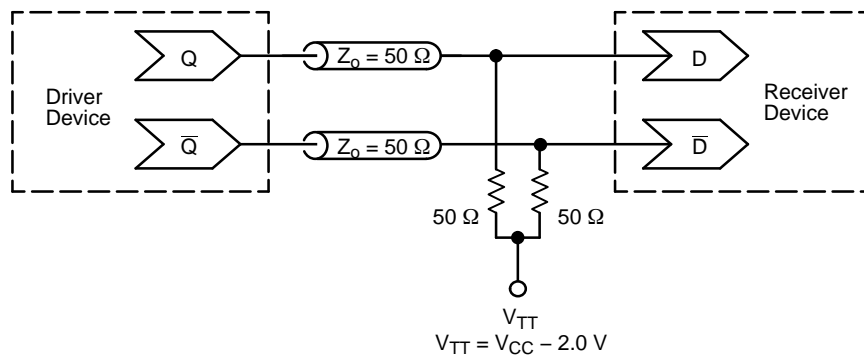


Figure 4. F_{max} Typical

MC100LVEP210



**Figure 5. Typical Termination for Output Driver and Device Evaluation
(See Application Note AND8020/D – Termination of ECL Logic Devices.)**

ORDERING INFORMATION

| Device | Package | Shipping [†] |
|-------------------|--------------------|-----------------------|
| MC100LVEP210FAG | LQFP (Pb-Free) | 250 Units / Tray |
| MC100LVEP210FARG | LQFP (Pb-Free) | 2000 / Tape & Reel |
| MC100LVEP210MNG | QFN32 (Pb-Free) | 74 Units / Rail |
| MC100LVEP210MNR2G | 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.

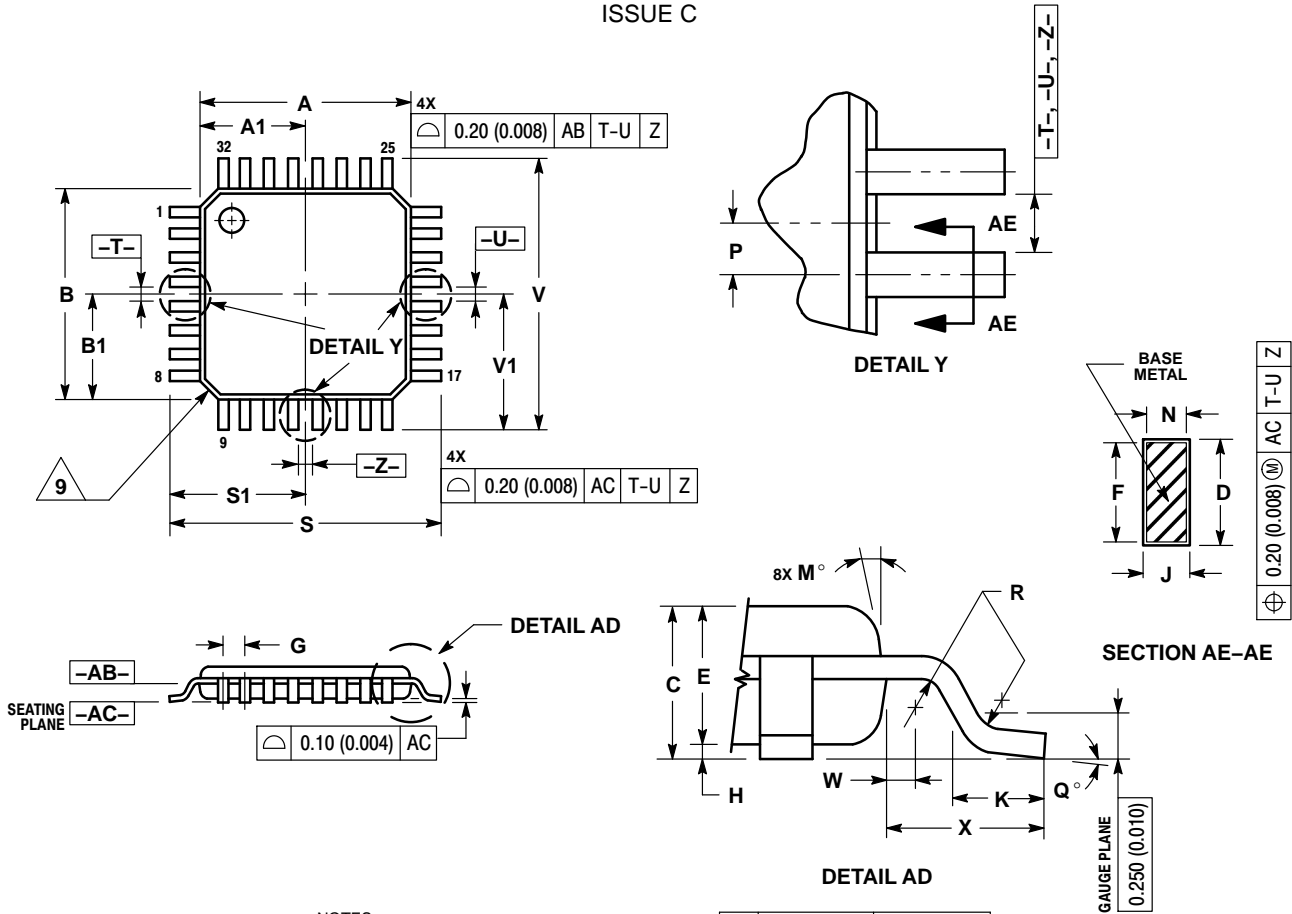
Resource Reference of Application Notes

- 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:

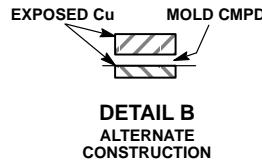
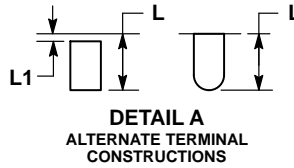
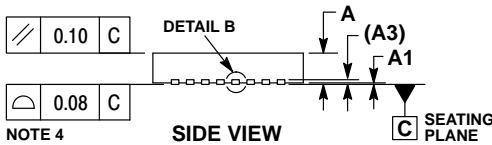
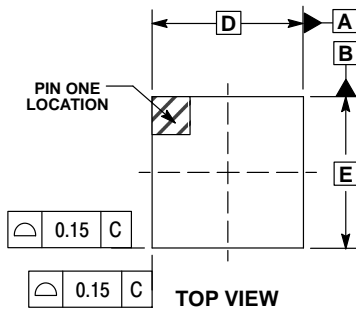
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: MILLIMETER.
- DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
- DATUMS -T-, -U-, AND -Z- TO BE DETERMINED AT DATUM PLANE -AB-.
- DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -AC-.
- DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE MOLD 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 |

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PACKAGE DIMENSIONS

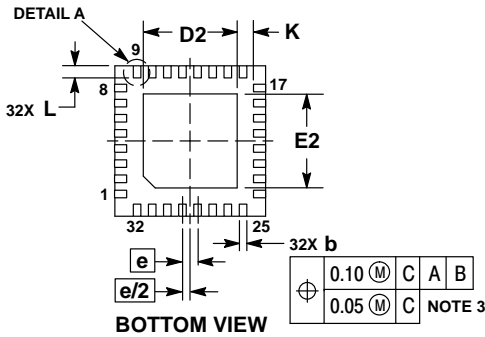
QFN32 5x5, 0.5P
CASE 488AM
ISSUE A



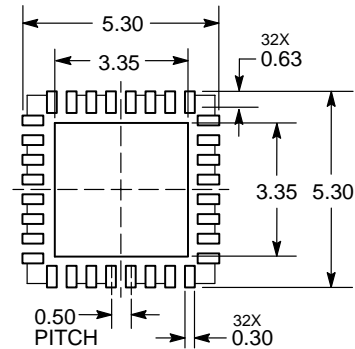
NOTES:

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.

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