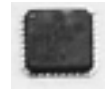




# 2.5V/3.3V TWO INPUT, 1GHz LVTTTL/CMOS-TO-LVPECL 1:4 FANOUT BUFFER/TRANSLATOR WITH 2:1 INPUT MUX

Precision Edge®  
SY89834U



Precision Edge®

## FEATURES

- Selects between two LVTTTL/CMOS inputs and provides 4 LVPECL output copies
- Guaranteed AC performance over temperature and voltage:
  - DC-to >1.0GHz throughput
  - <500ps propagation delay (IN-to-Q)
  - < 20ps within-device skew
  - < 225ps rise/fall time
- Ultra-low jitter design:
  - < 1ps<sub>RMS</sub> cycle-to-cycle jitter
  - < 1ps<sub>RMS</sub> random jitter
  - < 10ps<sub>PP</sub> deterministic jitter
  - < 10ps<sub>PP</sub> total jitter (clock)
- Low voltage 2.5V and 3.3V supply operation
- 100K LVPECL outputs
- Industrial temperature range: -40°C to +85°C
- Includes a 2:1 MUX select input
- Accepts single-ended TTL/CMOS inputs and provides four LVPECL outputs
- Available in 16-pin (3mm × 3mm) MLF™ package

## DESCRIPTION

The SY89834U is a high-speed, 1GHz LVTTTL/CMOS-to-LVPECL fanout buffer/translator optimized for high-speed ultra-low skew applications. The input stage is designed to accept two single-ended LVTTTL/CMOS compatible signals that feed into a 2:1 MUX. The selected input is translated and distributed as four differential 100K LVPECL outputs. Within device skew is guaranteed to be less than 20ps over supply voltage and temperature.

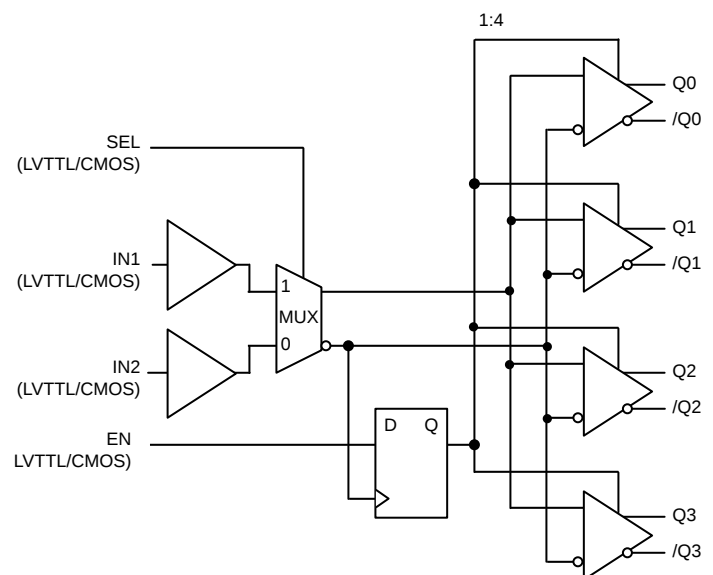
The single-ended input buffers accept TTL/CMOS logic levels. The internal threshold of the buffers is defined as  $V_{CC}/2$ .

The SY89834U is a part of Micrel's high-speed Precision Edge® family. For applications that require a different I/O combination, consult Micrel's website at: [www.micrel.com](http://www.micrel.com), and choose from a comprehensive product line of high-speed, low-skew fanout buffers, translators and clock generators.

## APPLICATIONS

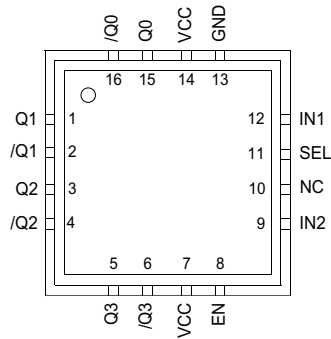
- Processor clock distribution/translation
- SONET clock distribution/translation
- Fibre Channel clock distribution/translation
- Gigabit Ethernet clock distribution/translation
- Single-ended ASIC-to-differential communication IC signal translation

## FUNCTIONAL BLOCK DIAGRAM



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MicroLeadFrame and MLF are trademarks of Amkor Technology, Inc.

## PACKAGE/ORDERING INFORMATION



## 16-Pin MLF™ (MLF-16)

## Ordering Information<sup>(1)</sup>

| Part Number                    | Package Type | Operating Range | Package Marking                      | Lead Finish    |
|--------------------------------|--------------|-----------------|--------------------------------------|----------------|
| SY89834UMI                     | MLF-16       | Industrial      | 834U                                 | Sn-Pb          |
| SY89834UMITR <sup>(2)</sup>    | MLF-16       | Industrial      | 834U                                 | Sn-Pb          |
| SY89834UMG <sup>(3)</sup>      | MLF-16       | Industrial      | 834U with Pb-Free bar line indicator | NiPdAu Pb-Free |
| SY89834UMGTR <sup>(2, 3)</sup> | MLF-16       | Industrial      | 834U with Pb-Free bar line indicator | NiPdAu Pb-Free |

**Notes:**

1. Contact factory for die availability. Dice are guaranteed at  $T_A = 25^\circ\text{C}$ , DC Electricals only.
2. Tape and Reel.
3. Pb-Free package is recommended for new designs.

## PIN DESCRIPTION

| Pin Number                       | Pin Name                                 | Pin Function                                                                                                                                                                                                                                                                                                                             |
|----------------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15, 16<br>1, 2,<br>3, 4,<br>5, 6 | Q0, /Q0<br>Q1, /Q1<br>Q2, /Q2<br>Q3, /Q3 | Differential 100K LVPECL Outputs: These LVPECL outputs are the precision, low skew copies of the inputs. Please refer to the “Truth Table” section for details. Unused output pairs may be left open. Terminate with 50Ω to $V_{CC}-2V$ . See “Output Termination Recommendations” section for more details.                             |
| 8                                | EN                                       | This single-ended TTL/CMOS-compatible input functions as a synchronous output enable. The synchronous enable ensures that enable/disable will only occur when the outputs are in a logic LOW state. Note that this input is internally connected to a 25kΩ pull-up resistor and will default to logic HIGH state (enabled) if left open. |
| 12,<br>9                         | IN1<br>IN2                               | Single-ended TTL/CMOS-compatible inputs to the device. These inputs are internally connected to a 25kΩ pull-up resistor and will default to logic HIGH state if left open. The input threshold is $V_{CC}/2$ .                                                                                                                           |
| 10                               | NC                                       | No connect. Not internally connected.                                                                                                                                                                                                                                                                                                    |
| 11                               | SEL                                      | TTL/CMOS Compatible Select Input for signals IN1 and IN2. The input threshold is $V_{CC}/2$ . HIGH at the SEL input selects signal IN1. LOW at the SEL input selects signal IN2. SEL includes a 25kΩ pull-up resistor. The default state is HIGH when left floating.                                                                     |
| 13                               | GND                                      | Ground. GND pins and exposed pad must be connected to the most negative potential of the device ground.                                                                                                                                                                                                                                  |
| 7, 14                            | VCC                                      | Positive Power Supply: Bypass with 0.1μF//0.01μF low ESR capacitors and place as close to each VCC pin as possible.                                                                                                                                                                                                                      |

## TRUTH TABLE

| IN1 | IN2 | EN | SEL | Q0-Q3            | /Q0-Q3           |
|-----|-----|----|-----|------------------|------------------|
| 0   | X   | 1  | 1   | 0                | 1                |
| 1   | X   | 1  | 1   | 1                | 0                |
| X   | 0   | 1  | 0   | 0                | 1                |
| X   | 1   | 1  | 0   | 1                | 0                |
| X   | X   | 0  | X   | 0 <sup>(1)</sup> | 0 <sup>(1)</sup> |

**Note:**

1. On next negative transition of the input signal (IN).

**Absolute Maximum Ratings<sup>(1)</sup>**

|                                      |                          |
|--------------------------------------|--------------------------|
| Supply Voltage ( $V_{CC}$ )          | –0.5V to +4.0V           |
| Input Voltage ( $V_{IN}$ )           | –0.5V to $V_{CC} + 0.3V$ |
| LVPECL Output Current ( $I_{OUT}$ )  |                          |
| Continuous                           | 50mA                     |
| Surge                                | 100mA                    |
| Input Current ( $I_{IN1}, I_{IN2}$ ) | $\pm 50mA$               |
| Lead Temperature (Soldering, 20sec.) | 260°C                    |
| Storage Temperature ( $T_S$ )        | –65°C to +150°C          |

**Operating Ratings<sup>(2)</sup>**

|                                           |                    |
|-------------------------------------------|--------------------|
| Supply Voltage Range                      | +2.375V to +2.625V |
|                                           | +3.0V to +3.6V     |
| Ambient Temperature ( $T_A$ )             | –40°C to +85°C     |
| Package Thermal Resistance <sup>(3)</sup> |                    |
| MLF™ ( $\theta_{JA}$ )                    |                    |
| Still-Air                                 | 60°C/W             |
| MLF™ ( $\Psi_{JB}$ )                      |                    |
| Junction-to-Board                         | 32°C/W             |

**DC ELECTRICAL CHARACTERISTICS<sup>(4)</sup>**

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise stated.

| Symbol   | Parameter            | Condition              | Min          | Typ | Max          | Units |
|----------|----------------------|------------------------|--------------|-----|--------------|-------|
| $V_{CC}$ | Power Supply         |                        | 2.375<br>3.0 |     | 2.625<br>3.6 | V     |
| $I_{CC}$ | Power Supply Current | No load, max. $V_{CC}$ |              | 50  | 75           | mA    |

**LVTTTL/CMOS INPUTS DC ELECTRICAL CHARACTERISTICS<sup>(4)</sup>**

$V_{CC} = 2.5V \pm 5\%$  or  $V_{CC} = 3.3V \pm 10\%$ ;  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise stated.

| Symbol   | Parameter          | Condition                | Min  | Typ | Max | Units   |
|----------|--------------------|--------------------------|------|-----|-----|---------|
| $V_{IH}$ | Input HIGH Voltage |                          | 2.0  |     |     | V       |
| $V_{IL}$ | Input LOW Voltage  |                          |      |     | 0.8 | V       |
| $I_{IH}$ | Input HIGH Current | $I_{IH} @ V_{IN} = 2.7V$ | –125 |     | 30  | $\mu A$ |
| $I_{IL}$ | Input LOW Current  |                          | –125 |     |     | $\mu A$ |

**(100KEP) LVPECL OUTPUTS DC ELECTRICAL CHARACTERISTICS<sup>(4)</sup>**

$V_{CC} = 2.5V \pm 5\%$  or  $V_{CC} = 3.3V \pm 10\%$ ,  $R_L = 50\Omega$  to  $V_{CC} - 2V$ ;  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise stated.

| Symbol          | Parameter                         | Condition       | Min              | Typ              | Max              | Units |
|-----------------|-----------------------------------|-----------------|------------------|------------------|------------------|-------|
| $V_{OH}$        | Output HIGH Voltage               |                 | $V_{CC} - 1.145$ | $V_{CC} - 1.020$ | $V_{CC} - 0.895$ | V     |
| $V_{OL}$        | Output LOW Voltage                |                 | $V_{CC} - 1.945$ | $V_{CC} - 1.820$ | $V_{CC} - 1.695$ | V     |
| $V_{OUT}$       | Output Voltage Swing              | See Figures 2a. | 550              | 800              | 1050             | mV    |
| $V_{DIFF\_OUT}$ | Differential Output Voltage Swing | See Figures 2b. | 1100             | 1600             | 2100             | mV    |

**Notes:**

1. Permanent device damage may occur if absolute maximum ratings are exceeded. This is a stress rating only and functional operation is not implied at conditions other than those detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
2. The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.
3. Junction-to-board resistance assumes exposed pad is soldered (or equivalent) to the device's most negative potential on the PCB.  $\theta_{JA}$  and  $\Psi_{JB}$  values are determined for a 4-layer board in still-air, unless otherwise stated.
4. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

**AC ELECTRICAL CHARACTERISTICS<sup>(5)</sup>**

$V_{CC} = 2.5V \pm 5\%$  or  $V_{CC} = 3.3V \pm 10\%$ ,  $R_L = 50\Omega$  to  $V_{CC} - 2V$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ , unless otherwise stated.

| Symbol       | Parameter                           | Condition                            | Min | Typ | Max | Units         |
|--------------|-------------------------------------|--------------------------------------|-----|-----|-----|---------------|
| $f_{MAX}$    | Maximum Frequency                   | Input $t_r / t_f \geq 350ps$         | 1.0 |     |     | GHz           |
| $t_{pd}$     | Propagation Delay IN-to-Q           | Note 6                               | 200 | 320 | 500 | ps            |
| $t_{SW}$     | Switchover Time SEL-to-Q            |                                      | 200 | 320 | 500 | ps            |
| $t_{SKEW}$   | Within-Device Skew                  | Note 7                               |     | 5   | 20  | ps            |
|              | Part-to-Part Skew                   | Note 8                               |     |     | 300 | ps            |
| $t_{JITTER}$ | Data                                |                                      |     |     |     |               |
|              | Random Jitter (RJ)                  | Note 9                               |     |     | 1   | $\mu s_{RMS}$ |
|              | Deterministic Jitter (DJ)           | Note 10                              |     |     | 10  | $\mu s_{PP}$  |
|              | Clock                               |                                      |     |     |     |               |
|              | Cycle-to-Cycle Jitter               | Note 11                              |     |     | 1   | $\mu s_{RMS}$ |
|              | Total Jitter (TJ)                   | Note 12                              |     |     | 10  | $\mu s_{PP}$  |
| DC           | Duty Cycle                          | Input $t_r/t_f \geq 350ps$ , Note 13 | 45  | 50  | 55  | %             |
| $t_S$        | Set-Up Time EN to IN1, IN           | Note 14 and Note 15                  | 300 |     |     | ps            |
| $t_H$        | Hold Time EN to IN1, IN             | Note 14 and Note 15                  | 500 |     |     | ps            |
| $t_r, t_f$   | Output Rise/Fall Times (20% to 80%) |                                      | 70  | 140 | 225 | ps            |

**Notes:**

- High-frequency AC parameters are guaranteed by design and characterization.
- $V_{IH} = 2.0V$ ,  $V_{IL} = 0.8V$ , 50% duty cycle. Delay measured at 100MHz from the crossing of the input signal with  $V_{CC}/2$  as the crossing of the differential output signal. See Figure 1.
- Within device skew is measured between two different outputs under identical input transitions.
- Part-to-part skew is defined for two parts with identical power supply voltages at the same temperature and no skew at the edges at the respective inputs.
- Random jitter is measured with a K28.7 pattern, measured at  $\leq f_{MAX}$ .
- Deterministic jitter is measured at 2.5Gbps with both K28.5 and  $2^{23}-1$  PRBS pattern.
- Cycle-to-cycle jitter definition: The variation period between adjacent cycles over a random sample of adjacent cycle pairs.  
 $T_{JITTER\_CC} = T_n - T_{n+1}$ , where T is the time between rising edges of the output signal.
- Total jitter definition: with an ideal clock input frequency of  $\leq f_{MAX}$  (device), no more than one output edge in  $10^{12}$  output edges will deviate by more than the specified peak-to-peak jitter value.
- If  $t_r/t_f$  is less than 350ps, the duty cycle distortion will increase beyond the duty cycle limits.
- Set-up and hold times apply to synchronous applications that intend to enable/disable before the next clock cycle. For asynchronous applications set-up and hold times do not apply.
- See "Timing Diagrams," Figure 1a.

TIMING DIAGRAMS

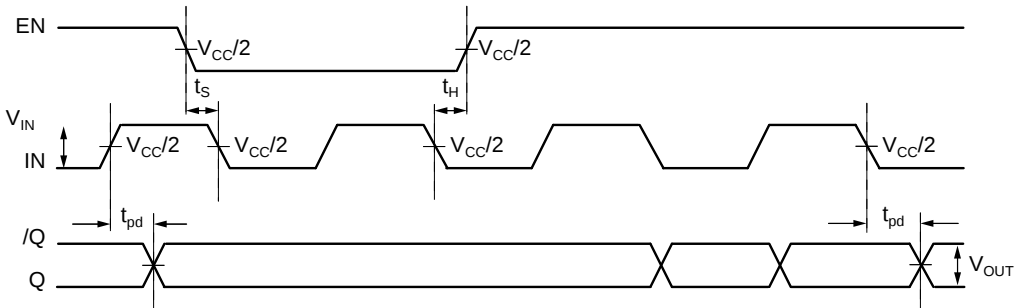


Figure 1a. Timing Diagram  
(EN, IN1, IN2)

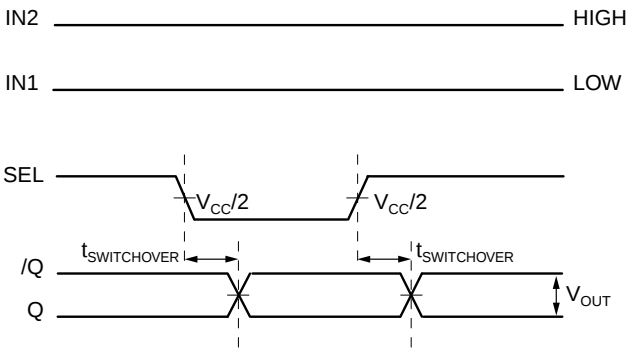


Figure 1b. Timing Diagram  
(SEL)

SINGLE-ENDED AND DIFFERENTIAL SWINGS

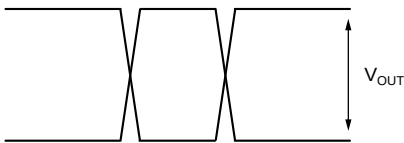


Figure 2a. Single-Ended Swing

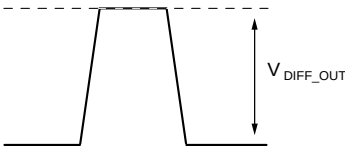
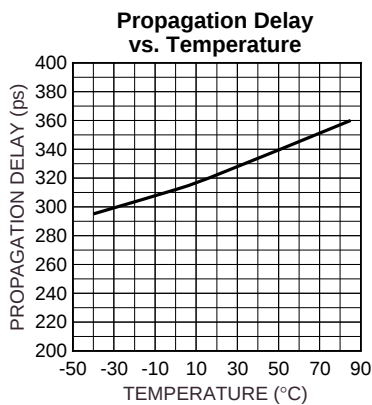
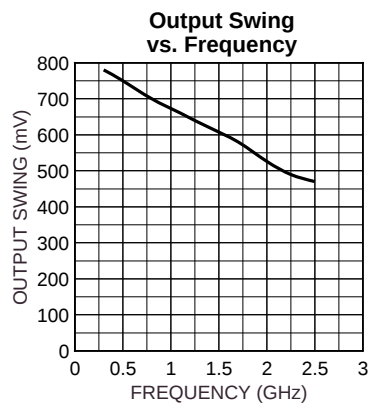


Figure 2b. Differential Swing

TYPICAL OPERATING CHARACTERISTICS

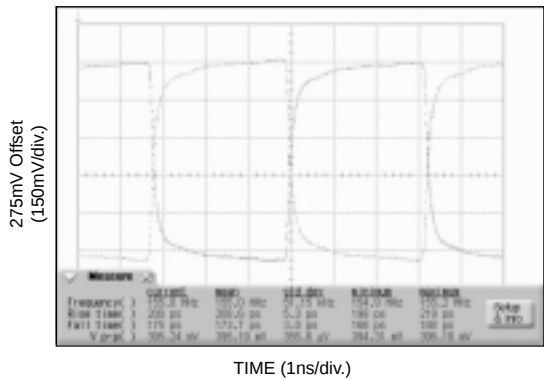
V<sub>CC</sub> = 3.3V, GND = 0V, R<sub>L</sub> = 50Ω to V<sub>CC</sub>-2V; T<sub>A</sub> = 25°C, unless otherwise stated.



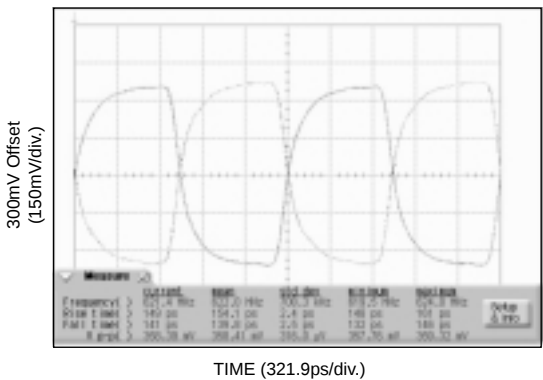
FUNCTIONAL CHARACTERISTICS

V<sub>CC</sub> = 3.3V, GND = 0V, R<sub>L</sub> = 50Ω to V<sub>CC</sub>-2V, T<sub>A</sub> = 25°C, unless otherwise stated.

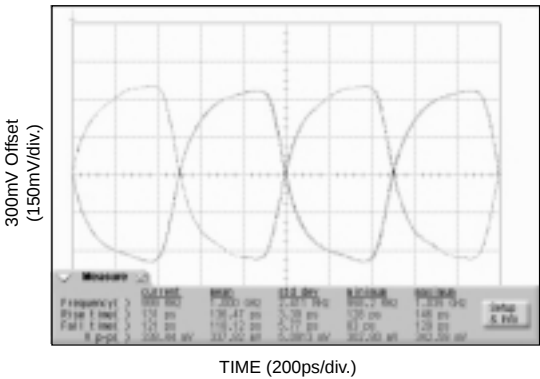
155MHz Output



622MHz Output



1GHz Output



DIFFERENTIAL INPUT

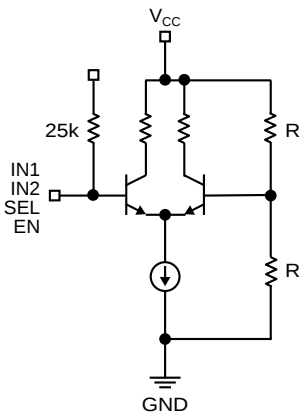


Figure 3. Simplified TTL/CMOS Input Buffer

RELATED PRODUCTS AND SUPPORT DOCUMENTATION

| Part Number   | Function                                                                         | Data Sheet Link                                                                                                                               |
|---------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| SY89830U      | 2.5V/3.3V/5V 2.5GHz 1:4 PECL/ECL Clock Driver with 2:1 Differential Input Mux    | <a href="http://www.micrel.com/product-info/products/sy89830u.shtml">http://www.micrel.com/product-info/products/sy89830u.shtml</a>           |
| SY89831U      | Ultra-Precision 1:4 LVPECL Fanout Buffer/Translator with Internal Termination    | <a href="http://www.micrel.com/product-info/products/sy89831u.shtml">http://www.micrel.com/product-info/products/sy89831u.shtml</a>           |
| SY89832U      | 2.5V Ultra-Precision 1:4 LVDS Fanout Buffer/Translator with Internal Termination | <a href="http://www.micrel.com/product-info/products/sy89832u.shtml">http://www.micrel.com/product-info/products/sy89832u.shtml</a>           |
| SY89833U      | 3.3V Ultra-Precision 1:4 LVDS Fanout Buffer/Translator with Internal Termination | <a href="http://www.micrel.com/product-info/products/sy89833u.shtml">http://www.micrel.com/product-info/products/sy89833u.shtml</a>           |
|               | 16-MLF™ Manufacturing Guidelines Exposed Pad Application Note                    | <a href="http://www.amkor.com/products/notes-papers/MLF-appnote-0301.pdf">http://www.amkor.com/products/notes-papers/MLF-appnote-0301.pdf</a> |
| HBW Solutions | New Products + Termination App Note                                              | <a href="http://www.micrel.com/product-info/as/solutions.shtml">http://www.micrel.com/product-info/as/solutions.shtml</a>                     |

## TERMINATION RECOMMENDATIONS

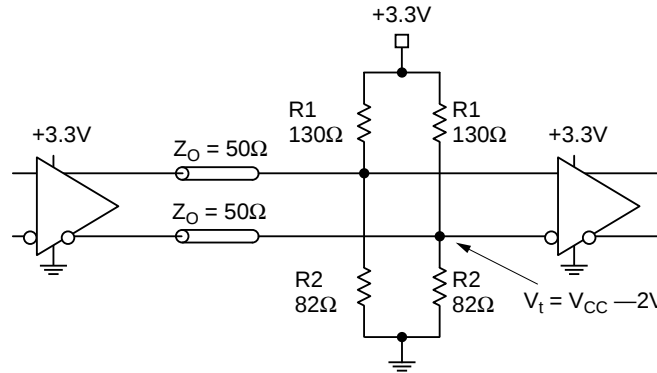


Figure 4a. Parallel Termination-Thevenin Equivalent

**Note:**

1. For +2.5V systems:  $R_1 = 250\Omega$ ,  $R_2 = 62.5\Omega$   
For +3.3V systems:  $R_1 = 130\Omega$ ,  $R_2 = 82\Omega$

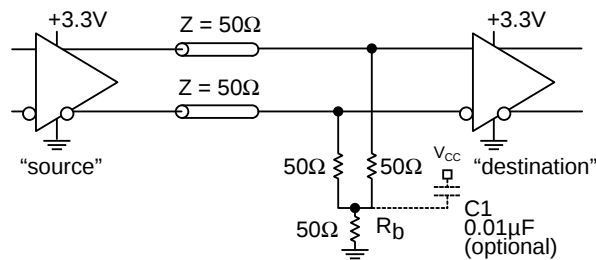


Figure 4b. Three-Resistor "Y-Termination"

**Notes:**

1. Power-saving alternative to Thevenin termination.
2. Place termination resistors as close to destination inputs as possible.
3.  $R_b$  resistor sets the DC bias voltage, equal to  $V_t$ . For +3.3V systems  $R_b = 50\Omega$ . For +2.5V systems  $R_b = 19\Omega$ .

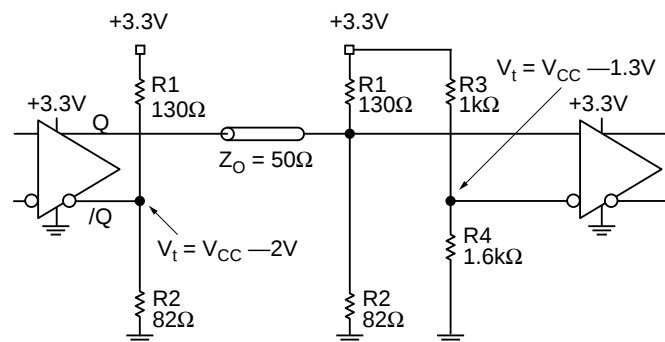
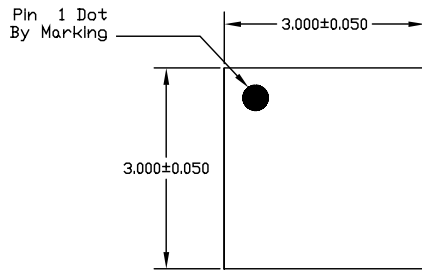


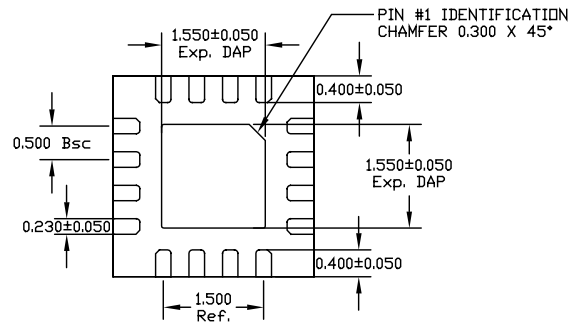
Figure 4c. Terminating Unused LVPECL I/O

**Notes:**

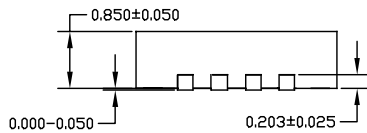
1. Unused output (/Q) must be terminated to balance the output.
2. For +2.5V systems:  $R_1 = 250\Omega$ ,  $R_2 = 62.5\Omega$ ,  $R_3 = 1.25k\Omega$ ,  $R_4 = 1.2k\Omega$ .
2. Unused output pairs (Q and /Q) may be left floating.

**16 LEAD EPAD *MicroLeadFrame*™ (MLF-16)**

TOP VIEW



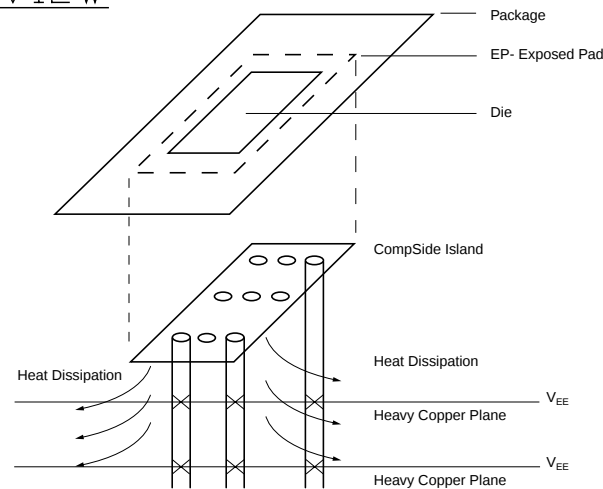
BOTTOM VIEW



SIDE VIEW

## NOTE:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. MAX. PACKAGE WARPAGE IS 0.05 mm.
3. MAXIMUM ALLOWABLE BURRS IS 0.076 mm IN ALL DIRECTIONS.
4. PIN #1 ID ON TOP WILL BE LASER/INK MARKED.



**PCB Thermal Consideration for 16-Pin MLF™ Package**  
(Always solder, or equivalent, the exposed pad to the PCB.)

**Package Notes:**

- Note 1.** Package meets Level 2 moisture sensitivity classification, and are shipped in dry-pack form.  
**Note 2.** Exposed pads must be soldered to a ground for proper thermal management.

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