



## SY89311U

2.5V/3.3V/5V 1:2 DIFFERENTIAL  
PECL/LVPECL/ECL FANOUT BUFFER

Precision Edge®

### General Description

The SY89311U is a precision, high-speed 1:2 differential fanout buffer. Having within-device skews and output transition times significantly improved over the EL11V, the SY89311U is ideally suited for those applications which require the ultimate in AC performance in a small package.

The differential inputs of the SY89311U employ clamping circuitry to maintain stability under open input conditions. If the inputs are left open, the Q outputs will be LOW.

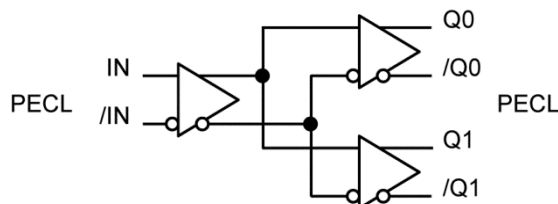
The differential inputs can accept 10/100K ECL/PECL signals (external termination required) and the outputs are 100K ECL/PECL compatible.

Datasheets and support documentation are available on Micrel's web site at: [www.micrel.com](http://www.micrel.com).

### Features

- 2.5V, 3.3V and 5V power supply
- Guaranteed AC parameters over temperature:
  - $f_{MAX} > 3.0\text{GHz}$
  - $< 20\text{ps}$  output-to-output skew
  - $< 200\text{ps}$   $t_r / t_f$
  - $< 300\text{ps}$  propagation delay
  - $51\text{fs}_{(RMS)}$  phase jitter (typical)
- 100K compatible I/O
- Wide temperature range:  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$
- Available in ultra-small 8-pin MLF®  
(2mm x 2mm) package

### Block Diagram



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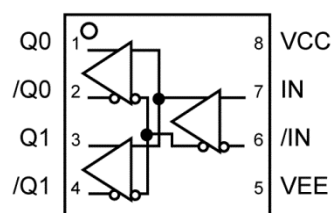
## Ordering Information

| Part Number                | Package Type | Operating Range | Package Marking                     | Lead Finish    |
|----------------------------|--------------|-----------------|-------------------------------------|----------------|
| SY89311UMITR               | MLF-8        | Industrial      | 311                                 | Sn-Pb          |
| SY89311UMGT <sup>(1)</sup> | MLF-8        | Industrial      | 311 with Pb-Free bar-line indicator | Pb-Free NiPdAu |

**Note:**

- Other voltages are available. Contact Micrel for details.

## Pin Configuration



**8-Pin MLF<sup>®</sup>**  
**Ultra-Small Outline (2mm x 2mm)**

## Pin Description

| Pin Number | Pin Name            | Type                  | Pin Function                                                                                                                                                                                                                                      |
|------------|---------------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 2, 3, 4 | Q0, /Q0,<br>Q1, /Q1 | 100K Output           | Differential PECL/ECL Outputs: Default to LOW if IN inputs are left open. Q1, /Q1 See "Output Interface Applications" section for recommendations on terminations. Unused output pairs may be left floating without any impact on skew or jitter. |
| 5          | VEE,<br>Exposed Pad | Negative Power Supply | Negative Power Supply: VEE and exposed pad must be tied to most negative supply. For PECL/LVPECL connect to ground.                                                                                                                               |
| 6          | /IN                 | 100K Input            | Differential PECL/ECL Input: Internal 75kΩ pull-up and pull-down resistors. If left floating, pin defaults to Vcc/2. When not used, this input can be left open. See "Input Interface Applications" section for single-ended inputs.              |
| 7          | IN                  | 100K Input            | Differential PECL/ECL Input: Internal 75kΩ pull-down resistor. If left open, pin defaults LOW. Q output will be LOW. Accepts differential 10K and 100K ECL/PECL. See "Input Interface Applications" section for single-ended inputs.              |
| 2          | 5                   | Positive Power Supply | Positive Power Supply: Bypass with 0.1μF//0.01μF low ESR capacitors                                                                                                                                                                               |

## Absolute Maximum Ratings (Error! Reference source not found.)

|                                       |                  |
|---------------------------------------|------------------|
| Supply Voltage ( $V_{CC}$ )           | -0.5V to +6.0V   |
| Input Voltage ( $V_{IN}$ )            | -0.5 to $V_{CC}$ |
| LVPECL Output Current ( $I_{OUT}$ )   |                  |
| Continuous                            | 50mA             |
| Surge                                 | 100mA            |
| Input Current                         |                  |
| Source or sink current on IN, /IN     | ±50mA            |
| Lead Temperature (soldering, 20 sec.) | +260°C           |
| Storage Temperature ( $T_S$ )         | -65°C to +150°C  |

## Operating Ratings (Error! Reference source not found.)

|                                                    |                    |
|----------------------------------------------------|--------------------|
| Supply Voltage $ V_{CC}-V_{EE} $                   | +2.375V to +2.625V |
|                                                    | +3.0V to +3.6V     |
|                                                    | +4.5V to +5.5V     |
| Ambient Temperature ( $T_A$ )                      | -40°C to +85°C     |
| Package Thermal Resistance, <a href="#">Note 3</a> |                    |
| MLF™ ( $\theta_{JA}$ )                             |                    |
| Still-Air                                          | 93°C/W             |
| 500lfpm                                            | 87°C/W             |
| MLF™ ( $\theta_{JB}$ )                             |                    |
| Junction-to-Board                                  | 60°C/W             |

## DC Electrical Characteristics <sup>(3)</sup>

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

| Symbol   | Parameter            | Condition               | Min.   | Typ. | Max.   | Units |
|----------|----------------------|-------------------------|--------|------|--------|-------|
| $V_{CC}$ | Power Supply Voltage | LVPECL                  | 2.375  | 2.5  | 2.625  | V     |
|          |                      | LVPECL                  | 3.0    | 3.3  | 3.6    | V     |
|          |                      | PECL                    | 4.5    | 5.0  | 5.5    | V     |
|          |                      | ECL                     | -5.5   | -5.0 | -4.5   | V     |
|          |                      | LVECL                   | -3.6   | -3.3 | -3.0   | V     |
|          |                      | LVECL                   | -2.625 | -2.5 | -2.375 | V     |
| $I_{EE}$ | Power Supply Current | Max. $V_{CC}$ , no load |        | 30   | 44     | mA    |
| $I_{IH}$ | Input HIGH Current   | $V_{IN} = V_{IH}$       |        |      | 150    | μA    |
| $I_{IL}$ | Input Low Current    | IN $V_{IN} = V_{IL}$    | 0.5    |      |        | μA    |
|          |                      | /IN $V_{IN} = V_{IL}$   | -150   |      |        | μA    |
| $C_{IN}$ | Input Capacitance    |                         |        | 1.0  |        | pF    |

## (100K) ECL/LVECL DC Electrical Characteristics

$V_{CC} = +2.5V \pm 5\%$  or  $+3.3V \pm 10\%$  or  $+5.0V \pm 10\%$  and  $V_{EE} = 0V$ ;  $V_{CC} = 0V$  and  $V_{EE} = -2.5V \pm 5\%$  or  $-3.3V \pm 10\%$  or  $-5.0V \pm 10\%$ ;

$R_L = 50\Omega$  to  $V_{CC}-2V$ ;  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ , unless otherwise noted.

| Symbol      | Parameter                            | Condition              | Min.           | Typ. | Max.           | Units |
|-------------|--------------------------------------|------------------------|----------------|------|----------------|-------|
| $V_{OH}$    | Output HIGH Voltage                  |                        | $V_{CC}-1.145$ |      | $V_{CC}-0.895$ | V     |
| $V_{OL}$    | Output LOW Voltage                   |                        | $V_{CC}-1.945$ |      | $V_{CC}-1.695$ | V     |
| $V_{IH}$    | Input HIGH Voltage                   |                        | $V_{CC}-1.225$ |      | $V_{CC}-0.88$  | V     |
| $V_{IL}$    | Input LOW Voltage                    |                        | $V_{CC}-1.945$ |      | $V_{CC}-1.625$ | V     |
| $V_{IHCMR}$ | Input HIGH Voltage Common Mode Range | <a href="#">Note 6</a> | $V_{EE}+1.2$   |      | $V_{CC}$       | V     |
| $I_{IH}$    | Input HIGH Current                   | $V_{IN} = V_{IH}$      |                |      | 150            | μA    |
| $I_{IL}$    | Input LOW Current (IN)               | $V_{IN} = V_{IL}$      | 0.5            |      |                | μA    |
|             | Input LOW Current (/IN)              | $V_{IN} = V_{IL}$      | -150           |      |                | μA    |

### Notes:

- 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.
- The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.
- Package Thermal Resistance values assume exposed pad is soldered (or equivalent) to the device's most negative potential on the PCB.
- This circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.
- $V_{IHCMR}$  (min) varies 1:1 with  $V_{EE}$ , (max) varies 1:1 with  $V_{CC}$ .

## AC Electrical Characteristics<sup>(7)</sup>

$V_{CC} = +2.5V \pm 5\%$  or  $+3.3V \pm 10\%$  or  $+5.0V \pm 10\%$  and  $V_{EE} = 0V$ ;  $V_{CC} = 0V$  and  $V_{EE} = -2.5V \pm 5\%$  or  $-3.3V \pm 10\%$  or  $-5.0V \pm 10\%$ ;  
 $R_L = 50\Omega$  to  $V_{CC}-2V$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ , unless otherwise noted.

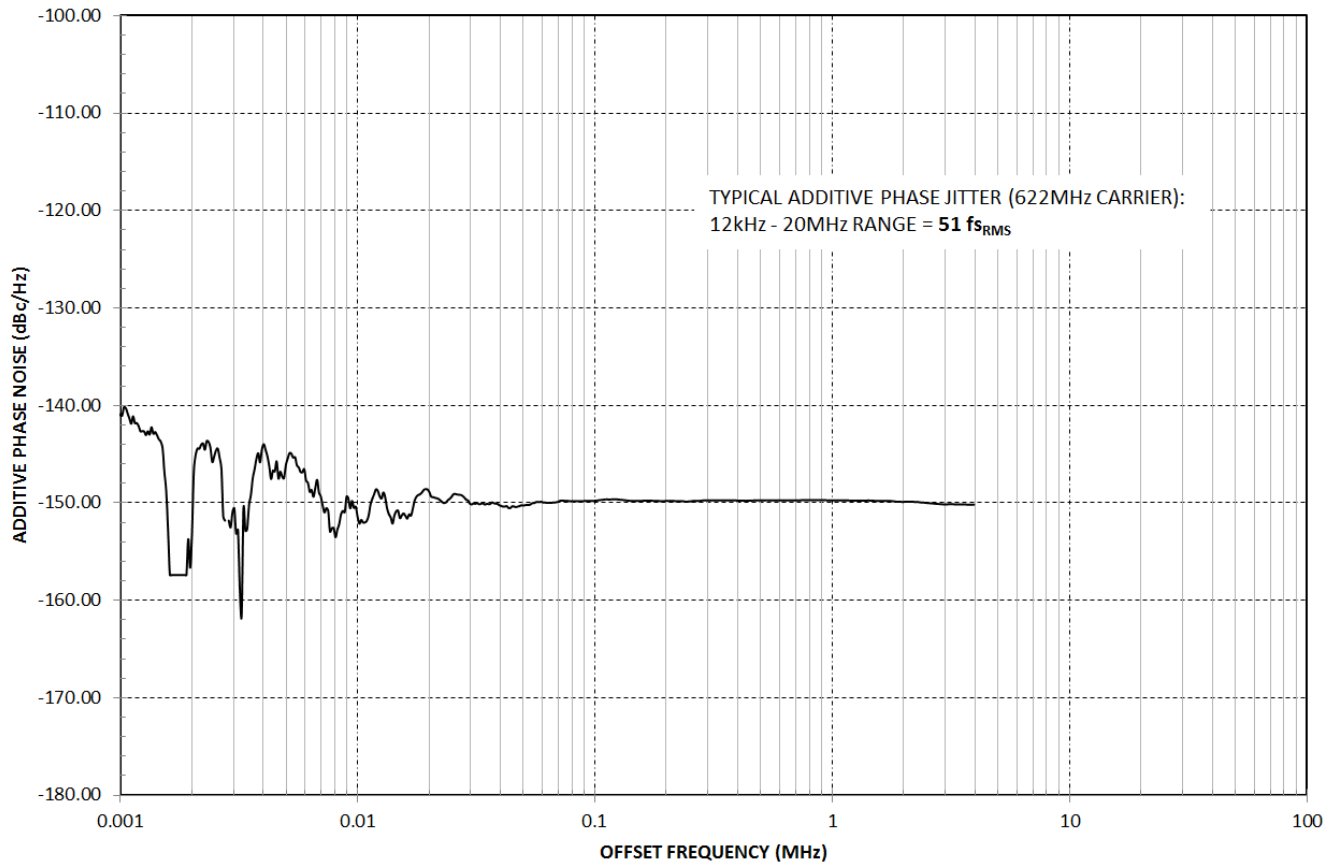
| Symbol       | Parameter                          | Condition                                                                               | Min. | Typ. | Max.       | Units               |
|--------------|------------------------------------|-----------------------------------------------------------------------------------------|------|------|------------|---------------------|
| $f_{MAX}$    | Maximum Toggle Frequency           |                                                                                         | 3    |      |            | GHz                 |
| $t_{pd}$     | Propagation Delay (Differential)   |                                                                                         |      |      |            |                     |
|              | IN to Q, /Q                        | $V_{CC} = 3.3V/5V$                                                                      | 140  | 220  | 300        | ps                  |
|              | IN to Q, /Q                        | $V_{CC} = 2.5V$                                                                         | 170  | 240  | 360        | ps                  |
| $t_{SKEW}$   | Within-Device Skew                 | Q, /Q <a href="#">Note 8</a>                                                            |      | 5    | 20         | ps                  |
|              | Part-to-Part Skew                  | $V_{CC} = 3.3V/5V$ , <a href="#">Note 8</a><br>$V_{CC} = 2.5V$ , <a href="#">Note 8</a> |      |      | 150<br>120 | ps<br>ps            |
| $t_{JITTER}$ | Cycle-to-Cycle Jitter (rms)        |                                                                                         |      |      | 1          | ps <sub>(rms)</sub> |
|              | Additive Phase Jitter              | 622MHz over 12kHz-20MHz                                                                 |      | 51   |            | fs <sub>(rms)</sub> |
| $V_{DIFF}$   | Input Swing                        | <a href="#">Note 9</a>                                                                  | 150  | 800  | 1200       | mV                  |
| $t_r, t_f$   | Output Rise/Fall Time (20% to 80%) |                                                                                         | 70   | 120  | 200        | ps                  |

### Notes:

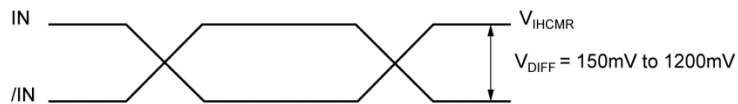
7. Measured with 750mV input signal, 50% duty cycle.  $V_{DIFF\_OUT}$  is  $\geq 400mV$ .
8. Skew is measured between outputs under identical transitions. Duty cycle skew is defined only for differential operation when the delays are measured from the cross point of the inputs to the cross point of the outputs.
9. See "Input Waveform".

## Additive Phase Noise Plot

$V_{CC} = +3.3V$ ,  $GND = 0$ ,  $R_L = 50\Omega$  to  $V_{CC}-2V$ ,  $T_A = 25^\circ C$



## Input Waveform



## Input Interface Applications

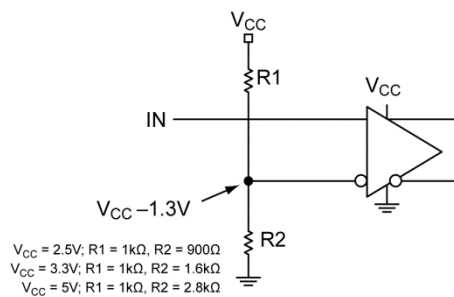


**Figure 1. Single-Ended Input  
(Terminating unused Input)**

## LVPECL Output Interface Applications

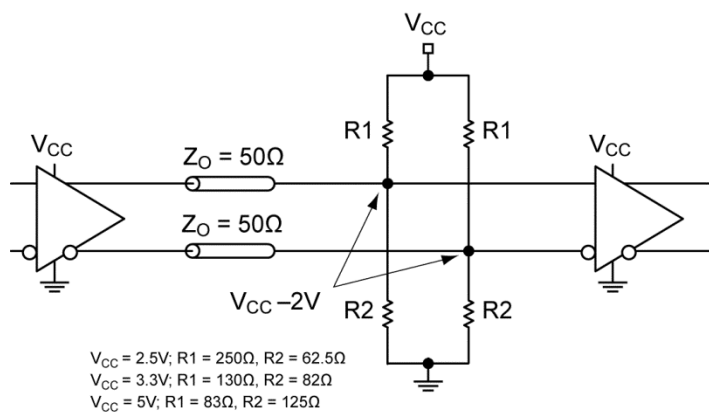


Figure 2. Parallel Thevenin-Equivalent Termination

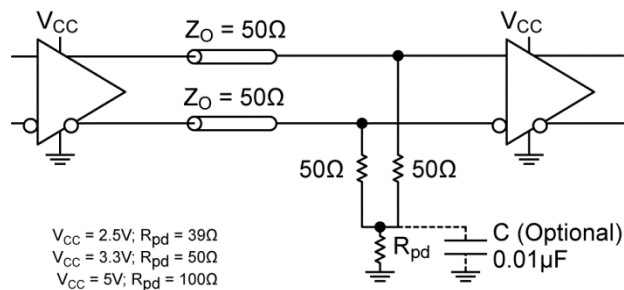


Figure 3. Three Resistor "Y Termination"

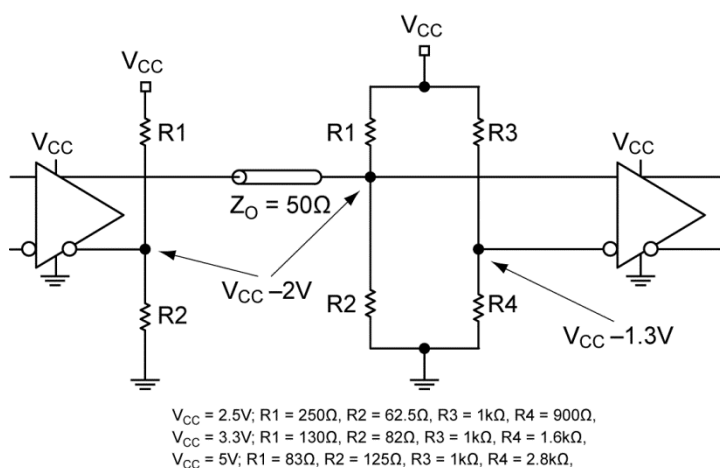
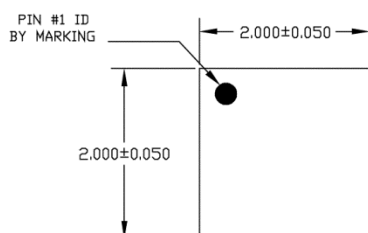
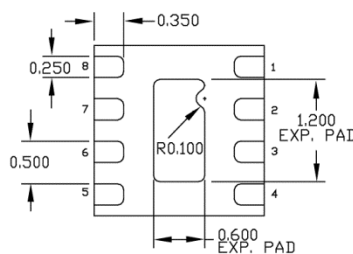


Figure 4. Termination Unused I/O

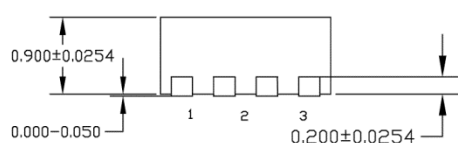
## Package Information<sup>(10)</sup>



TOP VIEW



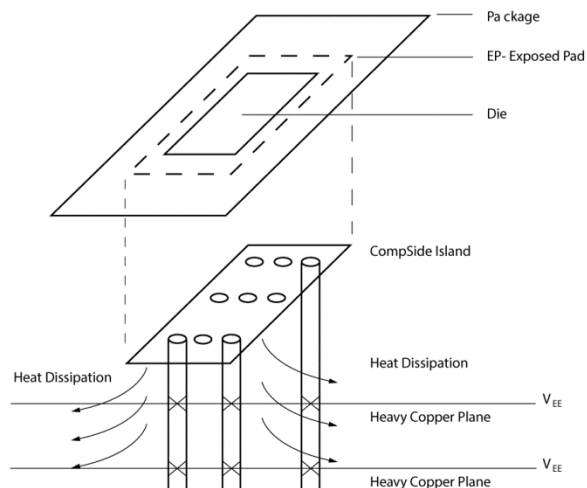
BOTTOM VIEW



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 8-Pin MLF<sup>®</sup> Package

## Package Notes:

1. Package meets Level 2 qualification.
2. All parts are dry-packaged before shipment.
3. Exposed pads must be soldered to a ground for proper thermal management.

### 8-Lead MLF (MLF-8)

## Note:

10. Package information is correct as of the publication date. For updates and most current information, go to [www.micrel.com](http://www.micrel.com).

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## Revision History

| Date    | Change Description/Edits by:                                                 | Rev. |
|---------|------------------------------------------------------------------------------|------|
| 8/4/10  | Added new paragraph to disclaimer in boiler plate. Per Colin Sturt. M.Galvan | 14   |
| 1/16/13 | Complete rework                                                              | 15   |
|         |                                                                              |      |
|         |                                                                              |      |
|         |                                                                              |      |
|         |                                                                              |      |
|         |                                                                              |      |