



## SY898530U

500MHz 1:16 3.3V-to-2.5V LVPECL  
Fanout Buffer

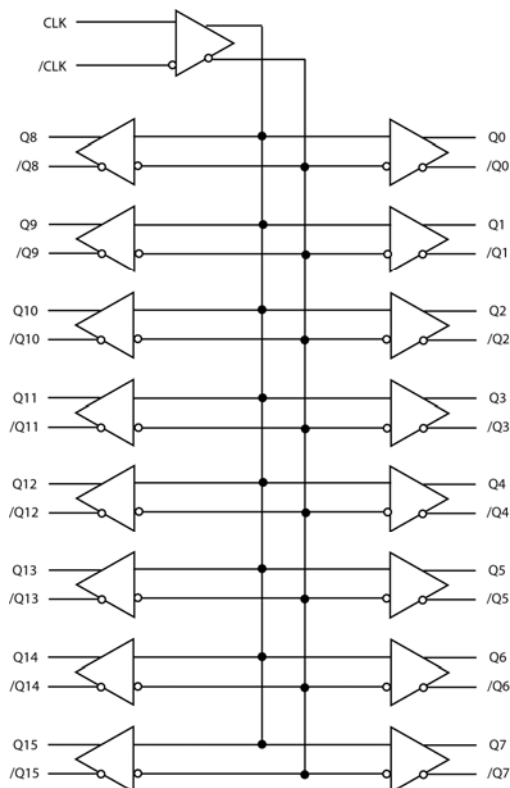
### General Description

The SY898530U is a 1:16 Fanout buffer which can accept most standard differential logic levels and outputs the signal as a differential 2.5V LVPECL signal. The part can amplify input signals as small as 150mVpp to the full LVPECL output swing. The SY898530U is well suited for clock distribution applications which demand versatility and low-skew performance. It is pin-to-pin compatible with IDT's ICS8530 fanout buffer.

The SY898530U operates from a 3.3V  $\pm 5\%$  core power supply and a 2.5V  $\pm 5\%$  output supply and is guaranteed over the full commercial temperature range (0°C to +70°C). It is available in a 48-pin TQFP lead-free package.

Data sheets and support documentation can be found on Micrel's web site at [www.micrel.com](http://www.micrel.com).

### Functional Block Diagram



### Features

- 16 Differential 2.5V LVPECL outputs
- Differential CLK inputs. Accepts LVDS, LVPECL, LVHSTL, SSTL, HCSL logic levels
- Translates any single-ended input signal to 2.5V LVPECL levels with a resistor bias on /CLK input
- 500MHz maximum output frequency
- <50ps output skew
- <250ps part-to-part skew
- <2ns propagation delay
- 3.3V Core, 2.5V output operating supply
- 0°C to +70°C operating temperature
- Available in 48-pin TQFP package
- Pin-to-pin compatible with ICS8530

### Applications

- Data distribution
- High-performance PCs
- Communications
- Parallel processor-based systems

Precision Edge is a registered trademark of Micrel, Inc.

Micrel Inc. • 2180 Fortune Drive • San Jose, CA 95131 • USA • tel +1 (408) 944-0800 • fax + 1 (408) 474-1000 • <http://www.micrel.com>

January 2011

M9999-013111-C  
[hbwhelp@micrel.com](mailto:hbwhelp@micrel.com) or (408) 955-1690

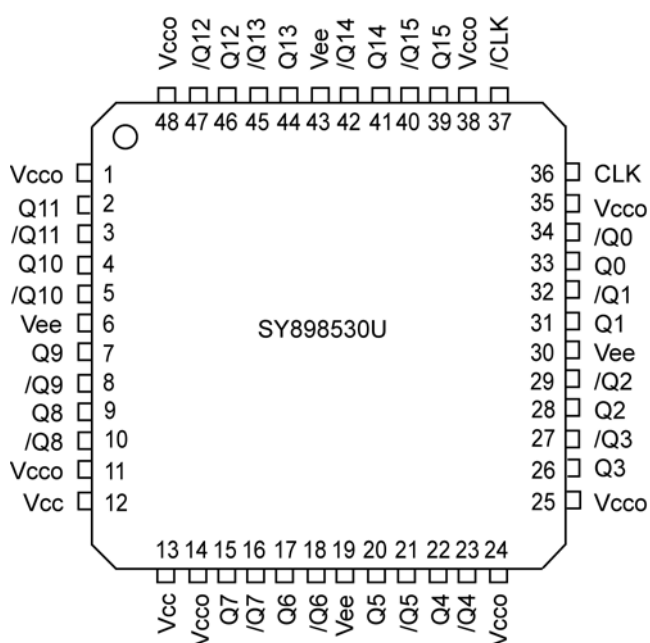
## Ordering Information

| Part Number                     | Package Type | Operating Range | Package Marking                             | Lead Finish |
|---------------------------------|--------------|-----------------|---|-------------|
| SY898530UTZ                     | TQFP-48      | Commercial      | SY898530UTZ with Pb-Free bar-line indicator | Matte-Sn    |
| SY898530UTZTR <sup>(2)</sup>    | TQFP-48      | Commercial      | SY898530UTZ with Pb-Free bar-line indicator | Matte-Sn    |
| SY898530UTZTX <sup>(2, 3)</sup> | TQFP-48      | Commercial      | SY898530UTZ with Pb-Free bar-line indicator | Matte-Sn    |

**Notes:**

1. Contact factory for die availability. Dice are guaranteed at T<sub>A</sub> = 25°C, DC Electricals only.
2. Tape and Reel.
3. EIA specification orientation.

## Pin Configuration



**48-Pin TQFP (TQFP-48)**

## Pin Description

| Pin Number  | Pin Name   | Pin Function   |
|---|--|--|
| 36, 37  | CLK, /CLK  | Differential Clock Inputs. Accepts LVDS, LVPECL, LVHSTL, SSTL, HCSL logic levels. CLK is internally connected to a pull-down resistor, /CLK is internally connected to a pull-up resistor. See "Pin Characteristics" for typical values. |
| 33, 34<br>31, 32<br>28, 29<br>26, 27<br>22, 23<br>20, 21<br>17, 18<br>15, 16<br>9, 10<br>7, 8<br>4, 5<br>2, 3<br>46, 47<br>44, 45<br>41, 42<br>39, 40 | Q0, /Q0<br>Q1, /Q1<br>Q2, /Q2<br>Q3, /Q3<br>Q4, /Q4<br>Q5, /Q5<br>Q6, /Q6<br>Q7, /Q7<br>Q8, /Q8<br>Q9, /Q9<br>Q10, /Q10<br>Q11, /Q11<br>Q12, /Q12<br>Q13, /Q13<br>Q14, /Q14<br>Q15, /Q15 | 2.5V LVPECL Differential Output Pairs. Differential buffered copies of the input signal. The output swing is typically 740mV. See Interface Applications for termination information.  |
| 1, 11, 14, 24,<br>25, 35, 38, 48  | VCCO   | Output Power Supply: Bypass with 0.1 $\mu$ F//0.01 $\mu$ F low ESR capacitors as close to the VCCO pins as possible. Supplies the output buffers.  |
| 12, 13  | VCC  | Core Power Supply: Bypass with 0.1 $\mu$ F//0.01 $\mu$ F low ESR capacitors as close to the VCC pins as possible. Supplies input and core circuitry.   |
| 6, 19, 30, 43   | VEE  | Ground   |

## Pin Characteristics

| Symbol                | Description              | Min. | Typ. | Max. | Units      |
|-----------------------|--------------------------|------|------|------|------------|
| C <sub>IN</sub>       | Input Capacitance        |      | 4    |      | pF         |
| R <sub>PULLUP</sub>   | Input Pull Up Resistor   |      | 50   |      | K $\Omega$ |
| R <sub>PULLDOWN</sub> | Input Pull Down Resistor |      | 30   |      | K $\Omega$ |

## Clock Input Function Table

| Inputs                |                       | Outputs |      | Input to Output Mode         | Polarity      |
|-----------------------|-----------------------|---------|------|------------------------------|---------------|
| CLK                   | /CLK                  | Qx      | /Qx  |                              |               |
| 0                     | 1                     | Low     | High | Differential to Differential | Non-Inverting |
| 1                     | 0                     | High    | Low  | Differential to Differential | Non-Inverting |
| 0                     | Biased <sup>(1)</sup> | Low     | High | Single-Ended to Differential | Non-Inverting |
| 1                     | Biased <sup>(1)</sup> | High    | Low  | Single-Ended to Differential | Non-Inverting |
| Biased <sup>(1)</sup> | 0                     | High    | Low  | Single-Ended to Differential | Inverting     |
| Biased <sup>(1)</sup> | 1                     | Low     | High | Single-Ended to Differential | Inverting     |

### Note:

1. Refer to Interface Applications for Single-Ended Interfaces.

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

|                                      |                          |
|--------------------------------------|--------------------------|
| Supply Voltage ( $V_{CC}$ )          | 4.6V                     |
| Input Voltage ( $V_{IN}$ )           | -0.5V to $V_{CC} + 0.5V$ |
| LVPECL Output Current ( $I_{OUT}$ )  |                          |
| Continuous                           | 50mA                     |
| Surge                                | 100mA                    |
| Lead Temperature (soldering, 20sec.) | 260°C                    |
| Storage Temperature ( $T_s$ )        | -65°C to +150°C          |

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

|   |                  |
|---|------------------|
| Supply Voltage ( $V_{CC}$ )               | 3.135V to 3.465V |
| Output Supply Voltage ( $V_{CCO}$ )       | 2.375V to 2.625V |
| Ambient Temperature ( $T_A$ )             | 0°C to +70°C     |
| Package Thermal Resistance <sup>(3)</sup> |                  |
| TQFP                                      |                  |
| Still-air ( $\theta_{JA}$ )               | 48°C/W           |
| Junction-to-Case ( $\theta_{JC}$ )        | 25°C/W           |

### DC Electrical Characteristics<sup>(6)</sup>

$V_{CC} = 3.135V$  to  $3.465V$ ,  $V_{CCO} = 2.375V$  to  $2.625V$ ,  $T_A = 0^\circ C$  to  $+70^\circ C$ , unless otherwise stated.

| Symbol    | Parameter                  | Condition                 | Min.                                | Typ. | Max.            | Units |
|-----------|----------------------------|---------------------------|-------------------------------------|------|-----------------|-------|
| $V_{CC}$  | Power Supply Voltage Range |                           | 3.135                               | 3.3  | 3.465           | V     |
| $V_{CCO}$ | Output Power Supply        |                           | 2.375                               | 2.5  | 2.625           |       |
| $I_{EE}$  | Power Supply Current       | Max. $V_{CC}$ , $V_{CCO}$ |                                     |      | 125             | mA    |
| $I_{IH}$  | Input HIGH Current         | CLK                       | $V_{CC} = V_{IN} = 3.465V$          |      | 150             | uA    |
|           |                            | /CLK                      |                                     |      | 5               | uA    |
| $I_{IL}$  | Input LOW Current          | CLK                       | $V_{CC} = 3.465V$ , $V_{IN} = 0.5V$ | -5   |                 | uA    |
|           |                            | /CLK                      |                                     | -150 |                 | uA    |
| $V_{PP}$  | Peak-to-Peak Input Swing   |                           | 0.15                                |      | 1.3             | V     |
| $V_{CMR}$ | Common Mode Input Voltage  | Note 4, 5                 | 0.5                                 |      | $V_{CC} - 0.85$ | V     |

### PECL Outputs DC Electrical Characteristics<sup>(6)</sup>

$V_{CC} = 3.135V$  to  $3.465V$ ,  $V_{CCO} = 2.375V$  to  $2.625V$ ,  $T_A = 0^\circ C$  to  $+70^\circ C$ , Outputs terminated with  $50\Omega$  to  $V_{CCO} - 2V$  unless otherwise stated.

| Symbol    | Parameter            | Condition | Min.            | Typ. | Max.            | Units |
|-----------|----------------------|-----------|-----------------|------|-----------------|-------|
| $V_{OH}$  | Output HIGH Voltage  |           | $V_{CCO} - 1.1$ |      | $V_{CCO} - 0.7$ | V     |
| $V_{OL}$  | Output LOW Voltage   |           | $V_{CCO} - 2.0$ |      | $V_{CCO} - 1.4$ | V     |
| $V_{OUT}$ | Output Voltage Swing |           | 0.55            |      | 0.93            | V     |

**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 ratings 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. Package thermal resistance assumes exposed pad is soldered (or equivalent) to the device's most negative potential on the PCB.  $\psi_{JB}$  and  $\theta_{JA}$  values are determined for a 4-layer board in still-air number, unless otherwise stated. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.
4. For single-ended applications, the maximum input voltage for CLK, /CLK is  $V_{CC} + 0.3V$ .
5. Common mode voltage is defined as  $V_{IH}$ .
6. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

## AC Electrical Characteristics

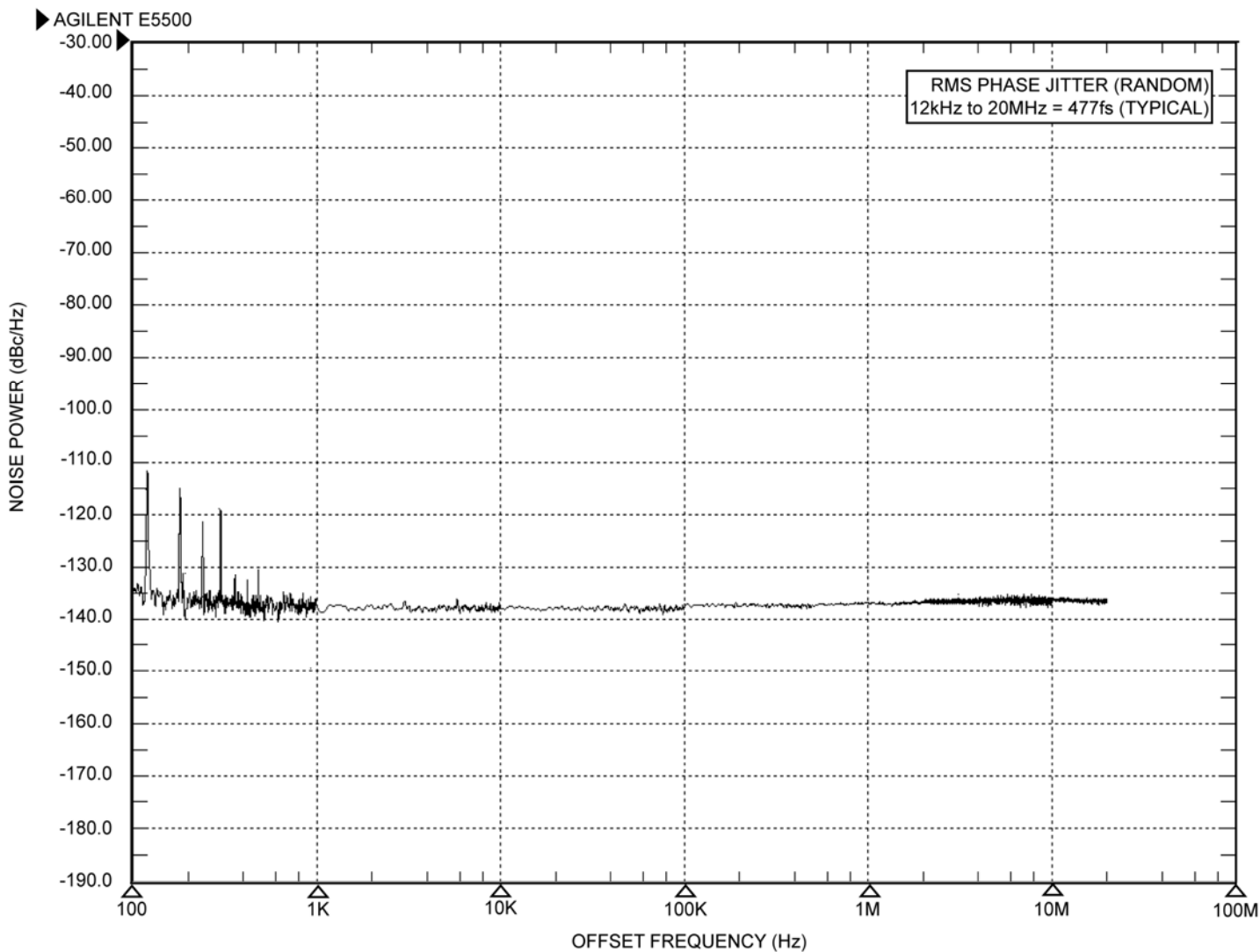
$V_{CC} = 3.135V$  to  $3.465V$ ,  $V_{CCO} = 2.375V$  to  $2.625V$ ,  $T_A = 0^{\circ}C$  to  $+70^{\circ}C$ , unless otherwise stated.

| Symbol       | Parameter                              | Condition             | Min. | Typ. | Max. | Units |
|--------------|--|-----------------------|------|------|------|-------|
| $f_{MAX}$    | Maximum Frequency                      |                       | 500  |      |      | MHz   |
| $t_{PD}$     | Propagation Delay                      | Note 7                | 1    |      | 2    | ns    |
| $t_{Skew}$   | Output-to-Output skew                  | Note 8, 10            |      | 26   | 50   | ps    |
|              | Part-to-Part Skew                      | Notes 9, 10           |      |      | 250  | ps    |
| $t_{JITTER}$ | Integration Range = 12kHz – 20MHz      | Output = 312MHz       |      | 477  |      | fs    |
| $t_R, t_F$   | Output Rise/Fall Times<br>(20% to 80%) | At full output swing. | 300  |      | 700  | ps    |
|              | Duty Cycle                             |                       | 47   | 50   | 53   | %     |

### Notes:

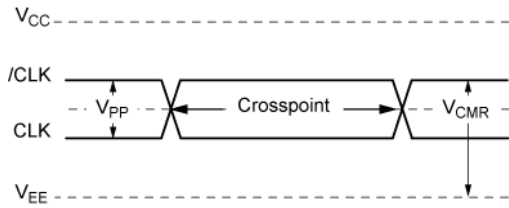
7. Measured from the differential input crossing point to the differential output crossing point.
8. Output-to-Output skew is the difference in time between outputs, receiving data from the same input, for the same temperature, voltage and transition.
9. Part-to-part skew is defined for two parts with identical power supply voltages at the same temperature and no skew at the edges at the respective inputs.
10. This parameter is defined in accordance with JEDEC Standard 65.

# Phase Noise Graph

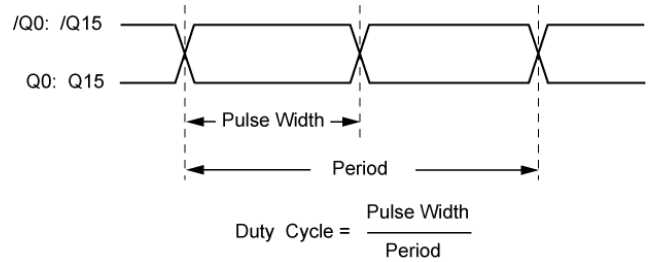


Phase Noise Plot: 312MHz @ 3.3V

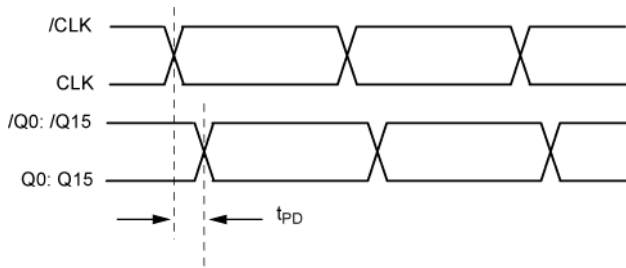
### Test Circuit



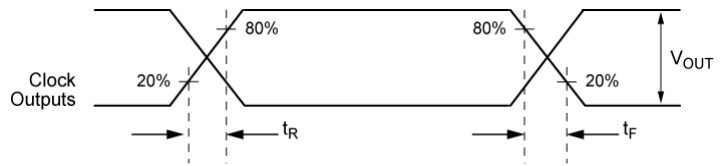
**Differential Input Level**



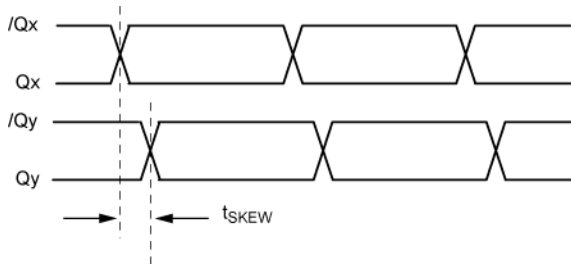
**Output Duty Cycle**



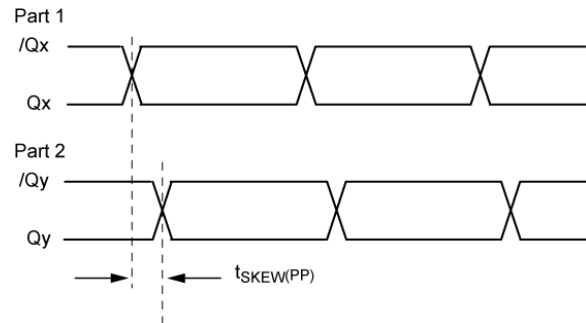
**Propagation Delay**



**Output Rise/Fall Times**



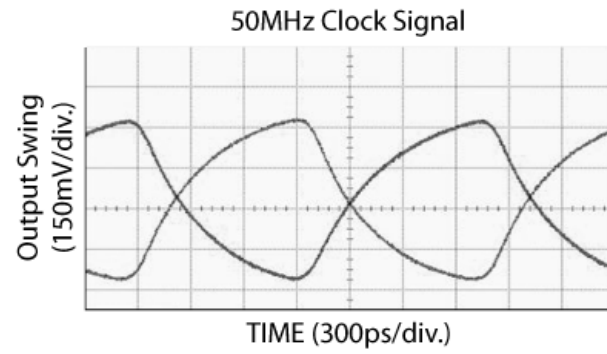
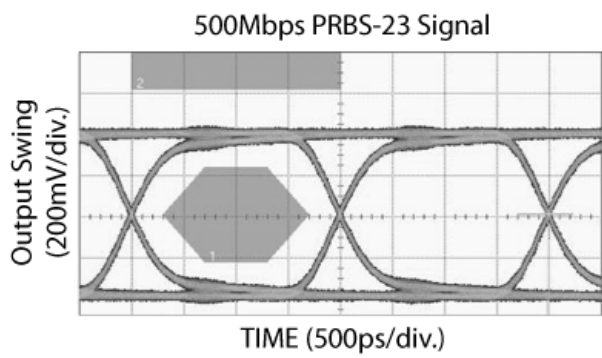
**Output-to-Output Skew**



**Part-to-Part Skew**

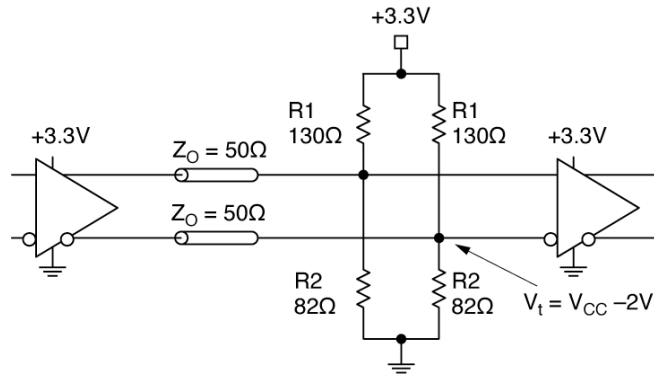
## Typical Characteristics

$V_{CC} = 3.3V$ ,  $V_{CCO} = 2.5V$ ,  $T_A = 25^\circ C$ , Input Signal = 800mV





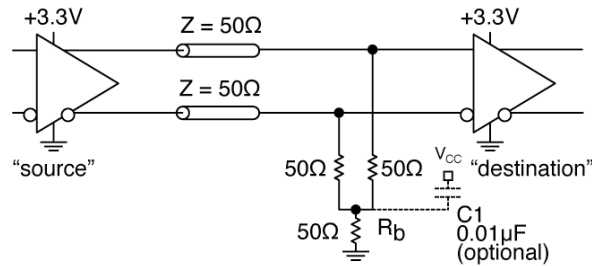
## Output Interface Applications



**Figure 1. Parallel Termination-Thevenin Equivalent**

**Notes:**

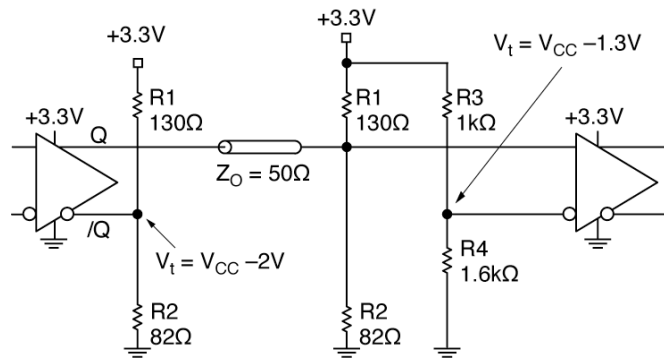
1. For +2.5V systems: R1 = 250Ω, R2 = 82.5Ω.
2. For +5.0V systems: R1 = 82Ω, R2 = 130Ω.



**Figure 2. Three-Resistor "Y-Termination"**

**Notes:**

1. Power-saving alternatives to Thevenin termination.
2. Place termination resistors as close to destination inputs as possible.
3. R<sub>b</sub> resistor sets the DC bias voltage, equal to V<sub>t</sub>. For +3.3V systems R<sub>b</sub> = 46Ω to 50Ω. For +5V systems, R<sub>b</sub> = 110Ω.



**Figure 3. Terminating Unused I/O**

**Notes:**

1. Unused output (/Q) must be terminated to balance the output.
2. For 2.5V systems: R1 = 250Ω, R2 = 62.5Ω, R3 = 1.25kΩ, R4 = 1.2kΩ.

## Input Interface Applications

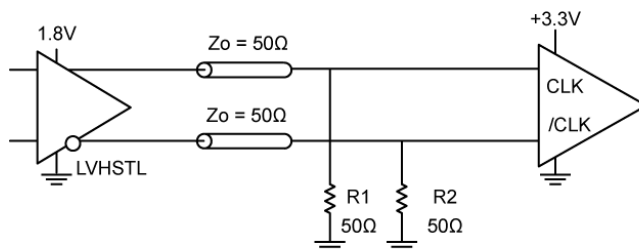


Figure 4. CLK and /CLK Input Driven By 1.8V LVHSTL

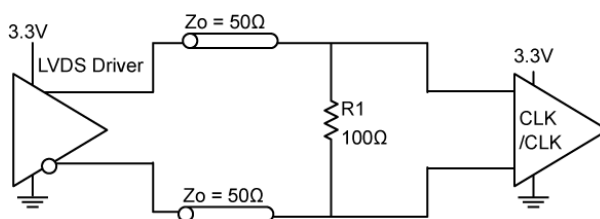


Figure 5. CLK and /CLK Input Driven By 3.3V LVDS Driver

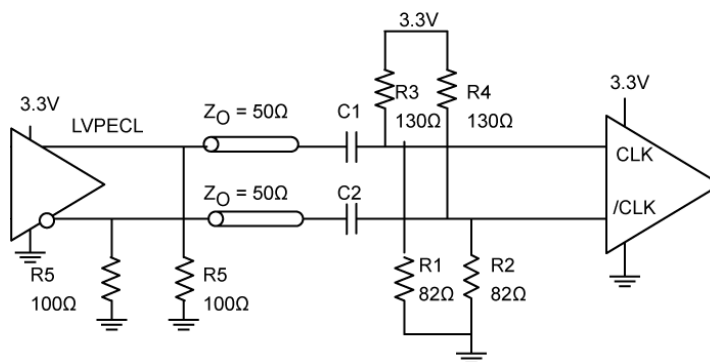
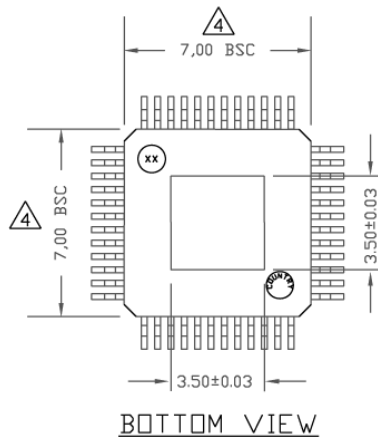
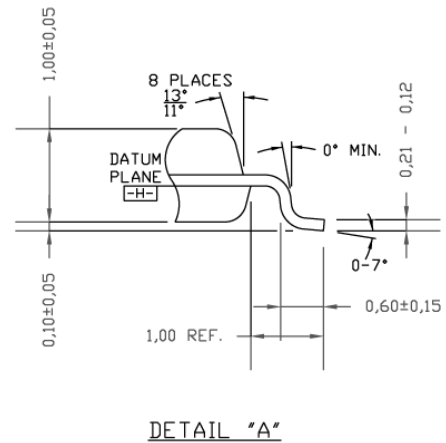
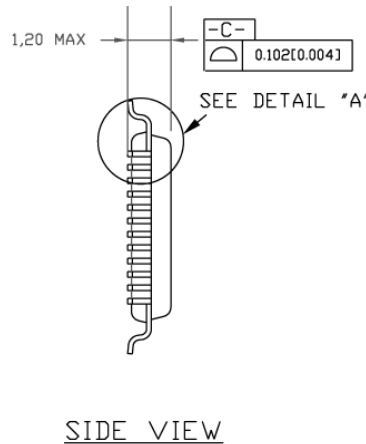
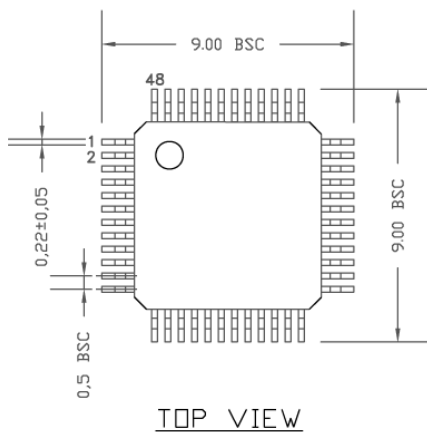


Figure 6. CLK and /CLK Input Driven By 3.3V LVPECL Driver with AC Couple

**Notes:**

1. For +2.5V systems: R1 & R2 = 250Ω, R3 & R4 = 82.5Ω.
2. For +5.0V systems: R1 & R2 = 82Ω, R3 & R4 = 130Ω.

## Package Information



### NOTES:

1. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS, EITHER OF WHICH SHALL NOT EXCEED 0.254MM.
  2. LEAD DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION.
  3. PACKAGE TOP MOLD DIMENSIONS ARE SMALLER THAN BOTTOM
- MOLD DIMENSIONS AND TOP OF PACKAGE WILL NOT OVERHANG BOTTOM OF PACKAGE.**

### 48-Pin TQFP (TQFP-48)

**MICREL, INC. 2180 FORTUNE DRIVE SAN JOSE, CA 95131 USA**  
 TEL +1 (408) 944-0800 FAX +1 (408) 474-1000 WEB <http://www.micrel.com>

Micrel makes no representations or warranties with respect to the accuracy or completeness of the information furnished in this data sheet. This information is not intended as a warranty and Micrel does not assume responsibility for its use. Micrel reserves the right to change circuitry, specifications and descriptions at any time without notice. No license, whether express, implied, arising by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Micrel's terms and conditions of sale for such products, Micrel assumes no liability whatsoever, and Micrel disclaims any express or implied warranty relating to the sale and/or use of Micrel products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright or other intellectual property right.

Micrel Products are not designed or authorized for use as components in life support appliances, devices or systems where malfunction of a product can reasonably be expected to result in personal injury. Life support devices or systems are devices or systems that (a) are intended for surgical implant into the body or (b) support or sustain life, and whose failure to perform can be reasonably expected to result in a significant injury to the user. A Purchaser's use or sale of Micrel Products for use in life support appliances, devices or systems is a Purchaser's own risk and Purchaser agrees to fully indemnify Micrel for any damages resulting from such use or sale.

© 2009 Micrel, Incorporated.

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «JONHON», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «FORSTAR».



## JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



Телефон: 8 (812) 309-75-97 (многоканальный)

Факс: 8 (812) 320-03-32

Электронная почта: [ocean@oceanchips.ru](mailto:ocean@oceanchips.ru)

Web: <http://oceanchips.ru/>

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А