

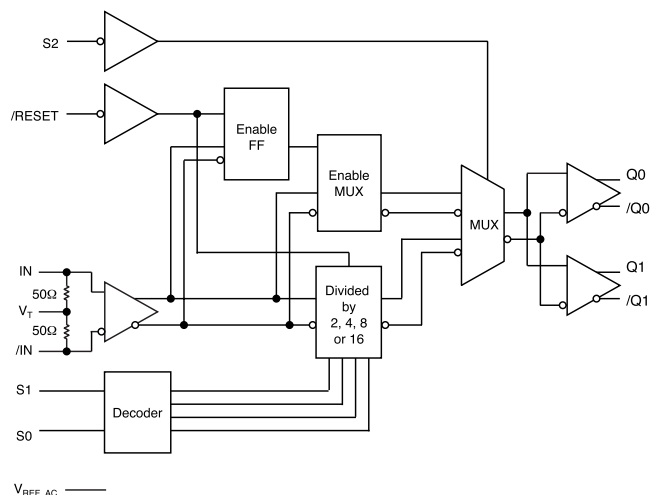
FEATURES

- Integrated programmable clock divider and 1:2 fanout buffer
- Guaranteed AC performance over temperature and voltage:
 - > 2.0GHz f_{MAX}
 - < 200ps t_r/t_f
 - < 15ps within device skew
- Low jitter design:
 - < 10ps_{PP} total jitter
 - < 1ps_{RMS} cycle-to-cycle jitter
- Unique input termination and V_T Pin for DC-coupled and AC-coupled Inputs; CML, PECL, LVDS and HSTL
- LVDS compatible outputs
- TTL/CMOS inputs for select and reset
- Parallel programming capability
- Programmable divider ratios of 1, 2, 4, 8 and 16
- Low voltage operation 2.5V
- Output disable function
- -40°C to 85°C temperature range
- Available in 16-pin (3mm x 3mm) MLF® package

APPLICATIONS

- SONET/SDH line cards
- Transponders
- High-end, multiprocessor servers

FUNCTIONAL BLOCK DIAGRAM



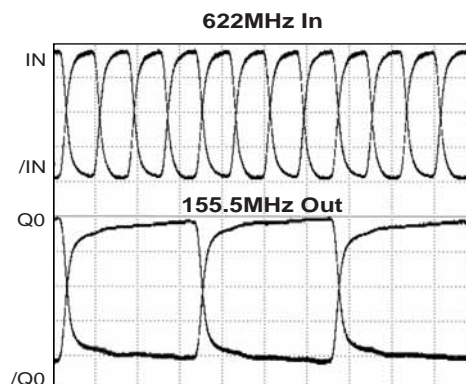
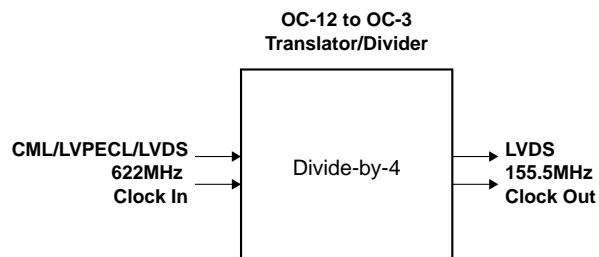
DESCRIPTION

This low-skew, low-jitter device is capable of accepting a high-speed (e.g., 622MHz or higher) CML, LVPECL, LVDS or HSTL clock input signal and dividing down the frequency using a programmable divider to create a lower speed version of the input clock. Available divider ratios are 2, 4, 8 and 16, or straight pass-through.

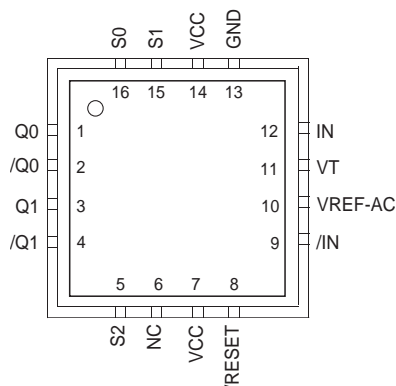
The differential input buffer has a unique internal termination design that allows access to the termination network through a V_T pin. This feature allows the device to easily interface to different logic standards. A V_{REF-AC} reference is included for AC-coupled applications.

The /RESET input asynchronously resets the divider. In the pass-through function (divide by 1) the /RESET synchronously enables or disables the outputs on the next falling edge of IN (rising edge of /IN).

TYPICAL PERFORMANCE



PACKAGE/ORDERING INFORMATION



16-Pin MLF® (MLF-16)

Ordering Information(1)

| Part Number | Package Type | Operating Range | Package Marking | Lead Finish |
|--------------------------------|--------------|-----------------|--------------------------------------|----------------|
| SY89875UMI | MLF-16 | Industrial | 875U | Sn-Pb |
| SY89875UMITR ⁽²⁾ | MLF-16 | Industrial | 875U | Sn-Pb |
| SY89875UMG ⁽³⁾ | MLF-16 | Industrial | 875U with Pb-Free bar line indicator | NiPdAu Pb-Free |
| SY89875UMGTR ^(2, 3) | MLF-16 | Industrial | 875U with Pb-Free bar line indicator | NiPdAu Pb-Free |

Notes:

1. Contact factory for die availability. Dice are guaranteed at T_A = 25°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 |
|------------|---------------------|--|
| 12, 9 | IN, /IN | Differential Input: Internal 50Ω termination resistors to V _T input. Flexible input accepts any differential input. See “Input Interface Applications” section. |
| 1, 2, 3, 4 | Q0, /Q0 Q1, /Q1 | Differential Buffered LVDS Outputs: Divided by 1, 2, 4, 8 or 16. See “Truth Table.” Unused output pairs must be terminated with 100Ω across the different pair. |
| 16, 15, 5 | S0, S1, S2 | Select Pins: See “Truth Table.” LVTTTL/CMOS logic levels. Internal 25kΩ pull-up resistor. Logic HIGH if left unconnected (divided by 16 mode.) Input threshold is V _{CC} /2. |
| 6 | NC | No Connect. |
| 8 | /RESET, /DISABLE | LVTTTL/CMOS Logic Levels: Internal 25kΩ pull-up resistor. Logic HIGH if left unconnected. Apply LOW to reset the divider (divided by 2, 4, 8 or 16 mode). Also acts as a disable/enable function. The reset and disable function occurs on the next high-to-low clock input transition. Input threshold is V _{CC} /2. |
| 10 | VREF-AC | Reference Voltage: Equal to V _{CC} -1.4V (approx.). Used for AC-coupled applications only. Decouple the V _{REF-AC} pin with a 0.01μF capacitor. See “Input Interface Applications” section. |
| 11 | VT | Termination Center-Tap: For CML or LVDS inputs, leave this pin floating. Otherwise, See Figures 4a to 4f, “Input Interface Applications” section. |
| 7, 14 | VCC | Positive Power Supply: Bypass with 0.1μF//0.01μF low ESR capacitor. |
| 13 | GND Exposed | Ground. Exposed pad must be connected to the same potential as the GND pin. |

TRUTH TABLE

| /RESET ⁽¹⁾ | S2 | S1 | S0 | Outputs |
|-----------------------|----|----|----|-------------------------------------|
| 1 | 0 | X | X | Reference Clock (pass through) |
| 1 | 1 | 0 | 0 | Reference Clock ÷2 |
| 1 | 1 | 0 | 1 | Reference Clock ÷4 |
| 1 | 1 | 1 | 0 | Reference Clock ÷8 |
| 1 | 1 | 1 | 1 | Reference Clock ÷16 |
| 0 ⁽¹⁾ | X | X | X | Q = LOW, /Q = HIGH Clock Disable |

Note 1. Reset/Disable function is asserted on the next clock input (IN, /IN) high-to-low transition.

Absolute Maximum Ratings^(Note 1)

| | | |
|---|-------|-----------------------|
| Supply Voltage (V_{CC}) | ..... | -0.5V to +4.0V |
| Input Voltage (V_{IN}) | ..... | -0.5V to $V_{CC}+0.3$ |
| ECL Output Current (I_{OUT}) | | |
| Continuous | ..... | 50mA |
| Surge | ..... | 100mA |
| Input Current I_N , I_{IN} (I_{IN}) | | ± 50 mA |
| V_T Current (I_{VT}) | | ± 100 mA |
| V_{REF-AC} Sink/Source Current ($I_{VREF-AC}$), Note 3 | | ± 2 mA |
| Lead Temperature (soldering 20 sec.) | ..... | 260°C |
| Storage Temperature (T_S) | ..... | -65°C to +150°C |

Operating Ratings^(Note 2)

| | | |
|-------------------------------------|-------|-----------------|
| Supply Voltage (V_{CC}) | ..... | +2.5V $\pm 5\%$ |
| Ambient Temperature (T_A) | ..... | -40°C to +85°C |
| Package Thermal Resistance | | |
| MLF® (θ_{JA}) | | |
| Still-Air | ..... | 60°C/W |
| 500lfpm | ..... | 54°C/W |
| MLF® (ψ_{JB}), Note 4 | | |
| Junction-to-Board | ..... | 32°C/W |

- Note 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.
- Note 2.** The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.
- Note 3.** Due to the limited drive capability use for input of the same package only.
- Note 4.** Junction-to-board resistance assumes exposed pad is soldered (or equivalent) to the device's most negative potential on the pcb.

DC ELECTRICAL CHARACTERISTICS^(Notes 1, 2)

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

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|----------------|---|------------------------|----------------|----------------|----------------|----------|
| V_{CC} | Power Supply | | 2.375 | | 2.625 | V |
| I_{CC} | Power Supply Current | No load, max. V_{CC} | | 70 | 95 | mA |
| R_{IN} | Differential Input Resistance (IN-to-/IN) | | 90 | 100 | 110 | Ω |
| V_{IH} | Input High Voltage (IN, /IN) | Note 3 | 0.1 | - | $V_{CC}+0.3$ | V |
| V_{IL} | Input Low Voltage (IN, /IN) | Note 3 | -0.3 | - | $V_{IH}-0.1$ | V |
| V_{IN} | Input Voltage Swing | Note 4 | 0.1 | - | V_{CC} | V |
| V_{DIFF_IN} | Differential Input Voltage Swing | Note 5 | 0.2 | - | - | V |
| $ I_{IN} $ | Input Current (IN, /IN) | Note 3 | - | - | 45 | mA |
| V_{REF-AC} | Reference Voltage | Note 6 | $V_{CC}-1.525$ | $V_{CC}-1.425$ | $V_{CC}-1.325$ | V |

- Note 1.** The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.
- Note 2.** Specification for packaged product only.
- Note 3.** Due to the internal termination (see Figure 2a) the input current depends on the applied voltages at IN, /IN and V_T inputs. Do not apply a combination of voltages that causes the input current to exceed the maximum limit!
- Note 4.** See "Timing Diagram" for V_{IN} definition. V_{IN} (Max) is specified when V_T is floating.
- Note 5.** See "Typical Operating Characteristics" section for V_{DIFF} definition.
- Note 6.** Operating using V_{IN} is limited to AC-coupled PECL or CML applications only. Connect directly to V_T pin.

LVDS DC ELECTRICAL CHARACTERISTICS(Notes 1, 2)

$V_{CC} = 2.5V \pm 5\%$; $T_A = -40^\circ C$ to $+85^\circ C$; Unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|------------------|-------------------------------|------------------|-------|-----|-------|-------|
| V_{OUT} | Output Voltage Swing | Note 3, 4 | 250 | 350 | 400 | mV |
| V_{OH} | Output High Voltage | Note 3 | | | 1.475 | V |
| V_{OL} | Output Low Voltage | Note 3 | 0.925 | | | V |
| V_{OCM} | Output Common Mode Voltage | Note 4 | 1.125 | | 1.375 | V |
| ΔV_{OCM} | Change in Common Mode Voltage | | -50 | | 50 | mV |

Note 1. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

Note 2. Specification for packaged product only.

Note 3. Measured as per Figure 2a, 100 μ across Q and /Q outputs.

Note 4. Measured as per Figure 2b.

LVTTL/CMOS DC ELECTRICAL CHARACTERISTICS(Notes 1, 2)

$V_{CC} = 2.5V \pm 5\%$; $T_A = -40^\circ C$ to $+85^\circ C$; 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 | | -125 | | 20 | μA |
| I_{IL} | Input LOW Current | | | | -300 | μA |

Note 1. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

Note 2. Specification for packaged product only.

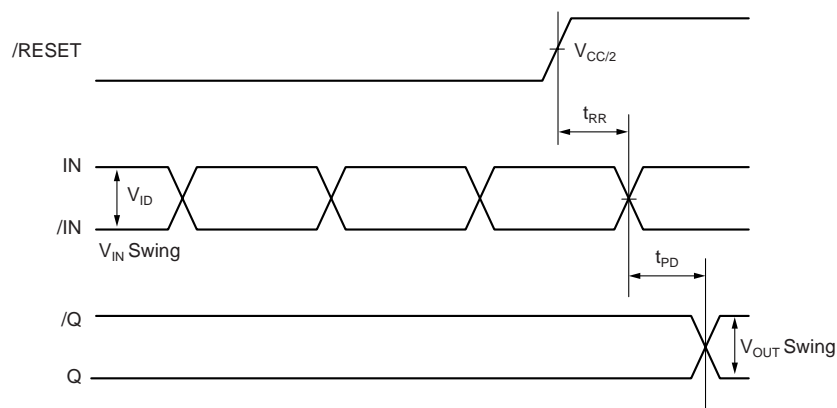
AC ELECTRICAL CHARACTERISTICS(Notes 1, 2)

$V_{CC} = 2.5V \pm 5\%$; $T_A = -40^{\circ}C$ to $+85^{\circ}C$; Unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|--------------|---|---------------------------|-----|-----|-----|-------------------|
| f_{MAX} | Maximum Input Frequency | Output Swing $\geq 200mV$ | 2.0 | 2.5 | | GHz |
| t_{PD} | Differential Propagation Delay IN to Q | Input Swing $< 400mV$ | 590 | 690 | 870 | ps |
| | | Input Swing $\geq 400mV$ | 540 | 690 | 820 | ps |
| t_{SKEW} | Within-Device Skew (diff.) | Note 3 | | 5 | 15 | ps |
| | Part-to-Part Skew (diff.) | Note 3 | | | 280 | ps |
| t_{RR} | Reset Recovery Time | Note 4 | 600 | | | ps |
| t_{JITTER} | Cycle-to-Cycle Jitter | Note 5 | | | 1 | ps _{RMS} |
| | Total Jitter | Note 6 | | | 10 | ps _{PP} |
| t_r, t_f | Rise/Fall Time (20% to 80%) | | 70 | 120 | 200 | ps |

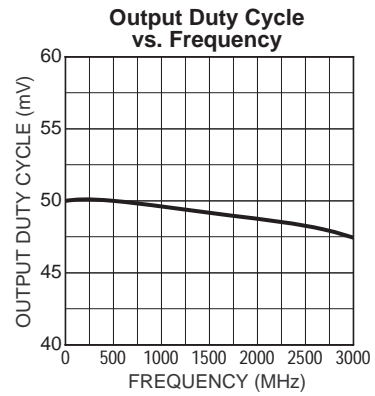
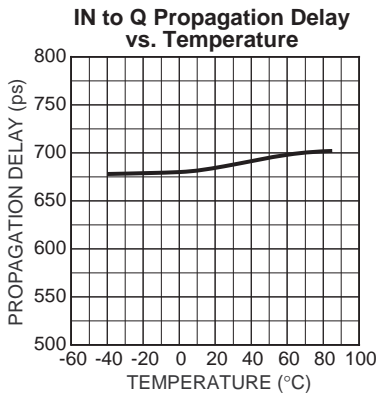
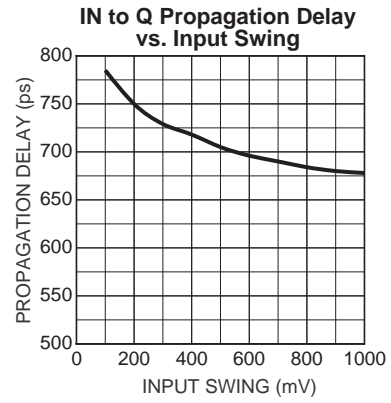
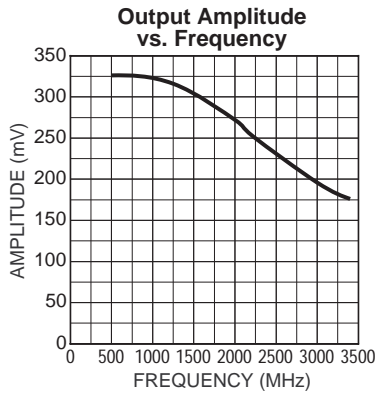
- Note 1.** Measured with 400mV input signal, 50% duty cycle, all outputs loaded with 100 Ω across each output pair, unless otherwise stated.
- Note 2.** Specification for packaged product only.
- Note 3.** Skew is measured between outputs under identical transitions.
- Note 4.** See "Timing Diagram."
- Note 5.** Cycle-to-cycle jitter definition: the variation in 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.
- Note 6.** Total jitter definition: with an ideal clock input of frequency - f_{MAX} , no more than one output edge in 10^{12} output edges will deviate by more than the specified peak-to-peak jitter value.

TIMING DIAGRAM



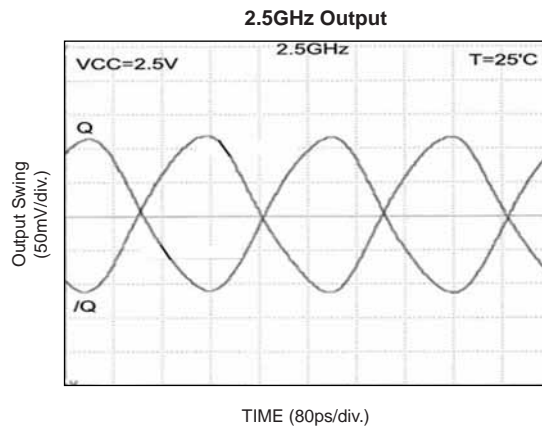
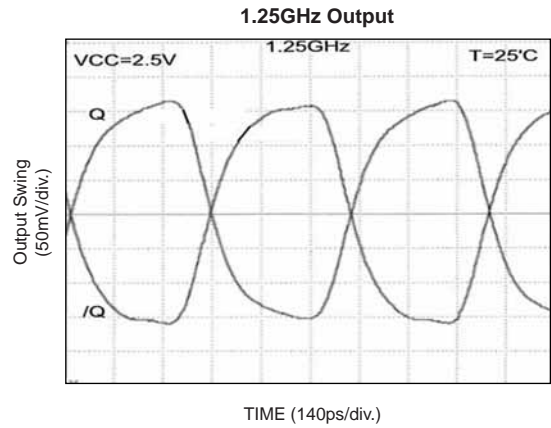
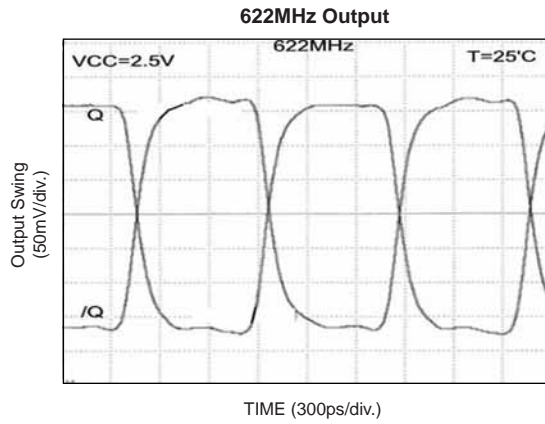
TYPICAL OPERATING CHARACTERISTICS

$V_{CC} = 2.5V$, $T_A = 25^\circ C$, unless otherwise stated.



TYPICAL OPERATING CHARACTERISTICS (Continued)

$V_{CC} = 2.5V$, $T_A = 25^\circ C$, unless otherwise stated.



DEFINITION OF SINGLE-ENDED AND DIFFERENTIAL SWINGS

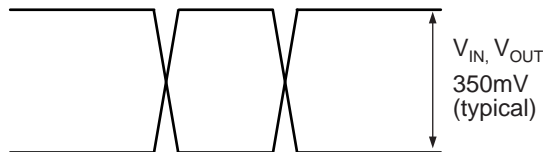


Figure 1a. Single-Ended Swing

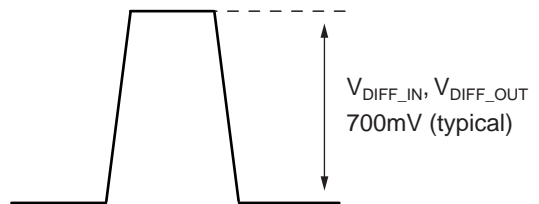


Figure 1b. Differential Swing

INPUT INTERFACE APPLICATIONS

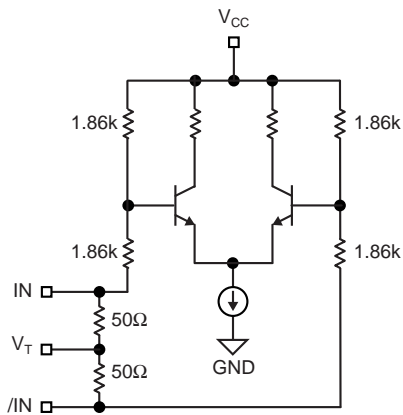


Figure 2a. Simplified Differential Input Buffer

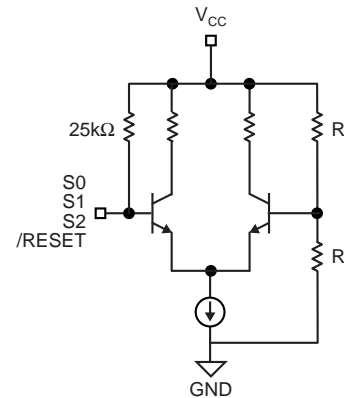


Figure 2b. Simplified TTL/CMOS Input Buffer

LVDS OUTPUTS

LVDS (Low Voltage Differential Swing) specifies a small swing of 350mV typical, on a nominal 1.25V common mode above ground. The common mode voltage has tight limits

to permit large variations in ground between an LVDS driver and receiver. Also, change in common mode voltage, as a function of data input, is also kept tight, to keep EMI low.

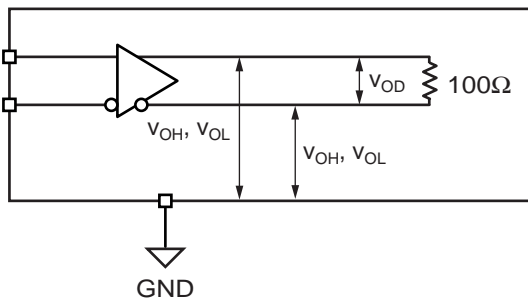


Figure 3a. LVDS Differential Measurement

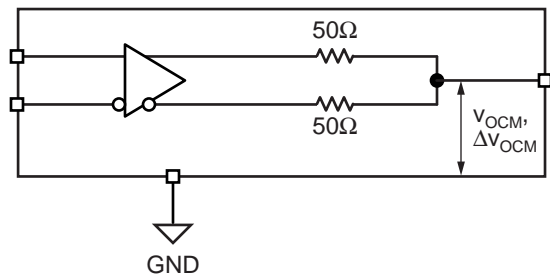


Figure 3b. LVDS Common Mode Measurement

INPUT INTERFACE APPLICATIONS

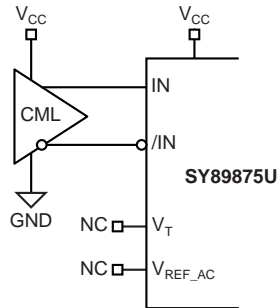


Figure 4a. DC-Coupled CML Input Interface

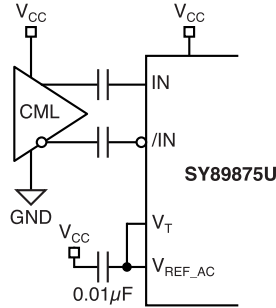


Figure 4b. AC-Coupled CML Input Interface

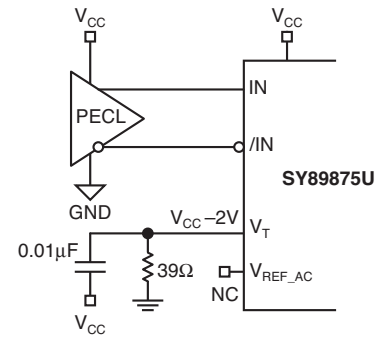


Figure 4c. DC-Coupled PECL Input Interface

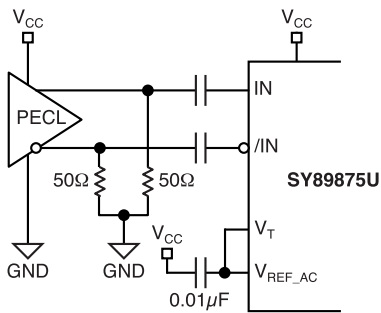


Figure 4d. AC-Coupled CML Input Interface

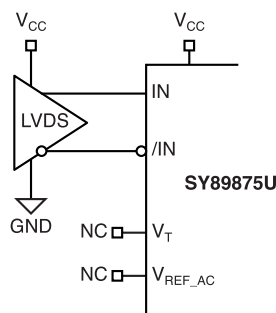


Figure 4e. LVDS Input Interface

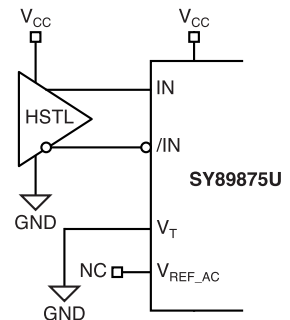
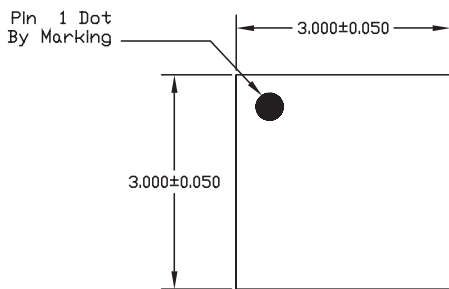


Figure 4f. HSTL Input Interface

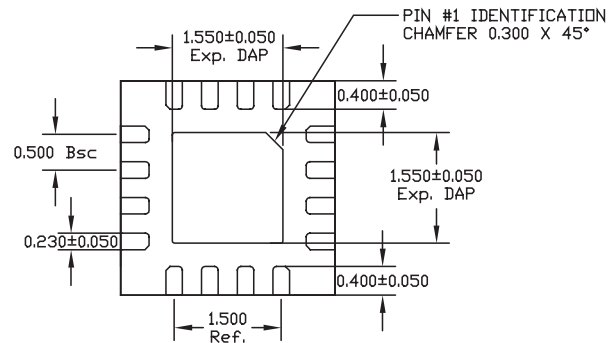
RELATED PRODUCT AND SUPPORT DOCUMENTATION

| Part Number | Function | Data Sheet Link |
|---------------|--|---|
| SY89872U | 2.5V, 2.5GHz Any Diff. In-to-LVDS Programmable Clock Divider/Fanout Buffer w/ Internal Termination | http://www.micrel.com/product-info/products/sy89872u.shtml |
| | MLF® Application Note | http://www.amkor.com/products/notes_papers/mlf_appnote_0902.pdf |
| HBW Solutions | New Products and Applications | http://www.micrel.com/product-info/products/solutions.shtml |

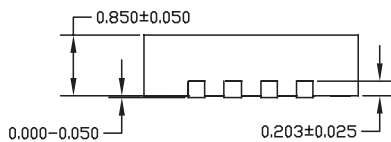
16-PIN MicroLeadFrame® (MLF-16)



TOP VIEW



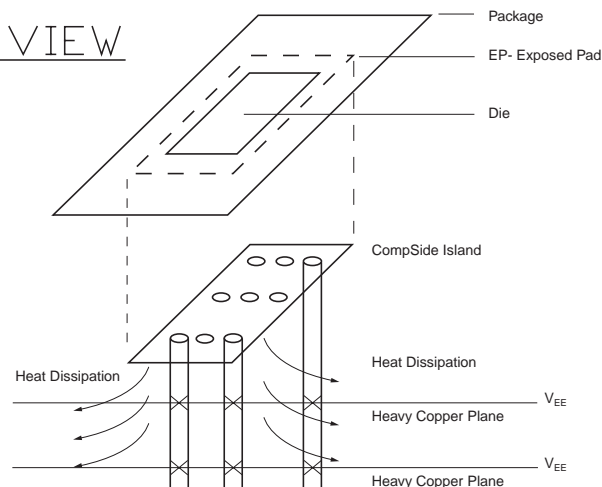
BOTTOM VIEW



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.

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>

The information furnished by Micrel in this datasheet is believed to be accurate and reliable. However, no responsibility is assumed by Micrel for its use. Micrel reserves the right to change circuitry and specifications at any time without notification to the customer.

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 at Purchaser's own risk and Purchaser agrees to fully indemnify Micrel for any damages resulting from such use or sale.

© 2005 Micrel, Incorporated.