



## SY89852U

### Precision Low Power Differential 2:1 LVPECL MUX with Internal Termination

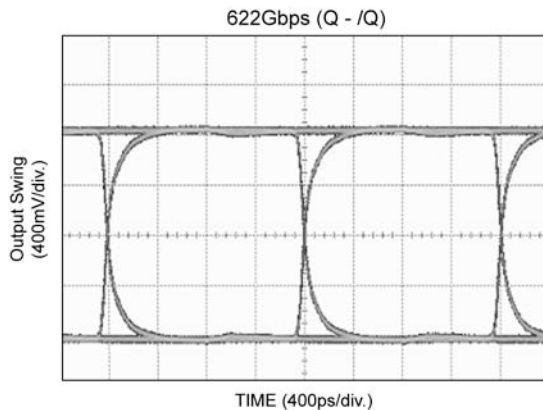
## General Description

The SY89852U is a 2.5V/3.3V precision, high-speed, 2:1 differential MUX capable of handling clocks up to 2.5GHz and data streams up to 2.5Gbps.

The differential input includes Micrel's unique, patent pending 3-pin input termination architecture that allows users to interface to any differential signal (AC- or DC-coupled) as small as 100mV (200mV<sub>pp</sub>) without any level shifting or termination resistor networks in the signal path. The unique, patent input isolation design minimizes crosstalk minimizing crosstalk induced jitter. The outputs are 800mV LVPECL, with extremely fast rise/fall time guaranteed to be less than 180ps.

The SY89852U operates from a 2.5V  $\pm$ 5% supply or a 3.3V  $\pm$ 10% supply and is guaranteed over the full industrial temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . The SY89852U is part of Micrel's high-speed, Precision Edge<sup>®</sup> product line. All support documentation can be found on Micrel's web site at: [www.micrel.com](http://www.micrel.com).

## Typical Applications



Precision Edge is a registered trademark of Micrel, Inc.  
MicroLeadFrame and MLF are registered trademarks of Amkor Technology, Inc.



## Features

- Provides a low jitter copy of the selected input
- Superior alternative to the EP58 2:1 MUX
- Low power: 58mW (2.5V nominal, no load)
- Guaranteed AC performance over temperature and supply voltage:
  - DC- to > 2.5Gbps data rate throughput
  - DC- to > 2.5GHz clock  $f_{MAX}$
  - < 340ps In-to-Out  $t_{pd}$
  - < 180ps  $t_r/t_f$  time
- Ultra-low Jitter Design:
  - < 1ps<sub>(rms)</sub> random jitter
  - < 10ps<sub>(pp)</sub> deterministic jitter
  - < 10ps<sub>(pp)</sub> total jitter (clock)
  - < 0.7ps<sub>(rms)</sub> crosstalk induced jitter
- Unique, patent-pending input isolation design minimizes crosstalk
- Unique, patent pending input termination and VT pin accepts DC-coupled and AC-coupled inputs (CML, PECL, LVDS)
- Typical 800mV (100k) LVPECL output swing
- Power supply 2.5V  $\pm$ 5% or 3.3V  $\pm$ 10%
- Industrial temperature range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Available in ultra-small (3mm x 3mm) 16-pin MLF<sup>®</sup> package

## Applications

- Redundant clock distribution
- SONET/SDH clock/data distribution
- Loopback
- Fibre Channel distribution

## Markets

- LAN/WAN
- Enterprise servers
- ATE
- Test and measurement

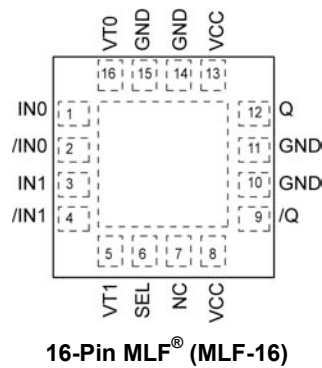
## Ordering Information<sup>(1)</sup>

Part Number	Package Type	Operating Range	Package Marking	Lead Finish
SY89852UMG	MLF-16	Industrial	852U with bar-line designator	NiPdAu Pb-Free
SY89852UMGTR <sup>(2)</sup>	MLF-16	Industrial	852U with bar-line designator	NiPdAu Pb-Free

**Notes:**

1. Contact factory for die availability. Dice are guaranteed at T<sub>A</sub> = 25°C, DC Electrical Only.
2. Tape and Reel.

## Pin Configuration



## Pin Description

Pin Number	Pin Name	Pin Function
1,2, 3,4	IN, /IN	Differential Input: This input pair is the signal to be buffered. These inputs accept AC- or DC-coupled signals as small as 100mV (200mV <sub>PP</sub> ). Each pin of this pair internally terminates to a VT pin through 50Ω. Note that this input will default to an indeterminate state if left open. Please refer to the “Input Interface Applications” section for more details.
16,5	VT	Input Termination Center-Tap: Each side of the differential input pair terminates to this pin. The VT pin provides a center-tap to a termination network for maximum interface flexibility. See “Input Interface Applications” section for more details.
8,13	VCC	Positive Power Supply. Bypass with 0.1μF    0.01μF low ESR capacitors as close to the V <sub>CC</sub> pin as possible.
12,9	Q, /Q	Differential 100K LVPECL Output: This LVPECL output is the output of the device. Terminate through 50Ω to V <sub>CC</sub> -2V. PECL output requires DC path to ground. Thus, AC-coupled applications require pull-down resistors. See “Output Interface Applications” section.
10,11,14,15	GND, Exposed Pad	Ground. Ground pin and exposed pad must be connected to the same ground plane.
6	SEL	This single-ended TTL/CMOS-compatible input selects the inputs to the multiplexer. Note that this input is internally connected to a 25KΩ pull-up resistor and will default to logic HIGH state if left open.
7	NC	No connect.

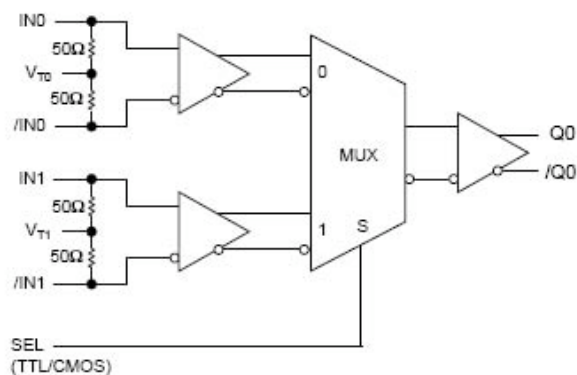
## Truth Table

IN0	IN1	SEL <sup>(1)</sup>	Q
0	X	0	0
1	X	0	1
X	0	1	0
X	1	1	1

**Note:**

1. SEL is connected to a 25kΩ pull-up resistor and will default to logic high if left open.

## Functional Block Diagram



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

Supply Voltage ( $V_{CC}$ )	-0.5V to +4.0V
Input Voltage ( $V_{IN}$ )	-0.5V to $V_{CC}$
LVPECL Output Current ( $I_{OUT}$ )	
Continuous	50mA
Surge	100mA
Termination Current <sup>(3)</sup>	
Source or sink current on $V_T$	$\pm 50$ mA
Lead Temperature (soldering, 20sec.)	+260°C
Storage Temperature ( $T_s$ )	-65°C to 150°C

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

Supply Voltage ( $V_{CC}$ )	+2.375V to +2.625V
	+3.0V to +3.6V
Ambient Temperature ( $T_A$ )	-40°C to +85°C
Package Thermal Resistance <sup>(4)</sup>	
MLF <sup>®</sup> ( $\theta_{JA}$ )	
Still-Air	60°C/W
MLF <sup>®</sup> ( $\psi_{JB}$ )	
Junction-to-Board	38°C/W

**DC Electrical Characteristics<sup>(5)</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	2.5	2.625	V
			3.0	3.3	3.6	V
$I_{CC}$	Power Supply Current	No load, max. $V_{CC}$		23	35	mA
$R_{DIFF\_IN}$	Differential Input Resistance (IN-to-/IN)		80	100	120	$\Omega$
$R_{IN}$	Input Resistance (IN-to- $V_T$ )		40	50	60	$\Omega$
$V_{IH}$	Input High Voltage (IN-to-/IN)	Note 6	$V_{CC} - 1.6$		$V_{CC}$	V
$V_{IL}$	Input Low Voltage (IN-to-/IN)		0		$V_{IH} - 0.1$	V
$V_{IN}$	Input Voltage Swing (IN-to-/IN)	See Figure 1a.	0.1		1.7	V
$V_{DIFF\_IN}$	Differential Input Voltage Swing  IN-/IN	See Figure 1b.	0.2			V
$V_{T\_IN}$	IN-to- $V_T$ (IN-to-/IN)				1.28	V

**Notes:**

1. Permanent device damage may occur if the "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. Due to the limited drive capability, use for input of the same package only.
4. Package thermal resistance assumes exposed pad is soldered (or equivalent) to the devices most negative potential on the PCB.  $\theta_{JA}$  and  $\psi_{JB}$  use a 4-layer board in still air, unless otherwise stated.
5. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.
6.  $V_{IH}$  (min) not lower than 1.2V.

### LVPECL Outputs DC Electrical Characteristics<sup>(7)</sup>

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

Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_{OH}$	Output HIGH Voltage Q, /Q		$V_{CC}-1.145$		$V_{CC}-0.895$	V
$V_{OL}$	Output LOW Voltage Q, /Q		$V_{CC}-1.945$		$V_{CC}-1.695$	V
$V_{OUT}$	Output Voltage Swing Q, /Q	See Figure 1a.	550	800		mV
$V_{DIFF-OUT}$	Differential Output Voltage Swing Q, /Q	See Figure 1b.	1100	1600		mV

### LVTTL/CMOS DC Electrical Characteristics<sup>(7)</sup>

Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_{IH}$	Input HIGH Voltage		2.0		$V_{CC}$	V
$V_{IL}$	Input LOW Voltage				0.8	V
$I_{IH}$	Input HIGH Current		-125		30	$\mu A$
$I_{IL}$	Input LOW Current		-300			$\mu A$

**Note:**

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

## AC Electrical Characteristics<sup>(8)</sup>

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

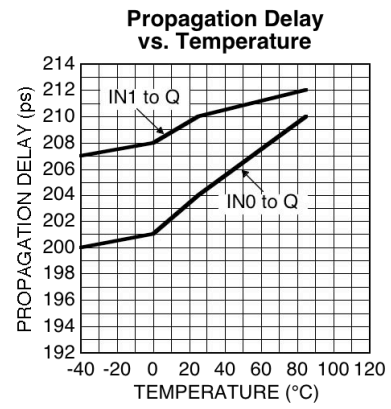
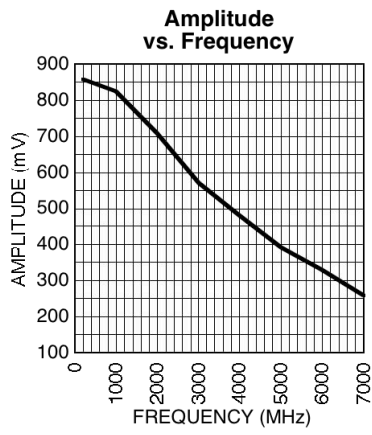
Symbol	Parameter	Condition	Min	Typ	Max	Units
$f_{MAX}$	Maximum Operating Frequency	NRZ Data	2.5	3.2		Gbps
		Clock, $V_{OUT} \geq 400mV$	2.5	3.5		GHz
$t_{PD}$	Propagation Delay IN-to-Q, /IN-to-Q SEL-to-Q	$V_{IN} \geq 100mV$	140	230	340	ps
			100	250	400	ps
$t_{PD}$ Tempco	Differential Propagation Delay Temperature Coefficient			100		fs/ $^\circ C$
$t_{Jitter}$	Data Random Jitter (RJ)	Note 9			1	ps <sub>RMS</sub>
	Deterministic Jitter (DJ)	Note 10			10	ps <sub>RMS</sub>
	Clock Cycle-to-Cycle Jitter	Note 11			1	ps <sub>PP</sub>
	Total Jitter	Note 12			10	ps <sub>RMS</sub>
	Crosstalk-induced Jitter	Note 13			0.7	ps <sub>RMS</sub>
$t_r, t_f$	Output Rise/Fall Time (20% to 80%)	At full output swing.	50	100	180	ps

### Notes:

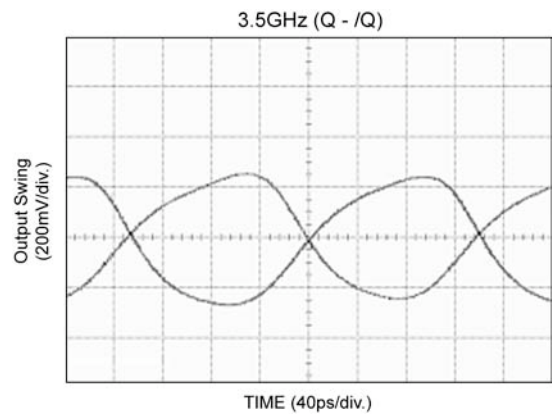
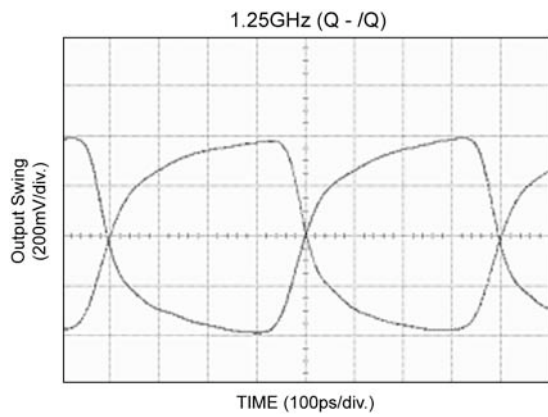
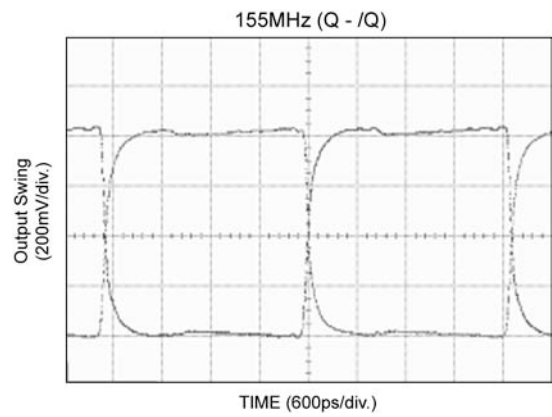
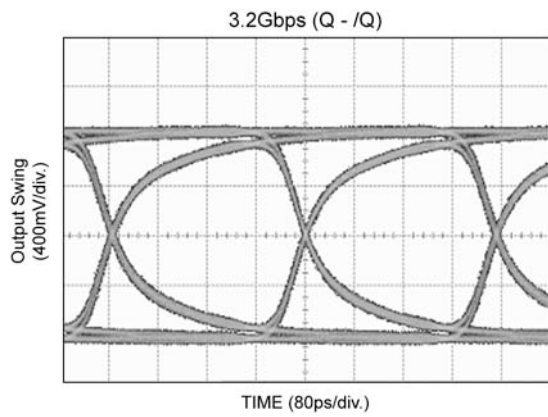
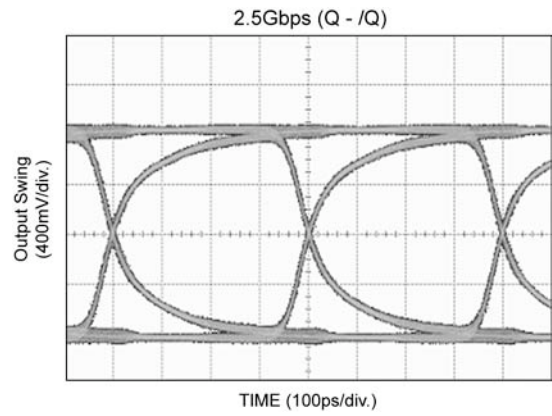
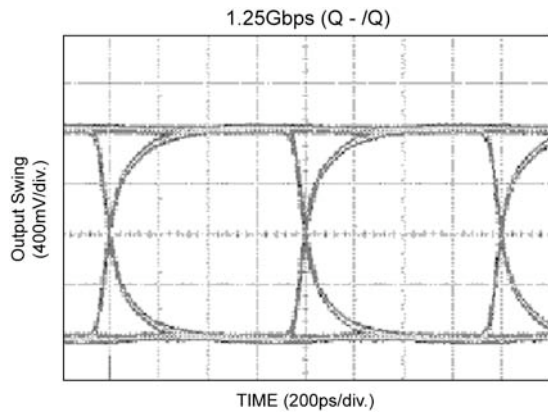
8. High-frequency AC-parameters are guaranteed by design and characterization.
9. Random jitter is measured with a K28.7 character pattern, measured at 2.5Gbps.
10. DJ is measured at 2.5Gbps, with both K28.5 and  $2^{23} - 1$  PRBS pattern.
11. Cycle-to-cycle jitter definition: The variation of periods between adjacent cycles,  $T_n - T_{n-1}$  where T is the time between rising edges of the output signal.
12. 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.
13. Crosstalk induced jitter is defined as the added jitter that results from signals applied to two adjacent channels. It is measured at the output while applying two similar, differential clock frequencies that are asynchronous with respect to each other at the inputs.

## Operating Characteristics

$V_{CC} = 2.5V$ ,  $V_{IN} = 100mV$ ,  $T_A = 25^\circ C$ ; unless otherwise stated.



### Operating Characteristics





## Singled-Ended and Differential Swings

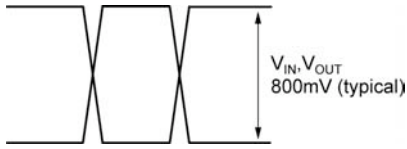


Figure 1a. Single-Ended Voltage Swing

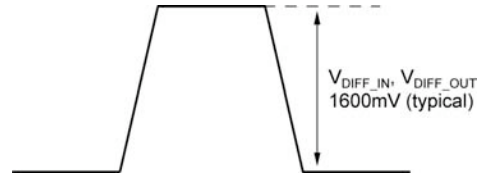


Figure 1b. Differential Voltage Swing

## Timing Diagrams

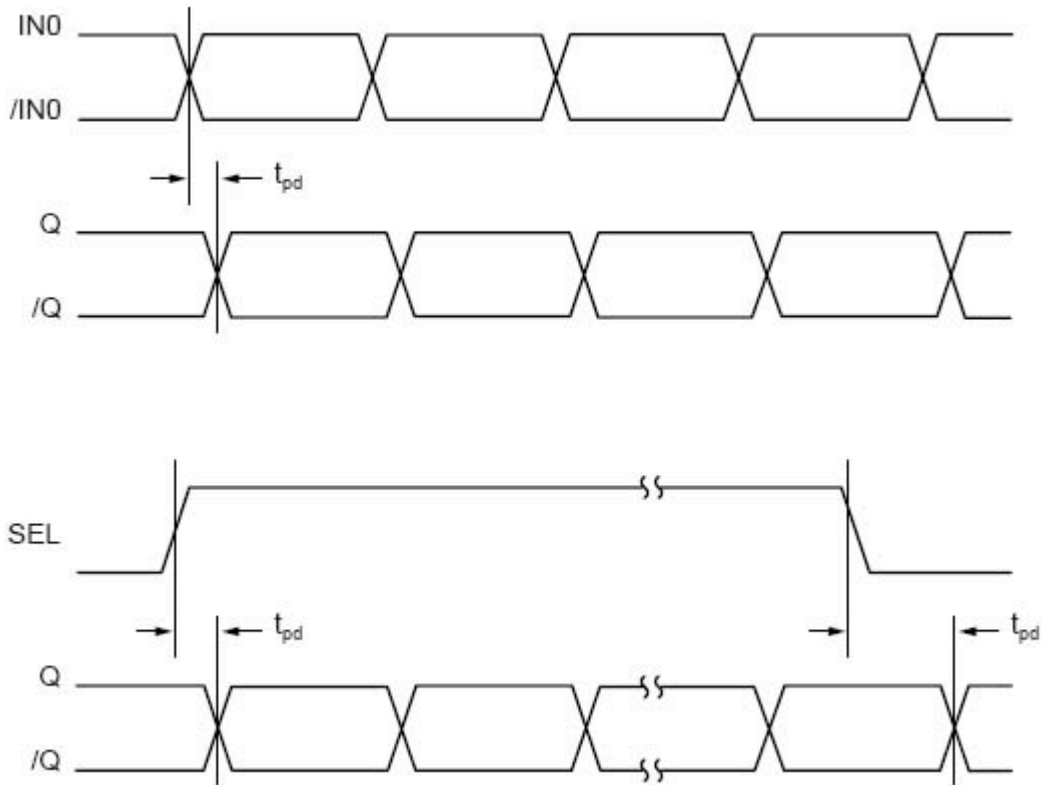


Figure 2. Timing Diagram

## Input and Output Stages

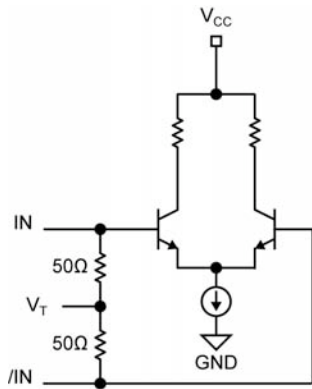


Figure 3a. Simplified Differential Input Stage

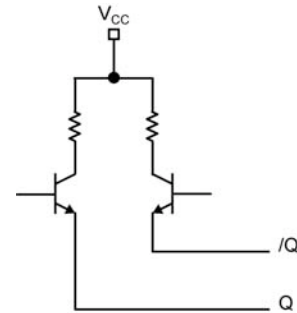
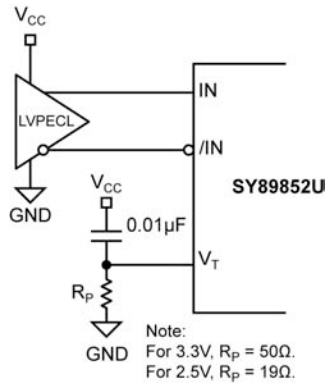
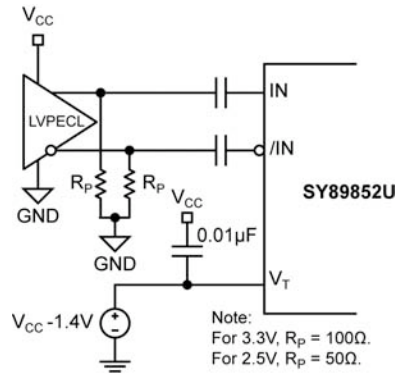


Figure 3b. Simplified LVPECL Output Stage

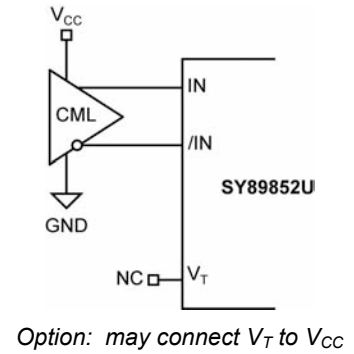
## Input Interface Applications



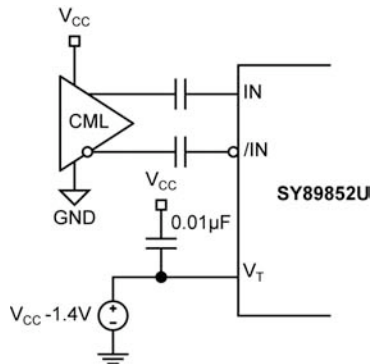
**Figure 4a. LVPECL Interface (DC-Coupled)**



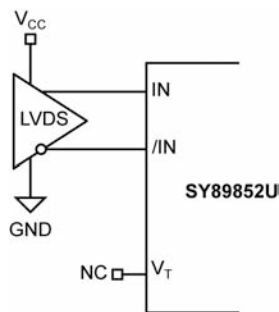
**Figure 4b. LVPECL Interface (AC-Coupled)**



**Figure 4c. CML Interface (DC-Coupled)**  
*Option: may connect V<sub>T</sub> to V<sub>CC</sub>*

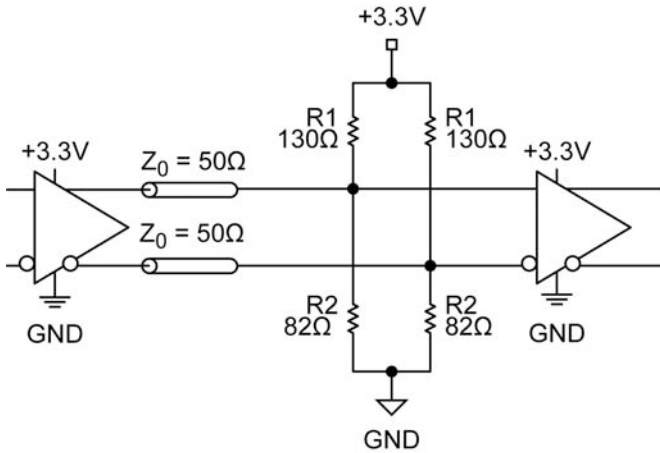


**Figure 4d. CML Interface (AC-Coupled)**



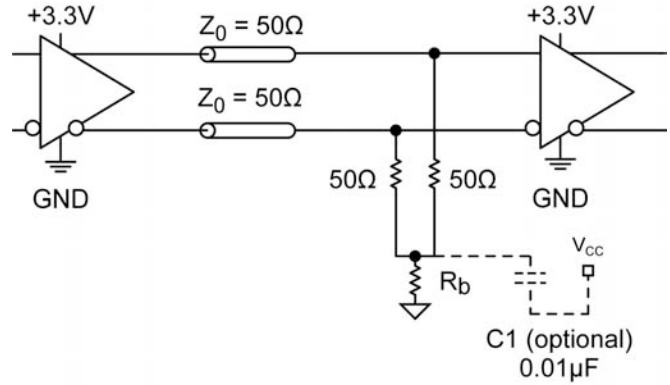
**Figure 4e. LVDS Interface**

## Output Interface Applications



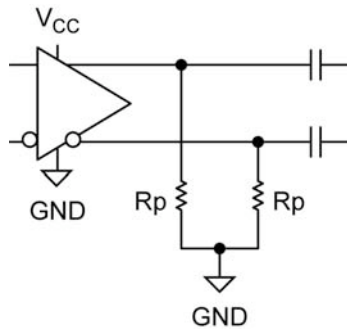
**Note:**  
For +2.5V systems  
R1 = 250Ω, R2 = 82.5Ω

**Figure 5a. Parallel Thevenin-Equivalent Termination**



**Note:**  
For +2.5V systems: Rb = 19Ω  
For 3.3V systems Rb = 50Ω

**Figure 5b. Parallel Termination (3-Resistor)**



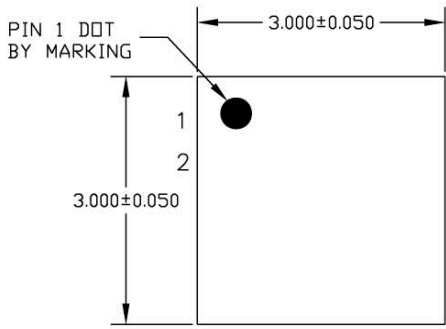
**Note:**  
For +2.5V systems: Rb = 50Ω  
For 3.3V systems Rb = 100Ω  
The output pair requires a DC-current path to GND.

**Figure 5c. AC-Coupled Output Pull-down Resistors**

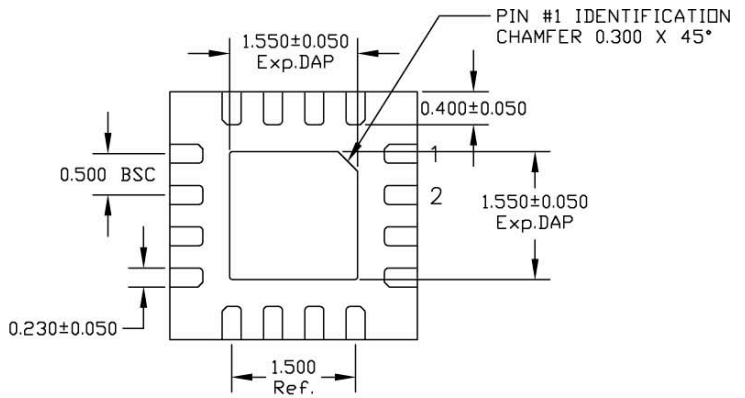
## Related Product and Support Documentation

Part Number	Function	Data Sheet Link
SY89852U	Precision Low Power Differential 2:1 LVPECL MUX w/Internal Termination	<a href="http://www.micrel.com/product-info/products/sy89852u.shtml">www.micrel.com/product-info/products/sy89852u.shtml</a>
	MLF <sup>®</sup> Application Note	<a href="http://www.amkor.com/products/notes_papers/MLF_AppNote.pdf">www.amkor.com/products/notes_papers/MLF_AppNote.pdf</a>
HBW Solutions	New Products and Applications	<a href="http://www.micrel.com/product-info/products/solutions.shtml">www.micrel.com/product-info/products/solutions.shtml</a>

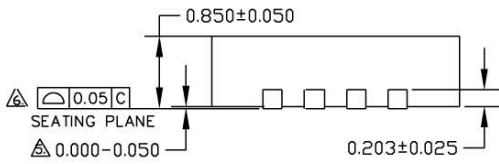
**Package Information**



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.
- ⚠ APPLIED ONLY FOR TERMINALS.
  - ⚠ APPLIED FOR EXPOSED PAD AND TERMINALS.

**16-Pin (3mm x 3mm) MLF® (MLF-16)**

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