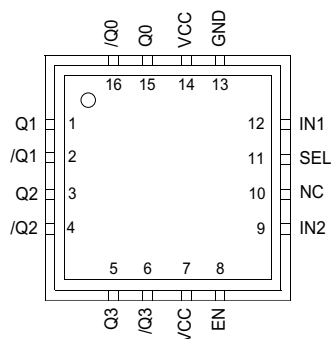


## PACKAGE/ORDERING INFORMATION



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 1, 2, 3, 4, 5, 6	Q0, /Q0 Q1, /Q1 Q2, /Q2 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 $50\Omega$ 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 $25k\Omega$ pull-up resistor and will default to logic HIGH state (enabled) if left open.
12, 9	IN1 IN2	Single-ended TTL/CMOS-compatible inputs to the device. These inputs are internally connected to a $25k\Omega$ 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 $25k\Omega$ 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 $0.1\mu\text{F}/0.01\mu\text{F}$ 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 3.0		2.625 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>**

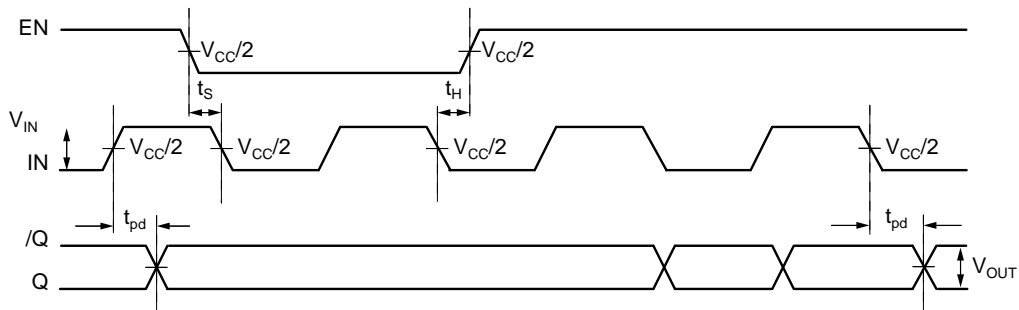
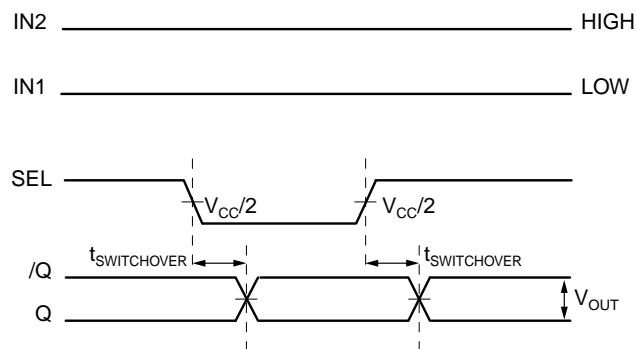
$V_{CC} = 2.5V \pm 5\%$  or  $V_{CC} = 3.3V \pm 10\%$ ,  $R_L = 50\Omega$  to  $V_{CC} - 2V$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ , unless otherwise stated.

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	ps <sub>RMS</sub>
	Deterministic Jitter (DJ)	Note 10			10	ps <sub>PP</sub>
	Clock					
	Cycle-to-Cycle Jitter	Note 11			1	ps <sub>RMS</sub>
	Total Jitter (TJ)	Note 12			10	ps <sub>PP</sub>
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

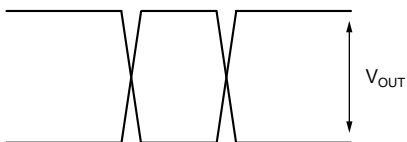


Figure 2a. Single-Ended Swing

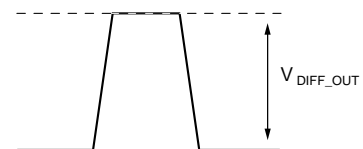
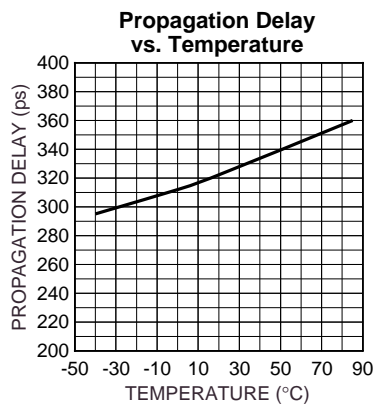
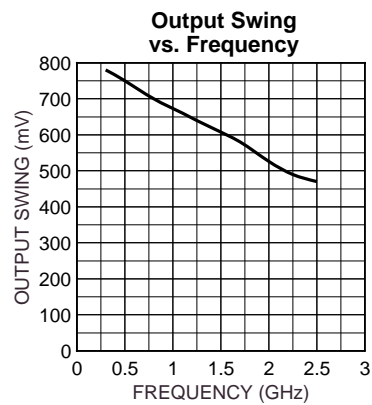


Figure 2b. Differential Swing

TYPICAL OPERATING CHARACTERISTICS

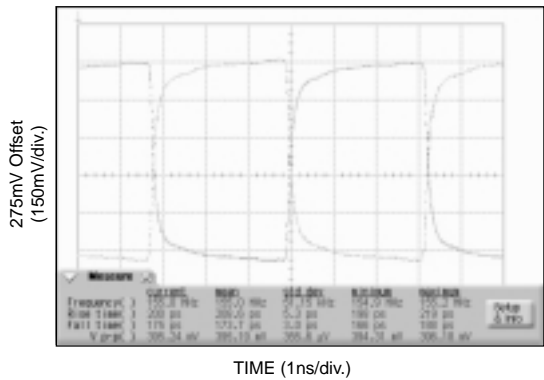
$V_{CC} = 3.3V$ ,  $GND = 0V$ ,  $R_L = 50\Omega$  to  $V_{CC}-2V$ ;  $T_A = 25^{\circ}C$ , unless otherwise stated.



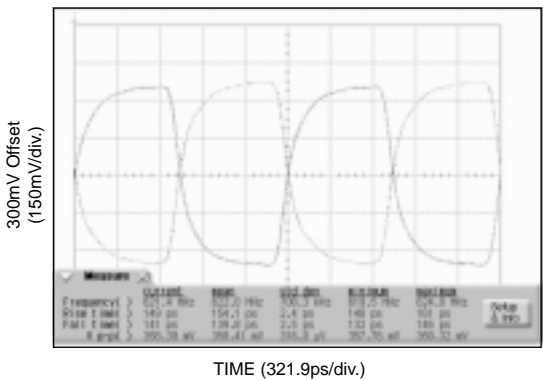
FUNCTIONAL CHARACTERISTICS

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.

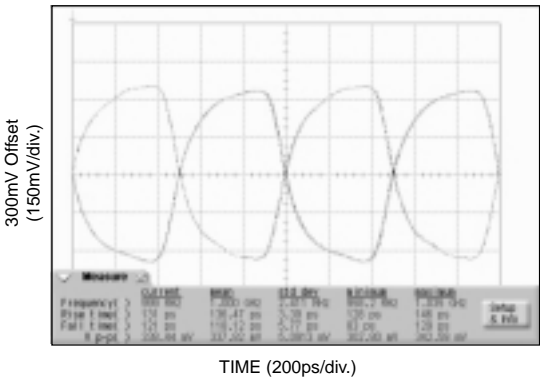
155MHz Output



622MHz Output



1GHz Output



DIFFERENTIAL INPUT

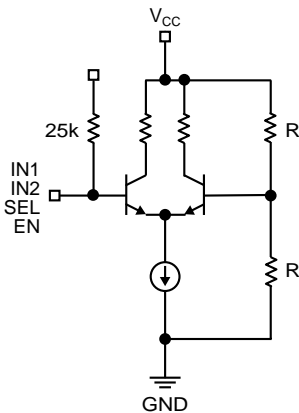


Figure 3. Simplified TTL/CMOS Input Buffer

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

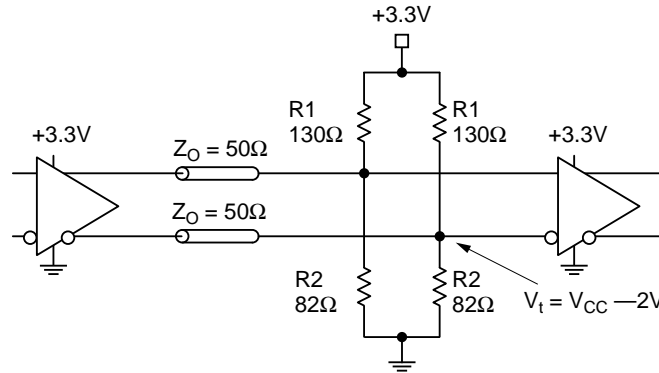


Figure 4a. Parallel Termination-Thevenin Equivalent

**Note:**

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

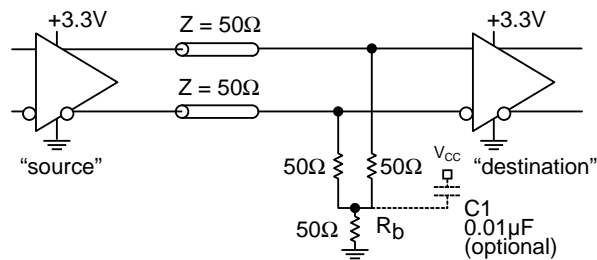


Figure 4b. Three-Resistor "Y-Termination"

**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  $R_b = 19\Omega$ .

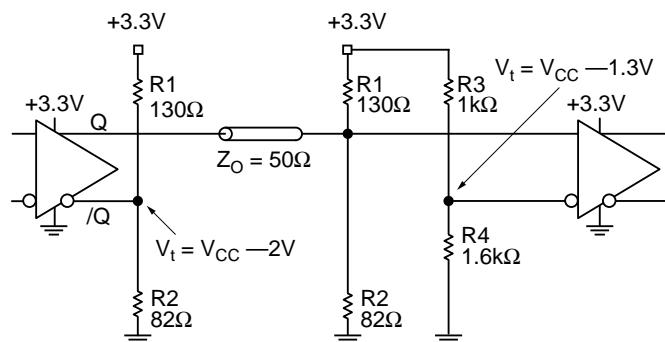
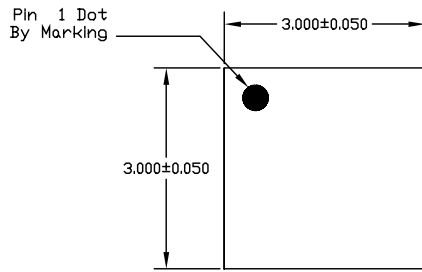


Figure 4c. Terminating Unused LVPECL I/O

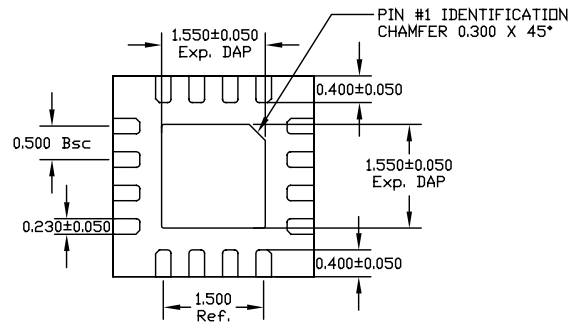
**Notes:**

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.

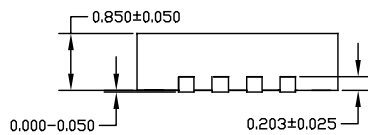


**16 LEAD EPAD *MicroLeadFrame*™ (MLF-16)**

TOP VIEW



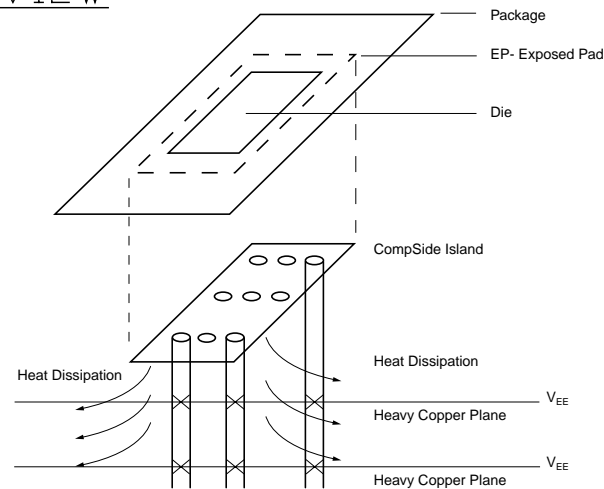
BOTTOM VIEW



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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