3.3V, 2.0GHz ANY DIFF. IN-TO-LVDS PROGRAMMABLE CLOCK DIVIDER/FANOUT BUFFER W/ INTERNAL TERMINATION

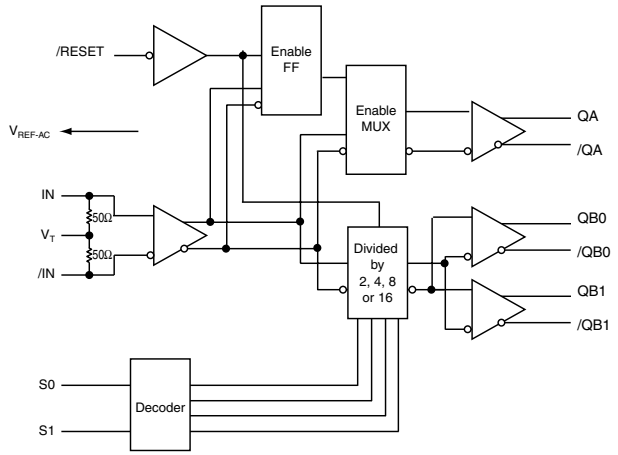
FEATURES

- Guaranteed AC performance
  - > 2.0GHz F_{MAX} output toggle
  - > 3.0GHz F_{MAX} input
  - < 800ps T_{pd} (matched-delay between banks)
  - < 15ps within-device skew
  - < 190ps rise/fall time
- Low jitter design
  - < 1ps (rms) cycle-to-cycle jitter
  - < 10ps (pk-pk) total jitter
- Unique input termination and V_T pin for DC-coupled and AC-coupled inputs: any differential inputs (LVPECL, LVDS, CML, HSTL)
- Precision differential LVDS outputs
- Matched delay: all outputs have matched delay, independent of divider setting
- TTL/CMOS inputs for select and reset/disable
- Two LVDS output banks (matched delay)
  - Bank A: Buffered copy of input clock (undivided)
  - Bank B: Divided output (÷2, ÷4, ÷8, ÷16), two copies
- 3.3V power supply
- Wide operating temperature range: –40°C to +85°C
- Available in 16-pin (3mm × 3mm) MLF™ package

APPLICATIONS

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

FUNCTIONAL BLOCK DIAGRAM



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*Micro*LeadFrame and MLF are trademarks of Amkor Technology, Inc.

Precision Edge™

DESCRIPTION

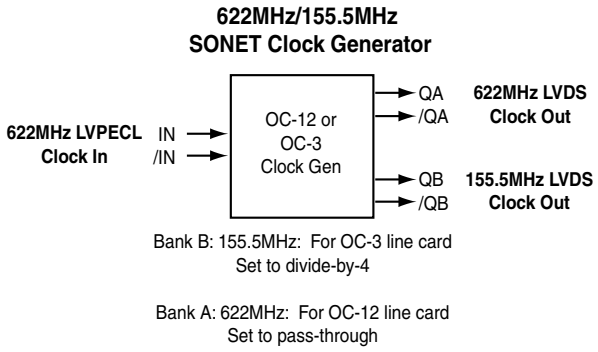
This 3.3V low-skew, low-jitter, precision LVDS output clock divider accepts any high-speed differential clock input (AC- or DC-coupled) CML, LVPECL, HSTL or LVDS and divides down the frequency using a programmable divider ratio to create a frequency-locked, lower speed version of the input clock. The SY89873L includes two output banks. Bank A is an exact copy of the input clock (pass through) with matched propagation delay to Bank B, the divided output bank. Available divider ratios are 2, 4, 8 and 16. In a typical 622MHz clock system this would provide availability of 311MHz, 155MHz, 77MHz or 38MHz auxiliary clock components.

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 all AC- or DC-coupled differential logic standards. A V_{REF-AC} reference is included for AC-coupled applications.

The SY89873L is part of Micrel's high-speed Precision Edge™ timing and distribution family. For 2.5V applications, consider the SY89872U. For applications that require an LVPECL output, consider the SY89871U.

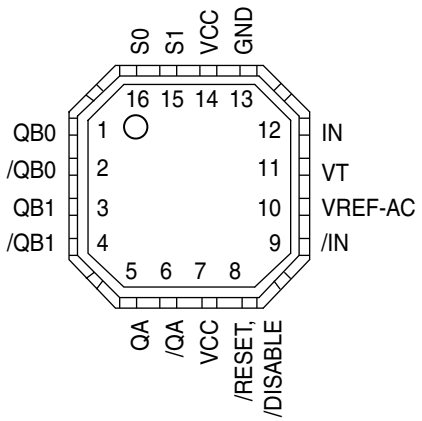
The /RESET input asynchronously resets the divider outputs (Bank B). In the pass-through function (Bank A) the /RESET synchronously enables or disables the outputs on the next falling edge of IN (rising edge of /N). Refer to the Timing Diagram.

TYPICAL APPLICATION



Rev.: B Amendment: /1
Issue Date: February 2003

PACKAGE/ORDERING INFORMATION



16-Pin MLF™

Ordering Information

Part Number	Package Type	Operating Range	Package Marking
SY89873LMI	MLF-16	Industrial	873L
SY89873LMITR*	MLF-16	Industrial	873L

*Tape and Reel

PIN DESCRIPTION

Pin Number	Pin Name	Pin Function
1, 2, 3, 4	QB0, /QB0 QB1, /QB1	Differential Buffered Output Clocks: Divide by 2, 4, 8, 16. LVDS compatible.
5, 6	QA, /QA	Differential Buffered Undivided Output Clock: LVDS compatible.
7, 14	VCC	Positive Power Supply: Bypass with 0.1μF//0.01μF low ESR capacitors.
8	/RESET, /DISABLE	TTL/CMOS Compatible Output Reset and Disable: Internal 25kΩ pull-up. Input threshold is V_{CC}/2. Logic LOW will reset the divider select, and align Bank A and Bank B edges. In addition, when LOW, Banks A and B will be disabled.
9, 12	IN, /IN	Differential Input: Internal 50Ω termination resistors to V_T input. See “Input Interface Applications” section.
10	VREF-AC	Reference Voltage: Equal to V_{CC}–1.4V (approx.), and used for AC-coupled applications. Maximum sink/source current is 0.5mA. See “Input Interface Applications” section.
11	VT	Termination Center-Tap: For CML and LVDS inputs, leave this pin floating. Otherwise, see “Input Interface Applications” section.
13	GND	Ground: Exposed pad is internally connected to GND and must be connected to a ground plane for proper thermal operation.
15, 16	S0, S1	Select Pins: LVTTL/CMOS logic levels. Internal 25kΩ pull-up resistor. Logic HIGH if left unconnected (divided by 16 mode). S0 = LSB. Input threshold is V_{CC}/2.

TRUTH TABLE

/RESET /DISABLE	S1	S0	Bank A Output	Bank B Outputs
1	0	0	Input Clock	Input Clock ÷ 2
1	0	1	Input Clock	Input Clock ÷ 4
1	1	0	Input Clock	Input Clock ÷ 8
1	1	1	Input Clock	Input Clock ÷ 16
0	X	X	QA = LOW, /QA = HIGH(1)	QB0 = LOW, /QB0 = HIGH(2) QB1 = LOW, /QB1 = HIGH(2)

Note 1. On the next negative transition of the input signal.

Note 2. Asynchronous Reset/Disable function. See "Timing Diagram."

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
LVDS Output Current (I_{OUT}) ..... ±10mA
Input Current IN, /IN (I_{IN}) ..... ±50mA
V_{REF-AC} Input Sink/Source Current ($I_{VREF-AC}$), **Note 3** . ±2mA
Lead Temperature (soldering, 10 sec.) ..... 220°C
Storage Temperature (T_S) ..... –65°C to +150°C

Operating Ratings(Note 2)

Supply Voltage (V_{CC}) ..... +3.3V ±10%
Ambient Temperature (T_A) ..... –40°C to +85°C
Package Thermal Resistance
MLF™ (θ_{JA})
Still-Air ..... 60°C/W
500 lfpm ..... 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,

T_A= –40°C to +85°C; Unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{CC}	Power Supply		3.0	3.3	3.6	V
I_{CC}	Power Supply Current	No load, Max V_{CC}		85	115	mA
R_{IN}	Differential Input Resistance IN, /IN		80	100	120	Ω
V_{IH}	Input High Voltage IN, /IN	**Note 2**	0.1		V_{CC}+0.3	V
V_{IL}	Input Low Voltage IN, /IN	**Note 2**	–0.3		V_{CC}+0.2	V
V_{IN}	Input Voltage Swing	**Notes 2, 3**	0.1		3.6	V
V_{DIFF_IN}	Differential Input Voltage Swing	**Notes 2, 3, 4**	0.2			V
$\|I_{IN}\|$	Input Current IN, /IN	**Note 2**			45	mA
V_{REF-AC}	Reference Voltage	**Note 5**	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 *"Input Buffer Structure"*) 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 Figures 1c and 1d 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 OUTPUT DC ELECTRICAL CHARACTERISTICS(Notes 1, 2)

V_{CC} = 3.3V ±10%; T_A = –40°C to +85°C; Unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{OUT}	Output Voltage Swing	**Notes 3, 4**	250	350	450	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 3**	1.125		1.275	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 package product only.

Note 3. Measured as per Figure 1a, 100Ω across Q and /Q outputs.

Note 4. See Figure 1c.

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

V_{CC} = 3.3V ±10%; T_A = –40°C to +85°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 package product only.

AC ELECTRICAL CHARACTERISTICS[Notes 1, 2]

V_{CC} = 3.3V ±10%; T_A = –40°C to +85°C; Unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{MAX}	Maximum Output Toggle Frequency (Bank A and Bank B)	Output Swing: ≥ 200mV	2.0			GHz
	Maximum Input Frequency	**Note 3**	3.2			GHz
t_{PD}	Differential Propagation Delay (IN-to-Q)	Input Swing < 400mV	550	660	800	ps
		Input Swing ≥ 400mV	500	610	750	ps
t_{SKEW}	Within-Device Skew (diff.) (QB0-to-QB1)	**Note 4**		7	15	ps
	Within-Device Skew (diff.) (Bank A-to-Bank B)	**Note 4**		12	30	ps
	Part-to-Part Skew (diff.)	**Note 4**			250	ps
t_{rr}	Reset Recovery Time	**Note 5**	600			ps
T_{jitter}	Cycle-to-Cycle Jitter	**Note 6**			1	ps(rms)
	Total Jitter	**Note 7**			10	ps(pk-pk)
t_r, t_f	Rise / Fall Time (20% to 80%)		60	110	190	ps

Note 1. Measured with 400mV input signal, 50% duty cycle. All outputs terminated with 100Ω between Q and /Q, unless otherwise stated.

Note 2. Specification for package product only.

Note 3. Bank A (pass-through) maximum frequency is limited by the output stage. Bank B (input-to-output ÷2, ÷4, ÷8, ÷16) can accept an input frequency >3GHz, while Bank A will be slew rate limited.

Note 4. Skew is measured between outputs under identical transitions.

Note 5. See *"Timing Diagram."*

Note 6. 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 7. Total jitter definition: with an ideal clock input, of frequency ≤ 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.

LVDS OUTPUT

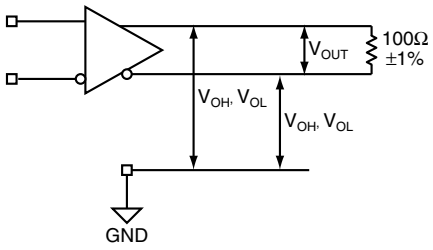


Figure 1a. LVDS Differential Measurement

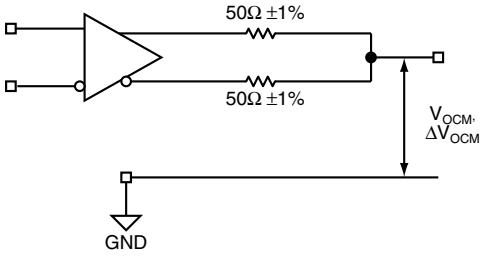


Figure 1b. LVDS Common Mode Measurement

DEFINITION OF SINGLE-ENDED AND DIFFERENTIAL SWING

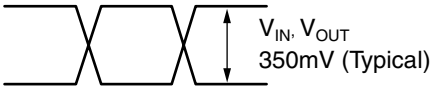


Figure 1c. Single-Ended Swing

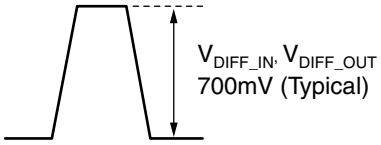
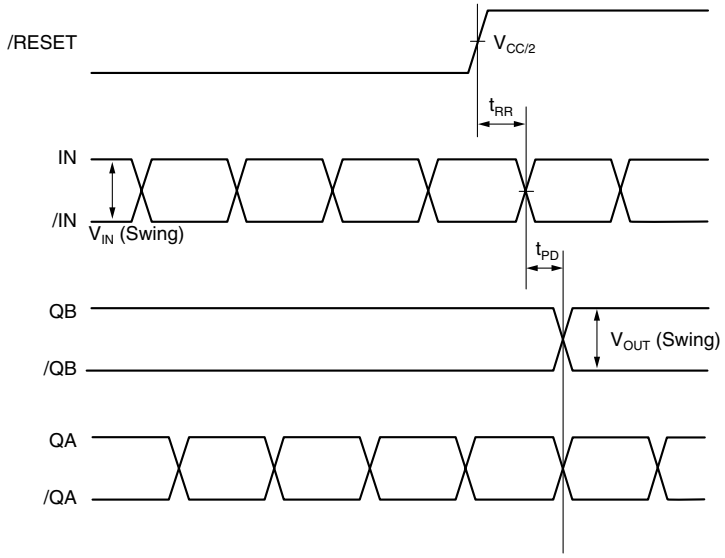


Figure 1d. Differential Swing

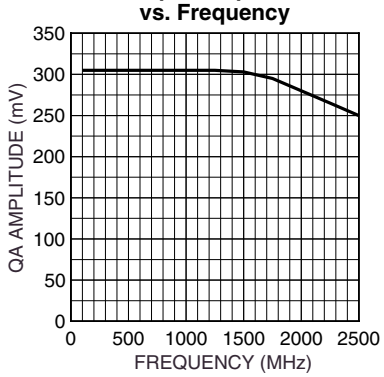
TIMING DIAGRAM



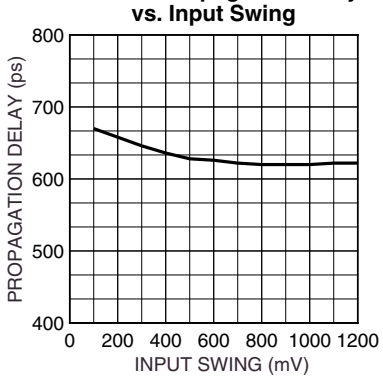
TYPICAL OPERATING CHARACTERISTICS

V_{CC} = 3.3V, V_{IN} = 400mV, T_A = 25°C, unless otherwise stated.

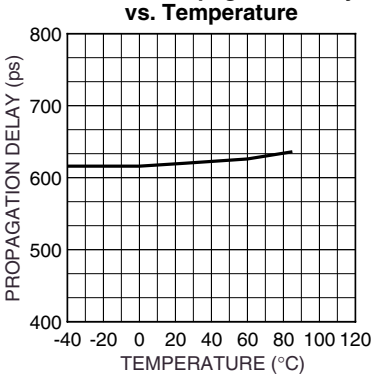
Output Amplitude vs. Frequency



Nominal Propagation Delay vs. Input Swing



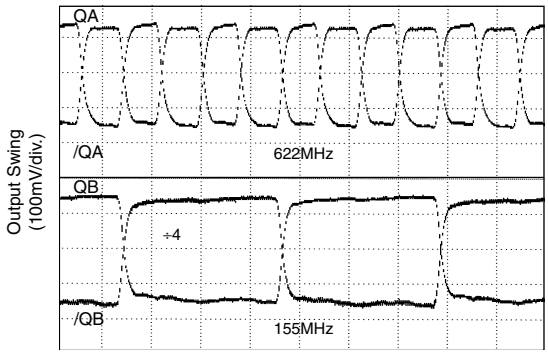
Nominal Propagation Delay vs. Temperature



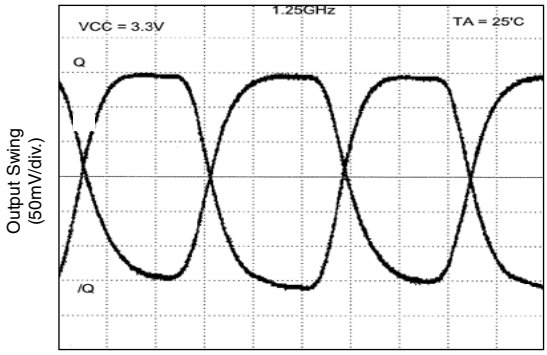
FUNCTIONAL CHARACTERISTICS

Conditions: V_{CC} = 3.3V, T_A = 25°C, unless otherwise stated.

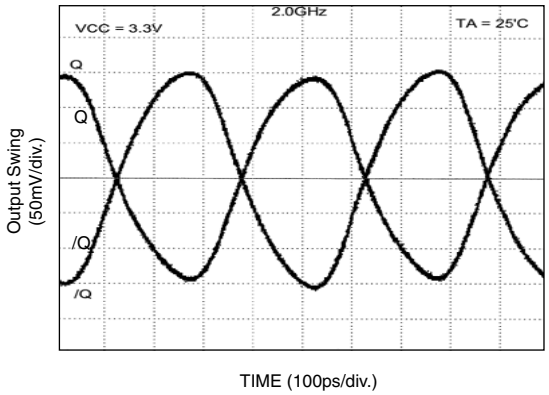
QA @ 622MHz and QB @ 155.5MHz (Divided-by-4)



QA Output @ 1.25GHz



QA Output @ 2.0GHz



INPUT BUFFER STRUCTURE

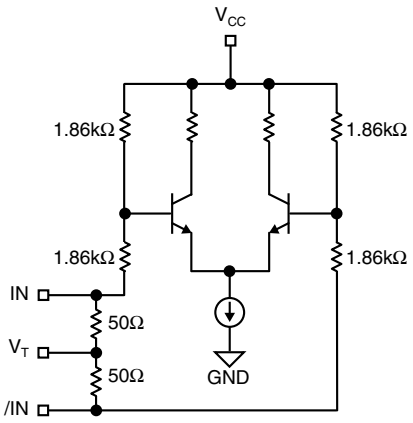


Figure 2a. Simplified Differential Input Stage

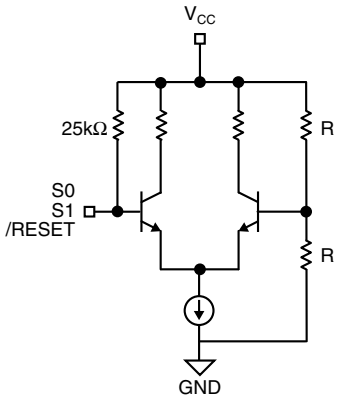


Figure 2b. Simplified TTL/CMOS Input

INPUT INTERFACE APPLICATIONS

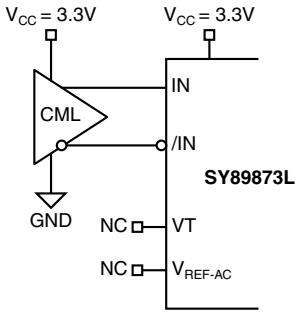


Figure 3a. DC-Coupled CML Input Interface

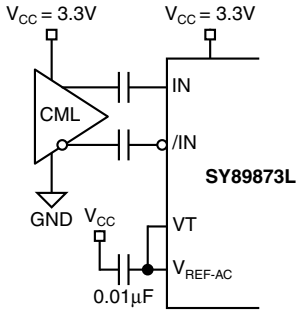


Figure 3b. AC-Coupled CML Input Interface

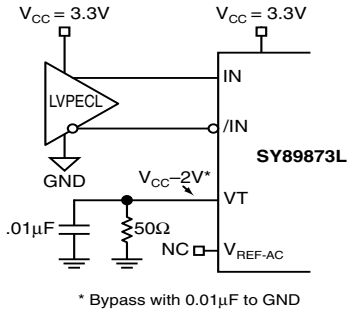


Figure 3c. DC-Coupled LVPECL Input Interface

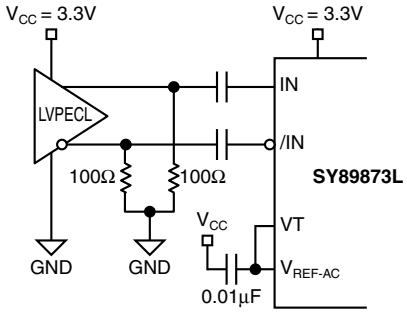


Figure 3d. AC-Coupled LVPECL Input Interface

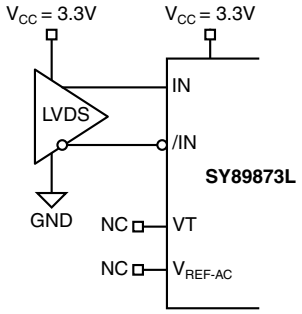


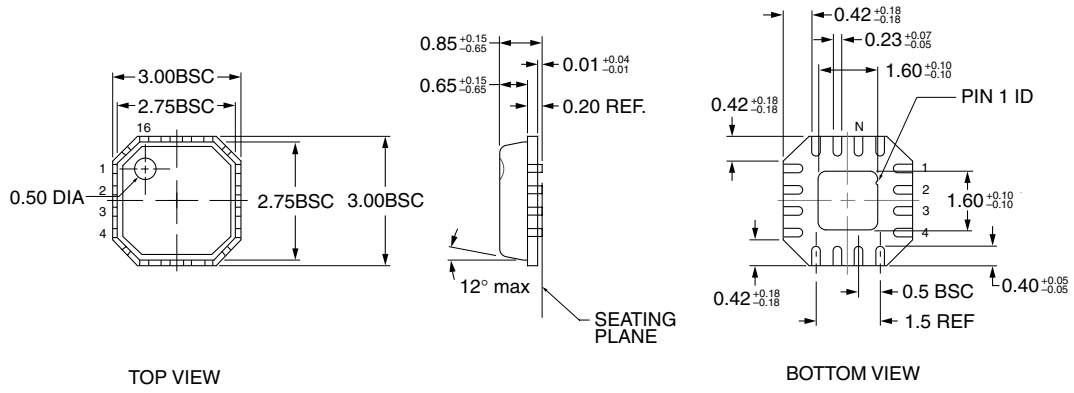
Figure 3e. LVDS Input Interface

Figure 3f. HSTL Input Interface

RELATED MICREL PRODUCTS AND SUPPORT DOCUMENTATION

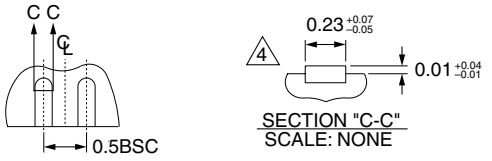
Part Number	Function	Data Sheet Link
SY89871U	2.5GHz Any Diff. In-to-LVPECL Programmable Clock Divider/Fanout Buffer w/Internal Termination	www.micrel.com/product-info/products/sy89871u.shtml
SY89872U	2.5V 2GHz Any Diff. In-to-LVDS Programmable Clock Divider/Fanout Buffer w/Internal Termination	www.micrel.com/product-info/products/sy89872u.shtml
	MLF™ Application Note	www.amkor.com/products/notes_papers/MLF_AppNote_0902.pdf
HBW Solutions	New Products and Applications	www.micrel.com/product-info/products/solutions.shtml

16 LEAD *Micro*LeadFrame™ (MLF-16)



TOP VIEW

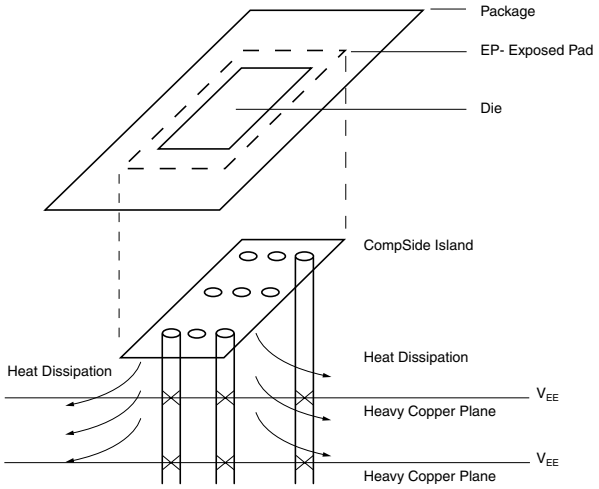
BOTTOM VIEW



FOR EVEN TERMINAL/SIDE

1. DIMENSIONS ARE IN mm.
2. DIE THICKNESS ALLOWABLE IS 0.305mm MAX.
3. PACKAGE WARPAGE MAX 0.05mm.
4. THIS DIMENSION APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20mm AND 0.25mm FROM TIP.
5. APPLIES ONLY FOR TERMINALS

Rev. 02



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 is shipped in dry-pack form.

Note 2. Exposed pads must be soldered to a ground for proper thermal management.

MICREL, INC. 1849 FORTUNE DRIVE SAN JOSE, CA 95131 USA

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