



Precision Edge®

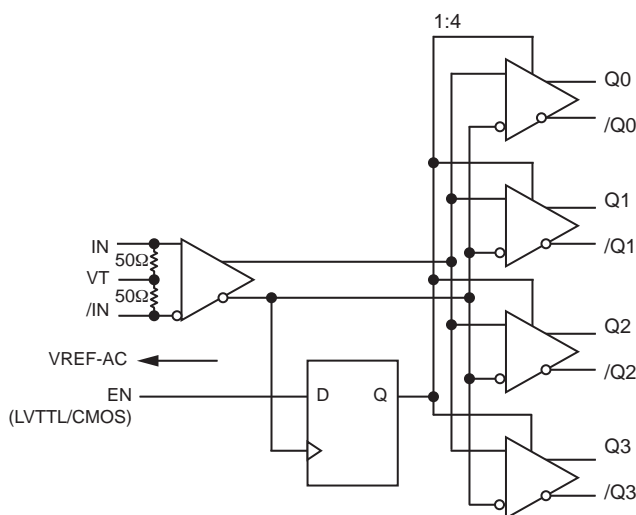
## FEATURES

- **Guaranteed AC performance over temperature and voltage:**
  - DC-to > 2GHz throughput
  - <600ps propagation delay (IN-to-Q)
  - <20ps within-device skew
  - <190ps rise/fall times
- **Ultra-low jitter design**
  - <1ps<sub>RMS</sub> cycle-to-cycle jitter
  - <10ps<sub>PP</sub> total jitter
  - <1ps<sub>RMS</sub> random jitter
  - <10ps<sub>PP</sub> deterministic jitter
- **Unique input termination and VT pin accepts DC- and AC-coupled inputs**
- **High-speed LVDS outputs**
- **3.3V power supply operation**
- **Industrial temperature range: -40°C to +85°C**
- **Available in 16-pin (3mm x 3mm) MLF® package**

## APPLICATIONS

- Processor clock distribution
- SONET clock distribution
- Fibre Channel clock distribution
- Gigabit Ethernet clock distribution

## FUNCTIONAL BLOCK DIAGRAM



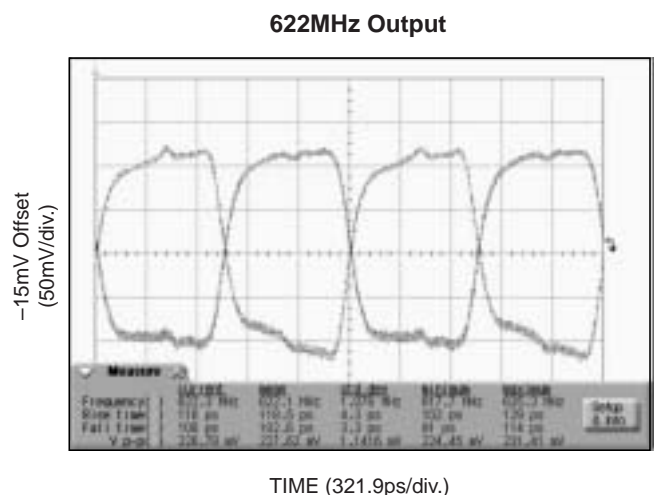
## DESCRIPTION

The SY89833L is a 3.3V, high-speed 2GHz differential Low Voltage Differential Swing (LVDS) 1:4 fanout buffer optimized for ultra-low skew applications. Within device skew is guaranteed to be less than 20ps over supply voltage and temperature.

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

The SY89833L is part of Micrel's high-speed clock synchronization family. For 2.5V applications, the SY89832U provides similar functionality while operating from a 2.5V ±5% supply. For applications that require a different I/O combination, consult the Micrel website at: [www.micrel.com](http://www.micrel.com), and choose from a comprehensive product line of high-speed, low-skew fanout buffers, translators and clock generators.

## TYPICAL PERFORMANCE





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

Supply Voltage ( $V_{CC}$ )	.....	-0.5V to +4.0V
Input Voltage ( $V_{IN}$ )	.....	-0.5V to $V_{CC} + 0.3V$
LVDS Output Current ( $I_{OUT}$ )	.....	$\pm 10mA$
Input Current		
Source or Sink Current on (IN, /IN)	.....	$\pm 50mA$
$V_{REF-AC}$ Current		
Source or Sink Current on ( $I_{VT}$ )	.....	$\pm 2mA$
Maximum Operating Junction Temperature	.....	125°C
Lead Temperature (Soldering, 20 sec.)	.....	260°C
Storage Temperature ( $T_S$ )	.....	-65°C to +150°C

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

Supply Voltage Range	.....	+3.0V to +3.60V
Ambient Temperature ( $T_A$ )	.....	-40°C to +85°C
Package Thermal Resistance <sup>(3)</sup>		
MLF® ( $\theta_{JA}$ )		
Still-Air	.....	60°C/W
MLF® ( $\psi_{JB}$ )	.....	33°C/W

## DC ELECTRICAL CHARACTERISTICS<sup>(4)</sup>

$T_A = -40^\circ C$  to  $+85^\circ C$ , unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_{CC}$	Power Supply Voltage Range		3.0	3.3	3.6	V
$I_{CC}$	Power Supply Current	No load, max. $V_{CC}$ .		75	100	mA
$R_{IN}$	Input Resistance (IN-to-VT)		45	50	55	$\Omega$
$R_{DIFF-IN}$	Differential Input Resistance (IN-to-/IN)		90	100	110	$\Omega$
$V_{IH}$	Input HIGH Voltage (IN, /IN)		0.1		$V_{CC} + 0.3$	V
$V_{IL}$	Input LOW Voltage (IN, /IN)		-0.3		$V_{IH} - 0.1$	V
$V_{IN}$	Input Voltage Swing (IN, /IN)	<b>Note 3</b> , see Figure 2c.	0.1		$V_{CC}$	V
$V_{DIFF\_IN}$	Differential Input Voltage	<b>Note 3</b> , see Figure 2d.	0.2			V
$ I_{IN} $	Input Current IN, /IN				45	mA
$V_{REF-AC}$	Reference Voltage	<b>Note 5</b>	$V_{CC} - 1.525$	$V_{CC} - 1.425$	$V_{CC} - 1.325$	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 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. 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.
4. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.
5. Due to the internal termination (see "Input Buffer Structure" section) the input current depends on the applied voltages at IN, /IN and VT inputs. Do not apply a combination of voltages that causes the input current to exceed the maximum limit!

**LVDS OUTPUTS DC ELECTRICAL CHARACTERISTICS<sup>(6)</sup>**

$V_{CC} = 3.3V \pm 10\%$ ,  $R_L = 100\Omega$  across the outputs;  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_{OUT}$	Output Voltage Swing	See Figure 2c.	250	325		mV
$V_{DIFF\_OUT}$	Differential Output Voltage Swing	See Figure 2d.	500	650		mV
$V_{OCM}$	Output Common Mode Voltage		1.125		1.275	V
$\Delta V_{OCM}$	Change in Common Mode Voltage		-50		50	mV

**LVTTTL/CMOS DC ELECTRICAL CHARACTERISTICS<sup>(6)</sup>**

$V_{CC} = 3.3V \pm 10\%$ ,  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_{IH}$	Input HIGH Voltage		2.0		$V_{CC}$	V
$V_{IL}$	Input LOW Voltage		0		0.8	V
$I_{IH}$	Input HIGH Current		-125		30	$\mu\text{A}$
$I_{IL}$	Input LOW Current				-300	$\mu\text{A}$

**Note:**

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

## AC ELECTRICAL CHARACTERISTICS<sup>(7)</sup>

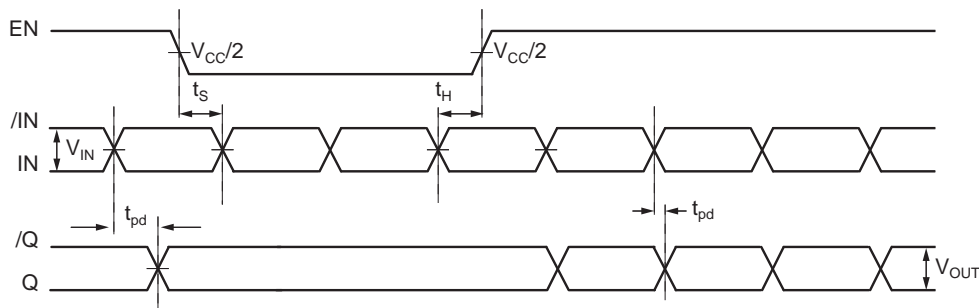
$V_{CC} = +3.3V \pm 10\%$ ;  $R_L = 100\Omega$  across the outputs;  $T_A = -40^\circ C$  to  $+85^\circ C$  unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
$f_{MAX}$	Maximum Frequency	$V_{OUT} \geq 200mV$	2.0			GHz
$t_{pd}$	Propagation Delay	IN-to-Q $V_{IN} < 400mV$	400	500	600	ps
		IN-to-Q $V_{IN} \geq 400mV$	330	440	530	ps
$t_{SKEW}$	Within-Device Skew	<b>Note 8</b>		5	20	ps
	Part-to-Part Skew	<b>Note 9</b>			200	ps
$t_S$	Set-Up Time	EN to IN, /IN	300			ps
$t_H$	Hold Time	EN to IN, /IN	500			ps
$t_{JITTER}$	Data Random Jitter (RJ) Deterministic Jitter (DJ)	<b>Note 11</b> <b>Note 12</b>			1 10	ps <sub>RMS</sub> ps <sub>PP</sub>
	Clock Cycle-to-Cycle Jitter Total Jitter (TJ)	<b>Note 13</b> <b>Note 14</b>			1 10	ps <sub>RMS</sub> ps <sub>PP</sub>
$t_r, t_f$	Output Rise/Fall Times (20% to 80%)	At full output swing.	60	110	190	ps

**Notes:**

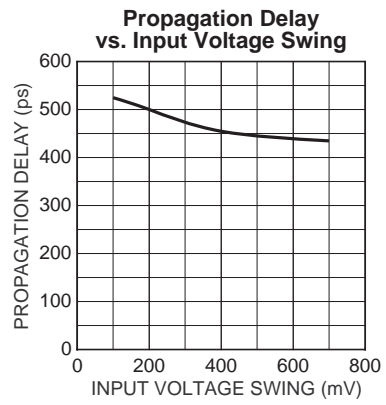
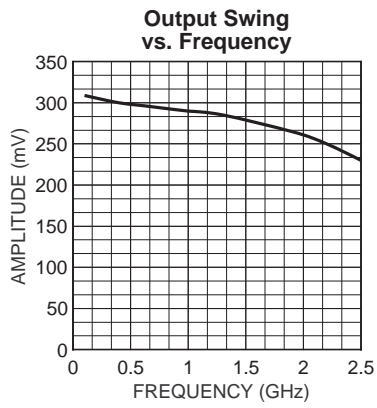
7. High-frequency AC parameters are guaranteed by design and characterization.
8. Within device skew is measured between two different outputs under identical input transitions.
9. Part-to-part skew is defined for two parts with identical power supply voltages at the same temperature and no skew at the edges at the respective inputs.
10. 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.
11. Random jitter is measured with a K28.7 pattern, measured at  $\leq f_{MAX}$ .
12. Deterministic jitter is measured at 2.5Gbps with both K28.5 and  $2^{23}-1$  PRBS pattern.
13. 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.
14. 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.

## TIMING DIAGRAM



**TYPICAL OPERATING CHARACTERISTICS**

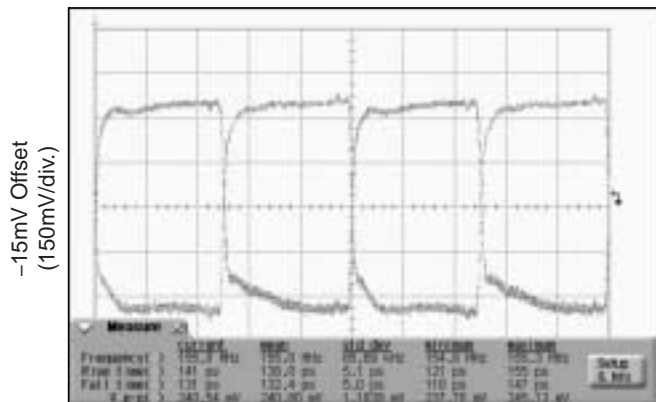
$V_{CC} = 3.3V$ ,  $GND = 0V$ ,  $V_{IN} = 400mV$ ,  $R_L = 100\Omega$  across the outputs,  $T_A = 25^\circ C$ , unless otherwise stated.



**FUNCTIONAL CHARACTERISTICS**

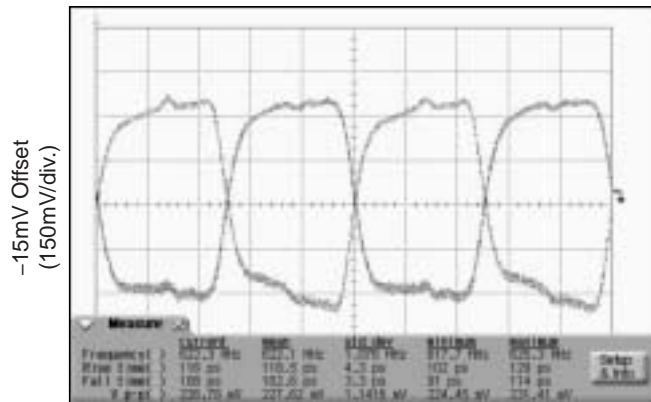
$V_{CC} = 3.3V$ ,  $GND = 0V$ ,  $V_{IN} = 400mV$ ,  $R_L = 100\Omega$  across the outputs;  $T_A = 25^\circ C$ , unless otherwise stated.

**155MHz Output**



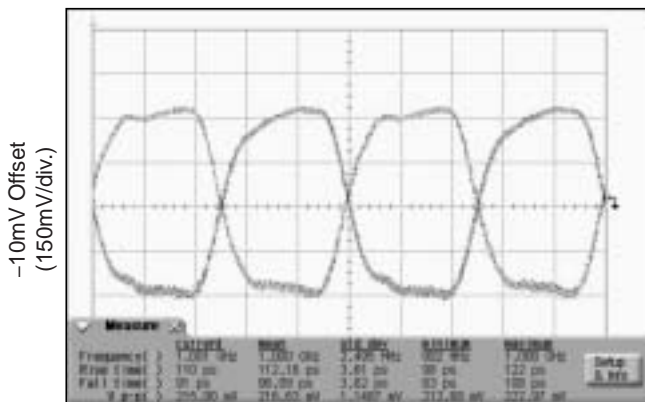
TIME (1.29ns/div.)

**622MHz Output**



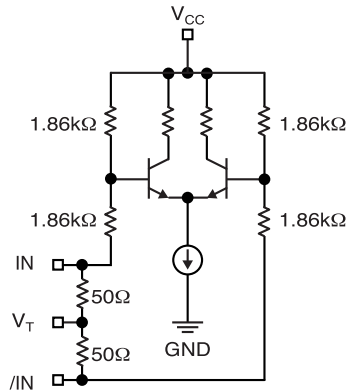
TIME (321.9ps/div.)

**1GHz Output**



TIME (200ps/div.)

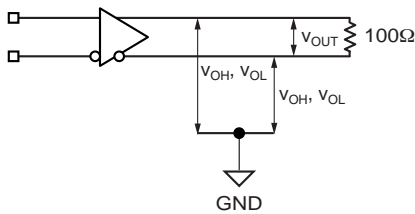
**INPUT STAGE**



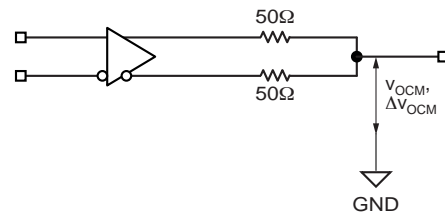
**Figure 1. Simplified Differential Input Buffer**

**LVDS OUTPUTS**

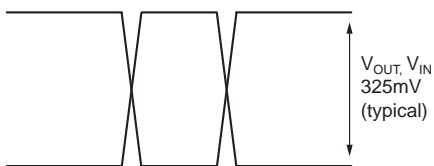
LVDS specifies a small swing of 325mV typical, on a nominal 1.20V common mode above ground. The common mode voltage has tight limits to permit large variations in ground noise between an LVDS driver and receiver.



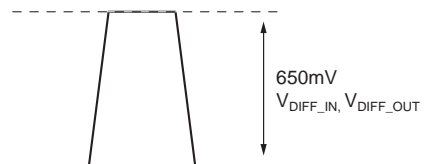
**Figure 2a. LVDS Differential Measurement**



**Figure 2b. LVDS Common Mode Measurement**



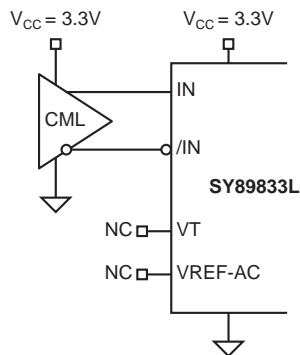
**Figure 2c. Single-Ended Swing**



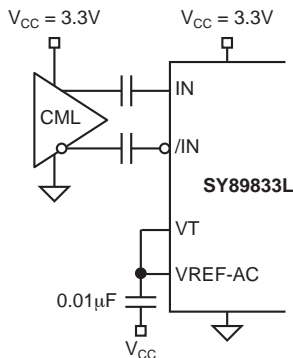
**Figure 2d. Differential Swing**



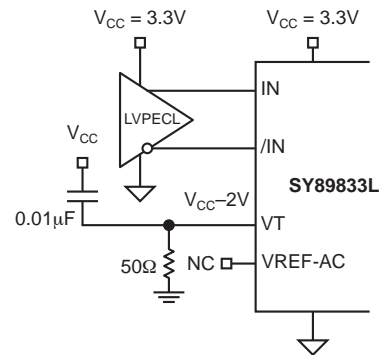
**INPUT INTERFACE APPLICATIONS**



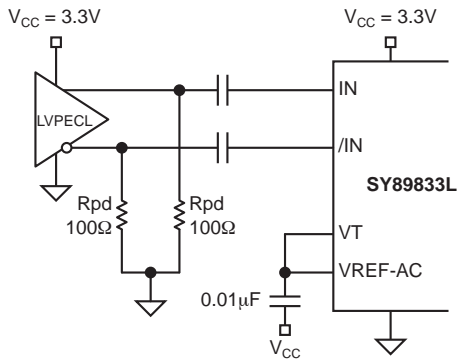
**Figure 3a. DC-Coupled CML Input Interface**



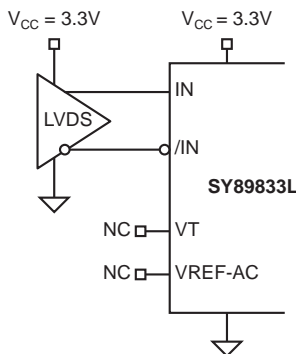
**Figure 3b. AC-Coupled CML Input Interface**



**Figure 3c. DC-Coupled LVPECL Input Interface**



**Figure 3d. AC-Coupled LVPECL Input Interface**

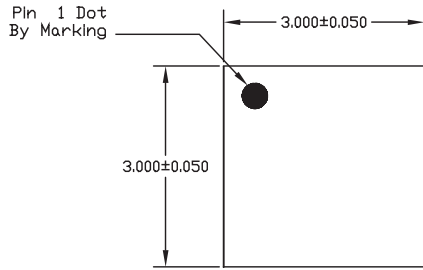


**Figure 3e. LVDS Input Interface**

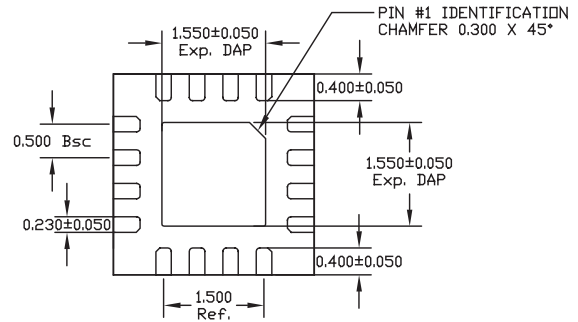
**RELATED PRODUCT AND SUPPORT DOCUMENTS**

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>
SY89834U	2.5/3.3V Two Input, 1GHz LVTTTL/CMOS-to-LVPECL 1:4 Fanout Buffer/Translator	<a href="http://www.micrel.com/product-info/products/sy89834u.shtml">http://www.micrel.com/product-info/products/sy89834u.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 and Termination App. Note	<a href="http://www.micrel.com/product-info/as/solutions.shtml">http://www.micrel.com/product-info/as/solutions.shtml</a>

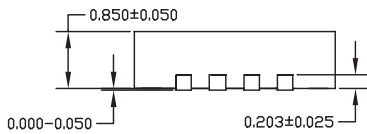
**16-PIN EPAD *MicroLeadFrame*® (MLF-16)**



TOP VIEW



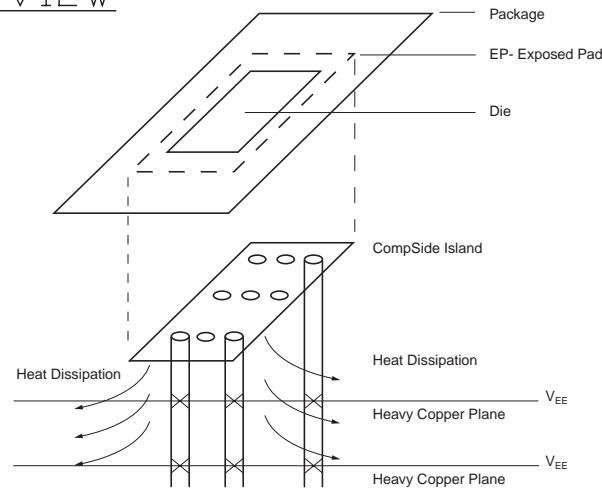
BOTTOM VIEW



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:**

1. Package meets Level 2 moisture sensitivity classification, and are shipped in dry-pack form.
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>

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