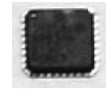


**FEATURES**

- Precision 1:8, LVPECL fanout buffer
- Guaranteed AC performance over temperature and voltage:
  - Clock frequency range: DC to 4GHz
  - <110ps  $t_r/t_f$  times
  - <330ps  $t_{pd}$
  - <20ps skew
- Low-jitter performance:
  - 76fs<sub>RMS</sub> phase jitter (typ)
- 100k LVPECL compatible outputs
- Fully differential inputs/outputs
- Accepts an input signal as low as 100mV
- Unique input termination and  $V_T$  pin accepts DC-coupled and AC-coupled differential inputs: (LVPECL, LVDS, and CML)
- Power supply 2.5V ±5% or 3.3V ±10%
- Industrial temperature range: -40°C to +85°C
- Available in 32-pin (5mm x 5mm) MLF® package



Precision Edge®

**DESCRIPTION**

The SY58032U is a 2.5V/3.3V precision, high-speed, fully differential LVPECL 1:8 fanout buffer. The SY58032U is optimized to provide eight identical output copies with less than 20ps of skew and only 76fs<sub>RMS</sub> phase jitter. It can process clock signals as fast as 4GHz.

The differential input includes Micrel's unique, 3-pin input termination architecture that allows the SY58032U to directly interface to LVPECL, CML, and LVDS differential signals (AC- or DC-coupled) without any level-shifting or termination resistor networks in the signal path. The result is a clean, stub-free, low-jitter interface solution. The LVPECL (100k temperature compensated) outputs feature 800mV typical swing into 50Ω loads, and provide an extremely fast rise/fall time guaranteed to be less than 110ps.

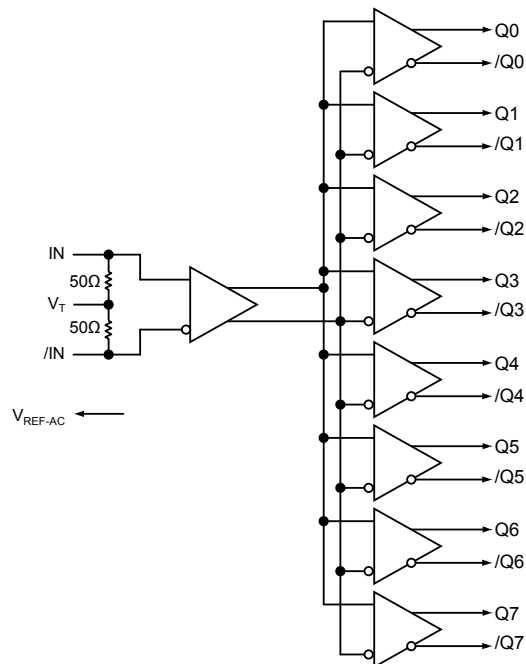
The SY58032U operates from a 2.5V ±5% supply or 3.3V ±10% supply and is guaranteed over the full industrial temperature range (-40°C to +85°C). For applications that require a higher high-speed 1:8 fanout buffer, consider the SY58031U or SY58033U. The SY58032U is part of Micrel's high-speed, Precision Edge® product line.

All support documentation can be found on Micrel's web site at [www.micrel.com](http://www.micrel.com).

**APPLICATIONS**

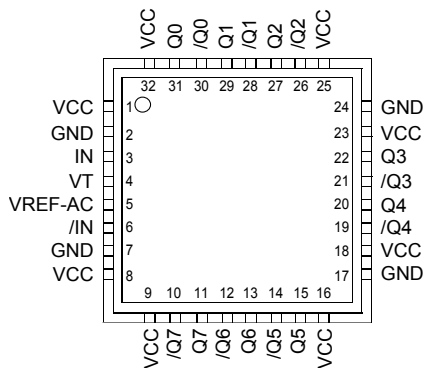
- All SONET and all GigE clock distribution
- All Fibre Channel clock and data distribution
- Network routing engine timing distribution
- High-end, low-skew multiprocessor synchronous clock distribution

**FUNCTIONAL BLOCK DIAGRAM**



United States Patent No. RE44,134  
Precision Edge is a registered trademark of Micrel, Inc.  
MicroLeadFrame and MLF are registered trademarks of Amkor Technology, Inc.

**PACKAGE/ORDERING INFORMATION**



**32-Pin MLF® (MLF-32)**

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

Part Number	Package Type	Operating Range	Package Marking	Lead Finish
SY58032UMI	MLF-32	Industrial	SY58032U	Sn-Pb
SY58032UMITR <sup>(2)</sup>	MLF-32	Industrial	SY58032U	Sn-Pb
SY58032UMG <sup>(3)</sup>	MLF-32	Industrial	SY58032U with Pb-Free bar-line indicator	Pb-Free NiPdAu
SY58032UMGTR <sup>(2,3)</sup>	MLF-32	Industrial	SY58032U with Pb-Free bar-line indicator	Pb-Free NiPdAu

**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 recommended for new designs.

**PIN DESCRIPTION**

Pin Number	Pin Name	Pin Function
3, 6	IN, /IN	Differential Signal Input: Each pin of this pair internally terminates with $50\Omega$ to the $V_T$ pin. Note that this input will default to an indeterminate state if left open. See "Input Interface Applications" section.
4	VT	Input Termination Center-Tap: Each input terminates to this pin. The $V_T$ pin provides a center-tap for each input (IN, /IN) to the termination network for maximum interface flexibility. See "Input Interface Applications" section.
2, 7, 17, 24	GND, Exposed Pad	Ground. Exposed pad must be connected to a ground plane that is the same potential as the ground pin.
1, 8, 9, 16, 18, 23, 25, 32	VCC	Positive Power Supply: Bypass with $0.1\mu\text{F}  0.01\mu\text{F}$ low ESR capacitors as close to the pins as possible.
31, 30, 29, 28, 27, 26, 22, 21, 20, 19, 15, 14, 13, 12, 11, 10	Q0, /Q0, Q1, /Q1, Q2, /Q2, Q3, /Q3, Q4, /Q4, Q5, /Q5, Q6, /Q6, Q7, /Q7	100k LVPECL Differential Output Pairs: Differential buffered output copy of the input signal. The LVPECL output swing is typically 800mV into $50\Omega$ . Unused output pairs may be left floating with no impact on jitter. See "LVPECL Output" section.
5	VREF-AC	Bias Reference Voltage: Equal to $V_{CC} - 1.2\text{V}$ (typical), and used for AC-coupled applications. See "Input Interface Applications" section. When using $V_{REF-AC}$ , bypass with $0.01\mu\text{F}$ capacitor to $V_{CC}$ . Maximum sink/source current is 0.5mA.

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

Power Supply Voltage ( $V_{CC}$ ) ..... -0.5V to +4.0V  
 Input Voltage ( $V_{IN}$ ) ..... -0.5V to  $V_{CC}$   
 Current ( $V_T$ )  
 Source or sink current on  $V_T$  pin .....  $\pm 100$ mA  
 Input Current ( $V_T$ )  
 Source or sink current on IN, /IN .....  $\pm 50$ mA  
 Current ( $V_{REF}$ )  
 Source or sink current on  $V_{REF-AC}$ <sup>(3)</sup> .....  $\pm 1.5$ mA  
 Lead Temperature Soldering, (20 sec.) ..... 260°C  
 Storage Temperature Range ( $T_S$ ) ..... -65°C to +150°C

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

Power Supply Voltage ( $V_{CC}$ ) ..... +2.375V to +3.60V  
 Ambient Temperature Range ( $T_A$ ) ..... -40°C to +85°C  
 Package Thermal Resistance<sup>(4)</sup>  
 MLF® ( $\theta_{JA}$ )  
 Still-Air ..... 35°C/W  
 MLF® ( $\psi_{JB}$ )  
 Junction-to-Board ..... 20°C/W

**DC ELECTRICAL CHARACTERISTICS<sup>(5)</sup>**

$T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$

Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_{CC}$	Power Supply Voltage	2.5V nominal	2.375	2.5	2.625	V
		3.3V nominal	3.0	3.3	3.6	V
$I_{CC}$	Power Supply Current	$V_{CC} = \text{max.}$ No load. Includes current through 50 $\Omega$ pull-ups.		190	250	mA
$V_{IH}$	Input HIGH Voltage	IN, /IN, Note 6	$V_{CC}-1.6$		$V_{CC}$	V
$V_{IL}$	Input LOW Voltage	IN, /IN	0		$V_{IH}-0.1$	V
$V_{IN}$	Input Voltage Swing	IN, /IN, see Figure 1a.	0.1		1.7	V
$V_{DIFF\_IN}$	Differential Input Voltage Swing  IN0, /IN0 ,  IN1, /IN1	IN, /IN, see Figure 1b.	0.2			V
$R_{IN}$	In-to- $V_T$ Resistance		40	50	60	$\Omega$
$V_{TIN}$	Max. In-to- $V_T$ (IN, /IN)				1.28	V
$V_{REF-AC}$			$V_{CC}-1.3$	$V_{CC}-1.2$	$V_{CC}-1.1$	V

**LVPECL DC ELECTRICAL CHARACTERISTICS<sup>(5)</sup>**

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

Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_{OH}$	Output HIGH Voltage		$V_{CC}-1.145$		$V_{CC}-0.895$	V
$V_{OL}$	Output LOW Voltage		$V_{CC}-1.945$		$V_{CC}-1.695$	V
$V_{OUT}$	Output Voltage Swing	see Figure 1a.	500	800		mV
$V_{DIFF\_OUT}$	Differential Voltage Swing	see Figure 1b.	1000	1600	2000	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 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. Thermal performance assumes exposed pad is soldered (or equivalent) to the device's most negative potential (GND) on the PCB.  $\psi_{JB}$  uses 4-layer  $\theta_{JA}$  in still-air number unless otherwise stated.
5. The circuit is designed to meet the DC specifications shown in the above tables after thermal equilibrium has been established.
6.  $V_{IH}$  (min) not lower than 1.2V.

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

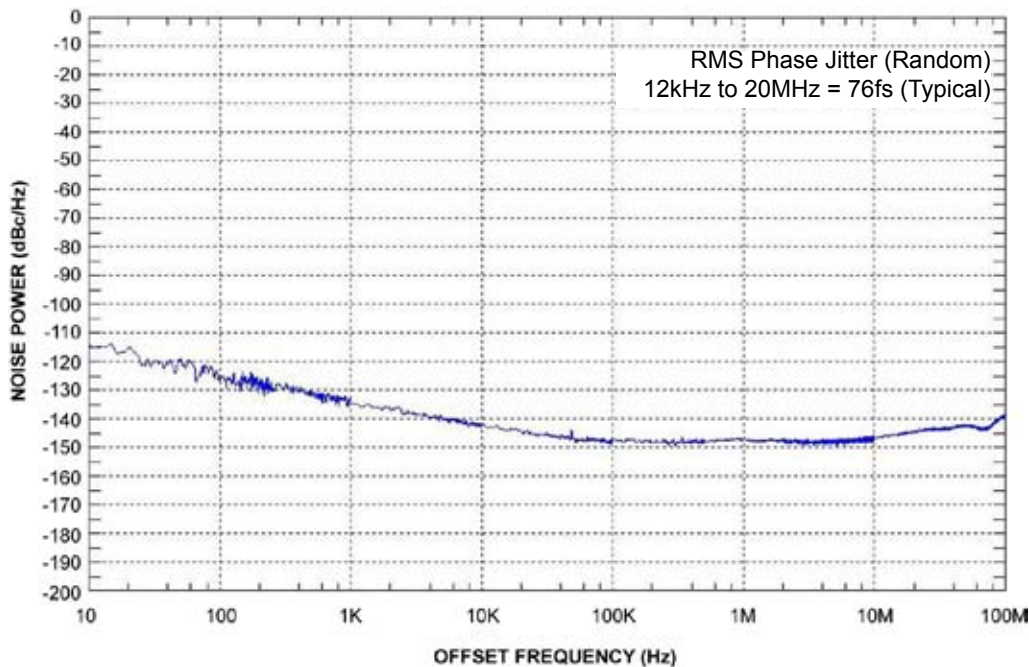
$V_{CC} = 2.5V \pm 5\%$  or  $3.3V \pm 10\%$ ;  $R_L = 50\Omega$  to  $V_{CC} - 2V$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ , unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
$f_{MAX}$	Maximum Operating Frequency	$V_{OUT} \geq 400mV$ Clock	4			GHz
$t_{pd}$	Propagation Delay (IN-to-Q)		180	260	330	ps
$t_{pd\ tempco}$	Differential Propagation Delay Temperature Coefficient			35		fs/°C
$t_{SKEW}$	Output-to-Output Skew (within Device)	<b>Note 8</b>		7	20	ps
	Part-to-Part Skew	<b>Note 9</b>			100	ps
$t_{JITTER}$	RMS Phase Jitter	Output = 622MHz Integration Ranges 12kHz - 20MHz		76		fs
$t_r, t_f$	Output Rise/Fall Time	20% to 80%, at full output swing.	35	75	110	ps

**Notes:**

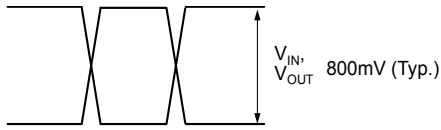
- High frequency AC electricals are guaranteed by design and characterization. All outputs loaded with  $50\Omega$  to  $V_{CC} - 2V$ ,  $V_{IN} \geq 100mV$ .
- Output-to-output skew is measured between outputs under identical transitions.
- Part-to-part skew is defined for two parts with identical power supply voltages at the same temperature and with no skew of the edges at the respective inputs. Part-to-part skew includes variation in  $t_{pd}$ .

**PHASE NOISE**

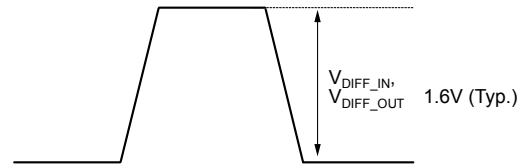


**Phase Noise Plot: 622MHz @ 3.3V**

**SINGLE-ENDED AND DIFFERENTIAL SWINGS**

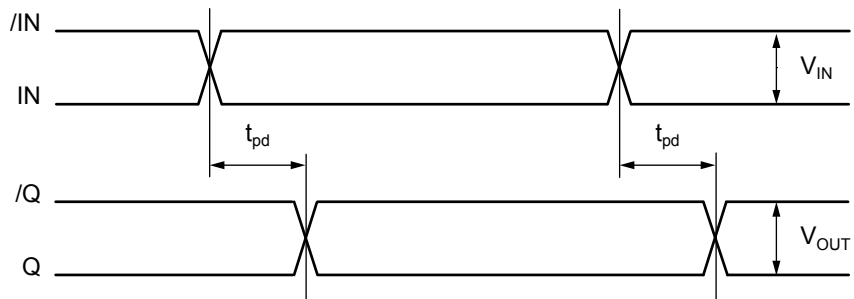


**Figure 1a. Single-Ended Voltage Swing**



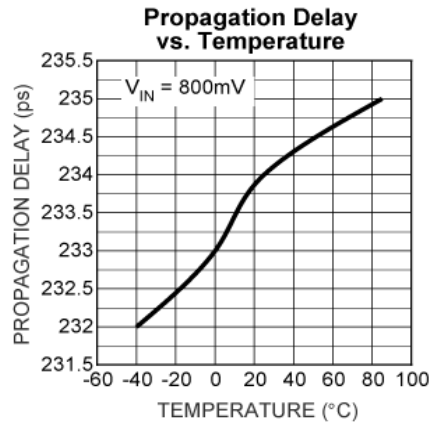
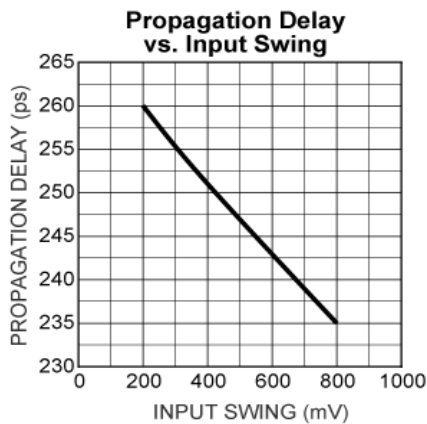
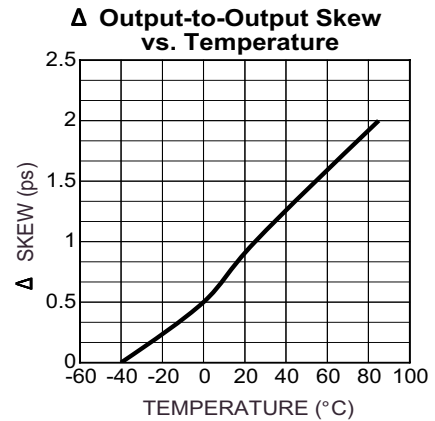
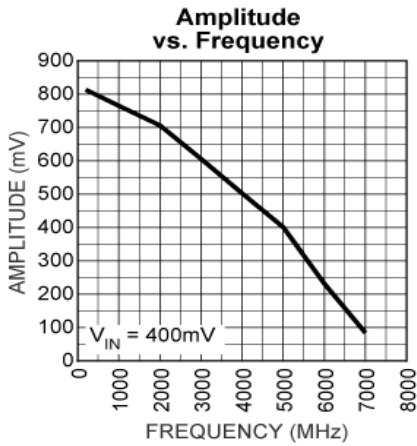
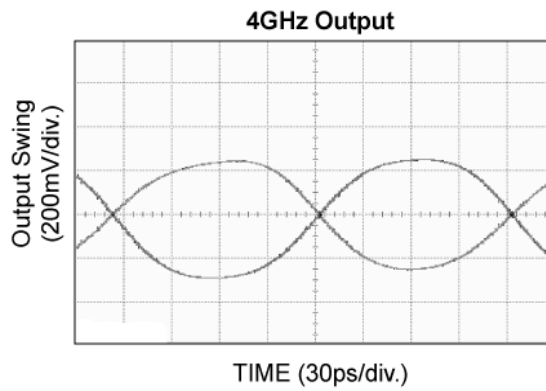
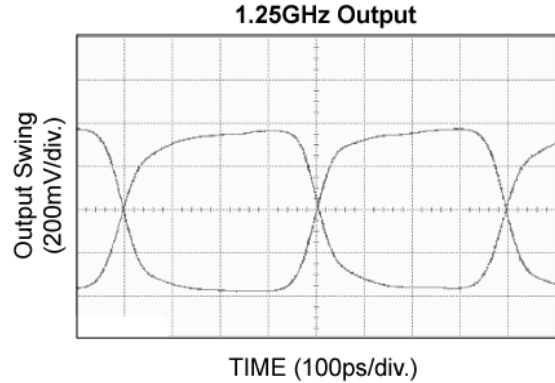
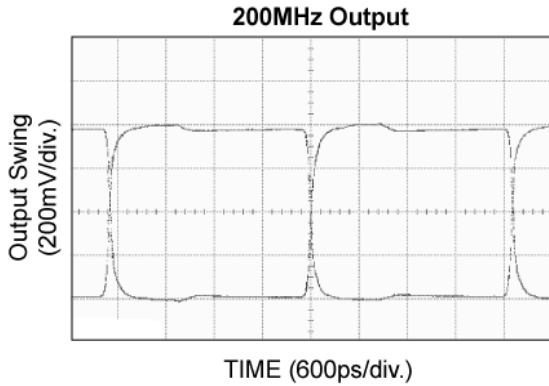
**Figure 1b. Differential Voltage Swing**

**TIMING DIAGRAM**

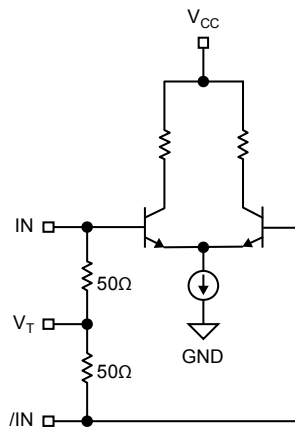


**TYPICAL OPERATING CHARACTERISTICS**

$V_{CC} = 2.5V$ ,  $GND = 0$ ,  $V_{IN} = 100mV$ ,  $T_A = 25^\circ C$ , unless otherwise stated.

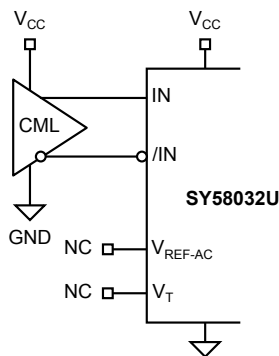


**INPUT BUFFER**

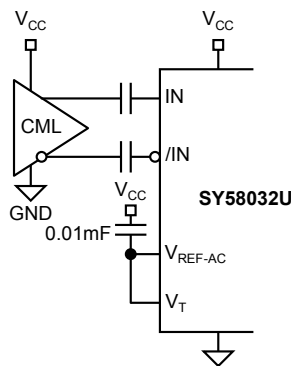


**Figure 2. Simplified Differential Input Buffer**

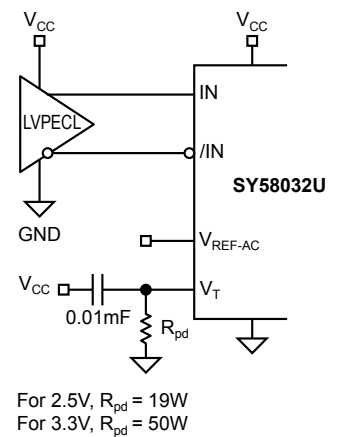
**INPUT INTERFACE APPLICATIONS**



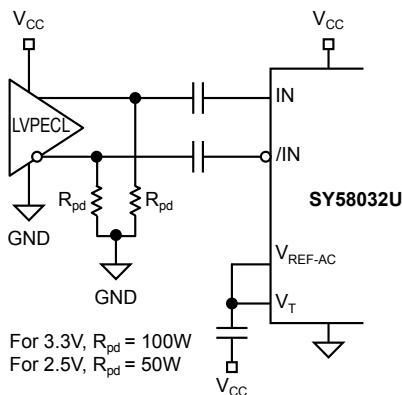
**Figure 3a. DC-Coupled CML Input Interface**  
*Option: May connect  $V_T$  to  $V_{CC}$ .*



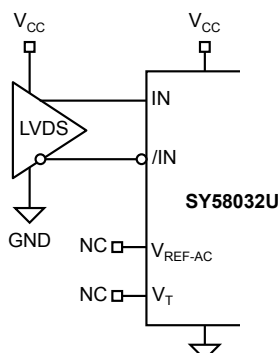
**Figure 3b. AC-Coupled CML Input Interface**



**Figure 3c. LVPECL Input Interface**



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

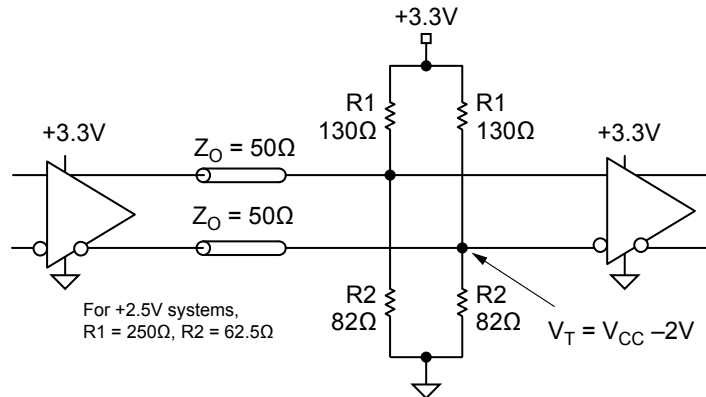


**Figure 3e. LVDS Input Interface**

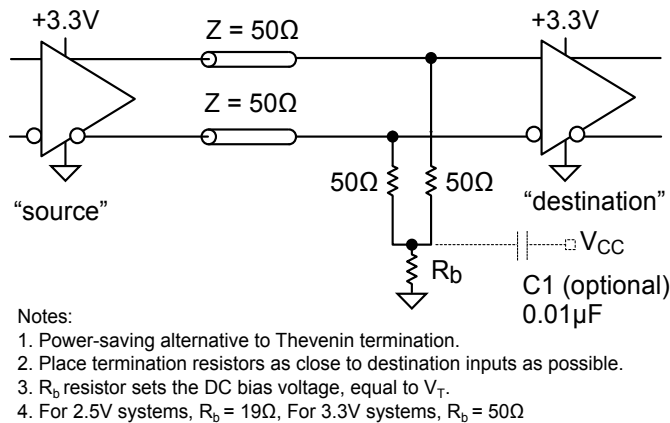
**LVPECL OUTPUT**

LVPECL has high input impedance, and very low output impedance (open emitter), and small signal swing which results in low EMI. LVPECL is ideal for driving 50Ω and 100Ω controlled impedance transmission lines. There are several techniques for terminating the LVPECL output: Parallel

Termination-Thevenin Equivalent, Parallel Termination (3-resistor), and AC-coupled Termination. Unused output pairs may be left floating. However, single-ended outputs must be terminated, or balanced.



**Figure 4. Parallel Termination-Thevenin Equivalent**

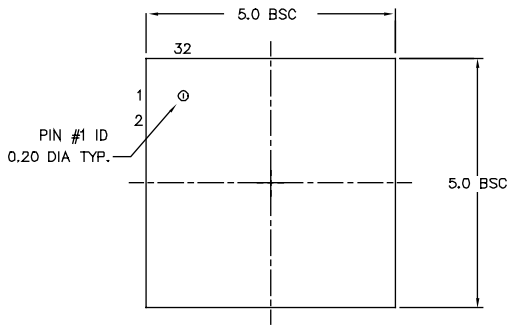


**Figure 5. Parallel Termination (3-Resistor)**

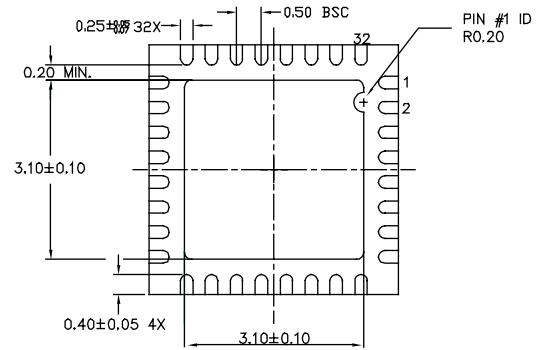
**RELATED MICREL PRODUCTS AND SUPPORT DOCUMENTATION**

Part Number	Function	Data Sheet Link
SY58031U	Ultra-Precision 1:8 Fanout Buffer with 400mV CML Outputs and Internal I/O Termination	<a href="http://www.micrel.com/product-info/products/sy58031u.shtml">http://www.micrel.com/product-info/products/sy58031u.shtml</a>
SY58032U	Ultra-Precision 1:8 Fanout Buffer with LVPECL Outputs and Internal Termination	<a href="http://www.micrel.com/product-info/products/sy58032u.shtml">http://www.micrel.com/product-info/products/sy58032u.shtml</a>
SY58033U	Ultra-Precision 1:8 Fanout Buffer with 400mV LVPECL Outputs and Internal Termination	<a href="http://www.micrel.com/product-info/products/sy58033u.shtml">http://www.micrel.com/product-info/products/sy58033u.shtml</a>
	32-MLF® Manufacturing Guidelines Exposed Pad Application Note	<a href="http://www.amkor.com/products/notes_papers/MLF_AppNote_0902.pdf">www.amkor.com/products/notes_papers/MLF_AppNote_0902.pdf</a>
	HBW Solutions	<a href="http://www.micrel.com/product-info/as/solutions.shtml">http://www.micrel.com/product-info/as/solutions.shtml</a>

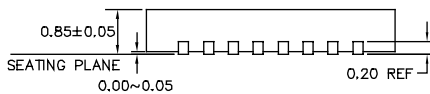
**32-PIN MicroLeadFrame® (MLF-32)**



TOP VIEW



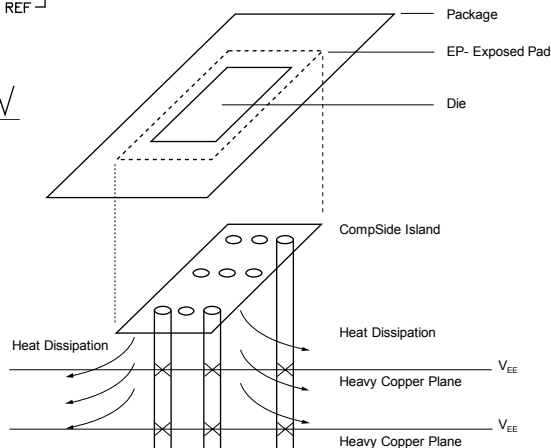
BOTTOM VIEW



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 32-Pin MLF® Package  
(Always solder, or equivalent, the exposed pad to the PCB)**

**Package Notes:**

1. Package meets Level 2 qualification.
2. All parts are dry-packaged before shipment.
3. Exposed pads must be soldered to a ground for proper thermal management.

**MICREL, INC. 2180 FORTUNE DRIVE SAN JOSE, CA 95131 USA**

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