ULTRA-PRECISION 1:8 FANOUT BUFFER WITH 400mV LVPECL OUTPUTS AND INTERNAL TERMINATION

Precision Edge®
SY58033U

FEATURES

- **Precision 1:8, 400mV LVPECL fanout buffer**
- **Low-jitter performance:**
  - **76fs$_{RMS}$ phase jitter (typ)**
- **Guaranteed AC performance over temperature and voltage:**
  - **Clock frequency range: DC to 5.5GHz**
  - **<80ps t_r / t_f times**
  - **<280ps t_{pd}**
  - **<20ps skew**
- **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) QFN Package**

Precision Edge®

DESCRIPTION

The SY58033U is a 2.5V/3.3V precision, high-speed, fully differential 400mV LVPECL 1:8 fanout buffer. The SY58033U is optimized to provide eight identical output copies with less than 20ps of skew and only 76fs$_{RMS}$ phase jitter. It can process clock signals as fast as 5.5GHz.

The differential input includes Micrel's unique, 3-pin input termination architecture that allows the SY58033U to directly interface to LVPECL, CML, and LVDS differential signal (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 solution. The LVPECL (100k temperature compensated) outputs feature a 400mV typical swing into 50 ohms loads, and provide an extremely fast rise/fall time guaranteed to be less than 80ps.

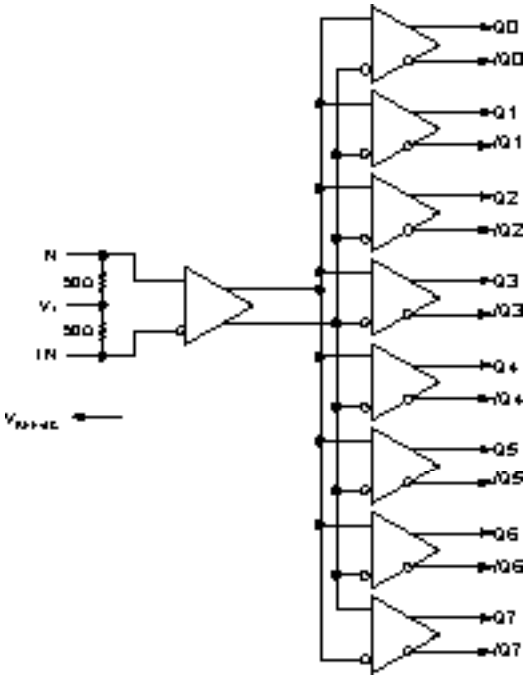
The SY58033U operates from a 2.5V ±5% supply or 3.3V ±10% supply and is guaranteed over the full industrial temperature range (–40°C to +85°C). Other high-speed 1:8 fanout buffers include the CML SY58031U and the 800mV LVPECL SY58032U. The SY58033U is part of Micrel's high-speed, Precision Edge® product line.

All support documentation can be found on Micrel's web site at www.micrel.com.

APPLICATIONS

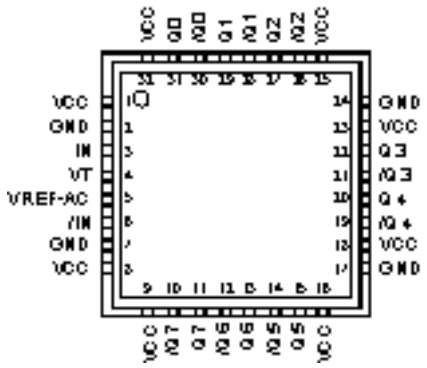
- **All SONET and all GigE clock distribution**
- **All Fibre Channel clock and data distribution**
- **Network routing engine timing distribution**
- **High-end, low-skew multiprocessor synchronous clock distribution**

FUNCTIONAL BLOCK DIAGRAM



Precision Edge is a registered trademark of Micrel, Inc.

PACKAGE/ORDERING INFORMATION



32-Pin QFN (QFN-32)

Ordering Information[1]

Part Number	Package Type	Operating Range	Package Marking
SY58033UMG[3]	QFN-32 Pb-Free	Industrial	SY58033U with Pb-Free bar-line indicator
SY58033UMGTR[2, 3]	QFN-32 Pb-Free	Industrial	SY58033U with Pb-Free bar-line indicator

Notes:

1. Contact factory for die availability. Dice are guaranteed at T_A = 25°C, DC electricals only. All devices are Pb-Free.
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 50Ω 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 0.1µF||0.01µF 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	400mV LVPECL Differential Output Pairs: Differential buffered output copy of the input signal. The LVPECL output swing is typically 400mV into 50Ω. 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}–1.2V (approx.), and used for AC-coupled applications. See “Input Interface Applications” section. When using V_{REF-AC}, bypass with 0.01µF capacitor to V_{CC}. Maximum sink/source current is 0.5mA.

Absolute Maximum Ratings(1)

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..... ±100mA
Input Current (V_T)
  Source or sink current on IN, /IN ..... ±50mA
Current (V_{REF})
  Source or sink current on V_{REF-AC}(3)..... ±1.5mA
Lead Temperature Soldering (20 sec.) ..... 260°C
Storage Temperature Range (T_S).....–65°C to +150°C

Operating Ratings(2)

Power Supply Voltage (V_{CC}) ..... +2.375V to +3.60V
Ambient Temperature Range (T_A) ..... –40°C to +85°C
Package Thermal Resistance(4)
  QFN (θ_{JA})
    Still-Air ..... 35°C/W
  QFN (ψ_{JB})
    Junction-to-Board ..... 20°C/W

DC ELECTRICAL CHARACTERISTICS(5)

T_A= –40°C to +85°C.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{CC}	Power Supply Voltage	2.5V nominal 3.3V nominal	2.375 3.0	2.5 3.3	2.625 3.6	V V
I_{CC}	Power Supply Current	V_{CC} = max. No. load includes current through 50Ω pull-ups.		180	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	Ω
$V_{T\ IN}$	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(5)

V_{CC} = 2.5V ±5% or 3.3V ±10%; R_L = 50ý to V_{CC}–2V; T_A= –40°C to +85°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}–1.545		V_{CC}–1.295	V
V_{OUT}	Output Voltage Swing	see Figure 1a.	150	400		mV
V_{DIFF_OUT}	Differential Voltage Swing	see Figure 1b.	300	800		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. ψ_{JB} uses 4-layer θ_{JA} in still-air number 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 lowers than 1.2V.

AC ELECTRICAL CHARACTERISTICS[7]

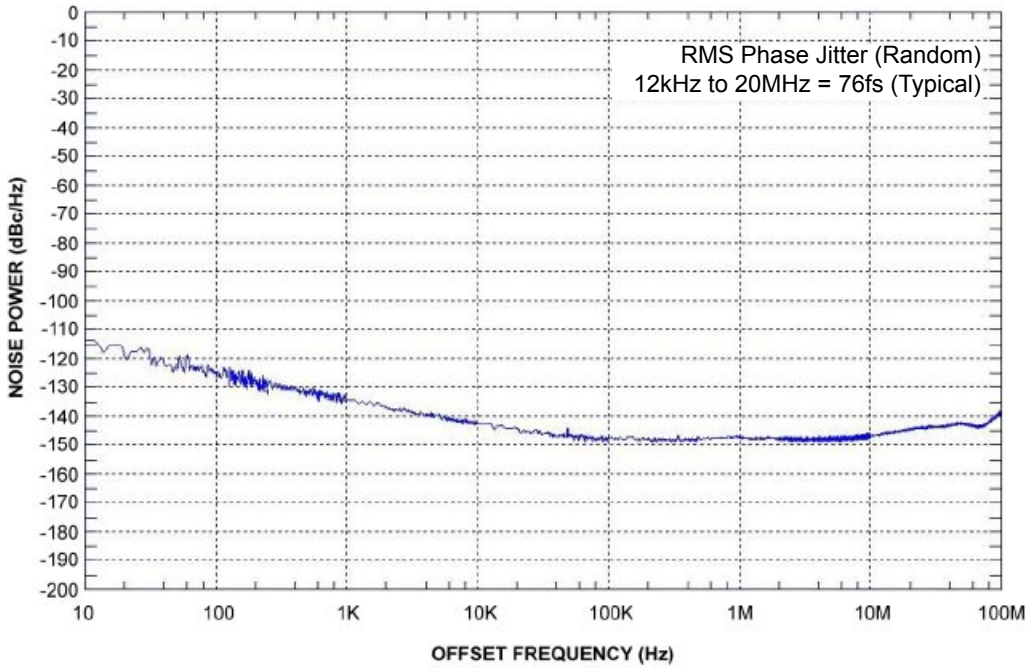
V_{CC} = 2.5V ±5% or 3.3V ±10%; R_L = 50ý to V_{CC}–2V; T_A = –40°C to +85°C, unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{MAX}	Maximum Operating Frequency	V_{OUT} ≥ 200mV Clock	5.5			GHz
t_{pd}	Propagation Delay (IN-to-Q)		130	200	280	ps
t_{pd} tempco	Differential Propagation Delay Temperature Coefficient			35		fs/°C
t_{SKEW}	Output-to-Output Skew(within device)	**Note 8**		7	20	ps
	Part-to-Part Skew	**Note 9**			100	ps
t_{JITTER}	RMS Phase Jitter	Output = 622MHz Integration Range 12kHz - 20MHz		76		fs
t_r, t_f	Output Rise/Fall Time	20% to 80%, at full output swing.	20	50	80	ps

Notes:

7. High frequency AC electricals are guaranteed by design and characterization. All outputs loaded with 50Ω to V_{CC}–2V, V_{IN} ž 100mV.
8. Output-to-output skew is measured between outputs under identical conditions.
9. 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

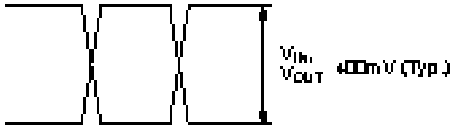
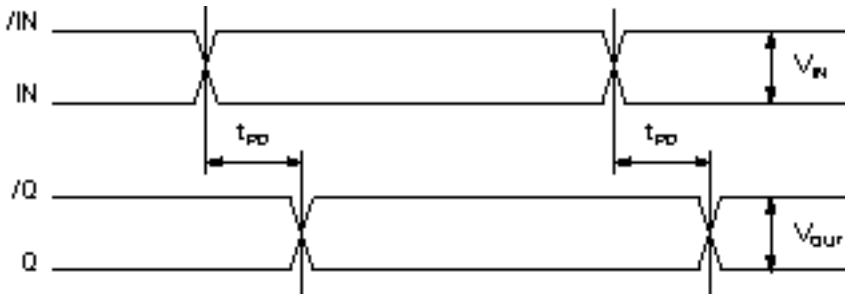


Figure 1a. Single-Ended Voltage Swing

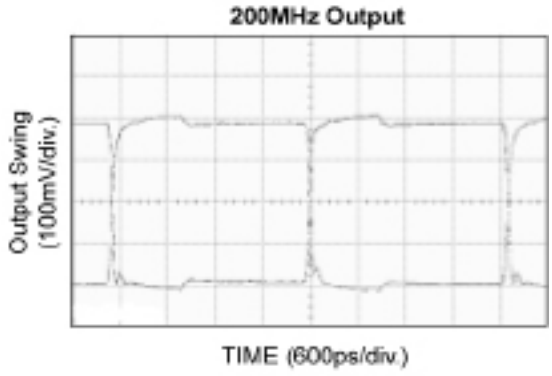
Figure 1b. Differential Voltage Swing

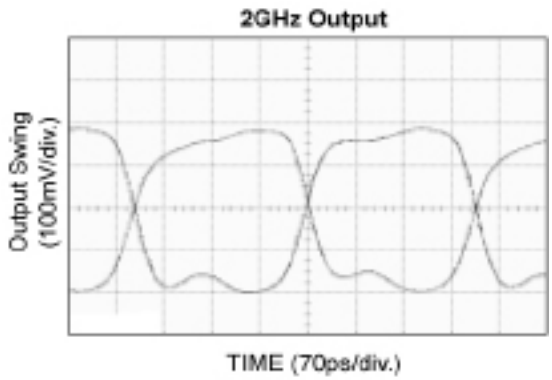
TIMING DIAGRAM

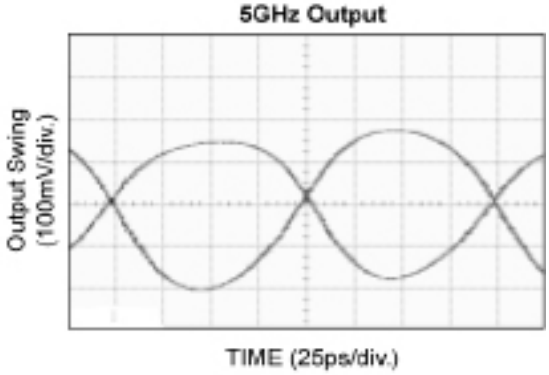


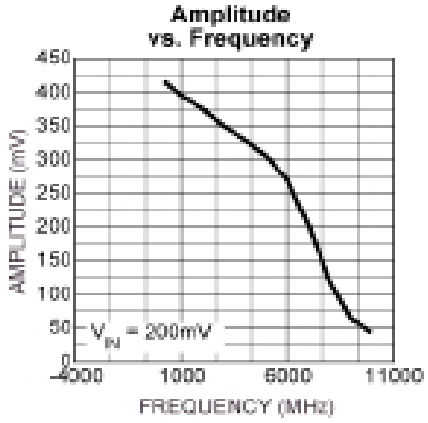
TYPICAL OPERATING CHARACTERISTICS

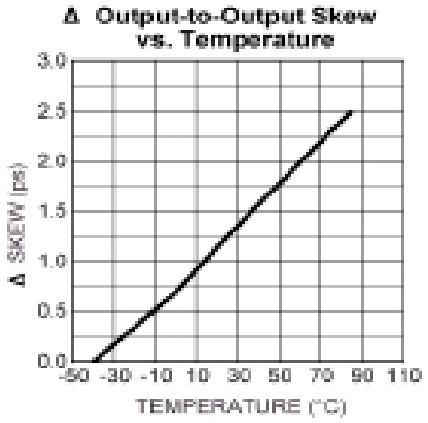
V_{CC} = 2.5V, GND = 0, V_{IN} = 100mV, T_A = 25°C, unless otherwise stated.

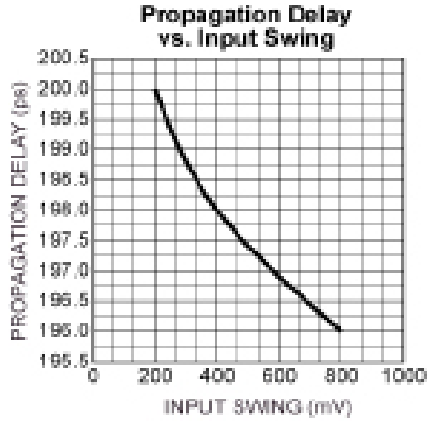


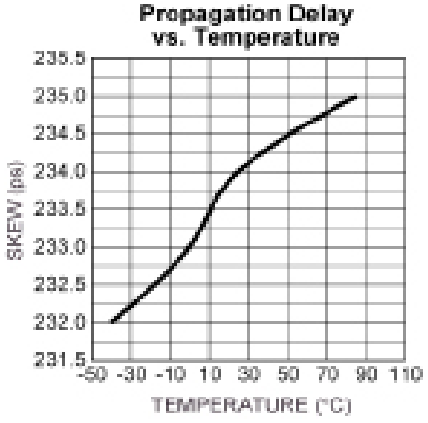












INPUT BUFFER

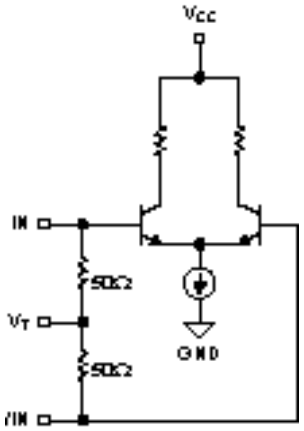


Figure 2. Simplified Differential Input Buffer

INPUT INTERFACE APPLICATIONS

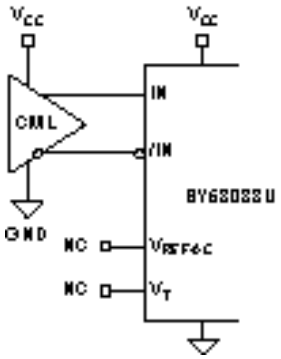


Figure 3a. DC-Coupled CML Input Interface

Option: May connect V_T to V_{CC}.

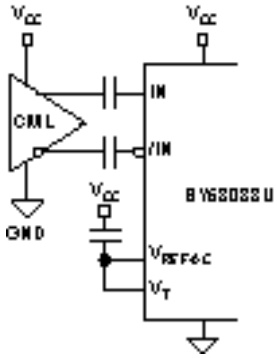


Figure 3b. AC-Coupled CML Input Interface

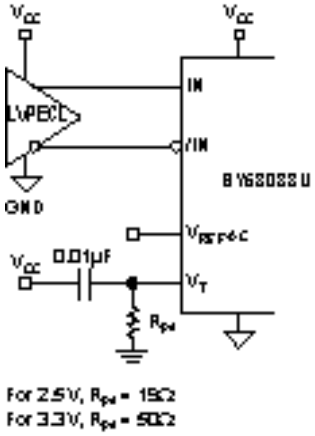


Figure 3c. LVPECL Input Interface

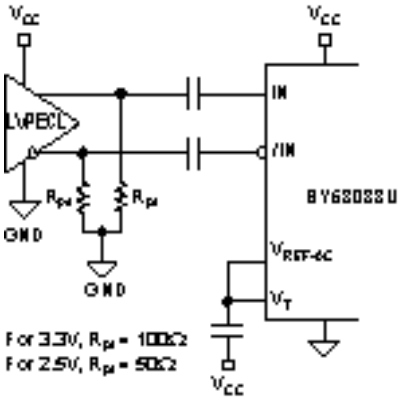


Figure 3d. AC-Coupled LVPECL Input Interface

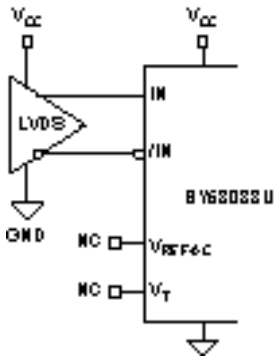


Figure 3e. LVDS Input Interface

LVPECL OUTPUT

LVPECL has high input impedance, and very low output impedance (open emitter), and small signal swing which results in low electromagnetic interference (EMI). LVPECL is ideal for driving 50Ω and 100Ω controlled impedance transmission lines. There are several techniques in terminating the LVPECL output, which are the Parallel Termination-Thevenin Equivalent, the Parallel Termination (3-Resistor), and the AC-Coupled Termination. Unused output pairs may be left floating. However, single-ended outputs must be terminated, or balanced.

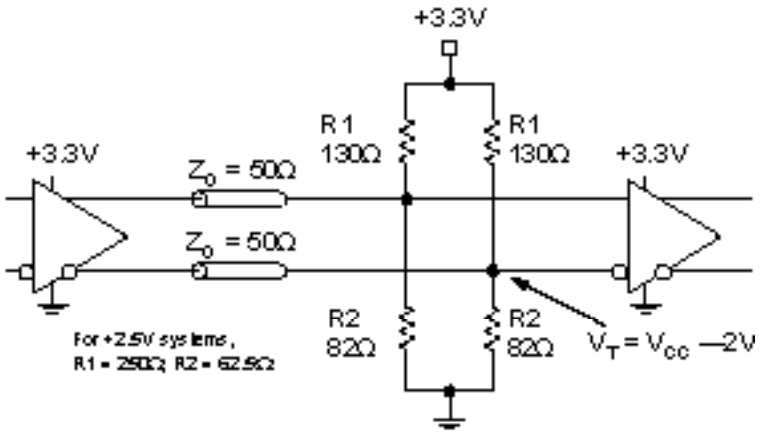
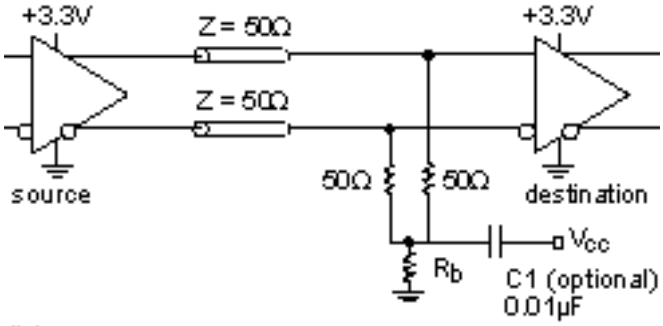


Figure 4. Parallel Termination-Thevenin Equivalent



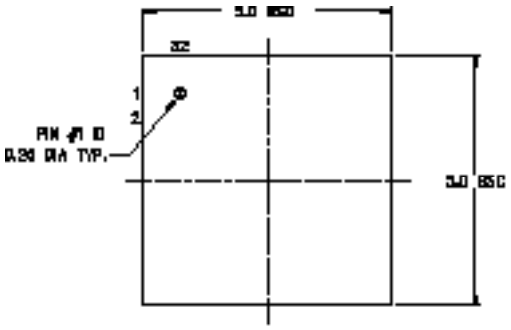
Notes:
1. Power saving alternative to Thevenin termination.
2. Place termination resistors as close to destination inputs as possible.
3. R_b resistor sets the DC bias voltage, equal to V_T.
4. For 2.5V systems, R_b = 150Ω. For 3.3V systems, R_b = 50Ω.

Figure 5. Parallel Termination (3-Resistor)

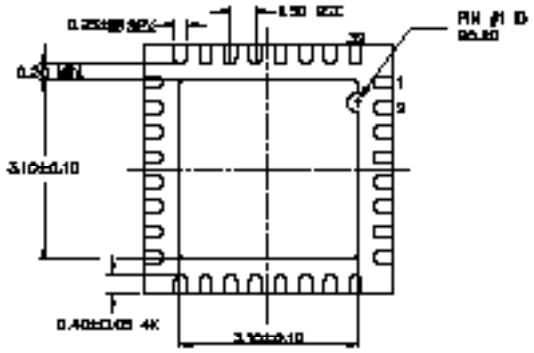
RELATED MICREL PRODUCTS AND SUPPORT DOCUMENTATION

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

32-PIN *QFN* (QFN-32)

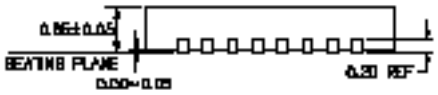


TOP VIEW

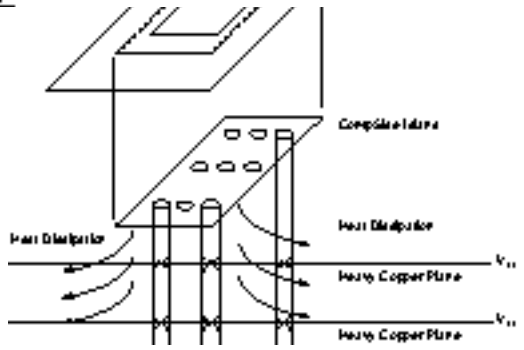


BOTTOM VIEW

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. MAX. PACKAGE WARPAGE IS 0.05 mm.
3. MAXIMUM ALLOWABLE BURRS OF 0.076 mm IN ALL DIRECTIONS.
4. PIN #1 ID ON TOP WILL BE LASER/INK MARKED.



SIDE VIEW



PCB Thermal Consideration for 32-Pin QFN 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
TEL + 1 (408) 944-0800 FAX + 1 (408) 474-1000 WEB http://www.micrel.com