

## FEATURES

- Two independent differential 2:1 multiplexers
- Guaranteed AC performance over temperature and voltage:
  - DC-to >5Gbps data rate throughput
  - <310ps IN-to-Out  $t_{pd}$
  - <110ps  $t_r / t_f$
- Unique, patent-pending input isolation design minimizes crosstalk
- Ultra-low jitter design:
  - <1ps<sub>RMS</sub> random jitter
  - <10ps<sub>pp</sub> deterministic jitter
  - <10ps<sub>pp</sub> total jitter (clock)
  - <0.7ps<sub>RMS</sub> crosstalk-induced jitter
- Unique, patent-pending 50 $\Omega$  input termination and VT pin accepts DC-coupled and AC-coupled inputs (CML, LVDS, PECL)
- 800mV LVPECL output swing
- Power supply 2.5V  $\pm$ 5% or 3.3V  $\pm$ 10%
- -40°C to +85°C temperature range
- Available in 32-pin (5mm  $\times$  5mm) MLF® package



Precision Edge®

## DESCRIPTION

The SY58026U features two ultra-fast, low jitter 2:1 differential muxes with a guaranteed maximum data throughput of 5Gbps.

The SY58026U differential inputs include a unique internal termination design that allows access to the termination network through a VT pin. The device easily interfaces to different logic standards, both AC- and DC-coupled, without external resistor-bias and termination networks. The result is a clean, stub-free, low jitter interface solution. The differential 800mV LVPECL outputs have extremely fast rise/fall times guaranteed to be less than 110ps.

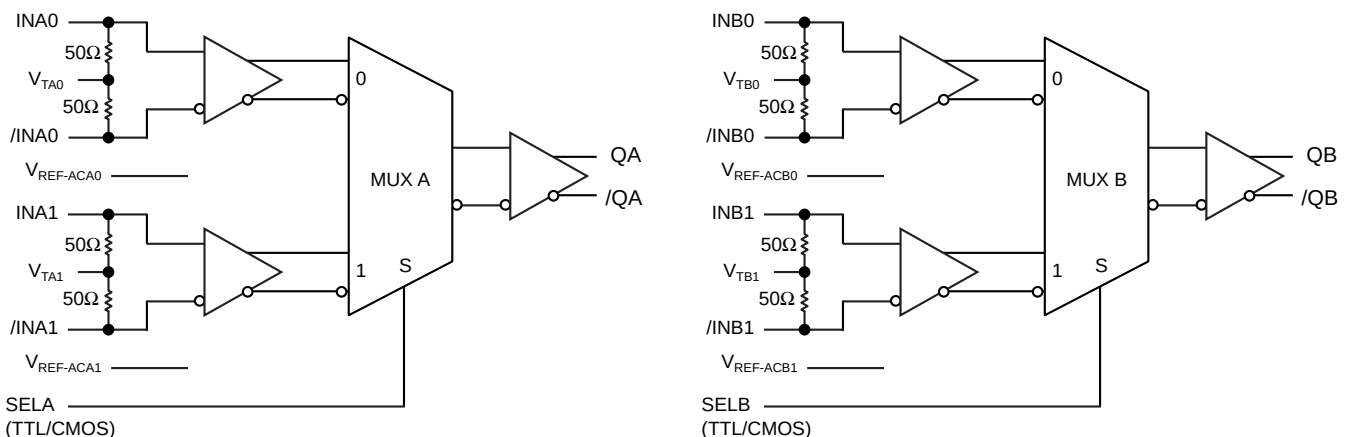
The SY58026U operates from a 2.5V or 3.3V supply, and is guaranteed over the full industrial temperature range (-40°C to +85°C). The SY58026U is part of Micrel's Precision Edge® product family.

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

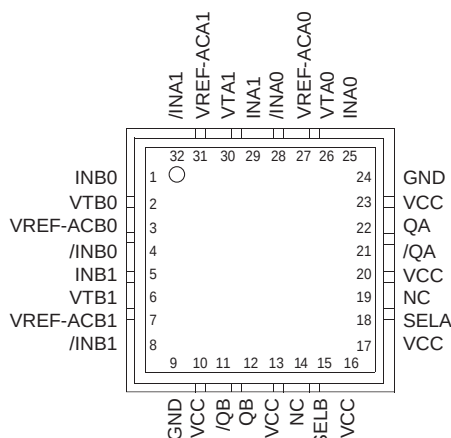
## APPLICATIONS

- Data communication systems
- SONET applications
- Fibre Channel applications
- GigE applications

## FUNCTIONAL BLOCK DIAGRAM



## PACKAGE/ORDERING INFORMATION



32-Pin MLF® (MLF-32)

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

| Part Number                 | Package Type | Operating Range | Package Marking                          | Lead Finish    |
|-----------------------------|--------------|-----------------|------------------------------------------|----------------|
| SY58026UMI                  | MLF-32       | Industrial      | SY58026U                                 | Sn-Pb          |
| SY58026UMITR <sup>(2)</sup> | MLF-32       | Industrial      | SY58026U                                 | Sn-Pb          |
| SY58026UMG                  | MLF-32       | Industrial      | SY58026U with Pb-Free bar-line indicator | Pb-Free NiPdAu |
| SY58026UMGTR <sup>(2)</sup> | MLF-32       | Industrial      | SY58026U 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.

## PIN DESCRIPTION

| Pin Number                          | Pin Name                                                    | Pin Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25, 28,<br>29, 32,<br>1, 4,<br>5, 8 | INA0, /INA0,<br>INA1, /INA1,<br>INB0, /INB0,<br>INB1, /INB1 | Differential Inputs: These input pairs are the differential signal inputs to the device. Inputs accept AC- or DC-coupled differential signals as small as 100mV. Each pin of a pair internally terminates to a VT pin through 50 $\Omega$ . Note that these inputs will default to an indeterminate state if left open. Unused differential input pairs can be terminated by connecting one input to $V_{CC}$ and the complementary input to GND through a 1k $\Omega$ resistor. The VT pin is to be left open in this configuration. Please refer to the "Input Interface Applications" section for more details. |
| 26, 30, 2, 6                        | VTA0, VTA1,<br>VTB0, VTB1                                   | Input Termination Center-Tap: Each side of the differential input pair, terminates to a VT pin. Each VT pin provides a center-tap to a termination network for maximum interface flexibility. See "Input Interface Applications" section for more details.                                                                                                                                                                                                                                                                                                                                                         |
| 18, 15                              | SELA, SELB                                                  | Bank A, Bank B Input Channel Select (TTL/CMOS): These TTL/CMOS-compatible inputs select the inputs to the multiplexers. These inputs are internally connected to a 25k $\Omega$ pull-up resistor and will default to a logic HIGH state if left open. Input switching threshold is $V_{CC}/2$ .                                                                                                                                                                                                                                                                                                                    |
| 27, 31, 3, 7                        | VREF-ACA0,<br>VREF-ACA1,<br>VREF-ACB0,<br>VREF-ACB1         | Reference Output Voltage: These outputs bias to $V_{CC} - 1.2\text{V}$ . Connect to VT pin when AC-coupling the data inputs. Bypass with 0.01 $\mu\text{F}$ low ESR capacitor to $V_{CC}$ . Maximum current source or sink is 0.5mA. See "Input Interface Applications" section.                                                                                                                                                                                                                                                                                                                                   |
| 10, 13, 16,<br>17, 20, 23           | VCC                                                         | Positive Power Supply: Bypass with 0.1 $\mu\text{F}$ ™ $\geq$ 0.01 $\mu\text{F}$ low ESR capacitors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 22, 21,<br>12, 11                   | QA, /QA,<br>QB, /QB                                         | Differential 100k LVPECL Outputs: MUX A and MUX B selected LVPECL outputs. See "Output Interface Applications" section for termination. Refer to the "Truth Table" for logic operation.                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 9, 24                               | GND,<br>Exposed pad                                         | Ground: Ground pins and exposed pad must be connected to the same ground plane.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 14, 19                              | NC                                                          | Not connected.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

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

|                                                       |                         |
|-------------------------------------------------------|-------------------------|
| Power Supply Voltage ( $V_{CC}$ )                     | ..... -0.5V to +4.0V    |
| Input Voltage ( $V_{IN}$ )                            | ..... -0.5V to $V_{CC}$ |
| LVPECL Output Current ( $I_{OUT}$ )                   |                         |
| Continuous                                            | ..... 50mA              |
| Surge                                                 | ..... 100mA             |
| Termination Current <sup>(3)</sup>                    |                         |
| Source or sink current on $V_T$                       | ..... $\pm 100$ mA      |
| Input Current                                         |                         |
| Source or sink current on IN, /IN                     | ..... $\pm 50$ mA       |
| Current ( $V_{REF-AC}$ )                              |                         |
| 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 +2.625V |
|                                           | ..... +3.0V to +3.6V     |
| 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  $+85^\circ\text{C}$ ; unless otherwise stated.

| Symbol         | Parameter                                        | Condition                                        | Min            | Typ            | Max            | Units    |
|----------------|--------------------------------------------------|--------------------------------------------------|----------------|----------------|----------------|----------|
| $V_{CC}$       | Power Supply                                     | $V_{CC} = 2.5\text{V}$<br>$V_{CC} = 3.3\text{V}$ | 2.375<br>3.0   | 2.5<br>3.3     | 2.625<br>3.6   | V        |
| $I_{CC}$       | Power Supply Current                             | No load, max. $V_{CC}$                           |                | 100            | 130            | mA       |
| $R_{DIFF\_IN}$ | Differential Input Resistance (IN-to-/IN)        |                                                  | 80             | 100            | 120            | $\Omega$ |
| $R_{IN}$       | Input Resistance (IN-to- $V_T$ , /IN-to- $V_T$ ) |                                                  | 40             | 50             | 60             | $\Omega$ |
| $V_{IH}$       | 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  IN - /IN       | See Figure 1b.                                   | 0.2            |                |                | V        |
| $V_{T\_IN}$    | In-to- $V_T$ (IN, /IN)                           |                                                  |                |                | 1.28           | V        |
| $V_{REF-AC}$   | Output Reference Voltage                         |                                                  | $V_{CC} - 1.3$ | $V_{CC} - 1.2$ | $V_{CC} - 1.1$ | 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 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. Package thermal resistance 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 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 lower than 1.2V.

**LVPECL OUTPUT DC ELECTRICAL CHARACTERISTICS<sup>(6)</sup>**

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

| Symbol         | Parameter                                  | Condition      | Min              | Typ  | Max              | Units |
|----------------|--------------------------------------------|----------------|------------------|------|------------------|-------|
| $V_{OH}$       | Output High Voltage<br>Q, /Q               |                | $V_{CC} - 1.145$ |      | $V_{CC} - 0.895$ | V     |
| $V_{OL}$       | Output Low Voltage<br>Q, /Q                |                | $V_{CC} - 1.945$ |      | $V_{CC} - 1.695$ | V     |
| $V_{OUT}$      | Output Voltage Swing<br>Q, /Q              | See Figure 1a. | 550              | 800  |                  | mV    |
| $V_{DIFF-OUT}$ | Differential Output Voltage Swing<br>Q, /Q | See Figure 1b. | 1100             | 1600 |                  | mV    |

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

$V_{CC} = 2.5V \pm 5\%$  or  $3.3V \pm 10\%$ ;  $T_A = -40^\circ C$  to  $85^\circ C$  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 |               | -175 |     | 75  | $\mu A$ |
| $I_{IL}$ | Input LOW Current  | $V_{IL} = 0V$ | -300 |     |     | $\mu A$ |

**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>**

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

| Symbol       | Parameter                                                 | Condition                              | Min | Typ | Max | Units             |
|--------------|-----------------------------------------------------------|----------------------------------------|-----|-----|-----|-------------------|
| $f_{MAX}$    | Maximum Operating Frequency                               | NRZ Data Clock<br>$V_{OUT} \geq 400mV$ | 5   | 6   |     | Gbps<br>GHz       |
| $t_{pd}$     | Propagation Delay IN-to-Q                                 | $V_{IN} \geq 300mV$                    | 160 | 230 | 310 | ps                |
|              | SEL-to-Q                                                  |                                        | 100 | 220 | 400 | ps                |
| $t_{SKEW}$   | Input-to-Input Skew (Within-bank)                         | <b>Note 8</b>                          |     | 7   | 15  | ps                |
|              | Bank-to-Bank Skew                                         | <b>Note 9</b>                          |     | 8   | 20  | ps                |
|              | Part-to-Part Skew                                         | <b>Note 10</b>                         |     |     | 100 | ps                |
| $t_{JITTER}$ | Data Random Jitter (RJ)                                   | <b>Note 11</b>                         |     |     | 1   | ps <sub>RMS</sub> |
|              | Deterministic Jitter (DJ)                                 | <b>Note 12</b>                         |     |     | 10  | ps <sub>PP</sub>  |
|              | Clock Cycle-to-Cycle Jitter (RJ)                          | <b>Note 13</b>                         |     |     | 1   | ps <sub>RMS</sub> |
|              | Total Jitter (TJ)                                         | <b>Note 14</b>                         |     |     | 10  | ps <sub>PP</sub>  |
|              | Crosstalk-induced Jitter Channel-to-Channel (Within-bank) | <b>Note 15</b> , Within-bank.          |     |     | 0.7 | ps <sub>RMS</sub> |
| $t_r, t_f$   | Output Rise/Fall Time 20% to 80%                          | At full swing.                         | 35  | 70  | 110 | ps                |

**Notes:**

- High-speed AC parameters are guaranteed by design and characterization.  $V_{IN}$  swing  $\geq 100mV$  unless otherwise noted.
- Input-to-input skew is the difference in time between two inputs to the output within a bank.
- Bank-to-bank skew is the difference in time from input to the output between bank.
- 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.
- Random jitter is measured with a K28.7 comma detect character pattern, measured at 5Gbps and 2.5Gbps/3.2Gbps.
- Deterministic jitter is measured at 2.5Gbps/3.2Gbps, with both K28.5 and 2<sup>23</sup>-1 PRBS pattern
- Cycle-to-cycle jitter definition: the variation of periods between adjacent cycles,  $T_n - T_{n-1}$  where T is the time between rising edges of the output signal.
- Total jitter definition: with an ideal clock input of frequency -  $f_{MAX}$ , no more than one output edge in 10<sup>12</sup> output edges will deviate by more than the specified peak-to-peak jitter value.
- Crosstalk is measured at the output while applying two similar frequencies that are asynchronous with respect to each other at the inputs.

**TRUTH TABLES**

| INA0 | /INA0 | INA1 | /INA1 | SELA | QA | /QA |
|------|-------|------|-------|------|----|-----|
| 0    | 1     | X    | X     | 0    | 0  | 1   |
| 1    | 0     | X    | X     | 0    | 1  | 0   |
| X    | X     | 0    | 1     | 1    | 0  | 1   |
| X    | X     | 1    | 0     | 1    | 1  | 0   |

| INB0 | /INB0 | INB1 | /INB1 | SELB | QB | /QB |
|------|-------|------|-------|------|----|-----|
| 0    | 1     | X    | X     | 0    | 0  | 1   |
| 1    | 0     | X    | X     | 0    | 1  | 0   |
| X    | X     | 0    | 1     | 1    | 0  | 1   |
| X    | X     | 1    | 0     | 1    | 1  | 0   |

## SINGLE-ENDED AND DIFFERENTIAL SWINGS

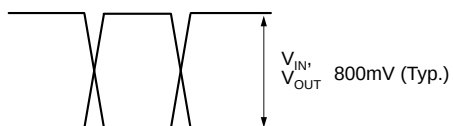


Figure 1a. Single-Ended Voltage Swing

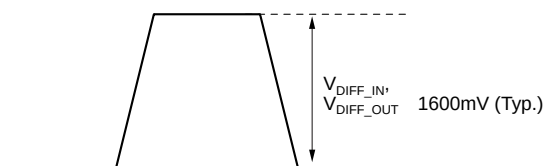
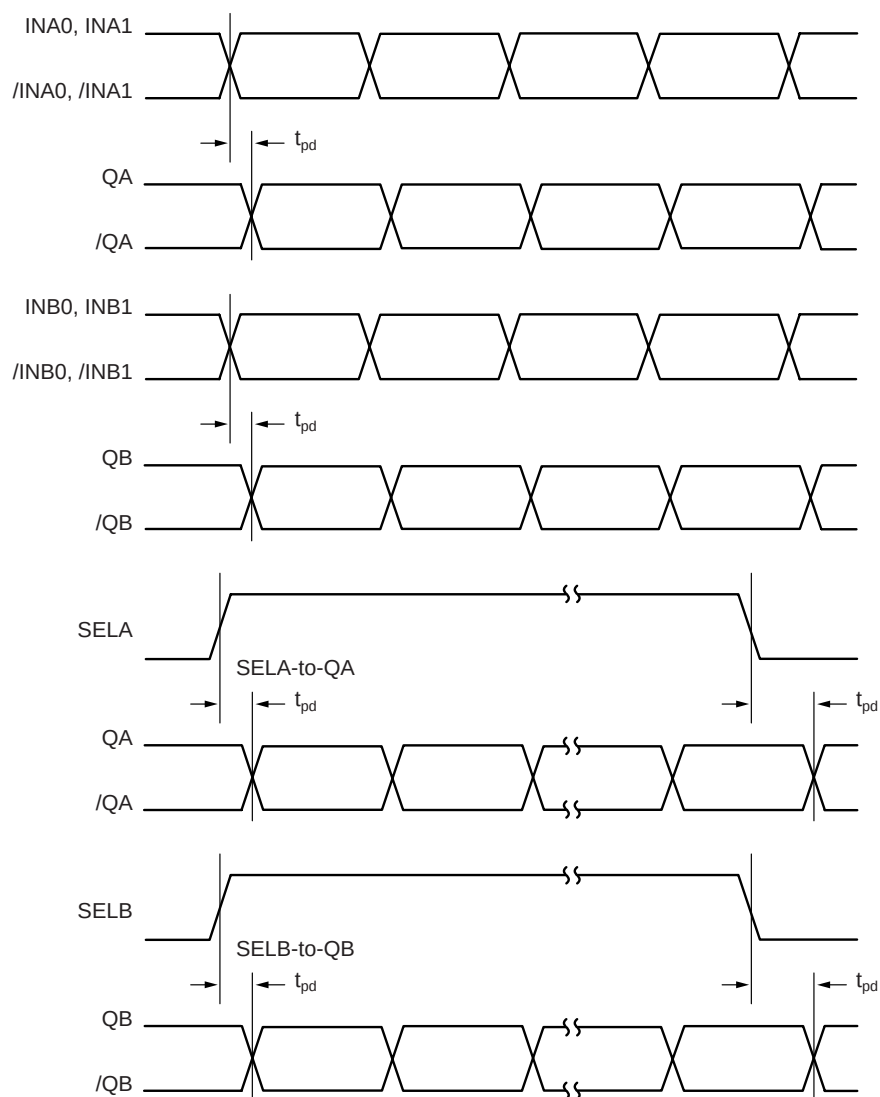


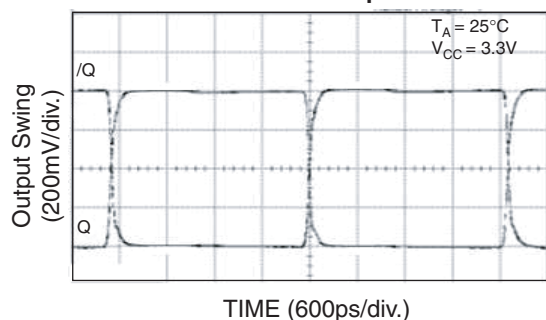
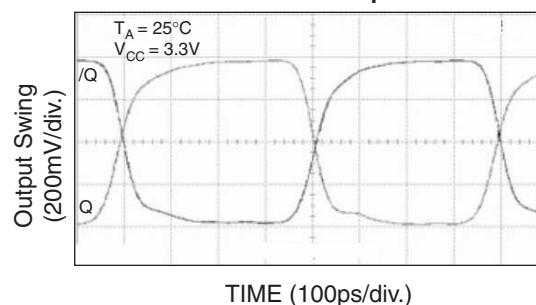
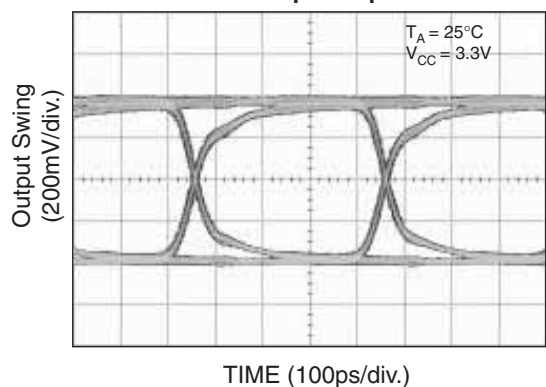
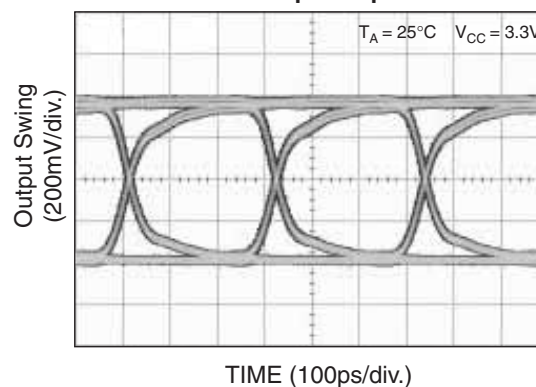
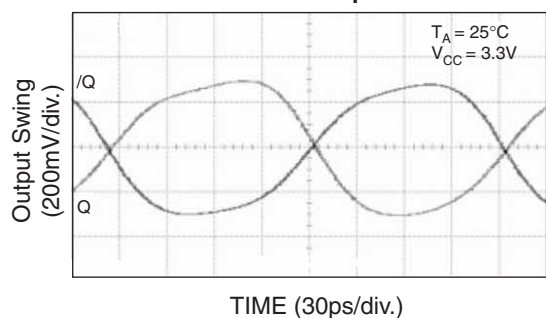
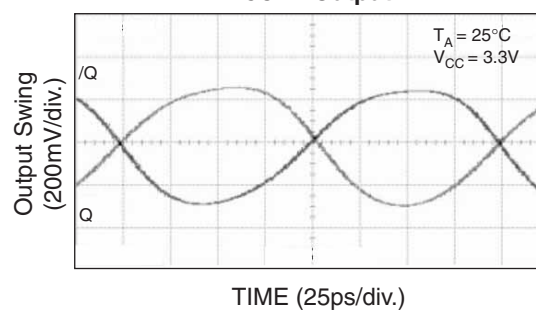
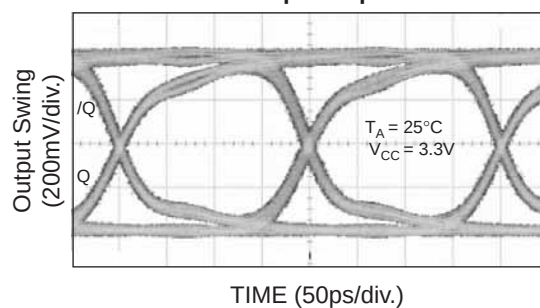
Figure 1b. Differential Voltage Swing

## TIMING DIAGRAM



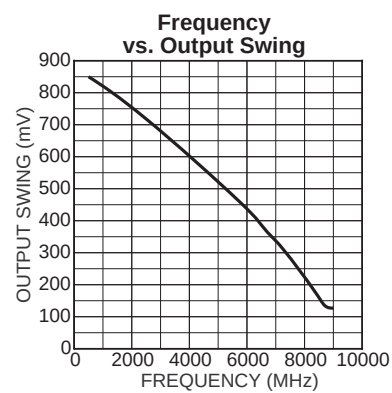
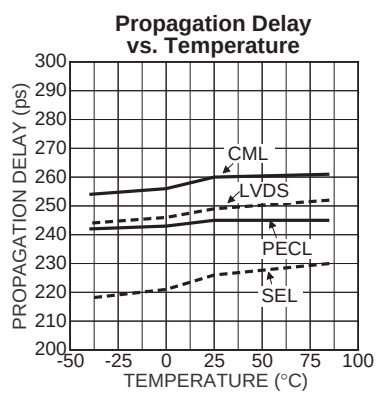
**TYPICAL OPERATING CHARACTERISTICS**

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

**200MHz Output****1.25GHz Output****2.5Gbps Output****3.2Gbps Output****4GHz Output****5GHz Output****5Gbps Output**

**TYPICAL OPERATING CHARACTERISTICS**

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





## INPUT AND OUTPUT STAGE INTERNAL TERMINATION

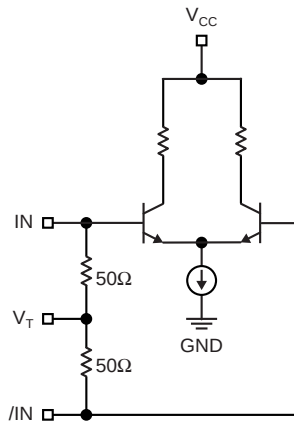


Figure 2a. Simplified Differential Input Stage

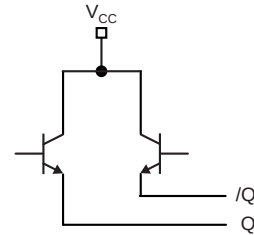
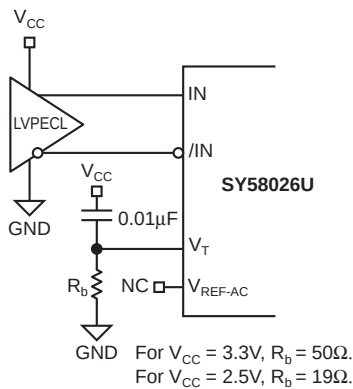
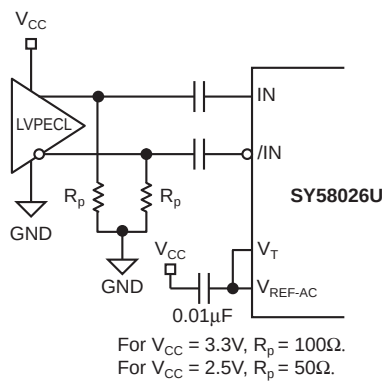
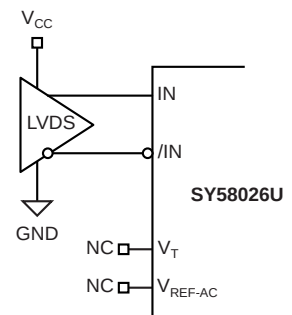
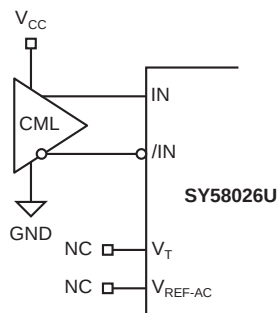
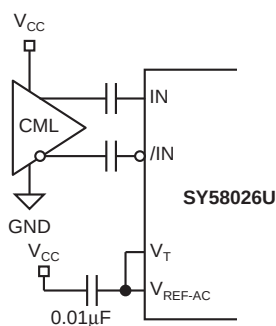


Figure 2b. Simplified LVPECL Output Stage

## INPUT INTERFACE APPLICATIONS

Figure 3a. DC-Coupled  
PECL InterfaceFigure 3b. AC-Coupled  
PECL InterfaceFigure 3c. LVDS  
Interface

Option: May connect  $V_T$  to  $V_{CC}$ .

Figure 3d. DC-Coupled  
CML InterfaceFigure 3e. AC-Coupled  
CML Interface

## OUTPUT INTERFACE APPLICATIONS

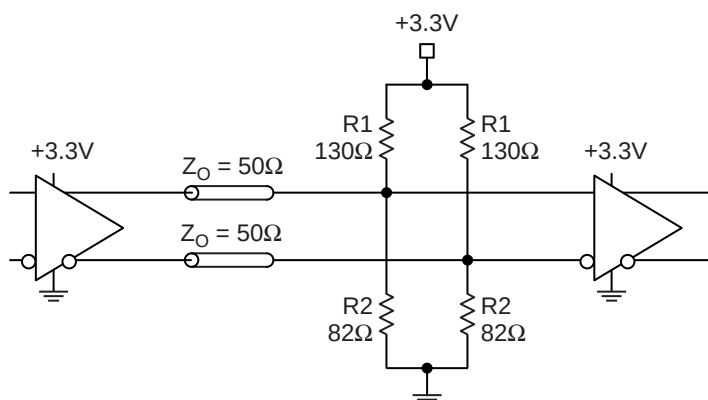


Figure 4a. Parallel Thevenin-Equivalent Termination

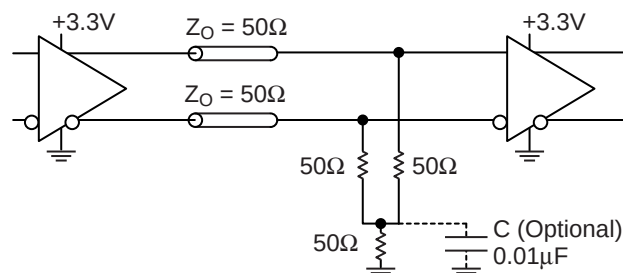


Figure 4b. Parallel Termination (3-Resistor)

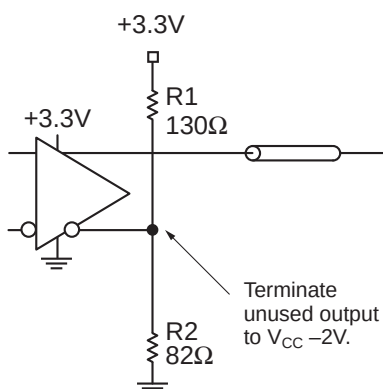
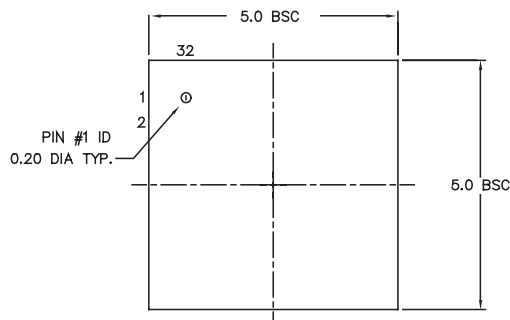


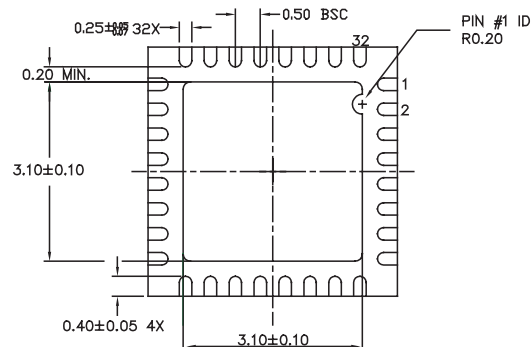
Figure 4c. Terminating Unused Outputs

## RELATED MICREL PRODUCTS AND SUPPORT DOCUMENTATION

| Part Number   | Function                                                                    | Data Sheet Link                                                                                                                        |
|---------------|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| SY58016L      | 3.3V 10Gbps Differential CML Line Driver/Receiver with Internal Termination | <a href="http://www.micrel.com/product-info/products/sy58016l.shtml">http://www.micrel.com/product-info/products/sy58016l.shtml</a>    |
| SY58017U      | 10.7Gbps Differential CML 2:1 MUX with Internal Termination                 | <a href="http://www.micrel.com/product-info/products/sy58017u.shtml">http://www.micrel.com/product-info/products/sy58017u.shtml</a>    |
| SY58018U      | 5Gbps LVPECL 2:1 MUX with Internal Termination                              | <a href="http://www.micrel.com/product-info/products/sy58018u.shtml">http://www.micrel.com/product-info/products/sy58018u.shtml</a>    |
| SY58019U      | 10.7Gbps 400mV LVPECL 2:1 MUX with Internal Termination                     | <a href="http://www.micrel.com/product-info/products/sy58019u.shtml">http://www.micrel.com/product-info/products/sy58019u.shtml</a>    |
| SY58025U      | 10.7Gbps Dual 2:1 CML MUX with Internal Termination                         | <a href="http://www.micrel.com/product-info/products/sy58025u.shtml">http://www.micrel.com/product-info/products/sy58025u.shtml</a>    |
| SY58027U      | 10.7Gbps Dual 2:1 400mV LVPECL MUX with Internal Termination                | <a href="http://www.micrel.com/product-info/products/sy58027u.shtml">http://www.micrel.com/product-info/products/sy58027u.shtml</a>    |
| SY58051U      | 10.7Gbps AnyGate® with Internal Input and Output Termination                | <a href="http://www.micrel.com/product-info/products/sy58051u.shtml">http://www.micrel.com/product-info/products/sy58051u.shtml</a>    |
| SY58052U      | 10Gbps Clock/Data Retimer with 50Ω Input Termination                        | <a href="http://www.micrel.com/product-info/products/sy58052u.shtml">http://www.micrel.com/product-info/products/sy58052u.shtml</a>    |
|               | MLF™ 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 | New Products and Applications                                               | <a href="http://www.micrel.com/product-info/products/solutions.shtml">www.micrel.com/product-info/products/solutions.shtml</a>         |

**32-PIN MicroLeadFrame® (MLF-32)**

TOP VIEW



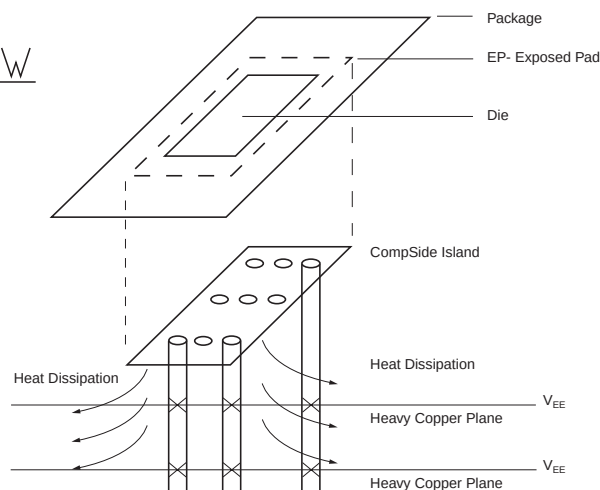
BOTTOM VIEW



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 Moisture Sensitivity Classification.
2. All parts are dry-packaged before shipment.
3. Exposed pads must be soldered to a ground for proper thermal management.

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