



SY58610U

3.2Gbps Precision, LVPECL 2:1 MUX with Internal Termination and Fail Safe Input

General Description

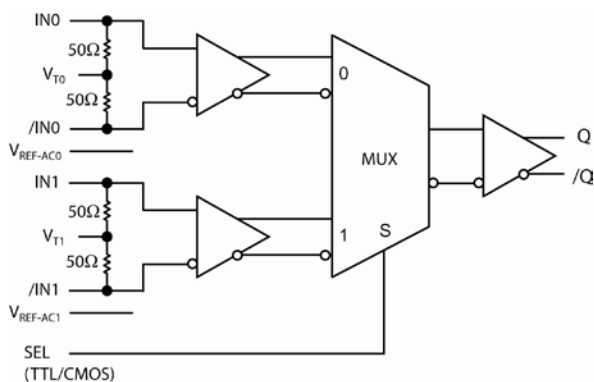
The SY58610U is a 2.5/3.3V, high-speed, fully differential LVPECL 2:1 MUX capable of processing clock signals up to 2.5GHz and data patterns up to 3.2Gbps. The SY58610U is optimized to provide a buffered output of the selected input with less than 10ps_{pp} total jitter.

The differential input includes Micrel's unique, 3-pin input termination architecture that interfaces to LVPECL, LVDS or CML differential signals, (AC- or DC-coupled) as small as 100mV (200mV_{pp}) without any level-shifting or termination resistor networks in the signal path. For AC-coupled input interface applications, an integrated reference voltage (V_{REF-AC}) is provided to bias the V_T pin. The outputs are 800mV LVPECL, with extremely fast rise/fall times guaranteed to be less than 130ps.

The SY58610U 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 CML or LVDS outputs, consider Micrel's SY58609U and SY58611U, 2:1 MUX with 400mV and 325mV output swings, respectively. The SY58610U is part of Micrel's high-speed, Precision Edge® product line.

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

Functional Block Diagram



United States Patent No. RE44,134

Precision Edge is a registered trademark of Micrel, Inc.

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Precision Edge®

Features

- Precision 800mV LVPECL 2:1 MUX
- Guaranteed AC performance over temperature and voltage:
 - DC-to > 3.2Gbps throughput
 - <370ps propagation delay (IN-to-Q)
 - <130ps rise/fall times
- Fail Safe Input
 - Prevents outputs from oscillating when input is invalid
- Unique, patented MUX input isolation design minimizes adjacent channel crosstalk
- Ultra-low jitter design
 - <1ps_{RMS} cycle-to-cycle jitter
 - <10ps_{pp} total jitter
 - <1ps_{RMS} random jitter
 - <10ps_{pp} deterministic jitter
- High-speed LVPECL outputs
- 2.5V ±5% or 3.3V ±10% power supply operation
- Industrial temperature range: -40°C to +85°C
- Available in 16-pin (3mm x 3mm) QFN package

Applications

- All SONET clock distribution
- Fibre Channel clock and data distribution
- Gigabit Ethernet clock and data distribution
- Backplane distribution.

Markets

- Storage
- ATE
- Test and measurement
- Enterprise networking equipment
- High-end servers

M9999-082907-C

hbwhelp@micrel.com or (408) 955-1690

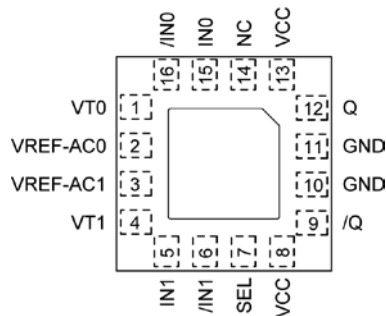
Ordering Information⁽¹⁾

| Part Number | Package Type | Operating Range | Package Marking | Lead Finish |
|-----------------------------|--------------|-----------------|--------------------------------------|----------------|
| SY58610UMG | QFN-16 | Industrial | 610U with Pb-Free bar-line indicator | NiPdAu Pb-Free |
| SY58610UMGTR ⁽²⁾ | QFN-16 | Industrial | 610U with Pb-Free bar-line indicator | NiPdAu Pb-Free |

Notes:

- Contact factory for die availability. Dice are guaranteed at TA = 25°C, DC Electricals only.
- Tape and Reel.

Pin Configuration



16-Pin QFN

Truth Table

| SEL | Output |
|-----|--------------|
| 0 | IN0 Selected |
| 1 | IN1 Selected |

Pin Description

| Pin Number | Pin Name | Pin Function |
|----------------|------------------------|---|
| 1, 4 | VT0, VT1 | Input Termination Center-Tap: Each side of the differential input pair terminates to the VT pin. This pin provides a center-tap to a termination network for maximum interface flexibility. See "Input Interface Applications" subsection. |
| 2, 3 | VREF-AC0, VREF-AC1 | Reference Voltage: These outputs bias to $V_{CC}-1.2V$. They are used for AC-coupling inputs IN and /IN. Connect VREF-AC directly to the corresponding VT pin. Bypass with 0.01 μ F low ESR capacitor to VCC. Due to limited drive capability, the VREF-AC pin is only intended to drive its respective VT pin. Maximum sink/source current is $\pm 0.5mA$. See "Input Interface Applications" subsection. |
| 5, 6 15, 16 | IN1, /IN1 IN0, /IN0 | Differential Inputs: These input pairs are the differential signal inputs to the device. Inputs accept DC-Coupled differential signals as small as 100mV (200mV _{pp}). Each pin of the pairs internally terminates with 50 Ω to the corresponding VT pin. If the input swing falls below a certain threshold (typical 30mV), the Fail Safe Input (FSI) feature will guarantee a stable output by latching the output to its last valid state. See "Input Interface Applications" subsection. |
| 7 | SEL | Single-Ended Input: This single-ended TTL/CMOS-compatible input selects the inputs to the multiplexer. Note that this input is internally connected to a 25k Ω pull-up resistor and will default to logic HIGH state if left open. The input-switching threshold is $V_{CC}/2$. |
| 8, 13 | VCC | Positive Power Supply: Bypass with 0.1 μ F//0.01 μ F low ESR capacitors as close to the VCC pins as possible. |
| 9, 12 | /Q, Q | LVPECL Differential Output Pair: Differential buffered output copy of the selected input signal. The output swing is typically 800mV. Unused output pair may be left floating with no impact on jitter. See "LVPECL Output Termination" subsection. |
| 10, 11 | GND, Exposed Pad | Ground. Exposed pad must be connected to a ground plane that is the same potential as the ground pins. |
| 14 | NC | No connect. |

Absolute Maximum Ratings⁽¹⁾

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
 Current (V_T)
 Source or sink on V_T pin±100mA
 Input Current
 Source or sink Current on (IN, /IN)±50mA
 Current (V_{REF})
 Source or sink current on V_{REF-AC} ⁽⁴⁾±0.5mA
 Maximum operating Junction Temperature 125°C
 Lead Temperature (soldering, 20sec.) 260°C
 Storage Temperature (T_s) -65°C to +150°C

Operating Ratings⁽²⁾

Supply Voltage (V_{IN}) +2.375V to +3.60V
 Ambient Temperature (T_A) -40°C to +85°C
 Package Thermal Resistance⁽³⁾
 QFN
 Still-air (θ_{JA}) 60°C/W
 Junction-to-board (ψ_{JB}) 33°C/W

DC Electrical Characteristics⁽⁵⁾

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

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|----------------|---|------------------------|--------------|------------|--------------|----------|
| V_{CC} | Power Supply Voltage Range | | 2.375 3.0 | 2.5 3.3 | 2.625 3.6 | V |
| I_{CC} | Power Supply Current | No load, max. V_{CC} | | 40 | 50 | mA |
| R_{DIFF_IN} | Differential Input Resistance (IN-to-/IN) | | 90 | 100 | 110 | Ω |
| V_{IH} | Input HIGH Voltage (IN, /IN) | IN, /IN, Note 7 | $V_{CC}-1.6$ | | V_{CC} | V |
| V_{IL} | Input LOW Voltage (IN, /IN) | IN, /IN | 0.2 | | $V_{IH}-0.1$ | V |
| V_{IN} | Input Voltage Swing (IN, /IN) | see Figure 3a, Note 6 | 0.1 | | 1.0 | V |
| V_{DIFF_IN} | Differential Input Voltage Swing ($ I_{IN} - /I_{IN} $) | see Figure 3b | 0.2 | | | V |
| V_{IN_FSI} | Input Voltage Threshold that Triggers FSI | | | 30 | 100 | mV |
| V_{REF-AC} | AC Reference Voltage | | $V_{CC}-1.3$ | | $V_{CC}-1.0$ | V |
| V_{T_IN} | Voltage from Input to V_T | | | | 1.28 | 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. Package thermal resistance assumes exposed pad is soldered (or equivalent) to the device's most negative potential on the PCB. ψ_{JB} and θ_{JA} values are determined for a 4-layer board in still-air number, unless otherwise stated.
4. Due to the limited drive capability, use for input of the same package only.
5. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.
6. V_{IN} (max) is specified when V_T is floating.
7. V_{IH} (min) not lower than 1.2V.

LVPECL Outputs DC Electrical Characteristics⁽⁷⁾

$V_{CC} = +2.5V \pm 5\%$ 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 |
|-----------------|-----------------------------------|------------------|----------------|------|----------------|-------|
| V_{OH} | Output HIGH Voltage | Q0, /Q0, Q1, /Q1 | $V_{CC}-1.145$ | | $V_{CC}-0.895$ | V |
| V_{OL} | Output LOW Voltage | Q0, /Q0, Q1, /Q1 | $V_{CC}-1.945$ | | $V_{CC}-1.695$ | V |
| V_{OUT} | Output Voltage Swing | See Figure 3a | 550 | 800 | 950 | mV |
| V_{DIFF_OUT} | Differential Output Voltage Swing | See Figure 3b | 1100 | 1600 | | mV |

LVTTTL/CMOS DC Electrical Characteristics⁽⁷⁰⁾

$V_{CC} = 2.5V \pm 5\%$ 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 | | -125 | | 30 | μA |
| I_{IL} | Input LOW Current | | -300 | | | μA |

Notes:

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

AC Electrical Characteristics⁽⁸⁾

$V_{CC} = +2.5V \pm 5\%$ or $+3.3V \pm 10\%$, $R_L = 50\Omega$ to $V_{CC}-2V$; Input $t_R/t_F \leq 300ps$, $T_A = -40^\circ C$ to $+85^\circ C$, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|--------------|-------------------------------------|-------------------------|-----|-----|-----|-------------------|
| f_{MAX} | Maximum Frequency | NRZ Data | 3.2 | | | Gbps |
| | | $V_{OUT} > 400mV$ Clock | 2.5 | 3 | | GHz |
| t_{PD} | Propagation Delay IN-to-Q | $V_{IN}: 100mV-200mV$ | 180 | 340 | 470 | ps |
| | | $V_{IN}: >200mV$ | 140 | 290 | 370 | ps |
| | SEL-to-Q | | 150 | | 450 | ps |
| t_{Skew} | Input-to-Input Skew | Note 9, 10 | | 5 | 20 | ps |
| | Part-to-Part Skew | Note 11 | | | 150 | ps |
| t_{Jitter} | Data Random Jitter | Note 12 | | | 1 | ps _{RMS} |
| | Deterministic Jitter | Note 13 | | | 10 | ps _{PP} |
| | Clock Cycle-to-Cycle Jitter | Note 14 | | | 1 | ps _{RMS} |
| | Total Jitter | Note 15 | | | 10 | ps _{PP} |
| t_R, t_F | Output Rise/Fall Times (20% to 80%) | At full output swing. | 40 | 100 | 130 | ps |
| | Duty Cycle | Differential I/O | 47 | | 53 | % |

Notes:

8. High-frequency AC-parameters are guaranteed by design and characterization.
9. Input-to-input skew is the time difference between the two inputs to one output, under identical input transitions.
10. Input-to-Input Skew is included in IN-to-Q propagation delay.
11. Part-to-part skew is defined for two parts with identical power supply voltages at the same temperature, same transition edge, and no skew at the edges at the respective inputs.
12. Random jitter is measured with a K28.7 pattern, measured at $\leq f_{MAX}$.
13. Deterministic jitter is measured at 2.5Gbps with both K28.5 and $2^{23}-1$ PRBS pattern.
14. 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.
15. 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.

Functional Description

Fail-Safe Input (FSI)

The input includes a special fail-safe circuit to sense the amplitude of the input signal and to latch the outputs when there is no input signal present, or when the amplitude of the input signal drops sufficiently below 100mV_{PK} (200mV_{PP}), typically 30mV_{PK} . Maximum frequency of the SY58610U is limited by the FSI function.

Input Clock Failure Case

If the input clock fails to a floating, static, or extremely low signal swing, such that the voltage swing across the input pair is less than 100mV , the FSI function will eliminate a metastable condition and latch the outputs to the last valid state. No ringing and no undetermined state will occur at the output under these conditions. The output recovers to normal operation once the input signal returns to a valid state with a swing greater than 100mV .

Note that the FSI function will not prevent duty cycle distortion in case of a slowly deteriorating (but still toggling) input signal. Due to the FSI function, the propagation delay will depend on rise and fall time of the input signal and on its amplitude. Refer to "Typical Operating Characteristics" for detailed information.

Timing Diagrams

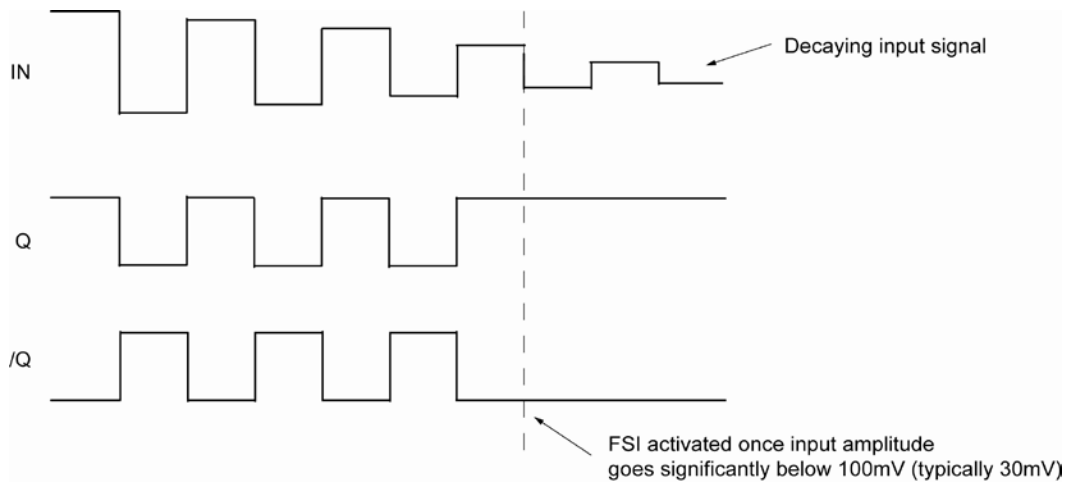


Figure 1a. Fail Safe Feature

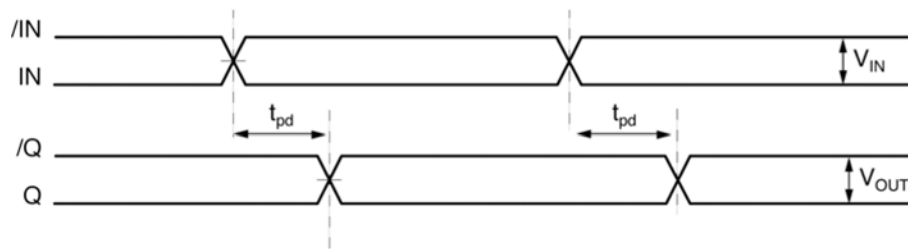


Figure 1b. Propagation Delay IN-to-Q

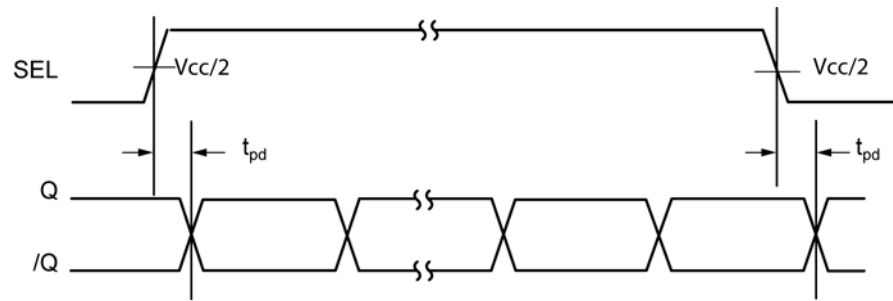
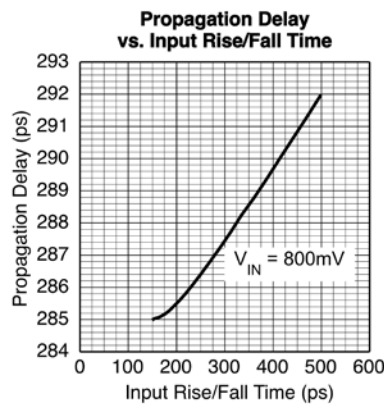
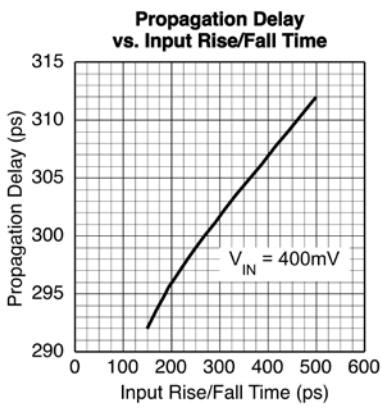
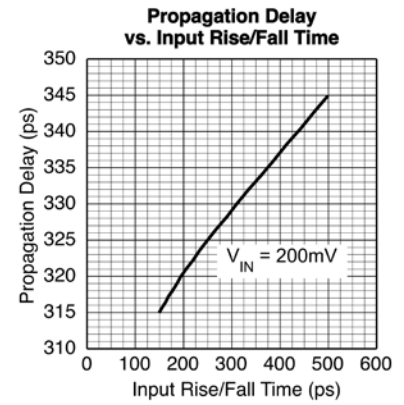
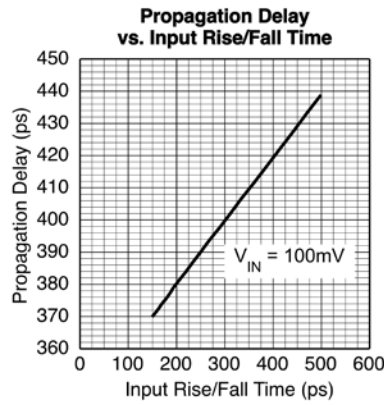
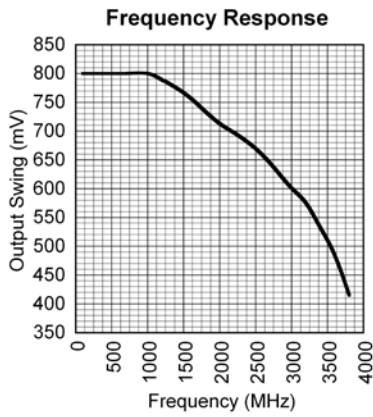


Figure 1c. Propagation Delay SEL-to-Q

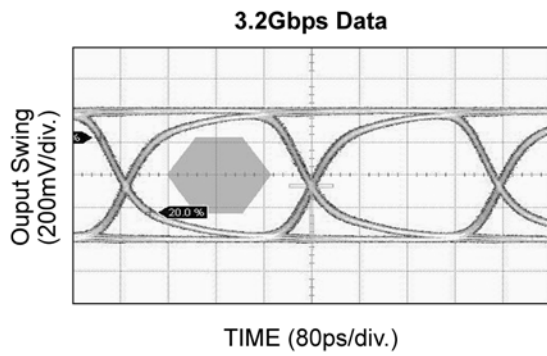
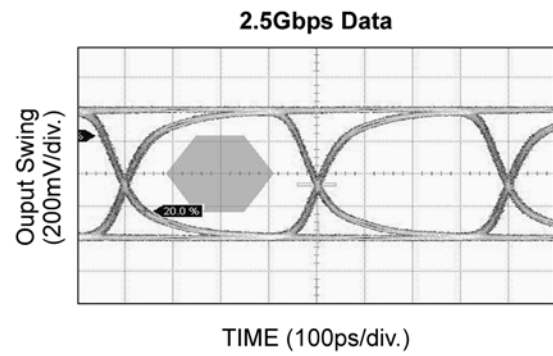
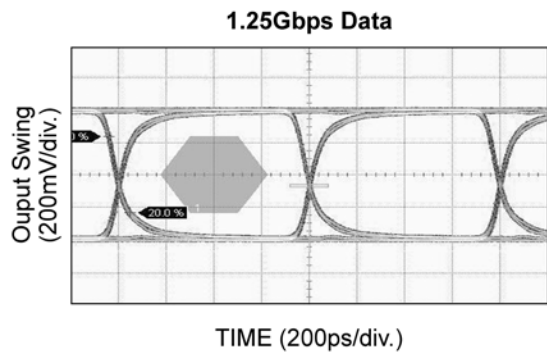
Typical Characteristics

$V_{CC} = 3.3V$, $GND = 0V$, $V_{IN} = 100mV$, $R_L = 50\Omega$ to $V_{CC}-2V$, $T_A = 25^\circ C$, unless otherwise stated.



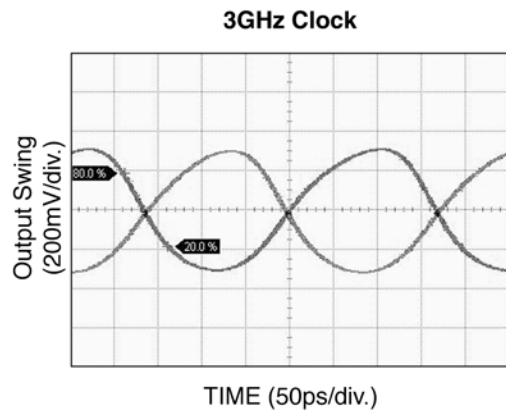
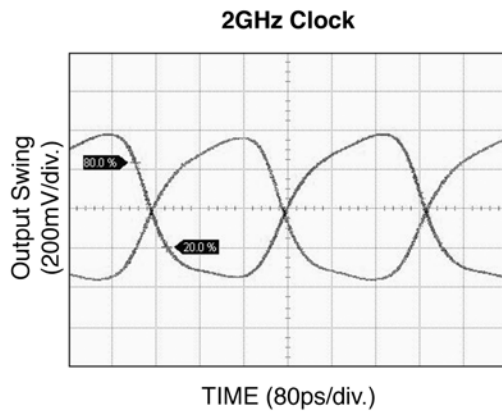
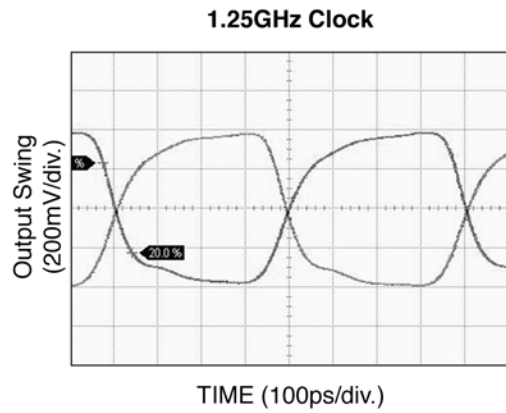
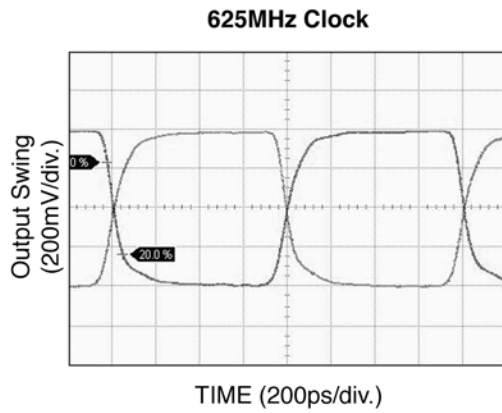
Functional Characteristics

$V_{CC} = 3.3V$, $GND = 0V$, $V_{IN} = 400mV$, $R_L = 50\Omega$ to $V_{CC}-2V$, $T_A = 25^\circ C$, unless otherwise stated.



Functional Characteristics (continued)

$V_{CC} = 3.3V$, $GND = 0V$, $V_{IN} = 400mV$, $R_L = 50\Omega$ to $V_{CC}-2V$, $T_A = 25^\circ C$, unless otherwise stated.



Input and Output Stage

Single-Ended and Differential Swings

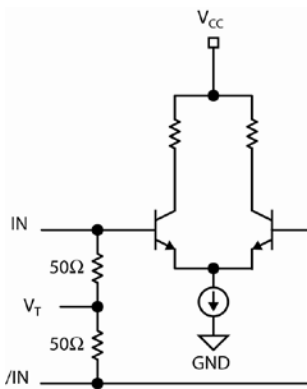


Figure 2a. Simplified Differential Input Buffer



Figure 3a. Single-Ended Voltage Swing

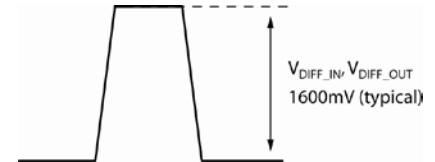


Figure 3b. Differential Voltage Swing

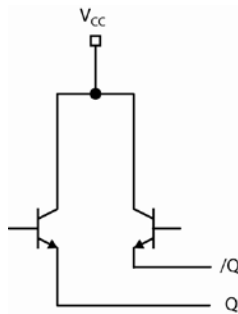


Figure 2b. Simplified LVPECL Output Buffer

Input Interface Applications

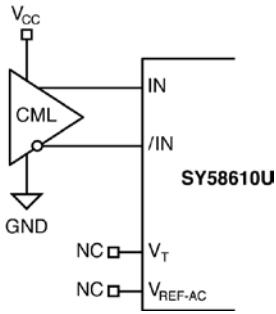


Figure 4a. CML Interface (DC-Coupled)

Option: May connect V_T to V_{CC}

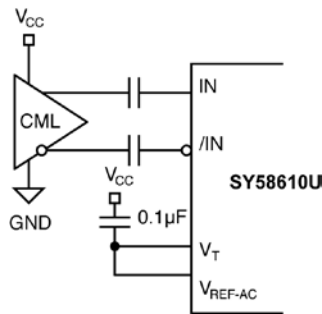


Figure 4b. CML Interface (AC-Coupled)

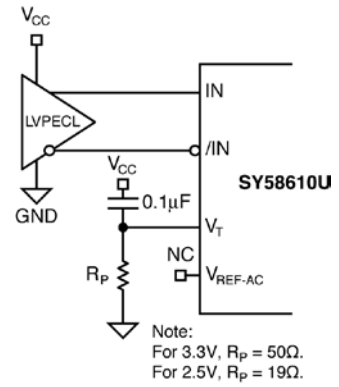


Figure 4c. LVPECL Interface (DC-Coupled)

Note:
For 3.3V, $R_P = 50\Omega$.
For 2.5V, $R_P = 19\Omega$.

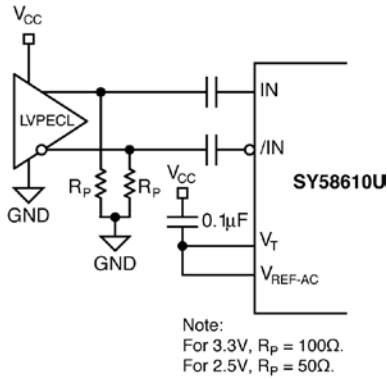


Figure 4d. LVPECL Interface (AC-Coupled)

Note:
For 3.3V, $R_P = 100\Omega$.
For 2.5V, $R_P = 50\Omega$.

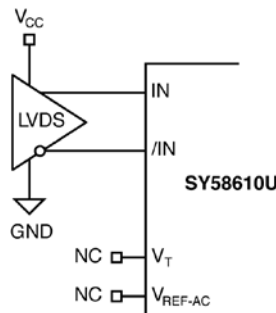
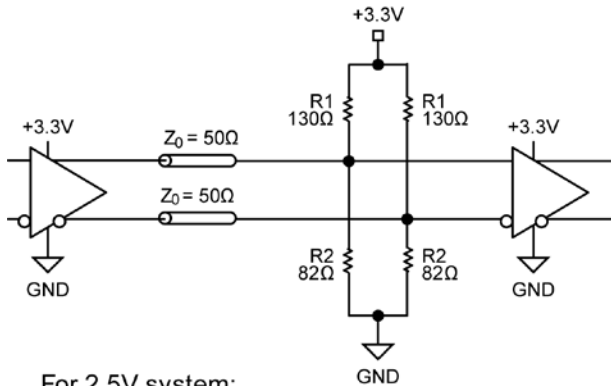


Figure 4e. LVDS Interface

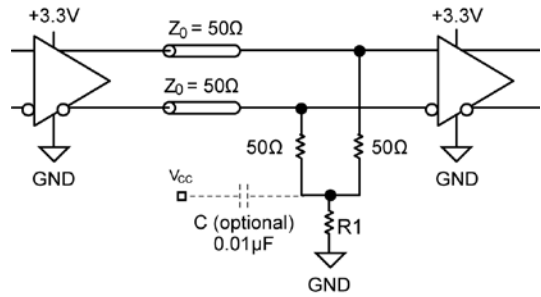
LVPECL Output Termination

LVPECL output has very low output impedance (open emitter), and small signal swing which results in low EMI. LVPECL is ideal for driving 50 and 100Ω - controlled impedance transmission lines. There are several techniques in terminating the LVPECL output, as shown in Figures 5a and 5b.



For 2.5V system:
R1=250Ω, R2=62.5Ω

Figure 5a. Parallel Termination-Thevenin Equivalent



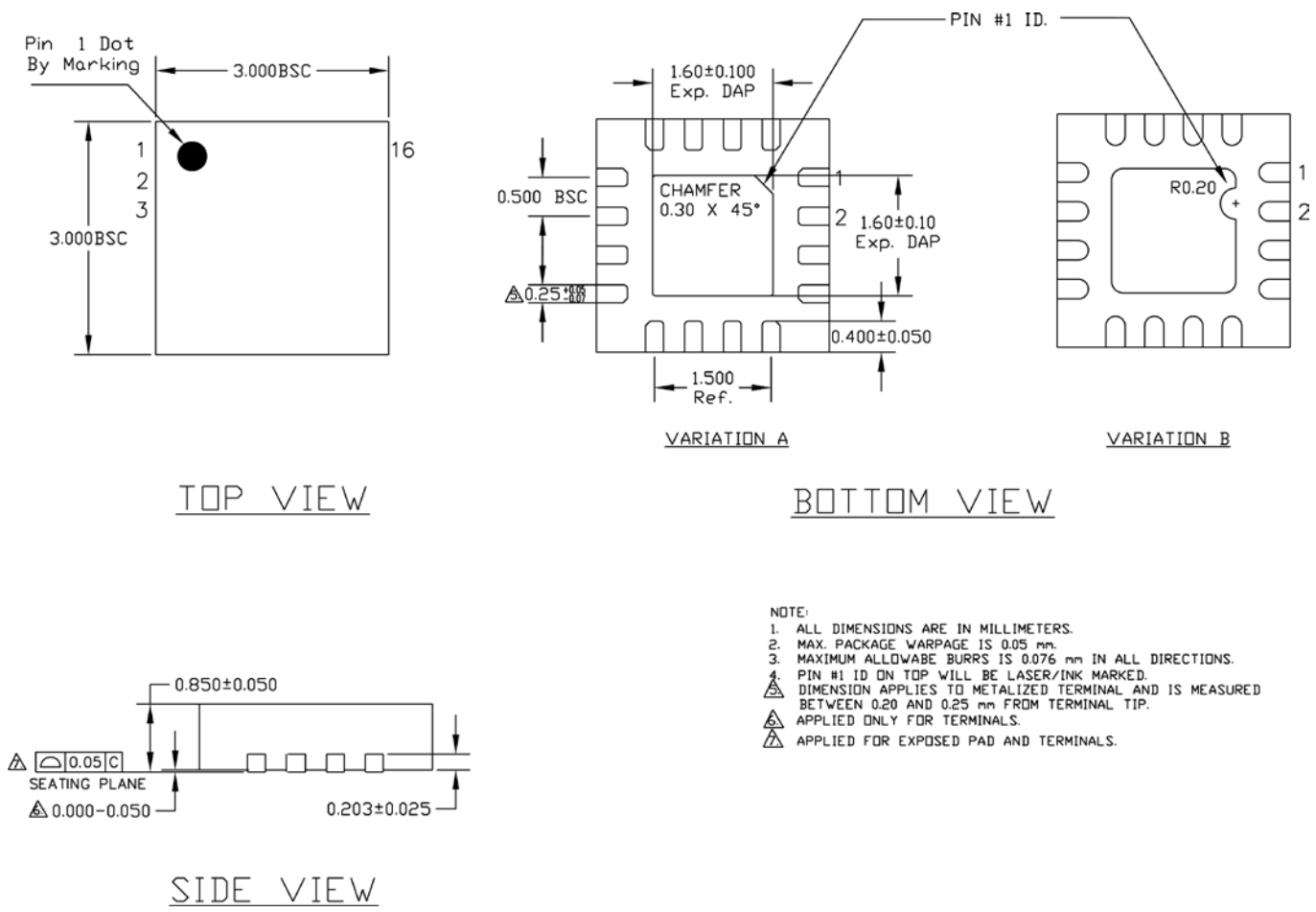
For 2.5V system: R1 = 19Ω.
For 3.3V system: R1 = 50Ω.

Figure 5b. Three-Resistor “Y-Termination”

Related Product and Support Documents

| Part Number | Function | Data Sheet Link |
|---------------|---|---|
| SY58609U | 4.25Gbps Precision, CML 2:1 MUX with Internal Termination and Fail Safe Input | http://www.micrel.com/_PDF/HBW/sy58609u.pdf |
| SY58611U | 3.2Gbps Precision, LVDS 2:1 MUX with Internal Termination and Fail Safe Input | http://www.micrel.com/_PDF/HBW/sy58611u.pdf |
| HBW Solutions | New Products and Termination Application Notes | http://www.micrel.com/page.do?page=/product-info/as/HBWsolutions.shtml |

Package Information



16-Pin (3mm x 3mm) QFN

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