3.3V 3.0Gbps DUAL 2 × 2 CROSSPOINT SWITCH

FEATURES

- **AC-coupled and terminated emitter follower inputs**
- **AC-coupled CML outputs**
- **Selects set through on-board DIP switch**
- **All data inputs and outputs accessible via SMA connectors**

AVAILABLE MEASUREMENTS

- **AC performace**
  - **Data rate/frequency**
  - **Output eye pattern**
  - **Jitter**
  - **Output rise/fall times**
- **BER testing**

EVALUATION BOARD COMPONENTS

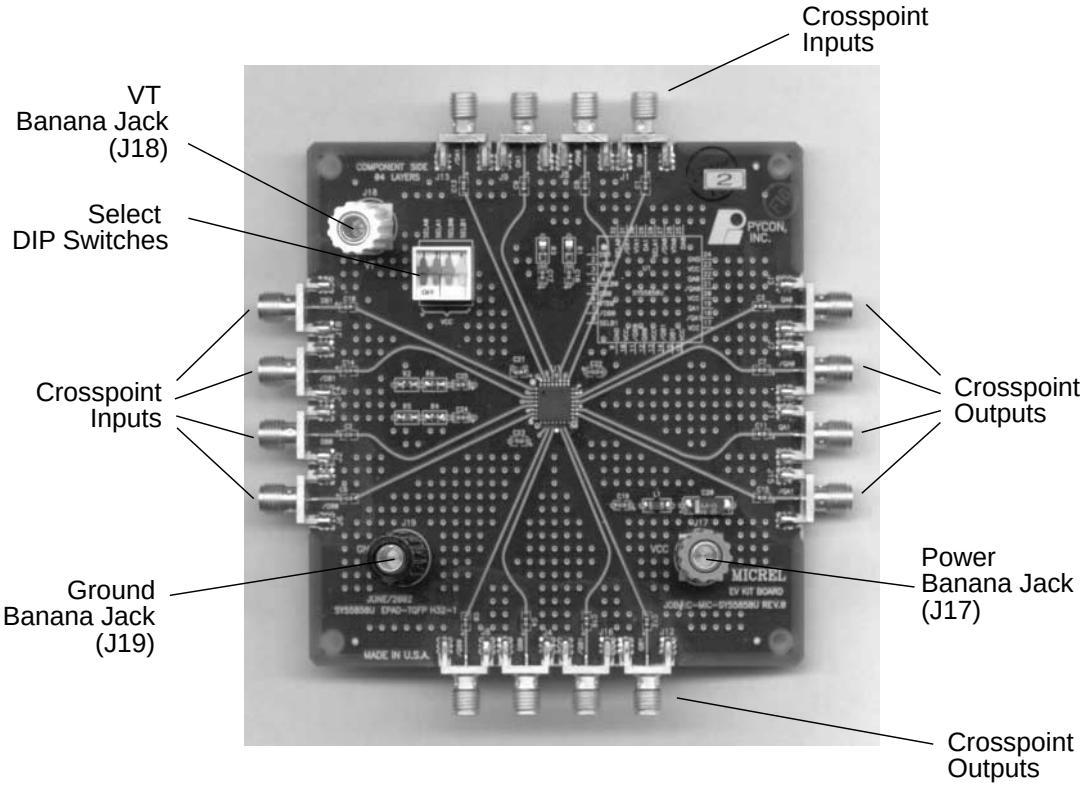
- **C-MIC-SY55858U REV.0 evaluation board**
- **SY55858U data sheet and this document**
- **Various pairs of length-matched SMA cables (user supplied)**

DESCRIPTION

The SY55858U is a dual 2 × 2 crosspoint switch optimized for high-speed data and/or clock applications (up to 3.0Gbps or 3.0GHz) where low jitter and skew are critical. Each 2 × 2 of the SY55858U routes any input to any output, and thus can distribute or multiplex a clock or data stream.

This document provides a detailed description of the evaluation board and how to use it. Complete information in the document includes:

1. Measuring an eye
2. Measuring deterministic jitter (DJ)
3. Measuring the effects of crosstalk
4. Board schematic
5. Bill of materials



Precision Edge is a trademark of Micrel, Inc.

Rev.: A Amendment: /0
Issue Date: October 2002

TEST SET-UP

This section discusses how to make three common measurements with the SY55858U evaluation board.

What you will need:

1. The SY55858U evaluation board
2. Various length-matched SMA cables
3. A high-speed oscilloscope, capable of making eye diagrams
4. A high-speed digital signal generator, such as the Agilent 8133A
5. To measure cross-talk, a second digital signal generator, running asynchronously to the first one (optional)
6. A device capable of making DJ and bathtub curve measurements, such as the Wavecrest DTS-2079
7. A power supply capable of delivering at least 3.3V at 0.5Amps

First, we show how to make and eye measurement, then we show how to measure DJ with the SY55858U evaluation board. Finally, we demonstrate a technique to assess crosstalk by measuring the impact of a non-switched in signal on the edges of a signal switched through to an output.

EVALUATION PROCEDURE

Measuring an Eye with SY55858U

This section describes how to obtain an eye diagram using the SY55858U evaluation board. An example bench setup is shown in Figure 1. Following these instructions, you will be able to obtain an eye diagram similar to the one show in Figure 2.

You will need:

- The SY55858U evaluation board
- A power supply
- A digital signal source capable of generating pseudo-random patterns at up to 2.7Gbps
- An oscilloscope capable of showing eye patterns
- Two pairs of length-matched SMA cables
- Twelve 50Ω termination SMA

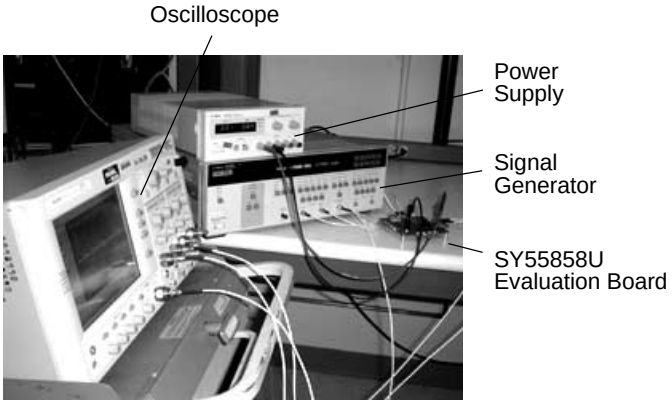


Figure 1. Measuring an Eye Diagram

The following steps allow the user to generate an eye diagram using the SY55858U evaluation board:

1. *Connect Power Source:* The power supply must be set to about 3.3V. Current consumption will be under 200mA. Connect the positive power supply to the red banana jack, J17, labeled "V_{CC}." Connect the negative power supply to the black banana jack, J19, labeled "GND."

2. *Connect Data Source:* Set your data source to generate a pseudo-random data stream. Any pattern 2^7–1 PRBS or better will do. If there is a choice, use 2^{23}–1 PRBS. Set the data rate to 2.7Gbps. Set the output high level to be +400mV, and the output low level to be –400mV.

Using one pair of length matched SMA cables, connect the differential output of the signal generator to J1, labeled "DA0," and J5, labeled "/DA0." In the setup shown in Figure 1, an Agilent 8133A signal source generates a 2^{32}–1 PRBS pattern.

3. *Connect Data Output:* Using another pair of length-matched SMA cables, connect J3, labeled "QA0," and J7, labeled "/QA0" to oscilloscope vertical channels. Connect a trigger output from the digital generator to the trigger input of the oscilloscope.

4. *Terminate Unused Inputs and Outputs:* Cap the 12 other SMA connectors with 50Ω terminators.

5. *Configure the SY55858U Evaluation Board:* Ensure that the first switch of S1, labeled "SELA0," is open or off. For further information regarding what each switch of S1 does, please refer to Table 1 below.

6. *View the Eye:* Adjust the oscilloscope to show the eye diagram. An example eye, coming from an Agilent 86100A DCA, appears in Figure 2.

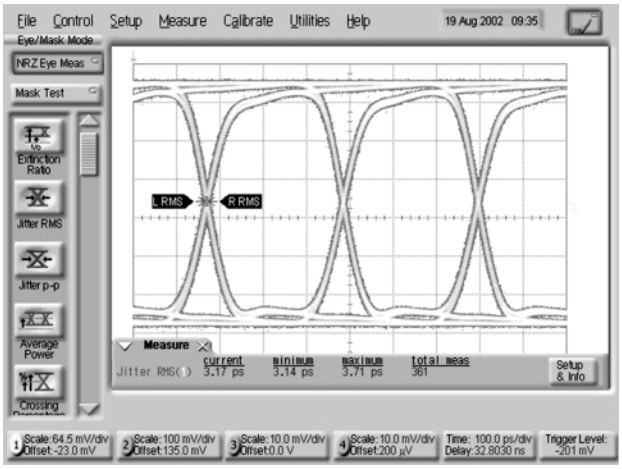


Figure 2. Example Eye Diagram at 2.7Gbps

Switch Position	Label	Setting	Function
First	SELA0	CLOSED or ON OPEN or OFF	QA0, /QA0 sources DA1, /DA1 QA0, /QA0 sources DA0, /DA0
Second	SELA1	CLOSED or ON OPEN or OFF	QA1, /QA1 sources DA1, /DA1 QA1, /QA1 sources DA0, /DA0
Third	SELB0	CLOSED or ON OPEN or OFF	QB0, /QB0 sources DB1, /DB1 QB0, /QB0 sources DB0, /DB0
Fourth	SELB1	CLOSED or ON OPEN or OFF	QB1, /QB1 sources DB1, /DB1 QB1, /QB1 sources DB0, /DB0

Table 1. S1 DIP Switch Settings

Measuring DJ with the SY55858U Evaluation Board

This section describes how to measure DJ using the SY55858U evaluation board. An example bench setup is shown in Figure 3. Of the various methods to obtain DJ, this document describes use of a Wavecrest DTS-2079 TIA. Other instruments, will, of course, require slightly different procedures, though the major steps are common. Following these instructions, you will be able to measure DJ, and obtain results like Figures 4a and 4b.

You will need:

- An SY55858U evaluation board
- A power supply
- A digital signal source capable of generating a fixed 20-bit or 32-bit pattern, at up to 2.5Gbps
- A Wavecrest DTS-2079 TIA
- Two pair of length-matched SMA cables
- Thirteen 50Ω termination SMA

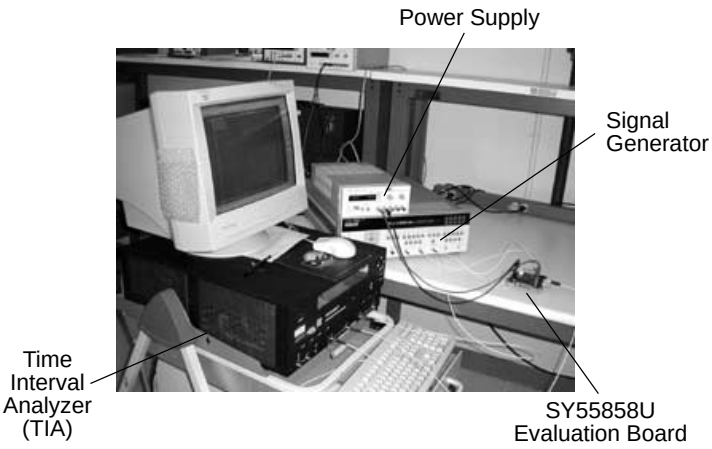


Figure 3. Measuring DJ

The following steps measure DJ using the SY55858U evaluation board:

1. *Connect Power Source:* The power supply must be set to about 3.3V. Current consumption will be under 200mA. Connect the positive power supply to the red banana jack, J18, labeled "V_{CC}." Connect the negative power supply to the black banana jack, J17, labeled "GND."

2. *Connect Data Source:* Set your data source to generate a pseudo-random data stream. Any pattern 2^7–1 PRBS or better will do. If there is a choice, use 2^{23}–1 PRBS. Set the data rate to 2.5Gbps. Set the output high level to be +400mV, and the output low level to be –400mV.

Using one pair of length matched SMA cables, connect the differential output of the signal generator to J1, labeled "DA0," and J5, labeled "/DA0." In the setup shown in Figure 3, an Agilent 8133A signal source generates a 2^{32}–1 PRBS pattern.

3. *Connect Data Output:* Using another pair of length matched SMA cables, connect J3, labeled "QA0," and J7, labeled "/QA0" to oscilloscope vertical channels. Connect a trigger output from the digital generator to the trigger input of the oscilloscope.

4. *Terminate Unused Inputs and Outputs:* Cap the 12 other SMA connectors with 50Ω terminators.

5. *Configure the SY55858U Evaluation Board:* Ensure that the first switch of S1, labeled "SELA0," is open or off. For further information regarding what each switch of S1 does, please refer to Table 1.

6. *Measure Output Amplitude:* Measure the peak-to-peak amplitude of the output from the SY55858U evaluation board.

7. *Adjust Source Amplitude:* Remove the connections to the oscilloscope. Move the connection from the signal source so that it now goes to the oscilloscope. Adjust the output amplitude of the signal source so that it equals the output amplitude measured in step 6.

8. *Use Data Source:* Set the data source to generate a K28.5 pattern, which is the 20-bit sequence "0011 1110 1011 0000 0101," where the spaces are added for readability. The Agilent 8133A used in Figure 3 can only generate a 32-bit pattern. In this case, use "0011 1110 1011 1010 1100 0001 0100 0101," where once again, spaces are added for readability.

9. *Calibrate TIA:* Connect the signal source to the TIA CH1. Connect the signal generator trigger output to the TIA ARM1, and set the signal generator to generate a trigger pulse once for each iteration of the pattern. Select TIA "DATACOM TOOLS," then "KNOWN PATTERN W/ MARKER." Select view of "DCD+DDJ vs. Spacing." Set "Quick Mode" and "Advanced" both on.

Click the PULSE FIND button and verify that there is swing on both CH1 and ARM1. On page 2, click the LEARN button. Set the data rate to 2500, the pattern length to 20 or 32 bits, as appropriate, and select the "DCD" check box. Save the calibration.

Return to page 1. Perform an acquisition, and record the DJ number. This step calibrates the TIA against the signal generator output, and then records the "clean" DJ value from this signal generator and TIA combination. You will get something like Figure 4a.

10. *Use the SY55858U Evaluation Board:* Connect the signal source to SY55858U evaluation board "DA0" and "/DA0," as before. Connect the SY55858U evaluation board J3, labeled "QA0" to TIA CH1. Connect a 50Ω termination to SY55858U evaluation board J7, labeled "/QA0." Perform an acquisition on the TIA again. You will get something like Figure 4b. Record the new DJ number. The difference between this DJ value, and the DJ recorded in step 9, is the DJ of SY55858U evaluation board.

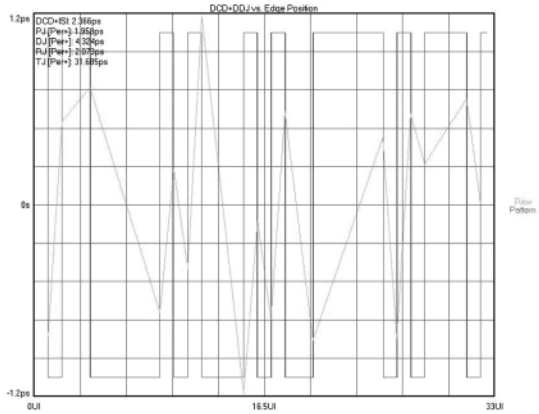


Figure 4a. TIA Output of the Source, Just After Calibration

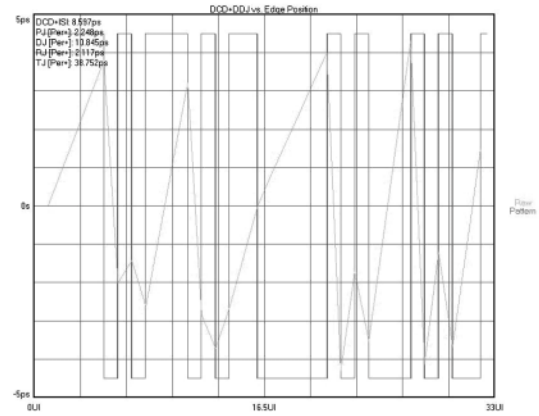


Figure 4b. TIA Output of the SY55858U

Measuring Crosstalk with the SY55858U Evaluation Board

This section describes how to measure crosstalk using the SY55858U evaluation board. An example bench setup is shown in Figure 5. Of the various methods to obtain crosstalk, this document describes use of a Wavecrest DTS-2079 TIA. Other instruments, will, of course, require slightly different procedures, though the major steps are common. Following these instructions, you will be able to measure crosstalk, and obtain results like Figure 6.

You will need:

- An SY55858U evaluation board
- A power supply
- A digital signal source capable of generating a fixed 20-bit or 32-bit pattern, at up tp 2.5Gbps
- Another digital signal source capable of generating a pseudo-random pattern at up to 2.5Gbps
- A Wavecrest DTS-2079 TIA
- Three pairs of length-matched SMA cables
- Thirteen 50Ω termination SMA

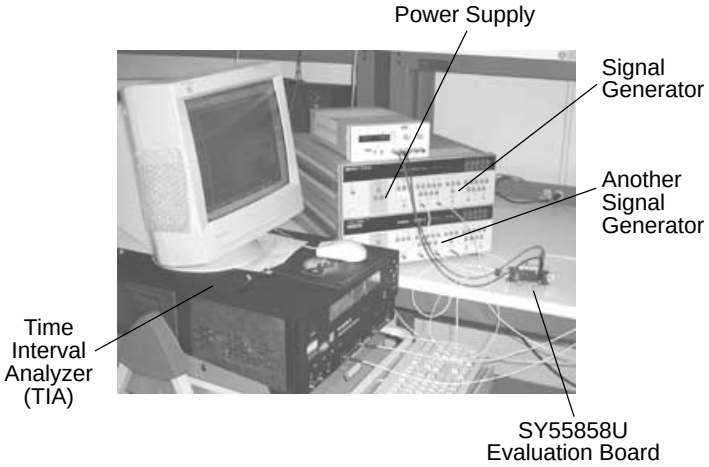


Figure 5. Assessing Crosstalk

The following steps measure DJ using the SY55858U Evaluation Board:

1. *Connect Power Source:* The power supply must be set to about 3.3 Volts. Current consumption will be under 200mA. Connect the positive power supply to the red banana jack, J18, labeled "V_{CC}." Connect the negative power supply to the black banana jack, J17, labeled "GND."

2. *Connect Data Source:* Set your data source to generate a pseudo-random data stream. Any pattern 2^7–1 PRBS or better will do. If there is a choice, use 2^{23}–1 PRBS. Set the data rate to 2.5Gbps. Set the output high level to be +400mV, and the output low level to be –400mV.

Using one pair of length-matched SMA cables, connect the differential output of the signal generator to J1, labeled "DA0," and J5, labeled "/DA0." In the setup shown in Figure 5, an Agilent 8133A signal source generates a 2^{32}–1 PRBS pattern.

3. *Connect Data Output:* Using another pair of length matched SMA cables, connect J3, labeled "QA0," and J7, labeled "/QA0" to oscilloscope vertical channels. Connect a trigger output from the digital generator to the trigger input of the oscilloscope.

4. *Terminate Unused Inputs And Outputs:* Cap the 12 other SMA connectors with 50Ω terminators.

5. *Configure the SY55858U Evaluation Board:* Ensure that the first switch of S1, labeled "SELA0," is open or off, and that the fifth switch of S1, labeled "ENA0" is closed or on. For further information regarding what each switch of S1 does, please refer to Table 1 above.

6. *Measure Output Amplitude:* Measure the peak-to-peak amplitude of the output from the SY55858U evaluation board.

7. *Adjust Source Amplitude:* Remove the connections to the oscilloscope. Move the connection from the signal source so that it now goes to the oscilloscope. Adjust the output amplitude of the signal source so that it equals the output amplitude measured in step 6.

8. *Use Data Source:* Set the data source to generate a K28.5 pattern, which is the 20-bit sequence “0011 1110 1011 0000 0101,” where the spaces are added for readability. The Agilent 8133A used in Figure 5 can only generate a 32-bit pattern. In this case, use “0011 1110 1011 1010 1100 0001 0100 0101,” where once again, spaces are added for readability.

9. *Calibrate TIA:* Connect the signal source to the TIA CH1. Connect the signal generator trigger output to the TIA ARM1, and set the signal generator to generate a trigger pulse once for each iteration of the pattern. Select TIA “DATACOM TOOLS,” then “KNOWN PATTERN W/ MARKER.” Select view of “DCD+DDJ vs. Spacing.” Set “Quick Mode” and “Advanced” both on.

Click the PULSE FIND button and verify that there is swing on both CH1 and ARM1. On page 2, Click the LEARN button. Set the data rate to 2500, the pattern length to 20 or 32 bits, as appropriate, and select the “DCD” check box. Save the calibration. Return to page 1.

10. *Prepare Source Of Crosstalk:* Connect the other signal generator to J9 and J13 (“DA1” and “/DA1”). Set the generator for a pseudo-random pattern at 2.5Gbps, with a high level of +400mV, and a low level of –400mV. Disable the outputs of the second generator.

11. *Measure Crosstalk:* Select a view of “Bathtub.” Set overlays to 2, and markers to both. Perform one acquisition. This is the eye opening without noise at the other input to the crosspoint. Enable the second source, and perform one more acquisition. This is the eye opening with noise at the other input to the crosspoint.

Set one horizontal marker to the minimum, and set the other horizontal marker to the level 1×10^{-12}. Zoom in on the two bathtub curves near 0UI. Set the vertical markers to where each of the two bathtub curves cross the horizontal marker. You will get something like in Figure 6 below. The “Delta UI” is the amount that the eye is reduced by crosstalk from the other input to the crosspoint.

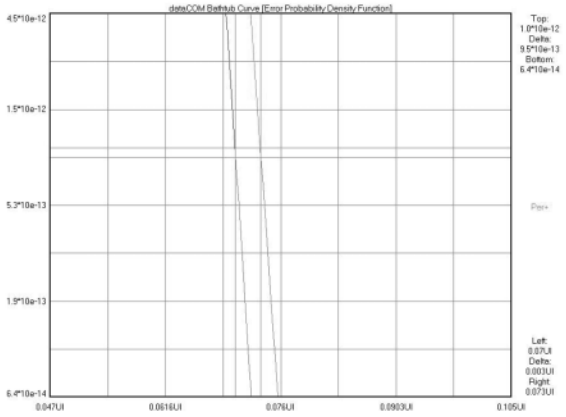


Figure 6. TIA Crosstalk Bathtub Curves

EVALUATION BOARD SCHEMATICS

Figure 7 is the schematic for the SY55858U evaluation board. All data inputs and outputs are AC-coupled. For DC-coupling applications, replace the relevant in-line capacitors with 0Ω resistors. Since the control inputs should never be left open, care is taken that, even with a DIP switch left open, there is a low enough resistance to actually set that input low.

The SY55858U evaluation board includes a resistor divider R2/R5 that establishes the proper V_T bias point for AC-coupled inputs. Should the user wish to terminate a DC-coupled board to some voltage other than the default provided by the R2/R5 voltage divider, simply supply the desired voltage at the white V_T banana jack, J18. For the default AC-coupled usage of the SY55858U evaluation board, the default 2.4V bias arrangement.

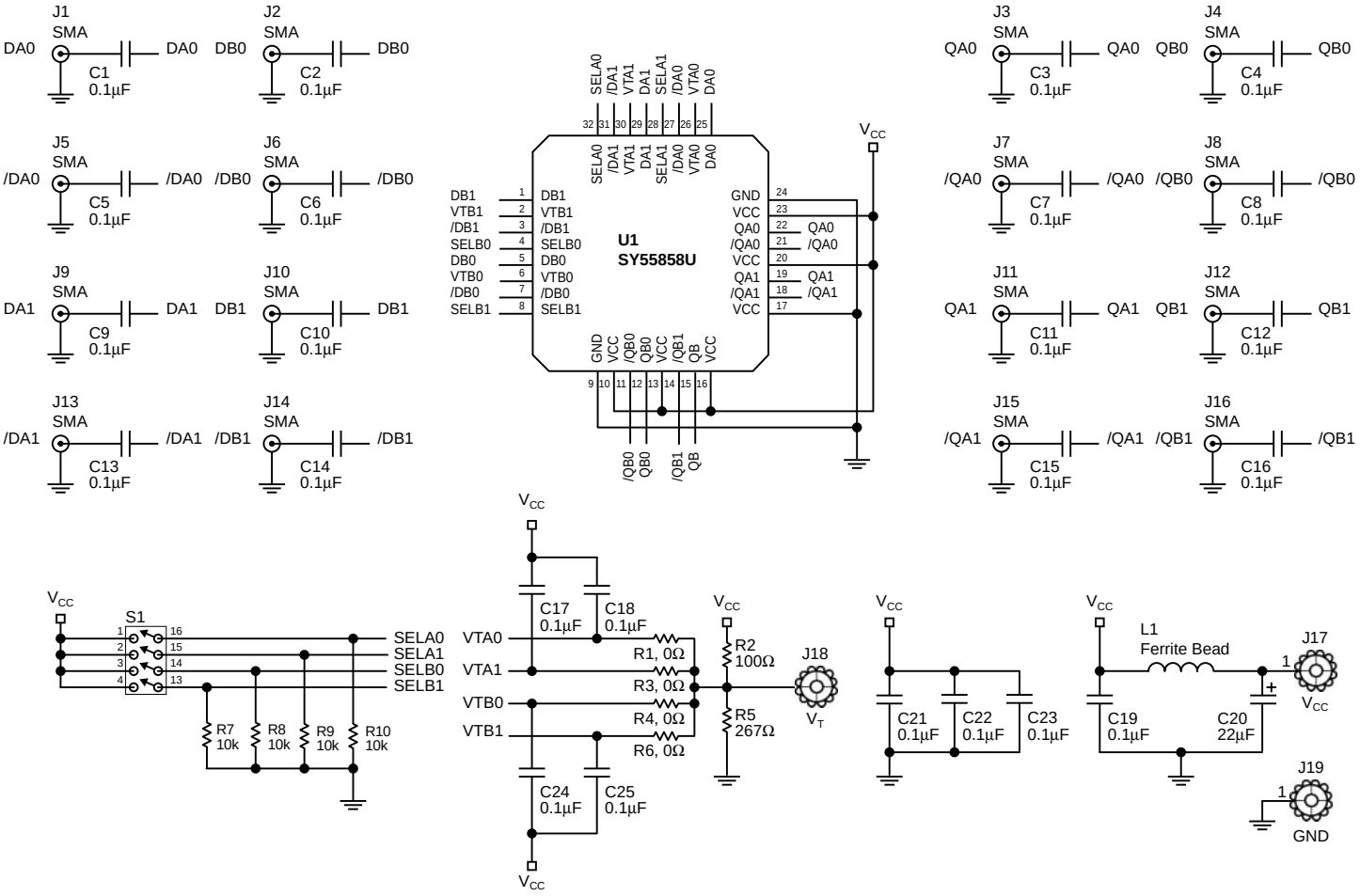


Figure 7. SY55858U Evaluation Board Schematic

BILL OF MATERIALS

Item	Part Number	Manufacturer	Description	Qty.
C1–C19, C21–C25			100nF, 10V X7R, Size 0603 Ceramic Capacitor	24
C20			22µF, 16V Size “C” Tantalum Electrolytic Capacitor	1
J1–J16			SMA Edge Launch Connector	16
J17–J19			Banana Jack Binding Post, Black Red and White	3
L1			Ferrite Bead, Size 0805	1
R1, R3, R4, R6			0Ω Resistor, Size 0603	4
R2			100Ω 1%, 1/10W Resistor, Size 0805	1
R5			267Ω 1%, 1/10W Resistor, Size 0805	1
R7–R10			10kΩ 1%, 1/10W Resistor, Size 0805	4
S1			4 Position SPST DIP Switch, 0.3"	1
U1	**SY55858U**	**Micrel Semiconductor**	3.3V 3.0Gbps Dual 2 × 2 Crosspoint Switch	1

TECHNICAL SUPPORT INFORMATION

Telephone Number:	1 (408) 914-7671
Email:	hbwhelp@micrel.com

ORDERING INFORMATION

Evaluation Board Part#	IC Package	Operating Range
SY55858U–EVAL	EPAD MLF-32	–40°C to +85°C

MICREL, INC. 1849 FORTUNE DRIVE SAN JOSE, CA 95131 USA

TEL + 1 (408) 944-0800 FAX + 1 (408) 944-0970 WEB http://www.micrel.com