UG206: Si838xISO-EVB User's Guide

This user's guide explains the features of the Si838xISO-EVB, which is designed for the evaluation of the Si838x part family and its recommended bill of materials.

The Si838x product family is a set of eight-channel isolators, rated to 2.5 kVrms, which utilize LED emulator inputs to drive the isolation channel. Various configurations, including the number of high speed (2 Mbps) channels and output types (SPI or Parallel), are available per the ordering guide in the Si838x data sheet.

The Si838xISO-EVB is populated with an Si8384P and three different input networks, each representing a recommendation derived from the respective IEC 61131-2 digital input types at 24 V dc.

The Si838xISO-EVB allows designers to quickly evaluate the Si8384P's functionality and capabilities by driving either 24V digital logic signals into the test-points labeled "EXT" or 2V signals into the remaining test-points. For more Si838x information, visit the Silicon Labs web site at www.silabs.com. The product data sheet and application notes should be referenced to facilitate designs.

KEY POINTS

- Discusses kit contents.
- Provides IEC 61131-2 Recommended Bill of Materials.
- Demonstrates System-Level Transition Values.
- Displays EVB Schematic and Layout.
- Demonstrates Timing Characteristics.
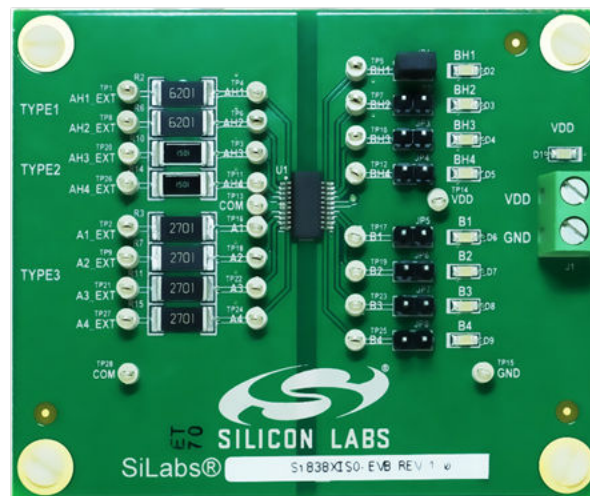
Si838xISO-EVB

1. Si838x as a PLC Digital Input Module

The Si838xISO-EVB is populated with a Si8384P unit, providing 8 parallel outputs, 4 channels which are high-speed and 4 channels which are low-speed. Further, the EVB combines the Si838x LED emulator inputs with two-resistor input networks to form PLC digital input modules per IEC 61131-2, as illustrated in the figure below. The Si838xISO-EVB has 2 channels configured for both Type-1 and Type-2, and 4 channels configured for Type-3. For more information on how to select an input network based on system constraints, view Application Note 970: Si838x Design Guide.
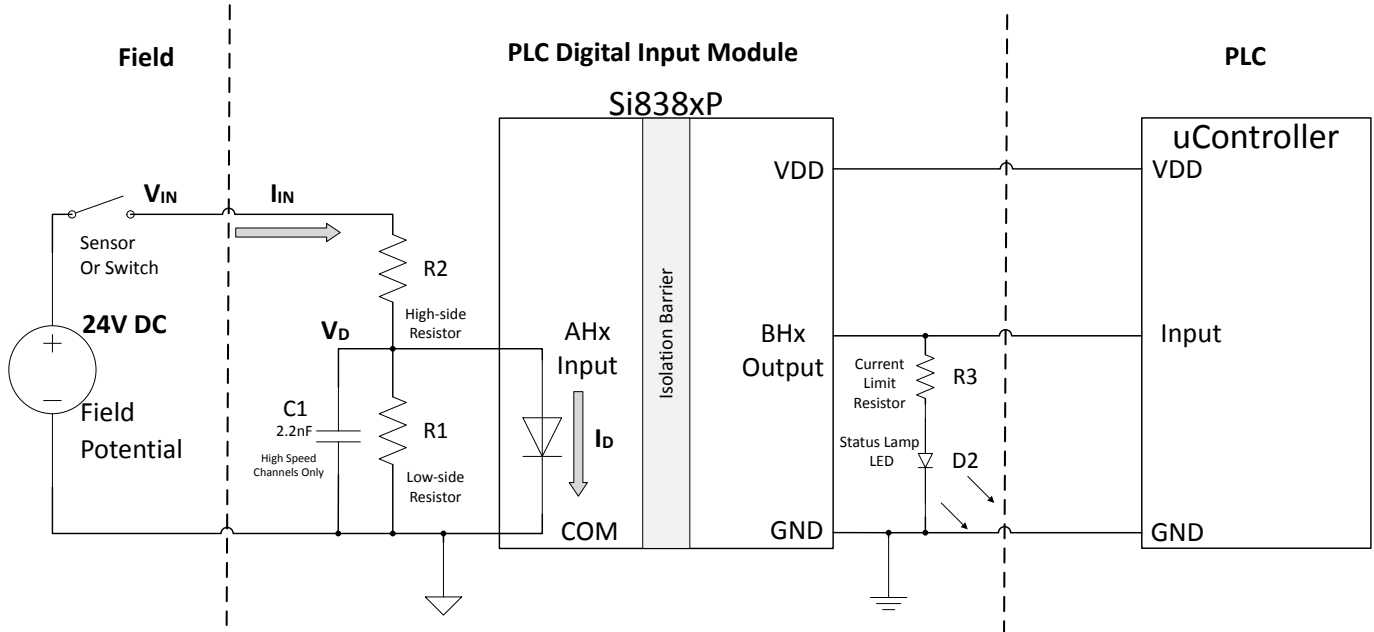

Figure 1.1. The Schematic for a Single Si838xP Channel Configured as a PLC Input Module in a 24 V DC System

2. Kit Contents and Required Equipment

The Si838x Evaluation Kit contains the following items:
- Si838xISO-EVB evaluation board as shown on the front page.
- Si8384P-IU, 8 Channel (4 High Speed, 4 Low-Speed), 2.5 kVrms, 20-pin QSOP Body

2.1 Required Equipment

The following equipment is required to demonstrate the evaluation board:
- (Supply A) One DC Power supply 24V, 100mA
- (Supply B) One DC Power supply 2.5-5.5V, 100mA
- Two banana-to-test clip cables to supply signal and power to the input side of the board
- Two banana-to-wire cables to supply power to the output side of the board
- One 2-pin header shunt (included)

2.2 Optional Equipment

The following equipment is optional and can be used to demonstrate dynamic signally functionality of the evaluation board including signal propagation statistics:
- One Signal generator (capable of sourcing 2mA)
- Two BNC Coaxial cables
- One BNC splitter
- One BNC to test-clip connector
- One 2-Channel Oscilloscope
- One 10x Voltage Probe

3. Background: Understanding Si838x and System Transitions

The Si838x LED emulators have built-in hysteresis around the input threshold, as illustrated in the figure below.
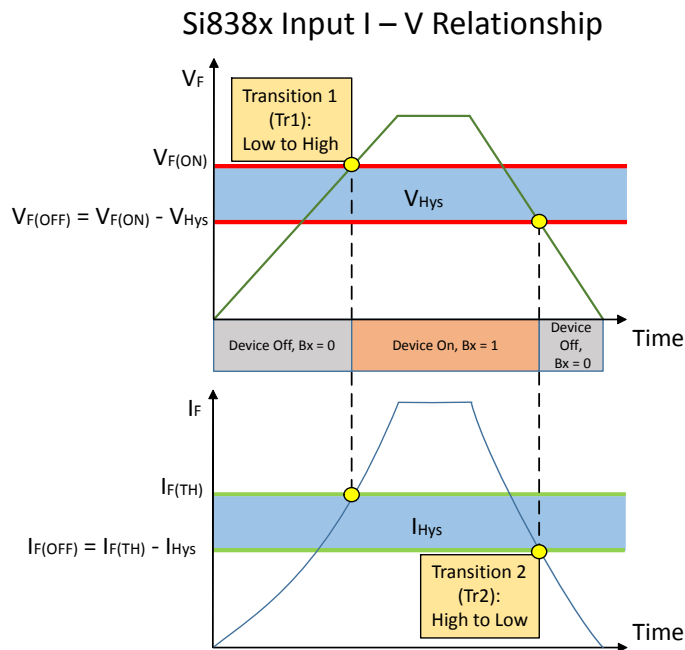

Figure 3.1. Illustration of input hysteresis for the Si838x and the definitions $I_{F(OFF)}$ and $V_{F(OFF)}$

When the Si838x inputs are combined with the two resistor input network, the system transitions as shown in the figure below.
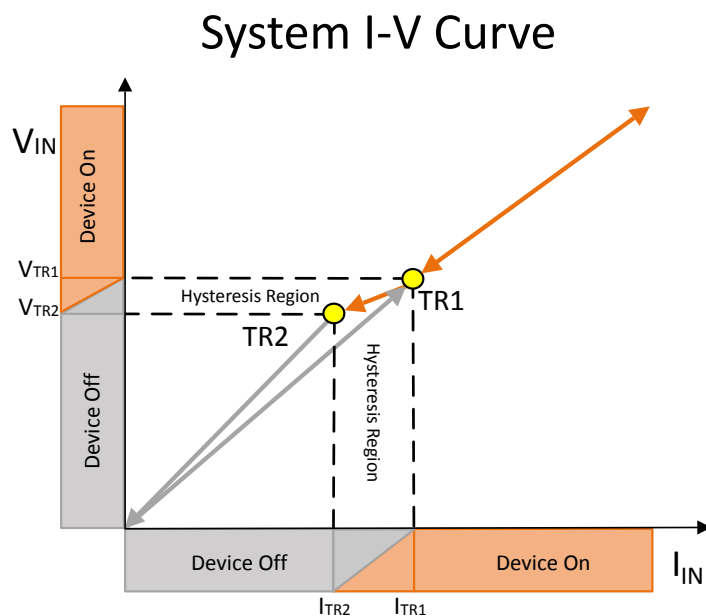

Figure 3.2. Illustration of the system level transition points and the hysteresis region between them

A more detailed exploration of this topic can be found in Application Note 970, however this evaluation board serves to demonstrate the values of TR1 and TR2 per the recommended bill of materials.

4. Demonstration and Hardware Setup

This section demonstrates the static and dynamic properties of the Si838xISO-EVB reference design. The first demonstration allows the user to evaluate system-level input voltage and current pairs in static situations. Meanwhile, the second demonstration, dynamic switching, allows the user to evaluate the timing characteristics of the Si838x.

4.1 Static Signaling Demonstration

4.1.1 Powering the Board

Perform the following steps to set up and power the Si838xISO-EVB.

1. Remove all shunts.
2. Power Side-B
    a. Supply 5.0V from Supply B to VDD and GND on the terminal block, matching GND.
        i. Alternatively supply 5.0V power via clips at TP14 and GND at TP15.
   b. LED, D1, will light up, confirming power is supplied.
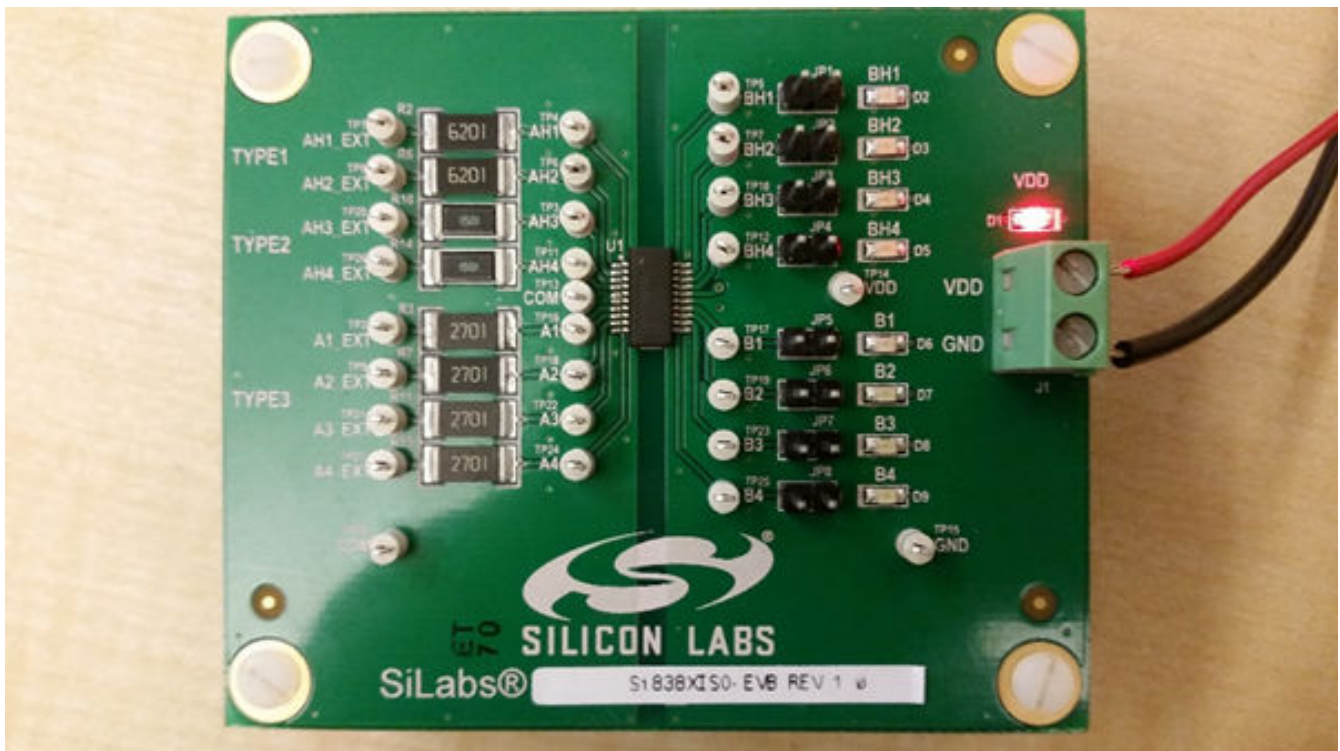
Figure 4.1. EVB--Powered Up

4.1.2 Defaults/Failsafes

The default output signal of the Si8384P is a logic LOW, and this occurs when no power/signal is being supplied to the respective input (for example, it is left floating).

1. Clear all signal test points on Side-A, thus floating the inputs.
2. Sequentially shunt each output, BH1-B4 via JP1-JP8, respectively
   a. Note that the respective LEDs D2-D9 remain off.
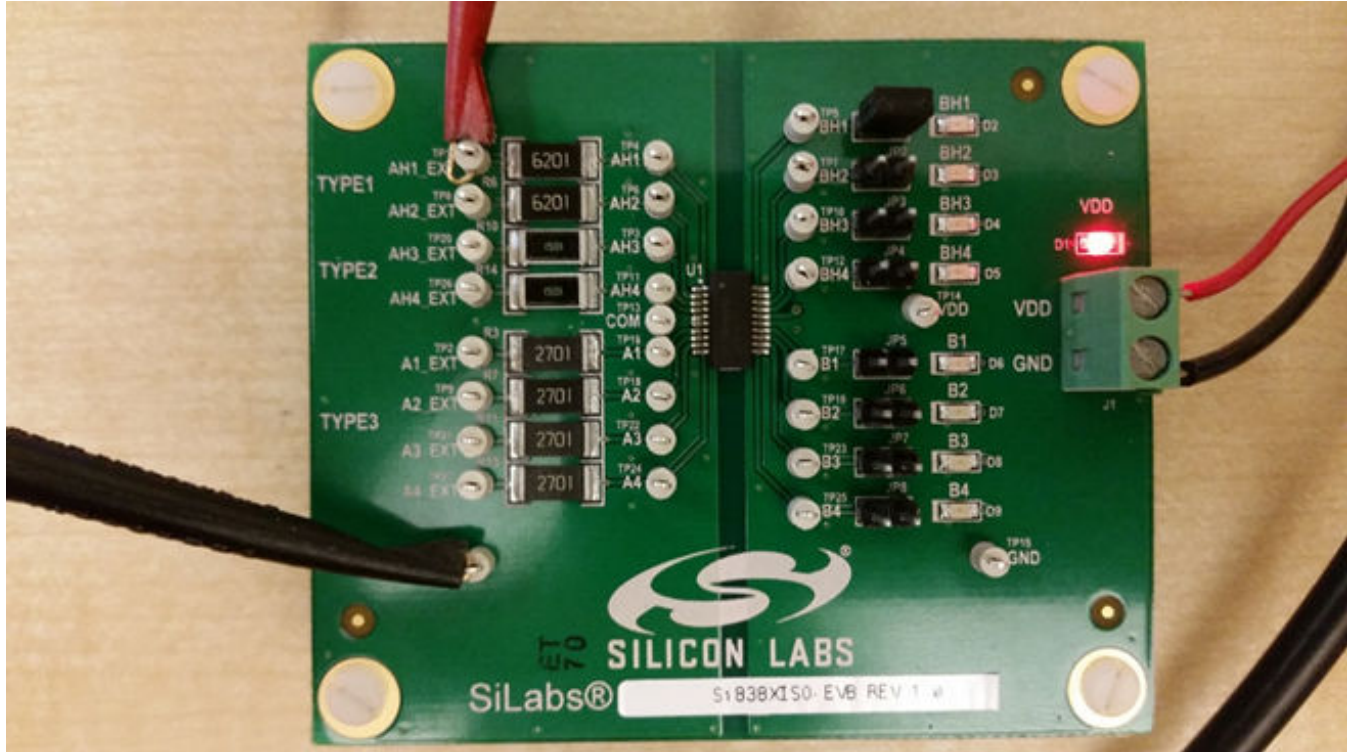
Figure 4.2. EVB powered up without Side-A power or signal

3. Power Side-A
   a. Side-A is powered on a per-channel basis from the input current and voltage across the LED emulator. This will be covered in the following section.

4.1.3 Per Input Type Transition/Static Signaling

1. Place a shunt across JP1, connecting output BH1 to D2.
2. Connect Supply A across AH1_EXT at TP1 and COM at TP28.
   a. Increment the voltage from 0V to 24V and note the voltage and current when BH1 D2 first lights up

      Note: The voltage and current combination at which the LED turned on is TR1,

   b. Decrement the voltage from 24V to 0V and note the voltage and current when BH1 D2 first turns off.

      Note: The voltage and current combination at which the LED turned off is TR2.

3. Repeat Step 2 for all AHX and AX channels.
   a. The I-V values for TR1 and TR2 will vary from type to type.
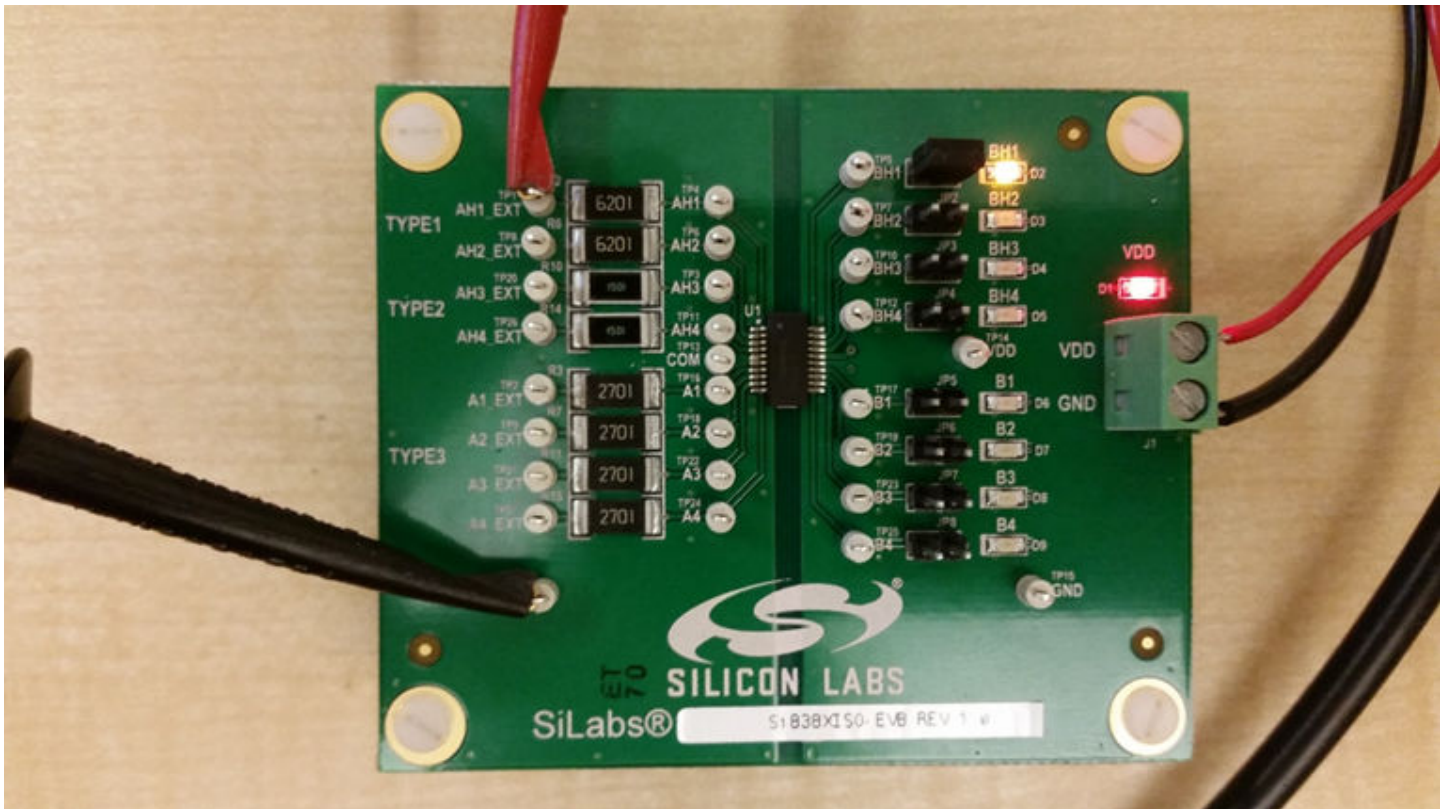
Figure 4.3. EVB configured for static signal demonstration

4.2 Dynamic Signal Demonstration (Optional)

N.B. Make sure that your function generator can source approximately 2mA of current at 2.0V to drive the Si838x inputs directly. The function generator will bypss the IEC recommended bill of materials in this demonstration. See the figure below.

1. Remove all shunts and clear all test points.
2. Set up signal generator and oscilloscope.
    a. Generate a 2 Vpk-pk square wave at 100 kHz on the signal generator.
    b. Split the signal generator output to two separate BNC cables via the splitter.
    c. Attach one BNC cable end to oscilloscope Channel 1 and configure the channel for 1x gain.
    d. Connect the remaining BNC cable end to the BNC-to-test-clip adapter.
    e. Attach the 10x oscilloscope probe to oscilloscope Channel 2 and configure the channel for 10x gain.
3. Apply signal to board.
    a. Clip the signal generator's output to AH1 (TP4) relative to COM (via either TP13 or TP28).
    b. Connect the oscilloscope probe to the output BH1 (TP5).
    c. Apply a jump across JP1 and observe D2 lighting up at 100 kHz.
4. Observe Channel 1 (input-AH1) and Channel 2 (output-BH1) on the oscilloscope for various parameters such as skew and jitter.
5. Repeat steps 3 and 4 for all channels.

    Note: The AHx high-speed channels have a maximum signal frequency of 1 MHz, while the Ax low-speed channels have a maximum input frequency of 100 kHz.
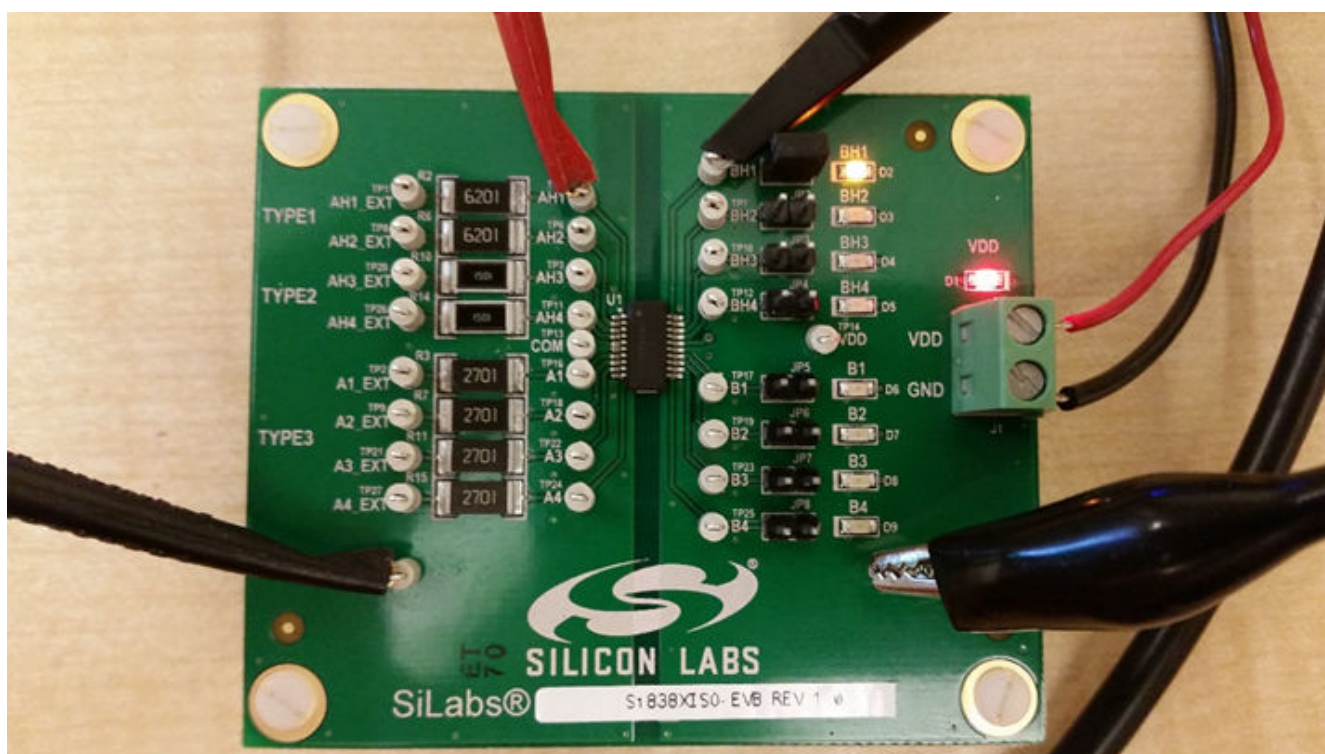

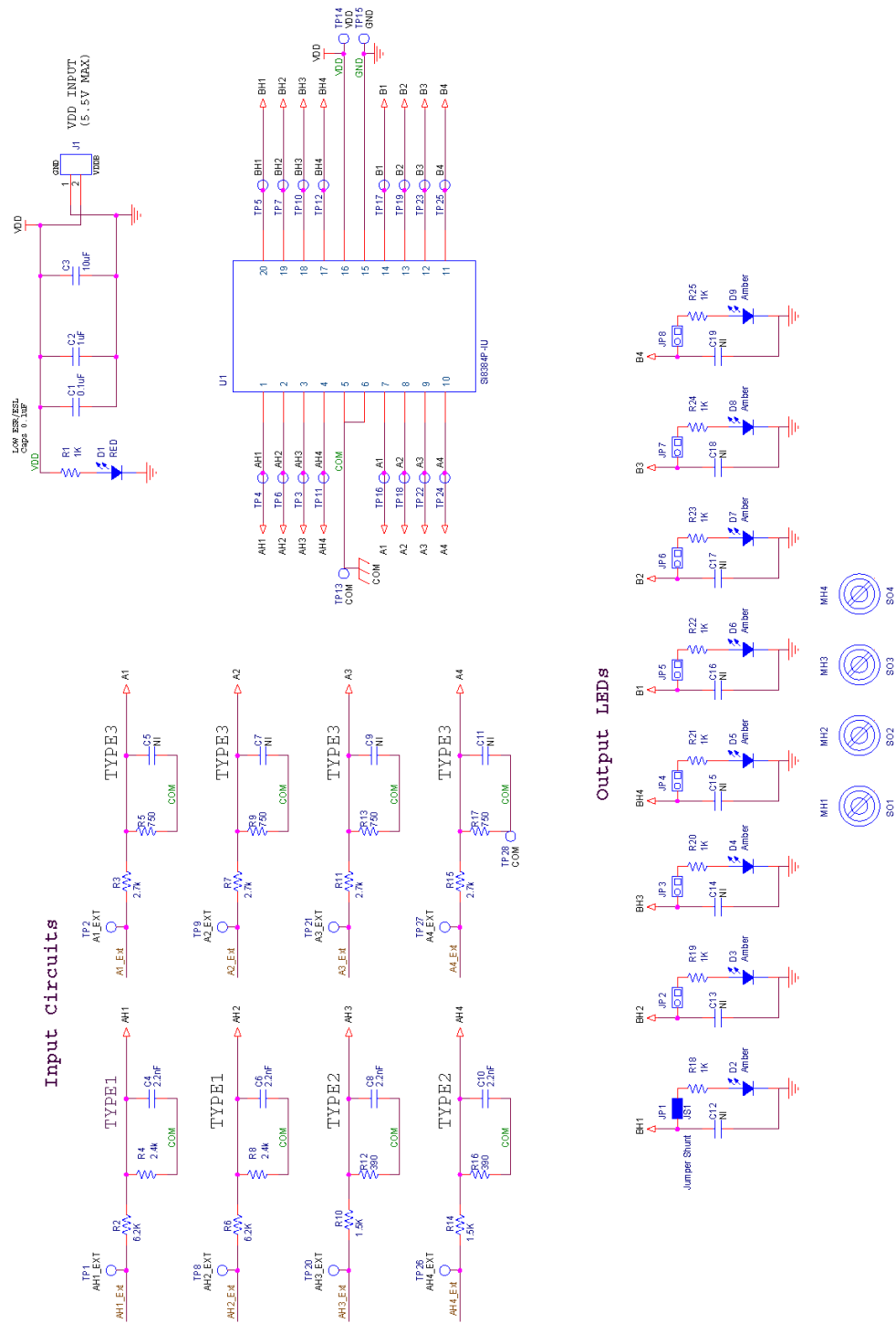**Figure 4.4. EVB Configured for Dynamic Signal Demonstration Without Enable**

5. Schematic
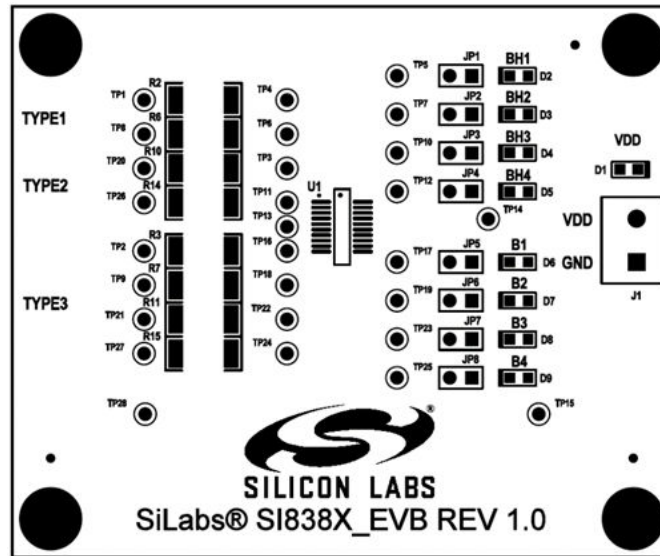

Figure 5.1. Si838xISO-EVB Schematic
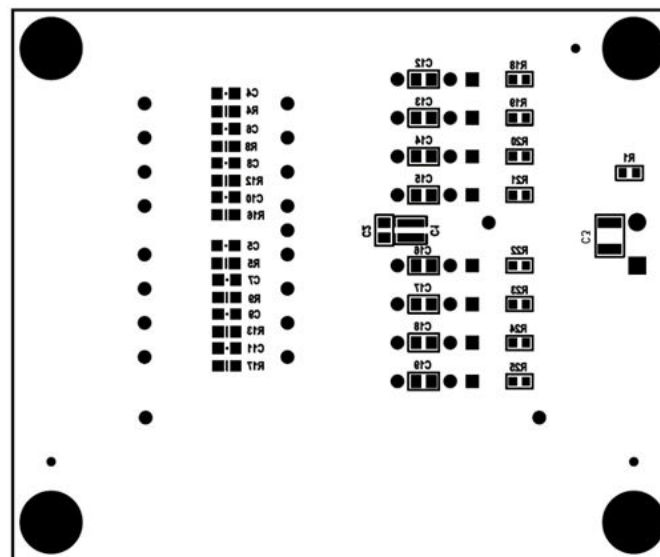
6. Layout

Figure 6.1. EVB—Top Silk

Figure 6.2. EVB—Bottom Silk
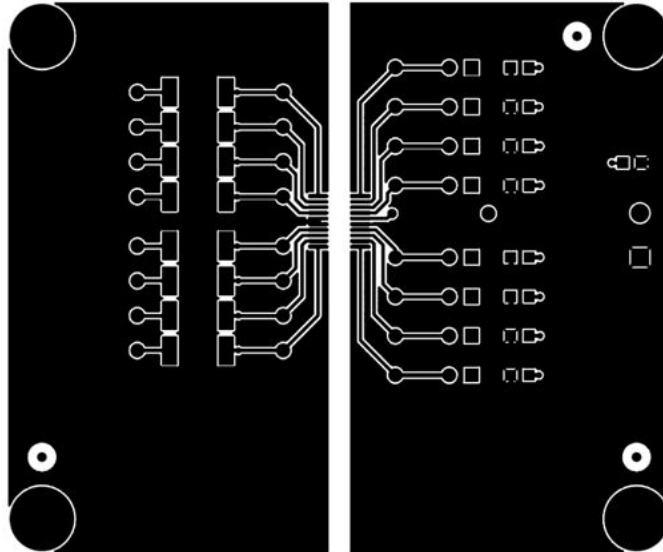
Figure 6.3. EVB─Top Copper
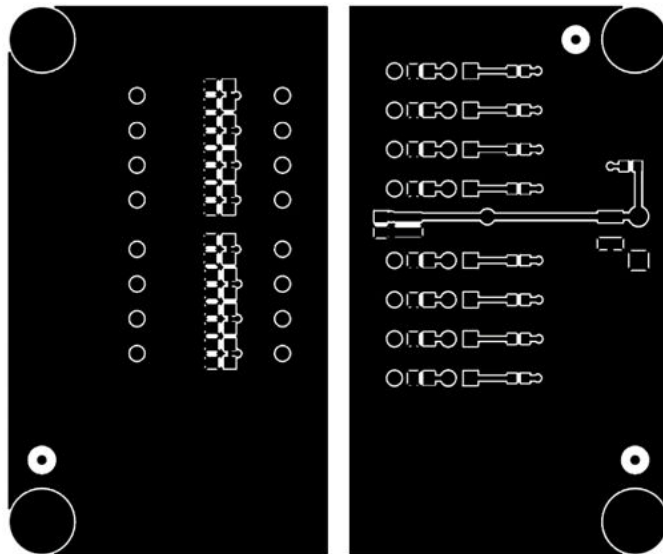
Figure 6.4. EVB─Bottom Copper

7. Bill of Materials

Item	Qty	Reference	Value	Rating	Volts	Tol.	Type	PCB Foot-print	Mfr Part #	Mfr
2	1	C2	1 µF		50 V	±10%	X7R	C0805	CL21B105K BFNNNE	Sam-sung
3	4	C4, C6, C8, C10	2.2 nF		50 V	±10%	C0G	C0805	C0805C0G500-222K	Venkel
4	1	C3	10 µF		50 V	±20%	X7R	C1210	C1210X7R500-106M	Venkel
5	1	D1	RED	25 mA	1.9 V		SMT, ChipLED	LED-HSMX-C170	HSMC-C170	Avago
6	8	D2, D3, D4, D5, D6, D7, D8, D9	Amber	25 mA	1.9 V		SMT, ChipLED	LED-HSMX-C170	HSMA-C170	Avago
7	1	J1	CONN TRBLK 2				TERM BLK	CONN-1X2-TB	1729018	Phoe-nix
8	8	JP1, JP2, JP3, JP4, JP5, JP6, JP7, JP8	Jumper				Header	CONN1X2	TSW-102-07-T-S	Sam-tec
9	1	JS1	Jumper Shunt	Place over JP1			Shunt	N/A| SHUNT	SNT-100-BK-T	Sam-tec
10	1	LB1	OPN: Si838xI-SO-EVB	Place by SL			POLYI-MIDE, WHITE	PTL-14-477	LABEL-Si838xISO-EVB	Silabs
11	4	MH1, MH2, MH3, MH4	4–40				HDW	MH-125 NP| MH-125	NSS-4-4-01	Richco Plastic
12	1	PCB1	Si838x EVB REV 1.0				BARE PCB	N/A	Si838x EVB REV 1.0	SiLabs
13	9	R1, R18, R19, R20, R21, R22, R23, R24, R25	1 kΩ	1/16 W		±1%	Thick-Film	R0603	CR0603-16W-1001F	Venkel
14	2	R10, R14	1.5 kΩ	1 W		±1%	Thick-Film	R2512	CR2512-1W-1501F	Venkel
15	2	R12, R16	390 Ω	1/8 W		±0.1%	±25PPM	R0805	TFCR0805-8W-E-3900B	Venkel
16	2	R2, R6	6.2 kΩ	1 W		±1%	Thick-Film	R2512	CR2512-1W-6201F	Venkel
17	4	R3, R7, R11, R15	2.7 kΩ	1 W		±1%	Thick-Film	R2512	CR2512-1W-2701F	Venkel
18	2	R4, R8	2.4 kΩ	1/8 W		±0.1%	±25PPM	R0805	TFCR0805-8W-E-2401B	Venkel
19	4	R5, R9, R13, R17	750 Ω	1/8 W		±0.1%	±25PPM	R0805	TFCR0805-8W-E-7500B	Venkel

Item	Qty	Reference	Value	Rating	Volts	Tol.	Type	PCB Foot-print	Mfr Part #	Mfr
20	4	SO1, SO2, SO3, SO4	Standoff				HDW		1902D	Key-stone
21	28	TP1, TP2,TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13,TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28	White				Loop	TEST-POINT	151-201-RC	Kobi-conn
22	1	U1	Si8384P-IU				QSOP	SOP20N6.0P0.635	Si8384P-IU	Silicon Labs

Not Installed Components

NI	Qty	Reference	Value	Rating	Volts	Tol.	Type	PCB Footprint	Mfr Part #	Mfr
NI	12	C5, C7, C9, C11, C12, C13, C14, C15, C16, C17, C18, C19	200 pF		50 V	±10%	C0G	C0805	C0805C0G500-201K	Ven-kel

8. Ordering Guide

Ordering Part Number (OPN)	Description
Si838x-KIT	Si8384P 8 Channel PLC Input Isolator Evaluation Kit
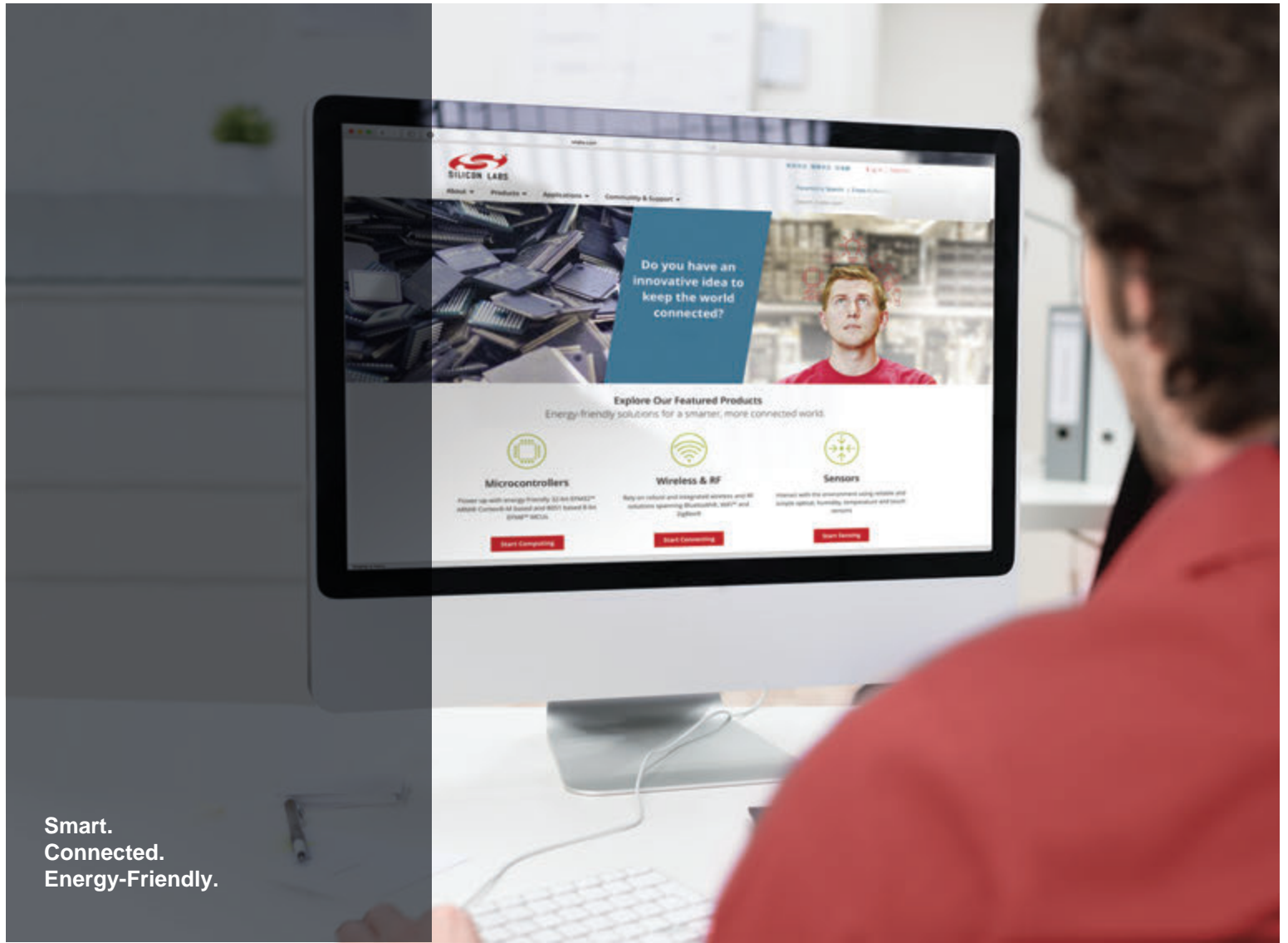
Smart.
Connected.
Energy-Friendly.

Products	Quality	Support and Community
www.silabs.com/products	www.silabs.com/quality	community.silabs.com
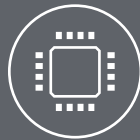
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