

## EVALUATION BOARD FOR Si5020 SiPHY™ MULTI-RATE SONET/SDH CLOCK AND DATA RECOVERY IC

### Description

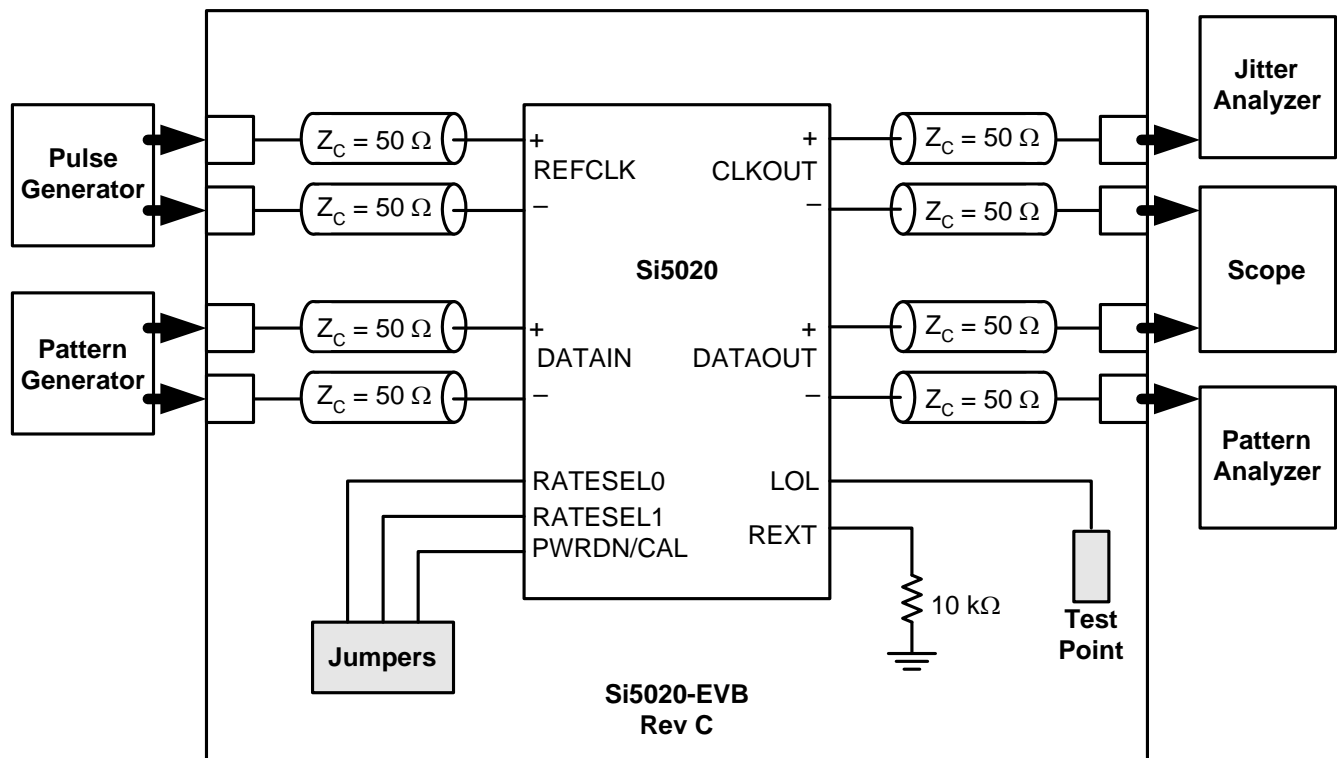
The Si5020 evaluation board provides a platform for testing and characterizing Silicon Laboratories' Si5020 SiPHY™ multi-rate SONET/SDH clock and data recovery IC. The Si5020 CDR supports OC-48/12/3, STM-16/4/1, Gigabit Ethernet, and 2.7 Gbps FEC rates.

All high-speed I/Os are AC coupled to ease interfacing to industry standard test equipment.

### Features

- Single 2.5 V power supply
- Differential I/Os ac coupled
- Simple jumper configuration

### Function Block Diagram



# Si5020-EVB

## Functional Description

The evaluation board simplifies characterization of the Si5020 Clock and Data Recovery (CDR) device by providing access to all of the Si5020 I/Os. Device performance can be evaluated by following the Test Configuration section below. Specific performance metrics include jitter tolerance, jitter generation, and jitter transfer.

### Power Supply

The evaluation board requires one 2.5 V supply. Supply filtering is placed on the board to filter typical system noise components, however, initial performance testing should use a linear supply capable of supplying 2.5 V  $\pm 5\%$  dc.

**CAUTION:** The evaluation board is designed so that the body of the SMA jacks and GND are shorted. Care must be taken when powering the PCB at potentials other than GND at 0.0 V and VDD at 2.5 V relative to chassis GND.

### Self-Calibration

The Si5020 device provides an internal self-calibration function that optimizes the loop gain parameters within the internal DSPLL™. Self-calibration is initiated by a high-to-low transition of the PWRDN/CAL signal while a valid reference clock is supplied to the REFCLK input. On the Si5020-EVB board, a voltage detector IC is utilized to initiate self-calibration. The voltage detector drives the PWRDN/CAL signal low after the supply voltage has reached a specific voltage level. This circuit is described in Silicon Laboratories application note AN42. On the Si5020-EVB, the PWRDN/CAL signal is also accessible via a jumper located in the lower left-hand corner of the evaluation board. PWRDN/CAL is wired to the signal post adjacent to the 2.5 V post.

### Device Powerdown

The CDR can be powered down via the PWRDN/CAL signal. When asserted the evaluation board will draw minimal current. PWRDN/CAL is controlled via one jumper located in the lower left-hand corner of the evaluation board. PWRDN/CAL is wired to the signal post adjacent to the 2.5 V post.

### CLKOUT, DATAOUT, DATAIN

These high-speed I/Os are wired to the board perimeter on 30 mil (0.030 inch) 50  $\Omega$  microstrip lines to the end-launch SMA jacks as labeled on the PCB. These I/Os are AC coupled to simplify direct connection to a wide array of standard test hardware. Because each of these signals are differential both the positive (+) and negative (–) terminals must be terminated to 50  $\Omega$ . Terminating only one side will adversely degrade the performance of the CDR. The inputs are terminated on the die with 50  $\Omega$  resistors.

To improve the DATAOUT eye-diagram, short 100  $\Omega$  transmission line segments precede the 50  $\Omega$  high-speed traces. These segments increase the interface bandwidth from the chip to the 50  $\Omega$  traces and reduce data inter-symbol-interference. Please refer to Silicon Laboratories application note AN43 for more details.

**Note:** The 50  $\Omega$  termination is for each terminal/side of a differential signal, thus the differential termination is actually 50  $\Omega$  + 50  $\Omega$  = 100  $\Omega$ .

### REFCLK

REFCLK is used to center the frequency of the DSPLL™ so that the device can lock to the data. Ideally the REFCLK frequency should be 1/128th, 1/32nd, or 1/16th the VCO frequency and must have a frequency accuracy of  $\pm 100$  PPM. Internally, the CDR automatically recognizes the REFCLK frequency within one of these three frequency ranges. Typical REFCLK frequencies are given in Table 1. REFCLK is AC coupled to the SMA jacks located on the top side of the evaluation board.

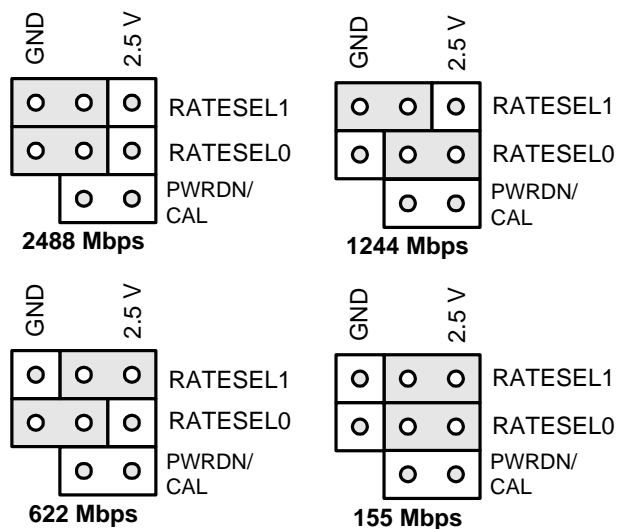
**Table 1. Typical REFCLK Frequencies**

SONET/SDH	Gigabit Ethernet	SONET/SDH with 15/14 FEC	Ratio of VCO to REFCLK
19.44 MHz	19.53 MHz	20.83 MHz	128
77.76 MHz	78.125 MHz	83.31 MHz	32
155.52 MHz	156.25 MHz	166.63 MHz	16

### RATESEL

RATESEL is used to configure the CDR to recover clock and data at different data rates. RATESEL is a two bit binary input that is controlled via two jumpers located in the lower left-hand corner of the evaluation board. RATESEL0/1 are wired to the center posts (signal post) between 2.5 V and GND. For example, the OC-48 data rate is selected by jumping RATESEL0 to 0.0 V and RATESEL1 to 0.0 V.

The table given on the evaluation board lists approximate data rates for the jumper configurations shown in Figure 1. Applications with data rates within  $\pm 7\%$  of the given data rate are also accommodated.



**Figure 1. RATESEL Jumper Configurations**

### Loss-of-Lock (LOL)

LOL is an indicator of the relative frequency between the data and the REFCLK. LOL will assert when the frequency difference is greater than  $\pm 600$  PPM. In order to prevent LOL from de-asserting prematurely, there is hysteresis in returning from the out-of-lock condition. LOL will be de-asserted when the frequency difference is less than  $\pm 300$  PPM.

LOL is wired to a test point which is located on the upper right-hand side of the evaluation board.

### Test Configuration

The three critical tests that are typically performed on a CDR device are jitter transfer, jitter tolerance, and jitter generation. By connecting the Si5020 Evaluation Board as shown in Figure 2, all three measurements can be easily made.

REFCLK should be within  $\pm 100$  PPM of the frequency selected from Table 1. RATESEL must be configured to match the desired data rate, and PWRDN/CAL must be unjumpered.

**Jitter Tolerance:** Referring to Figure 2, this test requires a pattern generator, a clock source (synthesizer signal source), a modulation source, a jitter analyzer, a pattern analyzer, and a pulse generator (all unconnected high-speed outputs must be terminated to  $50 \Omega$ ). During this test the Jitter Analyzer causes a modulation on the data pattern which drives the DATAIN ports of the CDR. The Bit-Error-Rate (BER) is monitored on the Pattern Analyzer. The modulation (jitter) frequency and amplitude is recorded when the BER approaches a specified threshold.

**Jitter Generation:** Referring to Figure 2, this test requires a pattern generator, a clock source (synthesizer signal source), a jitter analyzer, and a pulse generator (all unconnected high-speed outputs must be terminated to  $50 \Omega$ ). During this test, there is no modulation of the Data Clock, so the data that is sent to the CDR is jitter free. The Jitter Analyzer measures the RMS and peak-to-peak jitter on the CDR CLKOUT. Thus, any jitter measured is jitter generated by the CDR.

**Jitter Transfer:** Referring to Figure 2, this test requires a pattern generator, a clock source (synthesizer signal source), a modulation source, a jitter analyzer, and a pulse generator (all unconnected high-speed outputs must be terminated to  $50 \Omega$ ). During this test the Jitter Analyzer modulates the data pattern and data clock reference. The modulated data clock reference is compared with the CLKOUT of the CDR. Jitter on CLKOUT relative to the jitter on the data clock reference is plotted versus modulation frequency at predefined jitter amplitudes.

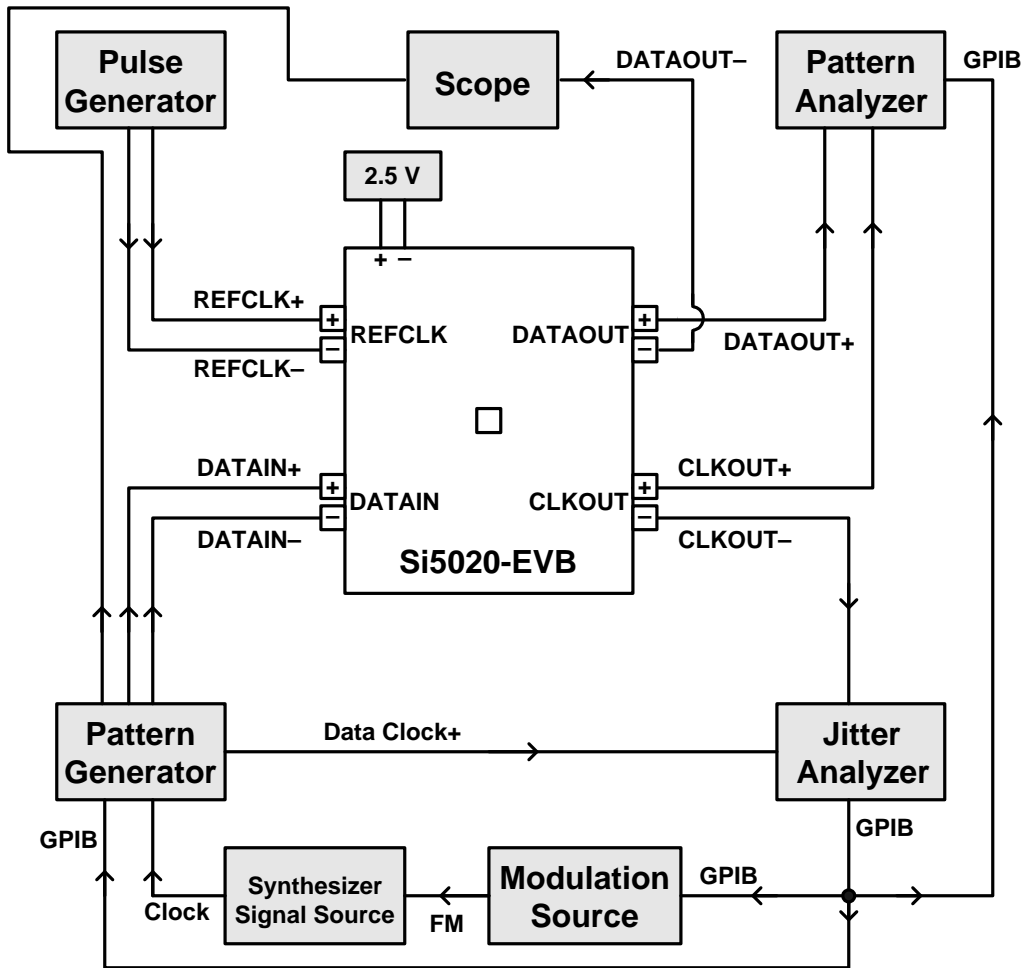


Figure 2. Test Configuration for Jitter Tolerance, Transfer, and Generation

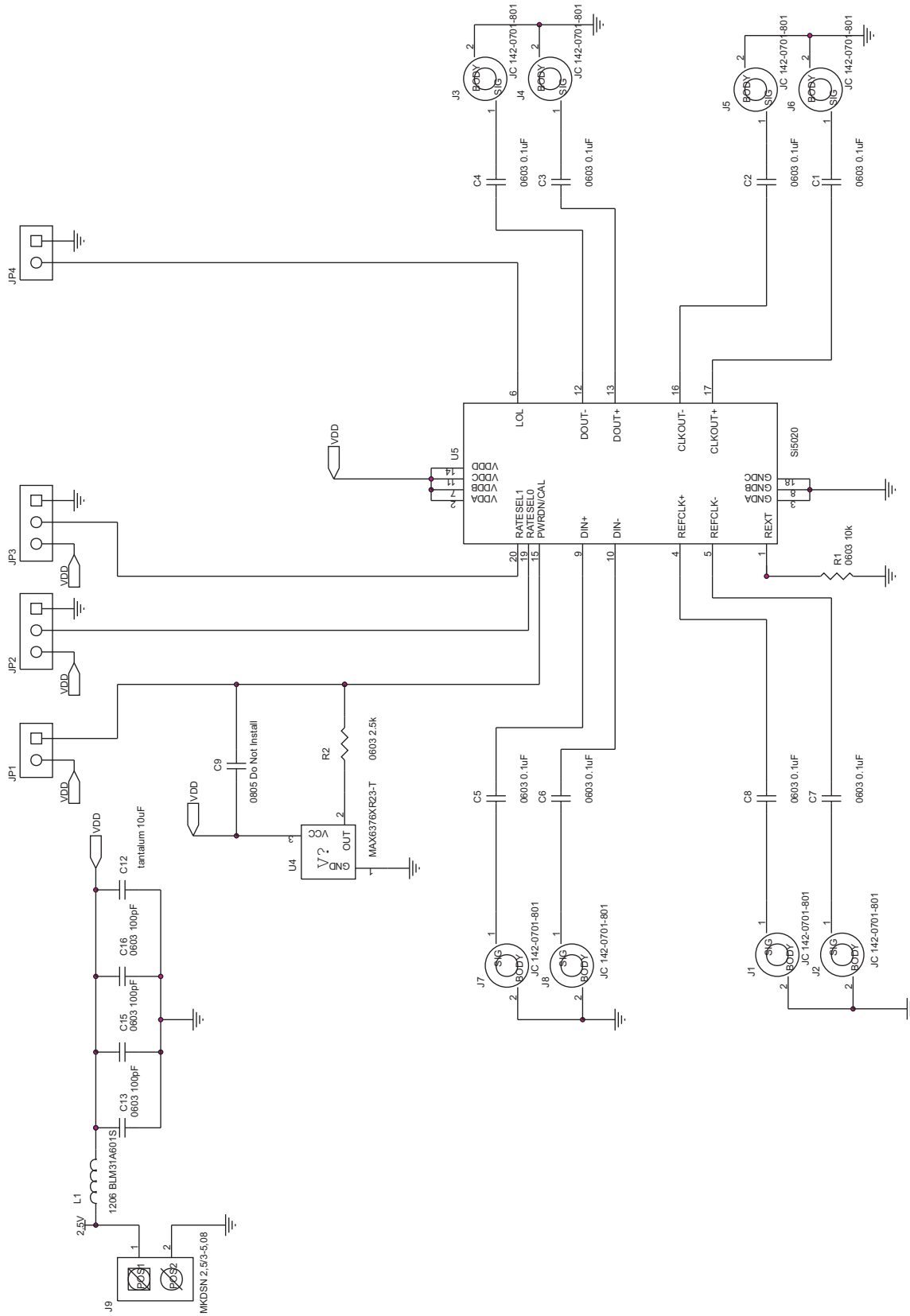


Figure 3. Si5020 Schematic

# Si5020-EVB

## Bill of Materials

Si5020EVB Assy Rev B-02 BOM			
Reference	Part Desc	Part Number	Manufacturer
C1,C2,C3,C4,C5, C6,C7,C8	CAP, SM, 0.1uF, 0603	C0603X7R160-104KNE	Venkel
C12	CAP, SM, 10 uF, TANTALUM, 3216	TA010TCM106KAR	Venkel
C13,C15,C16	CAP, SM, 100 pF, 16V, 0603	C0603C0G500101KNE	Venkel
JP1,JP4	CONNECTOR, HEADER, 2X1	2340-6111TN or 2380-6121TN	3M
JP2,JP3	CONNECTOR, HEADER, 3X1	2340-6111TN or 2380-6121TN	3M
J1,J2,J3,J4,J5,J6, J7,J8	CONNECTOR, SMA, SIDE MOUNT	901-10003	Amphenol
J9	CONNECTOR, POWER, 2 POS	1729018	Phoenix Contact
L1	RESISTOR, SM, 0 OHM, 1206	CR1206-8W-000T	Venkel
R1	RESISTOR, SM, 10K, 1%, 0603	CR0603-16W-1002FT	Venkel
R2	RESISTOR, SM, 2.55K, 1%, 0603	CR0603-16W-2551FT	Venkel
U4	MAX6376XR23-T	MAX6376XR23-T	Maxim
U5	Si5020	SI5020-BM	Silicon Laboratories
PCB	PRINTED CIRCUIT BOARD	SI5020-EVB PCB Rev C	Silicon Laboratories
<b>No Load</b>			
C9	SPARE,0805		

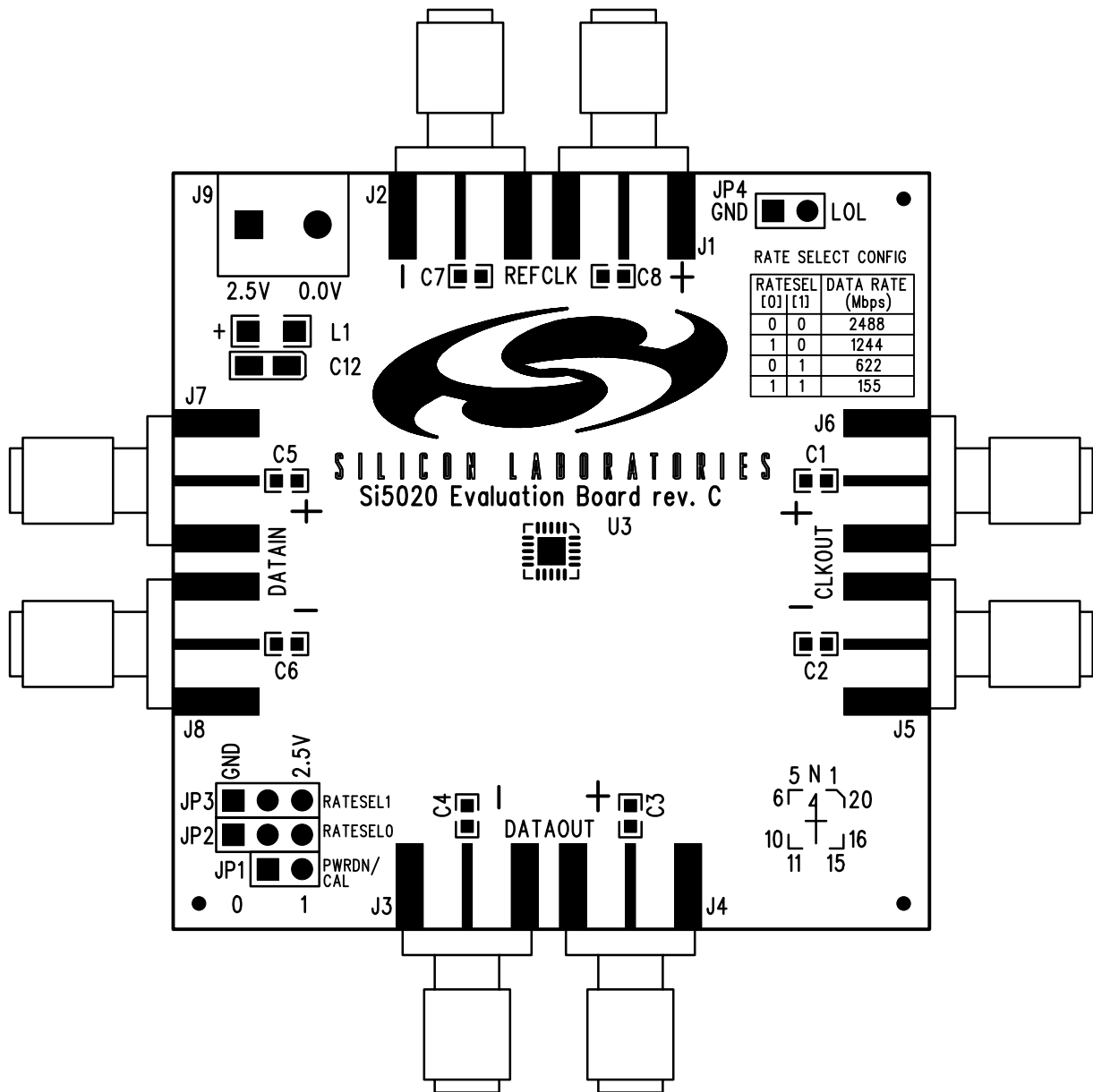


Figure 4. Si5020 Silkscreen

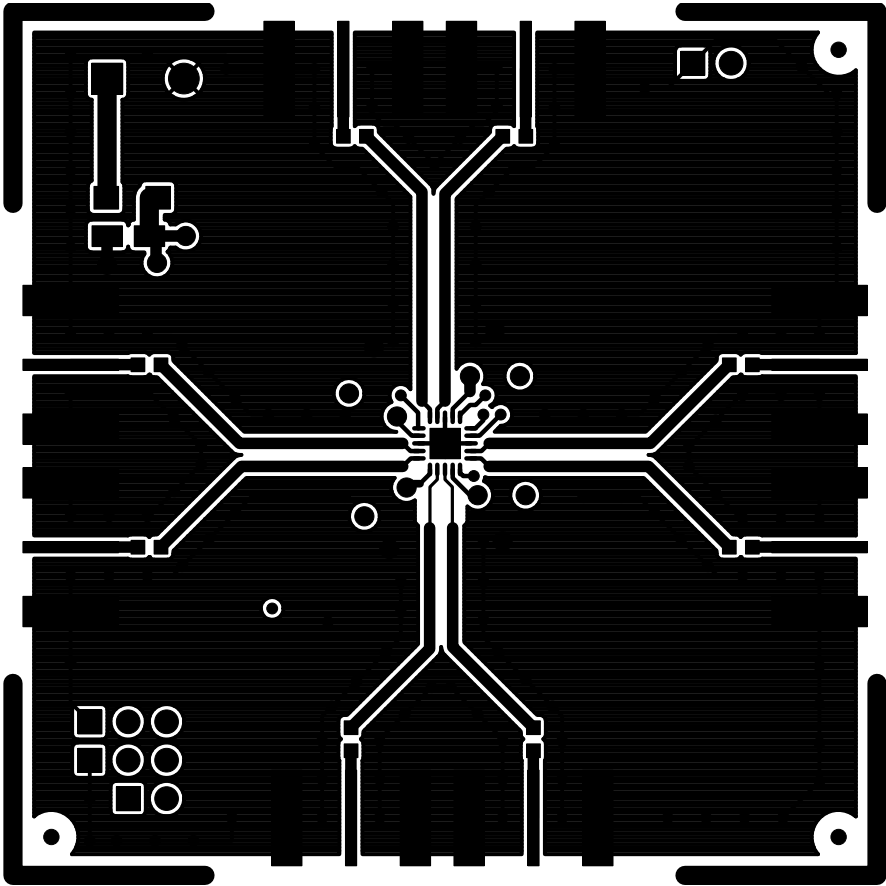


Figure 5. Si5020 Component Side



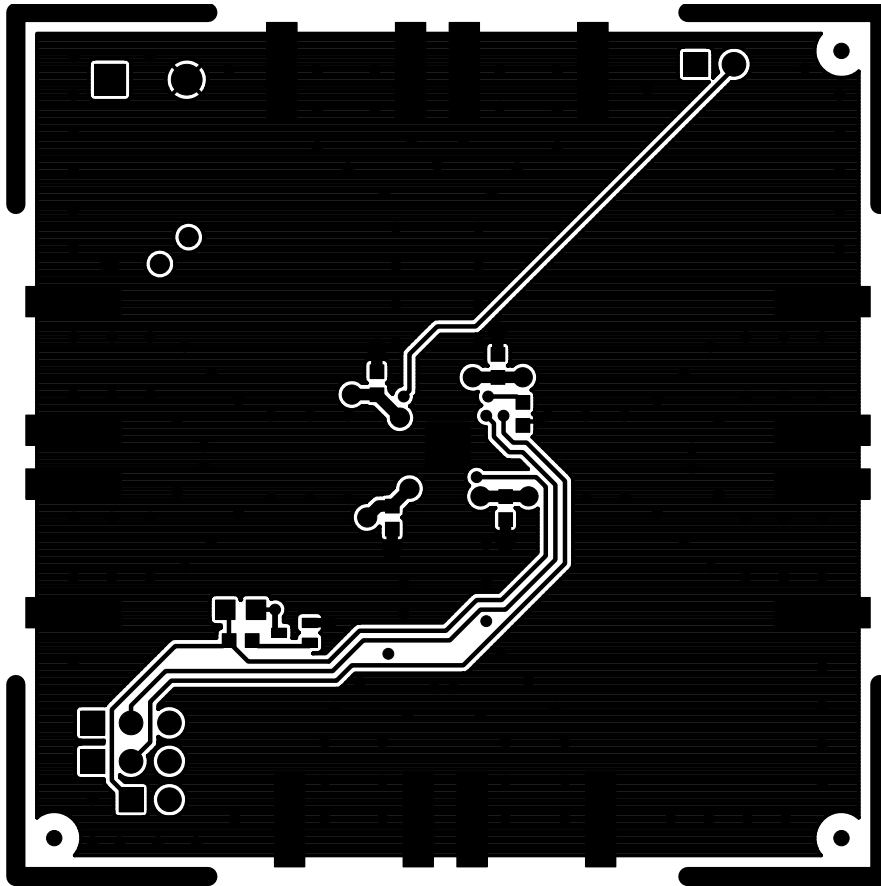


Figure 6. Si5020 Solder Side

# Si5020-EVB

---

## Document Change List

### Revision 0.41 to Revision 1.0

- “Preliminary” language removed.

## Evaluation Board Assembly Revision History

Assembly Level	PCB	Si5020 Device	Assembly Notes
A-01	A	A	Assemble per BOM rev A-01.
B-01	B	B	Assemble per BOM rev B-01.
B-02	C	B	Assemble per BOM rev B-02.

**Notes:**



## ClockBuilder Pro

One-click access to Timing tools, documentation, software, source code libraries & more. Available for Windows and iOS (CBGo only).

[www.silabs.com/CBPro](http://www.silabs.com/CBPro)



**Timing Portfolio**  
[www.silabs.com/timing](http://www.silabs.com/timing)



**SW/HW**  
[www.silabs.com/CBPro](http://www.silabs.com/CBPro)



**Quality**  
[www.silabs.com/quality](http://www.silabs.com/quality)



**Support and Community**  
[community.silabs.com](http://community.silabs.com)

### Disclaimer

Silicon Laboratories intends to provide customers with the latest, accurate, and in-depth documentation of all peripherals and modules available for system and software implementers using or intending to use the Silicon Laboratories products. Characterization data, available modules and peripherals, memory sizes and memory addresses refer to each specific device, and "Typical" parameters provided can and do vary in different applications. Application examples described herein are for illustrative purposes only. Silicon Laboratories reserves the right to make changes without further notice and limitation to product information, specifications, and descriptions herein, and does not give warranties as to the accuracy or completeness of the included information. Silicon Laboratories shall have no liability for the consequences of use of the information supplied herein. This document does not imply or express copyright licenses granted hereunder to design or fabricate any integrated circuits. The products must not be used within any Life Support System without the specific written consent of Silicon Laboratories. A "Life Support System" is any product or system intended to support or sustain life and/or health, which, if it fails, can be reasonably expected to result in significant personal injury or death. Silicon Laboratories products are generally not intended for military applications. Silicon Laboratories products shall under no circumstances be used in weapons of mass destruction including (but not limited to) nuclear, biological or chemical weapons, or missiles capable of delivering such weapons.

### Trademark Information

Silicon Laboratories Inc., Silicon Laboratories, Silicon Labs, SiLabs and the Silicon Labs logo, CMEMS®, EFM, EFM32, EFR, Energy Micro, Energy Micro logo and combinations thereof, "the world's most energy friendly microcontrollers", Ember®, EZLink®, EZMac®, EZRadio®, EZRadioPRO®, DSPLL®, ISOmodem®, Precision32®, ProSLIC®, SiPHY®, USBXpress® and others are trademarks or registered trademarks of Silicon Laboratories Inc. ARM, CORTEX, Cortex-M3 and THUMB are trademarks or registered trademarks of ARM Holdings. Keil is a registered trademark of ARM Limited. All other products or brand names mentioned herein are trademarks of their respective holders.



**SILICON LABS**

Silicon Laboratories Inc.  
400 West Cesar Chavez  
Austin, TX 78701  
USA

<http://www.silabs.com>