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FIELD PROGRAMMER USER'S GUIDE

Description


The Silicon Laboratories Si50x-FPB1-CUST kit contains the hardware and software needed for field programming the Si501/2/3/4 Single/Dual/Quad/Any-Frequency single-wire programmable CMEMS® (CMOS + MEMS) oscillators. The Field Programmer Board (FPB) can be run on a USB-equipped PC.

Features


- Field programming of Silicon Laboratories' Si501/2/3/4 CMEMS oscillators
- Windows-compatible software control and device programming

Field Programmer Software

50X – Blank Part



↓



**Si50X
Programmer Board**

50X Field Programmer - Board Serial #: si501fpb_0100_0000146b5d1d

Options Tools Reports Help Buy More Blank Parts

Enter Part Number: 501JCA27M0000DAG

Device Type: 501 | Single Frequency

Vdd | Jitter/Power | tRise/tFall (CL=15pF): 3 | 3.3V | Lower Jitter | 1.3ns

Frequency Stability: C | ±20 ppm

OE High | OE Low | Internal Resistor: A | Enable | Stop | Pull-Up

Output Frequency (MHz): 27.000000

Package: D | 2 x 2.5 mm

Revision: A | A


Operating Temperature Range: G | -40 to 85 °C

Part Number: 501JCA27M0000DAG

Buttons: Buy Now, Create Report, Create Sample & Generate OPN, Start Over, Generate OPN


SILICON LABS Si50x CMEMS® Oscillator Field Programmer www.silabs.com/cmems MEMS

⇒




501 – any configuration

⇒




502 – any configuration

⇒



503 – any configuration

⇒



504 – any configuration

Si50x-FPB1-CUST

1. Quick Start

1. Install the Si50x CMEMS® FPB Software and driver.
2. Download FPB GUI Software from www.silabs.com/Si50x-FPB1
3. Launch the Field Programmable Oscillator Software by selecting Start → All Programs → Silicon Laboratories → Si50x Field Programmer.
4. Install blank Device Under Test (DUT) to be programmed and follow the Graphical User Interface (GUI) directions.

2. Introduction

This Si50x-FPB1 User's Guide documents immediately useful information for programming blank devices (DUTs) and additional reference details in support of the Si50x-FPB1(FPB). This document also describes the operation of the Silicon Laboratories Si50x-FPB1 field programmer kit. The Si50x-FPB1 kit refers to the field programmer board hardware and software intended for field programming of the Si501, 502, 503, and 504 CMEMS oscillators. The term, "field programming" as it is used in this document refers to writing the write-once configuration registers in Non-Volatile Memory (NVM). The NVM controls the configuration of the device on powerup.

2.1. Kit Contents

The Si50x-FPB1 kit contains the following:

- Si50x Field Programmer Board
- USB Type B retractable cable
- 5 blank 2025 parts
- 5 blank 2532 parts
- 5 blank 3250 parts

Note: The FPB GUI must be downloaded from www.silabs.com/Si50x-FPB1. It is not included in the FPB Kit.

The software components run on a USB-equipped PC and are described in detail in Section "11. Software Guide". The Si50x-FPB1 field programmer board can be used to program one Si50x CMEMS oscillator at a time when installed in 1 of 4 differently sized sockets.

2.2. FPB-EVB GUI Quick Start Guide

The screenshot shows the Si50x Field Programmer GUI. The title bar reads "Si50x Field Programmer - Board Serial #: si501fpb_0100_0000146b5d1d". The menu bar includes "Options", "Tools", "Reports", "Help", and "Buy More Blank Parts". The main form contains the following fields and controls:

- Enter Part Number:** A text input field containing "503ACA000641DAG".
- Device Type:** A dropdown menu showing "503 | Quad Frequency".
- Vdd | Jitter/Power | Rise/Fall (CL=15pF):** A dropdown menu showing "A | ALL | Lower Power | 0.7ns".
- Frequency Stability:** A dropdown menu showing "C | ±20 ppm".
- Internal Resistor:** A dropdown menu showing "A | Pull-Up".
- Output Frequency #1 (Strong High) (MHz):** A text input field containing "0.032".
- Output Frequency #2 (Weak High) (MHz):** A text input field containing "20".
- Output Frequency #3 (Weak Low) (MHz):** A text input field containing "24".
- Output Frequency #4 (Strong Low) (MHz):** A text input field containing "27".
- Package:** A dropdown menu showing "D | 2 x 2.5 mm".
- Revision:** A dropdown menu showing "A | A".
- Operating Temperature Range:** A dropdown menu showing "G | -40 to 85 °C".
- Part Number:** A text input field containing "503ACA000641DAG".
- Buttons:** "Buy Now", "Create Report", "Create Sample & Generate OPN", "Start Over", and "Generate OPN".
- Visual Indicators:** A green checkmark icon and a magnifying glass icon.

Callout boxes provide the following explanations:

- Type an existing OPN here and all existing OPNs display below. Hit <enter> to deploy OPN configuration into option drop-down boxes.
- Select device : Si501/Si502/Si503/Si504. The available options change according to the selected device.
- Package selection corresponds to a specific socket shown by lighted LED.
- Revision is not selectable because there is only Rev A.
- "Part Number" will display "XXXX" until an official OPN is available. If an OPN is available, this field will display the full OPN.
- Green check indicates board is connected.
- Hit magnifying glass to see a list of all OPNs generated by the user's FPB.
- Option 1: Vdd, low power/low jitter, tr/ff
- Create report only generates the report and does not program any sample. This is available with or without an FPB board.
- Program the target device, generate an OPN and report. User must have a SiLabs.com user ID and be connected to the internet. User DOES NOT have to be connected to program the part and report, but an OPN will not be generated.
- Provides the OPN and report. Does not program a part. User must have a SiLabs.com user ID and be connected to the internet.
- Clears form.

Figure 1. Main Screen (1 of 2)

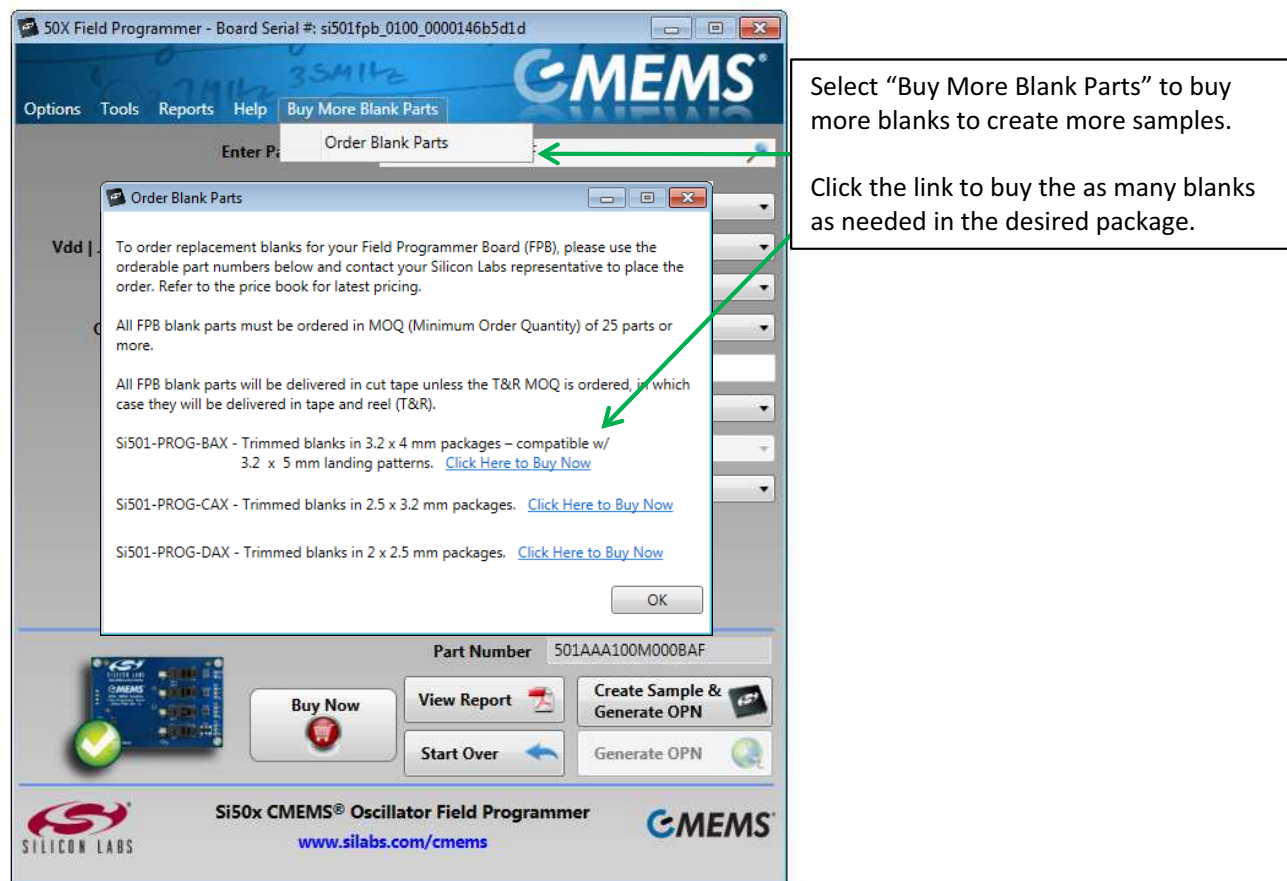


Figure 2. Buy More Blank Parts Screen

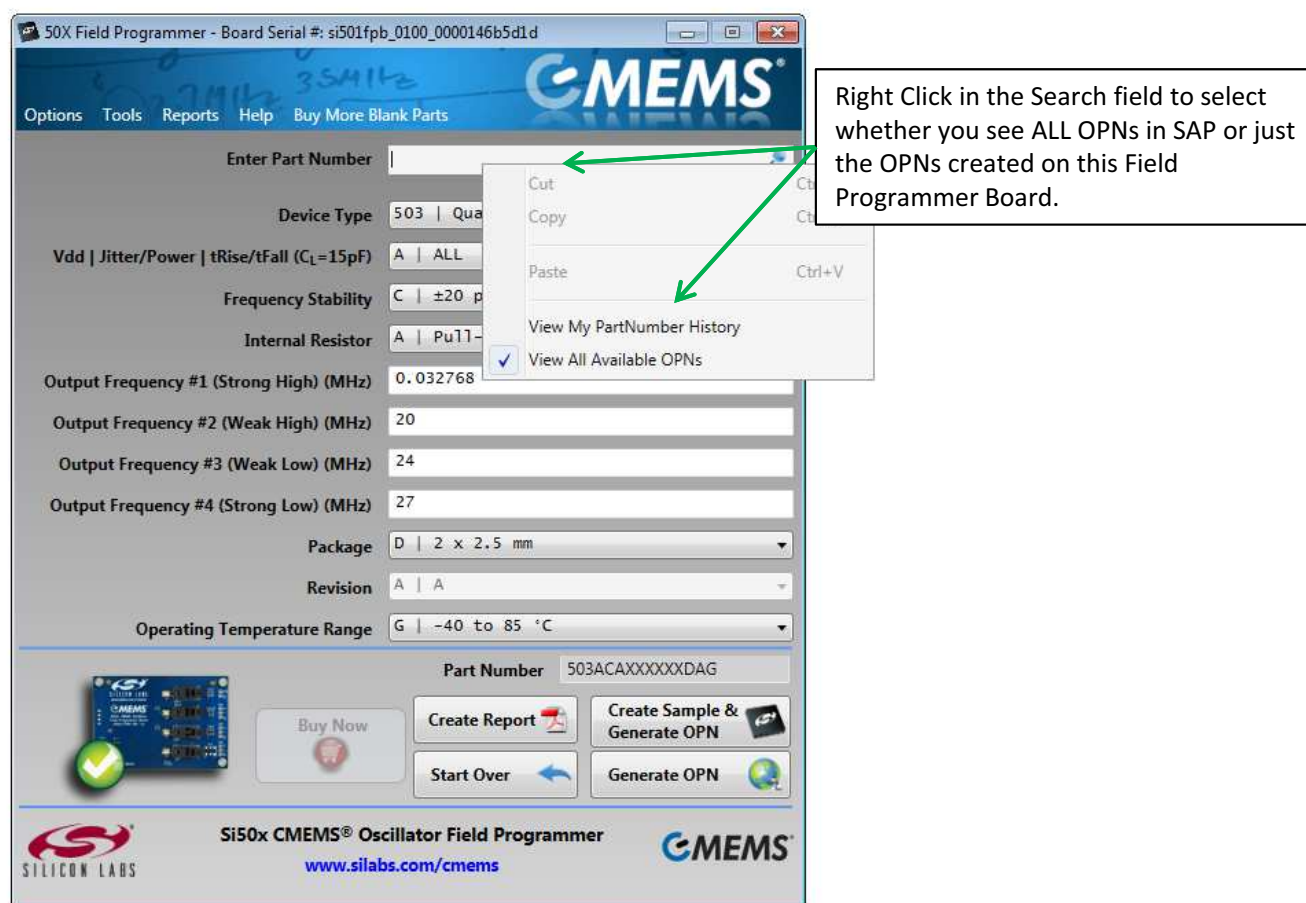


Figure 3. Main Screen (2 of 2)

50X Field Programmer - Board Serial #: si501fpb_0100_0000146b5d1d

Options Tools Reports Help Buy More Blank Parts

SILICON LABS
MEMS
Si50x MEMS Oscillator
Field Programmer Board
Si50x-FPB1-REV 1.0

LED indicates target socket for programming. An error message will display if the device is in a different socket than the one targeted.

Please place the device in the correct socket.

Back OK

* Your Company Name * Your Application

Your Personal Name

Your Title * 1000000

first.last@yourcompanyname.com 2014

* Required fields about INTENDED SAMPLE RECIPIENT

Figure 4. Programming Screen

Table 1. Drop Down Menus

| Drop Down Menu | Selection | Function |
|----------------------|---------------------------------------|--|
| Options | Exit | Exits GUI. |
| Tools | Advanced → Control Programmer Board | Allows user to enable/disable VDD and set OE High/OE Low. This is an advanced feature. |
| | Advanced → Update FW | Updates EVB FW with file saved to hard drive. New FW is included any time the GUI is updated. |
| | Submit Pending OPNs | If a user has created part configurations while not connected to the internet, they will be stored here. The GUI will also prompt the user to submit pending OPNs at launch. |
| | Generate OPN | Initiates the process to generate an OPN. |
| | Query FPB FW Version | Provides FPB MCU Firmware version. |
| Reports | View Latest Sample Report | Opens last generated report. |
| | View Part Number History | Opens a table of all part numbers generated by the FPB. The report can be exported to Excel. |
| | View All Sample Reports on Hard Drive | Opens the directory where all sample reports are stored. |
| | EVB Firmware Version | Provides the EVB FW version number. |
| Help | User's Guide | Opens the User's Guide in pdf. |
| | Device Data Sheet | Opens latest device data sheet. Later revisions of the data sheet are loaded with new GUI SW updates. |
| | Order Blank Parts | Provides the OPN for more blank parts. More parts must be ordered through Silicon Labs representatives. |
| | Check for GUI Software Update | Checks www.silabs.com for any available GUI updates. |
| | Check for FPB Firmware Update | Checks www.silabs.com for any available FW updates for the FPB MCU. |
| | About | Provides information on FPB SW and FW version numbers. |
| Buy More Blank Parts | Order more blank parts | Order more blanks samples in whatever package size is required. |

Si50x-FPB1-CUST

3. Board Views

3.1. Top Board View

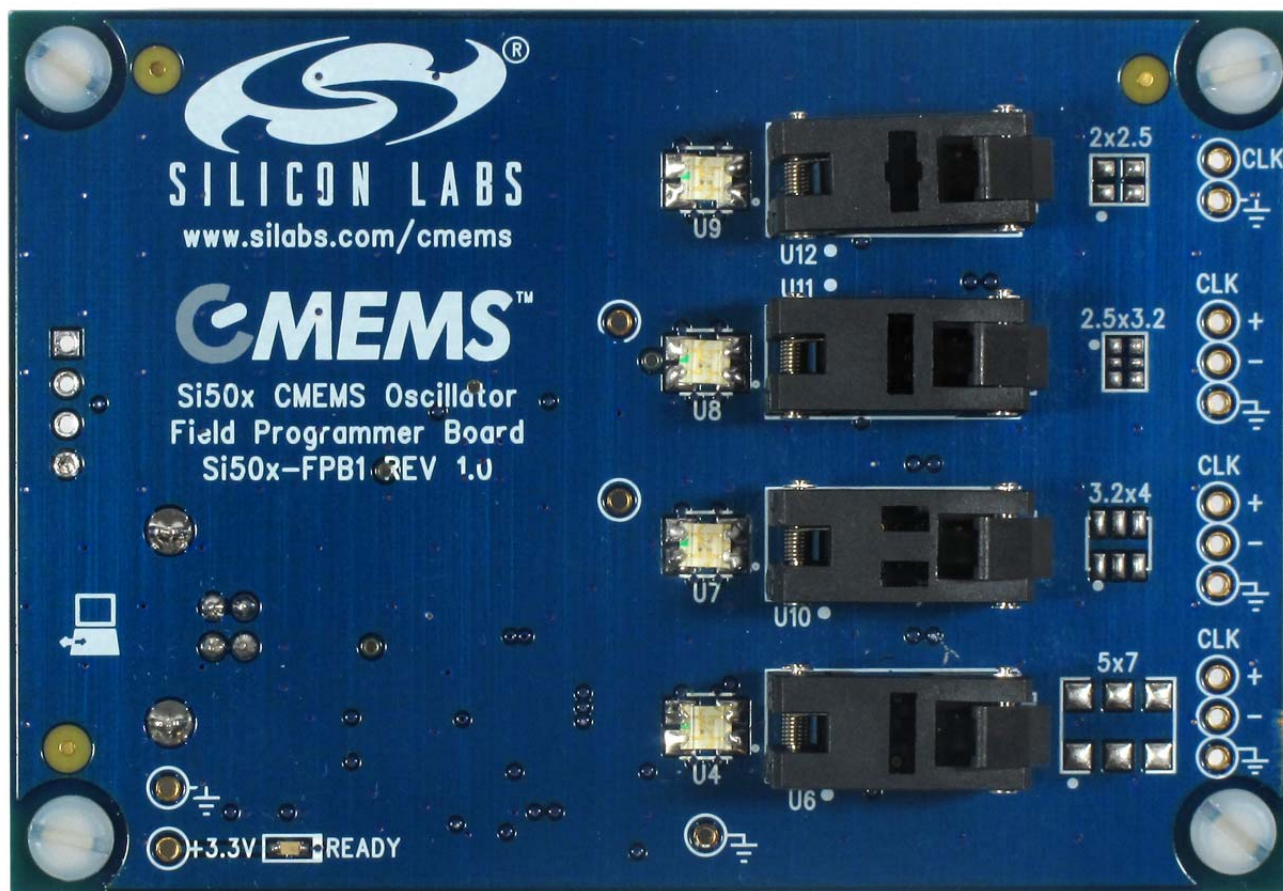


Figure 5. Top Board View

3.2. Bottom Board View

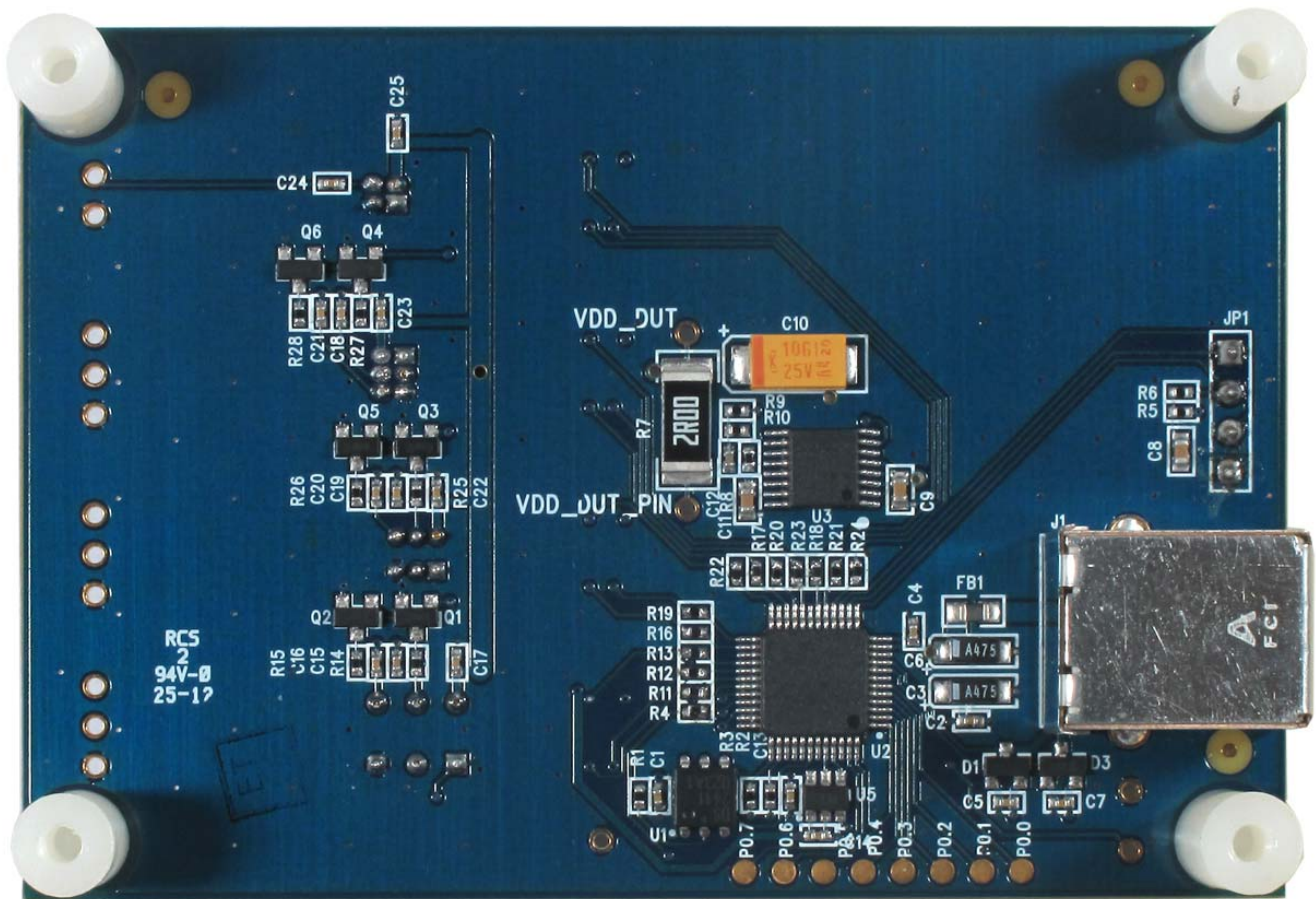


Figure 6. Bottom Board View

4. Functional Description

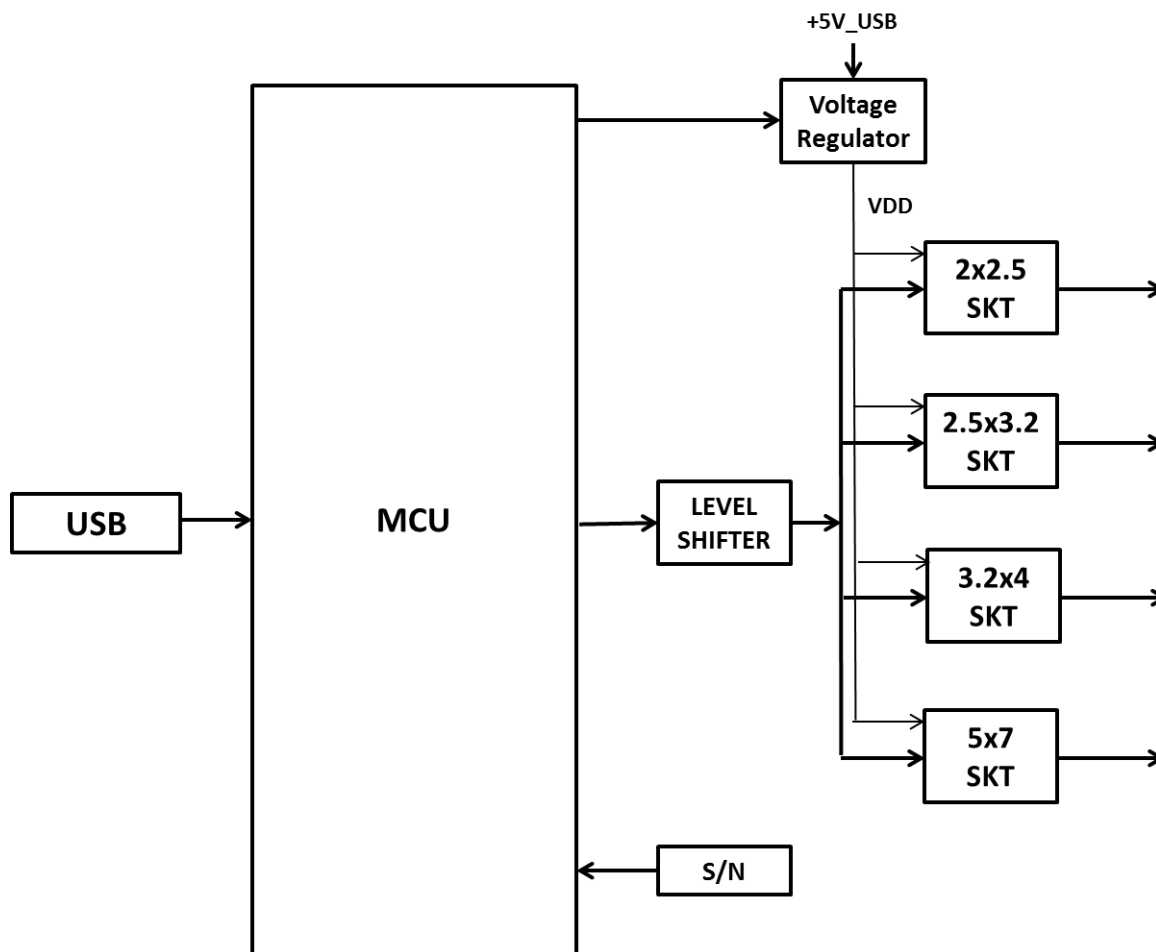


Figure 7. Block Diagram

The pages that follow provide the detailed functional description of the hardware. The FPB schematics, bill of materials, and PCB layouts are included as sections 15, 16, and 17, respectively. Figure 7 provides a block diagram for the board.

Location descriptions in this document assume the reader is viewing the board in the conventional orientation, i.e., looking down on the top side (primary side) with the silkscreen text right side up as in Figure 5.

4.1. Power Supply

The Si50x-FPB1 is pre-configured to accept +5 V from the USB connector at J1. The +5 V is filtered and routed to the MCU, the DUT VDD voltage regulator, and to each DUT's status LEDs. The output of the voltage regulator is under MCU control and yields either 3.3 V or 4.1 V. The higher voltage is used when writing to the DUT's NVM. The power supply components are mounted on the back side of the board

4.2. MCU

The Silicon Laboratories MCU, P/N C8051F380 is also mounted on the back side of the board at U 2. The MCU provides the following functions:

- Supports single-wire communication (C1) to the DUT on behalf of the host PC per the Field Programmable Oscillator Software
- Drives 3-state status indicator LEDs (see Table 3)
- Supplies 3.3 V to peripheral ICs (the serial number generator and the C1 voltage level shifter)
- Controls DUT voltage supply regulator (see Section “4.1. Power Supply”)
- Switches in pull-down near end bias resistors (reserved for future use)
- Auto-detects the board type. The firmware identifies the board type MCU via port P1.7 (pin 29). The voltage at this pin is pulled up internally on the Si50x-FPB1. (The pin is pulled down via an external resistor on the Si501/2/3/4-EVB customer evaluation board.)

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5. Device Support

The FPB has four latch-able sockets installed to support four different surface mount package sizes. These are enclosed in red in Figure 8 below. To the right of each socket is the corresponding device footprint to further guide the user as to which socket supports which size package. Note that the pin 1 location is marked in silk screen beside each package footprint. The device must be inserted into the socket in this orientation to work. Also note that some landing patterns have six pads. This is to support future differential output devices. The Si501/2/3/4 have four pins and only support single-ended LVCMOS outputs.

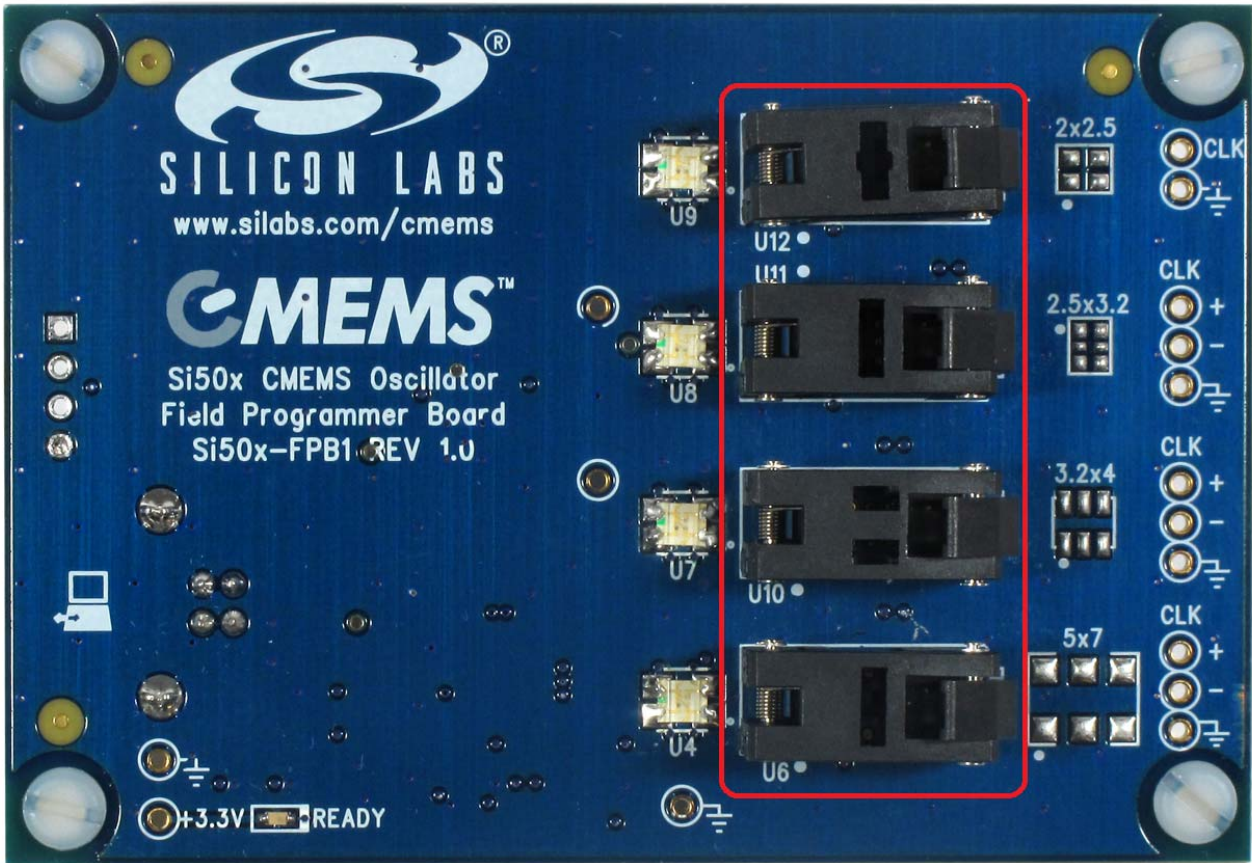


Figure 8. Socket Locations

Reference information regarding sockets and package compatibility is listed in Table 2 below. Sockets are listed in the same relative order as shown in Figure 8.

Table 2. Si50x-FPB1 Device Support

| Nominal Package Size (mm) | Socket Ref Des | # Pins | Supported Devices | Notes |
|---------------------------|----------------|--------|------------------------------|----------|
| 2x2.5 | U12 | 4 | Si501, Si502 Si503, Si504 | |
| 2.5x3.2 | U11 | 6 | | |
| 3.2x4 | U10 | | | |
| 5x7 | U6 | | N/A | Reserved |

6. USB

A 4-pin USB Type B receptacle is provided at location J1. The Si50x-FB1 is compatible with USB Specification 2.0. This connector is mounted on the back of the PC board in the lower left hand corner. The location is noted on the top side with silkscreen artwork showing an icon of a PC with bidirectional arrows. See Figure 9 below.

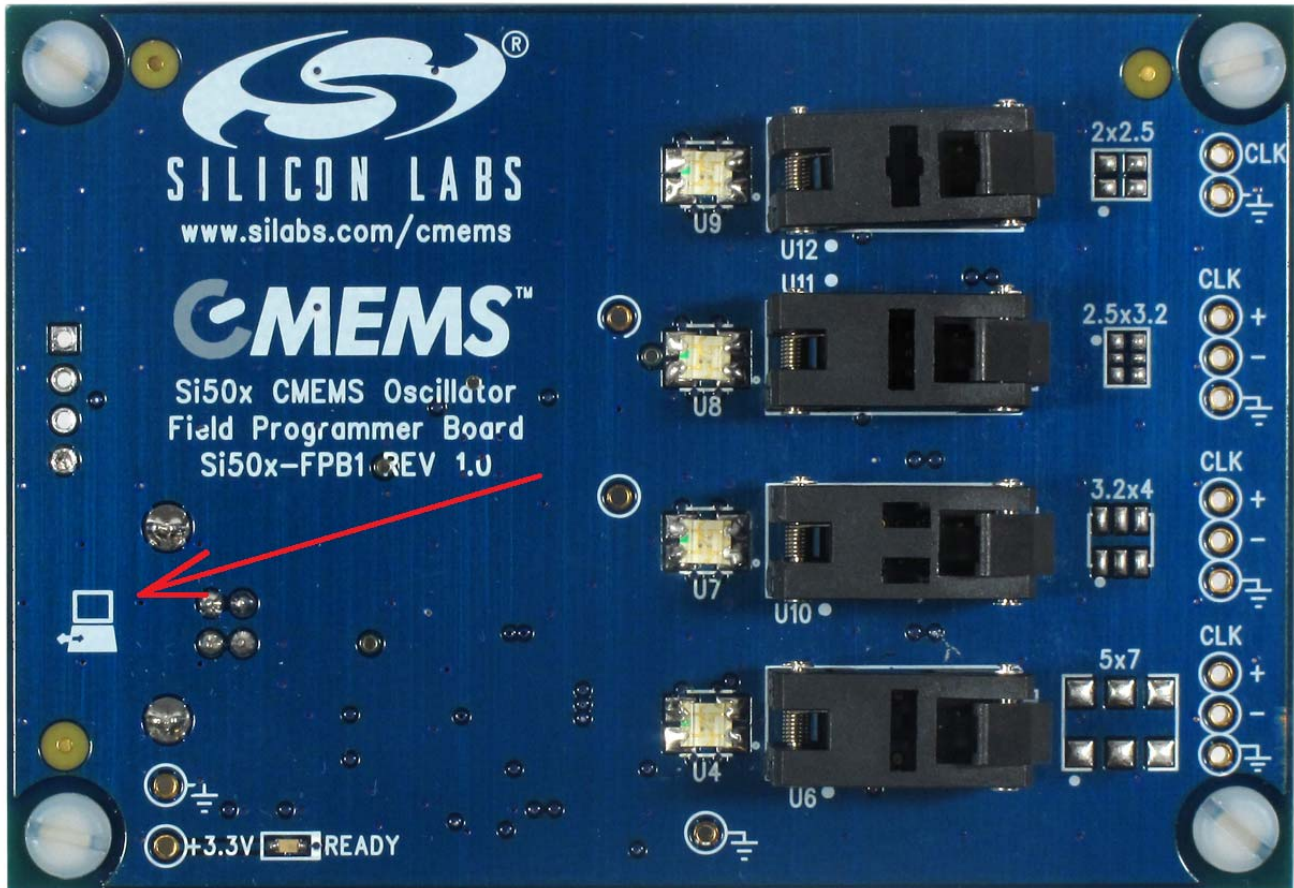


Figure 9. USB Connection Location

7. Status Signals

The five LEDs on the board are listed in Table 3. Four of these are surface mount tri-color Red, Green, Blue (RGB) LED units that report the programming status for DUTs in their respective sockets. (Note that yellow or amber is produced by mixing Red + Green light simultaneously). The location of these LEDs is noted in Figure 10.

Table 3. Si501-FPB1 LEDs

| Ref Des | Signal | Color (Status) | Notes |
|---------|----------------|---|--|
| D2 | Ready | Green | Should illuminate on USB connection (power up) |
| U4 | 5x7 Status | Green (Pass) Red (Fail) Yellow (Busy) Blue (Socket Location) | Reserved |
| U7 | 3.2x4 Status | | |
| U8 | 2.5x3.2 Status | | |
| U9 | 2x2.5 Status | | |

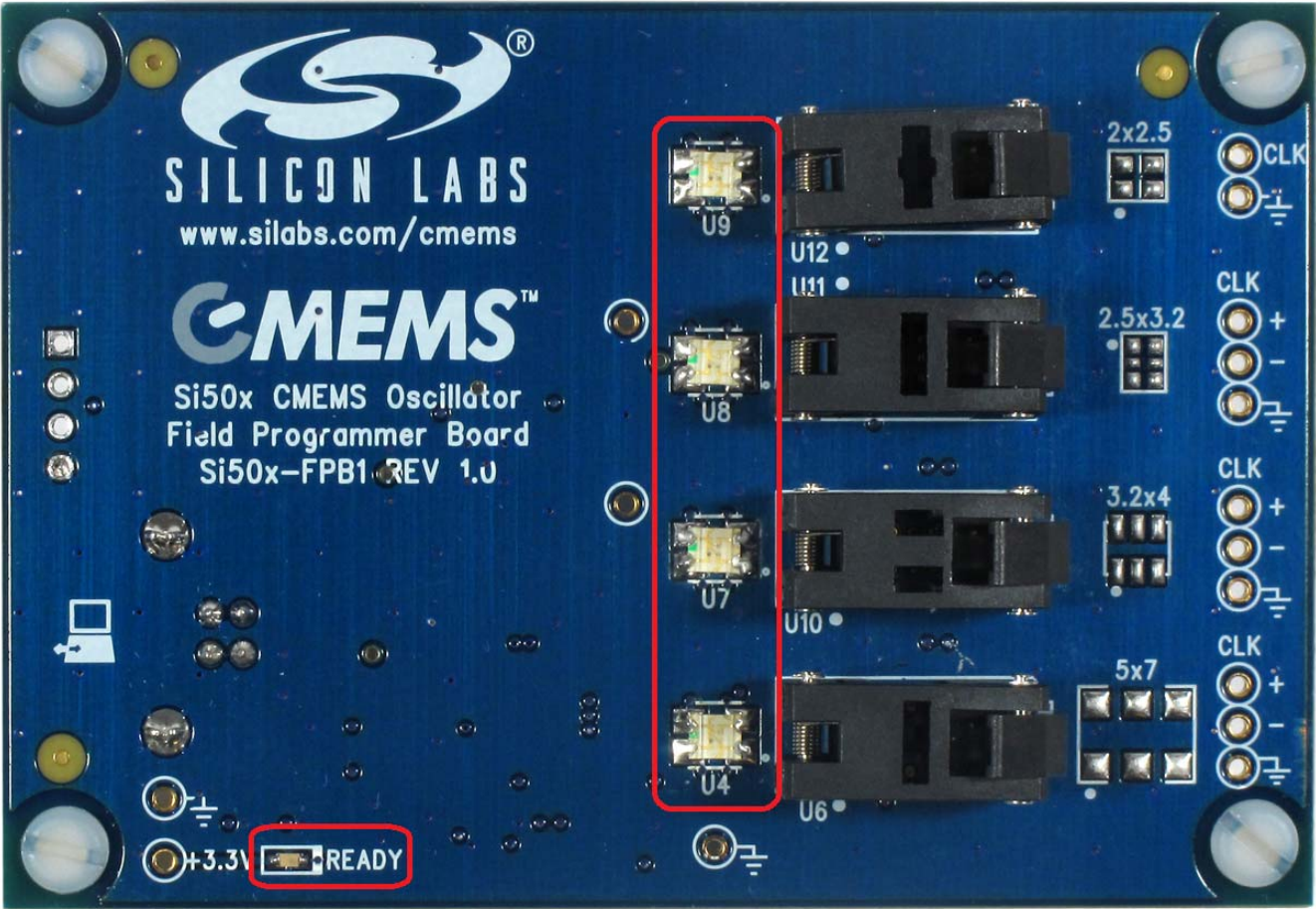


Figure 10. Si501-FPB1 LEDs

8. Current Sense Resistor

There is one current sense resistor located on the FPB designated R7 and placed between test points VDD_DUT_PIN TP15 and VDD_DUT TP16 in the center back side of the board. R7 is pointed out in the photo below. The default or pre-loaded resistor value is $2\ \Omega$. The voltage drop across this resistor may be used for calculating a DUT's current draw and power consumption.

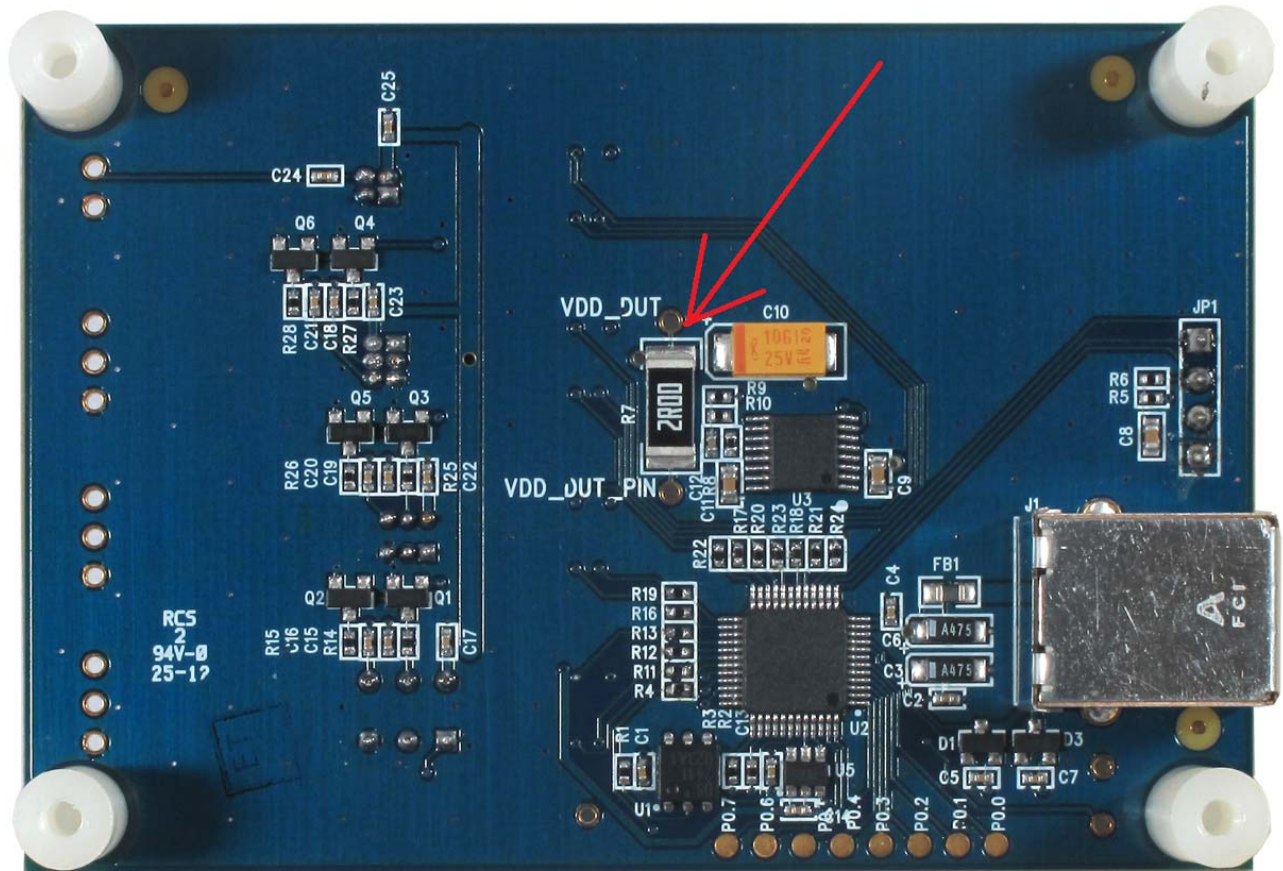


Figure 11. Current Sense Resistor Location

9. Outputs

At this time, the Si50x-FPB1 supports only single-ended format outputs on the Si501/2/3/4 CMEMS oscillator. The three 6-pin sockets will support differential outputs on future oscillator devices. Near-end bias resistors are installed to support future devices. All outputs are ac-coupled to test points on the right hand side edge of the board (see Figure 12). These output test points are also included in Table 4.

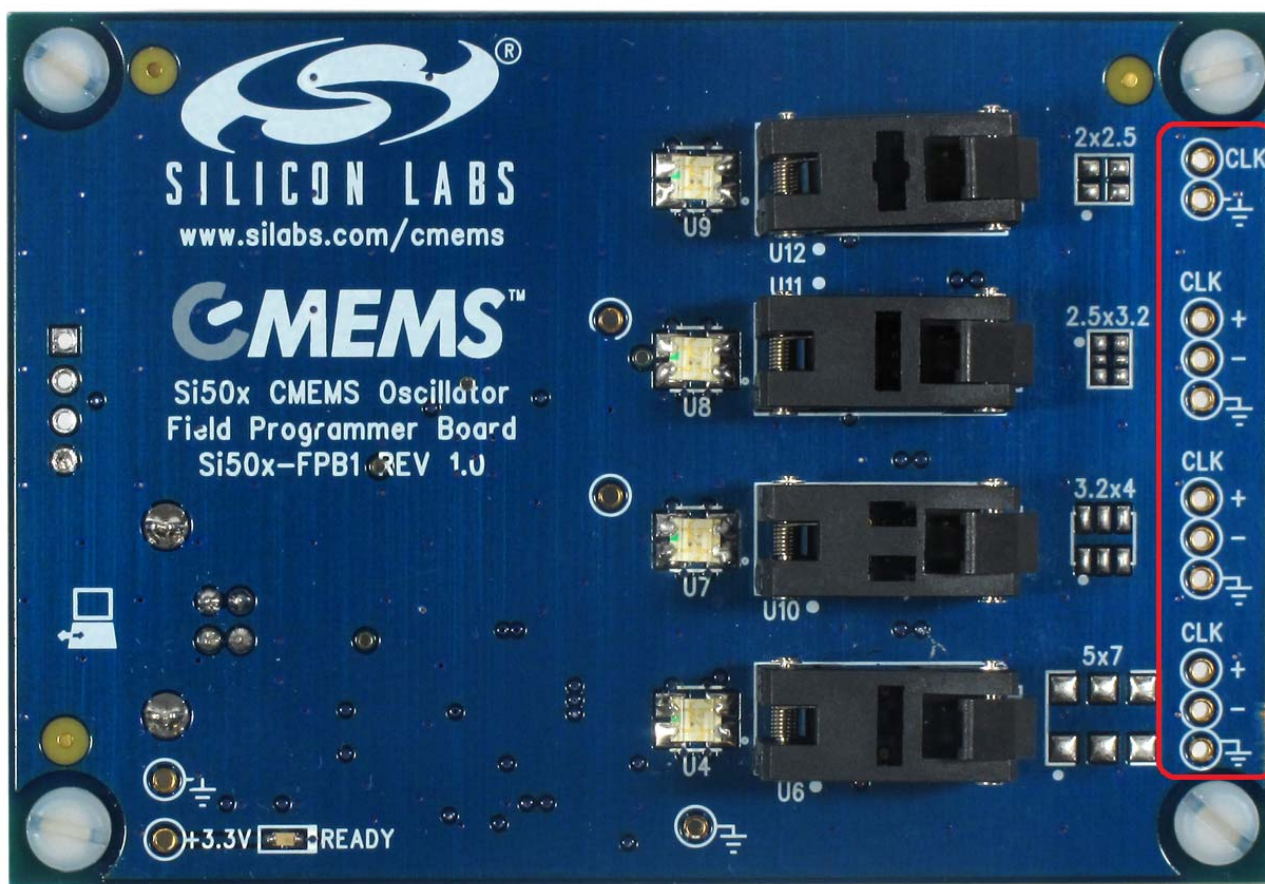


Figure 12. Output Test Points

10. Headers and Test Points

For reference purposes, all headers (JP*) and test points (TP*) are collected in Table 4. There are no headers intended for routine jumper use in the current version of the FPB. The output test points give ac-coupled access to a DUT installed in a socket. Generally, these test points are not populated. (The “NI” in the Notes column means “Not Installed”.)

Table 4. Si50x-FPB1 Headers and Testpoints

| Category | Ref Des | Signal | Notes |
|----------------|---------|--------------|------------|
| MCU | JP1 | 1-C2D | Header 4x1 |
| | | 2-C2CLK | |
| | | 3-BOOTLDR | |
| | | 4-GND | |
| Power Supplies | TP1 | 3.3V | Red Loop |
| | TP11 | GND | Black Loop |
| | TP12 | GND | Black Loop |
| | TP15 | VDD_DUT_PIN | Red Loop |
| | TP16 | VDD_DUT | Red Loop |
| Outputs | TP17 | 5x7 CLKN | NI |
| | TP18 | 5x7 CLKP | NI |
| | TP19 | 5x7 GND | NI |
| | TP20 | 3.2x4 CLK_N | NI |
| | TP21 | 2.5x3.2 CLKN | NI |
| | TP22 | 3.2x4 CLKP | NI |
| | TP23 | 2.5x3.2 CLKP | NI |
| | TP24 | 2x2.5 CLK | NI |
| | TP25 | 3.2x4 GND | NI |
| | TP26 | 2.5x3.2 GND | NI |
| | TP27 | 2x2.5 GND | NI |

11. Software Guide

Users must download the Si50x CMEMS Oscillator Software, available from the Silicon Labs website at www.silabs.com/Si50x-FPB1. This software includes a User's Guide as well. The FPB SW controls the FPB and allows the user to set all configurable parameters, program devices, and generate orderable part numbers and reports.

11.1. Configuring the Si501-FPB1

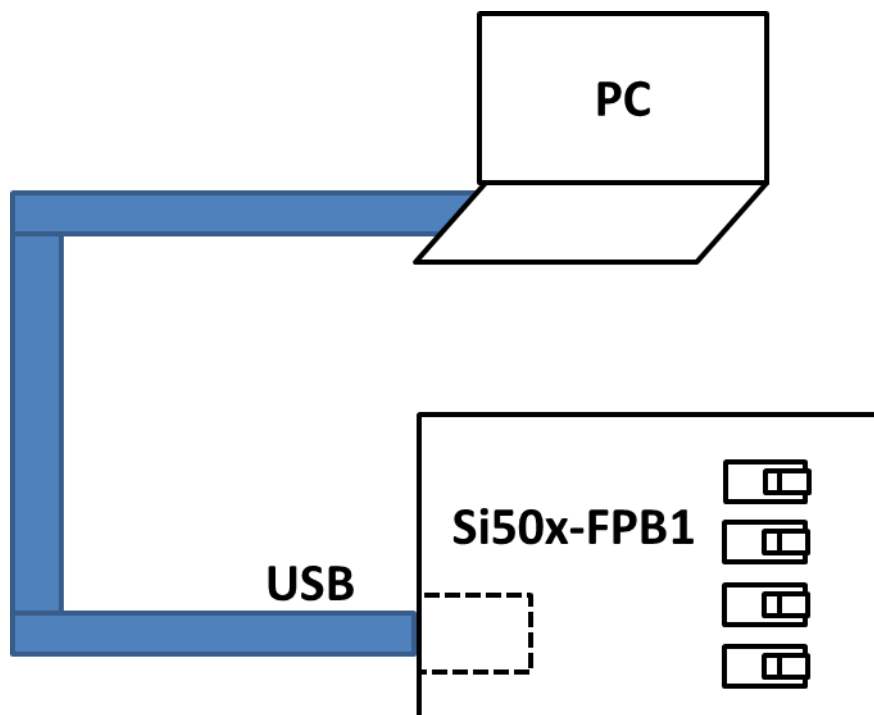


Figure 13. Si50x-FPB1 Typical Configuration

11.2. 50X Field Programmer Software Installation

The following sections describe how to install and use the 50X Field Programmer software. This software runs on a USB equipped PC to field program the NVM of Si501/2/3/4 MEMS oscillators. It can also be used to generate an OPN (Orderable Part Number). Context sensitive help windows pop up when the cursor hovers above a feature on the GUI.

There is a readme.txt file with the installation files as well as a software user guide installed with the software.

System Requirements

- Microsoft Windows® 2000, XP, Vista, 7
- USB 2.0
- 2 MB of free hard drive space
- 1024 x 768 screen resolution or greater
- Microsoft .NET Framework 4.0
- USBXpress 3.1.1 driver

Note: USBXpress 3.1.1 driver is provided and installed with the software.

11.3. Microsoft .NET Framework Installation

The Microsoft .NET Framework is required before installing and running the software. Details and installation information about the .NET Framework are available via a shortcut in the NETFramework directory or at the following web site:

<http://www.microsoft.com/en-us/download/details.aspx?id=26>

There are multiple versions of the .NET Framework available from Microsoft, and they can be installed side-by-side on the same computer. The software requires Version 4.0. Contact your system administrator for more details.

11.4. Si50x CMEMS® Field Programmer Oscillator Software Installation

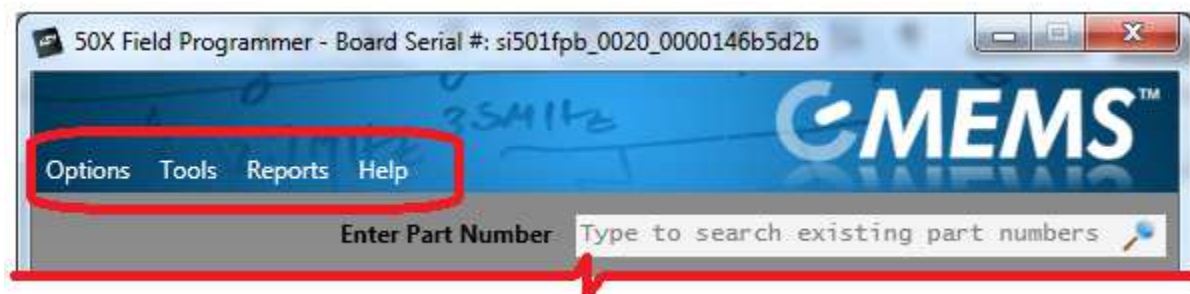
The Si50x CMEMS Oscillator Software is installed from the Si50xCMEMSSwInstall.exe file.

1. Double-click the install file to start the wizard.
2. Follow the wizard instructions to complete the installation for both the software and the driver. Use the default installation location for best results.
3. After the installation is complete, click on Start → Programs → Silicon Laboratories → Si50x CMEMS Oscillator Software. Select one of the items in the menu including the User Guide to get more details on how to run the software.

Si50x-FPB1-CUST

12. Si50x CMEMS® Field Programmer Oscillator Software Overview

The FPB software supports specifying a configuration and then creating a sample or generating an Orderable Part Number or OPN. The main menus appear at the top as shown in the red rounded rectangle in the GUI excerpt below.



The top level menus and their pull-down functions are listed in Table 1, “Drop Down Menus,” on page 7.

13. Basic Operating Instructions

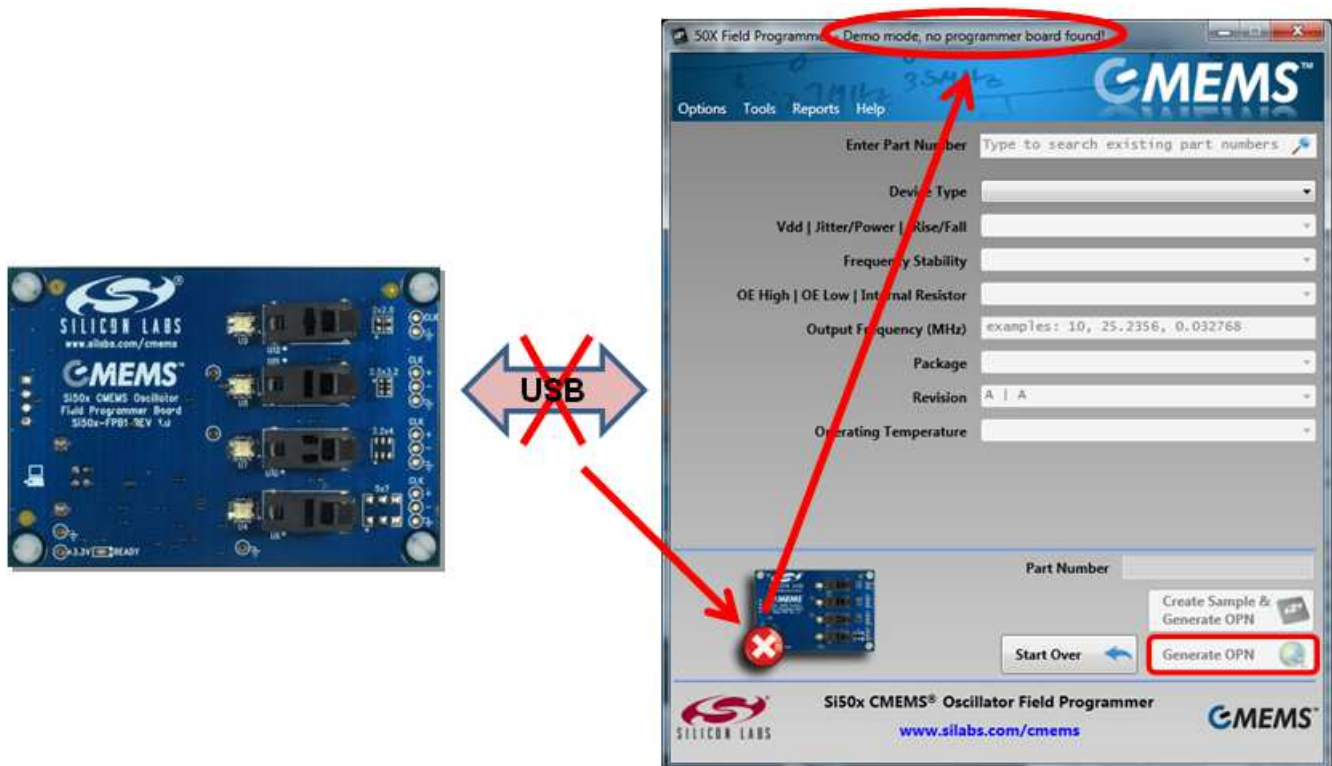
Basic operating instructions are illustrated in the following section based on a step by step example session.

1. Connect the Field Programmer Board by USB

Once the GUI software is installed, the Field Programmer Board must be connected to any available USB port on the PC hosting the GUI software.

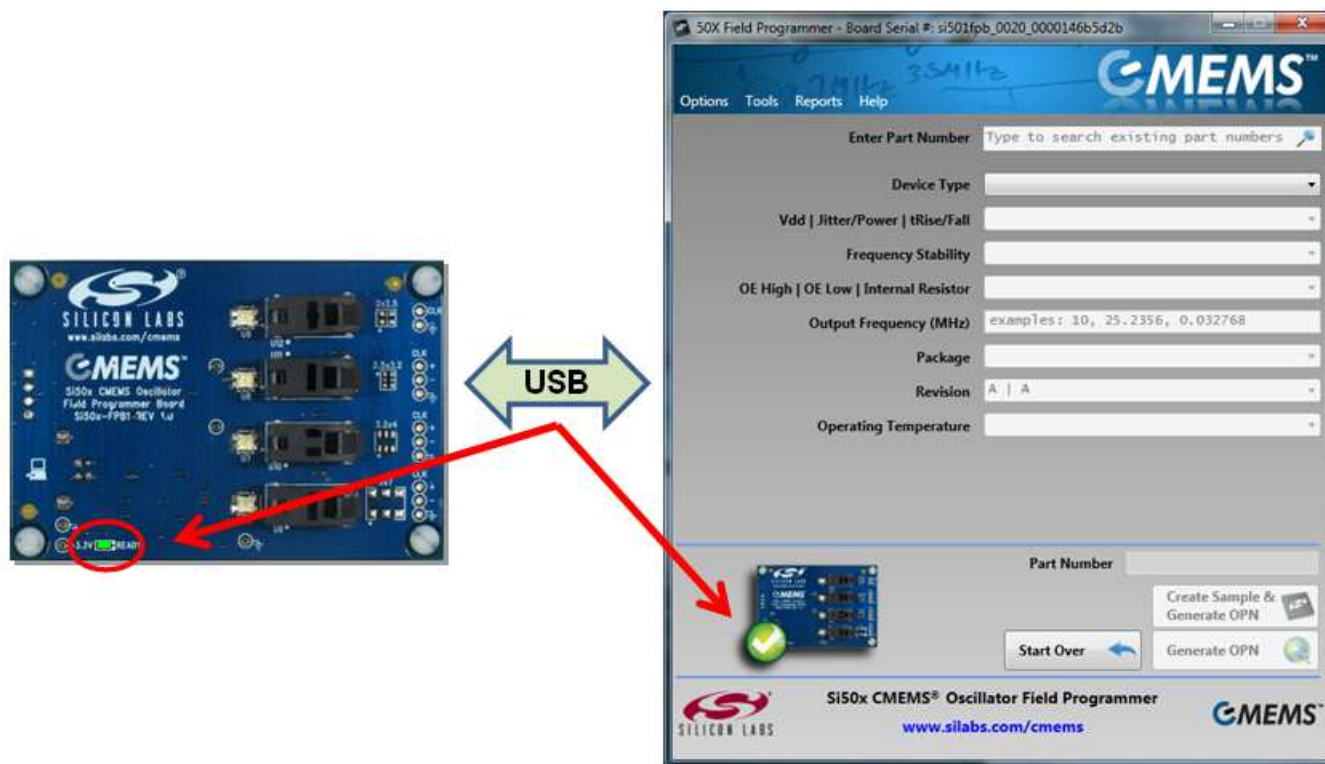
If the USB connection is broken or not functional, a red indicator on the GUI will be displayed. The top banner of the window will also indicate “no programmer found”.

If this error occurs unexpectedly, verify that your USB port is operational and/or the GUI software and USB driver is properly installed.



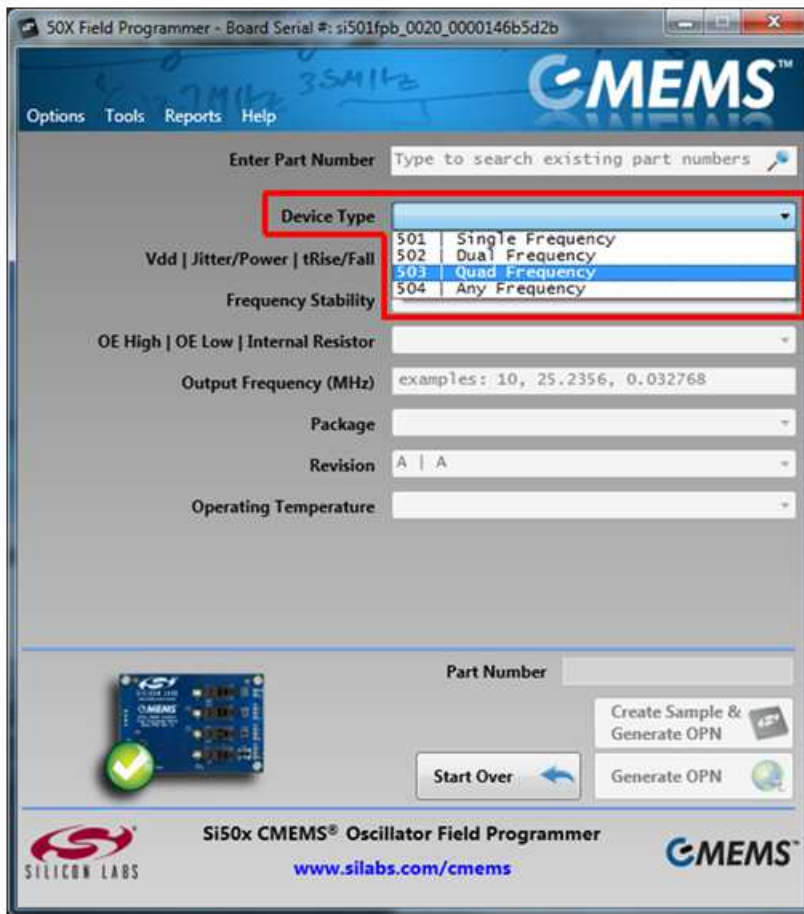
Si50x-FPB1-CUST

When the USB connection is operating, the indicator turns green and a green “Ready” LED will illuminate on the Field Programmer Board. We can now move on to selecting the target device and options.



2. Select Device Type

It is recommended that option parameters are selected starting from the top with “Device Type” and proceeding sequentially downward. Pull down selections are available for most options. In this example, we select the Si503 as our target device. The Si503 allows for the selection of four programmed frequencies controlled by external pull-up and pull-down resistors at the FS/OE pin.

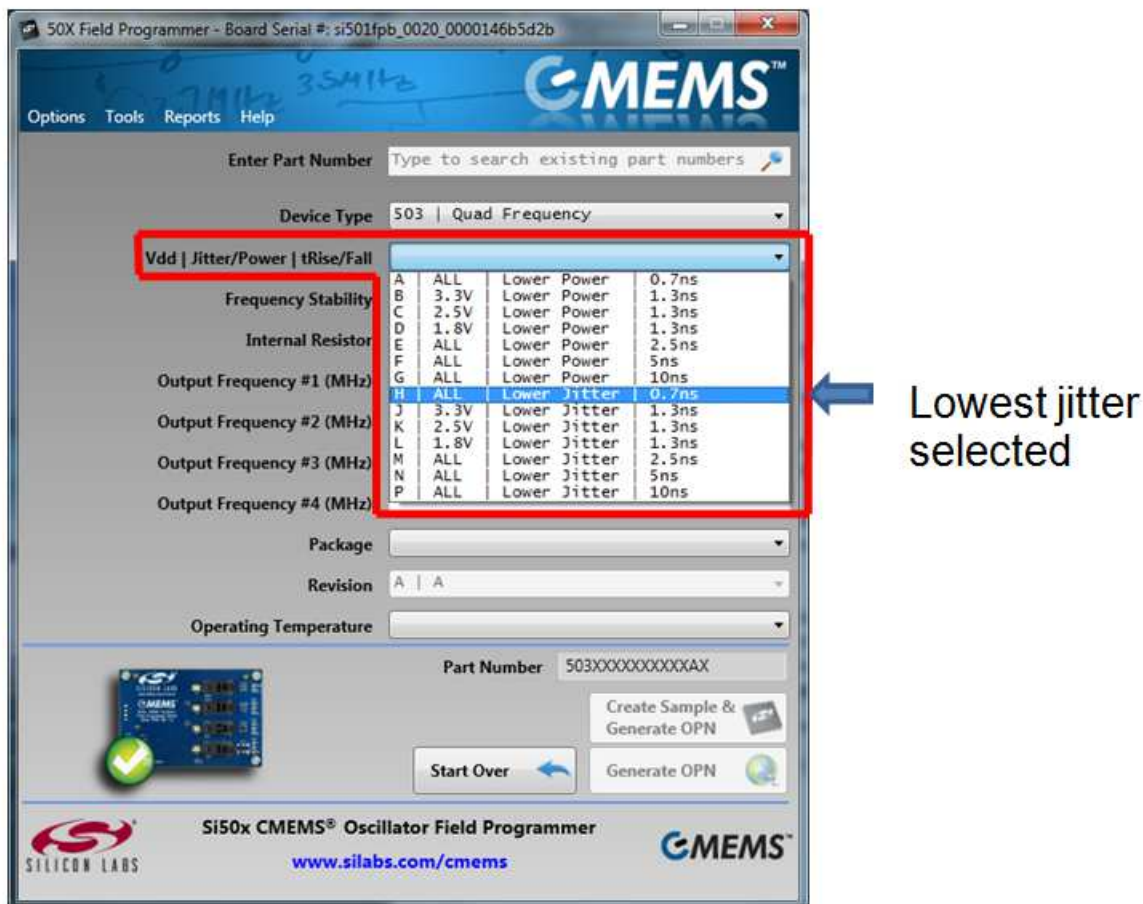


Si50x-FPB1-CUST

3. Select VDD, Jitter/Power, and Rise/Fall Time Options

VDD, Jitter, Power Mode, and Rise/Fall Time (tRise/Fall) options are shown in the pull down menu. The Si501 family supports a low period jitter option that consumes slightly more power (about 1 to 2 mA) or a low-power option that results in slightly more period jitter (about 1 to 1/2 ps rms). Selecting the right tRise/Fall is a key benefit of the Si501 family as you can easily drop-in to competitive sockets by matching their existing drive strength.

For this example, Lower Jitter with 0.7 ns rise/fall time options are selected, which is option “H”.



50X Field Programmer - Board Serial #: si501fpb_0020_0000146b5d2b

Options Tools Reports Help

Enter Part Number Type to search existing part numbers

Device Type 503 | Quad Frequency

Vdd | Jitter/Power | tRise/Fall

| | | | |
|---|------|--------------|-------|
| A | ALL | Lower Power | 0.7ns |
| B | 3.3V | Lower Power | 1.3ns |
| C | 2.5V | Lower Power | 1.3ns |
| D | 1.8V | Lower Power | 1.3ns |
| E | ALL | Lower Power | 2.5ns |
| F | ALL | Lower Power | 5ns |
| G | ALL | Lower Power | 10ns |
| H | ALL | Lower Jitter | 0.7ns |
| J | 3.3V | Lower Jitter | 1.3ns |
| K | 2.5V | Lower Jitter | 1.3ns |
| L | 1.8V | Lower Jitter | 1.3ns |
| M | ALL | Lower Jitter | 2.5ns |
| N | ALL | Lower Jitter | 5ns |
| P | ALL | Lower Jitter | 10ns |

Frequency Stability

Internal Resistor

Output Frequency #1 (MHz)

Output Frequency #2 (MHz)

Output Frequency #3 (MHz)

Output Frequency #4 (MHz)

Package

Revision A | A

Operating Temperature

Part Number 503XXXXXXXXXAX

Create Sample & Generate OPN

Generate OPN

Start Over

Si50x CMEMS® Oscillator Field Programmer

www.silabs.com/cmems

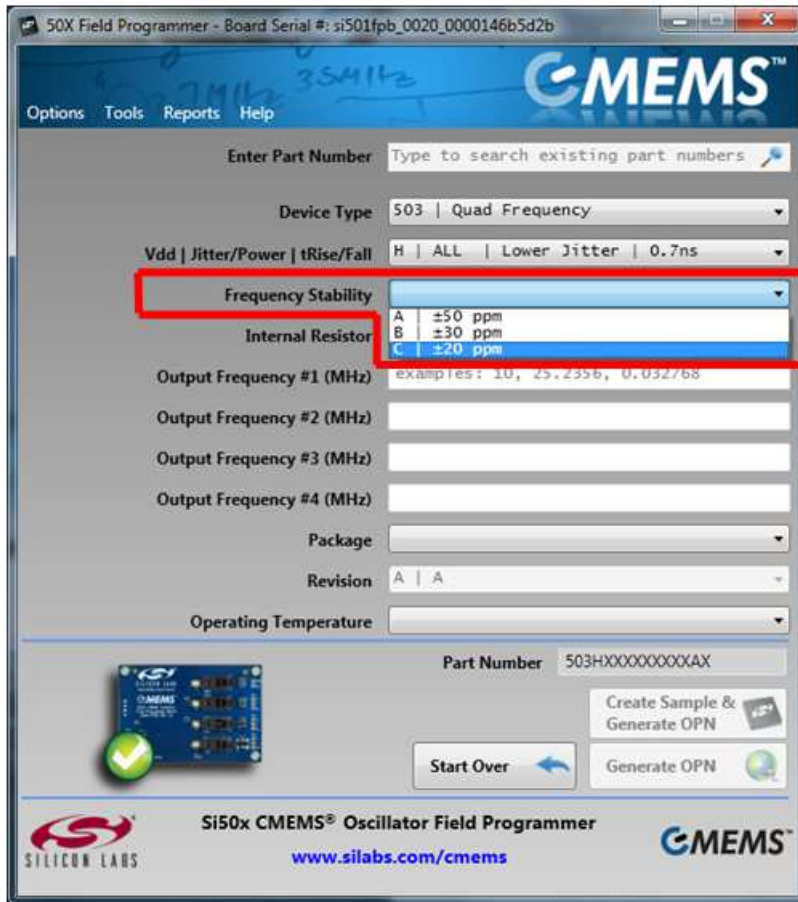
SILICON LABS

CMEMS™

Lowest jitter selected

4. Select Frequency Stability

The Si501 frequency stability is guaranteed for 10 years of operating life. In this example, a frequency stability of ± 20 ppm is selected.



20 ppm selected