MCP37X1X-200
12-Bit Evaluation Kit
User's Guide

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Object of Declaration: MCP37X1X-200 12-Bit Evaluation Kit

EU Declaration of Conformity

Manufacturer: Microchip Technology Inc.
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This declaration of conformity is issued by the manufacturer.

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Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA

Derek Carlson

12-Sep-14
Date

Derek Carlson
VP Development Tools

Table of Contents

MCP37X1X-200 12-BIT EVALUATION KIT USER'S GUIDE

Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our website (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXXXXA", where "XXXXXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MCP37X1X-200 12-Bit Evaluation Kit. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Recommended Reading
- The Microchip Website
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the MCP37X1X-200 12-Bit Evaluation Kit to demonstrate the performance of the MCP37X1X-200 device family. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MCP37X1X-200 12-Bit Evaluation Kit.
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with the MCP37X1X-200 12-Bit Evaluation Kit.
- **Appendix A. "Schematics and Layouts"** – Refer to the board's web page for the complete Schematics and Layouts.
- **Appendix B. "Bill of Materials (BOM)"** – Refer to the board's web page for the complete Bill of Materials.

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, Italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	`file`.o, where `file` can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options] file [options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

RECOMMENDED READING

This user's guide describes how to use the MCP37X1X-200 12-Bit Evaluation Kit. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- **MCP37211-200/MCP37D11-200 Data Sheet – "200 Msps, 12-Bit Low-Power ADC with 8-Channel MUX" (DS20005355)**

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- Technical Support

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Technical support is available through the website at: http://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (August 2016)

- Initial release of this document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MCP37X1X-200 12-Bit Evaluation Board (ADM00707) and covers the following topics:

- What is the MCP37X1X-200 12-Bit Evaluation Board (ADM00707)?
- What is the MCP37XXX High-Speed Pipeline ADC Data Capture Card (ADM00506)?
- What is the Pipeline ADC Utility Software?
- MCP37X1X-200 12-Bit Evaluation Kit Requirements

1.2 WHAT IS THE MCP37X1X-200 12-Bit Evaluation Board (ADM00707)?

The MCP37X1X-200 12-Bit Evaluation Board (ADM00707) is intended to demonstrate the performance of the MCP37X1X-200 device family. This evaluation board is used together with:

- MCP37XXX High-Speed Pipeline ADC Data Capture Card (ADM00506)
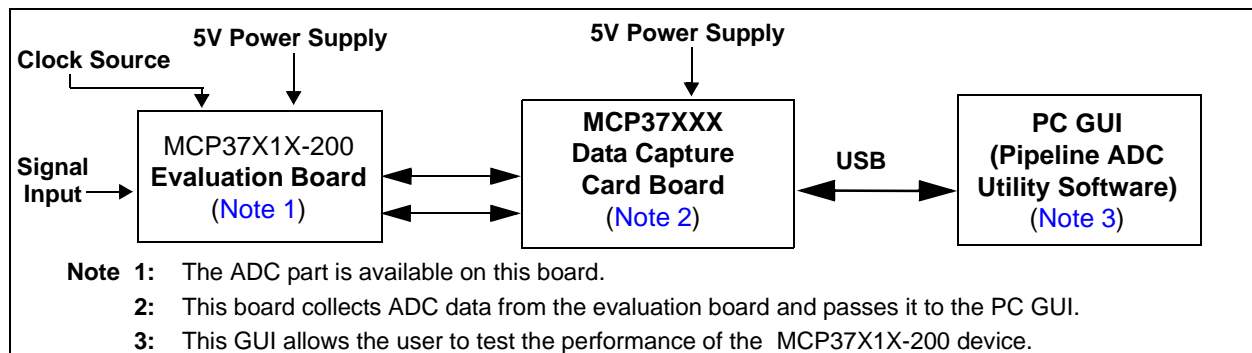- Pipeline ADC Utility Software

Refer to Figure 1-1 for the system setup.

Note 1: The ADC part is available on this board.
2: This board collects ADC data from the evaluation board and passes it to the PC GUI.
3: This GUI allows the user to test the performance of the MCP37X1X-200 device.

FIGURE 1-1: *Evaluation Kit System Setup.*

This evaluation board supports the following Microchip high-speed ADC device families:

- The MCP37X1X-200, which is Microchip Technology Inc.'s baseline single-channel 12-bit 200 Msps pipelined Analog-to-Digital Converter (ADC) device family, featuring a built-in high-order digital decimation filter, gain and offset adjustment per channel, noise-shaping requantizer and fractional delay recovery.
- The MCP37D1X-200 device family, which features digital down-conversion and CW beamforming capability, in addition to the features offered by the baseline device family.

The MCP37X1X-200 12-Bit Evaluation Board (ADM00707) comes with the MCP37D11-200 device on board. All conditions and features can be evaluated using this device. Refer to Figure 1-3 for close-up photos of the evaluation board.

(a) Top View

MCP37D11-200

(b) Bottom View
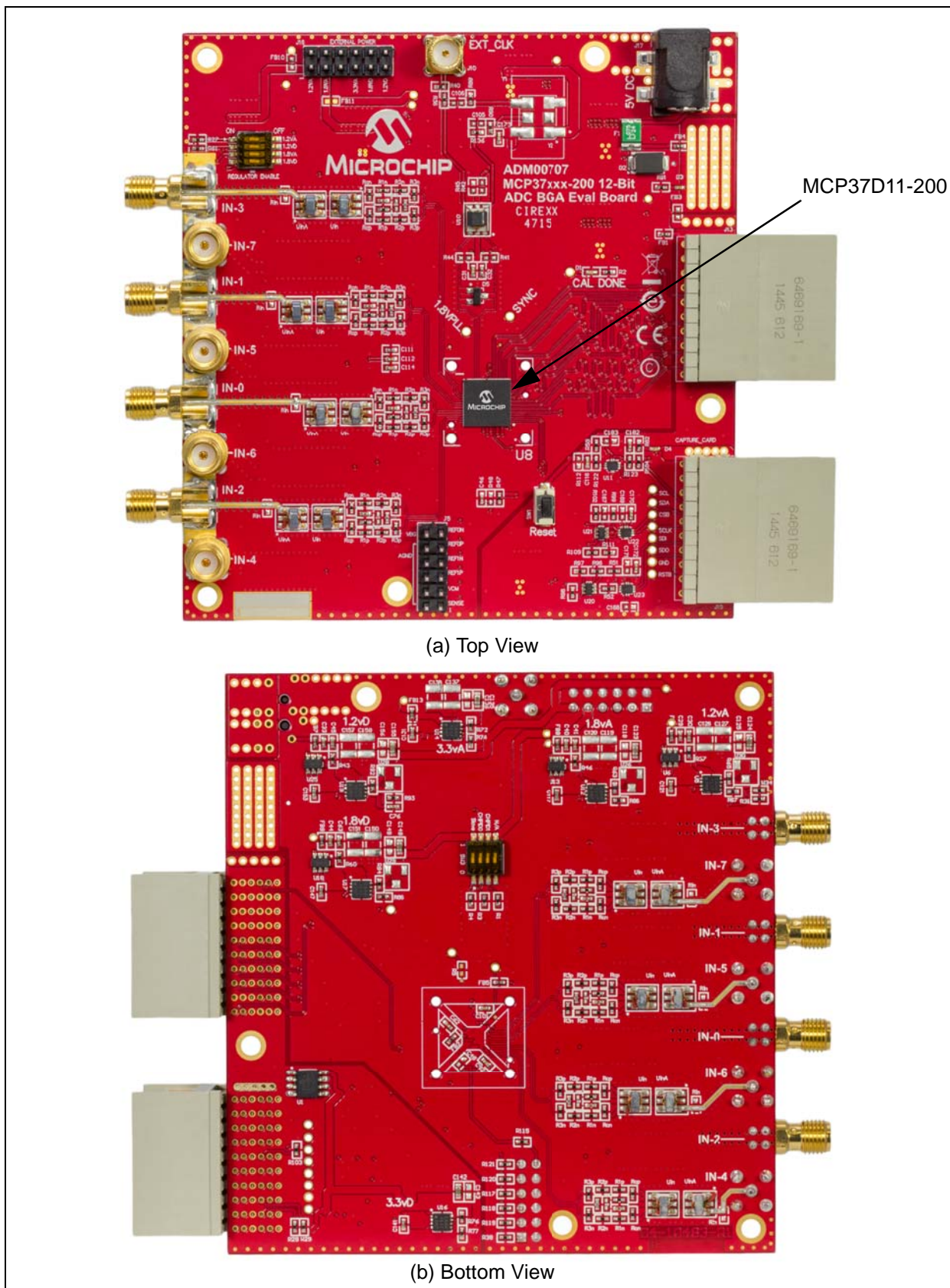
FIGURE 1-2: *MCP37X1X-200 12-Bit 200 Msps ADC BGA Evaluation Board (ADM00707).*

1.3 WHAT IS THE MCP37XXX HIGH-SPEED PIPELINE ADC DATA CAPTURE CARD (ADM00506)?

The MCP37XXX High-Speed Pipeline ADC Data Capture Card (ADM00506) is an FPGA-based memory buffer for the digital data received from the Analog-to-Digital Converter (ADC) evaluation board. Figure 1-1 shows the connection of the data capture card directly between the evaluation board and the PC GUI.

The data capture card connects to the PC through a USB cable, providing the user with two functionalities:

- The ability to send user commands directly to the device from the PC GUI.
- The ability to collect data from the evaluation board and send it to the PC GUI.

Refer to Figure 1-3 for close-up photos of the data capture card.

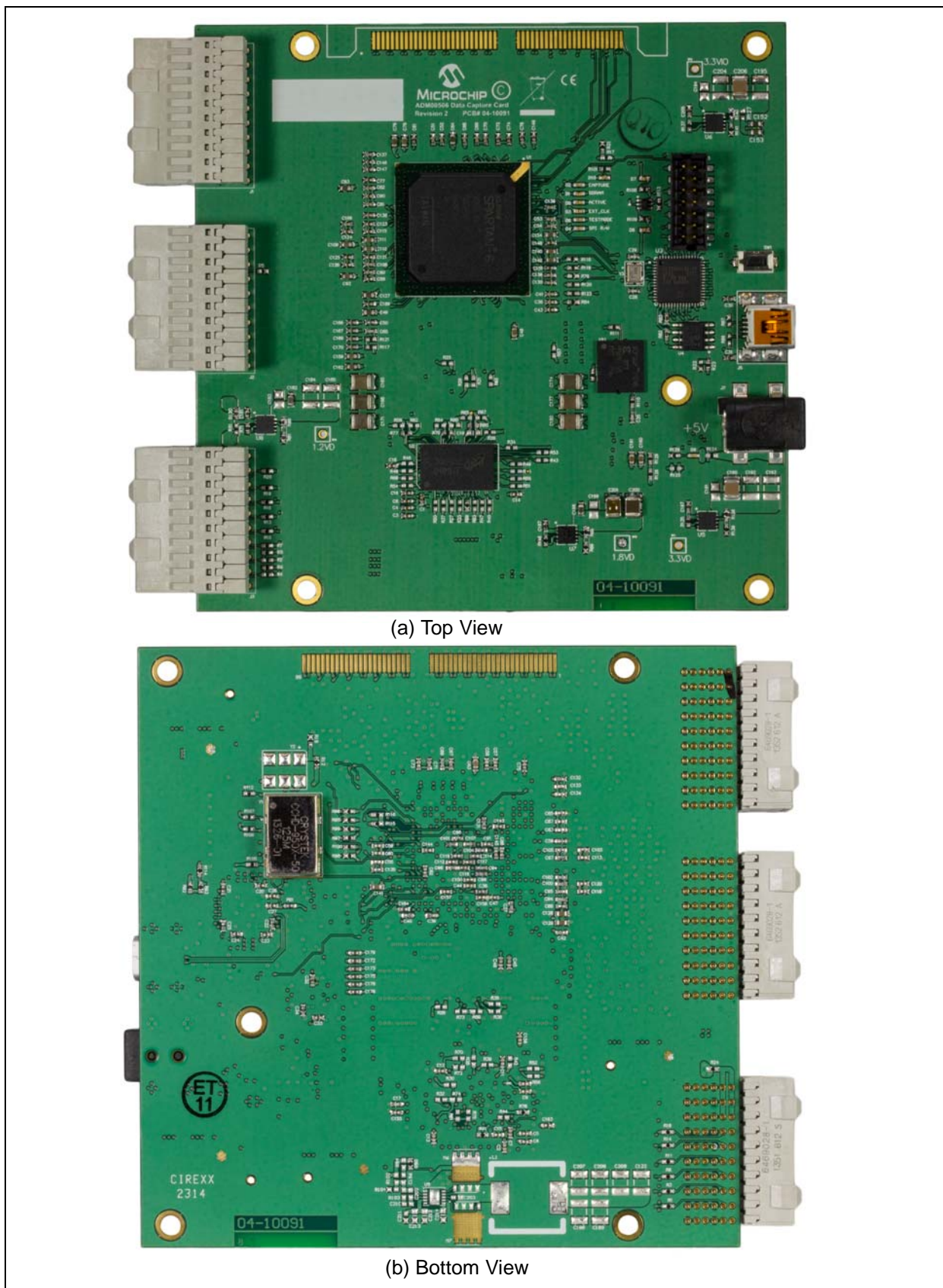(a) Top View

(b) Bottom View

FIGURE 1-3:   *MCP37XXX High-Speed Pipeline ADC Data Capture Card (ADM00506).*

1.4   WHAT IS THE PIPELINE ADC UTILITY SOFTWARE?

The Pipeline ADC Utility software is the graphical user interface (GUI) used to communicate with and to configure the operating parameters of the device. The software communicates with the part through the data capture card via a USB cable, allowing the user to program the internal ADC registers. When the user interacts with the software (for example, by updating the registers), the user's commands are passed to the MCP37D11-200 device via the data capture card. Once the commands are executed by the evaluation board, the software receives the requested data from the data capture card. The software will then analyze the data, perform a FFT or other analysis, and display the results. Refer to Figure 1-1 for a diagram of the system setup. Figure 1-4 shows a screen shot of the graphical interface.
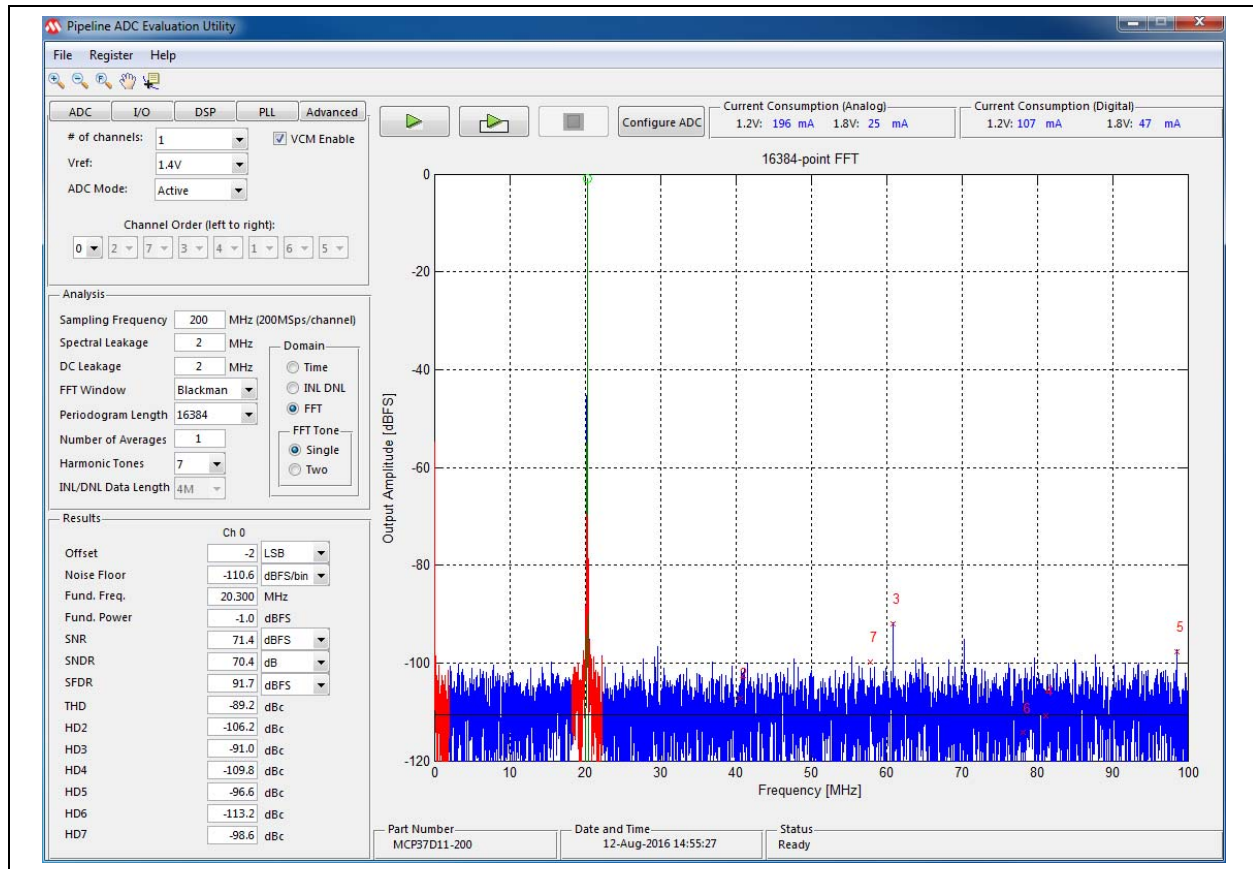
FIGURE 1-4:   *Pipeline ADC Utility Software Displaying a Typical FFT Waveform.*

The Pipeline ADC Utility software is available for download on Microchip's website. For instructions on using the GUI, refer to the software's supporting documentation included with the installation file, as well as within the application Help menu.

1.5   MCP37X1X-200 12-BIT EVALUATION KIT REQUIREMENTS

The evaluation kit requires the following:

- MCP37X1X-200 12-Bit Evaluation Board (ADM00707)
- MCP37XXX High-Speed Pipeline ADC Data Capture Card (ADM00506)
    - Sold separately
- Two 5V Power Supplies
    - Included with the evaluation board and data capture card
- USB-A to USB Mini-B Cable
    - Included with the data capture card
- External Clock Source or Crystal Oscillator
    - Supplied by the user
- External Signal Input
    - Supplied by the user
- Pipeline ADC Utility Software
    - Available on the Microchip website

Chapter 2. Installation and Operation

2.1   MCP37X1X-200 12-BIT EVALUATION KIT FEATURES

This MCP37X1X-200 12-Bit Evaluation Kit is a fully assembled, programmed and tested solution (with the exception of a clock source) to evaluate and demonstrate the MCP37X1X-200 operating performance.

The evaluation kit has the following features:

- Programmable Full-Scale Analog Input Range
- Dynamic Performance Monitoring
- Evaluation of Performance Metrics, such as: SNR, SFDR, INL, DNL, etc.
- User-Programmable Registers
- Real-Time Monitoring of Power Consumption
- Digital Post Processing Options: Decimation Filter, Digital Down-Conversion, CW Beamforming, Noise-Shaping Requantizer, etc.
- Ability to Save and Load Software Configurations
- Ability to Save and Load Raw Data for User Post-Processing

The evaluation kit features a sample rate of up to 200 Msps. Since the device can support up to eight input channels, the effective sample rate per channel is a function of the number of channels enabled. Refer to Table 2-1 for a detailed list of the input sample rate per channel.

For information about the device features, refer to the **MCP37211-200/MCP37D11-200 Data Sheet – "200 Msps, 12-Bit Low-Power ADC with 8-Channel MUX" (DS20005355).**

TABLE 2-1:   INPUT SAMPLE RATE VS. NUMBER OF CHANNELS SELECTED

No. of Channels Selected	Sample Rate per Channel (in Msps)
1	200
2	100
3	66.67
4	50
5	40
6	33.33
7	28.57
8	25

2.2 GETTING STARTED

2.2.1 Configuration Requirements

To power-up and run the evaluation kit, the following are required:

- Pipeline ADC Utility Software
- MCP37X1X-200 12-Bit Evaluation Board (ADM00707)
- MCP37XXX High-Speed Pipeline ADC Data Capture Card (ADM00506)
- Two 5V Power Supplies
- A USB-A to USB Mini-B Cable
- External Clock Source or Crystal Oscillator (see **Section 2.2.4.1 "Optimizing the Clock Connection"**)
- External Signal Input (see **Section 2.2.4.2 "Optimizing the Analog Input Connection"**)

2.2.2 Power Input Connection

This evaluation kit comes with two switching power supplies (Mean Well: GS06U-1P1J): one for each of the boards. These power supplies are able to provide a 5V, 1A maximum output. They can be connected to an AC wall outlet rated between 90V AC and 264V AC, at a frequency of 47 Hz to 63 Hz. The other end of the power supply is a 2.1 mm barrel plug that connects to both the evaluation board and the data capture card (see Figure 2-1). If the user chooses to connect a different external power supply, a minimum output of 750 mA is required.

The evaluation board's power supplies can also be supplied by external voltages directly to the power domains. This can be done by disabling the desired regulator using the dip switch SW2 - Regulator Enable on the silkscreen. Then, a DC voltage can be driven directly into the appropriate pin of header J16. Note that the even pins of the J16 header are GND.

The power domains on the evaluation board may be merged, if needed. Specifically, the 1.2VA and 1.2VD power domains may be merged by populating a ferrite bead on FB10. Similarly, the 1.8VA and 1.8VD power domains may be merged by populating a ferrite bead on FB11. In both cases, the digital regulators should be disabled using the appropriate switches.

WARNING
Avoid connecting a power supply with a voltage greater than 5V. Doing so can damage the voltage regulators, requiring them to be replaced.

2.2.3 Evaluation Kit Set-Up

1. Connect the evaluation board and the data capture card as shown in Figure 2-1.
2. Power up both boards using the supplied 5V Power Supplies.
3. Ensure that a clock input is connected or that a crystal oscillator is installed correctly. Follow instructions in section **Section 2.2.4.1 "Optimizing the Clock Connection"**.
   - **1:** Note: If this is done correctly, the CAL DONE LED will be ON. Otherwise, the user should check the clock input or crystal oscillator for issues.
4. Connect the data capture card to a computer using the provided USB cable.
5. Press the Reset button on both boards.
6. Run the Pipeline ADC Utility Software.

For help with troubleshooting the boards and operating the GUI, please refer to the software's supporting documentation.

WARNING
Avoid applying an input signal while the board is powered off. This may damage the input baluns! If a high second harmonic is seen, it is likely that these baluns need to be replaced.
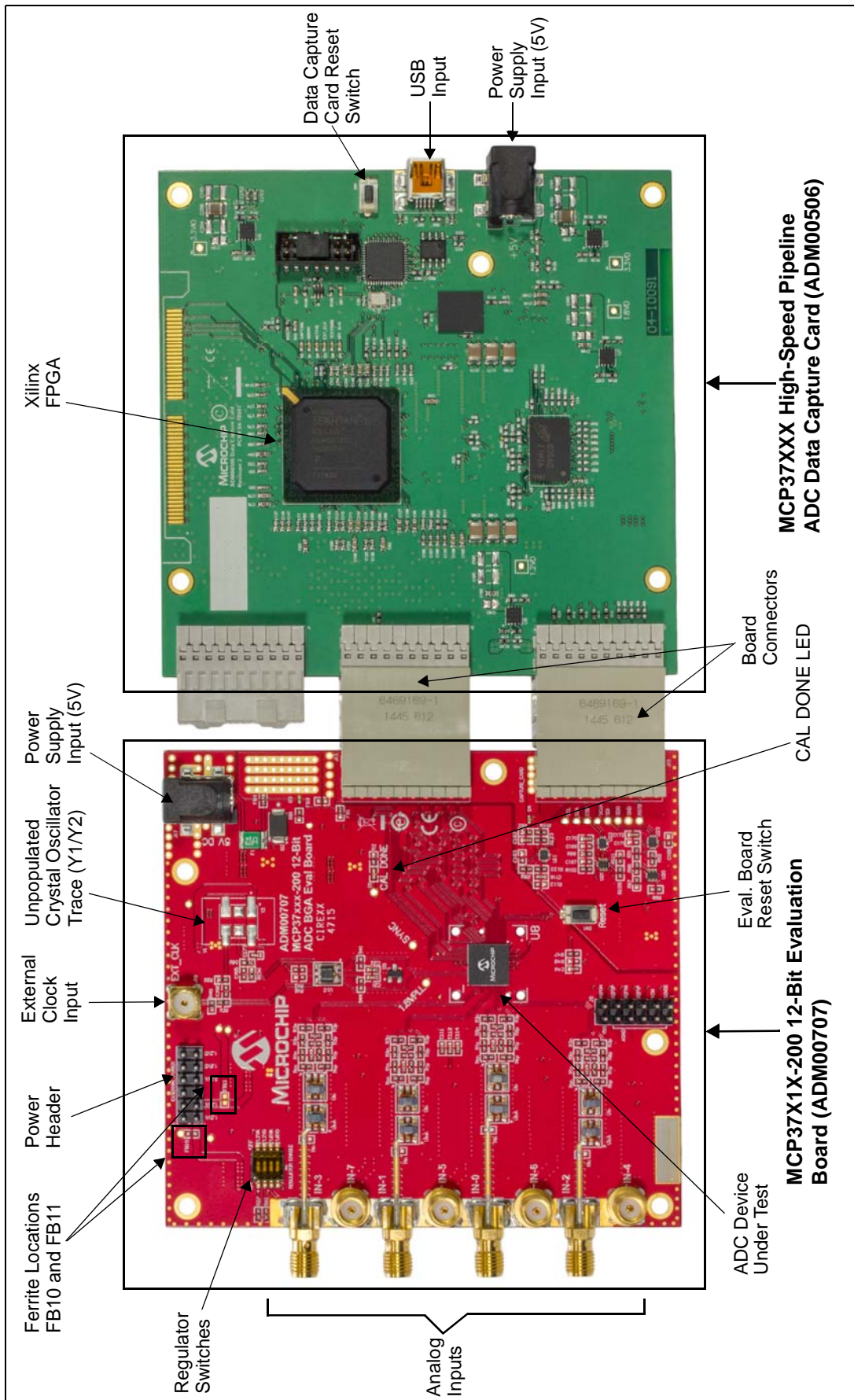
FIGURE 2-1: *Evaluation Kit - The evaluation board connected to the data capture card.*

Labels in figure:
- Data Capture Card Reset Switch
- USB Input
- Power Supply Input (5V)
- Xilinx FPGA
- **MCP37XXX High-Speed Pipeline ADC Data Capture Card (ADM00506)**
- Board Connectors
- Power Supply Input (5V)
- Unpopulated Crystal Oscillator Trace (Y1/Y2)
- External Clock Input
- Power Header
- Ferrite Locations FB10 and FB11
- Regulator Switches
- CAL DONE LED
- Eval. Board Reset Switch
- **MCP37X1X-200 12-Bit Evaluation Board (ADM00707)**
- ADC Device Under Test
- Analog Inputs

2.2.4 Input/Output Optimization

2.2.4.1 OPTIMIZING THE CLOCK CONNECTION

The evaluation board does not come with a clock source for the device. The user must provide a clock source in order to run this evaluation board. The user has the following options:

- Using Microchip's 200 MHz Clock Source Evaluation Boards:
  - Microchip's ADM00725 or ADM00791 evaluation boards may be connected to the external clock SMA input (See Figure 2-1). These boards were developed as an optimized clock source for Microchip's High-Speed ADCs. For more information, refer to the board web page.
- Using a signal generator:
  - A clean and low-jitter clock signal can be connected to the external clock SMA input. For the signal generation, Rohde & Schwarz® SMA100A or Agilent Technologies HP8644B signal generators can be used. To ensure that a clean and low-jitter clock signal is provided, the user should interpose a band-pass filter to reduce the harmonics coming from the signal source. A 200 MHz band-pass filter, such as KC4T-200M-10P-50-3A from TTE® Inc., is recommended. A high-jitter or unfiltered clock source will reduce achievable SNR at higher input frequencies.
- Using a Crystal Oscillator on the board:
  - An unpopulated footprint is available on the board where the user can place a crystal oscillator. For a single-ended clock, refer to the instructions in Example 1. For a differential clock, refer to the instructions in Example 2. The user may also choose to place another type of clock as well. Note that the component values given below are for example only and may vary depending on the exact clock source used.

Example 1

A clock oscillator with a single-ended output may be populated on Y2. The use of a Microchip oscillator is recommended, such as the MXT573ABC200M000 for a 200 MHz clock. In this case, proceed to make the following modifications:

1. Remove R36
2. Populate R89 with a 499Ω resistor
3. Populate C106 with a 15 pF capacitor.

Example 2

A clock oscillator with a differential LVPECL output may be populated on Y2. The use of a Microchip oscillator is recommended, such as the MXT575ABA200M000 for a 200 MHz clock. In this case, proceed to make the following modifications:

1. Remove R36 and R136
2. Populate R89 and R90 with a 210Ω resistor
3. Populate C105 and C106 with a 22 pF capacitor.

2.2.4.2 OPTIMIZING THE ANALOG INPUT CONNECTION

The best way to evaluate the MCP37X1X-200 device is to use a clean analog input signal with as little noise as possible. The signal can be provided using a signal generator, such as Rohde & Schwarz SMA100A or Agilent Technologies HP8644B, and can be used along with a bandpass filter. The filter will help with filtering the harmonic tones of the fundamental, as well as with reducing the phase noise of the source. Two such filters that can be used are:

- KC4T-70M-15P-50-69A, TTE Inc.'s 70 MHz filter
- KC4T-20M-15P-50-69A, TTE Inc.'s 20 MHz filter

> **Note:** If one of the analog inputs appears to not work properly, exhibiting issues such as a high 2nd harmonic or substantially lower fundamental power, it is likely that the baluns on that input network are damaged. Replacing them should resolve these issues.

2.2.4.3 OUTPUT DATA CONFIGURATION

The MCP37X1X-200 device is able to provide both LVDS and CMOS outputs. However, this evaluation kit is designed for LVDS outputs only. The user can modify various other output data properties using the GUI, with the exception of the LVDS/CMOS output mode.

Appendix A. Schematics and Layouts

NOTICE TO CUSTOMERS
Refer to the board's **web page** for the complete Schematics and Layouts.

NOTES:

Appendix B. Bill of Materials (BOM)

NOTICE TO CUSTOMERS
Refer to the board's **web page** for the complete Bill of Materials.

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