iC-PZ AN1
GETTING STARTED GUIDE iC-PZ

preliminary

CONTENTS

INTRODUCTION

The iC-PZ is an EncoderBlue® lensless reflective optical encoder IC featuring integrated HD Phased Array photosensors and a blue LED in an OptoQFN32 package. It is designed for high-resolution absolute position measurement without the need for highly accurate alignment of each encoder system. To achieve this goal, numerous automatic calibrations are implemented.

This application note discusses the proposed adjustment procedure both for the development phase and mass production.

Complete information on the iC-PZ is available at

www.ichaus.de/iC-PZ

GENERAL SETUP AND REQUIREMENTS

Figure 1 shows the setup used in this application note. It consists of

- Motherboard (iC-PZ EVAL PZ1D) [1]
- Scanner module (iC-PZ2656 EVAL PZ1M) [2]
- BiSS-to-PC adapter (iC-MB4 iCSY MB4U) [3]
- Drive with mounted code disc (PZ03PS) [4]
- A PC with running Windows 7 operating system.

Note: Other BiSS-to-PC adapters like iC-MB3 iCSY MB3U, iC-MB3 iCSY MB3U-I2C and iC-MB5 iCSY MB5U can also be used. In any case, the related driver has to be installed before connecting the BiSS-to-PC adapter to the PC. The latest drivers are available at www.ichaus.de/adapter_drivers. A comparison of the different adapters can be found at www.ichaus.de/MB3AN2_appnote_en.

Note: The graphical user interface (GUI) software requires a windows operating system and the LabVIEW™ Run-Time Engine (RTE). See chapter SOFTWARE SETUP for further information.

Note: The adjustment procedures described in chapters PROCEDURE FOR AUTOMATIC ELECTRICAL ADJUSTMENT and PROCEDURE FOR MECHANICAL ADJUSTMENT are applicable for other setups as well if the respective electrical connections are correct.

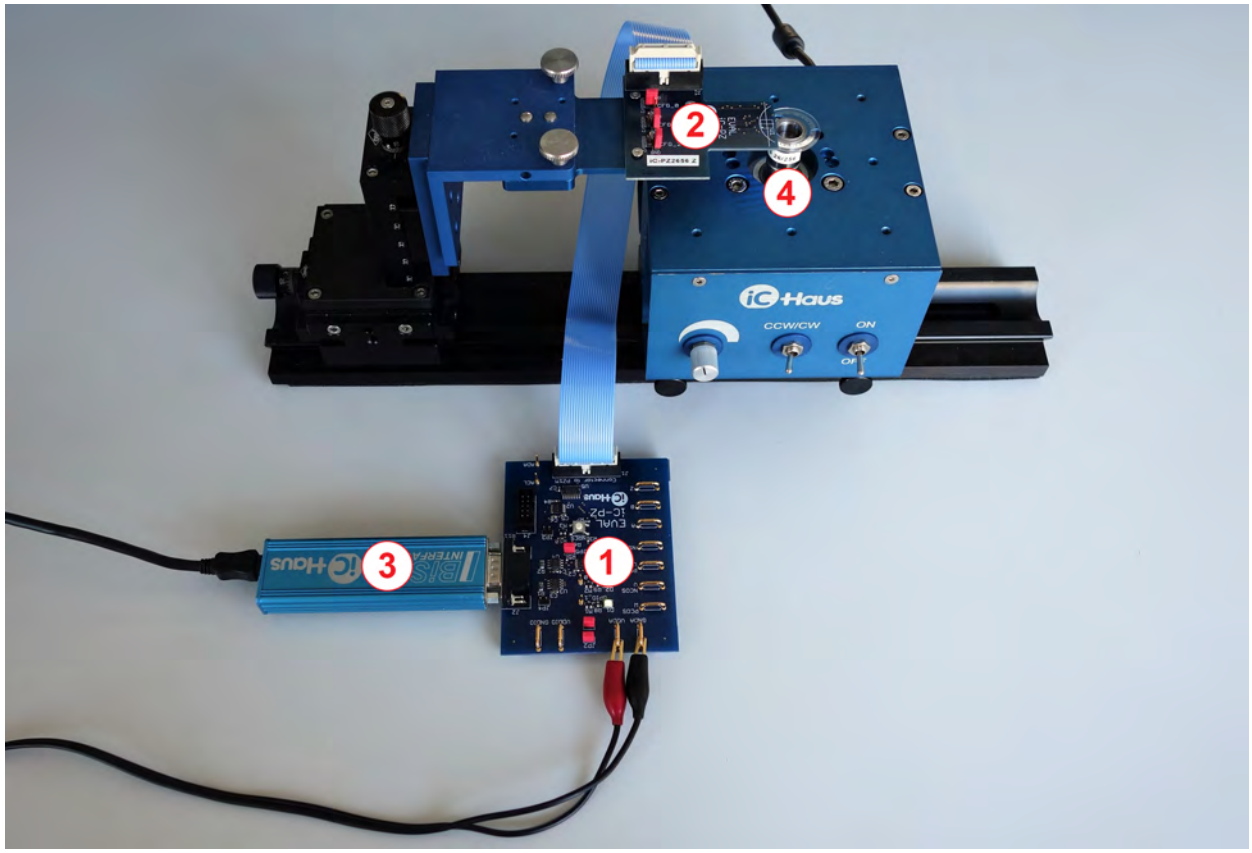

Figure 1: Hardware setup: Motherboard [1], scanner module [2], BiSS-to-PC adapter [3] and drive with mounted code disc [4]

HARDWARE SETUP

To configure iC-PZ using the graphical user interface software, the hardware has to be connected as follows:

1. Connect the scanner module to the motherboard via the included 20-pin ribbon cable.
2. Connect the motherboard to the BiSS-to-PC Adapter.
3. Connect the BiSS-to-PC Adapter to the PC via the usb cable. Please make sure you have installed the related driver before connecting the BiSS-to-PC adapter to your PC.
4. Ensure the jumper setup of the scanner module is in default configuration:
   - CFG_0/ JP1 = M (= VDDIO/2)
   - CFG_1/ JP2 = L (= GNDIO)
   - CFG_2/ JP3 = H (= VDDIO)

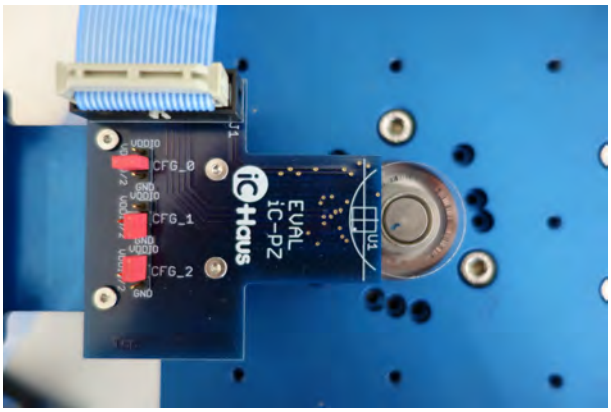

Figure 2: Scanner module (iC-PZ2656 EVAL PZ1M) and code disc PZ03PS in detail

5. Ensure jumper setup of motherboard is in the following configuration:
   - JP1 = Closed (VDDIO supplied by VDDA)
   - JP2 = Closed (GNDIO connected to GNDA)
   - JP3 = Open
   - JP4 = Open
   - JP5 = Closed (BiSS Port enabled)

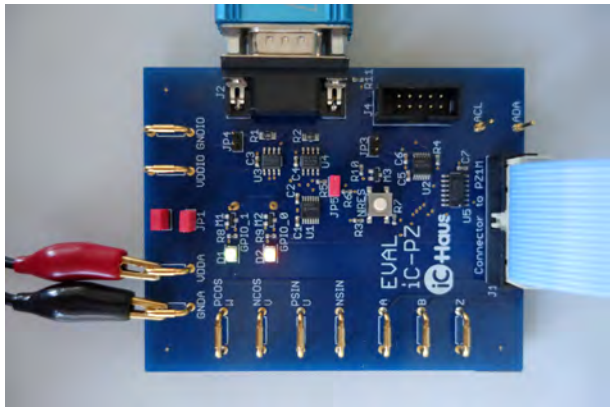

Figure 3: Motherboard (iC-PZ EVAL PZ1D) in detail

6. Connect a 5V power supply to the motherboard.

SOFTWARE SETUP

For easy configuration of iC-PZ, iC-Haus offers a graphical user interface (GUI) that can be used on a PC that runs the Windows operating system.

1. Download the latest iC-PZ GUI. Note that the GUI requires the LabVIEW™ Run-Time Engine (RTE). Both a software package with GUI only and a software package with GUI and its related RTE version are available at www.ichaus.de/iC-PZ.
2. Install the iC-PZ GUI. A detailed description of the GUI setup can be found in the enclosed software manual.
3. Start the iC-PZ GUI and accept the End User License Agreement (EULA).
4. Click 'Connect'.

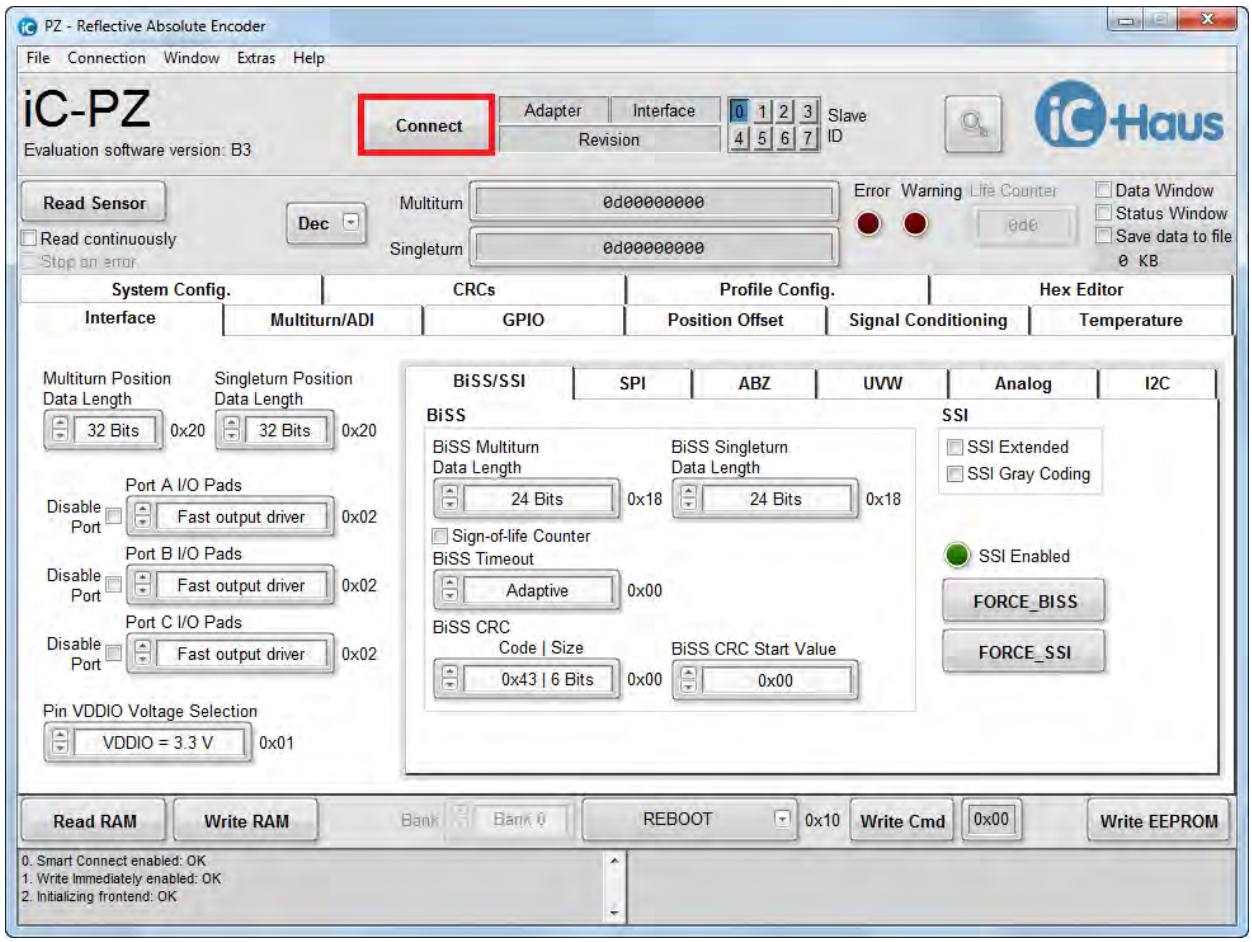

Figure 4: GUI start-up

ADJUSTMENT PROCEDURE OVERVIEW

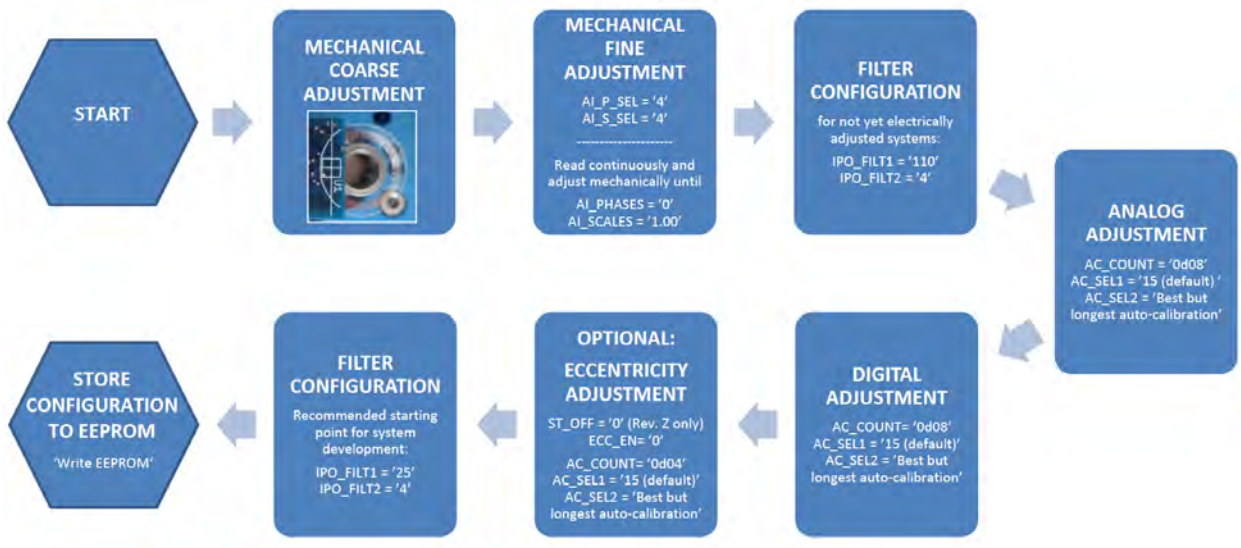

Figure 5: Order of adjustment procedures

PROCEDURE FOR MECHANICAL ADJUSTMENT

Best measurement results are achieved at the ideal mechanical position. iC-PZ supports this process of finding the ideal position by offering white marks on the scanner module for coarse adjustment and dynamic values in the GUI for fine adjustment.

Mechanical coarse adjustment

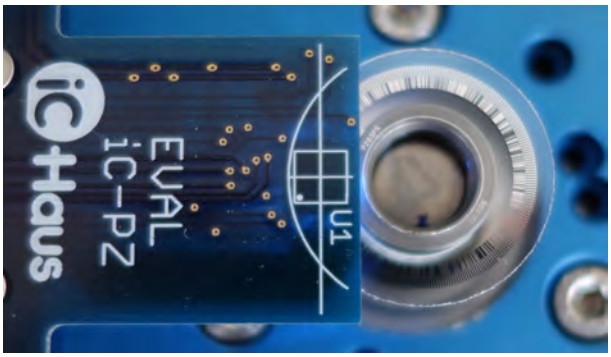

Figure 6: White marks on scanner module (iC-PZ2656 EVAL PZ1M) for mechanical coarse adjustment

- White marks on top of the scanner module (iC-PZ2656 EVAL PZ1M) help to easily find the coarse position of the sensor iC with respect to the code track. The scanner module is moved until the curved white mark completes the cicumference of the code disc as shown in Figure 6. Note that the recommended air gap betweeen code disc and sensor is 1 mm to 2 mm.

Mechanical fine adjustment

- Rotate/ move at least at minimum speed required for the automatic analog adjustment. The following values are recommended:

  Rotary (iC-PZ2656): 300 RPM
  Linear (iC-PZ205): 25.6 cm/s

- In the GUI tab 'Signal Conditioning' section 'Digital Adjustment' enable dynamic phase and dynamic scale adjustment by setting

  AI_S_SEL = '4' [= 0x04]
  AI_P_SEL = '4' [= 0x04]

- Continuously read AI_PHASES and AI_SCALES. The registers show the currently effective adjustment values and are marked with a yellow frame in Figure 7.

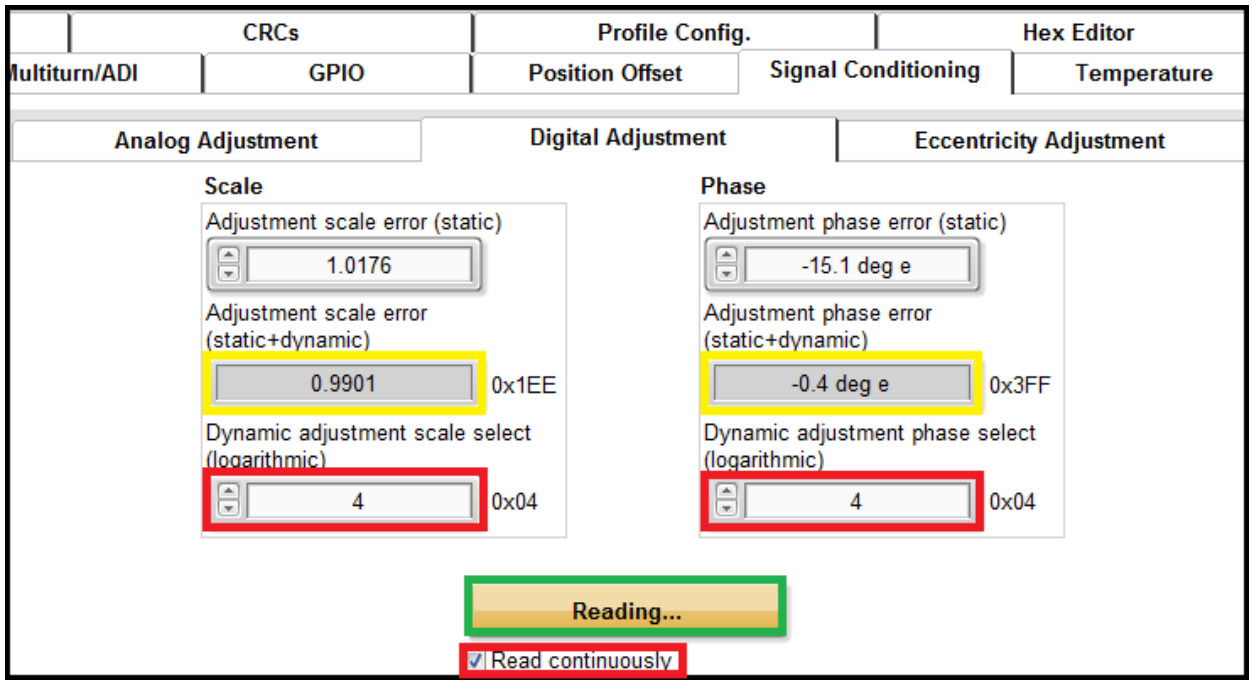

Figure 7: Mechanical adjustment

- By mechanical adjustment, change the position of the IC with respect to the code disc/ linear scale until

  AI_SCALES = '1.00'

  AI_PHASES = '0 deg e'

- When the ideal position is found, stop 'Reading...' and disable dynamic phase and dynamic scale adjustment by setting

  AI_S_SEL = 'Disabled' [= 0x00]
  AI_P_SEL = 'Disabled' [= 0x00]

  Then perform automatic electrical adjustment.

PROCEDURE FOR AUTOMATIC ELECTRICAL ADJUSTMENT

iC-PZ is designed for high resolution position measurement without the need for precise mechanical alignment of the IC to the code disc or linear scale. Highly automated production processes can only provide placement with limited accuracy. To correct the errors resulting from mechanical misplacement, iC-PZ provides numerous automatic calibration functions. The following procedure is proposed for the automatic electrical adjustment:

Filter configuration

- In tab 'System Config' set filter parameters to its default values

  IPO_FILT1 = '110' [= 0x6E]
  IPO_FILT2 = 4 [= 0x04]

  to allow stable operation with systems that are not yet electrically adjusted.

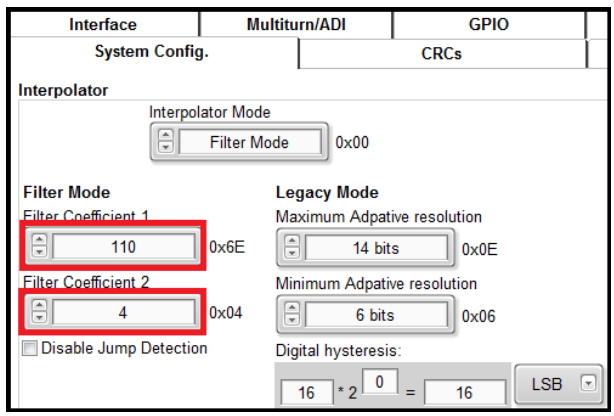

Figure 8: Filter configuration

Automatic analog adjustment

- In tab 'Signal Conditioning' section 'Analog Adjustment' set

  AC_COUNT = '0d08' [= 0x08]
  AC_SEL1 = '15 (default)' [= 0x0F]
  AC_SEL2 = 'Best but longest auto-calibration' [= 0x00]

- Rotate/ move at least at minimum speed required for the automatic analog adjustment. The following values are recommended:

  Rotary (iC-PZ2656): 300 RPM
  Linear (iC-PZ205): 25.6 cm/s

- Send command AUTO_ADJ_ANA to execute autocalibration.

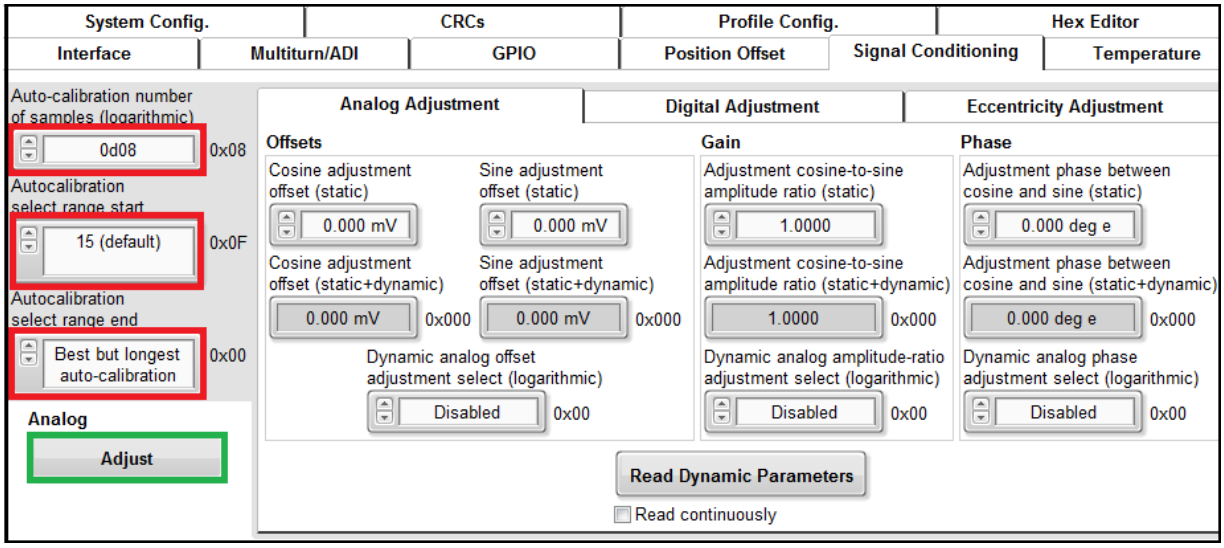

Figure 9: Automatic analog adjustment

Automatic digital adjustment

- In tab 'Signal Conditioning' section 'Digital Adjustment' set

  AC_COUNT = '0d08' [= 0x08]
  AC_SEL1 = '15 (default)' [= 0x0F]
  AC_SEL2 = 'Best but longest auto-calibration' [= 0x00]

- Rotate/ move at least at minimum speed required for the automatic digital adjustment. The following values are recommended:

  Rotary (iC-PZ2656): 300 RPM
  Linear (iC-PZ205): 25.6 cm/s

- Send command AUTO_ADJ_DIG to execute autocalibration.

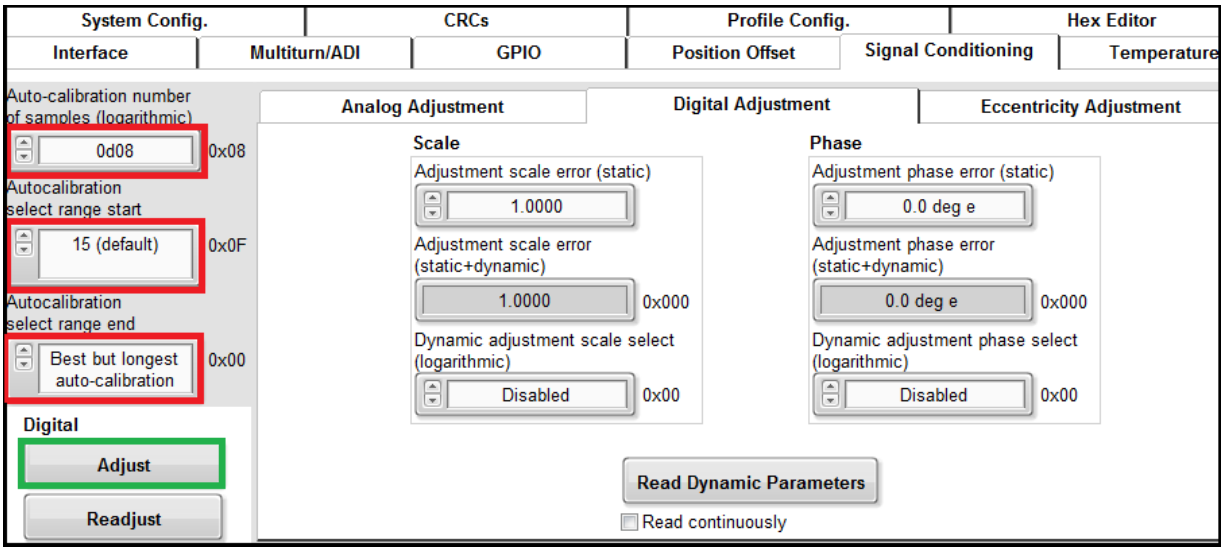

Figure 10: Automatic digital adjustment

Automatic eccentricity adjustment (optional)

- In tab 'Position Offset' set
  ST_OFF = '0' [= 0x00] (iC-PZ revision Z only)

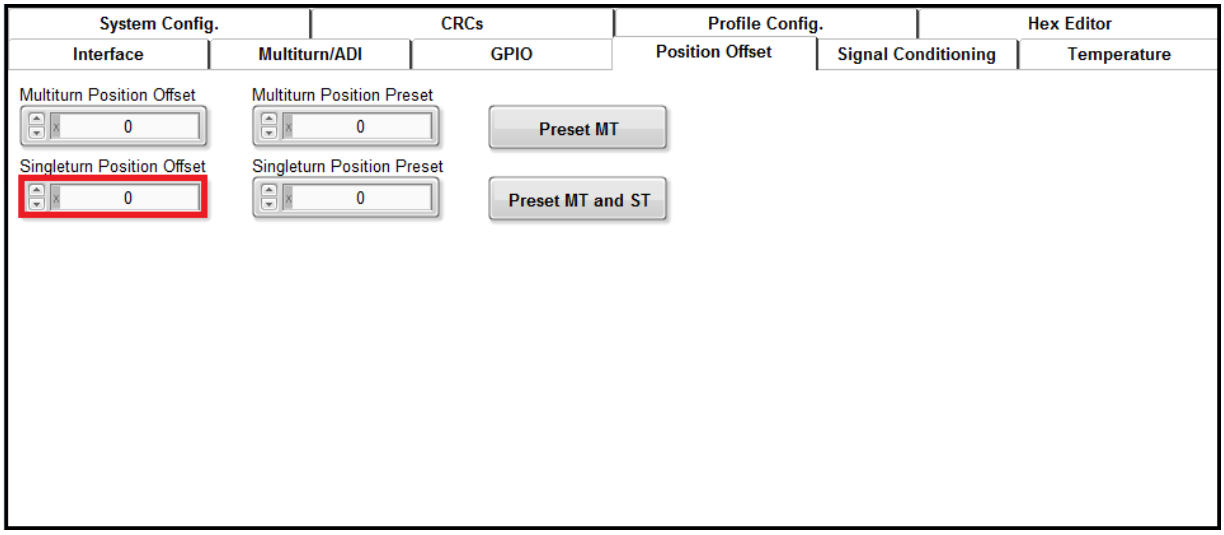

Figure 11: Offset

- In tab 'Signal Conditioning' section 'Eccentricity Adjustment' set
  AC_COUNT = '0d04' [= 0x04]
  AC_SEL1 = '15 (default)' [= 0x0F]
  AC_SEL2 = 'Best but longest auto-calibration' [= 0x00]
  ECC_EN = '0' [= 0x00]
- Rotate at least at minimum speed required for the automatic eccentricity adjustment. The following value is recommended:
  Rotary (iC-PZ2656): 300 RPM
- Send command AUTO_ADJ_ECC to execute auto-calibration.
- To enable eccentricity correction set
  ECC_EN = '1' [= 0x01]

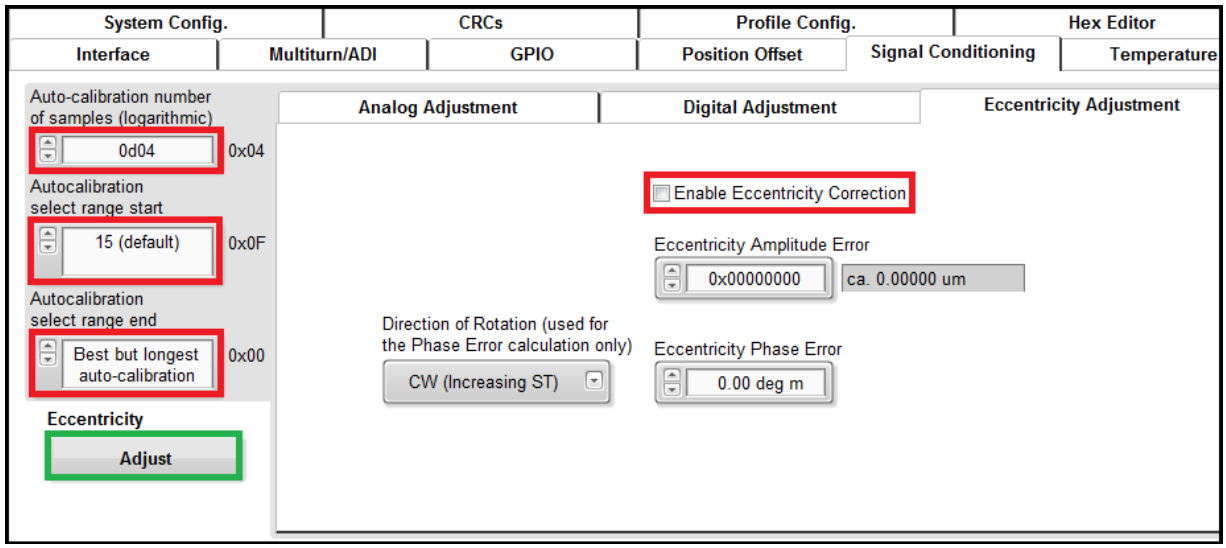

Figure 12: Automatic eccentricity adjustment

- After performing automatic adjustment procedures analog and ABZ output signals can be checked with an oscilloscope. Figure shows the positive sine (yellow) and cosine (blue) signal at output pins PSIN and PCOS of the motherboard (iC-PZ EVAL PZ1D). Please note that the single-ended output signals should have an offset of 2.5 V and an amplitude of about 250 mV in default analog output selection.

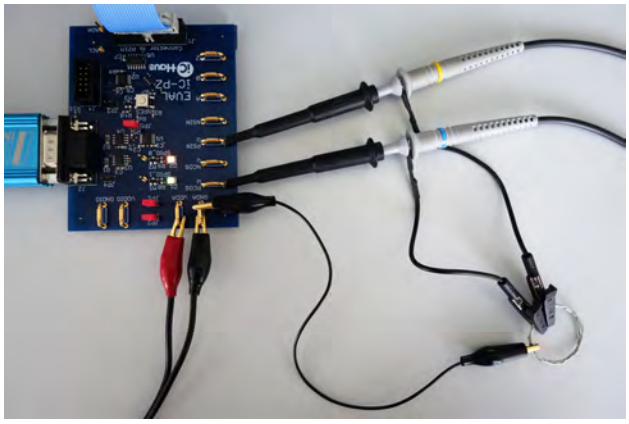

Figure 13: Measuring analog output signals at pin PSIN and PCOS of motherboard (iC-PZ EVAL PZ1D)

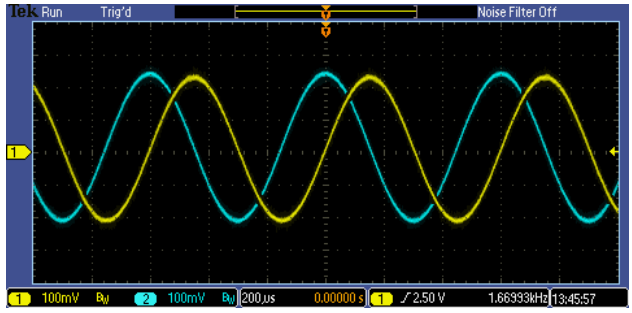

Figure 14: Single-ended analog output in clockwise rotation: Positive sine (yellow) and cosine (blue) with offset of 2.5 V and amplitude of about 250 mV

FURTHER CONFIGURATION HINTS

Filter configuration for system development

- The default filter values

  IPO_FILT1 = 110 [= 0x6E]

  IPO_FILT2 = 4 [= 0x04]

  ensure stable filter operation before analog signal adjustment compensates signal errors. However, with the default settings, neither high-precision nor high-dynamic-systems show best performance. It is thus recommended to change the filter settings after signal adjustment. As a starting point for system development, the following settings are recommended:

  IPO_FILT1 = 25 [= 0x19]

  IPO_FILT2 = 4 [= 0x04]

Port configuration and output signals

- The jumper setup of the scanner module (iC-PZ2656 EVAL PZ1M) recommended in this application note enables analog (PORTC), ABZ (PORTB) and BiSS (PORTA) outputs. Other possible output signals are SSI, UVW and SPI. For more information regarding the port configuration check the eval board description and the datasheet at www.ichaus.de/iC-PZ

BiSS Reader Software

- To evaluate the BiSS sensor communication, iC-Haus offers a BiSS Reader Software. Note that the BiSS Reader requires LabVIEW™ Run-Time Engine (RTE). The current version and its related software manual are available with RTE at www.ichaus.de/BiSS_gui_rte and without RTE at www.ichaus.de/BiSS_gui.

REVISION HISTORY

Rel.	Rel. Date*	Chapter	Modification	Page
A1	2019-04-02	all	Initial release	

* Release Date format: *YYYY-MM-DD*