ZSSC3240

Cyclic Mode and Sequencer Operation

This document describes the Cyclic Mode and the Sequencer operation and relevant set up procedures through EVK GUI for the ZSSC3240 resistive sensor conditioner.

It is highly recommended to read the following documents before using this manual:

- ZSSC3240 Datasheet: ZSSC3240 - High-End 24-Bit Sensor Signal Conditioner with Analog and Digital Output | Renesas.
- ZSSC3240 SSC Evaluation Kit User Manual: ZSSC3240 - High-End 24-Bit Sensor Signal Conditioner with Analog and Digital Output | Renesas.
- SSC Communication board - SSCCOMMBOARDV4P1C: SSC Communication Board.

Contents

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1. User Computer Requirements and Setup

A Windows®-based computer is required for interfacing with the Evaluation Kit and configuring the ZSSC3240.

1.1 Computer Requirements

Note: The user must have administrative rights on the computer to download and install the ZSSC3240 Evaluation Software for the kit.

The computer must meet the following requirements:

- Windows® 7, 8, 8.1, 10
- Microsoft® .NET Framework 4.0 or higher
- Supported architecture: x86 and x64
- USB port
- Internet access to download the install setup

1.2 Evaluation Software Installation and Setup

The latest version of ZSSC3240 Evaluation Software, which is required for the kit, must be downloaded from the Renesas web site at ZSSC3240 - High-End 24-Bit Sensor Signal Conditioner with Analog and Digital Output | Renesas. The Evaluation Software and all drivers, libraries are transferred within a single exe-file.

Note: FTDI USB drivers are needed only for backwards compatibility with older Renesas communication hardware. If these drivers are not already installed on the user's computer, the software automatically installs the correct drivers after user confirmation.

Follow these procedures to install the Evaluation Kit Software on the user's computer:

1. Downloading and extract the contents of the zip file to the user's computer.
2. Start the *ZSSC324X_Evaluation_SW_vX.XX.exe* file, the 'X.XX' marks the revision number.
   Note: running the file could take considerable time, the process could be additionally slowed down by an anti-virus software.

2. Hardware Requirements and Setup

2.1 Boards

The following boards are needed:

- SSC Communication Board: SSCCOMMBOARDV4P1C
- ZSSC3240 Evaluation Board: ZSSC3240EVB

2.2 Evaluation Board Jumpers Setup

Remove all jumpers and ensure that J21, J22 (SPI side), J12 (5V side) are in place as per Figure 1.

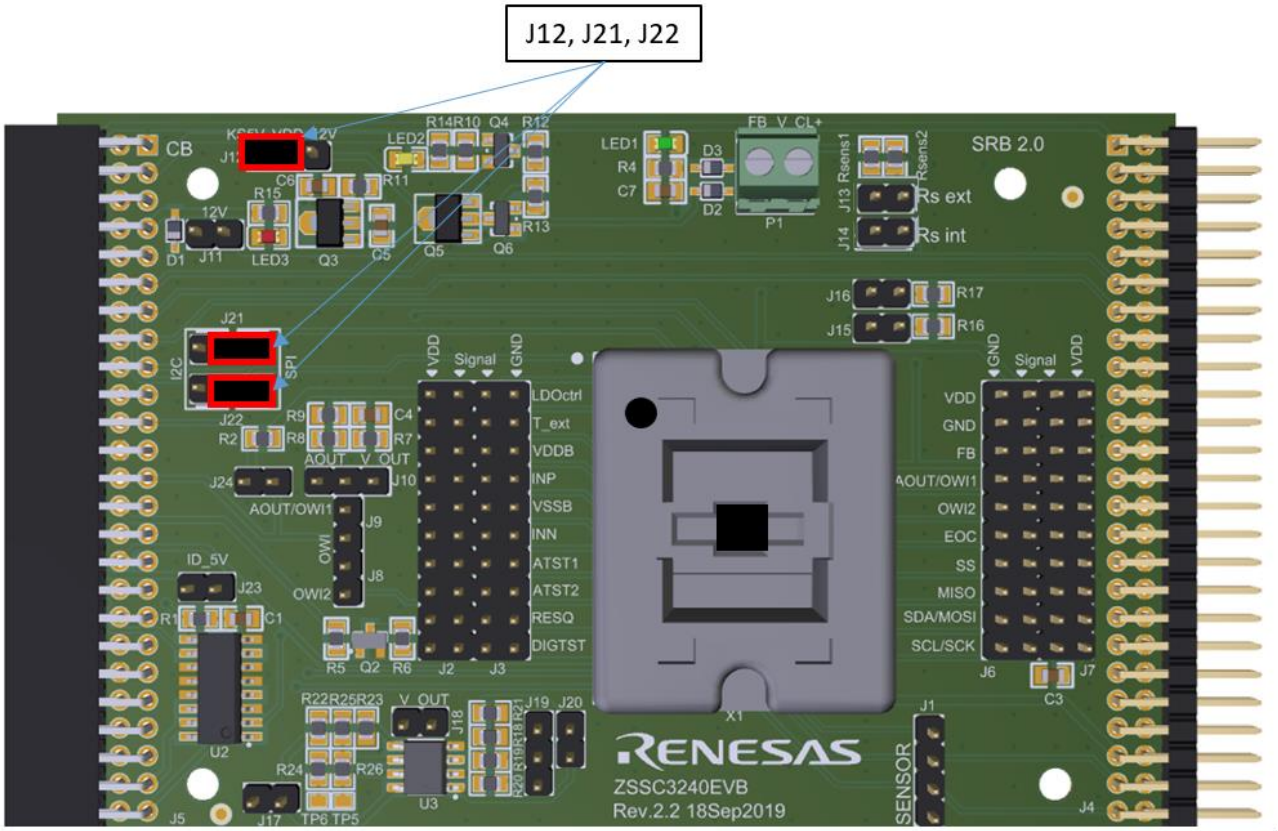


Figure 1. EVB Jumper Settings

2.3 Overall System Assembly

Connect the Communication Board to the ZSSC3240EVB through the dedicated connector, and attach the Communication Board to the host PC via a USB cable (see Figure 2).

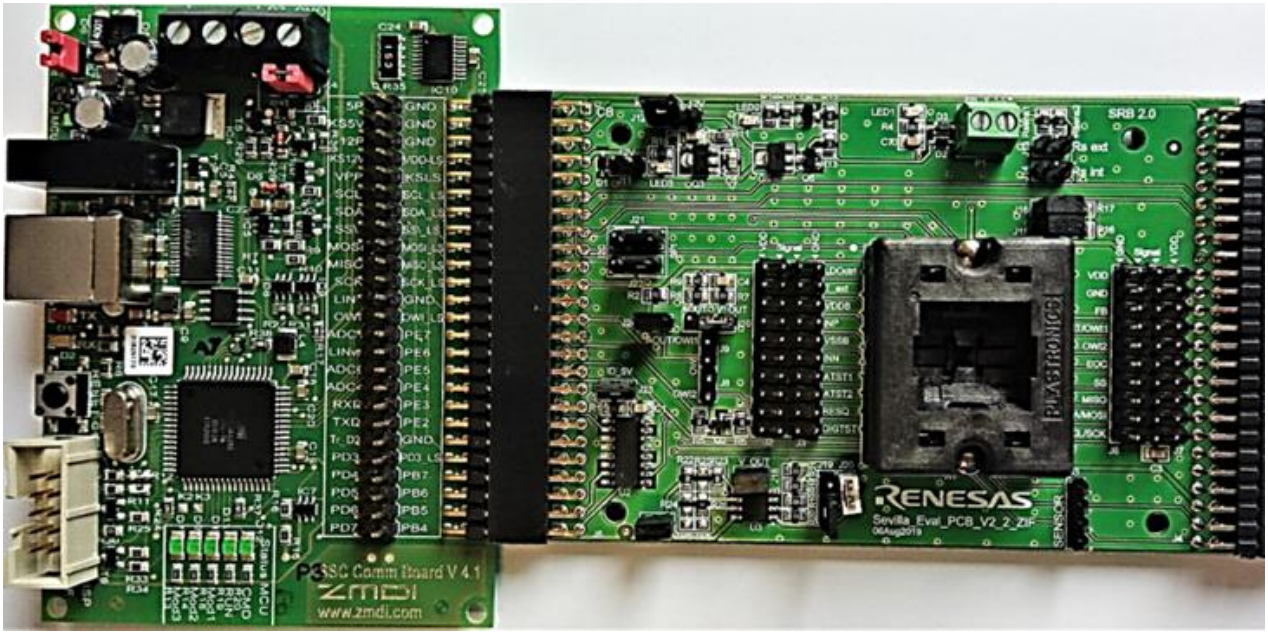


Figure 2. Overall System

3. Cyclic Mode

Single measurements requests to the ZSSC3240 (for example, the *AAHex* command) trigger the following sequence of basic measurements:

1. auto-zero-sensor measurement
2. sensor measurement
3. an auto-zero-temperature measurement and a temperature measurement
4. post acquisition correction
5. measurements are available to the user

For the complete list of commands for single measurements requests, refer to the *ZSSC3240 Datasheet* document. The ZSSC3240 can be configured for cyclic measurements, such that the host microcontroller is relieved to issue single measurement requests when the signal conditioner is configured with analog output.

3.1 Setup

ZSSC3240 powers up in Cyclic Mode if the *Default Mode* dropdown is set to Cyclic Mode on the *NVM* tab of the Main page of the GUI, see Figure 3.

Note: NVM has to be saved (by the Write NVM button) and reset before the IC powers up in Cyclic Mode, see Figure 4.

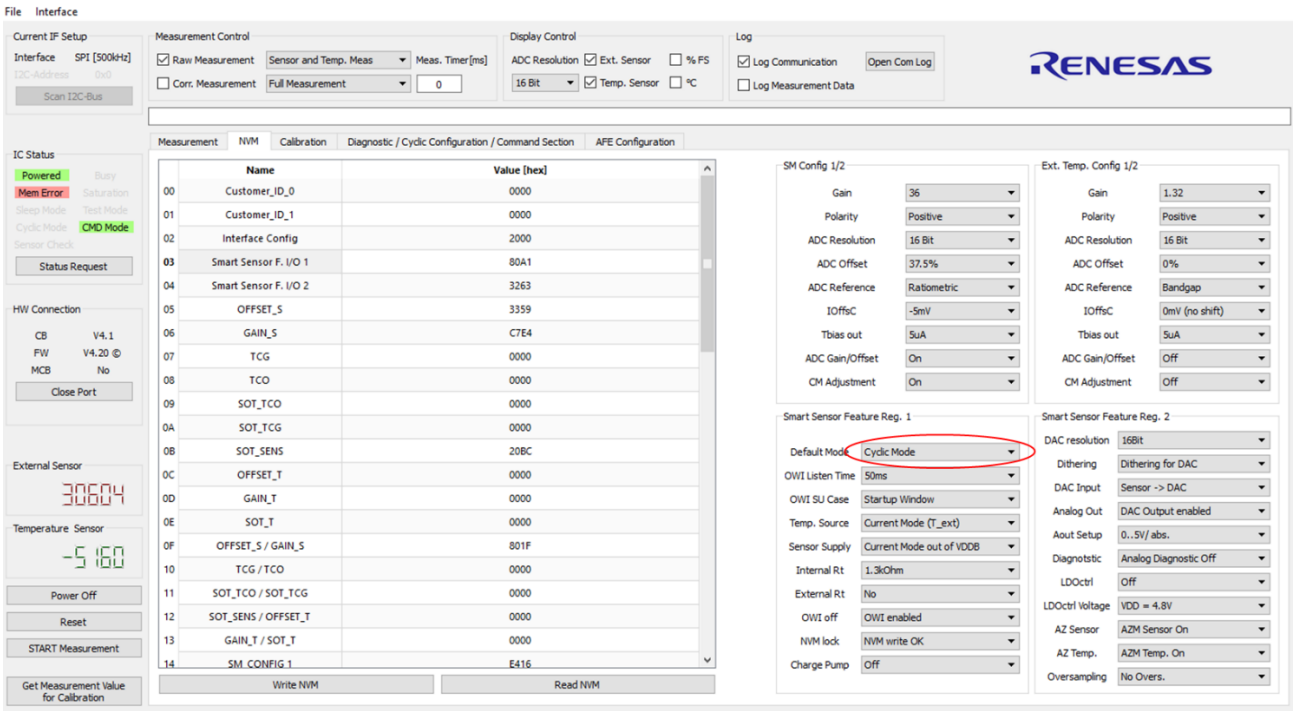


Figure 3. Mode Setting

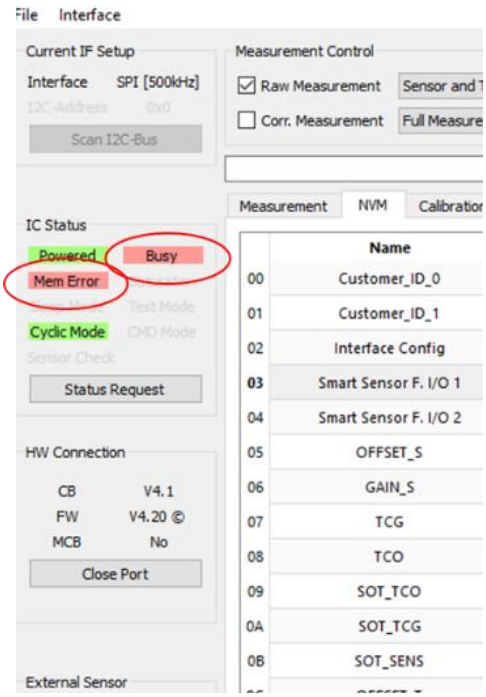


Figure 4. Cyclic Mode at Start Up

3.2 Exit

In Cyclic Mode the IC status is Busy, signifying that the ZSSC3240 is continuously measuring and converting the sensed signals. To exit Cyclic Mode click the 'Start Command Mode' button (see Figure 5) and enter the next user command.

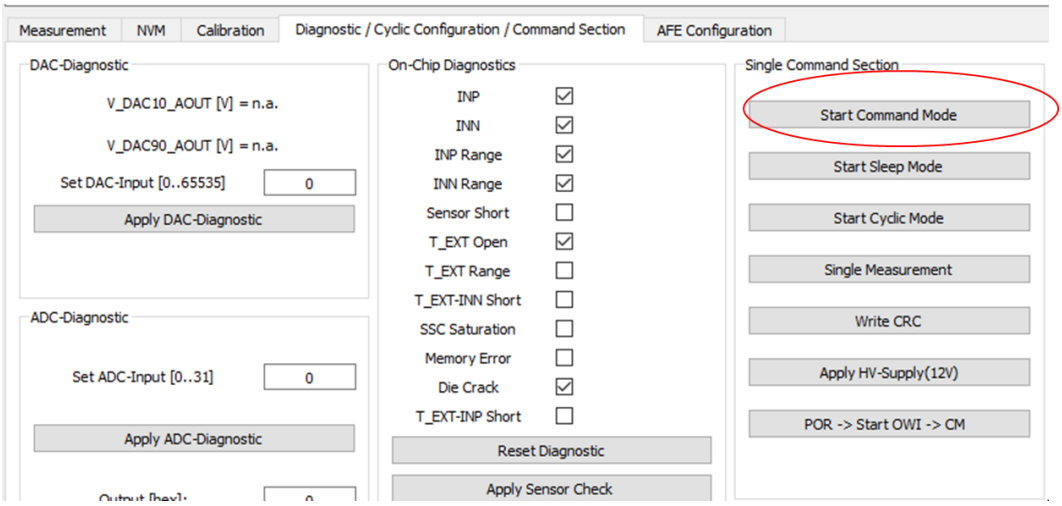


Figure 5. Entering Command Mode

3.3 EOC Signal

The output is provided at the AOUT pin (analog output) in Cyclic Mode. If the analog output is not activated in the device configuration, the microcontroller can monitor the EOC pin for updated data. The EOC signal is a pulse signalizing the effective end of conversion, i.e. the availability of the corrected measurement from the SSC calculation unit. With the default configuration (register 02_{HEX} -> INT_setup = 00_{BIN}) the End of Conversion pulse is indicating that a new measurement result is available in the output registers. It could be fetched by a reading sequence of the configured digital interface (SPI, I2C, OWI).

Figure 6 displays the EOC signal on the CH1 track and the AOUT level (0-5V range) on the CH2 track when the bridge provides an input signal that is converted to 2V66 output. The cycle is composed by AZSM, SM, AZTM and TM.

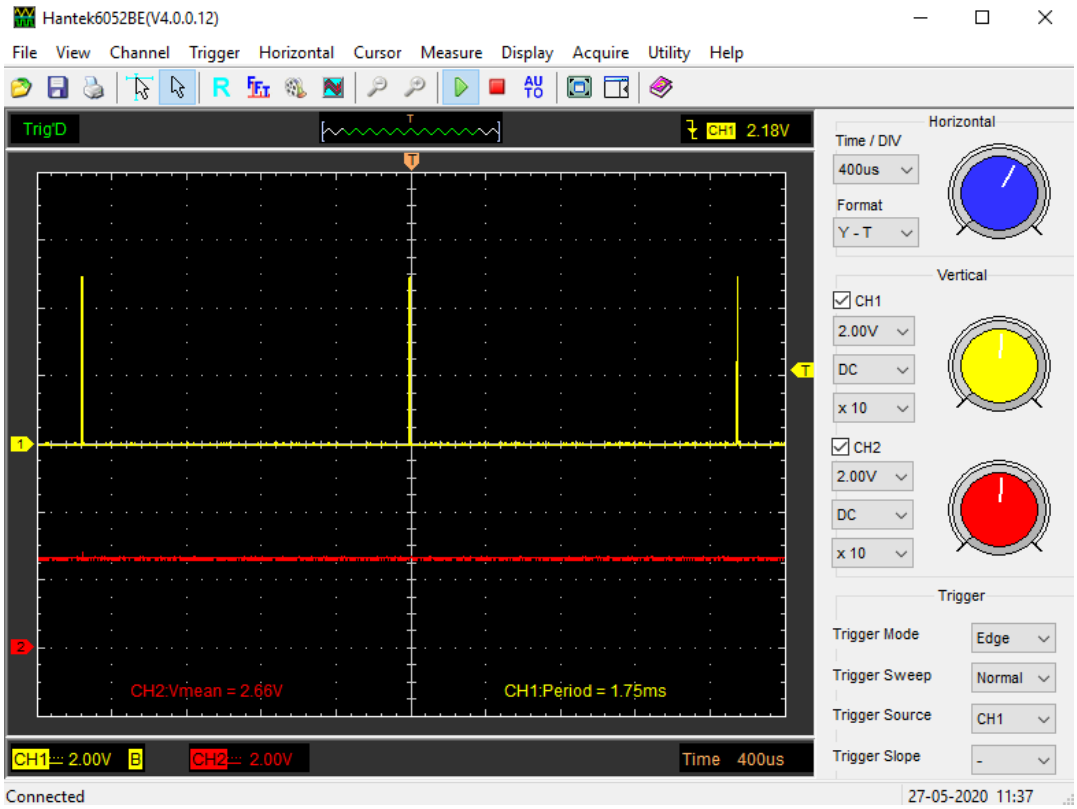


Figure 6. EOC and AOUT Signal

The end of conversion signal is issued after the AAHex command is received and the full sequence of AZSM, SM, AZTM and TM (including the correction calculation) is executed. Figure 7 shows the sequence of event started by the AAHex command.

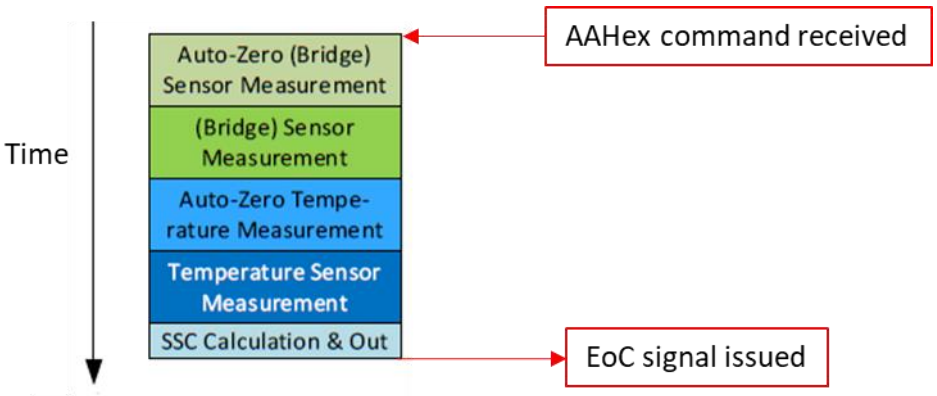


Figure 7. AAHEX Command for Full Measurement Sequence

The configurations analyzed in section 5 show how the EOC signal is issued in complex measurements schemes defined by the scheduler.

3.4 Measurement Time Slot

A measurement time slot denotes the time needed to complete a predefined set of measurements and update the ZSSC3240 output. Pauses between the slots must be defined by the update period (CYC_period). The first slot in a predefined sequence is defined as slot 0.

3.5 Analog Output Settings

Figure 8 shows the GUI options configuration to select the desired sensor data at the AOUT pin (sensor or temperature measurements).

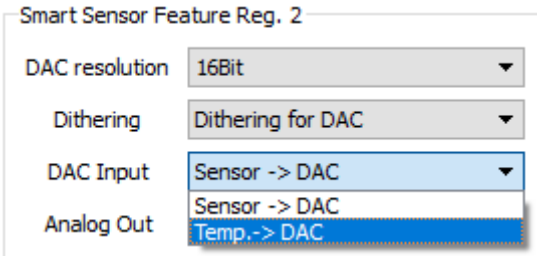


Figure 8. AOUT Data Selection

4. Scheduler GUI Control

Follow these steps to configure the measurement scheduler on the GUI (Diagnostic Tab):

1. Set the Cyclic Operation Sequence according to Figure 9 and save the configuration clicking the “Write to NVM” button.

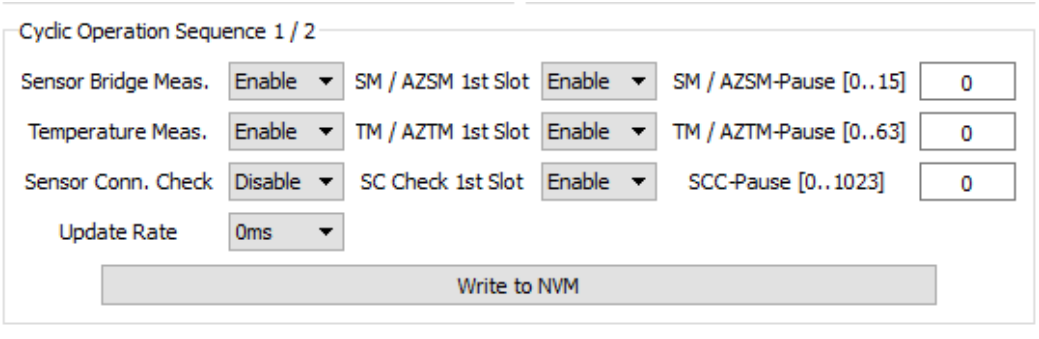


Figure 9. Scheduler for Cyclic Operation

2. Set the smart sensors according to Figure 10 to use Cyclic Mode and the Auto-Zero measurements.

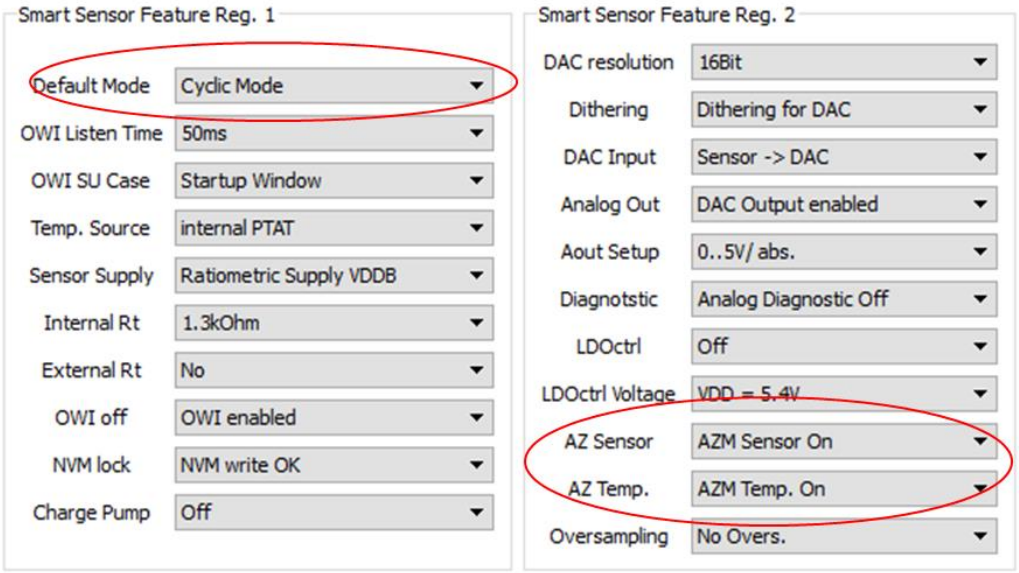


Figure 10. Cyclic Mode and AZs on the NVM Tab of the GUI

The displayed typical timing diagrams depend on the used device configuration, such as the ADC resolution (see Figure 4).

5. Scheduler Operation

The scheduler operation can be analyzed by probing the EOC signal. In the scope plots displayed in section 5 and 6, the channel CH1 is monitoring the EOC pin. The channel CH2 is generally used to monitor the AOUT pin and the analog output presence (Sensor or Temperature) with no specific goal of relating it with the input signal.

Numbers shown in this section represent typical values for the relevant configurations.

5.1 Scheduler without Configured Measurements

The first scheduler configuration analyzed is with no measurements active as per Figure 11.

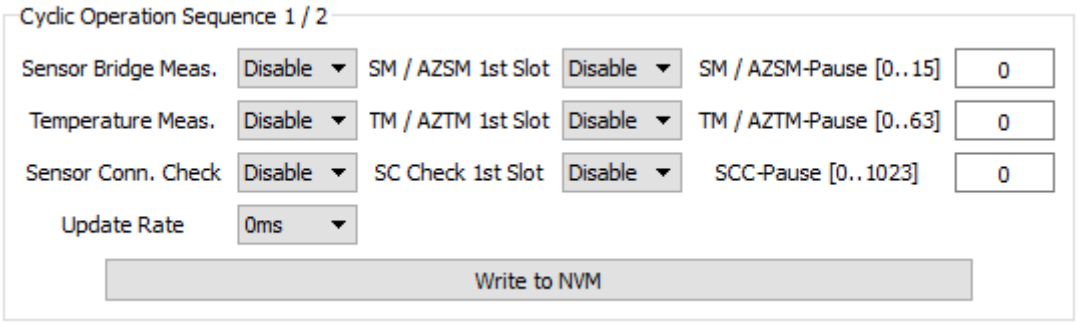


Figure 11. Scheduler Settings no Measurements

The scope plot shows the EOC signal behavior, see Figure 12.

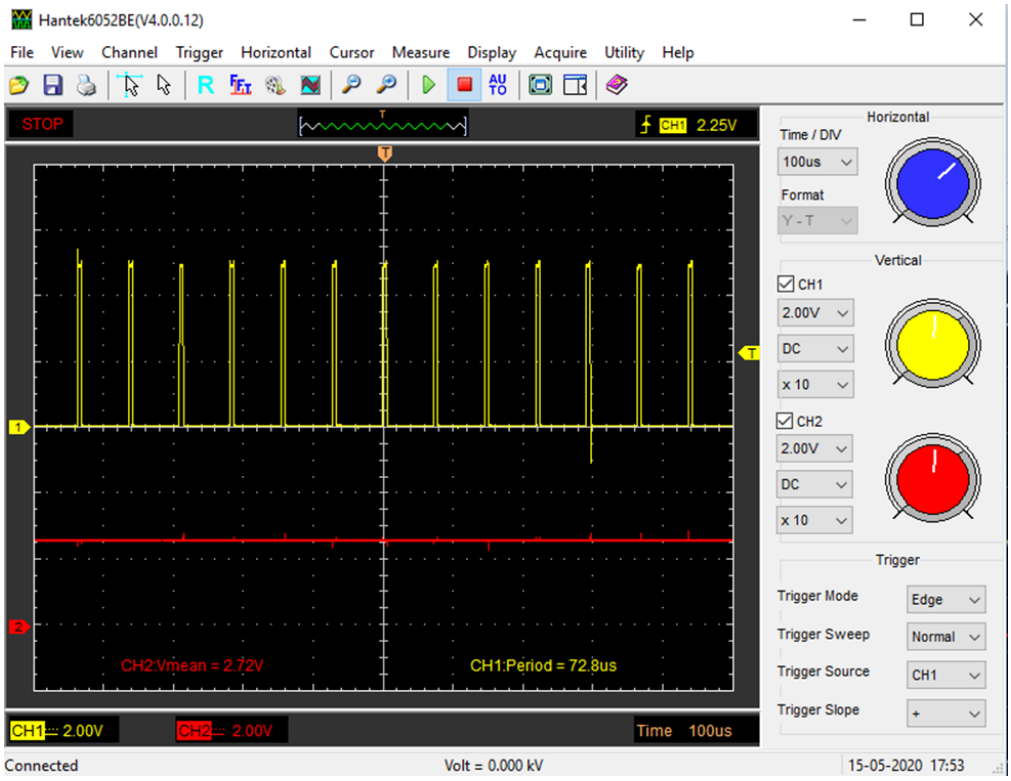


Figure 12. EOC Pin Output, no Measurements

A fixed interval between two adjacent time slots is present amounting to about 73µs. Since no measurements are configured for any time slot (not reasonable in practice), the time between the pulses is due to the processing duration performed by digital math core block, which is always active.

5.2 Scheduler with Activated SM

To enable the output at AOUT of the signal measurement, the settings are shown in Figure 13. Monitoring the EOC shows the timing in Figure 14.

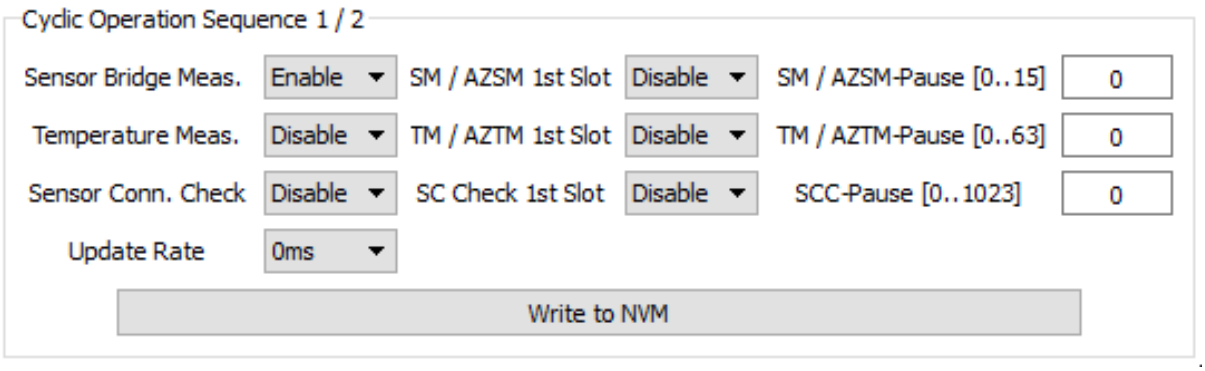


Figure 13. Scheduler Settings SM

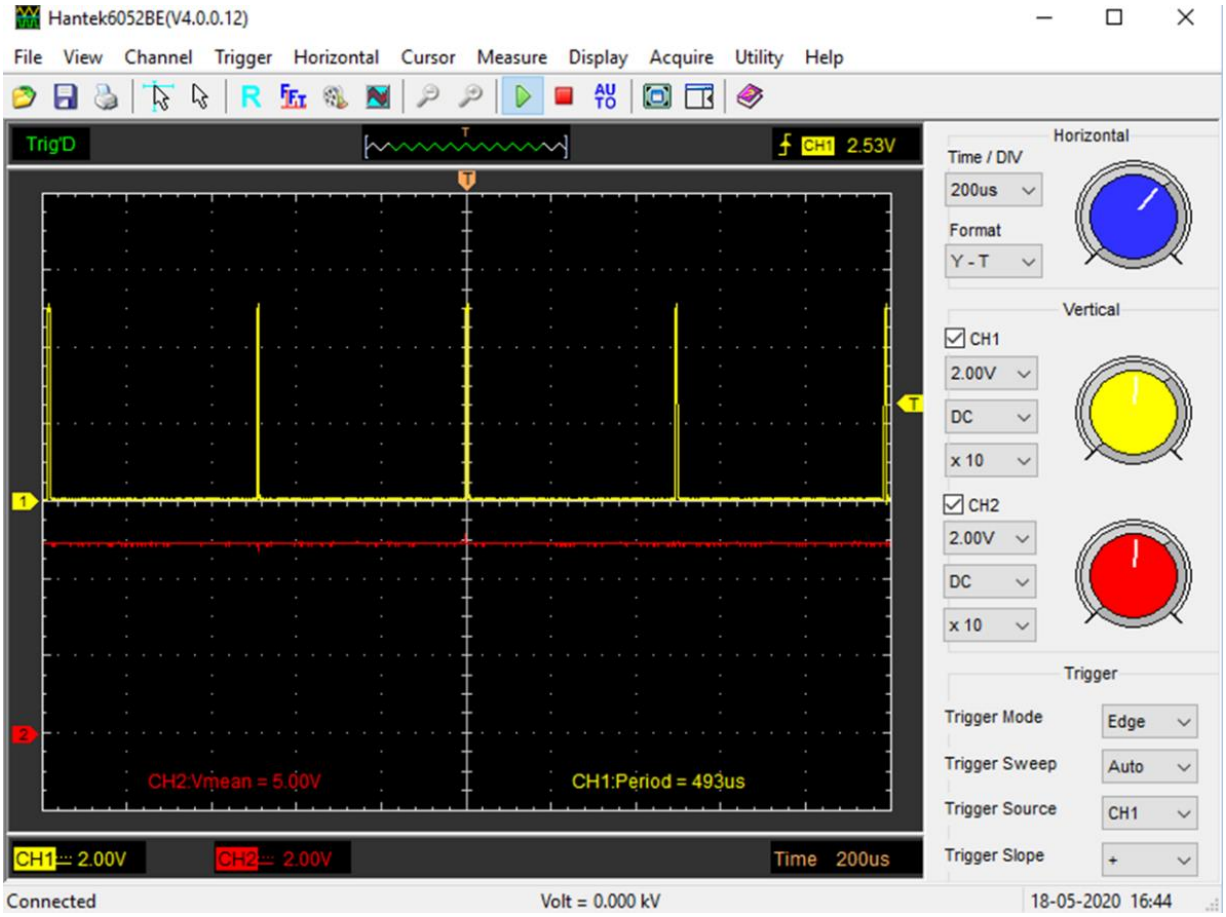


Figure 14. EOC Pin Output, SM

The SM measurement takes approximately 493µs - 73µs = 420µs.

5.3 Scheduler with AZSM + SM

To add and enable the AZ signal measurement, use the settings shown in Figure 15. Monitoring the EOC, the timing is shown in Figure 16.

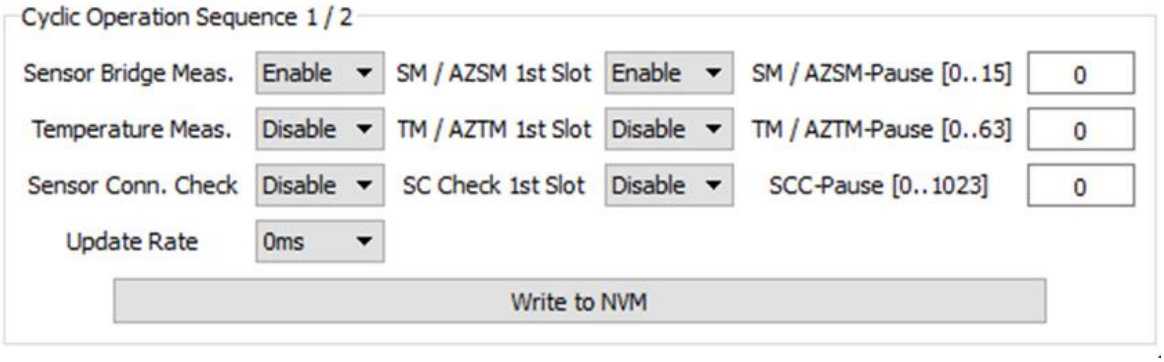


Figure 15. Scheduler Settings AZSM + SM

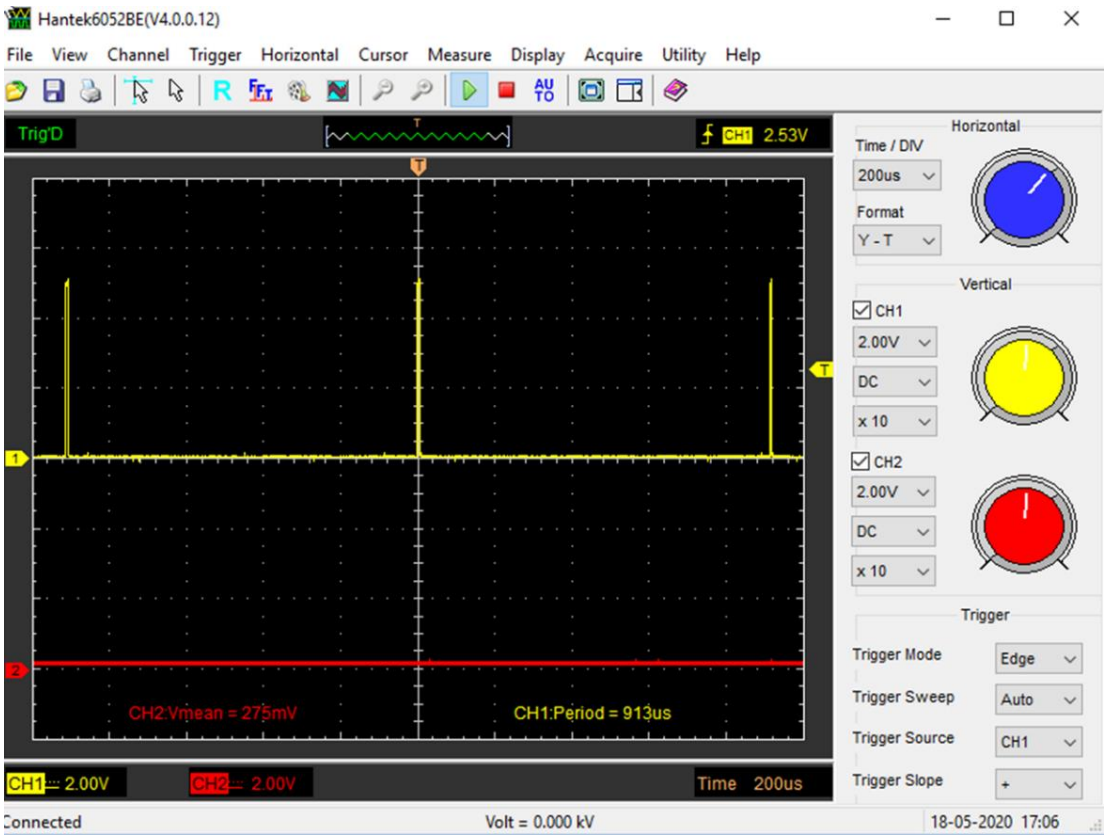


Figure 16. EOC Pin AZSM + SM

The timing accounts for 420µs (AZSM) + 420µs (SM) + 73µs = 913µs.

5.4 Scheduler with External AZTM + TM

Data can be collected for the external temperature sensor. Summary of the measurements (not included for brevity) shows the same behavior as the SM.

The timing accounts for 419µs (AZTM) + 419µs (TM) + 73µs = 911µs.

5.5 Scheduler with AZSM, SM, AZTM and TM

The full set of measurements is achievable with the settings in Figure 17.

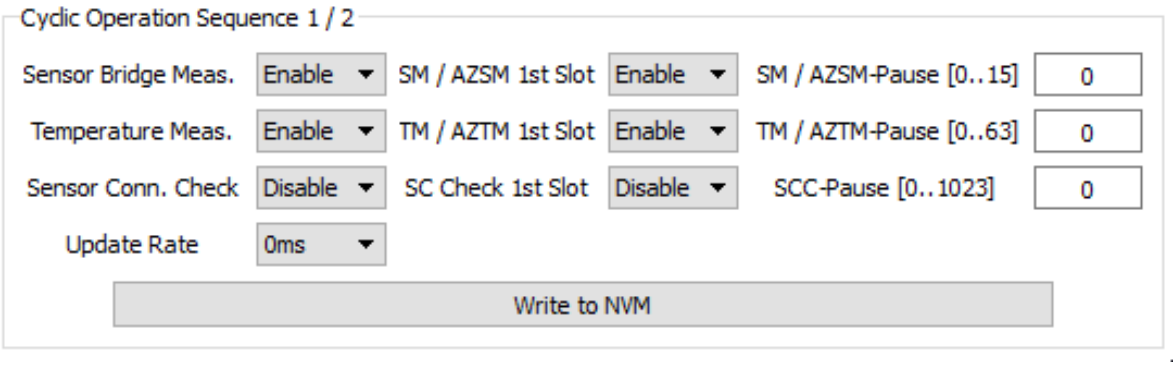


Figure 17. Scheduler Settings AZSM + SM + AZTM + TM

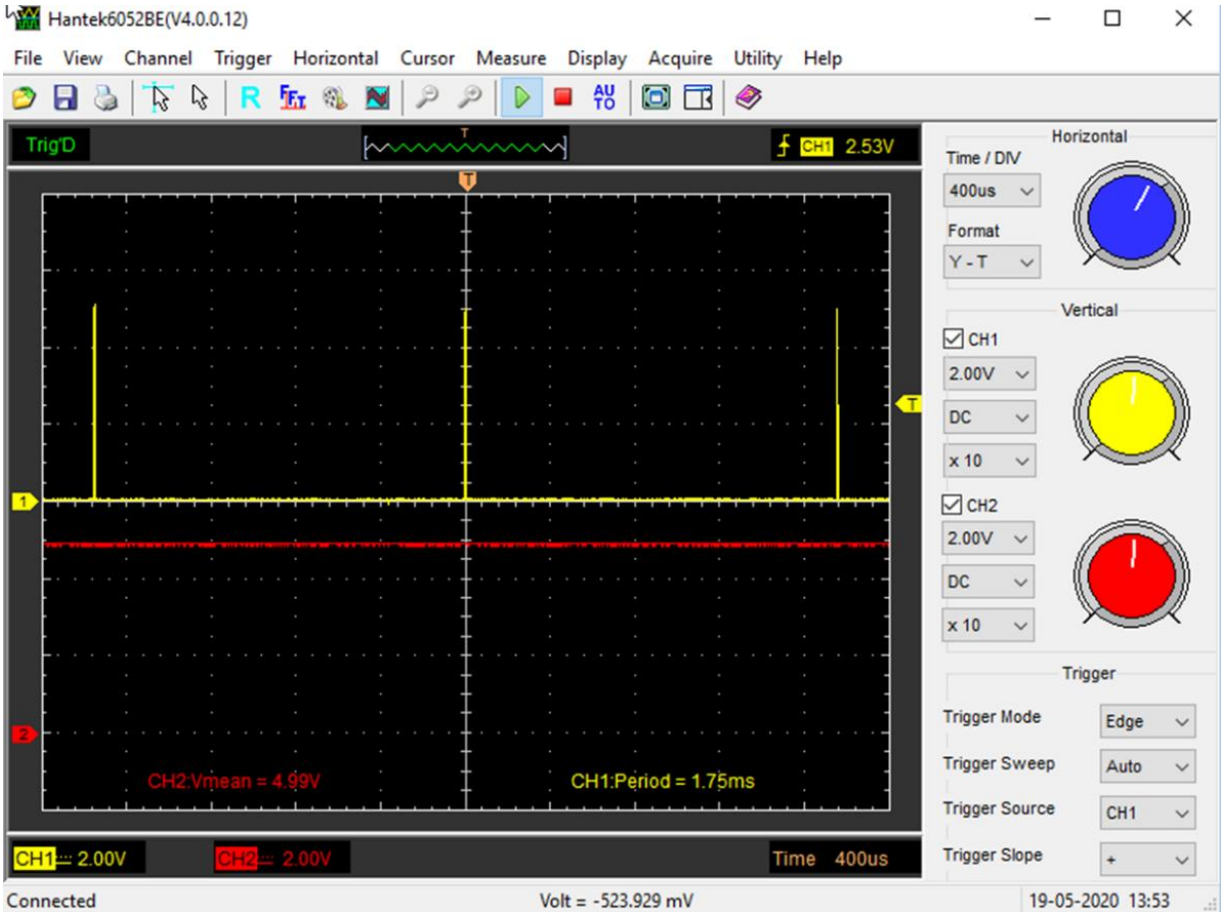


Figure 18. EOC Pin AZSM + SM + AZTM + TM

Summary of measured EOC timings is provided in Figure 19.

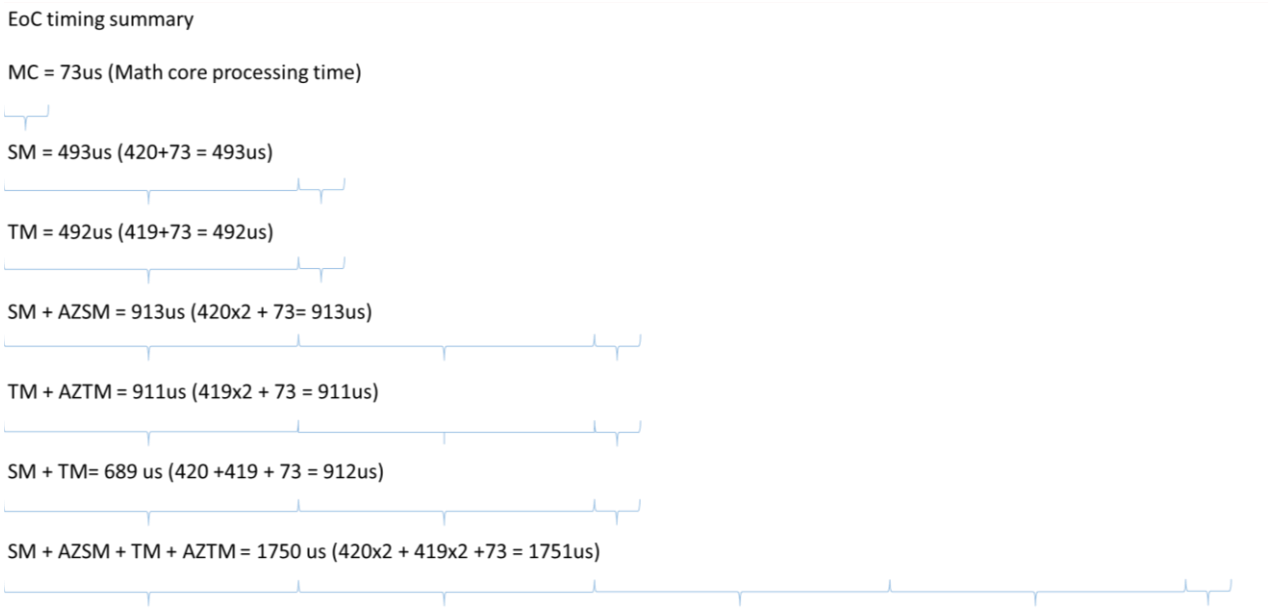


Figure 19. Summary of Measured EOC Timings

5.6 Sensor Connection Check

The diagnostic checks available in the ZSSC3240 are one component of the tasks that can be included by the scheduler, in addition to the sensor and temperature measurements. “Cyclic Operation Sequence 1 / 2” part of the GUI settings are dedicated to show these measurements, see Figure 20. The set of the checks to be performed can be defined using the selection boxes of the “On-Chip Diagnostic” section in the Diagnostic Tab of the GUI.

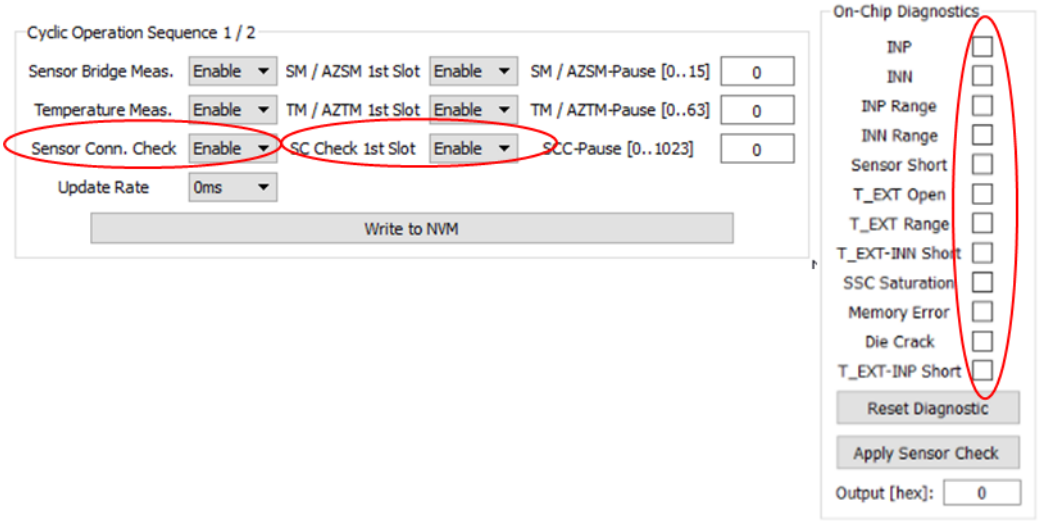


Figure 20. Scheduler Settings SC Check and Checks Selection

The amount of time (time between two consecutive EOC pulses) for the sole SC check depends on the number of check selected and spans about from 80µs and 347µs (all checks active).

5.7 Update Rate

The scheduler allows the introduction of a selectable delay between the measurement slots, as shown in Figure 21.

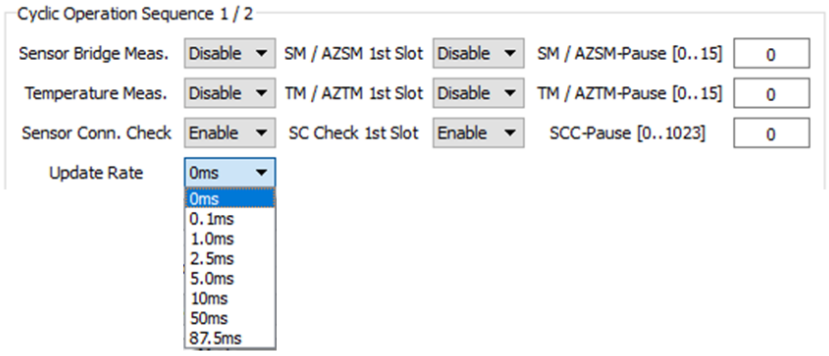


Figure 21. Update Rate Setting

The selection of 1ms delay in a AZSM+SM+AZTM+TM sequence with 1 slot pause for the temperature measurement is shown in Figure 22.

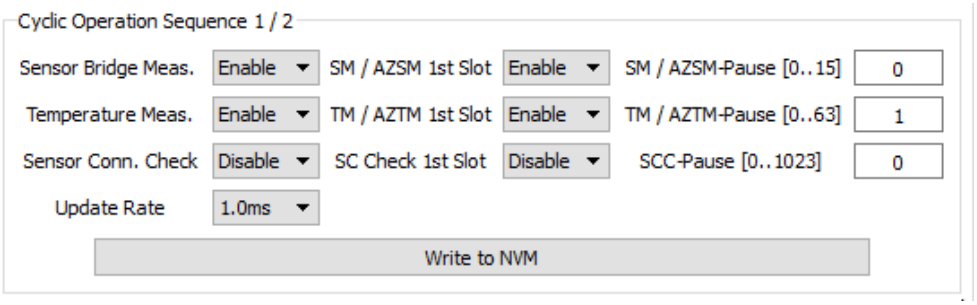


Figure 22. 1ms Update Rate Delay

The result of the above setting is displayed in Figure 23. It shows a slot with AZSM+SM+1ms delay (approximately 0,92ms + 1ms ~ 1,98ms) and a slot with AZSM+SM+AZTM+TM+1ms delay (1,84ms + 1ms ~ 2,826ms).

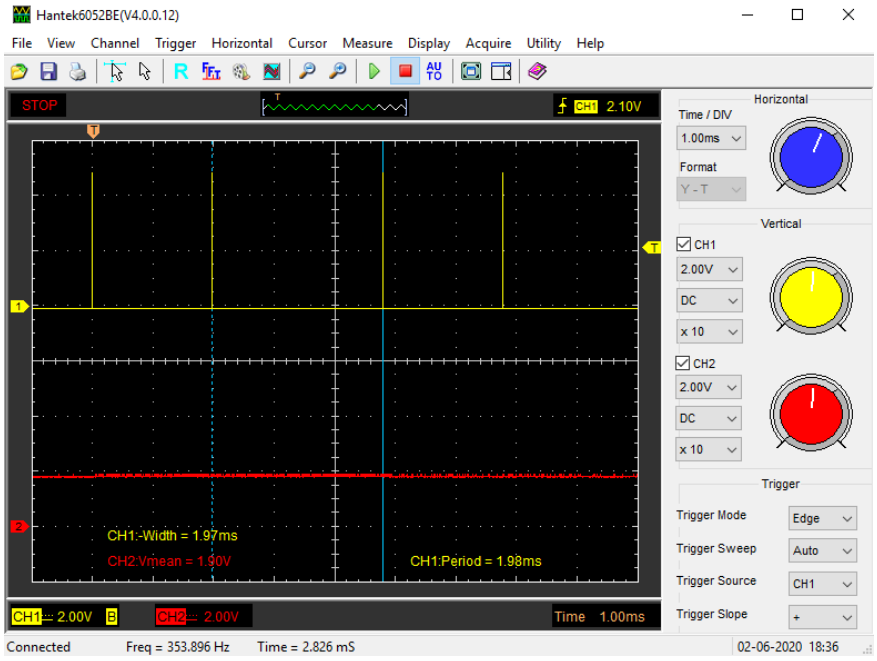


Figure 23. Measurements Slots with 1ms Delay

6. Scheduler Operation Examples

6.1 Example 1

The desired measurements slots sequence is displayed in Figure 24.

SLOT N°	Measurements
0	AZSM + SM +AZTM +TM
1	No Measurement (*)
2	AZTM +TM
3	AZSM + SM
4	AZTM +TM
5	No Measurement (*)
Repeat from 0	AZSM + SM +AZTM +TM

Figure 24. Example 1 Sequence

In Figure 25 the required GUI settings are described.

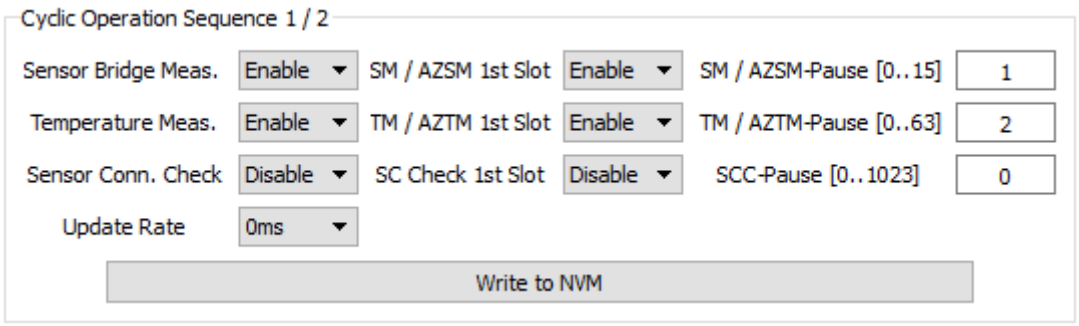
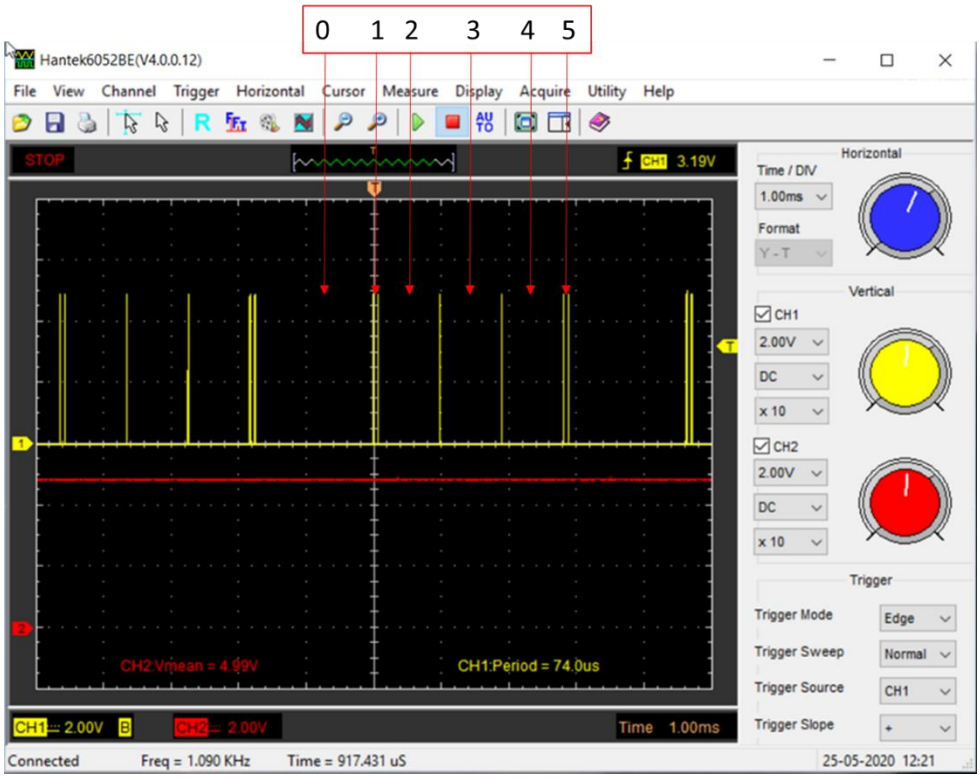


Figure 25. Example 1 GUI Settings

The result, after activation of the Cyclic Mode, is visible in Figure 26, the slots are identified by the red arrows.



The “no measurements” slot, math core operation time, lasts about 73µs.

Figure 26. Example 1 Slot Timings

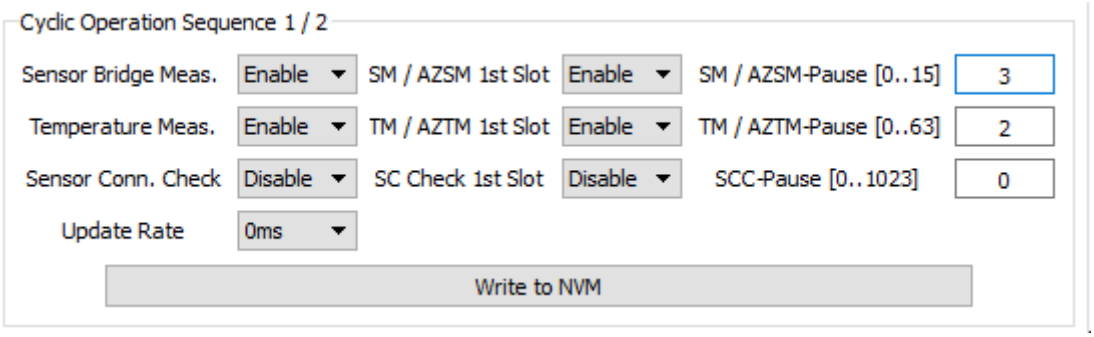
6.2 Example 2

The desired measurements slots sequence is displayed in Figure 27.

SLOT N°	Measurements
0	AZSM + SM +AZTM +TM
1	No Measurement (*)
2	No Measurement (*)
3	AZTM +TM
4	AZSM + SM
5	No Measurement (*)
6	AZTM +TM
7	No Measurement (*)
8	AZSM + SM
9	AZTM +TM
10	No Measurement (*)
11	No Measurement (*)
Repeat from 0	AZSM + SM +AZTM +TM

Figure 27. Example 2 Sequence

In Figure 28 the required GUI settings are described.



The “no measurements” slot, math core operation time, lasts about 73µs.

Figure 28. Example 2 GUI Settings

The result, after activation of the Cyclic Mode, is visible in Figure 29, the slots are identified by the red arrows.

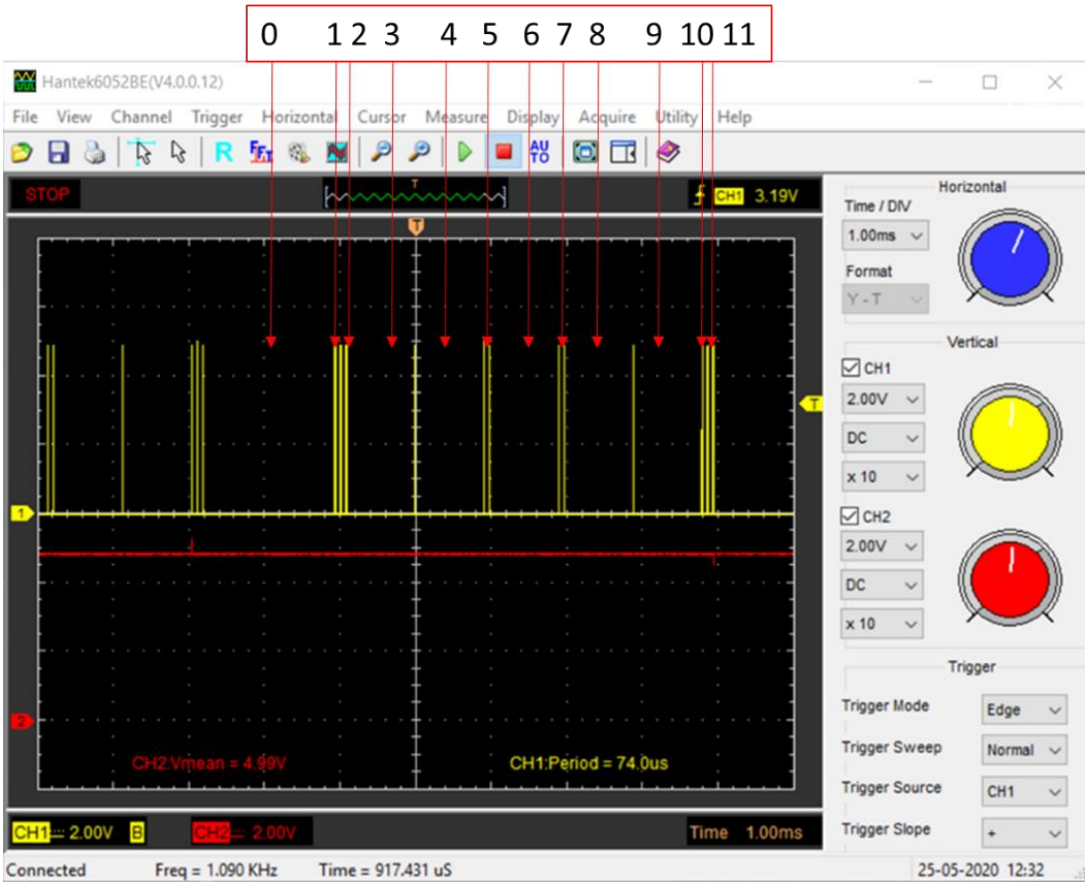


Figure 29. Example 2 Slot Timings

6.3 Example 3

The desired measurements slots sequence is displayed in Figure 30.

SLOT N°	Measurements
0	AZSM + SM + ASTM +TM+ SC check
1	SC Check
2	AZSM + SM + SC check
3	AZTM + TM + SC check
4	AZSM + SM + SC check
5	SC Check
Repeat from 0	AZSM + SM + ASTM +TM+ SC check

Figure 30. Example 3 Sequence

In Figure 31 the required GUI settings are described.

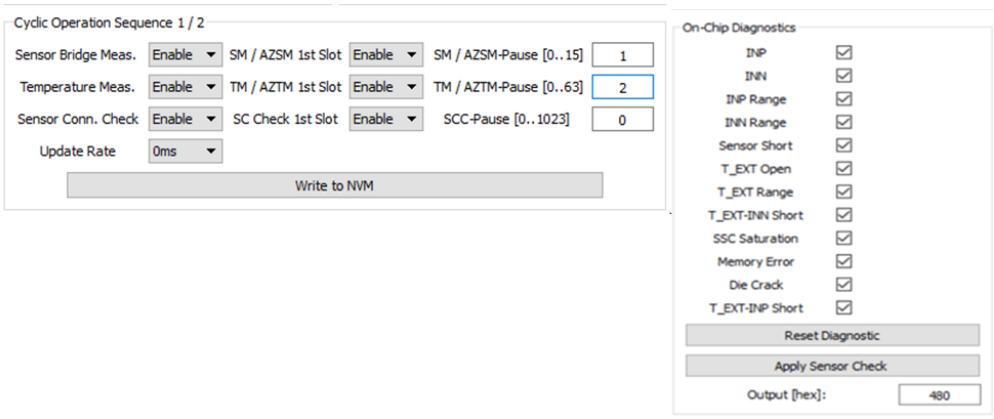


Figure 31. Example 3 GUI Settings

The result, after activation of the Cyclic Mode, is visible in Figure 32, the slots are identified by the red arrows.

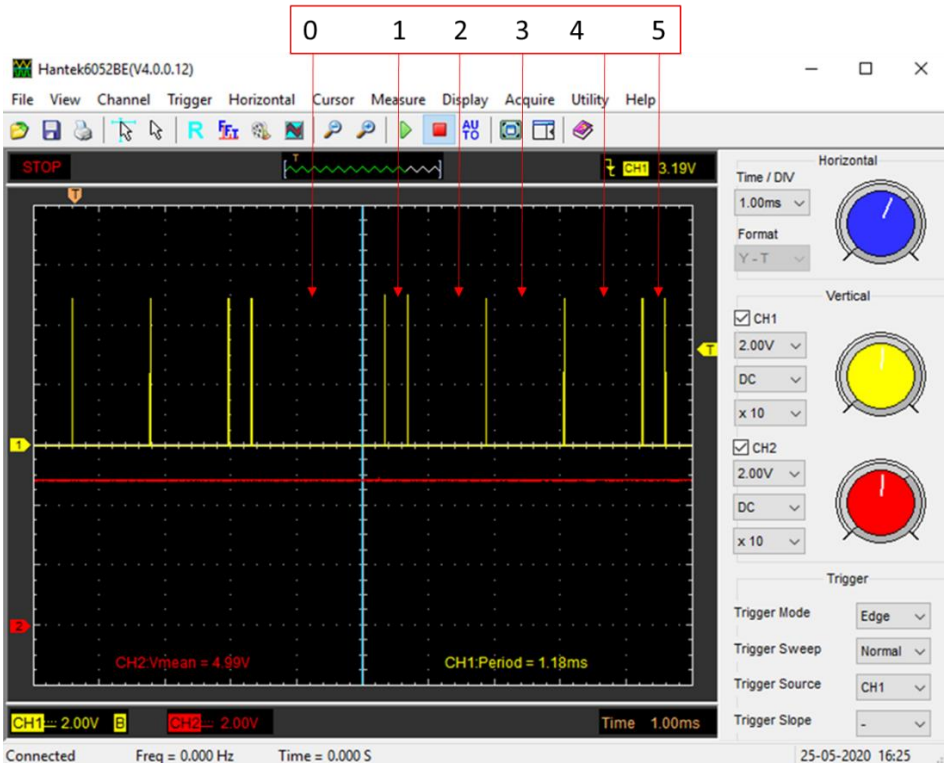


Figure 32. Example 3 Slot Timings

7. Glossary

Term	Description
AZ	Auto Zero
AZSM	Auto Zero Sensor Measurement
AZTM	Auto Zero Temperature Measurement
SM	Sensor Measurement
TM	Temperature Measurement
SC	Sensor Connection
GUI	Graphical User Interface
IC	Integrated Circuit
NVM	Non Volatile Memory
PC	Personal Computer
SSC	Sensor Signal Conditioner
EOC	End of Conversion
MC	Math Core

8. Revision History

Revision	Date	Description
1.00	Jul 7, 2022	Initial release.

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