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Innovation Matters

E703.11 Evaluation Kit

rev. 1.0

Evaluation Kit – E703.11

- Content of the Evaluation Kit
  - Hardware Components
  - PC Software Tool (PSSC GUI)
  - Documentation
- Getting Started
  - Hardware & Software Set-up
  - Calibration Example

Content

Evaluation Kit – E703.11

- Evaluation Kit Content:

  Order Code: K70311-0001 (complete kit)

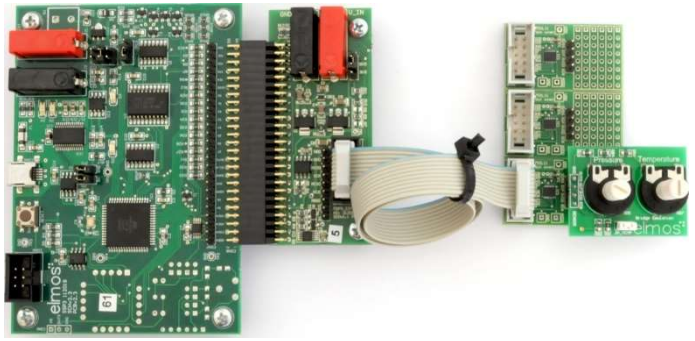
  - SSP3 Board

    Order Code: Z00000-0015
  - Interface Board

    Order Code: K70311-0003
  - Application Circuit Board

    Order Code: K70311-0004
  - Sensor Emulator (span 25mV/V)

    Order Code: K70311-0005
  - Cables
  - USB Stick



Content of the Evaluation Kit

Evaluation Kit – E703.11: Hardware Components

SSP3 Board

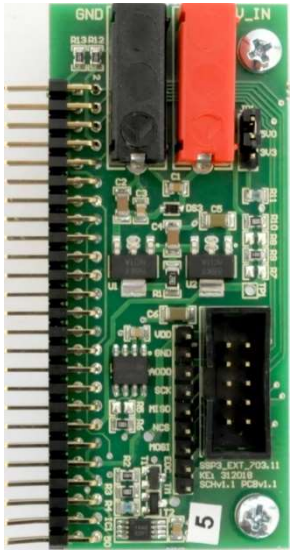
Computer to signal conditioner communication interface:

- USB based (virtual com port)
- 1-Wire (SIO), I²C and SPI output supported

Interface Board

Programmer interface for the E703.11:

- Connection to application circuit board and external 5V power supply option



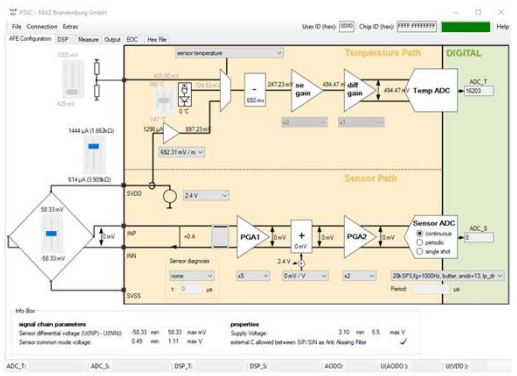
Application Circuit Board

Carrier PCB for the E703.11:

- Supports initial prototype and configuration tests with custom pressure sensing elements

Evaluation Kit – E703.11

- PC Software Tool (PSSC GUI)
  - Chip Configuration
  - Sensor Calibration
  - Sensor Verification



Calibration Kit Software

PC Software Tool – PSSC GUI Overview

Introduction

- GUI Functionality and Use Cases:

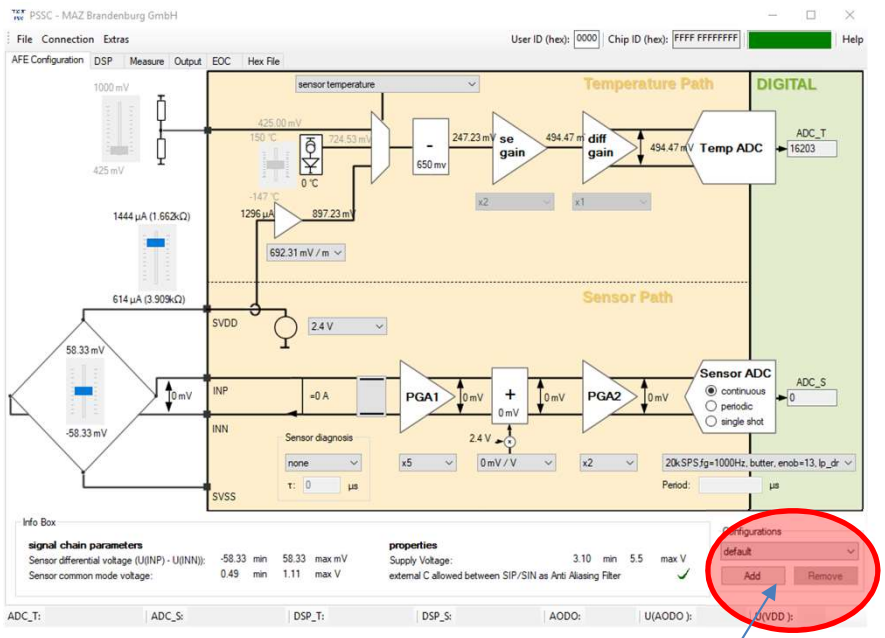
The GUI is used to determine the correct configuration settings of the 703.11 signal conditioner for a specific application.

The graphical presentation of the main functional blocks guide the user through the configuration process. The GUI consists of three main configuration blocks: analog frontend, digital signal processor and output interface. An additional window allows to configure a digital pin as output of status register signals.

A coloured indication box signals the connection status. After the hardware is connected the colour is changed from red to orange. When the configuration is loaded to register memory it changes into green. If the configuration changes again the colour changes back to orange.

The GUI can also be configured using setup files. Two different formats can be used : XML-Files with the entire content of a calibration session or a hexadecimal file containing only the NVM-content. The XML-setup files can include different sets of configurations. A stored configurations can be activated by name using a configuration window´.

PSSC GUI start window



Automatic NVM-CRC-updates

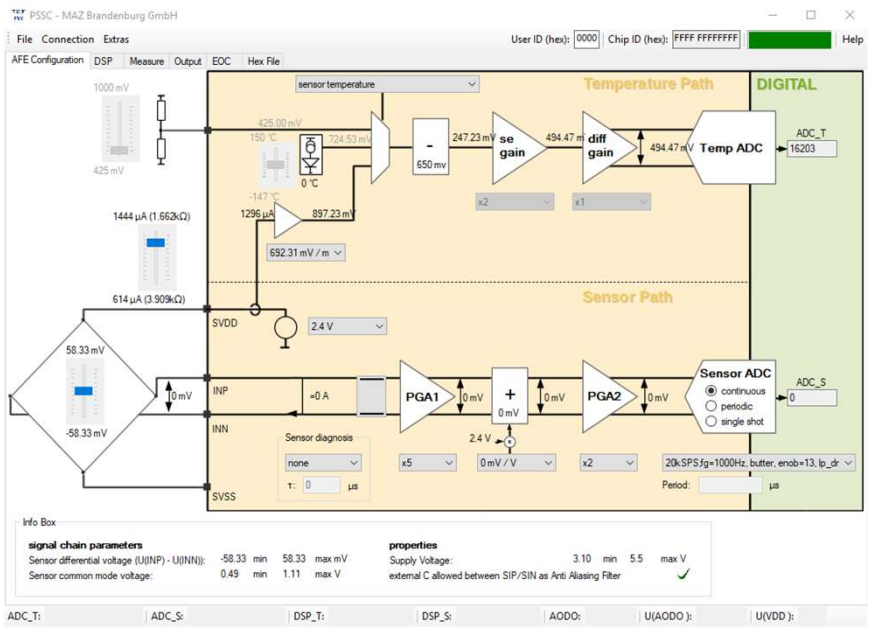
When the NVM content is changed it is necessary to update the check sum. The GUI software calculates a new CRC automatically, if needed.
The GUI can work with different configuration settings if enabled under Extras-> Options. In this case a configuration window is shown.

Configuration – Analog Front End (AFE)

Settings

- Temperature Path:
  - Input multiplexer setting determines temperature sensing source (chip temperature, sensor temperature or external voltage)
  - Single ended and differential gain amplifiers
  - Bridge current amplifier
- Sensor Path:
  - Bridge supply voltage SVDD (1.6V, 2V, 2.4V)
  - High-Z mode
  - Signal inversion swaps SIN and SIP
  - Sensor and wiring diagnostics
  - PGA (max. 700mV at any point)
  - Offset (absolute offset at SIP/SIN)
- Sensor ADC:
  - Pressure signal bandwidth, accuracy and output update rate widely configurable
  - Different sampling modes available

AFE Tab



Datasheet

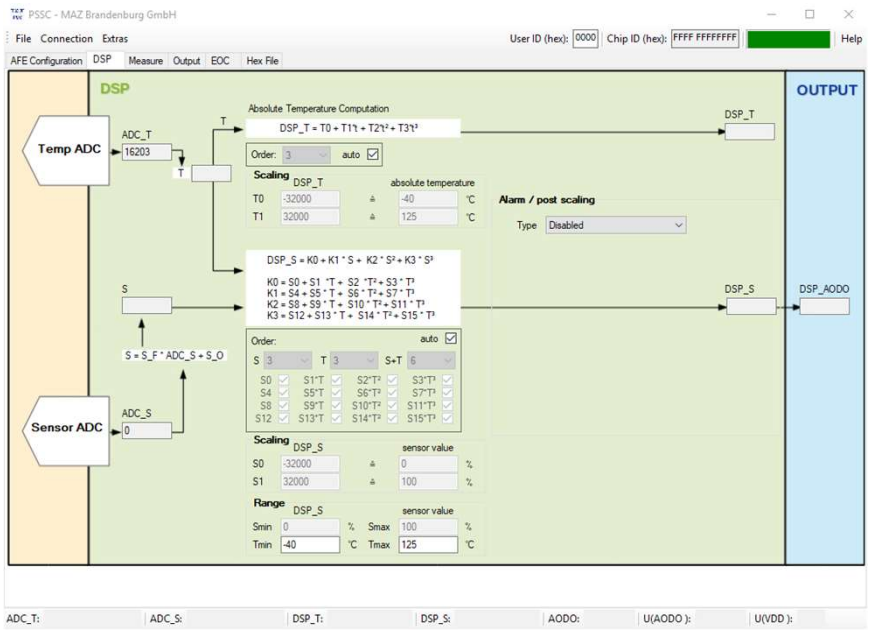
Please see chapter „**Configuration Tables**“ of the E703.11 datasheet for a detailed explanation of the front end functionalities to determine the best settings for your sensor.

Configuration – Digital Signal Processor (DSP)

Settings

- Temperature Path:
  - One dimensional, up to 3rd order polynomial gain and offset scaling of ADC_T/TC
  - DSP_T can provide accurate absolute temperature
- Sensor Path:
  - Two dimensional, up to 3rd order polynomial gain and offset scaling of ADC_S
  - Temperature and sensor range settings
  - Alarm thresholds (HIGH and LOW)
  - Corrected sensor signal DSP_S
- Calibration Order:
  - It is recommended to use AUTO order at the beginning. In this case the GUI is calculating the best fit result using an integrated algorithm and the number of provided calibration measurements.
  - During later development states, it is also possible to choose correction orders manually based on sensor characteristics and calibration points.
  - During final optimization steps, with the purpose to reduce test time, it is also possible to use statistical coefficients.

DSP Tab



Note

Scaling: enter input values for digital output scaling in section

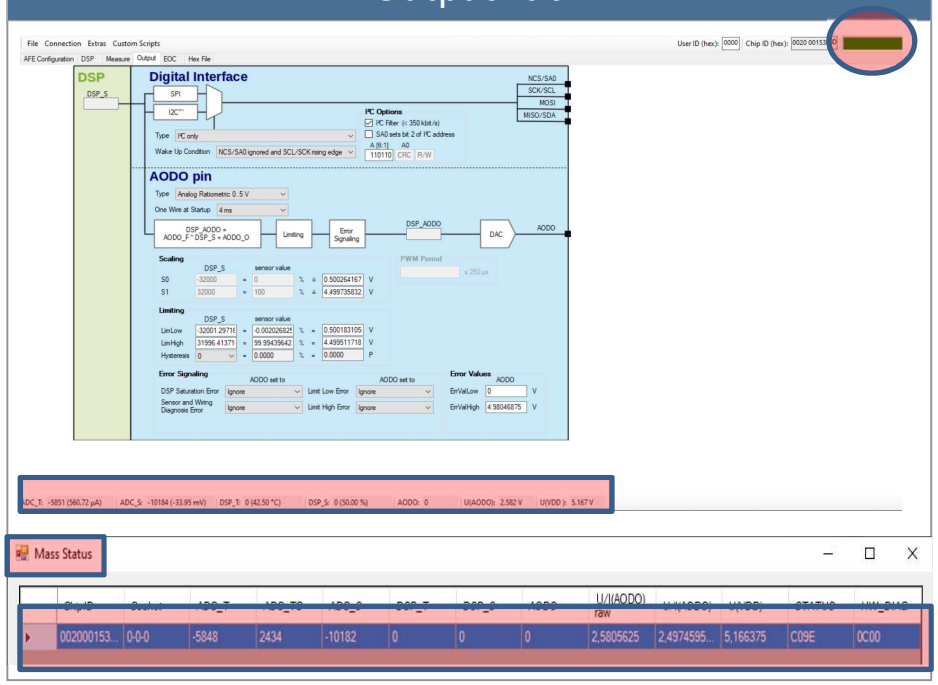
Range : enter input values for used ranges for increased accuracy with optimized ADC- range usage

Configuration – Output

Settings

- Digital Interface:
  - **Default start up mode**: *I²C/SPI selected by pull up/down on NCS pin at power-on*
  - I²C, SPI, One wire
  - I²C- address and filter configuration
  - Wake-up conditions
- AODO Pin:
  - Ratiometric voltage output scaling ($AODO = AODO\_F \cdot DSP\_S + AODO\_O$)
    - Rescaling of output range possible without new calibration
  - Limiting (high and low limits with common hysteresis)
  - Error signaling

Output Tab



Output Register Content

Current measurement values available (e.g DSP_S , AODO, ..) for evaluation on the bottom of the GUI after status is green.

Same information can be found under Extras-> MassStatus

(red marked area)

Configuration – Digital Signal Output

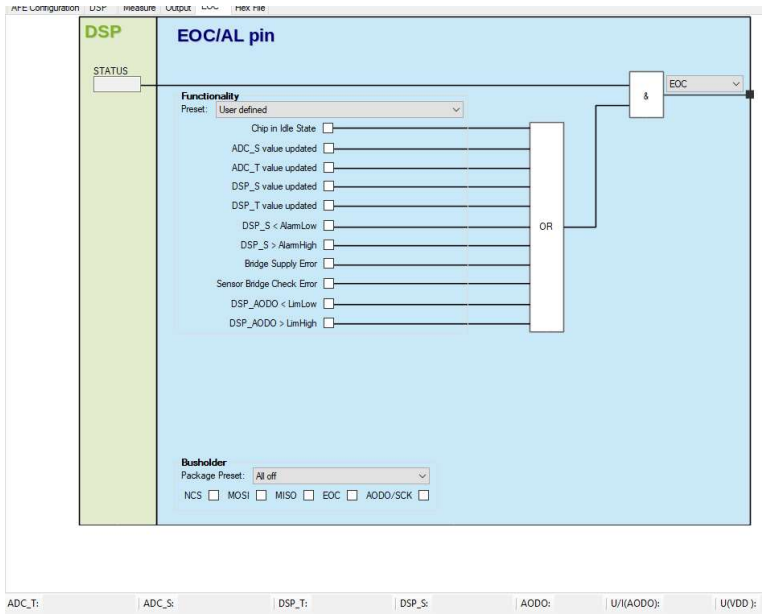
Settings

- Digital Signal Output:
  - Status information
  - Alarm output

Use cases of the digital output can be a trigger output for an end of conversion signal (EOC) to start data collection or an alarm output in case a digital threshold has been reached.

It is possible to switch the EOC functionality to a different output pin. This feature is useful in case the EOC pin is not accessible.

EOC/AL configuration Tab



Attention

Configuration options for pin-signal association are described in the data sheet pin description.

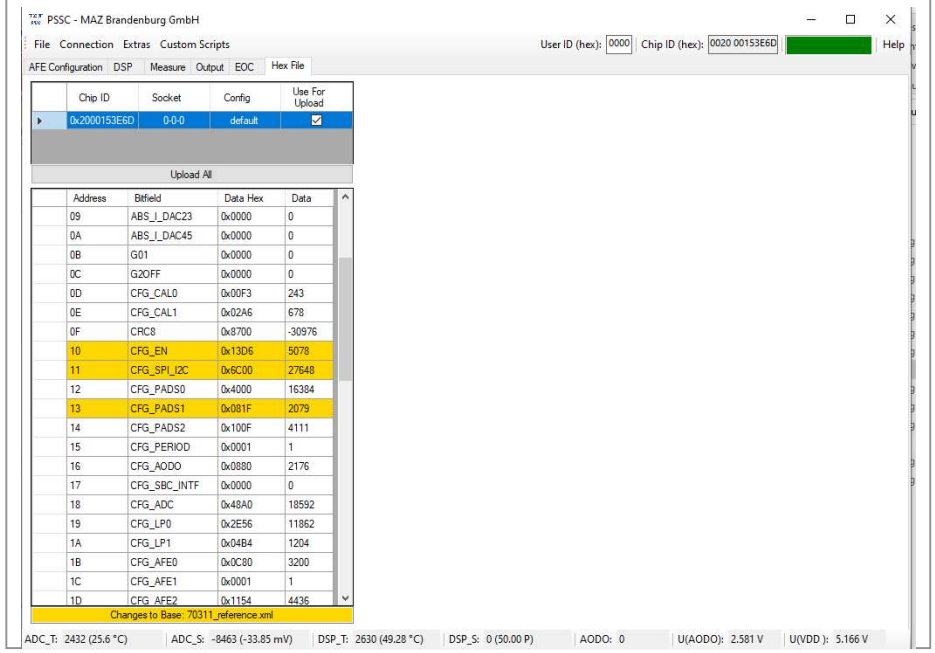
Configuration – Hex File

Memory information and upload

- Memory Map Image :
  - Select by:
    - Chip ID
    - Used configuration name
  - Use upload selection marker to prepare upload
  - 70311_reference.xml for comparison

The configuration currently used in the GUI related to the different settings is shown in the hex-Tab as an image of the configuration memory. This image can be loaded to the RAM if the upload switch is marked. The yellow fields indicate differences between a 703.11 reference XML-File when it is placed in the same directory as the executable GUI file.

Hex- File -> configuration memory



Upload

Displayed configuration from the Hex-tab can be uploaded from the Connection – tab to RAM or permanently stored to NVM

Configuration – Extras -> Options

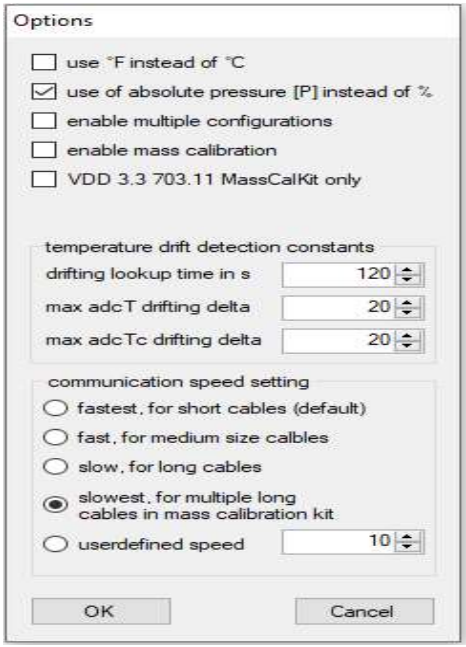
GUI - configurable options

- Additional Configuration Settings :
  - Switch temperature unit between F and C
  - Use absolute pressure values in DSP-Tab
  - Enable usage of different configuration settings in AFE-tab
  - Enable Mass_calibration when MassCal Kit -Is connected
    - Switch from 5V to 3.3V Supply (703.11 only)
  - Setup temp drift window during measurement of calibration values
    - Window opens during measurement collection and indicates stable temperature condition for ADC_T and ADC_TC
  - Select communication speed depending on capacitive load conditions:

I2C/SPI [kbit]	1-wire in [bit/khz]
1) 100	100
2) 70	50
3) 50	7
4) 30	6

    - 5) User defined

Options-tab

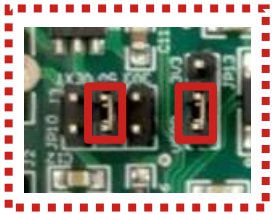


Attention

When selecting the communication speed it is also important to keep the startup-window for one-wire communication in mind. A message has to be fully received within the startup window.

Hardware Setup – 703.11 (5V-USB or external)

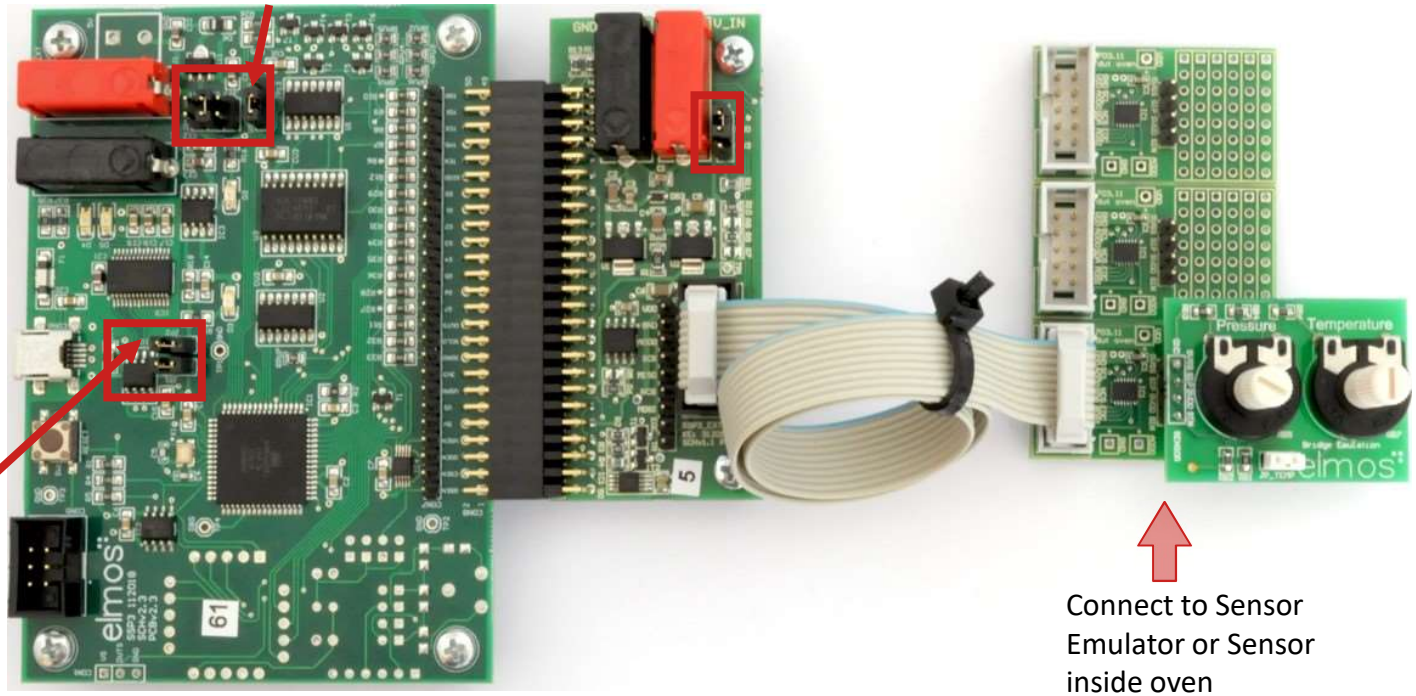
Digital Supply Jumper Settings :
JP3: set to 5V
JP13: set to VS_pre



External supply (max 30V)
P1,P2: connect for external power supply
P3: set regulator output to 5V (VS_pre)
JP1, JP2: disconnect for external power

J1/J2:
Do Not Connect!

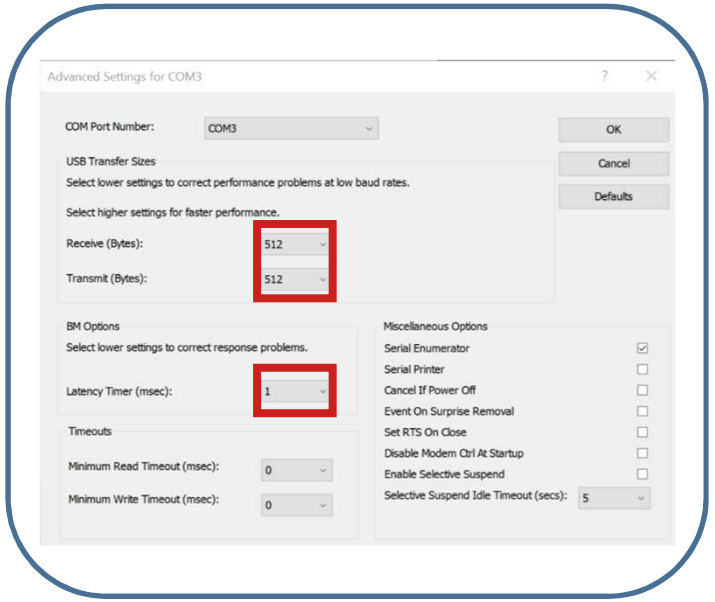
USB to PC
For USB power:
JP1, JP2 connect
P1,P2 disconnect



Connect to Sensor Emulator or Sensor inside oven

Software Setup – E703.11

- System Requirements
  - Windows 10
  - Microsoft .NET Framework v4.0 or later
- Software Installation
  - **FTDI driver installation:**
    Install the Virtual COM Port driver from FTDI, download and execute
    CDM v2.12.00 WHQL Certified.exe
  - **FTDI driver configuration:**
    Open device manager and choose the corresponding COM Port of connected SSP3, open *Properties*, go to *Port Settings* and click on *Advanced*, set both *USB Transfer Sizes* to 512 and the *Latency Timer* to 1 ns
- PC-Software
  - Unzip PSSC_mc_dev_YYYYMMDD.zip
  - Execute …./pssc_gui.exe



Getting Started

Calibration – Connect & Send

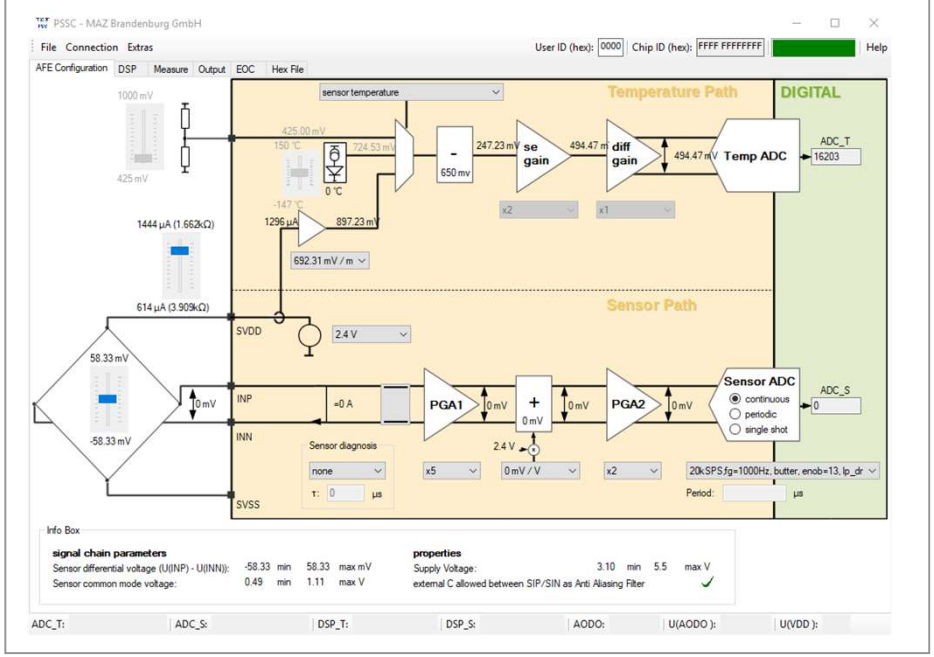
Instructions

- Connect Device:
  - At first the connection status is **red**
  - Open menu *Connection*, select interface (*I²C* , SPI, One wire) and COM port
  - After successful connection the unique chip ID is displayed and the connection status becomes **orange**
- Upload Current Configuration from GUI to IC
  - Open menu *Connection* and click on *Send Configuration "default" to RAM*
  - The connection status becomes **green**, the current configuration has been uploaded
- Upload Current Configuration from IC to GUI

(GUI configuration will be modified based on NVM-Content):

  - Open menu *Connection* and click on *Import NVM*
  - Confirm changes related to current connected device
  - The connection status becomes **orange**
  - Click *Send Configuration "default" to RAM*
  - The connection status becomes **green**, the current configuration has been uploaded

PSSC GUI



Note

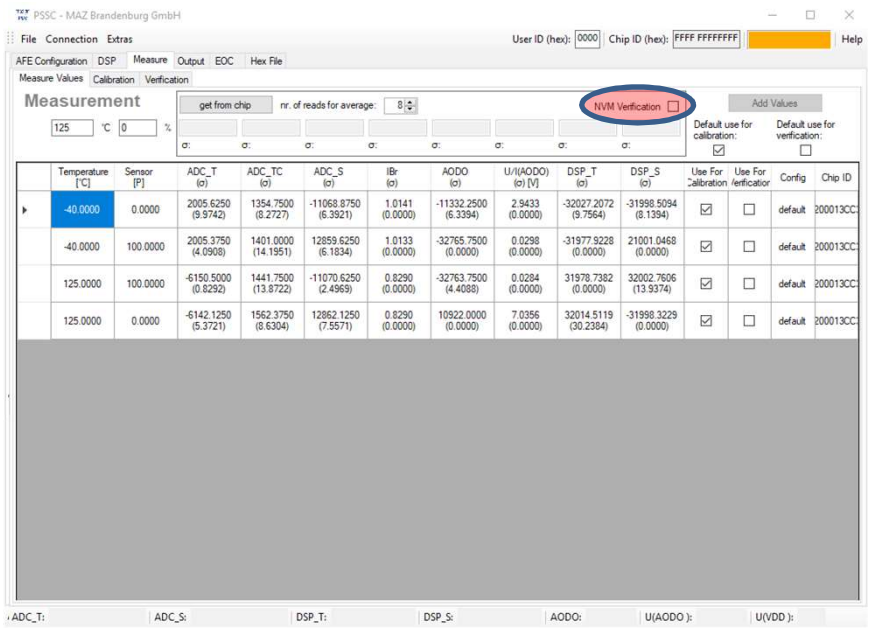
Send to RAM: Only the registers of the PSSC are written, so after a power cycle or a disconnect the configuration has to be uploaded again.
Program to NVM: NVM content is changed based on current configuration settings, so after POR new content is copied to RAM

Calibration – Measure values

Instructions

- Enter Current Temperature and Pressure
- Select *Default use for calibration*
- Specify *Number of measurements for averaging*
- Click on *get from chip* to Read ADC Data from Devices
  - The measured data is displayed with statistical information
  - Optionally, measurement data can be displayed to show raw data settling process
- Add Measurement Data to List by clicking *Add Values*
  - Change temperature and pressure and repeat the steps to collect all calibration points
  - When collecting new measurements correction coefficients are immediately calculated in the GUI. When the coefficient set changes the status window changes the colour back to orange.

Measure Tab



Note

Check the variances (σ) shown below the ADC values. If any variance of ADC_T, ADC_TC or ADC_S is too high, do not add this measurement!
Be aware of the NVM-content switch. It is needed for verification measurements after calibration is completed

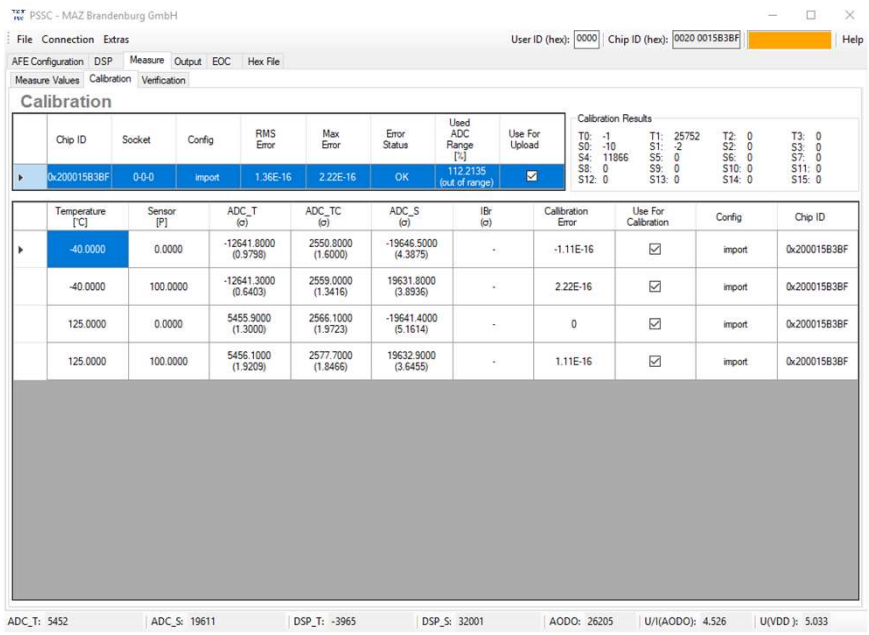
Calibration – Calibration

Instructions

- Check the Calibration Results:
  - RMS Error:
    Root mean square error for all calibration points
  - MAX Error:
    Error of the worst calibration point
  - Used ADC Range:
    ADC range for this calibration, specified on the DSP Tab. 100% ADC range corresponds to an ADC input voltage of ±0.7V. ADC ranges slightly lager than 100% are thus possible with small loss of accuracy.

- Upload Coefficients
  - select *Use For Upload* option
  - open menu *Connection* and click on *Send Configuration Selected by "Use For Upload" to RAM*
  - After upload of the new GUI configuration to RAM the connection status will change changes from orange to green

Calibration Tab



Note

Send to RAM: Only the registers of the PSSC are written, so after a power cycle or a disconnect the configuration has to be uploaded again.

Calibration – RAM Verification

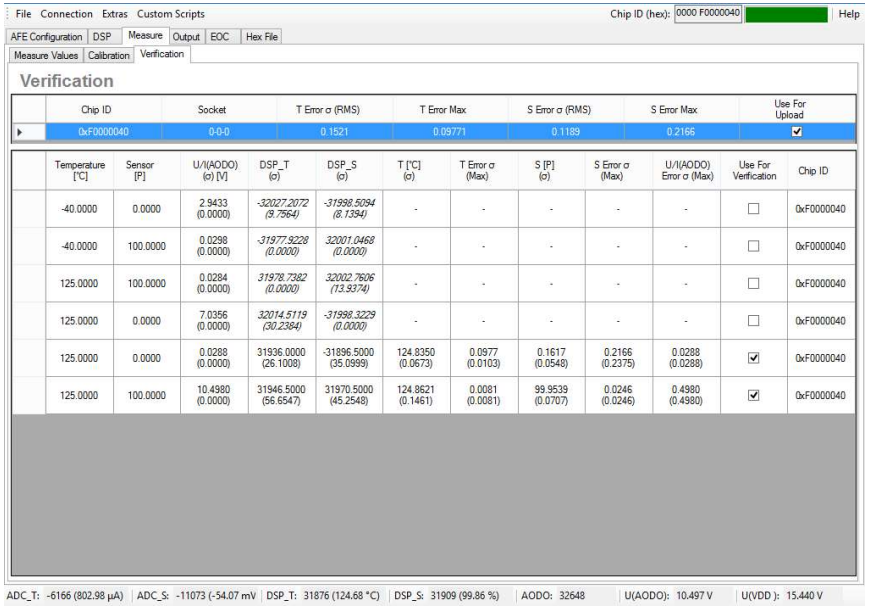
Instructions

- Repeat Steps from **Calibration:**
  - Measure values for each temperature and pressure combination, but select *Default use for verification*
  - Check errors and standard deviations

When RAM –Verification is OK :

- Program Calibration Results:
  - select *Use For Upload*, open menu *Connection* and click on *Program NVM with Configuration Selected by "Use For Upload"*
  - Bottom status line will show valid DSP_T/S and AODO values

Verification Tab



Note

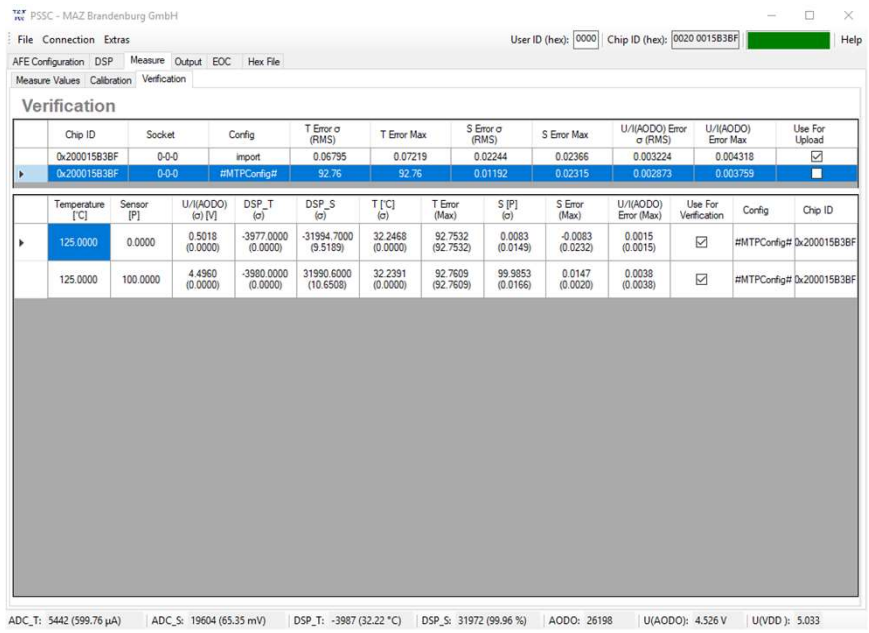
An ADC range graph can be shown by opening menu *Extras* and clicking on *ADC range graph*. It shows the locations of the calibration and verification points in the ADC range. The green area corresponds to an ADC excitation of ±0.7V.

Calibration – NVM Verification

Instructions

- Repeat Steps from **Calibration:**
- Measure values for each temperature and pressure combination, but select *NVM Verification*
  - Stored NVM-values from device are used for this measurements
- Check errors and standard deviations

Verification Tab



Note

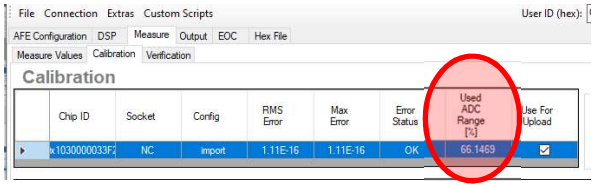
The NVM verification values are displayed as *#MTPConfig#*, selecting will show the corresponding verification points.

Extras – Show ADC Range Graph

Settings

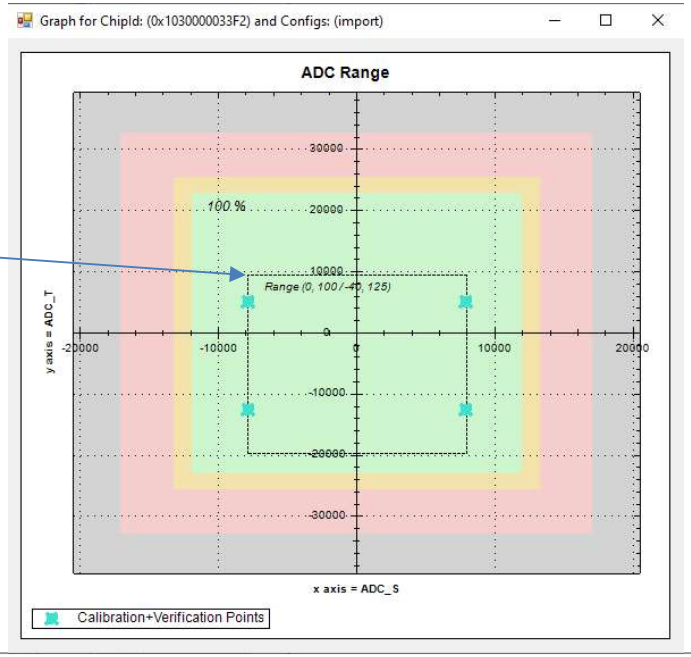
- Range Optimization Feature:
  - Used **ADC_S** range is calculated and visualized based on provided range input values from DSP – tab

  - Out of range indication for ADC_S values



  - Tab: Extras -> show adc range
    - All calibration and verification points are included
    - ADC_T and ADC_S range shown

ADC Range Graph



Note

Green:	optimum usage at 100% of ADC linear range
Orange:	slightly over specified linear ADC range, but not critical
Red:	out of allowed range

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Thank you for your attention

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