# ZMD31050
## Advanced Differential Sensor Signal Conditioner

Application Note                                                                    PRELIMINARY

## 1. Startup

First you have to install driver and software form CD - refer KIT2 installation description "CB_descr_*.pdf" (former name "tech_desr_comm._board_revxxx.pdf") in folder "Manual Evaluation Kit 2.0" on CD for details.

For a demo application without hardware access it is not necessary to install the USB port driver. After the end of software installation procedure you find two additional icons on your desktop or programs in program menu:

- ZMD31050  (former ZMD31050 EV KIT)

- ZMD31050_SSC2 (former ZMD31050 EV KIT2)

ZMD31050 is tool supporting all features and functions in detail – recommended for being familiar with the ZMD31050, design in a sensor, developing and verifying a configuration/application.

ZMD31050_SSC2 is tool, which is made for pre series calibration work. The configuration is displayed as configuration words only, but this tool supports "ZMD SSC Kit command language" (SSC_CML). SSC_CML  enables to write command procedures for full automated calibration of sensor modules. SSC_CML is in development now. Additional ZMD31050_SSC2 software enables mass calibration using "ZMD SSC Mass Calibration Board" – a mass calibration solution, which calibrates up to 120 sensor modules in one batch.

### 1.1 ZMD31050 software

After starting ZMD31050 software has to be select desired interface (lower arrow).

ZMD31050 software is applicable for KIT1 (in software called "ParallelPort-Kit") and KIT2 ("USBPort-Kit").

ZMD recommends for first steps $I^2C$ interface.

Founded hardware and port is messaged in top of the window, if "Communication Board" and "ZMD31050 SSC Board" is connected at the computer and was found by the software (upper arrow). ZMD31050 circuit revision number is displayed in status line.
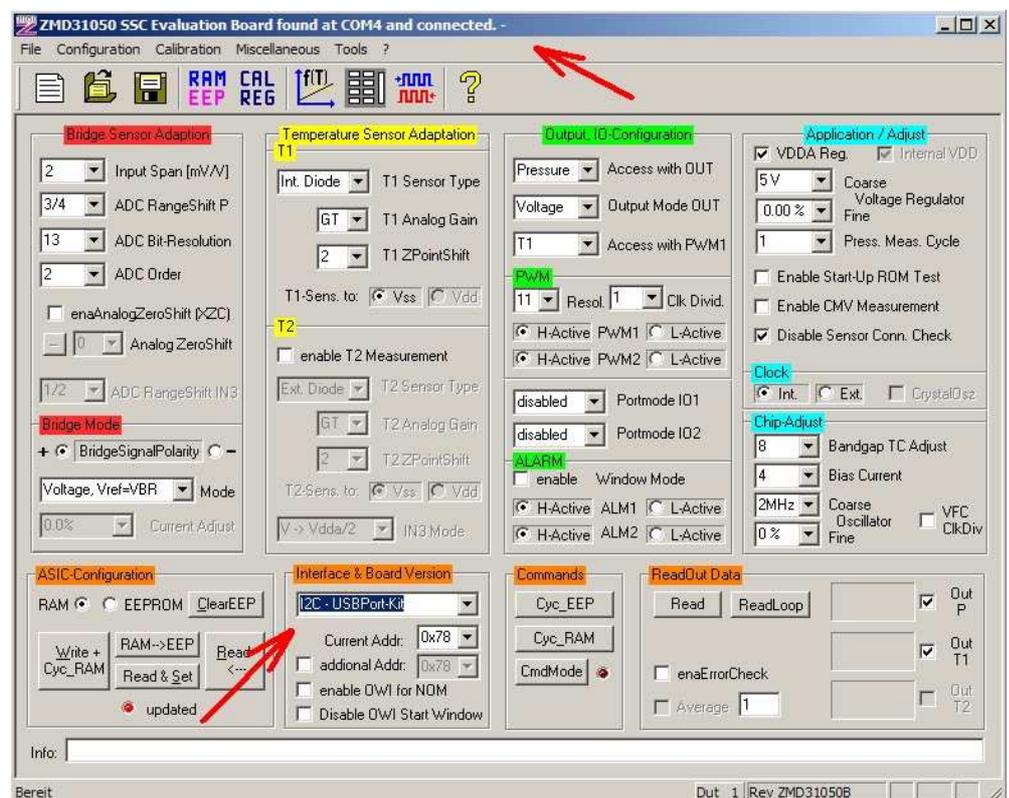
To change type of interface select first "NULL" and then a new one. To verify command mode press "CmdMode" button, if applicable the "LED" near the "CmdMode" button is flashing green for some seconds.

## 1.2     ZMD31050_SSC software

ZMD31050_SSC software supports only KIT2 (USB).

After starting ZMD31050_SSC software connection status is displayed in header of window.

To access ZMD31050 has to be select desired interface and then power on.

Supply LED on SSC Board is flashing, if this successful and indicates, that ZMD31050 IC is supplied correct.

As next step current register content can be read out by pressing the *"readRAM"* button in RAM_EEPROM frame. RAM content is displayed then RAM register fields #1...31.
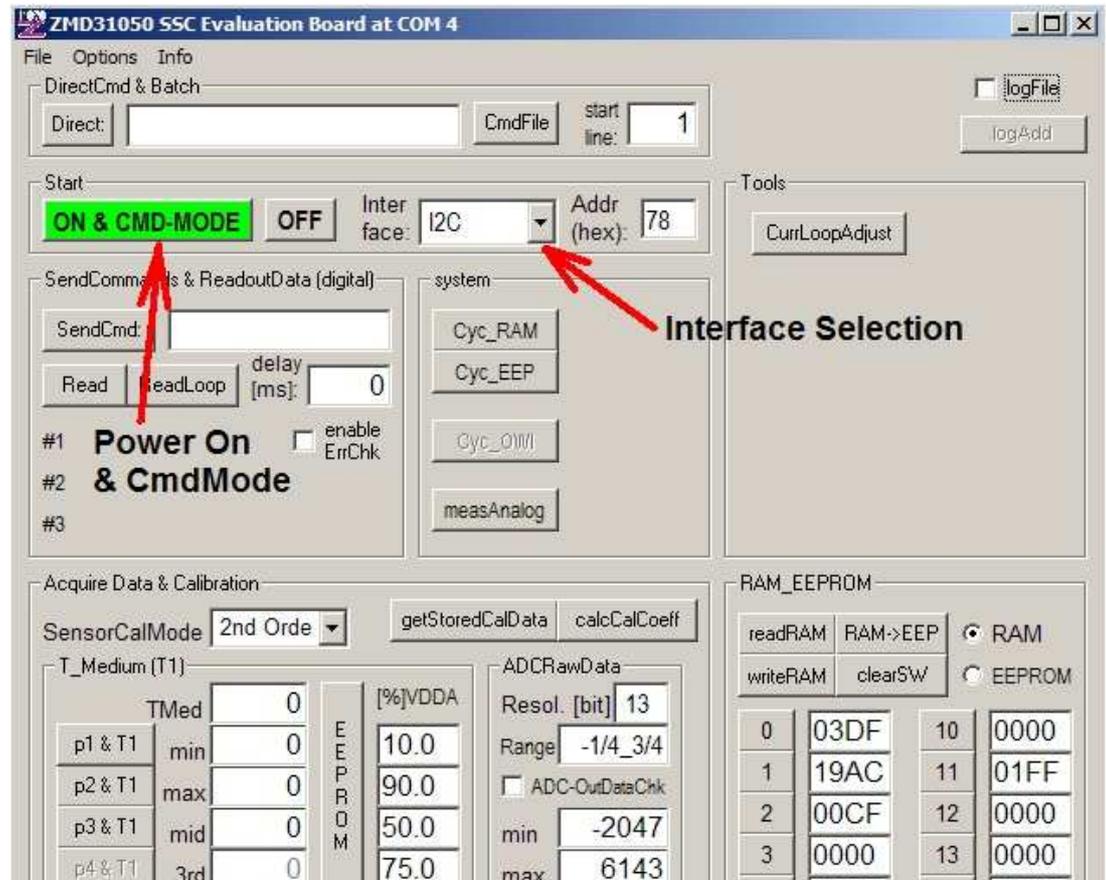
## 1.3     ZMD SSC Terminal

ZMD SSC terminal is the lowest level of communication, which transfers commands direct to communication board (CB) microcontroller. Controller command language is used for this and is described in "CB_descr_*.pdf" chapter 7 & 8.

Input a command in input line and press <CR> or *"send"*. Sent command and answer is displayed in terminal window. A practical communication example is displayed terminal program screenshot.

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| T01100 | set trigger, communication should start 100ms after power on |
|---|---|
| IWT7800172 | I2C, power on & send cmd: "72" = activate ZMD31050 command mode |
| IW_7800102 | I2C, send cmd: "02" = start cylce ram |
| IR_78002 | I2C, read 2 bytes of SIF output register |
| => 0x2AEC | digital readout result of conditioning |

change adjustment of potentiometer on sensor replacement board now => changed input signal

| IR_78002 | I2C, read 2 bytes of SIF output register |
|---|---|
| => 0x4C80 | digital readout result of conditioning |

changed input signal delivers also other output signal

| IW_7800129 | I2C, send cmd: "29" = read content fof RAM register 0x19 |
|---|---|

content of addressed register is copied to SIF output, continuous conditioning ("cycle_ram") is stopped

| IR_78002 | I2C, read 2 bytes of SIF output register |
|---|---|
| => 0x9806 | register content of RAM register 0x19 |
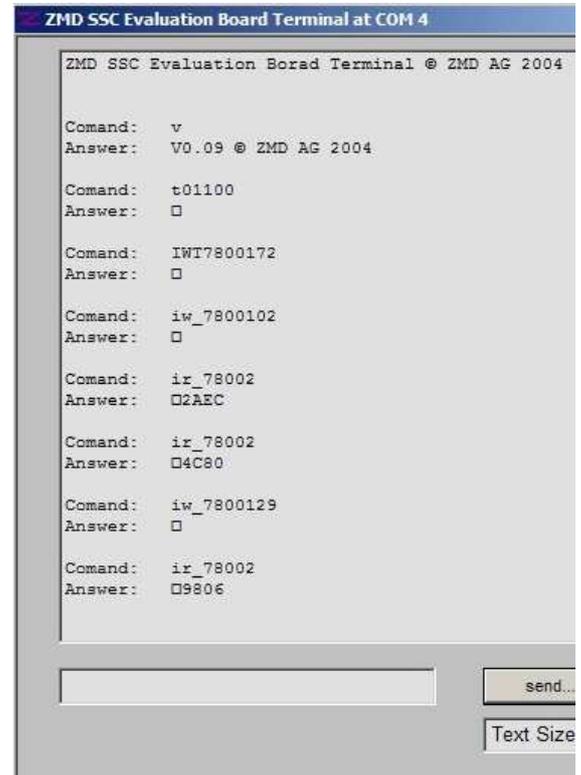
ZMC SSC Terminal

### 1.4    Troubleshooting

Communication problems:

- If software don't found the communication board check in "system control" of your computer for accessible COM ports etc. – refer "CB_descr_*.pdf" for details)

- If software get no access to ZMD31050 (e.g. message "… Command Mode failed …") verify power supply of the ZMD31050 (wrapped jumpers, measure supply voltage @ K10 Vsupply-GND, …). Software can detect type of connected SSC board - in headline of software type of founded SSC board is messaged. Verify board type …

- Try it again with other software (ZMD31050_SSC2.exe).

- A error code is displayed in case of communication errors in software. ZMD31050_SSC2 messages errors in *"SendCommand & ReadoutData"* frame. An error code is an "e" with a number of three digits e.g. "e032". Refer "tech_desr_comm._board_revxxx.pdf" for detailed error description. At using ZMD31050-software press *"Read"* button in *"ReadOut Data"* frame of main window " or open *"RAM-Register"* dialogue (RAM_EEP-icon) and press also *"Read"* button. Error code is displayed in related output data fields.

- If all this doesn't help send problem description with screenshots of software, software version (about dialogue), error code etc. to ZMD support. Use mail task in about/support dialogue for this.

## 2.    First Example

The following example describes first steps being familiar with KIT2 and ZMD31050-software and ZMD31050.

- Plug all 3 delivered PCBs in order Communication Board (CB) – Sensor Signal Conditioner Board (SSC) - Sensor Replacement Board (SR) together and connect these to the USB port of your computer

- Verify wrapped jumper connection at SSC: K5 (Vsupply), K10 (Bridge Mode Voltage) and at SR: K4 (BR)

- Start ZMD31050 software and activate USB Port access via I2C interface (refer chapter 1.1) and verify accessed board and command mode
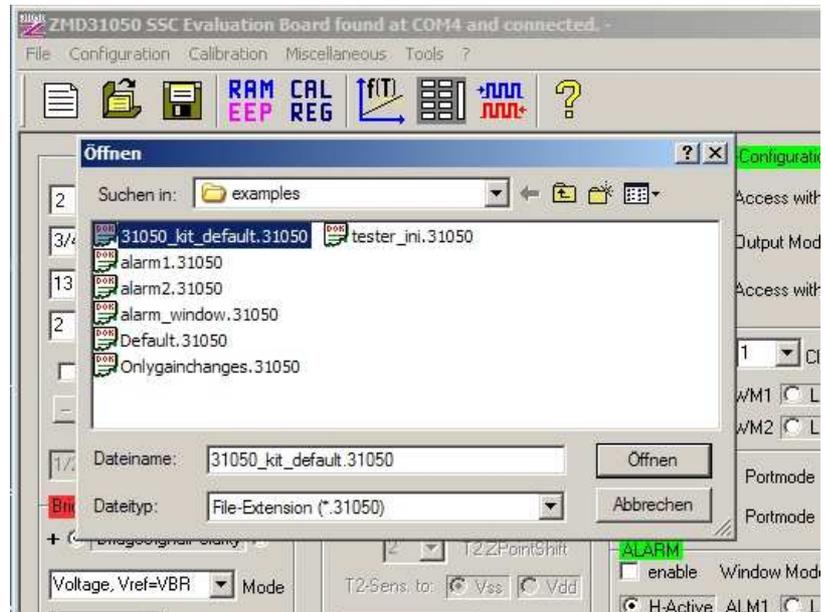


Loading a saved configuration

- Open File menu and load "31050_kit_default.31050" configuration. These file contains needed programming data for ZMD31050 circuit to adjust/configure the ZMD31050 for application completely. These file or set of data is called following "**config**".

"31050_kit2_default.31050" config is loaded in software now. These config is made for KIT2 to learn basics in handling of KIT and ZMD31050. A short description of the loaded config is displayed as info text. These config gain the input signal - generated by the sensor replacement (SR) and was calibrated to deliver 0.5/4.5V for SR potentiometer top/down end adjustment. To verify this you have to do:

- Connect a DMM to the analog out of the ZMD31050. Use "SSC: K10 – pin OUT" and "SSC: K10 – pin GND" measure point for this. Now the DMM measures the analog output signal (VOUT). Refer ZMD31050 SSC Board description for details.

- Adjust SR – potentiometer (poti) in middle position.

- Press "Write+Cyc_RAM" button: Loaded config is written (Write) to ZMD31050 and started (Cyc_RAM) now.

- Check measured VOUT at the DMM: VOUT should be approx. 2.5V and should be alter at changing SR – poti adjustment.

- Measure VOUT for top and bottom position of the poti.
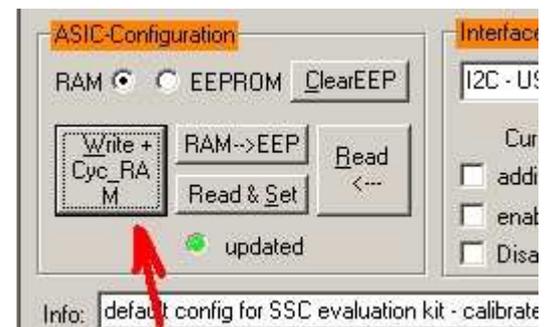


Write to 31050 and starting a config
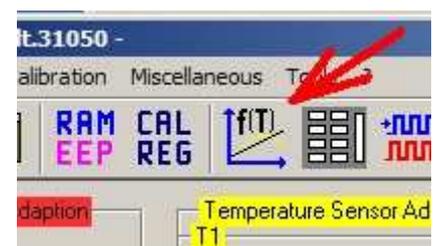


Open "Sensor calibration" dialogue

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These values should be 0.5/4.5V. In most cases this wouldn't be so and is caused by tolerances of all components/elements at the PCBs – calibration is necessary. This is the next step.

- Open "Sensor-Calibration" dialogue (last picture)

- A two point calibration (poti top & down) should be done.

➔ **"Calibration Mode"** is linear, no temperature behaviour. Adjust this like displayed in screenshot. Tooltips in software give you additional help for use.

➔ **"Targets"** are the output aims for calibration. In example output voltage should be 0.5/4.5V for minimum/maximum input signal. All targets are inputted proportionally to VDDA, complete calibration is done proportionally to VDDA. For VDDA=5V is a



Sensor-Calibration: Target input fields and acquire raw data buttons

required output voltage of 0.5/4.5V => target is 10/90%. This has to be inputted in target frame for minimum and maximum.

➔ **"Acquire Raw Data"** frame is used to collect data of all needed measurement points for calibration. In minimum 2 input fields and acquire buttons are enabled depending on selected "Calibration Mode".

- Adjust SR poti to top end and press **"P1M"** button.

The current analogue input signal is gained and AD-converted now, the result is displayed in the input field beside the button.

- Adjust SR poti to down end and press **"P2M"** button.

Both required data points for calibration are acquired now, calculation of calibration coefficients can be done now.

- Press **"calcCoeff"** button in *"Sensor Calibration"* dialogue.

Software messages success of coefficients calculation. Founded calibration coefficients are copied to RAM register block. To verify this open *"RAM-Register"* dialogue by pressing the *"RAM_EEP"* icon in icon list of software.

- Press **"Write+Cyc_RAM"** button in main window now.

Calibration results are transferred to ZMD31050 and activated



Calibration results



RAM Register dialogue

now. New calibration is ready and result can be verified now.

- Measure VOUT for top and bottom position of the poti.

You should measure 0.5V for poti down end 4.5V for poti top end now.

- Repeat the same procedure with reverse acquiring (pressing P2M instead P1M and otherwise).

You will get a mirrored output function for this case. We see, the output signal can be inverted by calibration for the same input signal.

## 3.        ZMD31050 Software Description

Main window is split in 8 frames:

- *"ASIC-Configuration"* configures memory access. Configuration data can be written into RAM or EEPROM. All modifications can be done in and activated from RAM. Write new configuration into EEPROM, if changes should be made non-volatile. To do this, ZMD recommends to write first all data into RAM and then copy into EEPROM by pressing *"RAM->EEP"* button. The "LED" indicates whether the displayed information in software are identical to ZMD31050 circuit or not.

- *"Bridge Sensor Adaptation"* enables config of basic "Sensor Design-In" and "ADC" parameters

- *"Temperature Sensor Adaptation"* enables configuration of temperature measurement for conditioning (T1) and additional temperature measurement

- *"Output, IO-Configuration"* configures analogue and PWM output and IO channel

- *"Application/Adjust"* configures supply voltage regulator, safety feature, bandgap voltage and TC. Additional clock frequency and biasing can be adapted/modified.

- *"Interface & Board Version"* is used to select interface type, board and addressing.

- *"Commands"* enables to start signal conditioning using RAM or EEPROM data. Enabled "Command Mode" can be verified and is displayed by a green flashing "LED".

- *"ReadOut Data"* enables digital readout via serial communication interface (SIF). If continuous readout is activated averaging mode can be enabled. Via the SIF can be read output data for pressure and temperature 1 & 2 channel. A description of data is displayed beside the output fields.

Info line enables to add a short description of application to configuration data. Additional in status line is displayed revision number of accessed ZMD31050 circuit. Refer detailed software description for further information and examples.

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## 4.      Calibration Examples

### 4.1      Conditioning a Pressure Signal

### 4.2      Conditioning a Temperature Signal

### 4.3

1st step - acquire calibration data

temperature out calibration target:

- 0.5V at 0deg = 10%
- 4.5V at 100deg = 90%

and/or digital:

- 3277 (10% of 32768) at 0deg
- 29491 (90% of 32768) at 100deg
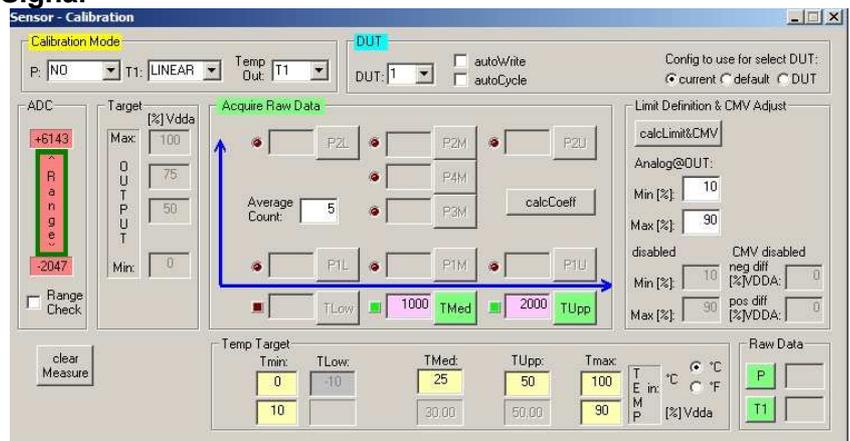
Temperature-Calibration Example

--- room temperature = 25deg

OW_78001D9  => acquiring T1

OR_78002        => you get first acquired raw data for current temperature calibration point now  (1) in example: 1000

--- change of temperature =50deg

OW_78001D9  => acquiring T1

OR_78002        => you get second acquired raw data for current temperature calibration point now  (2) in example: 2000

=> calculate coefficients now and write calibration data to RAM/EEPROM

OW_7800102    => start cycle RAM

OR_78004        => readout of 4 bytes, @ 25deg you should read 9830

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