CEBO MSA lite Tools 2.0

The Cebo MSA lite tools can be used to transform resistor values measured with Cebo-MSA64 or Cebo-MSA64W into physical values. Additionally these values can be captured and stored into files.

Common information

Cebo-MSA64 and Cebo-MSA64W devices are capable to measure up to 8x8 resistive sensors, 4 analog voltages and read up to 4 digital inputs. Additionally, IO 0 can be configured to increment a 32-bit counter value, whenever a rising edge on IO 0 is detected. All those elements are packed in a so called **frame** and transferred to the host side with a maximum speed of up to 250 frames per second.

On the host side, the voltages corresponding to the respective resistor values are transformed into an intensity. With the help of the lite tools these intensities can further be represented as a measurement unit, like weight or some other physical unit that can be measured using the connected sensors. This process is called **calibration**.

Detailed description: Sensor grid

The 64 sensors are grouped into 8 columns, while each column consists of 8 sensors. For each column an individual sensitivity can be set, which allows to connect sensors with different characteristics within one sensor array (column wise). Sensors are measured column by column, the 8 sensors in a single row are handled quasi-parallel. The resistor value is transformed into a voltage of range 0 .. 3.0 V and temporally stored in the device, until all sensors for a given frame have been recorded.

Detailed description: Transfer

After all sensor values are measured, the four analog inputs, as well as the digital port are sampled. All these elements together build a frame. Completed frames are stored in a device side FIFO, that is cyclically transferred to the host.

Detailed description: Sensor value transformation

As described earlier, each sensor value is measured as voltage in the range of 0 .. 3.0V. The default level for the sensor driving voltage is 2.5V, which is why all sensor values are divided by a factor of 2.5 to get an intensity in the range of 0 .. ~1.2, which is shown as 0 .. ~120%. Both tools show current values in this format until a calibration has been done. From then on the intensity values are replaced by the set physical unit.

Differences compared to version 1.0

- The most important enhancement is the support of all 64 sensors, the hardware is capable of. An eight sensor mode similar to the one available in version 1.0 is still available.
- Besides the bar graph, DAQ now also provides an 8x8 grid view on a secondary tab.
- In addition to terminating the measurement manually by pressing the **Stop** button, now in DAQ also a maximum number of samples to capture can be defined.
- The GUI has received a visual overhaul.

Supported operating systems

The lite tools are supported on the following systems:

- Windows 7 x64
- Windows 10 x64
- Ubuntu 16.04 LTS

Functionality is not restricted to these and the tools may also work fine with another OS, but official support is limited to these, as all tests are run using one of the aforementioned operating systems.

Application startup

Both CAL and DAQ show a device connection dialog on startup:

Device selection dialog
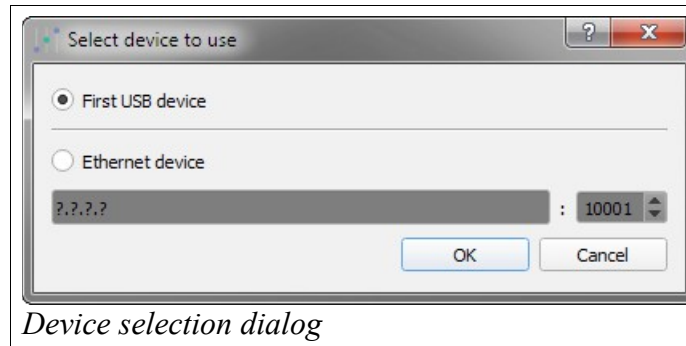
If a Cebo-MSA64 is connected via USB, select the **First USB device** option to use it. In case, a Cebo-MSA64W shall be used, check the **Ethernet device** option and enter the IP address of the device next to the selection. Currently no reason exists to change the default port value **10001**.

There is an option in DAQ to start CAL from its tool bar. In this case, all connection details are transferred from DAQ to CAL and this dialog is skipped.

Application modes

CAL and DAQ can work in three different modes:

- 8 sensor mode: Rebuilds the behavior of Cebo CAL lite 1.0. Only the diagonal sensor line is active, each column shows only one sensor.
- All sensors mode: All 8x8 sensors are active.
- Custom mode: The user is able to select which sensors are to be measured. This allows adjustments for custom array setups. In this mode, all 64 sensors are shown as well, but only the selected ones are shown in normal color, while deselected sensors are kept only barely visible in the display and will not be saved to the DAQ output file.

Cebo MSA CAL lite

As the name implies, this tool is used to define the mapping between the intensity and the corresponding measurement unit, which is called the calibration process. After device selection, the main screen pops up:
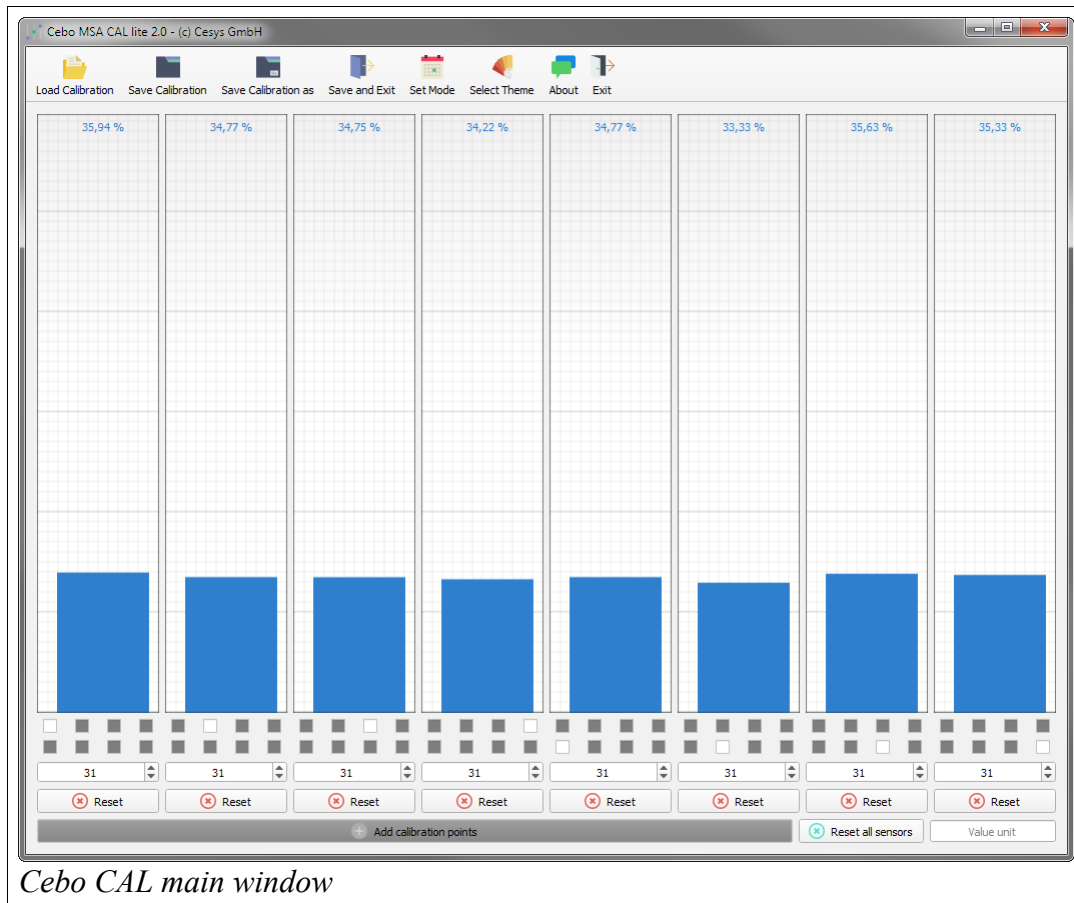
Cebo CAL main window

GUI reference

- Toolbar:
    - Load Calibration: This will open a file dialog to select a previously saved calibration file.
    - Save Calibration: Stores the active settings to the current calibration file. If no file has been selected previously, a **Save as...** dialog is shown.
    - Save Calibration as: Opens a **Save as...** file dialog to store the active configuration to a user selected file.
   - Save and Exit: Like **Save Calibration** plus close of Cebo CAL.

Useful when starting CAL from DAQ, adjusting some settings and returning to DAQ with a single click.

- Set Mode: This opens a dialog where you can choose and configure the sensor mode. This mode is bound to the calibration file and used in DAQ as well.
- Select Theme: Opens a dialog to select one of three GUI themes.
- About: Shows the about dialog.
- Exit: Terminates the application.

- Sensor display:
  - For each sensor column one grid is shown, so in total eight column-grids are visible. In **8 sensor mode**, each column-grid contains only one single sensor, while in all other modes, eight sensors are shown per column grid.
  - The value(s) at the top show either the current intensity or the corresponding physical value.
  - Each sensor bar shows the current value. The level is based on the known facts:
    - If a sensor has no single calibration point, the height of the bar is linearly scaled along the intensity of 0 .. 120%.
    - In the other case, the sensor with the highest value at the maximum intensity defines the Y scale and all sensors that have calibration points are scaled to this maximum.
  - If sensors have calibration points, they are rendered on top of each sensor bar. Hovering the mouse over these points will display the mapping.

- Column controls:
  - The eight check boxes directly below the sensor display allow to choose which sensors will be included in the next calibration point insertion. The upper line of controls represents row 1-4, while the lower line is for row 5-8. Only sensors available in the current mode can be chosen.
  - The value below the check boxes shows the sensitivity for the respective column. This value can have values in the range of 0 .. 63. If at least one sensor in the column has a calibration point, this value can not be changed anymore, as this would invalidate the calibration points. If it is necessary to change the sensitivity of this column, the calibration values for this column need to be reset.
  - The reset button removes the calibration points of all sensors in the corresponding column. After reset the sensitivity can be set again as well.

- Add calibration points: Clicking on this button opens the window to enter a physical meaning for the value the selected sensors are currently measuring.

- Reset all sensors: Similar to click **Reset** for each column separately.
- Value unit input field: The physical unit in which calibrated values express their value. Used everywhere a calibrated value is calculated.

Suggested calibration procedure

After opening Cebo CAL and a successful connection to the device, the application shows eight sensors, one per column. First decision to be done is to set the mode to be used henceforth. If eight sensors are sufficient, the default mode is the best choice. If not, click on **Set Mode** in the toolbar, to switch to either all sensors or define a custom layout. It is possible to change this setting later, but may require additional calibration steps.

Mode selection dialog
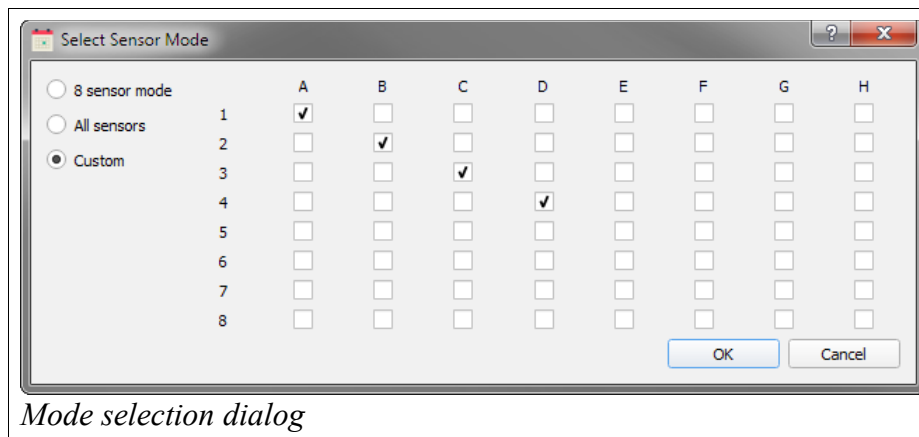
The next task is to find a suitable sensitivity. For this, you have to load at least all sensors of a specific column to the expected maximum. While doing this, set the sensitivity to a value, so that the maximum intensity of the sensor with the highest value is somewhat below 100%. The reason for this step is to adjust the range of the input as high as possible to get the best accuracy for input values.

After finding a good sensitivity it is time to add a measurement unit in the right bottom corner of CAL, e.g. kg, pound, ... Now think about how to do the calibration. There are scenarios where a sensor by sensor calibration makes sense, but sometimes calibrating all sensors at once may be reasonable, too. Select the check boxes of sensors you wish to calibrate in a single step and hit the **Add calibration points** button. Load the sensor(s) with a defined value and enter the value in the input field.

Set current intensity to 5 kilograms
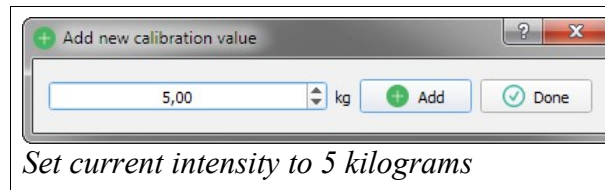
You can repeat these steps to add more calibration points to the current sensor selection. The intensity to value calculation first tries to do a linear interpolation for the intensity between two calibration points. In the lower and upper ends, the value is extrapolated from the two closest points. If only one single point is set, the process assumes a value of 0 at 0%.

You should do this for all sensors active in the current mode, so every sensor has at least one calibration point. You can store this setup to use in DAQ or to modify it later in CAL.

Cebo MSA DAQ lite

This tool is used to capture data from Cebo-MSA64 or Cebo-MSA64W devices and to store this to .CSV files. If calibration information is available, data is stored in multiples of the measurement unit, otherwise the intensity is used. In addition to the sensor values, the current counter value, all four analog inputs as well as the digital port mask is stored to the output file.

After startup and successful device selection, the main window pops up:
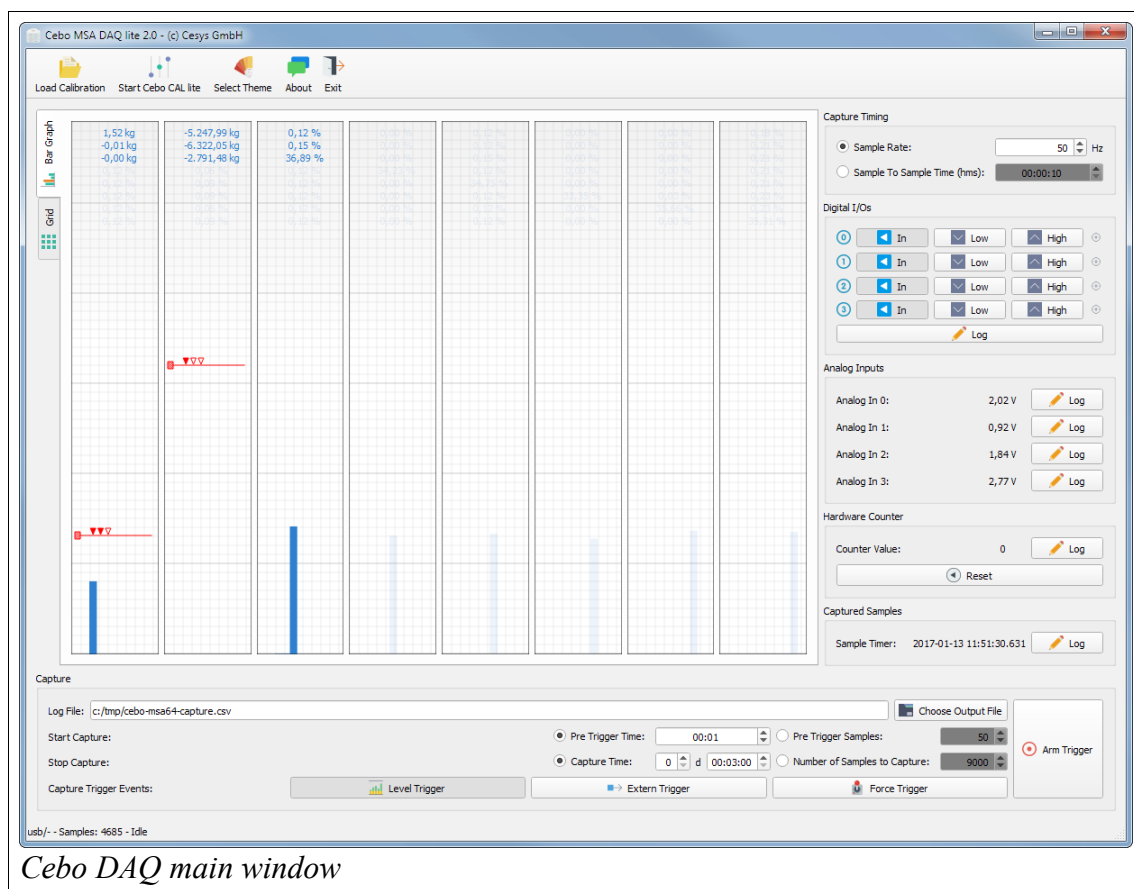

Cebo DAQ main window

GUI reference

- Toolbar:
  - Load Calibration: This will open a file dialog to select a previously saved calibration file.
  - Start Cebo CAL lite: Opens CAL to change the calibration. If a

calibration file in DAQ is already loaded, this is automatically used by CAL and reloaded when returning from CAL. In addition, the selected device from DAQ is automatically used in CAL as well.

- Select Theme: Opens a dialog to select one of three GUI themes.
- About: Shows the about dialog.
- Exit: Terminates the application.
- Bar graph display:
  - For each sensor column one grid is shown, so in total eight column-grids are visible. In **8 sensor mode**, each column-grid contains only one single sensor, while in all other modes, eight sensors are shown per column grid.
  - The value(s) at the top show either the current intensity or the corresponding physical value.
  - Each sensor bar shows the current value. The level is based on the known facts:
    - If a sensor has no single calibration point, the height of the bar is linearly scaled along the intensity of 0 .. 120%.
    - In the other case, the sensor with the highest value at the maximum intensity defines the Y scale and all sensors that have calibration points are scaled to this maximum.
  - If **Level Trigger** is enabled and at least one sensor in a specific column has calibration data, a handle with a horizontal bar and one or more small triangles is visible. Clicking on the triangles enables (filled) or disables (not filled) the specific sensor to trigger capture start. By dragging the rectangular handle up and down, the level at which the trigger should be tripped can be set column wise.
- Grid display:
  - Shows an 8x8 grid. The intensity is visualized using the brightness for each tile (0% = black -> 100+% = white). In addition, sensor name and value/intensity is visible too.
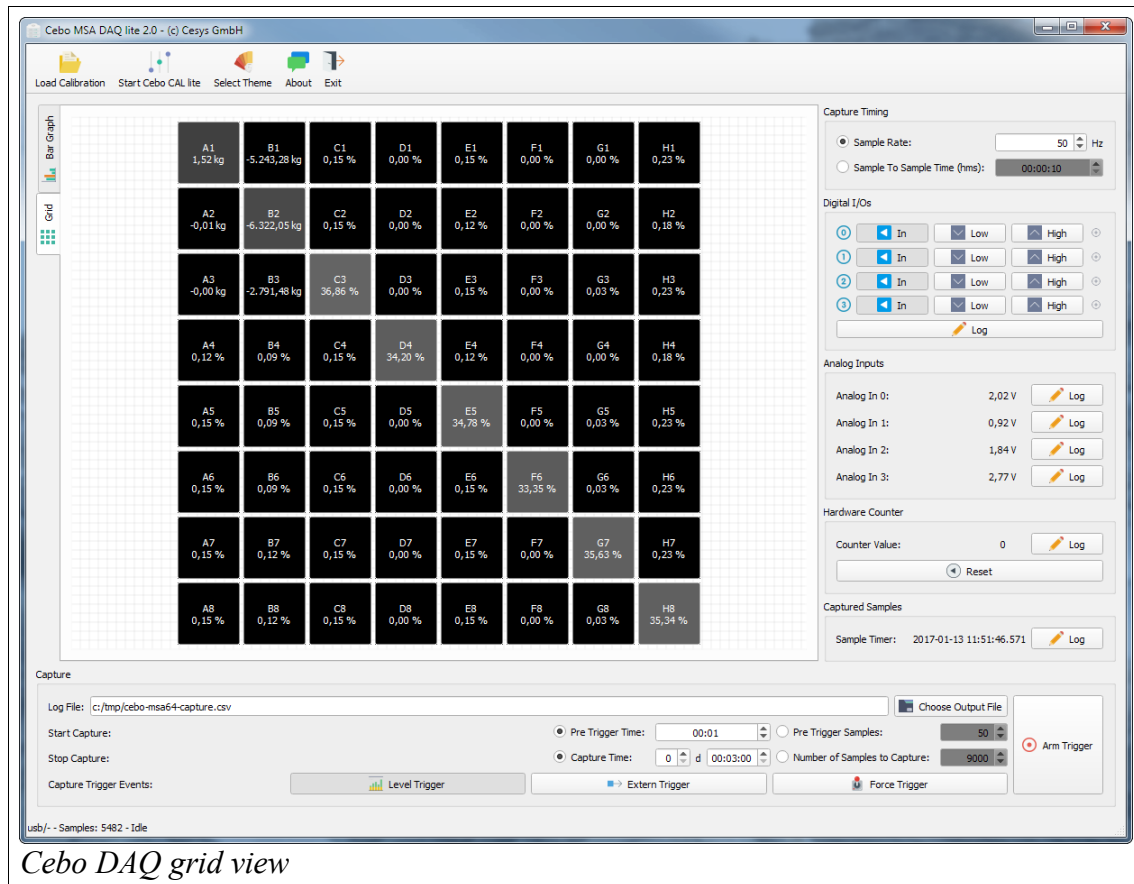
Cebo DAQ grid view

- Controls on the right side:
  - The individual Log buttons can be used to select the components that should be logged to file together with the sensor values.
  - Sample Rate: The rate in Hz at which the hardware samples all input values. Can be in the range of 10 to 250 Hz.
  - Sample To Sample Time: If a rate of 1 Hz or lower is required, select this software sampling mode and set the time between two samples. (Note, internally samples are captured at 10 Hz to leave the UI alive, but only samples at the defined rate are analyzed and captured.)
  - Digital I/Os: Allows configuration of all four supported digital I/Os. If **In** is selected, the IO is configured as input and displays its current level right to the **High** button. With the **Low** and **High** buttons, the IO is configured as output, directly setting its output level.
  - Analog Inputs: Displays the current voltage values measured on

the individual inputs.
- Hardware Counter: The current counter level. The counter increases on every rising edge of I/O 0, which can be set to be used as trigger too.
  - The counter can be reset to zero by clicking on the 'Reset' button.
- Sample Timer: Timestamp for the current sample.
- Capture controls:
  - Log File: Defines the .CSV file where captured data will be stored. The **Choose Output File** button next to the control opens a file dialog to select a file.
  - Pre Trigger Time/Pre Trigger Samples: Number of frames to capture at most **in front of** the trigger event. One of both values can be adjusted at once, while the other is calculated based on the frame rate.
  - Level Trigger: Enable to allow capture start based on a sensor level. See bar graph description above on how to adjust the trigger levels.
  - Extern Trigger: If enabled, capture starts on a rising edge of IO 0 (wich increments the counter too).
  - Force Trigger: Clicking this button starts capture (if trigger is armed) immediately.
  - Arm trigger/Stop: No capturing is done, if DAQ is not in **Trigger armed** state. Enabling this, brings the application in a waiting state. If during this phase one of the trigger events occur, capture starts. An active capture can be stopped clicking on the button when **Stop** is visible.
  - Capture Time/Number of Samples to Capture: If this has a value of zero, capture runs until manually stopped. If any value other than 0 is defined here, the given amount of samples/frames is captured. One of both values can be adjusted at once, while the other is calculated based on the frame rate.

Suggested capture procedure:

After starting DAQ and selecting a device, it is useful to load a calibration file, otherwise only intensities are logged. If no calibration has been done yet or the active one needs an adjustment, click on **Start Cebo CAL lite**. You should start to adjust the sample rate to a useful value. A too high value creates a large output file which may be difficult to handle, but this depends on the capture time as well.

Set the output file by clicking on **Choose Output File**. If capture should start based on

a given sensor activity, enable **Level Trigger** and configure the handle in the respective sensor column. Don't forget to select the little triangle for the sensor in question. If an external trigger on IO 0 is used, enable **Extern Trigger**. Within the field **Pre Trigger Samples** define the number of frames which should also be stored in the file before the actual trigger event.

If capturing samples within a predefined time range is suitable or only a defined number of samples should be stored, configure either **Capture Time** or **Number of Samples to Capture**, respectively.

Arm the trigger by clicking on the **Arm Trigger** button. The system will now start on the next trigger event. If no trigger has been configured, click on **Force Trigger** to start the capturing process manually. To terminate the capture process or (if no trigger has occurred yet) return to the state to configure the capture, just click the **Stop** button.

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Revision history

Version	Date	Comment	Author	Approved
1.0	May, 16 2014	Initial release		
2.0	Jan, 20 2017	Updated to Tools 2.0	th	th