TECH NOTE :: QuantumX channel Auto Calibration Routine

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Intro

QuantumX is a modular distributable data acquisition solution from HBM for measurement and testing solving demanding engineering tasks for quicker innovation. The data acquisition modules offer highly accurate inputs acquiring physical quantities in the wide field of **mechanical, hydraulics, thermal** and **electrical or mixed systems** with data rates from 0.1 to 100 kS/sec and channel. QuantumX acquires sensor or transducer inputs measuring **force, strain, torque, pressure, temperature, displacement, speed, position, acceleration, flow, voltage, current and many more**. QuantumX offers superb A/D inputs supporting **voltage, current, bridge based inputs for strain gage or inductive transducers, LVDT, resistive, thermocouple, digital pulses** and signals from data busses like **CAN bus** parallel and time synchronous to all other inputs.
Some modules have output capability and work as signal converter (input to output), signal generator, real-time reaction (analog, digital) or gateway to other digital busses then Ethernet or FireWire like CAN bus or EtherCAT bus.

Abstract

This TECH NOTE shows in principle the Auto Calibration Routine of analog inputs and how to optimize it.

Auto Adjust and Auto Calibration

The Auto Calibration Routine (short name: AutoCal) of an analog input in the QuantumX amplifier world mainly compensates environmental temperature influences from start of power supply on and targets long term data acquisition jobs and highest accuracy demands.

This mechanism is used in amplifiers like MX840, MX840A and MX440A with full and half bridges (strain gauge or inductive), with LVDTs and potentiometric sensors.

This mechanism is also used in MX1615 with strain-gauge full and half bridges.

The mechanism works in default configuration in this way that the analog input is switched to an internal reference channel every 30 s and for some micro seconds. In certain cases this AutoCal mechanism can cause visible little cyclic peaks which are within accuracy class of the device input but may be visible when using Auto Scaling in a software tool. Reasons to spot effect might be the use of strain gages with high impedance, work in only a small part of the total measurement range). Therefore this mechanism can be parameterized and adapted to perfectly fit to the DAQ job and its application.
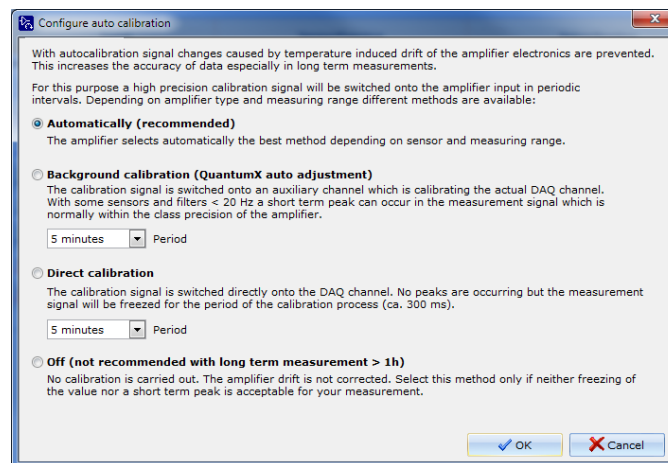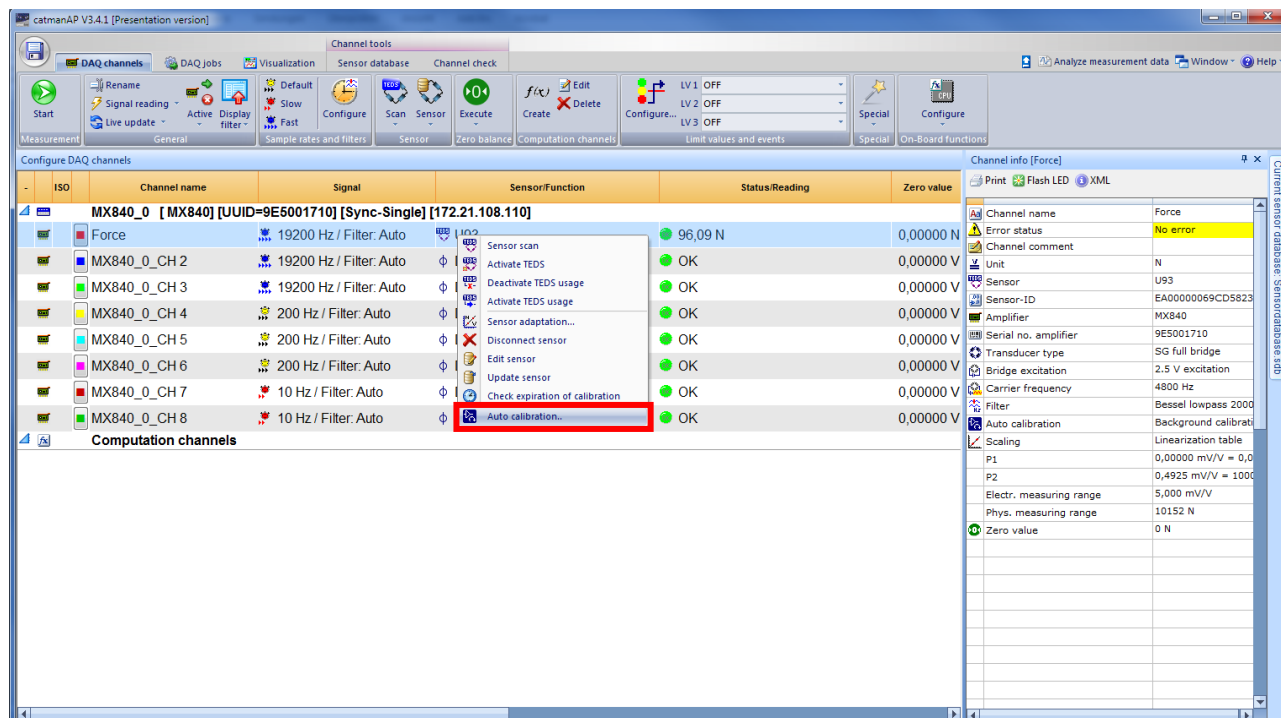
Available Parameters:
- AutoAdjust:
  - Parameter activation: ON / OFF
  - Parameter timing: input in seconds
  - Parameter still active after reboot or on / off switch)
  - Default = ON, 30 s cycle
  - Effect: possible small peaks during adjustment under specific circumstances
- AutoCal
  - Same like above
  - Effect: last measurement value is frozen for some micro seconds

The parameters shown above can be used with catmanEASY, QuantumX Assistant, LabVIEW and .NET API users.

catmanEASY/AP – Parameterization

The following screenshots show how to use it and parameterize it in the appropriate way:

catmanEASY – right mouse click on channel in sensor column and select "Auto calibration":

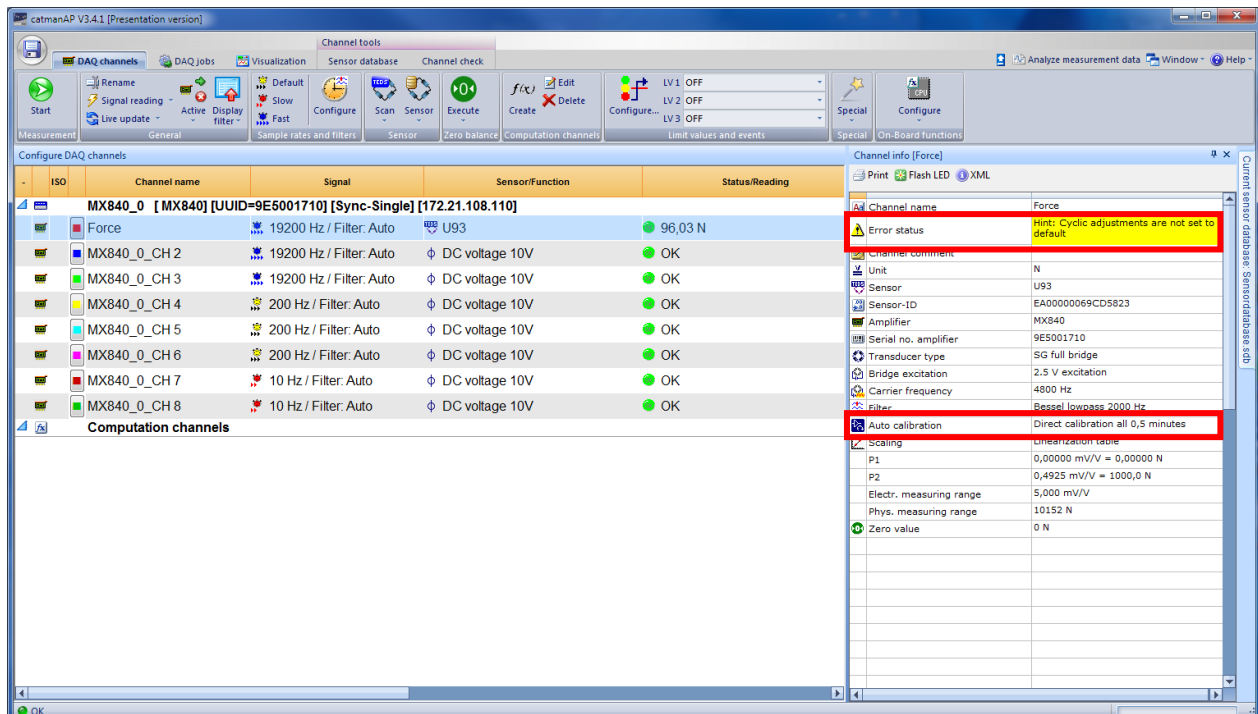QuantumX auto calibration (auto adjustment) is possible depending on the module.

- **Off:** The autocalibration is deactivated. This setting is only recommended for short-term measurements.

- **Background calibration:** This is the type of calibration preferred for QuantumX. Every x minutes (period) the second measuring amplifier (refer to background information below) is disconnected for about 300 ms from the measurement signal and calibrated. The actual amplifier is adjusted based on the data obtained. With very small signals and high resolutions this disconnection and reconnection may however lead to distortion in the measurement signal.

- **Direct calibration:** Every x minutes (period) the measuring amplifier is disconnected from the measurement signal and calibrated. The measurement signal is frozen in this period (approx. 300 ms) and a plateau is produced in the signal trace. This corresponds to the autocalibration process of the MGCplus.

- **Automatic (selection):** The setting for this module recommended by HBM and the selected measurement range are used. This is generally the background calibration.

The term autocalibration is not appropriate but widely used. Here not only the difference to a reference is measured it is is also adapted (auto adjustment).

Internally, QuantumX uses two measuring amplifiers located on one chip and therefore have practically identical behavior. One of them the actual measurement takes place, whereas the other input is calibrated with a high precision calibration signal. After a specified period of time the amplifier is connected to an internal calibration signal for some mili seconds. If this signal is different the amplifier is adjusted accordingly.

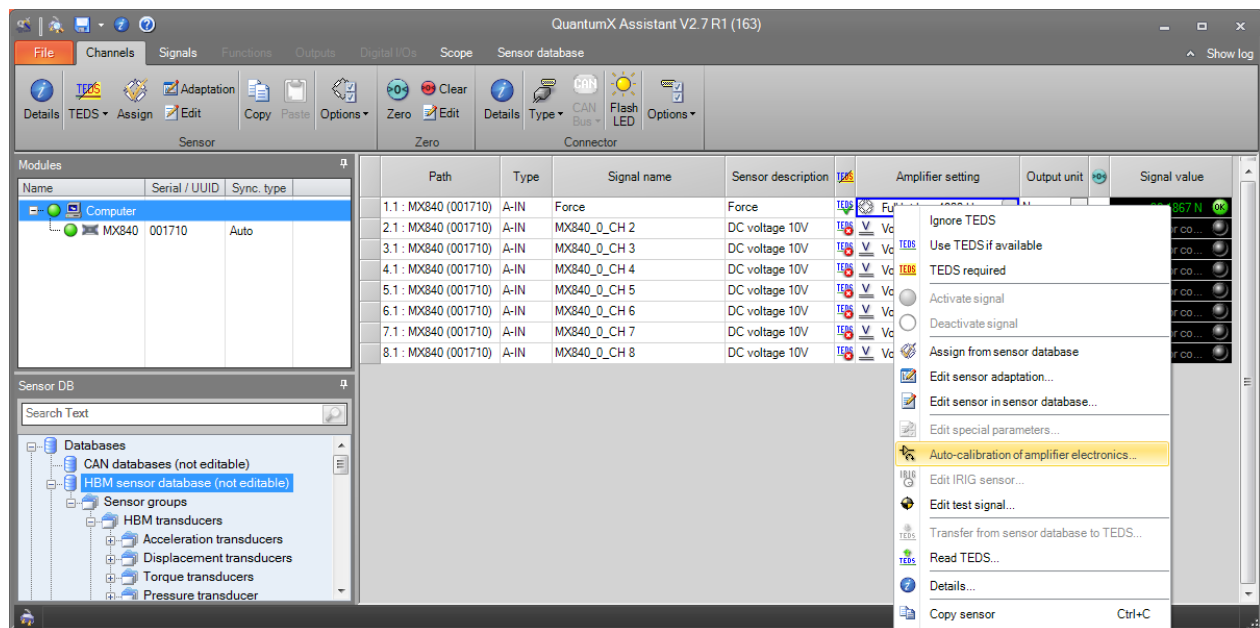All changes to that parameters are listed in the meta data:
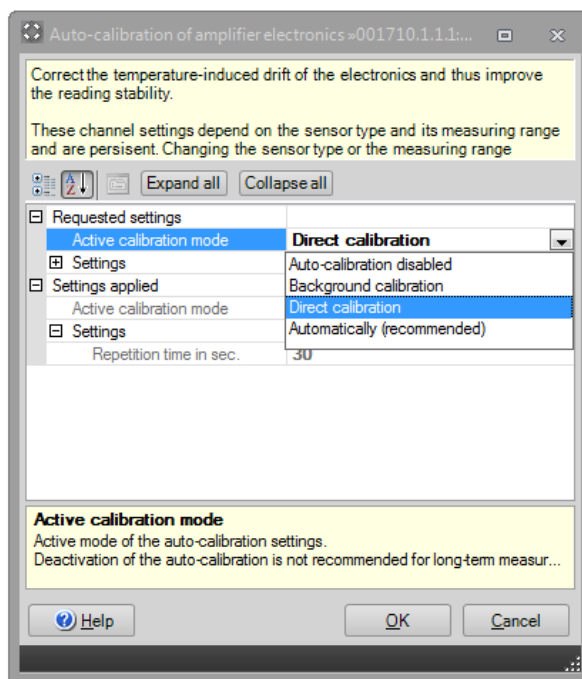
QuantumX Assistant – Parameterization

The following screenshots show how to use it and parameterize it in the appropriate way:

Open QuantumX Assistant – Procedure:

1. Activate the Channels tab.

2. Mark the channel(s) for which the auto-calibration is to be changed.

3. In the Amplifier setting column call the context menu **Auto-calibration of amplifier electronics**.

4. Under Requested settings "Active calibration mode specify the desired method.

5. Set the desired time period between two calibrations under Settings Repetition time in sec.

It takes approx. 2 seconds for the auto-calibration function to change.

The dialog is always accessible and you can always play around with the settings (Requested settings), but no change occurs if the settings are not available. The actual setting used is displayed under Settings applied "Active calibration mode". Recall the dialog after a change.

If no calibration function is available, then with all requested settings except Automatically "CALOFF" (auto-calibration deactivated) is additionally displayed in the Amplifier setting column.

Available settings

1. Auto-calibration deactivated - no auto-calibration takes place.

In the high-sensitivity measurement ranges this is only practicable when a (once-only) calibration cycle is started using control software at times when no measurement is taking place. This can for example take place always before a measurement and takes about 200 ms.

2. Background calibration.

Every 30 to 3600 seconds (repetition time) the second measuring amplifier is disconnected for some milli seconds from the measurement signal and calibrated. With very small signals and high resolutions this disconnection and reconnection may lead to distortion in the measurement signal. The actual amplifier is readjusted (corrected) using the data obtained during the calibration. The correction does not occur abruptly, but rather gradually over a time period of many hundreds of milliseconds. The default setting of the repetition time is normally 30 s, but with thermocouples and in the 100 mV measurement range this is 300 s.

3. Direct calibration

Every 30 to 3600 seconds (repetition time, default setting 300 s) the measuring amplifier is disconnected from the measurement signal and calibrated. The measurement signal is frozen in this period and a plateau is produced in the signal trace. If a zero-point correction is necessary due to the calibration values, a step change may then occur in the signal trace which will however be reduced by following filters.

4. Automatically

The setting for this module recommended by HBM and the selected measurement range are used. This is generally the background calibration.

- The assignment of a sensor resets the setting to Automatically. The changes are displayed when you use the default setting in the general program options with regard to the display of warnings.

When a change to a setting is made, a (once-only) calibration is always carried out. The selected setting is also retained after a restart of the module.