Sensors overview

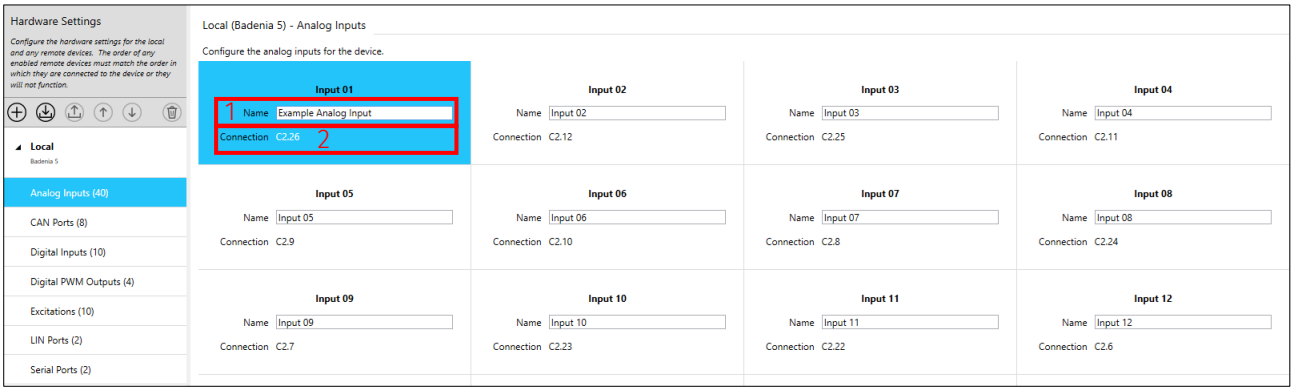
Configuring sensors within Toolset is an essential part of monitoring vital data imported from a car. The following provides an overview of how to configure analogue and digital sensors, and various configuration options.

Note: Refer to Beacons for configuring a digital beacon input.

Analog sensors

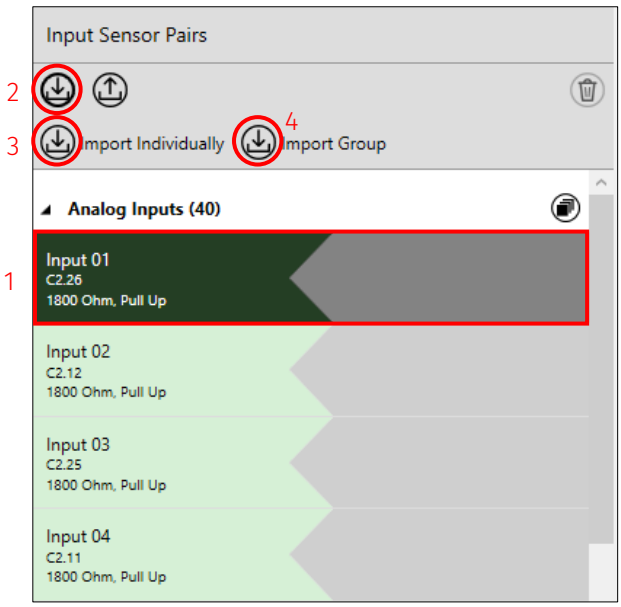
Identify an analog input

You can configure the name of the analog inputs on the Hardware Settings node (1). Underneath each input label is a connection identifier in the format 'CX.Y', where X and Y are values that identify the connector and the pin of the device, respectively (2).

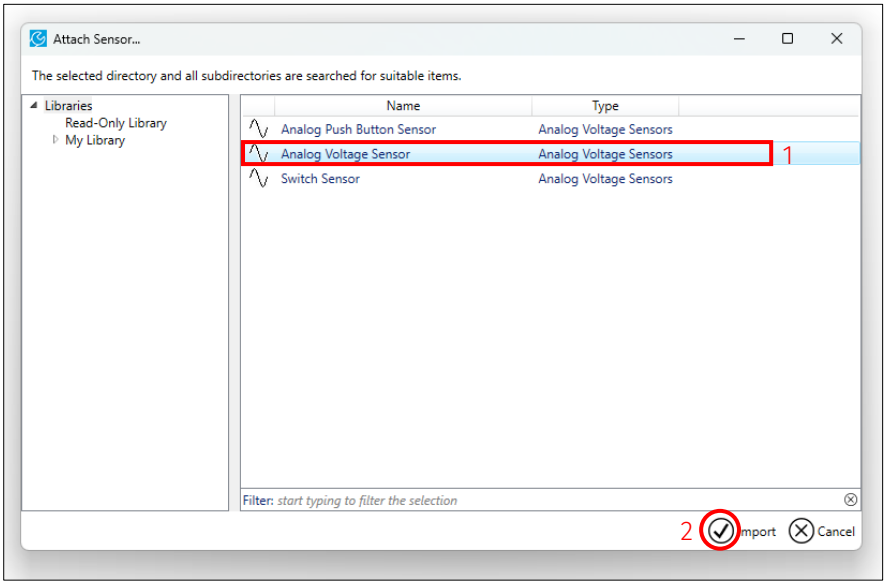


Add an analog sensor

You can now configure the analog input on the **Sensors** node. To specify the desired sensor input, select an analog input (1), click the 'import' icon (2), and then click **Import Individually** (3). You can import multiple sensors as a group (4). You can import and export sensors between existing setups.



When you click the 'import' icon a popup is displayed that shows the Toolset sensor library. This allows you to select the required sensors. Select the required sensor (1), and then click **Import** (2).

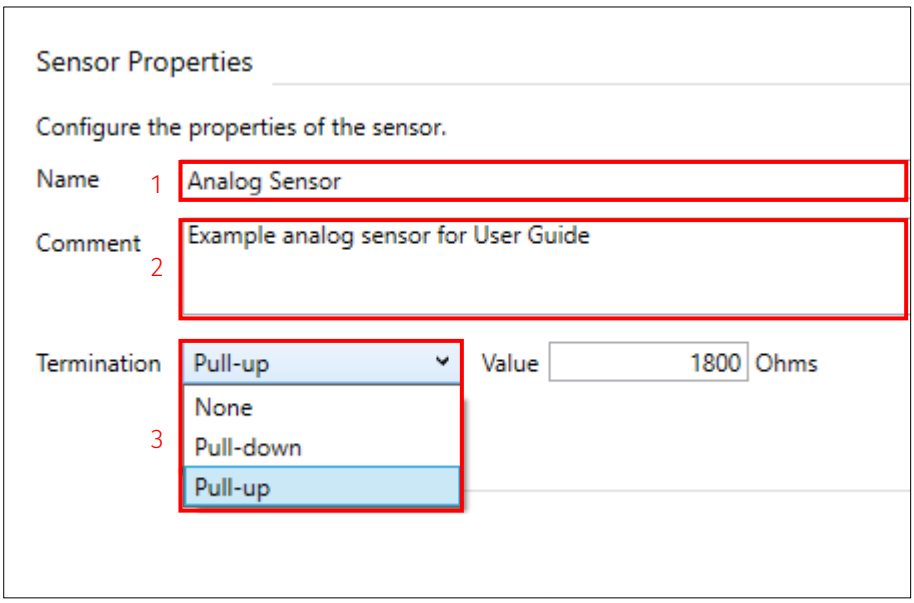


Configure an analog voltage sensor

Sensor properties

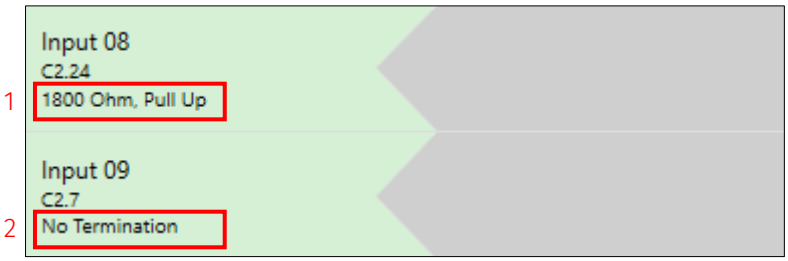
Once the sensor is imported, a new window is displayed to the right of the screen to allow you to configure the sensor.

Enter a name for the sensor (1), add an optional comment about the sensor (2), and specify the termination type if required (3).



Terminations are available on specific inputs. You can see which inputs feature software selectable termination in the **Input Sensor Pairs** menu. The available termination for the input is denoted under the connector/pin identifier (1).

If no termination is available, 'No Termination' is displayed (2). If a 'Pull Up' termination is selected, the resistor must be specified to match the value in the **Sensor Pairs** menu.
The Pull Up termination is not available on all inputs. The Pull Down termination is not available on all analog inputs.

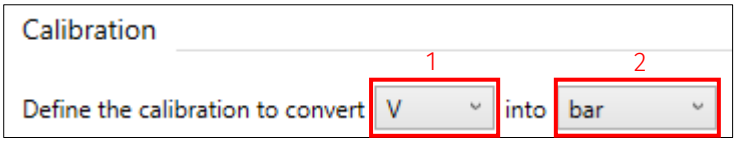


Calibrated channel

Enter the calibrated channel name for the sensor (1), the units for the output quantity (2), and specify the data type (3). You can set an optional uncalibrated channel name to generate a raw uncalibrated voltage channel (4).

Sensor calibration

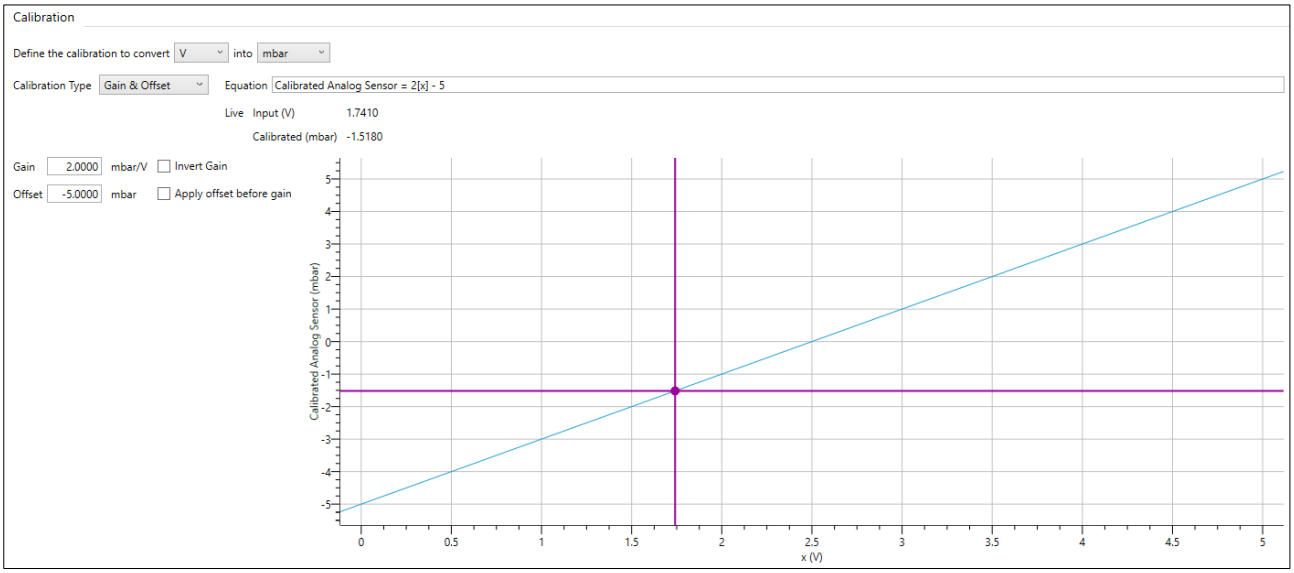
You can now calibrate the analog sensor input. You can define the conversion between voltage units (µV, mV, kV) (1) and the units of the selected output quantity (in this case the units of the selected quantity (pressure) are in bar) (2).



There are three calibration types available to select from the **Calibration Type** dropdown menu:

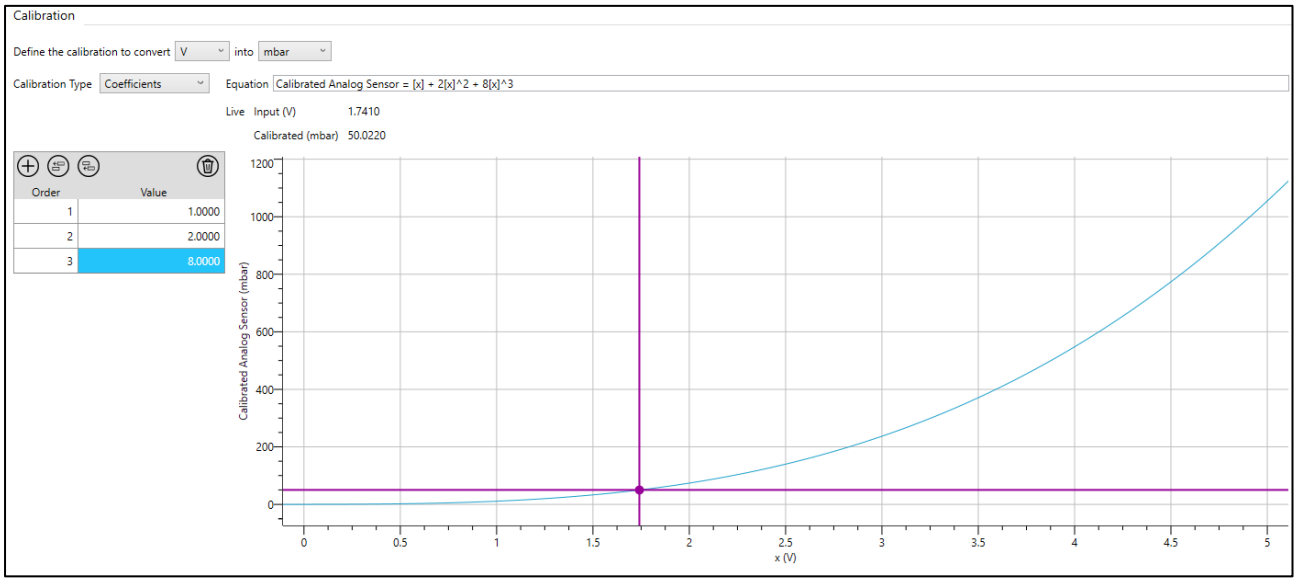
Gain & Offset

Used for proportional calibrations. You can apply a gain and offset to the raw analog voltage input to generate the calibrated output channel. You can insert the required gain and offset, invert the gain and the offset applied before the gain if required. The sensor curve is displayed on the X/Y chart and the equation of the line is displayed in the equation box. When connected to the device, the current sensor readout is displayed on the X/Y chart.



Coefficients

Used for exponential sensor curves. You can add and remove the number of orders from the equation with the = and 'bin' icons. Use the 'insert entry' tools to add orders before or after entries in the table. The sensor curve is displayed on the X/Y chart and the equation of the line is displayed in the equation box. When connected to the device, the current sensor readout is displayed on the X/Y chart.

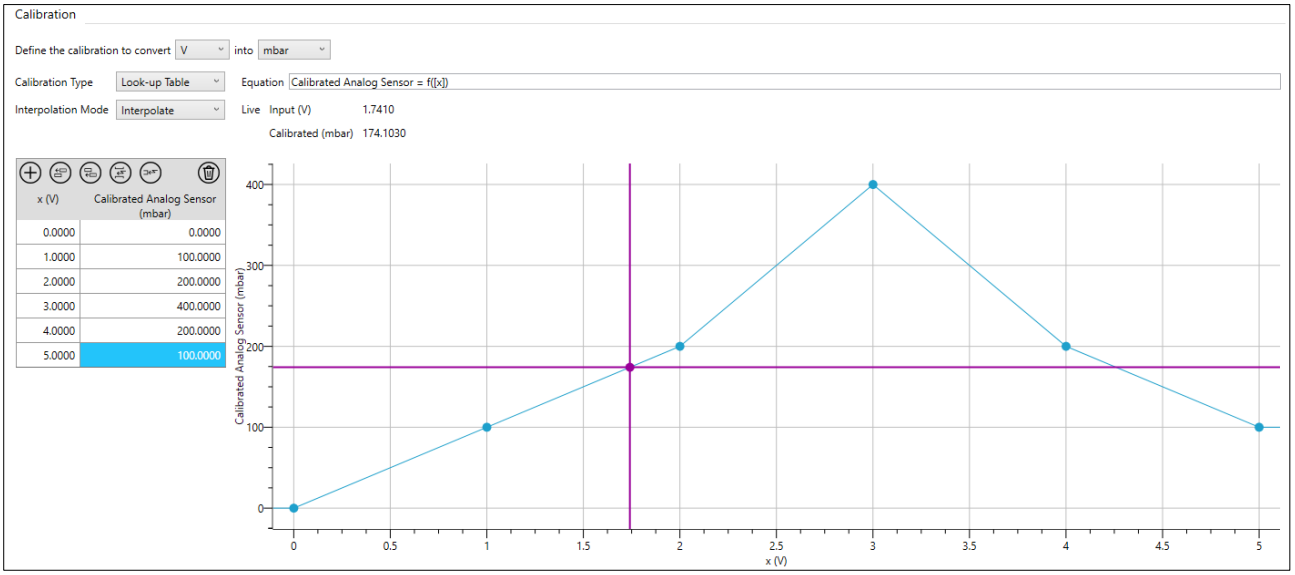


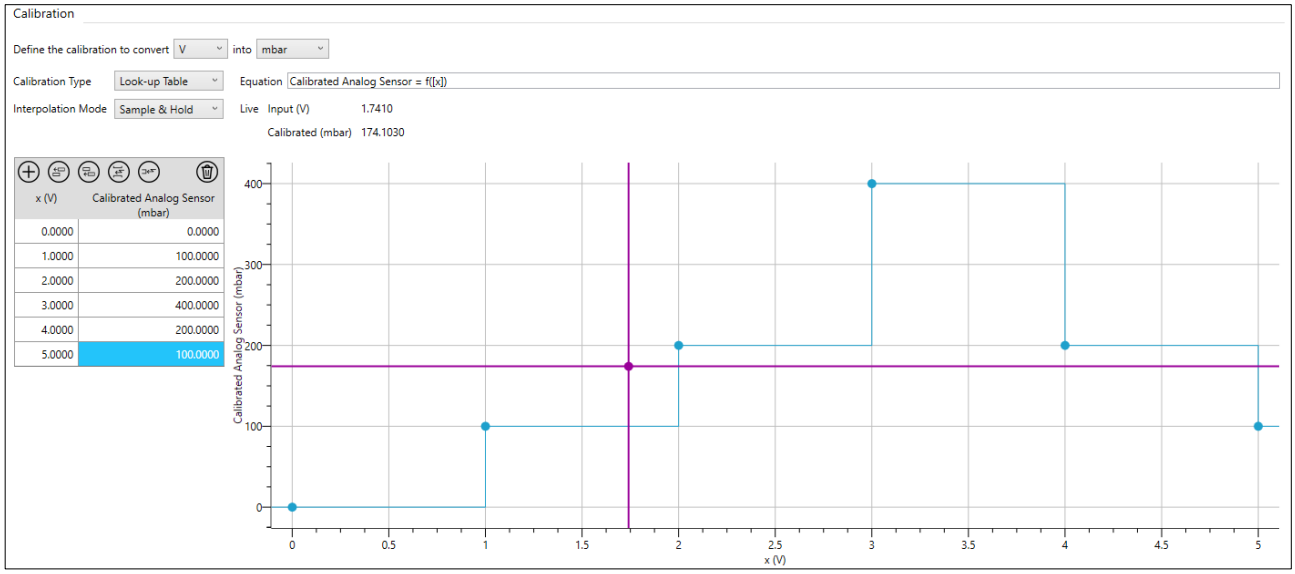
Look-up Table

Used to configure a sensor when the sensor curve is known from a datasheet or look-up table. In the look-up table you can associate certain values of the input channel to a corresponding output value. Toolset then offers three modes to interpolate input/output points in the look-up table:

- Extrapolate – Toolset estimates output values given an input value outside the defined range.
- Interpolate – Toolset calculates the output values between defined input value and corresponding output values.
- Sample & Hold – Toolset holds the output value of its corresponding input until the next defined input value is reached and the output is then updated

  By default, the interpolation mode is set to Interpolate.





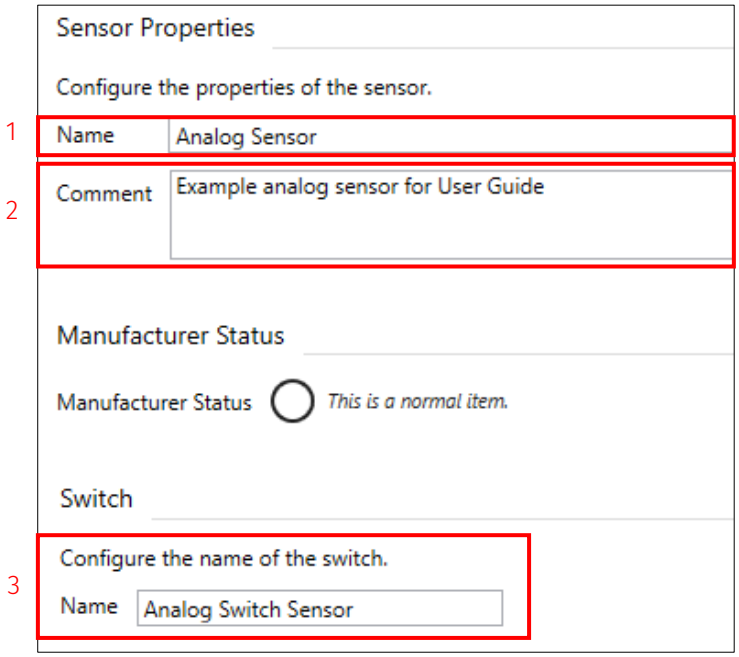
Note: The Equation display is a display of the mathematical function of the sensor curve only. The equation of the sensor curve cannot be written in the field. If you need to copy in a known equation, transfer that equation into a coefficient or table form, and then copy those values into Toolset. You can copy tables from external sources and then copy them into Toolset. Once the table is copied, the corresponding equation will match.

Configure an analog push button sensor

The push button sensor provides a way to use the analog input as a push button/switch input. The AIN input has a maximum input range of 0-30V 'to battery'. However, if you select 'switch to ground' an external pull up resistor is required to generate the switch to the input logic.

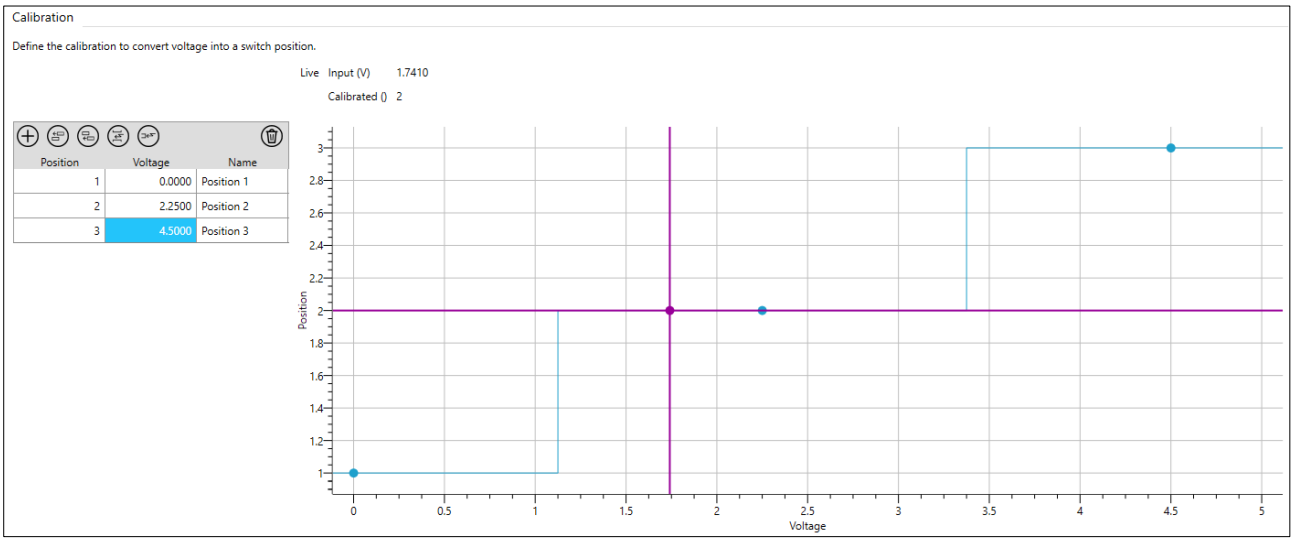
Configure an analog switch sensor

Add a name for the switch sensor (1) and an optional comment about the sensor (2) in the **Details** section. The actual switch sensor name is configurable in the **Switch** section (3).



This sensor type enables a user-defined number of switches at various voltages. To modify these values, simply add additional rows to the table or change the existing values. The graph changes based on the number of positions and voltage set.

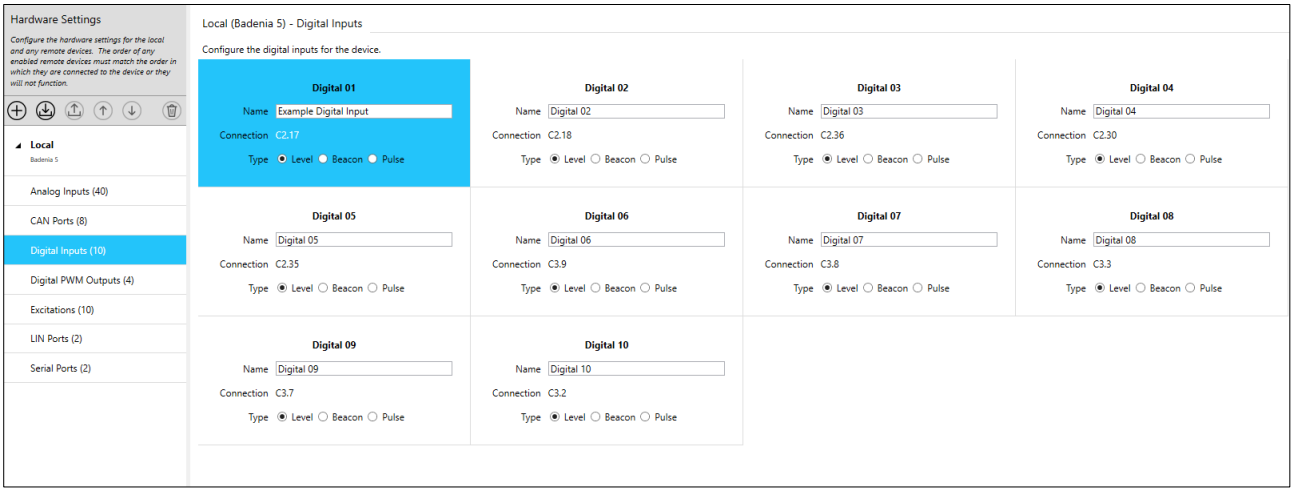
The order of the positions must be respective to the voltages, such that the voltages increase from 0V to 5V. If this condition is not satisfied, then Toolset displays an error and highlights the boxes in red.



Digital sensors

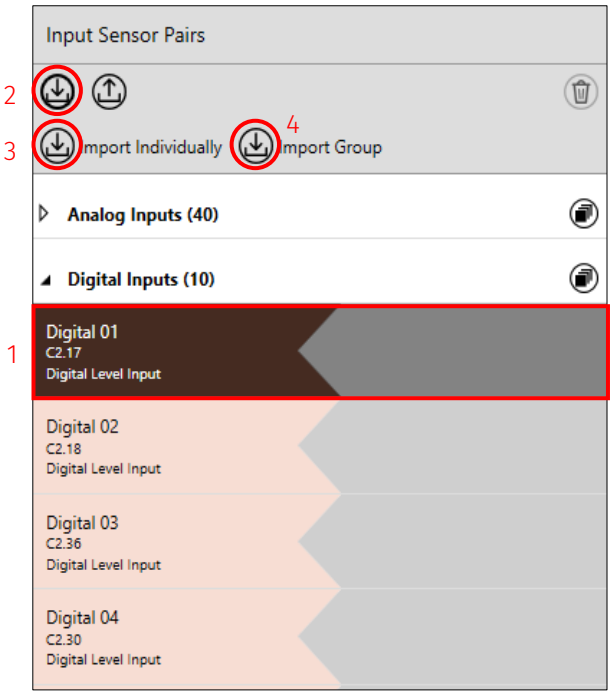
Identify a digital input

You can configure the names of digital inputs on the **Hardware Settings** node, depending on the sensor configuration required.

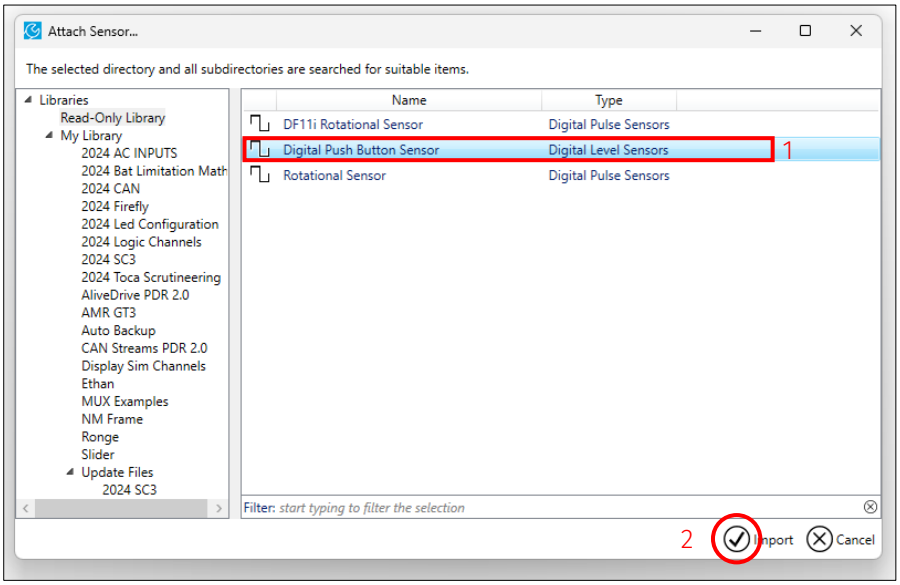


Add a digital sensor

You can then configure the digital input on the **Sensors** node. To specify the desired sensor input, select a digital input (1), click the 'Import' icon (2), and then click **Import Individually** (3). You can import multiple sensors as a group (4) and import and export sensors between existing setups.

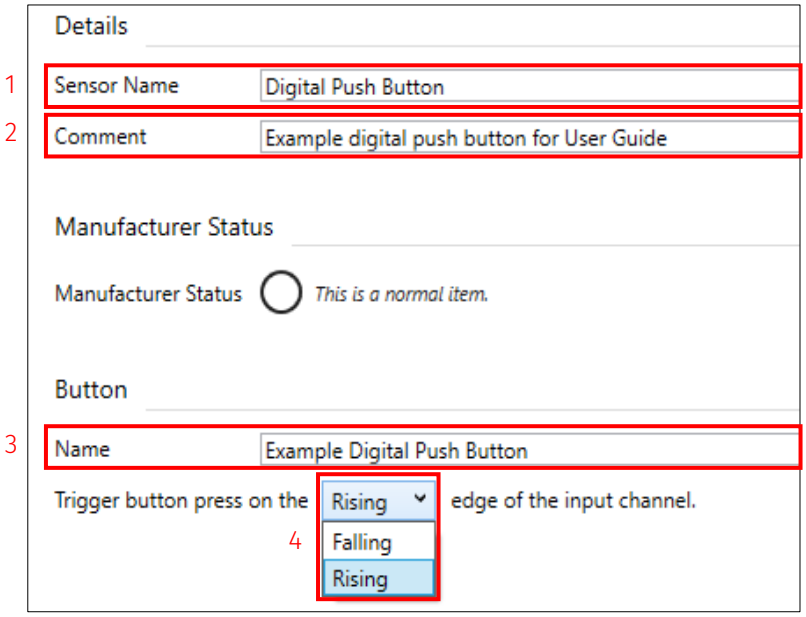


When you click the 'import' icon a popup is displayed that shows the Toolset sensor library. This allows you to select the required sensors. Select the required sensor (1), and then click **Import** (2).



Configure a digital push button sensor

Add a name for the sensor (1) and an optional comment about the digital button (2) in the **Details** section. The actual button channel name is configurable (3), together with the 'mode' (4) in the **Button** section. The 'mode' allows you to configure if the button triggers on the rising or falling edge of the digital input channel.

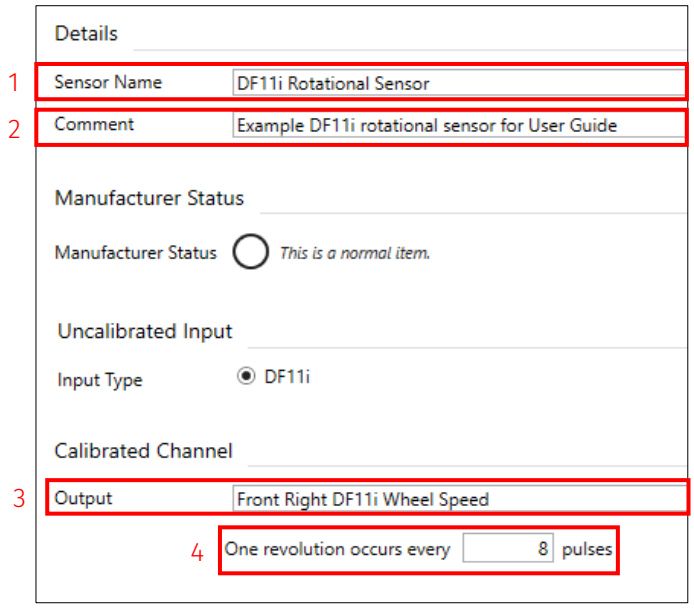


Configure a DF11i rotational sensor

If a DF11i wheel speed sensor is attached to a digital input, you can configure the number of pulses that occur in a revolution of the sensor trigger wheel.

Note: For a 48- tooth reluctor wheel, the total number of pulses per revolution is 96.

You can enter a name for the sensor (1) and add an optional comment (2) about it in the **Details** section. You can configure the **Calibrated Channel** name (3) and set the number of pulses per revolution (4).



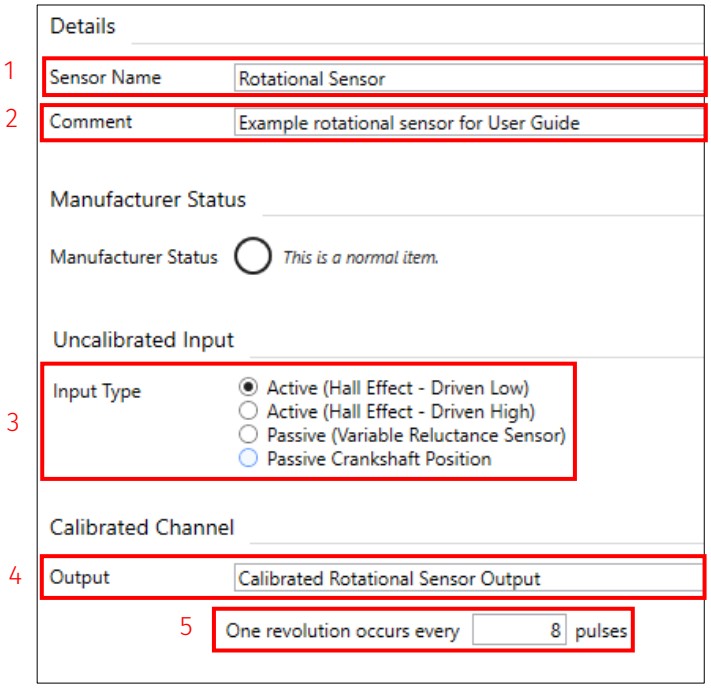
Configure a rotational sensor

If another type of wheel speed or rotational sensor is used, then you must import the rotational sensor. There are four different options:

Sensor Type	Specification	Description
Active	Hall effect – Driven Low	Low would assert an output of 1 when the input signal is Low
Active	Hall effect – Driven High	High would assert an output of 1 when the input signal is High
Passive	Variable Reluctance Sensor	Uses a two-wire sensor and magnetic pickup
Passive	Crankshaft Position	Uses a two-wire sensor and magnetic pickup

You can enter a name for the sensor (1) and add an optional comment (2) about it in the **Details** section. Select the uncalibrated input type (3). You can configure the calibrated output channel name (4) and set the number of pulses per revolution (5). This is determined by the tooth count of the trigger wheel used to drive the digital input.

Note: If you create an input for a wheel speed sensor, the sensor is not defined internally as a wheel speed until it is set up within the **Wheel Speed** node. Until this is done, Toolset only recognizes it as a rotational sensor.



Digital input information

Maximum input voltage

The table below shows the maximum input voltage for the different sensor types:

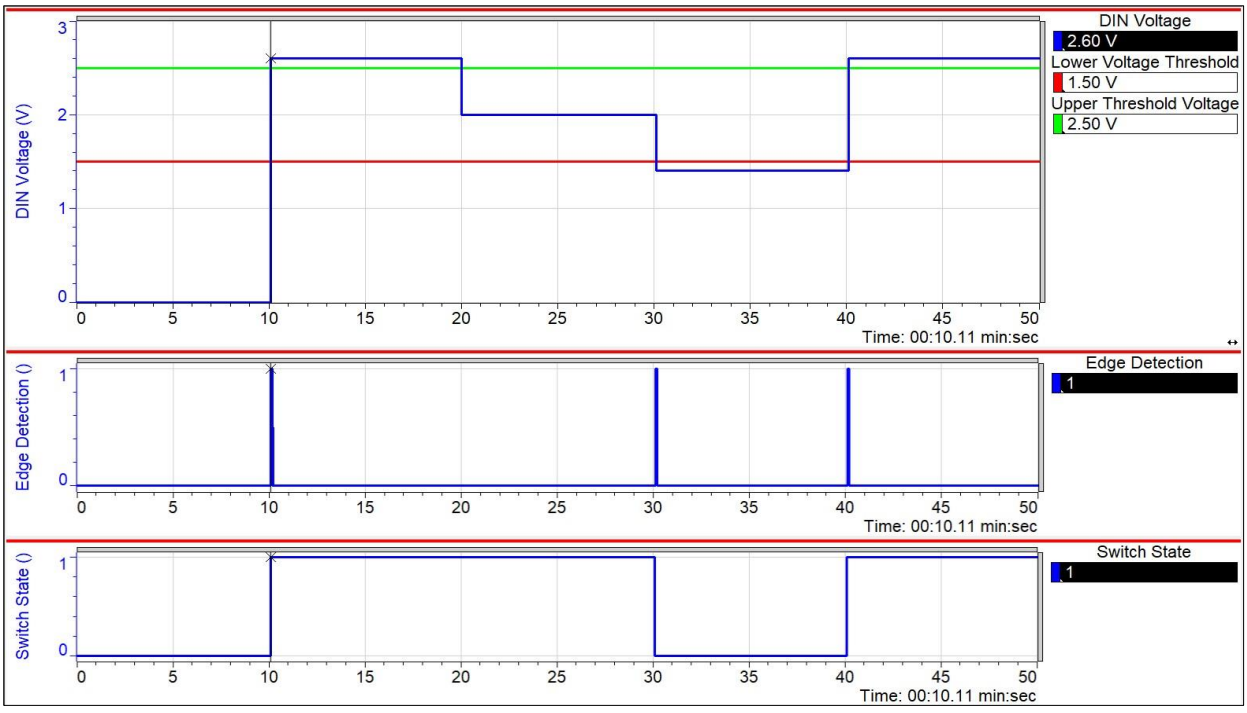
Input type	Maximum input voltage
Digital Push Button Sensor	Battery voltage (up to 32V)
Rotational Sensor	Battery voltage (up to 32V)
DF11i Rotational Sensor	Only to be used with a DF11i Sensor. Any over-voltage could cause damage to the pull down resistor.

Threshold voltages

The table below shows the threshold voltages for the signal edge detection. Both the upper and lower thresholds must be passed for an edge to be detected. The input remains registered until both the upper and lower threshold have been passed back through again.

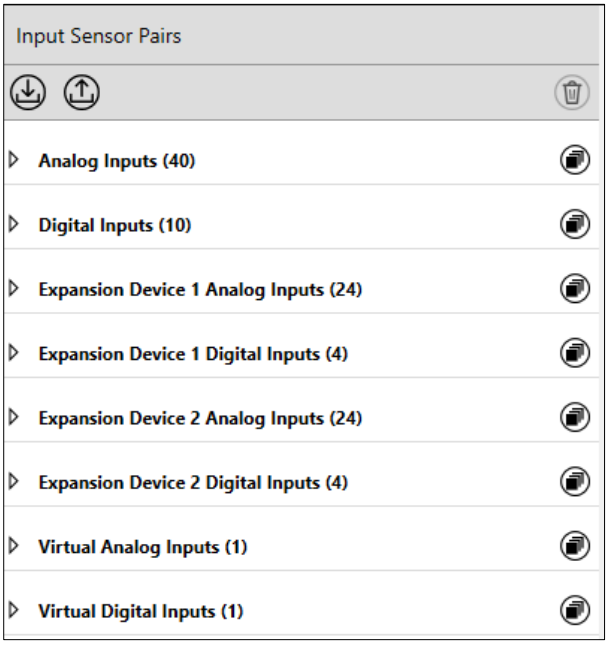
Mode	Pull	Lower voltage threshold (V)	Upper voltage threshold (V)
OFF	None	0	0
Beacon/Level/Hall Effect	Pull Up	1.5	2.5
VRS	None	-0.5	0.5
Current (DF11i)	Pull Down	2.25	3.25

The diagram below shows the digital input edge detection logic. Both the lower and upper thresholds must be passed, in either direction, for an edge to be detected by the CLU.

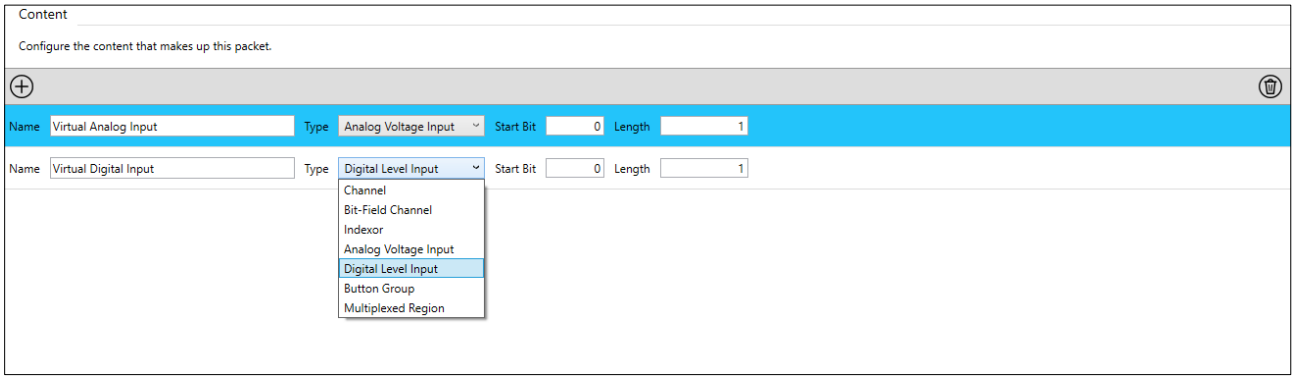


Virtual sensors

You can configure CAN channels (see **Setups - Streams**) to be an analog voltage input or a digital level input from the **Type** dropdown menu.



When you select an analog voltage input or a digital level input type, a virtual sensor is generated on the **Sensors** node.



A virtual sensor is configured in the same way as a standard analog or digital sensor.