

Digital / Frequency Input Setup Manual

Revision History

Revision	Description	Release Date	Author
0	Initial Release	2021-03-10	TS

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1 Notes and symbols used in this Manual



These paragraphs contain tips and practical advice for working with the System



In the paragraphs highlighted with this symbol, you will find additional information and it is very important that you follow the instructions given.



Documentation reference

- A user manual reference number is provided so the user can seek further assistance

“Software Parameter”

Monospaced text in quotation marks designates a software parameter, pages, tabs or tables in the 2D Software

“#Channel”

Monospaced text in quotation marks with a leading hash mark designates a channel in the 2D Software

..cross-reference..

Italic, dotted underlined text designates a cross-reference to a different chapter of the manual

2 Introduction

This Manual is intended for everyone who sets up a logger system and therefore need an understanding who the different Frequency inputs work and how-to setup them correctly to get the best results.

The Inputs Chapter is describing the different measurement principles of the different Inputs.

Please pay close attention to the Input Dimensions in chapter - 4.1 - General -.

2.1 General

Frequency inputs count the digital pulses and convert them into a signal, considering the selected settings, such as circumference, pulses, timeout, digital threshold and the selected dimension.

The internal sampling rate of the 2D Systems is much higher than the sampling rate you can select within the channel. This way it is possible to recognize all pulses. The sampling rate you can select on tab "Parameter" is used to send the data out on the CAN bus and for recording

2.2 Different Inputs

The 2D Logger and CAN Boxes have different types of Frequency Inputs:

- High Speed / High Precision Inputs
- Hybrid Inputs
- Legacy Digital Inputs
- Legacy Universal Inputs

This Manual will explain the detailed differences between those Inputs and how to configure the Inputs for your application.

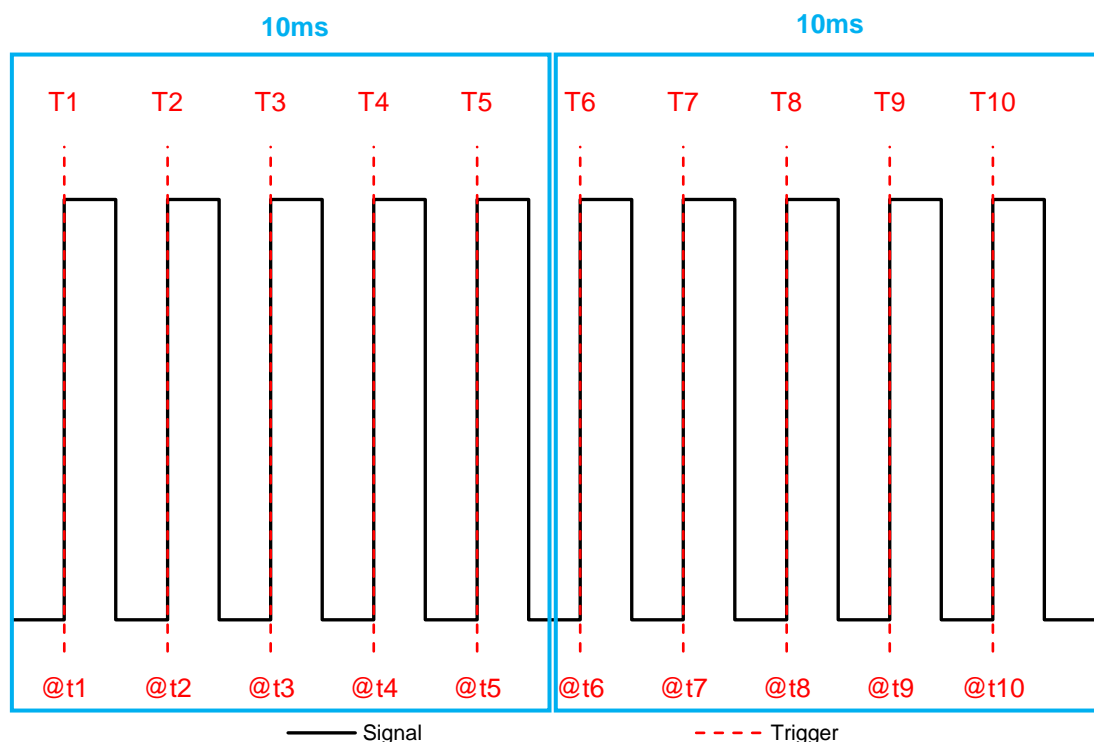
3 Inputs

3.1 High Speed / High Precision Inputs

In the High Speed / High Precision Inputs the Frequency is measured by timestamping every trigger with a resolution of 14ns and calculating the resulting frequency every time a sample is recorded and the timestamp of the last trigger and last sample is kept and used for calculating the frequency.

With this measurement principle you can sample a high frequency signal with relatively low sampling rate without missing a single trigger.

In the example we have a sampling rate of 100Hz ($\pm 10\text{ms}$)



2D principle

Sample 1	Sample 2
$N = 5$	$N = 6$
$t_1 = 0\text{ms}$	$t_5 = 10,15\text{ms}$
$t_5 = 10,15\text{ms}$	$t_{10} = 21,77\text{ms}$
$F = \frac{1}{\left(\frac{\Delta t}{N}\right)} = \frac{1}{\left(\frac{t_5 - t_1}{N}\right)} = 492,61\text{Hz}$	$F = \frac{1}{\left(\frac{\Delta t}{N}\right)} = \frac{1}{\left(\frac{t_{10} - t_5}{N}\right)} = 516,35\text{Hz}$

Conventional system which only counts the triggers per sample

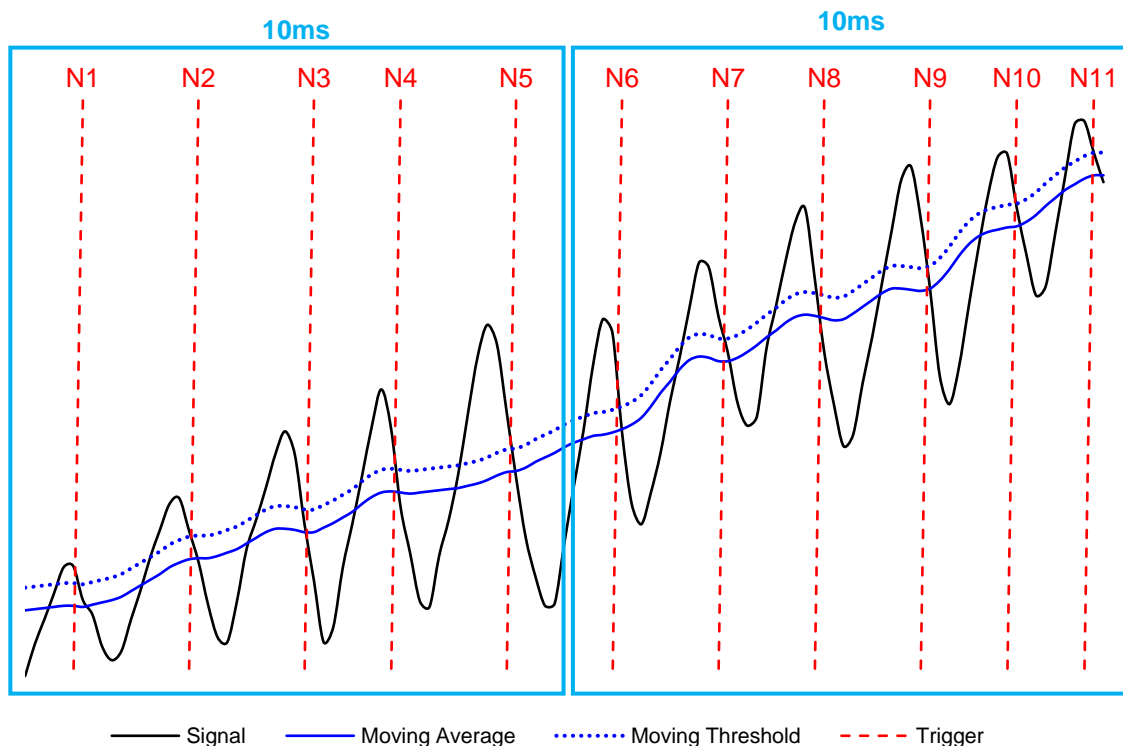
Sample 1	Sample 2
$N = 5$	$N = 5$
$\Delta t = \text{sampling rate} = 10\text{ms}$	$\Delta t = \text{sampling rate} = 10\text{ms}$
$F = \frac{1}{\left(\frac{\Delta t}{N}\right)} = 500\text{Hz}$	$F = \frac{1}{\left(\frac{\Delta t}{N}\right)} = 500\text{Hz}$

3.2 Hybrid Inputs

In the Hybrid Inputs the Frequency is measured by internally sampling the analog signal with 32 kHz and then calculating a moving average. When the threshold value above the moving average is crossed a trigger signal is generated, counted and then used to calculate the frequency.

With this principle it is possible to measure signals from sensors whos output level changes with the frequency, for example NPN oder PNP sensors.

In the example we have a recording rate of 100Hz ($\triangleq 10\text{ms}$)

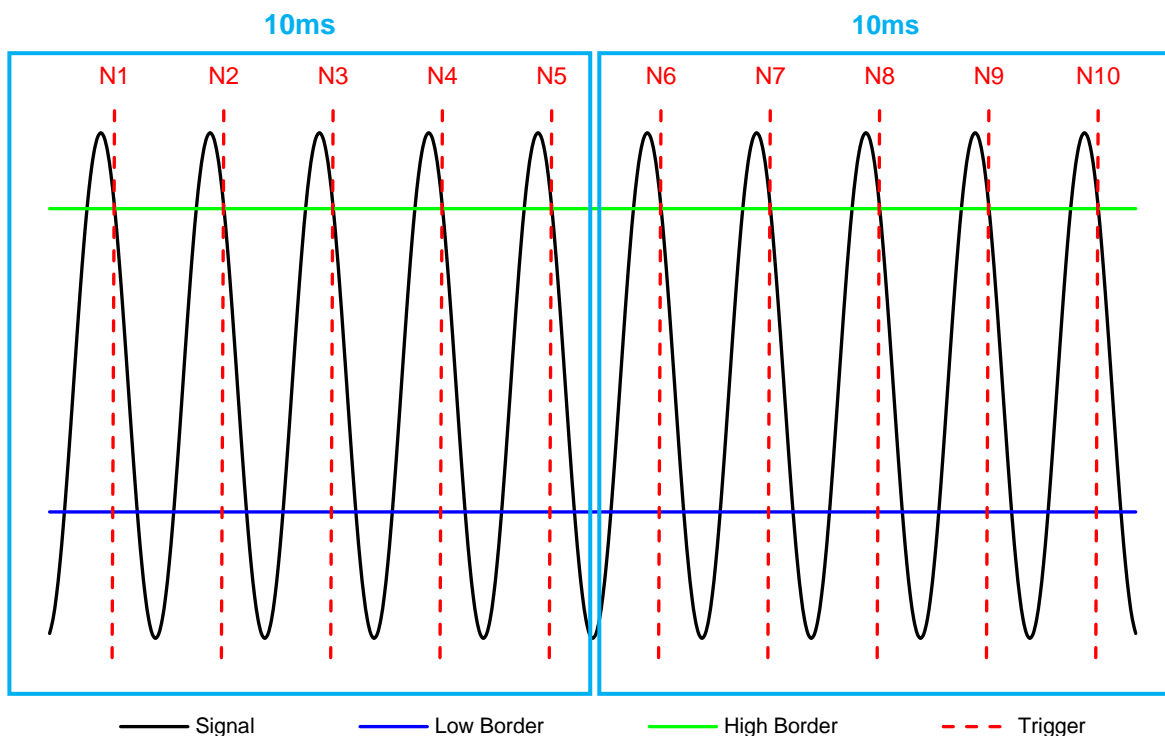


Sample 1	Sample 2
$N = 5$	$N = 6$
$\Delta t = \text{recording rate} = 10\text{ms}$	$\Delta t = \text{recording rate} = 10\text{ms}$
$F = \frac{1}{\left(\frac{\Delta t}{N}\right)} = 500\text{Hz}$	$F = \frac{1}{\left(\frac{\Delta t}{N}\right)} = 600\text{Hz}$

3.3 Legacy Digital Inputs

In the Digital Inputs the Frequency is measured by internally sampling the analog signal. When the trigger threshold border is crossed a trigger signal will be generated, counted and then used to calculate the frequency.

In the example we have a sampling rate of 100Hz ($\pm 10\text{ms}$)



Sample 1

$$N = 5$$

$$\Delta t = \text{sampling rate} = 10\text{ms}$$

$$F = \frac{1}{\left(\frac{\Delta t}{N}\right)} = 500\text{Hz}$$

Sample 2

$$N = 5$$

$$\Delta t = \text{sampling rate} = 10\text{ms}$$

$$F = \frac{1}{\left(\frac{\Delta t}{N}\right)} = 500\text{Hz}$$



Input Setup

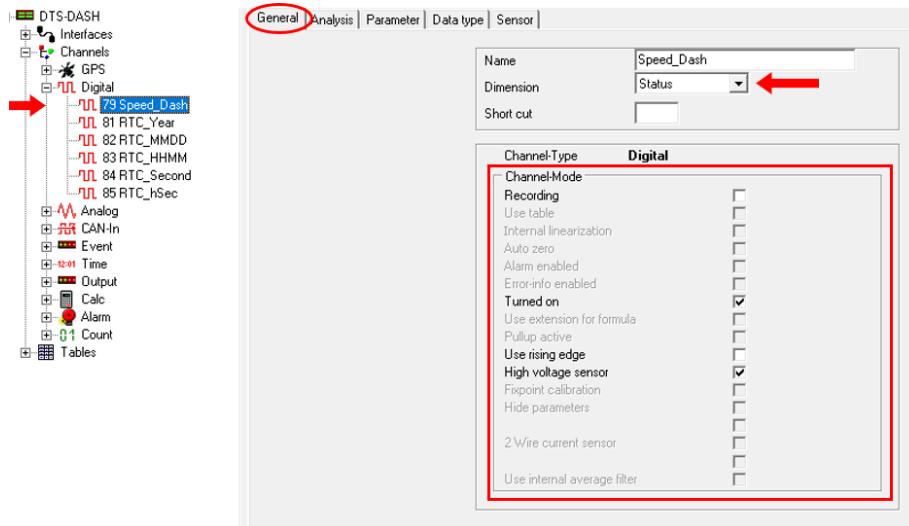
Thresholds, Edge selection, Timeouts and other features can be configured individually per input. Please refer to [chapter - 4 - Input Setup](#) in this manual

4 Input Setup

The Inputs Setup is the same for both types Inputs

4.1 General

In tab “General1” of the frequency channels you can change the following settings:



- “Dimension”: select a dimension from the drop-down list (availability of the Dimensions is depending on the used Device)
 - “Hz” – frequency in Hz
 - A new value is calculated when the defined number of triggers is reached
 - “rpm” - rotational speed, time scale one minute
 - a set number of pulses per revolution will be calculated into rotational speed
 - this setting is designed to accept “missing tooth” tone wheels from crankshafts, etc.
 - A new value is calculated when the defined number of triggers is reached
 - “km/h” - speed in km/h
 - a set number of pulses per revolution and the wheel circumference will be calculated into the vehicle speed
 - the value will be averaged when smaller sampling rates are used
 - A new value is calculated when the defined number of triggers is reached
 - “mph” - speed in mph
 - a set number of pulses per revolution and the wheel circumference will be calculated into the vehicle speed
 - the value will be averaged when smaller sampling rates are used
 - A new value is calculated when the defined number of triggers is reached
 - “m/s” - speed in m/s
 - a set number of pulses per revolution and the wheel circumference will be calculated into the vehicle speed
 - the value will be averaged when smaller sampling rates are used
 - A new value is calculated when the defined number of triggers is reached

- “1/s” - pulses per time, scale 1s
→ A new value is calculated on every trigger
- “Status” - can only be low or high
→ A new value is calculated on every trigger
- “1/min” - pulses per time, scale 60s
→ A new value is calculated on every trigger
- “ATM” - pulse interval (time gap between 2 pulses) in ms
- “ATU” - pulse interval (time gap between 2 pulses) in μ s
- “DTN” - pulse interval (time gap between 2 pulses) in μ s, relative to the previous frequency input on the device (phase shift)
- “L/s” - flow in liters per second
→ a set number of pulses per set volume will be calculated into flow
→ A new value is calculated on every trigger
- “L/min” - flow in liters per minute
→ a set number of pulses per set volume will be calculated into flow
→ A new value is calculated on every trigger
- “ml/s” - flow in milliliters per second
→ a set number of pulses per set volume will be calculated into flow
→ A new value is calculated on every trigger
- “ml/min” - flow in milliliters per minute
→ a set number of pulses per set volume will be calculated into flow
→ A new value is calculated on every trigger
- “ μ l/s” - flow in microliters per second
→ a set number of pulses per set volume will be calculated into flow
→ A new value is calculated on every trigger
- “ μ l/min” - flow in microliters per minute
→ a set number of pulses per set volume will be calculated into flow
→ A new value is calculated on every trigger
- “Recording”: enable or disable the recording of the channel
- “Turned on”: turn this channel on or off
- “Use rising edge”: activate to use the rising edge of the signal, otherwise the falling edge is used
- “High voltage sensor”: enables the input to handle high voltages signals
→ only on selected devices, please refer to the datasheet / manual of the device for further information.

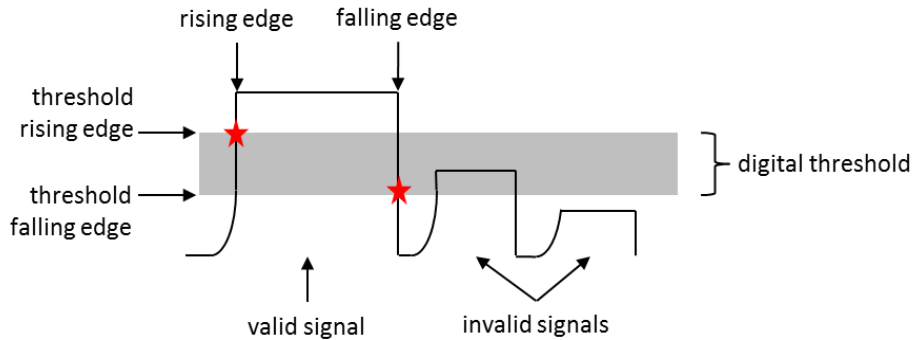
**hold last value timeout**

To avoid signal dropouts at low speeds / frequencies the devices will hold the last value for 5s after the last trigger was recognized before sending a 0 value.

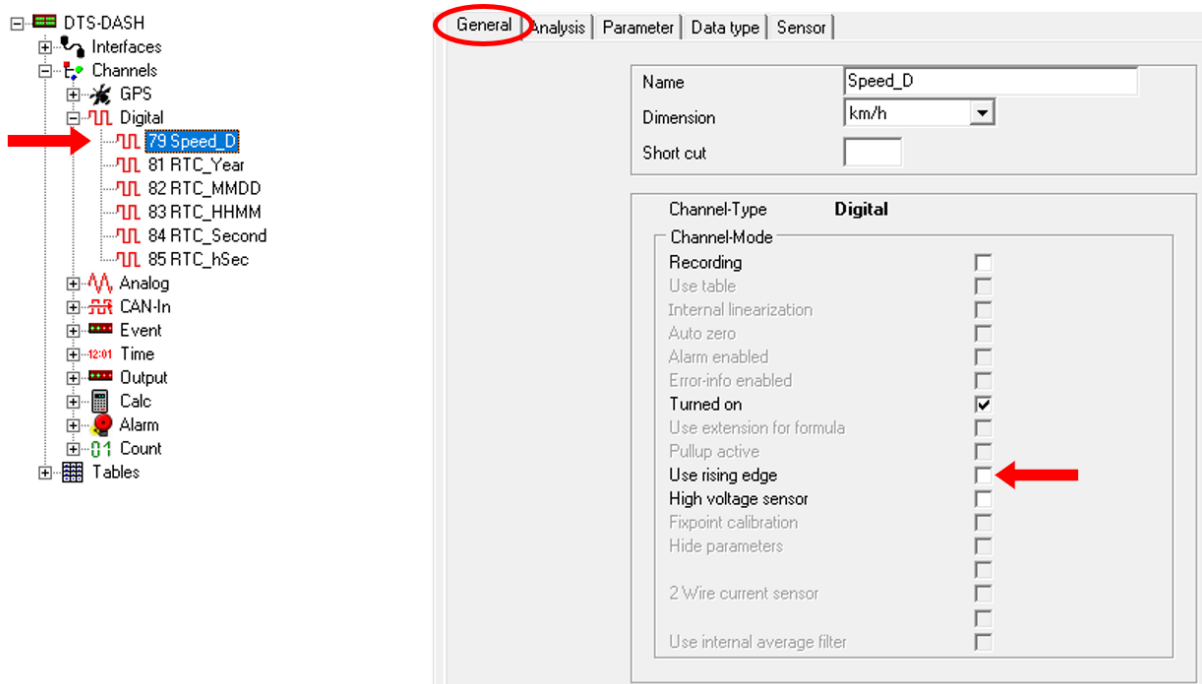
4.2 Trigger Edge

To trigger the channel through the signals rising edge enable the checkbox “Use rising edge”.

If this option is not activated the logger will automatically use the falling edge of the signal. The meaning of rising and falling edge is also explained in the figure further down.

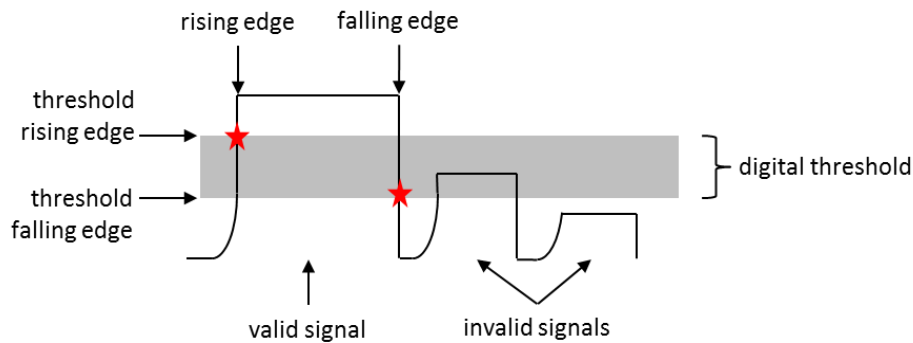


To change the trigger edge, navigate to tab “General”:



4.3 Trigger Threshold

A threshold needs to be set so that the trigger level at which the signal is supposed to be low or zero can be recognized. This can be the case if an open collector sensor is connected. For example: the sensor is not powerful enough to lower the voltage down to 0V. The voltage is merely lowered down to 3V. But with a threshold of 4V the device can still differ between the high- and the low-level signal. Therefore, you have to specify the threshold for the rising edge of the signals and the threshold of the falling edge. If the edges of the signal pass both thresholds the signals are recognized as a valid frequency input signal. (see figure below, the red stars indicate the situation where the signals crosses thresholds)



To change the trigger threshold, navigate to tab “Parameter”:

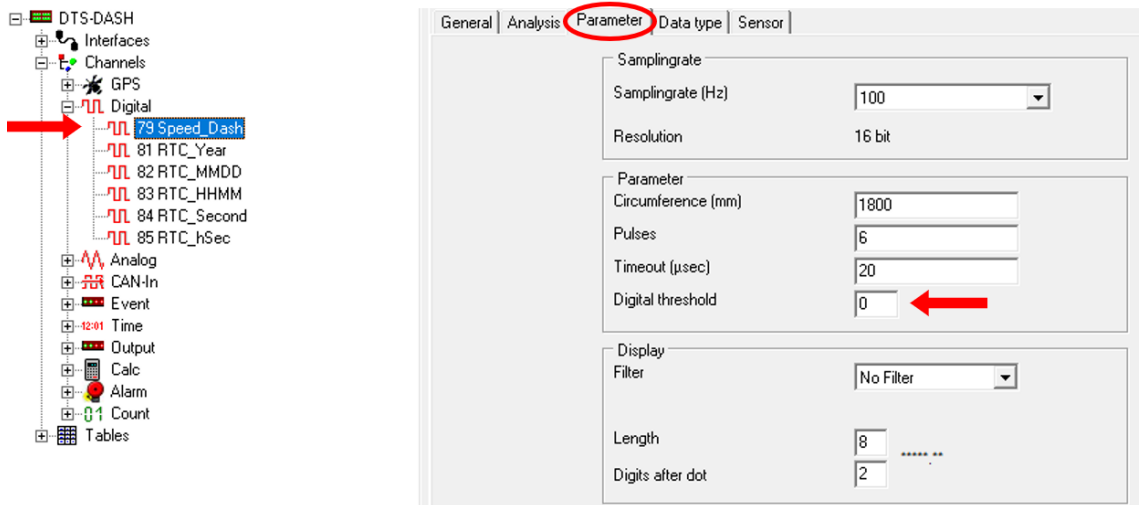
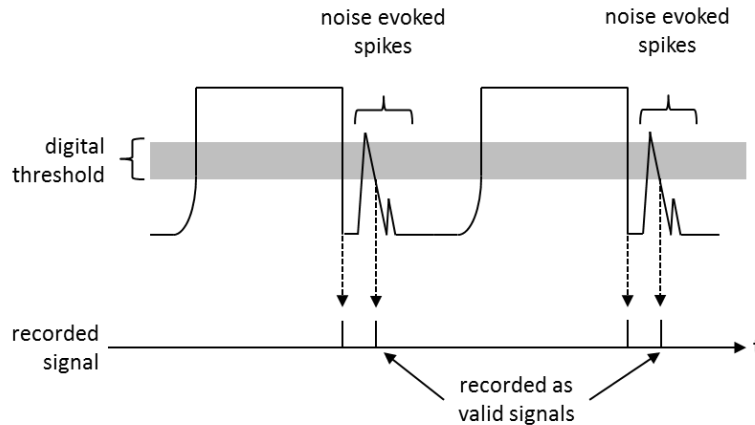


Table 4.1 – Threshold Values

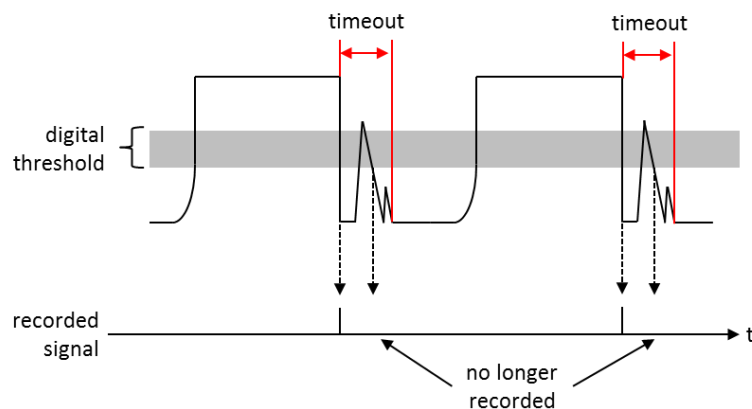
Threshold Value	Threshold rising edge [V]	Threshold falling edge [V]
1	0.04	0.00
10	0.42	0.31
20	0.84	0.64
30	1.24	0.94
40	1.63	1.26
50	2.00	1.55
60	2.36	1.84
70	2.71	2.11
80	3.05	2.38
90	3.38	2.64
100	3.70	2.89
110	4.01	3.13
120	4.31	3.37
130	4.60	3.59
140	4.88	3.82
150	5.15	4.03
160	5.42	4.24
170	5.68	4.44
180	5.93	4.64
190	6.17	4.84
200	6.41	5.02
210	6.64	5.20
220	6.87	5.38
230	7.09	5.55
240	7.30	5.72
250	7.51	5.89
255	7.61	5.97

4.4 Timeout

At higher frequencies the noise evoked spikes tend to increase. This means that they might rise above the trigger level and cause interference (see figure below).

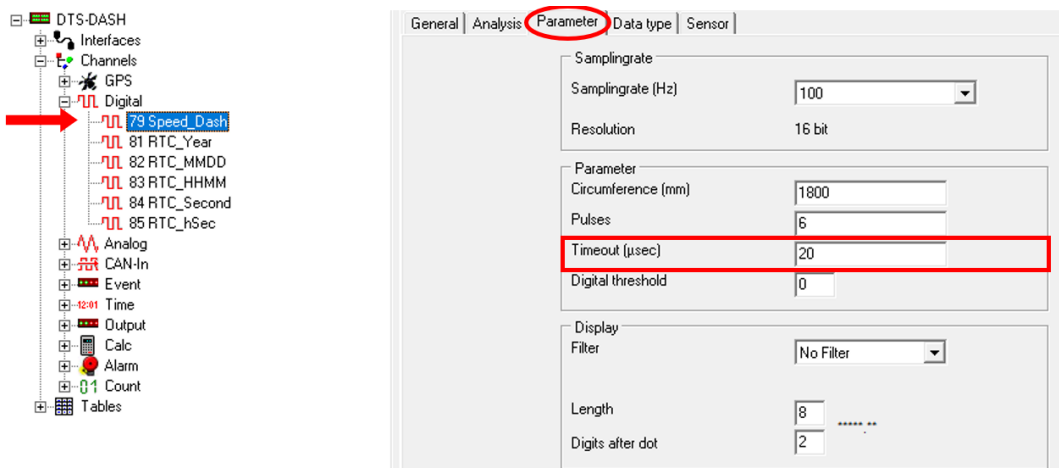


To counter this effect, it is possible to define a timeout period for the input signal. The timeout period starts as soon as the falling edge of a signal crosses the falling edge threshold. During the timeout period, the device ignores pulses on this input. It does not react on incoming signals.



The timeout needs to be set that the noise spikes are completely masked out of the measurement. Be careful not to specify a too long timeout period because that might mask out valid signals.

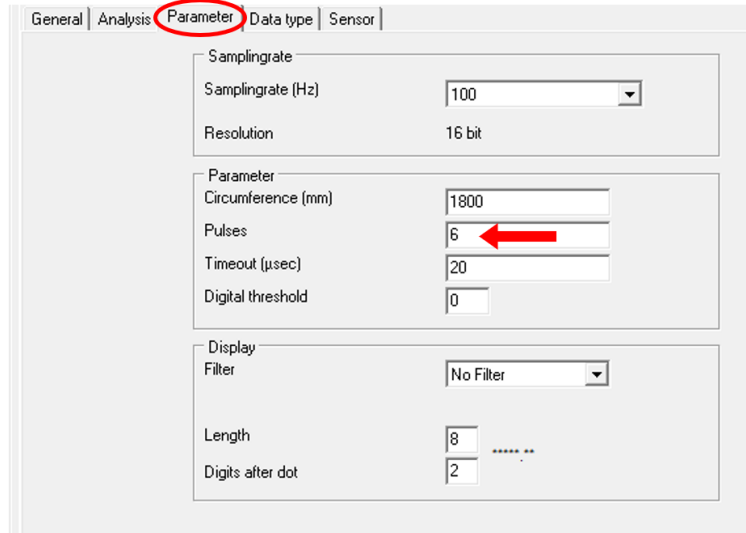
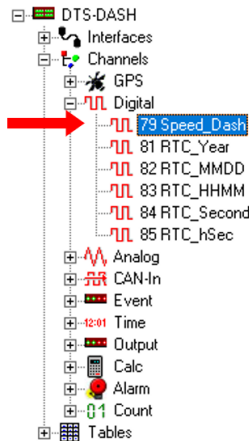
Set the timeout, navigate to tab “Parameter”:



4.5 Tone Wheel Definition

To calculate the (rotational) speed the device needs to know the number of pulses per revolution

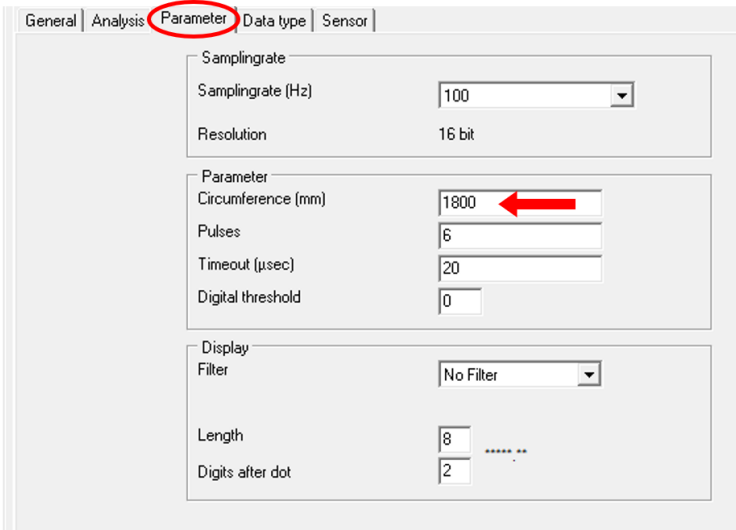
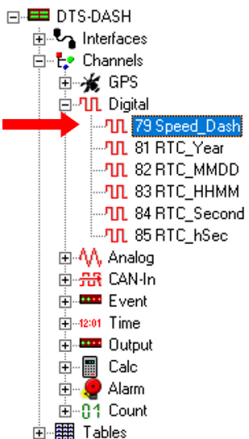
In tab “Parameter” of the frequency channel, put in the correct value:



4.6 Wheel Circumference Setup

To calculate the vehicle's speed the device needs to know the wheel circumference in mm

In tab “Parameter” of the frequency channel, put in the correct value:

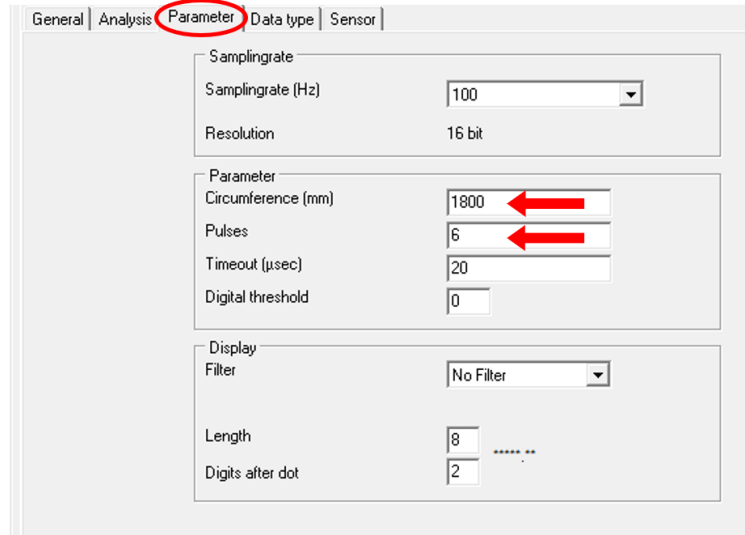
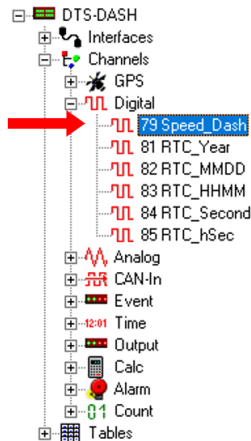


4.7 Fuel / Liquid Flow Setup

To calculate the Fuel / Liquid Flow the device needs to know how many pulses equals how much volume.

The Volume in the selected dimension [l / ml / µl] is put in the circumference field, the number of corresponding pulses per volume is put into the pulses field.

In tab “Parameter” of the frequency channel, put in the correct value:



Integer Volume Value



The Volume can't be put in in a decimal value!

If you have a decimal value please calculate the smallest common integer multiple.

For Example: 5 pluses \triangleq 2,5ml \rightarrow 10 pulses \triangleq 5ml