Brake Noise

DEWESoft®

SOFTWARE USER MANUAL

Brake Noise V21-2

1. Table of contents

2. About this document

This is the users manual for Brake Noise module.

2.1. Legend

The following symbols and formats will be used throughout the document.

Important
It gives you important information about the subject.
Please read carefully!

Hint
It gives you a hint or provides additional information about a subject.

Example
Gives you an example of a specific subject.

3. Introduction

Brake noise plugin is used for detecting and tracking noise caused by mechanical vibration in various braking systems using an algorithm that is based on the VDA 303 guideline.

The detection of brake noise is based on the comparison of sound and the mechanical vibration amplitude spectrum. The only inputs needed to detect brake noise events are sound and vibration measurements. The amplitude spectrum calculation with a fast Fourier transform (FFT) algorithm is completely integrated into the plugin. During the measurement, the plugin can detect and track *multiple brake noise events* in *multiple sound-vibration detection pairs simultaneously*, while *statistical parameters* of the noise event, or of any scalar Dewesoft channel, can be calculated during an actual brake noise event.

Brake noise plugin is flexible regarding different hardware configurations. With an automatic pairing of defined sound and vibration inputs in detection pairs, the configuration workload is significantly reduced for large measurement setups. The amount of brake systems measured and analyzed is only limited by the available computer resources.

As with Dewesoft's math modules, Brake noise plugin can also be used in analysis mode to recalculate the data and correct initial setup mistakes.

4. Brake Noise Setup

Brake noise plugin can be set up by its user interface in channel setup. On Image 1 it is shown that plugin's user interface can be divided in four major parts:

1. *Fourier transformation settings*
2. *Sound weighting*
3. *Noise detection*
4. *Channel groups*

By setting up the plugin you get output channels in which results are written. The range of results and how they are generated from detection pairs has its own topic - *Outputs*.

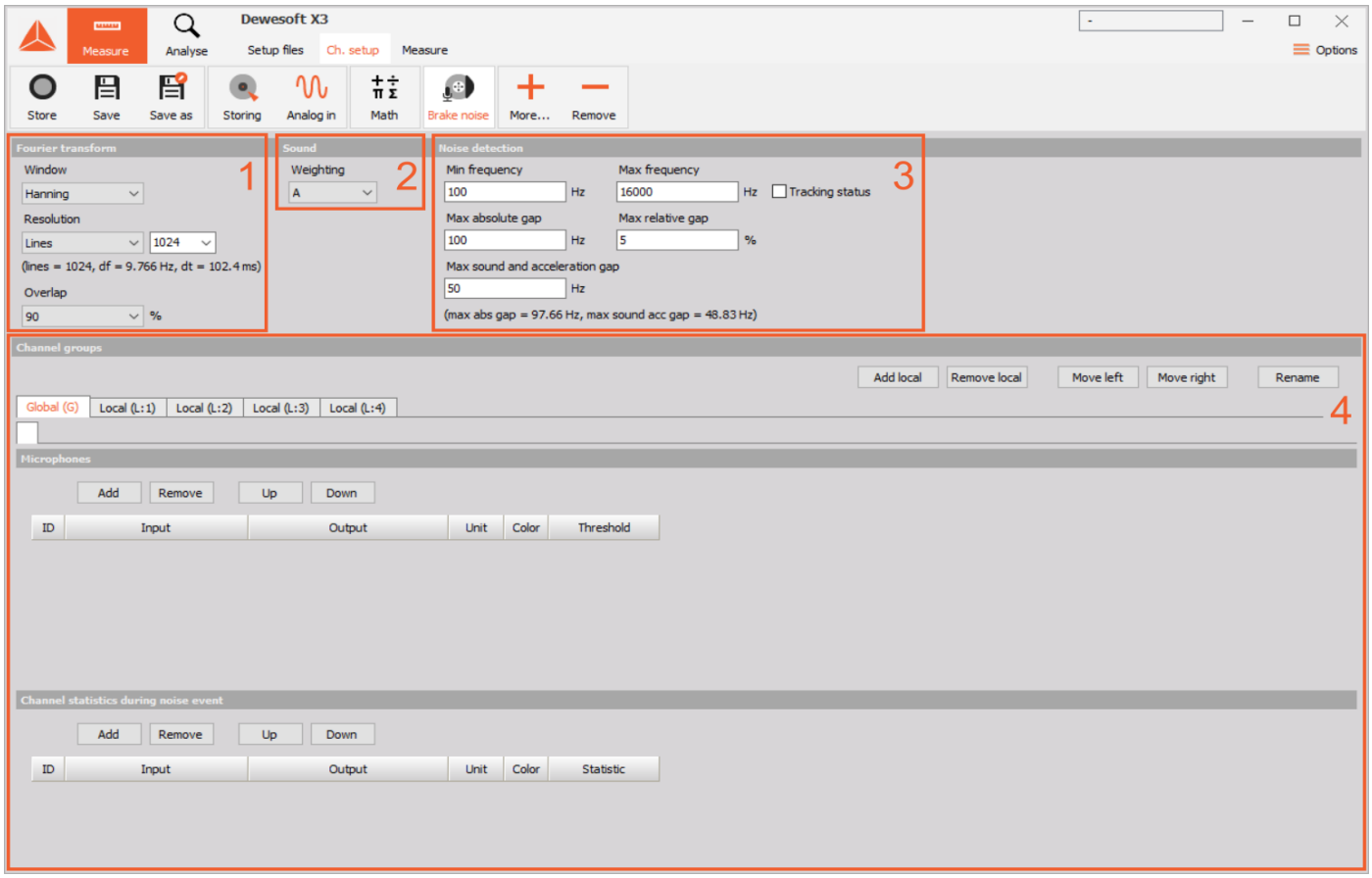

Image 1: Layout of the Brake Noise plugin user interface

4.1 Fourier transformation settings

To detect brake noise caused by vibration, plugin compares amplitude spectrums of sound and mechanical vibration measurements. The transformation from time signal to frequency spectrum is calculated in the plugin. Therefore the only inputs needed for brake noise detection are sound pressure signal in pascals and mechanical vibration signal which is usually measured with an accelerometer. Amplitude spectrum of the measured signals is calculated with the fast Fourier transform algorithm (FFT). The algorithm used is the same as in other Dewesoft components that calculate signal frequency spectrum like Fourier Transform. The settings exposed in the plugin are those that are relevant to brake noise detection. The default settings are based on the VDA 303 guideline.

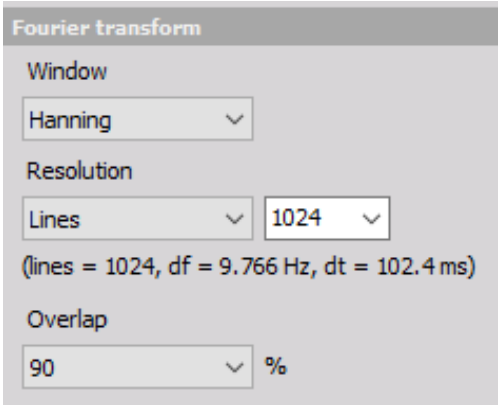

Image 2: Fourier transform setup

4.1.1 Window

Here you can select *which window is applied to the signal before amplitude spectrum calculation*. You can select from one of this windows:

- Rectangle,
- Hanning,
- Hamming,
- Flat top,
- Triangle,
- Blackman,
- Blackman-Harris.

By default the Hanning window is selected.

4.1.2 Resolution

Here you can select the *amount of samples that are used in the transformation*. This determines the number of lines calculated by the transform, line resolution and duration of the signal that is used for the transformation. Resolution can be specified in three different ways:

- **Lines**: the number of lines of the frequency spectrum calculated,
- **Delta frequency**: frequency resolution in Hz of calculated spectrum,
- **Duration**: the duration of the signal in milliseconds that is taken into the transformation.

In every option you can select one of the values that are already defined or you can input the desired value. The label below resolution combo boxes shows the actual values of lines, delta frequency and duration of the transformation. In case of specified delta frequency or duration the exact values specified usually cannot be achieved. This is determined mostly by the acquisition sample rate selected. The actual FFT that will be used in calculations will be as close as possible to the specified value. Also in case of duration or delta frequency the actual FFT size and number of lines does change if Dewesoft acquisition sample rate changes. In case of lines as the resolution input option, the size of FFT will remain the same if Dewesoft acquisition sample rate changes. But the resolution in terms of actual delta frequency and duration will change. The default setting of the resolution option is lines, with 1024 lines calculated by the transformation. With acquisition sample rate set to 50 kHz FFT fulfills the requirement of being able to detect brake noises with duration of at least 45 ms.

4.1.3 Overlap

To correctly capture noise events amplitude spectrums have to be calculated with an overlap. The percent of overlap determines the amount of newest samples from the previously calculated FFT that are going to be used also for the new FFT calculation. You can select **50, 66, 75** or **90 percent overlap**. By default 90 percent overlap is selected, this ensures that the calculation will at worst capture noise events that are as long as the duration of the signal used in the FFT calculation.

4.2 Sound weighting

The sound amplitude spectrum is always calculated in decibels and frequency weighted according to the selected weighting setting. Weightings that you can select are: Linear (no weighting), A, B, C and D. By default A weighting is selected.

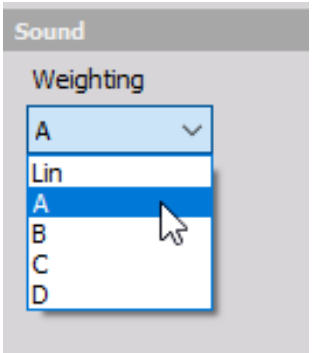

Image 3: Weighting setup

4.3 Noise detection

Brake noise event detection and tracking works by comparing the amplitude spectrum of sound and vibration signals. Amplitude peaks from both spectrums have to be above a threshold that is specified for each sound and vibration channel on it's own. Amplitude peaks that are above the threshold are then checked in the detection algorithm.

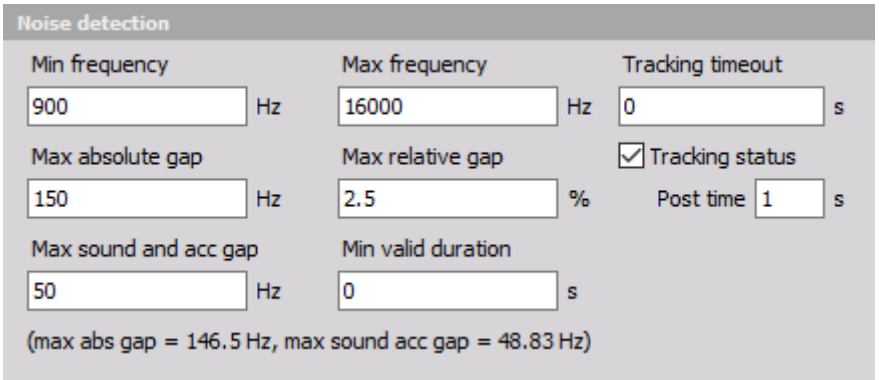

Image 4: Noise detection setup window

Detection algorithm can be setup with the edit boxes:

- **Minimum frequency and Maximum frequency**: the detection algorithm will only compare amplitude peaks which are in the range between minimum and maximum frequency set here. By default minimum frequency is set to 100 Hz and maximum to 16000 Hz.

- **Maximum absolute gap:** this determines if two or more amplitude peaks belong to the same noise event or should they be treated as different noise events. Therefore if the difference in frequency of peaks is less than the maximum absolute gap defined here, the algorithm treats

this as one noise event. In statistics involving amplitude peak calculations only the peak with maximum value is used. By default maximum absolute gap is set to 100 Hz.

- **Maximum relative gap:** has the same functionality as maximum absolute gap. However the frequency difference between peaks that determine if they belong to the same noise event is calculated as a percent of frequency at which these peaks are. For example if relative gap is set to 10 percent and there is one peak at 1000 Hz and one at 1040 Hz the absolute gap determined from the maximum relative gap is calculated as 1000 Hz * (5% / 100%) = 50 Hz. Because the difference between peaks is 1040 Hz - 1000 Hz = 40 Hz which is less than 50 Hz these two peaks are treated as coming from a single noise event. By default the maximum relative gap is set to 5%.

- **Maximum sound and acceleration gap:** this setting is crucial to match sound and vibration amplitude peaks. It determines if the sound amplitude peak is actually related to any peak in the vibration amplitude spectrum. If the difference in frequency between the sound and vibration amplitude peak is less than the one defined here sound peak is caused by mechanical vibration. By default maximum sound and acceleration gap is set to 50 Hz.

- **Minimal valid duration [s]:** short noise events that are not really important for measurement because they are undetectable by the human ear, can be rejected for certain periods that are defined as minimal valid duration.

- **Tracking timeout [s]:** Brake noise events are often unstable or are pulsating. In that case the amplitudes of vibration and noise during the noise event can go below amplitude thresholds for short periods of time. Without tracking timeout brake noise detection algorithm will stop with the tracking of that particular event when it can not detect it. At stop of detection the results of event statistics are going to be written out. When the same event reappears it is going to be treated as a new noise event. This usually isn't desirable. Therefore an additional tracking timeout can be set. When tracking timeout is above zero the *detection algorithm will wait for a set amount of time* for each noise event to reappear. If the same noise event reappears in the time set, *it is going to be tracked as the same noise event*. It is important to note, that when amplitudes of an event are below threshold *the statistics of an event won't be updated*. However the duration output of an event is going to take into account also the time between periods of event disappearance if that period is followed by event reappearance.

The label at the bottom shows an exact value of *maximum absolute gap* and *maximum sound and acceleration gap* according to the FFT resolution. Usually the exact values can not be met. In that case gaps are rounded down to the closest possible gap. This is also true when an absolute gap is calculated from *maximum relative gap* setting. This ensures that the settings are always respected.

Plugin detection state can be observed by checking the **Tracking status** checkbox:

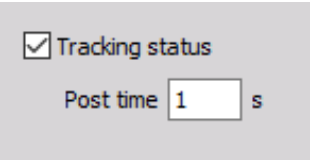

Image 5: Tracking status checkbox

4.3.1 Tracking status

When activated, the plugin will output an additional channel called Tracking status. Also an additional edit box for tracking status **Post time** will appear. The channel will output a value of **Not tracking** (value: 0) or **Tracking** (value: 1). The value Not tracking will be output if the plugin hasn't detected any brake noise event in any detection pair for at least the time specified in the post time editbox. Otherwise the value in the channel will be set to Tracking. The main purpose of this channel is for the use with *triggered storing* when brake noise is detected. Tracking status post time is used to ignore the small gaps in tracking when the noise event is fading out. When using tracking status as a store trigger it is important to also store enough data for possible recalculation in analysis mode. Therefore you have to set enough *store trigger pre time* to fit the duration of the FFT. It is important to know that tracking status post time has no relation to the *store trigger post time*.

4.4 Channel groups

When investigating noise caused by mechanical vibration, the detection is based on detection pairs composed of one sound and one vibration measurement. This is an input to the detection and tracking algorithm. To investigate the type of noise and what is causing it, the plugin also offers statistical calculations that are calculated for the duration of each noise event. Because different noise events can occur at the same time: simultaneous detection, tracking and statistical calculations are fully supported. With multiple measurements of sound and vibration the definition of all the pairs and related statistics would get time consuming and error prone. The aim of defining detection channels and statistics in channel groups is to reduce the workload. This is done by generating the detection pairs with statistical calculations automatically.

When measuring brake noise usually there are channels that are relevant for the whole vehicle (cabin microphone, vehicle velocity, environment temperature...) and channels that are only related to a specific brake system (brake pad vibration, disc temperature, brake pressure...). Input channel and statistic definitions are separated into **one global group** and **multiple local groups.** In the user interface each channel group has its own tab. The first tab is always reserved for the global group and cannot be removed.

4.4.1 Global group

In the global group you can define sound signal inputs and channel statistics which are relevant for an investigation of noise events on all of the measured braking systems.

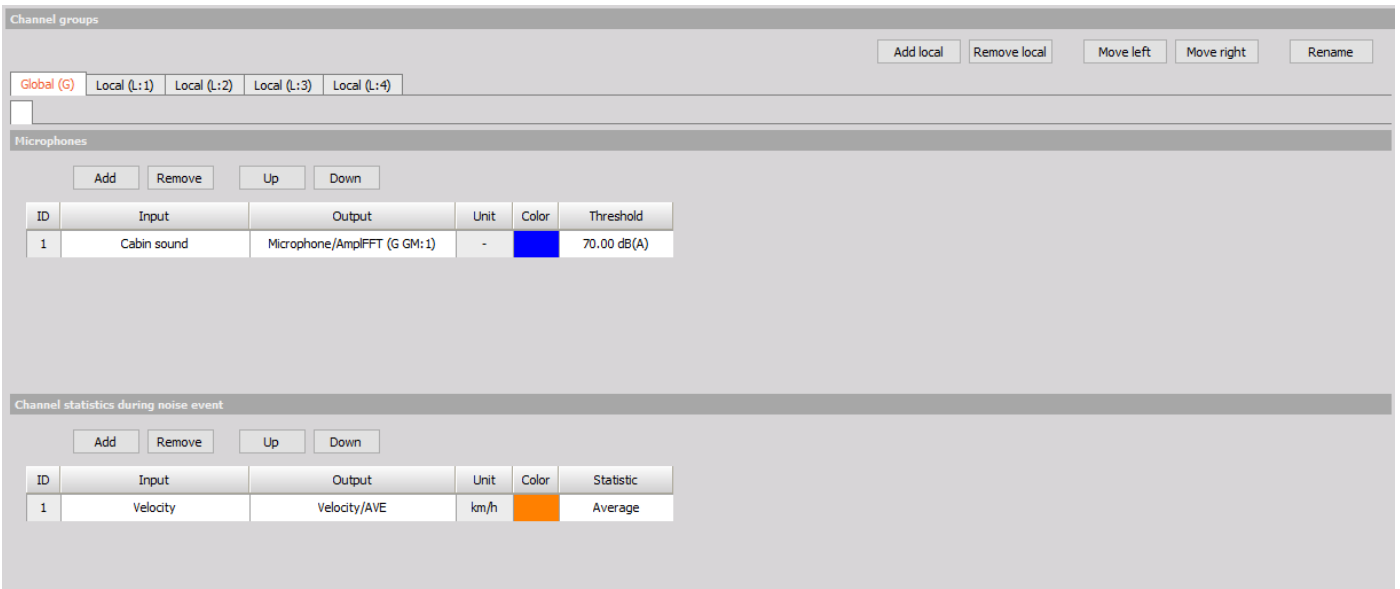

Image 6: Global group setup window

On Image 6 you can see the user interface of the global channel group. It is separated in two parts:

- **Microphones**: this contains an input grid for global microphones. Here you can define sound input channels which are going to be used to investigate the noise events on all local groups. Usually signals from cabin microphones are input here. For every microphone you can define the threshold in decibels. Only sound amplitudes above this threshold are going to be regarded as

brake noise events in the detection algorithm. It is important to know that sound pressure measurement signals selected in the grid have to be measured in pascals. Only synchronous channels without sample rate dividers are supported.

- **Channel statistics during squeal**: here you can define the statistic calculation that is going to be calculated during any brake noise event detected in any detection pair. You can select any scalar Dewesoft channel as an input. The statistic calculations that are available are: *Average, Minimum, Maximum* and *Delta*.

4.4.2 Local groups

Here you can define the **vibration**, **sound measurements** and **statistics** that are related to the specific brake assembly. The number of local groups is variable, you can add, remove or rearrange their order. This can be done with the four buttons on the top left of the channel group user interface:

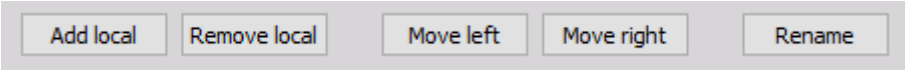

Image 7: Local group generation and manipulation row

By default four local groups are already added in the plugin (one for each wheel brake assembly). The settings of a local group are divided by two tabs:

4.4.2.1 Accelerometers and microphones

In this tab you can define the inputs that measure vibration of the components and microphones that are going to be used to detect noise events only with vibration inputs of this group.

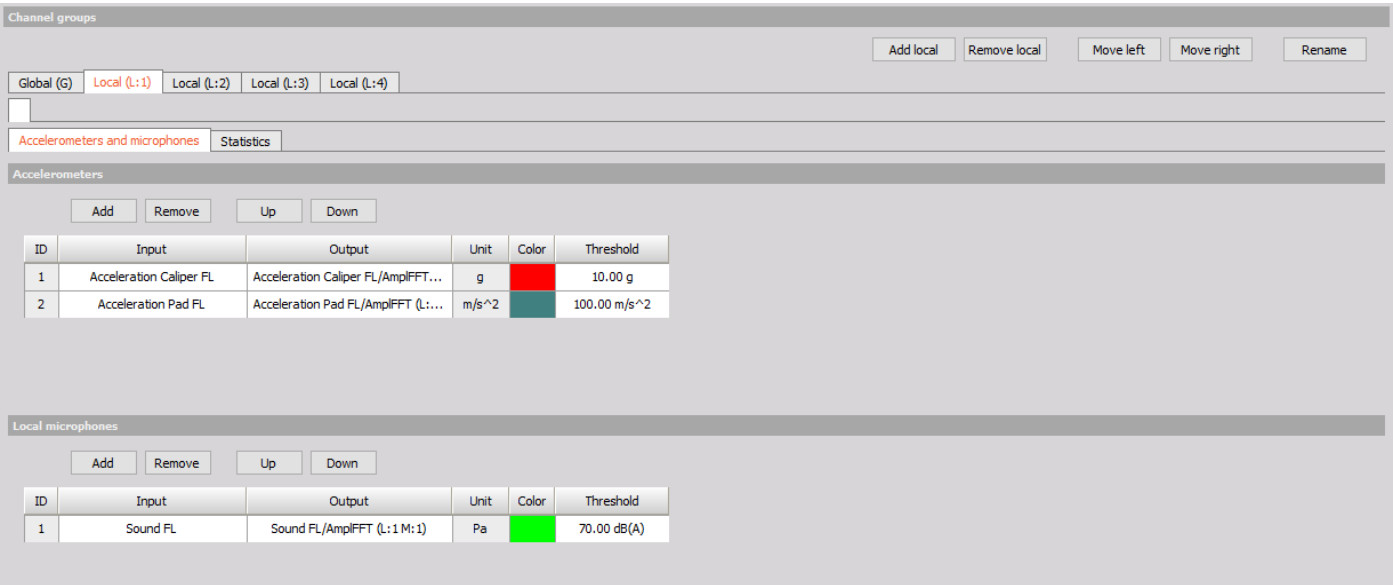

Image 8: Local group is defined by accelerometers and local microphones

- **Accelerometers**: here you can define the vibration measurement channels used for detection of brake noise. Usually vibrations are measured with an accelerometer but also other sensors with high enough bandwidth can be used. For every input you can define a threshold. Only the amplitudes above this threshold are going to be regarded as high enough vibrations that could

cause the noise. The unit of the input signal isn't important, threshold is always defined in the same unit as the input signal. Only synchronous channels without sample rate dividers are supported as an input.

- **Microphones**: similar to microphone input grid in the global group here you can define sound input channels. The difference is that these will only be used to detect noise with vibration inputs of the same local group. For every microphone you can define the threshold in decibels. Only sound amplitudes above this threshold are going to be regarded as brake noise events in the detection algorithm. It is important to know that sound pressure measurement signals selected in the grid have to be measured in Pascals. Only synchronous channels without sample rate dividers are supported as an input.

4.4.2.2 Statistics

In the statistics tab you can pick the noise event statistics that you want to be calculated or add a channel statistic that is going to be calculated only in detection pairs of this group.

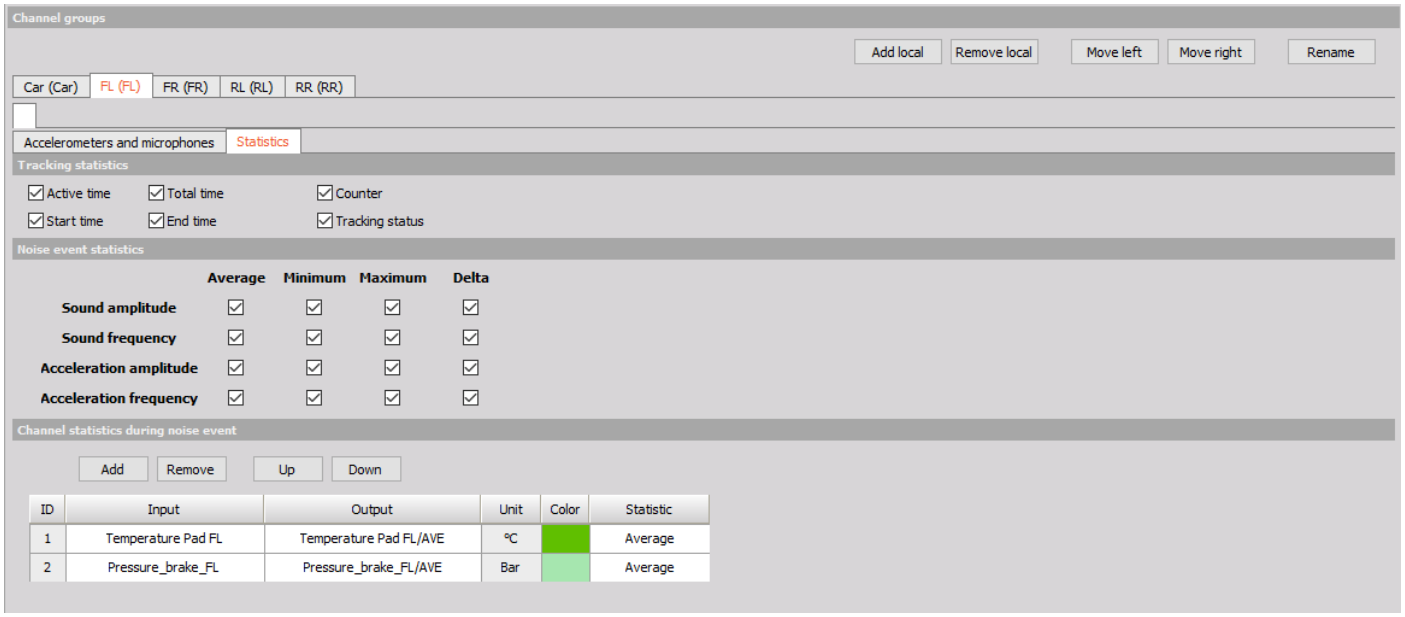

Image 9: Statistics definition for a specific Local group

- **Tracking statistics:**
  - *Active time* - is calculating active time of event duration. It is calculated only when values are above a certain threshold of minimum valid duration [s].
  - *Start time* - will output the start time of a valid noise event.
  - *Total time* - is calculating total time of an event duration.
  - *End time* - will output the end time of a valid noise event.
  - *Counter* - will count valid noise events for each statistic acc-mic pair where it is applied.
  - *Tracking status* - each detection pair has its own tracking status, and it's possible to read if the event is detected on a detection pair of interest.

- **Noise event statistics:** here you can pick various statistics of the brake noise event to be calculated. In the top table of checkboxes you can activate the calculation of: *Average, Minimum, Maximum* and *Delta values of Sound amplitude, Sound frequency, Acceleration amplitude* and *Acceleration frequency.* In the bottom line you can activate the output of noise event *Duration,*

Start time, *End time* and *Counter*. Counter will output the consecutive number of brake noise events detected at a specific detection pair.

- **Channel statistics:** here you can define the statistic calculation that is going to be calculated during any brake noise event detected in the detection pair defined by the local group. You can select any scalar Dewesoft channel as an input. The statistic calculations that are available are: *Average*, *Minimum*, *Maximum* and *Delta*.

4.5 Outputs

Results of plugin calculations are written in the outputs. There are three different types of outputs:

- **Amplitude spectrums:** result of amplitude spectrum calculation of each microphone and accelerometer is written in an asynchronous array channel,
- **Statistic outputs:** the statistics calculations on each microphone-accelerometer detection pair are going to have its own outputs. In it the results of statistical calculations are going to be written each time the noise event is finished. Statistics results are always output in asynchronous scalar channels.
- **Tracking status:** only one tracking status can be output by the plugin. It outputs the state of the tracking algorithm according to Tracking status.

Since Tracking status is straightforward and only requires one setting to activate here we are going to focus on Amplitude spectrum and Statistic outputs and how they are related to the setup. In the following image we have an example of the setup with two local groups.

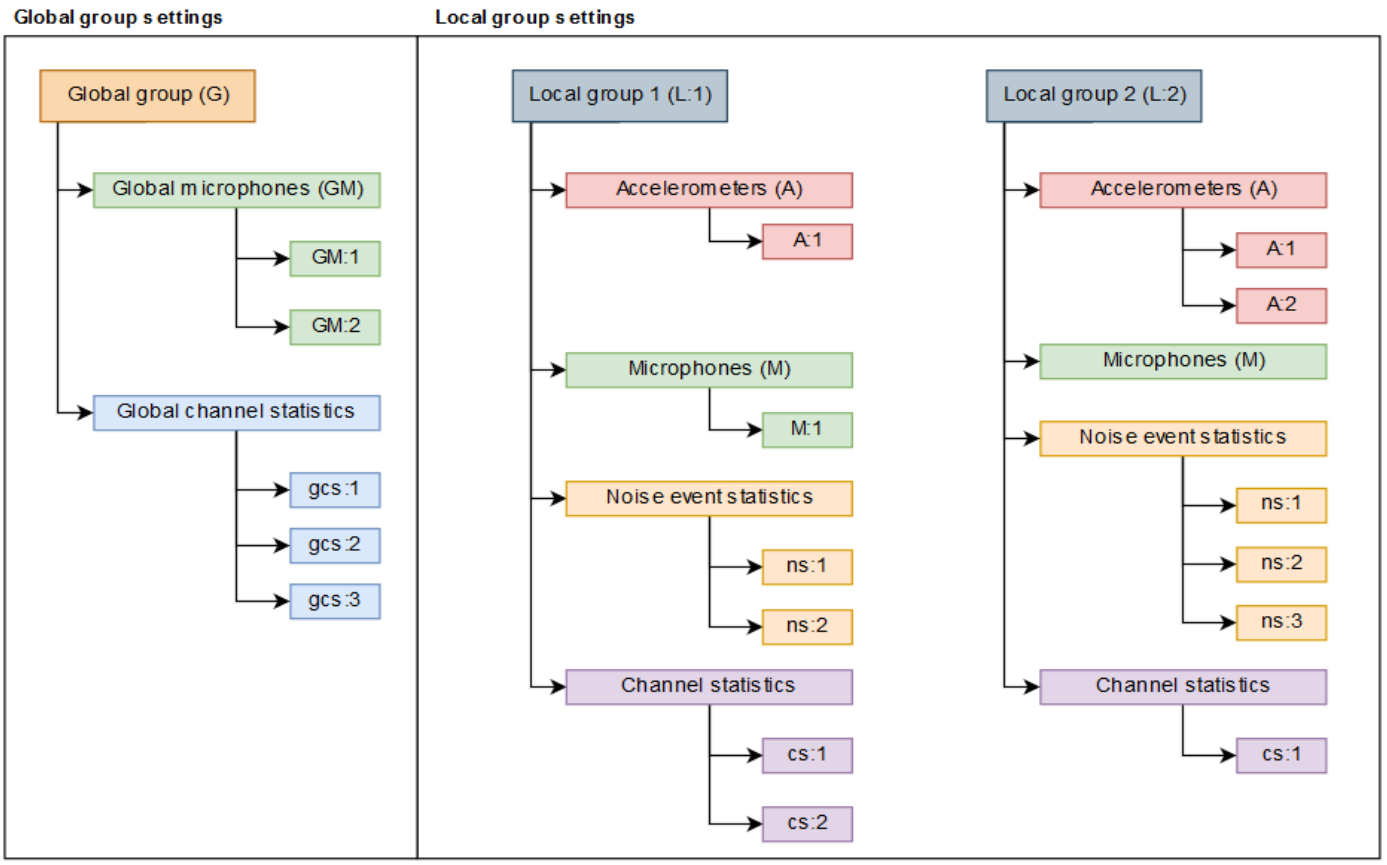

Image 10: Local groups and Global group structure tree

In the global group there are two global microphones (GM:1, GM:2) and three global channel statistics (gcs:1, gcs:2, gcs:3). In local group 1 there is one accelerometer (A:1) and one local microphone (M:1), two noise event statistics (ns:1, ns:2) and two channel statistics (cs:1, cs:2). In the local group 2 there are two accelerometers (A:1, A:2), no local microphones, three squeal statistics (ns:1, ns:2, ns:3) and one channel statistic (cs:1).

From each microphone and accelerometer an amplitude spectrum output is generated.

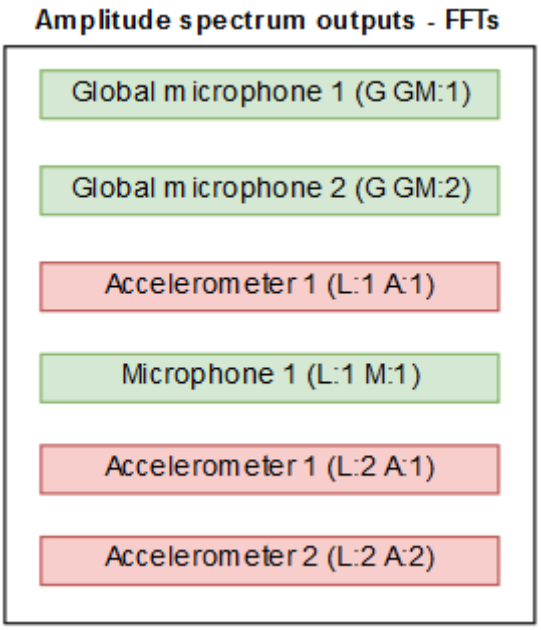

Image 11: Amplitude spectrum outputs - FFTs

Each accelerometer forms detection pairs with global and local microphones defined in the same group as the accelerometer. Each detection pair from a local group accelerometer has statistic calculations which are composed of: global channel statistics, local squeal statistic and local channel statistic. Each statistic calculation has its own output. In the presented setup there are seven detection pairs. In local group 1 the accelerometer (A:1) forms detection pairs with two global microphones (GM:1, GM:2) and one local microphone (M:1). In each detection pair three global channel statistics (gcs:1, gcs:2, gcs:3), two noise event statistics (ns:1, ns:2) and two channel statistics (cs:1, cs:2) are calculated.

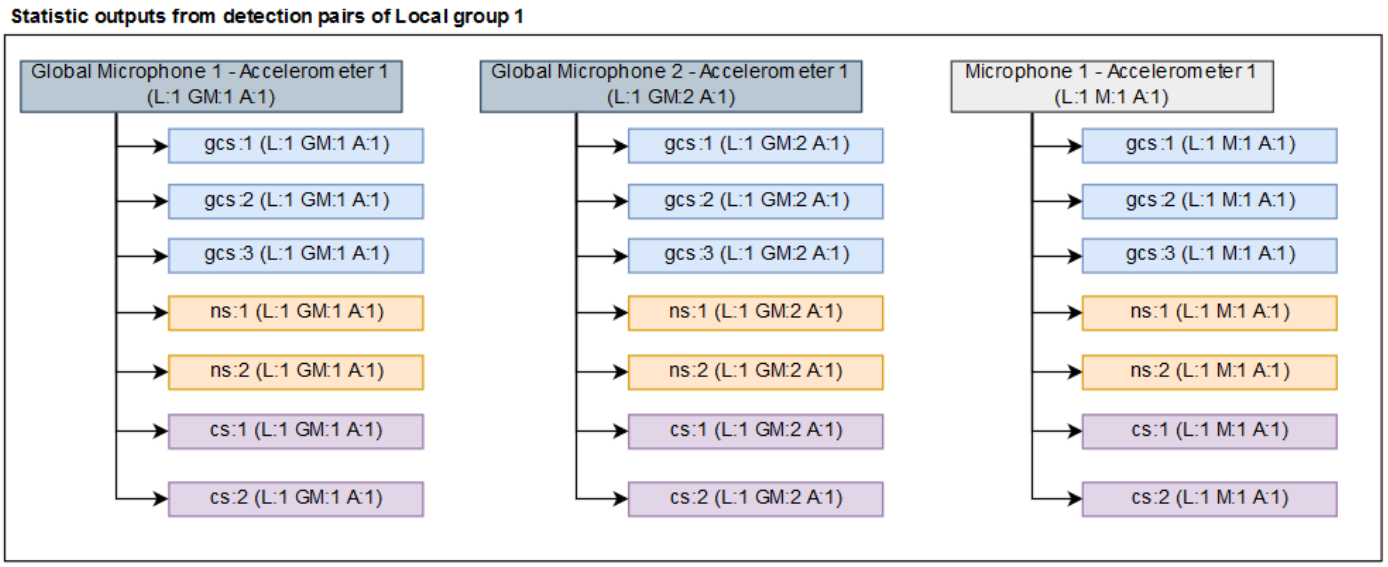

Image 12: Statistic outputs from detection pairs of Local group 1

In local group 1 the accelerometers (A:1, A:2) form detection pairs with two global microphones (GM:1, GM:2). In each detection pairs three global channel statistics (gcs:1, gcs:2, gcs:3), three noise event statistics (ns:1, ns:2, ns:3) and one channel statistic (cs:1) are calculated.

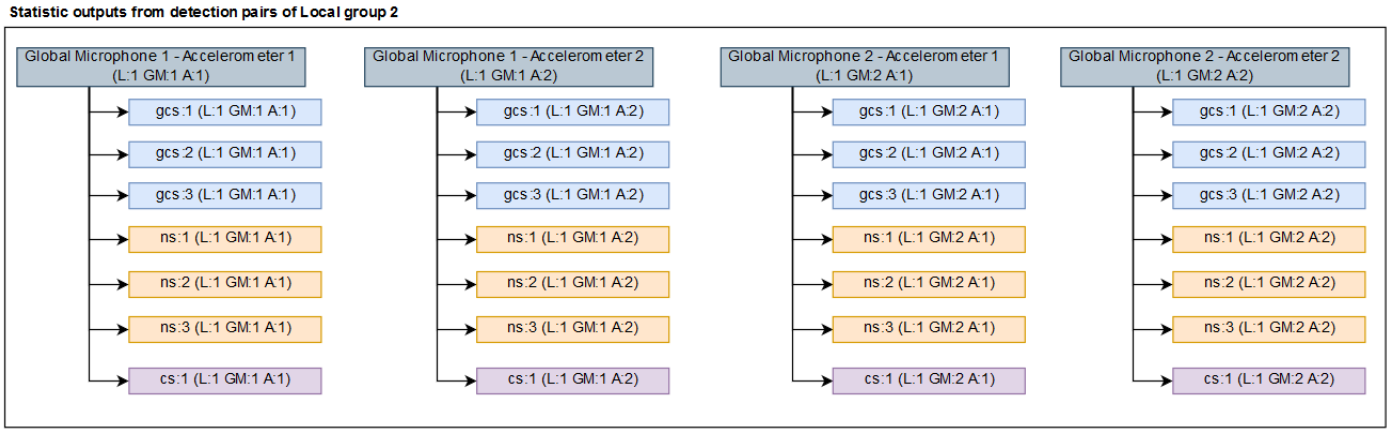

Image 13: Statistic outputs from detection pairs of Local group 2

4.5.1 Numbering

The numberings of the outputs are automatically added to the outputs. All of the numberings are related to the position of the group, microphone and accelerometer in the user interface. The automatic numbering and naming will stop if the output name is manually changed to a different value than the automatically assigned value. The abbreviations of microphones and accelerometers are fixed: **GM** for global microphones, **M** for local microphones and **A** for accelerometers. The abbreviations of groups can be changed. This is done in the rename dialog that opens for the selected channel group when pressing the **Rename** button in the [Channel group]{#Channelgroup} user interface. In channel selector outputs are organized according to channel groups and detection pairs that they belong to.

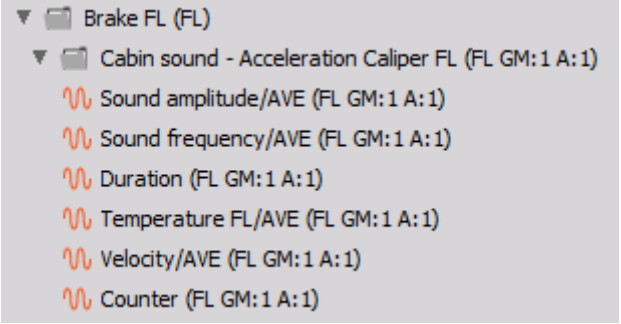

Image 14: Channel naming

In the above image we can see the statistics outputs of a pair that comes from a local group named *Brake FL* with an abbreviation *FL*. The pair is formed between a global microphone channel *Cabin sound* and accelerometer channel *Acceleration FL*.

5. Warranty information

Notice
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The copy of the specific warranty terms applicable to your Dewesoft product and replacement parts can be obtained from your local sales and service office. To find a local dealer for your country, please visit https://dewesoft.com/support/distributors.

5.1. Calibration

Every instrument needs to be calibrated at regular intervals. The standard norm across nearly every industry is annual calibration. Before your Dewesoft data acquisition system is delivered, it is calibrated. Detailed calibration reports for your Dewesoft system can be requested. We retain them for at least one year, after system delivery.

5.2. Support

Dewesoft has a team of people ready to assist you if you have any questions or any technical difficulties regarding the system. For any support please contact your local distributor first or Dewesoft directly.

Dewesoft d.o.o.
Gabrsko 11a
1420 Trbovlje Slovenia

Europe Tel.: +386 356 25 300
Web: http://www.dewesoft.com
Email: Support@dewesoft.com
The telephone hotline is available Monday to Friday from 07:00 to 16:00 CET (GMT +1:00)

5.3. Service/repair

The team of Dewesoft also performs any kinds of repairs to your system to assure a safe and proper operation in the future. For information regarding service and repairs please contact your local distributor first or Dewesoft directly on https://dewesoft.com/support/rma-service.

5.4. Restricted Rights

Use Slovenian law for duplication or disclosure. Dewesoft d.o.o. Gabrsko 11a, 1420 Trbovlje, Slovenia / Europe.

5.5. Printing History

Version 2.0.0, Revision 217 Released 2015 Last changed: 23. July 2018 at 16:54.

5.6. Copyright

5.7. Trademarks

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6. Safety instructions

Your safety is our primary concern! Please be safe!

6.1. Safety symbols in the manual

Warning
Calls attention to a procedure, practice, or condition that could cause the body injury or death

Caution
Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

6.2. General Safety Instructions

Warning

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Dewesoft GmbH assumes no liability for the customer's failure to comply with these requirements.

All accessories shown in this document are available as an option and will not be shipped as standard parts.

6.2.1. Environmental Considerations

Information about the environmental impact of the product.

6.2.2. Product End-of-Life Handling

Observe the following guidelines when recycling a Dewesoft system:

6.2.3. System and Components Recycling

Production of these components required the extraction and use of natural resources. The substances contained in the system could be harmful to your health and to the environment if the system is improperly handled at its end of life! Please recycle this product in an appropriate way to avoid unnecessary pollution of the environment and to keep natural resources.

This symbol indicates that this system complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). Please find further information about recycling on the Dewesoft web site www.dewesoft.com

Restriction of Hazardous Substances
This product has been classified as Monitoring and Control equipment and is outside the scope of the 2002/95/EC RoHS Directive. However, we take care of our environment and the product is lead-free.

6.2.4. General safety and hazard warnings for all Dewesoft systems

Safety of the operator and the unit depend on following these rules.

- Use this system under the terms of the specifications only to avoid any possible danger.
- Read your manual before operating the system.
- Observe local laws when using the instrument.
- DO NOT touch internal wiring!
- DO NOT use higher supply voltage than specified!
- Use only original plugs and cables for harnessing.
- You may not connect higher voltages than rated to any connectors.
- The power cable and connector serve as Power-Breaker. The cable must not exceed 3 meters, the disconnect function must be possible without tools.
- Maintenance must be executed by qualified staff only.
- During the use of the system, it might be possible to access other parts of a more comprehensive system. Please read and follow the safety instructions provided in the manuals of all other components regarding warning and security advice for using the system.
- With this product, only use the power cable delivered or defined for the host country.
- DO NOT connect or disconnect sensors, probes or test leads, as these parts are connected to a voltage supply unit.
- Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), a non-interruptible safety earth ground must be provided from the mains power source to the product input wiring terminals.
- Please note the characteristics and indicators on the system to avoid fire or electric shocks. Before connecting the system, please read the corresponding specifications in the product manual carefully.

- The inputs must not, unless otherwise noted (CATx identification), be connected to the main circuit of category II, III and IV.
- The power cord separates the system from the power supply. Do not block the power cord, since it has to be accessible for the users.
- DO NOT use the system if equipment covers or shields are removed.
- If you assume the system is damaged, get it examined by authorized personnel only.
- Adverse environmental conditions are Moisture or high humidity Dust, flammable gases, fumes or dissolver Thunderstorm or thunderstorm conditions (except assembly PNA) Electrostatic fields, etc.
- The measurement category can be adjusted depending on module configuration.
- Any other use than described above may damage your system and is attended with dangers like short-circuiting, fire or electric shocks.
- The whole system must not be changed, rebuilt or opened.
- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until the safe operation can be verified by service-trained personnel. If necessary, return the product to Dewesoft sales and service office for service and repair to ensure that safety features are maintained.
- If you assume a more riskless use is not provided anymore, the system has to be rendered inoperative and should be protected against inadvertent operation. It is assumed that a more riskless operation is not possible anymore if the system is damaged obviously or causes strange noises. The system does not work anymore. The system has been exposed to long storage in adverse environments. The system has been exposed to heavy shipment strain.
- Warranty void if damages caused by disregarding this manual. For consequential damages, NO liability will be assumed!
- Warranty void if damage to property or persons caused by improper use or disregarding the safety instructions.
- Unauthorized changing or rebuilding the system is prohibited due to safety and permission reasons (CE).
- Be careful with voltages >25 VAC or >35 VDC! These voltages are already high enough in order to get a perilous electric shock by touching the wiring.
- The product heats during operation. Make sure there is adequate ventilation. Ventilation slots must not be covered!
- Only fuses of the specified type and nominal current may be used. The use of patched fuses is prohibited.
- Prevent using metal bare wires! Risk of short circuit and fire hazard!
- DO NOT use the system before, during or shortly after a thunderstorm (risk of lightning and high energy over-voltage). An advanced range of application under certain conditions is allowed with therefore designed products only. For details please refer to the specifications.
- Make sure that your hands, shoes, clothes, the floor, the system or measuring leads, integrated circuits and so on, are dry.
- DO NOT use the system in rooms with flammable gases, fumes or dust or in adverse environmental conditions.
- Avoid operation in the immediate vicinity of high magnetic or electromagnetic fields, transmitting antennas or high-frequency generators, for exact values please refer to enclosed specifications.
- Use measurement leads or measurement accessories aligned with the specification of the system only. Fire hazard in case of overload!

- Do not switch on the system after transporting it from a cold into a warm room and vice versa. The thereby created condensation may damage your system. Acclimatise the system unpowered to room temperature.
- Do not disassemble the system! There is a high risk of getting a perilous electric shock. Capacitors still might be charged, even if the system has been removed from the power supply.
- The electrical installations and equipment in industrial facilities must be observed by the security regulations and insurance institutions.
- The use of the measuring system in schools and other training facilities must be observed by skilled personnel.
- The measuring systems are not designed for use in humans and animals.
- Please contact a professional if you have doubts about the method of operation, safety or the connection of the system.
- Please be careful with the product. Shocks, hits and dropping it from already- lower level may damage your system.
- Please also consider the detailed technical reference manual as well as the security advice of the connected systems.
- This product has left the factory in safety-related flawlessness and in proper condition. In order to maintain this condition and guarantee safety use, the user has to consider the security advice and warnings in this manual.

EN 61326-3-1:2008
IEC 61326-1 applies to this part of IEC 61326 but is limited to systems and equipment for industrial applications intended to perform safety functions as defined in IEC 61508 with SIL 1-3.

The electromagnetic environments encompassed by this product family standard are industrial, both indoor and outdoor, as described for industrial locations in IEC 61000-6-2 or defined in 3.7 of IEC 61326-1.

Equipment and systems intended for use in other electromagnetic environments, for example, in the process industry or in environments with potentially explosive atmospheres, are excluded from the scope of this product family standard, IEC 61326-3-1.

Devices and systems according to IEC 61508 or IEC 61511 which are considered as “operationally well-tried”, are excluded from the scope of IEC 61326-3-1.

Fire-alarm and safety-alarm systems, intended for the protection of buildings, are excluded from the scope of IEC 61326-3-1.

7. Documentation version history

Version	Date	Notes
V20-1	20-04-2020	Initial version
V21-1	23-02-2021	Updated template
V21-2	07-04-2021	Added functionalities: Tracking timeout, Minimal valid duration, Tracking statistics for each detection pair