Nanoprecise

Prediction with Precision

DASHBOARD USER MANUAL

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Introduction

Welcome to the comprehensive manual of the Nanoprecise Dashboard, designed to provide a complete understanding of the platform's functionalities and features. As a dynamic maintenance professional, your journey through this manual will familiarize you with the intricacies and capabilities of the cutting-edge platform developed by Nanoprecise Sci Corp.

This manual will offer a clear and detailed explanation of each element and feature present on the dashboard. By thoroughly exploring the contents within, you will gain a deep insight into the diverse functionalities available, empowering you to leverage the platform's full potential.

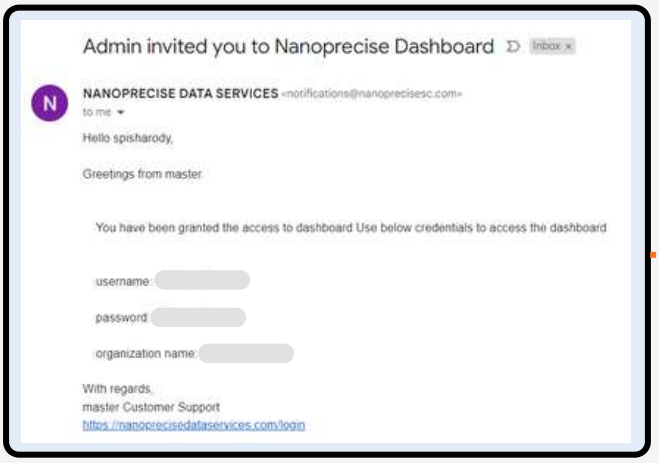
Whether you are a seasoned professional or a novice user, this guide will serve as your key companion, enabling you to navigate through the dashboard with confidence and efficiency. We are confident that this manual will provide you with the necessary tools and knowledge to maximize your experience and drive your productivity to new heights.

Login

Nanoprecise Users

Access the website through the following link:
https://nds.nanoprecisedataservices.com/login

Enter the Username, Password, and Organization Name, received via email from notifications@nanoprecisesc.com, then click on "Sign In."

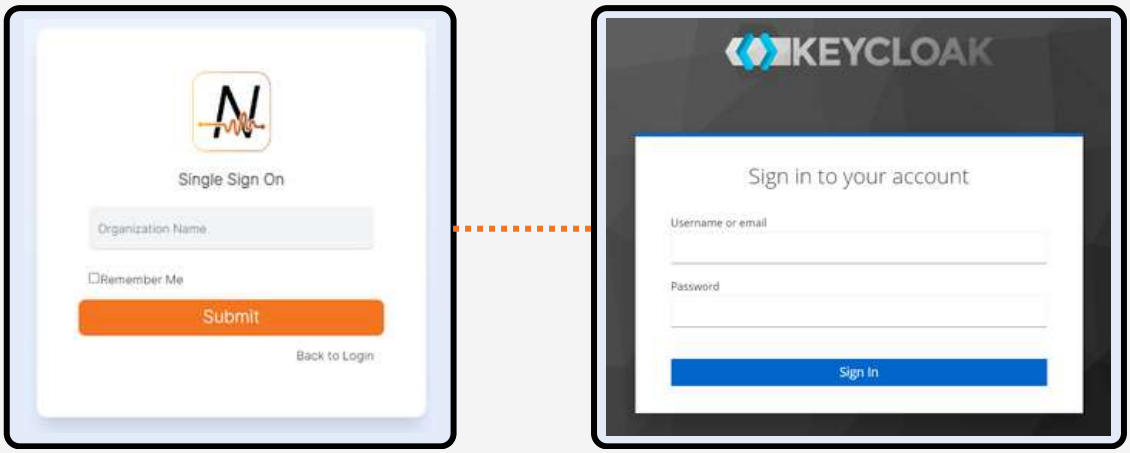


Sample email with Credentials

Login

SSO Users

Enter the “Organization Name” of the Company you are trying to access. If Organization is setup for SSO, it will redirect you to the “Sign In” page of your company SSO



Upon successful sign-in, you will be automatically redirected to the Nanoprecise Homepage. If you would like to setup SSO for your company, please contact your Nanoprecise representative or customer-success@nanoprecise.io

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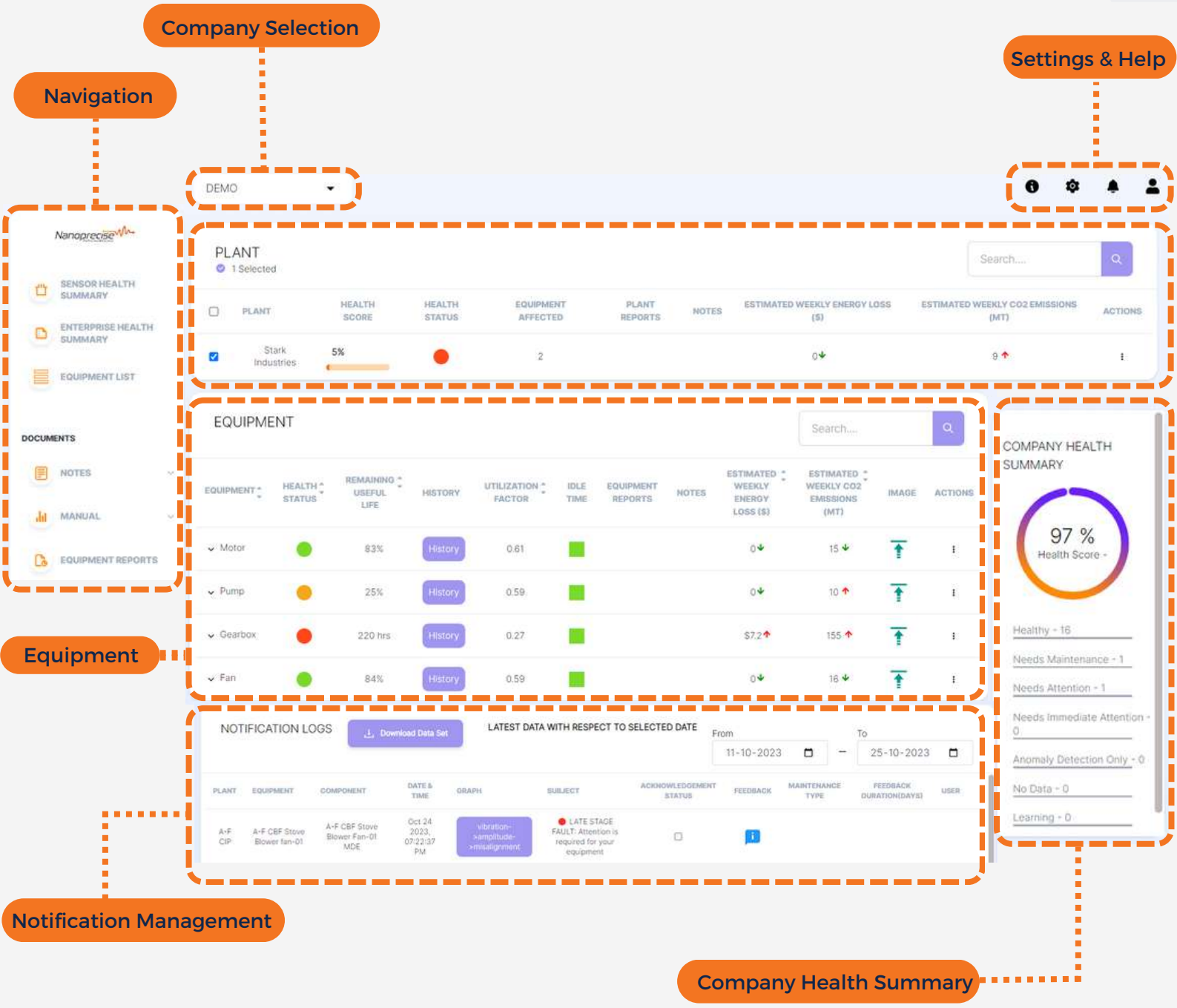
Homepage



Navigation

Facilitates rapid access to various sections of the dashboard, with available options contingent upon user privileges and activated features.

Company Selection

Enables users with access to multiple companies to make selections from a dropdown menu.

Company Health Summary

Displays the total number of equipment under each health status for the currently selected plant/s.

Plant

This section furnishes an inclusive health assessment and status overview for each of the company's plants. The presentation is structured based on the health score, with the lowest scores taking precedence. By default, the first plant on the list is automatically selected, although the option to select multiple plants is available. The chosen plant's details will be displayed in the machine/equipment tab below, along with a concise "Plant Health Summary" on the right-hand side.

Features

Plant List: Encompasses a comprehensive listing of all company plants, each accompanied by a checkbox for selecting the desired plant(s) to populate the equipment list.

Health Score: Represents a computed value reflecting the overall health of a specific plant, derived from the collective health status of the respective equipment under that plant. (Refer to Appendix C for detailed information)

Health Status: Indicates the current health status of the most compromised equipment within the plant.

Equipment Affected: Displays the count of equipment exhibiting an increased health status within the plant.

Plant Report: Serves as a centralized repository for storing supplementary findings and reports specific to individual plants.

Notes: Facilitates the addition of remarks at various levels of the hierarchy.

Action: Enables users to rename both the equipment and plant names as needed.

Equipment

Based on the selected plant(s) (which can be multiple), the equipment will be listed in order of priority, with the lowest health score ranked first.

Features

Equipment List: Displays all equipment corresponding to the selected plant(s) from the Plant section.

Health Status: Determined by the active Fault Severity/stage (2/3/4) and the Remaining Useful Life (RUL). (Refer to Appendix C for detailed information)

Remaining Useful Life (RUL): Represents the remaining useful life of the most critical or degraded component in an equipment. Presented as a percentage up to 750 hours (+- 30 days), after which it is displayed in hours.

Utilization Factor: Indicates the percentage of running measurement points relative to the total measurement points.

Idle Time: Provides an indication if the equipment has not operated for a specific number of days. (Refer to notifications settings for details)

Image: Displays an image of the equipment.

Equipment Report: Serves as a central repository for analysis reports and additional findings.

Notifications

Notifications from the selected plant(s) (accessible to the user) will be exhibited for the previous 2 weeks, with the most recent appearing first.

Features

Plant/Equipment/Component: Indicates the location where the notification was triggered.

Date & Time: Displays the exact moment when the notification was triggered.

Graph: Provides a hyperlink redirecting to the component page that initiated the notification.

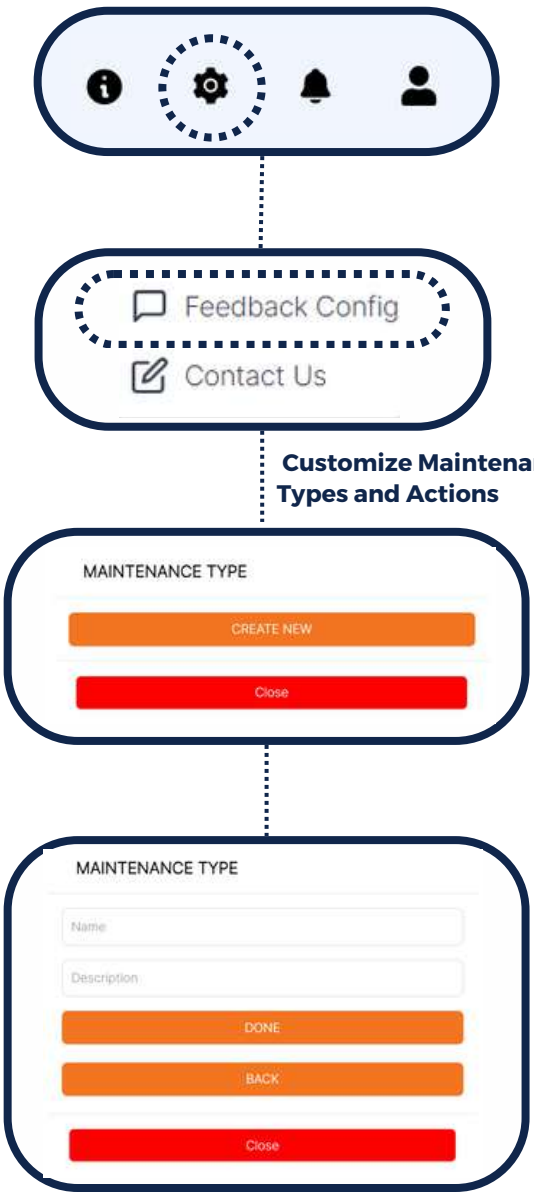
Subject: Specifies the subject of the notification.

Acknowledgement Status: Allows for the acknowledgment of notifications, signifying that they have been reviewed. Users can hover over to view which user acknowledged it.

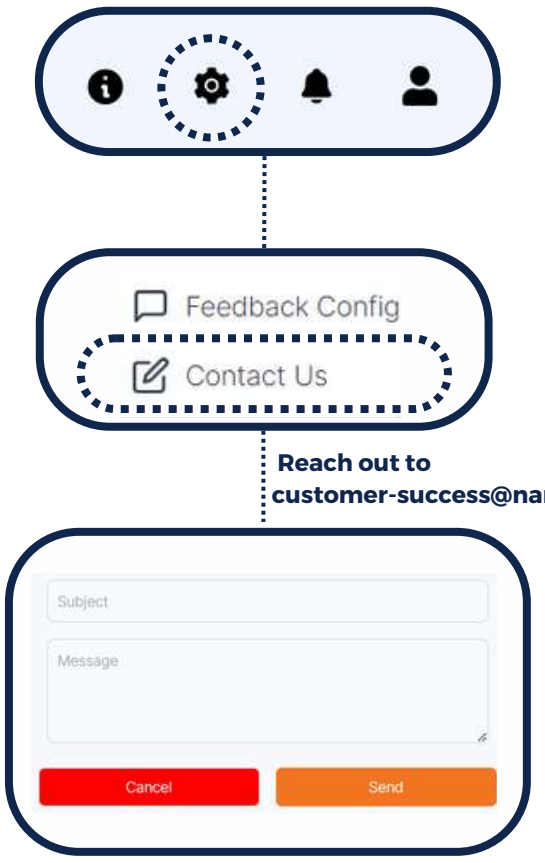
Feedback: Enables users to log follow-up actions resulting from a notification. Users can select a predefined maintenance type, provide a description, specify the time range, and allocate resources. Once saved, the entry will be visible in the notification log, facilitating the closure of the loop and ensuring a comprehensive record of actions taken and by whom.

Settings

Provides access to various user and company settings, along with pertinent information concerning health statuses and notification types.



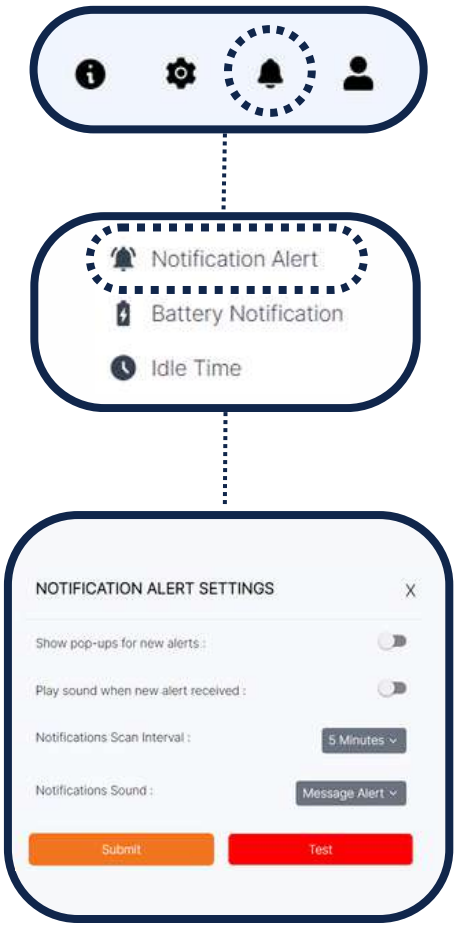
Customize Maintenance Types and Actions



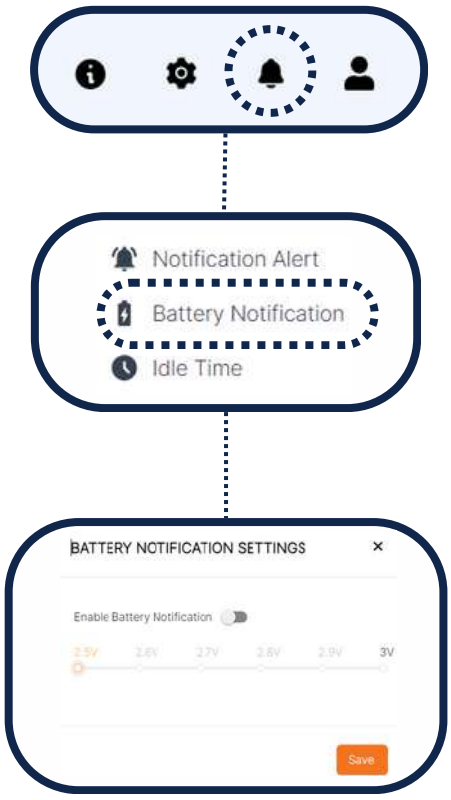
Reach out to customer-success@nanoprecise.io

Notifications

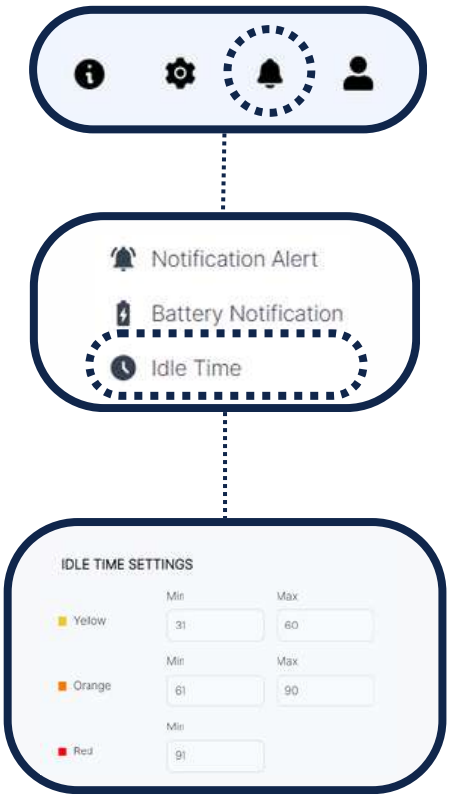
Enable and Control Pop-Up Notifications



Configure notifications for battery levels below a specific threshold



Establish configuration for displaying idle time indications in the equipment overview for a specified number of days



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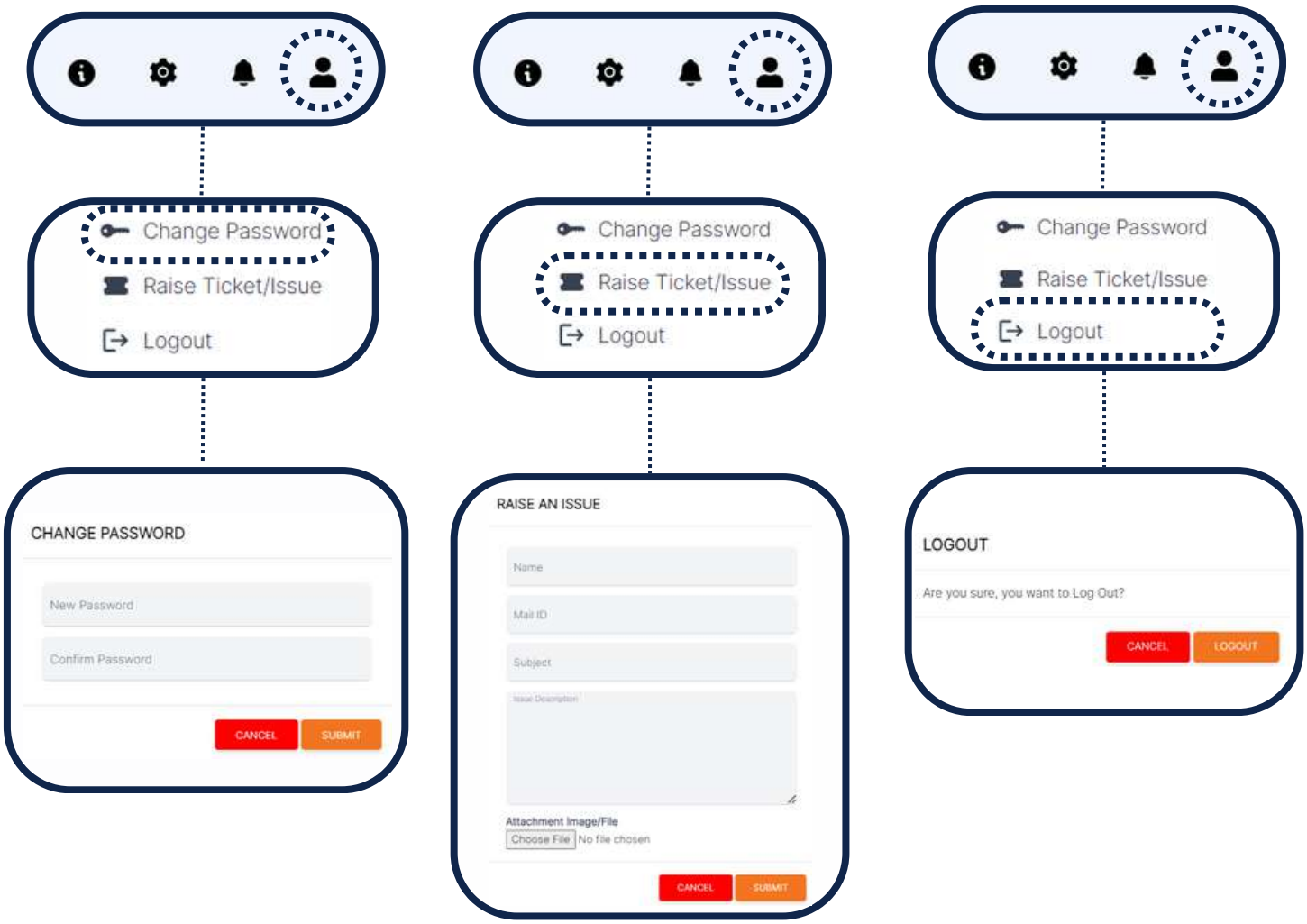
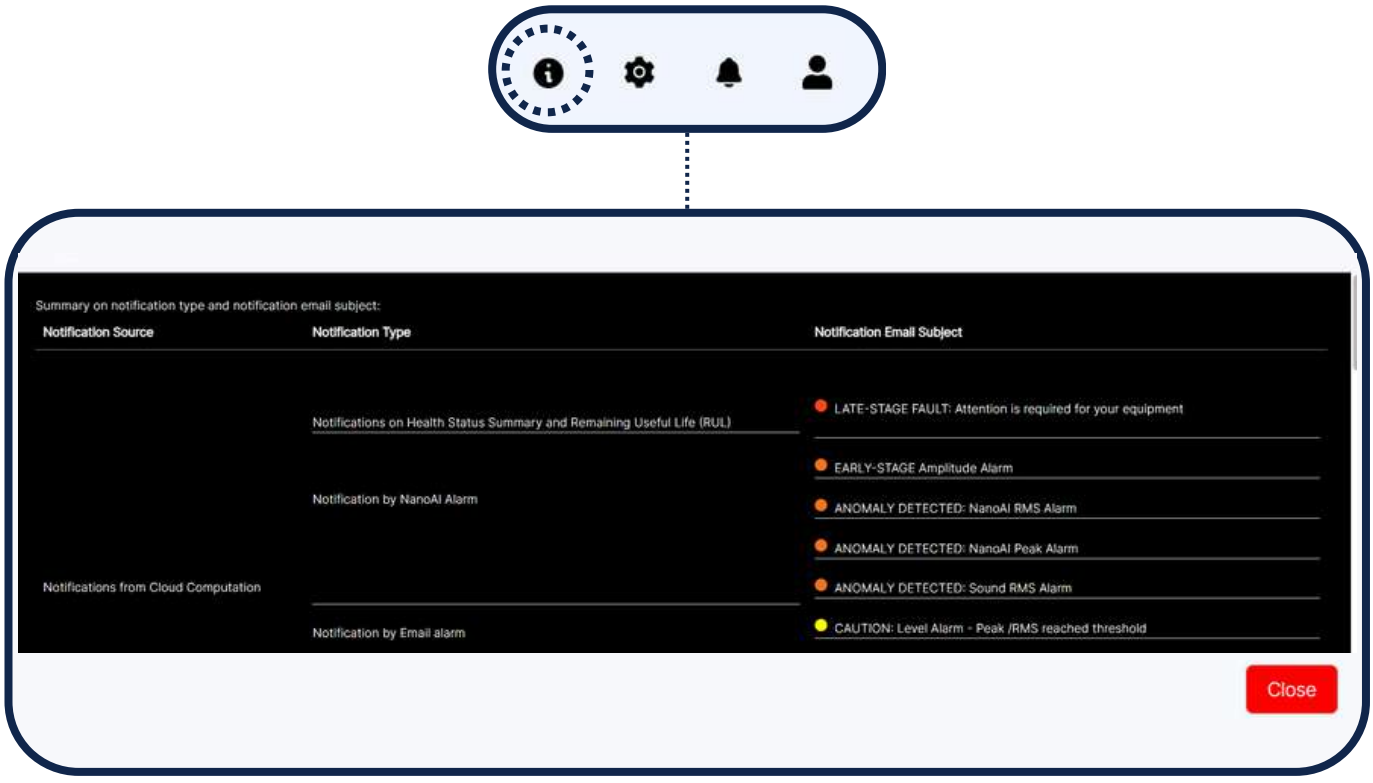
User Settings

Access password modification, ticket submission, and logout functionalities



Info

The info button shows details on different notification types and what triggers each and also how we define health status based on Fault Severity and RUL



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Component Health Summary

Easy Navigation to the Various Data Sources

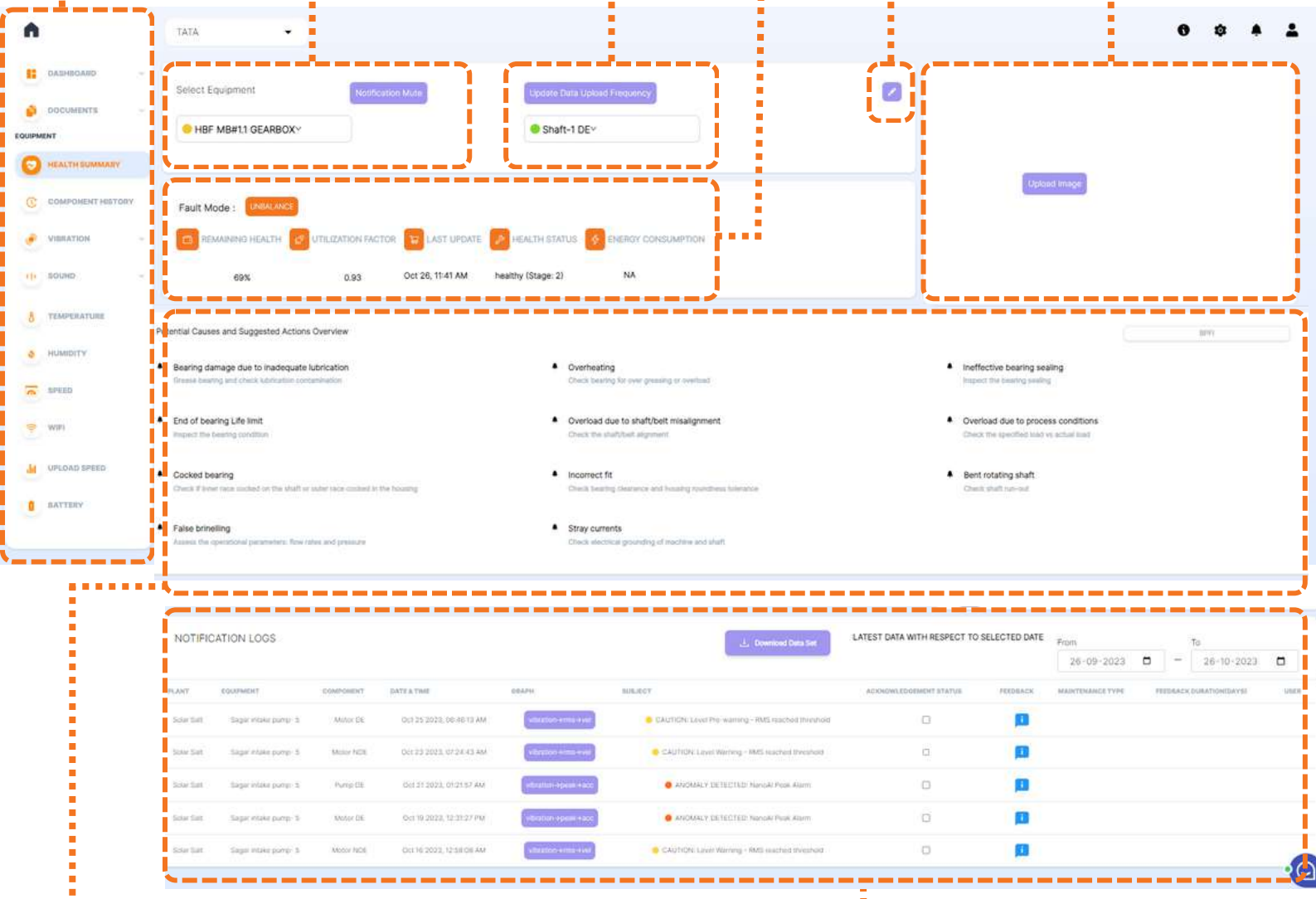
Modify Component Name

Adjust Data Upload Rate

Add Component Image

Equipment/Component Navigation Bar for a Single Plant

Critical Health Information



Active Fault Mode, Potential Causes, and Suggestions

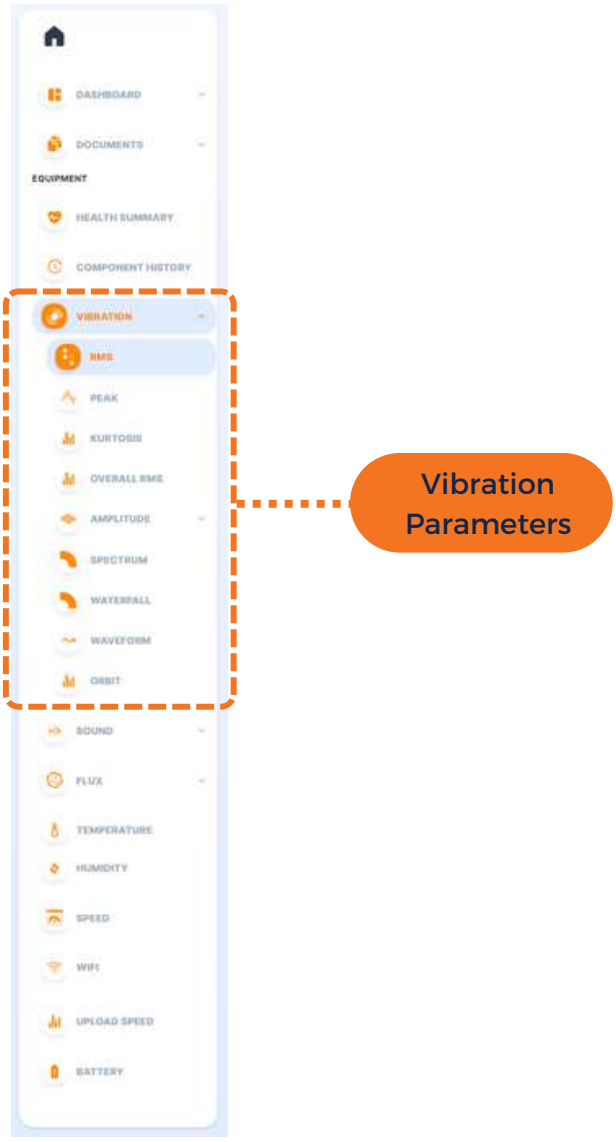
Filter Notification Log by Selected Equipment

Navigation and General Functionality

Navigation

The data sources are individually selectable, and the navigation tree expands accordingly to display all available options within each data type.

Navigate seamlessly and explore the diverse functionalities available within the platform. Familiarize yourself with the comprehensive and user-friendly features that facilitate an enhanced user experience and streamlined operations.



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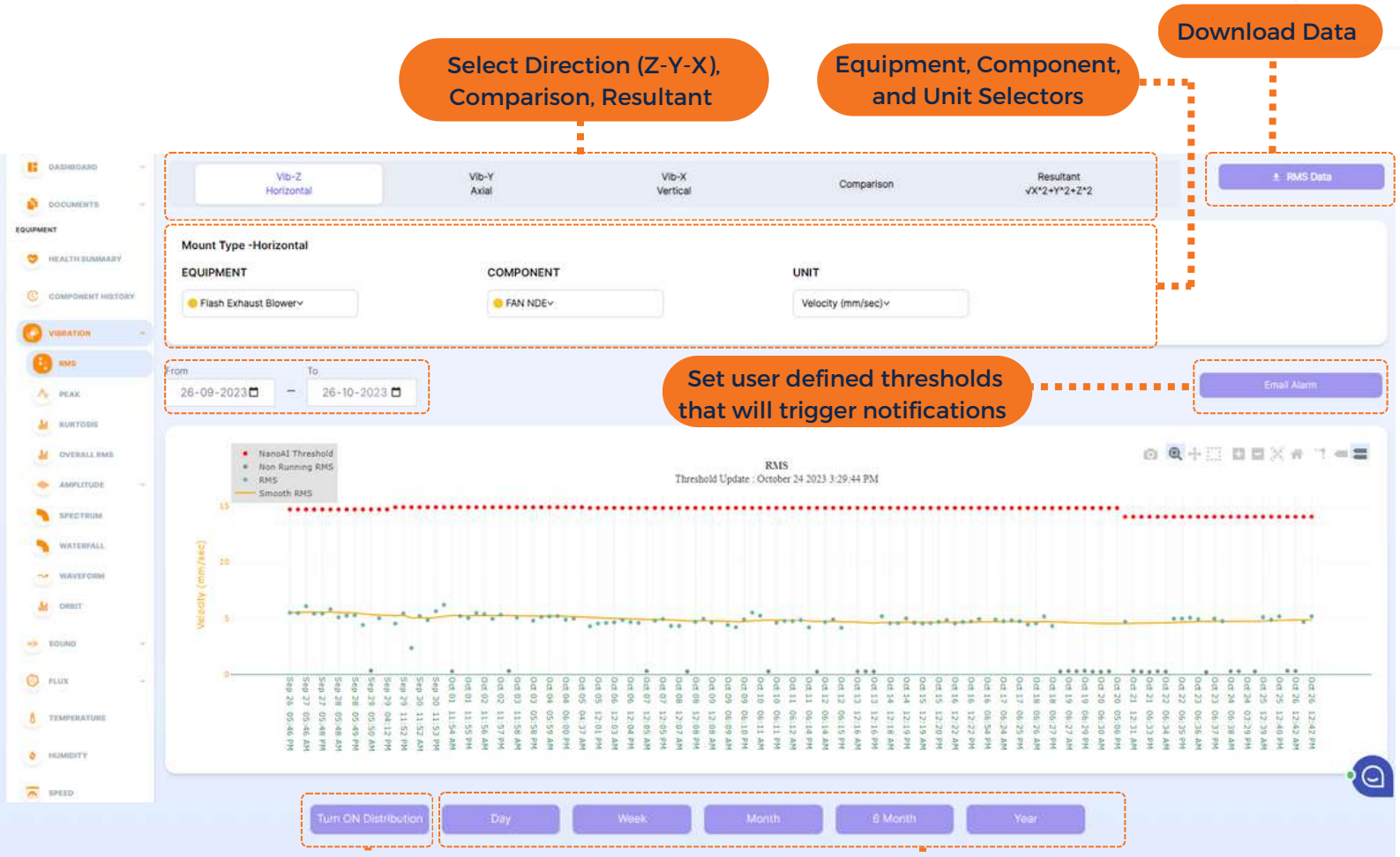
Trending Graph Functionality

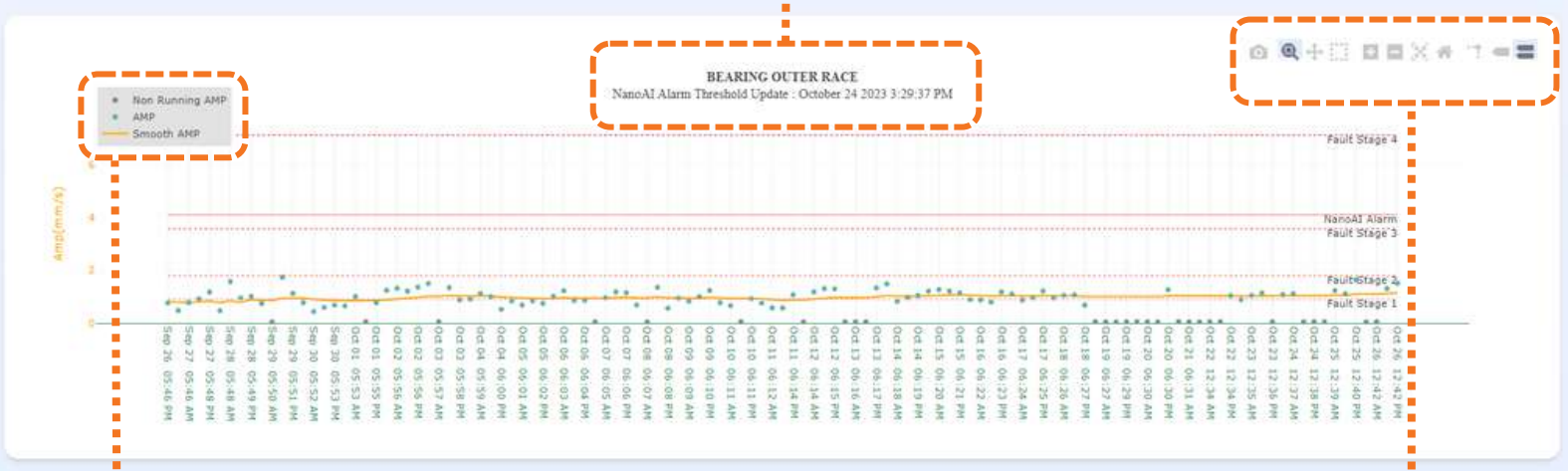


Plot Time Axis to True Scale

Time Scaler for Swift Data Access within a Defined Period; Select Dates to Display Corresponding Data

Amplitude Graph

Title and when NanoAI was last updated time



Legend for Amplitude Graphs

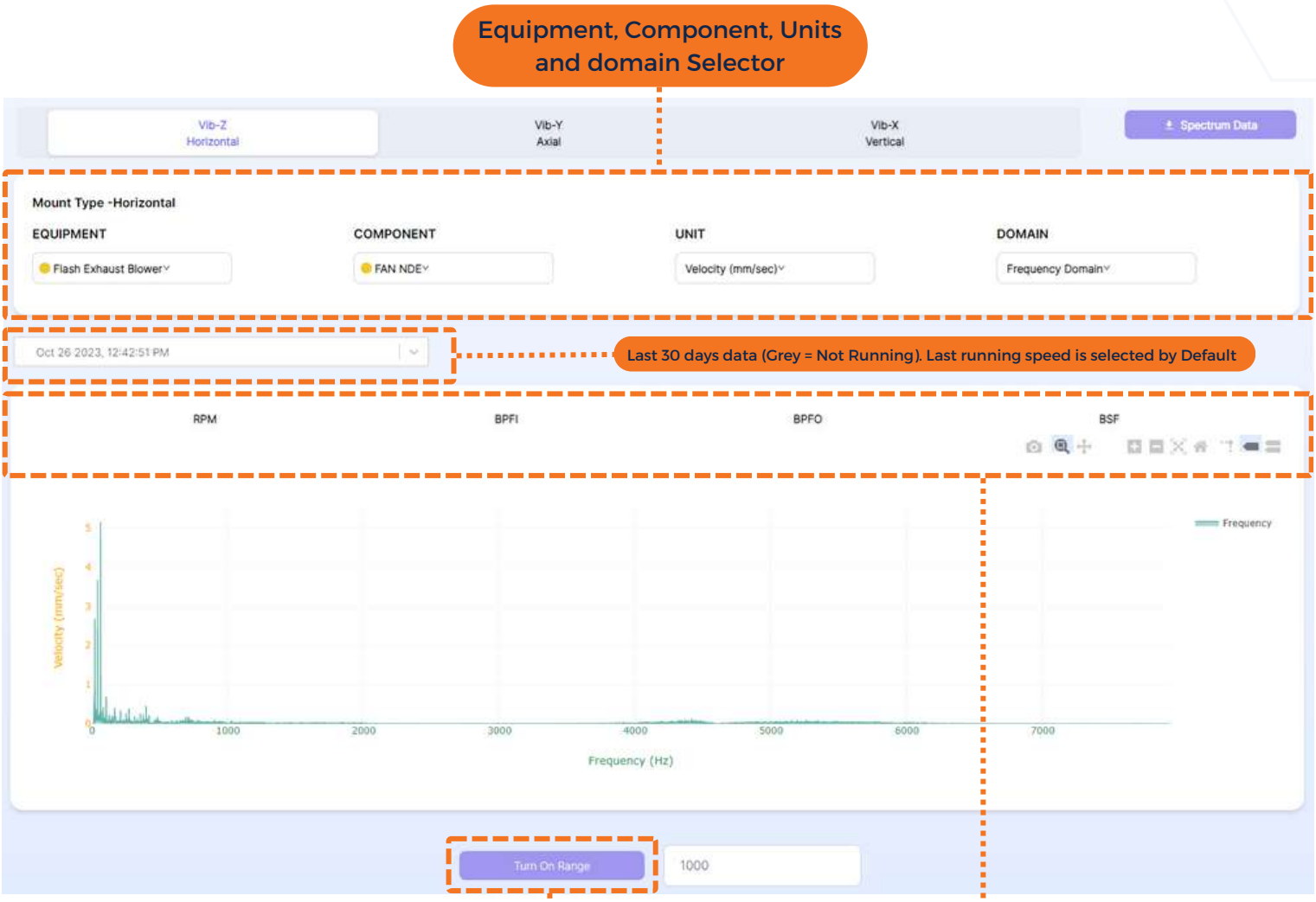
- Non Running AMP
- AMP
- Smooth AMP

Zoom and other graph options

Legend for Vibration Graphs

- NanoAI Threshold
- Non Running RMS
- RMS
- Smooth RMS

Spectrum & Time Waveform Graph



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Vibration

RMS, Peak, Kurtosis, Overall RMS

RMS

Vibration RMS is the root mean square of the entire frequency range of the vibration waveform. It describes the energy emitted by the machine, the higher the energy, the higher the RMS value is.

PEAK

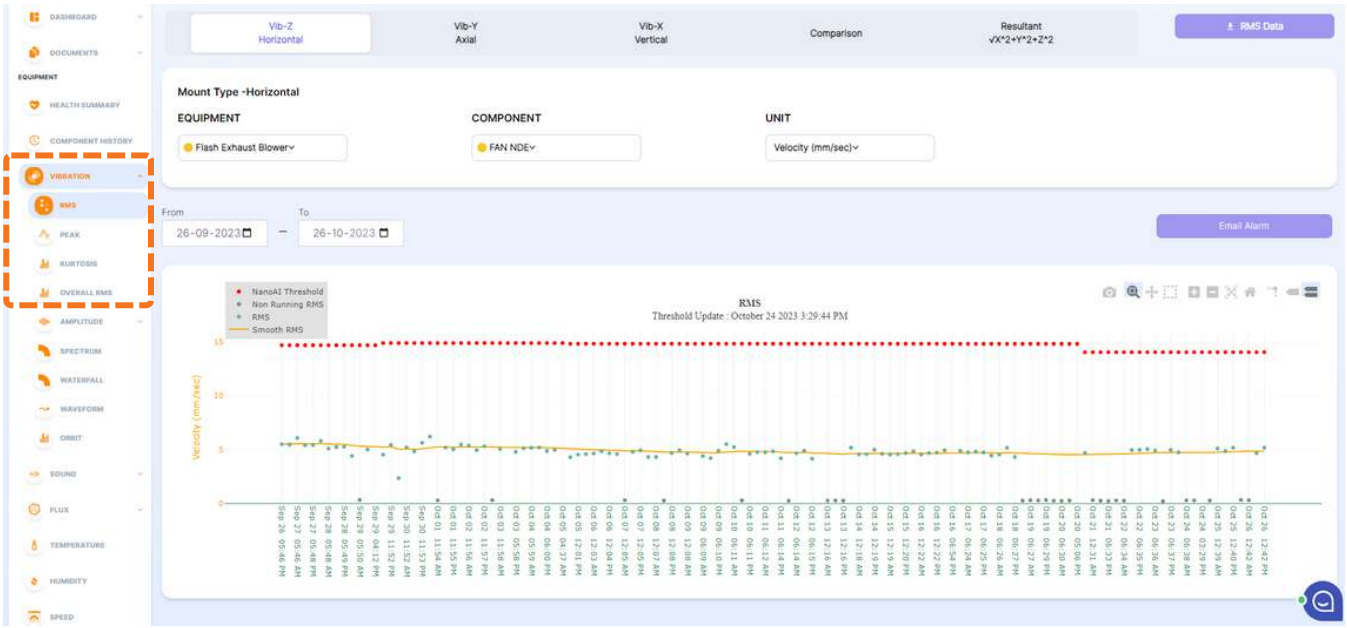
Vibration peak refers to the maximum excursion of the time wave from the zero point. The amplitude describes the severity of a specific fault mode.

KURTOSIS

Kurtosis provides a measure of the peak intensity within a vibration signal. Signals that have a higher kurtosis value have more peaks that are greater than three times the RMS value.

OVERALL RMS

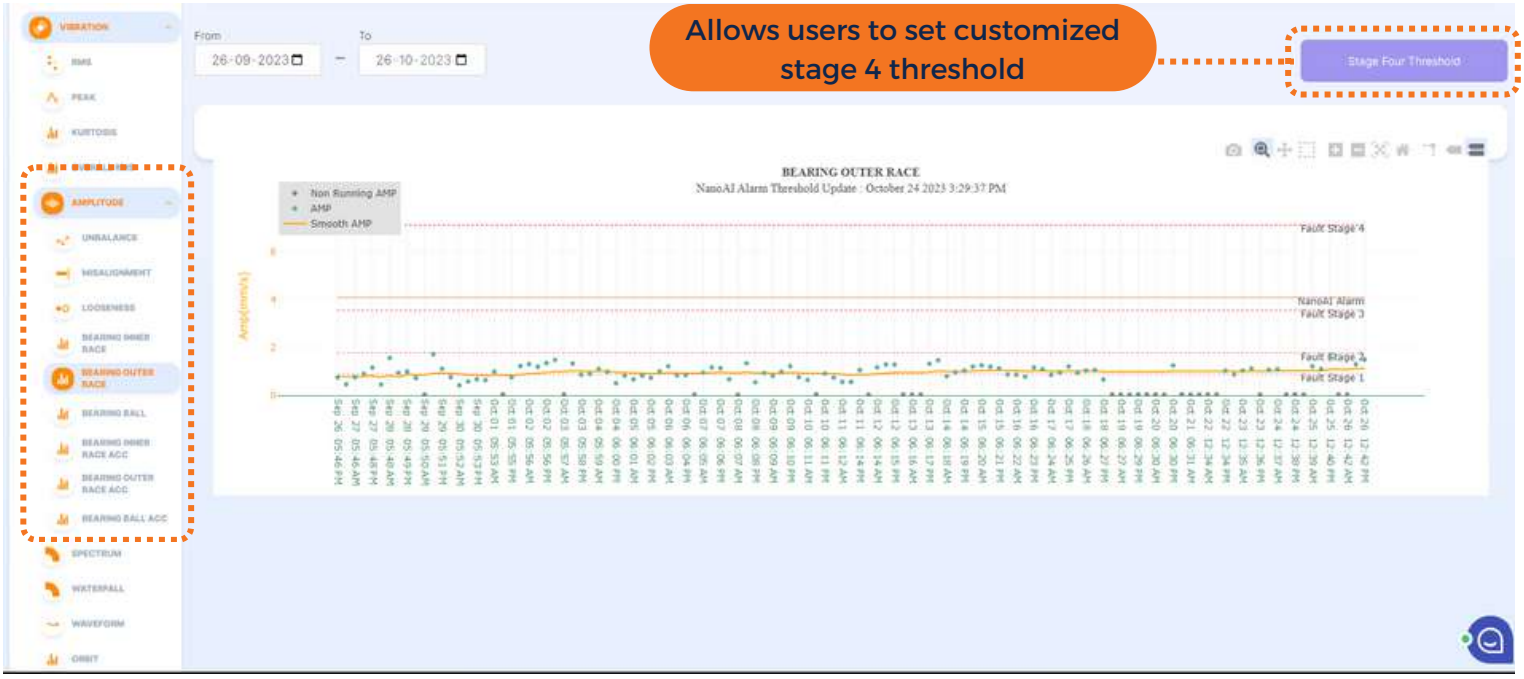
Overall RMS is the root mean square of the vibration waveform from 2-1000 Hz as of ISO10816. It describes the energy emitted by the machine, the higher the energy, the higher the RMS value is.



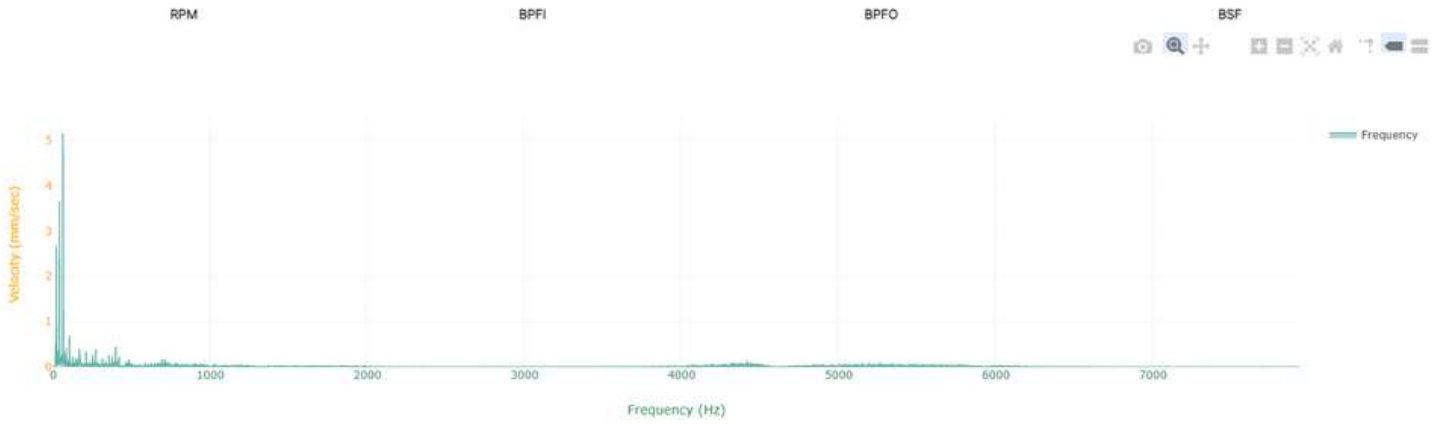
Amplitude

The amplitude graphs correspond to the monitored component, with each sensor configured to cover relevant fault modes based on its specific location. For instance, antifriction bearing faults are addressed through graphs for Bearing Inner Race, Bearing Outer Race, and Bearing Ball, while options for shaft faults encompass unbalance, misalignment, and looseness.

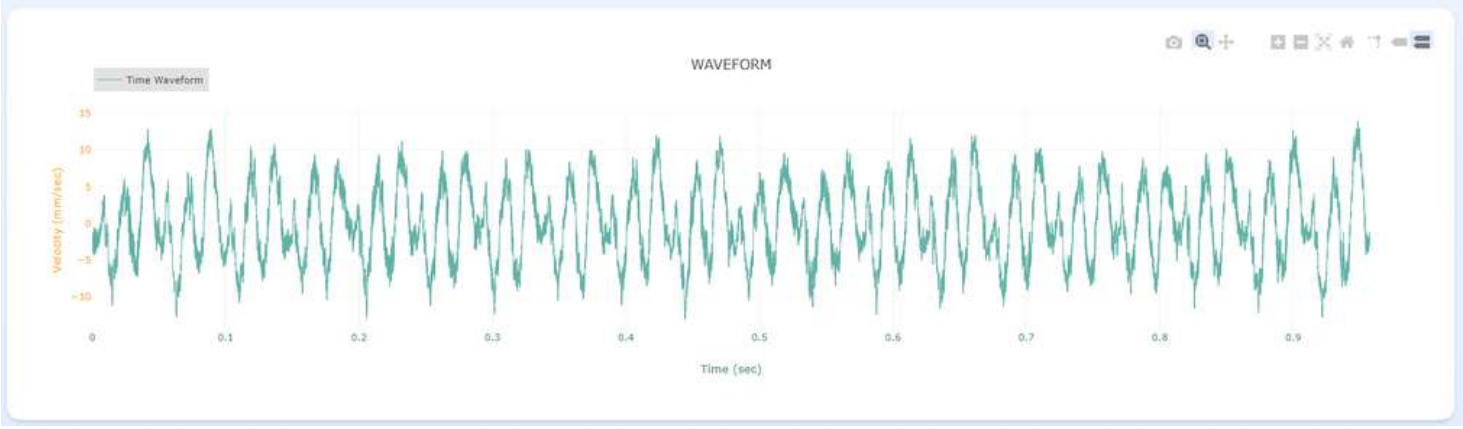
These graphs play a crucial role in determining the Remaining Useful Life (RUL) of a component, with each fault categorized into four stages. RUL is calculated as the time taken to reach Fault Stage 4, with the equipment deemed unstable upon crossing the Fault Stage 4 threshold. Appendix D provides additional insights into the initial setting of the Stage 4 threshold during the learning phase and its subsequent self-adaptive behavior.



Spectrum



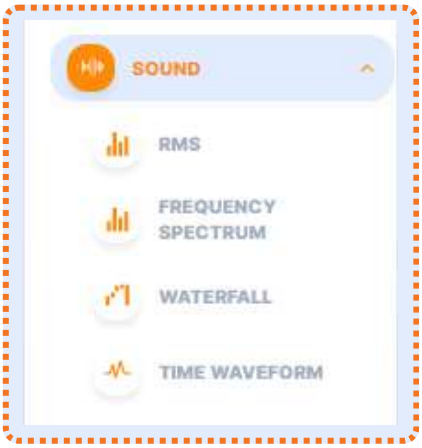
Waveform



Waterfall Spectrum

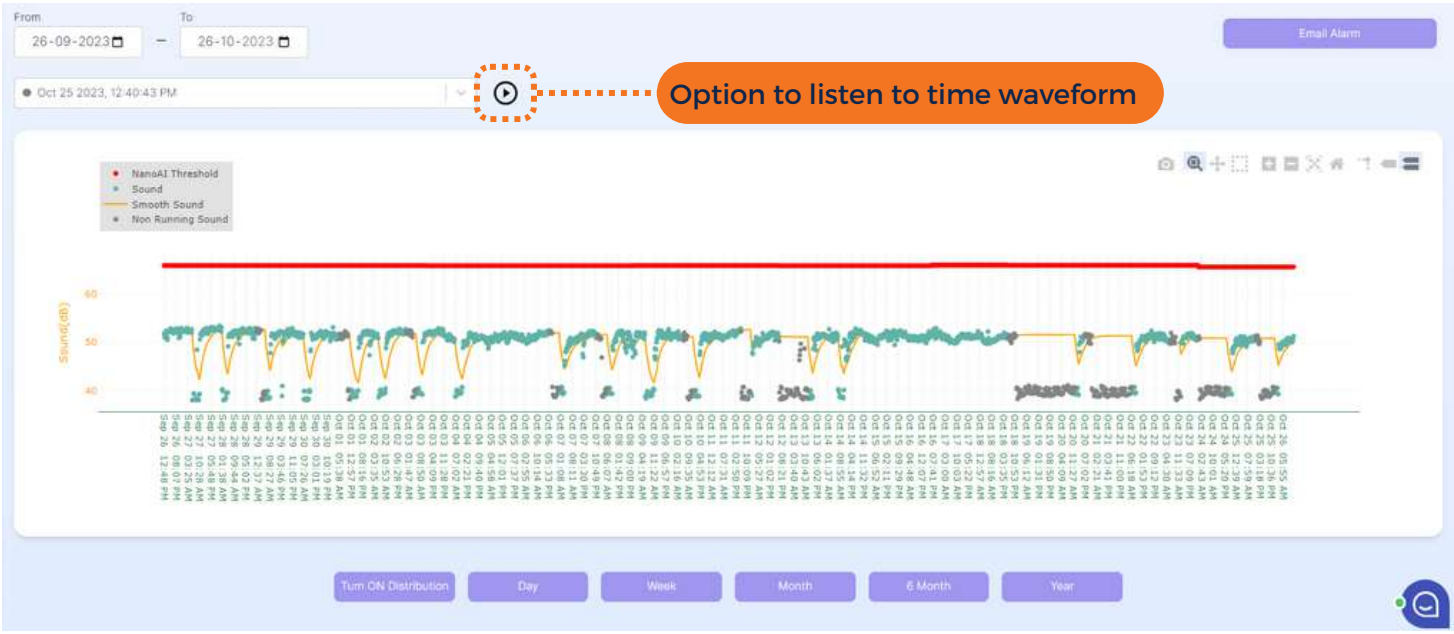
Can be moved in 3D with mouse and zoom (scroll)

Sound



The acoustic emission data has a set frequency range of 20kHz – 40 or 80 kHz to capture the maximum amount of useful data, which is beyond human hearing range.

RMS



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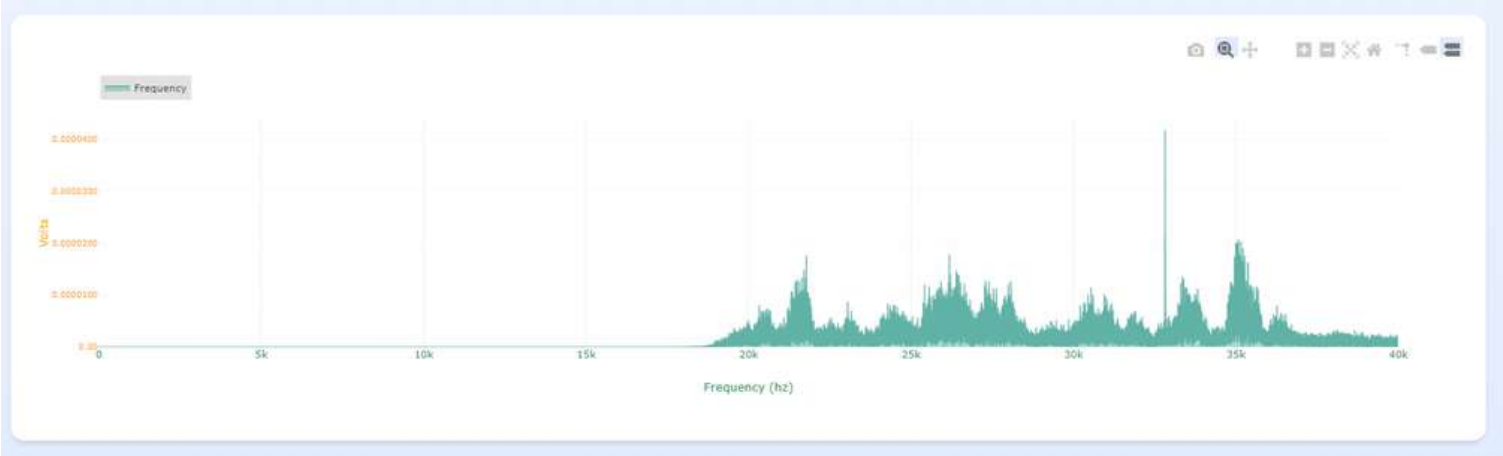
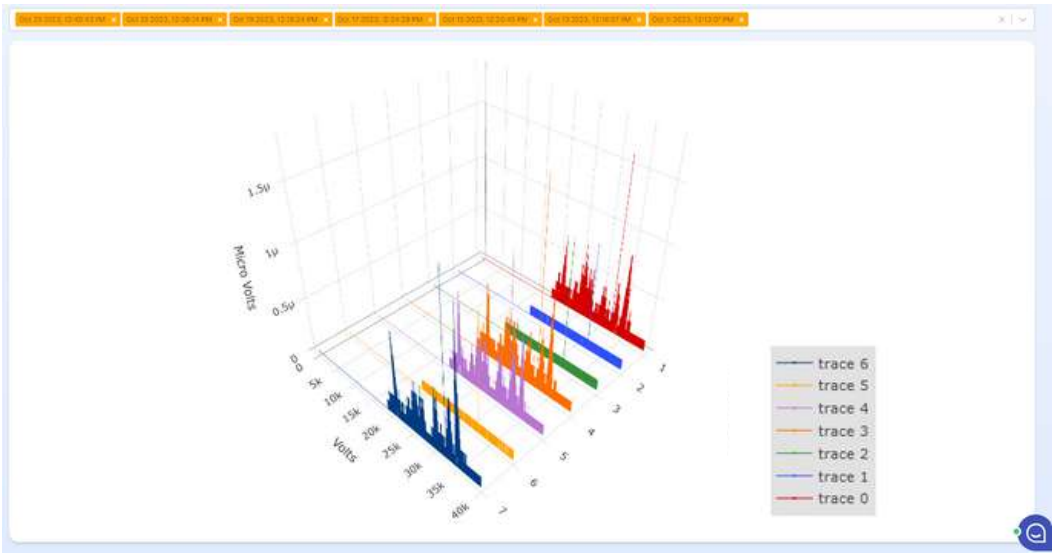
Spectrum



Waterfall Spectrum



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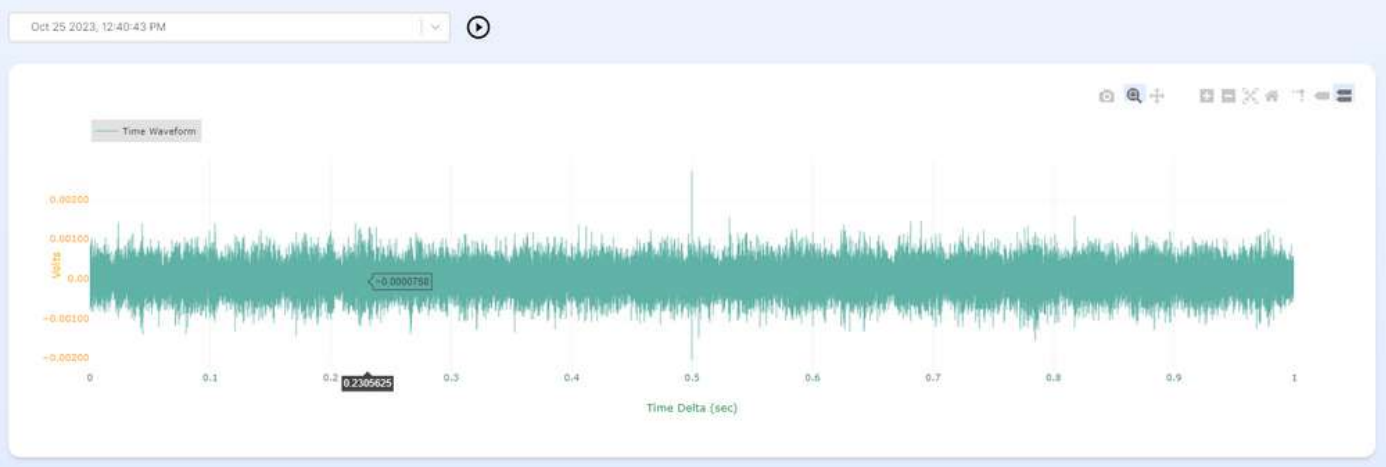
Time Waveform



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Magnetic Flux

The graph represents magnetic flux near the sensor mounting position. It displayed in RMS, Spectrum and Time Waveform.

Temperature

Temperature graph represents surface temperature of each location on which the sensor is mounted.

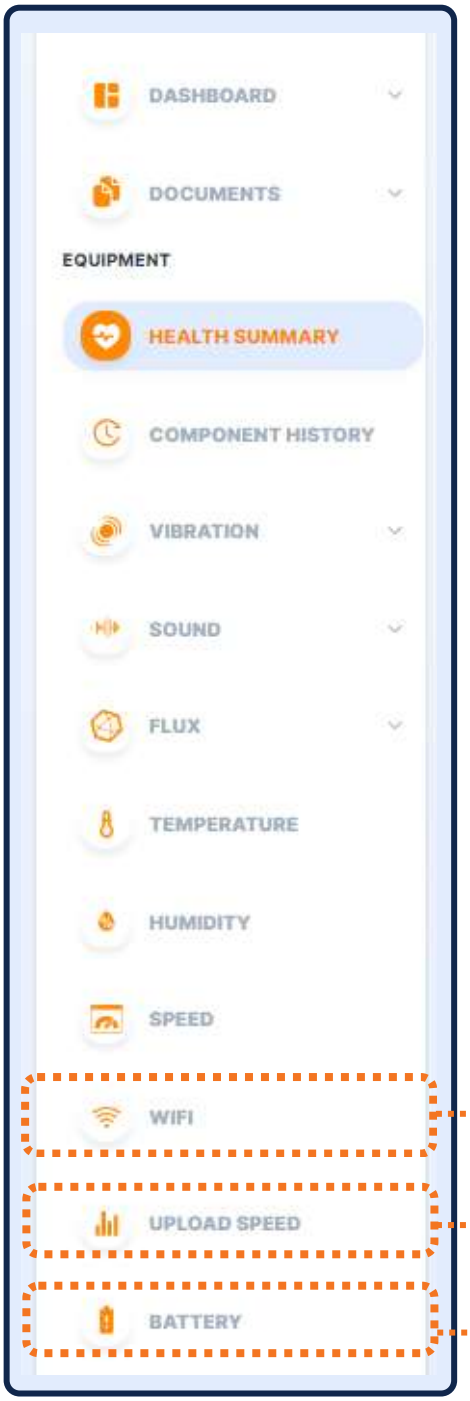
Humidity

The humidity graph represents the atmospheric humidity value near the sensor.

Speed

The speed graph provides RPM of the equipment, which is extracted from the vibration or flux signal

Device Metrics



The Wi-Fi graph provides the strength of the network. Higher values (greater than -70dBm) represent good connectivity.

Upload speed is measured and displayed in trend with every data upload.

The battery graph indicates the current status of battery life.

Appendix A

NanoAI Alarm & Adaptive Fault Amplitude Threshold

- Threshold is automatically updated every 30 days based on the data of the last 30 days
- AI trained model is used to capture the features of data
- Threshold is set/modified to adapt to the features
- No prior knowledge is required from customer
- Alarms will be automatically sent to customer if RMS/Peak hits the threshold
- Applies to RMS/Peak of vibration signals (acceleration & velocity) and RMS of ultrasonic signals.
- It can also be applied to Amplitude fault trends

Appendix B

Vibration

Waveform

A plot of amplitude versus time. The waveform illustrates how the vibration signal (i.e., acc., vel., and dis.) appears when graphed as amplitude over time.

Spectrum

- A plot of amplitude versus frequency.
- The Spectrum is obtained by applying a Fast Fourier Transform (FFT) on Waveform, which breaks the signal down into specific amplitudes at various component frequencies.
- If a machinery problem exists, FFT Spectrum provides information to help determine the location of the problem, the cause of the problem, and, with trending, how long until the problem becomes critical.
- Because we know that certain machinery problems occur at certain frequencies, we analyze the FFT spectrum by looking for amplitude changes in certain frequency ranges.

Frequency Spectrum Waterfall

- A three-dimensional plot in which multiple vibration spectra curves are displayed simultaneously.
- On the Nanoprecise Dashboard, vibration frequency spectrum waterfall plot covers multiple spectra for the last 7 days
- By using the frequency spectrum waterfall plot, it can show how the frequency spectral structure changes over time

Amplitude

The maximum amplitude for the fault characteristic frequencies and its harmonics up to 10th order. This amplitude describes the severity of a specific fault mode. Nanoprecise uses such amplitudes for RUL calculation.

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Vibration

Peak

Peak value in time domain. The maximum excursion of the time wave from the zero or equilibrium point in the time domain.

Kurtosis

Kurtosis is a statistical parameter used to characterize a signal. Kurtosis provides a measure of the peak of a vibration signal. Signals that have a higher kurtosis value have more peaks that are greater than three times the RMS value, which are, for mechanical vibration signals, the impulses introduced by the mechanical impacts, indicating the potential mechanical fault.

RMS

Root Mean Square is the square root of the average of the squared values of the vibration waveform. RMS describes the vibration energy in the machine. The higher the vibration energy, the higher the vibration RMS is.

Magnetic Flux

Time Waveform

The time waveform illustrates how the magnetic flux appears when graphed as amplitude over time.

Frequency Spectrum

A plot of amplitude in micro voltage versus frequency. The Flux spectrum describes the amplitude at each frequency component.

RMS

Root Mean Square is computed from the spectrum to quantify the magnetic flux energy emitted by the machine.

Sound

Time Waveform

The Acoustic Emission (AE) waveform illustrates how the AE signal appears when graphed as amplitude over time.

Frequency Spectrum

A plot of amplitude in micro voltage versus frequency. The AE spectrum describes the amplitude at each frequency component.

Frequency Spectrum Waterfall

- A three-dimensional plot in which multiple AE spectra curves are displayed simultaneously.
- On Nanoprecise Dashboard, AE frequency spectrum waterfall plot covers multiple spectra for the last 7 days
- By using the frequency spectrum waterfall plot, it can show how the frequency spectral structure changes over time

RMS

Root Mean Square (RMS) is the square root of the average of squared values within the AE waveform. RMS characterizes the acoustic emission (AE) energy emitted by the machine. A higher AE energy level corresponds to an elevated AE RMS value.

Appendix C

Health Status

Health Status is defined by a combination of Fault Severity of the worst condition Fault Amplitude of that component and the Remaining Useful Life.

HELP INFORMATION

Based on the comprehensive signal processing and transfer learning techniques, fault severity is analyzed and trended subject to ASNT standards with proper severity stage categorization by our algorithm. Various health summary metrics in the dashboard are linked to the fault severity as mentioned in the following table:

Fault Severity	Remaining Useful Life	Health Status	Fault	Suggestion
lower than stage 2	>75%	Healthy	Not Available	None
stage 2	>50%	Healthy	Not Available	None
stage 2 & fault anomaly detected*	>50%	Needs maintenance review	Applicable fault	Review maintenance plan and parts availability
stage 3	>750 hours	Needs maintenance review	Applicable fault	Review maintenance plan and parts availability
stage 3	251-750 hours	Needs attention	Applicable fault	Schedule maintenance activity
stage 3	<250 hours	Needs immediate attention	Applicable fault	Repair immediately
stage 4	0	Needs immediate attention	Applicable fault	Repair immediately

*fault anomaly detected: fault amplitude data exceeds NanoAI Amplitude threshold

Health Score

Health score on Plant level is the average rating of each equipment health status under the plant. Assuming Plant A has 4 different equipment in it. Each equipment has 4 health modes with following health modes and associated score of ranking.

- **Healthy - 3**
- **Needs Maintenance Review - 2**
- **Needs Attention - 1**
- **Needs Immediate Attention - 0**

If two equipment are in the Healthy mode, 1 is in Needs Maintenance Review mode and 1 is in Needs Attention mode then he health score will be calculated by averaging the total score. In this case, it will be calculated as 3 + 3 + 2 + 1 / 12 = 0.75 = 75 is the health score

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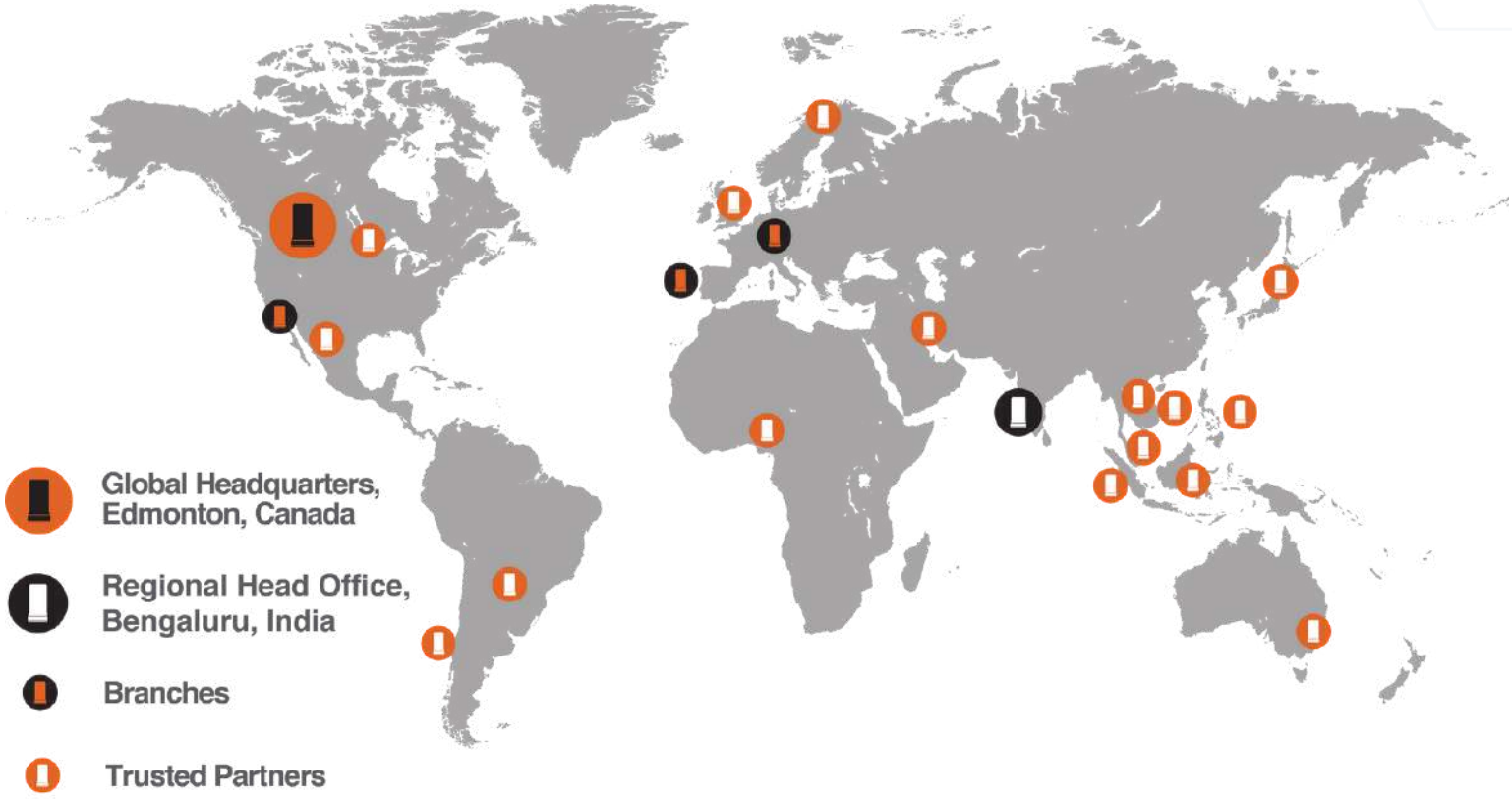
Remaining Useful Life

Remaining Useful Life is based on the rate of change of a specific fault amplitude trend and the projection for each to reach a stage 4 severity. The main added value is to track how quickly a specific fault mode is developing and update health status with matching priority

Fault Stage	Predicted RUL in hours	RUL Representation on Dashboard
Stage 1	NA	Percentage
Stage 2	NA	Percentage
Stage 3	>750	Hours
	<750	Hours
Stage 4	>750	Hours
	<750	Hours
Note 1	By NA for Stage 1 and Stage 2, it means the RUL will be represented in percentage regardless of the value of predicted RUL in hours.	
Note 2	Two factors are taken into consideration for RUL calculation: Absolute Amplitude and Relative Amplitude Increasing Trend.	
Note 3	750 hours is around one month, being treated as the boundary to have RUL in percentage or in hours.	
Note 4	When the Remaining Useful Life (RUL) is expressed in hours, immediate action accompanied by a field check is necessary, as the escalating trend in detected fault amplitude would be substantial.	
Note 5	When the Remaining Useful Life (RUL) is presented as a percentage, continuous monitoring is required without immediate action, as the detected fault amplitude would likely remain relatively consistent.	

Global Presence



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