
2022 | v02



ADI OtoSense SMS Installation and Web User Guide

Live — Last update: 21 October 2022

otosensesms

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1. OtoSense SMS Installation Guide

Thank you for choosing Smart Motor Sensor (SMS) from Analog Devices. SMS is a device that performs predictive maintenance on low voltage electric motors.

The SMS solution consists of the following components:

- The Smart Motor Sensor device, or hardware
- Expert fault prediction software hosted on the OtoSense Server
- Mobile and web app: configuration and access to dashboard

General information about SMS:

- SMS works with:
 - three-phase squirrel cage induction electric motors
 - with frames up to 450 (IEC 600034) or 500 (NEMA MG1)
 - whose power range varies from 0.37 kW to 500 kW, or 0,5 to 700HP
 - driven directly to line (DOL), by frequency inverter (VFD), soft starter, star-triangle drive, or by any other driving device.
- SMS can be installed on both old and new motors, horizontal or vertical.
- Once the installation of the SMS on the motor and the configuration of the device (Wi-Fi Network Motor) are completed, the device starts sending data to the OtoSense cloud server, which requires a process of learning about the motor's operation to be able to predict its faults. This process' duration varies, depending on the motor's operating conditions, but it usually takes approximately four weeks.

This manual acts as an installation and configuration guide for SMS.

It is composed of 3 sections:

- [Quick start guide](#): provides you with a checklist to get ready, and a form to help you collect information on your motor.
- [Detailed installation guide](#) : provides more information about each aspect of the installation, from the network settings to the actual physical installation of the device.
- [Tutorial videos](#)

Read this manual carefully and perform the steps in sequence specified herein.

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1.1. Quick start guide

Here is the general procedure for installing an SMS device; Please refer to each section of this guide to see in detail the operations required at each step.

1. Install the ADI OtoSense SMS app on your mobile device
2. Enter your credentials on the Login screen
3. Follow the onboarding steps in the app to configure the SMS device
4. Fix the device to the motor
5. Check that the device is sending data



Prior to the installation, we recommend you check and/or fill-up the following documents






- [Pre-installation checklist](#)
- [Motor information form](#)
- [How to read a motor plate to find the information](#)


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1.1.1. Pre-installation Checklist


Make sure you verify all these items before installing or commissioning a SMS device.

	What to verify	How to verify	
1 	Verify Wi-Fi access point is 2.4GHz 802.11b/n/g.	Check the settings on the back of the router, as seen on the picture.	

	What to verify	How to verify	Android mobile app	iOS mobile app
2 	Prepare a mobile device (smart phone / tablet, Android or iOS) that can connect to the above access point. The mobile device is mandatory only for the commissioning: the monitoring can be done via PC and mobile device	Confirm OS version. Make sure you are not using a Windows tablet. Verify connectivity to the target network	Android OS6.0 or later	iOS13 or later
3 	Install SMS app on your mobile device	Use the following links	ADI OtoSense SMS – Google Play 	ADI OtoSense SMS – App store 
4 	Activate SMS account	Click on the link in the invitation email		

		and log into your account. If you have not received the invitation email, skip steps 4 and 5 and go to 6. Contact your ADI sales representative to get the invitation		
5	 <p>Confirm Wi-Fi signal strength is greater than -60dB at the motor location and connect to the internet</p>	At the motor location, open SMS mobile app and tap “Validate Your Wi-Fi Network” (Run the validation)	<p>Confirm that you passed all 4 steps</p> <p>Step 1: Network Signal</p> <p>Step 2: Network Frequency</p> <p>Step 3: Internet connectivity</p> <p>Step 4: SMS access to cloud</p>	On iOS, step 1 and 2 can't be performed: ignore the result “Warning” and confirm Step 3 and 4 pass. Regarding the network signal, the strength should be confirmed using a Wi-Fi Analyser running on an Android or Windows device, and should be > -60dB. Regarding the network frequency, confirm item 1 on this checklist

What to verify	How to verify	
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<p>6</p> <input type="checkbox"/>	<p>Find the right position to attach the device to the motor</p>	<p>Attach as drawn on the SMS case:</p> <ul style="list-style-type: none"> • on the center line • opposite the shaft and load 	
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<p>7</p> <input type="checkbox"/>	<p>Prepare the necessary information for commissioning the SMS by collecting the motor parameters on its label and the electrical connection information.</p>	<p>Fill in the Motor info form and make sure that the mandatory parameters marked with an * are filled in. Print it out and have it available at the time of commissioning, it will save you time</p>
<p>8</p> <input type="checkbox"/>	<p>Take a 3mm, 2.5mm Hex Wrench</p>	<p>T Hex Rench is recommended when installing multiple SMSs</p>
<p>9</p> <input type="checkbox"/>	<p>Take a Phillips screwdriver</p>	
<p>10</p> <input type="checkbox"/>	<p>Take gloves</p>	<p>You will be using Epoxy, which is a very strong adhesive</p>
<p>11</p> <input type="checkbox"/>	<p>Watch the video “How to Commission a SMS device”</p>	<p>Watch video</p>
<p>12</p> <input type="checkbox"/>	<p>Watch the video “How to install a SMS device”</p>	<p>Watch video</p>
<p>13</p> <input type="checkbox"/>	<p>If you run into an issue, you will find more detailed explanations in the next sections of this user guide</p>	

1.1.2. Motor Information Form (info required for the commissioning)



We recommend you print this page and fill in the parameters to make the commissioning process easier. If you don't know where to find this information, please refer to the section [How to read a motor plate](#).

Mandatory fields	Field	Example	Write the data for your motor
•	SMS Serial Number (printed on SMS case)	xxxxxxxxA (xxxxxxxx are numbers)	
•	Motor name (Tag)	<i>Secondary Water Pump 1</i>	
•	Wi-Fi SSID (at motor location)		
•	Password	xxx	
	Manufacturer	<i>Brand Name</i>	
•	Rated Power (KW)	2.984	
•	or Rated Power (HP)	4	
	Rated Voltage (V)	300	
•	Number of Poles	4	
•	Frequency (Hz)	60	
	Connection	<i>Star, Delta, Double Star, etc.</i>	
	Drive	<i>VFD or DOL, etc.</i>	
	Efficiency level	<i>IE1, IE2 or IE3</i>	
•	Model	1AA46	
•	Location	xx Factory	
•	Plant	<i>Incinerator #1</i>	
•	Process	<i>Induced Draft Fun #1</i>	
•	Rated Speed (RPM)	3420	
•	Rated current (A)	7.3	
	Eff @100%	84.5	
	Bearing manufacturer	SKF	
•	DE bearing	6206	

•	NDE bearing	6206	
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1.1.3. How to read a motor plate

Confirm Motor Details

Motor Name (Tag)
Secondary Water Pump 1

Manufacturer
Brand Name

Rated Power (Kw)
2.984

Rated Voltage (V)
300

Number Of Poles
4

Frequency (Hz)
50Hz 60Hz Other

Connection
Star Delta Other

Double-Star

Drive
VFD

Efficiency Level
84.5

Model
1AA46

Check Motor Details

Confirm Motor Details

Confirm details match your motor correctly

Edit Motor Details

Confirm Motor Details

- A** Information requested on the mobile form
A Needed information not requested on the mobile form

BRAND NAME

Made in P.R.China BRAND NAME STANDARD MOTORS LTD.

3~MOT.1LE0142-1AA46-4AA4E100LMB3 IP55 LMH-1008 / 800003888993 / 001

DV	F Hz	G HP	L A	I EFF.	cosΦ	K r/min	EFF.CL.
220/380 ΔΔYY	60	4	12.6/7.3	84.5 %	0.85	3420	IE1
440 ΔG	60	4	6.3	84.5 %	0.85	3420	IE1

N BRG DE 6206 2Z C3 O BRG NDE 6206 2Z C3

Th.Cl. 155(F) AMB 40°C

OCV1104A IEC60034 Net: 33 kg

- A** Motor Name (Tag): A name that you give to the Motor.
B Usually situated at the top of the Motor Plate
C 1HP (E) = 746W = 0.746Kw
D Voltage: enter the middle value. For example, 220/380 = enter 300V for a frequency of 60Hz
 50Hz for European countries
 60Hz for USA and Australia
E In general, the number of poles is situated on the first line with the model.
 In this case, enter 4 as in 1LE0.....AA4.

	50Hz	60Hz
2 poles	3000rpm	3600rpm
4 poles	1500rpm	1800rpm
6 poles	1000rpm	1200rpm
8 poles	750rpm	900rpm

The rpm value in this table relates to the electrical speed.
 In this motor plate, the Rated Speed (rpm) relates to the mechanical speed.
 Thus, for a 60Hz frequency, 3600rpm = 3420rpm. For a 50Hz frequency, 3000rpm = 2920rpm.

- F** 50Hz for European countries and Australia
 60Hz for USA, North America and South America
G This motor plate indicates double-delta (ΔΔ) or double-star (YY) if we go with 300V at a frequency of 60Hz. If we select 440V, we have a Delta connection (Δ).
H Drive: please ask Maintenance to get this information.
I Efficiency level (also named Efficiency @100% or EFF @100%):
 Sometimes, Efficiency level is written as follow IE2-88(100%)-88.5(75%)-87.6(50%).
 In this case, choose the 100% one i.e. 88.
J Model: 1AA46
K Rated Speed (RPM) can also be written:
 • r/min
 • RPM
 • #/min
 • min-1
L Rated Current (A i.e. Amps): depending on the connection, we enter 12.6 (ΔΔ), 7.3 (YY) or 6.3 (Δ).
 In this example, we have a double-star connection (YY) therefore we enter 7.3.
M Bearing Manufacturer:
 Contact the Motor Manufacturer (Sales Department) or consult the Motor Manufacturer catalogue to get this information
N De Bearing: 6206
O NDE Bearing: 6206
P Frame (also named Shaft Height): 100L in this example.
 Check Motor Manufacturer catalogue to find the information if not on the Motor Plate.
 *See Frame References table for NEMA and IEC Motor Plates
Q 3 phase induction can be written as follow:
 • 3~MOT
 • 3~
 • PH3

IEC Frame	NEMA Frame
63	42

71	48
80	56 56H
90S	143T 145T
90L	182 184 182T 184T
100	213 215 213T 215T
112	254U 256U 254T 256T
132	284U 286U 284T 286T 284TS 286TS
160	324U 326U 324T 326T 324TS 326TS
180	364U 365U 364T 365T 364TS 365TS
200	404U 405U 404T 405T 404TS 405TS
225 S	444U

	445U 444T 445T 447T 449T 444TS 445TS 447TS 449TS
225 M	
250 S	
250 M	
280 S	
280 M	
315 S, 2p	
315 S, 4p-8p	
315 M, 2p	
315 M, 4-8p	
355 S, 2p	
355 S, 4-8p	
355 M, 2p	
355 M, 4-8p	
355 L, 2p	
355 L, 4-8p	

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1.2. Detailed installation guide

This part of the installation guide goes into more detail on each aspect of the installation:

- [Networking requirements](#)
- [Getting started](#)
- [Invitation process](#)
- [Device configuration](#)
- [Fixing the device to the motor](#)
- [Checking device connection](#)
- [Learning process](#)
- [Repairing / replacing a motor](#)
- [Replacing the batteries](#)

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1.2.1. Networking requirements

Networking Basics

ADI OtoSense™ Smart Motor Sensor (SMS) devices require internet connectivity to send data to the cloud application.

To connect your *ADI OtoSense SMS* devices to the internet, you must use your local WiFi network. Your WiFi network must use:

- Dedicated 2.4GHz network
- Security: WEP, WPA, or WPA2

Certain network configurations are not supported:

- Proxy
- 5GHz WiFi networks
- Security: WPA3 or WPA/WPA2/WPA3 Enterprise

What to do if your network does not meet these requirements

If your network does not meet these network requirements, you can purchase a router to connect your ADI OtoSense SMS devices to the internet.

Routers

Recommended features:

When purchasing a router, the following features are recommended:

- **Pingreboot/Keepalive** (highly recommended): when the router detects that it does not have Internet connection, it will automatically restart.
- **Periodic Reboot**: the router will periodically restart to maintain optimal performance.
- **Remote Management**: request router status or restart router remotely using API, text, or call.

Examples of routers with recommended features

- Teltonika RUT240 02U000 (North America)
- Teltonika RUT240 06E000 (Europe and UK)

SIM cards and data plans:

Each ADI OtoSense SMS consumes up to 500 MB of data per month under normal operating conditions. If purchasing a SIM card to use with your router, consider the following:

- A **contract** or **bill pay** SIM card is preferred, to avoid interruption to internet connectivity.
- If using a **prepaid** SIM card, you should apply sufficient credit to the SIM plan to cover the trial period (90 days).

If You Have a Corporate Firewall

You may need to configure your firewall ports to allow your ADI OtoSense SMS devices to connect to the cloud:

- Device communication uses MQTT over TLS/SSL, therefore port 8883 must be open
- HTTPS port (port 443) must be open

Note port 8883 will need to allow ingress traffic to support Over The Air (OTA) updates to the ADI OtoSense SMS.

You may also have to whitelist the following domains to ensure the device is able to connect to the cloud application:

- .otosensesms.com
- .amazonaws.com

If you have to whitelist the device MAC addresses on your network, the MAC addresses are available by request.

ADI OtoSense SMS does not currently support IP address whitelisting.

Useful corporate firewall configuration information

ADI OtoSense SMS leverages the AWS Cloud to provide scalable and reliable Internet-of-Things (IoT) connectivity. AWS publish the complete list of AWS IP Ranges used by their cloud services (<https://ip-ranges.amazonaws.com/ip-ranges.json>).

This list is dynamic and the IP addresses change periodically. Your Network Administrator can subscribe to notifications about changes and apply these to maintain your network firewall configuration. Access full details at <https://docs.aws.amazon.com/general/latest/gr/aws-ip-ranges.html>

Firewall support for AWS IP ranges

Check Point Firewall

The Check Point firewall has a feature named **Updatable Objects** that supports the dynamic AWS IP Ranges list and automatically maintains your network firewall configuration whenever IP ranges change.

- https://sc1.checkpoint.com/documents/R81/WebAdminGuides/EN/CP_R81_SecurityManagement_AdminGuide/Topics-SECMG/Updatable-Objects.htm
- https://supportcenter.checkpoint.com/supportcenter/portal?eventSubmit_doGoviewsolutiondetails=&solutionid=sk131852

The subset of AWS IP ranges that are applicable to ADI OtoSense SMS comprise of the following:

- **Amazon Services**
- **API Gateway Services**

- **CloudFront Services**
- **Rout53 Services**

Create an Accept rule for traffic to these services on ports 8883 and 443 in the Updatable Objects console.

Palo Alto Firewall

The **Palo Alto** firewall has a similar feature to Check Point's Updatable Objects named **External Dynamic Lists** (EDL).

- <https://docs.paloaltonetworks.com/pan-os/8-1/pan-os-admin/policy/use-an-external-dynamic-list-in-policy>
- <https://docs.paloaltonetworks.com/pan-os/9-1/pan-os-web-interface-help/objects/objects-external-dynamic-lists.html>

Signal Strength

Reliable connectivity between your ADI OtoSense SMS devices and the cloud requires a signal strength **greater than -60dB**.



When deploying your *ADI OtoSense SMS* devices it is recommended to use the *Network Validator tool* in the ADI OtoSense SMS app, or a similar network tester, to ensure adequate signal strength where you deploy your *ADI OtoSense SMS devices*.

**Signal Strength indicator is only available in Android App*

**All traffic on port 8883 should be allowed initially when using the Network Validator to test that the port is open*

ADI OtoSense SMS App

Used to commission ADI OtoSense SMS devices. iOS and Android application available.

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1.2.2. Getting started

The configuration of the SMS device is done through the ADI OtoSense SMS mobile application, available for iOS and Android.

The shipping box contains:

- The SMS device
- [Epoxy bi-component adhesive](#)*
- [Four lithium batteries](#)
- Two fixing clamps, including screws**
- Sandpaper

*We recommend you wear gloves when using Epoxy as it's a very strong adhesive!

**If there are no cooling ribs in the frame of the motor (motors whose housing does not have cooling fins, for example), contact your ADI Sales representative to purchase a specially designed base for the installation of the SMS.



Note: You can install the device even if the motor is running. Be careful though: the motor's frame can be very hot!

Install the ADI OtoSense SMS app from the App Store or from Google Play. You will receive an invitation email to log in to the app.



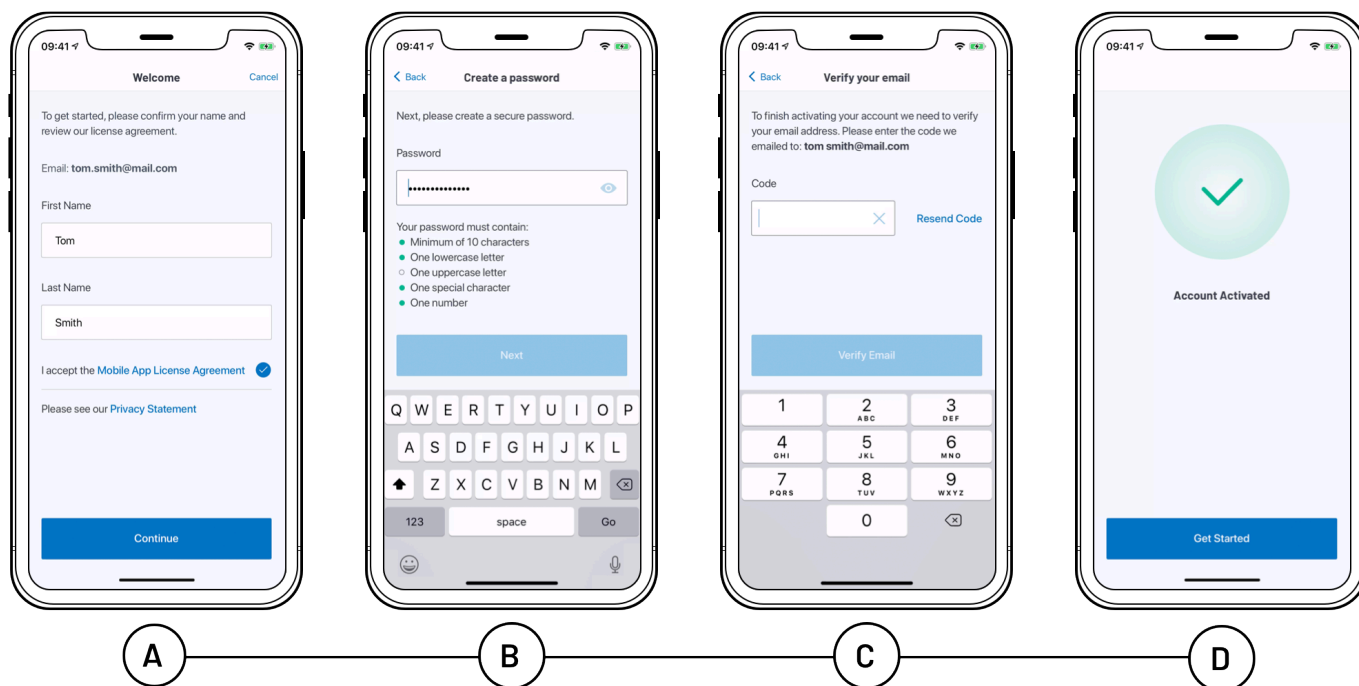
Revision: 37 — Last modified: 8 June 2021

1.2.3. Invitation Process

You can only log in to the ADI OtoSense SMS app by invitation. If you did not receive an invitation email, please contact your Sales representative.

Once you receive the invitation email you can activate your account via the web or mobile app,

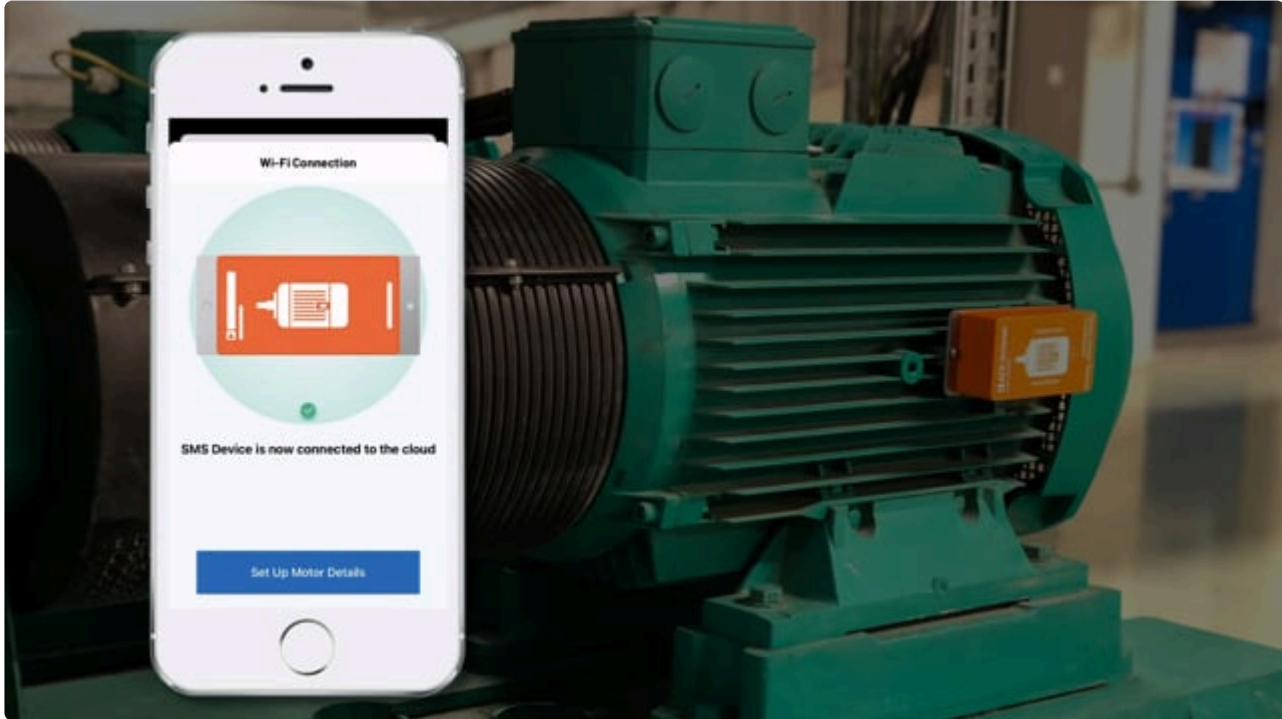
1. Enter or confirm first name, last name and create a password.
2. Verify your identity by entering the code sent to the email address specified.
3. Enter the code and tap 'Verify our email' to start working with the ADI OtoSense SMS app.



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1.2.4. Device Configuration

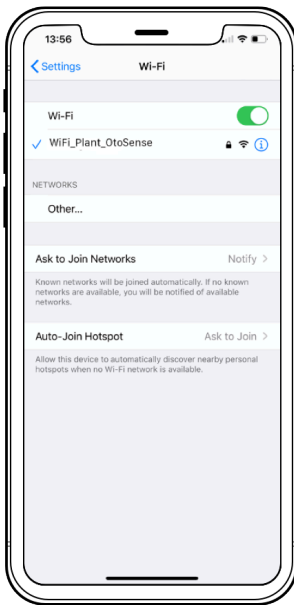
The process described below corresponds to the iOS mobile app. The process is quite similar with the Android app, only simpler as you won't have to navigate between the Wi-Fi settings of your smartphone and the ADI OtoSense SMS app.



<https://player.vimeo.com/video/551961335>

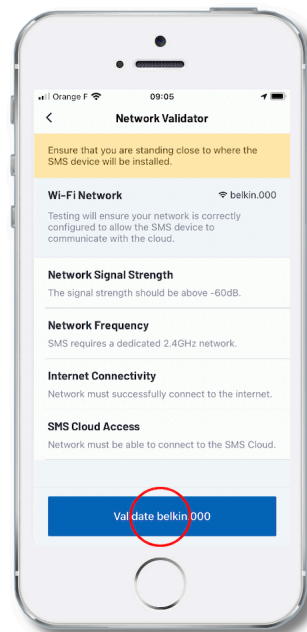
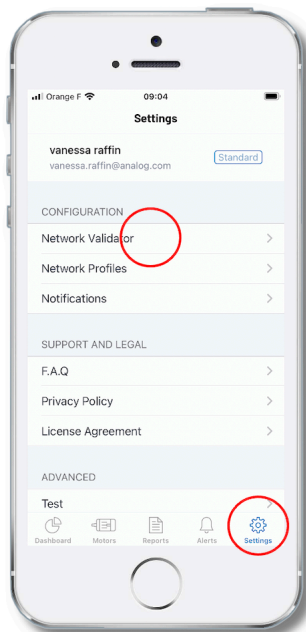
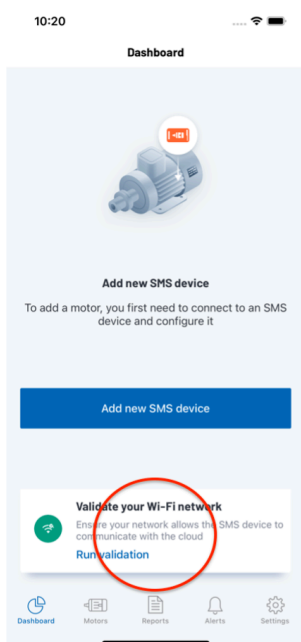
After logging in:

- * To complete the set up of an SMS on a motor, you will need to connect your smartphone to an existing Wi-Fi network on the plant, or to the router provided by Analog Devices/ Partner
 - a. Make sure you can see that the network is available in the Wi-Fi settings of your mobile device and that there is a good signal. This **connectivity must be enabled 24h/7**, so the device can communicate with the Cloud Server at all times.
 - b. Only **password protected** Wi-Fi networks can be used.
 - c. If you are experiencing a poor Wi-Fi or Internet connection during commissioning, please contact your company's IT department to request guidance in improving your router signal.



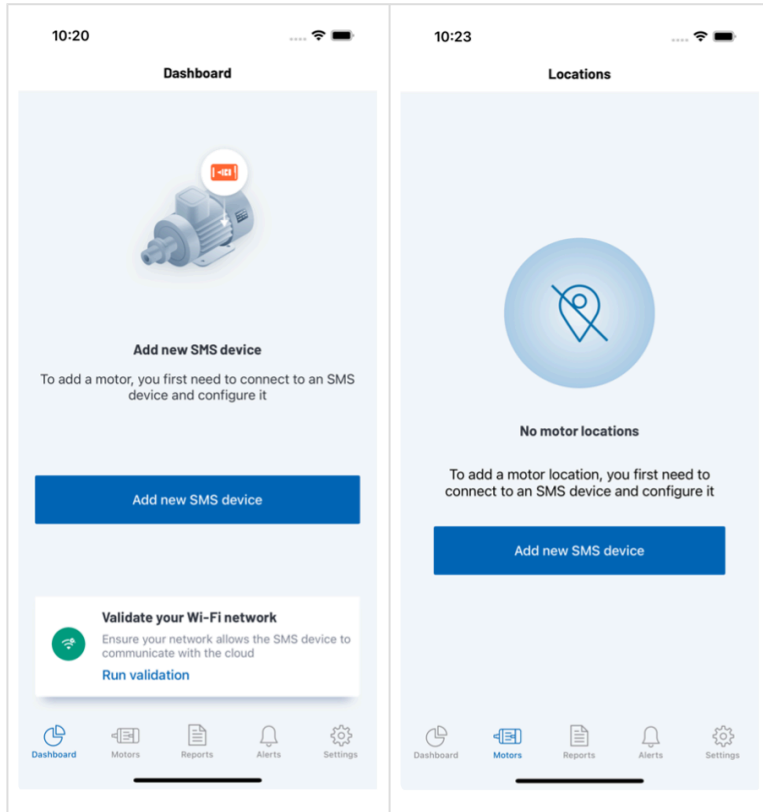
! You need to connect the SMS to an existing **2.4 GHz Wi-Fi network** on the plant: if the WiFi Router can support only 5GHz, you won't be able to commission the SMS. See the section Networking Requirements of this guide for more details.

When deploying your *ADI OtoSense SMS* devices it is recommended to use the *Network Validator tool* in the ADI OtoSense SMS app, or a similar network tester, to ensure adequate signal strength where you deploy your *ADI OtoSense SMS devices*.



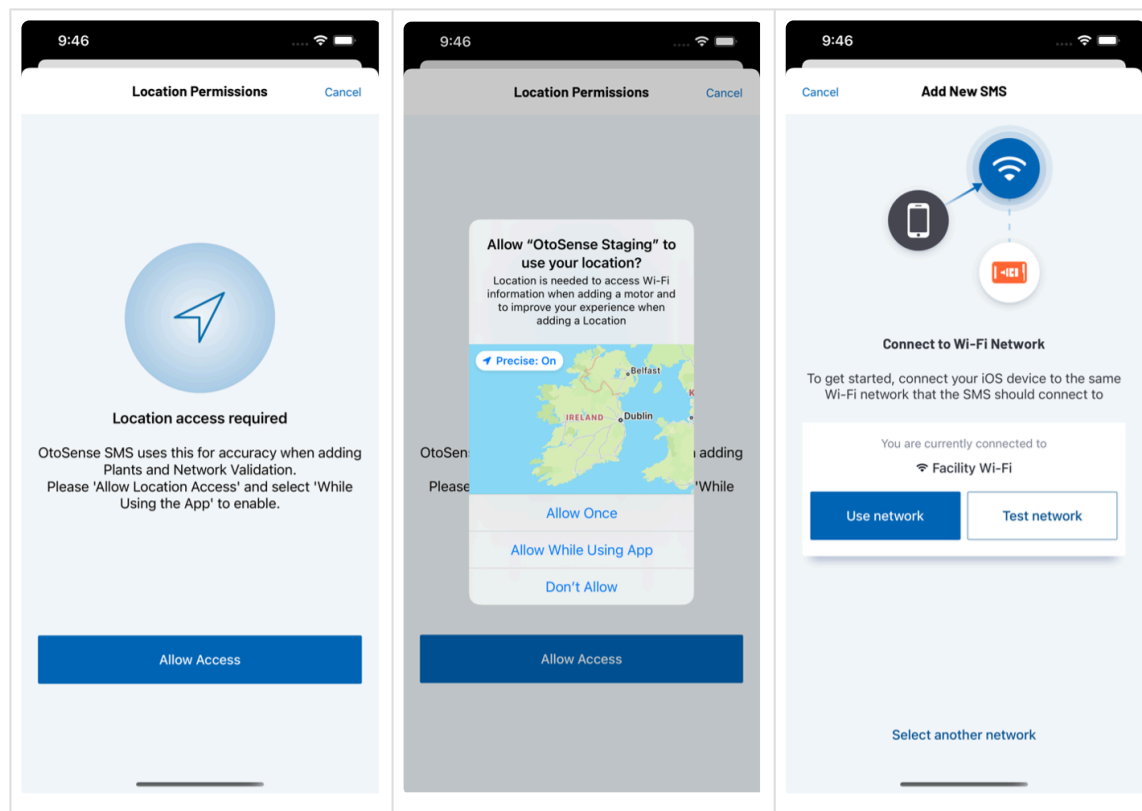
**Signal Strength indicator is only available in Android App*

- Go to the “Dashboard” or “Motors” tab on the bottom of the screen. If this is the very first time this account is being populated, tap on “Add new SMS device” to start commissioning your SMS device.

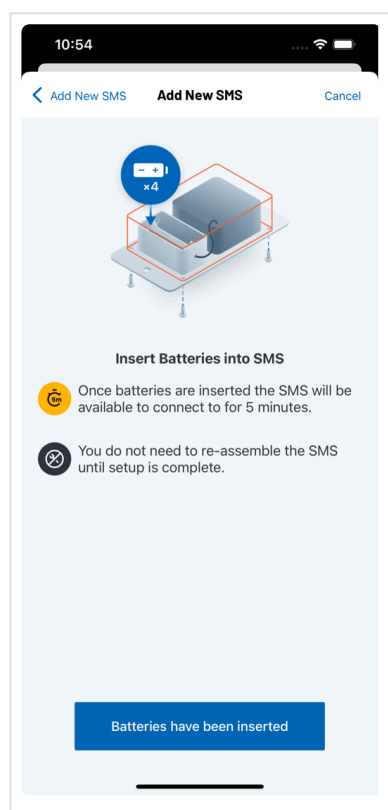


The app requires your location information in order to access Wi-Fi information. If it hasn't already been granted you will see a Location Permissions screen. Tap the “Allow Access” button. When the pop-up appears, tap the “Allow while using app” button.

The next screen will display the current Wi-Fi network the iPhone is connected to. Take a moment to verify that this is a working network. You can also test the network at this point again. Once you are happy with this information, tap the “Use network” button.

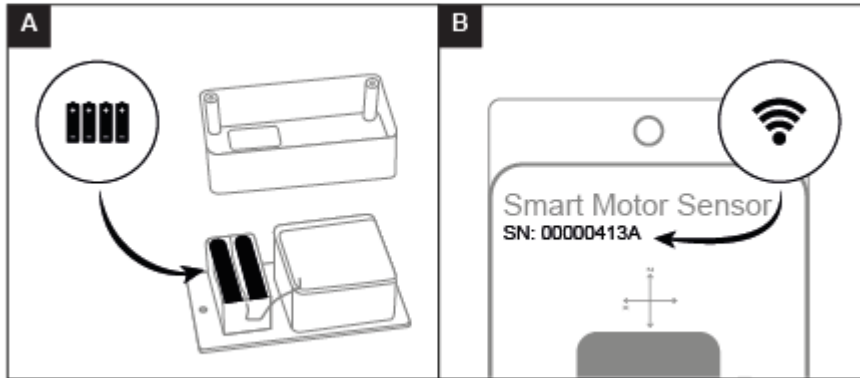


- Insert the batteries in the device. It will generate a Wi-Fi network with the same numbering as the device, for example: SMS00000413A.

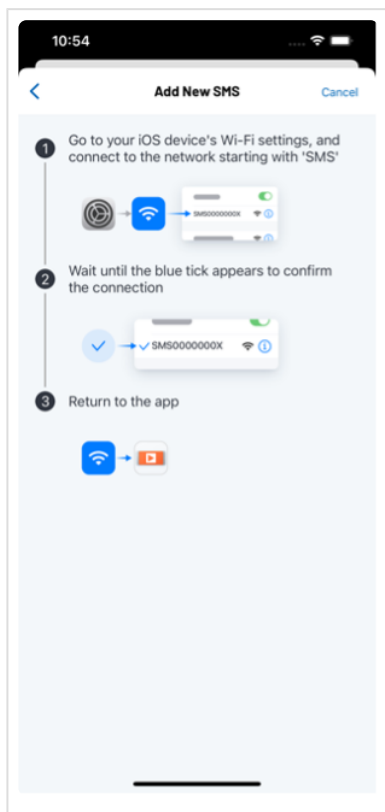


Note: The device must be configured within 5 minutes because the network cannot remain active any longer.

- a. If the client's plant connection is not enabled for any reason (client AP turned off, SSID/Wi-Fi network name or password changed, etc.) after the five minutes have elapsed, remove the batteries from the device so that you don't drain them (after five minutes, the device will work in a more consuming mode). Make sure the plant's Internet connection is in a working state before you re-insert the batteries and try the connection process again.
- b. If for any reason you didn't succeed in provisioning the device within the 5-minute timeframe, remove the batteries, wait for roughly 20 seconds, re-insert the batteries and start the process again.

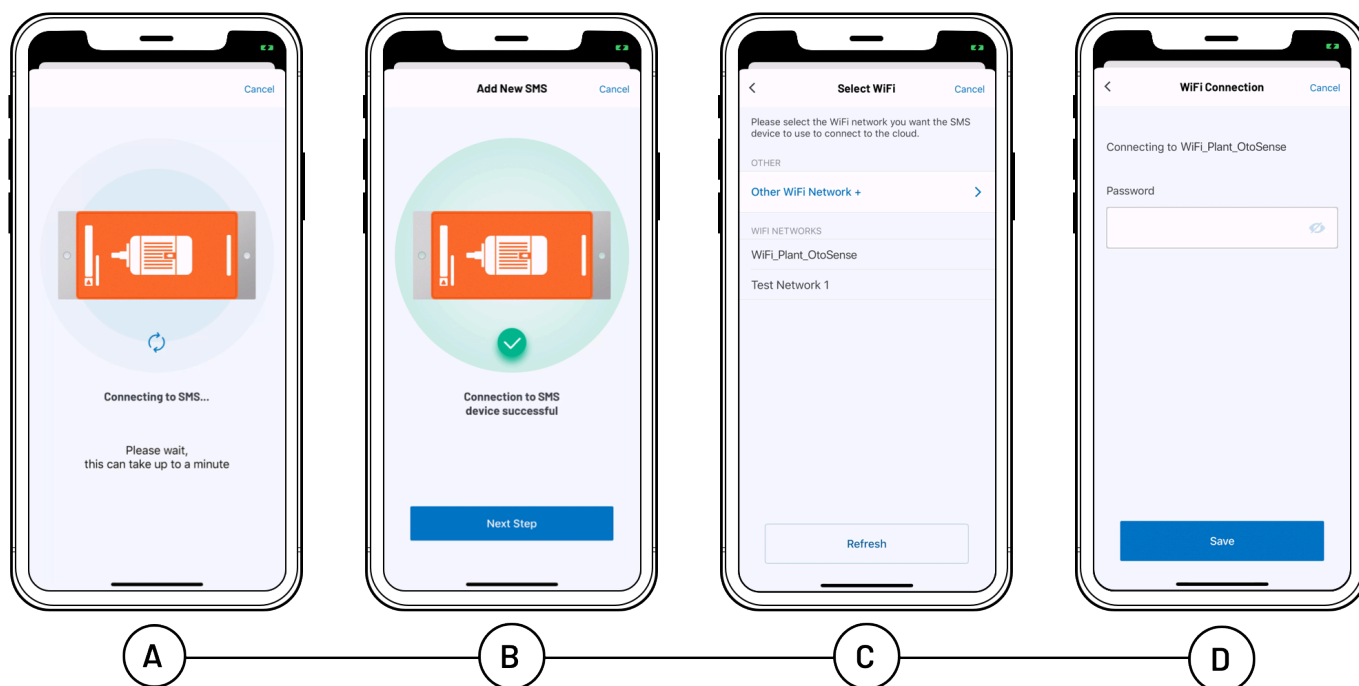


- Access your smartphone's Wi-Fi settings and connect to the Wi-Fi network whose name starts with 'SMS'. Wait until the blue tick appears to confirm that the connection with the SMS has been established. Then, return to the ADI OtoSense SMS app.

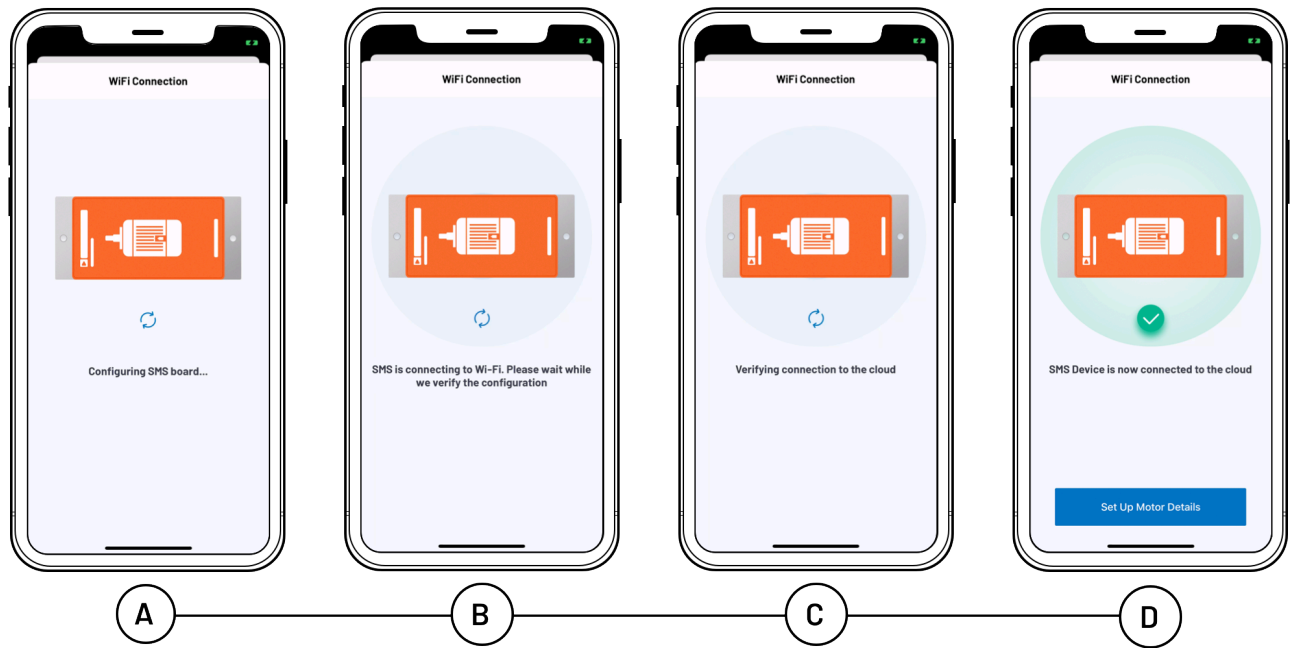


- Once connected, tap 'Next Step.' The list of available Wi-Fi networks will appear. Select the appropriate option, enter the password and tap Save.

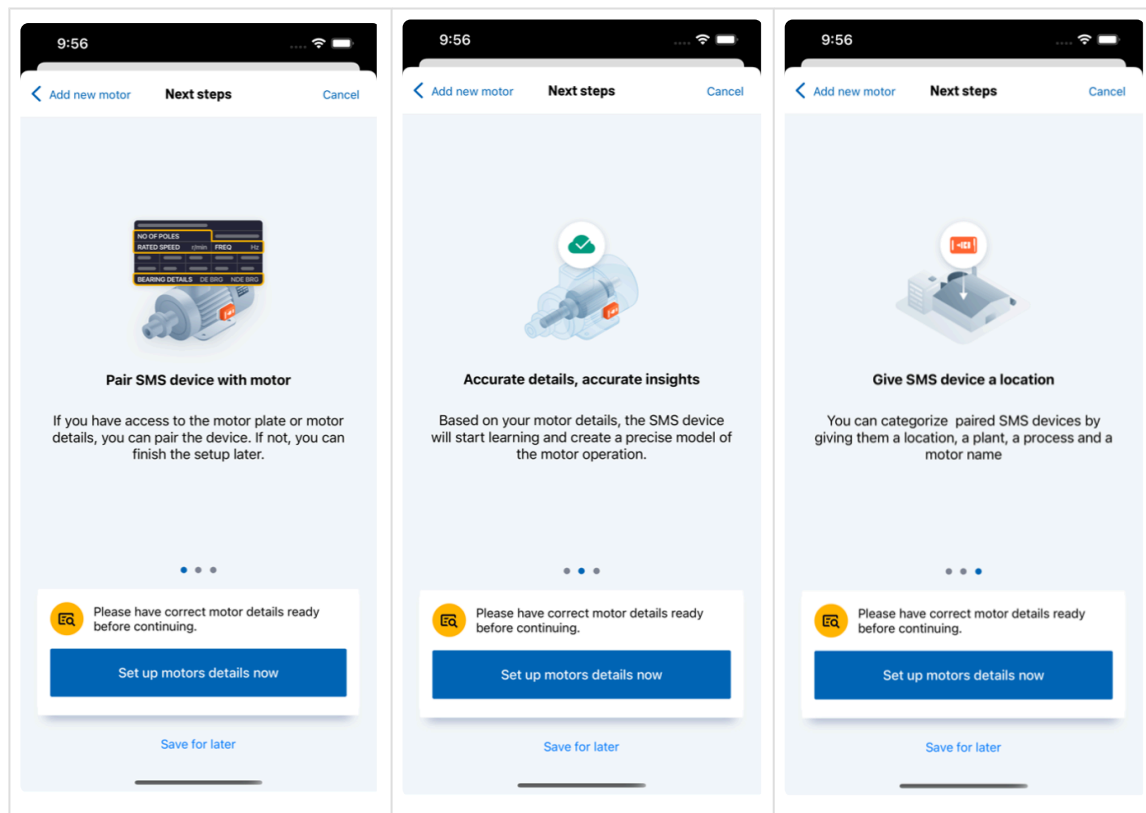
* Note: Only password-protected Wi-Fi networks can be used.
When using iOS, if it takes more than 90 sec for the connection to be established, you may see a pop up message asking you if you want to use Cellular data instead of Wi-Fi: select “Keep Trying Wi-Fi”.



- Once SMS is connected to the cloud via Wi-Fi, tap 'Set up Motor Details'.



- Next you will start entering details for the motor you wish to attach the SMS device to. You can continue creating the motor at this point by tapping the “Set up motor details now” or tap the “Save for later” button to come back to this step at a later point.



- Fill in the motor's details. Start by adding a photo of the motor and its nameplate.

- Fill in the motor data
- Motor name (TAG): Identification of the motor
- Manufacturer: Enter manually if it does not appear on the list
- Rated Power (kW)
- Rated Voltage (V)
- Number of Poles
- Frequency (Hz)
- Connection
- Drive
- Efficiency level
- Model



Note: The ADI OtoSense SMS application features some pre-filled data. Tap the relevant field to change the information, if needed.



IMPORTANT: Bearing models are required to identify potential problems!

If you don't enter the Motor Bearing Model Part Number, the SMS algorithm will just default the Bearing info to an Index of Ten, or *good all of the time*. Hence the algorithm will not really learn the bearing harmonic signatures for that motor.

If the Bearing diagnostic is important to you:

- Enter the Motor Bearing Model Part Number, which is typically a **four digit Industry Standard Number** for LV, for example: 6321.
- do not leave Bearing part number field Blank

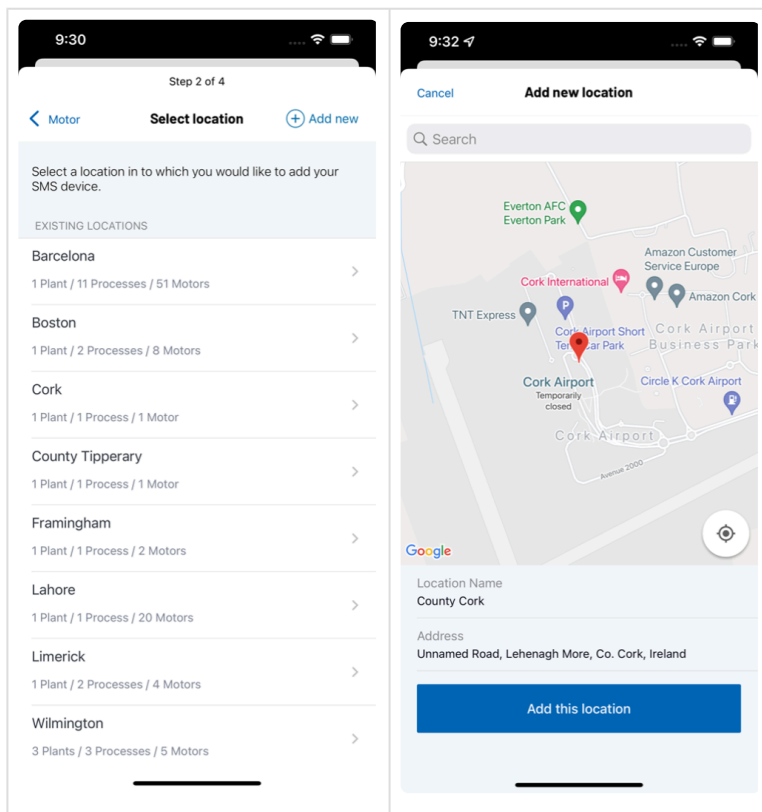
- do not type in a word (e.g. UNKNOWN or MISSING)
- do not enter a single digit
- do not add variable letters at the end of number string e.g. 6313ZZ
- do not enter Numbers with forward slashes e.g. 6321/56C

A list with all the motor data is displayed. Confirm or edit as required.

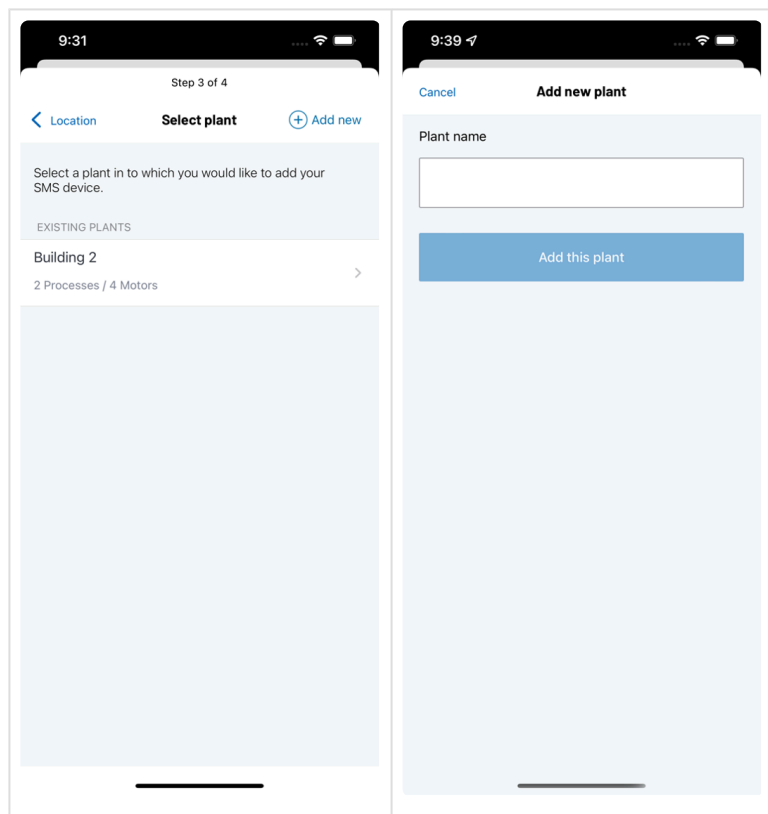
To help you fill this information and see the correspondance between IEC frames and NEMA frames, check the section [How to read a motor plate](#).

- You will now be prompted to add several tags to the Motor Details; Location, Plant and Process.

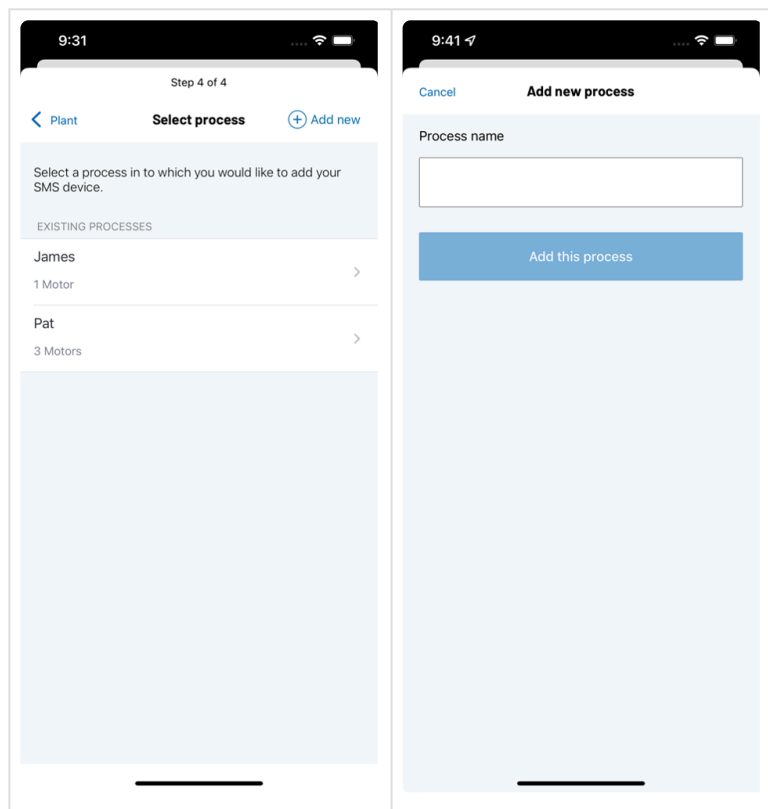
You can select a Location that has previously been added. If it's the first time you have added a motor and there are no existing Locations, you will be prompted with a screen to select a Location. Subsequently, if you wish to add a new Location that doesn't already exist, tap on the "Add New" button in the top right of the screen to access this Add new location screen.



You can select a Plant that has previously been added. If it's the first time you have added a motor and there are no existing Plants, you will be prompted with a screen to select a Plant. Subsequently, if you wish to add a new Plant that doesn't already exist, tap on the "Add New" button in the top right of the screen to access this Add new plant screen.

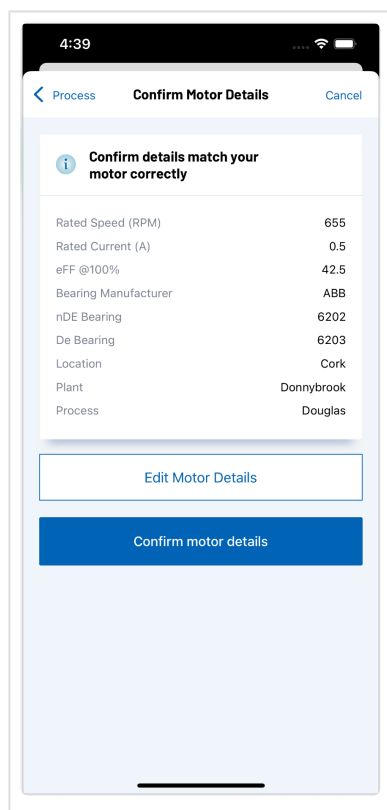


You can select a Process that has previously been added. If it's the first time you have added a motor and there are no existing Processes, you will be prompted with a screen to select a Process. Subsequently, if you wish to add a new Process that doesn't already exist, tap on the "Add New" button in the top right of the screen to access this Add new process screen.



Once you are happy with all details you will be presented with a screen that list subsequent motor details. If you are happy to proceed tap the "Confirm motor details" button. If for any reason the details

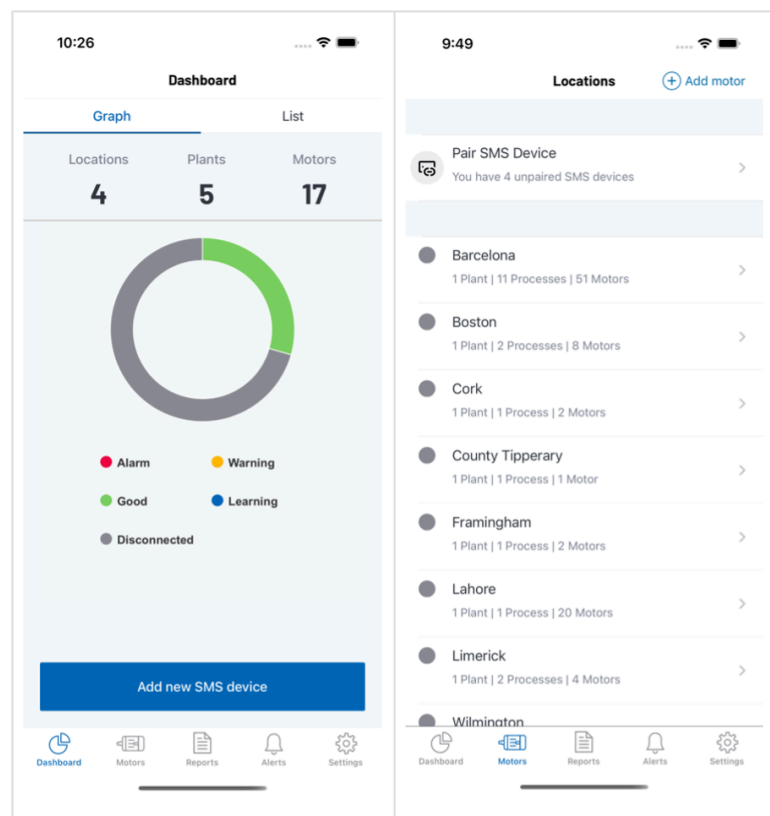
presented are incorrect then tap the “Edit motor details” button.



- Adding another motor

Once you have added your first motor the app will update the Dashboard and Motors tabs.

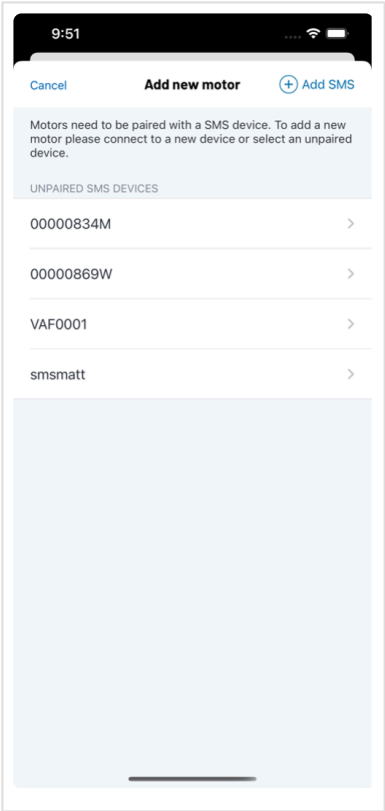
To add a new Motor you can tap the “Add new SMS device” from the Dashboard tab or tap the “Add Motor” button in the top right of the navigation on the Motors tab.



If you have previously commissioned an SMS device but haven't entered in the Motors details you will see a "Pair SMS Device" section in the Motors tab at the top of the screen.

Tapping Add new SMS device from the Dashboard tab or the Pair SMS Device from the Motors tab will bring you to an Unpaired SMS Devices screen.

Here you will find a list of unpaired SMS devices that have no motor associated with them. If you wish to add a motor from here, tap one of the unpaired devices in the list. This will start the motor creation process covered above.



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1.2.5. Fixing the device to the motor

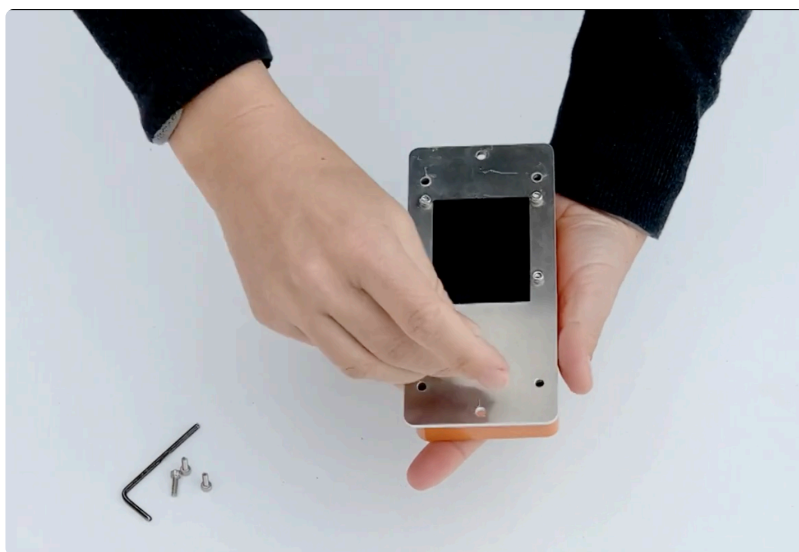
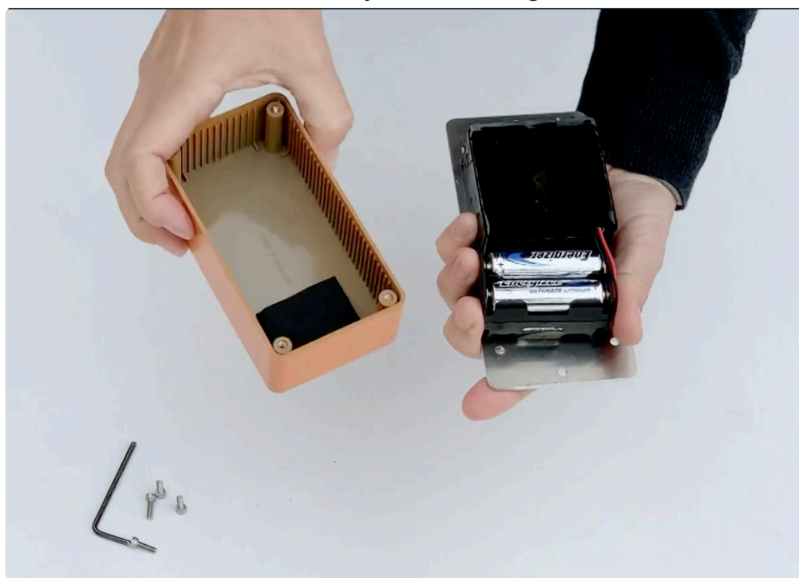
* We recommend you wear gloves when using Epoxy as it's a very strong adhesive!

Most of the time, there are cooling ribs in the frame of the motor, and you will use clamps to fix the SMS to the motor. For motors whose housing does not have cooling ribs, contact your ADI Sales representative to purchase a specially designed base for the installation of the SMS.

If you are using clamps to fix the SMS to the motor:

[See tutorial video](#)

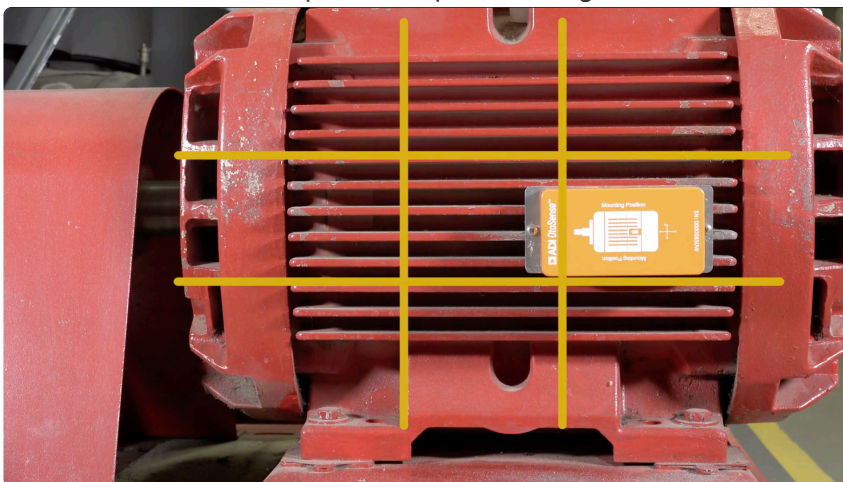
- 1. Make sure the batteries are installed in the device and put the case back on, verify that the foam area covers the battery holder – Fig 2.



- 2. Screw the fixing clamps on the base of the device. Make sure they do not exceed beyond the edge of the SMS. Don't completely tighten at this time – Fig. 3.



- 3. Place the device in the back-center area, as shown in the sketch on the SMS case (respect these indications whether the motor is in a vertical or horizontal position) and mark with a pen on the fins where the clamps will be placed – Fig.1.





- 4. Next, sand the surface where the device will be fitted to remove the paint. This surface preparation will improve adhesion – Fig. 4.

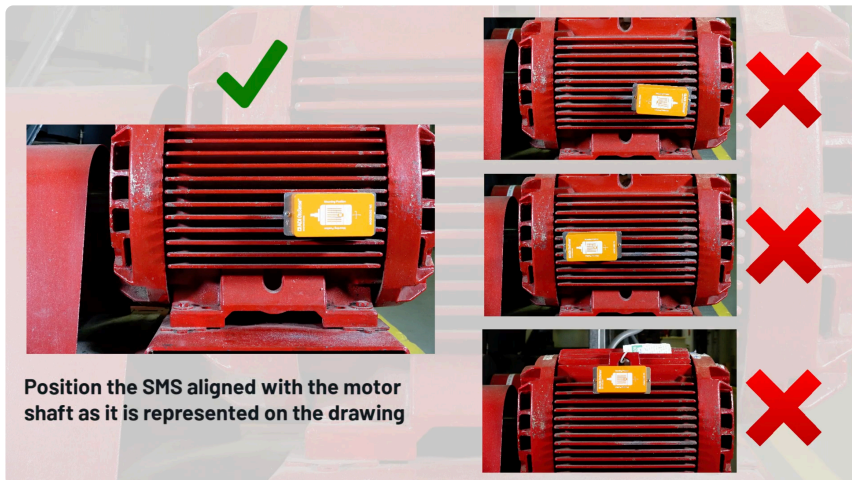


- 5. Make the mixture of the bi-component adhesive on a piece of cardboard. Place adhesive on both sides of the cooling fin in the sanded area where the clamps are to be placed – Fig. 5.





- 6. Place the device on the cooling fins using the fixing clamps. Please take note of the orientation of the device with respect to the motor as indicated on the case – Fig. 6



- 7. Tighten the screws on top of the clamps using an Allen Wrench. Using a Philips screwdriver finish tightening the screws to secure the SMS to the clamps.



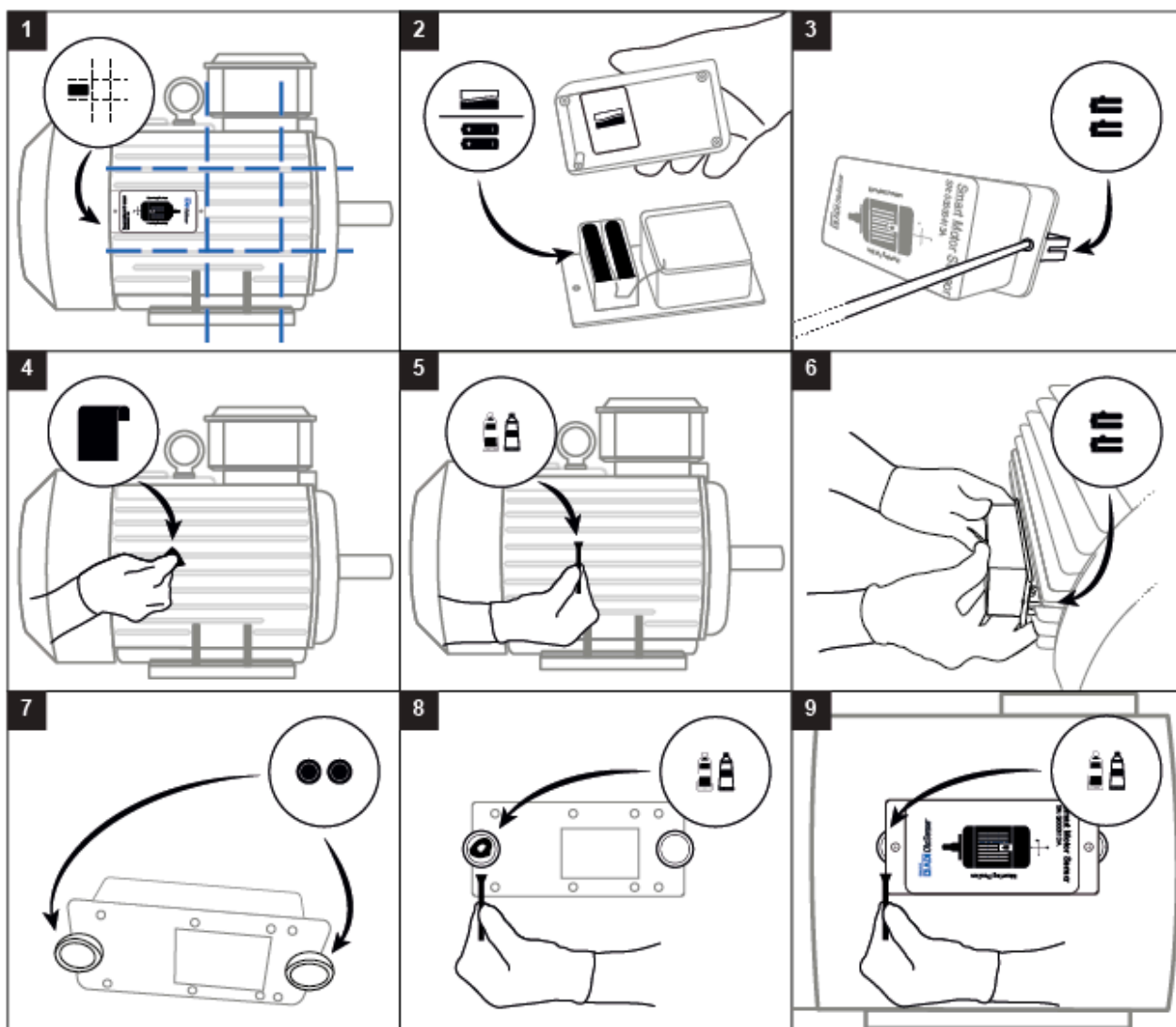
If your motor doesn't have cooling fins

1. You will need to use a magnetic base – Fig. 7.
2. Screw the magnetic base to the base of the device.
3. Place the device in the back-center area, as shown in the sketch on the SMS case (respect these indications whether the motor is in a vertical or horizontal position) and mark with a pen where

magnetic base will be placed – Fig.1.

4. Next, sand the surface where the device will be fitted to remove the paint. This surface preparation will improve adhesion – Fig. 4.
5. Mix the bi-component adhesive mixture and apply it to the magnetic base – Fig. 8
6. Fix the device using the magnetic bases with the bi-component adhesive to the motor housing.

✿ Note: The adhesive is required in addition to the magnetic base.



Dos and don'ts



Correct installation of the SMS. Note that depending on the size of the motor, the SMS will take up more more surface than what is shown in the sketch on the SMS case.



Device is not placed in the back-center area



Device is not placed in the back area (in regards with the shaft of the motor)



Device is not parallel with the cooling fins and it is laterally-inverted, in relation to the motor shaft. The motor shaft in the sketch must point in the same direction as the real motor shaft.

Revision: 28 — Last modified: 18 June 2021

1.2.6. Checking device connection

Once the device is installed and configured (Wi-Fi Network – Factory/Plant), the device starts sending data to the cloud server.

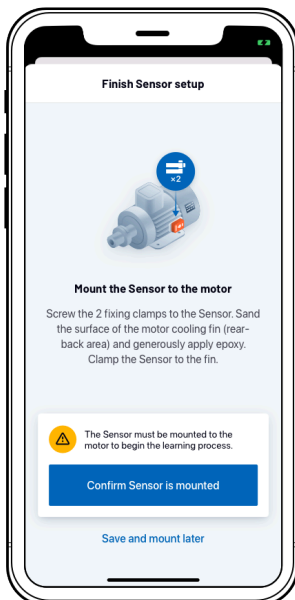
You can log into the dashboard and check that the device is visible in a learning mode (it is displayed in blue on the dashboard).

You can also check that the device is correctly sending data to the server by watching the plots of the different sensing modalities collected. To do so, search and select the right motor on the Web application, choose the tab **History Plot**, then the sub-tab **Parameters**. Select any parameter and the date and time corresponding to the moment of the installation: you should see the corresponding waveform.

Revision: 3 — Last modified: 8 June 2021

1.2.7. Learning Process

ADI OtoSense SMS requires a learning process about the operation of the motor to create a motor model that will 'learn' to predict motor component faults. This learning process comprises of 3 stages: Quick Learning (approximately 7 days), Predictive Learning (approximately 4 weeks) and Fully Predictive (ongoing). During this process, we recommend that the motor should run at all RPMs, temperatures and with all loads that will apply in a typical operation, if possible, to create the best model. While commissioning the device by using the mobile app, you are guided to mount the device on the motor and confirm when this is done so that the learning process starts and can collect motor data from the beginning. If for any reason, the device is not mounted on the motor at the time of installation, you will be able to choose the option: 'Save and mount later'. The learning will begin when you confirm that this has been completed on the mobile app.



You can view the 3 stages of the learning process either on the web or mobile app and know which stage you are currently on:

1. Quick Learning

Smart Motor Sensor requires approximately 7 days to create an initial model of how the motor operates in its unique environment*.

Smart Motor Sensor will not predict faults during this stage.



*Smart Motor Sensor only learns when the motor is in operation, and the Sensor is within proximity of a stable Wi-Fi connection.

2. Predictive Learning

After Quick Learning, Smart Motor Sensor will predict faults, while simultaneously learning for an extended period**. This stage enables improved predictions for all detectable fault types.

During this stage, faults will be predicted within the parameters of the motor conditions that Smart Motor Sensor observed during Quick Learning. The motor model will continue to improve based on learnings from any changes to operational conditions.

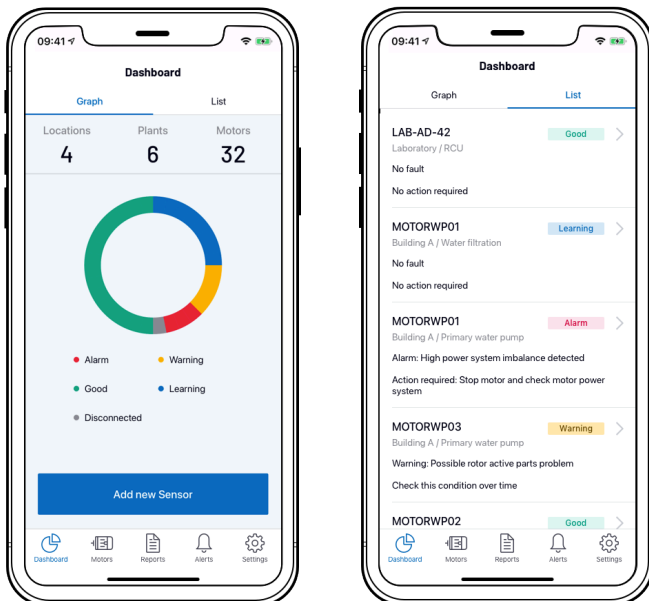


**Optimization can take anywhere from 4-6 weeks+, depending on motor uptime.

3. Fully Predictive

When Fully Predictive, Smart Motor Sensor is capable of detecting faults across all conditions observed throughout the Predictive Learning stage.

During the Quick Learning stage, the status indicator on both the mobile and web application will remain blue with a Learning badge. During the Predictive Learning stage, the status indicator on both the mobile and web application will show the motor status.



ADI OtoSense SMS can notify you about the progress through the learning stages with an email and a push notification in the mobile app once you have opted for these options in the Notification settings screen. From the second stage 'Predictive Learning', the device can learn and detect faults, and the traffic lights will indicate the motor status.

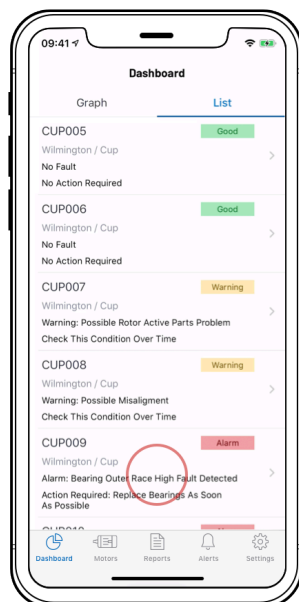


When different RPMs, ambient temperatures and loads that initially learned are detected during normal motor operation, ADI OtoSense SMS detects this and raises a performance alarm. Please contact your ADI account manager or our support team Support.PdM.Otosense@analog.com if you need assistance.

Revision: 16 — Last modified: 4 March 2022

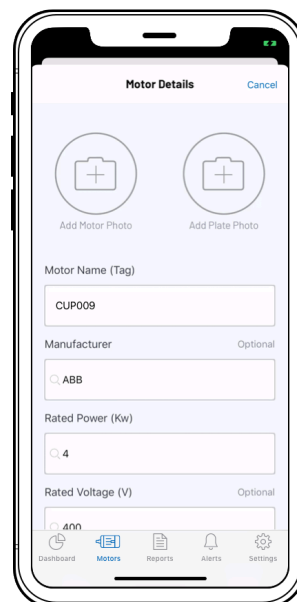
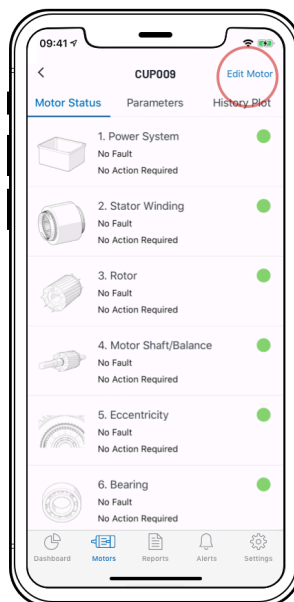
1.2.8. Repairing / replacing a motor

If the motor (or any of its parts) is repaired, or needs to be replaced, the new part or motor's details need to be updated in the mobile app. Tap 'Edit' to update the necessary fields.



Physical step:

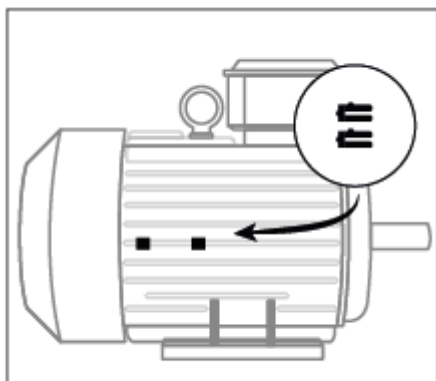
In this example, replace bearings as soon as possible for CUP009.



Request a new set of fixing clamps from your ADI Sales representative if a new motor is installed.

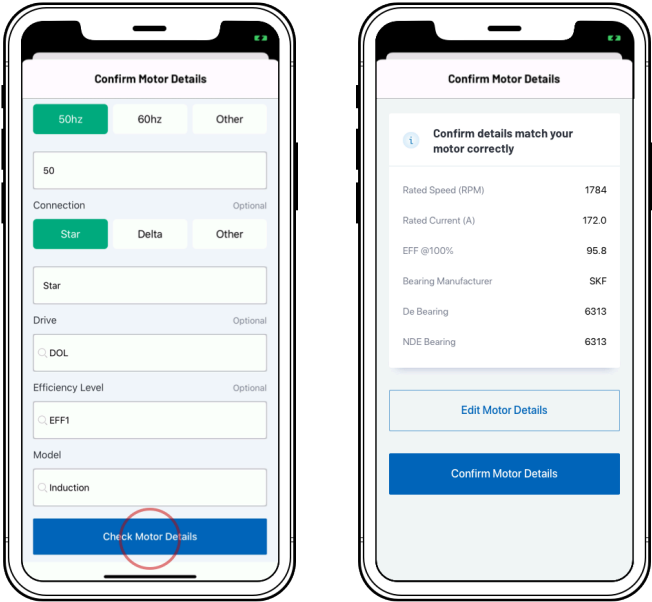


Note: It is not necessary to replace the fixing clamps in case of repair work.



Once the new or repaired motor is running again, confirm the details in the 'Parameters' screen.

! Important: A new learning process is necessary in both cases.

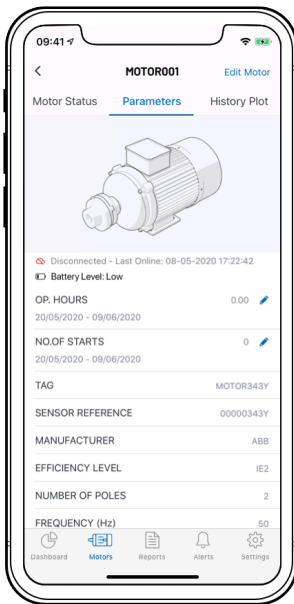


Revision: 7 — Last modified: 23 July 2020

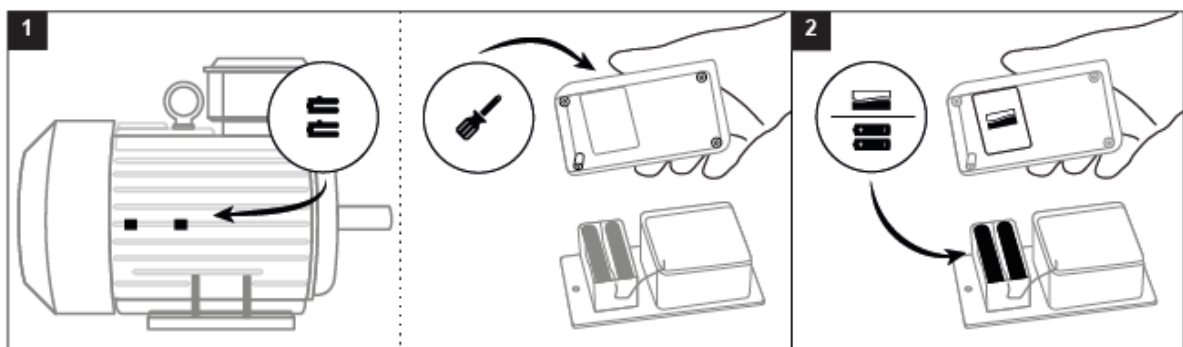
1.2.9. Replacing the batteries

The Parameters screen, both in the mobile and web applications, displays the battery status. The device will send an email and create a push notification in the mobile app in a low-battery situation.

A low-battery status means that the batteries will need to be replaced shortly. Replace the batteries before they become fully depleted. The SMS requires four lithium batteries with an output of 3000 mAh. We recommend Energizer L91 lithium AA batteries.

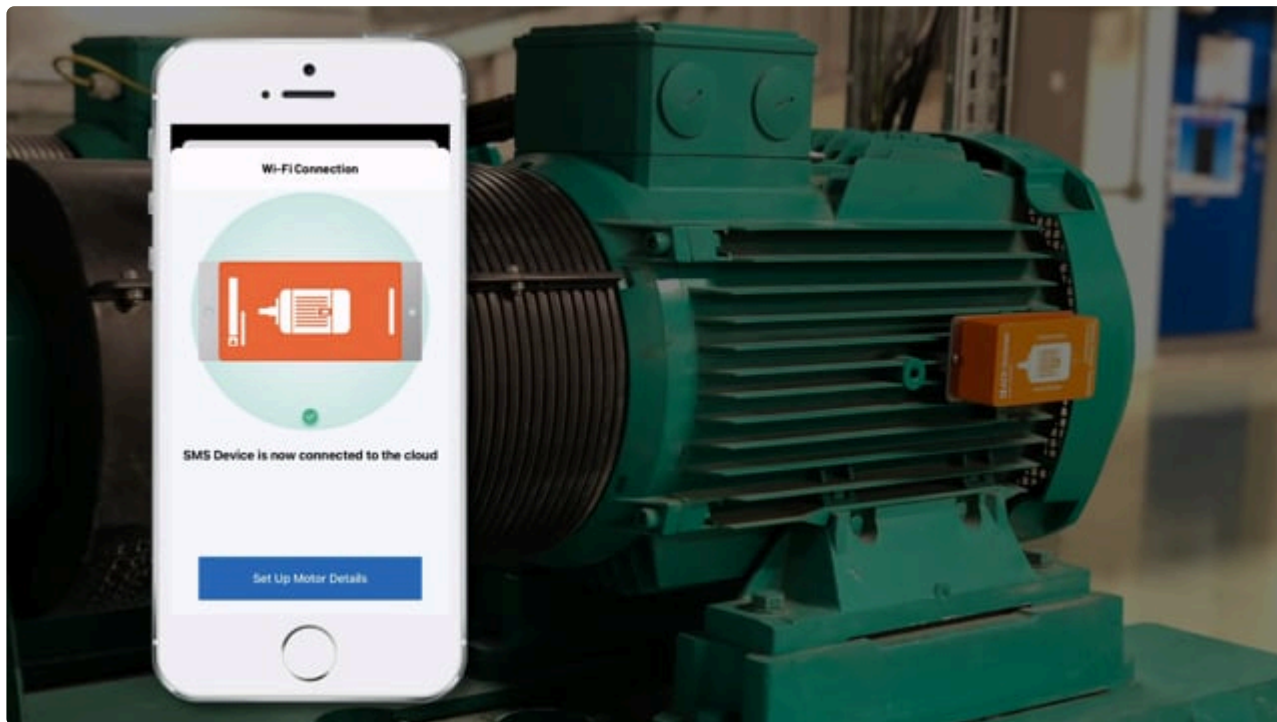


1. To replace the batteries, remove the SMS from the fixing clamps and then remove the device's case.
2. Insert the new batteries and replace the case, ensuring that the foam area covers the batteries. Replacing the batteries does not require any further action or learning process.



1.3. Tutorial Videos

How to commission your Smart Motor Sensor



<https://player.vimeo.com/video/551961335>

<https://player.vimeo.com/video/551961335>

How to install a Smart Motor Sensor on a motor



<https://player.vimeo.com/video/564696194>

Revision: 3 — Last modified: 18 June 2021

2. OtoSense SMS Web User Guide

About this guide

The ADI OtoSense Web Application User's Guide describes the features, components, and functionality of the ADI OtoSense web application.

ADI OtoSense is a browser-based application to monitor the status of motors fitted with Smart Motor Sensor (SMS) devices, which transmit real-time data about the motors' operating condition to the OtoSense Cloud Server. Operators can monitor this data through the ADI OtoSense application's web-based interface.

ADI OtoSense is the central monitoring point for motors equipped with SMS devices.

Intended audience

This guide is intended for all users of the ADI OtoSense web application.

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Revision: 14 — Last modified: 21 July 2020

2.1. Accessing the application for the first time

Before you can begin working with the ADI OtoSense web application, you must be added to the list of authorized users and receive an invitation email. Check with your ADI representative about this process.

The invitation email contains a *Click here to get started* link that launches the ADI OtoSense login screen.

To login to the ADI OtoSense environment:

1. Enter the email address to which the invitation email was sent. If this is the first time you access the ADI OtoSense web application, you will need to create a password.
2. Click Login.



ADI OtoSense™
SMART MOTOR SENSOR

Email Email is required

Password Password is required

LOGIN

[Forgot your password?](#)

ANALOG
DEVICES
AHEAD OF WHAT'S POSSIBLE™
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Figure 1. ADI OtoSense SMS Login Screen

Revision: 3 — Last modified: 14 July 2020

2.2. Navigating the application

ADI OtoSense web application is a browser-based interface used to manage your network of SMS devices.

The interface has the following components:

- [Dashboard](#)
- [Map](#)
- [Reports](#)
- [FAQ](#)
- [Documents](#)
- [Alerts](#)

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2.2.1. Dashboard

The **Dashboard** (Figure 2) offers a general view of the application environment.

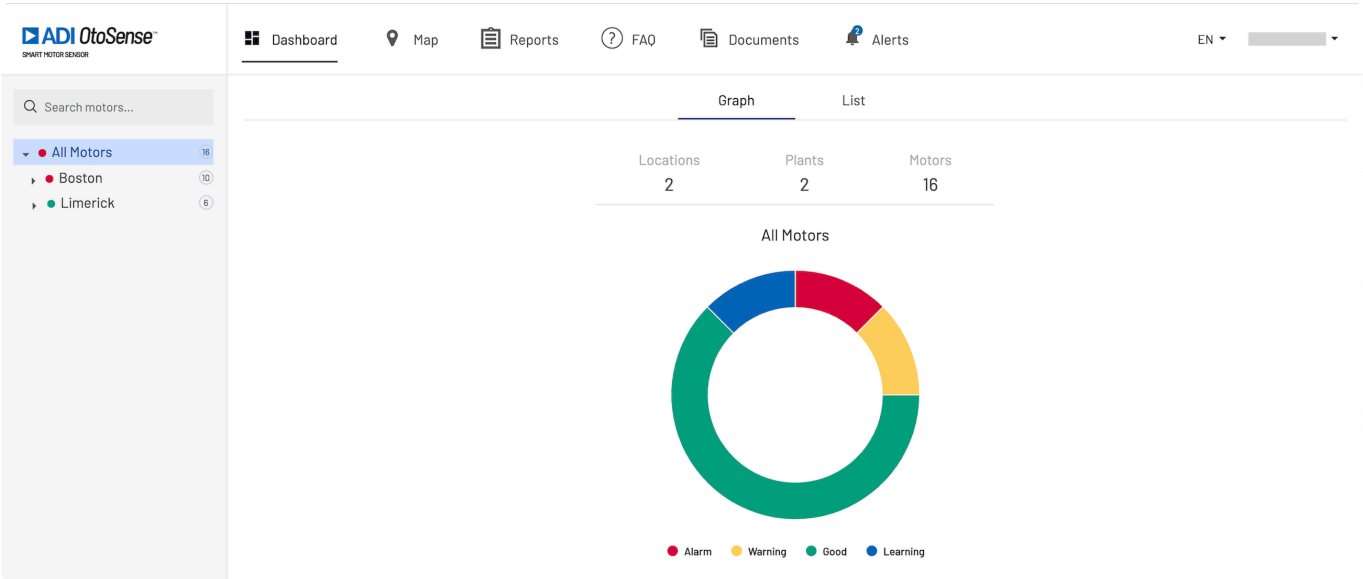


Figure 2. Dashboard – General View

The Dashboard includes a **Search Bar** (Figure 1a) and a **collapsible menu** (Figure 1b) that contains a list of all the motors currently being monitored by SMS devices, including city, plant name, process and motor name.

Use the Search Bar to quickly navigate to any of the motors you want to visualize, or start typing for a list of matches.

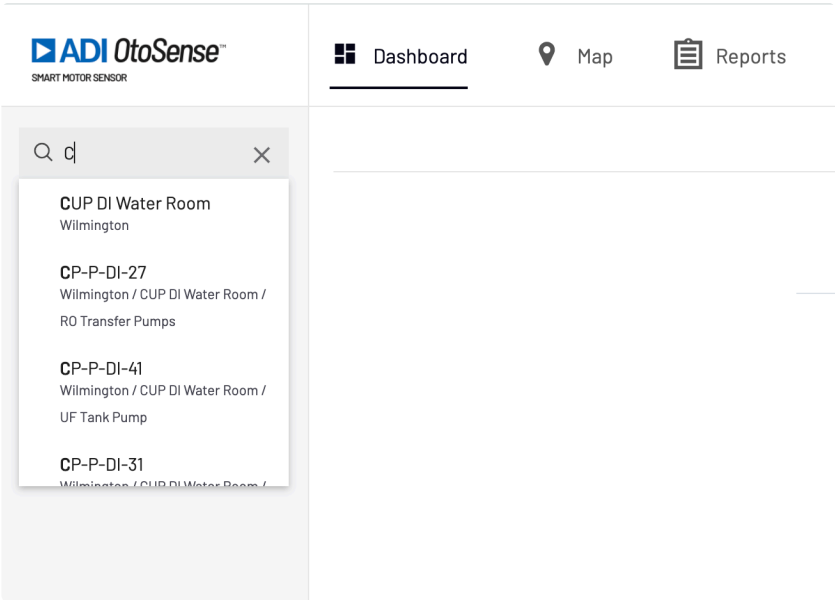


Figure 1a. Dashboard Search bar

In the collapsible menu, the numerical indicator to the right displays the number of motors being monitored at each level of locations, while the colored dots displays the most relevant status information.

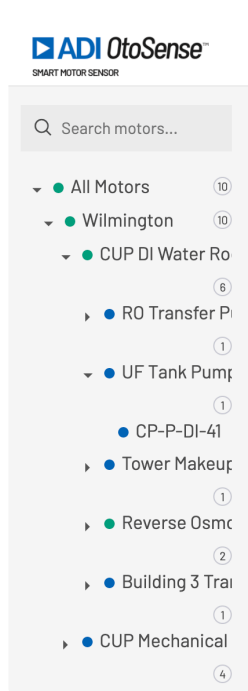


Figure 1b. Collapsible menu

ADI OtoSense uses a color-coded system for information and fault indication:

- Green if no faults have been detected
- Yellow if the SMS device predicts that a fault might occur soon
- Blue if the SMS device is currently performing a learning process
- Red if a fault has been detected on any of the motors installed in that location
- Gray if there is no communication with the device or if the battery is exhausted

The Dashboard presents a useful at-a-glance view in **Graph** or **List** (Figures 2a -2b) form so the operator can quickly navigate and visualize any problems detected and react accordingly, should an issue be flagged by the application.

Graph view offers a graphical depiction of the monitoring situation.

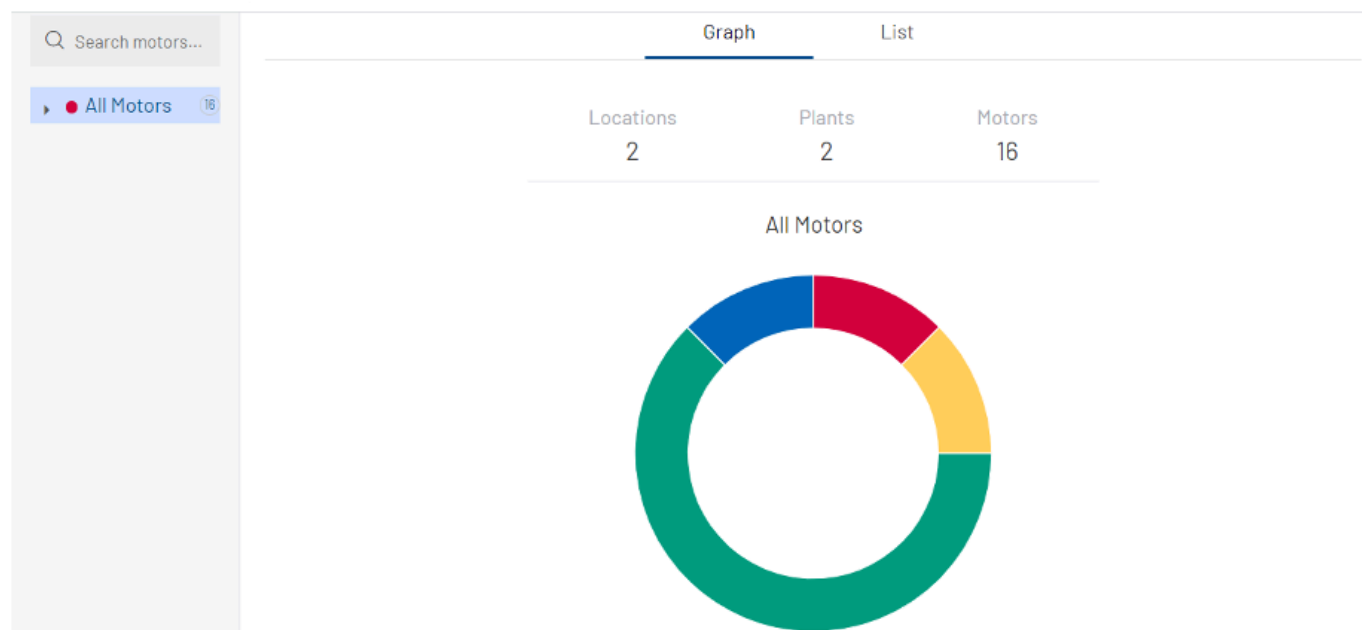


Figure 2a. Dashboard in Graph View

List view offers the same information, but in list form.

Note: Clicking any motor here will take you directly to that motor's information, see Figure 4 below. You can also search for any motors in your network using the provided Search Bar.

Dashboard
Map
FAQ
Alerts
EN
Fernando Sanchez

Search motors...
All Motors 16

Graph

List

Motor	Plant/Process	Status	Description	Action
CUP004	Wilmington/Cup	Good	No Fault	No Action Required
CUP009	Wilmington/Cup	Alarm	No Fault	No Action Required
CUP003	Wilmington/Cup	Good	No Fault	No Action Required
CUP010	Wilmington/Cup	Alarm	No Fault	No Action Required
CUP005	Wilmington/Cup	Good	No Fault	No Action Required

Figure 2b. Dashboard in List View

Note that you can sort the view according to several parameters: Motor, Plant/Process, Status, initial alarm, and repaired/recovered.

<div> <div>Dashboard</div> <div>Map</div> <div>Reports</div> <div>FAQ</div> <div>Documents</div> <div>Alerts</div> <div>EN vanessa raffin</div> </div>				
<div> <div>Graph</div> <div>List</div> </div>				
<div> <div>Search motors...</div> </div>				
Motor	Plant/Process	Status	Description	Action
CP-P-DI-27	CUP DI Water Room/RO Transfer Pumps	Learning	No Fault	No Action Required
CP-P-DI-41	CUP DI Water Room/UF Tank Pump	Learning	No Fault	No Action Required
CP-P-DI-31	CUP DI Water Room/Tower Makeup Water Feed	Learning	No Fault	No Action Required
CP-P-DI-01	CUP DI Water Room/Reverse Osmosis Pumps	Good	No Fault	No Action Required
CP-P-DI-02	CUP DI Water Room/Reverse Osmosis Pumps	Good	No Fault	No Action Required

Figure 2c. Dashboard in List View – filters

Click any of the locations to expand it and view the status of the motors installed at that location (Figure 3).

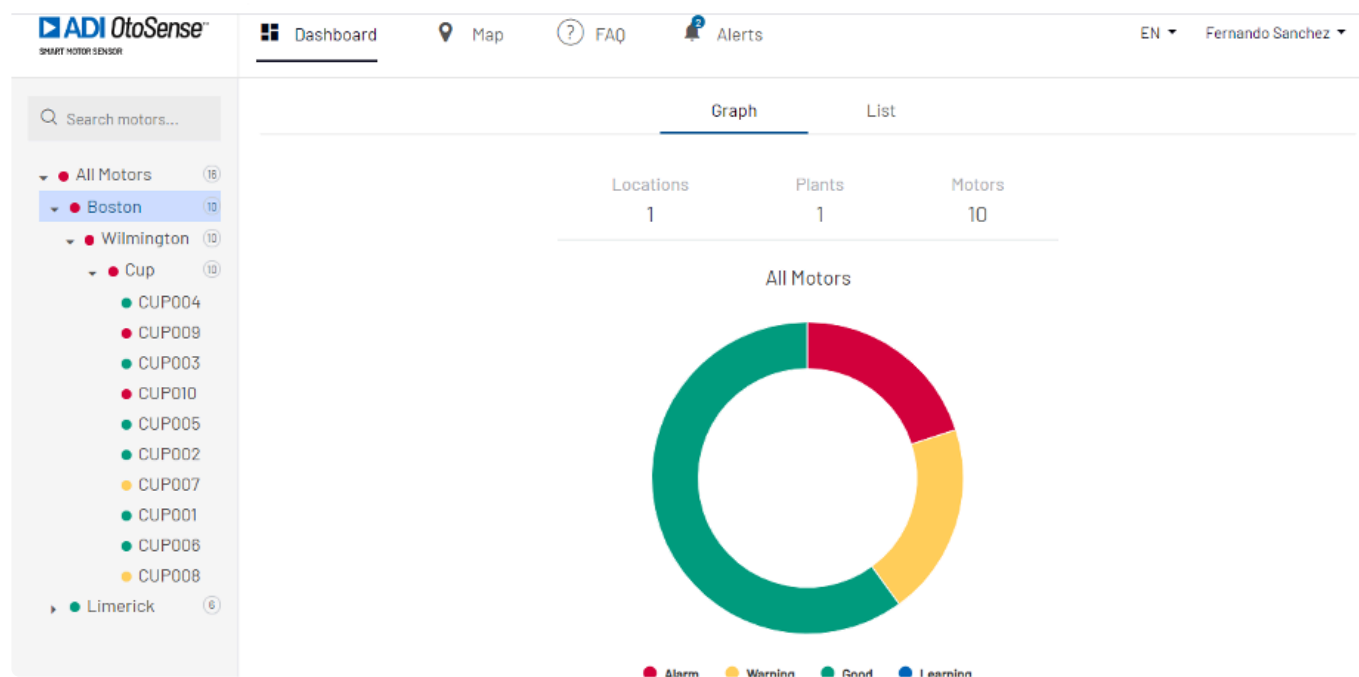


Figure 3. Expanded location view

Click any of the motors to view its operating parameters.

Here (Figure 4), we see that motor CUP009, located at a plant in Wilmington, Boston requires immediate attention as the bearings have failed.

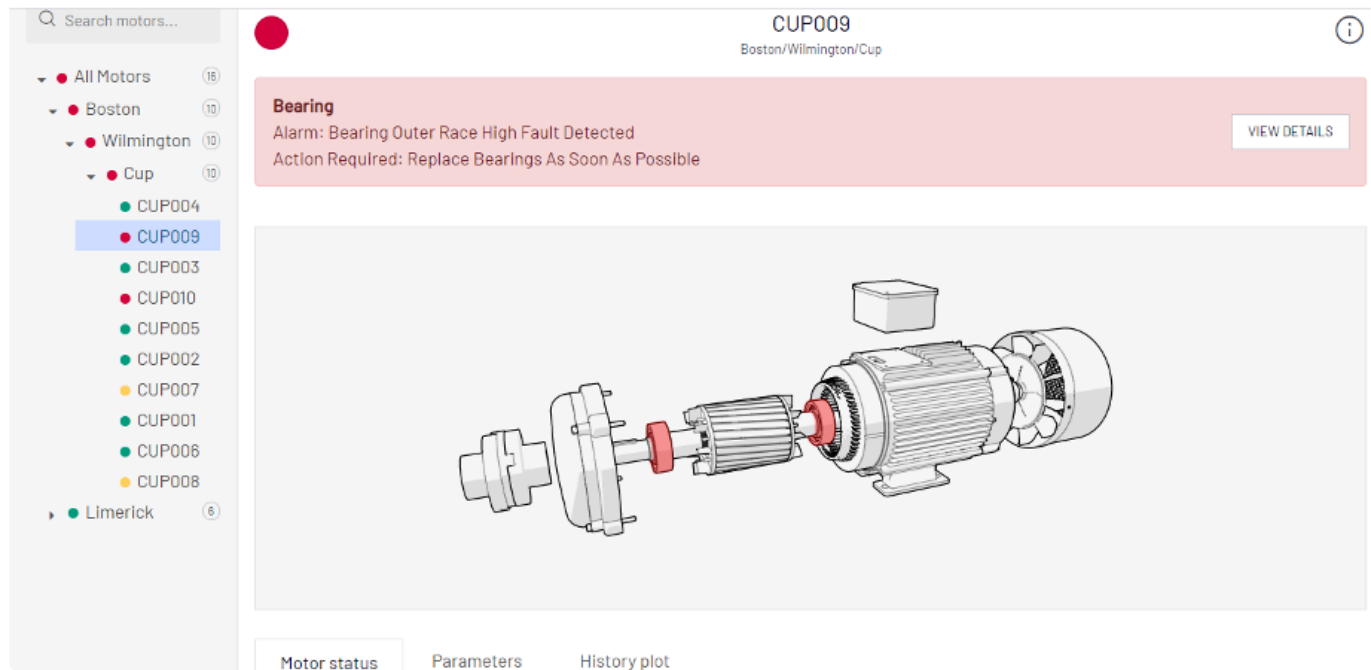


Figure 4 – Detailed motor view

This screen features three tabs for additional information about the motor (Figure 5).

- Motor Status
- Parameters
- History plot

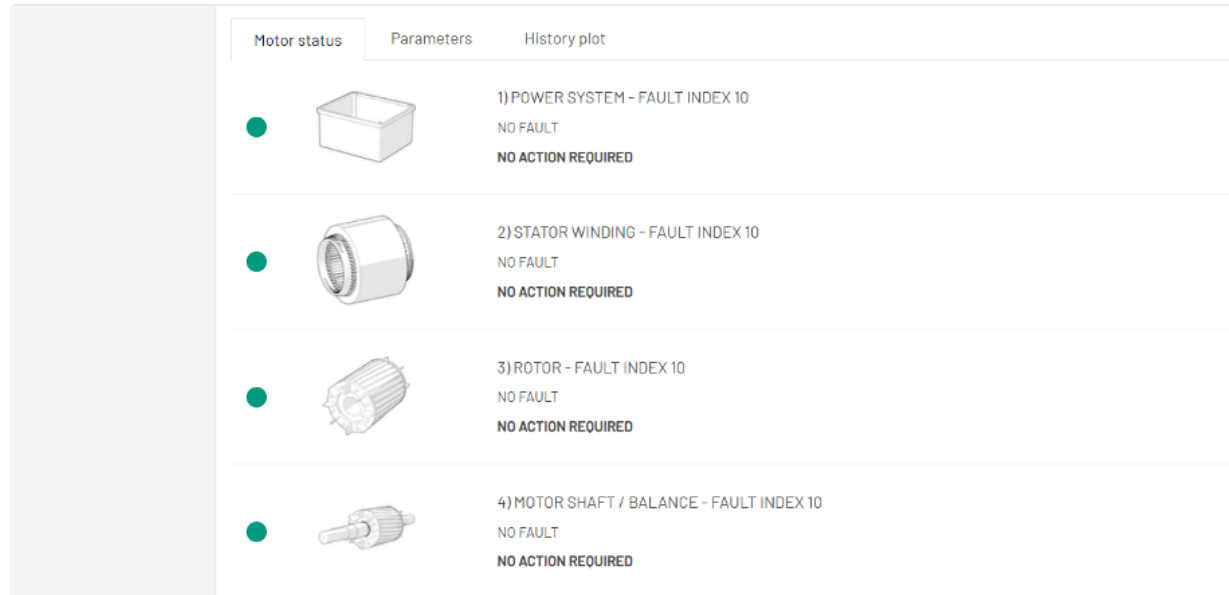


Figure 5 – Detailed motor information

Motor Status tab

The Motor Status tab displays the status of each component of the motor, including a light indicator to the left (green, yellow, or red), and whether or not a fault exists in that component.

Scroll down until you find the component that has failed – red (Figure 6) or the component that might require maintenance soon – yellow (Figure 7).

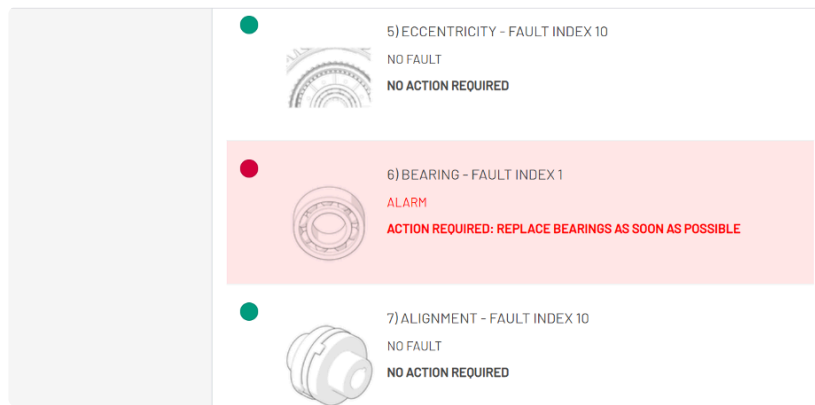


Figure 6. Failed component (red)

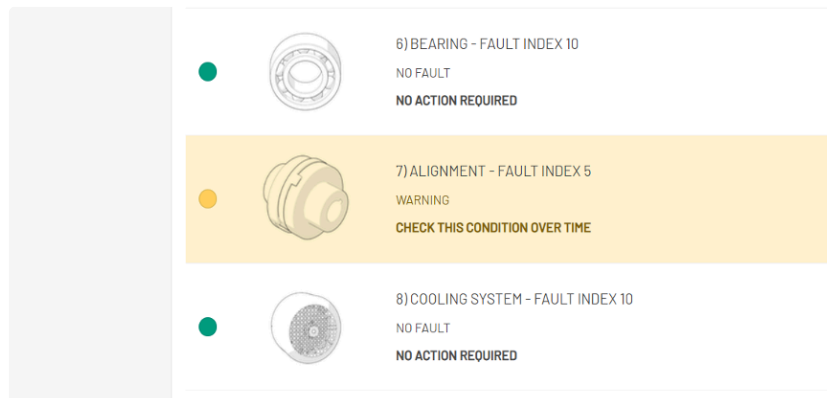


Figure 7. Component might require attention soon (yellow)

Note that the ADI OtoSense application suggests the precise course of action to take in both cases.

Parameters tab

The Parameters tab (Figure 8) offers comprehensive information about the motor, including its tag, model, rated power, and working parameters.

Motor status			Parameters			History plot		
BATTERY STATUS			CONNECTION STATUS					
			Connected					
OPERATION HOURS			NUMBER OF STARTS					
Jun 24, 2020 - Jul 14, 2020			Jun 24, 2020 - Jul 14, 2020					
260.37			122					
TAG		SENSOR REFERENCE		MANUFACTURER				
CP-P-DI-02		00000372C		Marathon Electric				
RATED POWER (KW)		NUMBER OF POLES		MODEL				
18.375		2		2VK 284TSTFN6001BD L				
EFFICIENCY LEVEL		RATED VOLTAGE (V)		RATED CURRENT (A)				
		460		28.1				
CONNECTION		DRIVE		FREQUENCY (HZ)				
Star		VFD		60				
RATED SPEED		EFF @ 100%		DE BEARING				
3560		98		311				
NDE BEARING		BEARING MANUFACTURER		DE BEARING #2				
210								
NDE BEARING #2		BEARING MANUFACTURER #2						

Figure 8 – Parameters tab

The Parameters tab offers additional monitoring options.

The **battery icon** shows the status of the batteries.

The **connection status** shows whether the SMS is correctly connected to the cloud.

Click the **calendar icon** next to Operating Hours and Number of Starts (Figures 9-10) to display a daily, weekly, or monthly range when the motor has been operating or how many times has the motor been started, respectively.

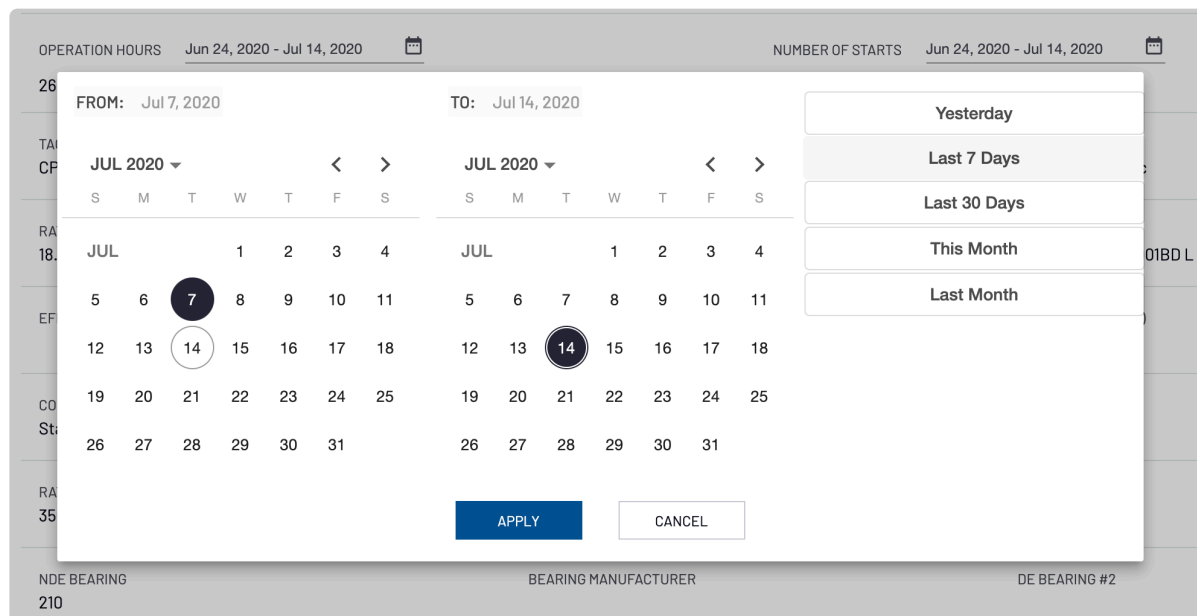


Figure 9 – Creating a date range

Click **Apply** to display the customized view.

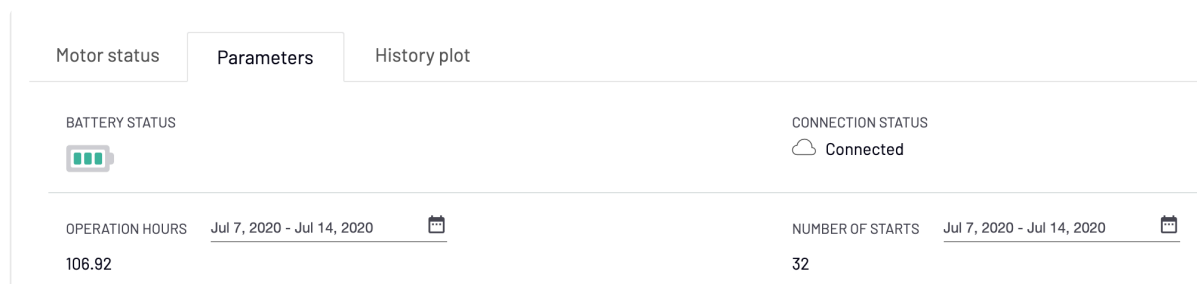


Figure 10 – Operating hours and number of starts

History Plot tab

Maintenance personnel will find it useful to visualize the historical pattern of a particular function (vibration, magnetic fields, etc.) within the motor, to determine whether or not problems might occur.

The History Plot tab includes three sub-tabs (Figure 11a):

- Parameters

- Performance
- Health

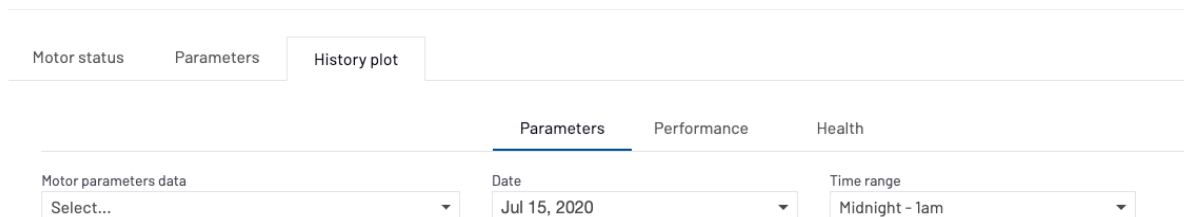


Figure 11a. History plot sub-tabs

Parameters sub-tab

In this sub-tab, you can plot raw data of vibration in X and Z axes (acceleration [m/s^2] and magnetic field in two different ways.

- time domain (sec) (WAVEFORM)
- frequency domain (hertz)(FFT).

SMS collects a sample of 2.5 sec of data every 20 min (the horizontal axis shows these 2.5 sec), so you will find three sets of data to display over a one-hour time range.

You can switch from one sample to the other by clicking on the different times the data was collected, below the horizontal axis.

● 00:17:53 ◆ 00:38:17 ■ 00:58:44

Select the Motor Parameters Data that you want to check the historical data for and a date and time range. The selected range will be displayed in graphic form (Figure 11b – Parameters sub-tab).

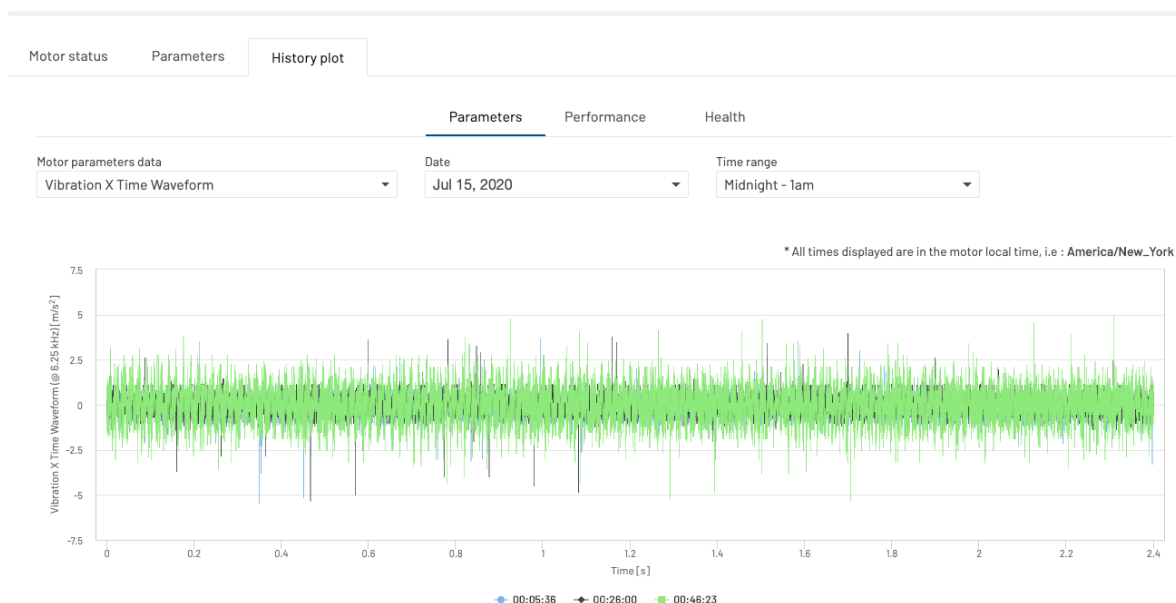


Figure 11b – Parameters sub-tab – plot

Performance sub-tab

In this sub-tab, we can see the RMS (Root Mean Squared) of the raw data for vibration X,Z axes (acceleration [m/s²], velocity [mm/s] and displacement [um]) as well as the magnetic field, and the mean value for speed and temperatures (frame and environment), and this for each set of data acquired every 20 min since the SMS was first activated.

To zoom in on a specific time period, select some dots by click-dragging your mouse over them.

Select one or more motor functions and click Draw Plot (Figure 12a).

Note that you can only select a maximum of four functions to be visualized at any one time.

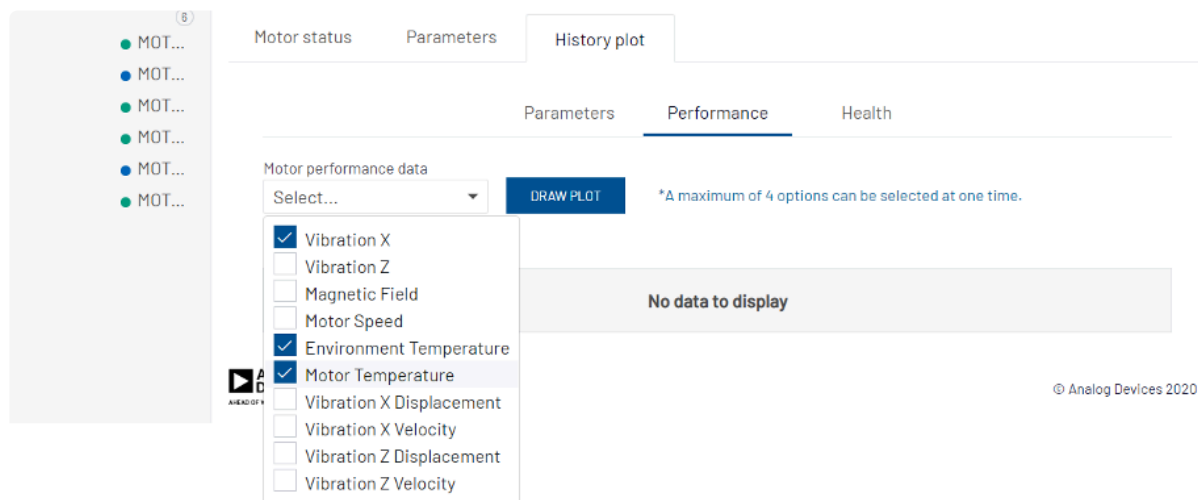


Figure 12a – Performance sub-tab – selection

You will see the plot of the selected functions (Figure 12b)



Figure 12b – Performance plot

Health sub-tab

Select one, or all the motor's components (Figure 13a) to visualize their health and click Draw Plot (Figure 13b).

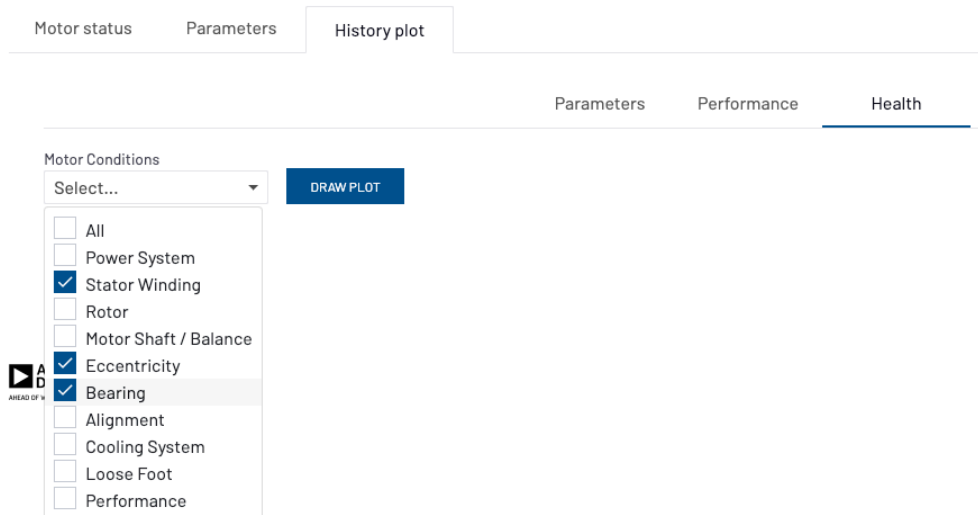


Figure 13a – Health sub-tab – selection

Each dot represent the health index per each sample data collected every 20 minutes for the chosen component: you can zoom in on a particular date and time by selecting the dots you want to look at more closely (click-drag your mouse on the plot to select these dots).



Figure 13b – Health plot

Revision: 31 — Last modified: 4 October 2021

2.2.2. Map

The Map view (Figure 14) pinpoints the location/s where the motors monitored by SMS are installed.

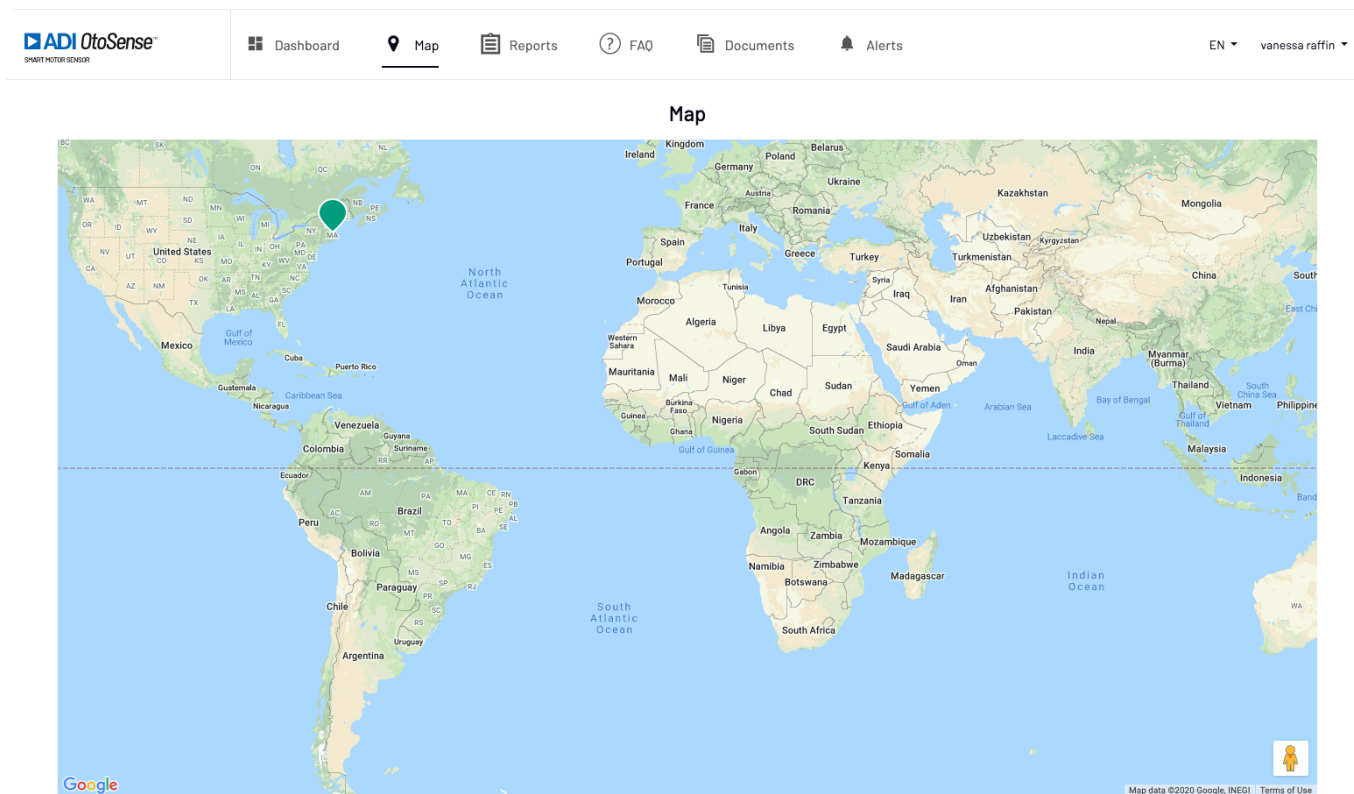


Figure 14 – Map view

Click the location icon to visualize motor data relevant to that location (Figure 15).

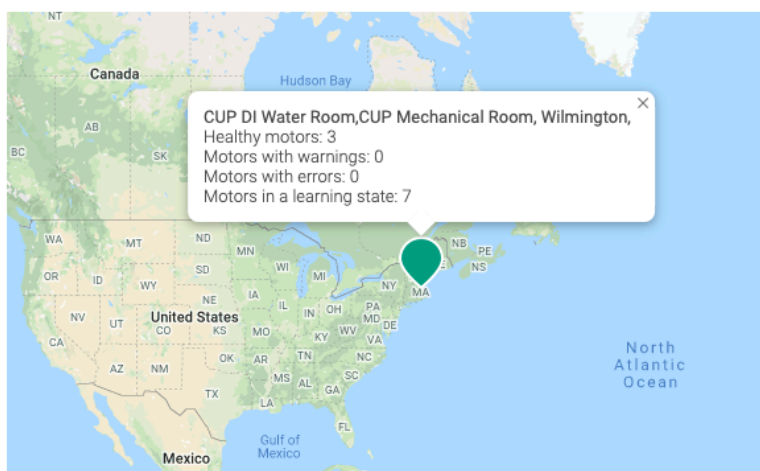


Figure 15 – Location data visualization

Revision: 2 — Last modified: 16 July 2020

2.2.3. Reports

In this tab, you can create customized reports.

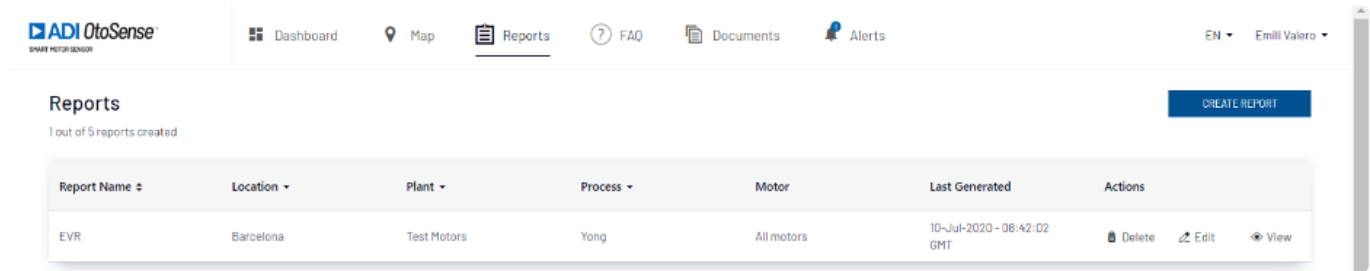


Figure 16a – Reports

Click **Create report** (Figure 16b).

Schedule which day you want to receive the report.

Select the location, plant, process and motors for which you want to receive the report.

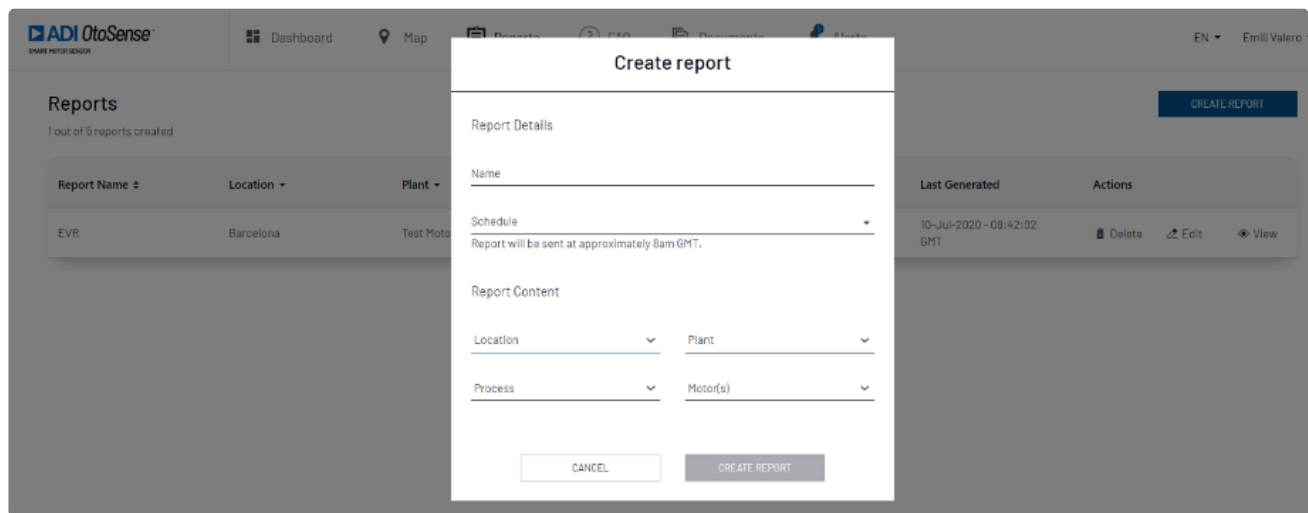



Figure 16b – Create report

In the report, you can find the following information (Figure 16c):

- Motor details
 - Status
 - Failure description
 - Action required to fix the problem
 - Battery status
 - Connexion status
 - Operation hours and number of starts.
- All these fields can be filtered.

		Dashboard	Map	Reports	FAQ	Documents	Alerts	EN ▾	Emilio Valero ▾
---	--	---------------------------	---------------------	-------------------------	---------------------	---------------------------	------------------------	------	-----------------







EVR Generated On: 10-Jul-2020 - 08:42:02 GMT									
Motor Name ▾	Motor Details ▾	Status ▾	Description	Action	Battery	Connected ▾	Operation Hours (Since 10-Jul-2020, 8am GMT)	Starts (Since 10-Jul-2020, 8am GMT)	
MOTOR378A	ABB/7.5kW/2890rpm	Learning	No Fault	No Action Required		 Disconnected	0	0	
MOTOR343Y	SIEMENS/5.5kW/1450rpm	Learning	No Fault	No Action Required		 Disconnected	0	0	
MOTOR479Y	BONFIGLIOLI/4kW/1440rpm	Warning	Warning: Cooling System Malfunction	Check This Condition Over Time		 Disconnected	0	0	

Figure 16c – Report – example

The report can be edited or removed (Figure 16d).



Reports 1 out of 5 reports created							CREATE REPORT
Report Name ▾	Location ▾	Plant ▾	Process ▾	Motor	Last Generated	Actions	
VR	Wilmington	CUP DI Water Room	UF Tank Pump	CP-P-DI-4I	Pending	 Delete	 Edit

Figure 16d – Edit report

Revision: 6 — Last modified: 17 July 2020

2.2.4. FAQ

A compendium of frequently asked questions about the ADI OtoSense web application. Click [here](#) to access the document.

Revision: 6 — Last modified: 8 June 2021

2.2.5. Documents

Access the **SMS Installation guide** and this **OtoSense SMS Web User Guide**.

Revision: 3 — Last modified: 17 July 2020

2.2.6. Alerts

When the system detects a failure, an email is sent to the user (Fig. 17a)

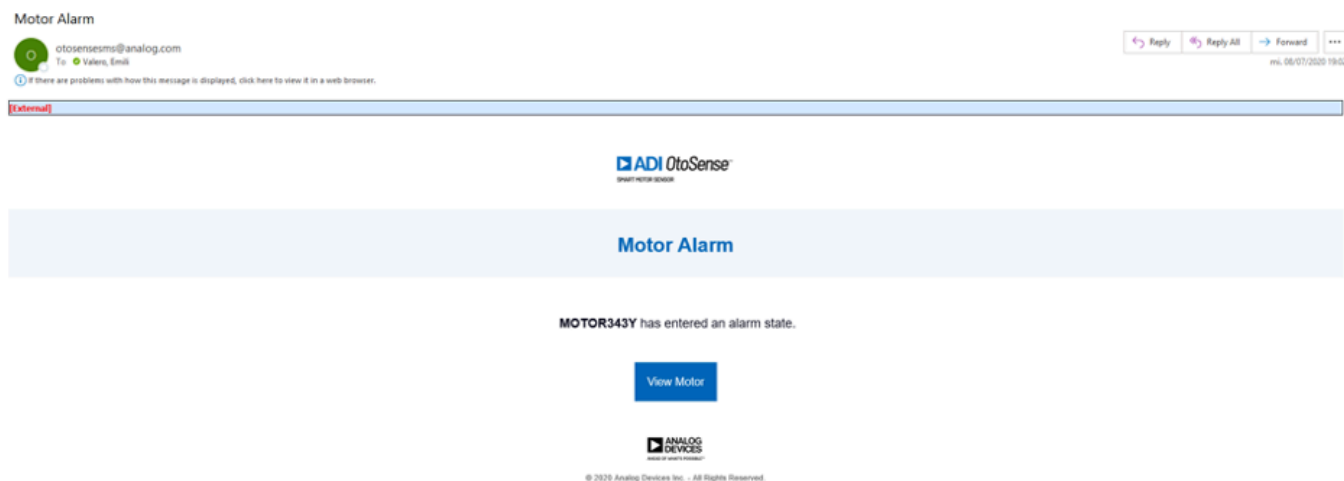


Figure 17a – Alert email

By clicking on the **View Motor** link, you will be guided to login page to access the dashboard. Click **Alerts** in the top bar to view this alert.

The Alerts screen (Figure 17b) displays information about problems that were detected by SMS devices, and the action/s that were performed.

Note that you can sort the view according to several parameters: Motor/Component, Plant/Process, and many others. You can also search for alerts using the Search Bar provided.

Motor/Component ▾	Plant/Process ▾	Status ▾	Description	Action	Initial alarm ↕	Recovered/Repaired ↕
CUP009/Bearing	Wilmington/Cup	Alarm	Alarm: Bearing Outer Race High Fault Detected	Action Required: Replace Bearings As Soon As Possible	10-Jun-2020 - 18:35:41 EDT	
CUP010/Motor Shaft / Balance	Wilmington/Cup	Alarm	Alarm: Imbalance Detected	Action Required: Balance Motor In Next Stop	10-Jun-2020 - 18:37:14 EDT	

Figure 17b – Alerts view

Clicking on Motor/Component will take you to the component's plot where you will see the evolution of the component that triggered the alert over time (Figure 17c).

The blue dots represent the fault index for a given sample on a given component.

Index between 0 and 4.9: alarm

Index between 5 and 6.9: warning

Index between 7-10: good condition

You can zoom in by selecting the dots you want to look at more closely (click-drag your mouse over those dots)

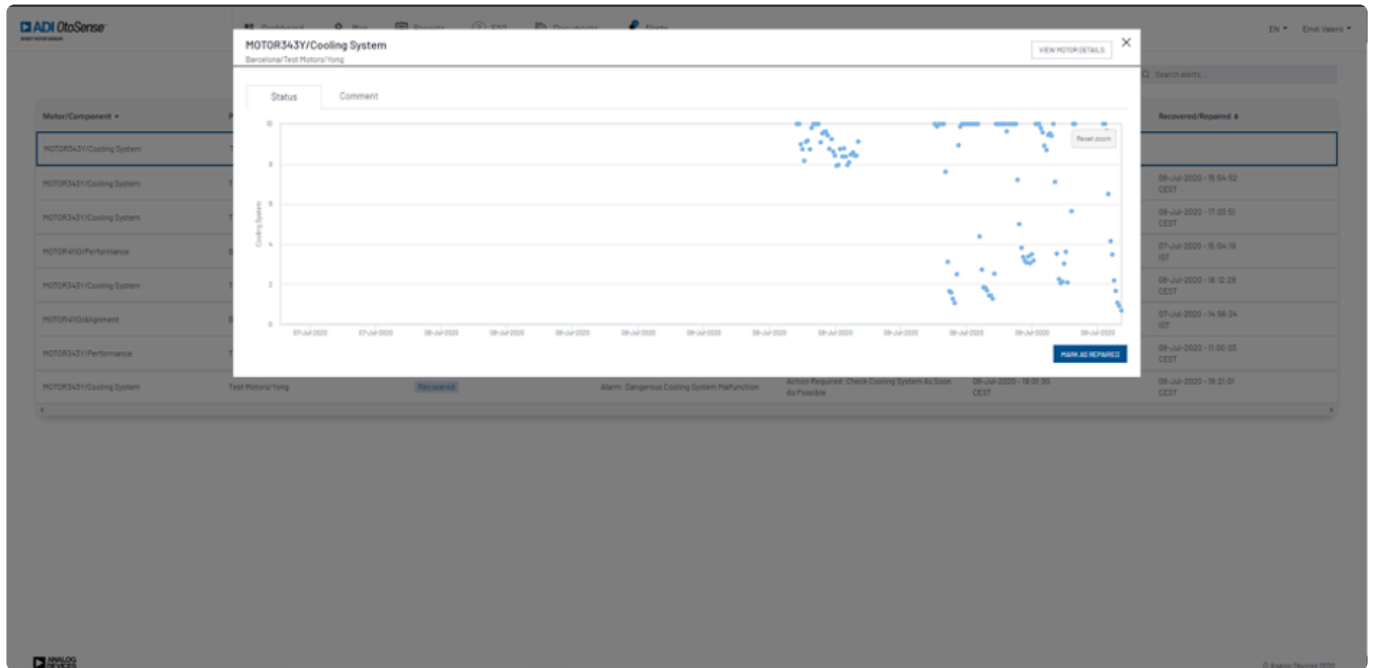


Figure 17c – Component fault condition evolution

Once the motor has been repaired, you can go back to this alert and click **Repaired**.

- ✿ Note that after clicking on “Repaired” the failure mode will disappear, and time will be registered. The system will evaluate again the component condition in the next data acquisition and the status will be updated again. If the same failure appears again, it will mean that the failure has not been fixed properly.

You can add some comments about this work by clicking the **Comment** sub-tab and enter information like “work order”.

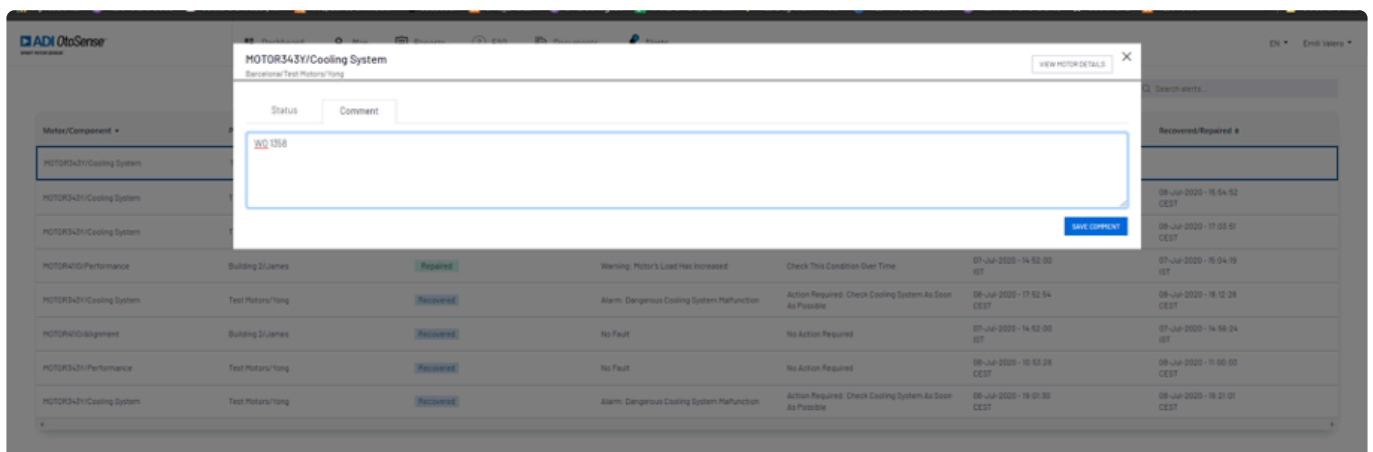


Figure 17d – Alerts – Comment view

Clicking **View Motor Details** on the top right corner will take you to the exploded motor view that shows what component of the motor triggered the alert.

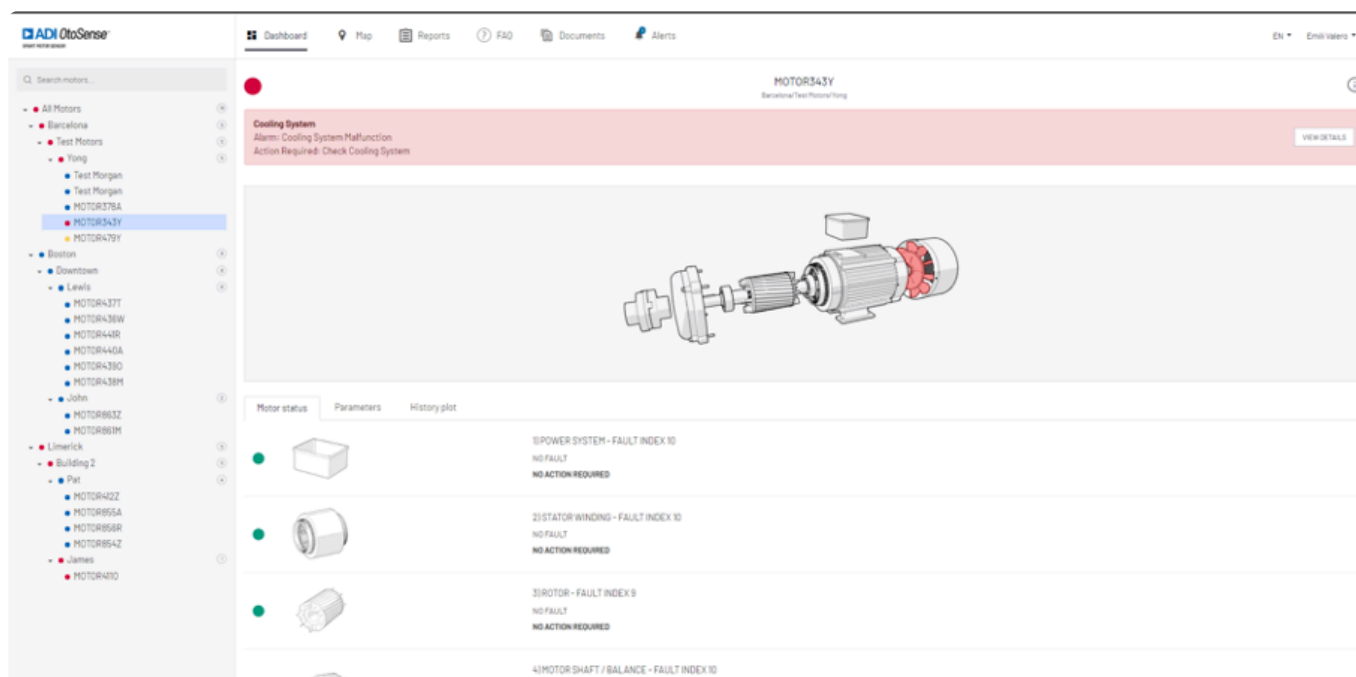


Figure 17e – Motor view with alarm notification

Alarm: indicates what problem the motor is experiencing.

Action required: Indicates how to fix the problem and when. Depending on the severity of the fault (fault index), the timeline of the correction action will change. In case of high severity failure, the actions will be required “as soon as possible” (Fig: 17f)

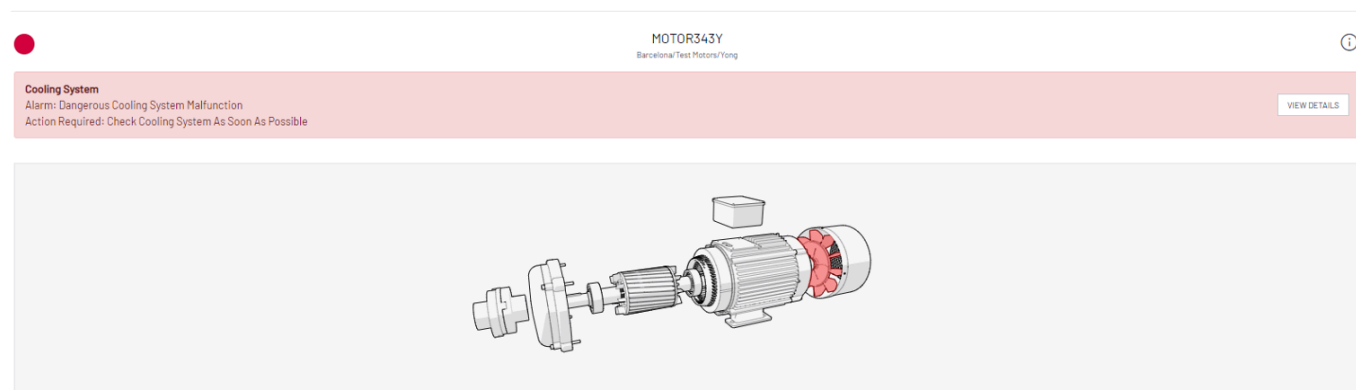


Figure 17f- Motor view with high severity alarm

The motor component under failure will be red colored, yellow in case of warning.

Click on **View details** on the alarm banner to see the failure mode health plot (Figure 17g).

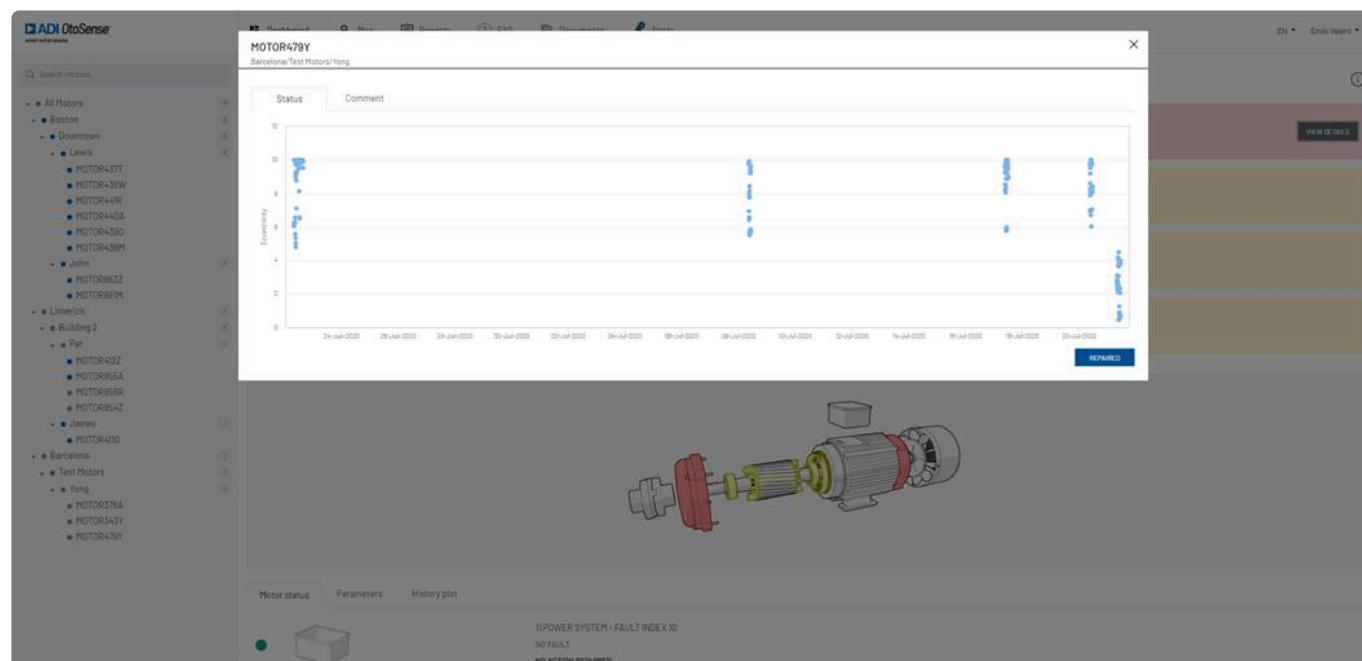


Figure 17g – Failure mode health plot

Blue dots represent the fault index.

Zoom in by click-dragging your mouse over the dots you want to see more closely.

Hovering over each dot opens a text box that displays the index and the date and time of the data acquisition.

Red area – Index between 0 and 4.9: alarm

Yellow area – Index between 5 and 6.9: warning

Green area – Index between 7-10: good condition

How to read the Alerts table

Alerts						
Motor/Component	Plant/Process	Status	Description	Action	Initial alarm #	Recovered/Repaired #
MOTOR479Y/Cooling System	Test Motors/Yong	Alarm	Alarm: Dangerous Cooling System Malfunction	Action Required: Check Cooling System As Soon As Possible	08-Jul-2020 - 20:36:12 CEST	
MOTOR479Y/Cooling System	Test Motors/Yong	Recovered	Alarm: Dangerous Cooling System Malfunction	Action Required: Check Cooling System As Soon As Possible	08-Jul-2020 - 16:38:28 CEST	08-Jul-2020 - 16:54:52 CEST
MOTOR479Y/Cooling System	Test Motors/Yong	Recovered	Alarm: Dangerous Cooling System Malfunction	Action Required: Check Cooling System As Soon As Possible	08-Jul-2020 - 16:40:48 CEST	08-Jul-2020 - 17:03:51 CEST
MOTOR479Y/Performance	Building 2/James	Repaired	Warning: Motor's Load Has Increased	Check This Condition Over Time	07-Jul-2020 - 14:52:00 IST	07-Jul-2020 - 15:04:19 IST
MOTOR479Y/Cooling System	Test Motors/Yong	Recovered	Alarm: Dangerous Cooling System Malfunction	Action Required: Check Cooling System As Soon As Possible	08-Jul-2020 - 17:52:54 CEST	08-Jul-2020 - 18:12:28 CEST
MOTOR479Y/Alignment	Building 2/James	Recovered	No Fault	No Action Required	07-Jul-2020 - 14:52:00 IST	07-Jul-2020 - 14:56:24 IST
MOTOR479Y/Performance	Test Motors/Yong	Recovered	No Fault	No Action Required	08-Jul-2020 - 10:53:28 CEST	08-Jul-2020 - 11:00:03 CEST
MOTOR479Y/Cooling System	Test Motors/Yong	Recovered	Alarm: Dangerous Cooling System Malfunction	Action Required: Check Cooling System As Soon As Possible	08-Jul-2020 - 19:01:30 CEST	08-Jul-2020 - 19:21:01 CEST

Figure 17h – Alerts: Alarm; Repaired; Recovered; Learning

Alarm

- Shows the “description” of the failure and the “action” to be taken to fix the problem.
- “Initial alarm” date indicates when the alarm was notified.
- If the failure was “Repaired”, the date of the reparation will be shown.

Status “Recovered”

Sometimes the failures are recovered without any reparation associated. The alarm may have been triggered by a sudden change in speed or in the performance and the AI detected that the motor component went back to normal. In these cases, the recovery date are shown in Alerts screen.

Revision: 16 — Last modified: 8 June 2021