

Edge Analytic Devices Can Deliver Continuous Monitoring and Asset- Specific Automated Analysis

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Portable Data Collection + Analysis



Week 1 Data Route
Week 2 Data Route
Week 3 Data Route
Week 4 Analyze Data

(Repeat Monthly)

- Primary vibration data collection methodology for last ~40 years
- Low capital outlay, but labor intensive
- Spending 90% of time looking for 1-5% of machines having an alert
- Personnel safety considerations of being in production areas
- “Blind Spots” between data collections (30-90 days)
- Resource limitations may prevent coverage of some machines
- Missed measurements due to off-line machines
- Hazardous areas preventing data collection

Digital Transformation of Asset Monitoring

Traditional Monitoring



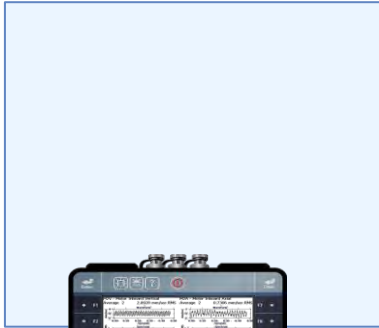
Automated Monitoring

90% Manual Monitoring

(100 Racks)

(100 Racks)

100% Automated Monitoring

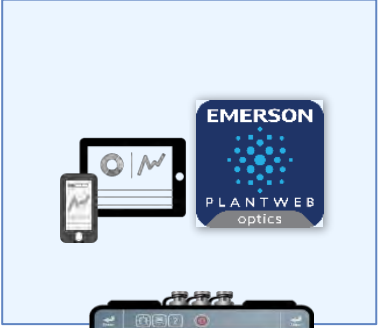


(35 Units)

300 High Consequence

650 Medium Consequence

(500 Units)



“Routes by Inspection”

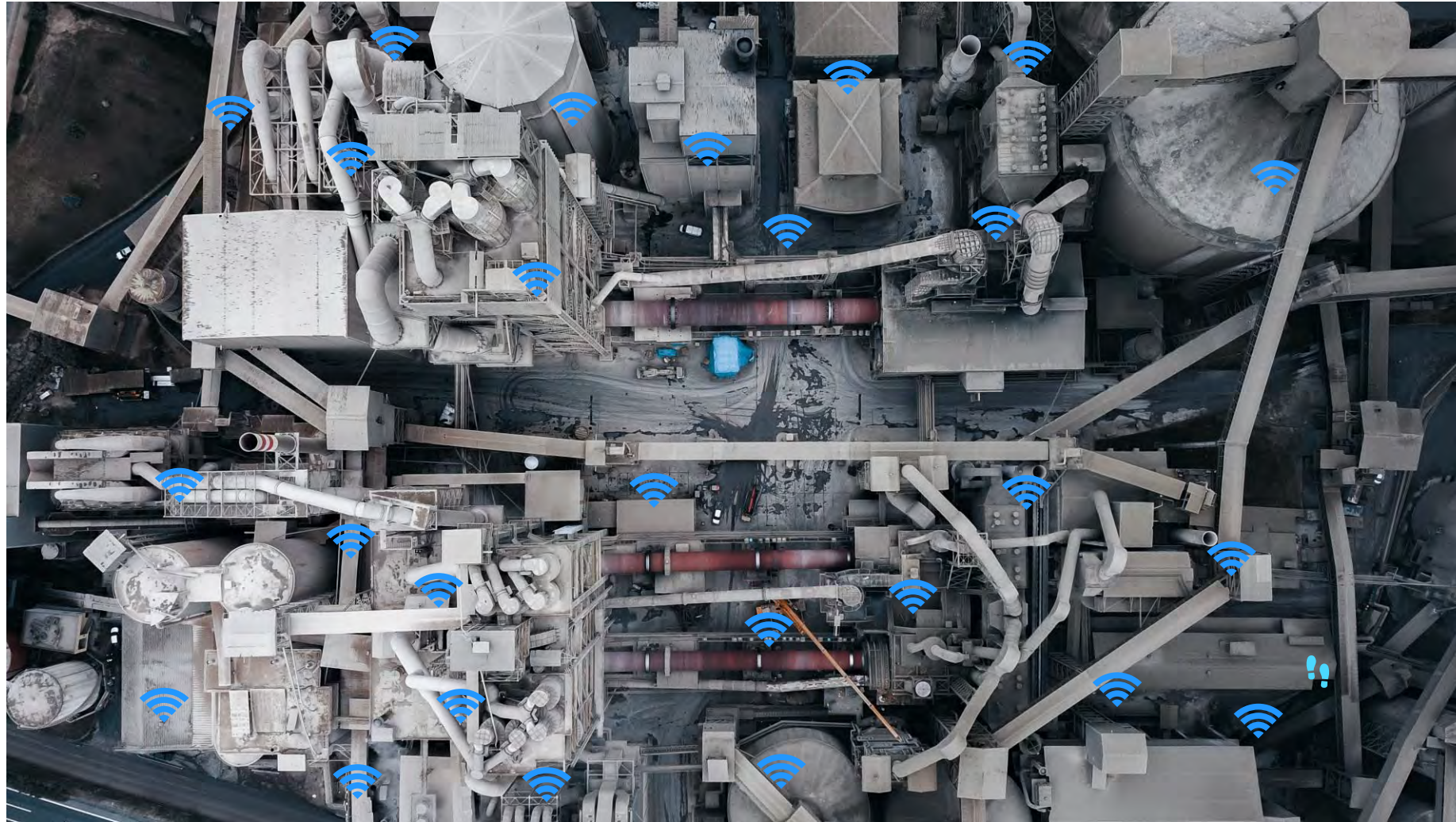
(> 10Units)

850 Low Consequence

(2500 Units)

“Routes by Exception”

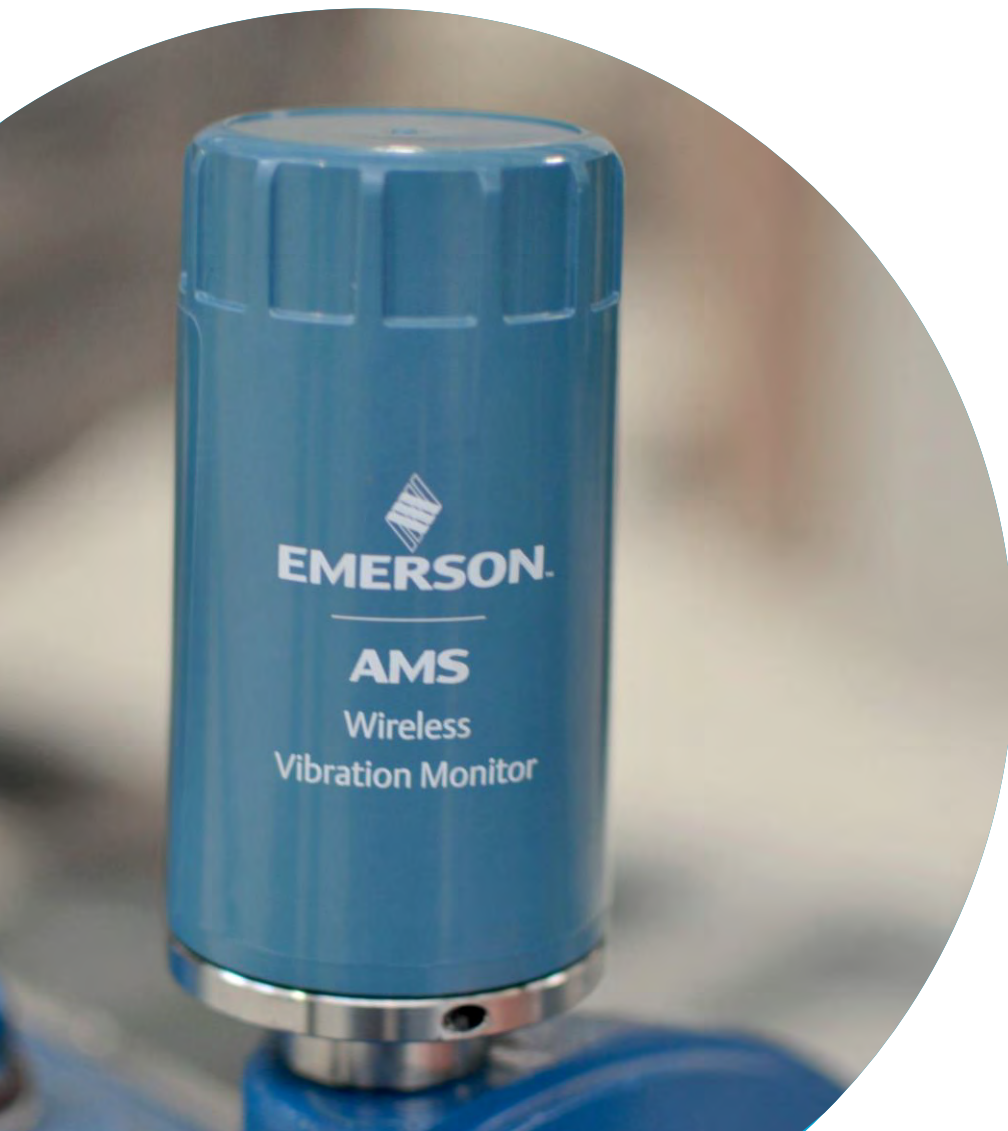
Automated Data Collection + Automated Analysis



- More frequent data collection to avoid “blindspots”
- Automated and prescriptive analytics to identify issues
- Spend analysis time on assets with alerts or significant data change
- Cover all assets in your facility, even in hazardous and remote areas
- Keep personnel in safe areas
- Remotely access machine health wherever you are
- Continuous monitoring of assets through weekends, holidays, PTO...

Wireless Data Collection – Focus On Data, Not Route Collection

- Complete plant coverage with a lower installation cost, lower project engineering cost, and provides accessibility to areas where route-based data collection is not feasible
 - Remote/Hazardous/Inaccessible locations
 - Balance of Plant assets
- Periodic but more frequently than route-based data collection
 - Allows the analytical resources to focus on data analysis of suspect assets
 - Provides more data than route-based data collection alone
- Data can be shared with other plant systems
 - SCADA, DCS, Historian, Data Lakes, AI and ML platforms
- Safety
 - Keeps plant personnel away from
 - Hazardous locations, confined spaces, and dangerous environments



Wireless Data Collection – Easy Mounting and Axes Alignment



X-axis indication



Y-axis indication



Easy Installation and Quick Alignment of Axes

Mounting

Encapsulated 1/4-28 mounting stud

- Standard mounting methods
 - Stud mount (preferred)
 - Epoxied mounting pad
 - Magnetic mount
 - Motor fin mount
 - Quick-release mount
- No special tools required

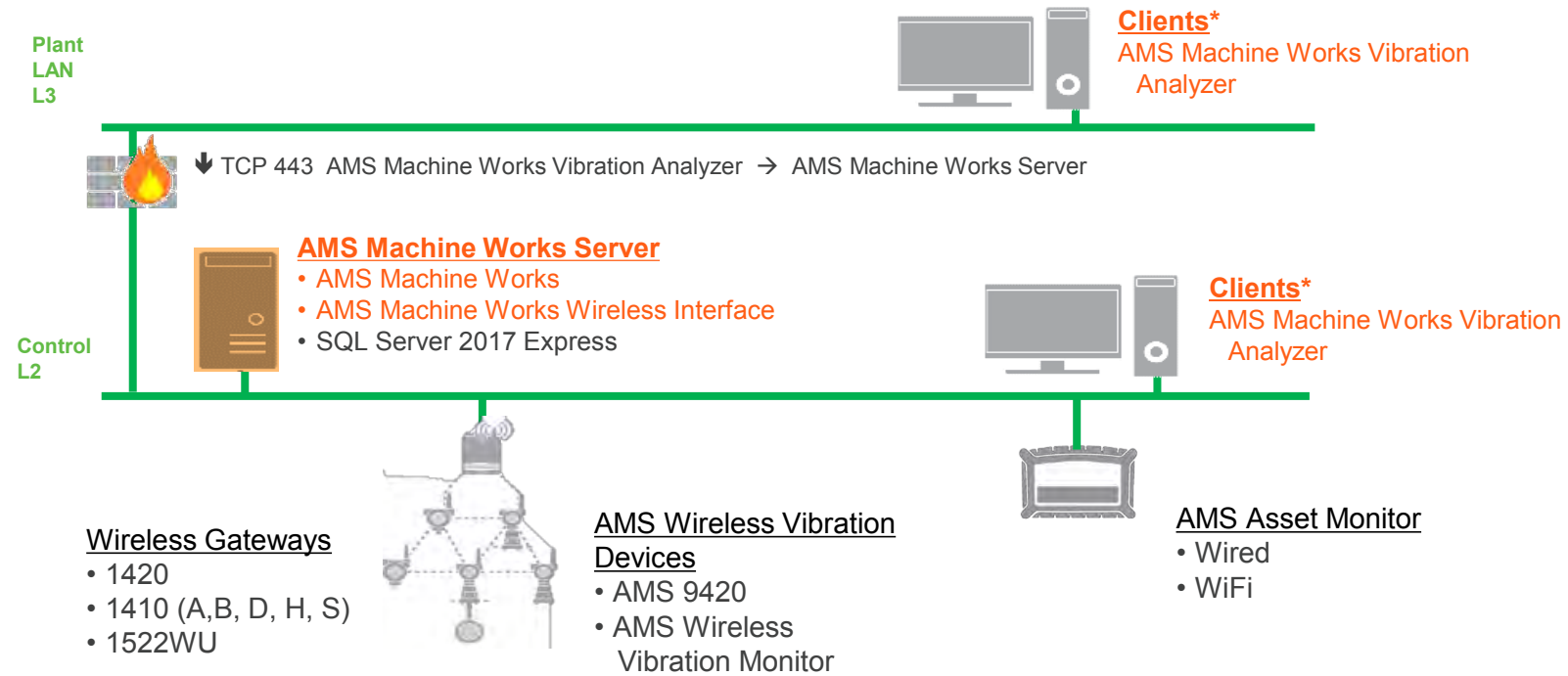
Benefits of Stud Mounting

- Better signal response
- Less expensive
- Lower maintenance (no pads to replace)

Alignment

1. Snug the mounting bolt
2. Place a small screwdriver or Allen wrench in the through holes located on the base.
3. Turn the base to align the X and Y planes with the appropriate axes.
4. Tighten the mounting bolt and install the battery.
5. Replace the cover.

Wireless Data Collection – System Architecture...It Is a System!



Emerson Wireless
1420 Gateway



Emerson Wireless
1410 (A, B, D, H, S) Gateway

- **WiHart Mesh Network**
 - Robust
 - Secure
 - Easy to expand
- **AMS Wireless Vibration Monitor**
 - Wireless communication to the gateway – the ground level of the network backbone
 - Ethernet (wired or wireless) from gateway to server
- **Each wireless device is a transmitter and a repeater by default**
 - Ensures network robustness
 - More neighbors enhances the ability to transmit data
 - Self-healing
- **Compatible with other Emerson and non-Emerson WiHart devices**

Wireless Data Collection – AMS Wireless Vibration Monitor (A9530)

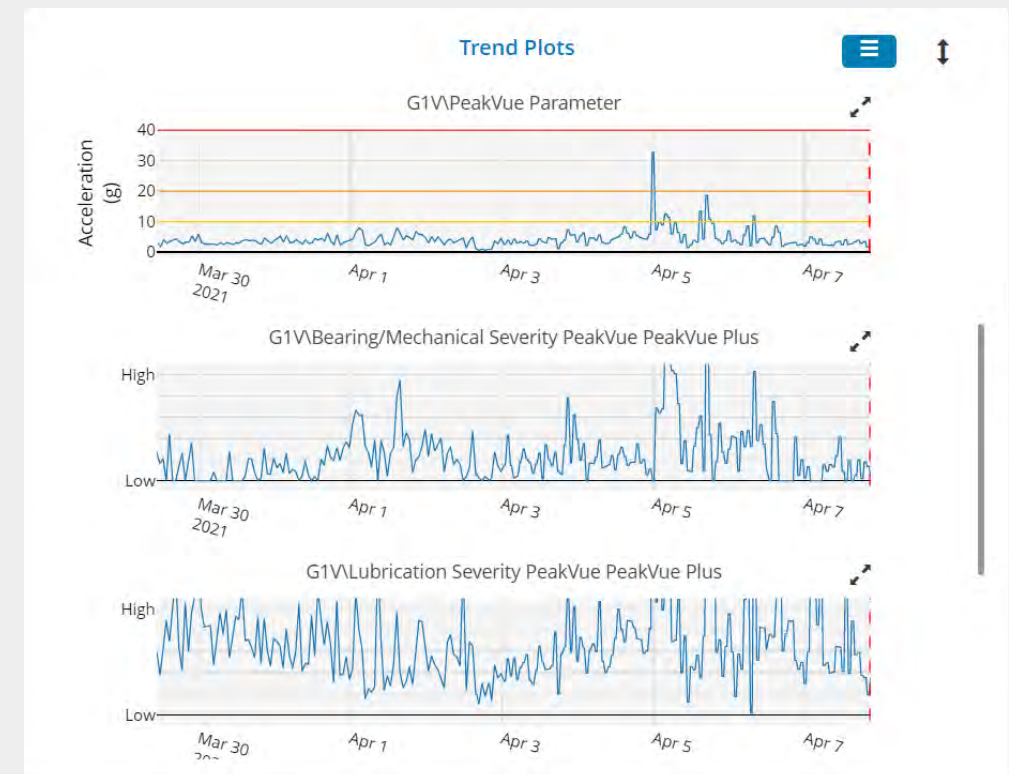
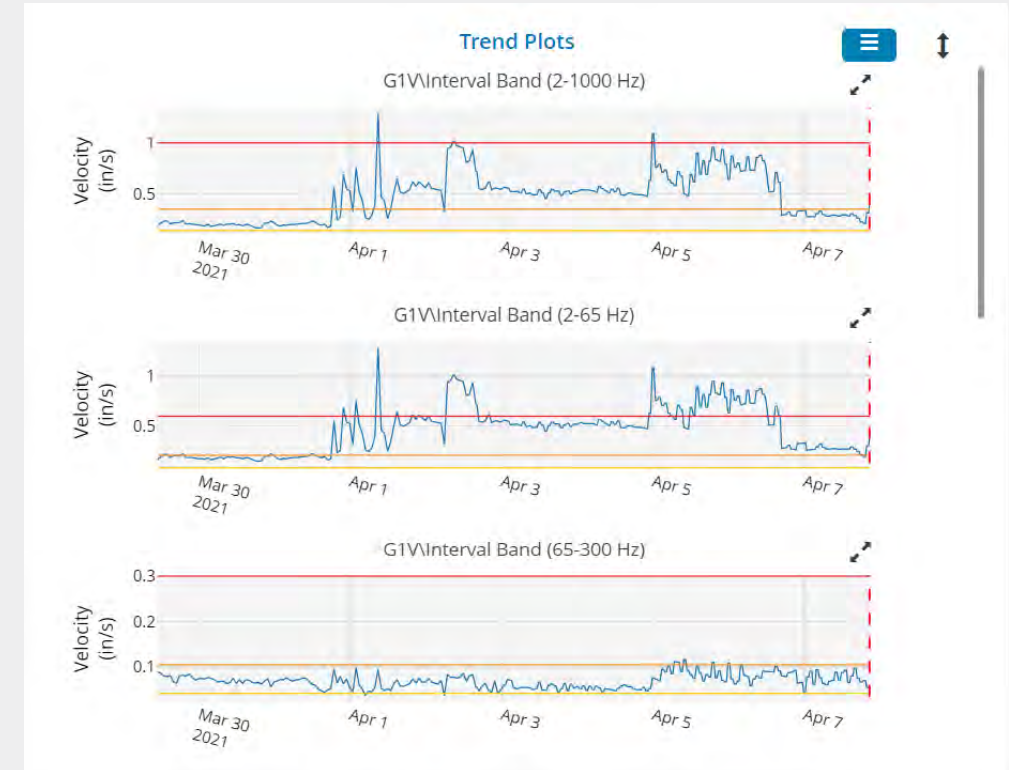
- **Triaxial** accelerometer with temperature
- **PeakVue** - High frequency impact detection
- Z-axis with a 20 KHz frequency range
- **User configurable** Fmax, filters, interval bands
- More data available – up to **13 key parameters** and then some...
- **Prescriptive Analytics** for bearing and lubrication health
- **CI I, Div 1 / IP66 / NEMA 4X** enclosure
- **Easy installation**
 - Mounting
 - Axis alignment
- **Battery Life – 3 – 5 years**
 - **Easy battery replacement**
 - **Battery replacement in Hazardous Area**
- Distance – 100m (~300 ft line of sight)
 - Mesh networking enhances this parameter
- Data collection on **Alert** and **On-Demand** and **Schedule**



Wireless Data Collection – Available Data

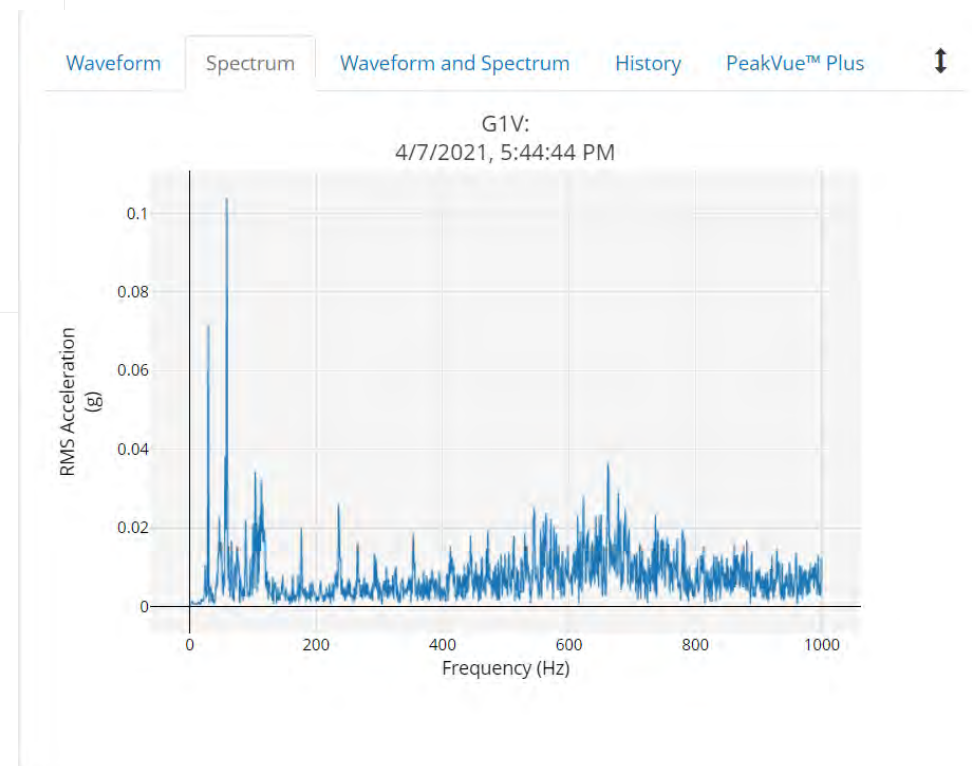
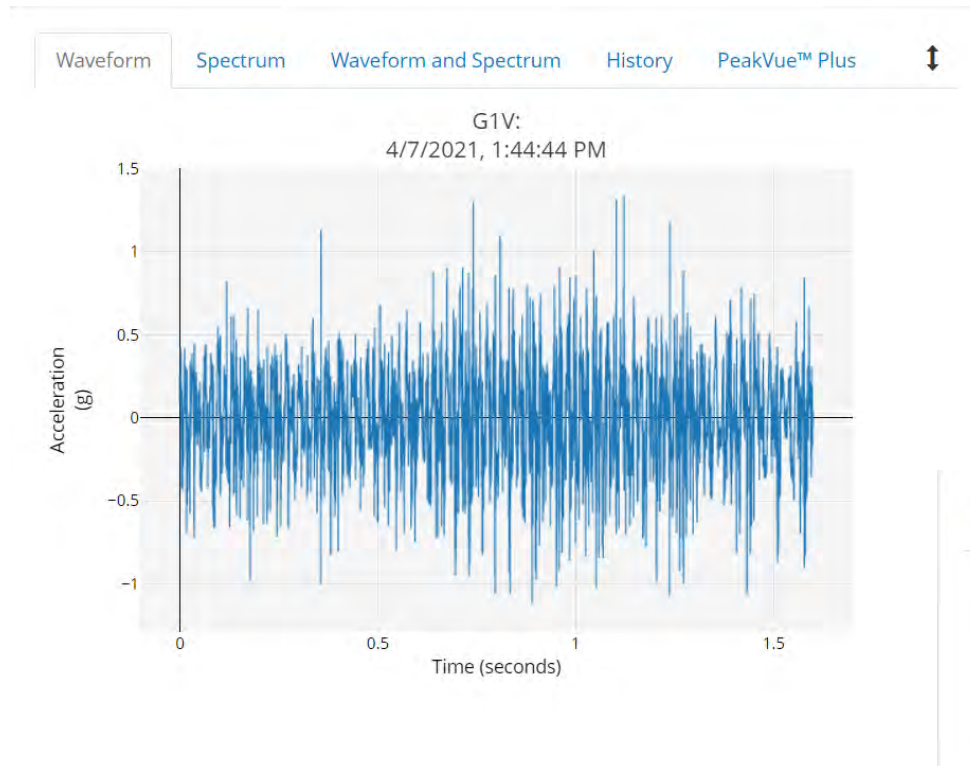
13 Scalar Values

<i>Shaft Condition</i>	✓	X-axis Overall Velocity
	✓	Y-axis Overall Velocity
	✓	Z-axis Overall Velocity
<i>Impacting</i>	✓	Z-axis PeakVue Acceleration
<i>Lower Frequency Faults</i>	✓	Velocity Parameter 1 (user selected)
	✓	Velocity Parameter 2 (user selected)
<i>Higher Frequency Faults</i>	✓	Acceleration Parameter 1 (user selected)
	✓	Acceleration Parameter 2 (user selected)
<i>Prescriptive Analytics</i>	✓	Bearing/Mechanical Severity
	✓	Lubrication Severity
<i>RPM</i>	✓	Calculated Speed
<i>Friction</i>	✓	Skin Temperature
<i>Battery Life</i>	✓	Supply Voltage



Wireless Data Collection – Available Data

Waveform and Spectral Data



Spectrum and Waveform Data

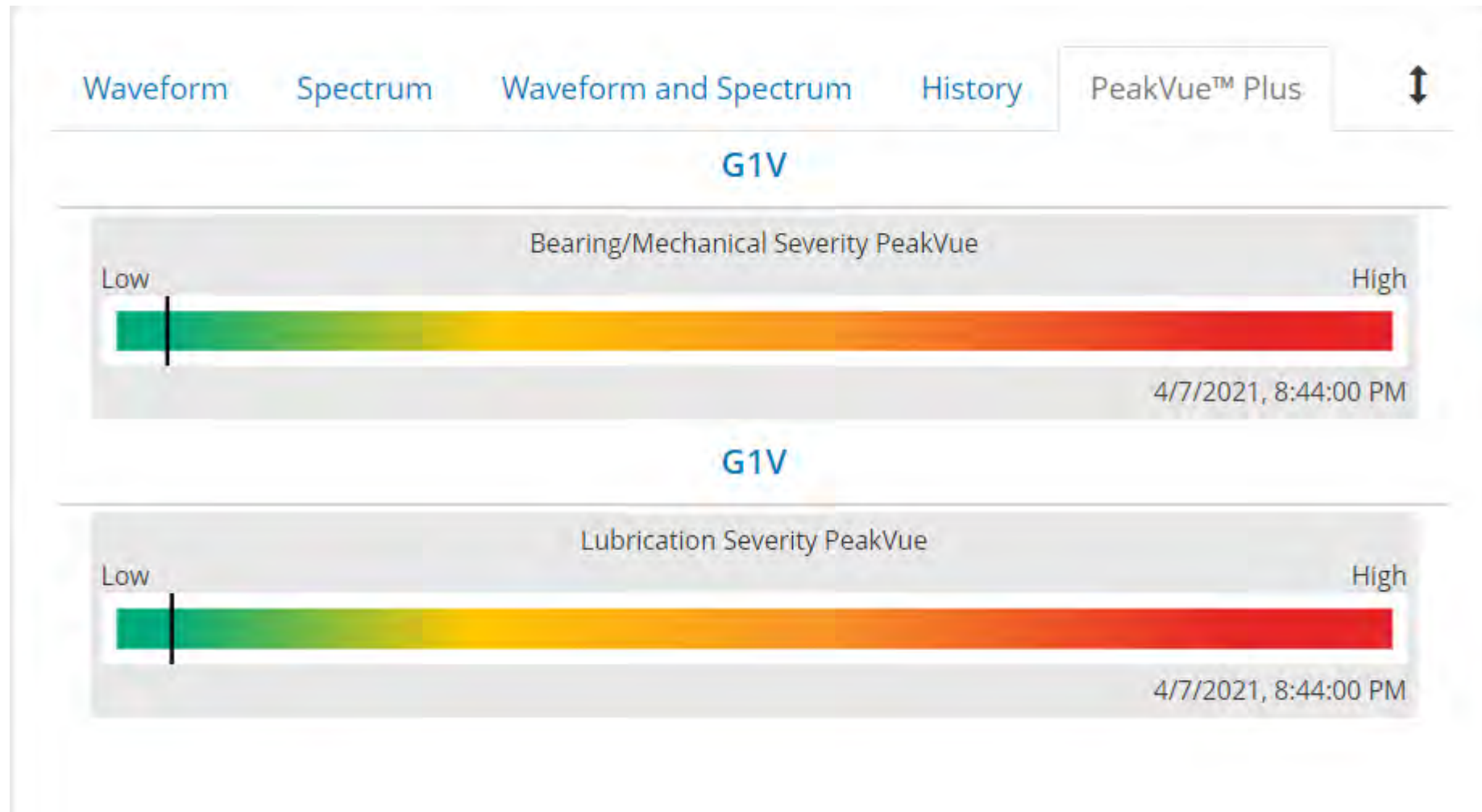
- X-axis Spectrum and Waveform
- Y-axis Spectrum and Waveform
- Z-axis Spectrum and Waveform
- PeakVue Spectrum and Waveform

Other Data

- Alert bits available for external systems
- Network performance data available for each wireless device

Wireless Data Collection – Available Data

Prescriptive Analytics



Actionable Information From Each Device – PeakVue Plus

- Know if there is material damage to a bearing or gear – including the severity
- Know if there is a lubrication issue – including the severity

Wireless Data Collection – Battery

- Off-the-Shelf (OTS) Battery
- Standard ‘C’ Size
- Low-cost consumable
- Expected battery life: 3 – 5 years default
 - Scalar values every hour
 - Thumbnail spectra every 8 hours
 - Spectra every day
 - X, Y, Z and PeakVue per day
 - Waveform every month
- Variations to the collection schedule can affect battery life.

MODEL TL-4920
International size reference: C, ER26500

TADIRAN LITHIUM BATTERIES

TECHNICAL DATA
(Typical values @+25°C for batteries stored for one year or less)

■ Nominal capacity @ 3 mA, to 2 V	8.5 Ah
■ Rated voltage	3.6 V
■ Maximum recommended continuous current	75 mA
■ Maximum 1 sec. pulse capability	200 mA
■ Weight	49.5 g (1.746 oz)
■ Volume	26 cc
■ Operating temperature range	-55 °C to +85 °C

U.L. Component Recognition, MH 12193

DISCHARGE CHARACTERISTICS @ +25°C

VOLTAGE VS. TEMPERATURE

CAPACITY VS. CURRENT

AVAILABLE TERMINATIONS
SUFFIX -S STANDARD 15-4920-21000
SUFFIX -T SOLDER TABS 15-4920-21000

XOL - Extended Operating Life

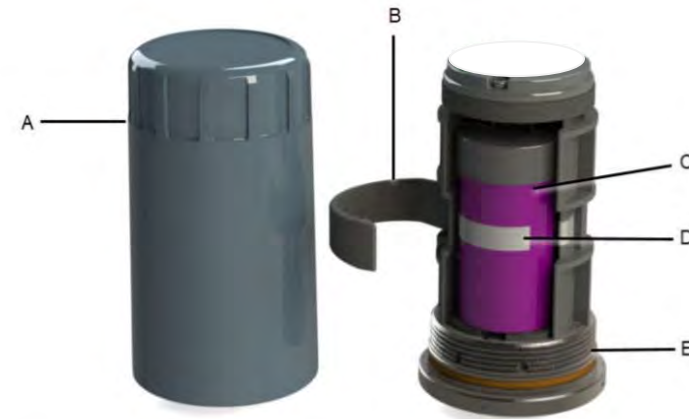
Note: Any presentations in this data sheet concerning performance are for information purpose only and are not construed as warranties either expressed or implied, of future performance. ECH 1561174 Rev. C 01/06

Wireless Data Collection – Easy Battery Replacement

Procedure:

1. Leave the device in its present location.
2. Remove device cover.
3. Release latch, pull the battery out and disconnect connector.
4. Plug the new battery wire into the connector
5. Place the battery into the compartment.
6. Close the latch and snap it into place
7. Mount the cover and then tighten it.

*Battery can be replaced even in hazardous rated areas



A. Cover
B. Battery clamp
C. Battery
D. Battery pull tab
E. Base O-ring

No special tools required!



It takes approximately 3-4 minutes to replace the battery.

Emerson's Edge Analytics Device - AMS Asset Monitor

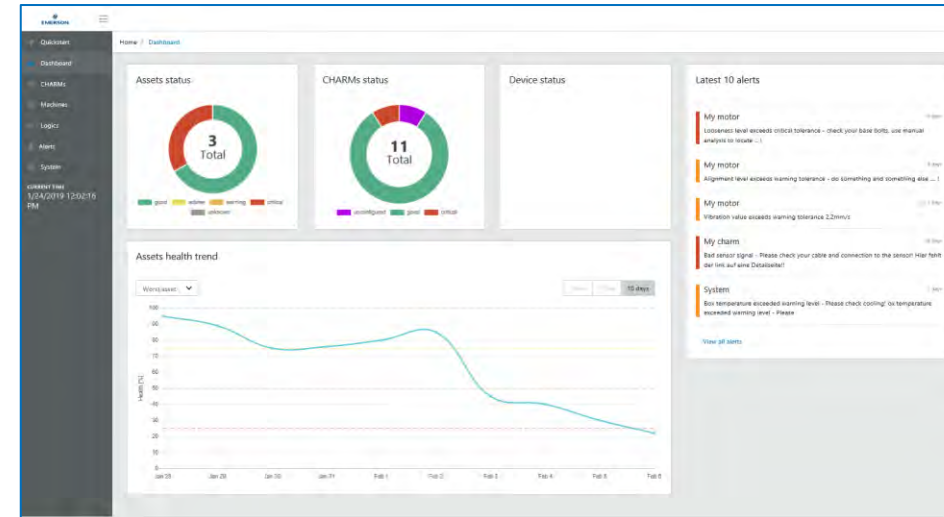
- ✓ Low cost Edge implementation
- ✓ Easy installation and configuration
- ✓ Measures and analyzes
- ✓ Embedded prescriptive analytics
- ✓ Relays for Machine Protection



AMS Asset Monitor – Field Mounted Edge Analytics Device

- **Eliminate Project Complexities**

- Install near the asset to reduce wiring cost
- Flexible IO interface with CHARMS
 - Process data CHARMS
 - Piezo CHARM with PeakVue for vibration monitoring
 - Tach CHARM
 - Voltage CHARM
- Hazardous area approvals CI I, Div 2 / ATEX Zone 2
- Daisy Chain up to 8 units – Simplify interface to software applications



- **Asset Studio - Software on Board**

- Asset Health Dashboard
- Parameter health and trending
- Current waveform and spectrum

- **IIoT ready – Installable on the Edge**

- Wired or Wireless interface
- Remote access via mobile device
- Integration to Plantweb Optics
- OPC UA interface to other 3rd party and IIoT applications

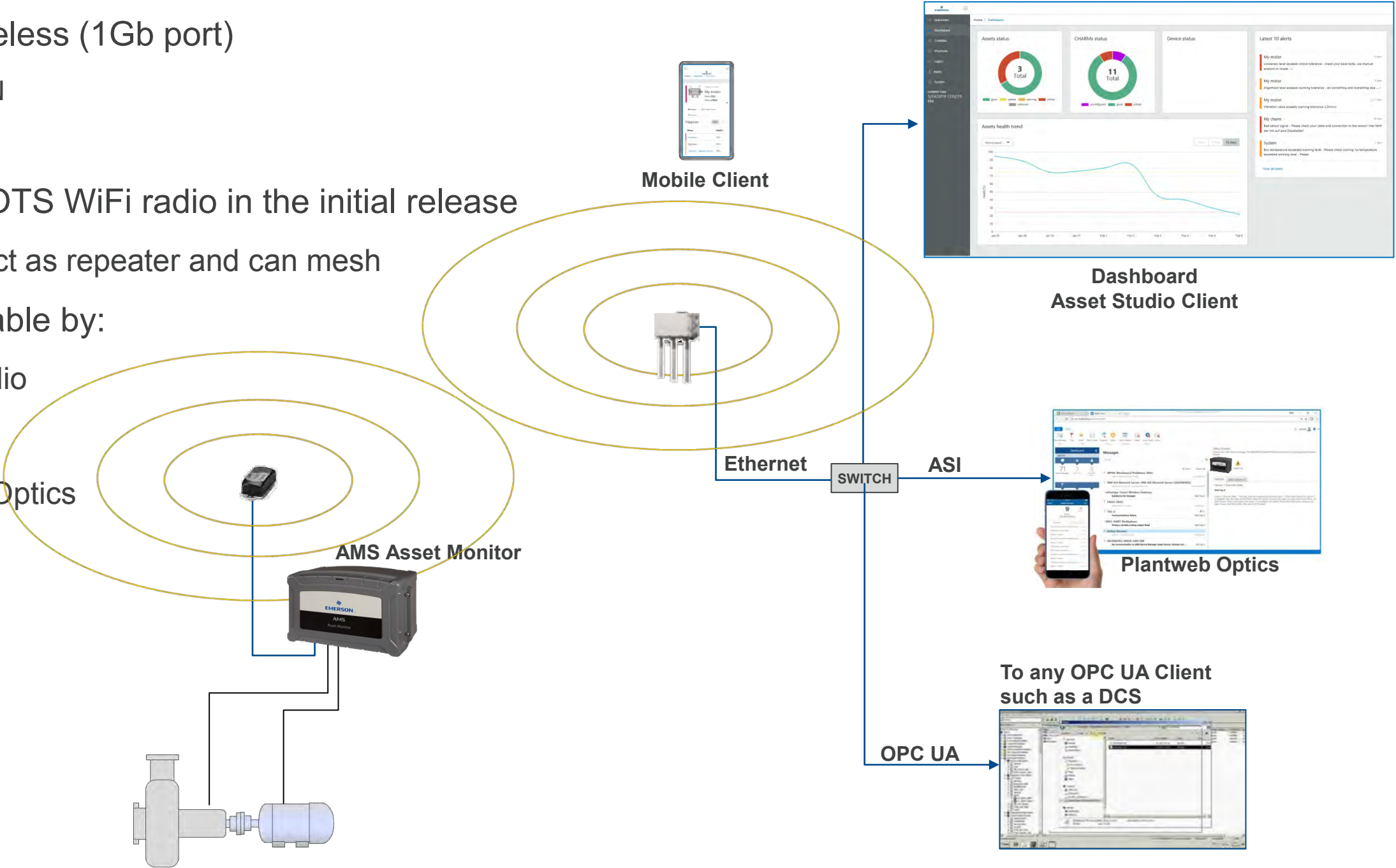
- **Embedded Analytics – Analytics on the Edge**

- Provides condition report on Imbalance, Misalignment, and Bearing defects plus 7 other typical machine issues.

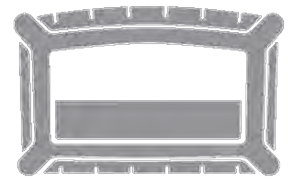


How to connect to AMS Asset Monitor

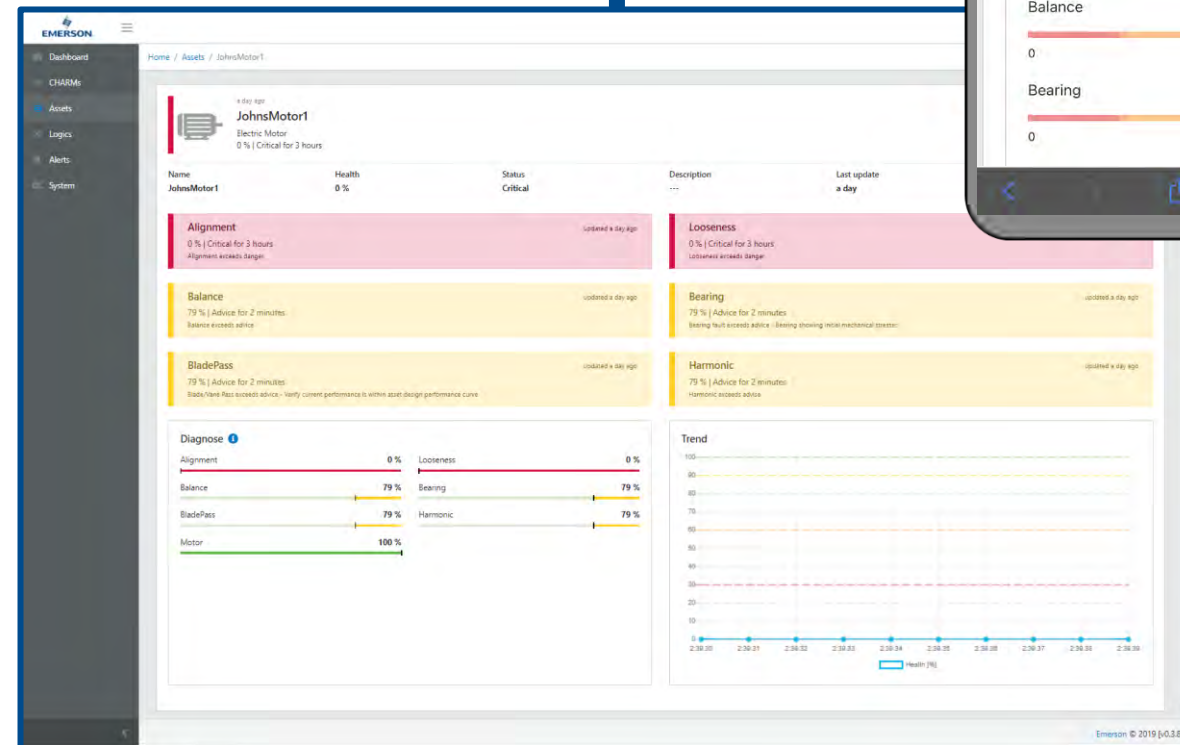
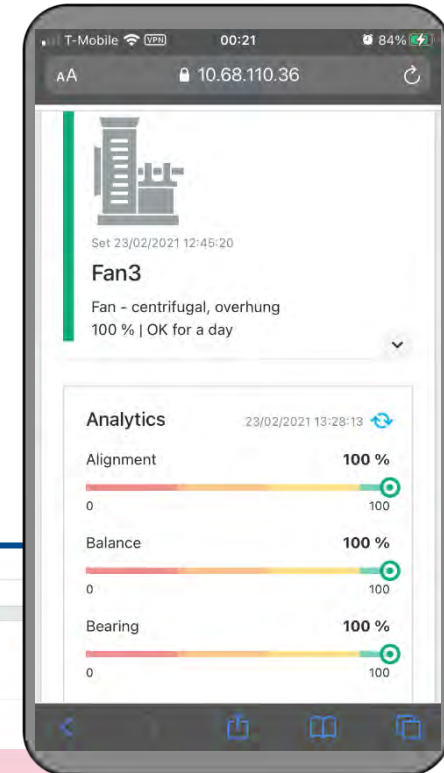
- Wired or Wireless (1Gb port)
 - Azure / VPN
 - IP connect
- We offer an OTS WiFi radio in the initial release
 - Unit can act as repeater and can mesh
- Data is available by:
 - Asset Studio
 - OPC UA
 - Plantweb Optics



Asset Monitor Interface



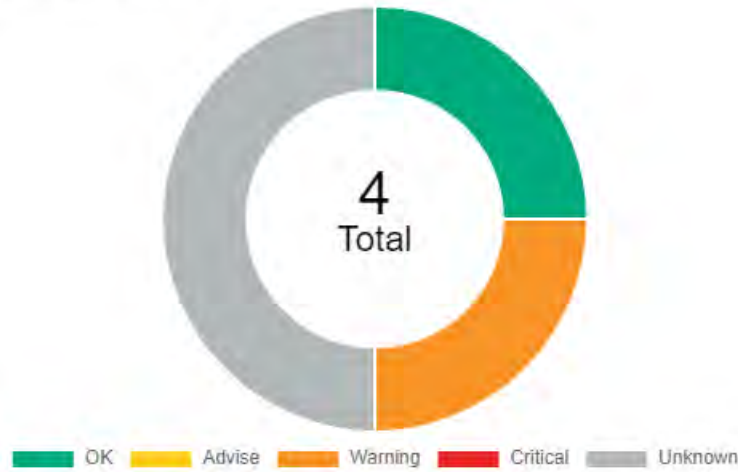
- Thin client browser-based interface
 - Secure password access
 - Setup
 - Data Visualization
 - Alerts, Alert Messaging and Health Index
 - Resizes to device used
- Embedded Prediction Logic
 - All applications report:
 - Measured or Rule Based values
 - Health Index



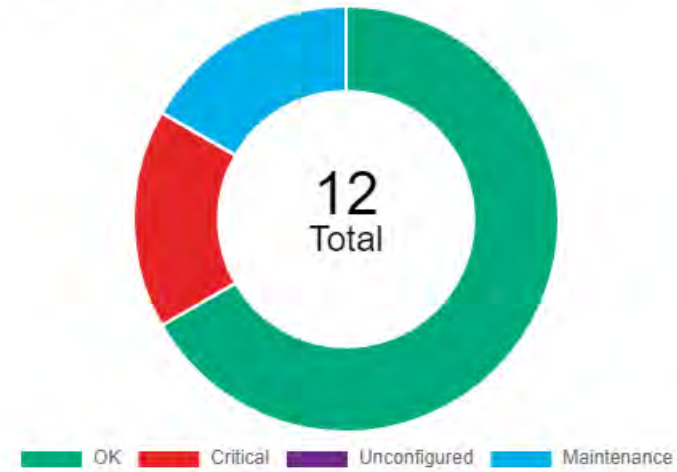
Asset Monitor Dashboard

- Dashboard
- CHARMs
- External data points
- Assets
- Output logics
- Alerts
- Users
- System

Assets status



CHARMs status

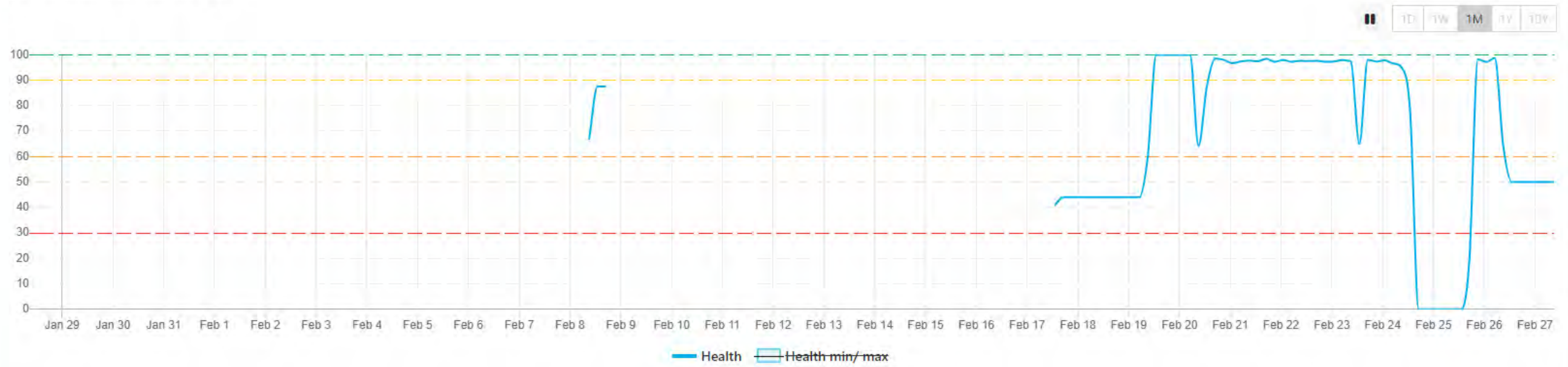


Device status

IP address 169.254.153.110
Time 02/27/2021 12:41:36 PM
Time zone Europe/Warsaw



Overall assets health trend





Set 02/28/2021 1:21:12 PM

Hydrocarbon Pump G2345

Pump - centrifugal, overhung - advisor

0 % | Critical for a few seconds

Very high bearing vibrations Automated detection of misalignment condition

Configure

Alerts

Delete



Outboard vertical vib - RMS

Set 02/28/2021 1:21:12 PM

0 % | Critical for a few seconds

Outboard vertical vib - RMS exceeds HiHiHi limit

Inboard horizontal vib - RMS

Set 02/28/2021 1:21:12 PM

0 % | Critical for a few seconds

Inboard horizontal vib - RMS exceeds HiHiHi limit

Alignment

Set 02/28/2021 1:19:51 PM

37 % | Warning for 2 minutes

Warning - 2X to 1X running speed amplitude ratio • Possible misalignment • Check alignment at earliest opportunity

Analytics

02/28/2021 1:19:52 PM

Alignment **37 %**



Bearing **98 %**



Flow **93 %**



Lubrication **100 %**



Balance **94 %**



Blade pass **100 %**



Looseness **100 %**



Measurements

02/28/2021 1:21:22 PM

Suction pressure **26 kPa**



Seal pressure **780 kPa**



Outboard vertical vib - RMS **15.55 mm/s**



Discharge pressure **755 kPa**



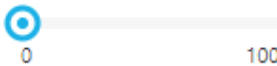
Seal level **54 %**



Inboard horizontal vib - RMS **15.57 mm/s**



Flow turbulence - O-P **0.79 g**



Hydrocarbon leak **2 %**

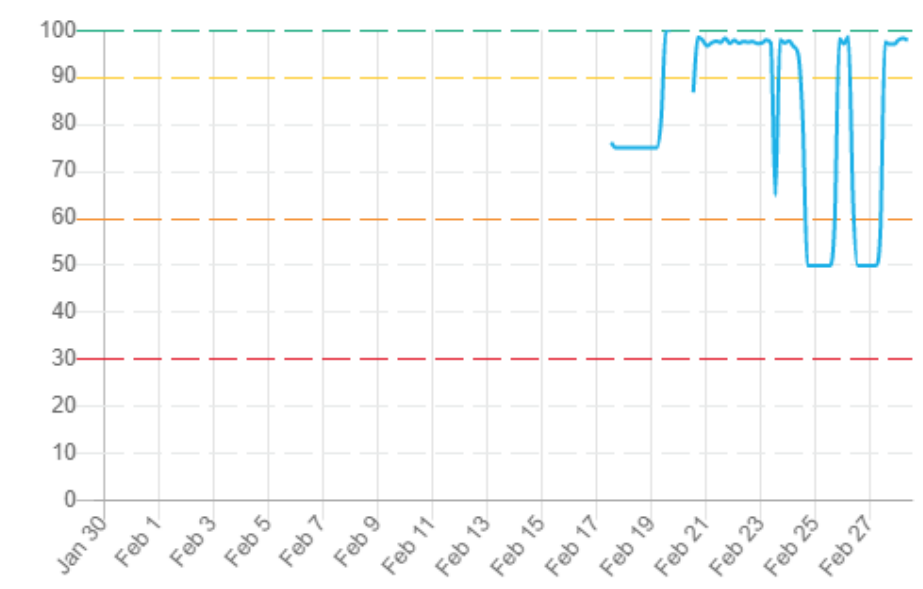


Temperature **72.50 °C**



Trend

1D 1W 1M 1Y 10Y



Health Health min/max

How to Get Started

Asset Templates

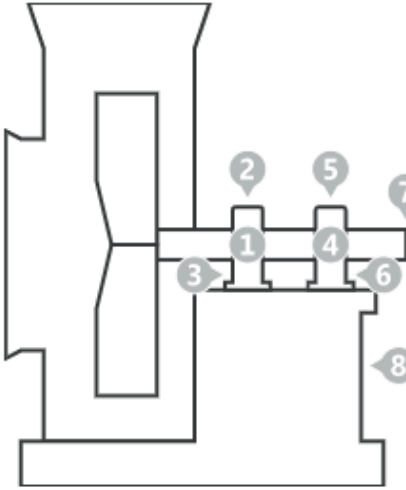
- **Embedded Prediction Asset templates:**













- **Pumps**
- **Fans**
- **Gearbox**
- **Generic rotating Motor**
- **Heat Exchanger**

- **Guided Setup**

- **What points to monitor**
- **Parameters and alerts**
- **Measurement types**
- **Easy configuration**

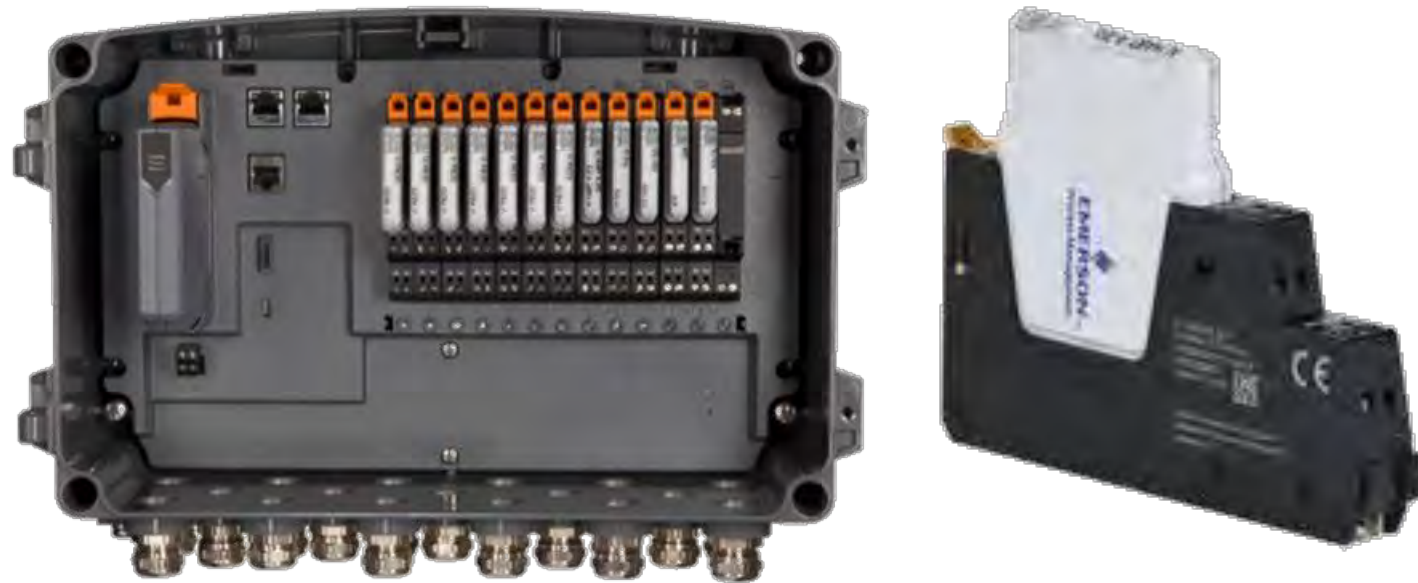
ML	ID	Description
1	FOH	Outboard horizontal vib
2	FOV	Outboard vertical vib
3	FOA	Outboard axial vib
4	FIH	Inboard horizontal vib
5	FIV	Inboard vertical vib
6	FIA	Inboard axial vib
7	FSPD	Speed
8	FTMP	Temperature



	Fan - axial, direct motor drive
	Fan - axial, gearbox drive
	Fan - centrifugal, centerhung
	Fan - centrifugal, overhung
	Gearbox - single reduction
	Generic - rotating, centerhung
	Generic - rotating, overhung
	Heat exchanger - tube - advisor
	Motor - electric, synchronous
	Pump - centrifugal, centerhung
	Pump - centrifugal, overhung
	Pump - centrifugal, overhung - advisor

Select a CHARM

- CHARM = sensor **CHAR**acterization **M**odule
 - A CHARM makes a channel into the appropriate input for the sensor it's designed to support



- AMS Asset Monitor has 12 CHARM slots for:
 - DeltaV CHARMs for Process Data
 - RTD – RTD Temperature Input
 - TC/mv – Thermocouple Temperature Input
 - AI – Analog Input 4-20 Transmitter
 - DI – Discrete Input Tachometer
 - DO – Discrete Output Relay
 - Vibration "VI" CHARM
 - Accelerometers
 - Velocity Sensors
 - Dynamic Pressure Sensors
 - Tach Charm
 - Eddy Current, MPU, and Hall Effect
 - Vibration Charm
 - Eddy Current Sensors

Sensor Options

Prediction Sensors



Accelerometers

Protection Sensors



Eddy Current Sensor with 4-20mA Transmitter



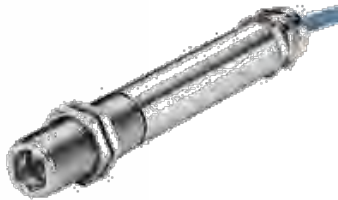
Temperature Sensors



Thermocouple



RTD



4-20 mA

Other Sensors (4-20mA and Piezo)



Rosemount Transmitters



Water In Oil



Static Pressure



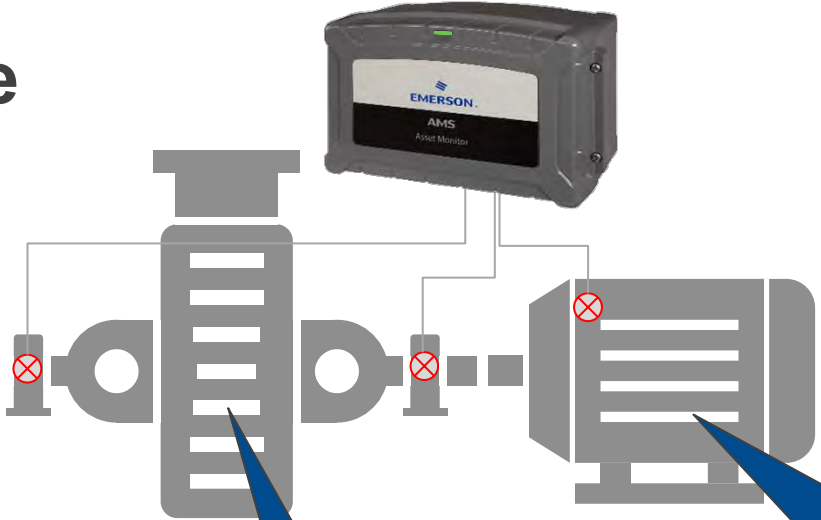
Current



Dynamic Pressure

Embedded Prescriptive Automated Analysis

- Selectable by asset type
- 10 common faults:
 1. Balance
 2. Alignment
 3. Looseness
 4. Blade Pass
 5. Flow Turbulence
 6. Gear Mesh
 7. Hunting Tooth
 8. Bearing
 9. Lubrication
 10. Motor



- Plus Process Inputs
1. Static Pressure
 2. Differential Pressure
 3. Mass Flow
 4. Temperature
 5. Lubrication Leakage
 6. Position
- and many more

- Pump**
1. Balance
 2. Alignment
 3. Looseness
 4. Blade Pass
 5. Flow Turbulence
 6. Bearing Fault (PeakVue)
 7. Lubrication (PeakVue Plus)

- Electric motor**
1. Balance
 2. Alignment
 3. Looseness
 4. Bearing Faults (PeakVue)
 5. Lubrication (PeakVue Plus)
 6. Motor Faults

Health scores and meaningful alert messaging allow all personnel to understand asset health condition

Standards-Based Vibration Alerts

- ISO 10816/20816 vibration severity limits
 - Class I – small machines
 - Class II – medium machines
 - Class III – large rigid foundation
 - Class IV – large soft foundation
- Custom Alerts
 - For specific limits

VIBRATION SEVERITY PER ISO 10816					
Machine		Class I small machines	Class II medium machines	Class III large rigid foundation	Class IV large soft foundation
in/s	mm/s				
Vibration Velocity Vrms	0.01	0.28			
	0.02	0.45			
	0.03	0.71		good	
	0.04	1.12			
	0.07	1.80			
	0.11	2.80		satisfactory	
	0.18	4.50			
	0.28	7.10		unsatisfactory	
	0.44	11.2			
	0.70	18.0			
0.71	28.0		unacceptable		
1.10	45.0				

Analytics

Choose diagnoses to be calculated and their sensitivity.

Alert limits

Sensitivity	<div style="border: 1px solid black; padding: 2px;"> Class II - medium machines ▾ </div> <ul style="list-style-type: none"> Class I - small machines <li style="background-color: #007bff; color: white;">Class II - medium machines Class III - large rigid foundation Class IV - large soft foundation Custom
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Automated Data Collection Software – AMS Machine Works

Next Generation Vibration Analysis Platform

Quick Identification

Key Performance Indicators (KPI)

- Machine Measurement Status
- Device Measurement Status
- Device Status
- KPI determines asset tiles
- KPI and Asset tiles used for navigation
 - Quick method for analysis

Navigation

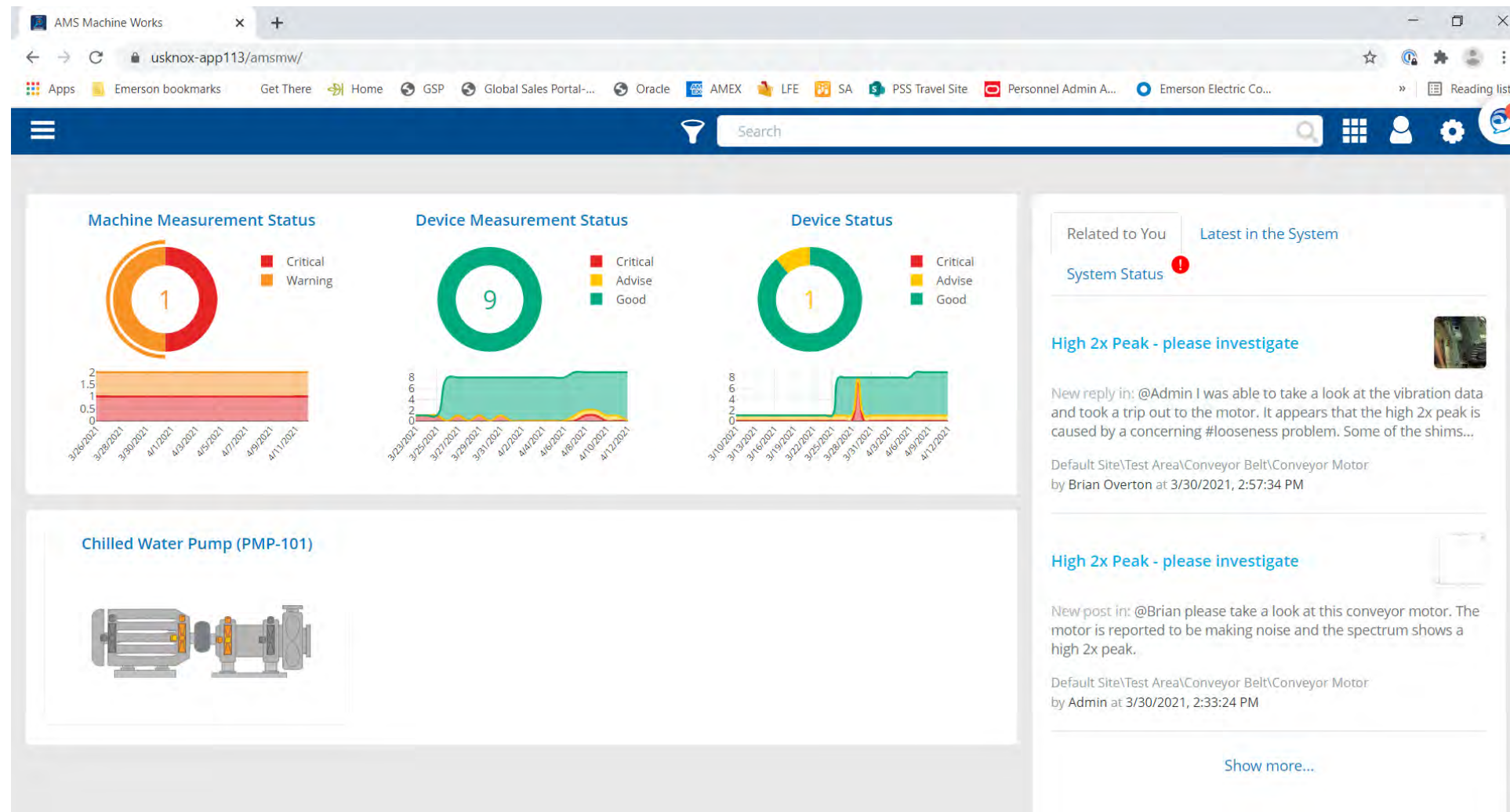
Easy to find asset of interest

- KPI navigation
- Search bar
- Navigation tree

Asset Dashboard

Limiting data for specific user/location

- Dashboard Filter – temporary
- User Manager – data access granted by system administrator - permanent



Automated Data Collection Software – AMS Machine Works

Next Generation Vibration Analysis Platform



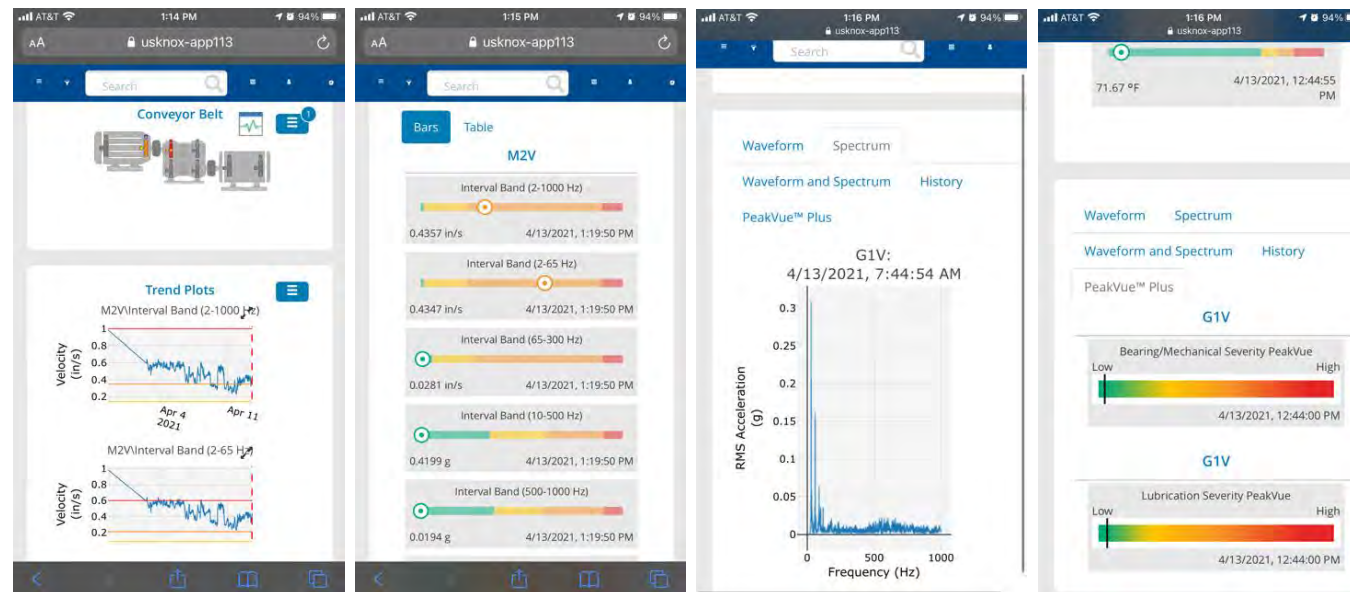
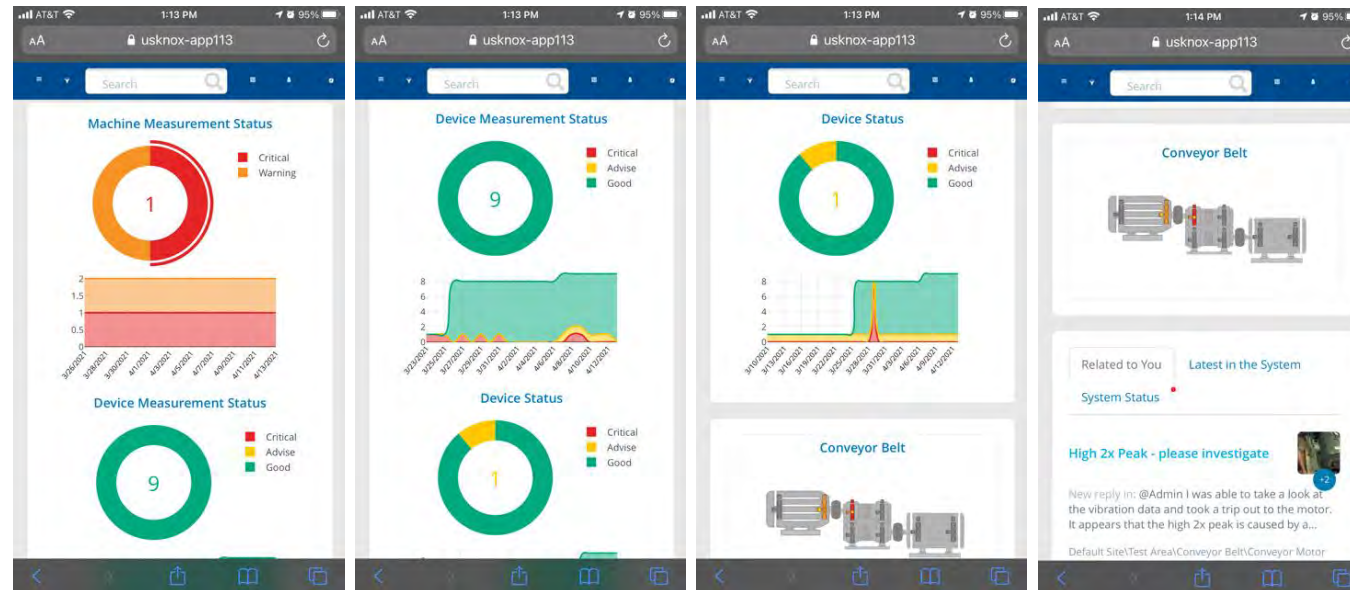
Same Toolbox as AMS Machinery Manager

- Same diagnostic tools to aid analysts of all levels
- Available “tools” are active plot sensitive
- Fault Frequency Overlays
- Harmonic Family Identifiers
- Differential (Sideband) Family Identifiers

Setup Data Collections Your Way

- Enable/Disable data storage based on your need
- Store on Alert capability
 - Store data (user specified) when an alert condition is detected
- Demand Collection
 - Any data type has an ability to collect on demand – when you need it

Automated Data Collection Software – on Your Mobile Device



Visibility From Where You Are

AMS Machine Works is Thin Client

This means that the system is running on a server located on your network, or in the cloud, and you access Machine Works using a browser.

- Phones/Tablets have browsers installed
- If permitted by local IT policy, mobile devices may be used to view data/status of assets
 - Portrait view
 - Landscape view
- Diagnostics capability on the PC
 - On roadmap to migrate these tools to the thin client application

Summary

- Automating data collection can leave more time for higher value tasks like data analysis and root cause determination
- Automated data collection and pervasive sensing have become more affordable and easier to deploy than in years past
- Built-in prescriptive analytics and edge analytics can further enhance efficiencies by automating the data collection and analysis and providing condition monitoring benefits to users with less experience
- Portables still have a critical role in the reliability strategy for troubleshooting and machine health verification
- Do more with less resources using a balanced approach between automated and portable monitoring

Questions
