# IoT

# Industry 4.0

# Machine Health Management

# THE DEVELOPMENT OF “AUTOMATION INTELLIGENCE” BY TECO

# Motivation


***Elevate "PRODUCTIVITY" to the highest level !***

1. Less labor with **Safety**

3. Flexibility with **Quality**

2. Service-driven **Agility**
With real time data.

# TECO Group

## Introduces the Market Leading

# ALL-SMART
# MACHINE HEALTH MANAGMENT
# (MHM) PLATFORM

# TECO Group

## All-Smart Machine Health managing (MHm) Platform

1. Install especially designed sensors/transducers in any machine in order to obtain operational data. Through the Internet of Things Gateway (IoT Gateway) , connect to remote smart phones or control room servers for machine health management.

2. Add a large scale server-based software with strong management functions, and the versatile, easy-to-use smart phone APP (iOS, Android), we have the TECO Smart MHm.

# Evolution of Machine Equipment Maintenance Philosophy

# METHODS OF MAINTENANCE

## THERE ARE THREE WAYS TO PERFORM MAINTENANCE:

**[John Mitchell, *Machinery Analysis and Monitoring*, 1993, pp. 485-486]**

- **PREDICTIVE**
  - Predictive maintenance is defined as maintenance actions, e.g. repairs, overhauls and component replacement based on assessment of machinery condition through condition monitoring techniques
- **PREVENTIVE**
  - Preventive or calendar time-based maintenance is accomplished at fixed time intervals regardless of condition.
- **REACTIVE**
  - Reactive or breakdown maintenance is the default alternative if problems aren't detected and corrected prior to machinery failure. This is the most expensive of the three, however perhaps justifiable on small nonvital machinery.

# REACITVE MAINTENANCE

**DISADVANTAGES:**

- **Unscheduled shut-downs;**
- **Production losses;**
- **Catastrophic failures**
- **Environmental disasters**
- **Excessive spare parts stock;**
- **Increase risk of accidents (personnel, material and/or environmental);**

# BENEFITS OF PREDICTVE MAINTENANCE

Predictive maintenance is based on condition monitoring techniques, which encompass periodic measurements of key electrical and mechanical parameters that yield an instantaneous picture of machinery service reliability, resulting in the following benefits:

- ⇒ Minimisation of unforeseen failures and subsequent production loss
- ⇒ Decrease in number of catastrophic failures
- ⇒ More efficient use of resources, with efforts directed to programmed shutdowns rather than reactive panic breakdowns
- ⇒ Decrease in overtime and breakdown repair costs

""“Organisations operating efficient programs centered around predictive maintenance report as much as a 50-60% reduction in maintenance costs compared to breakdown maintenance and a 30% reduction compared to preventive maintenance.” (Mitchell, J, 1993: p. 488)

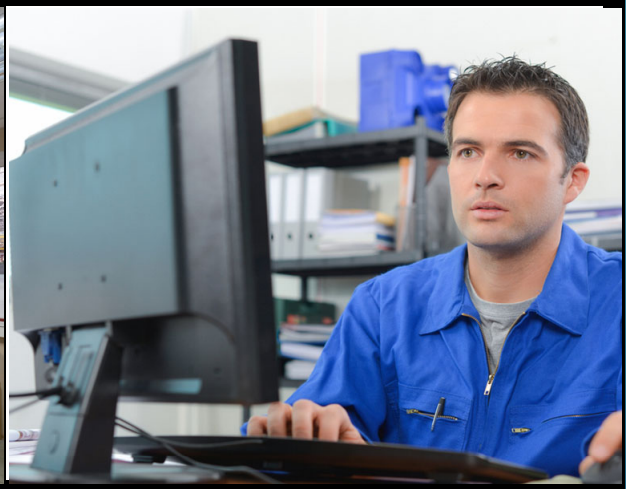
# PREDICTVE MAINTENANCE REQUIREMENTS

A good predictive maintenance program is based on:

- ⇒ In depth knowledge of those factors that can potentially reduce a machine's service life
- ⇒ Periodic or constant monitoring of the aforementioned factors
- ⇒ A solidly implemented predictive maintenance based program
- ⇒ Employment of experts in machinery condition monitoring
- ⇒ Commitment at all levels, operational and managerial, to such program

"Additional maintenance savings that have reportedly been attained with predictive methods include a reduction in labor costs by 20%, overtime by 35% and spare parts by 20%." (Mitchell, J, 1993: p. 488)

# Evolution of Maintenance Practices



In the beginning, it required physical presence on site.

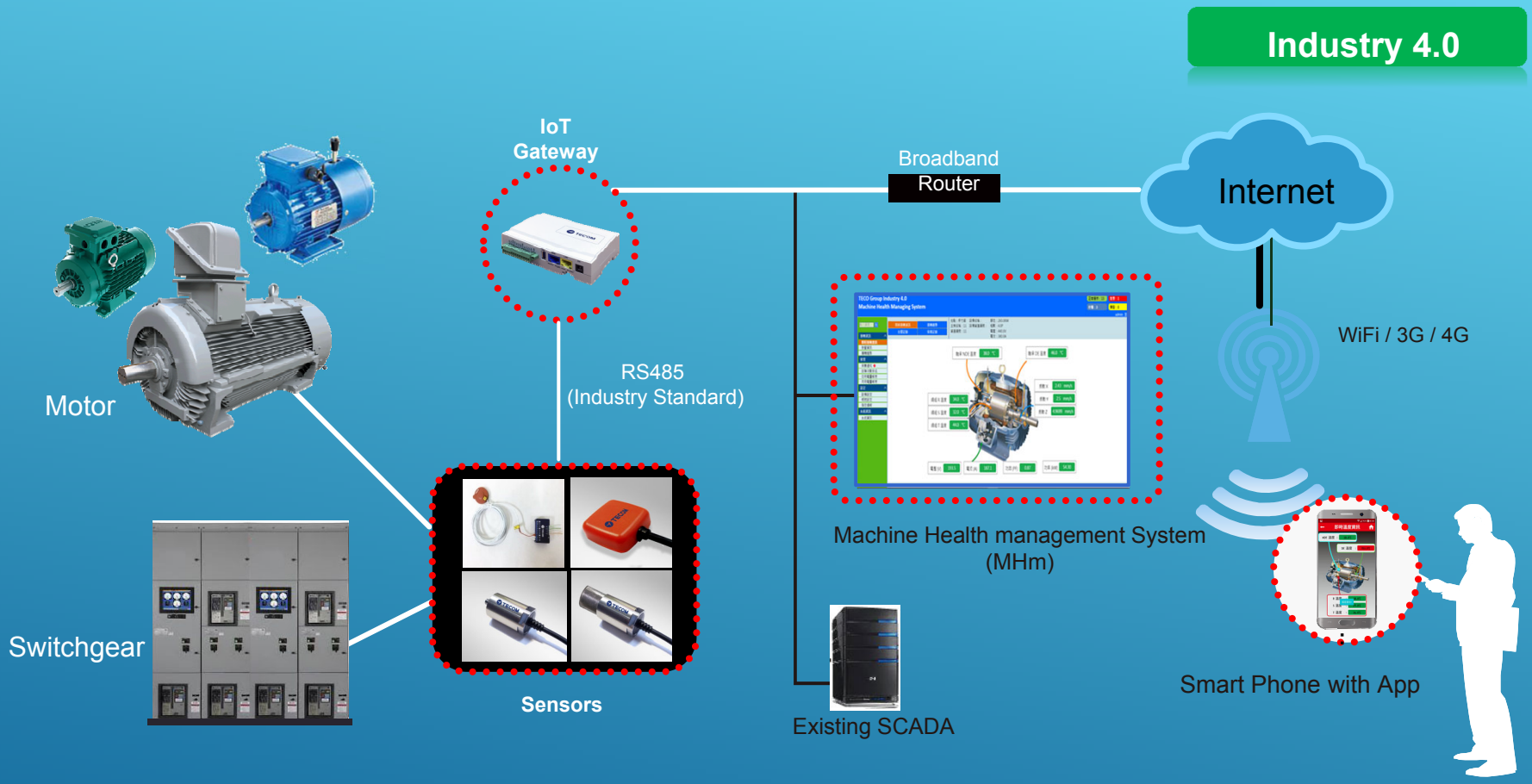
Later, a technician watched data in a control room.

Today one can see data on the office PC, the so called on-line watch.

**IoT era is coming, the on-line platform will** continue to evolve

***Next generation***

# Application Structure Diagram




**All remote operations are managed by Private Cloud, to protect operation privacy.**

# TECO 4.0 MACHINES REPORT/RECEIVE OPERATIONAL HEALTH DATA

**There are three functions for the four key variables being monitored (V, I, Temp and Vibration):**

1. Real-time report  and alarms.
2. Trend report to establish non-scheduled maintenance suggestions.
3. Emergency reports, including SMS to designated maintenance personnel.

## What to manage

### Machine Health Vitals

- Current
- Voltage
- KWh (Consumption)
- Vibration
- Temperature
- RPM
- Torque

**The MHm Platform consists of :**

1. **Especially designed Teco sensors**

   ►To be installed to any operating machine, retrieving their operational data, converting into RS-485 format and connecting to the IoT Gateway.

2. **IoT (Internet of Things) Gateway**

   ►The IoT GW receives operational data from the sensors, access the mobile internet with IoT communications protocol, and connect virtually to remote smart phones for Machine Health management. The IoT's always-connect and push-notification capabilities enable remote and real-time machine monitoring, reporting, alarming, diagnosis and control .

3. **Large scale server-based software, with strong management functions; plus versatile and easy-to-use smart phone Apps.**

## How To Manage
## Remotely, Interactively and in Real-time

The MHm deploys IoT (Internet of Things) technology.

The IoT Gateway always-connect and push-notification capabilities enables the remote monitoring, reporting, alarming and diagnosis of any machine. This is done interactively and in real-time via remote smart phones.

Conventional SCADA or Web-based on-line system do not have always-connect nor push-notification functions. Thus, they cannot make machine management interactive.

In comparison, the TECO MHm represents a new generation maintenance concept, with clear advantages over SCADA or Web-based systems.

# TECO Machine Health Management Features

1. **Operational Data Reports**

   real-time-on-demand, pre-set time reporting

2. **Trend Reports**

3. **Remote Alarms**

   The MHM provides 4 types of alarms to protect the machines from various angles:

   a) Over-Value Alarm

   b) Sudden Change Alarm

   c) Trending Alert

   d) Pre-set time alert

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# TECO Group Industry 4.0
# Machine Health managing System

Running : 0 | Offline : 1 | Stop : 2

Sudden : 0 | Alarm : 0 | Pre-Alarm : 1

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Input Equit No

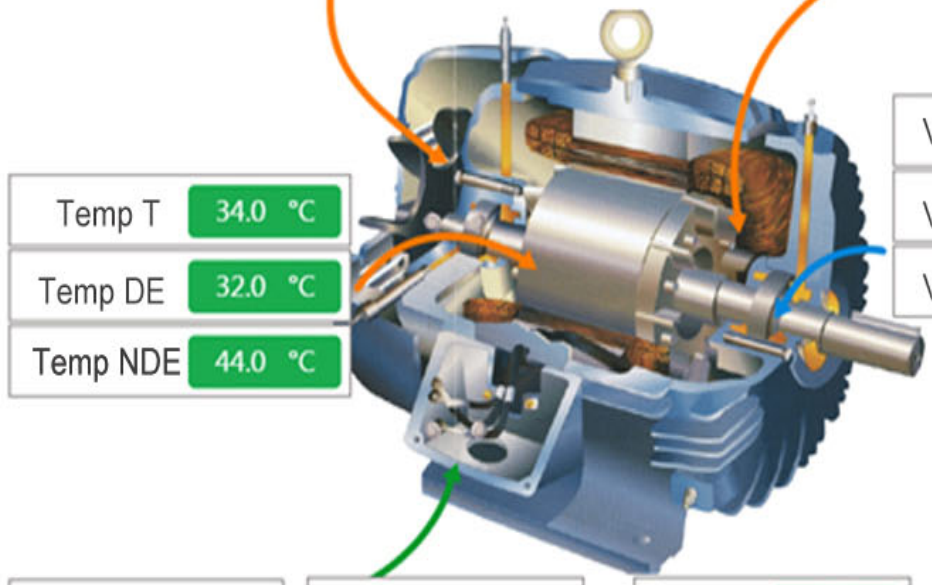
- Working Data
  - Real Time Working Data
  - Alarm
  - Operation Data Trend
- Management
  - Maintainence
  - Equip. Failure Ranking
  - Elec. Daily Report
  - Elec. MTH Report
  - History of running information
- Setting
  - Equipment Settings
  - Account Settings
  - Specify notification
- System Information
  - Egateway Upgrate
  - Turn Off Egateway Data
  - System Information

Real Time Working Data | Operation Data Trend | Warn Record | Maintainence

Location : location1
Hostname : 166
Host Asset ID : 166

Equip Serial No. : 166
Device Asset ID :
Device Model :

Rating : 60.0KW
Poles : 3.0P
Voltage : 220.0V
Current : 30.0A



## Benefits

1. The essence of MHm is to make “Mobile Maintenance” possible. Mobile Maintenance (MM) is the new maintenance philosophy and trend, it is one step more advanced than preventive maintenance (PM) , the current core maintenance concept. Through this technology maintenance can be done at any time, in any place, and interactively. The savings are substantial.

2. MHm keep machines working at optimum conditions, with highest productivity and lowest energy consumption.

3. These benefits generated by maintenance automation contribute directly to the reduction of manufacturing costs.

TECO Electric Proudly Introducing

# The First Industry 4.0 Grade Smart Motors

TECO

Operational Status

Maintenance Tips & Records

Remote Monitoring

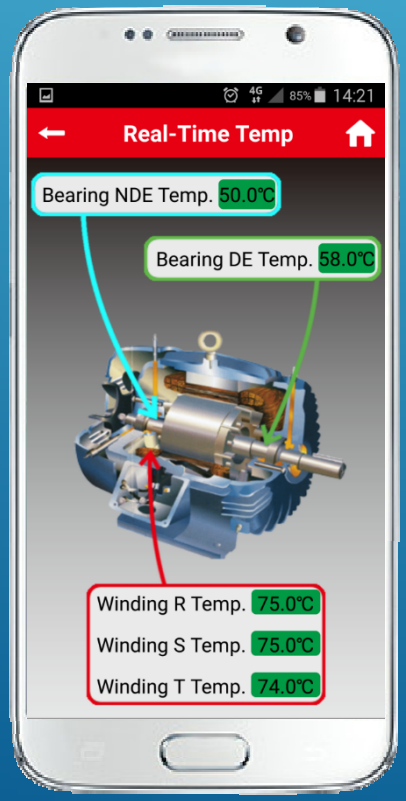
Remote Diagnostic

# *Full Mobile APP*,
# entering Industry 4.0 Generation

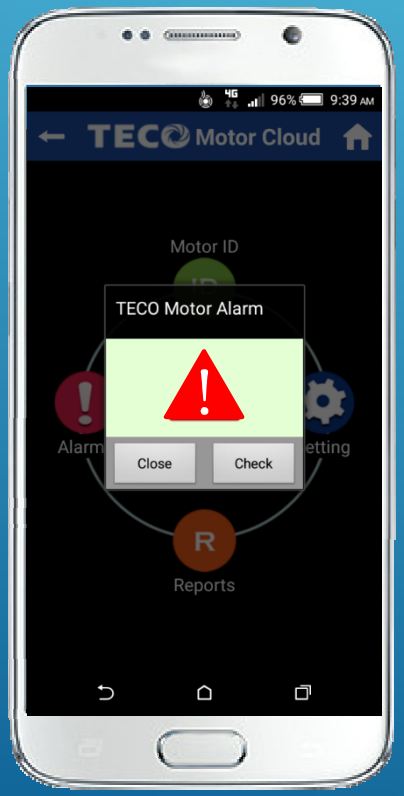
# 1. The Core module is The Data Acquisition and Diagnostic Unit:

It is equipped with self-learning capability (Big-Data), providing 3 functions:

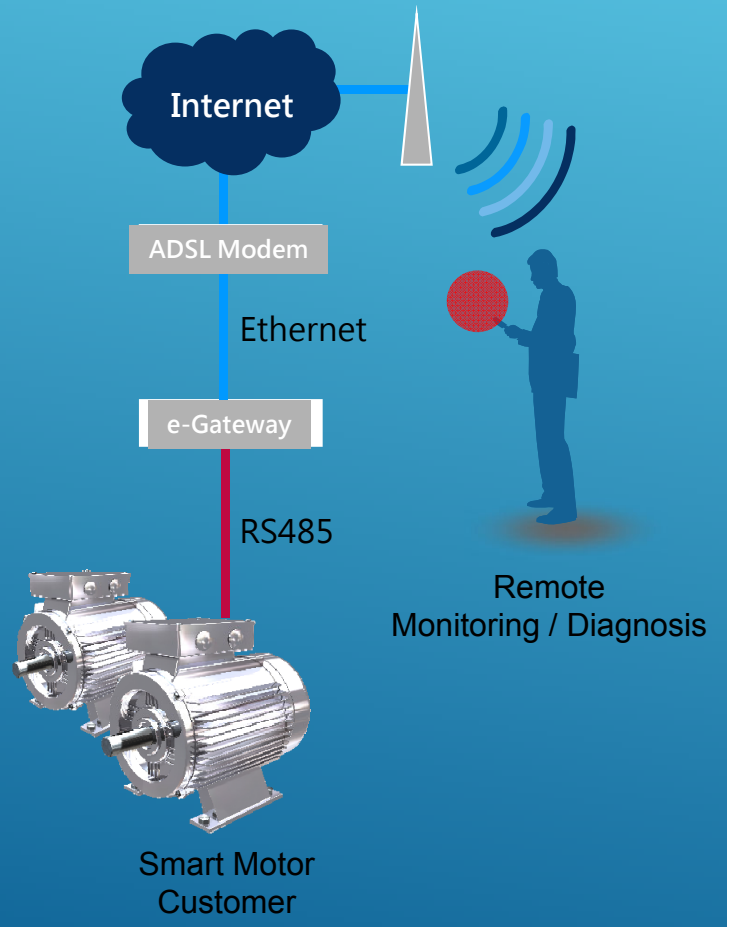
1. Collect operation data via sensors.




2. Generate early warning, diagnosis, root-cause suggestions, and provide repair records.



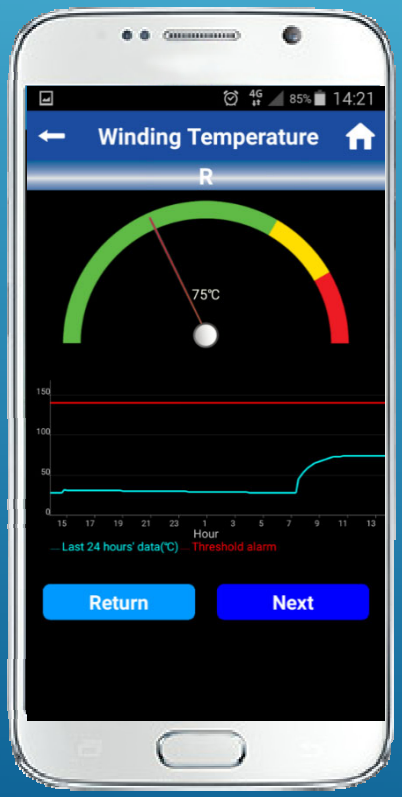

3. Report and receive, via internet communications with smart mobile devices.

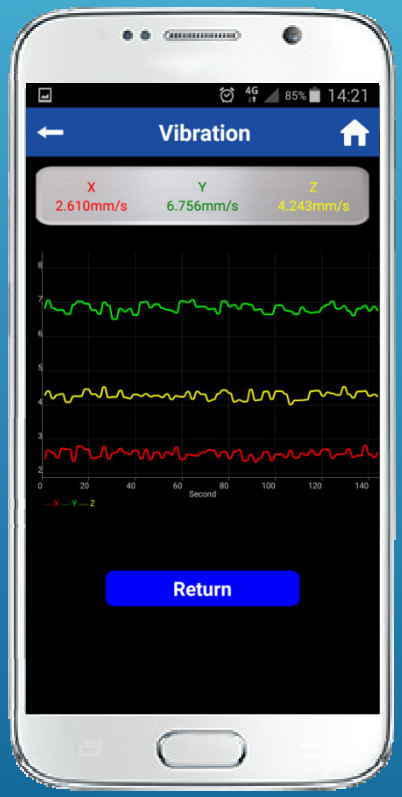


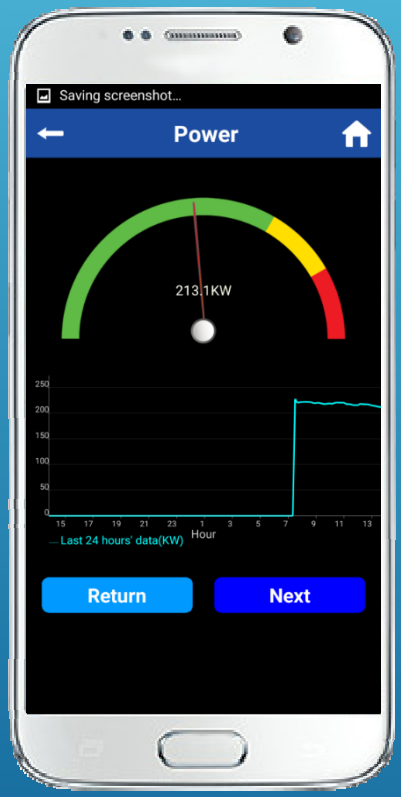
## 2. With special APP, users can remotely :

**a. Monitor:** motor operational status

- Temperature (widings and bearings)
- 3-D vibration data
- Voltage, current, power factor, KW, etc...

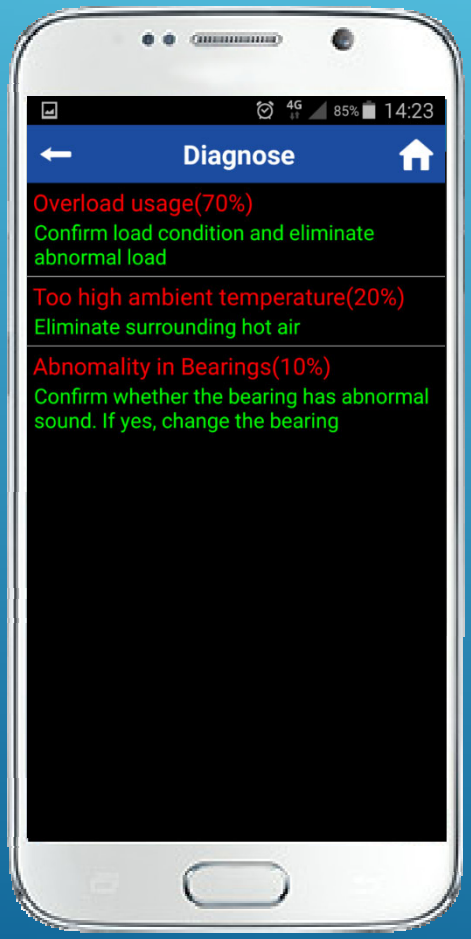



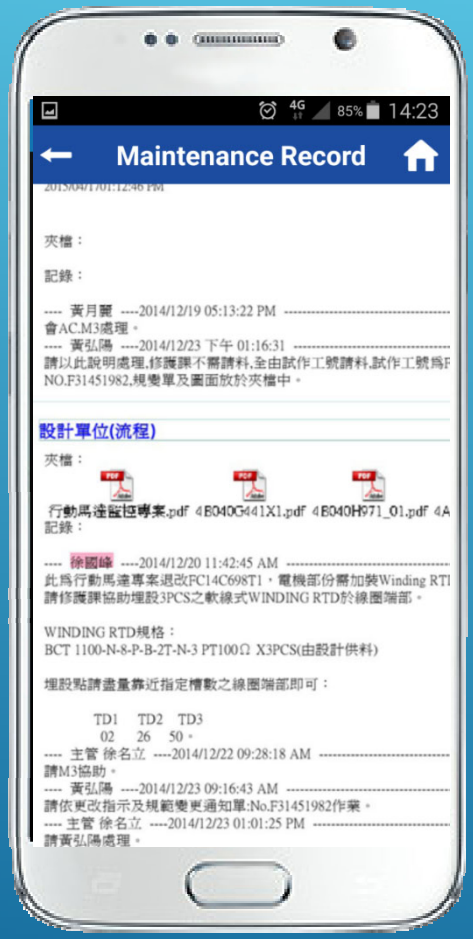



## b. Receive data :

- warning and alarms
- diagnostics
- root-cause suggestions etc.

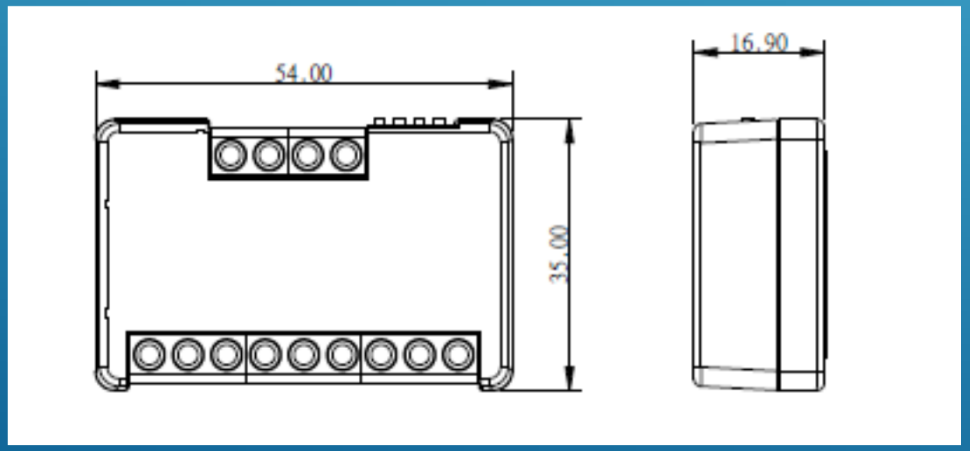



# Other Sensors

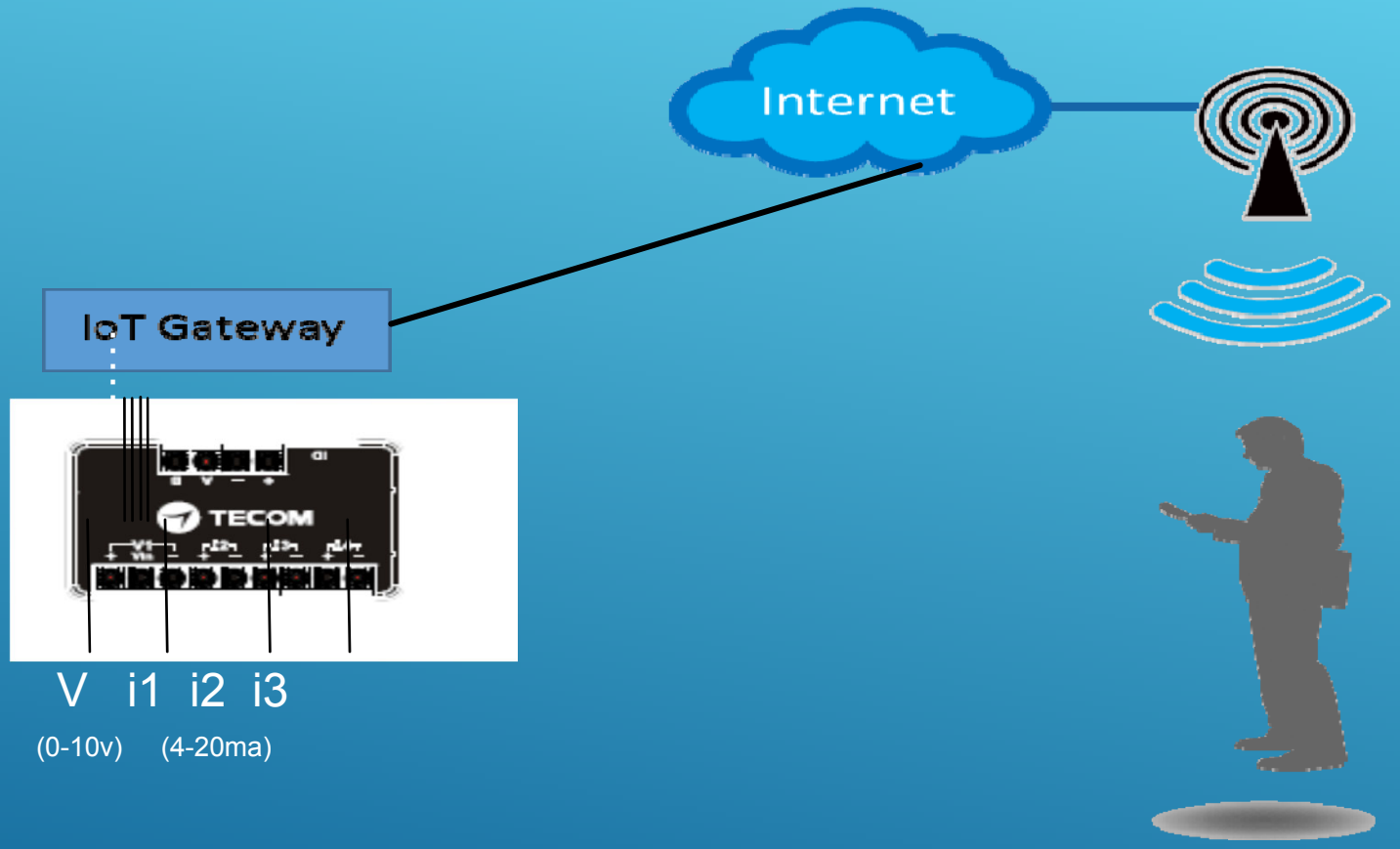
# IoT Gateway for Other Sensors

RS485 signal converter enabling on-line reporting of other parameters such as pressure and flow.





# IoT Gateway with Transducer

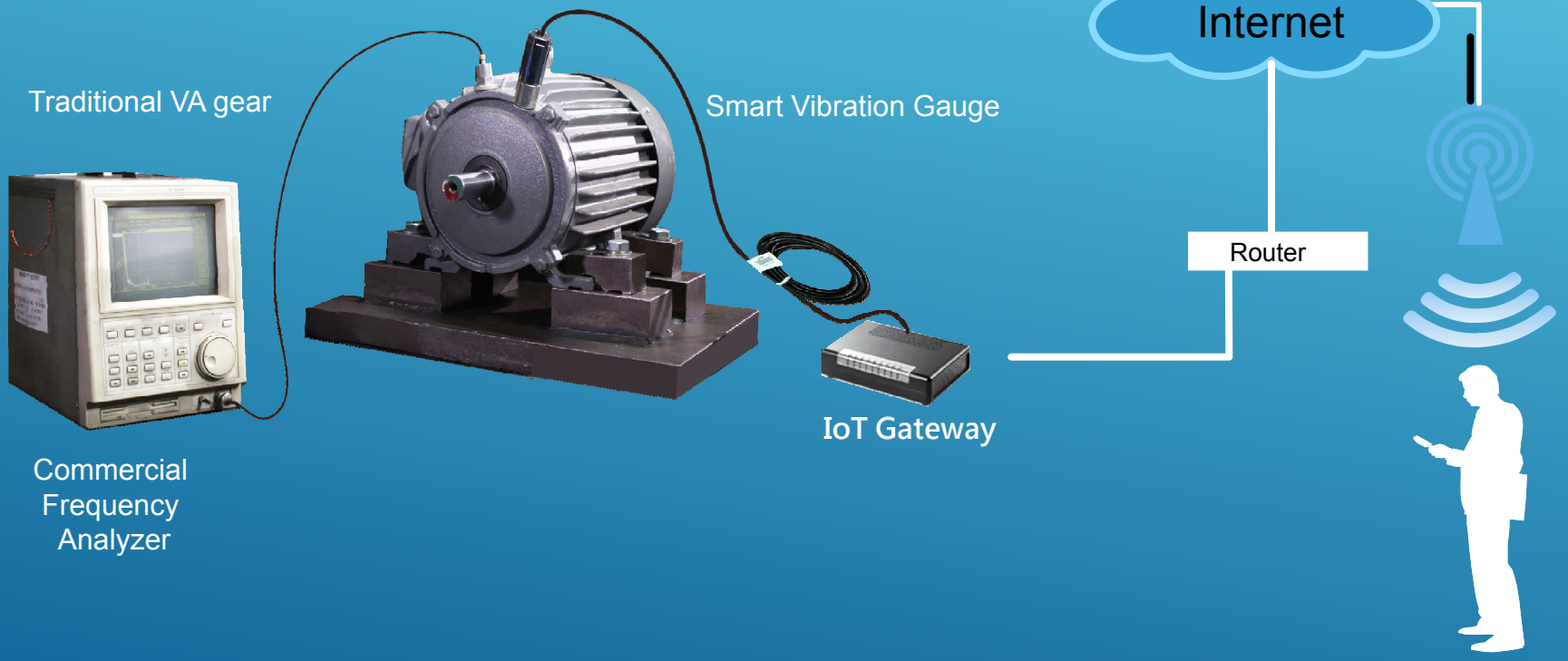



The output from pump Pressure or  Flow sensors are accessed via IoT gateway.

# Smart Vibration Gauge

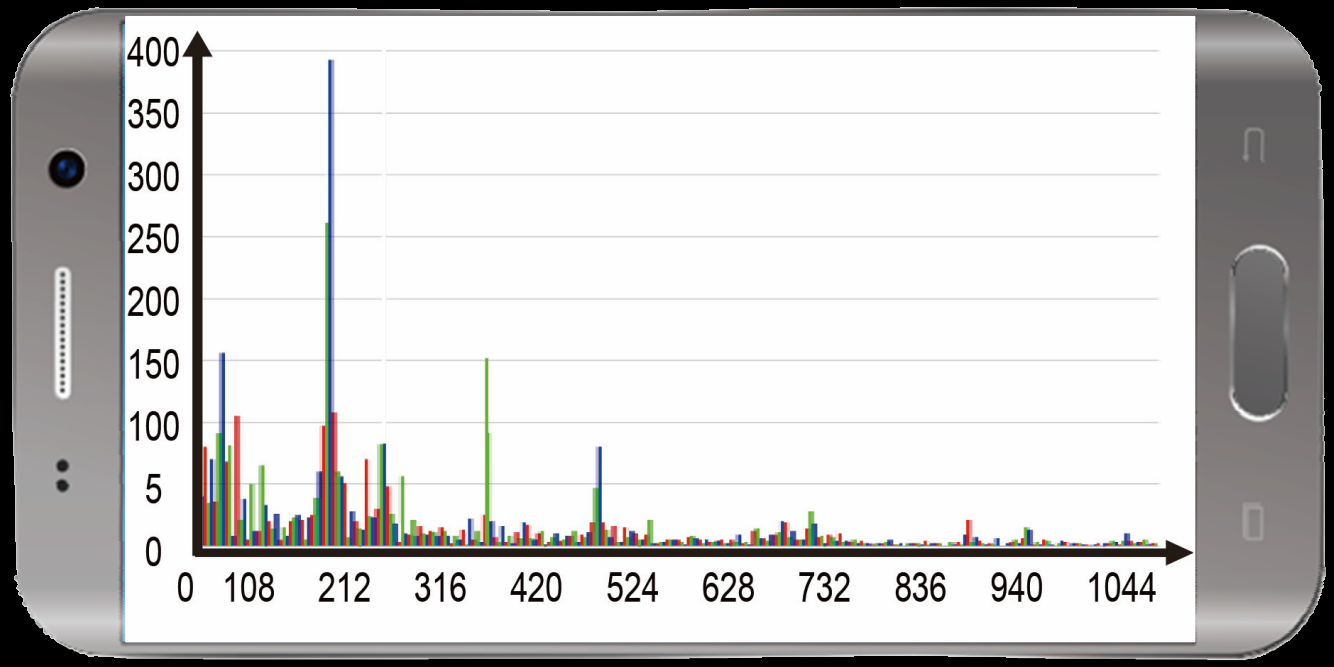
# TECO Smart Vibration Gauge

# Installation Diagram (Motor)

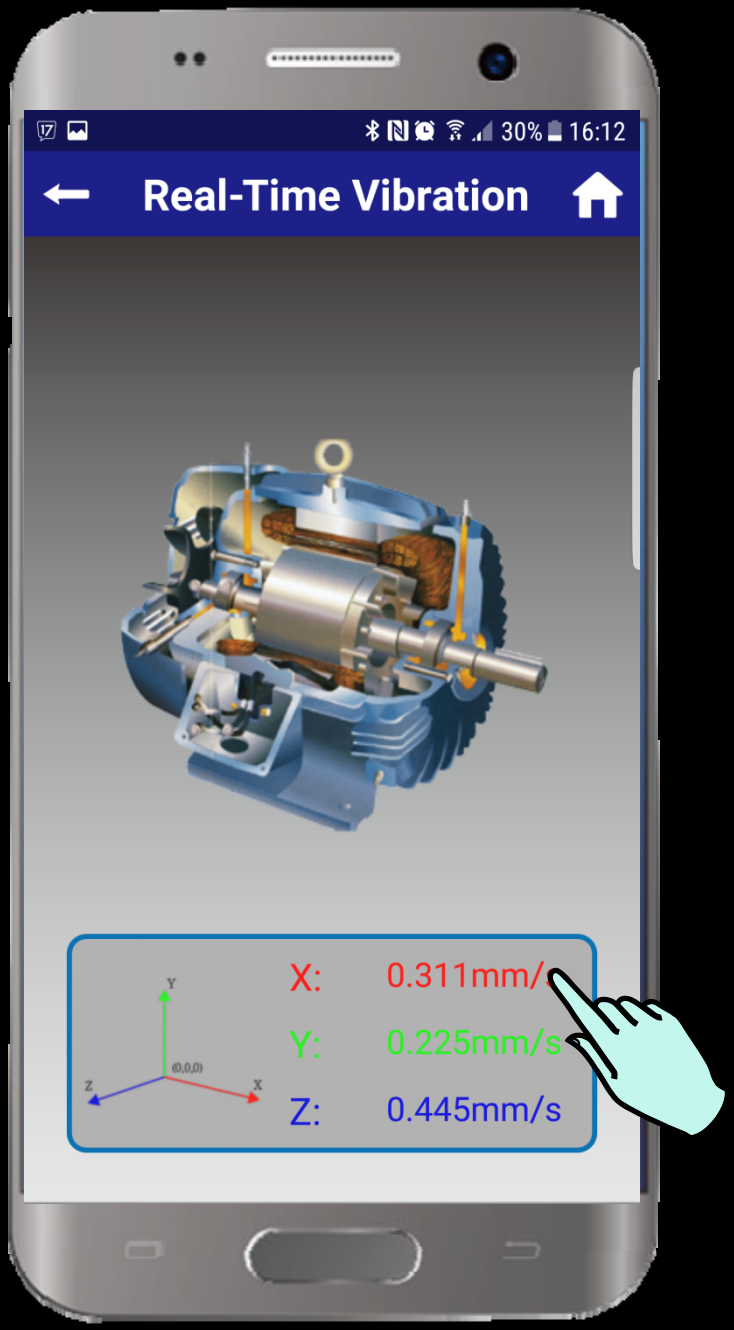


**The Smart Vibration Gauge Provides 3 axis Vibration Data in Time Domain (RMS) and Frequency Domain (FFT)**

**The Time/Frequency Data are selectable from remote Smart Phones**



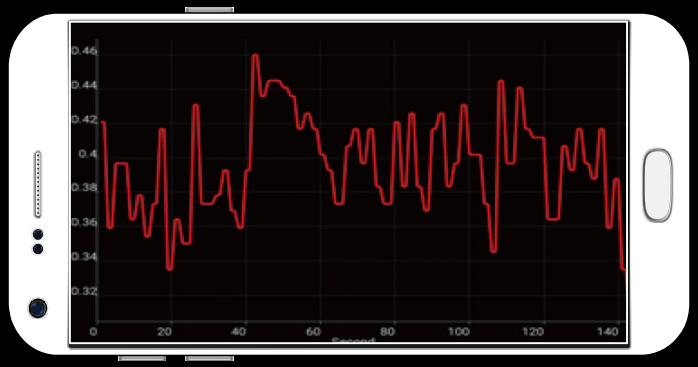

## Freq. Domain Display : Speed or Acceleration (FFT)



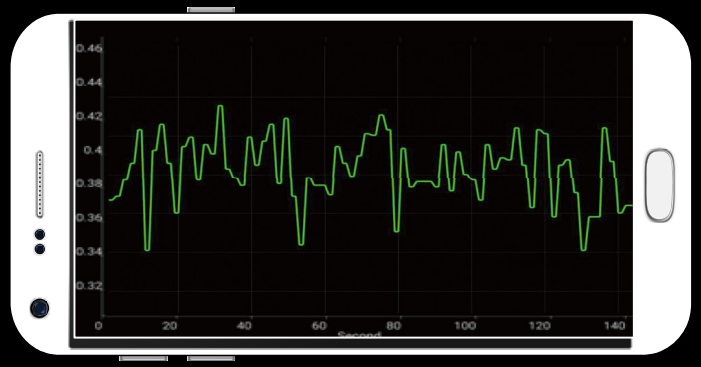

Select Time-Domain Data

Push “time-domain” values

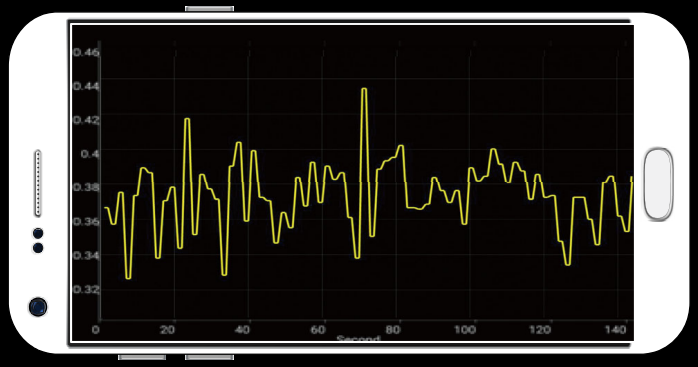
# **Time Domain** (RMS) Displays :




X-axis




Y-axis speed / Acc. RMS



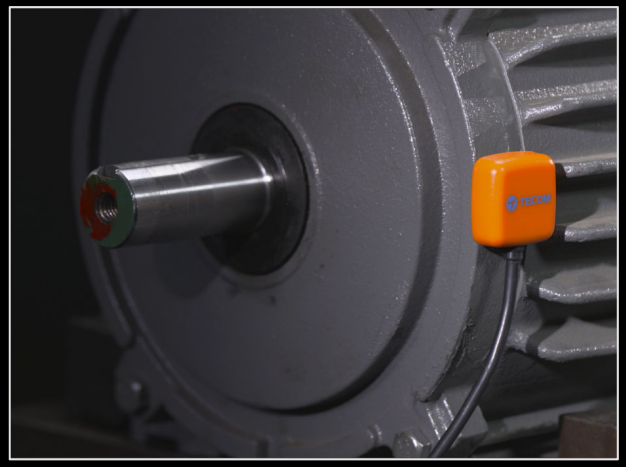

Z-axis

## TECO Smart Vibration Gauge reports the vibration data to selected remote smart phones：

- It is a reliable alternative to traditional VA equipment, and can measure vibration at any place, any time.
- It provides remote, real-time, Time/Freq. selectable, alarms, and interactive diagnosis, all new and innovative features :

# Easy Installation

# Easy to install, suitable for various types of machines



Stick-on type


Screw type


Magnetic-suction type

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Introduces

# Vibration Diagnosis Instrument PRO-3200

TECO


# "Portable Vibration Diagnosis Instrument"

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Industry 4.0

- 2 Integrated Vibration sensors


- IoT Gateway with Built-in WiFi


- Mobile Power Pack

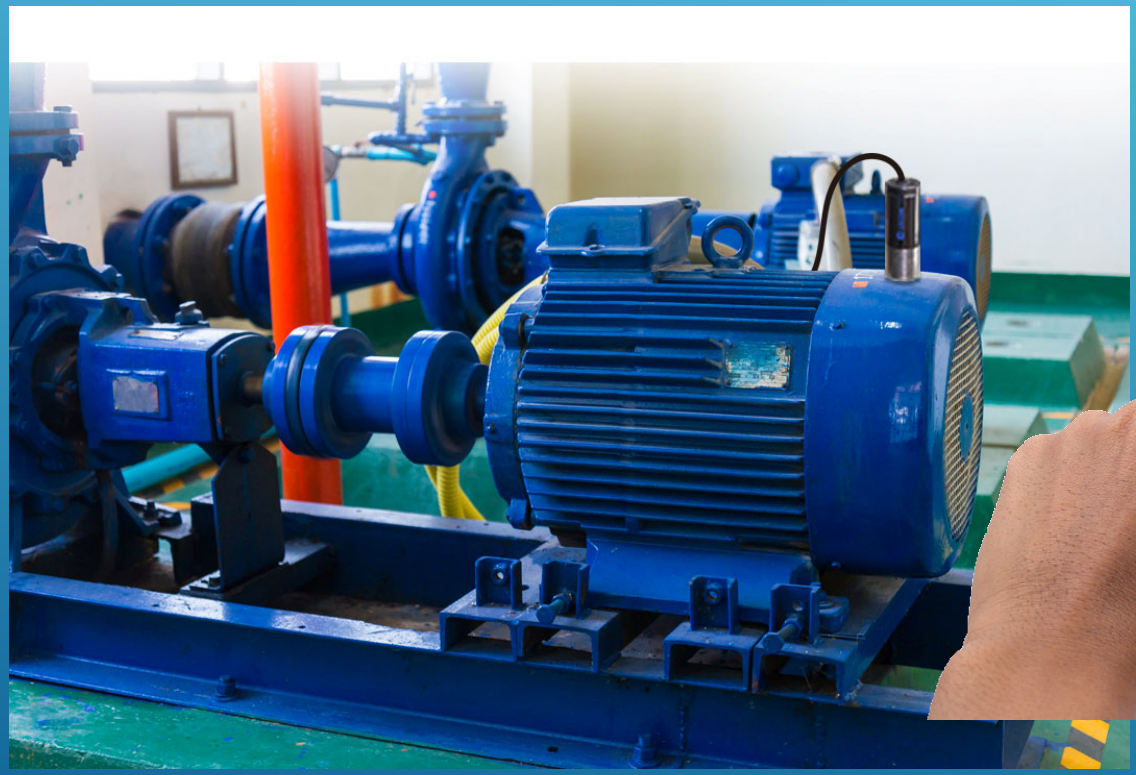
- Versatile and Easy to use Smart Phone APP (iOS, Android)

# Just plug the gauges and the mobile power pack to the Gateway and play.

**Industry 4.0**

# Instant diagnosis of machine vibration

Industry 4.0



# On-site Maintenance Operations

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Industry 4.0

1. Measure the 3-axis velocity/acceleration RMS data and compare against specified values (ISO standards).
2. Select FFT data and examine for energy distribution in Frequency-Domain.
3. From the frequency distribution, perform interactive diagnosis on possible defects such as misalignment, unbalance, soft-foot and bearing defect. The IoT software and smart phone App will guide the diagnosis process step by step.
4. Record all operation data for future repair references.

# New Trend

## Mobile Maintenance (MM)

Remote, Real-time, Alarming, Interactive, Diagnosis


TECO Smart Vibration Gauge applies the IoT technology, virtually connecting to selected remote smart phones. Those smart phones can do remote **monitoring, reporting, alarming, diagnosis and control** to manage the machine operational health. These are all necessary conditions for the new generation mobile maintenance.

**Currently, it is the market 1st and Only Smart Vibration Gauge.**

# Conclusions

The Smart Vibration Gauge is a high-tech 3-axis vibration sensor, integrated transducer, and IoT Gateway. It is available in three types: stick-on, screw-down and magnetic-suction, all are very easy to install.

Vibration measurement, data analysis, real-time interactive diagnosis, all-in-one.

Enables mobile maintenance, resulting in significant savings in maintenance costs.

Market 1st, competitively priced, suitable for all existing machines. A fast and effective way to enhance your plant to **"industry 4.0"** standards.

# Thank you