Faraday Predictive Inpod Manual

Version 1.3 2026

Contents

*Items in this manual are subject to change.

About

Faraday Predictive Ltd helps asset owners and operators become more efficient, through the adoption of optimised maintenance strategies, particularly Condition Based Maintenance, enabled by Model-Based Voltage and Current (MBVI) Condition Monitoring Systems.

Faraday Predictive brings more than a decade of experience with MBVI systems, and several decades of experience helping organisations improve the performance of their Maintenance and Operations activities.

Based in Cambridge, we build on the world-leading capabilities of Cambridge University departments including Mathematics, Computer Science and Engineering, allowing us to develop leading-edge solutions from the ground up. We have also had superb support from Mathematicians and Scientists from a number of other leading universities.

We combine this academic expertise with deep practical experience of the worlds of maintenance and asset management, of traditional Vibration-based Condition Monitoring technologies, and of education, training and consultancy support to deliver real improvements in many different industry sectors. We have real experiences of implementing RCM, TPM, CMMS/EAMS, and a variety of other maintenance improvement initiatives.

We have used this experience to define and develop the Faraday Predictive Condition Monitoring Systems, to make sure they are easy to use, easy to install, and that they provide easy to understand, actionable advice, that explains why the system has diagnosed a particular problem, the likely effect of that problem, and the recommended course of action. In short, they are designed by engineers like you for engineers like you.

Whether you just want a quick assessment of the condition of one or two machines, or are looking to implement a comprehensive Condition-Based Maintenance strategy, we are here to help you – through the supply of world-leading technological solutions, education and training, or consultancy advice.

Faraday Predictive Limited

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Overview

Monitor your energy consumption and equipment condition 24x7 with the Faraday Predictive Inpod system and enable Condition-Based Maintenance in your organisation.

Designed to be mounted inside your motor starter cabinet, the Inpod provides you with a continuous assessment of your equipment health including mechanical, electrical and operational aspects, using a Model-Based Voltage and Current (MBVI) technique.

By simply measuring the voltage and current drawn by the motor driving your equipment it can identify a wide range of specific failure modes and assess the degree to which the equipment is suffering from these effects. This has the effect of turning your motor or generator into a high-precision condition monitoring sensor – actually, the only sensor the system needs to deliver actionable information.

It also measures energy consumption and identifies a range of energy wasting parameters, assessing the amount of energy wasted by each one, allowing you to take cost-justified action to reduce energy consumption. Faults identified include:

- Mechanical Unbalance/misalignment
- Bearing problems
- Foundation looseness
- Transmission looseness or rubbing
- Motor rotor bars
- Motor stator problems
- Electrical odd harmonics
- Electrical even harmonics
- Any other spectrum peak beyond the normal expected values

In addition, it provides information on the electrical parameters including:

- Active Power, Reactive Power and Power Factor
- Voltage balance
- Current balance
- Voltage THD
- Current THD

If more detailed machine specific information is available, such as individual bearing type codes, the number of vanes on a pump, or the ratios of transmission systems, then the system will automatically identify any problems associated with these, and report on them specifically. But if you don’t have this information, the unit will still function well using generic fault parameters instead. So, you can get started with very little setup and then refine your setup later to get even better results.

What is it?

The Inpod is a compact unit, H 176mm W 128mm D 40mm, designed to fit inside your electrical cabinets. It measures the voltage and current drawn by the motor, and from this is able to identify a wide range of developing faults in the motor and/or the driven equipment. It also monitors power consumption, and assesses the energy being wasted by each developing fault, allowing you to create a cost-benefit case for intervention based on energy saving grounds.

It gives you a continuous assessment of the condition of your equipment, allowing you to keep a close eye on critical equipment, avoid doing unnecessary maintenance work, and avoiding unexpected breakdowns. The Inpod can help you plan and schedule work efficiently.

It can also help you to optimise energy consumption on your equipment.

How do I use it? / How and where is it installed?

The Inpod is installed either right inside your motor starter cabinet if there is sufficient space, or in an adjacent or nearby electrical compartment or cabinet if your switchgear is particularly compact. The unit comes with Current Transformers to measure the current drawn by the motor, which can be mounted either directly on the feeds to the motor, or on the secondary signal cables from existing CTs feeding the motor protection system where fitted. Each unit has its own local processing unit and local database, which in turn communicates via Ethernet (wired or wireless, or even over an LTE WAN) to a central database, allowing you to view the status of the equipment remotely.

What outputs will it give me / How and where do I see the answers?

The outputs from each unit are viewed via the Faraday Predictive B20 software system, which pulls together the data from all the Inpod units you have installed, allowing you to view them in one place. The system gives overviews of condition on one or all of your assets, provides alerts if faults are detected, provides trend graphs showing the progress of deterioration, and provides an overview of the condition of the equipment itself, and of the electricity supply. It also provides a forecast of overall condition for one month and three months into the future. For each fault identified, it will provide information on the nature of the fault, how and why the system has identified it, the likely impact of the fault, and the recommended corrective action. Specifically, you can view:

- Overviews of condition of all assets (tree structure and summary)
- Overview of condition of individual asset – showing status of each relevant fault category for this type of equipment, and the quality of the electricity supply
- Simple traffic light (Green-Amber-Red) assessment of equipment condition NOW, 1 month in future and 3 months in future
- Trend plots for each developing fault, and for each available electrical parameter (eg active power consumption, or supply frequency)
- Time-domain plots of actual voltage and current waveforms.
- Frequency domain plots of the fault energy spectrum, with automatic identification and labelling of significant peaks in the spectrum

This information can be viewed on your desktop PC, or a tablet or mobile phone, provided it can be connected to the network where the software is mounted, which can be either on your network server or on our cloud server. In this latter case, you can view all the data via browser, avoiding the need to install special software on your own network at all, and simplifying the IT aspects of the installation.

Inpod Data Sheet

Description	Monitor your energy consumption and equipment condition 24x7 with the Faraday Predictive Inpod system, and enable Condition-Based Maintenance in your organisation. Designed to be mounted inside your motor starter cabinet, the Inpod provides you with a continuous, 24x7, assessment of your equipment health including mechanical, electrical and operational aspects, using a Model-Based Voltage and Current (MBVI) technique. By simply measuring the voltage and current drawn by the motor driving your equipment it can identify a wide range of specific failure modes, and assess the degree to which the equipment is suffering from these effects. It also measures energy consumption and identifies a range of energy wasting parameters, assessing the amount of energy wasted by each one, allowing you to take cost-justified action to reduce energy consumption.
Dimensions	H 176mm W 128mm D 40mm (to back of box, i.e. front of DIN rail)
Voltage measurement	Voltage 3 Phase 100-1000V Direct connection to motor drive or via secondaries on voltage transformer. VTs must provide <0.5% accuracy. Maximum voltage 1000 Vac RMS line-line
Current measurement	Current 3 Phase 10mA via Split-core CTs <0.5% accuracy. CTs provided by Faraday Predictive
Output connection	Local connection: 2 x USB 3.0 peripheral interfaces LTE: 4G/5G network connection (optional) Ethernet: RJ45 connection to Modbus, intranet/internet
Power	Either: PoE:IEEE 802.3 Type 1 – 12.95W, 350mA 12VDC Barrel Connector (2.1mm ID, 5.5mm OD), 2A max
Environmental	-20 to +85°C <90% RH, non-condensing
Safety	EMC BSEN 61326, BSEN 61000 BSEN 61010-1 RED BSEN 62311 RoHS EN IEC 63000 Functional Earth & Double Insulated

EU Declaration of Conformity

1. Faraday Predictive Model Inpod series.
2. Faraday Predictive Ltd, St John's Innovation Centre, Cowley Road, Cambridge, CB4 0WS
3. This declaration of conformity is issued under the sole responsibility of the manufacturer
4. Inpod Condition Monitoring Unit for permanent installation measuring voltage and current drawn by motor driving the equipment or output by generator being driven by equipment

5. The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:
6.
    a. Low Voltage Directive (2014/35/EU)
        i. **EN 61010-1:2010** - Part 1 – General Requirements
        ii. **EN 61010-2-030:2010** - Part 2-030: particular requirements for testing and measuring circuits
    b. EMC Directive (Electromagnetic Compatibility Directive (2014/30/EU))
        i. **EN 61326-1:2013/AC:**2013 Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements
    c. RoHS (Restriction of Hazardous Substances (2011/65/EU))
        i. **EN 50581:2012** Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Signed for and on behalf of Faraday Predictive Ltd
Cambridge, January 2026
G.Walker, Director

Inpod Layout

Typical Inpod installation inside a cabinet.

Example shows voltage connectors plugged in.

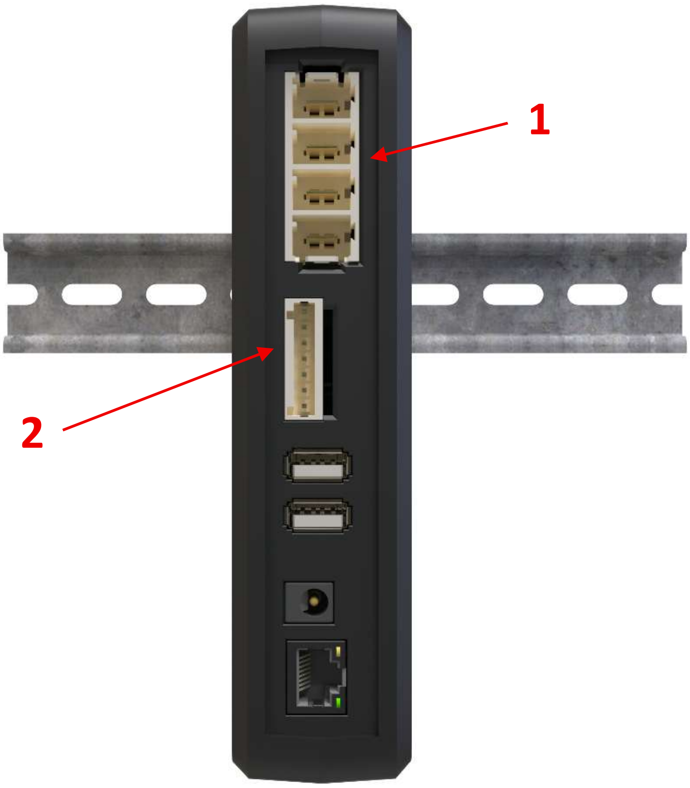
Always mount the Inpod this way up to allow good air flow.

Inpod Rear – Input labels and website link to product page

Inpod Front – Input lables and product information

Side Connections – Detailed

1	2
3-Phase Voltage Input Socket + Functional Earth (Pin 4)	3-Phase Current Input Socket (6 pins) + Functional Earth (Pin 7)



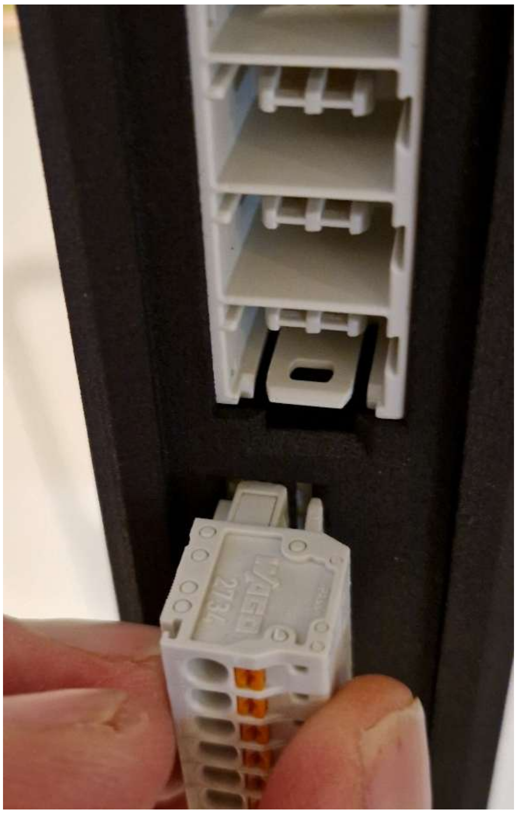
Additional Connections – Detailed

A	B	C
2 x USB 3.0 – Optional Data Transfer & LTE Comms	Barrel 12VDC, 2A (2.1mm ID, 5.5mm OD)	RJ45/Ethernet – PoE-Optional Data Transfer & Network Capability

Signal Cables Options

- 3-Phase Voltage Cable & Connector
- 3-Phase Current Cable, with 3 10A:10mA CTs & Connector
- 3-Phase Current Cable, with 3 30A:10mA CTs & Connector
- 3-Phase Current Cable, with 3 300A:10mA CTs & Connector
- 3-Phase Current Cable, with 3 600A:10mA CTs & Connector

The photographs below show the current (left) and voltage (right) connectors attached to the Inpod unit. Ferrule-terminated conductors are inserted into the front of the connectors and secured in place. Connectors may be wired before or after being plugged into the unit.



Installation Instructions

Please note – before any work is carried out that the necessary work permits are issued, barriers erected toolbox/safety talk is carried out and the work is done by an appropriately authorised person (electrical). Ensure power is isolated before any installation work is carried out.

Mounting Inpod

Inpod must always be mounted in the upright position as this helps air flow.

- Mount Inpod unit carefully on DIN rail, with clamp at bottom, easing clamp release tag if necessary to avoid damaging clamp.

Voltage and Current Signal Cable Connections

- Connect Voltage and Current sensing cables into the plug sockets on top edge of unit (there is only one orientation possible). Only use the cables that were supplied with each specific Inpod unit, as the units and their cables are calibrated as complete sets.

- Current Transformers should be connected to the specified current signal point for that machine – if connecting directly, current range must be between 1A and 330A. If connecting on protection or metering secondaries we would expect a 1A or 5A nominal current present.
    - The clip on CTs should be mounted with the arrow facing the source of supply.
    - The Drain wire on the CT Cable must be earthed to the Panel
    - Pin-7 on the Inpod Unit Current connector must be earthed to the Panel

Nominal Motor Current Range	Current Transformer
1 – 10A	10A:10mA CT
11 – 30A	30A:10mA CT
31 – 100A	100A:10mA CT
101 – 330A	300A:10mA CT
330A+ Secondary Signals 1-5A	10A:10mA CT

- Voltage connection should be connected to the specified voltage signal point for that machine – if connecting directly, voltage must be between 100V and 1000V.
  If connecting on protection or metering secondaries we would expect a 100V, 110V or 480V nominal voltage present.
    - Voltage lead has crimped ends for easy and reliable termination
    - The drain wire on the voltage cable must be earthed to the panel
    - Pin-4 on the Inpod unit voltage connector must be earthed to the panel

- **Remember** to pay close attention to make sure the current and voltage pickups are each mounted onto the corresponding phase (i.e. CT 1 must be measuring the current on the same phase that V1 is connected to).

Power Supply

1. **Power over Ethernet (PoE):**
   IEEE 802.3, Type 1 – 12.95W, 350mA
   The Maximum Power Consumption: 15W per unit

   PoE Switch Requirements:
   Type 1, Class 3 or above
   Is required to power multiple units

   When powered over PoE check to see that both lights on Inpod's RJ45 Port are flashing signalling Power on and network connected.

2. **Powered by 12V DC**
   Input Voltage: 12 V DC – 2A max
   2.1mm x5.5mm Barrel connector

   If using a Din-Rail mounted PSU Unit, the output must be 12V-2A

Optional Connections

The additional ports offer a range of optional connections.

- (A) 2 x USB 3.0 – for connection of LTE Comms (4G/5G) & Optional Data Transfer via Faraday USB drive or Workstation

- (C) RJ45 / Ethernet cable (Cat 5/6) for connection to Modbus, intranet/internet, Faraday Predictive B20 Server Software

Commissioning

Assumptions:

- Installation is fully complete (current, voltage and power connections made) and commissioning has been agreed to take place
- Inpod now has power
- User is connected to the Inpod using the Inpod Remote Control web interface

Motor/Generator Plate Details

One of the first steps in the commissioning process will be to enter equipment data into the software. The key details can be found on the motor plate, or possibly in a manual. Fundamentally the Inpod software only requires **Frequency (Hz)**, **Nominal Current (I)** and **Speed (RPM)** (red circles) to diagnose faults, trend and predict. However, additional information such as bearing codes (blue circles) may also be found on the motor plate allowing the system to track specific frequencies with precision.

All this information should easily be found in datasheets or on the Motor plate. A typical Motor Plate information layout is shown below:

3 ~ Motor	XXXXXX	Iso-CI	F	IP	55	
	XXXXXX	IC	41	S	1	Kg
50 Hz	0.25	kW	0.3	60 Hz		
△ 230	⅄ 400	V	△ 276	⅄ 480		
1.45	0.84	A	1.45	0.84		
Cos ?	0.72	1350	min-1	1620	Cos ?	0.72
NSK Bearings	AS	6202	NS	6202	XXXXXX	

Inpod Software

Once you have remotely connected to the Inpod unit via the web interface or Inpod Config / B20 desktop applications,

Equipment Information

1) Type in Basic Equipment Information. Go to *Basic Equipment* Info (LHS of the main form):
   - Motor rated frequency, current & speed as per motor plate.
2) Type in Equipment Information. Go to Settings/Equipment and type in mechanical related information such as rolling element bearing model codes, belt drives dimensions, etc. Make sure you enable the relevant component and tick *Specific* under *Select fault table*. If no mechanical information is available, click on *Generic* instead.

Calibration Factors

3) Calibration factors, enter these on the LHS under Basic Equipment Information – these must be done for each phase current and voltage. Current Calibrations according to CT used:

Voltage Calibrations:

Current Transformer	I Calibration Factor Value
10A:10mA CT	10
30A:10mA CT	30
100A:10mA CT	100
300A:10mA CT	300
Protection CT x 10A:10mA CT	Protection CT primary x 10

Voltage	V Calibration Factor Value
Direct 400 – 1000V	1
Protection VT example 6.6kV:110	60
Protection VT example 3.3kV:110	30

Getting a measurement and report

4) Select SCOPE mode (LHS of the main form) and click *Start* button. The software will now carry out a measurement loop which takes around 6 seconds.
5) Once finished, you can have a look at the three different charts:
6) Time chart plots the electrical waveforms in the time domain. Very useful for fault finding on hardware connections, loose probes and so on.
7) Spectrum chart plots the measured and modelled data in the frequency domain. It is the core of the system detection tool.
8) Condition chart plots a pre-digested condition assessment of the equipment in the form of vertical bars. The data is obtained from the Spectrum and analysed with automated tools.
9) Click on *Print Report* (LHS of the main form) to get a full report of your equipment's condition health for this measurement.

Quick Start Guide

The aim of this section is to allow you, the user to play with the system and start getting some useful insight into the monitored equipment. Some of the settings mentioned may need changing for when the system is in permanent service. Please contact Faraday Predictive for configuration settings.

Tips:

- ❖ When changing a value within a text box, make sure you press Enter to update the value. If the text box remains pink it means that the value hasn't been updated yet. In this case, press Enter to set the new entry.
- ❖ Click buttons for Modes (SCOPE, BASELINE, MONITOR) and Charts (TIME, FREQ, COND) become grey when selected, i.e. they merge with the background.
- ❖ You can recall default settings at any time. Just go to FILE/RECALL SETTINGS.
- ❖ STORE and RECALL ADHOC is used for Scope mode data only.
- ❖ RECALL MEAS is for that data that has been taken after a baseline, and it is stored under the Monitor mode. Please bear in mind that not all Monitoring data is saved; this can be customized under Project settings.

Connecting to Inpod for setup

Simple setup changes and basic controls for the Inpod can be performed through the Inpod Remote Control web interface hosted on the device, which is accessible to other devices on the same network through a browser.

More advanced control can be made using the Inpod Config or B20 desktop applications, with Inpod Config allowing you to connect to a single Inpod locally while B20 operates via the central database and can control Inpod devices while off site.

<u>For setting up connection to Modbus, OPC and configuring automated email alarms please contact Faraday Predictive.</u>

Software set up

If you have already made a project and would like to connect to it, select SETTINGS/PROJECT. Under the block *Connect to a project* select one from the list and click *Connect*. You can now start assessing the health of your equipment. Otherwise, you must create a new project.

- Create a new Project
  - Go to SETTINGS/PROJECT. Under the block *Create new project* enter the name of your new project, select whether your machine is a *Motor* or a *Generator* and use *Default* settings. If you select *Clone* then the settings for the new project will be copied from the present project.
  - The project will be created, and a blank chart will appear. Close the *Project settings* window.
- Type in Basic Equipment Information
  - Go to *Basic Equipment Info.* This is located in the left-hand panel of the main form.
  - Enter motor rated frequency (this is independent of whether the motor is driven by an inverter or not).
  - Enter motor rated current and speed. The system will then automatically set the number of poles and rated slip of the motor.
  - Enter calibration factors, which will depend upon the selected hardware set up.
- Enter Equipment Information
  - Go to SETTINGS/EQUIPMENT.
  - Enter mechanical related information such as bearing types, belt drives dimensions, etc. Make sure you enable the relevant component by clicking on the tick box next to it. Click on *Specific* under *Select fault table* to allow the software to use those values for diagnostic interpretation. If no mechanical information is available, click on *Generic* instead.
  - On the text box *Other information*, enter motor rated values (Voltage, Frequency, Current and Speed), type of equipment (Pump, Fan, etc) and any other relevant information about the equipment and/or the site.
  - Click on *Save other info.*

The system is now ready to start assessing the health of your equipment. It usually makes sense to take a few snapshot measurements on your equipment before starting routine monitoring both to check the present condition and to find the best settings for monitoring. These snapshot measurements are taken in Scope mode.

Equipment health assessment (Scope mode)

The following steps will allow you to take a snapshot of your Equipment's health within a few minutes.

- Select Scope mode and click the Start button. The software will now carry out a measurement loop which takes around 6 seconds.
- Once finished, have a look at the electrical waveforms and measured electrical parameters to make sure they look correct:
  - Click on Time button.
  - Select V1, V2, V3 and I1, I2 and I3 to be displayed on the chart. Those should have a sinusoidal shape; the voltage traces should be leading current traces in a motor driven system.
  - Check the *Electrical* measured parameters in the right-hand panel of the main form. Compare those against the motor rated values to make sure they look reasonable.
- If you click on Frequency button you will see the frequency domain of the measured electrical waveforms. Each peak has a label, although not all of them represent an incipient fault.
- If you click on the Condition button you will see an overview diagnostic of your equipment's health. If you click on any of those bars, you will find a description of the fault type below the chart.
- The measurement will be stored automatically as an AdHoc measurement.

- Click the Report button to get a full report of your equipment's condition based on this measurement. You can now carry out more measurements or learn the pre-existing condition of your equipment and monitor it.

Equipment health monitoring (Baseline and Monitor Modes)

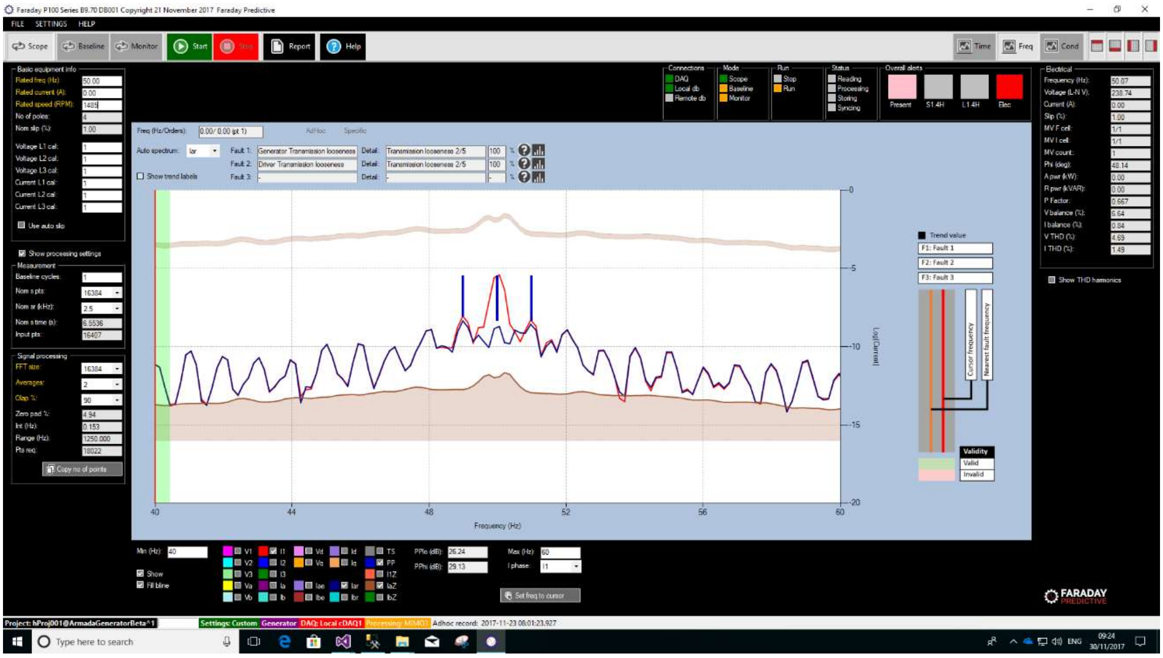
For monitoring the health of the equipment over time the unit must create a record of its present condition with Baseline mode. This allows it to identify changes over time that correspond to incipient faults on the equipment and to measure their present level for future comparison.

- Set the number of iterations for Baseline mode. For doing so, go to Scope mode. Click on the tick box *Show processing* (in the left-hand panel of the main form), and a list of settings will appear below. The first one is called *Baseline* and is under the *Measurement settings* block.

Type in the number of cycles to create the Baseline, 30 for demonstration purposes. For real running we suggest (fixed speed) 600 (1 hour) and (VSD or varying loads) 600 (1 hour) & 4 multivariate cells (2 F cells and 2 I cells) it would also be necessary to run the machine in its various load conditions, keeping in each state for 5 minutes for the hour. *Please contact Faraday Predictive for further information.*

- Select Baseline mode and click the Start button. Wait for the process to complete, where the total time required depends on the number of iterations selected (each iteration takes roughly 6 seconds).
- Once the Baseline measurement completes, Monitor mode will start automatically. You are now monitoring your equipment. It is advised to select the Condition chart for looking at the condition bars. Those will display the number of Standard Deviations of any existing faults from the baseline. You can click on any of those at any time to see their trend over time.
- You can stop monitoring at any time by clicking the Stop button.

Motor Current Signature Analysis (MCSA)



MCSA measures the spectrum at high resolution, to identify peaks related with rotor bar deterioration. This technique can only be used in Induction Machines, where slip is present and inherent to the machine performance.

When an induction motor is connected to the three-phase electrical supply, the rotating field created by the stator induces an electro motive force in the rotor, which in return creates a current that flows through the rotor bars. The amplitude and frequency of this current is maximum on the start-up and reduces as the rotor increases in speed. The rotor will never reach the synchronous speed, and the difference is called slip, which depends upon the load applied on the machine.

If one or more of the rotor bars is developing cracking or other deterioration, the electrical resistance of this bar increases with respect to the others, creating a pulse pattern in the stator current as the bar crosses the synchronous field. This pattern can easily be analysed in the frequency domain, appearing as sidebands of the main frequency supply. Those sidebands will depend upon the slip of the machine, being further apart as the slip increases (as load increases).

Analysing Sidebands

MCSA analysis is usually performed using the measured current, although it is easier to spot those sidebands when displaying the residual current as well. Damaged rotor bars show up as side bands on the main supply frequency, +/- pole pass frequency. Pole pass frequency = number of poles x slip frequency, which for a large motor is typically of the order of 1 – 2 Hz or less.

Using Auto slip will simplify the identification process. This estimates the slip of the machine, using a linear approximation between the motor rated current and the current being drawn at the time when the data was collected.

The process to identify and measure rotor band responses is as follows:

- Take a measurement using SCOPE Mode, with a high number of Nominal sampling points to allow high resolution spectral analysis (32768 or 65536 points are recommended).
- Nominal sampling rate should be set to a low value. 2.5 kHz is recommended).

- Signal Processing - Select the maximum FFT size and Overlap (32768 and 90% respectively if possible). Then select the maximum number of Averages that gives you a low Zero padding value. A value below 10% is suitable for MCSA purposes.
- On the Frequency Plot, you now need to select the view range for spotting the pole pass sidebands. For a 50Hz supply the viewing range should be set from 40Hz to 60hz to start with and can be narrowed down if a more zoomed-in picture is required.
- On the same plot, select I1 and Iar and Pole Pass (PP). If modelling is not available the residual currents will not be shown, but this does not present a problem for carrying out MCSA.
- Selecting Pole Pass (PP) causes two bars to appear at sidebands of the fundamental frequency. If Auto Slip is enabled, those should lie on top of the pole pass peaks. Two values will be displayed below the frequency Chart, on the text boxes PPlo (Pole Pass Lower) and PPhi (Pole Pass Higher). Those values will give an indication of the rotor bars' condition as per the table below.

Category	I (line) / I (pole pass)	Assessment	Action
1	60dB or more	Excellent	None
2	54-60dB	Good	None
3	48-54dB	Moderate	Continue surveys, trend
4	42-48dB	Rotor bar crack developing or high-resistance joints	Reduce survey interval, trend closely
5	36-42dB	2 bars likely to be cracked or broken, high resistance joint likely	Perform vibration tests to confirm problem source
6	30-36dB	Multiple cracked/broken bars or end rings indicated	Overhaul asap
7	< 30 dB	Multiple cracked/broken bars or end rings very likely; severe problems throughout	Overhaul or replace asap

If you think the pole pass bands are incorrectly located, you can change those by modifying the Rated speed of the motor.

Faraday Fault Types

The Faraday Predictive Condition Monitoring System is able to tell an astonishing amount about the motor, generator, driven equipment operational effects. Fault types the system can pick up on are in mechanical, electrical and energy domains as shown in the table below.

	Equipment type				Top 6 KPI					
Fault type	**Motor** *specific*	*generic*	**Generator** *specific*	*generic*	Motor Fault	Electrical Supply problems	Mechanical Rotating Fault	Mechanical Static Fault	Operational Fault inc Blocked Filter	Other
Electrical Rotor	x	x	x	x	Motor Fault					
Electrical Stator	x	x	x	x						
Electrical Odd Harmonics	x	x	x	x		Electrical Supply problems				
Electrical Even Harmonics	x	x	x	x						
Motor Rotor Bars	x	x	x	x	Motor Fault					
Motor Unbalance/Misalignment	x		x							
Generic unbalance / misalignment		x		x						
Motor Bearing 1	x		x							
Motor Bearing 2	x		x							
Motor Journal 1	x		x							
Generic Bearing		x		x						
Motor Foundation / Looseness	x		x							
Generic Foundation / Looseness		x		x						
Motor Transmission Looseness	x		x							
Generic Transmission Looseness		x		x						
Motor Resonance	x		x							
Trans 1 Belt Drive	x		x							
Trans 1 Gearbox	x		x							
Driven 1 Unbalance / Misalignment	x		x							
Driven 1 Bearing 1	x		x							
Driven 1 Bearing 2	x		x							
Driven 1 Journal 1	x		x							
Driven 1 Foundation Looseness	x		x							
Driven 1 Transmission Looseness	x		x							
Driven 1 Resonance	x		x							
Driven 1 Impeller 1	x		x							
Trans 2 Belt Drive	x		x							
Trans 2 Gearbox	x		x							
Driven 2 Unbalance / Misalignment	x		x							
Driven 2 Bearing 1	x		x							
Driven 2 Bearing 2	x		x							
Driven 2 Journal 1	x		x							
Driven 2 Foundation Looseness	x		x							
Driven 2 Transmission Looseness	x		x							
Driven 2 Resonance	x		x							
Driven 2 Impeller 1	x		x							
Power Factor	x	x	x	x						
Voltage Balance	x	x	x	x		Electrical Supply problems				
Current Balance	x	x	x	x						
Voltage THD	x	x	x	x						
Current THD	x	x	x	x						
Active Power: Nominal Power										
Any other spectral fault with Peak exceeding zone of goodness										

Range of Issues Detected

Motor Faults
- Foundation looseness/flexing
- Unbalance / misalignment
- Motor bearing problems
- Rotor bar cracking / asymmetry
- Stator problems
- Air gap eccentricity / asymmetry

Driven Equipment Behaviour
- Foundation looseness/flexing
- Unbalance / misalignment
- Bearing problems
- Transmission looseness/rubbing
- Belt drive problems
- Impeller vane pass signals

Supply Parameters / problems
- Frequency
- Voltage
- Current
- Phase Angle / Power Factor
- Active Power & Reactive Power
- Phase imbalance (voltage & current)
- Harmonic distortion (voltage and current; overall THD + odd harmonics up to 13th)

Operations issues
- Cavitation
- Overload / underload
- Overspeed / underspeed
- Too frequent starting

Energy saving opportunities
- Energy being wasted by each fault, compared to baseline – allowing cost-benefit justified intervention

Further fault types can be identified by expert analysis of the spectral outputs.

Troubleshooting

Handling errors – quick fix

Occasionally the system may not be able to produce a model and a message box will appear alerting the user that the number of retries has been exceeded. Most often simply trying again will produce a valid reading, but there may be rare cases when the system repeatedly produces an invalid model and in this event, we advise the user to carry out the following steps:

1. Select **Settings -> Measure Aux** and **uncheck Use Modelling**
2. Take a Scope measurement
3. Examine the waveforms using the time plot, checking for the following:
    - The **voltage and current channels** are correct (if not, then select **Settings -> Channels** to reorder these)
    - The **voltage and current calibrations** are correct (these can also be changed under **Settings -> Channels**). Particularly, current calibrations may need to be changed to be negative if the orientations of the CTs are not correct.
    - The **motor rated details** are correct (under Basic equipment info on the front screen).
    - The waveforms look roughly sinusoidal and in the correct phase orientations, with voltage leading current (for an inductive system).
4. **If any changes have been made, go back to Settings -> Measure Aux, check Use Modelling, and try again.** Most of the time, failure of the model is due to incorrect channel inputs. If problems persist, consult the error code key and carry out the steps required for further error correction.

Error code key

Default settings are intended to give results under most normal conditions, but occasionally these settings require fine-tuning

During the modelling process, the data measured by the system undergoes a number of validity checks. By clicking on **Settings -> Processing**, the user can see whether these validity checks have been passed or not. The table below summarises the 8 different errors that might be seen, and how they could be dealt with if the errors occur:

Error code	Error name	Meaning	Correction
0	No Fault	All validity checks passed	None
1	Crossings Invalid	The sample length is too short or the frequency too low for an accurate frequency estimate to be made	Decrease FFT cycles; under **Settings -> Measure Aux FFT Cycles.** Increase the sample length; under **show processing settings, nominal s pts.** Decrease the sampling rate to 2.5kHz; under **show processing settings, nominal SR (Hz).**
2	Current Threshold Invalid	The measured current is too low; the system assumes the small amount of current measured is just residual current (noise) and the motor is not running	Check the current calibrations and the rated current. If this is a recurring problem and the current is known to be correct, try lowering the rated current and increasing the current calibrations.
3	Frequency Variation Invalid	The frequency has changed by more than the recommended range over the course of the measured sample and is considered unstable	Re-take the measurement and/or decrease the sample length.
4	Current Variation Invalid	The amplitude of the current has changed by more than the recommended range over the course of the measured sample and is considered unstable	Re-take measurement and/or decrease the sample length.
5	Model Invalid	There is too much noise in the data for the system to build a stable model	Change the sample length and sample duration, in

			show processing settings, nominal s pts/ nominal SR (Hz). Change the number of modelling points, under **measure aux, Modelling Points.**
6	FFT Invalid	The system is unable to produce a spectrum as the model is unstable, and the FFT algorithm has encountered an infinite residual current	Change the sample length and sample duration, in **show processing settings, nominal s pts/ nominal SR (Hz).** Change the number of modelling points, under **measure aux, Modelling Points.**
7	Frequency Range Invalid	The measured frequency is outside of the range expected for the multivariate processing cells	Select **Settings -> Multivariate** and increase **Max f (Hz),** the maximum allowed frequency, to well above the measured frequency.
8	Current Range Invalid	The measured current is outside of the range expected for the multivariate processing cells	Select **Settings -> Multivariate** and increase **Max I (A)**, the maximum allowed current, to well above the measured current.

Note: Error readings such as '48' simply mean that both error code 4 and error code 8 have been triggered.

Model continually fails

If after trying all of these options it is still impossible to take a reading, please turn off Modelling (**Settings -> Measure Aux** and **uncheck Use Modelling**) and take multiple Adhoc readings and store each of them to a database. Then contact Faraday Predictive staff for support, either by phone on (+44) 0333 772 0748 or by email at info@faradaypredictive.com and we will be able to assist.

Contact

Whether you want to learn more about the advantages of a Condition-Based Maintenance Strategy, or how measuring the voltage and current drawn by the motor can predict bearing failure in three months' time, or you just want a quick quote for an on-site survey, please contact us. We are always interested to hear from people seeking to improve the performance and maintenance of their equipment. We have a small enough team that whoever you speak to will be able to put you in touch with the right person, so no need to ask for a special department or special email address. We like to make it easy for you.

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