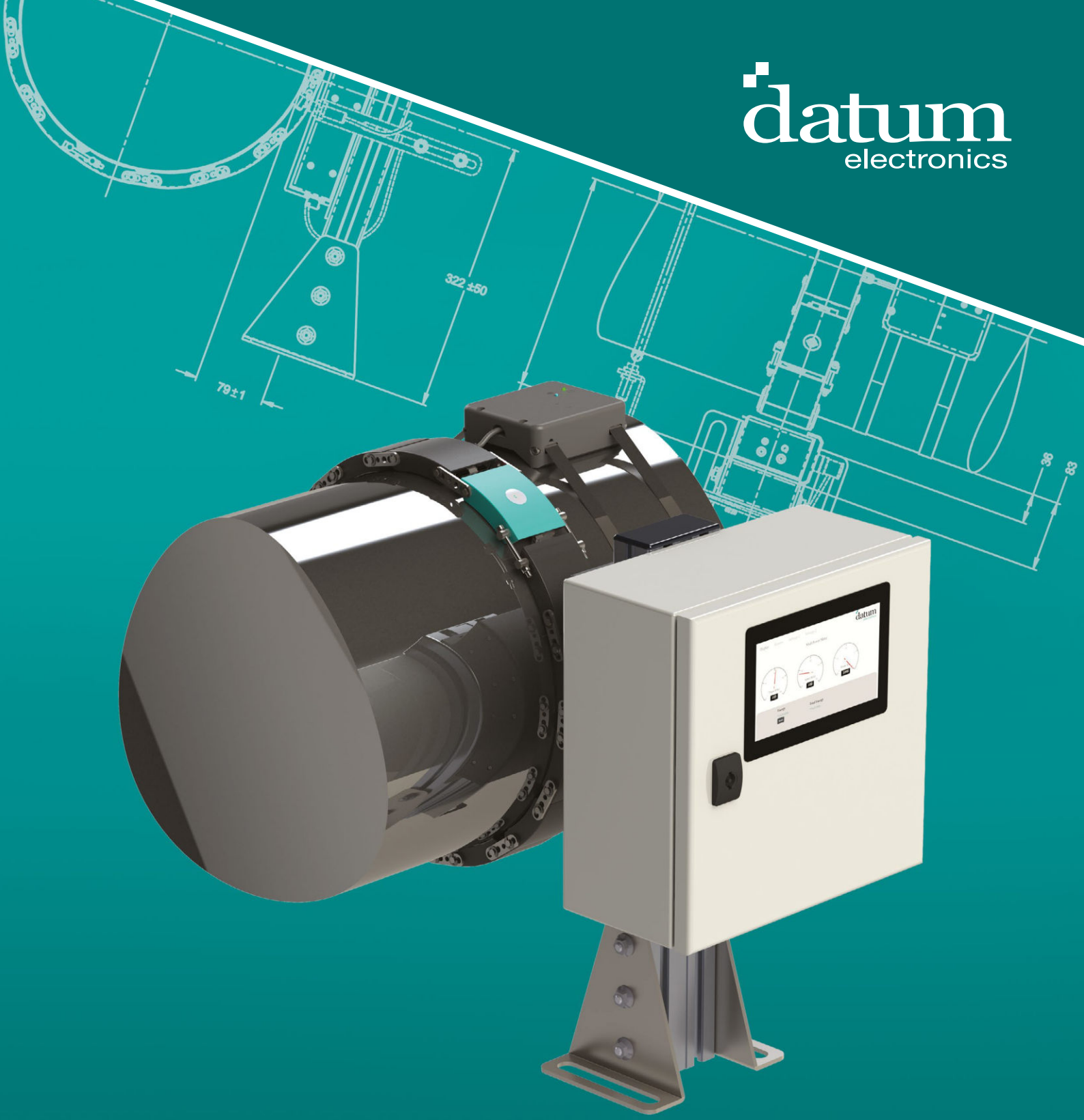
datum electronics




# Shaft Power Meter

USER MANUAL

MADE IN BRITAIN

PRECISION. DATA. INNOVATION.

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# Warranty

We warrant this product against defects in materials or workmanship for a period of 12 months (1) year from the date of purchase despatch.

In the event of a defect during the warranty period, the buyer should inform the seller immediately, allowing the seller all potential possibilities to remedy the issue remotely. Failure to resolve the issue remotely, the unit should be returned, freight (and all duties and taxes) prepaid by the Buyer to the authorised distributor or seller from where the hardware was purchased.

The Distributor or seller, at their discretion will either repair or replace (where authorised to do so) the defective hardware, and provide a full investigation report. The remedy will be presented to the buyer and if in agreement the hardware will be returned to the buyer with freight charges paid by the distributor or seller.

## Limitation of warranty

The foregoing warranty shall not apply to defects resulting from:

1. Improper or inadequate maintenance by the buyer.
2. Unauthorised modification or misuse.
3. Operation outside the environmental specification of the product.
4. Mishandling or abuse.

The warranty set forth above is exclusive and no other warranty, whether written or oral is expressed or implied. We specifically disclaim the implied warranties of merchantability and fitness for a particular purpose.

## Exclusive remedies

The remedies provided herein are the buyer's sole and exclusive remedies. In no event shall we be liable for direct, indirect, incidental or consequential damages (including loss of profits) whether based on contract, tort or any other legal theory.

## Introduction

Please contact us if you need help, if you have a complaint, or if you have suggestions to help us improve our products or services.

If you contact us about a product you already have, please tell us the full model number and serial number, so that we can give you accurate and fast help.

This product has a 1 year warranty. We will put right or replace any meter which is faulty because of bad workmanship or materials. This warranty does not cover damage caused by misuse or accident.

If you return a unit for repair, please include a detailed description of the problem, and the name of a contact who we can refer to for any questions. Please mark for the attention of the QA Department.

### IMPORTANT

Warranty repairs or replacements are usually returned with a standard courier service. We do not offer compensation for losses caused by failure of this instrument.

If you do not agree with these conditions, please return this item in unused, condition, in its original packaging and we will refund the purchase price, excluding any carriage paid.

We always try to improve our products and services, so these may change over time. You should keep this manual safely, because future manuals, for new designs, may not describe this product accurately.

We believe these instructions are accurate, and that we have competently designed and manufactured the product, but please let us know if you find any errors.

## Safety

Obey all safety warnings in this manual, and install the hardware according to local wiring and installation regulations. Failure to follow these guidelines may cause damage to the hardware, connected equipment, or may be harmful to personnel. Any moving mechanical device controlled by this equipment must have suitable access guards to prevent injury to personnel if the meter should fail.

# Warnings

Please carefully read this manual and all warnings. Install the system ONLY when you are sure that you've covered all aspects.

Please ensure that ALL pre-requisites have been actioned prior to attempting installation of this hardware.

Check that the model number and supply voltage suit your application before you install the solution.

Connect the system according to current IEE regulations, IEC61010 & NFPA:70 National Electric Code in USA.

Power supplies to this equipment must have anti-surge (T) fuses.

Only clean the control panels front with a soft damp lint free cloth. Only lightly dampen with water. Do not use any other solvents.

Ensure glands are fully tightened following connection into controller.

Ensure correct spacing and positioning of hardware as per the below guidelines.

It is best practise to run separate power and data cables, do not run power and data along the same cable.

**Caution:** There is a risk of electrical shock if this system is not properly installed.

**Caution:** Risk of danger: Read the whole manual before you install this meter.

# Marine Shaft Power Meter

Our Marine Shaft Power Meter (SPM) Systems are developed to provide real time and ongoing power monitoring data on propulsion shafts, thrusters and diesel generators. These devices are commonly used for fuel economy monitoring and equipment maintenance planning programs and can be used in conjunction with our **EEXI | ShaPoLi solution** to keep vessel owners in line with the latest legislation.

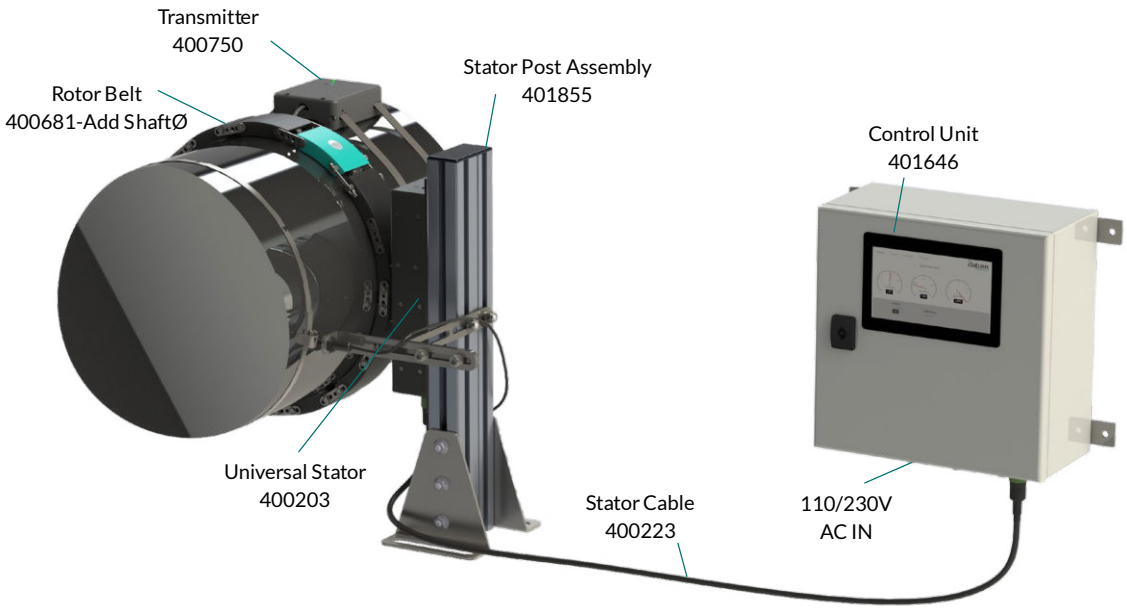
The principle is a set of strain gauges mounted directly to the shaft, connected to our 2.4 GHz wifi transmitter. The rotor belt is wrapped around the shaft and connected to the transmitter, this when placed in proximity to the stator induces power to transmit the converted digital signature of the strain gauge off shaft into our receiver unit in the controller. During first time use of the SPM system the inductive power system may require up to 5 minutes to allow for optimum operating conditions. This can be done statically or under rotation. The controller takes this sample data, analyses it and replicates on screen showing torque, speed and calculated power where reports and logs can be generated, all whilst displaying this live information on screen using simple to read dials.

The touchscreen interface is simple to use and the system is fully configured from the front panel.

## Datum SPM Hardware

This manual covers the current hardware which covers systems delivered from 2023. For any legacy generation systems please contact Datum Electronics or your Approved Support Partner for guidance on your system type.

## System Component Information



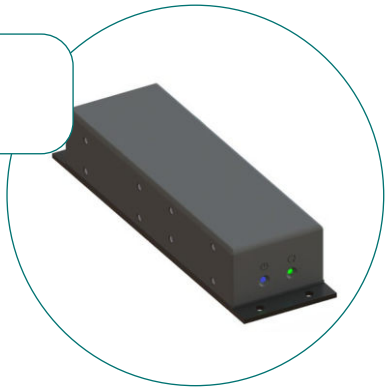
# What's included?

Control Unit

On-shaft transmitter

Rotor Belt Assembly

Speed & Power Link Assembly



Universal Stator

# Technical Specification

| | | |
|---|---|---|
| **Instrumentation Accuracy** | Shaft Torque | 0.1% |
| | Shaft RPM | 1 RPM |
| | Shaft Power | 0.1% |
| **System Accuracy** | Shaft Torque | 0.1% + Ke |
| | Shaft RPM | 1 RPM |
| | Shaft Power | 0.1% + Ke |
| | Ke | Total error in shaft modulus constant and shaft diameter measurement |
| **System Repeatablility** | Shaft Torque | 0.05% |
| | Shaft RPM | 1 RPM |
| | Shaft Power | 0.05% |
| **Data Output and Display** | Power, Torque and Speed Display | The display presents average values of torque, speed and power. The time period of this average is set the application and can vary from 0.1 seconds to 24 hours |
| | Total Energy | The total energy is displayed in kWh from the last time the counter was reset to the current time. |
| | Average Power | Average Power for the 24-hour period between midday to midday is displayed in W, kW, MW, or HP (units can be chosen by user) |
| | Power Measurement Data Output | Values of Power, Torque and Speed are outputted, via serial, and logged to USB, at 1 sample per second. |
| **Environmental** | Operating Temperature | 0°C to +55°C |
| | Storage Temperature | -25°C to +70°C |
| | Temperature Effect on Readings | 0.01% FS per degree centigrade |
| **Environment Sealing** | Shaft Mounted Equipment<br>Universal Stator Unit | IP65<br>IP65 |
| | Control Unit | IP54 |
| | Panel Mounted Display Unit | IP54 front and rear |
| **Power** | Supply Voltage | 88-264 Vac (2 Amp) |
| **Calibrated Outputs** | Selectable RS-485 outputs # | RS-485 [BMT-ECR] Required for use with EEXI<br>RS-485 NMEA (Not compatible with EEXI)<br>RS-485 MODBUS (Not compatible with EEXI) * |
| **Analogue Outputs** | Selectable Analogue outputs x 3 channels for Torque, Speed and Power | 4-20 mA<br>12+/-8 mA<br>0-10 V 0-5 V<br>+/-10 V +/-5 V |

For more information about standard outputs please contact Datum Electronics.

# Single channel only. For multi-channel output applications please contact Datum Electronics.

* Standard MODBUS output is for single shaft applications only. For multi-shaft applications please contact Datum Electronics.

### SERIAL OUTPUT TYPE: BMT-ECR

| |
|---|
| (Basic Marine Torsion Meter Calibrated output string for use with EEXI) Serial output: RS-485 (Transmit Only) |
| Output Baud Rate: 4800 [default] - configurable |
| Data Rate: 1 sample per second as standard |
| Data Bits: 8 |
| Parity: None |
| Stop Bits: 1 |
| The data is transmitted as readable ASCII |
| $BMT,+TTTTT,+XXXXX,RRR.R,PPPPP,+t.ttt,+x.xxx,+z.zzz, +y.yyy,V. VV,*CS |
| Where;<br>+TTTTT = the long running average of the shaft torque in kNm |
| +XXXXX = the long running average of the shaft thrust in kN – please discuss with sales |
| RRR.R = Average Shaft RPM. Averages as above |
| PPPPP = Power in kW. Averages as above |
| +t.ttt = Shaft Torsional Strain Signal mV/V Averaged as above – used for diagnosis |
| +x.xxx = Shaft Thrust Strain Signal mV/V Averaged as above – used for diagnosis |
| +z.zzz = Shaft Torsional Strain Zero mV/V – used for diagnosis |
| +y.yyy = Shaft Thrust Strain Zero mV/V – used for diagnosis |
| V.VV = Rotor Transmitter Input Voltage – used for diagnosis |
| *CS = checksum – contact Datum Electronics for details |

### SERIAL OUTPUT: RS485 NMEA

| |
|---|
| RS-485 (Transmit Only) |
| Output Baud Rate: 4800 [default] - configurable |
| Data Rate: 1 sample per second as standard |
| Data Bits: 8 |
| Parity: None |
| Stop Bits: 1 |
| The data is transmitted as readable ASCII |
| $ERBMT,+TTTTT,+XXXXX,RRR.R,PPPPP,+t.ttt,+x.xxx,+z.zzz, +y. yyy,V.VV,*CS |
| Where;<br>+TTTTT = the long running average of the shaft torque in kNm |
| +XXXXX = the long running average of the shaft thrust in kN – please discuss with sales |
| RRR.R = Average Shaft RPM Averages as above |
| PPPPP = Power in kW. Averages as above |
| +t.ttt = Shaft Torsional Strain Signal mV/V Averaged as above – used for diagnosis |
| +x.xxx = Shaft Thrust Strain Signal mV/V Averaged as above – used for diagnosis |
| +z.zzz = Shaft Torsional Strain Zero mV/V – used for diagnosis |
| +y.yyy = Shaft Thrust Strain Zero mV/V – used for diagnosis |
| V.VV = Rotor Transmitter Input Voltage – used for diagnosis |
| *CS = checksum – contact Datum Electronics for details |

## Serial Output Type: MODBUS RTU

### MODBUS RTU GENERAL CONFIGURATION SETTINGS

| | |
|---|---|
| Modbus Slave ID: | 101 |
| Modbus Register Base Address: | 3999 |
| Function: | 03 Holding Registers (4x) |
| Modbus Number of registers: | 14 (16 bit) |
| Serial settings: | Data bits: 8<br>Parity: None<br>Stop Bits: 1 |
| Output Baud Rate: | 9600 [default] - configurable |
| Endianness: | Byte order: Little<br>Word order: Little |

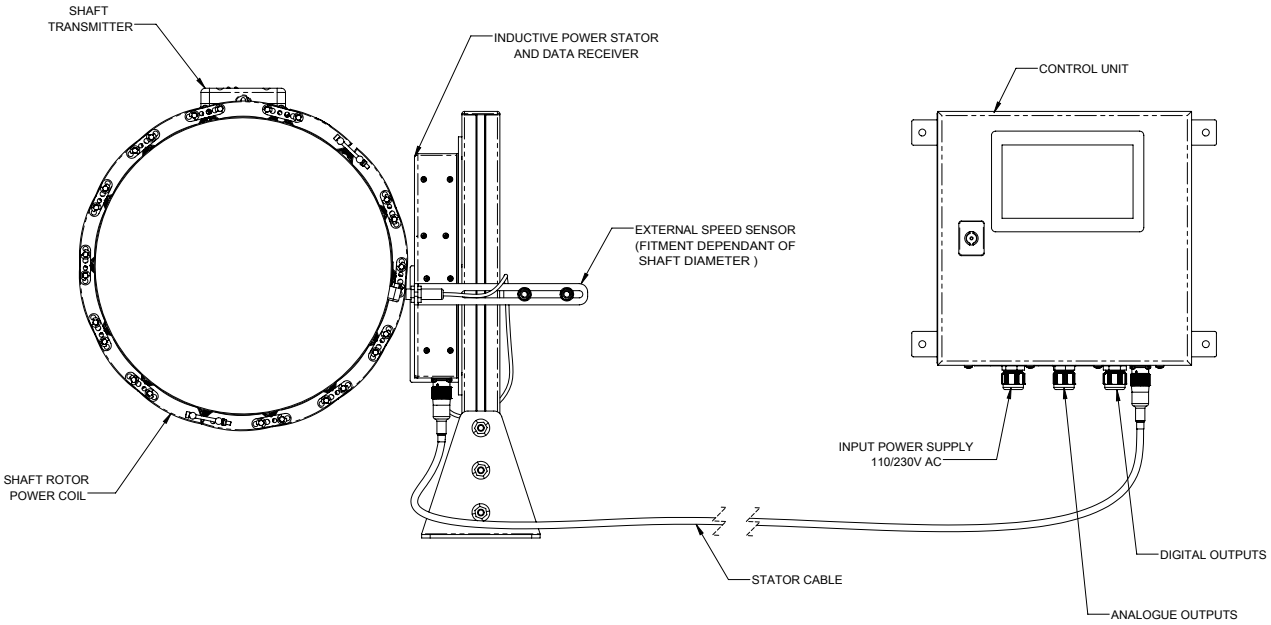
### MODBUS RTU REGISTER DEFINITIONS

| | | |
|---|---|---|
| 3999 - 4000 | Counter | unsigned 32-bit |
| 4001 - 4002 | Unix time | unsigned 32-bit |
| 4003 - 4004 | Torque (Nm) | float 32-bit |
| 4005 - 4006 | Speed (RPM) | float 32-bit |
| 4007 - 4008 | Power (W) | float 32-bit |
| 4009 - 4010 | Thrust | float 32-bit |
| 4011 - 4012 | Status | V (null terminated) |

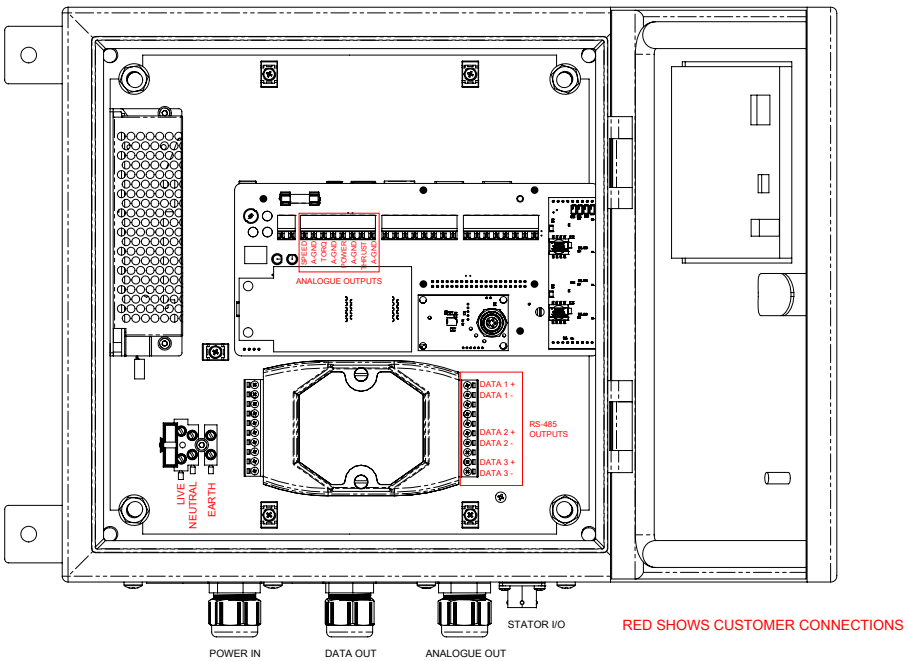
Note: this is the information for the standard MODBUS output from the SPM system.
For details on the optional MODBUS Conversion Kit and its output settings see page 33.

# Installation

## Connections




## Control Unit Customer Connections



## System Alignment

The Datum SPM System is simple and easy to install.

The Datum Electronics Approved Installer will ensure:

1. Continuous power transmission between Stator and Rotor Belt by ensuring correct power supply and alignment of Stator and Rotor Belt.

2. Accurate measurement of speed as 1 pulse per revolution between the 'master' link belt piece and the Stator.

Please see below drawings which illustrate best practice – please note that the transmitter can be positioned either side of the Rotor Belt:

The Datum SPM system comes in two variants depending on the shaft diameters that the equipment is installed to. This will be confirmed at order placement with Datum Electronics or Datum Electronics Partners.

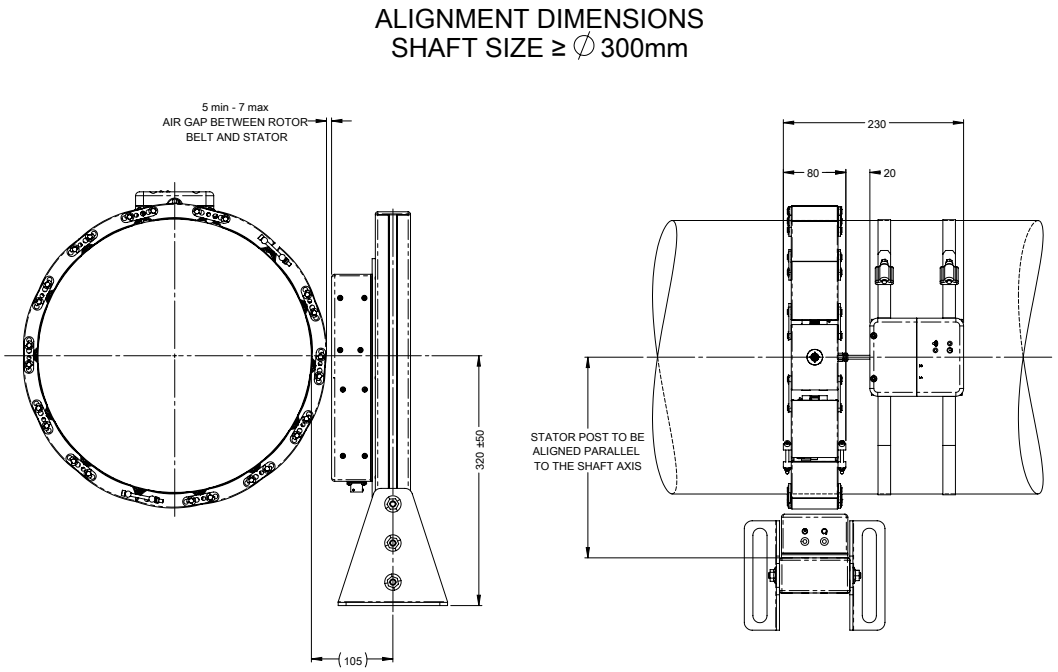
1. Shafts with a diameter greater than 300 mm features in-belt speed measurement through the green master pad.

2. Shafts with a diameter less than 300 mm features an external speed sensor which fits simply to the stator post assembly.

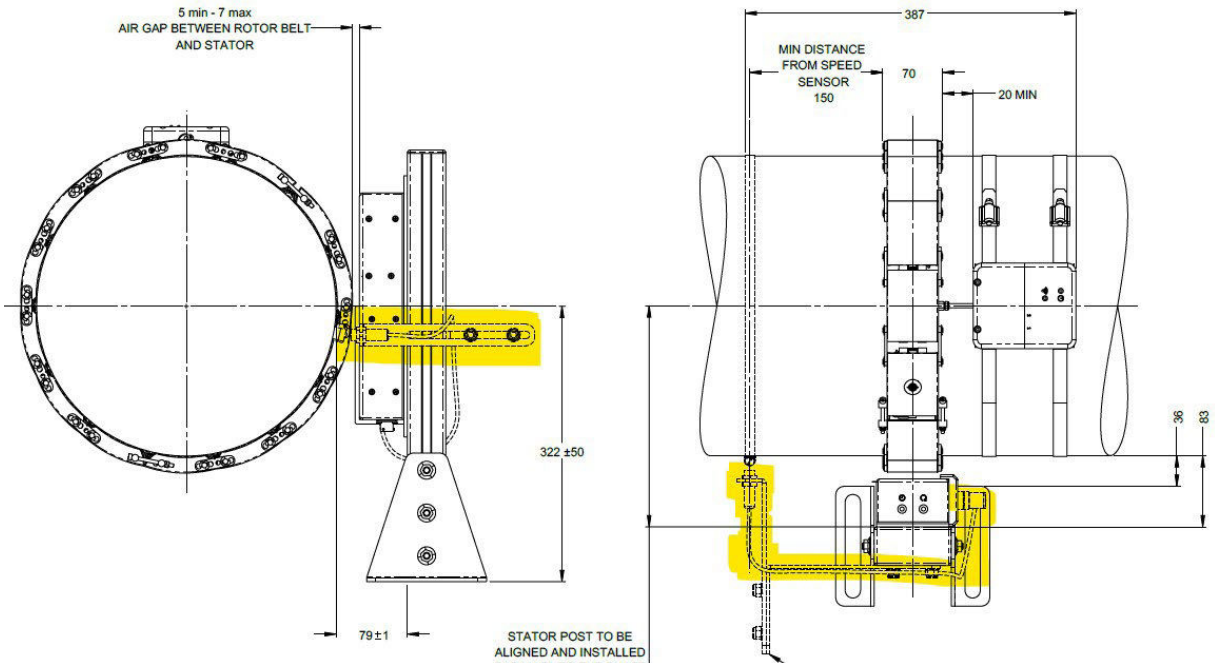
All required parts are supplied as standard with your SPM system and will be fitted by your approved installation partner.

Please refer to the Datum SPM drawing pack for full dimensional tolerances

## In-Belt Speed System overview




## External Speed Sensor overview




Highlighted parts show the external speed sensor fitted to the Stator Post Assembly

# SPM Control Unit

## Control Unit Instructions

The 401646 Control Unit is a touchscreen interface which is the primary interface for the SPM system outputting the calibrated Torque [kNm], Speed [RPM] & Calculated Power [kW] data from the SPM system.

The Control Unit touch screen display also shows the live Torque, Speed & Calculated Power data with clearly visible dials which is the screen is in sleep mode will switch on when interacting with the touchscreen display.

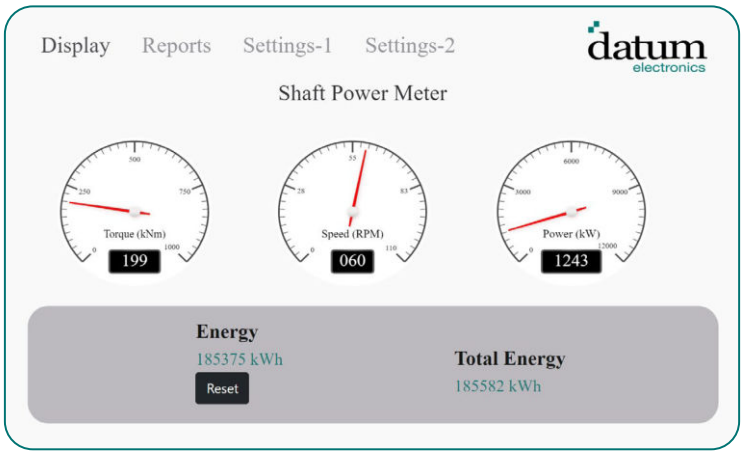
To interact with the Control Unit the user simply needs to touch the display and select the appropriate tabs as covered in the below guide.

Due to the Control Units importance as part of our EEXI-SHaPoLi solution this now features password protection as part of the tamper proof system. This prevents the user from modifying any key parameters but retain the ability to view the information from the Control Unit.

## The Display Screen

Navigation of the control unit is controlled via the tab navigation at the top of the display screen. The menus are for Reports, Settings-1 and Settings-2.

The display screen shows live torque [kNm], speed [RPM] and calculated power [kW] from the shaft power meter (SPM). In addition the total energy is displayed on the dashboard. This counter can be reset by pressing the **Reset** button on the main dashboard.

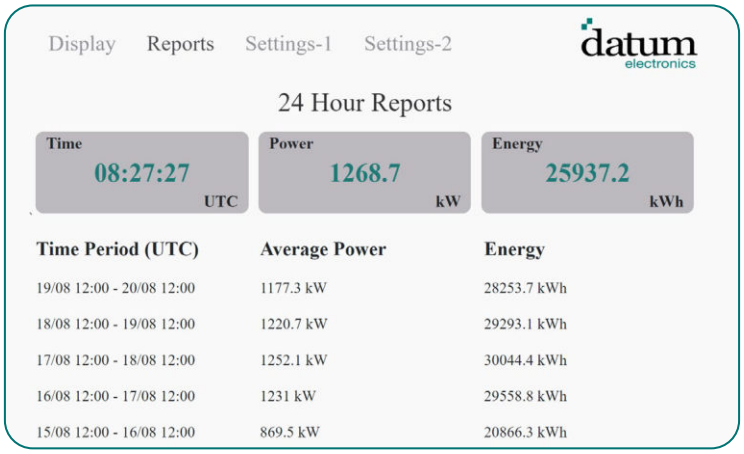


# Control Unit Instructions

## Reports

The Reports screen offers 24 hour reporting, recorded daily. It will automatically store the time, average power and energy each day and calculate an average power usage.

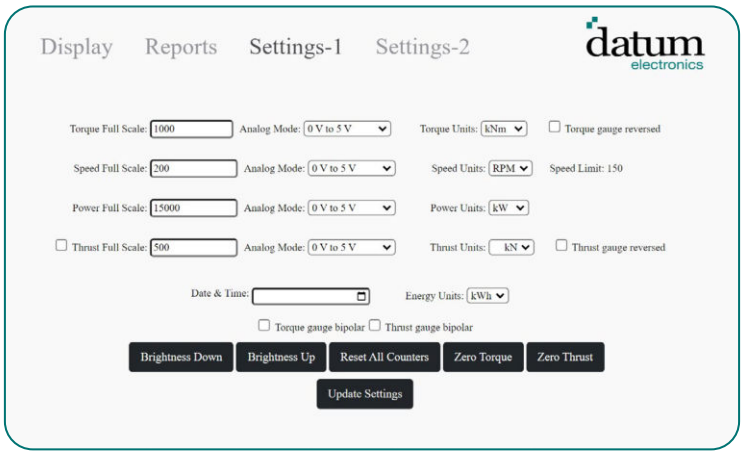
The Reports page will store the last 4 days of information and will then rollover.




## Settings-1

The Settings-1 screen controls all of the analogue output parameters of the SPM system including;

- Changing the full scale values for each dial, torque, speed and calculated power
- Changing the units for torque, speed and calculated power
- Changing the analogue output type and scaling
- Setting date and time for the SPM system
- Strain gauge input options



## Settings-1 - Explained

Whenever a change is made and you would like to save the change you must click the 'Update Settings' button. Once clicked your new values will be stored in the settings.

On the control unit there is a 1 minute time-out function to save energy. If the display is not used for more than 1 minute it will turn off until it is touched again.

### 1 - Torque Full Scale

The maximum full scale value that is entered will set the torque dial on the display page and the full scale value for calibrated analogue outputs if selected.

### 2 - Speed Full Scale

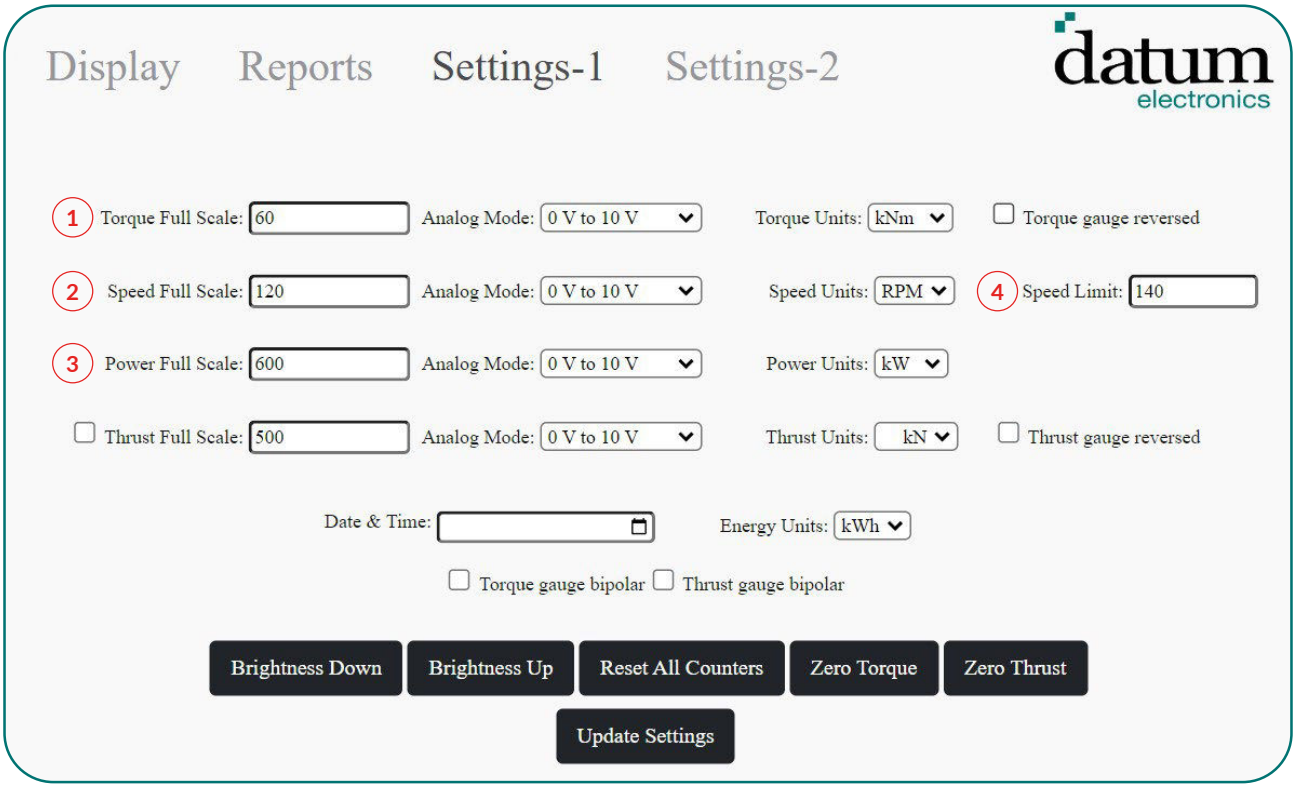
The maximum full scale value that is entered will set the speed dial on the display page and the full scale value for calibrated analogue outputs if selected.

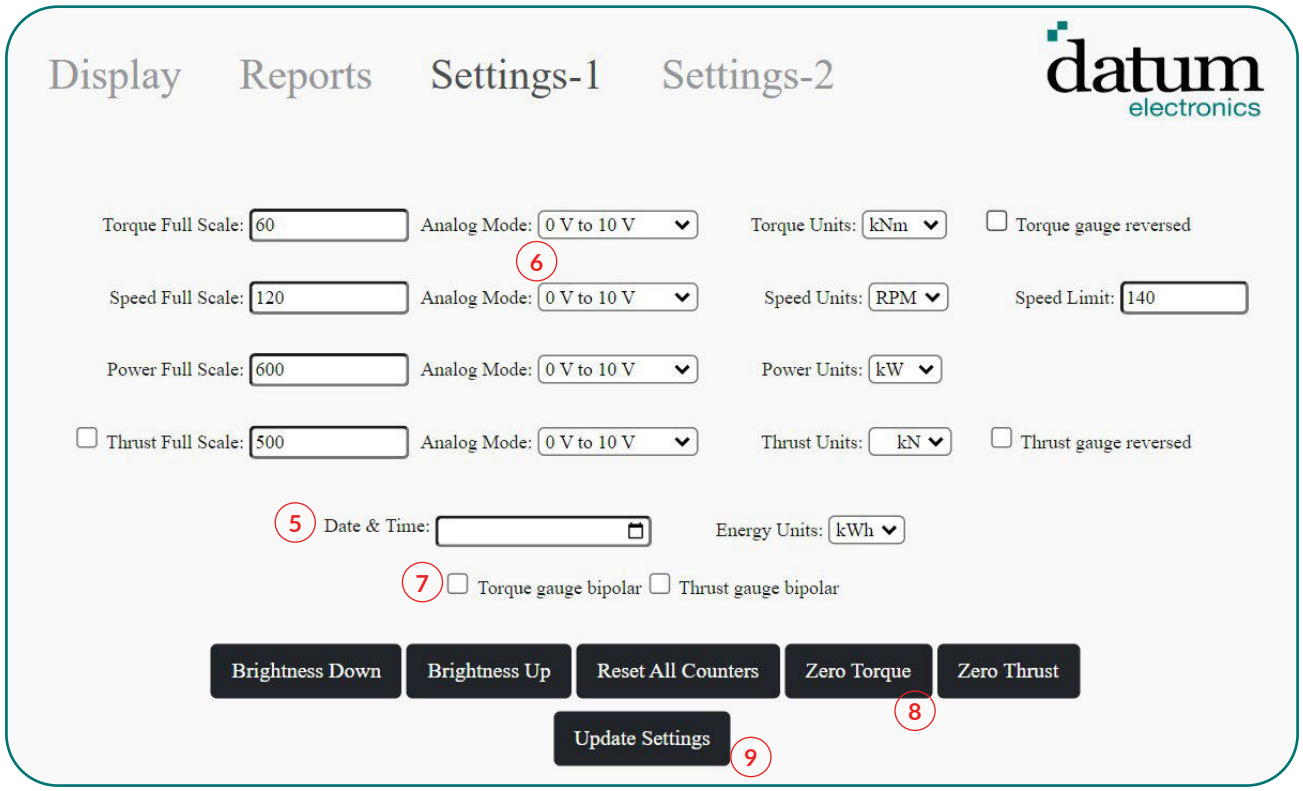
### 3 - Power Full Scale

The maximum full scale value that is entered will set the power dial on the display page and the full scale value for calibrated analogue outputs if selected

### 4 - Speed Limit

This represents the absolute maximum speed measurement range. It is recommended that this be set to 10% higher than the maximum RPM listed by the ships engine manufacturer.






## 5 - Date and Time

This lets the user set the date and time for the SPM system. It is recommended that UTC time is followed.

## 7 - Torque Gauge Bipolar

Selecting this option will allow for bi-directional torque.

## 9 - Update Settings

Any changes made to this page require the update settings button to action and store the changes.

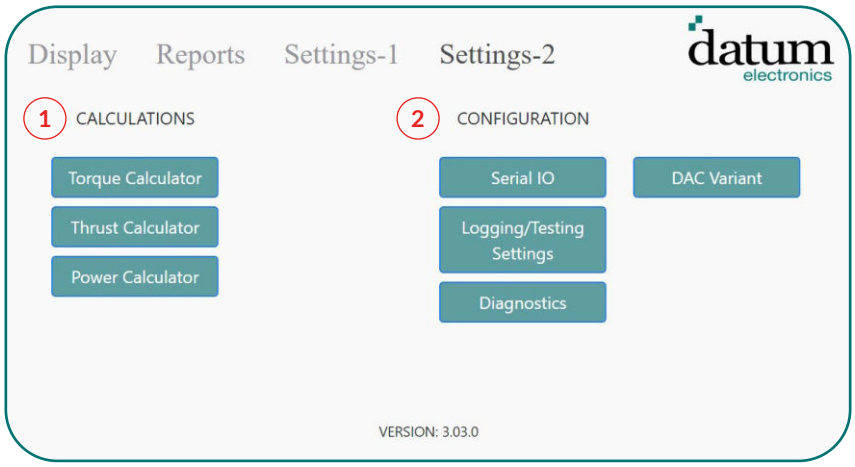
## 6 - Analogue Mode

The control unit has as standard, 3 channel analogue outputs for torque, speed and calculated power. The dropdown menu for each channel has several options that customers can select, please note that the full scale value for each channel is set by the maximum display value.

## 8 - Zero Torque

This removes any torque offset showing on the torque display during installation and commissioning. To zero the torque on the controller follow the below process.

## Settings-2



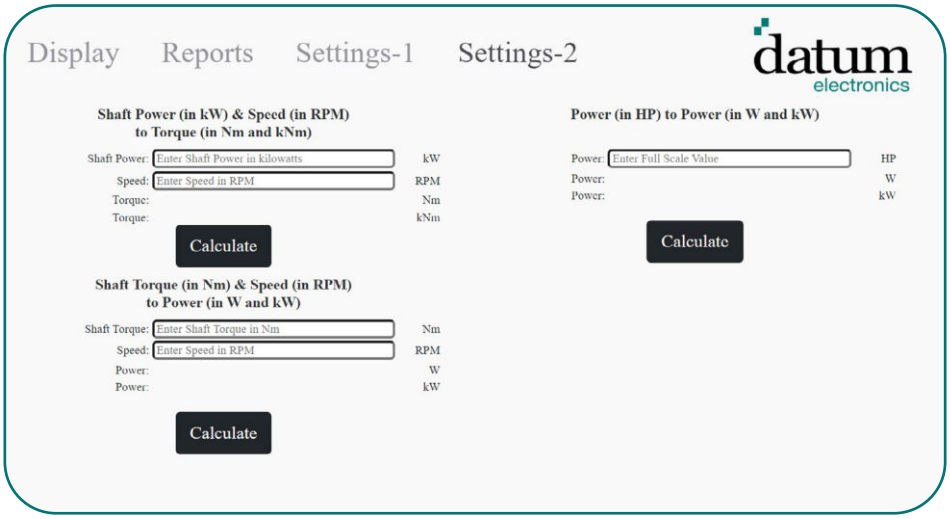

### 1 - CALCULATIONS

This Settings-2 screen allows users to change input calibration values for the SPM system for torque and power calculation.

### 2 - CONFIGURATION

This section has the configuration options for the digital outputs from the SPM Control unit using the Serial IO button see page 20 for more information. This section also has functions for installers and for fault finding if requested by Datum Electronics or Approved Partners.

## Power Calculator




This page allows the user to calculate torque from power and speed. To enter the values simply select the field and a keypad will open up at the bottom of the screen to enter your values. Also, power can be calculated from torque and speed.

## Torque Calculator

The Torque Calculator function calibrates the strain measured by the installed strain gauges [mV/V] and calibrates this to Torque [kNm] required for the power calculation. As part of the tamper-proof system these values cannot be changed and are behind password protection.

There are several key parameters that must be entered correctly at installation to ensure that the SPM system calculates power as accurately as possible.

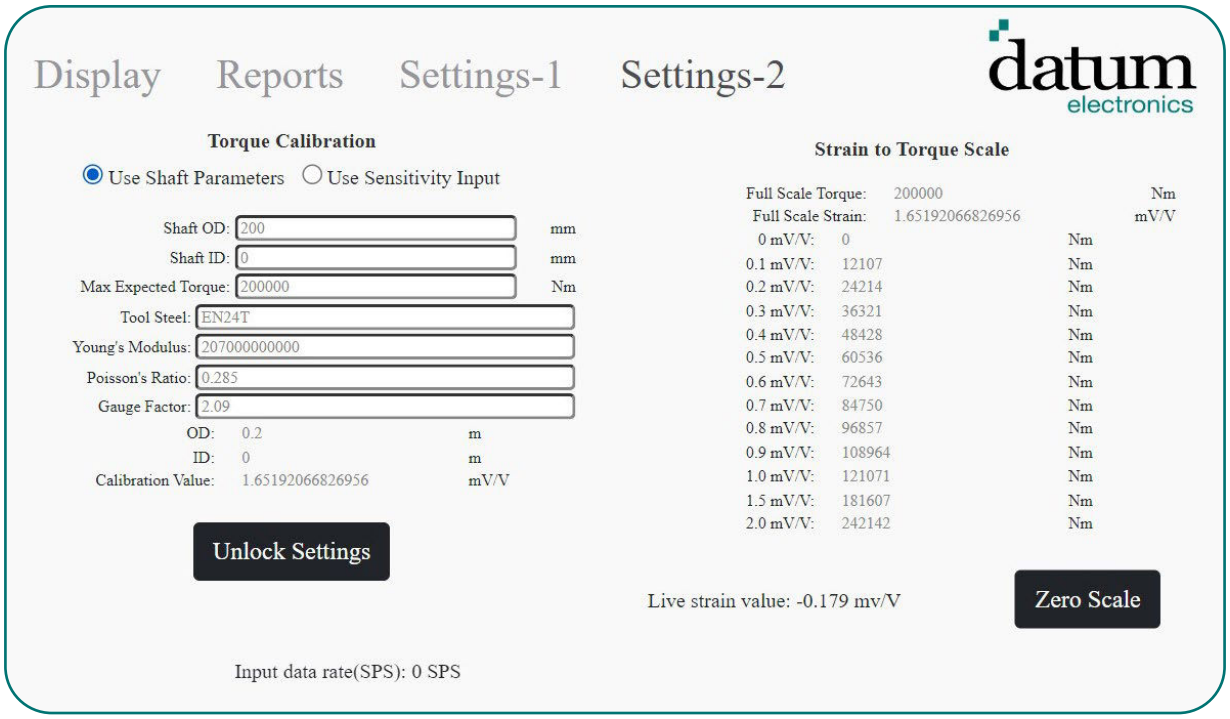
These values will be entered at installation. Please discuss with Datum Electronics or your approved installation partner if you have any questions about the below information.

**Shaft OD (Outer Diameter):** We recommend that the shaft diameter is measured with a calibrated diameter tape to find the value to be entered here in mm.

**Shaft ID (Inner Diameter)**: For a solid shaft this value should be set to 0. If you have a hollow shaft then the value here would change. The inner diameter measurement in most cases can be found on the shaft drawing.

**Gauge factor**: This is the resistance of the strain gauge supplied. This information is printed on the box the strain gauges are supplied in.

**Steel properties:** This is the Young's Modulus and Poisson's Ratio for the shaft where the strain gauges have been installed. The Datum default values are as shown for EN24T tool steel.

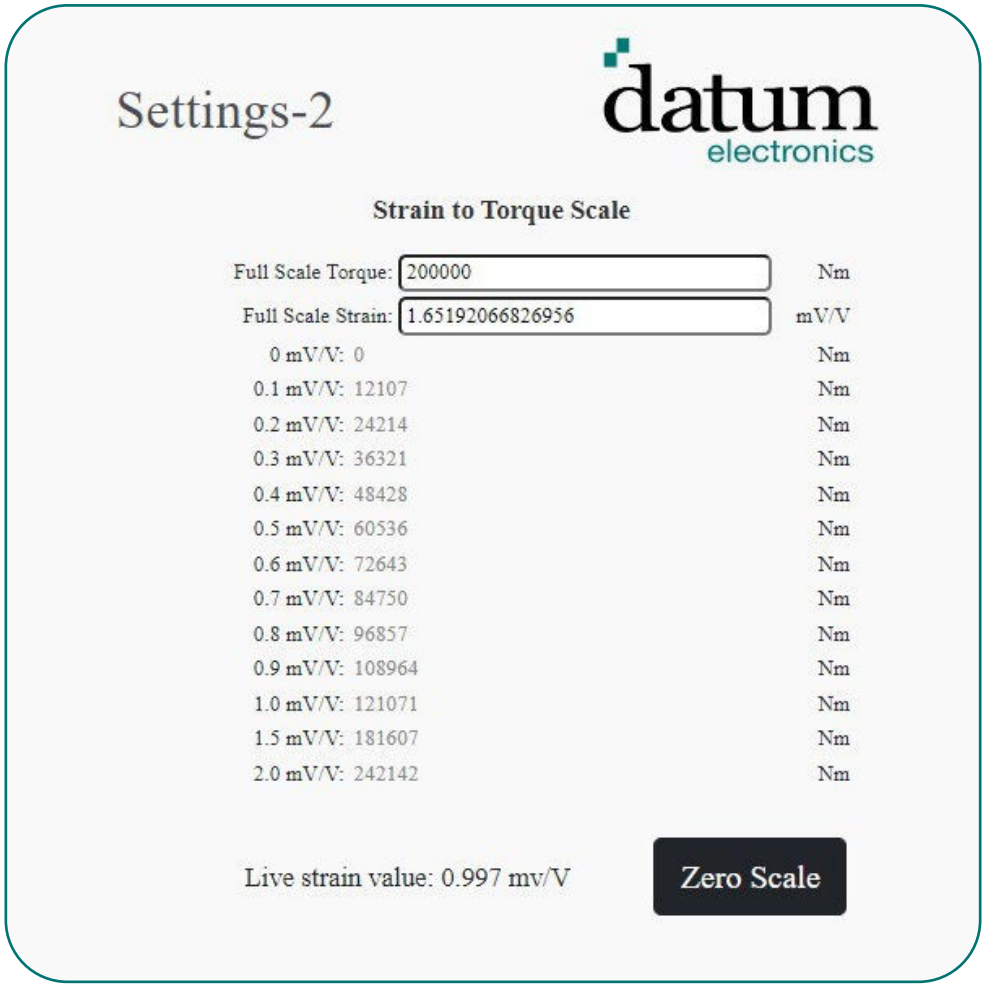


## Settings-2 - Continued

**Strain to Torque Scale:** This displays the calculated calibration factor for the strain [mV/V] to torque [Nm] scaling. It also shows the steps that the installer can use t o the verify the outputs o f the SPM control unit.

**Zero Scale**: This removes any torque offset showing on the torque display during installation and commissioning. To zero the torque on the controller follow the below process:

- Select **Settings-2** Tab
- Select **Torque Calculator**
- Press **Zero Scale** button



## Serial IO

This is a digital output settings page, for the calibrated serial data of torque, speed an d calculated power. There are 3 digital output options to select from:

**BMT-ECR (default mode**
Output required to communicate with Datum EEXI-SHaPoLi Interface unit and or Datum ECR Interface.

*$BMT,+TTTTT,+XXXXX,RRR.R,PPPPP,+t.ttt,+x.xxx,+z.zzz,+y.yyy,V.VV,*CS*

**RS485-NMEA**

*$ERBMT,+TTTTT,+XXXXX,RRR.R,PPPPP,+t.ttt,+x.xxx,+z.zzz,+y.yyy,V.VV,*CS*

**MODBUS-RTU** - For information about the MODBUS output see page 9.

Once you have selected your desired configuration click the save settings button to save the configuration. Please discuss with Datum Electronics or your approved installation partner if you have any questions about the below information.

# FAQs

## How is the Shaft Power Meter calibrated?

The SPM system receives the raw strain value [mV/V] from the strain gauges on shaft and mathematically calibrates this into torque [Nm]. The raw strain value is calculated using the following equation:

$$\frac{mV}{V} = \frac{Max.\,Engine\ Torque\ (Nm) * 16000 * Gf * (1+\sigma)}{(Outer\ Diameter^4 - Inner\ Diameter^4)(m) * \pi * Young's\ Modulus\ (Pa)}$$

Where:

- Gf: Gauge Factor (constant)
- σ: Poisson's Ratio (constant)

It is important for the calibration of the system that the correct dimensional information (outer and where needed inner diameters) be provided to the installation engineer and, where possible, shaft material, Young's Modulus and Poisson's Ratio.

As default, Datum uses the properties for EN24T, tool steel, for the Young's Modulus and Poisson's Ratio if the exact steel properties are not shared before or during installation.

## Does the Shaft Power Meter require annual calibration?

The SPM does no t require annual calibration if all shaft properties and relevant values have been correctly configured at the initial installation.

If requested Datum Approved Service engineers can attend on customers own schedule t o review the installed hardware – please discuss with your Datum Electronics partner.

It is recommended that ships crew periodically check Torque display whilst static to ensure that the displayed Torque is no t greater than 2% of full scale.

## How is the power calculated from the torque and speed data?

The power on the shaft is calculated using the torque by the following formula:

$$P = T\frac{N\pi}{30}$$

Where:

- T is the measured torque on the shaft [Nm]
- N is the engine rotational speed in revolutions per minute [RPM]. The π/30 factor is used to convert the RPM to rad/s, such that the power can be calculated in Watts.

## Negative displays of torque and power?

If the display or indicator is showing a negative value this is simply showing the direction of the torque measured by the strain gauges:

+ indicated clockwise strain/torque

- indicates counter-clockwise strain/torque

As the power is calculated from the Torque and Speed if there is counter-clockwise or "minus" torque then this will give a negative value of power.

Typically, the Datum SPM system does not show direction of torque, but this can be changed during installation by Datum approved installer.

## Torque still showing when there is no RPM?

The torque data is continuously being transmitted even when there is no shaft rotation, hence, when the SPM displays a torque value but the shaft is not rotating, it is due to one of the following reasons:

1. Locked in torque seen from a brake being applied to the shaft
2. Tidal effects on the propeller shaft
3. Torque zeroing at the initial installation was not performed correctly
4. Combination of the above

Please refer to page 19 for more information on zeroing the torque.

## Can the outputs of the system be changed after installation?

The SPM system has both digital and analogue outputs which can be set up during installation and commissioning.

If you wish to change your outputs, please discuss first with Datum Electronics or your Approved Datum Electronics partner on how to do this and what it may affect in your current system setup.

## Estimated power vs measured power

The SPM provides a very accurate means of measuring Torque and Power at the shaft of the vessel. Occasionally, some vessels provide their own engine Power estimation, through manufacturer's data, 3rd party software or sea trials.

At this point, it is very important to distinguish between theoretical estimations and live Power measurements. From Datum's experience and according to most manufacturers, a Power estimation based on shop test data or sea trials for a given RPM, can vary between 15-20% when compared with the strain gauge measurement of the SPM. The discrepancies range is different for each individual vessel and a systematic analysis of available Power and Speed data should be performed for each voyage to derive the ship's Power curve and compare it against manufacturer's/ sea trial data.

In most cases and under normal circumstances, SPM Power readings should be lower than theoretical estimations provided by manufacturers or 3rd party calculations (mostly due to mechanical losses, friction, engine age and other factors) and when a Power discrepancy is observed for a given vessel, it is in the best interest of the client to:

- Identify how the estimated Power that is compared against the SPM is calculated.
- Consult Datum Electronics for clarification and justification on the Power discrepancy.

## Strain Gauge Reliability as a measurement system

Datum Electronics uses its own proprietary strain gauges which have been designed, by the principal strain gauge manufacturing company in the world, to allow for simple and easy installation of the strain gauges.

Our strain gauges feature a full Wheatstone bridge with clip connectors, so there is no interconnecting wiring or on-site soldering required simplifying gauge installation.

Datum Electronics only recommends two permanent adhesives for strain gauge installation which are the best suited for installation in a marine environment which will ensure the strain gauges longevity. The use of other permanent adhesives is not recommended and may reduce the lifespan of the SPM installation.

## Does the Datum SPM installation require an approved installation partner

The Datum SPM system has been designed t o be a simple modular system allowing for simple installation requiring very limited shaft space and f or easy diagnosis. I t does require installation by an approved partner to ensure that the system will perform as expected and meet warranty conditions.

## Values appear to be changing slowly on Controller Display

The response of the displayed values is influenced by any averaging applied. The longer the averaging window the slower the response of the dials will appear.

## Touchscreen interface on SPM control unit keeps turning off

The SPM control unit has a power conservation mode f or the touchscreen interface, the t ouch screen interface will respond and power on after simple pressing the interface screen.

## Do I need to clean the SPM control unit touchscreen?

The SPM control unit is IP rated for the marine environment and can be cleaned b y using a non-abrasive cloth, e.g., micro-fibre cloth, to remove unwanted residue on the screen. D o not use any corrosive based cleaning materials.

## SPM Power Cycling

The SPM is designed t o be run continuously with no requirement to power cycle the system. Should the power be cut to the SP3 control unit then it will automatically start up as soon as power is returned. Please note that the system will require up t o 10 minutes for the inductive power system to reach peak efficiency, during this time data readings for speed could be affected. This power up can happen statically or rotating.

## Does the system require regular maintenance

Regular housekeeping actions are recommended as below.

- Add simple hardware checks f or nuts and bolts
- Alignment
- Cable runs
- Rotor belt t orque tightness
- Stator Post
- Cleanliness

# System Diagnosis

The Datum SPM features several simple indicators to help with system diagnosis:

- 2 x LEDs on the Transmitter (Rotor)
- 2 x LEDs on the Stator
- LEDs within Control Unit

## On Shaft Transmitter LED's

**BLUE** LED = Data connection status

**GREEN** LED = Power status

**BLUE** FLASH = Good data connection between the on-shaft transmitter and the off shaft receiver in the stator

**GREEN** LED = Good power to the on shaft transmitter

## Stator LED's

**BLUE** LED = Power status

**GREEN** LED = Speed signal status

**BLUE** LED = Power status OK (constant LED)

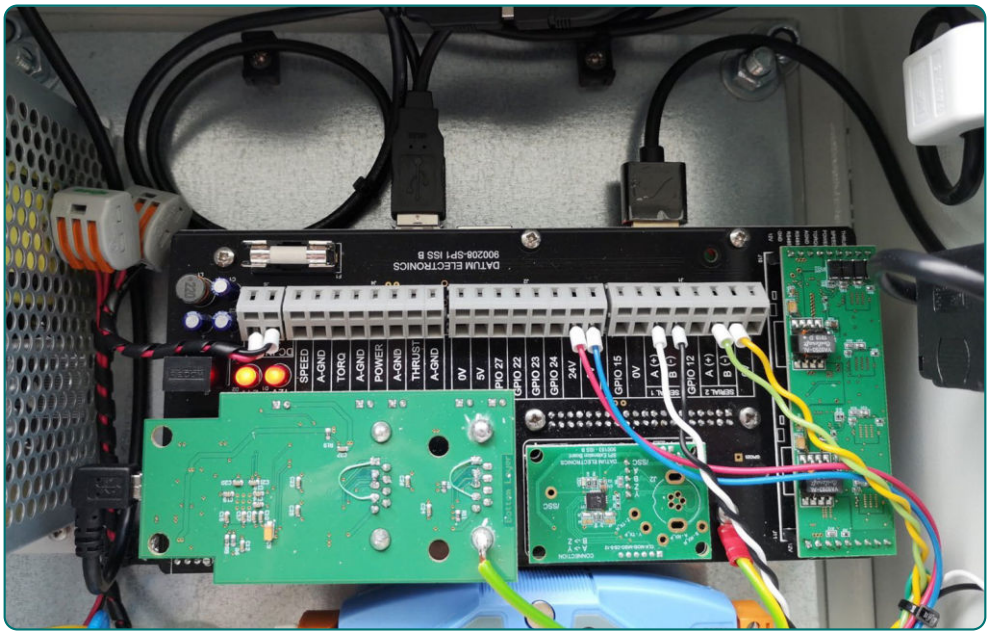
**GREEN** FLASH = Speed signal received

## Control Unit - 401646

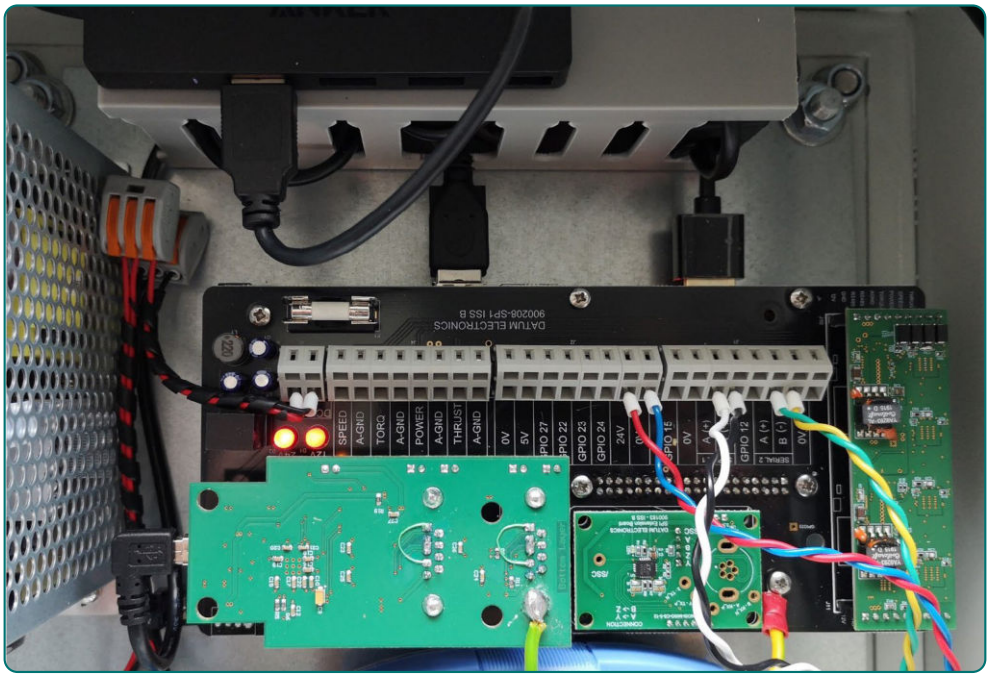
The control unit also has several LEDs that in the unlikely event of a fault will help Datum Electronics or a Datum Approved installer assist in diagnosis.

To access these you will need to open the Control Unit and ensure that you follow correct procedure for inspecting electronic circuits. Depending on when your system was shipped there are two possible internal layouts (Configuration 1 and Configuration 2)

The status LEDs are located on top board centrally located on the PCB as shown below:




Configuration 1




Configuration 2

## Circle 1

2 x Red LEDs representing 24V and 12V. LEDs permanently lit under correct operating conditions.

24V LED indicates correct power to the control unit when on constantly.

12V LED indicates that the power supply is supplying correct power to control board when on constantly.

## Circle 2

This is the serial communications status LED for the SPM system and should be on constantly.

Yellow LED permanently lit under correct operating conditions.

## Circle 3

This is the data input from the stator unit and should be flashing rapidly.

Green LED flashing 5 times per second under correct operating conditions. Red LED will be off.

Slow Green LED flash, 1 per second, can indicate an issue with stator communications from on shaft equipment.

## Circle 4

This is the serial outputs from the Control unit and has two effective modes dependant on the digital output selected during installation and commissioning

**Serial Data Output**

Red LED should be flashing once per second & Green LED off under correct operating conditions.

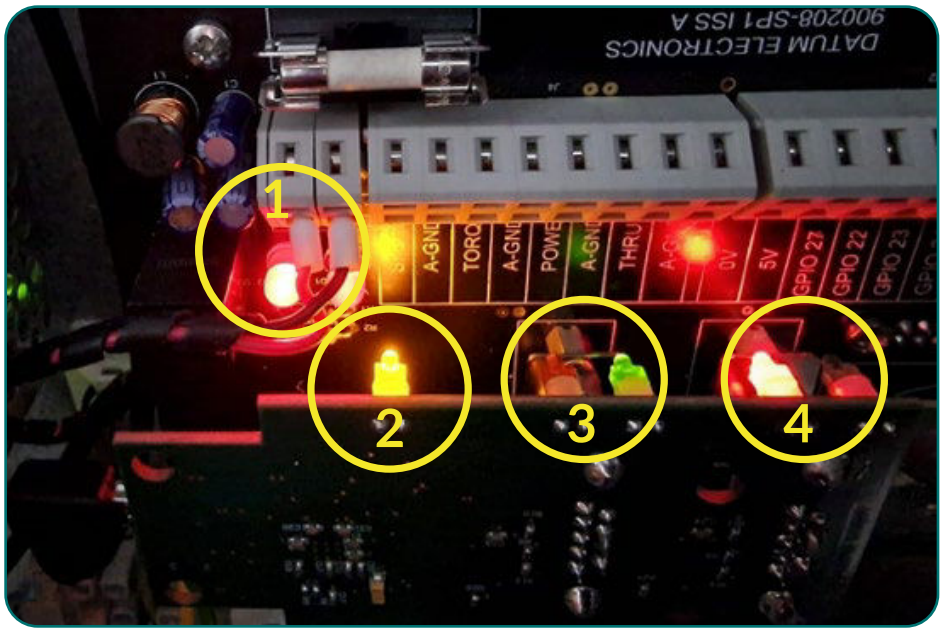
**MODBUS Data output**

Red & Green LED should flash once per second under correct operating conditions.

If the Red LED is not flashing then the serial output is not working.

- Check Settings-2 > Serial IO Page on control unit touchscreen to ensure correct serial output has been selected.

- Check termination connections to the serial output connections in Control Unit.



## Strain Gauge Simulator

If you are concerned about the amount of torque being displayed and have checked your calibration values then it is possible to prove the SPM system and its output o f torque by replacing the input fr om the strain gauges with a set of known mV/V values.

With every torsion meter Datum Electronics supply a strain gauge simulator which can inject known mV/V values in both directions of; 0, 0.2. 0.5, 1.0, 1.5 & 2.0 m V/V.

## Using the Strain Gauge Simulator

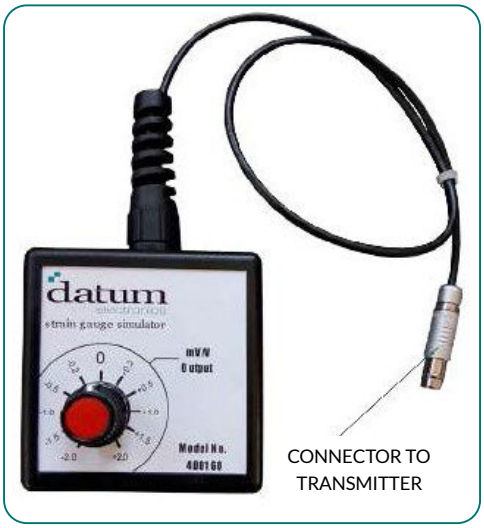
Please note that it is only possible to use the strain gauge simulator whilst the shaft is static as you will need to connect to the on shaft transmitter.

To use the strain gauge simulator you will need to remove the access cover on the on shaft transmitter and unplug the connector from the primary gauge. The primary gauge connector is the furthest from the rotor belt connection (labelled 1 on transmitter body).

Now connect the strain gauge simulator. You can t hen use th e dial to select the different mV/V values in both clockwise (positive) and counter-clockwise (negative) direction.

You can then compare the calibration setting of your system to the closest value on the strain gauge simulator to confirm the system is functioning correctly, i.e.:

Calibration setting for system = 0.9 mV/V is equal to 500 kNm, therefore using the simulator you should see torque of; 0.2 mV/V = 112 kNm, 0.5 mV/V = 278 kNm & 1.0 mV/V = 556 kNm.



## Fault Finding

For any fault finding and diagnosis you will need to check the status of all three sets of indicators, this will highlight where the potential issue could be.

Should you wish to report a fault or query to Datum Electronics Ltd or to your Approved Partner please ensure that you quote serial numbers and where possible share photographs of installed components to help with fault finding where required

Please send the de tails of your fault or query to: support@datum-electronics.co.uk

# SPM3 Troubleshooting

## Control unit

### Behaviour

- Expected SPM Display page does not load.
- SPM Control Unit continuously reboots.

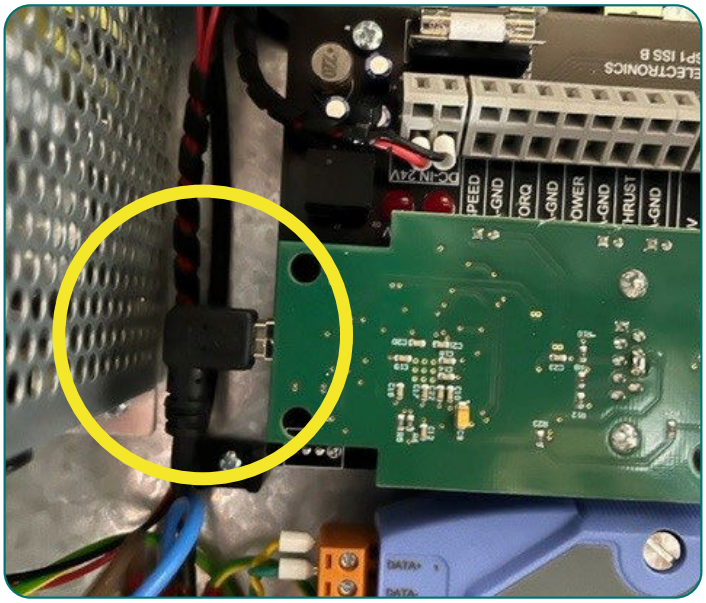
### Potential Cause

This occurs when the system cannot detect a serial board, therefore we must check to ensure all connections from and to this board are seated and connected correctly.

## Troubleshooting Steps

1. Power off the control unit as soon as this behaviour is observed. Leaving the system in this state can lead t o further problems.
2. Check all internal USB connections are sound b y gently attempting to remove and re-insert each end o f the cable. The images below show the USB connections related to the serial board. [Two variations for the USB connection are shown; one without the USB hub, and one with the USB hub ].
3. When all connections are confirmed to be good, power on the control unit.
4. If the reboot problem persists, replacement hardware may be required. Please refer to the System Diagnosis section (page 25) in this User Manual.

## USB Connections




Configuration 1

USB-Mini connected to COM485 (serial) board

USB connected to SPM interface board (900208)

Configuration 2

USB connected to 4-Port USB Hub

# SPM3 System Components

The SPM System may be sold with the following additional components:

| Part No. | Name | Item | Description |
|---|---|---|---|
| 400760 | SPM ECR Remote Repeater Display | | The first generation of touchscreen display designed for use with the SPM system. |
| 402069 | ECR2 Main Assembly | | ECR2 seamlessly integrates with your SPM system. ECR2 offers user-friendly reporting tools. Can be upgraded to include SFOC data. |
| 401897 | EEXI Interface Assembly | | The EEXI interface monitors and records instantaneous shaft power, ensuring regulatory compliance. Any ShaPoLi exceptional events that have occurred during the voyage are recorded and justified. |
| 402174 | ECR Compact | | The second generation of touchscreen designed for use with the SPM system |

For support or further information on any of these products please contact:
support@datum-electronics.co.uk

# SPM3 System Extras

The SPM System may be sold with the following optional component; this is the MODBUS Conversion Kit (402071). This can be used to enable SPM Control Units to provide simultaneous MODBUS RTU output and streamed serial output.

In this case the MODBUS output registers are different to the ones shown on page 9.

## Serial Output Type: MODBUS RTU

### MODBUS RTU GENERAL CONFIGURATION SETTINGS

| | |
|---|---|
| Modbus Slave ID: | 101 * |
| Serial settings: | Data bits: 8<br>Parity: None<br>Stop Bits: 1 |
| Output Baud Rate: | 9600 [default] |

### MODBUS RTU REGISTER DEFINITIONS

| Address | Description | Range # | MODBUS scale |
|---|---|---|---|
| 40001 | Torque | 0 - FS (kNm) | 0 - 20 000 |
| 40002 | Speed | 0 - FS (RPM) | 0 - 20 000 |
| 40003 | Power | 0 - FS (kW) | 0 - 20 000 |

* Check Slave ID shown on device (will be 101 or 102)
# FS = Full scale

For further information on the MODBUS Conversion Kit see DOC-02279

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