

Marine Shaft Power Meter Product Overview



Introduction

Datum Electronics Limited

ESTABLISHED IN 1989, Datum Electronics Limited is a leading UK manufacturer and supplier of torque, load & shaft power measurement solutions worldwide, spanning all industries including Automotive, Marine, Military, Oil & Gas & Civil Engineering.



Marine Shaft Power Meter

The Datum Electronics' Marine Shaft Power Meter has been developed to meet the requirements of the Commercial Marine Market, to provide ongoing power monitoring data on ships, including; Propulsion Shafts, Thrusters and even Diesel Generator Shafts.

The most common use of the system is to provide data for fuel economy and equipment maintenance planning programs.

Key Benefits

- Fully Modular
- 100% Contactless
- Maintenance Free
- Highly Reliable
- 0.1% Accuracy
- Cost-Effective
- Multiple Outputs
- Can Be Installed in 1-2 Days
- One-Time Calibration (no Re-zero or Re-Calibration required)

What Can a Shaft Power and Torsion Meter provide?

A Shaft Power & Torsion Meter accurately measures the power transmitted through a shaft, enabling the measurement of actual power an engine is delivering to the propeller or generator.

The Shaft Power & Torsion Meter System is an essential tool, helping to reduce the running costs by maximising:

- 1. Fuel Savings**
- 2. Improved Maintenance Scheduling**
- 3. Equipment Protection**

The cost of an accurate permanently installed torsion meter is very small, in comparison with potential savings in operational costs.

Shaft Power Measurement

Shaft Power is an essential input to Ship Performance Monitoring Systems. The data from monitoring actual power levels provides an accurate reference point, to assist with the assessment of:

- **Engine Performance Monitoring**
- **Hull Condition**
- **Propeller Condition**
- **Specific Fuel Consumption**
- **Operational Efficiency Planning**
- **Ship Condition Changes**

The same system will also provide data to assess the value of new equipment and operating procedures:

- **Changes to Operation**
- **Changes to Fuel Types**
- **Changes to Hull Coatings**

Fitted at an early stage, the torsion meter system can be used in Ship Acceptance Trials and, from that point on, be a measure of the condition of the ship, throughout its lifecycle.

Future of Shaft Power Measurement & Condition Based Monitoring

The standard systems can be easily upgraded to dynamic “Diesel Hawk” System for:

- **Real Time Condition Based Monitoring**
- **Predictive Maintenance**
- **Individual Engine Profiling**
- **Live Monitoring of Every Cylinder**
- **Propeller & Intermediate Shaft Condition Monitoring**



datum Diesel Hawk System

Marine Control Unit



The Standard System comes with a Marine Control Unit. This comprises a local display of Torque, Speed & Power and has a multitude of both Analogue & Digital Outputs, for simple integration into any performance monitoring software or data logger.

Control Unit Features:

- **LCD Display** (Torque, Speed, Power & Status)
- **Analogue Outputs for:**
 - Torque
 - Thrust (optional)
 - Speed
 - Power
 - (0-10V or 4-20mA – Uni or Bi-Polar)
- **Digital Outputs:**
 - RS485 / RS232 / NMEA
 - Modbus RTU
 - Ethernet (Various Options Available)
- **Local USB Logging** (.csv files)

ECR Display (Optional)



7" TFT Display with Real Time Torque, Speed, Shaft Power & Energy Counters (kWh).

ECR Display Features:

- **Torque**
- **Thrust** (Optional)
- **Speed**
- **Power**
- **Energy**

Certification

Datum Electronics Limited issue a system calibration certificate, that defines the accuracy of the instrumentation. A second certificate is issued on installation and this certificate defines the signal to torque relationship for the shaft, and states the values used for the shaft constants.

Technical Notes

The Torque and Power output from the torsion meter system is dependent on calculations, utilising constants from the shaft. These are:

Shaft Material – either as shear modulus, or Young's modulus & Poisson's ratio.

Shaft Diameter – by direct measurement of the inside and outside diameter of a hollow shaft.

The absolute accuracy of the system is dependent on the accuracy with which the above parameters are provided. The absolute accuracy is quoted at 0.1% + Ke, where Ke is the combined error from the shaft constants.

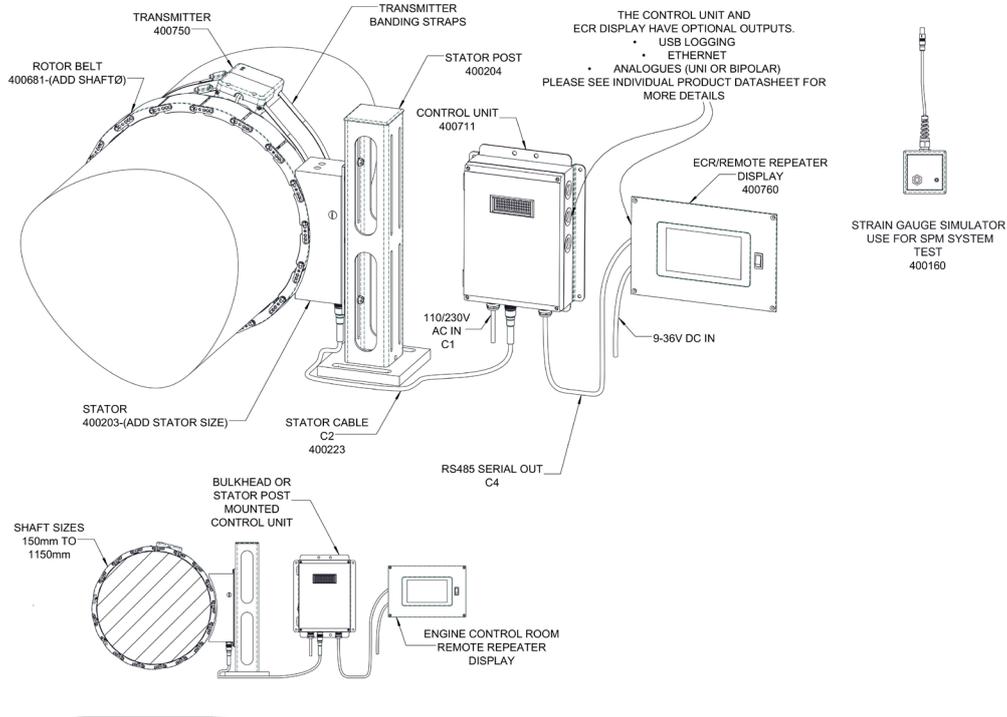
Datum Electronics Limited can conduct tests on a sample of the shaft material to determine the shear modulus. Two samples of shaft material, 20mm diameter and 150mm long, are required for this testing.

Technical Specifications

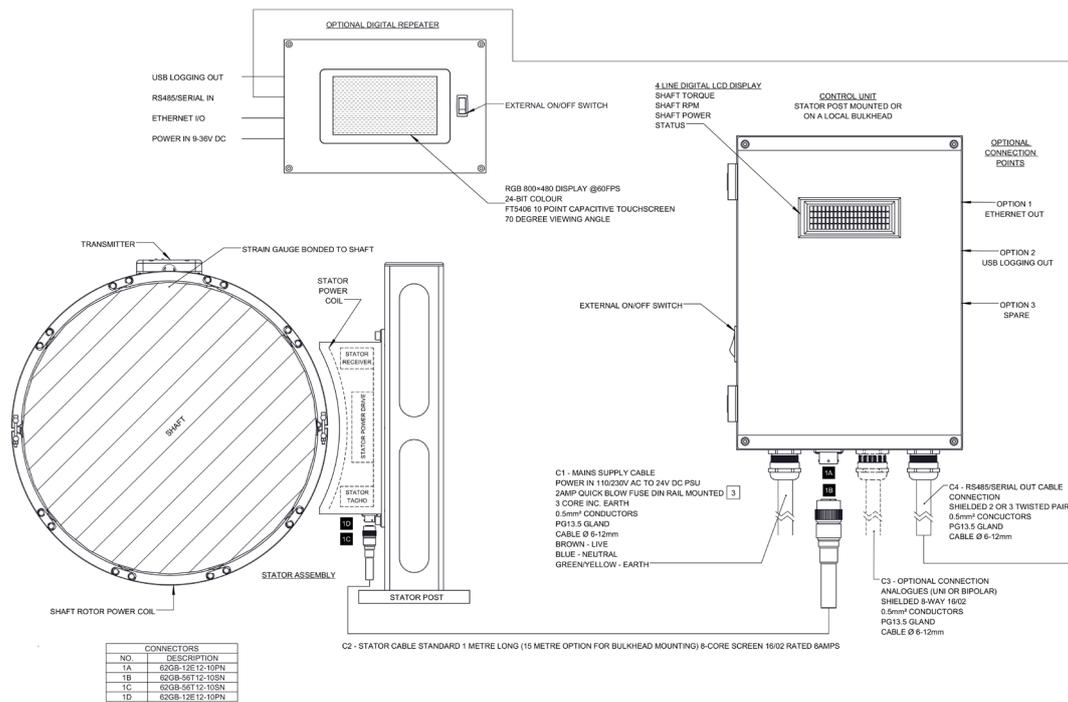
Instrumentation Accuracy	<i>Shaft Torque</i>	0.1%
	<i>Shaft RPM</i>	0.1%
	<i>Shaft Power</i>	0.1%
System Accuracy	<i>Shaft Torque</i>	0.1% + Ke
	<i>Shaft RPM</i>	0.1%
	<i>Shaft Power</i>	0.1% + Ke
	<i>Ke</i>	Total error in shaft modulus constant and shaft diameter measurement
System Repeatability	<i>Shaft Torque</i>	0.05%
	<i>Shaft RPM</i>	0.05%
	<i>Shaft Power</i>	0.05%
Data Output and Display	<i>Power, Torque and Speed Display</i>	The display presents average values of torque, speed and power. The time period of the average values can be configured in the software provided and can vary from 1 second to 15 minutes.
	<i>Total Energy</i>	The total energy is displayed in kWh from the Reset Date, to Today. Previous Totals between resets can be accessed through the menu.
	<i>Average Power</i>	Average Power for a period between resets is displayed in MW.
	<i>Power Measurement Data Output</i>	Average Values of Shaft Power, Torque and Speed are transmitted 10 times per second.
Environmental	<i>Operating Temperature</i>	-15°C to +55°C
	<i>Storage Temperature</i>	-25°C to +70°C
	<i>Temperature Effect on Readings</i>	0.01% per degree centigrade
	<i>Instrument Stability / Time Drift</i>	Less than 0.1% per annum
Environment Sealing	<i>Shaft Unit 106XXX</i>	IP67
	<i>Stator Electronics Unit</i>	IP67
	<i>Bulkhead Control Unit</i>	IP67
	<i>Panel Mounted Display Unit</i>	IP67 from fascia, IP54 from rear of panel
	<i>Contamination</i>	All materials and external components have been tested to DefStan 08-123, contaminants include Diesel oil, Sea water, Hydraulic oil, Gear oil, Grease, Water/ antifreeze.
	<i>Rotor Stator Air Gap</i>	Radial 5 - 10mm, lateral +/-8mm
	<i>Supply Voltage</i>	110-230Vac, III or I, AC, or DC12-24V

Dimensions

General Overview

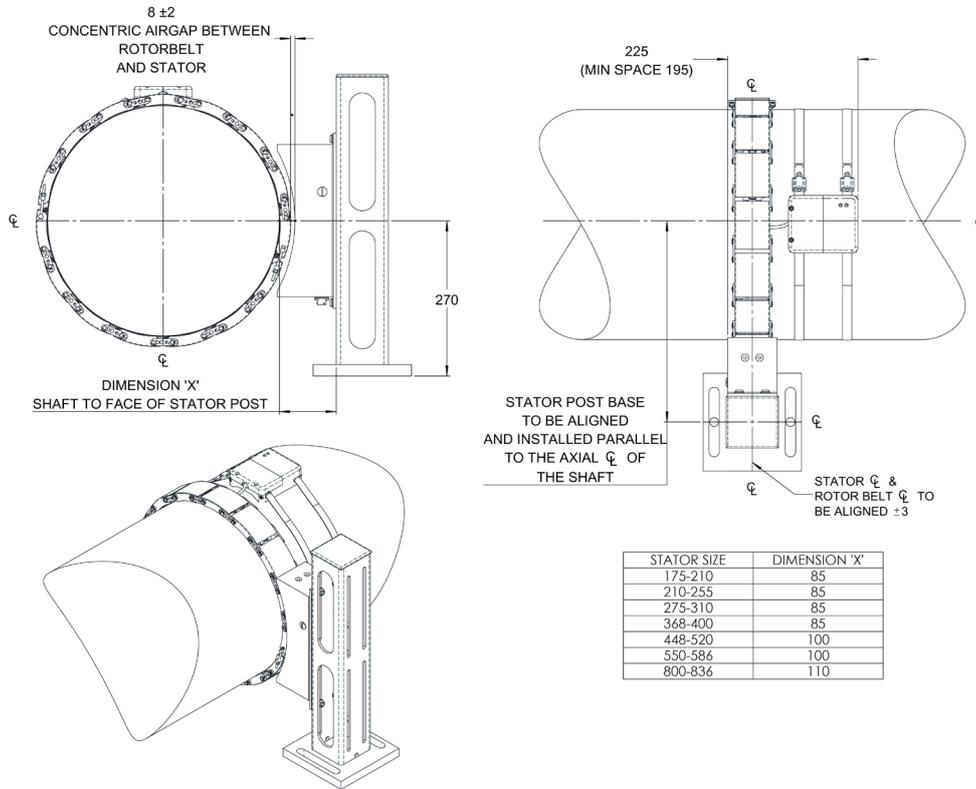


Block Diagram & Wiring Schematic



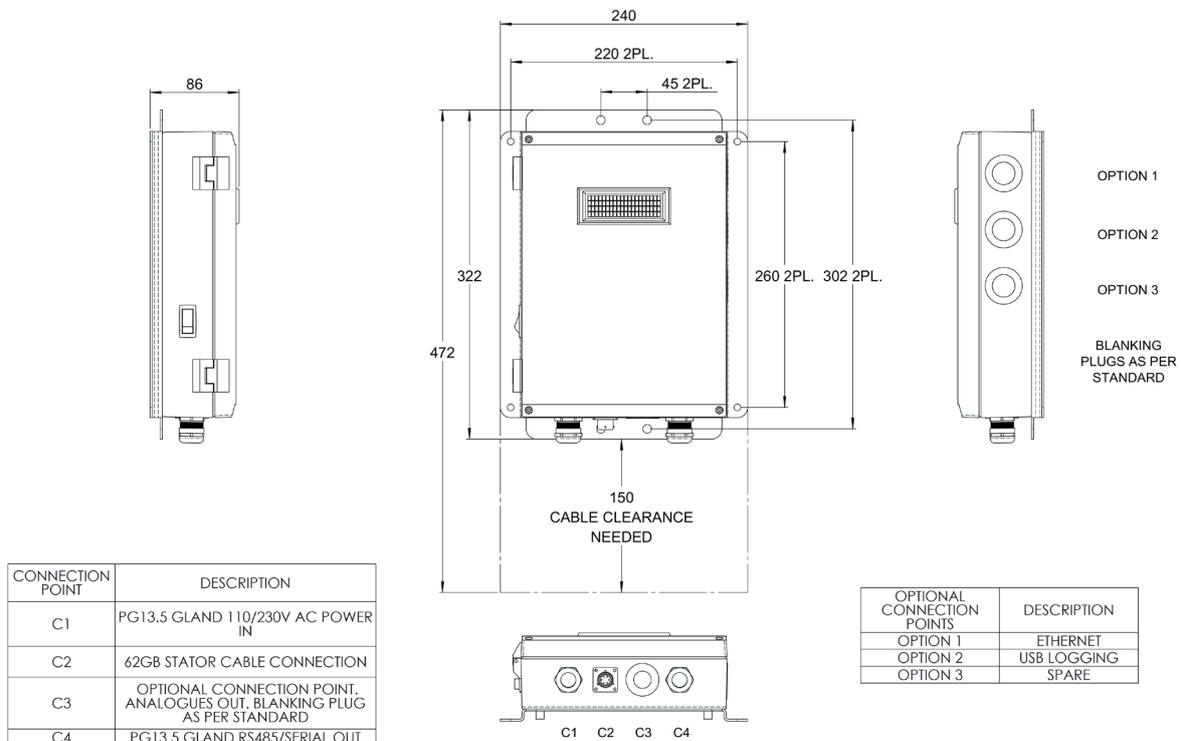
Dimensions (cont.)

Alignment Detail



STATOR SIZE	DIMENSION 'X'
175-210	85
210-255	85
275-310	85
368-400	85
448-520	100
550-586	100
800-836	110

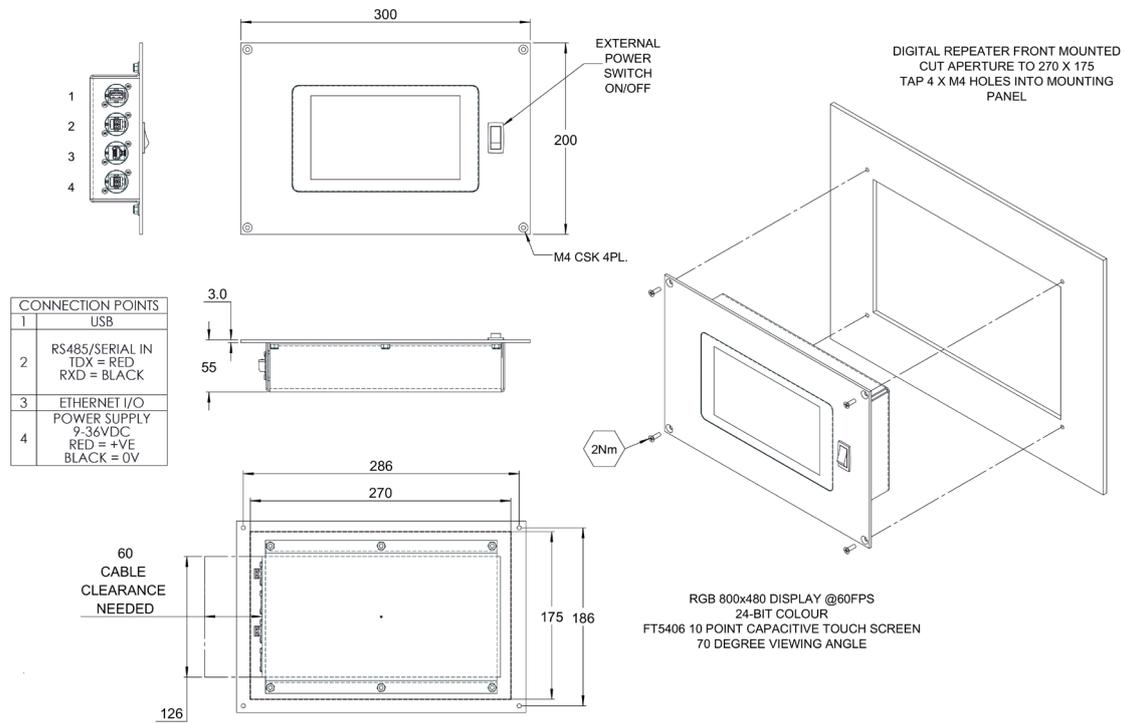
Control Unit



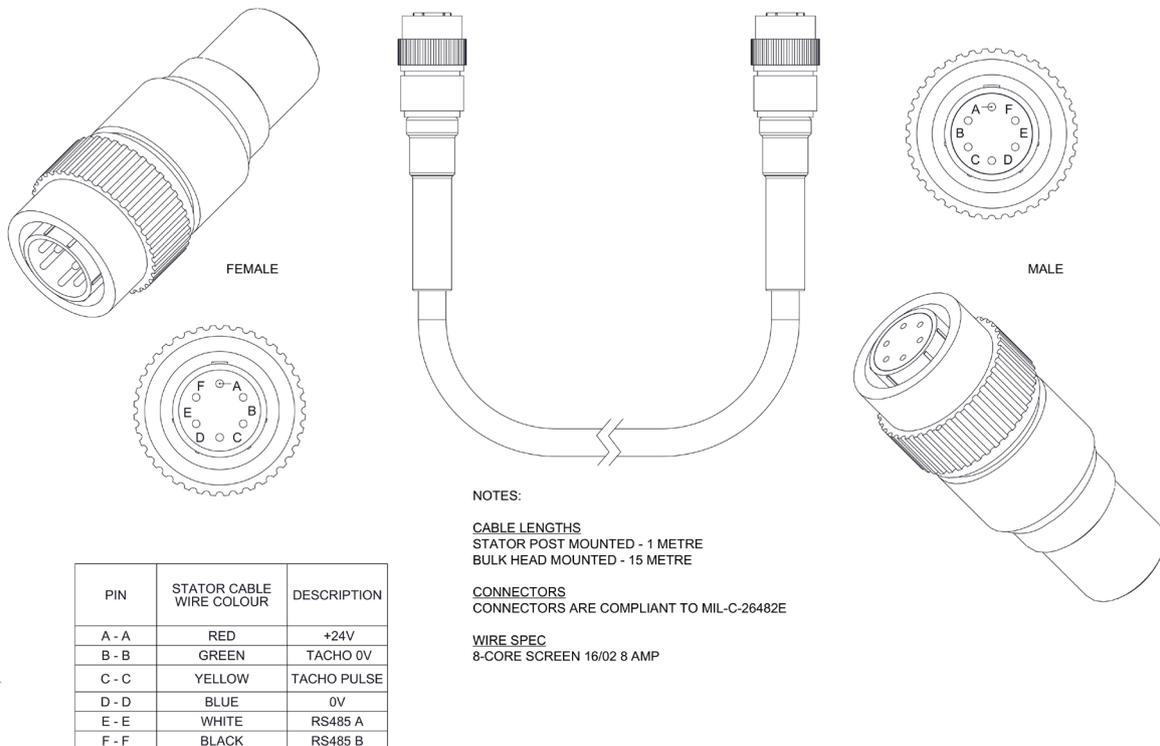
CONNECTION POINT	DESCRIPTION
C1	PG13.5 GLAND 110/230V AC POWER IN
C2	62GB STATOR CABLE CONNECTION
C3	OPTIONAL CONNECTION POINT. ANALOGUES OUT. BLANKING PLUG AS PER STANDARD
C4	PG13.5 GLAND RS485/SERIAL OUT

OPTIONAL CONNECTION POINTS	DESCRIPTION
OPTION 1	ETHERNET
OPTION 2	USB LOGGING
OPTION 3	SPARE

ECR Repeater Display (Optional)



Stator Cable

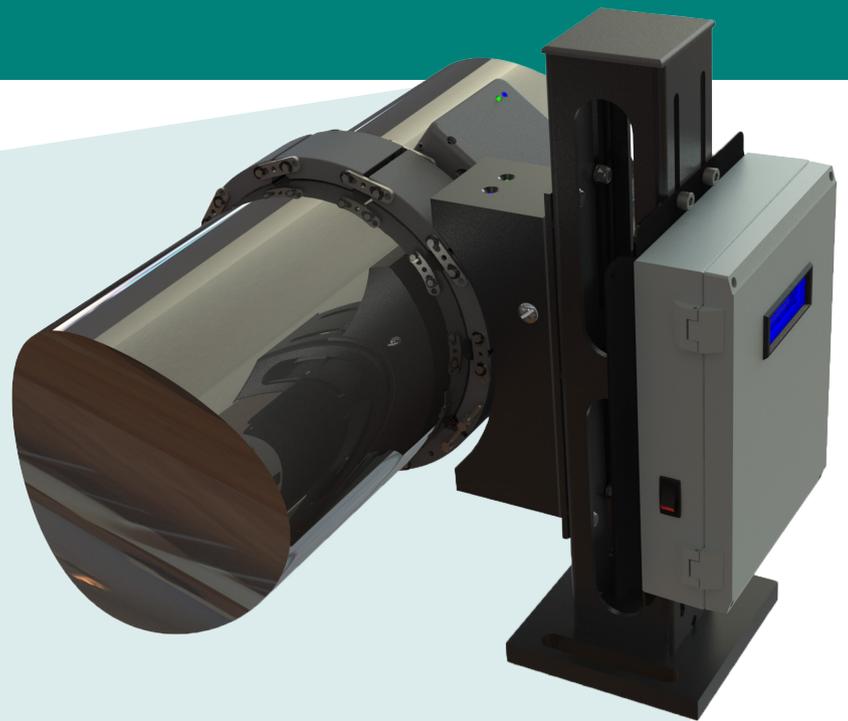


Marine Shaft Power Meter

*“Saving money
through
**accurate
shaft power
measurement**”*

A **Datum Electronics**’ Shaft Power Meter System accurately measures the power, torque & RPM transmitted through a shaft, enabling the measurement of the actual power, delivered by an engine to a propeller or a generator. This data is essential for SEEMP & EU MRV regulations.

The cost of an accurate, permanently installed shaft power meter is relatively small in comparison with potentially large savings in running costs.



A Shaft Power Meter is essential to help in the reduction of running costs relating to:

- 1. Fuel Saving**
- 2. Improved Maintenance Scheduling**
- 3. Equipment Protection**

With the cost of fuel continuing to impact businesses, the value of saving fuel has never been more important. An accurate, highly repeatable measurement of shaft power generated and power used are essential.

Accurate Shaft Power Measurement

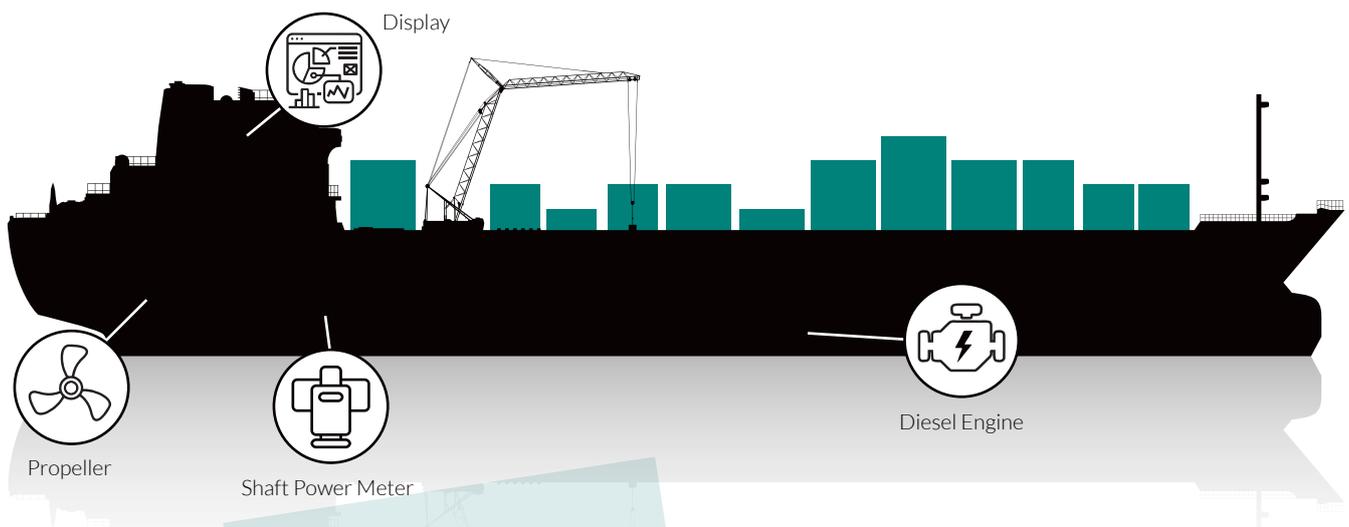
The modern shipping era sees “Big Data” as a key factor, and Shaft Power is an essential input to ship performance monitoring systems. The data from monitoring actual power levels provide an accurate reference point to assist with assessing:

Engine Performance Monitoring
Ship Propulsion Efficiency
Hull Condition
Propeller Condition
Specific Fuel Consumption
Operational Efficiency Planning
Ship Condition Changes

The same system will provide data to assess the value of new equipment and operating procedure:

Changes to Operation
Changes to Fuel Types
Changes to Hull Coatings

Fitted at an early stage, the shaft power meter system can be used in ship acceptance trials and from that point on be a measure of the condition of the ship throughout its lifecycle. It can also be retro-fitted where required to existing operational vessels of a fleet.



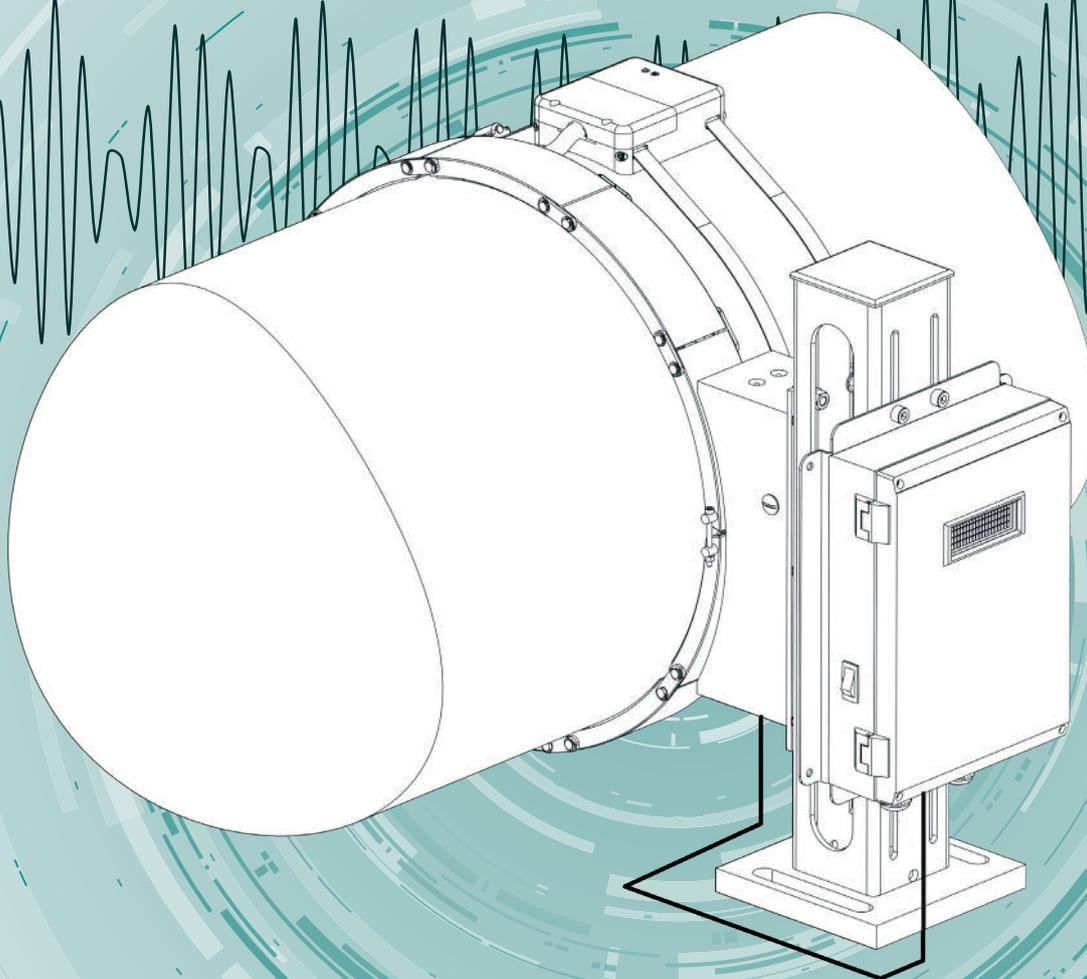
Key Advantages of a Datum Electronics Shaft Power Meter:

- Fully modular system
- Fast delivery from order
- Extremely competitive pricing with no compromise on quality or system accuracy
- Multiple digital and analogue outputs available as standard
- Local display of Torque, Speed, Power + System Status
- Post or Bulk Head Mount Control Unit
- ECR display (optional)
- Manufactured in the UK
- Can be installed in 1-2 days
- Worldwide installation service

For more information, call us on
+44 (0) 1983 282834 or email
web@datum-electronics.co.uk

DATUM ELECTRONICS

COMMERCIAL MARINE SHAFT POWER METER HANDBOOK



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CMSPM OVERVIEW

System design

The Commercial Marine Shaft Power Meter, CMSPM, system continually measures on shaft torque (kNm), speed (RPM) and power (kW).

The Commercial Marine Shaft Power Meter Systems have been developed to meet the requirements of the Commercial Marine customers to provide ongoing power monitoring data on ships including; Propulsion, Thruster and even Generator Shafts.

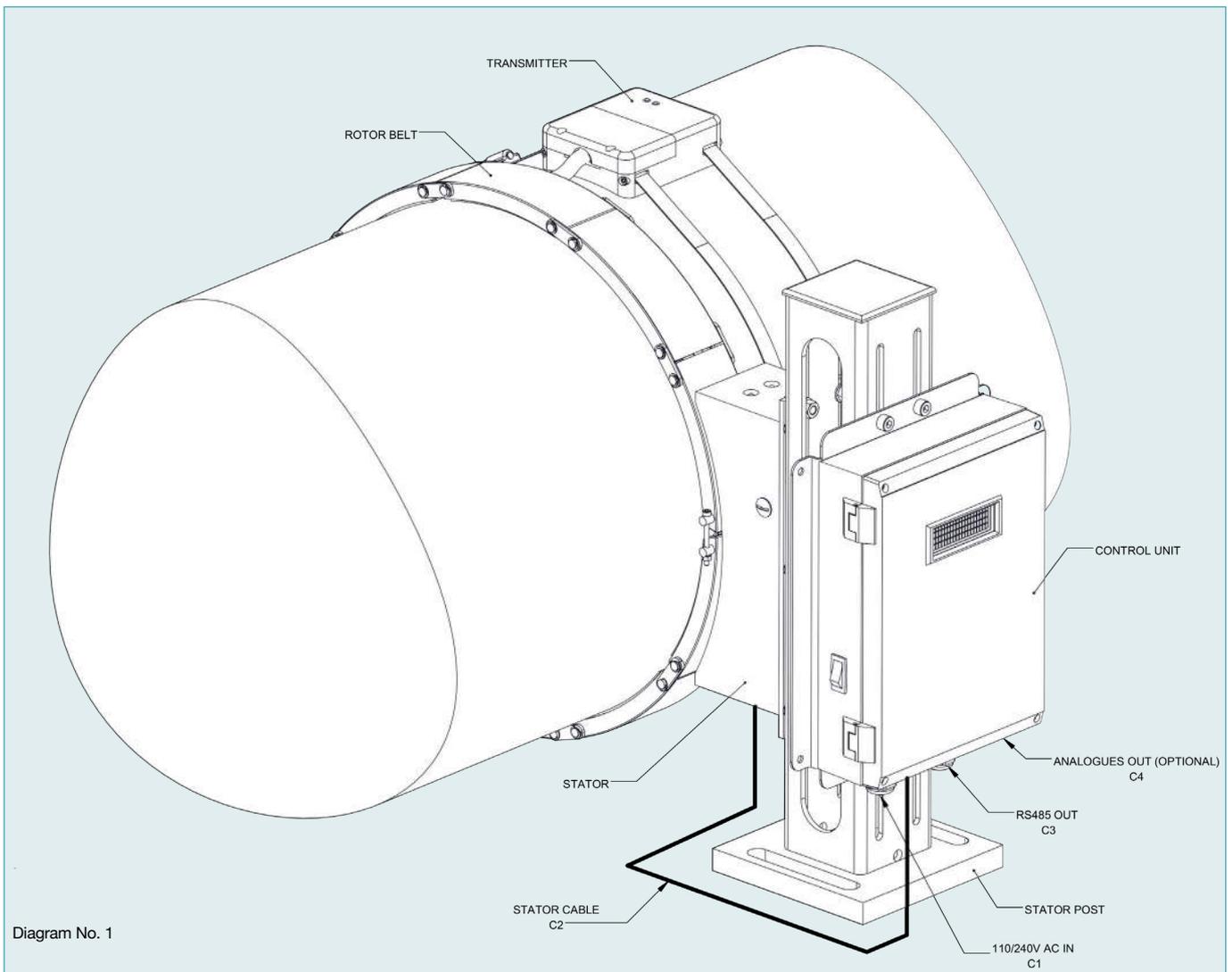
SYSTEM SPECIFICATIONS

CMSPM system performance and benefits:

- Simple and Easy to install
- Accurate - electronics rated at 0.1% accuracy
- Robust Design : IP68
- Modular system design
- Flexible shaft fit - 70mm - 1200mm
- Cost effective
- Efficient Power Usage compared to other systems

SYSTEM OVERVIEW

STANDARD SYSTEM OVERVIEW



Typical installation shown above.

The CMSPM system can also be supplied with the extra 7 inch ECR display (Diagram 2):



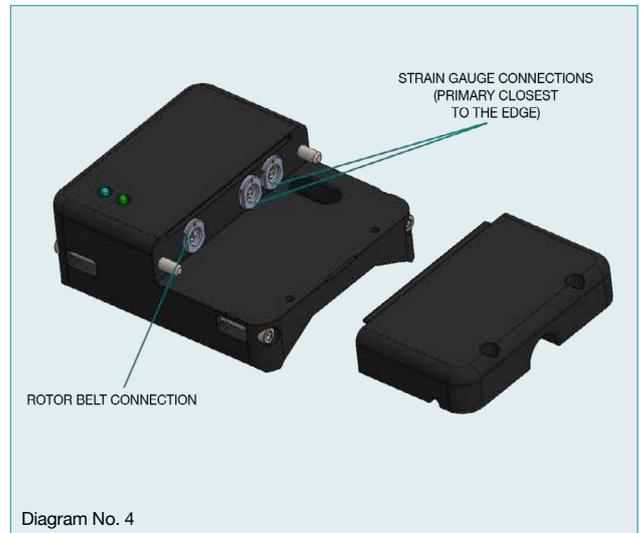
SYSTEM COMPONENT INFORMATION

TRANSMITTER (Diagrams 3-4)

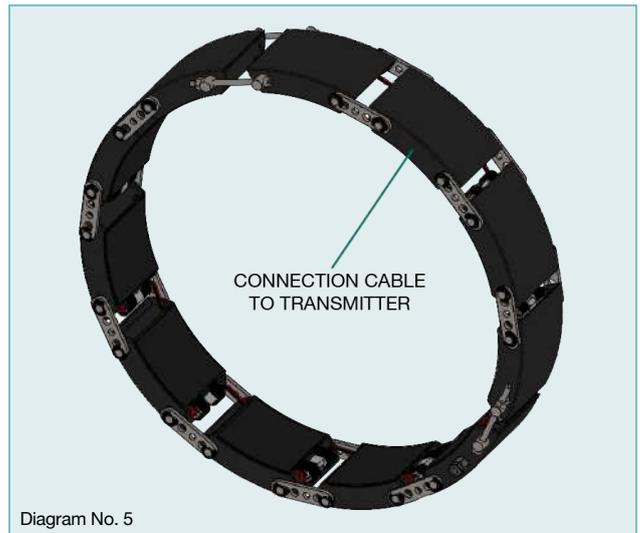


Features:

- Powered from Rotor belt (5V)
- IP 68 rated
- 2 status LED's for easy system diagnosis
- Transmits 2 channels of strain (optimal thrust)
- 2.4Ghz transmission
- Removable cover to access 2 x strain channels and rotor band power connection
- Acts as strain gauge protection cover
- Secured to shaft via 2 x supplied bands



ROTOR BELT (Diagrams 5)



Features:

- Modular belt design made up of individual links
- IP68 rated design
- Powers the on shaft Transmitter
- Inductively receives power from Stator
- Every belt has a 'master' link which comprises a magnet in to generate a 1 pulse per revolution rpm signal output

SINGLE POINT STATOR

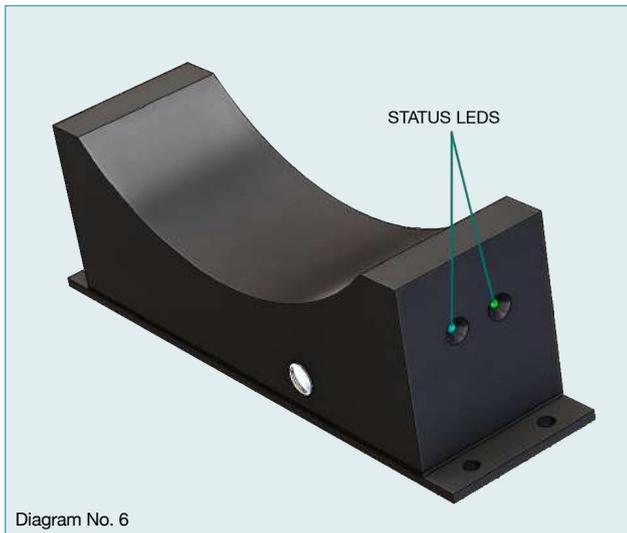


Diagram No. 6

Features:

- IP 68 Rated
- Inductively powers the on shaft Rotor Belt
- Receives data from the on shaft Transmitter
- Contains the rpm speed sensor to measure 1 pulse per revolution
- Features 2 LED's for simple system diagnosis
- Has a single cable output (not shown) for power and RS485 serial data to the marine controller
- Powered from marine controller (24VDC)

MARINE CONTROLLER



Diagram No. 7

Features:

- IP 68 Rated enclosure
- Simple 4 Line display showing; Torque, Speed, Power and System Status
- Can be supplied on post or be bulk-head mounted
- Requires 110/240VAC power (see system drawings for more information)
- Connects to Stator Head with single cable for power and RS485 serial data
- Supplies the stator head with 24vdc power
- Set-up and configured via USB mini b cable to PC with free supplied test and configuration software from Datum, DUI Config (for more information please see software guide)
- Contains Marine Datum Universal Interface (DUI), which can be configured for a range of outputs including:
 - 3 x analogue channels of calibrated; Torque, Speed and Power data
 - Analogue outputs selection include; 0-10V, +/-5V, 4-20mA, 12-8mA, +/-10V, 0-5V
 - Digital data output: RS485 and/or Ethernet as a variety of selectable output types for system integration
 - Local USB memory stick logging of data (Plug & Play)
- Sends RS485 Serial data to the Datum 7inch ECR display panel

7-INCH ECR DISPLAY PANEL (OPTIONAL EXTRA)



Diagram No. 8

Features:

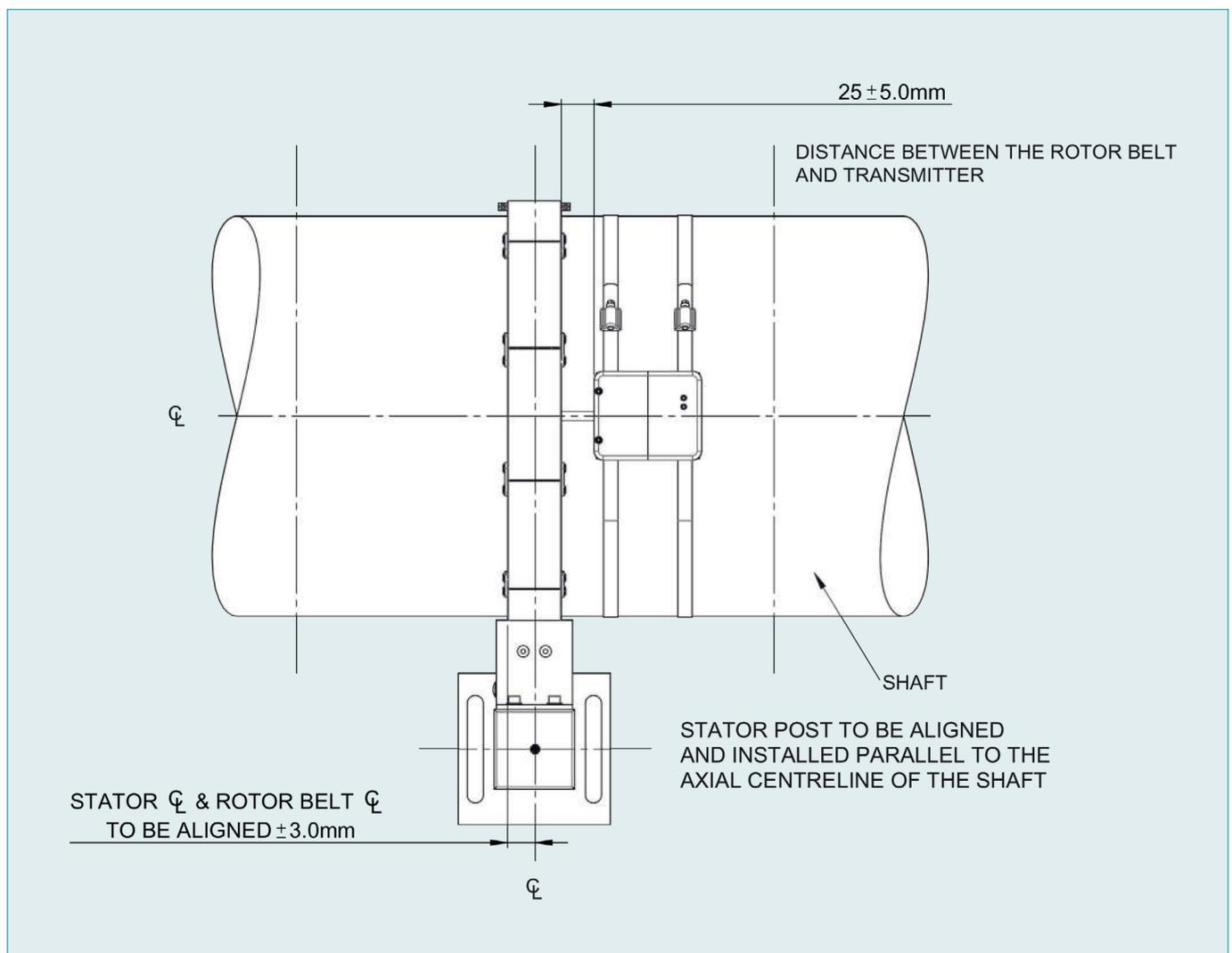
- Running display of calibrated information from the CMSPM system
- As standard displays; Torque, Speed & Power
- Can have multiple display panels per systems
- Receives RS485 data from the Marine Controller
- Simple Installation and usage
- Requires local power 24VDC

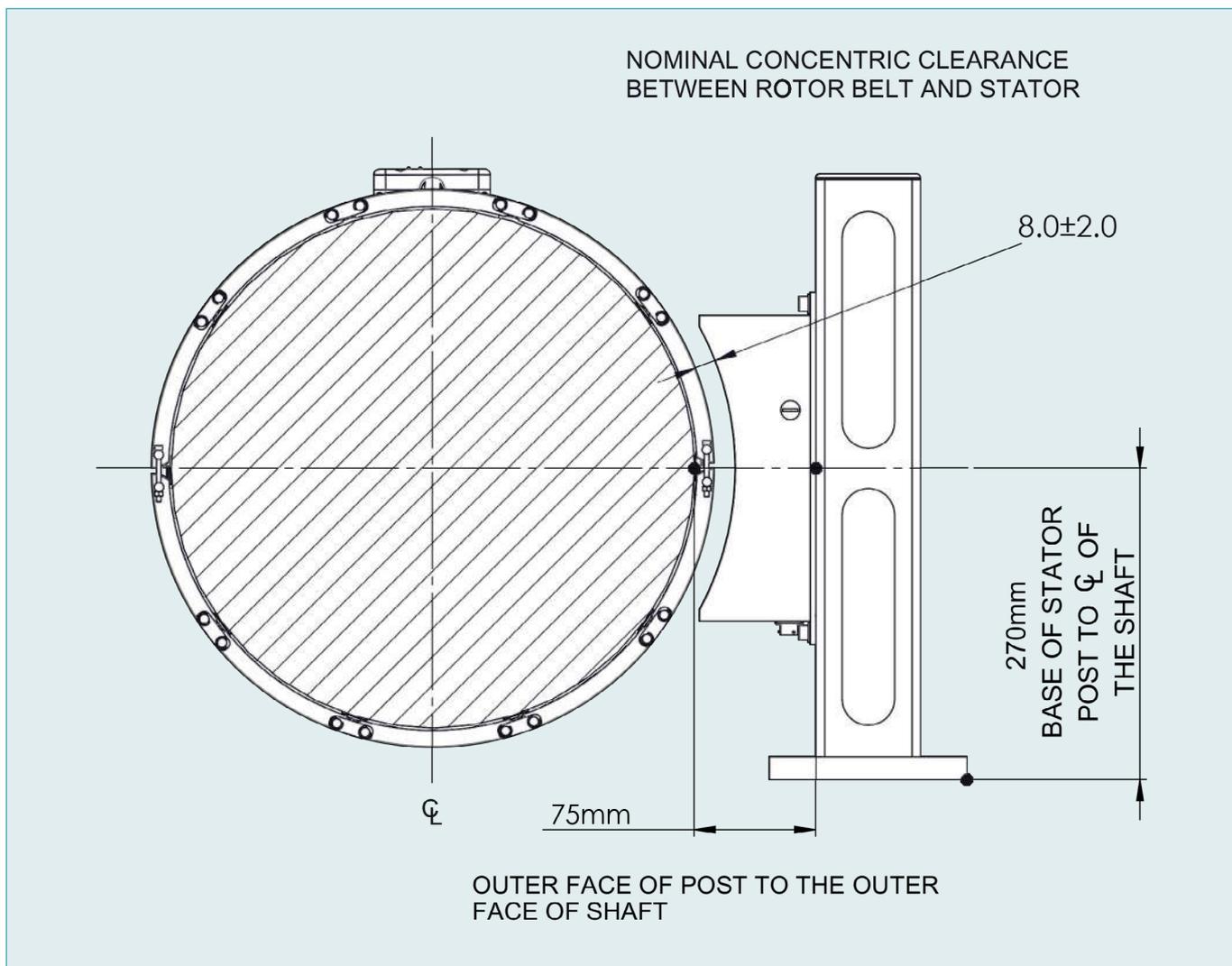
SYSTEM ALIGNMENT

The Datum CMSPM system is simple and easy to install. The engineer who installs it will have to ensure:

1. Continuous power transmission between 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:





For more information on the installation of the system and how to align the CMSPM please refer to the installation guide.

SYSTEM FAQ'S

How is the shaft power meter calibrated?

The CMSPM system receives the raw strain value (mV/V) from the strain gauges on shaft and mathematically calibrates this into torque (kNm). This is calculated using the following equation:

$$mV / V = \frac{Torque (Nm) * 16000 * Gauge Factor * (1 + \sigma)}{Diameter (mtrs)^3 * \pi * Young's Modulus (Pa)}$$

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 Poissons Ratio.

Datum use the properties for nominal tool steel for the Young's Modulus and Poisson's Ratio if the exact steel properties are not known during installation.

How is the power calculated from the Torque and speed data?

Power (KW) = Torque (kNm) x Angular Velocity (radians/sec)

or

Power (KW) = Torque (kNm) x Shaft Speed (RPM) x P/30

Can the outputs of the system be changed after installation?

Yes this can be done by accessing the marine DUI inside the controller and using the Datum configuration software. Please note that all the functions of the controller will be set up as requested during installation – see section 8 for more information.

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;

+ indicated clockwise strain/torque

- indicates counter-clockwise strain/torque

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

Datum Electronics can change this setting to only display one direction torque and power, if requested.

The values appear to be changing very quickly on Marine Controller display?

The Marine Controller has a 4 Line display which gives a simple indication of the Torque, Speed and Power and the system status. It will show live data from the shaft power meter which samples the data at a minimum of 10 samples per second, this can appear to change quickly. Please discuss this with the Datum Support Team as this can be changed in the settings to suit your needs.

Torque still showing when there is no RPM?

The torque data is continuously being transmitted even when there is no shaft rotation so an indication of torque is either

1. Locked in torque seen from a brake being applied to the shaft
2. Zero not being set correctly
3. Combination of the above

Please refer to section 8 for more information on zero setting information.

How to fault find system?

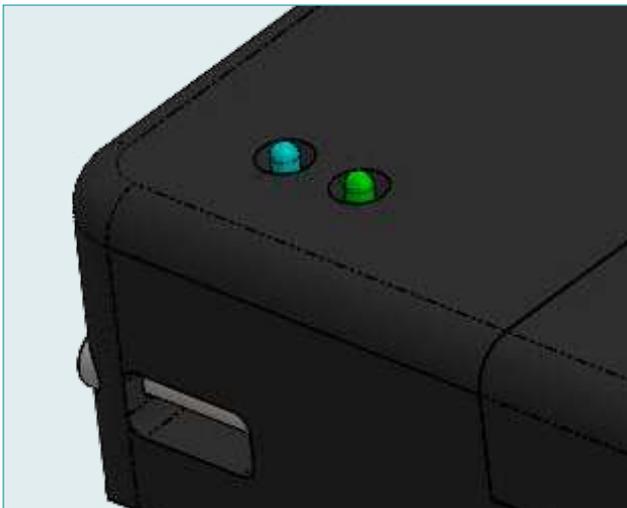
Refer to section 7 for more information on system diagnosis.

SYSTEM DIAGNOSIS

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

- 2 x LED's on the Transmitter (Rotor)
- 2 x LED's on the Stator
- 4 line display on the Marine Controller display

TRANSMITTER LEDS (ROTOR)



BLUE LED = Data status

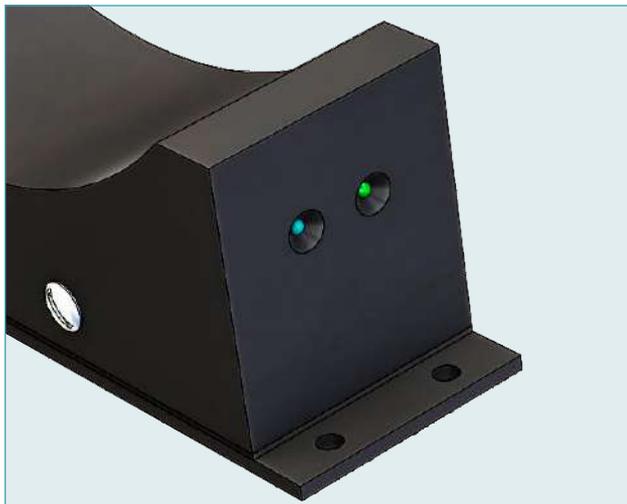
GREEN LED = Power status

BLUE FAST FLASH = Good data connection with Stator

BLUE SLOW FLASH (1 per second) = Powered but no connection stator received

GREEN = Good power from Rotor Belt

STATOR LEDS



BLUE FAST FLASH = Good data connection with on shaft transmitter

BLUE SLOW FLASH = No connection with the on shaft transmitter

GREEN = This will illuminate every time an RPM pulse is triggered from the Rotor master link

MARINE CONTROLLER DISPLAY & 7 INCH DISPLAY

The fourth line of the display alternatively shows the status of the controller as well as the current sample rate. The status will either show as;

- STATUS OK = receiving data from stator and transmitter, followed by samples per second being received
- STATUS no input = not receiving data from stator and transmitter, followed by 0 samples per second

Both the display and controller have a manual power on/off switch which can be used to reset the system. Please note that this will not delete any settings stored into the marine DUI.

CMSPM ADDITIONAL SETTINGS

CONFIRMING THE TORQUE OUTPUT

If you are concerned about the amount of torque being displayed and have checked your calibration values then it is possible to prove the CMSPM system and its output of torque by replacing the strain gauges with a set of known mV/V values. With every shaft power meter Datum Electronics supply a strain gauge simulator which can inject known mV/V steps in both directions of; 0, 0.2, 0.5, 1.0, 1.5 & 2.0 mV/V



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 (Diagram 4). Now connect the strain gauge simulator. You can then use the 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 = 0.9mV/V is equal to 500kNm, therefore using the simulator you should see torque of; 0.2mV/V = 112kNm, 0.5mV/V = 278kNm & 1.0mV/V = 556kNm.

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. Please then contact your distributor or the Datum Support team:

Email: support@datum-electronics.co.uk

Tel: +44 (0) 1983 282834

ZERO SETTING

If you wish to re-zero an offset (torque) at any time, this can be achieved by pressing the zero reset button within the control unit. You will need to undo the four cover hex screws to be able to open the marine controller.

Once opened, you can see the Marine DUI on the lid and on the top of this is the ZERO button. To zero the system you need to press and hold the button as indicated on the screen. Please ensure that when setting the zero point there is no locked in torque on the shaft.

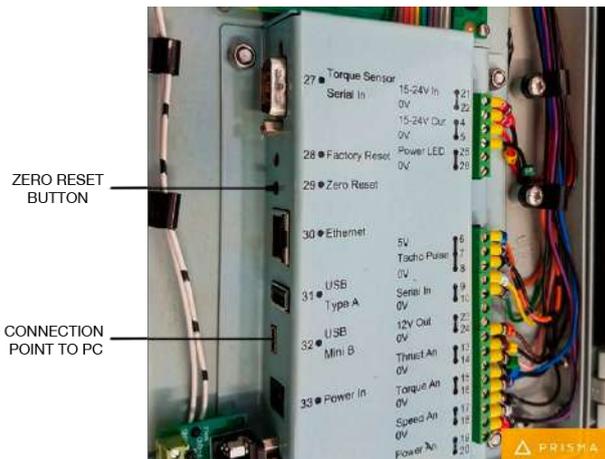
To zero the system you need to press and hold the button for 5 seconds and this will remove any offset on the shaft. The torque display will now read 0 kNm.

ALTERING SYSTEM CALIBRATION AND SETTINGS

If you need to change any settings on the shaft power meter this can be done using a few simple tools;

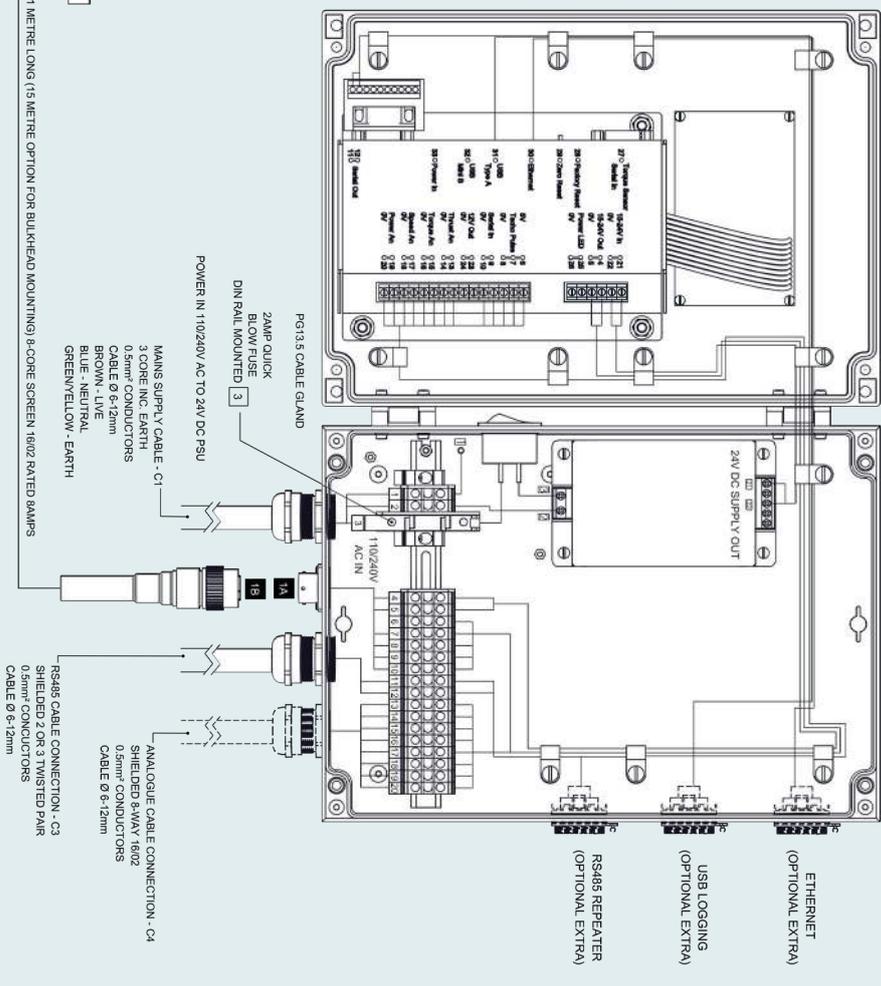
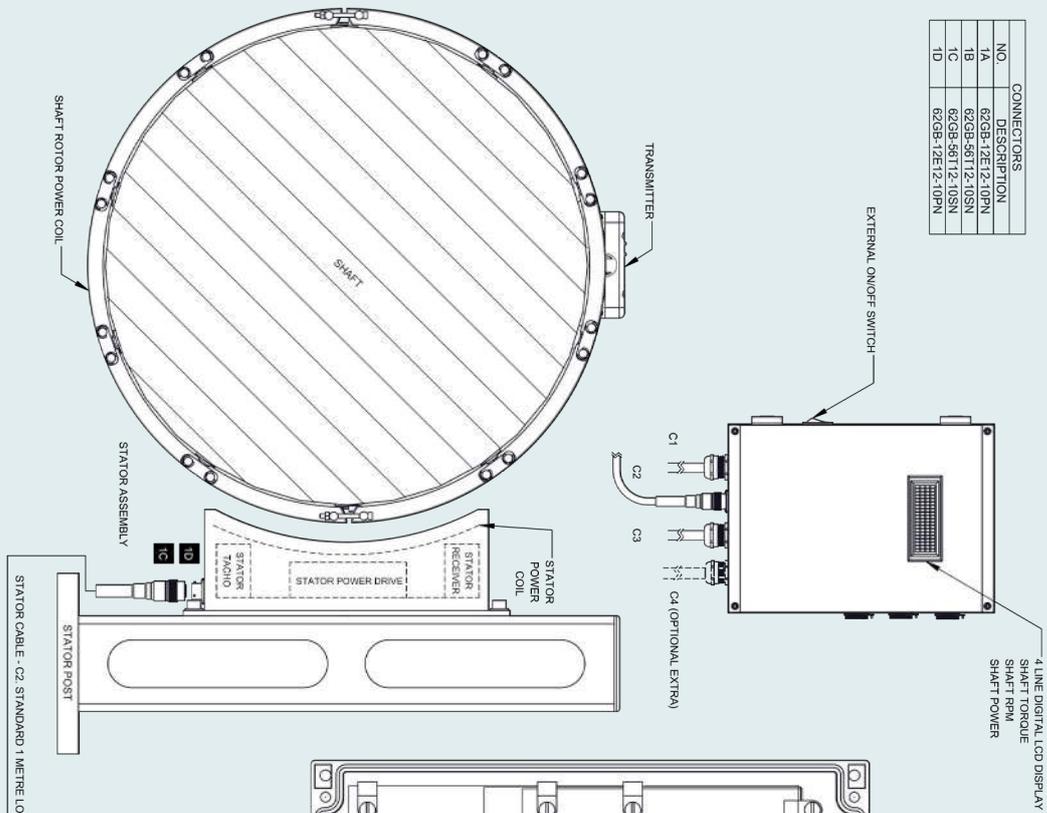
- Datum free DUI configuration software – a copy will be supplied with the shaft power meter
- User guide for the software
- USB mini B to USB A cable
- Windows laptop/netbook

The user guide contains information on how to change settings using the software if you have any questions or concerns about this please contact the Datum support team who will be able to assist.



SYSTEM WIRING AND DRAWINGS

CONNECTORS	
NO.	DESCRIPTION
1A	62GB-12E12-40PN
1B	62GB-56T12-40SN
1C	62GB-56T12-40SN
1D	62GB-12E12-40PN





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DESIGNED BY WWW.PEPPERCREATIVE.CO.UK

Shaft Power Meter Reference List

Commercial Marine			
Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
Oldendorff	Catharina Oldendorff	1 x Prop System	Bulk Carrier
Oldendorff	Paul Oldendorff	1 x Prop System	Bulk Carrier
Oldendorff	Lucas Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Edward Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Eike Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Elisabeth Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Elsa Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Jobst Oldendorff	1 x Prop System	Ultramax
Oldendorff	Lily Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Julia Oldendorff	1 x Prop System	Ultramax
Oldendorff	Emma Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Rixta Oldendorff	1 x Prop System	Bulk Carrier
Oldendorff	Johann Oldendorff	1 x Prop System	Ultramax
Oldendorff	Edwine Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Eckert Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Edgar Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Erna Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Austyn Oldendorff	1 x Prop System	Transloader
Oldendorff	Ernst Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Hedwig Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Regina Oldendorff	1 x Prop System	Bulk Carrier
Oldendorff	William Oldendorff	1 x Prop System	Capesize
Oldendorff	Eibe Oldendorff	1 x Prop System	OHBS Handysize
Oldendorff	Ingmar Oldendorff	1 x Prop System	Ultramax

Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
Oldendorff	Hanna Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Isa Oldendorff	1 x Prop System	Ultramax
Oldendorff	Ilisabe Oldendorff	1 x Prop System	Ultramax
Oldendorff	Imme Oldendorff	1 x Prop System	Ultramax
Oldendorff	Irene Oldendorff	1 x Prop System	Ultramax
Oldendorff	Ingrid Oldendorff	1 x Prop System	Ultramax
Oldendorff	Hubertus Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Hille Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Hinrich Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Hermann Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Helena Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Birte Oldendorff	1 x Prop System	Ultramax
Oldendorff	Hannes Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Helga Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Henriette Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Hermine Oldendorff	1 x Prop System	Newcastlemax
Oldendorff	Bulk Trader	1 x Prop System	Newcastlemax
Oldendorff	Theodor Oldendorff	1 x Prop System	Panamax
Oldendorff	Trina Oldendorff	1 x Prop System	Panamax
Oldendorff	Dorthe Oldendorff	1 x Prop System	Panamax
Minerva Marine	Minerva Evropi	1 x Prop System	Suezmax
Viken #1	Hull No. SB609	1 x Prop System	Tanker
Viken #2	Hull No. SB610	1 x Prop System	Tanker
Viken #3	Hull No. SN2199	1 x Prop System	Tanker
Viken #4	Hull No. SN2201	1 x Prop System	Tanker
Viken #5	Hull No. SN2202	1 x Prop System	Tanker
Minerva Marine	Minerva Kalypso	1 x Prop System	Suezmax
AET #1 (SHI)	Hull No. 2195	1 x Prop System	Tanker

Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
AET #2 (SHI)	Hull No. 2196	1 x Prop System	Tanker
AET #3 (SHI)	Hull No. 2197	1 x Prop System	Tanker
AET #1 (HHI)	Hull No. 2901	1 x Prop System	Tanker
AET #2 (HHI)	Hull No. 2902	1 x Prop System	Tanker
AET #3 (HHI)	Hull No. 2899	1 x Prop System	Tanker
AET #4 (HHI)	Hull No. 2900	1 x Prop System	Tanker
Valles Steamship	Hull No. H13121049	1 x Prop System	Panamax
Valles Steamship	Hull No. H13121050	1 x Prop System	Panamax
Pantheon	Sea Amber	1 x Prop System	Crude Oil Tanker
Pantheon	Sea Garnett	1 x Prop System	Crude Oil Tanker
Anglo Eastern	Mineral Hope	1 x Prop System	Bulk Carrier
COSCO Guanzgzhou	4600 Livestock Carrier 1	1 x Prop System	Livestock Carrier
COSCO Guanzgzhou	4600 Livestock Carrier 2	1 x Prop System	Livestock Carrier
COSCO Guanzgzhou	4600 Livestock Carrier 3	1 x Prop System	Livestock Carrier
COSCO Guanzgzhou	4600 Livestock Carrier 4	1 x Prop System	Livestock Carrier
COSCO Guanzgzhou	11000DWT Shuttle Tanker 1	1 x Prop System	Shuttle Tanker
COSCO Guanzgzhou	11000DWT Shuttle Tanker 2	1 x Prop System	Shuttle Tanker
COSCO Guanzgzhou	11000DWT Shuttle Tanker 3	1 x Prop System	Shuttle Tanker
COSCO Zhoushan	64000DWT Bulk Carrier 1	1 x Prop System	Bulk Carrier
COSCO Zhoushan	64000DWT Bulk Carrier 2	1 x Prop System	Bulk Carrier

Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
COSCO Zhoushan	64000DWT Bulk Carrier 3	1 x Prop System	Bulk Carrier
COSCO Zhoushan	64000DWT Bulk Carrier 4	1 x Prop System	Bulk Carrier
Jinhai Heavy Industry	305000DWT VLCC 1	1x Prop System	VLCC
Jinhai Heavy Industry	305000DWT VLCC 2	1x Prop System	VLCC
Jinhai Heavy Industry	305000DWT VLCC 3	1x Prop System	VLCC
Jinhai Heavy Industry	305000DWT VLCC 4	1x Prop System	VLCC
Jinling Shipyard	38330DWT Bulk Carrier 1	1 x Prop System	Bulk Carrier
Jinling Shipyard	38330DWT Bulk Carrier 2	1 x Prop System	Bulk Carrier
Jinling Shipyard	38330DWT Bulk Carrier 3	1 x Prop System	Bulk Carrier
Jinling Shipyard	38330DWT Bulk Carrier 4	1 x Prop System	Bulk Carrier
Jinling Shipyard	38330DWT Bulk Carrier 5	1 x Prop System	Bulk Carrier
Jinling Shipyard	38330DWT Bulk Carrier 6	1 x Prop System	Bulk Carrier
Jinling Shipyard	38330DWT Bulk Carrier 7	1 x Prop System	Bulk Carrier
Jinling Shipyard	38330DWT Bulk Carrier 8	1 x Prop System	Bulk Carrier
Jinling Shipyard	38330DWT Bulk Carrier 9	1 x Prop System	Bulk Carrier
Dayang Shipyard	63500DWT Bulk Carrier 1	1 x Prop System	Bulk Carrier
Dayang Shipyard	63500DWT Bulk Carrier 2	1 x Prop System	Bulk Carrier

Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
Dayang Shipyard	63500DWT Bulk Carrier 3	1 x Prop System	Bulk Carrier
Dayang Shipyard	63500DWT Bulk Carrier 4	1 x Prop System	Bulk Carrier
Dayang Shipyard	63500DWT Bulk Carrier 5	1 x Prop System	Bulk Carrier
Dayang Shipyard	63500DWT Bulk Carrier 6	1 x Prop System	Bulk Carrier
Dayang Shipyard	63500DWT Bulk Carrier 7	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 1	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 2	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 3	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 4	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 5	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 6	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 7	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 8	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 9	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 10	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier	1 x Prop System	Bulk Carrier

Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
Hantong Shipyard	64000DWT Bulk Carrier 12	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 13	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 14	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 15	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 16	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 17	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 18	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 19	1 x Prop System	Bulk Carrier
Hantong Shipyard	64000DWT Bulk Carrier 20	1 x Prop System	Bulk Carrier
Sanfu Shipyard	34500DWT Chemical Tanker 1	1 x Prop System	Chemical Tanker
Sanfu Shipyard	34500DWT Chemical Tanker 2	1 x Prop System	Chemical Tanker
Sanfu Shipyard	34500DWT Chemical Tanker 3	1 x Prop System	Chemical Tanker
Sanfu Shipyard	34500DWT Chemical Tanker 4	1 x Prop System	Chemical Tanker
Sanfu Shipyard	34500DWT Chemical Tanker 5	1 x Prop System	Chemical Tanker
Sanfu Shipyard	34500DWT Chemical Tanker 6	1 x Prop System	Chemical Tanker
CCC Tianjin	12000m ³ Dredger	4 x Systems	Dredger

Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
CCC Shanghai	12000m ³ Dredger	4 x Systems	Dredger
CCC Yangzi River	2000m ³ Dredger	4 x Systems	Dredger
Wuchang Shipyard	2000m ³ Dredger	2 x Systems	Dredger
Wenchong Shipyard	10000m ³ Dredger	2 x Systems	Dredger
CCC Tianjin	Dredger 1	2 x Systems	Dredger
CCC Tianjin	Dredger 2	2 x Systems	Dredger
CCC Shanghai	Dredger 1	2 x Systems	Dredger
CCC Shanghai	Dredger 2	2 x Systems	Dredger
Dingheng Shipyard	9990DWT Chem Tanker 1	1 x Prop System	Chemical Tanker
Dingheng Shipyard	9990DWT Chem Tanker 2	1 x Prop System	Chemical Tanker
Dingheng Shipyard	79500DWT Chem Tanker 1	1 x Prop System	Chemical Tanker
Dingheng Shipyard	79500DWT Chem Tanker 2	1 x Prop System	Chemical Tanker
Dingheng Shipyard	79500DWT Chem Tanker 3	1 x Prop System	Chemical Tanker
d'Amico	Cielo di Parigi	1 x Prop System	Chemical Tanker
d'Amico	Cielo di Londra	1 x Prop System	Chemical Tanker
d'Amico	High Endurance	1 x Prop System	Bulk Carrier
d'Amico	Medi Hong Kong	1 x Prop System	Bulk Carrier
d'Amico	Cielo di Livorno	1 x Prop System	Chemical Tanker
d'Amico	Medi Baltimore	1 x Prop System	Bulk Carrier
d'Amico	Medi Cagliari	1 x Prop System	Bulk Carrier
d'Amico	Cielo di Guangzhou	1 x Prop System	Chemical Tanker
d'Amico	Medi Valencia	1 x Prop System	Bulk Carrier
d'Amico	Medi Lausanne	1 x Prop System	Bulk Carrier
V-Ships	545mm	1 x Prop System	Bulk Carrier

Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
d'Amico	M/S Ore Itabira	1 x Prop System	Bulk Carrier
Allseas / RR Finland	Pioneering Spirit	12 x Thruster Systems	Pipe Layer
Hanjin Shipping	HJPH	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJCT	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJEM	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJFR	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJAM	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJCH	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJHA	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJIN	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJRC	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJOR	1 x Prop System	Bulk Carrier
Hanjin Shipping	HJRB	1 x Prop System	Bulk Carrier
Canada Steamships	Oakglen	2 x Prop systems	Bulk Carrier
Griffon Hoverworks	Island Flyer	2 x Prop Systems	Hovercraft
Griffon Hoverworks	Island Explorer	2 x Prop Systems	Hovercraft
Insatech	Confidential	6 x Systems	Confidential
Volcanis Shipyard	Marsys marine	3 x Systems	Oil Tanker
Bahrati Shipyard	Confidential	8 x Systems	Confidential
Technip	Deep Blue	4 x Systems	Pipe Layer
V-Ships	Sichem Mumbai	1 x System	Tanker
DEME	D'Artagnan	1 x System	Dredger
CFTO	Avel Vad	2 x Prop systems	Fishing Vessel
CFTO	Glenan	2 x Prop systems	Fishing Vessel
NEW Times Shipbuilding, China	Hull No. 0120801	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120802	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120803	1 x Prop System	Bulk Carrier

Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
NEW Times Shipbuilding, China	Hull No. 0120804	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120805	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120806	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120811	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120812	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120813	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120814	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120815	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120816	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120817	1 x Prop System	Bulk Carrier
NEW Times Shipbuilding, China	Hull No. 0120818	1 x Prop System	Bulk Carrier
Confidential	Hull No. AD0033	1 x Prop System	Bulk Carrier

Cruise Ship			
CUNARD	Queen Elizabeth	6 x DG Systems	Cruise Ship
CUNARD	Queen Victoria	6 x DG Systems	Cruise Ship
P&O	Ventura	6 x DG Systems, 2 x Prop Systems	Cruise Ship
Princess Cruises	Diamond Princess	2 x Prop Systems	Cruise Ship
Princess Cruises	Crown Princess	6 x DG Systems, 2 x Prop Systems	Cruise Ship
Princess Cruises	Sapphire Princess	2 x Prop Systems	Cruise Ship
Princess Cruises	Caribbean Princess	3 x DG Systems, 2 x Prop Systems	Cruise Ship
Princess Cruises	Ruby Princess	6 x DG Systems, 2 x Prop Systems	Cruise Ship
Princess Cruises	Emerald Princess	6 x DG Systems, 2 x Prop Systems	Cruise Ship
Princess Cruises	Island Princess	2 x Prop Systems	Cruise Ship
Princess Cruises	Grand Princess	2 x Prop Systems	Cruise Ship
P&O Australia	Pacific Dawn	4 x DG Systems, 2 x Prop Systems	Cruise Ship
P&O Australia	Pacific Jewel	4 x DG Systems, 2 x Prop Systems	Cruise Ship
P&O Australia	Pacific Pearl	4 x DG Systems, 2 x Prop Systems	Cruise Ship
Holland America Line	Westerdam	1 x DG System	Cruise Ship

Passenger Ferry			
Ship Owner / Shipyard	Vessel	Systems installed	Vessel Type
Condor Ferries	Condor Liberation	3 x DG Systems	PAX
Sea France	Moliere	2 x Prop System	PAX
Stena Lines	Stena North Sea	2 x Prop System	PAX

MILITARY			
UK MOD - British Navy	HMS Penzance	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Pembroke	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Grimsby	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Bangor	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Shoreham	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Blythe	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Walney	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Lyme Bay	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Ramsey	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Ledbury	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Cattistock	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Brocklesby	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Middleton	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Chiddingfold	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Atherstone	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Hurworth	2 x Prop Systems	Minesweeper
UK MOD - British Navy	HMS Quorn	2 x Prop Systems	Minesweeper
Indian Navy	Confidential	24 x Systems	Confidential
RRNM	Confidential	12 x Systems	Confidential
Royal Australian Navy	Confidential	4 x Systems	Confidential
Wartsila	Confidential	20 x Systems	Thrusters