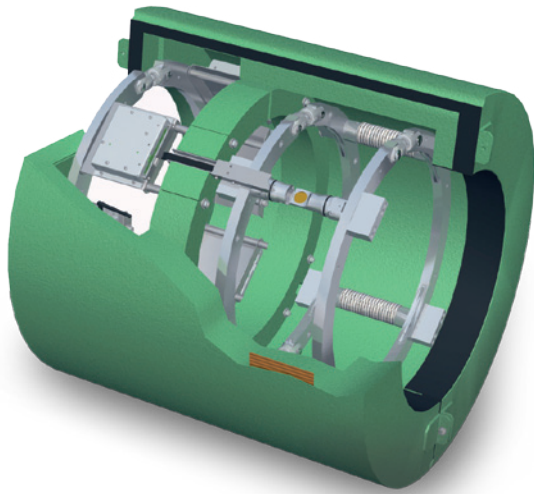


VAF

INSTRUMENTS



TT-Sense[®]

Optical Thrust and Torque Measuring Systems

663

Product Bulletin

WWW.VAF.NL

TO BE
REALLY
SURE

Introduction

With 75 years of experience VAF Instruments is an established name in the world of marine measuring equipment. The upcoming of IMO regulations like SEEMP inspired us to develop the next step in our successful line of sensors: the TT-Sense®. The use of a TT-Sense® means getting more insight in your propeller efficiency, hull resistance and vessel pitch optimization. This real thrust measurement is realized by an extremely accurate optical sensor technology.

Why a Thrust and Torque Measuring System?

Thrust measurement provides you with precise information on propeller efficiency related to consumed energy. By giving instantaneous read-out of real thrust, torque, speed and power, the effects of operational changes are monitored. Because these effects are measured, you can use your propulsion installation in the most efficient way. This will considerably reduce your fuel costs, and beside that it will discover malfunctions in the propulsion system as early as possible, both being primary cost drivers.

Where is the TT-Sense® Thrust and Torque Measuring System used?

TT-Sense® thrust and torque measuring systems can be used for propulsion installations of all kind. For example for continuous measurement of the propeller efficiency or the continuous power consumption measurement, as well as continuous level check for thrust, torque, shaft speed and power. Giving direct visual control of changes in hull and propeller fouling and trimming of the vessel.

System output

The standard output of the TT-Sense® thrust and torque measuring system consists of a thrust, torque, shaft speed and power signal. The system can be extended with VAF fuel consumption flowmeters and speedlog/GPS input.

Advantages

Due to a robust design, TT-Sense® thrust and torque measuring systems have a high durability and are able to withstand the typical harsh environmental conditions onboard ships, dredgers and in engine rooms, etc.

Innovative optical sensor technology results in a high accuracy.

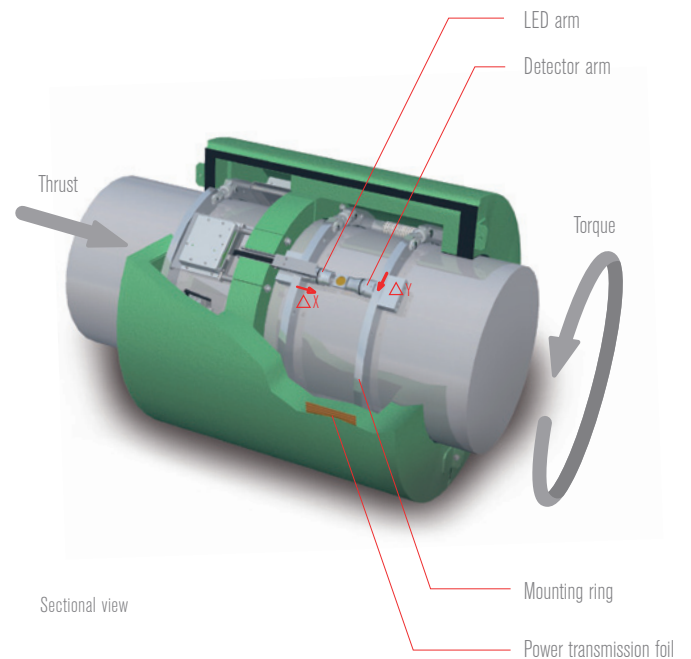
TT-Sense® thrust and torque measuring systems are maintenance free as a result of non-contact power and signal transmission. They are designed to work continuously. Yearly recalibration is recommended.

Principle of operation

The TT-Sense thrust and torque measuring system can be mounted on intermediate shafts after the thrust bearing.

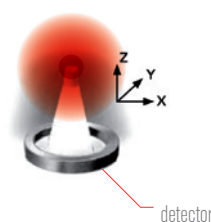
When a shaft is subject to thrust and/or torque this results in a small strain at the shaft surface.

LED's and extremely accurate optical sensors can detect these small displacements, in both axial and radial directions. The measured values are transferred continuously from the rotating shaft to the stator part through wireless data connection. Power transmission from the stator to the rotating shaft is performed by means of induction. The stator part consists of a power transmission coil, a data signal receiver and a control box equipped with digital or analogue output connections. These outputs can be linked directly to the vessels data network, monitoring- or control system. The stator part can optionally be connected to a PEM 2 touchscreen, which displays propeller thrust, shaft power, torque and speed. The PEM 3 Propulsion Efficiency Monitor displays all fuel consumption data, engine load diagram, power and thrust data, etc.



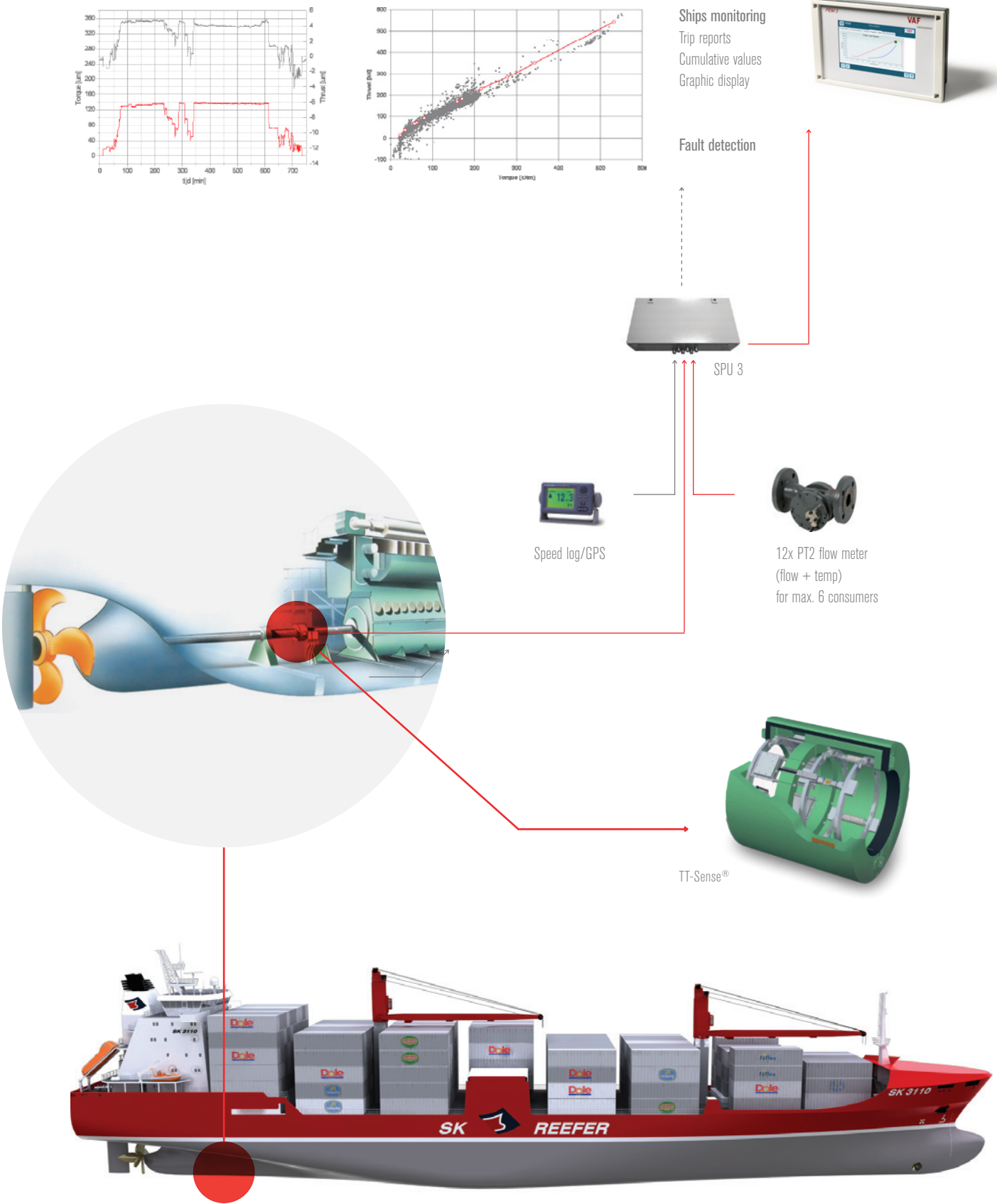
Δy and Δx are small movements of the propeller shaft surface due to strain.

Δy is the movement in torque direction and Δx is the movement in thrust direction.



Optical displacement measurement

Typical system arrangement



Typical TT-Sense® thrust and torque measuring system with optional fuel consumption measurement outputs

Features & benefits

VAF Instruments has developed the TT-Sense® thrust and torque measuring system with modern and user-friendly electronics, based on proven very accurate optical sensor technology.

The standard TT-Sense® thrust and torque measuring system will be delivered with a control box for easy connection to the ship's data network, monitoring or control system. A PEM 2 touch screen display or PEM 3 Propulsion Efficiency Monitor, can be supplied as a monitoring device.

Features	Benefits
Optical measuring principle	Very high accuracy and repeatability
	Designated to measure propeller thrust, torque, speed and power
Extreme accuracy of optical sensor (within nanometer range)	Very precise output signals resulting in high measuring precision and repeatability
	Propeller thrust and hull analysis is possible during long interval period
	Pitch optimization
	Cavitation detection
Wireless transmission of data and power	No maintenance, calibration only
	No wear
Digital output signal available	Easy and accurate digital data transfer to the vessels network, monitoring or control system
	Only 1 communication cable to the bridge
	User friendly installation
Easy installation and commissioning	No time consuming mounting of strain gauges
A genuine VAF Instruments product	Over 75 years of experience in sensor technology for maritime applications
Manufactured by a ISO 9001 certified organization	Assured constant product quality
Touch screen display	No operator training required
	User friendly human interface

Technical specification

TT-Sense® thrust and torque measuring system

Control box at stator part	
Power supply	115 or 230 VAC, 50 or 60 Hz +/- 20%
Power consumption	40 VA maximum
Input	2,4 GHz fully protected encrypted signal
Output	Ethernet, RS 485 for Modbus protocol and 4-20 mA isolated current output (optional)
Dimensions	408 x 360 x 111 mm
Rotor equipment	
Material of mounting rings	carbon steel
Material outside cover	polyurea coated high density foam
Material compensator arms	carbon steel
Shaft speed detection	accelerometer signal
Output	2,4 GHz fully protected encrypted signal
Shaft diameter	min. 200 mm, max. 1000 mm
Dimensions	depending on shaft diameter
Operating temperature	-10°C to 60°C
Measuring tolerance	< 0,25 % F.S.D. on Torque, < 1,0 % ¹ F.S.D. on Thrust
PEM 2 touch screen ²	
Power supply	24 VDC
Display	Touch screen, TFT, 320 x 234 pixels
Operating temperature	0° C to 55° C
Dimensions screen	5,6 inch
Front panel protection	IP65/NEMA4
PEM 3 Propulsion Efficiency Monitor ³	
Touch screen	
Power supply	24 VDC
Display	Touch screen, PCAP, 800 x 480 pixels
Operating temperature	0° C to 55° C
Dimensions screen	7 inch
Front panel protection	IP65/NEMA4
SPU 3 Signal Processing Unit	
Power supply	115 or 230 VAC ± 10%, 50 or 60 Hz
Protection class	IP65
Operating temperature	0° C to 55° C
Input	Modbus signal for thrust, torque, shaft speed and power, pulses from flowmeters and temperature via integrated PT 100 ⁴ temperature sensor, speed log as pulse input, GPS (NMEA) signal, 4-20 mA current input for shaft generator power level
Output ⁵	Modbus and Ethernet signal for thrust, torque, shaft speed, power, fuel consumption data and environmental data, optional relays for alarms and high/low torque levels

Notes: ¹ Depending on application

² For systems with TT-Sense® only

³ For systems including TT-Sense® and SPU 3 Signal Processing Unit for connecting multiple I/O

⁴ Refer to Product Bulletin 135 for MidFlow® Model PT

⁵ For other output options consult VAF Instruments



Options and accessoires

PEM 3 Propulsion Efficiency Monitor

The PEM 3 instantly shows thrust, torque, speed, shaft power and other selected measuring data. Additional flowmeter signals and temperature sensor (PT100) signals enable calculation of the engines fuel consumption with optional temperature compensation. In combination with input signals from speedlog or GPS, the PEM 3 will calculate the temperature corrected fuel consumption per kW or per nautical mile.



PEM 3 TT-Sense®

Features:

- Touch screen display;
- Easy menu structure;
- Display of bar graphs and engine load diagram;
- User friendly, log functions for alarms and instant detection of missing signals;
- Display of fuel consumption per kW;
- Display of fuel consumption per consumer;
- Display of fuel consumption per nautical mile;
- Remote accessible through standard webbrowsers;
- SPU 3 Signal Processing Unit included.

The PEM 3 helps the ship's crew and the owner to find the best settings for engine, trim and propeller pitch, as the effect of the changes will be instantly displayed.

PEM 2 Touch screen

For monitoring TT-Sense® thrust, torque, shaft speed and power output **only**, we supply the PEM 2 touch screen as a stand alone unit.



PEM 2 TT-Sense®

Applications

In combination with a PEM 3 Propulsion Efficiency Monitor or with the vessels monitoring system, the TT-Sense® thrust and torque measuring system can be used in a variety of applications such as continuous:

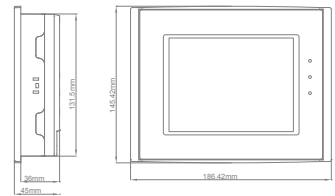
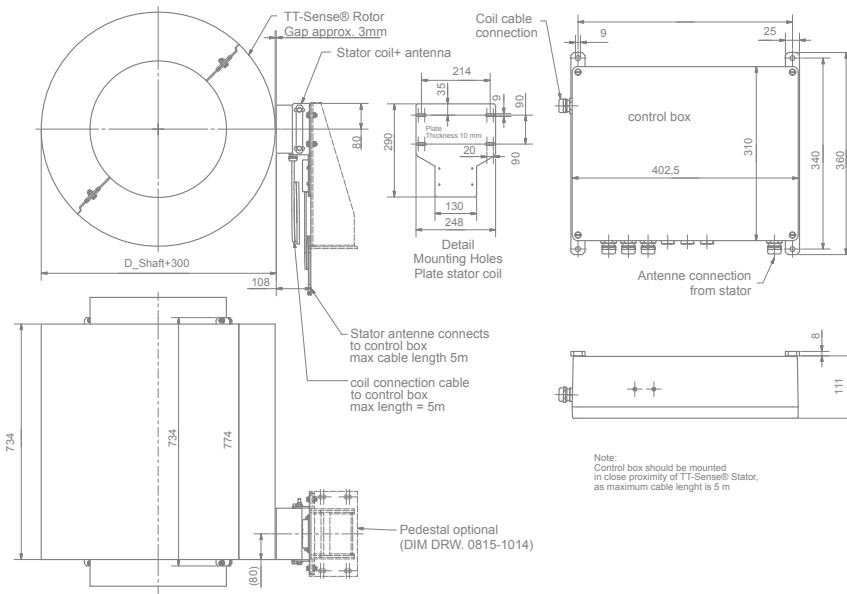
- Thrust measurement to optimize performance of the vessels propulsion system;
- Thrust measurement enabling effective hull analysis;
- Power and fuel consumption management;
- Visualisation of engine load margin;
- Avoiding engine overload;

- Direct visual control of changes in engine setting, hull or propeller fouling and the vessel trim;
- Long term monitoring of thrust, torque, speed and power; trend analyzing.

Besides these standard applications VAF Instruments also manufactures special designs, including tailor-made software.

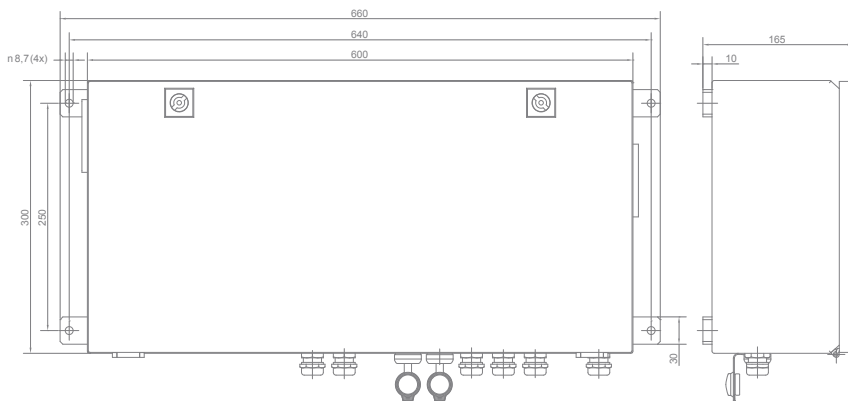
Dimensions

TT-Sense® components

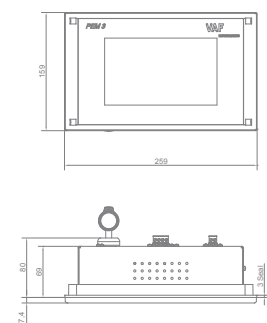


PEM 2 touch screen

For use with TT-Sense® control box



PEM 3 SPU 3 Signal Processing Unit



PEM 3 touch screen

For use with SPU 3 Signal Processing Unit

Quotation & ordering information

1. Number of units:			
2. Available shaft length [mm]:			
3. Ships name / hull:			
4. Please provide shaft line drawing for information:			
<input type="radio"/> new building		<input type="radio"/> retrofitting	
5. Design conditions:			
power [kW]:		thrust [kN]:	
speed [rpm]:			
shaft material:		shear modulus G [N/mm ²]:	Young's modulus E [N/mm ²]:
shaft diameter (+tolerance) [mm]:		(min 200 mm)	
inside (bore) diameter [mm]:			
duty		<input type="radio"/> propeller shaft	<input type="radio"/> other:
6. System:			
required output	thrust	<input type="radio"/> RS 485/Modbus	<input type="radio"/> Ethernet
		<input type="radio"/> range 4 - 20 mA =	- kN
torque		<input type="radio"/> RS 485/Modbus	<input type="radio"/> Ethernet
		<input type="radio"/> range 4 - 20 mA =	- kNm
speed		<input type="radio"/> RS 485/Modbus	<input type="radio"/> Ethernet
		<input type="radio"/> range 4 - 20 mA =	- rpm
power		<input type="radio"/> RS 485/Modbus	<input type="radio"/> Ethernet
		<input type="radio"/> range 4 - 20 mA =	- kW
		<input type="radio"/> other:	
options	<input type="radio"/> touch screen display for thrust, shaft speed and power read-out		
	<input type="radio"/> fuel consumption measurement		
	<input type="radio"/> total power calculation for twin screw vessels		

Name:

Place and date:

For further information see relevant Product Bulletins or www.vaf.nl

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