

# T-Sense<sup>®</sup>

Optical Torque Measuring systems

660

Product Bulletin

# Introduction

The use of a T-Sense® torque measuring system means efficiency improvement, overload protection and prevention of breakdown. For example in the shipping industry its application has lead to savings up to 10% on fuel costs.

The system is based on extremely accurate optical sensor technology and can be easily mounted around shafts in power transmission systems.

## Why a torque measuring system?

A torque meter provides you with precise information on engine performance related to consumed energy. By giving instantaneous read-out of torque, speed and power, the effects of operational changes are monitored. Because these effects are measured, you can use your engine-driven installation in its most efficient way. This will considerably reduce your fuel costs, one of the primary cost drivers.

## Where is the T-Sense® torque measuring system used?

T-Sense® torque measuring systems are used for engine-driven installations in all kinds of power and propulsion plants. For example continuous power output measurement of ship's propulsion, continuous power consumption measurement, continuous level check for torque, speed and power and direct visual control of changes in engine settings, trim and draught.

## Possible system extensions

A full range of T-Sense® torque measuring systems is available. The standard output of the torque measuring system consists of a torque, shaft speed and power signal. The system can be extended with fuel consumption measurement and speedlog/GPS input.

## Your advantage

### Designed for durability and accuracy

The systems have a robust design. They are built to withstand the typical harsh environmental conditions in ships, engine rooms, dredgers, steelworks and heavy industries. Innovative optical sensor technology guarantees high accuracy with an overall error of less than 0,25% F.S.D.

### No maintenance required

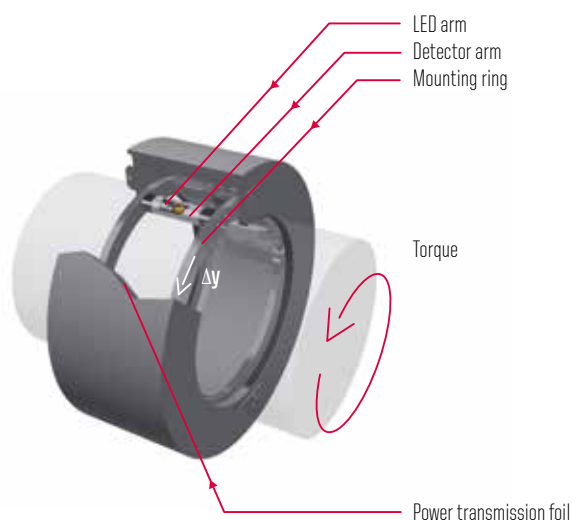
T-Sense® torque measuring systems are maintenance-free as a result of noncontact power and signal transmission. They are designed to work continuously. No recalibration is needed, because signals are stable during their lifetime.

### Easy installation and commissioning

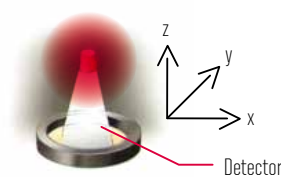
The intelligent design enables installation by any skilled technician.

# Principle of operation

The T-Sense® measuring system can be mounted on propeller or drive shafts. When a shaft is subject to torque this will result in a small strain at the shaft surface. A LED and an extremely accurate optical cell can detect these small movements of the surface. The measured values are transferred continuously from the rotating shaft to the stator part through a 2,4 GHz wireless data connection. Power transmission from the stator to the rotating shaft is performed by means of induction.



$\Delta y$  is a small movement of the propeller shaft surface due to strain.



Optical displacement measurement

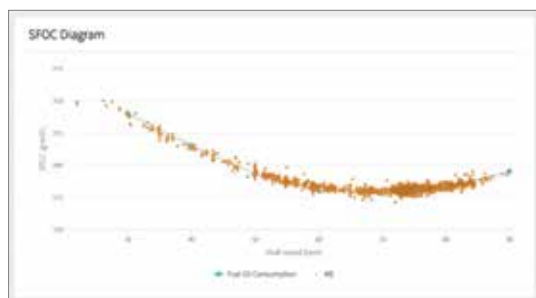
## Type approval

To emphasize the excellent quality, robustness and suitability of the T-Sense® for marine application, the system is type approved by major classification societies.

# Typical system arrangement



Ships monitoring



Fault detection



AMS or data acquisition



Nautical / navigational data

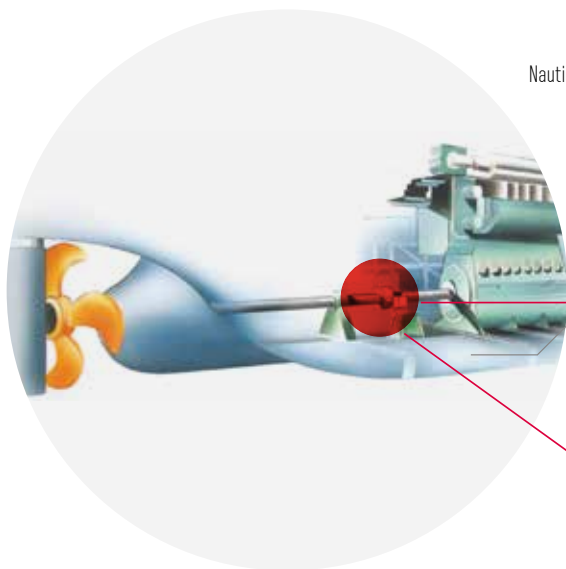
Speed log / GPS

SPU3

Fuel density



12x PT2 Flowmeter  
(flow + temperature)  
For max. 8 consumers



T-Sense®



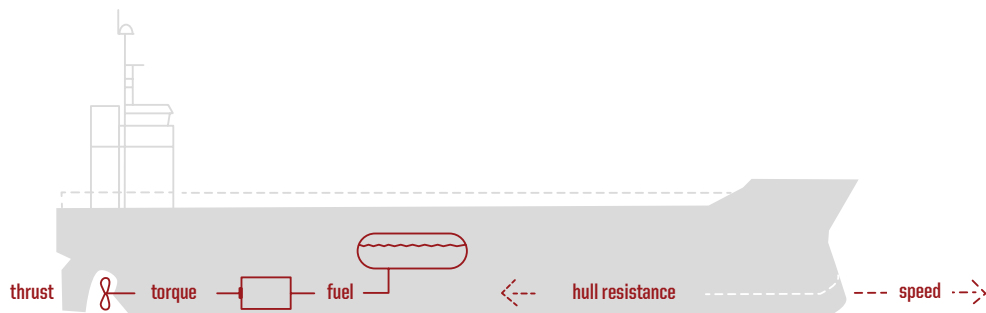
Typical T-Sense® torque measuring system with optional fuel consumption measurement



# Applications of torque measurement

By using the T-Sense® measuring system, the performance of the engine and ship's propulsion can be measured separately providing an important input to fuel saving and maintenance investment decisions. Customers have reported savings of up to 10% on fuel costs by managing fuel consumption and engine performance at full scale.

In combination with a monitoring or management system, such as VAF Instruments, PEM4 or IVY®, the T-Sense® measuring system can be used in a variety of applications.



**PROPELLER  
EFFICIENCY**

**FUEL  
EFFICIENCY**

**HULL  
EFFICIENCY**



## Energy conversions & efficiencies

By measuring propeller torque you are able to separate the engine efficiency from propulsion efficiency



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## The benefits of measuring torque:

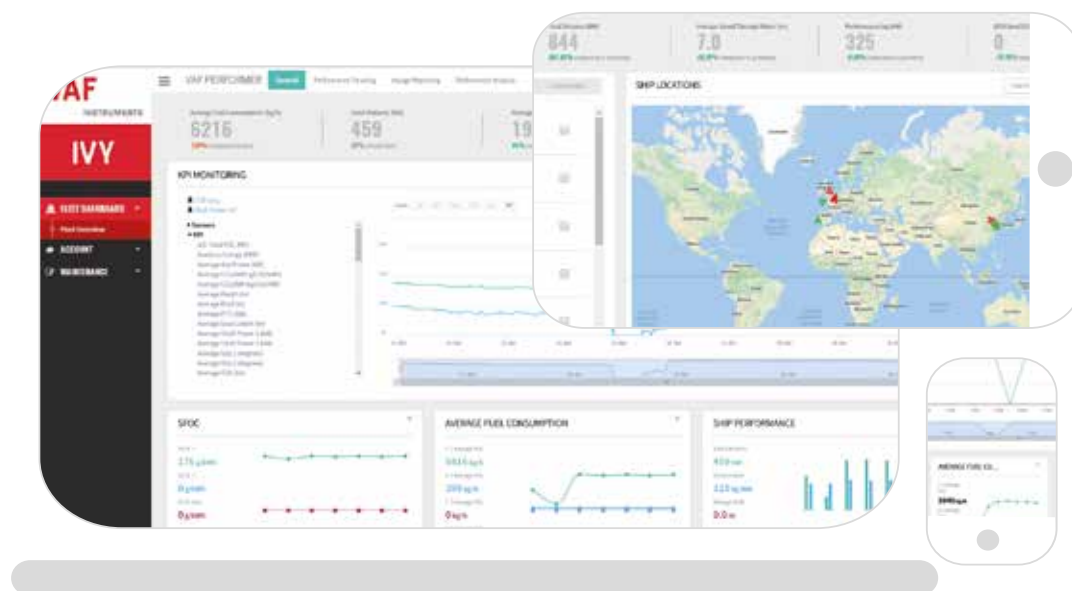
- Determines ship's propulsion performance over time.
- Provides insight into engine performance related to consumed fuel.
- Enables optimisation of the efficiency of engine-driven installations to reduce fuel costs.
- Visualisation of engine load margin. Avoiding engine overload.
- Provides insight in engine performance (SFOC) when combined with fuel Flowmeters.
- Direct visual control of the effects of operational changes.
- Torsional vibration analysis for frequencies up to 50 Hz.

# Monitoring and management solutions

The T-Sense® torque measuring system can be combined with the PEM4 Propulsion Efficiency Monitor, the vessel's monitoring system and/or IVY® Propulsion Performance Management Solution to use the T-Sense® to its full potential.

## IVY® Propulsion Performance Management Solution

IVY®, VAF Instruments' solution for Propulsion Performance Management, brings you the fleet at your fingertips. From ship to shore, IVY® enriches big data for powerful analysis. The web application of IVY® provides fleet and ship performance visualisation and insight into the relevant data and more than 40 KPIs. IVY® can be combined with a range of sensors on board, including T-Sense®. IVY® brings Big Data back to the essence. A solution for monitoring and management on shore as well as on board is available. Measuring data of sensors like eg. speed through water can be improved by applying IVY® virtual sensors.



## Propulsion Efficiency Monitor (PEM4) + Signal Processing Unit (SPU3)

The PEM4 + SPU3 instantly show torque, shaft power and other selected measuring data. Additional Flowmeter signals and temperature sensor signals enable calculation of the engines fuel consumption including temperature compensation. In combination with input signals from speedlog or GPS, the PEM4 will display the specific fuel consumption per kW and per nautical mile.



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## PEM4 Touch screen

For monitoring T-Sense® torque, shaft speed and power output only, we supply the PEM4 touch screen as a standalone unit.

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### Overview

Below table is a concise overview of the functionality of the various system solutions. For detailed information about each solution, we refer to the specific documentation.

	PEM4	PEM4 + SPU3	IVY®
User interface	Touch screen on ship	Touch screen on ship	Web application on any device
Visualisation of torque, shaft rpm and power	x	x	x
Visualisation of thrust and propeller quotient	x	x	x
Fuel consumption, SFOC, FOC	-	x	x
Ship speed (STW / SOG)	-	x	x
Zoom in on individual sensor signals	-	x	x
Conning screen incl. wind, trim and draft	-	x	x
Visualisation of KPIs	4	7	> 40
Data enrichment / Virtual sensors	-	-	x
Hull resistance (over time)	-	-	x
Propeller performance (over time)	-	-	x
Quantified additional FOC in \$ due to performance decrease	-	-	x
Integrated voyage reporting (eg. MRV)	-	-	x
Ship locations, track and heading	-	-	x
Compare sensor data	-	-	x
Compare ship's KPIs / sensor data	-	-	x
Fleet overview and performance	-	-	x

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# Technical specification

## Control box for stator part

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Power supply	115 or 230 VAC, 50 or 60 Hz $\pm$ 20%
Power consumption	40 VA maximum
Input	2,4 GHz fully protected encrypted signal
Output	Ethernet, RS 485 for Modbus or 4-20 mA isolated current output (optional)
Dimensions	408 x 360 x 111 mm

## Rotor equipment

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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. 100 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



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## PEM4

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<b>Supply voltage</b>	115 to 230 VAC $\pm$ 10% to power supply unit
<b>Power consumption</b>	8 W in full activity
<b>Temperature range</b>	-20 to 60° C
<b>Input</b>	Ethernet signal from SPU3
<b>Connections</b>	RJ45 Ethernet connection on back (bottom side) of panel
<b>Display color</b>	TFT LCD, PCAP touch screen, 7.0" (1024 x 600 dots) with adjustable LED backlight
<b>Dimensions</b>	235 x 150 x 44 mm (w x h x d)
<b>Cut out</b>	217,6 x 128,6 mm (w x h)
<b>Cut out depth</b>	38 mm
<b>Front panel thickness</b>	6 mm
<b>Protection class</b>	IP 65 at front facia
<b>Net weight</b>	1,3 kg

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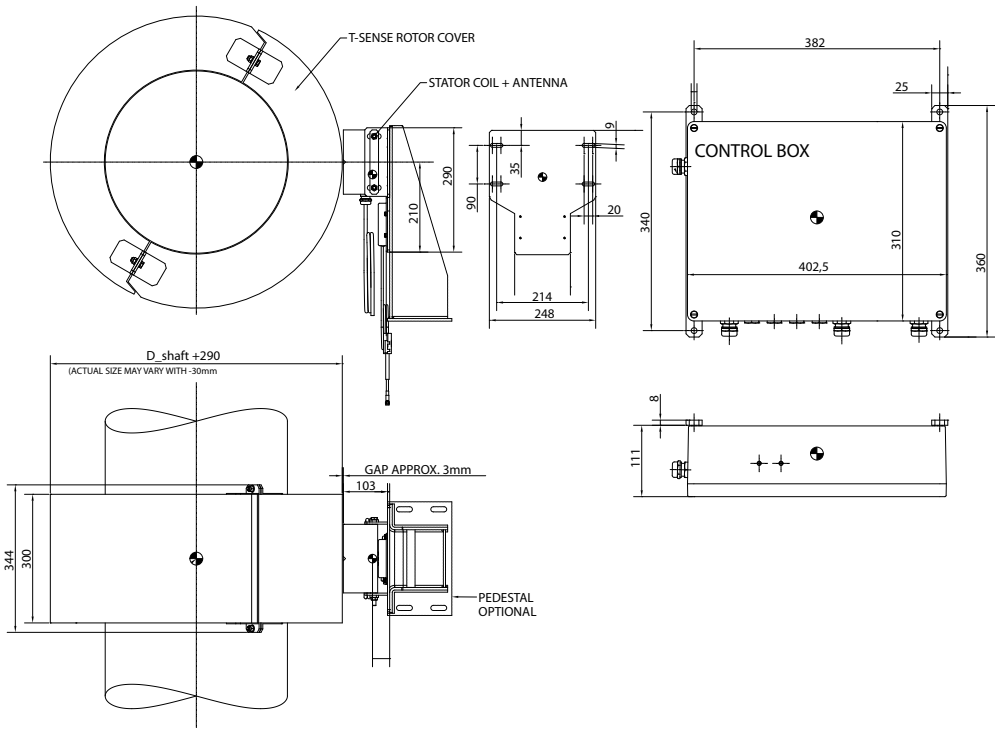
## SPU3

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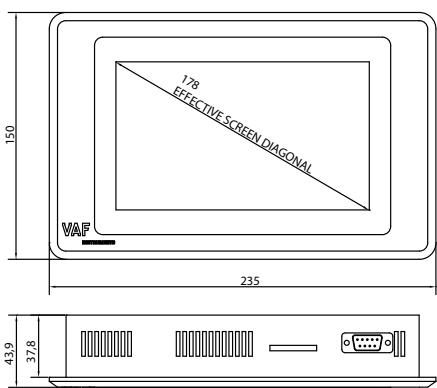
<b>Supply voltage</b>	115 to 230 VAC $\pm$ 10%
<b>Power consumption</b>	60 W
<b>Digital input</b>	2x RS 485 Modbus connection for input signal from T-Sense® (or IT-Sense®) optical sensors and an additional NMEA input.
<b>Analog input</b>	9 x optional (galvanic isolated) 4-20mA, used for shaft generator input, auxiliary power or ViscoSense®30
<b>Pulse counter</b>	Max. 12 Flowmeter pulse inputs 1x pulse input for speed log
<b>PT100 input</b>	Max. 12, used for fuel temperature compensation at Flowmeters.
<b>Digital output</b>	RJ45 Ethernet for connection to PEM4 touch screens or to a pc on board, either direct or via the ships network RS 485 Modbus connection for data transfer to an external system like AMS (Alarm and Monitoring System) or for connection to a separate pc running PEM data logger software (optional)
<b>Dimensions</b>	660 x 300 x 165 mm (w x h x d)
<b>Protection class</b>	IP65
<b>Net weight</b>	Approx. 10 kg

# Dimensions

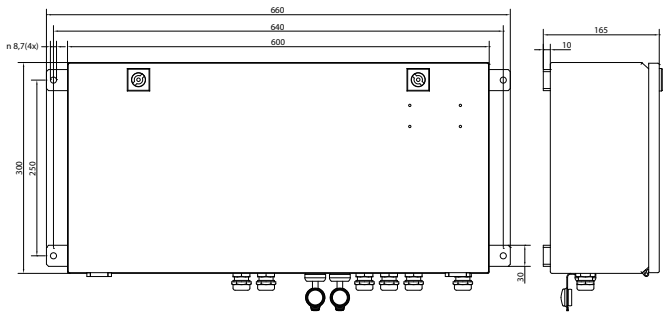
## T-Sense®



## T-Sense® optional components



PEM4 touch screen



SPU3 Signal Processing Unit

# Quotation and ordering information

1. <b>Please provide shaft line drawing for information:</b>			
<input type="radio"/> new building		<input type="radio"/> retrofitting	
2. <b>Number of units per ship:</b>			
3. <b>Available shaft length [mm]:</b>			
4. <b>Ship's name / hull:</b>			
5. <b>Design conditions:</b>			
power [kW]:			
speed [rpm]:			
shaft material:		shear modulus G [N/mm <sup>2</sup> ]:	
shaft diameter (+tolerance) [mm]:		(min 100 mm)	
inside (bore) diameter [mm]:			
application	<input type="radio"/> propeller shaft	<input type="radio"/> dredge pump	<input type="radio"/> engine drive shaft
	<input type="radio"/> jet pump	<input type="radio"/> other:	
6. <b>System:</b>			
Required output	torque	<input type="radio"/> RS 485/Modbus	
		<input type="radio"/> range 4 - 20 mA =	kNm
	speed	<input type="radio"/> RS 485/Modbus	
		<input type="radio"/> range 4 - 20 mA =	rpm
	power	<input type="radio"/> RS 485/Modbus	
		<input type="radio"/> range 4 - 20 mA =	kW
<input type="radio"/> other:			
options	<input type="radio"/> Propulsion Performance Management by IVY®		
	<input type="radio"/> PEM4 for Fuel Consumption Measurement, torque, shaft speed and power read-out		
	<input type="radio"/> touch screen display (PEM4) for torque shaft speed and power read-out		

Name:

Place and date:

Please fill out this form and send it to [sales@vaf.nl](mailto:sales@vaf.nl). We will reply with a quotation and ordering information for the requested product or solution a.s.a.p.

For further information see relevant Product Bulletins or [www.vaf.nl](http://www.vaf.nl)





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