

# VAF

INSTRUMENTS



# T-Sense<sup>®</sup>

Optical Torque Measuring systems

# 660

Product Bulletin

[WWW.VAF.NL](http://WWW.VAF.NL)

**TO BE  
REALLY  
SURE**

# 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

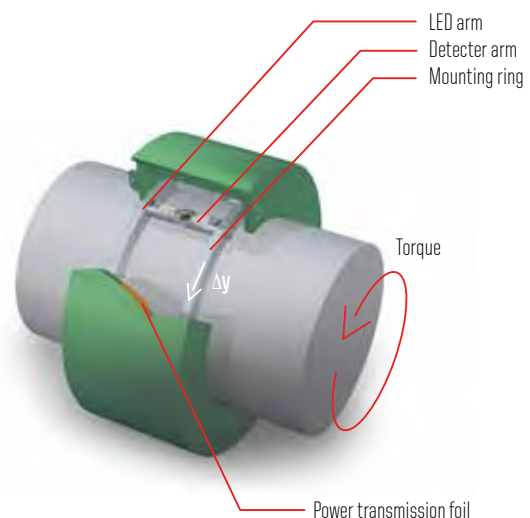
T-Sense® torque measuring systems are maintenance-free as a result of noncontact power and signal transmission. They are designed to work continuously. No recalibration is needed, because signals are stable during their lifetime.

### Easy installation and commissioning

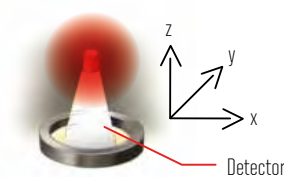
The intelligent design enables installation by any skilled technician.

# 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.

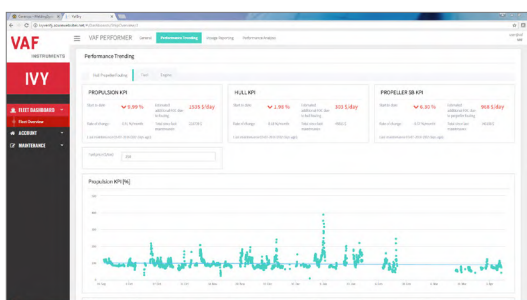
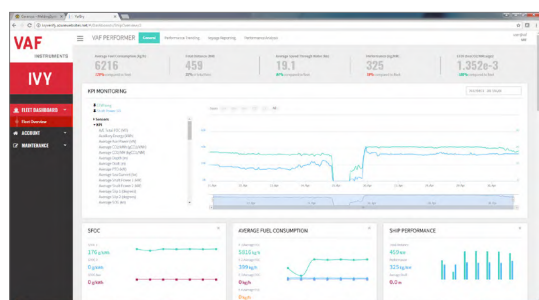


$\Delta y$  is a small movement of the propeller shaft surface due to strain.

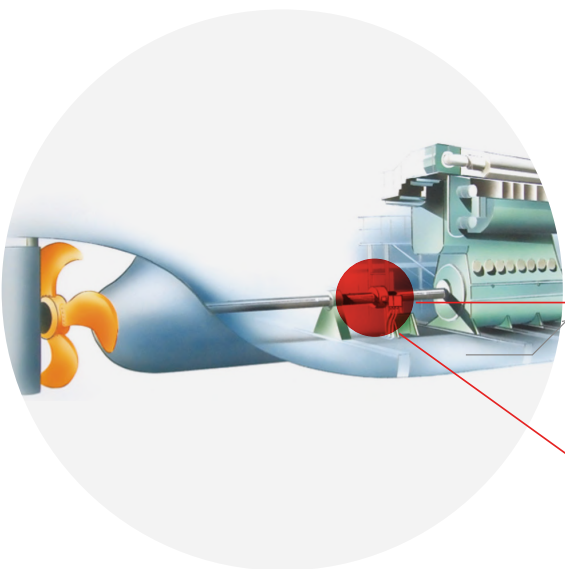


Optical displacement measurement

# Typical system arrangement



Ships monitoring



Fault detection

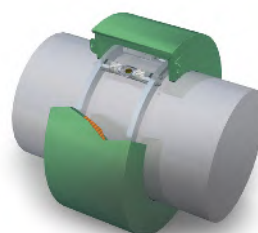


SPU3

Speed log/GPS



12x PT2 Flowmeter (flow + temp) For max. 6 consumers



T-Sense®



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



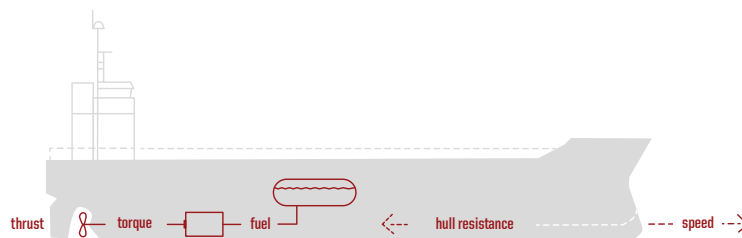
# Applications of torque measurement

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 PEM2, PEM4 or IVV®, the T-Sense® measuring system can be used in a variety of applications.

## 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.
- Monitoring of torque, speed, power and when combined with Flowmeters also fuel consumption and SFOC.
- Direct visual control of the effects of operational changes.
- Torsional vibration analysis for frequencies up to 50 Hz.



PROPELLER  
EFFICIENCY

FUEL  
EFFICIENCY

HULL  
EFFICIENCY

FUEL >

ENGINE + PROPELLER + SHIP'S HULL

> SHIP SPEED

FUEL >

ENGINE

> TORQUE >

PROPELLER + SHIP'S HULL

> SHIP SPEED

Energy conversions & efficiencies

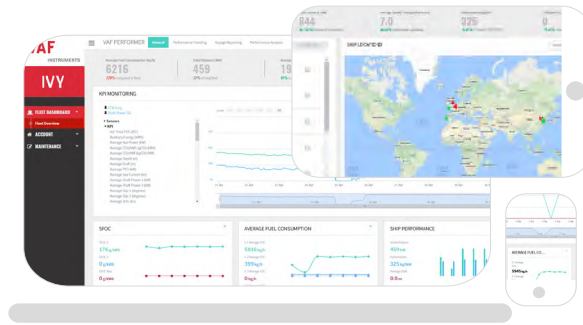
By measuring propeller torque you are able to separate the engine efficiency from propulsion efficiency

# 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 30 KPIs. IVY® can be combined with a range of sensors on board, including T-Sense®. IVY® brings Big Data back to the essence.



## Propulsion Efficiency Monitor

The PEM4 instantly shows torque, speed, 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.



## PEM2 Touch screen

For monitoring T-Sense® torque, shaft speed and power output only, we supply the PEM2 touch screen as a standalone unit.

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.

	PEM2	PEM4	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, SFDC, FDC	-	X	X
Ship speed (STW / SOG)	-	X	X
Zoom in on individual sensor signals	-	X	X
Visualisation of KPIs	4	7	> 30
Data enrichment	-	-	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

# Technical specification

## Control box for stator part

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

## Rotor equipment

<b>Material of mounting rings</b>	Carbon steel
<b>Material outside cover</b>	Polyurea coated high density foam
<b>Material compensator arms</b>	Carbon steel
<b>Shaft speed detection</b>	Accelerometer signal
<b>Output</b>	2,4 GHz fully protected encrypted signal
<b>Shaft diameter</b>	Min. 100 mm, max. 1000 mm
<b>Dimensions</b>	Depending on shaft diameter
<b>Operating temperature</b>	-10°C to 60°C
<b>Measuring tolerance</b>	< 0,25% F.S.D. on torque

## PEM4

<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

## SPU3

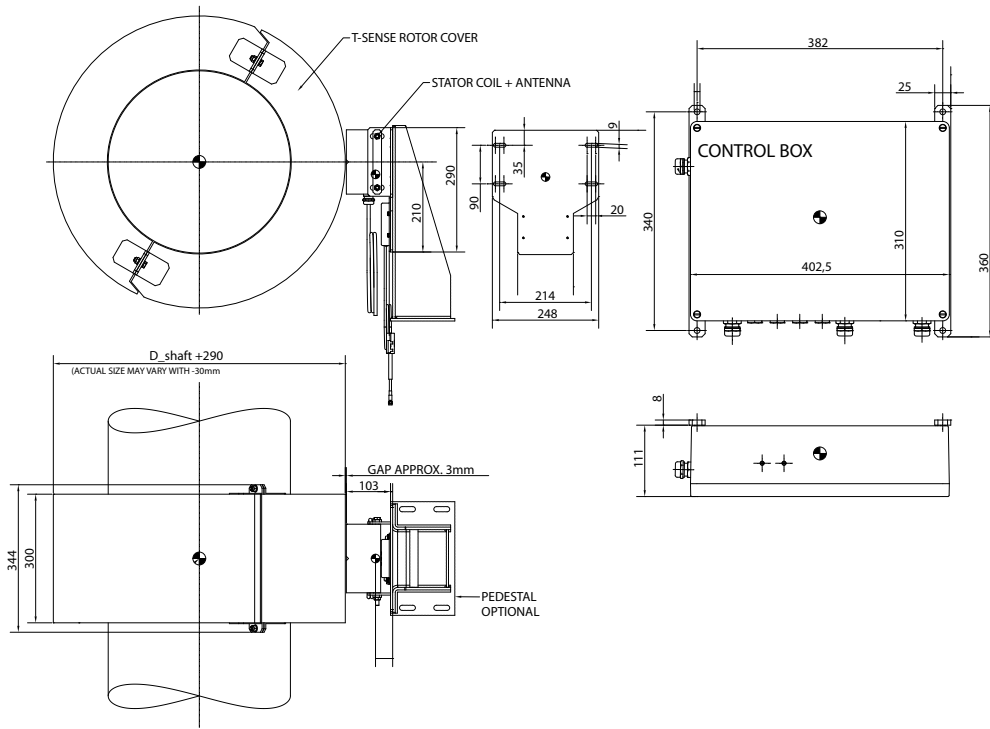
<b>Supply voltage</b>	115 to 230 VAC $\pm$ 10%
<b>Power consumption</b>	60 W
<b>CPU</b>	1GHz, SDRAM 512MB DDR3L 800 MHZ
<b>Digital input</b>	2x RS 485 Modbus connection for input signal from T-Sense® (or TT-Sense®) optical sensors and an additional NMEA input.
<b>Analog input</b>	9 x optional (galvanic isolated) 4-20mA, used for shaft generator input, auxiliary power or ViscoSense®3D
<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

## PEM2

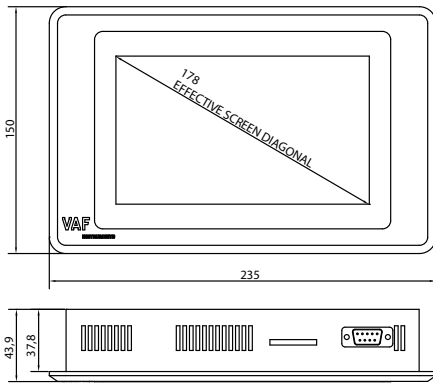
<b>Supply voltage</b>	24 V DC $\pm$ 10%
<b>Power consumption</b>	10 W
<b>Temperature range</b>	0 to 55° C
<b>Input</b>	Modbus signal from T-Sense®
<b>Connections</b>	Screw terminals and RS485 connection on back panel
<b>Display color</b>	TFT-touch screen 5.6" (320x234 dots) with adjustable LED backlight
<b>Dimensions</b>	188 x 143 x 46 mm (w x h x d)
<b>Cut out</b>	174.5 x 132.5 mm (w x h)
<b>Cut out depth</b>	40 mm
<b>Front panel thickness</b>	6 mm
<b>Protection class</b>	IP 65 at front facia
<b>Net weight</b>	0,8 kg

# Dimensions

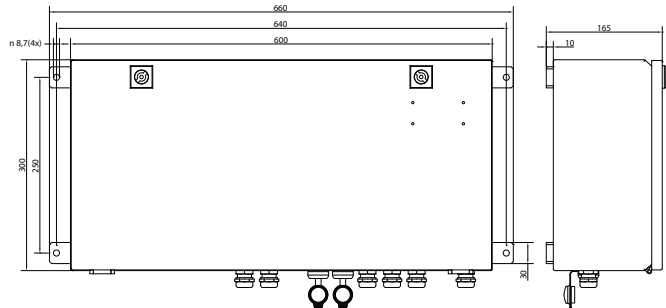
T-Sense®



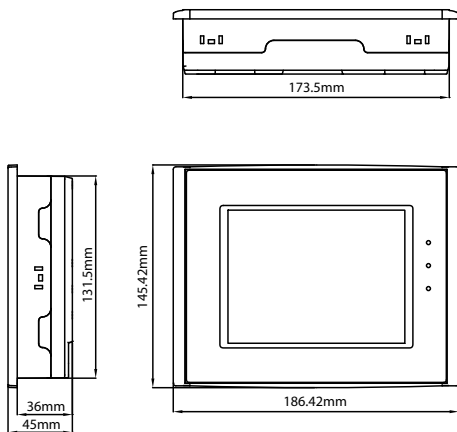
T-Sense® optional components



PEM4 touch screen



SPU3 Signal Processing Unit



PEM2 touch screen

### Quotation and ordering information

All copyrights reserved PB-660-GB-0517 Supersedes PB-660-GB-0816

<b>1. Please provide shaft line drawing for information:</b>			
<input type="radio"/> new building		<input type="radio"/> retrofitting	
<b>2. Number of units per ship:</b>			
<b>3. Available shaft length [mm]:</b>			
<b>4. Ship's name / hull:</b>			
<b>5. 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:	
<b>6. 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 IWV®		
	<input type="radio"/> PEM4 for Fuel Consumption Measurement, torque, shaft speed and power read-out		
	<input type="radio"/> touch screen display (PEM2) for, torque shaft speed and power read-out		

Name:

Place and date:

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

VAF Instruments B.V.

Vierlinghstraat 24, 3316 EL Dordrecht, The Netherlands  
P.O. Box 40, 3300 AA Dordrecht, The Netherlands  
T +31 (0) 78 618 3100, [sales@vaf.nl](mailto:sales@vaf.nl)

Specifications subject to change without notice.  
Agents and distributors in more than 50 countries.



**Mackay**  
MARINE  
[www.mackaymarine.com](http://www.mackaymarine.com)  
[marinesales@mackaymarine.com](mailto:marinesales@mackaymarine.com)  
+1 281 479 1515  
[service@mackaymarine.com](mailto:service@mackaymarine.com)  
+1 281 478 6245