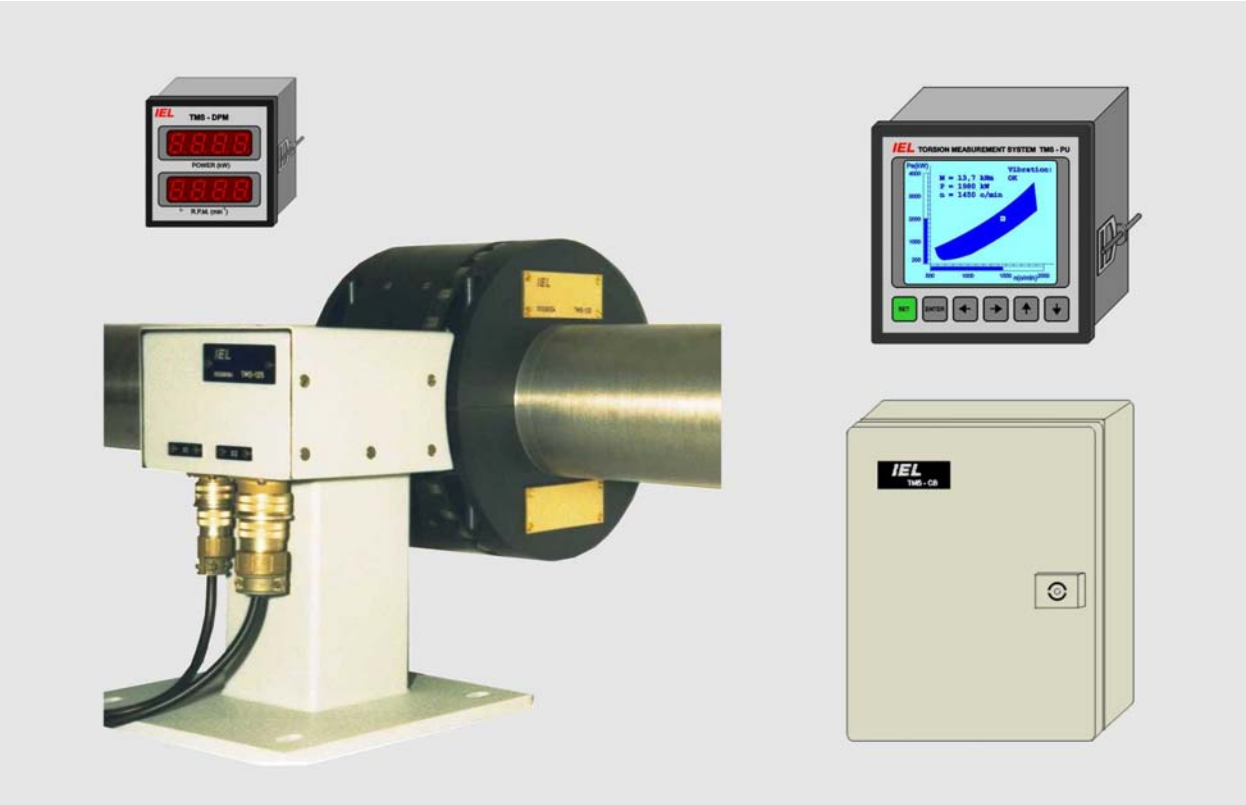
Development, Production and Engineering of Industrial Electronics Croatia

TORSION MEASUREMENT SYSTEM TMS

Measurement Program PM-01010E



Application

- Torque, power and r.p.m. measurement on the shaft of the ship
- Fuel consumption optimisation
- Ship's powerplant monitoring
- Twin screw load balancing
- Permanent vibration monitoring and analysis
- Overtorque and overvibration alarm (ALERT and DANGER)
- measurement and event registration
- communication with host SCADA system

Main Features

- Contactless torque and r.p.m. measurement
- High system accuracy
- Remote and local indication of torque, power and r.p.m.
- Microprocessor data acquisition control
- Automatic zero and full scale calibration
- Possibility of multishaft measurement (maximum 3 shafts)
- Wireless power supply for electronics on the shaft
- Rapid installation on the shaft, without its redesign or disassembly
- Reliability in harsh environment; high shocks and vibrations, and wide temperature range
- Simple maintenance

System description

Rotating unit carries measuring module, power supply module, and serves as a mechanical protection for strain gages mounted on the shaft. It contains inductive loop that receives energy for supplying modules and antenna for transmitting measuring signal. Measuring module contains measuring amplifier and voltage to frequency converter. Power supply module contains rectifier and measuring signal transmitter. Modules are encapsulated in epoxy, that provides harsh mechanical design and resistance against moisture, oil and dirt. Rotating unit consists of two halfrings, tightened with four screws. It is made of polyamid, that is resistant against mechanical strains, harsh environment, and has low specific gravity.

Stationary unit is mounted nearby rotating unit, and performs energy transmission for supplying rotating unit, and receives torque measuring signal from rotating unit. Stationary unit also cotaines inductive r.p.m. meter sensor. Robust steel profile construction ensures vibrations resistance. Mechanical solution of stationary unit enables positioning in three geometric axes in relation to rotating unit.

Connection box is mounted in engine room and it is designed for connecting and supplying the whole system.

Processing unit is designed for acquisition and processing of torque and r.p.m. measuring signals. The main part of Processing unit is microcomputer performs computation of power and corrections of influence quantities. Processing unit can be realized in two versions:

1. With numerical and graphic visualization of measuring quantities for one shaft on LCD display and communication with host computer (option)
2. With numerical indication of measuring quantities for up to three shafts on LED display (option).

Processing unit performs acquisition, processing and registration of measuring data and event. Version 1 is designed for panel mounting, and version 2 for wall mounting. Special amortisseurs are applied in version 2 to eliminate the influence of vibrations.

In addition to the basic versions, additional options for energy consumption and fuel consumption measurment are available. Option with analog outputs can be used for protection regulation and torsion vibration analysis. In addition, option with shaft assembly vibration measurement is possible. Figure 1. shows torsion measurment system TMS with Processing unit version 2.

Figure 1. Torsion Measurement System TMS

(1- Rotating Unit, 2-Stationary unit, 3-Connection box, 4-Measurement module, 5-Power supply module, 6-Processing unit (version 2), 7-Digital Panel Meter)

Principle of opreation

Torsion measurement on the shaft is based on physical principle that connects shaft deformation with the applied torque. In elastic region of the shaft material, deformation is directly proportional to the torque.

Figure 2. shows the block diagram of the Torsion measurement system TMS. Four strain gages connected in bridge are used as sensors for deformation measurement. the output voltage of the bridge is conditioned by measurement module in rotating unit. Amplified signal is forwarded to the measuring signal transmitter. *

Measuring signal receiver is placed in stationary unit and acts as an amplifier and demodulator of the received signal. Inductive sensor with impulse electronic circuits in stationary unit is designed for r.p.m. measurement.

Torque and r.p.m. signals are forwarded to Processing unit over Connection box. Microcomputer placed in Processing unit performs data acquisition, computes numeric corrections and automatically calibrates zero and full scale. In this way influence quantities (drift, long term stability) are compensated, and accuracy and reliability are increased. Full scale calibration can also be performed manually. After numeric corrections of measuring data power is calculated. Measuring results are integrated with adjustable integrating time. In this way torsional pulses common on diesel powered ships can be eliminated.

Optionally, Processing unit (version 1) is suitable for acquisition and display of vibration signals. Option with analog outputs of all measurement quantities is possible. Communication with host computer is possible over standard media (RS 485, RS232C, F.O.) and over MODBUS RTU or PROFIBUS DP protocol.

Rotating unit is wirelessly supplied. Power amplifier and power transmitter are placed in stationary unit. Power receiving on rotating unit is accomplished by inductive loop, which with appropriate rectifier ensures supply voltage for electronic circuits.

* Method of wireless signal transmission is protected by patent claim P-2237.

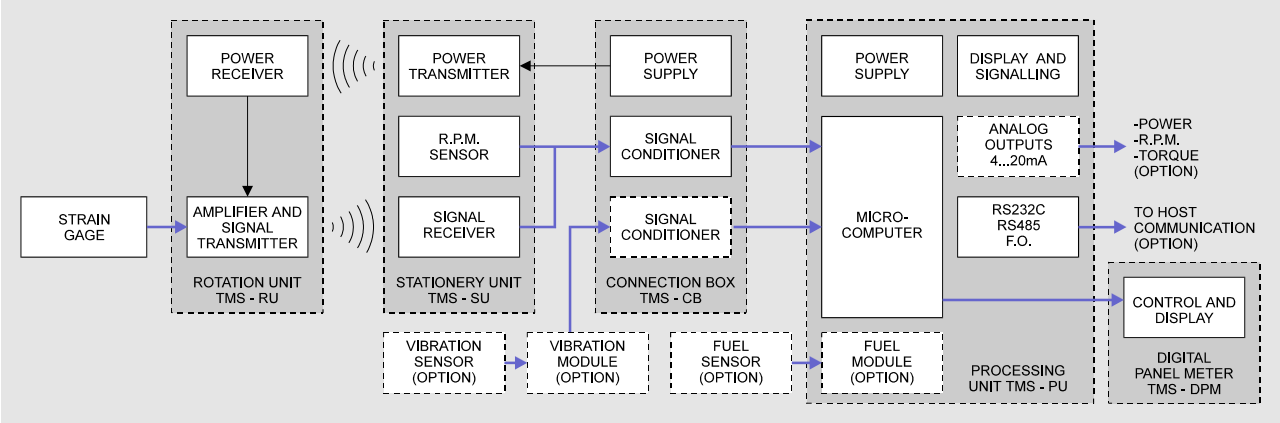


Figure 2. Block diagram of the Torsion Measurement System

Specifications

Input sensors
- torque.....4 arm strain gage bridge; 1kΩ
- r.p.m.....inductive sensor
- vibration (option) .....accelerometer or proximity sensor

Accuracy
- torque.....1% FSR
- r.p.m.....0,25% FSR
- power .....1% FSR
- energy.....1% FSR

Linearity
- torque, power .....0,05% FSR

Temperature effect
- torque, power .....on zero 0,015% FSR/ºC
  on full scalle 0,015% FSR/ºC

Frequency response .DC to 100 Hz
on request extended (option)

Integration time .....1 or 10s

Calibration .....automatic and remote

measuring signal transmission .....wireless

Rotating unit supply .....wireless, inductive

Communication.....RS 485, RS 232C, F.O. (option)
MODBUS RTU protocol
PROFIBUS DP protocol

Output displays, TMS-PU version 1:
- torque .....numerical on LCD display
- r.p.m., power diagram P=f(n).....numerical and graphical on LCD display
- energy, fuel consumption (option).....numerical on LCD display
- vibration (option).....numerical and graphical on LCD display

Output displays, TMS-PU version 2:
- torque .....LED display 5 digits
- r.p.m. .....LED display 4 digits
- power.....LED display 5 digits
- energy, fuel consumption (option).....LED display 5 digits

Output displays, TMS-DPM:
- r.p.m.....LED display 4 digits
- power. .....LED display 4 digits

Analogn outputs(option)
- torque.....-10V do +10V
- r.p.m., power .....0 do 10V

Signalling:
- power on .....LED green
- system failure.....LED display, LED red
- measuring units.....LCD display, LED yellow
- shaft selection .....LCD display, LED yellow

Power supply
- AC.....220V ili 110V, 50 to 60 Hz
- DC.....24VDC ±20 %, other on request
- consumption.....100 VA for one shaft
  additional 30 VA per shaft

General data
- temperature range ....within guaranteed
  limits 0 do 60ºC
  storage -40 do 80ºC
- relative humidity.....98 % without condensation
- resistivity against .....salt mist
  water dropping
  fungi and mould

- vibration test .....1mm od 5 to 15 Hz
  0,5 mm 15 to 25 Hz
  0,25 mm 25 to 55 Hz
- shock test .....20g frequency 2Hz

Mechanical design
- elements .....rotating unit, stationery unit
  connection box, processing unit
  digital panel meter
- dimensions .....according to figure 3.

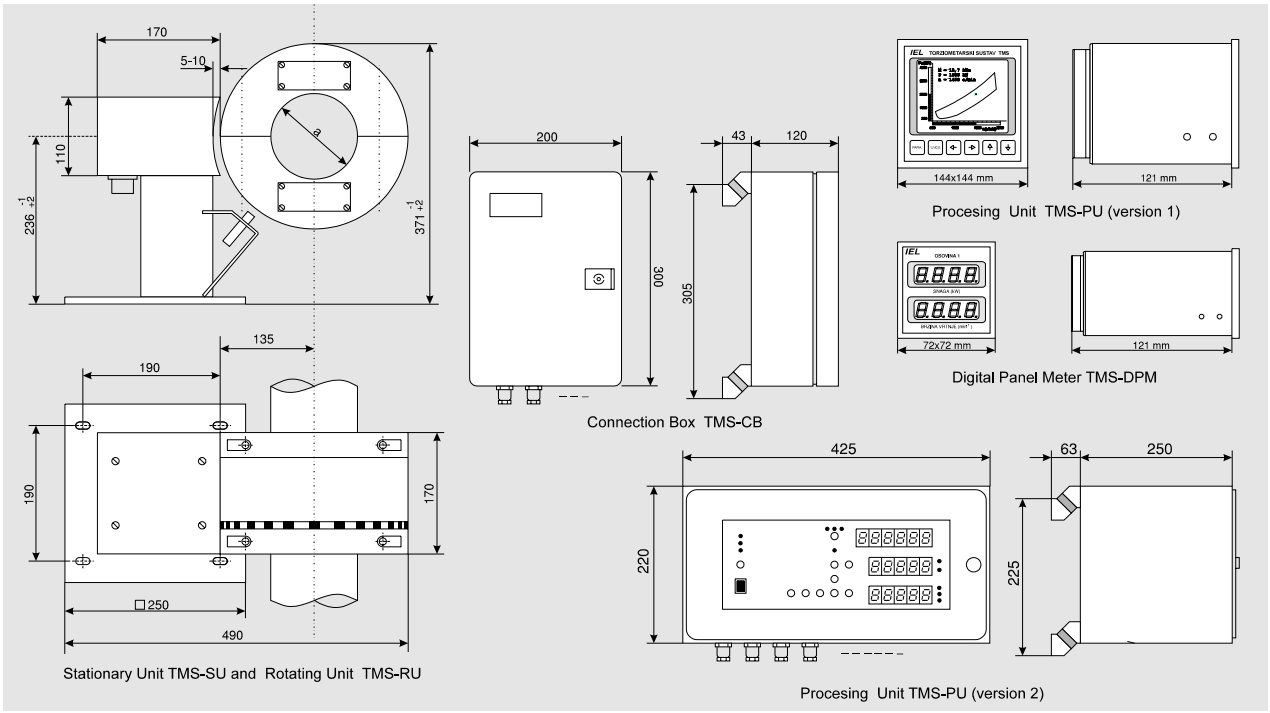


Figure 3. Dimensions of the System TMS components

Ordering information:

TMS - XXXX - X - XX

- Options
- Versions (1 or 2)
- Shaft diameter in mm

Options:

X0 - basic version for torque, r.p.m. and power measurement
X1 - torque, r.p.m., power and fuel consumption measurement
X2 - torque, r.p.m., power and energy consumption measurement
X2 - torque, r.p.m., power and energy consumption and fuel consumptionv measurement
0X - without analog outputs
1X - analog outputs
2X - vibration measurement

Before ordering ask for Ordering Information Form which specifies following parameters::

1. Outside diameter of the shaft with tolerance 0,125 mm (0,005 in).
2. Internal diameter of the shaft with tolerance 0,4 mm (0,016 in).
3. Modulus of rigidity of the shaft if known. (otherwise 8,21 10^{10} N/m^2 is asumed for steel)
4. Maximum r.p.m..
5. Full scale torque.
6. Horsepower at maximum r.p.m.
7. Units of horsepower display (British or metric).
8. Power supply voltage for measuring system.
9. Distance between shaft's center and stationary unit stand.
10. Number of shafts.
11. Requested version and option.

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