Dynamic Positioning System

Mega-Guard DP:
- Dynamic Positioning System
- Position Reference System
- Single, dual, triple DP (DP1, DP2, DP3)
- Kalman filtering & Fuzzy logic controller
- Auto position and auto track mode
- Cable and pipe laying modes
- DP Control functions in IEC61131-3
- Solid state disks
- Language option: Chinese, Japanese
- Power supply voltage: 19–32Vdc
- Worldwide service network
- Class type approved (DP1, DP2, DP3)
Dynamic Positioning System

Features

The Mega-Guard Dynamic Positioning System (DP) automatically controls a vessel’s heading and position by activating thrusters based on data received from position reference systems, gyrocompasses, wind sensors and motion reference units. The Auto Track mode allows the ship to move along a pre-defined track at low speed as defined by the operator.

The Mega-Guard Joystick Control System (JC) is a basic version of the Mega-Guard DP system and allows the operator to automatically control the heading and manually position the vessel based on data received from gyrocompasses and wind sensors.

The Mega-Guard DP and JC system are based upon the field-proven products of the Mega-Guard product line and the experience as gained on the design and delivery of joystick control systems as supplied on many different kind of vessels since 1980 (see reference list).

The Mega-Guard DP and JC system are suited for e.g. supply vessels, tug boats, dredgers, cable and pipe laying vessels, FPSO’s, heavy lift vessels and mega-yachts in full accordance with the applicable classification and IMO rules (DP1, DP2 and DP3).

Main advantages of the Mega-Guard Dynamic Positioning System:

- Accurate positioning with better than 0.5 meter accuracy in combination with DGPS and MRU (inclinometer). Higher position accuracies can be achieved with e.g. a laserbeam positioning system.
- Sea trial tuning and testing can be limited to three days maximum, Parameter tuning is already done before shipment out of our factory by modelling of the ship and testing with a ship simulator.
- Extremely reliable hardware by using only solid state components and 24VDC power supply for all components within the DP system. All Mega-Guard DP hardware and software is designed and manufactured by Praxis Automation Technology and is applied in other Mega-Guard products as well (AMCS, VCMs, PMS, PCS, INS, etc).
- Various language options are available including Chinese, Japanese and others.
- Supports third party and own (Mega-Guard brand) position reference systems: Mega-Guard DGPS/Chonass with NTRIP (DGN), Hydroacoustic Position Reference (HPR) and Taut wire Position Reference (TPR).
- Cost effective DP solution. Reliable hardware that is field proven on hundreds of vessels, allows for efficient off the shelf manufacturing in large quantities. As a result, we can offer our advanced Mega-Guard Dynamic Positioning System, including navigation sensor package, at a very attractive price level. In addition, customer's investment is supported by a world wide service network.
References

- Cable and pipe laying vessels (DP2)
- Offshore supply vessels (DP1 and DP2)
- Ocean salvage vessels (DP2)
- Tug and work boats (DP1)
- Multi purpose vessels (DP1 and DP2)
- Platform crew boats (DP1)
- Passenger ferries (DP1)
- Jack-up platforms (DP1)
- Mega-yachts (DP0)

Applicable classification: DNV, BV, LR, GL, ABS, CCS, RS, IRS, NKK.

The following modes of operation can be selected via the DP Operator Panel:

- Joystick Manual Heading Mode:
The operator manually controls the position of the vessel via Joystick and the heading is controlled via the Heading Knob.

- Joystick Auto Heading Mode:
The operator manually controls the position of the vessel via Joystick and the heading is kept automatically to the Set Heading.

- Auto Position Mode:
Station keeping. The position of the vessel is kept automatically to Set Position and the heading is kept automatically to the Set Heading. The Set Position can have absolute coordinates (Northings and Eastings) or relative coordinates (relative from e.g. a platform).

- Auto Track Mode:
The vessel's heading is kept to Set Heading and the operator has the ability to control the speed of the vessel by joystick control (forward direction). Only the main thrusters and rudders are used in this mode. In Auto Track mode the vessel moves along pre-configured tracks. Special modes are available for cable and pipe laying vessels and dredgers.

- Target Follow:
This mode enables the vessel to automatically follow a moving target and keeps the vessel at a constant position relative to the target (Hold Position to target). This mode is e.g. used for ROV follow.

- Simulation Trainer Mode:
Simulation mode can only be entered when the thrusters are in individual. This mode is used to train the operator in how to use and to get familiar with the Mega-Guard DP system.

Models

- Mega-Guard JC
  Joystick Control System with optional position holding capability

- Mega-Guard DP0
  Dynamic Positioning System

- Mega-Guard DP1
  Dynamic Positioning System with independent JC System

- Mega-Guard DP2
  Dual redundant Dynamic Positioning System with independent JC System

- Mega-Guard DP3
  Triple redundant Dynamic Positioning System with independent JC System
DP Operator Workstation

Operator mimics

The DP Operator Workstation contains user friendly mimic diagrams so that the ship's crew can execute DP operations in an accurate and safe way. The following main mimic diagrams are available:

- Map (North pointing upwards)
- Diagram (bow pointing upwards)
- Capability
- Positioning sensors
- Other sensors

The following sections describe the various functions available within the mimic diagrams.

Diagram section

- Heading indication with rotating compass and rotating decimal degrees
- HDG (°) and ROT (°/min)
- Latitude / Longitude
- COG (°) and SOG (knot)
- Error X (m) surge and Error Y (m) sway
- Wind and current vectors relative
- Total thrust vector with thrust amplitude and direction
- Individual thrust indication for each thruster with amplitude and direction

Map section

- Heading indication with compass slider
- HDG (°) and ROT (°/min)
- Latitude / Longitude; map indication
- COG (°) and SOG (knot)
- Error North (m) and Error East (m)
- Vessel orientation, heading and movement
- SOG vector (green)
- Wind vector (yellow)
- Force vector (green); controller output

Thruster section

- Bargraph and numeric value for each thruster; setpoint and feedback
- An icon for each thruster showing thrust angle setpoint and feedback
- Thruster ready indication
- Heading controller output
- Station in control and Operating mode

Alarm area

- 6 rows for alarm display with alarm acknowledgement for each alarm
- Day/night vision selection
**Capability section**
- Online X-Y plot of wind capability with selected thrusters and selected current value
- Wind vector, direction and speed; if this vector reaches the capability boundaries the vessel is out of capability
- Current settings

**Sensor section**
- Supports multiple position reference systems: DGPS, laser, radar, hydroacoustic, taut wire and winch
- Supports multiple sensors: gyro, wind and motion reference unit (MRU)
- Absolute (Northings and Eastings) or relative coordinates
- Sensor validation and weighing

**Heading setting**
- Heading setpoint (°) and ROT (°/min) maximum
- Alarm limit (°)
- Steer limit (°)
- Heading gain (%)

**Environmental setting**
- Wind compensation setting in between 0% and 100%
- Current direction (°)
- Current speed (knot)
- Check box to select or de-select automatic current compensation

**Position setting**
- Step (m) adjustment
- Bearing (°) adjustment
- Relative (X/Y) or absolute (N/E) mode
- Position setpoint mode
- Alarm limit (m)
- Set new position
- Up/down and Left/right step (m)
- Position gain

**Joystick setting**
The following parameters can be set:
- Joystick gain
- Display of thrust vectors to the thruster controller
### Dynamic Positioning class notifications and scope of supply

<table>
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<th>ABS</th>
<th>LRS</th>
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The table indicates the number of required reference sensors:

1. Position reference systems to be of different type. Dispensation can be given by class for DP1 in case not practical

### System lay-out:

The basic components of both the Joystick Control System and the Dynamic Positioning System are:

- **JC/DP Operator Panel**
  - Operator Panel with Joystick and 7" TFT Colour Graphic Screen with 12 soft pushbuttons.

- **JC/DP Controller**
  - Marine Personal Computer and Mega-Guard DP Control software under the Windows 7 embedded operating system.
  - Solid state disk and low power technology is applied.
  - A 17" to 26" TFT Colour Graphic Screen is connected to the DP Controller.

- **4 channel NMEA I/O Module**
  - The 4 channel NMEA I/O Module contains 4 NMEA-0183 links for interphasing to reference sensors.
  - The Mega-Guard DP system supports up to 24 NMEA links.
  - The 4 channel NMEA I/O Modules are connected to the JC/DP Controller through a high speed USB link.

- **JC/DP Thruster Controller**
  - The Thruster Controller is built-up with a Control Processor and 24 channel Mixed I/O Modules. The number of Mixed I/O Modules depends on the number of thrusters as installed on the vessel. The JC/DP Thruster Controller interfaces as well to the Power Management System.

All of the above components of the Dynamic Positioning System are interconnected by redundant Ethernet link.

All thruster inputs and outputs are wired in parallel to each Dynamic Positioning System. Only the active Dynamic Positioning System powers the outputs of the JC/DP Thruster Controller (DP/JC Change Over).
Reference sensors

Different class societies require a different number of reference sensors connected to the Mega-Guard Dynamic Positioning System. The reference sensors are divided in the following categories:

- Position reference system; e.g. DGPS, laser, radar, hydroacoustic and taut wire.
- Heading reference system; e.g. gyro.
- Environmental reference system; e.g. wind sensor.
- Ship motion reference system; e.g. MRU.

All reference sensors are interfaced with the JC/DP Controller through 4 channel NMEA I/O Modules.

Uninterruptable Power Supply

All components of the Mega-Guard Dynamic Positioning System, including the reference sensors, are fed by 24VDC which is supplied by the Uninterruptable Power Supply. The Uninterruptable Power Supply is connected to the ship’s grid (e.g. 230VAC or other) and contains a battery back-up in order to feed the Mega-Guard Dynamic Positioning System even in case of a blackout on the vessel.

Interface with PMS

An interface is provided to the Power Management System in order to request for enough electrical power in case the vessel is controlled by the Mega-Guard Dynamic Positioning System. At the same time, the Mega-Guard Dynamic Positioning System will make sure that the thrusters do not consume more power than available, in order to prevent a blackout.

DP Training System

The Mega-Guard DP Training System is a modular system, which is used by our training centre, DP training institutes and shipowners to train the crew members how to operate a vessel equipped with a Mega-Guard Dynamic Positioning System.

The Mega-Guard DP Training System includes a full bridge, equipped with dynamic positioning, propulsion control and integrated navigation system. All products installed on the bridge are part of the Mega-Guard product line.

The Mega-Guard DP Training System generates a realistic outside Bridge View as if you are looking through the bridge windows. In addition, the Mega-Guard DP Training System simulates the behavior of the vessel taking into account the position, heading, thrusters and rudders with different environmental conditions.

The Mega-Guard DP Training System simulates a supply vessel and an oil rig in order to train the different DP scenarios.
DP0 and DP1 Overview

Mega-Guard DP0 Block Diagram

Mega-Guard DP1 Block Diagram

UP TO 8 THRUSTERS, PROPELLERS, RUDDERS, ETC.
DP2 and DP3 Overview

UP TO 12 THRUSTERS, PROPellers, RUDDERS, ETC.
Position Reference System

### Overview position reference

The following Mega-Guard DP Position Reference Systems (PRS) are available:
- DGPS/Glonass with NTRIP (DGN-5000)
- Hydroacoustic Position Reference (HPR-5000)
- Taut wire Position Reference (TPR-5000)

Third party position reference systems like DGPS with IALA, Seastar or Veripos and position reference systems based on laser and radar are supported as well.

The Mega-Guard DP system supports up to 16 different position reference systems. The final position is calculated taking into account the reliability, accuracy and weighing factor of each position reference system.

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### DGPS/Glonass with NTRIP

The Mega-Guard DGPS/Glonass with NTRIP (DGN) position reference system is a cost-effective DGPS solution to reach sub-meter accuracy with global coverage. The Mega-Guard DGN requires a mobile internet connection (VSAT) in order to receive position corrections via the so-called NTRIP protocol. In many cases, the position corrections via NTRIP is a free-of-charge service. The Mega-Guard DGN includes a GPS/Glonass L1 receiver which is capable of receiving both GPS and Glonass satellites. A separate NTRIP Workstation (client) has access to the NTRIP Broadcasters who send position corrections via the internet.

The Mega-Guard DGPS/Glonass with NTRIP consists of the following components:
- DGPS/Glonass L1 receiver with 24 channels and including SBAS correction and external RTCM104 input receiving corrections from NTRIP Workstation.
- DGPS/Glonass antenna with 30 meter antenna cable.
- NTRIP Workstation with NTRIP Client software and control software for the DGPS/Glonass receiver.

The NTRIP Workstation is connected to the internet via a VSAT receiver (not part of scope of supply). The NTRIP Workstation transmits position corrections to the DGPS/Glonass receiver through RTCM104 protocol. The solid state (no moving components) Workstation includes a 17” TFT Colour Graphic Screen and a Trackball and is powered by 19–32VDC.

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### Third party reference systems

The following third party position reference systems are often used with the Mega-Guard DP system:
- CyScan: laser position reference system with deck unit and mirror as installed on platform.
- RadaScan: radar position reference system with deck unit and transponder as installed on platform.
- Fugro 9200: DGPS L1 and L band receiver for receiving Seastar position corrections via L band. Options include: IALA beacon (external), L2 and Glonass.
- Subsea7 LD5; DGPS L1/L2 and L band receiver for receiving Veripos position corrections via L band. Options include: IALA beacon and Glonass.
- C-Nav-1000; DGPS L1 with IALA beacon receiver.
Hydroacoustic Position Reference

The Mega-Guard Hydroacoustic Position Reference (HPR) is applied as a cost effective and highly accurate position reference system for the Mega-Guard Dynamic Positioning System (DP2 and DP3). The position of the seabed USBL Transponders are used as reference points for the ship mounted USBL Transceiver. The USBL Transceiver, MRU and Gyro are connected to the USBL Control Cabinet. The HPR Workstation accurately calculates the relative position of the vessel taking into account the data as received from the USBL Control Cabinet. An USBL Transponder contains a release mechanism with floating collar for recovery of the Transponder from the seabed.

The Mega-Guard Hydroacoustic Position Reference consists of the following components:

- HPR Workstation; a NMEA-0183 relative position output is provided for connection to the Mega-Guard DP.
- USBL Control Cabinet
- USBL Transceiver; two versions available: one for 5000 meter and one for 1500 meter water depth.
- USBL Transponder: various models available depending on water depth and beam width.

The USBL Transceiver can be mounted in 2 different ways:

- Hull mounted with Gate Valve and Deployment Machine.
- Pole mounted with Over-the-side Pole.

Taut wire Position Reference

The Mega-Guard Taut wire Position Reference (TPR) is applied as a position reference system for the Mega-Guard Dynamic Positioning System (DP2 and DP3). The Taut wire Deck Winch is deck mounted at port or starboard side of the vessel. The Mega-Guard TPR is very accurate, reliable and maintenance free as it is constructed as a full electric device (no hydraulics used for the winch).

The Mega-Guard Taut wire Position Reference consists of the following components:

- Taut wire Deck Winch with a 500 meter long / 6mm thick steel cable and clump weight. The clump weight is lowered to the seabed and the cable is put to constant tension. The Deck Winch includes a Taut wire Control Cabinet which calculates the relative position of the ship taking into account the input from the MRU. A NMEA-0183 relative position output is provided for connection to the Mega-Guard DP.
- Taut wire Control Cabinet, installed at a dry location, with control electronics for the deck winch. Powered by a three phase 440VAC power supply.
- A Taut wire Operator Panel is installed on bridge for controlling the Taut wire Deck Winch.