



AQUA
MANOEUVRA
SYSTEMS

Aqua Manoeuvra Systems

A Division of Innovative Technologies Ltd.



MARINE Rudder Propeller SYSTEMS

A full Series of Azimuthing Propeller Drives ranging from 200 to 6000 Hp providing full 360 degree Capabilities.

Aqua Manoeuvra Systems manufactures and Markets a unique “**Series**” of deck and through hull mounted 360 degree Rotatable Propeller Drives in the standard “Z” and “L” configurations.

The **Rotatable Propeller Drives** are normally deck mounted or through hull units mounted in a well, with the engine inside an enclosure or the hull and are usually installed in barges, ships, tugs, deck cranes, supply vessels and platforms for special work, diving, pipe laying, cable laying/repair, where maneuverability is a must and sometimes are used with dynamic positioning systems.

Tugs are fitted with Rotatable Propeller Drives either as conventional, or as tractor tugs with the propulsion units at the first third from fore.

More and more vessels will be fitted out with Aqua Manoeuvra Drives for an easy design for compact power with prime mover and propeller assembly, canceling the conventional rudder, and sometimes transverse thruster requirements.

The reliability of ***Aqua Manoeuvra Rotatable Drives*** is complete coping with all navigation areas, open sea, harbors and in all weather conditions.

A lot of innovation and safety devices, with agreement of Classification Boards and MARPOL regulations give Aqua Manoeuvra Systems Rotatable Thruster Drives a Leading Position in the Marine Propulsion Markets.

In general, Aqua Manoeuvra Systems, Rudder Propeller Propulsion Drives have been designed around the latest demands and technical standards, to meet today's high demands for reliability, sturdiness and quality. A long record of building thrusters and a related level of know-how has brought the Aqua Manoeuvra products to this high quality level.

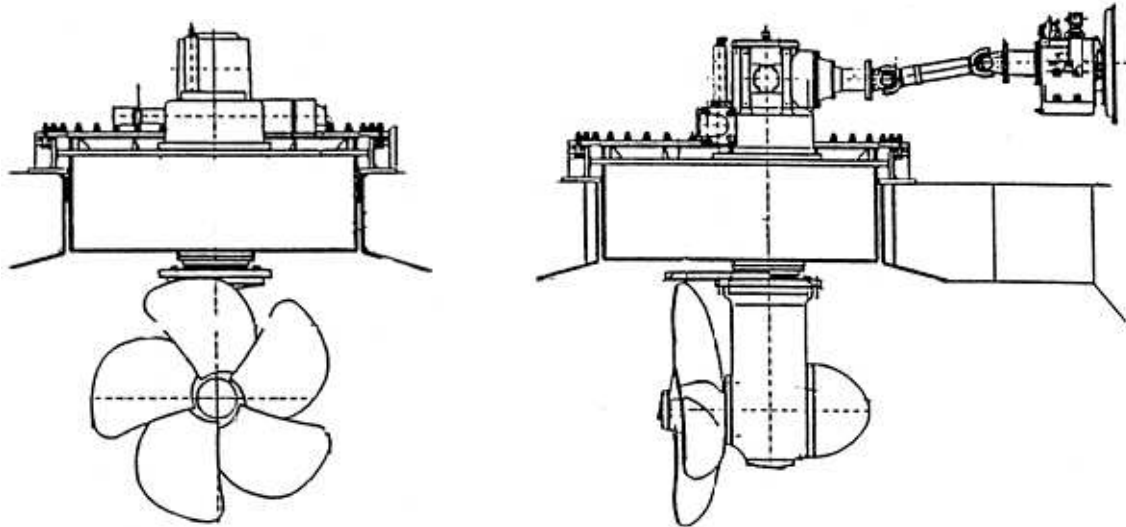
Model Selection

Model	Unit	ZM200	ZM300	ZM400	ZM700	ZM1200	ZM1700	ZM2000	ZM3000	ZM3500	ZM5000	ZM6000
Continuous torque at propeller	MdaN	200	300	480	860	1950	3400	4100	7000	9000	13300	16000
Max. (Input) Power	Kw	225	295	388	597	1015	1640	1790	2610	3000	4180	4700
	Hp	300	395	520	800	1360	2200	2400	3500	4000	5600	6300
Intermittent Power	Kw	205	254	336	530	933	1417	1570	2315	2700	3800	4180
	Hp	275	340	450	710	1250	1900	2100	3100	3600	5100	5600
Continuous Power	Kw	175	224	300	503	820	1230	1380	2100	2390	3440	3800
	Hp	235	300	400	675	1100	1650	1850	2800	3200	4600	5000
Max Input Speed	RPM	2400	2400	2400	2000	1800	1800	1800	1800	1800	1500	1500
Min. Prop Diameter. Rev speed	MM	762	850	950	1150	1600	1750	1900	2300	2400	2700	3000
	RPM	720	720	675	515	370	335	310	255	246	219	197
Max Prop Diameter Rev speed	MM	915	1000	1250	1450	1950	2100	2300	2600	2800	3250	3500
	RPM	685	590	473	408	303	282	257	228	211	182	169

... Optional ...

Model	Unit	ZM200	ZM300	ZM400	ZM700	ZM1200	ZM1700	ZM2000	ZM3000	ZM3500	ZM5000	ZM6000
Nozzle	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clutch (Hydraulic)	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Slipping Clutch	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Draught adjustment on Deck mounted Units	MM	600	700	800	900	1500	1500	1500	2000	2000	-----	-----

The full range of Rotatable Propulsion Drives available do meet the design requirements of the major classification societies, including Lloyd's (-and Indian) Register of Shipping, Bureau Veritas, G.L., American Bureau of Shipping and Det Norske Veritas.



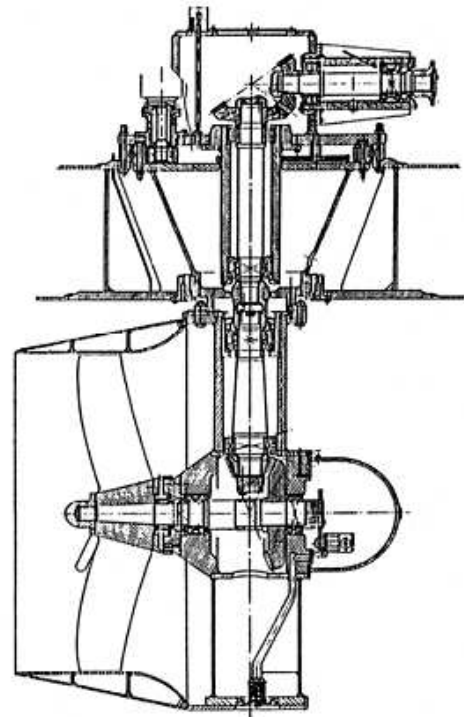
Well Mounted Through Hull Rudder Propeller System

The Aqua Manoeuvra Rudder Propeller Drives consist of the following:

- A. Rudder Propeller (Z-drive) section, comprising upper and lower gear box, intermediate stem section, steering gear and propeller with nozzle optional.
- B. Hydraulic control/operation system.
- C. Remote control system.

A. Rudder Propeller (Z-drive) section, Comprising upper and lower gear Box, intermediate stem section, Steering gear, propeller and nozzle.

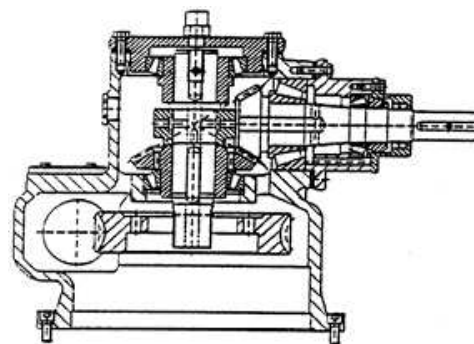
The lay-out of the Rudder Propeller Drive is as follows (Typical – various For different Power ranges.



Uppergearbox

A gearbox made out of cast iron GG20, Offering sufficient strength and provides For noise damping.

The gearwheels are of high tensile steel, carbonized and case hardened spiral bevel gear design, which are lapped in pairs for silent-mesh operation.



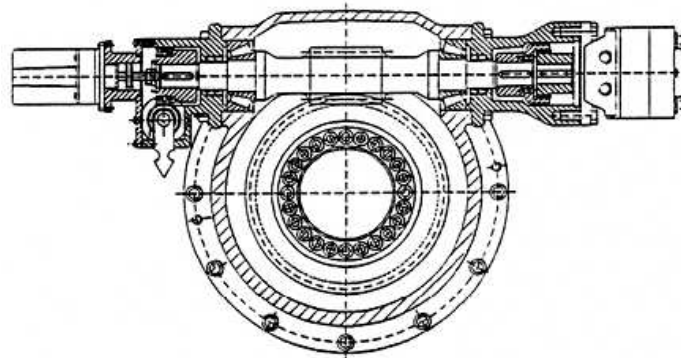
Upper Gear Assembly

Steering Gear

Aqua Manoeuvra uses a worm/worm wheel steering gear, comprising a bronze gearwheel and carbonized and hardened steel worm, with a reduction ratio ranging from 40:1 to 70:1.

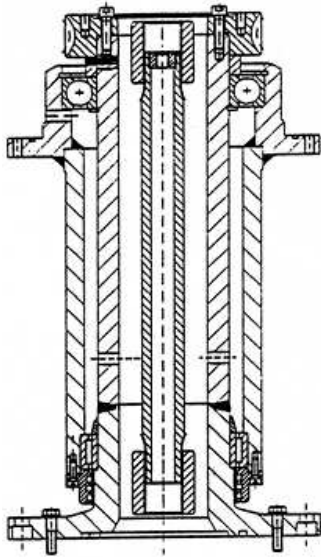
The steering mechanism is of the self-locking type and offers smooth and precise thrust angle accuracy. For larger units, the steering system operates with a large diameter gear with internal teeth and one hydraulic motor upto 1000 mdaN at the propeller shaft and two motors beyond these figures and gear for steering. Furthermore, automatic brakes keep stability of the drive when the hydraulic motor(s) are not activated.

Hydraulic motors drive the steering device capable to operate 180 degree steering angle in 6-7 seconds at constant speed. However, the speed is controllable from the bridge console.



Steering Gear Assembly

The steering system is also provided with a mechanical pointer, driven directly off the worm shaft, for local thrust angle indication and independent from the electrical power supply. The local pointer is indicating the thrust angle with 1:1 ration to the actual angle.



Vertical Stem

Vertical stem with ample sized pipe and vertical drive shaft. Outside diameter of the support tube is chromium plated for corrosion protection.

The diameter of the tubes are of sufficient size to create a high safety factor against bending forces, as well as to create a stable operation.

Underwater Gear Box

The gearbox is made out of high tensile nodular cast iron GN42, offering adequate strength.

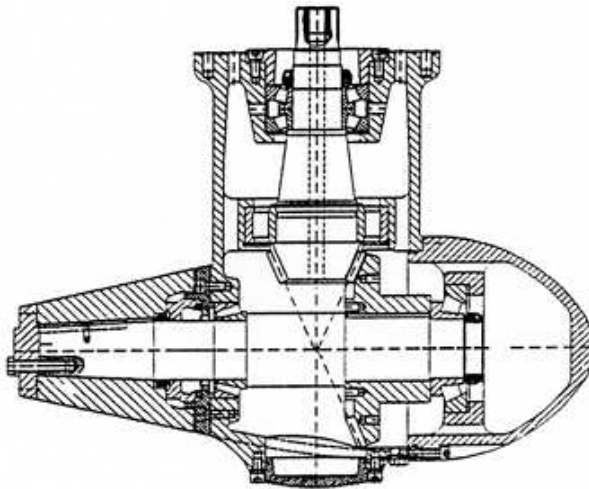
The underwater gear box is of a "Torpedo" shape, designed to keep the hydrodynamic resistance to a minimum level and to make sure the optimum hydrodynamics aspects are met.

The gearwheels are of the high tensile strength, carbonized and case hardened spiral bevel gear design, which are lapped in pairs for silent mesh and operation.

The propeller mounts to a 1:10 taper on an ample sized propeller shaft and is pushed in position by an end-plate, fitted with axial bolts in the propeller shaft. For larger units, the propeller is mounted without key according to SKF assembling on a conical shaft (hydraulically mounted).

The end-plate protects vulnerable threads and provides also for the possibility to pull the propeller off the shaft by flipping it over.

All underwater used bolts are of the stainless steel type.



Thruster “Pod” Assembly

Bearings:

All bearings used in Aqua Manoeuvra Rotatable Propeller Drives are roller bearings, sized for a long life time.

Mechanical losses are kept to a minimum.

The design life time of the bearings is over 20,000 hours, under full continuous load.

The bearings lay-out is such that in case of an overhaul, the gear-mesh set-up is uncomplicated.

Sealing Systems:

High quality nitrile rubber O-rings are applied between all static surfaces.

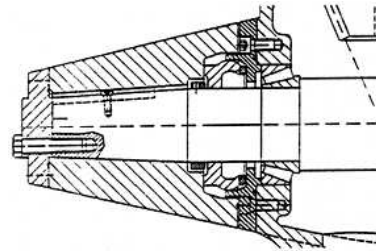
Oil sealing opposing air are by means of lip seals.

The steering tube Quad-rings at the seawater sealing, which are running on a stainless surface on the steering tube.

Special attention has been given to the most important seal in the Z-drive: The propeller shaft sealing system.

Aqua Manoeuvra uses an axial "Deep-Sea Seal"

Pressed by the propeller hub to a ni-resist seat. This sealing system is very reliable and resistant Against penetration of dirt/debris (such as-sand, Mud, plastics, fishing lines etc.) The application Of this seal offers supreme protection against oil Leakage, giving the best environmental protection As well as a safeguard for the valuable internal Power transmission parts inside the thruster drive.



Lubrication:

The lubrication of Aqua Manoeuvra Rotatable Propeller Drives is of the oil bath type, the optimum solution to provide supreme lubrication of all rotating parts such as gearwheels and bearings, as well as the seals.

In order to achieve a positive pressure inside the rudder propeller drive, the lubricant is pressurized by a header tank.

The header tank is complete with a self closing type oil level sight glass and a filler/breather cap offering a single oil-filling point for the complete system.

To safeguard the mechanism against damage from a possible loss of oil due to a broken seal, a low level alarm switch is installed, to deploy the thruster.

Propeller and Nozzle:

The Aqua Manoeuvra Rotatable Propeller Drives are fitted with high performance propellers, or the customer's selection, using the latest design standards to get the best performance possible.

The propeller can run in a nozzle (optional), which is bolted to the underwater gearbox.

Removal of the nozzle for maintenance during dry-dock is easily achieved.

The inner lining of the nozzle is made out of stainless steel AISI 316, over the full nozzle length.

The stainless steel lining gives the highest degree of protection of the inner side of the nozzle against corrosion.

B. Hydraulic Steering System

The Aqua Manoeuvra Rotatable Propeller Drive is provided with a Hydraulic System, for...

- Steering
- Retraction and lock-hook control (retractable units)

Hydraulic Power Pack:

A tank unit is mounted on the thruster, on which all components such as valves, pressure gauges, filters, filling cap, etc., are located.

Maintenance and monitoring is therefore possible from one center location.

The standard with Aqua Manoeuvra is the use of well proven and reliable hydraulics, of which components are readily available in many local markets.

Hydraulic Pump:

The system incorporates a hydraulic axial-piston type pump(s), with a load-sensing control. The pressure of the pump is automatically adjusted to a pressure level demanded by any of the power consumers in the hydraulic load system.

In case no power is required, the pressure drops to approx. 20 bar.

The pump is driven by a direct coupled electric motor, fitted on the thruster or driven off the front of the diesel engine drive.

Steering:

Rotation of the rudder propeller over 360 degrees is done by means of either a single or dual steering motor on the worm/worm wheel steering gear (internal gear drive for larger units). The steering speed is proportional to the command given by the control system. In a range of 20 degrees the steering speed accelerates from zero to maximum and comes to a stop over the same degree of steering rotation.

A 24 volt (dc) proportional controlled hydraulic directional valve is mounted on the thruster unit. Steering characteristics are therefore shockless and precise.

Emergency Operation:

The system is provided with a back-up steering system, provided through a separate 24 volt (dc) valve, using emergency power supply for operation in combination with the non-follow-up control system.

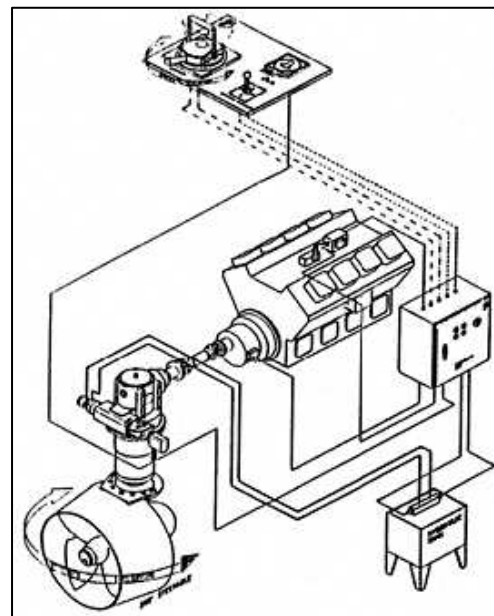
Pipes and Hoses:

All hoses are delivered with the system, are suitable to withstand a pressure of four times the normal operating pressure.

Pipes are of the high tensile steel precision type, adequately supported in plastic clamps.

B. Remote Control Systems. Electrical Remote Control Steering Systems 360 degree Rotatable Propeller units...

MKI-Series (Standard Master Control System)



Master Control MKI Series is a reliable all weather control system designed to operate remote steering control of Aqua Manoeuvra Rotatable Propeller Drives, in all circumstances and environments (Seaworthy-cold and tropical temperatures).

The control is carried out by 24 volt dc electro valves fed with available current on board, with weal sensitiveness to wetness and actual voltage current (the electro valves are activated with more or less 15% voltage).

The Master Control System comprises of the following:

- The **HYDRAULIC MOTOR** operating the steering device of the Rotatable part of the stem. Two (2) hydraulic motors are used beyond 1000 mdaN shaft torque of the propeller.
- A **HYDRAULIC POWER PACK** with one hydraulic pump driven either by the diesel engine or an electric motor. The hydraulic pump is fitted with a capacity regulation system providing a constant quick speed of steering (180 degree angle in 7/8 seconds).
- A **CONTROL PANEL** with controls is either located close to the power pack, or installed in the wheelhouse console.

One or several panels with selector switches can be located at various control stations to operate the ship.

The panels and the electric cabinet in the power pack are linked by electrical cables, without any other mechanical devices.

The Standard Main Panel is fitted with the following:

- 360 degree propeller steering
- Clutch and Throttle control of the engine

If applicable: a throttle lever combined with reverse

- Diesel engine (electric motor) controls and alarms
- Emergency direct steering control (hand lever)
- An independent steering propeller position indicator
- An engine RPM control gauge
- An electric cabinet to be connected to the power pack-cabinet with connection wiring.

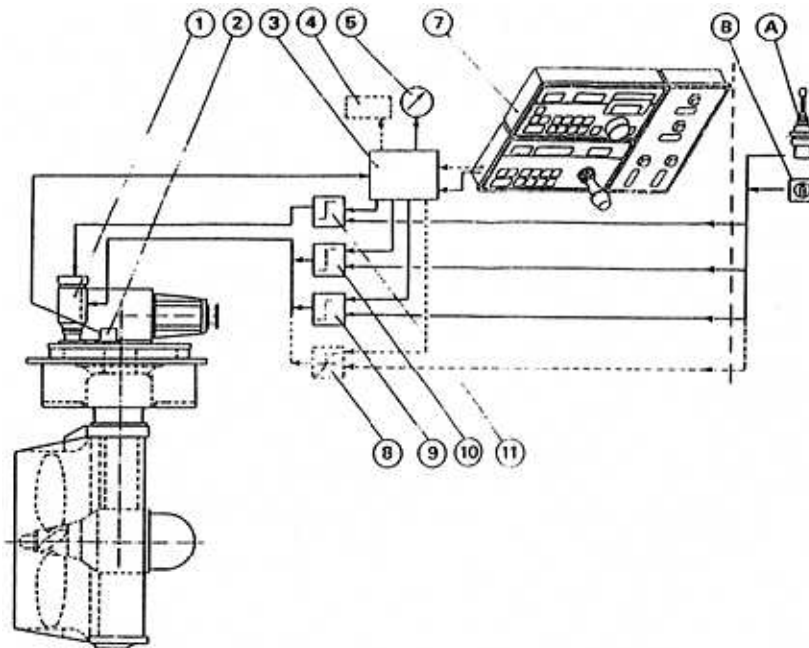
MKII – Series (Mastronic Control System)

The **Mastronic Control System Model MKII** is designed for the steering control of vessels fitted out with two or more Aqua Manoeuvra Rotatable Propeller Drives, Azimuthing and transverse thrusters.

It is implemented with Simrad-Robertson engineering and instrumentation for **AUTOPILOT** and **JOYSTICK CONTROL**; and because of its modular concept, it can be upgraded to incorporate full **Dynamic Positioning Systems**.

The Aqua Manoeuvra **MASTRONIC CONTROL SYSTEM** includes the following:

- Sensors and controls of the Aqua Manoeuvra Thrusters, engines and auxiliary equipment.
- The MASTRONIC programmable AUTOMAT.
- The emergency hand operated control for each thruster: MASTER CONTROL TYPE.
- The MASTRONIC ROBPOS JOYSTICK control



- The interface to GYROCOMPASS and NAVIGATION RECEIVER.
- Option: Interface to a Dynamic Positioning System.

1. Steering Motors
2. Position sensor
3. Automat
4. Display of stated direction
5. Steering indicator
6. Sensor of the direction
7. Control Panel
8. Proportional control
9. Low speed steering control
10. Quick speed steering control
11. Steering brake control
 - A. Revolution direction of propeller (in case of reverse)
 - B. Selector switch : Automatic operation / Hand operated – Emergency

Propulsion Units Under Control:

The MASTRONIC CONTROL is designed to interface to the following propulsion equipment: - Two (2) or more, Aqua Manoeuvra Thrusters
 azimuthally type-fixed pitch propellers
- One (1) or more, Aqua Manoeuvra transverse thruster(s)

Mastronic AutoMat;

The MASTRONIC CONTROL AUTOMAT assumes following controls...

- Input revolution speed – diesel engine or electric motor
- Output revolution speed of propellers (steerable or transverse thrusters).
- Thrust combination of propulsion units, and transverse, for steering.
- Management of outside parameters with input interfaces to GyroCompass and D.P. (optional).

MASTRONIC CONTROL operates the steering from an angular direction stated by the operator.

The order is converted in numeric data, compared to the actual position of the propulsion units and the thrust is steered in suitable position, kept by an automatic brake.

Acceleration or throttle controls are managed by the **MASTRONIC CONTROL SYSTEM**.

Adjustments of parameters are operated through the **AUTOMAT...**

- Time of acceleration.
- Accuracy of steering.
- Temporization.

The Joystick Control System has three (3) operational modes:

- AUTOPILOT
- MANUAL JOYSTICK

Control Model:

MANUAL JOYSTICK with AUTOMATIC HEADING CONTROL

Joystick:

The MASTRONIC Aqua Manoeuvra Joystick Control System integrates manual control of two azimuthal thrusters in a single Joystick controller.

The Joystick system interfaces to and controls the azimuthal thrusters and engine installation, based on information from the vessels gyrocompass and navigation receiver.

The **MASTRONIC CONTROL** is capable of automatically controlling vessel heading while vessel position is controlled manually.

The system also has the ability to rotate the vessel about three pre-determined points (i.e., midship, bow or stern).

The system is modular in concept and in addition to the module; the system includes the **ROBERTSON AP9MKII AUTOPILOT**.

This interface is designed to accept information from a navigation receiver with a standard NEMA 0183 output having a resolution of +/- 18 meters.

Should better accuracy be required, a more accurate positioning reference system should be installed on the vessel and accurate **AUTOMATIC TRACK STEERING** software installed.

Equipment Installed on the Main Control Console:

One (1) ROBERTSON AP9MKII AUTOPILOT CONTROL UNIT with the following features:

- Digital display of set course and analogue display of deviation from set course.
- Rotary set course heading selector.
- Off course alarm.
- Watch alarm.
- Common gyrocompass interface unit.
- Gyrocompass input as main heading reference and second input from backup compass, which is selectable.
- Rate of turn control.
- Mode selector.
- Station selector.

One (1) MASTRONIC ROBSTICK CONTROL MODULE with the following features:

- Joystick maneuvering mode.
- Auto Heading control mode.
- Vessel Rotation Point selection.
- Heading Change control.

One (1) THRUSTER DISPLAY MODULE with the following features:

- Vessel mimic display for positive orientation.
- Thruster and propulsion display.
- Thrust magnitude and direction indicators.
- Thruster and main propulsion on/off selection.

The MASTRONIC SYSTEM and ROBERTSON AUTOPILOT are fed with 24vdc.

Optional:

- Interface to Gyrocompass.
- Interface to Dynamic Positioning Systems.

About the Company

Aqua Manoeuvra BV, offers **Engineered Propulsion** for vessels of all types. We design, manufacture and support marine equipment which has a worldwide reputation as the standard of excellence in the industry.

The Company has an experienced staff of technical personnel who are familiar with the demanding requirements of the ocean environment. We are small enough to give you personal attention, yet big enough to give you excellent service. We maintain an extensive inventory of spare parts ready for rapid air shipment to your location. We have

sales and service representatives in many key locations around the world. Several of these representatives have systems and spare parts in stock for immediate delivery.

We have a complete manufacturing facility which includes a full CNC Machining Center for prototype development, manufacturing and assembly plus our test tank. Our in-house engineering department utilizes SolidWorks, TekSoft CAMWorks 2D/3D Mill, BobCAD/CAM and AutoCad, with... ProCad (Propeller Design and Drafting Software); PropExpert (Propeller Selection and Analysis Software; and MAKASS (Program for Ka-series / Propeller and Nozzle Selection). In addition to our line of standard products, we invite customer inquiries for special systems or service. Please feel free to call on us for assistance in your application.

Stay ON COURSE with Aqua Manoeuvra Systems ...

We offer tailored designed systems to suit any application. This, in combination with evolutionary designs, will fulfill your every need for propulsion and effective side-power. We have over 30 years experience in the maritime propulsion world.

Aqua Manoeuvra ... Marine Thruster Systems

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