FFG MODERNIZATION PROGRAM

IT HAS TO BE

Quantum

MARINE STABILIZERS

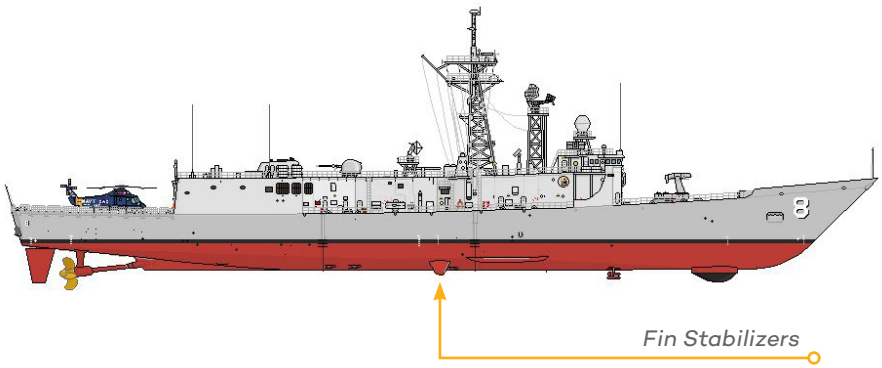
The upgrade is designed to have as much redundancy between the hull units as possible, such as, the system can operate on one fin, should the other fin become inoperable. Support, training and spare parts will remain available for the next 25 years.

FFG Stabilizer Modernization Program

Quantum Marine Stabilizers is introducing a new FFG Stabilizer Modernization Program, that streamlines the retrofit/upgrade process for an FFG without requiring any modification to the hull penetration.

The FFG Modernization Program was developed as a cost-effective alternative to support the life extension programs for Military vessels fitted with Brown Brothers fixed fins. Quantum's new system upgrade consists of the following replacements:

- Enhanced hydraulic power units
- Motor controls
- Control system
- Replacement cylinders and manifolds
- Cooling system



Note: Brown Brothers was acquired by Rolls-Royce In 1999 and was then sold to Kongsberg In 2019. Quantum is not affiliated with or sponsored by Kongsberg and Quantum makes no express or implied representation whatsoever regarding any endorsement by Kongsberg of Quantum's FFG Modernization Program and upgrade system or any of the equipment used in connection therewith.

SYSTEM COMPONENTS - CONTROLS SMC4000

The touch screen interface panel HMI (Human Machine Interface) on the bridge is night readable and meets the USN standards for a bridge control interface. An additional HMI is provided for the EOS (Engineering Operating Space), enabling any control function to be executed, should the bridge control not be available. The main control system and roll sensor are designed to be mounted in the Switch Gear Room. All other controls are mounted in the machinery spaces.

To simplify the installation of the SMC4000, a cabinet is provided for mounting in the Switch Gear Room. HMI's require only a single Cat 5 cable and power supply from the main SMC4000 control.

The operational mode of each fin can be selected independent of the other. This allows one fin to be either centered or off while the other fin can be fully active. This is a feature that was not available on the original Brown Brothers control system.

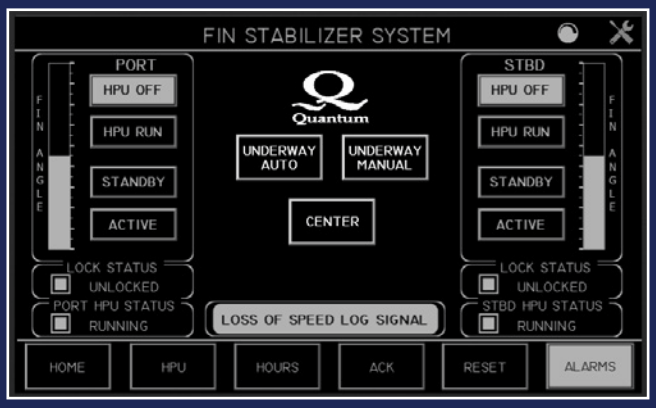
A speed log interface provides the necessary information to the control system to modulate the maximum fin angle settings at higher speeds. Conversely, it automatically centers the system when the vessel speed drops below a preset value. In the event the speed log interface fails, the system will notify the operator that the signal is lost and revert back to the center mode. At this point, only the manual mode will be available for selection, and the operator will have the ability to adjust the gain settings and maximum fin travel as required. This ensures that the operator can still use the system, but prevents the system's auto mode from activating. Essentially it adds safety without removing functionality.

Although the fins themselves are not upgraded, the overall performance of the system is dramatically improved due to the nature of the SMC's three term sensors.

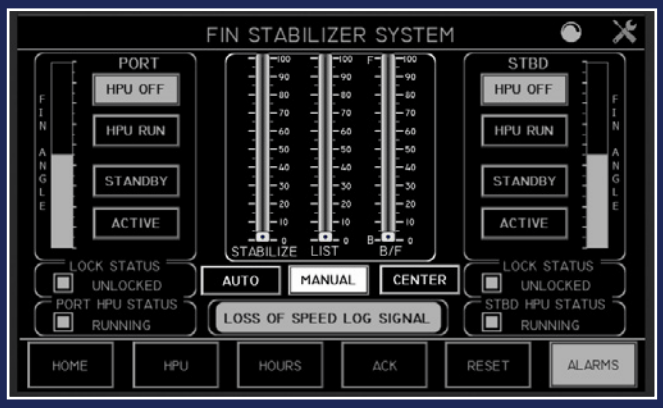
The SMC's three term sensor is able to instantaneously measure roll rate, roll angle and roll acceleration. Unlike the Brown Brothers control, the SMC4000 has both wind heel correction and natural list compensation built in.

The control also has the optional feature of being connected to the internet, allowing Quantum technicians to record data, monitor system performance and make control adjustments remotely. For security reasons, this feature is only initiated, operated and managed by onboard personnel.

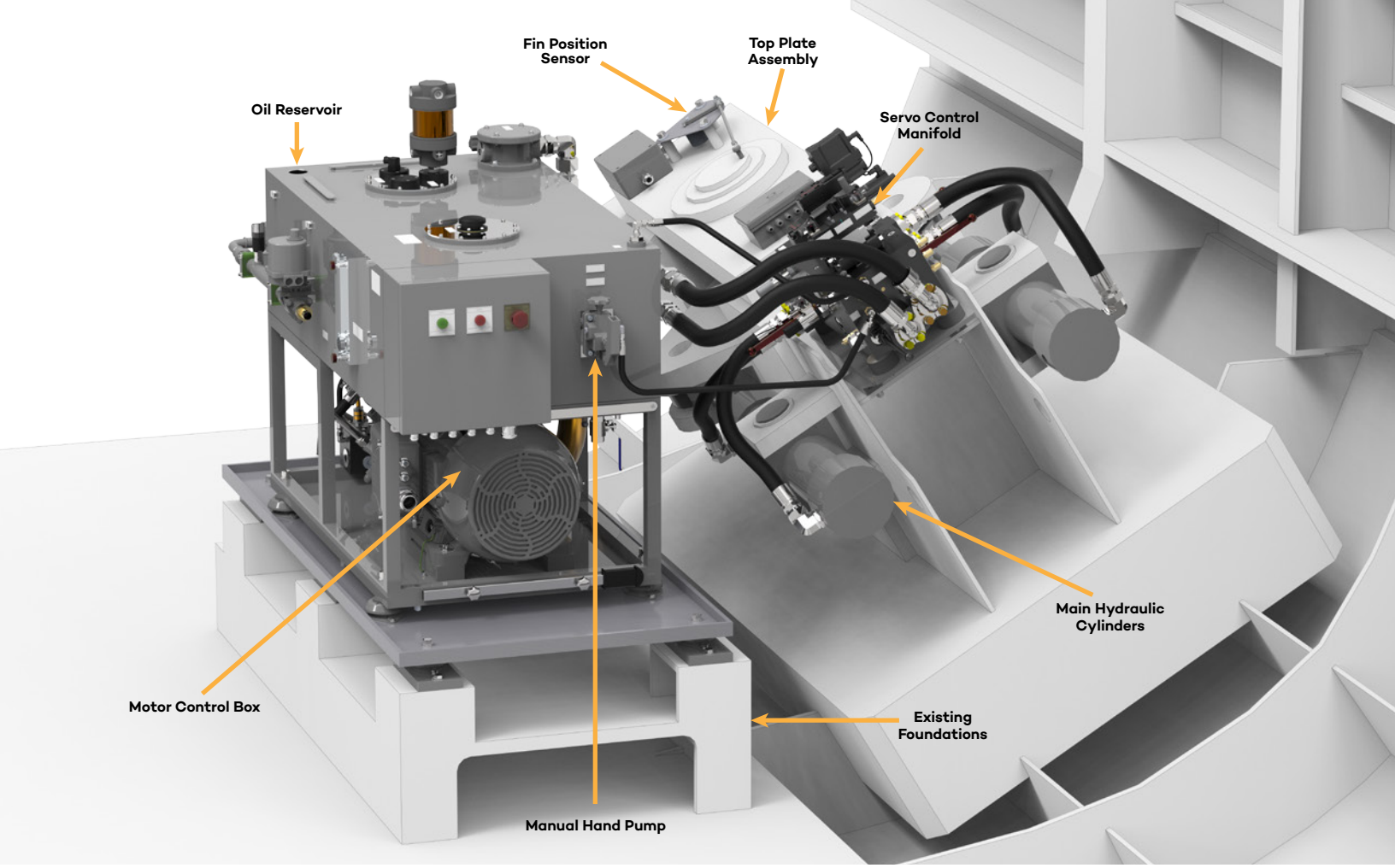
The control will monitor and record alarm data. It also logs the duration that the system runs, how many cycles each hull unit has made and the total amount of degrees each shaft has rotated. This allows the operators to predict, schedule and perform maintenance tasks with greater precision.



The HMI4000 control interface HOME SCREEN allows the operator to select the stabilizer operating mode. This mode provides real-time data on the fin angle and ship speed monitoring, in addition to feedback on the readiness of the stabilizer and the HPU.



The image above shows the MANUAL MODE screen which allows the operator to use the slider controls and customize the settings as needed, while still maintaining visibility of the HOME SCREEN, while making adjustments.



HYDRAULIC POWER UNIT

Each hull unit has a dedicated power unit carrying the designation MPU40C. The MPU40C is a direct replacement for the original power unit having very similar envelope dimensions and connection geography. To further simplify the installation, Quantum supplies a port and starboard specific MPU assembly to accommodate the surrounding equipment. The cooling system is built internal to the hydraulic oil tank and can operate on the same raw water supply as that of the original Brown Brothers unit.

The power unit is self-contained and requires the following:

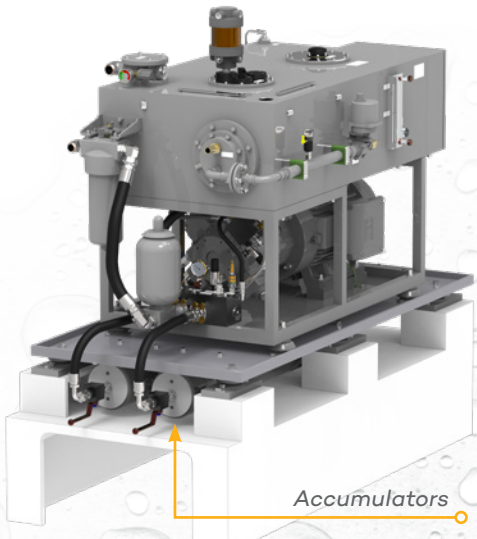
- AC power to the motor
- Control and alarm connection to the SMC4000
- Two hydraulic connections to the top plate (fin unit) assembly
- Cooling water

Main features of the MPU40C are as follows:

- Oil tank integral with heat exchanger
- Variable displacement hydraulic pump
- Return, suction and pressure filtration
- Certified pressure gauges
- Alarm sensors for oil level, temperature, pressure and filter clogging
- Servo control manifold
- Manual hand pump for emergency operation
- Accumulators
- Anti-vibration mounting system
- Manual override valves for trouble shooting and maintenance

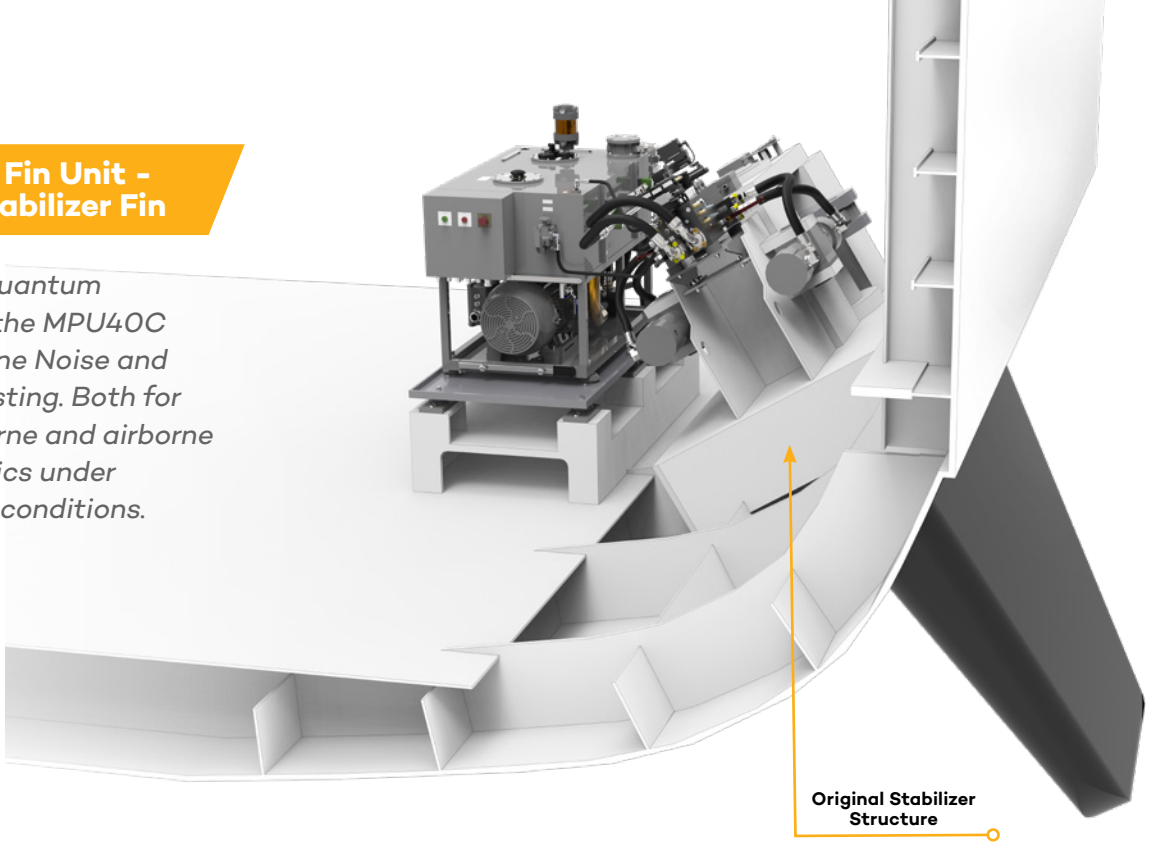
Installation can be either as one piece or if space is limited, the MPU40C can be completely disassembled and reassembled on-site.

Military Power Unit 40C



MPU40C - Fin Unit - Original Stabilizer Fin

As with all Quantum power units the MPU40C has undergone Noise and Vibration Testing. Both for structure borne and airborne characteristics under various load conditions.



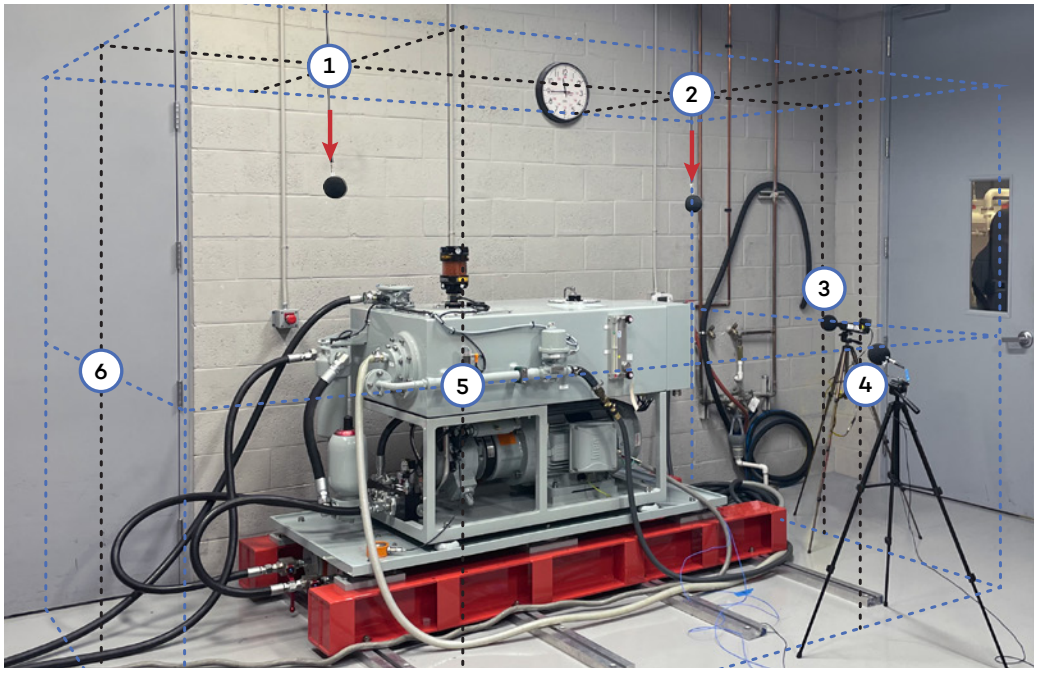
FIN UNIT UPGRADE

The Quantum upgrade makes use of the major components from the existing Brown Brothers Fin Unit. Shaft, fin, bearing assemblies, tiller and mechanical locking mechanism will remain unchanged. The original manifold assembly will be replaced with a distribution manifold allowing for the interconnection between the cylinders and the P-T supply from the power unit. The main cylinders are also replaced with a custom designed Quantum cylinder. Cylinders are ABS approved.

Fin position feedback and limit switches will be replaced with a Quantum custom fin angle sensor assembly. All upgrade components will make use of the existing mounting attachments. No welding will be required. Upgrades to the Fin Unit as noted above can be accomplished without docking the vessel.

All the replacement hardware is either nickel plated, anodized or painted for durability under severe conditions.

Extensive Noise and Vibration Testing



Using microphones, positioned on measurement surfaces, noise and vibration testing is conducted to capture data on airborne and structure borne noise levels.

Quantum

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sales@quantumstabilizers.com • +1 954.587.4205

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