

ON LEVEL

PART ONE: TRAILER BOAT GYROS

In Part One of a two-part series on gyros, we look at the DC options suitable for trailer boats.

Until recently gyro stabilisers have been the domain of cruisers and motor yachts, but thanks to companies like Seakeeper and Quick, they are now available to the larger trailer boat market.

THE EEL



DC GYROS

Gyros come in two modes, AC or DC. While they were in the past strictly something to be installed on a larger cruiser, thanks to companies such as Tohmei, Seakeeper and Quick, there are now DC (Direct Current) gyros compact and light enough to be suitable for larger trailer boats. In this article, we focus on models that are suited to trailer boats, where space and weight can be an issue. In Part Two (PPB Mar-Apr 2020), we look at both DC and AC gyros for the big boat market.

Stabilisation made its way into the marine industry when it was realised that stability at sea and seasickness needed to be minimised to essentially continue to attract new customers. There are two main types of stabiliser systems available, and both have their pros and cons, and all vary on what boats they work best on. There are fin stabilisers and the latest trend gyroscopic (gyro) stabilisers. Mounted anywhere in a boat's hull, gyroscopes will reduce a boat's roll significantly.

There are quite a few brands around the world, with three that have made their mark in New Zealand and Australia; Seakeeper, Quick and Tohmei. Seakeeper is American made, Quick comes from Italy and Tohmei (formerly Mitsubishi Heavy Industries) is Japanese.

A few years ago if you thought about putting a gyro in a large trailer boat you probably quickly went off the idea when you found out you needed a generator to run it and the overall weight and space all the machinery

took up. However, things are different now, and the latest gyros that run off 12V DC battery power rather than a 240V generator are more compact, and light enough to certainly be a consideration when looking for a stabilisation option for you 7-12m trailer boat. However, just because it doesn't need a generator to run, it doesn't mean it is going to be suitable for your trailer boat. Some DC gyros are still too big and too heavy to put in a boat under 10m and come into their own when boats are bigger and weigh more than around 5 tonnes.

Another consideration is the ambient air temperature the gyro needs to operate, so you need to make sure there is enough space around the unit so it doesn't overheat.

HOW DO THEY WORK?

A gyro consists of three fundamental parts.

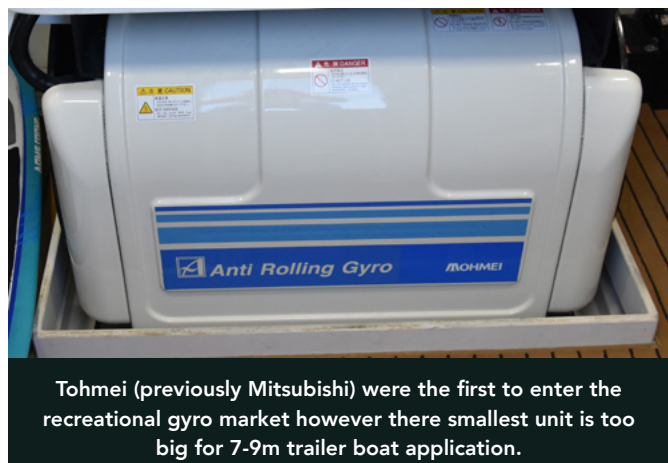
- **The flywheel.** Its size and speed of rotation determine a factor called angular momentum
- **The gimbal.** This allows the flywheel to rotate around an axis perpendicular to the spin axis. The velocity at which the gimbal rotates (precession), in reaction to the boats roll, is a factor called angular velocity
- **Damping system.** This controls the rate at which the gimbal is allowed to precess. Damping systems can be passive or active depending on manufacturer.

large units in 1930. The cost and weight of the systems were prohibitive, and other forms of stabilisation became more readily available.

They started appearing in pleasure yachts around 2000 when Mitsubishi Heavy Industries (now renamed Tohmei) teamed up with Ferretti Group with an exclusive agreement to put their gyros into the company's branded motor yachts. Over time the market started to accept the gyro and other manufacturers like Seakeeper and Quick entered the market. In recent years a focus has been on the development of smaller lighter units that can be used on smaller craft like trailer boats, and after 278 years it seems we have now got gyros for the masses.



A Seakeeper 1 fits in under the helm seat.



Tohmei (previously Mitsubishi) were the first to enter the recreational gyro market however their smallest unit is too big for 7-9m trailer boat application.

A BIT OF HISTORY?

John Serson invented the first known apparatus similar to a gyroscope (the "Whirling Speculum" or "Serson's Speculum") in 1743. It was used as a level, to locate the horizon in foggy or misty conditions. Not something being considered to keep the sailing boats of the day stable. The first experimental gyros were developed in the late 1860s and into the early 1900s, with less than desirable results. Several large ships used the technology, including USS Henderson, a military transport ship, in 1917, which had two 25-ton units, and an Italian cruise liner utilised three

SUITABILITY FOR TRAILER BOATS

DC gyros have certainly opened the market for installing on a trailer boat, but be aware that there are only a few that are suitable. Just because it is DC doesn't mean it is going to be ideal for your 8m alloy hardtop. There are several aspects to consider. Most importantly is weight and the physical size of the unit. Have you the space to fit the gyro and how much will it encroach into your cockpit area? Battery and charging systems will also be a consideration.

Only two manufacturers have suitable units for smaller trailer boats, Seakeeper with the Seakeeper 1 (2620Nm, 165kg) and Quick with their MC X2 (2000Nm, 131kg) and X3 (3900Nm, 131kg) models. Seakeeper pushes angular momentum as the true measure for how effective a gyro is, while Quick and Tohmei promote torque or maximum torque as the main contributor to roll reduction.

Tohmei's smallest gyro, the ARG50T (5000Nm) along with the Seakeeper 2 (5249Nm) and the Quick MC2 X5 cover the transition between the larger trailer boats and small cruisers.

BATTERY SUPPORT

John Dale from Battery Technology NZ says that if you are thinking of fitting a gyro stabiliser to your vessel, you need to consider how it will be powered. The bigger the gyro model required, the higher the power consumption.

"If the unit has an operating power 300 watts - 600 watts, (sea state dependant). As a straight forward calculation if you divide the wattage by the system voltage, this will give you

the amperage requirement and so to relate to battery size", says John. He adds that at $300\text{ w}/12\text{ v} = 25\text{ amps}$ & $600\text{ w}/12\text{ v} = 50\text{ amps}$. So to operate the gyro for one hour, 25 - 50AH will be consumed.

"Immediately, you can see the variation determined by the sea state or work the gyro is doing.

"This brings two dilemmas. Will the power supply delivered by the engine alternator be sufficient and secondly, If the gyro is to be battery supported only, perhaps when the engine is not running, will the battery bank capacity or run time be sufficient?" says John.

When it comes the question of the battery bank John sites the worst scenario of highest consumption of 50amps which will be supplied by a 100AH deep cycle battery (50% depth of discharge) and will last one hour. Or if you average out the consumption and say 37amps giving a run time of the same 100AH battery of 1 hour 20 minutes. To double that run time, a 200AH battery will be needed etc.

"We know if the engine electrical output is high enough, it may power the gyro and charge the battery a little with what is left or will it.

Angular momentum is a force. Try explaining gravity to someone who hasn't experienced it, and you'll understand the inherent difficulty of explaining something you can't see or haven't felt.

Angular momentum, measured in Newton-meter-seconds, or N-m-s, determines the total amount of torque available over time. Time is the biggest differentiating factor between angular momentum and torque, so keep that in mind. Greater angular momentum indicates a higher roll reduction potential for gyroscopic stabilizers. The Seakeeper 18 (18,000 N-m-s of angular momentum) is more powerful than the Seakeeper 1 (1,000 N-m-s). (P.S. this is also how they name their units!) The faster a gyroscope precesses (or if you've watched a Seakeeper in action, that's the sphere tilting fore and aft), the higher its peak torque value. However, a faster precession speed significantly reduces the amount of time the peak torque can be applied. If you've been on a boat that's rolling, you'll know that a wave doesn't happen instantaneously - it rolls - just like your boat on top of it. Those rolls, depending on the boat, usually happen in a timeframe of 2-10 seconds. Those are called wave periods, and the time it takes for your boat to make one full roll over that wave is the vessel's roll period.

Seakeeper say that because of this, the most effective use of a gyroscope's angular momentum is to spread the torque over a period of time that matches the wave period. "When you see "torque" listed for any given gyro stabilizer, it means the maximum torque output, measured in N-m (see, no time). So, what's wrong with that? Well, nothing, but it's misleading as a performance measurement because it doesn't account for the wave period or the natural roll period of the vessel", says Glen Frettingham, Twin Disc, Australia. The natural roll period of a boat varies anywhere from 2.3 seconds for smaller boats and 7 seconds for some mega yachts (don't confuse this with the wave periods discussed above). In order to eliminate boat roll, a gyroscope must be able to provide stabilising torque throughout the entire roll cycle (that requires time again!).



Seakeeper 1 even comes with a viewing window on the watertight plastic shield.

SEAKEEPER - All About Angular Momentum

Seakeeper pushes angular momentum as the true measure for how effective a gyro is. When you think of angular momentum, or gyroscopic power, the easiest way to understand it is to compare it to horsepower for an engine. Seakeeper say that angular momentum is the measuring stick for how much stabilising power any given gyroscope can have, similar to how you know that a 60hp engine is going to provide far less power than a 250HP engine.

SEAKEEPER 1

The new Seakeeper 1 gyroscopic stabiliser is designed for boats from 23-30ft weighing up to 5.5 tonnes. As it

runs off a 12V DC battery power rather than a 240V generator it can be used on everything from outboard-powered boats to compact cruisers.

The heart of the system is a compact new flywheel encased in a sealed vacuum that spins at up to 9,750rpm. The lack of air resistance enables the flywheel to spin roughly three times faster than would otherwise be the case, which in turn means it weighs up to two-thirds less and draws roughly half the power of a conventional flywheel.

Unlike the larger Seakeeper units the Seakeeper 1 is fully encased inside a watertight plastic shell with a clear viewing window. The whole unit weighs 165kg and consumes

between 25-55 amps depending on how hard it is having to work. Its lighter weight also means it has the fastest spool-up time of any Seakeeper with useful stabilisation available in just 15 minutes.

As the boat starts to roll, the flywheel is tilted fore and aft by a hydraulic ram, producing gyroscopic torque to port and starboard that counteracts the roll. This works whether the boat is stationary or under way, although once up to planing speeds, the dynamic stability of the hull starts to override the effect.

Another advantage of the Seakeeper 1 is that the whole system is mounted in a fully enclosed box that measures less than 2ft x 2ft and 16in high with a viewing window to show off its workings. This should make it easier to fit under seats or inside helm consoles and deck lockers than the taller, heavier Seakeeper 2. Nor are there any exposed parts that could snag loose items that may have to share the same locker space. A small keypad display on top of the unit means you can control it directly from here or via a remote unit at the helm.

Seakeeper is compatible with Garmin, Raymarine and Simrad MFD's, so no additional space is needed on a cluttered dash/helm of a trailerboat. Also the Active unit can be engaged and disengaged at touch of a button.



TOHMEI ARG50T – FOR THE EXTRA LARGE TRAILERBOAT

Tohmei's ARG50T is this Japanese companies newest and smallest gyro and while it is designed for boats under 10 tonne, at 234kg and dimensions it is really not suitable for your 7-9m trailer boat. However, if you do have something like a 10m US made centre console offshore fishing boat with triple outboards, then the Tohmei ARG50T may suit. Like the Seakeeper and Quick it also runs off 12V DC batteries and can also be switched to AC power. The ARG requires no external water hook ups, no hi-pressure oil lines, and no exposed moving parts making it safer and more reliable for everyday use.

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The Quick MC2 MX2/MX3 are the lightest and most compact of all gyros.

going airborne off waves. Quick also promote the fact that their gyros can operate in an ambient air temperature up to 55°C, which is a lot higher than some of their competitors. That might not be a problem in New Zealand because of lower temperatures, but it is a big problem in Australia. They also have off the shelf bearings on either side of the spinning mass that share the weight and load of the mass and don't require custom ceramic water-cooled bearings. Australasian distributor for the Quick gyro, Pierluigi Gambacorti (Gineico) points out that one of

major benefits of the Quick DC gyros is their fast spool up and simple switch off and walk away spool down. "This means you don't need to wait for our gyro to spool up to a certain percentage of RPM before you can leave the dock. No need to wait, our Gyro will spool up even if you are underway or the boat is still on the trailer on the boat ramp! Our spool up is also faster so you don't wait as long to start enjoying the full roll reduction", says Gambacorti. He adds that excellent sound proofed removable panels, combined with a slower spin speed, makes the Quick machines less noisy and eliminated harmonics and interference with your other electrical equipment. The new QNN Interface means you can choose to integrate the Gyro monitoring and control system into your Garmin, Raymarine, Furuno, Simrad, B&G screens. This optional kit makes it even easier for you to monitor the performance of the gyro, and push button stand-by mode (available on all Quick MC² Gyro models except for the X2 and X3 mini gyros) means you always have total control of the handling of your vessel at the touch of a button. This is important if you're backing down hard on your next catch in rough conditions. According to Gineico, the Quick MC² Gyros are the smaller, simpler and smarter options for any size boat.

QUICK - A Question of Torque

Quick promote the torque or maximum torque as the main contributor to roll reduction and have a number of unique features. Firstly they are the only gyro with a vertically spinning mass (not horizontal). This generates the same anti-roll torque / output torque as traditional horizontally spinning gyros but in a simpler smaller way. The side bearings "share" the weight of the mass as opposed to the bottom bearing doing all the hard work. This means a comparatively heavier mass that spins at lower RPM can achieve the same anti-roll performance.

Quick claim that the unique vertically spinning mass also means reduced track deviation even in big following or beam seas. This means a straighter track in beam or following seas. Quick say their machines are designed to work in any sea conditions and you can continue to operate their gyros with the vessel underway at any boat speed. This is a real bonus for smaller trailer boats.

They are all air cooled (not water cooled) bearings which means there are no water pumps to operate and maintain, no risk of electrolysis, no anodes to replace, no risk of air getting into the cooling pumps and causing them to stop working. Quick units are self-contained and work even if the vessel is reversing hard or travelling at high speed or even

DC GYROS

Brand	Spool-Up Max rpm	Spool-Up Stabilisation	Power (W)	Angular Momentum	Output Torque	Size (mm)	Weight
SEAKEEPER 1	30 minutes	15 minutes	300-600	1000 NMS	2620 Nm	582 x 598 x 398	165 kg
SEAKEEPER 2	35 minutes	24 minutes	300-650	2000 NMS	5249 Nm	648 x 630 x 508	188 kg
SEAKEEPER 3	50 minutes	36 minutes	400-750	3000 NMS	7854 Nm	680 x 685 x 592	249 kg
TOHMEI ARG50T	30 minutes	N/A	700-1000	1000 NMS	5000 Nm	525 x 536 x 741	234 kg
QUICK MC2 X2	10 minutes	8 minutes	400-600	551 NMS	2000Nm	419 x 419 x 470	131 kg
QUICK MC2 X3	15 minutes	10 minutes	650-990	643 NMS	3900 Nm	419 x 419 x 470	131 kg
QUICK MC2 X5	18 minutes	14 minutes	650-1000	1811 NMS	5560 Nm	480 x 480 x 590	255 kg
QUICK MC2 X7	20 minutes	16 minutes	700-1200	2174 NMS	6678 nm	480 x 480 x 590	290 kg
QUICK MC2 X13	32 minutes	30 minutes	1500-2200	4185 NMS	12850 Nm	610 x 610 x 670	470 kg

QUICK MC² X2 and X3 - SMALLEST & LIGHTEST

In 2019 Italian manufacturer, Quick Italy, announced the launch of five new 12VDC Quick gyro stabilisers, which are a simple, less complicated system. The MC² X2 and X3 models are well suited for trailer boats. The Quick MC² series offer a number of special features, including they are the only gyro with a vertical spinning flywheel, are designed to work in any sea conditions with the vessel underway at any boat speed and are air cooled. The new MC² Quick Gyro X2 and X3 stabilisers are the smallest in the extended family. Just 42cm square, and delivering an anti-rolling torque of up to 3,900 Nm, the X2 is perfect for trailable centre console fishing boats or little day cruisers, while the X3 model suits heavier trailer sportfish boats and small cabin cruisers up to around 8m.

Already known for their compact design, ease of installation and reliability, the new Quick gyro models are the result of many years' research and technical innovation that guarantee simpler operation and reduced maintenance, in a smaller machine.

The MC²X series stabiliser delivers up to 95% roll reduction from a machine that is physically much smaller than any other gyro on the market. Furthermore, these machines are air cooled as opposed to water cooled! This means easier installation because there is no more holes in the bottom of the boat and no cooling pumps and plumbing.

The whole package is much smarter because the patented design of these gyros means fewer expensive parts, less maintenance requirements and therefore less ongoing running costs.

The revolutionary MC² X DC series comprises five brand-new stabilisers; two of them specially designed for small-sized boats and available only in a 12V version while the other three models are suited to progressively bigger boats, and can be supplied in either the new 12VDC version, or the 240V AC version. The batteries on the boat will recharge via the inverter when the engines are running and it is time to go home. As a result, the overall consumption is significantly lower and thanks to sound proofed removable panels, combined with a slower spin speed, the units are exceptionally quiet, eliminated harmonics and interference with your other electrical equipment.

The MC² Quick gyro is equipped with a mass revolving on a horizontal axis, a feature that significantly reduces the mechanical stress, produces less friction and therefore needs lower heat output. The MC² Quick Gyro system is naturally dissipated; therefore, it does not require water pumps or seawater inlets, unlike water-cooled systems. ⚙️

PART 2: In the Mar-Apr issue of Pacific PowerBoat we look at larger DC and AC gyros for the cruiser and motor yacht market.

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