Position reference sensors for offshore wind vessels

www.guidance.eu.com
We continue to innovate, continue to offer best in class, and continue to improve our market leading products to enhance value year on year.”
Offshore Wind Farms

Technology and Applications

*Expert relative positioning sensors from 10m to 10,000m*

Guidance Marine is a leading global developer and supplier of Dynamic Positioning (DP) position measurement technologies for high value offshore marine markets for real-time vessel positioning and manoeuvring with the highest level of safety, reliability and ease of use.

Designed to meet all IMO DP class requirements, our laser and microwave CyScan® and RangeGuard® sensors can be integrated by all major DP manufacturers and are used on a daily basis by most DP1, DP2 and DP3 Service Operation Vessels for wind farm operations. Our products accurately measure relative position to enable the vessel to station keep and manoeuvre safely in close proximity to an installation, immune from DGPS errors caused by shadowing or reflections.

Our global support network underpins all activities and continues to expand into key oil producing regions. With local Guidance Marine service and support centres in Aberdeen, New Orleans, Singapore and representation in Brazil.

The Business of Safety

*Providing customers with smarter local position reference sensors*

Guidance Marine is the only company able to supply five local reference systems offering the greatest choice on the market. Based in the UK, we understand the importance of quick deployment and have sales and service capability in all the major oil producing regions of the world. We understand the importance of having spare parts and experienced personnel where our customers need them. We continue to invest heavily in developing a network of service agents, equipped with a full set of spares to cover all the major offshore areas of the world. Underpinned by our 3 year warranty and global support network; our products are robust, reliable and proven to deliver optimum navigational performance in the harshest offshore environments.

A Guidance Marine designed position reference system is more than just a sensor. A practical, well-engineered piece of sophisticated architecture that can be integrated into all the major DP systems anywhere in the world.
As an internationally successful, award-winning company, Guidance Marine has a strong track record of delivering significant safety and cost benefits by bringing innovative position measurement technologies to high value markets across the world. Whether our customers are looking to equip their vessels with a sensor for positioning and station-keeping, or protect an asset with targets for the safe approach in the 500m zone, Guidance Marine’s sensor technology is suitable for a variety of fixed and mobile operations.

Guidance Marine supplies the best in class position reference sensors to Dynamic Positioning (DP) enabled vessels. We focus on reliability so our customers’ can remain on charter – and fast and dependable target acquisition allowing customers to DP early and offload fast and safely. We remain the only supplier to offer a three year warranty. For crew transfer or other long periods of close proximity DP, Guidance Marine is your dependable partner.

Guidance Marine recognises our customers’ need to maximise vessel uptime, keep fleet costs to a minimum, and have high specification vessels capable of winning the highest value contracts. With a global spares and service network, supported by our own offices and service staff in Aberdeen, New Orleans and Singapore we can mobilise technicians and spares anywhere in the world at very short notice. Our fleet upgrade contracts offer life-of-vessel support that ensures our customers’ costs are minimised. The quality and ease of use of our equipment guarantees the support of captains.

Offshore installations are best protected by Guidance Marine. Only Guidance Marine offer both laser and microwave products that allow the vessel to engage the DP system from 1000m. Our patented sensor technology minimises the risk of false targets and unexpected vessel movement. Our range of reliable and rugged targets provide the lowest cost route to ensuring Offshore Installations are appropriately instrumented to incoming vessels. Guidance Marine is our customers’ trusted partner for crew transfers, safe positioning and tight weather windows. Guidance Marine works hard to add value to your supply fleet.
Our Track Record

Guidance Marine has a rich heritage of innovation since being founded over two decades ago.

Since then, our company name has changed more than once, but we’ve always preserved our core values of innovation, engineering excellence and technological integrity.

Positioning, whatever the technology or application has always been in our DNA. We are a company that prides itself on science based innovation, not imitation. The company has, and continues to play, a pivotal role in stimulating change within the markets it operates in. Our business philosophy and problem solving mind-set harnesses personal initiative, as everyone has a contribution to make.

The Changing Offshore Landscape

Providing customers with smarter local position reference sensors

At Guidance Marine we respond to challenges being faced in the industry today by providing solutions that continuously raise the industry standard. Our product portfolio includes both targeted and non-targeted solutions which improves our customers’ offering across a multitude of operations. Removing the need to install targets during operations eliminates the need to continuously maintain and deploy targets prior to a manoeuvre. Developed on the same positioning science and core safety principles, Environmental Referencing™ technology is the next evolution in local position reference sensing. Our RangeGuard Monopole system does not use dedicated targets – it uses the surrounding environment.

Solving tomorrow’s problems, today

Guidance Marine is pioneering the use of the local environment to provide position reference sensors that reduce the interdependence between Service Operation Vessels and the Wind Farm they support.

In recent years Guidance Marine has been very proud of listening to the end users, and understanding them. We continue to innovate, but – and possibly more importantly – we continue to listen.
Guidance Marine has recognised the need for rapid response and have invested significantly in a Global Support Network of Authorised Service Partners (ASPs).

Guidance Marine service engineers have personally provided all the ASPs with comprehensive technical training in order to fully support Guidance’s range of products.

USA and Singapore service and support centres opened in 2014 to underpin our current network and worldwide customer base.
Product Training

In today’s operational climate, with increasing pressure on product reliability and the cost of ownership, a basic understanding of DP sensor technology is not enough. Training is the cornerstone of strengthening knowledge and technical competence. This is of paramount importance with today’s user expected to become more and more self-sufficient.

Guidance Marine run Operator and Engineer courses focusing on Artemis, CyScan Mk4, RadaScan and RangeGuard. Through a combination of theoretical and practical lessons, experienced field service engineers bring real world experience in a hands-on classroom environment to demonstrate an all-round technical and operational understanding of the true product and their benefits.

3 Year Warranty

At Guidance Marine we take pride in leading the market and our 3 year warranty introduced in April 2014 offers the best peace of mind available. It reflects the confidence we have in our products and the benefit of years of continuous engineering improvement and proven experience with all Dynamic Positioning suppliers in the harshest marine environments.

We have listened to our customers and understand the implication of costs to your business of equipment failures in the field. We also understand the need to have replacement parts and stock in your areas of operation. Our international service and support centres in Aberdeen, New Orleans and Singapore reinforce our commitment to your business.

This initiative reflects our intention to continue to position ourselves as the local position reference sensor supplier of choice and work hard as your partner in Dynamic Positioning.

Online Sales

Guidance Marine Direct (GMD) is the global online sales platform for Guidance Marine. Designed for the convenience of our customers, the website’s primary purpose is to facilitate the sales of peripheral items. In particular the site focuses on targets, prisms, responders and all the vessel approach instrumentation that is the responsibility of the Installation Operators.
Crew Transfer

Guidance Marine’s products are utilised worldwide in dynamic positioning operations. Typical service operations vessel (SOV) and monopole instrumentation is illustrated here.

1. CyScan
   See page 17

2. AS Prism
   See page 20

3. RangeGuard
   See page 16
Offshore Construction

Guidance Marine’s products are utilised worldwide in dynamic positioning operations. Typical construction vessel operation is illustrated here.

1. CyScan
   See page 17

2. ASPRISM
   See page 20

3. RangeGuard
   See page 16

Illustrations by Station Jack
Targetless Monopole Positioning with the RangeGuard system

Reducing our customers' turnaround time with the RangeGuard Monopole system

- Provides the DP with range and bearing
- Accelerates DP settling time by allowing arbitration between DGPS and the CyScan system
- Provides microwave position reference sensing with independent redundancy with no need for any powered targets
The first targetless DP sensor optimised for positioning and station keeping at a wind turbine

Standard navigation and positioning techniques used in offshore oil and gas are not optimised for navigating inside a wind farm. Unlike an offshore supply vessel servicing an oil platform which may have 1 or 2 approaches per day, wind service vessels may visit as many as 50 wind turbines in a single day. This requires fast and efficient turnaround times without compromising safety.

A new type of radar sensor has been developed which does not use a dedicated target – rather it uses the local environment as its target; typically the leg or tower of a wind turbine. This removes the need for physical targets to be installed which makes the vessel completely independent and can increase both safety and decrease turnaround times.

RangeGuard Monopole System

**Measures range to the nearest object**
- Sends out a radar signal and detects the radar reflections from the environment
- An accurate range and bearing measurement is displayed on the Dashboard user interface

**All weather radar technology**
- Fixed beam radar sensors operating in the license exempt short range device band of 24GHz

A Complementary Position Reference Sensor

**CyScan System**

Unlike DGPS which provides a global position, the CyScan system provides a local position relative to a fixed target. The fixed targets for the CyScan PRS are reflective tape or prisms. The distance is calculated by measuring the time of flight of the reflected light. Vessel position is determined by both targeted and a non-targeted approach with both the CyScan and RangeGuard Monopole systems measuring range and bearing.
The RangeGuard Monopole system uses direct radar reflections from the transition piece rather than specific targets mounted on a structure.

The first targetless DP sensor optimised for positioning and station keeping at a wind turbine

A Targetless Future

Guidance Marine are the first company to offer a local DP Position Reference Sensor (PRS) solution that removes the requirement for targets altogether. The system consists of a minimum of 2 RangeGuard sensors connected to a control unit which in turn is connected to the bridge and the DP system of the vessel. The small light weight radar sensors are mounted onto the side of the vessel pointing in the direction of the transition piece and simple geometry determines the range and relative position of the vessel.

Bernhard Schulte have installed a full DP enabled system on their SOV Windea La Cour. Sensors were installed on the vessel at the yard on the starboard side of the vessel - the same side as the motion compensated gangway.
Simple Installation

User Interface

Targetless positioning for wind farms has begun

Sea trials have proven an environmentally referenced sensor system can be used for local position DP referencing. Being completely independent of mounted targets, and based on radar technology, it provides an additional input to the DP system. The RangeGuard Monopole system introduces a new method of data acquisition, thus is not having many common failure modes with DGPS or laser system. The common problems that occur with mounted targets are negated and maintenance of targets is no longer required.

Easy to set up
Dedicated Service Interface tool, maintaining the easy to use Dashboard interface for day to day operations.
The RangeGuard Monopole system consists of a minimum of two RangeGuard microwave marine range finding sensors mounted on the side of the vessel, pointing in the direction of the transition piece at the bottom of the wind tower. Simple geometry determines the range and relative position of the vessel to the transition piece which acts as the target which the system will report the range and bearing.

Applications:
The RangeGuard sensor is suitable for vessels that approach wind turbines such as:

- Service operation vessels
- Crew transfer vessels
- Walk-to-work vessels

Service & Warranty
Supported by Guidance Marine’s international network of service centres, the RangeGuard sensor is supplied by Guidance Marine with a 3 year warranty – the longest warranty from any supplier.

Delivering the future in dynamic positioning with consistently accurate products.
The CyScan sensor is a high performance local position reference sensor specifically engineered for marine Dynamic Positioning (DP) applications. The sensor accurately measures the range and bearing to retro-reflective targets allowing for the calculation of vessel position and heading making it ideal for station keeping, or for accurately moving a vessel.

### Applications

The CyScan sensor is suitable for applications which use fixed structures such as:
- Platform, offshore and multipurpose supply vessel operations
- Wind farm servicing
- Accommodation barge operation
- Crew boats station-keeping
- Heavy lift activities
- Dive and ROV support
- Fish farms

The CyScan sensor is also suitable for DP applications with mobile structures such as:
- Track and ship-follow
- Shuttle tanker loading
- Pipe and cable laying
- Rock dumping
- Replenishment at sea

- Automatic wave compensation
- Close range operation from 10m
- Full 360° scanning
- Operating range up to 2,500m
- ChartRange™ distance option
- Uniquely holds 4 type approvals: ABS, DNV GL, Lloyds Register and Russian Maritime Register of Shipping

Delivering the future in dynamic positioning with consistently accurate products.
The CyScan System

The CyScan system has three main components:

1. CyScan Targets
   One or more targets are mounted on the wind turbine

2. CyScan Sensor
   The Sensor is installed on a vessel equipped with a DP system

3. CyScan Dashboard
   Software is used by the DP operator to control the CyScan Sensor. It runs on a marine processor installed on the vessel’s bridge

Unique Features

- High Laser Pulse rate 30Khz
- Multi-target operation gives relative heading
- Selectable tilt at 1° increments, including auto-adjusting option
- Robust construction for highest reliability
- Ease of use for quick set-up and operation
- Automatic dynamic pitch/roll wave motion compensation provides optimum target lock
- Sophisticated tracking algorithms reject false reflections
- Optimised optics protect against low sun and bright lights
- Interfaces to all known DP systems
- Tracking is not stopped when manually tilting

ChartRange™

The CyScan sensor has the option to provide a direct horizontal distance (ChartRange™) to the reflectors.

For certain precision positioning operations it is advantageous to have an indication of the horizontal distance to the target.

The CyScan sensor can calculate this and provide a ChartRange™ output rather than the DirectRange™ output that is typically used for DP station keeping operations.

CyScan Dashboard

The CyScan Dashboard is an innovative touch screen interface that enables DP operators to use the CyScan sensor safely whilst providing optimum positioning performance.

The CyScan Dashboard is a state of the art solution to the control of the CyScan Mk4 sensor.

The same user interface philosophy is used on all of our systems, helping to make sure that Guidance Marine trained operators will already be familiar with controls.
Absolute Signature

Improved target acquisition for safer operations

It is well known that a laser sensor cannot always distinguish between different reflector targets. The AS Prism with its tinted lens has a unique signature that the CyScan AS sensor can exclusively identify as the AS Prism target.

How does Absolute Signature work?

**Standard Systems - Standard CyScan Sensor and Standard or AS Prism**

- Laser is reflected from the standard or AS Prism and detected by the sensor.
- AS Prisms perform exactly like standard prisms when used with standard laser sensors.

**CyScan AS Sensor and Standard Prism or Tape Target**

- A standard prism or reflector reflects both lasers.
- The CyScan AS sensor knows that this is not an AS Prism because 2 reflectors are detected.

**CyScan AS Sensor and AS Prism**

- The AS Prism blocks one of the wavelengths of the light from the CyScan AS.
- The CyScan AS sensor identifies the AS Prism by the absence of the second reflection.
- The reflection has a unique signature.

CyScan AS Sensor can exclusively identify the AS Prism target

The likelihood of walk off incidences due to false reflections are reduced to zero

The new AS Prism has a unique “Absolute Signature”

The AS Dashboard user interface automatically identifies the AS Prism targets

Reduces the workload for the DPO in identifying and selecting the targets
The Absolute Signature (AS) Prism is designed to endure the harsh environment of offshore weather conditions. The bright coloured exterior allows vessels to easily identify the visual target from a distance. Combined with the latest innovative technology, the AS Prism delivers a level of confidence previously unachievable in laser position reference sensor positioning.

The next generation in laser reference technology; delivering new levels of confidence

AS Prisms are suitable for applications which use fixed structures such as:
- Wind turbines
- Oil platforms

AS Prisms are also suitable for applications with mobile structures such as:
- Track and ship-follow
- Shuttle tanker loading
- Pipe and cable laying
- Rock dumping
- Replenishment at sea

AS technology benefits*:
- Guaranteed ‘lock’ between the sensor and target
- Improves visibility with automatic target identification and acquisition
- Reduces turnaround time – increases operational efficiency
- Eliminates the possibility of false reflection walk-off incidents
- Simple and reliable operator experience

*when used in conjunction with CyScan AS, to be launched in 2017

Delivering the future in dynamic positioning with consistently accurate products.
Key Prism Features

Prisms reflect almost all of the light received and provide the maximum signal strength allowing for longer operation in deteriorating visibility. They are typically mounted in clusters to provide a greater angle of visibility and/or to increase the signal response in locations prone to low visibility.

Reflective Prisms are becoming a standard choice for laser targets for offshore fixed assets as they are smaller, and are more robust than a tape target. UV degradation and salt build up will reduce the reflectivity of tape targets over time and consideration should be given to mandatory use of AS Prisms for instrumentation.

- Compatible with all laser sensors
- High visibility, easy to identify
- Robust housing design suitable for handovers
- Easy ‘drop on’ rail mounting
- Suitable for long-term wall or handrail mounting
- Increased range and durability over tape targets

Additional Installation Options

Rail Unistrut Install (Unistrut parts not supplied)  
Rail Unistrut Install (Unistrut parts not supplied)

Railing Post Option

The new easy drop on design allows the prism to hold its position on a rail without the need of u-bolts for temporary use.

Drop Down Rail Installation

Drop down bracket suits varying rail diameters

Side slots for 2.5 inch U-bolts or existing straps to fit varying rail diameters

Fitting against posts keep the target vertical

- Handles on both ends
- Bottom handle enables the unit to stand
- Security lanyard included in the purchase of a Rugged Prism
## RangeGuard Specification

### Details

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transceiver Type</strong></td>
<td>Frequency Modulated Continuous Wave (FMCW)</td>
</tr>
<tr>
<td><strong>Frequency Band</strong></td>
<td>24.05GHz – 24.25GHz (Licence Exempt Short Range Device)</td>
</tr>
<tr>
<td><strong>Maximum Power Output</strong></td>
<td>&lt;100mW EIRP</td>
</tr>
<tr>
<td><strong>Maximum Operating Range</strong></td>
<td>300m</td>
</tr>
<tr>
<td><strong>Minimum Operating Range</strong></td>
<td>1m</td>
</tr>
<tr>
<td><strong>Range Accuracy</strong></td>
<td>±2cm + 0.1% of Range</td>
</tr>
<tr>
<td><strong>Azimuth Beam width</strong></td>
<td>110° (flood) or 11° (spot) 10dB Width</td>
</tr>
<tr>
<td><strong>Target Detection</strong></td>
<td>Automatic or by manual selection</td>
</tr>
<tr>
<td><strong>Vertical Beam Height</strong></td>
<td>+/- 5.5°</td>
</tr>
</tbody>
</table>

### Vessel Interface

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensor Power</strong></td>
<td>85 to 264VAC 45-65Hz 5A, Max 114W</td>
</tr>
<tr>
<td><strong>Sensor Control</strong></td>
<td>Sensor Control capable of displaying 4 sensors simultaneously</td>
</tr>
<tr>
<td><strong>Sensor Control Protocol</strong></td>
<td>Ethernet from controlling computer or remotely via web browser</td>
</tr>
</tbody>
</table>

### Environmental

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating Temperature Range</strong></td>
<td>-25°C to +55°C</td>
</tr>
<tr>
<td><strong>Atmospheric Conditions</strong></td>
<td>Operates in fog, heavy rain, snow and ice conditions</td>
</tr>
<tr>
<td><strong>Standards Compliance</strong></td>
<td>EN 60945</td>
</tr>
<tr>
<td><strong>Ingress Protection Rating</strong></td>
<td>IP67</td>
</tr>
<tr>
<td><strong>RF Immunity</strong></td>
<td>Resistant to S and X band Radar when installed as recommended</td>
</tr>
</tbody>
</table>

### Sensor and Control Unit Weight and Dimensions

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Height</strong></td>
<td>28.5 cm</td>
</tr>
<tr>
<td><strong>Width</strong></td>
<td>17.0 cm</td>
</tr>
<tr>
<td><strong>Depth</strong></td>
<td>12.0 cm</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>4 kg</td>
</tr>
<tr>
<td><strong>Max Cable run per sensor</strong></td>
<td>Up to 100m (CAT5e SCTP cable, Min AWG 24)</td>
</tr>
<tr>
<td><strong>Control Unit</strong></td>
<td>400 x 250 x 10mm</td>
</tr>
</tbody>
</table>
## CyScan Specification

### Sensor Details

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Type</td>
<td>Pulsed (30kHz) laser diode</td>
</tr>
<tr>
<td>Laser Classification</td>
<td>Eye safe Class 1</td>
</tr>
<tr>
<td>Operating Range (nominal)</td>
<td>10m to 2500m (target type/environment dependent)</td>
</tr>
<tr>
<td>Range Resolution</td>
<td>8.5mm (&lt;30ps time of flight)</td>
</tr>
<tr>
<td>Angular Resolution</td>
<td>(typical) 0.012° (0.2mrad)</td>
</tr>
<tr>
<td>Levelling Optics</td>
<td>Single active axis</td>
</tr>
<tr>
<td>Beam Shape (nominal)</td>
<td>12° vertical, 0.13° horizontal</td>
</tr>
<tr>
<td>Tilt Compensation</td>
<td>-20° to +20° roll and pitch</td>
</tr>
<tr>
<td>Total Vertical Angular Coverage</td>
<td>52° (mechanical + optical)</td>
</tr>
<tr>
<td>Wave Motion Compensation</td>
<td>(typical) ±5 for 5s wave period</td>
</tr>
<tr>
<td>Chart Range Precision*</td>
<td>&lt; ±100mm *Available to special order.</td>
</tr>
</tbody>
</table>

### Target Details

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Type Typical Range</td>
<td>1.9m cylindrical 10m to 400m 2m flat 10m to 500m</td>
</tr>
<tr>
<td>Extended Operating Range</td>
<td></td>
</tr>
</tbody>
</table>

### Vessel Interface

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Requirement</td>
<td>85-264VAC, 45-65Hz, max 100W, 1.5A</td>
</tr>
<tr>
<td>Sensor Control and DP Feed I/O</td>
<td>2 x RS422 + 2 x Ethernet 100Base-T Auto MDIX</td>
</tr>
<tr>
<td>Supported DP Systems</td>
<td>Includes Beier Radio, GE Energy, (Converteam), Kongsberg, Marine Technologies, Navis, Praxis, Rolls Royce and Wärtsilä (L-3)</td>
</tr>
<tr>
<td>Supported DP System Configurations</td>
<td>Serial Console (single) with Serial DP (single) Ethernet Console (master &amp; slaves) with Serial DP (single, dual)</td>
</tr>
<tr>
<td>Supported DP Telegram Formats</td>
<td>NMEA0183R, NMEA0183P, ASCII17, MDL standard (single &amp; multi target), BCD, Artemis, Marine Technologies and Rolls Royce custom strings</td>
</tr>
</tbody>
</table>

### Environmental

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature Range</td>
<td>-25°C to +55°C (-40°C XT option available)</td>
</tr>
<tr>
<td>Standards Compliance</td>
<td>CE Certified, EN 60945, FCC Approved, IMO Resolution A962 (23) ‘GREEN PASSPORT’</td>
</tr>
<tr>
<td>Marine Type Approval</td>
<td>ABS, DNV GL, Lloyds Register, Russian Maritime Register of Shipping</td>
</tr>
<tr>
<td>Ingress Protection Rating</td>
<td>IP66</td>
</tr>
</tbody>
</table>

### Sensor Weight & Dimensions

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width</td>
<td>405mm</td>
</tr>
<tr>
<td>Depth</td>
<td>407mm</td>
</tr>
<tr>
<td>Height</td>
<td>456mm</td>
</tr>
<tr>
<td>Weight</td>
<td>25kg</td>
</tr>
</tbody>
</table>

### Flight Case Weight & Dimensions

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Dimensions</td>
<td>660 x 570 x 780mm</td>
</tr>
<tr>
<td>System Weight</td>
<td>61kg (with typical accessories such as computer, monitor and mouse)</td>
</tr>
</tbody>
</table>

### Standards Compliance

- CE Certified
- EN 60945
- FCC Approved
- IMO Resolution A962 (23) ‘GREEN PASSPORT’
- ABS, DNV GL, Lloyds Register, Russian Maritime Register of Shipping
- IP66

### Ingress Protection Rating

- IP66

### Marine Type Approval

- ABS
- DNV GL
- Lloyds Register
- Russian Maritime Register of Shipping

### Operating Temperature Range

- -25°C to +55°C (-40°C XT option available)

### Wave Motion Compensation

- (typical) ±5 for 5s wave period

### Chart Range Precision*

- < ±100mm *Available to special order.
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