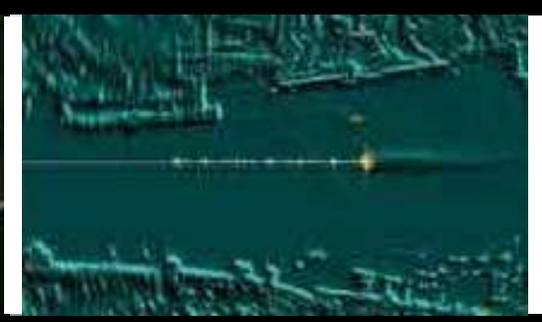
KELVIN HUGHES

RADAR REINVENTED



MANTADIGITAL™ Radar Systems

2010/2011

www.kelvinhughes.com

Introduction

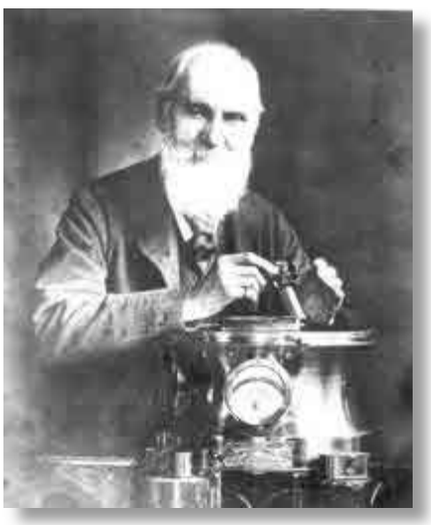
Kelvin Hughes - 250 years of history.....

A Rich Tradition

Kelvin Hughes can trace its history of instrument making back for more than two hundred and fifty years when it supplied mariners with chronometers and sextants to help them navigate the new world trade routes. Indeed, sales include a cabin clock to Captain Cook and a chronometer to Captain Bligh of HMS Bounty.

Kelvin Hughes was formed out of two companies, Kelvin Bottomley & Baird and Hughes & Sons that had existed side by side for many years. Kelvin, Bottomly and Baird was originally based in Scotland and had been a manufacturer and supplier of technical equipment designed by the great Lord Kelvin of Largs, famous for designing the Kelvin temperature scale. The Hughes family were originally clock makers in the East End of London who progressed into supplying sextants and chronometers to ships sailing into the Thames. The two companies joined together in the late 1940s to form Kelvin and Hughes eventually becoming Kelvin Hughes Limited in the early 1950s.

Kelvin Hughes products are installed in a wide range of commercial vessels, luxury yachts and cruise liners, including the new Queen Mary 2. They are also in service with over 30 navies around the world, including every United Kingdom Royal Navy warship.



Lord Kelvin of Largs (1902)

The First Type Approved Radar (1948)

Radar Reinvented

Since obtaining Type Approval for the first commercial marine Radar back in 1948, Kelvin Hughes has been in the forefront of Radar development for the marine market. Slotted waveguide arrays, solid-state modulators and low profile antenna systems have been pioneered by Kelvin Hughes during 65 years of product development for the radar market.

SharpEye™, the first commercial Radar without a magnetron, is the latest in this history of innovation and represents a milestone in the reliability and performance available to the Radar user. With Doppler and frequency diversity (hitherto impossible with magnetron based systems) SharpEye™ is a cost effective solution giving lower through-life costs and unrivalled performance.

Kelvin Hughes - Simply Making the Best Radars

KELVIN HUGHES
RADAR REINVENTED

Kelvin Hughes - A History of Innovation

Kelvin Hughes is a world leader in the design and supply of marine navigation and surveillance systems. It has a highly innovative product range, which is designed to provide the most advanced navigation solutions and services available. Products include Radar sensors and display technology, voyage data recorders, electronic chart displays and highly advanced integrated bridge systems. In addition, through ChartCo, it provides a unique means of data supply to ships at sea via satellite , email or internet. Kelvin Hughes is also the world's largest supplier of nautical charts and publications for commercial and leisure use.

Kelvin Hughes has its headquarters in East London, and subsidiary offices in other parts of the UK, Denmark, The Netherlands, Norway, Singapore, USA and China. With this global presence, Kelvin Hughes provides a first-class sales and support capability for customers world-wide.

MANTADIGITAL™

Wide-Screen Radar System

MantaDigital™ Philosophy

Designed for ease of operation MantaDigital™ is the latest product from Kelvin Hughes' Manta development programme. Intuitive operation and a clear display of relevant information provides the operator with a decision making tool which enhances safety and efficiency.

This new generation multi-function Radar system exceeds the 2008 IMO performance requirements and is the ideal partner to the solid-state SharpEye™ Radar transceiver.

Multi-Function by Design

From the outset MantaDigital™ has been designed for true multi-functionality, providing a platform for Radar, Chart Radar, ECDIS and Conning Display options. MantaDigital™ is driven by Kelvin Hughes' "common-core" processor system which is now in use throughout the Radar, ECDIS and VDR product ranges providing enhanced functionality, reliability and low cost of ownership.

The Range

MantaDigital™ is available in a variety of mounting arrangements to meet the needs of different vessel types and operational scenarios. It can be supplied in options ranging from a single 20" desktop retrofit system through to a fully interswitched bridge system with up to six Radar sensors and displays.

Display options include 20" and 26" high-definition screens for pedestal, desktop and mounting into consoles. The transmitter options include 10kW and 25kW X-Band and 30kW S-band magnetron systems and both S and X-band SharpEye™ solid-state solutions which can include high-performance Doppler processing.

All models in the range include an ARPA tracker as standard and optional modules such as chart overlay and Enhanced Target Detection (ETD).

The IMO Rules

Carriage Requirements (SOLAS V)

1. All ships of 300 gross tonnage and upwards and passenger ships irrespective of size shall be fitted with: a 9 GHz. (X-Band) Radar.
2. All ships of 500 gross tonnage and upwards shall have an automatic tracking aid.
3. All ships of 3000 gross tonnage and upwards shall have: a 3 GHz [S-band] radar or where considered appropriate by the Administration a second 9 GHz [X-band] radar, functionally independent of those referred to in paragraph 1.

Display Requirements	Cat 1	Cat 2	Cat 3
Mantadigital™ Model	**20" System**		**26" System**
Size of ship	Under 500 gt	500 to 10 000 gt, HSC<10 000 gt	Over10 000 gt
Minimum operational display area diameter	180 mm	250mm	320mm
Minimum display area	195x195mm	270x270mm	340 x 340 mm
Auto acquisition of targets	No	No	Yes
Minimum acquired radar target capacity	20	30	40
Minimum activated AIS target capacity	20	30	40
Minimum sleeping AIS target capacity	100	150	200
Trial manoeuvre	No	No	Yes

MANTADIGITAL™ Standard Features

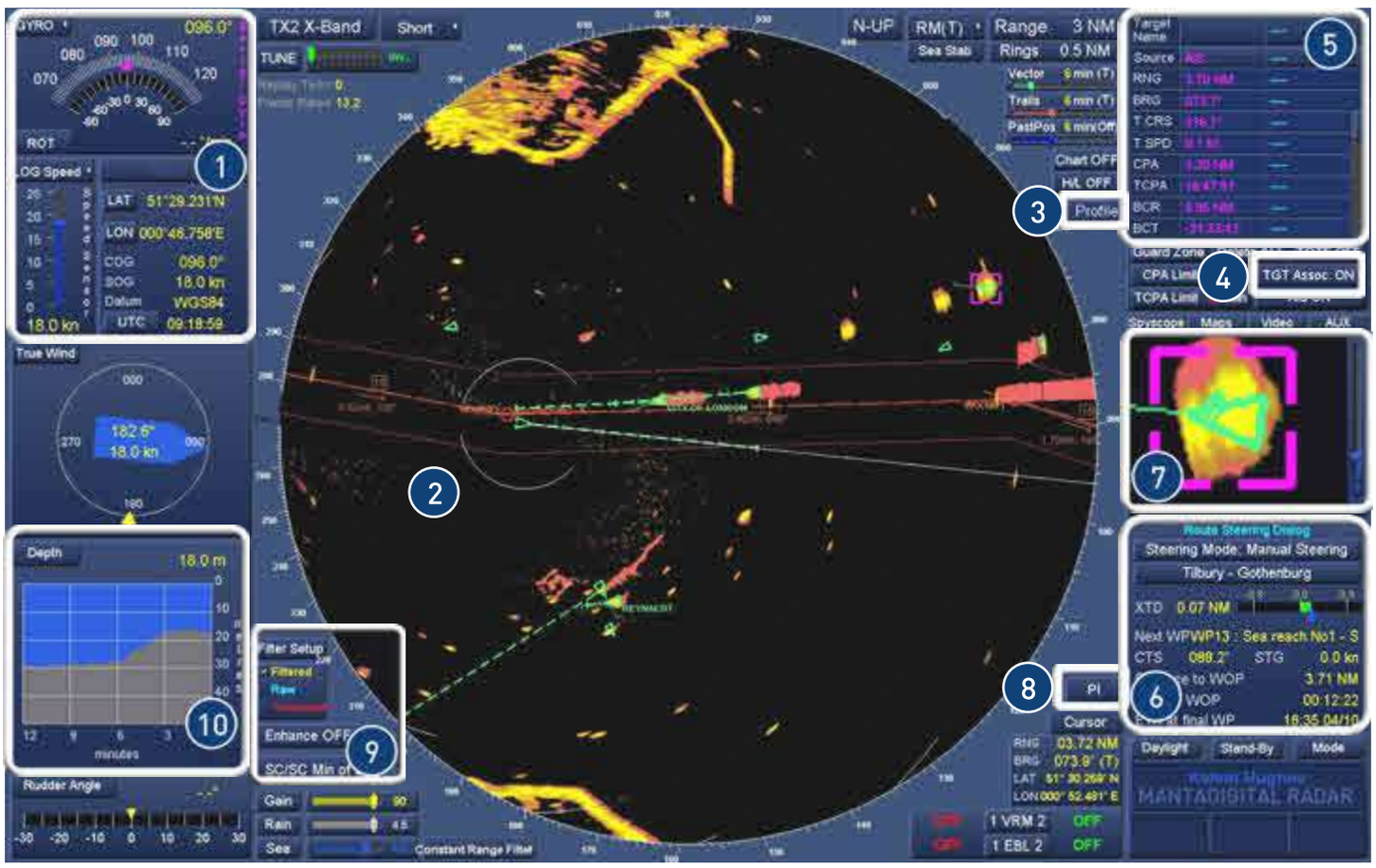
1 Ship Data
Real time display of ship manoeuvering data

2 Routes
Route centreline and track limits displayed with waypoints

3 Personal Profile
Users can define setting profiles

4 Contact Fusion
Parameter controlled fusion of AIS and ARPA contacts

5 Tote Table
Display of ARPA and AIS information of up to 6 targets



10 Depth Display
Graphical display of echo sounder data

9 Dynamic Clutter
Sophisticated clutter filter modes for target detection

8 Parallel Index
Parallel index lines provided for blind pilotage

7 Spyscope
Enlarged display of area around cursor

6 Steering Info
Distance to next waypoint together with track error

Kelvin Hughes - Simply Making the Best Radars

"This is the best Radar I have ever used, I can tell the difference between the waves and the buoys even in bad weather.

Navigation is usually very difficult in the west Scheldt in bad weather, but this Radar is amazing. It is so simple to use because of the colours," says Captain den Herder. "It is very easy to learn how to operate it and everyone who has seen it has been very impressed. I am surprised how easy it is to operate this 'high tech' Radar." *(Captain Pieter den Herder of Swalinge Scheepvaart)*

MANTADIGITAL™ Optional Features

MANTADIGITAL ETD

ETD (Enhanced Target Detection) significantly enhances the display of all targets without interfering with the normal Radar appearance or operation. It treats stationary and moving returns differently, highlighting the moving ones by displaying them in a different colour.

ETD combined with the dual PPI mode enables the operator to continue using the Radar in the normal way with the addition of a simultaneous advanced detection view available on the secondary PPI without cluttering the main display.

This mode can significantly enhace normal operation but is also of great benefit in ice navigation and oil slick detection .

As with all optional features, ETD mode can be enabled by the user after receiving a permit key from Kelvin Hughes, these options are also available for a free trial period.

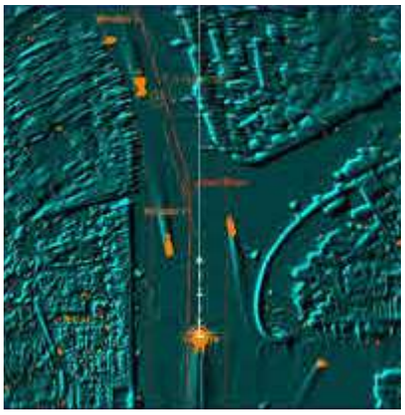


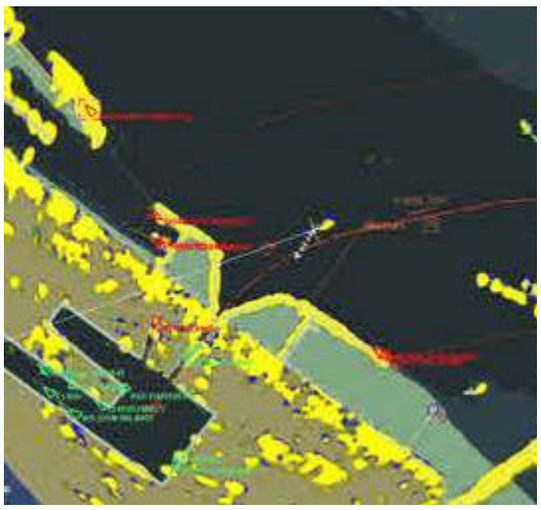
Chart Radar

Mantadigital™ can provide fully Type Approved Chart Radar functionality. Comprehensive chart management facilities are provided together with route planning.

The Chart Radar displays vector format ENC charts from vendors including the UK Hydrographic Office, Primar and C-Map, interlayed with the radar information. A comprehensive set of controls allows the user to adjust the density of data display layers to prevent screen clutter. Extensive tools are provided for route construction together with chart management tools which simplify the orgainsation and management of chart data and permits

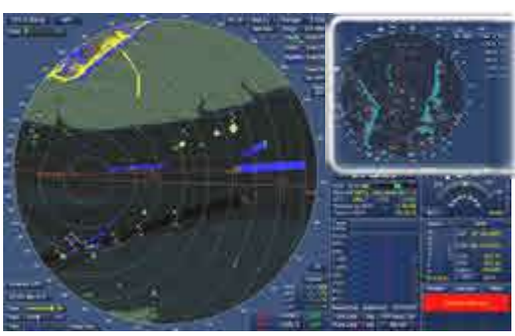
Route Planning

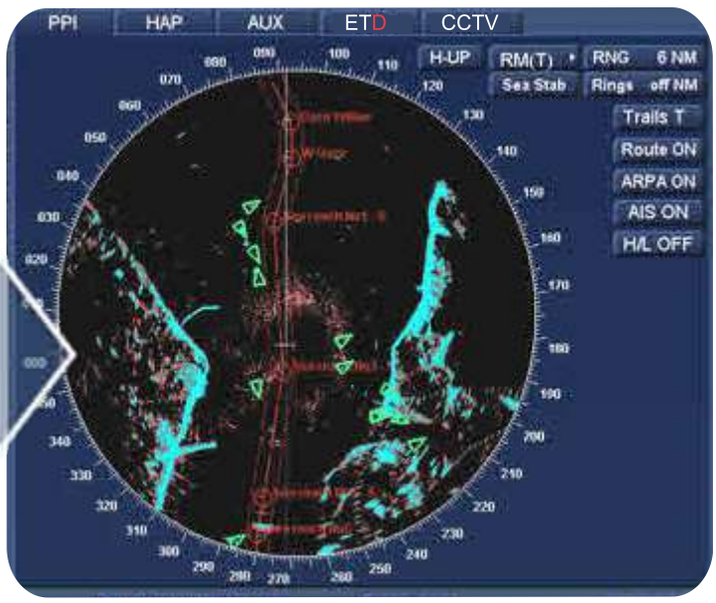
Chart Maintenance



Dual PPI

This secondary configurable display of Radar information is independent of the main radar PPI and can be used to provide simultaneous long and short range sitaution monitoring. The colour palette and amount of display data is controllable by the user. The window can also be used for vessel monitoring graphics and CCTV.





Transceivers

Transceiver Types

The Mantadigital™ range includes both magnetron and solid-state Radar transceivers. In both cases the latest low-profile anntennas are used to reduce wind loading and increase in-service life. Upmast and downmast options are available in both X and S-Band for the magnetron transceivers. In all cases high reliability and performance have been the design criteria. In all systems a transmission monitor is provided as standard.

Low-Profile Technology

Using the latest technology all Kelvin Hughes antennas use the polyrod lens principle. For both conventional and SharpEye™ systems this results in an antenna with reduced vertical dimension which is significantly lighter that a conventional unit. This has the effect of reducing motor and gearbox loading and results in an increase in service life.

Transceiver Characteristics

	X-Band Systems				S-Band Systems		
Transceiver	**10kW Upmast**	**25kW Upmast**	**25kW Downmast**	**SharpEye™**	**30kW Upmast**	**30kW Downmast**	**SharpEye™**
Peak Power	10kW	25kW	25kW	170W	30kW	30kW	170W
Frequency	9410 +/-30MHz	9410 +/-30MHz	9410 +/-30MHz	9220 -A3 9480MHz	3050MHz +/-10MHz	3050MHz +/-10MHz	2900-3100MHz
Pulse Length/PRF (Short)	55ns/3000Hz	70ns/3000Hz	70ns/3000Hz	N/A	55ns/3000Hz	70ns/3000Hz	N/A
Pulse Length/PRF (Med)	230ns/1500Hz	250ns/1500Hz	260ns/1500Hz	N/A	250ns/750Hz	260ns/750Hz	N/A
Pulse Length/PRF (Long)	600ns/750Hz	900ns/750Hz	900ns/750Hz	N/A	950ns/750Hz	900ns/750Hz	N/A
Receiver Noise Figure	<6dB	<6dB	<6dB	N/A	<6dB	<6dB	N/A
Receiver IF Frequency	60MHz	60MHz	60MHz	N/A	60MHz	60MHz	N/A
Receiver Bandwidth	6MHz / 22MHz	6MHz / 22MHz	6MHz / 22MHz	20MHz	6MHz/22MHz	6MHz/22MHz	20MHz
Minimum Range	<40m	<40m	<40m	<40m	<40m	<40m	<40m
Range Resolution	<2m	<2m	<2m	<15m	<2m	<2m	<15m
Compass Safe Dist.	3.0m /1.8m	3.0m / 1.8m	3.0m/1.8m & 1.4m/0.8m	3.0m / 1.8m	3.0m/1.8m	3.0m/1.8m & 1.4m/0.8m	3.0m / 1.8m

Antenna Characteristics

	X-Band Systems			S-Band Systems
Antenna Length	**1.3m**	**1.9m**	**2.5m**	**3.7m**
Beamwidth (H)	1.8°	1.25°	0.95°	1.9°
Beamwidth (V)	25°			26°
Antenna Gain	28dB	30dB	31dB	28dB
Polarisation	Horizontal	Horizontal	Horizontal	Horizontal
Sidelobes (+/- 10°)	< -26dB	< -26dB	< -26dB	< -30dB
Sidelobes (→10°)	< -34dB	< -34dB	< -34dB	< -35dB
Rotation Rate	24, 45 rpm option available			24, 45 rpm option available

10kW Upmast X-Band

25kW Upmast X-Band and 30kW Upmast S -Band Transceivers

KELVIN HUGHES
RADAR REINVENTED

SharpEye™ Solid-State Transceivers

SharpEye™ Transceivers

In addition to the range of S and X-Band magnetron based transceivers MantaDigital™ includes the option of transceivers using the latest solid-state SharpEye™ technology.

How Does SharpEye™ Work ?

SharpEye™ is a radical departure from convention due to its low power solid-state architecture. Traditional navigation Radars use short high power (typically 25-30 kW) pulses of microwave energy to detect objects on the sea surface, SharpEye™ transceivers have a nominal peak output power into the antenna of just 200 W, operating with duty ratios of up to 13%. This high duty ratio, made possible by the advanced transmitter design and pulse compression techniques in the receiver, results in an equivalent transmitted peak power of 200 kW when combined with a pulse compression ratio of 1,000:1.

The transceiver continuously outputs a sequence of pulses to meet the requirements of short, medium and long range detection. The sequence comprises a 0.1µs of gated CW (short pulse), and two pulses (medium and long pulse) containing a non-linear frequency modulated chirp with a swept bandwidth of approximately 20 MHz. This patented combination of pulse length and coding results in each transmission being unique in both length and coding, thereby enabling pulse compression. Received signals are processed and compared with a dynamic threshold to detect the presence or absence of targets. A digital pulse compressor, subject to UK export license approval, restores the medium and long pulse chirps to an equivalent range resolution of 15 metres.

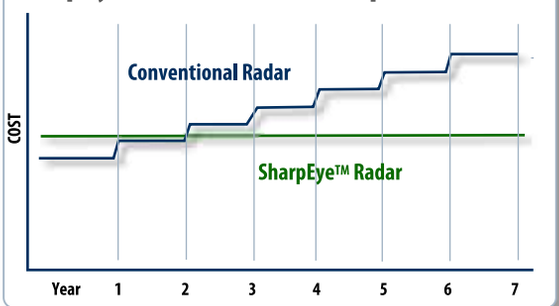
Five Year Warranty

Such is the reliability of the SharpEye™ transceiver that we are able to provide a free four year warranty in addition to the standard one year warranty provided on Kelvin Hughes' products.

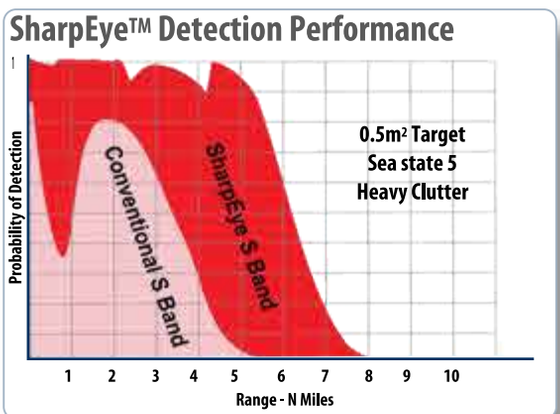
SharpEye™ Benefits

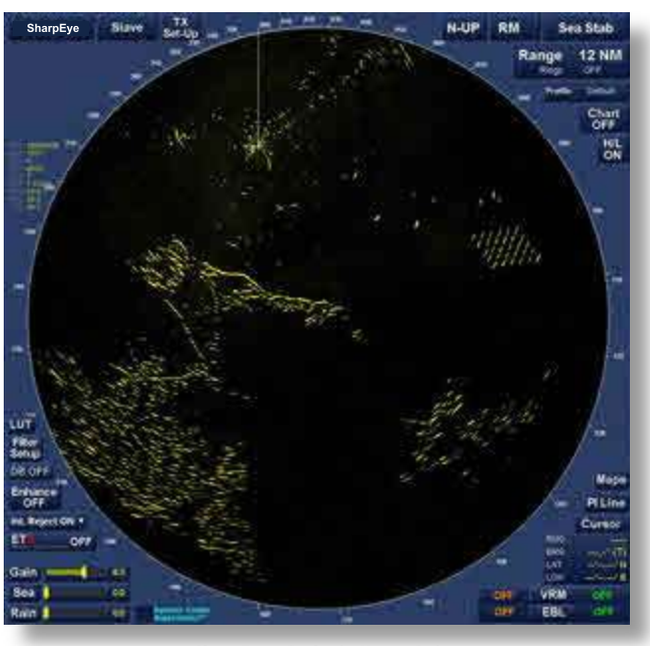
- Improved Reliability
- No Magnetron Replacement
- Lower Ownership Costs
- 4 Year Additional Warranty
- Superior Detection Performance

SharpEye™ Cost of Ownership

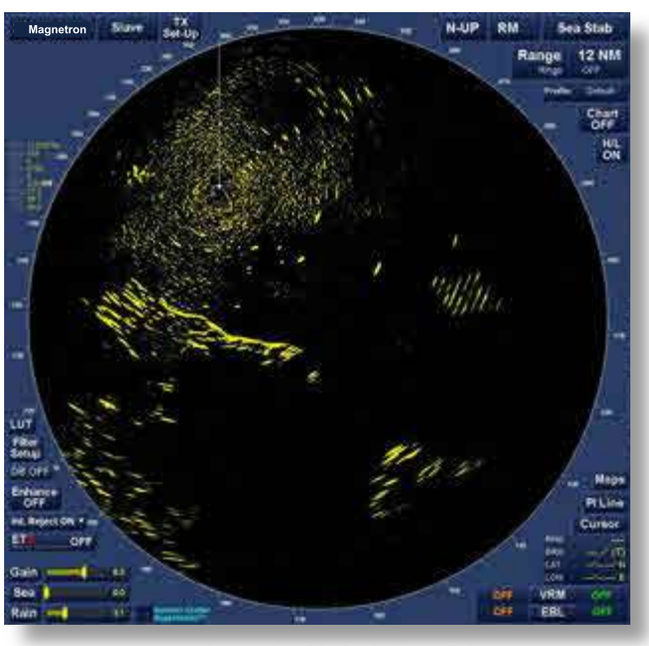


SharpEye™ Detection Performance





SharpEye™ Radar in Heavy Rain



Conventional Radar in Heavy Rain

MANTADIGITAL™ Specifications

Screen			
Display Type	Flat Panel TFT	**Screen Sizes**	26" (660mm) and 20" (510mm) diagonal active size.
Pixel Resolution	1920 x 1200	**Aspect Ratio**	16:10
Range Scales	1/8 (0.125nm) to 96nm	**Display Variants**	Pedestal, Desktop, Console and Bridge-Wing (Internal)

ARPA Tracking System			
Tracker Capability	100 Contacts	**Inclusion & Exclusion Zones**	Polyzone system to prevent tracking of land contacts
Acquisition zone	Automatic acquisition zone	**Guard Rings**	One fixed, one variable
Target Data Tote Table	Displays Data for up to 6 targets simultaneously	**Anchor Watch**	Uses fixed targets to monitor the vessels drift whilst at anchor

On-Screen Graphics			
Tracker Ball Cursor	Dynamic cursor with continuous display of range/bearing and Lat/Long	**Electronic Bearing Line**	2 provided, centred on ownship or any screen location
Variable Range Marker	2 provided, centred on ownship or any screen location	**Spyscope**	Shows an enlarged view centred on the cursor
Planned Track/Waypoints	Waypoints may be entered manually, downloaded from a GPS or obtained from an ECDIS via a network connection	**AIS Data Display**	Comprehensive data displayed for up to 6 AIS contacts
Navigation Graphics	Wheel over points, Curved Heading Line, Predicted Vessel Graphic, Parallel Index Lines	**User mapping**	Facilities provided for entry of lines and curves for user mapping.

Other Features			
Clutter Suppression	Automatic or manual with multiple integration settings	**Simulator**	Built-In fully-functional simulator with recorded radar playback for training.
Personal Setup Memory	Stores navigators' setup preferences shared through the network and stored on USB memory.	**Type Approvals**	MED Approved as both Radar and Chart Radar and country-specific approvals

Options			
Dual PPI	Allows the user to display a look-ahead whilst maintaining a short-range manoeuvering display. Settings are independant of the main radar PPI window.		
Chart Radar	Displays Official S57/S63 (AVCS) ENC and C-Map CM93 Vector Charts. Provides route planning / navigation and chart management.		
Enhanced Target Display (ETD)	ETD (Enhanced Target Detection) significantly enhances the display of all targets without interfering with the normal radar appearance or operation.		
Interswitching	Up to 6 displays and 6 transceivers		
Remote Trackerball	Desktop or built-in options available	**Remote Keyboard**	Desktop or built-in options available
MCI Panel	Dedicated control panel with controls for Sea, Rain, Gain, range-change etc desktop or built-in options available	**Chair-mounted "Ergopod"**	Left and right-handed control option for chair attachment

Interfaces			
Serial	Log, Gyro, GPS, AIS,Autopilot	**Analogue**	Gyro, Log, VDR
Digital	CAT5 Ethernet and CanBus		

KELVIN HUGHES
RADAR REINVENTED

Interswitched X & S-Band System

Interswitched Dual Transceiver / Display System







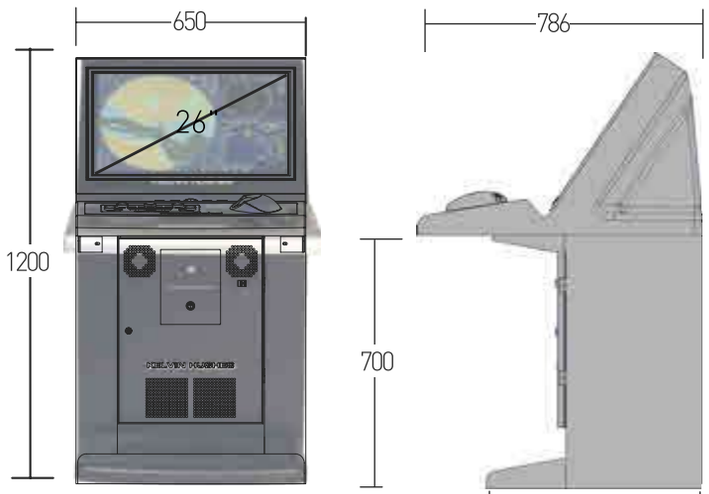




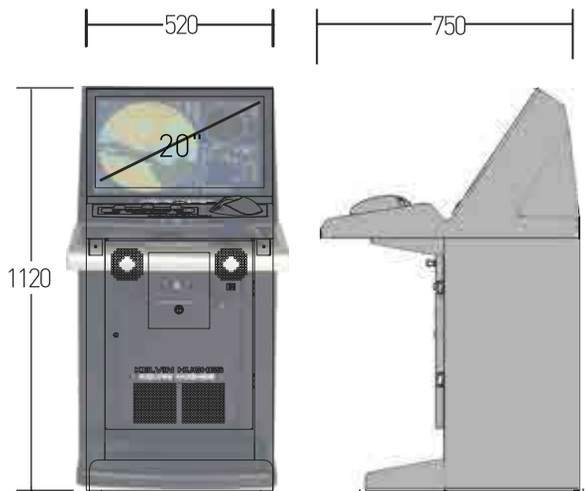

Dimensions and Weights

Displays/Processors

Pedestal Mount Displays (Processor Built-in)

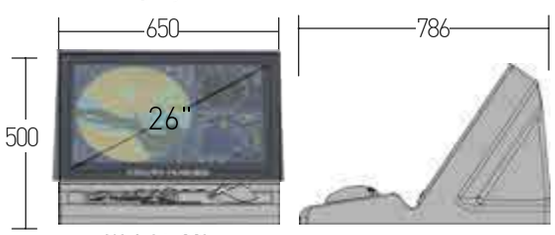


Weight: 99kg

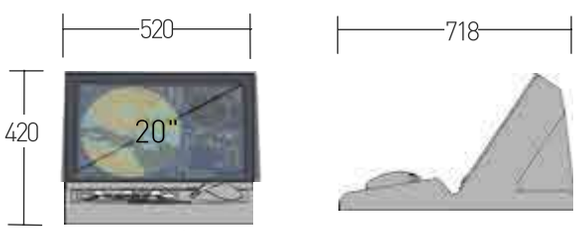


Weight: 78kg

Desk Mount Displays (External Processor)

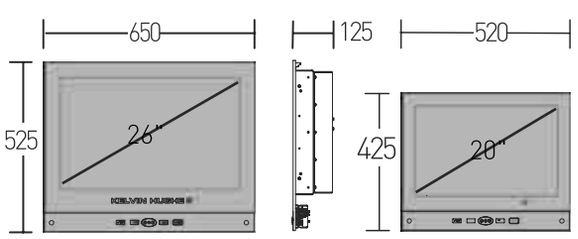


Weight: 38kg



Weight: 32kg

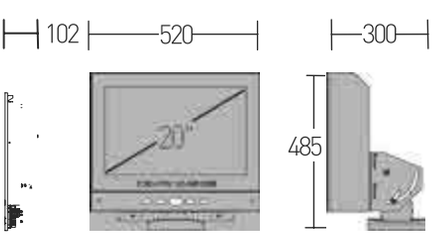
Console Mount Displays (External Processor & Trackerball)



Weight: 28kg

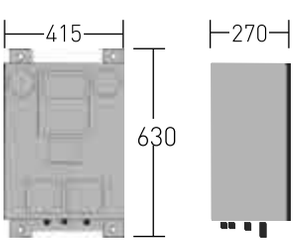
Weight: 20kg

Bridge Wing Display (Internal)



Weight: 32kg

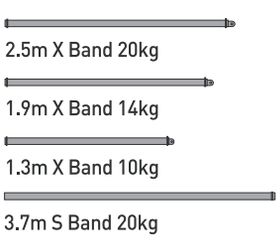
Processor Unit (desktop/console)



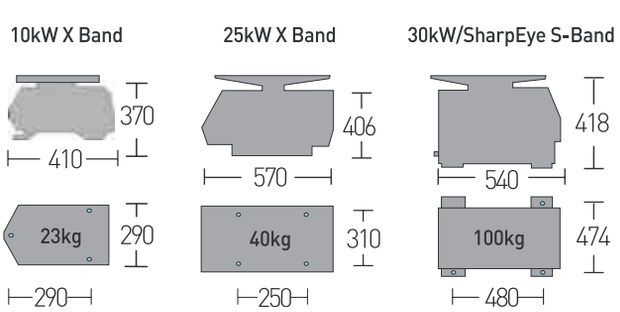
Weight: 25kg

Antennas/Transceivers/Ancillaries

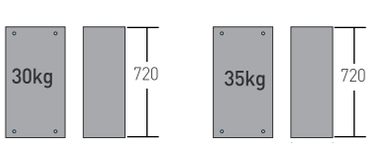
Antennas



Upmast Transceivers/Turning Mechanisms



Downmast Transceivers

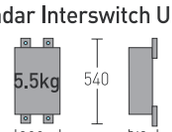


Mk VII X Band
25kW

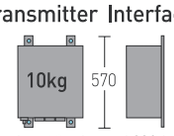
Mk VII S Band
30kW

Ancillary Items

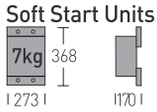
Radar Interswitch Unit



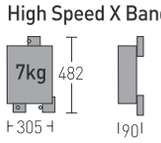
Transmitter Interface Unit



Soft Start Units



High Speed X Band



KELVIN HUGHES
RADAR REINVENTED

Kelvin Hughes WORLD SERVICE

Installation and After Sales Service

We recognise that delivering a first-time-fix and value for money are fundamental expectations of our customers.

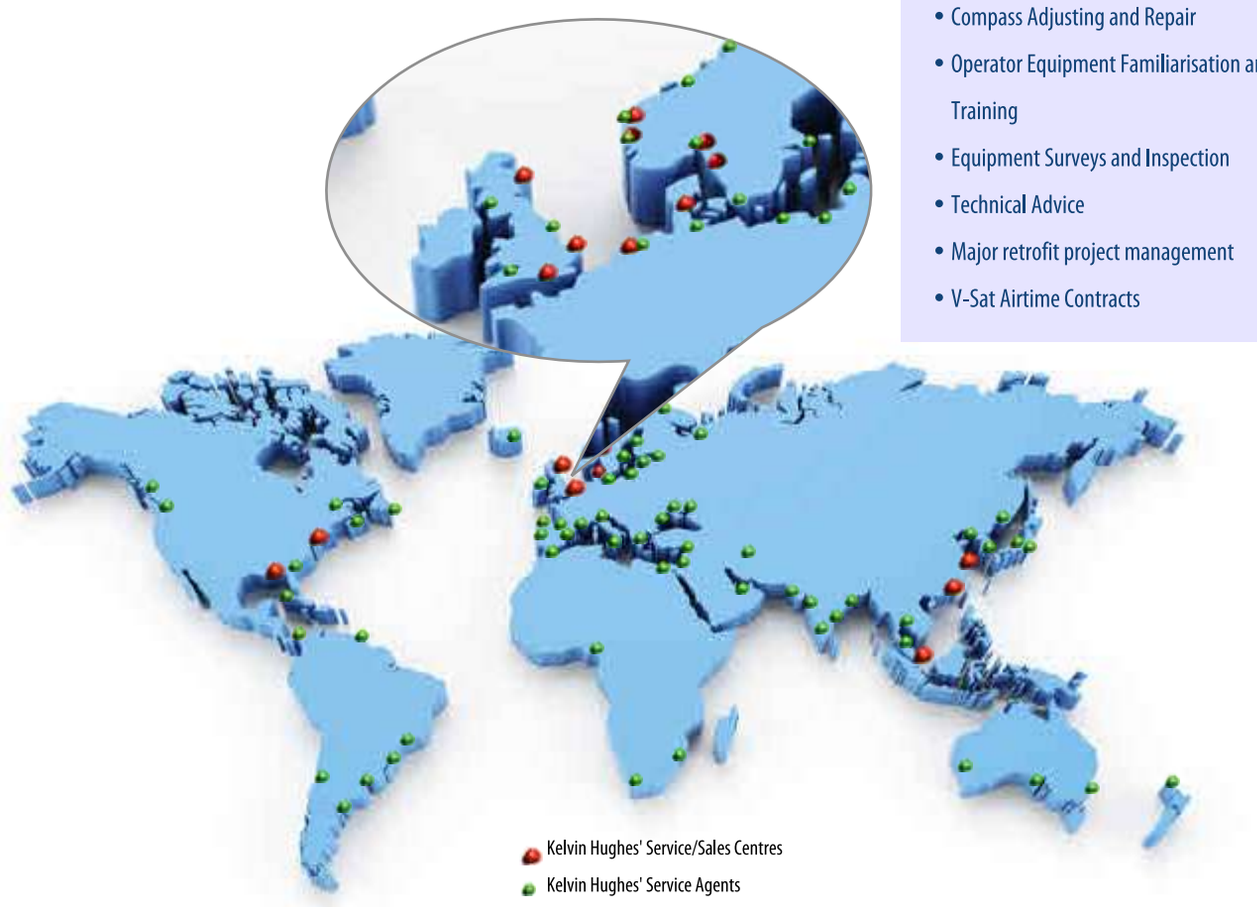
Key to meeting these expectations is a philosophy of working in partnership with our customers and suppliers centred around a global team of experienced service engineers and support staff who are all passionate about delivering service excellence to the marine industry.

In applying this approach a shared set of values has emerged that defines the way that we aim to work with our customers, our service suppliers and within our own organisation, these being to:

- Ensure that the customer is central to everything that we do.
- Apply mutual trust, fairness and honesty in all of our business dealings.
- Strive to exceed customer expectations, on time and right first time.
- Provide value for money, good quality and maintain vessel safety.
- Continue to improve the service offerings through process improvements and innovation.
- Adapt quickly to changing customer needs.

What We offer

- Spare Parts Sales
- Global Service
- Warranty Support
- Installation and Commissioning Services
- Management / Maintenance Contracts
- VDR Annual Performance Testing
- VDR Replay Services
- Compass Adjusting and Repair
- Operator Equipment Familiarisation and Training
- Equipment Surveys and Inspection
- Technical Advice
- Major retrofit project management
- V-Sat Airtime Contracts



These values and capabilities drive the entire customer experience and are at the heart of what we do 24 hours every day, 365 days a year.

For further information about any of our services please call us on **+44 20 8498 1761**,
email us at **world-service@kelvinhughes.co.uk**
or visit **www.kelvinhughes.com/world-service**

Kelvin Hughes - Providing value, quality and safety through a world-wide team

KELVIN HUGHES

RADAR REINVENTED

MANTADIGITAL™ Radar Systems

UK (Head Office): Kelvin Hughes Limited
New North Road, Hainault,
Ilford, Essex IG6 2UR
T: +44 20 8502 6887 F: +44 20 8500 0837
ChartCo:
T: +44 20 8276 0003 F: +44 20 8276 0004

Southampton: Kelvin Hughes Ltd,
Kilgraston House, Southampton Street
Southampton SO15 2ED
T: +44 23 8063 4911 F: +44 23 8033 0014

Scandinavia: A/S Kelvin Hughes
Copenhagen: T: +45 35 55 8116 F: +45 8611 2726
Århus: T: +45 86 11 2888 F: +45 86 11 2260
Norway: T: +47 6490 9988 F: +47 6490 9989

Benelux: Kelvin Hughes (Nederland) B.V
Rotterdam: T: +31 10 416 76 22 F: +31 10 416 72 18

China: Kelvin Hughes Shanghai Representative Office
Shanghai: T: +86 21 58780313 F: +86 21 58785944

Far East: Kelvin Hughes (Singapore) Pte Ltd
Singapore: T: +65 6545 9880 F: +65 6545 8892
Hong Kong: T: +85 2832 2077 F: +85 2832 2055

USA: Kelvin Hughes LLC
Washington: T: +1 703 548 4007 F: +1 703 548 4141
New Orleans: T: +1 504 731 2999 F: +1 866 648 9763

Sales Hotline +44 20 8498 1765

radar@kelvinhughes.co.uk

ISO 9001 BUREAU VERITAS Certification

2010/2011

www.kelvinhughes.com

COMMERCIAL KH8100 Iss1