



NEW THREATS DEMAND NEW SOLUTIONS

NAVAL RADAR SYSTEMS

SITUATIONAL INTELLIGENCE, THE WORLD OVER


**KELVIN
HUGHES**
surveillance

Introduction

Kelvin Hughes - in service with 30 navies world-wide.....

For two centuries Kelvin Hughes has been a key supplier to the UK Royal Navy and since the introduction of radar into naval service has been the premier supplier of navigation radars to the RN. First with the Type 975 Radar in the 1950s and 60s, the Type 1006 Radar in the 1970s and 80s and the Type 1007 Radar, currently in service since 1988, and now the innovative spirit of Kelvin Hughes continues and has found its most recent expression in SharpEye™, the first solid-state pulse doppler navigation and situational awareness radar.

The potential danger posed by a new genre of 'asymmetric' threats demands improved tactical surface surveillance out to the radar horizon. Fast inshore attack craft (FIAC), small light aircraft, periscopes and similar are small targets that have traditionally been difficult to detect and track in heavy clutter. In an era where the battle space begins as a ship leaves the dockside, this represents a critical shortfall in situational awareness. The latest Kelvin Hughes product range with its widescreen display technology and solid-state radar is designed to fill this shortfall.

Naval Product Range:

- SharpEye™ Solid-State Radar Systems
- Naval Displays
- ECDIS
- Magnetron Radar Systems
- Naval Integrated Bridges
- Submarine Radar Systems

Kelvin Hughes is a world leader in the design and supply of marine navigation and surveillance systems. It has a highly innovative product range, designed to provide mariners with the most advanced solutions available and is in service with 30 of the world's navies. Kelvin Hughes is also the world's largest supplier of nautical charts and publications for commercial and leisure use and in addition, through ChartCo, it provides a unique means of data supply to ships at sea via satellite, email or the



'NASAR' and SharpEye™

New Threats Demand New Solutions

The 'NASAR' Requirement

Recent years have seen navies pay increasing attention to navigation and tactical short range surveillance, responding to the twin drivers of a stricter regulatory framework for safe navigation and collision avoidance, and the emergence of an increasingly challenging set of surface threats. Taken together, these requirements have substantially 'raised the bar' for Navigation and Situational Awareness Radar (NASAR) performance.

SharpEye™ is a family of radars in both I Band (9 GHz) and F band (3 GHz) incorporating the very latest in solid-state and signal processing technologies. This radar offers performance benefits previously only available in expensive military surveillance systems.



How Does SharpEye™ Work ?

SharpEye™ is a radical departure from convention due to its low power RF 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.

What also differentiates SharpEye™ from magnetron radars is its use of Doppler processing to determine the radial component of the relative radar target velocity. Echoes received from a train of pulses are processed in a bank of coherently integrated narrowband filters and resolved into specific velocity bands. Using this filtering technique, SharpEye™ is able to separate targets from clutter through the differing radial velocity components. This additional dimension provides a significant advantage over existing radar systems in the detection of small targets in sea clutter or rain.

The transceiver outputs a frame of transmission pulses in a defined sequence to satisfy the requirements of short, medium and long range detection. The frame 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 clever combination of pulse length and coding results in each transmission within a frame being unique in both length and coding, thereby enabling pulse compression. Received signals are processed and compared with a variable threshold (CFAR) 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, equivalent to a 0.1µs transmit pulse.

Doppler is used to initiate target with target range, size and velocity all determined within the transceiver.

The receiver outputs both analogue and digital radar data to an associated display unit or combat system

SharpEye™ E/F and I Band Transceivers

Solid-State Radar Solutions

The SharpEye™ I and E/F Band transceivers are new generation navigation and short-range tactical surveillance radars exceeding the enhanced performance requirements mandated by the IMO under IEC 62388.

The I Band SharpEye™ will replace the existing Type 1007 and similar I Band navigation radars which are in service in both surface warships and logistics vessels. It provides the level of performance that is required for a future NASAR sensor, whilst at the same time delivering a system that is economically sustainable throughout its life.

Compared with a conventional I Band navigation radar system, SharpEye™ delivers an improvement in sub-clutter visibility typically in the region of 30 dB, enabling targets with small radar cross sections (typically 0.5m²) to be detected even in the presence of heavy sea and rain clutter. This makes it an ideal choice for the early detection of small 'asymmetric' targets such as FIACs and enhances situational awareness and vessel security.



I Band SharpEye Transceiver with 2.5m Antenna

What do these numbers mean ?

Range (NM) for an 80% Probability of Detection			
Vessel Type	Sea State/Rain mm/Hr	Conventional 25 kW X band	SharpEye™
Rib	3/0	3.3	5.9
	5/4	0	4.3
Helicopter	3/0	18.2	18.5
	5/4	0	15.5
Frigate	3/0	13.9	16.3
	5/4	13.7	16

- A conventional 25 kW XBand magnetron radar will not detect a typical RIB sized vessel until it gets within 3.3 nautical miles (NM) in calm seas and will not detect it at all in sea state 5 and above !
- SharpEye™ will detect the same target at 5.9 NM in calm seas and at 3.3 NM in a sea state 5.
- Helicopters will not be reliably detected on a conventional X Band magnetron radar in sea states higher than 5, SharpEye™ will detect these at 15.5 NM in the same sea state.

SharpEye™

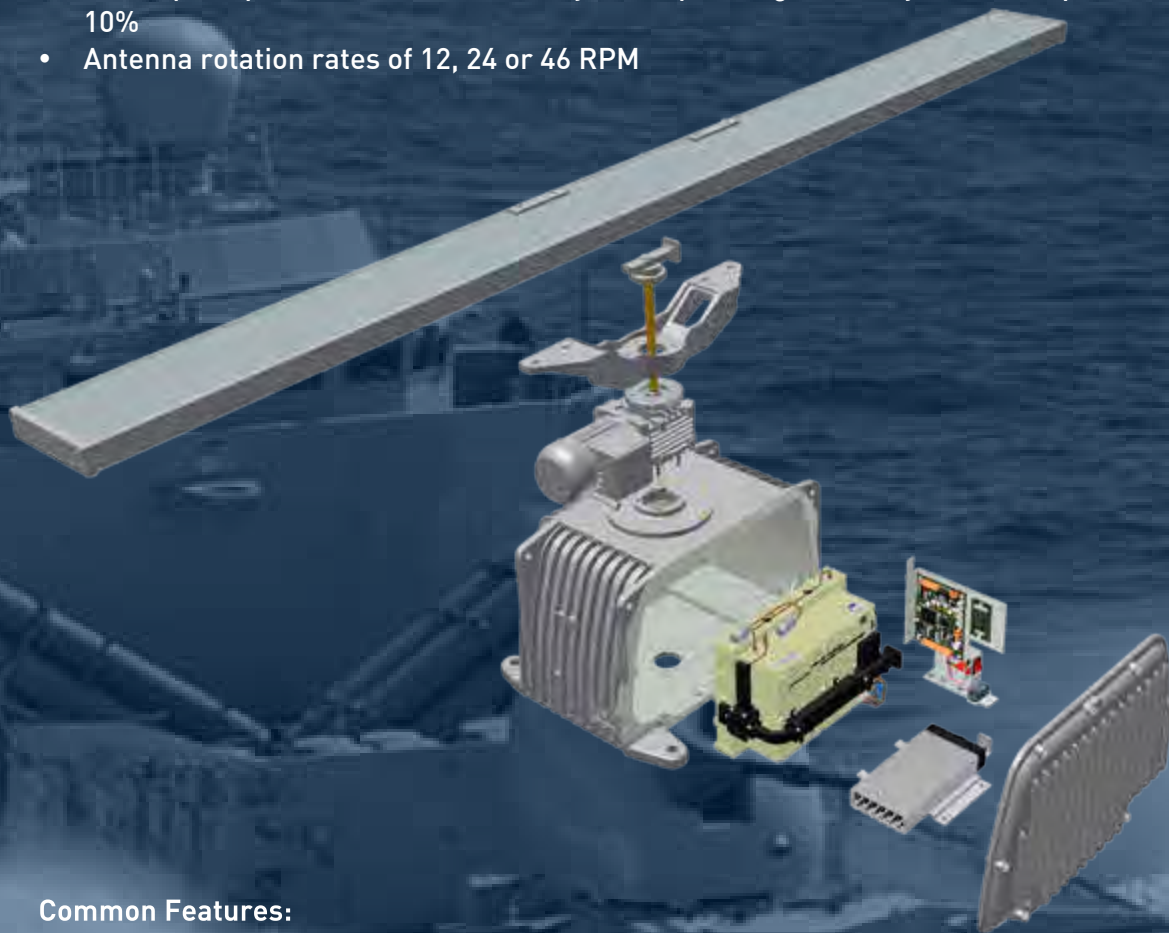
Specification and Features

I Band SharpEye™ :

- Operation in the 9300 MHz – 9500 MHz section of the NATO I Band
- 200 W peak power into the antenna system operating with duty ratios of up to 13%
- Antenna rotation rates of 24 or 46 RPM

E/F Band SharpEye™ :

- Operation in the 2900 MHz – 3100 MHz section of the NATO E/F Band
- 200 W peak power into the antenna system operating with duty ratios of up to 10%
- Antenna rotation rates of 12, 24 or 46 RPM



Common Features:

- Simultaneous long and short-range operation
- Solid-state transmitter for high reliability
- Digital Pulse Compression
- Pulse Doppler processing for rain and sea clutter rejection
- Sub-Clutter visibility improvement factor
- I Band: 30 dB typical
- F Band: 20 dB typical
- Dynamic range of 126 dB (inc. STC and Pulse Compression gain) ensures simultaneous detection of large and small targets
- Pulse Repetition Frequency Discrimination
- Digital and Analogue video outputs
- Plot data output on 1000BaseT LAN (UDP)
- Enhanced Low Probability of Intercept (LPI) when compared with conventional pulsed radars
- Internal monitoring – no external components required to monitor operation

NMD - Naval MANTADIGITAL Display

Navigation Features

Innovative Technology

NMD is driven by Kelvin Hughes' latest common-core processor system. The system can be a stand alone radar or can provide multi-function capability when integrated into a bridge system. In either case NMD delivers exceptional performance together with minimal through-life costs.

Flexibility

A large range of display and control options are available to meet differing bridge configurations and customer requirements. NMD will operate with the full range of Kelvin Hughes radar transceivers and will provide exceptional performance when coupled with SharpEye™ technology.



Features

- Type Approved to the 2008 IMO Radar Performance Standards
- 20" or 26"(320mm) 1920 x 1200 pixel TFT Display
- Widescreen display format to maximise functionality
- Dual radar PPI capability for enhanced situation awareness
- Trackball and three button control of all functions
- Optional MCI remote control panel
- ARPA facilities:
 - 200 contact tracker
 - Automatic contact acquisition zones
 - Polyzone acquisition exclusion zone
 - Tote table for multiple contact information displaying up to 6
- Integral Simulator
- Personal Setup Data
 - Information can be shared through the network or stored on a USB memory device for use on other vessels
- Spyscope providing enlarged display of cursor or selected ARPA/AIS contact area
- Returns from multiple scanners can be merged into a single presentation
- Serial and Analogue Sensor Interfaces
- Ground-stabilised user mapping
- Ownship graphic - scaled on lower ranges.
- Time, waypoint and route display with indication of cross-track error
- Man-overboard marker with drift compensation and elapsed time indicator.
- Parallel index lines
- Electronic tape measure for rapid range and bearing calculations.
- Common reference point for all measurements
- Two electronic bearing lines and two variable range markers
- Displays official AVCS, S57/S63 ENC and C-Map CM93 vector charts
- Provides route planning and monitoring functionality
- ARPA/AIS contact fusion

NMD - Naval MANTADIGITAL Display

Tactical Features

NMD - Navigation & Tactical Features

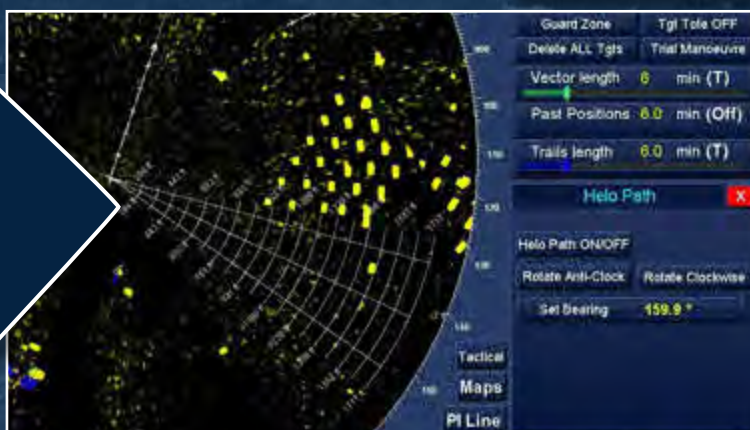


Dual Radar Mode

The NMD allows the simultaneous display of two radar PPIs showing different ranges from the same radar or from different radars. This allows the operator to conduct operations on short range whilst being able to assess the tactical or navigation safety

Helicopter Operations

The NMD allows the display of a helicopter approach flight path graphic to suit the ship and helicopter in use. The approach path displays height indications at 0.25 NM intervals based upon a 3° glidepath. The origin of the approach path, its offset relative to the ship and the flying course are all



SHARPEYE™ Radar Control

The NMD provides the control for the SharpEye™ range of radars allowing the operator to select the frequency of operation, the range mode, helicopter control mode and the power mode, which can be used when the system is operating in short range littoral conditions and when lower probability of intercept is required. BITE data from SharpEye™ can be displayed .

NMD Tactical Facilities

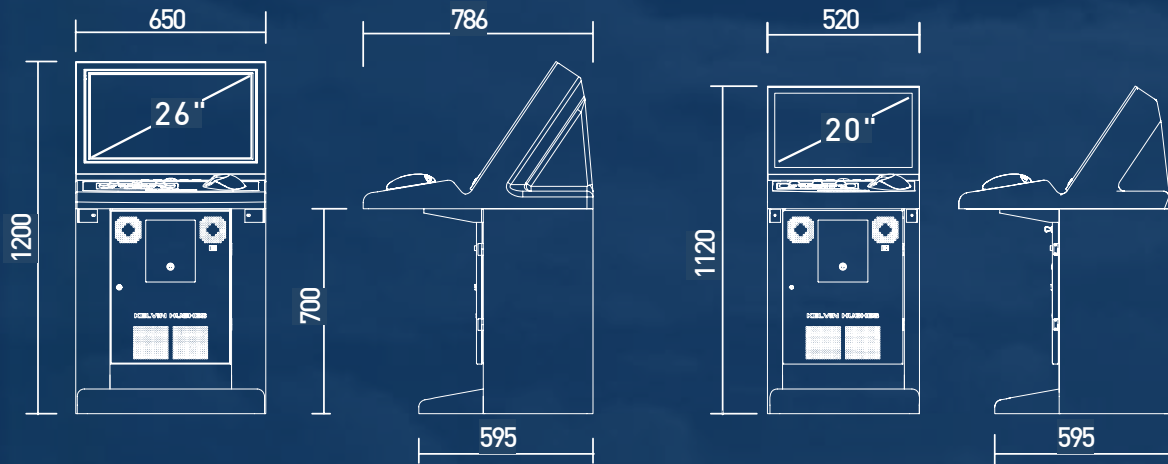
- Sector Transmission / Single Scan
- Sector Screens
- ESM Bearings
- FOC, Dogbox and Plan Cordons for anti-submarine warfare
- Weapons Maximum Engagement ranges and Gun Ricochet zone
- Relative Velocity calculations
- Blind Pilotage
- Construction and execution of NAVPLANS



NMD - Naval MANTADIGITAL Display

Dimensions

Displays



Pedestal Mount



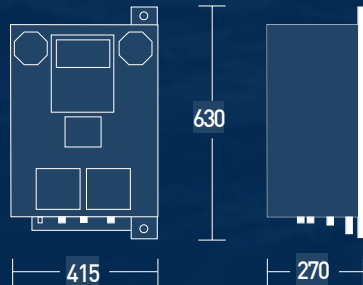
Desk Mount



Console Mount

Bridge Wing Mount

Processor



- Weight Less than 25kg
- Mounting Bulkhead mounted Provision to be mounted on pedestal
- Clearance required None - ventilation through front of main case
- Cable Entry Through base

2007 Transceiver

Magnetron-Based Down-Mast I and E/F Band Transceiver

To compliment the solid-state radar range, Kelvin Hughes is able to offer a magnetron-based radar transceiver solution.

The KH2007 Radar is available in both I Band (3 cm) and F Band (10 cm) with a range of antennas available to suit the size and role of the vessel. The transceiver is smaller and lighter in weight than previous models and is fully compatible with a range of display options.

The KH2007 is particularly suited to platform configurations where a down-mast solution is required, such as submarines.

Developments in transceiver design including the incorporation of a low noise front end (LNFE) and an FET Modulator have resulted in enhanced detection and improved range discrimination.



NMD Dimensions / 2007 Transceiver

Features

- I and E/F Band Variants
- High efficiency FET Modulator
- Low noise front end for improved detection
- ESM blanking pulses available
- CEMCON control for radar silence
- Sector transmission control
- CANbus interface for control
- Bite and Local Control available

Technical Specifications

Transmitter

Frequency (I Band)	9410MHz \pm 30MHz
Frequency (E/F Band)	3050MHz \pm 10MHz
Peak Power (I Band)	25kW
Peak Power (E/F Band)	30kW

PRF (Default can be re-configured)

Short	3000Hz \pm 100Hz
Medium	1500Hz \pm 40Hz
Long	750Hz \pm 20Hz
Long-Low	375Hz \pm 10Hz

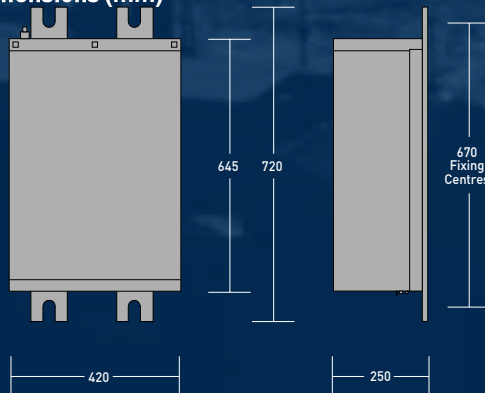
Pulse Length (Default can be re-configured)

Short	0.05 μ s
Medium	0.16 μ s
Long	0.4 μ s
Long-Low	0.4 μ s

Receiver

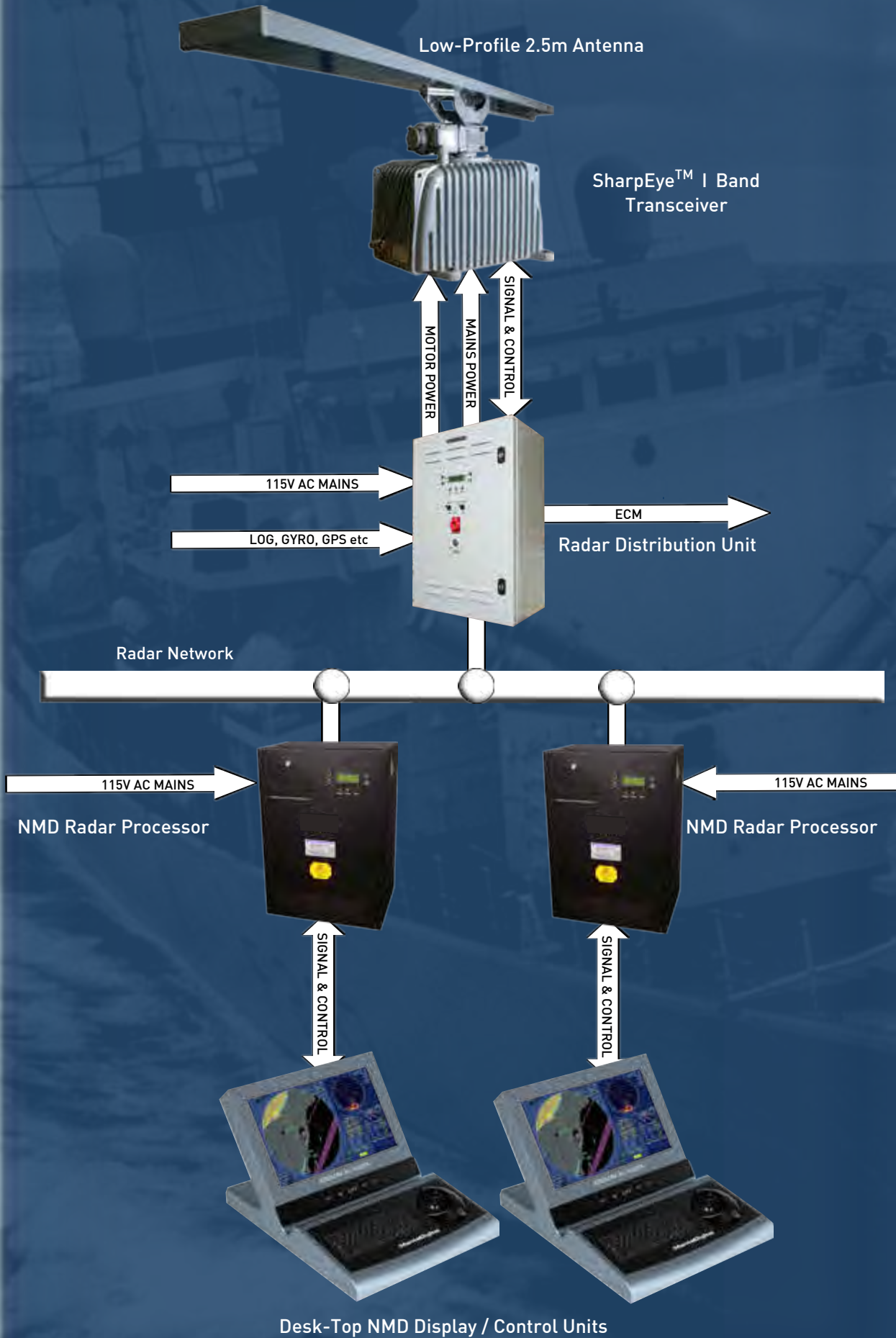
Noise	6dB nominal
Receiver	Logarithmic
IF Frequency	60MHz
Bandwidth (SP)	20MHz nominal
Bandwidth (MP & LP)	5MHz nominal
Dynamic Range	Better than 90dB
Tuning	AFC with manual override

Dimensions (mm)



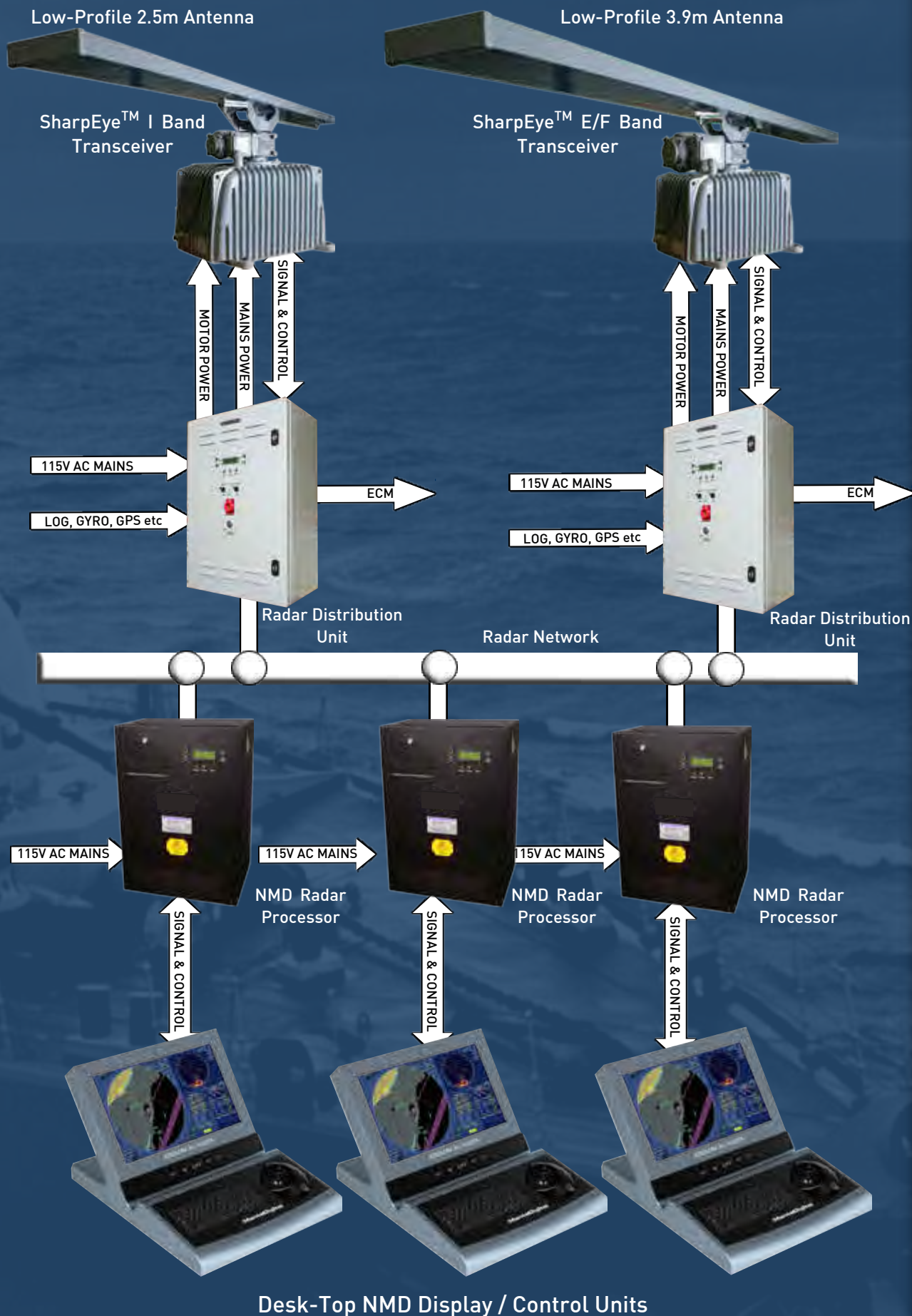
Single I Band Radar System

NMD + SharpEye™ for small and medium sized naval vessels



Dual E/F and I Band Radar System

NMD + SharpEye™ System suitable for larger naval vessels



Typical Systems

KH-8090 ISSUE 6



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