NAVAL AND COAST GUARD RADAR SYSTEMS

SEE WHAT YOU ARE MISSING
Kelvin Hughes provides the world's navies with surface search, navigation and helicopter control radars and pioneered the use of coherent pulse Doppler technologies for these roles. As a result, Kelvin Hughes radars are able to see small targets in sea, rain or land clutter that others will miss.

See what you are missing.
Kelvin Hughes radars provide earlier warning of the presence of small targets such as submarine periscopes and RHIBs while increasing the warship’s capability to detect targets in clutter that are invisible to other radar technologies.

PERFORMANCE ADVANTAGE
This advantage of seeing more and seeing further is complemented by a step increase in reliability and Mean Time Between Failures (MTBF) while simultaneously reducing maintainer training to a minimum.

- Clutter removal without picture degradation.
- Superior target discrimination on all range scales.

EXTREMELY LOW THROUGH LIFE COSTS
- No magnetron - no routine maintenance requirements.
- Solid state power amplifier – ultra high reliability.
- No fault-finding training required.
- Line replaceable unit – does not require radar-trained technician to replace.
- Low Mean Time To Repair (MTTR).
- Upmast solution – no waveguide to compromise citadel integrity, easy to retrofit and reduces signal loss.
- Built to military specifications - robust.

COVERT
- Stealth design for the transmitter housing.
- Low peak transmission power (300W v 25kW magnetron radars) – reduced probability of intercept.
- Customisable waveforms – can be configured for specific threats eg UAVs and USVs.
- Frequency diversity – user selectable frequencies.

INCREMENTAL CAPABILITY
- SharpEye™ transceiver is software based – add enhancements over time.
- Open architecture/standard interfaces – future proof.

MULTIPURPOSE
All from a single SharpEye™ transceiver.
- Navigation.
- Surface search.
- Helicopter control and recovery – no need for helicopter transponders – even over land.
- Camera slew to cue.
- Bi-directional links to combat management system.
- Uniform transmission on all ranges so that multiple users on different range scales all see the optimum picture.
- Submarine radar options.

MULTIFUNCTION RADAR DISPLAY
- Chart radar – interlays chart with radar video.
- Dual radar PPI displays increases ship safety.
- Enhanced Target Detection (ETD) – advanced scan correlation provides further improved detection and greater situational awareness.
NAVAL AND COAST GUARD PRODUCTS
**SharpEye™ is a state-of-the-art coherent, pulse Doppler radar for navigation and situational awareness.** The ability to see smaller targets in clutter and at greater ranges increases the warship’s capability.

**FEATURES**
- Enhanced detection performance – see smaller targets such as RHIBs and submarine periscopes at greater ranges and in clutter.
- Small target detection – can detect targets with a $0.5m^2$ RCS at several nautical miles.
- Clutter removal without picture degradation.
- Pulse compression – provides superior range discrimination across all radar range scales.
- Ultra-high reliability – 100% solid state electronics – NO MAGNETRON – NO MAINTENANCE.

**TYPICAL PERFORMANCE ADVANTAGE**

[Graph showing performance advantage]

**SHARPEYE™ RADAR**

- **SELF CONTAINED**
  - Uprated system, no magnetron, no waveguide, no signal loss

- **DIRECT DRIVE TURNING MECH**
  - No gearbox, no maintenance, higher reliability

- **LOW RCS DESIGN**
  - 90% reduction in the radar cross section of the housing

- **LRU APPROACH**
  - Remove hatch, unplug and replace

- **DURABILITY**
  - Designed to withstand 30G shock

- **LOW TCO**
  - LRU approach, no specialized maintenance training

- **LIGHTWEIGHT**
  - Composite carbon fibre materials

- **ANTI-CORROSION**
  - Carbon fibre – reduced galvanic and sea salt corrosion

- **LOW INSTALL COSTS**
  - Lift, secure with 3 bolts, plug in 3 sealed connectors
Kelvin Hughes has developed SharpEye™ to deliver superior radar performance and reliability. SharpEye™ is the world’s first affordable navigation and surface search pulse Doppler radar sensor offering high reliability, low cost of ownership and much improved detection ranges, especially of small targets in clutter.

SharpEye™ I-band (X-band) and E/F-band (S-band) technology is a fully coherent radar transceiver providing situational awareness in all weather conditions and in high sea states.

SharpEye™ I-band (X-band) transmitters are the first in their class to employ GaN (Gallium Nitride) power transistor technology. The significant performance benefits of GaN transistors have been harnessed by SharpEye™ to directly improve the performance of the radar.

SharpEye™ has a number of new features introduced such as ASTERIX open architecture interface and fibre optic UDP/IP and TCP/IP video and control. SharpEye™ also has an AntennaPark control, enabling the antenna to be positioned in the fore/aft or beam axis when not in use.

SharpEye™ uses the Doppler effect to determine target radial velocities. This is achieved by processing received echoes into velocity bands, enabling the separation of genuine targets from clutter. Extracting the relative motion of targets by measuring the phase of the received echo relative to the phase of the transmission enables the radial velocity to be determined.

Compelling reasons to adopt SharpEye™:

- Much improved radar performance.
- Inherent reliability.
- Range discrimination is maintained over all radar range scales and is equivalent to that obtained in the short pulse in a magnetron radar.
- Frequency Diversity further improves detection and clutter performance.
- Low peak power reduces the probability of intercept.
- Graceful degradation attributes from the multiple power output transistors.
- Fast switch-on.
- Long maintenance free service life.
- Tuning/retuning not required.
- Interoperability through frequency selection.
- Reduced risk of interference from other radars.
- Built in test equipment for fault detection and diagnosis.

TRADITIONAL RADAR IN HEAVY RAIN
SITUATIONAL INTELLIGENCE, THE WORLD OVER

SPECIFICATION

<table>
<thead>
<tr>
<th>TRANSCIVER</th>
<th>I-BAND (X-BAND)</th>
<th>E/F-BAND (S-BAND)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK RF POWER</td>
<td>UP TO 300W</td>
<td>UP TO 200W</td>
</tr>
<tr>
<td>AVERAGE RF POWER</td>
<td>39W</td>
<td>20W</td>
</tr>
<tr>
<td>PRF - 24NM</td>
<td>2300Hz</td>
<td>2300Hz</td>
</tr>
<tr>
<td>PRF - 48NM</td>
<td>1180Hz</td>
<td>1180Hz</td>
</tr>
<tr>
<td>POWER AMPLIFIER TECHNOLOGY</td>
<td>GaN</td>
<td>LDMOS</td>
</tr>
<tr>
<td>PULSE LENGTHS</td>
<td>0.1µs - 100µs</td>
<td>0.1µs - 100µs</td>
</tr>
<tr>
<td>RELIABILITY</td>
<td>UP TO 150,000 HRS MTBF</td>
<td>UP TO 150,000 HRS MTBF</td>
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<table>
<thead>
<tr>
<th>SIGNAL PROCESSOR</th>
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<tbody>
<tr>
<td>PULSE COMPRESSION WITH DOPPLER PROCESSING FOR:</td>
<td></td>
</tr>
<tr>
<td>CLUTTER DISCRIMINATION</td>
<td>UP TO 16 FILTERS</td>
</tr>
<tr>
<td>AUTOMATIC, ADAPTIVE CLUTTER SUPPRESSION</td>
<td>STANDARD</td>
</tr>
<tr>
<td>SECTORISED TRANSMISSION/PROCESSING MODES</td>
<td>OPTIONAL</td>
</tr>
<tr>
<td>DOPPLER</td>
<td>STANDARD</td>
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</tbody>
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BENEFITS

VALUE | ADVANCED CAPABILITY |
<table>
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<tr>
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<tbody>
<tr>
<td>AFFORDABLE</td>
<td>LOW COST OF OWNERSHIP</td>
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</table>

ULTRA-HIGH RELIABILITY | SOLID STATE ELECTRONICS |
| GRACEFUL DEGRADATION | MINIMUM MOVING COMPONENTS |

CLUTTER SUPPRESSION | DOPPLER PROCESSING |
| SMALL TARGET DETECTION |

INCREMENTAL CAPABILITY | CAPABILITY ENHANCEMENTS |
| MISSION UPDATES |
| USEFUL LIFE EXTENSION |

FEATURES

LOW POWER | PULSE COMPRESSION RATIOS UP TO 1000:1 |

CONTINUOUS HEALTH MONITOR | BUILT-IN SELF TEST |
| SYSTEM STATUS MONITOR |

OPEN ARCHITECTURE | INDEPENDENT DISPLAY OPTIONS |
| CAMERA/SENSOR INTERFACE |
| GIGABIT ETHERNET (ASTERIX) |
| SERIAL I/O |
| FIBRE OPTIC |

FULLY COHERENT | PATIENTED PULSE SEQUENCE |
| DOPPLER PROCESSING |
| MOVING TARGET DETECTION |

SHARPEYE™ IN HEAVY RAIN
NAVAL TACTICAL DISPLAY

The danger from difficult to detect asymmetrical threats demands improved tactical surface surveillance both at close range and out to the radar horizon. SharpEye™ increases a vessel’s overall capability by detecting threats other radars cannot see or by detecting the threat at a longer range.

TACTICAL RADAR DISPLAY

The standard radar navigation display is type approved to the latest IMO radar performance standards. Optional features include an Enhanced Target Detection (ETD) mode that eases the operator’s ability to differentiate between clutter and targets and a dual Plan Position Indicator (PPI) mode that provides the operator with two independently configurable PPIs. Tactical features listed overleaf are available in non-IMO mode.

The naval tactical radar display brings the processing advantages of the SharpEye™ radar transceiver to life.

The state of the art LED widescreen display is available in 22” and 26” sizes and is an easy to install console display with an integrated fifth generation Mil-Spec processor and 64-bit operating system and can be easily integrated into any bridge, CIC or operations room.

The integrated radar display is part of a fully redundant networked system and is type approved (MSC192/79 / IEC 62388 ED2).

USER EXPERIENCE

• Providing a platform for radar, chart radar and ECS.
• Easy to use and intuitive, with on screen prompts to assist the user.
• Open architecture enabling serial and digital interfaces.
• Twin PPI enables the user to build a complex picture on one PPI while leaving the other clear for collision avoidance.
• ETD mode provides a clearer picture and uses colour to differentiate between moving and stationary targets.
• ETD also helps the user to detect targets before they are strong enough to be tracked.
• LED widescreen with anti-reflective glass reducing sun glare.

BENEFITS

• Ease of operation.
• Decision making tool, that enhances safety and efficiency at sea.
• Manage the interface picture and share information across workstations.
• Dual PPI display and ETD enhance situational awareness.
• Tactical functionality developed with the naval operator in mind.
The Kelvin Hughes radar display is a software centric platform enabling it to be updated and additional functionality added in the future.

A naval software upgrade in addition to the standard commercial ARPA brings with it further multifunctionality and tactical features enhancing your vessels ability to manage the surface picture.

### TACTICAL FEATURES

| MRATS (MANUAL RATE AIDED TRACK FACILITY) AND SYNTHETIC TARGET |
| OPERATOR TRACK LABELLING |
| OPERATOR TARGET IDENTIFICATION |
| NORTH STABILISED TRANSMISSION SECTOR |
| SECTOR TRANSMISSION/SINGLE SCAN |
| SECTOR SCREENS AND PLAIN CORDON |
| ESM BEARINGS (ELECTRONIC SUPPORT MEASURES) |
| FURTHEST ON CIRCLE |
| RELATIVE VELOCITY CALCULATIONS |
| ANTI-SUBMARINE WARFARE - FOC, RUNNING TORPEDO (DOGBOX), PLAIN CORDONS |
| WEAPONS MAXIMUM ENGAGEMENT RANGES |
| GUN RICOCHET ZONE |
| NAVPLANS/BIND PILOTAGE |
| TARGET INDICATION TO WS/CMS/FIRE CONTROL SYSTEM AND WEAPON DATA DISPLAY |
| HELO PATH |

### MODES

| ECS MODE |
| ECS WITH RADAR INTERLAY |
| CHART RADAR |
| ENHANCED TARGET DETECTION (ETD) |
| IMAGING CAMERA |
| SIMULATION MODE (FAMILIARISATION MODE AVAILABLE FOR TRAINING SYSTEMS) |

### FEATURES

- **SHIP DATA**
- **AIS TARGET INFORMATION**
- **ROUTES**
- **USER DEFINED PROFILES**
- **CONTACT FUSION**
- **TARGET ASSOCIATION, VECTORS AND PAST POSITIONS**
- **TARGET DISPLAY AND TOTE TABLE**
- **STEERING INFORMATION**
- **DYNAMIC CLUTTER**
- **DEPTH DISPLAY**
- **SINGLE OR DUAL PLAN POSITION INDICATOR (PPI) FOR ENHANCED SITUATIONAL AWARENESS**
- **ARPA (AUTOMATIC RADAR PLOTTING AID)**
- **COG CONTACT TRACKER**
- **AUTOMATIC CONTACT ACQUISITION ZONES**
- **POLYZONE ACQUISITION EXCLUSION ZONES**
- **TOTE TABLE**
- **AGILE TRACKER OPTION**
- **INTEGRAL SIMULATOR**
- **PERSONAL SETUP DATA**
- **SPYSCOPE**
- **RADAR SENSOR CONTROL**
- **SERIAL AND ANALOGUE INTERFACES**
- **GROUND STABILISED USER MAPPING**
- **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 CALCULATION**
- **COMMON REFERENCE POINT**
- **TWO ELECTRONIC BEARING LINES**
- **TWO VARIABLE RANGE MARKERS**
- **DISPLAYS OFFICIAL ELECTRONIC NAVIGATION CHARTS (ENC) AND VECTOR CHARTS**
- **ROUTE PLANNING AND MONITORING**
- **ARPA/AIS CONTACT FUSION**
NAVAL TACTICAL DISPLAY

- High resolution screens: 1920 x 1200 pixel LED
- Console mount: integrated processor
- Naval tactical features: enhanced target detection (ETD)
- Interfaces: serial and analogue
- Tracker options: ARPA
- Operate as standalone or across workstations

SHARPEYE™ TRANSCIEVER

- Transmitter type: solid state
- Low power: up to 300W
- Solid state pulse doppler
- UPMAST (reduced system losses)
- Onboard preprocessing
- No maintenance required
- Low through life costs
- Navigation and tactical short and long range surveillance
- Simultaneous long and short range operation
- Pulse doppler processing for rain and sea clutter rejection
- Built in system monitor

Standard antenna types include 2.5m and 3.9m low profile designs to reduce wind loading. Kelvin Hughes also offer other antennas sized from 1m to 5m and AZL types as used in submarine applications.
Kelvin Hughes provides outstanding service throughout the life of our products.

**PROJECT MANAGEMENT**

All Kelvin Hughes customers benefit from our project management process. This ensures a central overview of customer requirements is maintained from an early stage of the relationship through to contract award and then throughout the life of the programme. This comes as standard and is key to ensuring smooth, on-time, and to budget programme delivery.

**RADAR TRIALS DELIVERY**

Validating that the system performance meets and exceeds the operational specification is a key element in implementing new systems, whether at sea, onshore or on land. Kelvin Hughes recognises the need for a comprehensive trials regime and has a dedicated Trials Team that work closely with the customer in planning and executing an appropriate trials programme to support the application.

**INTEGRATED LOGISTICS SUPPORT (ILS)**

ILS forms a key component of any radar supply programme whether the application is for defence, government or industry. Kelvin Hughes recognises the importance of considering these requirements at the outset and invites customers to explore the options we offer; from standard support contracts to tailored support services.

**SPARES & SUPPORT**

In addition to ILS services we have a dedicated customer services team with out-of-hours contact facilities, and a global support network providing full life cycle assistance and support for Kelvin Hughes equipment.

**TRAINING**

Kelvin Hughes navigation and surveillance system training is available for all products. We offer dedicated training programmes at our training school based in our HQ and also at a venue of the customer’s choice should this be required, and depending on the training requirements.

**INCREMENTAL CAPABILITY**

Due to the nature of solid state technology, it is possible to enhance and upgrade systems during their life without the need to change hardware. This enables upgrades to optimise transmissions for particular targets or simply take advantage of the latest detection algorithms.

**UPGRADING TO THE SHARPEYE™ SYSTEM**

The benefits of a SharpEye™ solution are abundant, not least the immediate cost saving achieved by not frequently replacing a magnetron. Upon request, Kelvin Hughes Surveillance will conduct an appraisal of a legacy or magnetron based radar system and present a SharpEye™ upgrade benefits case. We can then assist the customer in completing a feasibility study for the implementation of a SharpEye™ technology based system. By working with the customer at an early stage, Kelvin Hughes ensures maximum benefits are realised at the outset and brings world class radar design expertise to the application.