SHEPHARD

THE CONCISE GLOBAL INDUSTRY GUIDE

RADAR AND ELECTRONIC WARFARE SYSTEMS HANDBOOK

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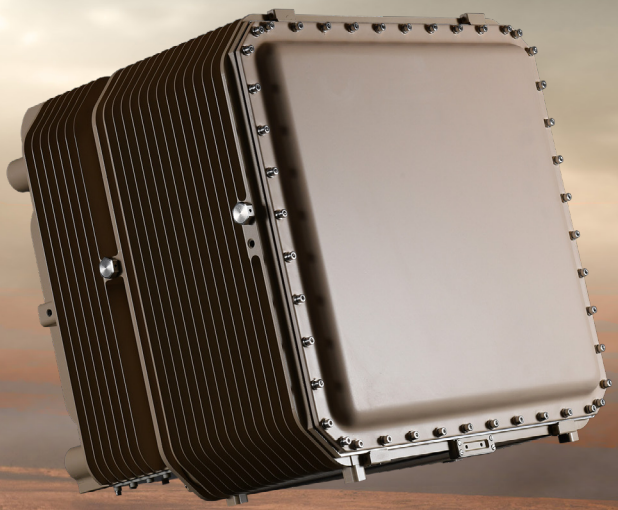
DETECTING
THE ALMOST-INVISIBLE



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COVER: Saab's EW countermeasure dispensing systems for airborne platforms provide self-protection in sophisticated, diverse and dense threat environments. (Photo: Saab)
ABOVE: RADA's proven ieMHR is an innovative software-defined, multi-mission, 4D AESA pulse-Doppler radar platform for a variety of operational missions. (Photo: RADA)

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Welcome

Developments in the EW domain over the past twelve months are dominated by Russia's invasion of Ukraine on 24 February 2022. The attack comprised the panoply of the Russian Army's EW capabilities. Likewise, in the skies above Ukraine and in the Black Sea, new EW systems belonging to Russia's navy and air force were being put through their paces.

For EW practitioners in NATO and allied nations, Russia's actions will yield a treasure trove of intelligence. NATO has the luxury of deploying SIGINT aircraft in alliance airspace close to Ukraine's borders. These planes collect COMINT/ELINT on Russian military radio networks. They also collect ELINT on Russian radars deployed to the Ukrainian theatre.

This COMINT/ELINT is vital as it will help determine the potential efficacy of EW systems deployed throughout NATO. Specifically, the intelligence will help ascertain whether the systems adequately counter Russian radar and communications. Moreover, observing Russian actions through government and open-source intelligence indicates how the Russian armed forces use EW to support manoeuvre. Clearly, the electromagnetic lessons learned from the Ukrainian conflict will be digested for years to come.

The other major electromagnetic challenge for NATO and allied nations is China. As shown by scientific journal articles published in the PRC, energetic efforts continue to develop avantgarde technologies like cognitive and quantum radar and radio communications. Similar interest has been shown in Russia vis-à-vis these technologies. This should concentrate minds in the West and allied nations on using EW to offset the potential advantages of these avantgarde technologies.

Capability investments

The riposte of Western and allied nations to Russian and Chinese military modernisation, particularly in the radio and radar domains, is continued investment in new EW capabilities. This has been illustrated by a renewed focus on land warfare EW systems.

The US Army is forging ahead with its Terrestrial Layer System (TLS), which provides cyber and EW capabilities to support the manoeuvre force. The TLS programme includes an array of systems deployed at tactical and operational levels. Full-rate TLS

production should commence in 2025.

Meanwhile, the British Army is receiving new ARTEC Boxer wheeled armoured fighting vehicles configured for EW, 11 of which will be delivered. They will equip the force's new Cyber and Electromagnetic Activities group. The French Army is following suit. It plans to overhaul its manoeuvre force EW posture, procuring new EW vehicles to this end. The ongoing war in Ukraine is likely to drive overhauls of land force EW capabilities elsewhere in NATO and allied armies.

Further afield, Japan is engaged in a wholesale modernisation of its land force EW capabilities. Several new EW formations are being activated in the Japan Ground Self-Defense Force. This is a direct response to the PRC's increasingly muscular strategic posture in and around the South and East China Seas.

Modernisation efforts in the land domain are mirrored in the air and naval domains. The UK RN, for instance, is moving ahead with its Maritime Electronic Warfare Programme, which outfits several surface combatants with new EW systems as part of a $668.1 million effort. The French Air Force, meanwhile, will receive new SIGINT aircraft from 2023,

The US Army's Terrestrial Layer System programme includes an array of systems deployed at tactical and operational levels to provide cyber and EW capabilities. (Image: PEO Intelligence, Electronic Warfare & Sensors)

which will replace the service's hard-working yet antiquated TransportAllianz C-160G Gabriel SIGINT platforms.

Across the Atlantic, the US Army will soon retire its Beechcraft RC-12X Guardrail tactical/operational SIGINT aircraft. These will be replaced by new platforms via the army's High Accuracy Detection and Exploitation System, better known as HADES.

In the kinetic realm, Turkey revealed in July 2021 that it was developing the Akbaba (Vulture) anti-radiation missile, which will equip the TF-X fifth-generation combat aircraft. Given the success of Turkish materiel during recent conflicts in Ukraine and the Caucasus, Akbaba may enjoy healthy export sales.

Overall assessment

Ongoing conflicts and investments into communications and sensor modernisations by near-peer strategic rivals continue to propel EW investment in NATO and allied nations. These efforts are driving the procurement of new systems and platforms. They are also encouraging investment into technologies like AI and machine learning, which are being adopted for emerging techniques like cognitive EW. This size and pace of investment looks set to continue into the near future while the geopolitical stage remains marked by instability.

Thomas Withington, Editorial Consultant

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EQUIPMENT

AIRBORNE RADAR SYSTEMS

This section contains basic data on a selection of radar systems used in fixed-wing aircraft and helicopters:

- airborne early warning and fire control
- helicopter
- surveillance and maritime patrol

The equipment is listed alphabetically by manufacturer within the above subsections.

If you think your product should be listed, please contact the team at insight@shephardmedia.com to ensure it appears in the *Shephard Defence Insight* online database (shephardmedia.com/defenceinsight) and is included in the next handbook edition.

ABOVE: The Northrop Grumman AN/APG-77 X-band radar equipping the USAF's F-22A Raptor fighters is thought to have an electronic attack capability. (Image: USAF)

AIRBORNE EARLY WARNING AND FIRE CONTROL

AVIC – AVIATION INDUSTRY CORPORATION OF CHINA

Falcon S-7

The Falcon S-7 is an airborne fire control radar that equips the Chengdu F-7 multirole combat aircraft. The radar, which is produced by Aviation Industry Corporation of China's Radar and Avionics Research Institute, is thought to be based on Leonardo's Grifo S-7. The Falcon S-7 is thought to be capable of detecting sea targets at a range of 150km and land targets at up to 250km. Range: 250km

ELTA SYSTEMS

ELM-2032

The ELM-2032 is a multi-mode airborne fire control radar. Modular hardware design, software control and flexible avionic interfaces enable installation in F-4, F-5, F-16, MiG-21, Mirage and other fighters, and the system can be customised. Air-to-air modes enable long-range target detection and tracking for weapon delivery or automatic target acquisition in close-combat engagements. Weight: 100kg Range: 144km

ELM-2052

The ELM-2052 is a fire control radar designed for air-to-air superiority and strike missions. The system is based on solid-state AESA technology, enabling the radar to achieve long detection ranges, mission reliability and multi-target tracking. The ELM-2052 provides simultaneous modes of operation: air-to-air, air-to-ground, air-to-sea and weapon deployment. In air-to-air mode, the radar delivers long-range multi-target detection and enables several simultaneous weapon deliveries in combat engagements.

ELW-2090 AEW&C

The L-band ELW-2090 airborne early warning and control (AEWAC) radar has a synthetic aperture mode that allows it to detect moving ground targets, airborne threats and maritime targets. To date, the radar has been installed in a large mushroom-shaped radome onboard an Ilyushin Il-76 transport aircraft. It performs 360° target detection and has integral electronic support measures, a self-protection system, an identification friend or foe interrogator and communications capability.

LEONARDO ELECTRONICS

Captor-E Radar

Captor-E is a multi-mode AESA pulse-Doppler radar upgrade to the Captor-M, designed for the Eurofighter Typhoon. Captor-E is being developed under a Eurofighter Jagdflugzeug GmbH contract by the Euroradar consortium, of which Indra is a participant. Features of the radar include increased air-to-air range, faster detection and tracking of targets, improved tracking performance and extended missile guidance and a wide field of regard re-positioner.

Grifo E

The X-band Grifo-E is a fire control E-scan radar for combat aircraft. The Grifo-E builds on the design of the Grifo, which has achieved over 150,000 flying hours, by adding a gallium nitride-based E-scan antenna, a multi-channel receiver and multi-core processing units. In practice, this improves the range and performance of the radar while reducing maintenance and repair requirements. The concept of the product is to provide the benefits of E-scan technology – including a variety of advanced new modes such as high-quality synthetic aperture radar – in a lightweight, cost-effective package suited for light combat aircraft. Weight: 160kg Range: 157km

Grifo S

The Grifo-S fire control radar is the most powerful version of the Grifo radar family for combat aircraft, featuring a 560W air-cooled travelling-wave tube-based transmitter with wide-band frequency agility, a monopulse flat-plate slotted array antenna with guard channel fully processed and identification friend or foe dipoles, as well as a flight-proven suite of operative modes. Weight: 120kg

Grifo-346

The Grifo-346 is a combat aircraft X-band radar covering +/-60° in azimuth and elevation and a weight under one kilogram. It can track up to ten targets and display eight of these. The radar has air-to-air, air combat, air-to-surface and navigation modes. It reduces its probability of detection with low sidelobes, pulse compression, low peak power and both random and adaptive frequency jamming. Weight: 100kg

Obstacle Warning System (LOAM & LOAM-V2)

Leonardo Obstacle Warning System (OWS) product family is composed of LOAM and LOAM-V2. OWS is an advisory system for rotary-wing platforms specifically designed to detect potentially dangerous obstacles nearby the flight trajectory and to warn the crew in suitable time to implement effective avoiding manoeuvres. A laser beam periodically scans the area around the flight trajectory and, based on the analysis of the returned echo, the system detects possible obstacles and provides the crew with the relevant information and warnings. LOAM is suitable for installation on large platforms, while LOAM-V2, thanks to its lightweight and small dimensions, can be installed on medium and small platforms.

Raven ES-05

Raven ES-05 is a high-performance AESA radar that equips the Gripen NG multirole combat aircraft. Raven ES-05 is being delivered to Sweden and Brazil on their Gripen E/F fighters. Raven features a roll-repositionable AESA antenna to provide a full ±100° field of regard allowing maximum situational awareness and platform survivability. This wide field of regard allows the aircraft to turn away after missile launch, whilst still maintaining data links to the missile. The highly reliable AESA transmit-receive module technology incorporated in Raven significantly improves system availability leading to reduced life-cycle costs. Weight: 215kg

The AN/APS-138 is used on board the seven Northrop Grumman E-2C Hawkeye aircraft operated by the Egyptian Air Force and some of the E-2Cs operated by the USN. (Photo: Lockheed Martin)

SIR-S/I & SIR-M IFF

The SIR–S/I (for civilian use) and SIR-M (for military land and naval use) Secondary Surveillance Radars are modular systems fully compliant with the latest ICAO and EUROCONTROL recommendations on Mode-S operations. The military versions also add the complete set of features for Mode 4, Mode 5 or the national dedicated crypto solution.

Vixen-1000E

The Vixen 1000E is an AESA fire control radar designed for fighter/interceptor aircraft. The Vixen 1000E features a roll-repositionable AESA antenna to provide a full ±100° field of regard. This wide field of regard allows the aircraft to turn away after missile launch, whilst still maintaining data links to the missile. Weight: 215kg

LOCKHEED MARTIN

AN/APG-67

The AN/APG-67 is a multi-mode radar providing situational awareness and fire control. Long-range detection and tracking allow manoeuvring to gain a tactical advantage. The system has been integrated and tested with beyond-visual-range missiles (semi-active and data link), and lock-on and tracking are reliable during high-G manoeuvres. Coherent pulse-Doppler picks targets out of ground and sea clutter. Distraction due to false alarms is minimised. Range: 75km

AN/APS-138

The AN/APS-138 can perform airborne and surface surveillance. The UHF radars use pulse compression to enhance resolution and suppress clutter. With a range of more than 460km, the AN/APS-138 is capable of detecting small targets such as cruise missiles at a range of 278km. The AN/APS-138 is used on board the seven Northrop Grumman E-2C Hawkeye aircraft operated by the Egyptian Air Force and some of the E-2Cs operated by the USN. Range: 463km

AN/APS-139

The AN/APS-139 is an upgrade to the APS-138 radar on E-2C Hawkeye airborne early warning and control aircraft designed to improve performance against low radar cross-section targets. It was succeeded by the Lockheed Martin AN/APS-145.

AN/APY-9

The UHF AN/APY-9 radar has a range of circa 550km and is outfitting the Northrop Grumman E-2D Advanced Hawkeye airborne early warning and control aircraft operated by the USN. In 2010, Lockheed Martin received a low-rate initial production contract for AN/APY-9 radars for integration into the USN's E-2Ds. The AN/APY-9 features a solid-state transmitter with higher power than its AN/APS-145 predecessor for extended range as well as digital receivers to increase sensitivity.

LOCKHEED MARTIN/NORTHROP GRUMMAN

AN/APG-78 Longbow

The AN/APG-78 Longbow is a Ka-band, low-probability-of-intercept fire control radar equipping the Boeing AH-64D Apache Longbow and AH-64E Apache Guardian attack helicopters. The company claims that the radar provides a seven-fold improvement in survivability and four-fold improvement in lethality over the AH-64A and automatically detects, prioritises and classifies highest-priority targets. The radar reduces exposure (inside threat timelines) and is effective against air and ground targets. Range: 8km

METEKSAN SAVUNMA

MILDAR Fire Control Radar

The MILDAR is a millimetre wave Low-Probability-of-Intercept (LPI) radar system for light and heavy attack helicopters, developed by the Turkish defence manufacturer Meteksan Savunma Sanayi. Its primary function is to search and detect land or air targets, under all weather conditions. One of its main features is the Track-While-Scan capability, which enables pilots to get a 360° picture of the close airspace, thereby enhancing their ability to launch effective countermeasures.

MITSUBISHI ELECTRIC

J/APG-1

Mitsubishi supplies the J/APG-1 fire control radar with a phased-array antenna for the F-2 fighter, which was developed from the F-16. The multi-mode radar offers air-to-air, air-to-ground and anti-shipping modes. It supports the targeting of weapons such as short-range and beyond-visual-range air-to-air missiles, air-to-surface missiles, free-fall bombs and guns, for which it can perform continuously calculated impact point calculations.

NANJING RESEARCH INSTITUTE OF ELECTRONICS TECHNOLOGY (NRIET)

KLJ-7A

KLJ-7A is an X-band AESA radar designed as a replacement for the KLJ-7 on the JF-17 Block-I fighter aircraft and the KLJ-7V2 on the Block-II variant of the aircraft. It may also be installed on the FC-31 fifth-generation stealth fighter. Modes for the radar include multi-object targeting, multi-target engagement

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and track-while-scan. The system can also carry out ground moving target identification. Weight: 120kg Range: 170km

NORTHROP GRUMMAN

AN/APG-66

The AN/APG-66 is a coherent pulse-Doppler fire control radar originally developed for the F-16, now adapted to platforms including Hawk 200, PBN Defender, Skyhawk, T-39N and aerostats. Compatible with radar-guided missiles, including AMRAAM, MICA, Penguin, Skyflash, Sparrow and IR-guided Sidewinder. The system uses a mechanically scanned slotted flat-plate antenna. Range: 148km

AN/APG-68

The AN/APG-68 is a multi-mode radar with a planar array antenna fitted to F-16 variants from Block 25 C/D onwards. The system allows beyond-visual-range engagements with AMRAAM missiles. The AN/APG-68(V)9 is the variant fitted to Block 50/52 aircraft. Air-to-air modes include track-while-scan of up to ten targets, range-while-search, velocity search, rapid resolution, up-look search, situational awareness mode and an automatic acquisition air combat mode. Weight: 164.2kg Range: 296km

AN/APG-76

The AN/APG-76 multi-mode radar system was developed as an upgrade for the Israeli F-4 Phantom 2000 programme. The system features a mechanically scanned flat-plate antenna. Air-to-air modes include look-up/look-down, air combat and beacon modes. Air-to-ground modes include real-beam mapping, Doppler-beam sharpening, synthetic aperture radar/ground moving target indication and beacon tracking.

AN/APG-77

The AN/APG-77 is a low-probability-of-intercept fire control radar for the F-22 Raptor. It is designed to significantly improve capability in air-to-air combat, allowing the pilot to track and shoot at multiple threats before the adversary's radar detects the aircraft. The antenna is an AESA with a separate transmitter and receiver for each of the radiating elements to provide the agility, radar cross-section and bandwidth needed.

AN/APG-80

The AN/APG-80 is an agile beam radar with an AESA antenna designed to continuously search for and track multiple targets within the forward hemisphere of the aircraft. The radar was originally intended for use on the F-16/ F-16E/F Block 60 Desert Falcons. First orders of the radar were delivered by Northrop Grumman to Lockheed Martin for the F-16 Block 60 aircraft, which was developed and produced for the UAE.

AN/APG-81

The AN/APG-81 is an AESA multifunction radar for the F-35 joint strike fighter that incorporates the agile beam-steering capabilities developed for the F-22's APG-77. Its multi-mode capability supports air-to-air, air-to-surface and EW missions, the latter thanks to an RF subsystem integrated with the main radar array. It provides the pilot with precision all-weather targeting and air-to-ground automatic target cueing, according to the manufacturer.

AN/APG-83 SABR

The AN/APG-83 Scalable Agile Beam Radar (SABR) is being developed as an upgrade option for the F-16. It is designed to replace the existing AN/APG-66 and AN/APG-68 conventional radars used by legacy F-16s. The AN/APG-83 SABR design is part of a planned upgrade programme for around 350 USAF F-16A/B Block 40/42 and F-16C/D Block 50/52 multirole combat aircraft.

AN/APY-1/2

The S-band AN/APY-1 radar is installed in a large rotodome above the fuselage of the Boeing KE-3A/E-3A/B Sentry Airborne Warning and Control System (AWACS) aircraft in NATO (E-3A), Saudi Arabian (KE-3A) and USAF (E-3B) service. The S-band AN/APY-2 radar equips Boeing E-3C/D/F AWACS aircraft in French (E-3F), UK (E-3D) and USAF (E-3C) service. The AN/SPY-2 radar is also used onboard the Boeing E-767 AWACS aircraft of the Japan Air Self-Defense Force. Range: 400km

MESA

The L-band Multi-Role Electronically Scanned Array (MESA) radar is a phased-array radar fitted to Boeing 737-700 airborne early warning and control aircraft. The radar's antenna is mounted longitudinally above the fuselage. It detects airborne and maritime targets simultaneously and electronically scans a 360° area in under ten seconds. The radar's identification friend or foe system is integrated with the overall MESA architecture and phased-array technology allows electronic beam-steering and multi-mode operation.

PHAZOTRON NIIR

Komar

The Komar is a multi-role radar aimed at upgrades of older Chinese and Russian combat aircraft. Air-to-air modes include boresight, head-up display, multiple target tracking and vertical manoeuvring. Air-to-ground modes include Doppler-beam sharpening,

The AN/APG-65 is a multi-mode radar for air-to-air and air-to-surface missions, featuring programmable digital computers. (Photo: Raytheon)

real-beam mapping and synthetic aperture radar. It can also designate targets for radar-guided air-to-surface missiles and produce fire control solutions for free-fall bombs and guns.

Kopyo

The Kopyo is a multi-mode coherent pulse-Doppler radar aimed at the MiG-21 upgrade market. It uses a slotted flat-plate antenna and digital signal processing. Air-to-air modes include boresight, head-up display search, look-up/down, track-while-scan (TWS) (eight targets, engages two), vertical search and wide-angle search. Air-to-ground modes include Doppler-beam sharpening, real-beam mapping, synthetic aperture radar, zoom/freeze-frame, TWS (four targets), moving target indication and ranging.

Kopyo-25

The Kopyo-25 is a podded version of Kopyo-21I designed for the Sukhoi Su-39 close support/strike aircraft. The system provides the aircraft with a radar without major modifications to the airframe. The Kopyo-25 may also be offered for Indian MiG-27L upgrades. The antenna is of the slotted, flat-plate type. Air-to-ground modes include ground mapping, moving target indication, synthetic aperture radar imaging and sea search. Weight: 90kg Range: 57km

Moskit 23

The Moskit 23 is a multi-mode radar developed to replace Sapfir in MiG-23 aircraft. Air-to-air modes include close combat, rangefinding, search and track, track-while-scan of eight targets and simultaneous engagement of two. Air-to-surface modes include Doppler-beam sharpening, real-beam mapping, synthetic aperture radar and moving target detection on land and water. Compatible with R-27R(T), RVV-AE and R-73 air-to-air missiles (as well as R-23T and R-24T missiles), Kh-31A missile and KAB-500KR guided bombs, bombs, guns and unguided rockets. Range: 100km

N019 Sapfir-29

The N019 Sapfir-29 is a pulse-Doppler fire control radar with look-down/shoot-down capability developed for the MiG-29. Dedicated to air-to-air combat, it has three pulse repetition frequency settings: high for closing targets, medium for retreating targets and interleaved high/medium for all-aspect detection. Multiple modes can be used together through time-division multiplexing. The antenna is of the twist Cassegrain type. Range: 150km

RP-22 Sapfir 21

The RP-22 Sapfir 21 is an upgraded Sapfir for late-1960s MiG-21 fighters. Range: 30km

RP-25 Sapfir 25

The RP-25 Sapfir 25 is a look-down/shoot-down radar for the MiG-25PD interceptor of late-1970s vintage, developed as a replacement for the RP-25 that was compromised by pilot Viktor Belenko's defection to Japan with his MiG-25. Range: 115km

RP-35

The RP-35 is a multi-mode digital phased-array coherent radar with Hands-On Throttle-And-Stick operation. Reported air-to-air modes include: automatic terrain avoidance, boresight, head-up display search, raid assessment, range-while-search, single-target tracking, track-while-scan (TWS) of 24 targets with engagement of four at once, velocity search, vertical scanning and wide-angle search. Air-to-surface modes are Doppler-beam sharpening, four-target TWS, ground mapping (including real-beam), ground moving target indication, synthetic aperture radar, zoom/freeze-frame and ranging. Range: 140km

Sokol

The Sokol is a passive phased-array fire control radar and navigation radar with air-to-air and air-to-ground modes, initially associated with Sukhoi Su-27 variants. Air-to-air modes include boresight search, head-up display search, wide-angle search and vertical scan. Air-to-surface modes include Doppler-beam sharpening, ground moving target indication, ranging, real-beam mapping, synthetic aperture radar, track-while-scan (four targets) and zoom/freeze-frame. Range: 180km

Super Komar

The Super Komar is an upgraded version of the Komar, featuring digital signal processing. Air-to-air modes include boresight, head-up display search, look-up/down, range-while-search, track-while-scan (TWS) and vertical manoeuvre. Air-to-ground modes include Kopyo plus moving target indication, TWS and zoom/freeze-frame in mapping. Range: 75km

Super Kopyo

The Super Kopyo is an upgraded Kopyo with longer detection ranges across all aspects, with lighter weight and faster processors.

Super Kopyo PH

The Super Kopyo PH is a lightweight version of the Super Kopyo with a phased-array antenna. Air-to-air modes include air combat manoeuvring, look-up/down, range-while-scan and single-target tracking. Air-to-ground modes include Doppler-beam sharpening, real-beam mapping and synthetic aperture radar.

Zhuk Series

Zhuk, Zhuk-ME, Zhuk-MSE and Zhuk-MSFE constitute a family of radars with slotted flat-plate or phased-array antennas, offering multiple air-to-air and air-to-ground modes. Air-to-air modes include target acquisition with speed/range measurement in free space and against ground or sea clutter and single/multiple target tracking with the simultaneous engagement of several. Range: 100km

RAYTHEON

AN/APG-63(V)1

The AN/APG-63(V)1 is a reliability/maintainability upgrade to the AN/APG-63 including new hardware with significant growth opportunities. As part of a radar retrofit programme for the USAF, the APG-63(V)1 is being produced to replace outmoded APG-63 radars installed in F-15C/Ds. Raytheon is supplying radar and spare systems, data requirements, programme management and test equipment to support this retrofit.

AN/APG-63(V)2

The AN/APG-63(V)2 is a radar upgrade for USAF F-15C aircraft, adding an AESA, increasing pilot situational awareness as well as reliability and maintainability. Agile beam provides nearly instantaneous track updates throughout the FOV, enhanced multi-target tracking capability and elimination of the need for a hydraulic system. It can simultaneously guide multiple AIM-120 AMRAAM to several targets widely spaced in azimuth, elevation or range.

AN/APG-63(V)3

The AN/APG-63(V)3 AESA radar is designed to provide adaptable technology and tactical flexibility as the newest member of Raytheon's F-15 radar family. It is designed to offer situational awareness, multirole capability, long-term support and future growth options. The APG-63(V)1 integrates the APG-63(V)3's AESA components with 'minimal' downtime.

AN/APG-65

The AN/APG-65 is a multi-mode radar for air-to-air and air-to-surface missions, featuring programmable digital computers. For air-to-air operations, it offers 'clean scope', look-down/shoot-down capabilities, search, track and automatic acquisition modes such as high-pulse repetition frequency (PRF) velocity search, high/medium-PRF range-while-search, single-target tracking and a track-while-scan mode that tracks ten targets simultaneously and displays eight.

AN/APG-70

The AN/APG-70 is a multi-mode radar with air-to-air and air-to-surface capabilities. As an upgrade to the APG-63, the APG-70 was designed for greater reliability and easier maintenance. Gate array technology enables the APG-70 to incorporate modes not available in earlier radars while providing enhanced operational capabilities in other modes. The APG-70 is employed on late-model F-15C/D/E aircraft and on the export F-15I and S. Range: 185km

AN/APG-73

The AN/APG-73 is a coherent, multi-mode, multi-waveform search-and-track sensor that uses programmable digital processors for air-to-air and air-to-surface missions. Its motion-sensing subsystem with reconnaissance software, a stretch waveform generator module and a test equipment instrumentation and reconnaissance module enables the F/A-18 to make high-resolution radar ground maps comparable with those of the F-15E and the U-2 and perform precision strike missions using image correlation algorithms.

AN/APG-79

The AN/APG-79 is an agile beam radar with a solid-state digital array that scans at nearly the speed of light, enabling detection and tracking of multiple air and ground threats simultaneously. The array is composed of numerous solid-state transmit/receive modules to help almost remove mechanical breakdown. Other system components include a receiver/exciter, ruggedised COTS processor and power supplies. It offers increased range and resolution and is used by the RAAF and the USN.

AN/APG-82(V)1

The APG-82(V)1 AESA radar is described as the latest radar advancement for the USAF F-15E fleet. It contributes to the platform's multi-role mission capability. In addition to its extended range and improved multi-target track and precision engagement capabilities, the APG-82(V)1 is claimed to offer a more than 20-fold improvement in system reliability over the legacy F-15E APG-70 radar.

SAAB

Erieye

The S-band Erieye is a long-range airborne early warning and control radar that detects and automatically tracks air and surface targets across a large area. The radar has an instrumented range of 400km. The Erieye is based on active phased-array pulse-Doppler technology and is designed to track small objects such as cruise missiles and jet-skis in heavy clutter/jamming conditions. Range: 400km

GlobalEye

In February 2016, Saab introduced GlobalEye, an AEW&C aircraft that provides air, maritime and ground surveillance in a single solution. The multirole airborne surveillance system combines the S-band Erieye Extended Range (ER) radar and mission system with Bombardier's Global 6000 jet aircraft. The UAE has purchased three GlobalEye aircraft to supplement its fleet of Saab 340 aircraft equipped with the Erieye. Length: 3,030cm Width: 2,865cm Height: 777cm Weight: 45,130kg Max speed: 300kt Range: 11,112km Service ceiling: 51,000ft Crew: 4

PS-05/A

Saab's PS-05/A is an X-band mechanically scanned pulse-Doppler radar used on the Gripen fighter aircraft. The system has undergone four iterations from the original variant, which was based on the Blue Vixen and flew in the first of the aircraft. The PS-05/A Mk4 was unveiled in April 2015 and has a new hardware configuration and radar back-end, as well as full Advanced Medium-Range Air-to-Air Missile and Meteor integration. Weight: 150kg

THALES

Cyrano IV

The Cyrano IV is a family of multi-mode airborne radars fitted to Mirage F1 and Mirage 50 fighter aircraft. It offers air-to-air modes, including search, automatic tracking, interception and fire control, dogfight and home-on-jam. The system can also be used for terrain avoidance, ground mapping and air-to-surface ranging.

RBE2

The AESA RBE2 is the first AESA radar produced in Europe for combat aircraft. The active phased array replaces the passive array in the RBE2 currently fitted to the Dassault Rafale F3/B/C/M combat aircraft. It offers a 50% range extension compared to legacy combat aircraft radars, greater waveform agility for high-resolution synthetic aperture imagery in air-to-ground mode and better resistance to jamming.

RC
The RC family comprises compact multi-mode radars of modular construction aimed at combat aircraft and advanced trainers, developed from the Mirage 2000-5's RDY radar. The mechanically scanned antenna is of the slotted, flat-plate type with four dipoles, serving the identification friend or foe interrogator and/or missile data link. Weight: 120kg

RDI
The RDI is an optimised pulse-Doppler radar installed on Mirage 2000B and C models used in the air superiority role. The slotted flat-plate antenna features integrated identification friend or foe capability. High pulse repetition frequency gives accurate target speed measurement. Air-to-air modes include all-altitude search, track-while-scan and continuous tracking/missile guidance. Air-to-ground modes include mapping and ranging.

RDM
The Radar Doppler Multifunction (RDM) is a multirole coherent Doppler radar developed for Mirage 2000B, C, D and E models. It has air-to-air capability, but air-to-surface functions are emphasised. Air-to-air modes include all-aspect, all-altitude search and interception. Air-to-surface modes are mapping, terrain avoidance and blind let-down, as well as maritime search and attack.

RDY
The Radar Doppler Multitarget (RDY) multifunction radar equips the Mirage 2000-5 Mk 2, providing air-to-air, air-to-ground and air-to-sea capabilities and enabling simultaneous detection and tracking of multiple targets. In air-to-air mode, it can select several targets for MICA missiles equipped with active electromagnetic or passive IR seekers. In air-to-ground and air-to-sea modes, the radar generates information

supplied to the system for firing conventional or guided weapons. Weight: 120kg

V TIKHOMIROV NIIP

Irbis-E

Irbis-E is an X-band multi-mode passive electronically scanned array radar system developed by Tikhomirov Scientific Research Institute of Instrument Design for the Sukhoi Su-35 fighter aircraft. It is based on the Bars system used on earlier Su-30 aircraft. The first flight of a prototype occurred in 2007 on a testbed Su-30MK2 aircraft.

N001

The N001 is a mechanically scanned pulse-Doppler fire control radar associated with the Su-27, -30 and -33 fighters. The system features single-target engagement capability. Range: 140km

N011

The N011 is an updated version of the N001 for more advanced Su-27 family aircraft featuring both air-to-air and air-to-ground (terrain following/avoidance and mapping) modes and a slotted flat-plate antenna. Simultaneous tracking of 15 targets and engagement of six are claimed. Range: 100km

N011M

The N011M is a multi-mode passive phased-array radar for advanced Sukhoi fighter variants, including the Su-27M, Su-30MKI and Su-35. Air-to-air and air-to-surface modes are offered. Air-to-surface modes include terrain following, avoidance and mapping. Range: 400km

Osa

Osa is a lightweight, multi-mode phased-array radar able to track and engage multiple targets simultaneously. Sources disagree on the numbers – some give it a 16-target track-while-scan capability with simultaneous engagement of four, others say it can track eight targets and engage four, while yet others say it can detect eight targets, track four and engage two at the same time. Weight: 120kg

SH121

The SH121 AESA airborne fire control radar is being designed for Russia's Sukhoi T-50 PAK-FA fifth-generation combat aircraft. The radar will be capable of simultaneous air and ground surveillance as well as multiple target engagement, possess target recognition and classification algorithms and be able to perform communications and electronic attack functions. The X-band SH121 uses antennas located on the front and on the sides of the aircraft, together with L-band antennas located on the leading edge of the wings.

Zaslon

Reportedly the first phased-array radar to enter service on a fighter aircraft, Zaslon is the primary sensor of the MiG-31 interceptor. It is capable of detecting and tracking cruise missiles through ground clutter. It is said to be able to track ten targets and engage four at the same time. Antenna is 1.1m in diameter and weighs 300kg of the total 1,000kg weight. Weight: 1,000kg Range: 300km

Zaslon AM

Zaslon AM is a variant with upgraded data-processing systems for all in-service MiG-31s.

Zaslon M

Zaslon M is a further upgrade to the Zaslon series, including the addition of a larger 1.4m-diameter phased-array antenna. Performance is reported to be 50-100 times better than the original. The system is reported to have hit a target 300km away with an R-37 missile. It tracks 24 targets at once and engages six. It also has an anti-tactical ballistic missile capability. Range: 400km

VEGA RADIO ENGINEERING CORPORATION

E-801M

The X-band E-801 airborne early warning and control radar equips the Kamov Ka-31 medium-lift utility helicopter. The radar can track up to 20 targets simultaneously. It has a detection range of up to 150km for airborne targets and up to 250km for large surface targets. Range: 150km

Shmel

The Shmel airborne early warning and control radar is produced in four variants. The baseline version is an S-band system with up to 1MW of peak output power. The radar possesses frequency agility as an electronic counter-countermeasures feature and can transmit low and high pulse repetition frequencies. The antenna has integrated identification friend or foe interrogator and data links. The radar performs mechanical azimuth scanning with electronic elevation scanning. Up to 60 targets can be tracked simultaneously, and the radar has a range of 150km. Range: 400km

HELICOPTER

ARTEMIS

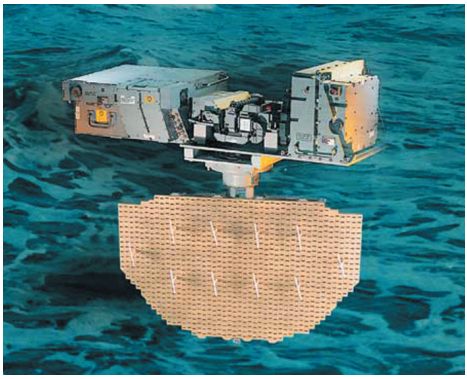
SlimSAR

The SlimSAR is a family of compact, polarimetric, multiband (UHF/L/X) synthetic aperture radars, which can be used for surveillance and reconnaissance over land and sea. Weight: 9kg

ELTA SYSTEMS

ELM-2022A

The ELM-2022A is a maritime surveillance radar family which can be used for long-range surveillance and ASW, navigation and weather, maritime moving target indication and Doppler-beam sharpening. Additionally, inverse synthetic aperture radar and range profile classification, synthetic aperture radar and beacon interrogation are also options. Specific tasks the radar system is designed to perform include littoral warfare operations, maritime surveillance and patrols in exclusive economic zones, SAR, as well as anti-drug enforcement operations, coast guard and fisheries patrol. Weight: 100kg



The ELM-2022A is a maritime surveillance radar family which can be used for long-range surveillance and ASW. (Image: Elta Systems)

ELM-2022ES

The ELM-2022ES is an airborne maritime surveillance radar designed to accommodate fixed-wing maritime patrol aircraft, maritime support helicopters and UAVs. The radar performs mechanical horizontal scanning and electronic vertical scanning. It can generate both synthetic aperture radar and inverse synthetic aperture radar imagery. It also includes ground moving target indication. The ELM-2022ES' range is in the region of 370km. Weight: 120kg Range: 370km

GENERAL ATOMICS AERONAUTICAL SYSTEMS

AN/APY-8 Lynx Block 20A

The Lynx Block 20A is a high-resolution, wide-area surveillance, Ku-band synthetic aperture radar/ground moving target indication (GMTI) radar with intelligence analysis and targeting capabilities. It features multiple synthetic aperture radar image modes, fast-scan GMTI, maritime and dismount capabilities that drive exploitation and tracking applications for demanding operations. Weight: 52kg

AN/DPY-1 Lynx Block 30

The multi-mode AN/DPY-1 Lynx Block 30 is a reduced weight, power and volume variant of the AN/APY-8. It is a high-resolution, wide-area surveillance, Ku-band synthetic aperture radar/ground moving target indication (GMTI) radar with intelligence analysis and targeting capabilities. According to the company, the Lynx Block 30 has multiple synthetic aperture radar image modes, fast-scan GMTI and maritime capabilities that drive exploitation imaging and tracking applications for demanding operations. Weight: 37kg

Predator B DRR

The Due Regard Radar (DRR) is an air-to-air radar developed under company funding to meet the requirements envisioned to enable remotely piloted aircraft (RPAs) to fly in international airspace. The DRR consists of a two-panel AESA antenna and a radar electronics assembly. This gives the RPA pilot the ability to detect and track aircraft across the same field of view as a manned aircraft.

HARRIS ELECTRONIC SYSTEMS

Airborne CMMR

The Airborne Compact Multi-Mode Radar (CMMR) is a small, lightweight, lower-price version of the mature X-band radar system originally designed by ELTA (ELM-2022). Harris and ELTA have teamed up to manufacture and provide technical and logistics support in the US. The CMMR is primarily intended for operation on helicopters and UAVs. Additionally, the CMMR's receiver processor is in use worldwide as a component on several airborne radar products.

Airborne MMR

The Airborne Multi-Mode Radar (MMR) is a mature X-band radar system originally designed by ELTA (ELM-2022). Harris and ELTA have teamed up to manufacture and provide technical and logistics support in the US.

Skysense-2020 Radar

Harris has created the Skysense-2020 family of sense-and-avoid 3D radars leveraging its Airborne Sense and Avoid radar for the USN's Triton UAS. The Skysense-2020H is based on the Triton design and is readily available for high-altitude UAVs. The Skysense-2020M is a smaller, modular version of the 2020H, suitable for medium-altitude and VTOL UAVs. The Skysense-2020G is a mobile, ground-based sense-and-avoid system for safely navigating and detecting low-flying UAVs, according to the company.

IMSAR

NanoSAR C

NanoSAR C is a high-performance, high-resolution, multi-mode radar with extremely low SWaP, according to the company. It is capable of generating real-time aerial synthetic aperture radar images, coherent change detection and moving target indication, as well as maritime search and detection, all from a payload small and light enough to be integrated on small platforms, including the Camcopter, Integrator, Puma, ScanEagle and Shadow UAVs and many fixed- and rotary-wing manned platforms. Length: 14cm Width: 9cm Height: 5cm Weight: 48kg

NSP-3

The NSP-3 is a dual 3in (7.6cm)-diameter pod configuration of the NanoSAR multi-mode radar designed for easy and versatile integration on manned or unmanned platforms, according to the company. One pod includes the NanoSAR radar processing and GPS units, while the other pod includes the inertial measurement unit, electronically scanned array antennas and elevation gimbals. Weight: 3.4kg

NSP-5

The NSP-5 is a single 5in (12.7cm)-diameter pod configuration of the NanoSAR multi-mode radar. According to the company, it is designed for easy and versatile integration on manned or unmanned platforms. The NSP-5 includes the NanoSAR radar processing unit, the inertial navigation system, electronically scanned array antennas and elevation gimbals. The complete system in a single configuration allows for simple mounting under the wing or along

the fuselage of a manned or unmanned aircraft. Weight: 7.3kg

NSP-8D

The NSP-8D is a single 8in (20.3cm)-diameter pod configuration of the NanoSAR multi-mode radar designed for integration on manned or unmanned platforms. The NSP-8D includes the NanoSAR radar processing unit, the inertial navigation system and mechanically gimballed antennas. The complete system in a single configuration allows for mounting on a manned or unmanned aircraft. The NSP-8D can increase a platform's capabilities with little impact on manned platform performance. Weight: 8.2kg

LEONARDO ELECTRONICS

PicoSAR

The PicoSAR radar is an overland-focused multi-mode electronically scanned surveillance radar. PicoSAR has a compact and lightweight (10kg) form factor for installation on platforms with limited payload capacity. It has been integrated on both crewed and uncrewed platforms. PicoSAR delivers high-resolution synthetic aperture radar imaging and ground moving target indication capability. Length: 13cm Width: 20cm Height: 22cm Weight: 10kg Range: 20km

PicoSTAR

The PicoSTAR radar is designed to provide a compact, lightweight, integrated AESA radar and EO capability for UAVs and other small fixed- or rotary-wing platforms. Twin AESA modules can be mounted up to two metres away from the central EO/processing unit to enable integration on different platform configurations. The EO subsystem uses a Swan II dual-mode imaging sensor together with a conventional zoom/e-zoom TV sensor.

Seaspray 7000E

The Seaspray 7000E is an AESA radar for helicopters, fixed-wing aircraft and UAVs. It combines AESA with a COTS-based processor to deliver a range of surveillance capabilities covering air-to-surface, air-to-air and air-to-ground environments. Weight: 86kg Range: 590km

LOCKHEED MARTIN

RAIDER

The Real-time Active Imaging in 3D at Extended Range (RAIDER) multi-sensor system is an extended-range version of the Polarimetric Imaging Laser Radar (PILAR). RAIDER includes an enhanced forward-looking infrared system, TV camera and upgraded laser detection and ranging (ladar) capability. The system provides high-resolution and 3D target imaging for civil and military applications. The new ladar allows the system to see farther with twice the resolution as the original PILAR and fly at higher altitudes while mapping terrain.

LOCKHEED MARTIN/NORTHROP GRUMMAN

AN/APG-78 Longbow

The AN/APG-78 Longbow is a Ka-band, low-probability-of-intercept fire control radar equipping the Boeing AH-64D Apache Longbow and AH-64E Apache Guardian attack helicopters. The company claims that the radar provides a seven-fold improvement in survivability and four-fold improvement in lethality over the AH-64A and automatically detects, prioritises and classifies highest-priority targets. The radar reduces exposure (inside threat timelines) and is effective against air and ground targets. Range: 8km

METEKSAN SAVUNMA

HETS Helicopter Obstacle Detection System

The HETS Helicopter Obstacle Detection System is a piece of mission equipment for rotary-wing aircraft, developed by the Turkish defence manufacturer Meteksan Savunma Sanayi. It consists of a fibre-laser sensor having a wavelength of 1550nm. This sensor detects obstacles such as wires, poles, trees and more, and alerts the pilots through aural and visual means.

MILDAR Fire Control Radar

The MILDAR is a millimetre wave Low-Probability-of-Intercept (LPI) radar system for light and heavy attack helicopters, developed by the Turkish defence manufacturer Meteksan Savunma Sanayi. Its primary function is to search and detect land or air targets, under all weather conditions. One of its main features is the Track-While-Scan capability, which enables pilots to get a 360° picture of the close airspace, thereby enhancing their ability to launch effective countermeasures.

NORTHROP GRUMMAN MISSION SYSTEMS

AN/SPQ-1 TESAR

The Tactical Endurance Synthetic Aperture Radar (TESAR) surveillance radar operates in both synthetic aperture radar and moving target indication (MTI) modes. Synthetic aperture radar mode is continuous, full-focus, high-resolution, near real-time strip map imagery formed on either side of the UAV. Coordinates of each map centre are provided to within 25m circular error probable (assumes P-coded GPS). The radar provides two strip map modes and a spot map mode. MTI mode provides target reports overlaid on a digital map.

PJSC KIEV RADAR PLANT

Osminog-E

The Osminog-E anti-submarine warfare suite has been designed for synthetic aperture radar and tracking applications, as well as submerged, surfaced and radar-visible targets. The Osminog-E is installed on the Ka-27 and Ka-28 naval helicopters. The system includes a radar station to observe the surface and navigational tracks, as well as a dipping sonar for the detection of underwater objects.

RAYTHEON

AN/APS-124

The AN/APS-124 is a long-range maritime search and targeting radar, originally developed for USN Sikorsky SH-60 Seahawk helicopters. It features a high mean

output power, clutter rejection for detection of small targets in high sea states, a digital scan converter for scan-to-scan integration and a data link for communication. Additionally, it can operate in a ship-helicopter team for missile targeting and submarine hunting.

RAYTHEON SPACE & AIRBORNE SYSTEMS

AN/APQ-174/186 MMR

The AN/APQ-174/186 Multi-Mode Radar (MMR) family provides terrain following and terrain avoidance for a variety of military aircraft. The MMR allows safe flight down to a 100ft clearance at night in adverse weather and in high-threat environments. It lowers the probability of detection by enemy forces and increases mission success through terrain masking and minimising time spent in threat range. Length: 109cm Width: 33cm Weight: 113kg

SeaVue

SeaVue is a family of maritime surveillance radars. The systems use colour or monochrome flat-panel displays, plan position indicators and B-scan presentations and multiple high-resolution video formats. In addition, SeaVue features inverse synthetic aperture radar imaging and range profiling (A-scan) as well as moving target detection. Weight: 37kg Range: 0km

SeaVue XMC

SeaVue is a maritime and overland radar system that provides surveillance for fixed-wing, helicopter, ship and land-based applications. Over 150 SeaVue radars are operational worldwide. Incorporating a maritime situational awareness package developed under the Ocean Surveillance Initiative programme, the SeaVue XMC radar provides operators with wide-area situational awareness to support tactical

decision-making with the aim of improving mission effectiveness and operational efficiency.

SANDIA NATIONAL LABORATORIES

MiniSAR

The MiniSAR weighs 12kg and is made up of the antenna/gimbal assembly and the radar electronics assembly, measuring about 18cm on either side. The system's current mode is spot synthetic aperture radar, with plans to include strip map mode and ground moving target indication. Waveform synthesiser: 3U, compact peripheral component interconnect, field-programmable gate array and quadrature outputs (1.2GHz clock, agile, programmable). Length: 18cm Width: 18cm Weight: 12kg

SRC

FORESTER

The Foliage Penetration (FOPEN) Reconnaissance, Surveillance, Tracking and Engagement Radar (FORESTER) is an airborne radar system that provides stand-off, persistent, wide-area surveillance for situational awareness of foliage-covered landscapes.

TELEPHONICS

AN/APS-143C(V)3 OceanEye

The APS-143C(V)3 is a family of maritime surveillance, tracking and imaging radars. Features include 46-frequency pulse-to-pulse agility, track-while-scan of up to 200 targets, five-colour weather avoidance mode and sea moving target indication. Additionally, it has integral identification of friend or foe, built-in display/control generator, scan-to-scan integration and SAR transponder beacon detection. Weight: 84.4kg Range: 8.53km

AN/APS-147

The AN/APS-147 is a multi-mode maritime inverse synthetic aperture radar for the Sikorsky MH-60R. It provides target imaging, small target/periscope detection and long-range surveillance, as well as weather avoidance, all-weather navigation, short-range SAR and target designation. The system uses data processing, a high-throughput signal and is capable of detecting small targets and displaying them in a high-resolution format.

AN/APS-153(V)1

The AN/APS-153(V)1 was designed by Telephonics to meet the requirements of the maritime military helicopter environment. It is rugged and lightweight with low prime power and is capable of small target detection, high-resolution imaging and long-range surface search. The system provides the MH-60R and its host ship with littoral and maritime domain awareness.

RDR-1500B

Telephonics' RDR-1500B search and surveillance and weather avoidance radar system is designed to provide multi-mode radar capability for helicopters and fixed-wing aircraft in low- and medium-altitude maritime missions. The primary mission of the RDR-1500B is as an airborne search and surveillance radar system for sea search operations. Secondary missions include terrain mapping, weather avoidance, beacon navigation and display of navigation information from the aircraft navigation system. Weight: 34kg

RDR-1500B/1700

The RDR-1500B/1700 is an X-band land and sea surveillance radar designed for medium to low altitudes. Modes include surface search, terrain mapping and weather avoidance, while the system features an LCD colour display, map overlay, forward-looking infrared steering and display. The RDR-1700 has a 20-target tracker and interfaces for glass cockpit integration. Weight: 34kg Range: 295km

RDR-1600

The RDR-1600 is a SAR and weather avoidance radar system selected for Danish EH101s. The system provides a full-colour presentation of weather returns, pilot-selectable antenna tilt and scan angle auto, pitch/roll correction and built-in-test for a range of operational modes. These modes include weather detection and weather alert, SAR, surveillance, beacon detection and ground mapping. Length: 35.6cm Width: 12.7cm Weight: 14kg

RDR-1700

Telephonic's RDR-1700 is a lightweight, X-band and 360° digital colour radar system designed for fixed- or rotary-wing aircraft engaged in maritime patrol, surveillance, rescue missions and precision terrain mapping. The system can also be configured in numerous system configurations. Weight: 27kg

RDR-1700B(V)1 & AN/ZPY-4(V)1

The RDR-1700B(V)1 and AN/ZPY-4(V)1 radar systems are designed for maritime surveillance, tracking and classifying targets of interest in a range of applications, including: naval aviation, maritime police and border patrol as well as environmental and fisheries protection. The systems are capable of tracking multiple targets and can be found on fixed- and rotary-wing aircraft as well as UAVs, enhancing situational awareness. Modes include inverse synthetic aperture radar, synthetic aperture radar, weather detection and avoidance as well as SAR transponder beacon detection. Weight: 34kg Range: 46km

THALES UK

I-Master

I-Master is a lightweight synthetic aperture radar/ground moving target indication for tactical UAVs and small fixed- and rotary-wing platforms. I-Master is capable of wide-area, all-weather surveillance, detection, classification and location of fleeting as well as time-sensitive targets. The radar system has been installed on Royal Jordanian Air Force AC-235 and AC-295 gunships and British Army Watchkeeper UAVs. Height: 47cm Diameter: 37cm Weight: 30kg Range: 35km

THALES

CATS

The Compact Airborne Threat Surveyor (CATS) is a modular and compact radar and surveillance system offering real-time threat detection and geolocation of radar emissions for UAVs, helicopters or transport

aircraft. The CATS system provides real-time battlefield situational awareness, radar warning and immediate alert for multiple simultaneous pulse, pulse-Doppler and continuous-wave emitters associated with air and surface threats, electronic support measures functions with onboard data recording, EW core system management with multi-sensor data fusion and optimisation of countermeasures. Weight: 15kg

DAV

Thales' DAV warning and surveillance radar enable the crew to detect, track, identify and designate air threats from a safe distance. The system is installed above the helicopter rotor to enable 360° situational awareness with 24° elevation. This has been designed to enable operation whilst the helicopter is partially masked, taking cover behind natural obstacles. Weight: 60kg

ENR

The NH90 NATO Frigate Helicopter is equipped with the European Navy Radar (ENR) developed by Thales in conjunction with Airbus and Leonardo.

Horizon

Horizon is an I-band, long-range ground surveillance radar. The primary sensor is mounted on the AS532 UL Cougar and feeds information to a ground station in a 5t truck via a data link. The frequency coverage of the Horizon system is 8-12GHz (I/G-band) with operating modes including high-resolution ground mapping, moving target indication, fixed echo indication and ELINT. The system's resolution is 40m in range and 2m/s in velocity.

Ocean Master

The Ocean Master is a sea surveillance and patrol radar for the detection of all types and sizes of targets in all sea states. It has been sold to the French Navy and export customers. The wide-band frequency agility of the Ocean Master claims to make it resistant to countermeasures and improves detection performance in sea clutter. The three line-replaceable unit system comprises one exciter/receiver processor, one transmitter and one antenna unit. The system is capable of installation on fixed- and rotary-wing aircraft. Weight: 85kg Range: 445km

Searchmaster

The Searchmaster is an airborne multirole surveillance radar that employs an AESA antenna and is derived from qualified technologies developed for the RBE2 radar of the Dassault Rafale combat aircraft. It offers threat detection over land or sea and in all weather conditions. Its compact, lightweight design allows the system to be integrated on a range of platforms. Weight: 75kg Range: 370km

SURVEILLANCE AND MARITIME PATROL

ARRAY SYSTEMS COMPUTING

SurSAR

The Surveillance Synthetic Aperture Radar (SurSAR) system is a real-time, high-resolution, coherent X-band imaging radar for commercial and military applications. The SurSAR is derived from UPD-8/9 systems that were primarily used by USAF and USMC RF-4s. It combines a proven US military synthetic aperture radar with a COTS scalable generic processor that produces detailed images of stationary and moving targets at long ranges, recording them for in- or post-flight analysis. Its computer operates on the open-source Linux system.

TriSAR

The Tri-mode Synthetic Aperture Radar (TriSAR) is a real-time, high-resolution synthetic aperture radar designed to meet land and maritime surveillance requirements. Configurations are available for fixed-wing aircraft, helicopters and UAVs. Its three imaging modes are strip map, inverse synthetic aperture radar and spotlight synthetic aperture radar. Missions include maritime and harbour surveillance, ice surveillance, fisheries patrol, exclusive economic zone enforcement, border surveillance, SAR, environmental surveillance (such as oil slick detection) and battle damage assessment.

ASELSAN

Sarper

The Sarper synthetic aperture radar is capable of operation under all weather conditions. This enables radar imaging and moving target detection even in cloudy and rainy weather by day and night. Sarper supports stripmap mode for wide-area imaging, spotlight mode for high-resolution imaging, ground moving target indication mode, inverse synthetic aperture radar, sea search mode and integration with manned and unmanned air vehicles. Range: 40km

ELTA SYSTEMS

ELI-3360 G5000 MPA

The ELI-3360 G5000 maritime patrol aircraft (MPA) radar is a long-range multirole MPA solution that is designed to provide a comprehensive multi-mission, all-weather solution for exclusive economic zones and long-range maritime security, ASW, anti-surface warfare, environmental control and SAR. The system has been designed to fit the high-end class of business jets such as the Bombardier Global 5000. Range: 9,630km

ELM-2022A

The ELM-2022A is a maritime surveillance radar family which can be used for long-range surveillance and ASW, navigation and weather, maritime moving target indication and Doppler-beam sharpening. Additionally, inverse synthetic aperture radar and range profile classification, synthetic aperture radar and beacon interrogation are also options. Specific tasks the radar system is designed to perform include littoral warfare operations, maritime surveillance and patrols in exclusive economic zones, SAR, as well as anti-drug enforcement operations, coast guard and fisheries patrol. Weight: 100kg

ELM-2022ES

The ELM-2022ES is an airborne maritime surveillance radar designed to accommodate fixed-wing maritime patrol aircraft, maritime support helicopters and UAVs. The radar performs mechanical horizontal scanning

and electronic vertical scanning. It can generate both synthetic aperture radar and inverse synthetic aperture radar imagery. It also includes ground moving target indication. The ELM-2022ES' range is in the region of 370km. Weight: 120kg Range: 370km

ELM-2022H

The ELM-2022H is the helicopter maritime patrol radar variant of the ELM-2022 family. Weight: 85kg

ELM-2022ML

The ELM-2022ML is a lightweight X-band maritime airborne surveillance radar from the ELM-2022 family. The synthetic aperture radar has been designed to carry out both day and night missions in all weather conditions. Weight: 50kg

ELM-2022U

The ELM-2022 maritime patrol radar system consists of a UAV payload and a ground operator station that controls the radar's operation and processes the data sent by the payload via the UAV's data link. Weight: 75kg

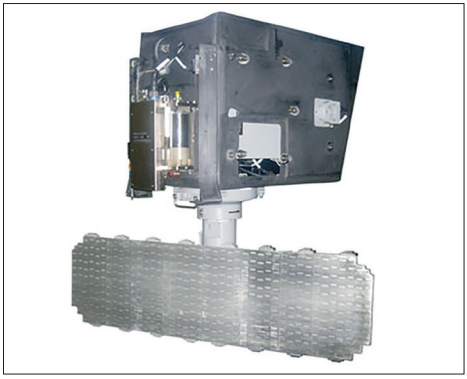
ELM-2054

The ELM-2054 is a lightweight synthetic aperture radar/ground moving target indication sensor for small tactical UAVs and similar applications, providing a solution for all-weather, air-to-surface ISTAR applications from manned or unmanned airborne platforms. The ELM-2054 can be configured for a range of platforms from UAVs and ultra-light reconnaissance aircraft to tactical aerostats. Applications include surveillance, battle damage assessment and target acquisition, protection of borderlines and key facilities, anti-terror warfare, counter-narcotics and smuggling prevention and monitoring of disaster areas. Weight: 15kg Range: 12km

ELM-2055 SAR/GMTI

The ELM-2055 provides all-weather, all-visibility, air-to-surface ISTAR for manned and unmanned airborne platforms. Together with the ELS-8994 GES, the ELM-2055 can be used for applications such as ISTAR, protection of borders and strategic assets, anti-terror warfare, smuggling and counter-narcotics, cartography, forensic investigation and disaster relief operations. Weight: 58kg

The AN/APY-11 multi-mode radar performs 360˚ azimuth surface surveillance, classification and synthetic aperture radar imaging. (Photo: Harris Electronic Systems)



ELM-2060P

The ELM-2060P is a synthetic aperture radar/ground moving target indication (GMTI) reconnaissance system for combat aircraft with three basic operating modes. Strip mode provides fast coverage of large areas at stand-off ranges plus overall assessment of a region with sufficient mapping detail for target detection; spot mode provides detailed examination of a designated area of interest with high resolution for target classification; and strip/GMTI mode allows moving targets to be highlighted on top of the strip synthetic aperture radar image. Weight: 590kg Range: 170km

ELM-2060T

The ELM-2060T is a synthetic aperture radar/ground moving target indication (GMTI) reconnaissance system for transport aircraft offering strip, spot and strip/GMTI modes. Strip mode provides fast coverage of large areas at stand-off ranges and overall assessment of a region with sufficient mapping detail for target detection. Spot mode enables detailed examination of a designated area of interest with high resolution for target classification.

ELW-2085 CAEW

The ELW-2085 is Elta's third-generation Conformal Airborne Early Warning and Control (CAEW) system. It is mounted on a modified Gulfstream G550 business jet. Elta's integrated sensor suite, with its communications system, supports missions such as long-range air surveillance, airborne C4I for air and naval operations, airborne C2 post and net-centric warfare operations/communication node.

GENERAL ATOMICS AERONAUTICAL SYSTEMS

Lynx

Lynx is a high-resolution synthetic aperture radar with ground moving target indication (GMTI), dismount MTI (DMTI) and maritime capability. Operating in the Ku-band, it produces 'photographic-quality' imagery with selectable resolution. A combat-proven system, it offers change detection capability. Synthetic aperture, spotlight and strip map modes are available, along with arc scan and spot scan GMTI and DMTI. Designed for use on manned and unmanned systems, including aerostats, it is approved by the US government for export to NATO and coalition forces. Weight: 52kg Range: 80km

HARRIS ELECTRONIC SYSTEMS

Airborne CMMR

The Airborne Compact Multi-Mode Radar (CMMR) is a small, lightweight, lower-price version of the mature X-band radar system originally designed by ELTA (ELM-2022). Harris and ELTA have teamed up to manufacture and provide technical and logistics support in the US. The CMMR is primarily intended for operation on helicopters and UAVs. Additionally, the

CMMR's receiver processor is in use worldwide as a component on several airborne radar products.

Airborne MMR

The Airborne Multi-Mode Radar (MMR) is a mature X-band radar system originally designed by ELTA (ELM-2022). Harris and ELTA have teamed up to manufacture and provide technical and logistics support in the US.

AN/APY-11

The AN/APY-11 multi-mode radar performs 360° azimuth surface surveillance, classification and synthetic aperture radar imaging. The multi-mode radar automatically detects and tracks targets, including signals from emergency beacons (SAR transponder). The radar also integrates with the identification friend or foe transponders, automatic dependent surveillance-broadcast and automatic identification systems. It can provide cueing for EO and IR payloads. The system tracks up to 5,000 targets up to an instrumented range of 370km.
Range: 370km

LEONARDO DRS

AN/APQ-170

The AN/APQ-170 is a multi-mode radar fitted to USAF MC-130H Combat Talon II special operations aircraft. The system is used for terrain following/avoidance, weather mapping and avoidance, navigation and beacon interrogation. The radar allows aircraft to safely operate at altitudes as low as 250ft in adverse weather conditions.

AN/APQ-175

The AN/APQ-175 is a dual-band radar at the heart of the adverse weather aerial delivery system fitted to USAF C-130 Hercules transport aircraft. As well as being able to image major terrain features and man-made structures, it is used for long-range and precision ground mapping, weather detection and beacon interrogation/reception.

LEONARDO ELECTRONICS

Gabbiano

The Gabbiano family is a range of X-band airborne radars for surveillance over ground, along coasts and at sea in all weather conditions. The radar supports a range of missions: homeland surveillance against drug trafficking, smuggling, illegal immigration and terrorism; EEZ protection; environmental surveillance (oil and hazardous material spills, wildlife protection); maritime patrol and SAR operations; CSAR; and support of covert operations by SF (day, night and all-weather). Weight: 62kg

Gabbiano TS Ultra-Light

The Gabbiano TS Ultra-Light (UL) is a surveillance radar for uncrewed aircraft. The multi-mode, multi-mission, mechanically scanning radar is Leonardo's lightest surveillance radar. Its compact size and reduced weight make it suitable for integration onto mini-class UAVs such as Leonardo's Hero as well as small fixed- and rotary-wing aircraft. Weight: 24kg

HEW-784/APS-748E

The X-band HEW-784/APS-748E is a pulse-Doppler surveillance radar designed for the airborne early warning and control version of the Leonardo AW101 helicopter used by the Italian Navy. It can perform 360° surveillance and has an integral identification friend or foe interrogator. When operating in air-to-air mode, the radar can track around 128 targets, with up to 64 being tracked when the radar is performing surface surveillance.

MM/APS-784

The MM/APS-784 is a maritime search radar for the Italian Navy's AW101, originally designed and manufactured by Eliradar, a consortium set up by FIAR and Officine Galileo. It is designed to detect small objects such as submarine periscopes against heavy sea clutter, rain and ECM. Modes include anti-surface warfare (ASuW) and ASuW long-range (including missile launch assistance), anti-submarine warfare (periscope detection), weather avoidance as well as short-range detection and navigation.

Osprey 30

The Osprey multi-mode surveillance radar is a low SWaP system that provides an affordable second-generation AESA surveillance capability as the primary sensor on airborne assets to meet the challenges of the 21st century. Osprey remains the only system of its type currently available which delivers full spherical coverage with no moving parts, allowing the radar to be installed on platforms where a rotating antenna would be unsuitable. The system can be easily and flexibly integrated and features various innovative scanning modes allowing optimisation of sensor positioning and operation to deliver effective multi-domain capability. Length: 20.6cm Width: 51cm Height: 23cm Weight: 28kg Range: 371km

Osprey 50

Osprey 50 is a larger-aperture variant of the international successful Osprey 30 model. It is the largest and most capable variant in the radar family providing enhanced performance for overland, maritime and air-to-air missions. It is ideally suited to medium and large aircraft that require superior multi-mode and multi-domain surveillance radar capability and that can provide the additional space and power needed to operate Osprey 50.

PicoSAR

The PicoSAR radar is an overland-focused multi-mode electronically scanned surveillance radar. PicoSAR has a compact and lightweight (10kg) form factor for installation on platforms with limited payload capacity. It has been integrated on both crewed and uncrewed platforms. PicoSAR delivers high-resolution synthetic aperture radar imaging and ground moving target indication capability. Length: 13cm Width: 20cm Height: 22cm Weight: 10kg Range: 20km

PicoSTAR

The PicoSTAR radar is designed to provide a compact, lightweight, integrated AESA radar and EO capability for UAVs and other small fixed- or rotary-wing platforms. Twin AESA modules can be mounted up to two metres

away from the central EO/processing unit to enable integration on different platform configurations. The EO subsystem uses a Swan II dual-mode imaging sensor together with a conventional zoom/e-zoom TV sensor.

Seaspray 7000E

The Seaspray 7000E is an AESA radar for helicopters, fixed-wing aircraft and UAVs. It combines AESA with a COTS-based processor to deliver a range of surveillance capabilities covering air-to-surface, air-to-air and air-to-ground environments. Weight: 86kg Range: 590km

Seaspray 7300E V2

The Seaspray 7300E V2 radar is a maritime-focused multi-mode surveillance radar. The 7300E V2 uses composite electronic and mechanical scanning in a gimbal configuration with an updated processor from the Osprey radar family. The 7300E V2 has the ability to rapidly interleave radar modes for effective multitasking operation. The radar mode suite comprises: ground moving target indication, spot/strip synthetic aperture radar, air surveillance modes and maritime capabilities, including inverse synthetic aperture radar and detection of small maritime targets in high-clutter environments. The Seaspray 7300E has been integrated on the AW159 helicopter, maritime patrol aircraft and multi-mission aircraft. Weight: 110kg Range: 592.64km

Seaspray 7500E V2

The Seaspray 7500E V2 radar is a long-range, maritime-focused multi-mode surveillance radar. The 7500E V2 uses composite electronic and mechanical scanning in a gimbal configuration with an updated processor from the Osprey radar family. The 7500E V2 has the ability to rapidly interleave radar modes for effective multitasking operation. The radar mode suite comprises: ground moving target indication, spot/strip synthetic aperture radar, air surveillance modes and maritime capabilities, including inverse synthetic aperture radar and detection of small maritime targets in high-clutter environments. The Seaspray 7500E has been integrated on maritime patrol aircraft, multi-mission aircraft and remotely piloted aircraft systems. Height: 56.5cm Weight: 110kg Range: 592.64km

LOCKHEED MARTIN

Advanced Imaging Radar System

The Advanced Imaging Radar System is a synthetic aperture radar developed from the ASARS-1 sensor used in the Lockheed SR-71 Blackbird. The system offers swath, fixed or moving target indication and navigation modes. Range: 185km

AN/APS-145

The AN/APS-145 is a high-power UHF Doppler radar fitted to the Northrop Grumman E-2C Hawkeye 2000 airborne early warning and control aircraft and can also be fitted to the C-130 Hercules transport aircraft. The radar has a range of around 550km and can track 20,000 targets simultaneously. The AN/APS-145 uses a rotating antenna within a circular radome mounted atop the aircraft to detect and track multiple threats at sea, in the air, over land and at the critical land-sea interface simultaneously. Range: 500km

ASARS-3

The Advanced Synthetic Aperture Radar System-3 (ASARS-3) is a 75kg payload providing Ku-band synthetic aperture radar and ground moving target indication capabilities for high-altitude and medium-range operations, used in conjunction with EO/IR full-motion video, target identification and tactical surveillance. An earlier version of the system is carried by U-2 reconnaissance aircraft; this new version may be installed on the platform. Weight: 75kg

L-88(V)3

The L-88(V)3 is the latest variant of a family of radars developed for use in aerostats for coastal surveillance. The system uses commercial technology to improve performance and reduce weight. The 8.8m radar antenna rotates within a fabric windscreen to provide 360° coverage. Length: 370cm

STacSAR

The Small Tactical Synthetic Aperture Radar (STacSAR) was developed for use on UAVs or small manned aircraft. Range: 10km

NORTHROP GRUMMAN

AN/APN-241

The AN/APN-241 is a high-resolution ground mapping radar developed for C-130 mission and operational requirements. It enables accurate low-level navigation and precision aerial drops, predictive wind shear detection in all weather conditions and situational awareness for all-weather formation flying. The system has been fielded on C-130H, C-130J, C-27J and C295 transport aircraft.

AN/APQ-156

The AN/APQ-156 is a multifunction tactical radar fitted to USMC and USN EA-6B Prowler EW aircraft. The platform is capable of search mapping, targeting, terrain following, terrain avoidance and beacon tracking. It is a member of the same family as the AN/APQ-148 and AN/APS-130.

AN/APQ-164

The AN/APQ-164 phased-array, multi-mode, pulse-Doppler, offensive radar system is integrated into USAF B-1B strategic bombers. The system performs navigation, terrain following/avoidance and weapon delivery functions, along with ground moving target indication, beacon interrogation and air refuelling rendezvous. The USAF awarded Northrop Grumman a $65 million Reliability and Maintainability Program base contract in September 2010 for 22 modification kits, along with test benches, spares, repairs and technical data and services.

AN/APS-504(V)

The AN/APS-504(V) is a multi-mode maritime patrol radar with surface search, anti-submarine warfare, ground-stabilised search, weather and weather contour and beacon modes. The travelling-wave tube transmitter features frequency agility, two surface acoustic wave-based pulse compression modes, three pulse modes. The system offers selectable constant false alarm rate processing, pulse-to-pulse integration, selectable scan-to-scan integration and sector scanning, plus multiple

(20-target) track-while-scan capability. The parabolic or high-performance flat-plate antenna is stabilised on two axes. The radar is in service on CN-235 Persuader maritime patrol aircraft operated by Irish, Spanish and Turkish forces. Range: 370km

AN/APY-3

The AN/APY-3 is a large, phased-array, ground surveillance, side-looking airborne radar with synthetic aperture radar/moving target indication (MTI) capability. It is the primary sensor of the USAF/US Army Joint Surveillance Target Attack Radar System in the E-8A, a converted Boeing 707. The radar has a frequency of 8-10GHz, and its operating modes include MTI wide-area surveillance, MTI sector search and synthetic aperture radar fixed target indication. The Radar Technology Insertion Program will add a more powerful radar, higher resolution and concurrent synthetic aperture radar and MTI modes. Range: 250km

AN/ASQ-236

The AN/ASQ-236 synthetic aperture radar pod can be used to assist cartography, generate bomb damage assessments and perform general day and night surveillance. The pod outfits the USAF's F-15E Strike Eagle combat aircraft. In March 2013, Northrop Grumman was awarded a $30 million contract to support the firm's AN/ASQ-236 radar pod. Length: 330cm Width: 50cm Height: 50cm Weight: 454kg

AN/ZPQ-1 TESAR

The AN/ZPQ-1 Tactical Endurance Synthetic Aperture Radar (TESAR) lightweight SAR and associated ground station provides continuous imagery onboard the Predator Tier II UAV. TESAR was first deployed in a peacekeeping mission in Bosnia in 1996 and was also used over Kosovo and other locations.
Weight: 75kg

AN/ZPY-1 STARLite

The AN/ZPY-1 Small Tactical Radar-Lightweight (STARLite) is a synthetic aperture radar/ground moving target indication (GMTI) sensor for UAVs and manned platforms that support tactical operations. It is under contract to US Army Communications-Electronics Command for its MQ-1C Gray Eagle programme. Weighing 30kg, it offers strip and spot synthetic aperture radar modes as well as GMTI, with maritime MTI capability under development. It occupies 0.03m^3 of volume and draws less than 750W of power. Weight: 30kg

AN/ZPY-5 VADER

The Vehicle and Dismount Exploitation Radar (VADER) is being developed for use with the Sky Warrior UAV to enable accurate ground moving target indication data and synthetic aperture radar imagery to be made available to ground commanders in real-time. The antenna is designed to support multiple missions, including detection of dismounted personnel, and to facilitate the exploitation of this data.

OPTIMARE

Optimare SLAR

The Optimare Side-Looking Airborne Radar (SLAR) – unveiled in June 2015 – is used to detect oil spills from long ranges, find maritime targets, perform surveillance of fishing activities and detection and mapping of speedboat wakes. The lightweight, wide-band, cloud-penetrating radar can be used for the detection and mapping of maritime areas. Available as a standalone system or as part of the Aerodata OctoPod, it has a swath width of 60-80km. Length: 331cm Width: 37cm Height: 15cm Weight: 16kg

PHAZOTRON NIIR

Gukol 4

The Gukol 4 is a weather, navigation and terrain-avoidance radar for military transport aircraft.
Range: 600km

Kopyo-21I

The Kopyo-21I is a multi-mode radar fitted to Indian MiG-21bis UPG strike fighters. Phazotron describes it as a fourth-plus generation radar that meets the requirements of the latest light multirole combat aircraft. It is the first in a new modular family that includes the Kopyo-25, Kopyo-A and Kopyo-M.
Range: 200km

Kopyo-A

The Kopyo-A is a multipurpose 360° radar intended for helicopters and designed for coastal monitoring, search and detection of sea surface and ground targets, including small targets (boats, cutters, periscopes); search and detection of air targets; identification and tracking of up to ten targets; weather mapping and avoidance. The system is a candidate for the upgrade of the Indian Navy's Ka-28s and is believed to be installed on the Russian Navy's Ka-27 naval helicopters. Weight: 100kg Range: 250km

Kopyo-M

The Kopyo-M is similar to Kopyo-21I, but due to modifications, including a new signal processor, its detection range against air targets is 25% greater as it generates maps in synthetic aperture radar mode in half the time, according to the company. Phazotron also claims greater reliability, lower weight and smaller size and offers it for a further upgrade of the MiG-21bis and similar aircraft. Range: 150km

PJSC KIEV RADAR PLANT

Osminog-E

The Osminog-E anti-submarine warfare suite has been designed for synthetic aperture radar and tracking applications, as well as submerged, surfaced and radar-visible targets. The Osminog-E is installed on the Ka-27 and Ka-28 naval helicopters. The system includes a radar station to observe the surface and navigational tracks, as well as a dipping sonar for the detection of underwater objects.

RAYTHEON SPACE & AIRBORNE SYSTEMS

AN/APQ-174/186 MMR

The AN/APQ-174/186 Multi-Mode Radar (MMR) family provides terrain following and terrain avoidance for a variety of military aircraft. The MMR allows safe flight down to a 100ft clearance at night in adverse

weather and in high-threat environments. It lowers the probability of detection by enemy forces and increases mission success through terrain masking and minimising time spent in threat range. Length: 109cm Width: 33cm Weight: 113kg

SeaVue

SeaVue is a family of maritime surveillance radars. The systems use colour or monochrome flat-panel displays, plan position indicators and B-scan presentations and multiple high-resolution video formats. In addition, SeaVue features inverse synthetic aperture radar imaging and range profiling (A-scan) as well as moving target detection. Weight: 37kg Range: 0km

SeaVue XMC

SeaVue is a maritime and overland radar system that provides surveillance for fixed-wing, helicopter, ship and land-based applications. Over 150 SeaVue radars are operational worldwide. Incorporating a maritime situational awareness package developed under the Ocean Surveillance Initiative programme, the SeaVue XMC radar provides operators with wide-area situational awareness to support tactical decision-making with the aim of improving mission effectiveness and operational efficiency.

RAYTHEON

AN Series

The AN series of radars from Raytheon include linear frequency modulation, fixed or agile anti-submarine warfare and anti-surface warfare radars derived from the AN/APS-137, which was installed on the Lockheed P-3 Orion aircraft. They are designed for the detection of periscopes exposed for under five seconds. The modes for the series include periscope and small target, surface surveillance, navigation and weather alert. The image antenna is stabilised, with 360° scan, six, 60 and 300rpm sector scans and 34.5dB gain transmitter. Range: 315km

AN/APQ-180

Used on the AC-130U Spectre gunship operated by the US SF, the AN/APQ-180 is a modification of the APG-70 and has fixed target track, ground moving target indication and track, projectile impact point position, beacon track and weather modes. The APG-70 antenna and analogue signal processors were modified and added to complete the APQ-180 system.

AN/APQ-181

The AN/APQ-181 is a low-probability-of-intercept radar fitted to USAF Northrop Grumman B-2 stealth bombers. During the B-2 Radar Modernization Program – completed in 2012 – the B-2's legacy 2D scanned antenna and transmitter were replaced with an AESA antenna and the operating frequency was changed to avoid conflicts with other RF spectrum users. The radar's frequency is 10-20GHz, and the system delivers capability in two separate radar mode sets.

AN/APS-124

The AN/APS-124 is a long-range maritime search and targeting radar, originally developed for USN Sikorsky SH-60 Seahawk helicopters. It features a high mean output power, clutter rejection for detection of small targets in high sea states, a digital scan converter for scan-to-scan integration and a data link for communication. Additionally, it can operate in a ship-helicopter team for missile targeting and submarine hunting.

AN/APS-137B(V)5

The AN/APS-137B(V)5 is a maritime patrol radar fitted to the USN's P-3C Orion as part of the Anti-Surface Warfare Improvement Program. It provides both multi-resolution synthetic aperture radar and inverse synthetic aperture radar (ISAR), allowing performance over the land, sea and in littoral regions. Current operational capabilities include long-range surface search/target tracking, periscope detection in high sea states, ship imaging and classification using ISAR and synthetic aperture radar for overland surveillance, ground mapping and targeting.

AN/APY-10

The AN/APY-10 airborne maritime surveillance radar equips the USN's Boeing P-8A Poseidon maritime patrol aircraft. The radar is a direct descendant of Raytheon's AN/APS-149 Littoral Surveillance Radar, which equips the Lockheed Martin P-3C Orion. The P-8A is intended to replace the P-3C. The AN/APY-10 radar uses an AESA antenna to gather synthetic aperture radar and inverse synthetic aperture radar imagery over land and water. It is thought to be an X-band system based on its AN/APS-149 lineage.

ASARS-2

The Advanced Synthetic Aperture Radar System-2 (ASARS-2) equips the USAF U-2 high-altitude reconnaissance aircraft. ASARS-2 is a real-time, high-resolution reconnaissance system with all-weather, day/night, long-range mapping capabilities. The system detects and locates fixed and moving ground targets. It gathers detailed information, formats the data and transmits high-resolution images. Raytheon is currently delivering upgrades under the ASARS Improvement Program.

ASTOR

The Airborne Stand-Off Radar (ASTOR) is a battlefield surveillance synthetic aperture radar/moving target indication (MTI) system installed in the UK RAF's Raytheon Sentinel R1 aircraft, a version of the Bombardier Global Express business jet developed for the ASTOR programme by Raytheon. The radar is a variant of ASARS-2. synthetic aperture radar provides high-resolution images for decision-makers, and MTI monitors quantity, direction and speed of hostile forces. Range: 300km

HISAR

Hughes Integrated Surveillance and Reconnaissance (HISAR) is a border surveillance, remote sensing and maritime patrol radar with ground mapping, moving target indication and synthetic aperture radar capability. It has been installed on Global Hawk UAVs and RC-7 and Beechcraft 200 King Air platforms. It is related to radars used in the Lockheed U-2 and Northrop Grumman B-2 aircraft. Strip synthetic aperture radar mode offers 6m resolution, while spot synthetic aperture radar offers 1.8m. The system can also detect oil spills. Range: 50km

The Swiss Air Force's FLORAKO (FLORIDA Radarersatz Radarluftlagesystem Kommunikationssystem) air defence system comprises several subsystems. (Photo: Swiss Air Force)

SANDIA NATIONAL LABORATORIES

MiniSAR

The MiniSAR weighs 12kg and is made up of the antenna/gimbal assembly and the radar electronics assembly, measuring about 18cm on either side. The system's current mode is spot synthetic aperture radar, with plans to include strip map mode and ground moving target indication. Waveform synthesiser: 3U, compact peripheral component interconnect, field-programmable gate array and quadrature outputs (1.2GHz clock, agile, programmable). Length: 18cm Width: 18cm Weight: 12kg

SWISS AIR FORCE

FLORAKO

The Swiss Air Force's FLORAKO (FLORIDA Radarersatz Radarluftlagesystem Kommunikationssystem) air defence system comprises several subsystems, including Link 16 and radar systems to create a C2 system. FLORAKO is capable of correlating civilian and military data feeds in real-time, enhancing the quality of the airspace picture and reducing decision-making times for operators.

TELEPHONICS

AN/APS-128/128D

The AN/APS-128 is a digital maritime surveillance radar fitted to a variety of fixed-wing aircraft using different radome and antenna shapes and sizes. Parabolic and flat-plate antennas are in service. Range: 222km

AN/APS-143C(V)3 OceanEye

The APS-143C(V)3 is a family of maritime surveillance, tracking and imaging radars. Features include 46-frequency pulse-to-pulse agility, track-while-scan of up to 200 targets, five-colour weather avoidance mode and sea moving target indication. Additionally, it has integral identification of friend or foe, built-in display/control generator, scan-to-scan integration and SAR transponder beacon detection. Weight: 84.4kg Range: 8.53km

AN/APS-147

The AN/APS-147 is a multi-mode maritime inverse synthetic aperture radar for the Sikorsky MH-60R. It provides target imaging, small target/periscope detection and long-range surveillance, as well as weather avoidance, all-weather navigation, short-range SAR and target designation. The system uses data processing, a high-throughput signal and is capable of detecting small targets and displaying them in a high-resolution format.

AN/APS-153(V)1

The AN/APS-153(V)1 was designed by Telephonics to meet the requirements of the maritime military helicopter environment. It is rugged and lightweight with low prime power and is capable of small target detection, high-resolution imaging and long-range surface search. The system provides the MH-60R and its host ship with littoral and maritime domain awareness.

AN/APS-508

The AN/APS-508 – fielded under the Royal Canadian Air Force's CP-140 Aurora Incremental Modernization Project – integrates ASW, anti-surface warfare, maritime patrol, overland air-to-ground synthetic aperture radar and ground moving target indication functionality into a single radar. The sensor suite is designed for upgraded or new production platforms where the user must fly multiple missions with a single aircraft. The APS-508 provides fine resolution and frequency agility. The three-channel receiver uses analogue and digital pulse compression, depending on mode.

APS-143G & AN/APS-508

Telephonics' APS-143G and AN/APS-508 multi-mission ISR radar systems combine maritime, littoral and land surveillance capabilities with an integrated identification friend or foe interrogator. This COTS-based radar is designed for medium to large fixed-wing aircraft on long-range surveillance missions over sea or land and in the air. Weight: 146kg

RDR-1500B/1700

The RDR-1500B/1700 is an X-band land and sea surveillance radar designed for medium to low altitudes. Modes include surface search, terrain mapping and weather avoidance, while the system features an LCD colour display, map overlay, forward-looking infrared steering and display. The RDR-1700 has a 20-target tracker and interfaces for glass cockpit integration. Weight: 34kg Range: 295km

RDR-1600

The RDR-1600 is a SAR and weather avoidance radar system selected for Danish EH101s. The system provides a full-colour presentation of weather returns, pilot-selectable antenna tilt and scan angle auto, pitch/roll correction and built-in-test for a range of operational modes. These modes include weather detection and weather alert, SAR, surveillance, beacon detection and ground mapping. Length: 35.6cm Width: 12.7cm Weight: 14kg

RDR-1700

Telephonic's RDR-1700 is a lightweight, X-band and 360° digital colour radar system designed for fixed- or rotary-

wing aircraft engaged in maritime patrol, surveillance, rescue missions and precision terrain mapping. The system can also be configured in numerous system configurations. Weight: 27kg

RDR-1700B(V)1 & AN/ZPY-4(V)1

The RDR-1700B(V)1 and AN/ZPY-4(V)1 radar systems are designed for maritime surveillance, tracking and classifying targets of interest in a range of applications, including: naval aviation, maritime police and border patrol as well as environmental and fisheries protection. The systems are capable of tracking multiple targets and can be found on fixed- and rotary-wing aircraft as well as UAVs, enhancing situational awareness. Modes include inverse synthetic aperture radar, synthetic aperture radar, weather detection and avoidance as well as SAR transponder beacon detection. Weight: 34kg Range: 46km

THALES UK

I-Master

I-Master is a lightweight synthetic aperture radar/ground moving target indication for tactical UAVs and small fixed- and rotary-wing platforms. I-Master is capable of wide-area, all-weather surveillance, detection, classification and location of fleeting as well as time-sensitive targets. The radar system has been installed on Royal Jordanian Air Force AC-235 and AC-295 gunships and British Army Watchkeeper UAVs. Height: 47cm Diameter: 37cm Weight: 30kg Range: 35km

THALES

Agrion

Agrion is a surveillance and missile targeting pulse radar from the Iguane family. Missions include anti-surface warfare (search, surveillance, over-the-horizon targeting for friendly ship-launched missiles, automatic guidance for the helicopter's own missiles), SAR, environmental protection, navigation and weather avoidance. The radar features a paraboloid antenna with other types as options, pulse compression, frequency agility and ECM resistance.

Anemone

The Anemone is a multifunction radar developed as an upgrade for the French Navy's Super Étendard carrier-borne strike aircraft. Air-to-surface surveillance and targeting is its primary function, in which it feeds target data to the Exocet missile, but it also has air-to-air and ground mapping functions. It is a monopulse radar with a low sidelobe slotted flat-plate antenna and track-while-scan capability.

CATS

The Compact Airborne Threat Surveyor (CATS) is a modular and compact radar and surveillance system offering real-time threat detection and geolocation of radar emissions for UAVs, helicopters or transport aircraft. The CATS system provides real-time battlefield situational awareness, radar warning and immediate alert for multiple simultaneous pulse, pulse-Doppler and continuous-wave emitters associated with air and surface threats, electronic support measures functions with onboard data recording, EW core system management with multi-sensor data fusion and optimisation of countermeasures.
Weight: 15kg

ENR

The NH90 NATO Frigate Helicopter is equipped with the European Navy Radar (ENR) developed by Thales in conjunction with Airbus and Leonardo.

Horizon

Horizon is an I-band, long-range ground surveillance radar. The primary sensor is mounted on the AS532 UL Cougar and feeds information to a ground station in a 5t truck via a data link. The frequency coverage of the Horizon system is 8-12GHz (I/G-band) with operating modes including high-resolution ground mapping, moving target indication, fixed echo indication and ELINT. The system's resolution is 40m in range and 2m/s in velocity.

Iguane

The Iguane is a frequency agile, pulse compression maritime surveillance radar with search and rescue capability. Missions include anti-submarine warfare, anti-surface warfare, search and rescue, environmental monitoring and weather avoidance. The system has been installed on ATL3 Atlantique maritime patrol aircraft of the French Navy.

Ocean Master

The Ocean Master is a sea surveillance and patrol radar for the detection of all types and sizes of targets in all sea states. It has been sold to the French Navy and export customers. The wide-band frequency agility of the Ocean Master claims to make it resistant to countermeasures and improves detection performance in sea clutter. The three line-replaceable unit system comprises one exciter/receiver processor, one transmitter and one antenna unit. The system is capable of installation on fixed- and rotary-wing aircraft. Weight: 85kg Range: 445km

Searchmaster

The Searchmaster is an airborne multirole surveillance radar that employs an AESA antenna and is derived from qualified technologies developed for the RBE2 radar of the Dassault Rafale combat aircraft. It offers threat detection over land or sea and in all weather conditions. Its compact, lightweight design allows the system to be integrated on a range of platforms. Weight: 75kg Range: 370km

Super Searcher

Super Searcher is a maritime surveillance radar with modes including surveillance, weather and ground mapping. Planar and paraboloid reflector types are available for antennas. Weight: 85kg

EQUIPMENT

GROUND RADAR SYSTEMS

This section contains data on a selection of radar systems in the following categories:

- battlefield and ground surveillance
- land-based air defence

The equipment is listed alphabetically by manufacturer within the above subsections.

If you think your product should be listed, please contact the team at insight@shephardmedia.com to ensure it appears in the *Shephard Defence Insight* online database (shephardmedia.com/defenceinsight) and is included in the next handbook edition.

ABOVE: Radars transmit and receive high-frequency radio waves to detect and track things that you may not be able to see with a naked eye. (Photo: Lockheed Martin)

BATTLEFIELD AND GROUND SURVEILLANCE

ASELSAN

ACAR

The ACAR ground surveillance and artillery fire adjustment radar is a land-based system for detecting, classifying and tracking targets moving on or close to the ground or sea, mainly for security applications. The system can also be used for artillery fire adjustment purposes. ACAR is a man-portable, all-weather, day and night operable system. It is a Ku-band, pulse-Doppler radar employing pulse compression and digital signal processing techniques. It also has low peak output power, leading to low probability intercept characteristics.

Serhat

Aselsan's Serhat L-band counter-mortar radar has been designed for the purpose of detecting and tracking mortar shells to determine the point of origin and the point of impact. The radar covers 360° in azimuth. The counter-mortar radar has a modular design so that it can be used on a tripod, placed on a building or on a vehicle with an extendable mast. Range: 10km

BATS BELGIAN ADVANCED TECHNOLOGY SYSTEMS

GR05

The GR05 tactical ground surveillance radar family provides 360° coverage using a single rotating antenna. These radars can either be used remotely or networked into a larger group to provide coverage over a wider area. They can also track up to 200 targets and be used for a number of applications, including coastal and border protection and port and harbour security.

GR12

The GR12 is a family of radars using FM CW architecture. 360° azimuth coverage is provided by four antennas, each of which provides 90° azimuth coverage. The GR12 family includes the GR12/1, GR12/2.5, GR12/5, GR12/10 and GR12/15. The GR12/1 is a C-band radar that has a detection range of 1km for a pedestrian and up to 2km for a vehicle. The radar also has a range accuracy of under 10m and 2° of azimuth accuracy.

GR14

The persistent perimeter detection radar GR14 is a high-resolution system. It provides surveillance and instantaneous target detection as well as tracking within a radius in 90° increments: pedestrians at 500m and vehicles at 1,000m. The GR14 is intended as an affordable 24/7 solution with high MTBF. Intrusions are also marked on a GIS display.

GR20

The GR20 X-band radar can detect flying objects such as helicopters and ground targets (eg pedestrians and vehicles) and can be used for artillery fire control. Customers also have the option of increasing the radar's detection range by adding a power amplifier and an enlarged antenna.

GR40

The GR40 can be used for artillery fire control, along with the detection of ground targets such as pedestrians and vehicles, and airborne targets such as helicopters and low-flying aircraft. This X-band radar provides 25W of peak transmitting power. In terms of range, the GR40 can detect a pedestrian at 15km, a helicopter at 25km and a heavy vehicle at 60km when operating in surveillance mode. Weight: 65kg

GR80

The GR80 is a fifth-generation family of movement detection tactical ground surveillance radars. The radar enables a high probability of target detection and tracking to support complex missions. The GR80 is a solid-state, active electronically scanning phased-array multi-beam radar family operating under all weather conditions and providing accurate detection data, either locally or to remote C2 systems. Additionally, the GR80 has a high update rate.

BHARAT ELECTRONICS

BFSR-MR

The BattleField Surveillance Radar – Medium Range (BFSR-MR) is a ground-based surveillance and acquisition radar capable of detecting and displaying moving targets, including people, vehicles, tanks and low-flying helicopters. It supports artillery units by providing the location of shell bursts and fire correction data. The BFSR-MR is a pulse-Doppler radar with a parabolic reflector, pulse compression and a superhet receiver.

BFSR-SR

The BattleField Surveillance Radar – Short Range (BFSR-SR) is a man-portable, battery-powered surveillance and acquisition radar capable of detecting and displaying a variety of moving targets such as pedestrians, vehicles, tanks, etc. The radar can also be carried in three manpacks. Weight: 30kg

BLIGHTER SURVEILLANCE SYSTEMS

A400 Series Radars

Blighter's A400 series of air security radars are electronic-scanning, modular, non-rotating radar systems operating at Ku band. The A400 series builds on the company's Blighter B400 series of ground surveillance radars. The radar systems use a passive electronically scanned array and frequency modulated continuous wave technologies to provide reliable, slow and small drone detection in all weather conditions and in complex environments. Length: 12.8cm Width: 66.6cm Height: 50.3cm Weight: 25kg Detection range: 20,000m

B202 Mk 2

B202 MK 2 is a Ku band, man-portable, medium-range e-scan micro-Doppler ground surveillance radar. It detects moving vehicles and persons out to 8km. The system is aimed at defence, homeland security and civil/commercial markets. The B202 Mk 2 features integrated

Blighter B400-series radars are long-range movement detection sensors for fixed and mobile surveillance applications. (Photo: Blighter Surveillance Systems)

Vortex fast-scan technology, simultaneous Doppler and Frequency Modulated Continuous Waves (FMCW) processing whilst fast-scanning. Length: 0.16m Width: 0.47m Height: 0.44m Weight: 0.45kg Range: 8km

Blighter B400 Series Radars

Blighter B400-series radars are long-range movement detection sensors for fixed and mobile surveillance applications. Modular construction provides azimuth e-scan angles from 90° for a single unit up to a full 360° e-scan for four units. They can detect human intruders at ranges in excess of 10km and vehicles in excess of 20km. Blighter Surveillance Systems also produces the Blighter Revolution 360 – a lightweight mobile radar system for deployment on vehicle or trailer masts.

Blighter Explorer Nexus

In February 2017, Blighter Surveillance Systems announced the development of the Blighter Explorer Nexus, an integrated, battery-operated, man-portable radar/camera surveillance system designed for rapid deployment. The system can be transported in backpacks or vehicles for use in remote border surveillance, temporary camp protection, forward reconnaissance and other covert operations.

Orbiter

Orbiter is a Ku band ground surveillance radar developed by Blighter. The system employs 15.7 to 17.2 GHz E-scan Frequency Modulated Continuous Wave (FMCW) Doppler Ground Surveillance function. It is designed to be aimed at low-cost and lightweight mobile radar surveillance. The Orbiter builds on lower power consumption and ground cutter rejection capabilities of Blighter B400 series radars by incorporating an azimuth positioner unit, according to the manufacturer. It is fitted with W20S wide elevation beam antennas to offer maximum performance in compact size, with the 20° wide elevation beam aimed for mobile deployment in hilly and mountainous areas. Length: 0.13m Width: 0.67m Height: 0.5m Weight: 56kg Range: 32km

COLLINS AEROSPACE

PSR-500 Perimeter Surveillance Radar System

The PSR-500 is a high-resolution, compact radar system designed for perimeter surveillance. PSR-500 radars are designed to detect mobile targets in all weather conditions, including rain and fog, 24h a day. The radars are adapted to the surveillance needs of many types of sites because of their range and target behaviour analysis algorithms. Length: 0.37m Width: 0.15m Height: 0.05m Weight: 1.5kg

ECRIEE – EAST CHINA RESEARCH INSTITUTE OF ELECTRONIC ENGINEERING

JY-17

The JY-17 is a man-portable battlefield radar developed for detection, location and recognition of targets moving on the ground. This solid-state, tripod-mounted system can be operated remotely and features automation and signal-processing techniques. Antenna is of the flat-plate type.

JY-17A

The JY-17A radar is designed for detection, location and identification of moving targets on the ground or water surface and of aircraft at low altitude. It is a solid-state, coherent pulse-Doppler system that uses pulse compression and both linear and circular polarisation. The JY-17A can also be mounted on vehicles or sited independently.

ELBIT SYSTEMS EW & SIGINT – ELISRA

Foxtrack

Foxtrack is a man-portable, lightweight and compact ground surveillance radar system that can be carried by two operators. It functions in a tripod-mounted configuration or when installed onboard a vehicle or on a tower. Foxtrack is designed to provide surveillance at medium to long ranges (6km for pedestrians and 15km for small cars). Weight: 30kg

VWS Radar

The Vehicle Warning Systems (VWS) include: VWS 1, part of an active protection system (APS) for hard-kill applications, destroying the threat; and VWS 2, part of an APS for soft-kill applications, diverting the missile. The VWS is a continuous-wave radar designed for APS installed onboard light and heavily armoured vehicles and stationary applications. With a high probability of detection and low false alarm rate, the radar detects, classifies and automatically tracks antitank rockets and guided missiles. Weight: 30kg

ELETTRONICA

MUROS Family

The MUROS family of systems is grouped into surveillance, communication and mission control (MC) systems. MUROS surveillance systems are multi-sensor, based on radar, EO, IR and passive coherent location systems and provide persistent ground surveillance and real-time situational awareness. The systems detect, identify, classify and respond to missions along

borders or improve the safety and security of public and industrial infrastructure. The MUROS communication family is designed to break into communication networks to provide information superiority.

ELTA SYSTEMS

ELL-8388

The ELL-8388 is a 3D ESM/ELINT surveillance system for tactical and strategic intelligence collection and air defence support. It creates a 3D situation picture by providing location and dynamic tracking of airborne, shipborne and mobile/fixed ground-based emitters. The system comprises two to six sensor sites with two complementary resources and a C2 centre.

ELM-2105 Family

The ELM-2105 is a range of tactical ground surveillance radars which form an extension of the ELM-2127 family, designed to provide 360° coverage with a single rotating antenna. Featuring a high update rate of targets, the ELM-2105 delivers a high probability of target interception and supports the missions of military forces and paramilitary law enforcement units. Weight: 35kg

ELM-2112 Family

The ELM-2112 is a family of high-resolution radars featuring simultaneous multi-beam technology. The radar provides persistent surveillance, target detection and tracking over a wide area. The radars are designed for dual use – ground and sea surface surveillance – even in adverse weather conditions.

UHF Radar Family

At the Paris Air Show in June 2015, IAI unveiled a UHF AESA radar. The ULTRA-C1 (single cluster configuration) is a lightweight mobile system designed to provide an autonomous search and detection capability of up to 500km for a typical fighter aircraft. Another variant is the ULTRA-C6 (six clusters configuration) which is designed for early warning of ballistic missiles and airborne targets at long ranges.

EMBRAER

Sentir-M20

The Sentir-M20 is a portable synthetic aperture radar capable of detecting air and ground targets out to a maximum range of 30km. It is a compact system that can be combined with a variety of EO/IR sensors and is light enough to be integrated on different platforms. These characteristics make the Sentir-M20 particularly well-suited to border surveillance and protecting sensitive areas. It currently performs this role for the Brazilian Army. Height: 1.46m Diameter: 161cm Weight: 59.87kg Range: 29.9km

ERA

VERA-NG

VERA-NG is a passive ESM (electronic support measure) tracker that can be transported in general-purpose vehicles. It uses techniques to conduct cross-border, inland long-term and long-range surveillance without alerting its neighbours. VERA-NG was designed for tactical 3D real-time detection, location, identification and tracking of air, ground and naval targets. Emitting zero electromagnetic energy, it is invisible to anti-radar missile systems. Height: 25m Range: 500km

HENSOLDT SENSORS

COBRA

The Counter Battery Radar (COBRA) is a large, long-range radar mounted on a four-axle, off-road-capable truck developed for the armies of France, Germany and the UK. It employs a fully active, microwave phased-array antenna. Search and track beams are automatically scheduled and multiple projectiles – hostile as well as friendly counterfire – are simultaneously detected, verified, classified and tracked.

SPEXER 10

The SPEXER 10 radar was designed for the surveillance of small perimeters and infrastructures (eg industrial plants, prison facilities, airports, seaports) and can be used outdoors or indoors. It detects and tracks small and slow-moving targets such as pedestrians at up to 100m. SPEXER 10 is small and lightweight and supports multi-radar operation, also in combination with cameras (in a network).

SPEXER 500

The SPEXER 500 radar was designed for camp, perimeter, infrastructure and border surveillance against asymmetric threats – including the surveillance of sensitive and protected areas (oilfields, power plants, airports). It automatically detects, classifies and tracks ground targets and low-flying air targets (even small and slow-moving ones) at up to 9km. SPEXER 500 also allows the surveillance of large areas and medium distances.

SPEXER 1000

The SPEXER 1000 radar was designed for camp, perimeter, infrastructure and border surveillance with asymmetric threats – including the surveillance of sensitive and protected areas (eg oilfields, power plants, airports). It automatically detects, classifies and tracks ground targets, low-flying air targets and coastal sea targets (even very small and slow-moving ones) at up to 18km. SPEXER 1000 also ensures the surveillance of large areas and long distances.

SPEXER 1500

The SPEXER 1500 radar was designed for large-perimeter surveillance, border surveillance and security applications with asymmetric threats. It automatically detects, classifies and tracks ground targets, coastal sea targets and low-flying air targets (even small and slow-moving ones) at up to 40km. SPEXER 1500 allows the surveillance of large areas and long distances and facilitates an early warning as well as situational awareness.

SPEXER 2000

The SPEXER 2000 radar was designed for border surveillance and security applications against asymmetric threats. It automatically detects, classifies and tracks ground targets, coastal sea targets and low-flying air targets (even small and slow-moving ones) at up to 40km. SPEXER 2000 allows the surveillance of large areas, long distances and facilitates early warning as well as situational awareness.

TRML-3D/32

The TRML-3D is a short/medium-range surveillance and target acquisition radar system housed in a six-axle cross-country vehicle. Self-contained and mobile, it includes an integrated secondary radar system and operator workstations in one vehicle for rapid deployment. It is a fully coherent multi-mode phased-array surveillance and target acquisition radar system for detecting/tracking small, fast and low-flying aircraft, missiles and hovering helicopters.

TRML-4D

The TRML-4D is based on the maritime TRS-4D radar produced by Hensoldt and is designed to provide similar scanning and surveillance capabilities to forces on land. Range: 250km

TwInvis

The TwInvis is a passive radar system that can be employed for air, coastal and ground surveillance. Designed to be lightweight and easy to deploy, the TwInvis can be mounted on many different platforms, including vehicles and fixed installations. Unlike an active radar, the TwInvis does not transmit energy and therefore cannot be located. By using existing VHF and UHF transmissions, it also circumvents an increasingly overcrowded electromagnetic spectrum. Range: 250km

INDRA SISTEMAS

INTACT

The INTACT (Intelligence and Surveillance Tactical Vehicles) system combines EO/IR sensors, GIS consoles and a long-range surveillance radar into a single integrated package. It is small enough to be transported by a single 4x4 military vehicle. Designed to perform a whole range of different surveillance and reconnaissance missions, INTACT is a modular platform that can be adapted and reconfigured multiple times in order to suit its particular mission.

IRAN ELECTRONICS INDUSTRIES (IEI)

Khalij-e Fars

Unveiled in April 2020, the Khalij-e Fars ('Persian Gulf') is a long-range strategic radar system with an operational range of more than 800km. According to the Iranian officials, it is a phased-array 3D system with modern technology that can detect all conventional and radar-evading targets as well as ballistic missiles. Range: 800km

KELVIN HUGHES

SharpEye SxV

Kelvin Hughes' SharpEye SxV is an X-band lightweight ground surveillance radar. SharpEye SxV is described as a low-power and environmentally sealed X-band surveillance and tracking system that provides capability in cluttered environments, day or night and in all weather conditions. The radar also employs the same pulse compression, Doppler processing and solid-state electronics technology that characterises all SharpEye products.

Kelvin Hughes' SharpEye SxV is an X-band lightweight ground surveillance radar. (Photo: Kelvin Hughes)

KINTEX

NR-100

The NR-100 is a man-portable pulse-Doppler radar designed to detect and track moving people and vehicles, providing targeting information for infantry weapons.

LEONARDO DRS

AN/PPS-5C MSTAR V4

The lightweight AN/PPS-5C Manportable Surveillance and Target Acquisition Radar (MSTAR) features wide-area surveillance, acquisition and audio mode (for target classification) to 42km range. Clutter map overlay on detection is available as an aid to set up and determine areas of visibility. It also provides a fall-of-shot mode for the adjustment of friendly artillery and mortar fire. Available with ruggedised PC-based human-machine interface. Weight: 39kg

AN/PPS-5C MSTAR V6

The AN/PPS-5C Manportable Surveillance and Target Acquisition Radar (MSTAR) V6 is a ground surveillance radar that is the latest addition to the MSTAR series. It features wide-area surveillance and audio mode (for target classification) over a continuous 27km range. The V6 is designed for emerging applications and as a drop-in replacement for existing MSTAR integrations. Weight: 39kg

LEONARDO ELECTRONICS

TMMR

The Tactical Multi-Mission Radar (TMMR) is a 3D C-Band full AESA Antenna Radar providing detection, classification and tracking of airborne and surface targets. It is a digital radar, with no analogue signal distribution and processing, designed to be a compact 'all-in-one' light-weight portable system. Length: 0.42m Width: 0.39m Height: 0.32m Weight: 50kg Range: 40km

LOCKHEED MARTIN

AN/TPQ-53

The AN/TPQ-53 counterfire target acquisition radar can track incoming rounds at a range of 60km when using

its 90° search mode or at 20km range when performing a 360° search. Range: 60km

DART

DART (Digital Array Row Transceiver) is a radar technology that will improve the performance of existing Lockheed Martin radar technology products. DART, which was introduced in November 2015, combines row transmitter and row receiver into a single line-replaceable unit, reduces array power consumption and can help extend a radar's useful life.

METEKSAN SAVUNMA

Retinar OPUS Perimeter Surveillance Radar

The Retinar OPUS Perimeter Surveillance Radar is a multifunctional surveillance system developed by Turkish defence manufacturer Meteksan Savunma Sanayi. It's design is based on 'slew-to-cue' technology (integration of the Retinar PTR-X radar system and thermal cameras) for protecting critical infrastructures, borders and forces. The integrated radar-camera suite can also be deployed for detecting and tracking Unmanned Aerial Vehicles (UAVs). The standard configuration also includes a Built-in Global Positioning System (GPS) and a magnetic compass. Communication is possible via the 10/100 ethernet or the Opsiyonel Wi-Fi network. Range: 24km

Retinar PTR Perimeter Surveillance Radar

The Retinar PTR Perimeter Surveillance Radar is a medium-range radar system developed by the Turkish defence manufacturer Meteksan Savunma Sanayi. It is designed for the protection of borders, military bases and critical infrastructures including airports, seaports and harbours. The standard configuration consists of a radar, one rugged computer, one tripod, two-pack battery set, one cable set and two carrying backpacks, a GPS and a magnetic compass. Range: 12km

Retinar PTR-X Perimeter Surveillance Radar

The Retinar PTR-X Perimeter Surveillance Radar is a medium-range radar system developed by the Turkish defence manufacturer Meteksan Savunma Sanayi. It is an advanced version of the Retinar PTR system used to detect and identify humans, animals, vehicles as well as drones. Unlike the Retinar PTR Radar, it can be integrated onto military vehicles as well. The standard configuration consists of a laptop with a polar screen, a Global Positioning System (GPS), a magnetic compass and a radar having a sensor unit and an antenna pan & tilt unit. Communication is possible via the 10/100 ethernet or the Opsiyonel Wi-Fi network. Range: 24km

The Retinar PTR-X Perimeter Surveillance Radar is a medium-range radar system developed by Turkish defence manufacturer Meteksan Savunma Sanayi. (Image: Meteksan Savunma)

POLY TECHNOLOGIES

Ground Artillery Location Type 904

The 904 artillery-locating radar is designed to provide rapid and accurate location of various hostile artillery and rocket launcher positions simultaneously. It has a multi-target capability of up to eight and is able to calculate the coordinates of friendly impact points for fire correction. The deployment time for the 904 is fewer than ten minutes, while it has a reaction time of fewer than five minutes.

RADA ELECTRONIC INDUSTRIES

CHR

RADA Electronic Industries' Compact Hemispheric Radar (CHR) is a family of sensors used in active protection systems for land vehicles. The CHR family comprises active protection (RPS-10), all-threat air surveillance (RPS-12), 3D perimeter surveillance (RHS-14) and hostile fire location (RPS-15). The system provides threat data to enable the neutralisation of threats. Length: 22cm Width: 53cm Height: 33cm Weight: 0.02kg Detection range: 15,000m

eMHR

RADA'S Enhanced Multi-Mission Hemispheric Radar (eMHR) forms the basis of hostile fire-locating (RPS-70/71), perimeter surveillance (RPS-72) and all-threat air surveillance (RPS-74) systems. It can be installed on vehicles or vessels and at fixed bases. The system can also operate in search while in tracking, target revisit and single-target tracking modes.

Hostile Fire Location Radar

RADA's Hostile Fire Location radar systems – which include the RPS-15, RPS-40/RPS-41, RPS-70/RPS-71 and RPS-82 – detect, track, classify and locate all types of direct and indirect fire. This includes rockets, artillery, mortars, antitank guided missiles, RPGs and small arms. The system classifies threats, calculates the point of origin and point of impact, displays tracking and provides an audible and visual warning/alert, as well as data over Ethernet to external C4I systems for alerting the threatened forces.

ieMHR

RADA's ieMHR (Improved and Enhanced Multi-Mission Hemispheric Radar) is the largest in a family of MHRs manufactured by the company to provide hostile fire location (RPS80/81), 3D perimeter surveillance (RHS-84) and all-threat air surveillance (RPS-82). It is an S-band radar that provides detection for pedestrians to a range of 20km and large transport aircraft to 100km.

Multi-Mission Hemispheric Radar

RADA's Multi-Mission Hemispheric Radars (MHR) are S-band, software-defined, pulse-Doppler AESA radars. The radars have beam-forming capabilities and advanced signal processing, which can provide for various missions on each radar platform. The radars are compact and mobile, enabling multiple missions on each radar and work while on the move.

pMHR

Portable Multi-Mission Hemispheric Radar (pMHR) is the smallest in the family of MHRs manufactured by Israeli company RADA Electronic Industries. It provides hostile fire location as part of the RPS-40/41 system, all-threat air surveillance (RPS-42) and 3D perimeter surveillance (RHS-44). It was unveiled at the AUSA exhibition in October 2017. Weight: 20kg Detection range: 10,000m

Three-Dimensional Perimeter Surveillance Radars

RADA's Three-Dimensional (3D) Perimeter Surveillance Radars, which include the RHS-14, RHS-44, RHS-74 and the RHS-84, provide border and perimeter surveillance through detection, classification and tracking of surface and aerial intruders such as pedestrians, vehicles, slow and small aircraft, vessels and more. These radar systems can be based on any member of RADA's Multi-Mission Hemispheric Radar (MHR) family of tactical radar platforms or Compact Hemispheric Radar (CHR).

ROSOBORONEXPORT

Credo-M1

The Credo-M1 is a portable battlefield surveillance radar designed to detect ground and above-water moving targets. It is also capable of controlling artillery fire. The system operates in all weather conditions, including zero visibility such as fog, snow, rain, smoke and dust. The Credo-M1 is able to track up to ten operator-selected targets as well as determine their coordinates, motion direction and speed. Weight: 51kg

SAAB

Arthur

The Artillery Hunting Radar (Arthur) was designed to be the weapon-locating element within a counter-battery system at brigade or division level. Arthur is capable of detecting, tracking and determining the point of origin and impact of artillery shells, mortar projectiles and rockets. The system can be used to register and correct outgoing fire. It is also used for force protection to warn of incoming fire.

SENTRYX

SX-500

The SX-500 is a compact surveillance radar that is not only capable of detecting targets, but also of calculating their distance, angle, velocity and direction of travel. It is marketed as both a standalone product and as part of the SentryX 3D perimeter protection solution, which integrates the SX-500 radar with the SX-8000 counter-UAS system and MP-4K-936 D/N PTZ cameras. This provides comprehensive protection from ground-based and airborne threats. Range: 1km

SRC

O-PEN Wall Penetration Radar

SRC's O-PEN sense-through-the-wall radar system, previously known as SOMISR II, was developed to address urban warfare requirements under a US Army Technology Objective programme. The radar system can detect and locate people behind concrete walls, doors and other barriers from a significant stand-off range. It also generates an image of the building that maps the walls of the building, for a clear tactical picture of the operation.

SR Hawk Ground Surveillance Radar

The SR Hawk surveillance radar provides continuous 360° surveillance of the ground, ports and harbours and airspace. It performs these tasks in a single system. It detects personnel, land vehicles, marine vessels, avian targets and low-flying aircraft such as UAS. These capabilities make it suitable for a range of applications. This includes ground surveillance, air surveillance, border and perimeter surveillance, counter-UAS mission support, port and harbour surveillance, wind farm bird strike avoidance, avian surveillance and artillery spotting. Weight: 21kg Range: 48km

STM SAVUNMA TEKNOLOJILERI MUHENDISLIK VE TICARET

UHTES

The UHTES (Standoff Through the Wall Radar) is a vehicle-mounted radar system designed for detecting the presence and location of stationary or moving people in buildings or other enclosed spaces where visual access is restricted. It is therefore primarily envisioned for use in situations where direct access to the building by the operator is not possible, such as in hostage rescue or counter-terrorism operations. Length: 0.4m Width: 1.5m Height: 0.4m Range: 0.04km

STRELA

ARK-1M

The ARK-1M is a mortar, artillery and rocket-locating fire control radar. Frequency: 6GHz Wavelength: 5cm

Monitor

Monitor is a man-portable, tripod-mounted ground surveillance radar designed to detect moving targets. Control and display via PC.

P-200 Credo-1

The P-200 Credo-1 is a tripod-mounted, pulse-Doppler ground/coastal surveillance radar capable of detecting and tracking a variety of targets. This includes people, vehicles, ships and helicopters, as well as providing fire control data for artillery.

RP-100 Fara-1

The RP-100 Fara-1 is a tripod-mounted, pulse-Doppler ground/coastal surveillance radar capable of detecting and tracking a variety of moving targets and cueing infantry weapons. Additionally, it can be operated remotely and transmit warnings over radio links.

Zoopark-1
Zoopark-1 is a counter-battery and ATC radar system mounted on a tracked MT-LB armoured vehicle. It tracks incoming artillery, mortars, rockets and missiles.

TELEPHONICS

ARSS
Relied upon by US as well as international paramilitary and government agencies, Telephonics' Advanced Radar Surveillance System (ARSS) uses pulse-Doppler technology, providing wide-area ground surveillance for border security and perimeter protection applications.

FoPEN
The FoPEN is a wide-band, pulse-Doppler and ground surveillance radar that operates in the UHF band, minimising foliage attenuation. The system features track-while-scan and pulse compression technology, providing wide-area surveillance capability to search, detect, acquire and track targets through mixed foliage. The FoPEN employs an array of pulse widths for continuous coverage at short ranges while maintaining detection at longer ranges. Weight: 17kg

RaVEN-M
The Radar and Video Enforcement Network-Mobile (RaVEN-M) offers an integrated deployable mobile ground surveillance system capable of operating as a standalone or networked system, creating a 'virtual fence'. The RaVEN-M offers flexibility, enabling effective border surveillance in all terrains and environments. Large vehicles can also be detected up to a range of 30km and single people up to 12km. Weight: 1,700kg

RaVEN-P
Addressing the needs of military and border security agencies, the Telephonics' Radar and Video Enforcement Network-Portable (RaVEN-P) system is designed for the surveillance of borders, ports and harbours as well as security for bases and critical infrastructure. When paired with ARSS, the RaVEN-P is capable of locating moving personnel, day or night, at a range of 5km and vehicles at a range of 8km.

THALES NETHERLANDS

Squire
The Squire radar has a range of up to 48km and can detect targets moving at a minimum speed of 0.5m/s. A tank-sized target can be viewed by the radar at 24km, a helicopter at 15km and a pedestrian at 10km. The radar uses a Windows XP operating system and can employ wireless connectivity. Weight: 18kg

THALES

AMSTAR
The Australian Man-portable Surveillance and Target Acquisition Radar (AMSTAR) is designed to meet peacetime and battlefield surveillance requirements of observer and reconnaissance elements of infantry, armour and artillery forces. Radar performance is optimised for operations against targets including personnel, vehicles, inshore vessels and low-flying helicopters. A version of the MSTAR system, which is known as the AN/PPS-5C, is in service with the US Army.

AN/TPQ-37(V)9 RMI
The Reliability Maintainability Improvement (RMI) upgrade to the AN/TPQ-37 is aimed at improving reliability and maintainability. The AN/TPQ-37(V)9 RMI is a long-range weapon-locating radar that automatically locates simultaneous fire from up to ten different enemy mortars, artillery and rocket launchers, reporting their positions on the first round in seconds. It can be positioned and ready for operation in 30min. It also adjusts friendly fire.

BOR-A 550
The BOR-A 550 is a ground, coastal and low-level air surveillance radar that detects, locates, automatically classifies and tracks moving targets. It has performance at long ranges against small and slow targets such as people and rubber boats. The mechanically scanned parabolic reflector and receiver/processor are tripod-mounted and linked by cable to a laptop-style control and display unit. Range: 80km

Cymbeline
The Cymbeline is a phased-array, mortar-locating radar that detects the flight path of a mortar bomb at two points in its trajectory as it passes through the radar beam, allowing the point of origin to be identified and engaged. Cymbeline has been delivered in vehicle-mounted and towed configurations. The system was in British Army service from 1975-2003.

GA10
Ground Alerter 10 (GA10) is an anti-mortar force protection solution that performs early detection of an incoming mortar shell or rocket and warns persons located in the threatened sector, prior to threat impact. GA10 provides the estimated location of the mortar shell or rocket launch point, enabling any appropriate counter-operation.

GO12
Ground Observer 12 (GO12) is a lightweight ground surveillance radar. The Ku-band, pulse-Doppler GO12 is suitable for applications including battlefield, border, coast and site surveillance by military/paramilitary forces or civilian users. It can be operated standalone on a tripod or integrated with masts/vehicles. The manpack configuration with tripod and laptop MMI can be set up in ≤2min and operated by one man. Weight: 30kg

GO80
The Ground Observer 80 (GO80) is a ground surveillance radar for use by armies, navies, border and coast guards and other security forces. A lightweight system, it is able to detect humans at up to 24km and larger targets at up to 80km. High resolution is provided by a large antenna and 2,000 range gates down to 10m width. The GO80 can also be flexibly configured with 40W or 80W transmitters, 0.8m or 1.6m antennas. Weight: 34kg

Ground Fire Radar

Thales unveiled its Ground Fire Radar family, a range of multifunction ground radars, on 19 June 2017 at the Paris Air Show. Using AESA technology, the radar system, which is fully digital, has been designed to carry out air defence and surveillance missions. It can also simultaneously detect and track targets such as ballistic missiles from the Aster family in hostile environments such as clutter, rain and jamming.

MSTAR

The Manportable Surveillance and Target Acquisition Radar (MSTAR) is designed to detect ground-based and low-flying moving targets such as aircraft, vehicles and infantry. Powered by a standard army field battery, it provides a day/night wide-area surveillance capability. Colour map-based display shows dead ground, relief and target track history. Support for vector, raster and DTED maps, including a variety of datum and grid standards. Weight: 37.5kg

RASIT

The Radar d'Acquisition et de Surveillance Terrestre (RASIT) is a ground surveillance pulse-Doppler radar designed to detect and classify moving targets on the ground or at very low altitudes. It can also be mounted on light utility trucks, armoured vehicles, shelters or a tripod.

RATAC-S

The Radar d'Aide au Tir d'Artillerie de Campagne (RATAC-S) is a multipurpose radar designed to detect, locate and classify ground targets or low-flying aircraft at medium to long ranges. It can also be used for artillery fire control. More than 300 units have been sold to the armed forces of France, Germany, Morocco, the UAE and others.

RB-12

The RB-12 is a short-range, portable surveillance radar. It detects, automatically locates and recognises pedestrians, vehicles, light aircraft, helicopters, microlights and UAVs. The RB-12 fulfils multiple tactical surveillance missions such as battlefield intelligence, infantry reconnaissance, artillery, border or sensitive site surveillance.

RB-12B

The RB-12B is a short-range ground surveillance radar optimised for detection, classification and tracking of moving targets on the ground from individuals to armoured vehicles. Features include a tripod-mounted flat-plate antenna and receiver/processor, separate laptop-style control and display unit linked by a 25m cable. It is in service with the French Air Force.

RD-170BT

The RD-170BT is a man-portable surveillance radar deployed ashore to protect moored patrol boats of the Royal Norwegian Navy.

ZAUN TECHNOLOGY

EPR-100

The EPR-100 is a radar that autonomously monitors, detects and alerts users of objects in protected regions. Used around perimeters, the EPR-100 can detect objects over 360°, up to 250m away (across flat terrain, no obstructions). The EPR-100, which is suitable for all-weather operations, can be used for applications including military bases, industrial sites and public utilities. Height: 0.25m Weight: 5.1kg

LAND-BASED AIR DEFENCE

ALMAZ-ANTEY

1L121-E

The vehicle-mounted 1L121-E radar system operates in the UHF segment of the spectrum and is thought to have a range of circa 90km when operating with 60° elevation. When the radar's FOV is increased to 90° elevation, it is able to track up to 64 targets, although this brings a range decrease to around 20km. Range: 90km

9S19M2

The Almaz-Antey 9S19M2 Imbir (Nato: High Screen B) long-range phased-array air defence radar is a mobile sector scanning system designed for the rapid acquisition and initial tracking of shorter-range ballistic missiles, cruise missiles and aircraft. It operates in the I/J Band. Range: 185km

55Zh6UE NEBO-UE

The Almaz–Antey 55Zh6UE NEBO-UE is a VHF mobile, long-range, 3D digital phased array air surveillance radar designed to detect medium targets and large targets such as ballistic missiles. It has been in service since 2008 and deployed alongside S-400 systems. It can detect a fighter aircraft up to a range of 700km and a hypersonic cruise missile up to 300km. Range: 400km

Kasta-2E

The Kasta-2E2 (39N6E) is a low-altitude three-dimensional circular scan radar system. Operating in stand-by mode it is designed to monitor air space and determine the range, azimuth, flight level, and route parameters of airborne objects, such as aircraft, helicopters, remotely piloted aerial vehicles, and cruise missiles. The radar system is used in air defence, coastal defence, and border control systems and air traffic control and air space control systems at airfields. Range: 150km

ASELSAN

FCR

Fire Control Radar (FCR) is a mobile Ku-band short-range 3D track radar for point air defence of critical assets. FCR offers an instrumented range of 30km and can track air targets, adding classification information to target track. FCR is a monopulse track radar with a cassegrain antenna. The system employs electronic protection measures and uses digital pulse compression for high range resolution, low transmission power and pulse coding. Range: 30km

Kalkan

Kalkan is a mobile X band phased array 3D search and track radar for point and area defence of critical military

and civilian assets developed by Aselsan to meet the requirements of Turkish Armed Forces. Kalkan offers an instrumented range of 100 km and can track multiple targets accurately, adding classification and identification information to each target track. Kalkan II provides a range of 120 km and integrated Mod 5 IFF. Range: 120km

MSR

Mobile Search Radar (MSR) is a mobile X-band short-range 3D search and track radar for point air defence of critical assets. MSR offers an instrumented range of 70km and can track multiple targets accurately, adding classification and identification information to each track. MSR is an active phased-array radar with digital beam-forming architecture. The system employs electronic protection measures and uses digital pulse compression for high range resolution, low transmission power and pulse coding. Range: 70km

AVIBRAS INDÚSTRIA AEROESPACIAL

EDT-FILA

Avibra EDT-FILA is a trailer-mounted fire control radar (FCR) system designed for use with 35-40mm anti-aircraft guns.

BAE SYSTEMS

Celldar

BAE Systems and Roke have developed the Celldar passive radar which detects disturbances to civilian Global System for Mobile Communications digital cellphone networks operating in the UHF range. A prototype was constructed in 1999, with BAE Systems joining the programme in 2002.

iMOTR

The Innovative Multiple-Object Tracking Radar (iMOTR) system has been designed to provide military test ranges with more accurate time, space and position information for several in-flight objects. iMOTR features a C-band or X-band active electronically scanned array antenna and enhanced clutter suppression for improved accuracy. The radar system is mounted on a commercial trailer optimised for enhanced mobility. Range: 100km

LAADS

The Low Altitude Aircraft Detection System is a truck/helicopter/C-130-transportable low-altitude air defence radar, C2 and FCS for short-range anti-aircraft systems such as MANPADS and guns. Stowable, parabolic reflector antenna is supported by an extendable mast on a standard S-280 shelter. Range: 60km

BATS BELGIAN ADVANCED TECHNOLOGY SYSTEMS

AD06

The AD06 is a fourth-generation, 3D tactical air defence radar. It can also be used in the gap-filler role and provide local ground-based air defence coverage for MANPADS. The L-band radar is portable, weighing less than 100kg. It produces 400W of peak transmit power and is compatible with NATO's Modes 1, 2, 3/A and C identification, friend or foe protocols, with the option available for Mode 4 compatibility.
Range: 60km

AD06 ATAR

The AD06 Advanced Tactical Acquisition Radar (ATAR) is a 3D solid-state L-band medium-range tactical air defence radar which uses an AESA to provide elevation coverage. The radar detects a variety of low-radar cross section targets such as low-velocity ultralights and UAVs. Additionally, it provides accurate target measurements of range, azimuth and elevation angles, differentiating between aircraft and helicopters and classifying the helicopter type according to echoes from the aircraft's rotor blades.

AD26

The AD26 Very Short Range Air Defence (VSHORAD) radar is a fifth-generation 3D tactical air defence system. The AD26 is a lightweight, transportable X-band solid-state electronically scanned, pulse-Doppler radar. It delivers early warning and target data for supporting surface-to-air missile weapon systems. The radar employs multi-beam elevation coverage by applying digital beam-forming and 360° azimuth coverage by antenna rotation. Weight: 75kg Range: 25km

AD26D

The BATS AD26D is a key component of the Drone Guard counter-UAV system and is designed specifically for detecting UAVs but also detects low-radar cross section and ground targets. Key applications for the lightweight system if the protection of airports or high-value sites and border monitoring as well as a gap-filler for larger radar systems. Weight: 30kg Range: 6km

AD88

The AD88 is a 3D S-band pulse-Doppler, ground-based air surveillance radar family that uses digital beam-forming for elevation and is capable of automatic target tracking. The AD88 product range includes two radars; the AD88 Medium Range (MR) and AD88 Extended Range (ER). The former is housed in a single shipping container and has an antenna with 32 row elements. Range: 480km

MR84

The MR84 is an S-band 3D air surveillance radar which can also be used for artillery fire control. Employing an AESA antenna, the MR84 can scan a 120° sector when being used for weapons location and a 360° sector for air surveillance. Operating in an air surveillance mode, the radar has a detection range of up to 474km.
Range: 474km

BHARAT ELECTRONICS

3D CAR

3D Central Acquisition Radar-Akash (CAR) is a medium range radar mounted on a mobile platform and designed to meet the operational requirements of the Indian Defence Forces. Its variants include Rohini, Revathi and 3D Tactical Control Radar, respectively for the Indian Air Force, Navy and Army. Range: 150km

3D Tactical Control Radar

Bharat's 3D Tactical Control Radar is a mobile, air-transportable, short-range warning, alerting and cueing radar system with weapon control and other C2 functions. It is designed to minimise mutual interference between air defenders and friendly airspace users. Features multiple target handling and engagement capability. It makes local threat evaluation and engagement calculations to assist the commander's decision-making process and gives local fire distribution. Range: 90km

Indra II

The Indra II is a low-altitude radar designed for the gap-filling role in an air defence network. It is a transportable, self-contained system with mobility and deployment features. Capable of handling 200 tracks, it is a coherent system, uses frequency agility, pulse compression and signal processing techniques such as MTI and CFAR. Range: 90km

CEIEC – CHINA NATIONAL ELECTRONICS IMPORT & EXPORT

H-200

CEIEC's H-200 is the basis of the KS-1 air defence missile which is thought to have developed from reverse engineering a Patriot air defence system. It is believed to operate in the G-Band and can be set up in ≤30 minutes and is reported to be able to track targets at a speed up to 2.18 Mach. Range: 120km

JL3D-90A

The CEIC JL3D-90A is a fully coherent, 3D radar with a low side-lobe, planar, phased array antenna. It is believed that the system uses an agile radio frequency transmitter with a klystron amplifier chain and a low-noise linear receiver, using digital pulse compression techniques to achieve long-range detection. Adaptive digital signal processing is employed with comprehensive BITE. Range: 300km

CHESS DYNAMICS

Hawkeye AD

Hawkeye Air Defence (AD) is an integrated sensor suite optimised for acquisition, tracking, classification and engagement of air targets from fixed and mobile platforms. The system's combination of frequency-modulated, continuous-wave Doppler radar and EO sensors enables operation against a wide range of targets 24h a day in all weather conditions. It is derived from the Sea Eagle naval fire control system for the land domain. Length: 62.3cm Width: 60.6cm Height: 85.6cm Diameter: 93.5cm Weight: 100kg Detection range: 15,000m

CHINA AEROSPACE SCIENCE AND INDUSTRY CORPORATION (CASIC)

HK-JM2

The HK-JM2 is a long-range 2D surveillance radar for detecting various air-breathing targets. It can be used for early warning in national air defence as well as providing target designation for weapon systems. Features include:

The CPMIEC HT-233 fire control radar is designed to detect and track flying targets and is associated with HQ-9 and HQ-10 surface-to-air missile batteries. (Photo: CPMIEC)

all-solid-state, coherent pulse compression; stealth target detection capability; anti-jamming capability.

Phased-Array Precision Tracking and Measurement Radar

CASIC's Phased-Array Precision Tracking and Measurement Radar can perform real-time flight trajectory measurement of multiple air targets. It can be used for tracking and measuring missiles, launch vehicles, conventional weapons and other air targets on the test range and also for the acquisition, tracking and trajectory measurement of space targets.

SJ-231

The CASIC SJ-231 air defence passive phased-array radar is based on the HT-233 PESA antenna and cabin design. It operates in the C-Band. Additionally, It serves as the C2 center of the KS-1A weapon system and is capable of guiding between four and and eight missiles to intercept four targets at the same time. Range: 120km

CHINA ELECTRONICS TECHNOLOGY GROUP CORPORATION (CETC)

JY-29

The CETC JY-29 (LSS-1) is a mobile 2D low-altitude tactical radar which is designed to act as gap filler. It is believed to operate in the L-Band and can track up to 72 targets. It was reported in 2013 that the system or a variant of it had been deployed at four sites by Syrian armed forces. Range: 250km

CPMIEC

HT-233

The CPMIEC HT-233 fire control radar is designed to detect and track flying targets and is associated with HQ-9 and HQ-10 surface-to-air missile batteries. Sources indicate it is believed to operate in the G-Band, possibly between 5.2GHz and 5.9GHz. It is believed to be passive phased array and can track up to 50 targets simultaneously. Range: 120km

ECRIEE – EAST CHINA RESEARCH INSTITUTE OF ELECTRONIC ENGINEERING

JY-9

The JY-9 is an air defence surveillance radar designed to detect targets at low altitudes, in clutter and ECM. Antenna, ops shelter and power cart are air-transportable. Set-up time 90min by eight personnel. Range: 150km

JY-9F

The JY-9F is a multipurpose, low-altitude air defence, fire control and ATC radar mounted in two truck/trailer pairs. Range: 150km

JY-10F

The JY-10F family of cabinet-mounted data processing systems is capable of handling inputs from up to six radars, performing A/D conversion and generating an air picture.

JY-11

The JY-11 is a fixed-site or mobile solid-state low-altitude surveillance radar for integrated or standalone applications. Features include a dual-frequency antenna and solid-state transmitter. It also uses pulse compression and CFAR processing techniques. Range: 180km

JY-14

The JY-14 is a large, long-range 3D air-surveillance and GCI radar with frequency agility/diversity and low sidelobe antenna, 1mW transmission power and low-power decoy mode. It covers 20° in elevation. Range: 450km

JY-27

The JY-27 is a long-range surveillance radar with airborne MTI and CFAR processing capabilities. Solid-state transmitter offers frequency agility, pulse compression, spectrum filtering. It can also be operated unattended. Range: 330km

ELTA SYSTEMS

ELL-8388

The ELL-8388 is a 3D ESM/ELINT surveillance system for tactical and strategic intelligence collection and air defence support. It creates a 3D situation picture by providing location and dynamic tracking of airborne, shipborne and mobile/fixed ground-based emitters. The system comprises two to six sensor sites with two complementary resources and a C2 centre.

ELM-2026B VSHORAD

The ELM-2026B Very Short Range Air Defence Radar (VSHORAD) is designed for detection and tracking of airborne targets, including a variety of low-RCS and low-flying targets such as fighter aircraft, ultralights and UAVs. It is Elta's fifth generation of 3D tactical air defence radars, featuring a lightweight transportable, X-band, pulse-Doppler solid-state electronically scanned array. Weight: 75kg Range: 25km

ELM-2080 Green Pine

The ELM-2080 is transportable ground-based, multi-mode solid-state phased-array radar designed to autonomously detect and simultaneously track multiple tactical ballistic missiles from long ranges, under all weather and ECM conditions. Modular active array technology includes multiple advanced T/R modules, provides high redundancy, graceful degradation, high reliability and high availability, says the company. The radar is part of the Arrow anti-balistic missile system. In service with Israeli and Indian forces. Range: 500km

ELM-2084 MMR

The ELM-2084 radar is an S-band system optimised to detect incoming rocket and artillery rounds in environments with significant ground clutter and electromagnetic noise. It forms an integral part of the Israeli Iron Dome SAM system. The radar has a detection range of up to 474km and can detect weapon launching points at a 100km range. Range: 474km

ELM-2090S

IAI-ELTA's ELM-2090S Spectra is an S-band search and track radar designed to autonomously detect and simultaneously track Ballistic Missiles (BMs), Air Breathing Targets (ABT) and satellites at very long ranges. The radar is suited for either land-based or ship-based operation.

ELM-2090T

IAI-ELTA's ELM-2090T Terra is a strategic early warning dual band radar system. It consists of the ELM-2090U Ultra for search and detect mission at very long range and the ELM-2090S Spectra for highly accurate tracking mission at long range, operating jointly as a unified system.

ELM-2090U

IAI-ELTA's ELM-2090U UHF Ultra is a land-based long-range early warning radar designed to autonomously detect and simultaneously track Ballistic Missiles (BMs), satellites and airborne targets at very long ranges. The radar operates under all weather conditions and in the presence of dense electromagnetic environments. Its modular design enables the construction of scalable radar configurations using multiple antenna building blocks (clusters) according to customer requirements. Its variants include ELM-2090U Ultra-C1 (mobile) , Ultra-C6 and Ultra-C22. Range: 500km

ELM-2106 ATAR

The ELM-2106NG tactical 3D air mobile truck-mounted defence radar can detect a variety of airborne platforms, including low-altitude high-speed fighter aircraft, hovering helicopters, UAVs and low-speed ultralights. The radar provides accurate range, azimuth and elevation angle measurements for each target, differentiating between fixed-wing aircraft and helicopters and classifying helicopters by rotor rotation rate. Weight: 320kg Range: 110km

ELM-2106NG

The ELM-2106NG tactical 3D air defence radar can detect a variety of airborne platforms, including low-altitude high-speed fighter aircraft, hovering helicopters, UAVs and low-speed ultralights. It can be used as a tripod-or vehicle-mounted system. The radar provides accurate range, azimuth and elevation angle measurements for each target, differentiating between fixed-wing aircraft

and helicopters and classifying helicopters by rotor rotation rate. Range: 100km

ELM-2138T Green Rock

The Green Rock is a mobile autonomous tactical C-RAM radar system. It is designed to support a variety of ground force protection missions, including fire source location, friendly forces warning, friendly fire correction and low-RCS and slow-flying airborne target (such as UAVs, gliders and hovering platforms) detection. The system provides a low/high trajectory target, real-time intelligence and rapid response for tactical forces. Range: 10km

ELM-2288 AD-STAR

The ELM-2288 Advanced Air Defense, Surveillance, Threat Alert and Air Traffic Control Radar (AD-STAR) is a 3D solid-state long-range S-band family of transportable radars designed to support air defence, early warning and ATC activities. Featuring digital beam-forming in elevation (receiving and transmitting), the AD-STAR provides 3D data on detected targets, initiating automatic target tracking based on pre-programmed parameters. Range: 480km

EMBRAER

Saber M60

The Saber M60 is a low-altitude air-defence radar developed by the Brazilian Army's CTEx (Army Technology Centre) in collaboration with Bradar, part of Embraer Defence and Security. Intended for use in Brazil's mountainous terrain, the system is designed to be mobile and fast to deploy. When connected to a mobile air defence operations centre, the radar can provide detection, classification and IFF capabilities to an integrated air defence network. Length: 3.2m Width: 3.2m Height: 2.85m Weight: 364.25kg Range: 60km

Saber-M200

The Saber-M200 is a 3D medium-altitude air defence radar developed by the Brazilian Army's CTEx (Army Technology Centre) in collaboration with Bradar, part of Embraer Defence and Security. Its defining characteristic is its ability to fit inside a standard ISO 20' container, allowing the complete system to be easily transported by air, land or sea. As a modular software-defined radar, it can be rapidly adapted to perform different roles without creating an extensive logistical footprint. Length: 6.1m Width: 2.44m Height: 2.59m Range: 200km

ERA

Silent Guard

ERA's Silent Guard is a passive radar which detects airborne objects by detecting the reflection of FM radio signals from flying objects.The radar is housed on top of a mast which can be mounted on a vehicle and uses a circular array antenna to detect disturbances to FM radio transmissions. Silent Guard does not emit, but instead detects disturbances to civilian broadcasting FM radio signals (typically within the VHF frequency range in the atmosphere). Range: 150km

VERA-NG

VERA-NG is a passive ESM (electronic support measure) tracker that can be transported in general-purpose vehicles. It uses techniques to conduct cross-border, inland long-term and long-range surveillance without alerting its neighbours. VERA-NG was designed for tactical 3D real-time detection, location, identification and tracking of air, ground and naval targets. Emitting zero electromagnetic energy, it is invisible to anti-radar missile systems. Height: 25m Range: 500km

HARRIS ELECTRONIC SYSTEMS

AN/SPS-48G(V)1

The AN/SPS-48G(V)1 is a 3D, long-range air surveillance radar used for the detection and tracking of aircraft and missiles. The radar is available in fixed-site, transportable or shipboard configurations to support customer needs on land or at sea. The multi-pencil beam architecture provides jamming immunity, low false-alarm rates and the ability to detect and track small targets, as well as weather detection and display capabilities. Its variants include AN/SPS-48, -48C, -48E and -48F. Length: 3.96m Width: 3.65m Weight: 1,125kg Range: 408km

Skysense-2020 Radar

Harris has created the Skysense-2020 family of sense-and-avoid 3D radars leveraging its Airborne Sense and Avoid radar for the USN's Triton UAS. The Skysense-2020H is based on the Triton design and is readily available for high-altitude UAVs. The Skysense-2020M is a smaller, modular version of the 2020H, suitable for medium-altitude and VTOL UAVs. The Skysense-2020G is a mobile, ground-based sense-and-avoid system for safely navigating and detecting low-flying UAVs, according to the company.

HENSOLDT SENSORS

MSSR-2000-I

In terms of performance, the MSSR-2000-I family (Monopulse Secondary Surveillance Radar 2000-I) has an instrumented range of up to 613km, and can detect up to 1,500 targets across a 360° radius, 400 targets across a 45° segment of the sky and 110 targets in a 3.5° segment. Range: 613km

Passive Radar

The Passive Radar detects airborne and sea targets by detecting disturbances to civilian FM radio, DAB and DVB-T transmissions in the VHF range. When receiving FM transmissions, the radar has a detection range of up to 200km, while the use of the DAB/DVT-B signals allow a detection range of 40km for a small aircraft. The Passive Radar employs a mast-mounted antenna on the top of a van at a height of up to 13m. Range: 200km

TRML-4D

The TRML-4D is based on the maritime TRS-4D radar produced by Hensoldt and is designed to provide similar scanning and surveillance capabilities to forces on land. Range: 250km

TwInvis

The TwInvis is a passive radar system that can be employed for air, coastal and ground surveillance. Designed to be lightweight and easy to deploy, the TwInvis can be mounted on many different platforms, including vehicles and fixed installations. Unlike an active radar, the TwInvis does not transmit energy and therefore cannot be located. By using existing VHF and UHF transmissions, it also circumvents an increasingly overcrowded electromagnetic spectrum. Range: 250km

INDRA SISTEMAS

APIS

Indra successfully led the Array Passive ISAR Adaptive Processing (APIS) programme sponsored by the European Defensive Agency. At the core of the initiative is the employment of Inverse SAR imagery techniques. These have sufficient detail to perform target recognition via the radar picture, rather than the target being represented as a 'blip' on the radar operator's screen.

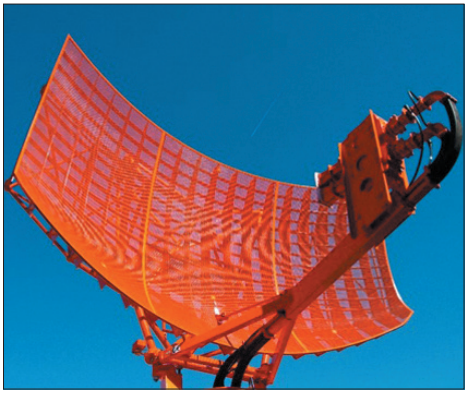
Civil PSR 3D

The Civil Primary Surveillance Radar (PSR) 3D is part of the Lanza family of 3D radar systems. The Civil PSR 3D has been designed especially for airport and air route surveillance. It operates in an L-band frequency and is ICAO compatible. In addition to aircraft detection and tracking, the radar features a weather processor that provides the controller with the required weather information for safe air traffic control management. Range: 330km

Lanza LRR

The Lanza Long Range Radar (LRR) is a long-range tactical fixed radar, part of the Lanza family of 3D radar systems. The Lanza LRR operates in an L-band frequency and at a range of up to 470km. The radar has a NATO FADR (Class I) compliance in both fixed-site and transportable installations and with the extended long-range possibility (XLR) for very-low-RCS targets or TBMs. Range: 470km

Indra's Primary Surveillance 2D S-Band Radar is an airfield surveillance radar with dual channel configuration. (Photo: Indra Sistemas)



Lanza LTR-20

The Lanza Long Range Tactical system-20 (LTR-20) is a deployable radar and part of the Lanza family of 3D radar systems. Missions that the radar has been designed to carry out include air defence and air policing (illegal traffic interception). The LTR-20 operates in an L-band frequency and with a range of up to 470km. Range: 470km

Lanza LTR-25

The Lanza Long Range Tactical system-25 (LTR-25) is a long-range tactical deployable radar, part of the Lanza family of 3D radar systems. The LTR-25 operates in the L-band frequency and with a range up to 470km. The radar has NATO FADR (Class I) compliance and can be deployed in under two hours. Range: 463km

Primary Surveillance 2D S-Band Radar

Indra's Primary Surveillance 2D S-Band Radar is an airfield surveillance radar with dual channel configuration. Weather conditions detected by the radar are measured in six levels of intensity conforming to ICAO and US Weather Bureau standards. Additionally, they are processed using a weather channel in parallel with the target channel. Range: 230km

SkyFender ADR

SkyFender Air Defence Radar (ADR) is a pulse-Doppler radar, operating in the X-band, that performs signal processing in time and spectral domains to provide target detection and tracking capabilities. It uses Indra's X-band radar technology from air defence fire control and surveillance radar systems.

IRAN ELECTRONICS INDUSTRIES (IEI)

Khalij-e Fars

Unveiled in April 2020, the Khalij-e Fars ('Persian Gulf') is a long-range strategic radar system with an operational range of more than 800km. According to the Iranian officials, it is a phased-array 3D system with modern technology that can detect all conventional and radar-evading targets as well as ballistic missiles. Range: 800km

Moraqeb

Unveiled in April 2020, Moraqeb ('Watchful') is a 3D advanced phased-array radar with a range of 400km. Iranian media outlets claimed that Moraqeb can spot airborne targets with high accuracy and detect different types of small objects at low and medium altitudes, as well as low radar cross-section aircraft and UAVs. Range: 400km

KB RADAR

Rosa

A low-altitude target detection radar system, Rosa is designed for automatic detection and tracking of low-altitude aerial platforms and output of track information to an automated control system. The radar system is composed of one to five autonomous low-altitude target detection radar sets (LARS). The sets are fully automatic (operator-free) with the capability of functional checks. The radar sets are controlled from the remote control system.

Vostok-E

The Vostok radar family is designed for detection of aerial platforms, measurement of their range, azimuth and range rate, automatic target tracking and classification and transmission of radar information into an integrated control system. Vostok is a new fully Belarusian development capable of replacing the P-18 radar, Oborona and similar systems.

KELVIN HUGHES

SMS-D

Kelvin Hughes has developed the Single Mast Solution-D (SMS-D) for UAS detection. It is designed for detection and real-time tracking of small aerial targets, using an integrated, medium-range, radar-based surveillance system. It was unveiled in March 2017 at the UK Home Office Security and Policing exhibition. Detection range: 1,500m

L3HARRIS TECHNOLOGIES

Series 320

The Series 320 is a family of E/F-band air defence radars with large planar phased-array antennas, electronically scanned in elevation and mechanically in azimuth. Available in two versions with either 6.4x5.18 or 3.65x9.75m trailer-mounted antennas. They use a high degree of automation. MTI also helps penetrate ground clutter. Range: 556km

LEMZ

1L117M Mobile 3D Radar

The 1L117M is designed to detect, identify and measure three coordinates (azimuth, slant range and altitude) of air targets and provide the data to external users. The EN version features a power amplifier enhancing the stability of emitted signals, increasing passive noise suppression characteristics and improving the ability to detect low-flying targets. Frequency agility improves the radar's jamming resistance. Range: 350km

96L6E

The 96L6E is a 3D target acquisition radar with an AESA antenna. The radar can be acquired in either a mobile configuration (96L6E), or as a tower-mounted system (966A14). The radar itself is a C-band system that can cover ranges of between 5 and 300km. Additionally, It provides 360° azimuth scanning and angles of elevation between 0° and +20°. Range: 300km

LEONARDO ELECTRONICS

ATCR 33S-NG

The ATCR 33S-NG (New Generation) provides en-route and terminal management area services. It is an S-band air traffic control radar. It replaces the operational proven ATCR-33 integrates the latest radar technologies. It is also available in a transportable configuration for easy deployment.

ATCR 44S-NG

The ATCR 44S-NG (New Generation) is the new Leonardo ATC L-band Primary Radar, designed for the detection of "cooperative" or "non-cooperative" aircraft, suited for long-range surveillance and en-route Air Traffic Control.

AULOS

The AULOS passive radar utilises civilian FM, DAB and DVB-T signals in the VHF range to track low-observable airborne targets and low-flying aircraft. The company has not publicly revealed the range of the AULOS, although it is thought that detection can be performed out to several hundred kilometres. AULOS can detect and track several targets with a low-radar cross-section simultaneously and determine the location and altitude of these targets.

KRONOS

KRONOS is a mobile multifunctional C-band radar system designed by Leonardo to support air and coastal defence tactical operations. The system simultaneously performs surveillance, dedicated target tracking and electronic counter-countermeasures. It is a member of the KRONOS multifunctional radar family, based on AESA technology. Range: 250km

KRONOS Grand Mobile HP

The KRONOS GRAND Mobile HP is the upgraded version of the KRONOS Grand Mobile using GaN (Gallium Nitride) technology for the AESA antenna. The radar simultaneously performs surveillance, dedicated target tracking for weapon engagement and fire control, and ECCM. it can be integrated with Medium Range Air Defence systems against ABT and MRBM (Ballistic Missiles up to 3000km range), where it can act, at the same time, as Surveillance Radar and Fire Control Radar. Detection Range: >300 km. Range: 300km

KRONOS Land

KRONOS Land is a mobile multifunctional C-band radar system designed by Leonardo to support air and coastal defence tactical operations. The system simultaneously performs surveillance, dedicated target tracking and electronic counter-countermeasures. It is a member of the KRONOS multifunctional radar family, based on AESA technology. Range: 250km

KRONOS Power Shield Land

This system is an L-Band Digital AESA Anti-TBM Radar. It is the Land-based version of the naval KRONOS Power Shield. KRONOS Power Shield can operate as a rotating radar, at 15RPM or in fixed stare mode aimed at the expected direction of the incoming threat. Range: 1,500km

RAT 31DL

The RAT 31DL is a high-performance, transportable L-band (NATO D-band) land-based phased-array 3D long-range radar, with a solid-state antenna. It has multiple independent simultaneous narrow pencil beam-scanning architecture with monopulse technique for height measurement. Classified as a NATO Class 1 radar, RAT 31DL incorporates 'advanced technical capabilities' for electronic counter-countermeasures. Designed to operate in a modern, complex environment, RAT 31DL is able to adapt to a broad spectrum of changing scenarios where jammers co-exist with heavy clutter. Range: 500km

RAT 31DL/M
The RAT 31DL/M is a tactical long-range radar operating in the L-band, designed to support NATO troops on peacekeeping missions. It can be deployed on the battlefield as a frontline system to protect and survey territories and assets against air threats. To perform these tasks in a worldwide tactical environment, RAT 31DL/M is mobile and does not require any special loading/unloading equipment. Weight: 30,000kg Range: 400km

RAT 31SL
The RAT 31SL is a 3D S-band radar system designed to operate within both military air defence and air traffic control networks. It can adapt to changing operational scenarios where jammers co-exist with heavy clutter. The RAT 31SL 3D early warning radar uses multiple simultaneous independently phase-controlled pencil beams. This technology provides flexibility in scanning and a high data rate, effective for clutter processing.

RAT-31 DL/ATC
The RAT-31 DL/ATC is an advanced L-band solid-state 3D radar with AESA antenna, dedicated to the modern Air Traffic Control mission where security must be provided also in presence of unexpected and sophisticated threats. It is derived from the military RAT-31 DL digital version, using the same physical and data processing architecture with a reduced number of radiating rows. Range: 500km

TMMR
The Tactical Multi-Mission Radar (TMMR) is a 3D C-Band full AESA Antenna Radar providing detection, classification and tracking of airborne and surface targets. It is a digital radar, with no analogue signal distribution and processing, designed to be a compact "all-in-one" light-weight portable system. Length: 0.42m Width: 0.39m Height: 0.32m Weight: 50kg Range: 40km

LIG NEX1
Counter-Artillery Detection Radar-II
In April 2017, South Korea's Defence Acquisition Program Administration (DAPA) announced that it had concluded development and successful testing of the Counter-Artillery Detection Radar-II mobile system. The radar will be mounted on a Doosan DST 8x8 truck chassis with armoured cab and will be deployed close to the DMZ to counter North Korean artillery, mortar or rocket fire. The system has a detection range of more than 60km and can operate continuously for eight hours.

LRADSR
The LRADSR is an L-band system which has a range of circa 370km and a ceiling of 100,000ft. This 3D radar uses an AESA antenna. The LRADSR is being procured to eventually replace the Lockheed Martin AN/FPS-117 L-band air surveillance radars which the Republic of Korea Air Force currently uses. In terms of performance, the LRADSR has similar capabilities to the AN/FPS-117. Range: 370km

MRADSR
The Medium Range Air Defence Surveillance Radar (MRADSR) has a range of around 140km and a 40,000ft ceiling. It is an S-band radar which is expected to soon enter service with the Republic of Korea Air Force. There is no word on when this radar may enter service nor on how many of the MRADSR the air force may procure. Range: 140km

Weapon Locating Radar
LIG Nex1 exhibited two new vehicle-mounted radar system prototypes, the Weapon Locating Radar, alongside the Short-Range Air Defence Radar, at Seoul ADEX 2017. According to its designer, the self-contained Weapon Locating Radar is capable of weapon location and identification by detecting, tracking and calculating the ballistic trajectory of field guns and rockets. Weight: 8,866kg

LOCKHEED MARTIN UK
Skykeeper SW
Skykeeper Sense and Warn (SW) is a system that provides deployable base protection capability by detecting and classifying incoming ballistic projectiles and then alerting threatened personnel. According to the manufacturer, Lockheed Martin, the system was successfully deployed to meet an Urgent Operational Requirement in Iraq and Afghanistan for where it provided 24/7 availability and reliability for protection of the UK Forces.

LOCKHEED MARTIN
AN/FPS-117
The AN/FPS-117 is a medium- to long-range air defence, air traffic control and ground-controlled interception radar featuring moving target indication and Doppler processing to assist in clutter rejection, and integrated identification, friend or foe capability. Large, square (7.32m sides) phased-array antenna produces multiple short- and long-range pencil beams. The antenna is scanned electronically in elevation, mechanically in azimuth, and offered in both fixed-site and mobile variants. Range: 330km

LIG Nex1 exhibited two new vehicle-mounted radar system prototypes, the Weapon Locating Radar, alongside the Short-Range Air Defence Radar, at Seoul ADEX 2017. (Photo: LIG Nex1)

AN/FPS-124(V)
The AN/FPS-124(V) is a 2D medium-range surveillance radar designed for unattended operation in fixed sites, tower-mounted and protected from weather by a dome. Range: 130km

AN/TPS-59
The AN/TPS-59 is a long-range tactical surveillance radar with capability against tactical ballistic missiles. Solid-state transmitter elements feed a large rectangular (9.1x4.9m) planar array that generates pencil beams scanned mechanically in azimuth. The antenna is truck- or trailer-mounted with processing electronics and operator console in a separate shelter. The TPS-59M variant has a smaller antenna for easier mobility. Weight: 20,000kg Range: 740km

AN/TPS-77
The AN/TPS-77 is an L-band medium-range ground-based air surveillance radar. The AN/TPS-77 uses an AESA and shares many characteristics and specifications with the company's AN/FPS-117, with the exception that the AN/TPS-77 is transportable, as opposed to the AN/FPS-117 which is designed as a fixed-site radar. Range: 470km

Silent Sentry
The Silent Sentry passive radar was unveiled in 1998. It can be mounted at a fixed site or on a vehicle. The radar exploits disturbances to FM radio transmissions in the VHF range to detect airborne targets. Silent Sentry employs a minimum of three broadcast signal sources to determine a target's location. It has a detection range of 220km, detects targets at 60° or 360° azimuth and provides up to 50° of elevation coverage. Range: 220km

TPS-77 MRR
The TPS-77 MRR is a multirole radar (MRR), designed for low power consumption and is the most transportable version of the TPS-77 product line. This radar can be truck mounted or transported via C-130, truck, rail or helicopter and is the newest member of Lockheed Martin's ground-based surveillance radar family. It is believed to be the first US radar system, utilising Gallium Nitride (GaN) technology, to be fielded for tactical ground-based air surveillance missions. Range: 463km

LOCKHEED MARTIN/RAYTHEON

AN/MPQ-65
The AN/MPQ-65 is a C-band passive electronically scanned phased array radar, designed for the PAC-3 surface-to-air missile defense system. Range: 100km

MBDA

MCP
The Mistral Coordination Post (MCP) was developed by MBDA to provide optimum surveillance, command and control functions for Mistral missile Ground Based Air Defence (GBAD) systems. Its variants include Improved Missile Control Post (IMCP) unveiled at IDEX 2011. The system provides the necessary functions required for the deployment and engagement of Mistral operational units at troop / platoon level that are equipped with Atlas, Alabi or MPCV (see separate entries). Range: 80km

METEKSAN SAVUNMA

Retinar FAR-AD Drone Detection Radar
The Retinar FAR-AD Drone Detection Radar, developed by Meteksan Savunma, is a radar system for protection against mini/micro-UAVs and threats from land. Based on a solid-state RF design, it serves as the primary sensor of the security forces against drones. It uses a pulse-compression pulse-Doppler waveform to scan large areas and monitor threats. Detection range: 7,000m

MITSUBISHI ELECTRIC

J/FPS-5
The J/FPS-5 is a long-range 3D phased-array air defence radar.

MYDEFENCE COMMUNICATION

Eagle
Eagle is a radar that provides 360° detection and tracking of drones by classifying the specific radar signature of a UAS. The Eagle radar does this by analysing the fast-rotating propellers and provides real-time information on direction, range and speed. Eagle is suited for mobile scenarios where fast deployment is required due to its easy set-up and low weight. Length: 19cm Width: 54cm Height: 64cm Diameter: 0.19m Weight: 23kg Detection range: 1,000m

NANJING RESEARCH INSTITUTE OF ELECTRONICS TECHNOLOGY (NRIET)

YLC-2
The NRIET YLC-2 is a three-dimensional L-Band long-range air surveillance radar and is believed to be an active phased array system. There is little in the way of confirmed details for the system but it is believed to have a range of 330km and is reported to have a height accuracy of 400m at 200km and 750m at 300km. Width: 9m Height: 7m

YLC-4
YLC-4 is a P-Band UHF solid-state, fully coherent 2D long range surveillance radar. The radar is able to synthesise data from up to four other radars. When equipped with height-finding radar, it can perform the function of guidance and providing target data for an air traffic control system. With long range detection range, high reliability and easy maintenance, YLC-4 radar is a main radar in air defense network. Range: 410km

YLC-6
NRIET's YLC-6 is a demountable medium-range two-dimensional radar with a range of up to 150km to an altitude of 10km. It is believed to be deployed on the south-east coast of China to detect aircraft operating out of Taiwan and it is also thought to be in service with Pakistani forces.

NATIONAL CHUNG-SHAN INSTITUTE OF SCIENCE AND TECHNOLOGY

ADAR-1 Chang Bei

The ADAR-1 Chang Bei is a truck-mounted multi-function phased-array search, target tracking and fire-control radar associated with Taiwan's Tien Kung surface-to-air missile system. It cues a continuous-wave illuminator for missile guidance, enabling multiple target engagements. Range: 500km

MPG-25

The MPG-25 is a CW target illumination radar cued by ADAR-1. It uses centre-fed dish antenna to illuminate targets for Tien Kung SAMs. Range: 200km

NORTHROP GRUMMAN

AN/TPS-43

The AN/TPS-43 is a mobile tactical 3D surveillance, ground-controlled interception and fire control radar system. Digital coherent moving target indication, pulse-to-pulse frequency agility, jamming analysis and transmission selection, coded pulses and sidelobe blanking provide performance in the face of clutter and countermeasures. It fits into two M35 trucks or one C-130 aircraft and Features a flat-plate antenna. Weight: 3,400kg Range: 450km

AN/TPS-70

The AN/TPS-70 is a long-range tactical radar capable of detecting and tracking tactical ballistic missiles and aircraft simultaneously. A flat-plate antenna generates multiple beams to scan all ranges and elevations at the same time. The system consists of an antenna and separate electronics and operator shelter. Additionally, azimuth scanning is mechanical. Range: 450km

AN/TPS-75

The AN/TPS-75 is a deployable, long-range, tactical 3D radar system used as an integral sensor in the US Ground Theater Air Control System. Transportable by truck, helicopter or C-130, its main components are the shelter and the large flat-plate ultra-low sidelobe antenna. Identification, friend, foe function is integrated. As of mid-2015 a contract to replace the system had been delayed by court appeals against an award to Raytheon for its 3DELRR. Range: 445km

AN/TPS-78

The AN/TPS-78 tactical mobile radar system is the next generation of the AN/TPS-70. It has the capabilities of its predecessor but is a completely air-cooled solid-state radar with the additional capabilities of moving target indication processing and increased tactical mobility using a redesigned mobile pallet. It can also be configured for aircraft or missile detection. Range: 450km

AN/TPS-80 G/ATOR

AN/TPS-80 Ground/Air Task Oriented Radar (G/ATOR) is a multi-mission system designed to support worldwide expeditionary requirements. It provides detection and tracking capabilities and offers traffic control capabilities. The multi-network capability enables compatibility with additional US DoD C2 systems. The AN/TPS-80 uses an AESA and can perform a range of tasks, from air surveillance to air traffic control.

ARSR-4 (AN/FPS-130)

ARSR-4 is an unmanned, long-range, 3D air surveillance radar capable of civil air traffic control (ATC) and military air defence roles in fixed installations. Includes full secondary surveillance radar/identification, friend, foe capability. An array of feed horns generates two stacks of elevation beams from the single antenna. Circular polarisation improves detection performance in bad weather. The 44-radar system is also used for commercial ATC by the FAA and the USAF for peacetime air sovereignty and drug interdiction purposes. Range: 400km

Tactical Ballistic Missile Detection Radar

Tactical Ballistic Missile Detection Radar is a variant of the AN/TPS-70 designed to detect and track tactical ballistic missiles or switch back to air defence mode. It features twin, angled phased-array antennas mounted on the back of a truck.

OKB TSP

RLS-50

OKB TSP gave its first public display of the RLS-50 3D air surveillance mobile radar at ADEX 2016, at Baku, in September 2016. Its beam has a width of 32° of elevation, which can be reduced to 6° for a longer-range detection. With a wider setting, the maximum detection range is 50m against a target with 1m² RCS, although a narrow beam width setting provides an increase in the detection range of up to 100km. Range: 100km

PIT-RADWAR S.A

Bystra

The Bystra Redeployable Radar is designed for detecting and localising air targets at short ranges and for supporting air defence units that cover tactical battle groups against attacks from the air. The Bystra is a multifunction and multi-mission, trailer-mounted radar with various applications, including detection and tracking of typical air threats such as combat aircraft and helicopters as well as missiles, UAVs and mortar shells. Detection range: 80,000m

N22-N(3D)

The N22-N(3D) Medium Range 3D Surveillance Radar is intended for tactical use. The radar is recommended as anti-aircraft squadron/battery level sensor or as a mobile system to fill the gaps in the radar network coverage. Range: 100km

N-22

The N-22 is a family of medium-range 3D surveillance radars for tactical use, mounted on a four-axle truck chassis. With reflector antenna elevated on twin arms, its deployment time is three minutes. The family includes two mobile radars: lightweight (N-22B) and armoured (N-22C). Range: 100km

RDL-45

The RDL-45 is a long range 3D, phased array air surveillance radar, designed for the detection

QinetiQ North America's WiPPR has been designed to provide near-real-time wind measurements for a variety of applications. (Photo: QinetiQ North America)

of air targets. It was unveiled at Poland's MSPO (Międzynarodowy Salon Przemysłu Obronnego) exhbition in September 2017. The RDL-45 operates in an L-band frequency and with a range of up to 472km. The system can track over 200 objects, has an azimuth coverage of 360° and an elevation coverage of 30,000m. Range: 472km

Soła

Soła is a multi-mission 3D radar, which has been designed to detect and track air targets. The radar output data contains full information about the detected targets, including three location coordinates, speed, heading and classification of helicopters as a separate target category. Detection range: 60,000m

TRS-15

The TRS-15 is a mobile medium-range 3D surveillance radar for air defence C2 systems. It is able to detect and automatically track up to 255 air targets to the altitude of 98,500ft at an instrumented range of 240 km. The planar antenna produces a cosec square transmit beam and seven fan-shaped receive beams to use the monopulse method of measurement of height. Range: 240km

POLY TECHNOLOGIES

JH-18

The JH-18 low-altitude 3D gap-filling radar is an S-band, solid state, mobile surveillance radar designed to carry out detection and tracking of low-flying targets in cluttered environments. It is accurate within a distance of up to 50m and azimuth of 0.3˚. The radar can also be deployed and withdrawn within 10 minutes by four personnel.

QINETIQ NORTH AMERICA

WiPPR

QinetiQ North America's WiPPR (Wind Profiling Portable Radar) has been designed to provide near-real-time wind measurements for a variety of applications including mission planning and data gathering. WiPPR is described by the company as smaller than comparable radar systems. The system can be stationed on a trailer for transportation. It is claimed the WiPPR provides wind profile updates as rapidly as one per minute.

QINETIQ

Alarm

The Alerter of Approaching Rocket Munitions (Alarm) radar is designed to provide notification of an attack by short-range rockets. Multiple radars can provide protection for an operating base. A low-power solid-state transmitter and a sensitive low-noise receiver give a high probability of detection of low-radar cross section rockets. The radar can be operated 24h a day. It can also be configured in the field and has a modular construction for rapid assembly.

RADA ELECTRONIC INDUSTRIES

All-Threat Tactical Air-Surveillance radar

RADA's All-Threat Tactical Air Surveillance radar systems, which include the RPS-12, RPS-42, RPS-72 and RPS-82, detect all types of aerial vehicles (including UAVs of all groups), missiles, rockets and mortars. It classifies threats, provides and displays tracking and warning/alert, and provides data to external C4I and air defence systems over Ethernet. These tactical radar systems can also function as gap-fillers, complementing medium- and long-range air surveillance systems. Weight: 45kg

CHR

RADA Electronic Industries' Compact Hemispheric Radar (CHR) is a family of sensors used in active protection systems for land vehicles. The CHR family comprises active protection (RPS-10), all-threat air surveillance (RPS-12), 3D perimeter surveillance (RHS-14) and hostile fire location (RPS-15). The system provides threat data to enable the neutralisation of threats. Length: 22cm Width: 53cm Height: 33cm Weight: 0.02kg Detection range: 15,000m

eMHR

RADA'S Enhanced Multi-Mission Hemispheric Radar (eMHR) forms the basis of hostile fire-locating (RPS-70/71), perimeter surveillance (RPS-72) and all-threat air surveillance (RPS-74) systems. It can be installed on vehicles or vessels and at fixed bases. The system can also operate in search while in tracking, target revisit and single-target tracking modes.

ieMHR

RADA's ieMHR (Improved and Enhanced Multi-Mission Hemispheric Radar) is the largest in a family of MHRs manufactured by the company to provide hostile fire location (RPS80/81), 3D perimeter surveillance (RHS-84) and all-threat air surveillance (RPS-82). It is an S-band radar that provides detection for pedestrians to a range of 20km and large transport aircraft to 100km.

pMHR

Portable Multi-Mission Hemispheric Radar (pMHR) is the smallest in the family of MHRs manufactured by Israeli company RADA Electronic Industries. It

provides hostile fire location as part of the RPS-40/41 system, all-threat air surveillance (RPS-42) and 3D perimeter surveillance (RHS-44). It was unveiled at the AUSA exhibition in October 2017. Weight: 20kg Detection range: 10,000m

RAYTHEON

AN/FPS-132

AN/FPS-132 is a solid-state, phased-array, all-weather long-range radar developed by Raytheon. It is also known as Upgraded Early Warning Radar (UEWR). The AN/FPS-132 provides early detection and precise tracking of incoming ballistic missiles, as well as determination of threat versus non-threat objects. Height: 36.58m Range: 4,828.03km

AN/MPQ-53

The AN/MPQ-53 is a C-band/G/H-band passive electronically scanned phased array radar, designed for the Patriot defence system. The AN/MPQ-53 is remotely controlled by the MSQ-104 control station, via a cable link, is able to track more than 100 potential targets and can engage up to nine targets. Length: 17.1m Width: 2.87m Height: 3.6m Weight: 35,870kg Range: 170km

AN/TPY-2

The Army Navy/Transportable Radar Surveillance (AN/TPY-2) is an X-band missile defence radar that can detect, classify and track ballistic missiles. It uses an AESA antenna comprising 25.344 T/R modules. It has a ceiling of around 1.000km and can be used to detect both short- and long-range ballistic missiles and to discern these from other objects such as space debris. The radar can be truck-mounted. AN/TPY-2 radars are stationed in a number of countries and are used for ballistic missile defence and early warning. Range: 1,000km

JLENS

Raytheon's Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS) completed a series of tests in 2014 to demonstrate that it can be integrated into the bilateral US/Canadian NORAD air surveillance C2 architecture. The JLENS system comprises two aerostats, each of which is tethered at an altitude of 10,000ft. Range: 296km

KuRFS

The KuRFS is a Ku-band multi-mission advanced electronically scanned array system, providing detection of rocket, artillery, mortar and UAS threats by providing a critical sense and warn capability.

LTAMDS

The Raytheon Lower Tier Air and Missile Defense System (LTAMDS) is an active electronically scanned array Gallium Nitrade (GaN) radar. The use of GaN strengthens the radar signal and its sensitivity. It has been designed to be fully integratable into existing US Army defense infrastructure and will replace the radar used in the Patriot Missile defence system. It is capable of providing 360-degree coverage.

RETIA

ReVISOR

RETIA's ReVISOR lightweight X-band battlefield surveillance radar entered production in late 2012 and is currently being manufactured to satisfy a requirement of the Czech Republic's MoD. The ReVISOR supports VSHORAD/SHORAD systems of ground-based air defence units, and the radar provides range and azimuth information. It has a number of operational configurations, including C2 module.

RHEINMETALL AIR DEFENCE

Skyguard

Rheinmetall's Oerlikon Skyguard is an air defence system developed for the protection of stationary high value assets such as air fields, bridges, industrial installations and military command and control centres. It compromises of fire control unit and up to four effectors including Oerlikon Twin Gun, VSHORAD missile launchers and Oerlikon Revolver Gun Mk-3. Its variants include Skyguard 1, 2 and 3. Calibre: 35mm Effective range: 4,000m

X-TAR 3D

The X-Band Tactical Acquisition Radar 3D (X-TAR 3D) air surveillance and acquisition radar is the newest member of Rheinmetall's X-TAR family. The fully coherent phased-array pulse-Doppler radar performs the functions of short-range search, detection, acquisition, tracking, classification and identification of air targets. This enables it to supply a 3D local air picture to the C2 network as well as track threat data for cueing fire control system (FCS). Range: 55km

X-TAR

The X-Band Tactical Acquisition Radar (X-TAR) is a fully coherent X-band radar designed for such applications as early warning for MANPADS and guns or tactical air defence units dealing with very low-altitude threats in an intense ECM environment. Antenna is of parabolic reflector type. Range: 28km

RHEINMETALL

FIRST

Fast InfraRed Search and Track (FIRST) is a infrared scanning device for 360° surveillance with short reaction times. It consists of a sensor head, a signal processing unit as well as a control and display unit. In the signal processing unit, raw data are evaluated and compiled in real time. For target assignment, the operator is supported by the threat evaluation software and alarms are generated automatically.

ROSOBORONEXPORT

1L122E-2E

The 1L122E-2E is a compact mobile solid-state 3D radar. It is designed to provide information support for short- and medium-range air defence weapons and is also capable of providing information for flights at airfields, temporary or permanent. The radar can be used in place of older acquisition radars such as the P-15, P-18, P-19 and others used to provide

information support for the Pechora, Kvadrat and Osa SAM systems and their counterparts. Weight: 900kg Range: 80km

9S15MV3

9S15MV3 is a mobile 3D radar that can identify aerial targets and act as an identification, friend or foe system. The radar forms part of the S300V air defence missile system with electronic scanning in elevation and mechanical in azimuth and is based on a planar waveguide array. It is claimed to have a high resistance to jamming and a high standard of mobility as it is mounted on a large tracked vehicle.

59N6-TE

The 59N6-TE is a 3D mobile radar developed and produced by the JSC Federal Research and Production Centre Nizhniy Novgorod Research Institute of Radio Engineering (NNIIRT). It provides detection of aerial hypersonic targets at medium and high altitudes using a decimetre wavelength range. The system is capable of providing the user with measurements of the range, azimuth and altitude of the tracked targets. This information is then processed and exchanged with C4I complexes. Range: 450km

Gamma-DE

The Gamma-DE is a surveillance radar designed to detect, identify, measure 3D co-ordinates for and track a range of current and future air threats including high-altitude low-signature air-launched missiles. It is capable of operating in a heavy ECM and clutter environment. The system is also able to receive data from aircraft equipped with ICAO-code transponders. Range: 400km

Nebo-SVU

The Nebo-SVU radar is designed for air defence. It provides automatic detection, positioning and tracking of a range of air targets including ballistic and low-signature stealthy targets. It is also capable of friend-or-foe identification, locating active jammers and target identification when operating as part of both automated air defence C2 systems and non-automated control systems. Range: 350km

Protivnik-GE

The Protivnik-GE is a mobile 3D surveillance radar. The system uses a digital phased array and digital space-time signal processing. It is designed to automatically or semi-automatically detect, position and track strategic and tactical aircraft, cruise missiles, ballistic targets, small-size low-speed aerial vehicles, classify targets, conduct IFF interrogation and locate active jammers. Range: 400km

RRS - REUTECH RADAR SYSTEMS

ESR 220 Thutlwa

The ESR 220 is a rapid-deployment battlefield local warning radar system which provides low-altitude target detection. Features include solid-state bulk amplifier, fully coherent architecture, mobility on all-terrain transporter, full autonomy on single vehicle, air transportability by standard cargo aircraft, integral command centre within armoured shelter, ECCM suite, integral generator, combined radar/IFF, and local or remote control and status monitoring. Range: 65km

The ESR 220 is a rapid-deployment battlefield local warning radar system which provides low-altitude target detection. (Photo: RRS)

RSR900 StealthRad Family

The RSR 900 StealthRad product range has been developed in response to increasing demands for persistent, all-weather and high-visibility situation awareness of borders, strategic infrastructure, marine protected areas and inland waterways. StealthRad is a family of lightweight, LPI, FM CW wave radars. Products in this range may be applied in multiple roles, and can be tailored to specific user needs.

RSR 150

RSR 150 is a 3D radar sensor for detection and tracking of fast-moving projectiles. The radar sensor is designed for the rapid acquisition and tracking of multiple incoming projectiles, such as RPGs, in order to designate fast-reaction soft or hard kill countermeasures. The sensor has also been used to detect and track bullets in sniper detection and hostile fire indication applications.

RSR 320 – DBRXL

The RSR 320 – DBRXL 3D ground-based dual-band radar is based on the ESR 220 Thutlwa local warning radar already in service with the South African Army Air Defence Artillery, with the addition of high-accuracy 3D target detection and tracking capabilities. The product can be used for the support of ground-based SAMs.

RTI SYSTEMS

Surok

The Surok radar was unveiled in 2012. In terms of performance, it is reportedly capable of detecting and tracking a target flying at 650ft altitude at a distance of 12km. Targets flying at 3,300ft altitude can be detected at 20km, and those flying at 16,400ft at 50km range. The Surok was designed to provide a mobile radar that provides 360° protection for critical infrastructure. Range: 50km

SAAB

Giraffe 1X

The X-band Giraffe 1X is a mobile, deployable or fixed asset for short-range surveillance and Ground Based Air Defence (GBAD) that provides forces with early warning and the ability to detect and track hundreds of targets simultaneously including in high-clutter environments. It can be mounted on a four-wheel drive vehicle. The system monitors the air volume 360 degrees for air targets and simultaneously locates and warns against incoming rocket, artillery and mortar rounds (RAM). The Giraffe 1X has a range of 75km and can monitor up to circa 100 air targets or up to 200 surface targets. Weight: 300kg Range: 75km

Giraffe 4A

The C-band Giraffe 4A performs air surveillance, weapons locating and sense and warn functions. This radar provides 3D air surveillance using 15 stacked beams which provide up to 70° of surveillance. In air search mode, the radar has a range of up to 280km, whereas in weapons location mode it can detect targets at 100km range. Range: 280km

Giraffe 8A

The Giraffe 8A is a 3D long-range Active Electronically Scanned Array (AESA) radar system on the S-band, designed for the highest level of situational awareness and Ballistic Missile defence. It is offered in versions for fixed, transportable and mobile applications, all providing operational flexibility and multi-role capabilities. Range: 470km

Giraffe AMB

The Giraffe Agile Multi Beam (AMB) 3D surveillance radar system with integrated C3 is for use in tactical air defence and surveillance systems. In addition it can also warn of incoming rocket, artillery and mortar rounds. Range: 120km

Hard 3D

The Helicopter and Aircraft Radar Detection (HARD) system is a 3D search radar originally developed by Ericsson to support Bofors' RBS 70 ARMAD air defence system intended mainly against anti-tank helicopters. The Hard radar features X-band and pulse-Doppler search. Weight: 110kg Range: 20km

The AESA50 is a multi-mission radar that is the next generation of the AN/TPQ-50 radar. (Image: SRC)

SIEMENS

DR Series

DR 621, 622, 641 and 645 are pulse-Doppler radars designed for very low-altitude air defence against strike aircraft and helicopters. Features include flat-plate, low-sidelobe antenna and robust ECCM capability. Range: 20km

MPDR 12

The MPDR 12 is a high-data-rate (60rpm) pulse-Doppler radar with good clutter rejection performance. Teamed on Gepard with a Siemens pulse-Doppler tracking and FCR. Used as search/acquisition radar for the German Gepard tracked air defence vehicle, it features an integral MSR 400 Mk XII IFF/secondary radar. Range: 16km

SRC

AESA50

The AESA50 is a multi-mission radar that is the next generation of the AN/TPQ-50 radar. Applications that the AESA50 has been designed to carry out include: air surveillance, CTA, SHORAD, UAS sense-and-avoid and wind farm gap filler. Weight: 295kg Range: 50km

AN/TPQ-50

The AN/TPQ-50 is a lightweight, L-Band counterfire radar that performs early warning for indirect fire, target acquisition, and air surveillance modes. Part of SRC's Lightweight Counter-Mortar Radar (LCMR) family, the AN/TPQ-50 provides continuous 360° surveillance and 3D rocket, artillery and mortar (RAM) location using a non-rotating, electronically steered antenna. Height: 2.16m Diameter: 1.02m Weight: 227kg Range: 15km

GBSAA Radar System

Ground-Based Sense and Avoid Radar System (GBSAA) is an integrated radar network that enables UAS flights in domestic air space without a chase plane or ground observer. It was developed to meet integration requirements of UAS to the US National Airspace System (NAS). The GBSAA uses LSTAR ground sensors (see separate entry) to detect airborne traffic, providing the UAS operator with the information necessary to maintain separation between their UAS and other traffic. Range: 40km

LSTAR

The LSTAR family of air surveillance radars provides 360°, 3D electronic scanning capabilities for detecting and tracking airborne targets. The radars detect and track fixed- and rotary-wing aircraft, such as ultralights, paragliders/hang gliders and UAS. These systems can be used for border air surveillance, UAS sense and avoid, local airspace management, critical infrastructure protection and wind farm applications. Weight: 227kg Range: 50km

MMR
The Multi-Mission Radar (MMR) is a mobile, stand-alone radar that has been built for the US Army to meet the needs of modern highly mobile forces. The MMR is capable of performing air defence surveillance, air traffic control, cognitive task analysis and fire control in a single system. Width: 1.5m Range: 100km

Omni-Directional Weapon Locating Radar
The Omni-Directional Weapon Locating Radar (OWL) is a target acquisition radar being developed for the US Army by SRC. The radar is able to run multiple missions at the same time (including hemispherical sense-and-warn, counterfire target acquisition, air surveillance and counter-UAS). Length: 1.83m Width: 1.83m Height: 3.96m Weight: 2,630.83kg

SkyChaser
SkyChaser is a lightweight on-the-move (OTM) radar, designed to perform target detection and tracking of various airborne targets. Weight: 22.68kg

THALES

Arabel
Arabel is a multi-function fire control radar capable of detecting, tracking and engaging multiple targets, including jet aircraft, cruise missiles and tactical ballistic missiles. Arabel can track 100 and engage ten targets simultaneously. It includes a data link to send target position updates to Aster 30 missiles until their own active radar seeker takes over. Range: 100km

Castor family
The Castor radar family includes several products. This X-band radar is designed to perform fire control. It has a beamwidth of 2° and peak power of 200kW. The Castor-1 (also known as the TRS-3200) has a range of around 30km, transmitting up to 8,000 pulses per second (pps) from its magnetron transmitter. The Castor-2/TRS-3201 can transmit up to 7,200pps using a 30kW coherent travelling-wave tube transmitter.

CONTROLMaster 200
CONTROLMaster 200 is a solid-state tactical radar and air defence coordination system, capable of detecting and tracking 200 targets simultaneously at ranges up to 250 km, combined with detection capabilities for incoming rocket, artillery and mortar rounds (RAM). Thales' ConrolMaster 200 was developed as part of ForceShield air defence solution to meet the requirements of customers against symmetric and conventional air threats. It combines GM200 radar with CONTROLView stations. Length: 6m Range: 250km

Crotale
Surveillance and FCR for the Crotale short-range air defence missile system. Designed to counter fixed- and rotary-wing aircraft, cruise and tactical ballistic missiles, saturation attacks with stand-off weapons. Pulse-Doppler search radar has phased-array antenna that rotates at 60rpm. Monopulse Doppler tracking radar features centre-fed dish antenna. Both have ECCM and the tracking system includes thermal imager. Range: 16km

Crotale NG
Surveillance and FCR for the Crotale NG short-range air defence missile system. Designed to counter fixed- and rotary-wing aircraft, cruise and tactical ballistic missiles, saturation attacks with stand-off weapons. Pulse-Doppler search radar is the Gerfaut solid-state device. Monopulse Doppler tracking radar features centre-fed dish antenna. Both have ECCM. Tracking system also includes thermal imager. Range: 20km

GM60
Ground Master 60 (GM60) is the short-range version of the Ground Master family radar. This 3D S-band solid-state radar is designed for surveillance, early warning, target acquisition and designation for short- and very short-range air defence systems. It comprises an aerial and radar electronics that can be installed in different types of vehicle. Range: 80km

GM200
The Ground Master 200 (GM200) is a medium range tactical radar. It is part of the Ground Master family architecture, which shares common hardware, software building blocks and interfaces. As a multi-mission radar, it can carry out air surveillance, air defence, CRAM and surface vessel detection. Length: 6.09m Width: 2.44m Height: 2.59m Weight: 10,000kg Range: 250km

GM400
Ground Master is a family of multi-mission air defence radars designed for protection of key assets and forces deployed in remote theatres from a variety of airborne threats, including combat aircraft, helicopters, UAVs, ballistic missiles, airliners and light aircraft. This network-enabled, digital, S-band full-Doppler radar uses digital beam-forming, generating stacked beams for maximum time on target. Additionally, the phased-array antenna rotates once every 6s. Weight: 900kg Range: 470km

Master-M
The Master-M is a long-range 3D air defence radar designed for unattended operation, standalone transceiver/antenna system with co-located C2 facility. Available in fixed and mobile configurations. Backbone infrastructure integrated in air C2 network. Deploys in three 10t trucks and one 20t trailer. Range: 470km

Master-T
The Master-T is a tactical 3D long-range radar operable under active jamming, chaff and clutter conditions. Mobile in two 10t trucks/C-130, designed for unattended, standalone operation with co-located C2 facility or integration into air C2. Set-up/tear-down in 30 minutes with four people. In April 2012, Thales announced that it had delivered three Master-T radars to be positioned in eastern Indonesia to provide air surveillance over that part of the country. Range: 440km

RAC-3D
The RAC-3D is an intermediate-range, 3D multi-mode radar. It is designed to provide ground-based air surveillance to a range of 100km. It can also be used to provide gap filler coverage as part of a larger ground-based air defence network. The C-band RAC-3D has a 600MHz operating bandwidth. As well as its 100km

range, the radar has a ceiling of 30,000ft and elevation coverage of 45°. Range: 100km

Roland

Surveillance and FCR associated with Roland short-range SAM system. Surveillance and target acquisition is by the 1-2GHz Siemens MPDR-16 radar, while the target is tracked and missile is guided by the Thales Domino 3D radar through a command-to-LOS mechanism. Roland is generally mounted on vehicle turret between twin missile tubes. Range: 16km

Shahine

Surveillance and FCR associated with Shahine short-range SAM system. Surveillance and target acquisition is by the 2-4GHz pulse-Doppler MTI radar on one tracked vehicle, while target is tracked and missile is guided by the monopulse-Doppler radar on the missile firing vehicle. The system is in service in Saudi Arabia. Range: 17km

THALES RAYTHEON SYSTEMS

AN/MPQ-64 Sentinel

The AN/MPQ-64 Sentinel is a mobile 3D phased-array radar used to alert SHORAD weapons about hostile airborne targets and queue up their shots. It operates in the X-Band frequency and the system also includes integrated identification, friend or foe capability. Length: 7.92m Width: 2.56m Height: 3.34m Weight: 607kg Range: 40km

V TIKHOMIROV NIIP

5N64S

The NIIIP 5N64S Big Bird is an air defence radar with specific capability against ballistic missiles and forms part of the S-300PM system. Derivatives and variants include 64N6E/1/2 and 91N6E which form part of other S-300 systems. The radar also has a 360° rotation and can detect up to 200 targets in a sweep and track up to 12 targets. Range: 250km

9S15MTZ

The 9S15MTZ is a 3D target acquisition and tracking radar associated with the S-300V SAM system. It is designed to detect and identify targets including aircraft, tactical ballistic and cruise missiles and feed the information either to the S-300V command post data processing centres or air defence C3I systems. Large, low-sidelobe planar-array antenna is mounted on a tracked armoured vehicle. Range: 100km

The AN/MPQ-64 Sentinel is a mobile 3D phased-array radar used to alert SHORAD weapons about hostile airborne targets and queue up their shots. (Photo: Thales Raytheon Systems)

9S18M1-1

The 9S18M1 Snow Drift is a mobile 3-D radar that uses an electronically steered pencil beam. The radar is designed to be agile frequency to avoid counter-measures. The system can also provide target designation for six targets and is associated with SA-11 Gadfly and the SA-17 Grizzly. Range: 140km

9S18M1E

The 9S18M1E is a mobile, 3D, frequency-agile coherent pulse radar designed to detect and identify air threats and feed target data to the Buk-M1E AD missile system and air defence C2 systems over a secure data link. Electronic beam scanning is used for elevation and mechanical antenna rotation in azimuth. Additionally, its pulse-to-pulse cancellation circuit reduces clutter, chaff and cloud returns. Range: 100km

9S32

The 9S32 is a missile guidance station for S-300V SAM. Phased-array radar is mounted on a missile battery and capable of tracking 12 targets simultaneously. Set-up/tear-down time of five minutes by a crew of six. Range: 150km

64N6E

The 64N6E is a mobile, 360° scanning radar with a two-face phased-array antenna and automatic operation. It cues the 83M6E control system associated with the S-300PMU1 AD missile. Additionally, it tracks a variety of threats even with heavy ECM, identifies detected threats and measures the bearings of hostile jammers. Carrier frequency-hopping protects against spot jamming, while a three-path automatic equaliser handles sidelobe barrage jamming. Range: 320km

EQUIPMENT

NAVAL RADAR SYSTEMS

This section contains basic data on a selection of radar systems used in surface vessels, submarines and coastal installations:

- coastal surveillance
- naval fire control
- naval surveillance

The equipment is listed alphabetically by manufacturer within the above subsections.

If you think your product should be listed, please contact the team at insight@shephardmedia.com to ensure it appears in the *Shephard Defence Insight* online database (shephardmedia.com/defenceinsight) and is included in the next handbook edition.

ABOVE: The Sea Giraffe 4A combines long-range air surveillance and defence with full horizon coverage on surface targets and is described by Saab as the ultimate sensor for mission success and survivability throughout the whole scale of conflict in any naval environment. (Image: Saab)

COASTAL SURVEILLANCE

ASELSAN

Serdar

The Serdar coastal surveillance radar is a fully solid-state, X-band, FMCW (frequency-modulated, continuous-wave) system that enables automatic detection and tracking of above-water naval and low-flying airborne targets. The radar can be installed on a stationary ground platform and controlled by a remote C2 centre. Due to low output power and the waveforms used, it is able to detect without being detected, according to the company. Range: 90km

BATS BELGIAN ADVANCED TECHNOLOGY SYSTEMS

CR20

The CR20 is an FMCW (frequency-modulated, continuous-wave) coastal surveillance radar family, designed for detection of surface targets, including in adverse sea conditions. The radar uses automatic detection and tracking, generating a tactical situation display. The system can be supplied in fixed or mobile configurations for coastal surveillance and vessel traffic services. The family includes short-, medium- and long-range variants. Range: 60km

BLIGHTER SURVEILLANCE SYSTEMS

Blighter C400

Blighter C400-series radars are based on the company's B400 ground surveillance range. The C400 series has a modular, non-rotating solid-state design and is fitted with an electronic scanning system. The radars are designed for coastal surveillance missions with Doppler signal processing to examine the motion of waterborne objects. This also allows the radar to separate targets of interest from background clutter so that it can detect small targets in busy environments. Width: 0.66m Height: 0.5m Weight: 24kg Range: 11km

DIGINEXT

Stradivarius

Stradivarius is a high-frequency, surface-wave radar (HFSWR) that is able to detect small vessels out to 370km from the coastline. The system is currently deployed on the French Mediterranean Sea and under the European RANGER (Radars for Long-distance Maritime Surveillance and Search and Rescue Operations) project. The programme was announced in May 2016.

FURUNO

TZ Coastal Monitoring

This coastal surveillance solution incorporates Furuno radar with TimeZero TZ Coastal Monitoring software and systems. It is designed for the monitoring of oil rigs, sea farms, ports, waterside facilities and protected areas. TZ Coastal Monitoring packages are designed to provide the functions of a standard system that covers most business requirements at a lower cost as a custom-made option.

GEM ELETTRONICA

Gemini-DB

Gemini-DB is a digital X-Ka dual-band radar system featuring automatic radar plotting aid. It can be used as a standalone system or integrated with bridge systems. The Gemini-DB is aimed at port security or surveillance of critical infrastructure including offshore platforms, nuclear power plants, oil refineries and SMGCS (surface movement guidance and control systems) for airport ground control. Height: 0.88m Diameter: 2.79m Weight: 230kg Range: 177.8km

MFRAD

MFRAD is an X-band 3D surface and air surveillance radar featuring weapon systems target designation. It is aimed at shipborne and coastal applications. In shipborne installations, MFRAD fulfils the role of secondary search radar for large-medium combatant ships and a primary search radar for ships like corvettes and offshore patrol vessels. Range: 178km

SeaFalcon

The SeaFalcon coastal surveillance and VTM frequency-diversity radar is available in 25kW and 50kW versions. The unit is designed for high azimuth and range discrimination and can be remotely operated via a LAN interface operating on a Windows-based package. The latest variant is the SeaFalcon/S. Length: 0.3m Width: 0.24m Height: 0.84m Weight: 65kg

Sentinel

Sentinel is a family of X-band, solid-state coastal and maritime surveillance radars. There are four standards of peak transmitter power, two sizes of antenna in each standard and two types of antenna polarisation in each group, resulting in 16 different types of system. Transmitter peak power standards are 50, 100, 200 and 400kW, with antenna sizes of 5.8 and 6.4m with horizontal or circular polarisation. Width: 6.4m Weight: 520kg

INDRA SISTEMAS

Aries CS

Aries CS is a coastal surveillance radar and part of a family that includes submarine and precision approach variants. It is shore-based and capable of detecting small targets at short and long ranges in rough seas and severe weather conditions. It can be employed as a VTM system. Range: 463km

iCSR-20

The iCSR-20 is a low-power solid-state radar available in both S and X bands for medium- to long-range coast surveillance VTS applications. It is able to operate in severe weather conditions and has been developed specifically to meet the recommendations of the International Association of Lighthouse Authorities (IALA) Advanced (V-128) for radar sensors for VTS.

The SBS-900 family of coastal surveillance systems are improved versions of the SBS-800 and provide dual redundancy for the transceiver. (Photo: Kelvin Hughes)

KELVIN HUGHES

SBS-700-2

The SBS-700-2 is a non-coherent coastal surveillance radar, designed to complement the SBS-800 SharpEye radar family. Part of Kelvin Hughes' family of shore-based radar systems, the SBS-700 family has been specifically developed to meet the operational requirements of port, harbour and river traffic operators as well as government agencies responsible for the protection of coastal and littoral zones. Length: 0.65m Width: 0.42m Height: 0.27m Diameter: 640cm Weight: 30kg Range: 178km

SBS-800

The Shore-Based Sensor (SBS) 800 family is designed to provide coastal surveillance and meet operational requirements of port, harbour and river traffic operators as well as government agencies responsible for the protection of coastal and littoral zones. SBS-800 family radar installations are configured to provide an upmast system without the need for dual redundancy of the radar itself. They include the company's SharpEye transceiver and sensor. Weight: 185kg

SBS-900

The SBS-900 family of coastal surveillance systems are improved versions of the SBS-800 and provide dual redundancy for the transceiver. They are configured for a mast-mounted, sealed enclosure and designed to provide a complete sensor package. The SBS-900-1 system operates over X band with a mast-mounted SharpEye transceiver; the SBS-900-2 provides similar capability with frequency diversity; the SBS-900-3 is similar to the 900-2 with dual redundancy; and the SBS-900-4 has both S- and X-band SharpEye transceivers. Weight: 130kg

LEONARDO

SPN-730

Developed by Leonardo, SPN-730 is an I-band low-probability-of-intercept (LPI) surveillance and navigation radar. The SPN-730 comprises two units that can be supplied already integrated with a conventional magnetron navigation radar to provide LPI or normal operational mode. The system has been installed on about 30 combat ships in Italy and Turkey.

MDA – MACDONALD, DETTWILER AND ASSOCIATES

MDA BlueHawk

MDA developed BlueHawk, a multi-sensor, unclassified maritime domain awareness solution that provides navies, coast guards, environmental and regulatory agencies with near-real-time access to broad-area maritime surveillance across EEZs and global areas of interest. Fusing SAR and optical satellite imagery, AIS data, vessel registries and other maritime information, MDA BlueHawk provides critical information and tools to detect, track and respond to security and environmental threats.

OBZERV

ARGC-2400

The ARGC-2400 long-range camera is designed for coastal and border surveillance as well as critical infrastructure protection. With a range-gated intensified camera for night surveillance and two colour sensors (narrow and wide FOV) for day operation, the ARGC-2400 can be used for identification tasks such as reading vessel names and detecting pointed optics or camouflage nets. Length: 0.56m Width: 0.52m Height: 0.52m Weight: 55kg

PLATH GMBH

MACOS

MACOS is designed as an entry-level solution with a passive radar and a communication signal DF sensor. The combined passive antenna solution makes it unnecessary to deal with different suppliers for different sensors. The combined antenna weighs less than 55kg and incorporates elements for communication frequency ranges from 20 to 3,000MHz and a compact passive radar detection system, covering the 2-18GHz range. The system can be controlled by a single operator.

RADA ELECTRONIC INDUSTRIES

eMHR

RADA'S Enhanced Multi-Mission Hemispheric Radar (eMHR) forms the basis of hostile fire-locating (RPS-70/71), perimeter surveillance (RPS-72) and all-threat air surveillance (RPS-74) systems. It can be installed on vehicles or vessels and at fixed bases. The system can also operate in search while in tracking, target revisit and single-target tracking modes.

ieMHR

RADA's ieMHR (Improved and Enhanced Multi-Mission Hemispheric Radar) is the largest in a family of MHRs manufactured by the company to provide hostile fire location (RPS80/81), 3D perimeter surveillance (RHS-84) and all-threat air surveillance (RPS-82). It is an S-band radar that provides detection for pedestrians to a range of 20km and large transport aircraft to 100km.

Three-Dimensional Perimeter Surveillance Radars

RADA's Three-Dimensional (3D) Perimeter Surveillance Radars, which include the RHS-14, RHS-44, RHS-74 and the RHS-84, provide border and perimeter surveillance through detection, classification and tracking of surface and aerial intruders such as pedestrians, vehicles, slow and small aircraft, vessels and more. These radar systems can be based on any member of RADA's Multi-Mission Hemispheric Radar (MHR) family of tactical radar platforms or Compact Hemispheric Radar (CHR).

RAYTHEON ANSCHÜTZ

Smartblue

Developed by Raytheon Anschütz, Smartblue is an X-band maritime surveillance radar family. It is suitable for coastal surveillance systems, mobile radar installations and vessel traffic services. A ruggedised design with a range of antennas from 8, 12 and 18in, the radar family has been built to withstand use on ships, in maritime environments and on unmanned sites in all weather and climate conditions. Length: 5.6m Height: 584m Diameter: 5.5m Weight: 24.5kg

ROSOBORONEXPORT

MR-10M1E

The MR-10M1E is a coastal radar designed to detect, track, locate and identify surface ships and small, high-speed targets in the open sea and littoral areas. The radar determines target co-ordinates and motion parameters in the relative and geographic coordinate system. The system transfers the data to automated gathering and processing systems. Range: 200km

TERMA

Scanter 5000 Series

The Scanter 5202/5102 coastal surveillance radar and VTS is designed for management and detection of ships and boats as well as providing an option for low-level air surveillance. A Scanter 5102 system was evaluated by the Port of London and radars of the series are in service in several major international ports.

NAVAL FIRE CONTROL AND AIR DEFENCE

ASELSAN

AKR-D

The AKR-D family comprises fire control radar systems designed by Aselsan for naval platforms. They include the Ku-band AKR-D Block-A1 with an instrumented range of 30km; the Ku-band AKR-D Block-A2 with an instrumented range of 80km; the X- and Ka-band AKR-D Block-B1 with an instrumented range of 120km; and the X-/Ka-band and X-band Illumination AKR-D Block-B2 with an instrumented range of 120km. Range: 120km

CEA TECHNOLOGIES

CEAMount

CEA is providing the CEAMount active phased-array illuminator for the anti-ship missile defence upgrade to the RAN's Anzac-class frigates. It performs target illumination and missile uplink for multiple simultaneous semi-active homing missiles. The CEAMount can be configured as a mechanically trained face or a fixed multi-face solution.

SSCWI

The Solid State Continuous Wave Illuminator (SSCWI) is a high-powered solid-state transmitter providing semi-active missile air target illumination for ship self-defence. The SSCWI uses broadband solid-state power amplifiers and features a sophisticated control and monitoring system, including remote maintenance and access options. It is installed on UAE Baynunah-class corvettes and RAN Anzac-class frigates.

CEIEC – CHINA NATIONAL ELECTRONICS IMPORT & EXPORT

Type 344

Type 344 is an I-band fire control radar used for 76mm, 100mm, 136mm gun and anti-ship missile targeting for surface and airborne threats. Its export name is MR34. The system is installed on Chinese destroyers and frigates which have been built after 1990.

CHINA ELECTRONICS TECHNOLOGY GROUP CORPORATION (CETC)

LR66

The China Electronics Technology Group Corporation (CETC) LR66 fire control radar is a component of ship defence close-in weapon systems, including the Type 730. The major role of the radar is to search, capture and automatically track cruise missiles or low-RCS missiles and provide control for anti-missile gun systems. Range: 18km

CONCERN GRANIT-ELECTRON JSC

3TS-25E

The 3TS-25E, known also as Garbun-B, Plank Shave (NATO) or BEL Aparna (India), is a Russian target designation radar system. Using active and passive channels, it can support missile designation. The system has been deployed on multiple vessel classes of the Indian and Russian navies. Range: 0.14km

CONCERN MORINFORMSYSTEM-AGAT JSC

Bagira MR-123-02

The Bagira Fire Control System (FCS) is also known as MR123, Bass Tilt or Vympel. Originally developed in the Soviet Union, the Bagira FCS can be used simultaneously by up to four naval guns ranging from 30mm up to 100mm. Bagira can undertake target surveillance, selection and identification tasks. The main users of the system are the Indian and Russian navies. Weight: 3,600kg Range: 45km

MR-90 Orekh

The MR-90 Orekh, also known as Front Dome, is a Russian fire control system developed originally in the 1980s. It is a pulse-Doppler radar with continuous-wave illumination. Range: 74.1km

ELTA SYSTEMS

EL/M-2221

The EL/M-2221 is a Search, Track and Guidance/ Gunnery Radar (STGR), developed and manufactured by Israeli company ELTA Systems. Originally, the system was developed for the Barak missile system. The radar is a monopulse pulse-Doppler system. The EL/M-2221 has been exported to India, Chile and Singapore, having earlier been in service also in Taiwan. Weight: 1,420kg Range: 30km

LEONARDO ELECTRONICS

KRONOS Dual Band

Leonardo's Kronos Dual Band is a multi-functional, solid-state naval radar utilising CMM and X bands. It combines Kronos Quad (C-band) and Kronos StarFire (X-band) scalable radar architectures.

NA30S MK2

The NA30S is a modular weapon control system designed to control surface-to-air missiles and guns (up to three gun outputs) in a sophisticated threat environment and in coordinated fire reaction mode. It is based on the Orion RTN-30X tracking naval radar and I-band fully coherent equipment, which is characterised by anti-nodding, electronic counter-countermeasures and anti-clutter features together with tracking accuracy. Height: 1.5m Weight: 700kg

LEONARDO

RTN-25X

RTN-25X, also known as MM/SPG-74, is a K-band fire control radar designed to be coupled with close-in weapon systems (CIWS). It is an improved version of the earlier RTN-20X radar. The RTN-25X, currently manufactured by Leonardo, is also a part of the NA-25X fire control system. Range: 15km

LIG NEX1

SPG-540K

The SPG-540K is a Korean fire control radar installed on the Daegu and Incheon-class of surface vessels.

LOCKHEED MARTIN

AN/SPY-1 air search radar

Aegis is an integrated missile guidance system used on USN and allied ships to perform anti-air and ballistic missile defence missions. The S-band phased-array AN/SPY-1D(V) radar acquires and tracks multiple targets, handing off to the missile control station via the MK99 FCS.

RADA ELECTRONIC INDUSTRIES

All-Threat Tactical Air-Surveillance radar

RADA's All-Threat Tactical Air Surveillance radar systems, which include the RPS-12, RPS-42, RPS-72 and RPS-82, detect all types of aerial vehicles (including UAVs of all groups), missiles, rockets and mortars. It classifies threats, provides and displays tracking and warning/alert, and provides data to external C4I and air defence systems over Ethernet. These tactical radar systems can also function as gap-fillers, complementing medium- and long-range air surveillance systems. Weight: 45kg

RATEP JSC

5P-10E

The 5P-10E, also known as 5P-10E Puma, is an FCS developed and manufactured by Russian company Ratep JSC. The system is capable of performing autonomous search and surveillance tasks with target prioritisation capability. The 5P-10E is commonly coupled with the Russian-built A-190 100mm naval gun, but it can also be delivered separately.

RAYTHEON

AN/SPG-62

Th AN/SPG-62 is an X-band fire control radar (FCS) developed and manufactured by Raytheon. It is also a component of the US MK 99 fire control system. The AN/SPG-62 utilises continuous wave and illumination contributing to the semi-active radar homing system on standard missiles. Its main users include Japan, South Korea and the US. Diameter: 2.29m Range: 305.6km

SAAB

Ceros 200

The Ceros 200 is a radar and optronic tracking system designed for use on naval vessels. When interfaced with modern missile or gun systems, it provides defence against threats including sea-skimming missiles and asymmetric surface combatants in littoral environments. Ceros 200 combines acquisition speed, tracking precision and the ability to track targets in any weather, according to the company. Length: 1.82m Width: 1.63m Height: 1.96m Weight: 750kg Range: 100km

TERMA

C-FIRE EO

The C-Fire EO system is an EO naval solution that can perform surveillance and fire control tasks. Developed and manufactured by Terma, the system is equipped with a thermal imager, a TV camera and a laser rangefinder. It can control up to three separate gun mounts simultaneously with the ability to provide independent ballistic predictions to each.

THALES NETHERLANDS

APAR

APAR is operational on the four De Zeven Provinciën-class vessels of the Royal Netherlands Navy, the three Sachsen-class ships of the German Navy and the three

Iver Huitfeldt ships of the Danish Navy. The Active Phased Array Multi-function (APAR) radar is an X-band naval surveillance radar and FCS. The system provides 360° azimuth scanning and a range of circa 150km, with an 8.5° angle-of-elevation coverage. Weight: 10,000kg Range: 150km

Flycatcher Mk 2

The Flycatcher Mk 2 is a fire control system for short-range air defence guns and missiles. It features 3D radar and IR/TV sensor with laser rangefinder. It is an older system, but production was restarted in September 2015 on the back of an order from Germany believed to be worth €17 million ($19 million). Range: 25km

STIR 1.2 EO Mk 2

STIR 1.2 EO Mk 2 is a tracking radar for gun and missile fire control. Its claimed reliability and stealth target detection capabilities support long missions. The STIR 1.2 is the first track radar with a full set of solid-state transmitters, according to the company. It has been designed for stealth target detection in littoral and ECM environments. An EO suite complements the dual-band radar. Height: 2.3m Weight: 850kg Range: 120km

THALES

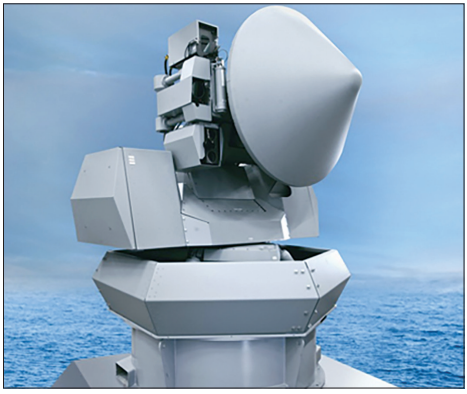
Castor 2B

The Castor 2B is a monopulse MTI I/J-band radar featuring an integral EO sensor used for weapon control, including gunfire splash-spotting. It is designed to operate against low-altitude targets, in the presence of jamming and in severe weather conditions. Key features of the system include automatic target acquisition for quick reaction times; passive tracking of a jammer; and autonomous surveillance, continuous and by sector, with absolute elevation. Range: 27km

Castor 2C

The Castor 2C is an I/J-band target-tracking radar for gunfire control against air, surface and shore targets. It uses Doppler filtering techniques to track targets in heavy clutter and ECM. The system is integrated with EO sensors and is in service on Taiwan's Kang Ding-class frigates. It is able to acquire targets and track them in conditions of heavy clutter, chaff and active jamming. Range: 27km

STIR 1.2 EO Mk 2 has been designed for stealth target detection in littoral and ECM environments. (Image: Thales Netherlands)



Castor family

The Castor radar family includes several products. This X-band radar is designed to perform fire control. It has a beamwidth of 2° and peak power of 200kW. The Castor-1 (also known as the TRS-3200) has a range of around 30km, transmitting up to 8,000 pulses per second (pps) from its magnetron transmitter. The Castor-2/TRS-3201 can transmit up to 7,200pps using a 30kW coherent travelling-wave tube transmitter.

DRBC 32

The X-band DRBC-32 radar family includes the DRBC-32B, 32C, 32D and 32E. Designed to provide fire control for naval guns, the radar has a range of circa 15km and a 1.5° beam width. With a peak power of 80kW, the radar uses monopulse compression. Range: 15km

Herakles

Thales' Herakles radar provides 3D imagery for surveillance and fire control. The S-band radar has an integrated Mode-5/Mode-S compatible IFF interrogator. When performing air surveillance, it has a range of 250km and a range of 80km when performing surface surveillance. The radar covers 360° azimuth and 70° elevation. The antenna revolves at 60rpm and the radar can track over 400 targets.

SF 500

Sea Fire 500 (SF 500) is a multifunction radar providing simultaneous long-range air and surface surveillance, target acquisition and tracking and fire control (ASTER missiles and guns) against any type of targets in harsh environments. These targets may be conventional, asymmetric or ballistic. SF 500 has a compact AESA digital array and instantaneous bandwidth associated with a large number of multi-beam clusters and adaptive radar resources management. It is claimed to be the first fully digitalised naval radar.

Variant

Variant is a 2D C/X-band naval surveillance and fire control radar. Providing a horizontal beam width of 1.8° and a vertical beam width of 14°, it has a detection range of 30km in the C band and 28km in the X band. The use of two frequency ranges is intended to make the radar less susceptible to electronic countermeasures. The radar has a selectable pulse width of 4.5, 12.8 or 16µs and a pulse repetition frequency of 3-9KHz. Range: 120km

ULTRA ELECTRONICS COMMAND & SONAR SYSTEMS

Series 2500 EOS

The Series 2500 EOS is a tracking and fire control radar for small- and medium-calibre guns as well as short-range missiles. Manufactured by Ultra Electronics, the Series 2500 is deployed by both the British and Australian navies. Width: 106cm Height: 91.5cm Weight: 285kg

NAVAL SURVEILLANCE

ASELSAN

ALPER

ALPER (Aselsan Low Power ECCM Radar), being an X-band radar with high range resolution, has no blind range. Its performance is achieved by use of a dual-slotted antenna with low sidelobe levels, digital FM CW waveform and a digital receiver with DSP architecture. Low and adjustable output power makes the radar virtually undetectable by enemy ESM, it is claimed, while providing the user the advantage of detecting before being detected. Range: 65km

ANX3100 Naval 3D Air & Surface Surveillance Radar

ANX3100 Naval 3D Air & Surface Surveillance Radar is a lightweight, multi-beam, solid-state active phased-array radar system operating in the X band. ANX3100 is designed to provide medium-range air and surface surveillance and target designation. It is suitable for installation on OPVs, corvettes and fast attack boats due to its lightweight antenna and below-deck compactness. Weight: 300kg Range: 100km

Smart-S Mk 2

Smart-S Mk 2 is a naval air and surface surveillance radar that applies a multi-beam concept. Its reliability and stealth target detection (including in clutter) support long missions and operation in littoral environments. The Smart-S Mk2 is designed to be easy to operate, using two automatic operational modes, as well as easy to install, integrate and maintain. The Smart-S Mk 2 is able to automatically detect and track air and surface targets. Range: 250km

BAE SYSTEMS

Artisan 3D radar

The Advanced Radar Target Indication Situational Awareness and Navigation (Artisan), also known as Type 997, is a medium-range 3D radar series. Designed for the UK RN's Type 23 frigates, Artisan will be replacing the Type 996 surveillance and target indication radar and has already been fitted on 11 frigates to date. Weight: 700kg

S1850M

Developed by BAE, S1850M is an L-band long-range 3D radar for wide-area search focusing on both air and surface targets. It is derived from Smart-L. The system has fully automatic detection and track initiation, which means that it can track up to 1,000 air targets at a range of around 400km. Range: 400km

Sampson

Sampson is the multi-function 3D radar selected for UK RN's Type 45 anti-air warfare destroyers, following development from the Multi-function Electronically Scanned Adaptive Radar programme. Sampson is a software-controlled radar that provides search and precision tracking of multiple targets, along with weapons control, offering the option of automatic operation. Range: 400km

BATS BELGIAN ADVANCED TECHNOLOGY SYSTEMS

AMR 22

The AMR 22 airborne maritime surveillance radar is an X-band multi-mode radar that is provided in three variants: AMR 22A for aircraft, AMR 22H for helicopters and AMR 22U for UAVs. The company describes the radars as suitable for all-weather operation during day and night, and capable of penetrating clouds, fog, smog and man-made camouflage. Operational missions include exclusive economic zone patrol, maritime law enforcement, search and rescue, and air-to-air and air-to-ground surveillance. Weight: 95kg Range: 370km

BEL-THALES SYSTEMS

Pharos

Pharos is a multi-target tracking radar designed for gun and very-short-range air defence missile control, developed as a JV between Thales and Bharat Electronics. The system will be used to control medium-calibre guns ranging from 30mm to 76mm for ground-based and naval applications. With guided ammunition, the radar will be able to provide anti-ship missile capability. Width: 1.4m Height: 1.85m Weight: 950kg

CEA TECHNOLOGIES

CEAFar

CEA is providing the CEAFar active phased-array radar for the anti-ship missile defence upgrade to the RAN's Anzac-class frigates. The CEAFar provides digital beam-forming radar capability able to perform 3D volume search, surface search, fire control support or target classification in demanding, cluttered and jamming environments.

CEIEC – CHINA NATIONAL ELECTRONICS IMPORT & EXPORT

Type 364

Type 364 is an S-band fire control radar system developed by Yangzhou Marine Electronic Instruments Research Institute for Type 630 and Type 730 close-in weapon systems (CIWS). It can track 20 targets simultaneously with 30rpm rotation speed. The radar has a maximum range of 75km against 2m2 radar cross-section (RCS) aircraft and 12km against 0.1m2 RCS targets. Weight: 520kg
Range: 75km

Type 517

Type 517, known also as Spider or SUR17B, is a long-range air search radar deployed by Chinese Navy surface vessels. It is manufactured by the Beijing Leiyin Electronic Technology Development Company. It has a maximum range of 350km against 4m2 radar cross-section (RCS) targets and 100km against 0.1m2 RCS stealth aircraft. The system can track 20 targets simultaneously. Range: 350km

CHINA ELECTRONICS TECHNOLOGY GROUP CORPORATION (CETC)

Type 346

Type 346 (NATO classification: Dragon's Eye) is a multifunctional, S/C- and X-band active phased-array radar developed to detect and track several hundreds of airborne and surface vessels, including fast boats and sea-skimming missiles. The radar is similar to the USN's SPY-1 radar. Its variants include Type 346, 346A, 346B. Range: 500km

CHINA STATE SHIPBUILDING CORPORATION

Type 360

The Type 360, also known as Seagull-S, SR-60 or H/LJQ360, is a E/F-band surface search radar produced by Yangzhou Marine Electronic Instruments Research Institute, which functions under the China State Shipbuilding Corporation. The Type 360 radar is reportedly based on Selenia's RAN-10S radar and it is deployed on multiple Chinese surface vessel classes.

CONCERN GRANIT-ELECTRON JSC

3TS-25E

The 3TS-25E, known also as Garbun-B, Plank Shave (NATO) or BEL Aparna (India), is a Russian target designation radar system. Using active and passive channels, it can support missile designation. The system has been deployed on multiple vessel classes of the Indian and Russian navies. Range: 0.14km

CONCERN MORINFORMSYSTEM-AGAT JSC

Fregat M2EM / Top Plate

The Fregat M2EM, also known as Top Plate or Top Steer, is a Russian E-band surveillance radar with integrated IFF capability. The radar is capable of providing a 3D image of the target with the effective range varying from 2km to 300km for surface targets and 98,400ft in altitude. The main users of the Fregat M2EM are the Russian and Indian navies. Weight: 11,800kg Range: 300km

Podberezovik-ET1/2

The Podberezovik-ET2 is a Russian UHF-band air and surface surveillance radar capable of performing 3D scanning and providing target designation data for weapon systems. The Podberezovik radar system can detect targets from distances up to 500km, and it is also equipped with IFF capability. The most prominent deployment of the system is on the Russian-built Vikramaditya aircraft carrier of the Indian Navy.

Positiv-E/Cross Dome

The Cross Dome radar, also known as the The Positiv-E or MR-352, is a Russian E/F-band naval radar system. The radar is capable of performing IFF and TWS (track while scan) tasks. The Cross Dome functions on E/F bands. Range: 129.6km

Pozitiv-ME1

The Pozitiv-ME1 is a Russian X-band radar designed to search, detect and track air and surface targets. It can perform situational surveillance tasks, IFF and analysis of the coordinates, motion parameters, classification and prioritisation of the targets. Weight: 3,200kg Range: 150km

Pozitiv-ME1.2

The Pozitiv-ME1.2 is a Russian X-band radar designed to search, detect and track air and surface targets. It is the lightest product in the Pozitiv family of active radars. It can perform situational surveillance tasks, IFF and analysis of the coordinates, motion parameters, classification and prioritisation of the targets. Weight: 2,150kg Range: 80km

CONTROP PRECISION TECHNOLOGIES

iSea-50HD

The iSea-50HD is part of a family of surveillance systems designed for day and night operations in harsh maritime environments. iSea variants have been installed on a range of platforms, including coast guard and naval ships and manned and unmanned vessels. The four-gimbal system is gyro-stabilised and has 22.5x continuous zoom, an optional eye-safe laser rangefinder, an optional laser pointer and an automatic target tracker. Diameter: 35.4cm Weight: 29kg Detection range: 27.78km

ELTA SYSTEMS

EL/M-2238 STAR

EL/M-2238 Surveillance Threat Alert Radar (STAR) is an S-band, pulse-Doppler, 3D, surface and air search radar for naval platforms. The STAR has three antenna variants: small, medium and large. Width: 4m Height: 2m Weight: 2,000kg Range: 350km

ELM-2248 MF-STAR

The ELM-2248 Multi-function Surveillance Track and Guidance Radar (MF-STAR) is a solid-state active phased-array radar system. The radar system delivers a situation picture and weapons support under severe target/environmental conditions in the naval arena. The MF-STAR employs multi-beam and pulse-Doppler techniques, as well as robust ECCM to extract low-RCS targets from complex clutter and jamming environments. Weight: 1,500kg Range: 125km

ELM-2258 ALPHA

The ELM-2258 Advanced Lightweight Phased Array (ALPHA) naval radar is a multi-function solid-state active phased-array system for modern medium-sized combat ships. The ALPHA radar antenna consists of a lightweight, rotating/scanning, 3D active S-band array that is suited for installation on board ship classes such as corvettes, frigates and larger vessels. The system delivers a maritime theatre situational awareness picture and supports the ship's weapon systems under tough target/environmental conditions. Weight: 700kg Range: 120km

GEM ELETTRONICA

Gemini-DB

Gemini-DB is a digital X-Ka dual-band radar system featuring automatic radar plotting aid. It can be used as

a standalone system or integrated with bridge systems. The Gemini-DB is aimed at port security or surveillance of critical infrastructure including offshore platforms, nuclear power plants, oil refineries and SMGCS (surface movement guidance and control systems) for airport ground control. Height: 0.88m Diameter: 2.79m Weight: 230kg Range: 177.8km

MFRAD

MFRAD is an X-band 3D surface and air surveillance radar featuring weapon systems target designation. It is aimed at shipborne and coastal applications. In shipborne installations, MFRAD fulfils the role of secondary search radar for large-medium combatant ships and a primary search radar for ships like corvettes and offshore patrol vessels. Range: 178km

HARRIS ELECTRONIC SYSTEMS

AN/SPS-48G(V)1

The AN/SPS-48G(V)1 is a 3D, long-range air surveillance radar used for the detection and tracking of aircraft and missiles. The radar is available in fixed-site, transportable or shipboard configurations to support customer needs on land or at sea. The multi-pencil beam architecture provides jamming immunity, low false-alarm rates and the ability to detect and track small targets, as well as weather detection and display capabilities. Its variants include AN/SPS-48, -48C, -48E and -48F. Length: 3.96m Width: 3.65m Weight: 1,125kg Range: 408km

INDRA SISTEMAS

Aries-S

The Aries-S submarine radar is part of Indra's Aries family of radars, providing a surveillance and navigation solution for submarines. According to the company, the system's low transmission power makes it 'virtually undetectable' by tactical ESM systems. Features include low probably of interception, a solid-state transmitter, target tracking and trajectory estimations. It is a high-resolution solution.

Lanza-N

The Lanza-N is a long-range naval radar, part of the Lanza Family of 3D radar systems. The Lanza-N operates in an L-band frequency and has a range of under 334km. The radar is IFF/SIF-integrated and also uses soft fail technology and solid-state transmitters. The system is fitted to the Spanish Navy's Juan Carlos I amphibious assault ship. Range: 334km

Skyfender AMSR

The SkyFender AMSR is an all-weather pulse-Doppler radar that operates in the X band. It is able to provide air and maritime target detection and tracking capabilities, allowing for situational awareness and a timely response to air and seaborne threats in naval shipborne scenarios during all weather, night and day conditions.

KELVIN HUGHES

SharpEye

The SharpEye radar is available in S- and X-band configurations. In the former, the radar has a peak output power of 200W and an average output power of 20W. Length: 3.9m Weight: 177kg Range: 89km

LEONARDO ELECTRONICS

EMPAR

The European Multi-function Phased Array Radar (EMPAR) operates in the C band, concurrently performing 3D detection, multiple target tracking and missile guidance. Fitted on board medium and large vessels, playing the role of main ship sensor, it can be integrated within combat and missile systems, supporting self-defence, local area defence, medium-range defence, long-range defence and detecting high-diving and sea-skimming missiles, aircraft and helicopters, large vessels and fast patrol boats. Length: 1.1m Width: 2.2m Height: 2.1m Diameter: 5m Weight: 2,500kg Range: 150km

KRONOS Dual Band

Leonardo's Kronos Dual Band is a multi-functional, solid-state naval radar utilising CMM and X bands. It combines Kronos Quad (C-band) and Kronos StarFire (X-band) scalable radar architectures.

KRONOS Grand Naval

Leonardo's KRONOS Grand Naval is a multi-functional radar system utilising AESA technology. Its applications include extended self-defence, air and surface surveillance, tracking of multiple targets, multiple missiles guidance and volumetric search. The KRONOS Grand Naval is also used as the main radar for the Principal Anti-Air Missile System (PAAMS).

KRONOS Naval

KRONOS Naval is a multi-functional radar family based on AESA technology. Kronos can simultaneously perform a range of functions, including air and surface surveillance, threat evaluation and tracking, missile guidance, ECM and firing. The KRONOS family is designed to provide maximum operational flexibility due to an enhanced modular architecture. Range: 250km

KRONOS Power Shield

KRONOS Power Shield is a naval early warning radar developed and manufactured by Leonardo. It utilises AESA technology with a fully digital antenna. The applications for the Kronos Power Shield include ballistic missile defence and surveillance. Its main operators include the Italian Navy and the Qatar Emirates Navy. Range: 1,500km

KRONOS Quad

The KRONOS Quad is a C-band naval radar comprising four fixed panels. Produced by Leonardo, it is part of the Kronos family of radars utilising active electronic scanning antennas, and it can be delivered as a part of the Kronos Dual Band system alongside KRONOS Starfire. Range: 463km

NA25X

The NA25X is a radar/EO fire control system capable of controlling medium-calibre guns in the anti-aircraft and anti-surface roles, as well as small-calibre guns in the close-in weapon system role. Up to three guns of different calibres can be controlled at the same time. It features

a tracking radar and J-band fully coherent equipment, which is characterised by anti-nodding, electronic counter-countermeasures and anti-clutter features together with high tracking accuracy. Height: 1.4m Weight: 490kg

RAN-30X/I

The RAN-30X/I is a 2D air/surface surveillance radar in the X band. RAN-30X/I plays four different roles: air/surface surveillance; navigation support and helicopter control; over-the-horizon detection; and anti-sea-skimming missile detection. Each mode has been designed with a set of transmitting waveforms. The antenna is mechanically stabilised in roll and pitch. The reflector antenna has two different beams and polarisation methods (linear and circular) used to cope with the different applications. Height: 2.3m Weight: 600kg

RAN-40L

Leonardo's RAN-40L (also known as the SPS-798) is a 3D L-band naval surveillance radar. Capable of detecting aircraft at a range of 400km, it can use both short- and long-range waveforms, the former of which can be used for clutter suppression from natural phenomena, and the latter allows the radar to perform in conditions of intensive ECM jamming. Range: 1,000km

SPN-720

SPN-720, developed by Leonardo, is a shipborne precision-approach radar to provide a safe and reliable final approach and deck landing guidance for aircraft during day/night and in adverse weather conditions. It employs an I-band Doppler radar with a coherent solid-state transceiver, utilising frequency-agile monopulse tracking at an operating range of 22km. The SPN-720 Man-Machine Interface features two consoles (master and slave), each with a precision-approach radar display and an air search display. Length: 1.2m Width: 1.2m Height: 1.2m Weight: 300kg Range: 22.2km

SPS-732

The SPS-732 is an X-band naval surveillance radar utilising solid-state technology and low-probability-of-intercept (LPI) capability. It performs two-dimensional surface and air target detection featuring track-while-scan capability and short reaction time. Range: 29.63km

LEONARDO

KRONOS Starfire

The KRONOS Starfire is an X-band naval radar comprising four fixed panels. Produced by Leonardo, it is part of the KRONOS family of radars utilising active electronic scanning antennas, and it can be delivered as a part of the KRONOS Dual Band system alongside Kronos Quad Range: 463km

RAN 21S

Leonardo's RAN 21S is designed to detect small air and surface targets over short to medium ranges. It is equipped with a monopulse antenna, solid-state S-band transmitter and a digital receiver. The system is also IFF-integrated, supporting multiple IFF modes.

SPN-730

Developed by Leonardo, SPN-730 is an I-band low-probability-of-intercept (LPI) surveillance and navigation radar. The SPN-730 comprises two units that can be supplied already integrated with a conventional magnetron navigation radar to provide LPI or normal operational mode. The system has been installed on about 30 combat ships in Italy and Turkey.

LIG NEX1

SPS-550K

SPS-550K is a medium- to long-range 3D air and surface surveillance radar. It employs digital multi-beam forming, pulse-Doppler and medium pulse repetition frequency techniques to extract low-radar cross-section targets and to suppress the multipath. Width: 4m Height: 3m Diameter: 1.7m Weight: 2,500kg Range: 250km

MDA – MACDONALD, DETTWILER AND ASSOCIATES

MDA BlueHawk

MDA developed BlueHawk, a multi-sensor, unclassified maritime domain awareness solution that provides navies, coast guards, environmental and regulatory agencies with near-real-time access to broad-area maritime surveillance across EEZs and global areas of interest. Fusing SAR and optical satellite imagery, AIS data, vessel registries and other maritime information, MDA BlueHawk provides critical information and tools to detect, track and respond to security and environmental threats.

NORTHROP GRUMMAN SPERRY MARINE

BridgeMaster E

BridgeMaster E is a navigation and surveillance radar family introduced in 1999, featuring a detailed tactical display system that is able to integrate inputs from two totally asynchronous radar heads simultaneously in the same video circle including other manufacturers' products. The radar uses S and X bands. It can track targets at speeds of up to 600kt and target manoeuvres can move up to 4G, depending on target range, antenna rotation rate and local clutter conditions. Width: 0.73m Height: 0.68m Diameter: 0.36m Weight: 163kg

NORTHROP GRUMMAN

AN/SPQ-9B

The AN/SPQ-9B TWS radar is used with the MK86 and MK160 gunfire control systems. It detects sea-skimming missiles on the horizon, including in heavy clutter, and simultaneously detects and tracks surface and air targets. Also interfaces with the SPY-1 radar. Equipped ships include US Ticonderoga-class cruisers, LHD-1 amphibious ships, LPD-17 San Antonio-class amphibious ships, California-class cruisers, Virginia-class cruisers and USCG National Security Cutters.

PEOPLE'S REPUBLIC OF CHINA

Type 382 Radar

The Type 382, also known as the Sea Eagle, is a Chinese 3D search radar. It is heavily based on the Russian MR-710 Fregat radar and is currently deployed on multiple Chinese surface vessels as well as the Chinese-built vessels sold to Pakistan. Range: 250km

RADA ELECTRONIC INDUSTRIES

eMHR

RADA'S Enhanced Multi-Mission Hemispheric Radar (eMHR) forms the basis of hostile fire-locating (RPS-70/71), perimeter surveillance (RPS-72) and all-threat air surveillance (RPS-74) systems. It can be installed on vehicles or vessels and at fixed bases. The system can also operate in search while in tracking, target revisit and single-target tracking modes.

ieMHR

RADA's ieMHR (Improved and Enhanced Multi-Mission Hemispheric Radar) is the largest in a family of MHRs manufactured by the company to provide hostile fire location (RPS80/81), 3D perimeter surveillance (RHS-84) and all-threat air surveillance (RPS-82). It is an S-band radar that provides detection for pedestrians to a range of 20km and large transport aircraft to 100km.

pMHR

Portable Multi-Mission Hemispheric Radar (pMHR) is the smallest in the family of MHRs manufactured by Israeli company RADA Electronic Industries. It provides hostile fire location as part of the RPS-40/41 system, all-threat air surveillance (RPS-42) and 3D perimeter surveillance (RHS-44). It was unveiled at the AUSA exhibition in October 2017. Weight: 20kg Detection range: 10,000m

RAYTHEON ANSCHÜTZ

Smartblue

Developed by Raytheon Anschütz, Smartblue is an X-band maritime surveillance radar family. It is suitable for coastal surveillance systems, mobile radar installations and vessel traffic services. A ruggedised design with a range of antennas from 8, 12 and 18in, the radar family has been built to withstand use on ships, in maritime environments and on unmanned sites in all weather and climate conditions. Length: 5.6m Height: 584m Diameter: 5.5m Weight: 24.5kg

RAYTHEON

AN/SPS-73

The AN/SPS-73 is an X-band navigation and surveillance system manufactured by Raytheon. It provides short-range, two-dimensional surveillance image, advanced signal processing and automatic target detection capabilities. The most significant user of the AN/SPS-73 radar is the USN.

AN/SPY-6(V) AMDR

Raytheon's Air and Missile Defence Radar (AMDR), now officially designated as AN/SPY-6(V), was purchased by the USN to equip the three new Arleigh Burke-class destroyers that the service is procuring under its Flight III initiative. On 10 October 2018, it was announced that the testing performed at the USN's Pacific Missile Range Facility in Kauai, Hawaii, was completed. Width: 4.2m Height: 4.2m

DBR

The Dual Band Radar (DBR) phased-array system works in both X- and S-bands simultaneously, coordinated by a resource manager. The system performs multiple functions automatically and simultaneously, detecting and tracking high- and low-altitude anti-ship cruise missiles. It combines the functionality of the X-band AN/SPY-3 multi-function radar and the S-band Volume Search Radar (VSR). Weight: 2,500kg

The Oerlikon Seaguard Biax is a naval tracking system with a two-axis multipurpose tracker suitable for all-weather use. (Image: Rheinmetall Air Defence)

RHEINMETALL AIR DEFENCE

Oerlikon Seaguard Biax

The Oerlikon Seaguard Biax is a naval tracking system. Derived from the three-axis Oerlikon Seaguard Triax, it is a two-axis multipurpose tracker suitable for all-weather use. Both use radar to counter above-water symmetric and asymmetric threats including anti-ship missiles. The Biax is fitted with a naval TV camera and can integrate additional EO sensors such as an IR camera. A video tracking module is also included. Weight: 750kg Range: 45km

RHEINMETALL DEFENCE ELECTRONICS

MSP 500

The Multi-Sensor Platform 500 (MSP 500) is an EO system capable of performing fire control and reconnaissance tasks. Originally developed by STN Atlas Elektronik and Zeiss Optronik, it has been most recently produced by Rheinmetall Defence Electronics. The system can be installed in land-, air- or shipborne applications. Weight: 150kg Range: 32km

RHEINMETALL

TMX/EO

The TMX/EO three-axis tracking module is equipped with X-band radar and TV camera, IR camera and laser rangefinder, for precision measurement of aerial, naval and land-based targets for guns and missiles in the Seaguard family of ship defence systems. CW signal-in-beam injection for target illumination is optional. The system has been ordered for Malaysia's Second Generation Patrol Vessel Littoral Combat Ships (SGPV LCS). Range: 80km

RRS - REUTECH RADAR SYSTEMS

RSR 210N

The RSR 210N is a lightweight X-band 2D naval air/sea surveillance radar designed for application on smaller naval and coastguard vessels. This radar, which provides coverage to beyond 100km, may be supplied with a dedicated console or interfaced to a combat management system. While it is suited to helicopter support operations aboard ship, it can also be used for general surveillance and in a gunfire support role. Range: 100km

RTS 3200 FORT

The lightweight FORT (FMCW Optronics Radar Tracker) operates in X band, is instrumented to 40km and provides the operator with an all-weather target engagement capability. The product is designed for application aboard smaller naval vessels which would normally only employ EO trackers. Range: 40km

SAAB

Sea Giraffe 1X

The Saab Sea Giraffe 1X is an X-band, short-range naval application of the Giraffe 1X radar. It is the most compact and affordable naval radar solution by Saab. According to the manufacturer, the system's small footprint makes it particularly suitable for patrol craft or even combat boats and unmanned vessels. Weight: 300kg

Sea Giraffe 4A

Sea Giraffe 4A is a medium-/long-range AESA surveillance radar, combining designs from the Sea Giraffe AMB and Arthur product families, with a new radar sensor. It was unveiled in January 2016. It can scan a search volume of up to 70° at 60rpm and provides a 3D target update rate, along with high-altitude coverage and monopulse accuracy. The radar simultaneously detects small fast-moving targets at all altitudes and in clutter.

Sea Giraffe AMB

Sea Giraffe AMB is a 3D multipurpose medium-range surveillance radar with the ability to simultaneously track air and surface targets, with an optional mortar and rocket detection (C-RAM) capability. Sea Giraffe AMB has the designation AN/SPS-77V(1) for installation on the USN's Littoral Combat Ship (LCS-2/4) and AN/SPS-77V(2) for LCS-6 and higher. The system permits instantaneous and simultaneous 0-70° coverage on all antenna revolutions and has a data distribution service interface for combat management system integration. Range: 180km

SOLUSI247

Indera MX-3AH

The Indera MX-3AH is an X-band naval radar system featuring solid-state FMCW technology with low transmit power, frequency agility and LPI. Its hardware and signal processing techniques lead to greater capability in detection of surface targets, it is claimed. The Indera MX-3AH is equipped with Maritime Tracking Aid software enabling it to function as an onboard navigation system on its own. Length: 1.7m Width: 0.6m Height: 1m Weight: 160kg

The Scanter 6000 radar is designed to detect surface and aerial threats and particularly track small targets at close ranges. (Photo: Terma)

STX ENGINE

SPS-95K

Developed by STX Engine, SPS-95K is a C-band surface search and navigation radar. It is composed of transceiver, remote control unit and a reflector with omnidirectional IFF antenna. Range: 200km

TELEDYNE FLIR

SeaFLIR 380-HD

The SeaFLIR 380-HD is a long-range, shipboard HD multi-spectral surveillance system that is fully seaworthy and hardened for military vessels. The system has 120x high magnification optics and laser payloads to covertly illuminate, point out targets and determine distance and location. The system also combines important HD IR, colour or shortwave IR spectral information and has true metadata embedded in the digital video. It is in use with the USN and Royal Danish Navy. It is integrated as a node on a network and requires no additional junction boxes. Height: 0.47m Diameter: 0.38m Weight: 48kg

TERMA

C-FIRE EO

The C-Fire EO system is an EO naval solution that can perform surveillance and fire control tasks. Developed and manufactured by Terma, the system is equipped with a thermal imager, a TV camera and a laser rangefinder. It can control up to three separate gun mounts simultaneously with the ability to provide independent ballistic predictions to each.

Scanter 4603

Scanter 4603 is a naval radar system providing situational awareness with automatic volume surveillance and early detection of multiple targets simultaneously. Developed and manufactured by Terma, the X-band radar is suitable for OPVs, fast attack craft, corvettes and amphibious vessels.

Scanter 6000

The Scanter 6000 radar is designed to detect surface and aerial threats and particularly track small targets at close ranges. It can also monitor low-level airspace around

a vessel. For SAR operations, the Scanter 6000 has the capability to detect small surface targets in combination with helicopter control. Operable in all weather conditions, the system uses low-voltage solid-state power amplifier technology. Programmable frequencies are within the 9-9.5GHz range.

THALES NETHERLANDS

APAR

APAR is operational on the four De Zeven Provinciën-class vessels of the Royal Netherlands Navy, the three Sachsen-class ships of the German Navy and the three Iver Huitfeldt ships of the Danish Navy. The Active Phased Array Multi-function (APAR) radar is an X-band naval surveillance radar and FCS. The system provides 360° azimuth scanning and a range of circa 150km, with an 8.5° angle-of-elevation coverage. Weight: 10,000kg Range: 150km

Gatekeeper

The Gatekeeper is an LWIR-band EO ship security system developed and manufactured by Thales Netherlands. It provides 360° surveillance around the ship, detecting small targets such as patrol boats, rubber boats and swimmers. The Gatekeeper has been exported to Mexico and Belgium, in addition to wide domestic deployment in the Netherlands. Length: 0.48m Width: 0.7m Height: 0.42m Weight: 42kg Range: 7km

NS100

The NS100 is a 3D E/F-band naval surveillance radar. It uses an AESA antenna and has an instrumented range of circa 200km, with up to 70° elevation. It has an integral IFF interrogator compatible with Mode-5/S NATO and ICAO protocols. It was announced in August 2015 that factory acceptance tests had been completed for installation on the Republic of Singapore Navy's first-of-class LMV RSS Independence, and sea trials began in late 2015. Width: 3m Height: 3m Range: 200km

Smart-L

The Smart-L naval surveillance radar is a 3D system transmitting in the D band. Capable of detecting targets at a range of up to 400km, the radar also offers up to 70° of elevation. Variants of the system include the Smart-L EWC, which is a specific modification for the De Zeven Provincien-class frigates of the Royal Netherlands Navy to provide a ballistic missile detection capability. Weight: 7,200kg Range: 2,000km

SMART-S Mk 2

The Smart-S Mk 2 S-band 3D air and surface search radar has a maximum instrumented range of 250km, with the ability to detect missiles at 50km and large aircraft at 200km. Up to 500 air and surface targets can be tracked simultaneously, and the radar has an integral IFF system. Each beam is 2° in width, with the radar capable of detecting targets at 0-70° of elevation.

STIR Family

The STIR family of tracking and illumination radars includes the STIR 2.4, STIR 1.8, STIR 1.8HP, STIR 1.2, SPG-501 and SPG-503 systems. These radars were designed to detect anti-ship missiles and the principle discriminating factors between each member of the STIR family is the radar's dish size and transmission power. Transmitting in the K and X bands, such high-frequency ranges are suitable for the detection of small targets. Height: 2.3m Weight: 850kg Range: 512km

Surface Scout

Surface Scout is an X-band, medium-range surveillance radar with a range of up to 44km. It covers 20° of elevation and has a beam width of below 1.2°. It can automatically detect and track up to 500 targets. Surface Scout uses frequency-modulated continuous-wave architecture, which reduces its output power. Range: 44km

THALES

Arabel

Arabel is a multi-function fire control radar capable of detecting, tracking and engaging multiple targets, including jet aircraft, cruise missiles and tactical ballistic missiles. Arabel can track 100 and engage ten targets simultaneously. It includes a data link to send target position updates to Aster 30 missiles until their own active radar seeker takes over. Range: 100km

Castor family

The Castor radar family includes several products. This X-band radar is designed to perform fire control. It has a beamwidth of 2° and peak power of 200kW. The Castor-1 (also known as the TRS-3200) has a range of around 30km, transmitting up to 8,000 pulses per second (pps) from its magnetron transmitter. The Castor-2/TRS-3201 can transmit up to 7,200pps using a 30kW coherent travelling-wave tube transmitter.

Herakles

Thales' Herakles radar provides 3D imagery for surveillance and fire control. The S-band radar has an integrated Mode-5/Mode-S compatible IFF interrogator. When performing air surveillance, it has a range of 250km and a range of 80km when performing surface surveillance. The radar covers 360° azimuth and 70° elevation. The antenna revolves at 60rpm and the radar can track over 400 targets.

IM400

The Integrated Mast 400 (IM400) is an integrated naval sensor and communications suite packed into a mast structure. By resolving the electromagnetic conflicts and LoS obstructions inherent in traditional topside arrangements, it provides advantages in terms of operational performance and shipbuilding risk. Being built and tested in parallel with the construction of the ship, the IM400 solution will reduce risk and time for the entire programme. Weight: 52,000kg Range: 250km

LIROD Mk 2

The LIROD Mk 2 is a K-band naval FCR. Using a travelling wave tube architecture, the radar is equipped with a TV camera for visual target identification. Offering a detection range of up to 36km, the LIROD Mk 2 has a beamwidth of 0.55° and 1.5°. The use of the K-band frequency provides higher levels of accuracy and the ability to discriminate small targets in conditions of high clutter, says the company. Range: 36km

MRR-3D
The MRR-3D radar family includes the MMR-3D and the MMR-3DNG. The C-band architecture of the MRR-3D family can perform 2D and 3D surveillance. Although the antenna rotates, it uses an AESA configuration which provides up to 70° elevation coverage. Along with providing general surveillance, the radar can perform fire control and air traffic management tasks. Range: 180km

Pollux
The X-Band Pollux FCR family includes the THD-1280 and TRS-3220 systems. The radar has a peak output power of 200kW and a beamwidth of 2°. With a pulse width of 0.3µs, the radar has a pulse repetition frequency of 1,500 pulses per second. The radar has an instrumented range of 9km for a small aircraft. Range: 9km

Sea Fire 500
The Sea Fire is a four-panel phased-array naval surveillance radar developed by Thales that was unveiled in 2014. This S-band radar is designed to outfit vessels displacing between 3,500t and 7,000t. To this end, it can be scaled up or down according to the vessel's size, with the only element of the radar which needs to be changed being the antenna. Range: 400km

Sea Master 400
The Sea Master-400 (also known as SMILE) is an E/F-band naval surveillance radar that uses much of the architecture from Thales' APAR and Smart-L/S families. The radar can perform air and surface surveillance, fire control and air traffic management. Range: 250km

Sea Watcher 100
The Sea Watcher 100 (also known as the Sea Star) is an X-band radar that uses fixed-panel antennas. Offering a range of up to 40km, this 2D radar uses active phased-array architecture and can update every two seconds for short- and medium-range surveillance, and every five seconds for longer-range target detection. Range: 40km

The WM20 is a family of gun and missile radars which includes the WM20, WM22, WM25, WM27, WM28 and the Mk.92. (Photo: Thales Netherlands)

Sting EO Mk 2
Sting EO Mk 2 is a short- to medium-range, lightweight dual-band (I and K) weapon control system, primarily for gun control. It combines a 1.2m radar director with TV, IR and laser sensors, allowing optronic tracking and an automatic 'best sensor' selection process. The three data sources provide redundancy, performance and ECCM resistance, according to the company. A shell-measuring feature is incorporated to support facilities such as pre-action calibration and miss-distance indication. Range: 120km

WM20 Series
The WM20 is a family of gun and missile radars which includes the WM20, WM22, WM25, WM27, WM28 and the Mk.92. The system can be used as a multi-channel FCR to accompany a ship's gun, missile or torpedo systems. All of the WM20-series radars can provide air and surface search, navigation and fire control, but the WM24 has an additional anti-surface role, while the WM26 is designed for surface target engagement.

ULTRA ELECTRONICS 3 PHOENIX

MFHR Radar
The Multi-Function High Resolution (MFHR) Radar is a lightweight naval surveillance system capable of performing a variety of surface search missions, including detecting swarms of small vessels and classifying targets by type. Developed by Ultra Electronics 3 Phoenix, this system has been used to support the development and testing of future systems in this field. Range: 56km

ULTRA ELECTRONICS OCEAN SYSTEMS

NGSSR
Next-Generation Surface Search Radar (NGSSR) is a software-defined radar being develop by Ultra Electronics Ocean Systems to meet the requirements of the USN to replace all variants of the current AN/SPS-67, AN/SPS-73, BridgeMaster E series and COTS radar systems. On 15 March 2019, Ocean Systems was awarded a $28 million contract with options that could increase its value to $34.6 million to develop NGSSR for surface warships. The new radar will provide enhanced performance and situational awareness and provide ship defence against surface and low-altitude threats.

EQUIPMENT

AIRBORNE EW SYSTEMS

The equipment featured in this section is divided into:

- Chaff, flare and decoy systems
- ELINT and COMINT systems
- Integrated self-protection systems
- Jammers
- Laser warning receivers
- Missile launch detectors and approach warners
- Radar warning receivers

The systems are listed alphabetically by manufacturer.

If you think your product should be listed, please contact the team at insight@shephardmedia.com to ensure it appears in the *Shephard Defence Insight* online database (shephardmedia.com/defenceinsight) and is included in the next handbook edition.

ABOVE: Since unveiling BriteCloud in late 2013, the Expendable Active Decoy has continually undergone a range of trials over several years, with Leonardo EW technologists working alongside UK and overseas defence forces to confirm the full operational capability of the decoy. (Image: Leonardo)

CHAFF, FLARE AND DECOY SYSTEMS

ALLOY SURFACES

IRCM Decoys

Alloy Surfaces' family of 'virtually covert' pyrophoric IRCM decoys are designed to protect military fighter, transport and helicopter aircraft from surface-to-air and air-to-air IR-guided missiles in reactive and pre-emptive dispensing scenarios. Products include MJU-49/B (36mm), M211, MJU-50A/B, MJU-64/B, MJU-66/B (1x1x8), MJU-51A/B (1x2x8) and other decoys for advanced/future threats. All can be used from ALE-40, 45, 47, M130 and any CMDS.

BAE SYSTEMS ROKAR

ACDS

The Advanced Countermeasures Dispensing System (ACDS) is a combat-proven, computer-controlled airborne system that has capabilities for chaff, flare and decoy dispensing. Functioning as a standalone unit or integrated with an EW suite, ACDS includes a range of smart dispensers. The NVG-compatible mini-control and display unit provides display of the threat direction detected by EW sensors and generates an audio warning. The system interfaces with EW warning systems, aircraft avionics and smart dispensers of any type.

ACDS Pod

The Advanced Countermeasures Dispensing System (ACDS) pod can be offered in a subsonic or supersonic installation. The system can function as a standalone SPS with the installation of an MWS in the pod or as an integrated part of an EW suite. Directions of dispensing are adjustable on the ground. The ACDS, installed inside the pod, is currently in production and fielded on various aircraft types.

ADDS

The Advanced Digital Dispensing System (ADDS) is a computer-controlled, threat-adaptive CMDS for use on fast jets, helicopters, transport and maritime patrol aircraft. Via its cockpit control and display unit, ADDS can dispense chaff, flare, RF and future types of expendable payloads. ADDS operates in automatic, semi-automatic or manual modes. It can fire dual-chaff cartridges that double the number of onboard stores per mission. In addition, ADDS can dispense multiple payloads simultaneously to provide a multispectral response or a stronger decoy signal when needed.

BAE SYSTEMS

AN/ALE-40

Chaff/flare dispensing system for fixed-wing aircraft. Comes in several configurations adapted to different aircraft types. Contains 30 chaff or 15 flare cartridges per dispenser.

AN/ALE-47A(V)

The ALE-47A(V) incorporates new technology to update the standard ALE-47 family. It uses information from EW sensors such as RWR and MWS to determine the correct response to defeat IR and RF threats. The ALE-47A(V) includes a range of smart dispensers of different types. For internal, dual and external mounting.

AN/ALE-52

BAE Systems' AN/ALE-52 countermeasures dispensing system was developed for the United States Air Force Lockheed Martin F-22A Raptor air superiority fighter. The AN/ALE-52 can launch standard chaff and flare countermeasures, although it has flexibility regarding the physical size and number of countermeasure magazines it can accommodate.

AN/ALE-55 FOTD

The ALE-55 Fibre Optic Towed Decoy (FOTD) is coherent and works with an aircraft's onboard EW equipment to defeat RF threats. It protects aircraft throughout the threat envelope, delivering three layers of defence, it is claimed. The FOTD is suitable for fighter, bomber and transport aircraft. In service with Australian, Saudi and US air forces.

Chaff and Flare Cartridges

The BAE Systems family of chaff and IR expendables includes M206 207x25x25mm (0.04kg) IR decoy flare; MJU-x 264x74mm (0.4kg) IR decoy flare; RR-129/AL 147x36mm (0.23kg) chaff cartridge; RR-136/AL 196x40mm (0.09kg) chaff cartridge; RR-170/AL 207x25x25mm (0.03kg) chaff cartridge; RR-171/AL 31m long (19kg) chaff roll; and RR-179/AL 19kg chaff roving bundle matching any frequency in A-L bands.

ICMD

The Integrated Countermeasures Dispenser (ICMD) is an integral element of the AN/ALQ-212 Advanced Threat Infrared Countermeasures System.

TACDS

Threat Adaptive Countermeasures Dispenser (TACDS) is a replacement for the earlier ALE-39/40/45 and M130 that is able to take input from threat warning systems and respond. It has manual, semi-automatic and automatic operating modes. Load/mission mixes include five payload types per magazine, 15 magazine mixes, multiple and simultaneous firing.

BHARAT DYNAMICS

CMDS

The Bharat Dynamics Counter Measures Dispensing System (CMDS) is an airborne defensive system providing self-protection to aircraft by passive ECM against radar-guided and IR-seeking AAMs and SAMs. Protection for the aircraft is achieved by misguiding the missiles by dispensing chaff and/or flare payloads.

CEIEC – CHINA NATIONAL ELECTRONICS IMPORT & EXPORT

GT-1E

China National Electronics Import and Export's (CEIEC) GT-1E is the standard countermeasures dispenser that

BAE Systems' AN/ALE-52 countermeasures dispensing system was developed for the USAF Lockheed Martin F-22A Raptor. (Image: BAE Systems)

the company says is used throughout the PLAAF and PLAN combat aircraft fleet.

CHEMRING COUNTERMEASURES

118 Mk 3 Type 1

The Chemring CM118 Mk.3 Type-1 is a spectral flare intended to defeat infrared-guided, surface-to-air and air-to-air missiles. The flare is designed to equip rotorcraft and large fixed-wing aircraft such as freighters or tankers. There appears to be no information in the public domain regarding the unit price of the flare, although we estimate that the cost is below $1,000 per countermeasure. The company's official literature says that the flare has a peak output power of 20 kilowatts-per-steradian-per-cubic metre and has a minimum burn time of three seconds. The flare is compatible with all standard countermeasure launchers in service with NATO and allied armed forces.

118 Mk 3 Type 3

The Chemring CM118 Mk.3 Type-3 is a spectral flare intended to defeat infrared-guided, surface-to-air and air-to-air missiles. The flare is designed to equip rotorcraft and large fixed-wing aircraft such as freighters or tankers. There appears to be no information in the public domain regarding the unit price of the flare, although we estimate that the cost is below $1,000 per countermeasure. The company's official literature does not provide any information regarding the flare's output power. The flare is compatible with all standard countermeasure launchers in service with NATO and allied armed forces.

218 Mk 3 Type 1

The Chemring CM218 Mk.3 Type-1 is a spectral flare intended to defeat infrared guided surface-to-air and air-to-air missiles. The flare is designed to equip rotorcraft and large fixed-wing aircraft such as freighters or tankers, and fast jets. There appears to be no information in the public domain regarding the unit price of the flare, although we estimate that the cost is below $1,000 per countermeasure. The company's official literature says that the flare has a peak output power of 20 kilowatts-per-steradian-per-cubic metre and has a minimum burn time of 3.5 seconds. The flare is compatible with all standard countermeasure launchers in service with North Atlantic Treaty Organisation and allied armed forces.

Chaff Pack BOL Mk2 Type 1

Chemring developed the BOL Mk.2 Type-1 chaff pack to work with Saab's BOL countermeasures dispenser. The latter is deployed widely on fast jets through the North Atlantic Treaty Organisation and allied nations. There appears to be no information in the public domain regarding the unit price of the BOL Mk.2 Type-1 chaff pack, although we estimate this to have a cost below $10,000 per pack. No details have been released in Chemring's official literature regarding the frequencies covered by the chaff comprising the BOL Mk.2 Type-1. It would be reasonable to assume that this provides broadband coverage of at least two gigahertz/GHz to 18GHz.

DSTL 22

Chemring's DSTL-22 is a spectral flare intended to defeat Infrared (IR) guided surface-to-air and air-to-air missiles. The flare is designed to equip rotorcraft and large fixed-wing aircraft such as freighters or tankers. There appears to be no information in the public domain regarding the unit price of the flare, although we estimate that the cost is below $1,000 per countermeasure. The company's official literature also demurs from providing information on the IR output of the flare, its rise time or burn time. That said, the flare is compatible with all standard countermeasure launchers in service with North Atlantic Treaty Organisation and allied armed forces.

DSTL 73

Chemring's DSTL-73 is a spectral flare intended to defeat Infrared (IR) guided surface-to-air and air-to-air missiles. The flare is designed to equip rotorcraft and large fixed-wing aircraft such as freighters or tankers. There appears to be no information in the public domain regarding the unit price of the flare, although we estimate that the cost is below $1,000 per countermeasure. The company's official literature also demurs from providing information on the IR output of the flare, its rise time or burn time. That said, the flare is compatible with all standard countermeasure launchers in service with North Atlantic Treaty Organisation and allied armed forces.

MEB Mk 3 Type 1

Chemring's MEB Mk.3 Type-1 is a chaff magazine which can equip standard NATO (North Atlantic Treaty Organisation) countermeasures dispensers. The company says in its official literature that the MEB Mk.3 Type-1 has harnessed miniaturisation to provide twice the number of chaff payloads that can be accommodated into a standard expendables magazine. This translates into longer protection against radar-based threats for aircraft using the magazine. The company says that the MEB Mk.3 Type-1 can equip fixed- and rotary-wing platforms. There is no information in the public domain regarding the unit cost of the MEB Mk.3 Type-1 but based on the average cost for comparable products the MEB Mk.3 Type-1 is thought to have a maximum unit cost of $10,000.

RR129 Chaff Cartridge

Chemring's RR129 chaff cartridge is designed to equip fixed- and rotary-wing aircraft protecting them against radar-guided air-to-air and surface-to-air missiles. The company's official literature says that the cartridge is deployed to ensure that an incoming missile misses the targeted aircraft by a safe distance. It continues that the chaff is cut to provide broadband coverage of between two gigahertz/GHz to 18GHz, although it can be cut to lengths to meet the specific customer requirements. Chemring continues that the RR129 is fully compatible with the Marconi/Tracor AN/ALE-39 countermeasures dispenser and with the Tracor/BAE Systems' AN/ALE-47 which has superseded the former.

RR170 Chaff Cartridge

The RR170 Chaff Cartridge forms part of a defensive aids system to protect the host aircraft from passive radar-guided missile threats by providing a suitable alternative and preferred target or decoy. The purpose of the decoy is to make sure that the missile passes the target aircraft by an effective miss distance.

Typhoon IR Decoy

Chemring's Typhoon Infrared (IR) decoy has been specifically designed for the Eurofighter Typhoon series combat aircraft. As a result it is thought to be in service onboard the entirety of the global Typhoon series fleet, chiefly those aircraft flown by the air forces of Austria, Germany, Italy, Kuwait, Oman, Qatar, Spain, Saudi Arabia and the United Kingdom. The Typhoon IR Decoy is used to protect the aircraft against infrared-guided surface-to-air and air-to-air missiles. There are no details in the public domain regarding the unit price of the Typhoon IR Decoy.

ELBIT SYSTEMS LAND

Advanced Round IR Spectral Flare/ARM-017

According to IMI, the Advanced Round IR Spectral Flare/ARM-017 provides fixed- and rotary-wing combat aircraft with increased survivability against MANPADS. The flare is compatible in form, fit and function with the MJU-32B naval flare and can be dispensed from AN/ALE-39, ADDS, SAMP 60/120/240A and equivalent dispensers. IMI has partnered with Esterline Defense Technologies to produce and market the flare to US customers under the designation ARM-017.

ASF-3/-6

ASF-3/6 spectral IR flares provide combat aircraft with increased survivability against MANPADS. They can be dispensed from AN/ALE-40/47, ADDS SAMP 60/120/240A and equivalent dispensers, and are in use and combat-proven by the Israeli Air Force.

ATALD

Elbit's ATALD (Advanced Tactical Air Launched Decoy) is designed to support SEAD (Suppression of Enemy Air Defence) missions. Few details have been released regarding the systems' design or capabilities. Given that the decoy was conceived to support the SEAD mission it would be safe to assume that many of these parameters remain classified. The decoy is almost certainly in service with the Israeli Air Force (IAF) but there has been no official confirmation to this effect, nor have details emerged in the public domain regarding additional air forces around the world using the system.

CG-17

The CG-17 chaff cartridge provides protection against radar detection and radar-guided missiles. When ejected from the aircraft, the countermeasure forms EM fields, creating safe, screened flight corridors. CG-17 is fully compatible with the RR-170A/AL cartridge and provides massive area saturation. The cartridge can be dispensed from AN/ALE-40/-47, ADDS, SAMP 60/120/240A and equivalent dispensers. Dimensions: 25x25x200mm.

FG-3/-6/-9 IR Flares

The FG-3/-6/-9 IR Flares are fully compatible in form, fit and function with M206 and MJU-7B flares respectively, and they all use magnesium/PTFE cartridge pellets. The decoy flares can be ejected from modern fighters, such as the F-16, F-15 and F-4, as well as from transport aircraft, such as the C-130 Hercules.

Multi-BLU

Multi-BLU is an FG-3 IR flare split into two parts with built-in ejection delays, providing twice as much protection as the standard variant. Multi-BLU is fully compatible in form and fit with FG-3/M206, and can be dispensed from AN/ALE-40/-47, ADDS, SAMP 60/120/240A and equivalent dispensers. Dimensions: 25x25x205mm.

SAMP 60/120/240A

SAMP 60/120/240A are standalone dispensers, which can be integrated into a complete EW SPS. SAMP 60A consists of a control and operating panel and two 30-round chaff/flare magazines, while SAMP 120A/240A can hold four or eight magazines, each with 30 chaff/flare rounds. The system allows selection of manual, semi-automatic and automatic operating modes, as well as trigger modes, and continuously displays inventory.

ELETTRONICA

ELT/590 SPARK

The ELT/590 SPARK (Self Protection Airborne Reactive (K) Countermeasure) is an expendable active decoy countermeasure designed for the protection of airborne platforms. The system draws threats away from the host platform, generating large miss distances. The airborne RF decoy deceives enemy radar-based threats.

KANFIT

RTM Chaff and Flare Magazines

Kanfit builds an array of chaff and flare magazines. According to the firm's official literature these magazines are remarkable as they are produced as a single, structure without seams or bonding which the company says reduces the risk of failure. The use of composite materials in the magazine's construction helps to reduce weight improving aircraft fuel consumption. Kanfit continues that the rugged nature of its design means that the magazines suffer less degradation caused by the launch of chaff and flare countermeasures during their service lives. The firm has declined to provide

specific examples but does say that its magazines are in service onboard a wide array of civilian and military aircraft around the world.

KILGORE FLARES COMPANY, LLC

IRCM Flares

Kilgore develops and manufactures a range of airborne IR decoy flares. These are compatible with most available dispenser systems. Standard flare products manufactured include: MJU-7A/B, MJU-10/B, M206, MJU-32A/B, MJU-38A/B, ALA-17/C, MJU-53/B, M212, MJU-39/B, MJU-40/B. Kilgore also offers a range of commercial decoy flares. These flares are standard form factors and fit dispenser systems that accept 1x1x8in, 2x1x8in and 36mm sizes.

LACROIX

Chaff, Flare and Decoy Systems

Verdite (IR) and Junon (chaff) are three-shot 19mm diameter cartridges. IR output is adapted to signature of helicopters. Junon is a wide-RF bandwidth chaff cartridge optimised to protect helicopters. Verdite and Junon are integrated onto Mucalir ammunition for the MBDA Saphir dispenser, Helir ammunition for the Alkan ELIPS dispenser, M119 magazine and any other type of existing dispenser.

LEONARDO ELECTRONICS

AGP

The Aircraft Gateway Processor (AGP) is an aircraft survivability equipment (ASE) controller contained within a single flight-qualified line-replaceable unit. The AGP provides the ability to integrate federated ASE sensors and countermeasures at initial aircraft configuration or post-installation upgrade. This system provides a combined threat picture and prioritised tactical response per the user-programmed pre-flight message.

Ariel

Leonardo's Ariel family of towed RF decoys entered service with the RAF in 1990. The decoy uses a fibre optic connection to link Ariel's transmitting element to the aircraft's self-protection systems. The targets of Ariel are radar-guided threats notably air-to-air and surface-to-air missiles using active and semi-active radar homing. The decoy can transmit a range of discrete jamming waveforms to defeat contemporary electronic counter-countermeasures techniques.

Ariel Mk II

The Ariel Mk II fibre-optic towed radar decoy protects fighter and transport aircraft from radar-guided threats, including those employing mono-pulse tracking techniques. The decoy is capable of being streamed at low speed, in supersonic flight and during high-G manoeuvring. It is nose-towed for stability and effectiveness throughout the flight envelope.

Ariel Mk III

Ariel III is a fibre-optic towed RF decoy for the self-protection of fighter and transport aircraft from radar-guided threats, including those employing mono-pulse tracking techniques. Deployed when entering areas of operation, the decoy is recovered on return to base. It is capable of being streamed throughout the maximum/minimum speed and G limits of the deploying aircraft.

BriteCloud

BriteCloud is an expendable active RF decoy designed to be deployed from a combat aircraft's existing countermeasures (chaff and flare) dispensers. To this end, Leonardo produces two distinct versions; the BriteCloud-55, which equips spherical magazines, and Britecloud-218, which equips oblong magazines. BrightCloud can defeat the majority of modern and legacy Surface-to-Air and Air-to-Air threat systems. Formally launched in November 2015, BrightCloud initially equipped the RAF's Panavia Tornado combat aircraft fleet and has now migrated to the RAF's Eurofighter Typhoon-F/GR4A combat aircraft.

MBDA

Elips

MBDA's ELIPS countermeasures dispenser is designed to outfit a wide array of aircraft, from medium-lift utility helicopters to tactical turboprop freighters and combat aircraft. The system can launch all standard chaff and flare countermeasures. The standard ELIPS design has been developed into the ELIPS-NG. The system remains one of the most widespread chaff and flare dispensing systems in service around the world.

Saphir 400

MBDA's SAPHIR-400 is a countermeasures dispenser designed to equip the Airbus A400M Atlas turboprop strategic freighter and is integrated directly with the A400M's Integrated Self-Protection System.

SAPHIR-M / ELIPS-NH

SAPHIR-M is a chaff and flare dispensing system for the Tiger and NH90, and is also offered for other helicopters. It offers a high decoy capacity and is interoperable with a variety of decoy standards. The ELIPS-NH is progressively replacing form, fit and function SAPHIR-M on the NH90 in the form of a mid-life update. It is an expansion of SAPHIR systems deployed on Ecureuil, Gazelle, Puma, Super-Puma, Cougar and Lynx.

Spectra

Internally mounted radar, laser and IR self-protection system in service on French Air Force and French Navy Rafale fighters. Fully integrated internal system featuring techniques and technologies which ensure detection, location analysis and countering all threats in the usable frequency range, it is claimed. Cooperation and compatibility with navigation and weapon systems. Incorporates MBDA chaff/flare dispenser and IR missile detector functions.

RAFAEL ADVANCED DEFENSE SYSTEMS

X-Guard

Rafael Advanced Defence Systems' unveiled its X-Guard fibre optic towed decoy back in 2003. Open-source information noted that the decoy was designed to equip combat aircraft with an electronic protection system to safeguard them against Active Radar Homing/Semi-

Active Radar Homing (ARH/SARH) Surface-to-Air and Air-to-Air Missiles (SAMs/AAMs). Length: 65cm Width: 8cm Height: 8cm Weight: 67kg Field of View - Azimuth: 360° Field of View - Elevation: 360°

RAYTHEON

ADM-160B/C MALD

Teledyne Ryan (now Raytheon) was the original manufacturer of the ADM-160A Miniature Air-Launched Decoy (MALD), the acquisition of which was cancelled by the US Air Force in 2002 amidst dissatisfaction with its range and endurance. This led to the programme's restart that same year with Raytheon at the helm to develop the ADM-160B which is now in service. Length: 280cm Width: 170cm Weight: 115kg Range: 920km

AN/ALE-50

Raytheon's AN/ALE-50 fibre-optic towed decoy is designed to protect combat aircraft from Air-to-Air and Surface-to-Air Missile (AAMs/SAMs) using Active and Semi-Active Radar Homing (ARH/SARH). The AN/ALE-50 is in widespread use with across the US armed forces, and with other forces around the world with more than 25,000 units produced.

RHEINMETALL WAFFE MUNITION

Birdie Flares

Birdie Flares are spectrally balanced IR decoy flares designed to protect helicopters, fixed-wing transport aircraft and fast jets through replication of the aircraft signature in MWIR. These decoy flares have a fast rise time and high radiance intensity, and are effective against modern IR homing missiles with two-colour filtering, the OEM claims. The solution is offered in two variants: the 118 Birdie (1x1x8in) and the 218 Birdie (2x1x8in).

Chaff and Flare Systems

Rheinmetall produces efficient spectrally balanced decoys, array flares and spot flares to protect carrier aircraft, helicopters and jets against IR-guided missiles. The decoys have an aircraft-like signature with fast rise time combined with high radiance intensity, allowing protection against modern SAMs/AAMs with IR seeker heads, including those with two-colour ratio discrimination. The efficiency is seeker-tested.

Saab's BOL countermeasures dispensing system adorns a wide array of combat aircraft around the world. (Photo: Saab)

Examples include the DM69 A2 array flare, a 2x1x8in flare fitting AN/ALE-40/47 dispensers.

Cirrus 118

Cirrus 118 is a development of the DM69 A2 array flare, offering improved effectiveness, according to the company. It is designed to offer an aircraft-like IR signature with fast rise time and high radiant intensity in the short-, medium- and long-wave IR bands. It is described as effective against missiles with two-colour discrimination, and provides a large masking IR cloud effective against missiles with a small seeker FOV. The decoy cloud also blocks UV radiation.

RUAG AVIATION

CAST-easy

RUAG unveiled the Countermeasure Advanced System Test Equipment (CAST-easy) in 2017 earmarking it for the Panavia Tornado series of combat aircraft. The 2017 announcement stated that the equipment had been qualified for the Tornado and that it could also be used with any rotary or fixed-wing aircraft chaff and flare countermeasures dispensing system. Length: 20cm Width: 2.5cm Height: 2.5cm Weight: 0.18kg

SAAB

BOH

The BOH countermeasures self-protection pod is designed for use on any fixed-wing aircraft. It provides covert sustainable pre-emptive dispensing, missile warning, forward firing of flares and cocktail dispensing. All these capabilities have been incorporated into the form factor of a missile utilising the AIM-9 Sidewinder and AIM-120 AMRAAM interfaces and characteristics for lean aircraft integration. BOH is an implementation of the Saab BOL CMDS and CIDAS DAS into the shape of a missile.

BOL

Saab's BOL countermeasures dispensing system adorns a wide array of combat aircraft around the world. Designed to launch standard chaff and flare physical countermeasures, BOL takes the form of an oblong box which ejects the countermeasure behind the aircraft into its wake vortex. This aids the dispersion of the countermeasure around the platform. Each BOL launcher can carry up to 160 packs of chaff/flare decoys. Saab recommends that the launcher be affixed to an underwing hardpoint to take advantage of the airflow behind the aircraft to create this desired effect. Launchers can be mounted in symmetrical twin or quadruple launchers on these hardpoints. BOL can be used with aircraft which already possess countermeasures dispensers to increase protection. Customers can opt to install the BOL internally.

BOZ-EC

Saab designed the BOZ-EC as a pod-mounted countermeasures dispenser to equip the Panavia Tornado series of combat aircraft. The pod employs Saab's CIDAS-100 compact integrated defensive aids suite in its architecture and can launch all standard

chaff and flare decoy calibres. To this end, it can hold 39 25mm x 25mm x 203.5mm or 19 50.8mm x 25mm x 203.5mm countermeasures payloads. These can be launched in forward, aft or sideways trajectories, according to the nature of the threat. In addition to the countermeasures dispenser the pod includes an aft-mounted missile approach warning system. The pod will perform the necessary processing to determine the nature of a threat and to then initiate a response. Saab designed the BOZ-EC pod to have similar aerodynamic characteristics to the firm's legacy BOZ pod. Moreover, the BOZ-EC is compatible with the US Department of Defence's MIL-STD-1553 serial databus, alongside the RS-422 serial databus standard.

TERMA

ACMDS

The Advanced Countermeasures Dispenser System (ACMDS) is designed to coordinate, integrate and operate expendable countermeasure payloads on fixed-wing fighter, transport and wide-body aircraft as well as helicopters. The ACMDS components consists of a series of autonomous LRUs that includes a digital sequencer switch, an EM interference filter/safety switch and a number of dispenser assemblies.

PIDS

The Pylon Integrated Dispenser Station (PIDS) system takes the form of a Lockheed Martin F-16 wing weapon pylon that, in baseline form (designated as the PIDS), has been modified to accommodate the Terma ACMDS or AN/ALE-47 CMDS or Chemring's Chaffblock payload module without impacting on the station's ability to carry munitions.

THALES

Vicon 78

Thales' Vicon-78 lightweight countermeasures dispensing system is believed to have been in production since the early 1990s. Since then, it has found its way onto a myriad of fixed- and rotary-wing airframes. The system can be used in a standalone configuration, or alternatively integrated into an aircraft's suite of self-protection systems. It can accommodate all standard North Atlantic Treaty Organisation (NATO) chaff and flare expendables and can be used in a manual, semi-automatic or fully-automatic fashion. Likewise, the Vicon-78 is agnostic regarding the radar and missile warning systems it can work with.

Vicon-XF

Thales' Vicon-XF is a countermeasure dispensing system which can equip an array of platforms, primarily large aircraft and rotorcraft, according to the manufacturer's official literature. Platforms acknowledged to use the Vicon-XF include the Royal Australian Air Force's Boeing E-7A Wedgetail airborne early warning aircraft and the Beechcraft Shadow-R1 signals intelligence aircraft equipping the Royal Air Force. The Vicon-XF was revealed as equipping these latter aircraft in September 2019 following the award of a contract by the Ministry of Defence to a joint team involving Leonardo and Thales to outfit the Shadow-R1 with an array of new self-protection systems.

ELINT AND COMINT SYSTEMS

BAE SYSTEMS ELECTRONIC SYSTEMS

NanoSIGINT

The NanoSIGINT is a lightweight SIGINT payload capable of detecting, identifying, voice copying, direction-finding and geolocation of a variety of emitters of interest. System SWaP has been designed for real-time automatic detection and geolocation of RF emitters at operationally significant ranges for Group 3 UAV platforms.

BAE SYSTEMS

TSP

The Tactical SIGINT Payload (TSP) can identify, detect and geolocate electronic signals emitters. Designed to be carried by UAS, it has an open software-defined architecture and can provide a 360° aerial FOV. This system has been procured by the US Army for its MQ-1C Gray Eagle UAVs, but it can also be adapted for use on other platforms.

BIRD AEROSYSTEMS

ASIO

The Airborne Surveillance, Intelligence and Observation (ASIO) system is an end-to-end ISR solution that provides real-time SIGINT, COMINT, ELINT and imagery intelligence information for wide-area maritime and ground surveillance, as well as targeted monitoring missions. It has been installed on a variety of fixed- and rotary-wing platforms, including the Beechcraft King Air 350, Cessna Citation and Bell 407.

CEIEC – CHINA NATIONAL ELECTRONICS IMPORT & EXPORT

KZ-800

China National Electronics Import and Export's (CEIEC) KZ-800 is an airborne Electronic Intelligence (ELINT) gathering system believed to be in widespread use onboard People's Liberation Army Air Force (PLAAF) ELINT gathering aircraft.

CELESTIA

RF Data Recorders

The Celestia family of RF data recording (RFDR) systems is designed for demanding signal recording requirements. The equipment is typically used for capturing and recording the raw RF spectrum, configurable up to 500MHz instant RF bandwidth. Length: 620cm Width: 480cm Height: 220cm Weight: 18kg

CETC INTERNATIONAL

JN1101-U

An intelligent and compact UAV-borne system that provides rapid scanning, intercept, analysis, monitoring,

direction-finding and jamming against hostile tactical radio transmissions such as ground-to-ground and ground-to-air VHF/UHF C2 communications. It is capable of flying deep into enemy territory and providing in-depth attack on enemy nodal points without interfering with friendly force communications, it is claimed. Range: 70km

COLLINS AEROSPACE

ANT-1040A

The ANT-1040A is an airborne spinning direction-finding antenna for surveillance and reconnaissance. Covering the 0.5-40GHz frequency range, it has spin rates from 0-200rpm. There is an option to outfit the CS-1040 with an omni-antenna set integrated into the radome and supporting the same frequency range. The CS-1950 Antenna Interface Unit provides DC power and fibre-optic control. Length: 50cm Width: 50cm Height: 52cm Weight: 22.7kg

CS-1018ABN

The CS-1018ABN is an airborne version of the CS-1018 high-gain spinning direction-finding antenna to accommodate a wider airborne operating temperature range. The CS-1018ABN covers the 0.5-18GHz frequency range. Antenna modes of operation include point, sector azimuth scan and spin, with spin rates from 0-200rpm. The antenna includes RF limiters and filtering, low-noise amplifiers and RF switching. Length: 50cm Width: 50cm Height: 52cm Weight: 19kg

CS-1218

The CS-1218 is a small, high-performance, omni-directional antenna that operates over the 0.5-18GHz range. It is intended for use up to 40,000ft. The CS-1218 is radome-enclosed, foam-filled and moisture-proof and designed to meet environmental conditions required for most airborne applications. It meets the needs of many airborne electronic support measures and ELINT applications. Weight: 4kg

CS-1240

The CS-1240 is a small, high-performance, omni-directional antenna that operates over the 18-40GHz frequency range. It is intended for use up to 25,000ft. The CS-1240 is radome-enclosed, foam-filled and moisture-proof and designed to meet the environmental conditions required for most airborne applications. The antenna meets the needs of many airborne electronic support measures and ELINT applications. Length: 10cm Width: 10cm Height: 7cm Weight: 0.5kg Field of View - Azimuth: 360° Field of View - Elevation: 16°

CS-3001

The CS-3001 pulse analyser unit provides radar signal measurement and processing for radar emitter analysis. The VME-based CS-3001 accepts intermediate frequency (IF) and video inputs and provides de-interleaved digital pulse descriptor word (PDW) data for radar analysis, identification and direction finding. The PDW data includes measured frequency, primary rate interface, pulse width, amplitude and modulation flags for each received pulse.

CS-3002

The CS-3002 dual-pulse analyser unit provides radar signal measurement and processing for radar emitter analysis. The VME-based CS-3002 accepts IF and video inputs and provides de-interleaved digital pulse descriptor word (PDW) data for radar analysis, identification and direction finding. The PDW data includes measured frequency, primary rate interface, pulse width, amplitude and modulation flags for each received pulse. Length: 32cm

CS-3045

Designed for use in airborne environments, the CS-3045 airborne ELINT system consists of omni- and direction-finding-antennas, receivers, signal processors and operator workstations and can be employed in a variety of surveillance, ELINT and electronic support measures applications. The CS-3045 detects, captures and identifies radar signals in the 0.5-18GHz or 0.5-40GHz range.

CS-3240

The CS-3240 automatic ELINT system detects, captures and identifies radar signals in the 2-18GHz range – options for higher- and lower-frequency coverage are available. The CS-3240 may be used for automatic ELINT or electronic support measures applications and consists of mature, field-proven equipment and software.

CS-3645

The CS-3645 hybrid ELINT/electronic support measures (ESM) system provides simultaneous tactical threat warning, ESM and technical ELINT capabilities from 0.5-40GHz. The CS-3645 combines the characteristics of high-gain directional antennas, omni-antennas, precision monopulse direction-finding antennas, digital receiver technology, high-sensitivity receivers and wideband high probability of intercept receivers into an integrated mission system. It reduces system cost through the use of shared antennas, common receivers, signal processing hardware and analysis software.

CS-5020C Series

CS-5020C-series microwave tuners and receivers are high-performance instruments covering the centre tune frequency range from 0.1-18GHz. The CS-5020C Series are superhet, set-on and sweep units that convert signals in the covered frequency range into intermediate frequency (IF) outputs of one gigahertz and user-selectable 70, 140 and 160MHz outputs. Specialised models have video (AM/FM/LOG) and audio demodulated outputs.

CS-5998

The CS-5998 is an ultra-broadband set-on microwave tuner with two gigahertz intermediate frequency (IF) output. It covers the 1.5-18GHz tuning range, with the edges covering 0.5-19GHz. It has a low-noise figure, high dynamic range and low-phase noise. The two gigahertz bandwidth, centred at three gigahertz, gives the user the opportunity to look at an ultra-wide IF anywhere in the microwave range. Length: 21cm Width: 53cm Height: 9cm Weight: 8.2kg

DPAU-4001

The DPAU-4001 Digital Pulse Analyzer Unit provides digital radar signal measurement and processing for

radar emitter analysis. The DPAU-4001is a VME-based signal processor that accepts intermediate frequency (IF) inputs (or RF inputs with the RC-5850 option) and provides de-interleaved digital pulse descriptor words (PDWs), digital intrapulse and spectral data for radar analysis, identification and direction-finding. Weight: 15.5kg

IFMR-6070

The IFMR-6070 is a VME-based wideband instantaneous frequency measurement (IFM) receiver and signal processor that instantaneously receives radar signals across the entire 0.5-18GHz spectrum, providing a high probability of signal detection for rapid emitter detection and analysis. Length: 66cm Width: 53cm Height: 8cm Weight: 14.5kg

PRISM-6090

The Precision Intercept Spectral Monitoring (PRISM) 6090 system is a full-range system that covers a frequency range from 0.5-18GHz (40GHz optional). The RF search system generates RF spectral displays across the 0.5-18GHz range for the detection of signal activity. The PRISM GUI is displayed on a host computer screen to allow the system chassis to be located close to antenna feeds. Length: 55cm Width: 53cm Height: 17cm Weight: 14.5kg

RC-5800

The RC-5800 is a microwave tuner covering the centre tune frequency range from 0.5-18GHz for applications that require tuning performance and phase noise in a compact unit. The RC-5800 consists of two separate 6U VME modules designated as the synthesiser module (SYN-5800) and RF module (DCV-5800). This functional partitioning allows the tuner to support in-channel direction-finding for phase interferometry applications.

RC-5850

The RC-5850 is a fast-tuning microwave receiver covering the 0.5-18GHz frequency range, with 35µs tuning time for applications that require tuning speed and phase noise in a compact tuner. The RC-5850 builds on the field-proven RC-5800. It consists of two separate 6U VME modules designated as the synthesiser module (SYN-5850) and the RF module (DCV-5800). This functional partitioning allows the tuner to support in-channel coherent direction-finding for phase interferometry applications.

RC-8800

The RC-8800 is a multi-channel microwave tuner for technical ELINT or multichannel electronic support measures applications. Configured with one to four tuners on a single-slot 6U VME carrier card and operating from 0.5-20GHz, the RC-8800 greatly reduces the SWaP needed for single and multi-tuner systems. Weight: 1.6kg

DTS

ELINT DMI-604

DTS' ELINT system is integrated into a direction-finding system. It is designed for permanent installation onboard any type of platform. It can be provided with a fixed antenna array with high probability of intercept,

The RC-8800 is a multi-channel microwave tuner for technical ELINT or multichannel electronic support measures applications. (Image: Collins Aerospace)

and/or with a high-gain rotating antenna to maximise detection range.

ELBIT SYSTEMS EW & SIGINT – ELISRA

ACVS 200-WB

ACVS 200-WB is an airborne COMINT/DF system, handling VHF/UHF (HF optional) signals. It detects and intercepts radio emissions (voice and data) and determines their DOA and location. ACVS 200-WB is designed for use in airborne applications as part of a SIGINT system or as a standalone DF and location finder along with monitoring and signal analysis capabilities.

AES-212 Emerald

Elbit Systems' AES-212 Emerald is a combined Electronic Intelligence (ELINT) and electronic support measure designed to equip UAVs, rotorcraft and fixed-wing aircraft. Elbit's official literature states that the product covers a waveband of 100 megahertz to 40 gigahertz. Weight: 50kg Field of View - Azimuth: 20,626.48° Range: 713.02km

Air Keeper

Elbit Systems unveiled the Air Keeper, an airborne SIGINT and EW system for aircraft at the Paris Air Show 2015. Already operational, Air Keeper is designed to to suit a range of mission types, and offers intelligence-gathering and EW soft-kill capacities. The system enables 'any' existing cargo, transport or passenger aircraft to be integrated, allowing the aircraft to perform missions.

Emerald AES-210/E

Emerald AES-210/E is a family of lightweight electronic support measures and ELINT systems for helicopters and aircraft tasked with land or maritime surveillance, and also contributes to self-protection. Weight: 45kg Field of View - Azimuth: 360°

Skyfix Cellular

Elbit Systems' Skyfix Cellular is a combined Communications Intelligence (COMINT) and Communications Jamming (COMJAM) system designed to outfit small platforms such as UAVs.

Elbit's official literature states that the system can detect emitters across wavebands of 30MHz to 1.2GHz, although this has the option of being extended further to three gigahertz. From a COMJAM perspective, Skyfix Cellular can engage emitters transmitting on frequencies between 30MHz to 500MHz. Weight: 70kg Field of View - Azimuth: 360° Field of View - Elevation: 40° Range: 305.58km

Skyfix Satellite

Elbit Systems' Skyfix Satellite is a Communications Intelligence (COMINT) system designed to outfit small platforms such as UAVs. Elbit's official literature states that the system can detect Satellite Communications (SATCOM) emitters, principally those using the Iridium (1.616GHz to 1.626GHz) and Thuraya (1.525GHz to 1.661GHz) constellations. Beyond these two examples, the literature omits to mention which other wavebands are covered by Skyfix Satellite. Range: 305.58km

Skyfix/Skyfix DF

Skyfix is a lightweight, precision COMINT/direction-finding system, covering the 30MHz to three gigahertz band. The system uses the correlative interferometer technique and a wide-aperture antenna array. It is designed to provide direction-finding accuracy, combined with fast direction-of-arrival integration time, using compact wideband multipurpose receivers. Weight: 35kg Field of View - Azimuth: 360°

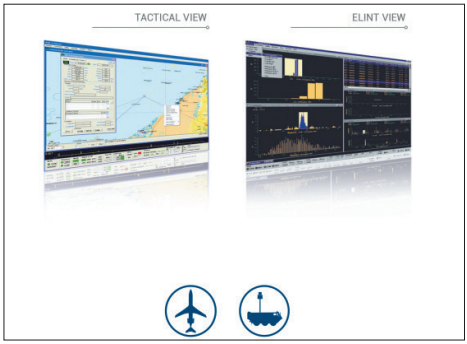
ELETTRONICA

ELT/332

ELT 332 is a counter electronic support measure/COMINT system designed for fast real-time interception, direction finding and automatic characterisation of complex broadband signals, frequency-agile transmissions (e.g. frequency hopping emitters) and analogue/digital modulated signals. The system fully meets the operational and technical requirements identified for surface ships and offers state-of-the-art performances with high sensitivity, wide dynamic range and full-azimuth spatial coverage. The system provides surveillance of the electromagnetic spectrum by performing automatic detection, discrimination, pre-classification and technical identification of communication emitters, demodulation and decoding of communication signals and content production with real-time audio listening; wideband recording of RF signals for data collection and off-line analysis (to be done with other systems).

ELT/819A

Elettronica's ELT/819A is a low band ELINT system designed for both airborne and naval applications. In the frame of the ELT ELINT Systems, the ELT/819A extends the ELINT capability into the field of the renewed interest and utilization of VHF/UHF radar systems for its well-known capability to counter the stealth technology. The high flexibility of the system allows multiple installations in several possible ground and air solutions. ELT/819A is a piece of low band equipment that exploits the state of the art of digital receivers' technology to perform both technical and tactical functions.



Elettronica's ELT/819A is a low band ELINT system designed for both airborne and naval applications. (Image: Elettronica)

ELT/819B

Elettronica's ELT/819B is an ELINT system designed for airborne applications. In the frame of the ELT ELINT Systems, the ELT/819B covers C-J radar bandwidth. ELT/819B is equipment that exploits Direction Finding and geolocalization techniques based on TDOA and phase interferometry.

ELT/819C

Elettronica's ELT/819C is an ELINT system designed for both airborne and naval applications. In the frame of the ELT ELINT Systems, the ELT/819C covers E-K radar bandwidth. ELT/819C is a piece of equipment that exploits techniques based on a digital receiver ultrawideband and phase interferometry.

ELT/1001

The ELT/1001 is a communication electronic support measures payload designed to be carried by tactical UAS. Elt 1000 is a brand new generation of software-defined radio sensor for light Communication ISR missions, based on the latest generation of FPGA and processing boards, characterised by high-performance levels joined with a very compact and modular architecture. The System is designed for fast real-time interception, direction finding and automatic pre-classification of complex broadband signals, frequency-agile transmissions (e.g. frequency hopping emitters) and analogue/digital modulated signals. This data can then be transferred to a GCS, thus improving overall situational awareness.

LOKI

The LOKI family is a cross-platform C2 system designed to integrate EW, SIGINT and Electro-Magnetic Spectrum Operations on many distributed platforms. The platform can be distributed in any domain operation (air land, sea, space) and could be fixed/moving and crewed/uncrewed.

ELTA SYSTEMS

ELI-3001 AISIS

Israel Aerospace Industries' (IAI) ELI-3001 Airborne Integrated Signals Intelligence System equips the Israeli Air Force's (IAF) three Gulfstream G-550 Shavit SIGINT

aircraft. IAI's official literature states that the ELI-3001 can gather both COMINT and ELINT. The system and platform are designed to be used at the strategic and operational levels.

ELI-3120

Israel Aerospace Industries' (IAI) ELI-3120 is a Signals Intelligence (SIGINT) system designed for use at the operational and tactical levels. The ELI-3120 architecture also includes an optronics payload. The system is designed to gather Communications Intelligence (COMINT) and Electronic Intelligence (ELINT).

ELK-7065

The ELK-7065 ground and naval HF COMINT direction-finding system was unveiled in 2013, with a compact, lightweight airborne version launched in September 2017. The sensor was installed on a Schiebel Camcopter S-100 rotary-wing UAV in Q3 2015 and demonstrated on an S-100 as part of an Australian Army exercise in 2018. Length: 12cm Width: 50cm Height: 30cm Weight: 3kg

ELK-7066

This COMINT system performs off-the-air passive interception and monitoring of voice and SMS GSM traffic, without interfering with network operation. With RF and processing capabilities, the system can be installed on aerostats or in helicopters.

ELK-7071

Israel Aerospace Industries' (IAI) EL/K-7071 is an integrated electronic support measure designed to equip UAVs. While not explicitly stated by the system's manufacturer, it is possible that this apparatus outfits the company's Heron UAVs, specifically those in service with the Israeli Air Force (IAF). Range: 413km

ELK-7071 IUCOMS

The ELK-7071 Integrated UAV COMINT/direction-finding System (IUCOMS) is designed to cope with the challenges of modern dense communications network environments and perform long-range, high-endurance COMINT missions. The system's tasks are to scan, intercept, measure, locate, analyse, classify and monitor ground, airborne and naval communications transmissions characterised by high mobility, short duration and modern signals.

ELL-8385

Israel Aerospace Industries' (IAI) ELL-8385 is an integrated electronic support measure designed to equip Unmanned Aerial Vehicles (UAV). Open source imagery intelligence indicates that the ELL-8385 maybe in service onboard the IAI Heron UAVs flown by the Israeli Air Force (IAF). Weight: 30kg

ELL-8385 IUELIS

The ELL-8385 Integrated UAV ESM/ELINT System (IUELIS) is designed to cope with the challenges of modern dense radar environments and perform long-range, high-endurance ESM/ELINT missions. Its tasks are to search, intercept, measure, locate, analyse, classify and monitor ground, airborne and naval radar transmissions characterised by high mobility, short duration and modern signals.

GENESIS EW

GenCOM Defense Air

GenCOM Defense Air provides an automatic multi-layered situational awareness picture to the decision-maker, based on external signal data (metadata) gathered in real time. Integrating with single or multiple airborne COMINT direction-finding or time difference of arrival payloads, deployed on UAVs or other aircraft, GenCOM Defense Air is a software solution designed to automatically deliver multi-layered battlefield-related geo-spectral, communications and tactical knowledge. This solution is used for terrain dominance.

HORIZON TECHNOLOGIES

FlyingFish

FlyingFish is an Airborne Satellite Monitoring System designed to detect and intercept SATCOM from airborne ISR platforms. As a passive system, it cannot be detected by either the mobile user or the satellite network. Now in its third generation, FlyingFish has been deployed by several airforces (including NATO members) in operations spanning across three continents. Length: 37.1cm Width: 39.2cm Height: 24cm Weight: 16kg Range: 400km

FlyingFish Maritime

The FlyingFish Maritime SIGINT system is one of several derivatives of the FlyingFish Airborne Satellite Monitoring System developed by Horizon Technologies. Designed to be mounted on airborne SAR and ISR platforms, it can detect and locate satellite phones being used at sea. It is a COTS product that is not subject to ITAR restrictions. Length: 41.1cm Width: 39.8cm Height: 17.8cm Weight: 10kg Range: 400km

FlyingFish Xpod

The FlyingFish Xpod is a plug-and-play ISR and SIGINT module that can be attached to almost any aircraft equipped with standard BRU-14 hardpoints. Incorporating both the FlyingFish Xtender system and a suite of other sensors, the Xpod can detect and intercept SATCOM as well as collect a range of other data.

FlyingFish Xtender

The FlyingFish Xtender has been designed to provide SIGINT capabilities at the tactical level. As its name suggests, this small and lightweight module extends the effective range of the third-generation FlyingFish system by turning UAVs into SIGINT platforms. The Xtender is also incorporated into the FlyingFish Xpod module and can be installed on CubeSats. Weight: 0.5kg

INDRA SISTEMAS

AMES

Modular ESM system that can be upgraded with ELINT capabilities. The basic system has four spiral DF antennas with channelised receivers and a DSP. An advanced version adds a fine DF subsystem. Adding superhet receivers and an intrapulse analysis package turns AMES into an ELINT system.

L3HARRIS TECHNOLOGIES

ALR-97(V)

The ALR-97(V) is a maritime-patrol electronic support measures system. The system enhances an aircraft's survivability by detecting, identifying and locating hostile radar signals. The AN/ALR-97(V) is designed to provide automatic signal intercept, identification and Direction-Finding (DF). System applications include maritime domain awareness, sovereignty patrol, long-range surveillance and monitoring the EEZ.

ES-5080

The ES-5080 is a wideband digital receiver-based ELINT/electronic support measure system for land and coastal surveillance. Its system architecture combines omni-directional and high-gain spinning dish antennas with multiple wideband digital receivers. According to Harris, this combination provides the sensitivity and parameter measurement accuracy needed to identify complex low-power radars at long ranges. Field of View - Azimuth: 360°

ES-5500

The ES-5500 is an electronic surveillance and collection system with wideband multi-channel acquisition, receiving, ELINT collection and analysis capability. The system supports multiple operator positions, which include Windows-based human-machine interface with full search and collection control, signal recording and signal analysis functions.

LEONARDO ELECTRONICS

Sage ESM

Leonardo's SAGE system is a digital ESM/ELINT for RF intelligence, surveillance and reconnaissance missions. It has both single and multi-platform geo-location of RF assets, parallel wideband and channelized receivers, and delivers instantaneous detection and ELINT analysis. The system can collect ELINT from land, maritime and airborne emitters, providing highly accurate direction-finding capabilities. SAGE is suitable for a range of aircraft from tactical UAVs and light helicopters to larger reconnaissance and maritime patrol aircraft. Weight: 20kg

Spider COMINT

The Spider, named after its eight RF antennas, is a COMINT system developed by Leonardo for installation onto twin-turboprop fixed-wing aircraft, MALE UAVs and military helicopters. Housed in a pod underneath the aircraft, this system is capable of targeting enemy forces using communications devices and intercepting their signals, allowing hostile battle plans to be analysed in real-time. Length: 50cm Width: 50cm Height: 150cm Weight: 20kg

LOCKHEED MARTIN

ADRP EW System

The Advanced Digital Receiver Processor (ADRP) EW System is a passive digital receiver-based ESM package that provides situational awareness by detecting, identifying and locating combat threats autonomously. The system provides ELINT, ESM and RWR functions. Installation flexibility for airborne, sea-based, land-based and manned and unmanned platforms is enabled by a modular open systems architecture.

AN/ALQ-217

Lockheed Martin's AN/ALQ-217 is an Electronic Support Measure (ESM) designed to equip large, fixed-wing aircraft. Although not mentioned in the company's official literature, it is thought that the AN/ALQ-217 can detect radar signals transmitting in wavebands of 500 megahertz/MHz to 40 gigahertz. The AN/ALQ-217 is used onboard Northrop Grumman E-2D Hawkeye airborne early warning aircraft. The system plays an important role in detecting airborne and surface targets via their radar emissions. No details have been made available in the public domain. Nonetheless, by examining average unit prices for comparable systems, we estimate that the AN/ALQ-217 has a unit cost of $1.8 million. Weight: 92kg Field of View - Azimuth: 360°

PRSS

Passive Ranging SubSystem (PRSS) is a radar detection, identification and location system that allows a single tactical aircraft to locate hostile emitters. Based on an open architecture using VME cards.

MERCURY DEFENSE SYSTEMS

SIGINT Payload

Suited to cross-cueing imaging sensors, these SIGINT payloads for small UAS combine direction-finding capability and efficient SWaP packaging, says the company.

NORTHROP GRUMMAN

ADACS

The Airborne Digital Automatic Collection System (ADACS) is adaptable to fixed-wing aircraft and helicopters and combines ESM and precise emitter parameter measurement, covering 0.5-20GHz.

QINETIQ

ASX

Qinetiq's ASX series of COMINT/direction-finding systems provides solutions for airborne signals applications. Qinetiq can provide tailored SIGINT solutions from individual sensor systems up to fully equipped platforms. The ASX range is built on scalable and modular receiver and antenna architectures to provide performance and payload size matched to small, mid-class and large platform applications. It was unveiled in June 2014.

ROHDE & SCHWARZ

COMINT and CESM systems

Rohde & Schwarz offers scalable strategic and tactical COMINT and CESM systems for various airborne platforms. Solutions for user requirements can be tailored from a range of antennas, receivers, direction-finding devices with multichannel signal processing, and analysis units.

ELINT systems

Rohde & Schwarz strategic airborne ELINT payload provides a high-quality data acquisition based on the R&S WPU2000 Wideband Processing Unit. The real-time, fully digital, 2GHz-wide bandwidth solution is capable to deal with the latest RF agile radar systems, significantly enhancing the range of platform built-in sensors. It is tailored to intercept and record Low Probability of Intercept emitters such as Frequency Modulated Carrier Wave and low-power solid-state radars.

SAAB ELECTRONIC DEFENCE SYSTEMS

ESP-50

The ESP-50 is an ESM payload for UAV applications. It provides the electronic order of battle through emitter identification and location and operates as a standalone ESM system integrated with UAV systems possessing a high probability of intercept for search radars. Length: 34.3cm Width: 12.7cm Height: 19.3cm Weight: 16kg Field of View - Azimuth: 210° Field of View - Elevation: 70°

SAAB MEDAV TECHNOLOGIES

ATR-8000

ATR-8000 is a family of systems for airborne COMINT monitoring and direction finding for tactical and strategic applications. Systems are installed on aircraft and ground stations (central stations). Distributed systems consisting of multiple aircraft or ground sites can be realised. They can communicate with each other depending on the availability of satellite uplinks or aircraft communication links.

SAAB

Arexis

Arexis is an ECM, ISR and radar warning receiver (RWR) concept developed by Saab to support fighter aircraft requirements. It provides situational awareness for self-protection through its RWR, and tactical support via its ISR capabilities. Arexis also includes an advanced electronic attack application. A version of Arexis will be installed onboard the new version of the Gripen E/F and the first flight was in November 2019.

BOW

Saab's BOW family of Radar Warning Receivers (RWRs) and electronic support measures are designed to outfit a diverse array of fixed-wing aircraft. The BOW family covers wavebands of two gigahertz to 20GHz, although customers can extend this downwards to 500MHz and upwards to 40GHz if desired. The BOW-21 is the RWR member of the family. This outfits the Luftwaffe's (German Air Force) Panavia Tornado-IDS/ECR fighter and air defence suppression aircraft and legacy Saab JAS-39C/D Gripen combat aircraft. Unit prices for the BOW family have not been published. By examining average prices for comparable RWRs, we estimated that the radar warning receivers in the BOW product series may have a unit cost of circa $1.2 million.

ESP

The Electronic Surveillance Payload (ESP) is a lightweight system providing capabilities for Electronic Support Measures(ESM)/ELINT operations. It is designed to operate as a standalone ESM system integrated with UAVs or other light airborne platforms and consists of an airborne and a ground segment, plus the remote terminal. The primary purpose of ESP is to provide an electronic order of battle through emitter identification and location. Length: 34cm Width: 12cm Height: 19cm Weight: 10kg Field of View - Azimuth: 210° Field of View - Elevation: 70°

HES-21

HES-21 provides ESM, ELINT and self-defence as a pod. The HES-21 is an integrated system with tactical situational awareness claimed in terms of EOB, as well as data-strategic collection and analysis capabilities for creation and maintenance of ELINT databases and libraries for emitter identification. It is installed on the Saab 2000 AEW&C. Weight: 250kg

Sirius SIGINT

The Saab Sirius SIGINT system is a complete solution including airborne and ground segments. The airborne segment contains advanced COMINT and ELINT sensors that perform signal collection, while the ground segment includes mission planning and post-mission analysis.

SIERRA NEVADA CORPORATION

SS-6100

The SS-6100 is a manual, all-digital, multi-channel/multi-operator ELINT system consisting of one or more integrated receiver processor chassis. A separate COTS workstation computer hosts the operator GUI and the resource controller software which coordinates the assignment of the receiver processing resources among multiple operators. Frequency coverage and direction-finding precision vary with available options.

SS-6500

The SS-6500 automatic ELINT/ESM suite is a configurable DF system offering customers a range of options regarding DF precision, frequency, FOV, signal/emitter processing capabilities, size/weight configurations and user interfaces. The SS-6500 consists of an integrated receiver processor unit and separate antenna units suitable for a variety of ground applications. Frequency coverage and DF precision vary with available performance options.

THALES

ACS

The Airborne COMINT/DF Solution (ACS) is designed to carry out intelligence, detection, search, monitoring, DF and localisation. ACS can be integrated onto a range of civil and military airborne platforms such as fixed-wing aircraft, helicopters, UAVs and aerostats.

ULTRA ELECTRONICS TCS

UltraEAGLE

UltraEAGLE (Electronic Acquisition Gathering Locating Equipment) is a family of electronic support measures systems designed for a range of ELINT missions. It is available in various models covering C to K bands with

direction-finding options including high directional gain steered antennas, monopulse and interferometer arrays.

INTEGRATED SELF-PROTECTION SYSTEMS

ASELSAN

HEWS

Work on Aselsan's HEWS (Helicopter Electronic Warfare System) commenced in 2004 following the award of a contract to the firm by the Turkish Defence Industries' Undersecretariat. The contract covered the design and production of 285 Radar Warning Receivers (RWR), 191 jammers, 283 laser warning receivers and 285 electronic warfare management systems. The contract was worth $576 million, equating to $792.8 million in 2019 values. This gives a unit price of $789,641 for each of these disparate components comprising the overall HEWS. The contract called for these systems to be rolled out across the entirety of the Turkish armed forces' helicopter fleet. Series production of the HEWS commenced in 2014, with deliveries starting in 2015. It is known that the Turkish Air Force and Turkish Army's 60-strong Sikorsky UH-70 Black Hawk series medium-lift utility helicopters have been upgraded with the HEWS.

ASELSAN/BAE SYSTEMS

AN/ALQ-178V(5)+

The AN/ALQ-178(5)+ is an internally mounted self protection systems designed and developed by Aselsan and BAE Systems for Turkish F-16C fighter aircraft. It comprises an integrated RWR and jamming system, providing the pilot with situational awareness and deceptive RF jamming. It is marketed as the SPEWS-II Electronic Warfare (EW) self-protection system. Weight: 133kg

BAE SYSTEMS AUSTRALIA

Air-5416 Project Echidna

BAE Systems' commenced its work on the Australian Department of Defence's Air-5416 Project Echidna initiative in 2001. The rationale of the programme was to overhaul the self-protection systems used on a raft of rotary- and fixed-wing aircraft flown by the Australian armed forces. These included Sikorsky UH-70A9 medium-lift utility helicopters and Boeing CH-47D heavylift helicopters flown by Australian Army Aviation, and Lockheed Martin C-130J turboprop tactical freighters flown by the RAAF. Flight tests of the Air-5416 architecture commenced in 2009 onboard a Gates/Bombardier Learjet series business jet testbed. Specific unit prices for the Air-5416 architecture have not been published, however, by examining the average unit cost of comparable systems it is reasonable to assume that the ensemble has a unit price of $3.3 million.

BAE Systems' AN/AAR-57 Common Missile Warning System (CMWS) provides missile warning and hostile fire detection for rotary- and fixed-wing aircraft. (Photo: BAE Systems)

BAE SYSTEMS

AN/AAR-57 CMWS

BAE Systems' AN/AAR-57 Common Missile Warning System (CMWS) provides missile warning and hostile fire detection for rotary- and fixed-wing aircraft. The CMWS' ensemble includes the Advanced Threat Infrared Countermeasure and the Common Missile Warning System. The AN/AAR-57 employs lasers to defeat incoming IR guided surface-to-air and air-to-air missiles. The laser, which is mounted in a moveable turret, is designed to blind the missile's IR seeker and to steer the threat away from the aircraft. Although the AN/AAR-57 is primarily used by rotary wing aircraft technically it can equip fixed wing platforms too, provided that they are equipped with a data bus which uses the US Department of Defence's Military Standard-1553 protocols. Length: 0.27m Width: 0.23m Height: 0.14m Weight: 8.5kg

AN/ALQ-239

BAE Systems' ANALQ-239 Digital Electronic Warfare System (DEWS) is designed to equip the McDonnell Douglas/Boeing F-15 series combat aircraft. According to the company, the equipment provides 360 degrees of protection around the aircraft and includes a radar warning receiver, Digital Radio Frequency Memory (DRFM) and a countermeasures dispenser, all of which are linked to the aircraft's main computer system. The ANALQ-239 has now been adopted to outfit the F-15 series aircraft flown by the Japan Air Self Defence Force (JASDF) and those aircraft flown by the Royal Saudi Air Force (RSAF). Field of View - Azimuth: 20,626.48°

BHARAT ELECTRONICS

Mayavi

Bharat Electronics Limited (BEL) and the Defence Avionics Research Establishment (DARE) have bilaterally developed the Mayavi Integrated Self-Protection System (ISPS) which equips the Indian Air Force's and Indian Navy's Hindustan Aeronautics Limited Tejas Mk.1 light combat aircraft.

BIRD AEROSYSTEMS

AMPS/AMPS-MV

The Airborne Missile Protection System (AMPS) family of products – developed in cooperation with Airbus Defence and Space – is a third-generation self-protection system that protects from MANPADS and other missile threats. The system automatically detects the missile

threat, processes and optimises the countermeasure solutions, either chaff and flares or DIRCM, while providing visual and audio alerts to the crew.

EKRAN RESEARCH INSTITUTE

L-370 Vitebsk

Ekran's L-370 Vitebsk Integrated Self-Protection System (ISPS) equips several rotary- and fixed-wing aircraft in service with the Russian armed forces. Elements of the L-370, specifically the L-370-5 Directional Infrared Countermeasure (DIRCM), form the basis of Ekran's President-S DIRCM which equips export versions of the Mil Mi-28N (NATO reporting name Havoc) attack helicopter. No prices for the L-370 have been released, but by analysing average prices of comparable equipment, it is reasonable to estimate that the L-370 has a unit cost of $3.2 million.

Vitebsk-25

The Ekran Vitebsk-25 self-protection system forms a key part of the Russian Air Force's Sukhoi Su-25SM3. The Vitebsk-25 includes several systems which work to protect the aircraft. These include Zakhvat ultraviolet missile approach warning systems mounted fore and aft of the aircraft, along with two wing-mounted L-370-3S radar jammers positioned on hardpoints beneath each of the aircraft's wings. These are accompanied by the L-150-16M Pastel radar warning system and a pair of UV-26M 50mm countermeasures dispensers.

ELBIT SYSTEMS EW & SIGINT – ELISRA

All-in-Small

All-in-Small is an SPS designed for use in military and commercial fixed-wing aircraft and helicopters. The integrated EW suite comprises an EW controller, a digital RWR, an IR MWS, a laser warning system and a chaff/flare dispensing system. The compact, lightweight system has a modular and open architecture with multiple interface ability. Weight: 17kg

ASPS

The Advanced Self-Protection System (ASPS) includes both passive and active subsystems, and incorporates (for the first time for an F-16) both full azimuth coverage RWR and passive (EO) MWS. The system can detect pulse, CW, high-PRF and pulse-Doppler signals, discriminate them from interference and prioritise the most threatening ones. The system points at a valid threat by both visual and audible means. The MWS can also track a threat throughout the engagement.

SPS-65(V)3

The SPS-65(V)3 radar and laser warning system, also known as Spectrolite, is designed for use on helicopters and fixed-wing aircraft. It integrates RWR, which detects all CW, high-PRF, low-ERP radars and laser sensors. Features: DF, high POI, high sensitivity, fast reaction time, audio alarm, frequency measurement, interface with chaff/flare dispensers and automatic recording of emitter data. Length: 2.14m Width: 1.24m Height: 1.94m Weight: 16kg

UAS Self Protection System

The UAS Self-Protection System, based on the modular SPS-65V5, is an EW system for UAVs that range from tactical to HALE. The principle is similar to the company's All-in-Small protection system for helicopters and fixed-wing aircraft, and has been adapted to UAV requirements. Weight: 7.5kg

ELBIT SYSTEMS LAND

Airmor

Airmor is an autonomous modular countermeasure SPS designed for helicopters and transport aircraft. Airmor's core components are IMI's management control unit (MCU), which processes information from EW sensors and the aircraft avionics, generating an optimal response to a particular threat; a control and display unit (CDU), which provides situational awareness; as well as controls for operating the system.

ELBIT SYSTEMS

J-MUSIC

Elbit's J-MUSIC is the latest incarnation of the company's MUSIC Direction Infrared Countermeasure (DIRCM) product. J-MUSIC differs from other members of the MUSIC family in that it is configured as a distributed system designed to outfit medium-to-large fixed-wing aircraft. Length: 0.34m Height: 0.21m Weight: 57kg

ELETTRONICA

ALR-733 family

Elettronica's ALR-733 series of electronic support measures are designed to equip fixed and rotary wing aircraft. The company's official literature states that the equipment can detect radar signals across a waveband of two gigahertz/GHz up to 18GHz. The firm claims that the equipment provides a probability of interception of 100 percent, adding that it performs accurate inter and intra-pulse analysis for radars transmitting a wide variety of waveforms. The literature continues that analysis can be performed in real time, or recorded by the system for later post-mission examination.

ELT/950

The ELT/950 family consists of an in-platform electronic warfare management (EWM) system that enables the integration of several EW sensors and countermeasures and includes versions for airborne, naval and ground applications. The system is based on a modular architecture and can be tailored for the specific customer requirements allowing the management of any EW equipment interface based on common libraries that constitute the solid core of the product.

Virgilius

Virgilius is an advanced, fully integrated all-in-one Electronic Warfare system for Alarm, Surveillance and Countermeasure functionalities. It is conceived to perform emitter detection, classification, identification, and to counter a large threat variety, including radar-controlled Anti-Aircraft Artillery (AAA), Surface-to-Air Missiles (SAM), Air-to-Air Missiles (AAM), Early Warning, Search and modern Multifunction Radars. Virgilius is installable on any fixed and rotary-wing platform, naval surface and submarine platforms and ground-based systems.

ELTA SYSTEMS

EL/L-8427/8 Integral Compact EW Suite/RWJS

ELTA's EL/L-8247/8 Integral Self Protection Suites Radar Warning and Jamming Systems (RWJS). are designed to be compact, modern, advanced and cost-effective. The systems are designed to enhance the survivability of fighter aircraft and helicopters by suppressing multiple threats in dense radar-guided weapon systems environments. The RWJS is comprised of a central unit, front-end amplifiers, transmitters, transmitting antennas, and receiving antennas. Weight: 30kg Field of View - Azimuth: 360°

ELL-8260/2 INEW SPS

The ELL-8260/2 is an integrated self-protection suite for helicopters, fixed-wing aircraft and UAVs and protects against surface-to-air and air-to-air projectiles. Once threats have been identified, countermeasures are activated according to programmed pre-flight messages. It identifies pulse, CW and other exotic threats in a short cycle time.

HENSOLDT SENSORS/BIRD AEROSYSTEMS

AMPS

The Airborne Missile Protection System (AMPS) is a modular EW suite for helicopter and transport aircraft and consists of radar, laser and missile warners, a threat evaluation and display processor, as well as chaff/flare dispensers. The single components can be selected by customers to reflect requirements. In a threat situation, the system reacts automatically without any involvement of the crew.

IAI ISRAEL AEROSPACE INDUSTRIES

ADA - IAI

The ADA system, named after the system's adaptive antenna, is designed to protect avionics systems from GPS jamming. The system, that has won a tender from Israel's MoD, is based on an electronic architecture and uses digital processing to protect a broad range of global navigation satellite systems operating on manned and unmanned combat aircraft and helicopters as well as surface vehicles and munitions. Length: 0.2m Width: 0.2m Height: 0.2m

KNIRTI

L-005S Sorbsiya

KNIRTI's L-005S Sorbsiya integrated self-protection system is used exclusively by the Sukhoi Su-27 (NATO reporting name Flanker) combat aircraft flown by the Russian Air Force and the People's Liberation Army Air Force. The L-005S is an internally-mounted system directly connected with the aircraft's mission computer. The system covers a bandwidth of six gigahertz to ten gigahertz. The L-005S architecture includes a digital radio frequency memory which detects and records hostile radar signals, demodulates the transmission and then adds a jamming modulation to the signal parameters and retransmits this back to the radar thus providing discreet radar jamming and spoofing. Maximum Signals Tracked: 10

KRET

L-402 Himalaya

KRET's L-402 Himalayas integrated self-protection system has been developed by the company's KNIRTI subsidiary and equips the Sukhoi Su-57/T-50 (NATO reporting name Felon) fighter. Deliveries of the L-402 commenced in 2014. This technology will likely form the basis of the electronic warfare systems equipping new Russian Air Force (RUAF) platforms and may be installed on the Tupolev PAK-DA strategic bomber currently under development.

L3HARRIS TECHNOLOGIES

AN/ALQ-161A

L3Harris' AN/ALQ-161A integrated self-protection is at the heart of the defensive apparatus of the Rockwell International/Boeing B-1B Lancer strategic bomber. The system was designed from the outset specifically for the B-1B and served two purposes: to help protect the aircraft against all RF threats, and to serve as a tail warning system to protect the aircraft against missiles approaching from aft. The company's official information states that the AN/ALQ-161A is capable of engaging and defeating simultaneous RF threats. This is especially relevant when the aircraft is flying in contested airspace where radar-guided surface-to-air and air-to-air missiles; ground-based air surveillance and fire control radars; plus airborne fire control radars and airborne early warning radars are present. Weight: 2,363kg

AN/ALQ-211(V) AIDEWS

L3Harris' AN/ALQ-211(V) is an Integrated Self-Protection System (ISPS) designed to protect fixed-wing aircraft and rotorcraft against RF threats. It is thought that the baseline AN/ALQ-211(V) architecture can detect radar threats transmitting across wavebands of two gigahertz to 18GHz and is capable of performing electronic attack across similar frequencies. Open source information states that the ISPS is effective against a wide array of radar modulation techniques including continuous wave and standard pulse-Dopplar radars. The full AN/ALQ-211(V) architecture includes Radar Warning Receivers (RWRs) and an RF jammer. Both the RWRs and jammers can be positioned around the aircraft in such a fashion as to provide 360° coverage. The AN/ALQ-211(V) can also be linked to an aircraft's countermeasure dispenser. Weight: 44kg Field of View - Azimuth: 360°

WIPPS

L3Harris' Widebody Integrated Platform Protection System (WIPPS) is designed to equip widebody aircraft and is primarily aimed at civilian customers seeking a self-protection system to safeguard such planes against attack by IR guided MANPADS. The primary market for such protection systems are those platforms carrying dignitaries, or performing passenger or freight flights into and out of areas where MANPADS proliferation is a problem.

L3HARRIS TECHNOLOGIES/LOCKHEED MARTIN

Viper Shield AN/ALQ-254(V)1

L3Harris, in partnership with Lockheed Martin and the USAF, are developing an all-digital EW suite, which is

custom design to be the baseline on advanced F-16 Block 70/72 aircraft. The next-generation AN/ALQ-254(V)1 Viper Shield will provide a virtual electronic shield around the aircraft. The all-digital architecture uses COTS technology to enable enhanced system performance, a smaller form factor and reduces weight along with easier future upgrades.

LEONARDO ELECTRONICS

CDAS

The Common Defensive Aids System (CDAS) is an evolution of the HIDAS and BAKER integrated DAS solutions that protect a range of UK and export airborne platforms. By introducing a flexible and modular open architecture, together with an adaptive DAS controller, CDAS provides the user with the ability to securely address today's complex and rapidly changing threat environment, says the company.

HIDAS

Leonardo's Helicopter Integrated Defensive Aids System (HIDAS) combines laser, missile and Radar Warning Receivers, and a Chaff and Flare Dispensing System (CFDS). The RWR takes the form of the company's Seer RWR Seer is available in several configurations covering a 0/5MHz to 40GHz waveband. Alongside the HIDAS' RWR the equipment employs optronic and infrared sensors to detect incoming air-to-air and surface-to-air missiles, and possibly also small arms fire and rocket-propelled grenades. The HIDAS architecture is linked to Leonardo's Defensive Aids System Controller, with the Integrated Self-Protection System being fitted internally. Leonardo offers the option of adding a directional infrared countermeasure and radio frequency jamming system to the HIDAS.

HIDAS-15

Leonardo's HIDAS-15 is an Integrated Self-Protection System (ISPS) optimised for rotorcraft which has evolved from the firm's baseline HIDAS product. The HIDAS-15 is in service on the British Army Air Corps' AgustaWestland/Leonardo Wildcat AH.1 light utility helicopter variant of the AgustaWestland/Leonardo AW-159 series rotorcraft. The army has 27 of these aircraft in service. Deliveries commenced in 2015. The HIDAS-15 was also selected to equip the Republic of Korea Navy's eight AW-159 series naval support helicopters acquired in 2015. Specific unit prices for the HIDAS-15 have not been released. However, by examining average prices for comparable products we estimate that the HIDAS-15 has a unit cost of $3.2 million.

Praetorian DASS

The Praetorian Defensive Aids Sub-System (DASS) for the Eurofighter Typhoon combat aircraft provides protection against air-to-air and surface-to-air threats. It integrates an Electronic Support Measure (ESM), radar warning receiver, missile warning receiver, jamming system, countermeasures dispenser and a towed radar decoy to detect, evaluate and counter threats. Praetorian is produced by the EuroDASS consortium which includes Elettronica, Hensoldt, Indra and Leonardo. The DASS is installed internally. Praetorian is used throughout the global Typhoon fleet. Although not publicly confirmed, the DASS is thought to cover a waveband of two gigahertz to 18GHz. This may be extended downwards to 0.5GHz and upwards to 40GHz to ensure that the system can detect low-frequency ground-based air surveillance radar threats and that it can detect and jam Millimetre Wave (MMW) threats upwards of 30GHz. This is particularly important given the increasing proliferation of MMW seekers in Air-to-Air and Surface-to-Air Missiles. The DASS' ESM is housed in the aircraft's wingtip pods, with the port wingtip pod containing the jammer. The starboard wingtip pod carries the towed decoy.

NORTHROP GRUMMAN

Defensive Management System-Modernisation

The Defensive Management System-Modernisation (DMS-M) is the overarching effort to substantially enhance the Northrop Grumman B-2A Spirit strategic bomber's Integrated Self-Protection System (ISPS) which includes radar warning receivers supplied by Lockheed Martin along with the company's AN/APR-50 defensive management system. This is in addition to a Northrop Grumman defensive aids subsystem. The programme is in peril with funding planned to be zeroed out over five years in the US Air Force's fiscal year 2021 budget request.

Falcon Edge/IEWS

Northrop Grumman's Falcon Edge Integrated Self-Protection System (ISPS) equips the United Arab Emirates Air Force's (UAEAF) Lockheed Martin F-16E/F Block-60 fighters.

SISCM

The Suite of Integrated Sensors and Countermeasures (SISCM) is designed to provide an integrated, multi-sensor threat warning and countermeasures capability using off-the-shelf technology for helicopters and tiltrotor aircraft. The SISCM records threat and GPS data for post-mission analysis and planning.

NOVATEL

GAJT-AE

Novatel's GAJT-AE is an electronic protection system designed to safeguard a platform against GNSS (Global Navigation Satellite System) jamming. The company has designed the GAJT-AE to equip size-, weight- and power-constrained platforms, notably Uninhabited Aerial Vehicles (UAVs). The GAJT-AE employs a digital beamforming algorithm, according to the company's official literature. The equipment detects jamming by recognising anomalies in the jamming signal, such as its high power level compared to the low power levels usually associated with GNSS signals. The GAJT-AE will then create a null in the platform's GNSS receiver antenna gain pattern in the direction of the jammer. This will prevent the GNSS system receiving navigation signals only from the direction of the jammer while ensuring that the equipment can receive GNSS signals from other directions. As the GAJT-AE is dynamic it can continue nulling the direction of the jamming as the platform moves. Novatel's GAJT-AE is an electronic protection system designed to safeguard a platform against GNSS (Global Navigation Satellite System) jamming. The company has designed the GAJT-AE to equip size-, weight- and power-constrained platforms, notably Uninhabited Aerial Vehicles (UAVs).. Length: 0.15m Width: 0.18m Height: 0.04m Weight: 1.2kg

RAYTHEON

ACES

Raytheon's Advanced Countermeasures Electronic System (ACES) is an Integrated Self-Protection System (ISPS) designed to equip Lockheed Martin F-16 series combat aircraft. The ACES architecture includes Raytheon's AN/ALQ-187(V)2 Radio Frequency (RF) jammer, Northrop Grumman AN/ALR-93 radar warning receiver and BAE Systems' AN/ALE-47 chaff and flare dispensing system. ACES is thought to cover a two gigahertz/GHz to 18GHz waveband, although it is possible that this may have been extended downwards to 0.5GHz to allow the system to detect low-band radar threats, and upwards to 40GHz to enable it to jam millimetre wave threats transmitting at frequencies of 30GHz and above. Such wavebands are increasingly used for the radar seekers equipping air-to-air and surface-to-air missiles.

AN/ALR-89

Raytheon's AN/ALR-89 integrated self-protection system equips Northrop Grumman's RQ-4 Global Hawk and MQ-4 Triton series High-Altitude, Long-Endurance (HALE) Unmanned Aerial Vehicles (UAV). The AN/ALR-89 includes several subsystems such as the company's AN/APR-49 Radar Warning Receiver (RWR), AN/AVR-3 laser warning system and AN/ALE-50 towed decoy. The AN/APR-49 detects incoming radar signals which can then be jammed using the AN/ALE-50. Meanwhile, the AN/AVR-3 detects laser threats to the aircraft.

RUAG AVIATION

ISSYS-POD

The Integrated Self-Protection System (ISSYS) alerts helicopter crews to imminent threats, and deploys countermeasures for both ground and air-based attacks. ISSYS accomplishes this by detecting a broad spectrum of radar and laser threat emissions, as well as IR emissions from approaching missiles

SAAB

Civil Aircraft Missile Protection System

Civil Aircraft Missile Protection System (CAMPS) is an intelligent system designed to counter and combat MANPADS attacks against civil aircraft. The system comprises four MAW 300 missile approach warning systems, BOA civil dispenser system, CVI-IR decoys and an electronic control unit. CAMPS is excluded from the military products listing and fully compliant with the Wassenaar Arrangement regulations. Maximum Signals Tracked: 8

ESTL

The Enhanced Survivability Technology (ESTL) is an integrated self-protection pod with missile approach warning (MAWS) to counter RF and IR threats. The ESTL pod consists of MAWS, LWS, pyrotechnical dispenser (BOP), chaff and flare dispenser (BOL), and electrronic warfare controller. It can be integrated onto any aircraft equipped with a standard Raytheon AIM-9 or AIM-120 missile hardpoint and is installed in place of a missile on a mission.

HES-21

HES-21 provides ESM, ELINT and self-defence as a pod. The HES-21 is an integrated system with tactical situational awareness claimed in terms of EOB, as well as data-strategic collection and analysis capabilities for creation and maintenance of ELINT databases and libraries for emitter identification. It is installed on the Saab 2000 AEW&C. Weight: 250kg

IDAS/CIDAS

Saab's IDAS (Integrated Defensive Aids Suite) is designed to equip fixed-wing and rotary aircraft. The IDAS is an Integrated Self-Protection System (ISPS) which is a further development of the firm's CIDAS-300 ISPS. The principle difference between the IDAS and the CIDAS-300 is that the former is equipped with a Radar Warning Receiver (RWR). Weight: 20kg

TERMA

AN/ALQ-213(V) DAC

Terma's AN/ALQ-213(V) electronic warfare management unit is used extensively on General Dynamics/Lockheed Martin F-16 Fighting Falcon series combat aircraft around the world. The AN/ALQ-213(V) is intended to act as a central controller for an array of aircraft self-protection systems, providing the interface between these and the aircraft's avionics. The equipment is free of restrictions under US International Traffic in Arms Regulations and thus can be exported to countries which may be unwilling or unable to secure US materiel. Alongside F-16 series aircraft, the AN/ALQ-213(V) can equip Lockheed Martin C-130 and TransportAllianz C-160 series tactical turboprop freighters, Boeing CH-47 Chinook series heavylift helicopters and Eurocopter/Airbus Helicopter AS-532 Cougar series medium-lift utility helicopters. Length: 0.17m Width: 0.15m Height: 0.1m Weight: 1.6kg

AN/ALQ-213(V) EWMS

The AN/ALQ-213(V) EW Management System (EWMS) is designed for combat and transport aircraft and helicopters. It replaces individual control and display units with a management unit, a new MFD and PCMCIA data loading/recording/unloading.

Electronic Combat Adaptive Processing (ECAP)

ECAP has an automatic threat response component that can be used to improve survivability against weapon system engagements. In addition, ECAP also has a passive capability to ensure the EWMS is optimally configured throughout all phases of the mission. Recorded and stored information is also used for Embedded Training (ET).

ET

The Terma Embedded Training (ET) capability is designed to enable flexibility in EWMS in-flight training both on how to operate the system and how the system and aircrew need to react to threat engagements. In addition it allows the EWMS to operate as if the MWS and ACMDS were installed even without the pods being on the aircraft.

The Compact Airborne Threat Surveyor (CATS) for helicopters provides electronic situational awareness and self-protection for a range of military platforms. (Image: Thales)

EW-MST

The Terma Electronic Warfare Mission Support Tool (EW-MST) is an application designed to run on Windows-equipped personal computers. The purpose of the EW-MST is to enable pre-flight mission data to be loaded onto the aircraft and enable post-flight analysis based on in-flight collected mission data.

THALES

Aircraft Self-Protection

Off-the-shelf solution for VIP and transport aircraft. It provides missile detection for all types of aircraft and additional radar warning on military aircraft. It can operate in all weathers, boosting crew situational awareness, and has been proven on operations. In production and supports major international programmes. The RWR offers wideband coverage for high POI. It covers the C-J-band range, automatically and instantaneously identifying radar threats. It includes features optimised for widebody aircraft.

CATS for Helicopters

The Compact Airborne Threat Surveyor (CATS) for helicopters provides electronic situational awareness and self-protection for a range of military platforms in a lightweight unit. It provides real-time detection of multiple simultaneous air defence threats through its RWR and can also be installed on fixed-wing aircraft and UAVs. Length: 0.19m Width: 0.16m Height: 0.32m Weight: 10kg Field of View - Azimuth: 360° Field of View - Elevation: 90°

EWS-16

The EWS-16 is an internally mounted SPS for F-16 aircraft including radar warning, jamming and locating subsystems. Designed to detect, identify and localise all modern threats without ambiguity in dense EM environments. Includes a 32-bit processor-based management unit, crystal video and high-speed wideband superhet receiver, an instantaneous wideband DF interferometer, IFM receiver, real-time spectral analysis processing, a plug-in mission report module and a jammer capable of countering multiple threats, integrated with the decoy dispenser.

ICMS

The Integrated Counter Measures Suite (ICMS) is internally mounted in the Mirage 2000. It incorporates three RWR, two detector jammers and a chaff/IR flare dispenser. Missile detector function can incorporate an IR warning receiver. All parts linked to a central interface and management unit. The Mk1, Mk2 and Mk3 are the variants currently available for the Dassault Mirage 2000-5 fighter.

SPS-H/TA/FA

This is a family of lightweight and modular self-protection systems (SPS) for helicopter (SPS-H), transport aircraft (SPS-TA) and fighter aircraft (SPS-FA) integrates TDS-family RWR, MWS-20 MAW, customers choice of chaff/flare dispenser, and optional LWR. SPS-H provides helicopters with a dedicated SPS.

TWE

Threat Warning Equipment (TWE) is a lightweight integrated SPS based on an RWR from Thales Airborne Systems linked to a laser warner, manufactured by Airbus Defence & Space. It provides interfaces to subsystems such as chaff/flare dispensers. Weight: 15kg

THALES/MBDA

SPECTRA

Thales' SPECTRA (Rafale Fire Control Radar Protection and Avoidance System) is the Integrated Self-Protection System (ISPS) used by the Dassault Rafale series of combat aircraft. The system has been produced in collaboration with MBDA.

JAMMERS

ALBRECHT TELECOMMUNICATIONS

SAJ-2000MD

The digital broadband jammer SAJ -2000MD serves as a means of disturbance, confusion and de ception of radio stations within an EW/ECM system. Individual frequencies or defined bands can be jammed. As a result, single targets , frequency-agile methods such as fast frequency hopping or spread spectrum transmissions are covered. In addition to the single-frequency jamming, multiple targets can be covered through simultaneously transmitting jamming signals of different frequencies (multi-threat capability).

BAE SYSTEMS

AN/ALQ-144

BAE Systems' AN/ALQ-144(V) is an infrared countermeasure designed to equip fixed-wing and rotary wing aircraft. The countermeasure is thought to be in service onboard the AgustaWestland/Leonardo AH-129C/D Mangusta attack helicopters flown by the Italian Army. In the past, the AN/ALQ-144(V) has been used onboard a wide array of USN, US Army and USMC rotorcraft. Length: 32cm Width: 34cm Height: 32cm Weight: 13.5kg Field of View - Azimuth: 360°

AN/ALQ-157

BAE Systems' AN/ALQ-157(V) is an Infrared (IR) countermeasure in widespread service onboard Northrop Grumman E-2C Hawkeye airborne early warning aircraft. The AN/ALQ-157(V) was originally produced by Lockheed Martin, but is now a BAE Systems product. Publicly available specifications states that the equipment provides 360 degrees of protection around an aircraft with one transmitter positioned on either side of the fuselage, although the location of the transmitters is dependent on the airframe's design. Weight: 99.8kg Field of View - Azimuth: 360°

AN/ALQ-178(V)

BAE System's AN/ALQ-178(V) is an integrated self-protection system designed to protect combat aircraft. During its service life it has outfitted several airframes including the Dassault Mirage-V, Lockheed Martin F-16 Fighting Falcon, Grumman F-14 Tomcat and McDonnell Douglas/Boeing F/A-18 Hornet series combat aircraft. Weight: 90.8kg

AN/ALQ-212 ATIRCM

BAE Systems' AN/ALQ-212(V) is a Directional Infrared Countermeasure (DIRCM) which uses laser energy to blind the seekers employed by infrared (IR) guided surface-to-air and air-to-air missiles. The AN/ALQ-212(V) incorporates one or more infrared jammers to counter multiple attacks. The system has a unit price of $1.3 million in 2019 values. The AN/ALQ-212(V) has formed the basis for the Jeteye DIRCM developed as a prototype by BAE Systems to equip civilian airliners.

BIRD AEROSYSTEMS

SPREOS

Bird Aerosystems' SPREO is a Directional Infrared Countermeasure (DIRCM) designed to protect rotary and fixed-wing aircraft against incoming infrared (IR) guided surface-to-air and air-to-air missiles. It was unveiled at Eurosatory in June 2016. Length: 25cm Height: 33cm Weight: 13kg Field of View - Azimuth: 360° Field of View - Elevation: 120°

CEIEC – CHINA NATIONAL ELECTRONICS IMPORT & EXPORT

GT-1E

China National Electronics Import and Export's (CEIEC) GT-1E is the standard countermeasures dispenser that the company says is used throughout the PLAAF and PLAN combat aircraft fleet.

CETC INTERNATIONAL

JN1101-U

An intelligent and compact UAV-borne system that provides rapid scanning, intercept, analysis, monitoring, direction-finding and jamming against hostile tactical radio transmissions such as ground-to-ground and ground-to-air VHF/UHF C2 communications. It is capable of flying deep into enemy territory and providing in-depth attack on enemy nodal points without interfering with friendly force communications, it is claimed. Range: 70km

CHEMRING COUNTERMEASURES

118 Mk 3 Type 1

The Chemring CM118 Mk.3 Type-1 is a spectral flare intended to defeat infrared-guided, surface-to-air and air-to-air missiles. The flare is designed to equip rotorcraft and large fixed-wing aircraft such as freighters or tankers. There appears to be no information in the public domain regarding the unit price of the flare, although we estimate that the cost is below $1,000 per countermeasure. The company's official literature says that the flare has a peak output power of 20 kilowatts-per-steradian-per-cubic metre and has a minimum burn time of three seconds. The flare is compatible with all standard countermeasure launchers in service with NATO and allied armed forces.

218 Mk 3 Type 1

The Chemring CM218 Mk.3 Type-1 is a spectral flare intended to defeat infrared guided surface-to-air and air-to-air missiles. The flare is designed to equip rotorcraft and large fixed-wing aircraft such as freighters or tankers, and fast jets. There appears to be no information in the public domain regarding the unit price of the flare, although we estimate that the cost is below $1,000 per countermeasure. The company's official literature says that the flare has a peak output power of 20 kilowatts-per-steradian-per-cubic metre and has a minimum burn time of 3.5 seconds. The flare is compatible with all standard countermeasure launchers in service with North Atlantic Treaty Organisation and allied armed forces.

Chaff Pack BOL Mk2 Type 1

Chemring developed the BOL Mk.2 Type-1 chaff pack to work with Saab's BOL countermeasures dispenser. The latter is deployed widely on fast jets through the North Atlantic Treaty Organisation and allied nations. There appears to be no information in the public domain regarding the unit price of the BOL Mk.2 Type-1 chaff pack, although we estimate this to have a cost below $10,000 per pack. No details have been released in Chemring's official literature regarding the frequencies covered by the chaff comprising the BOL Mk.2 Type-1. It would be reasonable to assume that this provides broadband coverage of at least two gigahertz to 18GHz.

DSTL 22

Chemring's DSTL-22 is a spectral flare intended to defeat Infrared (IR) guided surface-to-air and air-to-air missiles. The flare is designed to equip rotorcraft and large fixed-wing aircraft such as freighters or tankers. There appears to be no information in the public domain regarding the unit price of the flare, although we estimate that the cost is below $1,000 per countermeasure. The company's official literature also demurs from providing information on the IR output of the flare, its rise time or burn time. That said, the flare is compatible with all standard countermeasure launchers in service with North Atlantic Treaty Organisation and allied armed forces.

DSTL 73

Chemring's DSTL-73 is a spectral flare intended to defeat Infrared (IR) guided surface-to-air and air-to-air missiles. The flare is designed to equip rotorcraft and large fixed-wing aircraft such as freighters or tankers. There appears to be no information in the public domain regarding

the unit price of the flare, although we estimate that the cost is below $1,000 per countermeasure. The company's official literature also demurs from providing information on the IR output of the flare, its rise time or burn time. That said, the flare is compatible with all standard countermeasure launchers in service with North Atlantic Treaty Organisation and allied armed forces.

MEB Mk 3 Type 1

Chemring's MEB Mk.3 Type-1 is a chaff magazine which can equip standard NATO (North Atlantic Treaty Organisation) countermeasures dispensers. The company says in its official literature that the MEB Mk.3 Type-1 has harnessed miniaturisation to provide twice the number of chaff payloads that can be accommodated into a standard expendables magazine. This translates into longer protection against radar-based threats for aircraft using the magazine. The company says that the MEB Mk.3 Type-1 can equip fixed- and rotary-wing platforms. There is no information in the public domain regarding the unit cost of the MEB Mk.3 Type-1 but based on the average cost for comparable products the MEB Mk.3 Type-1 is thought to have a maximum unit cost of $10,000.

DEFENSE INITIATIVES

Talisman [Defense Initiatives]

The Talisman is an integrated self-protection system developed by Defense Initiatives of Belarus. It is designed to equip combat aircraft and is thought to be in service with several MiG-29 operators. The Talisman is a podded system which can equip the under-wing hardpoints of various platforms. The Talisman's architecture can also be installed inside the aircraft if preferred by the user. Weight: 65kg Field of View - Azimuth: 45° Field of View - Elevation: 30°

EKRAN RESEARCH INSTITUTE

President-S

Ekran's President-S is a Directional Infrared Countermeasures (DIRCM) designed to equip fixed-wing and rotary aircraft. The President-S is an export version of the firm's L-370 Vitebsk DIRCM. This latter system equips Mil Mi-28N series (NATO reporting name Havoc) attack helicopters in service with the Russian Air Force. To this end, it is likely that the President-S outfits the Mi-28N helicopters equipping the Algerian and Iraqi air forces. Prices for the President-S have not been revealed. By analysing average prices of comparable equipment, it is reasonable to estimate that the President-S has a unit cost of $1 million. Weight: 64kg

ELBIT SYSTEMS EW & SIGINT – ELISRA

Skyjam

SkyJam is a battle-proven, modular, flexible, standalone configuration of customisable, interoperable and interconnected airborne COMJAM payload components for UAVs. Weight: 35kg

SPJ-20

The SPJ-20 is a self-protection radar jammer for fixed-wing aircraft and helicopters. The system engages a number of ECM techniques: range and velocity gate pull-off, AM, false targets and noise. It utilises CW repeater, pulse repeater, two RF sources as ECM resources. Weight: 72kg

ELBIT SYSTEMS INTELLIGENCE AND ELECTRO-OPTICS – ELOP

MUSIC

Elbit Systems' MUSIC (Multi-Spectral Infrared Countermeasure) family of airborne DIRCM jammers is produced in three versions: MUSIC, J-MUSIC and C-MUSIC, the latter for large jet aircraft. The product line is designed to protect an aircraft against IR-guided missiles. C-MUSIC was selected by the government of Israel to protect the Israeli commercial fleet. MUSIC is designed to protect helicopters and fixed-wing aircraft. Length: 270cm Width: 60cm Height: 50cm Weight: 160kg

ELBIT SYSTEMS LAND

ATALD

Elbit's ATALD (Advanced Tactical Air Launched Decoy) is designed to support SEAD (Suppression of Enemy Air Defence) missions. Few details have been released regarding the systems' design or capabilities. Given that the decoy was conceived to support the SEAD mission it would be safe to assume that many of these parameters remain classified. The decoy is almost certainly in service with the Israeli Air Force (IAF) but there has been no official confirmation to this effect, nor have details emerged in the public domain regarding additional air forces around the world using the system.

ELETTRONICA

ELT/335

ELT/335 is a wideband communication jammer system designed for both airborne and ground installations to intercept (CESM) and disrupt (CECM) radio communications in the HF, VHF, UHF and SHF frequency bands. And deny the COMINT operations of the enemy without interfering with the friendly communications. The system is used for scanning the electromagnetic spectrum over the complete frequency range defined in the mission planning phase.

ELT/568

Elettronica's ELT/568 is an electronic countermeasures system designed to equip combat aircraft for self-protection and mutual protection. The system protects aircraft against Active Radar Homing (ARH) and Semi-Active Radar Homing (SARH) Air-to-Air and Surface-to-Air Missiles (AAMs/SAMs). In addition, the equipment can protect aircraft against ground-based air surveillance radars and fire control/ground-controlled interception radars.

ELT/577

ELT 577 is the latest generation of Directed InfraRed CounterMeasure System (DIRCM) that will be cued towards incoming missiles by a Missile Warning System. The ELT/577 DIRCM System will acquire and track the missile and will direct the laser beam towards the missile's seeker, disrupting its guidance system and

causing it to break lock and be diverted. The laser power is generated using Quantum Cascade Laser technology ELT 577 is a system used as a component of a Self-Protection Suite of airborne platforms to create jamming or deception effects against EO/IR guided missiles. When integrated into the Suite, ELT 577 generates the relevant jamming/deception techniques in a stand-alone mode or cooperating with passive decoys (flares) to enhance the effectiveness.

STINJAM

The product represents a gap filler in operations where Electronic Attack (EA) is an enabling and support capability. After Stand-Off and Escort mission roles, which imply the exposure of crewed platforms across the battlefield, the availability of uncrewed platforms with EA payloads open scenarios and possibilities never imagined before when used in a Stand-In mission. The product is a set of payloads, each covering a selected portion of the electromagnetic spectrum (UHF-VHF, C-D, X) and tuned in terms of power and countermeasures techniques against specific threats operating in those bands. Through the specific Mission Payload Command & Control Station, multiple payloads can operate in a coordinated way.

ELTA SYSTEMS

ELL-8251

The ELL-8251 Escort Jammer is intended for fighter aircraft used in the airborne electronic attack role. It is designed to suppress all types of enemy air defence, surveillance and fire control radars along the mission flight path. It can be configured for internal or podded installation. The system can be reprogrammed on the flight line, uploading threat data and jamming techniques with a PC-based interface.

ELTA SYSTEMS/L3HARRIS TECHNOLOGIES

ELL-8222/8212

The ELL-8222 is a jamming pod designed to enhance the survivability of large fighter aircraft. The system includes a receiver processor, exciter and transmitters, housed in a lightweight low-drag pod. Weight: 100kg

The BlackTALON Counter-Drone System provides detection, location, identification, tracking and RF inhibition of drones. (Photo: Enterprise Control Systems)

ENTERPRISE CONTROL SYSTEMS (ECS)

BlackTALON Counter-Drone System

The BlackTALON Counter-Drone System provides detection, location, identification, tracking and RF inhibition of drones. BlackTALON Model 982 incorporates Radar and RF sensors for drone detection, identification, location, and tracking; an electro-optical sensor for drone verification and video tracking; and a multi-channel RF inhibitor for drone defeat.

Claw Directional Inhibitor System

The Claw Inhibitor system provides directional inhibition capability over five independent RF bands (GNSS, 433 MHz, 915 MHz, 2.4 GHz and 5.8 GHz). Claw is designed to defeat and neutralise UAV threats.

INDRA SISTEMAS

ALQ-500

Indra Sistemas' ALQ-500 is a pod-mounted electronic attack system. The ALQ-500 covers frequencies of 500 megahertz to 18 gigahertz/GHz, although this can be extended up to 40GHz if desired by the customer. This frequency extension will allow the ALQ-500 to engage millimetric wave radar transmissions in frequencies of 30GHz and above. The company states that the jammer can cover up to eight disparate threats simultaneously. Although unit prices for the ALQ-500 have not been revealed, it is reasonable to assume that the ALQ-500 has a unit cost of $1 million based on the average unit prices for comparable systems.

ALQ-500P

The ALQ-500P is an ESM/ECM airborne pod produced by Indra in Spain and is based on the ALQ-500 onboard system. It is integrated with Indra's ALR-400 RWR. It can be installed under wing or belly and using stores interface MIL-STD-1760C. The system provides frequecy coverage from 2 to 18GHz against up to eight simultaneous threats. Length: 330cm Width: 48cm Height: 34cm Weight: 284kg Maximum Signals Tracked: 8

InShield

Indra's InShield Directional Infrared Countermeasure (DIRCM) system has been developed by the company to protect the Ejército del Aire (Spanish Air Force) Airbus A400M Atlas.

INDRA SISTEMAS/ROSOBORONEXPORT

Manta

Manta is a laser-based DIRCM system for airborne platforms. Designed to defeat first- and second-generation and imaging IR seekers, it is said to be effective against all types of IR missiles, offering high jamming success probability and performance against multiple missile attacks. It can classify a threat as 'IR/not IR missile' before activating countermeasures, and defeat incoming missiles from hundreds of metres.

KANFIT

RTM Chaff and Flare Magazines

Kanfit builds an array of chaff and flare magazines. According to the firm's official literature these magazines are remarkable as they are produced as a single, structure without seams or bonding which the company says reduces the risk of failure. The use of composite materials in the magazine's construction helps to reduce weight improving aircraft fuel consumption. Kanfit continues that the rugged nature of its design means that the magazines suffer less degradation caused by the launch of chaff and flare countermeasures during their service lives. The firm has declined to provide specific examples but does say that its magazines are in service onboard a wide array of civilian and military aircraft around the world.

KNIRTI

SAP-14

The Kaluzhsky Scientific Research Radio-Technical Institute (KNIRTI) SAP-14 is a pod-mounted electronic attack system designed to equip the ventral centreline hardpoint of Sukhoi Su-30/35 and Su-34 combat aircraft. The pod is thought to have been designed as an escort jammer to provide electronic protection to strike packages.

KRET

L-175V/VE Container/Khibiny

The L-175V/VE Container/Khibiny radar jammer equips the Russian Air Force's Sukhoi Su-34 (NATO reporting name Fullback) ground attack aircraft. The L-175V/VE has experienced a notably long gestation as work on its development commenced in 1977. In some ways the rationale behind the system which would eventually become the L-175V/VE was ahead of its time.

L-402 Himalaya

KRET's L-402 Himalayas integrated self-protection system has been developed by the company's KNIRTI subsidiary and equips the Sukhoi Su-57/T-50 (NATO reporting name Felon) fighter. Deliveries of the L-402 commenced in 2014. This technology will likely form the basis of the electronic warfare systems equipping new Russian Air Force (RUAF) platforms and may be installed on the Tupolev PAK-DA strategic bomber currently under development.

Rychag-AVM

KRET's Rychag-AVM radio frequency jammer is designed to perform electronic attack against hostile communications and radar systems. The Rychag-AVM ensemble is mounted onboard dedicated Mil Mi-8MTPR1 medium-lift utility helicopter. Range: 239km

L3HARRIS TECHNOLOGIES

AN/ALQ-99

The AN/ALQ-99 is an integrated, computer-controlled support jamming system, carried as the main payload on the EA-6B Prowler. and EF-11A (AN/ALQ-99E) aircraft with both types now retired but an upgraded version equips the EA-18G Growler. The system first entered service towards the end of the Vietnam War and has been used in most major US actions since, including both Gulf Wars (1991 and 2003), overwatch operations following the wars and operations during the Balkan Wars.

AN/ALQ-136

L3 Harris' AN/ALQ-136(V) is an electronic attack system capable of jamming radars across an 8GHz to 16GHz waveband. During its service life, the AN/ALQ-136(V) has been installed onboard a wide array of fixed-wing and rotary aircraft. Weight: 236.3kg

AN/ALQ-165 ASPJ

Northrop Grumman's AN/ALQ-165(V) Airborne Self Protection Jammer (ASPJ) is a widely used radar jammer and is deployed on an array of combat aircraft. The system is designed to provide protection against RF threats, typically radar-guided surface-to-air and air-to-air missiles. When the AN/ALQ-165(V) detects a threat this will be located and identified, with the system capable of prioritising multiple threats and performing simultaneous jamming. Weight: 111.7kg

AN/ALQ-167(V)

The AN/ALQ-167(V) is an ECM threat simulation pod. It utilises the ULQ-21 countermeasures set. There are a number of variants, each using different combinations of the ULQ-21 modules. These variants cover a frequency range of 425MHz-18GHz and generate noise, deception/repeater and combination ECM modes. It can provide manual or automatic podded noise as a deception jamming system and also used for training. Length: 367cm Width: 26cm Height: 26cm Weight: 175kg

AN/ALQ-172(V)

L3Harris' AN/ALQ-172(V) Radar Warning Receiver (RWR) equips the US Air Force's Boeing B-52H Stratofortress strategic bombers and C-130 large transport aircraft. The system is optimised to counter radar-guided air-to-air and surface-to-air missiles, and ground-based fire control radars. Weight: 286.5kg

AN/ALQ-214 IDECM RFCM

The ALQ-214 Integrated Defensive Electronic Countermeasures RF Countermeasures (IDECM RFCM) subsystem comprises an onboard technique generator developed by Harris integrated with an offboard fibre-optic towed decoy. The ALQ-214 supports autonomous operation in hostile environments. Weight: 129kg

WIPPS

L3Harris' Widebody Integrated Platform Protection System (WIPPS) is designed to equip widebody aircraft and is primarily aimed at civilian customers seeking a self-protection system to safeguard such planes against attack by IR guided MANPADS. The primary market for such protection systems are those platforms carrying dignitaries, or performing passenger or freight flights into and out of areas where MANPADS proliferation is a problem.

L3HARRIS TECHNOLOGIES/NORTHROP GRUMMAN

Next Generation Jammer - Low-Band

The Next Generation Jammer-Low Band (NGJ-LB), also known as NGJ-LB Increment-2, is the latest effort in the

US Navy's prevailing NGJ initiative. The project is working to develop a jammer which will engage radar threats transmitting across a 500MHz to 2GHz waveband.

LEONARDO DRS

AN/AAQ-45

Leonardo's AN/AAQ-45 Distributed Aperture Infrared Countermeasures is designed to equip rotorcraft. The system is being installed on Sikorsky HH-60G Pave Hawk medium-lift utility helicopters used by the US Air Force for search and rescue operations. In June 2020 Leonardo received a $120 million follow-on contract to provide systems for US services' HH-60G helicopters after a December 2018, $35 million development contract for installation on 35 helicopters.

SI-8649A/PF PicoFlexor Transceiver

The PicoFlexor Transceiver is a miniature tactical software-defined radio (SDR) platform that integrates a transmitter with a high-performance SIGINT superheterodyne receiver in a single, low-SWaP package. The unit's SIGINT receiver supports a frequency coverage of 2MHz to 3GHz with an instantaneous 25MHz bandwidth and can be used for jamming. The system was unveiled in August 2012 and is believed to be for ground and air applications. Length: 14.2cm Width: 7.62cm Height: 4.5cm Weight: 0.84kg

LEONARDO ELECTRONICS

Ariel

Leonardo's Ariel family of towed RF decoys entered service with the RAF in 1990. The decoy uses a fibre optic connection to link Ariel's transmitting element to the aircraft's self-protection systems. The targets of Ariel are radar-guided threats notably air-to-air and surface-to-air missiles using active and semi-active radar homing. The decoy can transmit a range of discrete jamming waveforms to defeat contemporary electronic counter-countermeasures techniques.

BriteCloud

BriteCloud is an expendable active RF decoy designed to be deployed from a combat aircraft's existing countermeasures (chaff and flare) dispensers. To this end, Leonardo produces two distinct versions; the BriteCloud-55, which equips spherical magazines, and Britecloud-218, which equips oblong magazines. BrightCloud can defeat the majority of modern and legacy Surface-to-Air and Air-to-Air threat systems. Formally launched in November 2015, BrightCloud initially equipped the RAF's Panavia Tornado combat aircraft fleet and has now migrated to the RAF's Eurofighter Typhoon-F/GR4A combat aircraft.

Miysis DIRCM

Leonardo's Miysis Directed Infrared Countermeasure (DIRCM) system provides high power, all aspect protection against modern and legacy Infrared Man-Portable Air Defence Systems (IR MANPADS) for all aircraft types. The system is small enough to be fitted to a lightweight helicopter and has the Energy-on-Target to protect a wide-bodied transport aircraft. Miysis can be used as a stand-alone DIRCM or integrated with an aircraft's other self-protection systems. The baseline twin-head system provides SWaP, all-aspect coverage and exceptional response speed. It is compatible with any DIRCM capable UV or IR Missile Approach Warner (MAWs) and is readily exportable. Length: 27cm Width: 18cm Height: 34cm Weight: 16kg

LIG NEX1

ALQ-200

LIG Nex1's ALQ-200 is a pod-mounted electronic attack system. Like other comparable products, it is designed to be used as an escort jammer to protect packages of aircraft against hostile ground-based air surveillance and fire control/ground-controlled interception radars. Although not revealed, the ALQ-200 maybe capable of performing stand-off and stand-in jamming according to mission requirements. The ALQ-200 covers frequencies of two gigahertz/GHz to 18GHz. Unit costs for the ALQ-200 have not been revealed, but by examining unit prices for comparable systems it is reasonable to assume that the ALQ-200 has a unit price of circa $1 million.

MBDA

Elips

MBDA's ELIPS countermeasures dispenser is designed to outfit a wide array of aircraft, from medium-lift utility helicopters to tactical turboprop freighters and combat aircraft. The system can launch all standard chaff and flare countermeasures. The standard ELIPS design has been developed into the ELIPS-NG. The system remains one of the most widespread chaff and flare dispensing systems in service around the world.

Saphir 400

MBDA's SAPHIR-400 is a countermeasures dispenser designed to equip the Airbus A400M Atlas turboprop strategic freighter and is integrated directly with the A400M's Integrated Self-Protection System.

MITSUBISHI ELECTRIC

J/ALQ-8

Like Israel, Japan elected to outfit its McDonnell Douglas/Boeing F-15J/DJ combat aircraft with an indigenous self-protection system. This takes the form of Mitsubishi Electric's J/ALQ-8 electronic countermeasures ensemble. This replaced the Tactical Electronic Warfare System (TEWS) which outfits the F-15 series combat aircraft flown by the US Air Force, the Republic of Singapore Air Force and the Royal Saudi Air Force.

NORTHROP GRUMMAN

AN/AAQ-24(V)

Northrop Grumman's AN/AAQ-24(V) is a Directional Infrared Countermeasure (DIRCM) designed to protect large aircraft. The system has been used to protect both military aircraft and civilian aircraft, notably those carrying dignitaries, since its introduction. The AN/AAQ-24(V) is specifically designed to counter infrared-guided surface-to-air and air-to-air missiles using a laser which is directed into the seeker to break its target lock on the aircraft.

AN/ALQ-131(V)

Northrop Grumman's AN/ALQ-131(V) is an electronic countermeasures pod which externally outfits an aircraft. The pod is believed to be in widespread service globally. In its baseline form the AN/ALQ-131(V) covers a waveband of two gigahertz/GHz to 20GHz and can transmit up to 48 simultaneous jamming waveforms. Weight: 299.2kg Maximum Signals Tracked: 48

AN/ALQ-135

Northrop Grumman's AN/ALQ-135 is the jamming system equipping the McDonnell Douglas/Boeing F-15 Eagle and Strike Eagle series of combat aircraft. The AN/ALQ-135 has equipped these aircraft since they entered service in the mid-1970s and mid-1980s respectively. The countermeasure is specifically designed to jam ground-based air surveillance and fire control radars, and airborne radars. Weight: 138kg

CIRCM

The Common Infrared Countermeasure (CIRCM) system is an infrared (IR) countermeasure designed to defeat IR-guided Surface-to-Air Missiles (SAMs). It is intended to yield cost savings by providing a common countermeasure which can be used across a wide array of aircraft, helping to reduce not only procurement, but also life-cycle costs. The first CIRCM system was delivered to the US Army for testing in 2016. Weight: 54.43kg

Guardian

Northrop Grumman's Guardian Directional Infrared Countermeasure (DIRCM) is intended to product airliners and large aircraft against IR-guided missiles, principally surface-to-air missiles fired from Man-Portable Air Defence Systems (MANPADS). The company used technology from its AN/AAQ-24 DIRCM in the Guardian's architecture. Length: 230cm Width: 81cm Height: 23cm Weight: 225kg

Viper 2.1

The Viper 2.1 is the latest development in the Viper family of IR lasers for IR countermeasure applications. It was introduced to market by Northrop Grumman in November 2014. The system features a form factor and interface for use on all directed IR countermeasure (DIRCM) systems. Length: 33cm Width: 33cm Height: 5cm Weight: 5kg

RADONIX

Omut

Radionix' Omut product series encompasses a range of airborne radar jamming pods intended to enhance the protection of combat aircraft. The Omut-K variant is believed to have entered service with the Ukraine Air Force in 2012. Weight: 71kg

RAFAEL ADVANCED DEFENSE SYSTEMS

Jam-Air

Jam-Air is designed to provide high-energy optical protection to a variety of combat helicopters and fixed-wing aircraft. A dual axis remotely operated gimbal equipped with a powerful lamp delivers the required energy. The jamming system is installed on the platform in specially designated locations for best performance. Weight: 25kg Range: 5km

Jam-Air is designed to provide high-energy optical protection to a variety of combat helicopters and fixed-wing aircraft. (Photo: Rafael Advanced Defense Systems)

Lite Shield

Rafael's Lite Shield RF jamming pod can equip combat aircraft such as the F-16C/D , along with other aircraft due to its ability to use MIL-STD-1553 and MIL-STD-1760 databuses. The Lite Shield covers 360° in azimuth and RF threats in the 2-18GHz section of the EM spectrum. Length: 200cm Width: 40cm Height: 40cm Weight: 200kg Field of View - Azimuth: 360°

Sky Shield

The Sky Shield RF pod jammer can perform simultaneous jamming against multiple, diverse threats and can equip both small and large platforms. Simultaneous jamming is achieved using a multi-beam array transmitter (MBAT) allowing the product to cover a wide range of frequencies, while fast switching enables the Sky Shield to move between threats and jam them using tailored techniques. Weight: 350kg

X-Guard

Rafael Advanced Defence Systems' unveiled its X-Guard fibre optic towed decoy back in 2003. Open-source information noted that the decoy was designed to equip combat aircraft with an electronic protection system to safeguard them against Active Radar Homing/Semi-Active Radar Homing (ARH/SARH) Surface-to-Air and Air-to-Air Missiles (SAMs/AAMs). Length: 65cm Width: 8cm Height: 8cm Weight: 67kg Field of View - Azimuth: 360° Field of View - Elevation: 360°

RAYTHEON

ADM-160B/C MALD

Teledyne Ryan (now Raytheon) was the original manufacturer of the ADM-160A Miniature Air-Launched Decoy (MALD), the acquisition of which was cancelled by the US Air Force in 2002 amidst dissatisfaction with its range and endurance. This led to the programme's restart that same year with Raytheon at the helm to develop the ADM-160B which is now in service. Length: 280cm Width: 170cm Weight: 115kg Range: 920km

AN/ALE-50

Raytheon's AN/ALE-50 fibre-optic towed decoy is designed to protect combat aircraft from Air-to-Air and Surface-to-Air Missile (AAMs/SAMs) using Active and Semi-Active Radar Homing (ARH/SARH). The AN/ALE-50 is in widespread use with across the US armed forces, and with other forces around the world with more than 25,000 units produced.

AN/ALQ-184

Raytheon's AN/ALQ-184 jamming pod equips several airframes, but is primarily used on fighters and ground attack aircraft. It is a modified version of Raytheon's AN/ALQ-119(V) system with the addition of digital hardware to replace the former's analogue architecture, and the use of an electrically scanned antenna to replace the AN/ALQ-118(V)'s fixed antenna. Weight: 289kg

NGJ

Raytheon's Next Generation Jammer (NGJ) was selected by the USN in 2013 to replace the legacy ALQ-99 systems used on the EA-18G electronic attack aircraft. It is planned for for service on USN and Royal Australian Air Force aircraft and Australia is contributing $250 million towards the programme.

SAAB

Arexis

Arexis is an ECM, ISR and radar warning receiver (RWR) concept developed by Saab to support fighter aircraft requirements. It provides situational awareness for self-protection through its RWR, and tactical support via its ISR capabilities. Arexis also includes an advanced electronic attack application. A version of Arexis will be installed onboard the new version of the Gripen E/F and the first flight was in November 2019.

SCRIEE – SOUTHWEST CHINA RESEARCH INSTITUTE OF ELECTRONIC EQUIPMENT

BM/KG 8601/8605/8606

The BM/KG 8601/8605/8606 is a family of self-protection jammers using noise and repeater techniques. A variant is installed on JF-17 multirole fighter aircraft.

SIERRA NEVADA CORPORATION/ NORTHROP GRUMMAN

AC/MC-130J RFCM

Sierra Nevada's AC/MC-130J RFCM (Radio Frequency Countermeasure) is an electronic attack system which furnishes the US Air Force's (USAF) Lockheed Martin AC-130J Ghostrider fixed-wing gunships and MC-130J Commando-II tankers; both of which are deployed with the USAF's Air Force Special Operations Command. The RFCM is designed to detect, identify and locate radar threats to the aircraft. The RFCM is thought to be capable of detecting such threats across a waveband of at least two gigahertz/GHz to 18GHz.

SPETSTECHNOEXPORT

ADROS KT-01AVE

The ADROS KT-01AVE is an integrated self-protection system designed to safeguard rotorcraft. The apparatus is specifically configured to protect helicopters against Infrared (IR) guided Surface-to-Air and Air-to-Air Missiles (SAMs/AAMs). The equipment is produced by Ukraine's Spets Techno Export. Field of View - Azimuth: 360° Range: 5km

TAGANROG RESEARCH INSTITUTE

L-203 Gardeniya

Taganrog's L-203 Gardeniya jammer is a self-protection system designed to outfit combat aircraft. The L-203 in fact comprises a family of jammers designed to be fitted both internally, and to be carried externally, on fighters. Today, the L-203 is thought to have little utility against contemporary radars which boast sophisticated electronic counter-countermeasures techniques, nonetheless, the L-203 is thought to remain in widespread service around the world, particularly on MiG-29 and Su-27 combat aircraft exported by Russia. Weight: 73kg Field of View - Azimuth: 6,875.49° Field of View - Elevation: 3,437.75°

THALES

Airborne Electronic Attack

Thales provides high-powered stand-off and escort jamming using AESA technology. It is designed to increase electronic support and electronic attack capability through jamming functions, according to Thales. The system can equip fighter aircraft, UAVs, UCAVs and special mission aircraft with network-centric warfare capabilities. Field of View - Azimuth: 360°

FLASH

The FLASH (Flying Laser Self-Defence System Against Seeker Head Missiles) is a DIRCM system for protecting helicopters and fixed-wing aircraft against missiles with IR seekers. The dual-laser system provides protection against commonly deployed IR-seeking missiles, as well as current and future jam-resistant weapons. FLASH offers multi-threat capability and missile target extraction.

PAJ-FA

Thales PAJ-FA (Podded Airborne Jammer for Fighter Aircraft) is an electronic attack system designed to equip fast jets. The PAJ-FA has been developed from Thomson-CSF/Thales' Barem podded jamming system. The Barem pod used the Thomson-CSF/Thales Sherloc radar warning receiver at its core. The PAJ-FA is intended to provide aircraft with the means to perform electronic attack against hostile radars to protect strike packages of aircraft. The PAJ-FA can engage radar threats across frequencies of five gigahertz/GHz to 15GHz. No details of the unit price of the PAJ-FA been made public, although by examining the average costs of comparable systems it would be reasonable to assume that the PAJ-FA has a unit price of circa $1 million. Length: 442cm Width: 16cm Height: 16cm Weight: 85kg

THALES/MBDA

SPECTRA

Thales' SPECTRA (Rafale Fire Control Radar Protection and Avoidance System) is the Integrated Self-Protection System (ISPS) used by the Dassault Rafale series of combat aircraft. The system has been produced in collaboration with MBDA.

LASER WARNING RECEIVERS

BAE SYSTEMS INC/LEONARDO DRS

LIMWS

BAE Systems is leading the US Army's Limited Interim Missile Warning System (LIMWS) initiative. This is intended to enhance the missile protection provided to US Army rotorcraft vis-à-vis the current Common Missile Warning System (CMWS).

ELBIT SYSTEMS EW & SIGINT – ELISRA

LWS-20V-3

The LWS-20V-3 is a laser warning system for helicopters, transport and attack aircraft. The system is capable of detecting laser beam riders, laser rangefinders and laser target designators. Its high sensitivity (for its laser beam rider) and high probability of intercept provide the system with a long detection range and fast response time in dense arena scenarios. The system also supports onboard laser source blanking. Weight: 6.5kg

ELETTRONICA

ELT/577

ELT 577 is the latest generation of Directed InfraRed CounterMeasure System (DIRCM) that will be cued towards incoming missiles by a Missile Warning System. The ELT/577 DIRCM System will acquire and track the missile and will direct the laser beam towards the missile's seeker, disrupting its guidance system and causing it to break lock and be diverted. The laser power is generated using Quantum Cascade Laser technology ELT 577 is a system used as a component of a Self-Protection Suite of airborne platforms to create jamming or deception effects against EO/IR guided missiles. When integrated into the Suite, ELT 577 generates the relevant jamming/deception techniques in a stand-alone mode or cooperating with passive decoys (flares) to enhance the effectiveness.

HENSOLDT SENSORS

ALTAS-2QB

Hensoldt's ALTAS-2QB is an airborne laser warning system is designed for fixed-wing platforms and rotorcraft. The system can detect and track up to four disparate laser threats simultaneously. The ALTAS-2QB can be deployed as a standalone system onboard an aircraft or can be integrated with the aircraft's self-protection systems. Length: 13.8cm Width: 23.4cm Height: 18.9cm Weight: 3.5kg Field of View - Azimuth: 182° Field of View - Elevation: 90° Maximum Signals Tracked: 4

KRET

L-402 Himalaya

KRET's L-402 Himalayas integrated self-protection system has been developed by the company's KNIRTI subsidiary and equips the Sukhoi Su-57/T-50 (NATO reporting name Felon) fighter. Deliveries of the L-402 commenced in 2014. This technology will likely form the basis of the electronic warfare systems equipping new Russian Air Force (RUAF) platforms and may be installed on the Tupolev PAK-DA strategic bomber currently under development.

LEONARDO ELECTRONICS

MAIR

MAIR is a passive missile warning system operating in the IR spectrum, capable to detect the IR radiation emitted from objects and background over a wide Field of Regard, such that it provides for the engagement of multiple targets and the imaging of the observed scenario. It provides also A/C with the following ancillary capabilities: HFI Hostile Fire Indication, Full spherical vision, Day and night increased situational awareness (picture on Helmet Mounted Display) Full sky surveillance (IRST functions) and Anti-collision (detection of near objects).

NORTHROP GRUMMAN INNOVATION SYSTEMS

AN/AAR-47A(V)2

The AN/AAR-47A(V)2 Missile and Laser Warning System (MWS) is an EW aircraft survivability system designed to protect low- and slow-flying fixed- and rotary-wing aircraft against surface-to-surface/air missiles and laser-guided or aided threats. Upon detection of the threat, the MWS will automatically initiate countermeasures and provide an audio and visual warning to the pilot. Weight: 13.6kg

AN/AAR-47B(V)2

The AN/AAR-47B Missile Warning System (MWS) is an EW system designed to protect low/slow-flying aircraft against surface-to-air and air-to-air missiles. The MWS will detect a missile fired at the aircraft or a laser pointed at the aircraft.

NORTHROP GRUMMAN INNOVATION SYSTEMS/BAE SYSTEMS INC

AN/AAR-59 JATAS

Orbital ATK (now Northrop Grumman) developed the AN/AAR-59 Joint and Allied Threat Awareness System (JATAS) to provide protection for aircraft against incoming threats typically surface-to-air and air-to-air missiles, and small arms/light weapons fire. The AN/AAR-59 can also detect laser illuminators and laser-guided ordnance. Weight: 16kg

SAAB

IDAS/CIDAS

Saab's IDAS (Integrated Defensive Aids Suite) is designed to equip fixed-wing and rotary aircraft.

The IDAS is an Integrated Self-Protection System (ISPS) which is a further development of the firm's CIDAS-300 ISPS. The principle difference between the IDAS and the CIDAS-300 is that the former is equipped with a Radar Warning Receiver (RWR). Weight: 20kg

THALES/MBDA

SPECTRA

Thales' SPECTRA (Rafale Fire Control Radar Protection and Avoidance System) is the Integrated Self-Protection System (ISPS) used by the Dassault Rafale series of combat aircraft. The system has been produced in collaboration with MBDA.

UTC AEROSPACE SYSTEMS - ISR SYSTEMS USA

AN/AVR-2B(V)

UTC-ISR Systems' laser warning systems detect, prioritise in order of lethality and characterise laser rangefinders, laser designators and laser beam-riding missile threats. They are designed for use in military helicopters, tanks and light armoured vehicles. The AN/AVR-2B(V) Laser Detecting Set provides audible and visual warnings, all-weather operation and threats detected over 360° coverage. Length: 20.7cm Width: 17.8cm Height: 14.7cm Weight: 1.8kg Field of View - Azimuth: 360° Field of View - Elevation: 45°

MISSILE LAUNCH DETECTORS AND APPROACH WARNERS

BAE SYSTEMS INC/LEONARDO DRS

LIMWS

BAE Systems is leading the US Army's Limited Interim Missile Warning System (LIMWS) initiative. This is intended to enhance the missile protection provided to US Army rotorcraft vis-à-vis the current Common Missile Warning System (CMWS).

BIRD AEROSYSTEMS

MACS

Bird Aerosystems' Missile Approach Confirmation Sensor (MACS) forms part of the company's Airborne Missile Protection Systems product line. The MACS is a radar-based sensor transmitting in Ka-band (33.4GHz to 36GHz) which will detect and track incoming air-to-air and surface-to-air missiles. Length: 30cm Width: 30cm Height: 35cm Weight: 8.5kg Field of View - Azimuth: 360° Field of View - Elevation: 125°

ELBIT SYSTEMS EW & SIGINT – ELISRA

PAWS

Designed to protect both fixed-wing and rotary aircraft against Surface-to-Air Missile (SAMs) attack Elbit's PAWS series equips a wide array of platforms both in Israel and further afield. The company heavily promotes the combat proven nature of the PAWS design given its substantial service with the Israeli armed forces. Alongside equipping military platforms the Elbit's official literature stresses that it has been used to equip civilian aircraft, in particular those transporting VIPs (Very Important Persons). As well as performing the detection of incoming SAMs the PAWS can be connected to an aircraft's self protection systems to initiate physical countermeasures or electronic attack via a DIRCM (Directional Infrared Countermeasure). The PAWS will also alert the aircrew with audible and visual warnings regarding incoming missiles. Length: 14.5cm Width: 14.5cm Height: 26cm Weight: 20kg

PAWS-2

The Passive Airborne Warning System 2 (PAWS-2) is an IR missile approach warning system that uses image and signal processing to detect and track a missile's hot plume as it appears against the landscape surrounding the aircraft. By evaluating the missile's trajectory, PAWS-2 is able to discriminate between threatening and non-threatening missiles. When the system detects a threatening missile, it alerts the aircrew with a warning signal and activates countermeasures. Length: 10cm Width: 10cm Height: 13cm Weight: 20kg

ELTA SYSTEMS

ELM-2160(V1)

The ELM-2160(V1) is a radar-based airborne MAWS that warns on an incoming missile attack, allowing timely activation of countermeasures to increase the platform's survivability. It is a field-proven system installed onboard military airlift, VIP aircraft, helicopters, special mission and commercial aircraft. In civilian service, it is referred to as Flight Guard. Length: 38cm Width: 30cm Height: 24cm Weight: 21kg

Designed to protect both fixed-wing and rotary aircraft against Surface-to-Air Missile (SAMs) attack Elbit's PAWS series equips a wide array of platforms both in Israel and further afield. (Image: Elbit Systems EW & SIGINT – Elisra)

HENSOLDT SENSORS

AN/AAR-60 MILDS

Hensoldt's AN/AAR-60 is a Missile Approach Warning System (MAWS) using ultraviolet optronics to detect and track the hot exhaust plume of incoming surface-to-air and air-to-air missiles. The sensor can determine the point of origin and the angle of attack of an incoming missile and automatically prioritise multiple threats. Length: 12cm Width: 12cm Height: 12cm Weight: 2kg Field of View - Azimuth: 360° Field of View - Elevation: 45° Maximum Signals Tracked: 48

AN/AAR-60(V)2 MILDS-F

Developed in cooperation with Airbus, the AN/AAR-60(V)2 is a Missile Launch Detection System for Fighter (MILDS-F). It is the latest version of the AN/AAR-60 and has been designed and optimised for use on fighter aircraft. It is described as a passive, UV solar blind, true-imaging sensor capable of detecting the radiation of a threatening missile exhaust plume in order to provide warning to aircrew and automatic countermeasure release. Length: 12cm Width: 12cm Height: 12cm Weight: 15kg Field of View - Azimuth: 360° Field of View - Elevation: 360°

KRET

L-402 Himalaya

KRET's L-402 Himalayas integrated self-protection system has been developed by the company's KNIRTI subsidiary and equips the Sukhoi Su-57/T-50 (NATO reporting name Felon) fighter. Deliveries of the L-402 commenced in 2014. This technology will likely form the basis of the electronic warfare systems equipping new Russian Air Force (RUAF) platforms and may be installed on the Tupolev PAK-DA strategic bomber currently under development.

L3HARRIS TECHNOLOGIES

TWF Radar

The Tail Warning Function (TWF) radar is a pulse-Doppler system designed to detect incoming missiles in the tail sector of aircraft and initiate countermeasures to protect the host platform. It is installed on a number of aircraft including the B-1B.

MBDA

DDM-NG

MBDA's DDM-NG is a Missile Approach Warning System (MAWS) which equips Thales' Spectra integrated self-protection system used by the Dassault Rafale-F3B/C/M combat aircraft. Official documentation published by MBDA says that the DDM-NG uses infrared to detect the hot exhaust plumes of incoming air-to-air and surface-to-air missiles with the ability to also detect incoming small arms fire. Field of View - Azimuth: 360° Field of View - Elevation: 360°

MS INSTRUMENTS

Hostile Fire Indicator Type 740

MS Instruments' Type-740 Hostile Fire Indicator is designed for rotary-wing aircraft to provide the crew with warnings of incoming small arms fire. The equipment provides an indication of the point of origin so that this can be avoided or engaged kinetically. Length: 9.4cm Width: 4.1cm Height: 22.8cm Weight: 3.95kg

NORTHROP GRUMMAN INNOVATION SYSTEMS

AN/AAR-47A(V)2

The AN/AAR-47A(V)2 Missile and Laser Warning System (MWS) is an EW aircraft survivability system designed to protect low- and slow-flying fixed- and rotary-wing aircraft against surface-to-surface/air missiles and laser-guided or aided threats. Upon detection of the threat, the MWS will automatically initiate countermeasures and provide an audio and visual warning to the pilot. Weight: 13.6kg

AN/AAR-47B(V)2

The AN/AAR-47B Missile Warning System (MWS) is an EW system designed to protect low/slow-flying aircraft against surface-to-air and air-to-air missiles. The MWS will detect a missile fired at the aircraft or a laser pointed at the aircraft.

ShotFinder Acoustic Hostile Fire Detection

Northrop Grumman's ShotFinder is a hostile fire detection system designed to protect aircraft against small arms and light weapons fire. The apparatus employs acoustic technology to detect incoming fire and to compute its location. Northrop Grumman claims that ShotFinder can detect fire at ranges of between 50 metres (164 feet/ft) up to three kilometres (1.9 miles). It continues that the system can detect fire from small to large calibre weapons from 5.45mm to 40mm including tracer and anti-aircraft artillery. Length: 33cm Height: 2.54cm Weight: 3.6kg

NORTHROP GRUMMAN

AN/AAQ-37 DAS

Although not electronic warfare apparatus in the purest sense, Northrop Grumman/Raytheon's AN/AAQ-37 optronic distributed aperture system is still tactically relevant to this mission. The AN/AAQ-37 forms part of the Lockheed Martin F-35A/B/C Lightning-II's self-protection system. While intended to provide overarching optronic enhancement to the aircraft and pilot, one of the functions the system performs is the detection and tracking of surface-to-air and air-to-air missiles. The AN/AAQ-37 provides 360 degrees surveillance around the aircraft, provides information regarding a missile's launch point and can be used to trigger aircraft countermeasures. Field of View - Azimuth: 20,626.48° Detection range: 800km

AN/AAR-54(V)

Northrop Grumman's AN/AAR-54(V) is a Missile Approach Warning System (MAWS) designed for fixed- and rotary-wing aircraft. The MAWS employs ultraviolet sensing to detect the hot exhaust plume of an incoming missile. The AN/AAR-54(V) can be installed as a standalone system or connected to an aircraft's existing self-protection systems to provide automatic cueing for countermeasures. The MAWS can detect and track multiple incoming missiles,

classify these missiles and compute the missile's point of origin. While no information appears to have been published regarding the AN/AAR-54(V)'s unit cost, based on the average unit prices for comparable systems, we estimate that the AN/AAR-54(V) has a unit cost of circa $794,000.

SAAB

IDAS/CIDAS

Saab's IDAS (Integrated Defensive Aids Suite) is designed to equip fixed-wing and rotary aircraft. The IDAS is an Integrated Self-Protection System (ISPS) which is a further development of the firm's CIDAS-300 ISPS. The principle difference between the IDAS and the CIDAS-300 is that the former is equipped with a Radar Warning Receiver (RWR). Weight: 20kg

MAW-300

Saab's MAW-300 is a Missile Approach Warning System (MAWS) that uses ultraviolet technology to detect the hot exhaust plume of an incoming missile. The product was developed from Saab's preceding MAW-200 missile approach warning system. Additions to the MAW-300 include improved software and a wider instantaneous FOV providing more directions in which the MAWS can detect incoming threats.

THALES UK

Elix-IR

Thales' Elix-IR is a Missile Approach Warning System (MAWS). It uses infrared sensors to detect the hot exhaust plumes of incoming air-to-air and surface-to-air missiles. The system is designed to equip rotary- and fixed-wing platforms. Alongside missile threats Elix-IR can detect small arms fire which might endanger the aircraft. Thales has used an open architecture, modular approach to realise the Elix-IR. Weight: 11kg Field of View - Azimuth: 360°

THALES

MWS-20

Thales' MWS-20 is a Missile Approach Warning System (MAWS) designed to equip fixed- and rotary-wing aircraft. The system takes a different approach from other MAWS in service as it uses radar to detect and track an incoming threat, as opposed to detecting the exhaust plume of incoming surface-to-air missiles using infrared or ultraviolet detection. There is no information in the public domain regarding the unit cost of the MWS-20. Weight: 20kg Field of View - Azimuth: 360°

THALES/HENSOLDT OPTRONICS GMBH

MIRAS

Thales' MIRAS (Multi-Colour Infrared Alerting Sensor) is a missile approach warning system equipping the Airbus A-400M Atlas strategic turboprop freighter. MIRAS is believed to be used onboard all customer A-400Ms. Open sources note that Thales has developed the optronics components for MIRAS while EADS/Hensoldt developed the detector element. Length: 23cm Width: 36cm Height: 36cm Weight: 10kg

UNITED STATES DEPARTMENT OF DEFENSE

Advanced Threat Detection System

The US Army's Advanced Threat Detection System (ATDS) is an overarching initiative that enhances the self-protection of the force's rotorcraft. It is intended to provide these aircraft with an array of new self-protection systems, principally a laser and missile warning system and hostile fire indicator.

RADAR WARNING RECEIVERS

BAE SYSTEMS

AN/ALQ-221

BAE Systems' AN/ALQ-221 is a self-protection system equipping the United States Air Force's Lockheed Martin U-2S Dragon Lady reconnaissance aircraft. The company announced that it had commenced the installation of the AN/ALQ-221 on the U-2S in October 2005. Open sources state that the AN/ALQ-221 includes a Radar Warning Receiver (RWR) and an electronic countermeasures system. It is thought that the installation of the AN/ALQ-211 has now been completed across the USAF's 26-strong fleet of aircraft. No details have been released regarding the unit cost of the AN/ALQ-211. Nonetheless, based upon the average prices of comparable systems the AN/ALQ-211 may have a unit cost of $5.8 million.

AN/ALR-56C

BAE Systems' AN/ALR-56C is a radar warning receiver. The AN/ALR-56C shares its data regarding radar threats with the aircraft's BAE Systems' Tactical Electronic Warfare System. The company states that the AN/ALR-56C is highly capable of detecting radar threats even in electromagnetically congested environments. Such threats can include ground-based air surveillance radars and fire control radars, and airborne radars.

AN/ALR-56M(V)

BAE Systems' AN/ALR-56M Radar Warning Receiver (RWR) is a development of the company's AN/ALR-56C RWR. The AN/ALR-56M's architecture includes a superheterodyne receiver and controller, signals processor, a low-band receiver and power supply and four receivers positioned around the aircraft to provide 360 degrees of protection. Field of View - Azimuth: 360°

BHARAT ELECTRONICS

Tarang

The Tarang family of Radar Warning Receivers (RWRs) was developed by India's Defence Research and Development Organisation and manufactured by Bharat Electronics Limited. The Tarang has been so ubiquitous in Indian Air Force (IAF) service that it can be considered the standard RWR equipping its combat aircraft fleet. It first entered service as a result of the wide-ranging upgrade initiative for the IAF's MiG-21bis (NATO reporting name Fishbed), resulting in the MiG-21 Bison. This particular aircraft was outfitted with the Tarang-II.

ELBIT SYSTEMS EW & SIGINT – ELISRA

SPS-3000

The Israeli Air Force (IAF) has outfitted its fleet of McDonnell Douglas/Boeing F-15I Ra'am combat aircraft with Elbit's SPS-3000 Radar Warning Receiver (RWR). Details of the RWR's parameters are scant although it is thought to cover a waveband of two gigahertz/GHz to 18GHz. Some sources state that it might be possible to extend this waveband down to 500 megahertz. Like the Japanese Air Self Defence Force the IAF has extensively upgraded its F-15Is with local equipment. This is most noticeable in terms of the aircraft weaponry, fire control and self-protection systems. Weight: 25kg

ELETTRONICA

ELT/160 Family

Elettronica's ELT/160 Radar Warning Receiver (RWR) equips the NH Industries NH-90TTH medium-lift helicopters of the Esercito Italiano (Italian Army) and the NH-80NFH naval support helicopters of the Marina Militare (Italian Navy). Elt 160 is based on a Wide Open architecture that allows full and instantaneous coverage in angle, time and frequency to ensure the highest probability of intercept of radar threats in a complex environment. The receiver is protected against CW communication signals up to 4G LTE frequencies employing switchable microwave filters. The system covers E-K bands.

ELT/162

The ELT/162 is a Digital Radar Warning Receiver used as a component of a Self-Protection Suite of airborne platforms to detect-discriminate-classify-identify radars from ground/air potential threats for the safety of the platform. When integrated into the Suite, the product generates the relevant information needed to initiate any counteraction, from manoeuvres to passive and active electromagnetic countermeasures or a combination.

ELT/1000

The ELT/1000 is a radar ESM ELINT System designed to meet the requirements for Reconnaissance, Surveillance, and Target Acquisition Missions of tactical UAV platform units. Incorporating a modular architecture, software-defined receivers and proprietary interferometric antennae, the ELT/1000 can detect, identify, measure and record radar emissions. This data can then be transferred to a GCS, thus improving overall situational awareness.

ELTA SYSTEMS

ELL-8265 RWL

The ELL-8265 RWL (Radar Warning and Locating System) is designed for fixed-wing aircraft, helicopters and UAV platforms. The system provides the ability for aircrew to view a situational awareness map in real time, and the locator provides operational alternatives such as bypassing or attacking the threat. The threat location can also be shared with other mission participants. Length: 30cm Width: 17.5cm Height: 12.6cm Weight: 7kg Field of View - Azimuth: 360°

GOSNRTI

SPO-15

The GosNRTI SPS-15 Radar Warning Receiver (RWR) has replaced the firm's erstwhile SPS-10 system and remains in widespread use around the world. The SPS-15 covers a two gigahertz/GHz to 15GHz waveband, which is an improvement on the two gigahertz to ten gigahertz waveband of its predecessor. Other improvements added to the SPS-15 compared to the SPS-10 is the formers' ability to depict the bearing and type of radar illuminating the aircraft. The SPS-10 could only provide an indication of the location of a radar in a 90 degree horizontal quadrant of the sky. The SPS-15 could also indicate to the aircraft the radar's operating mode. Field of View - Azimuth: 180° Field of View - Elevation: 30°

INDRA SISTEMAS

ALR-400

Indra's ALR-4000 is a Radar Warning Receiver. The company's official literature states that the ALR-400 covers frequencies of 500 megahertz/MHz to 42 gigahertz. The system can detect emissions from pulse Doppler radars with three megahertz of frequency accuracy which reduces to one megahertz for frequency modulated, continuous wave radars. The system is available in two versions, the ARINC-404 and the ARINC-600. The key differences is that the former includes two antenna assemblies, a radar receiver unit and an Electronic Warfare (EW) processor. The ARINC-600 meanwhile has a single antenna assembly, radar receiver unit and EW processor. A hybrid system including two antenna assemblies and two radar receiver units is available. All ALR-400 variants can be supplied with a cockpit control and display unit. Information regarding the unit cost of the ALR-400 has not been published. Judging by the average unit price for comparable systems, we estimate that the ALR-400 has a unit cost of $1.2 million. Weight: 14.5kg

KRET

L-402 Himalaya

KRET's L-402 Himalayas integrated self-protection system has been developed by the company's KNIRTI subsidiary and equips the Sukhoi Su-57/T-50 (NATO reporting name Felon) fighter. Deliveries of the L-402 commenced in 2014. This technology will likely form the basis of the electronic warfare systems equipping new Russian Air Force (RUAF) platforms and may be installed on the Tupolev PAK-DA strategic bomber currently under development.

L3HARRIS TECHNOLOGIES

AN/APR-46

The AN/APR-46 is an RWR fitted to USAF Special Operations Forces C-130s including MC-130E Combat Talon I (retired 2012), MC-130H Combat Talon II (18 in service) and AC-130H (retired in 2015). Weight: 65kg

LEONARDO ELECTRONICS

Sage ESM

Leonardo's SAGE system is a digital ESM/ELINT for RF intelligence, surveillance and reconnaissance missions.

It has both single and multi-platform geo-location of RF assets, parallel wideband and channelized receivers, and delivers instantaneous detection and ELINT analysis. The system can collect ELINT from land, maritime and airborne emitters, providing highly accurate direction-finding capabilities. SAGE is suitable for a range of aircraft from tactical UAVs and light helicopters to larger reconnaissance and maritime patrol aircraft. Weight: 20kg

SEER

SEER is a modular, high-performance digital Radar Warning Receiver providing sophisticated protection from radar threats. The system is sensitive, providing a detailed parametric and angle-of-arrival measurement of intercepted signals. SEER is also programmable, allowing users to configure its operation with indigenous mission-dependent data. SEER reduces a pilot's workload by efficiently identifying, categorising, discriminating and reporting radar threats Available in E-J, C-D and E-K band configurations. SEER is compatible with multi-mission displays and is easily installed onto a wide range of airborne platforms including large transport and small fixed-wing aircraft, rotary-wing vehicles and UAVs. Weight: 11kg

SIR-S/I & SIR-M IFF

The SIR–S/I (for civilian use) and SIR-M (for military land and naval use) Secondary Surveillance Radars are modular systems fully compliant with the latest ICAO and EUROCONTROL recommendations on Mode-S operations. The military versions also add the complete set of features for Mode 4, Mode 5 or the national dedicated crypto solution.

LEONARDO UK

SG200-D

Leonardo's SG200-D RWR is a UK-specific product which is almost identical to the company's SEER RWR. SG200-D is self-protection equipment which detects and identifies emitters in high-density and complex radar environments. Weight: 11kg

LOCKHEED MARTIN

AN/ALQ-210

Lockheed Martin's AN/ALQ-210 is an Electronic Support Measure (ESM) outfitting the Sikorsky MH-60R Romeo naval support helicopter. The manufacturer's official literature says that the product provides 360° surveillance around the aircraft. No details have been provided by the company, but it is thought that the AN/ALQ-210 can detect, locate and characterise a multiplicity of threats across wavebands of at least two gigahertz to 18GHz. However, there is a high likelihood that this may be extended to 40GHz. This is particularly important in the naval domain to ensure that the ESM can detect emissions from Anti-Shipping Missile (AShM) Active Radar Homing (ARH) seekers transmitting in millimetric wavebands of 30GHz and above. Such frequencies are increasingly used by ARH-guided AShMs on account of the detail of radar imagery they gather. Based upon published documentation regarding AN/ALQ-210 procurements we deduce that the system has a unit price of $2.6 million. Weight: 32.7kg Field of View - Azimuth: 20,626.48°

AN/ALQ-210 ESM/RWR

The multi-mission AN/ALQ-210 Electronic Support Measures (ESM) system provides situational awareness and threat warning with electronics intelligence (ELINT) quality measurement accuracy in complex and dense electronic battlefield scenarios. The system performs situational awareness and threat warning functions simultaneously. It also autonomously scans the environment allowing for a high probability of detection and accurate identification. Length: 31.5cm Width: 38.4cm Height: 39cm Weight: 25.7kg Field of View - Azimuth: 360°

AN/APR-48A

The APR-48A is a radar frequency interferometer, featuring a four-element interferometer combined with a three channel phase receiver. A four-element coarse direction-finding (DF) array is used for initial signal acquisition. When fine DF measurement is required, a four-element, long-baseline interferometer is used. This provides high DF accuracy and a tolerance of multi-path-induced phase errors. Weight: 13.3kg

AN/APR-48B

Lockheed Martin's AN/APR-48B is the standard Electronic Support Measure (ESM) used by the Boeing AH-64E Guardian attack helicopter. The ESM provides 360 degrees of surveillance around the aircraft; It is designed to detect radar threats, principally from ground-based air surveillance radars and fire control/ground-controlled interception radars to enable the AH-64E to accurately locate these threats and then engage them using the aircraft's weapons. The AN/APR-48B provides the aircraft the wherewithal to detect and attack ground-based air defence threats in support of wider suppression of enemy air defence efforts. Unit costs for the AN/APR-48B have not been published. By examining the average unit prices for comparable equipment, we can discern that the AN/APR-48B has a unit cost of $1.8 million. Weight: 18kg Field of View - Azimuth: 360°

NORTHROP GRUMMAN

AN/ALQ-155(V)

Northrop Grumman's AN/ALQ-155(V) is a radar jamming system used by the US Air Force's Boeing B-52H Stratofortress strategic bomber. It provides the aircraft with 360 degree protection against RF (Radio Frequency) threats and is designed to automatically jam ground-based air surveillance radars, naval surveillance radars; ground-based and naval fire control radars; airborne fire control radars and the active radar homing systems used by surface-to-air and air-to-air missiles. The AN/ALQ-155(V) detects RF signals and can automatically transmit jamming waveforms to help protect the aircraft. The AN/ALQ-155(V) also equipped the Lockheed Martin MC-130E Combat Talon-I special operations aircraft which was retired in 2013. Weight: 0.3kg

AN/ALQ-218

The ALQ-218 is a tactical support EW system with receiving and jamming capabilities. It is the electronic

attack suite in the EA-18G Growler tactical aircraft. In battle, says the company, the ALQ-218 jamming receiver is the first system 'on the scene' to detect the enemy. It provides initial verification for the correlation between the planned EOB and the actual on-scene EOB.

AN/APR-39(V)

Northrop Grumman's AN/APR-39(V) series of Radar Warning Receivers (RWRs) have been designed to equip a wide array of aircraft. Specifications regarding the waveband covered by the AN/APR-39 have not been revealed although it would be reasonable to assume that the equipment can detect emissions from radars transmitting in wavebands of two gigahertz/ GHz to 18GHz. This might be extended downwards to 500MHz and upwards to 40GHz. Similarly, there is no information in the public domain regarding the unit cost of the AN/APR-39 series. Based on the average unit cost for comparable systems, it would be reasonable to assume that the system has a unit price of $1.2 million. Weight: 17.6kg

APR-39(V)

The ARP-39(V) is an RWR system for combat helicopters, low-speed aircraft and fast attack craft. The system comprises two dual-video receivers, four spiral cavity-backed antennas, NOE blade antenna, indicator unit, a comparator and control unit. The APR-39(D)V2 is currently in development. All variants cover the frequency range from band C to K and provide conventional radar warning. Weight: 17.6kg

LR-100

Northrop Grumman's RA-4B Global Hawk uninhabited aerial vehicle is equipped with the company's LR-100 Electronic Support Measure (ESM). The LR-100 performs an important role supporting the aircraft's overall intelligence-gathering capabilities. No details appear to exist in the public domain, but it is likely that the LR-100 can detect, locate and characterise signals across a 500 megahertz to 40 gigahertz waveband. Moreover, given the 60,000 feet (18,000 metre) cruising altitude of the RQ-4B it is possible that the LR-100 can detect signals at ranges over 301 nautical miles (557 kilometres).

Leonardo's SG200-D RWR is a UK-specific product which is almost identical to the company's SEER RWR. (Photo: Leonardo UK)

There appear to be no details in the publicly available regarding the unit cost of the LR-300. That said, by analysing prices for comparable systems we estimate that the LR-100 has a unit cost of $2.2 million. Length: 43cm Width: 21.8cm Height: 21.6cm Weight: 27kg Field of View - Azimuth: 360° Field of View - Elevation: 90°

RAYTHEON

AN/ALR-67(V)3

The AN/ALR-67 series Radar Warning Receiver (RWR) has been produced both by Northrop Grumman and Raytheon. It is one of the most widely used RWRs in service today. The AN/ALR-67 was developed as the success to the Litton AN/ALR-45 which had entered service with the US Navy in 1975. That same year Litton commenced development of the AN/ALR-67(V) which was the baseline member of the AN/ALR-67 series. Litton was later acquired by Northrop Grumman in 2001 with the latter inheriting the AN/ALR-67(V) programme. Northrop Grumman was responsible for the AN/ALR-67(V) and AN/ALR-67E(V)2 incarnations, with Raytheon developing the AN/ALR-67(V)3. Open source reports note that the system can detect threats in the 500 megahertz to 40 gigahertz waveband. Field of View - Azimuth: 360°

AN/ALR-69A(V)

Raytheon's AN/ALR-69 Radar Warning Receiver (RWR) is in widespread use in the US armed forces and around the world. The system can detect, process and identify a wide array of radar transmissions including those from ground-based air surveillance and fire control radars, and airborne interception radars.

SAAB

BOW

Saab's BOW family of Radar Warning Receivers (RWRs) and electronic support measures are designed to outfit a diverse array of fixed-wing aircraft. The BOW family covers wavebands of two gigahertz to 20GHz, although customers can extend this downwards to 500MHz and upwards to 40GHz if desired. The BOW-21 is the RWR member of the family. This outfits the Luftwaffe's (German Air Force) Panavia Tornado-IDS/ECR fighter and air defence suppression aircraft and legacy Saab JAS-39C/D Gripen combat aircraft. Unit prices for the BOW family have not been published. By examining average prices for comparable RWRs, we estimated that the radar warning receivers in the BOW product series may have a unit cost of circa $1.2 million. The BOW radar warning/ESM system family has been designed to be modular and with growth potential and scalability for a long life, while adapting to changing requirements. In basic configuration, the wideband receiver gives good threat warning. The system can be complemented with a narrowband receiver for better detection range for weak signals, more selectivity in signal-dense environments and performance for more demanding applications. Field of View - Azimuth: 360° Field of View - Elevation: 90°

IDAS/CIDAS

Saab's IDAS (Integrated Defensive Aids Suite) is designed to equip fixed-wing and rotary aircraft. The

IDAS is an Integrated Self-Protection System (ISPS) which is a further development of the firm's CIDAS-300 ISPS. The principle difference between the IDAS and the CIDAS-300 is that the former is equipped with a Radar Warning Receiver (RWR). Weight: 20kg

TELEDYNE DEFENCE & SPACE

Phobos

The Phobos threat warner/radar ESM is a man-portable, end-to-end integrated EW sensor system comprising antennas, RF processing, digital processing, de-interleaving and emitter ID/library matching and operator interface. A key feature of Phobos is that there are no external cables, calibration or positioning alignment requirements during set-up, enabling ease of deployment. Details are for QR021-M1 variant. Length: 32cm Width: 32cm Height: 10cm Weight: 7.2kg Sensitivity (dB): -57 Field of View - Azimuth: 360° Maximum Signals Tracked: 500

TEXTRON SYSTEMS ELECTRONIC SYSTEMS

Model 527

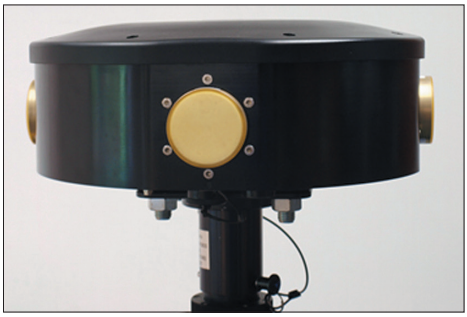
The Model 527 radar signal simulator is used for end-of-runway and walk-around radiated RWR testing to verify the operational status of the aircraft and its EW systems. In end-of-runway and walkaround testing up to 35m from the aircraft, it stimulates RWR systems with free-space radiation. The operational readiness of the SUT is verified by threat reception and recognition as displayed in the cockpit. Weight: 12.25kg

THALES

PAJ-FA

Thales PAJ-FA (Podded Airborne Jammer for Fighter Aircraft) is an electronic attack system designed to equip fast jets. The PAJ-FA has been developed from Thomson-CSF/Thales' Barem podded jamming system. The Barem pod used the Thomson-CSF/Thales Sherloc radar warning receiver at its core. The PAJ-FA is intended to provide aircraft with the means to perform electronic attack against hostile radars to protect strike packages of aircraft. The PAJ-FA can engage radar threats across frequencies of five gigahertz/GHz to 15GHz. No details of the unit price of the PAJ-FA been made public, although by examining the average costs of comparable systems it would be reasonable to assume that the PAJ-FA has a unit price of circa $1 million. Length: 442cm Width: 16cm Height: 16cm Weight: 85kg

The Phobos threat warner/radar ESM is a man-portable, end-to-end integrated EW sensor system. (Photo: Teledyne Defence & Space)



TDS-FA/-TA/-H

Thales' TDS family is comprised of Radar Warning Receivers (RWRs) designed to equip a range of fixed-wing aircraft. The product series includes the TDS-FA designed to equip combat aircraft, the TDS-H which is for rotorcraft and the TDS-TA designed to equip fixed-wing platforms such as freighters. All three products cover frequencies from two megahertz to 40 gigahertz/GHz. The RWRs can have these wavebands expanded downwards to one gigahertz, while the TDS-FA has the provision to extend this further downwards to 500 megahertz. No information has been made available in the public domain regarding the unit price of the TDS product. By analysing the average price of comparative products we estimate that TDS RWRs have a unit price of $1.5 million. Weight: 6kg

TDS-H

The TDS-H threat detection system is a compact, user-programmable RWR. Its sensitive instantaneous frequency-measurement capability enables high POI and early warning. The system utilises miniaturised technology and claims to offer high performance whilst maintaining its low weight, volume and power-consumption features.

THALES/MBDA

SPECTRA

Thales' SPECTRA (Rafale Fire Control Radar Protection and Avoidance System) is the Integrated Self-Protection System (ISPS) used by the Dassault Rafale series of combat aircraft. The system has been produced in collaboration with MBDA.

EQUIPMENT

GROUND EW SYSTEMS

The equipment featured in this section is listed under these headings:

- COMINT and ELINT systems
- DF systems
- Gunshot detection systems
- Jammers
- Self-protection systems

The systems are listed alphabetically by manufacturer.

If you think your product should be listed, please contact the team at insight@shephardmedia.com to ensure it appears in the *Shephard Defence Insight* online database (shephardmedia.com/defenceinsight) and is included in the next handbook edition.

ABOVE: Arthur is a lightweight, highly mobile weapon locating system, tactically deployed close to the forward line of own troops. (Photo: Saab)

COMINT AND ELINT SYSTEMS

ARGON ST

Gen5 Adder

The fifth generation of Argon ST's Adder is a software radio-based information operations and electronic surveillance system that targets multiple commercial satellite signals. Its applications target many of today's modern commercial communication systems and have been developed both by the manufacturer and customers through utilisation of Argon ST's Gen5 open software development kit.

ASELSAN

ARES-2LC/T

The lightweight, man-deployable ARES-2LCT system can be operated in combat environments where it is difficult for vehicles to reach. The ARES-2LCT system can search, intercept, measure, analyse and classify conventional and complex types of signals from missile seeker, guidance, shipborne tracking and fire control radars.

MİLKED-3S3

The core equipment of the Fixed V/UHF Electronic Support System is the ADF-3401 direction finding (DF) receiver, which is a receiver for all types of COMINT-DF applications. ADF-3401 is ready to provide four-channel digital data for accurate direction-finding functionality in fixed and land mobile platforms. With its capability of direct digital reception, it is able to demodulate signals within its instantaneous bandwidth.

MİLKED-4S

Aselsan's MILKED-4S is a HF Direction Finding and Monitoring system that can be operated locally or remotely via ethernet interface with full functionality. With its wide aperture antenna array, correlative interferometer-based direction finding (DF) method, the system provides accurate and stable line of bearing information. The system also runs super-resolution DF methods (MUSIC, ADBF) effective in co-channel signal analysis.

MİLKED-4T

The Transportable HF Electronic Support System is a portable direction finding (DF) system with digital receiving architecture. With several antenna options and DF algorithms, the system is designed to provide a range of solutions for mobility and DF accuracy requirements.

MOBDF-G2 - Mobile V/UHF Direction Finding System

The Mobile Direction Finding (MOBDF) system provides measurement and monitoring in 20-6,000MHz frequency band together with direction-finding information. The system components are integrated onto a 4x4 vehicle with disassembly possibility. In order to realise covert operations and measurement/monitoring while the vehicles are on the move, the antennas located on the 4x4 vehicle are covered by a radome.

The Mobile Direction Finding system components are integrated onto a 4x4 vehicle with disassembly possibility. (Photo: Aselsan)

MUKAS – Communication Jamming and Deception Simulator

MUKAS is a simulator system designed for training of EW and communication operators. MUKAS is mainly composed of Communication Electronic Support (MEDSIS), Communication Electronic Attack (METSIM). MEDSIS and METSIM Subsystems are integrated on the same vehicle. The MUKAS MEDSIS subsystem provides measurement, monitoring, direction-finding, narrowband and wideband signal analysis of signals in HF and V/UHF bands. Also, MEDSIS provides and transfers necessary parameters to RAKAS METSIM, for the application of effective electronic attack techniques.

PUHU

The PUHU Manpack V/UHF direction-finding system supports tactical combat units in operational areas. PUHU man-portable wideband direction finding (DF) equipment provides accurate line of bearings with its signal processing capabilities and DF algorithms.

RAKAS – Radar Jamming and Deception Simulator

RAKAS is a simulator system designed for the training of radar and EW operators in the Turkish armed forces. It is comprised of several subsystems to facilitate training in ECM techniques and electronic attack methods.

CELESTIA

RF Data Recorders

The Celestia family of RF data recording (RFDR) systems is designed for demanding signal recording requirements. The equipment is typically used for capturing and recording the raw RF spectrum, configurable up to 500MHz instant RF bandwidth. Length: 620cm Width: 480cm Height: 220cm Weight: 18kg

CETC INTERNATIONAL

JN1101

The JN1101 Vehicular Communication EW System is a reconfigurable, integrated, land-based system operating in HF and V/UHF. It is designed to intercept and analyse enemy communications and carry out location-fixing and jamming on target platforms. This includes air-to-air, air-to-ground and coordination communications.

The JN1101 is also available for Ship-borne and UAV communications (JN1101-S and JN1101-U).

CHEMRING TECHNOLOGY SOLUTIONS

Resolve EW Suite

Resolve is a manpack electronic surveillance system designed for the interception, geolocation and exploitation of tactical communications. It has a true 40MHz instantaneous wideband capability, offering the operator effortless SIGINT delivery. The man-on-the-march operation uses an Android tablet-based user interface (Tacfix) which can transition across the full range of operational scenarios, from on the move to short, medium and long halt.

COLLINS AEROSPACE

ANT-1040 Spinning DF Antenna

The ANT-1040 is a high performance, spinning, direction finding (DF) antenna covering the 0.5-40GHz frequency range, providing high gain and narrow bandwidth coverage for direction finding and signal isolation. The antenna modes of operation include point, sector scan and continuous spin with spin rates from 0-200rpm. The antennas in the spinning DF segment include a Log periodic antenna covering the 0.5-2GHz band, a 2-8GHz parabolic antenna with Log periodic feed and an 18-40GHz horn antenna.

CS-3001

The CS-3001 pulse analyser unit provides radar signal measurement and processing for radar emitter analysis. The VME-based CS-3001 accepts intermediate frequency (IF) and video inputs and provides de-interleaved digital pulse descriptor word (PDW) data for radar analysis, identification and direction finding. The PDW data includes measured frequency, primary rate interface, pulse width, amplitude and modulation flags for each received pulse.

CS-3002

The CS-3002 dual-pulse analyser unit provides radar signal measurement and processing for radar emitter analysis. The VME-based CS-3002 accepts IF and video inputs and provides de-interleaved digital pulse descriptor word (PDW) data for radar analysis, identification and direction finding. The PDW data includes measured frequency, primary rate interface, pulse width, amplitude and modulation flags for each received pulse. Length: 32cm

CS-3030

The CS-3030 ELINT/ESM Subsystem from Collins Aerospace is designed for high-precision radar signal measurement and analysis. The system is designed for use in demanding environments with field-proven equipment and software. Customers can choose from a range of COTS antenna, receiver and signal processing building blocks to meet a variety of surveillance, ELINT and electronic support measures (ESM) applications.

CS-5020C Series

CS-5020C-series microwave tuners and receivers are high-performance instruments covering the centre tune frequency range from 0.1-18GHz. The CS-5020C Series are superhet, set-on and sweep units that convert signals in the covered frequency range into intermediate frequency (IF) outputs of one gigahertz and user-selectable 70, 140 and 160MHz outputs. Specialised models have video (AM/FM/LOG) and audio demodulated outputs.

CS-5998

The CS-5998 is an ultra-broadband set-on microwave tuner with two gigahertz intermediate frequency (IF) output. It covers the 1.5-18GHz tuning range, with the edges covering 0.5-19GHz. It has a low-noise figure, high dynamic range and low-phase noise. The two gigahertz bandwidth, centred at three gigahertz, gives the user the opportunity to look at an ultra-wide IF anywhere in the microwave range. Length: 21cm Width: 53cm Height: 9cm Weight: 8.2kg

DPAU-4001

The DPAU-4001 Digital Pulse Analyzer Unit provides digital radar signal measurement and processing for radar emitter analysis. The DPAU-4001is a VME-based signal processor that accepts intermediate frequency (IF) inputs (or RF inputs with the RC-5850 option) and provides de-interleaved digital pulse descriptor words (PDWs), digital intrapulse and spectral data for radar analysis, identification and direction-finding. Weight: 15.5kg

IFMR-6070

The IFMR-6070 is a VME-based wideband instantaneous frequency measurement (IFM) receiver and signal processor that instantaneously receives radar signals across the entire 0.5-18GHz spectrum, providing a high probability of signal detection for rapid emitter detection and analysis. Length: 66cm Width: 53cm Height: 8cm Weight: 14.5kg

PRISM-6090

The Precision Intercept Spectral Monitoring (PRISM) 6090 system is a full-range system that covers a frequency range from 0.5-18GHz (40GHz optional). The RF search system generates RF spectral displays across the 0.5-18GHz range for the detection of signal activity. The PRISM GUI is displayed on a host computer screen to allow the system chassis to be located close to antenna feeds. Length: 55cm Width: 53cm Height: 17cm Weight: 14.5kg

RC-5800

The RC-5800 is a microwave tuner covering the centre tune frequency range from 0.5-18GHz for applications that require tuning performance and phase noise in a compact unit. The RC-5800 consists of two separate 6U VME modules designated as the synthesiser module (SYN-5800) and RF module (DCV-5800). This functional partitioning allows the tuner to support in-channel direction-finding for phase interferometry applications.

RC-5850

The RC-5850 is a fast-tuning microwave receiver covering the 0.5-18GHz frequency range, with 35µs tuning time for applications that require tuning speed and phase noise in a compact tuner. The RC-5850

builds on the field-proven RC-5800. It consists of two separate 6U VME modules designated as the synthesiser module (SYN-5850) and the RF module (DCV-5800). This functional partitioning allows the tuner to support in-channel coherent direction-finding for phase interferometry applications.

RC-8800

The RC-8800 is a multi-channel microwave tuner for technical ELINT or multichannel electronic support measures applications. Configured with one to four tuners on a single-slot 6U VME carrier card and operating from 0.5-20GHz, the RC-8800 greatly reduces the SWaP needed for single and multi-tuner systems. Weight: 1.6kg

COMMUNICATIONS AUDIT UK

CA7801 HF Wideband Receiver

The CA7801 is a low-SWaP wideband HF receiver covering 1-30MHz with a real-time full stare bandwidth of 29MHz. The CA7801 supports wideband super-resolution direction finding, multilateration and adaptive blind signal separation. The CA7801 is capable of streaming full bandwidth digital Intermediate Frequency (IF) data to processing and recording hardware.

CA7851 VHF – SHF Wideband Receiver

The CA7851 is a low-SWaP wideband VHF-SHF receiver covering 20MHz to 6GHz with a real-time full stare bandwidth of 100MHz. The CA7851 supports wideband super-resolution direction finding, multilateration and adaptive blind signal separation. The CA7851 is capable of streaming full bandwidth digital Intermediate Frequency (IF) data to processing and recording hardware.

Spectra

Spectra is an integrated HF-SHF COMINT system covering 1MHz-6GHz. Spectra systems are suitable for mobile, semi-static or fixed-site deployment and are capable of super-resolution DF. Spectra has an integrated management information system, including an interactive smart database.

ELBIT SYSTEMS EW & SIGINT – ELISRA

SkyFix DF

The SkyFix DF is a lightweight, high-precision COMINT/DF system covering the 30MHz-3GHz frequency band. It uses a correlative interferometer technique and wide aperture, high-precision antenna array, providing direction finding (DF) accuracy combined with fast DOA integration time. Utilising Elbit Systems' TSR compact wideband multi-purpose receivers, SkyFix DF enables monitoring of selected transmissions, while simultaneously performing spectrum scan and DF calculations.

Skyfix/Skyfix DF

Skyfix is a lightweight, precision COMINT/direction-finding system, covering the 30MHz to three gigahertz band. The system uses the correlative interferometer technique and a wide-aperture antenna array. It is designed to provide direction-finding accuracy, combined with fast direction-of-arrival integration time, using compact wideband multipurpose receivers. Weight: 35kg Field of View - Azimuth: 360°

Sunstone-ges-210

Sunstone GES-210/E is a line of field-tested systems for ground-based, tactical and strategic ESM/ELINT. Developed by Elisra, the Sunstone GES-210/E delivers real-time situational awareness and continuous, 24-hour ESM/ELINT information gathering. Supporting all mobile and stationary ground platforms, the GES-210/E system variants are suitable for any geographical arena. Modular, scalable and interoperable, the system can be quickly and easily configured to customer requirements, accommodating any frequency range and area of coverage.

ELETTRONICA

ELT/332

ELT 332 is a counter electronic support measure/COMINT system designed for fast real-time interception, direction finding and automatic characterisation of complex broadband signals, frequency-agile transmissions (e.g. frequency hopping emitters) and analogue/digital modulated signals. The system fully meets the operational and technical requirements identified for surface ships and offers state-of-the-art performances with high sensitivity, wide dynamic range and full-azimuth spatial coverage. The system provides surveillance of the electromagnetic spectrum by performing automatic detection, discrimination, pre-classification and technical identification of communication emitters, demodulation and decoding of communication signals and content production with real-time audio listening; wideband recording of RF signals for data collection and off-line analysis (to be done with other systems).

ELT/819A

Elettronica's ELT/819A is a low band ELINT system designed for both airborne and naval applications. In the frame of the ELT ELINT Systems, the ELT/819A extends the ELINT capability into the field of the renewed interest and utilization of VHF/UHF radar systems for its well-known capability to counter the stealth technology. The high flexibility of the system allows multiple installations in several possible ground and air solutions. ELT/819A is a piece of low band equipment that exploits the state of the art of digital receivers' technology to perform both technical and tactical functions.

LOKI

The LOKI family is a cross-platform C2 system designed to integrate EW, SIGINT and Electro-Magnetic Spectrum Operations on many distributed platforms. The platform can be distributed in any domain operation (air land, sea, space) and could be fixed/moving and crewed/uncrewed.

ZEUS

ZEUS is an integrated ESM/ELINT system based on an ultimate fully digital multichannel Multi-Function Unit (MFU). Primary ZEUS missions are: Fully Passive for ISR&RESM; missions (ISR and Radar Electronic Support Measurement); Integrate Passive and Active mission for ISR and Self/Mutual protection.

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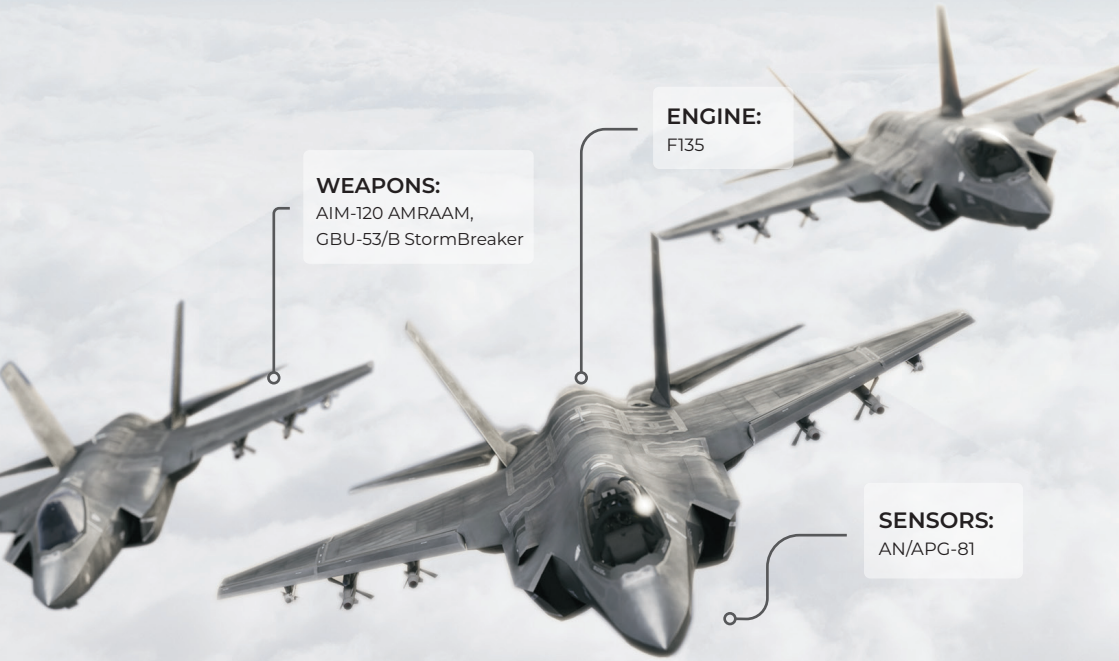

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ELTA SYSTEMS

ELK-6060

ELK-6060 is a radio location system designed to address the need of the combat unit to collect on-the-move, real-time intelligence on hostile V/UHF communication transmissions' locations, by implementing differential time-of-arrival techniques. The system includes an array of lightweight sensors carried by soldiers, combat vehicles, a tactical UAV and, if necessary, installed unattended near areas of interest. Weight: 1kg

ELK-7036

The ELK-7036 wideband V/UHF COMINT/DF radio interception and location systems are designed for fixed and mobile installations. The systems provide real-time intelligence reports and a situational awareness picture, digital direction finding (DF) and monitoring receivers, a high probability of detection and high DF accuracy. The ELK-7036 handles short transmissions, fixed frequencies and frequency-hopping networks. It is a field-proven system that is in operation worldwide.

ELK-7038

The ELK-7038 wideband HF COMINT/DF wideband HF interception and location system is designed for fixed installations or transportable solutions. It has digital direction finding (DF) and monitoring receiver and intercepts ground and sky waves. It provides radio communications in HF band and handles short-range transmissions, fixed frequencies and frequency-hopping networks. Emitter location is based on triangulation and by Single Site Location techniques.

GENESIS EW

GenCOM Defense Ground

GenCOM Defense Ground provides an automatic multi-layered situational awareness picture to the decision-maker, based on external signal data (metadata) gathered in real time. Integrating with single or multiple ground COMINT direction-finding or TDOA (Time or Direction of Arrival) sensors, stationary or deployed on vehicles, GenCOM Defense Ground is a software analysis system designed to automatically deliver multi-layered battlefield-related geospectral communications and tactical knowledge.

HENSOLDT SOUTH AFRICA

GEW GRJ8000

The GEW GRJ8000 family of electronic support measures (ESM)/ electronic counter measures (ECM), communications surveillance and electronic attack subsystems integrates receivers and exciters, enabling the rapid development of sophisticated, fast electronic surveillance/attack systems. It includes units in the HF and VHF/UHF frequency ranges. The GEW GRJ8000 units interface with power amplifiers and antennas, providing the user with a powerful and versatile system for tactical, ground mobile or airborne applications.

GEW GRXLAN

The GEW GRXLAN family of receivers is designed to provide a system where single or multiple narrowband receiver channels are required to be processed by computers on a LAN. The receivers provide baseband 1MHz-wide I/Q outputs, which may then be manipulated to derive spectral information including demodulation for listening purposes. The desktop model is offered in variants covering 9kHz-30MHz, 9kHz-3.6GHz and 9kHz-9GHz.

GEW MRR8001

The GEW MRR8001 family of receivers offer an ultra-wide-bandwidth software-definable receiver, allowing multirole system implementations with the same receiver. The receivers consist of one to three wideband, high-specification, independently tuneable RF units, each with analogue instantaneous bandwidth up to 80MHz. The RF units cover the frequency range of 500kHz to 3.6GHz. With the optional frequency extender, the range reaches 9GHz.

Sky-i7000

The Sky-i7000 is a compact and complete H/V/U/SHF radio monitoring solution. An RF receiver is combined with digital signal processing inside a rugged housing to provide an ITU-compliant receiver for dense signal environments. It is suitable for fixed, mobile or portable operations.

JSC CONCERN SOZVEZDIE

Borisoglebsk-2

The vehicle-mounted Borisoglebsk-2 EW system performs frequency scanning for hostile RF emissions. Produced by JSC Sozvezdie, it can perform both electronic surveillance and RF suppression. Deliveries to the Russian Army commenced in 2014. The manufacturer has released no details regarding the specifications or performance of the system, although the Russian media has reported that it is effective against HF and VHF emissions, leading to speculation that it could be designed to counter hostile tactical communications.

KB RADAR

Groza 2

The Groza 2 system is a co-development and co-production by KB Radar and Minotor-Service companies located in Minsk, the Republic of Belarus. The tracked vehicle, designed by Minotor-Service, accommodates a hardware and operator workstations section, two fast-deployment RX/TX antenna mast devices and a power generator. The correlation interferometer direction finder detects and locates signal sources at the rate of 2GHz/s.

Groza

The Groza jammer set includes cross-country transporter vehicle mounts; a shelter with the equipment and operator workstations; two fast-deployment RX/TX antenna mast devices; and two power generators. The correlation interferometer direction finder detects and locates signal sources at a rate of 2GHz/s. The jamming transmitter uses a digital jamming signal shaper and five independent 1,000W amplification channels. Each channel emits up to four jamming signals simultaneously.

Marker
The Marker is a multilateration complex for positioning aerial platforms. It has a range of 350km for detection of aerial platforms of 10km height and 100km for those of 1km height. The error of positioning aerial platforms does not exceed 1% of range. Possible to obtain semantic information in the 'A, C, S' modes, as well as individual recognition of aerial objects in the 'S' mode by transponder signals without coding. Range: 320km

OPTIMA-3.2
The OPTIMA 3.2 jammers emit up to 15W power jamming signals of optimal structure at the L1 and L2 frequencies of the GPS, or L1 and L2 of the GLONASS, or both GPS and GLONASS jamming signals simultaneously. The transmitters are mounted on elevated objects (mobile communications masts, tall buildings, etc.) Due to omnidirectional deployment of the jammers, effective jamming of navigation equipment of cruise missile and aircraft outfitted with adaptive antenna arrays is achieved.

Optima-B
Optima-B is a device that shapes and emits signals, at the L1 and L2 frequencies, identical to the navigation field of the GPS for an assigned navigation equipment location. Signal forming is based on user-assigned almanac and ephemeris files, the GPS time and required navigation receiver co-ordinates.

SPR-3
The SPR-3 protects troops and facilities from lethal effects of artillery munitions (artillery shells, rockets, mortar shells) outfitted with radio fuses operating in the 90-450MHz frequency band. Length: 47cm Width: 47cm Height: 20cm Weight: 51kg

L3HARRIS TECHNOLOGIES
Broadshield- MCS-EA
The MCS-EA is a compact, programmable and Modular Electronic Surveillance (ES) and Electronic Attack (EA) system capable of mounted and dismounted operations in the tactical EW environment. Built on L3 TRL's latest convergent technology, MCS-EA covers the 20MHz to six gigahertz threat spectrum. The unit contains an integral receiver, allowing it to scan target frequencies up to three gigahertz. Length: 9cm Width: 22.9cm Height: 28.2cm Weight: 9kg

Corvus- PECM
Corvus is a multi-role, scalable platform supporting operations across Cyber and Electromagnetic Activities (CEMA). The Corvus architecture is rapidly reconfigurable to deliver force protection, individual communications, direction finding, electronic support measures, electronic attack and SIGINT missions. Corvus has been created to enable mission-specific applications to be developed and deployed faster than conventional approaches.

Smartscan- Marlin
The Marlin is a lightweight, tactical system for the passive monitoring of Thuraya, Inmarsat and IsatPhone Pro networks. It detects and intercepts terminal and call activity within the radio line of sight of the deployed system, including voice, fax, data and SMS (where available). Each unit can monitor up to 32 calls simultaneously, recording content and call-related information for both the called and calling parties along with the geographical location.

Smartscan- MEWS
MEWS (Modular Electronic Warfare System) is a software-driven spectrum surveillance system covering two megahertz to three gigahertz. It is designed to detect, collect and geolocate Radio Frequency transmissions. MEWS can be deployed as a standalone sensor or as part of a networked, coordinated sensor/effector array. MEWS is compact and lightweight, enabling it to be rapidly deployed in a host of land/littoral tactical EW applications.

L3HARRIS TECHNOLOGIES/QINETIQ
MEWS
The Modular Electronic Warfare System (MEWS) is a land COMINT sensor that was jointly developed by L3 TRL and Qinetiq. Utilising L3 TRL compact receiver technology and Qinetiq's EW Suite software application, MEWS provides a medium-weight EW capability within a lightweight package, providing flexibility in deployment and value for money. Using a range of antennas and power supply options, MEWS operates in manpack, static and vehicle-mounted modes, switchable in software for rapid transition between operations.

PATRIA AVIATION
ARIS
ARIS (Advanced Real-Time Intelligence System) is a remote-operable ELINT system for radar signal searching, monitoring, recording and analysis on microwave (0.5-40GHz) and V/UHF (20-3,000MHz) bands. The system installations are available for various vehicle types or for transportable shelters. There is also an open interface for integration to external systems. ARIS is currently a land-based system but can be configured to airborne and ship-borne ELINT operations. Weight: 87kg

RAYTHEON SPACE & AIRBORNE SYSTEMS
EWPMT
Raytheon's Electronic Warfare Planning and Management Tool (EWPMT) is a US Army programme which began in 2014, designed to support electronic warfare officers and provide situational awareness for brigade combat team commanders. EWPMT provides a screen display of EW and C4I activity in the area and can also be used for planning, emulation and evaluation.

ROHDE & SCHWARZ
ELINT systems
Rohde and Schwarz ELINT ground solutions are designed for sites or mobile platforms. Equipped with the R&S®WPU2000 Wideband Processing Unit and high gain antennas, the ground systems provide a significantly increased detection range and signal quality. The sensors can be operated 24/7/365 remotely controlled from a central headquarter. The solutions collect valuable radar parameters to

populate or update the national ELINT or Electronic Warfare (EW) databases.

R&S CA120

The R&S CA120 is a universal and versatile multi-channel signal processing and analysis solution for small and large systems. The scalable subsystem covers automatic operation for detection of conventional and LPI signals as well as baseband classification, including script-based demodulation and decoding with automatic production of content. The R&S CA120 includes a comprehensive library of demodulators and decoders.

R&S EB510

The R&S EB510 wideband monitoring receiver for the HF range features high-performance signal measurements in line with ITU recommendations (optional). Fast spectrum scan, selective call analysis and digital downconverters are available as options.

R&S EM200

The R&S EM200 is a cost-efficient and optimised receiver and direction finder in a compact format. It detects, analyzes and demodulates from eight kilohertz to eight gigahertz and optionally supports direction finding with Rohde & Schwarz compact DF antennas from 20MHz to six gigahertz. Its small form factor allows easy integration and use in just a few steps. It comes with an easy-to-operate and ready-to-use graphical user interface.

R&S ESMD

The R&S ESMD has a wide frequency range (8kHz to 26.5GHz), high RF performance, up to 80MHz real-time bandwidth and a variety of additional functions. The receiver can perform demanding signal search and monitoring tasks and, in combination with the R&S CA120, simultaneously demodulate up to 128 signals in HF and up to 32 signals in VHF/UHF/SHF.

R&S ESME

The EMSE wideband monitoring receiver covers a frequency range from 8kHz up to 6GHz. Possessing up to 80MHz of real-time bandwidth, it has three different scan modes and a high scan speed. A total of 128 digital downconverters (DDCs) are available for HF or up to 32 DDCs for VHF/UHF.

R&S PR200

The PR200 is a portable monitoring receiver that can detect, analyse and locate signals at frequencies between 8kHz and 8GHz. With up to 40MHz of real-time bandwidth, the PR200 features several tools for frequency and time domain analysis, as well as low SWaP requirements. Length: 19.2cm Width: 6.2cm Height: 32cm Weight: 3.5kg

R&S RAMON

The Rohde & Schwarz R&S RAMON radio monitoring software is used for customised COMINT/C-ESM systems – all from a single source. R&S RAMON employs standardised hardware and software components to offer a broad range of functions – from mission planning to data evaluation. The system enables fully automatic workflows for signal interception, emitter location, multi-channel processing and analysis.

R&S UMS400

The R&S UMS400 universal monitoring system can be used for tactical mobile electronic warfare vehicles dedicated to surveillance and geolocation from eight kilohertz to eight gigahertz and can be extended up to 20 GHz by means of the R&S CS-MC20 microwave converter. The compact outdoor housing allows a wide range of use cases from tactical vehicle integration to foot patrol transportation and tactical compound outdoor use.

SAAB MEDAV TECHNOLOGIES

ARS-8000

The Automatic Reconnaissance System (ARS-8000) is a family of systems for COMINT radio reconnaissance intended mainly for strategic, but also tactical applications. Systems are available in different-sized configurations, from fixed installations with several processing racks to smaller and semi-mobile solutions. ARS-8000 operates in a wideband HF, V/UHF and SHF range. Narrowband signals can be extracted and processed from the wideband signals. A planning module is included for setting parameters for special missions.

SAAB

Sirius SIGINT

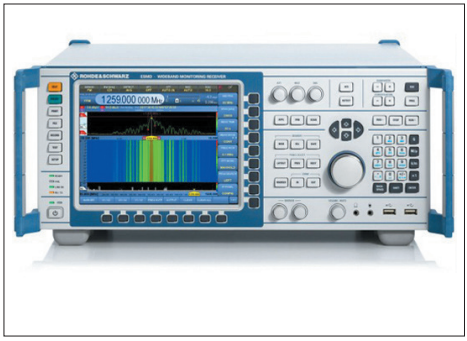
The Saab Sirius SIGINT system is a complete solution including airborne and ground segments. The airborne segment contains advanced COMINT and ELINT sensors that perform signal collection, while the ground segment includes mission planning and post-mission analysis.

SAGAX

SGX-ORION Integrated SIGINT/COMINT Receiver Systems

The compact wideband spectrum-monitoring SIGINT/COMINT receiver system is designed to search and monitor frequency spectrums in HF/VHF/UHF bands. Using a fast-scanning wideband receiver, the system is able to recognise and log the activity in the frequency spectrum.

The R&S ESMD has a wide frequency range (8kHz to 26.5GHz), high RF performance, up to 80MHz real-time bandwidth and a variety of additional functions. (Photo: Rohde & Schwarz)



SRM-3000 Multi-channel Monitoring and Collecting Receiver

The SRM-3000 is a HF/VHF multi-channel monitoring and collecting receiver. With a frequency pre-selector it can be used in HF bands as direct digitised receiver, while the frequency range can be extended using a VHF/UHF receiver front-end tuner with wideband IF output. The system's compact size, high channel density and high-level remote control functionality make it ideal for numerous system applications, including commercial frequency management and EW/SIGINT/COMINT missions.

SRS-3000 Wide-band Search and Intercept Receiver

The SRS-3000 is a frequency-agile, lightweight HF/VHF/UHF receiver designed for limited space and high-mobility applications in a ground environment. Its compact size, broad tuning range and high-level remote control functionality is designed for a multitude of system applications, including commercial frequency management and EW/SIGINT/COMINT missions. According to the company, the receiver couples high scan speed, high frequency and time resolution, high dynamic range and excellent selectivity to provide superior performance over many other receivers.

SSS-3000 RF/IF Storage and Delay Server

The SSS-3000 offers high-capacity, full-featured digital hard-disc signal record/playback capability in a compact rack-mount case. The storage server can be used to record and later play back the stored analogue signal with up to 40MHz instantaneous bandwidth. The bandwidth of the recording can be reduced by the built-in digital tuner to increase the storage capacity.

TCI

TCI Model 903S

The TCI Model 903S is a compact, man-portable COMINT and DF system, designed for transport by two personnel as well as mobile and transportable applications. The 903S system is typically configured with the TCI Model 649-8 high-performance, lightweight antenna array. The detection and DF of all signals range from 20 to 8,000MHz.

TELEDYNE DEFENCE & SPACE

QR020-M1 Phobos-R

The Phobos-R threat warner/radar electronic support measure (ESM) is a man-portable, end-to-end integrated EW sensor system comprising antennas, RF processing, digital processing, de-interleaving and emitter ID/library matching and operator interface. A key feature of Phobos-R is that there are no external RF cables, calibration or positional alignment requirements during set up. It is capable of operating on a variety of small platform types. The sensor employs a high degree of RF and demand-side platform (DSP) integration. Weight: 8kg

ULTRA ELECTRONICS TCS

UltraEAGLE

UltraEAGLE (Electronic Acquisition Gathering Locating Equipment) is a family of electronic support measures systems designed for a range of ELINT missions. It is available in various models covering C to K bands with direction-finding options including high directional gain steered antennas, monopulse and interferometer arrays.

UltraRAVEN

UltraRAVEN is part of a family of ECM systems designed for use in either ground-mobile or airborne applications. Each system is designed to operate standalone in a manned or unmanned configuration. The systems are tailored to each customer's needs to ensure optimum performance. Other features of the UltraRAVEN include real-time ECM control, multi-tasking ECM processor and high-power amplifiers with directional antennas.

DF SYSTEMS

ADSYS CONTROLS

PATS

The Passive Aerial Threat Surveillance (PATS) sensor produced by Adsys Controls is a detection and tracking system capable of monitoring airspace for extremely low-signature airborne threats such as small UAS. PATS offers full hemispherical threat surveillance. Up to 50 different threats can be simultaneously tracked by the sensor, which feeds into other sensor systems for warning and countermeasures. Length: 31.75cm Width: 31.75cm Height: 24.13cm Weight: 10kg Field of View - Azimuth: 360° Field of View - Elevation: 70° Maximum Signals Tracked: 50 Detection range: 10,000m

CHEMRING TECHNOLOGY SOLUTIONS

Resolve EW Suite

Resolve is a manpack electronic surveillance system designed for the interception, geolocation and exploitation of tactical communications. It has a true 40MHz instantaneous wideband capability, offering the operator effortless SIGINT delivery. The man-on-the-march operation uses an Android tablet-based user interface (Tacfix) which can transition across the full range of operational scenarios, from on the move to short, medium and long halt.

COBHAM ADVANCED ELECTRONIC SOLUTIONS

D-1509

The D-1509 is a compact, lightweight, MIL-qualified direction finding (DF) spinning Antenna System by Cobham Advanced Electronic Solutions, suitable for ground, sea and airborne platforms. It has a frequency coverage from 0.5-18GHz, and is capable of operating in full spin, variable spin, sector scan or manual mode to provide versatility and adaptability to mission requirements.

COBHAM ANTENNA SYSTEMS - UK

Cobham cavity-backed spiral antenna family

Cobham Antenna Systems has a range of traditional cavity-backed directional antennas, which can be

combined in a configuration to provide direction finding (DF) capabilities to a platform when used as part of a DF system. The antennas can be phased and amplitude matched at customers' request.

HENSOLDT SOUTH AFRICA

GEW MRD7

The GEW MRD7 is a multirole communications, direction finding (DF) and monitoring system for manpack, man-portable, mobile and special mission aircraft deployments. It has a frequency coverage of 1MHz-6GHz and can operate as a standalone system or as part of a networked operation.

GEW MRD600

The MRD600 is a high-speed, ultra-wideband direction finding (DF) designed by South Africa-based GEW. The MRD600 is designed for fast and accurate spectrum monitoring and direction finding. It can be used for standalone, single-operator spectrum surveillance solutions or as part of an integrated SIGINT or spectrum monitoring system.

GEW MRD5000/MRD7000

The MRD5000 and MRD7000 family range offers building blocks for wideband direction finding in Electronic Support Systems. Developed by South Africa-based GEW, it is capable of both strategic and mobile deployments with full-architecture implementation leading to a high probability of intercepting ultra-short signals.

GEW MRD5001

The wideband GEW MRD5001 is a HF direction finding (DF) system, providing high performance with single-capture interferometric operation for demanding signal environments. It combines a high rate of data capture with the frequency resolution offered by sensitive narrowband equipment in order to detect and measure signals with high-frequency accuracy. It also supports super resolution.

GEW MRD7000w3H

The GEW MRD7000w3H three-channel, wideband, HF, direction finding (DF) system is designed to provide an optimal match between performance and price, meeting requirements in the HF environment, according to the company. The system operates in a frequency range of 100kHz-30MHz and has a scan speed of 400MHz/s.

GEW MRD7050C Skylark

The GEW MRD7050C Skylark is a surveillance/direction-finding system, available in both wideband and narrowband formats. Due to its compact size and being DC-powered, the GEW MRD7050C is suitable for compact mobile installations and transportable applications.

GEW MRD7090

Utilising integrated circuitry and covering the full spectrum from 1MHz-3.6GHz (9GHz optional), the GEW MRD7090C provides a system for wide bandwidth direction finding (DF) and also includes the function of simultaneous monitoring without interrupting the taking of bearings. With an 80MHz instantaneous bandwidth and Interferometric operation, the system achieves up to 80GHz/s scan rate.

L3HARRIS TECHNOLOGIES

EGON

L3Harris' EGON is a counter-IED system designed to address all current and emerging radio-controlled IED threat. The active-reactive counter IED system has been operationally deployed since mid-2010 and can be tailored to meet individual mission requirements in less than 15min.

MS INSTRUMENTS

Hostile Fire Indicator Type 740

MS Instruments' Type-740 Hostile Fire Indicator is designed for rotary-wing aircraft to provide the crew with warnings of incoming small arms fire. The equipment provides an indication of the point of origin so that this can be avoided or engaged kinetically. Length: 9.4cm Width: 4.1cm Height: 22.8cm Weight: 3.95kg

ROHDE & SCHWARZ

Direction finding and geolocation subsystems

The Rohde & Schwarz digital direction finder (DF) family provides a range of systems for portable, mobile or stationary applications from 300kHz-6GHz. The portfolio ranges from portable single-channel devices such as the R&SDDF007 to the dual-receiver wideband R&SDDF550 and the high-performance three-channel R&SDDF5GTS. Operators can choose the suitable antenna for their application from more than 25 high-performance DF antennas.

R&S ARGUS

The R&S ARGUS system software combines powerful monitoring tools with easy and efficient operation to ensure spectrum monitoring in a military context. It integrates the complete range of Rohde & Schwarz monitoring receivers and direction finders (DFs). It can be used in manual, interactive, automatic and remote-control mode, for one portable device or nationwide systems.

R&S DDF1GTX

The DDF1GTX is a high-speed, HF, direction finding (DF) system that can cover a frequency range between 300kHz and 6GHz. With a real-time bandwidth of 30MHz and up to ten receive channels, the system is capable of measuring all signals across the HF range in one test step. When earmarked for use in complex environments, the DDF1GTX can be equipped with an optional beamforming function to increase the signal-to-noise ratio.

R&S DDF5GTS

The DDF5GTS is a high-speed scanning direction finding (DF) system that can automatically locate frequency-agile signals in complex environments. With a three-channel architecture and 80MHz real-time bandwidth, it has a fast DF scan speed and greater accuracy, sensitivity and immunity to reflections. Designed to operate in conjunction with R&S ADDx multichannel DF antennas,

the DDF5GTS can be connected to a DC power supply and used in mobile applications.

R&S DDF550

The DDF550 wideband direction finding (DF) system is designed to be used in conjunction with R&S ADDx DF antennas. Capable of finding signals up to the 6GHz range, it can be combined with an optional preclassifier for automatic location of frequency-agile signals. In addition to the standard version, a DC-powered model is available for mobile applications.

R&S DDF1555

The DDF1555 is a compact direction finding (DF) system designed for use in outdoor environments. Capable of covering a frequency range between 20MHz and 6GHz in DF mode or between 9kHz and 7.5GHz in receive mode, the system has a low power consumption to prolong battery life. In addition to being used in a temporary static position or as a portable system, an optional magnetic mount vehicle adaptor also allows the DDF1555 to be used in a mobile role. Length: 30cm Width: 21.08cm Height: 8.76cm Weight: 4.5kg

R&S EB500

The R&S EB500 monitoring receiver is designed to meet demanding radio monitoring tasks in stationary and mobile environments where power-saving operation is required. The receiver can be operated via the front panel or remote controlled. It performs high-speed signal searches in the spectrum and uses wideband demodulation for processing. In addition, the R&S EB500 can be used for a variety of other applications, including direction finding (DF) and time difference of arrival (TDOA) location processing.

R&S MobileLocator

The MobileLocator is a COTS direction finding (DF) system that can be used to detect and automatically locate a transmitter from a moving DF vehicle. Capable of operating in the 20MHz to 6GHz frequency ranges, the MobileLocator can be easily installed in most commercial vehicles, including helicopters. Once an operation has been concluded, it can generate an interference search report for post-operational analysis. Weight: 6kg

R&S PR200

The PR200 is a portable monitoring receiver that can detect, analyse and locate signals at frequencies between 8kHz and 8GHz. With up to 40MHz of real-time bandwidth, the PR200 features several tools for frequency and time domain analysis, as well as low SWaP requirements. Length: 19.2cm Width: 6.2cm Height: 32cm Weight: 3.5kg

GUNSHOT DETECTION SYSTEMS

ACOEM GROUP

Pilar

The Pilar sniper countermeasures system was originally developed by Metravib to detect the direction and distance of a gunshot. By using muzzle blast and shockwave information, the Pilar can indicate the shot source in order to facilitate quick reaction. The Pilar can be interfaced with RCWS, GPS or inertial navigation systems.

PILAR V

Manufactured by Metravib Defence, part of the ACOEM Group, PILAR V is an acoustic gunshot detector. It uses the sound waves generated by the firing of small arms, RPGs and mortars to detect and accurately identify their location in real-time, allowing the system's users to react appropriately to lethal threats. Field of View - Azimuth: 2° Field of View - Elevation: 3°

PilarW

PilarW is a soldier-wearable, passive acoustic GDS that indicates hostile shooter positions, tracks target locations and enables directed return fire, all on the move and through 360°. Outputs include azimuth, elevation, range and calibre of threats. Some configurations output detected threat grid co-ordinates. PilarW can be mounted on an assault rifle or GPMG. Microphones can also be vest-mounted. Length: 28cm Width: 21cm Height: 7cm Weight: 3.6kg

ELBIT SYSTEMS EW & SIGINT – ELISRA

G-Force

Elisra's G-Force concept creates a ground-based 'protection umbrella' for civilian airports that protects aircraft in their most vulnerable situation – while taking off and landing. G-Force detects the threat, locates its position continuously and integrates with ground-based active countermeasures to thwart the attack. The concept can be adapted to any size arena, and also deployed in other highly sensitive areas, such as energy installations.

SWAD

Small Arms Fire Warning and Direction (SWAD) is a passive stationary EO system designed to protect high-value infrastructure and strategic areas by detecting small-arms fire and locating the source. SWAD analyses fire patterns, including duration and intensity, and classifies the weapon type. Imaging and processing techniques precisely locate the source of the incoming fire. SWAD detects multiple small-arms/sniper fire sources simultaneously, day and night, at long ranges and with high precision.

ELTA SYSTEMS

ELO-5220

The Othello and Talent ELO-5220 are persistent, day and night, SWIR-based EO GDS modules designed to support a variety of surveillance systems for situational awareness images. The module detects IR signal transients caused by gun muzzle flashes and indicates the direction of a gunshot event within its FOV.

MS INSTRUMENTS

Hostile Fire Indicator Type 740

MS Instruments' Type-740 Hostile Fire Indicator is designed for rotary-wing aircraft to provide the crew with warnings of incoming small arms fire.

The equipment provides an indication of the point of origin so that this can be avoided or engaged kinetically. Length: 9.4cm Width: 4.1cm Height: 22.8cm Weight: 3.95kg

VHFI

The Vehicle Hostile Fire Indicator (VHFI) acoustic GDS was originally developed for helicopters and is now being adapted to ground vehicles. It is able to warn crew that they are under fire and gives general direction of where bullets are coming from. Five piezoelectric plate transducers detect shockwaves from supersonic bullets and feed signals to a central computer that generates visual and aural warnings.

NORTHROP GRUMMAN INNOVATION SYSTEMS

ShotFinder Acoustic Hostile Fire Detection

Northrop Grumman's ShotFinder is a hostile fire detection system designed to protect aircraft against small arms and light weapons fire. The apparatus employs acoustic technology to detect incoming fire and to compute its location. Northrop Grumman claims that ShotFinder can detect fire at ranges of between 50 metres (164 feet/ft) up to three kilometres (1.9 miles). It continues that the system can detect fire from small to large calibre weapons from 5.45mm to 40mm including tracer and anti-aircraft artillery. Length: 33cm Height: 2.54cm Weight: 3.6kg

QINETIQ NORTH AMERICA

EARS/SWATS

EARS/SWATS is a shoulder-worn acoustic targeting system that instantly detects and locates the origin of hostile gunfire. The system is designed to provide situational awareness and protection to those who need to quickly locate and respond to enemy threats. SWATS is designed to be rugged and reliable and has been field-proven by the US Army, USMC and other armed forces and national police around the world. Weight: 0.31kg Detection range: 700m

QINETIQ

Alarm

The Alerter of Approaching Rocket Munitions (Alarm) radar is designed to provide notification of an attack by short-range rockets. Multiple radars can provide protection for an operating base. A low-power solid-state transmitter and a sensitive low-noise receiver give a high probability of detection of low-radar cross section rockets. The radar can be operated 24h a day. It can also be configured in the field and has a modular construction for rapid assembly.

RAFAEL ADVANCED DEFENSE SYSTEMS

SpotLite M

The SpotLite M system is designed to accurately detect, classify and track small arms fire as well as anti-tank guided missiles (ATGMs), at ranges greater than the effective range of the respective weapon. The capability to detect fire of both small arms, RPG and ATGMs, allows mission flexibility and provides situational awareness.

SpotLite P

SpotLite-P is a portable EO muzzle flash detection and positioning system. The system is based on Rafael's experience gained in the area of flash detection and location of various hostile fire sources. The SpotLite-P detects, locates and classifies small arms, RPG and anti-tank guided missile fire sources in less than a second.

RAYTHEON BBN TECHNOLOGIES

Boomerang III

The Boomerang shooter detection system uses passive acoustic detection and computer-based signal processing to locate the shooter. When mounted on a vehicle, the system operates when the vehicle is stationary or moving. Boomerang uses a single mast-mounted compact array of microphones to detect incoming fire. The system detects incoming supersonic small-arms fire for bullet trajectories passing the mast, and for shooters firing at maximum effective weapon ranges.

Boomerang Warrior-X

Boomerang Warrior-X combines acoustic processing technology with lightweight hardware to provide a proven shooter detection system for the dismounted soldier. The Warrior-X system is designed to alert the individual to hostile small-arms fire and accurately localise the shooter's position, allowing a rapid, informed and coordinated response. The system works in both urban and mountainous terrain, without the need for user input. Length: 4.3cm Width: 8.1cm Height: 10.9cm Weight: 0.34kg

RHEINMETALL DEFENCE ELECTRONICS

SLS

Rheinmetall Defence's Sniper Locating System (SLS) enables reliable detection of snipers before a single shot is fired using reflections from the sniper's rifle optics. The system's range is at least as great as the maximum effective range of a sniper rifle, says the company. An optical and acoustic signal instantly warns the SLS operator of an acute threat.

RHEINMETALL

Acoustic Shooter Locating System (ASLS)

The compact Acoustic Shooter Locating System (ASLS) consists of a powerful acoustic sensor with integrated analysis electronics and a compact control and display unit. The sensor, designed for 360-degree coverage, has eight specialised microphones that measure the acoustic fingerprint of discharged weapons. Weight: 5kg

ULTRA ELECTRONICS COMMAND & SONAR SYSTEMS

RMGL

The Rifle Mounted Gunfire Locator (RMGL) developed by Ultra Electronics is suitable for a wide range of military

and security applications. It quickly and accurately detects and locates the hostile firing point or multiple positions with a visual display of direction, distance and elevation, if relevant. Currently optimised for rifle-mounted applications, the system alerts the individual under attack by displaying, on a 1in mobile-phone-like screen, the target information. Weight: 0.5kg

JAMMERS

AEGIS COREA

IEDS-200

The IEDS-200 is an RF jammer that is designed to prevent remote-controlled detonation of IEDs via mobile phone networks and other radio systems. The 9kg unit's bandwidth coverage encompasses code division multiple access (CDMA), global system for mobile communication (GSM), VHF, UHF and RC. It fits into a briefcase with no external antenna and can also be fixed to ceilings and walls. It will operate for 30-60min on internal batteries or indefinitely on external power (110-240V/50-60Hz). Weight: 9kg

ALLEN-VANGUARD CANADA

3XXX

The 3XXX ECM suite is a combination system based on the fully programmable 3140 and 3230 ECM units. The company states that 3XXX suites have been widely deployed across numerous global conflict zones and provide protection for several key agencies and military and civilian personnel. The 3XXX suite can be deployed in many ways to offer electronic vehicle protection or static point protection and can be configured to address varying threat frequency profiles.

Equinox

Equinox is Allen Vanguard's latest vehicle-based EW platform used to defeat remote controlled improvised explosive devices (RCIEDs). It is described by the company as a fully networkable, software-defined and open-architecture system which provides capabilities in line with standards set by several large military development programmes.

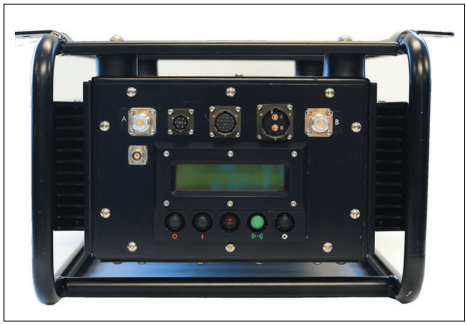
Scorpion 2

Scorpion 2 is a man-portable, non-ITAR remote controlled improvised explosive device (RCIED) jammer, designed to deliver a hybrid, full-spectrum system and threat-band coverage protection for dismounted personnel on the move and at stationary checkpoints. Allen-Vanguard unveiled the Scorpion 2 at the 2016 CANSEC trade show.

ASELSAN

Chameleon

Aselsan's Chameleon Tactical Signal Emulator radiates signals in RF communication band by programming parameters such as channel spacing, modulation type, tone/code and RF output power level. Chameleon is capable of emulating most of civilian/military-type radios. It can be used as an arbitrary waveform generator or programmable noise generator. It has the ability to generate both EW and civilian communication waveforms with a single generator.



The 3XXX ECM suite is a combination system based on the fully programmable 3140 and 3230 ECM units. (Photo: Allen-Vanguard Canada)

EJDERHA HPEM System

Aselsan's high-power electromagnetics (HPEM) EJDERHA system generates high-amplitude electromagnetic fields in specific frequencies and directs them to the potential targets such as electronic circuits of IEDs with its directional antenna-reflector set. The system has the effects of suppression, predetonation, resetting the control system, durable blocking and stopping the operation.

Gergedan

The Gergedan remote controlled improvised explosive device (RCIED) jammer is designed to protect convoys, VIP vehicles in motion and static infrastructure (high-value assets, checkpoints etc) against RCIEDs by jamming the communication between these devices and threats. With utilisation of modular, multi-band RF transmitter and digital frequency synthesis techniques, the software-defined jammer creates effective RF interference to prevent triggering of RCIEDs.

Kangal

Kangal is a member of the KIRPI RCIED jammer family. It is designed to provide EOD experts with protection by creating effective RF interference to prevent the triggering of remote controlled improvised explosive devices (RCIEDs). Utilising software-defined jammer technology and digital frequency synthesis techniques, Kangal is fully programmable over the whole frequency band that allows customisation flexibility for specific operational and tactical requirements.

KIRPI

KIRPI is designed to provide patrols with a protection umbrella by creating effective RF interference to prevent the triggering of radio controlled IEDs. KIRPI can be configured to provide protection for foot patrol, VIP vehicles (attaching the system on a passenger seat or integrating it in a roof-rack on top of the vehicle), checkpoint or facility protection, among others.

Koral
The KORAL supports suppression of enemy air defence operations. The system is composed of electronic support (ES) and electronic attack (EA) systems, each mounted on an 8x8 tactical truck. The system is operated by two operators within the operator control unit (OCU): one ES operator for the detection, analysis and direction finding (DF) functions; and one EA operator for jamming, deception and source allocation functions.

Kovan
Aselsan's suitcase global system for mobile communication (GSM)/Wi-Fi jammer system is designed for cellular or mobile phone jamming. The Kovan provides a protection umbrella against eavesdropping and sensitive information leaks, as well as assuring cellular silence. By using modular multi-band RF transmitter and digital frequency synthesis techniques, the GSM jammer system creates radio frequency signals to block cellular communications.

MİLKAR-3A2
Aselsan's MILKAR-3A2 mobile V/UHF jamming system has been developed for electronic attack operations against V/UHF frequency-band communication systems located on different platforms in the field. The system's aim is to reduce or completely block target V/UHF communications and/or cause incorrect data transmission. The system has a power amplifier subsystem that provides high-power RF output on a wide frequency band.

MİLKAR-4A2
Aselsan's MILKAR-4A2 mobile, high frequency, jamming system has been developed for electronic attack operations against HF frequency band communication systems located on different platforms in the field. The system's aim is to harm or completely block target HF communications and/or cause incorrect data transmission ensuring advantage for friendly troops in tactical field.

OPKAR G2- Remote-Controlled EW System
OPKAR G2 includes high-speed DDS (direct digital synthesis) and RF technology in an integrated package. Field units can be operated individually, remotely or in coordinated groups, typically deployed across an area to form an EW minefield. OPKAR also includes audio-interference jamming and deception modes of operation. It can be reprogrammed to add jamming profiles for jamming operations and audio records for deception operations. Weight: 17kg

REDET
Aselsan's REDET is a truck-mounted electronic support measure system designed to intercept, detect, identify and provide direction finding and geolocation of target radars. The system is mounted on an 8x8 tactical truck and each mobile radar electronic support and electronic attack system is operated by one operator within the control unit of each system.

Sapan
The Sapan programmable active/reactive jammer is designed to protect convoys against remoted controlled improvised explosive devices (RCIEDs) by jamming the communication between these devices and threats. Sapan has the ability to quickly survey the frequency spectrum and react immediately on the active signals. The hardware and the software algorithms have been designed so that any inevitable delay and all processing periods are minimised/optimised within the system. Ultrafast wideband tuners and defence digital service (DDS) based, FPGA-controlled exciters are used.

CETC INTERNATIONAL

JN1101
The JN1101 Vehicular Communication EW System is a reconfigurable, integrated, land-based system operating in HF and V/UHF. It is designed to intercept and analyse enemy communications and carry out location-fixing and jamming on target platforms. This includes air-to-air, air-to-ground and coordination communications. The JN1101 is also available for Ship-borne and UAV communications (JN1101-S and JN1101-U).

COBHAM ANTENNA SYSTEMS - UK

Cobham directional spiral antenna family
Cobham Antenna Systems produce a range of rugged and high-power directional spiral antennas that provide 5-10dBiC gains with circular polarisation. The products are suitable for applications where the polarisation of the RF signal to be countered is unknown. They are much shorter than the equivalent Horn Antennas and can cover wider bandwidths.

Cobham omni-directional antenna family
Cobham Antenna Systems has designed and manufactured a range of wide-band omni-directional antennas for 360-degree RF jamming. The same products can be used for ELINT, where they can be used at extended frequencies which are outside the standard high-power range. Custom design work is also regularly undertaken for customers to meet niche requirements and applications for specific frequencies, or where two or more antennas are required in the same housing.

ELBIT SYSTEMS EW & SIGINT – ELISRA

EJAB
The Electronic Jamming Anti Bomb (EJAB) utilises Elisra's battle-proven electronic jamming capabilities to block the remote activation of IEDs via RF and other communication means – radio, mobile phone, satellite and remote-control devices. The jammer can be either vehicle-mounted or manpacked. Developed in response to the requirements of Israel's security forces, the modular EJAB enables customers to extend the frequency range to meet emerging combat zone requirements.

MRJ Family
The Miniature Reactive Jammer (MRJ) family is a group of reactive systems that can be configured as reactive, active or a combination of both in order to jam remote controlled improvised explosive devices (RCIEDs). It is available in multiple configurations, including vehicle-mounted, man-packed and in a portable rolling case. Weight: 20kg

ELEKTROLAND

Jam-SZ series

The Jam-SZ-series jammers prevent operation of radio-controlled explosive devices. The jammers in this series include the Jam-SZ80, the Jam-SZ100 and the Jam-SZ150. All are vehicle-based jammers. However, the Jam-SZ150 can also be used as as a backpack jammer. Each jammer can be controlled from the distance of 300m. The SZ80 has a total power of 80W, while the SZ100 has a total power of 100W.

ELETTRONICA

ELT/334

The ELT/334 is a Counter - Radio-Controlled IED (C-RCIED) system used to provide "en route" protection during the movement of personnel deploying from patrol bases. The system offers the field commander some functions that contribute to reducing the enemy's combat capability by use of IEDs as weapons and enables them to retain the combat initiative and information superiority on the field. The system consists of an ES/EA solution featuring the most advanced techniques and waveforms to counteract the RC-IED threats. It is designed to protect dismounted ground troops from remotely activated explosive devices and to provide communication jamming. The targets of the ELT/334 system are the signals present in the VHF/UHF bands and in the cellular bands.

ELT/335

ELT/335 is a wideband communication jammer system designed for both airborne and ground installations to intercept (CESM) and disrupt (CECM) radio communications in the HF, VHF, UHF and SHF frequency bands. And deny the COMINT operations of the enemy without interfering with the friendly communications. The system is used for scanning the electromagnetic spectrum over the complete frequency range defined in the mission planning phase.

ZENITHAL JAMMER

The ZENITHAL JAMMER is an advanced integrated system of electronic countermeasures against SAR systems, and it is designed to identify and react to a wide range of SAR threats. The product is an all-in-one solution for search-track-countermeasure of aerial threats equipped with Synthetic Aperture Radars to deny/degrade the use of the electromagnetic spectrum (jamming) and create false targets or obfuscate the actual target with fake images/spots. The product is particularly effective in land and naval operations against aerial platforms equipped with radar imaging sensors, such as drones or satellites. The system is based on a solid-state AESA mono-pulse architecture, with receiving/transmitting capability, reprogrammable in terms of countermeasures techniques and wide operational bandwidth.

ELTA SYSTEMS

ELI-3375 counter-IED suite

The IAI ELTA ELI-3375 C-IED and counter-mine suite (CIMS) is an integrated protection system for detection of surface and underground IEDs, mines and roadside bombs. The CIMS was designed under the guiding principle that no single sensor can provide the adequate detection probability and low false alarm rate required by today's operational C-IED needs.

ENTERPRISE CONTROL SYSTEMS (ECS)

BlackTALON Counter-Drone System

The BlackTALON Counter-Drone System provides detection, location, identification, tracking and RF inhibition of drones. BlackTALON Model 982 incorporates Radar and RF sensors for drone detection, identification, location, and tracking; an electro-optical sensor for drone verification and video tracking; and a multi-channel RF inhibitor for drone defeat.

Claw Directional Inhibitor System

The Claw Inhibitor system provides directional inhibition capability over five independent RF bands (GNSS, 433 MHz, 915 MHz, 2.4 GHz and 5.8 GHz). Claw is designed to defeat and neutralise UAV threats.

Dart

The Dart RF Inhibitor has been designed to provide an efficient and effective system in a small, highly ruggedised package. Dart models were available in the UHF, satellite phone, 3G and WLAN bands; the system is now out of production. Dart 9 provides a single unit covering the GSM900 and GSM1800 bands. This single unit can easily be transported on-site, switched on and pointed for instantaneous jamming of mobile phone signals.

HENSOLDT SENSORS/MYDEFENCE COMMUNICATION

Xpeller

The Xpeller C-UAV system detects intruding aircraft over critical areas at long ranges and can neutralise them using electronic countermeasures, thereby minimising the risk of collateral damage. The modular Xpeller product family consists of radars, IR cameras and long-range jammers from Hensoldt, close-in RF detectors from Danish company MyDefence and short-range optical/acoustic/RF sensors from Dedrone. In early 2017, a lightweight jamming system from Hensoldt subsidiary Hensoldt South Africa (formerly Gew Technologies) was added to Xpeller. Range: 4km

HENSOLDT SOUTH AFRICA

CSJ10000

The CSJ10000 mobile phone jammer uses RF and digital signal synthesis technology to suppress mobile networks and other targeted mobile communications devices. The vehicle-mounted system is suited to long-range targeted jamming of cellular networks and satellite phones.

GEW GMJ9

The new-generation software-defined multirole GEW GMJ9 jammer combines a responsive jammer to counter remote controlled improvised explosive devices (RCIEDs) for vehicle patrol activities and a tactical communications jamming capability in a single system. At its core is a high-performance COMINT receiver,

which continuously monitors the frequency spectrum for threat signals and allows it to calculate the most effective use of its available jamming resources by precisely targeting those signals that pose a threat with specialised waveforms.

GEW H/V/UHF Communications Jamming System

Hensoldt South Africa offers a range of HF and V/UHF Communications Jamming Systems, providing a COMJAM capability against modern VHF/UHF signals, including spread-spectrum communications. Designed to be self-contained, with application-specific power amplifiers and antennas, the systems may be installed at a fixed location for static use or inside a transportable shelter for use in the tactical arena.

GMJ9000B

The GMJ9000B series of jammers utilises both RF and digital signal synthesis technology to suppress remote activation signals. Using broadband antennas, electronic circuitry and countermeasure algorithms combine in a solution to short-range radio-controlled IED protection and drone jamming requirements.

HI-TECH ELECTRONICS

DMR-1

The DMR-1 is described as a wide-frequency bomb jammer, covering the 20-2,020MHz band. It provides a jamming range of around 30m from a 26W output, and the internal antenna is hidden. As a portable system, it weighs 10kg and measures 46x34.5x24cm. It runs for 60min on internal batteries or indefinitely on mains power. Length: 46cm Width: 35cm Height: 24cm Weight: 10kg

DMR-2

The DMR-2 is intended for fixed-site or vehicle-mounted applications. The 23kg, 52.8x52.8x13.8cm system covers the 20-2,600MHz frequency band and offers a range of around 35m from its 62W output and external omni-antenna. It runs on 12V DC power. Length: 53cm Width: 53cm Height: 14cm Weight: 23kg

DMR-3

The DMR-3 is a briefcase-sized 12kg remoted controlled improvised explosive devices (RCIED) jammer covering the 20-520MHz frequency band. It offers a range of 'not less than 30m', with 60min operation on its internal rechargeable battery and unlimited operating time on external power, for which it has an AC/DC adapter. It has an internal antenna and can be fitted with a larger external one. In addition to being used as a portable device, the system can also be vehicle-mounted. Length: 46cm Width: 38cm Height: 12.5cm Weight: 12kg

DMR-22

The DMR-22 is larger, more powerful and boasts a longer range than the DMR-2. Also a vehicle-mounted or fixed-site bomb jammer, it has a power output of up to 355W and offers a range of around 40m. It uses an external omni-antenna and runs on 12V DC power.

HOMELAND SECURITY STRATEGIES

Manpack-6 Bomb Ranger

Manpack-6 is a portable jamming system that can be carried by a person in areas where there is a risk of encountering remoted controlled improvised explosive devices (RCIEDs). The system for EOD personnel is designed to jam pre-set radio spectrum frequencies and blanket entire areas. It emits radio energy to jam transmissions including shortwave and VHF frequencies, VHF aviation and satellite navigation systems, commercial simplex (duplex), trunking, cellular and satellite.

Terrorist Trap VIP-16

The Terrorist Trap VIP-16 is a remote-controlled jammer, operable from an undisclosed range. It can interrupt remote controlled improvised explosive devices (RCIEDs) in isolated areas such as hazardous territories, mountains and desert terrains, and be operated by the user from a safe distance. It is comprised of jamming modules that work with radio noise generators in conjunction with proprietary software, power amplifiers and an antenna feed. These modules are activated by an automated control unit (by long-range data transmitters).

VIP-200

The VIP-200 is a handheld bomb jammer built into a briefcase. It is designed as an IED jammer in that it transmits RF interference that blocks radio receivers found in a cellular IED, satellite phone IED, mobile IED or radio IED from obtaining any RF signals, and prevents a remoted controlled improvised explosive device (RCIED) from receiving a detonation signal. The RF jammer neutralises the detonation signal as a result of the saturated level of RF interference.

VIP-300C

The VIP-300C is an remote controlled improvised explosive device (RCIED) jamming system for devices that use an RF transmitter as a means of detonation. To counter an RCIED attack, the jammer neutralises the remote activation signal with a high level of radio interference to prevent the explosive device from triggering. This interference blocks radio signals of mobile phones, walkie-talkies and satellite phones.

The GMJ9000B series of jammers utilises both RF and digital signal synthesis technology to suppress remote activation signals. (Photo: Hensoldt South Africa)

VIP-300F
The VIP-300F Convoy Jamming System is an IED jammer for use by a group of vehicles travelling together as a convoy for security. It consists of a configuration of Bomb Jammer broadcasting modules that emit radio interference from various vehicles within the convoy. This interference is essentially a series of multiple RF jamming signals that are transmitted at high speed and envelop any radio receiver within their area of effectiveness.

VIP-300S
The VIP-300S is a vehicle-mounted modular radio signal jamming system designed for defensive jamming of remoted controlled improvised explosive devices (RCIEDs) using RF technology to disrupt trigger devices. The system can be mounted in a single vehicle or transferred between vehicles.

VIP-300T
The VIP-300T is a high-power IED jammer that can be installed into the boot of a car, rear of a truck or inside an armoured vehicle. It saturates the environment with RF pulses of electromagnetic energy and can deal with cellular, satellite phone, and low- and high-band radio-wave IED threats. The jammer is designed not to break squelch on a walkie-talkie.

VIP-300U/O
The VIP-300U/O is an upgraded transportable RF jammer that uses a proprietary barrage-jamming method to defeat remoted controlled improvised explosive devices (RCIEDs). It incorporates optional jamming modules for extended frequency coverage as well as increased output compared to the VIP-300U. Intensifying the power output helps to increase the level of protection in order to jam the radio receivers of an RCIED, especially if the transmitter is located in close proximity to the receiver/detonator.

VIP-300WOTS
The VIP-300WOTS vehicle-mounted modular multi-band radio signal bomb-jamming system is designed to suppress the extended spectrum of radio signals used to detonate a remote controlled improvised explosive device (RCIED). It transmits 'fast random sweep' signals that interfere with current threats, including mobile phones, walkie-talkies and satellite phones. It creates intensive barrage interference within the whole frequency range and simultaneously amplifies the jamming signal on the narrow-frequency channels, making it more effective against the use of walkie-talkies and mobile phones.

VIP-600
The VIP-600 is a portable IED or bomb jammer built into a backpack, designed for defensive jamming of remote controlled improvised explosive devices (RCIEDs). The VIP-600 broadcasts radio-wave energy, blanketing an entire area to prevent radio receivers from acquiring the detonation signals for RCIEDs. It is a man-portable system for law enforcement and military forces in the field. It can also be placed in a vehicle for greater mobility when securing areas against RCIEDs.

VIP-900
The VIP-900 is a stationary modular radio signal jamming system designed for defensive RF jamming of remote controlled improvised explosive devices (RCIEDs). The RF jammer helps secure and protect people in and around office buildings, embassies, consulates and border checkpoints from remote-controlled weapons. The RF jammer may also be used to protect homes, schools, convention halls, public buildings, hotels and other civilian gathering places. Weight: 35kg

JSC "RUSSIAN ELECTRONICS"/KRET

Repellent Anti-UAV Complex
The Repellent Anti-UAV EW complex is a counter-drone system that has been designed to neutralize and disrupt enemy small and medium-sized UAV, remotely piloted aircraft system (RPAS) and UAS. It is most commonly used to prevent terrorist attacks, espionage and other malicious activity targeting both critical military and civil infrastructure. The system was developed by JSC Scientific & Technical Center of Electronic Warfare (STC-EW) and is manufactured by KRET. Range: 30km

KINTEX

Mobile, Manpack and Portable Jammers
Kintex offers mobile, manpack and portable remote controlled improvised explosive device (RCIED) jammers to protect single objects or groups of moving objects, groups of people, cars and small-area targets. The jammers consist of different numbers of transmitting modules that operate independently. The modules jam frequency bands with different bandwidths. They are mounted on one common mechanical frame and can be controlled either by their own control panel or remotely (by cable).

KIRINTEC LTD

Mercury Blade 5
Blade 5 is a vehicle-mounted platform for jamming systems. Developed from the design of the Mercury Blade 4, Blade 5 has been designed as a high assurance ECM unit for force protection and or VIP protection. It is available in three frequency bands: low, mid and high. It can be adapted as the threat increases or for operations in different geographical locations. Length: 45cm Width: 42cm Height: 25cm Weight: 45kg

Special Operations Jammer
Kirintec unveiled its Special Operations Jammer (SOJ) in February 2017. The SOJ focuses on the domination of the electromagnetic spectrum and radio waves covering a range of 20MHz-2.7Ghz. The SOJ is a man-portable range of electronic attack systems that generates up to 45W of power and has three signal sources. Length: 46cm Width: 31cm Height: 14cm Weight: 15kg

KRET

Krasukha-2/4
The Krasukha-2 is a truck-mounted EW system in service with the Russian Army. According to open source

information, the Krasukha-2 is designed to provide EW protection to large fixed sites such as C2 centres, air defence installations, deployed formations of troops and industrial facilities. Open sources continue that it has been designed to provide EW protection against precision-guided weapons, presumably those which use either radar or GPS guidance.

L3HARRIS TECHNOLOGIES

Broadshield MCS-FP

The MCS-FP (Modular Countermeasures Suite - Force Protection) manpack is a compact, lightweight, programmable jammer available in two variants, operating over the 20-520MHz range and 420-6,000MHz range. Previously marketed under the Broadshield product name, the MCS-FP manpack can be rapidly reprogrammed in the field using a Windows-based laptop PC/PDA to change its jamming waveforms, target frequencies and operating parameters.

Broadshield- HCS

The High-power Compact System (HCS) is L3 TRL's latest generation high-power active, reactive and hybrid jammer utilising the modular countermeasures suite (MCS) technology. The HCS seeks to optimise the trade-off between SWaP and operational performance. The modular, quick-release design enables individual MCS units to be rapidly reconfigured and for future dismounted and EOD carry-forward operations.

Broadshield- LCS

The Lightweight Countermeasures Suite (LCS) is a small form factor manpack inhibitor. Utilising the company's modular countermeasures suite (MCS) technology, the LCS offers active only coverage across the full RCIED threat spectrum. The LCS is available in two variants: LCS-LLA operating over 20-520MHz; and LCS-LHA operating over 420MHz to 6GHz.

Broadshield- MCS-EA

The MCS-EA is a compact, programmable and Modular Electronic Surveillance (ES) and Electronic Attack (EA) system capable of mounted and dismounted operations in the tactical EW environment. Built on L3 TRL's latest convergent technology, MCS-EA covers the 20MHz to six gigahertz threat spectrum. The unit contains an integral receiver, allowing it to scan target frequencies up to three gigahertz. Length: 9cm Width: 22.9cm Height: 28.2cm Weight: 9kg

Corvus- PECM

Corvus is a multi-role, scalable platform supporting operations across Cyber and Electromagnetic Activities (CEMA). The Corvus architecture is rapidly reconfigurable to deliver force protection, individual communications, direction finding, electronic support measures, electronic attack and SIGINT missions. Corvus has been created to enable mission-specific applications to be developed and deployed faster than conventional approaches.

CREW Vehicle Receiver/Jammer (CVRJ)

The CREW Vehicle Receiver/Jammer (CVRJs) is a vehicle-mounted electronic jammer designed to prevent the detonation of IEDs. The CVRJ counters existing and evolving RF threats by jamming each threat's transmitted RF signals. The system is reprogrammable and adaptable to changes in the threat environment. Width: 35.56cm Height: 33.02cm Weight: 31.3kg

LEONARDO DRS

SI-8649A/PF PicoFlexor Transceiver

The PicoFlexor Transceiver is a miniature tactical software-defined radio (SDR) platform that integrates a transmitter with a high-performance SIGINT superheterodyne receiver in a single, low-SWaP package. The unit's SIGINT receiver supports a frequency coverage of 2MHz to 3GHz with an instantaneous 25MHz bandwidth and can be used for jamming. The system was unveiled in August 2012 and is believed to be for ground and air applications. Length: 14.2cm Width: 7.62cm Height: 4.5cm Weight: 0.84kg

LOCKHEED MARTIN

Symphony

Lockheed Martin's Symphony system has been in production since 2006. The system is designed to be vehicle-mounted. The company says that its product is interoperable with other C-IED and communications systems. Symphony is programmable and uses open architecture to ease its upgrade and modernisation in the future. More than 4,500 Block 10/20 versions of Symphony have been produced, and in July 2016, the USN approved the Block 40 variant.

NETLINE

C-Guard Netline

Netline's C-Guard is a family of vehicular and manpack Counter Improvised Explosive Device (CIED) systems. The vehicular variant of the system is thought to be in service with numerous militaries and also dignitary protection units around the world. The manpack variant is known to be in use with the Israeli Army, and is thought to have entered service in 2013. While the company refrains from providing specific details regarding the wavebands that C-Guard covers, it is reasonable to assume that this encompasses a 300 megahertz/MHz to three gigahertz/GHz waveband. This would allow the system to jam numerous cellular and wireless communications protocols, alongside civilian, commercial and military radio wavebands and other wavebands used by remote controlled devices.

PHANTOM TECHNOLOGIES

RCJ 1390 LT-I

The RCJ 1390 LT-1 is a vehicle-mounted high power jammer designed to protect convoys from IEDs and other similar threats. By providing wide band coverage against all known RF threats, this jammer can block most wireless communications, including HF, VHF, UHF and SHF transmissions, cellular networks, satellite phones and GPS signals. Length: 50cm Width: 43cm Height: 17.6cm Weight: 250kg Range: 0.7km

PLATH AG

JDS

The PLATH Jamming and Deceiving System (JDS) is a modular and scalable system that covers a frequency range of 1.5MHz to 3GHz. Thanks to software-based signal generation, this system offers various types of jamming signals, which enable the operator to change from one jamming mode to another.

PROTEK

R-330Zh

The R-330Zh, (also referred to as Zhitel) is a jamming communication station that has been designed for detection, analysis, direction finding and jamming of satellite and cellular phone communication systems. The system can be deployed in under 40min and can run at a maximum speed of 85km/h. Length: 736cm Width: 255cm Height: 271cm

ROHDE & SCHWARZ

VIPER communications jamming system

The R&S VIPER radio jamming system can be used to selectively jam advanced communications systems in the VHF/UHF range. It is available in a variety of customised configurations, and can be integrated into land, air and sea-based platforms. The R&S VIPER features a combined wide-band detector and exciter, which enables it to jam frequency-hopping radio communications systems at high hop rates.

SE NOVATOR

Garant M

The Garant M (Guardian M) is a jamming system intended to suppress the radio links of IEDs. Operating within a frequency range of 20-4000MHz, the system can protect mobile columns or stationary installations from multiple threats by disabling the receiving sections of various radio communication channels and telephones. Range: 0.07km

SESP GROUP

Jamkit

Jamkit is a high-power multi-band jamming system designed for easy installation inside any suitable vehicle. It is designed to simultaneously jam most of the existing cellular/satellite/walkie-talkie standards (frequency bands) used.

Jampack

The Jampack is a lightweight, battery-powered, portable, high-power, multi-band jammer that is built into a sturdy backpack. It is designed for protection of ground troops and bomb-disposal squads against the threat of remote controlled improvised explosive devices (RCIEDs). The system jams cellular, satellite and VHF/UHF frequency bands. It is intended to be suitable for use in any environment and is equipped with high-capacity mil-spec rechargeable batteries.

JAMV Mk 4

The JAMV Mk 4 is an remote controlled improvised explosive device (RCIED) jamming system integrated into luxury vehicles such as the Mercedes S500L and Toyota Land Cruiser. The JAMV system continuously and simultaneously covers RF communication frequencies from 66-2,500MHz, which are most commonly used to detonate roadside bombs. Using the latest jamming technology, the third generation of JAMV now has an ultra-high RF transmitting power of 1,000W (1,315W on the Land Cruiser) for maximum range.

JAMX

JAMX is an remote controlled improvised explosive device (RCIED) jammer offered in two versions, one for military shelters and one for the High Mobility Multipurpose Wheeled Vehicle. The JAMX Military Shelter continuously and simultaneously covers the full spectrum of RF communication frequencies from 20-3,000MHz (33 separate frequency bands). It offers more than 2kW of total RF power. The operator may choose to leave certain communication links 'open' as and when required.

Patrol-BJX

The Patrol-BJX is a VHF/UHF bomb jammer developed for SWAT teams, military security forces and bomb disposal squads for anti-terror security applications. The system has an overall RF output power of 300W, and is constructed to simultaneously jam most of the existing VHF/UHF communication standards around the world, as well as garage door remote controls, car alarm systems and hand-made radio emitters.

Patrol-PX/-T/-TX

The Patrol-PX multi-band jammer can be constructed to jam up to six frequency bands simultaneously and has a maximum overall RF output power of 300W. The Patrol-T multi-band jammer can be constructed to jam up to four cellular or satellite mobile phone frequency bands simultaneously, and has a maximum overall RF output power of 60W.

SRC

CREW Duke

The AN/ULQ-35 CREW Duke system is the most widely deployed counter-IED system currently protecting warfighters against roadside bombs, according to the OEM. The vehicle-mounted, lightweight system neutralises RCIED threats and gives troops a tactical advantage across the full spectrum of operations.

STEATITE ANTENNAS

Vivaldi

The Vivaldi antenna is used for detecting IEDs or mines. It operates over 0.5-6GHz.

THALES

Storm-H

Storm-H is a set of personal ECM equipment designed to inhibit detonation of remote controlled improvised explosive devices (RCIEDs). Comprising a lightweight,

soldier-worn unit, it allows freedom of movement. It offers wide continuous frequency coverage in HF/UHF/VHF, and covers the upper and lower global system for mobile communication (GSM) and digital enhanced cordless telecommunications (DECT) frequency ranges, 3G phone band, Wi-Fi and ISM (Bluetooth) frequency ranges. Length: 3.3cm Width: 6.6cm Height: 17.5cm

TRC 6274

TRC 6274 is a compact vehicle-mounted jammer designed to inhibit all radio signals used for the triggering of remote controlled improvised explosive devices (RCIEDs). Employing technologies such as wide-band exciters, wide-band power amplifiers and efficient jamming waveforms, TRC 6274 features four independent channels and can be configured to counter any threats from 20-2,500MHz (option up to 6,000MHz).

TOPAZ JSC

MONDAT-B1 E

The MANDAT-B1E has been developed by Ukraine's Topaz Joint Stock Company as a ground-based communications jammer for use at the operational level. The system can detect, identify and locate hostile communications transmissions, providing it with an additional COMINT capability. However, the primary role of the MANDAT-B1E is electronic attack and it can transmit jamming signals across a 1MHz-1GHz waveband. This allows it to jam HF (3-30MHz), VHF (30-300MHz) and some UHF (300MHz-3GHz) communications. Jamming can be performed using both spot and barrage techniques.

UNITED INSTRUMENT MANUFACTURING CORPORATION

Palantin

The Russian Army's United Instrument Manufacturing Corporation Palantin is a truck-mounted COMINT and communications jamming (COMJAM) system. Official information released by Russia's MoD states that the Palantin is tasked with gathering COMINT and performing COMJAM against hostile communications systems across a 1,000km radius. As well as jamming military communications, the system is thought to be capable of jamming civilian communications, including civilian mobile phone and wireless networks.

URC SYSTEMS

Star Manpack C

The Star Manpack C, available in variants C/C2/EOD, is a lightweight, modular, multiband jammer intended for remote controlled improvised explosive device (RCIED) protection. During its operation, the Star Manpack C jammer will either prevent possible activation of RCIEDs or dramatically reduce the distance for a bomb activation. The system, which can be easily mounted onto a vehicle, includes four independent modules/bands and is equipped with three omnidirectional antennas. Length: 46cm Width: 26cm Height: 15cm Weight: 13.5kg

SELF-PROTECTION SYSTEMS

AGENCY FOR DEFENSE DEVELOPMENT

Korean Active Protection System (KAPS)

South Korea's Agency for Defence Development's Korean Active Protection System (KAPS) is an active vehicle protection system which equips the Republic of Korea Army's Hyundai Rotem K2 Black Panther Main Battle Tanks (MBTs). At the heart of the system is a detection and tracking radar which provides 360 degrees of surveillance around the vehicle. Additional surveillance is provided by a thermal imager. KAPS is designed to engage and neutralise Anti-Tank Guided Missiles (ATGMs) and Rocket Propelled Grenades (RPGs). Field of View - Azimuth: 20,626.48° Detection range: 150m

ARTIS

Iron Curtain

Artis' Iron Curtain Active Vehicle Self Protection System (AVSPS) commenced development in 2005. Iron Curtain was specifically developed to intercept Rocket Propelled Grenades (RPGs) and Anti-Tank Guided Missiles (ATGMs). The programme was the direct result of insurgent attacks on US armoured vehicles in the Iraqi and Afghan theatres earlier this century. Testing and evaluation of the system was performed using General Dynamics M-1128 Stryker series eight-wheel drive armoured fighting vehicles in 2018, but the AVSPS not selected.

ASELSAN

Akkor

Akkor is an active protection system developed by Aselsan, equipped with both hard- and soft-kill functionalities. The EW self-protection suite provides complete protection against antitank missiles and rockets for armoured vehicles and is fully operational under severe environmental conditions, including snow, fog and rain. Features of the Akkor system include a high-resolution hard-kill radar, laser warning sub-system, soft-kill launchers and an EW computer, control panel and display unit.

Pulat

Pulat is an active protection system that helps platforms detect approaching antitank missiles or rockets using radar and then disable them at an optimum range by using a hard-kill method. It provides 360° protection, depending on the placement of the modules on the platform, and is effective in both asymmetric warfare and the operational environment of main battle tanks.

BAE SYSTEMS

CICM

Close In Countermeasure (CICM) is a complete active protection system designed to defeat incoming threats. CICM is modular, lightweight, low-cost and designed to be adaptable to a wide range of ground, sea and air

The Low Band Transmitter-Antenna Group (LBT-AG), developed by Cobham, has been in production since 2005 and is pictured above on an EA-18G. (Photo: Cobham Advanced Electronic Solutions)

platforms. The system is comprised of passive threat launch detection and active radar tracking subsystems, an advanced fire-control processor, a simple user interface and a high-speed gimballed launcher that fires a multi-gun cluster munition.

DAS

The Defensive Aids System is for the protection of armoured vehicles. Consists of a core processor and add-on threat warning modules including LWR, RWR and countermeasures such as smoke, flares, chaff and jammers.

IAAPS

The Integrated Army Active Protection System (IAAPS) was in development to protect the cancelled Future Combat Systems armoured vehicles against ATGMs and RPGs. It uses a mixture of active radar and passive EO sensors to detect, classify and track incoming threats and a combination of soft-kill (IR jammers and decoys) and hard-kill countermeasures to defeat them.

BRYANSK ELECTROMECHANICAL PLANT

SPR-2

The SPR-2 is designed to initiate premature detonation of radar proximity-fused artillery and mortar rounds to protect vehicles, installations and personnel. It is mounted on armoured personnel carriers, and requires two crew. The system jams single-frequency 'autodyne' fuses, even those with defensive channels. The jamming probability claimed is 0.8. Survivability is enhanced by short transmission and frequency agility.

CIO CONSORZIO IVECO-OTO MELARA

Scudo

OtoMelara's Scudo Active Vehicle Self Protection System (AVSPS) has been designed to equip Main Battle Tanks (MBTs), notably the Iveco/OtoMelara Ariete-C1 MBTs used by the Italian Army, and other heavy armoured vehicles. The company commenced its development of Scudo in 2002 following the publication of an Italian Army requirement for an AVSPS. As of 2010, development of Scudo was complete, and the system had entered the prototype stage, although it is not thought that Scudo has yet been formally installed onboard any vehicles. Despite this, the AVSPS has been mooted as part of a proposed upgrade package for the Ariete-C1, known as the Ariete-Mk.II. As of July 2019, the Italian Ministry of Defence had published a roadmap for the MBT's upgrade which could include the installation of Scudo, and which could commence by 2021.
Detection range: 100m

COBHAM ADVANCED ELECTRONIC SOLUTIONS

Low Band Transmitter

The Low Band Transmitter-Antenna Group (LBT-AG), developed by Cobham, has been in production since 2005. The LBT is designed to protect strike aircraft, ships and ground troops by disrupting enemy radar and communications. It is flown on USN EA-6B Prowler and EA-18G aircraft as well as the Marine Corps EA-6B aircraft, and has been used in combat operations.

DIEHL DEFENCE

AVePS

The AVePS (Active Vehicle Protection System) has been designed for the protection of armoured vehicles against shoulder-fired antitank rockets and guided missiles. Approaching projectiles are detected, tracked and engaged by a responsive 360° sensor system based on radar. A lightweight launcher, which can be aligned rapidly in azimuth and elevation to the direction of the approaching projectile, launches blast effectors, avoiding fragments or collateral damage.

ELBIT SYSTEMS EW & SIGINT – ELISRA

CV-RWR

CV-RWR is an RWR for vehicles that features detection of search-and-track pulsed radars and direction finding. It interfaces with vehicle display and control and records emitter parameters during operation. The system has a wide-band, high-sensitivity receiver, high POI and fast reaction time. Weight: 4kg

SPS-65(V)5

Elbit's SPS-65(V)5 Spectrolite is designed to protect aircraft against Radio Frequency (RF) and laser threats. The firm's official literature states that the SPS-65(V)5 can outfit a wide array of combat aircraft. This includes fixed and rotary-wing platforms and uninhabited aerial vehicles. The equipment supports electronic intelligence collection and has an integral electronic support measure. The architecture uses digital wide band and narrow band receivers. The SPS-65(V)5 can be linked to an aircraft's countermeasures dispenser and/or an RF jammer. The system is fully compatible with the US Military Standard 1553 data bus protocol. The SPS-65(V)5 has a unit cost of $2.6 million. Weight: 12kg

Tandir

Tandir is a passive warning system incorporating the latest IR technologies in military vehicles. Tandir enables fast, precision day and night identification of

multiple simultaneous incoming threat signatures. The system provides automatic warning against a variety of short-range threats including antitank rockets, ATGMs and small-arms fire. Functions include DF, range and time-to-impact estimation. The day and night panoramic view enables situation assessment and precautionary action.

ELBIT SYSTEMS LAND

Bright Arrow

A combined hard- and soft-kill active protection system with stabilised RCWS for 7.62mm machine guns, designed for light armoured vehicles. The system combines firepower, survivability and situation awareness. It is aimed at minimising weight, volume and cost constraints, while providing efficient protection against modern battlefield threats such as antitank rockets, ATGMs and kinetic energy tank projectiles. Bright Arrow is based on the proven technologies of IMI's Iron Fist. Weight: 250kg

Iron Fist

Development of Elbit Systems' Iron Fist Active Vehicle Protection System (AVSPS) commenced in 2006. Like Rheinmetall's AMAP-ADS AVSPS, Iron Fist was designed from the outset to have a modular construction to allow it to be scaled up or down to equip lighter or heavier vehicles. To date, the system has undergone exhaustive testing which has demonstrated its capabilities against a range of muntions including rocket propelled grenades (RPGs), high explosive anti-tank rounds and anti-tank guided missiles. However, unlike other systems such as Rafael Advanced Defence Systems' Trophy and the Republic of Korea's Agency for Defence Development's KAPS (Korea Active Protection System), Iron Fist has demonstrated its capabilities against kinetic energy penetrators.

Shock Absorber

The Shock Absorber is a man-portable, EO situational awareness and soft-kill protection system, designed to protect dismounted infantry troops and stationary targets against battlefield threats such as second-generation ATGMs. The system can also be integrated on vehicles and naval vessels. The design of the Shock Absorber is based on the proven technologies of IMI's Iron Fist. The system is currently under evaluation by several potential customers. Weight: 25kg

ELETTRONICA

ELT/950

The ELT/950 family consists of an in-platform electronic warfare management (EWM) system that enables the integration of several EW sensors and countermeasures and includes versions for airborne, naval and ground applications. The system is based on a modular architecture and can be tailored for the specific customer requirements allowing the management of any EW equipment interface based on common libraries that constitute the solid core of the product.

Virgilius

Virgilius is an advanced, fully integrated all-in-one Electronic Warfare system for Alarm, Surveillance and Countermeasure functionalities. It is conceived to perform emitter detection, classification, identification, and to counter a large threat variety, including radar-controlled Anti-Aircraft Artillery (AAA), Surface-to-Air Missiles (SAM), Air-to-Air Missiles (AAM), Early Warning, Search and modern Multifunction Radars. Virgilius is installable on any fixed and rotary-wing platform, naval surface and submarine platforms and ground-based systems.

HENSOLDT SENSORS

MUSS

The Multifunctional Self-protection System (MUSS) is a soft-kill active protection system designed for installation on armoured fighting vehicles. Equipped with UV sensors and a laser warning receiver, the system can detect and track incoming ATGMs, as well as trace the source of the incoming missile. It can then either jam the missile's guidance system or, if the missile is jam-resistant, launch pyrotechnic obscurant countermeasures to confuse the missile's targeting system. Weight: 160kg

KBM

Arena

KBM's Arena Active Vehicle Self Protection System (AVSPS) was developed for Main Battle Tanks (MBTs) and heavy armoured vehicles such as Armoured Personnel Carriers (APCs). To date, the system is believed to have undergone testing using a LKZ/Omsk Transmash/Malyshev T-80UM1 MBT and Kurganmashzavod BMP-3M tracked APC, although details as to whether Arena has entered service have remained sketchy at best. An export variant of the system known as the Arena-E has been developed. This variant underwent testing as a possible AVSPS to equip the Republic of Korea Army's Hyundai Rotem K2 Black Panther MBT, although ultimately the ROK's Agency for Defence Development's KAPS (Korean Active Protection System) was selected instead. Weight: 1,100kg Detection range: 50m

KBP INSTRUMENT DESIGN BUREAU

Afghanit

Afghanit is an active protection system developed for the latest generation of Russian armoured fighting vehicles. It combines soft-kill and hard-kill components with a number of sensors and an AESA radar system into a single suite that is claimed to be able to neutralise ATGMs (including top-attack munitions), RPGs and APFSDS rounds. Due to the developmental nature of the system and the fact that many details concerning its features remain unknown, claims surrounding its capabilities have been treated with scepticism by many analysts.

KVANT

SPN-2/3/4

The SPN series is a family of vehicle-mounted, threat-adaptive noise jamming systems against airborne fire control and side-looking surveillance radars. SPN-2/3/4 are aimed at 2-20GHz airborne and side-looking radars.

SPN-2 covers the 13.3-17.5GHz segment of J-band. SPN-4 aimed at emitters with wavelengths in 3dM range.

L3HARRIS TECHNOLOGIES

AN/VLQ-11 SEPS

The AN/VLQ-11 Shortstop Electronic Protection System (SEPS) is an electronic countermeasure system that prematurely detonates RF proximity-fused artillery, rocket and mortar rounds. Vehicle-mounted and man-portable versions are available. The system detects signals from proximity-fused weapons, modifies the signal and sends it back to the weapon, making it think it is close to the ground so it detonates prematurely.

Corvus- PECM

Corvus is a multi-role, scalable platform supporting operations across Cyber and Electromagnetic Activities (CEMA). The Corvus architecture is rapidly reconfigurable to deliver force protection, individual communications, direction finding, electronic support measures, electronic attack and SIGINT missions. Corvus has been created to enable mission-specific applications to be developed and deployed faster than conventional approaches.

LACROIX

Galix

Galix is a self-protection system for AFVs, and consists of a firing panel and launch tubes. Munitions are IR decoys. Galix is a self-contained modular system that can be easily fitted to virtually any vehicle. The launch tubes can accommodate an extended range of ammunition to adapt to the specific operational requirements.

LEONARDO ELECTRONICS

Laser Warning Receiver RALM02/V2

The Laser Warning Receiver RALM02/V2 is an improved version of the Laser Warning Receiver RALM02, designed for armoured vehicles and ground platforms to counter the laser threats of present and future scenarios. Length: 9.5cm Width: 11cm Height: 11cm Weight: 1.2kg

MICROTEK

Zaslon Microtek

Microtek's Zaslon Active Vehicle Protection System is believed to be in service with the KMDB T-84 Oplot Main Battle Tanks (MBTs) used by the Ukrainian and Thai armies. Zaslon was reportedly designed to protect MBTs against munitions with both direct and diving trajectories, the latter to provide the platform with protection against top attack munitions. Design work on Zaslon was believed to have commenced in 2003. The overall architecture takes a modular approach and can be scaled up or down according to the size of vehicle it equips. As a result Zaslon imposes a weight penalty of between 50 kilograms/kg (110 pounds/lb) up to 130kg (290lb). To this end, it has been developed in two versions; the standard Zaslon for heavy armoured vehicles and the Zaslon-L for lighter platforms. Weight: 130kg

MS INSTRUMENTS

Nimbus

The Nimbus non-lethal vehicle protection system is designed to be a deterrent against live-fire attacks. Nimbus creates a dense smokescreen around the vehicle and disorientates the aggressor with a bright flash and sound. The system is vehicle-borne and may be deployed while stationary or on the move, regardless of speed or weather conditions.

NORINCO

GL5

The GL5 is an active protection system (APS), designed to be mounted on MBTs, such as Norinco's VT4. The APS consists of four radar detector units, four launcher units (fitted with three rockets each) and a control terminal. Each detector and launcher unit mounted on the MBT turret covers a respective quadrant. The GL5 has an azimuth coverage of 360° and an elevation of 20°. Detection range: 100m

RADA ELECTRONIC INDUSTRIES

CHR

RADA Electronic Industries' Compact Hemispheric Radar (CHR) is a family of sensors used in active protection systems for land vehicles. The CHR family comprises active protection (RPS-10), all-threat air surveillance (RPS-12), 3D perimeter surveillance (RHS-14) and hostile fire location (RPS-15). The system provides threat data to enable the neutralisation of threats. Length: 22cm Width: 53cm Height: 33cm Weight: 0.02kg Detection range: 15,000m

eMHR

RADA'S Enhanced Multi-Mission Hemispheric Radar (eMHR) forms the basis of hostile fire-locating (RPS-70/71), perimeter surveillance (RPS-72) and all-threat air surveillance (RPS-74) systems. It can be installed on vehicles or vessels and at fixed bases. The system can also operate in search while in tracking, target revisit and single-target tracking modes.

Radar Sensors for Active Protection Systems (RPS-10)

The RPS-10 is a member of RADA's Compact Hemispheric Radar (CHR) family of sensors used in active protection systems for land vehicles. The RPS-10 detects relevant threats that may be fired at combat vehicles (RPGs, ATGMs, projectiles) and provides the data for the neutralisation of the threat. Weight: 54kg

RAFAEL ADVANCED DEFENSE SYSTEMS

Trophy

Rafael Advanced Defence Systems' Trophy Active Vehicle Self-Protection System (AVSPS) remains one of the most well-known such apparatus in use today. Trophy has been deployed extensively onboard armoured vehicles used by the Israeli Army and has attracted export interest. The system has accrued significant combat experience protecting Israeli Army vehicles during ground operations since its introduction in 2010. At the heart of the system is an

Israel Aerospace Industries' Elta division EL/M-2133 S-band (2.3GHz to 2.5GHz/2.7GHz to 3.7GHz) and C-band (5.25GHz to 5.925GHz) radar with antennas positioned in such a fashion as to provide 360° of surveillance around the vehicle.

RAYTHEON

Quick Kill

Raytheon's Quick Kill Active Vehicle Self-Protection System (AVSPS) was developed to engage a range of projectiles including Rocket Propelled Grenades (RPGs), Anti-Tank Guided Missiles (ATGMs) and rockets. Originally, Quick Kill was designed to equip platforms procured as a result of the US Army's now defunct Future Combat System collection of inhabited and uninhabited ground vehicles. In common with several other AVSPS the system employs a vehicle-mounted radar to initially detect the incoming munition. A computer then calculates the munition's velocity, bearing and trajectory before a countermeasure is launched to engage the projectile. Field of View - Azimuth: 20,626.48°

RHEINMETALL AIR DEFENCE

Skyranger Missile

Rheinmetall's Skyranger Missile is a short-range air defence system that is being developed to defeat low-flying air threats such as fixed-wing aircraft, helicopters and UAVs, as well as rockets, artillery and mortars. It is expected to come in two versions: Cheetah and Stinger missile launcher. Effective range: 4,000m

RHEINMETALL

ADS

Rheinmetall's ADS is an Active Vehicle Self-Protection System (AVSPS) which has also been marketed internationally as Shark and AAC. Although the system is believed to have completed development it is not thought to have yet been procured, although several countries have taken an interest, including Singapore. The ADS has a modular design to allow if to be scaled up or down according to the size of the vehicle it is to equip. In particular, the ADS is being promoted as an AVSPS which can equip lighter vehicles unable to carry heavy armour. The ADS forms part of Germany's Advanced Modular Armour Protection (AMAP) programme which includes a host of innovative armour designs for vehicle and aircraft protection. Weight: 140kg

SAAB DYNAMICS

LEDS

Saab's LEDS series of Active Vehicle Self-Protection Systems (AVSPSs) has been developed by the company's South African subsidiary. The system is available in three versions; the LEDS-50, LEDS-100 and LEDS-150. These have differing capabilities according to their architecture. In terms of sales, the LEDS-150 is believed to equip the Hägglunds/BAE Systems CV-9035NL infantry fighting vehicles operated by the Netherlands Army. Length: 10cm Width: 10cm Height: 12cm Weight: 0.8kg Field of View - Elevation: 65°

SAAB

LEDS 50Mk2

Land Electronic Defence Systems (LEDS) 50Mk2 is an integrated, modular active protection system consisting of laser warning sensors, an active defence controller, human-machine interface and an effector control segment. It can detect up to eight simultaneous anti-armour threats with threat direction and voice warning. LEDS is installed on CV90. It has also been installed on the Eagle IV, M60 MBT and the Piranha III.

SAFRAN ELECTRONICS & DEFENSE

Eirel/Eirel NG

Eirel is a family of IR jammers designed to protect armoured vehicles against modern IR-guided antitank missiles. Eirel is designed to be implemented as standalone equipment, while the new-generation product (Eirel NG) is designed to work with any soft-kill DAS, such as AUDAS, MUSS or KBCM. Eirel NG is effective against modern SACLOS guided missiles when directed at the threat by detector systems. Length: 17cm Width: 19.5cm Height: 45cm Weight: 20kg

THALES

LWD

Laser Warning Detector (LWD) for ground vehicles that detects a wide range of single, continuous and multiple-pulse lasers. It features a large detection footprint and a flexible configuration. Length: 17cm Width: 15cm Height: 6.5cm Weight: 1kg

TORREY PINES LOGIC

Beam/Sentinel

The Beam and Sentinel family of EO sensors is designed to detect hostile optics such as cameras and weapon sights. The Beam 100 family products are turreted systems intended for vehicle- and pole-mounted applications. They have automatic 360° scanning capabilities for all-weather 24-hour surveillance in applications such as VIP security, sniper detection, video and photography detection, border protection and location security. Dimensions: 20.3x20.3x30.5cm. Length: 30.5cm Width: 20.3cm Height: 20.3cm Weight: 9kg Detection range: 1,000m

VNII TRANSMASH

Shtora-1

Shtora-1 is a soft-kill active protection system originally developed in the Soviet Union. Equipped with IR emitters and smoke grenades, Shtora-1 confuses the guidance systems of laser-guided and wire-guided ATGMs, causing the missiles to miss their intended target. Introduced in the late 1980s, the system has been installed on most modern Russian and Ukrainian MBTs, including the T-80UK, the T-84 and the T-90. Weight: 350kg

EQUIPMENT

NAVAL EW SYSTEMS

Warship ESM and ECM equipment specifications, with basic descriptions and technical data.

The equipment featured in this section is listed under the following headings:

- ESM, ELINT, COMINT systems and jammers
- RF, IR and acoustic decoys and self-protection systems

The systems are listed alphabetically by manufacturer.

If you think your product should be listed, please contact the team at insight@shephardmedia.com to ensure it appears in the *Shephard Defence Insight* online database (shephardmedia.com/defenceinsight) and is included in the next handbook edition.

ABOVE: The AN/BLQ-10(V) electronic support system is helping to meet the challenges of today's and tomorrow's navy with a proven, low-risk and affordable EW system, providing critical analysis in an uncertain and dynamic environment. (Photo: Lockheed Martin)

ESM, ELINT, COMINT SYSTEMS AND JAMMERS

ALBRECHT TELECOMMUNICATIONS

SAJ-2000MD

The SAJ-2000MD is a digital broadband jammer for various platforms. RF output power is up to 1kW. The jammers of the SAJ-2000MD family can be used standalone or as part of a complex EW/ECM system. Operation modes are manual or fully automatic according to the specific application. Operational modes include multi-threat operation and programmable frequency hopping using high-speed exciters. The jammers can be interfaced to most monitoring receivers.

ARGON ST

Argon ST Communications ESM

The Argon ST Communications Electronic Support Measures (ESM) System (CES) is a transportable, automated sensor that can operate alone or be integrated with existing platform data feeds into a single situational awareness display.

Lighthouse MCSV1

The MCSV1 tactical maritime COMINT suite is part of Argon ST's Lighthouse product line, with over 200 systems delivered to date. It is described as suitable for permanent installation or carry-on/cross-decking deployment concepts. Scalable to a two-rack configuration, it is designed to meet EMI/EQT requirements for shipboard use. Automatic RF conditioning and RF distribution ensure performance in harsh shipboard RF environments.

ASELSAN

Naval Platform Compact ESM System

The Naval Platform Compact ESM System, which is used in ESM missions, has been designed specifically for attack boat light surface platforms. Offering the capabilities of detection, interception, classification and tracking of the radar signals, this ESM system also has automatic identification capability. With its modular structure it can be configured to user requests and can be adapted rapidly to new technologies and requirements.

Naval Platform ESM System

Aselsan's Naval Platform ESM System operates within 2-18 GHz range. The system has the capabilities of detection, identification, classification, tracking, direction-finding, geolocation and audible warning. It can detect radar signals in wide band, uses a monopulse direction-finding technique and has a high signal-processing speed. The system has sensitive parameter measurement and emitter identification capabilities, and is able to automatically track the emitters detected and determine their locations.

NEWS

Aselsan's Naval EW Suite (NEWS) is configured around an EW CPU. Around this unit, there are ESM, ECM and decoy-launching systems controlled by the EW console. All of the core technologies used for the EW suite have been developed by Aselsan. These include the broad and narrowband digital receiver, DRFM, solid-state power amplifiers, microwave modules, algorithms, design antenna and cooling systems.

Radar Warning Receiver/GPS Unit

The RWR/GPS combined antenna and signal distribution unit provides submarines with electromagnetic detection capability through their periscopes. Its antenna, with GPS, is resistant to pressures above 60 bars. The system has self-test capability and meets MIL-STD-810F environmental and MIL-STD-461E EMI/EMC standards.

Submarine ESM System

The Submarine ESM System performs detection, identification and classification of radar systems broadcasting in the 2-18GHz band, including radars with low probability of intercept. The system has automatic and manual recording and replaying capabilities. It features a 360° azimuth coverage, compact antenna, high technology broadband digital microwave receivers and high data processing capability. The system is resistant to high pressure. In order to reduce the acoustic signature, a liquid cooling system is used which meets MIL-STD-810F environmental and MIL-STD-461E EMI/EMC standards.

BAE SYSTEMS AUSTRALIA

PRISM

The Passive Radar Identification System (PRISM) is described as an ESM/ELINT system that automatically detects, DFs and classifies microwave emitters, providing extended situational awareness in a complex littoral environment. Its open-systems architecture makes it scalable, easing future upgrades. It is installed on the Royal Australian Navy's Huon-class Minehunter Coastal vessels as an integrated part of the Anti-Ship Missile Defence System.

BOEING DEFENSE, SPACE & SECURITY

AN/WLR-1H(V)

The AN/WLR-1H(V) ESM system covers the 0.55-20GHz range. It features automatic frequency, PRI, pulse width, AOA, scan type, scan period, pulse amplitude and beam width analysis. The system is capable of tracking 300 emitters.

CELESTIA

RF Data Recorders

The Celestia family of RF data recording (RFDR) systems is designed for demanding signal recording requirements. The equipment is typically used for capturing and recording the raw RF spectrum, configurable up to 500MHz instant RF bandwidth. Length: 620cm Width: 480cm Height: 220cm Weight: 18kg

CS-5020C-series microwave tuners and receivers are high-performance instruments covering the centre tune frequency range from 0.1-18GHz. (Photo: Collins Aerospace)

COLLINS AEROSPACE

ANT-1040 Spinning DF Antenna

The ANT-1040 is a high performance, spinning, direction finding (DF) antenna covering the 0.5-40GHz frequency range, providing high gain and narrow bandwidth coverage for direction finding and signal isolation. The antenna modes of operation include point, sector scan and continuous spin with spin rates from 0-200rpm. The antennas in the spinning DF segment include a Log periodic antenna covering the 0.5-2GHz band, a 2-8GHz parabolic antenna with Log periodic feed and an 18-40GHz horn antenna.

CS-3001

The CS-3001 pulse analyser unit provides radar signal measurement and processing for radar emitter analysis. The VME-based CS-3001 accepts intermediate frequency and video inputs and provides de-interleaved digital pulse descriptor word (PDW) data for radar analysis, identification and DF. The PDW data includes measured frequency, primary rate interface, pulse width, amplitude and modulation flags for each received pulse.

CS-3002

The CS-3002 dual-pulse analyser unit provides radar signal measurement and processing for radar emitter analysis. The VME-based CS-3002 accepts IF and video inputs and provides de-interleaved digital pulse descriptor word (PDW) data for radar analysis, identification and direction finding. The PDW data includes measured frequency, primary rate interface, pulse width, amplitude and modulation flags for each received pulse. Length: 32cm

CS-5020C Series

CS-5020C-series microwave tuners and receivers are high-performance instruments covering the centre tune frequency range from 0.1-18GHz. The CS-5020C Series are superhet, set-on and sweep units that convert signals in the covered frequency range into intermediate frequency (IF) outputs of one gigahertz and user-selectable 70, 140 and 160MHz outputs. Specialised models have video (AM/FM/LOG) and audio demodulated outputs.

CS-5998

The CS-5998 is an ultra-broadband set-on microwave tuner with two gigahertz intermediate frequency (IF) output. It covers the 1.5-18GHz tuning range, with the edges covering 0.5-19GHz. It has a low-noise figure, high dynamic range and low-phase noise. The two gigahertz bandwidth, centred at three gigahertz, gives the user the opportunity to look at an ultra-wide IF anywhere in the microwave range. Length: 21cm Width: 53cm Height: 9cm Weight: 8.2kg

DPAU-4001

The DPAU-4001 Digital Pulse Analyzer Unit provides digital radar signal measurement and processing for radar emitter analysis. The DPAU-4001is a VME-based signal processor that accepts intermediate frequency (IF) inputs (or RF inputs with the RC-5850 option) and provides de-interleaved digital pulse descriptor words (PDWs), digital intrapulse and spectral data for radar analysis, identification and direction-finding. Weight: 15.5kg

IFMR-6070

The IFMR-6070 is a VME-based wideband instantaneous frequency measurement (IFM) receiver and signal processor that instantaneously receives radar signals across the entire 0.5-18GHz spectrum, providing a high probability of signal detection for rapid emitter detection and analysis. Length: 66cm Width: 53cm Height: 8cm Weight: 14.5kg

PRISM-6090

The Precision Intercept Spectral Monitoring (PRISM) 6090 system is a full-range system that covers a frequency range from 0.5-18GHz (40GHz optional). The RF search system generates RF spectral displays across the 0.5-18GHz range for the detection of signal activity. The PRISM GUI is displayed on a host computer screen to allow the system chassis to be located close to antenna feeds. Length: 55cm Width: 53cm Height: 17cm Weight: 14.5kg

RC-5800

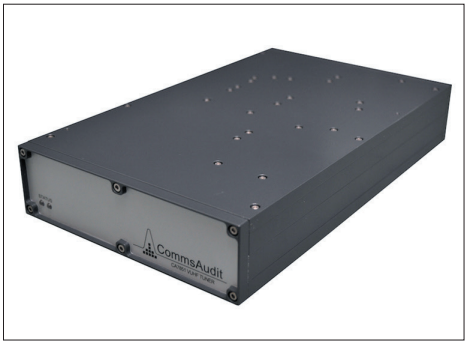
The RC-5800 is a microwave tuner covering the centre tune frequency range from 0.5-18GHz for applications that require tuning performance and phase noise in a compact unit. The RC-5800 consists of two separate 6U VME modules designated as the synthesiser module (SYN-5800) and RF module (DCV-5800). This functional partitioning allows the tuner to support in-channel direction-finding for phase interferometry applications.

RC-5850

The RC-5850 is a fast-tuning microwave receiver covering the 0.5-18GHz frequency range, with 35µs tuning time for applications that require tuning speed and phase noise in a compact tuner. The RC-5850 builds on the field-proven RC-5800. It consists of two separate 6U VME modules designated as the synthesiser module (SYN-5850) and the RF module (DCV-5800). This functional partitioning allows the tuner to support in-channel coherent direction-finding for phase interferometry applications.

RC-8800

The RC-8800 is a multi-channel microwave tuner for technical ELINT or multichannel electronic support



The CA7851 is a low-SWaP wideband VHF-SHF receiver, covering 20MHz-6GHz with a real-time full-stare bandwidth of 100MHz. (Photo: Communications Audit UK)

measures applications. Configured with one to four tuners on a single-slot 6U VME carrier card and operating from 0.5-20GHz, the RC-8800 greatly reduces the SWaP needed for single and multi-tuner systems. Weight: 1.6kg

COMMUNICATIONS AUDIT UK

CA4034 Series

The CA4034-48-48 antenna distribution system is a solid-state antenna switch matrix from HF receiving systems. Designed with high-performance, ultra-high-linearity amplifiers and proprietary solid-state switching topology, the CA4034 series is suited to HF communications systems, including ground-air, shore-ship or other OTH communications. The CA4034 series may be installed in fixed-site or mobile platforms. All RF modules, fan trays and PSUs are hot-swappable for easy maintenance.

CA7851

The CA7851 VHF/UHF wideband receiver offers instantaneous IF bandwidths over 40MHz. The tuning range is 20MHz-6GHz. The architecture employs ultra-low phase noise synthesisers and high-performance filters for best possible phase noise, dynamic range and minimal EVM. The CA7851 is designed as a multirole SIGINT tuner.

CA7851 VHF – SHF Wideband Sensor

The CA7851 is a low-SWaP wideband VHF-SHF receiver, covering 20MHz-6GHz with a real-time full-stare bandwidth of 100MHz. It supports wide-band super-resolution DF, multilateration (TDOA) and adaptive blind signal separation. The CA7851 is capable of streaming full bandwidth digital IF data to processing and recording hardware.

Spectra

Spectra is an integrated HF-SHF COMINT system covering 1MHz-6GHz. Spectra systems are suitable for mobile, semi-static or fixed-site deployment and are capable of super-resolution DF. Spectra has an integrated management information system, including an interactive smart database.

DTS

DM/A-301

The DM/A-301 is an ESM system suitable for ships, submarines and ground stations. An aircraft and helicopter version can also be provided. Frequency range from 2-18GHz with 3MHz RMS accuracy. DF accuracy 5° RMS (depending on installation). Over 1Mb/s processing capability, user-programmable database and recording capability for ELINT analysis.

DM/A-302

The DM/A-302 is an ESM system for ships, submarines and ground forces. It has a modular architecture and can be installed and integrated with combat management systems and active (jammer) and passive (chaff) ECM. The system has 10,000 user-programmable emitters.

ELBIT SYSTEMS EW & SIGINT – ELISRA

AES-210/V

The AES-210/V provides a lightweight and modular ELINT and ESM capability for USVs. The system can be remotely operated operation from a GCS via existing data link channels. It carries out DF by a digital-phase interferometer, and has high-sensitivity and POI. The AES-210/V conducts real-time intelligence gathering for dissemination to relevant consumers in different levels of information. It has a multi-channel superhet/IFM receiver and a Windows NT-based MMI. Weight: 22kg

Aqua Marine

Elisra's upgraded, digital Aqua Marine naval EW solutions replace the NS 9000 family of ESM and ECM systems. Suitable for frontline platforms, including fast missile patrol boats, corvettes, frigates and destroyers, Aqua Marine has a number of configurations: Aqua Marine Integrated EW (ESM/ECM) Systems Suite; Aqua Marine Integrated Radar and Communication (R&C ESM/ECM) Systems Suite; Laser Warning Systems Suite; Aqua Marine ESM; and Aqua Marine ECM.

NATACS 2020

The NATACS 2020 is an integrated tactical COMINT and DF system covering HF, SHF and VHF/UHF bands. The system features fast scanning (using wide-band receivers) and counters frequency-agile communications in dense EM environments. It enables monitoring, DF and location finding, signal classification and digital audio recording. Fusion of the data with that from onboard ESM systems enables completion of the tactical picture. The NATACS 2020 is in operation with Israel and other navies.

TIMNEX II

TIMNEX II is the third generation of an ESM/ELINT system for submarines which performs detection, DF, identification, display and recording of EM emitters in real time. Its processors and high sensitivity provide 100% POI, while small antennas provide high bearing measurement accuracy. TIMNEX II ensures a short response time for analysis of all types of radars and high omni-directional probability in dense EM environments. TIMNEX II-C includes an integrated COMINT segment for full EM analysis.

ELBIT SYSTEMS LAND

Shock Absorber (Naval)

Shock Absorber (Naval) is a portable, lightweight, soft-kill active protection system for maritime vessels. The system offers alarming of incoming threats, jamming capabilities against second-generation missiles and situational awareness. It is a variant of IMI's family of active protection systems for ground and aerial applications. Weight: 25kg

ELETTRONICA

ELT/225

ELT 225 is a Digital Light ESM System and RWR developed by Elettronica SpA for small and medium ships. The System provides surveillance of the electromagnetic spectrum and performs automatic detection, discrimination, classification and identification of the radar signals to provide a detailed EOB (Electronic Order of Battle). The System is based on a fully Digital Wide Open architecture that allows full and instantaneous coverage in angle, time and frequency to ensure the highest probability of intercept of radar threats in a complex environment. The receiver is also protected against CW communication signals up to 4G LTE frequencies by means of 'tunable' digital filters. The ELT/225 also supports the platform in early warning against radar-guided missiles and weapon systems. The ELT/225 is able to automatically detect and identify known and unknown Lock-on emitters, inbound active RF missiles through the seeker transmission, and pre-defined emitters classified as threats.

ELT/332

ELT 332 is a counter electronic support measure/ COMINT system designed for fast real-time interception, direction finding and automatic characterisation of complex broadband signals, frequency-agile transmissions (e.g. frequency hopping emitters) and analogue/digital modulated signals. The system fully meets the operational and technical requirements identified for surface ships and offers state-of-the-art performances with high sensitivity, wide dynamic range and full-azimuth spatial coverage. The system provides surveillance of the electromagnetic spectrum by performing automatic detection, discrimination, pre-classification and technical identification of communication emitters , demodulation and decoding of communication signals and content production with real-time audio listening; wideband recording of RF signals for data collection and off-line analysis (to be done with other systems).

ELT/819C

Elettronica's ELT/819C is an ELINT system designed for both airborne and naval applications. In the frame of the ELT ELINT Systems, the ELT/819C covers E-K radar bandwidth. ELT/819C is a piece of equipment that exploits techniques based on a digital receiver ultrawideband and phase interferometry.

EW Center

The Electronic Warfare Center is an operational support system for pre-and post-mission activities. The system handles various types of EW functions (ESM, ECM etc), for different frequency bands (radar, communications, EO/IR) and different types of host platforms (airborne, naval, ground). It is modular and configurable to customer needs.

LOKI

The LOKI family is a cross-platform C2 system designed to integrate EW, SIGINT and Electro-Magnetic Spectrum Operations on many distributed platforms. The platform can be distributed in any domain operation (air land, sea, space) and could be fixed/ moving and crewed/uncrewed.

ELTA SYSTEMS

ELM-2222 Nav-Guard

ELTA Systems' Nav-Guard, a lightweight, modular SPS, is designed to cope with the new threats and increase a naval platform's survivability. The Nav-Guard includes a radar-based MAWS and various response systems, such as smoke and chaff/flare dispensers. Upon detection, classification and verification of a potential threat, the system automatically initiates an alert to the crew and starts to dispense smoke, chaff and flares according to a pre-programmed procedure. Weight: 50kg

GENESIS EW

GenCOM Defense Naval

GenCOM Defense Naval offers an automatic situational awareness picture achieved through integration with single or multiple CESM-DF arrival sensors deployed on an array of naval vessels. The system supports multi-platform sensor deployments, integrating together measurements from land, air and naval systems. GenCOM Defense Naval is a customisable software analysis solution that delivers multi-layered battle-related knowledge in near-real time, while adjusting to the specific needs and requirements of different operators.

HENSOLDT SENSORS

COLDS NG

COLDS NG has been designed for naval applications, and detects lasers from rangefinders and target designators with only two or four sensor units (depending on the size of the ship) installed port and starboard. Each COLDS NG sensor unit covers more than 180° in azimuth and 90° in elevation. The system is in service with international customers and has proven its operational performance, among others, during the UNIFIL mission in Lebanon. Length: 13.8cm Width: 23.4cm Height: 18.9cm Weight: 4kg

HORIZON TECHNOLOGIES

FlyingFish Naval

The FlyingFish Naval SIGINT system is one of several derivatives of the FlyingFish Airborne Satellite Monitoring System (ASMS) developed by Horizon Technologies. Whereas the original FlyingFish is designed to be mounted on airborne ISR platforms, the FlyingFish Naval has been adapted for use on surface vessels and submarines, as well as naval UAVs.

Like its airborne counterpart, the FlyingFish Naval can detect and intercept satellite communications and, as a passive system, it cannot be detected by either the mobile user or the satellite network. Length: 41.1cm Width: 39.8cm Height: 17.8cm Weight: 10kg

INDRA SISTEMAS

Aldebaran

Aldebaran is an ESM/ECM system for maritime applications, used on Spanish Navy F-100 Aegis frigates.

BLQ-355

The BLQ-355 is a submarine ESM system with IFM receiver covering 2-20GHz. Offers 100% POI, identifies and tracks radar emitters. The system is fitted to Spanish Navy Galerna-class submarines and Type 209s of other navies.

L3HARRIS TECHNOLOGIES

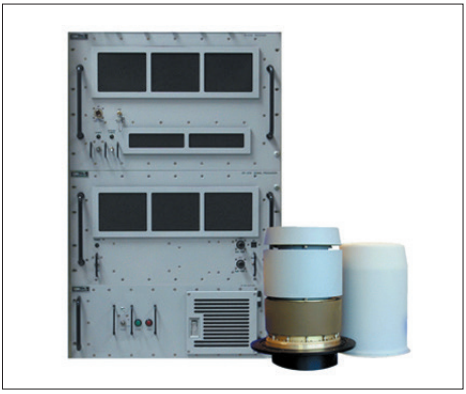
APECS

The Advanced Programmable Electronic Counter Measures System (APECS) is an electronic support measure (ESM) / electronic countermeasure (ECM) package utilising the ES-3701 system (see separate entry). The ECM subsystem covers the 0.5-18GHz frequency band. Phased-array transmitters jam through 360° and with over 18dBm average ERP over threat frequency range. Out of the 500 signals tracked by the ESM subsystem, the ECM can jam up to eight threats simultaneously.

AR-900

The AR-900 provides an electronic support measure capability for small ships and submarines, with 360° 1-18GHz RF coverage for 100% probability of intercept and accurate DF. The system can operate standalone or integrated with shipboard combat systems. The frequency range can be operationally extended to 40GHz. There is also a miniaturised antenna for submarine optronic masts.

The ES-3701S is part of L3Harris' family of passive radar-detection electronic support measure systems for surface vessels. (Photo: L3Harris Technologies)



ES-3601

The ES-3601 is a tactical radar electronic support measure and surveillance system designed for submarines, surface ships and land-based applications. It provides situational awareness, self-protection and surveillance in a small footprint, operated via a dedicated operator console or from the multi-function console (MFC) of the combat management system. The ES-2601 covers the 2-18GHz band, with a 100% POI and 360° instant direction finding.

ES-3601S

L3Harris' ES-3601S is a cost-effective high-capability radar electronic support measure (ESM) system for surface naval applications. It used a monopulse direction-finding (DF) system for bearing measurements. Its a proven system currently operational on platforms from Europe to Asia. The ES-3601S has 100% probability of intercept, instantaneous DF over 360°, long-range detection, DF and tracking and measures all radars simultaneously.

ES-3601U

The ES-3601U is a submarine radar electronic support measure system which is cost-effective and high-capability. By L3Harris, the system provides a modern update for the previous AS-900 ESM system but can utilise their existing antenna systems. The ESM system using an innovating monopulse direction-finding (DF) system for accurate bearing measurements and has already been integrated into a variety of combat system environments. The main capabilities are 100% probability of intercept, instantaneous DF over 360°, accurate 2x4 element monopulse direction finding (DF), long-range detection, DF and tracking and can measure all radars simultaneously.

ES-3701

The ES-3701 is a radar surveillance and precision monopulse direction-finding system intended for submarines, surface ships and land-based applications. It provides situational awareness, targeting, self-protection and surveillance, operated via a dedicated console or from the multi-function console of the combat management system. The ES-3701 offers a 100% probability of intercerpt and provides instantaneous frequency coverage over the two to 18GHz band.

ES-3701S

The ES-3701S is part of L3Harris' family of passive radar-detection electronic support measure (ESM) systems for surface vessels. It a high-performance radar ESM that provides situational awareness, targeting, self-protection and surveillance. It delivers complete RF coverage with direction finding from communication through radar bands. The system has already been proven and interfaced with many combat management systems (CMS) and uses a Windows graphical interface.

ES-3701U

The ES-3701U is a high-performance radar electronic support measure (ESM) for submarine applications. As part of L3Harris' family of passive radar-detection ESM systems for submarines, the system provides a robust interference removal to remain functional in a littoral signal environment while removing multipath to reduce the effects of reflected signals. It uses a circular phase

interferometer for monopulse angle of arrival (AOA) measurement to achieve 2° rms accuracy. The ES-3701U also implements advanced signal algorithms for positive emitter identification and library classification.

PATRIA AVIATION

ARIS-E

ARIS-E is a new ESM product built on ARIS. ARIS-E ESM system offers real-time tactical ESM capability with geolocation and tracking of emitters as well as real-time ELINT tools for precise signal analysis and library updates.

PLATH AG

MACSS

Plath unveiled its Maritime Communication Signal Surveillance System (MACSS) in January 2015. MACSS includes a high-sensitivity lightweight antenna and a seven-channel DF receiver. Analysis software characterises communications signals received by MACSS while an integrated map enables the display of the emissions once they have been geolocated. No additional information has been released by Plath regarding the system's performance.

RAFAEL ADVANCED DEFENSE SYSTEMS

C-Pearl-DV (S)

The C-Pearl-DV (S) is a variant of the C-Pearl system adapted for submarines by integrating an antenna array with the submarine's ESM mast, search periscope and attack periscope. The system features lightweight single receiving antenna, modern wide-band digital receiver channels, wide open receiver, embedded narrow-band analysis, one LRU receiver and standard communication busses.

C-Pearl-DV

The C-Pearl-DV is a compact and lightweight ESM system based on a digital receiver, enabling automatic detection, data measurement and identification of threats. It delivers 100% POI and high accuracy of frequency and direction measurements with intrapulse data. The C-Pearl family of ESM systems is fully qualified and operational in conjunction with onboard radars, and integrated with various combat systems.

Digital Shark

Digital Shark is an ECM system consisting of a digital receiver and a DRFM-based technique generator integrated with a multi-beam array transmitter. This system enables the ship's EW suite to support appropriate defensive responses against all types of airborne radars, surface radars and missile seekers.

SEWS-DV

The digital Shipborne EW Suite (SEWS-DV) combines the C-Pearl-DV ESM and Digital Shark ECM subsystems. SEWS-DV is based on digital receivers and digital technique generators, designed to handle dense EM environments. The system is capable of threat identification and simultaneous jamming and deception of multiple threats. It is an EW system for both ESM and ECM applications. It features high ERP and a DRFM-based technique generator, and employs advanced power management techniques.

SpotLite M for naval applications

The SpotLite M for patrol boats is an EO system for weapon fire source detection, location, classification and tracking applications. The system incorporates day and night passive sensors for multiple fire source threat detection. Additional sensors, capabilities and applications can be integrated. SpotLite M is multi-sensor, multipurpose and image-stabilised. It is operationally fielded on different platforms for various applications.

RAYTHEON

AN/SLQ-32(V)

The SLQ-32(V) is the principal EW system carried by major USN surface ships, with more than 450 systems produced to date. The (V)1 and (V)2 suites are passive, providing early warning, identification and DF capability for simultaneous multiple threats. The (V)3 suite provides an additional active response for simultaneous jamming of multiple threats. The (V)4, an expanded version of the (V)3, is used on aircraft carriers.

ROHDE & SCHWARZ

Naval ELINT

Rohde and Schwarz naval ELINT solution is designed for dedicated SIGINT platforms. The core component is the R&S WPU2000 Wideband Processing Unit with two gigahertz real-time bandwidth and fully digital I/Q processing. Spinning dish and high gain antennas provide the capabilities to achieve signal collection and situational awareness at maximum detection range with the highest data quality. A portable version of the Naval ELINT solution could upgrade the detection range / early warning capabilities of Radar Electronic Support Measure systems in operation.

Naval RESM-CESM

Rohde and Schwarz naval Electronic Support solution is a Radar Electronic Support Measures (RESM) and Communications Electronic Support Measures (CESM) system with a combined topmast antenna system. It monitors and performs direction finding in the frequency range of one megahertz to 40 GHz. With a highly sensitive automatic signal detection, the system recognizes threats earlier, provides enhanced situational awareness and raises the level of self-protection significantly.

R&S EM200

The R&S EM200 is a cost-efficient and optimised receiver and direction finder in a compact format. It detects, analyzes and demodulates from eight kilohertz to eight gigahertz and optionally supports direction finding with Rohde & Schwarz compact DF antennas from 20MHz to six gigahertz. Its small form factor allows easy integration and use in just a few steps. It comes with an easy-to-operate and ready-to-use graphical user interface.

R&S WPU2000

The R&S WPU2000 Wideband Processing Unit is a high-performance ELINT receiver, designed for

radar detection and analysis in the frequency range from eight kilohertz to 40 GHz. With 2 GHz real-time bandwidth and fully digital I/Q processing highest quality data acquisition for intra-pulse analysis is ensured. Its outstanding sensitivity enhances situational awareness and increases platform protection in modern and dense signal scenarios.

ROSOBORONEXPORT

Flat Track

The Flat Track (NATO reporting name) is a barrage and deception radar jamming system that is able to counter anti-ship missiles.

MRKP-60

The MRKP-60 is a combined RWR and navigational radar for submarines. It offers 24 RWR and eight active radar channels. Weight: 700kg

TK-25E-5

The TK-25E-5 ECM system is designed to intercept emissions of airborne and shipborne target acquisition radars, fire control radars and missile seekers, to perform automatic signal classification, threat prioritisation and jamming. Its configuration depends on ship type and displacement. Its range is said to exceed the detection range of hostile radars by 10-20%. The system can analyse more than 100 targets simultaneously and has a quota reaction time of 3s.

SAAB MEDAV TECHNOLOGIES

CRS-8000

CRS-8000 is a family of systems for COMINT monitoring and DF for both tactical and strategic applications. It can be installed on surface vessels and submarines as well as along the coastline. Multi-site distributed systems capable of communicating with one another can also be linked up to create a wider network, allowing signals received at different locations with poor quality to be merged to obtain one enhanced and reliable signal.

SAAB

Sirius SIGINT

The Saab Sirius SIGINT system is a complete solution including airborne and ground segments. The airborne segment contains advanced COMINT and ELINT sensors that perform signal collection, while the ground segment includes mission planning and post-mission analysis.

SME-50, SME-150 and SME-250

The SME family consists of a range of compact, high-performance, tactical ESM and ELINT systems for surface ships. The SME-50 is primarily a radar warning system with an RWR or ESM receiver. It operates between 2GHz and 18GHz and can track 500 simultaneous signals. The SME-150 provides additional ELINT functionality through the addition of an acquisition receiver, and the SME-250 provides parallel ESM and ELINT capability through the further addition of a digital ELINT receiver, with the option to extend the frequency range to 0.5-2GHz and 18-40GHz.

SME/UME

The UME and SME families of tactical ESM and ELINT systems are for submarines (UME) and surface ships (SME). The systems have a scalable architecture to allow future growth and provide a common base for all variants. Each system comprises an antenna unit and an EW controller processor, where the controller defines the family category and the antenna units are interchangeable across categories according to platform requirements.

UME-50, UME-150, UME-250

The UME family consists of a range of compact, high-performance, tactical ESM and ELINT systems. Different configurations, suitable for installation on all subsurface platforms, are available. The UME-50 is primarily a radar warning system with an RWR or ESM receiver. It operates between 2GHz and 18GHz and can track 500 simultaneous signals. The UME-150 provides additional ELINT functionality through the addition of an acquisition receiver, and the UME-250 provides parallel ESM and ELINT capability through the further addition of a digital ELINT receiver, with the option to extend the frequency range to 0.5-2GHz and 18-40GHz.

SAFRAN ELECTRONICS & DEFENSE

EWCC System

The EW Command and Control (EWCC) System coordinates engagement plans and performs appropriate soft-kill reactions against threats (anti-ship missiles, targeting radars etc). It controls EW sensors and effectors in conjunction with the combat system for picture compilation, threat evaluation and weapon assignment. The EWCC's EW library contains threat descriptions as well as associated countermeasures.

SIERRA NEVADA CORPORATION

SS-6100

The SS-6100 is a manual, all-digital, multi-channel/multi-operator ELINT system consisting of one or more integrated receiver processor chassis. A separate COTS workstation computer hosts the operator GUI and the resource controller software which coordinates the assignment of the receiver processing resources among multiple operators. Frequency coverage and direction-finding precision vary with available options.

SS-6500

The SS-6500 automatic ELINT/ESM suite is a configurable DF system offering customers a range of options regarding DF precision, frequency, FOV, signal/emitter processing capabilities, size/weight configurations and user interfaces. The SS-6500 consists of an integrated receiver processor unit and separate antenna units suitable for a variety of ground applications. Frequency coverage and DF precision vary with available performance options.

STEATITE ANTENNAS

RF Jammer

The RF Jammer is designed for use against anti-ship missiles.

TELEDYNE DEFENCE & SPACE

QR020-M1 Phobos-R

The Phobos-R threat warner/radar electronic support measure (ESM) is a man-portable, end-to-end integrated EW sensor system comprising antennas, RF processing, digital processing, de-interleaving and emitter ID/ library matching and operator interface. A key feature of Phobos-R is that there are no external RF cables, calibration or positional alignment requirements during set up. It is capable of operating on a variety of small platform types. The sensor employs a high degree of RF and demand-side platform (DSP) integration. Weight: 8kg

THALES

ALTESSE

Alert and Surface Ship Evaluation (ALTESSE) provides alerts on communication signals, tactical situation development and COMINT capabilities. Its wideband instantaneous bandwidth and processing capacities allow it to cope with both conventional and complex or frequency-hopping signals in HF/VHF/UHF bands. Real-time emitter bearing allows ALTESSE to quickly provide threats data to the combat management system for C2 of ship self-protection. Length: 11,000cm Width: 11,000cm Height: 16,500cm Weight: 45kg

ARBB 33

The ARBB 33 jammer is a shipborne noise and deception jammer for use against designation, pulsed fire control and active missile seeker radars. Jamming modes include continuous noise, pulsed noise, cover pulsed, synchronous and asynchronous false echoes, and range gate pull-off. The system operates in H-, I- and J-bands, covering two 180° sectors. A total of 36 10° lobes cover both sides and DF to within 5°. The ARBB 33 is in service on Cassard- and Barza-class ships.

EARL-Naval

Thales describes EARL-Naval as a lightweight naval CESM solution for fast patrol boats, providing situational awareness or COMINT capability based on interception/ DF of radio communication signals. Length: 43cm Width: 13cm Height: 32cm Weight: 15kg

Outfit UAP

Outfit UAP is an ESM system developed by Thales for UK RN submarines including Astute-class submarines.

Outfit UAT

Outfit UAT is an ESM system developed by Thales for UK RN surface vessels. It comprises an eight-element antenna array, receiver/processor and operator's console, and is integrated into ship's command system. The OEM announced in 2012 that it had been awarded a contract to install the system in UK RN ships and that HMS Daring, the first of class of the Type 45 destroyers, had entered service with the system installed.

Princesse

Princesse is a CESM/COMINT system dedicated to submarines, providing listening, monitoring, signal analysis and identification of communications signals in HF/VHF/UHF bands.

Q CIEW

Q CIEW is a family of COMINT and EW (CIEW) systems focused on counter-terror and counter-insurgency operations in a land environment, supported by naval, air and space dimensions. CIEW is designed to focus on the human dimension of information operations, taking raw sensor data and turning it into shared situational understanding for decision-makers. It offers a fully digital capability from sensor components to exploitation and dissemination. Payload elements are compact, modular and platform-independent.

Sabre

Sabre is a modular ESM and jamming system that automatically identifies and tracks emitters. It uses a phased-array transmitter with high ERP, and is interoperable with phased-array radars. A steerable antenna has polarisation control. The jammer uses DRFM-based techniques generator plus a wide range of noise and deception techniques. Sensitivity: -60dBm Dynamic range: 60dB Processing time: <1s

Scorpion 2

Scorpion 2 is a noise and deception jamming system covering 7.5-18GHz. It transmits up to 350kW ERP and handles up to six threats at once. The system offers automatic, semi-automatic and manual activation of jamming. It is designed to counter long-range search radars, target acquisition radars and missile radars operating in both search and locked-on modes. It can be integrated with any wide-open ESM system that provides instantaneous bearing measurements.

Sealion

Sealion is a search and warning system for surface vessels and submarines. It offers 100% POI, high bearing accuracy and a rapid reaction time. It can be operated from a dedicated console or fully integrated with the ship's combat system. The pulse train analyser de-interleaves the pulse stream and constructs essential track data on individual emitters.

Vigile

Vigile is a multi-platform naval ESM/ELINT system covering E-J bands simultaneously. It offers all-horizon single-pulse intercept and DF, accurate DF and true 100% POI. The system detects agile, multi-mode and pulse-Doppler emitters. It is highly resistant to reflection and multi-path. Vigile offers control of dense environments, with rapid threat classification and identification and high tracking capacity. It also features a user-programmable library and interfaces with other systems such as ECM, combat and navigation.

Vigile LW

Vigile LW is a lightweight radar ESM system for small naval platforms, providing a real-time tactical view of the surrounding area, situational awareness and threat warning. It is designed to detect, identify and display air and surface threats in real time in complex littoral environments. It can cope with a maximum pulse density of 1,000,000pps. The system can handle 200 targets simultaneously, reacting to locked-on threats in less than a second.

ULTRA ELECTRONICS TCS

UltraEAGLE

UltraEAGLE (Electronic Acquisition Gathering Locating Equipment) is a family of electronic support measures systems designed for a range of ELINT missions. It is available in various models covering C to K bands with direction-finding options including high directional gain steered antennas, monopulse and interferometer arrays.

RF, IR AND ACOUSTIC DECOYS AND SELF-PROTECTION SYSTEMS

ASELSAN

Zargana

Aselsan's Zargana is a submarine torpedo countermeasure system. It is designed to work integrated with submarine systems, collecting real-time data as well as operator-provided data to ensure submarine survivability against torpedo attacks by autonomous operation.

Zoka

Zoka is an acoustic countermeasure system designed for surface ships and submarines. The system is customisable with a long operating time. Capabilities include tactical awareness, monitoring of torpedo behaviour, noise barrier and target emulation.

BAE SYSTEMS AUSTRALIA

Nulka

The Nulka active anti-ship missile decoy was originally conceived in Australia, and developed under a joint Australian-US programme. BAE Systems Australia is prime contractor, while US subcontractors Lockheed Martin and Aerojet manufacture the EW payload and rocket motor respectively. Nulka is deployed on more than 140 Australian, Canadian and US surface combat ships and is described as Australia's largest and most successful regular defence export.

BAE SYSTEMS

Sea Lightning

Developed by a joint venture between BAE Systems and General Dynamics Advanced Information Systems, Sea Lightning is being offered to the USN for the Block II phase of its Surface EW Improvement Program. The team combines BAE Systems' EW experience with General Dynamics' expertise in open architecture, naval systems and subsystems integration.

BHARAT DYNAMICS

C-303

The C-303 decoy system is a torpedo countermeasures system for submarines, effective against any type of lightweight torpedo.

SFD

The Submarine Fired Decoy (SFD) is deployed from a single-cartridge launch tube. It functions as a jammer or preferred target.

BOEING DEFENSE, SPACE & SECURITY

AN/SLQ-25A Nixie

Argon ST's AN/SLQ-25A torpedo countermeasures system is a surface ship torpedo defence solution, of which more than 400 have been installed worldwide. It is a modular, digitally controlled, electro-acoustic soft-kill countermeasure decoy system. Upgrades available to current users include updated countermeasures and a new littoral fibre-optic tow cable (FOTC) for shallow-water deployment. Weight: 3,850kg

CHEMRING COUNTERMEASURES

Centurion Launcher

Centurion is a 12-barrel, 130mm directional launcher, but can be reconfigured to other calibres. The barrels, which are stored vertically to reduce the overall size and weight of the launcher, are mounted on a rotating plinth, with each barrel individually controlled in elevation. Its rapid response and high positional accuracy combined with barrel stabilisation enables payload placement to be precisely controlled, giving better ship signature replication in the missile seeker, says the company.

RF and IR Countermeasures (Current)

Chemring Countermeasures provides both radar-reflective and IR 130mm cartridges, as well as payloads in varying calibres up to 130mm for a range of current decoy systems. The product range supports distraction and seduction techniques to enable a layered defence approach. To counter dual-mode missiles or multiple-missile-type attacks, it offers a mortar-launched decoy with sequential chaff and IR payloads.

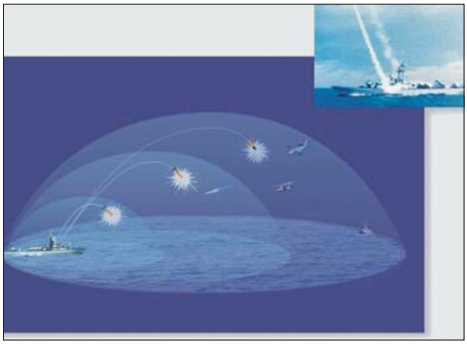
RF and IR Countermeasures (Developmental)

Chemring Countermeasures' development of RF distraction capability is focused on a single-burst chaff payload that features variable range and height control of the deployment point. This round is rocket-launched and has a data interface to allow setting of deployment characteristics immediately prior to firing.

IRVINGQ

IDS300

Airborne Systems' IDS300 naval decoy is a ship-deployed rapid-response, inflatable, passive RF floating soft-kill countermeasure, designed to defeat anti-ship RF missile seekers. The decoy system is fully independent and does not require support from other countermeasures such as jammers. A single decoy will give ship soft-kill protection per threat engaged, making it cost-effective compared to other multiple-firing countermeasures, says the company.n to supply the USN with the IDS300 decoys.



Rafael's integrated ship-defence decoy system features real-time decoy deployment, fixed and/or rotating launchers and a computerised decoy controller. (Image: Rafael Advanced Defense Systems)

LACROIX

Naval Countermeasures

Lacroix's naval countermeasures are shipborne expendable decoys for seduction, distraction and seduction/dissimulation, using both chaff and IR modules and chaff rockets. Chaff covers I/J band. IR decoys cover 3-5 and 8-14µm bands.

LEONARDO ELECTRONICS

SCLAR-H

SCLAR-H is a close-in missile decoy system with UCLAR FCS. It holds 20 105mm or 110mm chaff and IR rockets with automatic selection. Designed for accurate deployment of decoys to protect ships against radar and IR-homing missiles, the system can launch decoys that operate in confusion, dissimulation, seduction, distraction, dump, centroid and range gate stealing modes.

LOCKHEED MARTIN

ALEX

Lockheed Martin's Automated Launch of Expendables (ALEX) can be integrated into an EW suite or act as a standalone system. Modularity allows a number of control consoles, SRBOC Mk 137 launchers equipped with ARID and displays to be adapted to individual ships. The system is integrated with ship's ESM/nav/wind sensors; and features automatic misfire detection/correction. It provides and implements optimum tactics as developed by the tactical analysis workstation.

RAFAEL ADVANCED DEFENSE SYSTEMS

C-GEM

The C-GEM is an active offboard decoy system that can be packed into standard-size chaff rockets. It includes a low-power technique generator and high ERP arrays that transmit jamming signals. Features include wide-frequency coverage, extended spatial coverage, solid-state active array, fire-and-forget operation, electronic beam-steering and fast response. The system is suitable for various launcher types.

Heatrap

Heatrap IR decoy rockets are used to counter anti-ship missiles with IR seekers and those which use an IR detector alongside a radar seeker to discriminate between the real target and chaff. The payload consists of two parachute flares producing IR radiation in wavelengths 3-13µm. They are deployed 50-600m from the ship at an altitude of 150-300ft, persisting for 30-60s. Length: 92cm Width: 11.5cm Height: 11.5cm Weight: 10.2kg

Integrated Decoy System

Rafael's integrated ship-defence decoy system features real-time decoy deployment, fixed and/or rotating launchers and a computerised decoy controller that can be integrated with a ship's sensors and C4I systems. The controller features POST (automatic decoys) and BIT (launchers) and automatic decoy type detection.

LRCR

The Long-Range Chaff Rocket (LRCR) is a long-range confusion rocket decoy used as a first line of defence against a missile attack to create a large protected zone from search radars while the vessel is still below the radar horizon. The decoy creates a ship-sized target at a range of 12-14km from the ship at an altitude of 2,900ft. Operationally proven in two wars, LRCR decoys also counter airborne radars used for search and targeting. Length: 92cm Width: 22cm Height: 22cm Weight: 9.4kg Range: 12km

MRCR

The Medium-Range Chaff Rocket (MRCR) is a medium-range chaff decoy deployed before the incoming missile has achieved radar lock at real-time programmed ranges of 50-1,800m. It is designed to generate large chaff clouds that are detected by enemy missile seekers as legitimate targets, defeating the seekers in search mode. The rapid-blooming chaff clouds are designed to defeat missile salvos. Length: 78cm Width: 11.5cm Height: 11.5cm Weight: 8.1kg

Wizard

The Wizard corner reflector decoy distracts or seduces radar-guided anti-ship missiles that have chaff discrimination capability. The decoy folds out into one or more corner reflectors that create a realistic target with scintillation and glint from its combination of reflecting surfaces. The decoys do not degrade a ship's radar performance with self-clutter. It also prevents potentially dangerous situations in long encounters when lingering chaff clouds might serve as a beacon for a new threat. Length: 150cm Width: 11.5cm Height: 11.5cm Weight: 14kg

RHEINMETALL

Bullfighter

Bullfighter is a 130mm decoy for SRBOC launcher systems to protect naval vessels up to the size of frigates against anti-ship missiles equipped with RF and/or IR seekers. The combined RF/IR payload is co-located and effective against radar and IR threats simultaneously. Bullfighter has been successfully tested against modern RF and IR seekers with sophisticated ECCM during national and NATO trials. Length: 120cm Weight: 21kg

MASS

The Multi-Ammunition Softkill System (MASS) is a naval self-defence system that protects ships from attacks by sensor-guided missiles, whether on the high seas or in coastal waters, as well as against asymmetric terrorist attacks. The decoys operate by seducing the incoming missile's target-seeking system. The automated MASS offers substantial tactical, operational and logistical advantages and can be installed on a range of ships.

ROSOBORONEXPORT

PK-10

The PK-10 is a 120mm system that fires decoy rounds to protect ships from radar- and optically guided weapons. The rounds are fired from the KT-216-E launch system that comes in 2-/4-/8-/12-/16-round launchers, depending on ship type. All rounds are 120mm in diameter and 1,226mm long. Length: 80cm Width: 96cm Height: 80cm Weight: 80kg

SAFRAN ELECTRONICS & DEFENSE

Dagaie Mk 2

The Dagaie Mk 2 is a shipborne chaff and IR decoy launcher system. It is designed to provide protection for surface vessels against threats from any direction through neutralisation of hostile sensors prior to missile firing and in-flight neutralisation of the missile seeker. It can launch decoys to provide confusion/dilation, distraction, centroid seduction and, in combination with the jammer and depending on configuration, it can also use dissimulation and range gate pull-off seduction techniques. Height: 120cm Weight: 500kg

NGDS

The New-Generation Dagaie System (NGDS) is a decoy launcher that offers automatic operation, short reaction times, smart processing, multi-threat capability and ergonomic loading. It is designed to protect all types of surface vessel against anti-ship missiles and torpedoes. Each system has a pair of double-axis launchers loaded with up to 12 IR, radar or acoustic decoys. Fully trainable launchers are linked to a computer that selects the best decoy technique. Height: 160cm Weight: 1,200kg

The LEAD acoustic device has been installed on US submarines. (Photo: Ultra Electronics Ocean Systems)

TERMA

C-Guard

C-Guard, formerly known as SKWS, is a lightweight decoy launching system developed for small and large ships using standard NATO SeaGnat 130mm tubes in fixed positions at various azimuth angles. Key features are two types of six-tube launchers (DL-6T and Mk-137) and one type of 12-tube launcher (DL-12T), low-pressure deck mounts, 360° coverage, advanced launch algorithms, automated operation, and the option for a standalone control unit and/or full combat management system integration.

ULTRA ELECTRONICS OCEAN SYSTEMS

LEAD

The Launched Expendable Acoustic Device (LEAD) is an acoustic countermeasure deployment system designed to distribute a pattern of decoys around a warship and counter torpedo threats. The LEAD acoustic device is based on Bandfish Mk 2. Enclosed within a mortar or rocket-propelled cartridge, it is launched from standard SRBOC Mk 36/Seagnat launchers. LEAD cartridges are fully compatible with standard launch tubes and ready-use lockers. Width: 7.6cm

PRODUCTS

GUIDE TO SUPPLIERS

This section lists key companies supplying goods, services and equipment to the radar and electronic warfare systems industry worldwide.

The section is separated into two listings, by product then by supplier.

Products are listed alphabetically with suppliers and their location under each.

Supplier listings from p146 are shown alphabetically and include:

- Company address
- Email and website addresses
- Telephone numbers

Highlighted listings also include the company's logo and a summary of activity.

To update a listing or submit new information, please contact the team at insight@shephardmedia.com.

ABOVE: The UK's Future Combat Air System programme can generate billions for the UK economy. (Image: Leonardo)

PRODUCTS

RADAR SYSTEMS

AIRBORNE

AEW and fire control

AVIC – Aviation Industry Corporation of China (CHINA)
BIRD Aerosystems (ISRAEL)
CEIEC – China National Electronics Import & Export (CHINA)
Elta Systems (ISRAEL)
Lockheed Martin (USA)
MBDA (FRANCE)
Mitsubishi Electric (JAPAN)
Nanjing Research Institute of Electronics Technology (NRIET) (CHINA)
Northrop Grumman (USA)
Phazotron NIIR (RUSSIA)
Raytheon (USA)
Saab (SWEDEN)
TATA Advanced Systems (INDIA)
Thales (FRANCE)
TMD Technologies (UK)
V Tikhomirov NIIP (RUSSIA)
Vega Radio Engineering Corporation (RUSSIA)

Surveillance and maritime patrol

Aerodata (GERMANY)
Array Systems Computing (CANADA)
Aselsan (TURKEY)
Boeing Defense, Space & Security (USA)
China National Aero-Technology Import & Export Corporation (CATIC) (CHINA)
Communications & Power Industries (CPI) (USA)
Elta North America (USA)
Elta Systems (ISRAEL)
General Atomics Aeronautical Systems (USA)
Harris Communication Systems (USA)
IACIT (BRAZIL)
Leonardo (ITALY)
Leonardo DRS (USA)
Lockheed Martin (USA)
MicaSense (USA)
Northrop Grumman (USA)
Northrop Grumman Sperry Marine (USA)
Optimare (GERMANY)
Phazotron NIIR (RUSSIA)
PJSC Kiev Radar Plant (UKRAINE)
QinetiQ (UK)
RADA Electronic Industries (ISRAEL)
Raytheon (USA)
Raytheon Space & Airborne Systems (USA)
Saab (SWEDEN)
Sandia National Laboratories (USA)
Silent Sentinel (UK)
SRC (USA)
Swiss Air Force (SWITZERLAND)
Telephonics (USA)
Thales (FRANCE)
Vega Radio Engineering Corporation (RUSSIA)

GROUND

Battlefield and ground surveillance

Advanced Defense Systems, Inc (ADS) (USA)
Aselsan (TURKEY)
BATS Belgian Advanced Technology Systems (BELGIUM)
Bharat Electronics (INDIA)
Blighter Surveillance Systems (UK)
Collins Aerospace (USA)
ECRIEE – East China Research Institute of Electronic Engineering (CHINA)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elettronica (ITALY)
Elta North America (USA)
Elta Systems (ISRAEL)
Hensoldt Optronics GmbH (GERMANY)
Hensoldt Sensors (GERMANY)
IACIT (BRAZIL)
Indra Sistemas (SPAIN)
Kelvin Hughes (UK)
Kintex (BULGARIA)
Leonardo DRS (USA)
Liteye Systems (USA)
Lockheed Martin (USA)
NTGS (SPAIN)
Poly Technologies (CHINA)
RADA Electronic Industries (ISRAEL)
Rosoboronexport (RUSSIA)
Saab (SWEDEN)
SCRIEE – Southwest China Research Institute of Electronic Equipment (CHINA)
SentryX (AUSTRIA)
SRC (USA)
Strela (RUSSIA)
TATA Advanced Systems (INDIA)
Telephonics (USA)
Terma (DENMARK)
Thales (FRANCE)
Thales Netherlands (NETHERLANDS)
Weibel Scientific (DENMARK)

Indirect fire location radar

LIG Nex1 (SOUTH KOREA)

Land-based air defence

Almaz-Antey (RUSSIA)
Aselsan (TURKEY)
Avibras Indústria Aeroespacial (BRAZIL)
BAE Systems (UK)
BATS Belgian Advanced Technology Systems (BELGIUM)
Bharat Electronics (INDIA)
CEIEC – China National Electronics Import & Export (CHINA)
Chess Dynamics (UK)
China Aerospace Science and Industry Corporation (CASIC) (CHINA)
China Electronics Technology Group Corporation (CETC) (CHINA)
CPMIEC (CHINA)
ECRIEE – East China Research Institute of Electronic Engineering (CHINA)
Elta Systems (ISRAEL)
ERA (CZECH REPUBLIC)
Harris Electronic Systems (USA)
Hensoldt Sensors (GERMANY)
Indra Sistemas (SPAIN)
KB Radar (BELARUS)
Kelvin Hughes (UK)
LEMZ (RUSSIA)
Leonardo Land & Naval Defence Electronics (ITALY)
LIG Nex1 (SOUTH KOREA)
Lockheed Martin (USA)
Mitsubishi Electric (JAPAN)
National Chung-Shan Institute of Science and Technology (TAIWAN)
Northrop Grumman (USA)
OKB TSP (BELARUS)
PIT-Radwar S.A (POLAND)
Poly Technologies (CHINA)
QinetiQ (UK)
QinetiQ North America (USA)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon (USA)
RETIA (CZECH REPUBLIC)
Rheinmetall Air Defence (SWITZERLAND)
RRS - Reutech Radar Systems (SOUTH AFRICA)
RTI Systems (RUSSIA)
Saab (SWEDEN)
Siemens (USA)
SRC (USA)
Teledyne FLIR (USA)
Thales (FRANCE)
V Tikhomirov NIIP (RUSSIA)
Weibel Scientific (DENMARK)

NAVAL

Coastal surveillance systems

Advanced Defense Systems, Inc (ADS) (USA)
Aselsan (TURKEY)
BATS Belgian Advanced Technology Systems (BELGIUM)
Blighter Surveillance Systems (UK)
CEIEC – China National Electronics Import & Export (CHINA)
Controp Precision Technologies (ISRAEL)
Diginext (FRANCE)
Easat Radar Systems (UK)
Elta North America (USA)
Elta Systems (ISRAEL)
Furuno (JAPAN)
Gem Elettronica (ITALY)
Harris Communication Systems (USA)
Hensoldt Optronics GmbH (GERMANY)
Hensoldt Sensors (GERMANY)
Indra Sistemas (SPAIN)
Kelvin Hughes (UK)
Leonardo UK (UK)
Lockheed Martin (USA)
Marlan Maritime Technologies (UK)
Norinco (CHINA)
Plath GmbH (GERMANY)
Saab (SWEDEN)
SCRIEE – Southwest China Research Institute of Electronic Equipment (CHINA)
Synectics (UK)
TATA Advanced Systems (INDIA)
Terma (DENMARK)
Thales (FRANCE)
Westminster International (UK)

Commercial maritime radar
Furuno (JAPAN)
Kelvin Hughes (UK)
Navico (NORWAY)
Northrop Grumman Sperry Marine (USA)
Raytheon Anschütz (GERMANY)

Naval fire control
Aselsan (TURKEY)
Chess Dynamics (UK)
China Electronics Technology Group Corporation (CETC) (CHINA)
Leonardo Land & Naval Defence Electronics (ITALY)
Saab (SWEDEN)
SCRIEE – Southwest China Research Institute of Electronic Equipment (CHINA)
Thales (FRANCE)
Thales Netherlands (NETHERLANDS)

Naval surveillance systems
Aselsan (TURKEY)
BAE Systems (UK)
BEL-Thales Systems (INDIA)
CEA Technologies (AUSTRALIA)
Chess Dynamics (UK)
Communications & Power Industries (CPI) (USA)
Elta Systems (ISRAEL)
Harris Electronic Systems (USA)
Hensoldt Sensors (GERMANY)
Japan Radio Company (JAPAN)
Leonardo Land & Naval Defence Electronics (ITALY)
Northrop Grumman (USA)
Raytheon (USA)
Rheinmetall (GERMANY)
Rosoboronexport (RUSSIA)
RRS - Reutech Radar Systems (SOUTH AFRICA)
Selenica (Not Active) (ITALY)
Solusi247 (INDONESIA)
STX Engine (SOUTH KOREA)
TenCate Advanced Armor (USA)
Terma (DENMARK)
Thales (FRANCE)
Thales Netherlands (NETHERLANDS)

NAVIGATION RADAR
Wärtsilä Voyage UK (UK)

SPACE-BASED RADAR
Airbus Defense & Space, Inc (USA)
IAI MBT Division (ISRAEL)
Indian Space Research Organisation (INDIA)
MDA – MacDonald, Dettwiler and Associates (CANADA)
NASA Jet Propulsion Laboratory (JPL) (USA)
OHB System (GERMANY)
Thales Alenia Space (FRANCE)

WEATHER RADAR
Collins Aerospace (USA)
Communications & Power Industries (CPI) (USA)
Eldes (ITALY)
Enterprise Electronics Corporation (USA)
Furuno (JAPAN)
Honeywell Aerospace (USA)
Honeywell International (USA)
IACIT (BRAZIL)
SpotterRF (USA)
Vaisala (FINLAND)

EW SYSTEMS

AIRBORNE

Chaff and flare
Advanced Electronics Company (SAUDI ARABIA)
Aero Telemetry (USA)
Alkan (FRANCE)
Aselsan (TURKEY)
BAE Systems (UK)
BAE Systems Electronic Systems (USA)
BAE Systems Rokar (ISRAEL)
Bharat Dynamics (INDIA)
Chemring Countermeasures (UK)
CSIR (SOUTH AFRICA)
DHPC Technologies (USA)
Diehl Defence (GERMANY)
DTS (CHILE)
Ekran Research Institute (RUSSIA)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elbit Systems Land (ISRAEL)
Elettronica (ITALY)
Extant Aerospace (USA)
Field Aviation (CANADA)
IAI North America (USA)
IMI Rocket Systems Division (RSD) (ISRAEL)
Kanfit (ISRAEL)
Kilgore Flares Company, LLC (USA)
Lacroix (FRANCE)
Lockheed Martin UK (UK)
MASS (UK)
MBDA (FRANCE)
MBDA UK (UK)
NSWC Crane Division (USA)
Ordtech Military Industries (SWITZERLAND)
Petards Group (UK)
RCAF International Training Programs (ITP) (CANADA)
Rheinmetall Defence Electronics (GERMANY)
Rheinmetall Waffe Munition (GERMANY)
Tactical Technologies (CANADA)
Terma (DENMARK)
TNO (NETHERLANDS)

COMINT
Aero Telemetry (USA)
Argon ST (USA)
Aselsan (TURKEY)
Astron Wireless Technologies (USA)
ATDI (FRANCE)
ATDI - UK (UK)
Avalon Electronics (UK)
Bharat Electronics (INDIA)
BIRD Aerosystems (ISRAEL)
Boeing Defense, Space & Security (USA)
Celestia (NETHERLANDS)
CETC International (CHINA)
CMC Electronics (CANADA)
Cobham Antenna Systems - USA (USA)
Cobham Antenna Systems Microwave Antennas (UK)
Cobham Helicopter Services (UK)
Collins Aerospace (USA)
Communications Audit UK (UK)
Comtech PST (USA)
Cubic Global Defense (USA)
Curtiss-Wright Defense Solutions (USA)
D-TA Systems Inc. (CANADA)
Defence R&D Canada (CANADA)
Defence Research & Development Organisation (INDIA)
DIMIC Technologies (INDIA)
DRS Laurel Technologies (USA)
DTS (CHILE)
Elettronica (ITALY)
Elta Systems (ISRAEL)
EM Research, Inc. (USA)
Extant Aerospace (USA)
Field Aviation (CANADA)
General Dynamics Mission Systems (USA)
General Dynamics UK (UK)
Harris Communication Systems (USA)
Hensoldt South Africa (SOUTH AFRICA)
Horizon Technologies (UK)
HR Smith Group of Companies (UK)
IAI North America (USA)
Insulated Wire Microwave Products Division (USA)
Jenkins Engineering Defence Systems (AUSTRALIA)
Kongsberg Defence & Aerospace (NORWAY)
L3 Communication Systems-West (San Diego) (USA)
L3 Randtron Antenna Systems (USA)
L3 Telemetry & RF Products (San Diego) (USA)
Link Microtek (UK)
Lockheed Martin UK (UK)
LS telcom (GERMANY)
Marlborough Communications (UK)
Mercury Defense Systems (USA)
Mercury Systems (USA)
MicroKim (ISRAEL)
Mitsubishi Electric (JAPAN)
NSWC Crane Division (USA)
Ohio Microwave (USA)
Patria Aviation (FINLAND)
Plath GmbH (GERMANY)
Raytheon Applied Signal Technology (USA)
RFEL (UK)
Rohde & Schwarz (GERMANY)
Rohde & Schwarz USA, Inc (USA)
Saab Medav Technologies (GERMANY)
SEA (UK)
Sparton (USA)
Spectrum Signal Processing (CANADA)
TATA Advanced Systems (INDIA)
TCI (USA)
Teledyne Defence & Space (UK)
Textron Systems Advanced Information Solutions (USA)
Thales (FRANCE)

Thales Defense & Security (USA)
Thales USA, Inc (USA)
ThalesRaytheonSystems (FRANCE)
Times Microwave Systems (USA)
Times Microwave Systems International (UK)
TMD Technologies (UK)
Ultra Electronics Communication & Integrated Systems (UK)
WiNRADiO Communications (AUSTRALIA)

ELINT

Aero Telemetry (USA)
Aeronix (USA)
Annapolis Micro Systems (USA)
Applied Research Associates (USA)
Argon ST (USA)
Array Systems Computing (CANADA)
Aselsan (TURKEY)
Astronautics Corporation of America (USA)
ATDI - UK (UK)
Avalon Electronics (UK)
BAE Systems (UK)
BAE Systems Electronic Systems (USA)
Bharat Electronics (INDIA)
BIRD Aerosystems (ISRAEL)
Boeing Defense, Space & Security (USA)
CEIEC – China National Electronics Import & Export (CHINA)
China Aerospace Long-March International (CHINA)
CMC Electronics (CANADA)
Collins Aerospace (USA)
Communications Audit UK (UK)
Comtech PST (USA)
Cubic Global Defense (USA)
Curtiss-Wright Defense Solutions (USA)
Defence Research & Development Organisation (INDIA)
DIMIC Technologies (INDIA)
EaglePicher Yardney Division (USA)
Ekran Research Institute (RUSSIA)
Elbit Systems (ISRAEL)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
EM Research, Inc. (USA)
Engie INEO (FRANCE)
ESROE (UK)
EWA Government Systems Inc (USA)
EWAS Technologies (INDIA)
Extant Aerospace (USA)
Field Aviation (CANADA)
General Atomics Aeronautical Systems (USA)
Hensoldt South Africa (SOUTH AFRICA)
Horizon Technologies (UK)
HR Smith Group of Companies (UK)
IAI North America (USA)
Indra Sistemas (SPAIN)
Information Warfare Technologies (USA)
Insulated Wire Microwave Products Division (USA)
ISPAS (NORWAY)
Jenkins Engineering Defence Systems (AUSTRALIA)
Kontron (GERMANY)
L3 Randtron Antenna Systems (USA)
L3 Telemetry & RF Products (San Diego) (USA)
Link Microtek (UK)
Lockheed Martin Missiles and Fire Control (USA)
Lockheed Martin Rotary and Mission Systems (USA)
Lockheed Martin UK (UK)
Marlborough Communications (UK)
MASS (UK)
MC Countermeasures (CANADA)
Mercury Defense Systems (USA)
Mercury Systems (USA)
Mitsubishi Electric (JAPAN)
My-konsult (SWEDEN)
NSWC Crane Division (USA)
Ohio Microwave (USA)
Patria (FINLAND)
Patria Aviation (FINLAND)
Phazotron NIIR (RUSSIA)
QinetiQ (UK)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon Applied Signal Technology (USA)
Raytheon Space & Airborne Systems (USA)
RCAF International Training Programs (ITP) (CANADA)
RFEL (UK)
Rheinmetall Defence Electronics (GERMANY)
Rosoboronexport (RUSSIA)
Saab (SWEDEN)
Saab Electronic Defence Systems (SOUTH AFRICA)
Saab Medav Technologies (GERMANY)
SEA (UK)
Sierra Nevada Corporation Information and Sensor Solutions (USA)
Sparton (USA)
Spectrum Signal Processing (CANADA)
SRC (USA)
Systematic A/S (DENMARK)
Systematic UK (UK)
TATA Advanced Systems (INDIA)
Teledyne Defence & Space (UK)
Telephonics (USA)
Textron Systems Advanced Information Solutions (USA)
Thales (FRANCE)
Thales USA, Inc (USA)
ThalesRaytheonSystems (FRANCE)
Times Microwave Systems (USA)
TMD Technologies (UK)
Trident Systems (USA)
Ultra Electronics TCS (CANADA)
V Tikhomirov NIIP (RUSSIA)
Wavepoint Research, Inc. (USA)
WiNRADiO Communications (AUSTRALIA)

Integrated systems

Advanced Electronics Company (SAUDI ARABIA)
Aero Telemetry (USA)
Aeronix (USA)
Aethercomm (USA)
Airbus Defence & Space (Germany) (GERMANY)
Akon (USA)
Alpha Design Technologies (INDIA)
Ampex Data Systems (USA)
Analog Devices (USA)
Anaren Microwave (USA)
Argon ST (USA)
Aselsan (TURKEY)
Astronautics (ISRAEL)
Astronautics Corporation of America (USA)
BAE Systems (UK)
Ball Aerospace (USA)
BIRD Aerosystems (ISRAEL)
Boeing Defense, Space & Security (USA)
CACI International (USA)
CEIEC – China National Electronics Import & Export (CHINA)
CMC Electronics (CANADA)
Cobham Advanced Electronic Solutions (USA)
Collins Aerospace (USA)
CoreEL Technologies (INDIA)
Cornet Technology (India) (INDIA)
CSIR (SOUTH AFRICA)
Cubic Global Defense (USA)
Defence Research & Development Organisation (INDIA)
DHPC Technologies (USA)
DIMIC Technologies (INDIA)
e2v (UK)
Ekran Research Institute (RUSSIA)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
Engie INEO (FRANCE)
Esri (USA)
Evans Capacitor Company (USA)
EWAS Technologies (INDIA)
Extant Aerospace (USA)
FEI-Elcom Tech (USA)
Field Aviation (CANADA)
GE Intelligent Platforms (USA)
General Dynamics Mission Systems - Canada (CANADA)
Harris Electronic Systems (USA)
Honeywell International (USA)
IAI North America (USA)
ICON Design Automation (INDIA)
IMT – Integrated Microwave Technologies (USA)
Insulated Wire Microwave Products Division (USA)
Jabil (USA)
Kanfit (ISRAEL)
KMIC Technology (USA)
Kongsberg Defence & Aerospace (NORWAY)
Kontron (GERMANY)
L3 Advanced Laser Systems Technology (USA)
L3 Randtron Antenna Systems (USA)
Leonardo DRS (USA)
Link Microtek (UK)
Lockheed Martin Missiles and Fire Control (USA)
LS telcom (GERMANY)
MBDA (FRANCE)
MBDA UK (UK)
MC Countermeasures (CANADA)
Meggitt Avionics (UK)
Mercury Systems (USA)
Mercury Systems – Trusted Mission Systems (USA)
Microdata Telecomm Innovation (SWEDEN)
MS Instruments (UK)
NSWC Crane Division (USA)
Ohio Microwave (USA)
Ordtech Military Industries (SWITZERLAND)
QinetiQ (UK)
Radiall India (INDIA)

Rafael Advanced Defense Systems (ISRAEL)
Raytheon Space & Airborne Systems (USA)
Raytheon UK (UK)
RFEL (UK)
RUAG Aviation (SWITZERLAND)
Saab (SWEDEN)
Safran Data Systems (FRANCE)
Smiths Interconnect (USA)
Sparton (USA)
Special Technological Center (RUSSIA)
ST Engineering Electronics (SINGAPORE)
Tactical Technologies (CANADA)
TATA Advanced Systems (INDIA)
TE Connectivity – Aerospace, Defense & Marine (USA)
Tecom Industries (USA)
Terma (DENMARK)
Textron Systems Electronic Systems (USA)
Textron Systems Electronic Systems UK (UK)
Thales (FRANCE)
Thales Suisse SA (SWITZERLAND)
Thales UK (UK)
Thales USA, Inc (USA)
ThalesRaytheonSystems (FRANCE)
Times Microwave Systems (USA)
Uavos (USA)
Ultra Electronics Communication & Integrated Systems (UK)
ViaSat (USA)
Winchester Interconnect (USA)
WiNRADiO Communications (AUSTRALIA)

IR and EO

Advanced Coherent Technologies (USA)
AirScan (USA)
Alloy Surfaces (USA)
Alpha Design Technologies (INDIA)
Applied Research Associates (USA)
Avalon Electronics (UK)
BAE Systems (UK)
BAE Systems Electronic Systems (USA)
BAE Systems Rokar (ISRAEL)
Canon (JAPAN)
Chemring Countermeasures (UK)
CILAS (FRANCE)
CSIR (SOUTH AFRICA)
DHPC Technologies (USA)
e2v (UK)
Ekran Research Institute (RUSSIA)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elbit Systems Land (ISRAEL)
Elettronica (ITALY)
Field Aviation (CANADA)
HII Technical Solutions (HII-TSD) (USA)
IAI North America (USA)
IMI Advanced Systems Division (ISRAEL)
Kilgore Flares Company, LLC (USA)
KNIRTI (RUSSIA)
L3 Advanced Laser Systems Technology (USA)
L3 Space & Sensors (USA)
L3Harris Technologies (USA)
Leonardo DRS (USA)
Lockheed Martin Laser and Sensor Systems (USA)
MASS (UK)
MBDA (FRANCE)
MBDA UK (UK)
MC Countermeasures (CANADA)
Mercury Systems (USA)
MicaSense (USA)
Moog Inc (USA)
MS Instruments (UK)
Northrop Grumman (USA)
NSWC Crane Division (USA)
Ordtech Military Industries (SWITZERLAND)
Qioptiq (UK)
Rafael Advanced Defense Systems (ISRAEL)
Saab (SWEDEN)
Synectics (UK)
Tactical Technologies (CANADA)
Terma (DENMARK)
Tetracam (USA)
Textron Systems Electronic Systems (USA)
Textron Systems Electronic Systems UK (UK)
Trillium Engineering (USA)
Velodyne LIDAR (USA)

Radar countermeasures

Advanced Electronics Company (SAUDI ARABIA)
AECOM (USA)
Airbus Defence & Space (France) (FRANCE)
Albrecht Telecommunications (SWITZERLAND)
Alpha Design Technologies (INDIA)
Applied Systems Engineering (USA)
Applied Technology Institute (USA)
Argon ST (USA)
Aselsan (TURKEY)
ATDI (FRANCE)
BAE Systems (UK)
Bharat Electronics (INDIA)
China Electronics Technology Group Corporation (CETC) (CHINA)
Cobham Helicopter Services (UK)
Communications & Power Industries (CPI) (USA)
Crane Aerospace & Electronics (USA)
dB Control (USA)
Ekran Research Institute (RUSSIA)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elbit Systems Land (ISRAEL)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
Emerson & Cuming Microwave Products (USA)
Field Aviation (CANADA)
Harris Communication Systems (USA)
Hensoldt Sensors (GERMANY)
HII Technical Solutions (HII-TSD) (USA)
HR Smith Group of Companies (UK)
IAI North America (USA)
IMI Rocket Systems Division (RSD) (ISRAEL)
Information Warfare Technologies (USA)
innovative Technology Projects (UK)
Insulated Wire Microwave Products Division (USA)
Kirintec Inc (USA)
L3 Electron Devices (Williamsport) (USA)
L3 Electron Devices (Torrance) (USA)
Leonardo DRS (USA)
Link Microtek (UK)
Liteye Systems (USA)
MASS (UK)
MBDA (FRANCE)
MBDA UK (UK)
MC Countermeasures (CANADA)
Mercury Systems (USA)
Microdata Telecomm Innovation (SWEDEN)
MicroKim (ISRAEL)
Moog Inc (USA)
My-konsult (SWEDEN)
Northrop Grumman (USA)
Northrop Grumman UK (UK)
NSWC Crane Division (USA)
Ohio Microwave (USA)
Ordtech Military Industries (SWITZERLAND)
Patria (FINLAND)
Photonis Netherlands (NETHERLANDS)
QinetiQ (UK)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon Space & Airborne Systems (USA)
RFEL (UK)
Rheinmetall Defence Electronics (GERMANY)
Rodale Electronics (USA)
Saab (SWEDEN)
Scientific Research (USA)
SEA (UK)
Spectrum Signal Processing (CANADA)
Tactical Technologies (CANADA)
Teledyne Defence & Space (UK)
Textron Systems Electronic Systems (USA)
Textron Systems Electronic Systems UK (UK)
Thales (FRANCE)
Times Microwave Systems (USA)
TMD Technologies (UK)
TNO (NETHERLANDS)

Warning receivers

ACOEM Group (FRANCE)
Advanced Electronics Company (SAUDI ARABIA)
Aero Telemetry (USA)
Alpha Design Technologies (INDIA)
Argon ST (USA)
Aselsan (TURKEY)
BAE Systems (UK)
Cobham Helicopter Services (UK)
DHPC Technologies (USA)
DRS Laurel Technologies (USA)
DTS (CHILE)
Ekran Research Institute (RUSSIA)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
Field Aviation (CANADA)
HII Technical Solutions (HII-TSD) (USA)
HR Smith Group of Companies (UK)
IAI North America (USA)
Information Warfare Technologies (USA)

Insulated Wire Microwave Products Division (USA)
L3 Randtron Antenna Systems (USA)
L3 Space & Sensors (USA)
Leonardo DRS (USA)
MBDA (FRANCE)
MBDA UK (UK)
MC Countermeasures (CANADA)
Mercury Systems (USA)
Microdata Telecomm Innovation (SWEDEN)
MicroKim (ISRAEL)
Mitsubishi Electric (JAPAN)
MS Instruments (UK)
Northrop Grumman (USA)
Northrop Grumman UK (UK)
Ohio Microwave (USA)
Ordtech Military Industries (SWITZERLAND)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon Space & Airborne Systems (USA)
RFEL (UK)
Saab (SWEDEN)
Safran Electronics & Defense (FRANCE)
Scientific Research (USA)
Sparton (USA)
Spectrum Signal Processing (CANADA)
Tactical Technologies (CANADA)
Teledyne Defence & Space (UK)
Textron Systems Electronic Systems (USA)
Textron Systems Electronic Systems UK (UK)
Thales (FRANCE)
Times Microwave Systems (USA)
Times Microwave Systems International (UK)
TMD Technologies (UK)
TNO (NETHERLANDS)
WiNRADiO Communications (AUSTRALIA)

GENERAL

Associations

ADS Group (UK)
AFCEA International (USA)
AIAD – Italian Industries Federation for Aerospace, Systems and Defense (ITALY)
Association of Old Crows (AOC) (USA)
Canadian Association of Defence & Security Industries (CANADA)
National Defense Industrial Association (USA)

Components/power supplies

A.G. Franz (USA)
AeroVironment (USA)
Akon (USA)
Amphenol (UK)
Analog Devices (USA)
Anritsu (USA)
ApisSys SAS (FRANCE)
ARC Technology Solutions (USA)
Astra Microwave Products (INDIA)
B&Z Technologies (USA)
BSC Filters (UK)
Collins Aerospace ARINCDirect (USA)
Concord Components (USA)
D-TA Systems Inc. (CANADA)
Dayton-Granger (USA)
dB Control (USA)
Defense Research Associates, Inc. (DRA) (USA)
Emhiser Research (USA)
Empower RF Systems (USA)
Greenray Industries (USA)
Hyundai J. Comm (SOUTH KOREA)
ICOMM Tele (INDIA)
IRIS Technology (USA)
KMIC Technology (USA)
Krytar (USA)
L3 Micreo (AUSTRALIA)
L3 Narda-MITEQ (USA)
Leonardo DRS (USA)
Linwave Technology (UK)
MegaPhase (USA)
Micro-Coax (USA)
Micro-Semi (USA)
Midcon Cables Company (USA)
Nexter Systems (FRANCE)
Pharad (USA)
Power Distribution Inc (PDI) (USA)
Powervamp (UK)
Qorvo (USA)
SM Creative Electronics (INDIA)
Solid State Devices Inc (USA)
Sparton (USA)
Spinner (GERMANY)
Steatite Antennas (UK)
Steatite Rugged Systems (UK)
STI Electronics (USA)
TE Connectivity UK (UK)
TE Connectivity – Aerospace, Defense & Marine (USA)
Telephonics (USA)
Telkoor Power Supplies (ISRAEL)
TeraComm (USA)
TT electronics AB Connectors (UK)
TTI (GERMANY)
ViaSat (USA)
Wolfspeed (USA)

Consultancy

A.G. Franz (USA)
Advanced Testing Technologies (USA)
ATDI (FRANCE)
ATDI - UK (UK)
Atos (SWITZERLAND)
Booz Allen Hamilton (USA)
CGI (UK)
CSP Associates (USA)
CTL-SystemWare (USA)
DTM Global (UK)
Fujitsu (JAPAN)
LS telcom (GERMANY)
MacAulay-Brown (USA)
MASS (UK)
Milso AB (SWEDEN)
MITRE (USA)
My-konsult (SWEDEN)
Plextek (UK)
SRI International (USA)
Steatite Antennas (UK)
STM Savunma Teknolojileri Muhendislik ve Ticaret (TURKEY)

Engineering

Advanced Testing Technologies (USA)
AECOM (USA)
Aeromaoz (ISRAEL)
Airbus Defence & Space (Germany) (GERMANY)
Akon (USA)
Aldec (USA)
Applied Systems Engineering (USA)
ATDI - UK (UK)
Atkinson Aeronautics & Technology (USA)
BAE Systems Electronic Systems (USA)
BECOM Electronics (AUSTRIA)
Blue Ridge Envisioneering (USA)
Booz Allen Hamilton (USA)
CEIEC – China National Electronics Import & Export (CHINA)
Collins Aerospace ARINCDirect (USA)
Colorado Engineering Inc (CEI) (USA)
CoreEL Technologies (INDIA)
Defence Research & Development Organisation (INDIA)
Defense Research Associates, Inc. (DRA) (USA)
DHPC Technologies (USA)
Dynetics (USA)
Elettronica (ITALY)
Fujitsu (JAPAN)
GBL Systems (USA)
HII Technical Solutions (HII-TSD) (USA)
IMI Slavin Land Systems Division (LASD) (ISRAEL)
ITCN Dragoon Technologies (USA)
Jenkins Engineering Defence Systems (AUSTRALIA)
Kintex (BULGARIA)
Kongsberg Maritime (NORWAY)
Leidos (USA)
Leonardo DRS Airborne & Intelligence Systems (USA)
Lockheed Martin Rotary and Mission Systems (USA)
Lom Praha (CZECH REPUBLIC)
LS telcom (GERMANY)
MASS (UK)
Merlinhawk Associates (INDIA)
Midcon Cables Company (USA)
MITRE (USA)
MRSL (USA)
MTSI (USA)
New World Solutions (USA)
Nova Systems (AUSTRALIA)
Overlook Systems Technologies (USA)
Petards Group (UK)
QinetiQ North America (USA)
RUAG Aviation (SWITZERLAND)
Sparton (USA)
SpecPro (USA)
Spectranetix (USA)
STI Electronics (USA)
STM Savunma Teknolojileri Muhendislik ve Ticaret (TURKEY)
Survice Engineering (USA)
Sypaq (AUSTRALIA)
Systematic A/S (DENMARK)
Teleplan Globe (NORWAY)
Tri Star Engineering (USA)
Wavepoint Research, Inc. (USA)
Wojskowe Zakłady Uzbrojenia (POLAND)
Wolfspeed (USA)

Testing systems

3dB Labs (USA)
Adsys Controls (USA)
Advanced Testing Technologies (USA)
AeroVironment (USA)
Aethercomm (USA)
Agilent Technologies (USA)
Airbus Defence & Space (Germany) (GERMANY)

Aldec (USA)
Amewas, Inc. (USA)
Anritsu (USA)
ARC Technology Solutions (USA)
Aselsan (TURKEY)
Astra Microwave Products (INDIA)
Azure Summit Technology (USA)
BAE Systems (UK)
BAE Systems Australia (AUSTRALIA)
BAE Systems Electronic Systems (USA)
BECOM Electronics (AUSTRIA)
CI Systems (ISRAEL)
Communications Audit UK (UK)
Defence Research & Development Organisation (INDIA)
Defense Research Associates, Inc. (DRA) (USA)
DHPC Technologies (USA)
DIMIC Technologies (INDIA)
DRS Land Systems (USA)
Dynetics (USA)
Eldes (ITALY)
Electro-Metrics (USA)
Empower RF Systems (USA)
Engie INEO (FRANCE)
EWA Government Systems Inc (USA)
EWAS Technologies (INDIA)
EWSim Corporation (CANADA)
Fractal Antenna Systems Inc (USA)
FS Antennentechnik (GERMANY)
GBL Systems (USA)
Giga-tronics (USA)
Gigacomp AG (SWITZERLAND)
Gigacomp GmbH (GERMANY)
HII Technical Solutions (HII-TSD) (USA)
Innovationszentrum für Telekommunikations-technik (GERMANY)
ISPAS (NORWAY)
ITCN Dragoon Technologies (USA)
Keysight Technologies, Inc. (USA)
Leidos (USA)
Leonardo DRS (USA)
Leonardo DRS Airborne & Intelligence Systems (USA)
Leonardo DRS Electro-Optical Infrared Systems (USA)
MacAulay-Brown (USA)
Mercury Defense Systems (USA)
Mercury Systems (USA)
Meteksan Savunma (TURKEY)
Micro Systems Inc (USA)
MicroKim (ISRAEL)
MTSI (USA)
My-konsult (SWEDEN)
National Instruments Corporation (USA)
National Instruments India (INDIA)
Nexter Systems (FRANCE)
Northrop Grumman (USA)
Northrop Grumman Amherst Systems (USA)
Northrop Grumman UK (UK)
Petards Group (UK)
Procitec (GERMANY)
Qorvo (USA)
Rohde & Schwarz (GERMANY)
Rohde & Schwarz USA, Inc (USA)
RTW- Ride The Wave (ITALY)
RUAG Aviation (SWITZERLAND)
Safran Data Systems (FRANCE)
Scientific Research (USA)
Shrike Marine (SOUTH AFRICA)
Sparton (USA)
SpecPro (USA)
Spectra Research (USA)
STAR Dynamics (USA)
Survice Engineering (USA)
Tektronix Component Solutions (USA)
Tektronix GmbH (GERMANY)
Tektronix UK Ltd (UK)
TeraComm (USA)
Textron Systems (USA)
Textron Systems Electronic Systems (USA)
Textron Systems Electronic Systems UK (UK)
Ultra Electronics Herley (USA)
ViaSat (USA)

GROUND

Chaff and flare

Aero Telemetry (USA)
BAE Systems (UK)
Chemring Countermeasures (UK)
Elettronica (ITALY)
IAI North America (USA)
Lacroix (FRANCE)
NSWC Crane Division (USA)
Ordtech Military Industries (SWITZERLAND)
RCAF International Training Programs (ITP) (CANADA)
Rheinmetall Defence Electronics (GERMANY)
Tactical Technologies (CANADA)

COMINT

Aegis Corea (SOUTH KOREA)
Aero Telemetry (USA)
Albrecht Telecommunications (SWITZERLAND)
Argon ST (USA)
Aselsan (TURKEY)
Astron Wireless Technologies (USA)
ATDI (FRANCE)
ATDI - UK (UK)
Avalon Electronics (UK)
Bharat Electronics (INDIA)
CEA Technologies (AUSTRALIA)
Celestia (NETHERLANDS)
CETC International (CHINA)
Collins Aerospace (USA)
Communications Audit UK (UK)
Comtech PST (USA)
Cubic Global Defense (USA)
D-TA Systems Inc. (CANADA)
Defence R&D Canada (CANADA)
Defence Research & Development Organisation (INDIA)
DIMIC Technologies (INDIA)
Domo Tactical Communications (DTC) (UK)
Drumgrange (UK)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Electro-Metrics (USA)
Elettronica (ITALY)
Elta Systems (ISRAEL)
EM Research, Inc. (USA)
Enterprise Control Systems (ECS) (UK)
EWA Government Systems Inc (USA)
General Dynamics Mission Systems (USA)
General Dynamics UK (UK)
Genesis EW (ISRAEL)
Harris Electronic Systems (USA)
Hensoldt South Africa (SOUTH AFRICA)
Hi-Tech Electronics (SINGAPORE)
Homeland Security Strategies (USA)
IAI North America (USA)
Insulated Wire Microwave Products Division (USA)
Jenkins Engineering Defence Systems (AUSTRALIA)
JSC Concern Sozvezdie (RUSSIA)
Kirintec Ltd (UK)
Kongsberg Defence & Aerospace (NORWAY)
Kontron (GERMANY)
KRET (RUSSIA)
KVH Industries (USA)
L3 Communication Systems-West (San Diego) (USA)
Leonardo DRS (USA)
Lockheed Martin UK (UK)
LS telcom (GERMANY)
Marlborough Communications (UK)
Mercury Systems (USA)
MicroKim (ISRAEL)
NSWC Crane Division (USA)
Ohio Microwave (USA)
Patria Aviation (FINLAND)
Plath GmbH (GERMANY)
Poynting Antennas (SOUTH AFRICA)
Procitec (GERMANY)
Radixon UK (UK)
Raytheon Applied Signal Technology (USA)
RCAF International Training Programs (ITP) (CANADA)
RFEL (UK)
Rheinmetall Defence Electronics (GERMANY)
Rohde & Schwarz (GERMANY)
Rohde & Schwarz USA, Inc (USA)
Saab Medav Technologies (GERMANY)
Sagax (HUNGARY)
SEA (UK)
SESP Group (UK)
Sparton (USA)
Spectrum Signal Processing (CANADA)
TCI (USA)
Textron Systems Advanced Information Solutions (USA)
Thales (FRANCE)
Times Microwave Systems (USA)
TMD Technologies (UK)
TriaSys Technologies (USA)
Ultra Electronics Communication & Integrated Systems (UK)
WiNRADiO Communications (AUSTRALIA)
Wojskowe Zakłady Elektroniczne (POLAND)

ELINT

Albrecht Telecommunications (SWITZERLAND)

Annapolis Micro Systems (USA)
Argon ST (USA)
Aselsan (TURKEY)
ATDI - UK (UK)
Avalon Electronics (UK)
Avibras Indústria Aeroespacial (BRAZIL)
BATS Belgian Advanced Technology Systems (BELGIUM)
Bharat Electronics (INDIA)
CEA Technologies (AUSTRALIA)
CEIEC – China National Electronics Import & Export (CHINA)
China Aerospace Science and Industry Corporation (CASIC) (CHINA)
Collins Aerospace (USA)
Communications Audit UK (UK)
Comtech PST (USA)
Crane Aerospace & Electronics (USA)
Cubic Global Defense (USA)
Defence Research & Development Organisation (INDIA)
Defense Research Associates, Inc. (DRA) (USA)
DIMIC Technologies (INDIA)
Drumgrange (UK)
ECRIEE – East China Research Institute of Electronic Engineering (CHINA)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Electro-Metrics (USA)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
EM Research, Inc. (USA)
Engie INEO (FRANCE)
EURO-ART Advanced Radar Technology (GERMANY)
EWA Government Systems Inc (USA)
Hensoldt South Africa (SOUTH AFRICA)
IAI North America (USA)
Indra Sistemas (SPAIN)
Information Warfare Technologies (USA)
Insulated Wire Microwave Products Division (USA)
Jenkins Engineering Defence Systems (AUSTRALIA)
Kintex (BULGARIA)
Kontron (GERMANY)
L3 TRL Technology (UK)
LEMZ (RUSSIA)
Link Microtek (UK)
Lockheed Martin Rotary and Mission Systems (USA)
Lockheed Martin UK (UK)
Lun'tech (FRANCE)
Marlborough Communications (UK)
MASS (UK)
Mercury Systems (USA)
My-konsult (SWEDEN)
National Chung-Shan Institute of Science and Technology (TAIWAN)
NSWC Crane Division (USA)
Ohio Microwave (USA)
Patria (FINLAND)
Patria Aviation (FINLAND)
Phazotron NIIR (RUSSIA)
PIT-Radwar S.A (POLAND)
QinetiQ (UK)
RADA Electronic Industries (ISRAEL)
Raytheon Applied Signal Technology (USA)
RCAF International Training Programs (ITP) (CANADA)
RFEL (UK)
Rosoboronexport (RUSSIA)
RRS - Reutech Radar Systems (SOUTH AFRICA)
Saab (SWEDEN)
Saab Medav Technologies (GERMANY)
SCRIEE – Southwest China Research Institute of Electronic Equipment (CHINA)
Spectranetix (USA)
Spectrum Signal Processing (CANADA)
SpotterRF (USA)
SRC (USA)
SRI International (USA)
STAR Dynamics (USA)
Strela (RUSSIA)
Systematic A/S (DENMARK)
Systematic UK (UK)
Teledyne Defence & Space (UK)
Telephonics (USA)
Textron Systems Advanced Information Solutions (USA)
Thales (FRANCE)
Times Microwave Systems (USA)
TMD Technologies (UK)
Ultra Electronics TCS (CANADA)
V Tikhomirov NIIP (RUSSIA)
Wavepoint Research, Inc. (USA)
WiNRADiO Communications (AUSTRALIA)

Integrated systems

Advanced Electronics Company (SAUDI ARABIA)
Aero Telemetry (USA)
Aeronix (USA)
Aethercomm (USA)
Airbus Defence & Space (Germany) (GERMANY)
Akon (USA)
Allen-Vanguard UK (UK)
Ampex Data Systems (USA)
Analog Devices (USA)
Anaren Microwave (USA)
Argon ST (USA)
Aselsan (TURKEY)
Astronautics (ISRAEL)
Bharat Electronics (INDIA)
Bird Technologies Group (USA)
CEA Technologies (AUSTRALIA)
CEIEC – China National Electronics Import & Export (CHINA)
Clemaco Contracting (BELGIUM)
Cobham Advanced Electronic Solutions (USA)
COJOT (FINLAND)
Collins Aerospace (USA)
Communications Audit UK (UK)
Computer Application Services (UK)
CoreEL Technologies (INDIA)
Cornet Technology (India) (INDIA)
Crane Aerospace & Electronics (USA)
Cubic Global Defense (USA)
Data Modul AG (GERMANY)
Defence Research & Development Organisation (INDIA)
Denel Integrated Systems & Maritime (Denel ISM) (SOUTH AFRICA)
DIMIC Technologies (INDIA)
Drumgrange (UK)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
Engie INEO (FRANCE)
Esri (USA)
FEI-Elcom Tech (USA)
GE Intelligent Platforms UK (UK)
General Dynamics Mission Systems - Canada (CANADA)
Gigacomp AG (SWITZERLAND)
Gigacomp GmbH (GERMANY)
Harris Communication Systems (USA)
IAI North America (USA)
IMT – Integrated Microwave Technologies (USA)
Insulated Wire Microwave Products Division (USA)
Jabil (USA)
KBM (RUSSIA)
KMIC Technology (USA)
Kongsberg Defence & Aerospace (NORWAY)
KVANT (SLOVAKIA)
L3 Advanced Laser Systems Technology (USA)
L3 TRL Technology (UK)
Leonardo DRS (USA)
Life Safety Systems (USA)
Link Microtek (UK)
Lockheed Martin UK (UK)
LS telcom (GERMANY)
MBDA (FRANCE)
MBDA UK (UK)
Mercury Systems (USA)
Mercury Systems – Trusted Mission Systems (USA)
Microdata Telecomm Innovation (SWEDEN)
Microwave Marketing (UK)
MS Instruments (UK)
NSWC Crane Division (USA)
Ohio Microwave (USA)
Ordtech Military Industries (SWITZERLAND)
Plath GmbH (GERMANY)
Plextek (UK)
QinetiQ (UK)
Radiall India (INDIA)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon BBN Technologies (USA)
RCAF International Training Programs (ITP) (CANADA)
RFEL (UK)
Rheinmetall Defence Electronics (GERMANY)
Rohde & Schwarz (GERMANY)
Rohde & Schwarz USA, Inc (USA)
Rotating Precision Mechanisms (USA)
SEA (UK)
Smiths Interconnect (USA)
Sparton (USA)
SR Technologies (USA)
SRI International (USA)
Tactical Technologies (CANADA)
TE Connectivity – Aerospace, Defense & Marine (USA)
Teledyne Defence & Space (UK)
Thales (FRANCE)
Thales Suisse SA (SWITZERLAND)
Times Microwave Systems (USA)
Ultra Electronics Communication & Integrated Systems (UK)
Winchester Interconnect (USA)

WiNRADiO Communications (AUSTRALIA)

IR and EO

Alloy Surfaces (USA)
Alpha Design Technologies (INDIA)
BAE Systems (UK)
Chemring Countermeasures (UK)
CILAS (FRANCE)
e2v (UK)
Elettronica (ITALY)
Enterprise Control Systems (ECS) (UK)
IAI North America (USA)
Kilgore Flares Company, LLC (USA)
L3 Advanced Laser Systems Technology (USA)
L3 Space & Sensors (USA)
L3Harris Technologies (USA)
Leonardo DRS (USA)
Lockheed Martin Laser and Sensor Systems (USA)
Mercury Systems (USA)
Moog Inc (USA)
NSWC Crane Division (USA)
Photonis France (FRANCE)
Photonis Netherlands (NETHERLANDS)
Rafael Advanced Defense Systems (ISRAEL)
Rheinmetall Defence Electronics (GERMANY)
Rotating Precision Mechanisms (USA)
Safran Electronics & Defense (FRANCE)
Synectics (UK)
Tactical Technologies (CANADA)
Textron Systems Electronic Systems (USA)
Torrey Pines Logic (USA)

Radar countermeasures

Advanced Electronics Company (SAUDI ARABIA)
AECOM (USA)
Airbus Defence & Space (UK) (UK)
Albrecht Telecommunications (SWITZERLAND)
Applied Systems Engineering (USA)
Argon ST (USA)
Aselsan (TURKEY)
AT-Marine (FINLAND)
ATDI (FRANCE)
Avalon Electronics (UK)
BAE Systems (UK)
Bharat Electronics (INDIA)
Cobham Helicopter Services (UK)
Communications & Power Industries (CPI) (USA)
Crane Aerospace & Electronics (USA)
dB Control (USA)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
Emerson & Cuming Microwave Products (USA)
Harris Communication Systems (USA)
Hensoldt Sensors (GERMANY)
IAI North America (USA)
innovative Technology Projects (UK)
Insulated Wire Microwave Products Division (USA)
Leonardo DRS (USA)
Link Microtek (UK)
MASS (UK)
Mercury Systems (USA)
Microdata Telecomm Innovation (SWEDEN)
MicroKim (ISRAEL)
Moog Inc (USA)
My-konsult (SWEDEN)
MyDefence Communication (DENMARK)
Northrop Grumman (USA)
Ohio Microwave (USA)
QinetiQ (UK)
Quarterwave Corp (USA)
Rafael Advanced Defense Systems (ISRAEL)
RFEL (UK)
Rheinmetall Defence Electronics (GERMANY)
Rodale Electronics (USA)
Rotating Precision Mechanisms (USA)
SEA (UK)
Spectrum Signal Processing (CANADA)
SRC (USA)
Tactical Technologies (CANADA)
Teledyne Defence & Space (UK)
Textron Systems Electronic Systems (USA)
Thales (FRANCE)
Times Microwave Systems (USA)
Times Microwave Systems International (UK)
TMD Technologies (UK)
Ukrspecexport (UKRAINE)

Warning receivers

ACOEM Group (FRANCE)
Argon ST (USA)
Aselsan (TURKEY)
BAE Systems (UK)
Bharat Electronics (INDIA)
Bryansk Electromechanical Plant (RUSSIA)
Cobham Helicopter Services (UK)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
IAI North America (USA)
Insulated Wire Microwave Products Division (USA)
L3 Randtron Antenna Systems (USA)
Leonardo DRS (USA)
Mercury Systems (USA)
Microdata Telecomm Innovation (SWEDEN)
MicroKim (ISRAEL)
Northrop Grumman (USA)
Ohio Microwave (USA)
Ordtech Military Industries (SWITZERLAND)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon BBN Technologies (USA)
RFEL (UK)
Spectrum Signal Processing (CANADA)
Tactical Technologies (CANADA)
Teledyne Defence & Space (UK)
Textron Systems Electronic Systems (USA)
Times Microwave Systems (USA)
Times Microwave Systems International (UK)
TMD Technologies (UK)
WiNRADiO Communications (AUSTRALIA)

NAVAL

Chaff and flare

Aero Telemetry (USA)
AT-Marine (FINLAND)
BAE Systems (UK)
Bharat Dynamics (INDIA)
Chemring Countermeasures (UK)
Elettronica (ITALY)
IAI North America (USA)
Lacroix (FRANCE)
Lockheed Martin Sippican (USA)
MASS (UK)
Naval Team Denmark (DENMARK)
NSWC Crane Division (USA)
Ordtech Military Industries (SWITZERLAND)
Rafael Advanced Defense Systems (ISRAEL)
Rheinmetall Defence Electronics (GERMANY)
Tactical Technologies (CANADA)
Terma (DENMARK)

COMINT

Argon ST (USA)
Astron Wireless Technologies (USA)
AT-Marine (FINLAND)
ATDI - UK (UK)
Avalon Electronics (UK)
Bharat Electronics (INDIA)
Boeing Defense, Space & Security (USA)
CEA Technologies (AUSTRALIA)
Collins Aerospace (USA)
Communications Audit UK (UK)
Comtech PST (USA)
D-TA Systems Inc. (CANADA)
Defence R&D Canada (CANADA)
Defence Research & Development Organisation (INDIA)
DIMIC Technologies (INDIA)
Drumgrange (UK)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elettronica (ITALY)
Elta Systems (ISRAEL)
General Dynamics Mission Systems (USA)
General Dynamics UK (UK)
Genesis EW (ISRAEL)
Harris Communication Systems (USA)
Horizon Technologies (UK)
IAI North America (USA)
Insulated Wire Microwave Products Division (USA)
Jenkins Engineering Defence Systems (AUSTRALIA)
Kongsberg Defence & Aerospace (NORWAY)
KVH Industries (USA)
L3 Randtron Antenna Systems (USA)
Link Microtek (UK)
Lockheed Martin UK (UK)
Marlborough Communications (UK)
Mercury Systems (USA)
MicroKim (ISRAEL)
Naval Team Denmark (DENMARK)
NSWC Crane Division (USA)
Ohio Microwave (USA)
Patria Aviation (FINLAND)
Plath GmbH (GERMANY)
Raytheon Applied Signal Technology (USA)
RFEL (UK)
Rohde & Schwarz (GERMANY)
Saab Medav Technologies (GERMANY)
SEA (UK)

Spectrum Signal Processing (CANADA)
Teledyne Defence & Space (UK)
Thales (FRANCE)
Times Microwave Systems (USA)
TMD Technologies (UK)
Ultra Electronics Communication & Integrated Systems (UK)
WiNRADiO Communications (AUSTRALIA)

ELINT

Annapolis Micro Systems (USA)
Argon ST (USA)
Aselsan (TURKEY)
AT-Marine (FINLAND)
ATDI - UK (UK)
Avalon Electronics (UK)
BAE Systems (UK)
BATS Belgian Advanced Technology Systems (BELGIUM)
Bharat Electronics (INDIA)
Boeing Defense, Space & Security (USA)
CEA Technologies (AUSTRALIA)
CEIEC – China National Electronics Import & Export (CHINA)
Communications Audit UK (UK)
Comtech PST (USA)
Defence Research & Development Organisation (INDIA)
DIMIC Technologies (INDIA)
Drumgrange (UK)
EaglePicher Yardney Division (USA)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
EWA Government Systems Inc (USA)
Honeywell International (USA)
Horizon Technologies (UK)
IAI North America (USA)
Indra Sistemas (SPAIN)
Information Warfare Technologies (USA)
Infra RCS Indonesia (INDONESIA)
Insulated Wire Microwave Products Division (USA)
Jenkins Engineering Defence Systems (AUSTRALIA)
L3 Randtron Antenna Systems (USA)
Leonardo DRS (USA)
Link Microtek (UK)
Lockheed Martin Rotary and Mission Systems (USA)
Lockheed Martin UK (UK)
Marlborough Communications (UK)
MASS (UK)
MC Countermeasures (CANADA)
Mercury Systems (USA)
Naval Team Denmark (DENMARK)
NSWC Crane Division (USA)
Ohio Microwave (USA)
Patria (FINLAND)
Patria Aviation (FINLAND)
QinetiQ (UK)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon Applied Signal Technology (USA)
RFEL (UK)
Rheinmetall Defence Electronics (GERMANY)
RRS - Reutech Radar Systems (SOUTH AFRICA)
Saab (SWEDEN)
Saab Medav Technologies (GERMANY)
Spectrum Signal Processing (CANADA)
Teledyne Defence & Space (UK)
Telephonics (USA)
Thales (FRANCE)
Times Microwave Systems (USA)
TMD Technologies (UK)
Ultra Electronics TCS (CANADA)
Wavepoint Research, Inc. (USA)
WiNRADiO Communications (AUSTRALIA)

Integrated systems

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Airbus Defence & Space (Germany) (GERMANY)
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Communications Audit UK (UK)
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Cornet Technology GmbH (GERMANY)
Data Modul AG (GERMANY)
Defence Research & Development Organisation (INDIA)
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Drumgrange (UK)
Elbit Systems (ISRAEL)
Elbit Systems EW & SIGINT – Elisra (ISRAEL)
Elettronica (ITALY)
Elta Systems (ISRAEL)
Esri (USA)
General Dynamics Mission Systems - Canada (CANADA)
Harris Communication Systems (USA)
IAI North America (USA)
Insulated Wire Microwave Products Division (USA)
Jabil (USA)
Kongsberg Defence & Aerospace (NORWAY)
Kongsberg Maritime (NORWAY)
Leonardo DRS (USA)
Link Microtek (UK)
Lockheed Martin Rotary and Mission Systems (USA)
Lockheed Martin Sippican (USA)
Lockheed Martin UK (UK)
MBDA (FRANCE)
MBDA UK (UK)
MC Countermeasures (CANADA)
Mercury Systems (USA)
Microdata Telecomm Innovation (SWEDEN)
Naval Team Denmark (DENMARK)
Northrop Grumman (USA)
NSWC Crane Division (USA)
Ohio Microwave (USA)
QinetiQ (UK)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon Space & Airborne Systems (USA)
RFEL (UK)
Rheinmetall Defence Electronics (GERMANY)
Rohde & Schwarz (GERMANY)
Rotating Precision Mechanisms (USA)
Safran Electronics & Defense (FRANCE)
SEA (UK)
Smiths Interconnect (USA)
Tactical Technologies (CANADA)
TE Connectivity – Aerospace, Defense & Marine (USA)
Teledyne Defence & Space (UK)
Textron Systems Electronic Systems (USA)
Thales (FRANCE)
Thales Suisse SA (SWITZERLAND)
Times Microwave Systems (USA)
TNO (NETHERLANDS)
Ultra Electronics Command & Sonar Systems (UK)
Ultra Electronics Communication & Integrated Systems (UK)
WiNRADiO Communications (AUSTRALIA)

IR and EO

Alloy Surfaces (USA)
AT-Marine (FINLAND)
Avalon Electronics (UK)
Chemring Countermeasures (UK)
CILAS (FRANCE)
CSIR (SOUTH AFRICA)
e2v (UK)
Elettronica (ITALY)
IAI North America (USA)
Kilgore Flares Company, LLC (USA)
L3 Space & Sensors (USA)
Leonardo DRS (USA)
Lockheed Martin Sippican (USA)
MC Countermeasures (CANADA)
Mercury Systems (USA)
Moog Inc (USA)
Naval Team Denmark (DENMARK)
NSWC Crane Division (USA)
Rheinmetall Defence Electronics (GERMANY)
Rotating Precision Mechanisms (USA)
Safran Electronics & Defense (FRANCE)
Tactical Technologies (CANADA)
Textron Systems Electronic Systems (USA)
TNO (NETHERLANDS)

Radar countermeasures

AECOM (USA)
Airborne Systems North America (USA)
Airbus Defence & Space (France) (FRANCE)
Applied Systems Engineering (USA)
Applied Technology Institute (USA)
Argon ST (USA)
Aselsan (TURKEY)
AT-Marine (FINLAND)
Avalon Electronics (UK)
BAE Systems (UK)

Bharat Electronics (INDIA)
CILAS (FRANCE)
Communications & Power Industries (CPI) (USA)
dB Control (USA)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
Emerson & Cuming Microwave Products (USA)
Harris Communication Systems (USA)
Hensoldt Sensors (GERMANY)
IAI North America (USA)
Insulated Wire Microwave Products Division (USA)
IrvinGQ (UK)
Kelvin Hughes (UK)
L3 Electron Devices (Williamsport) (USA)
L3 Electron Devices (Torrance) (USA)
Leonardo DRS (USA)
Link Microtek (UK)
Lockheed Martin Sippican (USA)
MASS (UK)
MC Countermeasures (CANADA)
Mercury Systems (USA)
Microdata Telecomm Innovation (SWEDEN)
MicroKim (ISRAEL)
Moog Inc (USA)
My-konsult (SWEDEN)
Naval Team Denmark (DENMARK)
Northrop Grumman (USA)
NSWC Crane Division (USA)
Ohio Microwave (USA)
QinetiQ (UK)
Quarterwave Corp (USA)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon Space & Airborne Systems (USA)
RFEL (UK)
Rheinmetall Defence Electronics (GERMANY)
Rodale Electronics (USA)
Rotating Precision Mechanisms (USA)
SEA (UK)
Spectrum Signal Processing (CANADA)
Tactical Technologies (CANADA)
Teledyne Defence & Space (UK)
Textron Systems Electronic Systems (USA)
Thales (FRANCE)
Times Microwave Systems (USA)
TMD Technologies (UK)
TNO (NETHERLANDS)

Warning receivers

Argon ST (USA)
Aselsan (TURKEY)
AT-Marine (FINLAND)
Avalon Electronics (UK)
BAE Systems (UK)
Bharat Electronics (INDIA)
Elettronica (ITALY)
Elettronica (ITALY)
Elta Systems (ISRAEL)
Harris Communication Systems (USA)
IAI North America (USA)
Insulated Wire Microwave Products Division (USA)
L3 Randtron Antenna Systems (USA)
Leonardo DRS (USA)
Mercury Systems (USA)
Microdata Telecomm Innovation (SWEDEN)
MicroKim (ISRAEL)
Naval Team Denmark (DENMARK)
Northrop Grumman (USA)
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Raytheon Integrated Defense Systems (USA)
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Tactical Technologies (CANADA)
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Textron Systems Electronic Systems (USA)
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Times Microwave Systems (USA)
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TMD Technologies (UK)
TNO (NETHERLANDS)
WiNRADiO Communications (AUSTRALIA)

The UK MoD has awarded a contract worth approximately £250 million ($314 million) to progress the design and development of Tempest, the UK's Future Combat Air System. Tempest will pioneer cutting-edge technologies, including those assisted by AI, machine learning and autonomous systems to meet the capability requirements of future conflicts and be operational in the mid-2030s. (Image: Leonardo)

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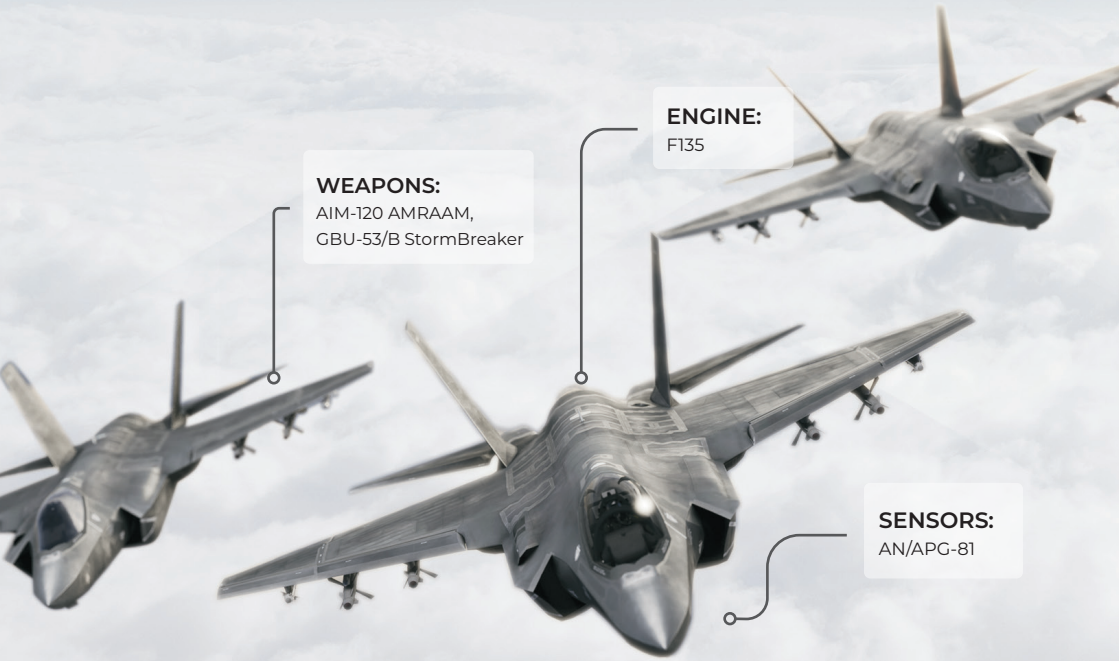

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