

OERLIKON SKYNEX® AIR DEFENCE SYSTEM

TAKING RESPONSIBILITY IN A CHANGING WORLD

RHEINMETALL

INTRODUCTION

The Oerlikon Skynex® Air Defence System is Rheinmetall's latest solution for short-range air defence. With its open and modular architecture, it sets new standards in terms of flexibility and expandability. The Oerlikon Skymaster® Battle Management System is the control node and centrepiece of the system. Various sensors and effectors can be linked in a modular way in order to fit mission requirements. One or several medium range radars or sensor units, such as the Oerlikon Multi Sensor Unit (MSU) or the Oerlikon X-TAR3D® Tactical Acquisition Radar, provide the air picture, which is consolidated in the control node. From there, air targets are assigned to autonomous effectors via the Skymaster network. Besides the high performance Oerlikon Revolver Gun® Mk3, the Oerlikon Twin Gun® GDF009 TREO, surface-to-air missiles, means for active and passive electronic warfare and future high-energy lasers can be integrated. Such a weapon mix generates a highly effective layered protection shield against a wide spectrum of air threats and provides the necessary capability against saturation and swarm attacks in the future. The Oerlikon Skynex® main characteristics are:

- Open, modular and flexible system architecture
- Increased saturation resistance
- Functional composition of single effectors and sensors according to the mission requirements
- Flexible command and control system
- Capability to integrate existing Oerlikon Skyguard® and Oerlikon Skyshield® fire units and most other legacy systems.

In the following pages, the Oerlikon Skynex® Air Defence System is presented from its basic configuration that exists today to its future full-scale capability featuring new technologies that will enhance the sensor and effector mix.

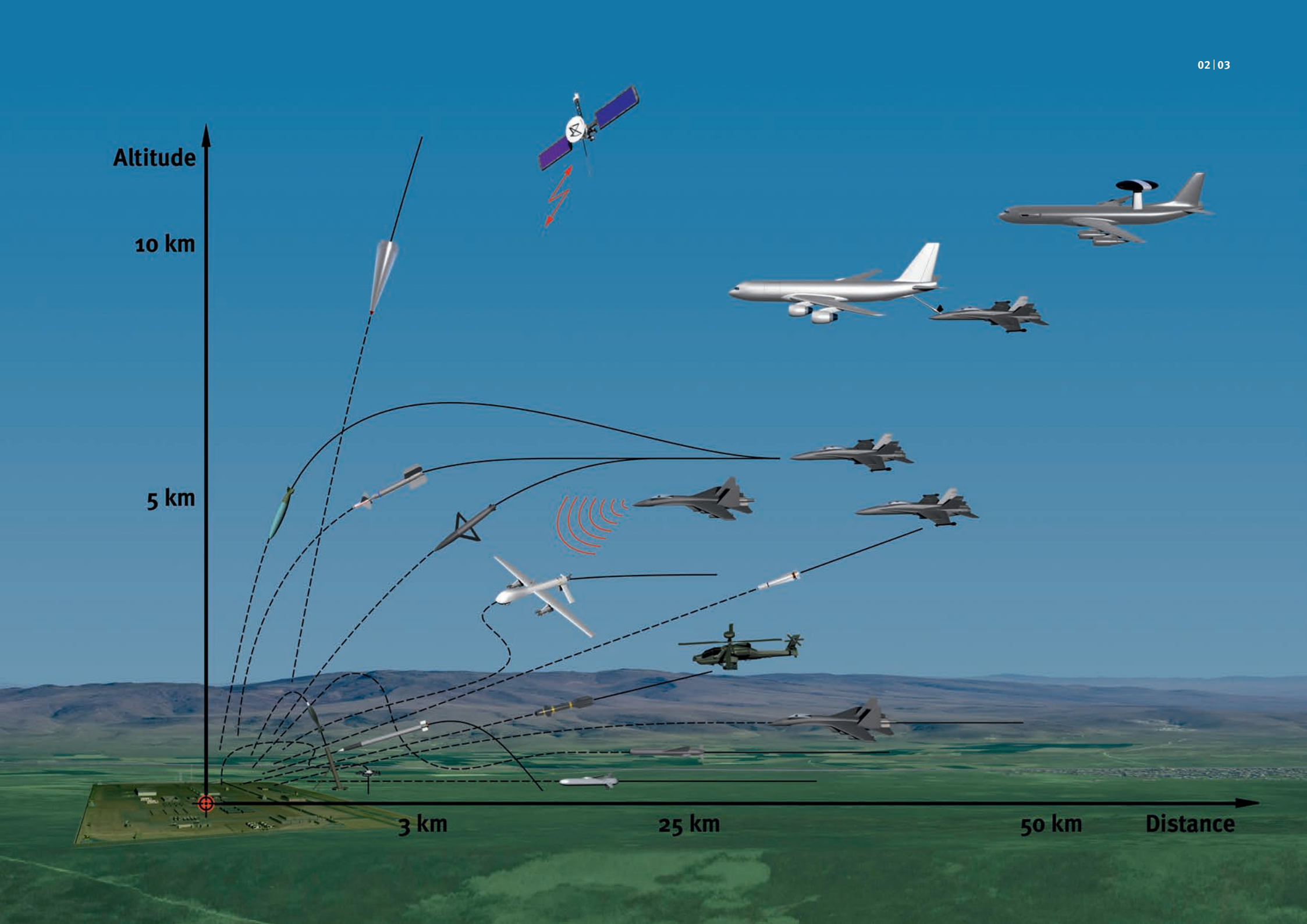
THE THREAT

For more than a century, air attacks have posed a major threat to ground forces and population centres as well as to vital military and civilian infrastructure. This is unlikely to change in the near future. Today's air threat ranges from fixed-wing combat aircraft and attack helicopters to cruise missiles, unmanned aerial systems (UAS), precision-guided munitions and even ground fired rockets, artillery and mortars (RAM). These air threats may persist by day and by night, irrespective of bad weather, terrain and poor visibility and under severe electronic countermeasure (ECM) conditions.

The main trends to be expected in the near future are: an increasing use of UAS with high precision and density, coordinated attacks, extensive use of electronic warfare techniques, exploitation of terrain masking opportunities and all-weather operations, all resulting in reduced target visibility and operated in a fully networked environment.

As standoff weapons and UAS are getting cheaper and are available in large quantities, the saturation resistance of a modern air defence system becomes a crucial success factor.

Only reliable high performance air defence systems with advanced, automated command and control systems provide the affordable means to counter and defeat today's symmetric and asymmetric threats in land and maritime or even hybrid conflict scenarios. The system architecture must be capable to seamlessly integrate new sensors and effectors to cope with the threats of the future even under the most adverse environmental conditions.


Altitude
10 km
5 km
3 km
25 km
50 km
Distance

SKYNEX – BASIC CONFIGURATION

The Oerlikon Skynex® Air Defence System is designed for symmetric as well as asymmetric missions. Its open architecture allows a flexible adaption of the integrated sensors and effectors.

The qualified basic configuration of the Skynex System consists of a control node with the Oerlikon Skymaster® Battle Management System, a sensor unit or a medium range search radar and up to four remote controlled Oerlikon Revolver Guns Mk3. Depending on the size of the defended asset the basic Skynex System can easily be expanded with additional sensors and effectors. As the central search sensor, we currently offer the Oerlikon Multi Sensor Unit (MSU) or the Oerlikon X-TAR3D® search radar.

The Oerlikon Multi Sensor Unit is the next generation of short range air defence sensor unit for target search, acquisition and tracking. The modular architecture allows a combination of various functional modules and sensor technologies such as Active Electronically Scanned Array search radars. The AESA radar suite is complemented with an electro-optical sensor package, holding an infrared and a TV camera as well as laser range finders. The AESA search radar technology provides 360° azimuth coverage and guarantees simultaneous detection of different target types.

The X-TAR3D is a three-dimensional tactical acquisition radar and provides the local air picture up to an instrumented range of 50 km.

Besides classification and identification of air targets, both the MSU and the X-TAR3D deliver accurate 3D target tracking data to the control node, where the target data is processed based on automatic threat evaluation analysis and then sent to the effectors.

Depending on mission requirements, up to four Revolver Guns Mk3 form the basic effector layer. The unmanned Revolver Gun Mk3 combines exceptional precision with high firepower, firing up to 1'000 rounds per minute. With its own sensor unit, consisting of a tracking radar, a TV and an IR camera as well as laser range finders, the gun can take over any in range air targets assigned by Skymaster and autonomously track and engage such targets. Using the programmable 35 mm Ahead ammunition, the gun is able to hit even the smallest targets.

With this set up, the basic version of Skynex is capable to engage aircraft, cruise missiles, small to large tactical drones, air-to-ground-missiles as well as mortars and artillery rockets up to distances of 4 km. This makes Skynex the ideal solution to protect high value stationary assets such as vital military and civil infrastructure like airfields, military bases, harbours, bridges or nuclear power plants against air strikes in all-weather conditions, at day and at night.

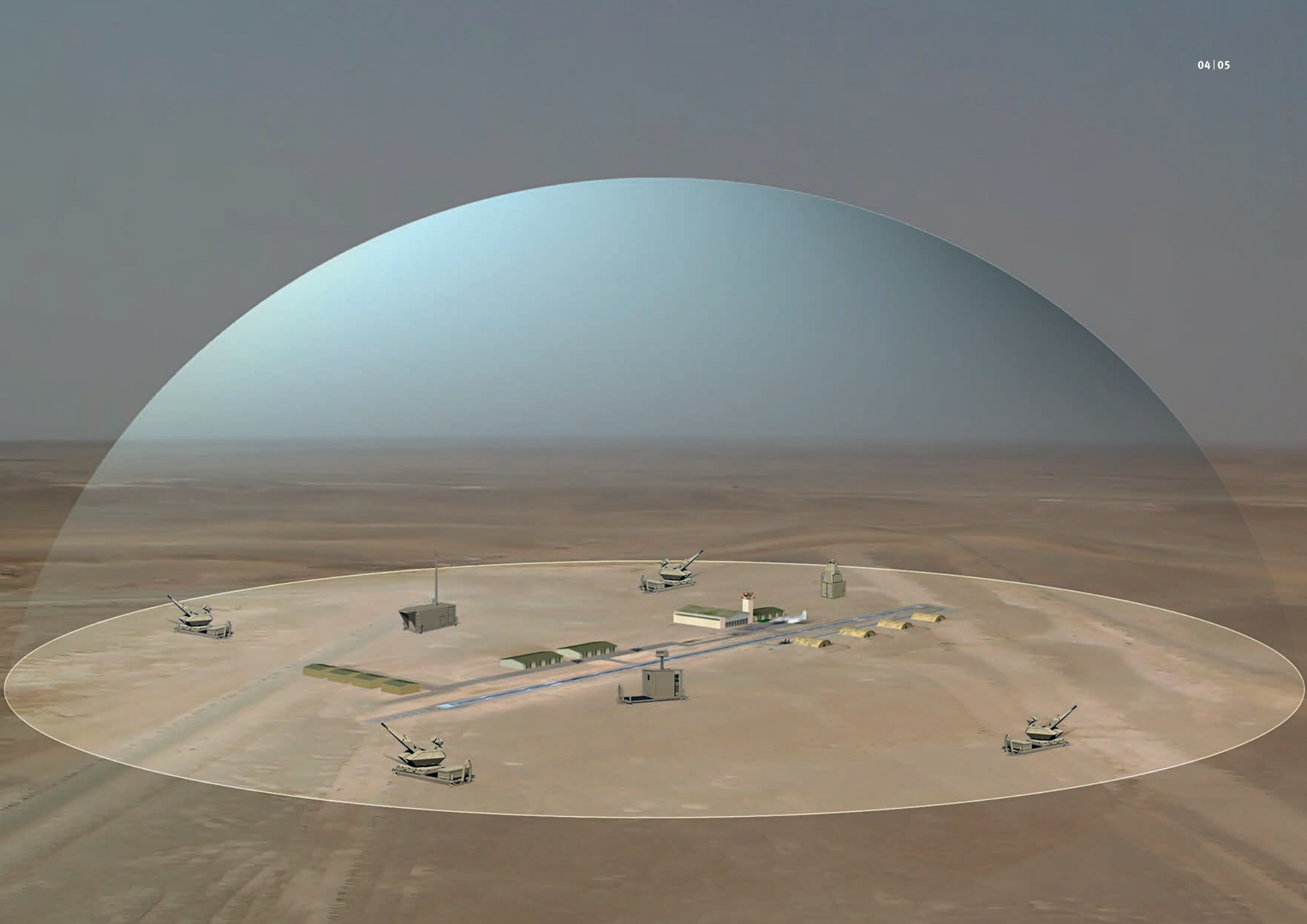
Combining high performance with fast reaction times, massive firepower and maximum tactical and strategic flexibility, the Oerlikon Skynex® is an extremely cost-effective and versatile air defence solution.

OPTION: SENSOR SUITE FOR PASSIVE EARLY WARNING

In today's highly contested battlespace through enemy electronic warfare activities, it is paramount to remain silent and undetected as long as possible. At the same time, early detection of potential aerial threats is very important in order to give the system and operators enough reaction time. Therefore, an optional passive sensor suite for early warning is introduced, based on detection of radio frequency emissions, the so-called C-ESM (Communication Electronic Support Measures) sensor suite. This sensor suite can be deployed as option within Skynex in order to significantly improve self-protection and survivability by EMCON and an improved situational awareness by an augmented air picture, ground picture and picture of the electromagnetic space. By connecting to a higher echelon, the sensor suite can act also as intelligence gap filler. Integration into an already existing or a new Skynex configuration can be done at low cost as limited adaptations to the sensors or the control node are necessary. This option for Skynex can be integrated and made available in a short period of time.

MAIN FEATURES

- Frequency coverage 9 kHz – 8 GHz
- Highest sensitivity
- Detection and localization
- Classification of radio services
- Rapid deployment
- High degree of automation
- Fully integration into battle management system Skymaster
- Flexible configuration (spectrum mask, own frequency assignment)
- Support frequency management and spectrum surveillance



SKYNEX – MAIN CHARACTERISTICS OF BASIC SUBSYSTEMS

OERLIKON SKYNEX® CONTROL NODE 1

The Skynex Control Node 1 houses the computers and operator consoles of the Skymaster Battle Management System in a 20 feet container equipped with power supply, air conditioning, protection and communication systems.

It provides the operators with all command and control functionalities required to conduct their air defence missions. This includes control of the connected weapons and sensors, targeting and firing.

The Skynex Control Node is designed to be operated by four operators, an operations officer, two target operators and a technical operator. In order to increase the maximum amount of simultaneous target engagements, two more target operator consoles can be installed.

The Oerlikon Skymaster® Battle Management Systems is a versatile software solution that significantly enhances ground based air defence operational capabilities. Its main operational benefits are the display of a common comprehensive air picture based on all available information sources, an effective real time threat evaluation, smart weapon assignment algorithm and coordinated fire control. It is the optimal C2-solution for the flexible Skynex Air Defence System and guarantees the best possible system performance. It coordinates all networked air defence sensors and effectors.

Operators work efficiently at configurable consoles with role-based, state-of-the art user interfaces, minimizing stress and maximizing efficiency. Consequently, the number of operators is kept at a minimum.

Built-in data processing and automation assists the operators in taking correct decisions quickly. Particularly the inherent C-RAM (counter-rocket/artillery/mortar) capability relies on automated procedures to deal efficiently with such threats.

The flexible interfacing capabilities allow a seamless integration into the chain of command with existing (netted) command and control infrastructure. Thus, the interoperability with higher echelon C2 systems or neighbouring forces is assured.

MAIN FEATURES

- Air defence system command and control
  - Operation of tactical and operative air defence networks
  - Total situational awareness on all command levels
  - Hierarchical cascadability of Skymaster control nodes
  - ‘Plug and fight’ capability for flexible system configuration
  - Digital network communication by means of land lines or radio links
- Air picture compilation
  - Multi spectrum sensor data fusion
  - Target identification
  - Comprehensive air picture generation and display
  - Control of all connected sensors
  - Information exchange with air traffic control
  - Support of air space control means
- Tactical operator support
  - Centralized and decentralized battle management functionality
  - Graceful degradation capability
  - Automated threat evaluation and weapon assignment
  - Automated engagement recommendations for the targets based on the threat level
  - Manual or automatic weapon engagement control for several weapons on one console
  - High safety standards for friend protection (including IFF functionality)
- Operational support
  - Mission planning system
  - Data logging
  - Integrated training system





OERLIKON MULTI SENSOR UNIT

The Oerlikon Multi Sensor Unit (MSU) is the next generation sensor unit for ground based air defence. It can be installed on a wide range of platforms and is equally suited for stationary or rapid deployment missions. The fully automated MSU is remotely controlled from the Oerlikon Skynex® control node or from a third party battle management system.

The non-rotating, software defined 3D AESA Multi Mission Radar (Oerlikon AMMR) enables superior awareness and mission flexibility. With the AMMR, the MSU achieves a high robustness even in the most trying electronic warfare environment. To support the identification of friend or foe (IFF), an interrogator with a non-rotating electronically scanning antenna is integrated. Once a target is detected, the electro-optical tracker is used to automatically verify and classify the threat using AI.

The modular architecture of the MSU permits a flexible mix of active and passive sensors. The precise target tracks provided by the MSU enable the control of modern air defence effectors such as the 35mm Oerlikon Revolver Gun® Mk3 or the Oerlikon Twin Gun GDF009 TREO.

The MSU provides a coherent air picture and total awareness at any time. It combines excellent performance for detection, acquisition and tracking of the most demanding targets, together with highly automated identification and classification capabilities. In an extended version, the MSU can also control SHORAD Surface-to-Air Missiles (SAM).

MAIN FEATURES

- Remote controlled air defence sensor unit
- Ideal for VSHORAD and SHORAD missions
- Detection of air targets up to 35 km
- Oerlikon AMMR in S-Band
- Reliable detection of small targets including micro UAS and RAM targets
- Advanced ECCM features and clutter mapping
- Growth potential: EO panoramic viewing system for passive and low-level target detection
- Growth potential: Dualband search radar
- Friend-foe identification using non-rotating E-Scan IFF
- EO tracking with HD cameras and laser range finders
- Reliable target classification using AI
- Option: Tracking radar
- Operation in day, night and all-weather conditions
- Rapid deployment
- Highly modular, flexible and scalable architecture
- Advanced sensor data fusion (SDF)
- Simple integration into Skynex and existing air defence systems



OERLIKON X-TAR3D® TACTICAL ACQUISITION RADAR

The X-TAR3D is a three-dimensional multi-mission X-band search radar. As a light and mobile tactical acquisition radar it is ideally suited for short and very-short range air defence systems such as the Oerlikon Skynex® Air Defence System.

The X-TAR3D performs the search, detection, acquisition, tracking and identification of high and low-altitude air targets, in order to provide the Skynex Control Node with a coherent three-dimensional air picture.

The X-TAR3D is specifically designed for a wide range of threats: fixed wing aircraft, helicopters (moving and hovering), unmanned aerial systems (UAS), cruise missiles, rockets, artillery and mortars (RAM) as well as low, slow and small targets. The X-TAR3D is a fully coherent phased-array radar, capable of simultaneously receiving from multiple antenna beams stacked in elevation, in order to measure precisely the target elevation in addition to azimuth and range. The narrow radiation beams result in outstanding angular accuracy and resolution capability for both target-to-target and target-to-jammer discrimination.

The excellent 3D target data accuracy, obtained also in elevation by exploiting multiple narrow receiving beams and the use of the Monopulse technique, allows a high target acquisition probability and a drastic reduction of acquisition time for the associated effectors.

The range performance of the X-TAR3D is appropriate to alert all weapon locations in a wide circle around the protected object. Fast and early weapon alerting allows target engagement at the weapons' maximum effective range. The X-TAR3D performs specific signal and data analysis for RAM classification and ballistic trajectory computation in order to accurately determine the point of launch and the point of impact of the RAM threat.

In the electronic warfare environment, the X-TAR3D shows state-of-the-art ECCM performance. Its high resistance to stand-off jammers is achieved by very low antenna sidelobe levels, while its high angular discrimination allows excellent performance against escort jammers. Track-on-jammer function, adaptive logics for track initiation and netting capability complete the X-TAR3D ECCM suite.

The design of the X-TAR3D is based on a modular concept: it is constituted by a minimum number of modular elements and the main subsystems, like transmitter, receiver and signal processing are based on multiple identical units. This architecture allows several advantages for the user, in terms of mission adaptability (several operative modes for different mission requirements), availability (fault tolerant capability in case of failures of single units), maintainability and life cycle cost.

MAIN FEATURES

- 25 – 50 km instrumented range with 3 main operative modes:
  – Combat (1.5 s/50°/35 km)
  – Surveillance (3 s/25°/50 km)
  – Sense and warn (1 s/70°/25 km)
- High detection capability of RAM targets
- X-band operation, excellent performance at low altitude
- Vertical phased array antenna
- High accuracy in all three dimensions and short revisit time
- Automatic target classification (aircraft, helicopter, UAS, missiles, RAM)
- State of the art ECCM capabilities
- New generation IFF integration (modes S and 5)
- High mobility, compactness and search on the move capability


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OERLIKON X-TAR 3D
SEARCH RADAR

OERLIKON REVOLVER GUN® MK3

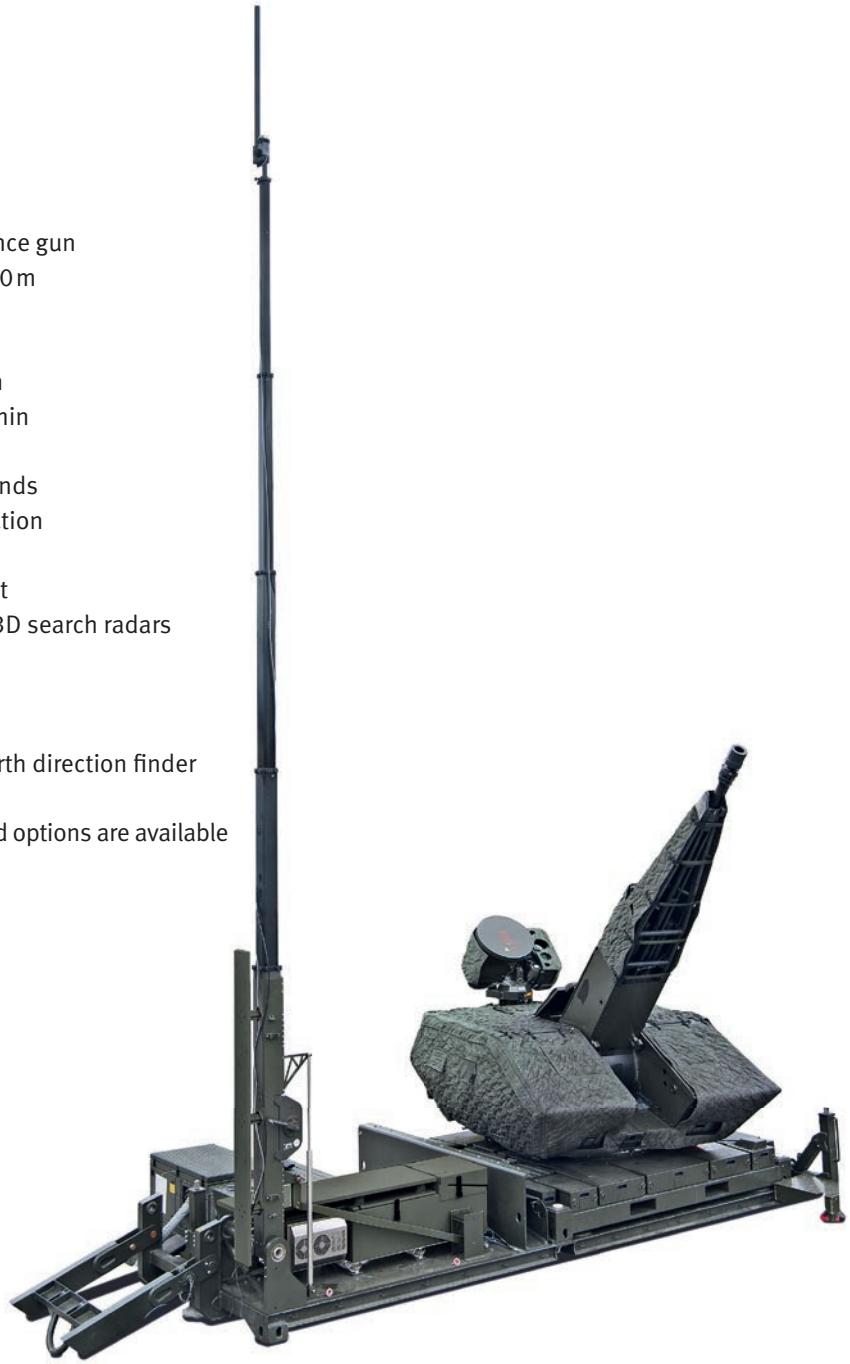
This remote controlled, high precision 35 mm air defence gun with integrated radar tracker and electro-optical sensor unit is a powerful, autonomous shooter suitable for various kinds of missions.

The Revolver Gun Mk3 can receive and process target data from 3D or 2D search radars or higher order control systems. The tracking radar's automatic search pattern makes target handover simple, fast and reliable. The integrated gun control computer manages target tracking and engagement. The electro-optical sensor unit enables visual target identification. Once the gun is deployed in the field, set up and ready for operation, it is fully remote controlled via the target operator console inside the Skynex Control Node.

The integrated 35 mm Oerlikon Revolver Cannon® provides superior firepower and accuracy. Combined with the Oerlikon Ahead® air burst ammunition the gun achieves a high effectiveness against a wide range of air threats, including low, slow and small (LSS) targets, UAS, artillery rockets, mortars and air-to-ground missiles. The cannon and ammunition are fully qualified and in service on land and sea platforms. The Revolver Gun Mk3 is based on an ISO 1D container compatible platform with retractable hydraulic feet for easy transport and deployment in the field. For a quick deployment, it can also be mounted on a STANAG 2413 compatible, hook-liftable platform or fixed and fired directly from a suitable truck.

MAIN FEATURES

- Remote controlled 35 mm air defence gun
- Effective combat range: up to 4,000 m
- C-RAM capability
- 35 mm Oerlikon Revolver Cannon®
- Nominal rate of fire: 1,000 rds/min
- Rapid single shot mode: 200 rds/min
- Ahead air burst ammunition
- Ready to fire ammunition: 252 rounds
- Remote charge and discharge function
- X-band or Ku-band tracking radar
- Modular electro-optical sensor unit
- Flexible target handover from 2D/3D search radars
- Active and passive target tracking
- Remote engagement supervision
- Simple handling and maintenance
- Integrated position locator and north direction finder
- No field alignment required
- Palletized hook-lift or truck mounted options are available




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OERLIKON REVOLVER GUN MK3 TM

OERLIKON TWIN GUN® GDF009 TREO

Alternatively to the Revolver Gun Mk3, Skynex can also be equipped with the Oerlikon Twin Gun® GDF009 TREO in its latest configuration of the 35 mm Twin Gun family. Every existing Oerlikon Twin Gun® can be upgraded to the GDF009 TREO configuration. The Twin Gun is combat proven and in use in numerous countries. The GDF009 TREO is fitted with a modern network capable gun computer and can receive and process target data from fire control units or 3D radars such as the Oerlikon X-TAR3D® or from the MSU. The gun can be remote controlled from the Skynex Control Node or used for autonomous target engagement by means of the integrated tracking sensor unit. Target handover is possible from the control node or an external optical target designator.

The two integrated 35 mm Oerlikon Cannon® KDC provide superior firepower and accuracy. Combined with the Oerlikon Ahead® Air Burst Ammunition the gun achieves a high effectiveness against various kinds of air or ground targets.

The Twin Gun GDF009 TREO is based on a wheeled trailer with hydraulic supports on swivel arms. The gun can easily be transported and deployed in the field on flat or uneven grounds. In the firing position, the wheels of the gun are tilted and the gun is automatically levelled by the hydraulic system integrated in the lower mount.

MAIN FEATURES

- 35 mm air defence twin gun
- Remote controlled or autonomous operation
- Effective combat range: up to 4,000 m
- Modern network capable gun computer
- X-band tracking radar
- Modular electro-optical sensor unit
- Autonomous target tracking and engagement
- Target handover from fire control unit, search radar or optical target designator
- Remote engagement supervision
- 2 x 35 mm Oerlikon Cannon® KDC
- Nominal rate of fire: 1,100 rds/min
- Ahead air burst ammunition
- Ammunition on gun/ready to fire: 280/112 rounds
- Automatic reloading function
- Integrated battery-based power supply unit
- Wheeled chassis with hydraulic supports on swivel arms
- Fast deployment and relocation time
- Simple handling and maintenance



OERLIKON AHEAD® AIR BURST TECHNOLOGY

The Revolver Gun Mk3 and the Twin Gun GDF009 TREO both rely on on the proven Oerlikon Ahead® Air Burst Technology to achieve the highest possible kill performance for small air threats and in particular for RAM threats and drones. The Ahead ammunition carries a payload of subprojectiles, which is ejected at a pre-determined distance ahead of the target, with the objective of achieving an optimal subprojectile density for maximum effectiveness.

The optimal ejection point is programmed into the time fuse of each shell. The fire control system calculates a fuse time corresponding to the required target intercept conditions, based on an assumed muzzle velocity.

The actual muzzle velocity of each round is measured by the Ahead measuring and programming base at the end of the gun barrel. The calculated fuse time is subsequently corrected to correspond with the measured actual muzzle velocity of each round. This value is then programmed into the Ahead round in real time by an inductive coil at the end of the Ahead measuring and programming base.

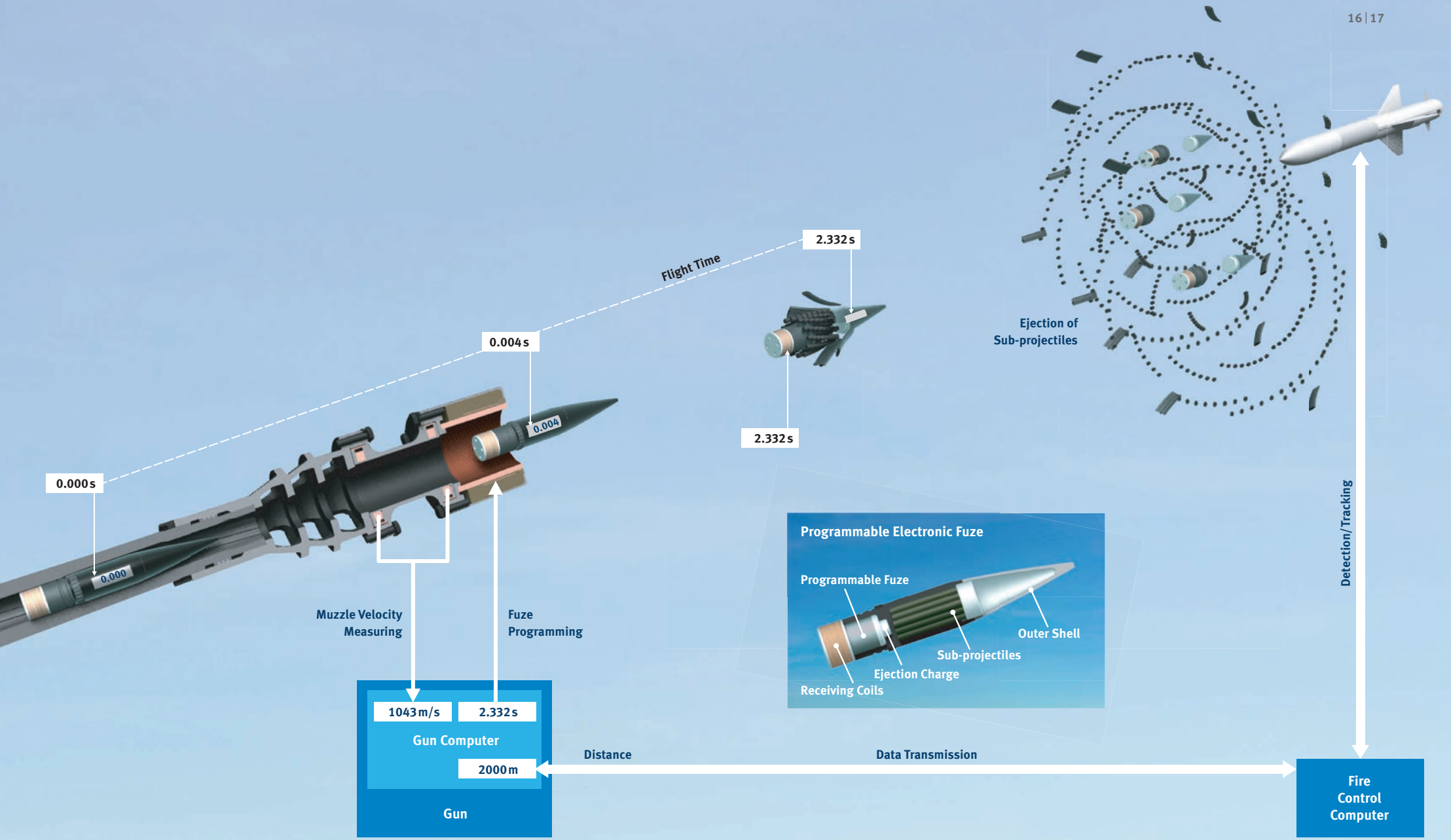
With the Ahead air burst ammunition, a cloud of subprojectiles intercepts the attacking target. A short burst of Ahead rounds produces a high density of subprojectiles ejected 10 to 40 metres in front of the attacking target, so that even the smallest target is hit with a sufficient number of subprojectiles.

The spin-stabilized subprojectiles penetrate the target – even at low impact angles – and inject a high level of kinetic energy into it. This will damage or destroy the target and thereby leads to a mission kill.

MAIN FEATURES

- High precision programmable base fuze
- Tungsten sub-projectile payload
- All payload kinetic energy is projected towards the target
- Spin-stabilized sub-projectiles
- Self-destruction incorporated
- Unprogrammed anti-armour mode
- Qualified and in service
- Inherently safe round
- No special maintenance needed
- More than 600,000 rounds delivered




Flight Time
0.000 s
0.004 s
2.332 s
0.000
0.004
2.332 s
Ejection of
Sub-projectiles
Detection/Tracking
Muzzle Velocity
Measuring
Fuze
Programming
Programmable Electronic Fuze
Programmable Fuze
Outer Shell
Sub-projectiles
Ejection Charge
Receiving Coils
1043 m/s
2.332 s
Gun Computer
2000 m
Gun
Distance
Data Transmission
Fire
Control
Computer

FUTURE SKYNEX EFFECTORS

OERLIKON HIGH ENERGY LASER

For more than a decade, Rheinmetall has been working on new weapon technologies such as the high energy laser. Its scalable degree of escalation, the low cost per engagement and the extended engagement range make it the ideal weapon against unmanned aerial systems, in particular drones and other low, slow and small targets that come in masses. Integrated into the Skynex Air Defence System, the high energy laser certainly adds a first level of saturation resistance that is well required looking at the future threat scenarios.

MAIN FEATURES

- Several mobile and stationary demonstrators (10 kW – 60 kW) in ongoing tests are available
- Low cost per engagement at extended ranges
- Scalable degree of escalation
- Effective against various target types such as drones, UAS, and fixed and rotary wing aircraft
- 100 kW power can be achieved by superimposing the HEL beams of 2 HEL guns
- Simple integration into Oerlikon Skynex
- Available with its own EO sensor package (TV, IR, LRF) and coarse tracking
- ITAR free

SKYKNIGHT MISSILE

Together with its partner company HALCON, Rheinmetall is currently developing a new type of very short range air defence missile in order to complete its effector portfolio. The SkyKnight counter PGM and counter RAM missile is specifically designed to counter hard-cased targets such as precision guided munitions and large artillery shells. With its extended range of up to 6 km against such targets and its multi launch capability, Skynex will experience a significant performance increase against saturation attacks and enhance its target spectrum. One missile launcher containing up to 60 ready to fire missiles can launch up to 5 missiles per second on individually assigned targets. Furthermore, thanks to engagement ranges of up to 10 km against soft-cased targets, the new missile significantly increases the combat radius of Skynex and truly contributes to the approach of a layered air defence system.

MAIN FEATURES

- All weather capability
- Stationary and mobile application
- 20 – 60 ready missiles per launcher
- Up to 4 SkyKnight missile launcher units per tactical unit
- 360 degree coverage (vertical launch)
- Effective range up to 10 km (depending on target type)
- Effective against RAM, PGM, UAS, cruise missiles and fixed and rotary wing aircraft
- Launch of up to 5 missiles per second to individually assigned targets
- Up to 80 missiles in flight at the same time
- High saturation resistance
- Protected area per launcher: at least 2.5 km x 2.5 km




SkyKnight
HALCON

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