Weibel Scientific A/S

Weibel XENTA M5 SHORAD Surveillance Radar

System Performance Specification (SPS)

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Weibel Scientific A/S

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1 INTRODUCTION TO XENTA M5

1.1 XENTA M5 – Product Overview

The Weibel Scientific XENTA M5 Multi-Frequency Surveillance Radar is an FMCW digital-array 3D Surveillance Radar, specifically designed for the complex environment for Short Range Air Defence operations.

XENTA M5 covers a full 360 degree Azimuth and 60 degree Elevation surveillance volume, and with processing that combines advanced a Digital-Array Synthetic-Beamforming 3-D Surveillance Radar and high-accuracy Tracking Radar technology in one radar system. XENTA M5 transmits 240W Power continuous. The Transmit Beam is steered and shaped to cover the full 8 x 60 degree Surveillance volume. Digital-Array Receive processing is by a mesh of synthetic Receive Beams, each Receive Beam 2 x 4 degrees.

The XENTA M5 Antenna is controlled by a high-performance Turning-Motor system that permits both high-speed (60 rpm) rotation with high-precision pointing-accuracy when tracking.

Exploiting the advanced sensor and signal processing possible from both FMCW and digital-array synthetic-beamforming, the XENTA M5 offers Target detection and situational-awareness support against Air Targets from small LSS up to Helo, Generic Aircraft, Fighters and Missiles. As typical clear-weather value, the XENTA M5 will detect and track (3D) 1m^2 Air Targets up to 6´000m and to 30 km range.

XENTA M5 Doppler-based processing is optimised for clutter-reduction, and for Target-classification. In particular, XENTA M5 offers unique classification performance against rotary-wing Targets : from Drones up to Helicopters.

XENTA M5 General Characteristic Benefits

FMCW processing of the XENTA M5 gives a number of inherent benefits :

- Optimum MTD-processing based on 100% Duty Cycle
- Optimum Range Accuracy and Discrimination
- Optimum Velocity Accuracy and Discrimination
- Optimum Time-on-Target due 100% Duty Cycle
- Optimum Target information from 100% Duty Cycle and Doppler-processing to support estimation of both Target Doppler and Target micro-Doppler.

XENTA M5 Frequency

XENTA M5 operates in the X-Band – this ensures an optimal

- High accuracy
- Compact system
- High mobility
- High range performance
- Operation in all weather conditions

XENTA M5 Flexibility

The XENTA M5 is developed and realised with a standard baseline comprising common hardware, microwave units and system-processing throughout. Built on this common baseline, the XENTA M5 is developed as a flexible family of Surveillance Radars able to offer a wide variety of configurations. XENTA M5 Configurations are adapted to provide functional performance optimised for Customer-defined operational roles.

Examples of functional flexibility include :

- Air Surveillance for general Short Range military and non-military operations
- Air Surveillance dedicated for Short Range LSS, UAV / UAS and Drone detection operations
- Air Surveillance suitable for general-service applications
- Air Surveillance (high-performance) for military fixed-radar SHORAD operations
- Air Surveillance (high-performance) for military mobile (vehicle) SHORAD operations.

1.1.1 XENTA M5 Summarised Functionality

01)	**Operational Roles of the XENTA M5 SHORAD**
01.1)	The XENTA M5 is developed as a first-line and Primary Air Surveillance Radar, with performance optimised for LSS and SHORAD applications.
01.2)	The XENTA M5 is also intended for applications as a secondary Air Surveillance Radar suitable for LSS and SHORAD applications in support of large-scale Combat and Surveillance Systems.
02)	**General Surveillance Functions**
2.1)	The XENTA M5 is realised as a multi-functional Surveillance Radar optimised for surveillance operations in highly flexible tactical environment.
2.2)	Exploiting the functional characteristics of Digital-Array Synthetic-Beamforming technology and processing, the FMCW / MFCW / CW XENTA M5 Surveillance Radar is able to carry out Air Surveillance to meet the challenging LSS and complex modern Air Target environment.
2.3)	XENTA M5 is designed for Surveillance Detection and Classification against a wide variety of Target types, including LSS, Helo, Missiles, High-Speed Missiles/HARM and Generic Aircraft by size.
2.4)	Surveillance processing is optimised for varying Target RCS, Target characteristics, Speed and Detection Ranges.
2.5)	Surveillance processing is designed to handle differing environments, reflecting the considerable variety in Clutter-environments that are expected for SHORAD-applications. Such environments will typically include clear free-space-like regions through to densely-cluttered urban-backgrounds.
2.6)	XENTA M5 is designed for All-Weather Surveillance operations.
2.7)	Clutter-minimisation and Bad-Weather processing is supported by flexible XENTA M5 System Modes and Profiles.

03)	**General Tactical Functions**
03.1)	General Air-Target Surveillance
03.2)	Surveillance Target-Tracking (Track-While-Scan)
03.3)	Target-Tracking (Closed-Loop)
03.4)	Target Classification
03.5)	Reporting of Air-Target Track-Data to a Command-and-Control System as primary input data for Air-Picture Compilation processing
03.6)	Reporting of Air-Track Data with adequate Accuracy and Precision for use as Designation Data source for high-precision Tracking Radar and Electro-Optical Tracking Systems
03.7)	Reporting of Air-Track Data with adequate Accuracy and Precision for use as Targeting Data source for Launch/Guidance of Anti-Air Defence Missile Systems

The Multiple Frequency CW/FM-CW ranging technique gives the following advantages:

- Optimum MTD (Moving Target Detection) based on 100% duty cycle on CW Doppler
- Optimal range accuracy
- Optimal velocity accuracy
- Optimal angle accuracy
- High duty cycle
- High range resolution in FM-CW mode (High bandwidth)
- No minimum object size
- Low elevation measurement

1.2 System Supplier

The XENTA M5 Multi-Frequency Surveillance Radar is designed, manufactured and supplied by :

Weibel Scientific A/S
Solvang 30
3450 Allerød
Denmark

1.3 System Flexibility

As Surveillance Radar product-line, the XENTA M5 is developed as a flexible family of Surveillance Radars offering a wide variety of configurations adapted for specific applications and cost-constraints. All MFSR-2100/XX configurations are however based one common engineering basis.

The XENTA M5 *common engineering basis* means that XENTA M5 is developed and realised with a standard baseline comprising common hardware, microwave units and system-processing throughout. Built on this common baseline, the XENTA M5 is a family of Surveillance Radars, offering a wide variety of configurations.

The XENTA M5 will realise the operational and functional flexibility by means of differing hardware and processing configurations, each adapted for the specific application. XENTA M5 configuration flexibility will include :

- Elevation coverage
- Transmit Power
- Nominal Maximum Range
- Implementation and characteristics of STARE processing
- Implementation and level of ECCM processing
- Implementation and level of integration of IFF-Interrogator.

1.4 Project-Specific SHORAD Implementation

As soon as any Contract and Application-specific requirements are known, Weibel will work with Contractual Partners, end-Users and Combat System Integrators to ensure that the XENTA M5 is optimised for the expected tactical operations.

2 SYSTEM DESCRIPTION

2.1 Main Characteristics of the XENTA M5 Surveillance Radar

01)	**XENTA M5 General Sensor Characteristics**
	New-generation Multi-Frequency 3D Surveillance Radar
	Multiple-feeding Micro-strip Sub-Array Solid-State Antenna,
	GaN Transmit Modules
	Frequency Bands[1)] : 9´000 – 9´500 ; 9´500 – 10´000 ; 10´000 – 10´500 MHz
	Frequency Sub-Bands[2)] : 500 MHz
	100% Duty Cycle
	240W Transmit Power (Full Power)
	Adaptive Transmit Power (Sector Power Management)
	Horizontal Polarisation
	Military Qualified (Environmental)
02)	**XENTA M5 Beam Coverage Characteristics**
	One Programmable Transmit Beam, Multiple Receive Beams
	Receive Beam 4 degrees
	Continuous-Wave Digital-Array Synthetic-Beamforming
	60 degree Elevation coverage
03)	**XENTA M5 Summarised Processing Characteristics**
	X-Band, 400MHz Bandwidth
	Processing uses FMCW-CW and MFCW-CW
	Signal Processing is primarily Range-Doppler analysis
	Optimum Clutter-Rejection using CW Doppler technology
	Optimum Range accuracy when using the MFCW processing
	Nominal Minimum Range is 150 m
	Instrumented Range 75 km
	Typical Detection Range of 30km (1 m^2)
	Modes (Surveillance, Stop-Stare, Maintenance)
	16 User definable Profiles
	10 Blanking / Transmit-Inhibit Zones

04)	**XENTA M5 Drive System**
	The MSR-2100/36 Antenna is controlled by a high-performance Drive System that is optimised for both high-duration high-power high-speed Antenna Rotation, and also high-precision Antenna Pointing and Target Closed-Loop Tracking.
	The Main Drive is a high-capacity Direct Drive Motor, controlled by the Motor Servo Controller located in the Interface Control Unit.
	Antenna Position is measured with two Renishaw 32-bit Encoders that are also interfaced with and processed in the Interface Control Unit. Rotation Axis of the complete Drive System including the integrated Rotary Joint is mounted on robust Roller Bearings rated to withstand Shock and Vibration requirements.
	The Drive System includes automatic and remotely-operated Locking Pins for securing the Antenna. Locking Pins are provided at the four 90° quadrants.
05)	**XENTA M5 Top-Level Functions**
	Optimised for and combining the functions of SHORAD and Close-Range LSS Surveillance operations
	General Surveillance Radar functionality
	Surveillance Antenna Rotation Speeds up to 60rpm
	High-precision Stare (Antenna-stopped) function
	Sector Power Management function
	Support special Customer-specific applications (to be examined / case-by-case)
	Beam Stabilisation up to 7 degrees Tilt
	Inertial Processing and Track Reporting
	Interfacing to Platform Reference Systems
	Simple integration of XENTA M5 to Command-and-Control Systems
06)	**XENTA M5 Frequency Management**
	Wide Frequency Band
	Agile, Fixed
	Automatic Disable of Disturbed Frequencies
07)	**XENTA M5 ECCM**
	Inherent and Active ECCM Processing
08)	**XENTA M5 Target Classification Characteristics**
	Processing optimised for Target Classification
	Classification optimised for Generic Aircraft by size, Missile, High-Speed Missile/HARM, Helicopter and LSS/UAV/Drone Targets
	Classification processing based on advanced Doppler-based analysis
	Support to overall Combat System performance by reporting of XENTA M5-internal Target Classification

09)	**XENTA M5 Target and Track Characteristics**
	Integrated Plot and Track Extraction
	Full-automatic Plot and Track Extraction
	Tracks created and reported for both Stationary and On-the-Move Vehicles
	XENTA M5 will create and report Tracks for Air Targets from Stationary LSS up to High-Speed Missile/HARM Targets
	High-quality and precise Track Reporting of Air Targets
	High-rate Surveillance and Data-update reports
	Minimal False and Unwanted Tracks
	Track Data reported in North-Oriented, Horizontally-Stabilised Reference Frame
	Track Data reported with high Accuracy, and suitable for integration in complex high-end Weapon Systems
	Track Data reported to Interface Partners such as C^2-Systems
	Main Interface Ethernet, ASTERIX and Native
10)	**XENTA M5 Reliability and Support Characteristics**
	Modern solid state technology
	Designed Modular redundancy with associated graceful degradation in Antenna components
	Low Voltage electronics for inherently high MTBF in critical RF components
	Modular design for relatively simple defect investigation and repair, and with maximal commonality in Spare Modules
	Support to Maintainers and MTBF with extensive integrated BITE processing Minimal obsolescence risk due to in-house design and manufacturing of almost all system assemblies and components.

NOTES :

1) The XENTA M5 can be supplied with one of the three 500 MHz Frequency Bands.

Actual Frequency Band for implementation should be selected and defined by (as example, end-User), and typically at Contract Award.

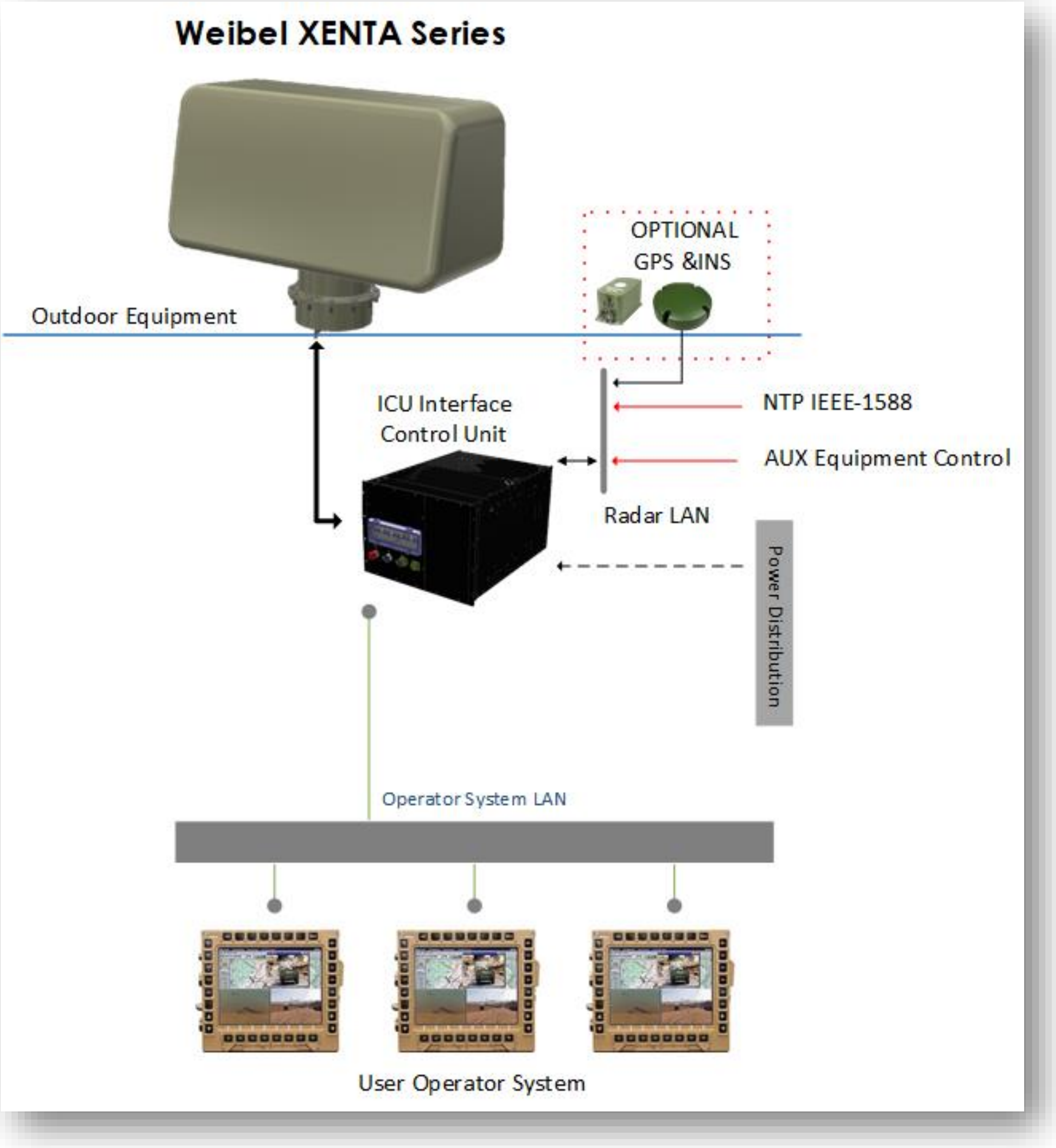
2) Frequency Sub-Bands are selected for Frequency-Agile operation (Synchronised and Unsynchronised).

Frequency Sub-Bands can be useful for :

- Minimisation of Surveillance Radar mutual-interference
- Improved ECCM capability.

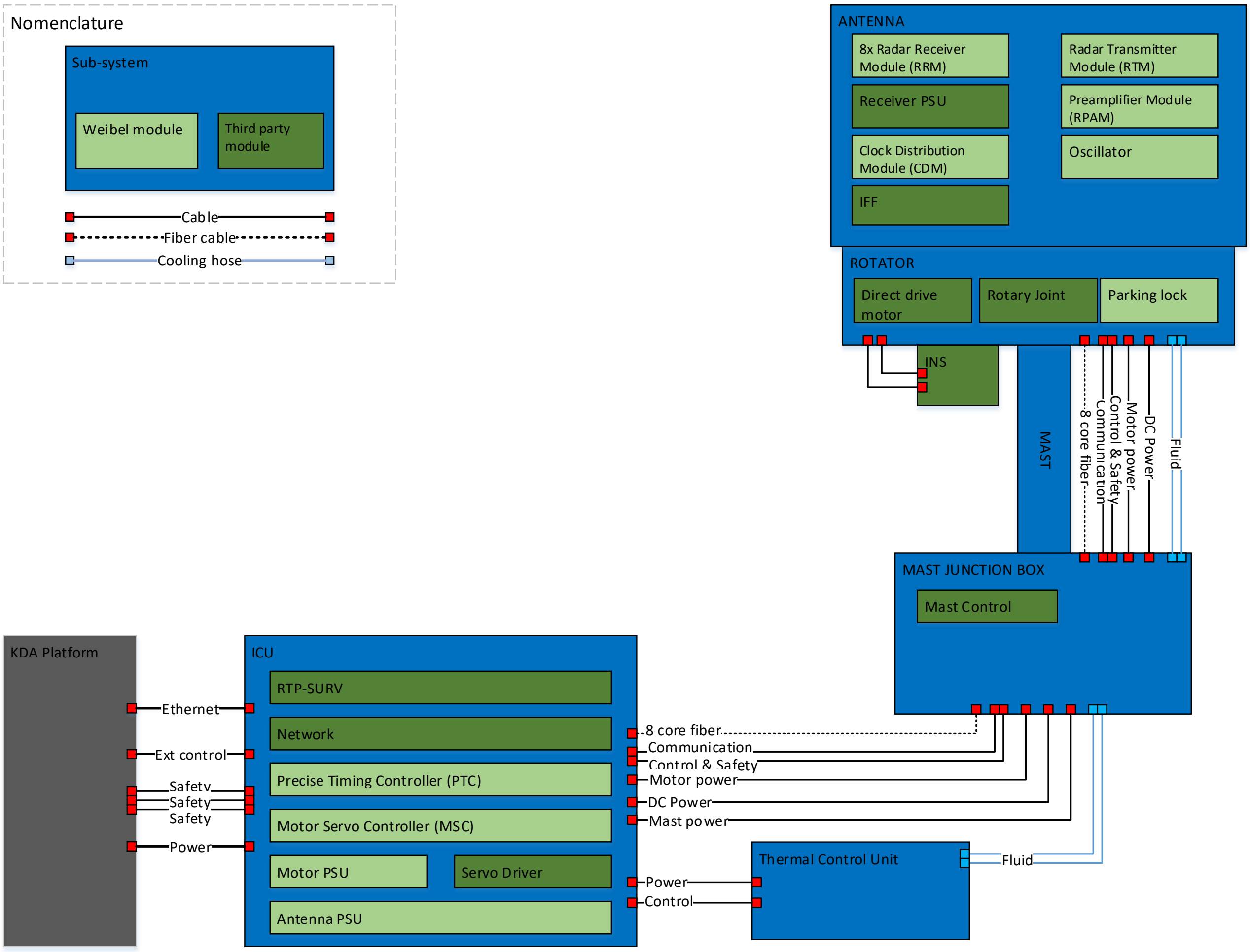
2.2 System Block Diagrams

2.2.1 General Block Diagram



Block Diagram shows the main components and assemblies of the XENTA M5 Surveillance Radar. Diagram shows a nominal and generic full-configuration XENTA M5 system, Including typical C^2-Interface arrangements and excluding IFF.

2.2.2 System Block Diagram



Basic Block Diagram in the <u>generic full</u> SHORAD Configuration

2.3 Main Components – MFSR Surveillance Radar

XENTA M5 Multi-Frequency Doppler Radar Antenna	
Antenna Model	**RR-2100/33**
Antenna Type	Micro-strip
Antenna Layout	4 x 16 Elements
Antenna Volume Coverage	8 x 60 degrees
Beamforming	One programmable Transmit Beam Multiple Synthetic Receive Beams
Beam Layout (H x V)	4 x 16
Receive Beam Coverage	2 x 4 degrees
Polarisation	Horizontal
Transmit Power – Normal	240W
Transmit Power Management	Flexible Sector-based Programmable Power Level
Duty Cycle	100% Nominal
Transmit Modes	MFCW-CW, FMCW-CW
Antenna Gain – Transmit	25 dBi (±1 dB)
Antenna Gain – Receive	36 dBi (±1 dB)
Frequency	9.0 – 9.5 ; 9.5 – 10.0 ; 10.0 – 10.5 GHz
Frequency Sub-Band	2 x 500 MHz Sub-Bands (Frequency Agility)
Frequency Selection	Active Frequencies selected by Frequency-Map
Frequency Disable	Auto-Disable, Manual-Disable
Frequency Modes	Agile-Unsynchronised, Agile-Synchronised, Fixed
RF Bandwidth	400 MHz
Receiver Type	Mono-pulse phase-phase comparison for angle tracking with Digital-Array Synthetic-Beamforming Multi-Beam Phased-Array technology
Noise Figure (Typical)	4 dB, includes Front-end microwave Filter
Instrumented Range	Nominal 75 km, Maximum 150 km
Operational Modes	Surveillance, Stop-and-Stare
Operational Profiles	16
Sector Blanking / Power Management	10 Sectors
ECCM	Customer Adaptable
Stabilisation	Track Data Stabilisation
Stabilisation Limit	7 degrees
IFF	OPTION : Antenna and Interrogator fully integrated

3 FUNCTIONAL CHARACTERISTICS

3.1 System Basic Functions

01)	**XENTA M5 Baseline Functional Characteristics**
	XENTA M5 is a compact Surveillance Radar
	XENTA M5 will operate as a Rotating full-volume Surveillance Radar, but can also function with a high-precision Stop-Stare (Antenna-stopped) sector-volume Surveillance function
	XENTA M5 can operate with variable Antenna Rotation Rates, up to 60 rpm
	XENTA M5 processing will be with high-levels of automatic and autonomous functions
	XENTA M5 will be optimised for and combine functions of SHORAD and Close-Range LSS Surveillance operations
	XENTA M5 will be specialised for Target Classification : classification will differentiate between Generic Aircraft by size, Fighter, Missile, High-Speed Missile/HARM, Helicopter and LSS/UAV/Drone Targets
	XENTA M5 will create and report Tracks for Air Targets from Stationary LSS up to High-Speed Missile/HARM Targets
	XENTA M5 will carry out Plot and Track Extraction fully automatically
	XENTA M5 will report Track Data with high Accuracy, and suitable for integration in complex high-end Weapon Systems
	XENTA M5 will report Plots and Tracks in North-Oriented, Horizontally-Stabilised Reference Frame
	XENTA M5 will report Track Data to Interface Partners such as C^2-Systems
	XENTA M5 will create and report Tracks whilst stationary and ON-THE-MOVE (OTM)
	XENTA M5 will report minimal False and Unwanted Tracks
	XENTA M5 will have flexible Modes, typically 3 – 8 Modes will be standard
	XENTA M5 will have up to 16 User-definable Profiles associated with Modes
	XENTA M5 will have up to 10 Blanking / Transmit-Inhibit Sectors – these Sectors will be combined with Transmit Power-Management Sectors
	XENTA M5 will support Maintainers and MTBF with extensive integrated BITE processing

3.2 System Special Functions

In addition to the more conventional functionality associated with most Surveillance Radars, the MFSR/2100 implements a number of specialised functions that exploit the inherent characteristics and capabilities of the sensor hardware and processing technologies.

Definition Table

01)	**General**
01.1)	The MFSR/2100 Surveillance Radar will be implemented with critical functional capabilities that give specialised and optimal system functionality.
01.2)	Special functions are summarised as covering : • Robust and high-reliability Target Classification • High-Speed Target Target-Detection and Track-Creation • Stop-Stare Function • Drone-detection, Classification, Track-Creation and Tracking • Complex Clutter cancellation.
02)	**Special Functions**
02.1)	Robust and High-Reliability Target Classification
02.1.1)	XENTA M5 will at minimum be able to correctly classify and report Targets of type : • Generic Aircraft by size • Generic Missile • High-Speed Missile/HARM • Helo • LSS / UAV / UAS.
02.2)	High-Speed Target (HST) Target-Detection and Track-Creation
02.2.1)	XENTA M5 will be able to detect and create Tracks on High-Speed Targets – typically considered as Targets with Speed > Mach 2.
02.2.2)	XENTA M5 will create Tracks on closing Targets with Speeds up to 2´000 m/s.
02.3)	Stop-Stare Function
02.3.1)	Stop-Stare Function will give improved and optimal Classification, Accuracy and Track-Creation Time in the Stop-Stare surveillance volume.
02.3.2)	Stop-Stare processing is described in more detail at Section 3.7.
02.4)	Drone-detection, Classification, Track-Creation and Tracking
02.4.1)	MFSR/2100 Surveillance Radar will implement Processing specialised for reliable Drone-Detection, Track-Creation and Tracking of LSS / Drone / UAV / UAS Targets.
02.4.2)	Processing will primarily exploit specialised characteristics of FMCW and high precision Doppler and micro-Doppler processing.

02.5)	Complex Clutter Cancellation
02.5.1)	MFSR/2100 Surveillance Radar will implement Processing specialised for elimination of complex clutter associated with : • Birds and other wildlife • Wind-Turbines.
02.5.2)	Processing will primarily exploit specialised characteristics of FMCW and high precision Doppler and micro-Doppler processing.

3.3 System Functional Flexibility

The MFSR/2100 is developed using a flexible and generic design suitable for adaptation to Surveillance Radar configurations optimised for a number of different roles and applications.

Definition Table

01)	General
01.1)	The MFSR/2100 implementation flexibility will be primarily designed to support functional configurations optimised for : • General Air Surveillance (SHORAD applications) • Military : Fixed Air Surveillance • Military : Mobile Air Surveillance (Vehicles) • Military Naval Air Surveillance (Growth Potential) • Non-Military Air Surveillance • Dedicated LSS / Drone / UAV-UAS Surveillance.
02)	**Principle of Flexibility**
02.1)	MFSR/2100 will be developed with the necessary flexibility inherent in system baseline design.
02.2)	MFSR/2100 hardware and functional flexibility will cover : • Antenna characteristics • Elevation coverage • Nominal Maximum Range coverage • Transmit Power • Handling of Stop-Stare function • Implementation and level of ECCM functions • Implementation and integration of IFF • Cooling arrangements.
03)	**Implementation**
03.1)	All configurations will place emphasis on Classification, and in particular Detection and Classification of LSS Targets.
03.1.1)	LSS functionality will be common and baseline on all MFSR/2100 configurations.
04)	**Processing**
04.1)	MFSR/2100 core-processing will be largely identical irrespective of the Antenna characteristics that are implemented in any configuration
04.2)	MFSR/2100 will automatically adapt internal processing/be parameterised to match the specific configuration.
04.3)	MFSR/2100 data and message-interfacing with external systems (including C^2-System) will be identical (or as far as possible), irrespective of specific configuration.

3.4 System Functional Flexibility

XENTA M5 will make effective Surveillance against a wide and flexible Target spectrum under a wide range of conditions. This broad functional flexibility is realised by the implementation of various Modes and Profiles. XENTA M5 operation will be controlled by various Modes and Profiles that will optimise performance for Detection Ranges, Probabilities, and Target and Environmental characteristics.

Definition of Modes and Profiles will be highly flexible, and will be adapted to the conditions and tactical/operational requirements as specified together with Customers and Users.

Definition Table

01)	**General**
01.1)	XENTA M5 Profiles will normally be defined and optimised for specific Customer applications, respectively expected operational requirements. That is, exact XENTA M5 Profile definitions will be implemented within the scope of Project execution.
02)	**Modes**
02.1)	Modes will be defined for high-level operational controlling of the XENTA M5.
02.2)	Although Modes will be defined in a flexible manner, and typically together with the Customer/User, typical Modes will be : • SURVEILLANCE SCAN • STOP-STARE • MAINTENANCE.
02.3)	SURVEILLANCE Mode will be the default and start-up Mode.
02.4)	Modes will be mutually exclusive.
02.5)	Modes will be selected/commanded by the C^2-System.
03)	**Profiles – General**
03.1)	Profiles will be lower-level definition of XENTA M5 operating characteristics. That is, Profiles will be subsets of Modes.
03.1.1)	SURVEILLANCE Mode will normally have multiple Profiles.
03.1.2)	MAINTENANCE Mode will normally have no Profiles assigned.
03.2)	XENTA M5 will permit the definition and selection of up to 16 Profiles.
03.3)	Profiles will be selected/commanded by the C^2-System.

04)	**Profiles – Typical Definitions**
04.1)	As examples, SURVEILLANCE Mode Profiles might typically cover the following.
04.1.1)	LONG-RANGE AIR SURVEILLANCE. Profile optimised for : • General Air Targets • Instrumented Range : 75km
04.1.2)	MEDIUM-RANGE AIR SURVEILLANCE. Profile optimised for : • General Air Targets • Instrumented Range : 50km
04.1.3)	SHORT-RANGE AIR SURVEILLANCE. Profile optimised for : • Small Air Targets • Instrumented Range : 25km
04.1.4)	VERY SHORT-RANGE AIR SURVEILLANCE. Profile optimised for : • Very Small (LSS) Air Targets • Instrumented Range : 6km
05)	**Profiles – Typical Parameters**
	Typical Parameters for definition as Profile will include : • Instrumented Range • Antenna Rotation Speed • Elevation Coverage • Rules for transition from "SURVEILLANCE" to "STOP-STARE" • Beam Management • Transmit Pulse Patterns • Clutter Suppression Laws • Detection Parameters • Plot and Track Extraction Management parameters, such as Thresholds, Association Gate-sizes • Track Update Management parameters, including kinematic plausibility processing • ECCM processing and functions.

3.5 Surveillance Processing

The XENTA M5 is primarily a general purpose Short Range Surveillance Radar. While the XENTA M5 is implemented with a number of special functions (Section 3.2) and implemented with considerable flexibility on functionality (Section 3.3), the primary function of the XENTA M5 is a full-volume rotating Surveillance Radar.

Within the scope of volume-surveillance, the XENTA M5 is optimised for the Detection, Classification, Tracking and Reporting of Targets of Class :

- UAV (micro)
- UAV (mini)
- HARM
- Missile
- High-Speed Missile / HARM
- Helo
- Generic Aircraft by size.

Definition Table

01)	**General**
01.1)	XENTA M5 is a multi-functional Surveillance Radar optimised for surveillance operations in highly flexible tactical environment.
01.2)	XENTA M5 operational and functional flexibility means that the XENTA M5 is able to carry out Air-Surveillance with : • Wide variety of Target types, including LSS, Helo, Missiles, High-Speed Missiles/HARM, Fighters and Generic Aircraft by size • Target types with considerable variation in RCS, Swerling characteristics, Speed and expected Track-Detection Ranges • Wide variety of Surveillance environments, and reflecting considerable difference in expected Clutter-characteristics. This will cover clear-regions through to densely-cluttered urban-backgrounds • All-Weather operations.

3.6 Surveillance Processing

A prime and critical function of the XENTA M5 Surveillance Radar is the ability to evaluate and report Target Classification estimates with high-reliability.

XENTA M5 Target Classification capability is realised by advanced signal-processing that exploits the information embedded in the Doppler signals, and the very long time-on-target that results from 100% Duty-Cycle CW-processing.

Definition Table

01)	**General**
01.1)	XENTA M5 will carry out Target Classification processing as standard system functionality, operative at all times.
01.1.1)	Target Classification will normally be executed using XENTA M5 sensor-data only, and could be used to support a higher-level system-side Target Classification.
02)	**Classification Functions**
02.1)	XENTA M5 will classify and report Targets of type : • Generic Aircraft by size • Fighter • Missile • High-Speed Missile / HARM • Helo • UAV / UAS.
03)	**Classification Reporting**
03.1)	Target Classification reporting is based on internal probabilistic analyses, and where the most likely Classifications are reported as possible solutions.
03.2)	Target Classification will include candidate Target Classes, suggesting most likely Class.

3.7 Stop-Stare Processing

XENTA M5 will implement Stop-Stare Processing.

Stop-Stare as processing Mode is realised as one of the primary features and unique functional characteristics of the MFSR 2100/36 Surveillance Radar when implemented in the Short Range Air Defence configuration.

Although Stop-Stare is generally a powerful functionality for the Surveillance Radar, effectively bridging performance characteristics of both Surveillance and Tracking, in the SHORAD configuration it is expected that Stop-Stare might be particularly useful for Anti-Air Missile engagements.

Overall characteristics of Stop-Stare are described below.

Definition Table

01)	**General**
01.1)	Stop-Stare function will carry out detailed and high-quality Detection and Tracking in a limited Surveillance Sector.
01.1.1)	As a matter of course, it is expected that Target Detection and Tracking will be improved with respect to normal Surveillance Mode processing.
02)	**Functional Control**
02.1)	C^2-System will start and terminate Stop-Stare.
02.2)	On command of Stop-Stare, XENTA M5 will position Antenna at the nominal Search Position.
02.3)	C^2-System will command Stop-Stare position as either : • Lock-to-Track • Lock-to-Azimuth.
02.3.1)	When controlled as “Lock-to-Track”, the Antenna nominal boresight will remain locked to the selected Target-of-Interest.
02.3.2)	When controlled as "Lock-to-Azimuth", the XENTA M5 will command and modify Antenna-position on receipt of Update Position Commands from the C^2-System.
02.4)	Stop-Stare will be terminated by either : • C^2-Command to Mode “Surveillance” • Loss of Track (Track-Ident control)
03)	**Functional Process**
	XENTA M5 will Search, Detect, Track, Classify and Report objects detected in the Stare Surveillance Volume.

04)	**Lock-to-Track Processing**
	Stop-Stare *Lock-to-Track* will be commanded together with a valid Track Identity (Track Number) as Command-argument. The Surveillance Radar will be automatically controlled so that the Antenna is positioned (pointed) at the last-known Azimuth Position of the commanded Track. The Surveillance Radar will attempt to acquire and track the commanded Target-of-Interest. When in Stop-Stare *Lock-to-Track*, the VRS tracking will be executed as Closed-Loop Tracking. That is, the Target-of-Interest will now be tracked in Closed-Loop, and not with the Surveillance Scan Track-While-Scan tracking. Closed-Loop Tracking will give significant improvements in terms of : • Track Accuracy, and • Track Update-Rate.
05)	**Lock-to-Azimuth Processing**
	Stop-Stare *Lock-to-Azimuth* will be commanded together with a nominal Azimuth Angle as Command-argument. The Surveillance Radar will be automatically controlled so that the Antenna is positioned (pointed) at the commanded Azimuth Angle. During *Lock-to-Azimuth*, the C^2-System can send Azimuth Angle updates, for which the Surveillance Radar will modify the pointing angle as commanded. The VRS will carry out normal open-loop Tracking on any objects detected in the VRS beamwidth. If required, the C^2-System can initiate Closed-Loop tracking on one of these Targets by issuing a *Lock-to-Track* command.

3.8 Transmit Power Management

XENTA M5 will implement a generalised and functionally unified Sector-based Transmit Power-Management.

Definition Table

01)	**General**
01.1)	XENTA M5 Sector Power Management will be realised as a unified Transmit Power Management function, and with functions of "Sector Blanking" and "Sector Power Management" handled in one common process.
01.2)	Considered in functional terms : • Sector Control processing will be common for all Power-levels • Power-levels will be defined and commanded with generic Arguments.
02)	**Functional Design**
02.1)	XENTA M5 will accept, process and execute Sector Power Management commands.
02.2)	XENTA M5 Sector Power Management processing will control Transmit Power level in the commanded Sector.
02.3)	Power Management commands will define : • Sector Limits : Azimuth • Transmit Power Level • Sectors commanded with "ZERO" Power will be equivalent to a conventional Blanking Sector command.
02.4)	Where Sectors overlap, Sector with the lowest commanded Power-level will have priority.
02.4.1)	In particular, Sectors where "ZERO" Power is commanded will always have Zero Transmit Power.
03)	**Command Interface**
03.1)	XENTA M5 will accept, process and execute Sector Power Management commands.
03.1.1)	XENTA M5 Sector Power Management processing will control Transmit Power level in the commanded Sector.
03.2)	Sectors for Scan-inhibit will be able to be commanded as both Platform-based and North-oriented.
03.3)	XENTA M5 will accept and process up to 16 Inhibit Sectors.

3.9 Stabilisation Processing

The XENTA M5 is designed for operation on moving platforms such as Vehicles.

The XENTA M5 will carry out the necessary processing for compensation of Platform motion (Linear and Rotational), and will report XENTA M5 Track Data in a stabilised inertial Reference Frame.

Definition Table

01)	**General**
01.1)	Stabilisation processing is XENTA M5 baseline functionality.
01.2)	Stabilisation Data processing will cover the general functional requirements for : • Transformation of Sensor/Vehicle-Referenced Data to an Inertial Reference System • Compensation of Vehicle Linear Kinematics • Plot and Track conversion to an Inertial Frame.
02)	**Data Stabilisation**
02.1)	XENTA M5 Plot and Track Data will be processed and reported in a North-Oriented, Horizontally Stabilised Inertial Reference Frame.
02.2)	XENTA M5 Stabilisation will give full Stabilised-functionality for Vehicle Tilts up to 7 degrees.
02.2.1)	Maximum Vehicle Tils is defined as the RMS-Total of the Vehicle Roll and Pitch Tilts.
03)	**Stabilisation Processing**
03.1)	XENTA M5 will use XENTA M5 Local Reference System Data for Stabilisation processing.
03.2)	To ensure Stabilisation-consistency between the SHORAD Fire Control System and the XENTA M5, the XENTA M5 will report Local Reference System Attitude Data to the C^2-System. It is expected that the C^2-System will be able to compensate for Reference System inconsistencies (primarily Heading), and apply necessary corrections to ensure precise and coherent Designation Data between the Surveillance Radar and the Fire Control System.
03.3)	XENTA M5 will realise normally be required to accept Vehicle Data such as GPS-Data to support the Local Reference System.

3.10 ECCM Processing

The MFSR 2100/36 can be equipped with powerful ECCM capabilities that will ensure optimal performance of the XENTA M5 when operating in an ECM environment.

Definition Table

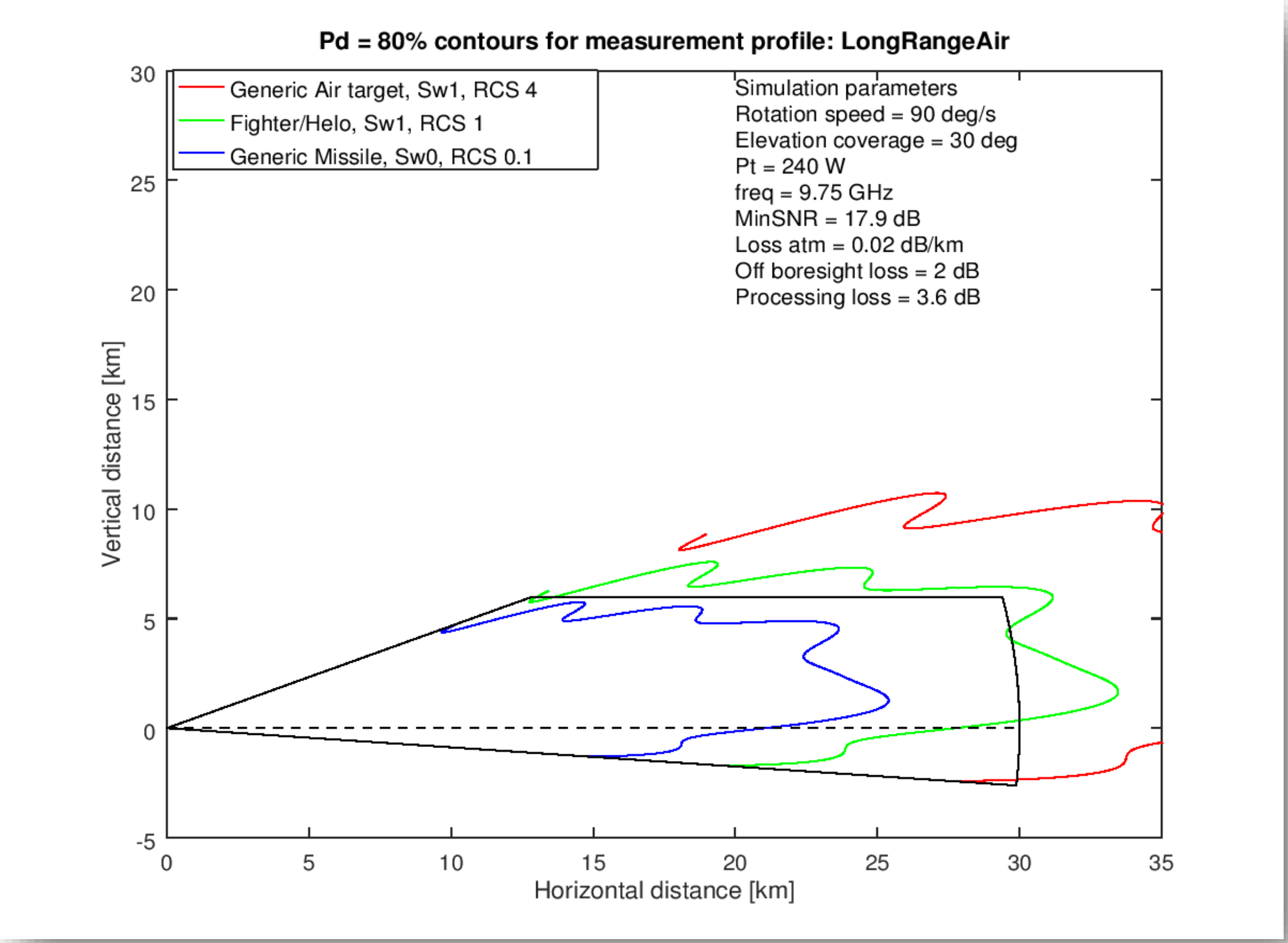
01)	**General**
01.1)	XENTA M5 can be implemented with ECCM characteristics and functions : • Inherent ECCM defence • Explicit ECCM defence • Jammer Detection and Processing.
02)	**Inherent ECCM**
02.1)	XENTA M5 is realised with characteristics that give an inherent protection against ECM. These characteristics are intended to limit the effectiveness of ECM systems – protection is based on : • Limit the ability for an ESM/ECM system to detect the XENTA M5 through very Low Transmit Peak Power • Limit the ability for an ESM/ECM system to detect the XENTA M5 through low side-lobes • Limit the ability for an ECM system to overpower the XENTA M5 through use of wide-band Transmission and Reception • Limit the ability for an ECM system to overpower the XENTA M5 through quasi-random hopping between over 100 Frequencies within the XENTA M5 bandwidth • Limit the ability of an ECM system to degrade the XENTA M5 through automatic de-selection of disturbed Frequencies • Limit the ability for an ECM system to confuse the XENTA M5 through transmission of different Frequencies and Waveforms.
03)	**Explicit ECCM**
03.1)	XENTA M5 is realised that give active defence against ECM. In addition to inherent designed characteristics, the XENTA M5 will realise specific functions to counter ECCM – primarily to maintain tactical effectiveness in the event that ECM has degraded XENTA M5 processing.
03.2)	Processes are intended to limit the effectiveness of ECM systems when attempting to disturb or confuse the XENTA M5 – protection is based on : • Jammer Processing • Burn-through processing.

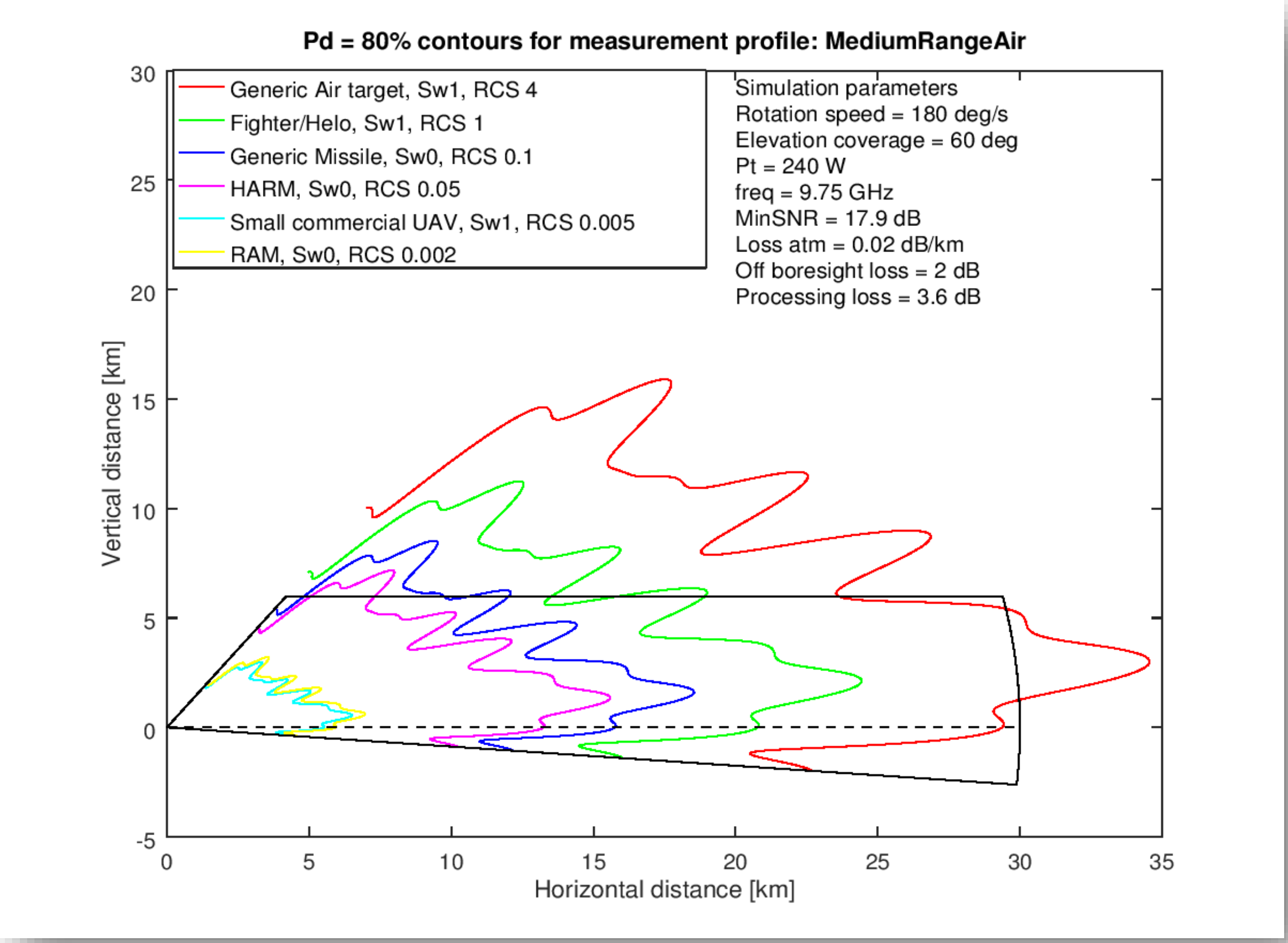
04)	**Jammer Detection and Tracking ECCM**
04.1)	**General**
04.1.1)	XENTA M5 will detect and process signals from external Transmitters such as Jammers.
04.2)	**Frequency Management**
04.2.1)	XENTA M5 will attempt to eliminate Jammer-effects by Frequency management : • Automatic disable of disturbed Frequencies • Automatic selection of Frequency with the lowest Jammer-effect.
04.2.2)	If the Jammer cannot be cancelled by these means, the XENTA M5 will transition to Track-on-Jam.
04.3)	**Track-on-Jam**
04.3.1)	XENTA M5 will report nominal Target Position (typically Angles-only) as measured for the Jammer.
04.3.2)	XENTA M5 will continue to monitor own-signals whilst operating in Track-On-Jam.
04.3.3)	XENTA M5 will automatically switch to Normal Tracking if and when XENTA M5 Tracking is possible (burn-through).
04.4)	**Jammer Reporting**
04.2.5)	XENTA M5 will report detection of Jammers to the C^2-System. Jammer reports will include : • Jammer Azimuth • Jammer Elevation • Jammer Intensity.

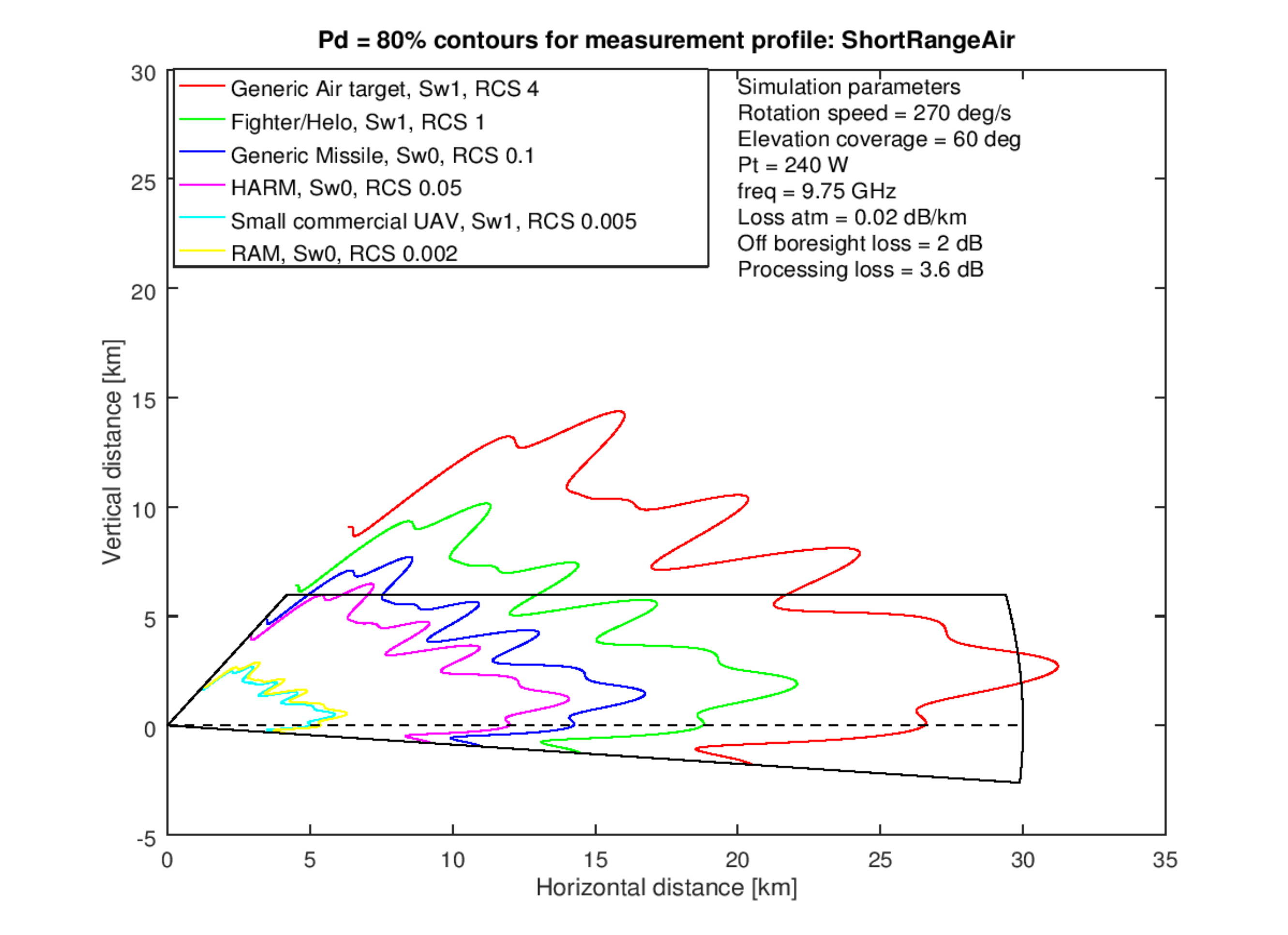
4 PERFORMANCE CHARACTERISTICS

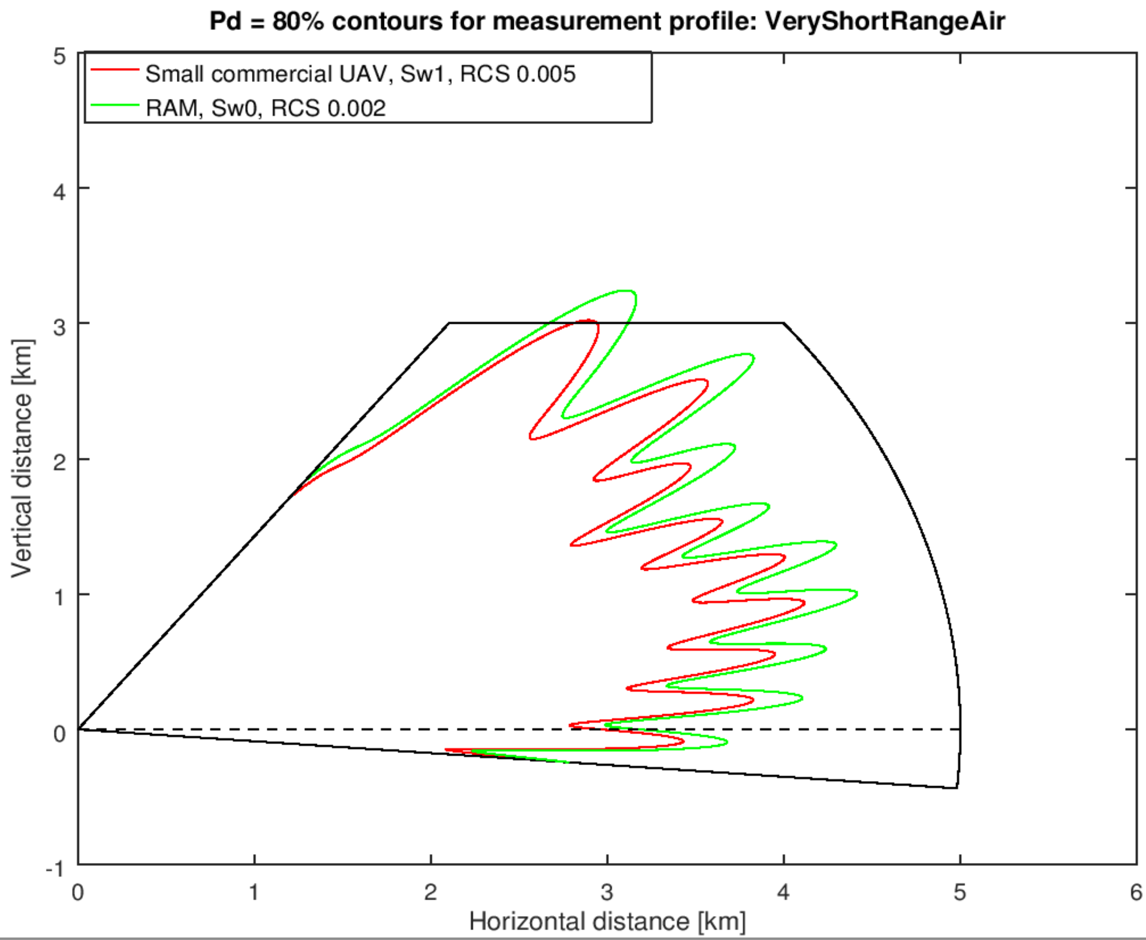
4.1 XENTA M5 Detection and Acquisition Performance

Typical XENTA M5 Detection Performance forecasts are shown below.




Pd = 80% contours for measurement profile: MediumRangeAir
Generic Air target, Sw1, RCS 4
Fighter/Helo, Sw1, RCS 1
Generic Missile, Sw0, RCS 0.1
HARM, Sw0, RCS 0.05
Small commercial UAV, Sw1, RCS 0.005
RAM, Sw0, RCS 0.002
Simulation parameters
Rotation speed = 180 deg/s
Elevation coverage = 60 deg
Pt = 240 W
freq = 9.75 GHz
MinSNR = 17.9 dB
Loss atm = 0.02 dB/km
Off boresight loss = 2 dB
Processing loss = 3.6 dB
Vertical distance [km]
Horizontal distance [km]
30
25
20
15
10
5
0
-5
0
5
10
15
20
25
30
35


Pd = 80% contours for measurement profile: ShortRangeAir
Generic Air target, Sw1, RCS 4
Fighter/Helo, Sw1, RCS 1
Generic Missile, Sw0, RCS 0.1
HARM, Sw0, RCS 0.05
Small commercial UAV, Sw1, RCS 0.005
RAM, Sw0, RCS 0.002
Simulation parameters
Rotation speed = 270 deg/s
Elevation coverage = 60 deg
Pt = 240 W
freq = 9.75 GHz
Loss atm = 0.02 dB/km
Off boresight loss = 2 dB
Processing loss = 3.6 dB
Vertical distance [km]
Horizontal distance [km]
30
25
20
15
10
5
0
-5
0
5
10
15
20
25
30
35



NOTES :

1	Instrumented Range is as applicable for the Nominal Profiles
2	Track Detection Ranges are generally defined for ideal conditions.
3	All Detection Ranges are with Probability-of-Detection (P_D) of 80%
4	Conditions are assumed to be Dry and Clear – no precipitation
5	Target Trajectory will be Linear, Fixed-Height, Direct-Approach
6	Antenna Rotation Speed is as applicable for the Nominal Profiles
8	Vehicle is not On-the-Move

Detection Performance will change for Targets with different characteristics, and under different environmental and clutter-conditions.

Performance of all radar sensor systems will be impacted by external factors such as weather, clutter, glint, immediate surroundings, multi-path and selected Target characteristics and scenarios.

4.2 Track Processing

Definition Table

01)	**General Requirement**
01.1)	XENTA M5 will extract and report Track Data for sensor-information that is assessed as representing real-world objects.
01.2)	Track Extraction Track Extraction and Filter processing will be adaptive, and optimised for kinematics expected for the primary Targets associated with the selected Mode and Profile.
01.3)	Track Extraction and Filter processing will function for XENTA M5 in both Fixed and Mobile Applications.
01.4)	Track Extraction and Filter processing will function for XENTA M5 Mobile with Platform ON-THE-MOVE (OTM).
02)	**Track Extraction**
02.1)	Track Extraction and Reporting will be a baseline function of the XENTA M5.
02.2)	Absolute Geo-Position Reports will be defined in accordance with the WGS84 System.
03)	**Track Management**
03.1)	XENTA M5 Track processing will be controllable from an external C^2-System.
03.2)	C^2-System controlling will permit overrides and changes to Track characteristics that have been generated by automatic XENTA M5 Track processing.
03.3)	Track Management will generally include functions for : • Manual Delete of a selected Track • Global Delete of all Tracks • Re-allocation of Track Identifier.
04)	**Track Initialisation**
04.1)	**Automatic Track Initialisation**
04.1.1)	Track Initialisation will be automatic.
04.1.2)	As a function of XENTA M5 Mode and Profile, Track Initialisation will be realised to balance and optimise : • Reaction-Time for close-range and high-threat Targets, and • Minimised False-Track Rate.

04.2)	**Manual Control of Automatic Track Initialisation**
04.2.1)	Main objective of Manual Control of Automatic Track Initialisation is to permit the C^2-System to take Operator-determined steps to minimise False-Tracks in areas of known high clutter density.
04.2.2)	XENTA M5 will accept C^2-System Commands to define Track Limitation / Inhibition Zones
04.2.3)	Limitation / Inhibition Zones will limit / inhibit Track Initialisation and Tracking based on Sensor, Plot and Track thresholds.
05)	**Track Reporting**
05.1)	**Track Reports**
05.1.1)	Track Data will be reported to : • C^2-System • Data Recording System
05.1.2)	Track Data (kinematics) will be reported based on sensor measurements, and can be fused with IFF and/or ADS-B data. As exception, when no sensor-data update was possible, reporting of extrapolated Track Data will be permitted when Track estimation is by Coast/Memo processing

4.3 Track Performance

4.3.1 Performance Definitions

Definition Table

01)	**Definition of General Characteristics when Evaluating Track Performance**
01.1)	Target Ranges are as specified in Performance Definition Tables.
01.2)	Track Accuracy (Accuracy and Precision) are defined for Azimuth, Elevation and Range.
01.3)	Performance specifications and evaluations are as defined at Section 14.1.
01.4)	Track Performance will be evaluated under the same Sensor and Environmental conditions as are applied for Detection Performance Trials.
01.5)	Performance specifications are guaranteed only when Tracking is fully stable.
01.6)	Performance reductions are permitted as described at Section 4.3.3.1.
01.7)	Small Targets will be a nominal Point-Target, and with zero-glint.
01.8)	Larger Targets will permit increase of Angular Precision by a function of the Angular-extent of the tracked Target.
01.9)	Target Model Swerling 1 will be used.
01.10)	Conditions are assumed to be Dry and Clear – that is, with no precipitation.
01.11)	Closest Background-Clutter to tracked Target will be minimum 1’000m.
01.12)	Target Range-Rate (approaching Speed) will be between 50 and 200ms^{-1}.
01.13)	Target Height will be between 500 and 1’000m.
01.14)	Target Trajectory will be Linear, Fixed-Height, Direct-Approach.

4.3.2 General Track Performance

Definition Table

01)	**Track Capacity**
01.1)	XENTA M5 will be able to process and report at least 150 Tracks for each Antenna Rotation / Scan.
02)	**Track Coverage**
02.1)	XENTA M5 will be able to generate and maintain Tracks on objects with characteristics : • Minimum Speed : $0ms^{-1}$ • Maximum Speed : $2´000ms^{-1}$
03)	**Track Processing**
03.1)	Track Data Time-Stamp Accuracy will not exceed 3ms.
03.2)	Track Data Latency will not exceed 100ms. Latency is defined as the time elapsed between instant at which the Object was illuminated by the Antenna Beam-centre, and the time at which the Track Data Message is published.
04)	**Track Creation – Linear Targets**
04.1)	Duration from FIRST DETECTION to CONFIRMED TRACK will not exceed 3 seconds / Antenna Rotation 60rpm. FIRST DETECTION is defined as First Instance of a Plot associated with the Track. XENTA M5 will report Track State "CONFIRMED TRACK" during Confirmed-Track (settling) Phase.
04.2)	Duration from CONFIRMED TRACK to STABLE TRACK will not exceed 3 seconds / Antenna Rotation 60rpm. XENTA M5 will report Track State "STABLE TRACK" during Stable-Track (settled) Phase.
05)	**Track Manoeuvre Timing**
05.1)	XENTA M5 Tracker will detect and report Target Manoeuvres.
05.2)	XENTA M5 will report Track State "MANOEUVRING TRACK" during Manoeuvring-Track Phase.
05.3)	XENTA M5 will report Track State "CONFIRMED TRACK" during Post-Manoeuvring-Track (settling) Phase.
05.4)	Duration from CONFIRMED TRACK to STABLE TRACK (Post-Manoeuvre) will not exceed 3 seconds / Antenna Rotation 60rpm.

06)	Track Loss Timing
06.1)	XENTA M5 Tracker will detect and report Track Loss.
	XENTA M5 will report Track State "MEMO/COAST TRACK" during Loss-Track Phase.
06.2)	XENTA M5 will attempt to re-acquire Track during Loss-Track Phase.
06.3)	XENTA M5 Track will time-out (TRACK-LOST) after a defined "Memo/Coast-Period".
06.4)	XENTA M5 will report Track State "LOST TRACK" on termination of Loss-Track Phase.

4.3.3 Track Accuracy Performance

Definition Table

TRACK PERFORMANCE CHARACTERISTICS		
Long Range Air Surveillance Mode – Typical		
Track Data Update-Rate	Update Rate	≥ 20 rpm
Position Data - Azimuth	Accuracy	7.0 mrad
	Precision	10.0 mrad
Position Data - Elevation	Accuracy	10.0 mrad
	Precision	15.0 mrad
Position Data - Range	Accuracy	15 m
	Precision	25 m
Medium Range Air Surveillance Modes – Typical		
Track Data Update-Rate	Update Rate	≥ 30 rpm
Position Data - Azimuth	Accuracy	5.0 mrad
	Precision	8.0 mrad
Position Data - Elevation	Accuracy	8.0 mrad
	Precision	12.0 mrad
Position Data - Range	Accuracy	15 m
	Precision	25 m
Short Range Air Surveillance Mode – Typical		
Track Data Update-Rate	Update Rate	≥ 45 rpm
Position Data - Azimuth	Accuracy	4.0 mrad
	Precision	6.5 mrad
Position Data - Elevation	Accuracy	7.0 mrad
	Precision	10.0 mrad
Position Data - Range	Accuracy	15 m
	Precision	25 m
Very Short Range Air Surveillance Modes – Typical		
Track Data Update-Rate	Update Rate	≥ 60 rpm
Position Data - Azimuth	Accuracy	2.5 mrad
	Precision	6.0 mrad
Position Data - Elevation	Accuracy	6.0 mrad
	Precision	9.0 mrad
Position Data - Range	Accuracy	10 m
	Precision	10 m

4.3.3.1 Track Accuracy – Performance Reductions

Definition Table

01)	**General**
01.1)	XENTA M5 Track Accuracy Requirements will be reduced during non-linear and settling Track-phases. This means that full Track Accuracy requirements as defined at Section 4.3.3 will be alleviated during non-linear/settling phases.
02)	**Track Accuracy – Confirmed Track**
02.1)	When Track Data is reported as CONFIRMED TRACK : • Position Accuracy will not exceed Nominal Track Position Accuracy by more than 50% • Position Accuracy will not exceed Nominal Track Position Accuracy by more than 75%
03)	**Track Accuracy – Manoeuvring Track**
03.1)	No Track Accuracy requirements will apply during Target Manoeuvre-phase.
03.2)	Track will not be lost as a result of manoeuvre during Target Manoeuvre-phase.

4.4 XENTA M5 False-Track Rate

Definition Table

01)	**General**
01.1)	Suppression and elimination of False and Unwanted Tracks is the primary design objective of the XENTA M5
01.2)	False and Unwanted-Track performance are defined for the same conditions as are applied for the definition of and when evaluating Track Detection/Track Accuracy performance.
02)	**Definitions**
02.1)	XENTA M5 generic False-Track performance will be evaluated in the following two classes : • False, and • Unwanted.
02.1.1)	FALSE-TRACKS are defined as Tracks that are not based on any physical object. Tracks are considered "False" if generated from : • Noise • Ground Clutter • Sea Clutter • Atmospheric Clutter.
02.1.2)	UNWANTED-TRACKS are defined as Tracks that are based on a physical object, but not an object-of-interest to the XENTA M5. Tracks are considered "Unwanted" if generated from • Birds • Wind Turbines.
03)	**Performance Requirements**
03.1)	XENTA M5 False-Track Rate will not exceed 10 Tracks / minute under clear clutter-free conditions
03.2)	XENTA M5 Unwanted-Track Rate will not exceed 10 Tracks / minute under clear clutter-free conditions
03.3)	XENTA M5 general Track processing (Track Creation and Tracking in clutter-free zones) will not be impacted in the event of occurrence of a limited region of high False and/or Unwanted Track density

5 ANCILLARY COMPONENTS AND FUNCTIONS

5.1 OPTION : IFF / ADS-B Integration and Processing

As OPTION, the MSFR-2100/36 can be supplied and fully integrated IFF Interrogator and Antenna System.

Definition Table

01)	**General**
01.1)	XENTA M5 can be supplied with a fully-integrated IFF Interrogator.
01.2)	IFF Interrogator Antennas (Main and Back-fill/Secondary) can be fully integrated in the XENTA M5 Antenna.
01.3)	IFF Interrogator should ideally include ADS-B processing.
01.4)	IFF Interrogator can be fully equipped and capable of implementation of secure Crypto Handling.
01.5)	XENTA M5 can realise all necessary interfacing to ensure correct Interrogation functions such as : • Data interfacing • Rotation Data • Time-of-Day data • Crypto-Management interfaces such as “CLEAR”.
01.5)	Antenna can be supplied with Electrical and RF-hardware associated with the IFF Antennas.
02)	**Interrogator Functions**
02.1)	Detailed Interrogator Functions will be described separately in the applicable Interrogator Product Specifications.
03)	**System Integration of IFF Interrogator and ADS-B**
03.1)	XENTA M5 can integrate IFF Reports with Surveillance Radar Track Data processing.
03.1)	XENTA M5 can also integrate ADS-B Data if reported with IFF Data.
03.1.1)	IFF and ADS-B Reports can be used to improve XENTA M5 Track Detection / Initialisation processing and Reaction-Times.
03.1.2)	IFF and ADS-B Reports can be used to minimise XENTA M5 False-Track generation.
04)	**XENTA M5 IFF / ADS-B Control and Reporting**
04.1)	XENTA M5 C^2-Interfacing will include all Commands / Tellbacks necessary to manage IFF Interrogator
04.2)	XENTA M5 C^2-Interfacing will include all IFF Interrogator Track Reports.
04.3)	XENTA M5 C^2-Interfacing will include all ADS-B Track Reports.

5.2 Thermal Control Unit

The XENTA M5 will be supplied with a Thermal Control Unit. The Thermal Control Unit (TCU) will :

- Chill and circulate Cooling Liquid to the Antenna Electronic Cold-Plate cooling arrangements under normal conditions
- Warm and circulate Cooling Liquid (heated) to the Antenna Electronic Cold-Plate cooling arrangements under Low-Temperature conditions.

Exact arrangements of the Thermal Control Unit will be project-specific.

6 MAINTENANCE FUNCTIONS

6.1 Maintenance Processing

Definition Table

01)	**General**
01.1)	Maintenance-related processing and functions will be executed when XENTA M5 is executing in Maintenance Mode.
01.2)	Maintenance-related processing will be realised for : • Off-Line Tests • Alignment Processing • Parameter Management.
01.3)	Transition from any other Mode (typically Surveillance) to Maintenance Mode will be initiated by selection of one of the above Maintenance functions.
02)	**Off-Line Tests**
02.1)	Off-Line Tests will be executed by the XENTA M5 as part of Maintenance processing, and whilst in Maintenance Mode.
02.1.1)	Off-Line Tests are described in more detail at Section 10.3.
02.2)	On selection of Off-Line Testing, XENTA M5 will automatically transition to Maintenance Mode.
02.3)	On termination of Off-Line Testing, XENTA M5 will automatically transition to Surveillance Mode.
03)	**Alignment**
03.1)	Alignment handling will be executed by the XENTA M5 as part of Maintenance processing, and whilst in Maintenance Mode.
03.2)	On selection of Alignment processing, XENTA M5 will automatically transition to Maintenance Mode.
03.3)	On termination of Alignment processing, XENTA M5 will automatically transition to Surveillance Mode.

04)	**Parameter Management**
04.1)	Parameter Management will be executed by the XENTA M5 as part of Maintenance processing, and whilst in Maintenance Mode.
04.1.1)	Parameter Management processing will provide utilities to : • Monitor • Input • Update, and • Backup and Restore XENTA M5 system parameters.
04.2)	On selection of Parameter Management, XENTA M5 will automatically transition to Maintenance Mode.
04.3)	On termination of Parameter Management, XENTA M5 will automatically transition to Surveillance Mode.

7 INTERFACE CHARACTERISTICS

The MFSR 2100/36 Surveillance Radar has been developed for flexibility and simplicity in interfacing to external systems. The following descriptions are indicate only : exact Interface Definitions will defined in detail within the scope Contract preparation and execution.

7.1 XENTA M5 Control Processing

XENTA M5 Control-methods are to be defined. The following Command/Tellback architecture should be understood as indicative only.

7.1.1 Control Commands

Definition Table

01)	**Sensor Controls : Typical**	
01.1)	XENTA M5 Sensor characteristics will normally be controlled from an external C^2-System.	
01.2)	Typical Commands are :	
	POWER COMMAND	Power Command
	MODE COMMAND	Select Mode
	PROFILE COMMAND	Select Profile
	STOP-STARE START CMD	Start Stop-Stare
	STOP-STARE UPDATE CMD	Update position dynamic Stop-Stare
	TRANSMIT COMMAND	Start/Stop Transmission
	ANTENNA COMMAND	Start/Stop Rotation
	ANTENNA SPEED COMMAND	Control Rotation-speed
	GLOBAL DETECT COMMAND	Control Track Detection - Global
	REGION DETECT COMMAND	Control Track Detection - Region
	FREQUENCY TYPE COMMAND	Control Frequency selection
	FREQUENCY SELECT COMMAND	Control available Frequencies
	ECCM-DETECT COMMAND	Activate ECCM-detection

02)	**Track Management Controls : Typical**
02.1)	XENTA M5 Track Management will normally be controlled from an external C^2-System.

02.2)	Typical Commands are :
	`TRACK INITIALISE ZONE` `Define Manual Initialise Zones`
	`TRACK DELETE / IDENT` `Delete a specific Track`
	`TRACK DELETE / GLOBAL` `Delete all Tracks`
	`DEFINE CLUTTER SECTOR` `Define Clutter-region (Sector`
	`DEFINE CLUTTER MAP` `Define Clutter-region (Co-ordinates)`

7.1.2 Control Tellbacks

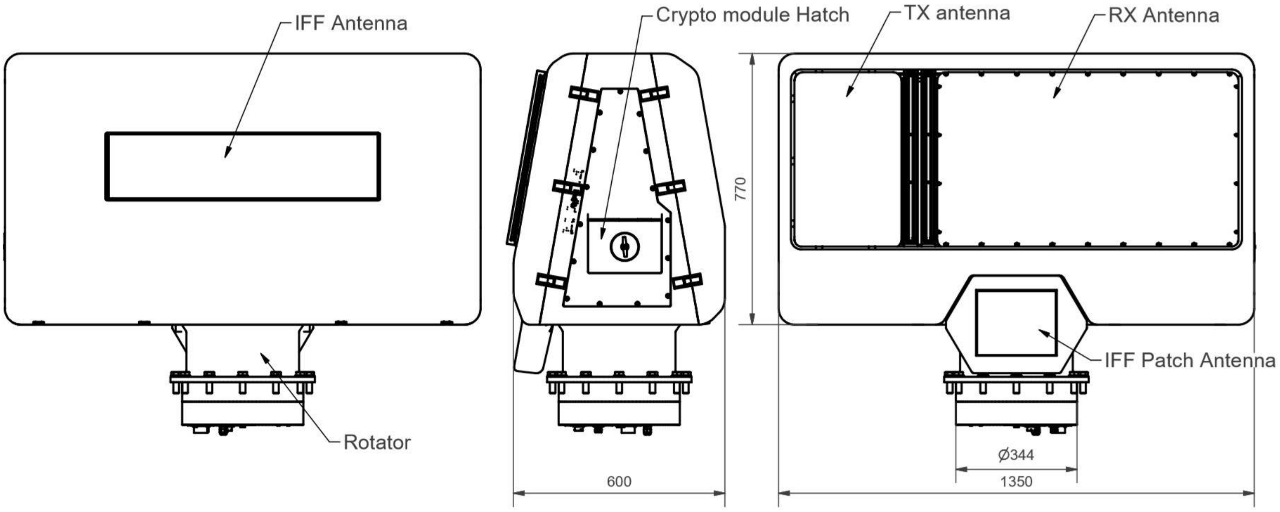
Definition Table

01)	**Tellbacks – Sensor Controls**
01.1)	XENTA M5 Sensor Tellback Messages will report the status and characteristics of the XENTA M5 sensor processing.
01.2)	Sensor Tellback Messages will generally mirror Sensor Commands.
02)	**Tellbacks – Track Management Controls**
02.1)	Track Management Tellbacks will report status of Track Management processing.
02.2)	Track Management Tellbacks will generally mirror Track Management Commands

7.2 Installation Data

7.2.1 Dimensions

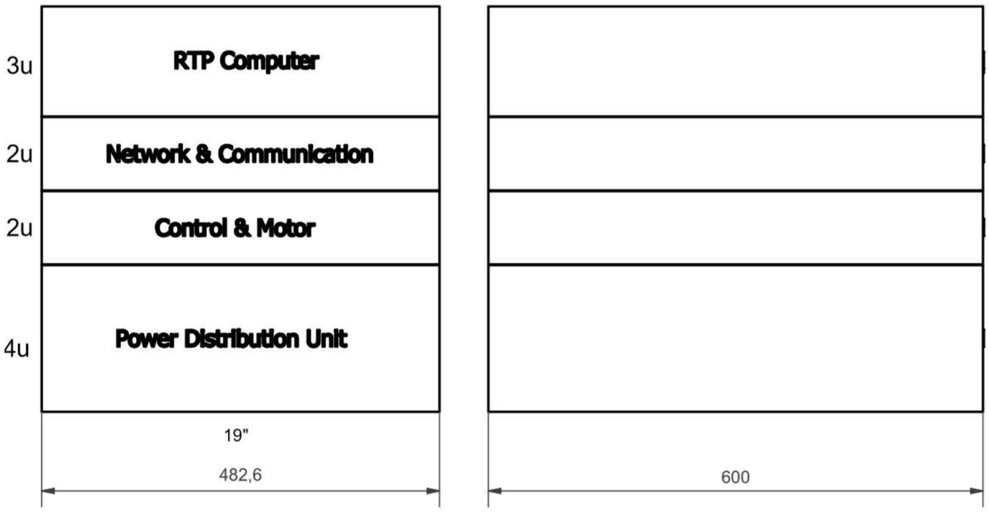
7.2.1.1 Antenna System



Definition Table

01)	**Antenna Maximum Dimensions**
	Width x Height x Depth .... 1´350 x 1´100 x 600 mm Weight .... 360 kg

7.2.1.2 Interface Control Unit



Definition Table

01)	**Antenna Maximum Dimensions**
	Height x Width x Depth .... 11U x 19” x 600 mm Weight .... 70 kg
	Mounting........ Assembly Mounted in Combat System Rack

7.2.2 Mechanical Interfaces

Mechanical Interfaces and Installation Instructions will be defined during later phases. Detailed Mechanical Interfaces will be presented at latest at the Critical Design Review (CDR).

7.3 Data Interfaces

Detailed Interface Design will be resolved during initial design-phases, and will be finalised at latest at Preliminary Design Review.

The following definitions are indicative for the expected XENTA M5 system-wide digital-data interfaces.

Definition Table

01)	**XENTA M5 System Digital Interfaces – Interface Types**		
01.1)	**XENTA M5 Sensor Commands and Tellback Interface**		
	-	Data Exchange	C^2-System ↔ XENTA M5
	-	Transport Protocol	Ethernet
	-	Transport Type	Fibre-Optic
	-	Data-Link	Data-exchange for : • C^2-System Sensor Control Commands to XENTA M5 • XENTA M5 Sensor Control Tellbacks to C^2-System • XENTA M5 Sensor Status Reports to C^2-System.
01.2)	**XENTA M5 Track Management Commands and Tellback Interface**		
	-	Data Exchange	C^2-System ↔ XENTA M5
	-	Transport Protocol	Ethernet
	-	Transport Type	Fibre-Optic
	-	Data-Link	Data-exchange for : • C^2-System Track Management Control Commands to XENTA M5 • XENTA M5 Track Management Tellbacks to C^2-System.
01.3)	**XENTA M5 Plot and Track Data Interface**		
	-	Data Exchange	XENTA M5 → C^2-System
	-	Transport Protocol	Ethernet
	-	Transport Type	Fibre-Optic
	-	Data-Link	Data-exchange for : • XENTA M5 Plot Data to C^2-System • XENTA M5 Track Data to C^2-System.

01.3)	**XENTA M5 BITE Report Interface**		
	-	Data Exchange	XENTA M5 → C^2-System
	-	Transport Protocol	Ethernet
	-	Transport Type	Fibre-Optic
	-	Data-Link	Data-exchange for : • XENTA M5 BITE Data to C^2-System.

7.3.1 XENTA M5 Control and Tellback Interface

Definition Table

01)	**General**
01.1)	**Limitations**
	Contents of the Control and Tellback Messages will be defined in detail. Signals and Arguments listed below are indicative and typical until final interfacing has been formalised.
01.2)	**Exchange Architecture**
	Requirements are described for Command Messages. Tellback Reports will generally be defined to mirror Commands. "Command mirroring" will normally be : • Directly with explicit Tellbacks, or • Indirectly through changes in XENTA M5 status. Various status reports might also be included in the Tellback Message which do not derive from Commands – as examples, status of the Man-Aloft Switch and BITE reports.
02)	**Control Commands**
02.1)	**XENTA M5 Sensor Controls** See Section 7.1.1.
02.2)	**XENTA M5 Track Management Controls**
	See Section 7.1.1.

7.3.2 XENTA M5 Track Data Interface

Definition Table

01)	**Sensor Controls : Typical**	
01.1)	**Limitations**	
	Contents of the Track Data Message will be defined in detail. Signals and Arguments listed below are indicative and typical until final interfacing has been formalised.	
02)	**Transfer Requirements**	
	Track Data Message will be reported to the C^2-System (Interface-partner) no later than 100ms after object-detection by the XENTA M5.	
03)	**Track Data Signals**	
03.1)	**Basic Track Data**	
	TRACK IDENT	Unique Track Number
	TRACK AGE	Age (seconds) of the Reported Track
	TRACK DATA REPORT TYPE	New Data, Extrapolated Data
	TRACK STATE	Tentative, Confirmed, Stable, Manoeuvring, Memo
	TRACK CLASSIFICATION	Air-Generic, Air-Large, Air-Small, Missile, High-Speed Missile, Helo, UAV-Generic, UAV-Large, UAV-Small
	CLASSIFICATION CHANGED	Boolean Trigger
	THREAT	Friend, Foe, Neutral, Unknown
	POSITION – POLAR	Azimuth, Elevation, Range
	POSITION – CARTESIAN	North, East, Down
	POSITION – ABSOLUTE	Latitude, Longitude, Height-ASL
	VELOCITY – POLAR	Course, Speed, Climb-Rate
	VELOCITY – CARTESIAN	North, East, Down
	TIME-STAMP	Time-Stamp of the Track Data, and consistent with the reported Track State Vector. Ideally, all Data and Time-Stamps will be defined at the instant and position of XENTA M5 measurement

03.2)	**Associated Plot Data**	
	TRACK IDENT	Associated Track Number
	POSITION – POLAR	Azimuth, Elevation, Range
	POSITION – CARTESIAN	North, East, Down
	POSITION – ABSOLUTE	Latitude, Longitude, Height-ASL
	PLOT DIMENSIONS	Azimuth-Extent, Range-Extent
	DOPPLER	
	MICRO-DOPPLER	

7.4 Data Interface - Format

In general, digital-data will be exchanged between the XENTA M5 and any Command-and-Control system using the ASTERIX protocol (Reference [17]).

Definition Table

01)	**ASTERIX Protocol – General**
01.1)	ASTERIX is the EUROCONTROL standard for the exchange of surveillance-related data. ASTERIX provides a structured approach to a message format to be applied in the exchange of surveillance-related information for various applications.
01.2)	ASTERIX formatted messages are encapsulated within the Internet Protocol (IP), and provides a structured message format for the exchange of surveillance-related data for various applications.
01.3)	In general, XENTA M5 will use ASTERIX Protocol definitions : • Category 253 – Control and Monitoring of Radar Sensor • Category 034 – Services Messages • Category 048 – Mono Radar Track Report.
02)	**Category 253 – Control and Monitoring of Radar Sensor**
02.1)	Control and monitoring is achieved by the use of a single message type that conforms to the ASTERIX Category 253, Control and Monitoring of Radar Sensor.
03)	**Category 034 – Services Messages**
03.1)	Message structure for the transmission of mono-radar service messages from a radar station that conform to ASTERIX Category 034 Services Message.
04)	**Category 048 – Mono-Radar Track Report**
04.1)	CAT-048 /40 Measured position message structure for the transmission of mono-radar Target reports.

8 ENVIRONMENTAL CHARACTERISTICS

8.1 General Requirement

XENTA M5 complies with General Environmental Requirements as expected for "Army Ground" conditions.

XENTA M5 is specified and will be validated for Environmental characteristics of :

- Physical Environment
- Climatic Environment
- Electro-Magnetic Effects.

8.2 Physical Environment

Characteristic	Requirement	Standard
Shock	XENTA M5 will satisfy Functional Shock Requirements[1)]	Reference [45]
	XENTA M5 will satisfy Transport and Transit-drop Shock Requirements	Reference [46]
Vibration	XENTA M5 will satisfy Vehicle Vibration Requirements	Reference [43]
	XENTA M5 will satisfy Transport Vibration Requirements	Reference [44]

NOTE :

1) Detailed analysis should ideally be based on representative vehicle-motion simulations. These might be derived from an Operational Profile analysis.

8.3 Climatic Environment

Characteristic	Requirement	Standard	Definition
Climate Zone	XENTA M5 will satisfy Climatic Zone Requirements :	A1, A2, A3, B1, B2, B3, C0, C1	References [16], [56]
Ambient Temperature	XENTA M5 Exposed Equipment Operational Temperature :	-32 to +55 degrees C	References [35], [36]
	XENTA M5 Protected Equipment Operational Temperature :	+10 to +30 degrees C	References [35], [36]
	XENTA M5 Storage and Transport Temperature :	-40 to +71 degrees C	References [35], [36]
	XENTA M5 will be Ready to Transmit after Power-On with external Temperature of -32 degrees C	15 minutes	
Humidity	XENTA M5 Equipment Operational Humidity characteristics :	• 95% @ 26°C • 74% @ 35°C • 75% @ 30°C • 19% @ 63°C	Reference [40]
	XENTA M5 Protected Equipment Operational Humidity :	30 - 70%	
Solar Radiation	XENTA M5 Protected Equipment Operational Solar Radiation :	1’120 W/m^2	Reference [38]
Atmospheric Pressure	XENTA M5 Full-Performance with Atmospheric Pressure Conditions :	870 – 1’069 hPa	Reference [34]
	XENTA M5 Operational High-Altitude Conditions :	< 3´000m	Reference [34]
	XENTA M5 Storage and Transport High-Altitude Conditions :	< 8´500m	Reference [34]

Characteristic	Requirement	Standard	Definition
Wind Exposure	XENTA M5 Full-Performance with Wind Conditions :	50 km/hr, Steady	XENTA M5 Internal
	XENTA M5 No Damage with Wind Conditions :	90 km/hr, Steady	XENTA M5 Internal
	XENTA M5 No Damage with Wind Conditions :	130 km/hr, Gusting	XENTA M5 Internal
Liquid Protection	XENTA M5 Exposed Equipment, Ingress Protection Requirement :	IP66	Reference [19]
	XENTA M5 Protected Equipment, Ingress Protection Requirement :	IP55	Reference [19]
	XENTA M5 Exposed Equipment will withstand Military Wash-down :	• Wash-Fluid Fresh-Water • Max Pressure 8 bar • Max Flow 10 litres/min • Min Distance 0.5 m • Duration 200 seconds	XENTA M5 Internal
	XENTA M5 Exposed Equipment will withstand Rainfall[1)] :	• Limit No Damage • Intensity 108 mm/hr • Duration 30 minutes	Reference [39]
	XENTA M5 Exposed Equipment will withstand Hail :	• Diameter ≤ 5 mm • Speed ≤ 25 m/s • Duration ≤ 7 minutes	Reference [32]
	XENTA M5 Exposed Equipment will withstand Snow Load :	< 100 kg/m^2	Reference [33]

NOTES :

1) Degradation to sensor-performance is permitted.

Characteristic	Requirement	Standard	Definition
Salt Water / Atmosphere	XENTA M5 withstands corrosive <u>Salty Atmosphere</u> :	• Exposure Period 48 hours • Storage Period 48 hours • Concentration ≤ 5% NaCl • Min Distance 0.5 m • Temperature 25 degrees C	Reference [42] : was 41
Sand	XENTA M5 <u>Exposed Equipment</u> will have <u>Full Performance</u> after :	• Density ≤ 1.0 g/m³ • Min Diameter 100 µm • Max Diameter 1'000 µm • 90% Minimum 150 µm • 90% Maximum 425 µm	Reference [51]
Dust	XENTA M5 <u>Exposed Equipment</u> will have <u>Full Performance</u> after :	• Density ≤ 0.1 g/m³ • Max Diameter 150 µm	Reference [51]
Fluid Contamination	XENTA M5 will not be damaged by <u>Corrosion or Contamination</u> from contact to liquids such as hydrocarbons and hydraulic-fluids :		Reference [37]
Flora	XENTA M5 will resist Mould-growth under conditions :	• Atmosphere Stagnant • Rel Humidity 95% • Temperature 20 – 35°C • Duration 28 days	XENTA M5 Internal
Fungus	XENTA M5 <u>Synthetic and Rubber-based materials</u> will <u>resist Fungus-growth</u> :		Reference [41]

8.4 Electro-Magnetic Effects

8.4.1 Electro-Magnetic Compatibility and Interference (EMC / EMI)

Definition Table

01)	XENTA M5 will satisfy EMC/EMI Test Methods tailored and applicable as defined at Reference [25] :	
	CS101	Conducted Susceptibility, Transients, Power Leads
	CS103	Conducted Susceptibility, Antenna Port, Intermodulation
	CS104	Conducted Susceptibility, Antenna Port, Rejection
	CS114	Conducted Susceptibility, Bulk Cable Injection
	CS115	Conducted Susceptibility, Bulk Cable Injection Impulse
	CS116	Conducted Susceptibility, Damped Sinusoid Transients, Cables
	CE102	Conducted Emissions, Power Leads
	RE102	Radiated Emissions, Electric Field
	RE103	Radiated Emissions, Antenna Spurious and Harmonics
	RS103	Radiated Susceptibility, Electric Field
02)	XENTA M5 will satisfy EME in accordance with Reference [27].	
03)	XENTA M5 will withstand Electrostatic Discharge in accordance with Reference [20].	

8.4.2 Lightning

Definition Table

01)	XENTA M5 will withstand <u>without malfunction</u> Electro-magnetic Environment generated by an Indirect Lightning Strike in accordance with Reference [26].

9 SAFETY REQUIREMENTS

9.1 Safety Engineering

9.1.1 XENTA M5 Safety Handling

Definition Table

01)	**Start-Up Handling**
01.1)	On start-up, the XENTA M5 will carry-out processing automatically in order that the XENTA M5 reaches the standard Safety and Default State of “STANDBY”.
01.2)	Failure to reach State “STANDBY” will only be the result of internal XENTA M5 failures such as hardware or software defects/exceptions.
01.3)	XENTA M5 will make no transmissions during the start-up phase – this includes during any Start-Up Test.
01.4)	XENTA M5 will not commence ROTATION.
02)	**General Handling**
02.1)	Transmission will only be possible on command from the XENTA M5 C^2-System.
02.2)	Transmission in State “STANDBY” will be impossible.
02.3)	Rotation will only be possible on command from the XENTA M5 C^2-System.

9.1.2 Software and Processing Safety

9.1.2.1 Exception Handling

Definition Table

01)	**Exception Handling**
01.1)	XENTA M5 processing will be realised with integrated Software Exception Handling.
01.2)	On detection of any software exception, XENTA M5 will : • Transition to State STANDBY • Cease Transmission • Cease Rotation • Report Exception Information.
02)	**Interface Handling**
02.1)	On failure and/or non-availability of communication with the C^2-System, XENTA M5 will : • Transition to State STANDBY • Cease Transmission • Cease Rotation • Report as BITE Error.
02.2)	On failure and/or non-availability of communication with the Platform Reference System, XENTA M5 will : • Inhibit Tracking • Report as BITE Error.

9.2 Personnel and Material Safety

9.2.1 Power and High-Voltage Protection

Definition Table

01)	**Power and High-Voltage Protection**
01.1)	All Power and High-Voltage Units will be marked with caution labels.
01.2)	All Power and High-Voltage Units will be completely covered, and can only be removed with Tools.
02)	**Transmission and Rotation Safety**
02.1)	When selected to “NORMAL SURVEILLANCE”, XENTA M5 will : • Transmit only when Antenna is rotating • Inhibit Transmission when Rotation is commanded “OFF”.
03)	**Man-Aloft Switch Safety**
03.1)	XENTA M5 will provide a hardware interface for an externally mounted Man-Aloft Switch interface.
03.2)	Man-Aloft Switch management (Transmission and Rotation) will be realised by hardware-means only.
03.3)	XENTA M5 will automatically inhibit Transmission when the Man-Aloft Switch interface reports "SAFE", and will automatically transition to State “STANDBY”.
03.4)	XENTA M5 will remain in State “STANDBY” if and when the Man-Aloft Switch is set to “NORMAL". Transmission will only be possible by explicit command from the C^2-System.
03.5)	XENTA M5 will automatically inhibit Rotation when the Man-Aloft Switch interface reports "SAFE", and will automatically transition to State “STANDBY”.
03.6)	XENTA M5 will remain in State “STANDBY” if and when the Man-Aloft Switch is set to “NORMAL". Rotation will only be possible by explicit command from the C^2-System.
03.7)	State of the Man-Aloft Switch interface will be reported to the C^2-System.

9.2.2 Sector Power Management

Sector Power Management (Section 3.8) is normally used for tactical or clutter-limitation reasons. Although Sector Power Management is not XENTA M5 primary Safety processing, it can however be useful and used limiting Transmission areas for protection of Personnel or Materials.

Sector Power Management processing will not be subject to Safety-processing validation and controls.

9.3 Radiation Safety

9.3.1 Requirements

Electromagnetic and Radiation Hazards from XENTA M5 Transmissions are analysed in accordance with Reference [13] and the Council of the European Union Recommendation 1999/519/EC.

Further, IEEE (Reference [14]) defines limits for Controlled and Uncontrolled environments. IEEE-defined limits are spatially averaged over the whole body, and time-averaged for 6 and 30 minutes for Controlled and Uncontrolled respectively.

Requirements are summarised as :

ICNIRP / European Union Recommendation

- General Public Exposure .... 10 W/m^2
- Occupational Exposure .... 50 W/m^2

IEEE Standards

- Uncontrolled Environments .... 10 W/m^2
- Controlled Environments .... 100 W/m^2

9.3.2 XENTA M5 Analysis

Safety-levels for the XENTA M5 are analysed in the worst-case condition – this means :

1. XENTA M5 is in Stop-Stare Mode, and
2. Antenna is illuminating the hazard object (personnel) directly and continuously.

XENTA M5 Safety Distances (worst-case) for the above limits are :

Power Level	Safety Distance
10 W/m^2	24.6 m
50 W/m^2	11.0 m
100 W/m^2	7.8 m

10 RELIABILITY, MAINTENANCE AND BITE

10.1 Reliability and Availability

10.1.1 Definitions

Failure Rates are evaluated as defined at Reference [21]. Failure-estimations are derived from a combination of theoretical analysis, and failure-analysis of Weibel systems and components under similar operational conditions.

Characteristics	Definitions
Operational Life(1)	
Operational Life	Operational Life..> 20 years
Reliability(2)	
Mean Time Between Failures	MTBF (Operating) (3)..> 1´000 hrs
Mean Time Between Critical Failures	MTBCF (Operating)...> 3´000 hrs
Mean Time To Repair	MTTR (Antenna) ....< 2 hrs
	MTTR (Others)...< 1 hrs
Availability	
Inherent Availability(4)	Availability.. > 95%

NOTES :

1 See Section 1.1.1.1

2 When evaluating Reliability factors such as MTTR and Availability, it is assumed that the necessary LRU's, Tools, Handbooks and other support arrangements are immediately available.

That is, calculations to be based on the repair-time required for direct repair work, as example covering :

- Controlled and Uncontrolled environments, and
- General Public and Occupational Exposure
- Failure Detection and Identification
- Exchange of LRU
- XENTA M5 set-up after installation of new hardware
- Final verification check of XENTA M5.

3 MTBF is based on Mean-Time between any Failure, and with no allowance for XENTA M5 redundancies and graceful-degradation which are inherent in the critical Antenna Transmit and Receive components

NOTES Continued :

4 Inherent Availability assumes no logistic-delays. Real Availability will normally be dependent on :

- End-User Maintenance concept
- Mission characteristics
- Availability of Replacement Units
- Maintainer Training and Expertise

General The XENTA M5 hardware configuration based on multiple Transmit and Receive Modules means that the critical Antenna-parts have a high level of graceful degradation.

When considering the inherent system-reliability that the XENTA M5 hardware redundancy brings, field trials with similar Antenna characteristics suggest a real MTBF of about 5´000 hours.

1.1.1.1 Through-Life Support

Weibel Scientific emphasise in-house design and manufacturing of almost all Weibel Radar components, sub-assemblies and assemblies. By concentrating design and manufacture in-house, Weibel are able to almost completely avoid typical supply-chain problems that arise when dependent on external Production and Suppliers.

Based on these specialised and dedicated in-house production techniques, Weibel can guarantee a minimum of 20-years through-life support that cannot be matched with more common procurement-based production processes**.**

Weibel through-life support covers :

- On-going engineering support
- Supply of Spares
- Repair of Defective Items
- Engineering Support with Upgrades and Modernisation projects.

10.2 Maintainability

10.2.1 Maintainer Support

Definition Table

01)	**General**
01.1)	XENTA M5 equipment layout (Mechanical, Electrical, Access-points) is designed to simplify and facilitate Maintenance Tasks.
02)	**BITE**
02.1)	XENTA M5 supports the Maintainer with a fully integrated and exhaustive Automatic BITE processing.
03)	**Documentation**
03.1)	XENTA M5 supports the Maintainer with the supply of Instructions, Drawings and Maintainer Handbooks.
03.2)	XENTA M5 Maintenance Handbooks and BITE-processing will be correlated and cross-referenced with respect to Defect Repair activities.

10.2.2 Line Replacement Units

Definition Table

01)	**Characteristics**
01.1)	XENTA M5 Maintenance methods will be defined for Defect-Repair at the Line Replacement Unit (LRU) level. LRU´s will generally comply with the following characteristics.
02)	**Definitions**
02.1)	LRU’s with the same part number will be interchangeable
02.2)	Duration for exchange of an LRU will not exceed 2, respectively 3 hours as defined at Section 10.1.1.
02.3)	LRU can be able to be carried by 2 able-bodied Maintainers
03)	**LRU Exchange**
03.1)	XENTA M5 Maintainer Handbooks and Support Arrangements include all Procedures, Tools and Utilities as necessary, and as XENTA M5 standard Scope-of-Supply
03.2)	If set-up of LRU´s is required, execution of these procedures will be possible by a Maintainer at Maintenance Level 3.

10.3 BITE

Definition Table

01)	**Definition**
01.1)	BITE Processing refers to the tools and utilities which are provided to monitor the system logistic status, and to assist the Maintainer when carrying out system tests and repair activities.
02)	**Basic**
02.1)	XENTA M5 will have an integrated BITE system.
02.2)	XENTA M5 BITE system will detect 95% of XENTA M5 hardware failures.
03)	**General Functions**
03.1)	XENTA M5 will handle BITE information from all XENTA M5 sub-systems and processes this data to generate the necessary reports to assist the Maintainer with : • Evaluation of XENTA M5 System-readiness • Failure Detection and Identification • Failure Identification and Localisation • Advice and Support for Defect Repair by means of cross-reference to Maintainer Handbooks.

10.4 Preventive Maintenance

Definition Table

01)	Preventive Maintenance Tasks will not exceed 30 minutes / week.

11 DESIGN AND CONSTRUCTION

11.1 ITAR Restrictions

XENTA M5 will have no components or technologies that are subject to ITAR restrictions.

11.2 General Manufacturing Requirements

Definition Table

01)	**Processes**
01.1)	Manufacturing will comply with Weibel manufacturing standards and processes.
02)	**Workmanship**
02.1)	Manufacturing processes and Workmanship will be under the control of Weibel Quality Assurance System. Workmanship practices will be based on requirements as specified at Reference [55].
02.2)	Weibel Quality Assurance Manufacturing and Workmanship Certificates-of-Conformance will be submitted prior to Factory Acceptance Testing.
03)	**Nameplates**
	Nameplate marking will comply with Weibel manufacturing standards and processes.

11.3 Hazardous Materials

Definition Table

01)	**Materials**
01.1)	Minimal use will be made of materials which support combustion, generate smoke or toxic fumes when subjected to fire, or are a hazard to health during installation, operation or maintenance.
01.2)	Connectors will be Cadmium-free.
01.3)	Cables will be Halogen-free, low fire-hazard Insulation and Sheathing.
01.4)	XENTA M5 will be free of : • Chrome-VI (Hexavalent) • Radioactive Materials • Beryllium-Oxide.

11.4 Corrosion Resistance

Definition Table

01)	**Connectors**
01.1)	XENTA M5 Connectors will be selected to minimise corrosion.
01.2)	Mating Connectors (Exposed) will be of Type MIL-C-38999 Series III, Stainless-Steel.
01.3)	Mating Connectors (Protected) will be of Type MIL-C-38999 Series III.
02)	**Electro-Chemical (Galvanic) Corrosion**
02.1)	XENTA M5 will be designed and manufactured to minimise Electro-chemical corrosion.
02.2)	Materials will not be placed in combinations which accelerate corrosion.
02.3)	Adjacent-materials will be selected according to Reference [53].
02.4)	Insulation and coatings will be applied if significant potential differences exist between Materials.
02.5)	Special care will be applied with respect to fissures and gaps in materials.
03)	**Protective Coatings**
03.1)	XENTA M5 protective surface treatment will be selected according to environmental and material characteristics.
03.2)	Synthetic and Rubber materials will be fungus resistant.
03.3)	Synthetic and Rubber will not be hygroscopic.
03.4)	Metals and alloys will be corrosion-resistant or will be given a corrosion-resisting treatments and coatings.
03.5)	Exterior surfaces will be protected against the action of corrosive environment, including salt fog and engine-exhaust.

11.5 Quality Statements

Definition Table

01)	XENTA M5 will be qualified for and marked with “CE” declaration. Marking will conform with directive 93/68/EEC
02)	XENTA M5 will comply with the quality directives : • Machinery Directive 2006/42/EC • EMC Directive 2014/35/EU • RoHS 2 Directive 2011/65/EU
03)	XENTA M5 will comply with REACH Regulations EC 1907/2006

12 VERIFICATION METHODS

12.1 Performance Definitions

Definitions for the methods of System Performance Verification and Testing will be defined between Weibel and Verification Authorities during detailed Contractual discussions.

12.2 Verification Principles

In general, when evaluating performance of the XENTA M5, it is critical that only performance of the XENTA M5 is considered, and that other sources of error (as example, comparison "truth" system) are not added.

XENTA M5 performance criteria have been defined for nominal Point-Targets. When executing Performance Trials under real is conditions, evaluation should be carried out by :

- Use of Targets that will limit Glint-effects as far as possible
- Trials performance criteria will be modified to account for Target true angular-dimensions.

12.2.1 Conditions for Verification

Characteristics	Definitions
Clutter Conditions	
Atmospheric	Atmospheric.. Clutter-free
Background Ground Clutter	Closest Background-to-Target .... ≥ 1'000 m
ECM	ECM .... None
Target Characteristics	
Target Radar Cross Section	Target RCS..≥ 1.0 m^2
Target Range	Target-Range.. 1´000..20'000 m
Target Height	Target-Height.. 500..1'000 m
Target Kinematics	Range-Rate .... 50..200 m/s
	Motion............................... Linear, Fixed-Height, Direct-Approach

12.3 Verification Method

12.3.1 Test Verification Matrix

Trials to be executed for verification of the XENTA M5 will be defined between Weibel and Verification Authorities. Verification of the XENTA M5 will be executed in accordance with a Test Verification Matrix.

The XENTA M5 Test Verification Matrix will define :

- General *Method* for Verification Testing
- *Occasion* for Verification Testing
- *Cross Reference* between this Product Description and Verification Test.

12.3.2 Process

XENTA M5 Verification Testing will be evaluated using criteria- principles of *Analysis, Demonstration, Inspection*, or *Test*.

Analysis	Analysis Verification uses of analytical techniques to evaluate and interpret system, equipment behaviour. Analysis will be used in lieu of or to supplement test data. Analysis by simulation modelling will also be accepted.
Demonstration	Demonstration Verification evaluates the performance of operations where visual observation is the primary means of verification. Demonstration is used when qualitative assurance is required.
Inspection	Inspection Verification is the visual checks and measurements to verify that requirements such as construction, workmanship, finished-condition, and dimensions comply with XENTA M5 specifications. Inspection verification will also cover review of Data-sheets, Test-Reports and Certificates-of-Conformance.
Test	Test Verification will be instrumented methods for validation of product requirements under specified conditions. Test- data results will be used as Proof-of-Compliance. Test-data are used to evaluate XENTA M5 quantitative performance and characteristics. Evaluation will normally be based on comparison of Test-data with Specifications.

12.3.3 Formal Verification

Within the scope of the verification processes described at Section 12.3.1, it is expected that the XENTA M5 will be subject to the following formal Verification Testing :

Environmental XENTA M5 will be fully verified and qualified for Environmental conditions as specified at Section 8. Results of Environmental qualification trials will be provided to the Buyer on completion.

Integration XENTA M5 will be verified for correct System Interfacing and Integration with the C^2-System.

In general, XENTA M5 Integration Testing will be conducted between :

- Weibel, as Supplier of XENTA M5
- Combat System Integrator (as applicable)
- C^2-System Supplier (as Interface Partner to XENTA M5).

FAT XENTA M5 will be subject to a formal Buyer-witnessed and approved Factory Acceptance Test (FAT).

SAT XENTA M5 will be subject to a formal Buyer-witnessed and approved Site Acceptance Test (SAT).

SAT testing for the XENTA M5 will normally be executed with the XENTA M5 fully set-to-work and integrated into and with the final Combat or Fire Control System.

It is therefore expected that the XENTA M5 SAT will be carried out as a part of a complete-system SAT, and typically under control of the Combat / Fire Control System responsible Parties.

As Supplier of the XENTA M5, Weibel will however provide full responsibility for support and validation of the XENTA M5 sensor sub-system.

12.3.4 Additional (Non-Formal) Verification

Subject to Contractual Scope-of-Work, additional Verification of the XENTA M5 might also be executed.

Additional Verification will normally be adopted as Risk-mitigation steps from and will typically cover XENTA M5 Pre-Integration Testing

13 DELIVERY AND STORAGE METHODS

13.1 Preparation

XENTA M5 Surveillance Radar will be preserved, packed and labelled in accordance with Weibel Trade-Pack standards.

Equipment packing will be corrosion-proof, and will be realised such that no maintenance will be necessary during Transport and Storage.

13.2 Transport

Transport of the XENTA M5 should be carried out with care necessary for a system of this type. In particular, XENTA M5 units should be handled in order that :

- Mechanical damage should be avoided
- Units are protected from weather
- Units will be lifted with due care and attention, and only by means of foreseen Lifting Points
- Cabling and Connectors are protected at all times
- Cabling / Insulation will not be damaged.

13.3 Storage

XENTA M5 equipment is to be stored undercover and in an environment that will provide protection from weather, rodents and insect infestation.

14 DOCUMENT NOTES

14.1 Definitions and Terminology

Accuracy	Accuracy (μ) is the Mean of repeated-measurements of Angular or Range Errors as defined below. Accuracy is calculated by the Mean of measurements from each Test-Run separately.
Accuracy Consistency	Consistency (or repeatability) of Accuracy defines the maximum permitted change in nominal Tracking Accuracy when compared run-to-run.
Angular Errors	Angular Errors are Azimuth or Elevation Angular differences between the XENTA M5 *reported* Azimuth or Elevation, and the *true* Azimuth or Elevation.
Association	Refers to the process by which a XENTA M5 Plot is associated with a XENTA M5 Track : association is part of the Track Update process.
Built-In Test	Built-In Test (BIT) is an integral capability of the mission equipment which provides an on-board, automated test capability, consisting of software or hardware (or both) components, to detect, diagnose, or isolate product (system) failures. The fault detection and, possibly, isolation capability is used for periodic or continuous monitoring of a system's operational health, and for observation and, possibly, diagnosis as a prelude to maintenance action. Defined at Reference [22]
Built-In Test Equipment	Built-In Test Equipment (BITE) is any device mounted as a component in the Prime Equipment (XENTA M5), and which is used for the express purpose of testing the XENTA M5 and associated sub-assemblies and components, either independently or in association with external test equipment.
Classification	Classification is the system-process by which the Target “Class” is evaluated. Target Class defines the general characteristic type the Target. Target Classes include definitions such as *Generic Aircraft by size, Helicopter, Missile, High-Speed Missile/HARM, UAV* etc.
Correlation	Refers to the process by which a XENTA M5 Track is correlated with Sensor Data (Tracks, Plots or other data) from another sensor such as (example) IFF Reports.

Data Age	Age of a data-set at the time of processing of that data. For a consumer of data, data-age will normally be the difference between the current-time and the time reported in the Time-Stamp signal of the associated data message.
Expected Update-Period	Expected Update-Period is the maximum permitted time for which an existing Track should be updated with valid XENTA M5 sensor measured data.
Extrapolated Track	Extrapolated Track refers to a Track Report with Target State information based on extrapolated data, and not on sensor measurement data. By definition, the latency-time of an Extrapolated Track will be more than the *Expected Update-Period*.
Measured Track	Measured Track refers to a Track Report with Target State information based on sensor measurement data, and not extrapolated data.
Memory Tracking	Memory Tracking defines a phase where an existing Track could not be updated with valid (new) sensor data within the *Expected Update-Period*. Memory Tracking phases are defined with a maximum permitted *Memory Track Period*. Lack of updates within the maximum Memory period will cause Track-loss processing for that Track. See definitions of *Measured Tracks* and *Extrapolated Tracks*.
Plot	"Plot" is a signal that is derived from a video object, and that will be reported and published by the XENTA M5 in a Plot Data message. Plots which are used/consumed in the process of Track generation and updates are referred to as "Associated Plots".
Precision	Precision (σ) is the <u>Standard Deviation</u> of repeated-measurements of Angular or Range Errors as defined below. Precision is calculated by the Standard Deviation of measurements from each Test-Run separately. Evaluation of Precision implies that Error-measurements are made under generally identical conditions.
Range	Range as reported by XENTA M5 will be Slant Range, with origin at the Radar Antenna.

Range Errors	Range Errors are the differences between the XENTA M5 *reported* Range, and the *true* Range.
Resolution – Angular	Angular Resolution is the minimum angular-separation of two objects of the same Range, and for which the XENTA M5 is able to discriminate and track as separate un-merged objects.
Resolution – Range	Range Resolution is the minimum range-separation of two objects of the same Azimuth and Elevation, and for which the XENTA M5 is able to discriminate and track as separate un-merged objects.
Scan	One complete rotation of the XENTA M5 Antenna.
Time-Stamp	Time-Stamp is the signal defining the date and time of the event to which the Time-Stamp is associated. For most XENTA M5 data, Time-Stamps are associated with physical state-vectors, and therefore define the date and time at which that state-vector is valid.
Time-Validity Processing	Time-Validity is used to describe handling associated with the processing of data-age. Time-Validity processing will therefore cover both : • Message Producer : evaluation of Time-Stamp signal based on Data-Age • Message Consumer : evaluation of Data-Age based on Time-Stamp signal
Track	"Track" is a generic term used to define a Target State Vector representing the characteristics of an object in space. XENTA M5 Tracks will be derived from XENTA M5 Video, Paints and Plots, and will be reported and published in the XENTA M5 Track Data message.

14.2 Abbreviations

AA	Anti Air
ADS-B	Automatic Dependent Surveillance - Broadcast
AECTP	Allied Environmental Conditions and Test Publications
AHR	Attitude (Roll & Pitch), Heading and their Rates
AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
ASCII	American Standard Code for Information Interchange
ASTERIX	All Purpose Structured Eurocontrol Surveillance Information Exchange
BIT	Built-In Test
BITE	Built-In Test Equipment
C2	Command-and-Control
C^2-System	Generic term for any C^2-System controlling the XENTA M5
CFAR	Constant False-Alarm Rate
CMS	Combat Management System
COTS	Commercial Off The Shelf
CSE	Course
CW	Continuous Wave
C/W	Complete With
DAR	Digital Array Radar
ECCM	Electronic Counter-Countermeasures
ECM	Electronic Countermeasures
EMC	Electro-Magnetic Interference
EMCON	Emission Control
EMI	Electro-Magnetic Interference
EPM	Electronic Protective Measures (also known as ECCM)
ESM	Electronic Support Measures
FAT	Factory Acceptance Test
FCR	Fire Control Radar
FCS	Fire Control System
FMCW	Frequency-Modulated Continuous-Wave
HARM	High-Speed Anti-Radiation Missile
HMI	Human Machine Interface
ICU	Interface Control Unit
INS	Inertial Navigation System
ITU	International Telecommunication Union
JSON	JavaScript Object Notation
LAN	Local Area Network
LPI	Low Probability of Intercept
LRS	Local Reference System
LRU	Line Replaceable Unit
MAS	Man-Aloft Safety Switch
MFCW	Multi-Frequency Continuous-Wave
MIL-STD	Military Standard
MTBCF	Mean Time Between Critical Failures
MTBF	Mean Time Between Failures
MTD	Moving Target Detection

MTI	Moving Target Indication
MTTR	Mean Time To Repair
N/A	not applicable
PD	Probability of Detection
PT	Probability of Track-Detection
PFA	Probability of False-Alarm
PRF	Pulse Repetition Frequency
PRS	Platform Reference System
PSU	Power Supply Unit
RADHAZ	Radiation Hazard
RAM	Radar Absorbent Material
RAM	Reliability, Availability and Maintainability
RCS	Radar Cross Section
RMS	Root Mean Square
RRM	Radar Receiver Module
RTM	Radar Transmitter Module
RF	Radio Frequency
RX	Receive / Receiver
S/N	Signal to Noise
SHORAD	Short Range Air Defence System
SIT	System Interface Test
SIT	System Integration Test
SOTM	Search-on-the-Move
SPD	Speed
TBA	To be Advised
TBD	To be Defined
TCU	Thermal Control Unit
TWS	Track-While-Scan
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
VCL	Vehicle Centre-Line
WRT	With Respect To

14.3 References

[1]		Reserved for XENTA M5 Data Interface Requirements Specification
[2]		Reserved for XENTA M5 Electrical Interface Requirements Specification
[3]		Reserved for XENTA M5 Installation Requirements Specification
[4]		Reserved for XENTA M5 Time Interface Requirements Specification
[5]		Reserved for XENTA M5 Platform Interface Requirements Specification
[6]		Reserved
[7]		Reserved
[8]		Reserved for XENTA M5 Environmental Qualification Test Plan
[9]		Reserved for XENTA M5 Test Verification Matrix
[10]		Reserved for XENTA M5 System Interface Test Procedure
[11]		Reserved for XENTA M5 Factory Acceptance Test Procedure
[12]		Reserved for XENTA M5 Site Acceptance Test Procedure
[13]	ICNIRP Guideline	ICNIRP Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields
[14]	IEEE Std C95.1™	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Field, 3 kHz to 300 GHz, dated 19 April 2006
[15]	AECTP 100 Edition 3	Environmental Guidelines for Defence Materiel
[16]	AECTP 230	Leaflet 2311/1 Climatic Categories and their Geographical Location
[17]	ASTERIX (SPEC-149)	EUROCONTROL Specification for Surveillance Data Exchange
[18]		Reserved
[19]	IEC 60529	Specification for Degrees of Protection Provided by Enclosures (IP code)
[20]	IEC 61000-4-2	International Electrotechnical Commission immunity standard for Electrostatic Discharge (ESD)
[21]	MIL-HDBK-217F	Reliability Prediction of Electronic Equipment
[22]	MIL-HDBK-338B	Electronic Reliability Design Handbook
[23]	MIL-HDBK-454	General Guidelines for Electronic Equipment
[24]		Reserved
[25]	MIL-STD-461F	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
[26]	MIL-STD-464C	Electromagnetic Environmental Effects Requirements for Systems
[27]	MIL-STD-464C	Electromagnetic Environmental Effects Requirements for Systems – Table 4
[28]	MIL-STD-810F	Environmental Engineering Considerations and Laboratory Tests / Method 501.4, Procedure II, Minimum 3 cycles

[29]	MIL-STD-810F	Environmental Engineering Considerations and Laboratory Tests / Method 502.4, Procedure II
[30]	MIL-STD-810F	Environmental Engineering Considerations and Laboratory Tests / Method 505.4, Procedure I, Figure 505-4-I
[31]	MIL-STD-810F	Environmental Engineering Considerations and Laboratory Tests / Method 514.5A, Para 2.3.20, Category 21
[32]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Hailstorm
[33]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Part 3, Section III
[34]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 500.5, Low Pressure, Altitude, Procedure I
[35]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 501.5, High Temperature Test I and II
[36]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 502.5, Low Temperature Test I and II
[37]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 504.1
[38]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 505.5, Solar Radiation Test
[39]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 506.5, Rain Test
[40]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 507.5, Humidity Test
[41]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 508.6, Fungus Test
[42]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 509.5, Salt Fog Test
[43]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 514.6, General Vibration Procedure I, Category 4 (Truck, Trailer, Composite Wheeled Vehicle)
[44]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 514.6, Procedure VI
[45]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 516.5, Functional Shock Test, Ground Equipment
[46]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 516.5, Functional Shock Test, Procedure IV
[47]	MIL-STD-167-1A	Mechanical Vibrations of Shipboard Equipment / Type I
[48]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 506.5, Procedure I – Rain and Blowing Rain
[49]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 507.5, Procedure II
[50]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 509.5
[51]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 510.5 Sand and Dust Test (I and II

[52]	MIL-STD-810G	Environmental Engineering Considerations and Laboratory Tests / Method 516.2
[53]	MIL-STD-889D	Dissimilar Metals
[54]	MIL-STD-461F	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
[55]	MIL-HDBK-454B	General Guidelines for Electronic Equipment
[56]	STANAG 4370	Environmental Testing

14.4 Document File-Name

PRSP_SYSTEM-PERFORMANCE-SPEC_SHORAD-GENERIC_V0001.docx

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Notes:
- The contractor reserves the right to change specifications provided overall performance is not decreased
- All specifications are typical and cannot be guaranteed under all conditions
- Not all features are included in all configurations and some features may be offered as options
- Not all specifications can be met simultaneously