**Missile Warning System**

**System Requirement Specification**

Index

[1. Scope 2](#_Toc272586290)

[1.1 Identification 2](#_Toc272586291)

[1.2 System overview 2](#_Toc272586292)

[1.3 Document overview 4](#_Toc272586293)

[2. Referenced documents 4](#_Toc272586294)

[3. Requirements 4](#_Toc272586295)

[3.1 States and modes 7](#_Toc272586296)

[3.2 Functional requirements 7](#_Toc272586297)

[3.3 External interfaces 7](#_Toc272586298)

[3.4 Internal nterfaces 7](#_Toc272586299)

[3.5 Design constraints 7](#_Toc272586300)

[4. Requirement traceability 7](#_Toc272586301)

**History**

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**References**

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| **ID** | **Document Name** | **Version** |
| Ref-1 | Therma case.pdf | 1 |
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**Abbriviations**

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| --- | --- |
| UR | User Requirement |
| FR | Functional Requirement |

# Scope

## Identification

This document describes a self protection suite for the F-16 combat aircraft used by the Royal Danish Air Force. The protection suite incorporates a pod for mounting under the left wing and an intelligent cockpit control unit for controlling the system. In the pod is mounted a Missile Warning System (MWS) which gives input to the cockpit control unit. From the cockpit control unit is the dispensing of flares and chaffs from the pod controlled. The solution shall provide warning upon detection of missile threats and be able to automatically dispense payloads in response.

The MWS will be provided as Government Furnished Equipment (GFE) and be physically installed by your company.

If there where more information about the system it should also be placed here, that could be information about which version and type of MWS system that shall be mounted.

## System overview

The system is a self protection suite for a F-16 combat aircraft , it shall protect the aircraft against missile attacks. The system consists of 2 main systems:

* Cockpit Unit, which communicate with the systems in the POD and Aircraft Mission Computer. Has also an interface to the aircraft intercom system and an interface for the user to control the system.
* POD, which holds magazines for flares and chaffs and what is needed for firing them of, plus the MWS system.



Missiles shall be detected by the MWS that are provided as a GFE equipment and mounted by Company F. When missile attacks are detected information is sent to the cockpit control unit, which depending on the mode it is in will react on the information and is able to react according to a number of programs by dispensing flares and chaffs according to the program chosen. By the interface to the aircraft intercom system audio cues and warnings can be provided.

The system has a number of different users depending on what is done and where:

* On ground the system can be maintained by technicians that update SW and control the system
* Ground personnel shall be able to mount it and when ready to takeoff arm it.
* The pilot shall use the system, by choosing an appropriate program and depending on program chosen do further to let it dispense when missile attacks are detected.
* After dispensing has happened maintenance has to be done again to fill up the magazines again with flares and chaffs.

Other relevant documents for this system are:

* Technical description of MWS system. Document number xxx
* Mechanical description of MWS system. Document number xxx
* User handbook of MWS system. Document number xxx

System overview. This paragraph shall briefly state the purpose of the system to which

this document applies. It shall describe the general nature of the system; summarize the history

of system development, operation, and maintenance; identify the project sponsor, acquirer, user,

developer, and support agencies; identify current and planned operating sites; and list other

relevant documents.

## Document overview

This document shall describe all the Systems Requirements for the Self Protection System for the F-16 combat aircraft and the development of the system shall be based on this document, when the system fulfil the requirements in this document the requirement of the Royal Danish Air Force is fulfilled.

This document must only be used in the project group by Company F and project group and other personal at The Royal Danish Air force that are cleared to have access to this project.

Document overview. This paragraph shall summarize the purpose and contents of this

document and shall describe any security or privacy considerations associated with its use.

# Referenced documents

# Requirements

|  |  |
| --- | --- |
| **REQ ID** | **Requirement** |
| FR-1 | The POD shall contain three dispenser magazine mounts, henceforth named first, second and third. |
| FR-2 | The POD’s first dispenser magazine mount shall physically be located before the second and third dispenser magazine mount relative to the nose of the plane. |
| FR-3 | The POD’s first dispenser magazine mount shall support forward dispensing. |
| FR-4 | The POD’s first dispenser magazine mount shall support two magazines. |
| FR-5 | The POD’s second dispenser magazine mount shall physically be located before the third dispenser magazine mount relative to the nose of the plane. |
| FR-6 | The POD’s second dispenser magazine mount shall support leftwards dispensing. |
| FR-7 | The POD’s first dispenser magazine mount shall support four magazines. |
| FR-8 | The POD’s third dispenser magazine mount shall support backwards dispensing. |
| FR-9 | The POD’s third dispenser magazine mount shall support two magazines. |
| FR-10 | The POD shall support standard NATO dispenser magazines type *DM30p*. |
| FR-11 | The POD must comply with all F-16 requirements for aerodynamics and radar reflections as specified by the F-16 POD standard *FP42f*. |
| FR-12 | The systems must comply with all F-16 EW standards for EMC and data bus load as specified by the F-16 EW standard *FE16d*. |
| FR-13 | The POD shall be mounted under the left wing. |
| FR-14 | The POD shall be mounted by two T-hooks as specified by the F-16 POD mounting standard *PM11b*. |
| FR-15 | The cockpit unit shall forward all threat data received from the MWS to the aircraft mission computer in body frame format. |
| FR-16 | The cockpit unit shall forward the threat data received from the MWS within 20ms (latency of one 50Hz MIL-1553B packet). |
| FR-17 | The cockpit unit shall use the NATO dispenser threat format *DF14b* to forward threat data to the aircraft mission computer. |
| FR-18a | The MWS shall communicate with the cockpit unit via a dedicated MIL-1553B data bus. |
| FR-18b | The MWS shall forward threat data to the cockpit unit in NATO dispenser threat format *DF14b* (50Hz). |
| FR-19 | The cockpit unit shall request the performance of a built in test by the ECU every 15 minutes. |
| FR-20 | The ECU shall perform the built in test that is supported by this Government Furnished Equipment (*GFE*). |
| FR-21 | The cockpit unit shall perform an internal built-in test of its internal subsystems and HW, as specified by the F-16 subsystem BIT standard *FBIT12c*. |
| FR-22 | The cockpit unit shall forward the built in test results to the aircraft mission computer with a maximum latency of 1 second from receiving the results. |
| FR-23 | The cockpit unit shall request status information from the ECU every 20ms (MIL-1553B 50Hz frame) |
| FR-24 | The ECU shall report the status information available for this Government Furnished Equipment (*GFE*). |
| FR-25 | The cockpit unit shall forward the status of the individual subsystems and LRUs; Magazine, DSS, ECU, aircraft unit to the aircraft mission computer with a maximum latency of 100ms from receiving the information. |
| FR-26 | The cockpit unit shall play an audio queue on the aircrafts audio system when a threat is detected. |
| FR-27 | The audio queue played in case of a threat shall be an indication of threat type (e.g. “Missile”), location (e.g. “4 o’clock”) and elevation (e.g. “low”), as specified by the audio queue table *ACTv2*. |
| FR-28 | The POD shall include a safety pin that prevents the dispenser from firing. |
| FR-29 | The POD safety pin shall be clearly labeled and accessible by aircraft maintenance crew as specified by the aircraft maintenance manual *AMM32f*. |
| FR-30 | The cockpit unit must include a button to trigger the erasing of sensitive data procedure. |
| FR-31 | The cockpit unit shall keep all sensitive data in an encrypted format as specified by the DOD sensitive data standard *SDS23v*. |
| FR-32 | The cockpit unit shall erase the decryption key using the DOD data wipe specification *DWS12g*. |
| FR-33 | The erasing of sensitive data procedure shall set the POD erase sensitive data discrete within 10ms of being initiated. |
| FR-34 | The erasing of sensitive data procedure shall erase the cockpit unit’s decryption key within 100ms of being initiated. |
| FR-35 | The POD shall keep all sensitive data in an encrypted format as specified by the DOD sensitive data standard *SDS23v*. |
| FR-36 | The POD shall receive a discrete signal to indicate that it should erase its sensitive data, i.e. erase the decryption key. |
| FR-37 | The POD shall erase the decryption key using the DOD data wipe specification *DWS12g*. |
| FR-38 | The POD sensitive data decryption key must be erased within 100ms of receiving the erase signal. |
| FR-39 | The POD shall supply the status of the following LRUs:   * The individual magazines * The DSSs * The Sensors * The POD as a whole |
| FR-40 | The status reported by the POD for the individual magazines shall be:   1. Magazine max round count 2. Magazine rounds remaining count 3. Magazine round type (no mixed payload supported) 4. Magazine operational status (OK, ERROR, MISSFIRE DETECTED) |
| FR-41 | The magazine status shall be reported in the magazine status format specified under interfaces. |
| FR-42 | The status reported by the POD for the individual DSSs shall be:   1. Magazines installed count 2. Total rounds count 3. Total rounds remaining 4. Magazine failure count 5. DSS operational status (OK, ERROR) |
| FR-43 | The DSS status shall be reported in the DSS status format specified under interfaces. |
| FR-44 | The status reported by the POD as a whole shall be:   1. Magazines installed count 2. Total rounds count 3. Total rounds remaining 4. Total magazine failure count 5. Total DSS failure count 6. POD internal temperature 7. ECU operational status (OK, ERROR) |
| FR-45 | The POD overall status shall be reported in the POD status format specified under interfaces. |
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## States and modes

## Functional requirements

## External interfaces

## Internal nterfaces

## Design constraints

# Requirement traceability

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| --- | --- | --- | --- | --- | --- |
| **REQ ID** | **Requirement (short)** | **Trace ID** | **Reference** | **Test description** | **Test type** |
| FR-1 |  | UR-2 |  | Inspect that the requested dispenser mounts are located on the POD | Inspection |
| FR-2 |  | UR-2 |  | Inspect that the first dispenser mount is mounted correctly on the POD. | Inspection |
| FR-3 |  | UR-2 |  | Inspect that the first dispenser mount is placed correctly on the POD. | Inspection |
| FR-4 |  | UR-1 |  | Inspect that the first dispenser mount can hold 2 magazines. | Inspection |
| FR-5 |  | UR-2 |  | Inspect that the second dispenser mount is placed correctly on the POD. | Inspection |
| FR-6 |  | UR-2 |  | Inspect that the second dispenser mount is placed correctly on the POD. | Inspection |
| FR-7 |  | UR-1 |  | Inspect that the second dispenser mount can hold 4 magazines. | Inspection |
| FR-8 |  | UR-2 |  | Inspect that the third dispenser mount is placed correctly on the POD. | Inspection |
| FR-9 |  | UR-1 |  | Inspect that the third dispenser mount can hold 2 magazines. | Inspection |
| FR-10 |  | UR-1 |  | Inspect that the dispenser mounts support the correct magazine type. | Inspection |
| FR-11 |  | UR-3 |  | The POD design and implementation must be verified by a certified third party F-16 POD certifying authority. | Inspection and verification |
| FR-12 |  | UR-3 |  | The POD design and implementation must be verified by a certified third party F-16 EW certifying authority. | Inspection and verification |
| FR-13 |  | UR-4 |  | Inspect that the POD is mounted correctly. | Inspection |
| FR-14 |  | UR-4 |  | Inspect that the POD is mounted correctly. | Inspection |
| FR-15 |  | UR-5 |  | Inspect the code and run simulation with a MWS simulator to verify the inertial format to body-frame format conversion. | Code inspection and test |
| FR-16 |  | UR-5 |  | Run simulation with a MWS simulator to verify the delay from cockpit unit reception to availability on aircraft mission bus. | Test |
| FR-17 |  | UR-5 |  | Inspect the code and run simulation with a MWS simulator to verify the threat data format. | Code inspection and test |
| FR-18a |  | UR-5 |  | Inspect that the MWS uses a dedicated MIL-1553B data bus. | Inspection |
| FR-18b |  | UR-5 |  | Inspect the code and run simulation with a MWS simulator to verify the threat data format. | Code inspection and test |
| FR-19 |  | UR-6 |  | Run simulation with a MWS simulator to verify the BIT request interval. | Test |
| FR-20 |  | UR-6 |  | Inspect that the supported BIT is requested and run simulation with a MWS simulator to verify the BIT responses. | Code inspection and test |
| FR-21 |  | UR-6 |  | Inspect the internal BIT code and run test with test setup (faulty HW) to verify BIT responses. | Code inspection and test |
| FR-22 |  | UR-6 |  | Run simulation with a MWS simulator to verify the maximum delay. | Test |
| FR-23 |  | UR-6 |  | Inspect the status request code time and run test with MWS simulator to verify status request interval. | Code inspection and test |
| FR-24 |  | UR-6 |  | Verify that all available status information is placed on the MWS to cockpit unit data bus. | Test |
| FR-25 |  | UR-6 |  | Run simulation with a MWS simulator to verify the maximum delay. | Test |
| FR-26 |  | UR-7 |  | Run simulation with a MWS simulator to verify an audio cue is played. | Test |
| FR-27 |  | UR-7 |  | Run simulation with a MWS simulator to verify the correct audio cues are played. | Test |
| FR-28 |  | UR-8 |  | Verify that a removable pin exists and that firing is disabled when the pin is present in the POD. | Inspection and test |
| FR-29 |  | UR-8 |  | Verify pin design according to standard | Inspection |
| FR-30 |  | UR-9 |  | Verify that zerorize button is present on cockpit unit. | Inspection |
| FR-31 |  | UR-9 |  | Verify the DOD standard is met with respect to sensitive data storage. | Code inspection |
| FR-32 |  | UR-9 |  | Verify the DOD standard is met with respect to decryption key erase. | Code inspection |
| FR-33 |  | UR-9 |  | Verify that the POD erase discrete is set within 10ms of depressing the zerorize button. | Test |
| FR-34 |  | UR-9 |  | Show that it is probable that the key will be wiped within 100ms. | Code inspection |
| FR-35 |  | UR-9 |  | Verify the DOD standard is met with respect to sensitive data storage. | Code inspection |
| FR-36 |  | UR-9 |  | Verify that the POD erase its sensitive data decryption key when the POD erase discrete is set. | Test |
| FR-37 |  | UR-9 |  | Verify the DOD standard is met with respect to decryption key erase. | Code inspection |
| FR-38 |  | UR-9 |  | Show that it is probable that the key will be wiped within 100ms. | Code inspection |
| FR-39 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
| FR-40 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
| FR-41 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
| FR-42 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
| FR-43 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
| FR-44 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
| FR-45 |  | UR-10 |  | Verify with MWS simulator that the required status is available and correct. | Test |
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## Standards

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| **Standard** | **Description** |
| DM30p | NATO dispenser magazine type contains the complete details about the magazines physical constructions and interface, |
| FP42f | F-16 POD standard contains complete specification about requirements for POD manufacturing, including size, weight, material, shape, etc. |
| FE16d | F-16 EW standard contains the requirements and test procedures required to have a new system approved on an F-16. |
| PM11b | F-16 POD mounting standard includes specifications on how a POD shall safely be mounted to an F-16 aircraft. |
| DF14b | NATO dispenser threat format specify the protocol to use when exchanging threat data with the F-16 aircraft mission computer. |
| GFE | The complete specification of the Government Furnished Equipment that is the MWS. |
| FBIT12c | F-16 subsystem BIT standard indicate how a subsystem must test its internal status to comply with the F-16 operational standard. |
| ACTv2 | Separate document excluded due to the fact that it is not important for the process. |
| AMM32f | Aircraft maintenance manual contains details about how removable parts on aircraft shall be located and labeled. |
| SDS23v | DOD sensitive data standard specify how sensitive data must be stored, and also how the decryption key must be stored. |
| DWS12g | DOD data wipe specification dictates how sensitive data must be wiped from different media. |
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