Software Interface Control Document (SICD)

W.I.D.M.O. Optical Payload Project

Version 1.1

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1 Introduction

This Software Interface Control Document (SICD) describes the software interfaces, data structures, and communication mechanisms used in the project. It complies with the general principles of ECSS-E-ST-40C for software–hardware and internal–external interface control.

The document contains:

- Microcontroller-level software interface documentation.
- Communication protocol description between the embedded controller and the host PC.
- Data frame structures, variable definitions, expected ranges, and default values.

2 System Overview

The Optical Payload consists of:

- UV and IR filter wheel mechanisms driven by BLDC motors.
- Microcontroller-based actuator and detector control board.
- Host PC software managing wheel positioning, detector triggering, and logging.

The microcontroller exposes a command API and a binary/ASCII communication protocol towards the PC for operational control.

3 Software Interface Overview

This section divides software interfaces into two categories:

1. **Internal embedded interfaces** (microcontroller C functions controlling hardware subsystems)
2. **External communication interfaces** (formatted messages exchanged between microcontroller and PC)

Each interface entry contains:

- Function or Frame Identifier
- Purpose
- Parameters or Fields
- Return values or description
- Additional constraints

4 Embedded Software Function Interfaces

This section describes the internal functions implemented on the microcontroller. These functions are used by firmware modules to control motors, read detectors, and communicate with the PC.

4.1 Function Table

Function Name	**fw_move_wheel**
Prototype	`int fw_move_wheel(uint8_t wheel_id, uint8_t position_id);`
Purpose	Moves a selected filter wheel (UV or IR) to a specified mechanical position.
Application	Called by command parser when PC requests wheel movement.
Parameters	• `wheel_id` – 0 = UV wheel, 1 = IR wheel • `position_id` – index of filter position
Return	• 0 = Success • 1 = Invalid position • 2 = Motion timeout

Function Name	**detector_read**
Prototype	`uint16_t detector_read(uint8_t det_id);`
Purpose	Acquires a raw intensity value from UV or IR detector.
Application	Used during measurement sequences after filter wheels are positioned.
Parameters	`det_id` – detector index (0 = UV, 1 = IR)
Return	12-bit raw ADC value.

Function Name	**comms_send_status**
Prototype	`void comms_send_status(uint8_t code);`
Purpose	Sends a status or error message to the PC host.
Application	Used after wheel movement, detector read, or internal sanity checks.
Parameters	`code` – numeric identifier for success or error events.
Return	None.

5 Communication Protocol

The software interface between PC and microcontroller is based on framed ASCII messages. This section defines all exchanged message types.

5.1 Data Frame Definitions

5.1.1 Command Frame (PC → MCU)

Field	Type	Size	Default	Description
Header	char[2]	2 B	"TC"	Command frame identifier
Command ID	uint8_t	1 B	–	Move, read, or control command
Param 1	uint8_t	1 B	0	Wheel or detector index
Param 2	uint8_t	1 B	0	Position or mode
Checksum	uint8_t	1 B	computed	XOR of all fields

5.1.2 Telemetry Frame (MCU → PC)

Field	Type	Size	Default	Description
Header	char[2]	2 B	"TM"	Telemetry identifier
Status Code	uint8_t	1 B	–	0=OK, others=error
Data Value	uint16_t	2 B	–	ADC reading or wheel status
Timestamp	uint32_t	4 B	increasing	System time (ms)
Checksum	uint8_t	1 B	computed	XOR checksum

6 Sequence Diagram

1. PC sends `TC 0 1 0`
2. MCU moves UV wheel, returns `TM 0`
3. PC sends `TC 1 1`
4. MCU returns detector data in telemetry frame