Ref.: 24489-800-DU010-A

CamSight LT

Interface Control Document
CamSight LITE

Approved by	RANNOU Julien	Camsight Activity Manager	Julien RANNOU Signature numérique de Julien RANNOU Date : 2026.07.15 13:58:23 +02'00'
Checked by	SOULIE Emmanuel	Camsight Technical Manager	 Signature numérique de SOULIE Date : 2026.07.15 09:15:34 +02'00'
Written by	Batuhan KOSEOGLU	Optronic Field Application Engineer	 Signature numérique de Batuhan KOSEOGLU Date : 2026.07.14 22:53:20 +02'00'
Written by	Antoine LANGUILLE	Software Embedded Engineer	 Signature numérique de Batuhan KOSEOGLU Date : 2026.07.15 11:27:33 +02'00'
Written by	Guillaume PHAM	Software Embedded Engineer	PHAM Guillaume Signature numérique de PHAM Guillaume Date : 2026.07.15 09:24:29 +02'00'
	Name	Title	Visa

SAS (French Simplified Joint Stock Company) with registered capital of 18 000 000 Euros ◢ 422 511 204 RCS VERSAILLES ◢
French APE business sector code 7112B
Head Office: Parc d'Activités du Pas du Lac ◢ 10 bis, avenue Ampère Montigny-le-Bretonneux (78) ◢ France ◢ +33 (0)1 39 30 60 00
Postal Address: BP 284 ◢ 78053 Saint-Quentin-en-Yvelines Cedex ◢ FRANCE
https://www.bertin-technologies.com

LIST OF REVISIONS

Rev.	Date	Modifications (main reasons, sections and pages affected)	Writer / Checker
A	29/06/2026	First issue	BKO / ESO

TABLE OF CONTENTS

List of Figures

List of Tables

1. SCOPE

This Interface Control Document (ICD) provides detailed information about the electrical and mechanical interface of the CamSight LT camera. The purpose of this document is to provide guidance for integrating the camera into other video equipment and systems, by describing the camera's powering requirements, interface, and connector pinouts.

This document is intended for use by engineers and technicians who are in charge of integrating the camera into their systems. It assumes a basic understanding of video signal processing, electrical engineering, and communication protocols. This document should be used as a general guide, and any specific requirements or questions should be addressed to Bertin Technologies.

1.1. Documentation

AD001	Compagnon software user manual	Upcoming Document
AD002	Updater software user manual	24489-800-DU008-C

1.2. Acronyms

BP	Bad Pixel
CLHE	Contrast-Limited Histogram Equalization
FoV	Field of View
NUC	Non-Uniformity Correction
SWaP	Size, Weight and Power
UART	Universal Asynchronous Receiver Transmitter
VFE	Video Front End
WIP	Work In Progress

1.3. Regulatory status and intended use

The CamSight LT is an Original Equipment Manufacturer (OEM) infrared camera module intended exclusively for integration into professional equipment and systems.

The CamSight LT is not intended for direct use by end users and requires integration into a final product providing the necessary mechanical, electrical and environmental protections.

The CamSight LT is an electronic and optoelectronic subassembly and does not constitute machinery or partly completed machinery within the meaning of Regulation (EU) 2023/1230 on machinery.

This document provides the technical data necessary for proper integration of the product. The manufacturer of the final equipment remains solely responsible for ensuring compliance of the complete system with all applicable European legislation or local legislation.

The information contained in this document does not relieve the integrator from performing a complete risk assessment and conformity assessment of the final equipment.

2. OVERVIEW

CamSight LITE is a low SWaP-C Original Equipment Manufacturer (OEM) digital core camera developed and manufactured by Bertin Winlight, a brand of Bertin Technologies. It has been designed to meet user's requirements of low SWaP cameras and high-volume applications offering easy integration within optronic systems while providing the smartest thermal detection features at the best cost.

Figure 1: Picture of CamSight LITE

The CamSight LITE camera is based around a thermal infrared sensor detailed in Table 1.

Sensor/Camera	Thermal IR
Manufacturer	LYNRED
Reference	ATTO640 grade LITE
Spectrum	LWIR
Resolution	640x480
Pixel pitch	12 µm

Table 1: CamSight LITE sensor characteristics

CamSight LITE is available in five different configurations, each corresponding to a specific field of view. The core camera features a shutter. The interface board provides image output via USB. The camera supports frame rates of 9, 25, and 60 Hz. All SWaP (Size, Weight, and Power) requirements, mechanical drawings, and technical characteristics are specified for each module.

3. MECHANICAL INTERFACES

The CamSight LITE includes a lens that requires mechanical support to maintain it and hides the parasitic infrared light. It is necessary to ensure proper alignment of the lens and to reduce the impact of parasitic infrared light on the image quality.
Mechanical step files are available, please contact Bertin Technologies if needed.

3.1. CS LITE 4.1 mm

The mechanical drawings for the CS LITE 4.1 mm are as follows:

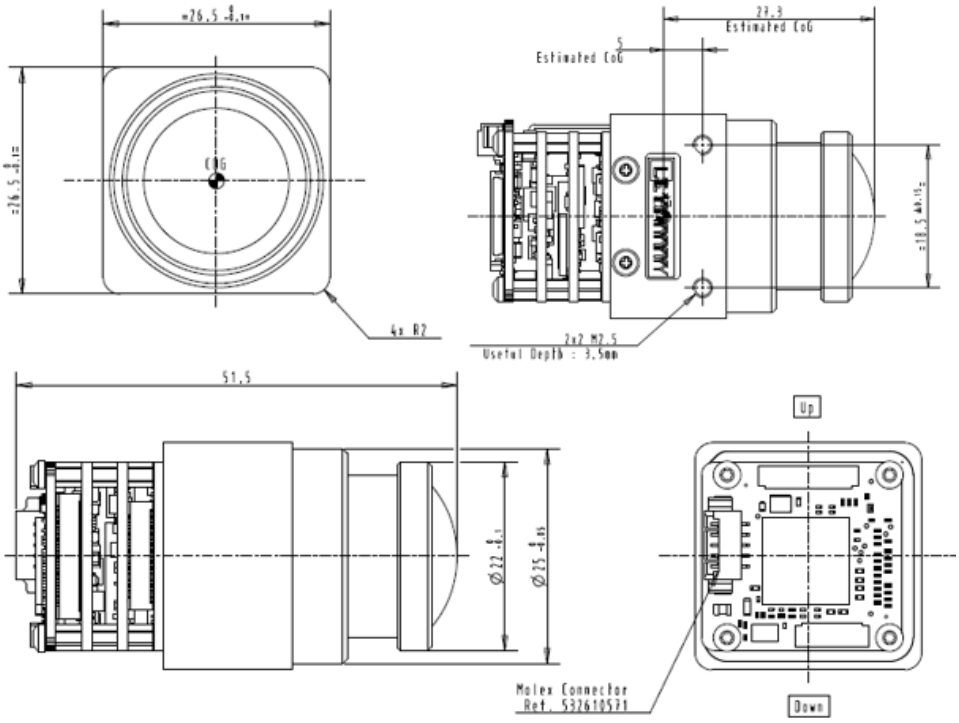


Figure 2: Drawings of the CamSight LITE 4.1 mm lens

Figure 3: 3D rendering of the CamSight LITE 4.1 mm lens

Description	Value
Foc. @ F#	4.1 mm @ F/1,2
Field of view	100° x 75,0°
Size (mm)	26,5 x 26,5 x 51,5 x ⌀ 22
Weight	60 g

Table 2: 4.1 mm Lens characteristics

3.2. CS LITE 7.5mm

The mechanical drawings for the CS LITE 7.5 mm are as follows:

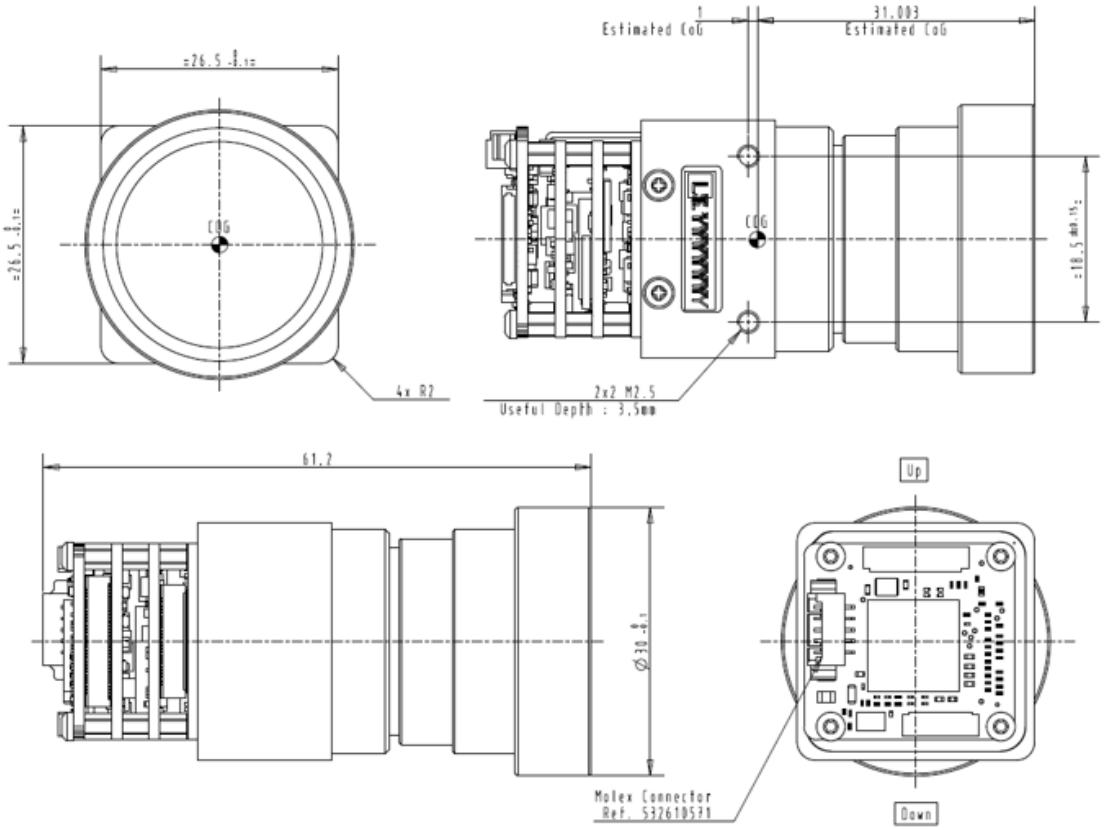


Figure 4: Drawings of the CamSight LITE 7.5 mm lens

Figure 5: 3D rendering of the CamSight LITE 7.5 mm lens

Description	Value
Foc. @ F#	7.5 mm @ F/1,2
Field of view	58,4° x 43,8°
Size (mm)	26,5 x 26,5 x 61,2 x ⌀ 30
Weight	75 g

Table 3: 7.5 mm Lens characteristics

3.3. CS LITE 9.1 mm

The mechanical drawings for the CS LITE 9.1 mm are as follows:

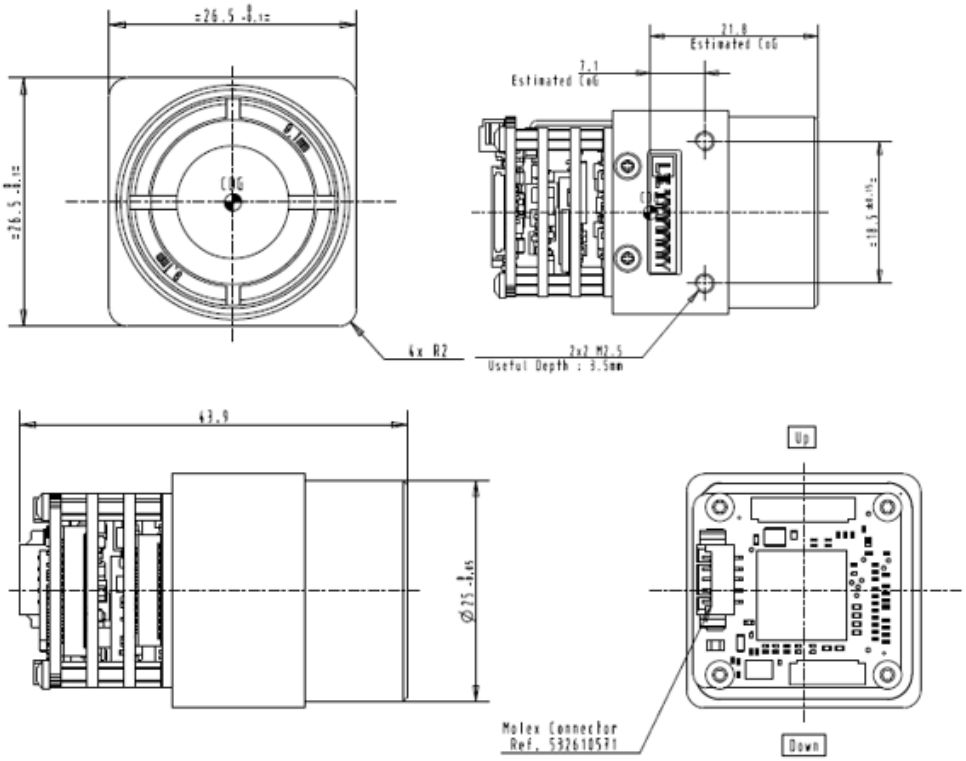


Figure 6: Drawings of the CamSight LITE 9.1 mm lens

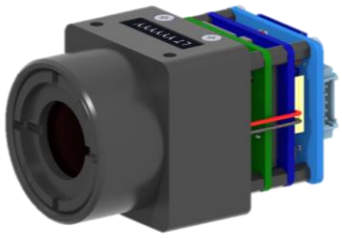


Figure 7: 3D rendering of the CamSight LITE 9.1 mm lens

Description	Value
Foc. @ F#	9.1 mm @ F/1,2
Field of view	48° x 36°
Size (mm)	26,5 x 26,5 x 43,9 x ⌀ 25
Weight	55 g

Table 4: 9.1 mm Lens characteristics

3.4. CS LITE 13.5 mm

The mechanical drawings for the CS LITE 13.5 mm are as follows:

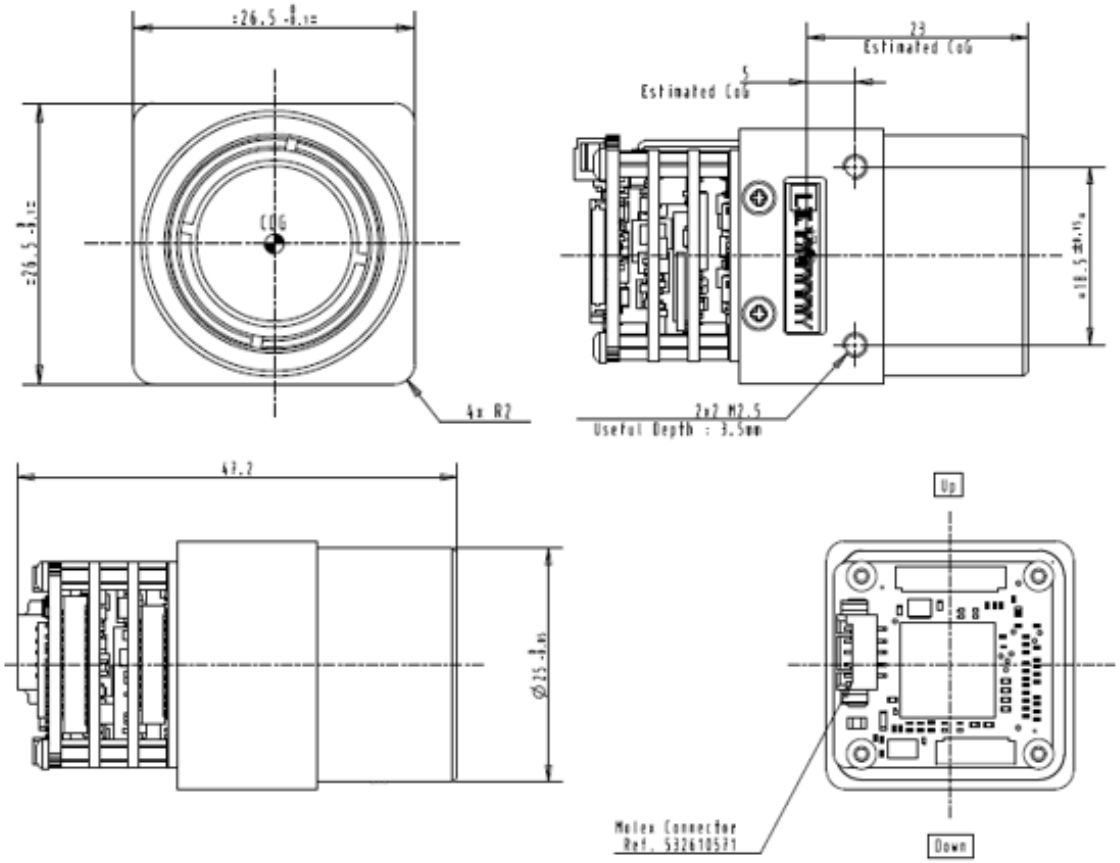


Figure 8: Drawings of the CamSight LITE 13.5 mm lens

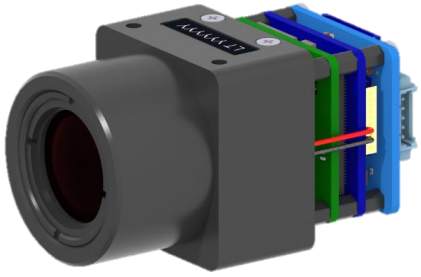


Figure 9: 3D rendering of the CamSight LITE 13.5 mm lens

Description	Value
Foc. @ F#	13.5 mm @ F/1,0
Field of view	31,7° x 24,0°
Size (mm)	26,5 x 26,5 x 47,2 x ⌀ 25
Weight	61 g

Table 5: 13.5 mm Lens characteristics

3.5. CS LITE 25 mm

The mechanical drawings for the CS LITE 25 mm are as follows:

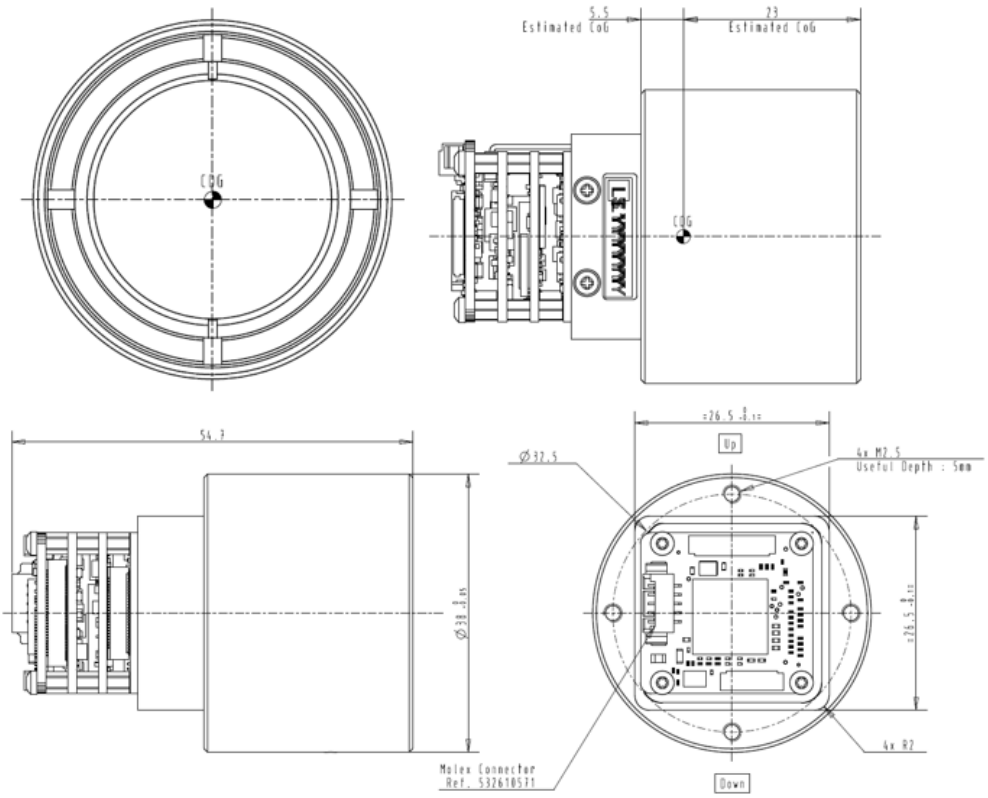


Figure 10: Drawings of the CamSight LITE 25 mm lens

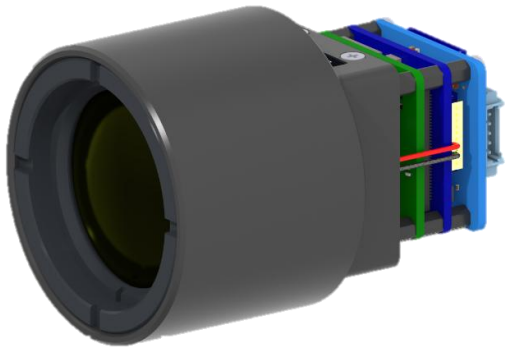


Figure 11: 3D rendering of the CamSight LITE 25 mm lens

Description	Value
Foc. @ F#	13.5 mm @ F/1,0
Field of view	31,7° x 24,0°
Size (mm)	26,5 x 26,5 x 47,2 x ⌀ 25
Weight	61 g

Table 6: 25 mm Lens characteristics

3.6. Interface

The CamSight LITE is available with a single electronic interface board: the USB-Molex board. This board provides image output through a 5 pins Molex connector.

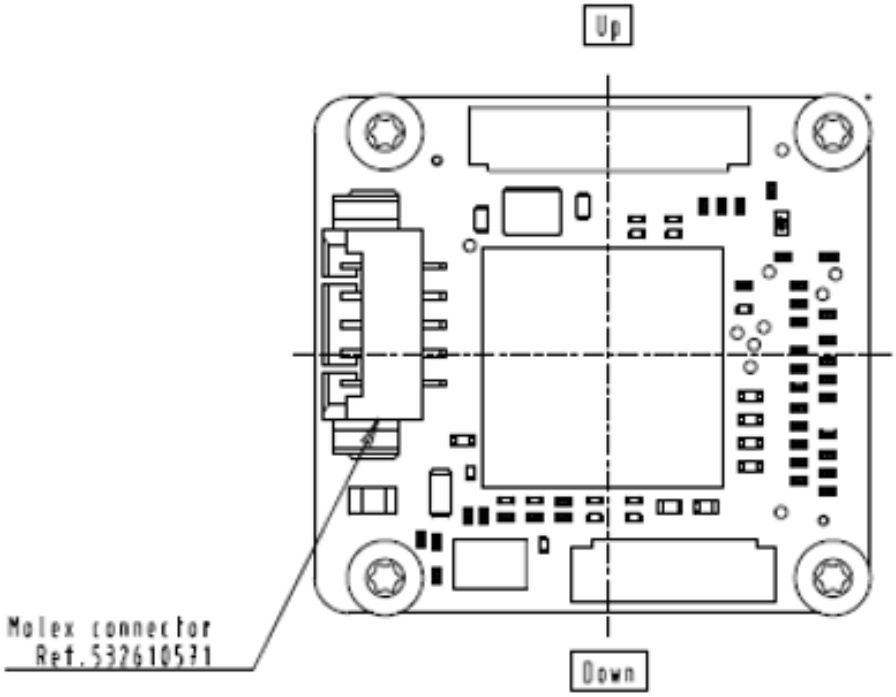


Figure 12: Drawing of USB Molex interface board

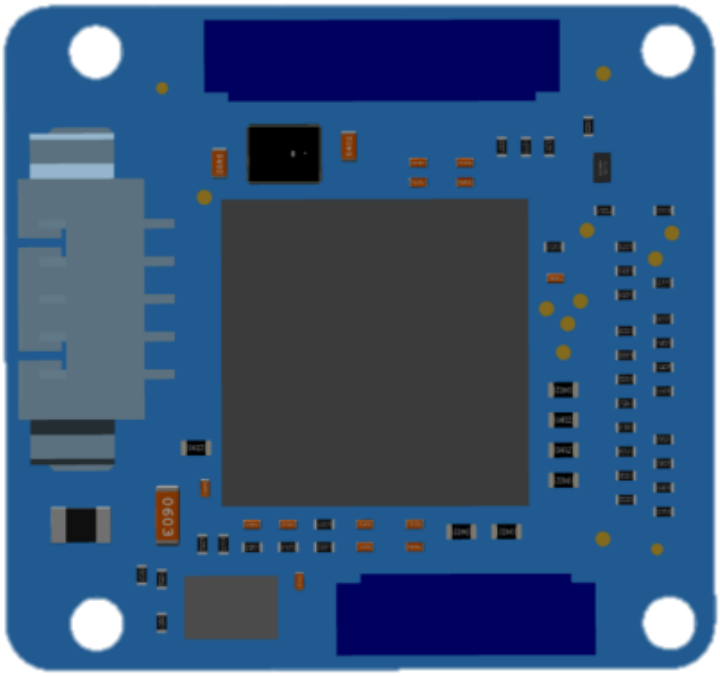


Figure 13: 3D rendering of USB Molex interface board

4. ELECTRICAL INTERFACE

4.1. Interface board connectors

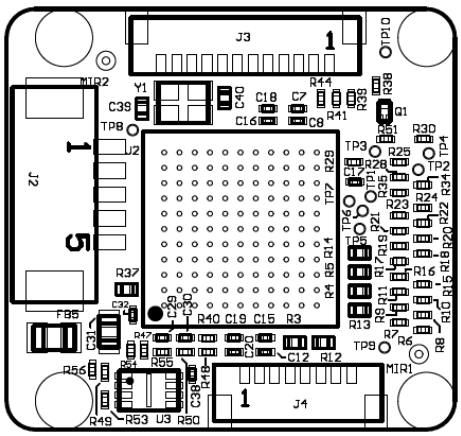


Figure 14: Drawing of the USB Molex interface board connectors

NOTE: J3 and J4 are factory reserved connectors.

Connector	Connector reference	Mating connector
J2	MOLEX 53261-0571	MOLEX 51021-0500

Table 7: USB-M interface board connector reference

J2 – USB MOLEX (MOLEX 53261-0571)				
Pin	**Name**	**I/O**	**Voltage**	**Description**
1	VUSB	P	5 V	*Power*
2	USB3_D_N	IO		*USB 2.0 differential pair*
3	USB3_D_P	IO		*USB 2.0 differential pair*
4	GND	P		*Power*
5	Reserved	-		*Do not connect*

Table 8: USB-M interface board J2 connector pinout

4.2. Power supply

Input pin	Requirement	Min	Max
1: “VUSB”’	Voltage	4.5 V	5.5 V
	Current	-	300 mA
	Ripple	-	60 mV

Table 9: USB MOLEX interface power supply requirements

4.3. Interface configurations

To configure and communicate with the camera, a serial UART interface is available on the USB interface board.

UART Parameter	Value
Default baud rate	115200 baud/s
Start bit	1
Stop bit	1
Number of data bits	8
Parity bit	None

Table 10: UART Serial interface parameters

5. IMAGE PROCESSING AND FEATURES OVERVIEW

5.1.1. Framerate

The camera is designed to handle different framerates (up to three frequencies), including 9, 25 and 60Hz. The 9Hz version (for civilian applications) is a factory hard-wired configuration and cannot be changed by settings. For framerates higher than 9 Hz, you can use your cameras with two different frequencies (25 Hz and 60 Hz). Cameras with a frequency higher than 9 Hz are subject to export control.

5.1.2. Shuttered operation

CamSight Lite cameras are fitted with a mechanical shutter allowing self-calibration operations (called Non-Uniformity Correction or NUC). During this calibration, the camera field is obstructed, and the video is replaced with dummy frames for a maximum duration of 1,5s. After the calibration is done, the shutter is reopened and the video stream resumes with enhanced quality.

5.1.3. Auto shutter management

A NUC is triggered at startup and when the camera crosses certain temperature thresholds. The user can also manually trigger a NUC or enable the “auto NUC” mode that will recalibrate the camera if time/temperature variations conditions are met.

The user can set the minimum/maximum time between consecutive auto NUCs as well as the sensor temperature drift threshold beyond which a new NUC will be triggered.

Each time a NUC is triggered, the time/temperature counters are reset to prevent multiple calibrations from triggering in a short time span.

5.1.4. Bad pixels

The CamSight Lite integrates the factory list of bad pixels and corrects them in real time with each frame.

5.1.5. Edge enhancement: sharpening or contouring

The camera is equipped with an edge enhancement algorithm which can improve the image quality by enhancing the edges. There are three modes available for this algorithm: disable, sharpening, and contouring.

In sharpening mode, the edges of the objects in the image are enhanced, resulting in a sharper image. In contouring mode, an edge detection algorithm is applied to the image, which can be particularly useful when aiming with a holographic thermal aiming sight.

Figure 15: Left: sharpening off / Right: Sharpening on

Figure 16: Left: contouring off / Right: contouring on

During contouring mode, it is recommended that image polarity is inverted, to have contours in white over black instead of black over white.

5.1.6. Histogram dynamic range enhancement

The camera includes a dynamic range correction algorithm that optimizes the histogram processing of the scene called CLHE (Contrast-Limited Histogram Equalization)

A parameter allows adjusting the algorithms to increase/decrease the scene contrast by equalizing the image histogram. The CLHE algorithm works on the histogram computed over a ROI (Region of Interest) defined by the user.

Figure 17: Picture of the CLHE algorithm

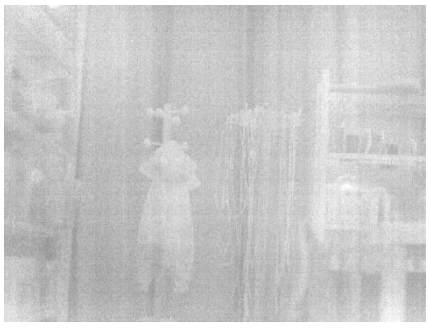
5.1.7. AHC gain limitation

The camera is equipped with a function to restrict the gain amplification AHC (Automatic Histogram Control). This functionality serves to diminish noise amplification in situations of low contrast. Users can employ two parameters, namely AHC black limit and AHC white limit, to confine the histogram to either black or white values, or both. The interplay of these parameters can result in a gray limitation as well.

Figure 18: Original image with low contrast and high noise (limit black = 0, limit white = 0)

limit black = 10, limit white = 0

limit black = 10, limit white = 10



limit black = 0, limit white = 10

In scenes with higher contrast, the effects of limitation will become noticeable only when employing higher values for the limitations:

limit black = 0, limit white = 0 | limit black = 20, limit white = 20 | limit black = 40, limit white = 40

Figure 19: CamSight Lite AHC gains variations

5.1.8. AHC speed temporal filter

A parameter is provided for adjusting the speed of the Automatic Histogram Control (AHC). A recursive filter is employed to restrict the AHC speed, where the filter coefficient is represented as alpha = $1/2^{AHC\_speed\_filter}$. This parameter can be adjusted within a range from 0 (indicating no temporal filter) to 8 (reflecting a very slow AHC response). Iterations time is typically 50ms.

5.1.9. Polarity

The camera features an image processing algorithm to invert image polarity (White Hot vs Black Hot).

Figure 20: Left picture - Black Hot / Right picture - White Hot

5.1.10. Gamma correction

A gamma correction can be applied to the image to modify its luminosity and contrast. Gamma values higher than 1 result in an overall darkening of the image while a gamma value less than 1 results in an overall lightening of the image.

The gamma correction value can be set by the user depending on the imaged scene.

NOTE: The gamma computation is approximated, resulting in a lack of brightness boosting for low values of gamma (3rd order approximation of $(1+x)^{\gamma}$).

Figure 21: Low gamma correction / Right picture – High gamma correction

5.1.11. Horizontal Flip

The camera includes a horizontal flip function that allows the image to be mirrored along the vertical axis in real time. This feature is designed to adapt the image orientation to the installation configuration and simplify system integration. By reversing the left and right sides of the image, users can ensure consistent visualization regardless of camera mounting position, such as in inverted or reflected optical setups (rear view mirrors etc).

Figure 22: CamSight Lite with 7.5 mm lens: Left: HFlip deactivated / Right: HFlip activated

5.1.12. False-color LUT

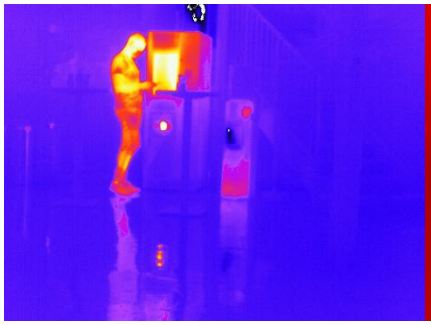
The camera includes a false-color LUT (Look-Up Table), enabling the display of colored videos. It's designed to enhance visualization and analysis of captured images.

This technique allows users to interpret image data in a unique and customizable way by mapping different pixel intensity values to a wide range of selectable colors.

False color LUT is only available for 8 bits outputs.

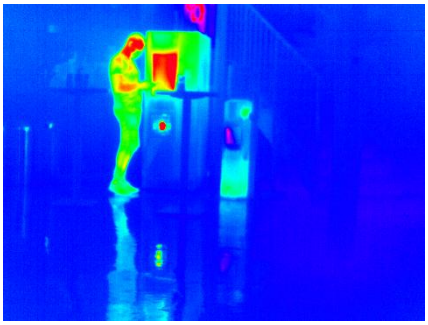
Six different LUTs are available:

GRAYSCALE YCbCr

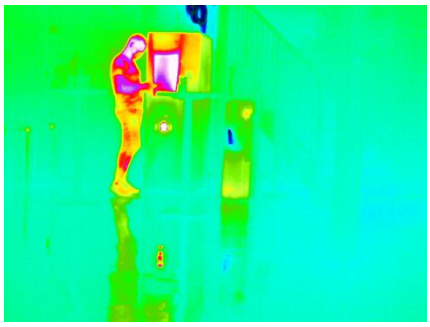


IRON

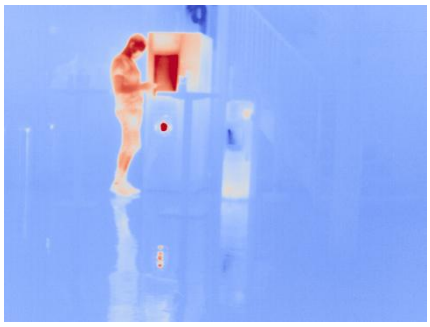
HOT



RAINBOW



NCAR



COOLWARM

CUBEHELIX

Figure 23: Available LUTs of the CamSight Lite

5.2. USB video output

The CamSight LITE camera is equipped with a USB interface. Recognized as a UVC V1.1 (USB Video Class) device, it allows effortless plug-and-play functionality across multiple platforms. Additionally, a virtual serial port is emulated via the USB connection (USB CDC), to communicate with the camera for configuration and control purposes.

The camera manages USB2.1 and USB 3.2 protocols. The resolution and framerate are limited to 640x480@25Hz.

Camera parameters to set while using USB:

- Framerate: 25Hz.
- Colorlut: from “IRON” to “GRAYSCALE YCbCr”. Do not use “GRAYSCALE”.

6. SOFTWARE INTERFACE

6.1. SERIAL communication interface

6.1.1. Hardware

A UART serial port allows communication with the camera. The characteristics are:

- Main UART parameters: 115200
- Baudrate: 115200 bps (default value)
- Start bit: 1
- Stop bit: 1
- Data bit: 8 bits data
- Parity: None

6.1.2. MAVLINK protocol

MAVLINK sources files (.xml) are available, please contact Bertin Technologies if needed.

The CamSight® camera is always configured as a slave device in the system. A master device must be connected to the camera to initiate communication, so the camera will never initiate a transaction by its own.

The CamSight MavLink Protocol is versioned. All devices implementing this protocol must ensure the protocol compatibility by respecting the command implementation guideline (see corresponding table: Command list, in this document).

6.1.2.1. Mavlink implementation

The CamSight MavLink Protocol is based on the MavLink v2 protocol. Moreover, all transactions are composed of 1 command packet sent by the master device and 1 response packet sent by the slave device.

6.1.2.2. Mavlink versioning

The list of available commands and corresponding responses is defined in the Command List Table. Depending on the version of the CamSight MavLink Protocol, the commands can be mandatory, optional, or deprecated (not to be implemented even if existing in previous versions).

Historical version of the CamSight MavLink Protocol is not versioned (it doesn't implement the `MAVLINK_MSG_ID_GET_CAMERA_PROT_VERS` command) and is identified in this document as version 0.

The `MAVLINK_MSG_ID_GET_CAMERA_PROT_VERS` command is used by the master device to identify the available camera command set.

6.1.2.3. Mavlink generator

6.1.2.3.1. GitHub tool

The following GitHub repository is used to generate automatically the MavLink code libraries to be implemented in the Camera firmware as well as in the master device that communicate with it: https://github.com/mavlink/mavlink

The python program 'mavgenerate.py' is used for this purpose. It needs an XML file describing the command set as input.

6.1.2.3.2. XML file description

The library generator program 'mavgenerate.py' takes, as input information, an XML file describing the command set to be implemented in the library.

One XML file is the reference for each version of CamSight MavLink Protocol.

The format of XML is described in the official MAVLink web site:https://mavlink.io/en/

6.1.3. Protocol packet description

In MavLink packets, all words are coded in little endian format.

6.1.3.1. Command packet format

Two kinds of command are defined:

- Set commands: the master device sends data to the slave; no data is sent back by the slave, who responds with an ACK message.
- Get commands: the master device sends some optional parameters to the slave; data are expected to be sent by the slave into the response, which consists in the same message than command.

6.1.3.1.1. Set command type

B0	B1	B2-B3	B4	B5-B6	B7-B9	n=LEN bytes	B(n+10)-B(n+11)
0xFD	LEN	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

LEN: length of the payload, expressed in bytes; can be from 0 to 255 bytes.

SEQ: sequence number, incremented at each command.

MID: Message ID (24 bits).

PAYLOAD: command data of LEN bytes.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B(n+9) bytes.

Unused: must be kept 0.

6.1.3.1.2. Get command type

B0	B1	B2-B3	B4	B5-B6	B7-B9	n=LEN bytes	B(n+10)-B(n+11)
0xFD	LEN	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

LEN: length of the payload, expressed in bytes; can be from 0 to 255 bytes.

SEQ: sequence number, incremented at each command.

MID: Message ID (24 bits).

PAYLOAD: contains some parameters, generally empty for a Get command.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B(n+9) bytes.

Unused: must be kept 0.

6.1.3.2. Response format

6.1.3.2.1. Acknowledge response type

In case of no data answer to a command, this ACK message is used to send the command result. It is used in 2 different cases:

- Set command type after correct completion; in this case, RESULT field is ACK.
- Any command type with error status after execution, in this case, RESULT field is NACK.

See the message description chapter for more details.

6.1.3.2.2. Data response type

In case of data expected by the master device, the slave response is the same message as the command, containing the data in the payload.

B0	B1	B2-B3	B4	B5-B6	B7-B9	n=LEN bytes	B(n+10)-B(n+11)
0xFD	LEN	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

LEN: length of the payload, expressed in bytes; can be from 0 to 255 bytes.

SEQ: sequence number, must be the same as corresponding command.

MID: Message ID (24 bits). Same value as command MID.

PAYLOAD: contains requested data.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B(n+9) bytes.

Unused: must be kept 0.

*

6.1.3.3. Noticeable specificities

In Mavlink v2 protocol specification, a payload truncation is defined.

If last bytes of any payload are equal to 0x00, they are removed from the payload, the LEN byte of the header is reduced. It is up to the message receiver to analyse the content and recover missing zeros.

This feature is used in this document to reduce the packet size in specific circumstances. This improves system performance.

6.2. Commands

All command parameters sent to the camera are stored in non-volatile memory, which means that they will be retained even when the camera is powered off. The camera loads with the stored parameters at startup.

Command	MID	Description
MESSAGE_ACK	8192	This message is used to respond to Set commands when only few data are sent back to the master or to any message to return an error
GET_SERIAL_NUMBER	8194	This message requests the camera serial number stored in non-volatile memory.
SHUTTER_CONTROL	8206	This message is used to control the shutter, open it and close it
SET_MAVLINK_SERIAL_SPEED	8217	This command switches the Mavlink UART baud rate between all possible values. Following standard values must be available for all slave devices: 9600, 115200, 230400, 460800 and 921600
GET_FPA_TEMPERATURE	8199	This command returns the sensor temperature.
GET_CAMERA_PROT_VERS	12287	This command requests the mavlink protocol version.
SET_GAMMA	12290	The Gamma parameter adjusts the contrast curve of the image in order to compensate the restitution of the final display.
SET_CONTRAST	12292	This command sets the CLHE value for image processing. This permits to adjust the dynamic of the LUT (more linear or more histogram equalization).
NUC_REQUEST	12296	This command processes a new NUC using the shutter

INVERT_POLARITY	12294	This command enables or disables the IR image polarity. Standard polarity means hot points are white and cold points are black
CAMERA_STATUS	12303	This command gets parameters information from the camera (contrast, gamma, polarity)
GET_FIRMWARE_ID	12321	This command reads both FPGA and RISC-V firmware IDs.
GET_FLIP_H	12322	This message reads the horizontal flip state.
SET_FLIP_H	12323	This message sets the horizontal flip state.
SET_FRAMERATE	12330	This command sets the video output frame rate. This information is stored in non-volatile memory. It is applied immediately and at next start-up
GET_FRAMERATE	12331	This command reads the video output frame rate currently in use.
SET_VIDEO_SELECT	12332	This command selects the video source to use as output for parallel and MIPI.
GET_VIDEO_SELECT	12333	This command gets the video source to use as output for parallel and MIPI.
SET_EDGE_PARAMS	12334	This command enables or disables the video edge processing (sharpening or contouring) and sets the corresponding parameters.
GET_EDGE_PARAMS	12335	This command reads the video edge processing settings currently in use in the camera
SET_COLORLUT	12340	This command sets the false color LUT
GET_COLORLUT	12341	This command reads the false color LUT
SET_ROI0_inclusive	12297	This command defines the Region of Interest inclusive 0 for the CLHE LUT algorithm.
GET_ROI0_inclusive	12315	This command gets the Region of Interest inclusive 0 for the CLHE LUT algorithm.
SET_ROI1_inclusive	12348	This command defines the Region of Interest inclusive 1 for the CLHE LUT algorithm.
GET_ROI1_inclusive	12349	This command gets the Region of Interest inclusive 1 for the CLHE LUT algorithm.
SET_ROI0_exclusive	12350	This command defines the Region of Interest exclusive 0 for the CLHE LUT algorithm.
GET_ROI0_exclusive	12351	This command gets the Region of Interest exclusive 0 for the CLHE LUT algorithm.
SET_ROI1_exclusive	12352	This command defines the Region of Interest exclusive 1 for the CLHE LUT algorithm.
GET_ROI1_exclusive	12353	This command gets the Region of Interest exclusive 1 for the CLHE LUT algorithm.
SET_AHC_GAIN_LIMITATION	12354	This command defines AHC (Automatic Histogram Control) gain limit the CLHE algorithm. It is used to limit the maximum amplification of the histogram in case of low contrast.
GET_AHC_GAIN_LIMITATION	12355	This command gets AHC (Automatic Histogram Control) gain limit from the the CLHE algorithm.
SET_LUT_TEMPORAL_FILTER	12356	This command defines AHC (Automatic Histogram Control) speed for the CLHE algorithm.
GET_LUT_TEMPORAL_FILTER	12357	This command gets AHC (Automatic Histogram Control) speed for the CLHE algorithm.
GET_CAMERA_TEMPERATURE	12359	This command gets camera internal temperatures.
GET_CAMERA_INFO	12361	This command gets number of startup and operating time from the camera.
SET_AUTO_NUC_REFRESH	13000	This command sets the settings used to trigger an Auto NUC shuttered calibration.
GET_AUTO_NUC_REFRESH	13001	This command reads the settings used to trigger an Auto NUC shuttered calibration.

SET_AUTO_NUC_ENABLE	13002	This message enables or disables the auto NUC triggering.
GET_AUTO_NUC_ENABLE	13003	This message gets the state of the auto NUC triggering.

Table 11: Command list

6.2.1. Message ACK

This message is used to respond to Set commands when only few data are sent back to the master or to any message to return an error.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B17	B18	B19-B20
0xFD	LEN	unused	SEQ	unused	MID	CID	VALUE	RESULT	CRC16

LEN: length of the payload, expressed in bytes; can be from 2 to 9 bytes.

MID = `MAVLINK_MSG_ID_MESSAGE_ACK` = 8192 (0x2000)

SEQ: sequence number, must be the same as corresponding command.

ACK_PAYLOAD (B10-B18) contains the corresponding command ID, an optional value and the result. Zeros terminating of the payload are removed from the sent message. In practice, it can be reduced to 2 bytes containing non-zero bytes of the command ID (all CID are greater than 256).

CID: Command ID. It contains the Message ID of the command to which this message responds.

VALUE: generally unused (filled at 0).

Result: 0 for ACK, 1 for NACK.

Unused: must be kept 0.

6.2.2. Get Serial Number

This message requests the camera serial number stored in non-volatile memory.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B15
0xFD	1	unused	SEQ	unused	MID	SERIAL_NUMBER	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_SERIALNUMBER` = 8194 (0x2002). This is a Get Command type.

PAYLOAD: used for both command and response:

- Command: empty.
- Response: SERIAL_NUMBER.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.

Unused: must be kept 0.

6.2.3. Shutter control

This message is used to control the shutter, open it and close it.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B11-B12
0xFD	1	unused	SEQ	unused	MID	COMMAND	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_SHUTTER_CONTROL` = 8206 (0x200E). This is a Set Command type.

PAYLOAD: COMMAND:

- SHUTTER_CONTROL_CMD_OPEN = 0
- SHUTTER_CONTROL_CMD_CLOSE = 1

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B10 bytes.

Unused: must be kept 0.

6.2.4. Set Mavlink Serial Speed

This command switches the Mavlink UART baudrate between all possible values. Following standard values must be available for all slave devices: 9600, 115200, 230400, 460800 and 921600. In addition, dedicated specific values can be implemented and depend on the camera model.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14	B15-B16
0xFD	5	unused	SEQ	unused	MID	BAUDRATE	PERMANENT	CRC16

0xFD is the magic number for MavLink v2.

MID = `MAVLINK_MSG_ID_SET_MAVLINK_SERIAL_SPEED` = 8217 (0x2019). This is a Set Command type.

PAYLOAD: 5 bytes.

- BAUDRATE, unit is bit/sec.
- PERMANENT: Boolean, if = 1, value is stored in non-volatile memory and used at next start-up. If = 0, new baudrate is valid until next reset only.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B14 bytes.

Unused: must be kept 0.

6.2.5. Get FPA Temperature

This command reads the Focal Plan Array Temperature from the image sensor. It returns a raw value that must be interpreted with dedicated formula.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B15
0xFD	4	unused	SEQ	unused	MID	TEMPERATURE	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_FPA_TEMPERATURE` = 8199 (0x2007). This is a Get Command type.

PAYLOAD: used for both command and response:

- Command: empty.
- Response: TEMPERATURE, raw value.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.

Unused: must be kept 0.

Formula to convert temperature from raw value to °C:

⇨ **TFPA (°C) = -188.65 × (1.5 – [((RAW_VALUE / 2^18) - 8192) / 8192] × 499 / 402) + 415.48**

6.2.6. Get Camera Protocol Version

This command is mandatory to identify the CamSight MavLink Protocol version implemented in the camera. This allows the PC to choose the right command set for next transactions.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B15
0xFD	4	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_CAMERA_PROT_VERS` = 12287 (0x2FFF). This is a Get Command type.

PAYLOAD: used for both commands and response:

- Command: Most recent Protocol version implemented by the master.
- Response: Protocol version implanted in the slave (= 1 for the version described in this document).

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.

Unused: must be kept 0.

6.2.7. Set Gamma

The Gamma parameter adjusts the contrast curve of the image in order to compensate the restitution of the final display. The nominal range for the Gamma value is between 0.5 and 2.5.

The Gamma value is encoded in 16-bit fixed point over 32-bit unsigned integer.

Example: Gamma = 0.5 → Encoded value = 0.5*65536 = 32768 (0x08000)

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B15
0xFD	4	unused	SEQ	unused	MID	GAMMA	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_SET_GAMMA` = 12290 (0x3002). This is a Set Command type.

PAYLOAD: GAMMA: uint32_t, 16-bit fixed point; Gamma value to set.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.

Unused: must be kept 0.

6.2.8. Set Contrast

The CLHE algorithm is a mix between a linear LUT and a histogram equalization. The lower the value applied to this parameter, the more linear the behavior is, and in turn, the higher the value applied to this parameter is, the more equalized the histogram will be.

This command sets the CLHE value for image processing.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B15
0xFD	4	unused	SEQ	unused	MID	CONTRAST	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_SET_CONTRAST` = 12292 (0x3004). This is a Set Command type.

PAYLOAD: CONTRAST, contrast value to set, between 0 and 30000.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.

Unused: must be kept 0.

6.2.9. NUC_REQUEST

This command processes a new NUC using the shutter. This NUC will be automatically applied to the output image at the end of the processing if everything goes well.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B14-B15
0xFD	1	unused	SEQ	unused	MID	OPTION	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_NUC_REQUEST`= 12296 (0x3008). This is a Set Command type.

PAYLOAD: OPTION:

- NUC_REQUEST_OPTION_NONE = 0
- NUC_REQUEST_OPTION_WITH_SHUTTER = 1. Manage automatically the shutter before and after the nuc processing

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B10 bytes.

Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.10. Invert Polarity

This command enables or disables the IR image polarity. Standard polarity means hot points are white and cold points are black.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B14-B15
0xFD	1	unused	SEQ	unused	MID	ENABLE	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_INVERT_POLARITY` = 12294 (0x3006). This is a Set Command type.

PAYLOAD: ENABLE, if =1, image polarity inverted; if =0, standard image polarity.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B10 bytes.

Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.11. Camera Status

This command gets parameters information from the camera (contrast, gamma, polarity)

This command reads the camera status information.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B28	B29-B30
0xFD	19	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_CAMERA_STATUS` = 12303 (0x300F). This is a Get Command type.

PAYLOAD: used for both commands and response:

- Command: empty (0x00 that are removed by library).
- Response:
  - Contrast: uint32_t, value set by 'Set Contrast' command.
  - Gamma: uint32_t, value set by 'Set Gamma' command.
  - Reserved: uint8_t.
  - Reserved: uint8_t.
  - Reserved: uint8_t.
  - Reserved: uint8_t.
  - Reserved ion: uint32_t.
  - Reserved: uint8_t.
  - Reserved: uint8_t.
  - IR polarity: uint8_t, value set by 'Invert Polarity' command.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B28 bytes.

Unused: must be kept 0.

6.2.12. Get Firmware ID

This command reads both FPGA and RISC-V firmware IDs.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13	B14-B15
0xFD	4	unused	SEQ	unused	MID	FPGA_V	RISCV_V	CRC16

0xFD is the magic number for MavLink v2.

MID = `MAVLINK_MSG_ID_GET_FIRMWARE_ID` = 12321 (0x3021). This is a Get Command type.

PAYLOAD: used for both commands and response:

- Command: empty (0x00 that is removed by library).
- Response: versions:
    - FPGA_V: (uint16_t)
        - Bit 13: (1) MIPI enable / (0) MIPI disable
        - Bit 12: (1) 9Hz Hz locked version / (0) 9/25/30/60 Hz version
        - Bits 0 to 11: FPGA firmware version. Format is hexadecimal 0x211 for 2.1.1.
    - RISCV_V : uint16_t, RISC-V firmware version.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.
Unused: must be kept 0.

6.2.13. Get Flip Horizontal

This message reads the horizontal flip state.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B11-B12
0xFD	1	unused	SEQ	unused	MID	ENABLE	CRC16

0xFD is the magic number for MavLink v2.
SEQ: sequence number, incremented at each command.
MID = `MAVLINK_MSG_ID_GET_FLIP_H` = 12322 (0x3022). This is a Get Command type.
PAYLOAD: used for both command and response:

- Command: empty.
- Response: ENABLE, =1 horizontal flip enabled; =0 horizontal flip disabled.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B10 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.14. Set Flip Horizontal

This message enables or disables the horizontal flip (rear mirror effect).

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B11-B12
0xFD	1	unused	SEQ	unused	MID	ENABLE	CRC16

0xFD is the magic number for MavLink v2.
MID = `MAVLINK_MSG_ID_SET_FLIP_H` = 12323 (0x3023). This is a Set Command type.
PAYLOAD: ENABLE, =1 to enable horizontal flip; =0 to disable horizontal flip.
CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B10 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.15. Set Frame Rate

This command sets the video output frame rate. This information is stored in non-volatile memory. It is applied immediately and at next start-up.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B15
0xFD	4	unused	SEQ	unused	MID	FRAMERATE	CRC16

0xFD is the magic number for MavLink v2.
SEQ: sequence number, incremented at each command.
MID = `MAVLINK_MSG_ID_SET_FRAMERATE` = 12330 (0x302A). This is a Set Command type.

PAYLOAD: VALUE, uint32_t, frame rate to apply, unit is frame per second.
CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.16. Get Frame Rate

This command reads the video output frame rate currently in use.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B15
0xFD	4	unused	SEQ	unused	MID	FRAMERATE	CRC16

0xFD is the magic number for MavLink v2.
SEQ: sequence number, incremented at each command.
MID = `MAVLINK_MSG_ID_GET_FRAMERATE` = 12331 (0x302B). This is a Get Command type.
PAYLOAD: used for both commands and response:

- Command: empty (0x00 that are removed by library).
- Response: uint32_t, 8-bit fixed point, sharpening value.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.17. Set Video Select

This command selects the video source to use as output for parallel and MIPI.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B11-B12
0xFD	1	unused	SEQ	unused	MID	VALUE	CRC16

0xFD is the magic number for MavLink v2.
MID = `MAVLINK_MSG_ID_SET_VIDEO_SELECT` = 12332 (0x302C). This is a Set Command type.
PAYLOAD: VALUE; can be:

- 0: RAW_OUTPUT; raw mode, 640x480, 14-bit pixels
- 1: NUC_OUTPUT; NUC mode, 640x480, 14-bit pixels
- 2: COLUMN_OUTPUT; not applicable
- 3: VIGNETTING_OUTPUT; not applicable
- 4: EDGE_OUTPUT; edge correction, 640x480, 14-bit pixels
- 5: LUT_OUTPUT; LUT correction, 640x480, 8-bit pixels. Default setting for customer usage.
- 6: RFU_OUTPUT; reserved for future use.
- 7: ZOOM_OUTPUT; not applicable
- 8: BT656_OUTPUT; BT656 format.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B10 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.18. Get Video Select

This command reads the video source currently in use as output.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B11-B12
0xFD	1	unused	SEQ	unused	MID	VALUE	CRC16

0xFD is the magic number for MavLink v2.
MID = `MAVLINK_MSG_ID_GET_VIDEO_SELECT` = 12333 (0x302D). This is a Get Command type.
PAYLOAD: used for both commands and response:

- Command: empty (0x00 that is removed by library).
- Response: VALUE; see 'Set Video Select' command description.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B10 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.19. Set Edge Parameters

This command enables or disables the video edge processing (sharpening or contouring) and sets the corresponding parameters.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B22	B23-B24
0xFD	17	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.
SEQ: sequence number, incremented at each command.
MID = `MAVLINK_MSG_ID_SET_EDGE_PARAMS` = 12334 (0x302E). This is a Set Command type.
PAYLOAD: linear description:

- MODE: uint8_t; Video edge processing mode, can be:
  - =0: disabled.
  - =1: Sharpening mode.
  - =2: Contouring mode.
- GAIN: uint32_t, 8-bit fixed point; used in sharpening mode only.
- THRESHOLD_1: uint32_t; between 0 and 255.
- THRESHOLD_2: uint32_t; between 0 and 255, must be higher than THRESHOLD_1.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B22 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.20. Get Edge Parameters

This command reads the video edge processing settings currently in use in the camera.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B22	B23-B24
0xFD	17	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.
SEQ: sequence number, incremented at each command.
MID = `MAVLINK_MSG_ID_GET_EDGE_PARAMS` = 12335 (0x302F). This is a Get Command type.
PAYLOAD: used for both commands and response:

- Command: empty (0x00 that are removed by library).
- Response: VALUE; see 'Set Edge Parameters' command description.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B22 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.21. Set colorlut

This command set the false colorlut type.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B15
0xFD	8	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_SET_COLORLUT`= 12340 (0x3034). This is a Set Command type.

PAYLOAD: linear description:

- x_ colorlut_sel: uint32_t; can be:
  - 0: GRAYSCALE (no colors)
  - 1: IRON
  - 2: HOT
  - 3: RAINBOW
  - 4: NCAR
  - 5: COOLWARM
  - 6: CUBEHELIX

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.

Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.22. Get colorlut

This command sets the colorlut type.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B15
0xFD	8	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_COLORLUT`= 12341 (0x3035). This is a Get Command type.

PAYLOAD: linear description:

PAYLOAD: used for both commands and response:

- Command: empty (0x00 that are removed by library).
- Response: VALUE; see 'Set colorlut' command description.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B13 bytes.

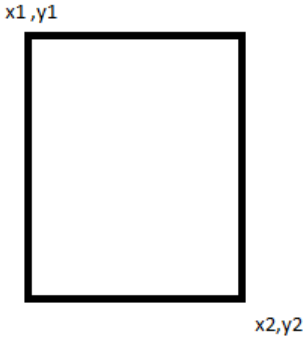
Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.23. Set ROI 0 inclusive

This command defines the Region of Interest inside current image.

The message contains 2 coordinates (x1, y1) et (x2, y2) that define the ROI rectangle as depicted in the picture below:



The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13	B14-B15	B16-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	X1	X2	Y1	Y2	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_ROI_CONTROL` = 12297 (0x3009). This is a Set Command type.

PAYLOAD: image positions defining the ROI:

- X1: X start: left limit of the ROI.
- X2: X end: right limit of the ROI.
- Y1: Y start: up limit of the ROI.
- Y2: Y end: bottom limit of the ROI.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.24. Get ROI 0 inclusive

This command reads the Region Of Interest currently in use in the camera.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13	B14-B15	B16-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	X1	X2	Y1	Y2	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_ROI` = 12315 (0x301B). This is a Get Command type.

PAYLOAD: used for both commands and response:

- Command: empty (0x00 that are removed by library).
- Response: image positions defining the ROI:
  - X1: X start: left limit of the ROI.
  - X2: X end: right limit of the ROI.
  - Y1: Y start: up limit of the ROI.
  - Y2: Y end: bottom limit of the ROI.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

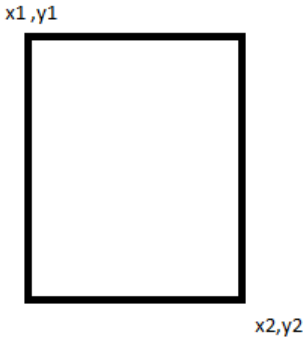
Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.25. Set ROI 1 inclusive

This command defines the optional Region of Interest 1 inside current image. It is used to include another rectangle to the ROI.

The message contains 2 coordinates (x1, y1) et (x2, y2) that define the ROI rectangle as depicted in the picture below:



The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13	B14-B15	B16-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	X1	X2	Y1	Y2	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_SET_ROI1_inclusive`= 12348 (0x303C). This is a Set Command type.

PAYLOAD: image positions defining the ROI:

- X1: X start: left limit of the ROI. Unused = 0.
- X2: X end: right limit of the ROI. Unused = 0.
- Y1: Y start: up limit of the ROI. Unused = 0.
- Y2: Y end: bottom limit of the ROI. Unused = 0.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.26. Get ROI 1 inclusive

This command reads the Region of Interest 1 currently in use in the camera.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13	B14-B15	B16-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	X1	X2	Y1	Y2	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_ROI1_inclusive` = 12349 (0x303D). This is a Get Command type.

PAYLOAD: used for both commands and response:

- Command: empty (0x00 that are removed by library).
- Response: image positions defining the ROI:
  - X1: X start: left limit of the ROI.
  - X2: X end: right limit of the ROI.
  - Y1: Y start: up limit of the ROI.
  - Y2: Y end: bottom limit of the ROI.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

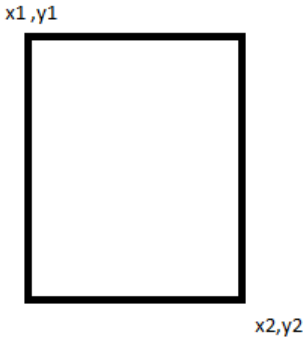
Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.27. Set ROI 0 exclusive

This command defines the optional Region of Interest 0 exclusive inside current image. It is used to exclude a rectangle from the ROI.

The message contains 2 coordinates (x1, y1) et (x2, y2) that define the ROI rectangle as depicted in the picture below:



The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13	B14-B15	B16-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	X1	X2	Y1	Y2	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_SET_ROI0_exclusive`= 12350 (0x303E). This is a Set Command type.

PAYLOAD: image positions defining the ROI:

- X1: X start: left limit of the ROI. Unused = 0.
- X2: X end: right limit of the ROI. Unused = 0.
- Y1: Y start: up limit of the ROI. Unused = 0.
- Y2: Y end: bottom limit of the ROI. Unused = 0.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.28. Get ROI 0 exclusive

This command reads the Region Of Interest 0 exclusive currently in use in the camera.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13	B14-B15	B16-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	X1	X2	Y1	Y2	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_ROI0_exclusive` = 12351 (0x303F). This is a Get Command type.

PAYLOAD: used for both commands and response:

- Command: empty (0x00 that are removed by library).
- Response: image positions defining the ROI:
  - X1: X start: left limit of the ROI.
  - X2: X end: right limit of the ROI.
  - Y1: Y start: up limit of the ROI.

- Y2: Y end: bottom limit of the ROI.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

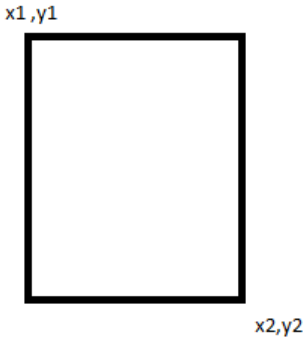
Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.29. Set ROI 1 exclusive

This command defines the optional Region of Interest 1 exclusive inside current image. It is used to exclude a rectangle from the ROI.

The message contains 2 coordinates (x1, y1) et (x2, y2) that define the ROI rectangle as depicted in the picture below:



The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13	B14-B15	B16-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	X1	X2	Y1	Y2	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_SET_ROI1_exclusive`= 12352 (0x3040). This is a Set Command type.

PAYLOAD: image positions defining the ROI:

- X1: X start: left limit of the ROI. Unused = 0.
- X2: X end: right limit of the ROI. Unused = 0.
- Y1: Y start: up limit of the ROI. Unused = 0.
- Y2: Y end: bottom limit of the ROI. Unused = 0.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.30. Get ROI 1 exclusive

This command reads the Region of Interest 1 exclusive currently in use in the camera.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13	B14-B15	B16-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	X1	X2	Y1	Y2	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_ROI0_exclusive` = 12353 (0x3041). This is a Get Command type.

PAYLOAD: used for both commands and response:

- Command: empty (0x00 that are removed by library).
- Response: image positions defining the ROI:

- X1: X start: left limit of the ROI.
- X2: X end: right limit of the ROI.
- Y1: Y start: up limit of the ROI.
- Y2: Y end: bottom limit of the ROI.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.31. Set AHC gain limitation

This command defines AHC (Automatic Histogram Control) gain limit the CLHE algorithm. It is used to limit the maximum amplification of the histogram in case of low contrast.

The message contains 2 parameters (BLACK_LIMITATION, WHITE_LIMITATION) to choose the behavior of the limitation. For example, by setting BLACK_LIMITATION = 20 and WHITE_LIMITATION = 0, the image will be limited in the dark. By setting BLACK_LIMITATION = WHITE_LIMITATION = 20 the image will be limited in gray.

The AHC will be limited to BLACK_LIMITATION^2+ WHITE_LIMITATION^2. SITF is usually around 40 DL/°C, if BLACK_LIMITATION = WHITE_LIMITATION = 10, so AHC limit will be 10^2+10^2 = 200, 200/40 = 5°C. If contrast is below 5°C, the gain will be limited.

The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B11	B12-B13
0xFD	8	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_SET_AHC_GAIN_LIMITATION` = 12354 (0x3042). This is a Set Command type.

PAYLOAD:

- BLACK_LIMITATION: from 0 to 100, limit the AHC to black.
- WHITE_LIMITATION: from 0 to 100, limit the AHC to white.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Unused: must be kept 0.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.32. Get AHC gain limitation

This command gets AHC (Automatic Histogram Control) gain limit of the CLHE algorithm.

The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B12	B13-B14
0xFD	8	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_AHC_GAIN_LIMITATION` = 12355 (0x3043). This is a Get Command type.

PAYLOAD:

- BLACK_LIMITATION: from 0 to 100, limit the AHC to black.
- WHITE_LIMITATION: from 0 to 100, limit the AHC to white.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.33. Set LUT Temporal filter

This command defines AHC (Automatic Histogram Control) speed for the CLHE algorithm. A recursive filter limits the AHC speed. alpha = $1/2^{N\_filter}$

The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B11-B12
0xFD	8	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_SET_LUT_TEMPORAL_FILTER`= 12356 (0x3044). This is a Set Command type.

PAYLOAD:

- N_Filter: from 0 to 8

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.34. Get LUT Temporal filter

This command defines AHC (Automatic Histogram Control) speed for the CLHE algorithm. A recursive filter limits the AHC speed. alpha = $1/2^{N\_filter}$

The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B11-B12
0xFD	8	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_LUT_TEMPORAL_FILTER`= 12357 (0x3045). This is a Get Command type.

PAYLOAD:

- N_Filter: from 0 to 8

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.35. Get camera temperatures

This command gets camera internal temperatures. The unit is mK (millikelvin).

The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.

SEQ: sequence number, incremented at each command.

MID = `MAVLINK_MSG_ID_GET_CAMERA_TEMPERATURE`= 12359 (0x3047). This is a Get Command type.

PAYLOAD:

- FPGA_TEMPERATURE: (uint32_t)
- SENSOR_TEMPERATURE: (uint32_t)

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.

Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.36. Get camera informations

This command gets number of startups and operating time from the camera.
The reference of these values is the picture left-up corner.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B17	B18-B19
0xFD	8	unused	SEQ	unused	MID	PAYLOAD	CRC16

0xFD is the magic number for MavLink v2.
SEQ: sequence number, incremented at each command.
MID = `MAVLINK_MSG_ID_GET_CAMERA_INFO`= 12361 (0x3049). This is a Get Command type.
PAYLOAD:

- STARTUP_NUMBER: (uint32_t). Number of camera startups
- OPERATING_TIME: (uint32_t). Minutes of operations.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.37. Set Auto NUC refresh settings

This command sets the settings used to trigger an Auto NUC shuttered calibration.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B17	B18-B21	B22-B23
0xFD	8	unused	SEQ	unused	MID	MIN	MAX	DELTA	CRC16

0xFD is the magic number for MavLink v2.
SEQ: sequence number, incremented at each command.
MID = `MAVLINK_MSG_ID_SET_AUTO_NUC_REFRESH_SETTINGS` = 13000 (0x32C8). This is a Get Command type.
PAYLOAD: Auto NUC settings

- MIN: Minimum delay between auto NUC, in ms.
- MAX: Maximum delay after which an auto NUC is triggered, in ms.
- DELTA: Temperature delta beyond which an auto NUC will be triggered, in mK.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.38. Get Auto NUC refresh settings

This command reads the settings used to trigger an Auto NUC shuttered calibration.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10-B13	B14-B17	B18-B21	B22-B23
0xFD	8	unused	SEQ	unused	MID	MIN	MAX	DELTA	CRC16

0xFD is the magic number for MavLink v2.
SEQ: sequence number, incremented at each command.
MID = `MAVLINK_MSG_ID_GET_AUTO_NUC_REFRESH_SETTINGS` = 13001 (0x32C9). This is a Get Command type.
PAYLOAD: used for both commands and response:

- Command: empty (0x00 that are removed by library).
- Response: Auto NUC settings
    - MIN: Minimum delay between auto NUC, in ms.
    - MAX: Maximum delay after which an auto NUC is triggered, in ms.
    - DELTA: Temperature delta beyond which an auto NUC will be triggered, in mK.

CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B17 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.39. Set Auto NUC enable

This message enables or disables the auto NUC triggering.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B11-B12
0xFD	1	unused	SEQ	unused	MID	ENABLE	CRC16

0xFD is the magic number for MavLink v2.
MID = `MAVLINK_MSG_ID_SET_AUTO_NUC_ENABLE` = 13002 (0x30C9). This is a Set Command type.
PAYLOAD: ENABLE, =1 to enable auto NUC; =0 to disable auto NUC.
CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B10 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

6.2.40. Get Auto NUC enable

This message gets the state of the auto NUC triggering.

B0	B1	B2-B3	B4	B5-B6	B7-B9	B10	B11-B12
0xFD	1	unused	SEQ	unused	MID	ENABLE	CRC16

0xFD is the magic number for MavLink v2.
MID = `MAVLINK_MSG_ID_GET_AUTO_NUC_ENABLE` = 13003 (0x30CA). This is a Get Command type.
PAYLOAD: ENABLE, =1 auto NUC enabled; =0 auto NUC disabled.
CRC16: 16-bit CRC (MCRF4XX) computed over B1 to B10 bytes.
Unused: must be kept 0.
Note: if the camera doesn't implement this command, it responds with NACK packet.

7. ADDITIONAL SOFTWARE

7.1. Compagnon Software

CamSight LT cameras are supplied with a companion software tool to set the camera parameters in factory.

See AD002 for full documentation.

7.2. Updater Software

CamSight LT cameras are supplied with an updater tool to download new firmware or update the existing camera firmware.

See AD002 for full documentation.

8. INTEGRATION GUIDELINES

The CamSight LT shall be integrated in accordance with the requirements described in this document.

The integrator shall ensure that the final equipment provides the appropriate level of protection against electrical, mechanical, environmental and electromagnetic hazards.

Failure to comply with the integration requirements described herein may affect performance, safety and regulatory compliance.

8.1. Electrostatic Discharge (ESD) precaution

In order to ensure the safe and reliable operation of the module, it is imperative that it be handled with Electrostatic Discharge (ESD) care. Electrostatic discharge can potentially damage sensitive electronic components and circuits within the module, leading to malfunctions or permanent impairment of its functionality. To mitigate this risk, it is essential to implement ESD-safe handling procedures, including the use of grounded wrist straps, antistatic mats, and ESD-safe tools, as well as working in ESD-protected environments. By adhering to these precautions, the integrity of the electronic module can be preserved, ensuring its optimal performance and longevity.

8.2. Precaution regarding dust on the sensor

Precautions regarding dust on the sensor are important to ensure high-quality image capture. Dust particles can accumulate on the sensor and cause visible spots on captured images. To prevent this, it is recommended to keep the camera lens clean and to store the camera in a protective case.

It's important to note that on ATTO640 sensors, the distance between pixels and the sensor window is shorter than on PICO640 sensors. Because of this, it's especially important to take precautions to minimize dust buildup on the sensor when using ATTO640 sensors.

Do not unmount the lens out of dust free clean room.

8.3. Precaution regarding direct sun view

Direct exposure to sunlight may cause temporary marks on the camera sensor. It is therefore recommended to avoid pointing the camera directly at the sun whenever possible. If such marks appear, they typically fade over time; however, the recovery process may take several hours, and in the case of more significant marks, even several days. During storage, the camera should be kept away from direct sunlight to prevent any risk of sensor marking.

Figure 24: Pictures of the temporary marks caused by an excessive pointing to the sun

9. ENVIRONMENTAL PROPERTIES

As mentioned previously, the CamSight camera is an OEM product intended to be integrated into a higher-level system by the customer. It is delivered as a pre-compliant module, meaning that although it has been designed and tested following key environmental and EMC guidelines, the final responsibility for full certification lies with the system integrator once the camera is embedded in its operational platform.

9.1. Climatic

Pre-compliance AECTP300 ed3

- Climatic conditions: the camera can operate in the following conditions:
- Storage temperature: -40°C to + 85°C
- Operating temperature: -40°C to + 70°C
- Humidity: up to 95% (non-condensing)

9.2. Shock & Vibration

Pre-compliance AECTP400 ed3 (Compliant with Casing version).

- Shock : Amplitude 30g RMS / Duration 18ms on 3 axis
- Vibration: 4.3g RMS 10-500Hz on 3 axis

9.3. EMC

Standards Tests Results:

- Pre-compliance to AECTP500 ed. E Ground army
    - Conducted Susceptibility
        - NCS02 control and signals, 20Hz-50 kHz Radiated Susceptibility
        - NCS07 BCI
        - NCS08 BCI Impulse excitation
        - NCS09 Damped sinusoidal transients
    - Radiated Susceptibility
        - NRS01 magnetic field, 30 Hz – 100 KHz
        - NRS02 electrical field of 50 kHz to 3 GHz.
    - Radiated Emissions
        - NRE01 Magnetic field 30Hz to 100 KHz.
        - NRE02 Electric field, 10 kHz to 3 GHz.
    - Conducted Emissions
        - NCE02 10kHz-10 MHz
        - NCE04 transient measurement.
        - NCE05 30Hz-150 MHz

10. REGULATORY COMPLIANCE AND INTEGRATION RESPONSIBILITY

The CamSight LT has been designed in accordance with applicable regulatory requirements relevant to the module level.

The product complies with:

- Directive 2014/30/EU (Electromagnetic Compatibility), when integrated according to the recommendations provided in this document;
- Directive 2011/65/EU and Directive (EU) 2015/863 (RoHS);
- Regulation (EC) No 1907/2006 (REACH).

As an OEM module, the CamSight LT is intended solely for integration into a final product.

Compliance of the final equipment with applicable legislation, including but not limited to Regulation (EU) 2023/1230, EMC Directive 2014/30/EU, Low Voltage Directive 2014/35/EU, Radio Equipment Directive 2014/53/EU or any other applicable legislation remains the responsibility of the manufacturer placing the final product on the market.

Any modification of the product or any use outside the conditions described in this ICD shall be assessed by the integrator for its potential impact on safety, performance and regulatory compliance.

10.1. EU Declaration of Conformity

The EU Declaration of Conformity applicable to the CamSight LT module is available as a separate controlled document.

The Declaration of Conformity applies exclusively to the camera module and shall not be interpreted as a declaration covering the final equipment integrating the product.

The manufacturer of the final equipment remains responsible for the conformity assessment of the complete system.