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micROM
Integration Instructions

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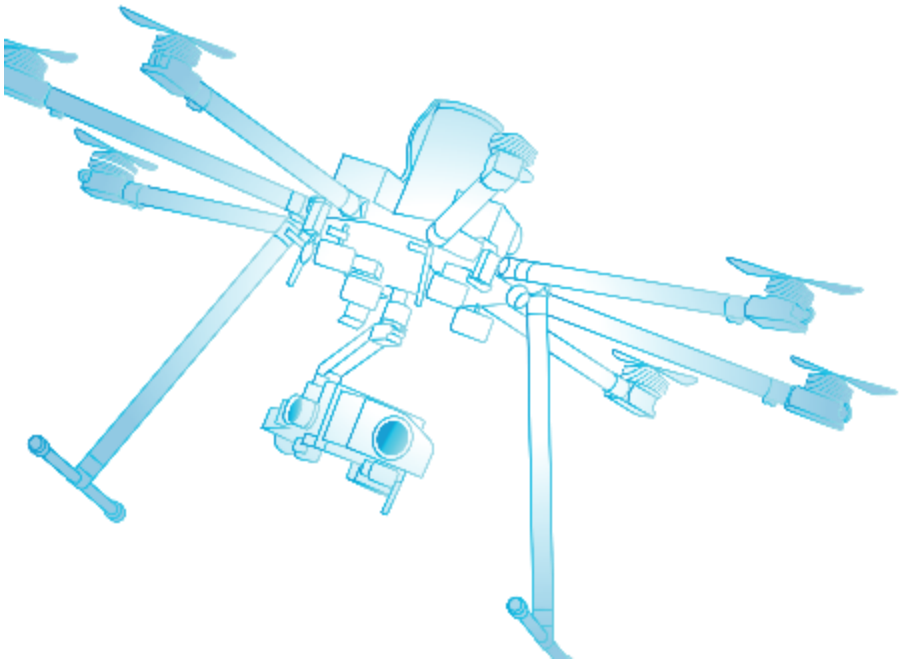


Contents

1. General Information

This document details the information needed for the integration of OFIL's micROM camera on a drone.

2. micROM Key Functions

2.1 Video Recording

Record video to the camera's SD card.
While the video is being recorded, the recording time will appear in the top icon bar and a full red circle will appear to the left of the recording time indication.
This indication is sent from the camera with the streamed video.

2.2 Still Image Recording (Snapshot)

Record snapshots to the camera's SD card.
While the image is being recorded, a full yellow circle will appear in the top icon bar.
This full yellow circle will be blinking for 3 seconds and then disappear.

This indication is sent from the camera with the streamed video.

2.3 Gain

The user can select any value within the range of 0-255, step: ±1.

While the camera is working (scanning or recording), the current gain value will appear at the bottom indication bar.
This indication is sent from the camera with the streamed video.

2.4 Zoom

The camera zooms in and out. When the camera zooms in, the UV and Visible zooms are synchronized in the zoom range 0-12. Visible zoom only, can continue in the range 13-14.

The user can select any value within the range of 0-15, step: ±1.

The camera does not send an indication that zoom is active. It is recommended to add such indication in the integration process.

2.5 UV color

The UV signal can be presented in one of 8 different colors: red, orange, yellow, green, light-blue, blue, purple, pink (and their transparent variant). Default color: opaque red.
There is an indication of the color in the top icon bar that is send from the camera with the streamed video.

2.6 Display Mode

The camera has 3 display modes: Combined View, UV Only, Visible Only.
The user should be able to select one of these 3 modes.
The default value is 'Combined View'.
The icon for the current display mode should be displayed in the top icon bar. When the camera is in Combined View or UV Only modes, it also shows the selected UV color:
Combined view:

UV Only:

Visible Only:

This indication is sent by the camera with the streamed video.

2.7 Count

Counting provides a qualitative indication of the corona strength. Counting is affected by factors such as distance, angles, ambient condition, voltage fluctuations and should be referenced to these factors.

Count window determines the effective area for counting UV events. There are 4 count window modes: No count frame, large count frame, medium count frame, small Count frame.

The feature is available when the camera is in the UV Only or Combined View modes. When the camera is in Vis Only mode or when Visible Zoom is activated, the Count function is inactive.

The count result (per second) is presented on the screen in the bottom bar:
This indication is sent by the camera with the streamed video.

2.8 Date & Time setting

The user can set the date and time, using the camera's commands.

2.9 Long Integration

Long integration is a means to enhance corona discharge visibility and a tool to eliminate noise. Long integration means joining 1-15 consecutive frames of the UV camera. As a result, repeating signals will become conspicuous while sporadic signals will remain small.
The letters LI will appear in the top indication bar.

3. Technical Specifications

3.1 Power

Camera: 7V-28V DC, 12 Watts

Power source: drone or battery

3.2 Control

Control of the camera is possible through the following options:

- MFIO-PWM using 6 ports on the camera.
- OFIL commands protocol using RS232 - Serial connection should be configured to 115200 bps 8-N-1, with no flow control.
- OFIL commands protocol using RJ45 - UDP connection can be reached by sending the messages to port 4526. Returned messages will be received on port 4527.

See part 4 for more details.

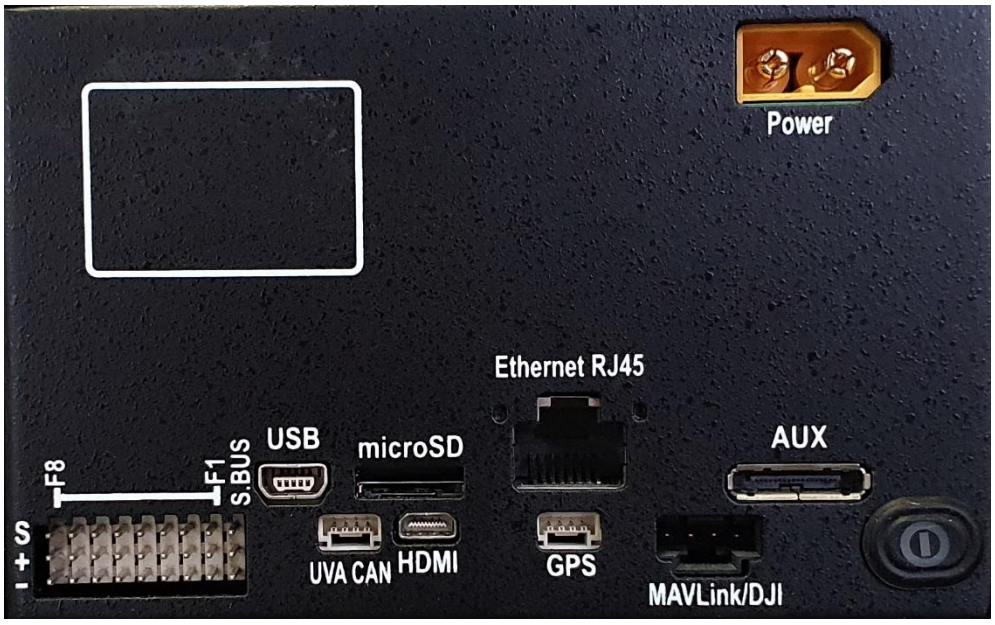
3.3 Video Output

Live video stream from the camera is possible through the following options:

- HDMI through micro-HDMI connector
- RTSP Video stream through Ethernet RJ45 connector

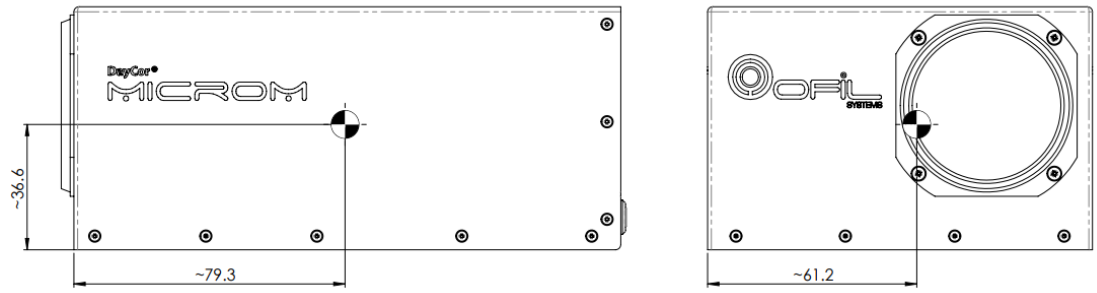
See part 4 for more details.

3.4 Connector panel

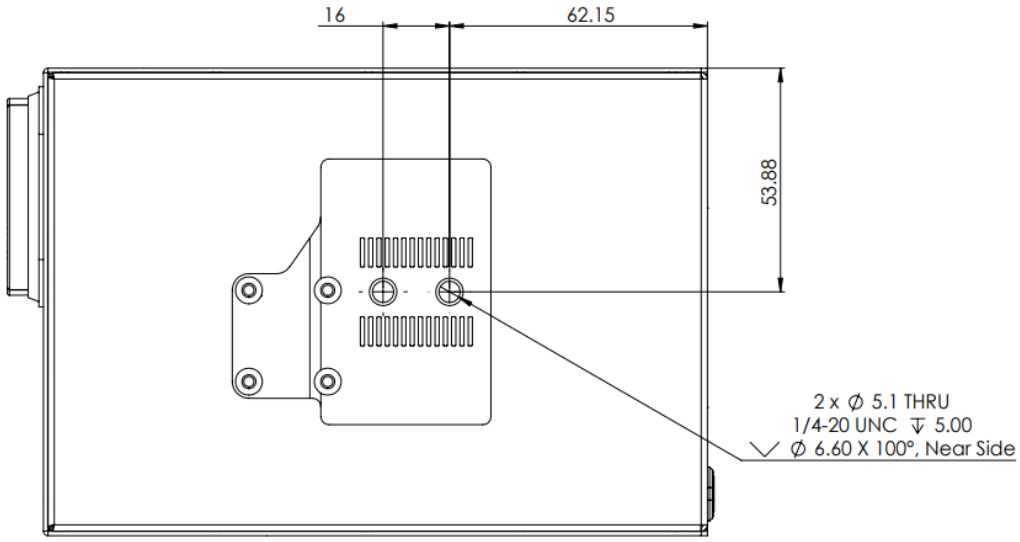


3.5 Physical Dimensions

- External dimensions: L156 x W112 x H71mm
- Weight: 875g
- Center of Gravity location diagram:



- Mounting plate dimensions diagram:



4. Communication Protocols & Interfaces

4.1 MFIO-PWM

The MFIO-PWM is a set of ports that connects the micROM to a compatible remote control. Each port controls a single camera function.

The PWM signal is a 400KHz signal.

There are a total of 7 ports as detailed below:

Port 1: **Snapshot** - to take still images.

- Frequency: 10-2000µs
- Default: 0µs
- Positions: 2 positions

Port 2: **UV Gain** – to control the camera's UV gain (sensitivity). Range: 0-255. Step size: 1.

- Frequency: 0-2500µs
- Default: 1300µs
- Positions: 250 positions

Port 3: **Zoom** – to control the camera's zoom. Range: 0-15. Step size: 1.

Range 0-12 is synchronized zoom (UV & Visible channels together), range 13-15 is visible only zoom (no UV).

- Frequency: 10-2500µs
- Default: 0µs
- Positions: 16 positions

Port 4: **Count** – to displays the number of corona events per minute in a specific area within the FOV. There are 3 possible area sizes that are represented by frames.
Default: no count window.
Effective only while in the Combined UV-Visible mode.

- Frequency: 10-2500µs
- Default: 0µs
- Positions: 4 positions

Port 5: **UV Corona color** – to modify the corona color. There are 16 optional colors: 8 opaque and 8 transparent. The colors are: Red, Orange, Yellow, Green, Light-blue, Blue, Purple, Pink (and their transparent variants). Default color: opaque Red.
Effective only while in the Combined UV-Visible mode.

- Frequency: 10-2500µs
- Default: 0µs
- Positions: 16 positions

Port 6: **Display Mode** – to toggle between UV only / Visible Only / Combined UV-Visible mode.

- Frequency: 833-2500µs
- Default: 2500µs
- Positions: 3 positions

Port 7: **Record video** – to record video clips.

- Frequency: 10-2000µs
- Default: 0µs
- Positions: 2 positions

To enable PWM control the camera's SD card must contain a .json file with the following structure of commands:

```
{
"RTSP": "N",
"gpios":
[
      {
            "PortNumber": 0,
            "Type": "GPI",
            "Edge": "none",
            "Function": "none"
      },
      {
            "PortNumber": 1,
            "Type": "GPI",
            "Edge": "none",
            "Function": "none"
      },
      {
            "PortNumber": 2,
            "Type": "PWMI",
            "Edge": "none",
            "Function": "picture"
      },
]
}
```

- The "Type" should be defined as "PWMI" when used, or as "GPI" when not used
- The "Edge" should be defined as "none"
- The "Function" should be defined to whatever function is used. The list includes:
  - picture
  - video
  - displaymode
  - zoom
  - count
  - gain
  - uvcolor
  - "none" when no function is to be performed

- For DJI M600: The "PortNumber" corresponds to the Fx number of the MFIO port plus 1, for example:
  F1 would be defined as "PortNumber" : 2
  F5 would be defined as "PortNumber" : 6

  "PortNumber" 0 and 1 is not found on the MFIO port

4.2 Camera Control Commands (OFIL protocol) and Video streaming

4.2.1 Video streaming

The camera sends RTSP video stream by Ethernet.

The way to view it is by common video players (VLC player, Windows media player, etc.) The stream format is: RTSP://192.168.0.168:9079/vis (where's the IP address is corresponding to the camera's IP in the network)

The other common usages of the stream are to record the data to the file / to capture the single frame / to make RT or post analyses of the data.

To enable RTSP streaming the camera's SD card must contain a .json file with the following command:

```
{
        "RTSP": "Y",
}
```

4.2.2 Ofil Protocol

1. Commands can be sent to the camera via RS232 or RJ45 connectors

   RS232
   Serial connection should be configured to 115200 bps 8-N-1, with no flow control.

   RJ45
   UDP connection can be reached by sending the messages to port 4526. Returned messages will be received on port 4527.

   All messages should include a direction sign:
   "IC_" messages from the remote control to the camera.
   "CI_" messages from the camera to the remote control.

2. Commands use suffixes: "S" or "Q" or "R" as follows:

   "S" = "set", "Q" = "query" and "R" = "reply".
   For example: Gain Value command (GA)
   GA**S**xxx (no spaces aloud) - set gain value to xxx
   GA**Q** - what is the current gain value
   GA**Rxxx** – camera response

3. All commands are case sensitive.

4. Command value(s) should be entered directly after the command name. For example, the command to set the gain value to 100 will be: **GAS100**.
   If more than one variable is required for the command, add a space between the values.

5. To initiate connection with the camera, remote-control (or integrated control unit) sends the command "IC*ALVS*". The camera responds with "CI*ALVR*". Once connection is established the camera keeps sending *every 10 seconds* the command "CI*ALVS"* waiting for the remote-control unit to respond with *"*IC*ALVR"*. If the remote-control unit fails to reply to 3 times in a raw, the connection will be terminated and a new registration process is required to re-connect.

Available commands:

Command	Alias	Parameters	Reply
Gain	GA	[0…255]	[0…255]
Gain sets the UV sensitivity. Default value=130; The higher the gain, the bigger the corona blobs. To pinpoint a source, reduce gain. Example: GA80 will set the gain to value 80; GAQ is a query to the camera "what is the current gain"			
Storage	SA		
Store internal values. Query command not accepted.			
Date & Time	DAT	YYYY MM DD hh mm ss	YYYY MM DD hh mm ss
Set date and time of camera.			
Auto focus	AF	1, 0	1, 0
Enable / disable auto focus function; 1 → enable, 0 → disable. Default value: auto.			
Auto exposure	AE	[0…22]	[0…22]
0 → enable auto exposure; 1 → 1/1, 2 → 1/2, 3 → 1/3, 4 → 1/6, 5 → 1/12, 6 → 1/25, 7 → 1/50, 8 → 1/75, 9 → 1/100, 10 → 1/120, 11 → 1/150, 12 → 1/215, 13 → 1/300, 14 → 1/425, 15 → 1/600, 16 → 1/1000, 17 → 1/1250, 18 → 1/1750, 19 → 1/2500, 20 → 1/3500, 21 → 1/6000, 22 → 1/10000			
Video and picture	K	v, p	
Perform and action: v → record video, p → take picture.			
Restart	RST		
Restart the camera; Query command not accepted.			
Power up	PUP		
Power up the camera; Query command not accepted.			
"Alive" and updates	ALV		
This command announces to the camera that an external interface needs continuous updates (updates include values that have recently been changed, count, etc.- the interface should use the relevant commands to register the updates required). The interface should send an ALVS command, to register for updates. The camera will respond with an ALVR command and start sending ALVQ command every few seconds. The interface should reply with ALVR. Once 3 ALVQ queries have not been answered, the camera will stop sending updates to this interface.			
Count window size	CNW	[0…3]	[0…3]
Set the count window size. 0 → disable counting, values above 0 set the size for the count window and will be followed with the replay CNVR {count value} if ALV command has been initiated.			

Command	Alias	Parameters	Reply
Count value	CNV		{value}
Count value; Only query command is accepted.			
Default values	DV		
Set default values in the camera; Query command not accepted.			
Turn off	PD	0, 1	
Turn camera off; 0 → power down requires user active confirmation, 1 → camera shutdown will start without user interaction; Query command not accepted.			
Software version	VERS		{value}
Returns the version of the software; Only query command is accepted.			
DC presence	DCP		1, 0
Check if the camera is connected to external power; 0 → camera not connected to power, 1 → camera is connected to power; Only query command is accepted.			
DC level	DCL		{value}
Check the DC level connected to the camera; The reply is the DC voltage that is connected to the camera; Only query command is accepted.			
TRH data	TRV		{value}
TRH data value sent from the camera; Only query command is accepted.			
Gain max value	QMGA		
The command returns the maximum value possible for Gain, as configured during production; Only query command is accepted.			
SD card size	QMSD		{value}
SD card size; Only query command is accepted.			
SD card used space	SD		{value}
SD card used space; Only query command is accepted.			
SD card presence	SDP		1, 0
SD card presence; 0 → SD card not present, 1 → SD card present; Only query command is accepted.			
Gyro enable	GR	1, 0	1, 0
Gyro enable command; 1 → enable, 0 → disable; The GRV (Gyro Value) command will follow with the reply GRVR {gyro coordinates value} if ALV command has been initiated.			
Gyro value	GRV		{x y z}
Gyro value command; Only query command is accepted.			
TRH enable	TRD	1, 0	1, 0
TRH enable command; 1 → enable, 0 → disable; The TRH, TEM and HUM commands will follow if ALV command has been initiated.			
TRH Status	TRHS		
TRH status; The TEM and HUM commands will follow every few seconds if ALV command has been initiated.			
Temperature value	TEM		{value}
Temperature value, as measured by the TRH sensor; Only query command is accepted.			
Humidity value	HUM		{value}
Humidity value, as measured by the TRH sensor; Only query command is accepted.			
GPS Status	GPSS		1, 0
GPS status indication: 1 → GPS locked, 0 → no GPS signal; Only query command is accepted;			

Command	Alias	Parameters	Reply
GPS Value	GPSV		{value}
GPS value; Only query command is accepted;			
Network I/F setup	NETI	{if, Type, IP, mask, gateway}	{if, Type, IP, mask, gateway}
Network interface setup command; Interface name (if): ETH0 or USB0; The type can be MANUAL, STATIC, DHCP or CLIENT			
Network I/F address	NETA		{if, IP, mask, gateway}
Interface name (if): ETH0 or USB0; Only query command is accepted;			
Recovery boot mode	RBM	{value}	{value}
Recovery boot mode set; 1 → enable boot mode, 0 → disable boot mode;			
RTSP address	STR		{value}
Get video RTSP streaming address; Only query command is accepted;			
Mass storage device	CMSD		1, 0
1 → the camera will be presented as a drive on the computer connected to it through USB; video / picture taking is disabled; 0 → → the camera will not be presented as a drive on the computer connected to it through USB; video / picture taking is enabled;			
UV color	UVC	[0…15]	[0…15]
UV color command. Values 0-7 set s solid color, values 8-15 set transparent color. 0 = solid red, 1 = solid orange, 2 = solid yellow, 3 = solid green, 4 = solid light blue, 5 = solid blue, 6 = solid purple, 7 = solid pink, 8 = transparent red, 9 = transparent orange, 10 = transparent yellow, 11 = transparent green, 12 = transparent light blue, 13 = transparent blue, 14 = transparent purple, 15 = transparent pink			
Display Mode	DMODE	[1…3]	[1…3]
Display mode command; 1 → Visible only, 2 → UV only, 3 → Combined.			
Long Integration (LI)	LIE	1, 0	1, 0
Long Integration enable command; 1 → enable, 0 → disable.			
LI Frame number	LIF	[2…15]	[2…15]
Long Integration number of frames command.			
Manual zoom max	QMMZ		{value}
Manual zoom maximum command; Only query command is accepted;			
Manual zoom setup	MZ	{value}	{value}
Manual zoom command; use this command to setup zoom value (up to the maximum value that can be read from the camera with the QMMZ command).			
Manual focus max	QMMF		{value}
Manual focus maximum command; Only query command is accepted;			
Manual focus setup	MF	{value}	{value}
Manual focus command; use this command to setup focus value (up to the maximum value that can be read from the camera with the QMMF command).			
Video recording start	VLST		
Video recording start command.			
Video recording stop	VLSP		
Video recording stop command.			
Video capture status	VCND		1, 0

Command	Alias	Parameters	Reply
Video capture status command; 0 → video is being recorded, 1 → video is not being recorded. Only query command is accepted.			
Take picture	PLST		
Take picture command			
Picture taking completed	PLSP		
Take picture command is completed.			
USB presence	USBP		1, 0
USB presence command; 1 → USB is present, 0 → USB is not present; Only query command is accepted;			
Camera feature	CF	{name, feature}	{name, feature}
Camera feature command. The '*name*' can be one of two possible values: 53 → camera white balance, 99 → picture effects; Feature options: - For the white balance option (53): 0 → normal auto, 1 → indoor, 2 → outdoor, 3 → one push white balance mode, 4 → auto tracking white balance, 5 → manual control mode, 6 → outdoor auto, 7 → auto including sodium lamp source, 8 → sodium lamp source fix mode; - For the picture effect option (99): 0 → off (no effect), 2 → negative art, 4 → black & white picture;			
Sleep mode	SLPM	{value} [0…60]	{value} [0…60]
Sleep mode command. Value is in minutes. Default = 0 → sleep mode disabled.			
Magnetometer value	MAV		{x y z}
Magnetometer value command; Only query command is accepted.			
Accelerometer value	ACV		{x y z}
Accelerometer value command; Only query command is accepted.			
Compilation date	CMPD		{date}
Compilation date; Only query command is accepted.			
Playback indication	PB	{value}	{value}
Playback indication command			
Reset to factory setting	FSR		
Reset to factory default setting values; Query command not accepted.			
Hang-up	HNGUP		
Remote hang-up command. Query command not accepted.			
Reboot	REBOOT		
Reboot message command; Query command not accepted.			
Rotate video	RF	1, 0	1, 0
Rotate video output, not including the GUI. Default = 0 → do not rotate video, 1 → rotate video.			