FIRST LIGHT
ADVANCED IMAGERY

C-RED 2 & C-RED 2 ER

Quick Start Manual

C-RED 2 – C-RED 2 ER Quick Start_20230622

Thank you for choosing a C-RED camera!

C-RED 2 and C-RED 2 ER features and performances are described in detail within their respective User Manual, that you can find on your USB key or on your First Light Library: https://www.first-light-imaging.com/my-library/
Please contact our support for any question at: support@first-light.fr

1. WARNINGS

Your camera contains fragile components, handle it with care.

Do not open the camera, your warranty will be void.

Always use the supplied power unit.

Always follow the instructions of use.

2. SYMBOLS AND INDICATIONS

Please read this Quick Start guide and the following definitions carefully to understand the potential dangers and the precautions to take.
Please refer to the User Manual if a WARNING symbol is marked on the camera.

CE	The CE marking indicates the conformity of the camera to the European legislation.
⎓	This pictogram indicates a direct current operation.
	This pictogram invites the user to refer to the instructions / user manual.
	This pictogram refers to indoor use.
	This pictogram refers to Protection class category 1.
RoHS	This pictogram indicates that the product is compliant with the RoHS limitation.

3. DISPOSAL

In case of disposal, do not throw your camera in waste disposal and send it back to First Light Imaging

4. WARNINGS

4.1. General warnings

The equipment must be plugged on an electrical wiring compliant with the relevant standards in the country (in France: NFC 15-100). This wiring must be protected from overcurrent, overvoltage and ground defaults.

Equipments connected must be compliant with the EN 60950-1 Ed.2006 standard, or to their own standards.

The power cable plug serves as a disconnection device and should be easily accessible.

Do not place the equipment close to a heating source or a humidity source.
Do not close the ventilation system to avoid any overheating.

The security of the system which integrates the equipment is the responsibility of the system assembler only.

For your safety, the equipment must be TURNED OFF AND UNPLUGGED before any technical intervention.

The security provided with this equipment is only guaranteed with a use in accordance with the specified purpose. Only use the provided (XPPower, model AJM90PS12) power supply.

The use of a Polymer Lithium battery involves fire hazard which can seriously harm goods and persons. The user fully agrees to accept the risks and responsibility.
The manufacturer and the distributor cannot be held responsible for any damage to goods and persons as they cannot control the proper use of the battery (charge, discharge, storage).

IMPORTANT NOTE: For Switzerland: the annex 4.10 of the SR 814.013 standard is applicable to batteries.

5. TECHNICAL AND OPERATIONAL SPECIFICATIONS

Power requirements	Voltage	100 – 240 VAC
	Frequency	50 – 60 Hz
	Current	1.5 A – 0.6A
Dimensions	Length	143 mm
	Width	74.91 mm
	Height	55 mm
Operation conditions (non-condensing condition)	Maximum temperature (case)	55°C
	Minimum temperature	-5°C
	Humidity	0% to 80 %*
Storage conditions	Maximum temperature	50°C
	Minimum temperature	-40°C
Cooling Fluid Temperature	Maximum cooling fluid T°	35°C
	Minimum cooling fluid T°	Dew point of the room (recommended)
Pressure	Absolute pressure	500 mbar** to 2 bar

** If the camera uses liquid cooling, be careful to the dew point.*
*** First Light Imaging recommends using liquid cooling for pressure lower than 1 bar.*

Dew point: Please use the cooling fluid at a temperature above the dew point. If the dew point is unknown, use a cooling fluid at a temperature which is not below the room temperature.

6. CONTENTS OF PACKAGE*

6.1.C-RED 2 / C-RED 2 ER Camera Pack

Item name	Quantity	Picture
Camera	1	
Power supply	1	
Power cable	1	
USB-C to USB-A cable	1	
Quick coupling set	2	
USB key with User manual + Demo software + Test report	1	
Quick start Manual	1	

6.2.Accessories

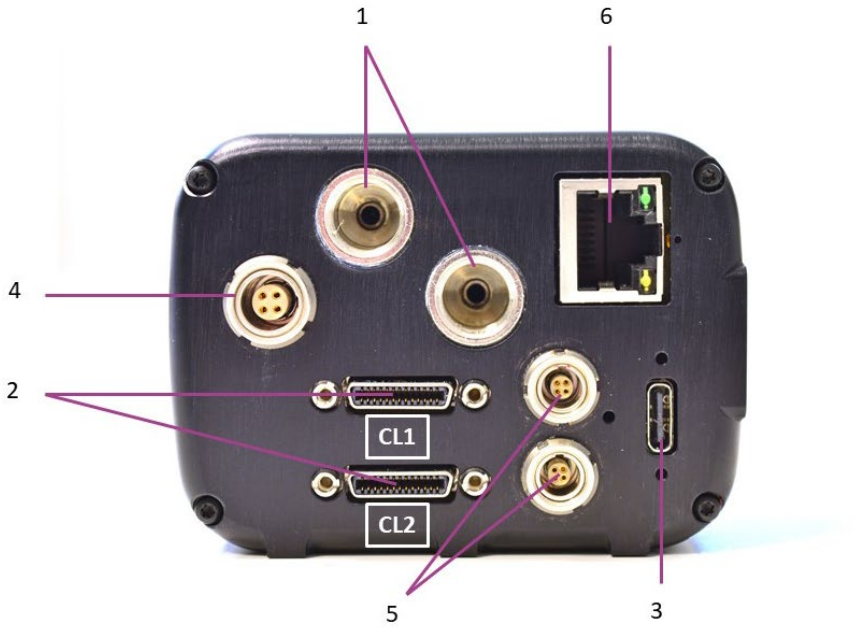
Please note that accessories can be ordered separately. Please contact your sales representative for details and pricing of our different accessory packs.

Item name	Quantity	Picture
M6 Adapter with 1 kit x screws	1	
LEMO male connectors for synchronization	2	
Industrial USB cable (2, 3 or 5m length)	1	

** Items may differ from pictures.*

7. CAMERA DESCRIPTION AND START UP

Please refer to the following figure and follow the order listed below, before connecting your camera:



1. Cooling
2. Camera Link ports
3. USB-C port
4. Power port
5. LEMO synchro port
6. Ethernet port

7.1. Cooling (1)

The camera can be air cooled or liquid cooled (no liquid nitrogen).
By default, the camera activates its fan.

Air cooling allows to cool the detector down to nominal -15°C with a maximum room temperature of 35°C.
Air cooling is ensured by the fan, and the fan speed can be controlled in automatic mode or manual mode.

With the following conditions liquid cooling (1) allows to cool the detector down to nominal -40°C (for C-RED 2 and C-RED 2 ER 1.9µm) or – 55°C (for C-RED 2 ER 2.2µm).
Water cooling with water at 35°C requires the fan to run a little bit, even at minimum speed.

Cooling System Parameters	Value
Flow rate	⩾ 0.5 L/min
Pressure	10 bar max
Liquid Temperature	35°C max
Approved Fluids	Ethylen Glycol aqueous solution (Max concentration: 50%) Distilled water or deionized water (Min temperature 10°C)
Cooling capacity	100 W minimum

Heat is evacuated by circulating a cooling fluid through two ports (G1/8 thread). To fasten your connectors, First Light Imaging recommends using Loctite 577 thread sealant.
The cooling hoses can be fastened in any order.

⚠ *When connecting the cooling unit, please make sure that there is no water spraying on the connectors or the camera*

⚠ *After turning on the cooling unit, please check that no leaks are visible.*

⚠ *First Light Imaging recommends turning on the cooling BEFORE turning on the camera.*

7.1.1. Setting up the Quick coupling set

Installing the Hydraulic Quick coupling set must be done very carefully to avoid damaging the insert at the back of the camera. To do so, we recommend using a torque screwdriver. Using a 13 mm square drive socket, a maximum tightening torque of 2.5 N.m must be applied. The pictures below illustrate how to properly install the Hydraulic Quick coupling set with a torque screwdriver.

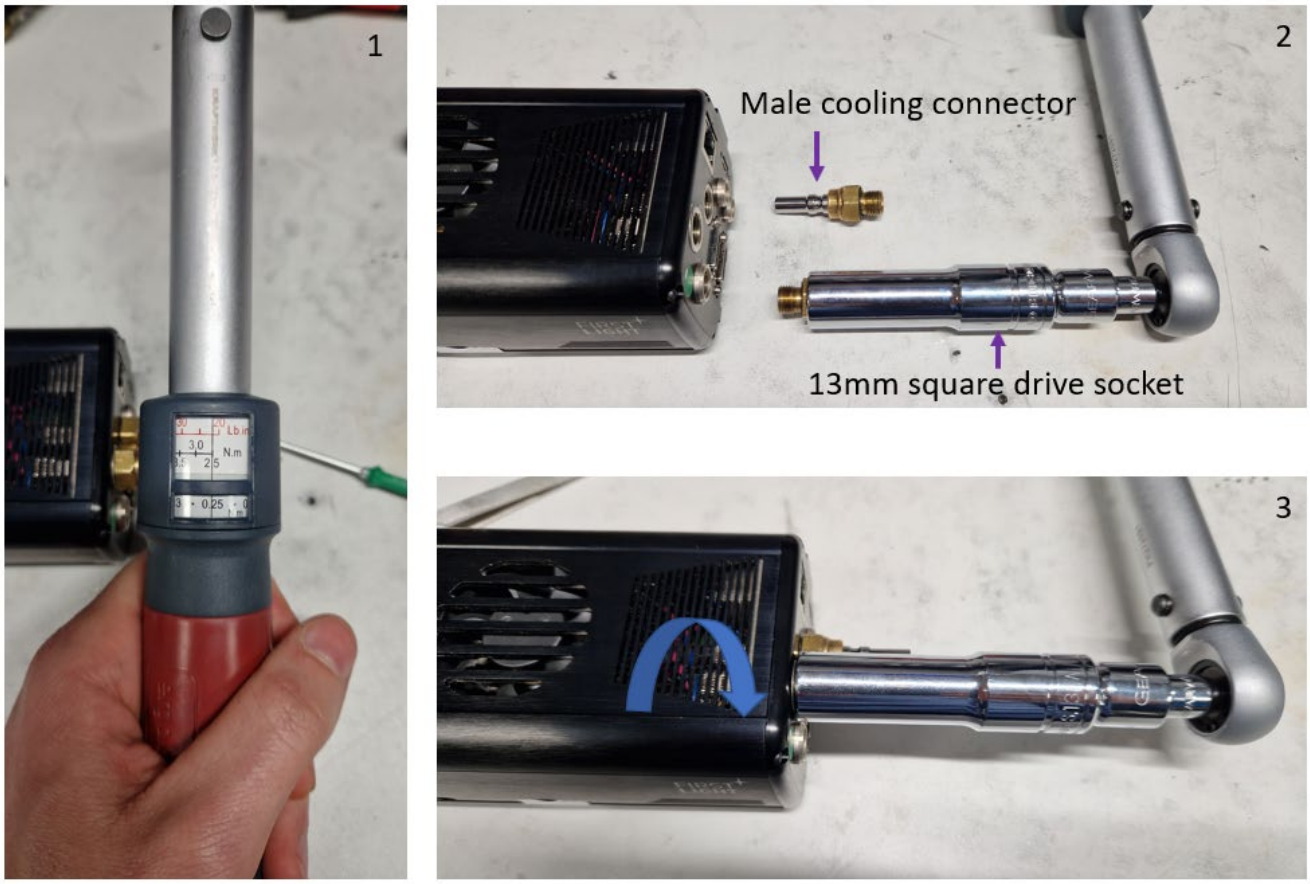


Fig. 1 : *Using a 2.5 N.m torque screwdriver (1), screw the 2 male coupling connectors (2,3).*

Make sure the male Hydraulic Quick coupling connector is properly installed by checking that the sealing ring is adequately squeezed, as illustrated in the pictures below.

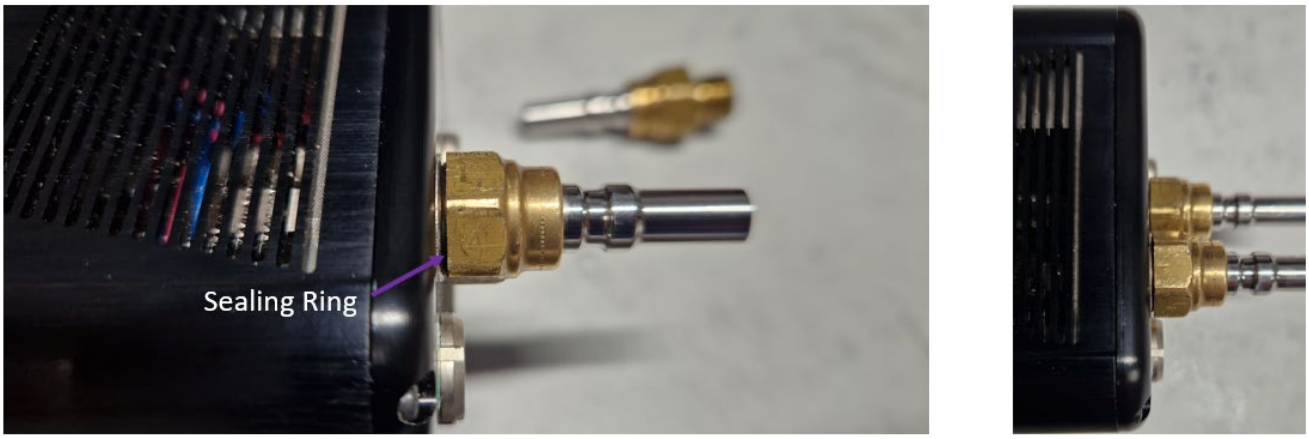


Fig. 2 : *Picture of male connector properly installed. Sealing ring (black) is squeezed between the connector and the camera's rear plate*

Make sure that there are no fluid leaks between the connectors and the G1/8 thread.

7.2. Data connection

The camera can operate either with Camera Link® or USB-3.1 Gen 1.

7.2.1. Camera Link® connection (2)

The camera is compliant with Camera Link® Full and requires two data cables with male SDR-26 Mini Camera Link® connectors.

The Camera Link® plugs are numbered: CL1 is on top, CL2 is below.

The Camera Link® connectors can be plugged and fastened in any order but reversing the order will prevent camera operation. The Camera Link® connections can be plugged or unplugged either if the camera is ON or OFF.

Please install the demo software for the acquisition board which is provided on the USB key.

Please note that our cameras have been developed and tested with specific grabbers that we highly recommend using. Please refer to the demo software manual.
List of tested recommended grabbers:

- MATROX Radient eV-cl full (drivers available for linux and windows)
- DALSA/TELEDYNE X64 Xcelera-CL (drivers available for windows only)
- EDT visionLink F4 (drivers available for linux and windows) (NEW)

7.2.2. USB connection (3)

The camera only supports USB-3.1 Gen 1 connection. The USB-3 interface requires a standard USB-C connector.

To use the camera USB connection, please use a windows 10 OS.

Also before using USB-3.1 Gen 1 connection, the camera's USB-3.1 Gen 1 drivers must be installed on the PC. Please refer to the demo software manual.

The camera strictly requires USB 3.1 speeds to function properly. Fig. 3 shows an example of the kind of issues you can encounter if the USB port on your computer is not quite up-to-specs. Other examples of issues include outright not detecting the camera and getting frames that seem to be shifted. We call this issue USB desynchronization.

If you suspect you are having issues with your USB connection, there are several steps you can take. First, please make sure the image tag feature is enabled on your camera (see your camera's User Manual for more information on this feature). Our software are designed to automatically check and fix this USB desynchronization, as long as it does not happen too frequently. Otherwise, you can try plugging into different USB ports, or even different computers, to find a port that can deliver the required bandwidth.

This issue, its diagnosing steps and its fixes have been described in detail in the **C-RED 2-2ER-3 TS2 optimizing USB 3.0 bandwidth** technical note, which you can read from your library in your First Light account.

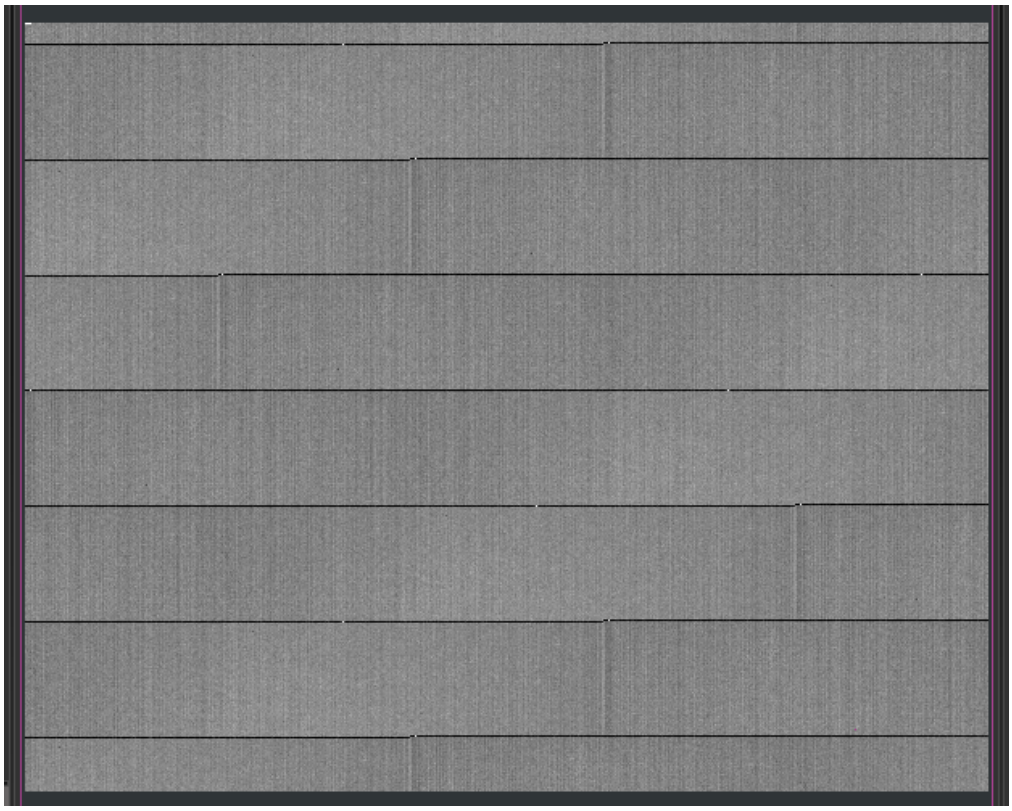


Fig. 3 : *Example of issues related to insufficient USB bandwidth*

7.3. Power supply connection (4)

Please plug firstly the provided power supply LEMO cable to the back of the camera (4), then connect it to the line plug.

First Light Imaging recommends turning the cooling system on BEFORE turning on the camera.

7.4. Synchro connection (5) and Ethernet connection (6)

Please refer to the User Manual.

8. POWERING UP/DOWN

8.1. Power ON:

When the power LEMO is connected to the camera, and the power supply to the line plug, the camera is ON.

8.2. Power OFF:

Please use the CLI command "shutdown" from a simple terminal before turning off the camera. First unplug the power supply from the line plug, then unplug the LEMO cable from the camera.

9. CAMERA CONTROL

9.1. First Light Imaging Graphical User Interface software

The Graphical User Interface (GUI) demo software is provided in the USB key supplied with the C-BLUE One camera, or available in Your Library on the website. It is a dedicated interface developed by First Light Imaging which allows to control almost all the parameters of the camera. Please refer to the GUI user manual.

9.2. Software Development Kit

A Software Development Kit (SDK) is also provided with your camera.
It will allow developers to code their own interface to control the camera. The source code of a demo software is provided in C/C++, and additional example codes are provided in several languages.
Please refer to the SDK User Manual.

9.3. Camera status

Once the camera is properly powered up the system boots and the camera is ready to operate.
A white or purple diode signal, visible through the camera's body holes, confirms the operability.

Camera status	Led color	Description
Configuring		Camera starting
Operational		Camera configuration is applied
Operational (cooling)		Camera is cooling down
Operational (cold)		Camera has reached target temperature
Operational (throttling)		Purple double blink: Because of temperature environment, the camera can't reach the set point and is limiting itself to the lower possible temperature
Safe		Red double blink: The camera detects an error. The detector is turned off. To be able to reuse the camera, you must restart it.
Prevsafe		When you restart the camera after a safe state, the camera will be stopped in prevsafe state. You have to use the ***continue*** command to resume the camera starting.
Locked		The camera detects a critical error. The camera is unusable, please contact First Light Imaging for support.
Safe (rescue FW)		Orange double blink: Recovery Software mode: the camera needs a new firmware. The camera is unusable. Please contact First Light Imaging for support.

10. C-RED 2 OPERATION

By default, the camera operates in CDS mode. C-RED 2 can also operate in IMRO mode.
The camera can operate in full frame or in cropping mode.

10.1. Integration/readout function

The acquisition speed can be set to any value from 0.001 to 600 fps.
The integration time can also be set. The integration time range is [50µs - ~1/fps] *

*For integration time below 50µs, please contact First Light Imaging at support@first-light.fr

10.2. Sensitivity scale mode

Signal can be integrated in low, medium or high gain corresponding to high, medium and small integration capacity, respectively.

The modification of the integration capacity impacts the dynamic of the signal and thus implies a change of the noise level.

10.3. Bad Pixel Correction

Bad pixel correction can be done on-the-fly by the camera.

When enabled, bad pixel correction is the first correction applied on pixel values received from the sensor. The bad pixels' value is replaced by the mean value of the adjacent pixels.

10.4. Bias/Flat Correction

Bias/Flat correction can be done on the fly by the camera.
Flat and Bias correction files can be computed automatically by the camera Alternatively, custom correction files can be uploaded to the camera using serial connection (either USB or CL).

To apply the image corrections: first, build the bias file and apply it, then, build the flat file and apply it.

Please refer to the software demo user manual for further details.

11. C-RED 2 ER OPERATION

C-RED 2 ER operates in CDS mode. The camera can operate in full frame or in cropping mode.

11.1. Integration/readout function

The acquisition speed can be set to any value from 0.001 to 600 fps.
The integration time can also be set. The integration time range is [50µs* - ~1/fps]

* For integration time below 50µs, please contact First Light Imaging at support@first-light.fr

11.2. Sensitivity scale mode

Signal can be integrated in low or medium gain corresponding to high, medium and low capacity, respectively.

The modification of the integration capacity impacts the dynamic of the signal and thus implies a change of the noise level.

11.3. Bad Pixel Correction

Bad pixel correction can be done on the fly by the camera.

When enabled, bad pixel correction is the first correction applied on pixel values received from the sensor. The bad pixels' value is replaced by the mean value of the adjacent pixels.

11.4. Bias Correction

Bias correction can be done on the fly by the camera.
The bias correction file can be computed automatically by the camera. Alternatively, custom correction files can be uploaded to the camera using serial connection (either USB or CL).

When enabled, bias correction is the second correction applied on pixel values received from the sensor.

11.5. Factory correction (C-RED 2 ER 2.2 µm)

Factory correction can be done on-the-fly by the camera. This feature is only available for C-RED 2 ER 2.2µm. The correction file is loaded in the camera during the calibration of the camera, in factory. It enables the compensation of the extended range artefacts. Bias correction should be applied prior to the factory correction.

When enabled, factory correction is the third correction applied on pixel values received from the sensor. It is recommended to use bad pixel, bias and factory corrections when employing C-RED 2 ER 2.2µm.

11.6. Flat Correction

Flat correction can be done on the fly by the camera.
The flat correction file can be computed automatically by the camera. Alternatively, custom correction files can be uploaded to the camera using serial connection (either USB or CL).

When enabled, flat correction is the fourth correction applied on pixel values received from the sensor.
Please refer to the software demo user manual for further details.

12. PRECAUTIONS

C-RED 2 and C-RED 2 ER are high end scientific instruments and should not be exposed to shocks, extreme temperatures, humidity, dusty environment, and static shocks.

Any electronic equipment that is connected to C-RED 2 or C-RED 2 ER should be fitted with appropriate protection on all power lines.
Any connected equipment should be powered off before removing any connection between the computer and C-RED 2 or C-RED 2 ER.

Please make sure to respect the voltage requirements for synchro signals – please refer to the User Manual of your C-RED 2 camera.

13. MAINTENANCE

13.1. Cleaning of window

Never use an unclean cloth to wipe the window of the camera.
The window should be cleaned with a dry and soft cloth.
You can also use a clean cloth dampened with ethanol and gently wipe the window.
Please avoid touching the window.

13.2. Storage

When not in use, please store your camera in a dry place, in its box.

14. CONTACTS

14.1. For the USA:

FIRST LIGHT IMAGING Corp.
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Cambridge, MA 02138
USA

Tel.: + 33 4 42 61 29 20
E-mail: support@first-light.fr
Website: www.first-light-imaging.com

14.2. For the rest of the world:

FIRST LIGHT IMAGING SAS
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France

Tel.: + 33 4 42 61 29 20
E-mail: support@first-light.fr
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