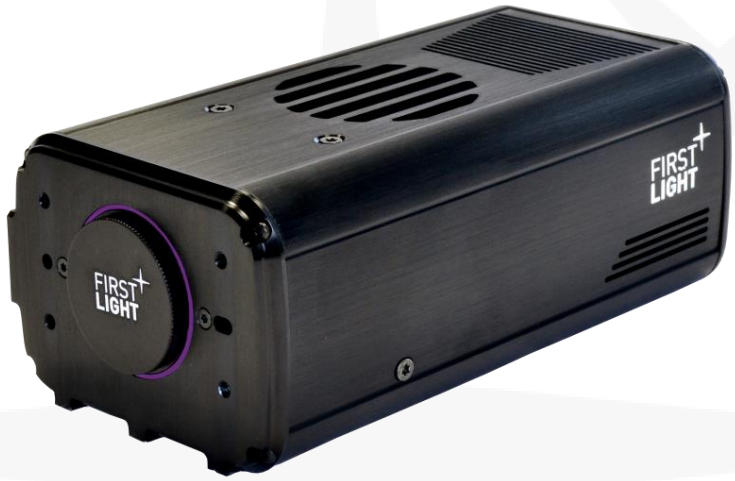
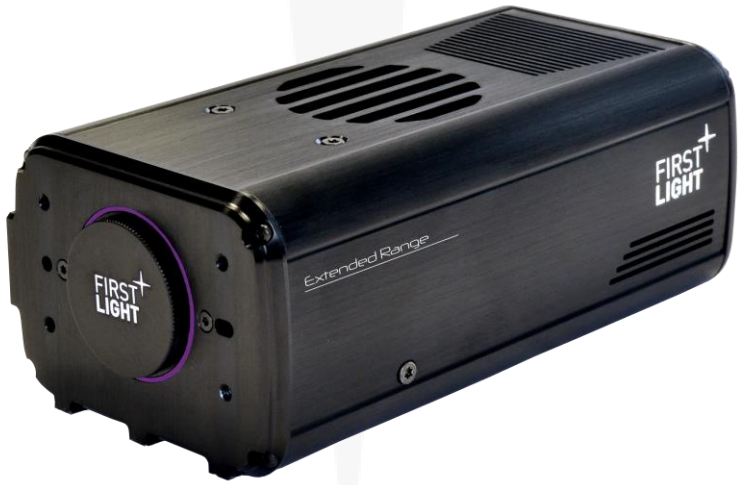
C-RED 2 / C-RED 2 ER

Firmware release notes

C-RED 2 / C-RED 2 ER firmware release notes.docx





Revision history

Issue	Date	Para	Details
001	26/06/2018		Initial release
002	20/11/2018		Release 3.0.0
003	07/07/2019		Release 3.1.1
004	17/09/2019		Release 3.2.0
005	19/09/2019		Release 3.2.1
006	23/10/2019		Release 3.2.2
007	13/02/2020		Release 3.3.2
008	22/09/2020		Release 4.0.1
009	19/11/2020		Release 4.0.2
010	04/02/2021		Release 4.0.3
011	07/16/2021		Release 5.0.5
012	05/11/2021		Release 5.0.6
013	18/01/2022		Release 5.0.7
014	26/04/2022		Release 5.1.0
015	25/08/2022		Release 5.2.0
016	16/06/2023		Release 5.3.0
017	XX/XX/XXXX		Release X.X.X

Table

1. Introduction

This document provides a description of the evolutions introduced in the different versions of the C-RED 2 and C-RED 2 ER (Extended Range) firmware.

This document intends to be as complete as possible. However, we advise you to always refer to the C-RED 2 / C-RED 2 ER User Manual for a complete description of the behavior of the camera.

For each firmware release, this document will present the main evolutions introduced in the release (prominent features), performance improvement of the camera, minor changes and bugfixes.

Finally, changes impacting the default configuration of the camera are provided.

The firmware is common to C-RED 2 and C-RED 2 ER camera, but all versions of the firmware do not support all cameras.

Firmware versions up to 3.3.3 only support C-RED 2 cameras.
Firmware versions 4.0.x are only targeting C-RED 2 ER cameras.
Firmware versions 5.0.x is the reunification of C-RED 2 and C-RED 2 ER cameras.

Firmware Version	C-RED 2 support	C-RED 2 -ER support
Up to version 3.3.3	YES	NO
Version 4.0.1 to version 4.0.3	NO	YES
Version 5.0.5 and above	YES	YES

2. Firmware version 5.3.0 (C-RED 2 / C-RED 2 ER)

2.1. Prominent features

- Added badpixel correction mode that uses interpolation around marked pixels.
- Added embedded filtering. Up to 100 convolution matrixes can be used and configured to filter pictures that are sent by the camera.

2.2. Changes

- Removed prevsafe camera status.
- When tint granularity is enabled, configurable fps values are restricted to ensure the same exposure can be set for different fps values. This ensures a more consistent behavior for users who wants to use several framerates with the same integration time.
- FPGA badpixel correction is now done at the end of the FPGA pixel handling.
- The camera no longer sends nonuser configured frames when the camera boots.

2.3. Bug fixes

- AGC repaired.
- Fixed a minor memory leak.
- 600 FPS license withdrawal always working.

3. Firmware version 5.2.0 (C-RED 2 / C-RED 2 ER)

3.1. Prominent features

- Improved integration time management (when tint granularity is enabled). Thanks to the new mechanism, the IWR artefact can be totally masked using a bias correction in most cases.

3.2. Changes

- Automatic creation of HDR and 600 fps license for all cameras that do not have already a license. The license can be disabled using the license management commands if needed. By default, newly created HDR license is enabled and newly created 600 fps license is disabled.

- Increased hardware probing robustness. Removed locked state.

3.3. Bug fixes

- Avoid returning NA values for temperatures, powers, during operational state of the camera.

- Fixed random entry in safe mode when reading of sensor temperature is performed during the early stage of the camera boot sequence.

- Do not allow to change sensitivity when AGC is enabled

- Returned minimum integration time is now properly set whether the tint granularity is enabled or not.

- Minor code cleanup (no user impact)

4. Firmware version 5.1.0 (C-RED 2 / C-RED 2 ER)

4.1. New features

Support of new camera motherboard revision.

Support of C-RED 2 ER sensor variant.

Notes: these features have no impact for the user.

4.2. Bug fixes

Handling of RTC when battery is dead.

5. Firmware version 5.0.7 (C-RED 2 / C-RED 2 ER)

This is a bugfix release only

5.1. Bug fixes

Fixed random temperature reading bug causing the camera to go into safe mode due to an invalid temperature (typically bad sensor temperature, but also heatsink, ….).

6. Firmware version 5.0.6 (C-RED 2 / C-RED 2 ER)

This is a bugfix release only

6.1. Bug fixes

Fixed a bug with low gain mode and presets.

7. Firmware version 5.0.5 (C-RED 2 / C-RED 2 ER)

7.1. Prominent features

7.1.1. Http server

A HTTP server has been added to the camera. This server allows to control the camera and allows to visualize acquired images using a standard web browser (Firefox, chrome….). When the camera is connected using a gigabit ethernet network, the server allows to display up to 25 frames per second in full sensor resolution (640x512).

The server allows to configure main acquisition parameters (acquisition frame rate, exposure duration, cropping, conversion gain….). The camera state is also monitored (status, temperatures….). A console is also available to send commands that are not directly available on the web page.

Image statistics (histogram, standard deviation, etc.) are also computed on the fly.

The HTTP server is controlled using `exec httpserver start` and `exec httpserver stop` commands. Once started, the HTTP server is listening on port 8888.

7.1.2. Ethernet grabber

The camera now supports transmission of acquired images using TCP/IP connection. When the camera is connected using a gigabit ethernet network, up to 25 frames per second can be sent in full server resolution (640x512).

The ethernet grabber is controlled using `exec ethernetgrabber start` and `exec ethernetgrabber stop` commands.

Once enabled, the camera waits for incoming TCP connection on port 8889. The streaming of the images starts immediately once the TCP connection established.

7.1.3. Raw HDR mode

The camera can now be configured to send the raw images used to compute the HDR images, prior to the computation. In this mode, the images acquired using high sensitivity and low sensitivity are sent alternatively. The raw HDR mode is controlled by the `set rawimages on` and `set rawimages off` commands.

7.1.4. Unsigned pixels

The camera can now be configured to send unsigned 16 bits pixels. This feature can be useful for some implementations that do not support negative pixels values (negative values are the result of the embedded bias correction and can occur in dark conditions). The default camera configuration remains use of signed pixels. To request transmission of unsigned pixels, use the command `set unsigned on`. To use signed pixels, use the command `set unsigned off`.

7.2. Miscellaneous new features

- New sensor commands equivalent to snake commands, *ie.* instead of `set snake xxx` or `snake xxx`, the `set sensor xxx` and `sensor xxx` commands can be used.

- New uptime commands that allow to monitor how long the camera has been used. The `uptime` command returns the elapsed time since the boot of the camera The `totaluptime` command returns how long the camera has been used since its manufacturing. This command is only valid for newly manufactured cameras. On older cameras, it returns NA. The `acculumateduptime` commands the accumulated uptime of the camera. It returns the accumulated

uptime of the camera since the firmware has been installed. On newly manufactured cameras, it corresponds to the `totaluptime` command.

- New `tintstep` command that returns the granularity of the integration time.
- New `date` and `set date` commands that allows to get/set the current date of the camera.
- New `ping` command that allows to check network connectivity.
- New imagepattern command that allows to configure the camera to send a pattern (fixed value or a ramp) instead of the acquired image. This mode can be used to diagnose connectivity issues (damaged Camera Link® cables….).

7.3. Changes

The exposure duration is now set automatically to its maximum when framerate is set.

7.4. Bug fixes

- Camera fully functional using SSH connection (some commands were not working properly).
- swtrig commands are now effective immediately after complete camera boot or cropping configuration change. Up to 4 swtrigs commands were necessary before receiving proper frames.
- `extsynchro source` and `extmarker source` commands were returning unknown instead of CC4.
- Logs improved to allow to get logs using chrome browser.
- Cleanup of NDR/CDS transitions

8. Firmware Version 4.0.3 [C-RED 2 ER only]

8.1. Changes

Reenable selection of high gain on new C-RED 2 ER camera.

9. Firmware version 4.0.2 [C-RED 2 ER only]

9.1. Changes

Implemented new commands using `sensor` keyword instead of `snake`.

- `<set> temperatures sensor` equivalent to `<set> temperatures snake`
- `power sensor` equivalent to `power snake`
- `<set> sensor xxx` equivalent to `<set> snake xxx`

The previous commands using `snake` are still supported but deprecated.

10. Firmware version 4.0.1 [C-RED 2 ER only]

10.1. Prominent features

10.1.1. Support of C-RED 2 ER cameras.

This release adds support of C-RED 2 ER cameras.

10.2. Performance improvements

10.2.1. Bad pixel correction

Improved bad pixel correction for bad pixel clusters aligned on 16 columns boundaries.

10.2.2. Factory correction

New image factory correction for **C-RED 2 ER** cameras.

10.3. Bug fixes

- Fixes legacy exec buildbias and exec buildflat random failures leading to bias/flat to be ineffective.
  Note: corresponding buildnuc commands were not impacted.

- Flat correction was not properly applied for low and medium gain.
  Note: Flat correction was working properly for high gain.

- Throttling on C-RED 2 Gen 0 (first generation of cameras) was not properly indicated (status was not set to throttling).

11. Firmware version 3.3.3

This is a maintenance release of 3.3.2

11.1. Performance improvements

This release allows tuning of dark current optimization during manufacturing of the camera. This update has no impact on previously manufactured camera.

12. Firmware version 3.3.2

This is a bugfix release of 3.3.1

12.1. Bug fixes

Fixed sensor temperature when tuning is set to short_exposure.

13. Firmware version 3.3.1

This is a bugfix release of 3.3.0

13.1. Bug fixes / Cleanup

Various CLI commands fixes:

- syncdelay (s) -> syncdelay
- minsyncdelay (s) -> minsyncdelay
- maxsyncdelay (s) -> minsyncdelay
- stepsyncdelay (s) -> stepsyncdelay

Note: no impact for user, since correct commands (without (s)) were properly handled anyway.

14. Firmware version 3.3.0

14.1. Prominent features

14.1.1. Support of Camera Link Camera Control (CC) signals

The acquisition can now be triggered using CC signals or using external synchro connector.
Images can also be marked using CC signals or using external synchro connector.

Note: this is only available on hardware enabled cameras.

14.2. Performance improvements

14.2.1. Improved dark optimization

Improved dark optimization, especially for low temperatures.

14.2.2. Camera Cooling

Fan speed management in automatic mode has been reworked to improve cooling of the camera.

14.3. Changes

- The minimal temperature allowed for camera operation has been decreased to -40°c (depending on camera generation).
- New operational cold_stabilized status when camera has achieved its temperature stabilization
- New sensititivity command that replaces deprecated sensibility command.
- Allow execution of single CLI commands using ssh/plink

14.4. Bug fixes

- Heatsink temperature measurement has been fixed (mostly visible on negative temperatures).

15. Firmware version 3.2.2

This is a bugfix release of 3.2.1

15.1. Bug fixes

- Minimum frontend temperature was set to 21°C instead of -21°C

16. Firmware version 3.2.1

This is a bugfix release of 3.2.0

16.1. Bug fixes

- External synchro / exposure duration configuration was not properly saved.
- Added missing help in CLI interpreter.

17. Firmware version 3.2.0

17.1. Prominent features

17.1.1. Automatic Gain control

When enabled, Automatic Gain Control (AGC) allows the camera to select automatically the integration capacitor according to the observed scene.

17.1.2. Bad pixel edition

The bad pixel map stored in the camera is now modifiable by the user. Bad pixels can be added or removed.

17.1.3. Triggered acquisition

Triggered acquisition (e.g. acquisition of N frames at a specified frame rate / exposure duration) can now be controlled via swtrig command (already available) or via synchronization signal on Lemo connector.

The triggered acquisition can now be aborted.

17.1.4. Bias / Flat computation improvement

Bias and flat corrections can now be automatically computed by the camera for frame rates below 5 fps. The quality of the correction has also been improved by using more images to compute the correction.

17.2. Performance improvements

17.2.1. Camera tuning

Camera operation can be tuned for general use (default value), short exposures or long exposures durations. This tuning allows to obtain the maximum camera performances for these different use cases.

17.2.2. Operational temperature range

The minimal temperature allowed for camera operation has been decreased to -20°c

17.3. Changes

- Sensor antiblooming feature is now deactivated by default.
- New busy status used during asynchronous bias/flat correction computations

17.4. Bug fixes

- Do not lock the camera when detecting an invalid HW id
- Avoid pixels set to 0 when automatic VREF adjustment is enabled on some cameras.
- Fix spurious trigs when camera is configured in triggered mode via swtrig command.
- Unable to set fps when switching back from external synchro/internal exposure.
- External synchro signal polarity was not properly saved.

18. Firmware version 3.1.1

18.1. Prominent features

18.1.1. HDR mode

A new HDR mode has been introduced to enhance the dynamic of the images captured by the camera. This feature requires the purchase of an HDR option license.

The HDR mode is available from cropping equivalent to 96*72 pixels up to full sensor geometry.

18.1.2. External synchronization improvement

A new external synchronization signal configuration (fullcmos) has been introduced. Using this configuration allow user to have access to the internal camera sensor clock (12202 kHz or 18214 kHz with 600 fps option).

Synchronizing external devices with this clock allows to prevent occurrence of jitter when camera framerate and exposure are controlled by the external device.

The external synchronization signal polarity is now configurable.

External synchronization has been also enhanced to allow to use the synchronization signal to control only the acquisition frame rate, the exposure duration being controlled by the camera, according to the value configured by the user.

18.2. Performance improvements

18.2.1. IMRO mode

Minimum cropping size in computed IMRO mode has been reduced to geometry configurations equivalent to 96*72 pixels, allowing to achieve greater framerate in computed IMRO mode.

18.2.2. Dark vs noise tradeoff

A new parameter has been defined to allow user to make a tradeoff between dark current and readout noise. This parameter allows to address a wider range of applications.

18.3. Changes

- VREF adjustment is now enabled by default, and default VREF values has been updated, allowing to recover some integration capacity.
- Exposure duration granularity is now enabled by default.
- Bad pixels correction is now enabled by default.
- Sensor antiblooming feature has been activated by default.
- Updated default sensor configuration parameters.

Notes:

- VREF adjustment, exposure duration granularity, bad pixel correction, anti-blooming can be disabled if needed.
- For specific needs, snake parameters can still be modified using `set snake xxx` command.

18.4. Bug fixes

- The exposure time of the first frame of an IMRO burst is now automatically set to its maximum value.
- Fixed internal flat correction computation for misbehaving pixels
- Increased XMODEM transfer robustness

19. Firmware version 3.0.0

19.1. Prominent features

19.1.1. New software synchronization support

A new synchronization mode has been introduced to allow user to trig acquisition of images by sending a command to the camera. The acquisition frame rate, exposure duration and the number of frames to be acquired can be configured by the user.

19.1.2. External synchronization improvement

It is now possible to add an extra delay when frame acquisition is controlled through external signal.
Note: the cameras are now configured to use LVCMOS 3.3 signaling instead of LVDS.

19.1.3. Enhanced IP configuration

When configured in DHCP mode, the camera IP defaults to 169.254.123.123/255.255.0.0. This address is compatible with APIPA protocol. This simplifies the communication with the camera when no DHCP server is available, by connecting the camera directly to a Windows ® PC.

IP configuration changes can also be applied immediately, without need to reboot the camera.

19.2. Bug fixes

- Exposure durations below 1µs can be set (regression introduced in firmware 2.9.x)
- Allow Gigabit in golden boot firmware

19.3. Changes

- Camera boot speed has been increased.
- restore factory settings command now resets IP configuration, synchronization and password configuration.
- Image tags are now enabled by default.

20. Firmware version 2.9.1

20.1. Prominent features

20.1.1. New 600 FPS acquisition speed.

This firmware allows to operate your C-RED 2 camera at 600 fps in full sensor resolution. [1]

All readout modes (CDS, IMRO, IMRO with embedded computation) are now available at 600 fps.

Control of the camera and frame acquisition can be done using Camera Link® or USB 3.0 connection, for both 400 and 600 fps configurations.

When using USB, the following limitations are applied:

- The total USB bandwidth is limited to 600 frames per second in full sensor resolution.
- The maximum framerate achievable through USB is limited to 9999 fps (for small cropping area)

When using Camera Link®, no limitations are applied:

- The maximum framerate at full sensor resolution is about 602 fps with default camera configuration.
- No limitation for small cropping areas.

20.1.2. New external synchronization

Control of the camera acquisition (framerate and exposure times) using external synchro signals has been improved to allow the use of LVCMOS33 signals (single ended).

The legacy LVDS (differential) synchronization remains available and is still the default camera configuration.

When LVCMOS33 synchro signals is set, the freed input can be used to tag the outcoming frames with the value of this input.

20.2. Performance improvements

- Slight improvement of noise for integration times above 40 µs

- Improved acquisition dynamic range, either using automatic VREF adjustment (disabled by default) or manual tuning of the VREF voltage.

20.3. Various

- New maintenance command to retrieve camera's logs (to be used on FLI support's request).

- New reboot command.

[1] *Provided the purchase of the 600 fps option license. Please contact us for more info.*

20.4. Bug fixes

- External frame synchro signal was not properly generated in IMRO mode.
- Bad rounding when setting max integration times.
- Added missing FPS range checks.
- Relaxed component probing at boot to avoid entering in locked mode immediately when a non-persistent issue is detected (false HW failure detection).
- Possible ERROR:903:Command answer timeout instead of OK for preset commands.
- version firmware detailed command now returns correct information.

20.5. Changes

- version fpga detailed has been removed. Information was erroneous/not relevant.
- Cropping with IMRO processing enabled is now restricted for cropping areas equivalent to 1/4 of the full sensor geometry or more (was previously limited to 1/8).
- When 600 fps option is enabled, IMRO processing is now enabled by default.

21. Firmware version 2.8.1

21.1. Prominent features

21.1.1. Preliminary 600 FPS acquisition speed.

This firmware allows to operate C-RED 2 camera up to 600 fps in full sensor resolution.

Limitations:

- Only CDS and IMRO without embedded computation are available at 600 fps.
- Control of the camera and data acquisition with Camera Link® only.

21.2. Bug fixes

- Fixed raw image management (bug only seen when using 600 fps configuration).

22. Firmware version 2.7.2

22.1. Prominent features

22.1.1. Bad pixel correction

Correction of bad pixels have been introduced in this firmware release.

To be enabled, this feature needs a bad pixel map to be uploaded in the camera.
Camera distributed with the firmware 2.7.2 already embed this correction file.
For older cameras, please contact FLI support () for a possible upgrade of the camera.

22.1.2. Embedded IMRO computation

This firmware introduces embedded processing of images in IMRO mode. This mode is limited to cropping areas above 1/8 of the full sensor size.

The raw IMRO mode available (image processing to be performed by user application) in previous firmware releases remains available.

22.1.1. Multiple configurations support

This firmware allows to set up to 10 different camera configurations, including image correction files.

22.2. Performance improvements

- Automatic sensor parameter adjustment for low integration times (below 100 µs) has been introduced.
- Sensor antiblooming feature is now enabled by default.
- Thermal regulation improvement (requires HW 4.4.4).

22.3. Various

- Support of very low framerates - can be set down to 0.001 fps, integration time around 1000 seconds.
- Support of X-MODEM protocol to send custom BIAS/FLAT correction files through serial line (raw mode is not reliable).

22.4. Bug fixes

- USB camera detection is now more reliable (with previous version, under some specific circumstances, the camera was seen as a USB 2.0 device).

- USB data acquisition stability improvement.
- USB serial port random hang has been fixed.
- When using Camera Link, Frame Valid is not kept active more than needed.
- FIX: Bias/Flat corrections were not properly applied after reboot

22.5. Changes

- Removed remaining offset of 200 ADUs when computing bias correction file.
- Embedded IMRO computation is now enabled by default.

23. Firmware version 2.3.1

Initial release