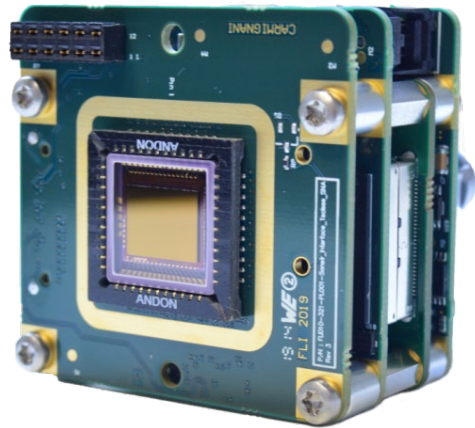


# C-RED 3

## Firmware release notes

C-RED 3 firmware release notes.docx



## Revision history

Issue	Date	Para	Details
001	09/07/2019		Initial release
002	29/10/2019		Release 1.1.0
003	20/02/2020		Release 1.2.0
004	29/04/2021		Release 1.3.1
005	05/11/2021		Release 1.3.2
006	18/01/2022		Release 1.3.3
007	22/02/2022		Release 2.0.0
008	28/02/2022		Release 2.0.1
009	XX/XX/2022		Release 2.1.0
010	09/09/2022		Release 2.2.0
011	27/10/2022		Release 2.2.1
012	20/04/2023		Release 2.3.0
013	18/07/2023		Release 2.3.3
014	02/04/2024		Release 2.3.4
015	10/04/2024		Release 2.3.5
016	12/04/2024		Release 2.3.6
017	15/04/2024		Release 2.3.7

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Title: C-RED 3 firmware release notes  
Document: C-RED 3 Lite firmware release notes.docx  
Issue: 017  
Classification: PUBLIC

Page : 5  
Date : 10/03/2025

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## 1. Introduction

This document provides a description of the evolutions introduced in the different versions of the C-RED 3 and C-RED 2 Lite firmware.

This document intends to be as complete as possible. However, we advise you to always refer to the C-RED 3 and C-RED 2 Lite 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.

### 1. Firmware version 2.3.7

#### 1.1. Bug fixes

- Setting minimum fps (0.0001) wasn't working

### 2. Firmware version 2.3.6

#### 2.1. Bug fixes

- Fix Cooling mode automatic\_step
- Update tintoffset configuration file

### 3. Firmware version 2.3.5

#### 3.1. Prominent features

- Re-enable "Power Saving mode" for C-RED 2 Lite/C-RED 3 cameras.

#### 3.2. Bug fixes

- Improved error detection during command parsing
- Fix version firmware detailed returned value (one digit missing)
- Setting minimum fps (0.0001) wasn't working
- Buildnuc abort answer received too early

#### 3.3. Changes

- Increase nbframesperswtrig maximum value to 16777215
- Do not send images during boot

### 4. Firmware version 2.3.4

#### 4.1. Bug fixes

- Temporarily disable Power Saving mode due to camera misbehavior.

## 5. Firmware version 2.3.3

### 5.1. Prominent features

- Enable "Power Saving mode" for C-RED 3 camera.

### 5.2. Bug fixes

- Fixed a regression with adaptative bias that was no longer applied.

## 6. Firmware version 2.3.0

### 6.1. Prominent features

- This firmware introduces a new bad pixel correction implemented using convolution matrix. This new correction gives better results, especially on bad pixel clusters, at the cost of an increase latency. The previous bad pixel correction is still available for applications where the increased latency is not acceptable.
- When the camera is configured to use the old bad pixel correction, it is now possible to apply a convolution matrix over the full image, allowing different applications such as image smoothing, edge detection, ...
- The camera now is able to apply image thresholding, e.g. allows to replace the actual pixels image values with specific values. Two pixels thresholds are available, allowing to replace the different pixels value with three different values. Both threshold and replacement values are configurable by the user.
- It is now possible to read the VREF voltage applied by the camera

### 6.2. Bug fixes

- Fixed Issue with legacy bad pixel correction for frame borders (introduced in version 2.2.0)
- HDR license creation failure
- Possible erroneous tint granularity when cropping is changed whereas cropping is not enabled
- status operational[cold] was never set when operated in manual cooling mode

### 6.3. Changes

- Removed prevsafe status. When a safe issue is encountered, on the next reboot, the camera will not remain in prevsafe but will perform a standard boot.
- When enabled, tint granularity now restricts possible FPS values. This allows to use the same exposure duration independently of the camera acquisition frame rate.

### 6.4. Miscellaneous

- Improved logs (for internal / debugging purposes)

- Ensure emmc reliability is set during camera production (internal use) - no impact for user.

## 7. Firmware version 2.2.1

### 7.1. Bug fixes

- Fixed a bug occurring during camera update.

## 8. Firmware version 2.2.0

### 8.1. Bug fixes

- Badpixel correction is now applied after bias and flat correction, in every mode, thus reducing the introduced noise.
- AGC Fixed.

## 9. Firmware version 2.1.0

### 9.1. Prominent features

- Support of readout direction configuration. Image can now be flipped horizontally, vertically or in both directions directly by the camera.
- Support of badger sensors: badger TECless support for C-RED 3, badger TEC2 5V for C-RED 2 Lite.
- C-RED 2 Lite USB support.
- 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.

### 9.2. Changes

- Increased temperature range for C-RED 2 Lite / C-RED 3 camera for new camera equipped with latest hardware. No change on older cameras.
- Increased thermal throttling threshold to max temperature minus 1°C instead of max temperature minus 5°C
- Automatic creation of HDR license for all cameras. The license can be disabled using the license management commands if needed.
- Increased hardware probing robustness. Removed locked state.

### 9.3. 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.
- Avoid camera communication timeout during adaptative bias computation (C-RED only)
- Minor code cleanup (no user impact)

## 10. Firmware version 2.0.1

### 10.1. Changes

- When switching from custom steps mode to automatic steps mode, the first step of the automatic step mode is now the closest lower one from the TEC Hot side temperature.

### 10.2. Bug fixes

- Fixed a bug that makes the step of the manual cooling mode being ignored and set to 0 when switching from automatic steps mode to manual in specific conditions.
- Fixed the various steps of the automatic steps mode to be always those intended.

## 11. Firmware version 2.0.0

### 11.1. Prominent features

#### 11.1.1.C-RED 2 Lite support

The temperature stabilized camera is now supported in this version.

This camera has three variations of a temperature stabilization algorithm. The factory presets of the C-RED 2 Lite cameras will enable the automatic steps version of the algorithm by default, which can be turned off.

For C-RED 2 Lite, adaptative bias has been disabled.

TEC voltage, current and power consumption can be tracked on C-RED 2 Lite exclusively.

#### 11.1.2. C-RED 3 Adaptation

Since C-RED 3 is not equipped with a TEC, all temperature stabilization commands are possible to be sent, but will return errors.

### 11.2. Changes

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

### 11.3. Bug fixes

- Fixes random corruption of images received using ethernet grabber
- Fixed invalid framerate / exposure after bias is applied

## 12. Firmware version 1.3.3

This is a bugfix release only

### 12.1. Bug fixes

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

## 13. Firmware version 1.3.2

This is a bugfix release only

### 13.1. Bug fixes

Fixed a bug with low gain mode and presets.

## 14. Firmware version 1.3.1

This is a bugfix release only

### 14.1. Bug fixes

Fixed HTTP server crash when refreshing web page.

## 15. Firmware version 1.3.0

### 15.1. Prominent features

#### 15.1.1. 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.

#### 15.1.2. 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.

### 15.1.3.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.

### 15.1.4.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`.

## 15.2. 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 `accumulateduptime` 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<sup>®</sup> cables...).

## 15.3. Performance improvements

### 15.3.1.Improved bad pixel correction

Improved pixel correction for pixels located on 32nd columns boundaries.

### 15.3.2.Smooth transition when bias or flat are enabled/disabled

The transition when bias or flat correction is toggled is now clean, meaning no frames with partially applied bias or flat corrections are sent by the camera.

## 15.4. Changes

- The maximum ambient temperature has been increased to 65°C.
- The flat correction can be enabled only when bias correction is also enabled.
- The ethernet LEDs are also controlled by the `set leds on` and `set leds off` commands.

## 15.5. 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.
- Acquired image was shifted on the right booting in a `swtrig` configuration.
- Logs improved to allow to get logs using chrome browser.

## 16. Firmware version 1.2.0

### 16.1. Performance improvements

#### 16.1.1. Improved dark optimization

Improved dark optimization, especially for low temperatures.

### 16.2. Changes

- The minimal temperature allowed for camera operation has been decreased to -40°C.
- New sensitivity command that replaces deprecated sensibility command.
- Allow execution of single CLI commands using SSH/plink

## 16.3. Bug fixes

- Ambient temperature measurement has been fixed (mostly visible on negative temperatures).
- Various CLI commands fixes:
  - o `syncdelay (s) -> syncdelay`
  - o `minsyncdelay (s) -> minsyncdelay`
  - o `maxsyncdelay (s) -> minsyncdelay`
  - o `stepsyncdelay (s) -> stepsyncdelay`

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

- Fixed sensor temperature when tuning is set to `short_exposure` or `long_exposure`
- Fixed inversion of CC3 and CC4 when using them as synchro/frame marker source.
- Collected logs size is no longer limited by the RAM of the camera
- Status detailed loss after launching `buildnuc`
- `exec buildbias / exec buildflat` failed silently (no bias/flat correction computed) due to memory overflow when `fps > 175`
- Collected logs size is no longer limited by the RAM of the camera
- Status detailed loss after launching `buildnuc`

## 17. Firmware version 1.1.0

### 17.1. Prominent features

#### 17.1.1. Bad pixel edition

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

#### 17.1.2. External synchronization signals

External synchronization signals (frame synchro, frame marker) are now available on synchro connector or using camera link control signals.

#### 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 externally via synchronization signal on Lemo connector or Camera Link Control signals.

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.

#### 17.2.1. Adaptive bias

Adaptive bias has been improved to give better results (smaller residual offsets in the dark).

#### 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 activated by default.
- Sensor gain is now set to medium 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 1.0.3

Initial release.