User Manual
S110 RGB/NIR/RE camera
Revision 3 / September 2014
Copyright © 2010-2014 senseFly Ltd

senseFly
a Parrot company

S110 RGB/NIR/RE camera

User Manual

Disclaimer

SenseFly Ltd reserves all rights related to this document and the information contained herein. REPRODUCTION, USE OR DISCLOSURE TO THIRD PARTIES WITHOUT WRITTEN PERMISSION FROM SENSEFLY LTD IS STRICTLY PROHIBITED.

SenseFly Ltd makes no warranties based on the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice.

By using senseFly Ltd software and products you accept senseFly's warranty and liability terms.

ALL USE OF SENSEFLY LTD PRODUCTS, INCLUDING BUT NOT LIMITED TO THE USE CONFORM TO THE APPLICABLE LAW OF THE COUNTRY IN WHICH THE PRODUCT IS OPERATED, IS UNDER YOUR SOLE RESPONSIBILITY. INFORM YOURSELF BEFORE USING THE PRODUCT. SOME COUNTRIES MAY HAVE LAWS THAT LIMIT THE USE OF UNMANNED AIRCRAFT TO 'LINE-OF-SIGHT' OPERATIONS AND/OR PROHIBIT THE USE OF UNMANNED AIRCRAFT IN SPECIFIC AREAS OR AT ALL.

Product limited warranty

SenseFly Ltd warrants that the product will be free from defects in workmanship and materials for a period of twelve (12) months from the date that the item was first purchased. During Warranty Period, should the covered product, in senseFly Ltd's sole opinion, malfunction due to any defect in material and/or workmanship, your sole remedy and senseFly Ltd's sole liability shall be, at senseFly Ltd's option, to either repair or replace the malfunctioning product with a similar product at no charge or to reimburse the purchase payment, provided that the malfunctioning product is returned, with proof of purchase in the form of your original copy of the sales receipt, within the applicable Warranty Period.

The warranty shall exclude defects due to normal wear and tear, including but not limited to deterioration of the airframe after first flight, normal degradation, misuse, moisture or liquids, proximity or exposure to heat, accidents, excessive strain, abuse, neglect, misapplication, repairs or modifications made by anyone other than senseFly Ltd, damage due to manual operation, damage due to take-off or landing location with obstacles, damage due to low altitude flight, damage due to loss of data radio connection, damage due to strong wind, rain or humidity or other causes for which senseFly Ltd is not answerable. Any claim related to in-flight malfunction of the product will be considered by senseFly Ltd only if accompanied with the related flight log.

There are no express or implied warranties, representations or conditions other than those stated in this limited warranty. The remedy set forth herein shall be the sole, exclusive remedy with respect to the product.

Product liability

UNDER NO CIRCUMSTANCES WILL SENSEFLY LTD BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (EVEN IF SENSEFLY LTD IS NOTIFIED OF THE POSSIBILITY OF SUCH DAMAGES) INCLUDING, BUT NOT LIMITED TO, ANY DAMAGES CAUSED BY YOU OR A THIRD PARTY WHILE OPERATING OR USING THE PRODUCT, ANY LOSS OF REVENUE, LOSS OF PROFIT, OR LOSS OF DATA WHETHER BASED UPON ANY ALLEGED BREACH OF WARRANTY, REPRESENTATION OR CONDITION, CONTRACT, OR ANY OTHER CONDUCT INCLUDING NEGLIGENCE (INTENTIONAL OR OTHERWISE), GIVING RISE TO SUCH CLAIM.

UNDER NO CIRCUMSTANCES WILL SENSEFLY LTD BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (EVEN IF SENSEFLY LTD IS NOTIFIED OF THE POSSIBILITY OF SUCH DAMAGES) INCLUDING, BUT NOT LIMITED TO, ANY DAMAGES CAUSED BY FAILURE OF THE AUTOPILOT, ELECTRONICS OR SOFTWARE. YOU SHALL NOT OPERATE THE PRODUCT IN AREAS OR UNDER CIRCUMSTANCES WHERE A FAILURE COULD CAUSE DAMAGES AND/OR HARM TO OBJECTS AND/OR PEOPLE.

S110 RGB/NIR/RE camera

Congratulations on your purchase of the *S110* camera, the advanced payload for the *eBee* mapping drone that allows users to define their own manual settings for better visual (*RGB*), Near Infrared (*NIR*), or Red-Edge (*RE*) 2D and 3D mappings.


> **Note:** This manual refers to versions 2.3 and later of the *eBee*'s *eMotion* software. Check the software version included in your *eBee* and consult the Release Notes for potential changes included in more recent versions of the software.
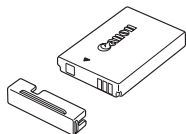
> **Caution:** The *S110* camera has been modified to be compatible with the *eBee* drone. It is therefore not recommended to use it for other purposes than payload on a senseFly drone.
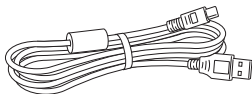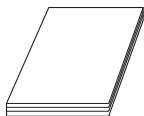
Box contents
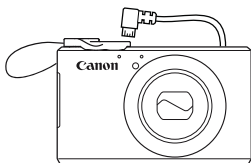
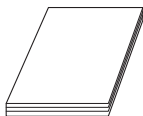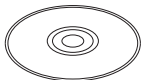Camera & dial lock

Battery pack

Interface cable

Battery charger

S110 RGB/RE/NIR
camera User Manual

Canon's Getting
Started guide

Canon's digital camera
solution disk

SD memory card

The camera package contains the following items:

- 1×*S110 RGB/NIR/RE* camera with dial lock

- 1×*S110* camera battery pack

- 1×*S110* camera battery charger

- 1×*S110* camera User Manual (this manual)

- 1×*S110* camera manufacturer's Getting Started guide

- 1×IFC-400PCU Interface cable

- 1×Digital camera solution disk

- 1×SD memory card

Depending on your order, your package may also include additional items. Please verify upon delivery that your package is complete. In case of a missing item, please contact your reseller immediately.

Contents

Part I
Getting started

Goal of this part: The first part of this guide covers the basics of using the *S110 RGB/NIR/RE* camera with the *eBee*.

1 Predefined camera settings

Although the *S110* camera can be fully manually configured, a predefined set of parameters optimised by senseFly (hereafter called factory settings) is saved within the camera. To use these predefined settings, select **C** on the camera's mode dial as shown below.

By default, the *S110 RGB* camera is set to store images in *JPEG* format, while the *S110 NIR* and *RE* cameras are set to produce both *JPEG* and *RAW* images. The *JPEG* format generates a good visual output without requiring any further image processing. On the other hand, for agricultural applications, computing precise vegetation indices requires *RAW* data, hence the default configuration of the *NIR* and *RE* cameras.

> **Note:** For all of these cameras, image size (◢L) is set to L (4000x3000) pixels with an aspect ratio of 4:3 by default. Only images taken with these settings can be processed by *Postflight Terra 3D*. If you have changed these settings, you must set them back to the default or carry out a reset (See senseFly factory settings).

For drone mapping purposes, the most important setting is the **Shutter Speed** as this can be configured to avoid motion blur on the images. Within the camera's predefined settings, the **Shutter Speed** is set

to 1/2000s (the fastest speed available) in order to prevent images being affected by vibrations and motion. In this mode, for every single shot, the camera adapts the **Aperture** and **ISO** speed according to the light conditions to ensure the best image exposure. Please refer to Part II to learn more about customizing camera settings for specific environmental conditions.

> ⓘ **Note:** The **Safety Shift** is activated by default in the factory settings. With this option enabled, the camera will automatically lower the **Shutter Speed** when reaching maximum **Aperture** and **ISO** speed to avoid underexposure in low light conditions.

2 Pre-flight procedure

Before installing your *S110* camera in your eBee...

- Check that there's enough space on your SD card.
- Check the camera's date/time setting.
- Install the dial lock.
- Remove the camera's battery[1].
- Check that the lens is clean.

Before every flight, make sure that the SD memory card contains enough free space.

---

[1] If you have an earlier *eBee*'s with a serial number that starts with **EB-01-**, the camera's battery must remain in the *S110* camera for flight.

With the battery installed in the camera, check that the camera has the right date and time. If it hasn't, set the correct date and time.

> ⚠️ **Caution:** If the battery is left out of the *S110* camera for extended periods, the date/time may reset. We recommend storing the camera with the battery installed. A battery with even a small amount of charge will keep the camera's internal clock running for extended periods.

To prevent undesired settings changes upon camera insertion into the drone or during flight, a camera dial lock is attached to the camera by a strap. Before inserting your *S110* camera into the *eBee*, the camera dial lock must be placed onto the mode dial and the trigger, as shown below.
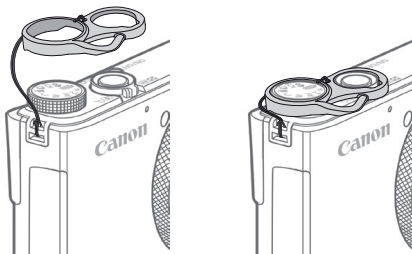
The *S110* camera is directly powered by the *eBee* and the *S110* camera battery must be removed before plugging it into your *eBee*. All flights have to be conducted without camera battery for weight reduction and safety reasons.

With the battery removed and the dial lock in place, insert the *S110* camera into your *eBee*, plug it into the connector (see icon 📷) and close the camera's compartment lid.

insert camera into compartment

plug in camera connector to camera plug

close camera compartment lid
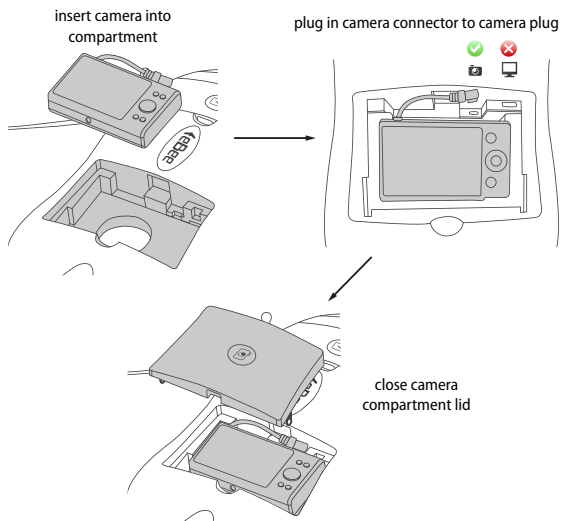
> **Note:** It is recommended before every take-off to perform a visual check of the camera's lens in order to ensure the best image quality for the 3D reconstruction.

2.1 *eMotion* settings

Once your *eBee* is connected to *eMotion*, verify that the correct camera model is selected in the **Camera** tab according to your variant (*RGB*, *NIR* or *RE*), as shown below.
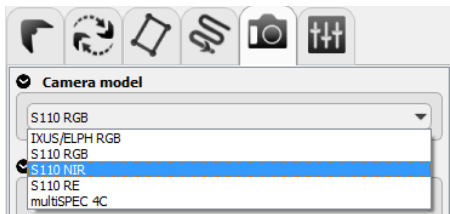
Once the *S110* camera is selected, the mission planner will automatically adjust flight altitude and other parameters to ensure the desired ground sampling distance and display correct image footprints. Camera selection is stored in the flight logs and later retrieved by the Flight data manager to select the appropriate image extraction method.

⚠️ **Pre-flight checklist:**

1. Check remaining space on SD card and install it into camera.

2. Set/check camera date/time.

3. Select **C** on the mode dial (or any desired custom settings).

4. Remove the *S110* camera's battery[2].

5. Place the camera's dial lock on.

6. Check/clean lens.

7. Plug the *S110* camera into the *eBee*.

8. Connect the *eBee*'s battery.

9. Connect to the *eBee* with *eMotion*.

10. Verify that the right camera model is selected in *eMotion*.

3   Launching the *eBee*

The take-off procedure is the same as described in your *eBee* User Manual. Nevertheless, the *S110* camera is slightly heavier (+20 grams / 0.7 oz) than the drone's default payload. Therefore, be sure to launch the *eBee* with a good initial speed against the direction of the wind.

---

[2] Not applicable if your *eBee* serial number starts with **EB-01-**.

4 In-flight performance

Flying with the *S110* camera reduces the endurance by up to 10% of flight time compared to the *IXUS/ELPH* camera. This is due to both the additional weight and the fact that the camera drains some power from the *eBee*'s main battery.

> **Note:** Endurance can vary greatly depending on external factors such as wind, altitude changes and temperature.
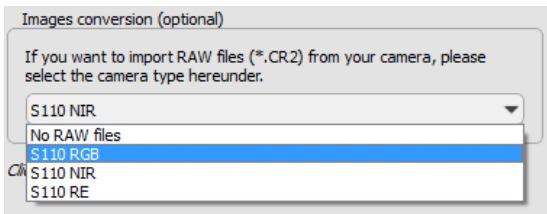
5 Processing flight data and images

The procedure for processing flight data on *S110* images is the same as described in the your *eBee* User Manual. However, do not connect the *eBee* to your computer before unplugging the *S110* camera from the *eBee* to prevent overloading the autopilot power management system. Similarly, never update your *eBee* with the *S110* camera plugged into the drone.

5.1 Processing JPEG images

Processing *JPEG* images adds geotags into their metadata. This information is then used to generate accurate 2D and 3D geo-referenced models. Although, *JPEG* processing is mostly relevant for the *RGB* version of the *S110* camera, this processing can also be used with the *NIR* and *RE* variants to perform a fast processing and validate that the images provide enough overlap.

5.2 Processing RAW images

The *NIR* and *RE* camera variants require each image to be preprocessed. This takes place via the *eMotion* Flight data manager at the same time as the image geotagging process. The processing of *RAW* images takes significantly longer than processing *JPEG*, as this involves band arithmetic that corrects the images and converts them into large 16-bit linear *TIFF* images, optimised for vegetation indices calculation. This process prioritises accuracy over visual quality and therefore produces images that look very different (and usually dimmer) to their *JPEG* equivalents. In order for the processing to produce correct images, the image source camera must be first identified. This information is stored with the flight logs, but can be modified by selecting the image source in the *eMotion* Flight data manager (see below).

Images conversion (optional)

If you want to import RAW files (*.CR2) from your camera, please select the camera type hereunder.

S110 NIR
No RAW files
S110 RGB
S110 NIR
S110 RE

This *RAW* processing can also be applied to *RAW RGB* images, for example if the *RGB* images are combined for index calculation with *NIR* or *RE* images.

Note: Due to their high precision, the *TIFF* files generated are significantly larger than the *RAW* files. Therefore, when archiving your projects it is more space-efficient to archive the *RAW* images instead of the *TIFF* images. Archiving these *RAW* versions also has the advantage of future-proofing your images with regards any forthcoming software updates that may require, for example, the reprocessing of *RAW* files in *eMotion*.

Part II

Advanced modes

Goal of this part: This part describes how to optimise the *S110* camera's settings to suit specific terrain conditions.
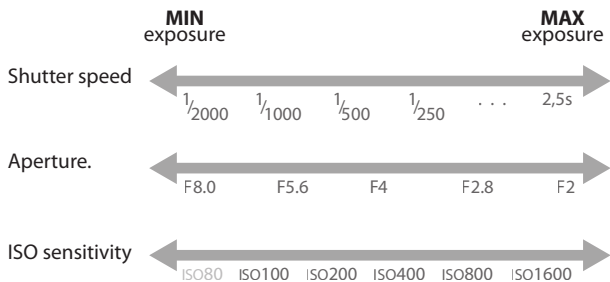
6   Understanding exposure

Exposure is the amount of light a digital camera's sensor captures in a given amount of time. Camera **Aperture**, **Shutter Speed** and **ISO** settings directly affect exposure. Selecting the right settings allows you to get the best out of the camera and avoid overexposed, underexposed or blurry images.

6.1   Shutter speed

The **Shutter Speed** is the speed at which the camera's 'curtain' opens and closes, measured in fractions of a second. The **Shutter Speed** is the most important setting as it directly influences an image's sharpness when the camera is moving: the faster the shutter speed, the less motion blur occurs, and also the less light enters the optical system. To compensate for this reduction of light, the **Aperture** and **ISO** sensitivity settings can be modified (either automatically in **Tv** mode or manually in **M** mode).

6.2   Aperture and ISO sensitivity

The **Aperture** setting controls the lens' diaphragm aperture and is represented by the F-number. It controls the amount of light passing through the lens. Similarly, the **ISO** speed determines the image sensor's sensitivity to light and each up/down incremental **ISO** setting represents a doubling or halving of the sensor's sensitivity to light, respectively.

MIN exposure   MAX exposure

Shutter speed $\frac{1}{2000}$ $\frac{1}{1000}$ $\frac{1}{500}$ $\frac{1}{250}$ . . .   2,5s

Aperture.   F8.0   F5.6   F4   F2.8   F2

ISO sensitivity   ISO80   ISO100   ISO200   ISO400   ISO800   ISO1600

7   Tv mode

As mentioned in the 'Predefined camera settings' section, factory settings are stored in the **C** mode. These default settings are based on the **Tv** mode, where the **Shutter Speed** is set to 1/2000s and both **Aperture** and **ISO** speed are automatically adjusted by the camera. Using this mode allows users to set a preferred **Shutter Speed**. The camera automatically adjusts the **Aperture** and **ISO** speed to ensure optimal image exposure. To customise the **Shutter Speed**, select **Tv** on the mode dial.

To change the **Shutter Speed** in **Tv** mode, turn the control dial right or left to select the desired **Shutter Speed** as shown below.

A **Shutter Speed** of 1/2000s is the optimal value for most projects. Going down to 1/500s may allow you to cope with low-light conditions without the **ISO** reaching extreme values, which would create pixel noise. However, setting the **Shutter Speed** to longer values will significantly increase the risk of getting blurry images, especially in windy conditions.

7.1 Safety shift

As indicated in the 'Predefined camera settings' section, the camera will lower the **Shutter Speed** when reaching the maximum **Aperture** and **ISO** speed (poor light conditions) in order to prevent underexposed images. This parameter can be deactivated by pressing Menu and then setting **Safety Shift** to **OFF** on the **Camera** tab.
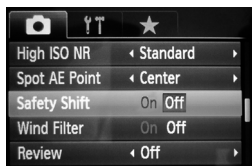
8 M mode

⚠️ **Caution:** This manual mode requires good knowledge of exposure as there is no means of verifying the quality of the images taken during flight. As this mode is totally dependent on user-chosen settings, it has to be considered with the utmost attention in order to avoid bad image exposure.

In manual mode, the **Shutter Speed**, **Aperture**, and **ISO** sensitivity have to be set manually before the flight. The manual mode can be useful if you want to have a constant exposure across the mission area.

To enter manual mode, turn the mode dial to **M**.

Use the control dial to set **Shutter Speed** and **Aperture**. Press the Up button to switch between **Shutter Speed** setting and **Aperture** setting. **ISO** sensitivity can be modified with the FUNC./SET button.

Set shutter speed and aperture

Set ISO sensitivity

switch from one to another
(shutter speed/aperture)

+

+

You can set a suitable exposure with the following procedure.

1. Take your *S110* camera out of the *eBee*, insert its internal battery and switch it on.

2. Point the camera toward a portion of the ground that is lit similarly to the planned mission area and manually trigger a single picture in **M** mode (i.e., do not take a picture of a shadow on a bright sunny day).

3. By pressing the playback button, you can visually check your image. Then, by pressing the DISP. button twice, you can access

the exposure values and adjust the settings if necessary (motion blur, overexposed, underexposed).

Repeat steps 2 and 3 until a satisfactory exposure setting is reached.

+

x2
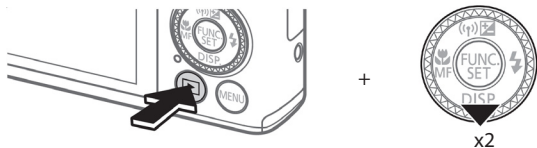
Note: Please note that this procedure has to be repeated before every flight as light conditions may change rapidly.

Part III
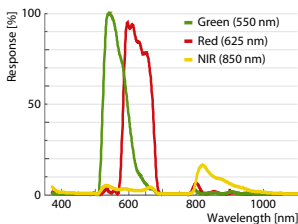
# Appendix

1 RGB, NIR and RE bands

Each camera variant features a different filter, with each capable of acquiring information in different regions of the light spectrum. The figures below compare the corresponding normalised response spectrums.
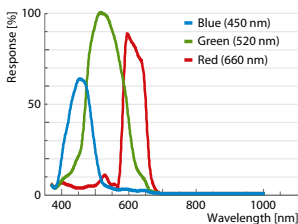
S110 RGB camera: The *RGB* variant provides standard Red, Green and Blue band data.

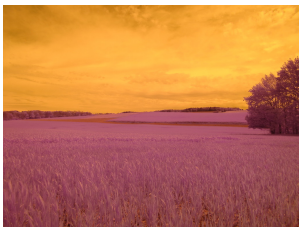**S110 NIR camera:** The *NIR* variant provides NIR, Red and Green band data.
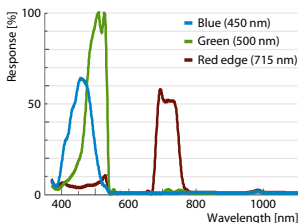
S110 RE camera: The *RE* provides Red-Edge, Green and Blue band data.

2 RGB, NIR and RE images comparison

The image guides below will help you to easily identify which camera variant was used to acquire your images. For a colour version of these figures, please refer to the electronic version of this User Manual.

S110 RGB camera: The *RGB* variant corresponds to the original *S110* camera. Colours are unmodified and look natural, e.g., when looking through the camera's LCD screen the vegetation appears green and the sky blue.

S110 NIR camera: The NIR variant features custom filters, which capture *Near Infrared* information in the blue channel. On the camera's LCD screen the vegetation therefore looks violet and the sky appears yellow/orange.
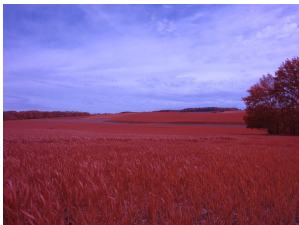
S110 RE camera: The *RE* variant's custom filters capture *Red-Edge* information in the red channel. On the camera's LCD screen, the vegetation appears red and the sky blue.

3 Specifications

Sensor	1/1.7" back-illuminated CMOS
Image size	12.1 Mpix
Maximum f/number	f/2.0
Maximum shutter speed	1/2000s
Output formats	JPEG and RAW
Operating environment	0 – 40 °C, 10 – 90% humidity
Weight	Approx. 153 g (5.4 oz) excl. battery

4 Handling precautions

- If water droplets or dirt stick to the camera or screen, wipe with a dry soft cloth, such as an eyeglass cloth. Do not rub hard or apply force.

- Never use cleaners containing organic solvents to clean the camera or screen.

- Use a blower brush to remove dust from the lens.

- To prevent condensation from forming on the camera after sudden temperature changes (e.g., when the camera is transferred from a cold to warm environment), put the camera in an airtight, resealable plastic bag and let it gradually adjust to the temperature before removing it from the bag.

- If condensation does form on the camera, stop using it immediately. Continuing to use the camera in this state may damage it.

Remove the battery and memory card, and wait until the moisture has evaporated before resuming use.

5 senseFly factory settings

The configuration of your *S110* camera is critical for the acquisition of quality images. In case of unwanted configuration changes, the camera can be configured back to senseFly factory settings using the following procedure.

- Insert the battery into the camera, and power it on.

- Reset to Canon factory settings:

  - Press the MENU button and navigate to the **Tools** tab.

  - Choose **Reset All** and confirm with **OK**.

- Select **AUTO** on the mode dial.

- In shooting mode, press MENU to enter into the **Shooting** settings and set them as follow:

Digital Zoom	OFF
AF-assist Beam	OFF
Flash Settings…	OFF
> Red-Eye Corr	OFF
> Red-Eye Lamp	OFF
Review	OFF
IS Mode	OFF
Face ID Settings > Face ID	OFF

- Into the **Tools** tab, set the options as follow:

Mute	ON
Date/Time	Correct the date and time
Time Zone	Correct the time zone
LCD Brightness	Set to minimum and press MENU
Power Saving…	
> **Auto Power Down**	OFF
> **Display Off**	3 min

- Leave the **AUTO** mode to enter the **Tv** mode with the mode dial.

- Press RING FUNC. and select **ISO Speed**, then FUNC./SET to confirm.

- Press FUNC./SET, press the Up and Down buttons to set:

Output format	RAW+JPEG
Still Image Aspect Ratio	4:3
Image Resolution (Size) ($\blacksquare$ L)	L

  Press FUNC./SET to confirm.

- Set **Shutter Speed** to **1/2000** seconds with to the control dial.

- Press MENU and set the following:

Safety Shift	ON
Save Settings…	OK

  (This last action will save the current settings into the **C** mode)

ℹ **Note:** Occasionally, the "Wrong flash position Restart the camera" message may appear on startup. This is a harmless message that can be safely ignored.