DeepSkyCamera for Android

App for astrophotography

Manual and reference

Based on version 2.1.4

February 2025

Michael Seeboerger-Weichselbaum

https://www.youtube.com/channel/UCHIUeFGXThOF0GJ5aijnr8w/

https://www.facebook.com/groups/745867855869000/

https://www.instagram.com/deepskycamera/

https://www.deepskycamera.de/

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Preface

DeepSkyCamera for Android started in January 2018 as a programming project only for the LG G4 smartphone with Android 6. At first I did not intend to publish the app in any form. The app was only intended as a programming project for my own smartphone, I hadn't even thought of universal compatibility with other phones.

The aim of the project was that I could use the ultimate mobile solution for astrophotography - I didn't want to take a lot of technical luggage with me on vacation and when traveling by air. Baggage regulations for air travel have been tightened and made more expensive. Mobile astrophotography should be small and light, with a maximum of a small mobile mount in your luggage. That should be it then.

I finished the first version in February 2018 and during the first experiments with the app I was speechless: it worked! The continuous shooting function at maximum exposure time ran smoothly on the LG G4! One astro image after the other was taken and saved, followed by the dark frames, bias frames and flat frames. The focus was fine. So it works!

At that time, the app was in its first rudimentary version. Back then, a lot of the programming code was hardwired. But the basic things worked: you could set the number of pictures to be taken, choose exposure time and ISO, set type and format of the picture.

Some amateur astronomers heard about the app and asked if they could test it. Due to the inquiries, I put the app in the Google Playstore in June 2018. Since everyone uses a different smartphone, I had to establish compatibility with the individual phones. Huawei and Honor devices offer up to 30 seconds, but Camera2API - and thus DeepSkyCamera - could only offer 1 second. What to do? I adapted the app to Huawei and Honor so that a maximum exposure time of 30 seconds is possible with these devices - almost no other app enables this. However, this adaptation to Huawei and Honor meant that there is a separate code area for these devices. The flagships of 2018 such as Huawei P20 Pro, Mate 20 Pro also had to be treated specially - again with their own code area.

For a long time I worked on the compatibility with Samsung S and Note devices, because many users asked about it. Similar to Huawei and Honor, Camera2API only offers 1/10 sec maximum exposure time. Far too little for astrophotography. In a first step, I was able to offer a maximum of 10 seconds exposure times for Samsung S6 to S8 and Note 5/8 in 2018 - which no other app can offer to this day (except for the original Samsung camera app). The programming code continued to grow - a separate code area had to be created for these Samsung models as well. The S9 was also released in 2018 and unfortunately my approach for S6 - S8 no longer worked. The solution for S9 / Note9 and higher should take over a year!

In 2019 the app appeared with a new user interface (version 1.3.0, August 2019). I was able to further increase the compatibility with the smartphones, including full compatibility with Xiaomi and OnePlus devices - again with their own code section. With update 1.3.1 from October 2019, I also wrote a manual for the app in German and English. At the same time, the Facebook group for the app, the YouTube channel and the Instagram account were created. In the same year, I uploaded the app to the Huawei AppGallery for the first time. Since the app runs very well on Huawei and Honor, it no longer has an expiration date there.

The year 2020 was all about full compatibility with Samsung devices. Finally I was able to offer 10 sec or 30 sec max exposure times for S9 / Note 9 and higher (Version 1.4.0 in March 2020). To this day, no other camera app can offer this. As a result, the program code grew more and more - because for

these Samsung S and Note models I had to integrate my own code. At the same time, I was able to drastically increase the exposure time on some Samsung devices of the A models, e.g. Samsung A70 with 106 sec. I was also able to increase max shutter speed on other A-models accordingly, but only to about 70 seconds. Many new functions were integrated that year, including grid, burstshot mode, and the internal file browser was further enhanced. The maximum exposure time could be increased for some Xiaomi and realme devices (sometimes up to 60 seconds). In the same year I made the app available in the Samsung Galaxy Store. Similar to the version in the Huawei AppGallery, the app in the Samsung Galaxy Store has no expiration date - because the app runs very well on Samsung S, Note and A models.

The year 2021 went on rapidly with new versions and new functions. External Bluetooth controllers can be used, exposure time extensions were added (including Google Pixel 4/5, OnePlus 8 Pro). Special code sections were added again, e.g. for OnePlus 8 and higher, OnePlus Nord and higher, realme 5. New functions have been added, e.g. histogram, sharpening and hot pixel removal. So far the app was in German and English - now Italian and Spanish have been added.

The response to DeepSkyCamera was and is enormous - in mid-2021 the app passed the 50,000 active installations mark for the first time. This number is very important because it tells you how many phones the app is used on continuously. The number of downloads is much higher at half a million, which is easy to explain. Users of the app switch phones and download the app again from the Playstore. As a result, the number of downloads increases faster than the number of active installations.

The project continues, of course - even if it is more than stressful on a few days and the manufacturers of the smartphones are thinking about new things or providing updates that lead to compatibility problems that I have to solve.

Finally, I would like to take this opportunity to thank several people who have contributed to the project:

Davide Galotti: Translation of the manual into Italian and Spanish.
Oscar A. Lithgow: Additional data and extensions in the list with the compatible telephones.
Phil Ovent: Translation of app into French.
Alain Abello: translation of manual into French.
Osvaldo Barraco: Translation of manual into Spanish.
László Heller: Translation of app into Hungarian

Finally, a warm and loving thank you to my wife Carla Margarida Lanca Seeboerger-Weichselbaum. I can't do it without you. And not without Neo Manuel either. I love you both.

Michael Seeboerger-Weichselbaum
Frankfurt am Main, Germany, September 2021

More than two years have passed since the first preface - time for enhancements. For developers perhaps quite interesting: the app was previously written in Java. At the beginning of 2022 I started to write new features for the app in Kotlin. Existing classes remain in Java for now.

On some Samsung phones I managed to increase the maximum exposure time up to 10 min per frame (including A52, S20 Ultra, Note 20 Ultra). There might be more here, but I stopped at 600 sec per frame for now. 10 min for a single image is already a bit crazy. Compatibility has been increased

further, including on Motorola phones and the new Honor devices (after being sold by Huawei). Here, the DeepSkyCamera app is still the only app in the Playstore that can offer long exposure.

With version 1.9.2 I integrated a calculator for point-like stars, i.e. up to which maximum exposure time the stars still remain point-like. Likewise a log file viewer was added, in order to have more analysis possibilities in particular with errors or problems.

At the end of 2023, the app was also released in French with version 1.9.9 - so the app is now available in 5 languages.

Michael Seeboerger-Weichselbaum
Frankfurt am Main, Germany, December 2023

1. Introduction

DeepSkyCamera for Android is an app for astrophotography. You should be familiar with astrophotography in general. The most important thing:

Astrophotography is not a 1-click solution!

If you are not familiar with astrophotography please read a little bit about astrophotography before using this app (see chapter "Astrophotography" below which provides links on the Internet).

The image below shows Crab nebula M1 in constellation Taurus – taken with DeepSkyCamera app, Xiaomi Pocophone F1, telescope Takahashi TOA 130, 1000mm focal length, APM Lunt 13mm 100 degrees eyepiece, 112 light frames each 35 sec, ISO 800, 65 min total exposure time, additionally dark frames, bias frames and flat frames. Processed with DeepSkyStacker, Fitswork, Photoshop CC

Overview

The app uses the camera sensor on the back of your smartphone. You can set up an imaging plan to take pictures, including flat frames, darks frames and bias frames. The procedure is very similar to astrophotography with a DSLR or a dedicated astro camera with a CCD/CMOS sensor. The app takes the pictures – post processing (stacking, editing, processing) must be done with separate software (DeepSkyStacker, Sequator, Astronizer, Photoshop, Gimp, PixInsight, AstroPixelProcessor, etc.). With the upcoming Pro version you can do also the post processing.

This manual describes the free version of DeepSkyCamera for Android. Features:

- DeepSkyCamera for Android was the first app for astrophotography in Google Playstore. First version was released in May 2018.
- Uses Camera2API to access the camera sensor. Max shutter speed, ISO, white balance etc. is determined via Camera2API only.
- Max shutter speed of 29 to 35 sec on lots of phones (f.i. Xiaomi Mi and Redmi, LG G, LG V).
- The only app in Google Playstore which provides 10 sec max shutter speed on Samsung (S6 - S9, Note 5 - Note 9) or 30 sec (Samsung S10/Note 10 and higher)
  Extended max shutter speed on:
  Samsung A05: 600 sec
  Samsung A06 (SM-A065): 30 sec
  Samsung A13 (SM-A137): 20 sec
  Samsung A14: 30 sec
  Samsung A15 (SM-A155): 25 sec
  Samsung A16 (SM-A165): 20 sec
  Samsung A23 4G: 49 sec
  Samsung A24 4G: 20 sec
  Samsung A33 5G: 30 sec
  Samsung A34: 20 sec
  Samsung A35: 600 sec
  Samsung A42 5G: 71 sec
  Samsung A51 5G: 22 sec
  Samsung A52 4G: 600 sec
  Samsung A52 5G: 75 sec
  Samsung A52s: 52 sec
  Samsung A53: 30 sec
  Samsung A54: 30 sec
  Samsung A55: 23 sec
  Samsung A70: 106 sec
  Samsung A71: 60 sec
  Samsung A72: 75 sec
  Samsung A73: 51 sec
  Samsung A80: 71 sec
  Samsung M15 (SM-M156): 20 sec
  Samsung M33: 30 sec
  Samsung M44 (Galaxy Jump 3): 600 sec
  Samsung M51: 71 sec
  Samsung M52 5G: 52 sec
  Samsung M54 (SM-M546): 30 sec
  Samsung F62: 30 sec

- Extended max shutter speed on these Samsung S and Note models with Qualcomm:
  Samsung Note 20 Ultra: 600 sec
  Samsung S20 Ultra: 600 sec
  Samsung S21 Ultra: 600 sec
  Samsung Note 20: 130 sec
  Samsung S20 5G: 130 sec
  Samsung S20 Ultra: 600 sec
  Samsung S20 Plus: 130 sec
  Samsung S20 FE 5G (SM-G781): 155 sec
  Samsung S21: 130 sec
  Samsung S21 Plus: 130 sec
  Samsung S21 Ultra: 600 sec
  Samsung S21 FE: 43 sec
  Samsung S22, S22 Plus, S22 Ultra: 55 sec
  Samsung S23, S23 Plus, S23 Ultra: 51 sec
  Samsung S24, S24 Plus, S24 Ultra: 51 sec
  Samsung Flip 3: 70 sec
  Samsung Flip 4: 55 sec
  Samsung Flip 5: 51 sec
  Samsung Flip 6: 210 sec
  Samsung Fold 2: 130 sec
  Samsung Fold 3: 130 sec
  Samsung Fold 4: 55 sec
  Samsung Fold 5: 51 sec
  Samsung Fold 6: 210 sec
  Samsung Fold 6 SE: 51 sec
  Samsung Tab S7 FE: 120 sec
  Samsung Tab S8, Tab S8 Plus, Tab S8 Ultra: 50 sec
  Samsung Tab S9 Ultra, Tab S9 Plus, Tab S9: 51 sec
  Samsung Tab S10 Ultra 5G: 170 sec
- OnePlus 8 Pro: 55 sec max shutter speed, OnePlus 9 and 9 Pro: 52 sec max shutter speed.
- Oppo Find X3 Lite: 183 sec max shutter speed, Oppo X2 Pro: 55 sec Oppo Reno 3: 90 sec, Oppo A55: 37 sec, A57s: 37 sec, A15 and A16: 55 sec
- Oppo X5: 84 sec max shutter speed
- Oppo X7 Ultra: 101 sec max shutter speed
- Provides 30 sec max shutter speed on Huawei and Honor devices.
- Extended shutter speed of 59 sec on Xiaomi Redmi 9, 43 sec on Xiaomi Redmi Note 9 and 34 sec max shutter speed on Xiaomi Mi 11 Lite 5G, Xiaomi Redmi Note 11: 44 sec.
- Xiaomi Black Shark 4 Pro: 51 sec max shutter speed
- Extended shutter speed of 60 sec on realme Narzo 20, C21, realme 7 Pro: 60 sec and 43 sec on realme 8 Pro.
- Extended shutter speed of 40 sec on realme C2, C3, C3i, C15.
- realme C55: 60 sec max shutter speed
- Extended shutter speed of 32 sec on Google Pixel 4, 5. 17 sec on Google Pixel 6/6 Pro/7/7 Pro and 10 sec on Google Pixel 1, 3.
- Google Pixel 8 / 8 Pro / 8a / Fold / 9 / 9 Pro / 9 Pro XL: 24 sec max shutter speed
- Full support of Motorola One devices (32 or 36 sec max shutter speed), Edge devices and on Moto G9 and higher. Extended max shutter speed on Moto G30: 55 sec, G40 Fusion: 55 sec

- Motorola Edge 30, 30 Pro: 51 sec max shutter speed
- Vivo X90 Pro and X90 Pro Plus: 43 sec max shutter speed , Vivo S1 Pro: 30 sec max shutter speed
- Vivo X100 Pro: 43 sec max shutter speed
- Vivo X100 Ultra: 33 sec max shutter speed
- Vivo X200 Pro: 45 sec max shutter speed
- Vivo Y15: 60 sec max shutter speed, Y51A: 32 sec max shutter speed
- Nokia XR20: 32 sec max shutter speed and on Nokia G10: 170 sec max shutter speed
- Asus Zenfone 8: 40 sec max shutter speed
- Sharp Aquos R7s: 30 max shutter speed
- Preview area to point to the stars.
- Live histogram of viewfinder (not available on Samsung S6/7/8, Note5/8 and Legacy devices)
- Histogram of images (not available on Samsung S6/7/8, Note5/8 and Legacy devices)
- Noise reduction based on Camera2API and camera sensor
- Noise reduction without camera sensor (3X3 Median, 5X5 Median)
- Focus methods: manual, auto, infinity, hyperfocal.
- Customized infinity
- Focus lock/unlock.
- Exposure time and ISO of viewfinder can be set independently from the exposure time and ISO of the images.
- Synchronize exposure time of the images with exposure time of the live view.
- Set up a plan for your imaging session.
- Supported file formats: JPEG and RAW (DNG).
- Manual settings:
    - ISO
    - Exposure time
    - Interval time between two pics
    - Number of pics
    - Delay before the imaging session starts
    - Whitebalance
- The path in which the images are stored can be selected individually. As of Android 14, only four storage locations are possible due to "Google Play's photo and video permission policy"
- Save pictures also in SD card, if your phone supports SD cards.
- Night mode (black background and red text color) and daylight mode (white background, black text color).
- Night mode of the app works totally independent from Dark Mode of Android 10 (or higher). Night mode of the app works on Android 6.0 and higher.
- Whitebalance manually and automatically.
- Internal file browser which provides navigation, sorting and deleting of image files.
- Internal file browser can display the images and can zoom into the images.
- Zoom function (not available on Samsung S6/S7/S8 and Note 5/8).
- Grid.
- variable aperture (if supported, f.i. Samsung S9, S10, Note9, Note 10).
- variable focal length (if supported).
- Interval time 0 sec / Burst shot mode (not available on Samsung S6/S7/S8, Note 5/8, some A and J models).
- Sharpness (edge mode)

- Hot pixel removal
- Calculator for pinpoint stars
- Timestamp on JPEG files
- Support of external Bluetooth controller to start/stop the imaging session.
- Support of wired headset to start/stop the imaging session.
- Huge compatability list with over 400 phones which contains the technical data of lots of phones.
- App available from Google Playstore, Samsung Galaxy store and Huawei AppGallery.
- No ads.

How DeepSkyCamera app works

DeepSkyCamera app works different. The settings of the viewfinder are totally independent from the settings of the images. This can be confusing but its essential. The advantage is that you can see the brightest stars in the viewfinder when you set ISO to 12800 (or similar) and exposure time of the viewfinder to 1 sec. This is also an advantage when the phone is attached to a telescope. With some devices you can see the brightest objects in the viewfinder!

The images below shows Orion nebula M42 in the viewfinder of the app. The smartphone was attached to a Taskahashi FS 60 refractor. You take the pictures with other values (f.i. ISO 800 and 30 sec shutter speed).
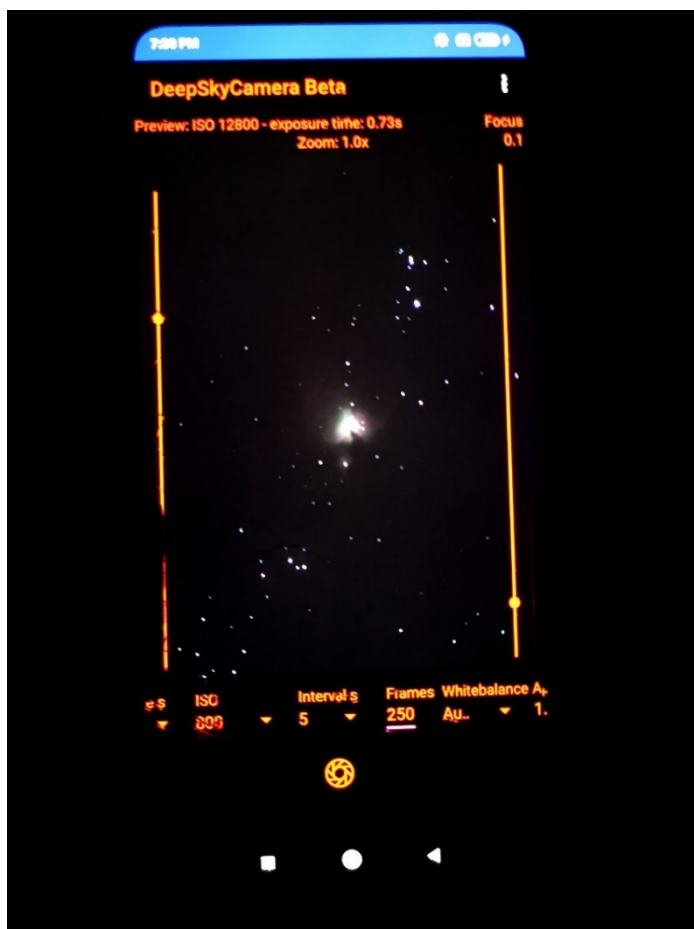
After taking light frames, dark frames, bias frames and flat frames you have lots of files. The image files must be transferred to a computer. You must stack and process these files with separate software.

Astrophotography

This manual is NOT an introduction to astrophotography. This manual explains NOT what flat frames are or how to process the image files. When you are not familiar with astrophotography you'll find here some links which explains all the necessary things.

Astrophotography in general

https://astrobackyard.com/beginner-astrophotography/

http://astronomyonline.org/Astrophotography/Introduction.asp?Cate=Astrophotography&SubCate=AP01

https://loadedlandscapes.com/intro-to-astrophotography/

https://www.bhphotovideo.com/explora/photography/tips-and-solutions/how-to-do-basic-backyard-astrophotography-part-i-introduction

Smartphone astrophotography

NASA Book "A Guide to Smartphone Astrophotography" by Dr. Sten Odenwald

https://spacemath.gsfc.nasa.gov/SMBooks/AstrophotographyV1.pdf?fbclid=IwAR3j0Z_CE_MNGHpvE-jypdhkiwk0GzT2iszj2-F-oupQAVm1jimcJkgJFe8

Stacking software

Siril
https://siril.org/

DeepSkyStacker (DSS)

http://deepskystacker.free.fr/

Sequator

https://sites.google.com/site/sequatorglobal/

Fitswork
https://www.fitswork.de/software/

Astronizer

https://stackmatik.hellstorm.de/index.php/en-us/2-uncategorised/4-astronizer-astronomical-image-processing

Nina

https://nighttime-imaging.eu/

PixInsight

https://pixinsight.com/

Astro Pixel Processor

https://www.astropixelprocessor.com/

Theli

https://www.astro.uni-bonn.de/theli/

StarTools

https://www.startools.org/

Postprocessing

Gimp

https://www.gimp.org/

Paint.net

https://www.getpaint.net/

Raw Therapee

https://rawtherapee.com/

Lightroom

https://www.adobe.com/products/photoshop-lightroom.html

Photoshop

https://www.adobe.com/products/photoshop.html

2. Installation

The app is available at Google Playstore:

https://play.google.com/store/apps/details?id=de.seebi.deepskycamera

If you have a Huawei or Honor smartphone you can install the app from Huawei AppGallery:

https://appgallery.huawei.com/app/C101316097

If you have a Samsung smartphone you can install the app from Samsung Galaxy store:

https://galaxystore.samsung.com/detail/de.seebi.deepskycamera

3. Updates

Updates of the app are only available at Google Playstore or Huawei AppGallery. You will be notified by Playstore or AppGallery, when a newer version is available.

4. First launch of the app

When starting the app for the first time, you must grant some specific rights to the app, such as for accessing the camera sensor. Whithout granting these rights, you cannot use the app.

You'll see the welcome screen and a dialog which tells you what's new in this version. All the dialogs with blue background have an option at the end "Do not show again". If you don't tick the box, the dialog appears again after restart. On some devices with a small display, you must scroll down to see the option "Do not show again".

5. Main page of the app

On the main page, you'll find everything you need to take pictures. Important configurations and settings are in the menu "Settings".

Overview

In the middle, you'll find the viewfinder. This is the viewfinder and shows the live stream of the camera sensor. It's also called preview area or live view.

The start page consists of these elements:

- In the center is the preview of the camera sensor
- Three dots top right: the menu
- The eye symbol: Settings for the preview
- The triangle at the bottom: Settings for the images
- The shutter button
- To the right of the shutter button is the icon for the internal file browser

When you tap the eye icon and the triangle, the settings bars will pop up.
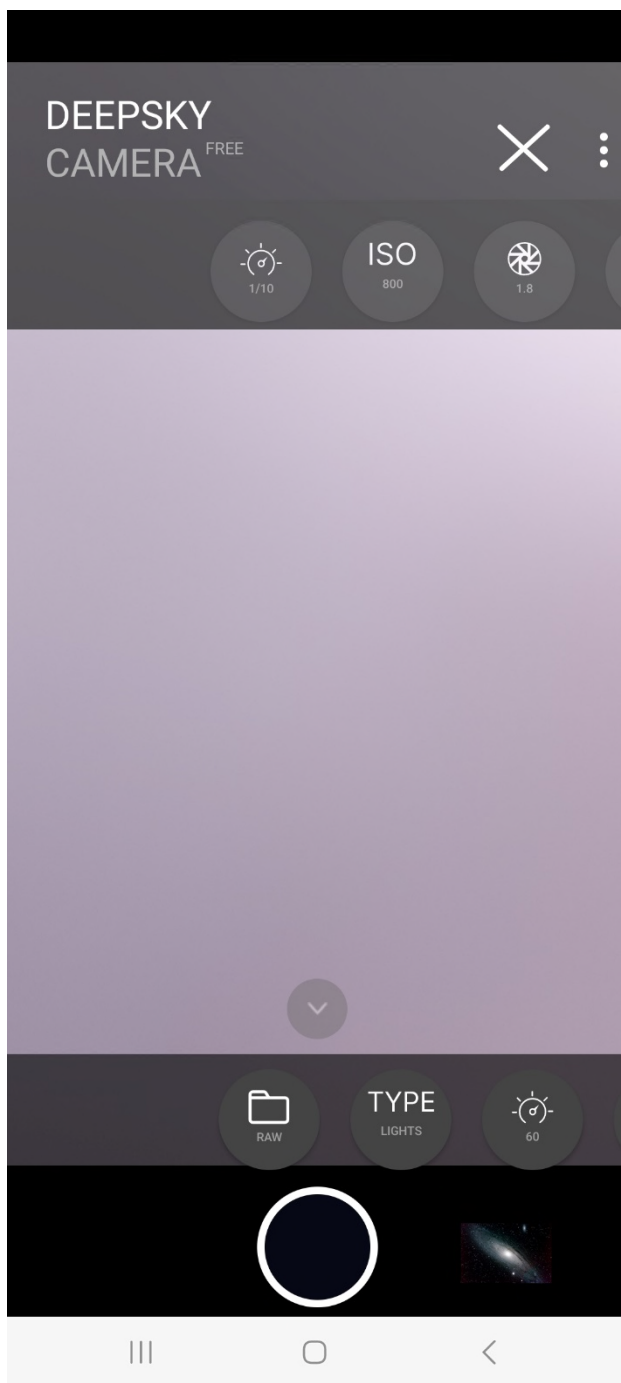
Note: It is possible that the preview area is black on some devices after start (see picture below). This is not an error. The exposure time of the viewfinder is set to 1/10 sec by default – thats why it's dark on some devices. There is a simple solution: Move the slider on the left up. The slider on the left controls the exposure time ONLY OF THE VIEWFINDER. You should see something now.

Preview settings
If you tap on the eye symbol, a bar with icons opens.
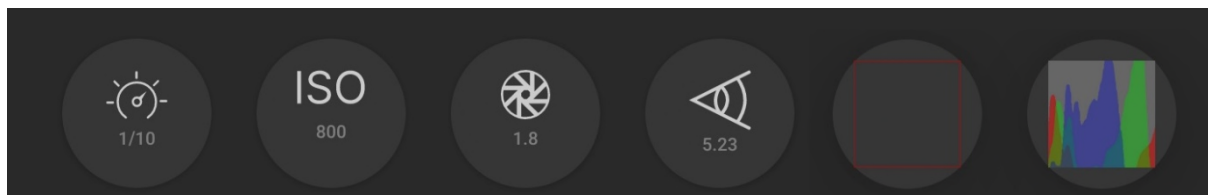
Here you can make the settings ONLY FOR THE preview. These are in the order of the icons:

- Exposure time
- ISO
- Aperture
- Focal length
- Grid
- Histogram

Preview exposure time
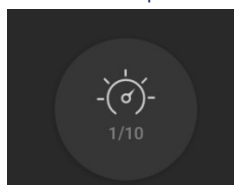
The first icon is for the exposure time of the preview. If you tap the icon, a slider opens above the shutter button, which you can use to adjust the exposure of the preview. This is important, for example, if you want to take pictures of the moon. It is often very bright and here you have the option of adjusting the exposure time very low so that you can see all the details on the moon's surface. This is also useful with the sun (please only ever use a solar filter).

With the "Auto" option, the app automatically controls the exposure time of the preview and adjusts it continuously. In this case, the slider is hidden.
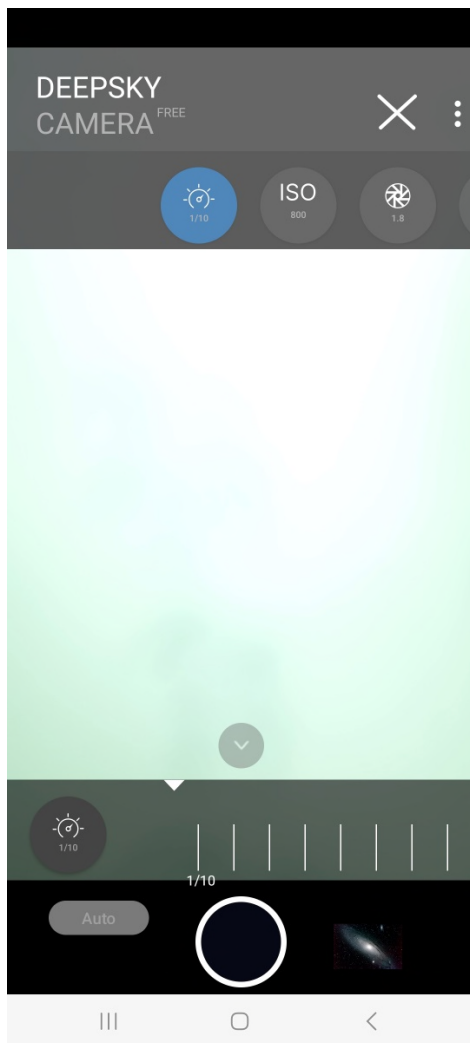
Note: The slider is not available on legacy devices.

At the same time, you can also adjust the ISO for the preview using the second icon. For moon it is recommended to use a low ISO number. For the sun (always only with a sun filter!) you also have to set the ISO value as low as possible (50, 100).

The slider for the exposure time of the preview initially has no influence on the later exposure time, which can be set in the slide bar above the shutter button. This exposure time for the specific recording is completely independent of the slider! DeepSkyCamera takes the approach that there are different settings: once for the preview and once for the recordings. The left slider only sets the exposure time for the preview.

However, if you set the exposure time of the images to "Preview", then the exposure time set for the preview will be used for the exposure time of the images - this is referred to as synchronization of the exposure times.

Under the starry sky, however, you should choose a higher ISO number and increase the exposure time of the preview until you see stars in the preview.

Note: The value for the exposure time of the preview is saved. If you close the app and restart it, the value you last used will be used.

Max shutter speed of viewfinder is 1 sec if phone support 1 sec or higher. This is intended behaviour and has nothing to do with shutter speed of the images. Due to technical reasons its a problem on

lots of phones when shutter speed of viewfinder is higher then 1 sec. On lots of phones the app hangs or crashes. It depends on phone, Android and camera sensor how this is handled. On some devices (f.i. Huawei, Honor) max shutter speed of 1 sec can be set but camera sensor reduces max shutter speed of viewfinder to something around 0.3 sec or 0.5 sec. The only thing you can do is to increase the ISO value of viewfinder to max ISO value (f.i. 3200, 6400, etc.).

When your device supports max shutter speed of 0.3 sec (or something faster then 1 sec) then camera sensor reduces max shutter speed of viewfinder automatically to supported max shutter speed. In this case 1 sec is not possible: max shutter speed of viewfinder is max shutter speed of the camera sensor.

Preview ISO
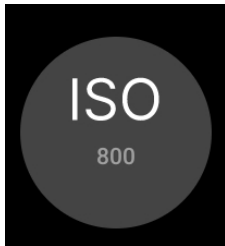
Tapping on the second icon opens the slider for the ISO range at the bottom. This setting can be used to specify the sensitivity of the sensor for the preview on the main page of the app. The possible ISO values depend on how the camera sensor was configured by the manufacturer and is different depending on the smartphone and camera sensor. The figure shows possible ISO values that can be set. The values can be different on your smartphone!
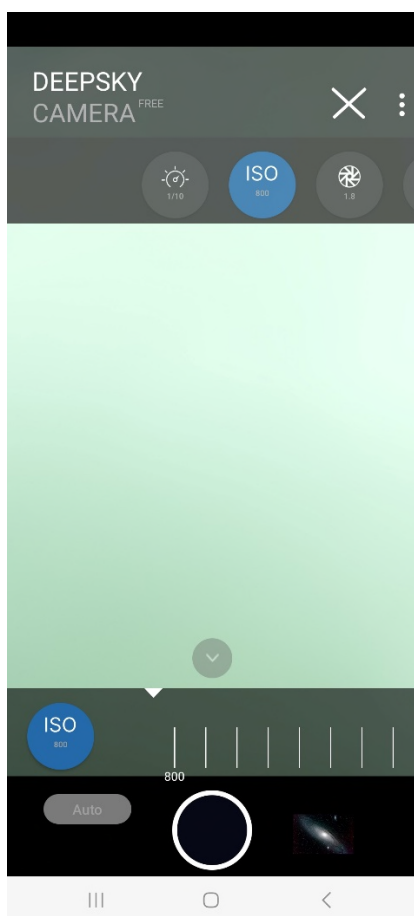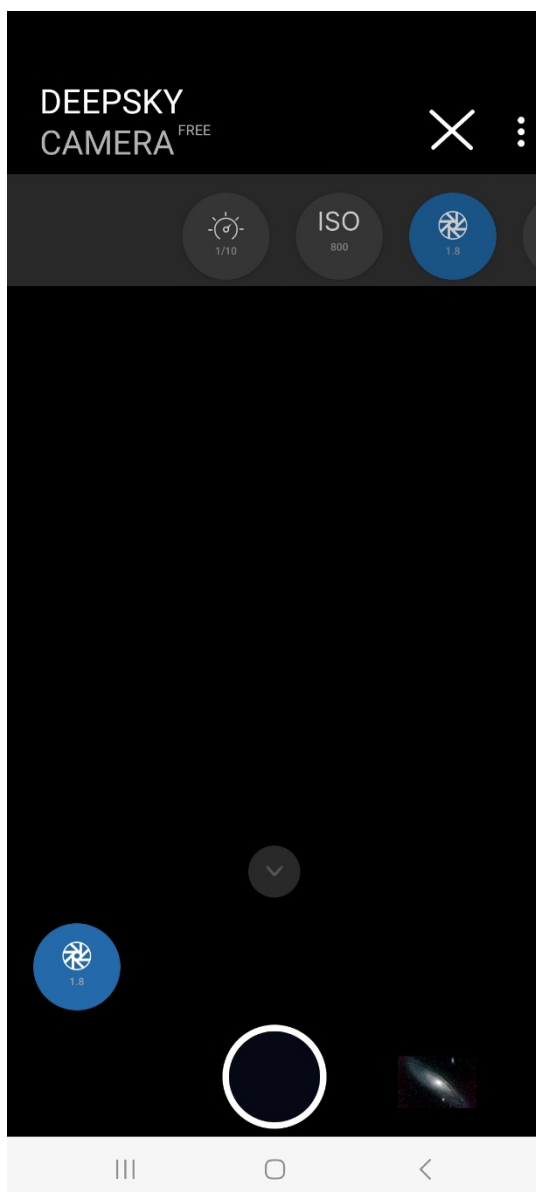
Note: On so-called legacy devices there is only the "Auto" setting. Legacy devices do not support manual settings and therefore do not support manual ISO.
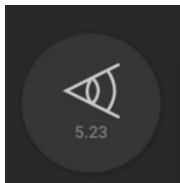
Preview Aperture
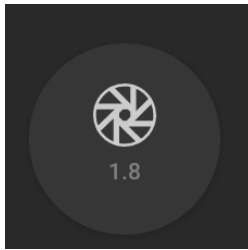
The third icon shows the available apertures. This depends on whether the manufacturer of the smartphone allows a variable aperture for the device. So far, only a few phones are able to offer a variable aperture. These are: Samsung S9, S10, Note 9 and Note 10 as well as Huawei P40 Pro (as of July 2020). On most smartphones, the aperture value is fixed and is for information purposes only.

This setting only affects the preview. If you want to set the aperture for the images, you can do this in the bottom bar.
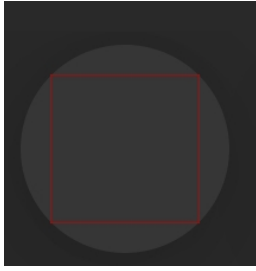
Preview Focal length

The fourth icon indicates the focal length. This depends on whether the manufacturer of the smartphone allows a variable focal length for the device. So far, only one phone is able to offer a variable focal length. This is: Huawei P40 Pro (as of July 2020). For most smartphones, the focal length is fixed and is for information purposes only.
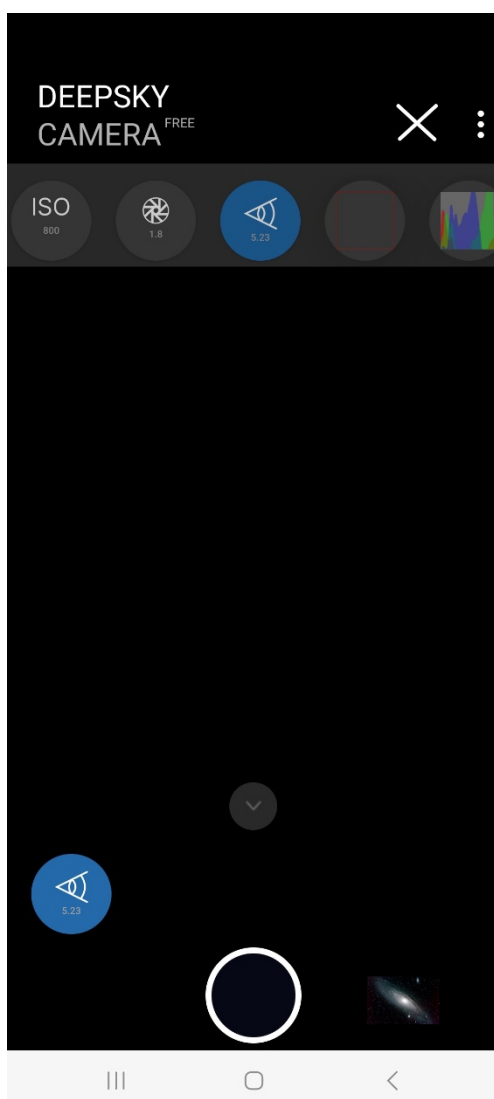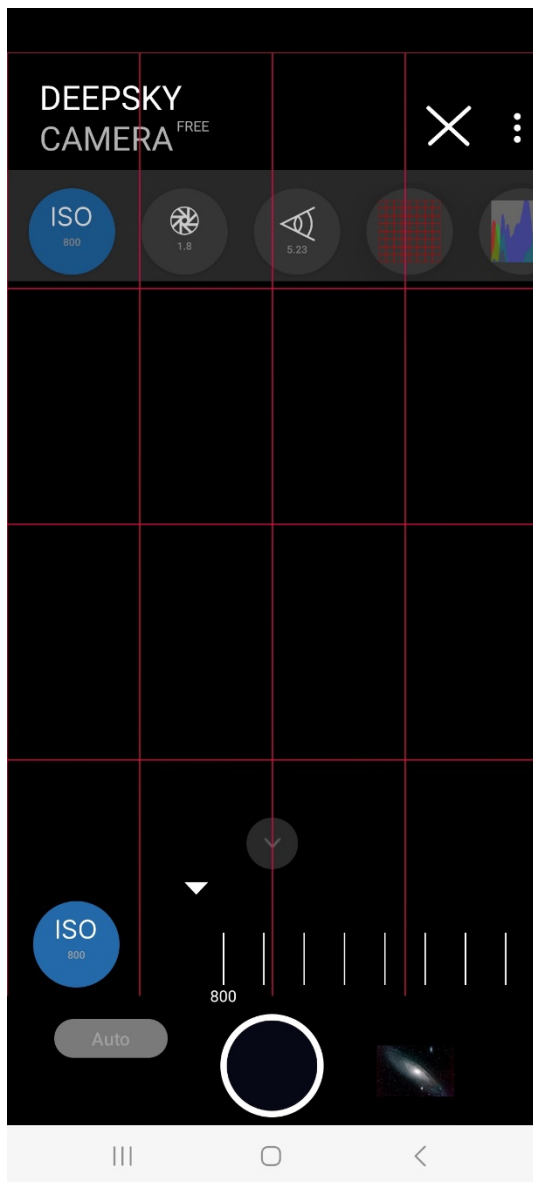

This setting only affects the preview. If you want to set the focal length for the images, you can do this in the bottom bar.

Grid

You can place a grid on the preview. This grid is very practical if you want to align the phone to a line, e.g. horizon, roof, etc. The following image shows the fine grid.
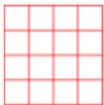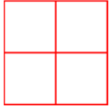

The grid is available in four forms:

- No grid (default)
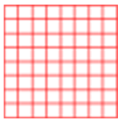- Rough grid
- Fine grid
- Very fine grid

The viewfinder does not show a grid by default. The grid icon shows only the outer border.

To get the rough grid you must tap the grid icon. You see the rough grid on the viewfinder. The icon changes.
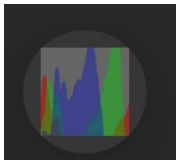

To get the fine grid please tap again the icon.

To turn grid off tap again the grid icon.

   Note: Grid is available on Android 8 and higher.

Histogram

You can enable or disable histogram of viewfinder by tapping on histogram icon right to grid icon


When you enable histogram of viewfinder a small windows pops up and shows the current histogram of the stream which comes from camera sensor. Histogram is updated after 500 ms and can change when you move the phone or vary the settings.

Note: Live histogram is available on Android 7 or higher. Live histogram is not available on Samsung S6/7/8, Note5/8 and Legacy devices.

Histogram is very helpful especially when you take flat frames. The peak of histogram of a flat frame should be in the middle. The image below shows a typical flat frame with histogram in internal file browser of DeepSkyCamera.
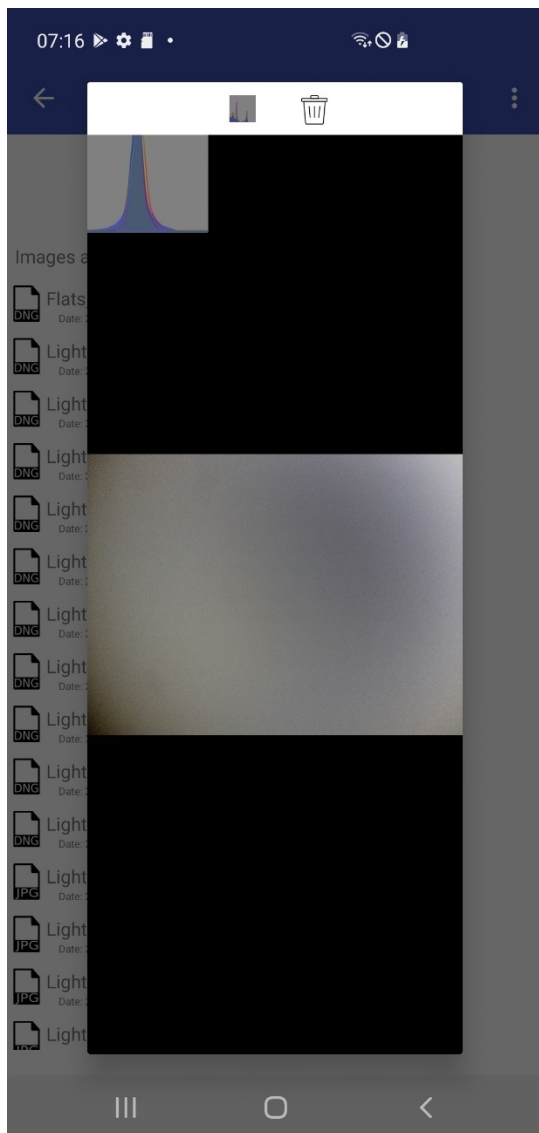
Settings for images

If you press the triangle above the shutter release button, the bar with the settings ONLY FOR THE PICTURES will appear. The bar can be moved from right to left and back again. The bar contains several controls that are important for taking pictures.
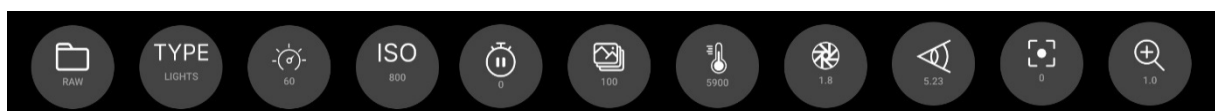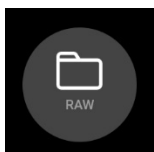

> **Note**: All settings that you make in the slider bar are saved. If you exit the app and restart it, the values you last used will be set again.

You can set this in the slider bar:

- Format of the images

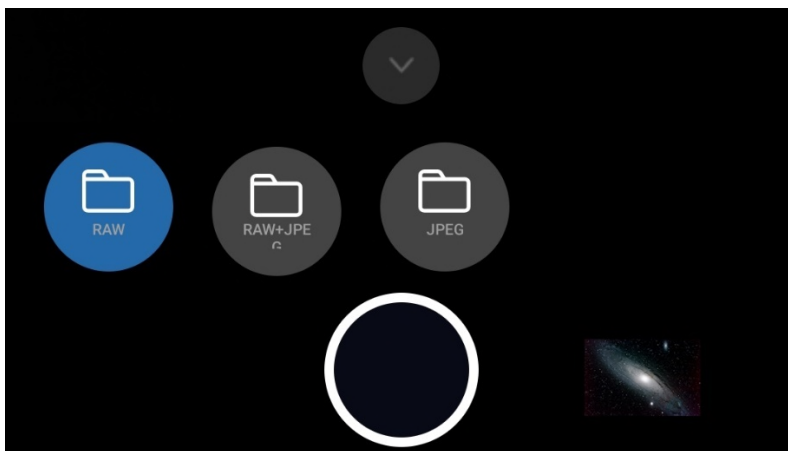- Type of images

- Exposure time in seconds

- ISO

- Pause between two images in seconds

- Number of images

- White balance

- Aperture

- Focal length

- Focus

- Zoom

Format

You can choose between these formats:

- RAW: You take pictures in RAW with file extension .dng
- RAW+JPEG: You take pictures in RAW and in JPEG
- JPEG: You take pictures in JEPG with file extension .jpeg

Note: There are smartphones on the market, which do not provide RAW (especially legacy devices). On those phones you can only take pictures in JPEG. The app detects automatically, what your device supports and changes the values in the control bar "Format".

Note: Due to technical reasons on Google Pixel 4a and 5 only "RAW" and "JPEG" are available, not "RAW+JPEG".

Type
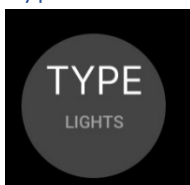
You can choose between these types:

- Lights: These are "normal" pictures of the stars, moon, etc.
- Darks: These are so called dark frames. The pictures must be taken with the same exposure time as the lights. You must cover the lens of your smartphone to take dark frames. The dark frames are useful, when you want to stack your images with separate software (DeepSkyStacker, Sequator, PixInsight, Astronizer, etc.). You can reduce the noise with dark frames.
- Bias: These are bias frames. When you select "Bias" the exposure time is automatically set to the fastest shutter speed available (e.g. 1/90000s or similar). You must cover the lens of your smartphone to take bias frames. The bias frames are useful, when you want to stack your images with separate software (DeepSkyStacker, Sequator, PixInsight, Astronizer, etc.). You can reduce the noise with bias frames.
- Darks+Bias: This is a combination of dark frames and bias frames. The app takes first the dark frames and then changes to bias frames with fastest shutter speed automatically. This saves time.
- Flats: They are great in combination with a stacking software to reduce the vignetting, dust on the sensor, etc. You need a flat field box or a T-Shirt for flat frames.
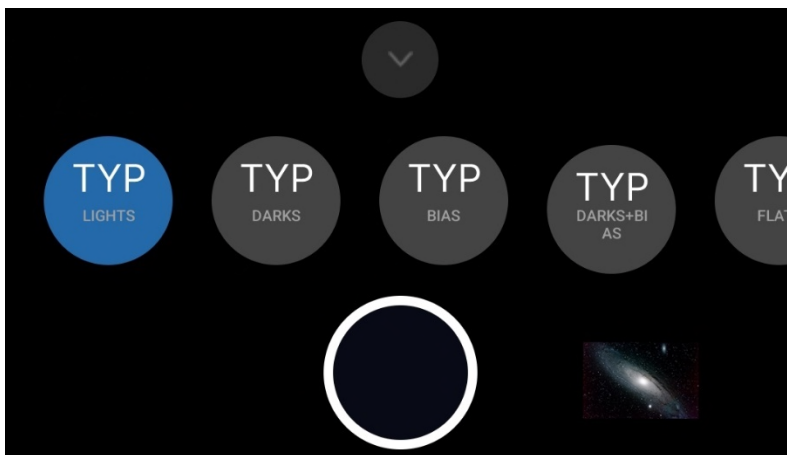
Exposure time
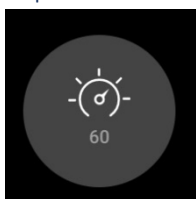
The control element "Exposure time" contains a list of available exposure times in seconds.
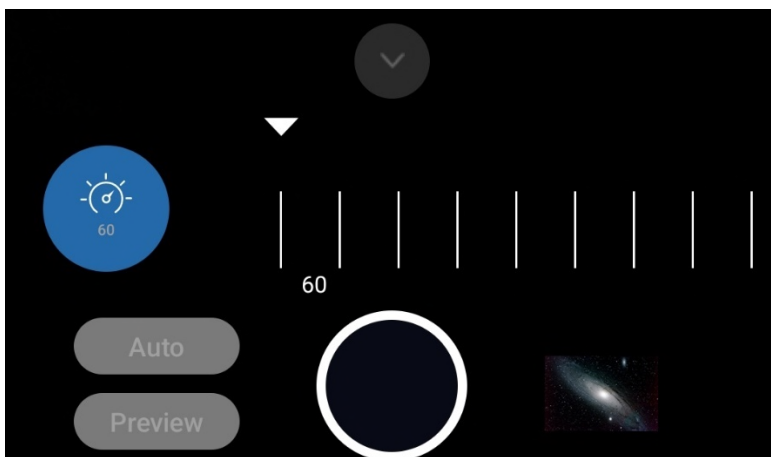
The values depend on the phone. Lots of smartphones provide max exposure time of 30 or 25 sec, other provide faster exposure times (8s or faster 1/4 sec). The list is dynamic. The app detects max exposure time of your phone and creates the list. For pictures of the night sky you should choose the highest possible value (20sec, 30 sec, etc.). For moon and the sun (with filter!) fast shutter speeds (1/10 sec and faster) are better, otherwise the moon or the sun will be overexposed. "Auto" exposure time is great only for sunsets, timelapse videos etc.

"Auto" is mostly not suitable in astrophotography. You can use is during daylight, sunsets etc. For deep sky and night sky images you should the longest shutter speed available (f.i. 30 seconds). Only for moon and sun images (sun always with appropriate solar filter!) you can set fast shutter speeds.

The entry "Preview" is useful when taking images of moon and sun (sun always with appropriate solar filter!). This function synchronizes the exposure time of the images with the exposure time of the viewfinder. The images will have the same shutter speed as the viewfinder.

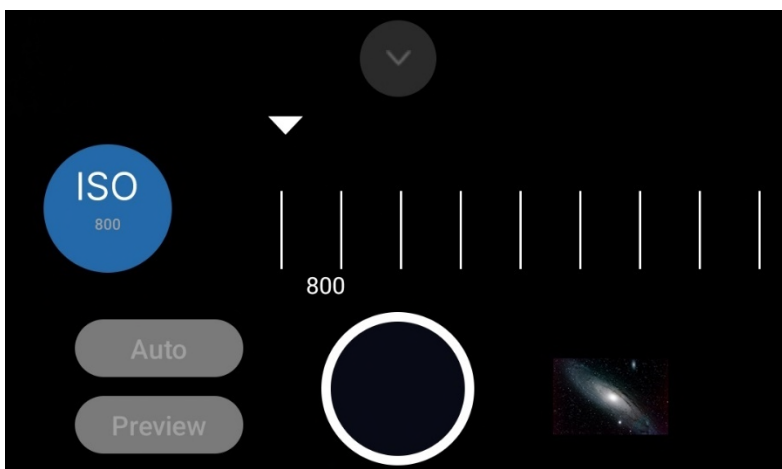   **Note**: On legacy devices only "Auto" is available.

When you select "Auto" exposure time in spinner "Exposure time" ISO is set to "Auto". This is a behaviour of the camera sensor on Android. Google defined that "Auto" means "Auto" exposure time and "Auto" ISO. This can not be changed.

   Note: Due to technical reasons "Auto" is not available on Samsung S6 – S8 and Samsung A51.

ISO
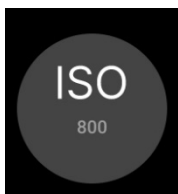
This is the sensitivity of the camera sensor. The normal term should be "Gain" but ISO is a term from the analogue world. The default is 800. Because of the wide aperature of the smartphones (mostly between f 1.5 and 2.5), you should not go higher than 800 or 1600. The values are device dependend. The app detects, which values the camera sensor supports and creates the list dynamically.
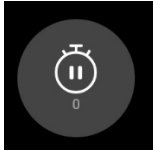

   **Note**: On legacy devices only "Auto" is available.

The entry "Preview" means that the ISO for the images is the same ISO value of the viewfinder.

When you select "Auto" exposure time ISO is set to "Auto". This is a behaviour of the camera sensor on Android. Google defined that "Auto" means "Auto" exposure time and "Auto" ISO. This can not be changed.

Interval time

Interval time is the time period between two images.
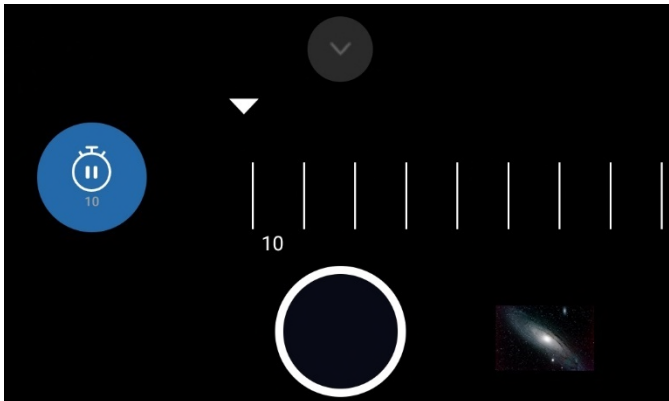
You have two options:

1. Interval time 0 sec ("Burst Shot Mode"). The interval time is not really 0 sec. The duration of interval time is set by camera sensor and its mostly 100 or 200 milliseconds. But the duration depends on lots of things which can not be controlled by the app:
    a. General administration and controlling by camera sensor
    b. Duration of writing an image file
    c. Speed of internal flash memory or SD card
    d. Speed of CPU
    e. Available RAM
    f. Activities of other apps or Android OS in the background

When you've selected interval time 0 sec the camera sensor triggers and controls the next image. It can not be changed by the app. The images are taken with minimal interval time. This changes some details of the app:

- When you set exposure time of the images faster then 1 sec and if you have date/time in file name then milliseconds are added to the filename. The reason is that taking the image, writing and taking next image can be so fast that the first image file can override the next image file.
- When you set fast or very fast shutter speeds (f.i. 1/100000 sec) it could be possible that a little bit more files are written then you've set in "Number of frames". The reason for this behaviour is that lots of data come in and the app tries to process the data sequentially. The app counts the number of frames but the camera sensor can be much more faster then counting. This happens NOT when you set slower shutter speeds (f.i. 2 sec, 10 sec or 30 sec).

Note: Due to technical reasons interval time 0 sec is not available on Samsung S6-8, Note 5/8 and some J models. Also not available on legacy devices.

2. Interval time greater then 0 sec. If you've selected a value greater then 0 the app pauses before taking the next image.

Please pay attention to the file size. Some smartphones have a camera sensor with an resolution of 8000 x 6000 pixel. A DNG file is about 90 to 100 MB, a JPEG file around 25 MB. The app must read the data from the sensor and must write the data to your storage location. The speed depends on the speed of flash memory or SD card. If you loose files please increase interval time or set it to 0 sec (in this case camera sensor controls the process). If your device is slow or do you have too much processes in the background (other apps running) it could be possible that this slows down the read/write process. Increase interval time to 6 sec or higher.

If you write on SD card please pay attention to the speed of your SD card. If you have a slow SD card (thats mostly nomal class 10 cards) it takes much more time to write the data. It could be possible that the app crashes after 100 images because writing is an asynchronus task. If you have too much asynchronous tasks in the queue then the device can run out of memory and app can crash or hang. When you want to save images on SD card use extreme fast SD cards. This is type UHS II or UHS III. Otherwise you will loose files or the app becomes unstable.

> **Note**: A progress bar is shown when you have set the interval time (see chapter "The bars"). This is a simple bar which counts the seconds down until the end of interval time. This helps you to estimate how long the app is idle until the next image will be taken.
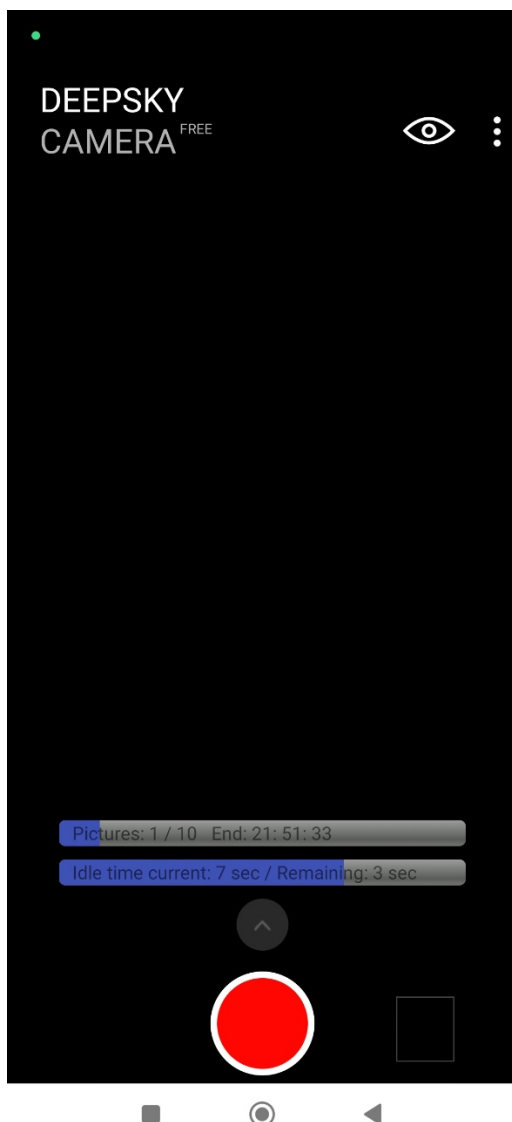
Note: Due to technical reasons the bar is not available on Samsung S6 – S8 and Note 5 – Note 8.
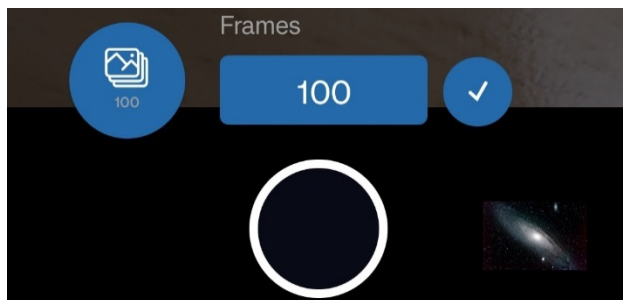
Frames
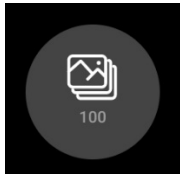
This is the number of pictures you want to take. The default is 100. The range of possible values is from 1 to 9999.

Note: When you change the number of frames in control bar and the keyboard does NOT show up you must configure the physical keyboard. Please check the steps in chapter 6 "Pairing the devices and activating the keyboard".

Whitebalance
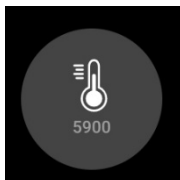
In the control element "Whitebalance" you can set the color temperature. The color temperature is listed in K (Kelvin). The list in the field "Whitebalance" is created dynamically. The values depend on the phone. The app detects on startup, which values the camera sensor supports and creates the list.

Note: On legacy devices only "Auto" is available.

Aperture
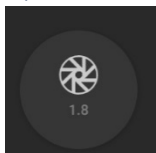
This listes the supported apertures of the camera sensor.

The values depend on the phone. Only a few phones provide a variable aperture. These are: Samsung S9, S10, Note 9, Note 10 and Huawei P40 Pro (Juli 2020). Most of the phones don't support a variable aperture. The value can not be changed. Its for information only.
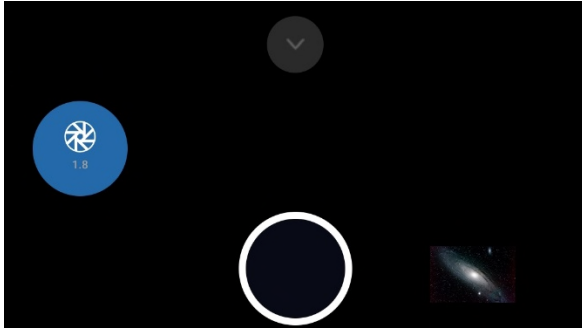
This setting affects the images. If you want to adjust the aperture of the preview, you can do this in the preview settings (eye icon).

Focal length
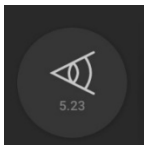
The spinner contains the supported focal lengths of the camera sensor.
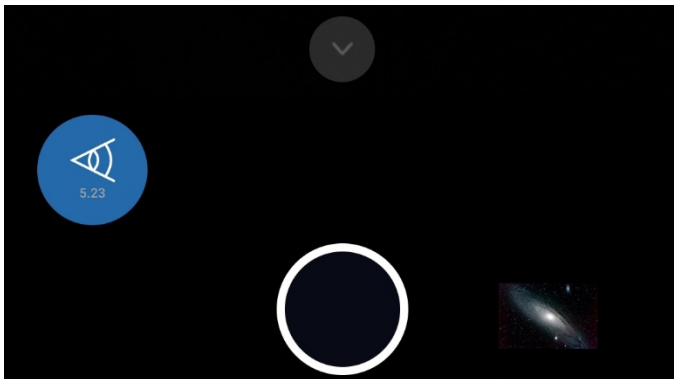
The values depend on the phone. Only one phone provides a variable focal length: Huawei P40 Pro (July 2020). Most of the phones don't support a variable focal length. The value can not be changed. Its for information only.

This setting affects the images. If you want to adjust focal length of the preview, you can do this in the preview settings (eye icon).

Focus
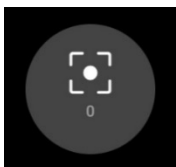
You focus manually with slider for viewfinder as well as for images.
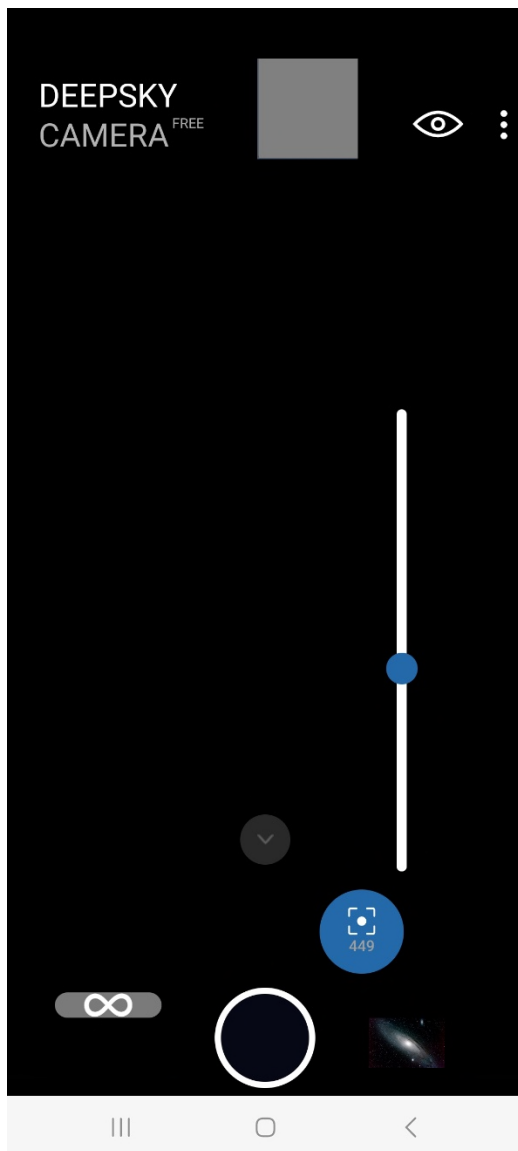
The slider on the right adjusts the focus of the viewfinder and for the pictures you take later. When you move the slider up and down, the focus changes.

> **Note**: The right slider is not available on legacy devices, or when you've set the focus method to "Auto", "Infinity" or "Hyperfocal" in menu "Settings". Slider is also not available on Samsung S6/S7/S8 and Note 5/8.

> **Note**: On some Samsung phones (f.i. S9, S10) as well as on Xiaomi and Oneplus 7 devices the right slider is disabled during the imaging session. The slider will be enabled after the end of the session.

When you try to shoot the moon with a telescope, then it's easy to focus, because the moon is light enough. But to get the correct focus for stars, it is not that easy. You can do it by follwoing these steps:

1. Set ISO of the viewfinder to the highest value, e.g. 3200 or 6400. Increase exposure time of viewfinder up to 1 sec.
2. Point your phone to a bright star. You should see the star at the viewfinder.
3. Zoom in to the star via zoom slider in control bar of the images.
4. Now adjust the focus, by moving the focus slider up or down until you get a good image of the star. The star must be a pinpoint star. The focus value is shown in focus icon.

5. Take one or two test images. Check the images, if the stars are pinpoint stars or not. If not, adjust the right slider a little bit.
6. Take one or two test images again. Check the pictures again. If necessary adjust the right slider again.
7. Repeat step 4 – 6 until you get pinpoint stars. Please be patient. Getting the correct focus can take some minutes. The procedure is necessary.

> **Hint**: Use the volume +/- buttons on the left or on the right of your smartphone. It goes 0.01 steps up or down. You can set or adjust the value precisely. If you have a wired headset plugged in via the jack plug, you can also use the speaker buttons +/- on the headset to focus more finely.

The app provides a table with focus values for various devices. You'll find the table at: app menu -> Help -> Focus help. If your phone is listed, try the recommended value from table. If your device is not listed you must do experiments yourself. If you found the correct focus value for your device, please report the value to the developer of the app (go to menu -> Report your device). The developer adds your phone and the focus value to the focus table.

> **Note**: Focus value is stored on your device. When you restart the app, the focus value will be loaded and set.

Left is the "infinity" icon.

You can use icon above focus slider to set the current value for the "Infinity" option. The value is saved. If you now select the "Custom infinity" option in the "Focus" section of the "Settings", the saved value for "Infinity" will be applied to both the preview and the images.

If you want to change the value, switch back "Manual" in the settings, set the value using the focus slider and then tap on the "Infinity" symbol. The previous value is overwritten by the new value.

> **Note**: This is not available on Legacy devices. Legacy devices do not provide manual focus. Function is also not available on Samsung S6/S7/S8 and Note 5/8.

Zoom
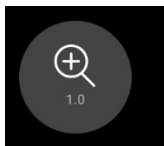
The last icon opens zoom slider.
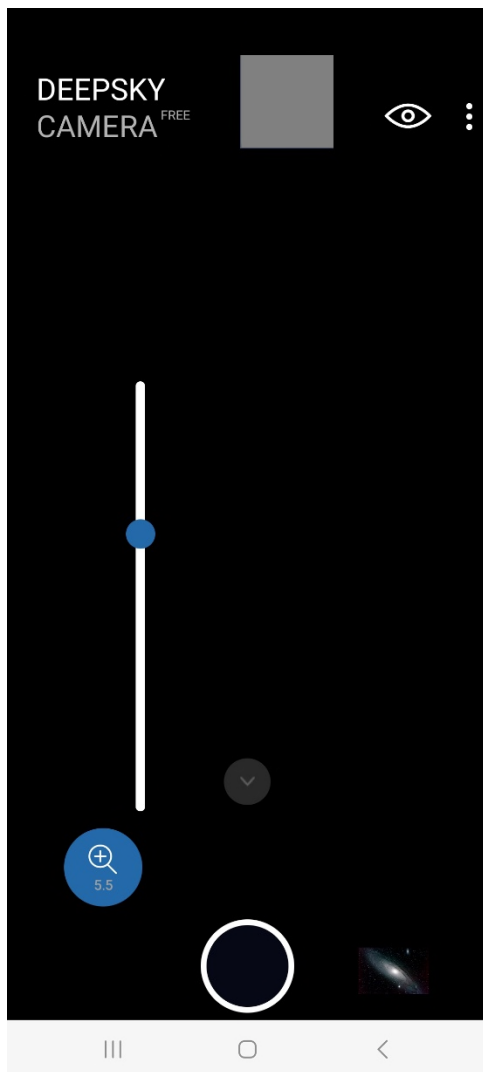
You can zoom with the slider to bring an object closer. On the one hand, this is intended to make it easier to adjust the focus. The current zoom value is displayed in the zoom slider icon.

When you want to take images with the zoom you must first go to the "Settings" menu. Tap on the option "Digital zoom". You have three options:

- Zoom off
- Zoom at the viewfinder only (default)
- Zoom at viewfinder and images

When you want to take pics with zoom you must select the third option. You can zoom in with your fingers at the view finder and the image is taken with the same zoom value.

Pay attention that the zoom is a digital zoom. The quality of the pic can get worse because its not an optical zoom.

Note: Zoom function is only applicable to JPEG files, not to RAW/DNG files.

Note: Zoom function is not available on Samsung S6/S7/S8 and Note 5/8.

The bars: delay bar, progress bar, countdown bar and interval time bar

The app contains four bars which informs you about important things:

- When you set a delay before the first image the **delay bar** appears. The delay bar counts the seconds down until the imaging session starts.
- When the imaging sessions starts a **progress bar** appears. It shows the current number of frames and the total number of frames.
- Below progress bar the **countdown bar** appears. It counts the seconds down until the end of the current image. The countdown bar is only visible when shutter speed is 2 sec or higher.
- When you've set an interval time between two images the **interval time bar** appears when interval time is 2 sec or higher. The bar counts the seconds down until the next image will be taken.

The following image shows the two most important bars: progress bar and countdown bar.
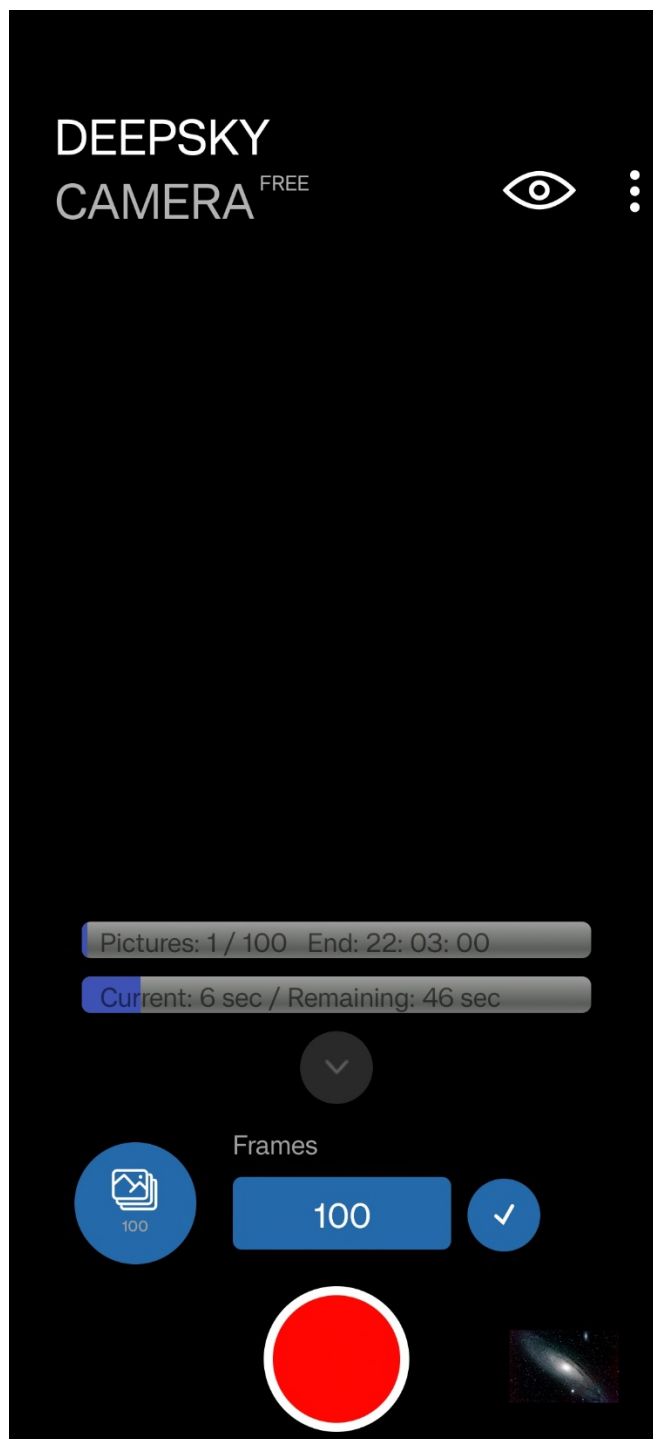
6. Shutter button

The shutter button is the most important button. Alternatively you can use an external Bluetooth controller to start/stop the imaging session and without touching your phone. Please check chapter "External Bluetooth controller" below.

Start

Tap on shutter button and the imaging session starts. The app reads the settings from the control bar. During exposure time a progress bar comes up and shows the progress. You can stop the imaging session any time by pressing the shutter button again. Normally it's not necessary but when you've made a mistake (e.g. set wrong ISO or wrong exposure time) you can stop the session. Please be patient. On some devices, it takes a couple of seconds until the session will stopp.

During exposure time, all elements on main page are locked. The app seems to be frozen – but it isn't. The app is busy and is taking pictures. You cannot change ISO, exposure time, etc. and you cannot go to the menu. If you need to call the menu, or you want to change the settings in the control bar, you must stop the imaging session by tapping the shutter button.

On some devices (especially Huawei, Honor, Xiaomi, Redmi, Samsung, OnePlus) you should always turn the display on. In menu "Settings" of the app is an option, where you can turn the display always on. Without this option the display turns off automatically after 15 – 30 sec (depends on your phone). The result is that the operating system sets the app into a hibernate mode. In hibernate mode the app does not operate and takes no pictures. That means, no image files will be written!

You can test that very easily. Take a couple of pics (e.g. 20 frames) with max shutter speed and wait until the display shuts off. Wait again 60 – 120 sec. Turn display on and check how many pics have been taken. When you miss frames turn "Display always on".

> **Note**: When you take pics of the stars, set the app into night mode (black background with red text color). You can set the night mode in menu "Settings" of the app (three dots upper right corner).

Stop

You can stop the imaging session at any time. Please tap shutter button once and stop request is send to the camera sensor. **But please be patient**. On some phones (Samsung, Xiaomi) it takes a couple of seconds until the imaging session is stopped. If you are impatient and you "hammer" on the button DeepSkyCamera app can stop or crash due to lots of requests to the camera sensor. On other phones (Huawei, Honor) the imaging sessions will be stopped immediately.
It is enough to tap button only once. Please wait until the imaging session has ended and the app is ready for the next session. **Please be patient!**

External Bluetooth controller

You can start and stop the imaging session with an external Bluetooth controller. Instead of touching the display of your phone you can do it remotely. External Bluetooth controllers are cheap and easy to use.
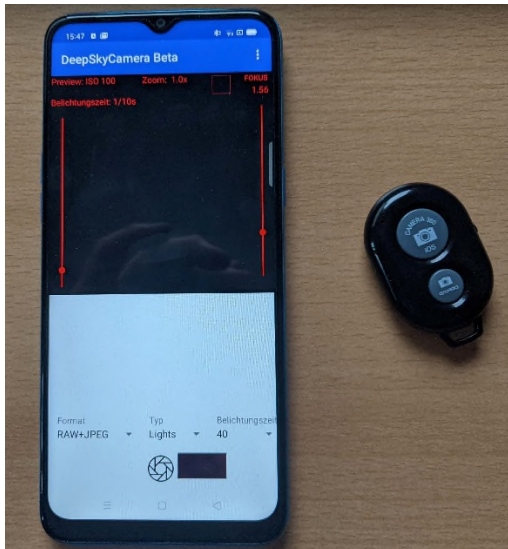
Before you can use the external Bluetooth controller you must do some preparations.

Note: When starting the app for the first time, you must accept the "Find nearby devices" option, otherwise the app w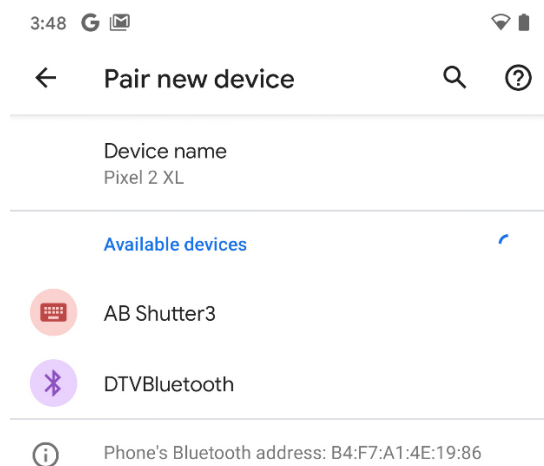ill not respond to the external Bluetooth controller. If you have rejected this right, then the external Bluetooth controller will not work. To reset this you have to reset the app in the Android settings and clear the cache. You then have to restart the app and can accept the "Find nearby devices" right.

Pairing the devices and activating the keyboard

First you must pair the two devices and after a successful pairing you must activate the keyboard. You can do it in this way:

1. You pair the external bluetooth controller and your phone in the same way you connect a Bluetooth headset to your phone. You must activate Bluetooth on your phone and on your Bluetooth controller.
2. Go to Android Settings -> Bluetooth. The phone lists the available bluetooth devices.

3. The external Bluetooth controller is named here "AB Shutter3" (the name of your controller can be different). You can pair your phone to this device by tapping on the name. On some devices you'll get a confirmation dialog. After a successful conection the external Bluetooth controller is listed in "Connected devices".
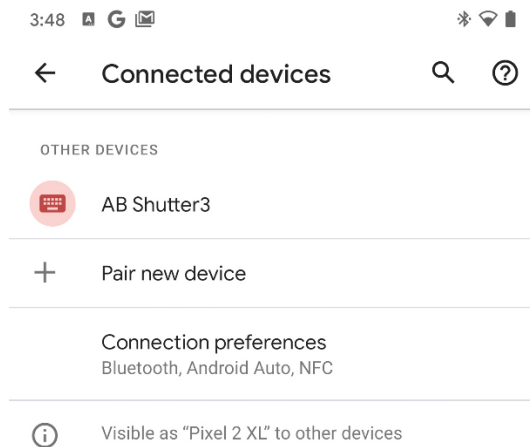
4. Now you must configure the physical keyboard on your phone. You must do it only once and your phone stores this information. When you connect your external Bluetooth controller next time the information is automatically restored.
    Why is it impoortant to configure the physical keyboard? If you don't do this the app waits for input from the Bluetooth controller only. In case you want to change the number of frames the app waits for input from your bluetooth controller. Because it does not have a keyboad nothing happens. Thats why you must tell the phone it should use the physical keyboard from your phone for other things than start/stop.
    Its easy to do: after succesfull pairing your phone asks you if you want to configure the physical keyboard. Tap now „Configure physical keyboard".

    Note: On some devices (f.i. OnePlus 8 Pro) you can not configure the physical keyboard. In this case the physical keyboard is automatically configured.
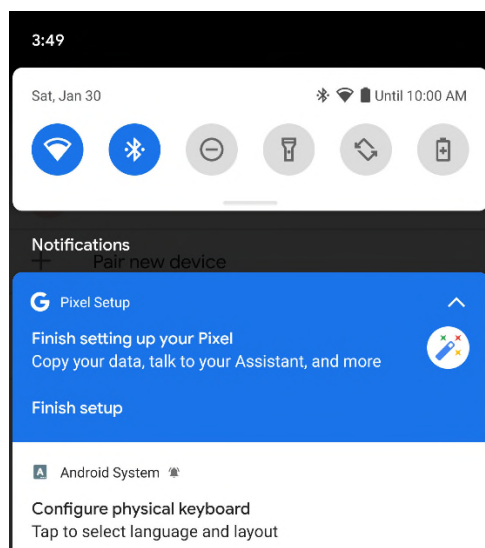
5. A dialog shows up. The option „Use on-screen keyboard" is turned off.
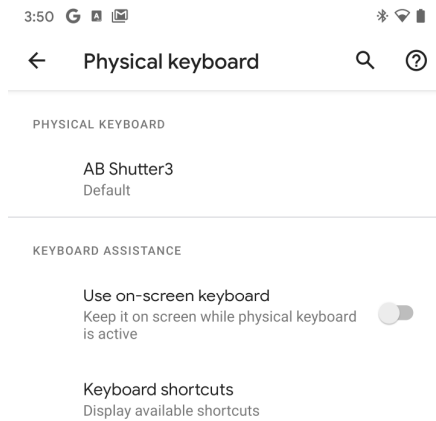
6. Turn the option „Use on-screen keyboard" on.

Thats all – everything's now configured and you can use your external Bluetooth controller.

How to use the external Bluetooth controller with DeepSkyCamera app

The usage is easy:

1. After successful pairing you start the app DeepSkyCamera.
2. Tap on the button on your external Bluetooth controller to start or stop the imaging session.
3. You can do a mix: You can start the session with your Bluetooth controller and you can stop by touching the shutter button (and vice versa).
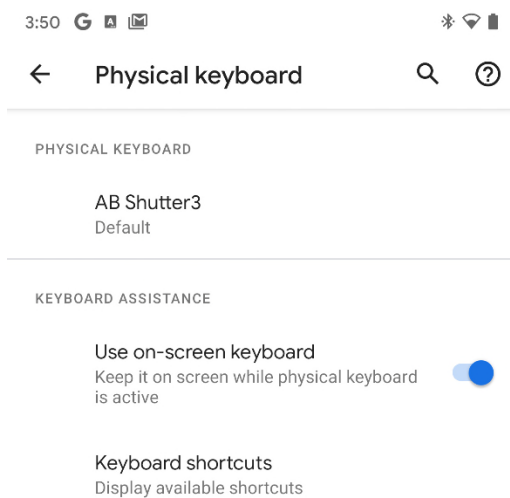
Note: When you change the number of frames in control bar and the keyboard does NOT show up you must configure the physical keyboard. Please check the steps in last chapter "Pairing the devices and activating the keyboard".

Note: The external Bluetooth controller must be close to the smartphone for the connection to remain intact. If the connection is lost, the app receives the stop signal and the session is aborted.

Wired headset

If you have a headset that is connected to your smartphone via a jack plug, you can start or stop the imaging session using the "Accept phone call / hang up" button. If the wired headset also has two volume buttons (+/-), you can use these buttons to focus very finely (0.01 steps up or down).

7. Internal file browser and displaying pictures

DeepSkyCamera contains an internal file browser where you can browse through the directories on your device. It contains an universal navigation, you can sort and delete files. Its also possible to display the images and to zoom into the image.

The pictures you've taken can be displayed within the app. The app contains a file browser to browse and to view the images. Right next to the shutter button appears an icon, which is a thumbnail of the last taken image. Tap on the icon and you'll get a list of images.

Internal file browser

The file browser lists all the files from a directory.
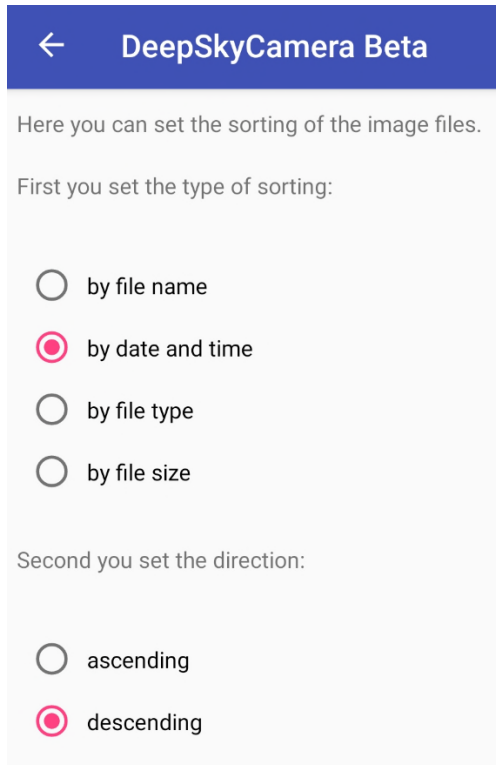
You can scroll the list. Below the filename you can see some additional data:

- Date and time of the image was saved
- File size in MB
- File type

Every entry in the list has an icon which shows if its a DNG or JPEG file.

Sorting

You can sort the list of files. Tap on the three dots upper right corner and tap "Sorting". A new page pops up.

In the upper field you can select the type of sorting:

- By file name
- By date and time
- By file type
- By file size

In the lower field you can select the direction of sorting: ascending or descending.

I use very often "by date and time" and "descending". This means that the latest picture is at the top of the list.

> **Note**: To go back to the file list, tap the back arrow upper left corner.

Deleting

You can delete images if you want. Tap three dots upper right corner and select "Deleting". This opens a new page with a file list. You can select the files you want to delete
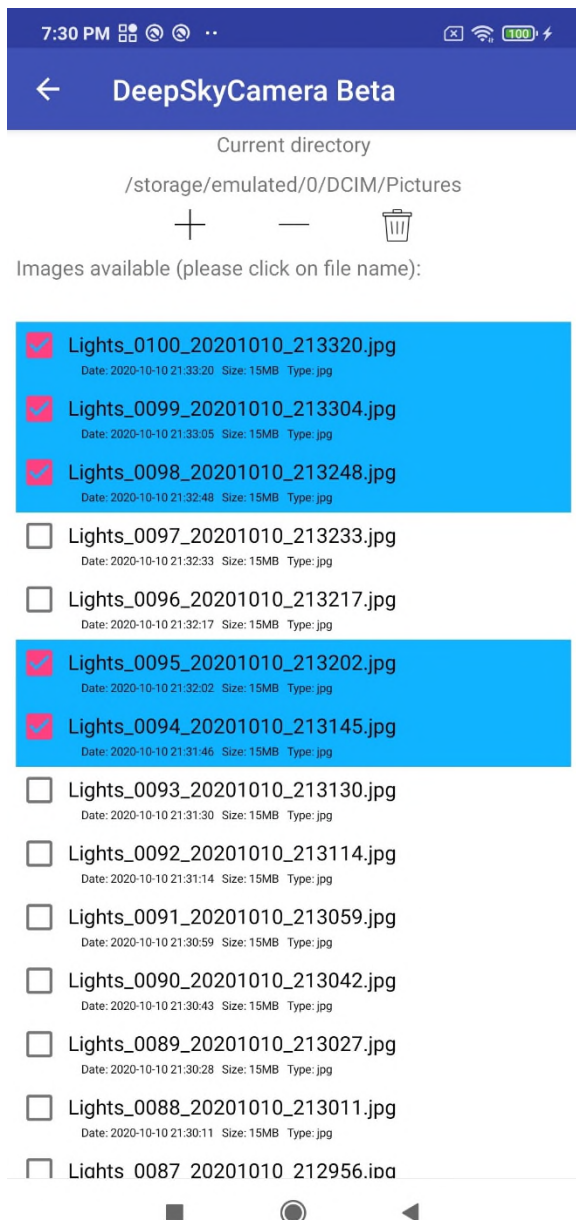
The list looks very similar to list from the internal file browser. Tap on a filename and the file is marked.

Tap on Recycle bin and the marked files will be deleted.

Before the app the files deletes the app wants to get a confirmation.
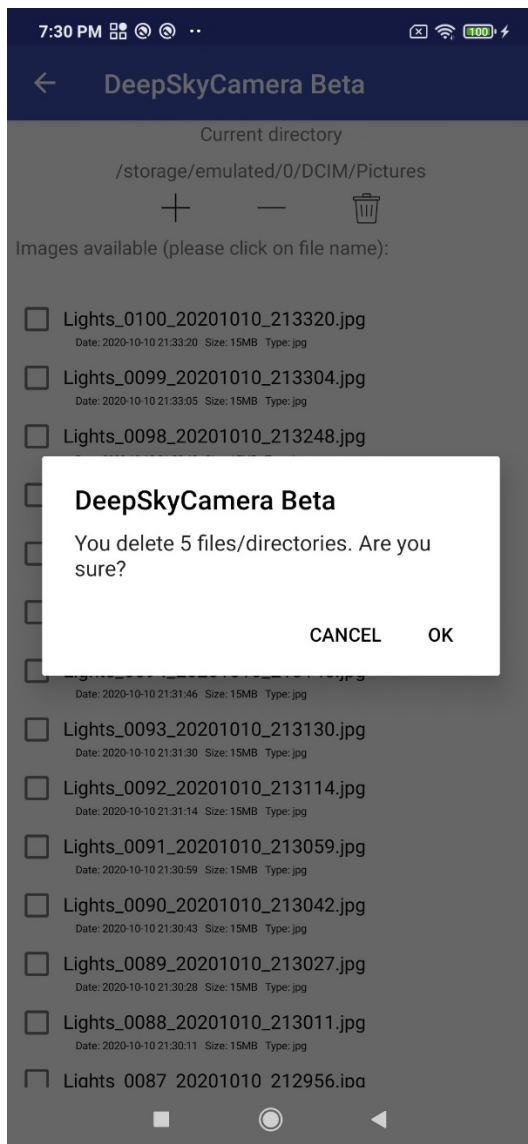
You can cancel the process. If you want to delete the images please confirm.

If you want to delete every image in the directory tap on plus symbol. This selects every image.

The minus symbol deselects every image.

You can also delete directories or subdirectories. If the directory contains one or more subdirectories then the subdirectories will be also deleted.

Navigation

The internal file is also a universal navigation file browser. You can browse through the directories on your devices and you can display image files taken with other apps.
It shows only DNG and JPEG files.

Directories have a folder symbol. Tap on the folder symbol and the file browser opens the directory.

Use the top bar to navigate. Up to and including Android 13, you can use these icons to navigate the phone's file system. You can also navigate within the location if you have created subdirectories.

As of Android 14, you can no longer leave the storage location and go up levels. As of Android 14, it is no longer a universal file browser through which you can navigate through the file system and view other directories (e.g. documents, music, alarm). This is because from Android 14 onwards an app can only see the data that it has generated itself. Please read the "Google Play Photo and Video Permission Policy: Changes in Android 14 and later" chapter.

This change makes the navigation bar look different for phones running Android 14 (or later) and for phones up to and including Android 13.

Navigation bar from Android 14

The icons in detail:

DCIM

The house icon always switches back to the DCIM path where the app's images are stored: DCIM/DeepSkyCamera

Private

Use this symbol to switch to the app's private directory (Android/data/de.seebi.deepskycamera/files/Pictures)

DCIM

Use this symbol to switch to the DCIM directory on the SD card: DCIM/DeepSkyCamera. If you have not inserted an SD card in your phone or your phone does not have an SD card slot, then tapping this symbol will have no effect.

Private

Use this symbol to switch to the app's private directory on the SD card (Android/data/de.seebi.deepskycamera/files/Pictures). If you have not inserted an SD card in your phone or your phone does not have an SD card slot, then tapping this symbol has no effect.

Back

You can use this symbol to go one directory level higher. However, you can no longer leave the "DeepSkyCamera" directory and go one level higher.

Navigation bar up to and including Android 13

The icons in detail:

The home symbol jumps directely back to your storage location where you have stored your images taken with DeepSkyCamera.

Tap on this symbol and internal file browser jumps always to the root directory on your phone.

This symbol jumps to the root directory of your sd card. If you don't have an SD card installed or your phone does not have an slot for SD card then this symbol does nothing.

This symbol returns to the parent directory.

Displaying images and zoom

Tap on filename and the image will be displayed. Please be patient. When you tap on DNG files, it can take up to 30 seconds to load and display the images. The reason is, that the images in RAW/DNG are very large (on Huawei P20 Pro: 78 MB, P40 Pro: 98 MB!). After tapping, a circle appears, which indicates that the file is loading. JPEG files can be loaded and displayed faster than DNG files, because they are much smaller.

Note: To go back to the main page, tap the back arrow upper left corner.

You can zoom into the image with two fingers. With one finger you can move over the image and you can select a specific region.

At the top there are two icons to delete current image and to enable or disable histogram of current image.

Note: The icons are not available on Samsung S6/7/8, Note5/8.

Histogram of current image

Tap on histogram icon and histogram is calculated of current image. To disable tap again on icon. If you want to have histogram permanent visible enable histogram only one time and thats it. DeepSkyCamera app stores this information. Every image you want to display later will show the histogram. The information is also stored when you exit the app and restart the app. The picture below shows an image with histogram.

Note: Histogram is available on Android 7 or higher. Live histogram is not available on Samsung S6/7/8, Note5/8 and Legacy devices.

Delete current image

Tap on trash icon and current file will be deleted. Before file is deleted a dialog appears which you must confirm (or cancel in case of a mistake).
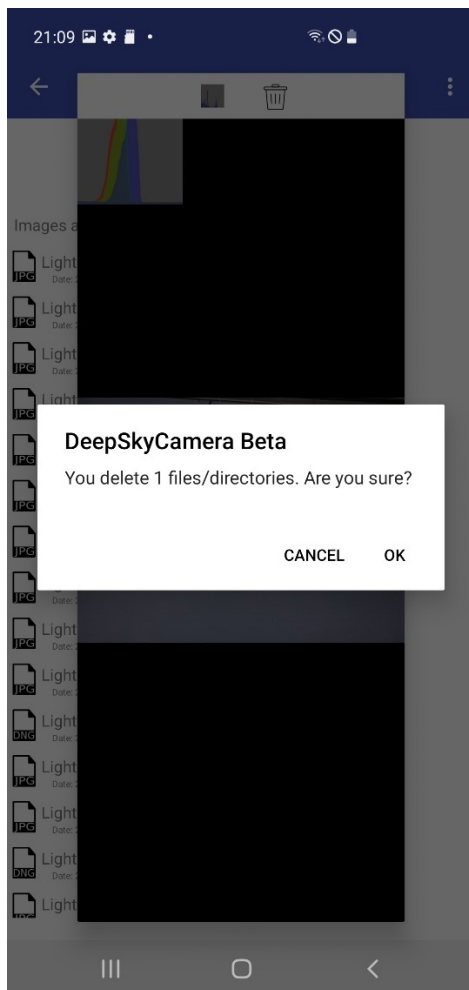
This function deletes only one image. If you want to delete more images at the same time this function is too slow. Use "Deleting" function to do a batch delete. Please go to chapter "Deleting".

8. Menu

You'll get the menu by tapping on the three dots upper right corner.
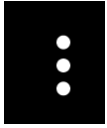
These entries are available:

- Settings: You can set or change the configuration of the app
- Info: Information about the camera sensor
- Supported devices: A list with compatible devices for DeepSkyCamera
- Report your device: You can report your phone to the developer.
- Tools: View log file
- Help: Help section
- Manual: The manual (what else)
- About: Information about the app
- Pro Version: Information about Pro Version
- YouTube: Link to YouTube channel "DeepSkyCamera"
- Facebook: Link to the Facebook group "DeepSkyCamera"
- Instagram: Link to #deepskycamera on Instagram
- Privacy policy: the privacy statement
- Exit: closes app
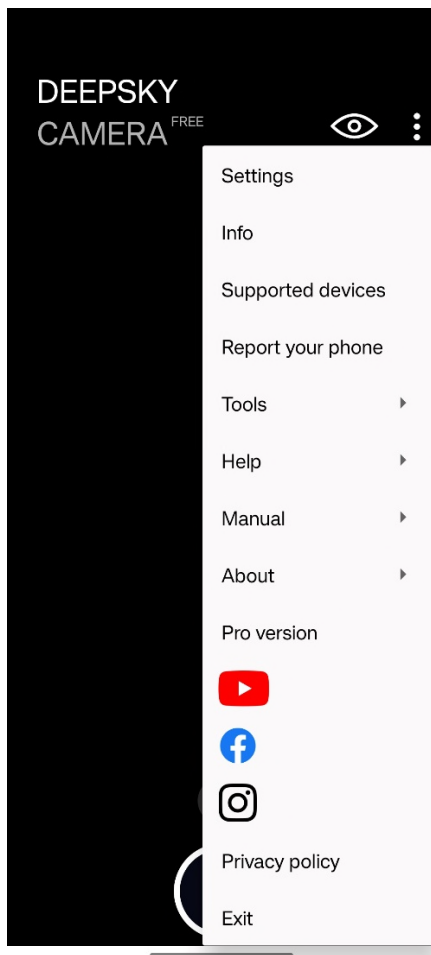
Settings

You can set and change the basic configuration on the "Settings" page.

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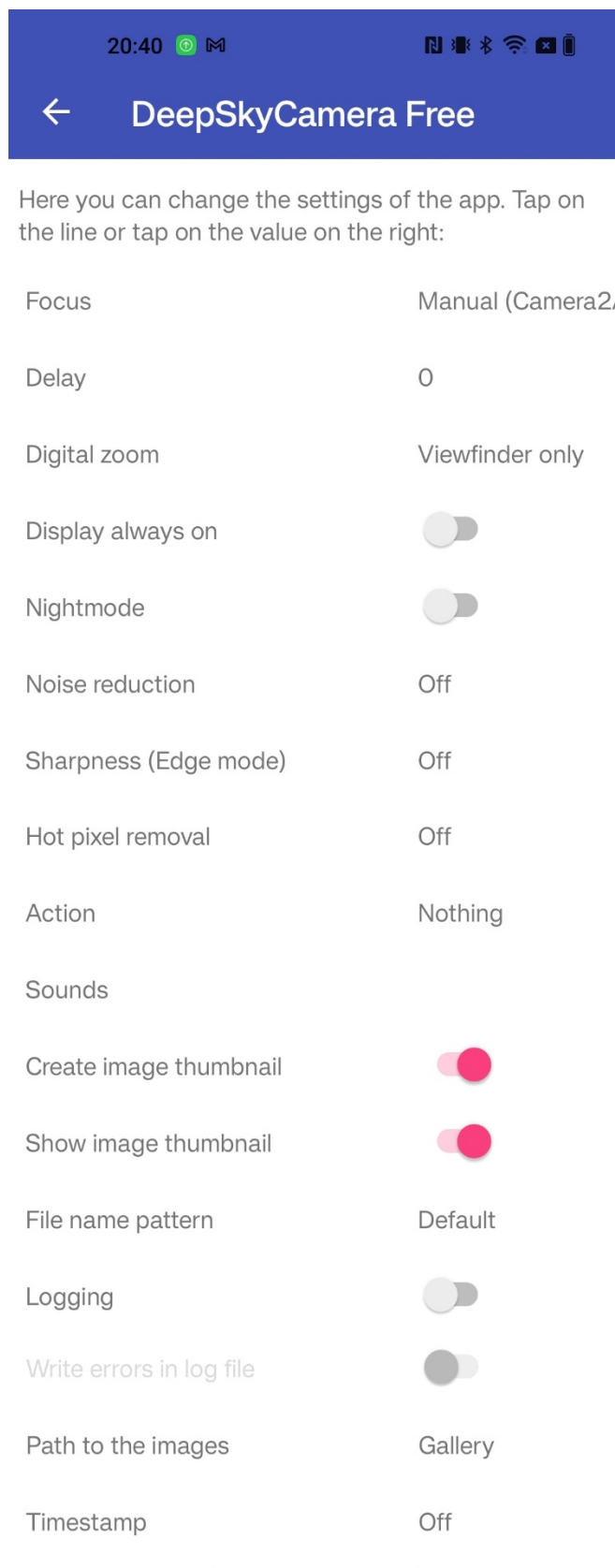
To go back to the main page tap the back arrow upper left corner. It is also the same procedure on every sub page of the "Settings" page.

On devices with smaller displays you must scroll down to view more settings.

Focus

You can choose between these types of focussing:

- Infinity
- Customized infinity
- Hyperfocal
- Manual
- Autofocus

Note: Not each of the four options is available on all devices. The "Custom infinity" option is also only visible if you have set your own focus value for "Infinity" on the app's start page ("Infinity" icon).

Infinity

The mode "Infinity" tries to determine the correct focus value for infinity. It works on some devices pretty well (such as LG) but on other devices it doesn't work. The calculation is based on calibration data of the camera sensor. If "Infinity" does not work on your device and the stars are blurred you must focus manually or try "Hyperfocal".

Note: When you choose "Infinity" the slider for focus on the main page is not accessible and disabled.

Note: On legacy devices only "Autofocus" is available.

Customized infinity

This option uses a previously determined value of infinity. This option is initially not visible by default and will only be visible if you previously determine an "infinity" value with the focus slider and tapped the "infinity" icon on the main page of the app. The value for "Custom infinity" is then set for the preview and the images. This value is also set if you exit the app and start it again later. If you want to overwrite it, go back to "Manual", reset the value on the focus slider and tap on the "Infinity" icon. You can then switch back to the "Custom infinity" setting. The new infinity value is now used.

Hyperfocal

"Hyperfocal" sets the focus to a value, where the foreground is sharp as well as the background.

Note: When you choose "Hyperfocal" the slider for focus on the main page is not accessible and disabled.

Note: On some devices "Hyperfocal" is not available (Huawei, Honor, Samsung S6/S7/S8/Note 5/8, legacy devices).

Manual

"Manual" is the best focus mode for astrophotography. You have full control of the focus. Switching to "Manual" enables the focus slider on the right on the main page of the app. You can move the slider on the main page up or down to adjust the focus.

Note: On legacy devices "Manual" is not available.

Note: On Samsung S6/S7/S8, Note 5/8 only "Infinity" is available.

Manual on Samsung models with Android 12 (or higher)

Especially on Samsung models with Android 12 or higher there is the possibility to switch between two focus systems:

- Manual (Camera2API)
- Manual (Samsung)

Samsung introduced a second focus system with Android 12. One of the two focus systems will work, it just cannot be automatically determined which of the two focus systems is ready for use on your device. Therefore you can switch here manually if a focus system does not work. This is quickly noticeable because the focus does not change when the focus slider on the main page of the app changes. In this case you should change the focus system. Samsung models up to and including Android 11 are not affected!

Autofocus

Autofocus is not available on all devices. With autofocus, the camera sensor focuses. This setting is not recommended for taking pictures of the sun, moon and the night sky, and the focus of each image is often not the same.

Digital zoom

You have three options:

- Zoom off
- viewfinder only (default): the zoom is only available at the viewfinder
- Zoom at viewfinder and images: zoom is available for both viewfinder and the images you take
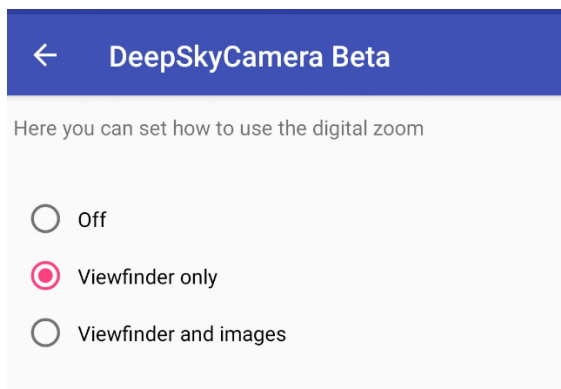
When you want to take pics with zoom you must select the third option. You can zoom in with your fingers at the view finder and the image is taken with the same zoom value.

> **Note**: Zoom function is only applicable to JPEG files, not to RAW/DNG files.

> **Note**: Zoom function is not available on Samsung S6/S7/S8 and Note 5/8.

Display always on

This function turns the display always on or off. On some device it's necessary to turn the display always on, otherwise the display turns off after a small period and the app is set to hibernate mode by the operating system. In this case the app does not take images anymore. To prevent this behaviour, you should turn the display to mode "Display always on", especially on Huawei, Honor, Samsung and Xiaomi.

Nightmode

This option switches from daylight mode (default) to nightmode.

It is highly recommended to switch to nightmode (black background, red text color), when you want to shoot pictures from the night sky.

Noise reduction

This function reduces the noise in the final image without taking dark frames and bias frames. The function is disabled by default. These are the available options:

- Off: No noise reduction (default)
- Fast: Fast noise reduction mode, recommended for interval times around 1 sec
- High Quality: best method to get the best quality of the pics with less noise. Highly recommended.
- Minimal: Simple method with minimal effect at the final image, but fast.
- 3x3 Median: Average value of 9 pixels (3x3) around each pixel
- 5x5 Median: Average value of 25 pixels (5x5) around each pixel

These functions reduce the noise in JPEG files.
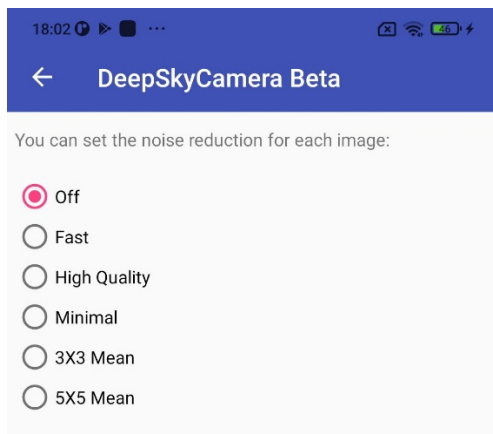
Note: Due to technical reasons only 3X3 Median and 5X5 Median are available on Huawei and Honor devices as well as on Samsung S6/S7/S8/Note5/Note8.

Note: The options depend on the camera sensor. The app detects automatically the possible options and creates the list dynamically.

The following examples show the differences between the settings Off, 3X3 Mean and 5X5 Mean. It is clear that the noise is very much reduced at 5X5 Mean - it will never go completely away with these algorithms. To do this, you have to use stacking. The examples show excerpts from images taken with Samsung A70, ISO 1882 and 15 sec exposure time.
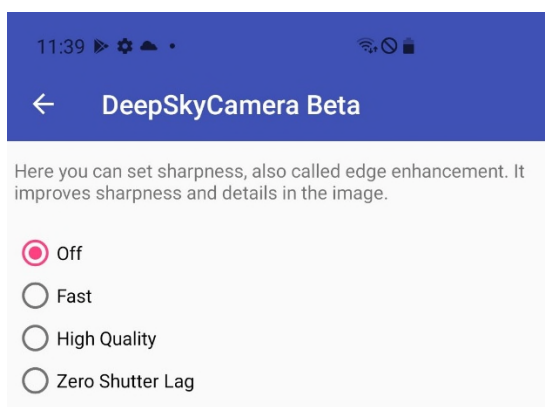
Noise reduction off:
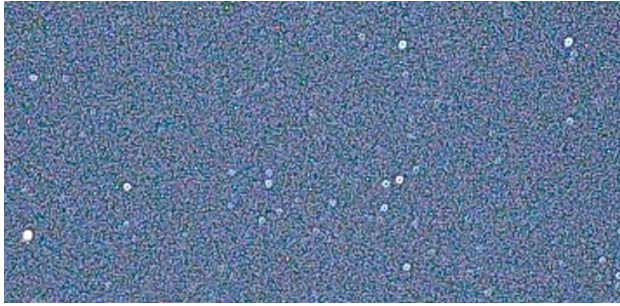
Noise reduction 3X3 Mean:

Noise reduction 5X5 Mean:

Sharpness (Edge mode)

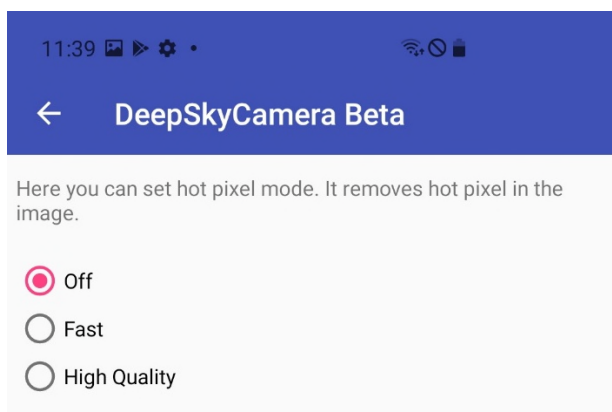This option improves sharpness and details in the captured image.

These are the available modes:

- Off: no enhancement.
- Fast: enhancement will be applied to image. The algorithm which is used will not slow down capture rate.
- High Quality: enhancement will be applied to image. It uses the highest-quality enhancement algorithm. This mode can slow down frame rate especially on fast shutter speeds (f.i. 1/1000 sec). On slow shutter speeds (f.i. 30 sec) this is not relevant and you can use "High Quality ".
- Zero Shutter Lag: A very fast sharpening with not so good quality because the shutter has no delay.

Note: This function has no effect on these phones: all Huawei and Honor devices, Samsung S6/7/8, Note5/8.

Hot pixel removal

This option removes hot pixels in the captured image.

These are the available modes:

- Off: no hot pixel removal will be done.
- Fast: hot pixel removal will be applied to image. The algorithm which is used will not slow down capture rate.
- High Quality: enhancement will be applied to image. It uses the highest-quality enhancement algorithm. This mode can slow down frame rate especially on fast shutter speeds (f.i. 1/1000 sec). On slow shutter speeds (f.i. 30 sec) this is not relevant and you can use "High Quality ".

You can set the mode to "Off" when you use stacking software like DeepSkyStacker or Sequator. These programs remove hot pixel during stacking process with dark frames and bias frames. Thats why you can set it to "Off" when using these stacking programs.

Note: This function has no effect on these phones: all Huawei and Honor devices, Samsung S6/7/8, Note5/8.

Action

This function tells the app what to do when the imaging session has ended. These are the available options:

- Nothing
- Exit app
- Shut down smartphone
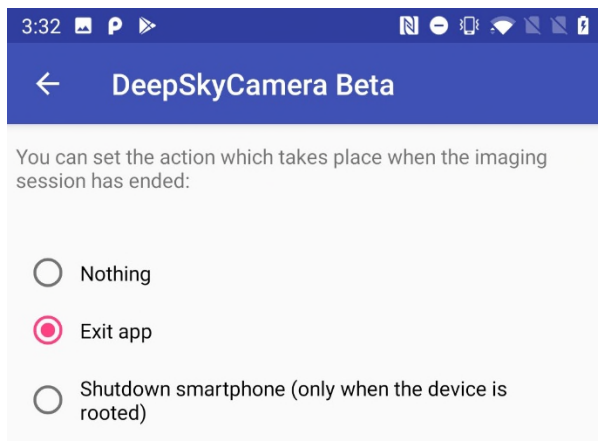
The Option "Nothing" does nothing. The app is idle and waits for your input 😊

The option "Exit app" exits the app automatically, when the imaging session has ended. This is really useful, when you want to take pictures for a couple of hours. It saves energy.

The option "Shutdown Smartphone" shuts down the phone at the end of the imaging session. But take care: the option is on every phone available but to shut down, the device must be rooted. Without a rooted phone, the app will not be able to shut down the phone. A popup will appear, saying that you do not have enough rights.

Sounds
You can control shutter sound and end sound.

Play shutter sound
This option turns on or off the shutter sound. When this option is turned on you will hear a shutter sound at the beginning of each new image.

Play end sound
This option turns on or off the end sound. When this option is turned on you will hear an end sound. This tells you that your imaging session is finished.

Create image thumbnail
This option enables or disables the creation of the image thumbnail. The icon is displayed on the main page of the app right to shutter button. This option is very useful especially when you shoot with very fast shutter speeds (f.i. 1/1000 sec). You can get a little bit more performance when you turn this option off and no thumbnail icon is generated. The code to recode and recalculate the image size is not executed. Turning off this option is also recommended when you shoot at very fast shutter speeds and interval time is set to 0 sec ("Burst Shot Mode").

Keep in mind that this option controls only the creation of the image icon. Displaying image icon is controlled by the next option "Show image thumbnail".

> **Note**: This function is especially for devices with less RAM. Turning off this option, performance of the app will increase. On high end smartphones with enough RAM (3 GB or more), it's not necessary to turn off this option.

Show image thumbnail

If you turn this option on, a thumbnail will appear right next to shutter button. The size of the icon is 80x50 pixel.

The previous option "Create image thumbnail" controls the creation of the thumbnail in general. Keep in my mind that only icons can be displayed when they are created.

> **Note**: This function is especially for devices with less RAM. Turning off this option, performance of the app will increase. On high end smartphones with enough RAM (3 GB or more), it's not necessary to turn off this option.

Turning off this option is also recommended when you shoot at very fast shutter speeds and interval time is set to 0 sec ("Burst Shot Mode").

File name pattern

This function controls the file names of the image files. You can choose between the default file names or customizable file names.
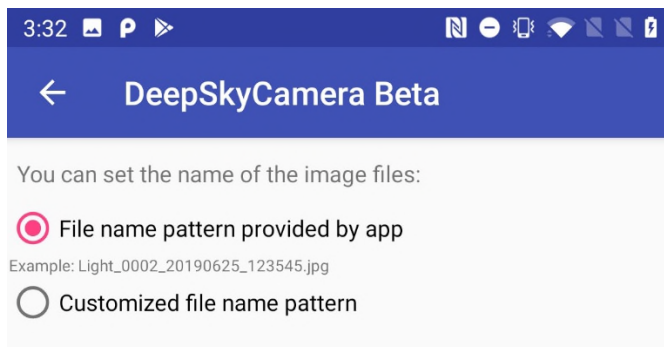

The option "File name pattern provided by app" creates the file names as follows:

- 1st step: Type of the image. The type can be selected on the main page of the app in the field "Type". It can be "Lights" for instance.
- 2nd step: A number with four digits, e.g. 0006.
- 3rd step: The current date year month day, e.g. 20190906
- 4th step: The current time hours minutes seconds when the file is generated, e.g. 010305

The default pattern generates following file name (this is an example): Lights_0006_20190906_010305.dng.

The file extension depends on the format (which can be selected in control element "Format" on the main page). The extension is .jpg for JPEG files and .dng for RAW files.

The option "Customized file name pattern" gives you the possibility to define your own file name pattern. The prefix can be set on your own, e.g. "Moon" or "M31". You must set one character or more for the prefix. The number, date and time can be selected optionally.
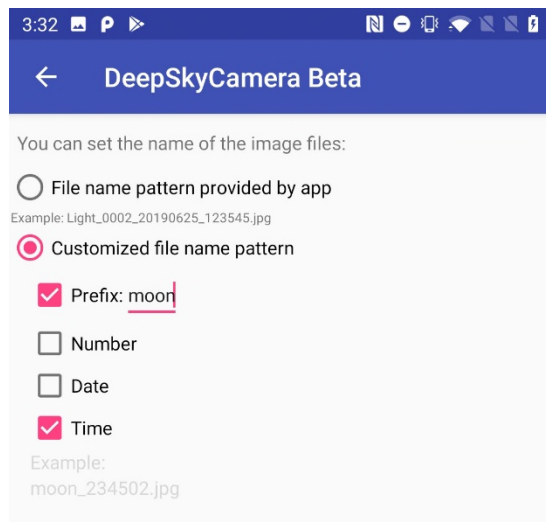
Note: When you choose "Customized file name pattern" you should select two options or more. If you choose only one option ("Prefix" for instance) the file name is always the prefix name and the next picture overwrites the previous picture. That's why you should choose two or more options.

Logging

This option turns logging on or off. When logging is turned on, a log file on Android 6 – 10 is created in the directory where the images are stored. Starting with DeepSkyCamera 1.8.5 running on Android 11 (or higher) the log file is always in the private directory (`Android/data/de.seebi.deepskycamera/files/Pictures`) and can be view via "Tools" menu entry.

The name of the file is "deepskycamera_log.txt". The log file logs every new pic, which is saved in your internal or external memory. Errors will also be logged in the file, when you turn on the option "Write errors to log file".
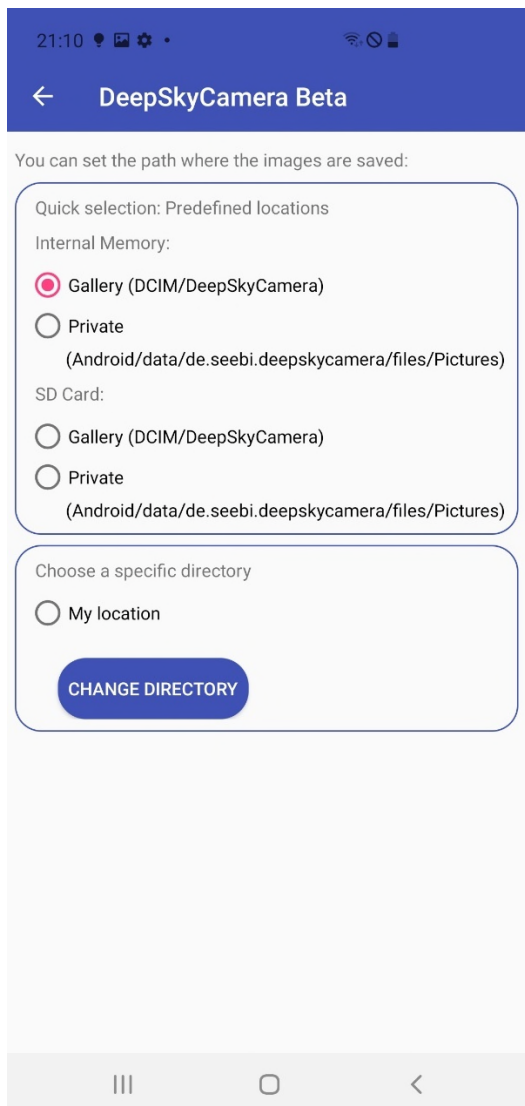
Write errors to log file

When this function is turned on, errors will be written into the log file. This is useful when you've detected a bug.

Note: Before you can activate this option you must turn "Logging" on.

Path to the images

This function sets the path to the images.

Starting with update 1.8.5 on Android 11 (or higher) default storage location is "Gallery":

`DCIM/DeepSkyCamera`

> **Note**: When you are upgrading from an older version of DeepSkyCamera default storage location is your last selection. Only when you install DeepSkyCamera 1.8.5 (or higher) on Android 11 or (higher) **for the first time** default storage location is "Gallery".

On Android 6 – 10 default storage location is so called private directory:

`Android/data/de.seebi.deepskycamera/files/Pictures`

This directory is sometimes hard to find. You can use an external file browser (f.i. FX File Explorer) or the internal file browser of DeepSkyCamera.

> **Note**: When you take images in JPEG format and storage location is "Gallery", the pictures will be added to the gallery. When you store the images in a different place then "Gallery", no images will be added to the gallery app. Don't worry they are saved on your device.

The page consist of two boxes. The first box contains predefined storage locations:

- Gallery (`DCIM/DeepSkyCamera`)
- Private (`Android/data/de.seebi.deepskycamera/files/Pictures`)

If you have a SD card installed you can set storage location to "Gallery" on SD card or to private directory on SD card.

> **Note**: Section "SD card" is only visible when you have SD card installed. If you don't have SD card in your phone the section "SD card" is NOT visible.

In the second box you can select or create any directory on your phone. Please note, however, that you may not have the appropriate read/write permissions in certain directories. This is not a bug in the app but is controlled by the rights management of the Android version on your smartphone. By tapping button "Change directory" a new page shows up, where you have the possibility to:

- Select an existing directory
- Create a new directory

You can use the "Change directory" button to select a different directory or create a new directory. To do this, tap the button and you will be taken to a new page. This looks a little different for smartphones with Android 14 (or higher) than for devices up to and including Android 13. These mainly differ in the icons. All available directories are listed below the icons. For Android 14 or later the page looks like this:
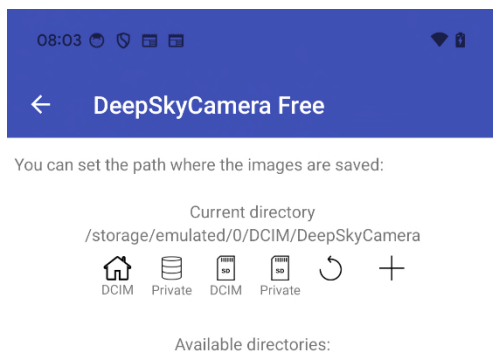
If you have a smartphone up to and including Android 13, the icons look a little different:

3:33

← **DeepSkyCamera Beta**
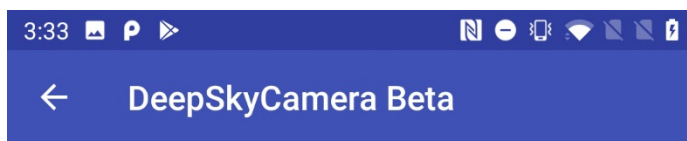
You can set the path where the images are saved:

Current directory
/storage/emulated/0/DCIM/DeepSkyCamera

Available directories:

.Ota

Alarms

Android

DCIM

Documents

Download

Movies

Music

Notifications

Pictures

Podcasts

Ringtones

obb

test

The reason for this different appearance is that as of Android 14, an app is only allowed to see the images that it has created itself. External images from other apps must not be visible, this is part of the privacy policy in Android 14 and has the unwieldy title "Google Play's Photo and Video Permission Policy". Below there is a separate chapter ": Changes in Android 14 and higher" that explains the background. In summary, you can navigate through the phone's file system on this page up to and including Android 13. As of Android 14, this is no longer possible and is limited to these directories:

- Gallery (DCIM/DeepSkyCamera)

- Private (Android/data/de.seebi.deepskycamera/files/Pictures)

- SD card gallery (DCIM/DeepSkyCamera)

- SD card private (Android/data/de.seebi.deepskycamera/files/Pictures)

These restrictions do not exist up to and including Android 13.

All existing directories are listed below the icons. To set a directory as a storage location (e.g. DCIM), simply tap on the directory name. The app opens the directory and automatically sets it as the storage location. This is set and you can go back to the app homepage using the back arrow at the top left.

Icon bar on Android 14 and higher

DCIM

You always use the first icon to jump to the app's gallery, especially in DCIM/DeepSkyCamera. You can use the + icon to create new directories and use the back icon to navigate between the directories within DCIM/DeepSkyCamera. You just can't navigate outside of DCIM/DeepSkyCamera.

Private

You can always use the second icon to jump to the app's private directory: Android/data/de.seebi.deepskycamera/files/Pictures. You can use the + icon to create new directories and use the back icon to navigate between the directories within the private directory. You just can't navigate outside of the private directory.

DCIM

You can always use the third icon to jump to the app's gallery on the SD card: DCIM/DeepSkyCamera. You can use the + icon to create new directories and use the back icon to navigate between the directories within the private directory. You just can't navigate outside the directory.

If you don't have an SD card in your smartphone, nothing happens when you tap the icon.

Private

You can always use the fourth icon to jump to the app's private directory on the SD card: Android/data/de.seebi.deepskycamera/files/Pictures. You can use the + icon to create new directories and use the back icon to navigate between the directories within the private directory. You just can't navigate outside of the private directory.

If you don't have an SD card in your smartphone, nothing happens when you tap the icon.

The fifth icon always goes back one step in the level. If you have selected the wrong directory, you can always go back one step. If Android 14 (or higher) is installed on your phone, you can only use this icon to navigate within the four predefined storage locations. You can no longer leave the predefined storage locations and go to higher levels (e.g. in documents or music). This is because from Android 14 onwards an app is only allowed to see the data that it has generated itself. External data should no longer be visible. For more detailed information, please read the "Google Play Photo and Video Permission Policy: Changes in Android 14 and later" chapter below.

 The sixth icon creates a new directory. To do this, you must have previously selected the directory in which the directory should be created. When you tap the icon, all you have to do is enter the name

of the directory and tap OK. The directory is created and set as the storage location. The name of the directory should be easy to understand, e.g. Moon to store moon images or M31 for images from M31.

Icon bar up to and including Android 13

By tapping first icon, app jumps always to the root directory of your device. If you want to set a directory to the current storage location of your images tap on the directory name (e.g. "Pictures"). The app opens the directory, and the choosen directory is automatically set as the new storage location. After that go back to "Settings" page via arrow button upper left corner!

By tapping second icon the app opens the root directory of the SD card and shows a list with several directories. You can select another directory by tapping a directory name. But take care: it could be possible that you do not have enough rights to write files on the SD card. The app tells you, when you have missing rights. In this case choose a different directory.
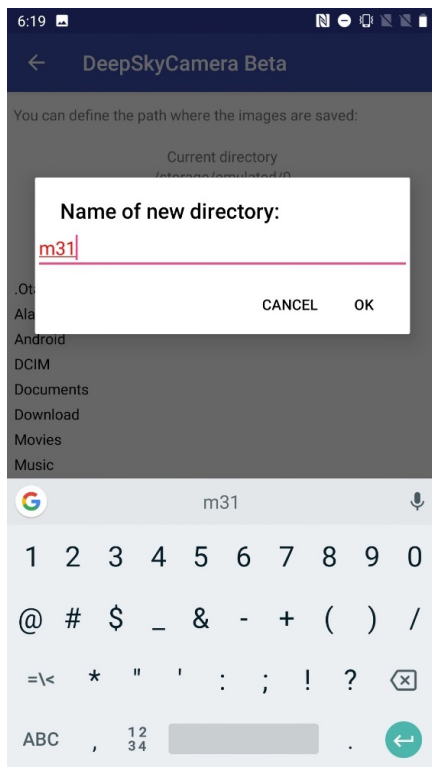
> **Note**: If you do not have a SD card installed, you will be redirected to the root directory of your internal memory.

By tapping this icon, you will always go one step back.

The fourth icon adds and creates a new directory on your internal memory or on your SD card. A new dialog appears, where you can enter a name for your new directory (e.g. "Moon", "Orion" etc.).

The created directory is automatically set as your storage location. Please go back via arrow button upper left corner.

> **Note**: The app tells you when you do not have the appropriate rights to create a directory. In this case choose a different parent directory.

Scoped Storage: Changes on Android 11 and higher

This chapter is only relevant to you when you are running Android 11 or higher. When you have Android 6 – 10 you can skrip this chapter.

Update 1.8.5 of DeepSkyCamera on Android 11 (or higher) implements so called "Scoped storage". This was a requirement set by Google and affects the visibility of directories on your device. This is part of privacy actions set by Google.

1. On Android 11 (or higher) lots of directories are forbidden/not visible to DeepSkyCamera, f.i. `Android`.

2. The default storage location (`Android/data/de.seebi.deepskycamera/files/Pictures`) is only visible to DeepSkyCamera. No other app can read/write the default storage location, maybe file browsers can read it. The popular FX File explorer can't read the directory yet. That means: you can not copy files from default storage location to any other location. DeepSkyCamera internal file browser can read/write this private directory but other apps can't.

3. The best storage location is one of the public directories like `DCIM` ("Gallery") or `Pictures`. Other apps like Gallery or file browsers can read/write these directories.

4. These are the public directories which are suitable for DeepSkyCamera:

`Documents, DCIM, Pictures, Download, Alarms, Audiobooks, Music, Podcasts, Ringtones, Movies, Notifications`

5. You can not create new directories at root level

6. If you store on SD card you can do it also with udpate 1.8.5 (or higher) on Android 11 (or higher). But only these directories on SD card are allowed:

- private directory (`Android/data/de.seebi.deepskycamera/files/Pictures`)
- directory `DCIM`
- directory `Pictures`

Google Play's Photo and Video Permission Policy: Changes in Android 14 and later
This chapter is only relevant to you if you are using Android 14 or higher. If you use Android 6 – 13 you can skip this chapter.

Update 2.1.0 of the DeepSkyCamera app on Android 14 (or later) implements the so-called "Google Plays Photo and Video Permissions Policy". In detail:

1. Google defines that an app can only see data generated by the app itself.

2. Images written by other apps (smartphone manufacturer's camera app or other camera apps) cannot be loaded or displayed in DSC.

These two things mean

1. If you have Android 14 (or later), only four locations can be set in DSC. These are the locations:

  A. DCIM (gallery)

  B. Private directory (Android/data/de.seebi.deepskycamera/files/Pictures)

  C. SD card DCIM (gallery)

  D. SD card private directory

    (Android/data/de.seebi.deepskycamera/files/Pictures on SD card)

2. You cannot save images outside of these four locations, such as Documents, Alarm, Music, etc.

3. You cannot create directories or subdirectories outside of these four directories, such as Documents, Alarm, Music, etc.

4. On Android 14, DSC's internal file browser is no longer a universal file browser. You can only browse the four predefined locations.

Of course, there is still the option to create subdirectories. On Android 14 (or higher) you can create corresponding subdirectories:

  A. DCIM (gallery)

  B. Private directory (Android/data/de.seebi.deepskycamera/files/Pictures)

  C. SD card DCIM (gallery)

  D. SD card private directory

    (Android/data/de.seebi.deepskycamera/files/Pictures on SD card)

2. There are no restrictions on Android 6 to 13.

Timestamp
This feature allows you to add a timestamp to the bottom of the image. You can choose between the options:

- No timestamp (default)
- Start of exposure time
- End of exposure time
- Start and end of exposure time

The time stamp is in the millisecond range and is only integrated in JPEG files. RAW/DNG files remain untouched.
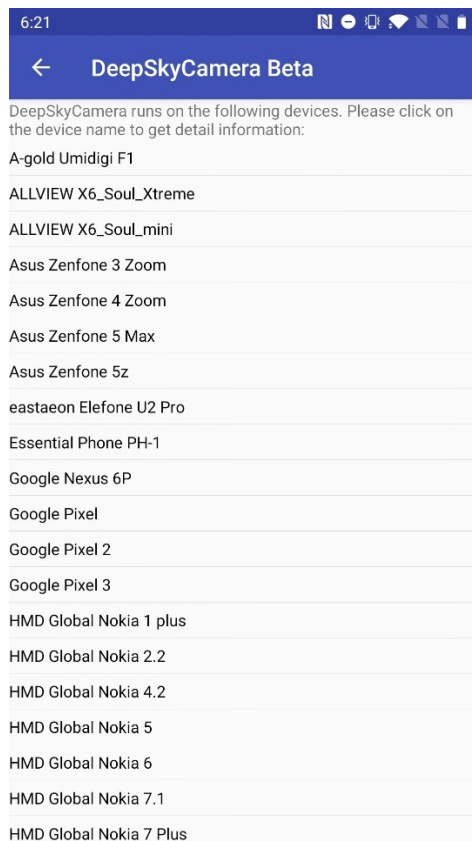
Info

This lists some technical information about the first camera sensor on the back of your device.
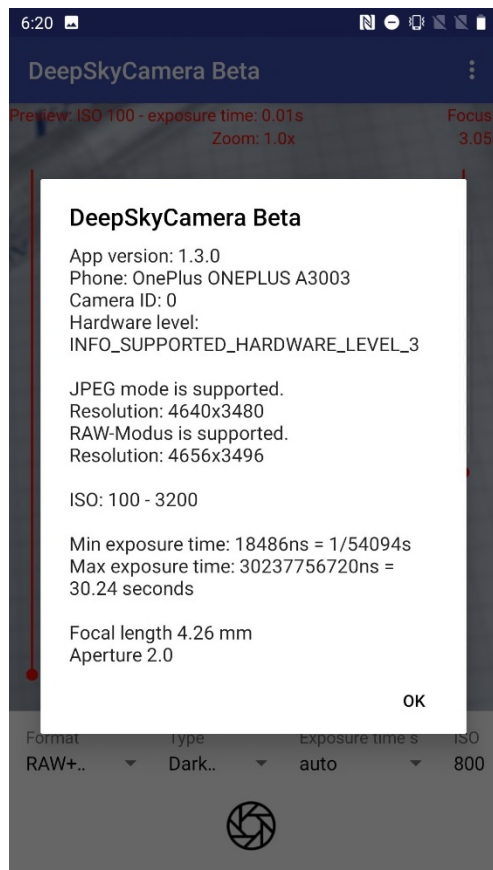
Supported devices

A listing of supported devices. The app runs fine on the listed devices. The list will be updated all the time. To have the actual information of listed devices, drag from top to bottom.

Select a phone name to see the technical details. Important for astrophotography is a device with a high value for exposure time (30 sec, 35 sec etc.).

Note: If your phone is not in the list and the app runs fine anyway, please report your device to the developer, tapping "Report your phone" in the menu of the app.

Note: The list can be empty when you don't have any internet connection or a very slow connection. To get the latest update please refresh the list of supported devices later, when you have a faster internet connection.

Report your phone

You can send technical data of your device and comments, questions, problems etc. It's a communication channel to the developer. It helps to improve the app!!!

You can send anonymously. Name and mail address are optional.

The function "Report your device" sends the file *deepskycamera_hardware_level.txt* to the developer. The txt file contains technical data about the camera sensors of your phone. On Android 6 to 10 file is stored on your device in the same directory where your images are stored. On Android 11 or higher log file stored in private directory *Android/data/de.seebi.deepskycamera/files/Pictures*. The file is generated by the app during startup and contains definitely no personal data. The file is necessary for the developer, to get the data about the camera sensors. This helps a lot, when reporting and fixing a bug.

The option "Include log file" adds log file to the message. This is also very helpful when fixing bugs. If log file is disabled no log file is added to the message. You can enable or disable log file on "Settings" page of the app.

Tools

Tools menu entry contains helpful tools.

Calculator pinpoint stars

If you don't have a telescope mount or tracking, you can calculate here what the maximum exposure time is for the camera sensor so that the stars remain pintpoint stars.
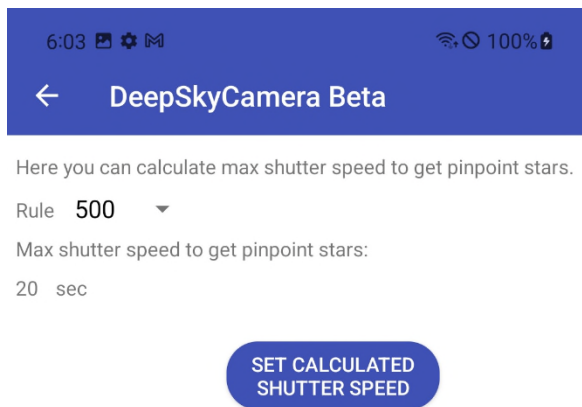
There are several formulas that can be used to calculate this. The app implements four formulas that you can choose from:

- 300 rule
- 400 rule
- 500 rule
- 600 rule

The 500 rule is a good average and works in many cases. The maximum exposure time is usually between 14 and 21 seconds.
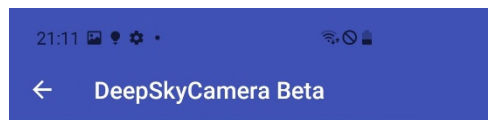
By tapping "Set calculated shutter speed" button, the app sets the calculated time on the main page – you can start right away. However, you have to be careful - especially with phones that only offer a short exposure time (e.g. 1 sec). The calculator calculates the maximum possible exposure time of the camera sensor with the given focal length in order for the stars to remain point-like, but if your phone doesn't support this exposure time, you can't use this value - you then have to go to the maximum exposure time.

If you find that the stars do show slight star trails or an egg shape, use the 400 rule or 300 rule, which calculates a slightly lower maximum exposure time.

> **Note**: The calculated exposure time is not set on legacy devices, since only "Auto" exposure time exists there.

View log file
This function displays log file.

You can delete content of log file by tapping on trash icon

This deletes the content of log file not log file itself. If you don't need log file please disable log file in "Settings" menu entry or delete the content from time to time. Otherwise log file gets bigger and bigger and can slow down the app.

Note: Page is empty when log file is disabled in "Settings" menu entry.

Help

This menu entry contains some help functions:

- Hints: hints about general use
- Focus help: a description how to focus manually. The page contains a table with focus values for infinity on various devices. If your device is not on the list, you must do experiments on your own to figure out what the best focus value for your device is. The stars must be pinpoint stars.
  If you have figured out the value of your device and your device is not listed, please report the value to the developer. He will add the value and the phone to the focus table.
- Tutorial: Link to the web site.
- New in this version: History of changes.

About

Information about the app.

Manual

PDF

By tapping the PDF logo, the app downloads the latest manual from the server as a PDF file. **Here, you need an internet connection.**

YouTube

By tapping the YouTub logo, the app opens the YouTube app or the website and shows the YouTube channel "DeepSkyCamera". The channel is open to the public.

Facebook

By tapping the Facebook logo, the app opens the Facebook app or the website and opens the Facebook group "DeepSkyCamera". You need a Facebook account to view the content of the group. You can post your images, ask questions etc.

Instagram

By tapping Instagram logo, the app opens the Instagram app or the website and shows #deepskycamera. You need an Instagram account to view the content of the hashtag.

Privacy policy

The privacy statement.

Exit

This exits the app. If you don't use the app, please exit the app, otherwise the app runs in the background and consumes energy from your battery.