Karmin2 Stereo Camera

User Manual

(v1.1) July 23, 2019

Contents

1 Available Models

Karmin2 is available in two different baseline distances: 10 cm and 25 cm. The 10 cm model is intended for close-range measurements, while the 25 cm model is intended for long-range measurements. The covered measurement range also depends on the selected lenses and on the processed disparity range, which is the image overlap range that is searched during image processing.

Both baseline distances are available with either monochrome or color image sensors. When used in combination with SceneScan, the monochrome versions can achieve higher image resolutions and frame rates. Using the monochrome models is hence recommended if color information is not important for subsequent processing.

When using identical lenses and a constant disparity range, the 10 cm models will have a lower minimum depth when compared to the 25 cm models. The depth error increases approximately quadratically with the measured depth, starting at the minimum depth. Hence the 25 cm models will have a lower depth error for all points that fall within its measurement range. If the minimum depth of the 25 cm models is sufficient, then these models should be preferred over the 10 cm models. Detailed characteristics, including the minimum depth, are available on the Karmin2 product page[1] for the most common configurations.

2 Specifications

2.1 General Specifications

Camera modules	Basler daA1600-60um / daA1600-60uc
Sensor resolution	1600 × 1200 pixels
Sensor	e2v EV76C570
Sensor format	1/1.8"
Lens mount	C/CS-mount
Chroma	mono / color
Shutter	global shutter
Interface	USB 3.0
Trigger-input	4-pin Binder M8 connector
Stereo baseline distance	10 cm / 25 cm
Mounting bottom side	4× M3 threaded hole
	1× 1/4" UNC threaded hole (tripod mount)
Mounting top side	2× M3 threaded hole
Weight without lenses	280 g for 10 cm baseline
	450 g for 25 cm baseline
Conformity	CE, FCC, RoHS

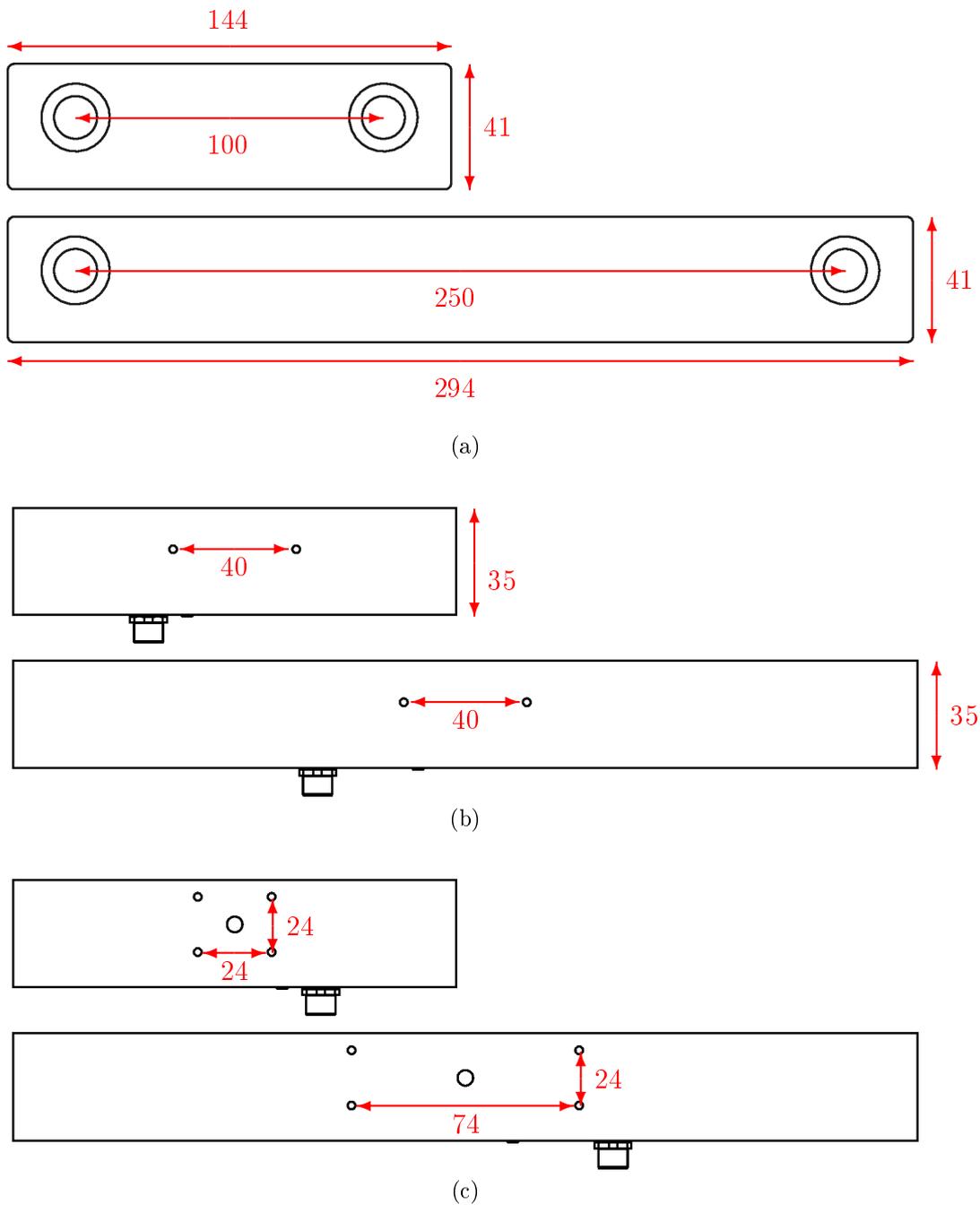[1]See: https://nerian.com/products/karmin2-3d-stereo-camera/

Figure 1: (a) Dimensions and (b-c) placing of mounting holes for 10 cm and 25 cm versions of Karmin2. All measurements are provided in millimeters.

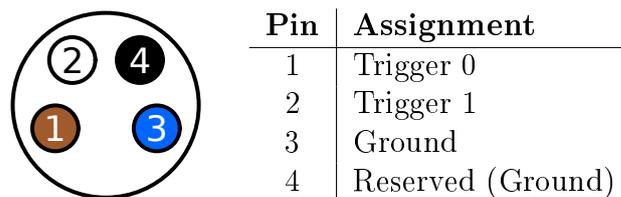| Pin	Assignment
1	Trigger 0
2	Trigger 1
3	Ground
4	Reserved (Ground)

Figure 2: Pin assignment of trigger connector.

2.2   Dimensions and Mounting Holes

Dimensions of the available models are shown in Figures 1a and 1b. The spacing of the available mounting holes is shown in Figures 1b for the top and in Figure 1c for the bottom side of both versions. The measures in all figures are provided in millimeters.

The top side features two threaded mounting holes with M3 metric threads. The bottom side features four additional mounting holes with M3 threads, and one mounting hole with a 1/4" UNC thread for use with tripods. The drill depth of all mounting holes is 6 mm.

3   Trigger Port

The camera features a trigger port on the backside, which uses a male 4 pin Binder 718/768 series connector. This connector matches the female trigger connector on SceneScan and SceneScan Pro.

The following manufacturer part numbers correspond to matching connectors, and should be used for custom trigger cables:

99 3376 00 04	Matching connector with solder termination, not shielded.
99 3376 100 04	Matching connector with screw termination, not shielded.
99 3376 500 04	Matching connector with cutting clamps termination, not shielded.
99 3362 00 04	Matching connector with solder termination for 3.5 - 5 mm^2 cable cross section, shielded.
99 3362 25 04	Matching connector with solder termination for 2 - 3.5 mm^2 cable cross section, shielded.
99 3362 100 04	Matching connector with screw termination for 3.5 - 5 mm^2 cable cross section, shielded.
99 3362 100 04	Matching connector with screw termination for 6 - 8 mm^2 cable cross section, shielded.

The pin assignment of the trigger port is shown in Figure 2. There are two trigger lines, named Trigger 0 and Trigger 1, which correspond to the equally named trigger signals provided by SceneScan.

By default, Karmin2 is configured such that image acquisition only happens

Table 1: Operating voltages for trigger port.

Voltage	Description
4.2 VDC	Absolute maximum voltage. Exceeding this voltage might damage the camera and will void the warranty.
0 – 3.4 VDC	Safe operating range
0 – 0.7 VDC	Indicates a logical 0
1.8 – 3.4 VDC	Indicates a logical 1

Table 2: Maximum allowed lens intrusion.

Mount type	Lens rear diameter	Maximum intrusion
CS-mount	Less than 13.5 mm	7.8 mm
CS-mount	More than 13.5 mm	6.0 mm
C-mount	Less than 13.5 mm	12.8 mm (with 5 mm spacer ring)
C-mount	More than 13.5 mm	11.0 mm (with 5 mm spacer ring)

upon a positive edge of Trigger 0. It is thus necessary to connect Karmin2 to SceneScan's trigger port or to an equivalent trigger source. The trigger signal will ensure that image acquisition of both cameras is synchronized, which is necessary for processing the acquired image data.

The relevant voltage levels for the two trigger lines are listed in Table 1. The absolute maximum voltage must not be exceeded in order to avoid damages to the device.

4   Lenses

On the front-side, Karmin2 features two lens mounts for its two image sensors. The lens mounts are compatible to the CS-mount standard. By using a 5 mm spacer ring, it is possible to connect a C-mount lens. Karmin2 is shipped with two spacer rings pre-mounted.

When mounting a lens, it is important that the lens doesn't intrude farther than the maximum allowed lens intrusion. If the lens intrudes farther, it can scratch the dust protection window. The maximum allowed intrusion depends on the rear diameter of the lens. A narrow lens is allowed to intrude farther than a wider lens. Table 2 provides a list of the allowed intrusions for C-mount and CS-mount lenses with different diameters.

5 Camera Configuration

5.1 Pixel Binning and Bayer Pattern Downsampling

For many applications a high frame rate is more important than a high image resolution. To cover such usage cases, the monochrome Karmin2 models can be configured to use a 2×2 pixel binning. In this setting, four sensor pixels are combined to form one image pixel. Using pixel binning allows the cameras to operate at a higher frame rate. When used with SceneScan Pro, a maximum frame rate of 40 fps is possible.

For the color models, SceneScan can perform a combined demosaicing and down-sampling, which also results in the image width and height being halved. This is the default operation mode when a color Karmin2 camera is connected to SceneScan, or when a Bayer pattern pixel format is selected. The combined demosaicing and down-sampling reduces artifacts from the Bayer pattern, which improves the image processing quality.

Switching the camera configuration between full resolution and pixel binning / down-sampling mode will also affect the covered depth range, if the disparity range is kept constant. A constant disparity range will cover a larger percentage of an image that was acquired with active pixel binning, compared to an image acquired at the native camera resolution. Hence, the disparity range should be adjusted when changing the pixel binning configuration.

5.2 Other Camera Settings

The cameras provide a multitude of different settings that can be configured when connected to SceneScan or SceneScan Pro. The available settings match the ones available in the Basler dart daA1600-60um / daA1600-60uc camera modules. For a full documentation of all settings, we hence recommend to consult the documentation available by Basler[2]. The most common camera settings are described in the following.

5.2.1 Analog Control

Gain:	Gain factor for the image sensor.
Gain auto:	Sets the mode for automatic gain control.
Black level:	Controls the analog black level as an absolute physical value.
Gamma:	Controls the gamma correction of pixel intensity.

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[2]See https://www.baslerweb.com/en/support/downloads/document-downloads/basler-dart-usb-3-0-users-manual/

5.2.2   Image Format Control

Width:	Width in pixels of the selected Region-Of-Interest (ROI).
Height:	Height in pixels of the selected ROI.
Offset X:	Horizontal image coordinate of the top-left corner of the selected ROI. When configured through Scene-Scan, this coordinate is measured relatively to the image center.
Offset Y:	Vertical image coordinate of the top-left corner of the selected ROI. When configured through SceneScan, this coordinate is measured relatively to the image center.
Binning horizontal:	Number of horizontal photosensitive cells that are combined for one image pixel.
Binning vertical:	Number of vertical photosensitive cells that are combined for one image pixel. There is a conditional dependency to the *binning horizontal* parameter, which has to be adjusted first.
Pixel format:	Desired pixel encoding mode.

5.2.3   Acquisition Control

Exposure time:	Sets the exposure time.
Exposure auto:	Sets the mode for automatic exposure control.
Trigger selector:	Selects the trigger that shall be configured.
Trigger mode:	Controls if the selected trigger is active.
Trigger source:	Specifies the internal signal or physical input line to use as the trigger source.
Trigger activation:	Specifies the activation mode of the trigger.
Exposure mode:	Sets the operation mode of the exposure.

6   Interfacing Karmin2

6.1   Connecting to SceneScan

Karmin2 is intended for use with the SceneScan or SceneScan Pro image processing systems. Karmin2 should be connected with a Micro USB 3.0 cable to one of SceneScan's USB ports. The Micro-USB-connector can be secure with lock screws if an appropriate cable is used.

In addition to the USB connection, Karmin2 also requires a connection to SceneScan's trigger port. A suitable trigger cable can be obtained from Nerian. It is alternatively possible to use a trigger source other than SceneScan. In this case please make sure that SceneScan is configured appropriately and that the

Table 3: Supported trigger frequencies / frame rates.

Binning / Demosaicing	SceneScan model	Disparity range	Max. feq.
2 × 2 binning	SceneScan	128	40 Hz
2 × 2 binning	SceneScan Pro	256	20 Hz
Demosaicing	SceneScan Pro	192	29 Hz
None	SceneScan Pro	128	15 Hz
None	SceneScan Pro	256	8 Hz

Figure 3: Karmin2 connected to SceneScan pro.

trigger source obeys to the voltage levels listed in Section 3. Figure 3 shows Karmin2 connected to SceneScan Pro with a USB and trigger cable.

The trigger signal must provide an appropriate trigger frequency that can be matched by the cameras and the selected SceneScan model. The possible frequencies for different system configurations are listed in Table 3. In low-light situations the desired frame rate might not be achieved if the sensor exposure time is too high. In these cases, an appropriate exposure time upper limit should be configured in the SceneScan camera settings.

SceneScan will load a suitable camera configuration for Karmin2 after the initial connection. Please refer to the SceneScan / SceneScan Pro user manual for information on the possible configuration options.

6.2 Connecting to a PC

When connected to a PC, Karmin2 will appear as two individual USB3 Vision cameras. Using Karmin2 with a PC is not officially supported. This is why an official API or example programs are not available. However, Karmin2 is compatible to Basler's Pylon camera API and software, which can be obtained from the Basler website[3]. Please refer to Basler's documentation for programming and using the cameras with a PC.

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[3]http://www.baslerweb.com/en/products/software

7   Support

If you require support or if you have other inquiries that are related to this product, please contact:

Nerian Vision GmbH
Zettachring 2
70567 Stuttgart
Germany
Phone: +49 711 2195 9414
E-mail: service@nerian.com

Website: www.nerian.com

8   Warranty Information

The device is provided with a 2-year warranty according to German federal law (BGB). Warranty is lost if the housing is opened by others than official Nerian Vision Technologies service staff. In case of warranty please contact our support staff.

Revision History

Revision	Date	Author(s)	Description
v1.1	July 13, 2019	KS	Fixed mistakes and added color support
v1.0	December 12, 2017	KS	Initial revision