Fotonic E and P-series User Guide

Part Number 402660 – Rev D
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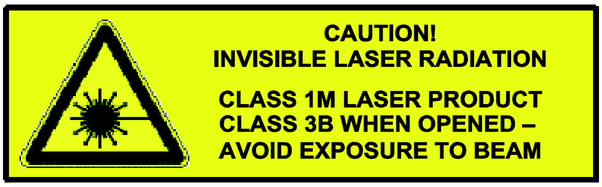
WARNING!

Do not under any circumstances use the camera without first reading the entire Quick Start Guide and User Guide.



1. Introduction

This is the Fotonic E and P-series User's Manual. Please read this guide carefully, as it will be your guide when installing and using your Fotonic camera.

1.1 Overview

Fotonic E-series is a series of 3D cameras that use the Time of Flight technology. The P-series cameras are based on structured light and triangulation technique by Prime sense. Both measure the surrounding in front of the camera and send the measurements to a computer for further processing. It's also possible to use the cameras internal ARM CPU for embedded image processing and then get a smart camera.

2. Quick start

2.1 Package contents

See Quick Start Guide for a complete list package contents and accessories.

2.2 Installation and Setup

2.2.1 Downloading and installing software

Software for supported OS can be downloaded from Fotonic's homage (www.fotonic.com). There you can also download needed SDK for embedded software development.

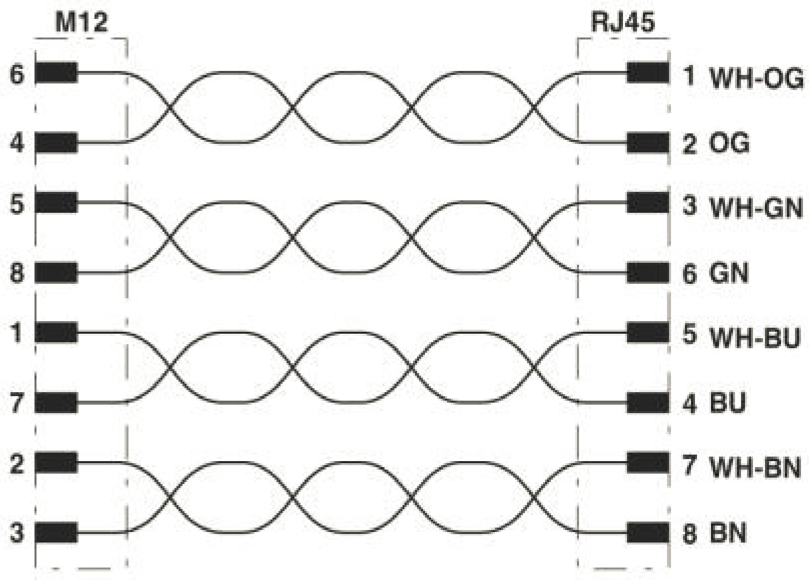
2.2.2 Connecting Fotonic E and P series cameras

The Fotonic E and P series cameras need to be connected to both a power supply and an Ethernet network. Both power supply, power cable and Ethernet cable are optional accessory to the camera.

The camera uses the following pinout:

Power interface	M12 connector 4 pin E-coded	Pin1 +24V, Pin4 GND Pin 2,3 NC	IEC 61076-2-101
Signal interface	M12 connector 8 pin D-coded	10/100/1000 Mbps Ethernet	IEC 61076-2-101
Powersupply	24V Typical 10 W max 20 W		

M12 Signal interface pin out for connection to RJ45 (T568B)



2.2.3 Using 3D Display

3DDisplay is an example application which can be used to test and evaluate Fotonic cameras.

Start the application with the shortcut located on the desktop or on the start menu, Start->All Programs->Fotonic->3DDisplay.

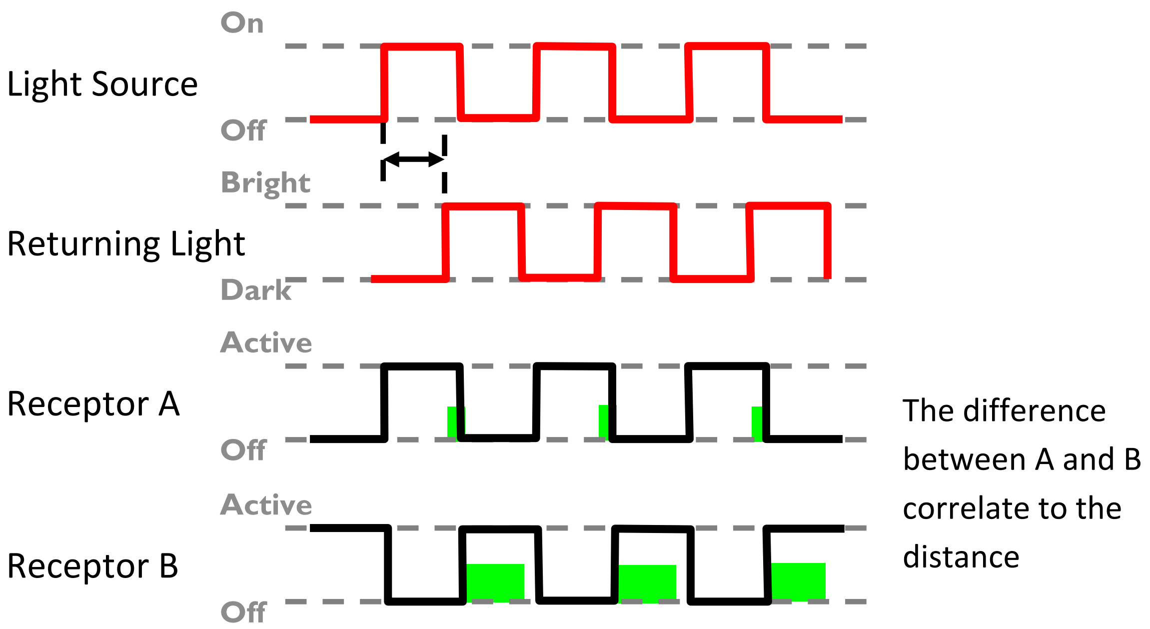
3DDisplay will start, use the first camera found and display measurements from that camera in the 3D view.

3. Measurement techniques

3.1 Time of Flight

In Time of Flight systems the distance to objects in front of the sensor is measured by analyzing the time for a light pulse to travel from an illumination source to the object and back to the sensor. The illumination source in Fotonic's cameras has a wavelength that's not visible to the human eye.

By modulating the light source and comparing the phase with the received signal, the distance can be determined at each pixel of the sensor.



The maximum measurement distance is given by the modulation frequency.

3.2 Structured light and triangulation

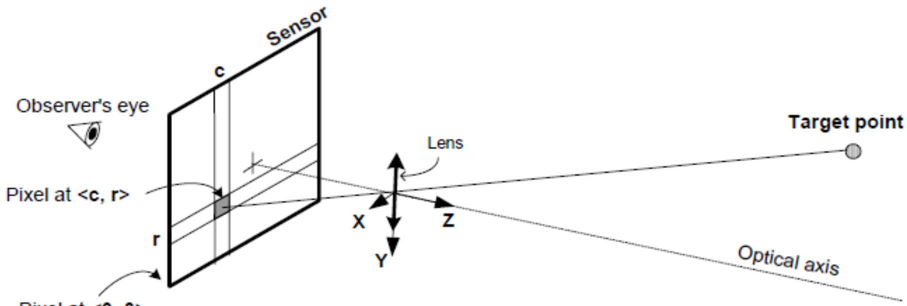
The core technology in this area is property of Prime sense but is based on structured light and triangulation. A speckle pattern produced by a Laser, diffuser and DOE and then projected on the object. The pattern of the speckle is called structured light and the distance is calculated on how the speckle varies by distance in Z-axis.

3.3 High dynamic rage mode

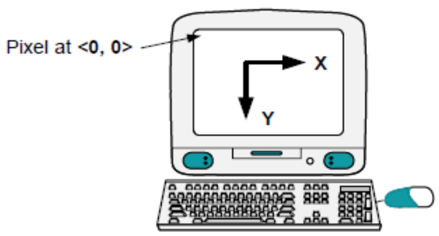
The E-series camera has a high dynamic range mode that uses two different shutter settings to achieve a higher dynamic range. The decision of witch shutter to use for each pixel is made internally in the camera and is not necessary to change.

4. System of coordinates

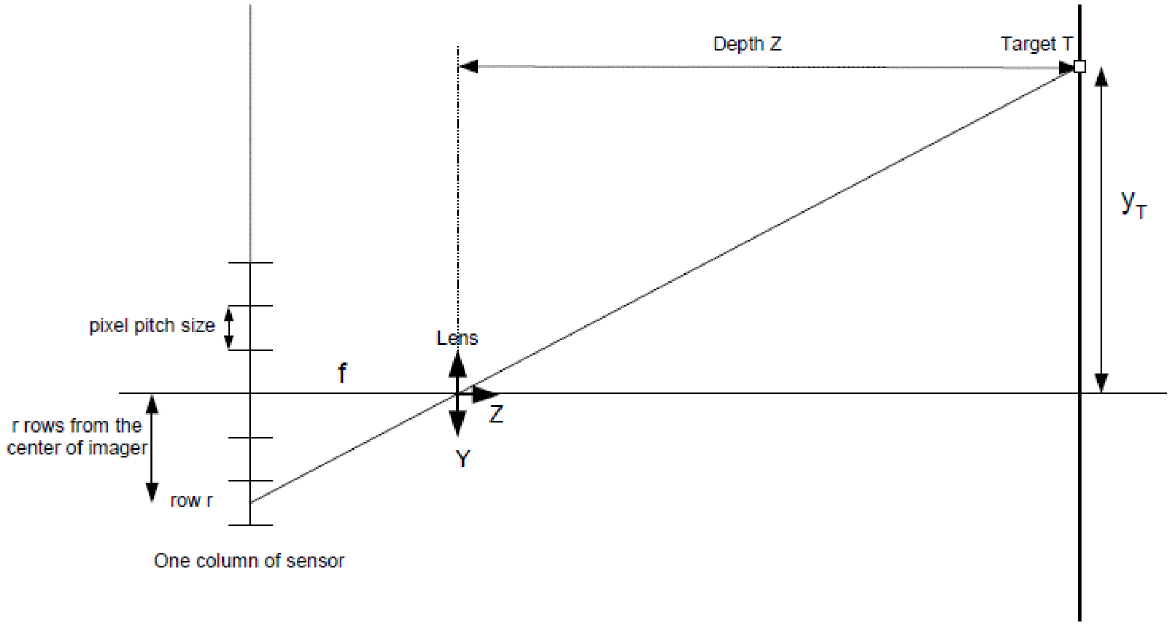
In order to introduce X, Y and Z coordinates, we need to define a system of coordinates relative to the camera. As shown in picture below, the center of the camera coordinate is the center of the camera lens. The x and y coordinates are as shown in picture below with the observer eye behind the sensor. Note that x and y coordinates, when mapped to the display monitor, are as shown in the bottom of picture below. Pixel <0,0> in the display will map to the upper left corner of the display.



(a)



The next picture shows the same information as above in a two dimensional view. Only one column of the sensor is shown. A target (or object) T is mapped to a row, r, in the figure. When the frame is produced, the value in the pixel is the depth Z to the target.

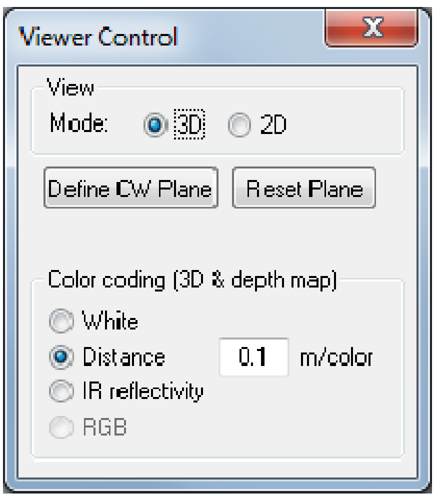


The depth distance (Z) produced by the API is the perpendicular distance from a target point to the front glass of the camera. The depth distance is different from the range distance which is the straight line distance from a target point to the camera. Note that if the target lies on the optical axis of the camera lens, the depth and range distances are the same. See picture above. The camera performs the necessary conversion from the range data to depth data for off-center targets.

5. 3D Display

3D Display is a demo application. This chapter describes how the application can be used for demo and evaluation of the camera.

Under the “settings” menu, there are four different control windows which can be activated or deactivated. The functions of each control window are described in the subsections below. There are also options to show more sensor information and statistics.



5.1 Viewer control

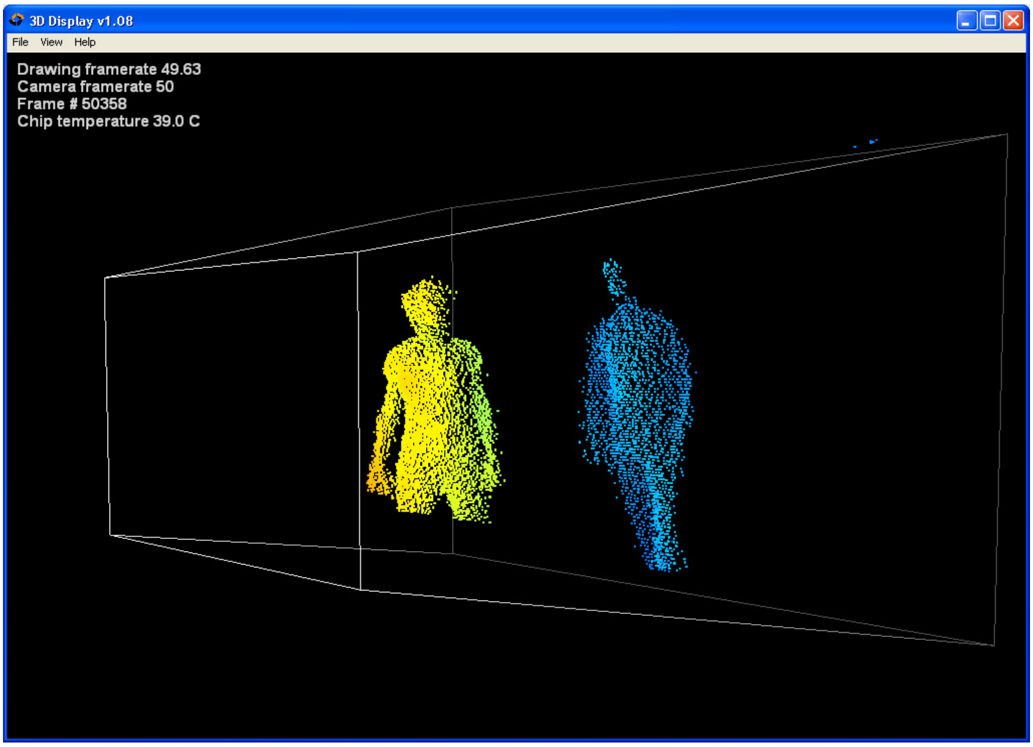
3DDisplay has two main views, 2D and 3D. The view to use is selected in the “Viewer control” window.

The 3D-view shows a 3D representation of the data received from the camera. You can use the mouse to rotate the view and the scroll wheel to zoom in and out. The 2D-view shows a 2D picture.

There are different options regarding how the pixels shown are colored, this is done using the options in the “viewer control” window. When choosing “distance” as color coding, the pixels are colored depending on its Z-value. The extension for which a color shall be used can then be modified to get the desired resolution in depth data. There is also options to other coloring like “White” or ”IR reflectivity”.

For the P70 camera there is also an option to color the pixels from its RGB sensor.

Define CW plane is a simple way to illustrate measured distance from a plane surface instead of the camera. To use this you need to be in 2D mode. Then press the “Define CW Plane” button. After that you need to click on three clockwise pixels in a plane surface in the 2D view. In the 3D view the coding of distance will now be calculated from the defined plane instead of the camera. To restore this setting to default press the “Reset Plane” button.

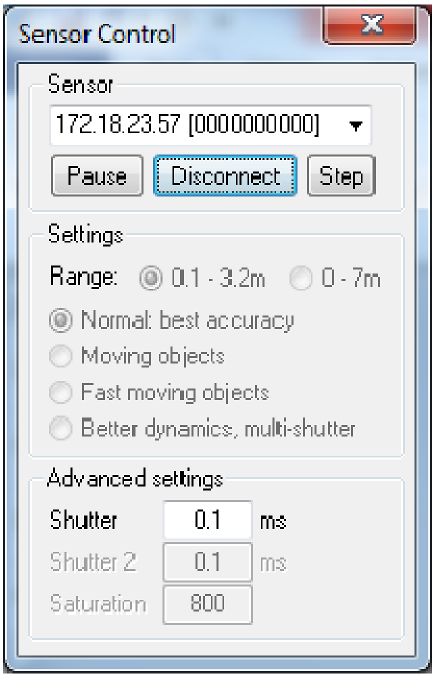


5.2 Sensor control

The sensor control is used to select camera and change camera settings.

The “Sensor” section is used to switch between connected and found cameras. When 3DDisplay is started the first camera is selected. It is also possible to enter the IP number of Ethernet cameras that cannot be found because they reside on a different network.

The Pause/Play button is used to start and stop playback from the camera. The Step button takes one image and then pauses.

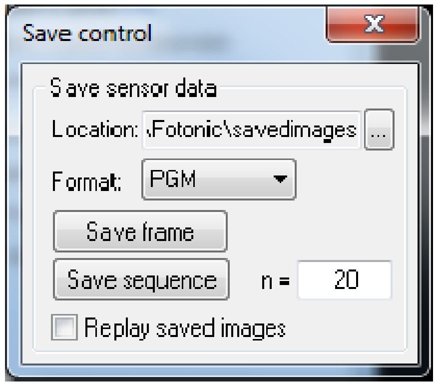


The setting section in the “Sensor control” window sensor dependent settings and settings that are not available for the used camera type will be grayed out.
Shutter time is same as exposure time in an analogous camera. The Shutter time is the time the shutter will be opened and the camera chip is exposed to light. The Shutter time is set in *milli-seconds* (ms).

The frame rate is the number of frames per second delivered from the camera.

5.3 Save control

The “Save control” window is used to save raw data from the camera. You can save either one image or a sequence of n images. The “Replay save images” checkbox will replay *all* saved images in a loop. Default, the files are located in “My Documents\Fotonic\savedimages\” and named after camera serial number and current date and time. When saving images on a slow computer frames may be lost because 3DDisplay makes no attempt to buffer images.



There are three different file formats supported:
PGM: Each image is saved as four different files. One for X,Y,Z and Active Brightness information. Save sequence saves all images in the sequence to the same files. This is the fastest file option.
3DD: Each image is saved as one file with header in exactly the same binary format as the image is read from the FZ-API.
CSV mean: A sequence of images is used to calculate a mean image and the Z and B data is stored in a comma separated file.

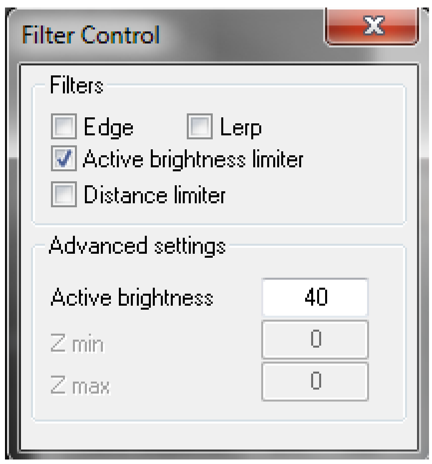
Please read the FZ_GetFrame chapter in FZ-API Reference Manual for more information about how the camera data is formatted.

5.4 Filter control

The “Filter control” window can be enabled in the “Settings” menu. It is used to configure how the data from the camera is shown.

Active brightness limiter

The Active brightness limiter is a threshold filter. It is only active in the 3D view and it removes pixels with active brightness values lower than the chosen value.



Distance limiter

The distance limiter is active in both 2D and 3D view.

It is a threshold filter, that limit the measurement range in Z to distances between “Zmin” and “Zmax”.

The color encoding for Z values is changed according to the limited Z range and the proportions in the 3D view is also changed.

Edge filter

The edge filter is an edge preserving filter, used to remove flying pixels. Flying pixels is pixels which lie on the border between two objects and therefore has signal contribution from both. If the objects are not on the same distance from the camera, such pixels will take on a value in-between.

Lerp filter

The Lerp filter is a noise reduction filter. It uses information from previous frames to stabilize the image.

6. Ethernet camera

Fotonic cameras support both dynamic IP configuration via DHCP and static IP assignment. A new camera is default set to DHCP configuration.

A camera can always be started in a fallback mode by connecting only the power cable to the camera and wait 30 before connecting the Ethernet cable. The camera will then start with the following IP settings:

IP: 192.168.1.10

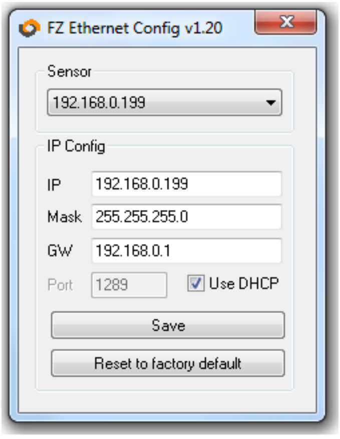
NETMASK: 255.255.255.0

7. Network configuration

The FZ Ethernet Config utility is installed with the Fotonic FZ installer and is located in the bin folder in the installation path.

The FZ Ethernet Config utility is used to change a camera network configuration. When the tool is started a camera must first be chosen by clicking in the drop down list at the top or by entering the Cameras IP address. When a camera is connected, its current IP configuration is shown and can also be changed. The "Use DHCP" checkbox is used to enable or disable the DHCP functionality.

If a camera can't be automatically detected for some reason it's also possible to connect to the camera by manually entering the IP of the camera in the drop down box.



8. Software development for Fotonic cameras

The software installer will install API for the camera including source code for the API, example 3D viewer application, example source, Matlab import scripts and documentation.

For information on how to develop your own software to interface the Fotonic cameras read the FZ-API Reference Manual.

9. Hardware Description

Technical Data

See product leaflet at www.fotonic.com for technical data for each Fotonic camera model.

Physical Dimensions

See product leaflet at www.fotonic.com for physical dimensions for each Fotonic camera model.