

**FPGA-Camera for  
Soldering stations „F-Cam I1“  
Documentation (english)**



F-Cam I1 Doc en (v.1.1) 13.02.11



**STAND-ALONE INSPECTION CAMERA SYSTEM**

**WITH LARGE WORKING DISTANCE AND ERGONOMIC WORK DIRECTION**

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## 1. INTRODUCTION

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### 1.1 Brief description

This inspection camera concerns around an intelligent camera with hardware-programmable switching circuit (FPGA) and 5 Megapixel CMOS sensors. By use of the inspection camera and by means of picture processing in divided monitor representation an ergonomic optical inspection can be carried out at soldering and repair work.

### 1.2 Description

An important condition for an exact work at soldering and repair work is the variable enlargement and positioning of the surface to be worked on (e.g., printed board with surface-mounting device). Furthermore the intelligent FPGA camera (F-CAM I1) offers image processing for actual and ergonomic work. Thereby the ergonomics is supported by a big working distance of the camera as well as a direct monitor control with image processing. F-Cam I1 is the new medal awarded (iENA - nuremberg inventors trade fair) soldering solution from germany.

Advantages:

- no PC necessary
- no Software maintenance required for camera functions
- entire image processing in camera with 5 Megapixel CMOS sensors
- VGA/SXGA monitor directly connectable
- big maximum working distance (> 30 cm)
- Monitor in working direction (ergonomics) with turning and tilting, height adjustable
- variable depth of field by aperture setting of the lens
- electronic image sharpening
- extensive set possibilities directly across the monitor-supported menu guidance
- variable electronic zoom (4 ... 16x with 25 mm lens, 8 ... 32x with 50 mm lens; depends also on object distance to lens)
- mirror (horizontal and vertical), pan, tilt (electronically)
- image filter functions as options
- an easy one-hand operation
- minimum energy consumption (camera: 2.5 W)
- variable illumination regulation / dimming of 2x 3 W LEDs
- PC connection per Ethernet/USB
- Options:
  - optical motor zoom
  - documentation by image storage on USB-Stick or PC system (Ethernet)
  - Reference image comparison
  - Component measurement, uvm.

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## 2. PRODUCT DESCRIPTION/ SYSTEM DESCRIPTION

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### 2.1 Components of the camera system

The camera system is comprised of:

- 1 massive stone stand support which serves with his big weight the stabilisation of the whole system, it can be omitted customizable and the stand support is fixed at a table directly,
- 1 profil support, the monitor and camera can be screwed on it by variable height,
- 19" SXGA monitor, incl. a bend-fixture and all necessary cables,
- 1 F-Cam I1 as a universal FPGA camera solution with VGA/SXGA output and lighting connection with dimmable output,
- 2 LED-lightings (3 W per piece) with flexible fastening,
- 1 operating device with operating button and connections for power supply unit and Ethernet communication,
- 1 power supply unit 230 VAC on 12 VDC with a power by leastwise 10 W,
- 1 C-Mount lens with a focal length of  $f = 50$  mm and an aperture of 1:1,4; other lenses sold as an option.

### 2.2 Product application

Soldering in the prototype construction and repair service require a high flexibility and ergonomics of the working surroundings. The F-Cam I1 can allow for these demands through flexible functions and direct display. The training time is minimized by means of the intuitive service of a set regulator (Encoder) and the monitor-supported menu guidance.

The ambient conditions are:

- Temperature  $T = 0 \dots 50^{\circ}\text{C}$
- Humidity  $H = 20 \dots 85\%$
- Climate protection class IP 20 according to DIN standard EN 60529 (optionally also higher)
- Supply voltage: 7 ... 30 VDC or provided power supply unit 12 V
- With power supply unit: 100... 240 VAC

Energy requirement of camera: max. 2,5 W

Energy requirement of lighting: max. 6 W

Energy requirement of monitor: approx. 48 W (depending on the used monitor type)

Running time: Continuous operation possibly

Turn-on time: Camera 1 second, monitor 10 seconds

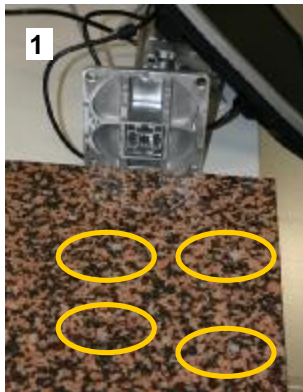
### 2.3 Product surroundings

The device can be used immediately with suitable soldering equipment and camera system storing position. No software system for the function of the camera is required from the user sides.

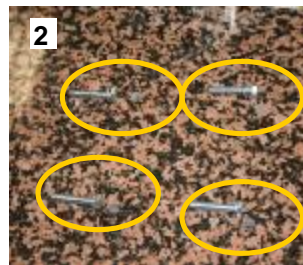
PC systems can be connected over Ethernet or USB (optionally) for extended functions. Software is provided.

## 2.4 Assembly

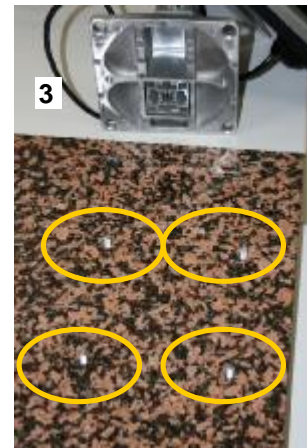
The F-Cam I1.1 is pre-assembled ex works incl. profil support, display, LED-lighting, cables and lens on the camera in package 1. Package 2 consist of the stand support of the F-Cam I1.1. This stand support is made of polished stone with mounting holes. The assembly simply consist of mounting pre-assembled profil support with the stand support by using the delivered separately screws, nuts and spanner as shown in the pictures below.



profile and stone made support



screws for the mounting holes



screws from downside the stone



profile stand in the screws



mounting the screws and nuts with both spanners

## 2.5 Getting started

To use the F-Cam system after assembly the LCD monitor and the F-Cam power supply have to connect to 230 V. It is also necessary to connect the 12 VDC from power supply to power plug in the operating device. The system starts within any seconds, the menu appears on screen. To receive a clear and sharp video image the rings (aperture and focus) on the lens have to turn in right position. Therefore an arbitrary target (circuit board) helps to do it. At first the aperture ring (1) have to opened, at second the focus ring (2) has turned till a sharp image appears. By closing the aperture ring a more depth of focus can be reached.

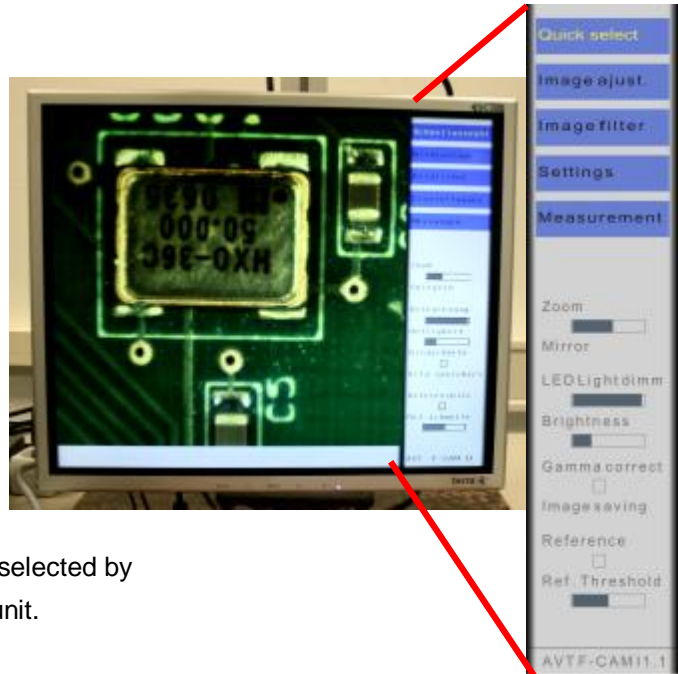


### 3. MENU STRUCTURE / DESCRIPTION OF THE FUNCTIONS

#### 3.1 Main menu

The menu is on the right side of the monitor representation. In that is the main menu at the upper area blue coloured. It consist of the menu items: Quick select, Image adjustment, Image filters, Settings and Measurement.

The active main menu item becomes coloured emphasised. The subjacent subitems belong to the active main menu item. The different main menu items will be selected by turning the adjusting knob at the operating unit.



The main menu item is selected with pushing on the adjusting knob and then the background colour of the subitem changes. Now the subitems are selectable with the adjusting knob whereat between the subitems is changed by pushing of the adjusting knob. The settings of the subitems are carried out by turning.

It will be returned to the main menu by pushing of the adjusting knob for 3 seconds. With it the background colour of the subitems becomes grey again. There is no limitation of the residence time in any subitem.

*Optionally buyable more functions are shown in this documentation in italics.*

**Inside submenus:** Push on the encoder knob select or deselect an item, which will change to/from bold letters. Turning of the encoder knob will change the submenu item or change the item value if the item is selected (bold letters).

#### 3.2 Subitems of „Quick select“

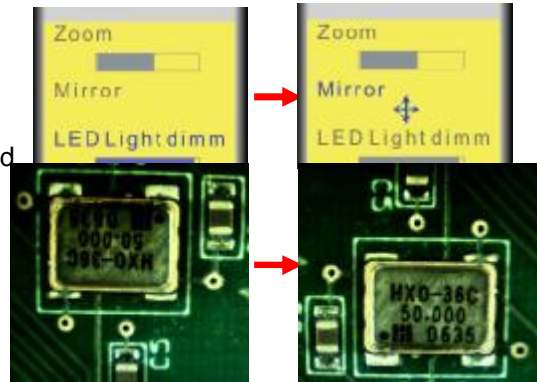
Important and often used functions became into a main menu summarised.

This is called quick select(ion) and consist of:

1. **“Zoom”** in different steps. 1024x960 picture points will be selected from the sensor. If the Zoom is 0 (blue bar is empty) the full area of video sensor is used. That is in the slightest enlargement about every 2nd pixel on the sensor surface (2048/2 x 1920/2). If the Zoom is 1 (blue bar is full) the middle sensor area in original resolution (1024 x 960) will be used in enlarged representation. An image section will be generated in this way and the position of it can be moved with the push-buttons at the control console.



2. With the subitem “**Mirror**” the image can be mirrored in horizontal and vertical direction separately and also concurrently. At the same time the image will be mirrored immediately according to the respective direction. The display will be supported through corresponding arrows.



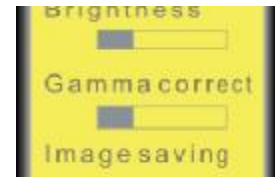
3. With the subitem „**LED light dimm(ing)**“ changes the dimming value therewith the brightness of the connected LED lighting. This lighting change occurs in 32 steps between 0 and maximum intensities. The display of the dimming value occurs over a volume indicator. Example: 50% =



4. “**Brightness**” changes the target value of the regulation by adjusted automatic brightness regulation in 32 steps, i.e. the regulation generates brighter pictures with high values of the brightness. For this reason the electronic brightness control can be combined with the intensity of the LED lighting quickly so as different conditions of lighting to realise and display.



5. “**Gamma correct(ion)**” changes the assessment of the pixel brightness with a power function depend on gamma in 8 steps. With it irradiation by e.g. soldering joints can be avoided.



6. “**Image saving**” will be used for the documentation of the activity by saving the indicated image. The image memory (USB-Stick, PC over Ethernet or USB) depends on the used connection. During the saving the indicated image is not updated (frozen display). The announcement will be supported with the text “Running” at the menu bottom and an volume indicator bar (see. Lighting).



**Option variations (separately buyable)**

7. “**Reference**” realises the function to position a model and to use it as a presentation with turn-on procedure. Other similar models are compared to the first one until the function is deactivated again. The comparison happens on a real-time as a video representation of the emphasised differences. This function can be used in the prototype assembly of several same boards in order to check assembly failure semi-automatically. All automatic processes (brightness, white comparison etc.) are stopped and stayed constant for the duration of comparison of the Reference image.

8. There is no error by partially shorter movement of component so that the subitem “**Ref. threshold**” (Reference threshold) conduces to the better support of the check. Therefore the amount of the movement/differences inside of an image can be adjusted. If this amount is overrun, a coloured frame of the video will mark this.

### 3.3 Subitems of „Image adjust(ment)“

Manual and automatic images settings can be carried out at the menu item image adjust.

1. **“Brightness Manual”** allows the changeover from automatic to manual brightness regulation. Particularly in a consistently and steadily illuminated surroundings the regulation is already often undesirable with shades or during manual operating steps. This can be switched off with it. The function of other two menu points is changed with it.

2. **“Integration”** is the direct setting of the integration time of the sensor in the manual mode. With it flicker appearances can be also reduced by means of the lighting. The flicker reduction for 50 hertz mains is preset. In the automatic mode the exposure is the maximum integration time which is used by the regulation.

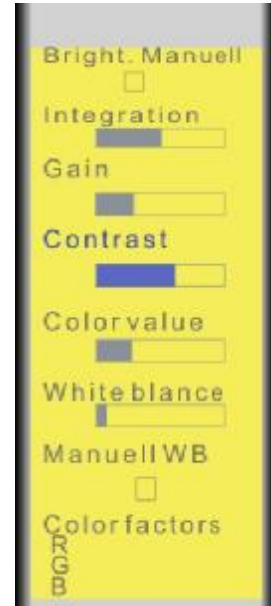
3. In the manual mode **“Gain”** is the direct setting of the analogous and digital reinforcing of the pixel signals in the sensor. In the automatic mode the strengthening corresponds to the target value of the brightness regulation, just like the item "Brightness" in 3.2.

4. **“Contrast”** changes the contrast of the images in reinforcement or assuagement in 32 steps. No influencing of the contrast corresponds to the medial position.

5. **“Color value”** changes the color saturation of the images in 4 steps.

6. **“White balance”** realises the automatic white compensation in 4 intensity steps. The comparison regulation occurs with it permanent automatically.

7. **“Manual WB”** is to the manual white balance by use of a white presentation in the complete camera image. The correction factors of the single colours (R, G, B) are shown with automatic and manual white comparison under it.

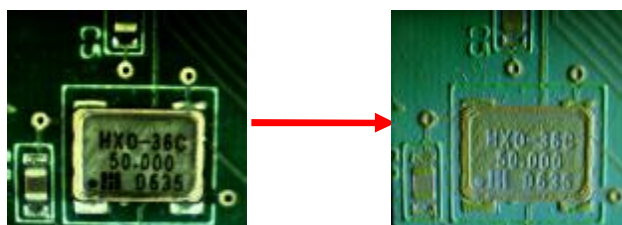


### 3.4 Submenus of „Image filter“

In the menu image filter electronic filters can be carried out in that image display, with it the inscriptions, differences etc. are better recognizable.

#### 1. **“Highpass”**

realises the high-pass filtering of shown video picture on a real-time basis.





**2. “Lowpass”**

realises the low pass filtering of the shown video picture on a real-time basis.

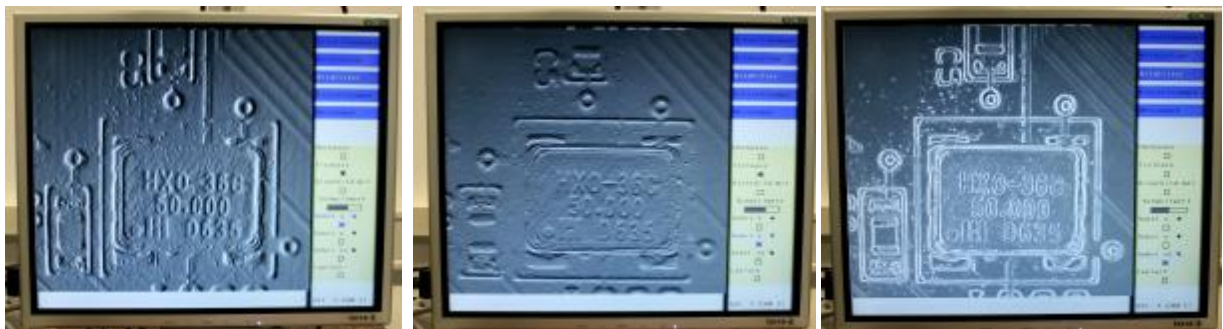
**3. “Binary image” with threshold**

realize the function to change the video image into a binary image (black-and-white image) in real-time. **4.** The “**Threshold**” can be changed to see differences between dark grey and a little lighter grey like black label on black integrated circuits. The two images show the result of two different threshold values. The pictures show the result for two different threshold adjustments. In particular inscriptions can be recognized with it also by low contrasts.



**5.-7. “Sobel x, y and xy”**

filter the video picture on a real-time basis with a Sobelfilter in x and Y direction or educated the sum of the filters from x and Y direction.



**8. “Laplace”**

realise the real-time video filtering.



### 3.5 Submenus of „Setting“

In the menu “**Settings**” producer significant basic settings are able to set with **Reset** and program **Updates** (together with a PC connection and the delivered software). Furthermore are the announcement from **Testimages** and different **Menu languages** (english and german at the time) possibly. If extensive settings are carried out in the menu, these are able to save in the Flash optionally and will be available after the new turning on again (**Save menu**). The **Serial number** identifies each F-Cam device. Image **Sharpness** can be turned on for increasing the image sharpness electronically.



### 3.6 Submenus of „Measurements“ (*Options variations; sold as an option*)

In the menu “**Measurements**” optional elements can be measured in the video picture. The measuring values (e.g., length, width, extent, surface etc.) are indicated in the display area under the video image. However before measurement a calibration is necessary in the measuring plane.

The submenu "Measurements" is soon available.

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## 4. SUPPLEMENTS

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### 5. GLOSSARY

*Definition of all important concepts to the backup of a uniform terminology.*

*The glossary should define not general places (e.g., Java, CPU etc.), but concepts from*

#### 5.1 Definitions

tbd

#### 5.2 Abbreviations

tbd

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## 6. CHANGE HISTORY

Date	Version	Change
05.10.10	1.0	First edition
22.11.10	1.1	Supplement of new functions
13.02.11	1.2	Supplement of Version I1.1