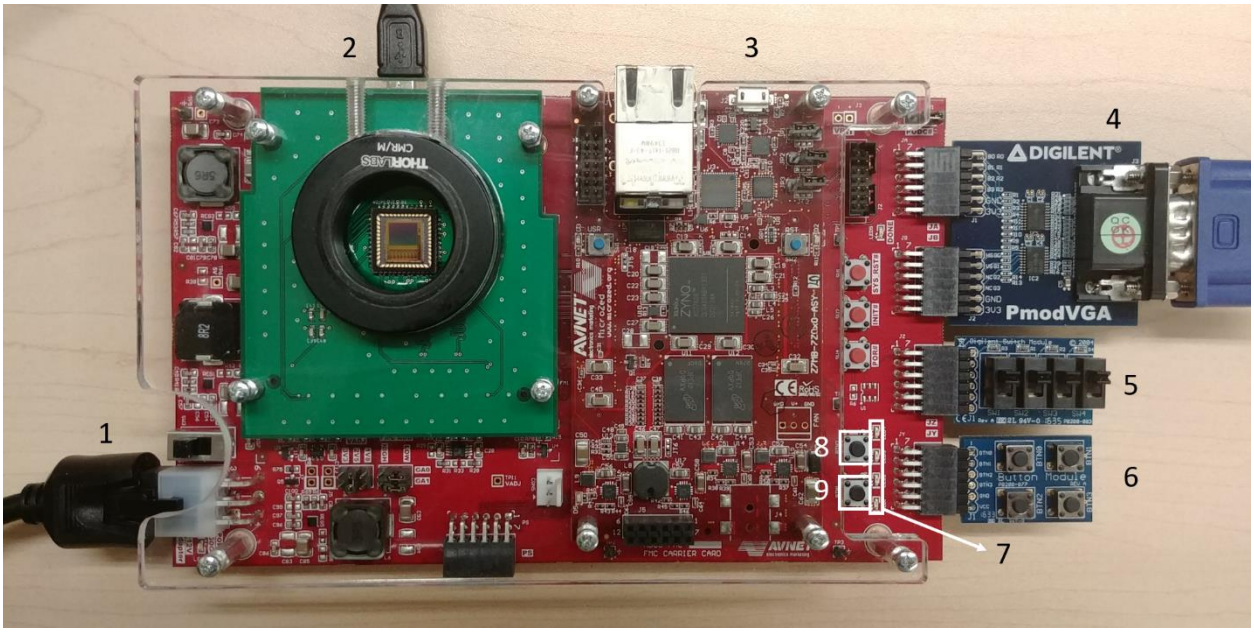
# CAMERA USER GUIDE

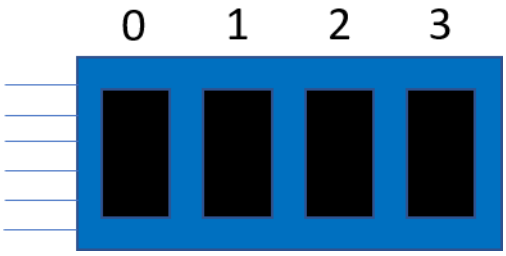
| | |
|---|---|
| **Sensor** | PYTHON 1300 |
| **Type** | CMOS |
| **Default res/fps** | 1280x1024 at 211 fps |
| **Pixel size** | 4.8 micron |
| **Shutter Type** | Global |
| **ADC** | 10 bit (recorded at 8 bit) |
| **Colour** | Greyscale |
| **Power** | ~ 4 W |
| **Price** | ~$650 USD for prototype |




| Number | Name | Description |
|---|---|---|
| 1 | Carrier board power supply | Supplies power to all components except the camera sensor. V_ADJ set to 2.5 V. |
| 2 | Camera sensor power supply | Supplies power to the camera sensor. |
| 3 | SD Card | Used for boot and for permanent storage of pics/vids. |
| 4 | VGA output | VGA output connection for real-time display of frames on a monitor. |
| 5 | Switches (SW) | Switches controlling resolution/fps and camera reset. |
| 6 | Pushbuttons (PB) | Pushbuttons to take pictures and videos and store them in the RAM. |
| 7 | Red LEDs (LED) | Red LED lights that indicate recording and storage status. |
| 8 | VGA toggle (VT) | Flips VGA output between greyscale and artificial colour. |
| 9 | Storage toggle (ST) | Used to alter the function of some of the PBs to transfer pics/vids from RAM to the SD Card. |

The system mounts onto a microscope through a C-mount adapter and is operated fully through the onboard switches and pushbuttons. Pictures and videos are stored on the SD Card in .pgm and .bin formats, respectfully. Video binary files can be processed into individual frames using the supplied convert application and converted into video using FFmpeg software.

## Switches (SW)

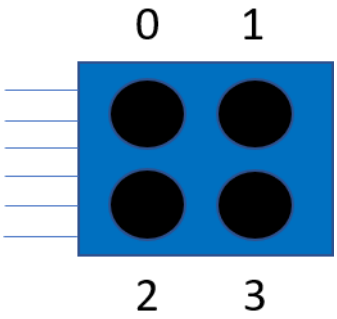



| SW[0:2] | Configuration |
|---|---|
| 000 | 1280x1024, 211 fps |
| 001 | 1280x1024, 100 fps |
| 011 | 1280x1024, 60 fps |
| 010 | 1280x1024, 30 fps |
| 100 | 640x480, 817 fps |
| 101 | 640x480, 400 fps |
| 110 | 256x256, 2329 fps |
| 111 | 256x256, 1000 fps |

By default, SW[3] acts as a high reset. When set low, the camera undergoes the power up sequence in the configuration set by SW[0:2]. Setting the reset high again during operation initiates the soft power down sequence for the camera and acts as a global reset.
The configuration can be changed during this reset period.

****It is recommended that turning off the camera is done by first setting SW4 high to initiate the power down sequence of the camera, wait about one second, and then turn off the carrier board power.**

## Pushbuttons (PB)




0: unused
1: take photo
2: start/stop continuous recording
3: take video

Pressing PB1 takes a photo and pressing PB3 carries out a video capture. PB2 can be used to put the camera in a continuous recording mode, where pressing it again stops the recording. The last few seconds (duration dependent on configuration) is stored. Once the pictures and videos have been captured and

stored in RAM, pressing ST changes the function of PB1 and PB3 to now transfer the picture or video, respectively, into the SD Card for long term storage.

| Resolution | Framerates | Record Time (s)<br>(8-bit pixels, ~1 GB storage) |
|---|---|---|
| 1280x1024<br>(SXGA) | 211 (MAX)<br>100<br>60<br>30 | 3.86<br>8.14<br>13.57<br>27.13 |
| 640x480<br>(VGA) | 817 (MAX)<br>400 | 4.25<br>8.69 |
| 256x256 | 2329 (MAX)<br>1000 | 6.99<br>16.29 |

## Red LED lights (LED)


When on,

4: storage mode on (ST has been pressed)
3: blinks when storage (RAM to SD Card) is underway
2: unused
1: camera is continuously recording

## VGA

The VGA port can output 4-bits of R, G, and B, which can produce $2^{(4+4+4)} = 4096$ different colours, but since the camera outputs in greyscale, we must feed 4-bits of each pixel into all the RGB channels resulting in only $2^4 = 16$ shades of greyscale on the monitor. The pixels are stored in memory as 8-bits meaning memory dumps of images retain their quality even though the images on monitor may be poor. To compensate and add more shades on-screen, an artificial colour setting was introduced for the frames displayed on the monitor which can be enabled by button VT. Instead of black to white, it is black – violet – white, which can create less banding in the observed image.

## Post-processing

To view the pictures and even the videos later, it is recommended to download and use **IrfanView**. It supports many if not all the file formats and is free.

After using the convert application provided to create the frames of a video from the .bin file, download **FFmpeg** to create a video from the frames. It is powerful command line program for processing video and audio and can encode the frames into a video. After installation, navigate into the folder with the frames, open the cmd using the technique above, and use the command below:

**ffmpeg -framerate 60000/1001 -f image2 -i frame_%d.pgm -vb 20M vid_60.avi**

This example translates frames frame_0, frame_1, … into a video named vid_60 in the avi file format at ~60fps and a 20M bitrate to maintain video quality. Depending on the monitor, it may not properly display 60fps so it is instead set here to 60000/1001 = 59.94 fps. You can also specify the start and end times (and set many other options) of the video using ffmpeg if you choose to learn and become familiar with the program.