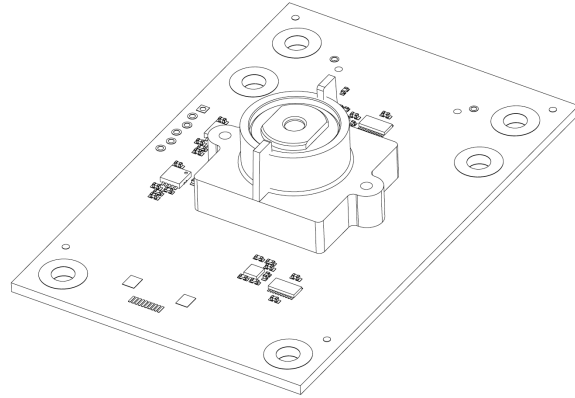


# SZG-CAMERA

A SYZYGY Standard peripheral with the following features and specifications...

- ON Semiconductor AR0330 1/3-inch CMOS digital image sensor
- 3.4 Mpixel up to 60 fps
- 196 Mp/s readout via 4-lane HiSPi
- RGB Bayer color filter array
- ERS (rolling shutter) and GRR (snap-shot) modes



## Resources

- [Aligni PLM](#) - See the **Attachments** tab for schematics and Altium Designer project files.
- [SYZYGY Specification](#)
- [SYZYGY GitHub Site](#) - Several projects that could be helpful.

## SYZYGY Information

### Compatibility Table

Compatibility Parameter	Specification
Port type	SYZYGY Standard
Width	Single
5V supply required	Yes
Nominal 5V supply current	< 10mA
Nominal 3.3V supply current	510mA
VIO supply voltage	1.8V to 3.3V
Nominal VIO supply current	50mA
Total number of I/O	23
Number of differential I/O pairs	4

### DNA Data

This data is stored in the SYZYGY DNA microcontroller on the SZG-CAMERA peripheral.

DNA Parameter	Data
Max 5V Load	0 mA
Max 3.3V Load	510 mA
Max VIO Load	50 mA
IS_LVDS	True
IS_DOUBLEWIDE	False
VIO Min	1.8V
VIO Max	3.3V

### Pinout

SYZYGY (J1)	Connection	Note
5 (D0P)	SLVS0_P	
7 (D0N)	SLVS0_N	
6 (S1)	FLASH	
8 (S3)	RESET_B	
9 (D2P)	SLVS1_P	
11 (D2N)	SLVS1_N	
10 (S5)	TRIGGER	
12 (S7)	SHUTTER	
13 (D4P)	SLVS2_P	
15 (D4N)	SLVS2_N	
14 (S9)	FOCUS_SDA	For use with an optional Autofocus Lens mount.
16 (S11)	FOCUS_SCL	For use with an optional Autofocus Lens mount.
17 (D6P)	SLVS3_P	
19 (D6N)	SLVS3_N	
18 (S13)	FOCUS_SDI	For use with an optional Autofocus Lens mount.
20 (S15)	FOCUS_SDO	For use with an optional Autofocus Lens mount.
21 (S16)	SDATA	
22 (S17)	FOCUS_SCK	For use with an optional Autofocus Lens mount.
23 (S18)	SCLK	
24 (S19)	FOCUS_SS_B	For use with an optional Autofocus Lens mount.
25 (S20)	SADDR	
26 (S21)	FOCUS_RST_B	For use with an optional Autofocus Lens mount.
27 (S22)	PGOOD	
33 (P2C_CLKp)	SLVSC_P	
35 (P2C_CLKn)	SLVSC_N	
34 (C2P_CLKp)	EXTCLK	

## Design

The SZG-CAMERA module includes a high performance AR0330 image sensor, along with the lens and mount necessary to begin taking images. On-board regulators provide power rails necessary to run the camera and level translation is provided to maximize the available VIO range.

## Power Supply

The SZG-CAMERA's DNA is configured to allow a SmartVIO range of 1.8v to 3.3v. Level translation is present on-board to convert the VIO voltage at the SYZYGY port to the 1.8v used by the image sensor.

Two linear regulators are present on the SZG-CAMERA, one at 1.8v and one at 2.8v. The 2.8v is required for the pixel array.

## FPGA Interface

Pixel information from the image sensor is communicated back to the carrier through a HiSPi interface. Configuration of the image sensor is accomplished through a series of registers programmed through an I<sup>2</sup>C connection. A series of single ended LVCMOS signals are also used to communicate with the sensor. Level translation is included for the I<sup>2</sup>C and LVCMOS signals, allowing the SZG-CAMERA peripheral to operate across a wide range of VIO voltages.

## HiSPi

The HiSPi interface consists of 4 differential pair data lines and a clock. The HiSPi data and clock lines use an SLVS/HiVCM voltage standard that is LVDS compatible. All HiSPi signals are output from the image sensor to the FPGA, internal termination must be used on the FPGA to ensure signal integrity.

## Register Settings

The following I<sup>2</sup>C register settings (set in order) will setup the image sensor with a set of default settings that will work for most environments. More information on each register itself can be found in the image sensor documentation.

Camera Register	Value
0x31C6	0x84
0x31C7	0x00
0x3064	0x00
0x31AC	0x0A
0x31AD	0x0A
0x306E	0x02
0x302B	0x05
0x3031	0x31
0x3037	0x0A
0x3012	0x04
0x3061	0x18
0x301C	0x01

## Mechanical Information

### Lens and Lens Holder (included with SZG-CAMERA)

A high-quality glass lens, plastic lens holder, and mounting hardware are included with the EVB1005. The part and supplier information is listed below. Sunex also has a higher-quality lens available with better optics, the DSL944.

Part	Description	Supplier
CMT821	Lens Holder	Sunex ( <a href="http://www.optics-online.com">www.optics-online.com</a> )
DSL853C-650	Glass Lens	Sunex ( <a href="http://www.optics-online.com">www.optics-online.com</a> )
92005A006	Screw M1.6, 8mm, pan-head	McMaster-Carr
90591A109	Hex nut, M1.6, 0.35mm	McMaster-Carr

### Autofocus Lens Mount (optional accessory)

The SZG-CAMERA is designed to be compatible with the M3-F series of autofocus lens mounts from [New Scale Tech](#). Level translation is provided for the SPI and 2-wire interfaces on the autofocus lens mount to translate from the VIO voltage of the carrier to 3.3V I/O required by the autofocus lens mount.

Note that none of the components related to the Autofocus module are placed by default on boards sold by Opal Kelly Inc.

## Additional Documentation

AR0330 Datasheet  
<http://www.onsemi.com/PowerSolutions/product.do?id=AR0330>

SZG-CAMERA HDL for Brain-1  
<https://github.com/SYZYGfpga/brain-sample-hdl/tree/master/pod-camera-ar0330/hdl>