THEIA-CAM™ Family Kit

THSCJ101

13Mega Pixel Phase Detection Autofocus Camera for NVIDIA Jetson Orin NX/Nano

In Acrylic Case with Flexible Flat Cable

General Description

THSCJ101 is a 13M pixel PDAF Linux camera board with MIPI CSI-2 interface, incorporating Sony IMX258 sensor and THine THP7312-P ISP. The PDAF sensor module is fully calibrated to perform fast and accurate auto focus. The ISP firmware is fully developed to support fine image quality.

THSCJ101 can be embedded into final products as is or be used as a reference design for NVIDIA Jetson Orin NX/Nano. The performance of each Kit is repeatable for use in high volume production due to our production process to characterize the image parameters of each image sensor and calibrate the image signal processing to compensate for the differences from sensor to sensor. All functions and choices for resolution defined herein are configurable via V4L2 Control of Linux system. THSCJ101 design files and firmware as well as tools to customize the camera system and/or THP7312-P can be requested to THine Solutions, Inc.

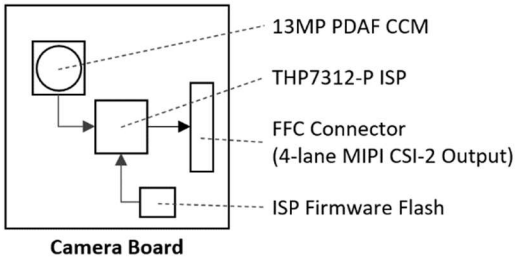
Features

- ✓ Up to 13Mega-pixel resolution, including 4k2k@30fps uncompressed data
- ✓ PDAF (Phase Detection Auto Focus)
- ✓ V4L2 Linux camera processor driver available
- ✓ Fully fine-tuned image quality with ISP firmware available
- ✓ Compatible with NVIDIA Jetson Orin NX/Nano

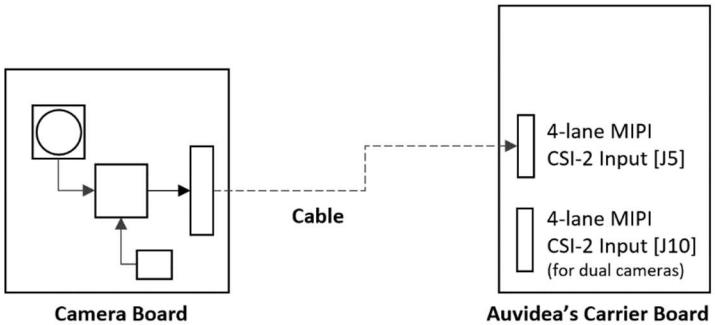
Applications

- Surveillance cameras
- Robotics and Drone cameras
- Smart glasses and AR/VR systems
- Education and web conference cameras
- Smart Appliances
- AIoT edge AI cameras
- Medical and healthcare cameras

Camera Board Block Diagram



THSCJ101 Single Camera Application Block Diagram



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1. System Requirement

Item	Specification
Hardware	● Jetson Orin NX Module ● Auvidea JNX42 Carrier Board Recommended carrier board for evaluating THSCJ101 with SSD (128GB), Heatsink and fan, and power adapter ● Display with HDMI Cable ● USB Mouse and Keyboard ● Ethernet Cable (for Internet access)
Hardware for Starting up	● Windows 10 Computer Recommended computer for Terminal Emulation ● Micro-B USB Cable (to connect with Carrier Board)

2. Contents of Kit

2.1 Contents in the Box

Item	Description
Camera Board	THEIA-CAM™ Printed Circuit Board (PCB)
Camera Case	Clear coated transparent case
Cable	15cm 0.5mm pitch 22pin Flexible Flat Cable (FFC) **Note**: Type D FFC (Bared and reinforced pins on opposite sides.)

Figure 2 Camera Board

Figure 1 Camera Case

Figure 3 Cable

2.2 Resources Available Online

Item	Description
Datasheet	This document
Start Guide	Brief document guiding how to set up initially
V4L2 Command Manual	Camera command reference manual

Note: Available at https://www.thinesolutions.com/

2.3 Resources Available Upon Request

Item	Description
Linux Driver Binary	V4L2 driver binary file
THine ISP (THP7312-P) Firmware Binary	THP7312-P (ISP) firmware binary file
V4L2 Driver Source Code	V4L2 camera processor THP7312-P driver for Jetson Orin NX/Nano

Note: Available Upon Request via https://www.thinesolutions.com/support-request

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3. Specifications

3.1 Operating Condition

Item	Description
Power Supply	Jetson Orin NX/Nano carrier board 3.3V power line
Power Consumption	1.74W, typical(4K@30fps)
Operating Temperature Range	-20 to 60 degrees Celsius

3.2 Mechanical Specification

Item	Value
Width	35 mm
Height	35 mm
Board Thickness	1.2 mm
Weight (Camera)	5.1g
Weight (Including camera case)	25.4g
Weight (Adapter card)	3.5g

3.3 Optical Specifications

Item	Description
Image Sensor Pixel Size	1.12 um x 1.12 um
Optical Size	1/3.06”
Type of Shutter	Rolling Shutter
Auto Focus	PDAF or Contrast Available
Field of View (Diagonal FoV)	78.4 degree
F. NO	2.0 +/- 5%
Effective Focal Length (EFL)	3.57 mm
TV Distortion	< 1.5%
Optical Distortion	< 2.0%

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3.4 Camera Functions

3.4.1 Output

Item	Description
Interface	MIPI CSI-2 4lane

3.4.2 Image Sizes and Frame rates

Item	Description
Image Size, Frame Rate and Format	1080p: 1920x1080@29.6fps, YUV422 1080p: 1920x1080@59.6fps, YUV422 3M pixel: 2052x1536@29.6fps, YUV422 4K2K: 3840x2160@29.6fps, YUV422 13M pixel: 4160x3120@19.8fps, YUV422

3.4.3 Auto Focus Modes

Item	Description
One Shot Contrast AF	THSCJ101 executes contrast-based AF once
Continuous Contrast AF	THSCJ101 executes contrast-based AF every time it detects scene change automatically.
One Shot Contrast and PDAF Hybrid AF	THSCJ101 executes hybrid AF of PDAF and contrast-based AF once.
Continuous Contrast and PDAF Hybrid AF	THSCJ101 executes hybrid AF of PDAF and contrast-based AF every time it detects scene change automatically.

3.4.4. V4L2 Functions

Function	Options
Image Size and Frame Rate	See Available Image Sizes and Frame Rates in Section 3.4.2
Focus Mode	Auto or Manual
Auto Focus Method	Contrast or PDAF Hybrid
Focus Position	Inf. to Macro
Brightness	21 Steps
Contrast	21 Steps
Saturation	32 Steps
Sharpness	32 Steps
Noise Reduction	Auto or Manual
Noise Reduction Level	11 Steps
Auto Exposure Bias	13 Steps -6/3EV to +6/3EV
Power Line Frequency (Flicker Cancel)	Disable, 50Hz or 60Hz
White Balance Mode	Auto or Manual
White Balance Manual	x1 to x7.97 for red and blue
Rotate	0 or 180 degree
Low Light Compensation	Exposure Time or Fixed Frame Rate

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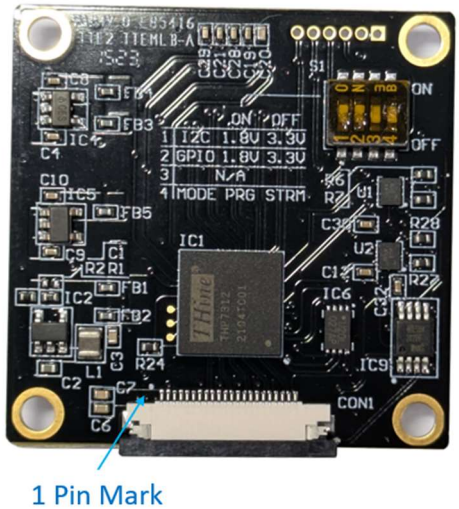
4. Start Guide

Start Guide of THSCJ101 is available at:
https://www.thinesolutions.com/thscj101/start-guide

5. Connector Pin Mapping

Number	Name	Description
22	GND	Ground
21	IMP0_N	MIPI CSI-2 Differential Pair Output Data Lane 0 Negative Side
20	IMP0_P	MIPI CSI-2 Differential Pair Output Data Lane 0 Positive Side
19	GND	Ground
18	IMP1_N	MIPI CSI-2 Differential Pair Output Data Lane 1 Negative Side
17	IMP1_P	MIPI CSI-2 Differential Pair Output Data Lane 1 Positive Side
16	GND	Ground
15	IMPC_N	MIPI CSI-2 Differential Pair Output Clock Lane Negative Side
14	IMPC_P	MIPI CSI-2 Differential Pair Output Clock Lane Positive Side
13	GND	Ground
12	IMP2_N	MIPI CSI-2 Differential Pair Output Data Lane 2 Negative Side
11	IMP2_P	MIPI CSI-2 Differential Pair Output Data Lane 2 Positive Side
10	GND	Ground
9	IMP3_N	MIPI CSI-2 Differential Pair Output Data Lane 3 Negative Side
8	IMP3_P	MIPI CSI-2 Differential Pair Output Data Lane 3 Positive Side
7	GND	Ground
6	RSTn	Camera Reset
5	GPIO	Camera GPIO
4	GND	Ground
3	SCL	I2C Clock
2	SDA	I2C Data
1	V3P3	3.3V Power Input



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Appendix

Camera function and image quality customization

You can customize camera functions and image quality by customizing firmware of THP7312.

Item	Description
THP7312 firmware customization	Camera Development Kit (CDK) by THine can be used to customize THP7312 firmware. Contact THine Solutions, Inc. for CDK License Agreement. You can implement your own camera function and image quality with CDK.

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Important notice

1. The product specifications described in this document are subject to change without prior notice.

2. The circuit diagrams described in this document are examples of the application. THine Solution, Inc. ("THine") assumes no responsibility for any losses incurred by you or third parties from the use of these circuit diagrams.

3. Testing and other quality control techniques are used to this product to the extent THine deems necessary to support warranty for performance of this product. Except where mandated by applicable law or deemed necessary by THine based on the user's request, testing of all functions and performance of the product is not necessarily performed.

4. This product is presumed to be used for general electric device, not for applications which require extremely high reliability/safety.

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