

# **eAP87606A Datasheet**

## **Depth-Map Camera Module of eSP876U**



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## Revision History

Rev	Date	Comments
0.1	March 23, 2017	Initial release
0.2	March 24, 2017	Fix typo and add comment on Table 4 Video Resolution, page 10-11
1.0	April 28, 2017	<ul style="list-style-type: none"><li>● Change revision number from 0.2 to 1.0, same naming role as eSP87003C</li><li>● Change revision history 0.2 comments from “in page 10-11” to “, page 10-11”, same naming role as eSP87003C</li><li>● Change revision history 0.1 and 0.2 date format from “Mar” to “March, same naming role as eSP87003C</li><li>● Change table 1 header, follow the same Table format as eAP87003C, page 5</li><li>● Change table 2 and table 3 header, follow the same Table format as eAP87003C, page 7</li><li>● Change table 4 header, follow the same Table format as eAP87003C, page 10</li><li>● Change table header, follow the same Table format as eAP87003C, page 11</li><li>● Change table 5 header, follow the same Table format as eAP87003C, page 12</li><li>● Change table 6 header, follow the same Table format as eAP87003C, page 13</li><li>● Change revision history table header, follow the same Table format as eAP87003C, page 3</li><li>● Remove 320x240 support, page 10 &amp; page 11</li><li>● Update color/depth of video mode #16 and mode #19 from 3 to 5 FPS, page 10</li><li>● Add eAP87606A00/eAP87606A01 dimension, page 15</li><li>● Add Operating Current/ Suspend Current, page 5</li><li>● Add weight information, page 5</li></ul>



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## 1 Introduction

This document contains technical information of the dual sensor camera module with Etron eSP876 depth-map camera controller. The module can provide either or both color video and/or depth-map video streams. The eSP876 depth-map controller is compliant to UVC1.1 and USB2.0/3.0 standard. Therefore, the module requires no specific drivers and provides high bandwidth for video transmission. The camera module can be integrated into applications involving VR/AR, People/Thing Counting, Robot/Drone Obstacle Avoiding. The camera module is also a demonstration of the eSP876 reference design for its compact size and the collaboration on IR patterned illuminator for textureless object (eAP87606A01 only).

**Table 1. Key Parameters**

Parameter	Description
Controller	eSP876U
Base Line	6cm
Image Sensor	AR0135 by ON Semiconductor. Refer to Chapter 4 Key Parameters of Image Sensor
Image Sensor Resolution	1280 x 960
Lens	AS133 by Calin. Refer to Chapter 5 Key Parameters of Lens
IR Cut	Visible and 850nm dual band filter
Output Video Resolution	Please refer to Chapter 3 Video Output
Illumination	Wavelength : 850 +- 10 nm IR adaptor board (optional) Number of Features : > 6,700 Peak Output Power : 2 x 250 mW FOI Diagonal : 80°
Field of View	HFOV: 100° VFOV: 67.5°
Depth Working Range	20cm – 350cm
Depth Accuracy	Refer to Chapter 2 Depth Accuracy
Maxima Depth-Map Resolution and Frame Rate	720P @ 60Hz
Color and Depth Sync	Yes
PC Interface Connection	USB3.0 or USB2.0
Power Source	USB bus power (5V/800mA by USB3.0; 5V/500mA by USB2.0) via USB connector
Operating Current	eAP87606A00 (w/o IR illuminator): Typ. 350mA (1.75W) in 720P at 60 FPS eAP87606A01 (w/ IR illuminator): Typ. 350~900mA (1.75W~4.5W) in 720P at 60 FPS depend on IR intensity 0~9
Suspend Current	2.52mA (12.6mW)
VID (Vender ID)	0x1E4E
PID (Product ID)	eAP87606A00 (w/o IR illuminator): 0x0117 eAP87606A01 (w/ IR illuminator): 0x0120
Weight	eAP87606A00: net weight 69g, gross weight: TBD eAP87606A01: net weight 72g, gross weight: TBD

Note: Operating current is measured under below criteria.

1. Image output is delivered by YUV format at USB3.0.
2. Depth-map resolution: 720P at 60fps with Black Side Band
3. Default value of IR intensity level in eAP87606A01 is 0 stand for turn-off and 1~9 are monotonically increased intensity controlled via FW register, recommend value is 2 (typical 500mA, 2.5W for reference)



Figure 1. eAP87606A00 6cm baseline without IR illumination



Figure 2. eAP87606A01 6cm baseline with IR illumination

### 1.1 Pin Information of USB3.0 Connector

Pin assignments and pin descriptions of USB3.0 micro B type connector are listed below.

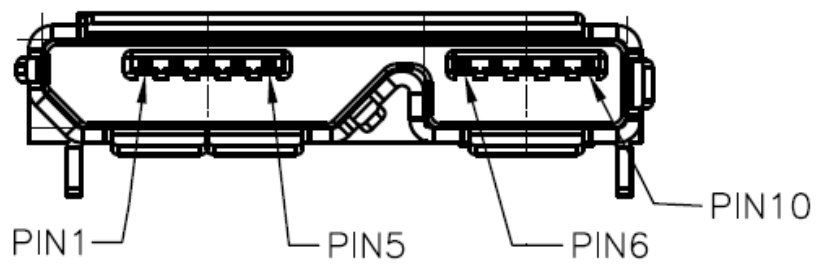


Figure 3. USB3.0 Micro B Type Connector Drawing



**Table 2. Pin Descriptions**

Pin No.	Signal	Description	Mating Sequence
1	VBUS	Power	Second
2	D-	USB differential pair	Third
3	D+		
4	ID(GND)	Slave device ID	Second
5	GND	Ground for signal return	Second
6	StdA_SSRX-	SuperSpeed receiver differential pair	Last
7	StdA_SSR+		
8	GND_DRAIN	Ground for signal return	
9	StdA_SST-	SuperSpeed receiver differential pair	
10	StdA_SST+		
Shell	Shield	Connector metal shell	

## 1.2 Ordering Information

**Table 3. Available Part Number**

Part Number	Description
eAP87606A00	6cm baseline without IR illumination
eAP87606A01	6cm baseline with IR illumination

## 2 Depth Accuracy

Depth accuracy is the minimum difference of distance at which the movement of same target can be distinguished and leads to at least 1 pixel difference of disparity on sensor plane. This is the meaning of the blue trend in the figures.

Here are the common notes for the three consecutive figures below.

1. Delta Distance means absolute value of the difference between distance of two locations of a measured object while it moves away from or moves forward to the camera module.
2. The accuracy shown above is a theoretical calculation based on perfect lighting condition and component specification. It is subject to change and would be downgraded in a real scenario.
3. The chart is generated based on below configuration.
  - Lens: AS133 by Calin
  - Sensor: AR0135 by On Semiconductor

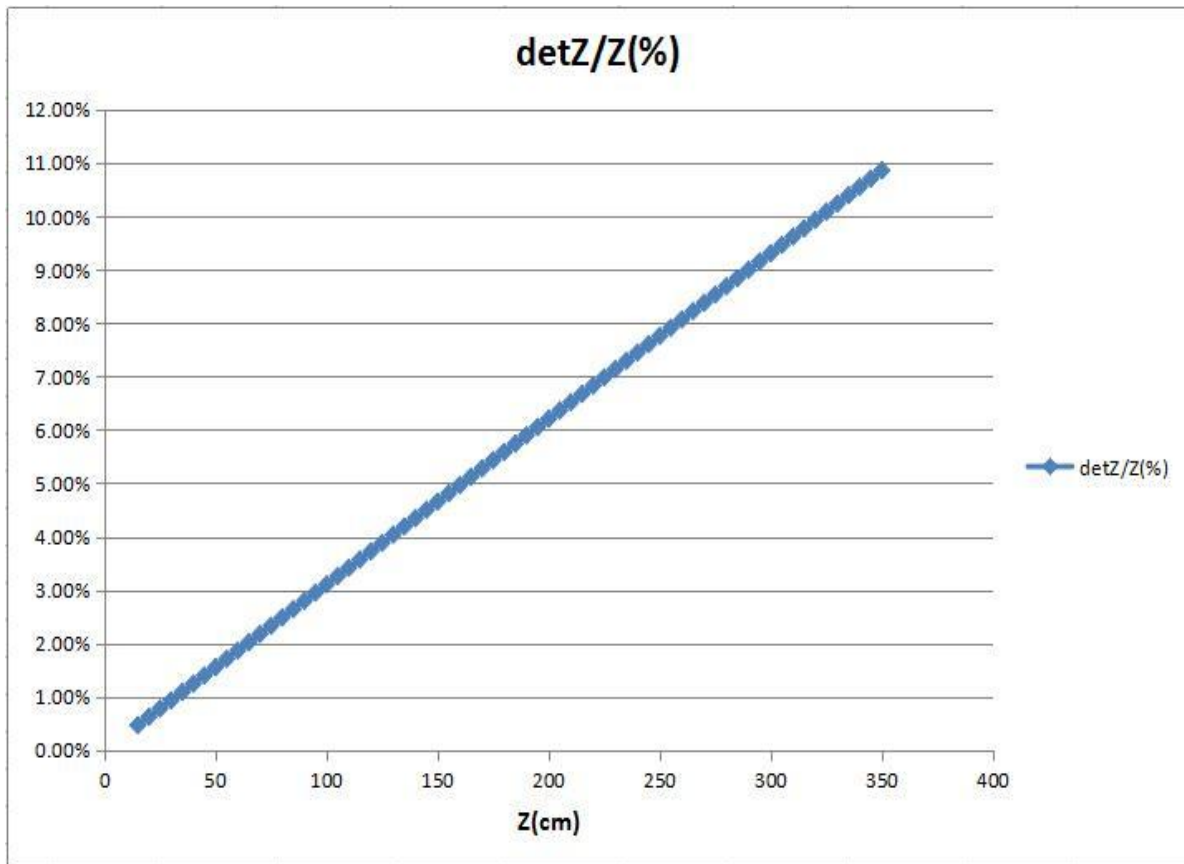


Figure 4. Depth Accuracy Chart of 6cm Baseline (Depth resolution: 1280x720 with FOV 100°)



### 3 Video Output

Table 4-. Video Resolution

Video			EP1 Color (2D or 3D)		EP2 (Depth-map)		Support	Comment
			Video Resolution	YUV (fps)	Video Resolution	Bitmap Frame Rate		
<i>L': Rectified Left, D: Depth, R: Right</i>								
Mode 1	L'+D	USB 3.0	1280x720	60/30	1280x720	60/30	Yes	
Mode 2	L'+D	USB 3.0	640x480	90/60/30	640x480	90/60/30	Yes	Binning
Mode 3	L'+R'+D	USB 3.0	2560x720	30	1280x720	30	Yes	Calibration
Mode 4	L'+R'+D	USB 3.0	1280x480	90/60/30	640x480	90/60/30	Yes	Calibration
Mode 5	L+D	USB 3.0	1280x720	60/30	1280x720	60/30	Yes	
Mode 6	L+R+D	USB 3.0	2560x720	30	1280x720	30	Yes	
Mode 7	L+R+D	USB 3.0	1280x480	90/60/30	640x480	90/60/30	Yes	Binning
Mode 8	L+R	USB 3.0	2560x960	30	-	-	Yes	
Mode 9	L+R	USB 3.0	2560x720	60/30	-	-	Yes	
Mode 10	L'+R'	USB 3.0	2560x720	60/30	-	-	Yes	
Mode 11	L(R)	USB 3.0	1280x720	60/30	-	-	Yes	Default
Mode 12	D	USB 3.0	-	-	1280x720	60/30	Yes	
Mode 13	D	USB 3.0	-	-	640x480	90/60/30	Yes	Binning
Mode 14	L'+D	USB 2.0	1280x720	5	1280x720	5	Yes	
Mode 15	L'+D	USB 2.0	640x480	15	640x480	15	Yes	
Mode 16	L'+R'+D	USB 2.0	2560x720	5	1280x720	5	Yes	
Mode 17	L'+R'+D	USB 2.0	1280x480	15	640x480	15	Yes	
Mode 18	L+D	USB 2.0	1280x720	5	1280x720	5	Yes	
Mode 19	L+R+D	USB 2.0	2560x720	5	1280x720	5	Yes	
Mode 20	L+R+D	USB 2.0	1280x480	15	640x480	15	Yes	
Mode 21	L+R	USB 2.0	2560x960	4	-	-	Yes	
Mode 22	L+R	USB 2.0	2560x720	5	-	-	Yes	
Mode 23	L'+R'	USB 2.0	2560x720	5	-	-	Yes	
Mode 24	L(R)	USB 2.0	1280x720	10	-	-	Yes	Default
Mode 25	D	USB 2.0	-	-	1280x720	5	Yes	
Mode 26	D	USB 2.0	-	-	640x480	30	Yes	



Video <i>L': Rectified Left, D: Depth, R: Right</i>			EP1 Color (2D or 3D)		EP2 (Depth-map)		Support	Comment
			Video Resolution	YUV (fps)	Video Resolution	Bitmap Frame Rate		
Mode 27	L'+D	USB 2.0 /MJPEG	1280x720	10	1280x720	10	Yes	
Mode 28	L'+D	USB 2.0 /MJPEG	640x480	30	640x480	30	Yes	
Mode 29	L'+R'+D	USB 2.0 /MJPEG	2560x720	10	1280x720	10	Yes	
Mode 30	L+D	USB 2.0 /MJPEG	1280x720	30	640x480	30	Yes	
Mode 31	L+R+D	USB 2.0 /MJPEG	2560x720	30	640x480	30	Yes	
Mode 32	L+R	USB 2.0 /MJPEG	2560x960	24	-	-	Yes	
Mode 33	L+R	USB 2.0 /MJPEG	2560x720	30	-	-	Yes	
Mode 34	L'+R'	USB 2.0 /MJPEG	1280x480	30	-	-	Yes	
Mode 35	L(R)	USB 2.0 /MJPEG	1280x720	30	-	-	Yes	Default

1. L' means Rectified Left. D means Depth. R means Input Right.
2. Mode 11/24/35 are default in preview mode

## 4 Key Parameters of Image Sensor

**Table 4. Key Parameters of AR0135**

<b>Vendor</b>	ON Semiconductor	
<b>Model</b>	AR0135CS RGB	
<b>Active Array Size</b>	1288 x 972	
<b>Shutter Type</b>	Global Shutter	
<b>Power Supply</b>	Core	1.7 ~ 1.95VDC
	Analog	2.5 ~ 2.94V
	I/O	1.7 ~ 1.9 or 2.5 ~ 2.94V
<b>Power Requirement</b>	Active (Total)	200mA
	Soft Standby (max. Analog 2.8V/Digital 1.8V)	25uA/1.7mA
	Hard Standby (max Analog 2.8V/Digital 1.8V)	15uA/125uA
<b>Power Consumption</b>	< 292 mW	
<b>Temperature Range</b>	Operating Temperature	-30°C to 70°C ambient temperature
		-30°C to 80°C junction temperature
Please consult ON Semiconductor for detail quality guarantee operating temperature		
<b>CRA</b>	0°	
<b>Pixel Size</b>	3.75 x 3.75um	
<b>Optical Size</b>	1/3"	
<b>Output format</b>	12-bit RGB RAW	

Note:

These values are subject to change based on real measurements.

## 5 Key Parameters of Lens

### 5.1 Specification of Lens

Table 5.1. Key Parameters of AS133

<b>Vendor</b>	Calin	
<b>Model</b>	AS133	
<b>FOV (Field of View)</b>	Vertical	89.2°
	Horizontal	114.8°
	Diagonal	137.2°
<b>FNO</b>	2.0	
<b>Mount Dimension</b>	M12 x P0.50mm	
<b>TV-Distortion</b>	V-15.8%	
<b>EFL (Effective Focal Length)</b>	2.09mm	
<b>BFL</b>	3.69mm (Include IR 0.4mm + CG 0.4+- 0.04mm)	
<b>CRA</b>	Image Height	
	2.163mm	: 10.98°
	2.472mm	: 12.64°
	2.781mm	: 13.46°
<b>Optical Size</b>	1/3"	
<b>Wavelength</b>	Tavg ≥ 90%	420 ~ 620nm
	Tmin ≥ 85%	420 ~ 620nm
	T = 50%	650 ± 10nm
	Tmin ≥ 60%	850nm
	Tmin ≤ 80%	850 ± 7nm
	T = 40%	843 ± 10nm
	T = 40%	857 ± 10nm
	Tavg ≤ 5%	900 ~ 1100nm

### 5.2 Spectrum Specification of IR Cut Filter

TBD

## 6 Module Dimensions

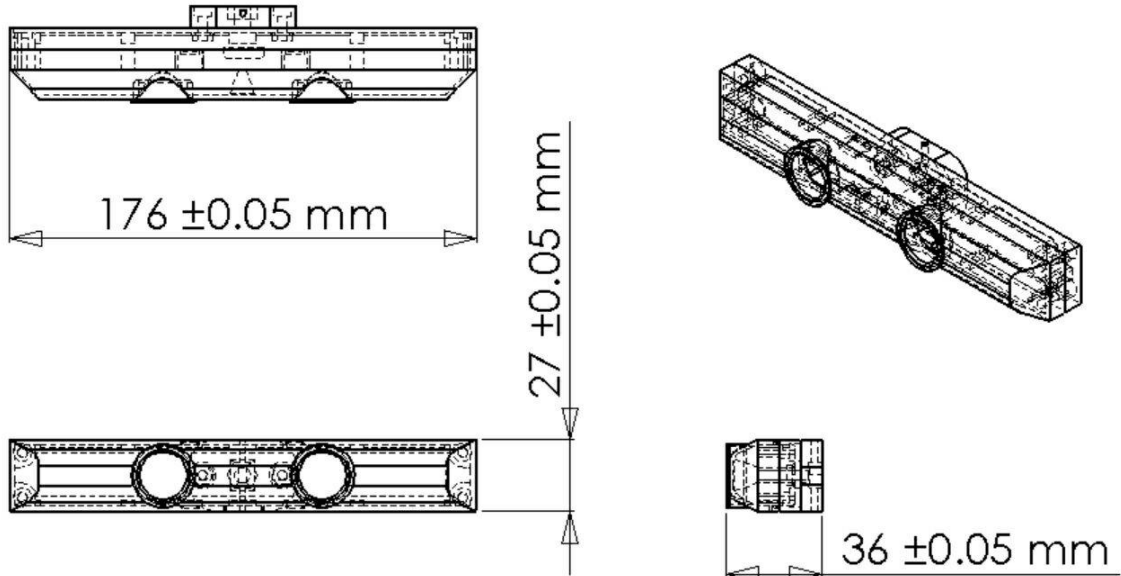


Figure 5. eAP87606A00 Module Dimension

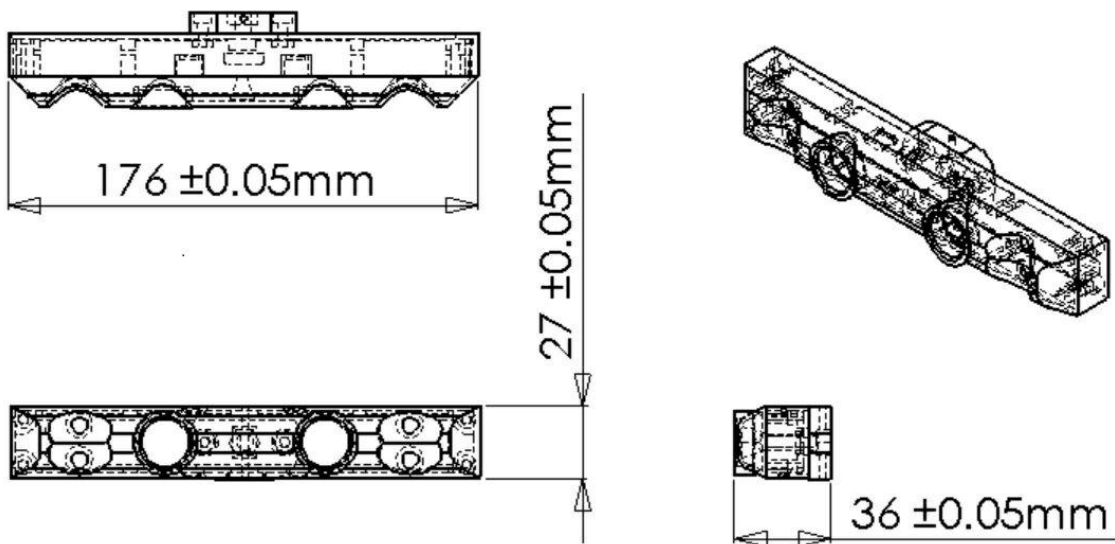


Figure 6. eAP87606A01 Module Dimension



## 7 Reference Documents

<b>Main Chip</b>	Etron eSP876 datasheet revision 0.3 or above
<b>Image Sensor</b>	On Semiconductor AR0135 datasheet revision 3 or above
<b>Optical Lens</b>	Calin AS133 AS133-OE-R003-F-OE Brief data sheet_Cux_0412