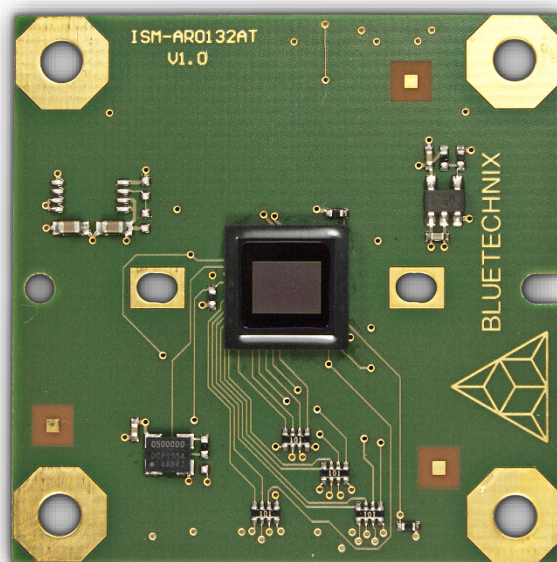


BLUETECHNIX
Embedding Ideas

ISM-AR0132AT

Hardware User Manual

Version 1.1





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Information

For further information on technology, delivery terms and conditions and prices please contact Bluetechnix (<http://www.bluetechnix.com>).

Warning

Due to technical requirements components may contain dangerous substances.

1 Introduction

The ISM-AR0132AT integrates Aptina's AR0132AT image SoC (System-on-a-Chip), oscillator, voltage control and a M12 or CS mount lens-holder to support numerous M12 or CS-mount lenses at a size of 40 x 40mm.

1.1 Overview

The AR0132AT CMOS digital image sensor from Aptina has an active-pixel-array of 1280H x 960V (1.2MP). This sensor can capture in either liner or high-dynamic-range (HDR) mode with rolling-shutter readout. The sensor can be programmed via an I²C-Interface and offers some sophisticated camera functions such as auto exposure control, windowing and both video and single frame modes. The sensor is able to capture in continuous mode for videos or single frame mode for clear sharp images for both low light and high dynamic range scenes.

The Sensor is available with three different color filter arrays: RGB Bayer, monochrome or RCCC.

1.2 Key Features

Description	Value
Optical Format	1/3-inch (5:4)
Active Array	1280H x 960V (1.2 MP)
Imaging Area	4.6mm(H) x 3.7 mm(V)
Pixel Size	3.75 x 3.75 μ m
Responsivity	5.48V/lux-sec (550nm)
SNR	Max 43.9 dB
Max. Dynamic Range	>115 dB
Frame Rate	45fps at 50MHz (SXGA 1280 x 960) 60fps at 50MHz (720p)
Data Output Format	Serial on request: HiSPi 12-, 14- or 20-bit Parallel: 12-bit
Color Filter Array	RGB Bayer, monochrome, RCCC
Shutter Type	ERS - Electronic Rolling Shutter
Master Clk	50MHz
Singly Supply Voltage	2.5V to 3.1V
Power Consumption	270mW @ 720p, 60 fps Parallel Output, Linear Mode 460mW @ 720p, 60 fps Parallel Output, HiDy Mode
Operating Temperature	-40°C to +105°C
RoHS Compliant	Yes
BLT-ISM-CONNECTOR	Yes
Lens Holder	M12 or CS-mount objective lens holder
CS-Mount Compatible	Yes
M12- Mount Compatible	Yes
Size	40 x 40mm ²

Table 1-1: Key features

1.2.1 BLT-ISM-Connector

The Bluetechnix Image-Sensor-Connector "BLT-ISM-Connector" is a Bluetechnix standardized interface with 30 pins, which allows easy connection of the Bluetechnix Image-Sensor-Modules to the development and extender boards from Bluetechnix.



Advantages of the BLT-ISM-Connector:

- One interface for all Image-Sensor-Modules
- Flexible, camera is not fixed on the baseboard
- Single* or dual power supply

*Depends on user hardware design.

1.3 Applications

- Lane Departure Warning (LDW)
- Traffic Sign Recognition (TSR)
- Stereo Vision
- High Beam Control (HBC)
- Driver Monitoring
- Rear View
- Surround View
- Blind Spot Monitoring
- Machine Vision
- Video Surveillance
- Object Recognition

2 General Description

The ISM- AR0132AT image sensor module features Aptina's AR0132AT image SoC. The on-board oscillator and power regulators for core and analog voltages make it easy to use the module for any embedded system hardware.

The module needs a single voltage supply between 2.5V and 3.1V. The sensor IC can be configured by an I²C compatible configuration bus, the pixel data is available on a 12-bit parallel interface, or the 12-, 14-, or 20-bit serial SLDS compliant HiSPi interface.

Some handshake lines are connected to the AR0132AT for power saving or capture triggering.

A 50MHz oscillator connected to the master clock of the image sensor, supplies the internal PLL. An external clock input is not needed.

For detailed information about the image sensor please refer to the AR0132AT data sheet and reference manual available on the Aptina website (<http://www.aplina.com>).

To not constrain the developer in the various applications, the module is shipped without lens holder and optics. Bluetechnix though offers a M12 as well as a CS-Mount lens holder and some fitting optics. But also many 3rd party suppliers deliver matching accessories.

2.1 Functional Description

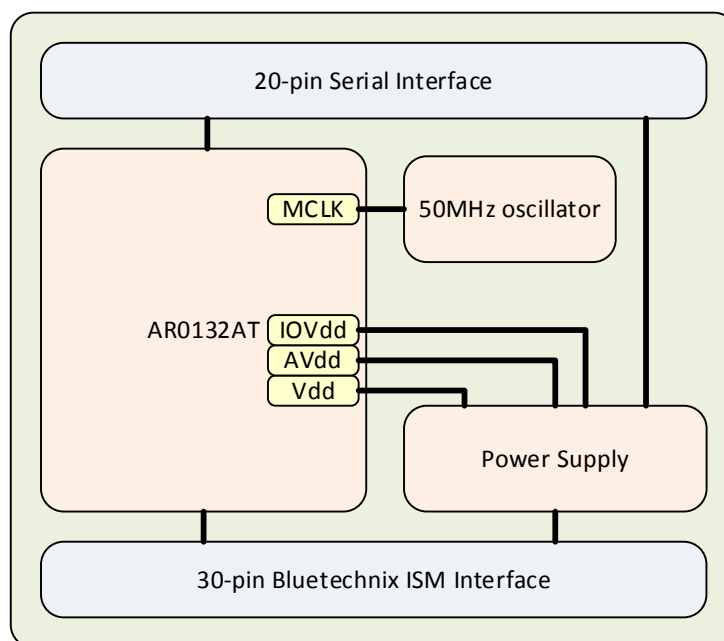


Figure 2-1: ISM-AR0132AT overview

2.1.1 Powering

The ISM-AR0132AT can be powered with only a single supply between 2.5V and 3.1V. If the MCU needs lower I/O voltage levels, a separate I/O voltage supply of min. 1.7V can be applied to the VDDIO pin.



2.1.2 Signal Termination

All data and sync signals are serial terminated with 100Ω serial resistors.

3 Specifications

3.1 Electrical Specifications

3.1.1 Operating Conditions

Symbol	Parameter	Min	Typical	Max	Unit
V_{DD}	Input supply voltage	2.5	2.8	3.1	V
V_{DDIO}	IO Voltage	1.7	1.8/2.8	3.1	V
V_{OH}	High level output voltage	$V_{DDIO} - 0.3$		V_{DDIO}	V
V_{OL}	Low level output voltage	0		0.4	V
I_{OH}	High level output current	-22		26.5	mA
I_{OL}	Low level output current			22	mA
V_{IH}	High level input voltage	$V_{DDIO} \times 0.7$			V
V_{IL}	Low level input voltage			$V_{DDIO} \times 0.3$	V
I_{IN}	Input leakage current	20			μA
P_{Lin}	720p, 60 fps Parallel Output, Linear Mode		270		mW
P_{HDR}	720p, 60 fps Parallel Output, HiDy Mode		460		mW
f_{MCLK}	Master clock frequency		50		MHz

Table 3-1: Electrical characteristics

3.2 Operating Current Consumption

Resolution	Framerate	Interface	Dynamic	Typ ¹⁾	Max ¹⁾	Unit
1280x960	45fps	Parallel	Linear	TBD	TBD	mA
720p	60fps	Parallel	Linear	TBD	TBD	mA
1280x960	45fps	Parallel	HiDy	TBD	TBD	mA
720p	60fps	Parallel	HiDy	TBD	TBD	mA
1280x960	45fps	HiSPi	Linear	TBD	TBD	mA
720p	60fps	HiSPi	Linear	TBD	TBD	mA
1280x960	45fps	HiSPi	HiDy	TBD	TBD	mA
720p	60fps	HiSPi	HiDy	TBD	TBD	mA

Table 3-2: Operating Currents for Video Streaming

¹⁾ Measured with single supply: $V_{DD} = V_{DDIO} = 2.8V$.

3.3 Maximum Ratings

Stressing the device above the rating listed in the absolute maximum ratings table may cause permanent damage to the device. These are stress ratings only. Operation of the device at these or any other conditions greater than those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Min	Max	Unit
V_{DD}	Supply voltage	-0.3	4.5	V
V_{IO}	Input or output voltage	-0.3	$V_{DDIO} + 0.3$	V
I_{MAX}	Total Current	0	265	mA
T_{OP}	Operating temperature	-40	85	°C
T_{STO}	Storage temperature	-40	150	°C
ϕ_{AMB}	Relative ambient humidity		90	%

Table 3-3: Absolute maximum ratings

3.3.1 ESD Sensitivity



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

4 Connector Description

4.1 BLT-ISM-Connector

The image sensor connector is a standard 0.5mm bottom contact ZIF connector and mates with any 30 pole 0.5mm pitch and 0.4mm thick flat flex cable. To prevent EMI problems we recommend keeping the cable as short as possible.

Pin	Name	Type	Description
1	Vdd	PWR	Voltage Supply
2	GND	PWR	Power Ground
3	SADDR ¹⁾	IpU	Serial Address (internally pulled up with 10kΩ)
4	NC (MCLK)	-	Not connected (Camera Master Clock) ²⁾
5	nRESET	I	Reset (Active Low)
6	SCL	I	Configuration Bus Clock Line (external pull-up needed)
7	SDA	I/O	Configuration Bus Data Line (external pull-up needed)
8	NC	-	Not connected
9	GND	PWR	Power Ground
10	PCLK	O	Pixel Clock
11	FV	O	Line valid (VSYNC)
12	LV	O	Frame valid (HSYNC)
13	TRIGGER	I	Trigger Signal
14	STROBE	O	Strobe Signal
15	NC	-	Not connected
16	NC	-	Not connected
17	D0	O	Pixel Data (LSB)
18	D1	O	Pixel Data
19	VddIO	PWR	I/O Voltage Supply
20	GND	PWR	Power Ground
21	D2	O	Pixel Data
22	D3	O	Pixel Data
23	D4	O	Pixel Data
24	D5	O	Pixel Data
25	GND	PWR	Power Ground
26	D6	O	Pixel Data
27	D7	O	Pixel Data
28	D8	O	Pixel Data
29	D9	O	Pixel Data (MSB)
30	nOE	IpU	Output Enable (Active Low; internally pulled up with 10kΩ)

Table 4-1: BLT-ISM-Connector interface description (X1)

- ¹⁾ The address of the sensors serial interface is 0x20 for write, and 0x21 for read access. The address the addresses may be changed to 0x30 and 0x31 by connecting the SADDR pin to ground.
- ²⁾ The Master Clock is generated by the on board oscillator. If a different clock frequency is needed, there is a possibility to apply an external clock signal to a modified Module. For modification details please contact Bluetechnix.

4.2 ISM- HiSPi-Connector

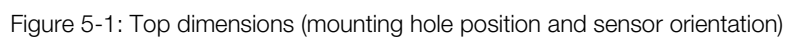
The HiSPi Interface is available on a 20 pin Hirose DF19 connector.

Note that this connector is not mounted in default configuration. If you need to use the HiSPi Interface, please contact Bluetechnix for specially prepared modules.

Pin	Name	Type	Description
1	GND	PWR	Power Ground
2	VddIO	PWR	I/O Voltage Supply
3	Vdd	PWR	Voltage Supply
4	GND	PWR	Power Ground
5	nRESET	I	Reset (Active Low)
6	STROBE	O	Strobe Signal
7	TRIGGER	I	Trigger Signal
8	SDA	I/O	Configuration Bus Data Line (external pull-up needed)
9	SCL	I	Configuration Bus Clock Line (external pull-up needed)
10	SLVS3+	O	HiSPi serial data lane 3, differential positive
11	SLVS3-	O	HiSPi serial data lane 3, differential negative
12	SLVS2+	O	HiSPi serial data lane 2, differential positive
13	SLVS2-	O	HiSPi serial data lane 2, differential negative
14	SLVS1+	O	HiSPi serial data lane 1, differential positive
15	SLVS1-	O	HiSPi serial data lane 1, differential negative
16	SLVS0+	O	HiSPi serial data lane 0, differential positive
17	SLVS0-	O	HiSPi serial data lane 0, differential negative
18	SLVSC+	O	HiSPi serial clock lane, differential positive
19	SLVSC-	O	HiSPi serial clock lane, differential negative

Table 4-2: BLT-ISM-Connector interface description (X1)

5.1 Top View



5.2 Bottom View

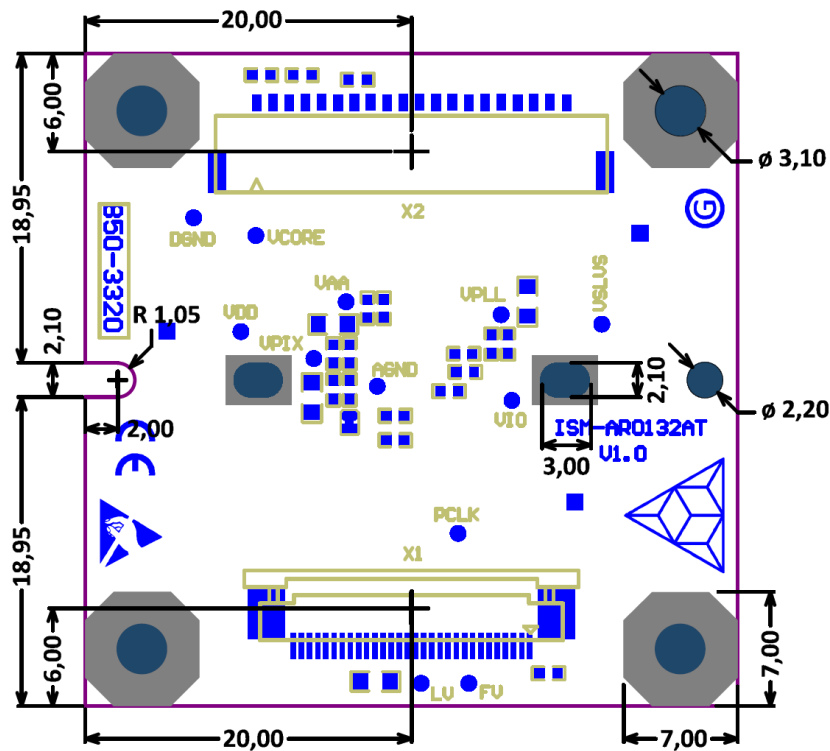


Figure 5-2: Bottom dimensions (mounting holes dimension)

6 Support

6.1 General Support

General support for products can be found at Bluetechnix' support site <https://support.bluetechnix.at/wiki>

6.2 Board Support Packages

Board support packages and software downloads are for registered customers only
<https://support.bluetechnix.at/software/>

6.3 Blackfin® Software Support

6.3.1 BLACKSheep® OS

BLACKSheep® OS stands for a powerfully and multithreaded real-time operating system (RTOS) originally designed for digital signal processing application development on Analog Devices Blackfin® embedded processors. This high-performance OS is based on the reliable and stable real-time VDK kernel from Analog Devices that comes with VDSP++ IDE. Of course BLACKSheep® OS is fully supported by all Bluetechnix Core-Modules and development hardware.

6.3.2 LabVIEW

You can get LabVIEW embedded support for Bluetechnix Core Modules by Schmid-Engineering AG
<http://www.schmid-engineering.ch>.

6.3.3 uClinux

You can get uClinux support (boot loader and uClinux) for Bluetechnix Core Modules at
<http://blackfin.uClinux.org>.

6.4 Blackfin® Design Services

Based on more than seven years of experience with Blackfin, Bluetechnix offers development assistance as well as custom design services and software development.

6.4.1 Upcoming Products and Software Releases

Keep up to date with all product changes, releases and software updates of Bluetechnix at
<http://www.bluetechnix.com>.



7 Ordering Information

7.1 Predefined mounting options for ISM-AR0132AT

Article Number	Name	Color filter array
100-3212-1	ISM-AR0132AT-Mono	Monochrome
100-3213-1	ISM-AR0132AT-Color	Color (RGB Bayer)
100-3214-1	ISM-AR0132AT-RCCC	RCCC

Table 7-1: Ordering information

NOTE: Custom Core Modules are available on request! Please contact Bluetechnix (office@bluetechnix.com) if you are interested in custom Core Modules.

8 Dependability

8.1 MTBF

Please keep in mind that a part stress analysis would be the only way to obtain significant failure rate results, because MTBF numbers just represent a statistical approximation of how long a set of devices should last before failure. Nevertheless, we can calculate an MTBF of the Core Module using the bill of material. We take all the components into account. The PCB and solder connections are excluded from this estimation. For test conditions we assume an ambient temperature of 30°C of all Core Module components except the Blackfin® processor (80°C) and the memories (70°C). We use the MTBF Calculator from ALD (<http://www.aldservice.com/>) and use the reliability prediction MIL-217F2 Part Stress standard. Please get in touch with Bluetechnix (office@bluetechnix.com) if you are interested in the MTBF result.



9 Product History

9.1 Version Information

9.1.1 ISM-AR0132AT

Version	Date	Changes
1.0	2013-06-06	First release V1.0 of the Hardware.

Table 9-1: Overview product changes

9.2 Anomalies

Version	Date	Description
1.0	2011 05 24	No anomalies reported yet.

Table 9-2: Overview product anomalies



10 Document Revision History

Version	Date	Document Revision
1	2009 12 03	First release V1.0 of the Document

Table 10-1: Revision history



11 List of Abbreviations

Abbreviation	Description
ADI	Analog Devices Inc.
AI	Analog Input
AMS	Asynchronous Memory Select
AO	Analog Output
CM	Core Module
DC	Direct Current
DSP	Digital Signal Processor
eCM	Enhanced Core Module
EBI	External Bus Interface
ESD	Electrostatic Discharge
GPIO	General Purpose Input Output
I	Input
I ² C	Inter-Integrated Circuit
I/O	Input/Output
ISM	Image Sensor Module
LDO	Low Drop-Out regulator
MTBF	Mean Time Between Failure
NC	Not Connected
NFC	NAND Flash Controller
O	Output
OS	Operating System
PPI	Parallel Peripheral Interface
PWR	Power
RTOS	Real-Time Operating System
SADA	Stand Alone Debug Agent
SD	Secure Digital
SoC	System on Chip
SPI	Serial Peripheral Interface
SPM	Speech Processing Module
SPORT	Serial Port
TFT	Thin-Film Transistor
TISM	Tiny Image Sensor Module
TSC	Touch Screen Controller
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
USBOTG	USB On The Go
ZIF	Zero Insertion Force

Table 11-1: List of abbreviations

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