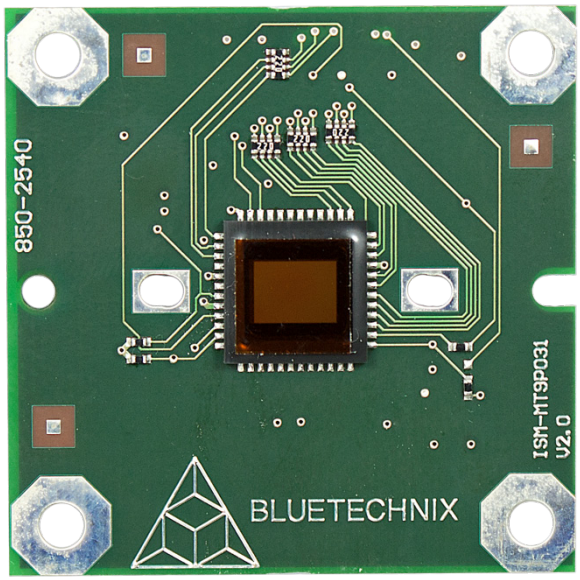
BLUE TECHNIX



Hardware User Manual

ISM-MT9P031 V2.x

...maximum performance at minimum space

Contact

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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-MT9P031 integrates Aptina's MT9P031 image sensor, 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 MT9P031 CMOS digital image sensor from Aptina has an active-pixel-array of 2592H x 1944V (5MP). It offers a global reset which triggers the exposure of all rows simultaneously, has superior low-light performance, an automatic black level calibration and an on-chip phased-locked-loop (PLL). The sensor supports Aptina DigitalClarity® imaging technology and very high frame rates. The sensor can be programmed via a simple Two-Wire-Interface (TWI) and offers some sophisticated camera functions such as

- Bulb exposure mode, for arbitrary exposure times,
- Column and row binning modes to improve image quality when resizing,
- Column and row skip modes to reduce image size without reducing field-of-view (FOV),
- Snapshot mode to take frames on demand and
- Horizontal and vertical mirror image.

1.2 Key Features

Description	Value
OPTICAL FORMAT	1/2.5-inch (4:3)
ACTIVE ARRAY	2592H x 1944V (5MP)
IMAGING AREA	5.70mm(H) x 4.28mm(V)
PIXEL SIZE	2.2µm x 2.2µm
RESPONSIVITY	1.4 V/lux-sec (550nm)
SNR	38.1dB (full resolution) 44dB (2 x 2 binning)
MAX DYNAMIC RANGE	70.1dB (full resolution) 76dB (2 x 2 binning)
FRAME RATE	14 fps (2592 x 1944) 53fps (VGA with binning 640 x 480) 60fps (720p skipping mode)
DATA OUTPUT FORMAT	12-bit parallel
CHROMA	RGB Bayer pattern / monochrome (see chapter Ordering Information)
SHUTTER TYPE	ERS - Electronic Rolling Shutter GRR - Global reset release Snapshot only
MASTER CLOCK	50 MHz
SINGLE SUPPLY VOLTAGE	2.5V to 3.1 V
POWER CONSUMPTION	381mW at 14 fps full resolution
OPERATING TEMPERATURE	–30°C to +70°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 40mm²

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 power supply (with different IO voltage support)

The BLT-ISM-Connector interface description can be read in chapter 4.

1.3 Applications

- High-resolution network cameras
- Wide field of view cameras
- High-definition surveillance cameras
- Dome cameras with electronic pan, tilt, and zoom
- Hybrid video cameras with high resolution stills
- Detailed feature extraction for smart cameras
- Small office monitoring
- Home monitoring

2 General Description

The ISM-MT9P031 image sensor module features Aptina's MT9P031 image sensor. 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 I^2C compatible configuration bus, the pixel data is available on a 12-bit parallel interface, some handshake lines are connected to the MT9P031 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 MT9P031 data sheet and reference manual available on the Aptina website (http://www.aptina.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

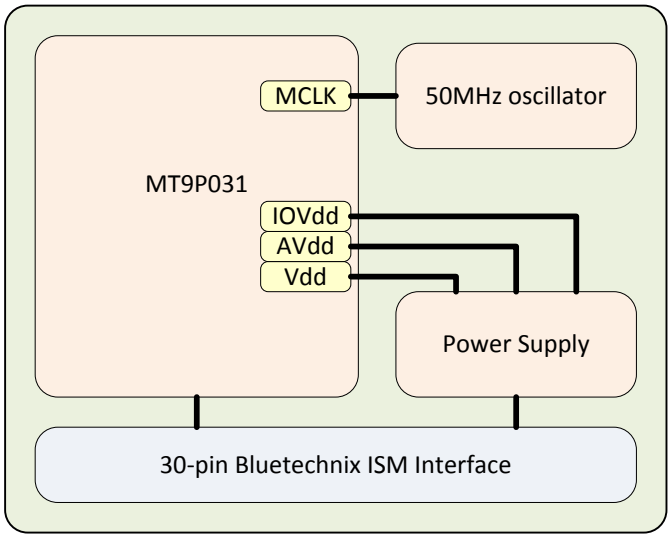


Figure 2-1: ISM-MT9P031 overview

2.1.1 Powering

The ISM-MT9P031 can be powered with only a single supply between 2.6V 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 by 100Ω.

2.2 Mechanical Outline

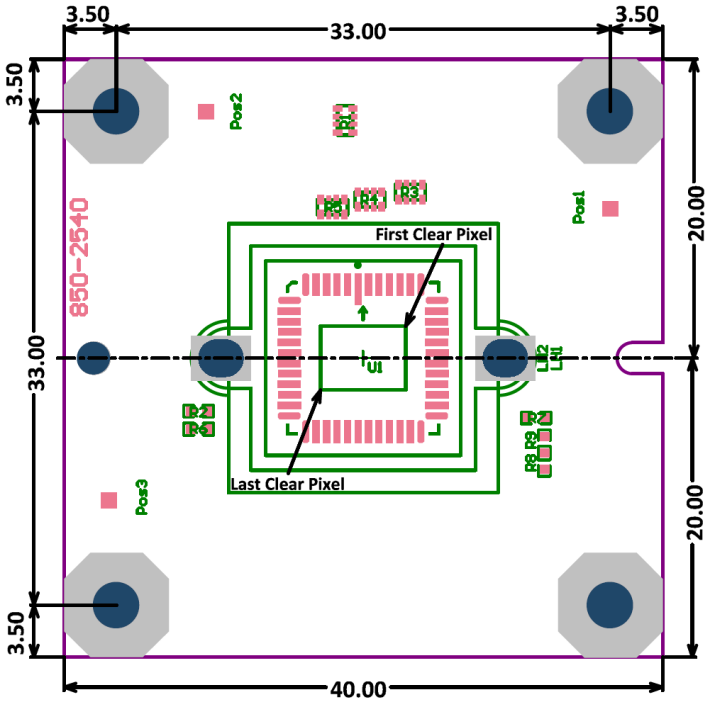


Figure 2-2: Mechanical Dimensions (Sensor Side)

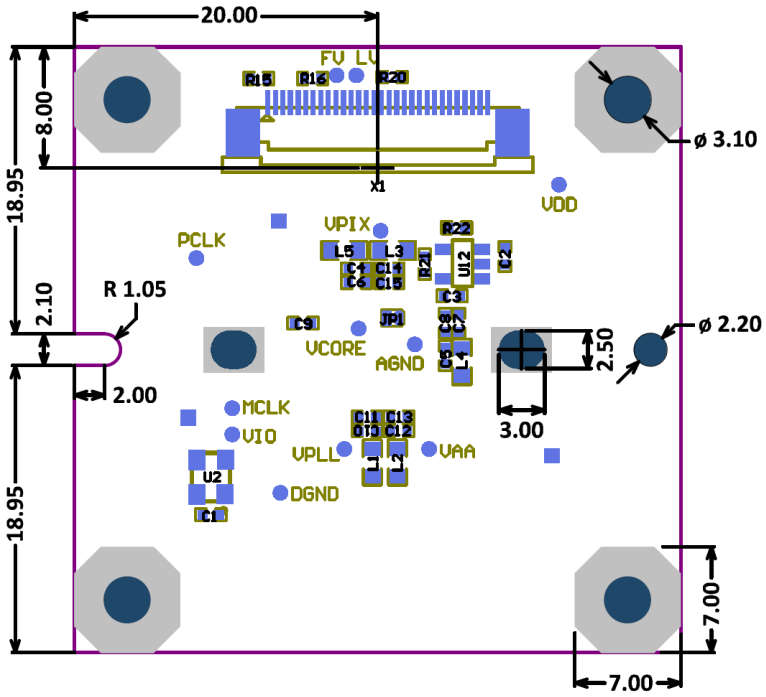


Figure 2-3: Mechanical Dimensions (Connector Side)

3 Specifications

3.1 Operating Conditions

Symbol	Parameter	Min	Typical	Max	Unit
V_{DD}	Input supply voltage	2.6	2.8	3.1	V
V_{DDIO}	IO Voltage	1.7	1.8/2.8	3.1	V
V_{OH28}	High level output voltage (V_{DDIO} = 2.8V)	1.9		V_{DD}	V
V_{OL28}	Low level output voltage (V_{DDIO} = 2.8V)	0		0.6	V
V_{OH18}	High level output voltage (V_{DDIO} = 1.8V)	1.3		1.82	V
V_{OL18}	Low level output voltage (V_{DDIO} = 1.8V)	0.16		0.35	V
I_{OH}	High level output current			22.3	mA
I_{OL}	Low level output current			5.1	mA
V_{IH28}	High level input voltage (V_{DDIO} = 2.8V)	2.0		3.3	V
V_{IL28}	Low level input voltage (V_{DDIO} = 2.8V)	-0.3		0.8	V
V_{IH18}	High level input voltage (V_{DDIO} = 1.8V)	1.3		2.3	V
V_{IL18}	Low level input voltage (V_{DDIO} = 1.8V)	-0.3		0.5	V
I_{INLK}	Input leakage current		<10		µA
P_{FULL}	Power consumption at 15fps streaming with full resolution		381		mW
P_{4xBIN}	Power consumption at 15pfs streaming with 4x Binning		363		mW
f_{MCLK}	Master clock frequency		50		MHz

Table 3-1: Electrical characteristics

3.2 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	3.1	V
V_{IO}	I/O voltage supply	-0.3	3.1	V
V_{IN}	voltage level on I/O pin	-0.3	3.4	V
I_{MAX}	Total Current	0	242	mA
T_{OP}	Operating temperature	-30	70	°C
T_{STO}	Storage temperature	-40	125	°C
φ_{AMB}	Relative ambient humidity		90	%

Table 3-2: Absolute maximum ratings

3.2.1 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 Selection (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	D0	O	Pixel Data
16	D1	O	Pixel Data
17	D2	O	Pixel Data
18	D3	O	Pixel Data
19	VddIO	PWR	I/O Voltage Supply
20	GND	PWR	Power Ground
21	D4	O	Pixel Data
22	D5	O	Pixel Data
23	D6	O	Pixel Data
24	D7	O	Pixel Data
25	GND	PWR	Power Ground
26	D8	O	Pixel Data
27	D9	O	Pixel Data
28	D10	O	Pixel Data
29	D11	O	Pixel Data
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 0xBA for write, and 0xBB for read access. The address the addresses may be changed to 0x90 and 0x91 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.

5 Support

5.1 General Support

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

5.2 Board Support Packages

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

5.3 Blackfin® Software Support

5.3.1 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.

5.3.2 LabVIEW

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

5.3.3 uClinux

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

5.4 i.MX Software Support

5.4.1 Linux

Linux BSP and images of derivates can be found at Bluetechnix' support site https://support.bluetechnix.at/wiki at the software section of the related product.

5.5 Blackfin® and i.MX Design Services

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

5.5.1 Upcoming Products and Software Releases

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

6 Ordering Information

6.1 Image Sensor Module

Article Number	Name	Description
100-3204-2	ISM-MT9P031 -Color	Image Sensor Module based on Aptina's MT9P031 imager.
100-3210-2	ISM-MT9P031 -Mono	Image Sensor Module based on Aptina's MT9P031 imager.

Table 6-1: Ordering information ISM

Note that the ISM-MT9P031 is shipped without lens holder and optics. For available accessories see the tables below and take a look on our website for new products.

6.2 Related Products

Article Number	Name	Description
100-2342-2	eDEV-BF5xx	Extended Blackfin Core Modules Development Board
100-2524-1	EXT-SBC-i.MX51-COMM	Communication Extension Board for the SBC-i.MX51
100-2523-1	EXT-SBC-i.MX51-DISP	Display Extension Board for the SBC-i.MX51
100-1420	DEV-i.MX53 Dev. Kit	Development Kit for the CM-i.MX53

Table 6-2: Ordering information of related products

6.3 Lens Holders and Optics

Article Number	Name	Description
100-9043	Lens holder M12 x 0,5 18mm	M12 Lens holder for ISM.
100-9103	ZIF cable 30 pins, 50mm for ISM	50mm ZIF cable for ISM.
100-9104	ZIF cable 30 pins, 150mm for ISM	150mm ZIF cable for ISM.

Table 6-3: Ordering information accessories

CS-Mount equipment can be bought from www.vd-shop.de

Article Number	Name	Shop
301461	Lense-Holder CS-Mount Boardlens	www.vd-shop.de
10208	C-CS-Mount-Adapter	www.vd-shop.de

Table 6-4 - CS/C Mount equipment

NOTE: Custom hard and software developments are available on request! Please contact Bluetechnix (office@bluetechnix.com) if you are interested in custom hard- and software developments.

7 Dependability

7.1 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 development board 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 development board components. 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.

8 Product History

8.1 Version Information

Version	Date	Changes
2.0	2011 11 30	New Mechanical Outlines (40x40mm^2).
1.0	2011 05 24	First release V1.0 of the Hardware.

Table 8-1: Overview product changes

8.2 Anomalies

Version	Date	Description
2.0	2011 11 30	No anomalies reported yet.
1.0	2011 07 11	No anomalies reported yet.

Table 8-2: Overview product anomalies

9 Document Revision History

Version	Date	Document Revision
3	2012 05 30	Updated for monochrome support.
2	2011 11 30	Update for new hardware release V2.0
1	2011 07 11	First release V1.0 of the Document

Table 9-1: Revision history

10 List of Abbreviations

Abbreviation	Description
ABR	Auto Black Reference
AWB	Auto White Balance
CM	Core Module
ERS	Electronic Rolling Shutter
ESD	Electrostatic Discharge
FPS	Frames per Second
GRR	Global reset release
HDR	High Dynamic Range
HiDy	High Dynamic
HiSPi	High-Speed Serial Pixel Interface
I	Input
IpU	Input with internal pull-up resistor
I^2C	Inter-Integrated Circuit
I/O	Input/Output
ISM	Image Sensor Module
LVDS	Low Voltage Differential Signaling
LSB	Least Significant Bit
MSB	Most Significant Bit
MTBF	Mean Time Between Failure
NC	Not Connected
O	Output
PLL	Phase-locked Loop
PWR	Power
QSXGA	Quarter Super Extended Graphics Array (640 x 512)
QVGA	Quarter Video Graphics Array (320 x 240)
RTOS	Real-Time Operating System
SLVS	Scalable Low-Voltage Signaling
SoC	System on Chip
SXGA	Super Extended Graphics Array (1280 x 960)
TISM	Tiny Image Sensor Module
ZIF	Zero Insertion Force

Table 10-1: List of abbreviations

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