BLUE TECHNIX

Hardware User Manual

ISM-MT9M131 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-MT9M131 integrates Aptina's MT9M131 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 MT9M131 CMOS digital image sensor from Aptina has an active-pixel-array of 1280H x 1024V (1.3MP). It is an ultra low power, cost effective, progressive scan image sensor with a completely integrated camera system (SoC) which has superior lowlight performance. The sensor can be programmed via an I^{2}C interface and offers some sophisticated camera functions such as auto exposure control, auto white balance (AWB), auto black reference (ABR), auto flicker avoidance, auto color saturation, auto defect identification and correction. The sensor is able to capture in continuous mode for videos or single frame mode for clear sharp images for both low light and normal scenes.

1.2   Key Features

Description	Value
OPTICAL FORMAT	1/3-inch (5:4)
ACTIVE ARRAY	1280H x 1024V (1.3MP)
IMAGING AREA	4.6mm(H) x 3.7mm(V)
PIXEL SIZE	3.6 x 3.6µm
RESPONSIVITY	1.0 V/lux-sec (550nm)
SNR	Max 44 dB
MAX DYNAMIC RANGE	71dB
FRAME RATE	15fps at 50 MHz (SXGA 1280 x 1024) 30fps at 50 MHz (VGA 640 x 480) 60fps at 50MHz (640 x 512)
CHROMA	RGB Bayer pattern
SHUTTER TYPE	ERS - Electronic Rolling Shutter
DATA RATE	27Mb/s
INPUT CLOCK	50MHz
MASTER CLOCK	50MHz
ADC RESOLUTION	10-bit, dual on-chip
DATA FORMAT	10 bit parallel
SINGLE SUPPLY VOLTAGE	2.5V to 3.1V
POWER CONSUMPTION	170mW SXGA at 15 fps (54 MHz EXTCLK) 90mW VGA at 30 fps (54 MHz EXTCLK)
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 40mm

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

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

*Depends on user hardware.

1.3 Applications

- Security
- Biometrics
- Video conferencing
- Toys
- 802.11 wireless network cameras
- Power line modem cameras
- IP cameras
- uPNP AV, WiFi, UWB cameras
- Small office monitoring
- Home monitoring

2 General Description

The ISM-MT9M131 image sensor module features Aptina's MT9M131 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 I²C compatible configuration bus allows to configure the sensor IC, the 10 bit parallel interface transfers the data.

Some handshake lines are connected to the MT9M131 for power saving or capture triggering.

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

For detailed information about the image sensor please refer to the MT9M131 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
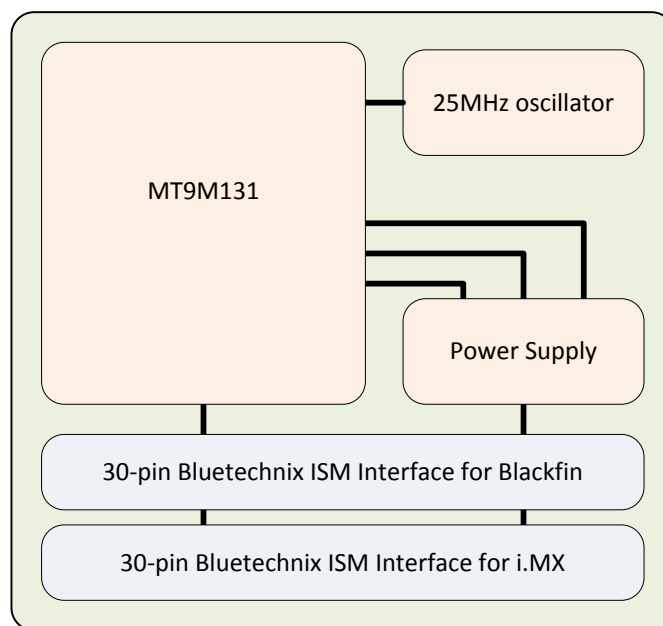
Figure 2-1: ISM-MT9M131 overview

2.1.1 Powering

The ISM-MT9M131 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 by 100Ω.

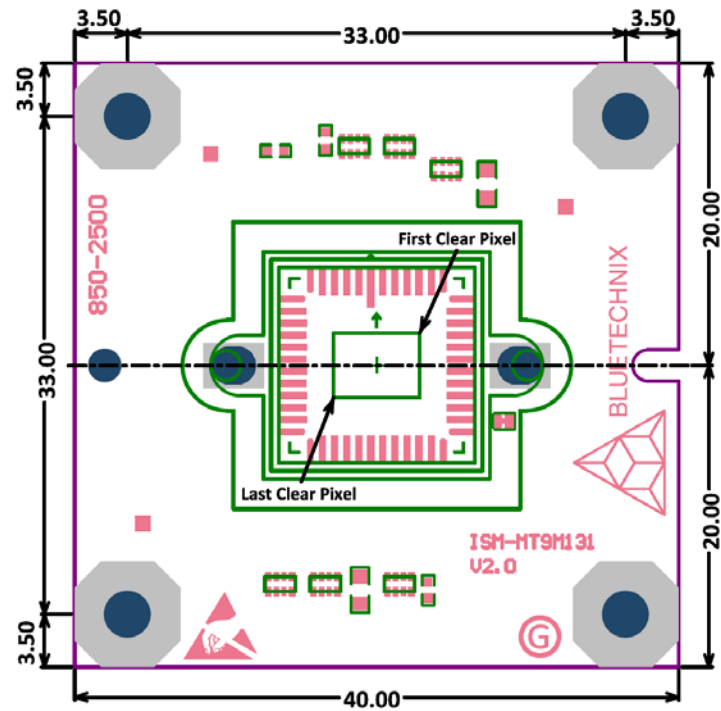## 2.2 Mechanical Outline

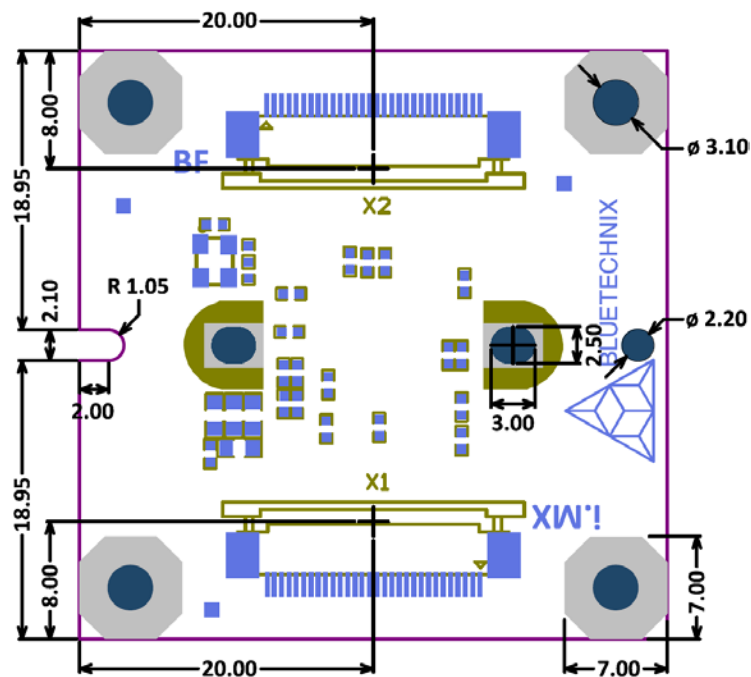Figure 2-2: Mechanical dimensions (sensor side)

Figure 2-3: Mechanical dimensions (connector side)

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
I_{2V8}	Current measurements (2.8V supply)	0.01	TBD	150	mA
V_{OH}	High level output voltage	V_{DD}-0.3		V_{DD}	V
V_{OL}	Low level output voltage	0		0.3	V
I_{OH}	High level output current	16		26.5	mA
I_{OL}	Low level output current	15.9		21.3	mA
I_{OZ}	Three state leakage current			10	µA
V_{IH}	High level input voltage	2			V
V_{IL}	Low level input voltage			0.9	V
I_{IN}	Input leakage current	-5		5	µA
P_{SXGA15}	Power consumption with SXGA at 15 fps			170	mA
$P_{QSXGA30}$	Power consumption with QSXGA at 30 fps			90	mA
$P_{QSXGA15}$	Power consumption with QSXGA at 15 fps			70	mA
P_{QVGA30}	Power consumption with QVGA at 30 fps			83	mA
f_{MCLK}	Master clock frequency		50		MHz

Table 3-1: Electrical characteristics

3.1.2 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	4.0	V
V_{IO}	Input or output voltage	-0.3	V_{DD} + 0.3	V
I_{MAX}	Total Current	0	150	mA
T_{OP}	Operating temperature	-30	70	°C
T_{STO}	Storage temperature	-40	85	°C
φ_{AMB}	Relative ambient humidity		90	%

Table 3-2: Absolute maximum ratings

3.1.3 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 (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.

The fact, that the i.MX needs MSB aligned data and the Blackfin LSB aligned data, requires different data line routing, and therefore there are two different connectors for i.MX-based hardware and for Blackfin-based hardware. For Blackfin related hardware only 8 data bits are usable, 10-bit RAW mode is not supported on Blackfin based hardware.

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	NC	-	Not connected
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 for i.MX-based hardware (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.

Pin	Name	Type	Description
1	Vdd	PWR	Voltage Supply
2	GND	PWR	Power Ground
3	SADDR[1]	IpU	Not Connected (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	NC	-	Not connected
14	STROBE	O	Strobe Signal
15	D0	O	Pixel Data (LSB)
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 (MSB)
25	GND	PWR	Power Ground
26	NC	-	Not connected
27	NC	-	Not connected
28	NC	-	Not connected
29	NC	-	Not connected
30	nOE	IpU	Output Enable (Active Low; internally pulled up with 10kΩ)

Table 4-2: BLT-ISM-Connector interface description for Blackfin-based hardware (X2)

[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
100-3202-2	ISM-MT9M131-Color	Image Sensor Module based on Aptina's MT9M131 image SoC.

Table 6-1: Ordering information ISM

Note that the ISM-MT9M131 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	Lens-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	Updated to new mechanical outline (40x40mm). Two different ISM connector pin out to support also Blackfin-related hardware.
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	Not compatible with Blackfin related hardware.

Table 8-2: Overview product anomalies

9 Document Revision History

Version	Date	Document Revision
2	2011 12 13	Changed product photo.
1	2011 11 30	Update for new hardware release V2.0
0	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
I	Input
IpU	Input with internal pull-up resistor
I²C	Inter-Integrated Circuit
I/O	Input/Output
ISM	Image Sensor Module
LSB	Least Significant Bit
MSB	Most Significant Bit
MTBF	Mean Time Between Failure
NC	Not Connected
O	Output
OS	Operating System
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
SADA	Stand Alone Debug Agent
SoC	System on Chip
SXGA	Super Extended Graphics Array (1280 x 1024)
TFT	Thin-Film Transistor
TISM	Tiny Image Sensor Module
ZIF	Zero Insertion Force

Table 10-1: List of abbreviations

A   List of Figures and Tables

Figures

Tables