1/1.8-inch 20 MP CMOS Digital Image Sensor
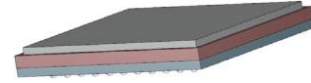
AR2020

PBGA78 13x10.5
CASE 117CV

General Description

The **onsemi** AR2020 is a stacked 1/1.8−inch back side illuminated (BSI) CMOS active−pixel digital image sensor with a pixel array of 5120H x 3840V (5136H x 3856V including border pixels). The AR2020 has enhanced NIR response.

It incorporates sophisticated on−chip camera functions such as Wake on Motion (WOM), context switching and multiple subsampling modes. It is programmable through a simple I^2C interface and has very low power consumption.

The AR2020 digital image sensor features **onsemi**'s breakthrough low−noise CMOS imaging technology.

The AR2020 sensor can generate full resolution image at up to 60 frames per second (fps) in 10−bit linear mode. AR2020 can achieve

30 fps in line interleaved high dynamic range (LI−HDR) and enhanced Dynamic Range (eDR) modes.

Features

20 MP CMOS Sensor with Advanced 1.4 m Pixel Stacked BSI Technology

Enhanced NIR Response at 850 nm and 940 nm Wavelength

LI−HDR: Supports Line Interleaved T1/T2 Readout to Enable HDR Processing in ISP Chip

enhanced Dynamic Range (eDR)

In Sensor Scaler that Supports both Mono and Bayer RGB Version

Super Low Power Mode (SLP)

Wake On Motion (WOM)/Motion Detection

Subsampling Modes: Skipping, Binning, Summing

Data Interfaces:
 MIPI D−PHY − 2x4 Lanes

Bit−depth Compression Available for MIPI Interface

I^2C Fast Mode+ Serial Interface

Various Trigger Modes for Multi−sensor Synchronization

Electronic Rolling Shutter (ERS) and Global Reset Release (GRR) Modes Supported

Context Switching

1952 bytes One−time Programmable Memory (OTPM) for Storing Shading Correction Coefficients and Module Information

Programmable Controls: Gain, Horizontal and Vertical Blanking, Frame Size/Rate, Exposure, Window Size, Cropping and Mirror and Flip

On−chip Temperature Sensor with 5C accuracy

On−chip Lens Shading Correction for RGB Bayer and Mono

ORDERING INFORMATION

See detailed ordering and shipping information on page 3 of this data sheet.

Non−NDA Data Sheet

Interested in what you see? If you would like more detailed information, please request the full version of our data sheet.

Request Full Data Sheet

Applications

Surveillance Camera

Video Conferencing

Machine Vision

3D and Stereo Imaging

Table 1. KEY PERFORMANCE PARAMETERS

Parameter		Value
Optical format		1/1.8−inch 20 MP (4:3)
Active pixels		5120H x 3840V
Color Filter Array		RGB Bayer, Monochrome
Pixel size		1.4 m Back Side Illuminated (BSI)
Chief ray angle (CRA)		13
Input clock frequency		6 − 48 MHz
Interface		2x4−lane MIPI (1x1, 1x2, 1x4, 2x4−lane supported) using D−PHY; Max data rate: 2 Gbps/lane
ADC resolution		10−bits, on die
Frame Rate	Full Size, Linear Mode	60 fps (MIPIx2), 30 fps (MIPIx1)
Gain Control: Gain Table		0−50.79 dB total (Analog 0−22.39 dB, Digital 0−28.4 dB)
Subsampling		Subsampling: Skipping (RGB, Mono), Binning (RGB), Summing (Mono)
Scaler		Adjustable x− and y−scaling up to 32x, with 0.05% accuracy, for Bayer and Mono variant.
SmartROI		Support SmartROI feature that can send out two ROIs over different MIPI Virtual Channels.
Temperature sensor		10−bit, controlled by two−wire serial I/F, 5C accuracy
Compression		DPCM: 10−8
3D Support		Frame rate and exposure synchronization
Supply voltage	Analog, Pixel	2.8 V (2.7 < V_{supply} < 2.9 V)
	I/O	1.8 V (1.7 V < V_{supply} < 1.9 V)
	Digital, PLL, MIPIphy	1.05 V (1.0 V < V_{supply} < 1.1 V)
Power consumption		430 mW (Typical) at (RGB) 20 MP and 60 fps
Responsivity		17.3 ke−/lux−sec (Clear in Mono) 8.7 ke−/lux−sec (Green in RGB)
SNRMAX		39.9 dB
Dynamic Range		73 dB (eDR 1−exp) 100 dB (LI−HDR Mode)
Operating Temperature Range (at junction) − T_J		−30C to +85C
Performance Specified Temperature Range (at junction) − T_J		0C to +60C
Package Options:		MPBGA−78 (13 mm x 10.5 mm)
JA (Note 1)		30C/W
JB		18C/W

1. JA is dependent on the customer module design and should not be used for calculating junction temperature.

Table 2. MODES OF OPERATION 10−BIT

Modes	Sensor Resolution	Mode Name	FPS (2x4 MIPI)	FPS (1x4 MIPI)
20M Linear	5120x3840	Native	60	37
20M LI−HDR	5120x3840	Native	30	18
20M LI−eDR	5120x3840	Native	30	15
5M Linear	2560x1920	Bin2	120	120
1280x960 Linear	1280x960	Bin4	240	240
20M SLP Linear	5120x3840	Native	1	1
Wake On Motion (WOM)	640x480	Skip2Bin4	2	2
Wake ON Motion (WOM) w/ streaming	1280x960	Bin4	2	2

NOTE: Contact your **onsemi** Field Applications Engineer for additional modes.

Table 3. MODES OF OPERATION 12−BIT

Modes	Sensor Resolution	Mode Name	FPS (2 x 4 MIPI)	FPS (1 x 4 MIPI)
20M eDR	5120x3840	Native	30	25

NOTE: Contact your **onsemi** Field Applications Engineer for additional modes.

Table 4. ORDERING INFORMATION

Part Number	Product Description	Orderable Product Attribute Description
AR2020CSSC13SMTA0−DP	20 MP 1/1.8" CMOS Image Sensor RGB 13 CRA	mPBGA with Protective Film
AR2020CSSC13SMTA0−DP2	20 MP 1/1.8" CMOS Image Sensor RGB 13 CRA	mPBGA with Protective Film, Small MOQ
AR2020CSSC13SMTAH3−GEVB	20 MP 1/1.8" CMOS Image Sensor RGB 13 CRA	Demo3 Headboard

Part Number	Product Description	Orderable Product Attribute Description
AR2020CSSM13SMTA0−DP	20 MP 1/1.8" CMOS Image Sensor Mono 13 CRA	mPBGA with Protective Film
AR2020CSSM13SMTA0−DP2	20 MP 1/1.8" CMOS Image Sensor Mono 13 CRA	mPBGA with Protective Film, Small MOQ
AR2020CSSM13SMTAH3−GEVB	20 MP 1/1.8" CMOS Image Sensor Mono 13 CRA	Demo3 Headboard

NOTE: Refer to AR2020 Die Data Sheet for Die Part Numbers & Ordering Information.

AR2020
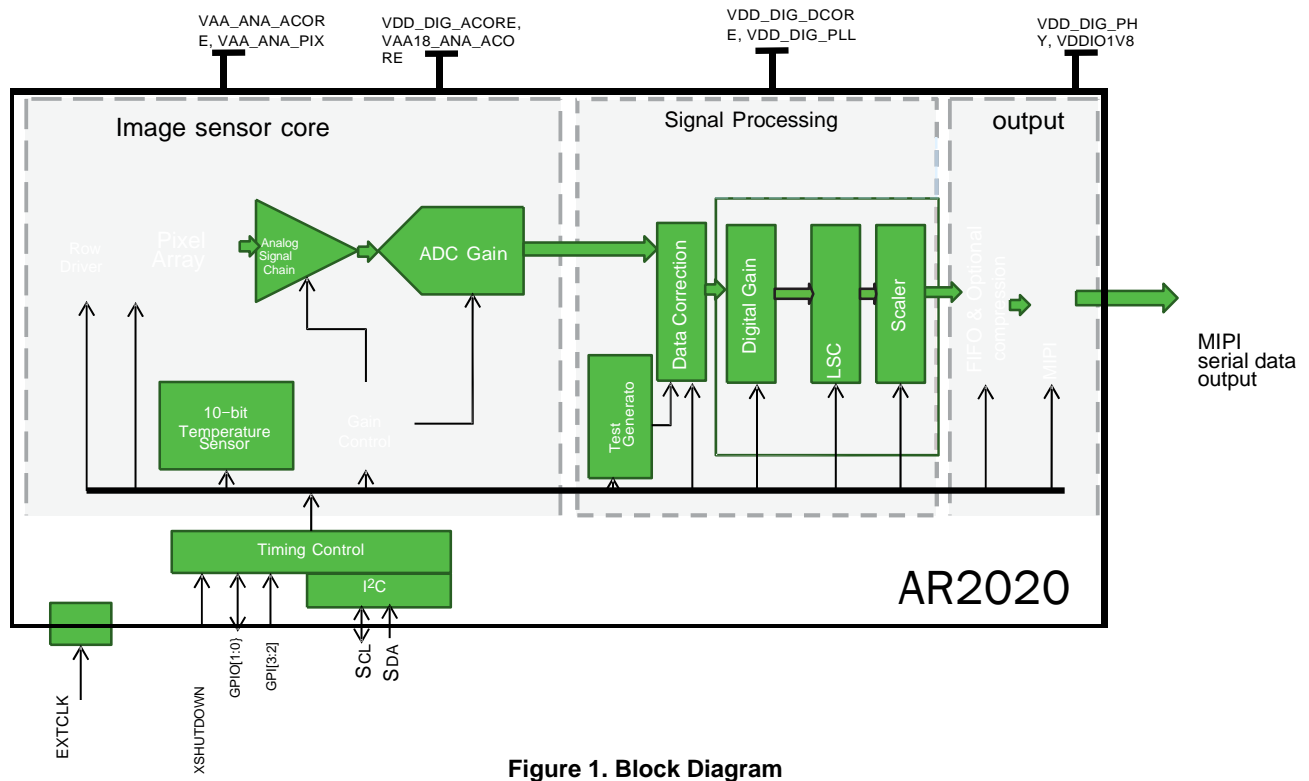
Figure 1. Block Diagram
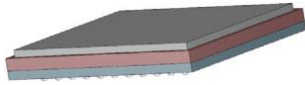
**PBGA78 13x10.5**
CASE 117CV
ISSUE O

DATE 28 OCT 2021
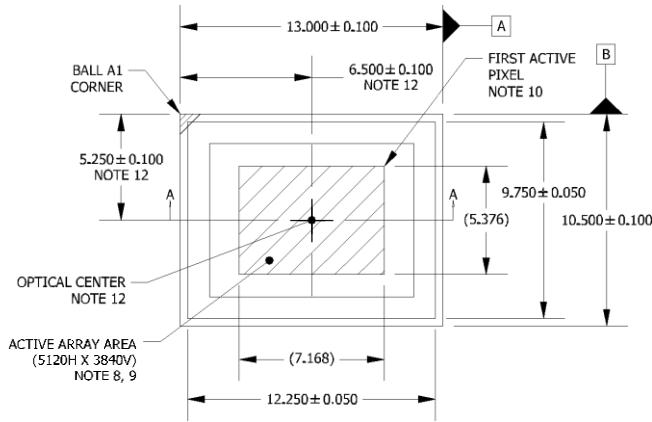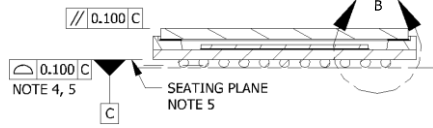
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS [mm].
3. SOLDER BALL DIAMETER IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER PARALLEL TO DATUM C.
4. COPLANARITY APPLIES TO THE SPHERICAL CROWNS OF THE SOLDER BALLS.
5. DATUM C, THE SEATING PLANE IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
6. GLASS: 0.550 THICKNESS; REFRACTIVE INDEX = 1.52.
7. AIR GAP BETWEEN GLASS AND PIXEL ARRAY: 0.275 THICKNESS.
8. PARALLELISM APPLIES ONLY TO THE ACTIVE ARRAY.
9. MAXIMUM ROTATION OF ACTIVE ARRAY RELATIVE TO DATUMS A AND B IS ± 1°.
10. REFER TO THE DEVICE DATA SHEET FOR TOTAL PIXEL ARRAY DEFINITIONS.
11. PACKAGE CENTER (X, Y) = (0.000, 0.000).
12. OPTICAL CENTER RELATIVE TO PACKAGE CENTER (X, Y) = TBD AS DRAWN (0.000, 0.000).

TOP VIEW

SECTION A-A
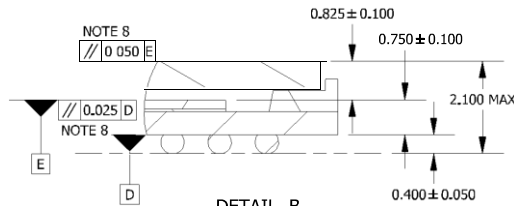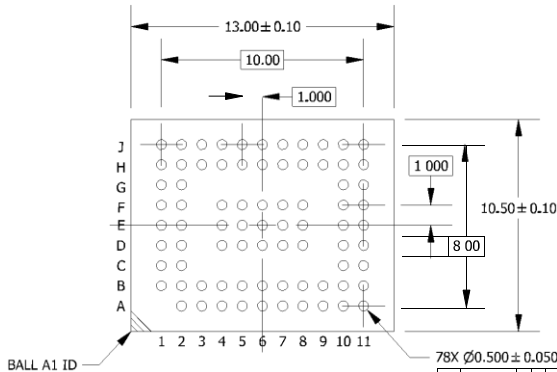
DETAIL B
SCALE 7 : 1

BOTTOM VIEW
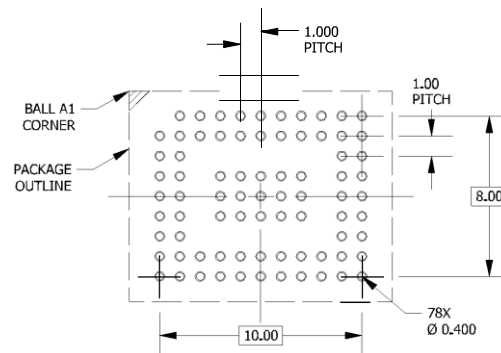
RECOMMENDED MOUNTING FOOTPRINT*

*FOR ADDITIONAL INFORMATION ON OUR Pb−FREE
STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD
THE ON SEMICONDUCTOR SOLDERING AND MOUNTING
TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

GENERIC
MARKING DIAGRAM*

PIN A1 INDICATOR
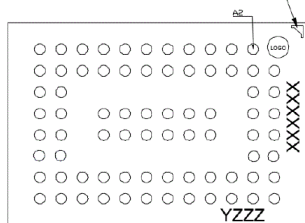
XXXX = Specific Device Code
Y   = Year
ZZZ   = Lot Traceability

*This information is generic. Please refer to
 device data sheet for actual part marking.
 Pb−Free indicator, "G" or microdot " ", may
 or may not be present. Some products may
 not follow the Generic Marking.

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DESCRIPTION:	PBGA78 13x10.5		PAGE 1 OF 1

ADDITIONAL INFORMATION

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For additional information, please contact your local Sales Representative at
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