

1/1.8-inch 20 MP CMOS Digital Image Sensor

AR2020

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.

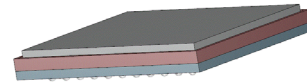
It incorporates sophisticated on-chip camera functions such as Wake on Motion (WOM), context switching and multiple subsampling modes. It is programmable through a simple I²C interface and has very low power consumption.

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 μ 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)
- Smart Roi:
 - ◆ Capability to Output Two Roi's Over Different Mipi Virtual Channels
 - ◆ Capability to Have Individual Image Crop Selection
 - ◆ Capability to Select Channel for Scaled Image
- 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
- I²C 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 ± 5 °C accuracy
- On-chip Lens Shading Correction for RGB Bayer and Mono



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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 μm 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		Linear Mode: 0 – 50.62 dB total (Analog 0 – 26.38 dB, Digital 0 – 24.24 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, ± 5 °C accuracy
Compression		DPCM: 10–8
3D Support		Frame rate and exposure synchronization
Supply Voltage	Analog, Pixel	2.8 V ($2.7 < V_{\text{supply}} < 2.9$ V)
	I/O	1.8 V ($1.7 \text{ V} < V_{\text{supply}} < 1.9$ V)
	Digital, PLL, MIPIphy	1.05 V ($1.0 \text{ V} < V_{\text{supply}} < 1.1$ 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		–30 °C to +85 °C
Performance Specified Temperature Range (at junction) – T_J		0 °C to +60 °C
Package Options:		MPBGA-78 (13 mm x 10.5 mm)
θ_{JA} (Note 1)		30 °C/W
θ_{JB}		18 °C/W

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

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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
AR2020CSCC13SMTA0-DP	20 MP 1/1.8" CMOS Image Sensor RGB 13° CRA	mPBGA with Protective Film
AR2020CSCC13SMTA0-DP2	20 MP 1/1.8" CMOS Image Sensor RGB 13° CRA	mPBGA with Protective Film, Small MOQ
AR2020CSCC13SMTAH3-GEVB	20 MP 1/1.8" CMOS Image Sensor RGB 13° CRA	Demo3 Headboard

AR2020CSCC13SMTA0-DP	20 MP 1/1.8" CMOS Image Sensor Mono 13° CRA	mPBGA with Protective Film
AR2020CSCC13SMTA0-DP2	20 MP 1/1.8" CMOS Image Sensor Mono 13° CRA	mPBGA with Protective Film, Small MOQ
AR2020CSCC13SMTAH3-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.

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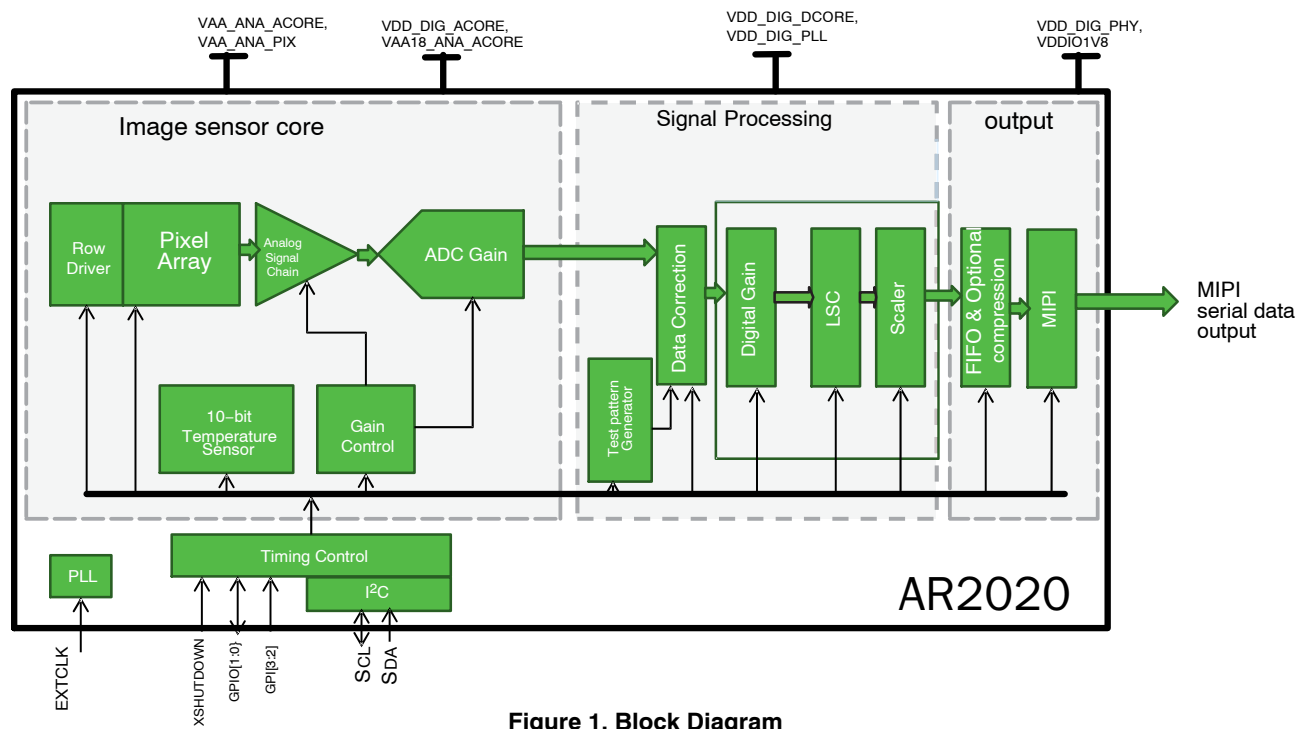
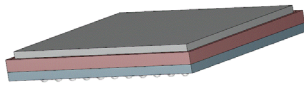
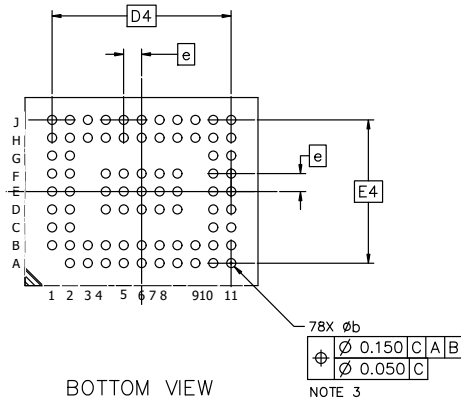
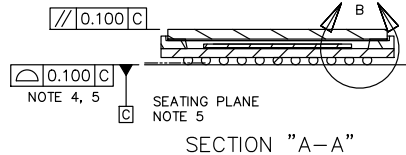
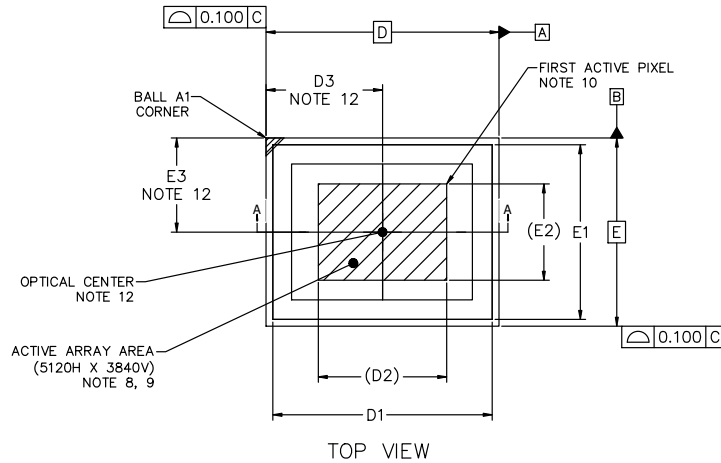


Figure 1. Block Diagram

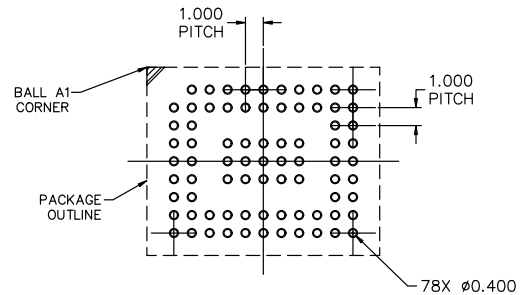
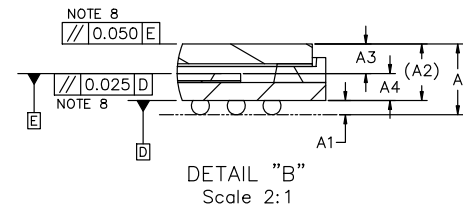


PBGA78 13.00x10.50x1.57, 1.00P
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MILLIMETERS			
DIM	MIN	NOM	MAX
A	---	---	2.100
A1	0.350	0.400	0.450
A2	1.575 REF		
A3	0.725	0.825	0.925
A4	0.650	0.750	0.850
b	0.450	0.500	0.550
D	13.000 BSC		
D1	12.200	12.250	12.300
D2	7.168 REF		
D3	6.400	6.500	6.600
D4	10.000 BSC		
E	10.500 BSC		
E1	9.700	9.750	9.800
E2	5.376 REF		
E3	5.150	5.250	5.350
E4	8.000 BSC		
e	1.000 BSC		



NOTES:

- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
- CONTROLLING DIMENSION: MILLIMETERS [mm].
- SOLDER BALL DIAMETER IS MEASURED AT THE MAXIMUM SOLDER BALL DIAMETER PARALLEL TO DATUM C.
- COPLANARITY APPLIES TO THE SPHERICAL CROWNS OF THE SOLDER BALLS.
- DATUM C, THE SEATING PLANE IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.
- GLASS: 0.550 THICKNESS; REFRACTIVE INDEX = 1.52.
- AIR GAP BETWEEN GLASS AND PIXEL ARRAY: 0.275 THICKNESS.
- PARALLELISM APPLIES ONLY TO THE ACTIVE ARRAY.
- MAXIMUM ROTATION OF ACTIVE ARRAY RELATIVE TO DATUMS A AND B IS $\pm 1^\circ$.
- REFER TO THE DEVICE DATA SHEET FOR TOTAL PIXEL ARRAY DEFINITIONS.
- PACKAGE CENTER (X, Y) = (0.000, 0.000).
- OPTICAL CENTER RELATIVE TO PACKAGE CENTER (X, Y) = (0.000, 0.000).
- PLAIN COVER GLASS WITHOUT AR COATING.

RECOMMENDED MOUNTING FOOTPRINT

*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

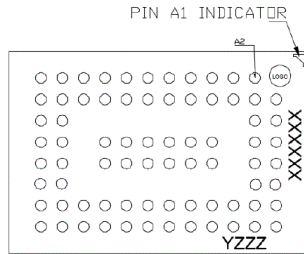
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**GENERIC
MARKING DIAGRAM***



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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