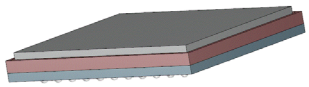
1/1.8-inch 20 MP CMOS Digital Image Sensor

AR2020



PBGA78 13x10.5
CASE 117CV

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

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 μm 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
- 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 ±5 °C accuracy
- On-chip Lens Shading Correction for RGB Bayer and Mono

Applications

- Surveillance Camera
- Video Conferencing
- Machine Vision
- 3D and Stereo Imaging

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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_{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		−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)
θJA (Note 1)		30 °C/W
θJB		18 °C/W

1. θJA 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
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
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.

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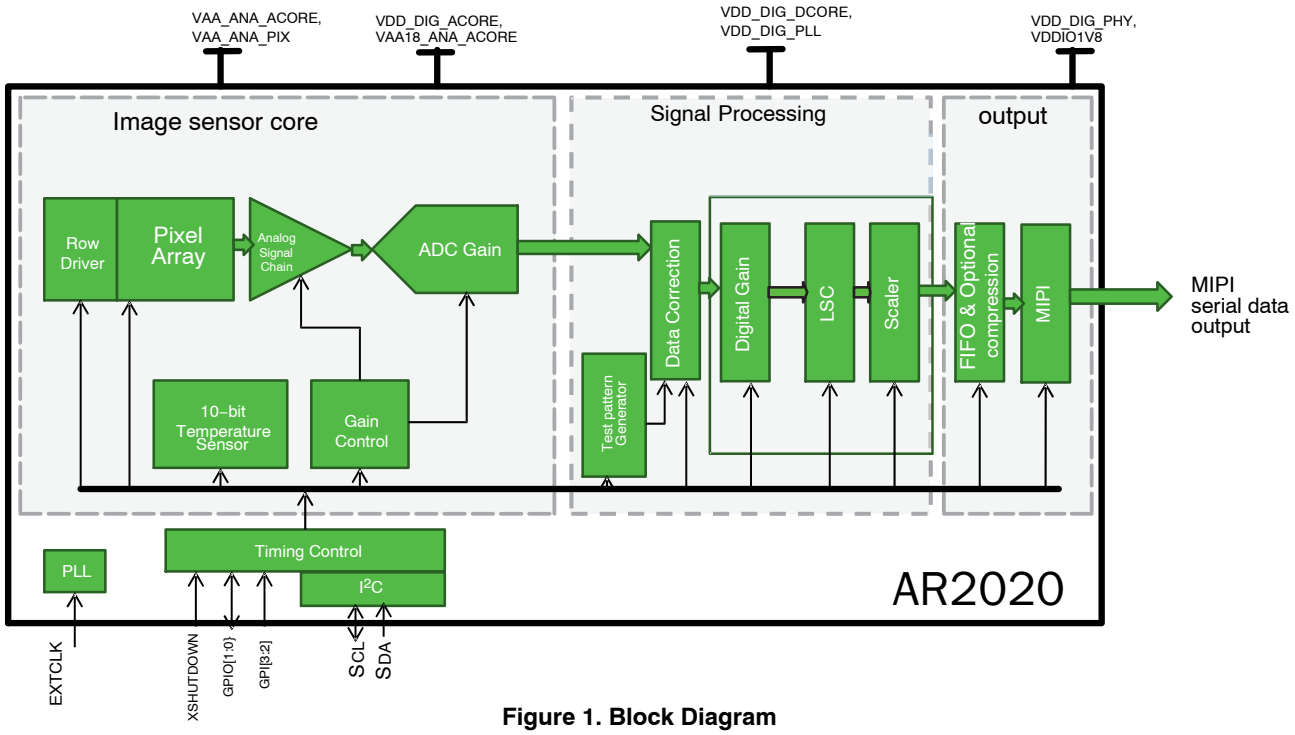

Figure 1. Block Diagram

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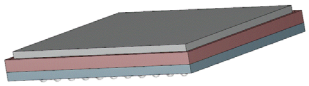

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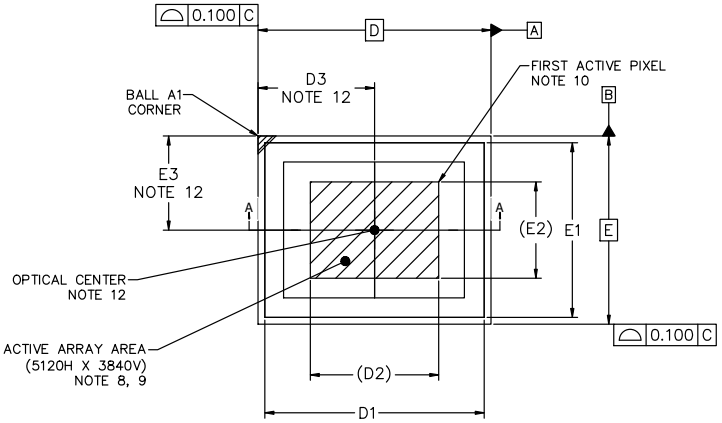
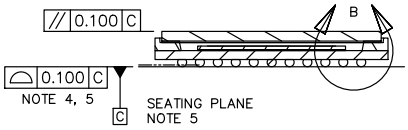
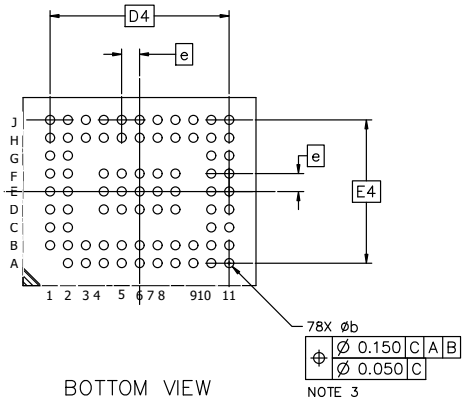
DATE 10 JUN 2025



TOP VIEW

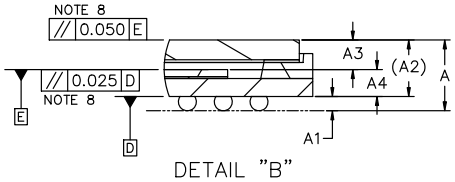


SECTION "A–A"

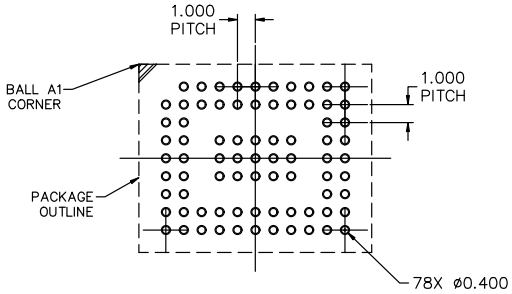


BOTTOM VIEW

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	



DETAIL "B"
Scale 2:1



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.

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
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) = (0.000, 0.000).
13. PLAIN COVER GLASS WITHOUT AR COATING.

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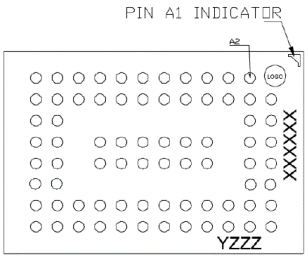
GENERIC
MARKING DIAGRAM*



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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