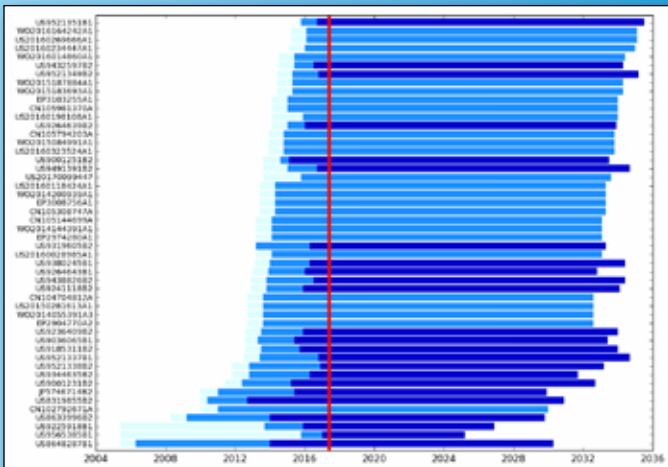


Rambus Binary Pixel Imager Technology Patent Portfolio Offering

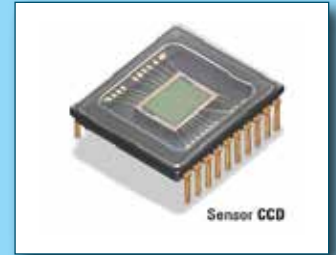
Quick Facts

- ≈ **Opportunity:** Acquisition of 50 patent assets, including 23 issued US patents, 8 pending US patent applications, and 19 foreign assets all relating to image sensing, and more particularly, to Rambus differential binary pixel technology
- ≈ **Earliest priority:** 2005-05-27
- ≈ **Technology:** Rambus Differential Binary Pixel Technology
- ≈ **Encumbrances:** Moderately encumbered with details available under NDA
- ≈ **Continuations:** Yes
- ≈ **Collateral Material:** Non-confidential technology white papers and executive presentations are available upon request.
- ≈ **Average Lifespan:** 15.8 years

Lifespan:



A breakthrough image sensor for dramatically better videos & photos with ultra-high dynamic range, improved low-light sensitivity and stop-motion performance



Portfolio Overview

Rambus is offering this patent portfolio for cash sale. This Rambus differential binary pixel portfolio relates to image sensor technology used to provide enhanced video and still image capture. In general, four advantages are provided by the technology: (1) ultra-high dynamic range, providing pixel-level dynamic range optimization in DSLR-quality image capture devices (cameras, etc.), (2) single shot high dynamic range (HDR) photographs and videos, enabling operation in a single exposure period to capture HDR images in real time with no post-processing, (3) improvements in low light sensitivity, comprising employing spatial and temporal oversampling to reduce noise and graininess, and (4) compatibility with all standard CMOS 4T pixel architectures, providing ease of integration and manufacturing.

The present portfolio covers various aspects relating to four successive sub-frame samples in a single exposure period, including two full reads of all pixels and two differential reads of all pixels, with an image reconstruction that produces better results than previously available. Charges are collected in a better way and transferred only in certain circumstances, again

continued...

Rambus Binary Pixel Imager Technology

Patent Portfolio Offering



Portfolio Overview (cont.)

resulting in a better overall image. The patents in the portfolio address providing longer low light exposure time and better SNR (signal to noise ratio) performance under low light conditions

Using differential partial transfer according to the patents in the portfolio, the binary pixel methodology shows a 7dB improvement in SNR in low light conditions. Such an improvement is readily noticeable to even a casual observer when low light conditions are encountered.

Claims of the patents and patent applications being offered in this portfolio touch on all aspects of this technology, including pixel architecture, processing, sampling, pixel readout, tone mapping, and so forth.

HOW IT WORKS



Ultra-High Dynamic Range (HDR)

Binary Pixel technology produces professional-quality images by capturing details in the full gamut of a scene — from brightest highlights to the darkest shadows. The sensor is optimized at the pixel level to deliver DSLR-level dynamic range from mobile and consumer cameras.



Single-Shot HDR Photos & Videos

Operating in a single exposure period at high-speed frame-rates, Binary Pixel technology captures HDR images in real-time with on-the-fly processing, enabling hand-held photo and video capabilities with zero post-capture processing.



Improved Low-Light Sensitivity

Temporal oversampling technology improves the sensor's signal-to-noise performance in low-light conditions to reduce noise and graininess for better indoor and nighttime photography.



Enhanced Stop-Motion Performance

Binary Pixel processing enhances stop-motion performance for improved clarity and dramatically sharper images of moving objects.



Works with Current Mobile Platform

Rambus Binary Pixel imagers fit in a comparable form-factor, cost and power envelope as today's CMOS imagers. They are designed to be integrated in existing SoC architectures and can be manufactured using current CMOS image sensor technology.

HOW IT COMPARES

Conventional Mobile Sensor



- Blown highlights in bright regions
- Ghosting of objects in motion
- Lost detail in low-light regions
- Limited data for post-processing

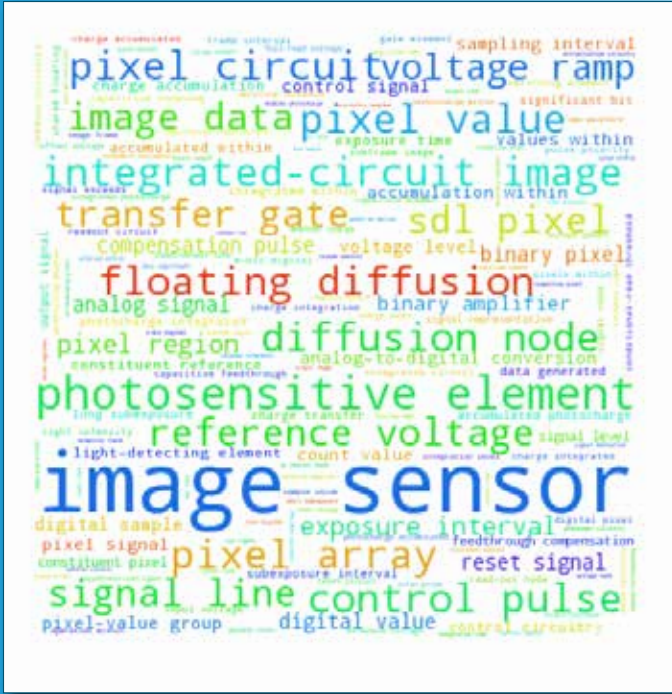
Binary Pixel Imager



- Full dynamic range for images & videos
- Improved clarity and stop-motion capabilities
- Enhanced detail in low-light regions
- Full spectra scene data for better post-processing



Claim Word Cloud



Exemplar Claim

Claim 14 of U.S. Patent No. 9036065:

14. An integrated-circuit image sensor comprising:
- a) a pixel array; and
 - b) circuitry to iteratively sample individual pixels of the pixel array at varying sampling rates during an exposure interval, including circuitry to sample a first pixel after a first integration time during an initial portion of the exposure interval and after a second integration time during a second portion of the exposure interval, and to sample a second pixel after the second integration time during the initial portion of the exposure interval and after the first integration time during the second portion of the exposure interval, the second integration time being longer than the first integration time.

Rambus Binary Pixel Imager Technology

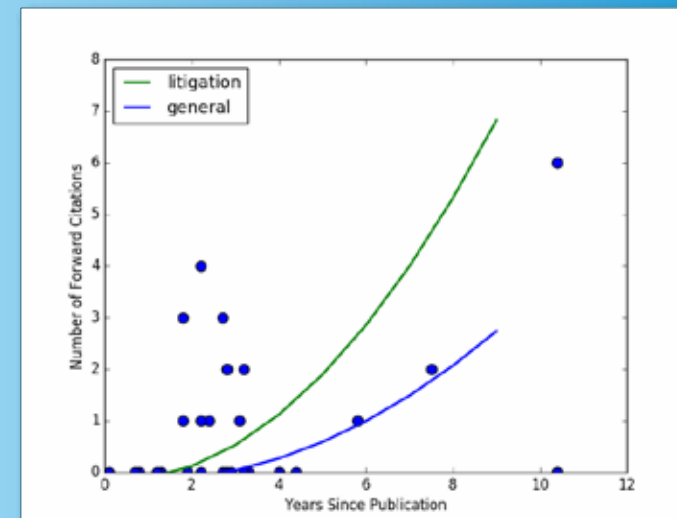
Patent Portfolio Offering



Forward Citations Parties

Party	Cites
DePuy Synthes Products, Inc.	3
Lawrence F. Glaser	3
Samsung Electronics Co., Ltd.	3
SK Hynix Inc.	2
Stmicroelectronics (Research & Development) Limited	2
Sony Corporation	2
Seek Thermal, Inc.	2
Commissariat A L'energie Atomique Et Aux Energies Alternatives	1
Trixell	1
Semiconductor Components Industries, LLC	1
Omnivision Technologies, Inc.	1
Panasonic Intellectual Property Management Co., Ltd.	1
Commissariat À L'Énergie atomique et aux Énergies alternatives	1
Nokia Corporation	1
Malone Michael R	1
Jess Jan Young Lee	1
Invisage Technologies, Inc.	1
General Electric Company	1
Universitat Zurich	1

Forward Citations



The graph compares forward citation scores of the patents in this portfolio (blue dots) against the scores for all US patents (blue line) and for litigated US patents (green line). Richardson and Oliver Law Group developed the scoring system.



Asset List

number	online	juris	title	status	priority	filed	issued	expiration	app_number	rol_score	citations	years_since_pub
CN105981370A	CN105981370A	CN	Feedthrough-compensated image sensor	application	2014-02-07	2015-02-06		2034-02-07	CN 201580007541			
CN105308747A	CN105308747A	CN	Split-gate conditional- reset image sensor	application	2013-06-11	2014-06-09		2033-06-11	CN 201480033602			
CN105144699A	CN105144699A	CN	Threshold-monitoring, conditional-reset image sensor	application	2013-03-15	2014-03-14		2033-03-15	CN 201480015633			
CN104704812A	CN104704812A	CN	Conditional-reset, multi-bit read-out image sensor	application	2012-10-05	2013-09-30		2032-10-05	CN 201380052410			
CN102792671A	CN102792671A	CN	A method and apparatus for image acquisition and conversion	application	2010-01-19	2011-01-19		2030-01-19	CN 201180006480			
CN105794203A	CN105794203A	CN	High dynamic-range image sensor	application	2013-12-04	2014-12-03		2033-12-04	CN 201480066459			
JP5746714B2	JP5746714B2	JP	Method and apparatus for acquiring an image conversion	issued	2010-01-19	2011-01-19	2015-07-08	2030-01-19	JP2012549350A			
EP3008756A1	EP3008756A1	EP	Split-gate conditional- reset image sensor	application	2013-06-11	2014-06-09		2033-06-11	EP20140734701			
EP3103255A1	EP3103255A1	EP	Feedthrough-compensated image sensor	application	2014-02-07	2015-02-06		2034-02-07	EP20150708933			
EP2904770A2	EP2904770A2	EP	Conditional-reset, multi-bit read-out image sensor	application	2012-10-05	2013-09-30		2032-10-05	EP20130789064			
EP2974280A1	EP2974280A1	EP	Threshold-monitoring, conditional-reset image sensor	application	2013-03-15	2014-03-14		2033-03-15	EP20140726239			
US20170099447	US20170099447	US	IMAGE SENSOR WITH THRESHOLD-BASED OUTPUT ENCODING	application	2013-09-10	2015-11-20		2033-09-10	US20170099447			2.2
US9521338B2	US9521338B2	US	Image sensor sampled at non-uniform intervals	issued	2011-11-08	2012-11-08	2016-12-13	2033-04-13	US14355814	12.94	0	4
US20160234447A1	US20160234447A1	US	Image sensor with oversampled column output	application	2015-02-06	2016-02-02		2035-02-06	US15013927			0.8

Rambus Binary Pixel Imager Technology

Patent Portfolio Offering



Asset List

number	online	juris	title	status	priority	filed	issued	expiration	app_number	rol_score	citations	years_since_pub
US9264643B1	US9264643B1	US	Methods and circuitries for pixel sampling	issued	2012-12-29	2013-12-26	2016-02-16	2032-12-29	US14140618	60.6	2	2.8
US9001251B2	US9001251B2	US	Oversampled image sensor with conditional pixel readout	issued	2013-09-10	2014-09-10	2015-04-07	2033-09-10	US14482065	63.58	7	2.2
US8633996B2	US8633996B2	US	Image sensor having nonlinear response	issued	2008-05-09	2009-04-09	2014-01-21	2029-11-15	US12992235	45.87	3	7.5
US9565385B1	US9565385B1	US	Image sensor having sub-diffraction-limit pixels	issued	2005-05-27	2015-11-20	2017-02-07	2025-05-27	US14947215	34.83	0	10.4
US9001231B2	US9001231B2	US	Image acquisition using oversampled one-bit poisson statistics	issued	2011-06-03	2012-06-04	2015-04-07	2032-11-01	US13488394	30.39	0	4.4
US20150281613A1	US20150281613A1	US	Conditional-reset, multi-bit readout image sensor	application	2012-10-05	2013-09-30		2032-10-05	US14433003			3.1
US9344635B2	US9344635B2	US	Conditional-reset, temporally oversampled image sensor	issued	2011-11-08	2012-11-08	2016-05-17	2031-11-08	US14355799	16.79	0	4
US9491391B2	US9491391B2	US	Image sensor with threshold-based output encoding	issued	2013-09-10	2015-03-04	2016-11-08	2034-11-19	US14638161	63.58	1	2.2
US9241118B2	US9241118B2	US	High fill-factor image sensor architecture	issued	2012-12-06	2013-12-02	2016-01-19	2034-05-14	US14094077	41.31	0	2.9
US9521337B1	US9521337B1	US	Reset-marking pixel sensor	issued	2012-07-13	2013-07-08	2016-12-13	2034-11-30	US13936985	20.29	0	3.3
US9521349B2	US9521349B2	US	Image sensor architecture with power saving readout	issued	2014-06-19	2015-06-02	2016-12-13	2035-06-08	US14727869	39.41	0	1.3
US9036065B1	US9036065B1	US	Shared-counter image sensor	issued	2012-08-16	2013-04-17	2015-05-19	2033-05-22	US13864427	74.8	3	3.2
US9236409B2	US9236409B2	US	Binary pixel circuit architecture	issued	2012-08-23	2013-08-07	2016-01-12	2034-03-11	US13961842	74.74	1	3.2
US8319855B2	US8319855B2	US	Method, apparatus and system for image acquisition and conversion	issued	2010-01-19	2010-07-07	2012-11-27	2031-03-23	US12831712	62.38	2	5.8



Asset List

number	online	juris	title	status	priority	filed	issued	expiration	app_number	rol_score	citations	years_since_pub
US20160118424A1	US20160118424A1	US	Split-gate conditional-reset image sensor	application	2013-06-11	2014-06-09		2033-06-11	US14898054			2.4
US9432597B2	US9432597B2	US	Low-noise, high dynamic-range image sensor	issued	2014-07-25	2015-07-23	2016-08-30	2034-07-25	US14807794	38.33	0	1.2
US9438826B2	US9438826B2	US	Pixel structure and reset scheme	issued	2012-12-20	2013-12-19	2016-09-06	2034-08-22	US14135014	40.12	0	2.8
US9521351B1	US9521351B1	US	Fractional-readout oversampled image sensor	issued	2015-09-21	2016-01-13	2016-12-13	2035-09-21	US14995138	37.01	0	0.1
US8648287B1	US8648287B1	US	Image sensor using single photon jots and processor to create pixels	issued	2005-05-27	2006-05-26	2014-02-11	2030-06-18	US11442458	52.55	10	10.4
US9225918B1	US9225918B1	US	Image sensor having sub-diffraction-limit pixels	issued	2005-05-27	2013-10-17	2015-12-29	2027-01-06	US14056752	34.34	0	10.4
US9380245B1	US9380245B1	US	Conditional-reset image sensor with analog counter array	issued	2013-02-14	2014-02-05	2016-06-28	2034-08-09	US14173077	60.95	2	2.8
US20160028985A1	US20160028985A1	US	Threshold-monitoring, conditional-reset image sensor	application	2013-03-15	2014-03-14		2033-03-15	US14772311			2.7
US20160323524A1	US20160323524A1	US	High dynamic-range image sensor	application	2013-12-04	2014-12-03		2033-12-04	US15100976			1.9
US9264639B2	US9264639B2	US	Feedthrough-compensated image sensor	issued	2014-02-07	2015-02-06	2016-02-16	2034-02-07	US14616546	69.29	4	1.8
US20160269666A1	US20160269666A1	US	Image sensor with feedthrough-compensated charge-binned readout	application	2015-03-09	2016-03-02		2035-03-09	US15059229			0.7
US20160198108A1	US20160198108A1	US	Image sensor with multi-range readout	application	2014-02-07	2016-01-06		2034-02-07	US14989580			1.8
US9319605B2	US9319605B2	US	Increasing dynamic range using multisampling	issued	2013-03-15	2013-03-15	2016-04-19	2033-04-24	US13842760	37.39	0	2.7