

FAIRCHILD IMAGING

Fairchild Imaging is a manufacturer of high and highest quality image sensors and cameras for industry, research, military and space applications. EURECA Messtechnik GmbH is the exclusive representative of Fairchild Imaging in Germany and provides comprehensive service as well as technical support for all products and services by Fairchild Imaging including the development of customized CCD and CMOS sensors and cameras. For the integration of the products in application qualified partner companies are at the customer's service and extensive accessories are available.

**Fairchild
imaging**



Highlights of the product range are a 83 Mpixel sensor for remote sensing, TDI sensors with up to 24000 pixel for industry and aerospace, high resolution cameras for science and research, as well as a CMOS technology for sensors in ultra low light applications. Another focus is the development of customized sensors, for OEM applications as well as for small volumes e.g. for aerospace. Beside sensors industrial line scan cameras on TDI or CMOS basis are available. Large-sized area cameras for scientific applications complete the product range.

Product group	Applications (Examples)	Page
Linear sensors		
CCD	Barcode readers	3-5
CMOS	Spectroscopy	
TDI (Time delayed integration)	Scanner, remote sensing	
Matrix sensors		
Full frame	Astronomy, low light spectroscopy	6
Frame transfer	Scanning of documents	
Interline	Quality control	
High speed	High speed imaging	
Cameras		
CCD line scan cameras	Quality control	7-8
TDI cameras	Spectrometers, scanners	
CCD matrix cameras	Astronomy, echelle spectrometers, bio technology	
X-ray cameras	Dental, material science	
Customized products		
X-ray sensors	X-ray cristallography	9-10
Products for space applications	Star tracker, earth observation	
Special developments	Customized applications	

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History of FAIRCHILD IMAGING

The success story of FAIRCHILD IMAGING started more than 80 years ago, when the inventor, scientist and industrialist Sherman Fairchild developed the first devices for aerial photography. Among the many FAIRCHILD companies, which were founded within the following years, was 1957 also FAIRCHILD SEMICONDUCTOR, which has had a large influence on the development of the semiconductor devices of this time. 1970 the first CCD image sensor was developed, which was the basis for all devices available nowadays.

FAIRCHILD IMAGING is today the direct descendant of the original FAIRCHILD companies, through its successive owner companies, SCHLUMBERGER, WESTON, LORAL, LOCKHEED MARTING and BAE SYSTEMS.



Up to now several hundred thousands of various image sensors in every shape, size and configuration were manufactured. FAIRCHILD IMAGING was always the pioneer for new image applications. They were the first to produce in volume defence electronic imagers, the first to develop commercial imagers for satellite resource mapping and the first to successfully integrate electronic imaging into fax machines and bar code readers. In the late 1980s to early 1990s they introduced commercial dental X-ray sensors and the flat panel spot mammography camera.

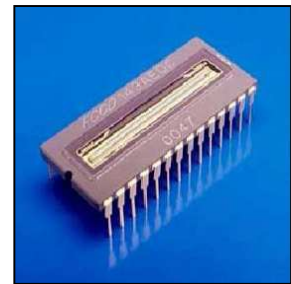
The CCD/CMOS image sensors by FAIRCHILD IMAGING cover today the full spectral range from X-ray to VNIR, provide a very excellent signal quality and reliability. In contrast to other manufacturers many sensors are available over a period of up to 20 years.








The production of the CCD sensors is today made in cooperation with SUPERTEX, based on the most advanced technologies.

CCD linear sensors

FAIRCHILD IMAGING provides CCD linear sensors with an excellent internal charge transfer at low noise. Because of this these sensors are often used for spectroscopy purposes. Other applications are found in the industrial quality control as well as in many scientific and military projects, where a high resolution and sensitivity is needed.

All linear sensors provide a ceramic housing for extended temperature ranges. The sensors can also be delivered without glass cover on request.



	Type	Pixel	Pixel size [µm²]	Max. Data rate [MHz]	Sensitivity [V / (µJ · cm²)]	Dynamic	Remarks
	CCD111A	256	13 x 17	5	3,6	7000	CDS, for NIR applications
	CCD111B				2,5		CDS
	CCD133A	1024	13 x 13	20	3,0	7500	Low dark noise, high sensitivity, 2 outputs, integrated clock drivers
	CCD134				4,5		Low dark noise, high sensitivity, 2 outputs, anti blooming, exposure control, integrated clock drivers
	CCD143A				2048		3,5
	CCD153A	512			3,0	5000	Low dark noise, high sensitivity, 2 outputs, integrated clock drivers
	CCD181	1024 1728 2048 2592	10 x 10	20	4,0	7500	Low dark noise, high sensitivity, anti blooming, 2 outputs, selectable pixel number, CDS, for low light applications, exposure control, sample & hold outputs
	CCD191	6000	10 x 10	5	6,0	15000	Low dark noise, high sensitivity, 2 outputs, CDS, anti blooming, exposure control

The sensor CCD181EDC can be configured to different pixel numbers. The CCD111ADC and the CCD111BDC differ in their sensitivity in the VNIR range.

In sensors with antiblooming circuit special structures on the chip avoid that bright regions of the optical image cause the readout register to saturate and to distort the recorded signal. Exposure control allows integration times below the line frequency of the sensor, which is essential e.g. for imaging quickly moving objects. Sensors with enhanced blue sensitivity provide an increased sensitivity in the range of 400nm. CDS (**CDS = Correlated Double Sampling**) finally is a technology which increases the signal-to-noise ratio of the sensor.

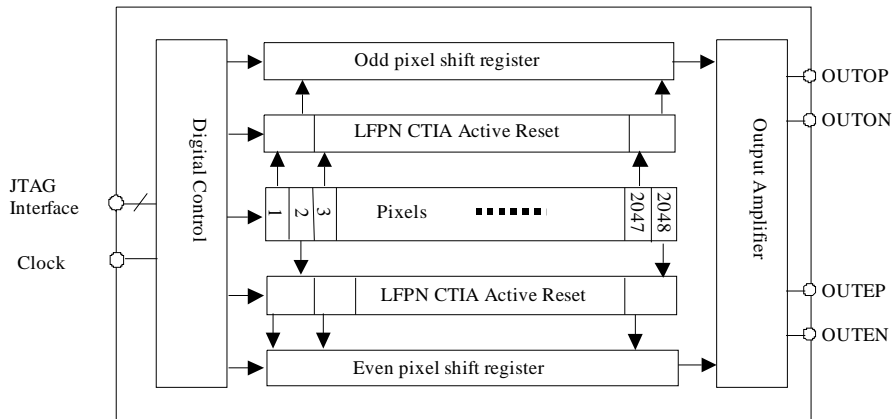
CMOS linear sensor

FAIRCHILD IMAGING now offers also a linear sensor based on the „Active Reset“-Technology (TM) developed by PDI. This sensor provides highest sensitivity, a very low dark noise and a pixel frequency of up to 80 MHz via two outputs. The sensor is suitable for high speed applications in industrial quality control or other areas of image processing.

	Designation	Pixel	Pixel size [µm²]	Data rate [MHz]	Sensitivity [V / (µJ · cm²)]	Remarks
	CMOS1421	2048	7 x 7	2 x 40	169	Very high linearity, 94dB dynamic, 85% fill factor CDS, Anti blooming, 2 outputs

The CMOS1421 can be used in two operation modes. In RDI mode the sensor can be read out while the integration continues. At a readout frequency of 38kHz the readout noise is only approx. 9 electrons. In MRDI mode, which allows a multiple readout during integration, the readout noise drops even below one electron at a line rate of 2.9kHz.

The CMOS1421 is used in the line scan cameras of the OWL series (please refer to page 5). These cameras are available in two different versions and are suitable for the industrial quality control.









Sensor architecture

TDI sensors

TDI sensors are e.g. used for scanning documents at very high speed, as it is for example needed for sorting postage letters. In comparison with standard line scan cameras the processing speed can be increased or the needed lighting reduced.

Another important application for TDI sensor is the surveillance from highly flying planes or satellites. Here the movement of the camera in the plane or satellite provides the movement of the image across the sensor. The only thing to do is to adjust the shifting of the individual TDI stages to the movement across the earth surface. By using suitable filters in front of the sensor, the recorded spectral range can be narrowed. Colour pictures can be obtained with three TDI sensors, which are parallel to each other, rectangular to the moving direction and which are equipped with filters for the three basic colours red, green and blue. By using special filters for the absorption lines of e.g. chlorophyll, the current state of the vegetation can be examined.


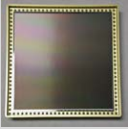
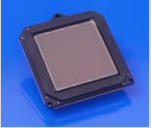
	Type	Pixel size [μm^2]	Pixel	TDI stages	Data rate [MHz]	Remarks
	CCD525	13 x 13	2048	24 32 48 64 96	4 x 25	High sensitivity, up to 44 kframes/sec, Horizontal anti blooming
	CCD5045		4096			High sensitivity, up to 23 kframes/sec, Horizontal anti blooming
	CCD5061	8,75 x 8,75	6144	128 64 32 16 8 4	4 x 20	up to 12 kframes/sec, suitable for bidirectional operation
	CCD8091		9216		6 x 20	
	CCD10121		12288		8 x 20	
	CCD21241		24000		64 32 8 1	

FARCHILD IMAGING supplies also TDI cameras for industrial use based on the CCD525 and CCD5045. Further details about these camera systems can be found on page 5.

For applications in aeronautics or space EURECA closely works together with the DLR (German agency for aeronautics and space) in Berlin Adlersdorf. So a competent partner is available for the integration of the products by FAIRCHILD IMAGING in respective systems. EURECA also offers a TDI test equipment for the CCD8091, which was developed by DLR and which can be used to test the TDI sensor for a certain application.

CCD matrix sensors

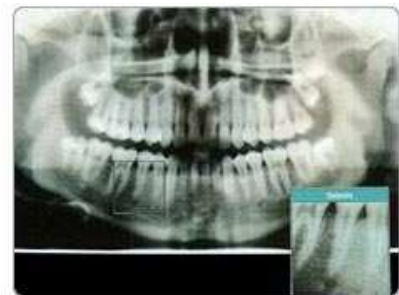
FAIRCHILD IMAGING produces a series of high resolution CCD matrix sensors with excellent technical data. Sensors from 1 MPixel up to a maximum of 83 Mpixel are available. In contrast to many sensors from other manufacturers the products by FAIRCHILD IMAGING provide rather large pixel in order to reach a higher full well capacity. In conjunction with their low noise these sensors are suitable for high end applications in science and medicine.

	Designation	Pixel	Pixel size [µm²]	Remarks
	CCD3041	2048 x 2048	15 x 15	Full frame, Multiport output (4 outputs), Full frame, 100% fill factor, Multi pinned phase option (MPP), Readout noise < 7 e- (at 250k Pixel / second), Dynamic: 10000 : 1, 3 phase „buried channel“ NMOS, Max. data rate: 5MHz
	CCD6161	4096 x 4096	15 x 15	100% Fill factor , 3 phase „buried channel“ NMOS, MPP mode, 4 low noise output amplifiers, Readout noise < 4 e- (at 50k Pixel / second), Data rate: 1MHz, Available as „frontside“ or „backside“-illuminated
	CCD595	9216 x 9216	8,75 x 8,75	Full frame, 100% fill factor, 8 outputs (four on each side), „Non MPP“ mode, extrem high resolution, Readout noise < 30 e- (at 4 x 25 MHz Pixel)

The CCD6161 is also available with an attached fiber optic or a scintillation screen for x-ray applications on request.

The matrix sensors by FAIRCHILD IMAGING can be used in many applications e.g.:

- Cameras for astronomical observations
- Star trackers for satellites
- Guiding systems for rockets
- Surveillance systems
- Taking medical and dental radiographs
- Industrial image processing
- Measurement applications in military, industry and science





CCD Sensors by FAIRCHILD IMAGING were often used in aerospace missions as e.g. Mars Observer, Cassini probe, Hubble Space Telescope, and many reconnaissance satellites. For such missions the sensors can specially be tested. Based on their own matrix sensors, FAIRCHILD IMAGING also supplies a series of complete camera systems for scientific purposes (please refer to page 7). Some of these cameras provide also a powerful peltier cooling, or a fiber optic.

CMOS line scan cameras

These cameras use an internal CMOS linear sensor with 2048 pixel (see page 2), which is based on the patented Active-Reset™ technology. This technology allows the production of CMOS image sensors, which can provide high data rates at a very low noise.

The cameras of this group are available in different versions regarding the integration times. In both cases the signal can be read out once or even several times, while the integration is going on. A rugged housing allows these cameras to be used in hard industrial environments also. By the standard lens adapter provided, a large number of lens types can be used.

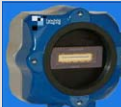



Designation	Pixel number	Digitization [Bit]	Data rate [MHz]	Remarks
 Owl CAM/CMOS-2KRDI.LS	2048	12	80	CameraLink; readout possible during integrating
 Owl CAM/CMOS-2KMRDI.LS				CameraLink; multiple readout possible during integrating

For use with these cameras EURECA also supplies suitable frame grabbers by MATRIX VISION. Together with these grabbers all drivers and libraries needed are supplied, in order to allow a quick and easy use of the cameras.

TDI cameras

The TDI cameras by FAIRCHILD IMAGING are based on the TDI linear sensors CCD525 and CCD5045 (please refer to page 3). Compared to common line scan cameras these products provide a high sensitivity. Main applications are e.g. sorting of letters, parcels or goods, as well as high speed scanning of documents.

Beside two models in rugged housings for industrial use, also a camera board available, which can be used to build up own camera systems.

Designation	Pixel number	TDI stages (selectable)	Data rate [MHz]	Remarks
 OSPREY CAM/CCD-2K.TDI	2048	96	100	anti blooming, CDS, programmable gain and offset, CameraLink or LVDS protocol
 OSPREY CAM/CCD-4K.TDI	4096			
 CAM8525-2K.TDI-ARRAY-BOARD	2048			Camera board for building own cameras, anti blooming, CDS, LVDS protocol, programmable gain and offset, OEM
 CAM8525-4K.TDI-ARRAY-BOARD	4096			

EURECA supplies a wide range of accessories as frame grabbers, lenses, filters and many more.

Matrix CCD cameras for scientific applications






To capture, image and analyze complex scientific image data FAIRCHILD IMAGING has developed a line of low-noise, multiport, cooled scientific cameras utilizing their own large area focal plane array technology (please refer to page 6).

The cooled cameras work at a sensor temperature down to -50° degree Celsius, which is achieved by an internal active peltier cooling. By this the noise is reduced significant, which increases the performance of the high end sensor types used even more. Some models also provide a scintillator for x-ray applications or a fiber optic window entrance, which allows e.g. the mounting to image intensifiers without losses of lights for low light applications.

At present there are available three different camera series:

- Condor: 6cm x 6cm CCD with different Fiber optics and scintillators, cooled
- Peregrine: high resolution frontside- and backside illuminated sensors, cooled

All cameras provide a high end readout electronic, which minimizes the signal noise also at high pixel frequencies. The readout of the cameras is made via several parallel outputs. The pixel size of all sensors are 15µm x 15µm.


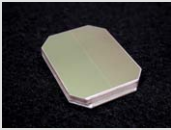
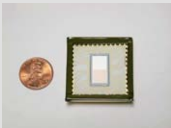

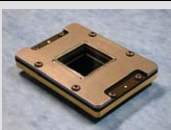
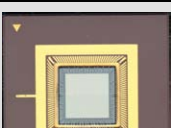



Designation	Pixel number	Data rate [MHz]	Readout noise [e-]	Digitization depth [Bit]	Readout frequency (multiport) [MHz]	Remarks
 Condor 486:90	4096 x 4096	4	<7	16	4	1:1 fiber optic, cooled
 Condor 486:135						1.5:1 fiber optic, cooled
 Condor 486:200						2.21:1 fiber optic, cooled
 Condor 486EF						
 Peregrine 3041	2048 x 2048	2	<12	14	2	cooled, front or back illuminated
 Peregrine-486	4096 x 4096		<7	16	4	

For decades FAIRCHILD IMAGING has remained dedicated to providing the highest performance optical imaging systems in the world. These scientific camera detectors have been used to image everything from stellar objects at the far reaches of the universe to the molecular details of biological structures.

Examples for other applications are electron microscopy, HTS (High Throughput Screening), analysis of micro arrays and micro titer plates, non-destructive testing methods, x-ray crystallography and x-ray inspections. Interference filters with high transmission and suitable lenses can also be supplied by EURECA. We advise you gladly in order to choose the best components.

Customized products

In many cases FAIRCHILD IMAGING solved problems in high performance applications by the development of customized products, which were optimized for the specifications needed. Here the long experience in developing sensors and handling x-ray scintillators, fiber optics, colour filters, micro lenses and backside-thinning was always of incredible advantage. The table below shows existing customized products, to reveal the range of what is possible. These products are, however, not commercially available. With the agreement of the original owner of the respective design, they can be used as a basis for new developments.

	Type	Pixel	Pixel size [µm]	Remarks
	CCD296	4096 x 132	45 x 45	4 chip hybrid, TDI as well as Full frame sensor, 4 parallel outputs, Multi pinned phased (MPP), Four phases buried channel NMOS, Fiber optic with scintillator
	CCD297	1600 x 1280	40 x 40	Full frame sensor, Multi pinned phased (MPP), Three phase buried channel NMOS, Fiber optic with scintillator
	CCD412	512 x 1024	15 x 15	Frame transfer sensor, Four output amplifiers, Multi pinned phased (MPP), Three phases buried channel NMOS, Space proved
	CCD417	512 x 512	15 x 15	Split frame transfer, Three phase architecture, 500 Frames per second, Fiber optic attached to the CCD sensor, With thermal heat sink mounted on flexible cable
	CCD424	1024 x 1024	21 x 21	Backside thinned, Four output amplifiers, Radiation tolerant, 200kHz readout frequency per output, Space proved
	CCD456	512 x 512	17 x 17	More than 1000 frames per second possible, Anti blooming, Two phases buried channel NMOS, Optional colour mode
	CCD447	2048 x 2048	15 x 15	Full frame, 100% fill factor, 4 output amplifiers (2x high speed, 2x low noise), Readout noise < 4 e- (at 50k Pixel / second), Max. data rate: 5MHz, supports 2x2 binning, Available as „frontside“ or „backside“-illuminated
	CCD485 mit Fiberoptik	4096 x 4096	15 x 15	Full frame sensor, Multi pinned phased (MPP), Attached fiber optic with scintillator, Three phase buried channel NMOS
	CCD85	4096 x 4096	15 x 15	For X-ray crystallography, High sensitivity, Fiber optic with scintillator, High readout frequency, Operation at low temperatures possible

Customized CCD image sensors

Not always a suitable sensor for a certain application can be found, which meets all specifications needed. If the budget of the project is high enough, a customized sensor can be developed and manufactured exclusively. EURECA offers this service for CCD sensors with the manufacturer FAIRCHILD IMAGING. A respective cooperation with a manufacturer of CMOS image sensors is planned for the near future.

In principle the customized production of a CCD image sensor is possible even for single pieces. There are, however, quite high research and development costs, which normally only makes sense for higher production volumes. If an existing design can be modified, the development costs can be reduced. However there are costs for producing the needed new lithographs. There is a minimum order volume of manufactured wafers in one production run. EURECA has all the knowledge and the tools to develop a new sensor design and to give an estimate of the technical specifications, which can be reached. After pre-configuration the design is optimized in cooperation with the manufacturer. The typical development time for a new sensor is about 24 months.

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