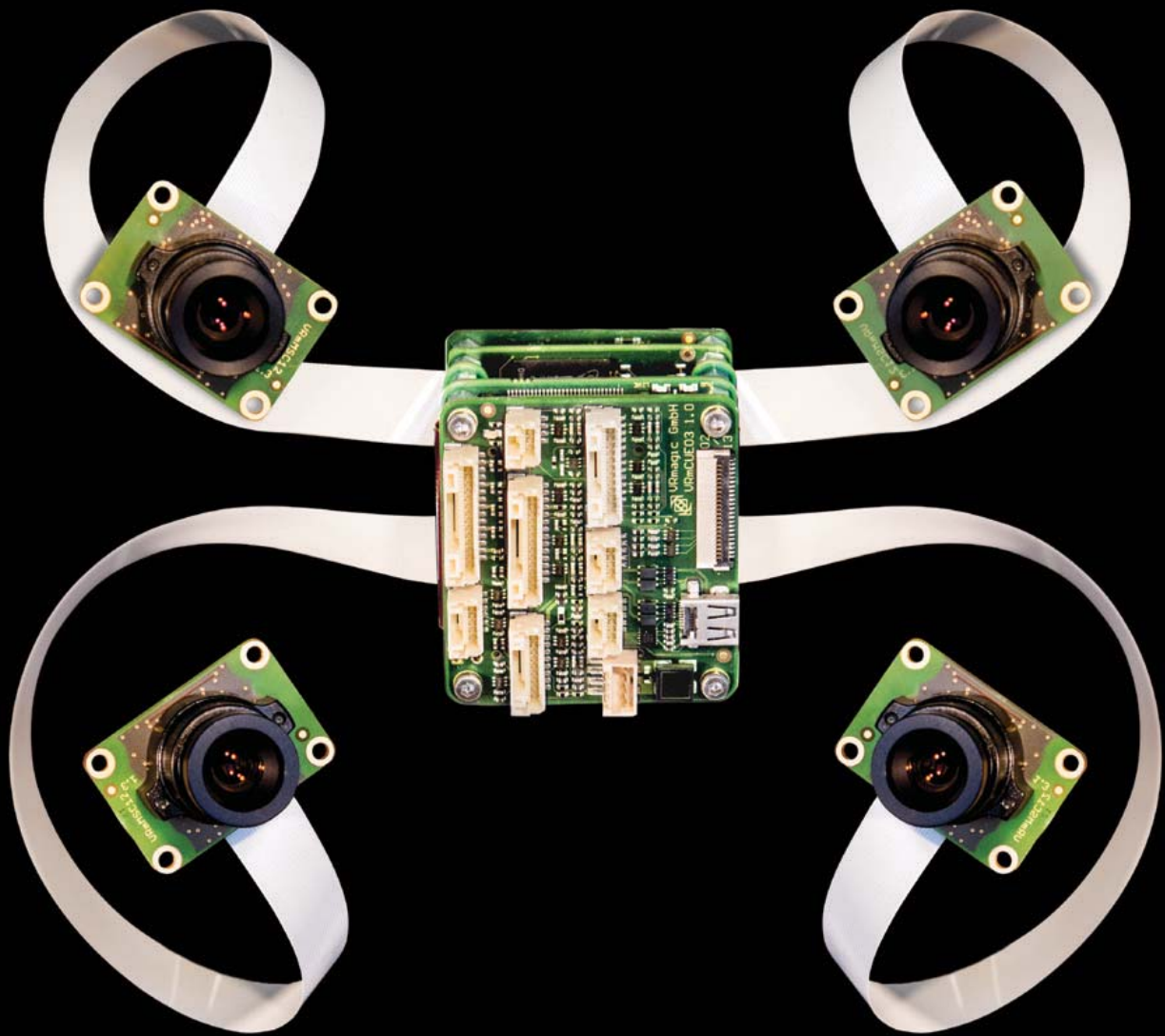


Easy!

D3 Intelligent Camera Platform



STEMMER[®]
IMAGING

Ease of Use

The D3 Intelligent Camera



The D3 Industrial Camera has a rigid aluminum body and industry-standard interfaces such as 24 V power supply and Power over Ethernet.

New Intelligent Camera Platform

The D3 is the latest, most advanced intelligent camera generation by VRmagic. The D3 platform was designed with usability, flexibility, and performance in mind.

Excellent Usability

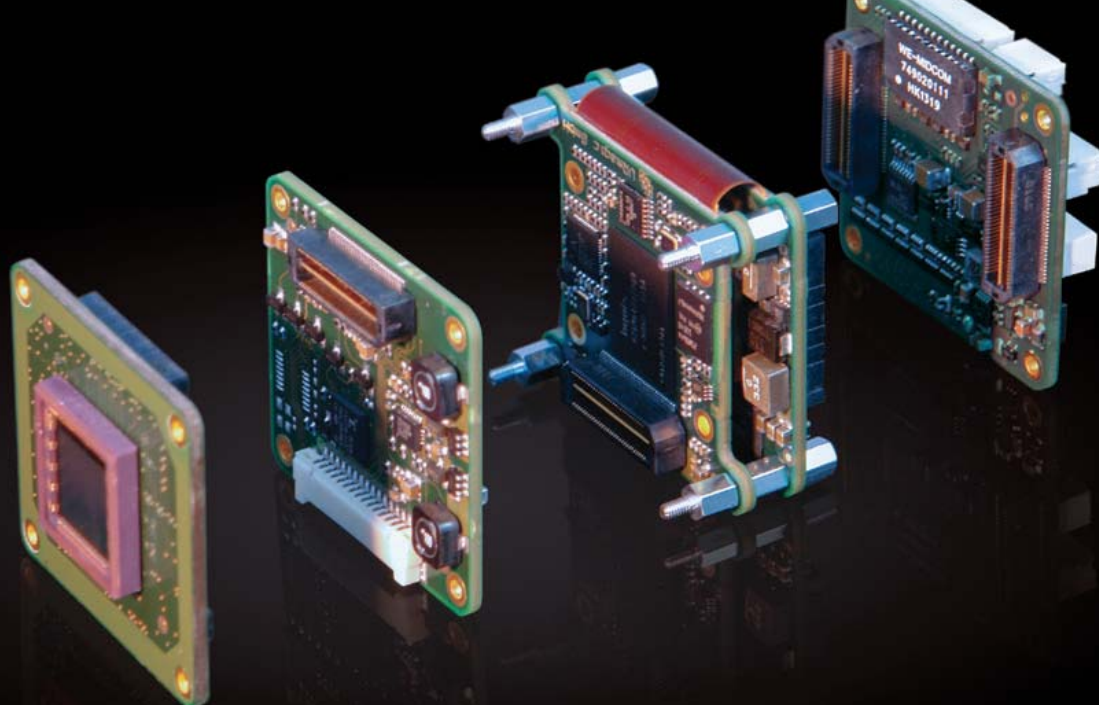
The D3 platform runs a wide range of embedded software and libraries, such as Common Vision Blox Embedded, EyeVision, or HALCON Embedded. This way you can easily take advantage of the latest, state-of-the-art machine vision algorithms. Additionally, the new Mono compatible .NET interface makes application development with the VRmagic SDK much easier. Software development for the D3 intelligent camera platform – that's ease of use.

Built-In Flexibility

The D3's embedded system provides users with a high level of flexibility by supporting a multitude of interfaces, such as Ethernet, USB, and GPIOs. Choose either a standard OEM interface board for compact systems integration or an interface evaluation board for convenient test and development. A version for industrial environments is also available. Depending on the business case, a custom interface board may also be a viable option.

High Performance

The D3 intelligent camera platform features a 1 GHz ARM® Cortex™-A8 Core with floating point unit (FPU) running Linux. A 700 MHz C674x™ DSP with FPU is at your disposal for computationally intensive algorithms. 2 GB DDR3-800 RAM with 6103 MB/s bandwidth and a Gigabit Ethernet interface ensure rapid processing and efficient transmission of image data.



Comparison of the D2 and D3 Intelligent Camera Platform

Intelligent Camera Platform	D2	D3
Operating System	Debian Linux	Ubuntu Linux
ARM Core and Frequency	300 MHz ARM9®	1 GHz ARM® Cortex™-A8
DSP Core and Frequency	600 MHz C64x™	700 MHz C674x™
ARM and DSP Instruction Type	Fixed point	Floating point (FPU) and fixed point
Cortex-A8 NEON™ Architecture	–	●
RAM	256 MB DDR2/333	2 GB DDR3/800
Memory Bus Width, Bandwidth	32 bit, 1332 MB/s	2 x 32 bit, 6103 MB/s
Flash Memory	512 MB	32 GB
Ethernet	Fast Ethernet (100 Mbit/s)	Gigabit Ethernet (1 Gbit/s)
Typical Ethernet Bandwidth	10 MB/s	40 MB/s
SD Card	–	●
USB Host / Device	● / –	● / ●
GPIOs	up to 13	up to 44
RS232 / RS485	● / –	● / ●
SATA	–	●
CAN Bus	–	●
JTAG	●	●
Real-time Clock (RTC)	–	●
Maximum Video Resolution	720p	1080p
S-Video	●	●
RGB888	●	●
HDMI	○	●
Audio in/out	○	●
Wake on LAN	–	●
Power over Ethernet	–	●
I2C	–	●
Watchdog	–	●
24 V operation	–	●



D3 Dual-Core Programming

Intelligent Camera with Ubuntu Linux Operating System

Image Processing on the Dual-Core Chip

The substantial processing power of the ARM processor is used to run the Linux OS as well as image processing tasks. The DSP is completely available for image processing. Both processors have a floating-point unit (FPU). Hardware codecs as well as various commercial codecs and open source algorithms are available for the DSP, for example the TI IMGLIB for basic image processing tasks. A free codec by VRmagic converts image data into various target formats, for example RGB565 or YUV.

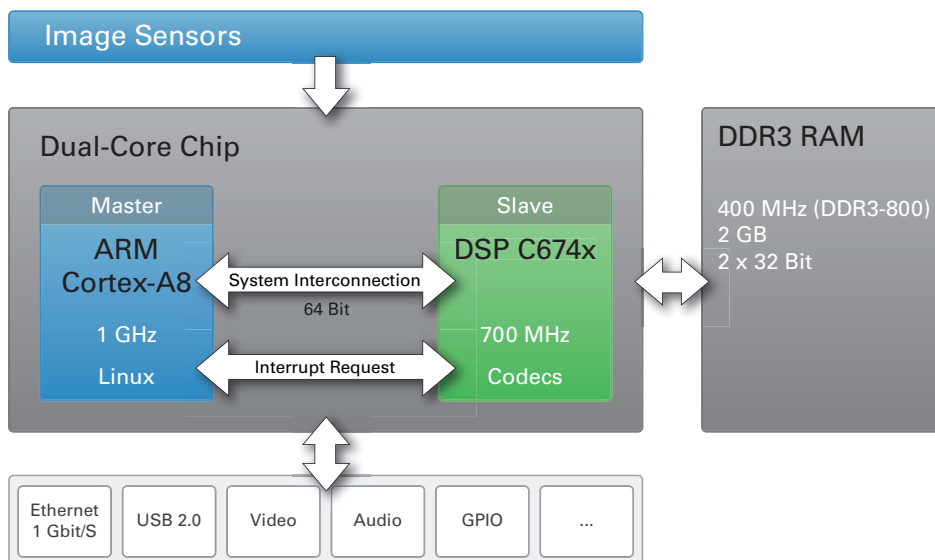
Extendable Linux Operating System

The D3 platform runs a customized Linux kernel. The root file system is taken from Ubuntu 12.04 LTS, which natively supports the instruction set of the Cortex-A8

(ARMv7, Thumb2) and its FPU (NEON). Additional components, such as web servers or NFS servers, can be easily installed using the Linux package repository. USB devices, such as Wi-Fi dongles, hard disks, or keyboards can also be used with the camera.

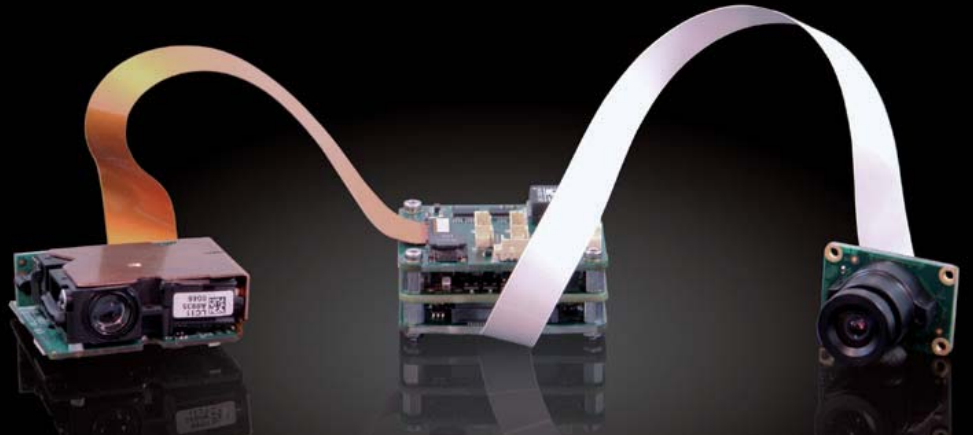
Convenient Application Programming

With a standard Ubuntu Linux operating system and full access to the ARM/DSP core, the D3 provides a convenient platform for programming applications with C/C++ or other programming languages. ARM software can be developed in standard integrated development environments under Ubuntu Linux. After cross-compiling, the software can be executed on the camera



« The D3 intelligent camera architecture

Machine Vision SDK and Libraries



Software Development for the D3 – It Doesn't Get Much Easier

Start Developing in 15 Minutes

The VRmagic Easy Installer automatically sets up a complete development environment with all required applications and toolchain elements. After only a few minutes, you can compile demos and start developing applications for the D3 intelligent camera platform.

CamLab Application

The CamLab application is part of the VRmagic SDK. It offers user full control over all sensor parameters via a graphical user interface. Tool tips indicate the respective API property for each parameter.

Free Demos with Source Codes

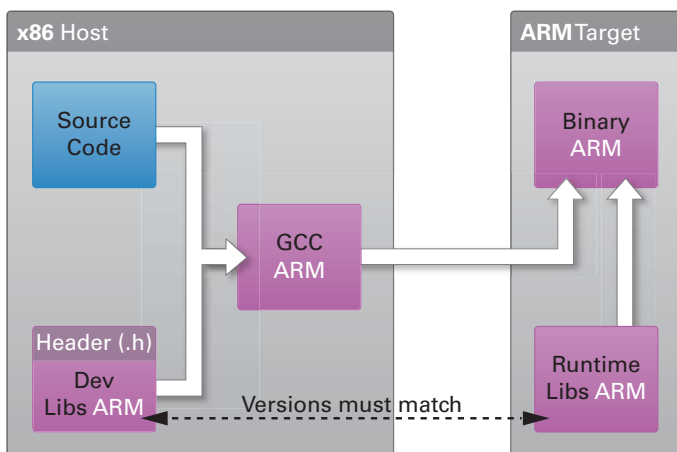
The following demos and sources are included in the SDK: Bayer/Grey to RGB565 converter on ARM or DSP, demo for integration of customer specific DSP codecs (JPEG, Sobel, and more), viewer for S-Video output (DirectFB and SDL), control of general purpose I/Os.

VRmagic SDK

The included VRmagic SDK contains an application programming interface (API), which offers full control over the camera and works with all VRmagic cameras and frame grabbers. This makes it possible to exchange devices without additional programming costs. The SDK also contains a VRmagic codec for the ARM and DSP, which converts image data into different target formats, for example RGB32, YUV, or GRAY.

Programming Libraries

The D3's floating point unit (FPU) allows a wide range of state-of-the-art machine vision libraries and toolkits to run on either the ARM or DSP cores. This lets you take advantage of numerous image processing algorithms. For example, develop a HALCON script on your PC and execute it directly on the D3 with HALCON Embedded – development for intelligent cameras has never been easier.



« Development process for the ARM: code is developed on an x86 PC using specific development libraries. After cross-compiling the code, the binary can run on the D3's ARM using the corresponding runtime libraries.

Camera Designs and Image Sensors



Multi-Sensor Camera

Up to four external plug and play sensor boards may be connected to the camera base unit using flex-foil cables. This design enables pixel-synchronous images from multiple positions and facilitates 3D applications.

Remote-Sensor Camera

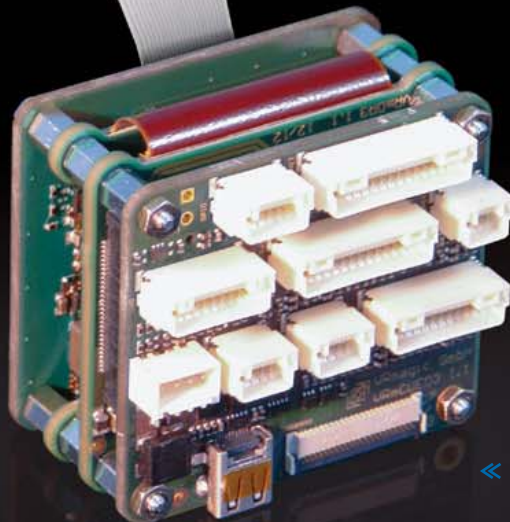
A single sensor board is connected to the camera base unit using a flex-foil cable or a round cable, making the camera perfect for narrow installation spaces.

Single-Sensor Camera

The sensor board is mounted directly onto the camera base unit, forming one compact unit. This is the most robust and cost-efficient camera design.

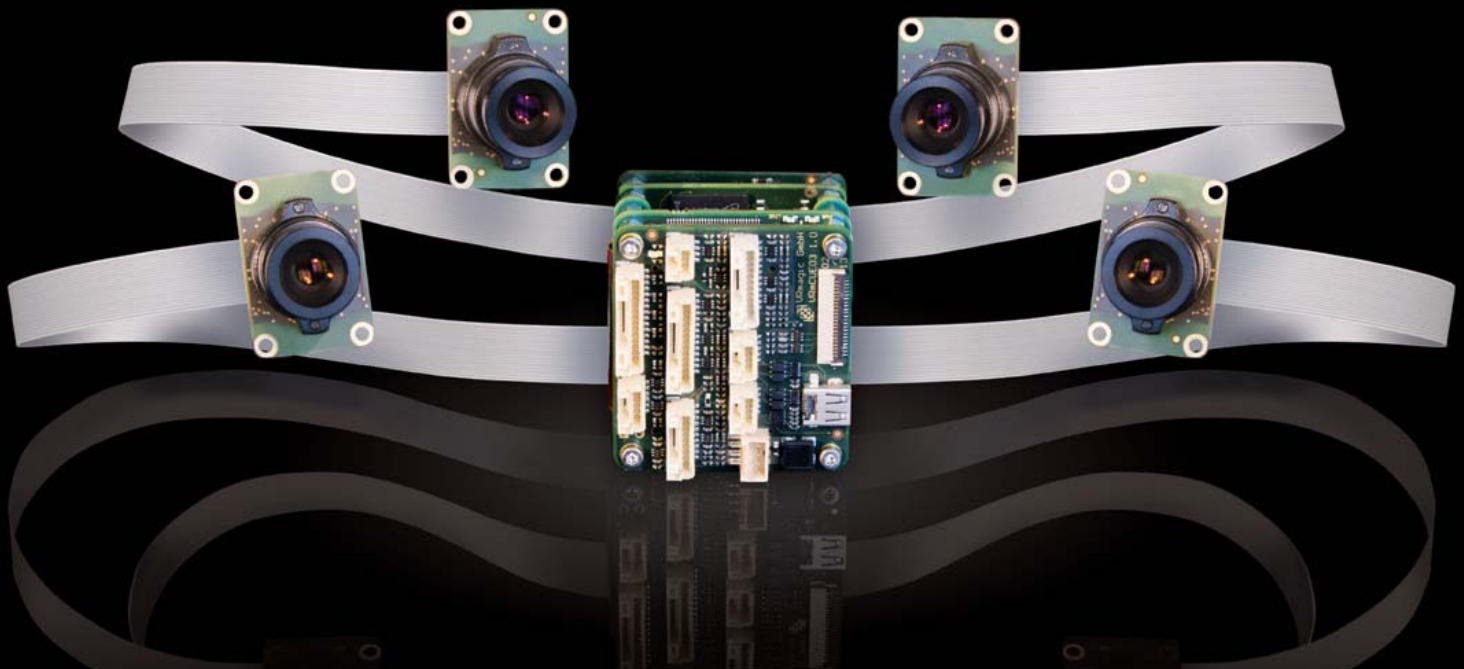
Analog Video Converter

Analog video converters convert PAL or NTSC cameras into a digital camera with the performance of the D3. This allows a step-by-step upgrade from analog to digital cameras.



« Left: D3 remote-sensor camera

Opposite page: D3 multi-sensor camera »

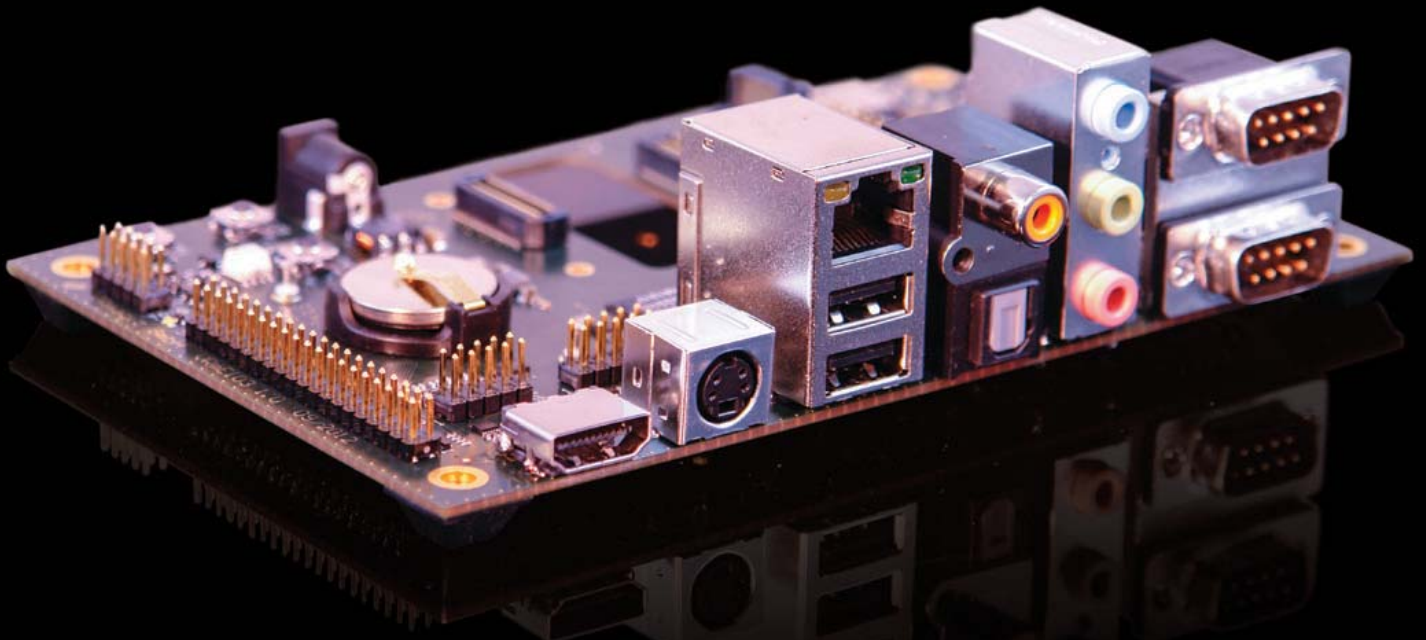


Available Image Sensors

Sensor ID	8			9			12			14		
Sensor Type	Aptina MT9T031			Aptina MT9M001			Aptina MT9V024			Sony ICX445		
Technology	CMOS rolling shutter			CMOS rolling shutter			CMOS global shutter			CCD interline transfer		
Color	●			–			●			●		
Monochrome	–			●			●			●		
Sensor Size [inch]	1/2			1/2			1/3 wide			1/3		
Resolution [px]	2056 x 1544			1288 x 1032			754 x 480			1296 x 966		
Pixel Size [µm]	3.2 x 3.2			5.2 x 5.2			6 x 6			3.75 x 3.75		
Bit Depth [bit]	8/10			8/10			8/10			8/10		
Available Camera Design	Single	Remote	–	Single	Remote	Multi	Single	Remote	Multi	Single	Remote	Multi
Min. Exposure Time [µs]	60	60	–	38	38	38	30	30	30	15	15	15
Pixel Clock [MHz]	5...48	10...48	–	5...48	10...48	26.6	13...27	13...27	26.6	36	36	26.6
Max. Frame Rate [Hz] *	13	13	–	30	30	16	70	70	69	22	22	16

Sensor ID	18			20			22			42		
Sensor Manufacturer	Aptina MT9M024			Aptina AR0134			CMOSIS CMV2000			CMOSIS CMV4000		
Technology	CMOS rolling shutter			CMOS global shutter			CMOS global shutter			CMOS global shutter		
Color	●			●			●			●		
Monochrome	●			●			●			●		
Sensor Size [inch]	1/3			1/3			2/3 ultra wide			1		
Resolution [px]	1280 x 960			1280 x 960			2048 x 1088			2048 x 2048		
Pixel Size [µm]	3.75 x 3.75			3.75 x 3.75			5.5 x 5.5			5.5 x 5.5		
Bit Depth [bit]	8/10			8/10			8/10			8/10		
Available Camera Design	Single	Remote	Multi	Single	Remote	Multi	Single	–	–	Single	–	–
Min. Exposure Time [µs]	22	103	187	56	86.75	156.6	44.3	–	–	44.3	–	–
Pixel Clock [MHz]	74.25	48	26.6	74.25	48	26.6	4 x 25	–	–	4 x 25	–	–
Max. Frame Rate [Hz] *	45	29	16	45	29	16	44 **	–	–	24 **	–	–

* This is the maximum value at full ROI with minimum exposure time. The actual frame rate depends on the pixel clock, sensor settings, and image format.
 ** With RLE image format



24 V Operation

The D3 intelligent camera can be operated with 24 V DC, which allows easy integration into industry applications.



Audio In/Out

The D3 has various interfaces for audio input and output: S/PDIF digital out (coaxial/optical), line out, line in, and microphone in.



CAN Bus

CAN bus is a multi-master broadcast serial bus standard designed for automotive applications.



Gigabit Ethernet

The Gigabit Ethernet interface offers high data transfer rates, enabling extra fast streaming of images.



General Purpose I/Os

Each general purpose I/O can be configured to be an input or output. Up to 44 GPIOs are available for your application.



HDMI

The HDMI output transfers uncompressed digital video data to any compatible monitor, projector, or TV.



I²C Bus

The I²C bus is a two-wire serial interface, which can be used to connect peripherals to the D3 platform.



JTAG

A JTAG interface makes it possible to connect real-time emulators (e.g. XDS510) for debugging purposes.



Power over Ethernet

Power over Ethernet allows the camera to obtain its power supply over the Ethernet cable, saving you time and money.



Real-Time Clock

The real-time clock keeps track of the current date and time while the camera is switched off.



RGB888

The RGB888 interface outputs image data in parallel 24 bit format.



RS-232

The UART allows serial communication via two ports: Serial0 for RS232 / console and Serial1 for RS232 / RS485.



SATA

The Serial ATA bus interface allows fast connection of mass storage devices such as hard disks and optical drives.



SD Card Reader

The SD card interface enables writing and reading of SD cards. The VRmEIO3 interface board features a microSD card slot.

Built-In Flexibility

D3 Interface Boards



SPI Bus

The SPI bus is a synchronous serial data link standard. Devices communicate in master/slave mode.



Status LEDs

The status LED indicates the camera system status, for example if the camera is booting up or ready for operation.



S-Video

The analog S-Video output transfers standard-definition video signals encoded on two channels.



Trigger and Strobe

The camera can be controlled by an external trigger (trigger in) and output strobe signals (strobe out).



High-Speed USB

The evaluation board features two high-speed USB ports. Both ports can be configured separately as USB device or host.



Watchdog

The watchdog timer triggers a certain action, for example a processor reset, if another component fails.



All of the listed interfaces are supported by the D3, however, some restrictions may apply. Please contact us for details. Opposite page: VRmEIO3 interface board. Right: VRmCUEO3 interface board.

More Than 20 Interfaces

Choose between a multitude of interfaces on different interface boards to get the most out of your application. Or order a custom interface board for production quantities.

VRmEIO3

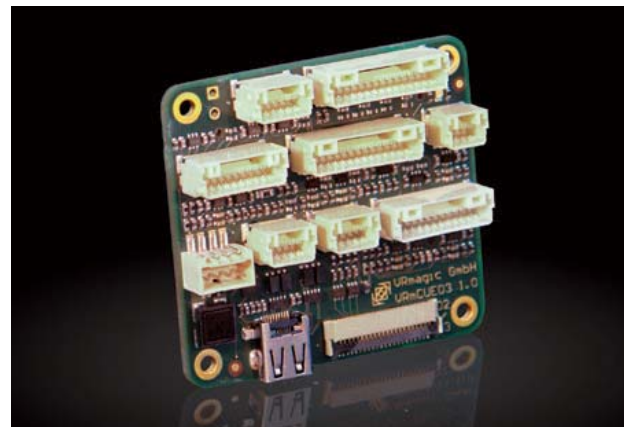
The VRmEIO3 interface board features all interfaces supported by the D3. Industry standard connectors and the large euroboard form factor allow convenient evaluation of every interface.

VRmCUEO3 and VRmCUEOS3 OEM

The compact OEM interface boards are equipped with miniature connectors, thus making them perfectly suitable for OEM applications. VRmCUEO3 features all D3 interfaces except SATA and JTAG. VRmCUEOS3 is identical apart from an additional SATA interface.

D3 Industrial Camera IC3 OEM

The IC3 OEM has an interface board that is optimized for industry applications and features a 24 V power supply, Power over Ethernet, and standard industry connectors.



Three Steps to Your Individual D3 Camera

1 Choose Design



Multi-sensor camera



Remote-sensor camera



Single-sensor camera



Frame grabber

2 Choose Sensor



Aptina sensors



CMOSIS sensors



Sony sensors

3 Choose Interfaces



Evaluation interface board



OEM interface board



Industrial interfaces



Custom interface board