

pco.1600 cooled digital 14bit CCD camera system

- excellent resolution (1600 × 1200 pixel)
- 14 bit dynamic range
- frame rate of 30 fps at full resolution
- image memory in camera (camRAM up to 4 GB)
- excellent low noise of $12e^-$ rms @ 10 MHz
- thermo-electrical cooling of -50° C vs. ambient
- standard interfaces (IEEE 1394, camera link)
- UV sensitive & color CCD image sensor available



pco.1600

This high dynamic 14 bit cooled CCD camera system comprises advanced CCD and electronics technology. With the new approach to integrate the image memory (camRAM) into the camera itself, it enables unmatched fast image recording with 160 MB/s. The system features thermo-electrical cooling (down to -50°C vs. ambient), an excellent high resolution (1600×1200 pixel) and low noise (down to $12e^{-}$ rms). It consists of a compact camera with an external intelligent power supply. The image data are transferred via customer selectable standard data interfaces to a computer (IEEE 1394 (“firewire”), camera link). The available exposure times range from $5 \mu\text{s}$ to 49 days (500 ns optional). This digital CCD camera system is perfectly suited for low light camera applications.

technical data

	unit	setpoint	pco.1600
resolution (hor x ver) ¹	pixel	@ normal @ extended mode	1600×1200 1648×1214
pixel size (hor x ver)	μm^2		7.4×7.4
sensor format / diagonal	mm^2 / mm	@ extended mode	12.2×9.0 / 15.2
peak quantum efficiency	%	@ 500 nm typical	55
full well capacity of CCD	e^{-}		40 000
linearity range of CCD output @ 40 MHz	e^{-}		40 000
image sensor			KAI-2001
maximum dynamic range	dB		70
dynamic range A/D ²	bit		14
readout noise	e^{-} rms	@ 10 / 40 MHz	12 / 21
imaging frequency, frame rate	fps	@ full frame	30
pixel scan rate	MHz		2×10 / 2×40
A/D conversion factor	e^{-} / count		2.1
spectral range	nm	normal UV sensitive	320..1000 200..1000
exposure time	s		$5 \mu\text{s}$..49 days (500 ns..49 days opt.)
anti-blooming factor		typical	>300
smear	%		0.01
binning horizontal	pixel		1, 2
binning vertical	pixel		1, 2, 4, 8
dark current	e^{-} / pixel·s	@ 20°C typical @ -20°C typical	0.5 0.01
region of interest	pixel	hor & ver	1, 2, 3, 4...n

technical data

non linearity	%	full temperature range @ 10 MHz	< 2
uniformity darkness DSNU ³	e ⁻ rms	@ 90 % center zone	< 20
uniformity brightness PRNU ⁴	%	typical	2
trigger, auxiliary signals		internal external	software TTL level
power consumption	W	typical maximum	24 40
power supply	VAC		90...260 (12 VDC optional)
mechanical dimensions camera (w x h x l)	mm ³		84x 66 x 175
mechanical dimensions power supply (w x h x l)	mm ³		135 x 51 x 195
weight	kg		1.8
operating temperature range	°C		+5..+40
operating humidity range	%		10..90
storage temperature range	°C		-20..+70
optical input			c-mount, Nikon f-mount
optical input window			fused silica
data interface			IEEE 1394, camera link
CE certified			yes
cooled CCD	°C	versus ambient temperature	Δ-50
cooling method			2 stage Peltier cooler with forced air cooling
interframing time (PIV mode)	ns		150

[1] horizontal versus vertical

[2] Analog-to-Digital-converter

[3] dark signal non-uniformity

[4] photo response non-uniformity

software

Camware software for camera control, image acquisition and archiving of images in various file formats, WindowsXP and later, 32 bit-dynamic link library (DLL) is available for user customisation and integration on PC platforms (software development kit - SDK), software is operational in either single mode or with built-in recorder functions, drivers for popular third party software packages are available (see website)

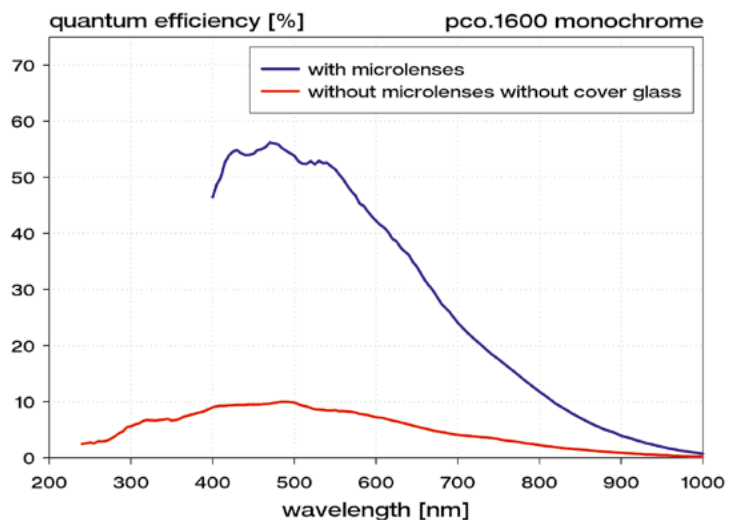
options

CCD image sensor in color & UV sensitive version
custom-made versions
camRAM available in: 512 MB, 1 GB, 2 GB & 4 GB

frame rate table [frames per second]

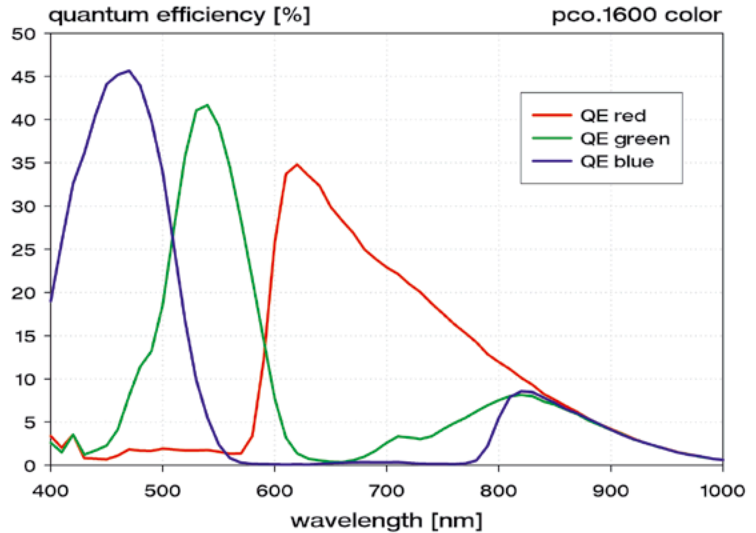
pixelclock used A/D converters	10 MHz 1 / 2	40 MHz 1 / 2
full frame	4.8 / 9.2	17.3 / 29.8
2 × 2 binning	9.4 / 17.7	32.4 / 53.4
2 × 8 binning	33.1 / 57.3	92.9 / 130.5
ROI 1280 × 1024 pixel	5.6 / 10.7	20.1 / 34.2
ROI 640 × 480 pixel	11.5 / 21.3	38.7 / 62.2
ROI 320 × 240 pixel	21.3 / 37.9	65.2 / 96.6
ROI 160 × 120 pixel	37.5 / 62.4	100.5 / 135.7

quantum efficiency



(KAI-2001 monochrome qe curves as measured by Kodak)

quantum efficiency



(KAI-2001 color qe curves as measured by Kodak)

areas of application

■ laser induced fluorescence ■ high resolution microscopy ■ luminescence microscopy ■ electron microscopy ■ fluorescence spectroscopy (up to NIR) ■ bioluminescence ■ chemoluminescence ■ low light level imaging ■ imaging of bio markers (e.g. green fluorescent protein, GFP) ■ time resolved spectroscopy ■ spray analysis ■ hydrodynamics ■ electrophoresis ■ absorption & luminescence spectroscopy ■ imaging of potential sensitive dyes (Neuroscience) ■ security ■ astronomy ■ combustion process analysis ■ gel imaging ■ fuel injection ■ scientific imaging ■ combustion imaging ■ spray imaging ■ piv imaging

contact

The Cooke Corporation
6930 Metroplex Drive
Romulus, Michigan 48174
USA
tel 248 276 8820
fax 248 276 8825
info@cokecorp.com
www.cookecorp.com

PCO AG
Donaupark 11
93309 Kelheim, Germany
fon +49 (0)9441 2005 50
fax +49 (0)9441 2005 20
info@pco.de
www.pco.de

pco.1600 product sheet 09/2005
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