



# The CCDelightful QSI 540wsg

*With its big chip and guider port, this camera delivers high performance and high elegance.*



## QSI 540wsg CCD Camera with Integrated Guider Port

Includes 4.2-megapixel Kodak KAI-04022 antiblooming CCD sensor with microlenses, internal mechanical shutter, off-axis guider port, internal five-position 1/4-inch filter wheel (filters optional), T-mount adapter and 2-inch nosepiece, T-mount or CS/C-mount guide-camera adapter, power supply, USB and guider cables, drivers for *MaxIm DL* and *CCDSOft*, and Pelican carrying case.

### WHAT WE LIKE:

- Compact, versatile design
- Low readout noise and dark current
- Very stable temperature control

### WHAT WE DON'T LIKE:

- Camera-control software not included
- No place to tie down cables

**U.S. price:** Starting at \$5,290  
Quantum Scientific Imaging  
[www.qsimaging.com](http://www.qsimaging.com)  
Sold by dealers worldwide

**Although relatively new to the astronomy market, Quantum Scientific Imaging has been building high-end CCD cameras for nearly two decades. The author's full-frame shot of the Moon shows the camera's field of view on the AT6RC telescope used for his testing.**



ing CCD cameras for other industries. Like many of its competitors, QSI builds cameras around Kodak sensors and provides drivers compatible with the most popular camera-control programs.

So how does QSI hope to stand out? The company's ads stress two factors: innovative mechanical design and uncompromising electronic performance. The former was evident the moment I first saw a QSI 500 Series camera at an astronomy convention last year. The CCD, its cooler, its electronics, a mechanical shutter, and a five-position 1¼-inch filter wheel were packed into an attractive octagonal housing barely 4½ inches (115 mm) across, 2½ inches deep, and weighing just 2½ pounds (1.12 kg). QSI vice president Kevin Nelson told me this was the company's "ws" body and mentioned two thinner, lighter versions that dispense with the filter wheel and shutter.

More recently QSI introduced the "wsg" body. A half inch thicker and 7 ounces heavier than the ws, it includes a pick-off prism and integrated off-axis guider port. Significantly, the pick-off prism is in front of the filter wheel, so the light from guide stars isn't dimmed by passage through the filters.

To find out if the personality of the 500 Series matched its good looks, *Sky & Telescope* arranged to borrow a 540wsg, featuring Kodak's 4.2-megapixel, 15.2-mm-square CCD of 2,048 by 2,048 pixels, each 7.4 microns square. (QSI has subsequently announced the debut of the 583wsg, with 8.3 million 5.4-micron pixels — the same chip as the Finger Lakes Instrumentation ML8300 reviewed on page 34 of last April's issue.)

The focal lengths of the telescopes I have access to at the Phillips Academy Observatory were not an ideal match for the pixel size of the QSI 540wsg. The rule of thumb is to put two pixels across a star's seeing disk, which in New England is rarely smaller than 2 arcseconds. Fortunately *S&T* also had an Astro-Tech AT6RC 6-inch f/9 Ritchey-Chrétien telescope on loan for testing, which is a good match. It was easy for me to piggyback it on Phillips Academy's 16-inch DFM Engineering telescope. The Astro-Tech's 1,370-mm focal length translates into 1.1-arcsecond pixels with the QSI 540, just right for the best nights I get — however rarely!

The QSI 540wsg comes in a custom-fit Pelican hard-shell case and includes all the adapters and cables needed to connect to a telescope with a 2-inch focuser, a computer with an available USB port, and an autoguider with a standard 6-wire RJ12 "telephone" connector. Ours also came with Astronomik Type IIc LRGB filters, a \$279 option.

QSI doesn't include software for camera control and image processing, though you can get Diffraction Limited's *MaxIm LE* for an extra \$99, or *MaxIm DL* for \$399, at the time of purchase. I already own the latest



The off-axis guider port uses a generous ½-inch-square prism and an adjustable focusing mechanism for autoguiders. Adapters are available for autoguiders with standard T mounts (shown attached) as well as CS/C mounts.

version of *MaxIm DL*, so that's what I used to control both the 540wsg and my Orion StarShoot Autoguider.

The QSI's pick-off prism is a generous half-inch square, well suited to the larger chips now standard in dedicated autoguiders like the Orion StarShoot. I never had any trouble finding a usable guide star. I'd place my target on the main chip, and if I didn't see a suitably bright field star on the autoguider chip, I'd just jog the telescope a little, and one would appear. This beats rotating the camera, which entails recalibrating the autoguider so it knows its new orientation on the sky.

Focusing the guide camera on first use requires a bit of patience and fancy finger work — you have to remove and replace it repeatedly between turns of the threaded guider-port focusing ring — but the instructions (supplied on a CD-ROM) are clear and easy to follow. And once it's done, you lock down the focusing ring with a set screw and never have to worry about it again unless you switch autoguiders.

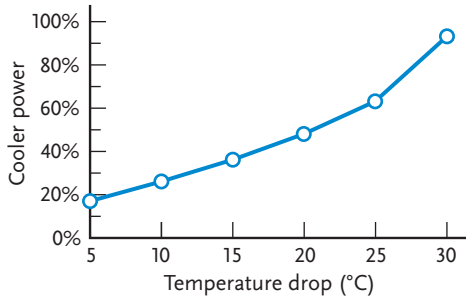
The 540wsg draws power from an included AC adapter that converts 90–240 volts to 12VDC. As with virtually every



Above: If you need additional cooling for the camera, QSI sells an optional, user-installed liquid heat exchanger and water circulating pump.



Despite its compact body dimensions, the QSI 540wsg includes a mechanical shutter and five-position filter wheel.



SOURCE: RICHARD TRESCH-FIENBERG

**During tests made with the ambient air between  $-5^{\circ}\text{C}$  and  $+5^{\circ}\text{C}$ , the thermoelectric cooler in the QSI 540wsg had no problem lowering the CCD's temperature by  $30^{\circ}\text{C}$  and holding it steady.**

brand of CCD I've used, the camera turns on when you plug in the cable. Why don't these devices come with on-off switches?!

With everything running, I had four cables dangling from the imaging system: power and USB for the QSI camera, and USB and RJ12 for the Orion guider. To avoid entanglements and accidental disconnections, I like to secure cables to the camera or telescope, so I would have liked to see a tie-down point on the QSI body.

When I started taking images with the 540wsg, I was at first confused by how clean they were. After all, I hadn't yet set up any image calibration — no dark frames, no flat fields. How could the images look so good? The answer is simple: QSI's electronics are nearly noise free!

Following the prescription in Richard Berry and James Burnell's *Handbook of Astronomical Image Processing* (Willmann-Bell, 2005), I measured the camera's readout noise to be a remarkably low 7 electrons per pixel. Furthermore, I literally couldn't detect any dark current in short exposures made with the chip cooled to  $-30^{\circ}\text{C}$  ( $-22^{\circ}\text{F}$ ). I had to make 10-minute dark frames to measure a fantastically low 0.006 electron per pixel per second. It's obvious that QSI's electronics squeeze every ounce of signal from the CCD, adding almost no noise or dark current and delivering the utmost in performance. This makes it an ideal camera for deep-sky and scientific imaging.

When it comes to making scientific measurements with a CCD camera, you'll like the QSI's thermal stability. It took only a few minutes for the camera to cool by  $30^{\circ}\text{C}$  from ambient temperature, and

once it reached the set point, it stayed there with not so much as a  $0.1^{\circ}\text{C}$  variation. This is critical for precision photometry of low-amplitude variable stars and exoplanet transits, where the target's brightness changes by less than 1%.

Given the elegance of QSI's camera design, the convenience and effectiveness of the off-axis guider port, and the high quality of the images, the 500 Series will be an excellent choice for many astro imagers. ♦

*S&T editor emeritus Rick Fienberg shuttles between his classroom at Phillips Academy in Andover, Massachusetts, and his roll-off-roof observatory in Danbury, New Hampshire.*



**The author tested the QSI 540wsg CCD camera with an Astro-Tech AT6RC Ritchey-Chrétien telescope piggybacked on Phillips Academy Observatory's 16-inch DFM Engineering classical Cassegrain telescope.**



RICHARD TRESCH-FIENBERG (2)

**The author acquired this 1-hour LRGB composite of the Orion Nebula, Messier 42/43, using images shot with the QSI 540wsg CCD camera and Astro-Tech AT6RC reflector. It includes ten 60-second exposures each (binned  $2 \times 2$ ) through red, green, and blue filters, and thirty 60-second frames (unbinned) through a luminance filter.**