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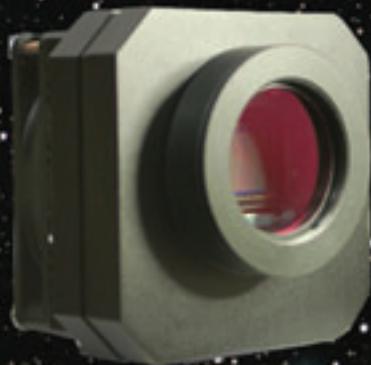


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# CCD Labs



**Q453-HR (QHY8)**



**Q285-M (QHY2 Pro)**

**Hitting the price/performance ratio on all cylinders!**

By Craig Stark

It's a great time to be an amateur astrophotographer. We have a dazzling array of equipment to choose from and performance at both ends of the price spectrum keeps getting better. While many of the names in the market are well-known to even someone with only a casual interest in astrophotography, there are a number of relative newcomers on the block worth noting. Two names you may not know but that are worth a look are CCD Labs ([www.ccd-labs.com](http://www.ccd-labs.com)) and QHY CCD Astronomy ([www.qhyccd.com](http://www.qhyccd.com)). Before covering two of their cameras here, a bit of history is in order.

William Behrens of CCD Labs (Wichita, KS) and Qiu Hongyun (Beijing, China) first began working together in the design of the SAC 10 camera for SAC Imaging. While SAC Imaging is no more, the SAC 10 enjoyed strong demand for its 3.3 megapixel sensor, good performance, and tight package. Several years ago, I was hired by SAC (Bill Snyder) to help test and assemble SAC 10 cameras and it was then that I got into frequent contact with both William Behrens and Qiu Hongyun. Their next creation, the Orion Starshoot Deep

Space Color Imager, was a very popular camera built by SAC imaging (and again, one that I had a lot of contact with, starting as an early beta-tester.) What both these cameras have in common is being designed to hit a sweet spot on the bang-for-the-buck curve. Neither was a "high end" camera, but both offered solid performance that was quite arguably better than what much of the competition was offering, and they were sold at a lower price.

Since this time, QHY has gone on to create a wide range of cameras and CCD Labs acts as a VAR (Value Added Reseller) for the cameras (a number of other dealers act as resellers or VARs as well, including Starizona in the USA). One camera, the QHY8, is sold through CCD Labs as the Q453-HR (formerly the Q8-HR) and a second, the QHY2-Pro (not to be confused with the entirely different QHY2), is sold through CCD Labs as the Q285-M. CCD Labs provides the cameras with additional capture and processing software, an install disk with a manual, assembles the cameras, does a full quality control check before shipping to customers, and seals the CCD

chamber following an argon purge to keep it nice and dry. Different vendors sell the cameras in slightly different formats, so it's worth checking with the vendors you're considering before making any final purchase decisions. By way of disclaimer, I should note that the supplied capture and processing software that augments the *AstroArt* and *Maxim* drivers is *Nebulosity* and that I am the author of *Nebulosity*.



## **Q453-HR: Overview**

The Q453-HR uses an APS-sized (23.4 x 15.6 mm), 6 megapixel (3032 x 2016, 7.4u square pixels), one-shot color CCD, the Sony ICX-453AQ. This pro-

## CCD LABS Q453-HR (QHY8) AND Q285-M (QHY2 PRO)

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gressive-scan chip is found in several Nikon DSLRs and in current versions of the Starlight Xpress SXVF-M25C (early versions of the M25C used an interlaced version sensor). These two other cameras provide a nice basis for comparison when considering the Q453-HR. Unlike the Nikon DSLRs, this is a dedicated CCD imager. Whereas DSLRs typically have 12-bit A/D converters (and 4096 shades of gray for representing the brightness in each pixel), dedicated CCDs like the Q453-HR and the SXVF-M25C have 16-bit A/D converters (with 65,536 shades of intensity). They are also cooled to reduce dark current, don't use optical or electronic low-pass smoothing filters, and are tuned for low noise rather than high speed. They can't take photos of the kids (unless they're really far away) and tend to cost a lot more too. The street price on a Nikon D40 is about \$500 as of this writing, while the Q453-HR costs \$2100 and the SXVF-M25C costs \$4195. A slightly stripped-

down version of the Q453 is currently set for release for about \$1500.

The current version of the Q453-HR comes in two pieces. The camera head itself is about 3.5 x 3.5 x 2 inches and weighs less than 1.5 pounds. This is light enough for any focuser you'd consider for use in configurations like Starizona's Hyperstar. The camera head has a USB2.0 port for connecting to your computer and a power input port (mini-DIN connector). T-threads are provided for attaching to your telescope.

The second piece is a control box (3.5 x 2.75 x 1) that creates the various power supplies needed by the camera from a 12-volt input. It has a small display, several control buttons, and the electronics needed to control the two-stage thermo-electric cooler (TEC) inside the camera. This second box, dubbed the DC102, is a fairly recent addition to the camera and earlier versions of the camera (including my own)

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did not require it or had a more basic supply dubbed the DC101. The DC102 has a number of features, some of which are quite obscure (e.g., being able to read out or set the current pulse-width modulation of the power supply feeding the TEC). Some are clearly more compelling. With the DC102 version comes temperature regulation, allowing the user to pick a set-point and ensure that darks and lights are taken at the same CCD temperature (set-point can be adjusted on the box itself or via your camera control software). With either control box, the camera requires a hefty 4 amps at 12 volts.



### Q285-M: Overview

The Q285-M uses the same monochrome, 1.4 megapixel (1360 x 1024, 6.4μ square pixels) Sony ICX-285AL sensor found in a wide range of popular cameras (e.g., Meade DSI III Pro, Atik 16HR and 314L, and Starlight Xpress H9). There is a reason this CCD has been very popular among astrophotographers: it is the largest of the monochrome Sony CCDs, sports their ExView HAD technology for extended IR response, has insanely low dark current, has very low read noise, and has a nicely flat spectral response in the visible spectrum with a QE that is just starting to drop at the critical Ha line. While the largest of the monochrome Sony CCDs and while several years ago it might have been considered large, its 10.2- x 8.3-mm sensor is about a quarter the area of the APS-sized Q453-HR. Pricing on the camera at time of this writing is \$1499, priced

between the uncooled Meade DSI III Pro and the cooled cameras using this chip.

Like the Q453-HR, the Q285-M comes in two pieces. The camera head itself is just a bit smaller than the Q453-HR, but weighs just a touch more. The same DC102 control box is used and provides the same temperature regulation for the two-stage TEC inside the camera head. Like the Q453-HR, the USB connector is on the camera head itself and a fan covers the back of the black anodized aluminum case.

### Bench Tests

I have reported data from a full suite of bench-tests on the Q453 elsewhere (“DSLR vs. CCD: A Bench Test Comparison,” *Astrophoto Insight*, December 2007, *Special Hardware Issue* Volume 3, Issue 7) and a full bench test of the Q285-M is forthcoming. Here, I will provide a synopsis of the cameras’ performance, however. The Q453-HR turned in a reasonable read noise value of 12 e- RMS, while the Q285-M turned in a very respectable value of 7 e- RMS. Raw read-noise values tell only part of the story and an examination of the bias frames turned up a few noise signatures in the cameras. The Q453-HR was overall quite clean, showing only a touch of very low frequency, horizontal fixed-pattern noise in an analysis of the average row and in 2D FFTs of individual frames. This was not present in the 2D FFT of the read noise frame (single frame vs. a stack), which looked almost perfect, demonstrating that the noise in each individual frame would be canceled well with things like bias subtraction or dark subtraction (a highly desirable property for your noise). While signature of the noise is nicely clean in this respect, there is noticeably more noise here than in my current reference standard, a QSI 520.

The Q285-M had a quite different signature. It showed almost zero fixed pattern noise in the average row FFT (only marginally worse than the QSI). It did, however, show evidence of diagonal band-

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## CCD LABS Q453-HR (QHY8) AND Q285-M (QHY2 PRO)



The shot shown here of M101 is a one-hour test taken with an 8-inch scope (Vixen R200SS, 20 frames at 3 minutes each) with no filter.

ing in the 2D FFTs. While difficult to see visually in the bias frames, there were clear frequencies that shone through in both the single frames and in the analysis of the read noise. The latter showed that, while the frequency of this noise is stable, the location of it in the image is not, meaning that it will not be removed by simple bias or dark subtraction. The good news is that it was variable enough that in modest sized stacks, the noise averaged out to a smooth bias frame. This does mean that either a solid stack of bias or dark frames should be used or that this step should be skipped entirely, instead relying on bad pixel mapping or standard-deviation based (sigma-clip) stacking employed for best results.

Dark current on both cameras was negligible, clocking in with numbers like 0.1 ADU (.024 e-) per second on the Q285-M when set to -10C (and even this rating is skewed by the hot pixels and doesn't reflect how low the current is for typical pixels). Dark current is such a non-issue on these cameras that you are better

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off doing bad pixel mapping or standard-deviation based stacking methods (and potentially bias subtraction) than doing dark subtraction, in my opinion. This advice does limit the usefulness of regulated cooling on these cameras, as it would suggest that you are fine simply running the cooler flat-out and dealing with the few hot pixels.

### Hands-on

I have had a lot of time to use the Q453-HR in its one-box variation as I was the first customer to buy one from CCD Labs and certainly one of the first to buy one in the world (a fringe benefit of being the software developer is that, since you need to have a camera to write the software, you sometimes have a good shot at being first in line). Sadly, my talents are such that others have really shown what the Q453-HR/QHY8 can do and a search on any of the popular Internet sites will turn up some absolutely breathtaking images. This is a big sensor that covers a

wide swath of sky and does so with very nice sensitivity. While the noise is a touch higher than some cameras, the noise is well behaved and the final shots can be simply gorgeous.

The shot of M45 in the background at the start of this article was taken with a 4-inch Borg refractor and comes from a total of 2 hours worth of data (40 frames at 3 minutes). In a recent shot of mine of the region around M81 / M82 with the same 4-inch Borg and a little over 3 hours of data, I pulled out 13 other small galaxies, such as the magnitude 15.3 UGC 5449 and UGC 5336 (which, by the way, are not candidates for the best non-Messier DSO targets). This is going quite deep for a one-shot color camera on a 4-inch scope, especially considering the size of chip and price-point. Overall, I'm very pleased with the camera and would easily buy it again.

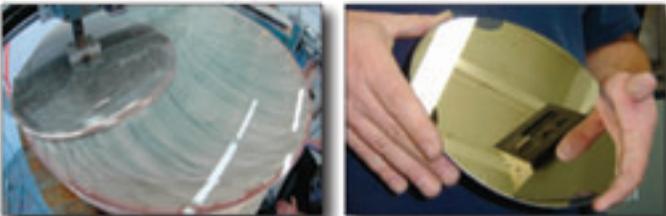
While I have not had the same amount of seat-time with the Q285-M, the work I have done with it has shown it

to be a fine performer. The shot **shown on page 46** of M101 is a one-hour test taken with an 8-inch scope (Vixen R200SS, 20 frames at 3 minutes each) with no filter. Having spent a lot of time with one-shot color cameras, I must admit feeling a nice jolt of excitement as the first few images came up on the screen, undimmed by the color camera's filters and with the nice boost provided by the ExView HAD's sensitivity and the camera's low noise. Pre-processing of the images consisted only of applying a bad pixel map. No smoothing, cropping, or local tools were applied to hide any camera defects as the Q285-M put up a very clean stack that was easily stretched.

Have a good look at the Q453-HR and Q285-M from CCD Labs. I've had a lot of cameras here on the test bench and these entries are hitting the price/performance ratio on all cylinders, offering up some very stiff competition in this part of the market, performing like they should cost a lot more than they do. 



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