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GY-HD100

JVC, \$6,295 (including 16 X Fujinon lens) Three-Chip 720p HDV Camera

BY ADAM WILT

SCORE
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Pros:

Lightweight, shoulder-mount camera has great ergonomics. HDV recording in 720p24/25/30, and 24p and 30i DV. High-resolution images, and minimal aliasing. Interchangeable lens. Excellent focusing aids. Extensive picture adjustments. XLR inputs and dual headphone jacks. Robust construction. Correct 7.5 percent setup options, 100 percent white clip.

Cons:

Camera shoots, but can't record, 50p and 60p. Split-screen effect sometimes visible. MPEG-2 codec artifacts occasionally noticeable. No Y/C output. No HD-to-SD down-conversion on 1394. No 25i DV mode.

Bottom Line:

The HD100 is a pleasure to use and makes excellent pictures—if you can live with its quirks. Its 30 fps maximum capture rate isn't for fast-action sports, but its true progressive images are crisp and scalable. Codec oddities mean off-tape monitoring is required for serious work. True 24p without resolution loss: great for film-outs.



above: The HD100 is the most compact shoulder-mount camera with interchangeable lens that I've seen.

JVC's first ProHD HDV camcorder sports a 16 X Fujinon lens and 1/2-inch full-resolution (1280 x 720) progressive-scan CCDs. The HD100 has a compact shoulder-mount design that's surprisingly comfortable to use, fully adjustable peaking and three-color focus assist, XLR mic/line audio inputs with phantom power, and a rich set of image-manipulation controls. Every aspect of it has been tuned to the needs of camera operators; although

it works as an NLE feeder, it's minimalist in playback, without single-frame or slow-mo functions.

The camera runs at 60, 50, or 48 fps, but the transport records only 30, 25, or 24 fps. Both 720p30 and 720p24 play back as 720p60, with frame-doubling for 30 fps and 2:3 pulldown for 24 fps source clips. It also frame-doubles 720p25 to 720p50 during playback. You can select JVC's Motion Smoothing to combine two camera-captured frames into one



above: In progressive imaging, 4:2:0 chroma is equally detailed in H and V directions, without the jagged and nasty chroma edges seen in interlaced 4:2:0. Chroma keying 4:2:0 720p is a lot easier to do than chroma keying 4:2:0 1080i.

for recording, or use a slower shutter speed for more natural motion blur, but if you're used to shooting 60 fps, the JVC's playback may seem to stutter.

Controls and handling

The HD100 is the most compact shoulder-mount camera with interchangeable lens that I've seen. The body is so light it has an extendable foot on the front to keep it from tipping over when a lens is attached, and the camera's 6.9-pound weight rides easily on the shoulder. Hang a larger battery on the back (I got 45 minutes from the stock battery, but I'm told I was lucky; many operators add Anton-Bauer bricks) and you might wind up holding down the front of the camera instead of supporting it.

The LCD viewfinder adjusts laterally and rotates 90 degrees downward and 180 degrees upward. The comfortable shoulder pad slides 2 inches fore and aft. The low-slung body affords excellent rightward visibility.

The HD100 comes with a 16 X, 5.5–88 mm Fujinon HD zoom. It's a real ENG-style lens with smooth, repeatable mechanical controls and a fully variable zoom rocker. It's not an internal-focus lens but its front ring and filter threads don't rotate. Near focus when not in macro is just over 3 feet. Macro is

enabled by sliding a switch against spring tension, so there's little chance of engaging it by mistake.

The lens can be replaced with Fujinon's \$12,000 13 X wide-angle zoom with an impressively wide 3.5 mm or a 1/8- to 1/2-inch lens adapter.

The camera's front offers the zebra on-off switch, also used for skin detail, and the auto white balance button. Zebra is variable from 60 percent to over 100 percent.

The right side has two XLR inputs with switches for line or mic level, 48-volt phantom power, and channel allocation; an SD card slot for storing camera setups; the tape-loading door, which lacks a window to show whether a tape is loaded; and AV I/O. JVC has smartly avoided proprietary connectors and offers standard jacks, so you won't be stuck in the field with no way to monitor pix and sound. Three RCAs provide analog component or composite output. Line-level audio is on a 3.5 mm stereo mini-jack; JVC supplies a mini-plug-to-dual-RCA cable, and you can buy similar cables at any electronics store. JVC uses a 6-pin FireWire jack, not the flimsier 4-pin jack used on other cameras. DC power connects to a small side jack, and the battery pack snaps into the rear of the camera.

The left side starts with the power

switch at the bottom, along with another start-stop push button. Two three-position toggles handle gain and white balance: the gain toggle has a flat, sharp blade while the white balance's is smooth and rounded, so you can find them by feel. Rotary controls provide audio leveling with orange LEDs to warn when auto-level control is selected (thanks, JVC). The controls are well-placed, with a small nubbin between them so you don't bump one control while twiddling the other.

A built-in ND filter provides two or four stops of attenuation. A thumbwheel selects shutter speeds and a push button cycles through operational and status displays (including an uncluttered mode). If you depress the button with a longer push, you'll bring up the camera's extensive, well-organized menus. Three user buttons allow control customization. You can use either buttons or the thumbwheel to navigate menus. Format lamps show whether HDV or DV is being recorded.

A Focus Assist push button lets you switch viewfinder and LCD to black and white with sharp focus shown by red, green, or blue detail. If you prefer a traditional peaking control, you can use a conical dial to choose the exact amount you'd like. Both modes work very well, making the HD100 the easiest low-cost HD camera to focus—all the more impressive because both LCD and EVF resolve only about 250 TVI/ph (TV lines per picture height) horizontally, and half that vertically. Another conical dial changes viewfinder brightness, and a flat dial adjusts monitor volume. The conical pots have a wobbly feel to them but work smoothly, and they're striped with glow-in-the-dark paint.

Like any proper camera, the HD100 lets you see zebra and peaking (or Focus Assist) at the same time. Zebra is active during playback so you can check exposure after the fact.

A 3.5-inch flip-out LCD occupies the rest of the left side. Behind it are

push buttons to change its brightness and toggle between camera and VCR modes, as well as auto and manual audio gain, and timecode selection switches.

The carrying handle—nearly as long and tall as the camera body itself—has an accessory shoe, another Focus Assist button, and a start-stop button. The rear sports the removable monitor speaker, which plugs into one of two 3.5 mm stereo headphone jacks. Finally there's a camera that provides monitoring both for camera operator and soundperson!

Beneath the speaker are switches to select monitoring source and whether the EVF or LCD is illuminated when the LCD is open. There's a switch to select full-auto shooting mode, and, under a delicate plastic cover, VTR transport buttons. These buttons are the only controls that feel cramped, as the speaker impedes access somewhat. It's good that you can detach the speaker or slide it up after loosening

its thumbscrews. Overall the camera exudes a comforting sense of solidity and robustness.

Formats and frame rates

The HD100 records 720p at 24, 25, or 30 fps. The camera itself runs at twice those rates (unless slow shutters are selected), so you'll see smoother motion while shooting rather than during playback. Normally the camera records every other frame, but JVC's Motion Smoothing menu option retains a defocused version of the previous frame and blends it with the current one. On playback the effect is convincing, but still frames will show double imaging. Or you can choose a shutter speed equal to the frame rate (like $\frac{1}{24}$ at 24p); the camera drops to the recording frame rate and you'll get more motion blur, and what you see while shooting is what you get on tape.

The camera has stepped shutter speeds from $\frac{1}{4}$ of the frame rate (i.e., $\frac{1}{60}$ for 24p) to $\frac{1}{10,000}$. Variable

shutters—like Sony's Clear Scan and Panasonic's Synchro Scan—are available, but not below the camera's fundamental frame rate, so the slowest variable shutter in 24p mode is $\frac{1}{48.11}$. Step mode shutters go from $\frac{1}{24}$ to $\frac{1}{48}$. If you want $\frac{1}{32}$, you're out of luck. There's no image degradation in slow shutters the way there is with interlaced cameras.

Progressive SD (480/60p and 576/50p) may be shot in HDV, but there aren't many editing systems out there that deal with these formats. Still, they're one way to get full frames of video at 50 or 60 Hz frame rates. The camera also shoots DV: The NTSC model (HD100U) records 30i, 24p, and 24p Advanced Pulldown (2:3:3:2 cadence), while the PAL model (HD101E) captures 25p and 25i.

During recording, the camera outputs what it's shooting: 720p, 480p, 576p, or 480i. During playback, it can cross-convert HDV recordings to 1080i, 720p, or SD, but DV is always output at native resolution. Unplugging the PB cable switches the Y output to composite mode, but there is no Y/C connection. If you're monitoring in SD and don't have component connections, you either monitor in monochrome using Y only, or in blurry composite color complete with dot-crawl.

There is no format conversion across FireWire. If you shoot 720p, you'll capture 720p HDV; there is no DV down-conversion in the camera. Most NLEs don't yet have the ability to capture JVC's 24p HDV natively, but users report good results with Final Cut Pro and AJA Kona LH cards for analog capture with real-time 24p extraction.

Picture performance

The camera uses three $\frac{1}{2}$ -inch, 16:9 native HD CCDs with a full 1280 samples per scanline, matched to 720p HDV's recorded resolution of 1280 x 720. In E-E and off tape, the HD100 shows a clean, pleasing picture with more usable horizontal resolution and



above: In a side-by-side test (actually top and bottom), wide-angle lockdowns of shaded foliage moving in a gentle breeze showed smooth motion in Sony's recording, whereas blocks of leaves in HD100's pictures tended to sit in place for a few frames and then jump slightly to their new positions (as the jumps tended to happen synchronously, several times a second, I'm guessing that they mostly jumped on I-frames).



above: There's a slide switch for the built-in ND filter, providing two and four stops of attenuation. A thumbwheel offers shutter speed selection, and a push button cycles through operational and status displays (including, thankfully, an uncluttered display) or, with a longer push, brings up the camera's extensive and well-organized menus. Three user buttons allow some control customization and can be used to navigate the menus if you prefer not to use the shutter wheel. Format lamps show whether HDV or DV is being recorded.

less aliasing than the 1080i Sony Z1; there was detail out to almost 700 TVL/ph with minimal aliasing beyond.

HD sensitivity is identical to the Z1, about 1.5 to 2 stops less than most current 1/2-inch SD cameras, but in SD, the HD100 recovers a full stop. Noise is somewhat more visible at 0 dB than on the Z1, but at +18 dB the HD100 looks quieter. Vertical smear is only slightly more evident than on the Sony. Highlight handling is clean and hot skin tones are beautifully rendered.

Wide open (f1.4) the lens is a bit soft at extremes of focal length, and f4 gives better sharpness (go much beyond f5.6 and diffraction limits set in, a limitation of 1/2-inch 720p chips). There's some portholing at 40 mm, cured by stopping down to f2.8, and f4 is necessary at 88 mm. Focus breathing is noticeable. Lens-induced chromatic aberration is less apparent than on the Z1, and is minimized between 10 mm and 40 mm.

There's a directionally color-fringed bokeh, with green light going up and magenta down as focus is pulled far, vice versa with focus pulled near. In fairness, many cameras show a similar if less pronounced effect.

The HD100 offers plenty of

adjustments. The Camera Process menu, in particular, offers more control over image rendering than what's available on almost any comparable camera. You can select from a wide range of Detail settings (including Off) and fine-tune detail frequencies and V/H detail balance. You can vary Master Black level by over 30 percent. You have three settings each for black stretch and compress. They vary shadow details by as much as +/-8 percent, with the effect tapering off gradually up to the 75 percent level. An auto-knee kicks in around 90 percent and higher; you can select manual knee from 80 percent to 100 percent.

You can let the camera allow levels up to 108 percent or clip the picture at the 100 percent broadcast-legal limit, a feature normally found only on cameras costing several times as much. The JVC's 7.5 percent setup option (for 480i output) applies the setup to the analog outputs only, leaving the digital black level at 0 percent, the way it *should* be. Few cameras in this price range handle this option properly.

The Advanced Process submenu opens up even more options. Cinelike mode provides quick access to cine gamma and cine matrix. With Cinelike

off, you can choose gamma and matrix separately. Gamma can be Standard; Cinelike, which steepens the contrast below an inflection point around 35 percent and flattens it above that level; and Filmout, a smooth curve with midtones depressed (50 percent levels in Standard gamma appear at 25 percent in Filmout). You can tweak the gammas by +/-8 percent at their midpoints.

The color matrix offers Off, a rather desaturated look; Cinelike, with a boost along the red-yellow/blue-cyan axis; and Standard, which further amplifies the R-Y axis, especially the green-cyan colors, which are quite strong on the HD100. Don't like the stock matrices? You can separately vary the gain of the R, G, and B axes by as much as 2.5 x, and rotate them up to +/-15 degrees. If you're trying to match the HD100 to a Sony, you can tweak all of the reds to look a bit orange, without affecting blues and greens.

It's almost anticlimactic to mention that you have an overall chroma gain control, can vary the white point along both red and blue axes, and can set the skin tone detail correction color with its own submenu.

The HD100 stores two setup files internally and more on removable SD cards, so the effort you put into crafting a look can be backed up and transferred between cameras.

Recording

The camera records 720p HDV with a six-frame GOP at 19.7 Mbps. Progressive images are easily scaled up or down, or converted to interlace, so 1080i and 480i/p images generated from the JVC's 720p recordings look very good. In progressive imaging, 4:2:0 chroma lacks the jagged, nasty edges seen in interlaced 4:2:0. Chroma keying 4:2:0 720p is much easier than chroma keying 4:2:0 1080i.

JVC's codec captures all of the detail of the image and does a good job distributing compression artifacts across space and time, minimizing their visibility. Subjectively speaking, I'd say it does as well as the Sony 1080i codec

does on many scenes.

However, JVC's codec appears to have a higher threshold for intra-GOP change detection than Sony's; in a side-by-side test, wide-angle lockdowns of shaded foliage showed smooth motion in Sony's recording, whereas the JVC's leaves tended to sit in place for a few frames and then jump slightly to their new positions. The effect only occurred for small, subtle motions in low-key parts of a visually complex picture. If I panned the camera, zoomed in closer, or even went handheld, the problem went away. The vast majority of my shooting showed no such lazy motion, but it's something to watch out for in the shadows.

I also saw a couple of cases where the codec improperly rendered images: Phantom echoes of several contrasty details briefly appeared 21 pixels left of their sources during periods of underexposure. However, I was unable to replicate these echoes when I tried.

The HD100 also records DV, of course. I shot material at 30i and 24p (advanced pulldown), and the HD100 recorded clean DV pictures at both frame rates. Final Cut Pro had no problems controlling the camera in both HDV (30p only) and DV modes, and it treated the JVC's advanced pulldown just like Panasonic's, extracting it on the fly.

The split-screen effect

JVC splits the HD100's CCDs down the



above: In normal operation, the camera records every other frame, but JVC's Motion Smoothing function retains a faint, defocused version of the previous skipped frame and blends it with the current one for recording. On playback, the effect is fairly convincing, but still frames pulled from the tape will show the ghost of the skipped frame.

middle: Each side runs at half the clock speed otherwise required, saving power and reducing heat. The two halves essentially work as separate chips—with separate adjustments. The camera automatically adjusts both halves to match, but if one side doesn't track the other exactly, you'll see a split-screen effect—half of the image has a slightly different black level, black balance, and/or gamma from the other half.

Under certain conditions, the right side of my test camera's picture was up to 1 percent brighter and greener in the shadows than the left side. In the vast majority of scenes I shot, I couldn't see the effect, but it is there in some low-key, high-gain footage. It occurred seemingly at random, and was most visible on defocused flat backgrounds and in darker areas with significant green content (human skin, unfortunately, has significant green content).

JVC suggests white-balancing the camera, letting it warm up, and changing iris, shutter, picture content, or illumination. I didn't find these suggestions to be uniformly helpful, aside from changing picture content—which means changing the scene.

The general consensus seems to be that some (mostly early) HD100s show a noticeable split-screen effect while most do not. If there was ever an argument for buying a camera in person from a full-service dealer, this is it: You'll want to check out the exact camera you buy before you buy it, to see if its split-screen effect is a showstopper.

Is this a fatal flaw? It will be for some. For me, it means that one HD100, #15031658, can't be trusted at high gain settings, although it's normally fine at 0 dB. The HD100 does too many things too well to reject the entire camera based on one defect—unless that defect keeps you from doing your job.

Conclusion

The JVC GY-HD100 is the best-



above: Focus Assist lets you switch the viewfinder and LCD to black and white with sharp focus indicated by a red, green, or blue detail signal. The HD100 also has a traditional peaking control.

handling, easiest-to-focus, low-cost HD camera I've used. It's the only 720p camera in its class with interchangeable lenses. It has more image tweaks than anything short of the Canon XL H1. It does a fine job of 24p in both SD and HD. Its true 1280 x 720 CCDs make beautiful, detailed images.

On the other hand, it won't record HD at 60p, only 30p and 24p. Sports shooters may spurn the HD100 while digital filmmakers snap it up.

Its codec appears to have some problems with subtle motion and low light. And on some cameras the split-screen effect can be problematic. Theoretical perfectionists may dismiss it for its quirks, while pragmatists seek it out for its unique capabilities. I can say I was sorry to see it go when my time with it was over. ■

Adam Wilt spent last year developing award-winning broadcast software (www.omneon.com/news/awards/2005_STARAward.html), but promises to spend more time on production this year.