BY RAY FURLONG*

More On Troubleshooting Camcorder Zoom Lenses

LAST MONTH, WE BEGAN OUR LOOK AT TROUBLESHOOTING CAMCORDER ZOOM LENSES BY LOOKING AT HOW A MODERN ZOOM LENS WORKS. THIS MONTH, WE'LL TURN OUR ATTENTION TO SOME REAL-LIFE SERVICING PROBLEMS AND HOW to solve them. We'll start out with a look at the camcorder's iris mechanism. (Note, while the specific systems discussed here are used in Hitachi camcorders, essentially similar systems are found in units from other manufacturers.)

Problems With The Iris

The camcorder lens has an iris diaphragm that is opened and closed to control the amount of light reaching the sensor, thus controlling the exposure. As shown in Fig. 1, a Hall-effect device mechanically connected to the iris motor monitors the iris opening and provides an accurate feedback of the opening size. The opening size is called the *f*-stop and is assigned a number (*f*1.2, *f*1.4, *f*1.8 . . . *f*11, etc.) that relates to the ratio of the focal length of the lens to the diameter of the lens opening.

A lens with a given *f*-stop number will always allow the same amount of light per unit area to strike the sensor regardless of the focal length of the lens. In video cameras the iris opening is not as round as in film-type cameras. As a result, a specific iris opening will equate to a specific *f*-stop, and the Hall-effect sensor will produce a voltage (F-DET) that corresponds to the *f*-stop. This voltage will range from 3 volts down to 1 volt. A typical calibration graph is shown in Fig. 2.

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Let's go back to Fig. 1 for a moment. It is a functional block diagram of the iris-drive and -control circuits. A digital microprocessor inside the camera creates a pulse width modulated (PWM) iris-drive signal. That signal is fed to the iris-drive amplifier, which smoothes the voltage before it is applied to the iris motor. The duty cycle of the PWM signal determines the size of the iris opening. The higher the duty cycle, the more the iris opens. The lower the duty cycle the less the iris opens. As the iris moves, the Hall device connected to the motor produces a voltage. That voltage is fed through three amplifiers to produce the F-DET voltage that tells the microprocessor the status of the iris motor movement.

As the iris closes (*f*-stop increases) the voltage produced by the Hall-effect sensor decreases. The calibration graph in Fig. 2 shows that a small change in the F-DET voltage results in a relatively large change in the *f*-stop. To counteract

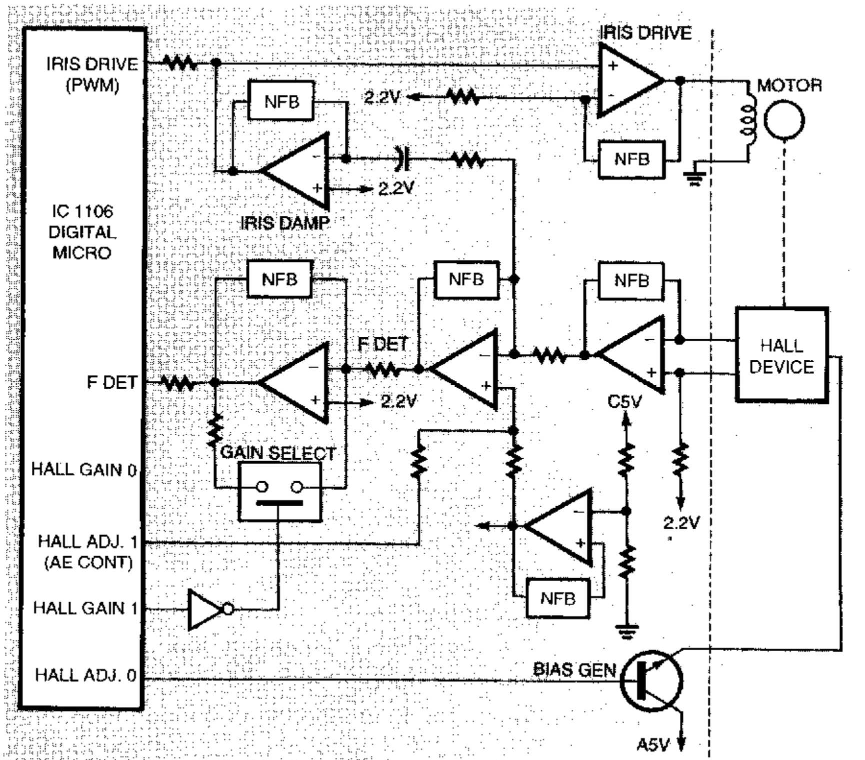

FIG. 1—AS SHOWN IN THIS BLOCK DIAGRAM of the iris drive circuit, a Hall-effect device is mechanically connected to the iris motor.

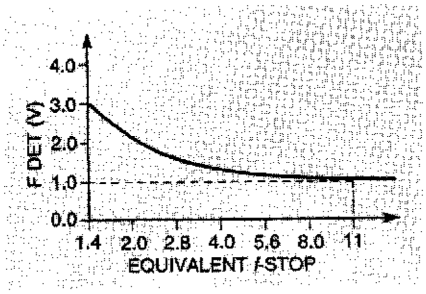

FIG. 2—THIS CALIBRATION CHART shows how the F-DET voltage corresponds to the camera *f*-stop.

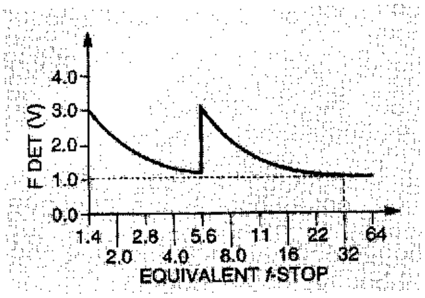

FIG. 3—HERE'S THE SAME CHART used in Fig. 3, but this time showing the effect of the gain-up circuit.

that problem a gain-up circuit brings the voltage back up to 3 volts and restarts the curve. The gain-up circuit is controlled by the Hall gain 1 output from the microprocessor. Notice that there is also a Hall gain 0 in the block diagram. Some earlier camcorders have a two-stage gain-up circuit. The second stage in those cameras is controlled by the Hall gain 0 output.

Figure 3 is similar to Fig. 2. It shows the effect of the gain-up circuit. Note that the range of *f*-stops has increased dramatically for a given range of F-DET voltages. That increased range allows better calibration of the iris, especially when used in conjunction with the electronic shutter

The braking portion of the motor circuit that controls excessive movement is called the *iris damp*. It prevents the violent opening and closing of the iris under bright light conditions. A negative feedback loop is derived from the Hall device, and that feedback is added directly to the iris drive PWM output to provide that protection.

Shutter Troubleshooting

The shutter in a video camera/camcorder does not use mechanical parts to shutter the incoming light. The sensor "sees" incoming light all the time. To change the shutter speed of a video camera the sensor must be read at specific time intervals. Since video is a frequency-based function, and frequency is based on time, the standard read time for a sensor is 1/60 second (NTSC format). The faster the sensors are, the faster the shutter speed. The most common shutter speeds for camcorders are 1/60 (standard), 1/120, 1/180, 1/250, 1/500, 1/1000, 1/2000, 1/4000 and 1/10,000th of a second.

Shutter speeds of 1/250th second and higher are not in sync with the 60-Hz line frequency of household AC voltage. Therefore, they are a problem during the iris and shutter alignment procedure. During every AC cycle, fluorescent lights used in conventional light boxes go on and off twice, producing a lighting frequency of 120 Hz (2 × 120 Hz = 240 Hz). That represents only a 10-Hz deviation from the 1/20th second shutter speed. That means that the sensor can sometimes read the incoming light at the off-time of the fluorescent light, and adjust to produce a darkening of the video image. As the iris is calibrated, the shutter speeds automatically change and the sensor will sometimes be read during the off-time of the fluorescent lamps in the light box. That can cause an error in the alignment of the iris calibration.

To prevent such errors, a special light box, that has a high-frequency switching ballast, must be used. Since the normal frequency of a high-speed switching ballast is around 32 kHz, the sensor is no longer reading during the off-time of the light box. At such a high frequency, there is virtually no off-time that even the highest available shutter speed of the camcorder can see.

In modern camcorders the shutter speeds are automatic, but not all of the shutter speeds mentioned are available in all models. An automatic function (Auto Exposure or AE) works in conjunction with the iris to automatically select the best shutter speed. That system works as follows: The microprocessor looks at the F-DET voltage to eval-

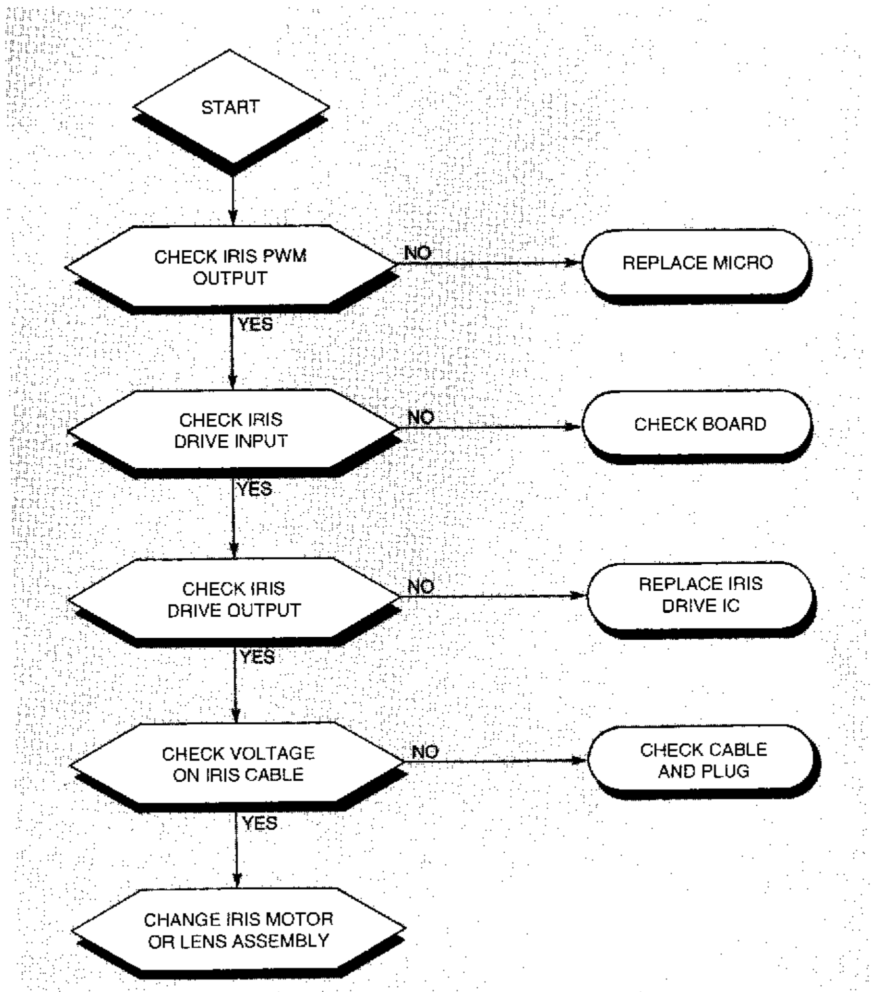

FIG. 4—THIS IRIS/SHUTTER troubleshooting chart presents a step-by-step procedure that simplifies the task of isolating a defect.

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HARDWARE RED ALERT

Last month I mentioned problems friends of mine had been having with the Seagate 43400N, a 5¼ 3-GB SCSI hard drive available for around $350. I also have one, but at that point had had no trouble.

Since then, however, I have had a few "incidents." The machine that contains that drive functions as the server for my network. The server started crashing, not often, but with gradually increasing frequency. Of course it never happened when I was around to try to glean some diagnostic symptoms. Then one day it happened while I was using it. I immediately opened the case, and found that the drive was extremely hot. That case happened to have a second fan, fortunately mounted almost directly across from the drive. After allowing things to cool down, I spliced the fan into a power cable, hooked things back up, sealed the case, and have now gone several weeks without incident. But I will be replacing that drive as soon as cash flow allows.

That's all for now. Until next time, you can stay in touch by e-mailing me at jkh@acm.org. EN

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uate the position of the iris and selects the appropriate shutter speed. It also controls the Hall-effect device and the F-DET voltage through outputs Hall adj 0 and Hall adj 1.

Troubleshooting the iris/shutter circuit is simple. Start by aiming the camera at something dark and observe the shutter setting and the F-DET voltage. Increase the light and check to see if the shutter speed and F-DET voltage increase. Follow the flow chart in Fig. 4 for the exact procedure to isolate the defect.

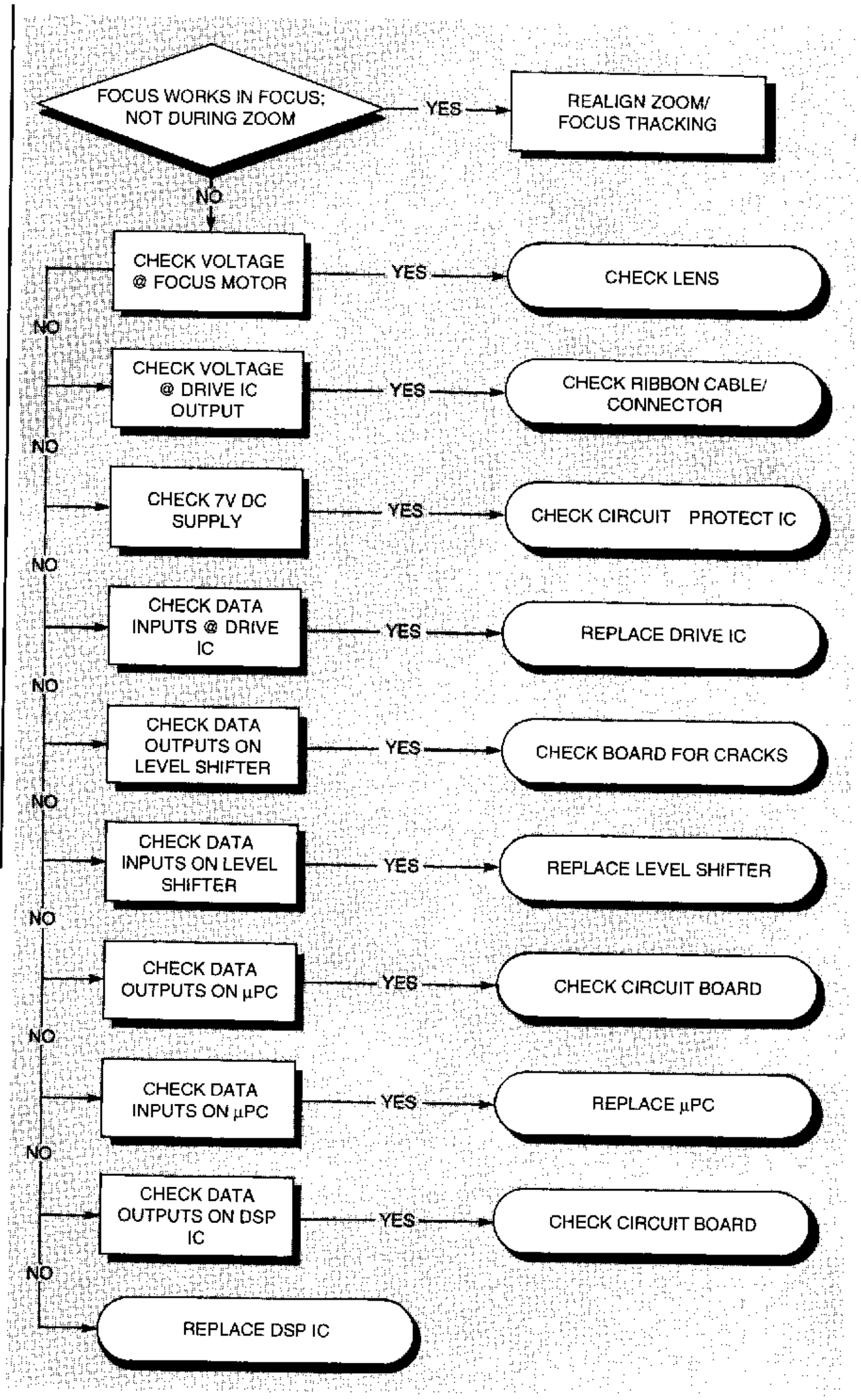

FIG. 5—THIS FLOW CHART for troubleshooting the zoom lens in camcorders begins by evaluating the output of the focus procedure.

Troubleshooting The Zoom/Focus Drive

At the end of last month's installment, we discussed the zoom/focus drive circuitry. In troubleshooting any electro-mechanical device, the first step is to isolate and identify the origin of the defect. In a camcorder-lens system, that means that we must first determine if the fault is in either the electronic or the mechanical systems. To do so we must carefully evaluate the systems involved. For example, does the focus operate only during a focus operation and *not* during a zoom operation? If so, the problem likely lies with the zoom/focus tracking alignment.

The troubleshooting flow chart in Fig. 5 outlines a proven fault-isolation process. Note that it begins by evaluating the output of the focus procedure—the voltage applied to the focus motor. That single step effectively isolates the mechanics of the assembly. Now the process continues as we methodically work our way back through the control circuitry as well. As the zoom and focus circuits are almost identical, you can use the same procedure to isolate defects in the zoom circuitry.

That concludes our look at servicing camcorder zoom-lens systems. We hope that you found it helpful. Look for similar troubleshooting tips and hints in future installments of this column. EN