Eye Tracking System Instruction
Manual

Model 501 - Mobile
Head Mounted Optics
with Mobile Electronics Package
(Addendum to Model 501 manual)
**Convention Notes**

1. All user keyboard responses and commands are indicated by underlining.

2. `<ccc>` denotes use of the keyboard key labeled ccc.

3. All eye tracker prompts appearing on the screen are in bold letters.
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INTRODUCTION AND SYSTEM DESCRIPTION

The Model 501 - Mobile system is designed to allow a subject wearing head mounted eye tracker optics to walk about without any physical tether to the environment. The eye tracker control unit is carried on a specially configured backpack along with camera electronics units, a miniature VCR, and a video transmitter. The system is temporarily connected to a PC and to an eye monitor during subject setup and calibration. After calibration these components can be disconnected, and the subject is then free to walk about. The video image from the head mounted scene camera, with superimposed point of gaze (POG) cursor is both recorded on the pack mounted VCR and also transmitted to a stationary receiver and monitor. Power is provided by a battery belt pack. The system is shown schematically in Figure 1.

Figure 1. Schematic showing head mounted eye tracker configured for mobile (non tethered) operation.
The standard “501-mobile” system consists of the following:

- Head band (or helmet) mounted eye camera optics module (HMO) and color head mounted scene camera (HMSC) [as described in the model 501 manual];

- Back pack equipped with
  - Series 5000 - port control unit. All connectors and their functions are the same as those described for the standard series 5000 control unit; however the unit measures only 10” x 8” x 2.125” and weighs only 4 lbs. The connectors are distributed over both the front and rear panels rather than just the rear pane. The switch for selecting head mounted (HMO) or pan/tilt optics is located on the rear panel rather the bottom cover as on early versions of the standard unit.
  - Video transmitter
  - 8 mm Video Cassette Recorder (PAL version includes 12 VDC to 8.4 VDC power converter)
  - Associated Cabling

- 12 VDC, 65 WH, Belt battery pack containing 5 battery modules and a junction box.

- DC power supply for series 5000 control unit (for use instead of battery pack only when mobile capability is not required) [as described in the model 501 manual].

- Adapter cable to allow connection of DC power supply to Belt battery pack junction box (allows battery power and power supply power to be swapped without shutting down system).

- Overnight charger module for the battery pack.

- Eye tracker interface PC (“Controller”), with serial cable for connection to the series 5000 control unit [as described in the model 501 manual].

- 9 inch black and white eye monitor, with BNC video cable [as described in the model 501 manual].

- 9 inch black and white scene monitor with sweep reverse switch, with BNC video cable [as described in the model 501 manual].

- Video receiver with DC power module.

System interconnections and backpack configuration are shown in Figures 2, 3, and 4.
Figure 2. Model 501- mobile system interconnections. Dotted lines show cables that are only connected during subject set up and calibration.
Figure 3. Interconnections for system configured with high speed eye camera.
Figure 4. Rear view of back pack with model 501- mobile eye tracker equipment installed
SYSTEM OPERATION

Battery Belt
Check the battery belt charge as follows. Plug the battery packs into one of the input connectors on the side of the battery belt junction box (see Figure 2 or 3). Turn on the status monitor switch (on the belt junction box) and observe the LED display. Green indicates full charge. Red, at the other end of the scale, indicates almost full discharge, followed by blinking red and finally by LED shut off when full discharge is reached. A fully charged battery pack should run the eye tracker system for at least 2 hours.

If the battery pack is discharged (or if it is not fully charged and a full charge is desired), use the charger module. First plug the charger into an AC outlet and verify that the red LED on the charger face plate is lit. Then plug the battery pack power output cable (normally connected to the belt junction box input) into the jack on the charger module face plate. Recharge from full discharge should take 12 - 14 hours. Do not leave the battery pack connected to the charger for more than 22 hours.

Note that the switch on the battery belt junction box only serves to turn the status monitor LEDs on or off; it does not switch power on or off. To power down, disconnect the battery module cable from the junction box input. Be sure that the battery pack is disconnected from the junction box when the equipment is not in use.

Back Pack
Interconnections and arrangement of components on the back pack are shown in figures 2-4. The system is usually shipped with back pack mounted components installed and cabled, but if components have been removed from the back pack, refer to figures 2-4 to reassemble the back pack. Figure 3 shows interconnections for systems with the optional high speed eye camera.

A “T” connector is provided on the eye tracker control unit “Scene out” connector so that scene video can be cabled to both the VCR and to the video transmitter as shown by figure 1. The “T” connector is also shown in figure 3.

The miniature VCR is mounted for easy access even when the back pack is being worn. Tapes can be loaded or removed and recording can be initiated or halted from accessible buttons and mechanisms.

Donning equipment
Before the back pack or head gear is donned, be sure all connections are complete within the pack and between the pack and the head gear. Do not connect the battery belt or non subject mounted components such as the interface PC or eye monitor until the equipment has been donned by the subject. Be sure that the “HMO—Pan/Tilt” switch, on the eye tracker control unit rear panel (same panel as the “DC In” and “Controller” connectors) is switch to HMO. The equipment can be most easily donned as follows.

- Use the back pack shoulder straps to hang the pack on the back rest of a chair.
• Place the head band or helmet on a table next to the chair.

• Have the subject sit in same chair, and help the subject don the head gear as described in the standard model 501 manual. Have the subject slowly stand up.

• As the subject stands, lift the back pack off of the chair and hold it close to the subject so that cables between the head gear and the pack do not become fully extended.

• Help the subject don the back pack.

• Help the subject to buckle on the battery belt pack.

• Connect the battery module cable to one of the belt junction box inputs (on the side of the junction box).

• With the model 5000 eye tracker control unit power switch in the OFF position, connect the “Ctrl/Xmtr pwr” cable and “VCR pwr” cable (see figure 2 or 3) from the back pack to the belt junction box power output connectors (on the top surface of the junction box).

• Turn the eye tracker control unit power switch to ON. The red pilot light on the control unit should turn on.

**Subject Set Up and Calibration**

• Connect the Interface PC with the provided serial cable and the eye monitor with the provided BNC video cable as shown in figure 2 or 3. Be sure the scene monitor is connected to the video receiver and both are powered up as shown in figure 2 or 3.

• Follow instruction in section 4 of the model 501 manual to upload software to the eye tracker control unit and begin running the eye tracker interface program on the PC. Note that if ASL has supplied the PC, it will generally boot under Windows 95 or 98 and the desk top will usually contain icons for “software upload to control unit” and “eye tracker interface program”. Double click on “software upload….” Icon and a DOS window will automatically open and execute the upload sequence described in the 501 manual. Subsequently close the DOS window, if it doesn’t close automatically, and double click on the “eye tracker interface” icon to run the interface program. (Alternately, use Windows Explorer to find the directory, usually labeled “Eyepos”, containing the ASL EYEPOS software and double click load.bat to upload followed by e5000.exe or e5Win.exe to start the interface program as described in the model 501 manual.) If the software upload program does not run, power cycle the eye tracker control unit and try again.

• The scene camera image should be visible on the scene monitor. If it is not, check all connections.

• If the high speed eye camera option is installed, set the camera dip switches and the radio buttons on the e5000 or e5Win program “System settings” dialog window as described in ASL Technical Note 5006.
From the interface program, use the \texttt{/IP <Enter>} command to turn on the illuminator, and adjust the head mounted optics as described in section 5.2 of the model 501 manual.

Make illuminator and discriminator adjustments as described in section 5.2.4 and 5.3.5 of the model 5.1 manual. If possible, have the subject look around in a fashion similar to that expected when data recording begins. If possible include have the subject look at areas that encompass the expected range of scene luminance during subsequent data collection. Try to position the optics and to set the discriminator threshold levels so that good performance is obtained over the entire expected range conditions. It will be inconvenient to adjust settings once data collection begins.

Subject Calibration and Data Collection

It is suggested that the calibration be performed using “Method 1 – Free Head/Scene calibration” as described by section 5.3.1 of the model 501 manual. This can be done with the subject standing, and does not require that the head be held perfectly still during calibration.

Once illuminator level, discrimination threshold levels, and calibration results are deemed to be satisfactory, disconnect the interface PC serial cable from the eye tracker control unit, and disconnect the eye monitor video cable from the control unit. The subject is now free of any external tether.

Do not exit the PC interface program (e5000.exe or e5Win.exe) before disconnecting the serial link. Leave the program running. When the serial link is disconnected, the interface program will begin to indicate “offline”. If a subsequent adjustment must be made, the serial cable can simply be reconnected, and the program should immediately indicate “online” and resume normal operation.

Be sure that an 8 mm video tape is properly loaded in the back pack mounted VCR, and press the record button on the VCR.

The subject can now move about. The image from the head mounted scene camera with superimposed point of gaze (POG) cursor will be recorded on the VCR, and will also be visible on the scene monitor via the video transmitter/receiver. The transmitted video image may sometimes flicker or exhibit some static or interference as the subject moves about, however the recorded data should remain clean. The transmitted image is intended not for data analysis use, but rather to allow the experimenter to monitor the system during data recording. If optics or bumped or system performance appears to be sub-optimal for any other reason, data gathering can be interrupted and appropriate adjustments made.

The near IR source that illuminates the eye will usually be visible to the scene camera as a small bright circle someplace on the scene image. If this location is marked on the monitor glass with a felt tip pen, directly after subject setup and calibration, this bright spot location can serve to indicate any disturbance of the optics components. If the visor, the scene camera, or the eye camera optics module are moved from their original position (due to accidental bumping, etc.), the position of this bright spot on the scene monitor will change. Suboptimal performance can also be detected by noting whether the scene image POG cursor is reasonably stable and is indicating a “believable” gaze pattern. With a little experience, these things will be readily apparent.
If preferred, the eye image rather than the scene image can be connected to the video transmitter on the back pack. Simply connect the cable from the video transmitter to the eye tracker control unit “Eye out” connector instead of to the “Scene out” connector. In this case performance can be monitored by noting whether good discrimination outlines and stable pupil and CR center crosshairs are maintained on the eye image.

If additional control adjustments need to be made or if calibration needs to be repeated any time during the eye tracking session, simply reconnect the serial cable from the PC COM port (usually COM 1) to the “Controller” connector on the eye tracker control unit. Similarly, reconnect the video cable from the Eye monitor to “Eye out” on the control unit. If the interface program has been left running, it should be possible to proceed as if it were never disconnected. If the interface program (e5000.exe) must be restarted, it will turn off the eye tracker illuminator on start up; type /IP <Enter> to turn the illuminator back on.

When the eye tracking session is finished, remove the equipment as follows:

- Switch off the eye tracker control unit.
- Disconnect all connections to the battery pack junction box.
- Remove the battery pack belt.
- Help the subject remove the back pack, and hold the back pack near the subject (to prevent cables from stretching to their limit) as the subject sits down.
- Using the shoulder straps, hang the pack on the chair back rest.
- Move the scene camera and visor out of the way, and gently remove the headband or helmet.
- Gently set the head gear on a table next to the chair.

**Alternate Configurations**

If the system need not be used for mobile, untethered, operation, the battery pack may be disconnected, and the standard interconnections diagrammed in the model 501 manual may be used. This would primarily entail connecting the provided eye tracker control unit power supply to an AC outlet and connecting the DC output from this unit to “DC IN” on the eye tracker control unit (in place of the battery pack); and connecting the “Scene out” video directly to an external monitor (instead of using the transmitter).

If desired, the provided adapter cable can be used to connect the power supply unit through the belt mounted junction box, rather than directly to the eye tracker control unit. If the adapter is used in this way, the power source for the system can be swapped from an AC outlet (through the DC power supply) to the batteries, or visa versa, without powering down the system.
For example, the system can be powered from a wall outlet as shown in figure 5a. Note that in figure 5a, only the power supply is connected to the junction box, and the batteries are not connected. To swap to battery power without shutting down the system, follow the steps shown in figure 5b, and c. First connect the battery cable to the junction box, so that both batteries and power supply are connected; then remove the power supply connector. To switch back to wall outlet power, simply follow the steps in reverse.

If the interface PC is left connected, digital data can be recorded on with the interface program in the usual fashion (see section 5.5 of the model 5.1 manual). Further, a magnetic head tracker can be used as described in section 2.3.5, 2.3.6, and 3.1.4 of the model 501 manual, and in the separate EYEHEAD integration manual.
Note that use of the optional high speed eye camera will not affect the update rate of the scene video image recorded by the back pack VCR. The point of gaze cursor, as displayed on the scene video, will show less delay with respect to the scene image, but the scene video will still display only 60 fields per second (50 fields per second if using PAL format). If the interface PC is left connected and used to record digital data, or if recorded data is recorded from the “serial data” port by some other device, the digital data will record with the full temporal resolution of the eye camera. (The high speed camera can be set for 60, 120, or 240 fields per second). Refer to Technical note 5006 for instructions specific to use of the optional high speed camera.