Construction and component costs

The components required for the read head are relatively inexpensive and easily obtained. The combined cost of the photodiode/phototransistor pairs (which are actually "end of tape" sensors from 9-track tape drives) and the associated electronics (op-amps and schmidt triggers) is less than $50. A Rockwell 65/11EB microcomputer is more than adequate, and costs $26. The 65/11EB is a single chip, 8-bit device containing RAM, I/O ports, a 6502 microprocessor, and a UART that provides asynchronous serial ASCII output (at selectable baud rates) of dome position and diagnostic information. Both RS-232 and RS-422 interfaces are provided for communication with the main telescope/dome control computer. A hex LED display is provided for diagnostics and to aid in the adjustment of the optical sensors. The software to operate the 65/11EB microcomputer as a stand-alone system includes extensive diagnostics, occupies less than 3 kilobytes of ROM, and easily fits in a 2732 EPROM costing less than $4. Parts costs for the power supply, circuit board, connectors, interface chips, LED display, and enclosure amount to another $50.

Since the total parts cost is well under $150, it would be feasible to build a spare read head. The spare could either be kept in storage and swapped in only if the primary unit failed, or permanently mounted at a second pick-off point and used as a backup unit. The cost of the read head is independent of the size of the dome.

The timing tracks and coded patterns for the data track were generated on a VAX 11/780 computer and printed on mylar transparencies using an IMAGEN laser printer. The VAX was used out of convenience, not necessity. A much less powerful computer and printer would be adequate to generate these patterns, since they do not involve any complicated arithmetic or graphics. A personal computer with a medium- or high-resolution dot matrix graphics printer would probably suffice. It might even be possible to print the patterns onto normal paper, and then use a Xerox-type copier (that uses a similar printing process to the laser printer) to copy the patterns onto the appropriate mylar material. However, many Xerox-type copiers have difficulty reproducing large solid black areas.

The IMAGEN laser printer was used to print the pattern of coded stripes directly onto 8-1/2 by 11-inch sheets of transparent mylar of a type used as transparencies for overhead projectors, 3M Transparency Film #686 for Plain Paper Copiers. (3M has since advised that Film #688 or #671 will produce better results.) The printing process produces the dark areas by thermally bonding the black toner particles onto the surface of the mylar sheets. The pattern of coded stripes is designed to be viewed through the mylar, so that the printed surface, and hence the toner particles, face away from the viewer.

These printed mylar sheets were then cut into 3- by 10-inch pieces, and grouped into sets of three. The pieces in each set were overlapped end-to-end on a light table, and connected together with transparent tape into 3- by 30-inch strips. (The 30-inch strip length was chosen to make the strips easy to attach to the dome. It is the maximum length strip one can comfortably hold at arms length.) Each piece is printed with its own sequence number to insure that it is assembled in the correct order. Dovetail patterns are printed at the edges to help align each piece with its neighbors. (See Figure 4.)

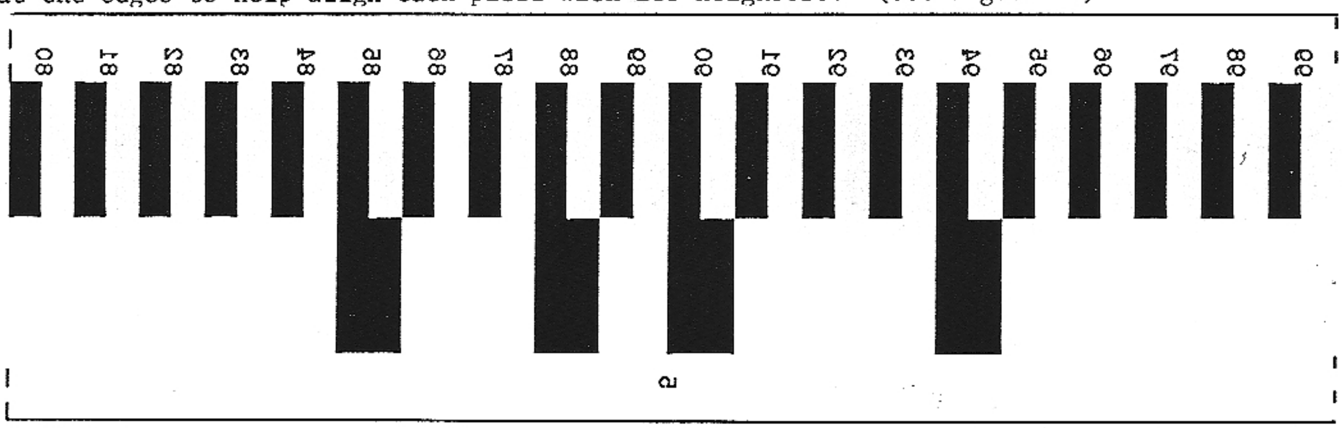

Figure 4. Sample piece of printed pattern for mylar strips (shown 70% of actual size).

To maximize the contrast of the printed patterns, a layer of highly reflective aluminized mylar tape (Chartpak Chrome Mylar 1-19 pressure-sensitive graphic tape) was then applied to the timing and data tracks along the complete length of each assembled strip. The sticky side of the tape was placed against the printed side of the strip. (The adhesive is transparent, so both sides of the aluminized mylar tape are reflective.) This way the laser printer toner particles are sandwiched between the two mylar surfaces and not exposed to the outside, where they could potentially be scraped off. (See bottom of Figure 2.)