



**Getting the  
Big Picture  
With a  
Picturephone<sup>®</sup> Set**

*Images of such objects as microfilm, bank checks, electrocardiograms, and engineering drawings can be viewed on Picturephone sets with the aid of new attachments. Now, a Picturephone set can magnify a small object—or maintain surveillance of a remote area.*

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PICTUREPHONE® SERVICE WAS DEVELOPED as a natural extension of telephone service. Now available in Chicago, Washington, and Pittsburgh, the service provides a means of visual communication in face-to-face, graphics, or data-access modes.

During the early growth of a cooperative service—which Picturephone service is—the customer's perception of his uses for the service is small while the network is small. But people have a way of thinking up new uses for new technology, and so it is not surprising that customers wanted more from their Picturephone station sets than the primary function of face-to-face contact. Some wanted, for example, to be able to read typewritten and printed pages, to verify signatures, or to view 35-millimeter slides. Other customers wanted to examine X-ray photographs or maintain surveillance over remote areas. By focusing on these self-contained, specific applications, customers were able to increase the utility of the new service.

The Mod II C station set, the first Picturephone station set offered for commercial service, does not have the flexibility to accommodate all the newly proposed applications. Its prime purpose is to view people, usually while they are seated at a desk. It therefore employs a wide-angle lens to accommodate anyone—small or tall—at a distance of about 36 inches from the set. A Mod II C station set can be switched to a "graphics mode" by positioning an integral mirror in front of the lens. This allows viewing of pages or small objects on the table on which the set rests. (Changing to the graphics mode automatically moves the lens, focusing it on the table top 14 $\frac{3}{4}$  inches below.)

In the graphics mode the Mod II C station set views an area of approximately 6 by 6 inches. It can clearly transmit sketches and bold script, but cannot resolve finer details—such as the letters on a page of pica type. Moving an object closer to the lens to obtain greater magnification would result in a blurred picture because the focus of the lens is fixed.

To meet new customer desires, engineers at Bell Labs, working with the marketing and engineering organizations in the Operating Companies and

their customers, developed inexpensive, easy-to-use "add-ons" for the Mod II C station set. These add-ons are various holders for objects to be viewed and various adapters to allow the use of close-up lenses and other optical hardware. The simplest add-on is a single convex lens placed in front of the lens of the Mod II C station set to reposition the plane of best focus. The add-on lens is secured to an adapter on the station set graphics visor in front of the lens. The adapter can accommodate a range of close-up lenses. A 20-diopter lens, for example, could focus on a 1-inch wide object only 1.8 inches from the lens, and make the object appear almost 5 inches wide on the station set screen. (A diopter is the power of a lens expressed as the reciprocal of its focal length measured in meters.)

The addition of a close-up lens decreases a Picturephone set's depth of field significantly. With an extreme close-up, it is difficult to keep a handheld object in focus. Accordingly, Bell Labs engineers have designed devices to hold the object in a fixed position with relation to the Picturephone lens for close-up viewing.

A representative add-on device is the one used to view an electrocardiogram roll chart. The device, called an EKG reader, consists of a close-up lens and a support that keeps the chart in the proper plane of focus. The EKG reader magnifies the chart 2 $\frac{1}{2}$  times.

The utility of the EKG reader is apparent. With it, a medical expert can examine the electrocardiogram of a distant patient, saving time and eliminating the inconvenience of travel. The EKG reader may find use in other fields, too. Engineers, for instance, may use it to examine the traces recorded on strip charts.

The mounting bracket for the EKG reader is a universal type and is used for other holding devices as well. It is hooked onto a ledge under the graphics visor. The EKG reader, like other add-ons, allows a user desiring face-to-face communication to rotate the holder to the top of the Picturephone display unit, out of view of the lens.

Another add-on is the document magnifier,

which is designed specifically for viewing signatures. It has the same general construction as the EKG reader, consisting mainly of a close-up lens and a clear plastic plate for supporting a signature card or other document. With this holder, a Mod II C station set expands a 3¼-inch-wide document to the full 5¼-inch width of the screen. Not only handwriting, but pica-size typewritten characters (in column widths half the size of a typed page) and newspaper print are legible when viewed on a Picturephone set.

A 35-millimeter slide viewer contains a close-up lens, a slide retainer, and a white reflector set at a 45-degree angle behind the slide holder. The reflector directs additional light from the ceiling through the slide and into the station set's camera. The reflector eliminates the need for an auxiliary light source. Slides can be moved continually through the holder for sequential viewing. The slide viewer could be a great asset in sales work. For example, a sales organization could display products to prospective customers, or a multiple-listing service could show properties to real estate agents and their clients. Another version of the slide viewer accepts aperture cards such as those used for storing X-ray photographs.

All such add-ons, however, have a limitation: they employ a simple close-up lens and are limited to a maximum of about 5 times magnification on the Mod II C station set. At greater magnifications, distortion becomes unacceptable and supplementary lighting may also be necessary.

However, there are applications that require greater magnification, or in which the nature of the object being viewed prohibits placing it in close proximity to the optics. A second version Picturephone set is now available which allows the use of commercial TV lenses. It is commonly referred to as the "C-mount" set because the camera incorporates a standard mechanical fitting known in the photographic industry as a C mount. This fitting allows the user to change lenses easily to suit his needs.

When large magnification is required, lenses having narrower fields of view may be used, instead of bringing the object closer and closer to the lens of the Mod II C station set (which has a wide field of view). The decreased field of view results in greater magnification and the resolution of fine detail.

The photo at bottom left on page opposite shows a 50-mm focal length, narrow-angle lens on a C-mount set. The horizontal field of view is about three inches at the table top. The ability to read pica type with the graphic material on the table top allows for easy interaction with the graphics



*The simplest add-on for a PICTUREPHONE® set is a single convex lens. Placed over the standard lens, the add-on can be used to provide as much as five times linear magnification of objects.*



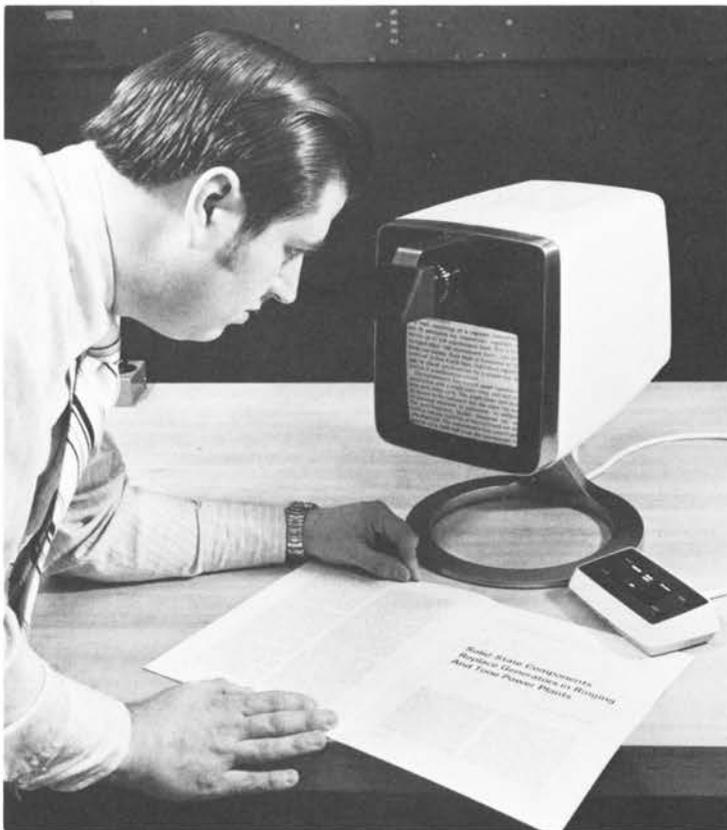
*A clear plastic holder and a close-up lens allow the viewer to send images of 35-millimeter slides. A reflector at an angle throws ceiling light on the slide—additional light is not needed.*



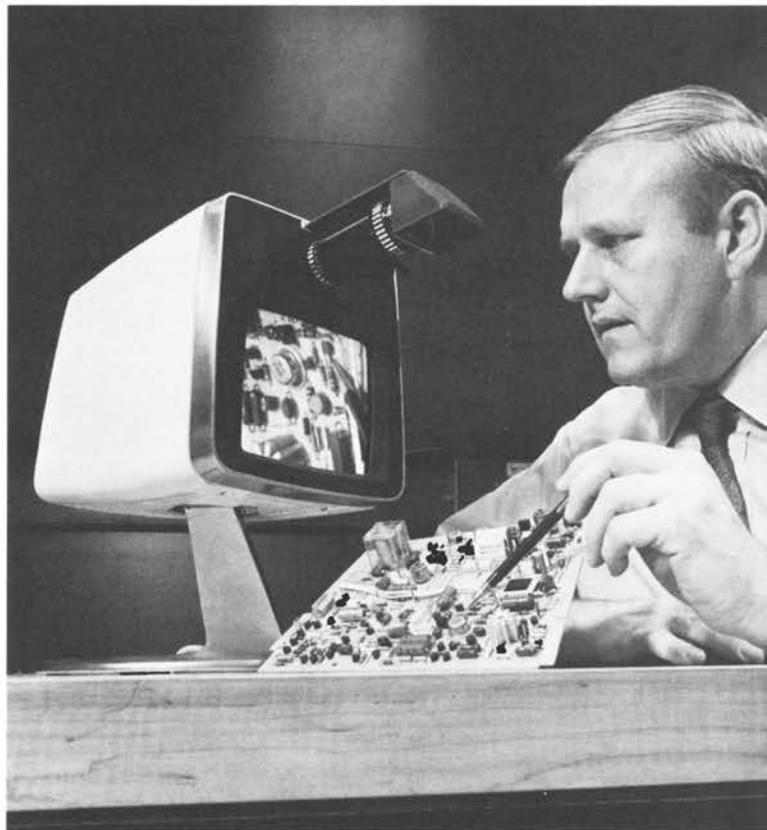
*Another possible use of the document magnifier is in transmitting certain printed information. Mathematical equations, typewritten characters, and newspaper print can be viewed this way.*



*One of the principal uses of the document magnifier is in banks. A teller can use it to transmit images of checks, for instance, to a person at a central location for verification of signatures.*



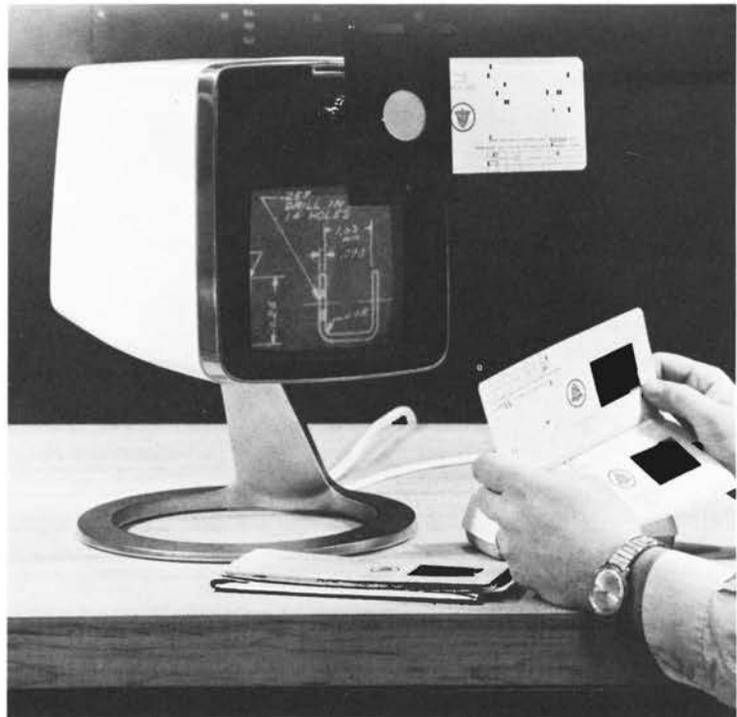
*One-column-wide sections of magazines or newspapers can be viewed clearly with a "C-mount" set and appropriate lens. A narrow-angle lens with 50-millimeter focal length is used here.*



*A "C-mount" set with a zoom lens transmits a detail of a printed-circuit board. The zoom lens can be conveniently adjusted for different fields of view. There is no necessity for changing lenses.*



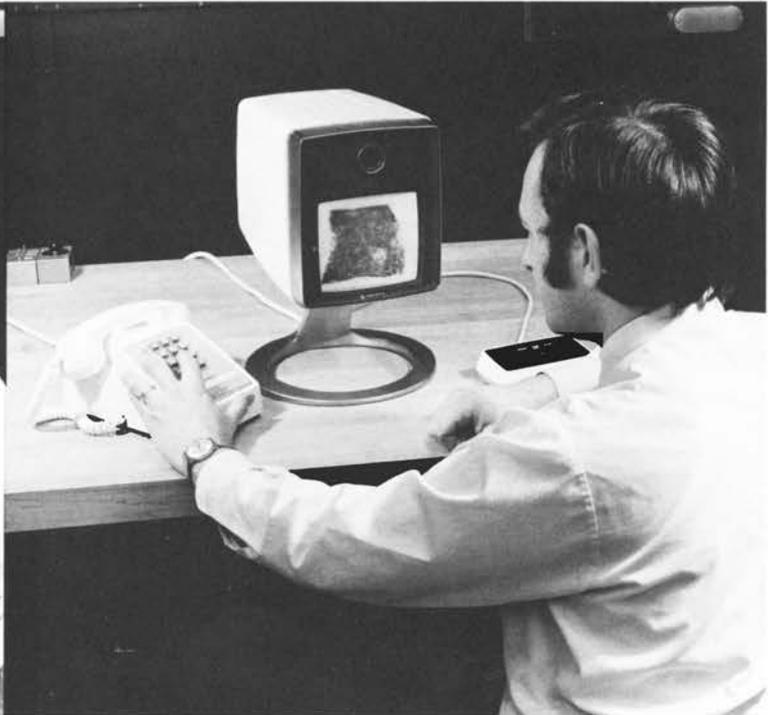
*When the PICTUREPHONE® set is placed on a specially designed rolling base, it can be moved around to view details on a large drawing. A zoom lens allows the user to adjust the magnification.*



*A retro-mounted lens gives high magnification, as in this microfilm reader attachment. The 0.125-inch film fills the 5-inch-wide PICTUREPHONE® display screen, for a magnification of 40 to 1.*



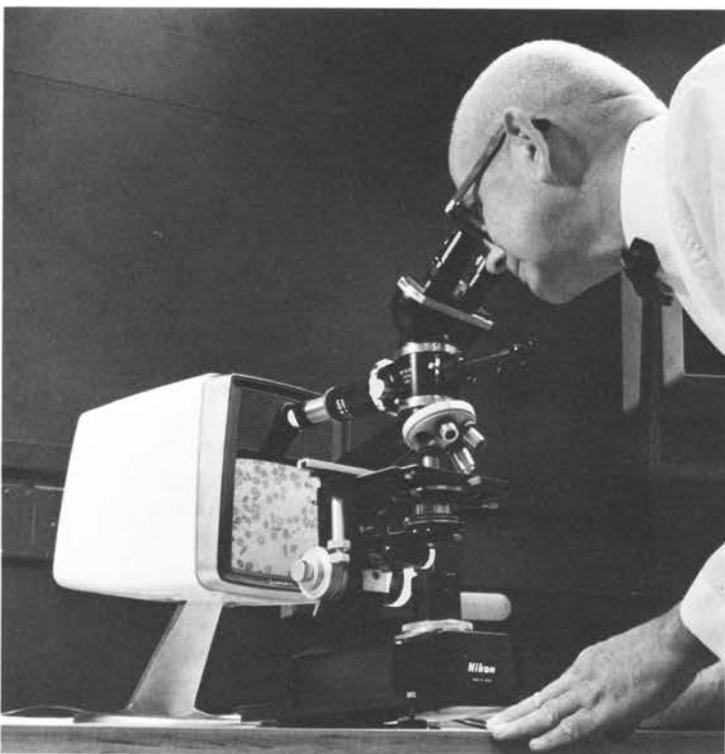
*A zoom lens can be used when magnification must be changed frequently. A zoom lens is like many lenses in one: simply by moving a lever, the user can view a scene at various levels of detail. A motorized zoom lens can also be controlled remotely.*



*This application in law enforcement is an example of remote control. The user first observes a specimen from a fingerprint file (above, left), then zooms in on a single fingerprint (at right, above) simply by pressing a button on a TOUCH-TONE® telephone.*



*If the standard base is replaced with a mounting bracket for a camera tripod, the PICTUREPHONE® set can be used in a variety of locations and orientations, much as a studio camera can be.*



*The "teaching" eyepiece of a medical microscope can be placed against the lens opening of a standard PICTUREPHONE® set to transmit slides to a remote location. Images might be sent from a pathology laboratory to an operating room, for instance.*

material. Unfortunately, when the lens in this example is used in the face-to-face mode, it intercepts a horizontal field of view of about 8 inches at a viewing distance of 36 inches—not wide enough for face-to-face viewing. Clearly, for flexibility with a one-lens arrangement, a zoom lens is required. This eliminates the inconvenience of changing the lens frequently for different fields of view.

The illustration on page 355, bottom right, shows a C-mount set equipped with a graphics attachment and a zoom lens having a focal length range of 17 to 85 mm, a 5-to-1 ratio. With the lens zoomed to 85-mm focal length, a field of view of about 1½ by 1½ inches is seen at table top height. At the 17-mm setting, the field of view is identical to that of the Mod II C station set and allows for face-to-face viewing.

Although commercial television, or "C-mount," lenses can provide a selection in the field of view, they have minimum distances to which they can be focused. The distance varies from lens to lens, but typically ranges from 10 inches for a lens with a focal length of 12.5 millimeters to 8 feet for a 150-millimeter lens. The graphics attachment on page 355, bottom right, is supplied with the C-mount set and incorporates a mirror and close-up lens to allow focusing of the lens at table top height.

Another way to get close focusing on a C-mount lens is through extension tubes. These are tubes with a male thread on one end and a female thread on the other, which are placed between the lens and the camera. Extension tubes come in sets of various lengths and allow focusing as close as ½ inch with most lenses.

For very high magnification, "retro-mounting" can be used. A C-mount lens can be reversed to produce as much as 500 times magnification of an object on the station set screen. To vary the magnification, the user can place an extension tube or bellows—or both—between the retro-mounted lens and the camera.

Retro-mounting can be used to view microfilm or microfiche. Ambient light is often adequate for viewing, although at very high magnifications, supplementary lighting is required.

Another version of the C-mount set is available. In this version the ringstand is replaced with a mounting bracket for a camera tripod. When this version is placed on a camera tripod and fitted with a zoom lens, the user has an extremely flexible arrangement for studio-type use. And if the camera tripod is replaced with a "pan and tilt" mechanism and a motorized zoom lens is incorporated, remote controlled surveillance becomes a possibil-



*With the electrocardiogram reader, an EKG record can be transmitted to a medical expert at a remote location (left). The reader consists of a close-up lens and a support that keeps the chart in*

*focus. This add-on device has already been used in hospitals. For face-to-face communication (right), the add-on can be rotated to the top of the set, away from the standard lens.*

ity. TOUCH-TONE® keys on the telephone set can be used as signalling devices. By pushing the appropriate Touch-Tone button, the user can rotate or tilt the called set as well as zoom the lens in on an important detail.

Many surveillance applications can exploit the sensitivity of the station set's camera to invisible wavelengths. The silicon camera tube is highly sensitive in the 8000 to 9000 Angstrom region of the light spectrum; the human eye cannot see at these wavelengths. With supplementary infrared lighting, this sensitivity permits surveillance of critical areas at night, monitoring of patient wards after lights-out, and observing industrial processes which must be completed in the absence of visible light. This monitoring is possible from remote locations via the switched Picturephone network.

The performance of a Picturephone station set in special cases can be enhanced by attaching various commercial filters to the front of any of the lenses by means of commercially available adapters. A filter can increase picture contrast, for example, when a cathode-ray tube is viewed by the camera. A polarizing filter can reduce glare from a bank teller's window. A neutral density filter can

be added to reduce the excessive illumination of an outdoor scene.

The document magnifier, EKG reader, slide viewer, and versions of the C-mount set are manufactured by Western Electric in Indianapolis. All of the items described in this article are in use by various customers in the cities in which Picturephone service is being offered. The individual close-up lenses, filters, and C-mount lenses shown in the various applications are available commercially along with an almost limitless number of special optical attachments. These special attachments can be purchased by the Picturephone customer to meet specific needs.

Here we have presented only a small sample of the many ways simple, commercially available optical equipment can enhance the utility of a video telephone. As Picturephone service grows, people will surely devise new applications. The information learned as a result of interaction with the Operating Companies and their customers will be used in the future designs of equipment for visual communication. Future Picturephone sets will incorporate many of the optical add-ons and accessories as integral parts, to provide a service which is easy to use and has maximum utility.