

The Evans & Sutherland

# PICTURE SYSTEM

SEP 18 1974

The interactive, dynamic, 3-D line-drawing system.

## PERSPECTIVE

Build models and display views of true three-dimensional objects.

## DYNAMICS

Rotate, tumble or translate any object smoothly.

## ZOOMING

Smooth, quick transition to any scale.

## CONVENIENCE

Your choice of coordinates and language.

## INTERACTION

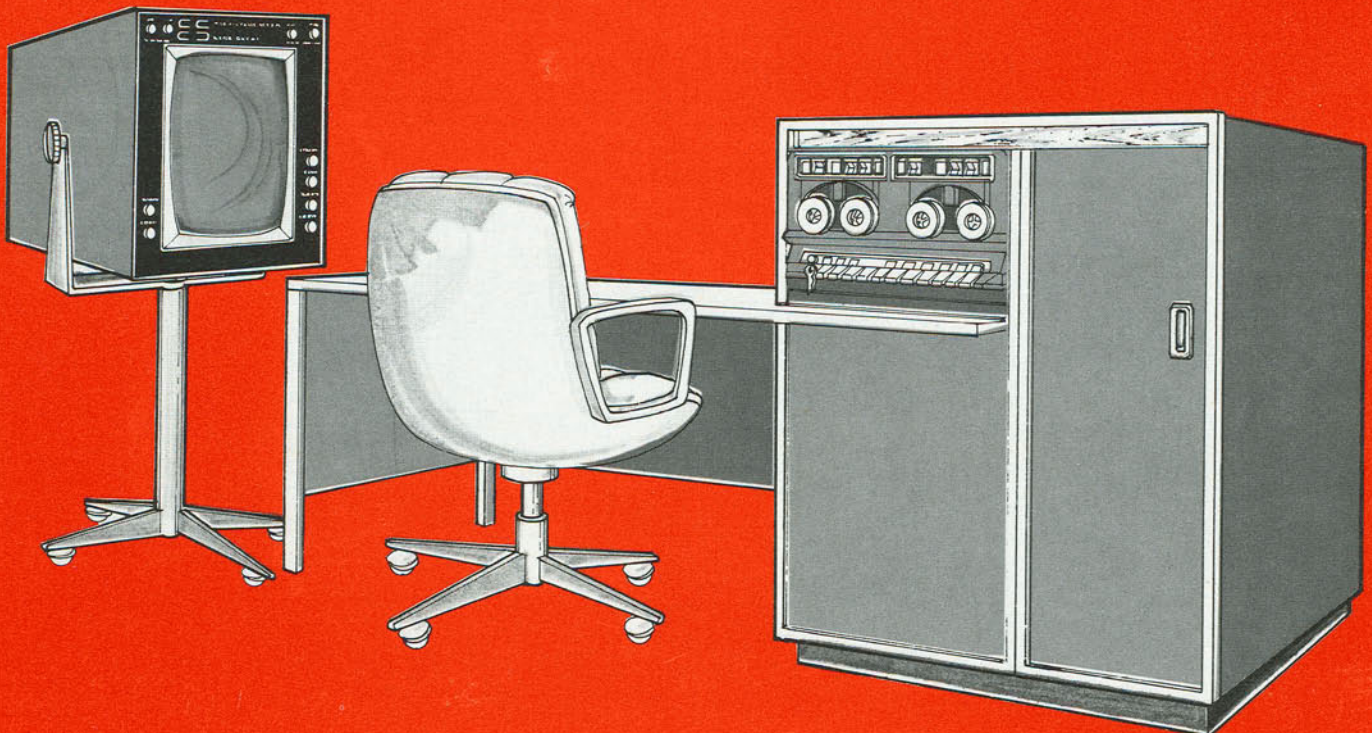
Change, test or manipulate as you wish.

## QUALITY

Sharp pictures at all times.

## VALUE / SERVICE / SUPPORT

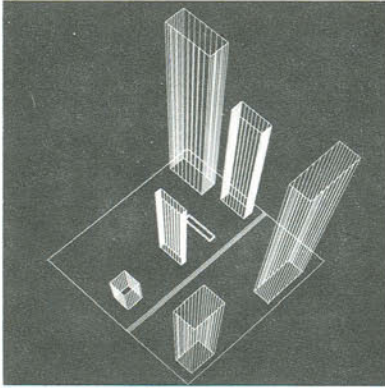
Now anyone can afford the very best.



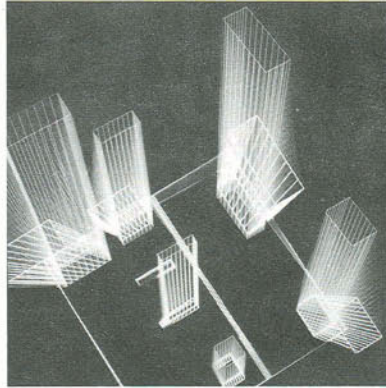
The Evans & Sutherland

# PICTURE SYSTEM

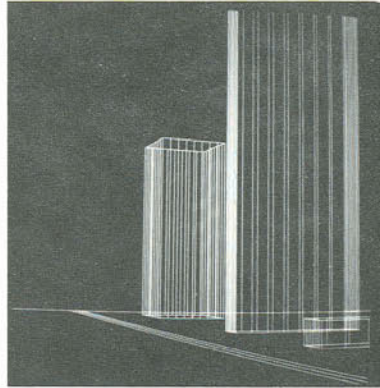
A high-performance, 3-D display at low cost



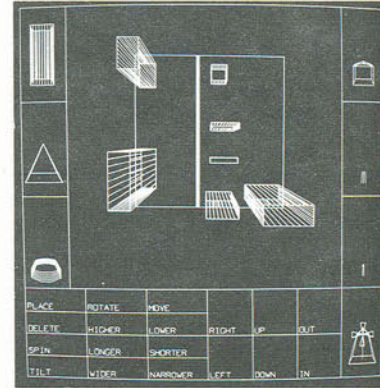
Simulated building complex seen in perspective.



Dynamic capacities of THE PICTURE SYSTEM enable smooth movement in real time of the building complex.



Street-level view: clipped to show only lines visible on the screen.



User controls program with commands displayed as a menu.

## PERSPECTIVE / Build and display true 3-D pictures

With an E & S computer graphics system you can build and dynamically display a complex three-dimensional model or scene. In effect, THE PICTURE SYSTEM is a window into your computer world — a window for viewing the model you have built in the computer.

In virtually all situations a model can be developed in this exciting computer graphics system in less time and for less money than it takes to make a physical model. And the computer model can be studied and changed in ways never possible before.

With only a change in parameters THE PICTURE SYSTEM can display perspective, orthographic or isometric pictures from a single object definition. It can show you cross sections, overlays or stereoscopic pairs. These are not options in the system, but they are integral real-time functions of the standard PICTURE SYSTEM.

The illusion of three dimensions is made realistic through perspective, so that parallel lines converge in the distance the way they should, so that the brightness or intensity of a line diminishes as the line drops away from the viewer.

## DYNAMICS / Rotate, tumble or translate any object smoothly

THE PICTURE SYSTEM is truly dynamic. Many objects can be displayed simultaneously, each with complex independent motion. They can be made to move smoothly to any position in real time. Over the years men have taught themselves to live with the basic constraints of traditional two-dimensional paper and ink drawings. Now your graphics can be freed from those restraints — you can be freed to use your time more efficiently and more creatively.

## ZOOMING / Smooth quick transition to any scale

With THE E & S PICTURE SYSTEM you can zoom into a complex model to view small sections in minute detail. Or, you can store and display massive complicated models in their entirety. The E & S "clipping" feature and the "refresh buffer" permit the viewer to deal with much more complex pictures since the computational hardware is dealing with new frames only and not with refreshing the picture or with computing parts of the picture which are not being displayed currently. This allows more lines and characters in your picture and eases the time and data storage burden on the computer which controls THE PICTURE SYSTEM.

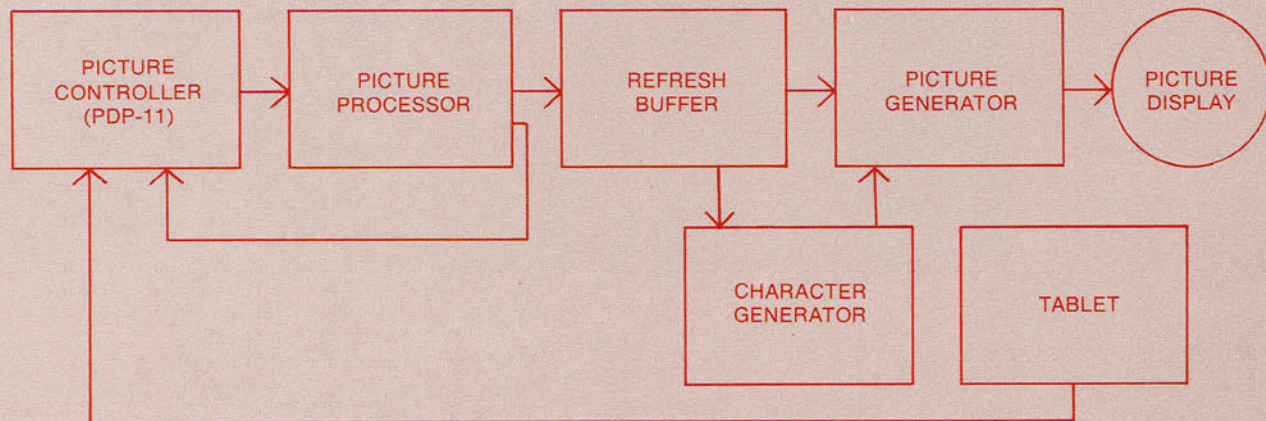
## CONVENIENCE / Change, test or manipulate pictures as you wish

Complicated three-dimensional models can be developed and then exploded so that parts can be studied individually as well as in their relationships one with another. Structural models in the system can be assigned physical, electrical or magnetic characteristics as though they were real life models, and then tested for structural stability, circuit integrity, etc.

# Overview of the PICTURE SYSTEM

THE PICTURE SYSTEM is a stand-alone computer graphics system which presents dynamically moving pictures of two- or three-dimensional objects.

The basic functional configuration of THE PICTURE SYSTEM is shown below:



## Picture Controller

The Picture Controller contains data which describes objects to be viewed on the Picture Display. It also computes parameters used by the other components in the system, as well as performing I/O and other functions required to support THE PICTURE SYSTEM.

In addition, the Picture Controller passes parameters to the Picture Processor to indicate how subsequent coordinate data is to be interpreted and what transformations are to be made to the data. The data interpretation parameters indicate connectivity (i.e., how points are to be connected) and point of origin (i.e., whether the coordinate data is absolute or relative to preceding coordinates).

## Picture Processor

The Picture Processor receives data sent by the Picture Controller in the form of two- or three-dimensional line endpoint coordinates. It performs several digital operations on this data, starting with rotations, translations, reflections, and changes in scale. These transformations are directed by parameters passed by the Picture Controller.

The next operation performed by the Picture Processor is to check the transformed coordinate data for visibility by comparison with a two- or

three-dimensional viewing window. Lines or portions of lines outside the window are removed by a clipping process so that only visible segments are processed further. At this point three-dimensional data is converted to two dimensions by computing perspective or, if desired, orthographic views.

The final stage in the Picture Processor's digital processing is a linear mapping of points from the objects' coordinate system into that of the Picture Display.

## Refresh Buffer

Processed data, still in digital form, is now deposited in the Refresh Buffer, either over-writing the data for the previous picture (single buffering) or in a separate area from the previous picture (double buffering). Processed data may also be returned to the Picture Controller's memory to drive a hard copy plotter for example, or as data for further computation.

## Picture Generator & Picture Display

At the same time the Picture Controller and Picture Processor are creating one frame of the picture and depositing it in the Refresh Buffer, the Picture Generator is reading coordinate and intensity information from the Refresh Buffer, converting it to analog signals, and drawing the picture on the Picture Display.

## Character Generator

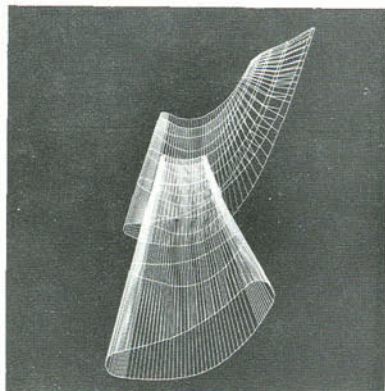
Character strings from the Picture Controller pass through the Picture Processor unmodified and are deposited in the Refresh Buffer as packed character codes. When character words are read out of the Refresh Buffer, the Character Generator unpacks them into codes which access a read-only memory containing character stroking data. The strokes are read out of the read-only memory one by one, multiplied by a pre-specified sizing parameter, and drawn by the Picture Generator on the Picture Display.

## Tablet

The Tablet serves as the standard, general-purpose graphic input device in THE PICTURE SYSTEM. Associated with the Tablet is a pen whose coordinates are read by the Picture Controller. Normally a "cursor" is drawn on the Picture Display to indicate the position of the pen on the Tablet. The Tablet can be used for positioning or pointing to picture elements and can perform the interactive functions usually reserved for such graphic input devices as light pens, joysticks, and function switches.



Tablet and other devices can provide input to THE PICTURE SYSTEM.



View of a jet engine turbine blade showing cavity surface with cooling tube partially removed. Data courtesy Pratt & Whitney Aircraft division of United Aircraft Corporation.



## INTERACTION / Communicate with THE PICTURE SYSTEM easily

With THE E & S PICTURE SYSTEM you are freed to work in your choice of coordinate systems, thus doing away with the time, work and inconvenience of adapting your own thinking or planning to any restrictions of the system.

Since the computer in the system is the DEC PDP-11, there is good standard software available. Plus, we provide graphics support software that allows you to write display programs in languages you know — FORTRAN or assembly language.

A tablet, standard with the system, can provide almost all interactive input required, including the "pointing" function normally associated with light pens. Other input devices can also be included with the system.

In short, the Evans & Sutherland computer graphics systems perform for you rather than forcing you to learn to perform for the system.

## QUALITY / High quality pictures at all times

E & S systems have always been digital which avoids the inaccuracy, range restrictions and calibration and maintenance problems of analog computational hardware. The use of a separate refresh buffer permits the production of flicker-free images even while the system is in the process of developing extremely complicated new frames.

The E & S Picture Generator draws lines at a constant rate thus maintaining constant line intensity and brightness independent of line length. Specifications for linearity, end-point match, and so forth are unexcelled.

Intensity and contrast controls are completely independent of each other, giving the operator complete freedom to select optimum picture presentation. The 256 intensity levels offer a wide choice of intensities when depth-cueing is not used, and they give the appearance of continuous gradation from the brightest to the dimmest line presentation when depth-cueing is used.

## VALUE / SERVICE / SUPPORT

When you buy from E&S you get not only the finest graphics hardware/software systems available, but also the finest possible service and support. The E&S design, fabrication and quality assurance practices are continually being reviewed and updated to increase system reliability and provide for ease of maintenance. E&S has one of the most automated design and test facilities in the industry today. E&S also provides qualified customer service from worldwide locations. System diagnostics, component parts and modules are available at those locations for use by our customer service engineers. As a result, E&S systems have a minimum of down time.

As the leader of computer graphics, E&S is committed to provide software and applications support to benefit the user. As additional applications evolve, PICTURE SYSTEM users can be confident that this line drawing system will remain a cost-effective tool to aid in visualizing and solving practical problems.

# Functional Specifications

## Picture Controller

Computer	DEC PDP-11/05, 4K Core Memory, Teletype with paper tape reader/punch (ASR33).
Word Size	16 Bit.
Dimension Modes	Two-dimensional Three-dimensional Homogeneous
Coordinate Specification Modes	Absolute Relative
Drawing Modes	Move Draw Dot Character
Instancing	
Parameter Load/Store	

## Picture Processor

Transformations	Translation Rotation Scaling Perspective Viewport
Compound Transformations	
Clipping	
Perspective	
Viewport Mapping	
Zooming	
Hit Test	
Memory Write Back	

## Refresh Buffer

Buffering	Single Double
Size	8K 36-bit words
Data Content	Coordinate data (12 bits x, 12 bits y, 8 bits intensity per word) Character data (up to three character codes per word) Status information

## Character Generator

Character Set	96 character extended ASCII
Sizes	8 sizes each with 8 character widths
Character Orientation	Horizontal 90° counter-clockwise
Capacity	Up to 2000 characters at 30 frames per second

## Picture Generator And Picture Display

Line Modes	Solid Blink Dash
Intensity Modes	256 levels of constant intensity Depth-cueing
Independent Intensity and Contrast Controls	
Display Rates	$\text{MAXIMUM MOVE TIME} = 7.8 (L_{MN}) + 3.0 \text{ usec}$ where $L_{MN} = \frac{\text{Move length (inches)}}{\text{Display width (inches)}}$ $\text{MAXIMUM DRAW TIME} = 15.7 (L_{DN}) + 3.0 \text{ usec}$ where $L_{DN} = \frac{\text{Draw length (inches)}}{\text{Display width (inches)}}$ Display capacities at 30 frames per second refresh rate: ° 8,700 one-half inch lines connected end-to-end ° 1,760 ten-inch lines connected end-to-end ° 10,000 uniformly distributed dots ° 2,000 characters
Display Type	Calligraphic
Deflection Type	Electromagnetic
Spot Size	0.020-inch
Addressable Locations	4096 x 4096
Endpoint Matching	0.020 inch
CRT Size	21" rectangular, 10" x 10" quality viewing area
Phosphor	P4
<b>Tablet</b>	
Output	10 bits of X, 10 bits of Y, and pen up/down status
Resolution	Digital: 10 bits for both X and Y Graphic: 75 lines per inch
Sampling Rate	500 samples per second
Size	11" x 11" useful area
Cursor	

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516-420-1787

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415-941-4540

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139 First Street, Cambridge, MA 02141  
617-661-9424 Telex: 92-1416

### European Office: Techex, Ltd.

42, Parkstone Road,  
Poole, BH15 2 PG  
England  
Poole: 6414 Telex: 851 41437

Distributor of E&S PICTURE SYSTEMS in  
Canada and worldwide mining applications  
outside continental United States:

### Olpin & Stehl, Co., Ltd.

Hollinger Office Bldg.  
P.O. Box 800, Timmins, Ontario, Canada P4N 7G7  
705-267-1429

Distributor of E&S Image Generator and Display  
Equipment for NOVOVIEW and Computer  
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### Redifon Flight Simulation Limited

Gatwick Road, Crawley  
Sussex, RH10 2RL England  
Crawley: 28811 Telex: 87327

Distributor of E&S Newspaper Systems:

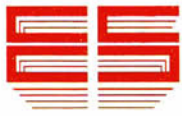
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