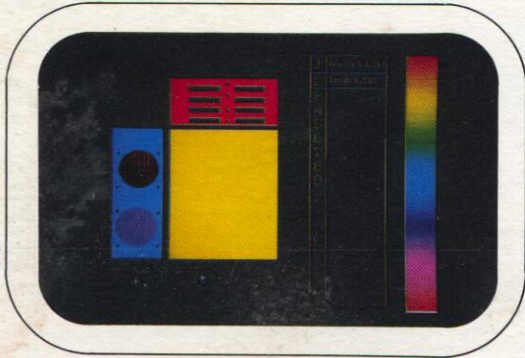
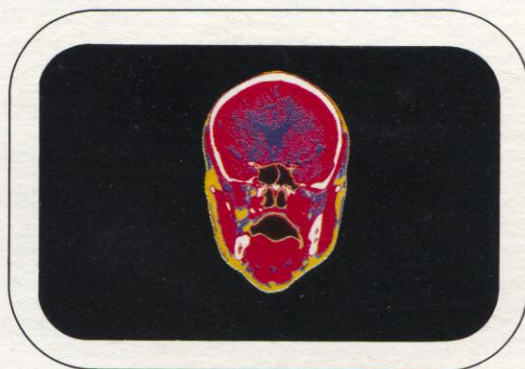
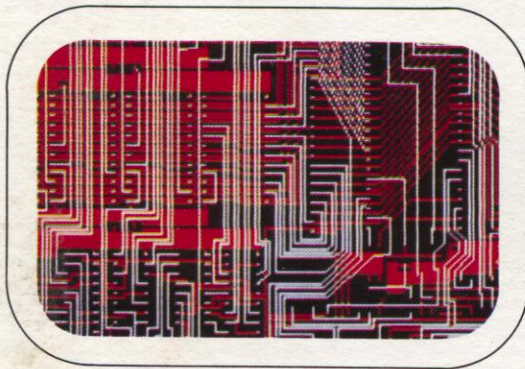


SYSTEM 3400 Display Processor

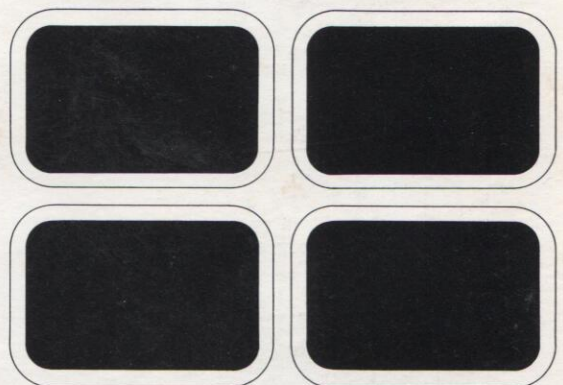


FRONT COVER PICTURES



1. Multicolor display aids design of high density printed circuits.
2. Color provides valuable diagnostic tool in biomedical imaging applications.
3. Raster-scan technology allows the combination of color vectors, polygon-fill and text in a single image.
4. Graphic arts applications benefit from color lookup table which permits up to 4096 colors to be displayed simultaneously.

BACK COVER PICTURES

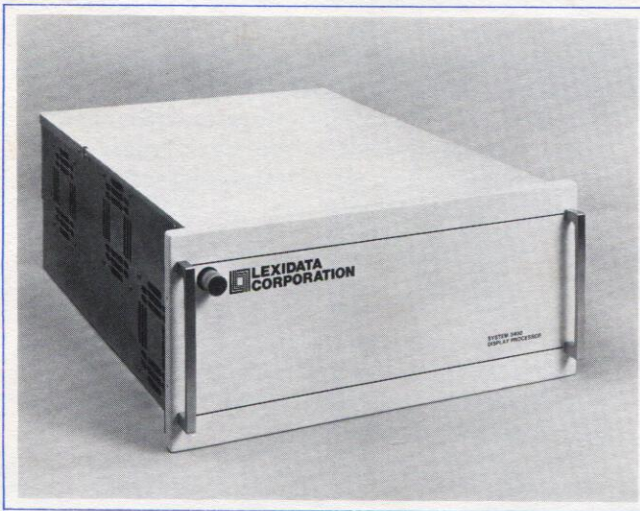


5. Ten bits/pixel appropriately selected generates excellent true color picture.
6. 1024 simultaneous color possibilities keep track of increasingly complicated integrated circuit design data.
7. True-to-life color is easily reproduced from color palette of up to 16.7 million color shades.
8. A satellite image utilizing pseudo coloring highlights areas having similar characteristics. Other applications include military reconnaissance and mapping.

INTRODUCTION

The Lexidata System 3400 is an image and graphics processor that provides state-of-the-art refreshed raster-scan display technology.

Operating as an intelligent peripheral device attached to a host minicomputer, the System 3400 drastically reduces the computer time and memory overhead required to perform picture display and image manipulation functions. Using an ultra-fast microprocessor and dual-ported display memory, the System 3400 not only off-loads image refresh and image manipulation functions, but also is capable of performing them at speeds many times faster than the host computer. By incorporating a microprocessor of its own design in the 3400, Lexidata has achieved a level of performance unmatched by other video processors. For example, the 3400 can generate pixels nine nanoseconds wide, with fast rise time and minimal ringing for sharp, uniform pixels at a refresh rate of up to 50/60 Hz. As a result, random data can be displayed rapidly with no annoying image flicker.



Front View of System 3400

The System 3400 features a highly modular design to handle a wide range of graphics and imaging applications using color, gray scale or monochrome displays. The availability of over three dozen hardware and software modules makes it both easy and economical to tailor a system configuration to fit a particular application's requirements. For instance, applications such as x-ray image analysis and satellite data reduction that require extensive manipulation of a large image data base can be easily accommodated by the 3400's high-speed memory controller, large picture memory, hardware pan and zoom features. Similarly the high-speed image microprocessor coupled with 4K words of memory for user-developed microcode allows the system to handle complex, interactive applications such as CAD/CAM and flight simulation.

Integration of the System 3400 into the user's host computing environment is simplified by Lexidata's operating systems and host computer interface drivers. The Image Display Operating System (IDOS) is a compact and efficient system that resides completely in the 3400. Its powerful macro-command library streamlines application software development and facilitates user interaction with a variety of real-time image manipulation devices such as trackballs and joysticks. The Extended Graphics Operating System (EGOS) provides the high-level graphics functionality necessary to meet the challenges of interactive computer graphics, including printed circuit board and very large scale integration (VLSI) computer-aided design, command and control, and computer-aided drafting. Lexidata also provides interface drivers that handle the transfer of data and commands between the 3400 and most popular minicomputers.

Cursor

With an optional hardware cursor installed, any shape cursor within a 64 pixel x 64 pixel matrix may be specified under software control. A full-screen, cross-hair cursor is also available.

Serial Interface

The 3400 offers up to six serial interfaces for optional control devices such as joysticks, trackballs, data tablets, and keyboards which can be connected directly to the System 3400. (These devices may also be interfaced to the host CPU via host serial connection.)

Blink Controller

The blink controller is an optional feature that enables the blinking of one pixel or any combination of pixels at a rate that is user-programmable. The blink controller may also control the blinking of all data on any memory plane selectable in software, or all pixels of the same intensity.

High-Speed Lookup Table

The System 3400 offers a number of different lookup table options containing special high-speed RAM memories that allow the user to translate any stored intensity level to any other intensity level prior to displaying it on the CRT screen. This is one of the most powerful tools available for image manipulation and enhancement, and graphic color selection.

Lookup tables for black-and-white processing are available with up to 12 bits "in" and eight bits "out". In color processing, the lookup table is essentially three tables in one, providing 24 bits of output for the RGB image components. A maximum of $2^{24}-1$ (approximately 16.7 million) color combinations are possible with three eight-bit outputs and any combination of up to 2^{12} (4096) colors can be displayed simultaneously.

Pan/Zoom Controller

The pan/zoom controller gives 1x, 2x, 3x, . . . up to 16x magnification selectable at any time. The integer powers of magnification offer more gradations, which are needed in certain imaging applications. Zoom is non-destructive. The panning function is performed in an even and smooth manner that eliminates visual jumping of the display. Margins can be user programmed to inhibit wraparound or block out unwanted portions of memory.

Consult your local sales representative for the availability of all features and products.



Image not panned or windowed



Image panned horizontally with wraparound

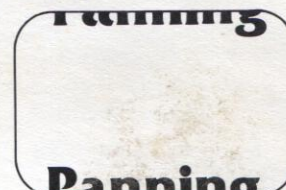


Image panned vertically with wraparound

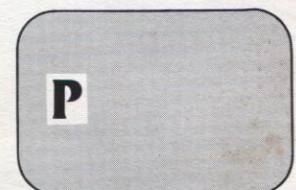


Image with portion windowed visible



Image with portion windowed not visible

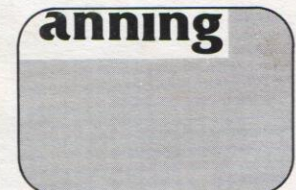
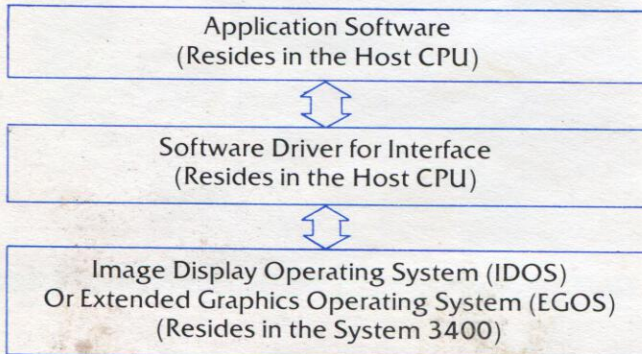


Image panned diagonally with no wraparound

Examples of panning functions

Software

System 3400 software is simple and straightforward. It consists of three basic elements: application software, software driver for interface, and Operating System.



Application software is written by the user to handle the necessary computations and specific data management functions. Such programs are usually written in FORTRAN, and run in the host CPU. When required, the application program makes the appropriate subroutine calls to the Image Display Operating System (IDOS) or the Extended Graphics Operating System (EGOS) via the FORTRAN library and the software driver for the interface.

The software driver program for the host interface operates under a particular operating system in a particular CPU. The driver often is optimized for the types of data transfers required by the application. Lexidata offers standard driver packages for all Data General, Digital Equipment PDP-11 and VAX 11/780, Hewlett-Packard, P-E/Interdata and Prime CPUs under a variety of manufacturer's operating systems. Other software drivers are available upon request.

The Image Display Operating System (IDOS) is a program that resides within the System 3400. IDOS performs the vector generation or image manipulation functions requested by the host CPU application programs. Users wishing to extend IDOS capabilities can do so with the optional WCS. This 1K or 4K RAM permits the user to execute modifications to IDOS as well as his own applications software. The Extended Graphics Operating System (EGOS) also resides within the System 3400. In addition to full IDOS capability, EGOS features compact *chained vector storage* and *arc generation*. Vectors of varying widths, colors, and patterns can be displayed up to six times faster, and are stored in as little as one-sixth the memory required by conventional methods. Up to 65,535 vectors of the same color may be generated at one time. *Polygon-fill* allows closed, convex polygons to be displayed and filled with any color.

Details on IDOS/EGOS

IDOS and EGOS furnish a means for controlling the System 3400 from the host computer. They allow the host to request block transfers of picture data, generation of alphanumeric characters, and other functions.

The host computer controls the IDOS/EGOS program by sending a series of commands to the System 3400. Each command requests a specific function of IDOS/EGOS and involves transfer of a variable-length block of data from the host to the System 3400. The first word of each block is the function code, which indicates the function to be performed. The remainder of the block consists of parameters and data words for the function. All data is transmitted and received as 16-bit words. Numbers are represented in 16-bit two's complement format.

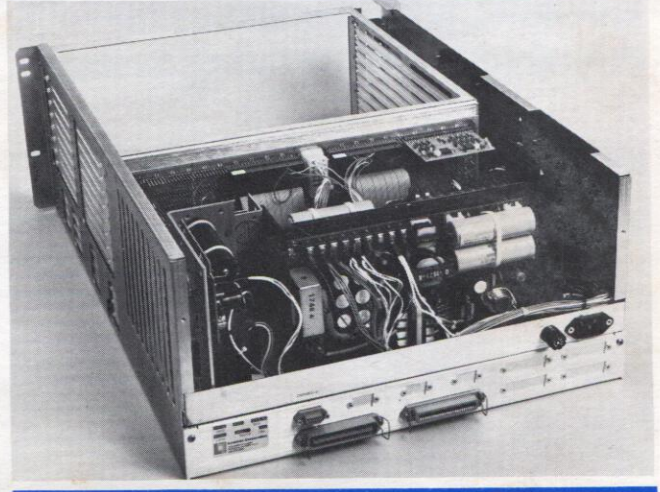
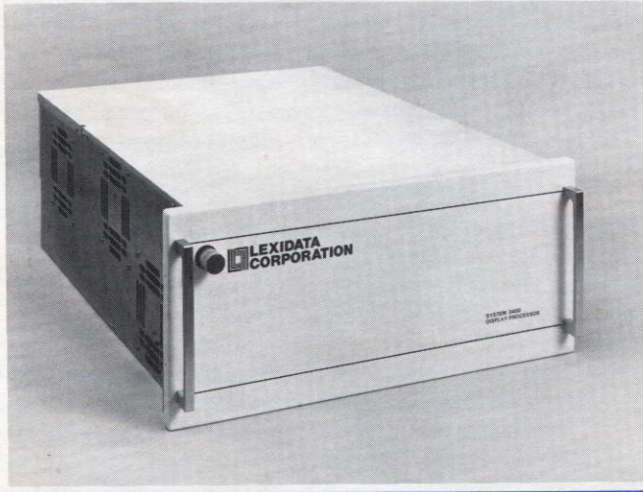
The host computer initializes IDOS/EGOS by pulsing the program start control signal (PSTART), after which IDOS/EGOS performs the following operations:

1. Sets zoom controller to display full view starting at (0,0), using the maximum display area (no margins).
2. Erases the entire display memory.
3. Initializes lookup table for simple black-and-white operation.
4. Displays the IDOS/EGOS program version number.

After completing these steps, IDOS/EGOS waits for a command from the host computer.

IDOS	
INITIALIZATION	
CONFIG	Set Display Memory Configuration
GENERAL	
CHSEL	Set Display Channel Masks
ECHO	Echo Data From Host
ERASE	Erase Display Memory Planes
IMAGE CHANNEL COMMANDS	
RTLIM	Set Rectangle Limits for Sequential Pixel Transfers
SEQW	Sequential Pixel Write
PPIXW	Packed Pixel Write*
SEQR	Sequential Pixel Read
PPIXR	Packed Pixel Read*
RANW	Write Random Pixels
RANR	Read Random Pixels
GRAPHICS CHANNEL COMMANDS	
POINT	Draw Random Points
VECTOR	Draw Vector
CIRCLE	Draw Circle
TEXT CHANNEL COMMANDS	
SAO	Set Alphanumeric Display Parameters
SAO	Set Alphanumeric Display Parameters Character Rotation*
TEXT	Write Text
LOOKUP TABLE COMMANDS	
LUTBL	Generate Lookup Table Ramp
LUTWT	Lookup Table Block Write
LUTRD	Lookup Table Block Read
PAN/ZOOM COMMANDS	
MARGIN	Set Display Margin
ZOOM	Zoom Display
MOVIE	Execute a Movie Display
HARDWARE CURSOR COMMANDS	
CURERS	Erase Cursor Pattern Matrix
CURLD	Load Cursor Pattern Matrix
CURSET	Set Cursor Type and Offset
CURXY	Set Cursor Position
SENDXY	Send Coordinate Input to Host
COORDINATE INPUT COMMANDS	
DSKYB	Get Data from Keyboard
DSSL	Send Lights
BLINK COMMANDS	
BCNTL	Blink Control
BRATE	Set Blink Timing
*Optional	
Additional Commands in EGOS	
DISP	Set Display Parameters
CVEC	Display Chained Vectors
POLY	Display Filled Polygon
ARC	Display Arc
ITAB	Initialize Data Tablet
RTAB	Read Data Tablet

SPECIFICATION SUMMARY



Physical Description

A typical System 3400 configuration fits within one eight-slot chassis, including built-in power supply. The chassis is 19" wide x 5 1/4" high x 24" deep and mountable in a standard 19" rack. A front snap-on faceplate adds another 1 1/4" to the depth dimension. For larger systems, a rack-mountable 12-slot chassis is available (19" wide x 8 1/4" high x 24" deep), with built-in power supply. A front snap-on faceplate adds another 1 1/4" to the depth dimension.

Host Interface

DMA (Direct Memory Access), command I/O, and serial interfaces between the System 3400 and the host CPU are available for a number of popular minicomputers. While the implementation details of each interface vary, they all contain the following physical components:

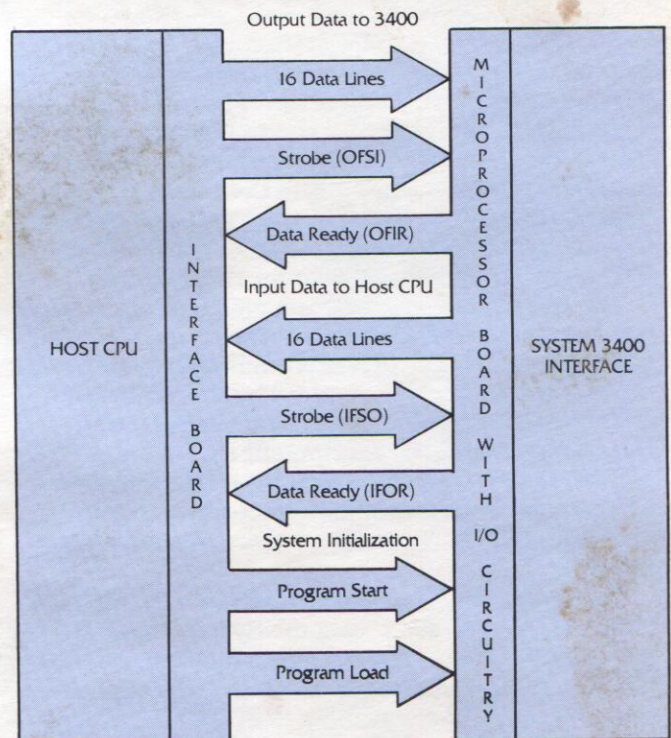
1. Interface residing in the host CPU.
2. Microprocessor board containing an interface residing in the System 3400.
3. Interconnect cables.

With burst data transfer speeds of up to one million 16-bit words per second, the parallel DMA interface is recommended for most high-speed applications. The DMA interface is limited to approximately 25 feet between the host CPU and the System 3400.

A typical DMA interface is shown at the right. Interface signals can be logically grouped into three categories: DATA, STATUS, and STROBES.

Command I/O can operate over all DMA interfaces.

The serial interface (located on the cursor I/O board in the System 3400) is provided for use with non-supported minicomputers. It can be factory-set for transmission speeds of up to 19.2 Kb.



DMA Interface

SPECIFICATIONS

Video output	RS-170 or RS-343A-compatible, or other composite sync and blanking. One volt peak to peak into 75 ohms. Maximum horizontal frequency 64 kHz.	Pixel update times	Based on average time to update System 3400 picture memory from new data in host computer memory: Random or sequential update: 2 μ sec/pixel. Random or sequential readback: 2 μ sec/pixel.																									
Refresh rate	Either 25/30 Hz interlaced or 50/60 Hz non-interlaced.	Vector drawing time	Setup time: 13 μ sec. Drawing time: 3 μ sec/pixel.																									
Alphanumerics	IDOS/EGOS supports any of the following character sets: <table><thead><tr><th>Character</th><th>Overall</th><th>Size</th><th>Size</th><th>Case</th></tr></thead><tbody><tr><td></td><td></td><td>5x7</td><td>7x9</td><td>Upper Only</td></tr><tr><td></td><td></td><td>5x7</td><td>7x11</td><td>Upper/Lower</td></tr><tr><td></td><td></td><td>7x9</td><td>9x11</td><td>Upper Only</td></tr><tr><td></td><td></td><td>7x9</td><td>9x14</td><td>Upper/Lower</td></tr></tbody></table> Changing the character sets is possible without affecting the IDOS/EGOS firmware. Ninety-degree character rotation is available as an option.	Character	Overall	Size	Size	Case			5x7	7x9	Upper Only			5x7	7x11	Upper/Lower			7x9	9x11	Upper Only			7x9	9x14	Upper/Lower	Pan and Zoom (option)	1x, 2x, 3x, . . . to 16x selectable over the screen area without destroying the original stored image in refresh memory. Panning is in any direction, at any zoom factor including 1x.
Character	Overall	Size	Size	Case																								
		5x7	7x9	Upper Only																								
		5x7	7x11	Upper/Lower																								
		7x9	9x11	Upper Only																								
		7x9	9x14	Upper/Lower																								
Cursor (option)	Size and shape of non-destructive cursor is user-loadable within 64 pixel x 64 pixel matrix. Full-screen cross-hair cursor is also selectable.	Blinking (option)	User-programmable blinking rate of any area or character on multiple planes, all data on a selectable plane, or all pixels of the same intensity.																									
Gray scale lookup table (option)	Program-controlled mapping of up to 12 bits of intensity data to eight bits of gray scale video output. Up to 256 levels of gray can be displayed.	Interfaces (option)	DMA, command I/O, or serial interface options to 16-bit parallel link; a 32-bit minicomputer may operate with the System 3400 through a modified 16-bit parallel interface.																									
Color lookup table (option)	Program-controlled mapping of 12 bits of intensity data to 24 bits of video output, eight for each gun (red, green, blue) of an RGB color monitor. Up to 4096 colors can be displayed simultaneously, selected from $2^{24}-1$ combinations. A gray scale lookup table can be operated in parallel with a color lookup table.	Software (option)	FORTTRAN-callable subroutines for a wide variety of minicomputers and operating systems (as described earlier) are available.																									
Picture memory	Standard configurations: 512 x 512 pixels 1 to 16 bits per pixel 640 x 480 pixels 1 to 16 bits per pixel 640 x 512 pixels 1 to 16 bits per pixel 1024 x 1024 pixels 1 to 4 bits per pixel 1280 x 1024 pixels 1 to 4 bits per pixel 640 x 512 pixel window of 1280 x 1024 memory (1 to 8 bits per pixel) 880 x 704 pixel window of 1280 x 1024 memory (1 to 4 bits per pixel)	Data transfer rate	Up to one megaword (16 bits/word) per second from host computer in burst mode.																									
Input devices (option)	Interfaced via the host computer or the System 3400—joystick, trackball, keyboard, data tablet.	Power requirements	Either 110 VAC or 220 VAC, 50 Hz or 60 Hz.																									
		Power consumption	300 W average (eight-slot chassis). Requirements vary depending on configuration size.																									
		Environmental requirements	Operating temperature: 0° to 55° C. Storage temperature: -35° to 70° C. Operating relative humidity: to 90% (non-condensing). Storage relative humidity: to 95% (non-condensing).																									
		Dimensions	8-slot chassis: 5¼" high x 19" wide x 25¼" deep. 12-slot chassis: 8¼" high x 19" wide x 25¼" deep.																									
		Weight	8-slot chassis: 40-70 lbs. including power supply. 12-slot chassis: 60-100 lbs. including power supply.																									

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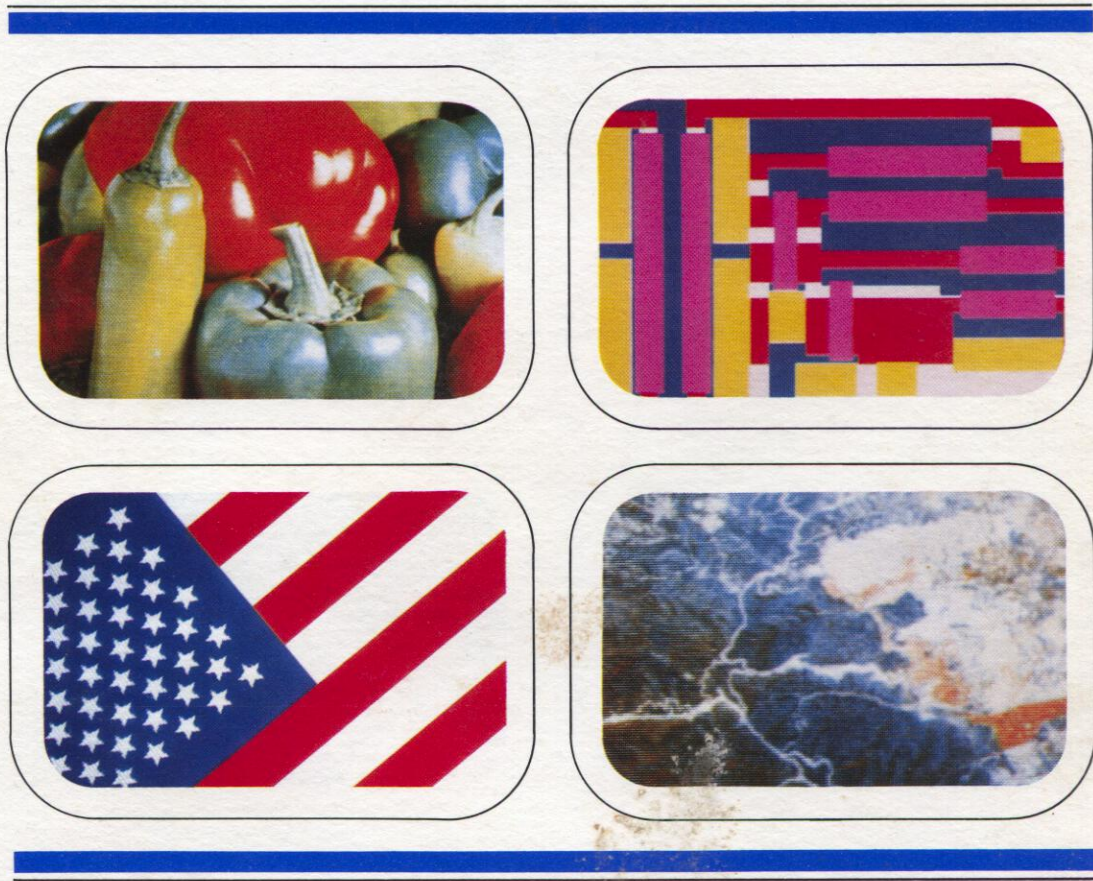
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