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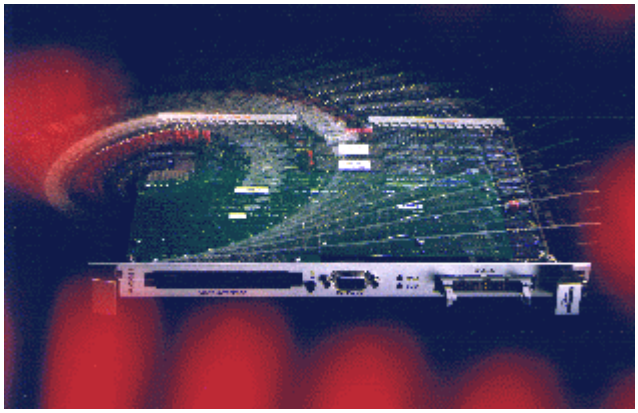
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Vantage-II Scan Converter



The Vantage-II Scan Converter card operates in conjunction with the Virgo++ radar input card to provide a complete display driver for raw radar images. The scan conversion algorithm is based on a powerful coordinate transformation processor which accurately maps the incoming rho-theta radar image to the Cartesian coordinates of the display framestore. Primagraphics' field-proven image mapping technique ensures that there are no holes in the displayed image and that target shapes are preserved at all range scales. The conversion processor is able to update a 2k x 2k resolution display in real time with up to 60 r.p.m. antenna rotation rate.

Vantage-II incorporates the Motorola MC68030 processor, clocked at 40MHz, to control the scan conversion process and to provide general purpose graphics drawing capability. It is able to define windows of any shape and size, and can perform simultaneous scan conversion in multiple windows. The special logic provides smooth fading of the radar image to simulate a long persistence phosphor. Fading is a visually smooth and continuous process which can be programmed to take any desired time period.

Vantage-II can also scan convert the image data from two separate radars and either overlay them in a single window or display them in two windows. The two radars can be shown in different colours and can be made to fade at different rates if required.

The display daughterboard provides the analogue video output via a high performance RAMDAC which gives up to 256 underlay colours and 15 overlay colours from a palette of 16 million colours. The maximum pixel frequency is 200MHz which allows a screen refresh rate of 72Hz at up to 1600 x 1280 resolution. This card can provide underlay and overlay graphics on its own, or can be connected to standard workstations or other Primagraphics cards to give high quality radar display in an X-windows environment. Other daughterboards are available.

Features

- Proven scan conversion technology
- Excellent image quality
- 4Mpixels per second conversion rate
- Variable persistence
- X-windows compatible
- Multiple radar windows
- Simultaneous scan conversion of 2 radars
- Zoom up or down over wide range
- Image rotation in 0.18° steps

- 360° rho-theta store for instant view changes
- Dual 2048 x 2048 rho-theta stores or single 2048 x 4096 store
- On-board framestore
- Display resolution up to 1600 x 1280
- 8 underlay planes and 4 overlay planes
- 3-colour hardware cursor
- 40MHz MC68EC030 processor
- Up to 1Mbyte fast static RAM
- Up to 1Mbyte EPROM
- Dual RS232 serial ports
- VME bus master and slave
- Up to 2048 x 2048 display resolution with off-board framestore
- Video keying option for standard workstations

Software Support

- PARIS interface for X-windows and Windows-NT
- Built-in test in EPROM
- Scan conversion software in EPROM

Technical Description

Radar Input

The card is connected to 1 or 2 Virgo++ radar input cards via a 16 bit parallel channel. The radar image data is input as 6 bit samples and written to the polar stores in rho-theta format. The capacity of each polar store is 2048 x 2048 pixels (2048 azimuth steps with up to 2048 samples per sweep). When used with a single radar input the two stores can be reconfigured by software to provide 2048 azimuths and 4096 range samples.

Scan Conversion

The scan conversion process is performed by transforming the X and Y coordinates, of each screen pixel in turn, into the corresponding rho and theta. This operation is performed by the Raytheon TMC2330 coordinate transform chip to provide the precise pixel location. Rho is then multiplied by a programmable factor, to give the required range scale, using a 16 bit multiplier. This is followed by subtracting the North offset from theta and the range offset from rho to give the final pixel coordinates in the polar store. The scan conversion process updates the screen image in sectors to give the appearance of a rotating update, closely following the antenna.

For each scan line segment within the sector, the control processor computes the X and Y coordinates of the first pixel in terms of screen pixels relative to the position of the radar origin. It also calculates the corresponding framestore address for this pixel and the length of the line segment. These values are loaded into a FIFO memory and are processed in order by the scan conversion logic. The processor also loads the registers defining the range scale, North offset, range offset and current black pixel value.

Persistence

A 6 bit pixel value is read from the radar image and is written to the display framestore if no fading is required. When the fade option has been selected the new data is compared with the old pixel data and the higher value is written back to the framestore. In general, fading is achieved by rotating the values in the RAMDAC look-up table so that older target images gradually reduce in brightness. To compensate for the changing value the new pixel values are added to a constant which represents the current black level for the display.

The fade rate is controlled by software and may be set to different values for the two radars.

Target Spreading

The scan conversion process results in a general enlargement of the radar image in the azimuth direction at long range, and a reduction at short range. Although targets appear bigger in rho-theta space as they approach the antenna, it is possible that very small targets may not be visible. An option on the Vantage-II card allows the target images to be spread in the azimuth direction at short range so that even single point targets will appear on the display. Targets may also be spread in the range direction when the image size is scaled down for display.

Processor and I/O

The card is controlled by the on-board Motorola MC68030 processor which runs software held in EPROM. The processor is responsible for communicating with other cards in the system, via the VME bus, and for controlling the on-board circuits.

The card is able to perform 8, 16 or 32 bit transfers via the VME bus in both master and slave modes, and incorporates the logic to act as bus controller. Part of the framestore can be configured as shared memory for communicating with a VME host. A dual serial channel controller allows direct connection of RS232 compatible devices, such as a keyboard and mouse, or connection to a remote host for control purposes.

Display Framestore

The display framestore has a 2Mbyte underlay memory with 8 bits per pixel and a 1Mbyte overlay memory with 4 bits per pixel. The framestore is directly accessible by the 68030 processor and via the VME bus in slave mode. The display format and pixel frequency are programmable over a wide range up to a maximum resolution of 1600 x 1280 pixels. A Brooktree Bt468 RAMDAC provides 256 underlay colours, 15 overlay colours and a 3 colour hardware cursor. Four of the underlay bit-planes may be used for displaying a background map if required. Alternative framestore daughterboards are available to provide resolutions of up to 2048 x 2048, or special interfaces including HIPPI and a synchronous video channel.



Vantage-II Architecture

The Vantage-II scan converter is one of a range of complementary radar processing and display products developed by Primagraphics. The Virgo++ radar interface card connects to a wide range of radar sources, preprocessing and digitising the radar video to provide a digital signal appropriate for the Vantage-II scan converter. The display output of the Vantage-II scan converter can be combined with that of a graphics workstation or a CAT-based graphics system using one of Primagraphics' range of video keyer cards. The video keyer extracts clock signals from a graphics display source to allow the Vantage-II display output to be exactly synchronised. The two display outputs are combined by the video keyer such that bright graphics from the workstation overlay the scan converted radar video image, whereas less bright graphics appear behind the video image (which itself is semi-transparent).

PARIS

Primagraphics' Advanced Radar Interface Software (PARIS) provides the architecture and interfaces that support the development of software using scan conversion, video windows, map graphics and X-windows. PARIS defines a number of layers that lie between the application program and the display hardware. The architecture supports a wide variety of hardware types and configurations (including Vantage-II), whilst preserving a consistent Application Programming Interface (API). PARIS allows a radar scan conversion application to be fully linked to X-windows or the Windows-NT GUI.

Specification

Data input:	16 bit TTL, 20MHz clock 8 bits per radar sample
Polar store:	2048 x 2048 resolution for two 360° images or 2048 x 4096 for a single image
Conversion hardware:	TMC2330 coordinate transform processor 16 bit multiplier 16 bit bit-slice processor

Conversion rate:	5.33Mpixels/sec. peak 4Mpixels/sec. mean
Persistence:	Fading through 128 levels by hardware Programmable fade rate over any period Software option for two independent fade rates
Processor:	MC68EC030 clocked at 40MHz
EPROM:	256k, 512k or 1Mbyte
Static RAM:	256k or 1Mbyte
Serial I/O:	Dual RS232 at up to 38.4kbaud
VME bus master:	D32/16/08 (EO), A32/24/16 Up to 13Mbytes/sec. transfer rate
VME bus slave:	Memory slave D32/16/08 (EO), A32 Memory address link selectable
VME interrupter:	I (1-7) ROAK D08 (0)
VME interrupt handler:	I (1-7) D08 (0)
Framestore:	2Mbyte underlay memory 8 bits deep (4Mbyte option) 1Mbyte overlay memory 4 bits deep
RAMDAC:	256 underlay + 15 overlay colours from 16M palette
Resolution:	Programmable up to 1600 x 1280, non-interlaced at 72Hz (2048 x 2048 option)
Video output:	1V nominal into 75Ω Sync-on-green or separate TTL syncs Up to 200 Mpixels/sec.
Board dimensions:	233mm x 160mm. Occupies standard 6U single VME slot
Power requirements:	+5V ± 5%, 6.0A max. +12V ± 10%, 1mA max. -12V ± 10%, 0.25A max.
Operating temperature:	0 to 55°C
Humidity:	5 to 95% non-condensing
Software support:	PARIS interface for integration into X-windows or Windows-NT environment Scan conversion and built-in test software in EPROM

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