# The EMS Spectron Video Synthesizer

EMS, Internationally known for its range of audio synthesizers, have introduced the world's first video equivalent. It is possible that their video synthesizer, known as Spectre, may do for colour television graphics what the electronic music synthesizer has done for sound. The designer of Spectre is Richard Monkhouse, a development engineer with EMS.

The potential uses of the synthesizer are graphic design, special effects for video recording and television broadcasting of kinetic art. Spectre controls the interaction between colours and brightness of an image that has been generated internally, or externally from a black and white video camera or video recording device. The result is displayed on a colour video monitor. The graphics are derived either directly from logic signals or from analogue function generators controlled by logic. This enables the synthesizer functions to build up on a patch board in a logical way with digital signals overcoming the problems of noise and signal interaction.

To generate patterns, the output from binary dividers are added together through AND gates which have their inputs brought out to a matrix pin board on the front panel. This produces a chequerboard pattern which may have outputs from the analogue generator superimposed upon it. The bars of the chequerboard can have a variable mark/space ratio and a variable distance between them, depending on which outputs from the binary dividers have been patched in.

The colour of the image can be dependent on the luminance level. There are 64 different colour combinations programmed by digital “words” setup on the patchboard. The luminance is controlled by 16 digital level combinations. 64 colours with 16 levels of associated brightness combinations. To create spheroids and triangles, dual ramp generators are used with the intersection of the two voltages producing a visible locus. These function generators have characteristics defined by the control voltages allowing modulation by internal oscillators or external signals or music to create random or pseudo-random pattern changes.

An input from an external video signal source may be processed by analysing the amplitude of the individual picture elements. The amplitude is split into seven discrete levels by a seven-stage comparator, each level involving am assigned colour or texture pattern. In addition to the luminance signal of the video frame, a separate coloured image is created. This facet of Spectre may find an application in X-ray recognition. Also, it is possible to create the equivalent of acoustic feedback by focussing the video camera on the screen of the monitor, resulting in a moving pattern every time the signal travels around the loop, it modifies the image.

The EMS video synthesizer can be produced to any video standard and is capable of operating from internal or external sync. The recommended package consists of the Spectre, a Sony black and white video camera, and a modified Sony monitor.

The complete package was available for over 4,000 pounds from Electronic Music Studios (London) Ltd, 277 Putney Bridge Road, London SW15 2PT (from Studio Sound October 1974).

Another description follows:

Spectre produces digital signals which control colour and luminance on the video monitor. There are 16 brightness levels and 64 different colour choices. It also generates signals which decide whether the colour and brightness occur on the screen on an X-Y coordinate basis. The signals are selected on a patchboard (a matrix of sockets which allows various cross-connections to be made). For example, patching X2 to zero luminance produces three light vertical stripes on the screen (the video signal is on, off and on). By patching to both X and Y positions, checkerboard patterns with different colours can be created.

Other shapes, such as circles, triangles and curves are also generated within Spectre. EMS foresee a wide range of applications for Spectre. The most obvious are in the graphic arts – poster, textile and wallpaper design, film titles and complete video programmes. Already, academics have expressed interest in the machine for teaching the principles of design, the nature of image and colour and even Boolean algebra.

# Spectron by EMS

Spectron is a compact, highly innovative complete video synthesizer. It combines great flexibility with proven design while still maintaining low cost. There are no compromises as to the treatment or composition of video signals. Spectron is an EMS product. EMS established and maintain a world lead in the design and manufacture of portable electronic music synthesizers. Many of the design concepts of these audio devices are incorporated into the video one. For instance, the portability, matrix patch panels and pins rather than clumsy patch cords, voltage of analogue signals and a full complement of separate device treatments within the unit.

Spectron is designed for any video graphics application. Whether it is fabric design, perception studies, television special effects or video abstract art. Combined with a colour TV projector it makes the ultimate light show for groups and discotheques. Spectron can be supplied with a specially adapted colour monitor 9for best colour reproduction) and with a black and white video camera. By itself, it is suitable for use with any colour TV monitor to which it is connected via the aerial socket.

Spectron will produce its own shapes and colours or it can be used to modify a video input signal such as from a video tape recorder or video camera. Both methods may be used at the same time so that an existing video signal can be colourised and patternised and then combined with a moving or static electronically generated image. An audio signal can be used in many ways to change to change the electronic images.

Spectron is divided into two main parts. The major digital portion which allows many logic operated combinations of basic pattern image sources and the smaller analogue part which is for the voltage control of comparator levels, shape generators, brightness and colour of the output signal, aw well as for controlling audio signal input.

# TECHNICAL SPECIFICATIONS

## IMAGE SOURCES

### X AND Y COUNTERS

These produce vertical and horizontal stripes in binary width multiples (0-9).

### SLOW COUNTER

Gives six binary related square waves which change state during frame flyback (0.2 Hz – 6 Hz).

### 4 SHAPE GENERATOR OUTPUTS

Each is one of sixteen basic shapes. The shape selection may be advanced manually or allowed to cycle round at controllable rates. (Each shape may be made to move and change by using appropriate voltage control input on the analogue control matrix).

### VIDEO COMPARATOR

Divides the grey scale of a monochrome input signal into seven levels , each of which may be individually patternised or colourised. (Comparator level spacing is voltage controllable).

## IMAGE MODIFIERS

### 4 OVERLAY GATES
Allow the areas of one image to cut those of another.

### 4 INVERTERS
Produce an active are that is the background of a signal fed into their input.

### EDGE GENERATOR
Produces a border around an image. Four outputs give narrow or wide edge effects at leading or trailing borders. (eg: to produce just the outline of the original image, or to create an illusion of depth when combined with the image itself).

### DELAY
To delay the signal at its input by approximately one micro-second, causing a shift to the right of the screen of about 1 cm. (May be used in conjunction rest of the patchboard to produce double images, edge effects and echo oscillation).

### 2 FLIP FLOPS
Divide the spatial frequency (horizontal) of an image. The two flip flops trigger on opposite edges.

### INVERT X INVERT Y
(Nine inputs of each): grounding an invert X reverses the phase of the appropriate X output. By patching dynamic signals into the invert input, many complex checker patterns may be obtained.

## OUTPUTS

### OUTPUT A & OUTPUT B

Each with four bits for luminance, the bits for each bias red and blue.

### COLOUR SWAP

Allows a changing over of the two colour axes (C1 and C2) on both output channels.

### TO ACM

Outputs (2) allow filtered versions of the video signals themselves to be fed across to the analogue control matrix and used as voltage control sources.

### VOLTAGE CONTROL SOURCES

2 oscillators with both square and sine outputs.
2 random voltages
3 audio inputs (bass envelope, treble envelope and signal).
2 from DSM inputs (low or high frequency filtering).
4 voltage control slider inputs
1 external input

### VOLTAGE CONTROL INPUTS

2 shape generators to control various functions.
1 video input with controls of luminance, red or blue bias which affects the whole of the final picture.
Comparator level spacing input.

## PANEL CONTROLS

4 voltage control sliders

2 oscillators: range 0.2 Hz – 30kHz. High/low range, course/fine controls of frequency, deviation, level and mode.

Audio input control of level and frequency split (500Hz – 5kHz(.

Random generated control of rate 0.1Hz – 100kHz, slew level and mode – recycle last 16 events/continuous.

2 independent shape generators each with two outputs with control of clock rate (0-10Hz), shape select. Advance and shape number indicator.

Video input – comparator level spacing control.

Video output with control of luminance and red and blue bias.

## ELECTRICAL SPECIFICATIONS

Normally the basic system is PAL, but modifications may be made to convert to NTSC.

Sync input (2.4v – Ve pulses). Sync required: horizontal drive, vertical drive, mixed syncs, mixed blanking, PAL switch (optional), burst gate and subcarrier (2v p.p.)

All the above signals are provided by an internal sync generator that may be linked across to the sync socket by a small jumper lead provided.

## COLOUR SEPARATION OUTPUTS

Red, green and blue (0.7v with blanking to drive 75 ohms bandwidth > 4mcs)

## COMPOSITE OUTPUT

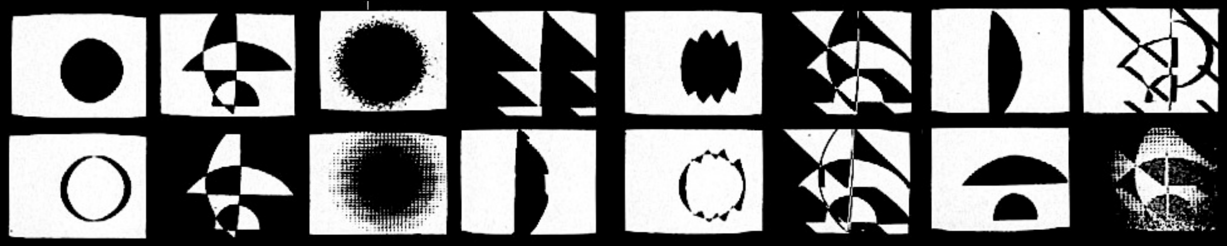
1v p-p. (0.7v video, 0.3v syncs)

**UHF OUTPUT**
Approximately 600 mcs. Suitable to connect to any commercial colour receiver aerial socket. Modulator may be used independently of rest of synthesizer.
**MAINS INPUT**
240/110v at approximately 250va
**ISOLATED MAINS OUTPUT**
240v at 150va max. suited to drive our custom RGB monitor.
**VIDEO INPUT**
1v p-p. composite monochrome 6 pin Din socket on back, suits Sony camera connections and provides horizontal and vertical drives.
**MONITOR OUTPUT**
Synch multiway connector on back provides all equired signals to drive our custom RGB monitor.
**AUDIO INPUT**
Approximately 1v (line level).
**EXTERNAL CONTROL**
Input +/- 5v.
**EXTERNAL DIGITAL INPUT**
Normal TTL levels, 2 inputs suitable for connection to character generators, chroma key switch outputs, etc.

All patching of functions in the Video Synthesizer is done by means of pin board matrix connections. Function outputs appear at horizontal positions (rows) and inputs to functions (as well as to the final output) are at vertical positions (columns). Outputs are labelled at the left side of the pin matrix, inputs on the top. In order to produce an image on the monitor screen, signals must eventually reach the input columns of either Output A or Output B on the DIGITAL SIGNAL MATRIX.

Signals may be processed by either digital or analogue functions. Analogue functions (oscillators, random voltages, control sliders, audio input signals (are controlled by means of sliders on the right hand side of the face panel, and their outputs appear on the rows of the ANALOGUE CONTROL MATRIX. Digital control signals will appears at the rows labelled From Signal Matrix, if patched on the DIGITAL SIGNAL MATRIX into the column labelled To Control Matrix. Other analogue signals (such as those from an audio synthesizer) may be patched in through the back panel, and their outputs will appear on the control matrix at the row labelled External Input.

Functions which may be controlled by analogue signals are: shape generators, video output, and video input comparator levels. Of these, the last two are also controlled by sliders on the face panel. Shapes can be controlled at their inputs on the ANALOGUE CONTROL MATRIX, but their outputs which appear on the DIGITAL SIGNAL MATRIX, is determined by the Shape Select function. Shape Select allows the user to call up any of 16 outputs, each shape is indicated by a particular combination of the four panel LEDs above the advance button.



It is also possible to clock through these outputs at a rate determined by the slider directly below. Any control signal directed to Shape Generator 1 on the ANALOGUE CONTROL MATRIX will affect both outputs 1A and 1B, and likewise with Shape Generator 2, but the outputs appear separately on the DIGITAL SIGNAL MATRIX as 1A, 1B, 2A, 2B.

Shapes indicated by panel graphics on top of the ANALOGUE CONTROL MATRIX are: vertical position, horizontal position, circle, frizz, lantern, gear, vertical “zoom”, horizontal “zoom”. The first two of these are not associated with Shape Select, but control the position of shapes as they appear on the monitor screen. The others may be chosen, separately or in combination, by calling up the proper output on the Shape Select (for instance, with all panel LEDs off – 0000 the circle output is present).

The levels of the three types of Video Output – brilliance, hue 1 (blue) and hue 2 (red) – can be controlled by the sliders on the face panel, or voltage controlled at the inputs on the ANALOGUE CONTROL MATRIX. These together control the overall level of the final output of the synthesizer to the monitor, but the configuration of the various levels of luminance and colour as they appear on the screen is determined by the signals present at their inputs on the DIGITAL SIGNAL MATRIX, where there are four bits for luminance and three bits for each colour.

The video input (available on the back panel) sends black and white video signals to a comparator which divides the luminance (black and white intensity) of the video signal into seven levels. The slider labelled Comparator Level Spacing allows the user to determine the range of luminance which is directed to the comparator. At maximum, the entire range will be divided, while at minimum, only the darkest areas of the input signal will be divided into different levels. In either case, these levels correspond to lighter and darker areas of the black and white image used as input, and appear as signal outputs on the DIGITAL SIGNAL MATRIX.

So far, digital signal outputs which we have discussed are the shapes and video comparator levels only. These two, plus the X and Y outputs, are the only signals which will produce an image when patched directly to Output A or B. Of the other outputs, overlay, invert, edge, delay, flip-flop are all signal processors; that is, they have no output unless there is a signal present at their input. The Slow Counter is a controller only, effectively producing on-off signals at six different frequencies, which is most useful when applied to an input such as the Colour Swap, or to disenable a signal at an overlay gate.

X positions produce vertical bands, Y horizontal bands. The different levels, 0 – 8, produce bands of different widths, each level being twice the frequency (half the width) of the level above it. When two different levels are patched into the same column of video output they are added together; the visual effect is that the positive bands produced by the level of higher frequency appear only where the band of the lower frequency is negative. This is true for any two signals patched into the same column, but it most clearly demonstrated with the X-Y signals.