VISUAL CORTEX

TECHNICAL MANUAL

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VERSION 1.1 – DECEMBER 9TH 2014
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DEAR VIDEO ARTIST

Our world moves rapidly at the pace of progress – ravenous for the highest definition, the largest display, and the fastest data transfers. In our hunger for new technology, we have left behind a vast expanse of unexplored dimensions and forsaken possibilities.

But not you, Video Artist. You're looking in a different direction. Not ahead, not behind, but parallel. You are a pilot, prepared to man the controls of a time machine.

Your video synthesizer is a retro-futuristic vessel outfitted to explore faraway vistas from the era of analogue television. From your seat in the cockpit you will unveil prismatic motions, expose mesmerizing geometries, and witness hypnotic entities never before seen. Swimming behind the diffused warmth of the cathode ray glow, living images linger, waiting for you. It takes guts to do what you do – many will say your path is absurd.

Thank you, Video Artist, for supporting our continuing efforts at LZX Industries to create new tools and workflows for the timeless medium of analogue video synthesis. Visual Cortex marks a new generation of our products, encapsulating several years of obsessed development and prototyping. While Visual Cortex forms the foundation of a modular system, it is also a powerful tool on its own – everything you need to learn the basics of video synthesis is right here.

Our work would not be possible without the pioneers of video art in the 1960s, 1970s and 1980s. These wonderful human beings cast the first rays that continue to inform and inspire us, and we owe them our gratitude: Bill Etra, Bill Hearne, Daniel Sandin, Dave Jones, Denise Gallant, Eric Siegel, Jim Wiseman, Nam June Paik, Kim Ryrie, Peter Vogel, Phil Morton, Richard Monkhouse, Rob Schafer, Sherry Hocking & Ralph Hocking, Shuya Abe, Stephen Beck, Stephen Jones, Steve Rutt, Steina & Woody Vasulka and countless others. With our work, we endeavor to continue the legacy of these visionaries and their tools.

All of us here at LZX Industries send our love and excitement to you and your companions … we're counting on you, Video Artist. We can't wait to see what you discover out there.

Over and out,

Elizabeth Kay Larsen
December 9th, 2014

Acknowledgments

Product Design & Development	Elizabeth Larsen, Edward Leckie
Assembly Technicians	Jonah Lange, Heather Larsen, David Townsend, Saschenka Lopez
Manufacturing & Distribution	Joshua Holley, Rico Loverde, Paul Baker, Sarah Holley, Anna Sitko, and everyone else at Darkplace Manufacturing in Portland, Oregon
Additional Graphic Design	Adam Fuchs, Hannes Pasqualini – Papernoise
Special Thanks	Johnny Woods, Jennifer Juniper Stratford, Sam Newell, Nick Bartoletti, Jason Nanna, Tommy DOG Prinz, Jordan Bartee, Dan Green, Aaron White, Marcus Webb, Todd Larsen, Paul Baker, Chad Allen, Malcolm Elijah Welbourne, Stephi Duckula, Scott Jaeger, Chris King, David Wagenbach, Shawn Cleary, Kylie Frame, Alex Peverett, Paul Millar and countless others

TECHNICAL SPECIFICATIONS

Mechanical

Width	26HP, 5.2 inches
Height	3U EuroRack Standard
Mounting Depth	1.75 inches
Power Connector	16-pin Male IDC Connector
Included Accessories	(4) M3 x 6mm Mounting Screws, (1) 16-pin EuroRack Standard Power Cable

Power

+12V Power Consumption	180mA
-12V Power Consumption	230mA

Inputs and Outputs

Internal Signals (3.5mm Jacks)	0-1V, DC Coupled, +/-12V tolerant, high bandwidth 0.5V threshold for trigger inputs
External Signals (RCA & S-Video Jacks)	1V after 75R input termination, AC Coupled, high bandwidth

Video Timing

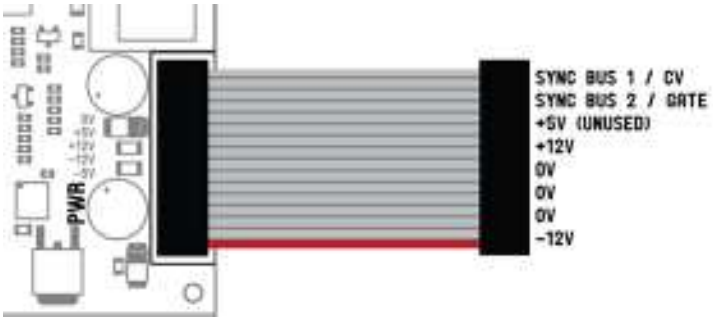
FORMAT	**NTSC/480i**	**PAL/576i**
H Sync Frequency	15,734KHz	15,625KHz
H Sync Pulsewidth	4.7uS	4.7uS
V Sync Frequency	59.94Hz	50Hz
Frame Clock Frequency	29.97Hz	25Hz
Total Scanlines	525	625
Active Scanlines	480	576
Active Pixels	720	720
Frame Clock Frequency	29.97Hz	25Hz
Total Scanlines	525	625

MODULE INSTALLATION

1. Remove module, mounting screws, and power cable from their packaging. Visually inspect all pieces to ensure there is no obvious damage, such as broken connectors.

2. Power down your synthesizer and disconnect the power cable from the wall outlet.

3. Attach the included power cable to the module's power connector, then connect the other end to the power distribution bus in your EuroRack synthesizer case as shown below.



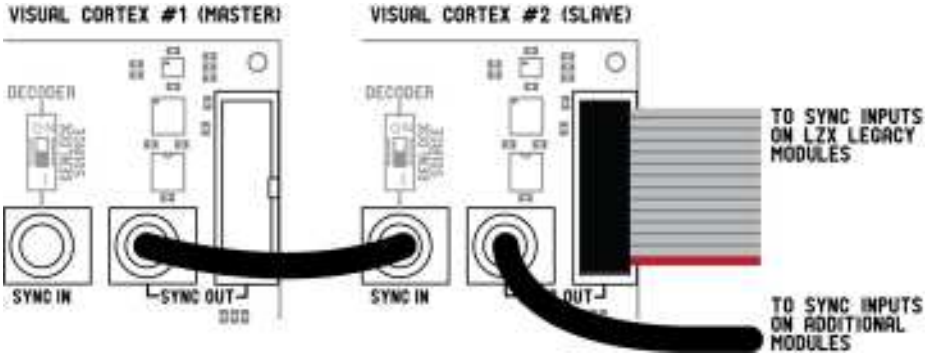
4. Position the module on the mounting rails in your EuroRack synthesizer case and screw down all four mounting screws. After double checking your connections, power your synthesizer back up.

VIDEO SYNC CONNECTIONS

When dealing with analogue video in a hardware environment, synchronization and timing is very important. Any devices with video input and output connections must be synchronized to each other in order to combine the video signals in the same domain. One device must serve as the synchronization master, providing timing references for all the other devices. Typically, this device is the Visual Cortex.

Connecting Additional Video Synthesizer Modules

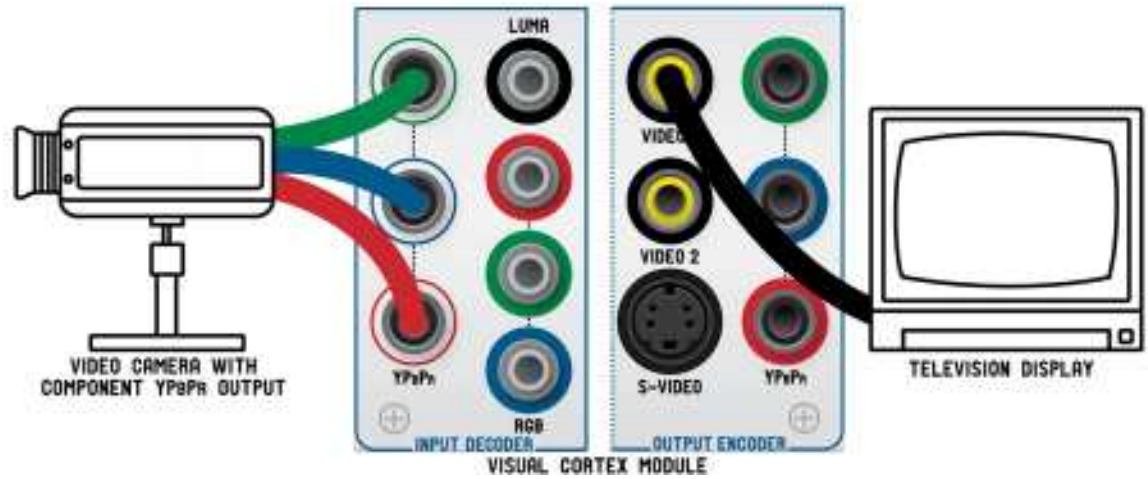
Many video synthesizer modules require access to the synchronization signals. Previous releases by LZX Industries used a 14-pin IDC cable to distribute these signals. The Visual Cortex includes an output header in order to retain compatibility with these modules. Visual Cortex and future releases will use standard video connectors to distribute synchronization timing.



Connecting External Video Input And Display Devices

Whenever an external video input is used with the Visual Cortex, one of two conditions must occur:
1) The external device must serve as the master source, slaving the Visual Cortex's timing to its own.
2) Or, the external device must be genlocked and synchronized to the timing of the Visual Cortex.

Since most video devices do not have a genlock input feature, option 1 will be the most common case. In the case of option 1, please ensure that the sync source selection switch on the rear panel (see the **Sync Generator** section) is set to "Decoder," so that synchronization will be derived from the Decoder input rather than the rear panel sync input.



If additional video inputs are desired, consider purchasing the LZX Color TBC module. This module provides composite video decoding and time base correction of an external source, meaning that genlock is no longer a concern.

SYNC GENERATOR

The **Sync Generator** section is a broadcast specification video sync generator which can operate in NTSC/480i or PAL/576i timing formats. It can provide the master timing reference for an entire video synthesizer system, and its timing may be synchronized to an external video source.

Frontpanel



A. Sync Format LED Indicators. Indicates NTSC or PAL mode.

B. Sync Lock Status LED Indicator. Green when locked to external sync, red when external sync is detected but no lock can be achieved.

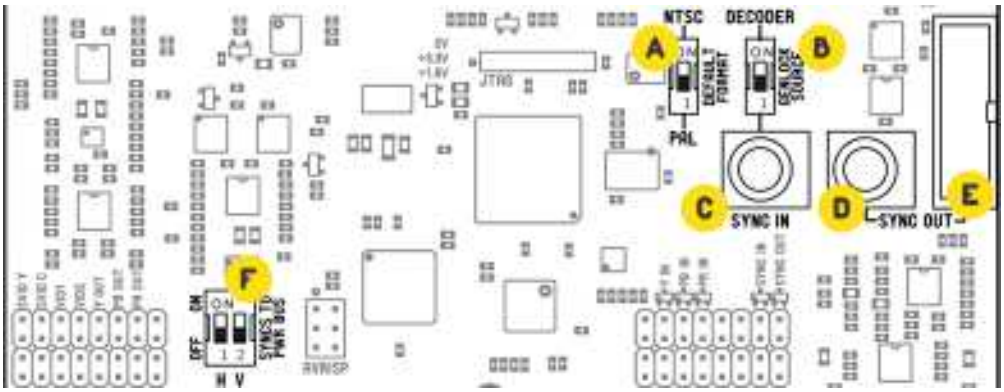
C. Horizontal sync output jack. A pulse at the beginning of each video scanline.

D. Vertical sync output jack. A pulse at the beginning of each video field.

E. Frame rate clock output jack. A gate is turned on at the beginning of each odd field (the start of a new frame), and off at the beginning of each even field.

F. Dither pattern output. A dithered pixel texture for shading video objects. The spatial geometry of the texture is influenced by the selected **Ramp Generator** modes.

Rear



A. Video format selection switch. Selects between NTSC/480i and PAL/576i video formats.

B. External sync source selection switch. Selects between **Input Decoder** or rear Sync In **(C)**.

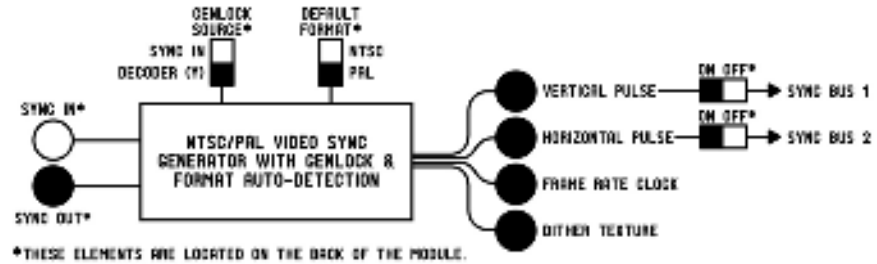
C. Sync In jack. A video input for external synchronization.

D. Sync Out jack. A black video output containing only synchronization pulses.

E. 14-pin LZX Sync Distribution Bus output. A 14-pin sync output for providing sync to previous LZX Industries products which require it.

F. Sync-to-Power Bus selection switch. When on, these switches send horizontal and vertical sync pulses to the CV and Gate pins on the 16-pin power connector.

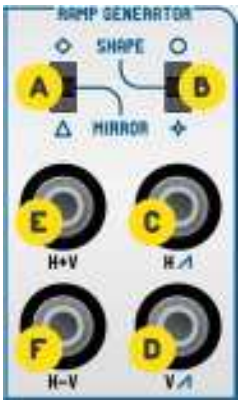
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RAMP GENERATOR

The **Ramp Generator** section is a dual synchronized waveform generator. It generates grayscale gradients in horizontal and vertical outputs, with selectable output waveshapes. These signals provide the basis for many shape and pattern generation techniques.

Frontpanel



A. Mirror mode switch. Controls symmetrical mirroring (ramp-to-triangle).

Up	H & V outputs mirrored
Center	No outputs mirrored
Down	H output mirrored

B. Shape mode switch. Controls the waveshape of the outputs.

Up	Logarithmic
Center	Linear
Down	Exponential

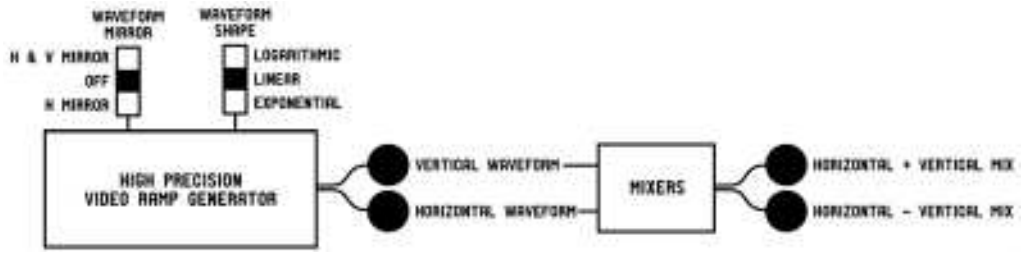
C. Horizontal waveform output jack.

D. Vertical waveform output jack.

E. Sum output jack. Horizontal and vertical waveforms summed together.

F. Difference output jack. Vertical waveform subtracted from horizontal waveform.

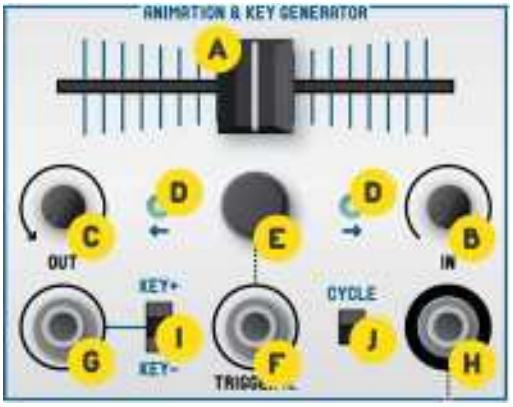
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ANIMATION & KEY GENERATOR

The **Animation & Key Generator** section is a multi-function control voltage generator, designed specifically for controlling transitions between two video images. It can function as a manual controller with slew, a flip-flop based envelope generator, or a low frequency oscillator. The key function enables a high-speed comparator, which generates a hard key image suitable for shape generation or luma keying.

Frontpanel



A. Slider control. Action dependent on mode:

Key Modes Off	Sets target value 0-1V
Key Modes On	Sets output amplitude

B. In time control. Sets the speed at which the output voltage *rises* to the target value.

C. Out time control. Sets the speed at which the output voltage *falls* to the target value.

D. LED indicators. Two color visual indication of target value and output voltage.

E. Pushbutton switch. Action dependent on mode:

Cycle Mode Off	Toggles inversion of target value
Cycle Mode On	Resets output waveform

F. Trigger input jack. On the rising edge of the input signal, the pushbutton **(E)** action is triggered.

G. Primary Input jack. Function dependent on mode:

Key Modes Off	Adds to the target value set by the slider control **(A).**
Key Modes On	Key generator input source.

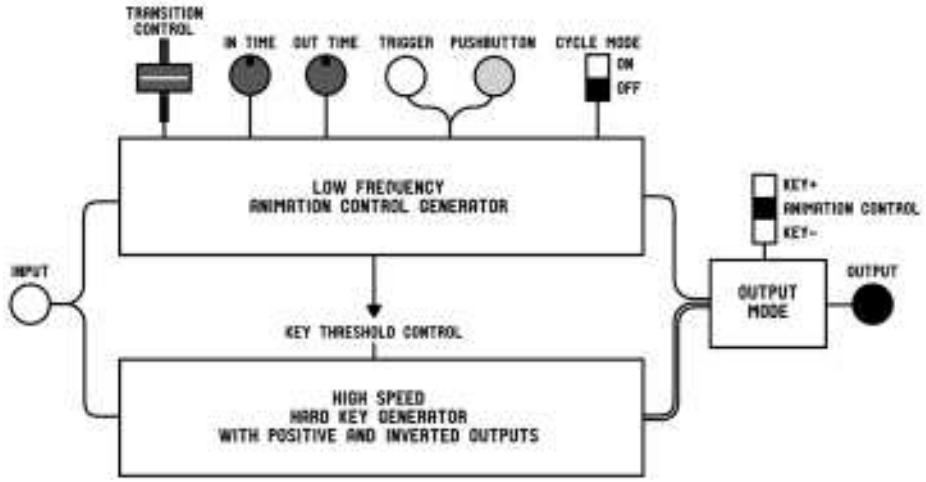
H. Primary Output jack. Output signal dependent on mode:

Key Modes Off	Control voltage output
Key Modes On	High speed video logic output, 0V = low, 1V = high

I. Key mode switch. Switches between positive key generator mode on (+KEY), key modes off (center) and inverted key generator mode on (-KEY.) While key modes are on, the internally generated control voltages become the key generator threshold.

J. Cycle mode switch. Turns automatic cycling mode on or off.

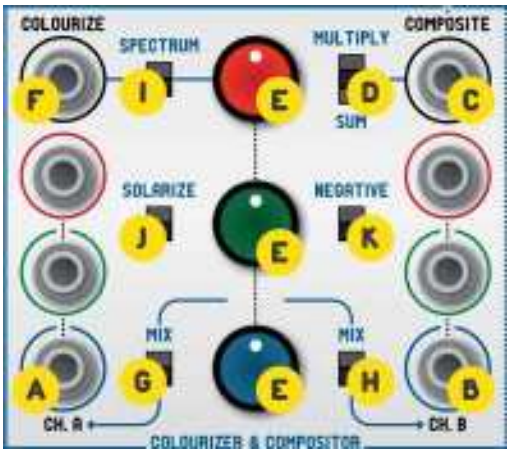
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COLOURIZER & COMPOSITOR

The **Colourizer & Compositor** section is a voltage controlled analogue video mixer. It features two RGB input channels, individual RGB controls and several advanced colour processing effects. We designed this section to be capable of addressing all the essential colour mixing required for a small to medium sized modular video synthesis system. The output of this section is sent directly to the **Output Encoder**.

Frontpanel



A. Channel A RGB input jacks. RGB inputs to Channel A.

B. Channel B RGB input jacks. RGB inputs to Channel B.

C. Composite input jack. Voltage control over the selected Composite mode **(D)**.

D. Composite mode switch. Selects formula used to combine Channel A **(A)** and Channel B **(B)**:

Multiply	(A*B)+((1-B)*VC)
Fade (center)	(A*(1-VC))+(B*VC)
Sum	A+((-B*(1-VC))+(B*VC))

*VC = Composite input signal **(C)**.*

E. RGB colour controls. Clockwise rotation adds the selected colour, while counterclockwise subtracts.

F. Colourize input jack. Voltage source of the RGB colour controls **(E)**. Connected to 1V by default.

G. Mix A on/off switch. Adds the output of the RGB colour controls **(E)** to Channel A **(A)**.

H. Mix B on/off switch. Adds the output of the RGB colour controls **(E)** to Channel B **(B)**.

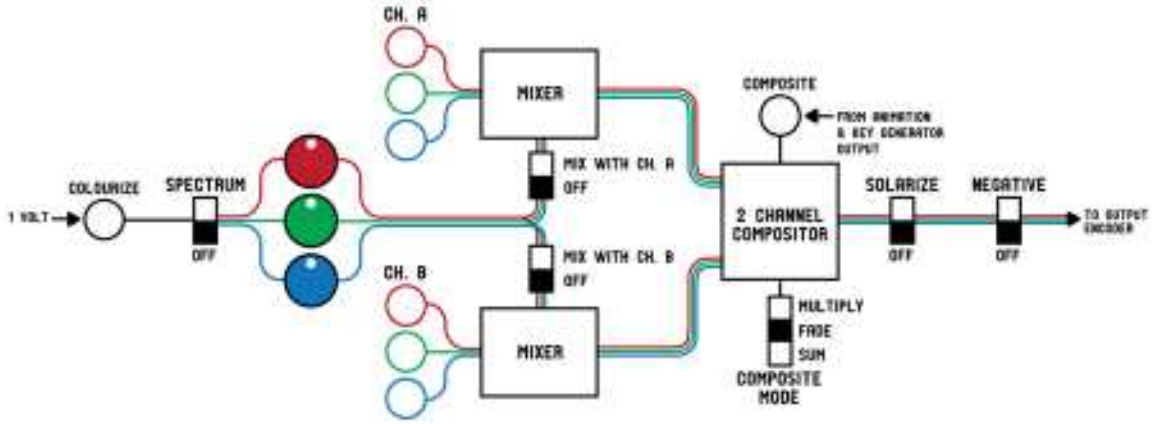
I. Spectrum on/off switch. Translates the value of the Colourize input **(F)** to colour channels:

0V – 0.5V	Red	0%	**0.5V – 1V**	Red	0% to 100%
	Green	0% to 100%		Green	100% to 0%
	Blue	100% to 0%		Blue	0%

J. Solarize on/off switch. Inverts all color values below 0V.

K. Negative on/off switch. Subtracts all color values from 1V.

Block Diagram



INPUT DECODER

The **Input Decoder** section is an analogue video input amplifier and colorspace converter. This section accepts YPbPr analogue component video, and processes it for patching internally inside a video synthesis system. The Y input can be used with Composite video signals if only grayscale operation is desired.

Frontpanel



A. Component YPbPr input jacks. Component YPbPr video inputs for external video gear. If no Component source is available, a Composite (NTSC/PAL CVBS) signal can be input to the Y jack independently. In that case, only grayscale video will be passed to the outputs.

B. Luma output jack. This output is full scale video representing the grayscale brightness of the source video signal.

C. RGB output jacks. These jacks output the Red, Green & Blue color channels of the source video feed when a Component YPbPr source is used.

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OUTPUT ENCODER

The **Output Encoder** section takes the output of the **Colourizer & Compositor** section, converting signals inside your video synthesizer into standard video signals which may be displayed and recorded.

Frontpanel

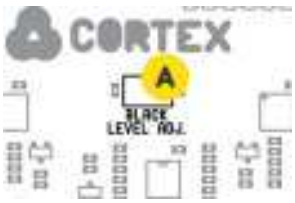


A. Composite video CVBS output jacks. Both jacks output identical video signals.

B. S-Video Y/C video output jack. Separate luma (Y) and chroma (C) signals to S-Video format Mini DIN 4 jack.

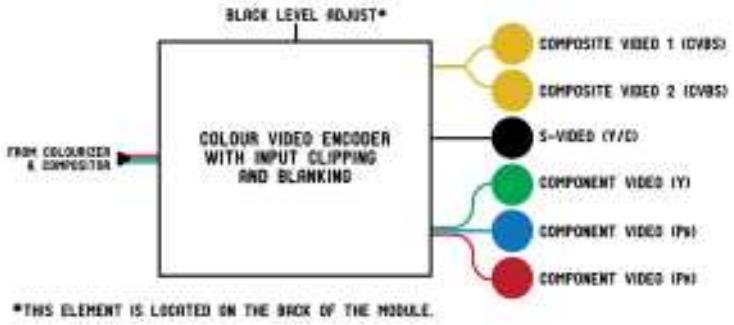
C. Component YPbPr video output jacks. Component video outputs for the highest quality full color analogue signal path.

Rear



A. Black Level Adjustment trimmer. Adjusting this trimmer will adjust the brightness level of all the encoder outputs when calibrating for displays and recording devices.

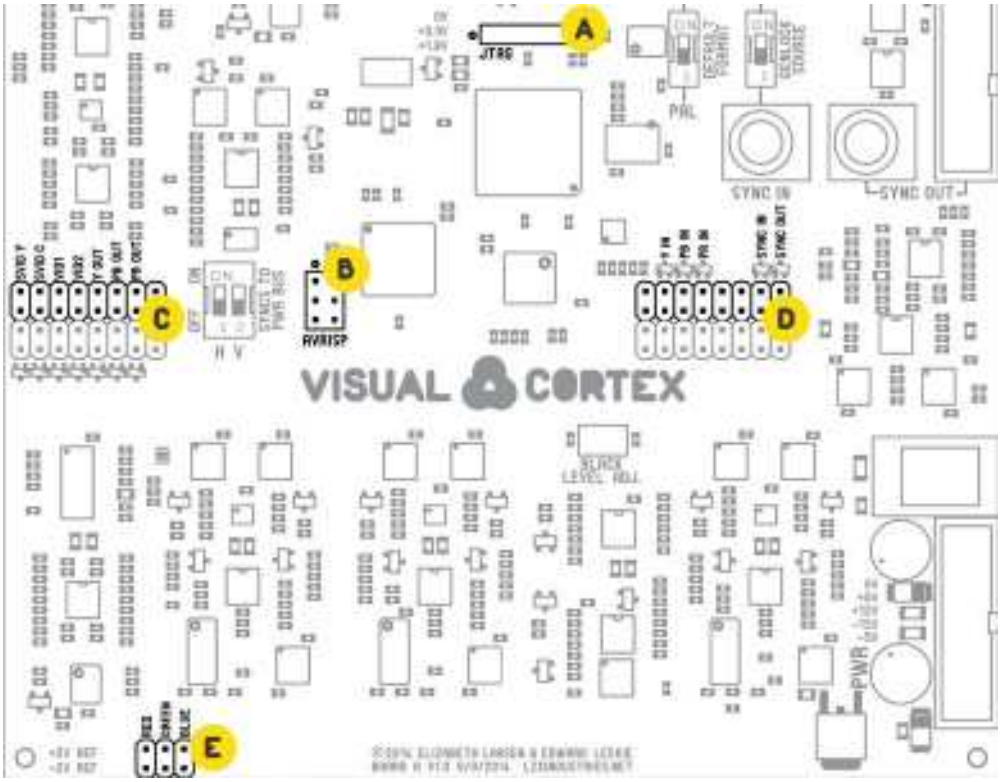
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EXPANSION & PROGRAMMING HEADERS

Visual Cortex contains many connectors accessible via the rear of the module. LZX Industries will not offer technical support or service for use of these headers, but savvy users may be able to tap into them and find them useful for custom applications.

Rear



A. JTAG programming header. For uploading firmware to the Xilinx XC2C256.

B. AVRISP programming header. For uploading firmware to the AVR Atmega32A.

C. Video IO connections header 1. For wiring external connectors.

1, 3, 5, 7, 9, 11, 13, 15	GND
2	Output Encoder, S-Video Y Out
4	Output Encoder, S-Video C Out
6	Output Encoder, CVBS Video 1 Out
8	Output Encoder, CVBS Video 2 Out
10	Output Encoder, Component Y Out
12	Output Encoder, Component Pb Out
14	Output Encoder, Component Pr Out

D. Video IO connections header 2. For wiring external connectors.

1, 2, 3, 5, **7, 9, 10, 11, 12, 13, 15**	GND
4	Input Decoder, Component Y In
6	Input Decoder, Component Y In
8	Input Decoder, Component Y In
14	Sync Generator, External Sync In
16	Sync Generator, External Sync Out

E. RGB expansion header. Direct access to the RGB channels before encoding.

WARRANTY

This product is covered by LZX Industries' warranty, for one year following the date of manufacture. This warranty covers any defect in the manufacturing of this product. This warranty does not cover any damage or malfunction caused by incorrect use – such as, but not limited to, power cables connected backwards, excessive voltage levels, or exposure to extreme temperature or moisture levels.

The warranty covers replacement or repair, as decided by LZX Industries. Please contact customer service via our website (http://www.lzxindustries.net) for a return authorization before sending the module. The cost of sending a module back for servicing is paid for by the customer.