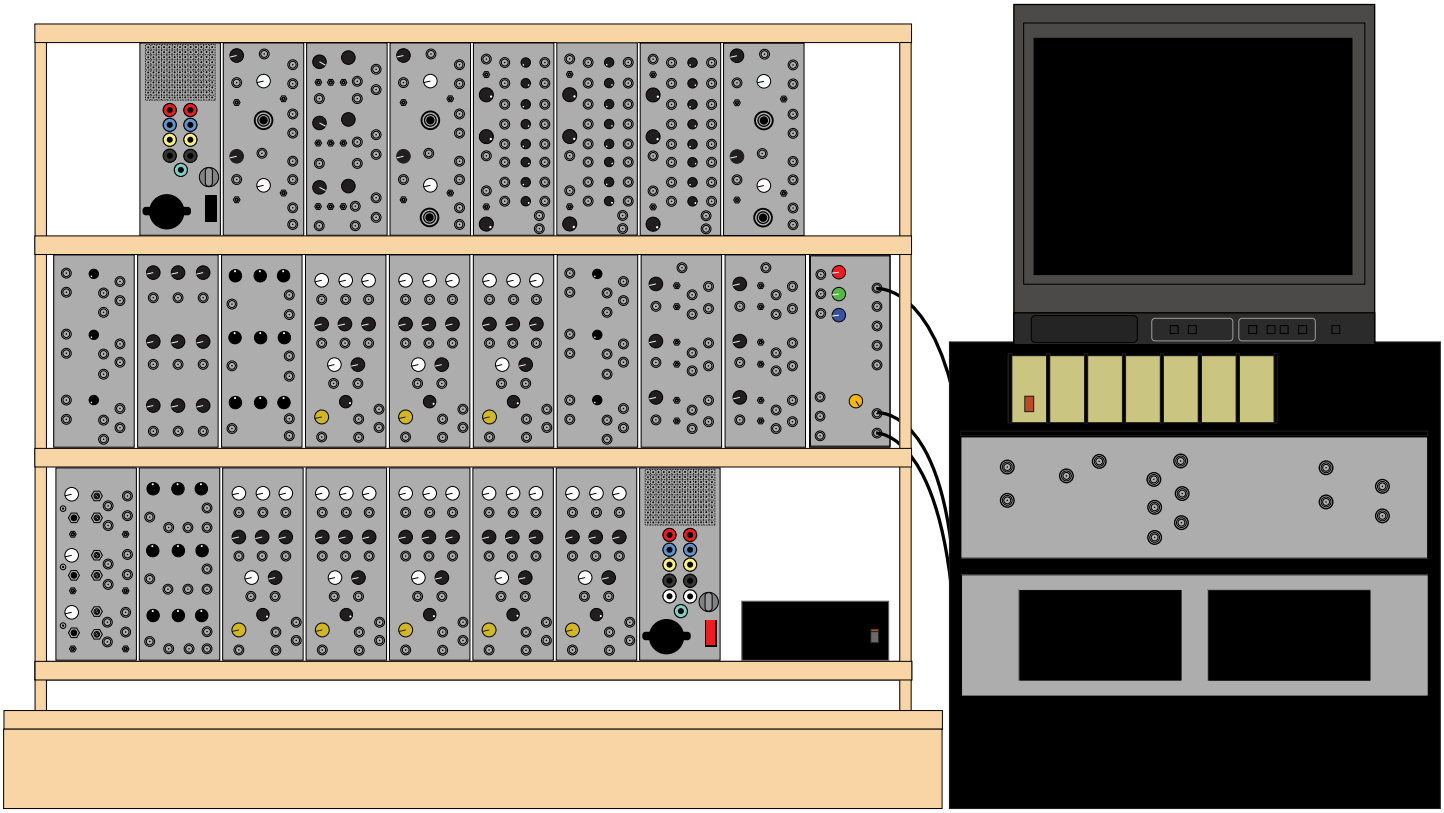
2026 GUIDE TO THE FVNMA SANDIN IMAGE PROCESSOR

REALTIME VIDEO, FVNMA 3812

JAMES CONNOLLY



This user manual was created for the Realtime Video class in the Film, Video, New Media, and Animation (FVNMA) class at the School of the Art Institute of Chicago (SAIC). It covers the functionality of several modules and shows example patching methods that are relevant for all Sandin Image Processor machines.

The guide uses the FVNMA SAIC Sandin Image Processor setup to show example patches, but the patching methodologies are relevant to all Sandin Image Processor setups, so I am sharing it publicly.

This guide introduces modules through detailed diagrams (including showing where each module is located in the FVNMA setup), and then shows how to use those modules to patch systems of increasing complexity.

These example patches include:

- Generating abstract visuals using the Oscillator and Adder/Multiplier modules
- Processing live video from one or two black and white video cameras using the Input, Adder/Multiplier, Function Generator, Differentiator, and Amplitude Classifier modules
- Processing full color live video from a laptop or any other video device connecting through a video mixer that converts video signal into three red, green, and blue inputs

These are just example patches to introduce the basics of the Image Processor, and do not represent the full capabilities of the machine. Once you understand the interfaces and signal flow, experiment on your own!

For Realtime Video students, these supplies are necessary for use:

1. An external hard drive to save captured footage to with at least 200 GB of space. Video is captured at a very large file size, so plan to encode the video before editing it. **(REQUIRED!)**
2. To use the black and white cameras in room 807, check out one or two tripods from the Media Center
3. If you want to send video from your laptop in, bring an HDMI cable and dongle necessary to output HDMI video if your device doesn't have direct HDMI output

TURNING THE FVNMA IMAGE PROCESSOR ON AND OFF

ONLY USE THIS MACHINE IF YOU HAVE RECEIVED CERTIFICATION TO DO SO!

ALWAYS FOLLOW THIS ORDER WHEN TURNING THE SANDIN IMAGE PROCESSOR ON:

1. TURN ON THE SONY TELEVISION VIA THE BUTTON AT THE BOTTOM RIGHT

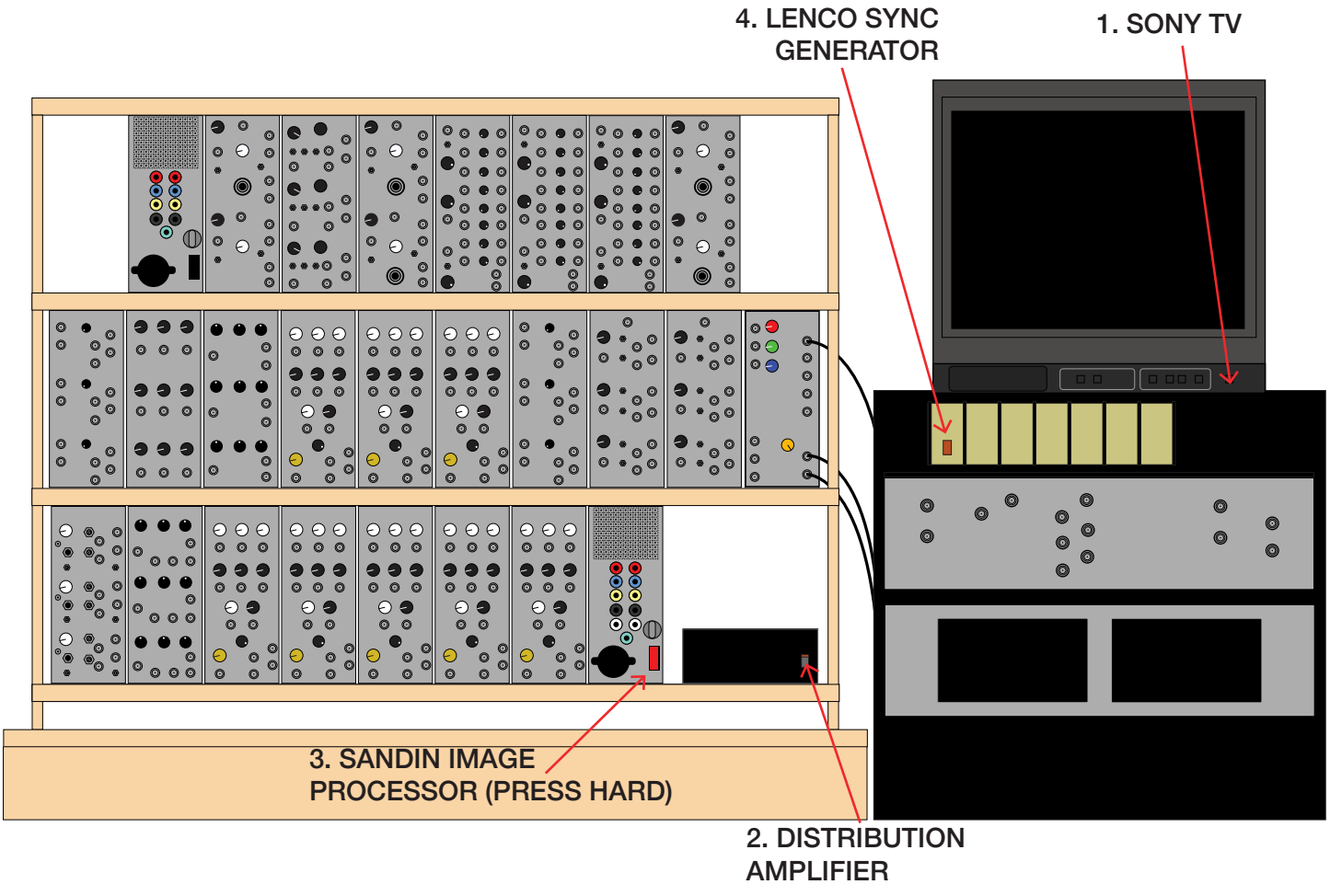
2. TURN ON THE BLACK DISTRIBUTION AMPLIFIER AT THE BOTTOM RIGHT OF THE ENTIRE SYSTEM

3. TURN ON THE SANDIN IMAGE PROCESSOR VIA THE POWER MODULE AT THE BOTTOM RIGHT

4. TURN ON THE CREAM-COLORED SYNC GENERATOR BELOW THE SONY TELEVISION

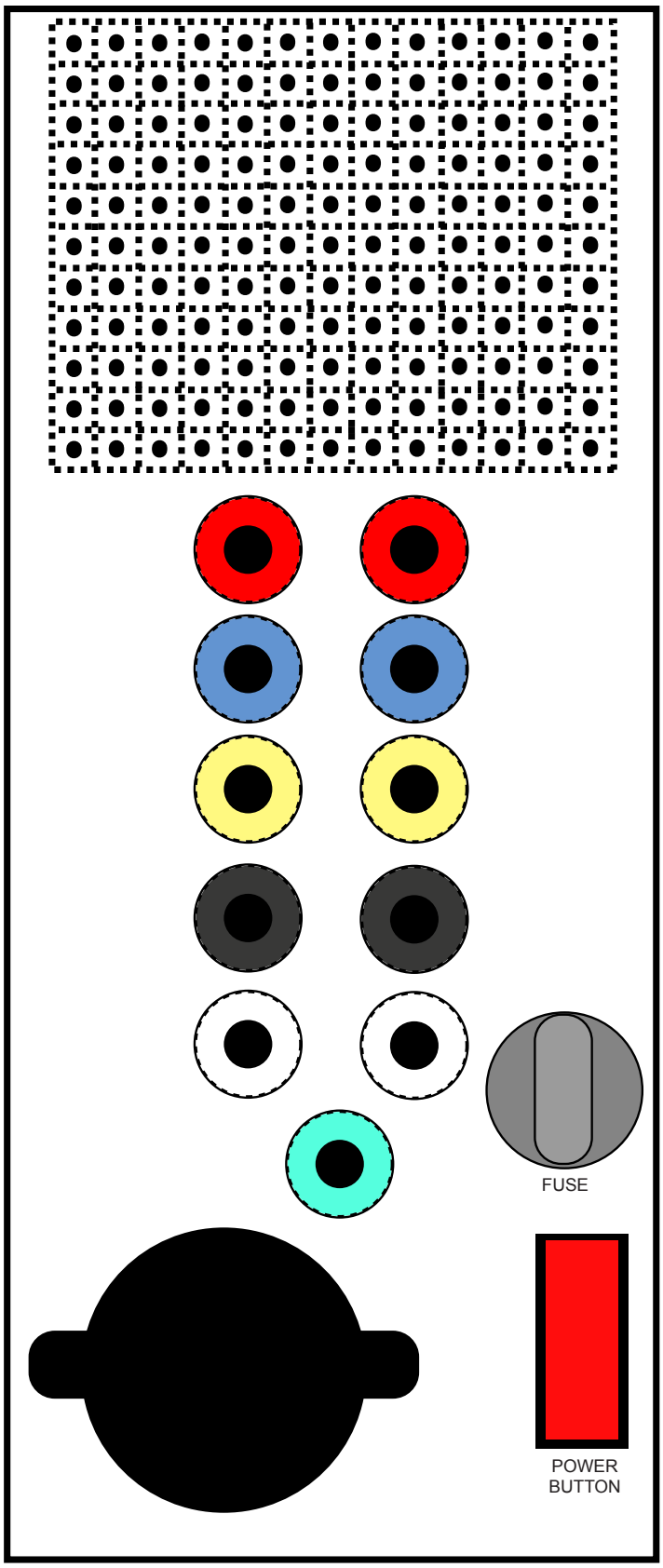
5. TURN ON ANY DIRECT INPUT DEVICES, SUCH AS THE VIDEO CAMERA OR V40HD VIDEO MIXER

TO TURN THE SANDIN IMAGE PROCESSOR OFF, FOLLOW THESE STEPS IN REVERSE ORDER



5. ANY EXTERNAL VIDEO INPUTS YOU ARE USING, SUCH AS THE VIDEO CAMERAS OR THE V40HD VIDEO MIXER

POWER MODULE

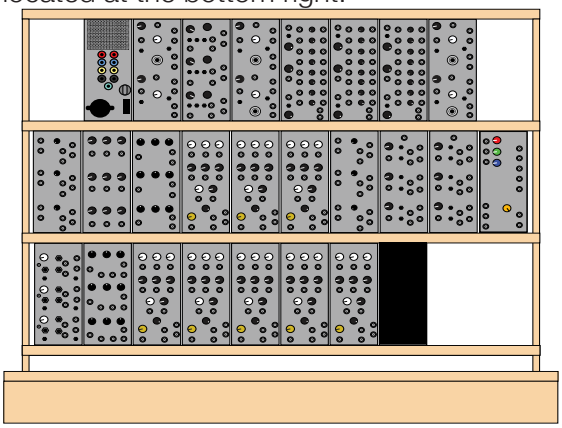


COMPONENTS

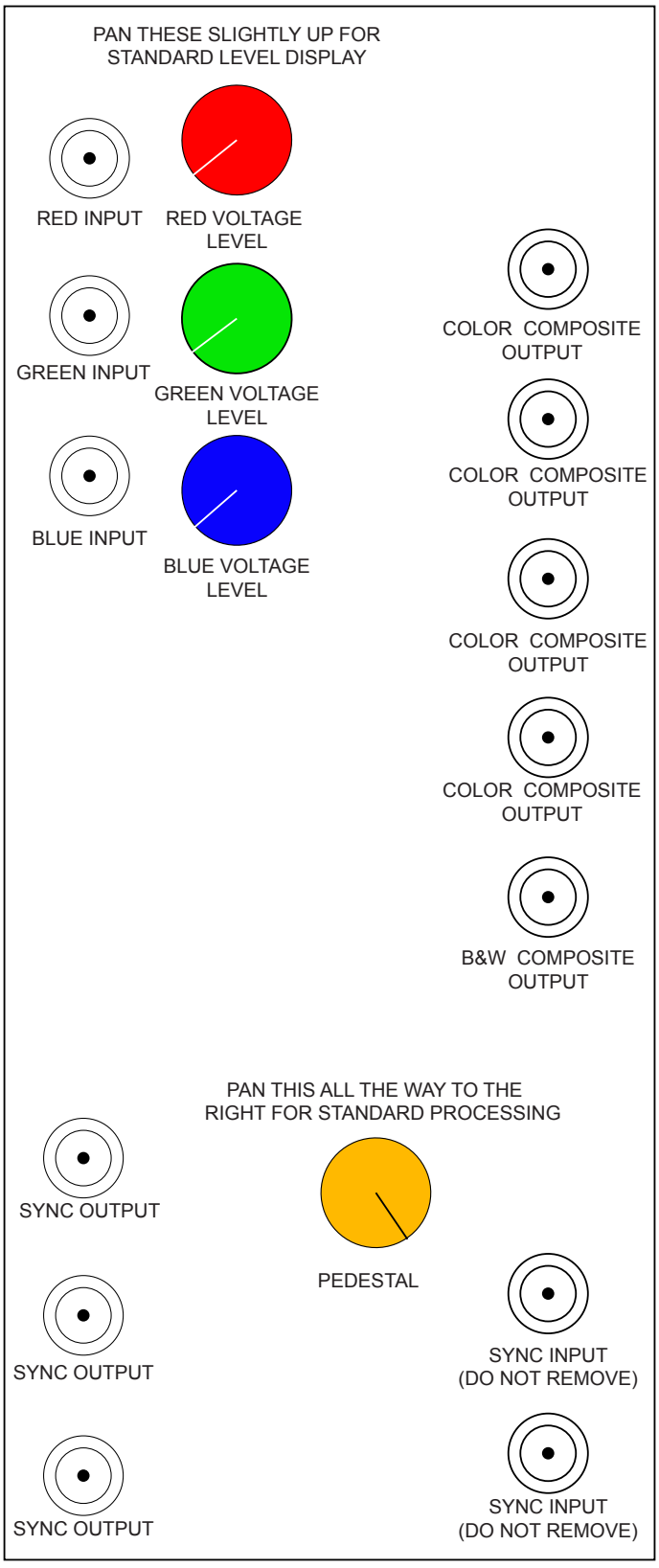
POWER BUTTON

The Power Module turns the system on and off via the rectangular button at the bottom right. Ignore all other components, and do not make contact with the metal inside the color binding posts.

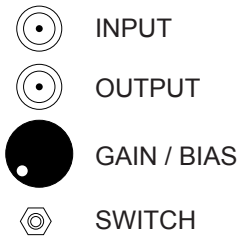
Throughout this guide, the location(s) of each module in the FVNMA Image Processor will be highlighted in black at the bottom right of its page. The power module, for example, is located at the bottom right:



@ISORYTHMICS 2023
COLOR ENCODER



COMPONENTS



The Color Encoder is the master output for the Image Processor. It encodes the signals sent into the red, green, and blue inputs into a composite video signal.

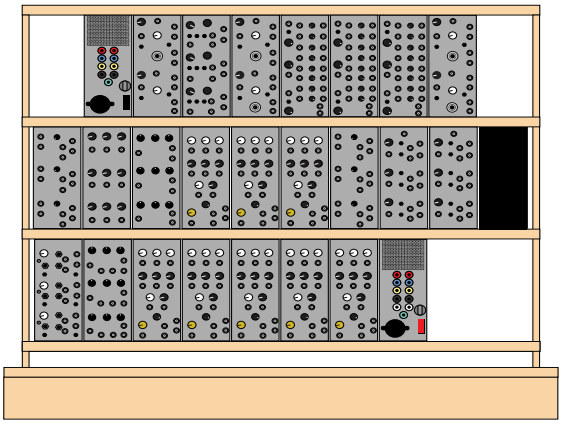
Voltage Level and Pedestal Knobs
The red, green, and blue inputs have voltage knobs that can be used to test the machine and turn the video voltage up, making it stronger. They only need to be turned up slightly for the video to be displayed properly.

The pedestal knob glitches the image. Turn it all the way up/to the right, as it is shown here, for standard video display. Turning it left to glitch it.

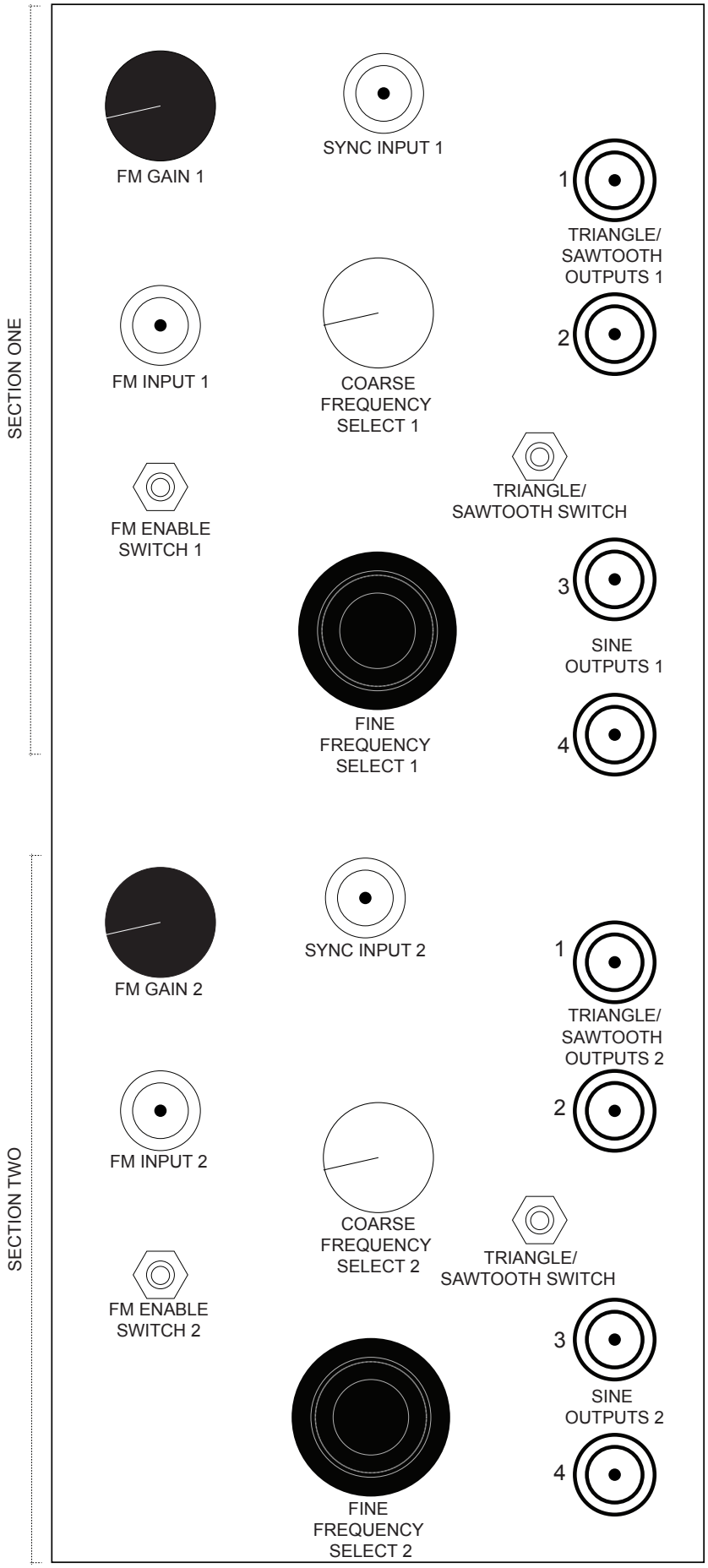
NOTE: turning the pedestal knob left/ glitching the image will break the digital capture of your video.

FOR STANDARD OPERATION: turn the red, green, and blue voltage knob up *slightly*, to the level they appear on this diagram. Turn the pedestal knob all the way to the right.

Outputs
The module provides 5 composite outputs, 4 color, and one black and white. Generally, leave the outputs exactly as they are set up. If you change them, return them their original setup for the next user.



OSCILLATOR



COMPONENTS

INPUT

OUTPUT

FM GAIN

SWITCH

COARSE FREQUENCY

FINE FREQUENCY

The Oscillator module outputs oscillations at dynamic frequencies to generate abstract visuals or act as control voltages in other modules.

Adjusting Frequencies

The Coarse Frequency Select knobs sets the gross frequency range from 1/100 Hz to 500,000 Hz. The Fine Frequency Select continuously adjusts the frequency between steps set by the Coarse Frequency Select knob.

Waveforms

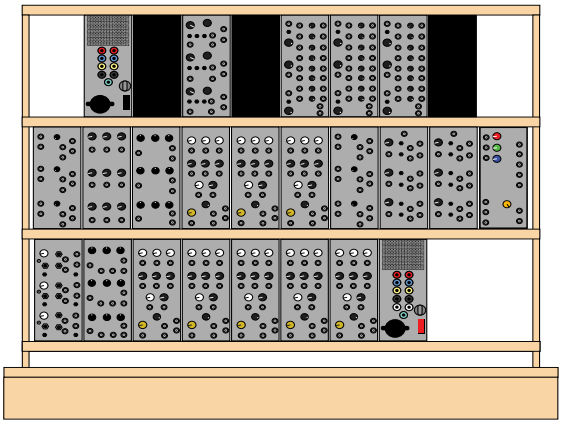
When the Triangle/Sawtooth switch is up, outputs 1 and 2 create a triangle wave, outputs 3 and 4 create a sine wave.

When the switch is down, outputs 1 and 2 produce sawtooth waves, outputs 3 and 4 produce “S” waves.

Frequency Modulation

FM stands for frequency modulation. If the FM Enable switch is up, a control voltage entering the FM input will modulate the frequency of the oscillator.

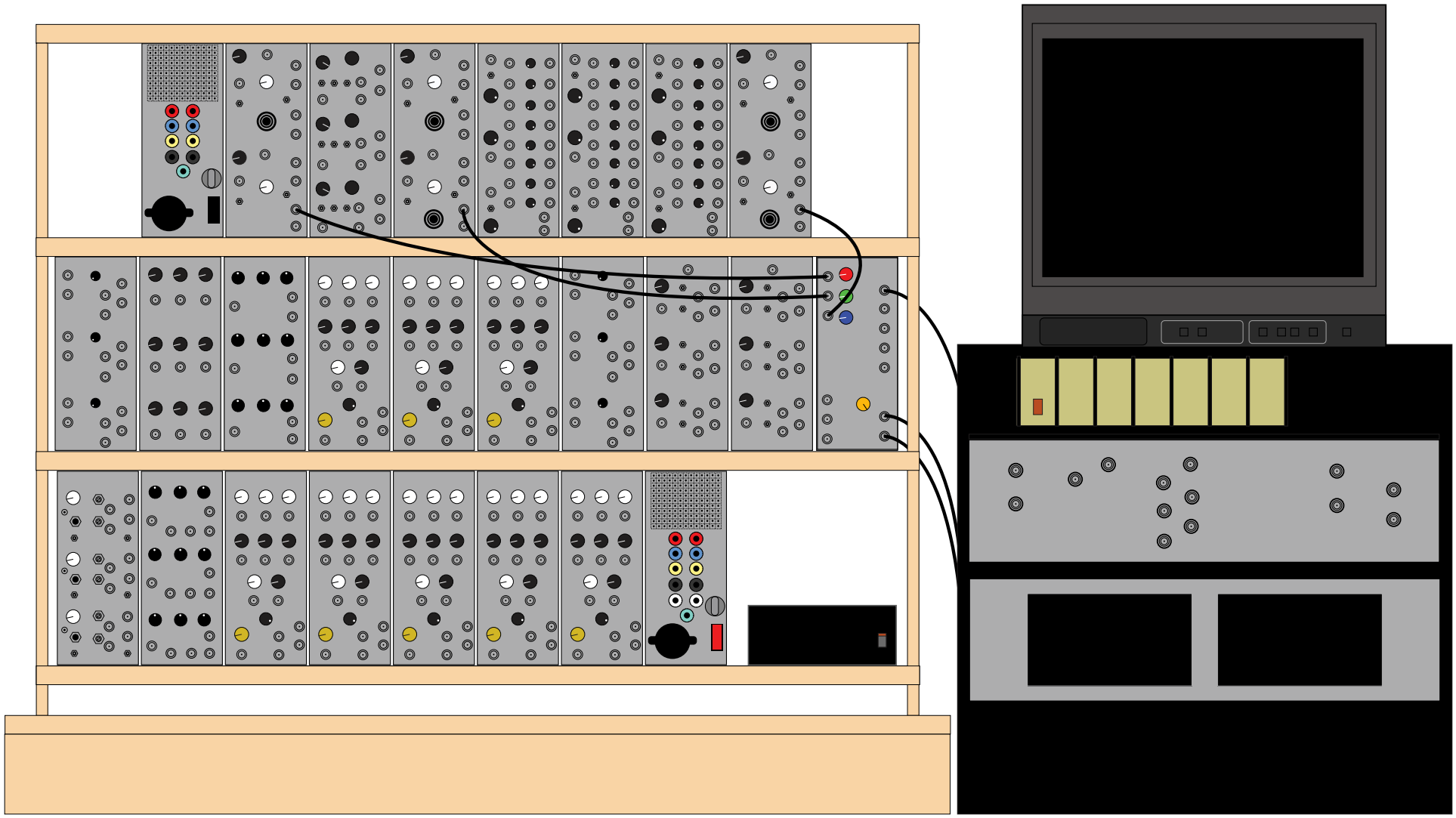
A gen sync signal into the sync input will stabilize/synchronize oscillation patterns.



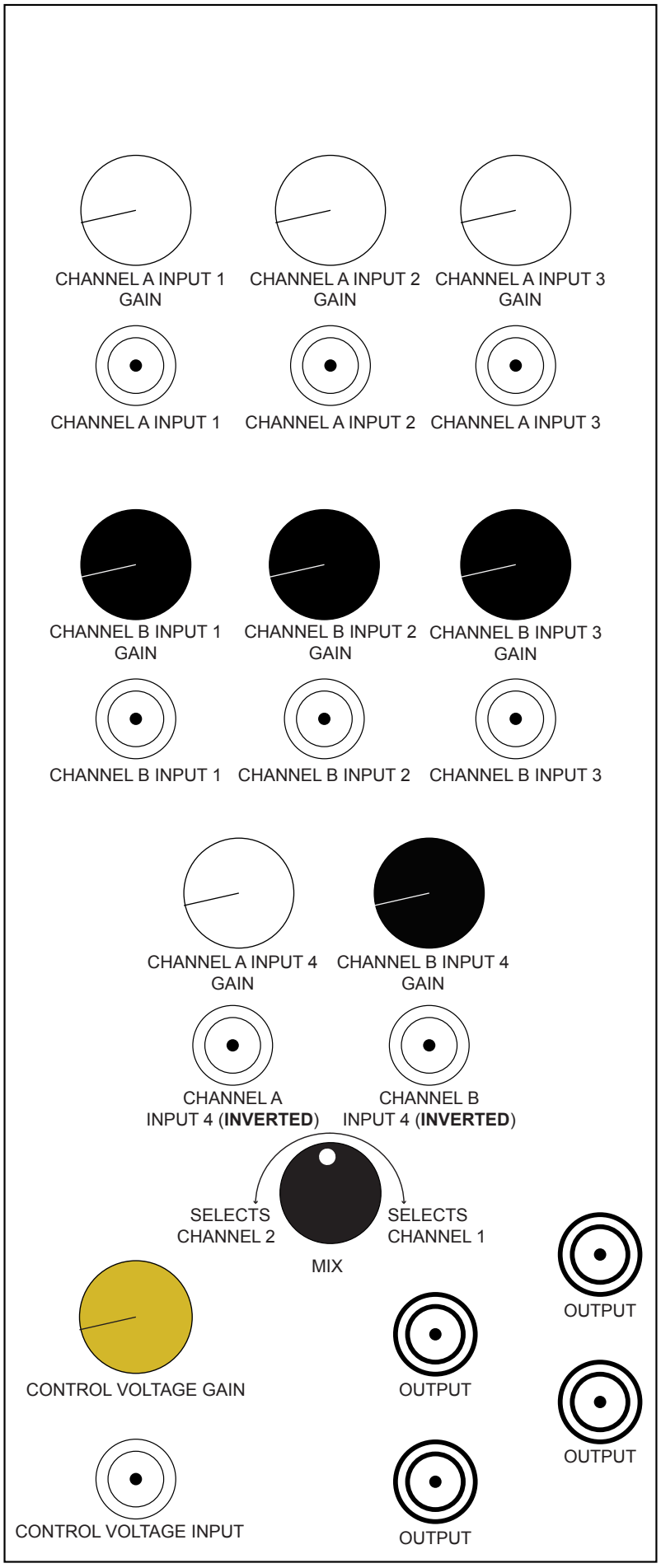
PATCH 1: SIMPLE OSCILLATORS

For the sake of demonstration, this is the most simple possible patch that generates red, green, and blue video by connecting outputs of Oscillator modules directly into the red, green, and blue inputs of the Color Encoder.

The next pages introduce the Adder/Multiplier module, which is essentially a video mixer that allows signals to be added together. The next patch uses the Adder/Multiplier to combine simple waveforms into complex waveforms before sending them to the Color Encoder.



ADDER/MULTIPLIER



COMPONENTS

The Adder/Multiplier module is a 2-channel video mixer that combines and inverts video, and pans between the two channels via the Mix knob or an external control voltage.

Channel A is the sum of all video being sent to inputs below white knobs. Channel B is the sum of video sent to black gain knobs.

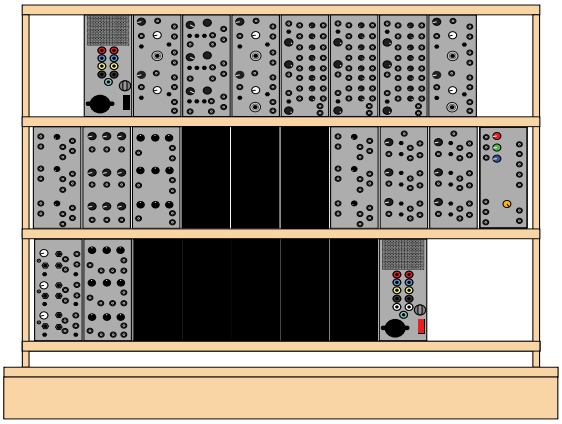
Inputs 1-3 and the invert of input 4 are added together to form the channel's output (input 4 inverts the signal it receives).

The four outputs at the bottom right are identical.

Panning Between Channels
The central Mix knob controls which channel is sent to the outputs: turning it to the right displays Channel A; turning it to the left displays Channel B; centering it will display a mix of both channels, and allow for Voltage Control via the Voltage Control Input.

Automatic Panning
The voltage control input automates the output mix between channels A and B when the Mix knob is centered and CV gain is up.

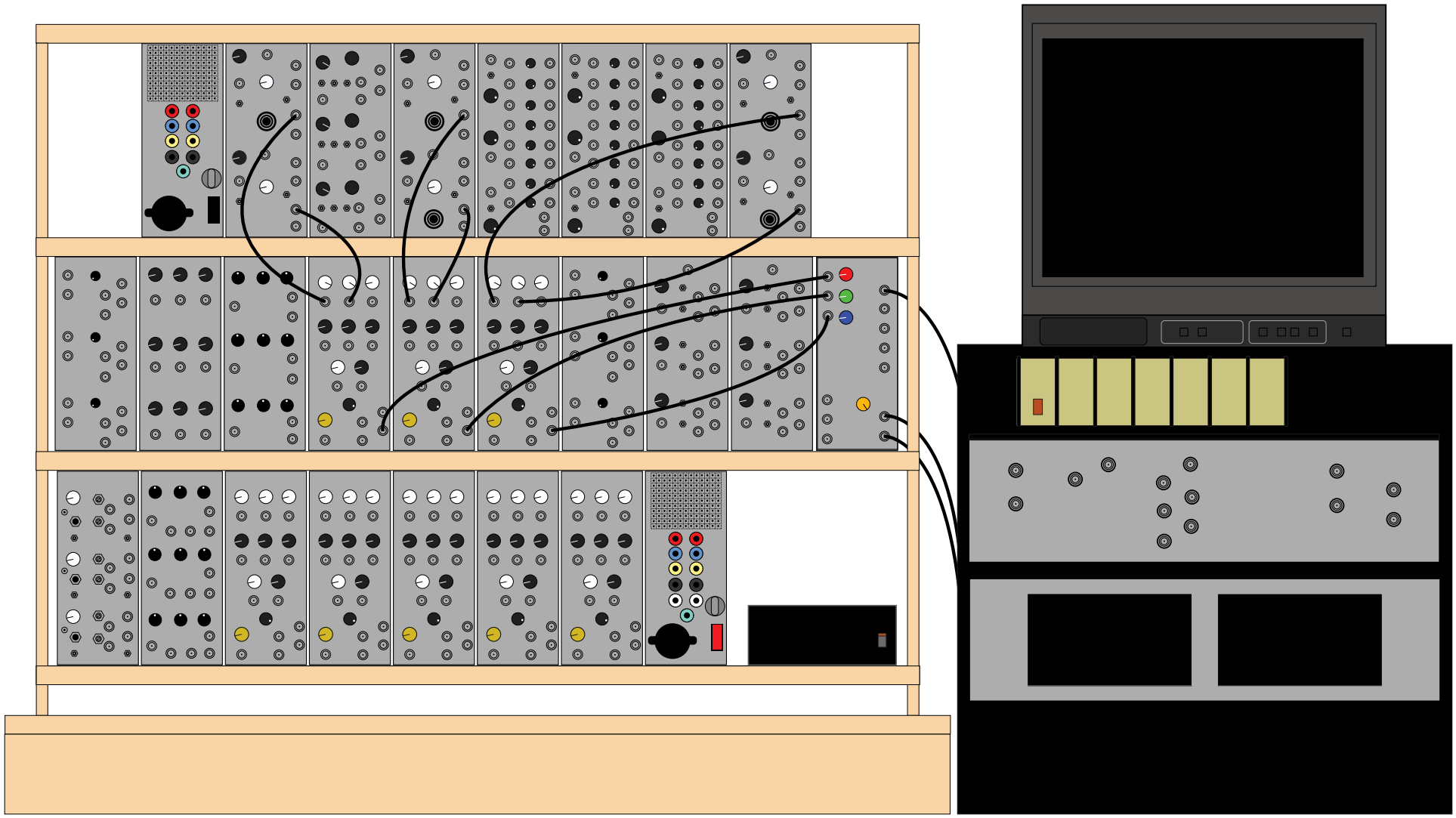
Tip: sending a low-frequency oscillation (LFO) into the Voltage Control input automates panning between channels A and B.



PATCH 2: COMPLEX OSCILLATORS COMBINED USING ADDER/MULTIPLIERS

In this patch, two outputs from each of the three Oscillator modules are sent to inputs of Channel A on the Adder/Multiplier modules to combine simple waveforms into complex waveforms before sending these signals into the red, green, and blue inputs on the color encoder. **Note that the central mix knob of all three Adder/Multipliers is turned all the way right to output channel A.**

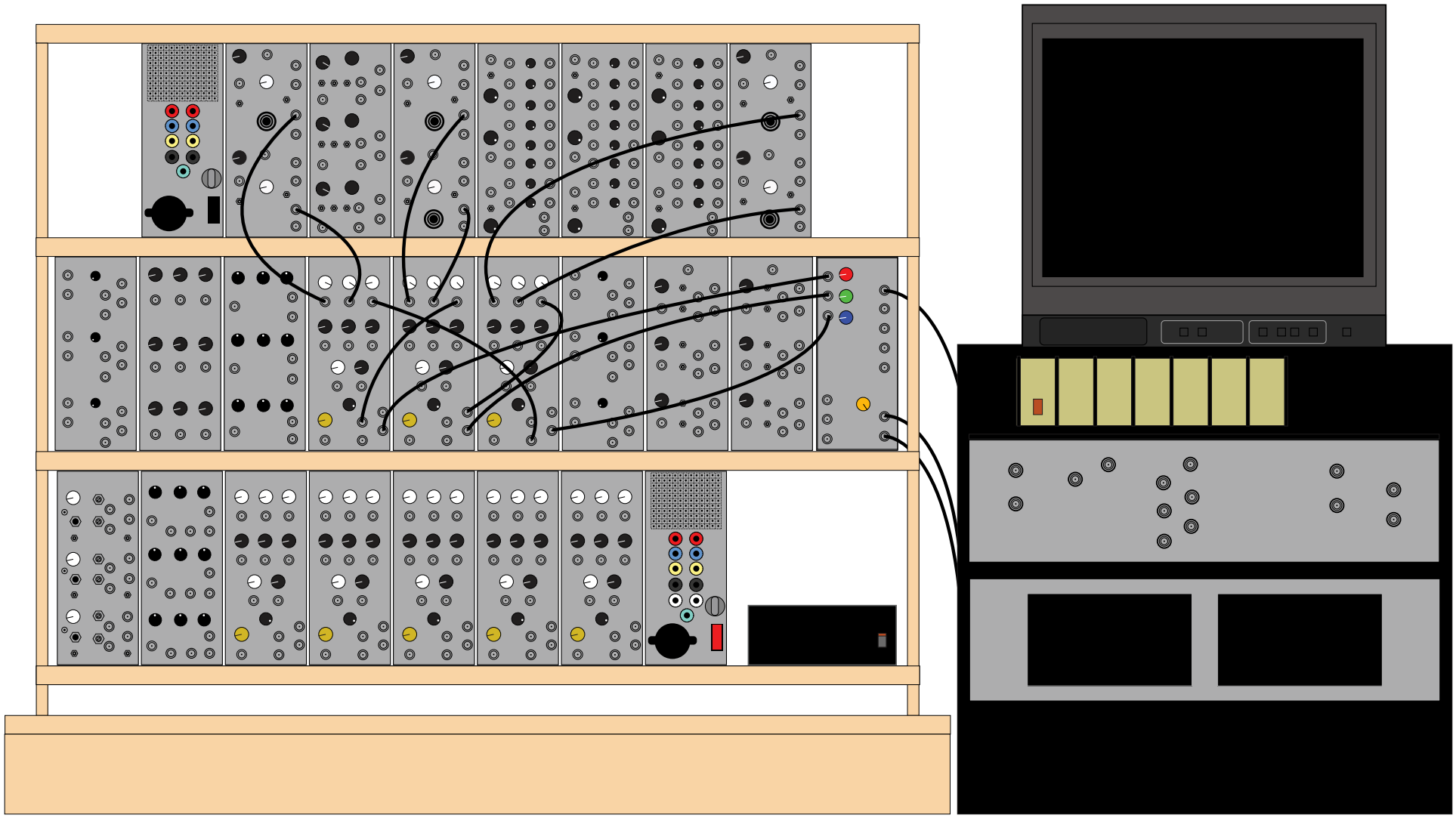
This patch produces more complex visuals to explore than three single waveforms, enabling 6 separate frequencies to mix at different levels.



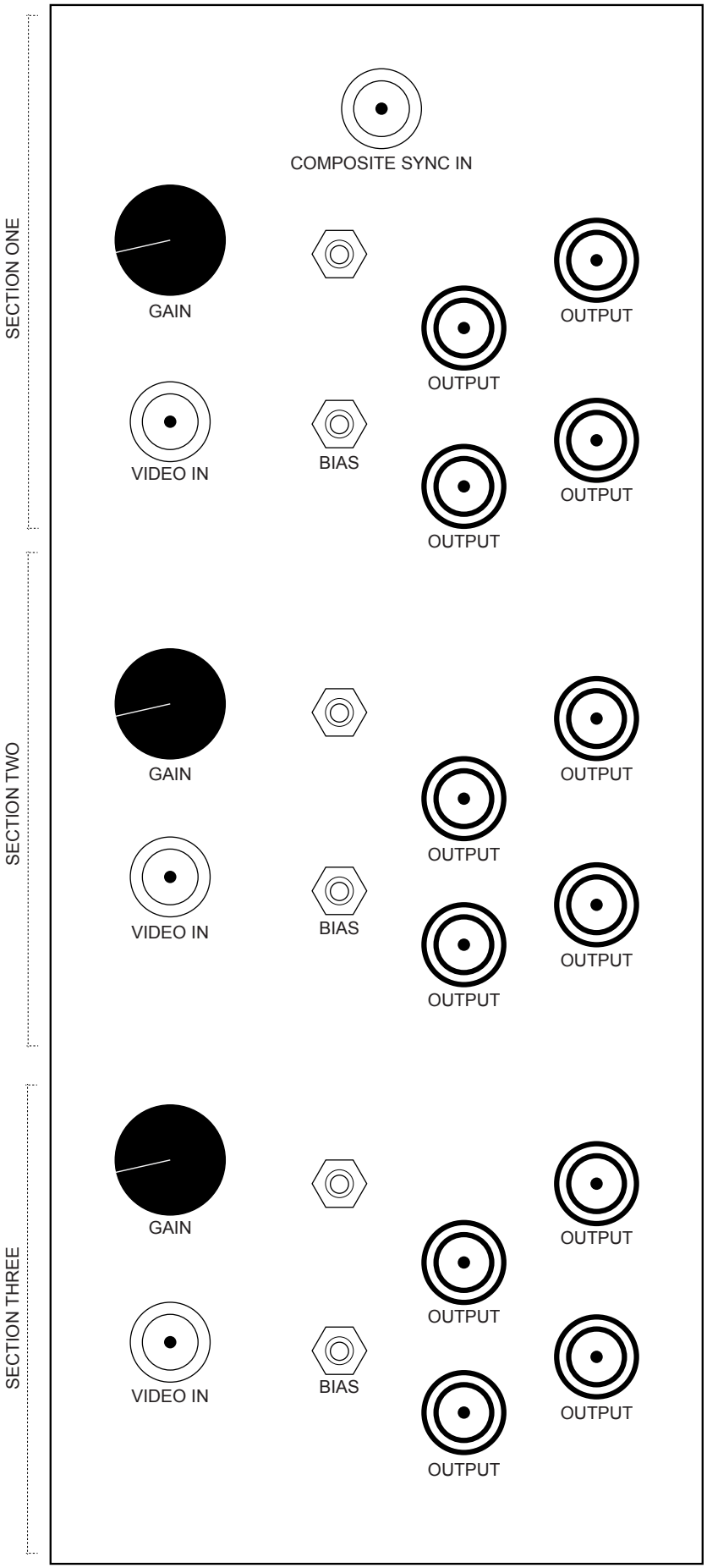
PATCH 3: COMPLEX OSCILLATORS COMBINED USING DAISY CHAINED ADDER/MULTIPLIERS

This patch is identical to patch 2, but each Adder/Multiplier module's output goes to the next Adder/Multiplier module as an input that can be turned up, enabling the visuals going into the red, green, and blue inputs of the Color Encoder to overlap with each other, generating cyan, yellow, magenta, and white where they overlap. This gives even more color to explore.

NOTE: turning up all three daisy chained inputs creates a feedback loop, which will turn the video black and white. Note that the third input of the far left Adder/Multiplier module is turned down to disable this.



INPUT



COMPONENTS

INPUT

OUTPUT

GAIN

BIAS IMAGE ADJUSTMENT KNOB

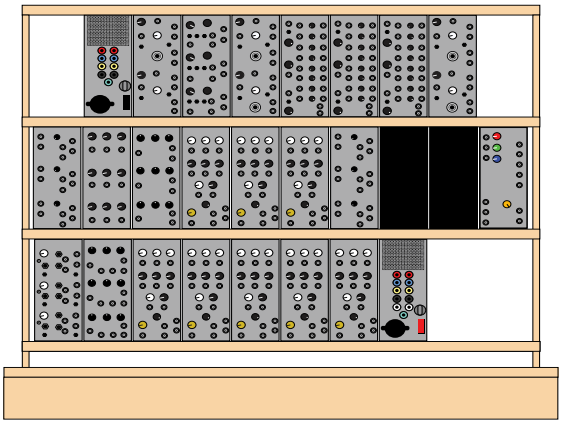
The Input module generates four identical outputs based on one video input signal, and is divided into three discrete sections for three different inputs.

Splitting 4 *Or More* Signals
Input modules can be used to split and distribute video signals. If an output of one is sent as the input of another section, a single video can generate 7 total outputs.

Note: we will use this split method beginning in Patch 6 to send three clean video signals and 3 processed video signals into the red, green, and blue inputs of the Color Encoder through corresponding Adder/Multiplier modules.

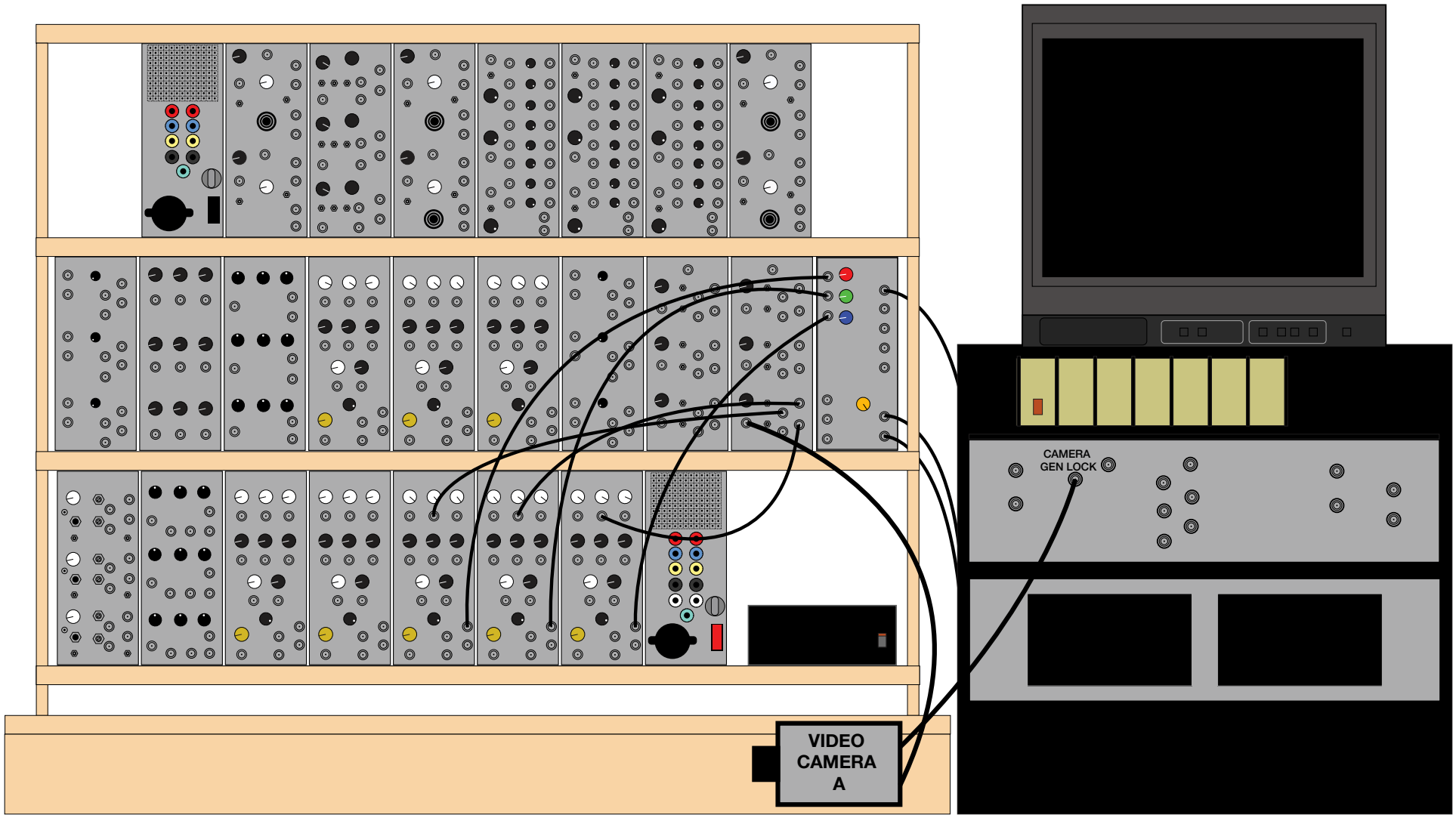
Adjusting video
The main gain knob adjusts the video level, and the central bias knobs adjust and fine-tune the image.

Tip: for optical feedback, adjust the focus of the camera pointed at the monitor, its exposure settings, and the bias knobs on the input module. Generally, it is best when the gain knob is all the way up/to the right.



PATCH 4: SINGLE BLACK AND WHITE CAMERA WITHOUT PROCESSING

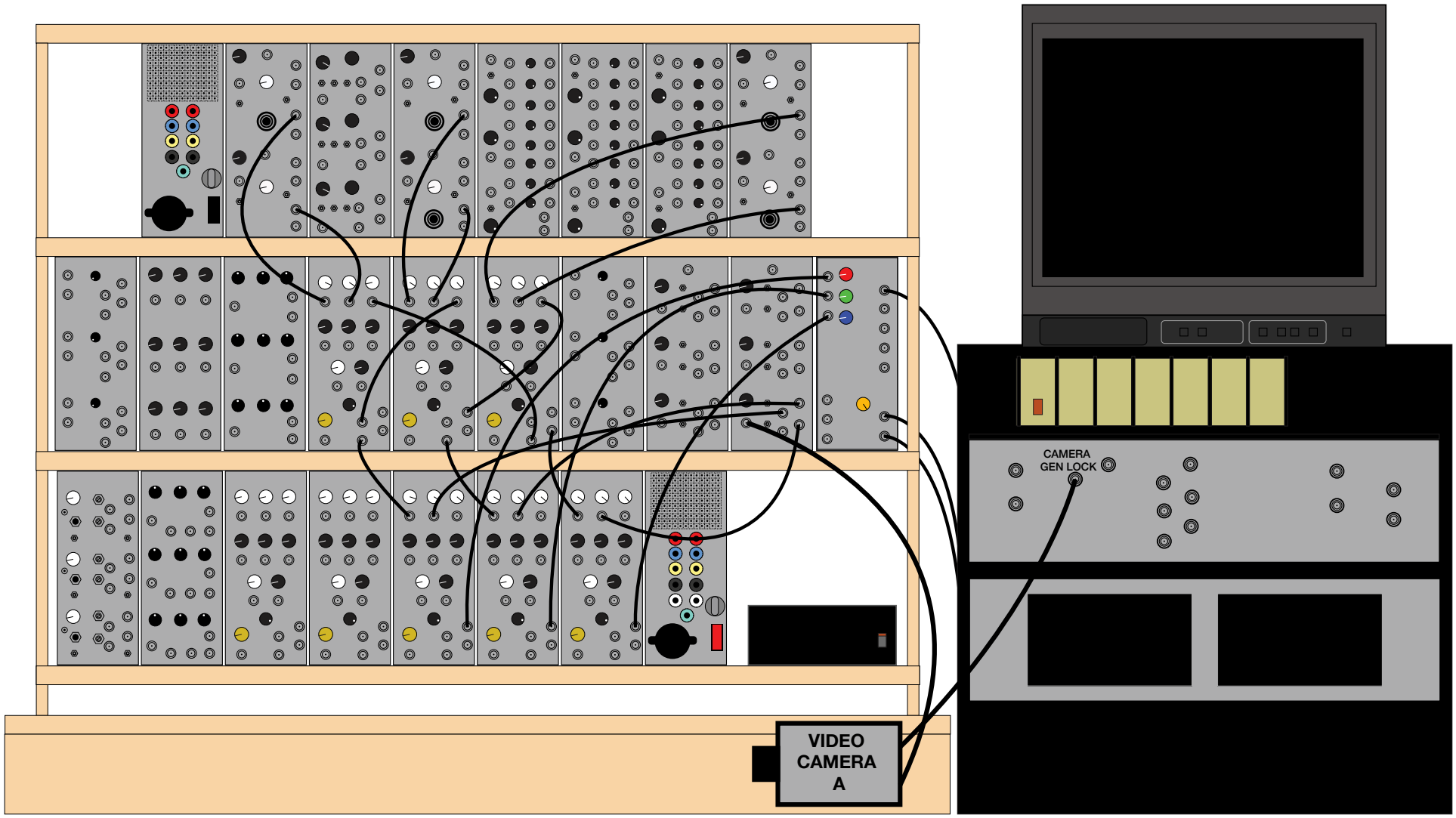
This patch connects a single black and white camera using the Input Module and 3 Adder/Multiplier Modules. The black and white camera needs to be powered on, it needs to receive a gen sync signal from the interface below the LENCO sync generator, and its video output needs to be connected to the Input Module, which will then output 4 identical outputs based on the gain level of the video. Three of those four outputs are routed to three Adder/Multipliers that connect to the red, green, and blue inputs of the Color Encoder output module. Note that the mix knobs of the Adder/Multipliers are turned right to output Channel A.



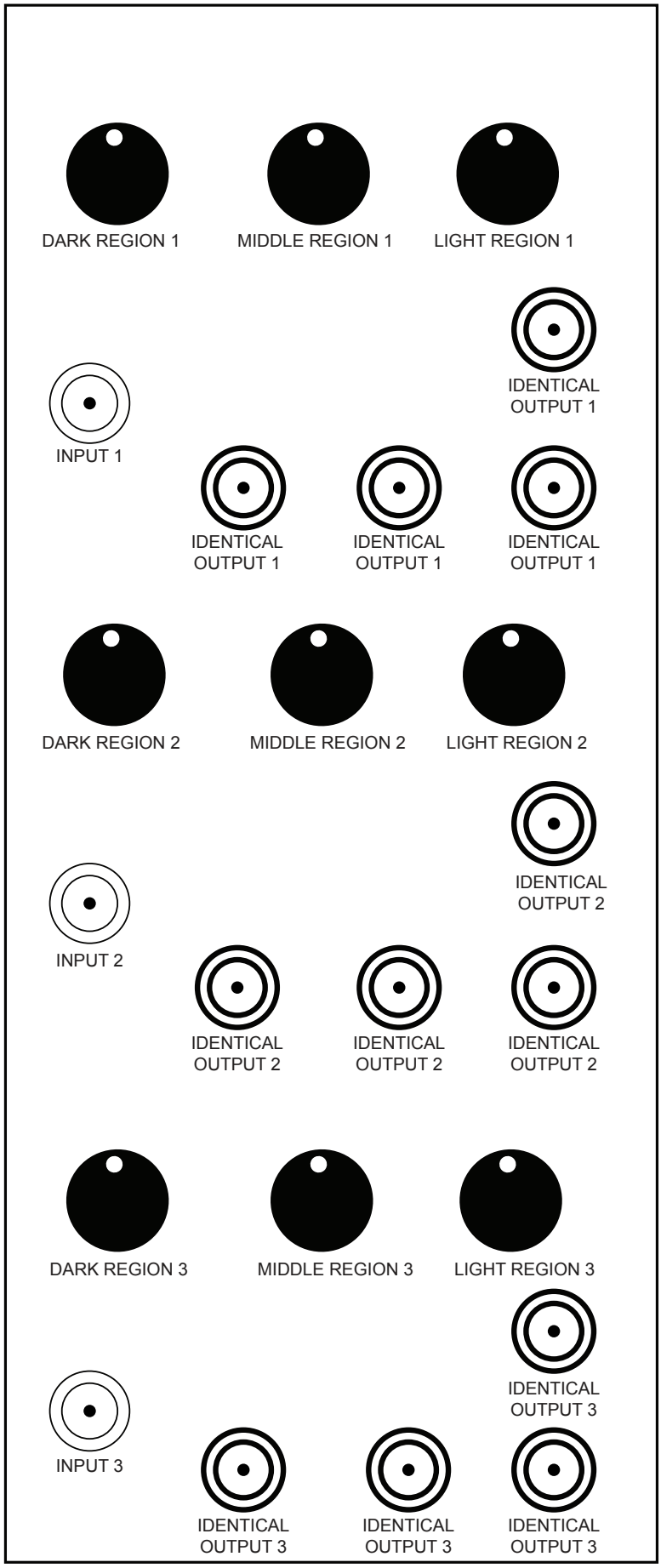
PATCH 5: SINGLE BLACK AND WHITE CAMERA WITH COMPLEX OSCILLATORS

This patch combines patches 3 and 4, allowing complex oscillators generated in the middle row of Adder/Multipliers to output to three more Adder/Multipliers in the bottom row, which also receive the video input from the camera. Note that the left-most Oscillators and Adder/Multipliers end in the Red input of the Color Encoder, the middle go to Green, and the right Blue. This left-to-right/R-G-B interface organization makes it more intuitive to use and remember.

Also note that, in the bottom row of Adder/Multipliers, oscillations are going into the left-most input, and black and white video is going into the center input. In the next patches, processed video will go into the right inputs, giving us 3 channels to mix per red, green, and blue signal path. As you build your patch, keep signal paths well-organized so they are easier to use as the patch becomes complex.



FUNCTION GENERATOR



COMPONENTS

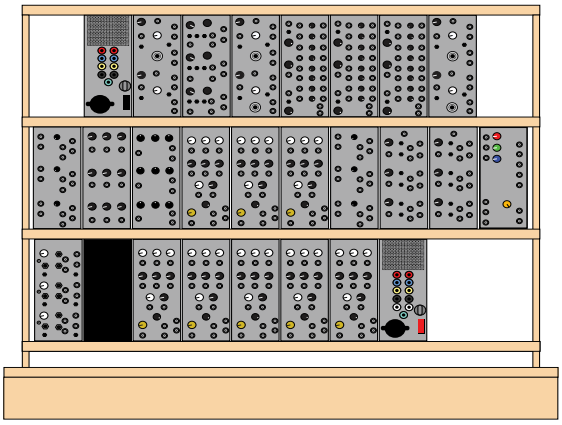
The Function Generator produces an effect similar to photographic solarization, but more complex and controllable.

It is a is a non-linear amplifier that adjusts negative, positive, and near zero signals through knob controls on the front panel.

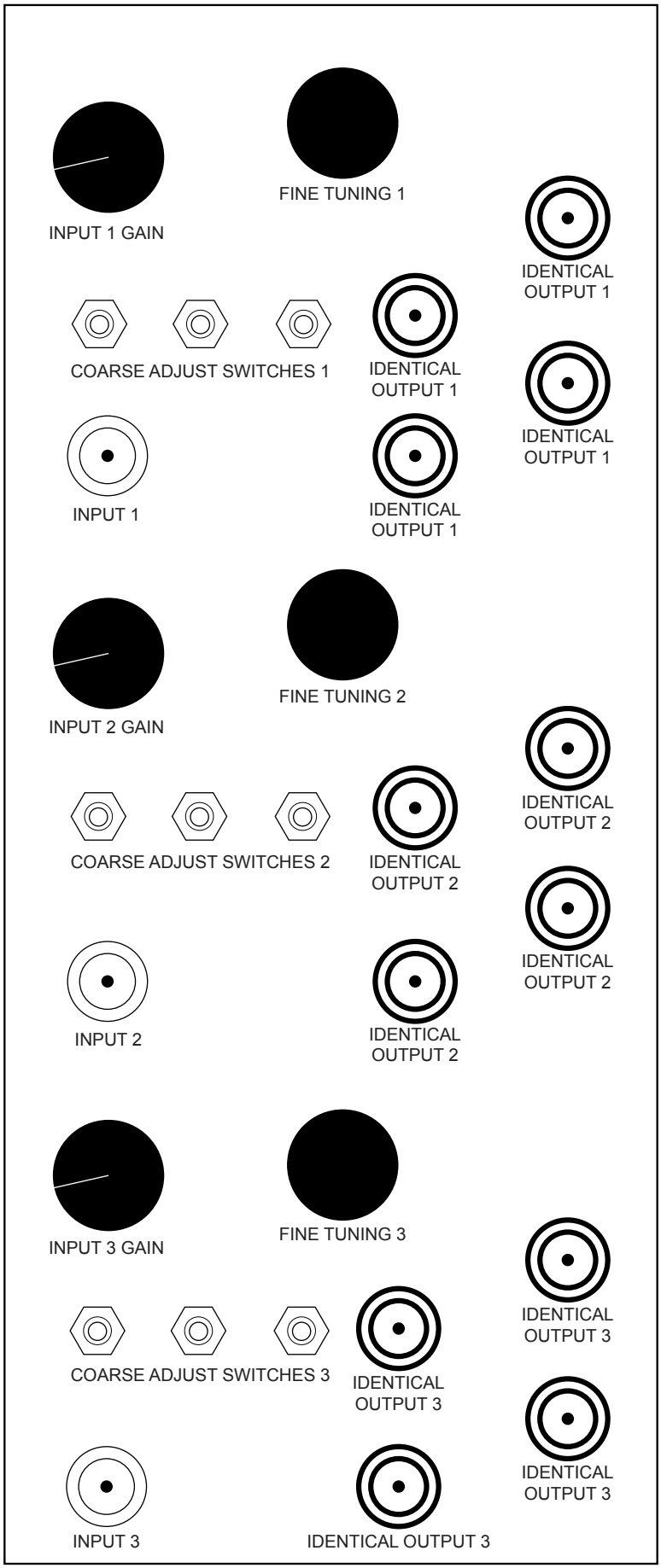
Dark, middle, and white regions of image can be individually adjusted from positive to negative to give solarization-like effects.

Each Function Generator module contains three independent sections, allowing Red, Green, and Blue signal paths to be separately processed in one single module.

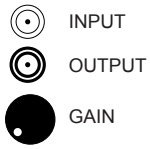
Each section has one input and four identical outputs.



DIFFERENTIATOR



COMPONENTS



The Differentiator highlights edges in a video image by producing an output which is proportional to the rate of change to the input signal.

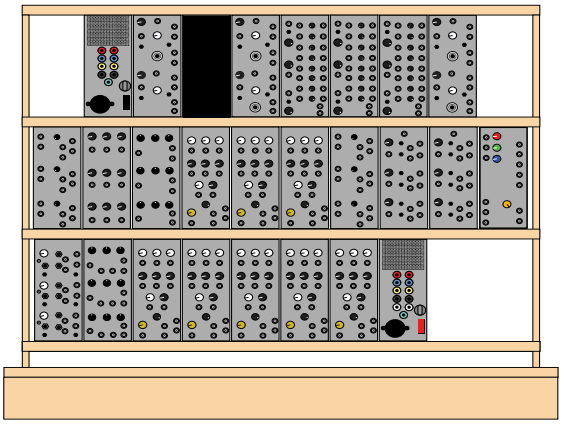
Fast rates of change (when the image goes from light to dark) correspond to edges in a picture and are preferentially amplified by the module.

The highlighting appearance depends on the range changes in the left-to-right scan: light to dark gives a dark line, while dark to light gives a white line.

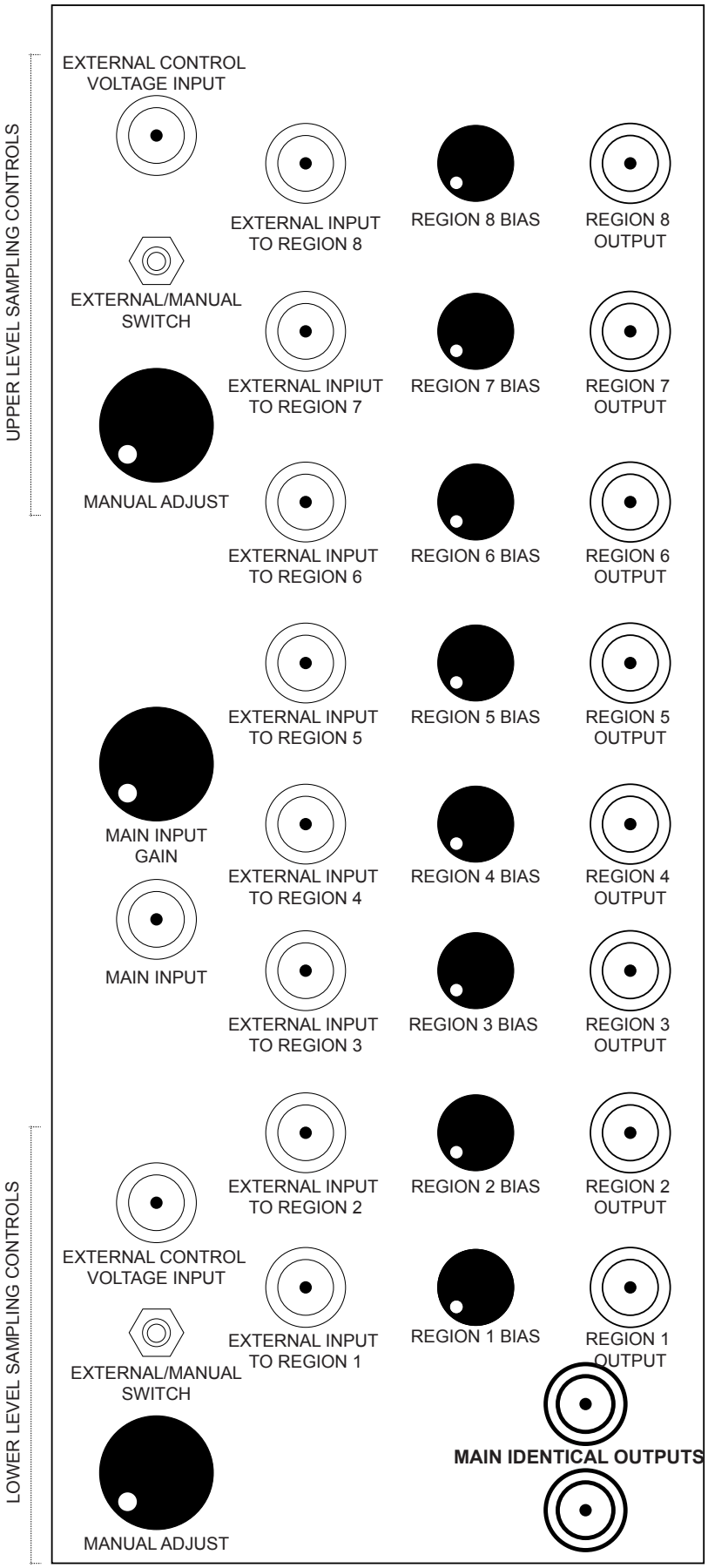
The course adjust switches are designed in such a way that each switch has twice as much effect as the switch immediately to the right of it.

Each Differentiator module contains three independent sections, allowing Red, Green, and Blue signal paths to be separately processed in one single module.

Each section has one input and four identical outputs.



AMPLITUDE CLASSIFIER



COMPONENTS

INPUT/REGION OUTPUT

MAIN OUTPUT

GAIN / BIAS

SWITCH

The Amplitude Classifier breaks video into 8 regions through a string of comparators that compare an input video signal against a ladder of 8 brightness levels/regions. It forms a set of intensity bands, corresponding to 8 contiguous gray levels evenly spaced from black to white

8 Region Inputs, Outputs, and Bias

The regions of the classifier are 8 discrete “digital” channels (Regions 1 - 8). These 8 regions can be controlled individually through a knob, receive individual inputs that will only appear in that gray-level region, and be sent out as individual outputs of just that gray-level region.

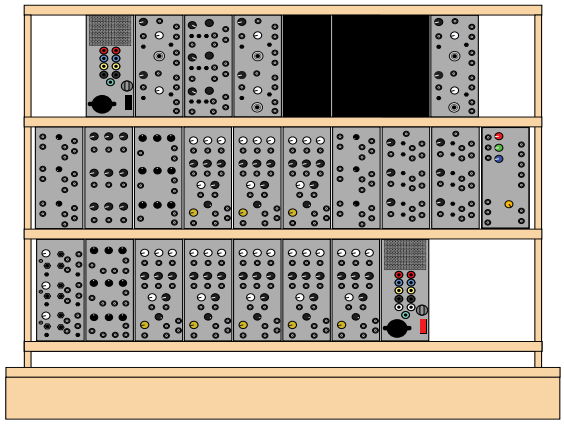
Main Outputs

The sum of all 8 signals is sent through two identical main outputs at the bottom right.

The Main Input Gain knob is sent to all comparators/regions.

Control Voltage/Manual Adjustment

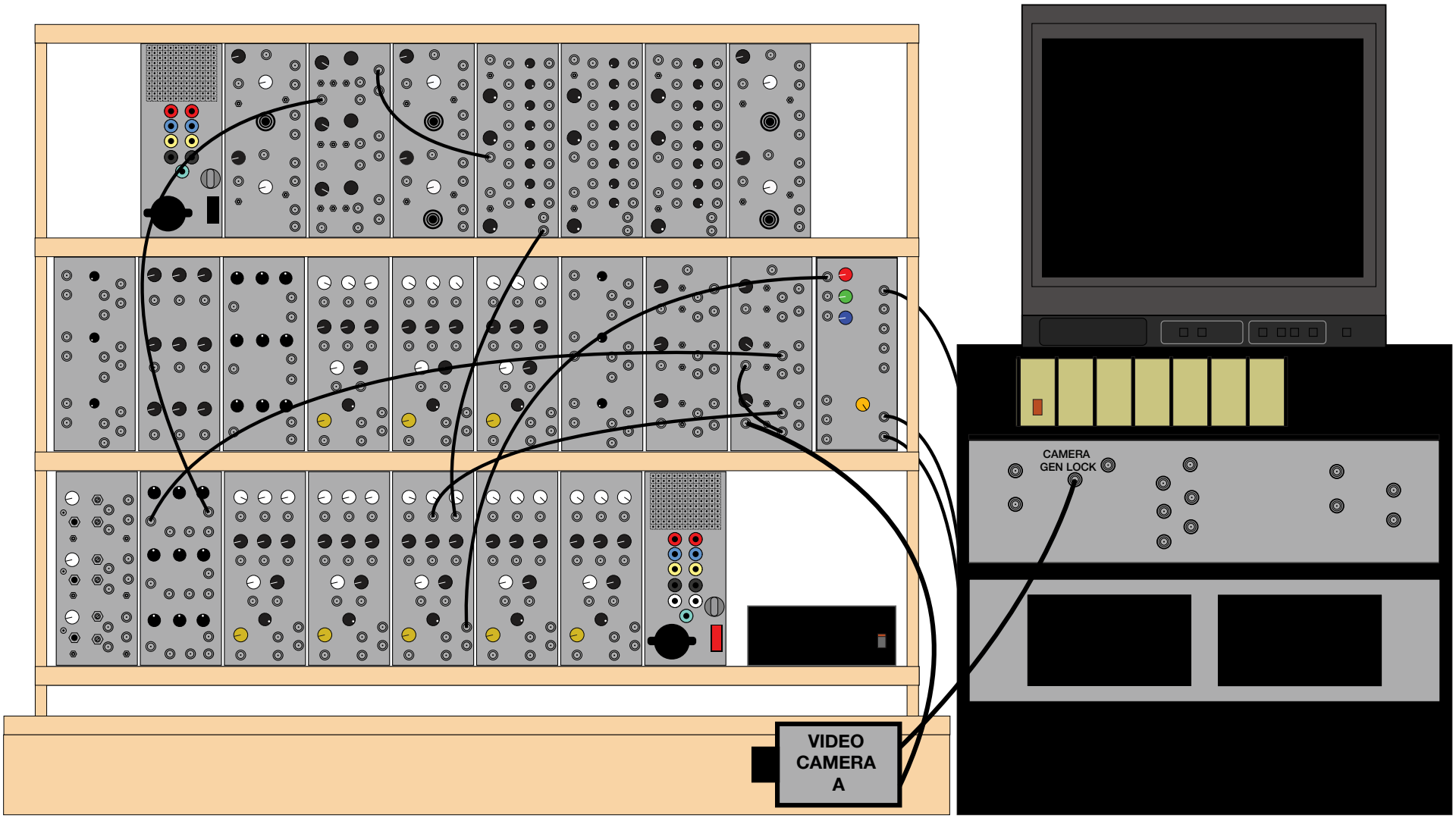
Manual Adjust knobs adjust the top or bottom 4 regions. The External Control Voltage Input adjusts these regions through control voltage when switched up.



PATCH 6 SINGLE PROCESSED VIDEO CHANNEL EXAMPLE: BLACK AND WHITE CAMERA FULLY PROCESSED THROUGH THE FUNCTION GENERATOR, DIFFERENTIATOR, AND AMPLITUDE CLASSIFIER MODULES

For the sake of legibility, this diagram only shows the red signal path of this patch, where a black and white camera is sent through three video processing modules: from the camera, to two Input modules to allow processed video to be mixed with unprocessed video, to the Function Generator, to the Differentiator, to an Amplitude Classifier, to an Adder/Multiplier, to the Color Encoder red input.

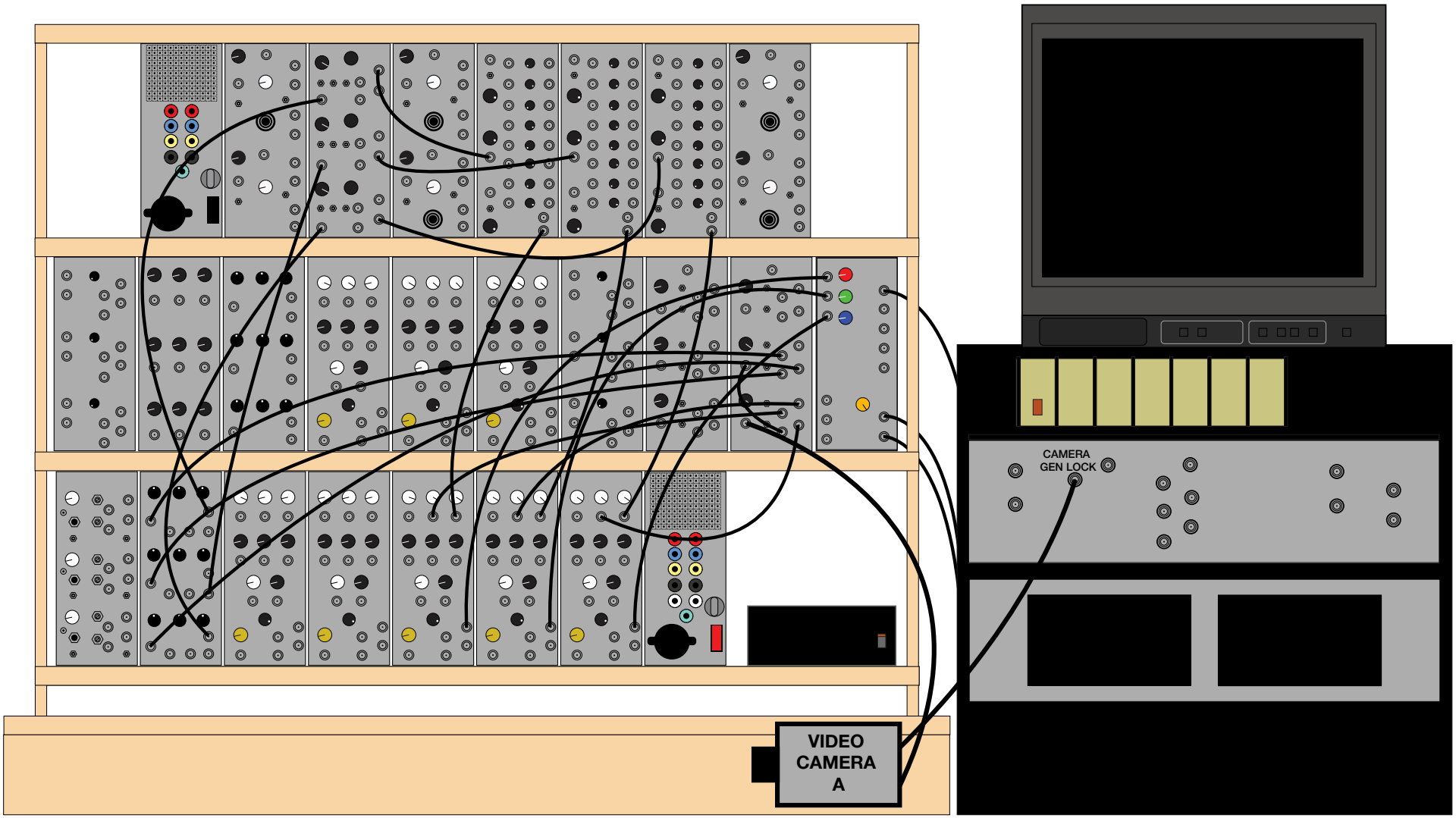
Note: Look carefully at the Input module. The patch sends the camera through two Input modules so that 6 total versions of its signal can be used, allowing us to mix processed video and unprocessed video to find a balance of legibility.



PATCH 7: BLACK AND WHITE CAMERA FULLY PROCESSED THROUGH THE FUNCTION GENERATOR, DIFFERENTIATOR, AND AMPLITUDE CLASSIFIER MODULES TO GENERATE RED, GREEN, AND BLUE VIDEO

This patch processes six total signals from a black and white camera to create send both clean and processed red, green, and blue monochromatic video signals using the Function Generator, Differentiator, and Amplitude Classifier. This is an advanced Sandin Image Processor patch that fully integrates its image processing capabilities. Note that the signal path is organized, from top-to-bottom, red-green-blue in the Function Generator and Differentiator modules to keep logical signal path orientation.

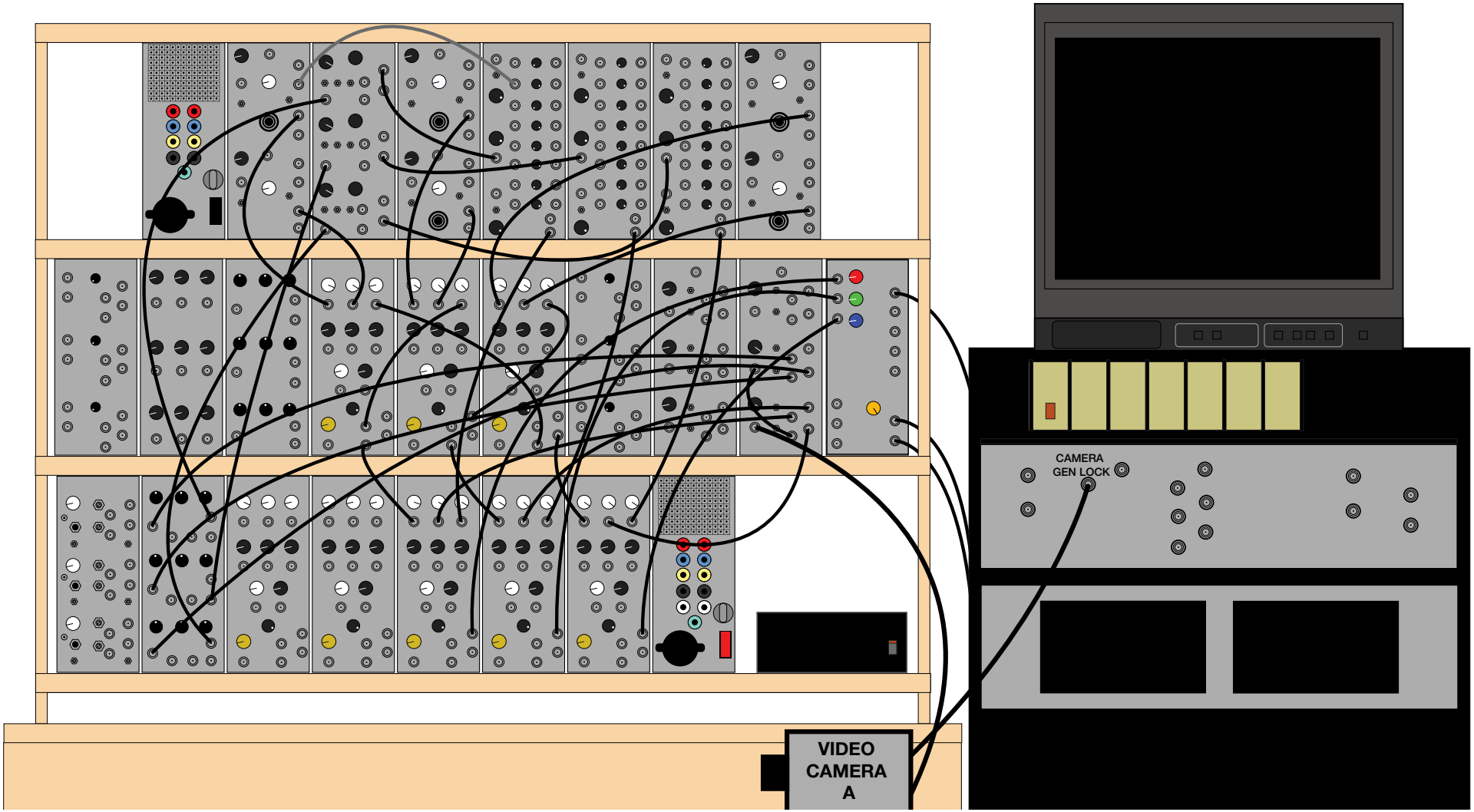
Note that, in the bottom three Adder/Multipliers, a clean video signal and a fully processed video signal are added together, allowing us to mix unprocessed and processed video to find a balance of legibility.



PATCH 8: BLACK AND WHITE CAMERA FULLY PROCESSED THROUGH THE FUNCTION GENERATOR, DIFFERENTIATOR, AND AMPLITUDE CLASSIFIER MODULES X3 TO GENERATE RED, GREEN, AND BLUE VIDEO

In This patch is identical to patch 11, but adds complex oscillators through additional Adder Multipliers. It also sends one oscillation into the second-from-top region of the left Amplitude Classifier module as an example of sending visuals only to one specific gray-level region of the video (this optional patch cable is dark gray rather than black). This is a very advanced Sandin Image Processor patch that fully takes advantage of the system's most unique features with a black and white camera. It does not use control voltages, which will be used in later patches.

Note: look closely at the bottom 3 Adder/Multipliers. The left-most input is complex oscillations from the above Adder/Multipliers, the center input is unprocessed video from the Input module, and the right input is fully processed video using three modules.

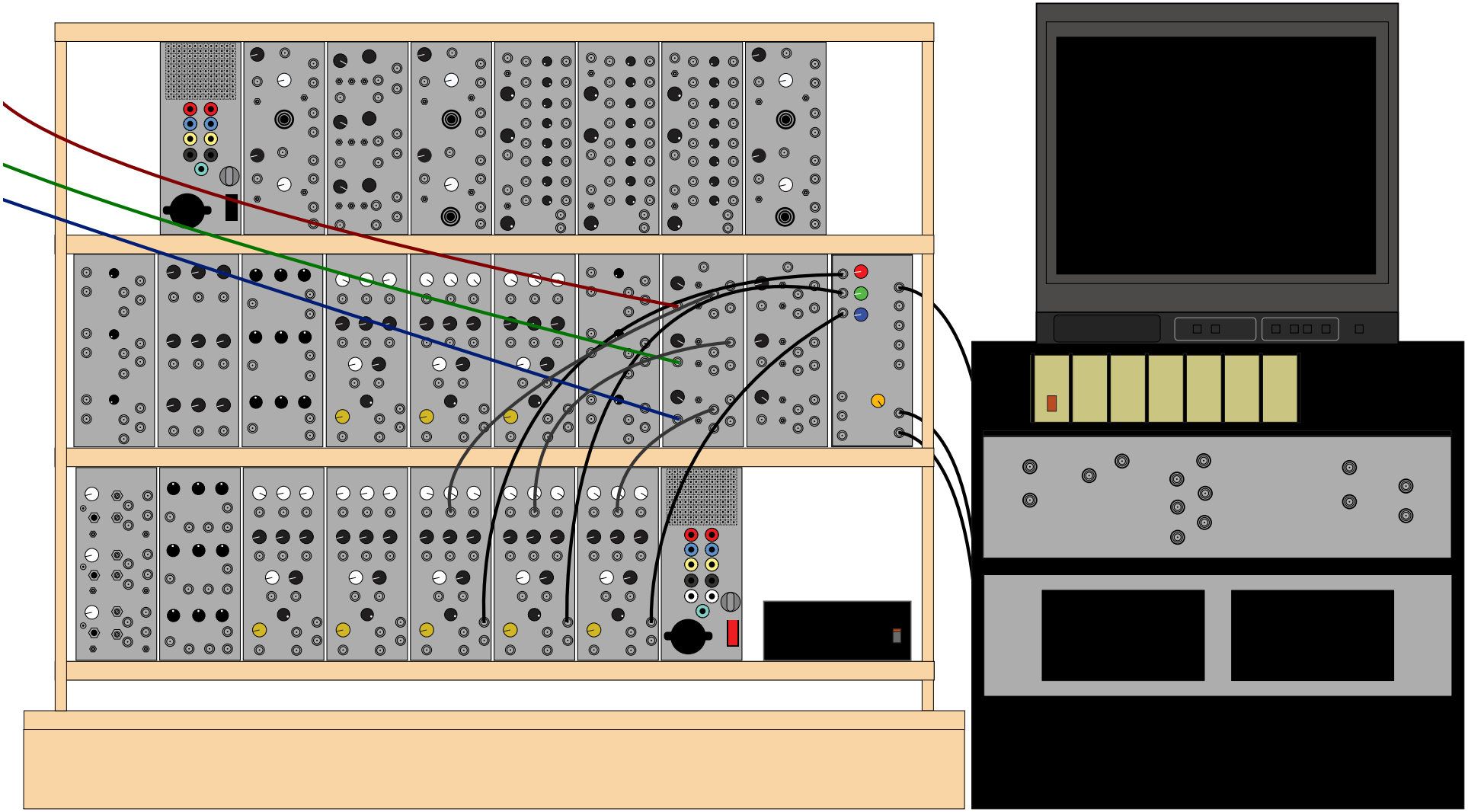


PATCH 9: FULL-COLOR EXTERNAL VIDEO ROUTED TO RED, GREEN, AND BLUE COLOR ENCODER INPUTS

This patch inputs external full-color video from the V40HD video mixer in room 314. The V40HD can receive any video signal (HDMI, component/VGA, or composite) and route it through three cables labeled RED, GREEN, and BLUE that will make proper color when eventually sent to the Red, Green, and Blue Color Encoder Inputs. For legibility, this diagram uses colors to show the cable's corresponding color channel. This patch uses the top-to-bottom/left-to-right R-G-B orientation for signal and interface organization.

See the canvas page Sandin IP Resource for information on using the V40HD video mixer.

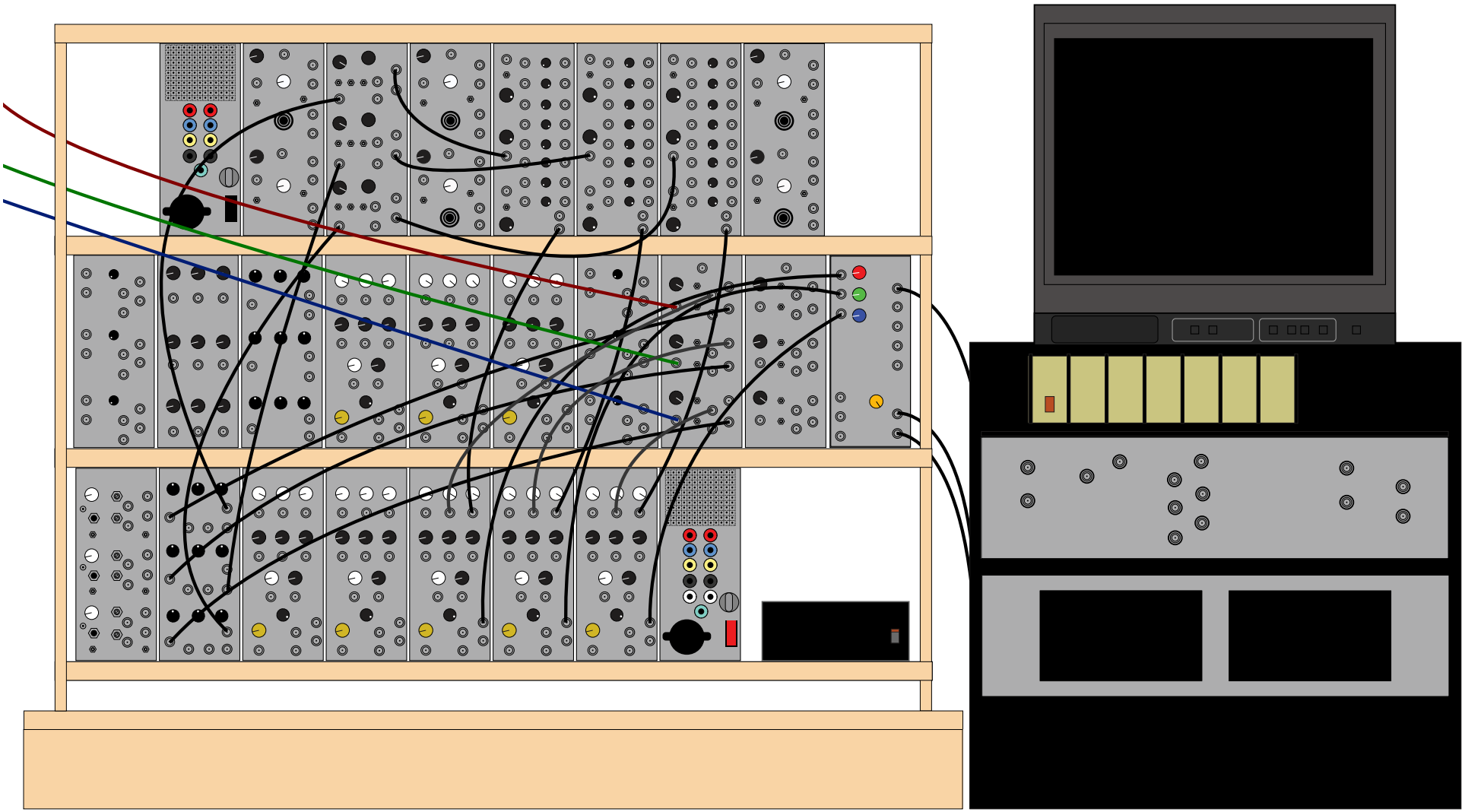
Note: take time to adjust the bias knobs on the Input module for each color. In time, the image will properly appear in full color.



PATCH 10: PROCESSED AND UNPROCESSED FULL-COLOR EXTERNAL VIDEO

This patch retains the three channels of unprocessed external video, but also processes each color channel through the Function Generator, Differentiator, and Amplitude Classifier modules, using the same signal path across processing modules previously used with the black and white video camera. Mixing unprocessed and processed video allows a balance of legibility and processing when levels are adjusted.

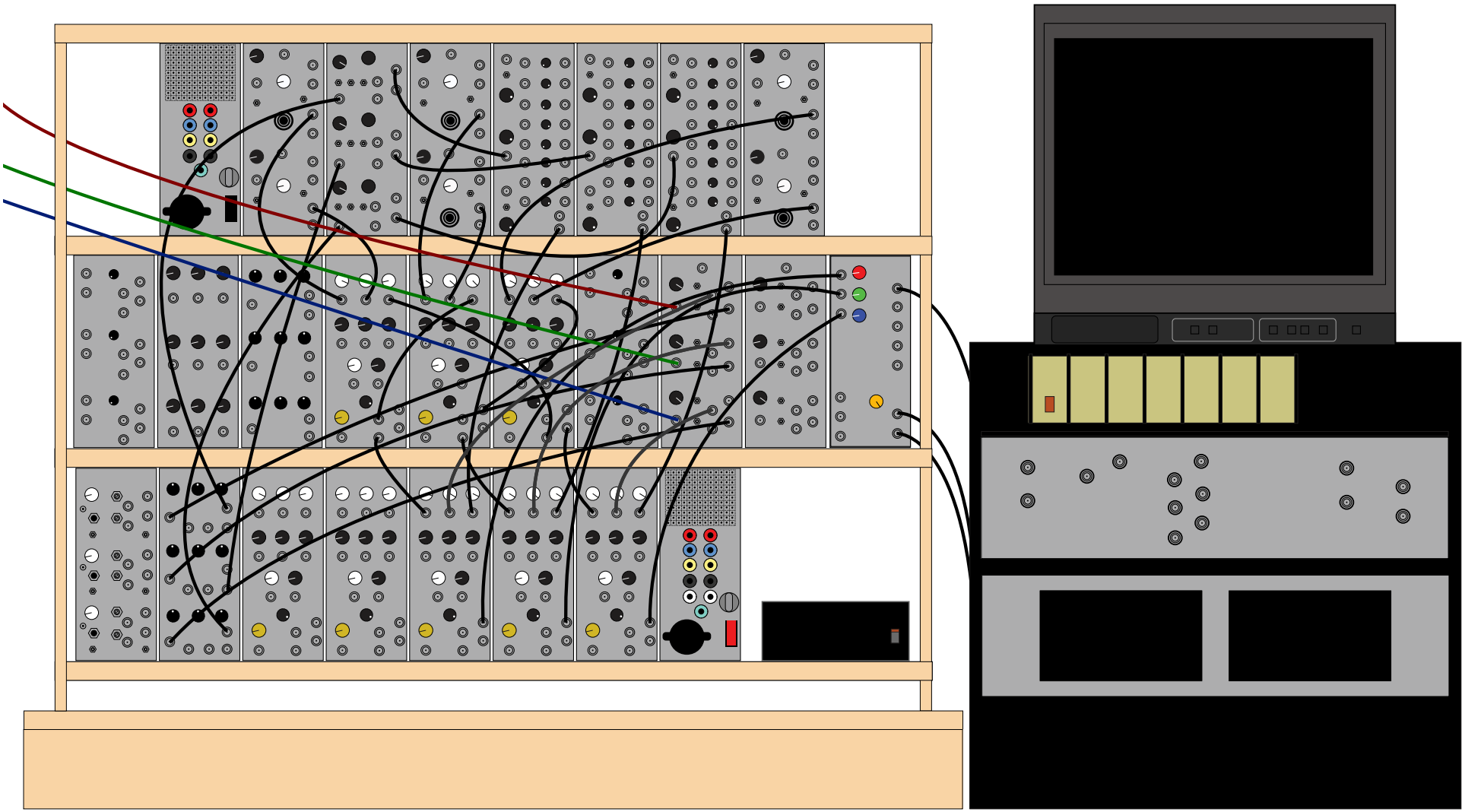
Note that, like the previous patches mixing processed and unprocessed video, the clean video is going into the center inputs of the bottom row of Adder/Multipliers, and the processed video is going into the right-most input. The left-most inputs are left open for oscillations, which will be added in the next patch.



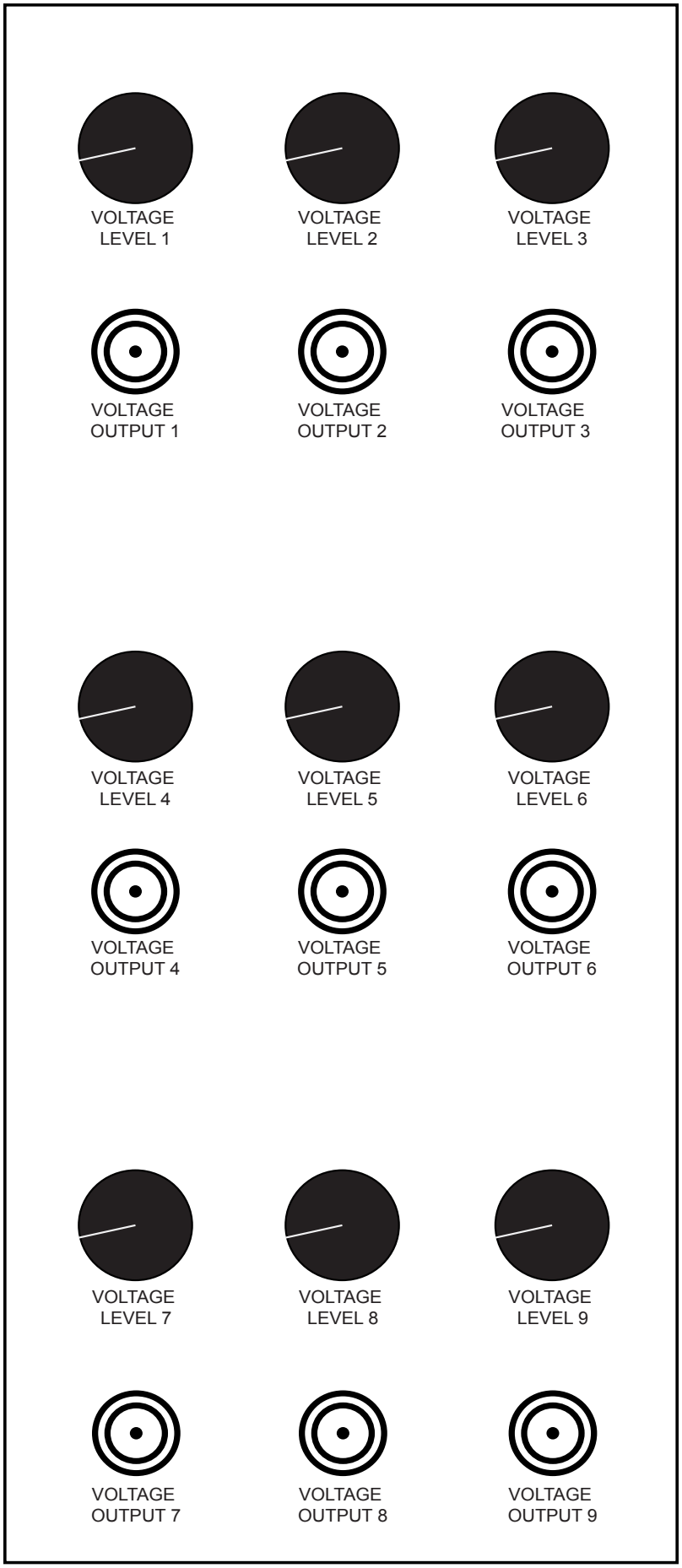
PATCH 11: PROCESSED AND UNPROCESSED FULL-COLOR EXTERNAL VIDEO WITH COMPLEX OSCILLATIONS

This patch combines patches 10 and patch 3, adding daisy-changed complex oscillations to the processed and unprocessed external video signal.

As with previous patches, in the bottom row of Adder/Multipliers, the left-most input is Oscillations, the center input is clean video, and the right-most input is processed video. This patch also uses the familiar left-to-right/top-to-bottom red-green-blue/R-G-B signal organization and interface orientation.



REFERENCE MODULE



COMPONENTS

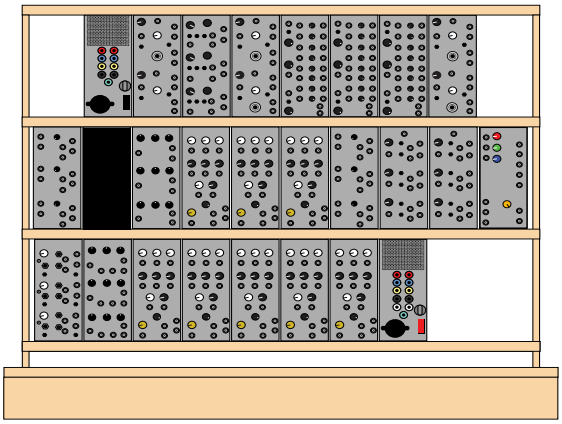
VOLTAGE LEVEL POTENTIOMETER

VOLTAGE OUTPUT

The Reference Module is a collection of 9 potentiometers with nine corresponding outputs. The potentiometers generate control voltages that can be used for Control Voltage inputs of other modules.

Each potentiometer generates a voltage through its corresponding output.

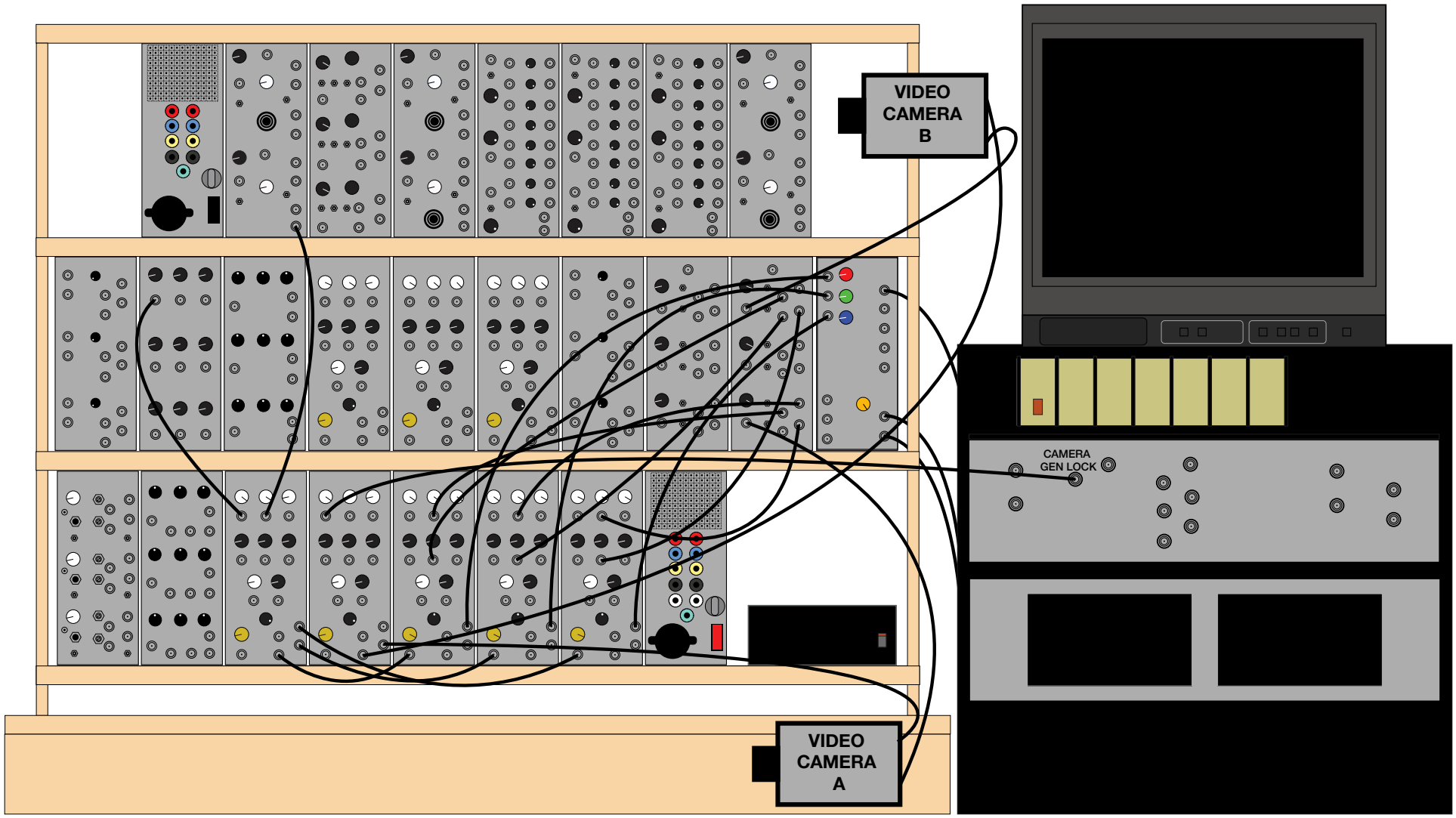
Tip: send an output to an Adder/Multiplier, then to the Voltage Control input of several other Adder/Multipliers to control their panning in unison. Mix the reference signal with an oscillation signal in that Adder/Multiplier to shift how the automatic panning is driven (as is done in the next patch).



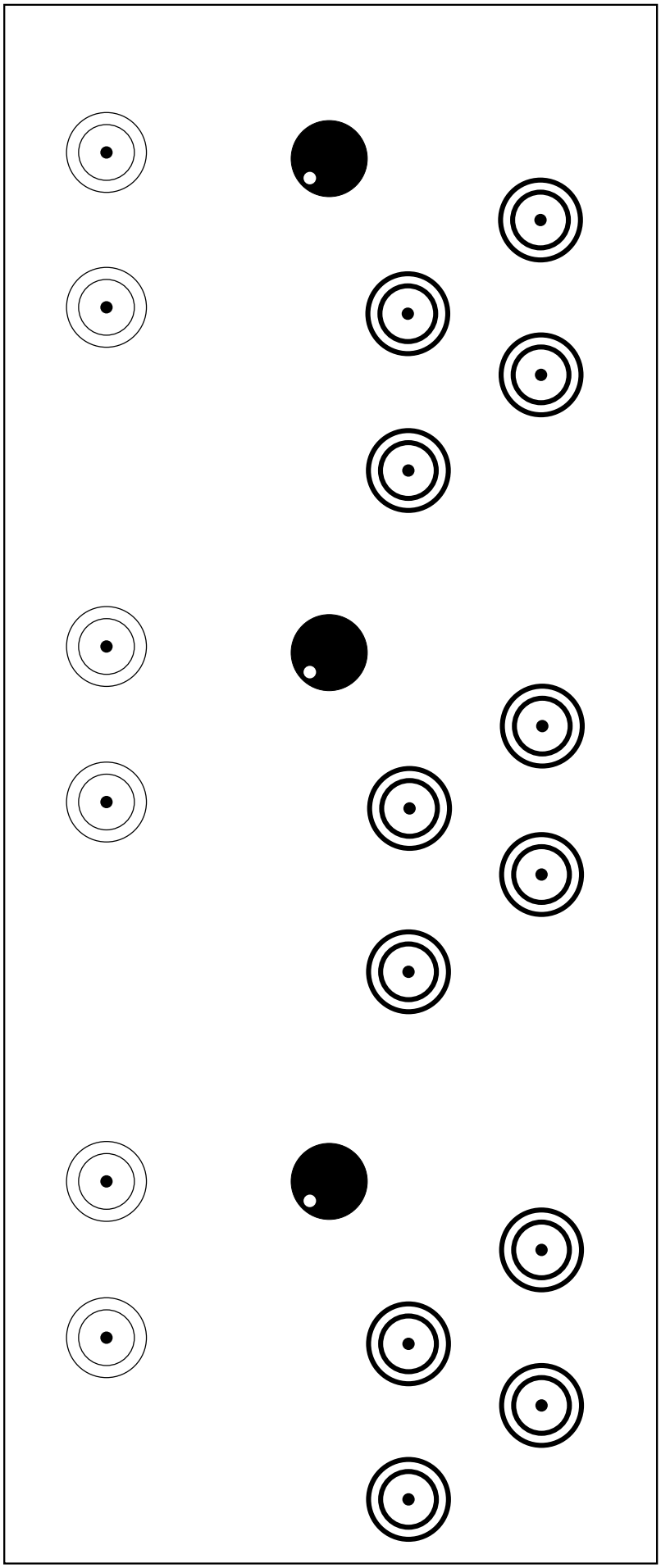
PATCH 12: TWO VIDEO CAMERAS WITH AUTOMATED PANNING THROUGH LOW FREQUENCY CONTROL VOLTAGE

This patch connects two video cameras, one in channel A and one in channel B, of the bottom row of Adder/Multipliers. It also pans those Adder/Multipliers from channel A to channel B automatically with a control voltage signal duplicated through an Adder/Multiplier and then sent to the Control Voltage inputs of each Adder/Multiplier (note that their Control Voltage Gain knobs are turned up, and their Mix knobs centered).

The left-most Adder/Multiplier is receiving 2 signals: one from the Reference module, and another from an Oscillator module. This allows for two different methods of panning from channel A to B: by turning the reference knob, or through an oscillation. In order to send proper video, both cameras need a sync signal, but only one is available. The sync signal is duplicated via the second Adder/Multiplier send to each camera's gen sync input. **Reminder: anything can be displayed in each channel (oscillations, processed video, inverted video, and more).**



COMPARITOR



COMPONENTS

INPUT

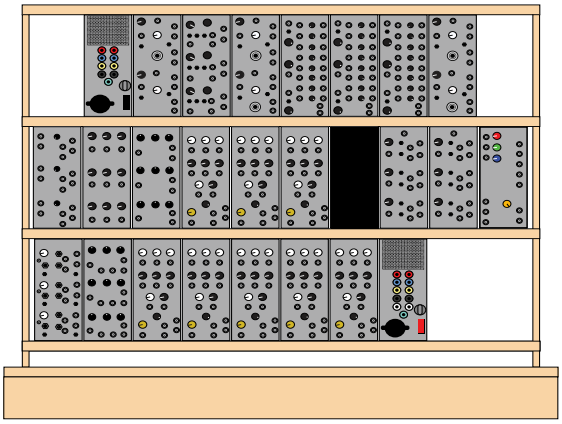
GAIN

OUTPUT

The Comparitor has two inputs which are compared to each other to yield an output that is either white or black. The effect is similar to A photographic kodalith image, with more control of the transfer point.

Though this module is not used in these example patches, it creates unique visuals that can be incorporated into unique signal flows.

CLOSING NOTE ON THE SANDIN IMAGE PROCESSOR USER GUIDE:
There are known additional modules not covered in this guide. This is meant to be an introduction to the core modules designed by Dan Sandin, with examples of how to effectively patch them together.

Dan designed this machine as a general purpose instrument that encourages experimentation and rewiring. He doesn't tell people how to patch it, just how it generally functions, empowering each user to forge their own path. Once you understand the functionality of the system, explore and mix signals in your own way to discover new paths. The possibilities are endless.

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