



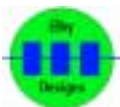
ASM-x Manual

Appendix B

Turning your ASM-x PCB in to a complete
Analogue Synthesiser

August 1st, 2004

Please note that this document is still currently under revision and I apologise for any errors or omissions. Readers should feel free to email any comments to me at the address given below.



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Before starting on your ASM-x pcb construction you should really give some thought to how the whole system is going to be put together. Are you going to go for a modular system, a semi-patched system or a fully hard-wired system? Each style has its advantages and disadvantages and you need to consider these factors in your overall design (see the following pages for more details on this).

Irrespective of the chosen design, it will be necessary to interconnect various module signals. All inputs on the ASM-x are fed through a buffer/mixer circuit which provides a fixed-gain or fixed-attenuation to the incoming signal. The values given in the design provide an optimum gain/attenuation factor and assume a relatively wide range signal will be applied. Once a design has been finalised for how the various modules will be interconnected it is possible to then fine tune the input resistors to optimise the performance of the panel controls. For example, if the initial ASM-x input is designed to accept a $-5V$ to $+5V$ control signal but your design will provide a $-10V$ to $+10V$ signal then you will, initially, find that the panel control for this signal will have a small 'working' area with the remainder of the pot travel resulting in overload. By adjusting the value of the input resistor we can adjust the pot to give us a working area over the complete pot rotation. An example of this is already shown in the VCO with the 'FINE TUNE' and 'COARSE TUNE' inputs having different input resistors that allow the control pots to operate correctly over a $-15V$ to $+15V$ range.

The selection of the components for these input circuits raises a common question regarding the positioning of these controls – “should the pots be placed on the inputs to a module, the outputs of a module or both?”

There is very little benefit in placing attenuator pots on both the inputs AND outputs of a module. Doing so would result in a very large panel size and a very high component cost.

Placing the attenuators on the outputs of a module probably provides the lowest cost solution but does mean that if two inputs on different modules are connected to the same output that they will both have the same signal levels all the time.

The more sensible approach is to place the attenuators on the inputs to a module which then allows each and every input to have its signal level tailored to its specific needs. If, as in the ASM-x, the various output signals comply with a predefined range of output level then this makes it easy to tailor the input attenuator resistors (as discussed above) to provide optimum control from the pot. This will mean that in a pre-patched or semi-patched system that additional inputs will need to be provided to allow for a reasonable selection of input controls. In a modular system the number of inputs is usually kept to a minimum and additional modules are added to the system to provide mixing and splitting options for the various signals.



Modular system:

A modular system lets you determine the route any signal or control voltage will take providing you with total control of every aspect of the sound being created.

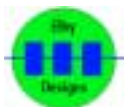
Modular systems tend to be physically large and expensive and can be quite difficult to set up to create a specific sound. In a modular system all inputs and outputs are brought out to a set of patch sockets. The user then connects an output signal from one module to an input signal of another module and repeats this until the complete signal path is generated.

To minimise the panel size for a module, there is normally only one connector/attenuator for each input type. This often means that there is a need for an external module where multiple signals may be combined prior to being applied to the module input. Similarly, splitter-modules are often used to allow a single output to be fed to a number of different modules



An Oakley-based system – a modular synthesiser

Modular systems rely heavily on patch cords with complex sounds often resulting in a 'spaghetti maze' of cords across the front panel making it difficult to document the settings for recall at a later date.



Hard-wired system:

In a hard-wired system the signal routes are predefined and so may limit the degree of control that you have.

Hard-wired systems can be physically quite small and this can reflect in a lower overall cost for the system.

Creating a sound is usually just a matter of tweaking a few controls and possibly setting a few switches.

If your main sound requirements are for tonal or melodic music then the pre-patched synthesiser works very well.



The Korg Mono/Poly – a hard-wired synthesiser.

Semi-patched system:

In a semi-patched system the more common sound routes are pre-wired but can be overridden using the patch sockets.

Semi-patched systems fit between the pre-patched and modular systems in both physical size and costs, offering you more connect options than the pre-patched system but at the same time not requiring the large space that a modular requires.



The Korg MS-20 – a semi-patched synthesiser.

The ASMx-Genie family:

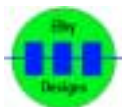
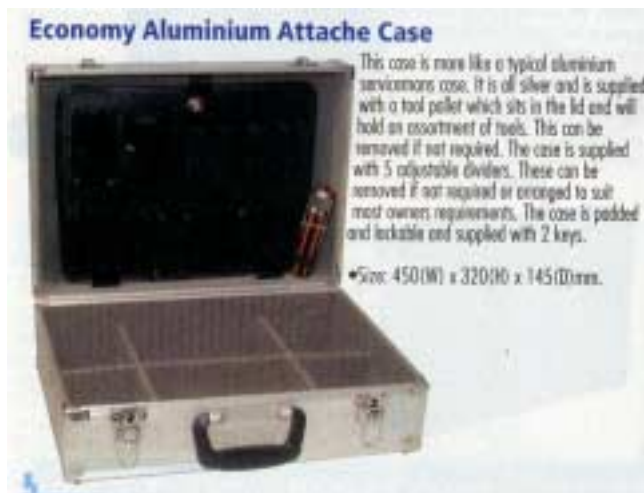
Some potential users of the ASM-x are put off by the fact that, as it stands, the ASM-x pcb is not a ready-to-go unit. As a minimum the builder will need to wire several panel controls and then provide some form of inter-module connection. Beginners to the world of analogue synthesisers and electronics may find this task to burdensome and may opt for a more 'complete' solution. This is, of course, in the nature of the one of the original design concepts behind the ASM-x – make it flexible!

To assist potential builders I decided to look at a 'complete analogue synthesiser' solution using the ASM-x. As there is no one perfect solution I defined a set of basic ground rules to help define the design:-

1. The design should utilise a readily available case. The case is one of the biggest problems to address. Although it would be nice to be able to offer a custom design, the cost of fabrication, the choice of materials and overall design make this option prohibitive. Commercial offerings seem very far and few between but eventually I came across two workable options:-
 - Flight-style case. These are quite common and can be found in most good electronic stores or camera houses. A bit of mechanical work is required to provide a mounting for the front panel as well as fitting of some items such as a power connector but a good quality result can be achieved for a relatively low outlay.
 - 19" racking enclosure. Some companies offer a basic metal shell that fits in to a 19" rack. These shells are usually offered in 1U, 2U and 3U heights as well as an appropriately sized 19" wide front panel and sub-front plate. The front panel is discarded as is the top plate for the enclosure. Your front panel is then fitted to the top of the enclosure resulting in a large (usually over 7U high) panel with a complete metal case enclosure. Using the 2U or 3U units gives you plenty of clearance inside for the pcb, wiring and any additional items such as a power transformer and additional modules. The whole unit can then be fitted in to either a very simple wooden housing or in to a suitable size 19" rack housing.
2. Minimise additional costs to that of constructing the ASM-x pcb.
3. In line with (4), minimise and additional modules or modifications to the ASM-x.

As it provided the most aesthetically complete solution, I opted for the flight-case approach for the case. This case gives us a panel size of around 440mm x 310mm which is reasonable close to a 6U rack system!

The semi-patched synthesiser design gives us, I believe, the best overall solution to a complete design and so this was adopted for the ASM1-Genie. The ASM2-Genie uses pre-patched design as the number of additional controls needed for the extra modules made it impractical to fit a patch section in the selected case.



ASM1-Genie – a semi-patched analogue synthesiser.

One point of contention in the modular world is the choice of patch connector. There is a wide variety of options here but investigating the popular systems you find that this list can be reduced substantially to three main contenders:-

1. ¼" (6.35mm) jack plug/socket,
2. 1/8" (3.5mm) jack plug/socket, or
3. 4mm banana plug/sockets

All of these have their advantages and disadvantages as discussed below:-

¼" (6.35mm) Plug/Jack:

Advantages:

- Mechanically robust, practically indestructible
- Electronically reliable
- Easy to patch into external equipment, since ground is provided as well as the signal
- Jacks are not very expensive if surplus parts are found
- Patch cords are not very expensive if they are home-made
- Switching contacts allow "normalized" patch connections, as on the ARP 2600

Disadvantages:

- Physically bulky
- Ground connection not really needed within the same system

1/8" (3.5mm) Plug/Jack:

Advantages:

- Physically compact
- Easy to patch into external equipment, since ground is provided as well as the signal
- Jacks are not very expensive if surplus parts are found
- Patch cords are not very expensive if they are home-made
- Switching contacts allow "normalized" patch connections, as on the ARP 2600

Disadvantages:

- Not very robust mechanically
- Not very reliable electrically
- Ground connection not really needed within the same system

Banana Plug/Jack:

Advantages:

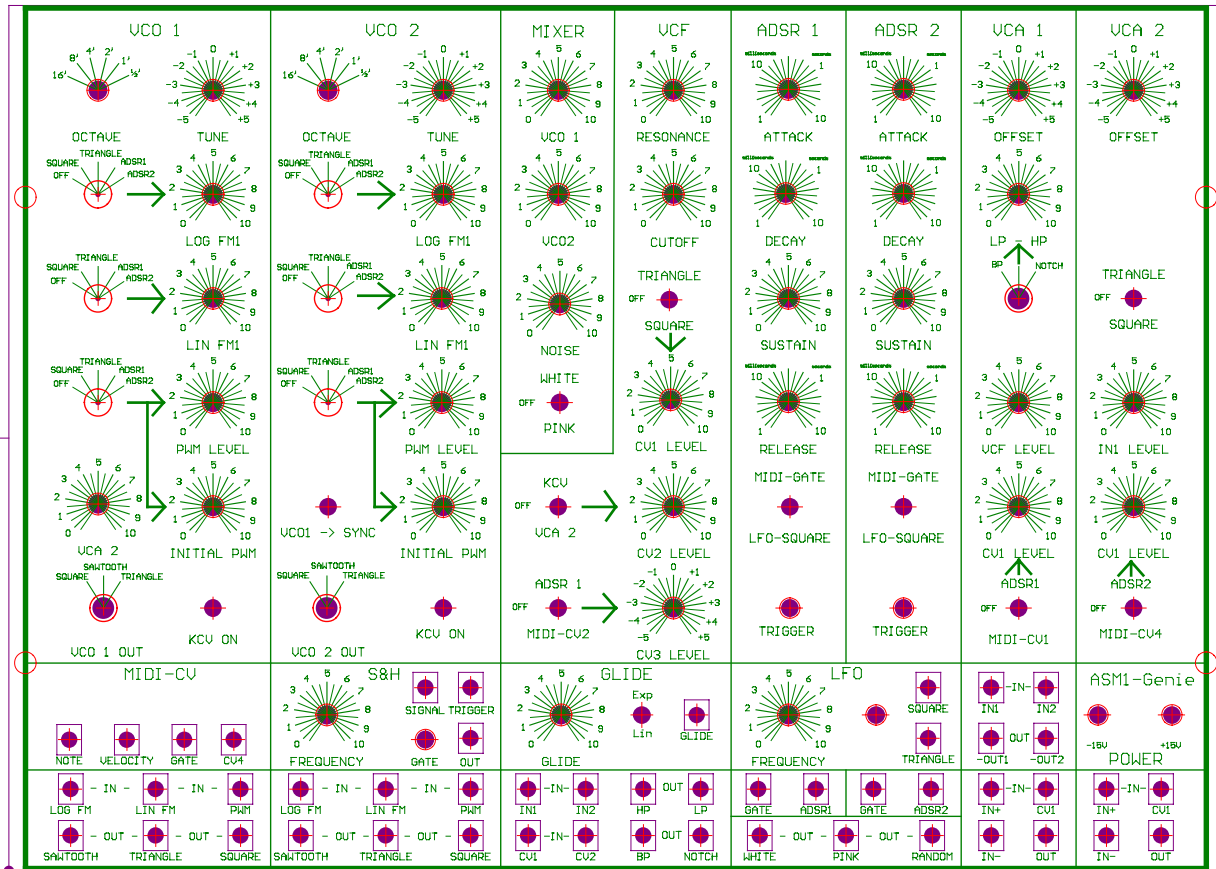
- Physically compact
- Not very expensive (plugs or jacks)
- Patchcords only have one conductor and are very easy to build
- Stacking plugs eliminates the need for multiple jacks
- Very reliable electrically

Disadvantages:

- No way to implement "normalized" connection
- No ground conductor for connection to external equipment

For the ASM1-Genie the physical size of the 3.5mm jack makes it the obvious choice.





The ASM1-Genie Front Panel

<http://www.elby-designs.com/asm-genie/asm1-genie-frontpanel.wmf>

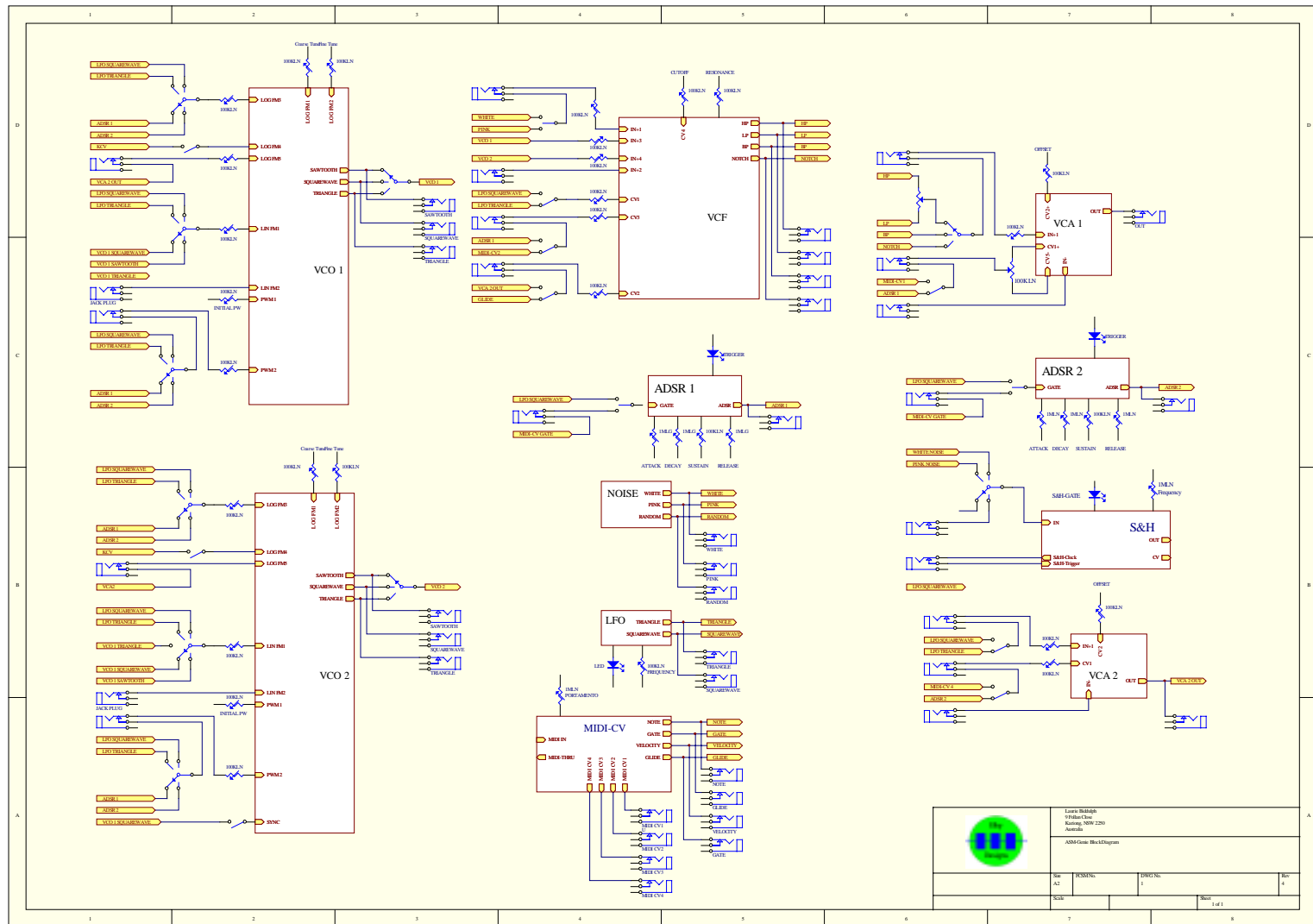
The following page shows a block diagram of the ASM1-Genie and how the various modules are interconnected with patch switching options.

MIDI support is provided through the use of my MIDI-CV module but any unit providing a 1V/Octave control voltage for NOTE and a suitable GATE signal (minimum of 2Volts) will work fine.

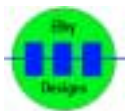
In addition, the PSU-1 provides regulated power supply for the whole system.



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<http://www.elby-designs.com.asm-genie/asm1-genie-block.pdf>



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ASM-1 Minimum Panel Controls

The following section lists recommended values for pots to be used in conjunction with the ASM-1. 'Recommended Minimum Panel Controls' lists those controls that are required for proper operation of the module. Depending upon your system you may need additional pots on the remaining inputs. These pots will provide you with attenuation control of incoming signals. Where applicable, a second list is provided which lists additional pots that can be added if desired.

VCO - Voltage Controlled Oscillator (VCO 1 & VCO2)

Recommended Minimum Panel Controls:

- CV1 - Fine Tune - 100K Linear
- CV2 - Coarse Tune – 100K Linear
- PWM1 - Initial Pulse Width – 100K Linear

The Coarse Tune pots on the VCO could be rotary switches giving octave selection if desired.

Additional controls: All remaining inputs, where used, should have 100K Linear pots.

VCF - Voltage Controlled Filter

Recommended Minimum Panel Controls:

- CV1 – Cut-off Frequency – 100K Linear
- Q - Resonance – 100K Linear

Additional controls: All remaining inputs, where used, should have 100K Linear pots.

VCA - Voltage Controlled Amplifier (VCA1 & VCA2)

Recommended Minimum Panel Controls:

- CV1 - Initial Gain – 100K Linear

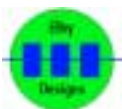
Additional controls: All remaining inputs, where used, should have 100K Linear pots.

ADSR Envelope Generator (ADSR1 & ADSR2)

Recommended Minimum Panel Controls:

- Attack – 1M Linear
- Decay – 1M Linear
- Sustain – 100K Linear
- Release – 1M Linear

Additional controls: There is no need for any additional controls on this module.



Noise Module

Recommended Minimum Panel Controls:

- None

Additional controls: There is no need for any additional controls on this module.

LFO - Low Frequency Oscillator

Recommended Minimum Panel Controls:

- Rate – 100K Linear

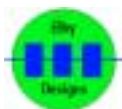
Additional controls: There is no need for any additional controls on this module.

Glide Buffer

Recommended Minimum Panel Controls:

- Portamento (Glide rate) – 1M Linear

Additional controls: There is no need for any additional controls on this module.



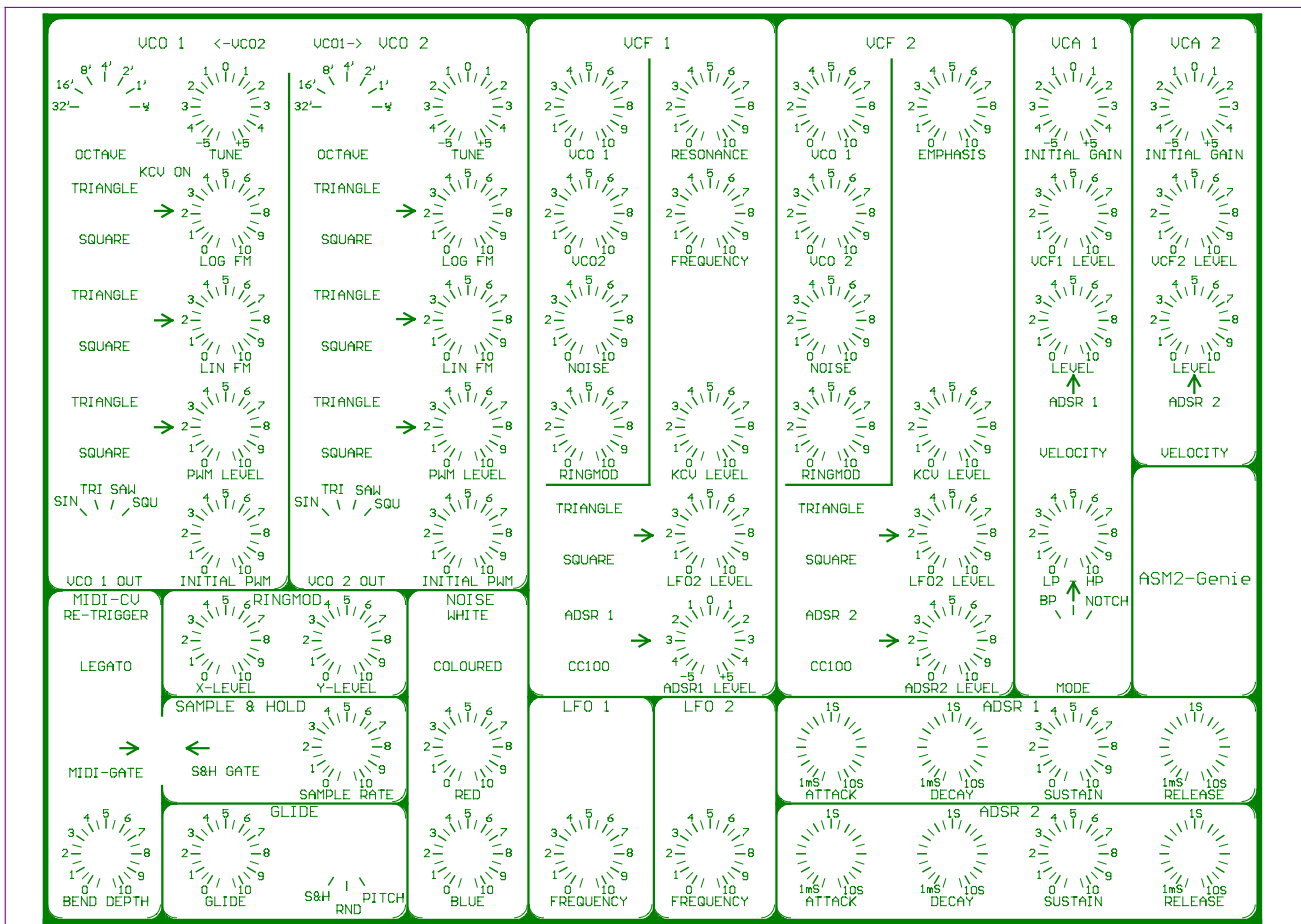
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ASM2-Genie – a hard-wired analogue synthesiser.

In comparison to the ASM-1, the ASM-2 has a number of additional synthesiser modules and selector options which means that a semi-patched version of the ASM-2 will not fit in the current flight-case. Consequently, the ASM2-Genie will be presented as a hard-wired system.

An external MIDI controller is still required and the MIDI-CV is used for this function. As with the ASM1-Genie, most 1V/Octave MIDI controllers will function fine.

Although the ASM-2 now includes an on-board power supply section we still need to provide a rough DC regulated supply which basically consists of a transformer, bridge rectifier and two smoothing capacitors. The RAW-DC pcb is suitable for this application or the unit can be built in-situ as desired.



Origin (0, 0)

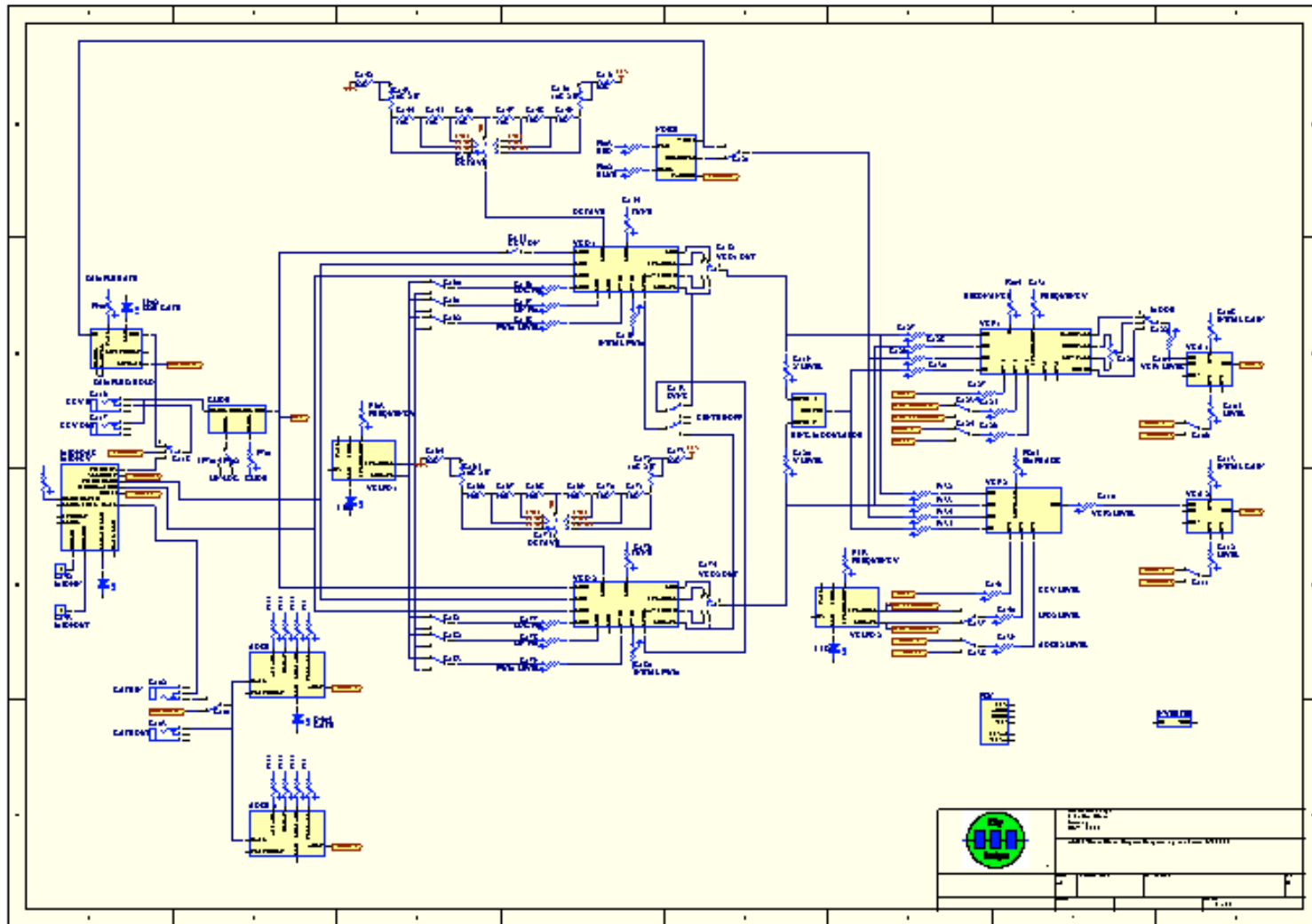
Outline of panel (450mm x 320mm)

The ASM2-Genie Front Panel

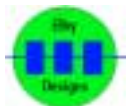
<http://www.elby-designs.com/asm-genie/asm2-genie-frontpanel.wmf>



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<http://www.elby-designs.com/asm-genie/asm2-genie-block.pdf>



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ASM-2 Minimum Panel Controls

The following section lists recommended values for pots to be used in conjunction with the ASM-2. 'Recommended Minimum Panel Controls' lists those controls that are required for proper operation of the module. Depending upon your system you may need additional pots on the remaining inputs. Where applicable, a second list is provided which lists additional pots that can be added if desired.

VCO - Voltage Controlled Oscillator (VCO1 & VCO2)

Recommended Minimum Panel Controls:

- CV1 - Fine Tune - 100K Linear
- CV2 - Coarse Tune – 100K Linear
- PWM1 - Initial Pulse Width – 100K Linear

Additional controls: All remaining inputs, where used, should have 100K Linear pots.

VCF - Voltage Controlled Filter (VCF1)

Recommended Minimum Panel Controls:

- CV1 – Cut-off Frequency – 100K Linear
- Q - Resonance – 100K Linear

Additional controls: All remaining inputs, where used, should have 100K Linear pots.

VCF - Voltage Controlled Filter (VCF2)

Recommended Minimum Panel Controls:

- Enhance – 50K Logarithmic

Additional controls: All remaining inputs, where used, should have 100K Linear pots.

VCA - Voltage Controlled Amplifier (VCA1 & VCA2)

Recommended Minimum Panel Controls:

- CV1 - Initial Gain – 100K Linear

Additional controls: All remaining inputs, where used, should have 100K Linear pots.

ADSR Envelope Generator (ADSR1 & ADSR2)

Recommended Minimum Panel Controls:

- Attack – 1M Linear
- Decay – 1M Linear
- Sustain – 100K Linear
- Release – 1M Linear

Additional controls: There is no need for any additional controls on this module.



Noise Module

Recommended Minimum Panel Controls:

- Red – 100K Linear
- Blue – 100K Linear

Additional controls: There is no need for any additional controls on this module.

LFO - Low Frequency Oscillator (LFO1 & LFO2)

Recommended Minimum Panel Controls:

- Rate – 100K Linear

Additional controls:

- Tuning – 100K Linear
- CV – 100K Linear

Glide Buffer

Recommended Minimum Panel Controls:

- Portamento (Glide rate) – 1M Linear

Additional controls: There is no need for any additional controls on this module.

Ring Modulator

Recommended Minimum Panel Controls:

- None

Additional controls: Recommend inputs, where used, have 100K Linear pots.

Sample & Hold

Recommended Minimum Panel Controls:

- Sample Clock – 1M Linear

Additional controls: There is no need for any additional controls on this module.

