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# ALL YOU NEED TO KNOW ABOUT SYNTHESIZERS

**Just the straight facts**

# WHAT IS HUMAN ENGINEERING?

Human engineering is the least talked-about aspect of synthesizer design. It is also the most important. Human engineering determines what your synthesizer will look like, where the knobs will be placed, what color to make the switches, what typeface to use for panel graphics. how far the keys must be depressed, and dozens of other considerations.

At ARP, we make a big deal about human engineering.
Because designing a perfect synthesizer requires much more than perfect oscillators and filters-it requires a sensitivity for how an instrument should be shaped and structured so that it feels good in your hands.

“Human Engineering” involves getting lots of performing musicians involved in the actual conceptual design process. The success of the process is crucial. A bunch of engineers sitting around a drafting table can come up with a synthesizer loaded with gadgets that are impossible to play!

The biggest mistake you can make when purchasing a synthesizer is to be lured by the lists showing how many oscillators, filters, etc., a synthesizer contains. You need a synthesizer that feels right to you. And unless you’re planning on disappearing into a laboratory, you need a synthesizer that is human engineered.

As Michael Brooks said in Creem magazine, “For a brief analysis, Moog, like Kleenex and Coca-Cola. is the name most commonly used to explain synthesizers, but ARP is the most popularly used synthesizer in rock. The ARP was aimed at the working musician, working musicians like Elton John, Beach Boys, N. Y. Rock Ensemble, Herbie Hancock, the Rascals. Grateful Dead. Frank Zappa, Jefferson Airplane, Chicago. Seatrain, John Lennon, Led Zeppelin, Miles Davis. Al Kooper, The James Gang. Santana, Three Dog Night, Sly and the Family Stone, Stevie Wonder, Peter Townshend, and on and on.”’ *

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*‘Creem, May 1973, Vol. 4, No. 12, p. 73.

**The biggest mistake you can make when purchasing a synthesizer is to be lured by the lists showing how many oscillators, filters, etc., a synthesizer contains.**

**The less glamourous aspects of synthesizers, like where certain knobs are placed on the panel can be much more important to a musician than how many oscillators or ring modulators he has.**

# LET'S TALK FUNCTIONS

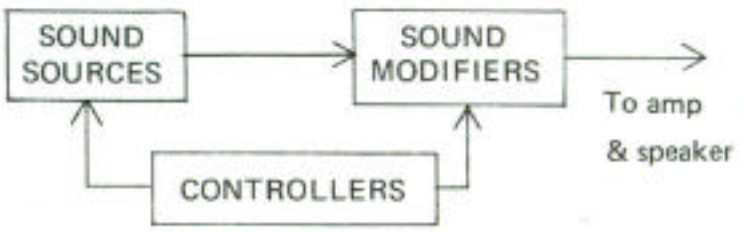
Oscillators, Filters. Envelope Generators, Ring Modulators.
and other wonderful devices all make up the "Functions" in a synthesizer. Ever since synthesizers were invented, manufacturers, including us, have run around with charts proving how many "Functions" their synthesizers had. We now know that less glamourous aspects of synthesizers, like where certain knobs are placed on the panel, can be much more important to a musician than how many oscillators or ring modulators he has.

So instead of just counting functions, let's talk about what these functions do for you. Because if you want to synthesize your way to stardom, you're going to have to do it with sounds. not figures.

In the following pages. we're going to compare the ARP Odyssey with three other synthesizers in a comparable price range. What we prove in this comparison is what most of the world's most famous synthesizer players already know that the ARP Odyssey is the synthesizer designed by musicians for musicians.

FIRST A LITTLE THEORY
All the functions on a synthesizer can be divided into three categories:

1). Sound Sources. Includes oscillators and noise generators.
2). Sound Modifiers. Includes Filters, ring modulators, etc.
3). Controllers. Includes keyboards, foot pedals. envelope generators.




The "raw" sounds from the oscillators or tone generators are "processed" through the Sound Modifiers like the filter or ring modulator. Controllers are hooked up to both the Sound Generator functions and Sound Modifier functions so that the performer can change or control the sounds being produced. That's all there is to it!

# AUDIO OSCILLATORS

The audio oscillators are the basic tone sources in any synthesizer. As you play up and down the keyboard, the oscillators will follow the notes. The oscillators do not have to be set for the same pitch. If you tune two oscillators to an interval. you can play that interval up and down the scales.

## OSCILLATOR WAVEFORMS

The waveforms produced by oscillators determine the overall limitations of a synthesizer. Each different kind of waveform contains different harmonics and has a different sound.
By filtering, you will be able to remove certain harmonics and change the sound somewhat. Since you can never add harmonics, the oscillator waveform will determine the general overall quality of the sound produced.

Waveforms are either Static or Dynamic. A static waveform is simply a steady, unchanging tone. A dynamic waveform is one which changes during the sound. If you looked at the waveforms from conventional instruments, like guitars or pianos. you would see that the waveforms are not constant. but are always changing as the tone dies away.

The most common synthesizer waveforms are:

| | | |
|---|---|---|
| Sawtooth | static | Brassy |
| Square | static | Hollow. clarinet-like |
| Pulse | static | Bright, reedy |
| Modulated pulse | dynamic | Rich, chorus-like |
| Phase-sync sawtooth | dynamic | Voice-like, wide range |
| Sine | static | Pure colorless tone, contains no harmonics |

The Odyssey is the only synthesizer in this comparison with dynamic waveforms. Both of the two audio oscillators in the Odyssey will produce all the common static waveforms as well as a modulated pulse wave and phase-synchronized wave.

**Only the Odyssey gives you 2 dynamic waveforms for rich, complex sounds, and a sine wave for pure tones.**

The Odyssey's filter can be used as a third oscillator and generates a sine wave output. The Odyssey is the only synthesizer that can produce a truly pure sine wave.

The Minimoog has three oscillators. None of its waveforms, however. are dynamic. The waveforms include sawtooth. square. and pulse waves. The triangle wave has the same overtones as a square wave, but is not as bright. A "Reverse Sawtooth" sounds exactly the same as a regular sawtooth.

The Sonic VI has only two voltage controlled oscillators, neither of which can produce dynamic waveforms.

The EML-101 has four oscillators. This synthesizer creates six waveforms, all static. However, out of that six. the square wave. “sloped square” wave and triangle wave all have the same harmonics, the only difference being brightness. In addition, as with the Minimoog. the inverted sawtooth wave is identical to a regular sawtooth wave in sound.

## NUMBER OF OSCILLATORS

Generally. more oscillators means a richer, more chorus like sound. However, the effectiveness of an oscillator depends on the variety of waveforms the oscillator can produce. For instance. one oscillator with dynamic waveforms can produce richer sounds than two or three oscillators with static waveforms only. If a synthesizer is equipped with a two-voice keyboard, then you obviously need at least two oscillators in order to produce two-note chords. Because both oscillators in the ARP Odyssey have dynamic waveform outputs, the Odyssey can create sounds that are as rich as or richer than synthesizers with twice the number of static waveform oscillators.

In most live performance situations, you will want to be able to add vibrato, tremelo, and other musical effects. This requires a Control Oscillator. If a synthesizer is not equipped with a special control oscillator, then one of the audio oscillators must be used for this purpose. In other words, a synthesizer with three audio oscillators but no control oscillator has Iittle advantage over a synthesizer with only two oscillators, since one of the three will almost always be used for making tremelos and vibratos. The Odyssey is the only synthesizer that includes a special control oscillator in addition to two audio oscillators and filter oscillator.

**Only the Odyssey gives you rock-stable oscillators that track over a wide range.**

## OSCILLATOR RANGE

Making an oscillator with wide range, i.e., the ability to make a continuous sweep of frequency over a wide range of pitch, is the most difficult achievement in oscillator design. You will notice that on some synthesizers the keyboard will go out of tune as you approach the high end, or the unit will require retuning when the pitch range of the instrument is changed.

## OSCILLATOR STABILITY

If an oscillator is not stable. your synthesizer will drift out of tune while you are playing it. To test for stability, turn

on a synthesizer that has not been used for several hours and quickly pin down one note and tune to a pitch reference like an organ. As the synthesizer warms up, its pitch may drift if the oscillators are not properly designed. Forget about the figures and trust your ears instead!

The range of the Odyssey oscillators is from 16 Hz to 16.000 Hz in one continuous sweep. We consider widerange drift-free oscillators a must on all our synthesizers.

The range of the Minimoog oscillators is limited and must be switched in octave intervals. Check to see if these octaves are perfect or whether they require additional tuning. The stability of the Minimoog oscillator is specified at 1% (6% equals one semitone).

# AUDIO OSCILLATORS

| | Odyssey | Minimoog | Sonic VI | EML-101 |
|---|---|---|---|---|
| Number | 3* | 3 | 2 | 4 |
| Dynamic waveforms | 2 | 0 | 0 | 0 |
| Extra control oscillators | 1 | 0 | 2 | 0 |

*'Includes filter in self-oscillating mode

# KEYBOARDS

The keyboard in a synthesizer performs two important functions:

1). It determines what note(s) the oscillators will play.
2). It triggers the envelope generators, which causes the attack and decay of the sound.

All the compared synthesizers have keyboards of roughly the same length and have the capability of gliding (portamento) from note to note. The Odyssey is the only synthesizer which includes a foot switch to control this glide, however.

**Only the Odyssey includes foot pedal-controlled glide and pitch bend.**

All the keyboards can play two notes at a time. except for the Minimoog, and all the units have the ability to transpose the range of the keyboard. All the synthesizers have some facility for "pitch bending," but the ARP Odyssey is the only synthesizer that includes a foot pedal for pitch bending.

Pressing a note on the keyboard of any synthesizer will trigger the envelope generator. However, pressing down a second note will not trigger the envelope generators on any of the instruments except the ARP Odyssey. This means

**Multiple triggering keyboard is an Odyssey exclusive.**

that in order to get clean attacks and decays, you have to lift your fingers off the keyboard inbetween notes. On the Odyssey, you can run notes together and never miss an attack because of the Odyssey's "multiple triggering" feature.

## KEYBOARDS

| | Odyssey | Minimoog | Sonic VI | EML-101 |
|---|---|---|---|---|
| Keys | 37 | 44 | 49 | 44 |
| Polyphonic | yes | no | yes | yes |
| Multiple triggering | yes | no | no | no |
| Foot pedals included | yes | no | no | no |

# VOLTAGE CONTROLLED FILTER

The voltage controlled filter is the most important modifying function in the synthesizer. The characteristics of the voltage controlled filter have an overall effect on the "sound" of a synthesizer. A filter is used to eliminate certain harmonics or frequencies from a sound. The most common types of filters are:

1). Low pass filter: Removes high frequencies, making the sound muffled or dull.
2). High pass filter: Removes bass frequencies.making the sound very raspy and thin.
3). Band pass filter: This filter eliminates all but a narrow band of frequencies.

The most useful filters are the low-pass and the band-pass filters, because most natural instruments are low-pass and band-pass filters. All instrumental sounds and most "electronic" sounds are created using these filters. All the synthesizers discussed here have one voltage controlled filter which can be either a low-pass or band-pass filter. The filter on the EML-101 has a high-pass output in addition. And the ARP Odyssey has a separate manual high-pass filter.

## FOOT PEDAL CONTROL

**Only the Odyssey includes foot pedal control for live performance control of the filter.**

The ARP Odyssey is the only synthesizer which includes a foot pedal filter control When the filter is being used as a low-pass filter. this pedal controls the brightness of the sounds. When the filter is being used as a band-pass filter, then the pedal acts like a wa-wa effect.

## FILTER CUTOFF CHARACTERISTICS

Cutoff characteristics determine the “sound” of your filter. Expressed in dB/octave, this figure tells you how effectively the filter eliminates sounds that it is supposed to filter out. The higher the figure, the greater the filtering effect. The Odyssey and the EML-101 have 12 dB/oct filters. The Minimoog and Sonic VI have 24 dB/oct filters. The 12dB/ oct filter will produce better string and reed sounds, but the 24 dB/oct will create better brass and flute sounds. Big studio synthesizers like the ARP 2500 offer both kinds of filtering.

**The Odyssey filter doubles as an extra oscillator.**

## VOLTAGE CONTROLLED FILTER

| | Odyssey | Minimoog | Sonic VI | EML-101 |
|---|---|---|---|---|
| Number | 1 | 1 | 1 | 1 |
| Cutoff in dB/oct | 12 | 24 | 24 | 12 |
| Foot pedal control included. | yes | no | no | no |

# NOISE GENERATOR

Only the EML-101 does not include both white noise and pink noise. Pink noise sounds even to the ear; white noise sounds very high-pitched and “hissy.” There is no filter on the EML-101 which can convert its white noise to pink noise.

## NOISE GENERATOR

| | Odyssey | Minimoog | Sonic VI | EML-101 |
|---|---|---|---|---|
| White & pink noise | yes | yes | yes | no |

# RING MODULATOR

A ring modulator takes two input signals and produces a complex output which contains many new frequencies derived from the sums and differences of the frequencies in the two input signals. In other words, the ring modulator can take two simple tones and produce a very rich and complex tone. This ring modulated tone is useful for synthesizing gong and chime sounds. Some manufacturers have special names for their ring modulators and claim different features, but basically the sound you get is the same for any of them.

## RING MODULATOR

| | Odyssey | Minimoog | Sonic VI | EML-101 |
|---|---|---|---|---|
| Included | yes | no | yes | yes |

**Only the Odyssey offers a sine wave control oscillator for realistic tremelo and vibrato effects.**

# CONTROL OSCILLATORS

## WAVEFORMS

Control oscillators are used for producing tremelos, trills, vibratos, and other repeating sounds. True vibrato and tremelo require a sine wave output from a control oscillator. A triangle wave output can be used to approximate a natural vibrato or tremelo, but is audibly inferior to a sine wave. Only the ARP Odyssey has a true sine wave control oscillator

A square wave is needed to generate trills. A sawtooth is particularly useful if the synthesizer also includes a sample & hold circuit. All the synthesizers can produce sawtooth and square waves.

## NUMBER OF CONTROL OSCILLATORS

An audio oscillator can be used as a control oscillator if its frequency can be made low enough. Obviously it would be useless to have this capability on all the audio oscillators since you always need at least one or two audio oscillators operating as sound sources. Typically, you will need only one or at most two control oscillators.

## CONTROL OSCILLATORS

| | Odyssey | Minimoog | Sonic VI | EML101 |
|---|---|---|---|---|
| Number | 2 | 1 | 1 | 2 |
| Sine wave | yes | no | no | no |

# SAMPLE & HOLD

The sample & hold circuit permits the generation of random or ordered patterns of tones. spontaneous changes in timbre, percussive rhythmic effects, etc. The OdysseyS sample & hold circuit includes a lag processor," which smooths out the sudden changes in voltage that are produced by the sample & hold. This smoothing process is particularly useful when the sample & hold is being used to control the filter, since it permits the filter frequency to change smoothly rather than in steps. A sample & hold can create many effects similar to a sequencer.

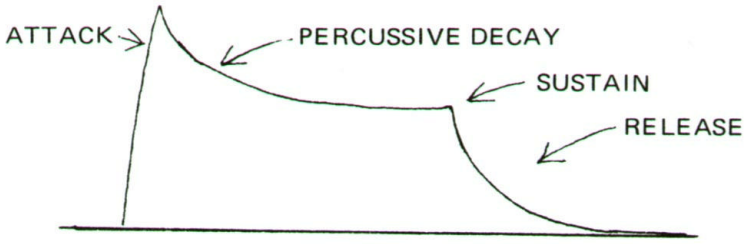
**Only the Odyssey offers a lag processor.**

## SAMPLE & HOLD

| | Odyssey | Minimoog | Sonic VI | EML-101 |
|---|---|---|---|---|
| Number | 1 | 0 | 0 | 1 |
| Lag processor | yes | no | no | no |

# ENVELOPE GENERATORS

The envelope generator is primarily used to control the attack and decay characteristics of a note. Some musical instruments have fairly complex envelopes. A piano note, for instance. looks like this:




The piano sound is characterised by an instantaneous attack and a percussive overshoot. While the note is held down, the sound sustains. When the note is released, the sound dies out quickly. The percussive attack of the piano is common to most stringed instruments. Even some wind instruments, especially brass instruments. have an initial overshoot on the attack.

Some envelope generators have four controls labelled “attack, decay, sustain, and release,” which allow you to set up nearly any attack and decay characteristic. A somewhat less sophisticated envelope generator has only three controls for “attack, decay. and sustain.” With this envelope generator, the percussive overshoot at the beginning of the sound is controlled by the same knob as the release. It is impossible with one of these envelope generators to produce a percussive attack on a sound and also a long release.

**The 4-control envelope generator is an Odyssey exclusive.**

The simplest and least sophisticated envelope generator has only two controls, “attack and release.” This type of envelope generator is useful for string ensemble sounds, woodwinds, and other sounds that do not have an overshoot characteristic on the attack.

Only the ARP Odyssey includes an envelope generator with all four controls.

## ENVELOPE GENERATORS

| | Odyssey | Minimoog | Sonic VI | EML-101 |
|---|---|---|---|---|
| Number | 2 | 2 | 1 | 2 |
| Maximum number of controls | 4 | 3 | 3 | 3 |

# PATCHING

“Patching” means the way in which the functions on a synthesizer are interconnected. Some synthesizers use patch cords, much like a telephone switch board. Other synthesizers use switches.

The “patch” which you set up on a synthesizer will determine the path of the signal through the synthesizer. and consequently will determine the kind of sound produced. To change from one sound to another usually requires changing the “patch.” If a synthesizer uses patch cords. this means unplugging some cords and plugging in some others. If a synthesizer uses switches for patching. you need only change the position of a few of these switches. Changing a patch in live performance is probably the most difficult part of playing a synthesizer. You have to be able to see at a glance how your synthesizer is set up. And in order to make fast transitions, you have to develop the ability to see your synthesizer controls as a pattern. just like you think of chords on a piano as a pattern, and not as a lot of individual notes.

A synthesizer that is properly human-engineered for performers will have the following characteristics:

1). The settings of any patching switches must be clearly visible at a glance.
2). All the patching switches should be organized in a neat row on the panel so that you can see the “pattern” of the patch at a glance.

**Only the Odyssey uses slide switches exclusively for patch connection**

Only the ARP Odyssey uses slide switches exclusively for patching. Slide switches. unlike rotary controls, give a clear visual indication of the switch setting. And only the Odyssey has all the patching switches lined up in a neat pattern so that their settings can be seen at a glance. Consequently, as you gain skill. the Odyssey’s human-engineered patching will let you change from one sound to another much faster.

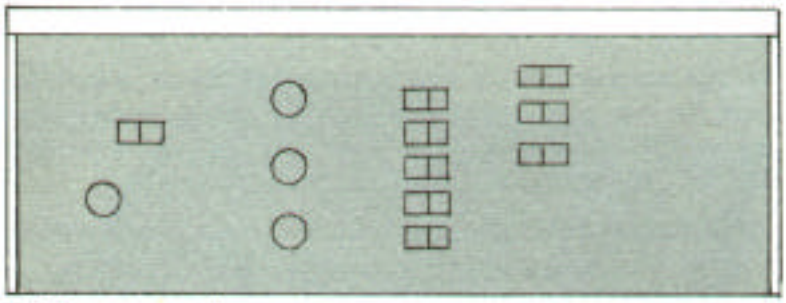
**AND only the Odyssey has all the patching switches lined up in a neat pattern so that their settings can be seen at a glance.**

All the other synthesizers use rotary knobs for patching and they are generally spread out all over the panel. This combination makes a patch nearly impossible to perceive as a pattern. especially in the dim lighting conditions of stage performance.

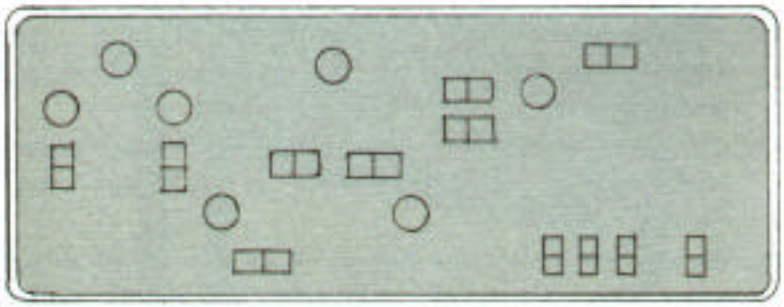
## LOCATION OF PATCH CONTROLS

Odyssey panel

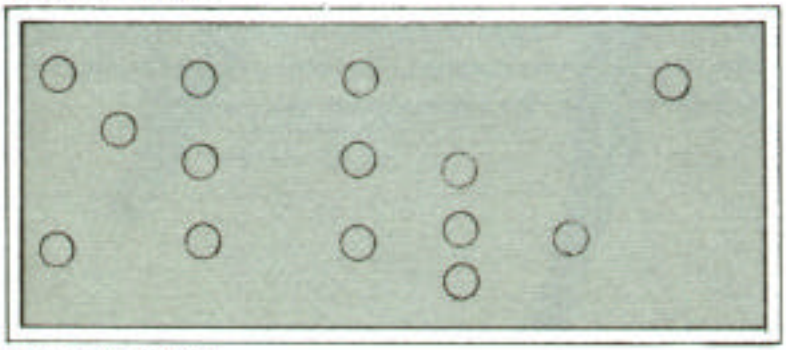
**Patch switches on the ARP Odyssey are in a neat line; only easy-to-use slide switches are used.**



Minimoog panel



Sonic VI panel



EML-101 panel

**On all other units, patch controls are all over the panel; several different types of switches are used.**

**Only the Odyssey has been designed especially for live performance.**

# COST EFFECTIVENESS

You will pay for all the features on any synthesizer. even the ones you'll never use.

Only the ARP Odyssey has been designed especially for live performance. On some other synthesizers, you pay for the ability to play microtonal scales. You pay for a full bank of jacks and patch cords. You pay for many features that are not generally useful to the performing musician.
On the other hand. the Odyssey includes two foot pedals especially for live performance. Only the Odyssey includes slide controls throughout for quick visual reference. Only the Odyssey includes a four-control envelope generator.
And only the Odyssey includes just what you really need. without redundant or inefficient controls or superfluous features.

# PRICE

**ARP backs up its Odyssey with a solid dealer service organisation.**

All the synthesizers are sold through retail music stores, except for the EML-101 which is sold primarily direct from the manufacturer. You may think that purchasing directly from the factory saves you money, but consider that:

1). Synthesizers sold through retail stores can be sold in higher volume, thus they can cost less.
2). Your local dealer is capable of training you on how to play your synthesizer. That's what he's paid for.
3). Your local dealer will service and maintain your synthesizer. This means no big shipping charges and long waits. That, too, is what he's paid for.
4). Your local dealer can take back the unit he sold you on trade-in when you want to move up to a bigger instrument.
5). Selling direct from the factory requires a lot of direct advertising. You pay for this advertising when you buy the product.

Every big manufacturer of musical instruments sells through retail music stores, because this form of distribution is, in the final analysis, the best value for the consumer.

## ADD IT UP YOURSELF !

1. Only the Odyssey has dynamic waveforms.
2. Only the Odyssey has a separate control oscillator.
3. Only the Odyssey has a multiple-triggering keyboard.
4. Only the Odyssey has a four-control envelope generator.
5. Only the Odyssey has foot pedal controls for filtering, pitch bend, and portamento.
6. Only ARP has the world's largest network of synthesizer dealers and service centers.
7. **Only ARP synthesizers are designed by musicians for musicians**.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