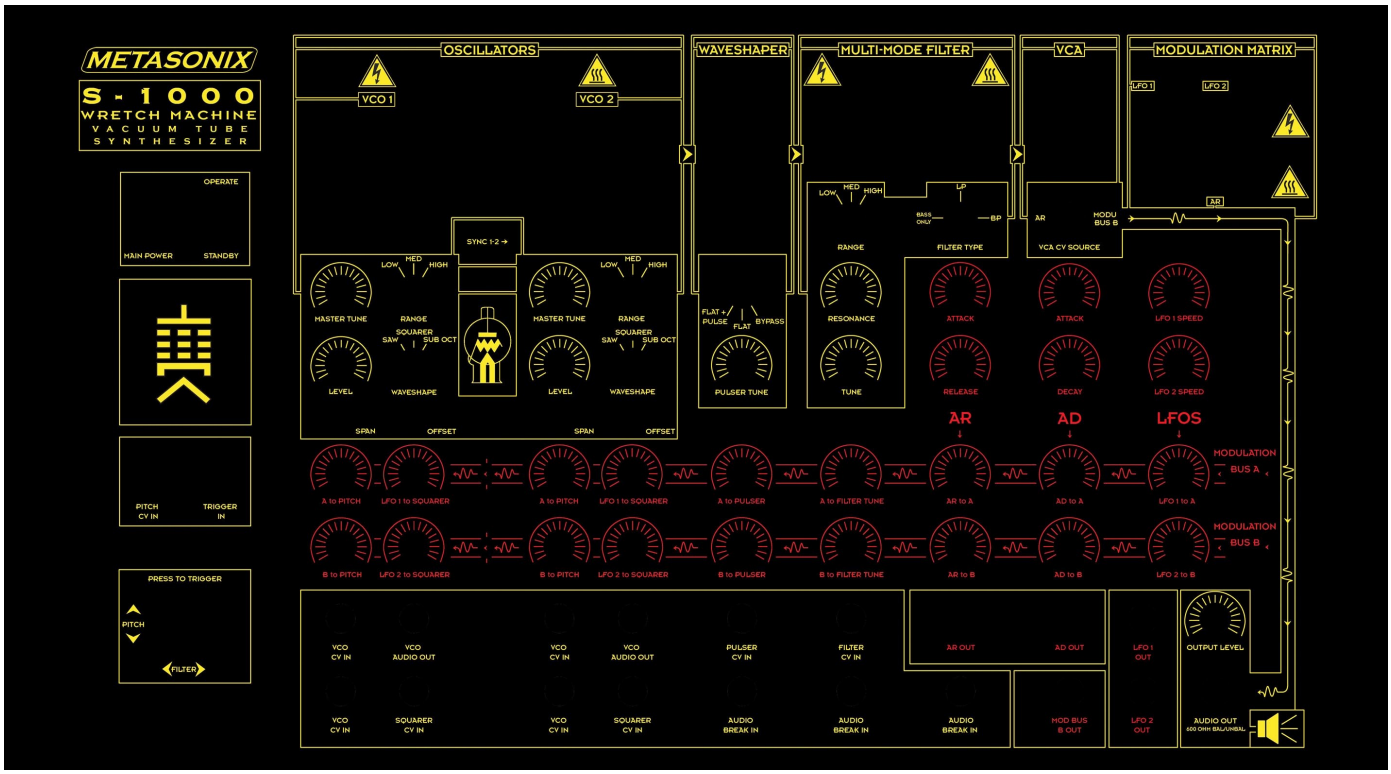
S-1000 “Wretch Machine”
vacuum tube monophonic synthesizer

Owner's manual
final edition 1.1
Nov 2006
by Michael Weeks and Eric Barbour

READ THIS MANUAL BEFORE ATTEMPTING TO USE YOUR S-1000!!!



METASONIX

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READ THIS, DAMMIT!!!!!!!!!

CAUTION: to reduce the risk of electrical shock, do not remove the bottom cover. HIGH VOLTAGE INSIDE. No user serviceable parts inside. Refer servicing to qualified service personnel.

WARNING: to reduce the risk of fire or electrical shock, *do not expose the S-1000 to rain or moisture.*

DETAILED SAFETY INSTRUCTIONS: All the safety and operation instructions must be read before the S-1000 is operated. *If you don't read and HEED them, you are a MORON and you deserve to be CASTRATED.*
RETAIN INSTRUCTIONS: The safety and operating instructions should be retained for future reference.
HEED WARNINGS: All warnings on the S-1000 and in the operating instructions should be adhered to.
FOLLOW INSTRUCTIONS: All operating instructions should be followed.

WATER AND MOISTURE: The S-1000 should not be used near water (e.g. near a bathtub, washbowl, kitchen sink, laundry tub, in a wet basement, near a swimming pool etc.). Care should be taken so that liquids are not spilled onto or near the enclosure.
VENTILATION AND COOLING: The S-1000 normally operates warm to the touch. It MUST be situated so that its location or position does not interfere with convective cooling. The S-1000 MUST NOT be used on a bed, sofa rug or similar surface which may prevent proper cooling. It is NOT a toy. If the S-1000 is mounted in a rack or other built-in installation, space must be left around it to allow convection from the case.
HEAT: The S-1000 MUST be situated away from heat sources such as radiators, heat registers, stoves, or other devices (including power amps) that produce heat.

POWER SOURCE: The S-1000 should be connected to a power supply ONLY of the type described in the operating manual or as marked on the S-1000.

DO NOT APPLY DC POWER TO THE S-1000!
It uses 12 volts AC ONLY!!

POWER CORD PROTECTION: Power supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them.

CLEANING: The S-1000 should only be cleaned with a soft cloth moistened with water. Unplug the power supply before attempting to clean.

NON-USE PERIODS: The power supply of the S-1000 should be unplugged from the outlet when left unused for a long period of time.

DAMAGE OR TUBE REPLACEMENT REQUIRING SERVICE:
The S-1000 should be serviced by qualified service personnel when:
-The power supply or plug has been damaged;
-The S-1000 has been dropped, physically damaged, or subjected to force;
-Liquid has been spilled onto the S-1000 or it has been exposed to rain;
-The S-1000 does not appear to operate normally or exhibits a marked change in performance.
SERVICING: The user should not attempt to service the S-1000. All servicing should be referred to qualified service personnel.

METASONIX LIMITED WARRANTY and standard legal disclaimer

Thank you for purchasing this Metasonix product. The following terms and conditions apply:

1. Warranty period is for 180 days from date of purchase with proof of purchase submitted. Warranty covers electrical failure of vacuum tubes and gas-filled tubes, except in cases explained in 3 below.
2. Operating instructions must be followed. This device was intended ONLY for use by AUDIO AND MUSIC PROFESSIONALS. *IT IS NOT INTENDED FOR USE BY ORDINARY CONSUMERS!!*
Product must not have been damaged as a result of defacement, misuse, abuse, neglect, accident, destruction or alteration of the serial number, improper electrical voltages or currents, repair, alteration or maintenance by any person or party other than our own service facility or an authorized service center, use or installation of non-Metasonix replacement parts in the product, or the use of this product outside of the U.S.A. or Canada (except as a product distributed by an authorized Metasonix dealer), or modification of the product in any way, or incorporation of the product into any other products, or damage to the product caused by accident, fire, floods, lightning, or acts of God, or any use violative of instructions furnished by Metasonix.
3. Obligations of Metasonix shall be limited to repair or replacement with

same or similar unit, at our option. To obtain repairs under this warranty, present the product and proof of purchase (e.g. bill or invoice) to the authorized Metasonix service center, transportation charges prepaid. When returning the product for repair, please pack it very carefully, preferably using the original packaging materials. Please also include an explanatory note.

IMPORTANT: To save yourself unnecessary cost and inconvenience, please check carefully that you have fully read and followed the instructions in this instruction manual.

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METASONIX shall not be held liable for any incidental, consequential, or direct damages or expenses associated with the use or misuse of its products. The audio output of this product is capable of damaging some types of solid-state audio equipment; such use is entirely at the risk of the user. METASONIX does not guarantee that any of its products are designed for any particular use or purpose. The entire risk of suitability and performance of this product lies with the user. Products manufactured and/or sold by METASONIX are not authorized for use as critical components in devices used in life support and other systems whose failure or performance could result in compromised safety or danger to life or property.

Did we mention the DANGEROUS HIGH VOLTAGES inside the S-1000? Well, here we mention it again.

DO NOT OPEN THE BOX unless you're a service technician or a blithering suicidal idiot.

And KEEP YOUR FINGERS OFF THE TUBES WHILE POWER IS ON! Some of the tubes get hot enough to BURN YOUR FINGERS!!

NOTE: All sales are FINAL, especially custom designs. Only a Metasonix authorized dealer is permitted to return products to Metasonix for a refund or exchange.

Section 1: what it is and how to use it.

Welcome to the ranks of vacuum-tube synthesists! You hold in your hands the key to the beginning and the end of synthesized sounds. For the past 50 years, integrated circuits have ruled over synthesis with an iron glove, but now the tubes have risen up from their disregarded place as guitarists' butt toys and are taking back their place as the true creators, shapers, and dictators of the TRUE electrical sound.

The S-1000 Wretch Machine is the product of years of development, and years of neglect by the corporate masters of the western world. We are STRIKING BACK. Safe in their suburban homes and corporate megaplexes, they've told us what sound is, what creativity is; they have set edicts defining standard keys and scales and tones and usability. We will DESTROY THEM. This is open war, and you're on your way to the front lines. Tie your shoes. This is going to get scary, and quickly.

The signal path is ALL TUBES. The oscillators are tubes, the filter: tubes, the waveshaper: tubes. There's not a single chip in there making bleepy bloopy noises for your stupid 1980s videogame fetish. Videogames detract from the revolution, they poison the mind and make you pliable and weak.

Because the S-1000 is fundamentally unlike other synths, we recommend reading this manual fully before attempting to operate the S-1000. This manual explains the core technologies behind the S-1000, and highlights its unique synthesis and modulation design and how it differs from todays perfect, clean, harmonious brainwashing digital chunks of plastic and silicon.

Note that the S-1000 is more EXPERIMENTAL than most other analog synths. It may not always be stable or repeatable enough for "professional" stage use. If the user desires perfect "traditional" pitch and tracking, it may be more sensible and safer to use the S-1000 to generate sounds, then sample the sounds for use onstage or in a studio setting. While this may limit some "professionals" from using the S-1000 live, the true innovator will embrace the chaos. By harnessing the power of the ALL TUBE signal path you will unleash sounds never heard before. You can keep it locked in a safe studio environment, racked along with your virtual analogs, keeping it safe and shiny, or you can grow a pair and do something that actually matters for once in your miserable life. The choice is yours.

Beginning setup using only internal joystick for control:
To get started quickly with the S-1000 Wretch Machine, we've conveniently installed a joystick on the panel. Note that this does not mean it's a video game - you must remain serious and focused at all times while using it. Super Mario will not pop out of the box and convulse around your room.

The joystick has three movements - pressing it in triggers the VCA. Pressing it in and releasing it quickly will play notes following the settings in the AR and AD sections of the panel, while pressing it in and holding it in will keep the envelope open. Moving the joystick up and down changes the pitch of the triggered note, and moving it left and right opens and closes the Filter. Try it out yourself! With your free hand, adjust knobs at random - remember: you MUST be very serious while doing this. This is not fun, this is war. You did remember your helmet, right?

Connecting a MIDI-CV controller or analog CV/gate source:
While we highly encourage you to play the S-1000 with nothing but the included joystick, you might wonder what the Pitch and Trigger inputs on the panel are for. The S-1000 is equipped with inputs to interface with your modern control voltage (CV) equipment. The Pitch input will accept Pitch CV scaled for Hertz per Volt (Hz/V) - there are several MIDI to CV converters on the market able to provide this, as well as some older Korg and Yamaha keyboards. For example, the current Kenton MIDI/CV products, the Frostwave Quad MIDI/CV, and the Analogue Systems RS370 are all capable of controlling the S-1000.

Other pitch CV sources will work as well. Standard V/Oct sequencers and ribbon controllers will also send continuous pitch messages which, while in a non even-tempered scale, will provide a whole range

of new and interesting pitch sequencing options. Ribbon controllers are especially easy to use and suitable for the S-1000. The Eowave Persephone and the Doepfer R2M are currently-made ribbon controllers that can drive the S-1000. Try anything and everything, this will unleash the true innovative nature of the Machine.

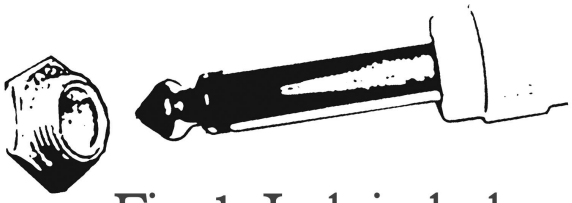


Fig. 1. Jack in hole.

The Trigger input responds to most trigger sources: any traditional gate or trigger CV source should suffice. It will accept a 5v, 10v or 12v positive trigger signal. Even a strong audio signal can trigger it. Please be creative.

The S-1000 can be ordered with an optional internal Midi-CV converter. This lets you run midi cables from your favorite MIDI keyboard or controller, or from your computer.

Sample settings for basic sounds:
To start working on a new sound from a neutral starting point, it's best to do several things:

1. Set the oscillators to the same range, and select the same waveform. Set the Level control and Master Tune control on each to 12 o'clock.
2. Make sure that all knobs in the modulation buss section are turned hard left. (this bypasses them) or else just the master level controls on each modulation buss on the far right.
3. Set the Waveshaper to Bypass.
4. On the filter: put the mode knob in Low Pass, adjust the filter Tune knob to hard right, and the Resonance knob to the 8-o'clock position. Also make sure the Range knob is set to Low.
5. Adjust the Attack setting to the leftmost position, and the Release to 12 o'clock.

(Note: turning RESONANCE fully down might silence the S-1000—it depends on the tubes installed.)

This is home. This is where the flowers grow.
Everything you do from here is uncharted territory.

Some basic patching tips for general sounds:

Bass:
The S-1000 Wretch Machine is a supremely capable bass emitter. Keys to programming effective bass:

Oscillators 1 and 2 should be set to Low range, and Oscillator 2's waveshape should be set to Sub Octave with Oscillator 1 set to either Saw or Square. Synching the two together will produce a searing sync. Without sync, work with the master tune controls of both to create dramatic harmonics and beat-frequency sounds.

The filter features 3 modes, with LOW PASS and BASS ONLY being the logical choices for bass patches. For solid and clean bass sounds, keep the filter range in either MED or LOW setting, and keep resonance at about 12 o'clock (adjust for best effect).

AR and AD: For snappier bass sounds, attack should be turned full left, and release should be kept short.

Lead:
Lead is a very flexible term - the S-1000 can achieve many types of lead sounds, varying from sync-leads with Oscillator sync enabled and closely-matched master tune settings, all the way through to monstrous soulbreaking wailing nightmares using high resonance and extreme LFO routing to the oscillator pitch.

For a basic lead patch - start with the bass settings but move the Oscillator range to Med. or High.

Diverse results can be had by setting one oscillator to MED and the other to HIGH, and adjusting the master tune appropriately. Here is where the Modulation busses will add some truly inspiring fluctuations to the sound: try using a slow LFO to one oscillator to bring a bit of vibrato to the sound - applying it in varying amounts to both oscillators or setting both LFO's to varying rates will create some wild cross modulation.

Some suggestions for sound experimentation from this point:

A) Explore the Waveshaper - try the two modes, FLAT and FLAT+PULSE. Turn the knob. Watch. Listen. Wash your hands after every meal.

B) Tune each oscillator independently, with sync on and off. Try it with differing ranges. Turn the level knobs up, overdriving the filter. The filter is your enemy - hurt it..

C) Spend at least an hour with the filter - trying combinations of range and resonance with one hand while holding the volume knob in the other. Connect a subwoofer and spend time with the bass only setting. Watch as Cthulhu rises from the ocean.

Using the modulation busses:

The modulation busses are there to fuck you up. There are two LFOs, each with a controllable rate knob. The magic eye indicator tube on the upper right portion of the panel displays the rate of each LFO, A on the left and B on the right. Watch this tube very closely - it will tell you all you need to know. Because it's magic!

The modulation busses allow you to use each LFO and envelope individually, or together, to create complex modulation sources for virtually every important parameter on the S-1000.

There are two busses - A and B. From right to left, you have individual level controls for each LFO allowing you to mix each LFO into that bus. LFO 1 goes only to bus A, LFO 2 only to bus B.

Common uses for LFOs and their application in the S-1000:
1. Set LFO 1's rate knob to 12 o'clock. Set the LFO 1 bus knob to midpoint. Set the A to Pitch knob under Oscillator 1 hard right. This will give you tremolo/vibrato effects. Adjust the LFO rate knob for varying speeds.
2. Set LFO 1's rate knob to 9 o'clock. Set the LFO 1 bus knob to full-clockwise. Set the A to Filter Tune under the Filter to hard right. This will give you an auto-wah like effect as the LFO sweeps the filter frequency. This setting is best done in Low Pass mode with Resonance at 9 o'clock. At 5 o'clock feed your dog - he's hungry.
3. Set LFO 1's rate knob to the hard right position. Now, set LFO 2's rate knob to the hard left position. Set the LFO bus knobs to midpoint. Set the A to Pitch for VCO 1 at 12 o'clock. Set the B Pitch for VCO 2 at 12 o'clock. Make sure sync is off. Watch the oscillators fight. Feel the rage.

Using the Envelopes:
The S-1000 has two envelope generators, which cycle when the TRIGGER is triggered (or the joystick is pressed in). They can be mixed into both modulation busses.

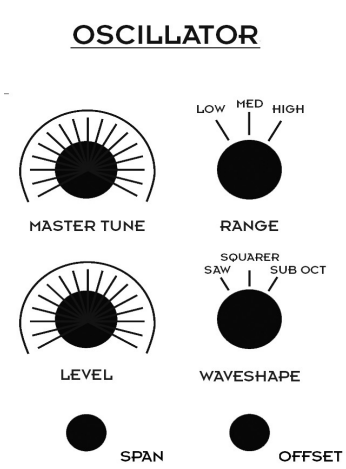
The AR Generator normally drives the S-1000's VCA, giving its output signal a typical loudness contour, as seen in most electronic synthesizers. Some vintage synths would call it an A(S)R generator. It attacks at a rate set by the ATTACK knob, and stays fully on as long as the TRIGGER is on. When TRIGGER goes off, it decays at a rate set by RELEASE. Attack and release is adjustable from less than 1 millisecond to more than 10 seconds. Most users would set ATTACK and RELEASE in the lowest 10% of the knob rotation, for relatively quick attack and release. The AR generator can be added to either modulation bus. (Because there can be a small “click” when the AD is triggered or relased with minimum attack/release, you might turn ATTACK and RELEASE slightly above their full counterclockwise settings, to minimize the click. This is an unavoidable side-effect of using a vacuum tube pentode as a VCA. You wanted an imperfect synthesizer....you got it.)

The AD generator ONLY cycles immediately after triggering. It attacks at a rate set by the ATTACK knob, and immediately decays at a rate set by DECAY. Attack and decay is adjustable from less than 1 millisecond to more than 10 seconds. Most users would set ATTACK and DECAY in the lowest 10% of the knob rotation, for relatively quick attack and decay. The AD generator can be added to either modulation bus. Most users would use the AD to sweep the filter, giving the typical “WOOOW” or “quack” sounds that synthesizers are famous for.

Section 2: descriptions of the individual circuit sections.

The S-1000 Wretch Machine is a semi-modular synthesizer, in that the signal flow is hard wired behind the panel, but with the patch points on the lower part of the panel you can integrate individual components into external modular equipment, or apply external control or audio signals to various sections of the synthesizer. This means think outside the box. Leverage the paradigm. Imminentize the eschaton. You are your own master!

VOLTAGE-CONTROLLED OSCILLATORS: the S-1000 contains two identical VCOs. Each is made of a 2D21/5727 thyratron tube, which generates the audio pitch signal, under the control of the input PITCH CV jack and the built-in joystick.



The MASTER TUNE knob allows tuning the VCO to a fixed “base” pitch. The range is approximately a third interval.

The LEVEL knob controls the output signal level. The outputs of the two VCOs mix together after their LEVEL controls.

The RANGE switch sets which octave the lowest note (C natural) appears in.
The LOW range starts at C = 33 Hz---however, it can be set to start at any pitch near that low-C pitch, as desired, by adjusting SPAN and OFFSET trimpots.
Please note that due to the slightly non-linear behavior of the VCO tube used here, switching the range might cause a slight detuning, requiring adjustment of MASTER TUNE. This can't be avoided. Sorry.

The WAVESHAPE allows selection of the three unique waveshapes produced by the VCO. The “SAW” is an imperfect sawtooth wave, unique to oscillators based upon thyratron tubes. “SQUARER” runs the sawtooth through a vacuum-tube triode, clipping the waveform and providing an approximation of a square/pulse waveform. “SUB OCT” is the SAW waveform, after being fed thru a primitive frequency divider made of neon lamps. This adds a pitch one octave below the main VCO pitch. The divider is imperfect and not always fully reliable, especially at higher pitches. But it is UNIQUE.

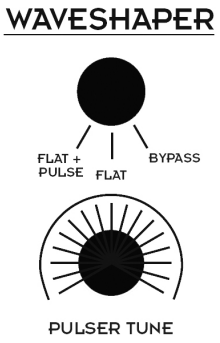
The SPAN and OFFSET trimmer potentiometers (recessed in holes below the VCO main controls) allow adjustment of that VCO's tracking to an external control voltage. A simple repetitive procedure allows setting the pitch range of the VCO while being controlled by an external control voltage source. See Appendix A for the procedure to follow. (This procedure varies depending on the device being used to control the S-1000's pitch.)

Finally, there is one control that is shared between the two VCOs. The SYNC switch feeds a small amount of the first VCO's output into the CV input of the second VCO, forcing it to follow the first VCO over a small range of variation. Please note that this is “soft” sync, unlike the forcible “hard' sync seen on most solid-state VCOs. However, it is usually good enough to make the two VCOs track together (even while offset in pitch) over the lowest octave of CV pitch control.

IMPORTANT NOTE: The oscillators are inherently non-linear - once tuned, changing range or waveform will lead to tuning issues: you will have to re-tune each oscillator. While it is possible to get reliable pitch response, changing these parameters WILL cause de-tuning.

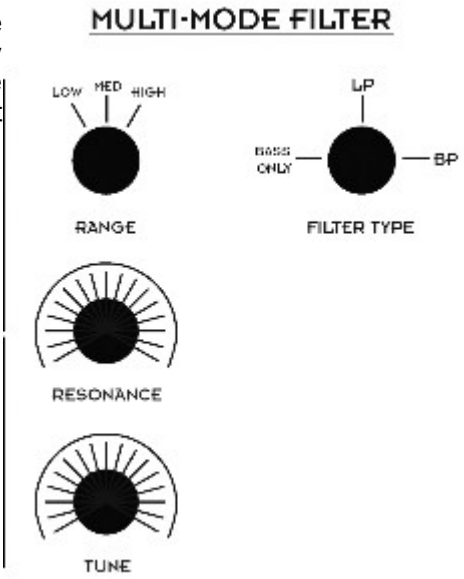
While the oscillator is the heart of the S-1000, the overall timbre and sound of the S-1000 is dramatically effected by the Waveshaper and Filter sections. Read on!

WAVESHAPER: This circuit is UNIQUE to vacuum-tube electronics. It is derived from the Metasonix TM-1 and TS-21 “Hellfire Modulator” waveshaper circuit.



There are two sections. The first section, which can be enabled by itself by switching the rotary switch in the waveshaper section to FLAT, inserts a BN6-type tube into the signal path. This provides voltage gain and a unique “soft clipping” effect, not usually found elsewhere. Set the rotary switch to FLAT+PULSE, and a very strange circuit tries to spit short pulses into the input waveform. Because this circuit is trying to “sync” to the input signal, it sounds like it is a VCO being synced. However, it is an imperfect oscillator, whose behavior is unstable and slightly unpredictable. By adjusting the PULSER TUNE knob, various effects (pitched or noisy) can be added to the waveforms of the VCOs. (When the switch is set to BYPASS, all waveshaper functions are disabled.) **Note that this circuit IS NOT completely reliable, stable or predictable. Thus, it is similar to the noise-based effects often used in conventional analog synthesizers. The adventurous synthesist will utilize this as a strength. Do not fear the unrepeatable.**
Also note, the waveshaper's CV input is quite insensitive—you might not be able to hear it being modulated. For best effect, use an external LFO or other strong CV source. You cannot overdrive this input.

FILTER:
This circuit is UNIQUE to Metasonix products and is derived from the Metasonix TM-6 filter circuit. It synthesizes a lowpass filter response by mixing together the outputs of two bandpass filters whose responses were adjusted for a reasonable lowpass response, while still allowing resonant peaking at the lowpass point with the RESONANCE control.



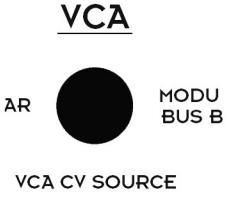
By adjusting the FILTER TYPE control, the filter output can be continuously faded from a bass-only bandpass filter, to a lowpass response, to the upper-frequency bandpass filter only (no low frequencies). The bass-only filter sweeps from about 100 to 350 Hz.

The RANGE switch controls the range of the upper resonant peak. Its effect is only heard when the FILTER TYPE is set to LP or BP. The LOW range is about 190-420 Hz, MED range is about 830-1200 Hz, and HIGH range is about 1150-1650 Hz. These ranges were selected for maximum usefulness in typical electronic-music applications.

RESONANCE can cause the filter to be so flat in response it is practically out of circuit; or it can cause the filter to resonate (oscillate) with great loudness, much louder than the VCOs on an external input signal.
RESONANCE must be adjusted VERY carefully. Keep your speaker volume low while adjusting RESONANCE, **or there is a real danger of speaker or hearing damage!**

The filter has very dramatic effects over the sound of the S-1000, spend as much time as possible exploring the range, filter type, and tune and resonance controls to see how they interact.

VCA:
Unlike other analog synthesizers, the S-1000 implements the voltage-controlled amplifier by applying the CV to the screen-grid of a vacuum-tube pentode.

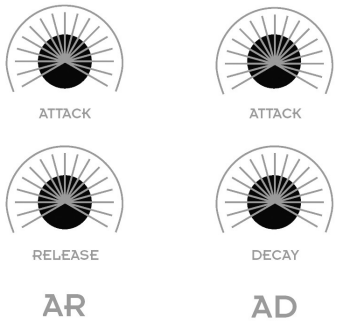


Operation is very basic: the only selectable function is a switch that lets the operator choose to modulate the VCA from either the AR generator only, or the total signal on modulation bus B (see below). By adjusting the AR and AD controls and mixing them together on bus B appropriately, it is possible to make an ADSR envelope for VCA control. It also allows the addition of LFO 2 to the envelope, if desired. This can really make freaky effects. (Note that using mod-bus 2 will give lower output levels from the S-1000's output---this is normal. Just turn up the volume!)

CONTROL VOLTAGE SOURCES:
There are two envelope generators and two low-frequency oscillators available. Both EGs are triggered by the TRIGGER IN or by pressing the joystick. The AD generator makes an ATTACK (rising voltage) upon trigger, then remains high while triggered. Trigger off causes the decay of the voltage to zero (release). Both the attack and

release rates are set with the knobs; fully to the LEFT for minimum attack and release times, and increasing (making them slower) as the knobs are turned to the RIGHT. Attack and reelase is adjustable from less than 1 millisecond to more than 10 seconds.

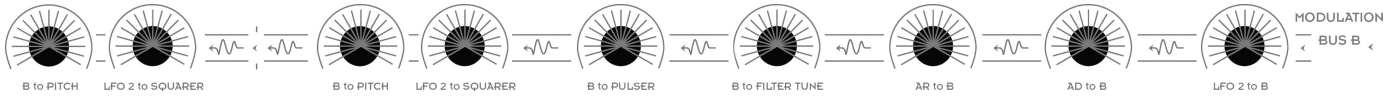
The AR generator is used for “transient” sweeps or CV effects. It attacks upon TRIGGER and decays immediately. Attack and decay is adjustable from less than 1 millisecond to more than 10 seconds.



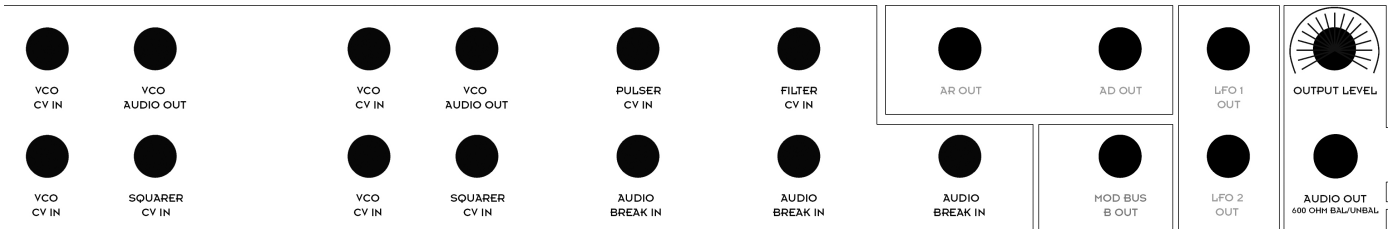
The two LFOs are basic triangle-wave oscillators that, unlike the VCOs, are only intended to provide varying control voltages to various functions. Slowest oscillation is obtained when the knob is turned fully LEFT, and fastest oscillation is with the knob fully to the RIGHT. Range is approximately below 0.5 Hz to greater than 10 Hz

MODULATION BUSSES:

The two modulation busses mix together the EGs and LFOs, and then distribute them to six CV destinations: pitch of VCO 1, squarer circuit (effects the square-waveform) of VCO 1, and pitch and squarer of VCO 2; plus the pulser of the waveshaper and the filter's resonant frequency.
Bus A accepts the AR and AD envelopes and the LFO 1 signal as inputs. Bus B accepts the AR and AD, plus LFO 2. (No, you cannot directly mix LFO1 and LFO2 on a buss. It IS possible to mix them externally, as their outputs are available on jacks in the patch field.) The outputs of the busses can be sent to the VCO pitches, pulser and filter as shown. The squarer circuit is slightly different; because the squarer modulation is VERY insensitive, the only signal that can be sent to it is the LFO signal present on each bus. The AR and AD envelopes can NOT be sent to the squarer circuits.



AUDIO / CV PATCH FIELD:



Below the modulation busses, you will find a field of ¼” patch points, enabling you to use the S-1000 as a semi modular beast. Let's take a look!

VCO patch section:
Under each VCO, there are two CV-input jacks for Pitch CV. These do not break the main Pitch CV source – they combine with it. This allows you to send two pitch CONTROL VOLTAGE sources to the two oscillators. As you can imagine, many unpredictable results may occur in this configuration.

There are also individual audio break out jacks for each VCO, allowing you to use them as individual oscillators in a modular synthesizer setup, or as raw tone sources. Or as a doorbell. Extra credit for this! **(Warning: these are very hot signal outputs. Don't try to overdrive some inexpensive effect pedals, this hot signal might damage them!)**

The Squarer CV In breaks the Squarer CV control on the modulation buss, allowing you to control it from any other CV source. Once again – unpredictable results abound! Plug other CV sources into it and try various configurations. This input is very insenstive - it's best to use a +/-10V peak to peak source, like an LFO.

Waveshaper and Filter patch sections:
The Pulser CV in on the Waveshaper allows you use an external source to trigger the pulser. It is quite insensitive, so use a strong CV or pulse waveform signal to hear the effect. Say trigger the pulser 10 times. Now spin around really fast. Now you're ready to make some prog rock!

The Filter CV in breaks joystick control of the filter – use an appropriate CV source to modulate filter cutoff; an external LFO, accent out from your sequencer of choice, etc. Make the filter squeal in time with your crazy electronic music!

There are audio break in jacks on the filter and waveshaper: these two patch points allow you to run external signals through the waveshaper, the filter, or through both in series (waveshaper to filter). These jacks break the signal input to allow inserting an external signal. (One important note – you will need to trigger the envelope to allow the sound to come out of the box. Be creative.)

There is also an audio break-in in the AR/AD section: this applies the envelope to an external signal by running the signal only thru the VCA.

The Main Audio Output:
In the lower right corner of the panel is the main audio output. The yellow knob directly controls this output level. The output is 600 ohms, and capable of +10 dBu signal output. It is transformer isolated. It is a BALANCED output if you use a TRS jack to obtain the isolated balanced output. (If you were making a cable to adapt this output to a balanced XLR connector, the TIP goes to pin 2, the RING goes to pin 3, and the SLEEVE goes to pin 1 and the shield.) If you just want an unbalanced output, simply use a regular TS patch cable—it will automatically ground the RING connection and make it appear to be unbalanced.

Tips for integrating external modular equipment or other instruments into the S-1000 signal path:

As mentioned above - there are many potential ways to integrate external audio or CV into the S-1000's routing, using the jackfield inputs and outputs at the bottom of the S-1000 panel.

One tip for using alongside other oscillators in other modular systems: the easiest way to handle tracking pitch between multiple oscillators is to use a converter that can send both Hz/V and V/oct simultaneously (for example, the Future Retro Mobius sequencer has this feature) or else use MIDI to CV converters for as many systems as you are attempting to combine.

Some potential uses:

Use the S-1000 as a VCO in a modular setup: Patching the VCO Audio Outs to a mixer module in your system, use the modular synth's amplifier and filter to shape the sound of the combined oscillators.

Use the S-1000 as a complete voice in a modular setup: similar to the above, patching the VCO Audio Outs to your modular, either to the mixer or to a filter, then patching the output back out to the Waveshaper in, then back out from the Master Output back to the modular for further processing and master Amplifier control. In this scenario, you will need to patch any master trigger CV source to the S-1000 as well as the amplifier control on your modular. This allows you to use the full processing power of your modular on the raw VCO's from the S-1000, and then further processing through the S-1000's Waveshaper and Filter.

Use the S-1000 as a guitar processor with tempo-synched filtering/effects: For best results interfacing a guitar with the S-1000, it's best to amplify the signal somewhat, either with a direct box or with the Metasonix TM-5. Once you've amplified the signal, connect to the Waveshaper Audio Break in - this way you can process the guitar through both the waveshaper and the filter.

For tempo-synched effects, connect a trigger source (Trigger Out from a sequencer, or any strong pulse from any other source) and work with the AR and AD controls to create a gate for your signal. Start up the Trigger source and

ROCK THE FUCK OUT!

Use the S-1000 VCOs as an effect for any audio source: Unlike most other synthesizer VCOs, the S-1000's VCOs are so sensitive that they are easily used for FM sound effects, simply by driving either CV input with a line-level audio signal. Both inputs are DC coupled and highly sensitive. The result is a unique, and very extreme, form of signal distortion.

POWER SUPPLY / JOYSTICK:
The power supply uses a large “wall wart” AC output transformer. 12 volts AC is converted internal to the S-1000 to +10v and -10v for the various solid-state control circuits and the tube heaters. Plus, the AC is stepped up to make a +120v plate supply to run the tubes.

ONCE AGAIN: The S-1000 DOES NOT run on DC power!!!

You CANNOT run it on a battery. It needs 12 volts AC power, 50 or 60 Hz.

If you don't know what this means, CONTACT METASONIX or SPEAK TO YOUR DEALER!

Do NOT assume that a given, random AC adapter will run the S-1000!!! (We have had a lot of problems with people who buy one of our TM modules, and without reading the manual, try to run it from a DC-output adapter—thus destroying the adapter or the module. Please don't be stupid.)

Users outside the USA, Canada or other countries will need to find an AC adapter locally that can produce 12 volts AC at 3 amps. Metasonix is unable to purchase such adapters in the USA. (Sorry.) If you are in Europe, you can use the USA power adapter with a 50-watt step-down transformer to convert the local 230v/240v mains to 120v.

The joystick is similar to the type used in modern videogame controllers. There are two degrees of freedom, with X controlling pitch shift on both VCOs and Y effecting the filter tuning. Both are effected by added CVs, which can change their ranges and offsets. Pressing the joystick inward triggers the S-1000's envelopes.

Final Notes:

You now have a general overview of the features and capabilities of the S-1000 Wretch Machine. The true power in the S-1000 is in its completely unique and unparalleled feature set, which, when harnessed by a creative and open mind, will make truly revolutionary sounds. In the beginning, synthesizers were engineered to make sounds nobody had heard before, eschewing musical convention and tonal restrictions. What started out as mankind's first foray into electrical sound exploration turned into an industry flooded with one trick ponies and a fetishistic culture of 1970s longhair prog-rock narcissists. Harness the new-found beginnings of synthesis.

Appendix 1: Tuning Adjustment

The S-1000 has two VCOs, which are independently adjusted for scale and offset, while still being driven from a master control-voltage source. The two VCOs are to be adjusted separately, whereupon they should be very close to tracking together if SYNC is activated. (Note that because of the electrical variation in 2D21/5727 thyratron tubes, it is impossible to guarantee perfect simultaneous tracking.)

To tune a VCO to standard equal-tempering, the procedure below is followed by using a MIDI-CV converter capable of Hz/V output. Most MIDI-CV units recently on the market are capable, including the Kenton Pro-2000 and Pro-Solo, the Encore Expressionist, the Frostwave Quad MIDI/CV, the PAIA midi2cv8 (with Hz/V adapter), the Philip Rees Little MCV, the Analogue Systems RS370, and some others. A Synhouse MIDIJACK II is also capable of controlling the S-1000. The S-1000's PITCH CV INPUT was set at the factory so the first octave occurs from 0 volts to 0.25 volts, and the second octave occurs from 0.25 volts to 0.75 volts.

Before starting, power on the S-1000 and interface, and let the S-1000 warm up for at least 10 minutes. Connect the interface's pitch-CV and gate outputs to the S-1000's PITCH CV IN and TRIGGER IN. Connect a MIDI controller to the interface via MIDI cable, and insure the interface triggers the S-1000 (visible on the lower bar of the eye tube). A small flat screwdriver is required to adjust the SPAN and OFFSET trimpots (accessible by removing the plastic plugs covering their holes). Best would be a technician's tuning tool, such as the Radio Shack 64-2230. Connect the VCO AUDIO OUT of the VCO to be aligned to a chromatic tuner or other method of determining equal-tempered pitch. Adjust VCO LEVEL so the tuner is showing a stable reading. (**Warning**, do **not** turn up VCO LEVEL to maximum when it is driving a digital electronic tuner—the output signal at this point might be "hot" enough to damage the tuner. Start with LEVEL set to minimum, and turn it up slowly until a stable pitch reading is obtained on the tuner.)

1) Press and hold a low C (usually MIDI note 36—use the controller's octave selector to obtain the correct range). Adjust the OFFSET trimpot until the low C is obtained.
2) Press the C one octave ABOVE. Adjust SPAN until the C one octave up is obtained.
3) Press the lower C and readjust OFFSET.
4) Repeat the steps until the two Cs are within 10 cents of the correct pitch. Please note that due to the variations of the thyratron tubes, there may be small variations from equal tempering between the two Cs, and in the range above them. The S-1000s VCOs are usually capable of about 2 octaves of CV control, depending on the individual tubes.

Then repeat the above on the second VCO. When not synched, the two VCOs should be within 10 cents of each other across two octaves,
however, because of the fickle nature of these thyratron tubes, this cannot be guaranteed.

APPENDIX 2: TUBE REPLACEMENT

Most users should obtain very long life from the S-1000's tubes. They are all fine NOS types, of American or European manufacture, and are being operated VERY conservatively in the S-1000. However, physical damage might necessitate tube replacement. The acrylic cover should be removed first.

WARNING: DO *NOT* BE TEMPTED TO EXPERIMENT WITH TUBE TYPES! IF AN INCORRECT TUBE TYPE IS PLUGGED IN, IT MIGHT DAMAGE THE S-1000! USE ONLY THE TYPES SHOWN!

TUBE TYPES, BY COLUMN, LEFT TO RIGHT:

First column (VCO1): upper is 5651 gas regulator. Lower is 2D21, 5727 or PL21 tetrode gas thyratron.
(Note: some early S-1000s used an 0B2 tube instead of the 5651. We recommend using 5651 instead.)

Second column: 6BQ7, 6BZ7, 6BS8 or similar---5BQ7, 5BZ7 or 5BS8 are also usable.

Third column (VCO2): upper is 5651 gas regulator. Lower is 2D21, 5727 or PL21 tetrode gas thyratron.
(Note: some early S-1000s used an 0B2 tube instead of the 5651. We recommend using 5651 instead.)

Fourth column (waveshaper): upper is type 4BN6, 6BN6 or 6KS6. Lower is 6BQ7, 6BZ7, 6BS8 or similar---5BQ7, 5BZ7 or 5BS8 are also usable. **(Note that this tube and the second-column tube must be the SAME TYPE, as their heaters are in series.)**

Fifth column (filter): we recommend a 6AK5/EF95 here. 6AU6 types will also work. **WARNING: this tube must be the SAME TYPE as the tube in the sixth column, as their heaters are in series.**

Sixth column (filter): we recommend a 6AK5/EF95 here. 6AU6 types will also work. **WARNING: this tube must be the SAME TYPE as the tube in the fifth column, as their heaters are in series.**

Seventh column (VCA): we recommend a 6AK5/EF95 here. Do not install a 6AU6 type. (It is possible to use other pentodes, it requires modifying the S-1000. Please contact Metasonix for more information.)

Eighth column: use **only** a 6AL7 magic-eye tuning indicator here. DO NOT try other eye tubes.

S-1000 SPECIFICATIONS:

VCO:
Range approximately 2 octaves using CV, octave switching gives range from 33 Hz (low C in lowest range setting) to more than 2 kHz. Usable range and closeness of tracking to equal tempering is dependent on individual thyratron tubes installed in S-1000. Three waveforms are available: thyratron sawtooth, clipped sawtooth (square), and sawtooth with suboctave square wave. Soft sync allows forcing VCO 2 to track closely when tuned in unison with VCO 1.

WAVESHAPER:
Two circuits: a) soft-clipper using 6BN6 type tube, b) pulse generator (PULSER) that free-runs and attempts to sync to input signal. This circuit works best with waveforms having sharp discontinuities. PULSER initial pitch is adjustable over a range that depends on the individual tube used.

FILTER:
Three type settings: bass-bandpass only, lowpass, or treble bandpass only.
Treble bandpass center frequency range is switchable over three ranges, for a total variation of ~190 Hz to ~1650 Hz. Bass bandpass is tunable from ~100 Hz to ~350 Hz
Voltage gain approximately 1--depends on tubes installed in unit, input signal, and TYPE, TUNE and RESONANCE settings.
Recommended input level 0.5v p-p to 2 v p-p (approximately line level). Hum and noise more than 60dB below 0dBu.
Frequency response typ. +-6dB, 10 Hz to 40 kHz when resonance set to flat response.
Distortion typ. less than 2% with 0dBu input signal (line level).
Control voltage input, filter CV 0 – 4.0 v for full one-octave sweep, offset with TUNE knob.

VCA:
Provides full signal cutoff (to below -80 dBu) when input CV is 0 volts. VCA may be switched to be controlled by either the AR envelope generator or by the total CV on modulation bus 2.

Modulation:
AR generator: produces attack/release CV with maximum sustain voltage of 10 volts. Attack and release are variable from less than 1 millisecond to more than 10 seconds.
AD generator: produces attack/decay CV with maximum peak voltage of 10 volts. Attack and decay are variable from less than 1 millisecond to more than 10 seconds.
Two LFOs, producing a triangle wave of -3v to +3v, speed variable from <0.5 Hz to >10 Hz.

Power input 12v AC, 50/60 Hz, 3.0 amps maximum at idle.

DO NOT apply DC power to the power jack or the unit will be damaged.

Dimensions: 19” wide (EIA standard rack panel), 10.5” high (6U standard size), depth behind panel approximately 3”. (482 mm wide, 267 mm high, approx. 77 mm behind panel.) Weight not including accessories approx. 20 pounds (9.1 kg).

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