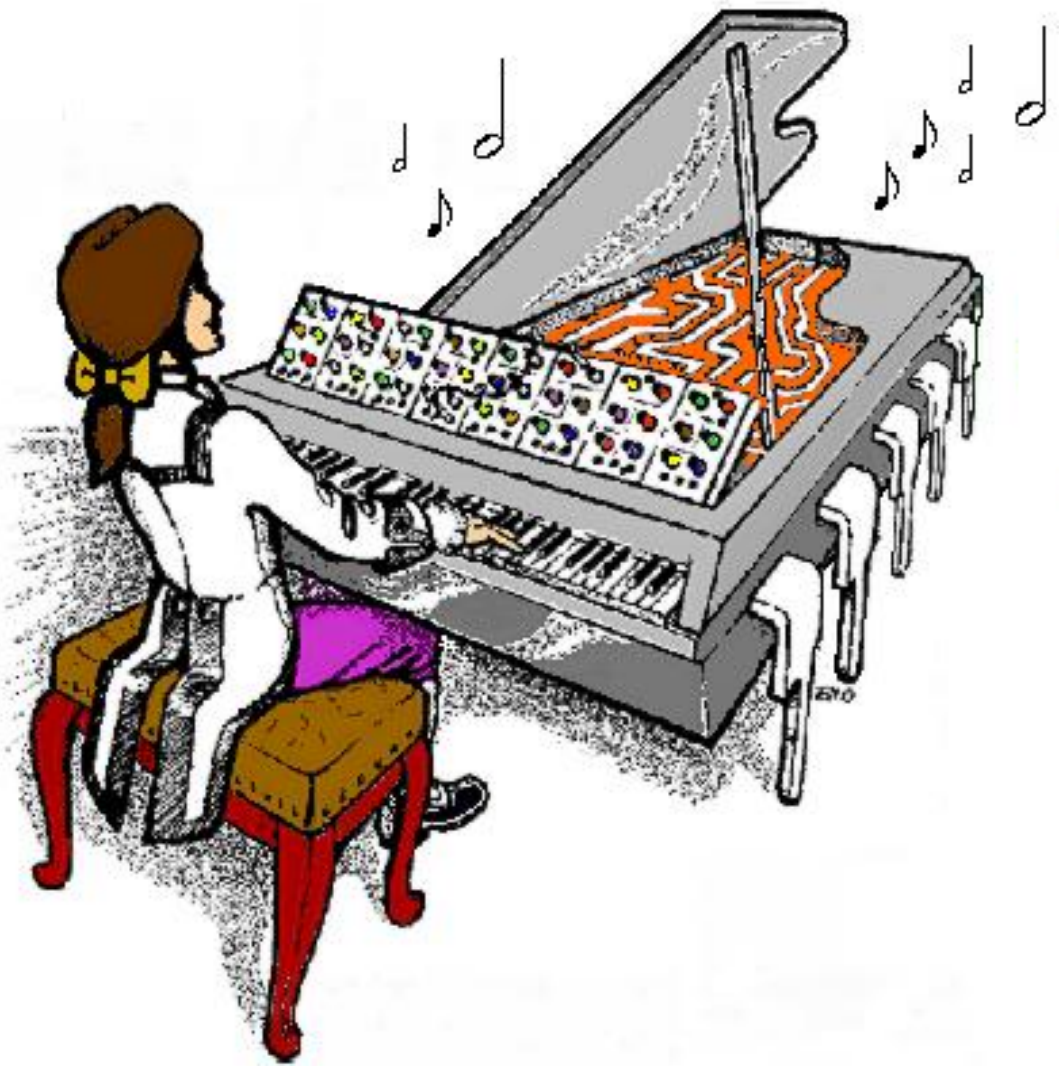

Pixie Manual

Revision 1.0

April 15th, 2010

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

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INTRODUCTION

The WASP by Electronic Dream Plant was developed as a low-cost high-performance electronic music synthesiser. The design of the instrument was kept as simple as possible. However every single control on the front panel had a part to play in creating the unique sound of the WASP.

The Pixie is a clone of the EDP WASP that includes features that offers several enhancements over the original EDP WASP.

SECTION I

Setting-up the Pixie

The Pixie requires and external DC power source. This is normally supplied by a DC Plug Pack (or wallwart) which should be rated for 9VDC to 12VDC and provide a current of 125mA or more. Alternatively the Pixie can be run from a 9VDC battery pack.

The Pixie has a POWER switch and a status LED to indicate when the power is ON.

Using an External Amplifier

The Audio OUTPUT on the Pixie panel is suitable for driving a pair of low-impedance headphones or small speakers.

The Audio OUTPUT is rated for approximately 0.5W in to a 4-8Ω load but will drive in to loads up to 50Ω.

The Audio OUTPUT jack is a stereo jack with the left and right channel outputs linked for monophonic output.

If you wish to plug the Pixie into an external amplifier, a jack lead should be linked from the LINE OUT socket to an amplifier input. As a result the Audio OUTPUT jack will be automatically disconnected. It is advisable to operate the Pixie with the volume control on full and to set the correct level of volume using the amplifier controls only. This will minimise any background noises.

Pixie Options

4 switches provide the following options:-

1. VOICE MODE
2. RETRIGGER
3. DUAL MODE
4. MIDI MODE

VOICE MODE – *(this feature is currently disabled)*

When ON the Pixie will replace the oldest playing note with new note (over write)
When OFF it will ignore new notes until the current note is released.

RETRIGGER

When ON, new notes will cause the Envelope Generators to re-trigger

DUAL MODE

When OFF, both VCOs track the keyboard on the same key
When ON, the 2 VCOs normally play the same note. If a 2nd note is received then this is assigned to the 2nd VCO. When either of the 2 notes is released, the other VCO switches to the remaining note. This creates a pseudo duophonic mode of operation

MIDI MODE – *(this feature is currently disabled)*

When OFF this mode allows the PITCHBEND and MODWHEEL functions to be modified under MIDI control
When ON, the panel controls are active

SECTION II

The Oscillators

SECTION IX

CONTROLLER

MASTER TUNE	approximately one tone up or down (preset to A = 440 Hz)
GLIDE	sweep adjustable up to 3 seconds over 2 octaves
SYNC	◄—1 DCO2 Syncs DCO1 —►2 DCO1 Syncs DCO2 CENTRE OFF – No syncing
GATE	MIDI Gate – ON while key is held down
MIDI ADDRESS	Binary address to define active address for MIDI receiver

Oscillator DCO1

TUNE	Selects footage range of five octaves - 32', 16', 8', 4' & 2'
WIDTH	Square duty cycle output adjustable from 50% to 100%
WAVEFORM	Square, Sawtooth, Triangle, Sine, Modulated Pulse

Oscillator DCO2

TUNE	Selects footage range of five octaves - 32', 16', 8', 4' & 2'
WIDTH	Square duty cycle output adjustable from 50% to 100%
WAVEFORM	Square, Sawtooth, Triangle, Sine, Modulated Pulse
PITCH	Detune from DCO1 by approximately one octave up or down

MIXER 1

DCO1	output from DCO1
DCO2	output from DCO2
RING MOD.	output from Ring Modulator
VCA OUT	output from VCA
NOISE	output from Noise Generator
EXTERNAL	signal from external source

LFO – Low Frequency Oscillator

FREQUENCY	approximately 1Hz to 100Hz.
WAVEFORM	Sinewave, Rising sawtooth Falling sawtooth Square White Noise Sampled White Noise and held at Control Oscillator rate
VCO MODULATION	Pitch of DCO1 and DCO2 can be modulated by approximately one tone up or down

Noise

Digitally generated 24-bit pseudo-random White Noise.

VCF1 & VCF2 – Voltage Controlled Filters

- RESONANCE – adjustable from maximally flat to verge of oscillation
- DISTORTION – On/Off control of distortion circuit on output of VCF1
  Low-pass, bandpass (fixed bandwith) or highpass. "Q" factor is adjustable from maximally flat to the verge of oscillation.
- MODE - When Mode switch is in Lowpass, Highpass, Bandpass and Notch modes the two filters are wired in series providing a 24dB slope (12dB in Bandpass mode).
  - When in Enhanced mode, VCF1 is in Highpass mode while VCF2 is in Lowpass mode and gives a 12dB slope (6dB in Bandpass mode).
- SEPARATION - applies an offset between the control voltage to VCF1 and VCF2 causing VCF2 to `mistrack' VCF1

Automatic overload limiter

12dB per octave roll-off in high- or low-pass, 6dB per octave in bandpass.

Turnover frequency is proportionally controlled by Control Oscillator, Control Envelope Generator or by manual means. It is also proportionally controlled by the keyboard. Range is 3 to 16 kHz.

VCF3

EMPHASIS	
VCF EG	

VCA-EG - VCA Envelope Generator

ATTACK	Linear attack rate, variable from 3mS to 2 seconds.
RELEASE	Exponential decay rate, variable from 3mS to 12 seconds. Decay is interrupted by a sustain period while the keyboard is being touched.
SUSTAIN	The sustain signal level is adjustable from 0% to 100%
REPEAT	The repeat function causes continuous attack/decay cycles while a key (GATE) is ON

VCF-EG – VCF1/VCF2/VCF3 Envelope Generator

ATTACK	Linear attack rate, variable from 3mS to 2 seconds.
RELEASE	Exponential decay rate, variable from 3mS to 12 seconds. Decay is interrupted by a sustain period while the keyboard is being touched.
SUSTAIN	The sustain signal level is adjustable from 0% to 100%
REPEAT	The repeat function causes continuous attack/decay cycles while a key (GATE) is ON

Outputs

VCA LEVEL (Volume control)	Adjusts LINE OUTPUT and AUDIO OUTPUT (headphones)
AUDIO OUTPUT	Nominal output at full volume is -10dBm into 600Ω line 0dBm into 50Ω speaker. Noise level at line output in quiet state is -65dBm

Power Consumption

Nominally 45mA with speaker not in use, 150mA at maximum volume with speaker connected.

SECTION V - THEORY OF OPERATION

This section describes the basic operation of the Pixie and should be read along with the schematics for each section. Much of the theory of operation applies equally to the original EDP WASP.

MIDI INTERFACE - DCO1 - DCO2

A 16-bit microcontroller forms the heart of this module. It provides an interface to the external world through a MIDI Interface allowing a variety of MIDI controller devices to interact with the Pixie.

Besides this interface, the main function of the microcontroller is to provide two digitally-controlled square-wave oscillators. Although fundamentally controlled by the digital MIDI data (hence why they are termed as DCO - digitally controlled oscillators) they also respond to a number of analogue voltages (Master Tune, DCO2 Pitch Offset etc) so they could also be deemed to be VCO – voltage controlled oscillators. Whether they are DCO or VCO is a matter of personal preference and on which side of the analogue/digital fence you sit. For the purposes of this document we will call them DCO's given that MIDI is the main form of control for these oscillators.

This module is the only major deviation from the original WASP design. Experimentation showed that the long-term stability and accuracy of the WASP 555 design to be unsatisfactory. Using the 555 design also required a reasonable amount of logic circuitry to provide the desired octave/note outputs for the DCO's as well as providing the LINK interface for external control. Use of the microcontroller allowed for the elimination of the logic circuitry as well as integrating the more widely accepted MIDI interface control over the more specialised LINK interface. Further, the crystal oscillator used for the microcontroller provides a very stable reference for the DCO which now offers long-term stability and accuracy. As this module replaces only the square-wave output from the oscillators it was felt that this not detriment the ability of the Pixie to replicate the WASP as all the sound shaping circuitry was still being retained.

Although not implemented in the current release of the Pixie firmware, the microcontroller offers the option of an extended control range. The WASPs Note Divider section only provides for a maximum of 3 octaves of control (the LINK connector is configured with a 4-bit Note selector – which is restricted to the 12 notes that make an octave, and a 2-bit Octave selector of which one setting is not used). The MIDI interface portion of the firmware supports the full 127-note range of the MIDI specification, however at the higher end of the frequency range the accuracy of each note generated by the DCO becomes noticeably inaccurate.

DUAL-SAWTOOTH GENERATOR

The two DCO square-wave outputs feed in to the main wave shaping circuitry. The Sawtooth Generator is virtually taken straight from the original WASP design.

The incoming `note' frequency is fed to a divider circuit which allows the 2-octave range of the WASP keyboard to be divided down by up to 4 octaves. If we assume this incoming frequency to be the define the default frequency range of the keyboard i.e. 1', then the range switch provides for 2', 4', 8' and 16'.

Two divider circuits are actually used in this stage. One divider provides a `reset' pulse for the square-sawtooth converter while the other divider is used to select the charging current for the converter capacitor. By changing this charging current the circuit optimises the rise-time of the sawtooth and helps to compensate for non-linearity in the rise-time over a wide range of frequencies.

A signal, derived from the square-sawtooth converter for DCO1 is used to provide a control voltage which is proportional to the frequency. This control voltage is used as a `keyboard control voltage' for the filter circuits and is equivalent to the output voltage from an analogue keyboard.

The sawtooth output is also fed to a `buffer and comparator' section which allows for the generation of a (limited range) pulse-width output.

The outputs from this module, along with the TRIANGLE GENERATOR outputs, are wired to a WAVESHAPE selector switch which then connects directly to MIXER 1.

TRIANGLE GENERATOR

To extend the range of waveforms available to the Pixie the sawtooth output is fed in to a sawtooth-triangle converter taken from a design by Scott Gravenhorst. This designs uses the MOSFET transistors in a CMOS 4007 chip and provides a triangle output. In addition a final stage provides an approximation to a sinewave output.

A final waveform is offered by applying a fixed low-frequency oscillator output to the pulse-width input of the sawtooth generator (see PWM-LFO for further details).

The outputs from this module are fed to the WAVESHAPE selector switch on the respective DCO modules.

PWM-LFO

Two fixed low-frequency-oscillators provide outputs which are connected directly to the pulse-width modulation input in the sawtooth generator section. The two PWM-LFO's are set to different frequencies and this provides for a slight `beating' between the two oscillators when this waveform option is selected.

RING MODULATOR

This simple design uses two LM3900 opamps as comparators for the outputs from the two DCO's. The outputs from these comparators are then fed in to an XOR gate constructed around four NAND gates (CMOS 4011).

The output from this module is fed directly to MIXER 1

MIXER 1

This 5-channel mixer provides a mixer input for the subsequent sound processing circuitry and allows a blend of DCO1, DCO2, RING MODULATOR and NOISE GENERATOR signals to be processed. In addition the output from the VCA can also be mixed in along with an external signal.

The mixer uses the LM3900 as the active element.

VCF1 – VCF2

This filter module is probably what defines the WASP sound and gives it it's unique character. The `WASP Filter' has had several reincarnations testifying to the uniqueness of this particular design.

The Pixie incorporates two of these modules and allows them to be switched in to several configurations.

The Pixie filters include an enhancement by Jurgen Haible that provides a `distortion' affect.

VCF3

VCF CONTROL

This module provides a number of control options for the filter stages

NOISE GENERATOR

The original CMOS 4006 based Noise Generator circuit has been replaced by a pseudo 24-bit design using the more readily available CMOS 4015 (Dual 4-bit Shift Register). This design has also been taken from a Scott Gravenhorst offering.

LFO

This is a copy of the original WASP design.

VCF-EG – VCA-EG

The WASP provided two slightly different EG circuits for the VCF and one for the VCA. The VCA had an ATTACK-SUSTAIN-RELEASE (ASR) envelope generator while the VCF had a simpler ATTACK-RELEASE (AR) design.

The Pixie replaces the AR design for the VCF and replaces it with a copy of the ASR design thus offering better control of the filter profile.

In all other regards, the Envelope Generators are a copy of the original WASP design.

MIXER 2

This final stage mixer allows the user to combine the outputs from the VCF1-VCF2 combination, VCF3 and a dry-mix from the output of MIXER 1. The output from this module is fed directly to the VCA.

VCA

The VCA module is a copy of the original WASP design using the CA3080. The control voltage for this stage is provided by the VCA-EG

AUDIO

The audio output stage uses a 0.5W power amplifier to provide an output suitable for driving a pair of low-impedance headphones.

An output on the input side of this module provides a connection for external amplification or connection to other equipment. Inserting a jack in to this output socket will disable the internal amplifier.

If desired, the audio amplifier could be connected to an internally fitted speaker. This speaker should be rated to at least 1W and should have an impedance of between 4Ω and 8Ω. A mid-range speaker would offer an acceptable frequency range for this application.