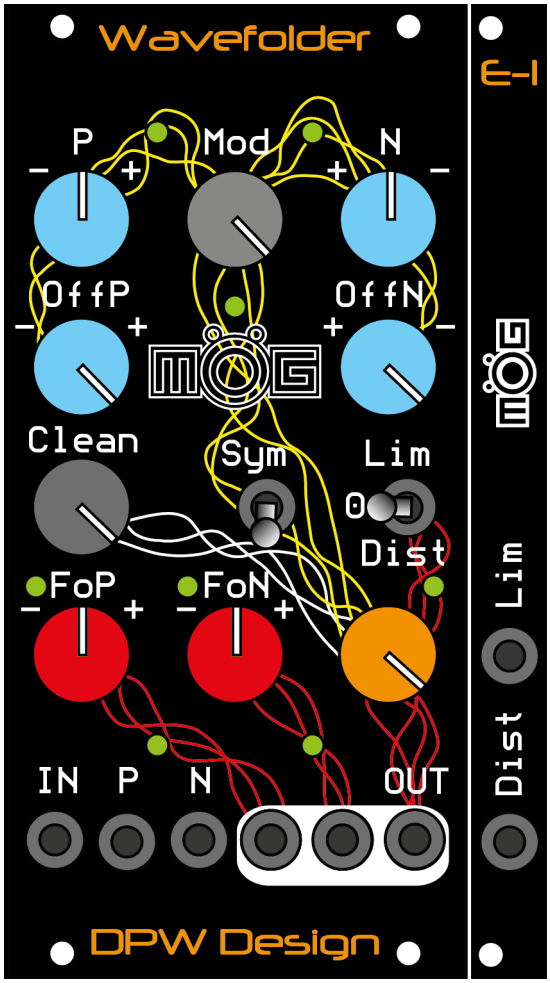
Wavefolder WF-1 and E-1 Expander

WF-1 is a Eurorack format wavefolder with some extra functions. It can be used for audio signal manipulation or as a utility module for control voltages. Everything in the module is DC coupled.
It is mainly made up of two wavefolders. One for the positive side of the incoming wave folding it down and one for the negative side of the wave folding it up. The two folders can be operated individually or connected so you can fold asymmetrically or symmetrically.



Getting started

The artwork on the panel is done to explain the signal paths in the module. White background of jacks indicate outputs.
White lines represent clean signal.
Yellow lines represent the modulation and control path.
Red lines represent output signals.

The position of knobs and switches on the picture is a good starting position.
In this position an audio signal in on IN will pass unaffected to the OUT jack.
From this setting you can start turning OffP and OffN towards its center position to activate the folders.
For audio OffP and OffN is mainly useful from center position to fully clockwise.

You can see when the folder is starting to affect the signal as the FoP and FoN LEDs starts flashing.

Turning the FoP away from the center position will add or subtract a square wave to the OUT jack. FoP and FoN are normaled to OUT via the main volume out, orange knob.
You can see how much is being sent out from FoP and FoN by the LED along the outgoing red lines.

Controls, in and outputs

IN

Audio or control voltages in. Whatever you want to affect with the module. The complete signal path through the module is DC coupled.

Clean

Sets the amount of clean signal going to the main mix in the OUT jack.

OUT

The main mix output. The output volume is controlled via the orange out volume knob.
The signals FoP and FoN are normaled to the OUT jack via the out volume knob.

Both the folder part of the module, FoP and FoN can output +/-5V. So if all of them are full on the out volume knob will have to be rolled down if you don't want the output to exceed +/-5V.

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OffP
Offset for the positive folder. This is the threshold value for the positive folder. It can be set from -8V to +8V.
For audio signals OffP is mainly usable from its center position to fully clockwise. That is from 0 to +8V.
Setting the offset to negative voltages can be useful for manipulating control voltages.

P
Control voltage in to the attenuverter P controlling the positive wavefolders offset voltage.
This signal is added to the OffP level.

The LED close to the P knob shows the output voltage from the attenuverter. Green is positive and red is negative voltage going to the Mod knob that controls the amount of folding.

OffN
Offset for the negative folder. This is the threshold value for the negative folder. It can be set from +8V to -8V.
For audio signals OffP is mainly usable from its center position to fully clockwise. That is from 0 to -8V.
Setting the offset to positive voltages can be useful for manipulating control voltages.

N
Control voltage in to the attenuverter N controlling the negative wavefolders offset voltage.
This signal is added to the OffN level.

The LED close to the N knob shows the output voltage from the attenuverter. Green is positive and red is negative voltage going to the Mod knob that controls the amount of folding.

Mod
The amount of signal fed down to the main mix resulting in the folding effect together with the Clean signal.
Mod controls the volume of the folding signal from the sum of the positive and negative folder.

The LED below the Mod knob shows the output voltage going to the main out mix. Green is positive and red is negative voltage.

Sym
The folding is done individually on the positive and the negative side of the incoming signal when the switch is down. Asymmetrical mode.

Setting the switch to Sym makes the folders go symmetrically, folding equally from both the positive and negative side of the incoming signal.
With this setting OffN is disconnected and the offset value for both sides are controlled via OffP.
The attenuverter signals coming from P and N are added together and sent to both the positive and negative folder.

FoP
Folder Positive. The FoP signal is normally low, -5V. When the positive folder is active the FoP signal goes high, +5V. You can see this on the LED next to the FoP knob.
The FoP knob is an attenuverter. The output level from this attenuverter can be seen on the LED along the red lines after the knob. Green for positive and red for negative voltages.

This output is max +/- 5V and can be used as an audio source or a gate signal.
If the FoN LED isn't flashing the folder has stopped in an on or off state and will output a DC voltage. Can be useful when used with control voltages as a DC offset on the output.

The output of FoP is normaled to OUT via the main out volume control.

FoN
Folder Negative. The FoN signal is normally low, -5V. When the positive folder is active the FoP signal goes high, +5V. You can see this on the LED next to the FoN knob.

The FoN knob is an attenuverter. The output level from this attenuverter can be seen on the LED along the red lines after the knob. Green for positive and red for negative voltages.

This output is max +/- 5V and can be used as an audio source or a gate signal.
If the FoN LED isn't flashing the folder has stopped in an on or off state and will output a DC voltage. Can be useful when used with control voltages as a DC offset on the output.

The output of FoP is normaled to OUT via the main out volume control.

Lim/0/Dist

There are two different distortion alternatives on the output. It is not just two versions of the same distortion, it is two completely different circuits that is being switched in.

The options are:

0

No distortion. Clean signal amplification trough the module is maximum one times with the orange out volume knob set to full.

Lim

A non transparent limiting like distortion. In this case amplification of the orange out volume knob is maximum 5 times. This gives the possibility to drive signals a bit in to the Lim distortion. The signal level is then compressed via the Lim distortion.

Dist

A fuzz like distortion. In this case amplification of the orange out volume knob is maximum 20 times. This gives the possibility to drive signals hard in to the Dist distortion. The signal level is then compressed via the Dist distortion.

Expander E-1

As an option the E-1 expander can be used to control Lim and Dist on and off via external control signals or audio rate signals. A positive signal of 1V or more will turn the distortion on.

The Lim/0/Dist switch on the Wavefolder overrides signals put in to the Lim and Dist jacks on the E-1.
This means that you can for instance have a audio signal in on the Dist jack on the E-1 modulating the output at audio rate and freeze it on with the switch.

An other application could be attaching the Lim and Dist jacks on the E-1 to a sequencer and use it to get two types of accent to notes played.

Device specs

Module size:	12 hp wide, 25 mm deep with power connector.
Input impedance:	100 kohm
Output impedance:	1 kohm
Power requirements:	+/- 12V. Max power consumption 140 mA Connect the power cable with the red stripe (-12V) down. The unit is protected for reverse power.

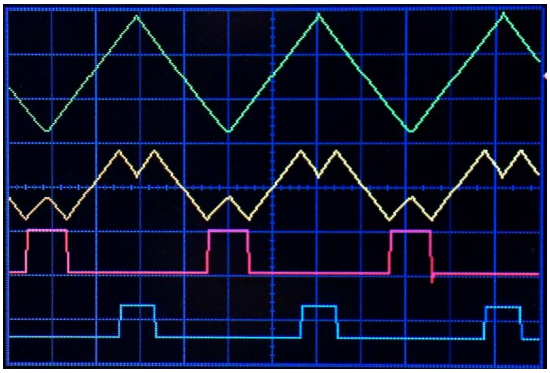
The E-1 Expander is completely passive, 2 hp wide and 25 mm deep including connector.
Connect the cable with red stripe down towards the Dist jack on the E-1 and with the red stripe towards the D printed on the WF-1.

Detailed description

The following description will assume that you start from the start setting of the panel picture.

It is helpful to understand the inner life of the module to get the most out of it. The following is a simplified description without any CV in. With CV control signals or audio signals in on P and N or via the E-1 expander it gets a lot more interesting.

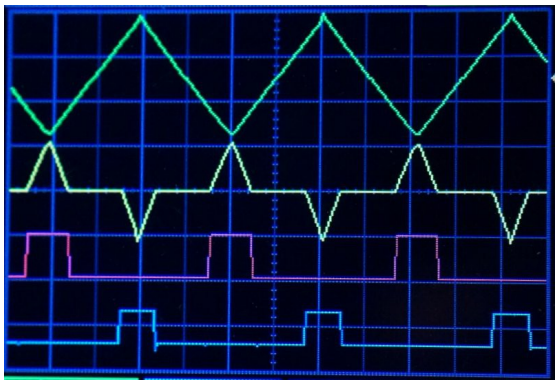
The WF-1 produces three new waves out of the incoming signal.



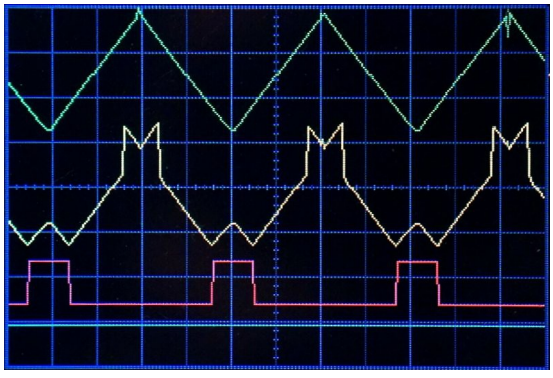
Green. Am using a triangle wave in this example because it is easy to see what's happening

Yellow. What you get on OUT with both OffP and OffN set to about 2 oclock.
You can see that the positive peak of the wave is folded down and the negative peak is folded up from the levels set on OffP and OffN.

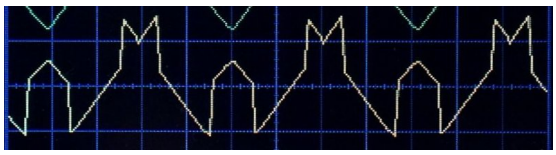
Blue is the FoP and the purple is the FoN signal with both those two knobs turned clockwise.
In this example they have been taken away from the main mix and routed out to separate channels.
You can see that FoP goes high when IN is higher than the value set on OffP (plus the P signal if used).
You can also see that FoN goes high when IN is lower than the value set on OffN (plus the N signal if used).



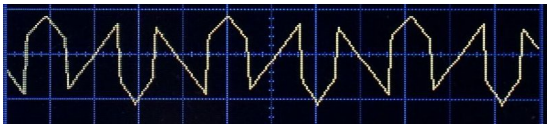
If Clean is set to max anticlockwise (off) the OUT signal will change to be as the yellow signal on the picture.
This wave comes just from the Mod knob.
The Mod signal is just what is above the OffP and below the OffN level. It is also inverted.
The amplification through the Mod is maximum 2 times and if that gets added to full Clean it will produce a one time full fold.



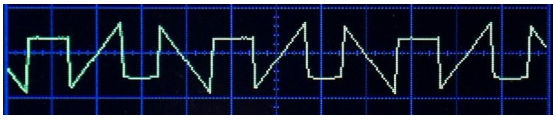
Having the Clean full on again and not patching FoP out adds it in the main mix on OUT.
You can see that FoP has been added just during the positive folders active time.



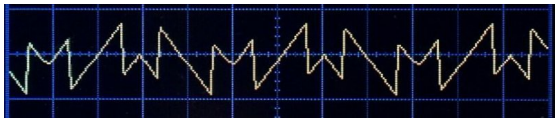
Also adding FoN to the main mix on OUT.
You can see that FoN has been added just during the negative folders active time.



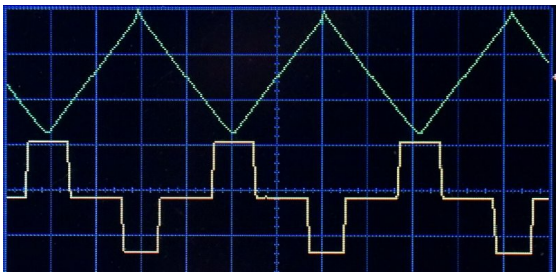
If you then turn FoP anticlockwise you can subtract the FoP signal from the wave when the positive folder is active.



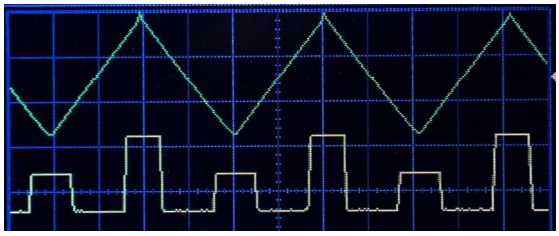
Turning Mod down to center position makes the wave be horizontal during the time the folders are active.



Turning the Mod completely off will restore the shape of the tips of the incoming triangle wave. So this is just a triangle wave with parts of it offset by FoP and FoN.

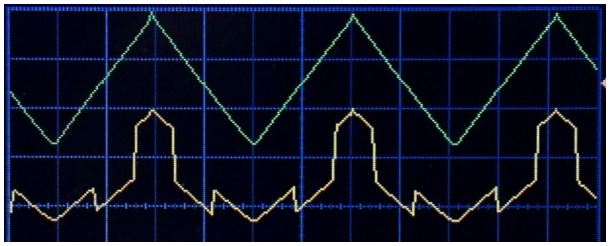


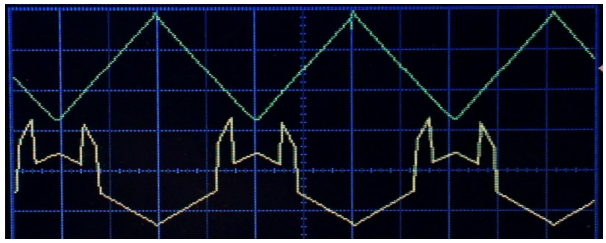
Turning the Clean off will leave a stepped square wave produced be FoP + FoN.
If you want it in phase with the triangle wave on IN you simply turn FoP and FoN to the other side of the center position.



Or you do this by adjusting FoP and FoN.

All steps describes so far with oscilloscope pictures has been with OffP and OffN in the same position just to explain how you build your waves.
Adding CV to P and N gives the possibility to morph your waves.





The two waves shown above are a simple example of one wave being morphed in to an other with control voltages in on P and N.

Try different waves in, LFOs or audio signals to P and N as well sa LFOs or audio signals to Lin and Dist on the E-1 expander and you can get very complex interesting shapes out.

Don't forget to try it with control signals. Messing up an envelope signal that controls a filter for instance can be very interesting. Or using the FoP or FoN to trigger something at different levels of the envelope signal.

Use case examples

A few examples outside of normal folding, just to get your imagination going.

Big mid-side PWM sound

Connect a sine audio signal to IN.
Set OffN and OffP in the center position. This sets both offsets to 0V.
Connect two different LFOs to P and N set to sine wave.
Adjust the P and N knobs clockwise till the FoP and FoN LEDs barely stops flashing.
This is the way to get as wide PWM as possible out from FoP and FoN.
Connect the FoP output to to the right in your mixer and FoN to the left.
Left in the OUT jack you now have the folded signal without FoP and FoN. Put the signal from OUT in the middle of the mix.
You now have a mid side wide sound with two completely independent PWM signals on the left and right.
Letting two different ADSR control the VCA for the mid and sides of the mix is nice too.

Audiorate on top of ADSR

Envelope in on IN. Connect OUT to the frequency CV input to a VCF. Run some audio through the VCF.
Set OffP close to the top of the envelope. You can now fold down the top of the envelope with Mod.
Connect an LFO to P and set the amount of modulation that will be applied on the top of the envelope with the P knob.
Connect the FoP out to resonance of the VCF. You can now set the level of resonance during the time that the positive folder is active or not active with the FoP knob depending on which way you turn it.

Connect an LFO or audio rate signal to Lim or Dist via the E-1 expander. It will affect the OUT connected to frequency on the VCF and could produce a bubbling or metallic sound from the filter depending on settings.

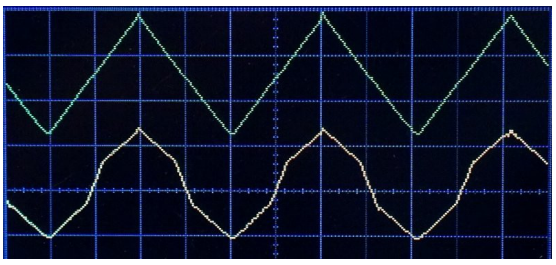
The negative folder is not yet used. You could set it up so FoN is adding stepped offset to the OUT signal. Or even an other LFO in to N.

Pulsating audiorate modulation

Connect a sine audio signal to IN and set the OffP to 3 oclock.
Connect a slow sine from an LFO in to P and set the P knob to full clockwise.
Connect an audio rate signal to N and set the N knob to 3 oclock.
Set the Sym switch on.
You now have a sound that is the original sine wave in and at the rate of the LFO the audiorate modulation comes down and cuts in to the sine wave. A pulsating sound.

The reason for the pulsating sound is that the LFO and the audio signal on P and N are added together when the Sym switch is on, and the LFO carries the modulating audio and offset threshold in and out of range of the folder.

Compressor - brick wall limiter - folder



With Mod set from off to middle position the WF-1 can act as a compressor. On the picture you can see how the amplification of the triangle wave decreases after a set value at OffP and OffN.
Mod at middle position it will act like a hard brick wall limiter.
Mod above middle position will put it in to folding.
When used as a compressor you should know that there is no makeup gain in the module. That has to be done with a VCA after the WF-1.

You can side chain control where the compressor knee is via P and N.
Setting the Sym switch on will give a symmetrical compression, with Sym off you can set it asymmetrically.