PHASE FOLLIES

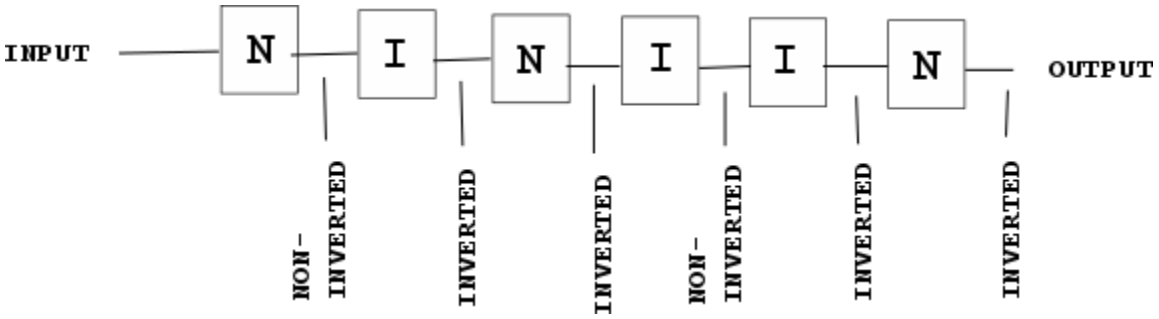
Let's look at how PHASE affects your pedals when placed together on your pedal board. Every pedal produces an output that either INVERTS the signal or does not. If it doesn't, it's called a NON-INVERTING pedal.

When we string several pedals together in a SERIES, you can mix INVERTING and NON-INVERTING pedals with <u>NO AFFECT</u> on your final signal. It does not matter if the final signal is inverted or not. Why? Because you are not comparing that signal to another signal! So you can forget about PHASE altogether.

<u>IMPORTANT!</u>

The only time we need to worry about the PHASE characteristic is when we are splitting the signal path into different chains and then RECOMBINING the signals back together. Again in a typical series scenario Phase Inversion doesn't matter.

Here is an example of a chain that includes INVERTING pedals marked with the letter "I" and non-inverting pedals marked with an "N":

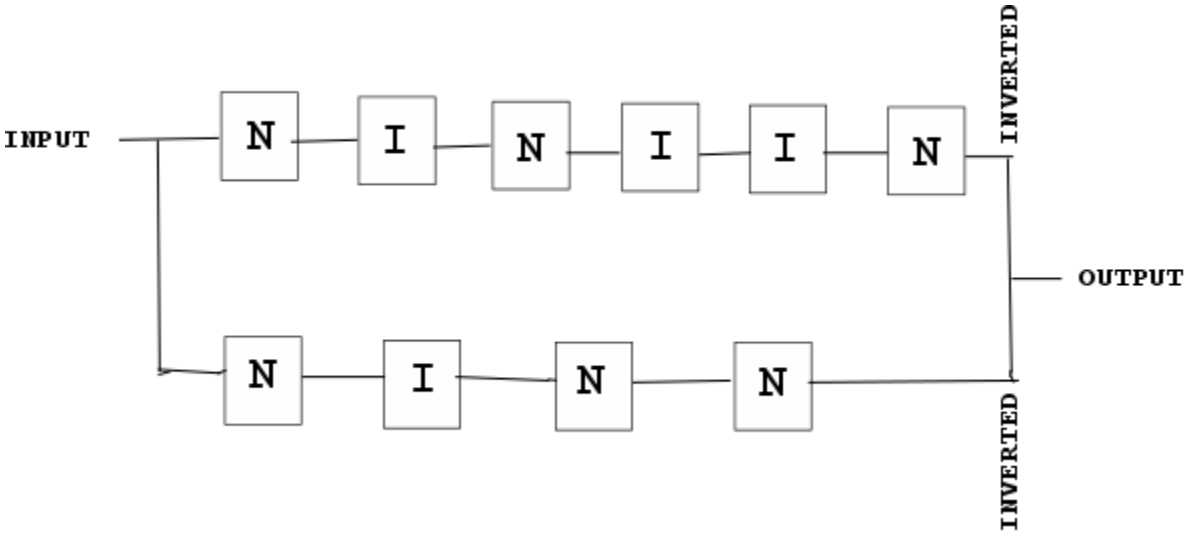


The signal at the end of the chain will be INVERTED if there is an ODD number of INVERTING pedals in the chain. Remember; when a pedal inverts the signal, it CHANGES the signal form. Whereas, if there is an EVEN number of INVERTING pedals in the chain, the signal at the end of the chain will not be inverted. But, if you are only using a single series chain of pedals, there is no reason to worry. It doesn't make any difference if the final signal is inverted or not. A NON-INVERTING pedal does NOT change the signal.

PARALLEL signal chains create the possibility for problems with inverting pedals. If both series chains are comprised of all non-inverting pedals, there is never a problem. But, if there are inverting pedals in one or more of the chains, you must examine the chains to determine what the result will be.

PARALLEL CHAINS with inverting pedals in one chain will result in a final signal that is inverted if the total number of inverting pedals is an ODD number.

EXAMPLE NUMBER 2:



Parallel chains with inverting pedals in BOTH chains will follow the same rule. If BOTH chains have either an ODD number or an EVEN number of inverting pedals as shown above, THEN BOTH CHAINS WILL END UP WITH THE SAME SIGNAL, WHETHER IT IS INVERTED OR NOT.

SO WHAT IS THE PROBLEM?

If you are combining 2 signal chains that have DIFFERENT signals at the end of their chain, the resulting combination will have “PHASE CANCELLATION”. This will result in a WEAK or MISSING signal.

To correct this problem, you must add or subtract inverting pedals to achieve a correct balance between the chains. This may also be corrected by adding another inverting circuit to the necessary chain.

SIMPLE, RIGHT? NOT SO FAST!!!!

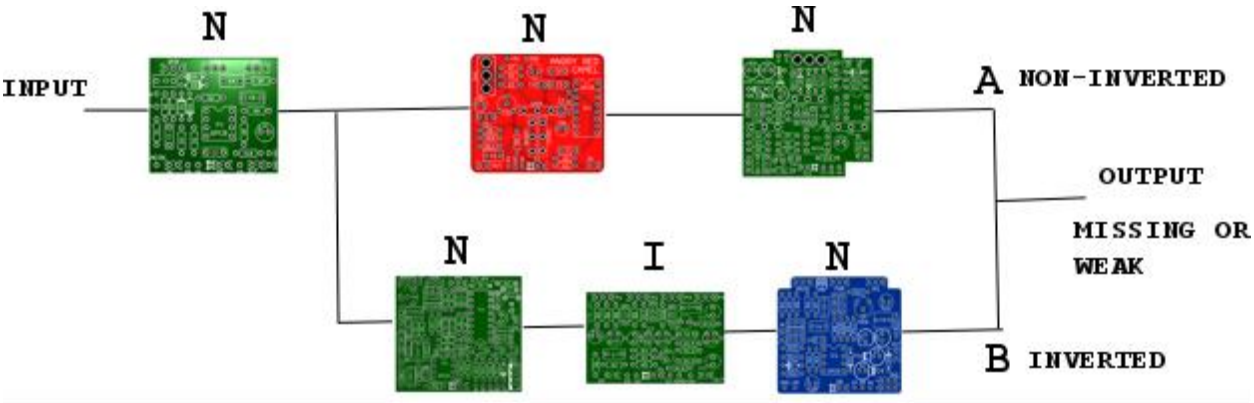
Everything is working fine as long as we have all of the inverting pedals turned on to the effects mode position. But the minute we BYPASS just one of the inverting pedals, that pedal becomes NON-INVERTING and we change the final signal of that chain to the OPPOSITE condition. If that chain was inverted, it now becomes non-inverted! If the chain was non-inverted, it becomes inverted!

MORE PHASE FOLLIES

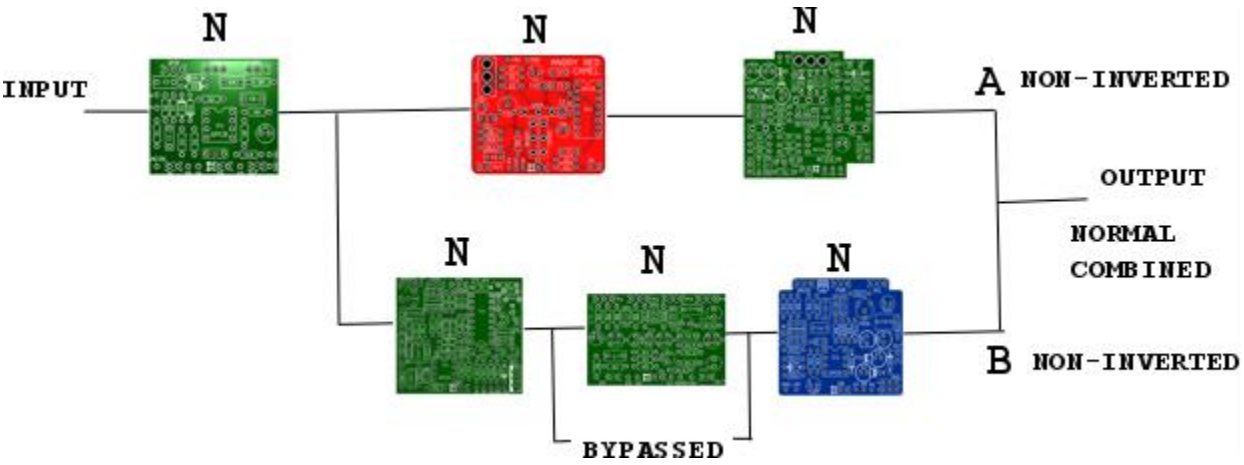
PHASE SOLUTIONS

Here are a few ways that phase issues can be managed in parallel chains of pedals.

This is a typical parallel chain of pedals that contains an inverting pedal. The resulting signal at points “A” and “B” are different and, therefore, will cause cancellation of all or part of the final signal.

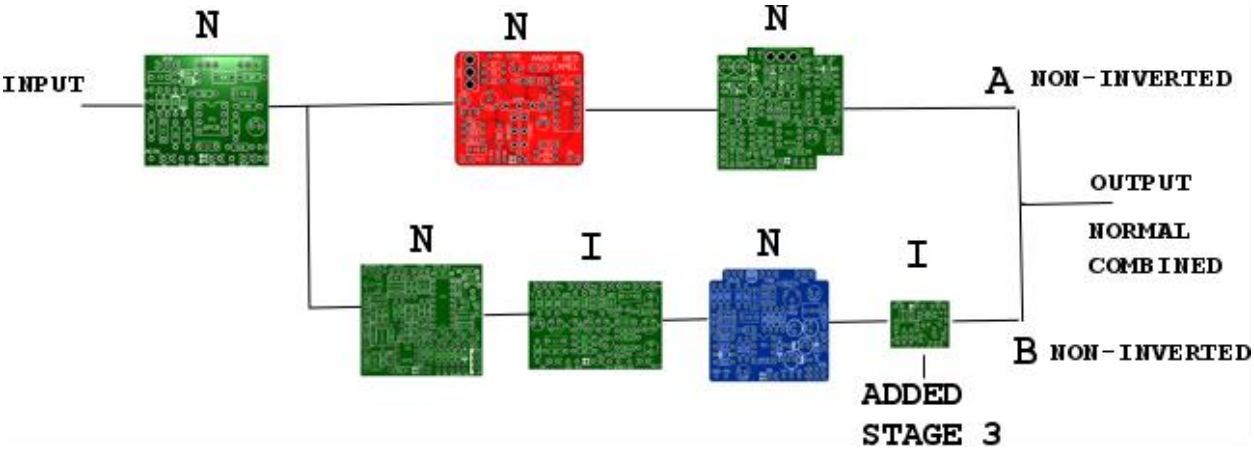


One way to correct this condition is to bypass the inverting pedal as shown here:



The inverted pedal becomes non-inverted and the signal at point “B” is now THE SAME as point “A”. All is well. The OUTPUT is now normal. But, you can’t use the offending pedal!

Another solution, (and I think a better one) is to add a small circuit that can be easily slipped into another pedal or even a 1590A small enclosure. The STAGE 3 just happens to be an INVERTING circuit that can be used to correct phase issues. This permits full use of all of your inverting pedals by simply adding or subtracting the STAGE 3 from the chain when needed as shown here:



When the desired INVERTING pedal is engaged along with the STAGE 3, the 2 INVERTING pedals result in a NON-INVERTED signal at point “B”. This matches the signal at point “A” and all is well.

Remember, the signals at “A” and “B” must be the same. They can both be inverted or non-inverted and still produce a normal output signal. Also notice that you may add the extra circuit to EITHER chain.

If you desire the ultimate in parallel chain control, use the PARAMIX designed by TONMANN which provides mixing as well as phase management. It will handle all of your pedal board issues.

So, what can we do to solve this condition? In the fine tradition of the Master, Mr. TONMANN, there is at least one solution. I will be happy to disclose my idea but first, I would like to hear other suggestions from our FORUM.

For a more technical discussion of how to determine the phase of a circuit, see the discussion by TONMANN in the forum GUIDES.

Wilkie1

Wilkinson of Colorado

Custom pedals

Here is a link to discussion regarding common commercial pedals which may or may not invert the phase: https://bit.ly/2NyM7GL

Note that GuitarPCB also marks their boards in their SHOP as to whether they invert the Phase or not just below video demos. https://guitarpcb.com/shop/

Enjoy the excellent information provided on the next page which contains the actual Phase determination Guide written by Tonmann himself.

Phase Determination Guide courtesy of Tonmann:

You can determine the input / output phase relationship for any circuit for yourself.

Transistors (BJT / FET). - The input is the base / gate of the transistor. If the output of the transistor is taken from the emitter / source the output signal is **in phase** with the input signal. If the output of the transistor is taken from the collector / drain the output signal is **out of phase** with the input signal.

Op Amps - The input determines the output phase of the op amp. If the non-inverting input (+) is used, the output is **in phase** with the input. If the inverting input (-) is used, the output is **out of phase** with the input. Now it is a matter of starting at the input of the circuit and going through each amplifier stage to see whether the stage output is inverted (out of phase) or not.

Remember from the schools of math - two negatives make a positive; if you invert an inverted signal you get a non-inverted signal.

Ratt Deluxe:

The first stage, IC1, doesn't invert (+ input used) and the second stage, Q1, also doesn't invert (source output used). Result is the output is in phase with the input.

KOTB v3

- Q1 - drain output inverts the signal (out of phase with circuit input)
- Q2 - drain output inverts the signal (in phase with circuit input)
- Q3 - drain output inverts the signal (out of phase with circuit input)
- Q4 - source output doesn't invert the signal (out of phase with circuit input)
- Q5 - drain output inverts the signal (in phase with circuit input)
- Q6 - drain output inverts the signal (out of phase with circuit input)

Result; the output is out of phase with the input.

Although you can do most circuits in your head or mark pluses and minuses on your schematic, an easy way is to count the number of stages where the signal is taken from the collector / drain and the number of op amps that use the inverting input, if you get an odd number of stages the circuit output is **out of phase** with the circuit input - obviously an even number of stages means that the circuit output is **in phase** with the circuit input.

Since the KOTB has **five** stages where the signal is taken from the drain, the circuit output is **out of phase** with the circuit input.