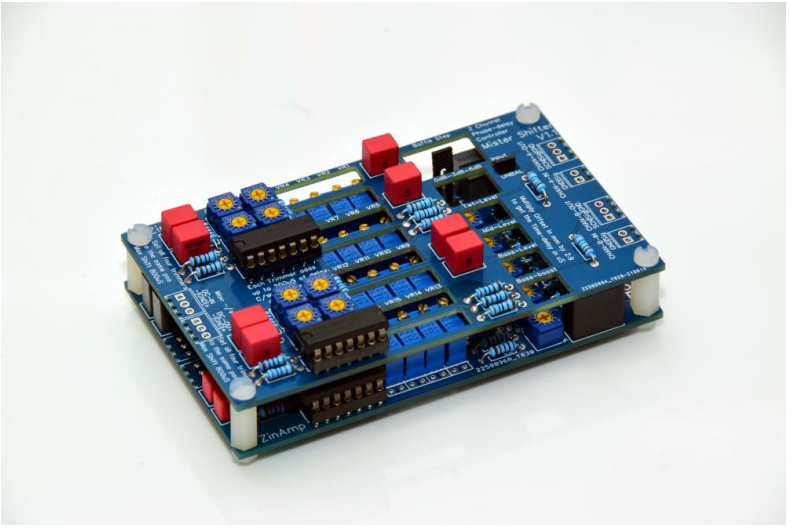
ZinAmp
Beautiful sound, for people who love music

Datasheet 3-Way Active Crossover

Application & Purpose:
3 Way Linkwitz-Reilly active crossover with a number of useful features including infinitely variable x/o slopes, baffle-step and bass-boost. This very flexible circuit can also be used as a gain stage providing up to x1.5 gain or 3.5dB. All slopes are 24dB.

Phase delay is available as a separate module that fits on top of the crossover module. Crossover can be used with or without the phase-shifter module.



Specification:

PCB Dimensions	63mm x 104mm x 1.6mm
Channels	One
Gain	Up to x1.5 or 3.5dB
Input Impedance	20kΩ
Frequency Response	15Hz-35kHz
OpAmps	Standard - TL074ACN Can be upgraded to OPA4227PA
Output Impedance	< 100Ω
Supply Voltage	Min +5/-5v DC (regulated power supply module available) Max +15/-15v DC (regulated power supply module available)
Idle Supply Current	100mA
Earth Nets	Power and Audio
THD	Typically 0.003%
Crossover Point Limits	Low-Mid Point - 120Hz - 5,000Hz Mid-High Point - 1200Hz - 10,000Hz Lower x/o points can be achieved with component swaps E.g. 80Hz for use with a sub-woofer is achievable

Features:

Infinitely Variable Crossover Points: All four slopes can be moved independently, using trimmer pots; useful for removing humps or dips. All slopes are 24dB i.e. 4th order.

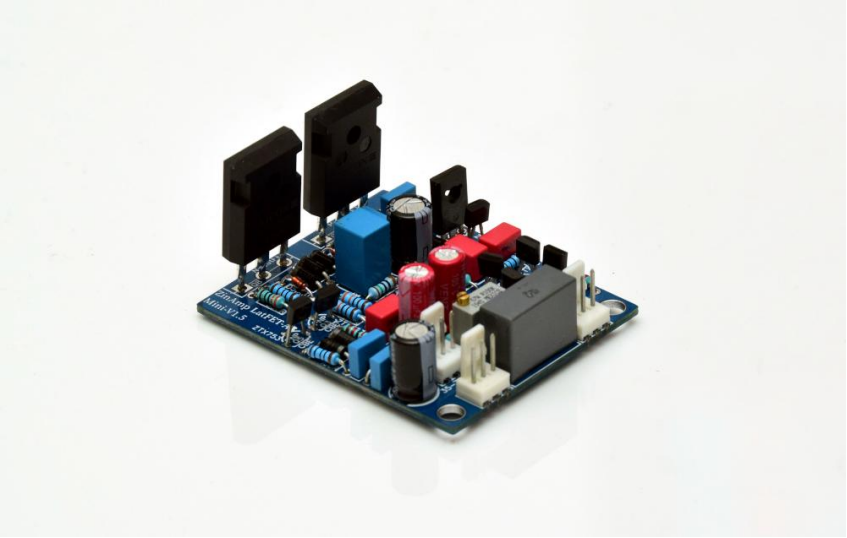
Baffle Step Filter - Three different baffle-widths can be selected and the filter slope trimmed with a pot from 0db to -6db

Bass Boost - An additional 3.5db of bass-response can be selected with a pot. This slopes away between 40Hz and 150Hz.

Phase Shift - An additional PCB module can be fitted 'on-top' of the crossover that adds up to 800uS of phase delay to two of the three channels from the crossover. The Crossover can still be adjusted through holes in the phase-shifter board.

Details:
The Linkwitz-Reilly Active crossover is not a new development. However, advances in DSP technology have seen a shift from conventional analogue crossovers to digital crossovers with Class D amplification becoming a popular choice.

The sound of DSP and Class D is not to everyone's taste; especially with analogue sources like vinyl records which require analogue-to-digital conversion for the DSP, then back to analogue for amplification. To address this, we have created these fully-featured analogue active crossovers and a set of compact class A/B power amplifier modules to make an analogue active crossover with class A/B amplification a practical proposition. Phase-delay, bass-boost, baffle-step and infinitely variable crossover slopes are all featured here. I.e. true analogue sound-shaping.



ZinAmp Compact Class A/B Power Amp - available separately

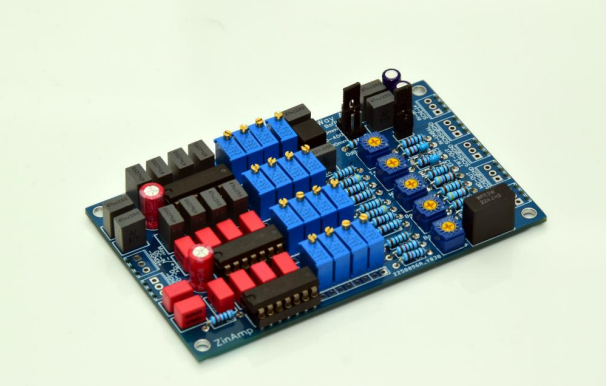
Setting the Crossover Points:

Please Note: the standard crossover has the following limits to where the crossover point can be set:

- Low-Mid Point - 120Hz - 5,000Hz
- Mid-High Point - 1200Hz - 10,000Hz

If you require a lower Low-Mid point than this - e.g. 80Hz for use with a sub-woofer - you can change all of the 47nF caps for 100nF. You will need to update these values in the spreadsheet used to set the crossover points - see below.

A simple spreadsheet can be downloaded from ZinAmp's website. This calculates the trimmer-resistor settings required for any given set of crossover points. The resistance of each trimmer is measured using a meter placed across 2 terminals below each trimmer and set according to the value indicated in the spreadsheet. This is a far-more flexible method than fixed x/o points and resistor packs sold by other manufacturers. It also allows compensation for variations in driver performance i.e. each slope can be moved to either squeeze or stretch the crossover region, if this is required.



PCB Showing 16 Trimmer Resistors - four per slope

Balanced or Unbalanced Inputs

Two separate inputs allow for balanced or unbalanced audio inputs. A simple jumper switch is closed for use with unbalanced and opened for balanced. Output is unbalanced only.

Driver Level Settings:
The output Level of each driver is set using a single-turn pot. Clockwise to increase, to a max of +3.5dB of gain.

Bass Boost:
Set using a single-turn pot. Clockwise to increase to a max of +3.5dB of boost. Max boost is in the 20-30Hz region, beginning to slope away from 40Hz to 150Hz. WARNING: Only increase bass-boost to the point where it no longer makes a difference, otherwise you may overdrive your bass power-amp. Don't set to more than 50% initially whilst experimenting.

Baffle Step:
A jumper switch selects the approx baffle width: <250mm; 250-400mm and >400mm. The amount of baffle compensation is set using a single-turn pot - from 0dB to 6dB.

Power Supply:
The op-amps in the crossover and shifter modules can be powered by a minimum of -/+5v and a maximum of -/+15v. More headroom is available at higher voltages and sources like CD players will require -/+6v to ensure clip-free performance.

Both the crossover and phase-shifter modules have two sets of power connections. One is marked DC-In and one marked DC-Out. They are linked in parallel so you can chain-wire, saving cable-space in your enclosure.

The zero-volts point needs to be grounded, so a split-rail supply is recommended. A floating supply can be used, but a zener diode and resistor on each rail will be necessary to maintain rail separation.

Connecting to Power Amps:

The crossover has three audio-outputs: Bass, Mid and Tweeter. Each of these connects to its own power amplifier. Input impedance of the power amp is more critical for the lowest frequency, which ideally should be 10k or more. Your power amplifiers should have coupling capacitors on their inputs. Whilst there are coupling caps at the input to the crossover, there are no coupling caps at the output, as there is almost no DC offset there.

Grounding - avoiding noise

To minimise noise and any chance of unwanted hum, this PCB has two separate ground nets; Power Ground and Audio Ground. These are not linked on the PCB as mixing these grounds may result in hum! These grounds do need to meet, but preferably at a single star-ground point in your installation.

Power Ground: The DC-In and DC-Out terminals have a pin marked GND. This is Power Ground. Connect this to the ground (gnd) of your power supply or to the star-ground point of your chassis, if there is space.

Audio Ground: The input and output terminals all have pins for SCN|Sig|GND. SCN is for the cable screen and is connected to Power Ground. The GND pin is Audio Ground and should be connected to the ground of the incoming signal source e.g. the pre-amp or volume control ground.

Connecting the Phase-shifter

The optional Phase-shifter module connects to the output of the Crossover. Any of the Crossover outputs can be connected to the Phase-shifter which acts as a pass-through. The outputs from the Phase-shifter connect to their respective downstream power-amp. Gain is unity (i.e. 1:1) For example, to add phase-shift to mid and tweeter outputs of the crossover, connect as follows:

Crossover Output	**Phase-shifter Input**		**Phase-shifter Output**	**Power Amp**
Twt-Out	Twt-in	-->	Mid Out	Twt Power Amp
Mid-Out	Mid-In	-->	Mid Out	Mid-Power-Amp
Bass-Out	Bass-Out	-->	Bass-Out	Bass-Power-Amp

Setting the desired Phase-shift
Phase shift is usually employed to compensate for the relative forward or backward center-point of a given driver in a cabinet and to tune out driver phase-differences at the crossover point. For example, a mid-driver may be 20mm further forward than a bass driver and a tweeter another 20mm forward from the mid. In this example we require 40mm of delay for the tweeter and 20mm for the mid.

Phase-shift(uS) = Offset(mm) x 2.9

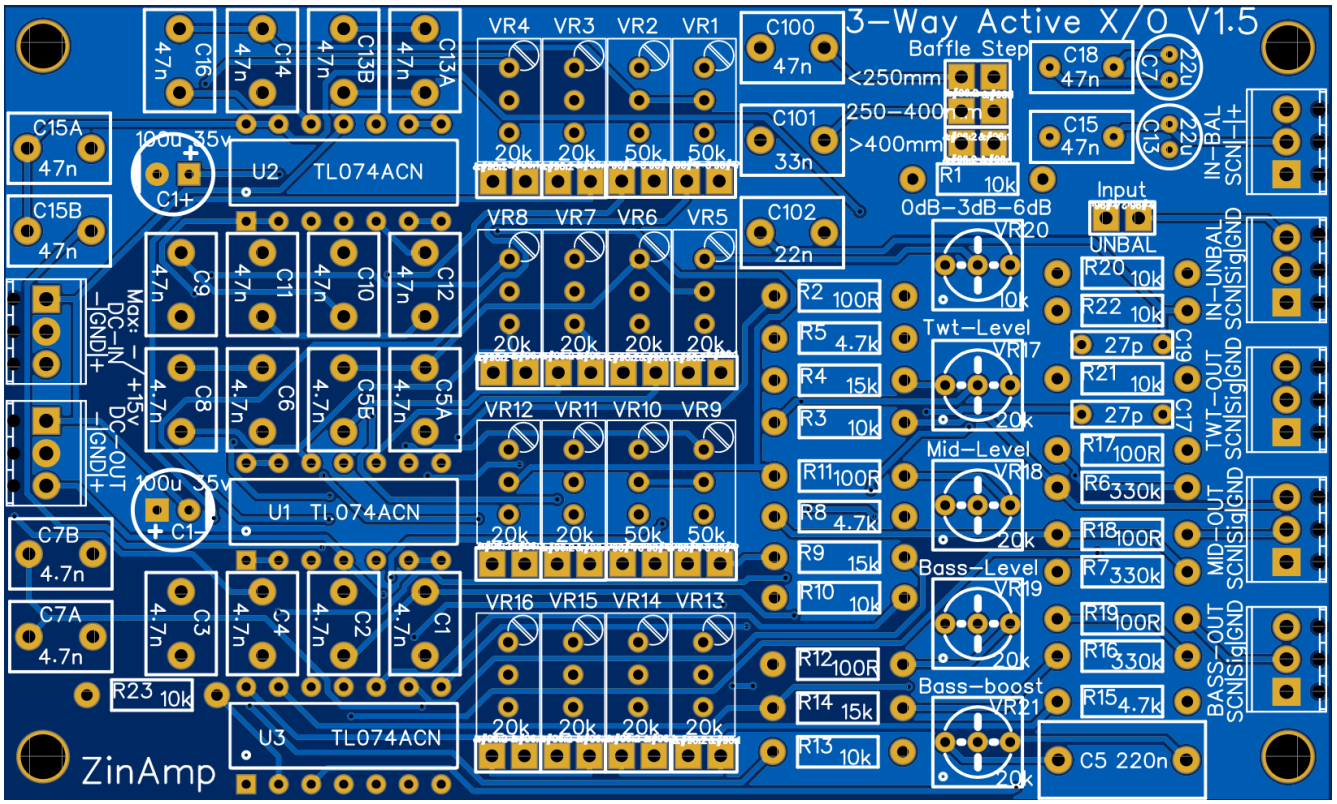
To select 20mm of shift for the mid-driver, multiply 20mm x 2.9 to give 58 microseconds. The **figure of 2.9** is a time-constant, based on the **speed of sound** at sea-level.

Each of the four trimmers on the phase-shifter-board can provide up to 200uS or 800uS in total. For 58uS, each trimmer needs to be set to around 15uS. (15÷200)x100=7.5%, so each trimmer should be set to approx 7.5% of its rotation.

To select 40mm of shift for the tweeter, double the figures above. I.e. each trimmer will be set to about 15% of its rotation.

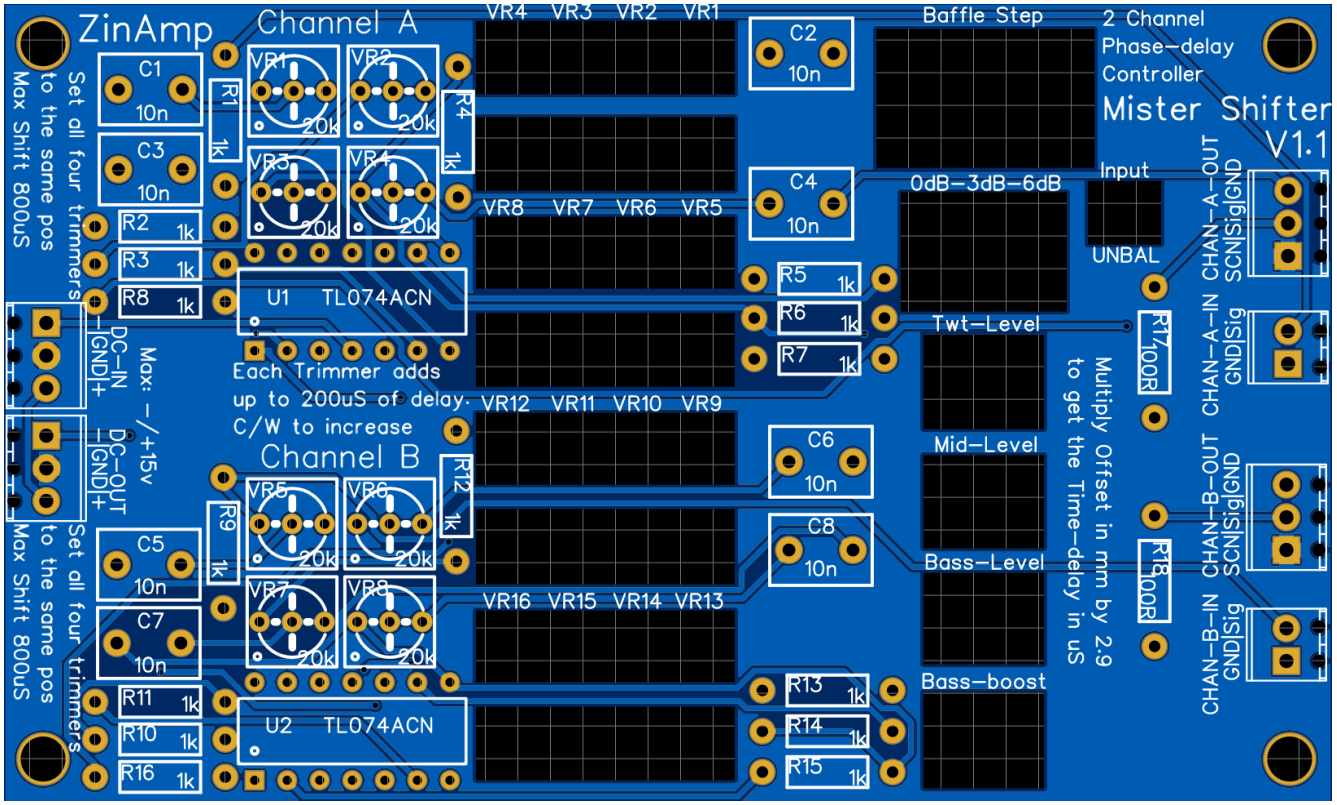
Note: The above example serves as a guide because in reality, setting a pot to 7.5% or 15% rotation is tricky to do by eye - and to verify by ear! Accurate adjustment of phase-shift is more easily done with an SPL mic and room EQ software. This ensures factors such as the frequency-dependent phase-shift of each driver are properly compensated for.

Bare PCB - Crossover:



Bare PCB - Phase Shifter:

Note holes for accessing Crossover controls when positioned above



Parts List:

CONNECTORS: Both blank and ready-built PCB requires connectors be purchased and soldered on by the constructor. This is to give the constructor a choice of how they wire their own particular installation. Terminal block connectors are indicated in the list below in blue and can be swapped for equivalent 2.54mm pitch connectors e.g. Molex KK254 headers, which are provided to the constructor in kits with ready-made wiring.

PLEASE NOTE THE QUANTITIES BELOW ARE FOR ONE **PAIR** OF CROSSOVERS or ONE **PAIR** OF PHASE_SHIFTERS (L & R):

Any values marked in yellow may differ from your PCB. Use the value in the parts-list below.

Email parts@zinamp.co.uk for help

Crossover - Parts (phase shifter parts in separate table below)

Designator	Value/Spec	Qty	Supplier	Manuf	Manuf Part	RS Part
C1+,C1-	100u 35v	4	RS	Vishay	MAL203850101E3	684-1973
C1,C2,C3,C4,C5A,C5B,C6,C7A,C7B,C8	4.7n	20	RS	Wima	FKP2/4700/63/5	115-736
C5	220n	2	RS	Panasonic	ECWFE2W224J	105-1074
C7,C13	22u	4	RS	Panasonic	ECEA1EN220X	176-3785
C17,C19	27p	4	RS	Murata	RDE5C2A270J0M1H03A	150-4025
C15,C18	47n	4	RS	Kemet	R79MC2470Z340J	171-9295
C9,C10,C11,C12,C13A,C13B,C14,C15A,C15B,C16,C100	47n	22	RS	Kemet	R79MC2470Z340J	171-9295
C101	33n	2	RS	Vishay	MKP1837333011	166-6459
C102	22n	2	RS	Kemet	R79IC2220Z345J	171-9259
R1,R3,R4,R9,R10,R13,R14,R20,R21,R22,R23	10k	22	RS	TE Connectivity	LR1F10K	125-1164
R2,R11,R12,R17,R18,R19	100R	12	RS	TE Connectivity	LR1F100R	125-1155
R5,R8,R15	4.7k	6	RS	Vishay	MRS25000C4701FCT00	683-3799
R6,R7,R16	470k	6	RS	TE Connectivity	LR1F470K	149-149
U1,U2,U3	TL074ACN	6	RS	Texas Instruments	TL074ACN	182-2441
VR1,VR2,VR9,VR10	50k	8	RS	Bournes	PV36W503C01B00	769-2195
VR3,VR4,VR5,VR6,VR7,VR8,VR11,VR12,VR13,VR14,VR15,VR16	20k	24	RS	Bournes	67YR20KLF	769-2170
VR17,VR18,VR19,VR21	20k	8	RS	Copal	CT-6EV 20kR	896-7169
VR20	10k	2	RS	Copal	CT-6EV 10kR	896-7140
3-pin Connectors	2.54mm pitch	14	RS	RS-PRO	790-1098	790-1098
Baffle Step Selector	2x3-pin 2.54mm pitch	2	RS	Harwin	M20-9980346	745-7046
Input Unbalanced Jumper	2-pin 2.54mm pitch	2	RS	RS-PRO	251-8086	251-8086

Phase-Shifter - Parts (crossover parts in separate table above)

Designator	Value/Spec	Qty	Manufacturer	Manufacturer Part	Supplier Part
C1,C2,C3,C4,C5,C6,C7,C8	10n	8	Wima	FKP2/0.01/63/5	115-758
CHAN-A-IN,CHAN-B-IN	GND|Sig	2	RS-PRO	790-1098	790-1098
CHAN-A-OUT,CHAN-B-OUT	SCN|Sig|GND, -|GND|+	4	RS-PRO	790-1098	790-1098
R1,R2,R3,R4,R5,R6,R7,R8,R9,R10,R11,R12,R13,R14,R15,R16	1k	16	Vishay	MRS25000C1001FCT00	683-3165
R17,R18	100R	2	TE Connectivity	LR1F100R	125-1155
U1,U2	TL074ACN	2	Texas Instruments	TL074ACN	182-2441
VR1,VR2,VR3,VR4,VR5,VR6,VR7,VR8	20k	8	Copal	CT-6EV 20kR	896-7169

Parts available from RS Online. Also try Farnell, Mouser and other online suppliers.

Parts from different manufacturers can be substituted where spec is sufficient

Supplier trading names may differ by country.