

## DCN23

### Digital Crossover with 2 inputs and 3 outputs

#### Features

- High performance Burr-Brown converters
- 24bit resolution
- 96kHz sampling frequency
- XOverWizard software
- Optical isolated USB interface
- 48 biquads total processing filters
- 76bit processor precision
- 21mS total delay option
- Latency 1ms
- 4 layer high performance PCB
- Decoupling at all active components

#### Applications

- Active Amplification Systems
- High End Stereo setup
- Supreme Surround Sound Systems

#### Description

DCN23 is a high performance digital crossover filter with equalization and delay. It features 2 balanced analogue inputs and 3 single-ended analogue outputs. High performance converters give DCN23 crystal clear sound and very low noise floor. DCN23 has an optical isolated USB interface to avoid hum and noise from the PC. The circuit board is a high quality 4 layer type which prevents noise and hum. The XOverWizard program is a graphical tool to change inputs, outputs, gain, crossover frequencies, crossover slopes, equalization and delay. The XOverWizard has a very significant feature: the ability to import a text file containing measured driver data of frequency, sound pressure level and phase. With these data the XOverWizard are able to display frequency response and more, while design is in progress. Compared to this method, the “old” trial and error method seems obsolete. The loading of parameters to filter are updated within about 1.5 seconds.

#### DCN23 Module



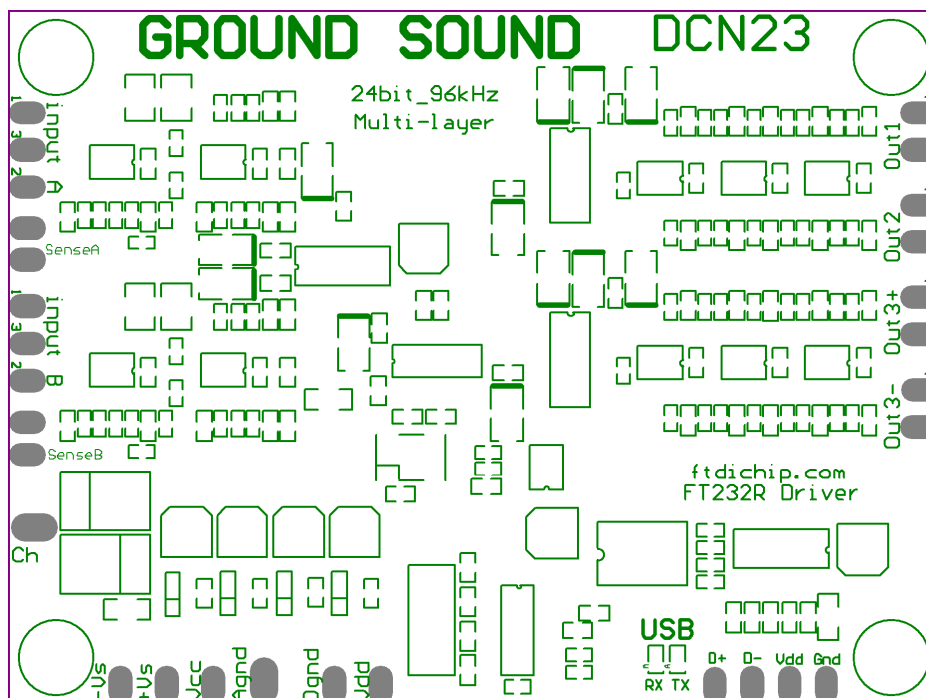
## Operating Conditions

Regulated voltage supplies	Min	Typ	Max	Units
Vdd, voltage digital circuit	3	3,3	3,6	V
Idd, current consumption digital circuit	105	110	115	mA
Vcc, voltage converters, analogue	4,8	5	5,2	V
Icc, current consumption converters, analogue	95	100	105	mA
Vs, voltage op-amps - dual supply	±8	±9	±15	V
Vs, current consumption op-amps – dual supply	±60	±70	±100	mA
USB interface, PC voltage		5		V

Note: To ensure perfect booting every time, the Vdd and Vcc has to power on simultaneously or in sequence of Vcc then Vdd. The supply has to be glitch and spike free for perfect performance and it is easily obtained with a classical regulated supply and normal transformer. A switch mode supply can also be used if desired, but care should be taken to avoid EMC problems and switch disturbance on the supply outputs. It can degrade the performance heavily, which is less desired.

## Technical Specifications

	Min	Typ	Max	Units
Converter resolution		24		bit
Sampling rate		96		kHz
Signal to Noise Ratio	108	110		dB
Frequency response, -3dB		5-48k		Hz
THD, 20Hz – 20kHz			<0,1	%
Input voltage, peak to peak, 0dB		4		V
Output voltage, peak to peak, 0dB		12		V
Processor resolution, internal		76		bit
Latency input to output		1		ms
Input impedance, balanced		10		kΩ
Output impedance		<50		Ω
Weight		35		g



## Connection pads

Label	Type	Description
Vdd	Supply	Digital circuit supply
DGND	Supply	Digital supply ground
Vcc	Supply	AD/DA converter analogue supply
-Vs	Supply	OP-AMP negative supply
+Vs	Supply	OP-AMP positive supply
AGND	Supply	Analogue supply ground
D+	USB	Data +
D-	USB	Data -
Vdd	USB	PC supplied voltage supply, standard 5V
Gnd	USB	PC ground (don't connect cable shield)
CH	Supply	Ground lift from AGND, connect to Chassis metal near input connector
A_1	Input	Channel <b>A ground</b> (AGND), 1 refers to XLR connector pin1, female
A_2	Input	Channel <b>A positive</b> , 2 refers to XLR connector pin2, female
A_3	Input	Channel <b>A negative</b> , 3 refers to XLR connector pin3, female
SENSE1	Output	Sense signal of Input A, (unconnected pad beside for mechanical strength)
B_1	Input	Channel <b>B ground</b> (AGND), 1 refers to XLR connector pin1, female
B_2	Input	Channel <b>B positive</b> , 2 refers to XLR connector pin2, female
B_3	Input	Channel <b>B negative</b> , 3 refers to XLR connector pin3, female
SENSE2	Output	Sense signal of Input B, (unconnected pad beside for mechanical strength)
Out1	Output	Channel 1 (High), single ended output
Out2	Output	Channel 2 (Mid or Low, 2way), single ended output
Out3+	Output	Channel 3 (Low/Sub), + refers to non-inverted signal
Out3-	Output	Channel 3 (Low/Sub), - refers to inverted signal

## Construction

DCN23 has dual high performance AD and DA converters from Burr-Brown (TI). It features 2 balanced analogue inputs and 3 single-ended outputs. DCN23 has a sampling rate of 96kHz and a resolution of 24bits, which surpasses the CD standard 44,1kHz and 16bit. The processing is based upon IIR filters (Infinite Impulse Response) giving low latency and good audio qualities. The internal processing operates with 76bit resolution to avoid processing overflow and maximize the linear range in the digital domain. A microprocessor takes care of the “household” like boot, mute, and PC communication. DCN23 will normally boot from an internal program without a PC connection. The PC only has to be connected during initial setup and future update of parameters.

The filter is designed for high integration with high end amplifier modules and dedicated power supply.

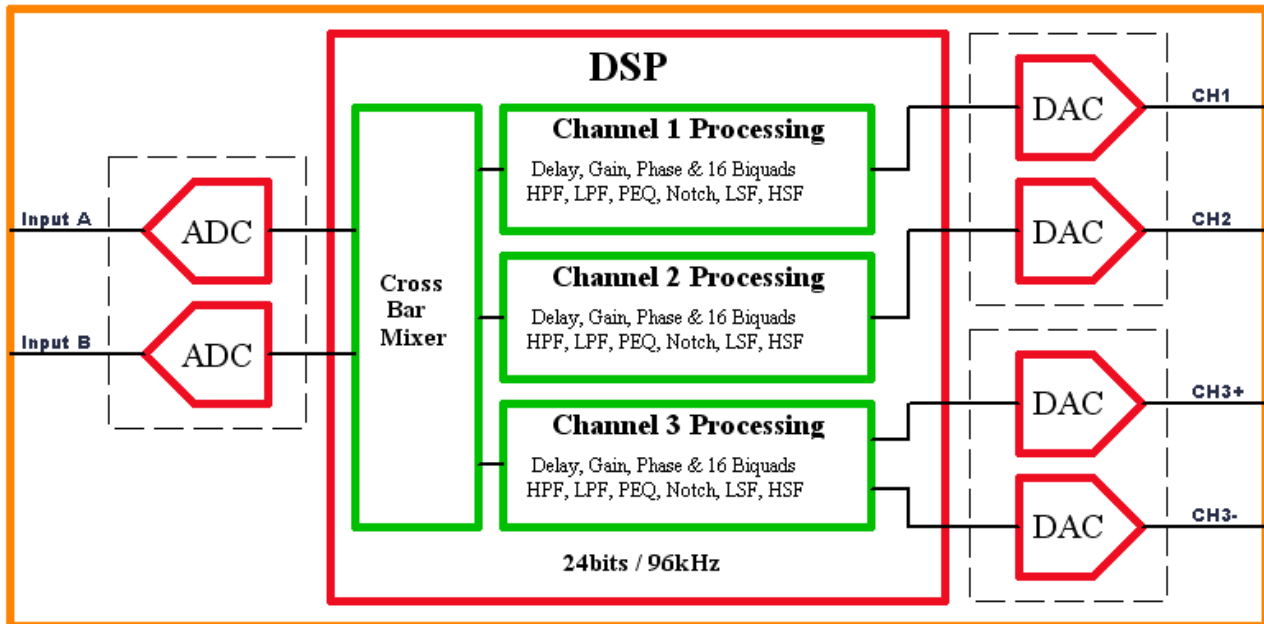
## USB interface

DCN23 communicates through an on board USB interface circuit which requires installation of a driver on the connected PC. The driver can be downloaded from the chip manufacture's homepage: [www.ftdichip.com](http://www.ftdichip.com) Download the FT232R driver for the operation system installed on the PC. The onboard USB interface acts as a com port and will be specified as com 1-8 in the XOverWizard. USB communication LEDs indicates transmitting TX and receiving RX.

## Setup possibilities

DCN23 features 2 input channels and 3 outputs which makes it possible to configure some different setups: Mono 2-way, mono 3-way, stereo passive top and mono sub, dual sub and 2 channel eq and room correction. The most likely setup is mono 3-way. The DCN23 was designed to do just this, but it has two inputs as all AD converters are dual and secondly it gained the possibility of mixing left and right for a mono sub.

# DCN23 signal processing

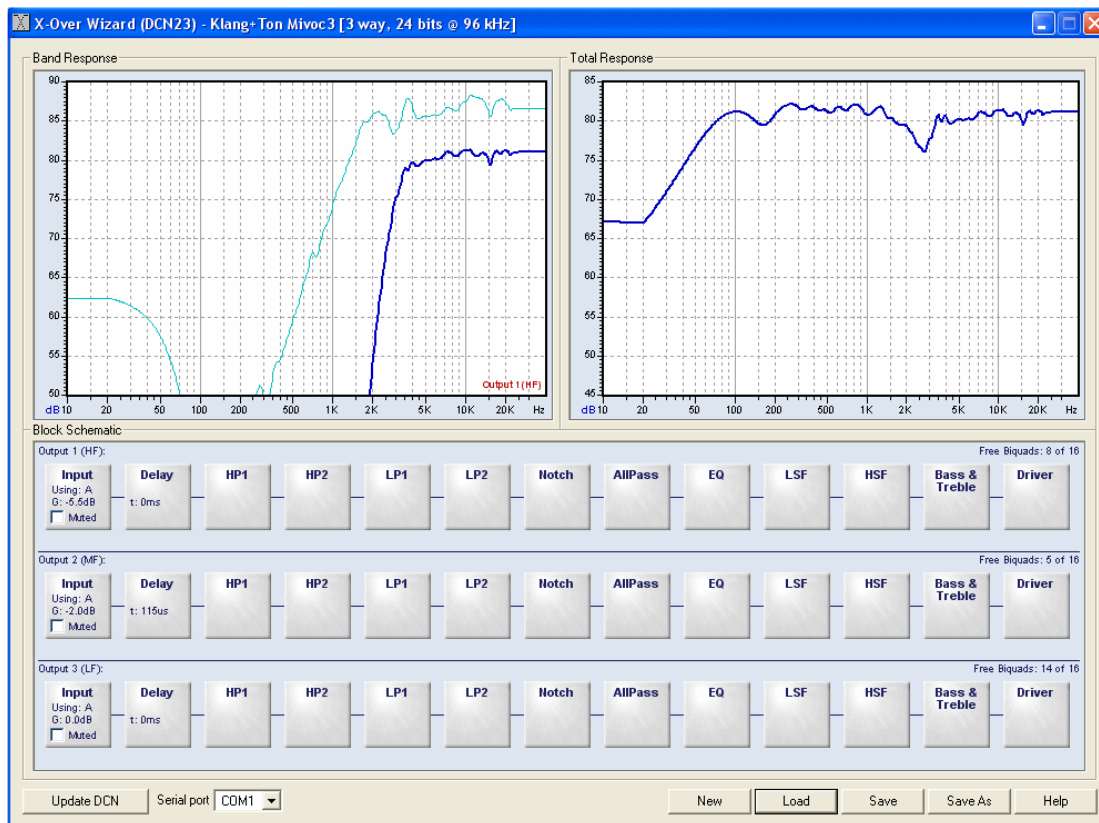


The above figure shows how the DSP of DCN23 is setup in software processing blocks

## XOverWizard & XOverWizard II

The software for controlling DCN23 is called XOverWizard. It a very powerful tool and it is best described by downloading the XOverWizard from the Ground Sound web page:

<http://www.groundsound.com/XOW.zip> This way it can be evaluated directly. Here is an example:



## Wiring

The **input** wiring depends upon the connector and the distance. If the distance is very short from connector to DCN23 input pads it should be sufficient to use ordinary 0,2mm<sup>2</sup> wire or else shielded cable. The shielded cable will have to have one inner core for unbalanced RCA connector and two inner cores for balanced female XLR. When the unbalanced RCA is used remember to short inverted input (pad3) to AGND (pad1) and the RCA has to be an isolated type to avoid ground loops. If only one input channel is used it's recommended to short both pad 2 and 3 to AGND (pad1) of the unused input.

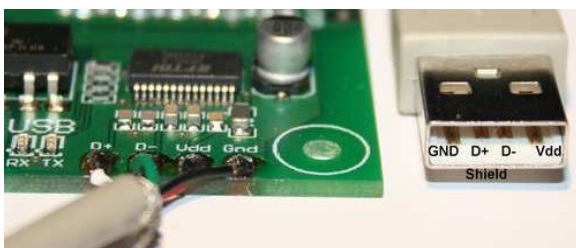
The **outputs** should be wired with a good shielded cable. It doesn't have to be large square as the signal is line level and low current. Remember to solder inner core to pad labelled Out and shield to AGND pad ⊥.

The **CH** pad is actually the lifted ground connection which should be wired to chassis metal very near (RCA) or on the input connector (the XLR connector often has a soldering tag for this purpose).

The **sense** output should be wired with the same shielded cable as the Out for amplifier modules. Solder the core for the pad marked sense and shield for unmarked pad. The pad is actually unconnected and its purpose is only mechanical strength, again to avoid ground loop.

The **supply** for DCN23 should be wired with 0,2mm<sup>2</sup>, which is sufficient except the AGND. The AGND should be wired with 0,75mm<sup>2</sup>. It's recommended to twist wire pair +Vs/-Vs and if there is a dedicated digital ground (DGND) then wire pair Vdd/DGND. If there isn't a separate dedicated digital ground, only wire the AGND from the supply star ground

The **USB** connection has four pads labelled D+, D-, Vdd and GND. This part of the circuitry is isolated from the rest of the board. An opto-coupler transfer data from the PC powered part to the μC. The board is designed with pads instead of a USB B connector for flexibility and mounting options. The chassis connector could be a Neutrik NAUSB or NAUSB-B or a USB B connector on a small printed PCB or simply a wire with a USB A connector. Be careful to connect red wire to Vdd and black wire to Gnd. Normally white wire connects to D+ and green wire to D-. The shield isn't connected on the DCN23 board, there is no need. Please notice that D+ and D- have to be swooped when using a NAUSB connector as it swoops the two inside the connector. If you get a pop-up window with the text "USB Device Not Recognized" when connecting the USB to the PC you simply have to swoop D+ and D-. Examples:



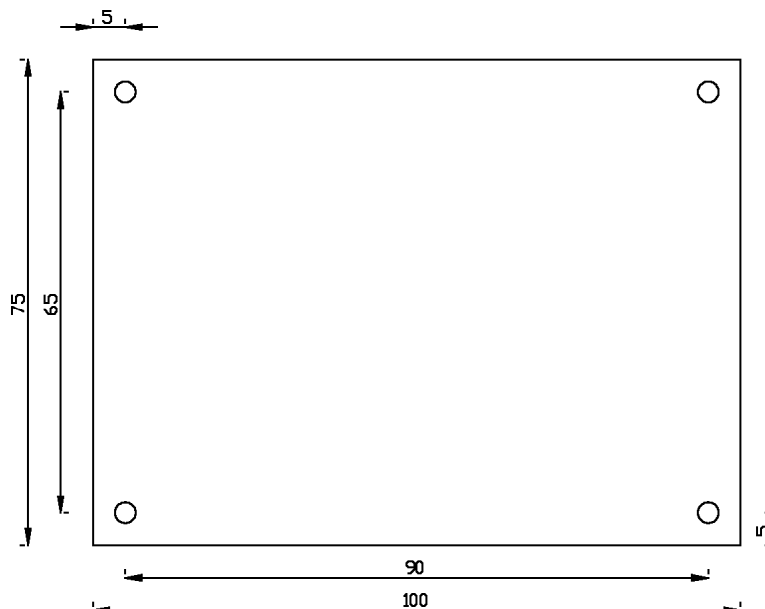
## Mechanical dimensions

The mounting of DCN23 requires:

4 pcs M3 x 16mm screws

4 pcs M3 x 3-10mm distances

4 pcs 3mm spring washers



Ground Sound reserves the rights to make alterations without prior notice.

Revision A: 2007-05-25

Revision B: 2009-09-16 DCN23 signal processing figure is added.