Danville Signal Processing, Inc.

Snowbird DSP Crossover Family

OEM Integration

High Performance DSP Crossovers
with Multiple Amplifier Support

User Manual

Version 1.20

Danville Signal Processing, Inc.
Snowbird™ DSP Crossover
OEM Integration User Manual

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Overview

The Snowbird family of Danville's DSP Crossover products are primarily intended for powered loudspeaker applications such as professional studio monitors and high end consumer audio systems.

Danville has a reputation for great sounding DSP crossovers. Obviously, this starts with great parts. The Snowbird uses an Analog Devices' floating point SHARC DSP as the processor. SHARC DSPs are the gold standard for high performance audio processing. The DAC & ADC functions are provided by an AKM Velvet Sound™ codec operating at 192kHz. The Velvet Sound data converters are recognized as the best in the industry by many audio pundits.

Even though the Snowbird family DSP Crossovers have high performance expectations, they are priced competitively when compared against other DSP crossover solutions that rely on highly integrated, but lower performance parts. Danville has its own automated SMT manufacturing line in the United States, that helps us keep costs down and flexibility high.

Snowbird DSP Crossovers are dependent on a mating power amplifier for its power. We currently have support for amplifiers from Pascal, Hypex, ICEpower and Powersoft. Each of these amplifiers have their own specific interfacing requirements. Danville has mating adapters that convert these requirements to the DSP board so that cabling is straightforward and control features such as mute, standby and fault protection are addressed.

We have similar versions of this manual that are tailored to each manufacturer. This allows us to detail specific features that are appropriate to each manufacturer's amplifier products.

There are many different Snowbird configurations. The basic feature list for the models described in this manual is as follows:

- Analog Audio Inputs (1 or 2 channels, Balanced XLR)
- Amplifier Outputs (2 or 4 channels)
- S/PDIF Input and buffered S/PDIF retransmitted Output (optional)
- USB Control Port for programming and field updates.
- Toggle Switches for user defined controls

Once we understand your specific requirements, we provide the configuration that makes sense for your target. This works well since we only provide these crossovers to OEM customers. This would be very impractical for a DIY customer base.

We also set up a customer support folder on Dropbox. This allows your staff and our staff to work interactively on specific crossover software designs and any other supporting documents. This shared folder is always kept proprietary and never shared outside Danville personnel and your team without your permission.

This manual covers the Snowbird as implemented as a collection of pretested board assemblies for integration into a custom speaker or embedded product. The assumption is that the OEM will take necessary steps to ensure that the finished product is electrically safe and meets EMC/RFI requirements. We may make suggestions with respect to layout and wiring but the OEM is responsible for the final implementation. Switching amplifier manufacturers do a good job of addressing these issues in detail.

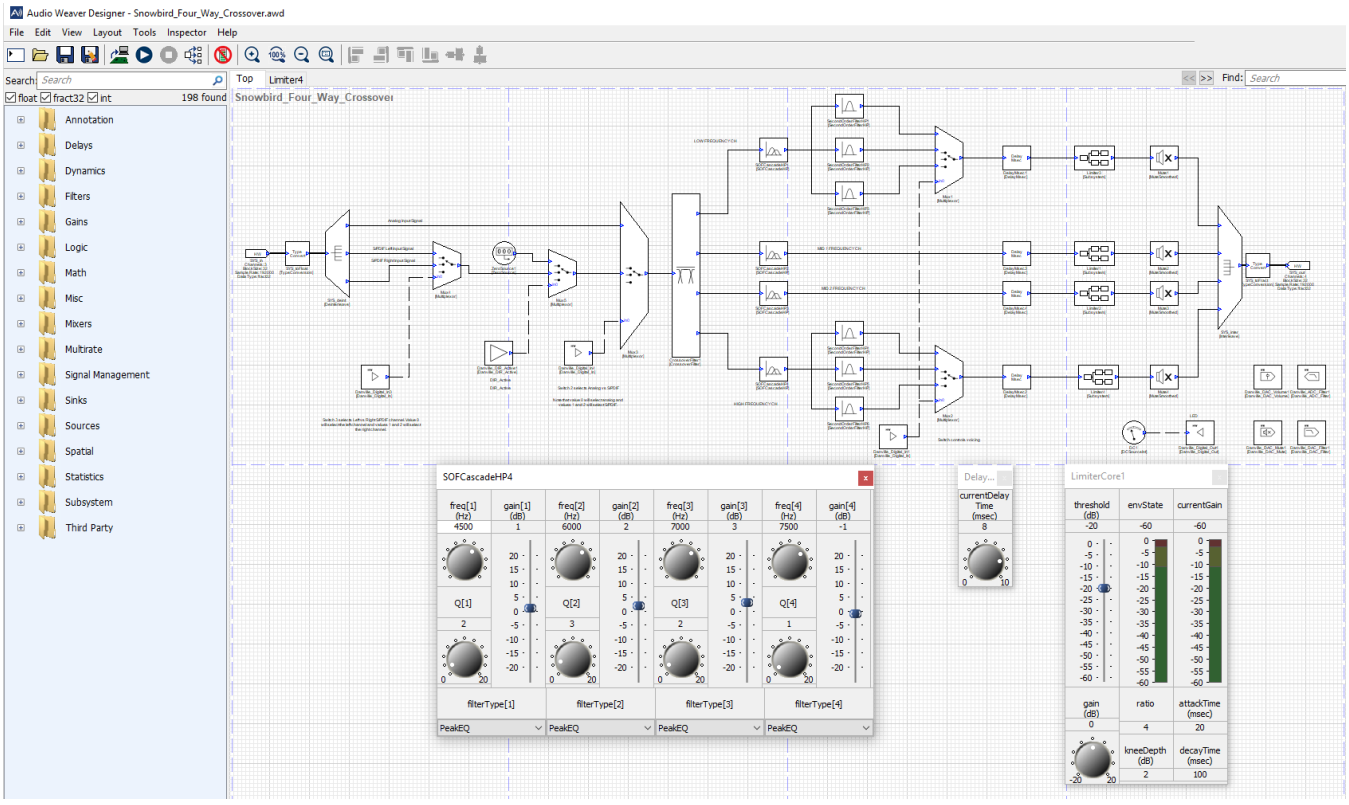
Software

The Snowbird DSP Crossover comes pre-installed with DSP Concepts' Audio Weaver. Danville has a licensing agreement that allows you to design and distribute your product without buying additional tools or licensing. All you need is a Windows computer.

Audio Weaver is a graphical design program that includes hundreds of optimized modules. Systems are designed in a drag and drop fashion to create signal flow. Audio Weaver runs natively on the SHARC DSP with optimized production quality modules. You design the signal processing system without the need for custom programming. Once you have your layout, you can adjust parameters in real time. For example, you can create a crossover design, make some measurements and listening tests, and then adjust parameters to fine tune the system without interruption of the test source or music.

One of the features we really think is important is that Audio Weaver includes a complete set of high performance filter modules. The precision of these modules is extremely important when creating filters with high Qs and low frequency corners, a.k.a woofer adjustments. There can be a 60dB signal to noise difference between an ordinary filter and the special high performance filters built into audio Weaver.

DSP Crossover design might seem a bit daunting at first. As part of our support program, we will help you get started by providing live training via Skype. We will also discuss signal flow architectures choices such as IIR versus FIR, bandsplitting options (Butterworth versus Linkwitz-Riley) and other useful features. After all, we want your loudspeaker to sell well. We sell a crossover every time you sell a loudspeaker.



Hardware Description

All Snowbird family boards share base features. This section will discuss details about each sub-component of a Snowbird crossover.

Analog Input Channel

The Snowbird analog input is balanced. It uses a standard female XLR connector very familiar to the professional community segment and increasingly common to higher performance consumer audio.

Powered monitors and power amplifiers do not have a standardized gain such as -10dBV or +4dBu. For example, power amplifiers typically have a voltage gain of 20 to 30dB. In some cases, balanced audio is assumed and in other cases single ended audio is assumed – so the situation is very loosely defined.

The Snowbird has a preset input gain structure that is similar to an external power amplifier. It needs to have reasonable headroom to match the input ADC full scale limits without sacrificing S/N.

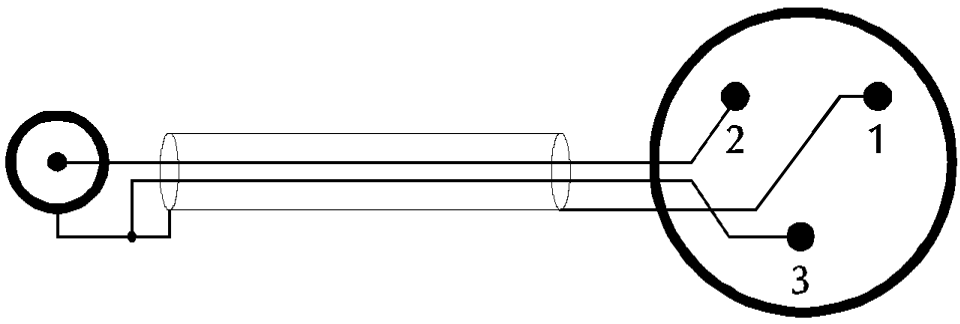
Some customers are going to need to interface with single ended sources (RCA phono). This can be done in two ways, the "OK" way and the better way. It both cases, you want the center hot of the phono to connect to pin 2 (hot) of the XLR connector. Ground of the phono connects to both pin 3 (cold) and pin 1 (gnd) of XLR. The difference between the two methods is where the pin 2 and pin 3 connections occur.

OK method:

This is likely a RCA to XLR adapter connected directly to the Snowbird. The connecting cable would be a phono to phono shielded cable. The advantages of the balanced input is largely eliminated in this configuration. It is convenient, but certainly not ideal.

Better method:

Use a two conductor shielded cable. You connect the RCA ground connection to one of the internal wires and the shield. The shield and internal wire are isolated on the XLR side. The picture illustrates this method.



DSP Processor

The Snowbird uses an Analog Devices fourth generation floating point SHARC DSP. This device is substantially more powerful than the typical canned audio processors used by other DSP crossovers. The SHARC also supports jitter attenuation. This is very important if the S/PDIF input is being used since phase jitter is intrinsically high with S/PDIF sources.

The SHARC does not contain data converters. The silicon fabrication requirements for fast DSP processing and high performance data conversion are incompatible. Integrated parts cost less, but sacrifice ADC & DAC S/N performance by as much as 15 dB. Danville always opts for better processors and converters.

ADC & DAC

The ADC and DAC data converter functions are implemented by an AKM "Velvet Sound" 24 bit codec operating at 192k sampling. This device has designed with audio quality in mind. Generally the internal anti-aliasing and anti-imaging filters are set to the short delay, slow roll off filter selection. This avoids pre-echos that can arise from the sharp roll off filters commonly employed in other devices.

Toggle Switches

There are two uncommitted three position toggle switches available for whatever you what to assign them for. These are usually used for slight tailoring of the frequency response, for example -2dB, 0, +2dB high and low frequency shelves.

The S/PDIF version has an additional switch for Left, Center (L+R) and Right channel selection. This makes the mounting requirements of the S/PDIF version a little wider. It is possible to reassign the S/PDIF toggle switch within Audio Weaver for other purposes. This might be reasonable for a target that doesn't need to select digital channels like a soundbar or standalone system.

Streaming Interface versions are available that replace the toggle switch assembly with a box header and a ribbon cable. This allows another PCB assembly to be connected. A single toggle switch and LED can still be used. These are soldered directly to the ribbon cable and located arbitrarily on the mating panel.

Power Supply Requirements

The Snowbird DSP relies on the auxiliary power supply of mating amplifier. These amplifiers have a bipolar 12 to 15 volt supply for the analog sections and a 5 or 7.5 volt supply for the digital sections. The Snowbird needs both the analog and digital supplies, but is flexible enough to use what is available. If the Snowbird is used in a standalone application, the power supply should be a triple supply type with either +/-12V or +/-15V high voltage rails and a 5V supply.

Control & Status Lines

Switching amplifiers generally have a variety of control and status signals. Some of these lines are active high and others are active low. The Snowbird addresses this situation by providing both polarities on the 40 pin header. This allows you to choose whatever amplifiers make since for your target. They can even be from multiple amplifier suppliers.

Mute

The Snowbird supports both active high and active low mute signals. These lines are used to avoid turn on and turn off thumps.

Standby

The Snowbird supports both active high and active low standby signals. These lines place the amplifier into a low power mode.

Fault

Switching Amplifiers usually have a status signal that reports when something bad has happened with the amplifier. This might be caused by shorted speaker lines, over temperature, or other parameters. The Snowbird has an interrupt driven line that can respond to this situation.

Snowbird Products

The Snowbird DSP platform usually consists two board assemblies, a DSP crossover board assembly and an amplifier adapter board.

The main DSP crossover board assembly includes the DSP, ADC and DAC(s) and local power supplies. There are a variety of control and monitoring circuits for mute, standby and fault monitoring. Some versions have digital inputs (S/PDIF) to complement the analog input(s). The DSP crossover boards are fairly universal but differ in the number of analog input channels, analog output channels, digital inputs and level control. They all share the same SHARC DSP and data converter types, so they all sound the same.

DSP Crossover	Part Number
Single Balanced XLR Analog Input with +/- 6dB level control	
2 output channels	A.03982E-2
4 output channels	A.03982E-4
2 output channels + S/PDIF	A.03982E-2-D
4 output channels + S/PDIF	A.03982E-4-D
Dual Balanced XLR Analog Inputs	
2 output channels	A.03983E-2
4 output channels	A.03983E-4
2 output channels + S/PDIF	A.03983E-2-D
4 output channels + S/PDIF	A.03983E-4-D
Single Balanced XLR Analog Input	
2 output channels	A.03984E-2
4 output channels	A.03984E-4
2 output channels + S/PDIF	A.03984E-2-D
4 output channels + S/PDIF	A.03984E-4-D
Single Balanced XLR Analog Input with XLR (Male) Pass Thru	
2 output channels	A.03985E-2
4 output channels	A.03985E-4
2 output channels + S/PDIF	A.03985E-2-D
4 output channels + S/PDIF	A.03985E-4-D

The adapter boards are much simpler. These boards mate with the universal 40 pin header on the DSP board and convert to the specific interface connectors and requirements of the mating amplifier(s). This

approach allows the Snowbird DSP to support amplifiers from many different manufacturers as well as to address the specific control requirements unique to each amplifier type.

The following list are the current adapters. Adapters are very easy and inexpensive to create so the list is constantly being updated.

Amplifier Adapters		Part Number
Pascal		
	Single U/T Pro with Capacitors (cable-less)	A.03988-1
	Dual U/T Pro with Capacitors (cable-less)	A.03988-2
	Dual U/T Pro with Capacitors	A.03988-3
	X/M Pro	A.03989A-5
	Single U/T/S Pro	A.03989-6-1
	Dual U/T/S Pro	A.03989-6-2
ICEPower		
	Single AS100S1/2	A.03989C-1-1
	Dual AS100S1/2	A.03989C-1-2
	Single AS700S1/2	A.03989C-2-1
	Dual AS700S1/2	A.03989C-2-2
	Single AS1200S1/2	A.03989C-8-1
	Dual AS1200S1/2	A.03989C-8-2
Hypex		
	Single Ncore NC122, NC252, NC502	A.03989-4-1
	Dual Ncore NC122, NC252, NC502	A.03989-4-2
Powersoft		
	LiteMod 4HC	A.03985-7

Snowbird DSP Board Variants

The Snowbird family boards are all semi custom variants that build from a well tested established base design. Loudspeaker systems almost always have some specific requirements that make a universal design impractical. From the previous table, you can see that the variations are all based on a few different modifications. The following sections will outline these differences.

Single Balanced Audio Input with Level Control
P/N A.03982-2
P/N A.03982-4

Single Balanced Audio Input with Level Control + S/PDIF
P/N A.03982-2-D
P/N A.03982-4-D

Dual Balanced Audio Inputs
P/N A.03983E-2
P/N A.03983E-4

Dual Balanced Audio Inputs + S/PDIF
P/N A.03983E-2-D
P/N A.03983E-4-D

Single Balanced Audio Input
P/N A.03984E-2
P/N A.03984E-4

Single Balanced Audio Input + S/PDIF
P/N A.03984E-2-D
P/N A.03984E-4-D

Single Balanced Audio Input with Pass Thru
P/N A.03985-2
P/N A.03985-4

Single Balanced Audio Input with Pass Thru + S/PDIF
P/N A.03985-2-D
P/N A.03985-4-D

Analog Input Channels

Most powered monitors will have a single audio input. This makes sense when the loudspeaker is going to be assigned to specific channel such as left or right.

Snowbird DSP boards of P/N A.03982, A.03984 and A.03985 are the single analog input types.

There are a few cases where you may want a two channel audio feed. Here are some examples:

- Subwoofer channel of a 2.1 system (sum L & R)
- Soundbar applications
- Standalone external crossovers
- External room correction or bass management component

Snowbird DSP boards of P/N A.03983 are the two analog input types.

Analog Output Channels

Each Snowbird variant is available with either 2 or 4 channels (DACs) to feed amplifiers.

If you are building a two way monitor or a subwoofer, you probably only need a 2 channel version (denoted with a -2 suffix) which will cost a little less. This configuration will usually mate to a single external power amplifier. If needed, You can flip the phase of one channel (in software) for bridging applications.

The 4 channel versions (denoted with a -4 suffix) supports 3 or 4 way systems. The main expense difference is going to be the additional cost of power amplifiers and loudspeaker drivers since the SHARC DSP has sufficient signal processing capability to manage 4 channels.

Input Gain Control

Snowbird DSP boards of P/N A.03982 include a +/- 6dB gain adjustment. This control is located in the same area as the secondary XLR used in some of the other variants.

The purpose of this control is to allow fine adjustment of input sensitivity with external equipment. It is not intended as a volume control since back of a loudspeaker is not the best place ergonomically. The best place for the setting is in its 0 dB position. This is where linearity is highest. The circuit topology eliminates the effect of contact resistance and non linearity typical in a traditional audio tapered potentiometer.

Most customers forego this option if for no more reason that it avoids a custom knob and perhaps extra machining.

Digital Input (S/PDIF)

A digital input can be attractive if the content is already in digital format. This means that the input ADC and the driving source's DAC can be bypassed.

Snowbird DSP boards of with suffix -D support digital input.

In the Snowbird Crossover, S/PDIF is limited to a maximum sampling rate of 96k even when the Snowbird is operating internally at 192k. The sample rate of the S/PDIF stream is automatically upsampled and jitter attenuated.

The Snowbird has a special expansion header for S/PDIF (coaxial 75 ohm) connections. It is possible to use these connections to support another interface with an external buffer or device, for example AES3 or Toslink. Normally, external RCA phono connectors are mounted on the plate amplifier with a mating cable. The expansion also provides a retransmit S/PDIF output. This allows you to cascade S/PDIF from one speaker to the next. This is important since many driving sources only have a single S/PDIF connector and you never want to use a Y cable for S/PDIF lines.

One of issues with S/PDIF is that you will need to select the desired channel from the stream. DSP Crossovers with this feature are a little wider (see the mechanical drawings). This is because an additional toggle switch is used to select the desired channel (up is left, center is L+R, down is right).

Before you get too excited about using S/PDIF, there is a very big caveat: it might not be practical! Consumer audio that has an S/PDIF output is likely to only provide a fixed level. If you can't control the gain, it will not be very useful (it might be very loud!). S/PDIF levels control be controlled in two ways: Scaling the bit stream at the source or adding control data via the U bit of the S/PDIF packet. The U bit is theoretically available for this purpose, but nobody uses it. This would likely require an external converter that doesn't exist currently. If this is something you care about, we can have a conversation.

The current practical uses of S/PDIF would be for recording studio monitors or custom commercial applications where these issues can be addressed.

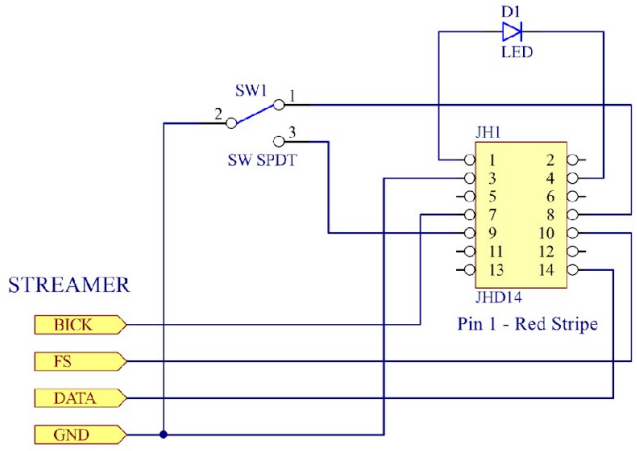
Streaming Interface

A variety of streamers are available for alternative input types such as USB Audio Class 2. This just takes a I2S like interface. In this variation, a ribbon cable connects to the module and inserts into a 2x7 box header. This means that the toggle switch interface PCB is no longer used.

The standard interface a MSB first 64 bit L/R stream. It is also possible to use the standard I2S protocol with a simple software change. The streaming interface upsamples and jitter attenuates any incoming stream to 192k

Wiring Diagram:

Wires are fanned out ribbon cable lines that connect to JH1. Run a separate wire from the streamer GND to pin 2 of the toggle switch.



Amplifier Adapters

Snowbird crossovers use a universal 40 pin right angle box header to connect to adapters. This allows each amplifier type to be optimized with respect to connections and control signals. There are several types of adapters that can be considered.

If you are building a powered monitor, one of the first issues to address is how to isolate the crossover from the internal acoustics of the enclosure. Crossovers are always going to be potential air leaks. XLR connectors, switches and other connectors are difficult to seal. Amplifiers are somewhat easier. They might be located in the acoustical space or outside this space. The main issue with the amplifiers is that you may need to mount them in a way to control heat generation.

The 40 pin header is oriented so that one possibility is using the adapter as an isolating wall between the acoustic space and the external connection (DSP Crossover) space. You might use a gasket for this purpose. Another possibility is to seal the ribbon cable or power amplifier output wires.

We currently have adapters for Pascal, Hypex, ICEpower and Powersoft, including special adapters for the Pascal T & U Pro amplifiers. These include bulk electrolytic capacitors for extra charge reserve for the power amplifier power supply rails. Adapters are not particularly complex, so making new or modified versions is quick and not costly.

Since every situation is different, a custom adapter might be more appropriate. Danville can create specific adapters for your requirements.

Amplifier Connections

1	Pin	2 Name	3 Description - Notes
JH2		**RA Box Header**	**2x20 0.100 Pitch Dual Row**
[4]	1	Reserved	5 Do Not Connect
	2	Reserved	6 Do Not Connect
Note 1	3	AMP_EN	Amplifier Enable, Active High referred to Amp Digital Supply
	4	LED	Same as front panel LED, Active Low - 1K00 limiting resistor
Note 1	5	STBY	Amplifier Standby, Active High referred to Amp Digital Supply
	6	GND	
	7	AMP3P	Balanced Output – NC on 2 channel boards
	8	AMP3N	Balanced Return – NC on 2 channel boards
	9	GND	Amplifier Input Signal Ground
	10	AMP2P	Balanced Output – NC on 2 channel boards
	11	AMP2N	Balanced Return – NC on 2 channel boards
	12	GND	
	13	Vc+5	5V Digital Power Supply Input or 5V supply from Vc+7.5
Note 1	14	MUTE	Amplifier Mute, Active High referred to Amp Digital Supply
	15	Vc-15	Negative Analog Supply from Power Amplifier -12V to -15V
	16	Vc-15	Negative Analog Supply from Power Amplifier -12V to -15V
	17	GND	Power
	18	GND	Power Supply Ground
	19	Vc+15	Positive Analog Supply from Power Amplifier +12V to +15V
	20	Vc+15	Positive Analog Supply from Power Amplifier +12V to +15V
	21	GND	Power Supply Ground
	22	GND	Power Supply Ground
	23	Vc+7.5	7.5V Digital Power Supply Input converted internally to 5V
	24	Vc+7.5	7.5V Digital Power Supply Input converted internally to 5V
Note 2	25	STBY#	Amplifier Standby – Active Low (open drain)
	26	DIT	3.3V logic level of S/PDIF loopback, useful for external AES3
	27	PWR_MONITOR	Power Monitor Interrupt Input
Note 2	28	MUTE#	Amplifier Mute – Active Low (open drain)
	29	SIGNAL_PRESENT	
	30	PROTECT#	Protect Interrupt Input
	31	S/PDIF IN	S/PDIF Input - 75 ohm
	32	S/PDIF IN RETURN	S/PDIF Return
	33	S/PDIF OUT	S/PDIF Retransmitted Output (echo of S/PDIF Input)
	34	V_MONITOR	Analog Positive Voltage Monitor (see text)
	35	GND	
	36	AMP1P	Balanced Output
	37	AMP1N	Balanced Return
	38	GND	Amplifier Input Signal Ground
	39	AMP0P	Balanced Output
	40	AMP0N	Balanced Return

Connection Details

Note 1:

> Active High Lines are passively pulled low. The active drive is via a MOSFET switch connected to the amplifier's digital power supply (5V or 7.5V).

Note 2:

> Active Low Lines are actively pulled low via a MOSFET switch to ground. There are no local pull ups.

Amplifier Outputs

The amplifier outputs are balanced 100 ohm circuits but only the positive side is driven (AmpP connections). This means that you can optionally flip the phase with a fully balanced amplifier input, but that you must use the positive output for amplifiers with single ended inputs.

On 2 channel Snowbird boards, Amp2 & Amp3 are not connected.

Digital Power Supply

Switching amplifiers usually provide either an unregulated raw digital supply or a regulated +5 volt supply. The Snowbird uses a regulated 5V supply which is further regulated on the board. The 7.5V input is fed into an onboard 5 volt linear regulator that is summed to the external +5V regulator input. Only one of these digital supply inputs are used.

Analog Power Supply

The analog power supply can be either +/- 12V or +/-15V.

Analog Voltage Monitor

When the switching amplifier is turned off, power starts to fall to both the amplifier and the Snowbird. This can present a race condition. One of the ways to determine if power has been removed is to monitor the level of the analog supply. We can do this by adding a zener diode and a resistor (1K00) from the positive analog supply to V_Mon. The zener diode is 9.1V for a 12V power rail and 12V for a 15V power rail.

This will cause Mute and Mute# to be asserted when the supply falls.

Power Monitor Interrupt

This input tells the DSP that power from the amplifier is out of range. This could be a status line on an amplifier. One useful connection is to tie MUTE# to PWR_MONITOR when the Analog Monitor is configured. In this case, if the Analog Supply falls, the DSP gets an interrupt which allows it to start a shutdown process while it still has power.

S/PDIF & AES3 Connections

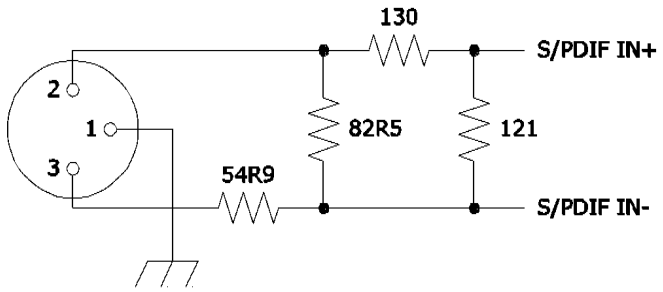
1	Pin	2 Name	3 Description - Notes
JH3		**Header – 6 pin**	**JST B6B-PH-K-S**
[4]	1	S/PDIF In	5 RCA Center
	2	S/PDIF In Return	6 RCA Shield
	3	+5V	
	4	DIT	3.3V Loopback
	5	S/PDIF Out	S/PDIF Loopback
	6	S/PDIF GND	GND

S/PDIF Connections

The S/PDIF Input assumes that an external RCA connector will be used. It is capacitively isolated from the board ground. The output of the S/PDIF input goes to the DSP which acts as the S/PDIF receiver (DIR). It also loops back with 3.3V logic (DIT) and buffered S/PDIF Out (0.5V). The Return is board Ground.

AES Connections

You can also use AES3 connections. In this case you will need an attenuator. Here is a circuit that will work for this.



Resistors can be either 1% thick film (0603 or 0805) or RN55 thru hole types.

You will also need a buffer. This is generally an RS-422 driver operating at 5V. This is the reason for the +5V supply on the connector. You drive the buffer with the DIT output.

Other Considerations

Unless you have a means of adjusting the S/PDIF or AES3 levels, this interface is not very useful since speaker levels need to be something other than maximum loudness.

Safety Considerations

The Snowbird Crossover is a subcomponent in a larger powered system in most cases. This means that it is likely that high voltages will be present in your system.

This topic is generally discussed in detail by the power amplifier supplier, since the high voltage portions of the system are in their domain.

There are a few points to reiterate:

- MAKE SURE THAT CREEPAGE DISTANCES ARE OBSERVED.
- MAKE SURE THAT SAFETY GROUND IS CONNECTED TO THE CHASSIS.
- YOU ARE RESPONSIBLE FOR SAFETY COMPLIANCE.

Ground Returns

The Snowbird Crossover is designed to avoid Pin 1 problems (AES-48).

The upper screw of the outside female XLR should be attached to the panel. There is an alternative chassis ground alternative located on the PCB directly behind the XLR. This can be used when the screw connection of the XLR is not practical.

Connections from the 40 pin header and companion adapters will route directly to the companion power amplifiers. The power amplifiers have chassis ground locations (discussed in their documentation).

Other Wiring

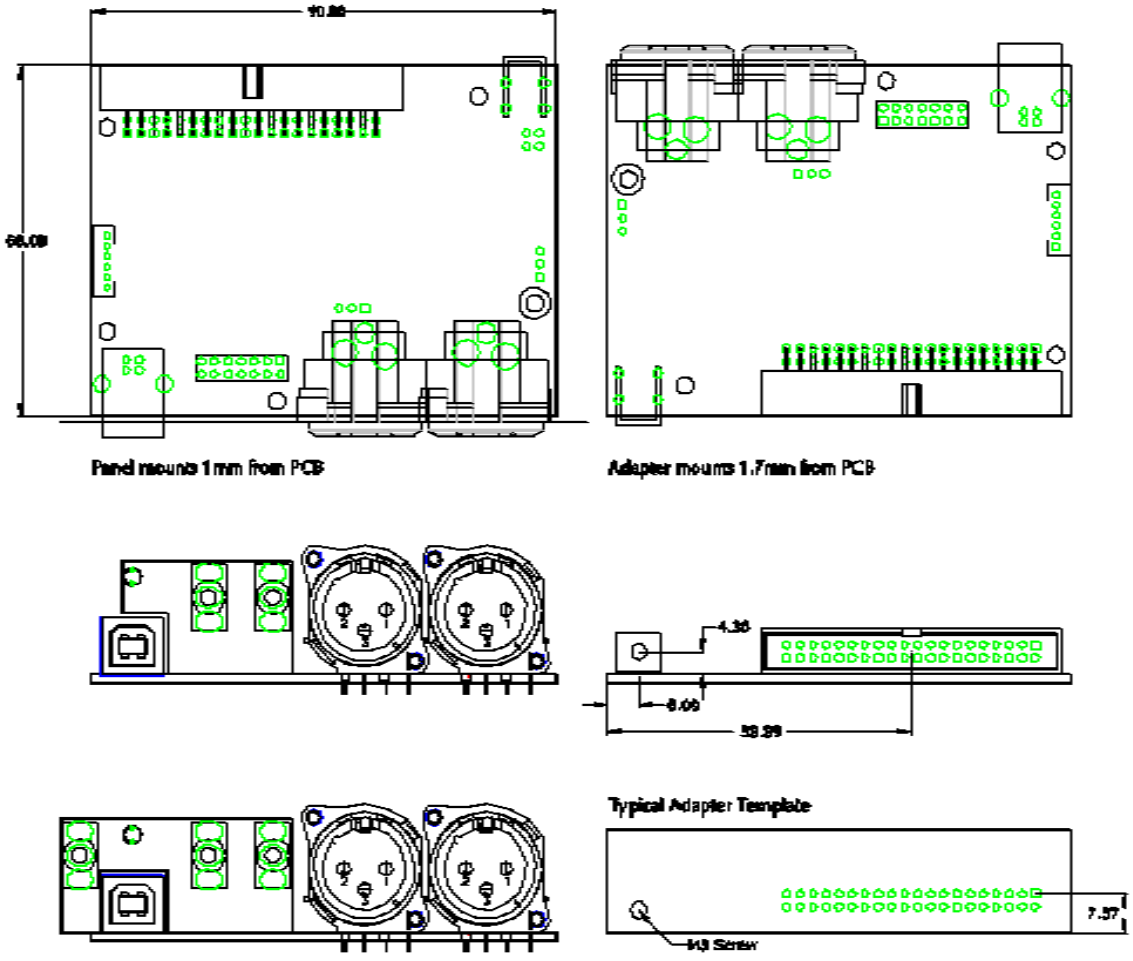
Internal twisted pairs are suggested when individual wires are used. Ribbon cables generally have pin assignments that provide adjacent return signals.

- Keep the AC mains away from other wiring. This is generally explained in the Amplifier Manual.
- Keep the amplifier outputs (speaker wires) away from the amplifier inputs.
- Amplifier output wiring should be as large a possible given the connector constraints.
- If you must cross cables, try to do it in a way so the wires cross perpendicularly to each other.

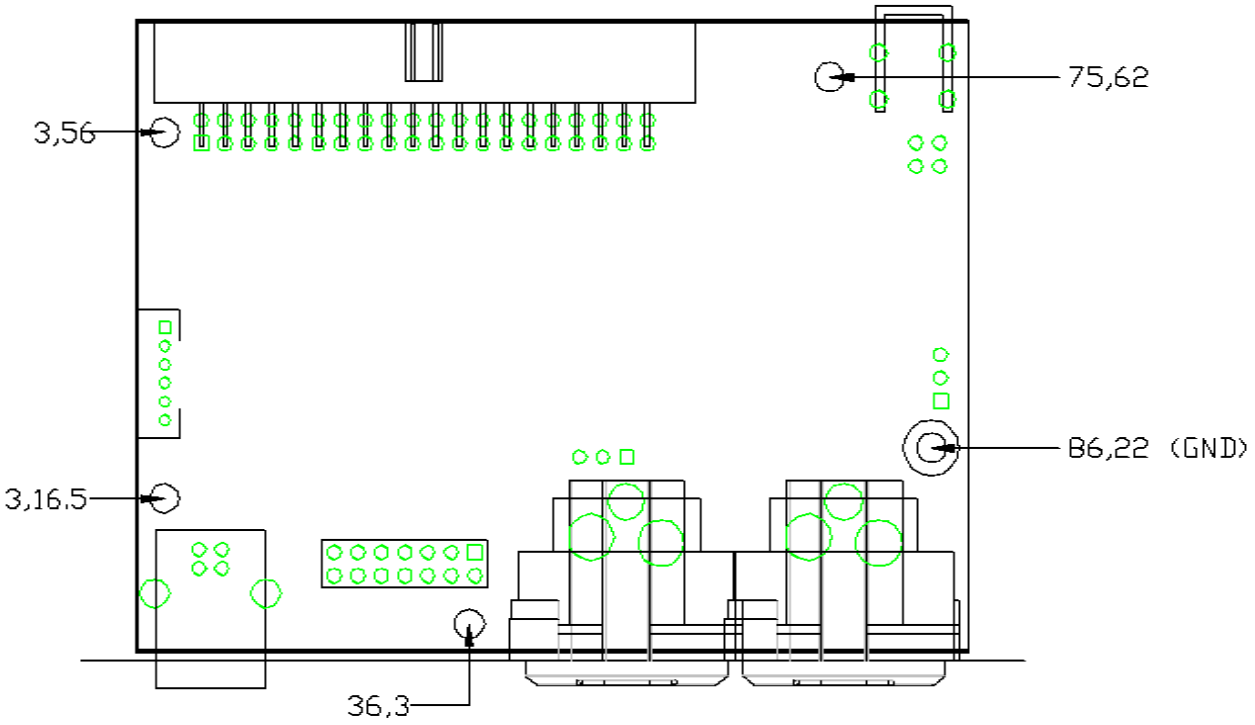
Dimensions

All of these drawings are available in dxf or dwg formats.

Overview of a Typical Snowbird Crossover

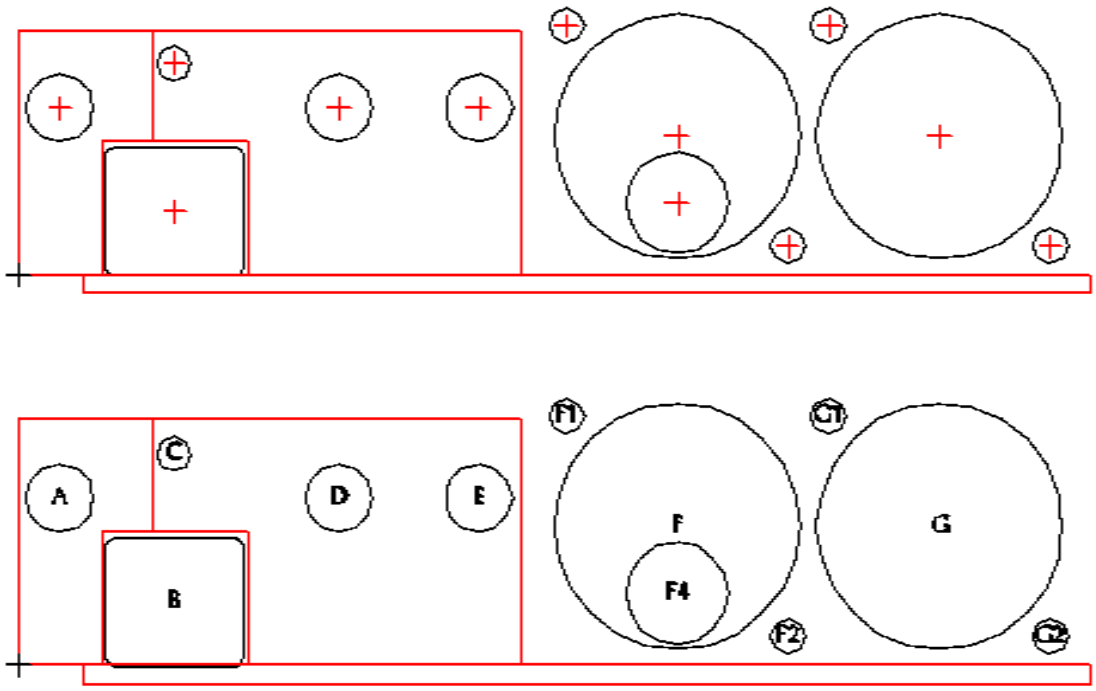


Dimensions – Hole Locations



Holes are 3.2mm suitable for 4-40 or M3 Screws

Panel Mounting



Item	Location	03982	03983	03984	03985	-D
S/PDIF Toggle Switch	A					✔
USB	B	✔	✔	✔	✔	
LED	C	✔	✔	✔	✔	
Toggle Switches	D, E	✔	✔	✔	✔	
Female XLR	F, F1, F2		✔			
Male XLR	F, F1, F2				✔	
Level Control	F4	✔				
Female XLR	G, G1, G2	✔	✔	✔	✔	

All versions may include -D option.
Red outlines are PCBs
Datum is marked by a plus, located at lower left corner of a PCB
Level Control shaft is 15mm from interior of the panel. You may need to relieve panel for knob.

Panel Machining

Item	Location	Center	X	Y	Diameter	Corner Radius
S/PDIF Toggle Switch	A	3.75, 50			6.00	
USB	B	14.00, 5.71	12.19	11.43		0.64
LED	C	14.00, 19.00			3.10	
Toggle Switch	D	28.75, 15,00			6.00	
Toggle Switch	E	41.25, 15.00			6.00	
XLR	F	59.00, 12.50			22.00	
	F1	49.10, 22.40			3.20	
	F2	68.90, 2.60			3.20	
Level Control	F4	59,00, 6.50			9.10	
XLR	G	82.50, 12.50			22.00	
	G1	72.60, 22.40			3.20	
	G2	92.40, 2.60			3.20	

All dimensions in mm.
Level Control shaft is 15mm from interior of the panel. You may need to relieve panel for knob.
Hole G2 should be non-anodized for proper Pin 1 grounding.

Product Warranty

Danville Signal Processing, Inc. products carry the following warranty:

Danville Signal Processing products are warranted against defects in materials and workmanship. If Danville Signal Processing receives notice of such defects during the warranty period, Danville Signal Processing shall, at its option, either repair or replace hardware products, which prove to be defective.

Danville Signal Processing software and firmware products, which are designated by Danville Signal Processing for use with our hardware products, are warranted not to fail to execute their programming instructions due to defects in materials and workmanship. If Danville Signal Processing receives notice of such defects during the warranty period, Danville Signal Processing shall, at its option, either repair or replace software media or firmware, which do not execute their programming instructions due to such defects. Danville Signal Processing does not warrant that operation of the software, firmware, or hardware shall be uninterrupted or error free.

The warranty period for each product is one year from date of installation.

Limitation of Warranty:

The forgoing warranty shall not apply to defects resulting from:

- Improper or inadequate maintenance by the Buyer;
- Buyer-supplied software or interfacing;
- Unauthorized modification or misuse;
- Operation outside the environmental specification of the product;
- Improper site preparation and maintenance.

Exclusive Remedies:

The remedies provided herein are the Buyer's sole and exclusive remedies. In no event shall Danville Signal Processing, Inc. be liable for direct, indirect, special, incidental or consequential damages (including loss of profits) whether based on contract, tort, or any other legal theory.