J0308	MUSIC RAIL™ APP NOTE: DAC Applications	2 Pages

For additional information, please visit the Bybee web site at www.BybeeLabs.com

When installing a Music Rail after a low-voltage regulator (as in a DAC or other digital application), you may wish to consider the insertion loss (dropout) of the Music Rail. A typical DAC chip is fed from a +5V regulator and a +3.3V regulator. Note that the 2A Music Rail drops 0.5V. This dropout or insertion loss can be compensated by the following technique:

To level-shift a 3-terminal regulator, lift the ground pin and insert a diode in series with it. The diode will boost the output of the regulator by 0.6V, making up the insertion loss of the Music Rail. You can use a 1N4001 diode, or any equivalent diode with a forward current rating of 100mA or greater. For positive regulators the diode should be inserted with the banded end toward ground (reverse it for negative regulators).

The level-shifting technique works well down to about 3V, even though our datasheet calls out a 4.5V minimum input voltage for the Music Rail. Here's why: to produce the rated output current, the input voltage must be 4.5V or higher. At lower currents, however, this rating can be relaxed. In other words, although 3.3V is below the minimum rated input voltage, the Music Rail still functions because the current draw of a DAC is very low.

You don't normally need to worry about level-shifting regulators that are >5V, but this will depend on the application. Given these workarounds, there is no reason why you cannot benefit from using Music Rails in several locations within your DAC.

Location, Location, Location

We have found that with a typical DAC, the most critical location is after the +5V regulator that feeds the analog pins of the DAC chip. The +3.3V digital pin of the DAC is less critical, but still provides benefits. Some of our customers also hear benefits when Music Rails are installed after the + / - 15V regulators that feed the analog output stage (not the outputs of the DAC chip itself, but the op-amps that buffer the DAC chip from the main output).

To summarize, the hierarchy of benefits is as follows:

1) +5V analog rail of DAC chip (5 stars)

2) +3.3 digital rail of DAC chip (4 stars)

3) + / - 15V rails of op-amp output stage (3 stars)

A full setup for a typical DAC would include the following:

1) 3 x 2A POS Music Rail

2) 1 x 2A NEG Music Rail

3) 2 x silicon rectifier diode

In a typical low-voltage application, each Music Rail should have its two ground pins (the two outermost pins) jumpered. Next, run a wire from either of these pins to the ground plane of the

corresponding regulator (that part of the PC board that the regulator ground pin is, or was, soldered to). Try to position each Music Rail close to its corresponding regulator.

Post Installation Performance Check

After installation and power up, you should read a 0.5V differential from input to output on each 2A Music Rail. Check the output noise with a scope or sensitive AC meter. The output noise should always be less than the input noise. Under certain conditions a Music Rail may produce a low-level, non-destructive oscillation. This oscillatory energy adds to the noise floor, which can then be seen on a scope. This oscillation can occur when capacitors are placed across the Music Rail output. Oscillation may also occur when the input capacitor is too far away from the Music Rail.

Occasionally, the use of a diode on the ground pin of a low-voltage regulator will adversely affect its dropout voltage. This usually happens only with tightly cascaded regulators (e.g., a 5V regulator feeding a 3.3V regulator). It may be necessary in these cases to add level-shifting diodes to both regulators. For this reason, you should ensure that each regulator is working properly after the mod, i.e., the output voltage of each regulator should remain stable when the AC line is decreased or increased with a variac.

After confirming the performance of the regulators and Music Rails, *listen!*

Demo Straps

For those wishing to demonstrate the benefits of the Music Rail by ear, there is a simple method by which the Music Rail can be bypassed: simply connect a bypass strap from input to output. This strap can be switched, or a pair of quick-connects can be used. Just ensure that the strap, switch, and/or connector are rated for the intended load. See app note J0412 for part numbers & suppliers.

Bybee Labs Resources

For further installation and performance details please see the Music Rail datasheet, which you can download from www.BybeeLabs.com . You can also request our detailed installation procedure for the Benchmark DAC 1 (app note #J0309). We are currently working on a procedure for the Music Hall 25.3 DAC, which will be available in April 2011.

If you need additional help, please contact:
techsupport@bybeelabs.com

##

MUSIC RAILS are manufactured in the United States.

8390 East Via de Ventura F-110
Scottsdale, Arizona 85258, USA
1-480-998-2880 / techsupport@bybeelabs.com