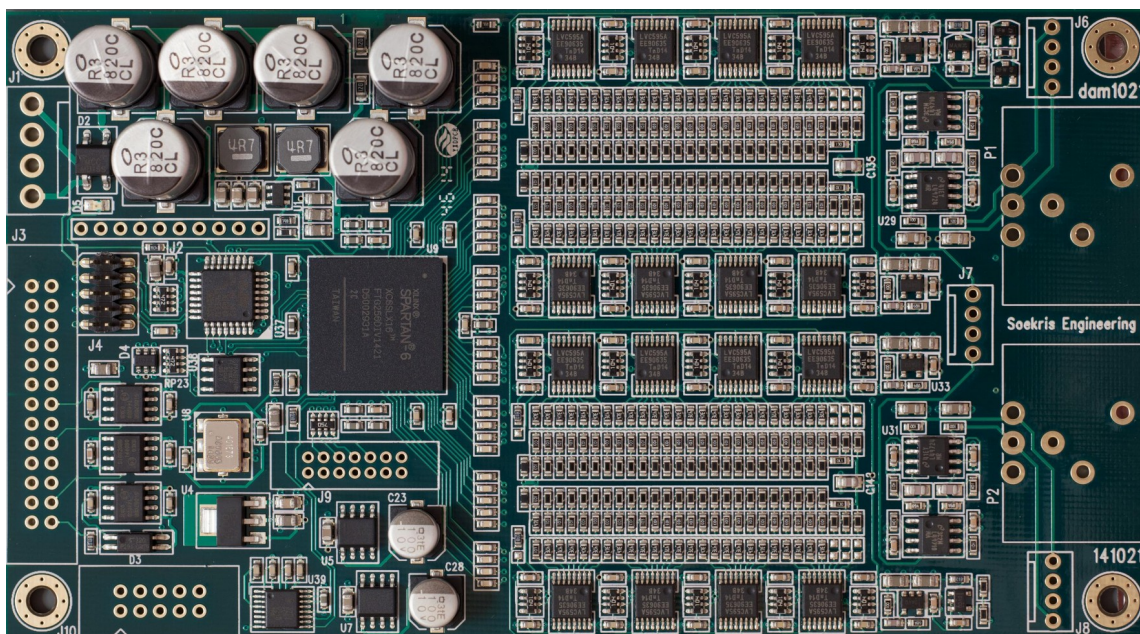


Soekris Engineering ApS

dam1021 series boards. User's Manual



Vers 0.90 – September, 2015

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INTRODUCTION

The dam1021 is a DAC module based on a discrete R-2R sign magnitude DAC design, with FPGA based FIFO buffering/reclocking and custom digital filters, < 1 ps jitter clock generator, with 28 bit resolution so there is headroom, oversampling up to 3.072 Mhz. Up to 24 bit / 384 Khz input from SPDIF, I2S and USB (via USB to I2S interface board), with isolation on the I2S interface. The board is very flexible, with digital volume control and filter parameters that can be downloaded. The board is fully firmware upgradeable over a simple serial connection, which enable new features later on.

The basis R-2R network has an output voltage of 1.4V RMS and output impedance of 625 ohm and can therefore drive a lot of things directly. There is also onboard balanced output drivers that can drive high impedance (≥ 300 ohm) headphones directly. The power supply is also onboard, just add a 5W or larger toroid transformer.

Standard Configurations

- dam1021-01: 0.01% resistor version
- dam1021-02: 0.02% resistor version
- dam1021-05: 0.05% resistor version

What is the difference between boards using 0.01%, 0.02% or 0.05% resistors ?

Only the harmonic distortion get better with more precise resistors, and typically they will sound much the same as the resistors initially are better then specified. But the more precise resistors has smaller temperature drift and better long term stability, and therefore will be better in the long term.

Specifications

dam1021 series

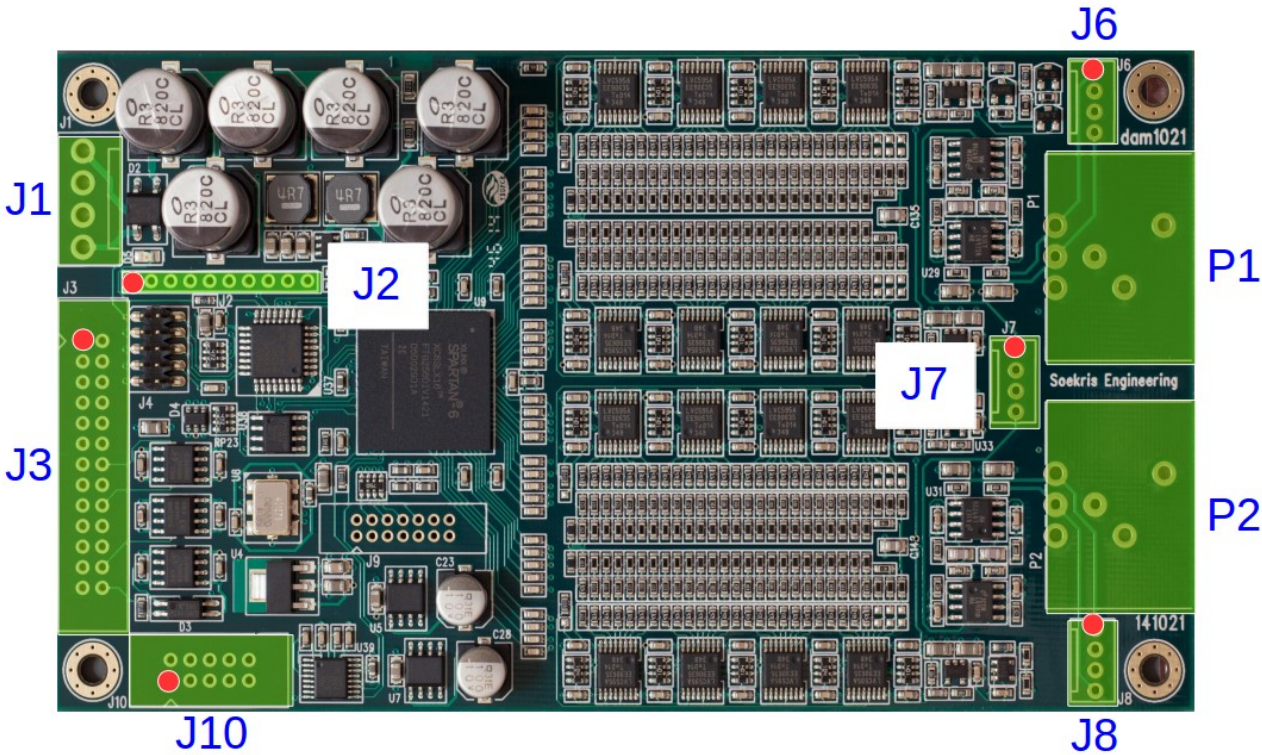
dam1021	-01	-02	-05
THD @ -1 dB output	0.008%	0.010%	0.015%
THD @ -60 dB output	0.03%	0.05%	0.09%
S/N 20Khz Bandwidth	127 dB unweighted		
Frequency Range +0.1dB -1.0dB	20hz - 20Khz		
Signal Input	Isolated I2S, t.ex. for external USB-I2S interface board. SPDIF digital, t.ex. for direct connection to Toslink receiver. SPDIF balanced receiver, t.ex. for AES3 of SPDIF Coax.		
Audio Output	<u>R-2R direct single ended:</u> 1.4V RMS Zout 625 Ohm. <u>Buffered single ended:</u> 2V RMS Zout 10 Ohm. <u>Buffered balanced:</u> 4V RMS Zout 20 Ohm.		
Power input	7-8V AC or +-7-15V DC max 5W		
Environmental Conditions	<u>Operating:</u> 0°C to 60°C temperature 10% to 90% relative humidity, non condensing. <u>Storage:</u> -20°C to 85°C temperature 5% to 95% relative humidity, non condensing.		
Board size	3.2" x 5.8" (81 x 147 mm)		

FEATURES

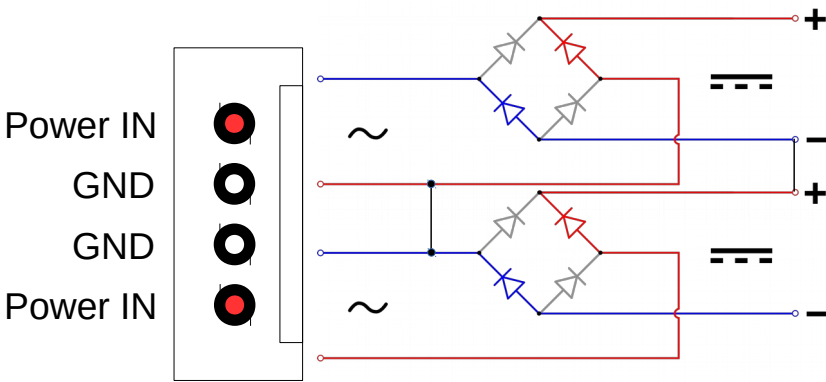
The initial rev 0.90 release of the firmware together enables the following features:

1. I2S input up to 384KHz sample rate
2. SPDIF input up to 192KHz
3. Automatic De-emphasis for 44.1KHz material
4. Built-in set of simple FIR filters for all sample rates
5. Digital volume control through simple potentiometer
6. Automatic input selection
7. Data reclocking: s/w PLL with 0.02 Hz low pass filter
8. S/W interface (serial interface) allows:
 1. Volume control (e.g. with Arduino)
 2. Input selection (e.g. with Arduino)
 3. Loadable FIR filters including bypass filter for NOS support (s/w utility included)
 4. Firmware update/upgrade

CONNECTORES AND INDICATORS



Power Connector/Header J1



7-8V AC or +-7-15V DC max 5W

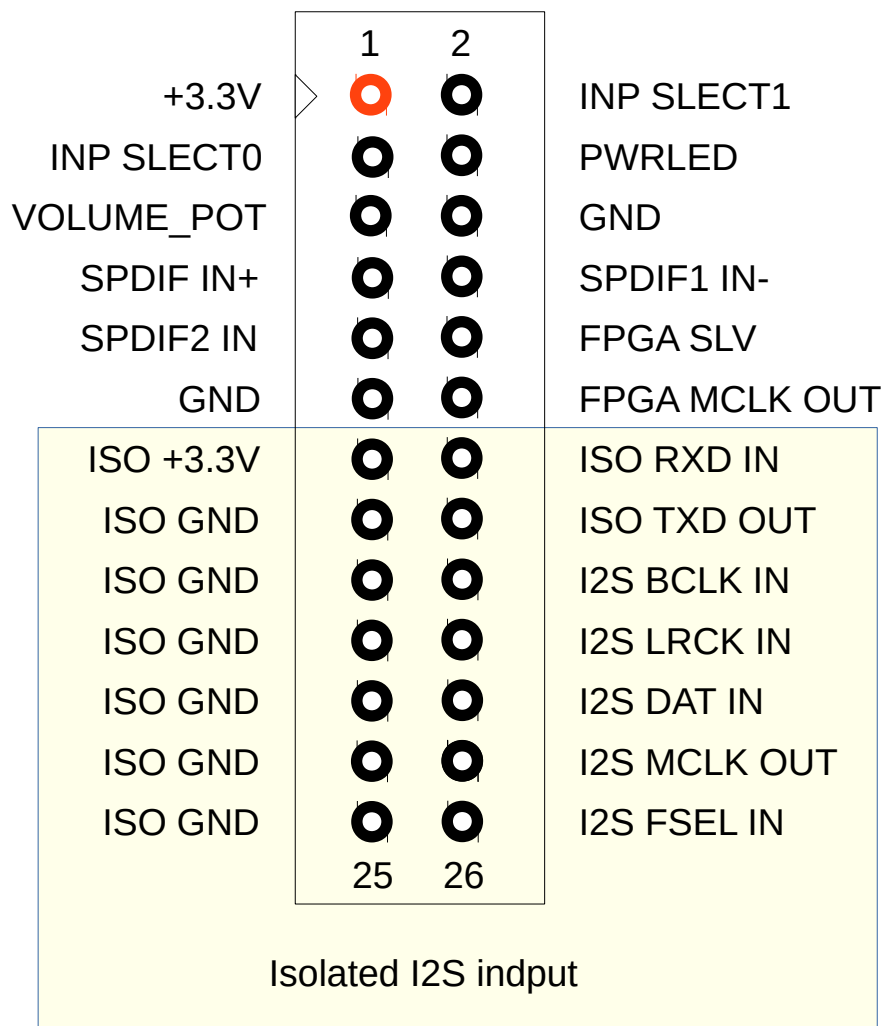
Power Rails Connector/Header J2

Connector with all the power rails, for testing or for supplying (limited) power to other things....

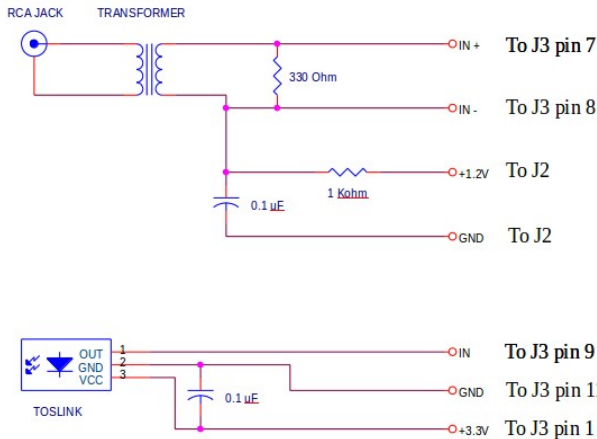
J2 Pin 1:	GND
J2 Pin 2:	PWR A-
J2 Pin 3:	PWR A+
J2 Pin 4:	GND
J2 Pin 5:	PWR -5 volt
J2 Pin 6:	PWR +5 volt
J2 Pin 7:	GND
J2 Pin 8:	PWR +3.3 volt
J2 Pin 9:	PWR +1.2 volt
J2 Pin 10:	GND

Header J3

All indputs are 3.3V level

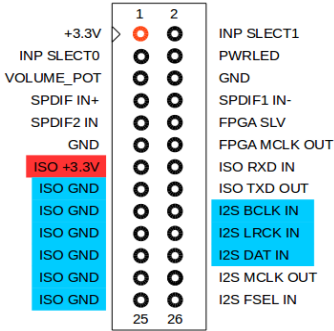


SPDIF Input Connections



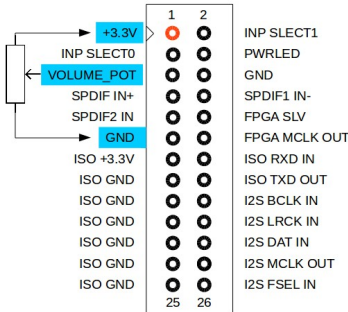
I2S Input Connections

- Connect BCLK to I2S BCLK IN Pin (J3, 18)
- Connect LRCK to I2S LRCK IN Pin (J3, 20)
- Connect Data to I2S DAT IN Pin (J3, 22)
- Provide external 3.3V to ISO +3.3V Pin (J3, 1)
- AND connect I2S GND to ISO GND (J3, 15)



Volume control connection

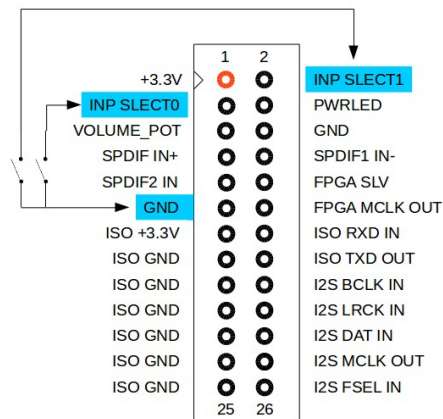
Requires the use of a 10K linear potentiometer. Volume can be controlled -90 to +15 db
 Connect low side of potentiometer to GND Pin (J3, 11)
 Connect high side of potentiometer to +3.3V Pin (J3, 1)
 Connect Volume Pot wiper to VOLUME POT Pin (J3, 5)



Input Selection

Input	INPSLCT0 J3, 3	INPSLCT1 J3, 2	
Auto Selection	open	open	dam1021 will search the 3 inputs for a valid signal and lock when found
I2S	GND	GND	
SPDIF 1 (Coax)	open	GND	Sensitive LVDS Receiver
SPDIF 2 (Toslink)	GND	open	Standard 3.3V digital level

Open means that there is nothing connected to the pin



Serial port

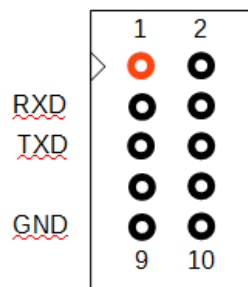
The dam1021 uses a standard RS-232 level serial port on J10 for the primary console interface. The serial port default baud rate is 115200, but it can be changed by the monitor “set” command.

The connected ANSI/VT100 terminal or terminal emulator should be set for 115200 baud, 8 databits, no parity, 1 stop bit, no flow control.

Pin 3: RXD

Pin 5: TXD

Pin 9: GND



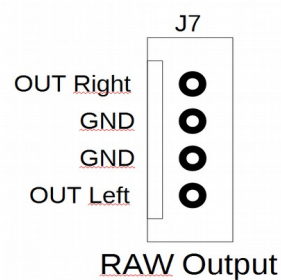
soekris – Part Number/SK: 14120901 converts the serial port connector to a standard PC type 9 pins D-SUB, so a serial crossover cable should be used when connecting to another PC.

Clocking and FIFO

The DAC have a low jitter digital controlled oscillator (SiLabs si570), data is sent though a short FIFO and the FPGA and uC work together to measure incoming bitrate and adjust clock as needed, basically a digital PLL with very fast lock and very slow filtering. So the DAC itself only need serial data, word clock and bit clock, no master clock is needed, it will sync to whatever you feed it.

Single Ended Output Connection

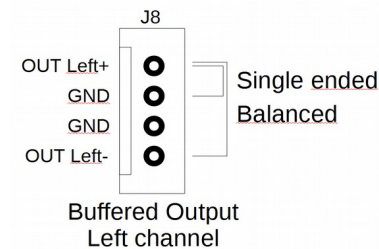
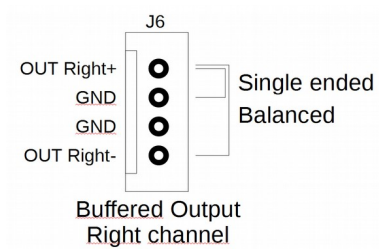
R-2R direct single ended:
1.4V RMS Zout 625 Ohm.



Balanced Outputs Connection

Buffered single ended:
2V RMS Z_{out} 10 Ohm.

Buffered balanced:
4V RMS Z_{out} 20 Ohm.



Power

Input Voltage (J1)

Power connector, Input voltage

- DC: +/- 7 to +/-15V DC; preferable 9-12V DC
- AC: 2x 7-8V AC
- Power goes through a diode bridge so polarity doesn't matter. Connector is MTA156 type.

Power Consumption

Positive Rail: 0.18A @ 10V

- Negative Rail: 0.06A @ 10V
- Total: 2.4W
- The positive supply draws about 3 times as much current as the negative; the current is almost independent of input voltage.

Filter, built in

FIR1, upsampling from incoming sample rate to 352/384 Ksps in one step, with different filter length based on incoming sample rate. All FIR1 filters are basic Parks-McClellan "brickwall" types, designed with <http://t-filter.appspot.com/fir/index.html>, but still shorter than your regular DAC.

IIR, bank of 15 biquads operating at 352/384 Ksps, with one used for the CD de-emphasis filter, none otherwise used for the basic DAC.

FIR2, upsampling from 352/384 Ksps to 2.8/3.1 Msps, reasonable short and soft but still using same design as FIR1.

All filters are using 32 bit coefficients, with up to 67 bit MAC accumulator.

Filter tool

Online filter design:

t-filter.appspot.com/fir/index.html

Windows filter software:

sourceforge.net/projects/rephase/

UMANAGER

Overview

The dam1021 have a small 32 bit ARM based microcontroller with a monitor for configurations and control functions over the serial port, the uManager. The default serial port is set for 115200, n,8,1. The uManager monitor can be entered by entering “+++” followed by a one second pause. It will then write the signon message and a “#” prompt, then waiting for commands. The uManager is a command line driven program for configuration and downloading new firmware. Typing “?” or “Help” at the command prompt will show a short list of commands available.

uManager Commands

? or Help	show this help
set par=value	set paramter to value, set alone to show
exit	exit uManager
update	update uManager firmware
download	download and update system flash
idf	show ID of flash
df [adr]	dump flash content

Updating firmware

The dam1021 firmware can be upgraded though the serial port, either in one step or you can upgrade the uManager, FPGA or Filters seperately. When upgrading uManager you need to also enter an “update” command.

1. Download newest firmware version (unzip as needed) from www.soekris.dk
2. Connect the dam1021 serial port to a PC serial port with a terminal program, set for 115200,n,8,1, no handshake
3. Enter the uManager by typing +++. You should then get the uManager prompt
4. Type "download" and start sending file from the terminal program using 1K X-modem protocol
5. If doing a full upgrade or just uManager, type “update”
6. Power cycle when done, you can verify by entering uManager again, uManager and/or FPGA revision should then be updated to newest version

USB to I2S / SPDIF interface

USB to I2S/DSD from
<http://www.diyinhk.com>

OEM Combo384 Module
<http://amanero.com/>

Accessories

worldwide distributor of semiconductors and electronic components

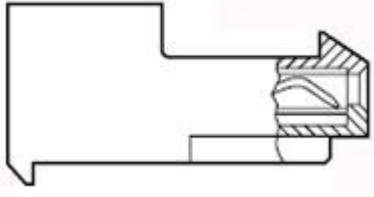
Digi-Key
<http://www.digikey.com>

Mouser Electronics
<http://www.mouser.com>


Connectors

J1: TE Connectivity / AMP - P/N: 640445-4
 Connector is MTA156 type.

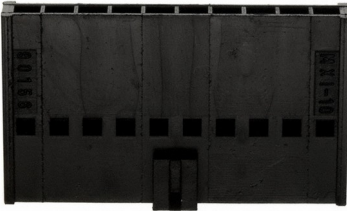
House: TE Connectivity / AMP - P/N: 3-640428-4

	Mouser:	Part number: 571-3-640428-4
	Digikey:	Part number: A31242-ND

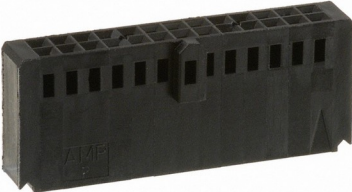
J2: Molex Connector Corporation / 10 pin

	Mouser:	Part Number: 538-90120-0770
	Digikey:	Part Number: WM8092-ND

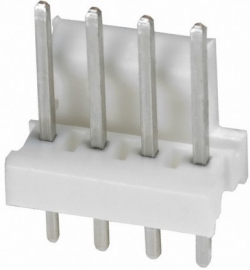
House: Molex Wire Housings series 90123

	Mouser:	Part Number: 538-90156-0150
	Digikey:	Part Number: WM8025-ND


J3: Connector 2x13 pin

	Mouser:	Part Number: 571-1023876
	Digikey:	Part Number: A25906-ND


J6, J7, J8: TE Connectivity Series: MTA-100

	Mouser:	Part Number: 571-6404544
	Digikey:	Part Number: A19431-ND


House: TE Connectivity Series: MTA-100 Headers & Wire Housings

	Mouser:	Part Number: 571-13758204
	Digikey:	Part Number: A111859-ND

J10: Connector 2x5 pin

	Mouser:	Part Number: 571-1023871
	Digikey:	Part Number: A25901-ND

P1, P2: Neutrik – P/N: NC3MAAH

	Mouser:	Part Number: 568-NC3FXX
	Digikey:	Part Number: SC1001-ND