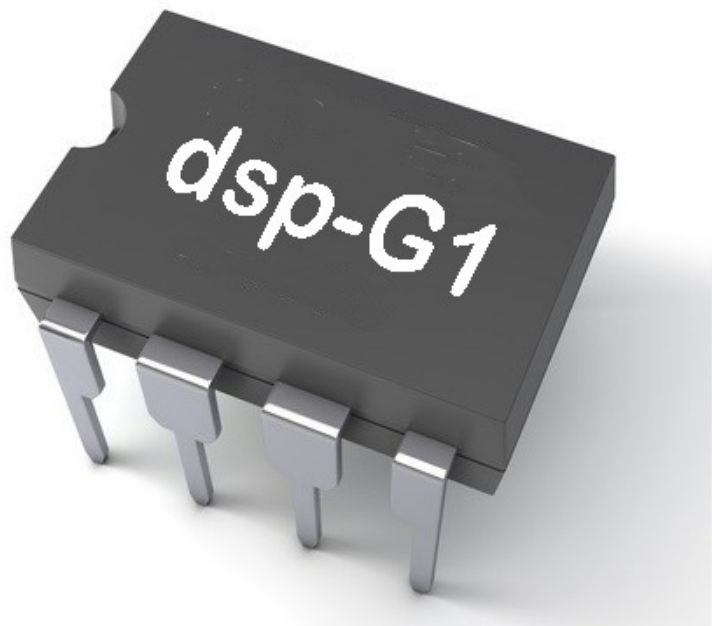# The dsp-G1 MIDI-Synthesizer Chip

The smallest Analog Modeling Synthesizer in the world

Application Manual v1.0

The dsp-G1 MIDI-Synthesizer Chip

The dsp-G1 synthesizer is a chip that contains a full analog modelling MIDI synthesizer in an 8-pin DIP package.

The chip can be used as a voice chip for an analog synthesizer, either as standalone receiving MIDI from a keyboard or other MIDI source or connected to another MCU used for programming and patch storage.

The synth is 5-voice paraphonic with 3 DCO's per voice, a +24dB resonant lowpass filter, 2 envelope generators and a LFO with sine and sample & hold waveform.

The DCO's are TRI-PULSE-SAW morphing oscillators with range, detune and wrap parameters. The wrapping is a form of pulse width adjustment that works on any waveform.

The DCF is a digital model of a +24dB 4-pole filter and has a resonance setting that can be driven to self oscillation. It has routing for ENV and LFO modulation.

The 2 ENV's are standard ADSR type and modulate the DCF and the DCA.

1 LFO is provided for DCF modulation and it has a TRI or S/H waveform.

The output is 16-bit 44.1KHz Sigma-Delta PDM and the synth parameters are controlled through 19 MIDI-CC parameters.
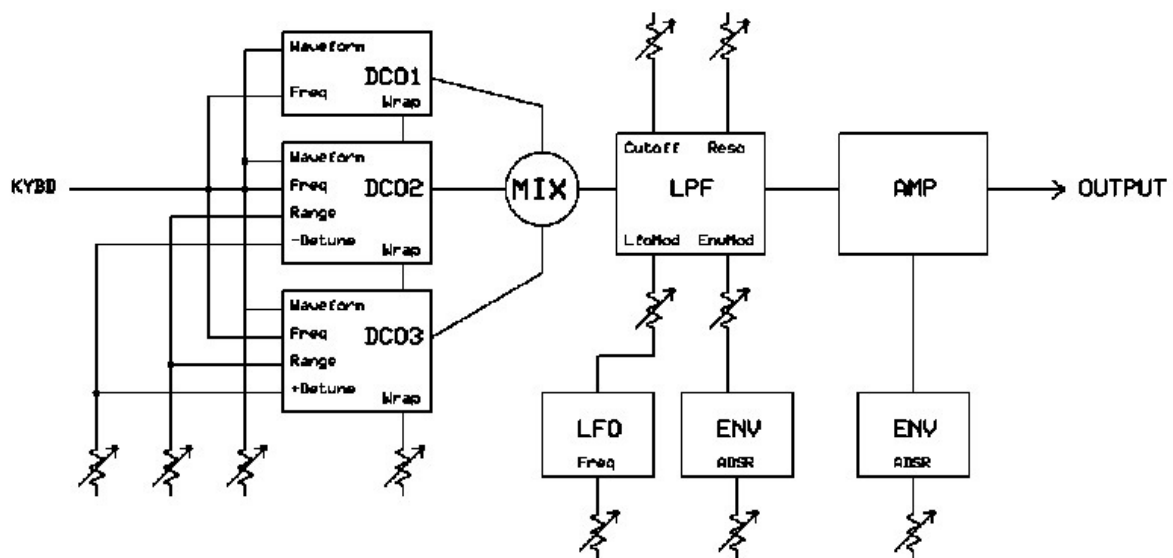
The structure for the dsp-G1 Analog Modeling Synth

MIDI implementation

Note On	
0x90, 0xNN, 0xVV	Note On, velocity not implemented

Note Off	
0x80, 0xNN, 0xVV	Note Off, velocity not implemented

CC-07 Master Volume	
0xB0, 0x07, 0xCC	Master Volume 0-127

CC-01 LFO Filter Modulation	
0xB0, 0x01, 0xCC	Modulation Level 0-127

CC-16 LFO Rate	
0xB0, 0x10, 0xCC	LFO Rate 0-127

CC-20 LFO Waveform	
0xB0, 0x14, 0xCC	LFO Waveform 0-63 TRI, 64-127 S/H

CC-74 DCF Cutoff	
0xB0, 0x4A, 0xCC	Filter Cutoff 0-127

CC-71 DCF Resonance	
0xB0, 0x47, 0xCC	Filter Resonance 0-127

CC-82 DCF Env Attack	
0xB0, 0x52, 0xCC	Filter Env Attack Rate 0-127

CC-83 DCF Env Decay	
0xB0, 0x53, 0xCC	Filter Env Decay Rate 0-127

CC-28 DCF Env Sustain	
0xB0, 0x1C, 0xCC	Filter Env Sustain Level 0-127

CC-29 DCF Env Release	
0xB0, 0x1D, 0xCC	Filter Env Release Rate 0-127

CC-81 DCF Env Modulation	
0xB0, 0x51, 0xCC	Filter Env Modulation Level 0-127

CC-76 DCO Waveform	
0xB0, 0x4C, 0xCC	Osc Wave TRI/PULSE/SAW 0-127

CC-04 DCO Wrap	
0xB0, 0x04, 0xCC	Waveform Wrap Modulation 0-127

CC-21 DCO Range	
0xB0, 0x15, 0xCC	Oscillator 2/3 Range 0-127

CC-93 DCO Detune	
0xB0, 0x5D, 0xCC	Oscillator 2/3 Range 0-127

CC-73 DCA Env Attack	
0xB0, 0x49, 0xCC	Amp Env Attack Rate 0-127

CC-75 DCA Env Decay	
0xB0, 0x4B, 0xCC	Amp Env Decay Rate 0-127

CC-31 DCA Env Sustain	
0xB0, 0x1F, 0xCC	Amp Env Sustain Level 0-127

CC-72 DCA Env Release	
0xB0, 0x48, 0xCC	Amp Env Release Rate 0-127

Example application circuits for the dsp-G1 chip

FULL SYNTH CIRCUIT

+2.7 - 3.6v battery or regulated

dsp-G1

Vdd MIDI RX
NC Gnd
DAC Vdd
NC Vdd

4K7

Optocoupler 4N25

1N4148

220

MIDI IN

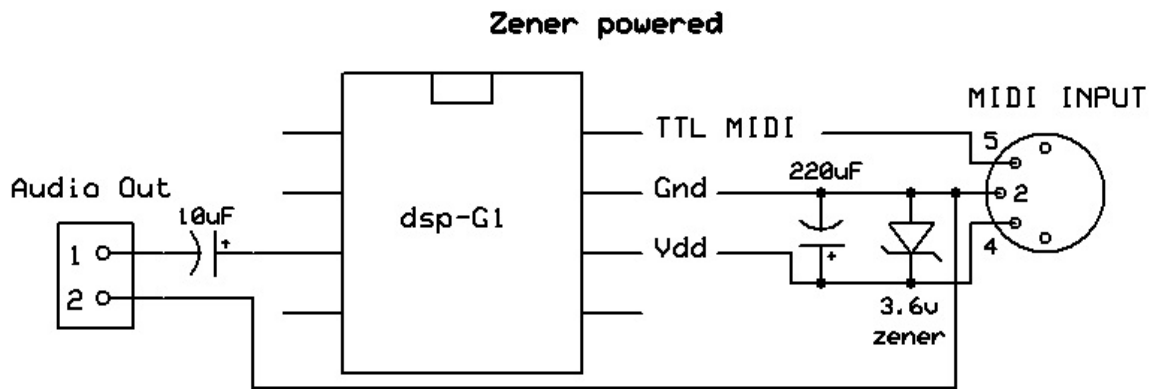4

5

Audio

10uF 470

100nF

1
2

GND
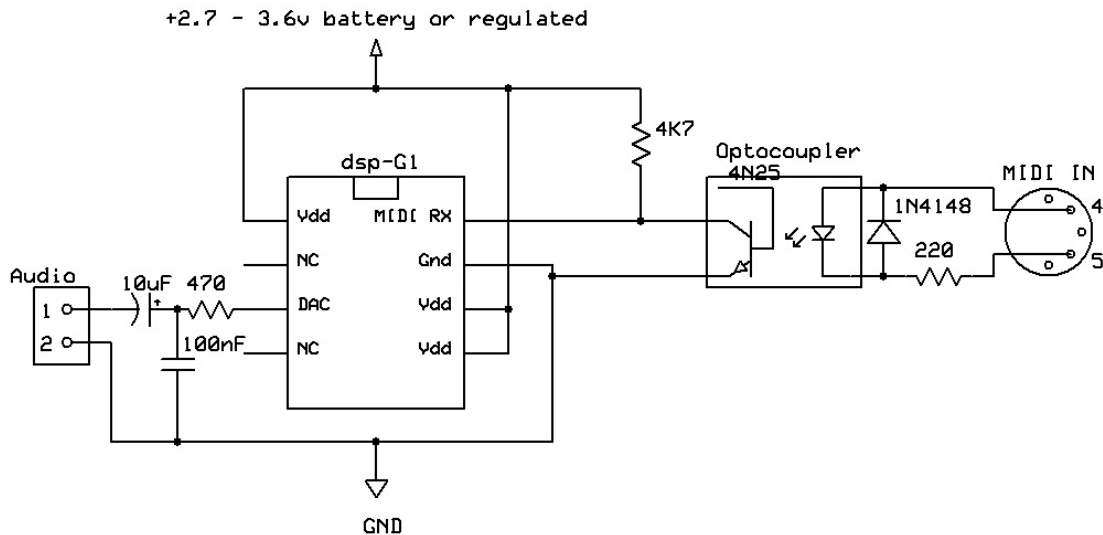
This is the full synthesizer schematics with a 3.3KHz anti-aliasing dac filter and an opto-coupled MIDI input. It needs to be powered by a 2.7 – 3.6v power source, 2 AA batteries give 3 volts so that works fine but in most cases a 3.3v linear regulator.

MIDI Ghost Powered

dsp-G1

1 8 TTL MIDI
2 7 Gnd
3 6 Vdd 3.3v
4 5

Audio Out

10uF

1
2

MIDI INPUT

5
2
4

5v

100nF 220uF

Gnd
Vout Vin

3.3v Low dropout reg
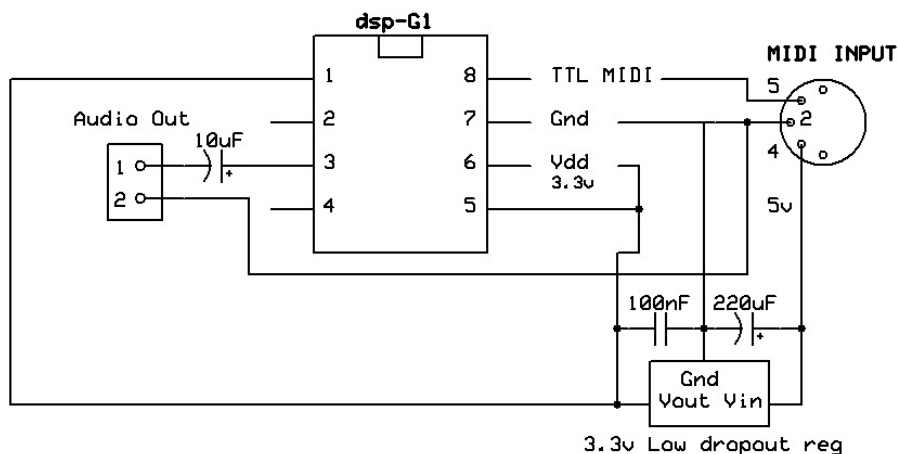
This version requires no extra power but draws it's power from the MIDI-IN port. This doesn't work with all MIDI devices but should work with most that runs on 5v. Note that the circuit also doesn't include the anti-aliasing filter but that is easily added from the top schematics if preferred.

Zener powered

Audio Out   dsp-G1   TTL MIDI   MIDI INPUT
10uF   Gnd   220uF   5
1   Vdd   3.6v   2
2   zener   4

This version uses a 3.6v Zener diode for regulation. This makes it work with all MIDI devices, even the newer ones that runs on a 3.3v MCU. Note that the circuit also doesn't include the anti-aliasing filter but that is easily added from the first schematics

For any of the MIDI powered version to work Pin-2, Gnd, must be connected in the MIDI-OUT connector and MIDI cables must have a minimum of 3 wires

Technical Specifications

DSP platform	NXP 60 DMIPS
Supply power	2.7 – 3.6 volt
Supply current	~3.2mA
MIDI input	31250bps, 8 databits, 1 stopbit TTL 0 – 5volt level
Audio output	44.1KHz 16-bit sigma-delta PDM, 1 channel mono audio
Synthesis method	Virtual Analog Modeling synthesis using DSP technology
Polyphony	5 voice paraphonic
DCO	3 oscillators morphable triangle/pulse/sawwave with wrap
DCF	+24db 4-pole lowpass filter with resonance
ENV	2 envelope generators with ADSR
LFO	Low frequency oscillator with triangle and sample&hold wave
MIDI support	Note on/off, supports running status, 19 MIDI-CC parameters
MIDI channels	Fixed receive on MIDI-CH 1

Contact & Support

For support and questions please use these contact addresses:

Website: http://www.dspsynth.eu
Email: contact@dspsynth.eu