Ruwisch & Kollegen
Gesellschaft mit beschränkter Haftung

NEMIC 900 Dual Channel DSP Board

Software: CNS & AGC, Vers. 1.0.2.0

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NEMIC 900 is a dual channel audio DSP-module with on-board voltage regulator and clock oscillator characterized by very low power consumption. Because of this prominent feature and its small dimensions, NEMIC 900 is ideally suited for portable applications.

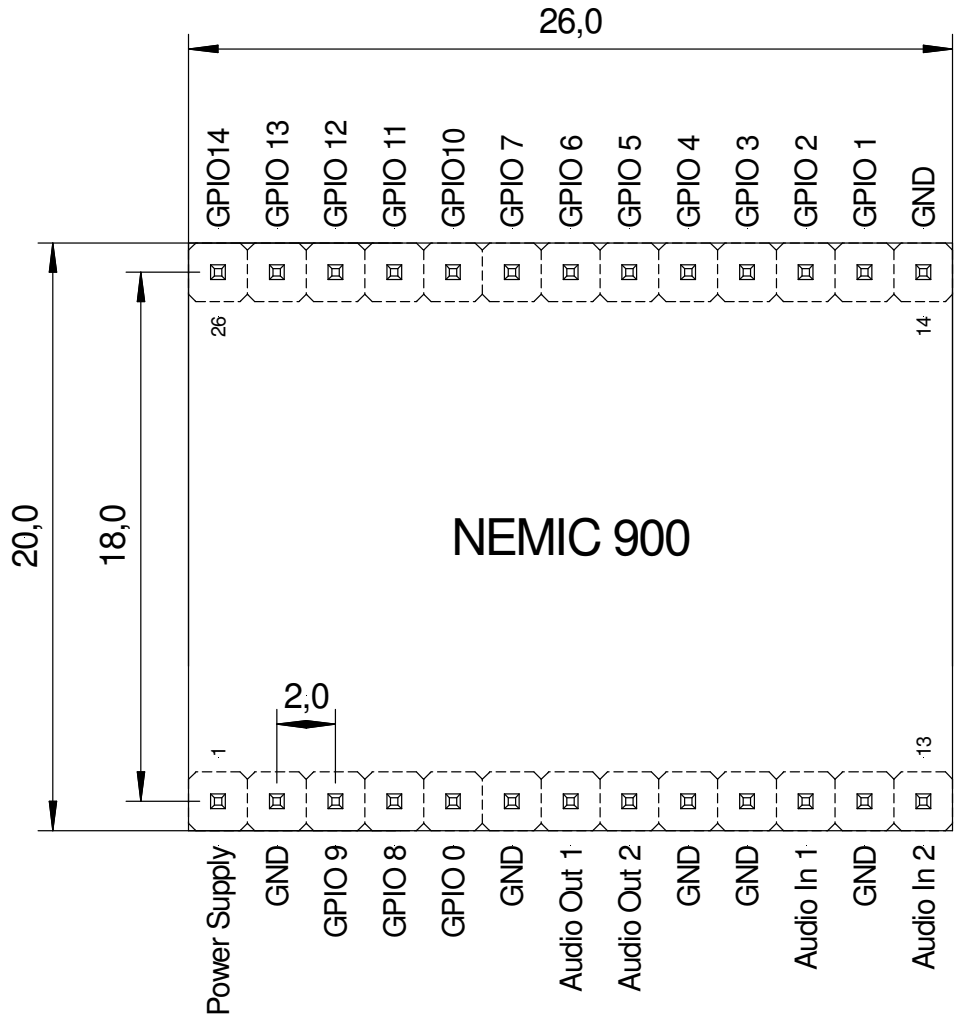
Features

- Dual channel configurable Noise Suppression
- 30 dB AGC in channel 1 switchable
- 30 dB max. Gain configurable Input Amplifiers
- Low power consumption
- Wide supply voltage range (3 … 20 V)
- In- and outputs RF protected with LC low pass filter

Applications

- Noise Cancelling Microphones
- Noise Suppression in radio transmission
- Noise Cancelling in voice recognition to improve accuracy rates

Dimensions and Pin Assignment



Overview of Configuration pins:

GPIO	Pin-No.	Function:	
GND	14	Ground connection	
GPIO 0	5	Channel 1 Input amplification (LSB)	See table below
GPIO 1	15	Channel 1 Input amplification	
GPIO 2	16	Channel 1 Input amplification (MSB)	
GPIO 3	17	Channel 2 Input amplification (LSB)	See table below
GPIO 4	18	Channel 2 Input amplification	
GPIO 5	19	Channel 2 Input amplification (MSB)	
GPIO 6	20	Channel 1 Noise Suppression level LSB	See page 6
GPIO 7	21	Channel 1 Noise Suppression level	
GPIO 8	4	Channel 1 Noise Suppression level MSB	
GPIO 9	3	Channel 1 Noise Suppression On	
GPIO 10	22	Channel 2 Noise Suppression level LSB	See page 6
GPIO 11	23	Channel 2 Noise Suppression level	
GPIO 12	24	Channel 2 Noise Suppression level MSB	
GPIO 13	25	Channel 2 Noise Suppression On	
GPIO 14	26	Channel 1 Automatic Gain Control On	

GPIO0 – GPIO14 are available as depicted above. Configuration pins are active low and internally pulled up. For activation (logic 0) connect to GND.

Configuration of Input Amplification:

	Input amplification (1 means: link is open)		
Gain:	GPIO 2 / 5	GPIO 1 / 4	GPIO 0 / 3
0 dB	1	1	1
12 dB	1	1	0
15 dB	1	0	1
18 dB	1	0	0
21 dB	0	1	1
24 dB	0	1	0
27 dB	0	0	1
30 dB	0	0	0

Notes:
The settings for input amplification apply to both channels. Amplification settings are applied during system initialization; a change of settings requires a system restart (power off – power on).

For the default setting 0 dB input amplification there is 9dB attenuation between input and output.

Absolute Maximum Ratings:

Power supply voltage	+24 V; Negative Voltage not allowed	
Max. Voltage at input outputs	> -0.2 V; < 1.8 V	
Max. Voltage at analog outputs	> 0 V; < 2 V	Note that the analog inputs and outputs have voltage range of 0V and 2V with “GND” at 1 V. These 0V, 1V and 2V correspond directly to AGND, V_{reg} and V_{DEL}
max. Ambient temperature	-50 °C … +100 °C	
Storage temperature	-55 +150 °C	

Operating Ratings:

Ambient temperature	-40 °C … +85 °C

Electrical Characteristics:

Parameter:	Symbol:	Value:	Remarks:
Supply voltage:	U_b	5 V (3.0 … 20.0 V)	
Power consumption:	I	<5.0 mA	During operation of noise cancellation
Audio channels		2	
Sampling rate		16 kHz	
Input:			
Max. Input Level	V_{in}	700 mV_{eff}	At 0dB Input Gain
Input Gain		0dB, 12dB … 30dB	In 3dB steps
Input resistance	R_{in}	550 kOhm	
Output:			
Output level	V_{out}	220 mV_{eff}	At Single Ended Analog Output
Output impedance	R_{out}	12 kOhm	At Single Ended Analog Output
Signal to Noise ratio:	SNR	> 60 dB	20 Hz … 20 kHz; Measured with max. amplitude
Total harmonic distortion:	k	< 0.4 %	Measured at 70 % of max. amplitude
Crosstalk between output channels		> 55 dB	Measured at max. amplitude
Power Supply Rejection Ratio		> 70 dB	At U_{SB} = 5 V; 1 V_{SS}; 20 Hz … 20 kHz

Software

CNS Noise Suppression is a patented technology for noise reduction of speech signals, known as one of the best algorithms of its kind. It is ideally suited for real-time processing in any kind of communication system in noisy environments, such as hands-free telephone sets or industrial intercom systems. Here it is integrated together with Automatic Gain Control (AGC).

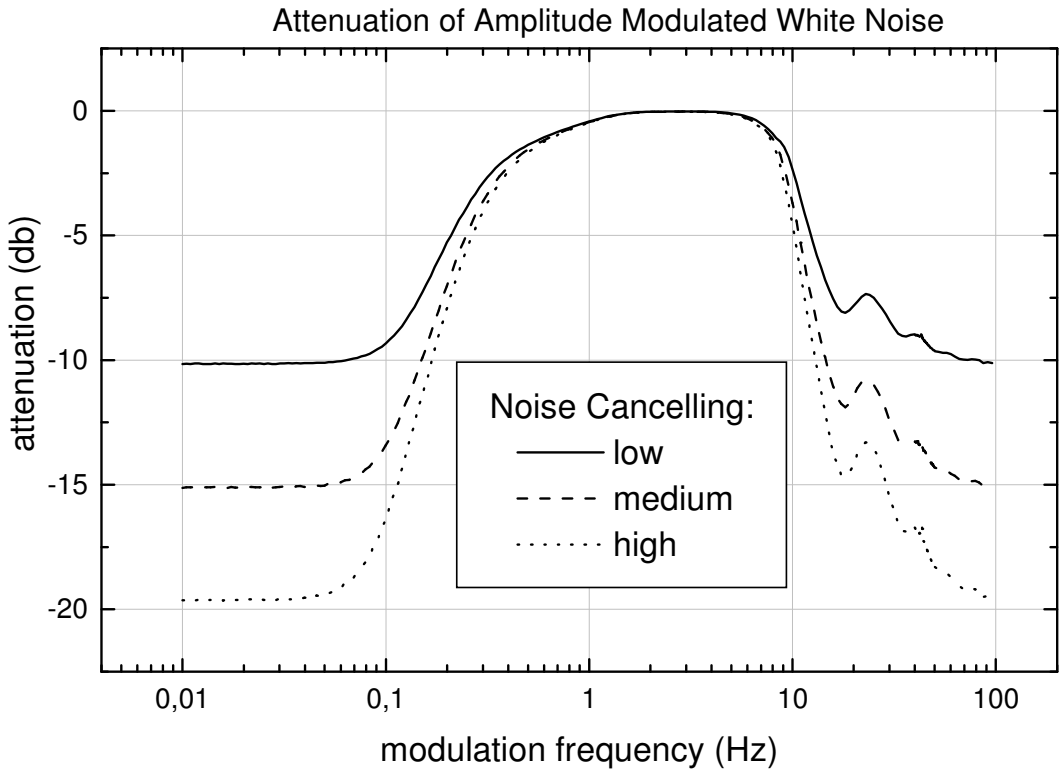
Features:

Noise Suppression:	20 dB typical, 40 dB max.(see next page for details)
AGC target level:	-10 dBFS
Max. AGC gain:	30 dB
Req. SNR of input signal:	> 0 db
Sampling rate:	16 kHz
Internal signal latency:	25 ms
Audio Cannels:	2 (AGC only in channel 1)

Algorithm Details

Automatic Gain Control (AGC) selects an optimal input gain according to the input level. For low input signals the AGC increases the gain up to 30 dB, whereas the AGC only cares for voice signals. The noise floor during speech pauses is disregarded.

CNS Noise Suppression is capable of distinguishing between voice and noise components of an audio signal. One of the signal properties being monitored is the modulation frequency of each spectral component of the input signal: Analysis of human speech yields typical modulation frequencies in the range of 2 to 5 Hz. The idea of the noise cancelling algorithm is that signal components with modulation frequencies in said interval pass the system nearly without attenuation, while signal components with higher or lower modulation frequency are classified as noise. Such signal components are attenuated in dependency of a selectable parameter. Figure 1 shows the modulation characteristic of the system measured with amplitude modulated white noise, shown for three different values of the Noise Suppression Parameter.



Modulation characteristic of Noise Suppression for different modulation frequencies (not to be confused with a band pass filter!)

Configuration of Noise Suppression

Configuration of the Noise Suppression level is done by means of four configuration pins for each channel as shown below:

Pin No. NEMIC 900	Pin name	function
channel1: 20 / channel 2: 22	GPIO 6 / 10	Noise Suppression level LSB
channel1: 21 / channel 2: 23	GPIO 7 / 11	Noise Suppression level
channel1: 4 / channel 2: 24	GPIO 8 / 12	Noise Suppression level MSB
channel1: 3 / channel 2: 25	GPIO 9 / 13	Noise Suppression On

Configuration of Noise Suppression in the NEMIC900 board

All configuration pins are active low. By means of GPIO 6-13 one can select eight different levels of noise suppression independently for each audio channel:

GPIO 6 / 10	GPIO 7 / 11	GPIO 8 / 12	GPIO 9 / 13	Attenuation of White Noise
don't care	don't care	don't care	1	0 dB (Noise Suppression off)
1	1	1	0	8 dB
0	1	1	0	12 dB
1	0	1	0	16 dB
0	0	1	0	20 dB
1	1	0	0	25 dB
0	1	0	0	30 dB
1	0	0	0	35 dB
0	0	0	0	40 dB (maximum suppression)

Setting of Noise Suppression level by means of configuration pins

Automatic Gain control

GPIO 14 (pin26) switches the AGC (Target level: -10 dBFS, max. gain: 30 dB).

AGC operates in channel 1 only.