

INDEX

1. Introduction
 2. Basic Specifications
 3. Installation
 4. External Overload Indicator
 5. Use with On-board Microphone
 6. External Microphones or signals
 - 6.1.1. Connecting and external Microphone Capsule or signal
 - 6.1.2. Dynamic Microphones
 - 6.1.3. Condenser Electret
 - 6.1.4. External Signal Sources
 - 6.1.5. Using external Signal Sources
 - 6.1.6. Setting the preamplifier gain
 - 6.1.7. AGC Settings
 - 6.1.8. Setting the output level
 - 6.1.9. Noise Cancellation Settings
- Appendix A – Block Schematic and PCB Outline
- Appendix B – Connection pin outs and Jumper settings
- Appendix C – PCB Dimensioned Drawing

1. Introduction

The NEDSP1068 module is a small DSP noise cancellation module, designed mainly for cleaning up noisy voice communications in the microphone path. It is based on the proven bhi NEDSP1061 pcb module, but has the added feature of an on-board AGC mic preamplifier with various options. This enables the module to be fitted easily into the microphone path of a target audio system, as well as in the receive path for use with line level audio signals. There are two options: The basic module is the NEDSP1068-PCBA, which has an adjustable AGC mic pre-amplifier circuit, and is able to operate with either an external electret or dynamic microphone. The NEDSP1068-PCBA-MIC has an on-board SMD microphone, and the adjustable AGC MIC pre-amplifier circuit.

2. Specifications

DSP Noise cancelling	9 to 35dB
Input Power	5 – 18v D.C.
Input Current	30mA
Audio input level	Before Preamp and AGC - 4mV to 100mV p-p dependent on preamp gain setting - Line Input - 800mV p-p
Input Impedance	Pre-amplifier -100KOhm Line in direct - 10KOhm
Audio Output level	Adjustable from 0v to 2.0v p-p
Output Impedance	10 K Ohm
Preset Controls	DSP input level, DSP Output level Optional PIC 'beep tone' level control (Tx)
Settings	Pre-amplifier Gain AGC Attack and Release Times Internal/External Microphone Noise Cancelling Level
Indications	On-board Overload LED Off -board Overload LED Drive capability
Board size	30mm x 36.5mm *
Mounting Hole pitch	24mm x 27.5mm *
Connectors Pitch	0.1" *
Options	On board controller for use with additional keyboard circuitry

*- See Appendix C – PCB Dimensioned Drawing

3. Installation

IMPORTANT NOTE: ESD – When handling this module, please take all possible precautions to ensure that the risk of accidental Electrostatic Discharge is minimised. Use of a personal grounding strap and static dissipative mat is recommended.

The NEDSP1068-PCBA module can be used two ways. One is to treat it as a sub-assembly board and mount it directly to a mother board assembly using 0.1” pitch PCB Header pins. A drawing showing the PCB dimensions and header locations is provided in Appendix C of this document. The Header pins and the integrated plastic spacer bar provide a very good securing medium for the PCB, especially if both the main connections and the external microphone pins are used. Alternatively, the main connector may be used and the two M3 securing holes at the other end. The other way of mounting is to connect the module in-line with the microphone path by wires to follow-on circuits, then all the mounting holes may be used to mount the pcb in a suitable location or housing. When using hardware to secure the PCB take care to note the fact that there are tracks very close to the mounting holes and therefore nylon washers may be required under the heads of any screws or nuts used. Please note that the securing holes are not part of the board grounding mechanism.

Note: Both module versions are supplied with all jumpers and links open. Before powering up the module, ensure that all the jumper links have been set correctly for your application and microphone type. In all cases, except when using the line level input from pin 9 J2, the **PRE** jumper link must be soldered.

4. External Overload Indicator

The module has connections that enable the Overload LED mounted on the PCB to be duplicated for use on a front panel, or used for monitoring by other circuitry. The connections for this can be found on J4 (**Ovr**). Pin 5 **Ovr** needs to be connected to the LED cathode, while the LED anode needs to be connected to Pin2 (**V+**) via a 180R resistor.

5. Use With The On-board Microphone

The on-board Knowles SPM0204HD5 SMD microphone (**NEDSP1068-PCBA-MIC**) makes this PCB extremely useful for many products. However, some consideration should be given to the way in which the PCB is mounted within the equipment to ensure that the pcb mounted microphone doesn't pick up mechanical noise and vibration from surrounding parts, such as power supplies and fans etc.

6. External Microphones or Signals

The standard **NEDSP1068-PCBA** does not have the on-board a microphone built onto it, and can be used with a variety of external microphones.

To select the external mic option, ensure that the **PRE** jumper link is soldered, and the jumper marked **MIC** is open. You may need to remove the solder link carefully using desolder braid.

6.1.1 Connecting an external microphone capsule or line signal

Locate and identify the jumper J4 (see diagram in appendix A). See the table below for the correct connections for the different types of microphone.

Pin	Designation	Use	Operation
1	I or In	External Microphone	External Microphone or low level audio input
2	+ or V+	Microphone Supply	Separate Bias Supply 3v3 (3 pin electrets)
3	0 or Gnd	Microphone Ground	Ground
4	S or Scr	Microphone Shield	Ground
5	O or Ovr	External Overload LED	External Overload LED facility

6.1.2 Dynamic Microphones

Dynamic microphones tend to have a lower output level than active Condenser Electret devices, but can have a much more rounded audio reproduction.

To use this type of device, resistor **R7** needs to be removed. This can be found on the underside of the PCB as shown in photograph in appendix A on page 11. Ensure that the **PRE** jumper is soldered and the **MIC** jumper is open. The Pre-amplifier Gain setting needs to be set to 60 dB (links **A** & **B** open, see section 6.1.6).

The microphone connections are then made to MIC IN (J4 pin 1) and MIC GND (J4 pin 3) respectively.

6.1.3 Condenser Electret Microphones

Electret microphones need to be biased either via the third pin or via the microphone input lead. Both types of microphone have been catered for on the 1068 module. For self biased devices R7 needs to be fitted. This is nominally factory fitted for 2.2K Ohms, but may be adjusted as per the following formula:

$$R7 = \frac{3.3v - 2v \text{ (Mic voltage)}}{0.5 \text{ mA}}$$

External biased capsules will need to use the regulated voltage available on J4 pin 2. This supplies 3v3 for the microphone bias.

The pre-amplifier gain should be set to 50dB for most electret inserts (see section 6.1.6).

6.1.4 External Signal Sources

The microphone input will also accept low level signals up to about 500mV p-p. However, the pre-amplifier gain should be set to its lowest (40dB) and R7 needs to be removed.

6.1.5 Using External Line Level Sources

Both NEDSP1068 module versions have the same pin-outs for the noise cancellation level, power and audio in/out. To input a signal source that bypasses the Preamp/AGC signal, connect to pin 9 of J2, with the ground connected either to the MIC Ground or to the J2 Pin 7. The **PRE** jumper needs to be removed using a good quality solder braid, and the pads should be inspected to ensure that they are not connected together.

6.1.6 Setting the Preamplifier Gain

Dependent on the what sort of signal source is being used, the Pre-amplifier gain needs to be set appropriately such that the AGC system is capable of accommodating the complete signal level range without causing the output to be continuously compressed or distorted (when the AGC is unable to cope). See the table below for the relevant gain settings.

Gain	A	B
40 dB	Soldered	Open
50 dB	Open	Soldered
60 dB	Open	Open

6.1.7 AGC Settings

Attack and Release Time Setting

The AGC has an attack time set by C27 & C31 which can be selected with the '**AT**' link. The **AT** link is not soldered for standard the factory setting, and the **A/R** links will be left open, setting the Attack Time to 0.11mS, and the Release Time to 55Ms, which should be adequate for normal use. However, for more noisy communication requirements a setting of 0.276 mS Attack time (**AT** Link soldered) and 550mS Release time (**A/R** Link 1 soldered) will provide a better solution. For link pad locations, refer to the board layout shown on page 10 of this document. The Attack and Release times may be altered by changing the jumper settings as given below:

Link Settings

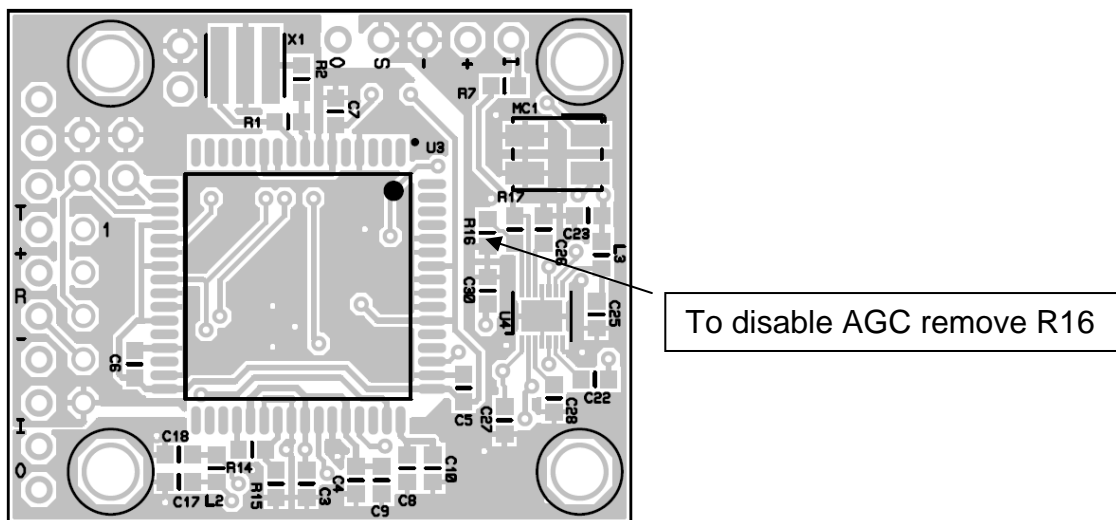
'AT' link	Attack Time	A/R Link 1 & 2 Open	A/R Link 1 soldered	A/R Link 2 soldered
Open	0.11mS	440mS	220mS	55mS
Soldered	0.276mS	1140mS	550mS	138mS

Because the DSP algorithm take up to one second to discriminate between noise and voice signals, it can be seen that the release time increments being smaller may not make a great deal of difference.

Disabling the AGC Action

For certain applications the AGC system may need to be disabled such that the pre-amplifier is not limited in any way. To disable the AGC circuit, locate and remove R16 on the underside of the 1068 PCB as shown below.

If the AGC system is disabled the user should be aware that too higher gain setting could give rise to overdriving of the DSP device, which may then cause it to malfunction. The Overload indicator should operate under these circumstances to help prevent this happening, but prevention is preferable and will make the module more reliable.



Underside of 1068 PCB showing location of R16

6.1.8 Setting the output level

Whilst the modules have been preset during manufacture, you will probably need to carry out minor adjustments to ensure that you have the required output level and the best response under all signal conditions for your application.

With the module connected to your system, apply power and check the audio performance.

Before going any further, reduce the noise cancelling level or switch the noise cancellation facility off – see Noise Cancelling settings (para 6.1.9).

Using the maximum audio level that your system is likely to encounter, check that the Overload LED is illuminating. Adjust potentiometer P2 (Audio in) to ensure that the LED illuminates and then back it off until there is just the odd flash on the LED.

Adjust potentiometer P1 (Out) for the required audio level into your system.

Check to make sure that the audio is clear and distortion free.

If there seems to be some spitting or distortion heard under sudden loud noises, then consider adjusting P2 (Audio in) again, counter clockwise very slightly and re-check under the same conditions.

If you have an oscilloscope to hand you can check the audio levels at the output and at the junction of R3/C13 (see page 11 for the top side of the PCB layout). The signal at this point should be no more than 2.0 V p-p maximum. Failure to observe this level can lead to the DSP IC shutting down, this then requires power to be removed from the board and then re-applied to cause a reset.

Alternatively, probe the wiper of P2 (Audio in) and check that the signal doesn't peak over 625mV peak/1.25volts p-p. This will ensure that the output signal won't spit on peaks or cause the DSP device to shut down until power is removed and re-applied.

6.1.9 Noise cancelling settings

Jumpers J5 through to J7 select the level of noise cancellation (see the table below). For most operations level 4 is quite adequate, but for more severe conditions, the level may be increased to 5, 6 or 7.

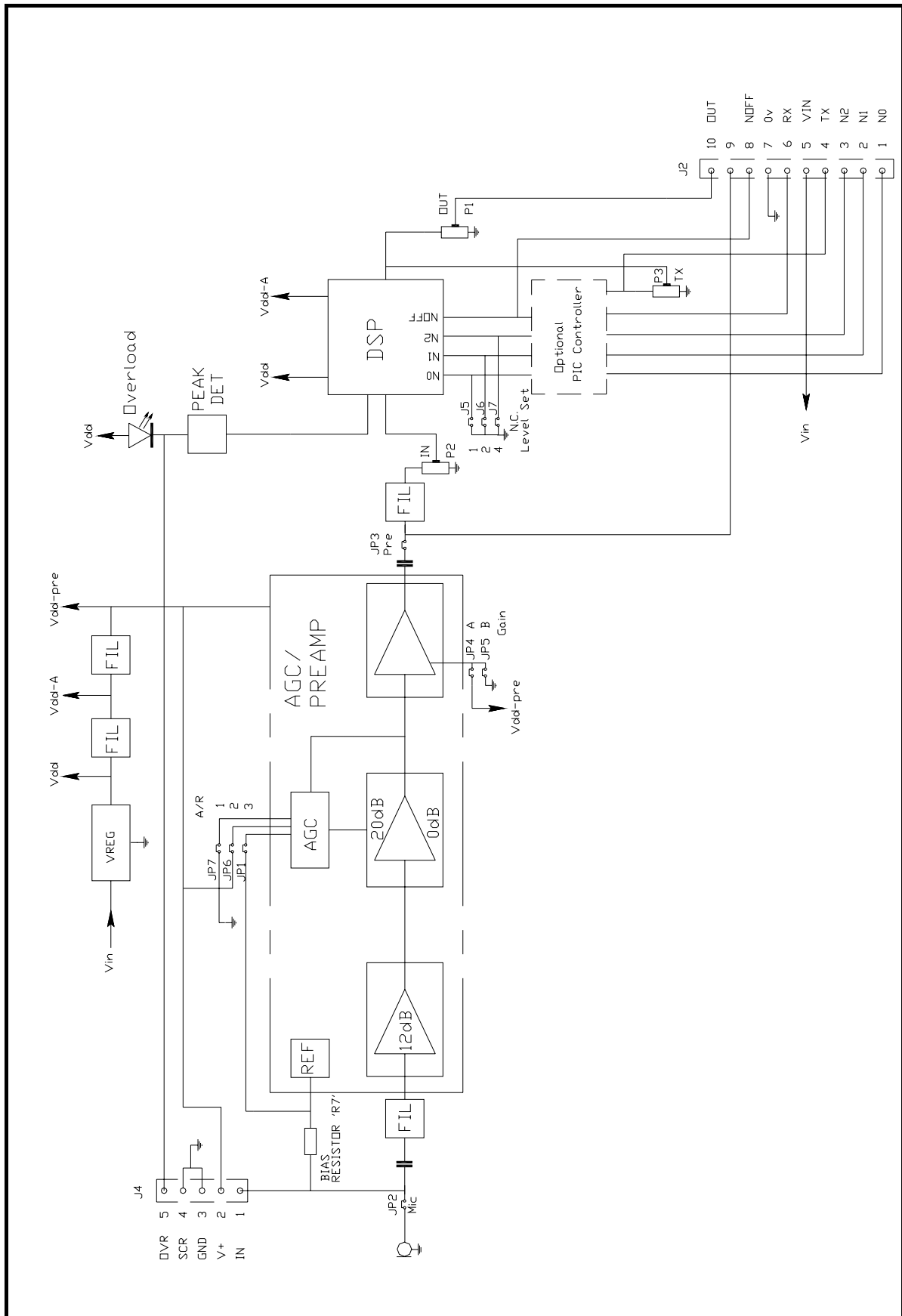
It will be found that under certain high noise conditions, and with poor speech quality, levels 7 and 8 can cause the audio quality to be rather mechanical with musical tones being present with the audio. This may be an acceptable trade off because as you may now be able to clearly hear the speech, whereas before the high noise prevented this.

To inhibit the noise cancelling algorithm completely, pin 8 of J2 should be grounded. Audio will be passed through un-processed. It is recommended that a switch be fitted to perform this function, so that you can check the audio quality and the filter performance.

Level	Tone Reduction (dB)	White Noise Reduction (dB)	N0	N1	N2
1	4	9	X	X	X
2	5	11	-	X	X
3	6	13	X	-	X
4	8	15	-	-	X
5	16	17	X	X	-
6	21	20	-	X	-
7	25	24	X	-	-
8	65	35	-	-	-

X – Jumpers require fitting to obtain the filter level. Remove all jumpers if the module is to be used with an external controller or via J2 pins 1, 2, 3 and 8.

Appendix A – Block Schematic and PCB outline



Appendix B - Connections and Jumper settings

J2 – General Input/Output Port

Pin	Designation	Use	Operation
1	N0	Noise Cancelling level Bit '1'	Selected when High, weak pull up applied
2	N1	Noise Cancelling level Bit '2'	Selected when High, weak pull up applied
3	N2	Noise Cancelling level Bit '4'	Selected when High, weak pull up applied
4	TX or T	Data TX/Beep out	Control data or Audio Beep
5	Vin or +	+Ve Supply	+5 v to +18v DC
6	RX or R	Data RX/Control Button	Control data or Control button input
7	0v or -	Ground	Ground
8	NOFF	Noise cancel ON/OFF	Selected when High
9	Audio In or I	External Line Input	Maximum 900mV input
10	Audio Out or O	Audio Output	Variable output up to 2.5v p-p

J4 – External Microphone and indicator Port

Pin	Designation	Use	Operation
1	In or I	External Microphone	External Microphone or low level audio input
2	V+ or +	Microphone Supply	Separate Bias Supply 3v3 (3 pin electrets)
3	Gnd or -	Microphone Ground	Ground
4	Scr or S	Microphone Shield	Ground
5	Ovr or O	External Overload LED	External Overload LED

Jumper Settings

Pre-amplifier gain

Gain	A	B
40 dB	Soldered	Open
50 dB	Open	Soldered
60 dB	Open	Open

AGC Attack & Release Times

'AT' link	Attack Time	A/R Link 1 & 2 Open	A/R Link 1 soldered	A/R Link 2 soldered
Open	0.11mS	440mS	220mS	55mS
Soldered	0.276mS	1140mS	550mS	138mS

Internal Microphone to Pre-amplifier Routing

Solder the '**MIC**' Jumper, note: that this has to be removed for any external microphone use.

Pre-amplifier to DSP Routing – Solder the '**PRE**' Jumper, note that this has to be removed for any LINE level signal input to the DSP device.

DSP Level Settings

Level	N0	N1	N2
1	X	X	X
2	-	X	X
3	X	-	X
4	-	-	X
5	X	X	-
6	-	X	-
7	X	-	-
8	-	-	-

X – Jumpers require fitting to obtain the level. Remove all jumpers if the module is to be used with an external controller such as the –KBD version or via J2 (pins 1, 2, 3 and 8)

Note: By grounding Pin 8 of J2, audio at the input to the DSP will be passed directly through the DSP to the output without being processed by the Noise Cancellation Algorithm.

Optional Connector – J1

For use with boards fitted with microcontrollers for push button or remote control similar to NEDSP 1061 – KBD.

Pin Number	Use
1	ICSP Data
2	Vdd
3	ICSP Clock
4	MCLR/Vpp
5	Vss

Appendix C - PCB Dimensioned drawing

