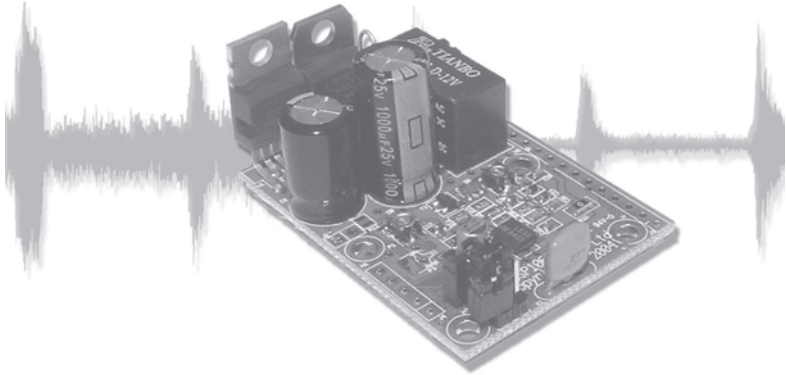


bhi

NEDSP1062-PCB

Amplified Noise Eliminating DSP Module

Installation and Operating Manual



1062-106D

Issue B

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1. Introduction.

The **NEDSP1062** is a modular solution for noise reduction. It incorporates Digital Signal Processing (DSP) technology to provide up to 35dB of noise cancellation and 65dB of tone reduction. The module features an on board power amplifier to allow it to be easily incorporated in to existing equipment by installing the module in line with the loudspeaker.

1.1 NEDSP1062 module features:

- Fully adaptive noise cancellation to 35dB
- Input and output level controls
- Input level over load indication
- Virtually no distortion to speech signal
- Easy to install
- 8 levels of noise reduction
- Frequency response 50Hz - 4.3KHz
- 3 Watts output (4Ω)
- Noise cancellation can be preset or remotely set during operation
- 12 - 18V supply range
- 27dB on board gain
- Wide range of connection possibilities
- Mounting holes
- Audio bypassed when power disconnected
- Small size 37 x 50mm

1.2 Limitations.

This module is designed to pass speech. Other signals such as data, music and morse (CW) will to some degree pass through, but the integrity of these signals cannot be guaranteed.

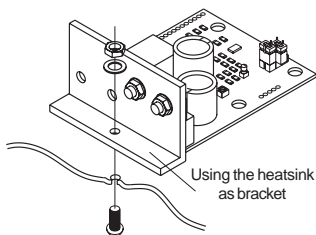
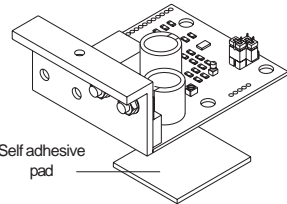
This module is designed to be driven from a high level signal, capable of driving a load of 22Ω .

(The module can be easily modified to be driven from a low power signal, see section 3.3 for more information).

1.3 Module connection and mounting

Connections to the module are made by a row of 15 pads at the right hand side of the PCB. These pads are on a 2.54mm (0.1") pitch, which allows the use of standard pin headers, PCB connectors and direct wiring. The heatsink doubles up as a mounting bracket.

The module can be mounted using the supplied self adhesive foam pad. Ensure that none of the circuit pins can make contact with any metallic parts.



For improved heat dissipation and a more rigid mechanical fixing the heatsink can be reversed and used as a bracket. Note that the heatsink is at 0V potential and therefore may have to be electrically insulated from any other metallic parts.

Alternatively the module has four fixing holes which allow it to be fixed to pillars.

(See section 6 for hole details and physical dimensions).

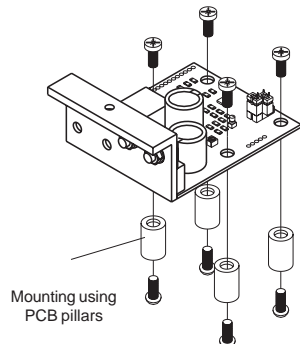


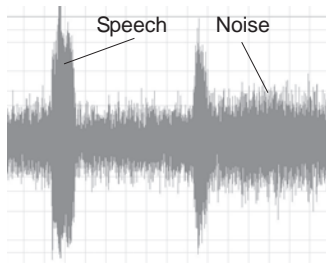
Figure 1. Mounting options

If the installation has limited space, and is housed in a metal enclosure, the heatsink can be removed, and the module mounted directly in a suitable position. The voltage regulator needs to be correctly insulated as the tab is connected to 0V. Insulate both the regulator and mounting screw. For improved heat dissipation use a suitable thermal paste between the power devices and the mounting.

1.4 DSP Noise cancellation.

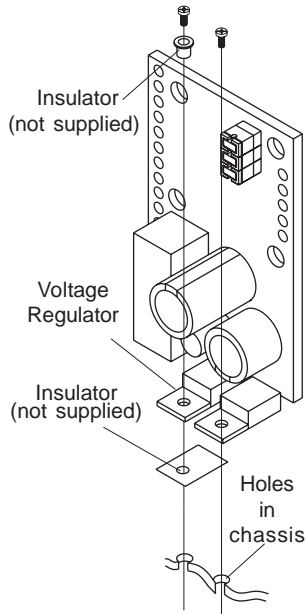
The bhi DSP processes the incoming signal and then differentiates the speech from the noise. The unwanted noise and interference is then attenuated to leave only the speech.

The following diagrams are taken from actual audio signals and illustrate how the signal is being processed.

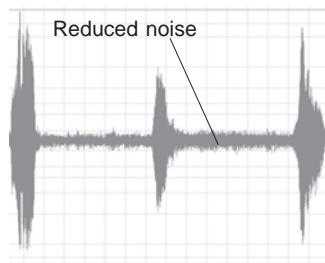


Original signal.

Speech with a lot of background noise



*Figure 2.
Direct mounting.*



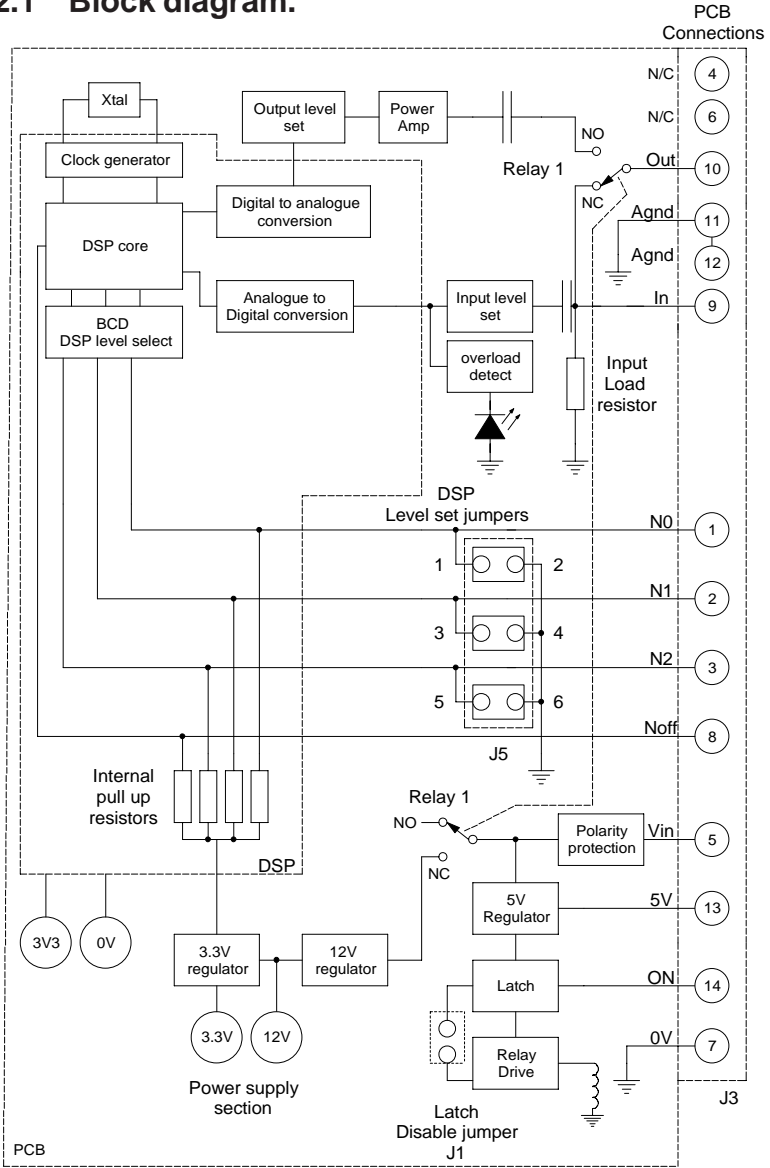
Processed speech.

Speech with reduced noise

Figure 3. Noise cancellation.

2. Module description.

2.1 Block diagram.



2. Module description.

Figure 4. NEDSP1062 block diagram

2.2 Module Layout.

The following diagram shows the layout of the **NEDSP1062** module.

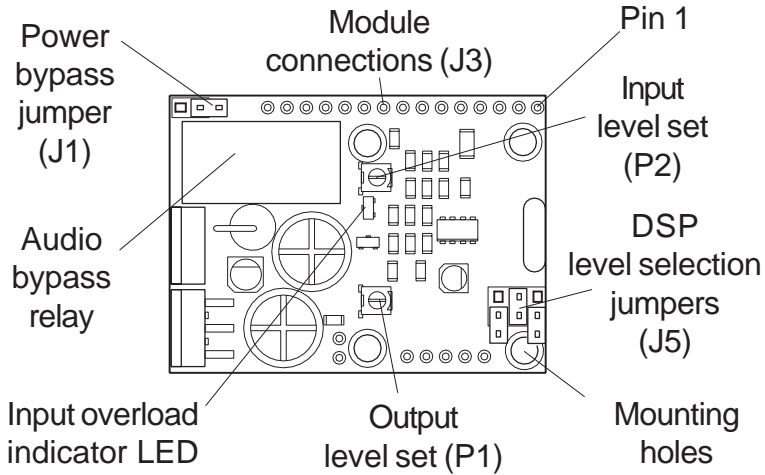


Figure 5. NEDSP1062 connections and controls

Table 1 on the following page gives a description of the pin functions.

Pin No.	Name	Description	Notes
1	N0	BCD LSB noise cancellation bit	Used to remotely set the DSP filter level. If these pins are used then remove jumpers J5(1-2), (3-4) &(5- 6)
2	N1	BCD noise cancellation bit	
3	N2	BCD noise cancellation MSB	
4	N/C	Do not connect	Not used
5	Vin	Supply voltage	12 - 18VDC power in
6	N/C	Do not connect	Not used
7	0V	0V connection	0V power connections
8	Noff	Noise cancellation on/off pin	Connecting this pin to 0V inhibits the noise cancellation. Leave this pin open for noise cancellation on.
9	In	Audio input	Audio signal in to be processed
10	Out	Audio output	Processed audio signal out
11	Agnd	0V for input audio signal	Analogue ground for audio in
12	Agnd	0V for output audio signal	Analogue ground for audio out
13	5V	5V supply for power on switch if used	Logic voltage out - for using external power switch
14	On	Logic input for power on switch if used	Logic input from external switch if used
15	0V	Additional 0V	Spare 0V connection

Table 1. NEDSP1062 connection functions

2.4 Controls.

The level controls provide adjustment for the audio levels entering and leaving the module. The modules are factory set to the maximum level.

Turning the potentiometers clock wise will decrease the levels. These potentiometers do not have end stops, so it is possible to set them in a position where the audio will be lost.

2.5 Electrical characteristics.

ELECTRICAL CHARACTERISTICS

($V_s = 16V$, $T_{amb} = 25^\circ C$ unless otherwise stated)

DIGITAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_{OutHigh}$	High level digital output voltage	$I_{OHigh} = 0.4mA$	$V_{dd} - 0.7$		V_{dd}	V
V_{Olow}	Low level digital output voltage	$I_{Olow} = -0.4mA$	0	0.2	0.4	V
I_o	Output leakage current				30	μA
R_{DL} C_{DL}	Output load (digital)		1	20		K Ω pF
V_{inHigh}	High level input voltage (Schmitt trigger)				3.3	V
V_{inLow}	Low level input voltage (Schmitt trigger)		0.8			V
I_{iHigh} I_{iLow}	Input leakage current	$V_{in} = V_{dd}$ $V_{in} = 0V$	10 -30	30 -30	60 -60	μA
V_{ON}	ON input	Edge triggered			5	V

Table 2. Electrical characteristics 1

DC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_s	Supply voltage		12	16	18	V
I_{q_s}	Quiescent current	$V_s = 12V$ $V_s = 16V$ $V_s = 18V$		4.6 6.8 7.1		mA
$I_{q_{on}}$	Quiescent current DSP on no load no signal	$V_s = 12V$ $V_s = 16V$ $V_s = 18V$		143 160 161		mA

AC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
P_o	Output power	$d = 10\%$ $f = 1KHz$ $R_i = 8\Omega$ $R_L = 4\Omega$	12V 1.16 1.7	16V	18V 2.06 3.17	V_s W W
V_i	Input sensitivity 4 Ω load	$f = 1KHz$ $P_o = 0.5W$ $P_o = 1.0W$ $P_o = 2.0W$			60 90 130	mV
V_i	Input sensitivity 8 Ω load	$f = 1KHz$ $P_o = 0.5W$ $P_o = 1.0W$ $P_o = 2.0W$			81 117 180	mV
B	Frequency response (-3dB)	$P_o = 1W$ $R_L = 8\Omega$	50		4300	Hz
d	Distortion	$f = 1KHz$ $P_o = 0.2 - 2.4W$ $R_L = 8\Omega$ $P_o = 0.2 - 2.4W$ $R_L = 4\Omega$		0.8 0.8		%
R_i	Input resistance		21	22	23	Ω
G_v	Voltage gain	$f = 1KHz$		27		dB
n	Efficiency	$f = 1KHz$ $P_o = 3W$ $R_L = 4\Omega$ $P_o = 2W$ $R_L = 8\Omega$		33 38		%

ANALOGUE CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max.	Units
T_d	System delay			26		mS

Table 3. Electrical characteristics 2

Figure 6. Frequency response

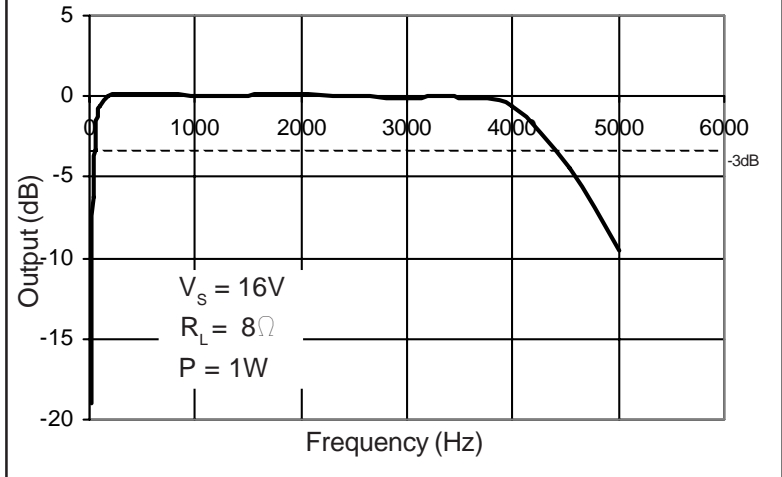


Figure 7. Distortion vs. Output power

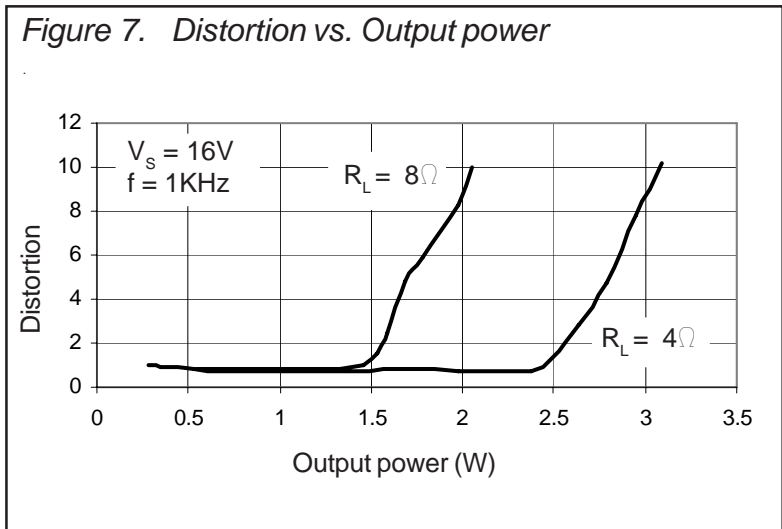
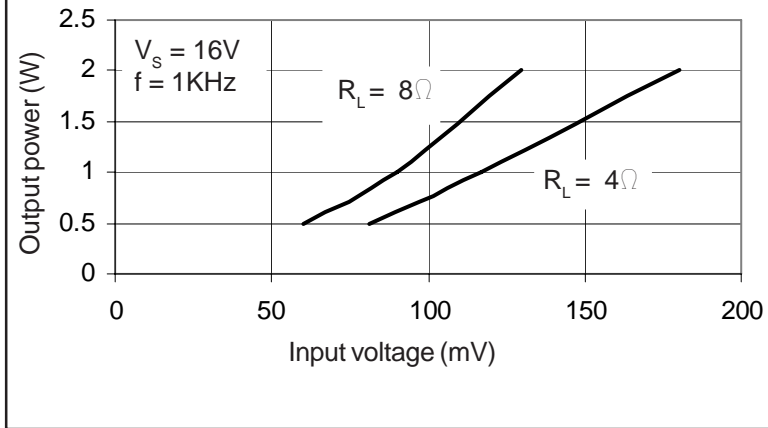


Figure 8. Sensitivity.



3. Installation

3.1 Installation overview.

The **NEDSP1062** module is inserted into the path of noisy audio. The input and output level controls allow the module to be fine tuned to suit most applications.

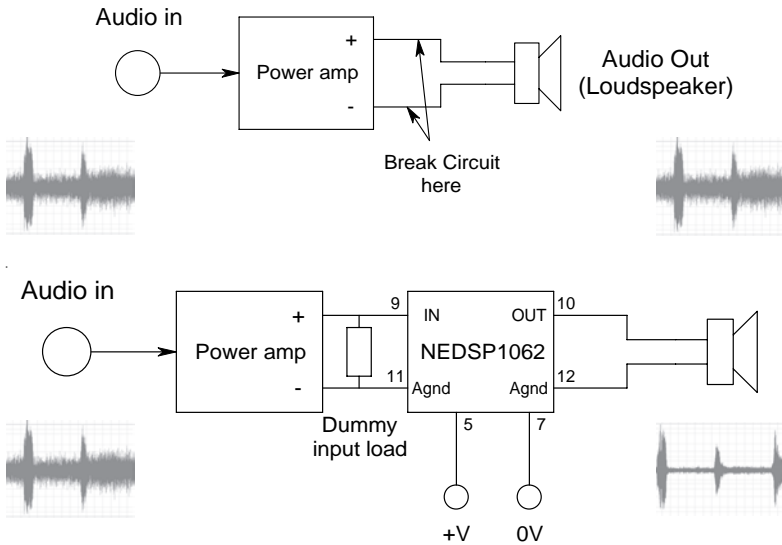


Figure 9. Basic connection diagram

The input to the module is loaded at 22Ω to provide a dummy load to the preceding circuit. This can be removed if required, such as using the module in applications where the audio source is provided by a low level, low power signal source. More information on this can be found in section 3.3 in this operating manual.

If V_{in} is less than approx. 13.8V ensure the power supply is well decoupled otherwise the power supply rejection ratio will deteriorate. Best results are obtained in the range of 13.8V - 16Vdc.

3.2 Module setup.

Both the input and output levels are adjustable on the module. This allows easy integration into the target system.

3.2.1 Overview.

To obtain the best results from the noise reduction the module should be set up with the maximum input level and the minimum output level.

The input sensitivity control has a range of 0.70mW - 3W to provide 2W (Ω) output.

Under certain conditions the DSP can create a small amount of noise, normally when the unit has no signal applied. You should not be able to hear this noise when a signal is applied.

3.2.2 Suggested set up procedure:

Basic setup procedure.

- Connect input source and output device.
- Ensure the **NEDSP1062** is switched off.
- Set the audio source to a typical audio level.
- Switch on the **NEDSP1062**.
- Adjust the input control (P2) until the overload LED illuminates. Reduce the level by approx. 1/4 turn.
- Adjust the output level to the desired level.

It should be possible to set all the levels such that when the module is switched on and off, there isn't a significant change in the audio level.

3.2.3 Change to output load.

The audio input to the module is loaded at 22Ω . This load is effectively connected across the output load when the unit is switched off (bypassed). This will reduce the impedance presented to the audio source.

For example:

8Ω will reduce to 5.9Ω

4Ω will reduce to 3.4Ω

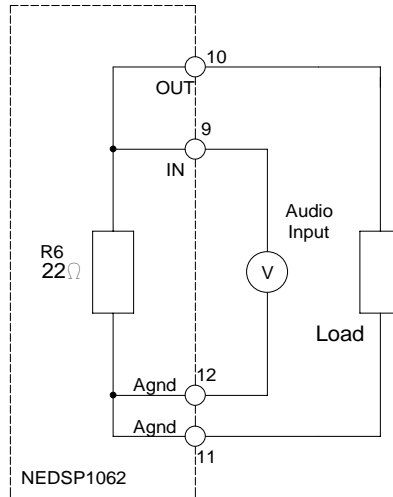


Figure 10. Input circuit - module powered down

3.2.4 Other signal considerations.

The **NEDSP1062** requires a signal of 125mV rms or greater for optimum performance. Signals lower than this may be used but the noise cancellation performance will decrease, as the signal levels drops. If the unit is used with low level signals such as microphones, the signal will need amplifying before applying it to the **NEDSP1062**.

Due to the adaptive nature of the noise cancellation a small delay may be heard when the audio signal changes. For optimum performance provide the module with a constant signal where possible.

When switching on the unit a thump maybe heard in the loudspeaker.

3.3 Driving from a low signal source.

The input to the module has a low impedance. This is to provide correct loading to any power circuits driving it. If the module needs to be driven from a low power signal then it must be modified in the following manner.

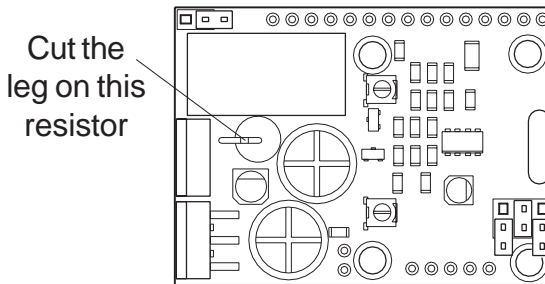


Figure 11. Physical modification for low power signal drive.

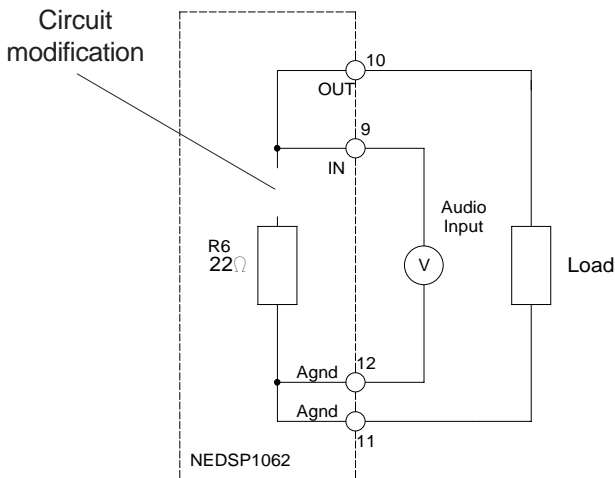


Figure 12. Circuit modification for low power signal drive.

4. Functions.

4.1 Noise reduction levels.

8 levels of noise reduction are available. The amount of noise and tone reduction is shown in the table below.

Level	Tone Reduction	White Noise Reduction
1	4dB	9dB
2	5dB	11dB
3	6dB	13dB
4	8dB	15dB
5	16dB	17dB
6	21dB	20dB
7	25dB	24dB
8	65dB	35dB

Table 4. Tone and noise reduction levels.

The DSP level is set by 3 jumpers. This is identified as J5 on the circuit board. When the jumper is placed over the two pins the jumper is ON. When the jumper is connected to one pin only, or removed from the board it is OFF. To reduce the risk of losing the jumper it is advised to place it on one pin when using the OFF position.

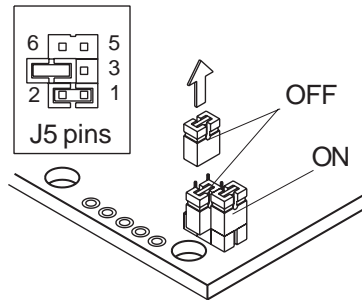


Figure 13. J5 detail.

4.2 Setting different filter levels.

The DSP levels are set by the following combination of jumpers.

Level	J5 (5 - 6)	J5 (3- 4)	J5 (1- 2)
1	On	On	On
2	On	On	Off
3	On	Off	On
4	On	Off	Off
5	Off	On	On
6	Off	On	Off
7	Off	Off	On
8	Off	Off	Off

Table 5. Preset DSP levels using on board jumpers.

4.3 Remote setting of DSP filter level.

Remote setting of the DSP level can also be achieved through PCB connections on J3. This allows the DSP filter level to be changed during operation. If remote DSP setting is used, remove the jumpers from J5 on the module or set them into the OFF position by placing them over one pin on the jumper.

These connections are connected directly to the DSP, do not apply voltages greater than 3.3V to these pins.

To set the DSP level remotely connect the pins N0, N1 and N2 (J3 pins 1,2, and 3) as shown on the following page.

Level	N2	N1	N0
1	0V	0V	0V
2	0V	0V	3.3V
3	0V	3.3V	0V
4	0V	3.3V	3.3V
5	3.3V	0V	0V
6	3.3V	0V	3.3V
7	3.3V	3.3V	0V
8	3.3V	3.3V	3.3V

Table 6. Remote DSP level setting.

Note:

The DSP has internal pull ups on its inputs, so any cell in the table containing 3.3V may be left open circuit. When processing signals with high levels of noise and high levels of noise cancellation, the signal may sound slightly strange. This is quite normal with this type of signal.

4.4 Noise Cancellation On/Off

The module has the provision for remotely enabling and disabling the noise cancellation, while in operation. The default setting for the module is noise cancellation on. This may be switched by the use of the noise cancellation on/off pin (PCB pin 8).

To inhibit noise cancellation, connect this pin to 0V.
To enable noise cancellation leave the pin unconnected.

4.5 Power On/Off.

The **NEDSP1062** features a relay to remove the power from the module and at the same time bypass the audio signal. This isolates the module from the target system. This relay can be controlled in 2 ways.

4.5.1 Module powers up with PSU.

The module can power up from the power supply and will connect the audio signal through the module. When the power is removed (or fails) the audio will bypass the module. Ensure that JP1 is fitted. J1 is located near the black relay, in the top righthand corner of the module.

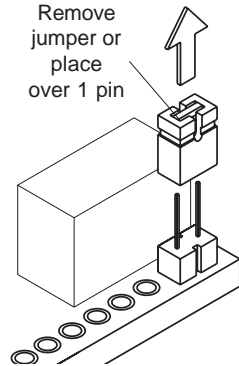


Figure 14. Jumper J1.

4.5.2 On/Off button.

The module has a latch input that allows it to be controlled by a single momentary push button or external logic signal. Remove jumper J1 from the PCB.

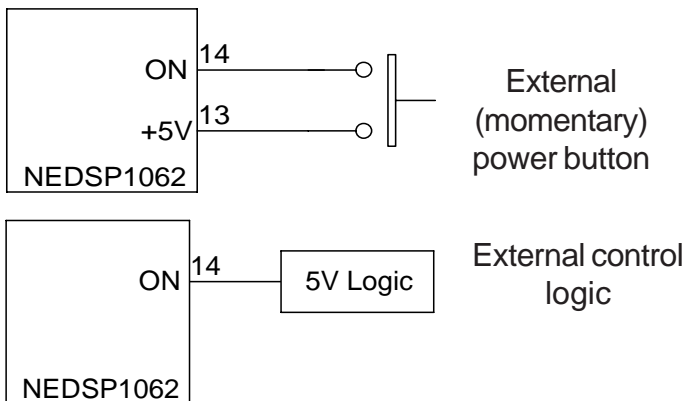


Figure 15. Examples of external power switching.

Applying 5V to the ON input will alternatively switch the power ON then OFF. This input is edge triggered, so the pin has to return to 0V before it can accept another latch input. The input is internally debounced to prevent multiple operations if it is driven by a noisy switch.

Note:

When the module is in the OFF state it draws a quiescent current of typically 6mA.

The signal to control the power to the module can come from a simple non latching push button, or be driven from external circuitry.

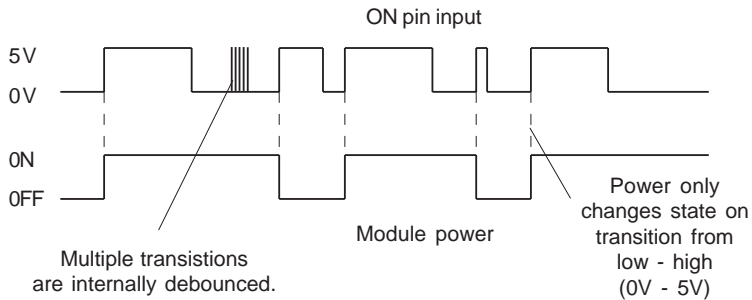


Figure 16. Power switching waveform.

5. Application Notes.

5.1 Noise cancellation On/Off indication.

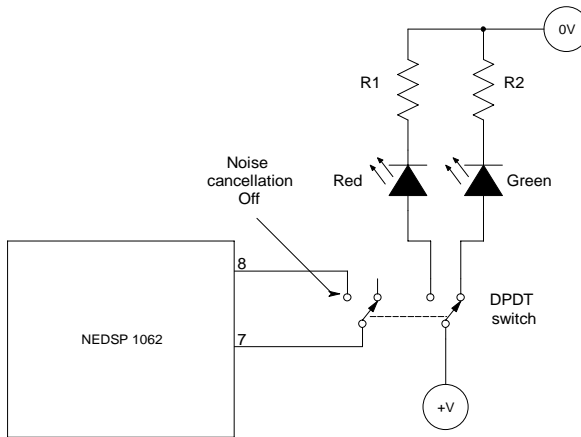


Figure 17. Red/Green LED indication of noise cancellation.

In the above example separate Red and Green LEDs are used to give a visual indication of the noise cancellation mode. The green LED will illuminate when the noise cancellation is on, and the red when off. A single tricolour LED could also be used.

The switch could be replaced by a relay if remote operation is required.

5.2 Remote adjustment of noise cancellation level.

This page illustrates various options for altering the DSP level remotely, during operation.

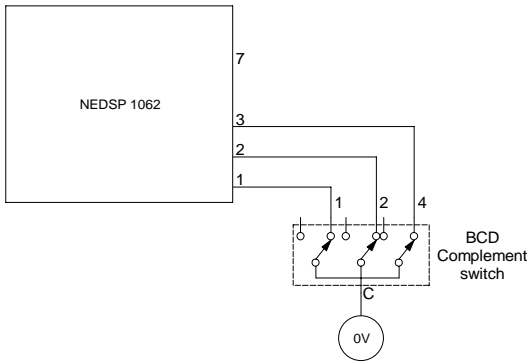


Figure 18. Basic setting using a BCD switch

The transistors allow interfacing with higher voltages to control the DSP level. These could be replaced by opto couplers for greater isolation.

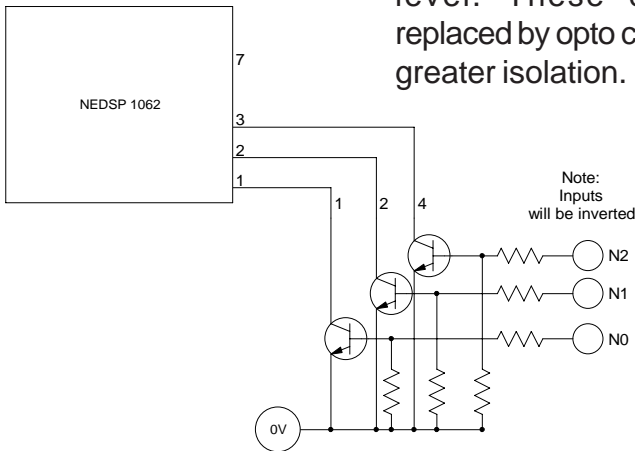


Figure 19. Basic setting using transistors

The module can be controlled with a microcontroller. As the DSP employs internal pull ups, it is not necessary to drive the microcontroller port pins high, they can be placed in a high impedance state.

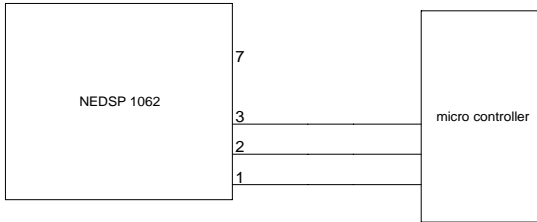


Figure 20. Control using a microcontroller

The following example employs a 7 segment display and keyboard. Noise on/off is also controlled by the microcontroller. In the diagram 3 buttons are used, up level, down level and DSP on/off.

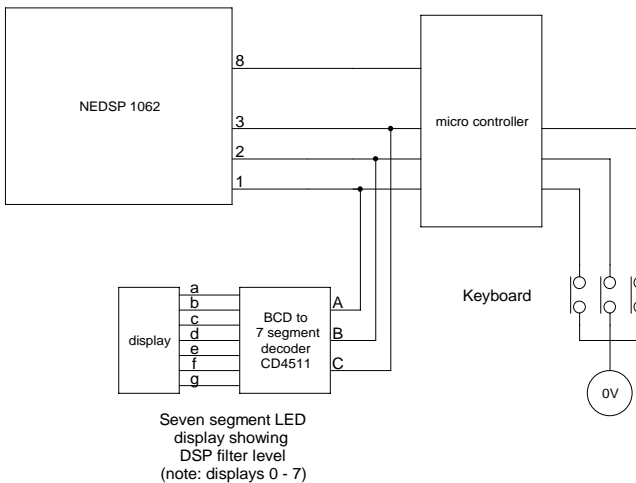


Figure 21. Control using a microcontroller with display and keyboard.

6. Physical Dimensions

6.1 Physical dimensions.

The following diagrams detail the physical dimensions of the module. All dimensions are in mm.

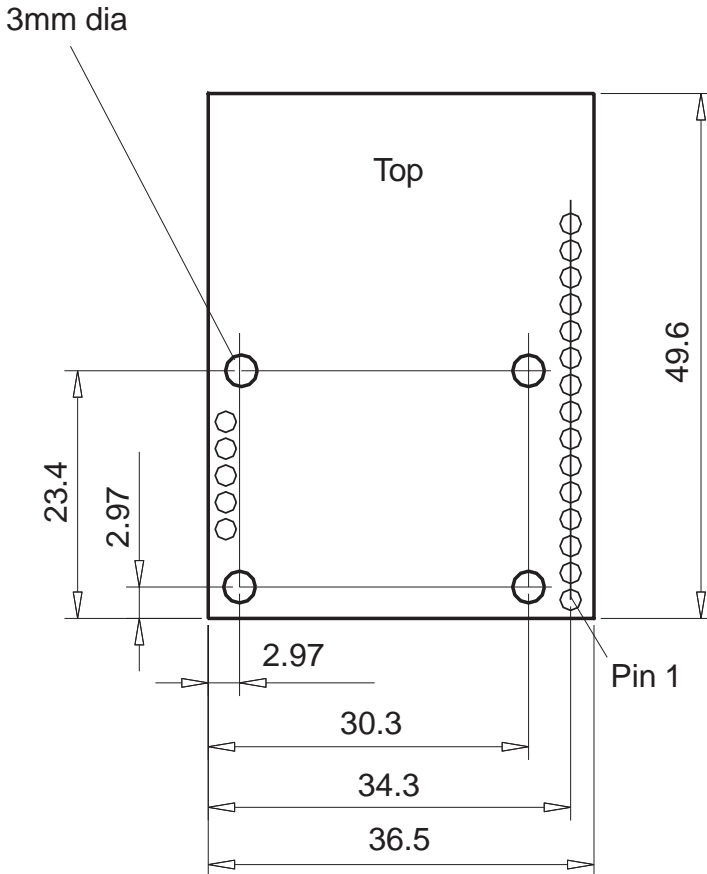
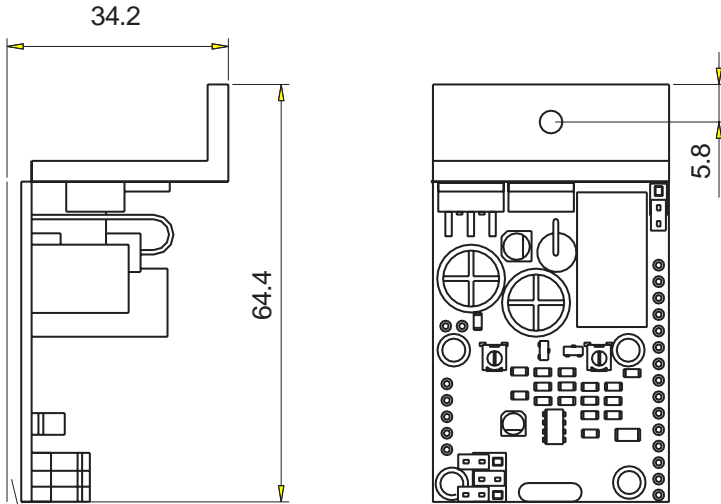


Figure 22. Mounting hole positions.



Components fitted to rear of PCB

Figure 23. Overall dimensions.

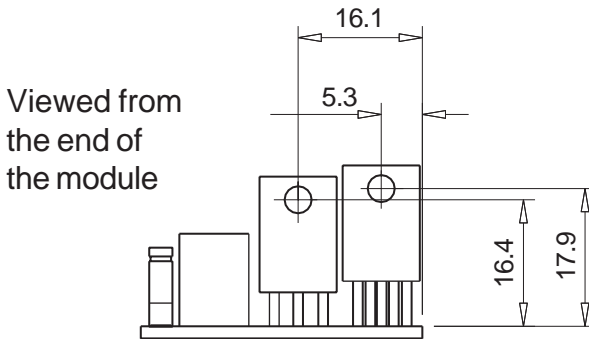
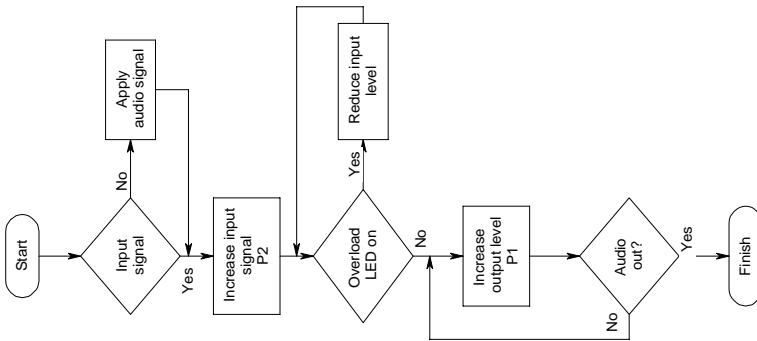


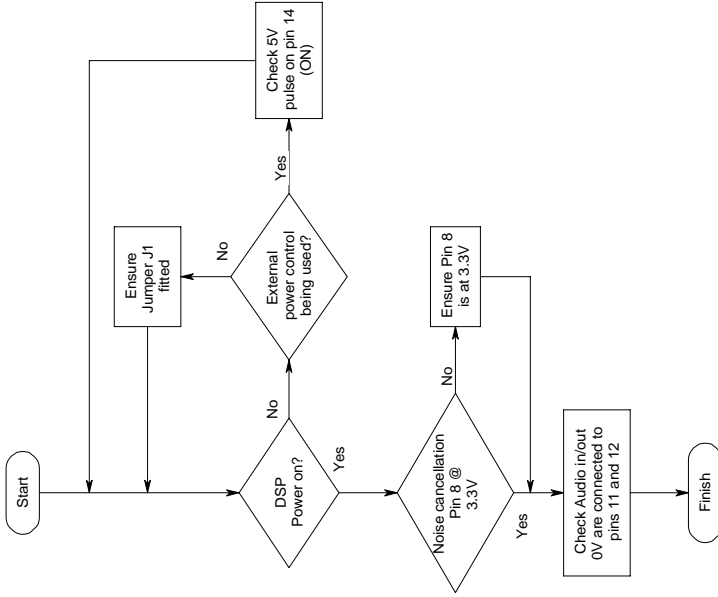
Figure 24. Hole dimensions of power devices - for direct mounting applications.

7. Troubleshooting.

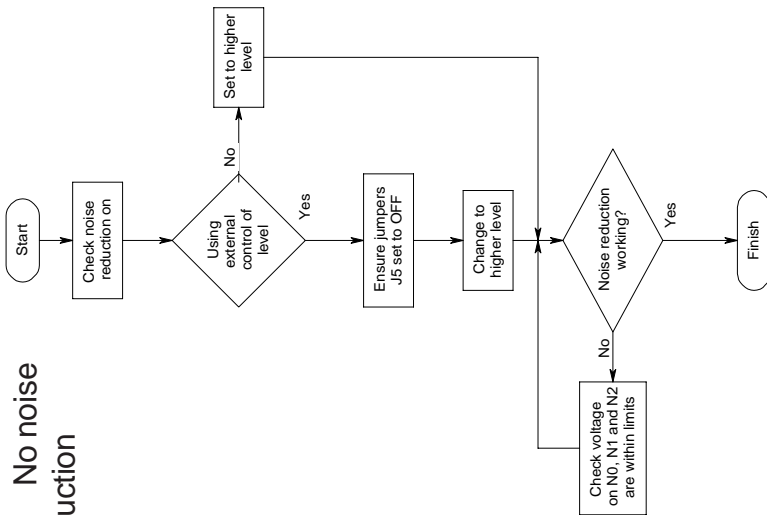
7.1 No audio out



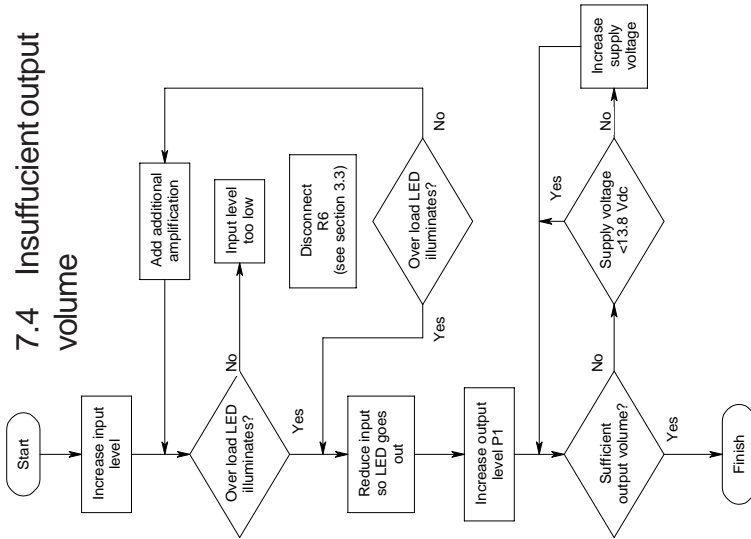
7.2 No noise reduction



7.3 No noise reduction



7.4 Insufficient output volume



8. Other bhi products

Other noise cancellation products from bhi. Visit www.bhi-ltd.co.uk for more information.

8.1 NES10-2 Noise Eliminating speaker.

DSP noise cancellation built into a compact speaker unit. the unit provides an easy to install solution to noise reduction



Features:

- Fully adaptive noise cancellation 9 -35dB
- 8 user selectable noise cancellation levels
- Mono earpiece socket
- Input sensitivity control
- Noise cancellation On/Off switch
- LED indication of power and noise cancellation
- 12-24VDC operation
- Compact robust speaker unit.
- Greatly improved signal to noise ratio
- Easy to install with adjustable mounting bracket
- 2m audio lead
- Optional extras available.

8.2 NES5 Noise Eliminating speaker.



Basic plug and go noise cancelling speaker preset to 20dB of noise reduction.

Features:

- Fully adaptive noise cancellation 20dB
- 12-24VDC operation
- Compact robust speaker unit.
- Greatly improved signal to noise ratio
- Easy to install with adjustable mounting bracket
- 2m audio lead

8.3 NEIM1031 In-line module.

Then **NEIM1031** provides a flexible solution to noise reduction. It features both amplified inputs and outputs, along with line level signal processing. The unit also features an audio bypass when the unit is switched off, so there is no need to disconnect when not in use.

Features:

- Fully adaptive noise cancellation 9 -35dB
- 8 user selectable noise cancellation levels
- Mono earpiece socket
- Input sensitivity control
- Noise cancellation On/Off switch
- Line level in/out
- Input overload indication
- Power on/off with audio bypass.



8.4 NEIM1031 accessories.



LSPKR

20 Watt extension speaker for use with the NEIM1031. Fitted with a 3.5mm mono jack plug.



1031-Sta

Mounting stand for the NEIM1031. Allows the NEIM1031 to be adjusted for the most comfortable operating position.

8.5 DSP modules.

DSP module range.

NEDSP1061:

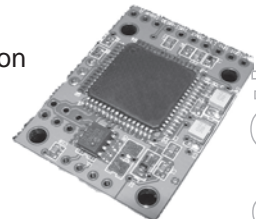
NEDSP1062 - KBD:

Low signal level module

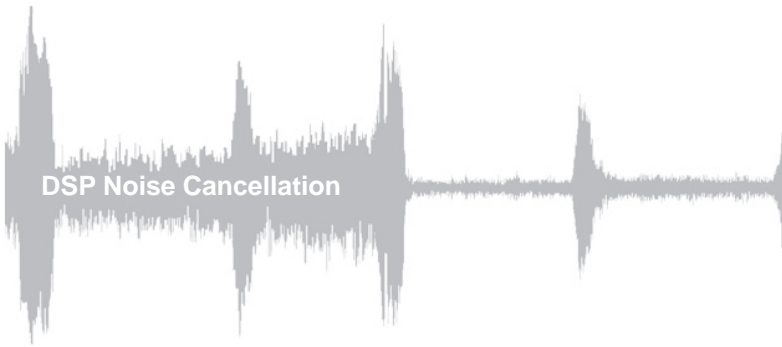
Low signal level module controlled by single button keyboard.

NEDSP1062 - KBD:

Amplified DSP module controlled by a 2 button keyboard.



bhi



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