

Operating Manual

A 4210 80VA Hearing Induction Loop Amplifier
A 4212 280VA Hearing Induction Loop Amplifier

SUITABLE FOR SIMPLE ONE AMPLIFIER DESIGNS.
NOT DESIGNED FOR COMPLEX MULTIPLE AMPLIFIER SYSTEMS.
NOT SUITABLE FOR INSTALLS WITH ADJACENT SYSTEMS.

User manual revision number: 1.1 22/09/2020

IMPORTANT NOTE:

Please read these instructions carefully from front to back prior to installation. They include important setup instructions. Failure to follow these instructions may prevent the amplifier from working as designed.



Since 1976 Redback amplifiers have been manufactured in Perth, Western Australia. With over 40 years experience in the commercial audio industry, we offer consultants, installers and end users reliable products of high build quality with local product support. We believe there is significant added value for customers when purchasing an Australian made Redback amplifier or PA product

Australian Made Status

All Redback house products will now be sporting the official Australian Made logo. Since starting manufacturing of commercial audio equipment in the mid 70's we have always taken pride in producing a quality local product.

The new adoption of the Australian Made logo will help us get the word out to local and export markets that our products carry the official compliance seal of the Australian Made campaign. We have always pushed our 'local is better' line in all of our marketing efforts, it's always an added boost when you are backed up by a widely recognised and respected icon.

Industry leading 10 year warranty.

There's a reason we have the industry leading DECADE warranty. It's because of a long tried and tested history of bulletproof reliability. We've heard PA contractors tell us they still see the original Redford amplifier still in service in schools - that's over 40 years of operation - and still going strong!

1.0 Overview	
1.1 Introduction	4
1.2 Features	4
1.3 What's in the box	4
1.4 Front panel guide	5
1.5 Rear panel connections	6
2.0 Setup	
2.1 Setup Guide	7
2.2 EWIS Input	8
2.3 DIP Switch Settings	9
2.4 LED status indicators	9
3.0 Loop Design	
3.1 Loop Design Guidelines	10
3.2 The Loop	10
3.3 Loop Types	10
3.4 The Amplifier	11
3.5 Theoretical Loops	12
3.6 Practical Loops	13
3.7 Steps In Loop Design	13
3.8 Placement of Loops	14
4.0 Terms and Abbreviations	15
5.0 Specifications	15

1.0 OVERVIEW

1.1 INTRODUCTION

Induction Loop amplifiers, also known as T-loop or Hearing Loop amplifiers, are installed to greatly enhance the listening experience of people using hearing aids. The hearing loop, as its name suggests, is basically a loop of wire which surrounds a designated area to transmit audio to a hearing aid. An audio source is fed into the Amplifier, and the output of the amplifier then sends a high current signal into the loop, which generates a magnetic field. The magnetic field is then picked up by the Telecoil inside a hearing aid.

Hearing Loops are commonly installed in public areas which are generally noisy, making it difficult for hearing impaired users to hear clearly. The A 4210 and A 4212 amplifier models have been engineered to meet AS60118.4-2007 and include a compressor/limiter circuit with tailored frequency response ensuring excellent speech intelligibility. They will operate into loads of less than 2 ohms and are short circuit proof. Great for places of worship, community halls, museums public places, etc.

The A 4210 80VA model delivers 3.5A RMS, 5 Amps peak and the A 4212 280VA model delivers 8A RMS, 11 Amps peak into a typical Loop Resistance of 0.2Ω to 1.7Ω (max 2Ω).

The A 4210 is suitable for areas of approximately 180-200m² subject to metal loss and the A 4212 is suitable for areas of approximately 400-650m² subject to metal loss.

Note that coverage may vary from site to site depending on outside influences such as steel reinforcement, high current electrical wiring etc.

Inputs are provided for balanced mic and line, auxiliary and an EWIS input with VOX muting for interfacing into venue emergency evacuation systems.

1.2 FEATURES

- Designed to meet AS60118.4-2007
- Coverage up to 180-200m² for the A 4210 and 400-650m² for the A 4212
- XLR line & mic inputs
- Aux input via stereo RCA
- EWIS signal connection (RCA)
- Short circuit proof
- Compressor for added speech intelligibility
- Adjustable VOX sensitivity
- Compatible with single loop designs
- 240V AC operation
- 19" Rack Mount (with optional A 4376 rack ears)

1.3 WHAT'S IN THE BOX

A 4210/12 Induction Loop Amplifier
240V AC IEC C13 Appliance Mains Lead 10A 3 Pin Black
Instruction Booklet
Hearing Induction Loop Installed Label

1.4 FRONT PANEL GUIDE

Fig 1.4 shows the layout of the front panel.

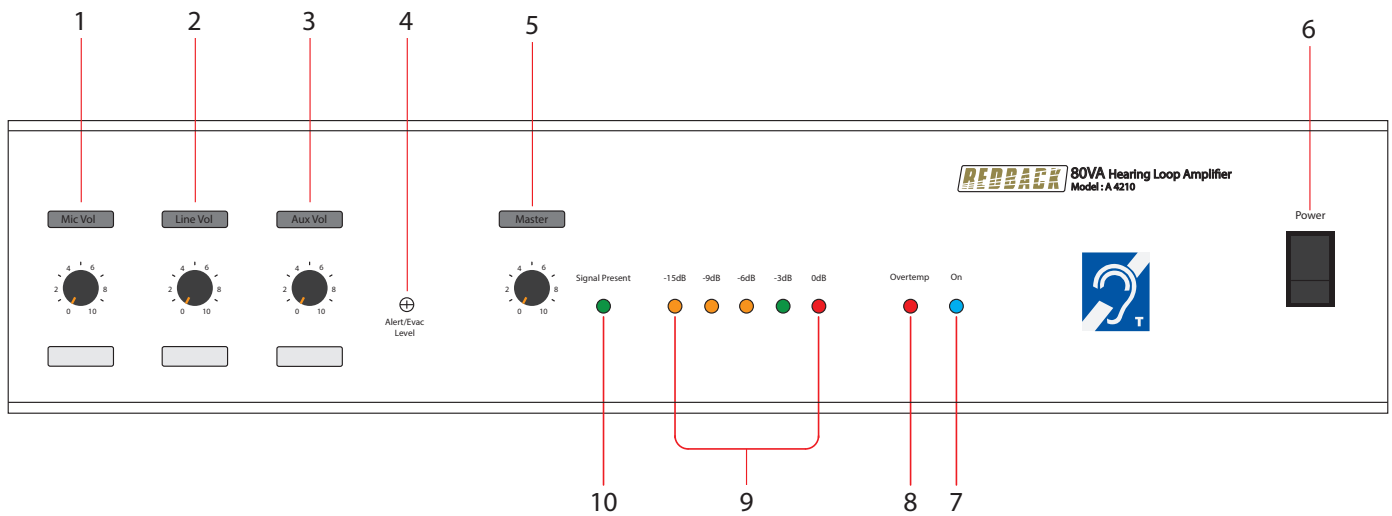


Fig 1.4

- 1 Mic volume control**
Use this control to adjust the microphone volume.
- 2 Line volume control**
Use this control to adjust the Line volume.
- 3 Aux volume control**
Use this control to adjust the Aux volume.
- 4 Ewis volume control**
Use this control to adjust the Ewis volume.
- 5 Master volume control**
Use this control to adjust the master volume.
- 6 Power Switch**
Use this switch to turn the amplifier on.
- 7 On Indicator**
This LED indicates when the amplifier has power.
- 8 Overtemp Indicator**
This LED indicates when the amplifier is running hot.
- 9 VU Indicator**
These LED's indicate the output level of the amplifier.
- 10 Signal Presence Indicator**
This LED indicates when a signal is present at the inputs of the amplifier.

1.5 REAR PANEL CONNECTIONS

Fig 1.5 shows the layout of the rear panel.

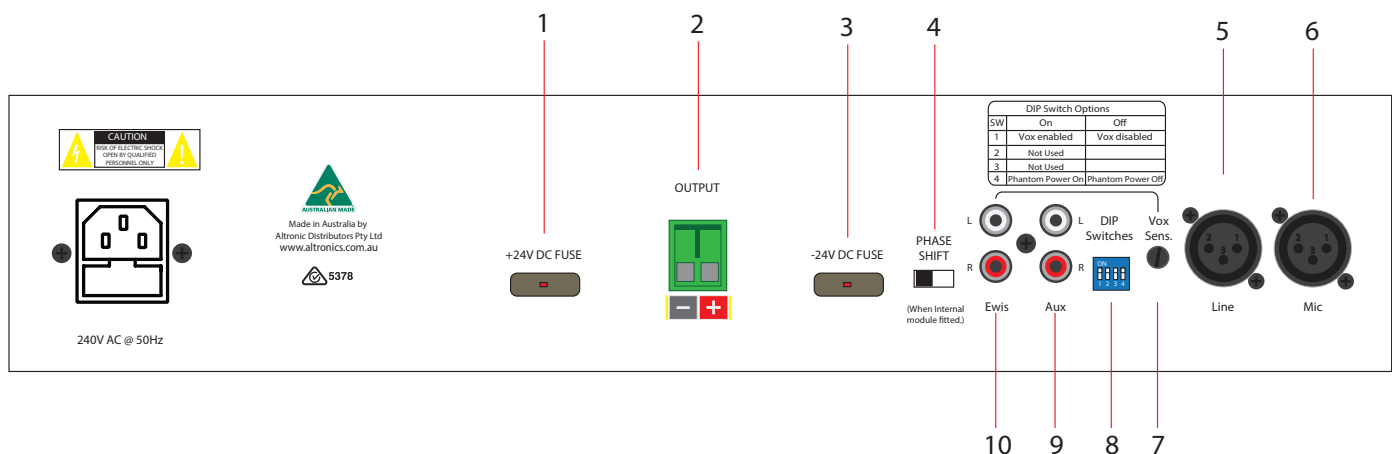


Fig 1.5

- 1 +24V DC Fuse**
This resettable fuse protects the positive supply rail inside the amplifier.
- 2 Output Connections**
Connect the loop to these terminals.
- 3 -24V DC Fuse**
This resettable fuse protects the negative supply rail inside the amplifier.
- 4 Phase switch**
Not currently available. i.e. inactive.
- 5 Line Input**
A 3 pin balanced Line level input.
- 6 Mic Input**
A 3 pin balanced Microphone level input. Phantom power is also available on this input (see DIP switch settings).
- 7 EWIS input vox sensitivity**
This trimpot adjusts the Vox sensitivity of the EWIS input. Once the VOX is activated the Mic, Line and AUX inputs will be overridden.
- 8 DIP Switches**
These DIP switches set the phantom power and Vox enable options.
- 9 Aux Input**
The AUX inputs are dual RCA connectors which are internally mixed to produce a mono input signal.
- 10 EWIS Input**
The EWIS inputs are dual RCA connectors which are internally mixed to produce a mono input signal.

2.0 SETUP

2.1 SETUP GUIDE

The A 4210 and A 4212 amplifiers have a total of four inputs. A balanced 3 Pin female XLR (Mic input), a balanced 3 Pin female XLR (Line input), a dual RCA (Aux input) and a dual RCA (EWIS input). The Microphone input has an input sensitivity of 100mV, while the Line, Aux and EWIS inputs have an input sensitivity of 1V. The Line input is suitable for connection from the Line Level output of another amplifier. Phantom power (12V DC) is available at the Mic input, and VOX muting is available on the EWIS input only. (See DIP switch settings for more info on the phantom power and enabling the VOX muting).

For best performance when using long lines between microphones and the amplifier use balanced lines. These reduce noise or hum that may be induced into the cables. Note that a balanced line uses three wires (two signal wires and one screened earth wire or shield) where an unbalanced cable uses only one signal wire and a screened earth.

Fig 2.0 illustrates the input connections available.

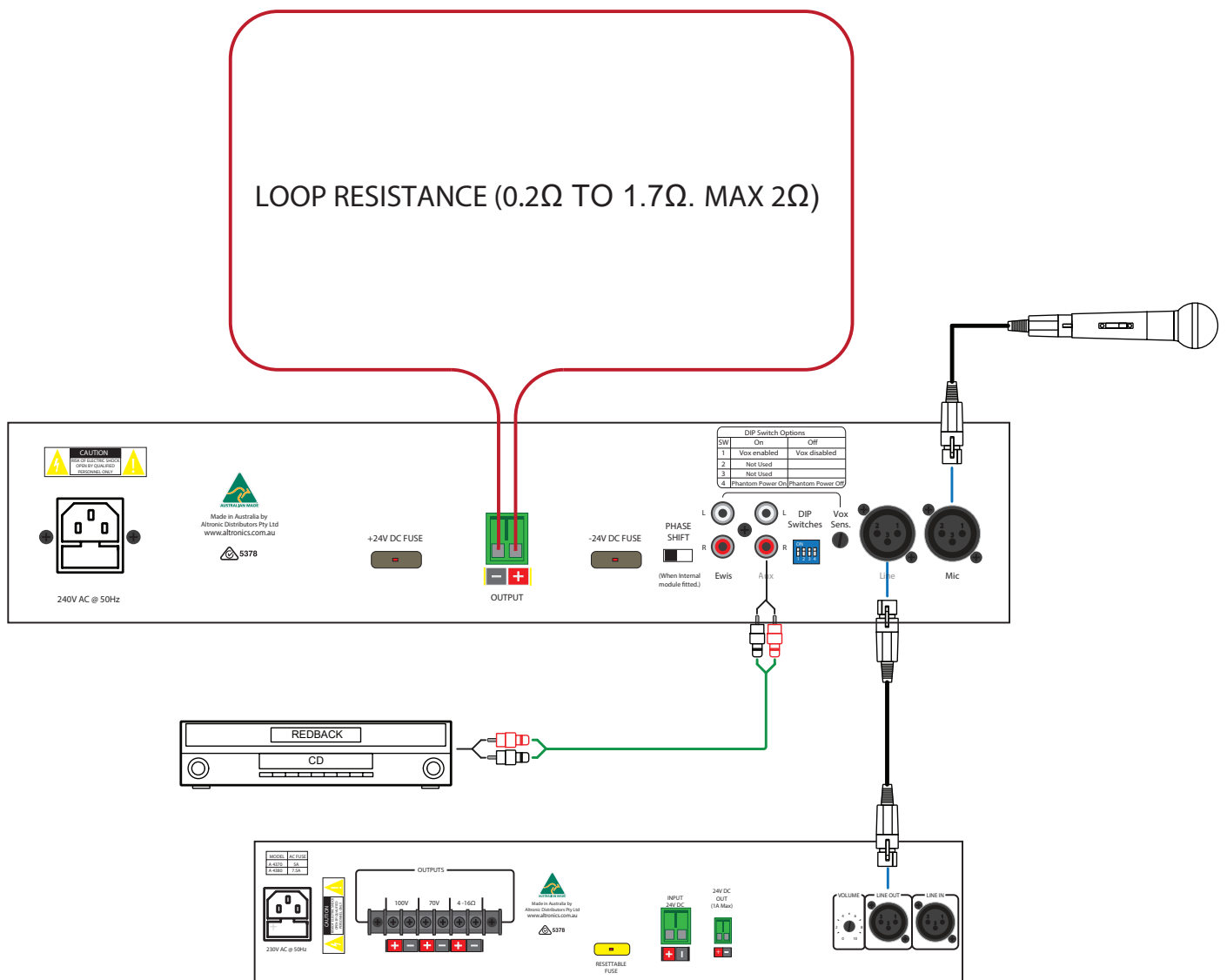


Fig 2.0

2.2 EWIS INPUT

The A 4210/12 amplifiers have a dedicated EWIS input for emergency situations.

A Fire Evacuation System can be configured when the A 4210/12 is complemented with an Emergency Tone Generator or Evacuation Controller such as the A 4565 as shown in Fig 2.1.

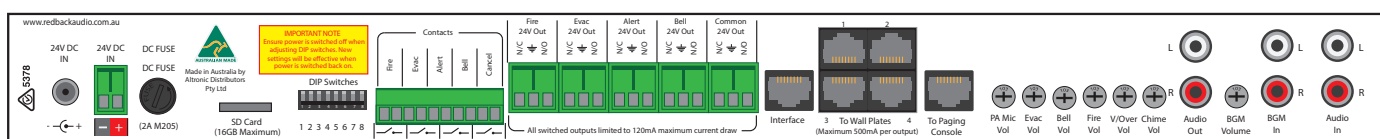
The A 4565 controller is designed around industry standard building emergency alert/evacuate requirements. When connected to a paging system amplifier, building occupants can be alerted and/or evacuated in the event of an emergency e.g.: fire, gas leak, bomb scare, earthquake.

Figure 2.1 demonstrates how to connect the A 4565 controller to the A 4210/12 amplifier.

The output of the A 4565 Evacuation controller is connected to the EWIS Input of the A 4210 using dual RCA leads. The output level of the signal from the Evacuation controller is set by the EWIS volume adjustment on the front of the A 4210/12 amplifier.

The A 4210/12 has an in-built VOX circuit, which is activated when a signal is applied to the EWIS input. The VOX sensitivity of the EWIS input is adjusted via the (Alert/Evac Level) trimpot adjustment on the front panel. Once the VOX is activated the Mic, Line and AUX inputs will be overridden, and the audio from the EWIS input will be output. (See DIP switch settings for more info on enabling the VOX Triggering).

A 4565 ALERT/EVAC CONTROLLER



A 4210/12 AMPLIFIER

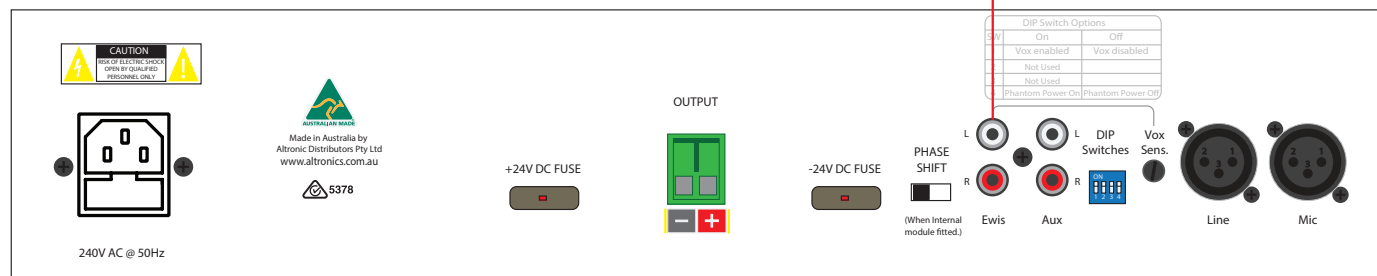
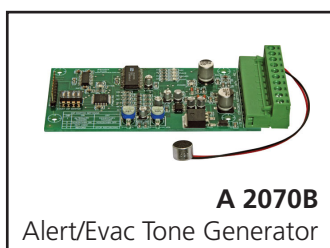


Fig 2.1

Other Emergency Tone Generators



2.3 DIP SWITCH SETTINGS

These switches configure the phantom power and Vox triggering function.

Switch 1 - Enables the VOX Triggering. The VOX is activated when a signal is applied to the EWIS input. The VOX sensitivity of the EWIS input is adjusted via the (Alert/Evac Level) trimpot adjustment on the front panel. Once the VOX is activated the Mic, Line and AUX inputs will be overridden, and the audio from the EWIS input will be output.

Switch 2 - Not Used

Switch 3 - Not Used

Switch 4 - Sets the phantom power (12V DC). The phantom power affects the Mic input Only.

2.4 LED STATUS INDICATORS

There are a series of LED's on the front panel which indicate the following.

On

Indicates when the amplifier has mains power applied.

Overtemp

Indicates when the amplifier reaches a high temperature. The unit will shutdown if this occurs, preventing damage.

Signal Presence

Indicates when a signal is present at any of the Mic, Line, Aux or EWIS inputs.

VU Meter

The dB output of the amplifier is indicated by the 0dB to -15dB LED's.

3.0 LOOP DESIGN

3.1 LOOP DESIGN GUIDELINES

Redback does not guarantee absolute outcomes from following any specific information produced in these instructions. This is purely a guide and assumes the Loop Design is made by someone with the appropriate qualifications or experience.

Note: The most successful loops are designed with access to the site for measurements and proof of concept prior to completion of facility. In the case of an existing venues, access limitations may lead to compromise in final performance.

In brief, Assisted listening Systems (ALS) include AM/FM Transmitters/Receivers, Infrared Transmitters/Receivers and Induction Loop Systems. Most Hearing Aid Devices are available with the built-in Telecoil (T) option. No additional equipment is required for the pickup of the Electro Magnetic signal therefore making them a versatile device for detecting an electronic signal.

In Audio Frequency Induction Loops (AFILs), the signal is baseband audio and requires only a simple Telecoil pickup (Hearing Aid fitted with T-coil). Listening (area) can be controlled by the loop layout and the system is not interrupted by physical obstacles. On the down side the signal can be affected by mains borne interference, spill from adjacent loops and variations of frequency response due to metal loss or localised variations in magnetic field strength. In Australia AFILs are the most commonly deployed hearing assistance mechanisms.

Loop locations: Apart from public spaces as set down by the BCA, loops can be utilized in lifts, trains, taxis, domestic locations (e.g. Living/lounge rooms), etc.

[These specifications relate to the vertical component of the magnetic field. The T-coil in hearing aids is usually mounted vertically. Not all hearing aids comply with this standard which often causes complaints about loop systems. Exceptions must be made in certain situations where the head of the listener is not vertical (places of worship, hospitals and recovery areas as people may be kneel, prone or supine).]

3.2 THE LOOP

In its simplest form, is a copper conductor fitted to the perimeter of area in interest (fig 8 cable is very satisfactory). As the installation gets more demanding due to metal loss (e.g. extensive use of reinforcement steel) and requirements for tight control of spill, the loop design becomes more complicated including use of multiple amplifiers. For such applications requiring low spill, high metal loss compensation designs, it is recommended that a consulting engineer with appropriate experience be utilised. The A 4210/12 amplifiers are not intended for use in multiple amplifier designs.

As for the loop resistance, A4210 and A4212 Hearing Loop Amplifiers preferred load resistance range is 0.2Ω to 1.7Ω (inherently short circuit proof and stability guaranteed to 2Ω).

See "Loop Resistance" and cable choice under Practical Loop section for more information.

3.3 LOOP TYPES

1. **Counter Loops:** Loops fitted to service/information counters e.g. Post Office, Doctors reception area, Rail Ticket office, etc. Can be a simple matt style pre-manufactured unit or more effectively a combination vertical/horizontal coil fixture under the counter/desk structure of the facility driven by a small amplifier and microphone combination.
2. **Perimeter Loop:** Placing a loop typically at the edge (or 600mm in) of room boundary with a suitable feed termination from amplifier. The loop wire resistance including feeder cable must meet requirements of amplifier specifications. Some problems may arise regarding metal loss and loop spill into adjacent areas. Never install the loop cable at head (Hear Aid) height as performance can be erratic due to field strength variation. Spill can be as far as 3.5 times width of loop, (rolling off then decaying to complete zero). Avoid installation of single Perimeter Loops in spaces larger than 10m x 10m, as the field strength will potentially have large variations. Plan for 2 or multiple loops.
3. **2-Turn Perimeter Loop:** A variation of the Perimeter loop is a 2-turn cable loop, which increases the field strength by 6dB, however the loop impedance goes up (4 times) and increases the risk of the amplifier clipping especially at high frequencies.
4. **Single Array Loop:** Two or multiple "fig 8" type segments nominally 2 to 5m, preferably all the same width. Requires less current than a Perimeter loop (3dB per 2 sections) but exhibits a brief but sharp signal "Null" at each segment or cable crossover. Most suitable for a permanent seating areas and individual desks (Classroom setup). Has limitations as the number of loop segments due to metal loss increases.

5. **“Electric Grill” variation of the Perimeter Loop:** Fitted as continuous sections approx. 2m wide giving a more consistent field and lowering spill and improved metal loss performance. Uses substantially more cable, requires considerations regarding lower resistance cable and potential for cable damage if fitted under floor cladding in heavy traffic area.
6. **Cancellation Loop (Passive):** In the simplest form, a narrow loop added to a Perimeter Loop, laid as a “fig 8” end of the main loop. The design of the extra loop is critical and best fitted by trial and error.
7. **Ultra Low Spill Array:** With mathematical Simulation and extremely precise placement of loop components (down to <50mm) an Ultra-Low Spill System can be achieved with spill down to approx. 1m. A site visit for sample test measurements (data) would enhance the quality of results.

3.4 THE AMPLIFIER

The preferred amplifier design must incorporate a compressor for reduction of the dynamic range and a limiter to protect the amplifier output from clipping (esp at high frequencies) and thus eliminating any risk of generating EMC transmissions i.e. must comply with C-tick requirements. It is also preferred that the amplifier has a true current drive output and thus minimizing problems with low impedance and driving an inductive load. Plan for the amplifier to have 20% margin.

[The amplifier must be capable of short term delivery of pulsed tone (125mS bursts) of current to achieve 400mA/m with no distortion see extract from AS 60118.4-2007]

Please Note: The amplifier's maximum coverage area is measured in a free field situation. In reality (with metallic objects, like reinforced concrete) the coverage could be reduced by approximately 20-50%.

Extract from AS60118.4 (2007)

“Magnetic Field Strength in Audio-Frequency Induction Loops for Hearing Aid Purposes”: The rigorous standard for Audio Induction Loop Systems, making Australia internationally compliant in regard to field strength and audio quality for the hearing impaired. This defines the performance criteria of an induction loop system. The key elements may be summarised:

- Field Strength in the specified listening area shall be -20dB re 1A/m average i.e. 100mA/metre long term average, using a 1kHz sinusoidal input, with a variation of +/-3dB.
- short term peaks up to 400mAmps/metre (0.125secs integration time)
- Environmental Magnetic Background noise shall be no higher than -40dB A-weighted (measured with the loop system off).
- Frequency Response of the system shall be from 100Hz to 5000Hz. The variation should be no more than +/-3dB from the value taken at 1kHz.

The international standard is IEC 60118.4 (also known as SN, EN or BS 60118.4)

In practical terms, the recommended field strength, based on Australian Standard 60118.4 (2007):

100mAmps/metre long term average (>60 secs) i.e. -12dB ref 400mA/m (rms)

400mAmps/metre (0.125secs) becomes 0dB ref and THD less than 1%.

Background noise -32dB A-weighted ref 400mA/m

Please note that this standard is about the ability of the amplifier to deliver correct current into loop.

The aim of AFILs is to obtain:

Reasonable magnetic field strength within the working area at ear level (1.2 metre sitting, 1.6 metre standing), per AS60118.4.

Minimal overspill which could cause interference with other similar systems or compromise confidentiality

Acceptably uniform magnetic field strength over frequency range 100Hz to 5000Hz, as per AS60118.4. Signal processing to achieve compression/limiting so that the variation in output level is limited in Dynamic Range and to ensure that the amplifier never goes into clipping (severe distortion) thus creating unwanted EMC interference.

Metal:

The presence of metal within the fabric/structure of buildings has an impact on loop performance. When any magnetic field generated, (by the audio loop in this case), Eddy currents are generated as a result within any metal structures within the space. The induced currents will lower the main magnetic field in localized spots/areas causing degradation to the audio signal level or modifications to the tonal balance resulting in lack of clarity at especially at higher frequencies.

The type of metal and the profile has a bearing on amount of loss. Examples of metallic structures include concrete floor reinforcement, suspended ceilings, metal counters and lifts.

By careful attention to design and detail, the effects of metal can be minimised and sometimes completely eliminated.

Background Noise:

Measure the environmental background electromagnetic noise utilising a Field Strength Meter (FSM) with the loop system off. The required figure is -32dB (re 400mA/m) ideally preferred if 47dB! Will accept -22dB as useable but report.

Hearing induction loop systems for large floor areas need to be carefully designed. Simple 'perimeter loop' layouts which work well for small rooms with timber floors, are often not suitable for larger rooms. For example, loops installed in large rooms built upon concrete slabs can suffer field strength and frequency response losses due to the presence of structural steel reinforcement (or 'reo') laid within the slab. In order to provide an installed system which meets the applicable Australian Standards (AS1428 and AS60118.4-2007) greater attention needs to be given to the site data, loop design and implementation. Finally adequate signage must be utilised for compliance.

3.5 THEORETICAL LOOPS

Definition of AMP/METRE:

A field strength (FS) of 1 Amp/metre (1A/m) exists at the centre of a circular loop of one metre diameter when a current of 1 Amp rms flows in the loop. (from $H = I/2R$, $I =$ loop current, $R =$ radius)

Square Loops:

For a square loop of one turn, the field strength at the centre is given, with "a" being the length of each side, by:

$$H = (2\sqrt{2} / \pi) \times (i / a)$$

Which means that a field strength of 100mA/m would be given by a current:

$$i = (0.1 \times \pi \times a) / 2\sqrt{2} = a/9 \text{ amps}$$

Naturally this calculation gives the field strength (FS) only at the centre of the loop but we need to know about the distribution of the field over the whole area of the loop. Refer to the cross section of loop below and notice that at the centre the FS is lower than just inside the edge of loop wire on each side of perimeter.

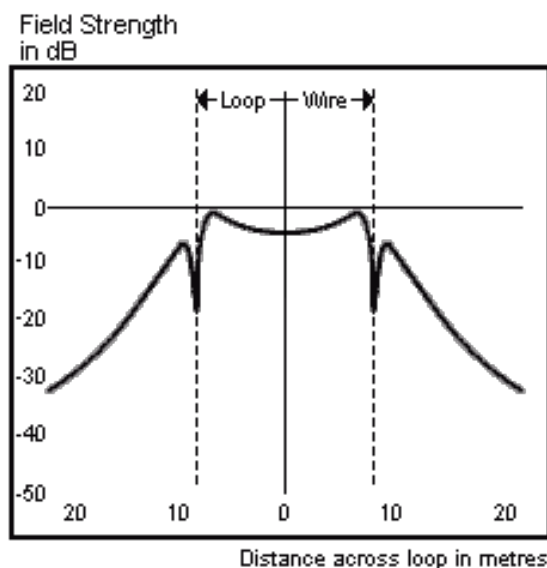


Fig 3.0 Cross section indicating Distribution of field strength

3.6 PRACTICAL LOOPS

Loop Resistance and Cable Choice: (as to be used with A4210 and A4212 amplifiers) Loop Cable Types:

The loop cable can be figure 8 cable, copper foil or multi-wire as long as the resistance is compatible with the amplifier requirements (preferred load resistance range is 0.2Ω to 1.7Ω). That includes feeder cable from amplifier location, all terminations and the loop itself. In the simplest installation, the loop is terminated at the amplifier.

The fig 8 cables can be bulky under carpet utilising thinner underlay and other floor covering. Foil and ribbon has a very low profile under carpet but are more prone to damage from excessive localised force or uneven flooring which moves with loading.

The table shown below provides examples of Redbacks' cables which would be suitable.

•Figure 8 cable (Note Flexibility: Resistance per cable length can be halved by paralleling or used as 2 Turn Cable)

Cat No:	Description	Max Current / leg	Resistance/100m	Uses
W2119		7.5A	2.45Ω	Small-medium loops
W2135		10A	1.85Ω	Larger loops
W4052	Heavy Duty	17A	1.05Ω	Larger loops/feeder cable
W4154	Very HD (Feeder)	20A	0.45Ω	HD Feeder cable only

•Multi-wire ribbon

Cat No:	Description
W2616	16 wires 28AWG=1.296mm ²

3.7 STEPS IN LOOP DESIGN (a suggested approach)

1. Decide location and measure loop size (length x width plus distance to Loop Drive Amplifier).
2. Check environmental (background) magnetic noise level (A-weighted) using Field Strength meter (FSM). This will be a combination of 50Hz Hum associated with proximity of mains cabling or switchboards and 100Hz Buzz caused by rectification or light dimmers.
3. Adjust location if required after noise level checks, any identified thoroughfares through the space and other factors affecting the space.
4. Calculate average current in single turn to give 100A/m field strength, from $i = a \div 9$
5. Determine loop wire resistance (R) compatible with amplifier requirements
6. Determine amplifier drive characteristics to meet loop drive requirements
7. If possible, install/tape temporary loop into place on floor
8. Inject 1kHz tone into amplifier, adjust gain control to correct operating level (setting current for long term average Field Strength of 100mA/m.)
9. Confirm Frequency Response of system tone 100Hz and 5kHz at +/-3dB (unweighted)
10. Verify signal quality with FS at 400mA/m (approximate) Note: correct signal should be a pulsed tone
11. For reference and repeatable calibrations, manually plot long term FS readings in selected reference locations.
12. Fit appropriate signage for system compliance under BCA.

As a starting point for typical Perimeter loops, the long term average current is approximately the length of the shorter side divided by 9 and the max (short term) current is 12dB higher i.e. approx. 4 times the length of shortest side divided by 9.

3.8 PLACEMENT OF LOOPS

Optimum position for loop is at floor level (up to 250mm above) or under floor depending on access to floor covering and floor structures or 2.4m to 3.5m above floor i.e. in suitable ceiling. (Bearing in mind the working area at ear level i.e. 1.2m sitting, 1.6m standing) However Loop Displacement, typically between 10% and 25% of loop width (up to 50% for small room), can alter these figures for larger rooms especially for Perimeter loops. Keep cabling 500mm to 600mm away from outside room border walls and preferably away from heavy traffic areas if placed under floor covering (protection of cable). In some construction styles, the loop cable can actually be placed outside the room perimeter walls.

FINAL CHECKS:

Before an induction loop system is **permanently** installed, it is recommended that:

- Environmental electromagnetic noise should be checked with the venue's lights and all electrical systems turned on.
- The loop wire should be temporarily taped or tacked in place and the system fully tested before performing final installation.
- To check whether the loop system is interfering with audio-visual systems, the venue's audio & video systems should be on when testing the loop.
- If electric guitars are used, they should be checked during the pre-installation loop test in order to determine if their magnetic pickups are sensitive to the planned loop location. Use of Dynamic Mics to be confined outside of Loop area.

Fig 4.0 illustrates the typical frequency response required.

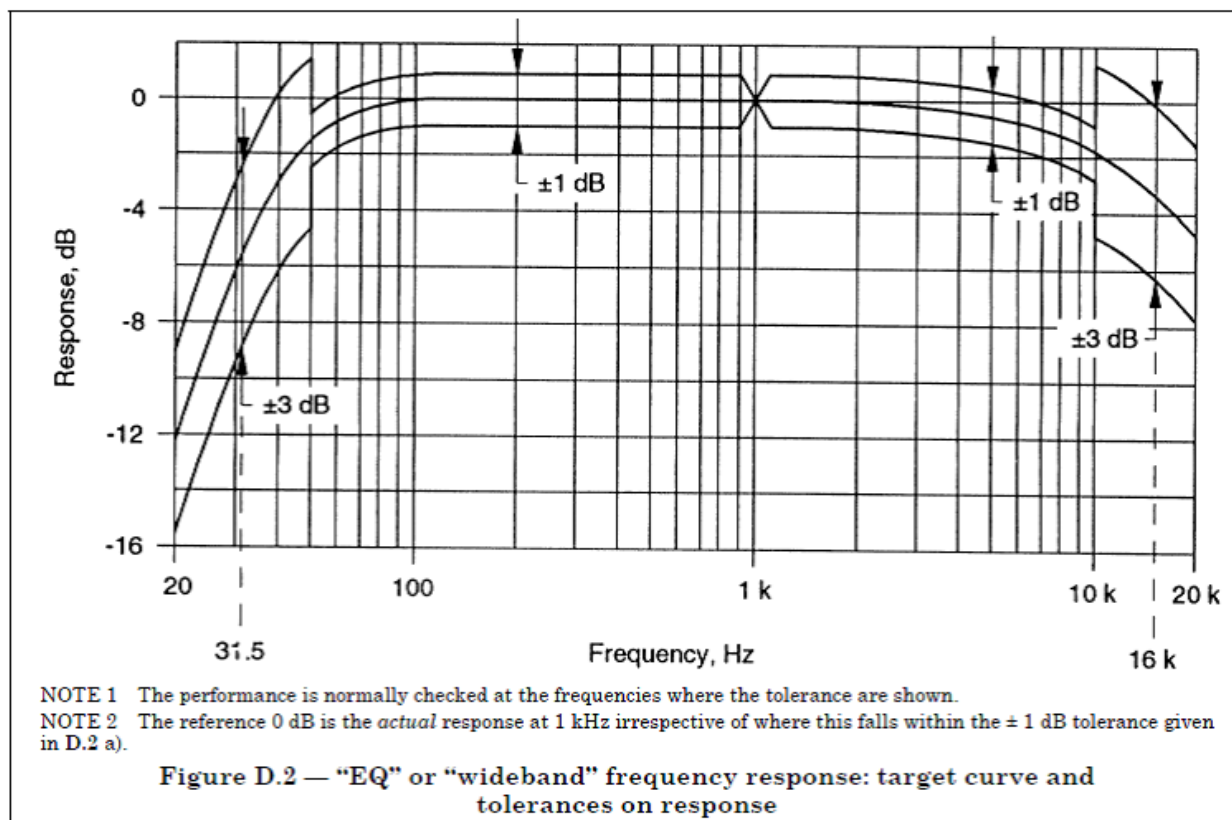


Fig 4.0

4.0 TERMS AND ABBREVIATIONS

Terms and Abbreviations	Explanations
AFILs	Audio Frequency Induction Loops
FS	Field Strength (Magnetic)
FSM	Calibrated Meter to indicate magnetic Field Strength (Baseband Audio)
T ("T" setting)	Telecoil
mA/m	(H) Magnetic Field strength measured in milliAmperes per metre
0.125secs integration time	An extended processing time measurement for level meter (not readily available but normal PPM reads approx. 30% higher)
dB L	Expressing dB levels in reference to Induction Loops
A-weighted	Filtered curve used for acoustic measurements
rms	Root-mean-squared (refers to sinewave signal level)
Spill	Unwanted magnetic signal transmitted outside the loop

5.0 SPECIFICATIONS

Measurements referenced to 1kHz

A 4210 drive current:	3.5A RMS, 5A Peak
A 4212 drive current:	8A RMS, 11A Peak
Loop requirements:	0.2Ω to 1.7Ω preferred range
Frequency response:	100Hz to 5kHz @ -2dB, 80Hz to 6kHz @ -3dB target.
THD:	<0.25% @ 50% drive
Compressor:	2:1 for dynamics control (fast attack)
Input:	3 pin XLR, Stereo RCA
Output:	Loop connection via pluggable terminals
Power:	240V ac
Dimensions:	432W x 380D x 88H

***Specifications subject to change without notice**

All Australian made Redback products are covered by a 10 year warranty.

Should a product become faulty please contact us to obtain a return authorisation number. Please ensure you have all the relevant documentation on hand. We do not accept unauthorised returns. Proof of purchase is required so please retain your invoice.