FDS 310

User Manual

V 2.0 JMK 9 August 1996

CE This equipment has been tested and found to comply with the following European Standards for Electromagnetic Compatibility:

Emission Specification:	EN55013	(1990)	(Associated equipment)
Immunity Specification:	EN50082/1	(1992)	(RF Immunity, Fast Transients and ESD)
Mains Disturbance:	EN61000/3/2	(1995)	

For continued compliance ensure that all input and output cables are wired with cable screen connected to Pin 1 of the XLR. The input XLR Pin 1 on BSS equipment is generally connected to chassis via a capacitor to prevent ground loops whilst ensuring good EMC compatibility.

We have written this manual with the aim of helping installers, sound engineers and musicians to get to grips with the **FDS-310** and obtain its maximum capability.
If you are new to BSS products, we recommend that you begin at the start of the manual. If, however, you are already familiar with the intended application, and just want to get the unit installed without delay, then follow the highlighted sections.
We welcome any comments or questions regarding the **FDS-310** or other BSS products, and you may contact us at the address or World Wide Web site given in the warranty section.

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1.0 What is a Crossover?

Crossovers are a necessary part of sound reinforcement systems because the loudspeaker drive-unit which can produce clear reliable high SPL (sound levels) over the full audio bandwidth has yet to be invented. All real-world drive units work best when they are driven over a limited band of frequencies, for example: Low, Mid and High.

Any crossover aims to provide the division of the audio band necessary, so each drive unit receives only the frequencies it is designed to handle. In a high power, high performance sound system, the crossover should also reject unsuitable frequencies to avoid damage and poor quality sound.

Fig 1.1 Stereo 2-way Crossover set-up

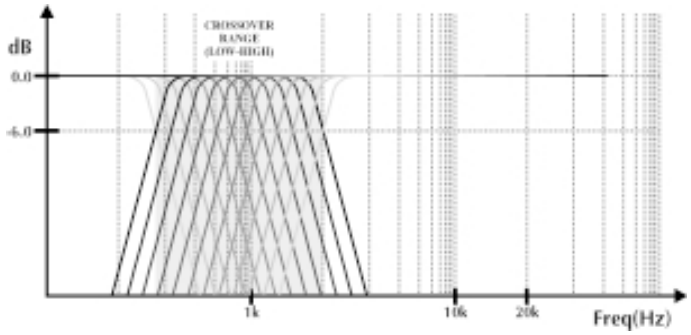
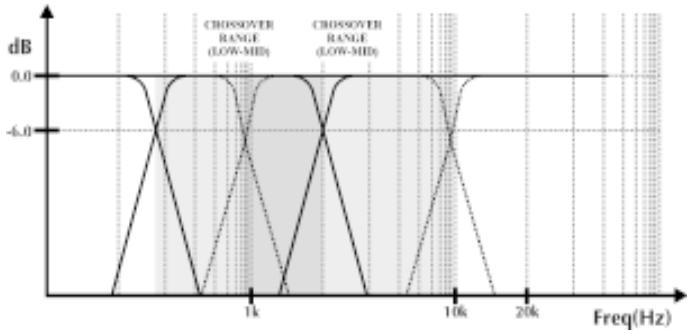


Fig 1.2 Mono 3-way Crossover set-up



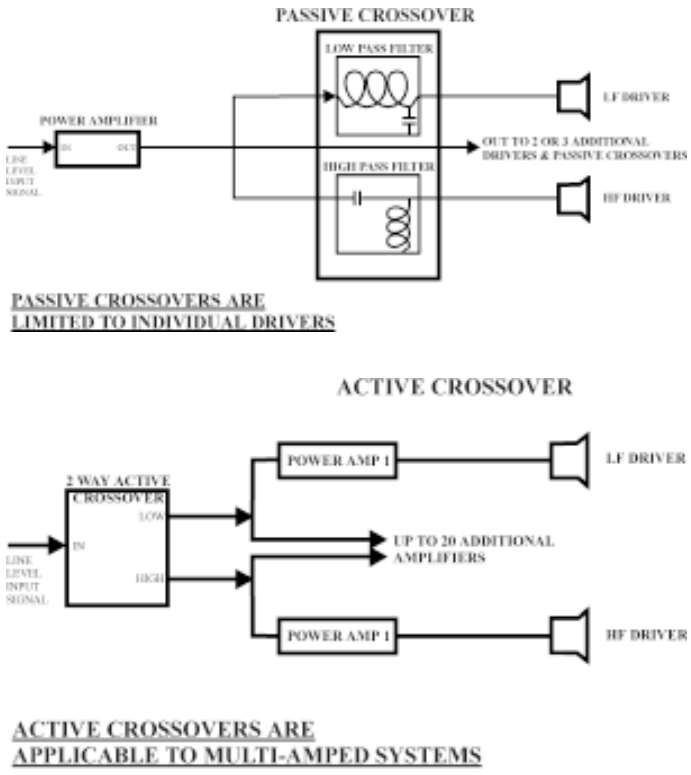
Active and Passive Crossovers

2.0 The difference between Active and Passive Crossovers

Passive crossovers divide the frequency spectrum after the signal has been raised to a high power level. They are generally heavy, bulky and inefficient.

Active crossovers utilise ICs and transistors, and divide the frequency spectrum at line levels immediately ahead of the amplifiers (***See Figure 2.1***). *An active crossover does the same job as a passive crossover, but with more precision, flexibility, efficiency, and quality.*

Fig 2.1



Some advantages of active crossovers are:

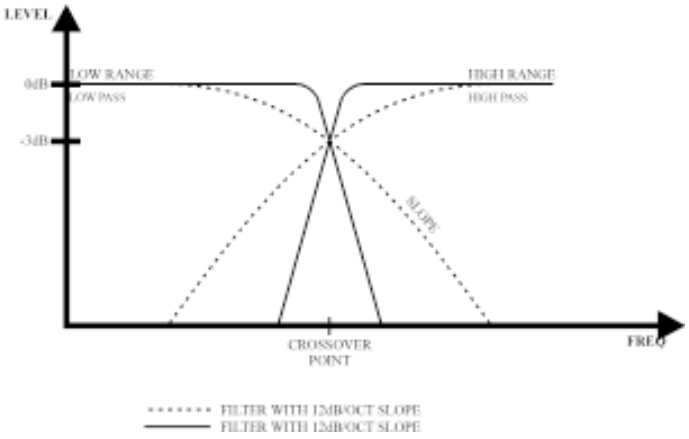
- Crossover frequencies can be more readily altered to suit different driver-horn combinations.
- The level balance between the 2 or 3 frequency bands (brought on by differences in driver and amplifier sensitivity) can be readily trimmed.
- Inside an active crossover unit, line-driving, signal summing, driver equalisation, system muting and polarity ('phase') reversal facilities can all be incorporated at small extra cost.

3.0 Other advantages

The drive-units in sound reinforcement systems utilising active crossovers benefit because:

• Steep rolloffs are readily attainable. The -24dB/OCT rolloff in the BSS **FDS-310** active crossover rapidly discharges out-of-band energy. *At one octave below the crossover point, power received by the driver has dropped to less than ½% (or 1/200th) of full power*. The result: Bad sound resulting from out-of-band resonances is effectively masked immediately beyond the crossover frequency (***See Figure 3.1***). This contrasts markedly with passive crossovers, where slopes in excess of -12dB/OCT are rarely achieved, and power rolloff is 4 times less rapid per octave.

Fig 3.1 Crossover Terminology



• If one frequency range is driven into clip, drive-units and horns in other frequency ranges are protected from damage, and distortion is kept to a minimum.
• Direct connection of drive-units to the power amplifier cut out loss of damping factor, normally inevitable, thanks to the appreciable resistance of the inductors in passive crossovers.

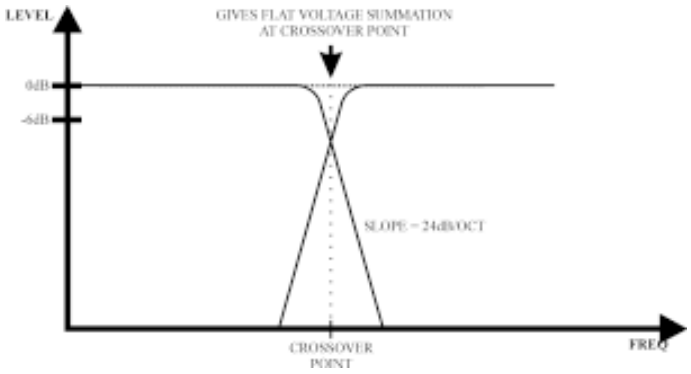
Amplifiers benefit too from the use of active crossovers. As they do not handle a full-range signal, clipping produces far less harmonic and intermodulation distortion. The results: Momentary overdrive sounds less harsh. Also the amplifiers' dynamic headroom is generally higher, and heatsink temperatures can run lower.

Linkwitz-Riley Alignment

4.0 The Linkwitz-Riley advantage

There is an additional set of advantages exclusive to active crossovers made by BSS, and other manufactures using the Linkwitz-Riley alignment (***See Figure 4.1***).

Fig 4.1 Linkwitz-Riley filters



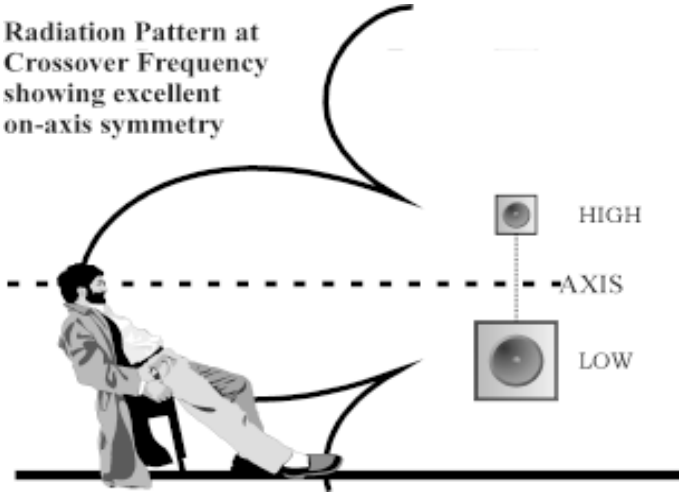
Zero Phase difference at crossover: The phase difference between drivers operating in adjacent frequency bands is close to zero degrees at the crossover frequency.

'Phase alignment' in this manner prevents interactive effects (i.e.: High and Low drivers 'fighting' each other) over the narrow band of frequencies around the crossover point, which is where the units from two adjacent frequency ranges are contributing near equal amounts of sound pressure.

More predictable sound dispersion: By providing in-phase summation at the crossover point(s), the Linkwitz-Riley alignment provides for more coherent sound dispersion - it provides on-axis symmetrical radiation patterns. (***See Figure 4.2***).

'Invisible' slopes: The absence of electrical phase difference close to the crossover frequency helps to make the steep -24dB/OCT slope effectively inaudible. Response peaks and dips are negligible and inaudible given the correct polarity ('phasing') of the speaker connections. The same is not true of the shallower (-6, -12 or -18dB/OCT) rates or rolloff, in other crossovers.

Fig 4.2 Radiation Pattern Frequency showing excellent on-axis symmetry



5.0 What is special about BSS Crossovers?

The **FDS-310** is a condensation of over ten years experience, manufacturing the industry's most advanced active crossovers for worldwide use. The **FDS-310** contains all the features required for todays sound reinforcement systems in a compact enclosure:

- It can be configured for 2 2-way channels, or for 3-way single channel operation.
- Crossover frequencies are easily and precisely adjustable for all applications including sub-woofers. ANY frequency between 180Hz and 9kHz can be selected at the turn of a knob. Additional crossover frequencies down to 18Hz can be selected by activating internal, tamper-free switches.
- Stereo signals can be summed for driving sub-woofers in mono.
- Equalisation suiting 'industry standard' HF CD (Constant Directivity) horn/driver combinations is factory fitted and can be immediately activated.
- All inputs and outputs are balanced for ease of system installation and interconnection, without hums and buzzes. Additionally, for each frequency band:
- A green LED confirms signal present.
- A red LED warns of peak clipping (overdrive).
- A MUTE switch allows each frequency band to be switched in/out as an aid to diagnosis and setting-up.
- A calibrated LEVEL CONTROL accommodates wide variations in the sensitivity of adjacent frequency bands.
- A POLARITY switch enables each bands' polarity (or absolute 'phase') to be reversed (or 'inverted').
- Additional, optional internal settings are confirmed by panel LEDs.

Every **FDS-310** is manufactured to the highest professional standards, with a robust steel case, high quality circuit boards, ICs and high quality components, to provide reliable performance under the most demanding conditions of the global sound-reinforcement environment. In common with all other BSS equipment, the **FDS-310** is subject to stringent quality control procedures throughout the manufacturing process. Components are tested against demanding acceptance criteria. Each completed unit is tested both by measurement, and in a listening test carried out by trained audio professionals. To positively ensure reliability, all units are burnt-in for fifty hours before being tested.

6.0 Unpacking

As part of BSS' system of quality control, this product is carefully inspected before packing to ensure flawless appearance.

After unpacking the unit, please inspect for any physical damage and retain the shipping carton and ALL relevant packing materials for use should the unit need returning.

In the event that damage has occurred, please notify your dealer ***immediately***, so that a written claim to cover the damages can be initiated. ***See Section 25***.

Getting to know the *FDS-310*

Fig 6.1 Front Panel

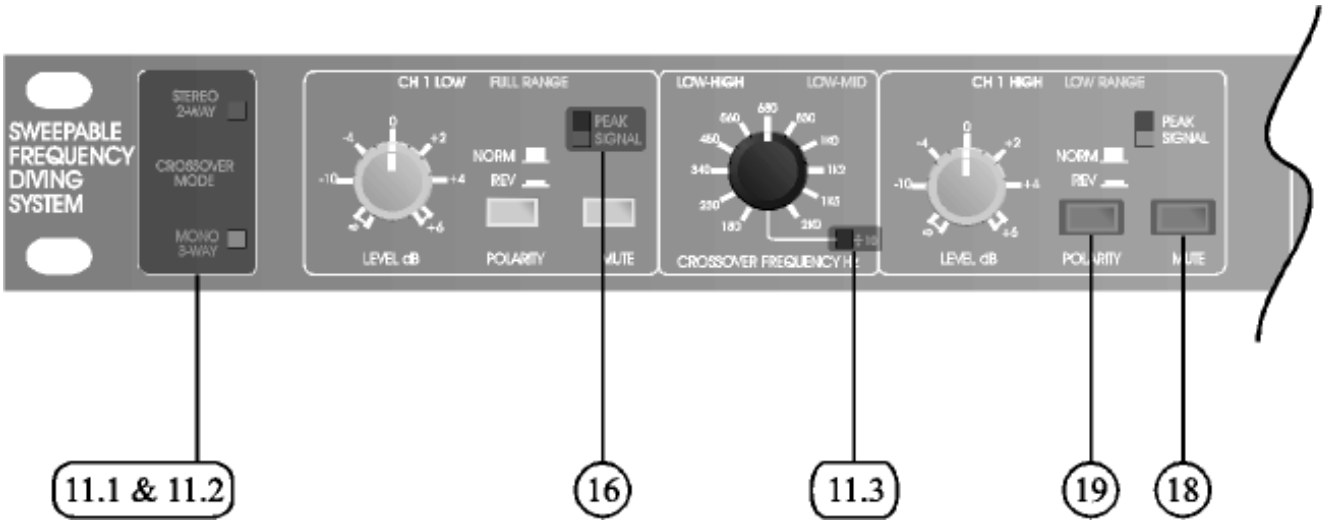
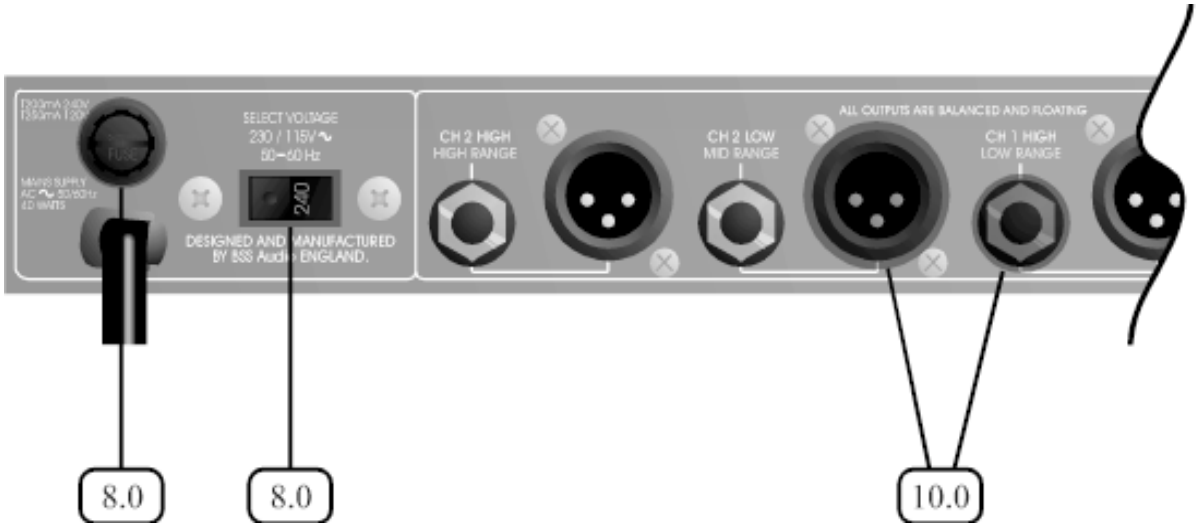
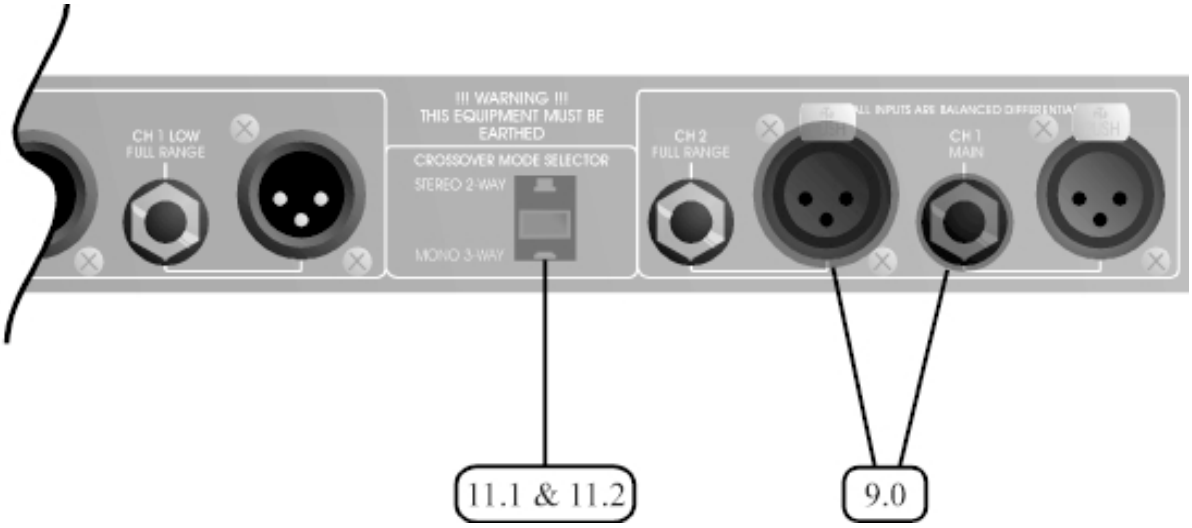


Fig 6.2 Rear Panel





All numbers in bubbles refer to Section numbers.

7.0 Mechanical Installation

A vertical rack space of 1U (1¾" / 44.5 mm high) is required. Ventilation gaps are unnecessary (***See Figure 7.1***).

If the **FDS-310** is likely to undergo extreme vibration through extensive road trucking and touring, it is advisable to support the unit at the rear and/or sides to lessen the stress on the front mounting flange. The necessary support can generally be bought ready-built as a rack tray. As with any low-level signal processing electronics, it is best to avoid mounting the unit next to a strong source of magnetic radiation, for example, a high power amplifier, to help keep residual noise levels in the system to a minimum.

Fig 7.1 Unit dimensions.

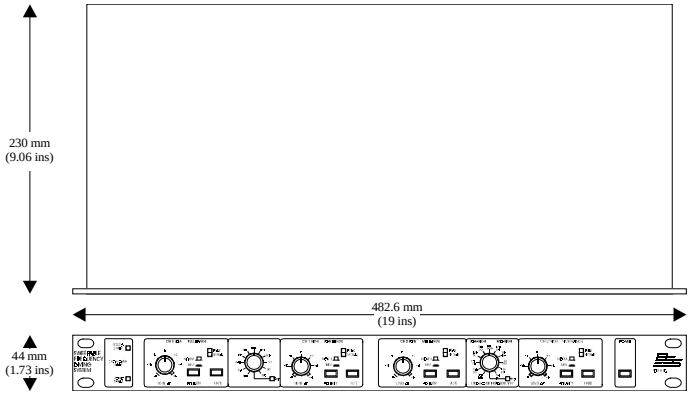
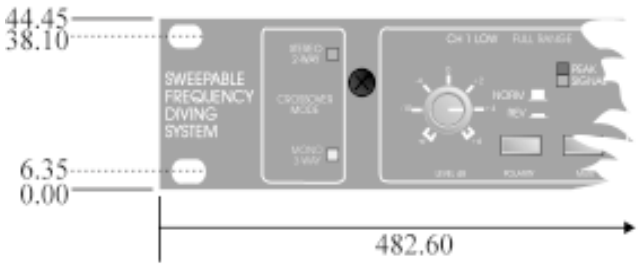


Fig 7.2 Rack dimensions.



Note: All dimensions in mm.

8.0 Mains Power Connection

Voltage: The **FDS-310** operates on either 115 or 230 volt supplies. Use the voltage selector switch to choose the required voltage setting. (***See Figure 8.1***).

Frequency: Both 60Hz and 50Hz are acceptable.

Fig 8.1 Mains fuse/ Voltage selector on rear panel.

Grounding: The **FDS-310** must always be connected to a 3-wire grounded ('earthed') AC outlet. The rack framework is assumed to be connected to the same grounding circuit. The unit must NOT be operated unless the power cable's ground ('earth') wire is properly terminated - it is important for personal safety as well as for proper control over the system grounding. To 'lift' the signal ground (0V), ***refer to section 21***.

AC Power fusing: The incoming line passes through an anti-surge ('T') fuse, accessible from the rear panel. If the fuse blows without good reason, ***refer to section 20***. Always replace with an identical 20mm x 5mm 'T' fuse, rated at 200mA or 250mA for 230V or 115V settings respectively, for continued protection from equipment damage and fire.

Power ON: This is indicated by either of the green and yellow LEDs on the left side of the panel, labelled 'MONO 3-WAY' and 'STEREO 2-WAY' depending on the mode you have selected. If neither of these LEDs are lit when the power is connected and the power switch is depressed, ***refer to section 20***.

9.0 Input Connections

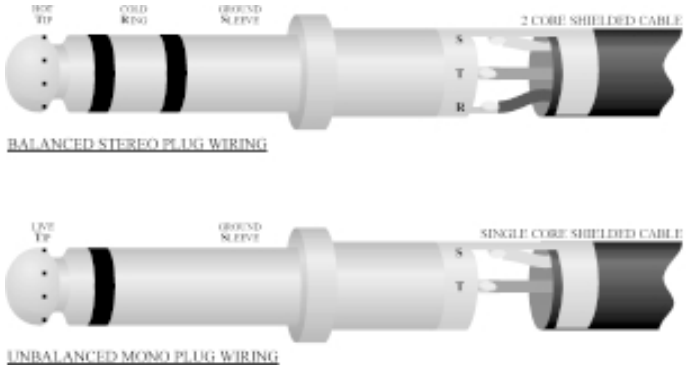
9.1 Using Jack Plugs.

Each jack socket accepts signal sources from a 3-pole (stereo), or 2-pole (mono), 'A' gauge phone plug (***See Figure 9.1***).

The balanced input of the **FDS-310** will accept both balanced or unbalanced signal feeds, without needing any modification.

There is no internal ground connection to the 'sleeve' on the input jack socket, to avoid possible interconnection earth loops. The input signal cable shield *must* therefore be tied to ground, or signal 0V, at the source end.

Fig 9.1 Phone Jack Wiring



9.2 Using XLR Plugs.

Each female XLR receptable accepts both balanced and unbalanced signal sources. For balanced sources, the incoming XLR plug should be connected as follows (***See Figure 9.2***):

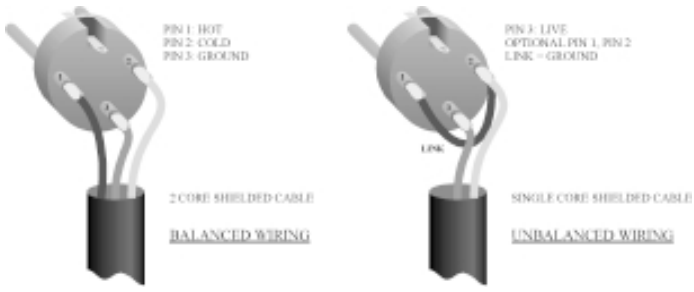
Pin 1: No connection (it is good practice to terminate the drain wire of the shield here).
Pin 2: Signal '-', out of phase or 'COLD'.
Pin 3: Signal '+', in phase or 'HOT'.

For unbalanced sources (***See figure 9.2***):

Pin 1: Leave open, or link to pin 2.
Pin 2: Shield, braid, or screen wire.
Pin 3: Signal '+' or 'HOT' (inner core).

There is no internal ground connection to Pin 1 of the female XLR to avoid possible interconnection earth loops. The input signal cable shield *must* therefore be tied to ground, or signal 0V, at the source end. ***See section 21*** for help with grounding procedure.

Fig 9.2 XLR Plug Wiring



10.0 Output Connections

10.1 Using Phone Plugs

Each jack socket outputs a balanced signal - symmetrical to ground and floating. The output is immune from short circuits and drives low impedances and long cable runs. Each socket accepts either 2-pole or 3-pole (stereo) ¼" 'A' gauge phone plugs. In general, these plugs will automatically provide a suitable interface with unbalanced and balanced circuits respectively (***See Figure 9.1***).

Correct phasing needs attention if the output lines are balanced. For the majority of balanced line interfaces where the mating jack plugs tip is '+' (or 'hot' or 'in phase'), simply insert the phone plug.

If the **FDS-310** output is normally connected via jacks *but the input is connected through an XLR plug*, be sure to check XLR polarity. If wired according to section 8, there will be no problem. If wired with reversed (European) polarity (Pin 2 'hot', Pin 3 'cold'), the output '+' (hot) will appear on the phone plugs ring, not tip. In other words, the signal phase or polarity is transposed when passing through the unit.

The situation can be resolved by swopping around the '+' and '-' connections to Pins 3 and 2 respectively on the incoming XLR. If in doubt, use a Phase-checker set. If *all* the surrounding XLR cables are wired Pin 2 '+' ('hot'), you may find it more convenient to transpose the output sockets polarity. If so, ***refer to section 19***. If the amplifiers you are feeding have unbalanced (single ended) inputs, and your system is normally hooked-up with jack plugs, we recommend you use a standard 2-pole 'A' gauge phone plug, conventionally wired, as with a guitar lead.

Tip:	To the inner live conductor.
Sleeve:	To the cable shield or screen.

10.2 Using XLR Plugs

Each male XLR outputs a balanced signal - symmetrical to ground and floating. The output is immune from short circuits and drives low impedances and long cable runs. Each output can be interfaced directly with balanced equipment inputs, down standard 2-core shielded terminated XLRs wired 'pin to pin' (***As Figure 9.2***).

Pin 1: Connects to shield, screen or drain wire.
Pin 2: '-', cold or 'out of phase' output.
Pin 3: '+', hot or 'in phase' output.

If the amplifiers you are feeding have unbalanced (single ended) inputs, but are fed from standard pin to pin XLR cables (see above), simply link the cable at the crossover end as follows:

Pin 1: Connects to shield or screen wire.
Pin 2: Link to Pin 1.
Pin 3: Connects to the inner 'hot' or live core.

Unbalanced transmission is not recommended for connections to distant equipment, but is generally acceptable for local connections within the rack or to an adjacent rack.

Technicians note: As with a traditional transformer balanced output, either output phase (+ or -, hot or cold) can be linked to ground to 'unbalance the line' without upsetting the operation of the unit. As with a transformer, output level remains the same in the unbalanced mode.

Setting up -
2-Way 2 Channel Operation

11.0 Connection and Setup

11.1 Selecting '2-Way' 2 Channel Operation

In a 2-way system, the incoming full range signal is split into 2 bands. Normally the corresponding loudspeaker drive units cover Bass (LOW), Top (HIGH) frequencies, and the crossover point between them lies between 180Hz and 2000Hz (2kHz). When setup for 2-way operation, the **FDS-310** handles two channels (stereo). If required, the levels and crossovers points of each channel can be independantly controlled:

• Release the grey switch on the rear panel 'CROSSOVER MODE SELECTOR'. Now looking at the front panel left side, check that the green LED 'STEREO 2-WAY' is lit.

• For single channel operation, insert one input and two output plugs into 'CH.1 MAIN', 'CH.1 LOW' and 'CH.1 HIGH' respectively.

• For dual channel operation, insert two input and four output plugs into the sockets labelled:

CH.1 MAIN CH.2 MAIN	INPUTS.
CH.1 LOW CH.2 LOW	LOW (LF) OUTPUTS.
CH.1 HIGH CH.2 HIGH	HIGH (HF) OUTPUTS.

For stereo operation, we recommend the following:

CH.1 is designated LEFT Channel.
CH.2 is designated RIGHT Channel.

• To set the crossover point, turn the black knob marked 'CROSSOVER FREQUENCY Hz' to the desired figure in Hz/kHz. On Channel 2's scale, refer to the upper, white legend scaled '180-2k0'.

*If the **FDS-310** has been used previously, check that the red LED marked '10' next to each frequency knob is unlit.* If lit, the 'divide by 10' option needs disabling - so do not use the crossover until you have read ***section 11.3***.

Setting up - 3-Way Mono Operation

11.2 Selecting '3-Way' Mono Operation

In a 3-way system, the incoming full range signal is split into 3 bands. Normally the corresponding loudspeaker drive units cover Bass (LOW), Mid and Top (HIGH) frequencies. In this mode, the **FDS-310** operates in mono and there are two crossover points.

The LOW-to-MID crossover point normally lies between 180Hz and 2000Hz (2kHz).

The MID-to-HIGH crossover point normally lies between 800Hz and 9000Hz (9kHz).

For 3-way operation, follow the yellow legend on the rear panel.

• Depress the grey 'CROSSOVER MODE SELECTOR' switch on the rear panel. Now check the yellow LED marked 'MONO 3-WAY' on the front panels left side is lit.

• Insert one input and three output plugs into the following sockets:

CH.1 MAIN LOW RANGE	INPUTS.
MID RANGE HIGH RANGE	OUTPUTS.

See ***sections 9 & 10*** for wiring details.

• To set the low-mid crossover point, turn the black knob marked 'LOW-MID' and 'CROSSOVER FREQUENCY Hz' to the desired figure in Hz/kHz. To set the mid-high crossover point, turn the black knob marked 'MID-HIGH' and 'CROSSOVER FREQUENCY Hz' to the desired figure in Hz/kHz. Ignore the white (2-way) scaling and refer only to the yellow legend, scaled 800-9k0.

*If the **FDS-310** has been used previously, check that the red LED marked '10' next to each frequency knob is unlit.* If lit, the 'divide by 10' option needs disabling - so do not use the crossover until you have read ***section 11.3***.

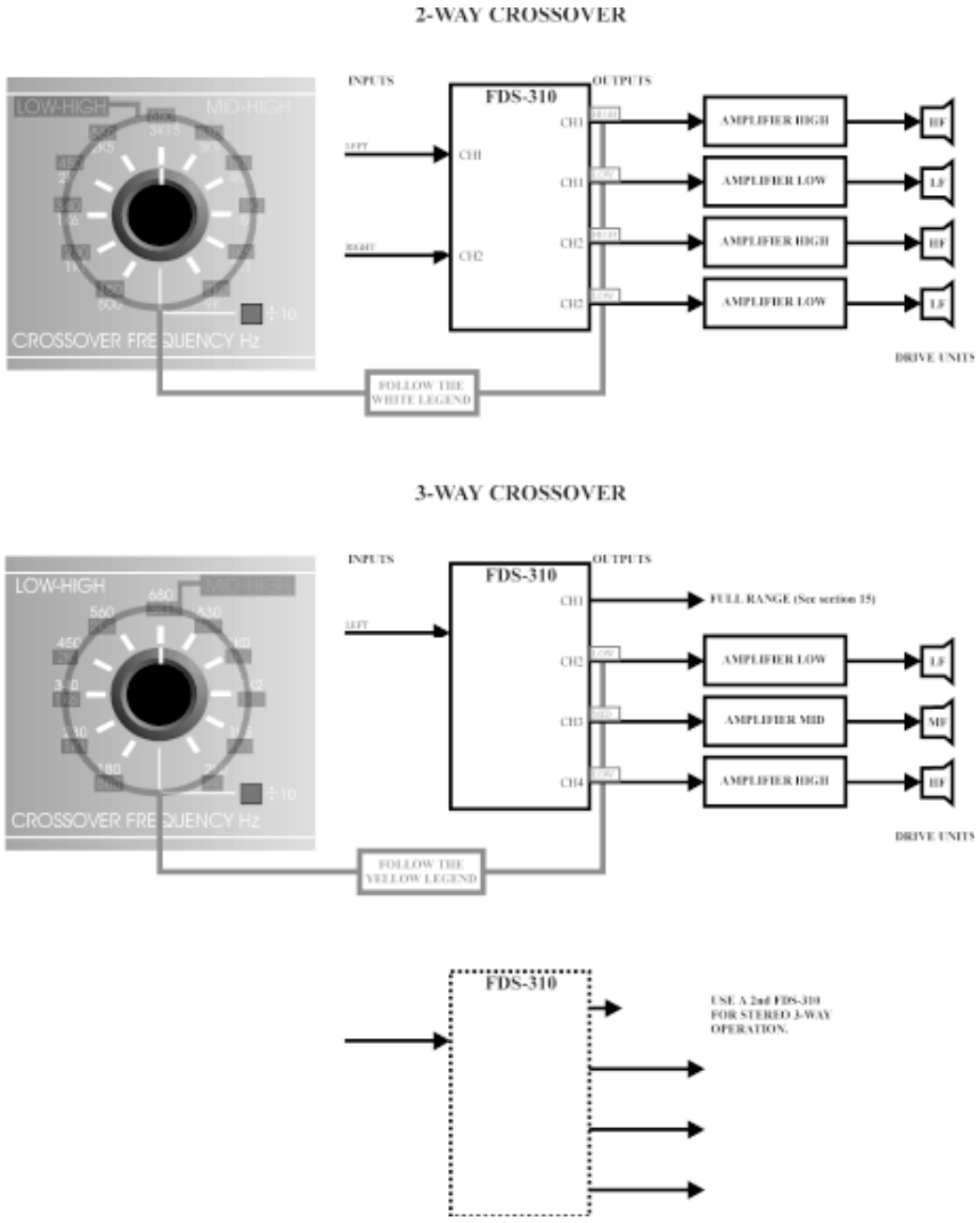
ALWAYS check the crossover frequency is set to a safe minimum figure before driving the system at high levels:

• Set levels controls to their centre zero position, for best sound balance, ***refer to section 17***.
• For CD Horn equalisation, ***refer to section 14***.
• For sub-woofer (sub-bass) applications, ***refer to sections 11.3 & 13***.

CAUTION: Setting too low a crossover frequency can damage HF drive-units and/or impair their reliability and sound quality.

Setting up - Schematics

Fig 11.1 2- and 3-Way Setups



11.3 2-Channel Sub-Woofer Operation

The **FDS-310** can drive sub-woofers ('Sub-Low or 'Sub-Bass' cabinets) when switched to the 2-way configuration. The Sub-woofer-to-HIGH crossover point can lie anywhere between 18Hz and 200Hz. The 'high' output is substantially a full range signal, and is normally split further into 2 or 3 bands, using a second active crossover. As with conventional 2-way operation, the **FDS-310** handles up to 2-channels (stereo) in sub-woofer mode. If a mono sub-woofer output is required, ***refer to section 13***. ***Refer to section 22.1*** for information on locating the FREQ switches.

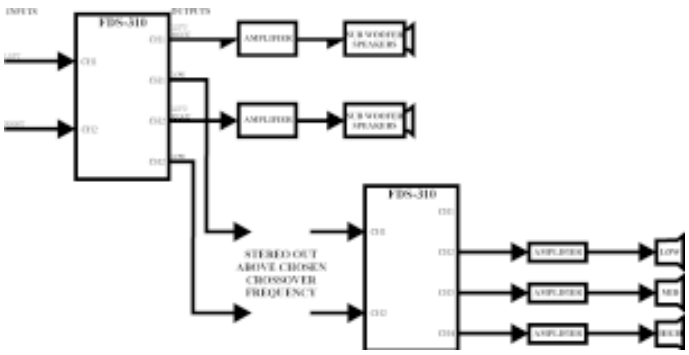
12.0 Monaural Sub-Woofer Operation - for stereo 2-way systems only

Because human hearing is insensitive to the location of low-frequency sound sources below 100Hz, stereo operation is normally dispensed with when driving sub-woofers. The **FDS-310** contains an internal link which can be set to sum (mix) the incoming two channel (stereo) signals, so that the two sub-low outputs are identical. Meanwhile, full stereo operation is retained on the 'high' outputs. ***Refer to section 22.2*** for information on activating the sub-woofers 'MONO mode:

The CH.1 and CH.2 'LOW' outputs will now output an identical sub-woofer signal. At the same time, the drive levels can be individually adjusted (as before), using the CH.1 LOW and CH.2 LOW 'LEVEL' controls. This is useful when the two outputs are used to drive different sub-woofer amplifiers at different locations, requiring an independent sound balance.

If there is only one sub-woofer, or the sub-woofers absolutely do not require different drive levels and can therefore be driven from just one of the two outputs, the unused output serves as a spare.

Fig 12.1 Mono Sub-Woofer System



13.0 Unusual Crossover Points - for 3-way systems only

This is for when a 3-way system requires crossover frequencies outside the normal range. The internal switches SW2 and SW3 (***described in section 11.3***) can be used to extend the range of available crossover points downwards:

• If you require a LOW-to-MID crossover frequency *below* 180Hz, set SW2 'FREQ' switch to 'divide by 10'. The control will now sweep from 18Hz to 200Hz.
• Setting SW3 to the 'divide by 10' position will produce a sweep from 18Hz to 200Hz for the MID-to-HIGH crossover frequency. This will only have limited applications for specialist systems, and care must be taken in its use.

14.0 How to Equalise CD Horns

Todays 'Constant Directivity' (CD) horns and drivers can be used in 2-way systems with comparatively low crossover frequencies.

Even so, the laws of physics dictate that the very high efficiency attained cannot be kept up all the way to 20kHz. In addition, the CD horns control of dispersion further 'thins out' the SPL at higher frequencies. As a result, response falls off progressively above 4kHz, and more rapidly above 20kHz.

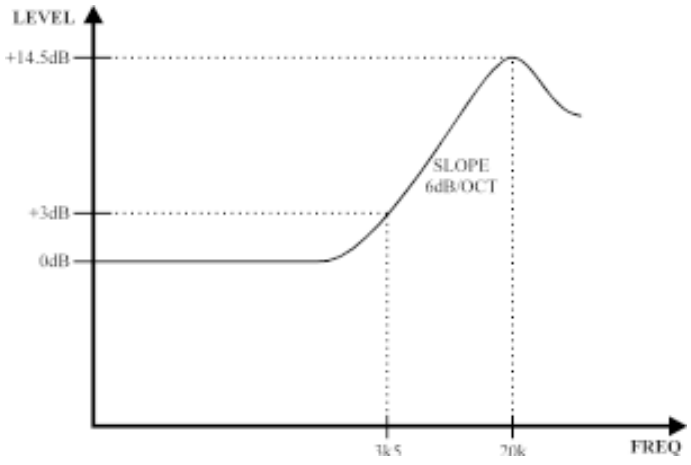
In the **FDS-310**, optional equalisation has been fitted to compensate for the effect and provide a more level acoustic response (***see Figure 14.1***).

When 'STEREO 2-WAY' operation is selected, CD horn equalisation can be individually setup on both CH.1 and CH.2 HIGH outputs.

When set to 'MONO 3-WAY' mode, the CD horn equalisation can be setup on the HIGH output (Output 4). The equalisation for output 2, even if selected, is automatically defeated when in 3-way mode. This means the **FDS-310** can be switched from 2 to 3-way operation with any combination of horn EQ installed, without complications.

Horn EQ selected	Output status:
	2-way Operation
OUTPUT 2	EQ on CH.1 HIGH only.
OUTPUT 4	EQ on CH.2 HIGH only.
OUTPUT 2 & 4	EQ in stereo (CH.1 & CH.2).
	3-way Operation
OUTPUT 2	No EQ.
OUTPUT 4	EQ on 'HIGH RANGE' only.
OUTPUT 2 & 4	EQ on 'HIGH RANGE' only

Fig 14.1 CD Horn EQ Response



Refer to section 22.3 for information on activating the equalisation.

15.0 Full range Output - 3-way operation only

When switched on 'MONO 3-WAY' mode, the Channel 2 input ('FULL RANGE' in 3-way mode) is not wasted. Instead, it can be used as a balanced in-out line driver passing through to the adjacent 'FULL RANGE' output sockets. Follow the yellow legend for this.

In combination with the remainder of the **FDS-310**, it shares the following facilities:

- Up to +6dB of gain.
- +6 to -00 gain adjustment, using the 'FULL RANGE' level trim control.
- Balanced or unbalanced drive into load impedances down to 600 ohms.
- Input filtration: -3dB down at 15Hz and 30kHz, see the main specification in ***section 24***.

Only the crossover filter slopes are disabled in 3-way mode. The 'FULL RANGE' output retains MUTE and POLARITY switching, and PEAK and SIGNAL present LED indication, as specified in ***section 16***.

16.0 LED indicators

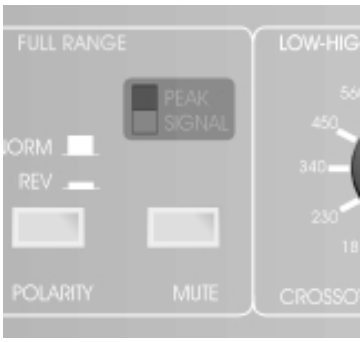
16.1 'Signal Present'

On each channel, the LED 'GREEN SIGNAL' lights to show that a signal is being received. Steady illumination means high drive levels. Periodic flashing indicates average drive levels. The LEDs will NOT LIGHT if the peak signal level stays below -15dBu (138 millivolts).

16.2 'Peak'

On each channel, the red 'PEAK' LED lights if the internal signal levels of the crossover approaches or exceeds overload. They will light at levels in excess of +17dBu, giving a 3dB advance warning of actual overload and clip which occurs at +20dBu .

Fig 16.1 Peak and Signal LEDs



The signal level appearing at the output sockets under these conditions will depend on the level control position. However, most power amplifiers will be driven hard into clip at levels in excess of +1dBu. Remember that clipped output signals are the number one cause of damaged loudspeaker drive-units. Under all normal conditions, and with a normal system gain-structure, the red 'PEAK' LED will NOT flash - EVER.

If the **FDS-310** requires driving so hard that the 'PEAK' LEDs are periodically lit up, we recommend that you investigate your system's gain structure, particularly the power amplifiers sensitivity.

Crossover Alignment Procedure

17.0 Crossover Alignment Procedure: Setting the level controls

The modern idea is to set the crossovers' level controls so the entire speaker system exhibits a uniform, flat response, independent of the rooms' own acoustic anomalies. This means that powerful T.D.S. (Time-Delay Spectrometry) equipment is needed to make speedy, reliable measurements. When room acoustics are less than perfect and the scope for improving the acoustics is limited, some element of compromise is needed.

A real time analyser (R.T.A.) can be used to aid setting up in conjunction with pink noise. However, R.T.A is not the complete answer, owing to it's inability to measure the direct sound field (it cannot altogether ignore the room's effects). For this reason, fine tuning is always best done by ear.

Using a Real Time Analyser: If the speaker system is concentrated in a single stack (or several stacks), the direct sound field will generally 'come together' about 10 to 15 feet *on axis to* (in line with the centre of) the front of the stack. This is the optimum location for the analyser's microphone.

• With the **FDS-310** switched on and connected, make sure you have set up the intended crossover frequency (***See sections 11.1 & 11.2***).
• Set all the level controls on the crossover to the 'Infinity' position (7 o'clock).
• Connect up the R.T.A. The pink noise output drives the system through the mixer, then the crossover. For now, set the mixers output fader at 'Infinity' (nil). All EQ controls throughout the sound system should be set to **flat**. House EQ (if fitted) should be adjusted later, once the sound systems' basic response has been made as smooth as possible by adjusting the crossover. The analysers microphone is positioned on axis to the speaker stack. At this juncture, any other speaker stacks should be muted (***See section 18***). If you are setting up a 2-Channel (stereo) system, tune up ONE channel at a time.
• Set all the power amplifiers attenuator (level) controls (where fitted) at maximum. Alternatively, and more cautiously, you can initially set all controls at halfway, but only if the amplifiers are identical. Otherwise the degree of attenuation could vary widely, making it difficult to maintain balance when the control settings are later increased to yield a better gain structure.
• Taking the 3-way mode as an example, set the LOW RANGE control on the crossover at 0dB, then gently raise the mixers output fader until you hear a moderate level of pink noise rumbling through the low frequency driver(s). A Sound Pressure Level of around 90 dB_{SPL} C-weighted is optimum, being enough to swamp the ambient noise level (unless the environment is very noisy).
• Set the analysers sensitivity control to a suitable level, usually between 90 and 100 dB_{SPL}. Then tweak the pink noise drive level using the mixers' output fader, until the low frequency read out (typically 100Hz up to your chosen crossover point) is averaging 0dB (referred to 90dB_{SPL}) on the analysers scale.
• Now slowly turn up the MID RANGE control on the **FDS-310** until the analyser shows the same average output level in the mid band region.

If the pink noise appears higher in pitch and/or seems to be coming from the mid or high drive-units, turn down immediately, and re-check connections!

If the mid output is not enough, even when the crossovers MID RANGE control is set at maximum (+6dB), check the mid-range power amplifiers sensitivity. If this cannot be altered, set the MID RANGE control at 0dB, then decrease the LOW RANGE control, until the two frequency bands fuse together to give an essentially straight line on the R.T.A display. If the response appears uneven around the LOW-to-MID crossover frequency, the drivers polarity may be reversed. ***Refer to section 24*** to remedy this.

• Repeat the procedure again for the HIGH RANGE control. Again, look for the response around the MID-to-HIGH crossover frequency. If uneven, ***refer to section 19***. If the high frequency output is not enough, even when the HIGH RANGE control is set at maximum (+6dB), check the high end amplifier(s). Since HF drive-units are generally 6 to 12dB more sensitive than mid and low drive-units, this condition suggests an error in the wiring. When looking for a 'flat' response, do not forget that the crossover cannot correct for the drivers rolloff at low and high frequencies. Concentrate instead on looking for a flat response in *upper* regions of the low drivers frequency range, and the *lower* regions of the high end drivers frequency range (Unless Horn EQ is applied, then ***refer to section 14***). You may wish to repeat the analyser readings with the microphone placed in a different location. If so, be aware that at locations of greater than 15 feet or off-axis to the drive-units, the rooms acoustic will affect the results. In general, the human hearing mechanism will give preference to the direct sound balance.

Using an SPL meter: If you do not have access to a Real Time Analyser, a conventional SPL meter can be used instead, provided you have a pink noise source. In general, tone or sine-wave generators are NOT acceptable in place of pink noise, unless they produce a pulsed 'warble' effect. Otherwise major standing-waves can build up, leading to an exaggerated response at spot frequencies. Like the RTAs microphone, an SPL meter should be mounted on a microphone stand, on-axis to the speaker stack. Set the meter to read 'C' weighted (flat). When setting up, measure just one frequency band at once. This means muting the low frequency band (Using the MUTE switch, ***see section 18***) before moving on to the mid (or high) frequency band. Then mute the low and mid, before moving onto the high setting. Overall, your aim is to ensure that the indicated SPLs of the low, mid and high ranges are the same, all $90dB_{CSPL}$ for example. Again, fine tuning should be done by ear.

Using your ears: Many skilled sound engineers will be confident about adjusting the LOW, MID and HIGH RANGE controls by ear alone. This method is quick, and here are some tips to enhance accuracy:

• For a system principally intended for music, use a selection of prerecorded music you know well. You should have a good idea of what it is *supposed* to sound like. For a speech only system, there is nothing better than using an experienced public speaker. If you have to use recorded speech, look out for comparable dynamics; recordings from FM radio can be heavily compressed.
• If the sound system is principally intended to reproduce *recorded* music, we suggest you use quality recordings of vinyl disc on IEC type II chrome (CrO_2) tape.
• If the sound system is principally intended to reproduce *live* music, prerecorder music from CDs will provide more representative dynamics. If a CD player is unavailable, recordings from CDs onto IEC type II chrome (CrO_2) tape are the next best thing.

MUTE switch

• All EQ controls throughout the sound system should be set flat before setting up the **FDS-310** LEVEL controls. Any house EQ adjustments can be made later.
• For a 3-way set up, set the MID RANGE control first for a comfortable level. Then bring up the LOW RANGE control until the music/vocals/speech is 'filled-out'. Next, increase the HIGH RANGE control until the vocals have a natural presence. Finally, you may want to readjust the LOW RANGE for the best balance.
• Where ever possible, note the LEVEL control settings and then challenge your colleague(s) to repeat the set up, from scratch. Compare your settings, and try to arrive at a 'best fit' if your ears disagree.

18.0 Using the Mute switch

Each frequency bands' control surface includes a MUTE switch (***See Figure 6.1***). Depressing it silences the output in question. The associated PEAK and SIGNAL LEDs remain in operation. Push button muting is an invaluable facility when setting up, otherwise the LEVEL controls would need to be reset to -00.

19.0 Polarity switching and Output Polarity reversal option

Each frequency bands' control surface includes a POLARITY switch (***See Figure 6.1***). Depressing it *reverses* the polarity ('phasing') of the signal emerging from the related output socket. It is a valuable 'instant' troubleshooting aid in complex multi-driver installations.

Polarity in/out relations are factory set, so at any input and any related output:

- XLR + or HOT goes to Pin 3.
- Phone sockets + or HOT goes to tip.

Although wired to 'Pin 3 HOT' convention, this arrangement is perfectly compatible with XLR Pin 2 systems (to IEC 268 standard), *provided input and output are wired alike* (meaning 'Pin for Pin'). This applies to the phone plugs only. The only problem with operating in 'Pin 2 HOT' mode concerns the phone plugs, where the 'ring' terminal become the 'HOT' one. If the remainder of the system is wired 'Pin 2 HOT', you may wish to reverse the sockets polarity, so the tip becomes the 'HOT' terminal. ***Refer to section 22.5*** for information on reversing polarity.

Aside from loudspeaker drive-unit connections, polarity transposition can arise in balanced interconnections, if 'HOT' and 'COLD' are swopped on one (stereo) channel, but not the other. If this has happened, it is more likely to occur before the crossover. The low frequencies will sound weak and the stereo image will be thin and distant. If you set up sound reinforcement systems frequently, a 'phase' or 'polarity' checker set is an invaluable tool for speedily tracking down any mistakes, and confirming that inter-channel and inter-band polarity are all correct.

20.0 Troubleshooting

Problem: **No Output**

Solution: Is the MUTE switch depressed?
Is the mains power on? (***See section 8***).
Check the connections. See Fuse failure (below).
Do you have an input signal?
Is the SIGNAL LED on?
Check the input and output connections (***See sections 9 & 10***).
Are the power amplifiers switched on?

Problem: **High Frequency signal from 'LOW' output**
Low Frequency signal from 'HIGH' output.

Solution: Switch unit to 3-way operation.

Problem: **Low Frequency signal from CH.1 'HIGH' output**
Full range signal from CH.1 'LOW' output.

Solution: Switch unit to 2-way operation.

Problem: **Sibilant, hissy HF response.**

Solution: Check CD Horn EQ:
If 'EQ IN', check if required.

Problem: **Low signal level on one or two outputs.**

Solution: If the effect depends on the frequency controls setting, view the panel LEDs to conform the internal 'FREQ' switches are set correctly (***See sections 11.3 - 13***).
Then check level control(s) and output wiring.

Problem: **Excessive Hum, Intermittent sound.**

Solution: First check the connections on your input and output plugs (***See sections 9 & 10***). Unshielded cables, improperly wired connectors and damaged cables are the most common cause of sound system hums and buzzes. Then ***refer to sections 8 and 21***.

Problem: **Fuse Failure.**

Solution: The mains supply fuse is unlikely to blow without an electronic fault being present (***See section 8***). If the fuse blows again at switch on or after a short interval, switch off the unit and arrange for servicing. The internal DC fuses will only blow in the event of major fault condition. If they are visibly blown, **DO NOT OPERATE THE UNIT**. Return it to be serviced.

21.0 Grounding/Earthing Procedures (Curing hums)

The **FDS-310** is supplied with the signal ground (0V) tied to chassis, which is connected in turn to:

- Mains ground (earth).
- Other equipment chassis' in the rack.

If the **FDS-310** outputs are connected to amplifiers with unbalanced inputs, it will normally be necessary to disconnect the internal ground link, to prevent ground-loop hums. ***Refer to section 22.4*** for information on this procedure:

Since the **FDS-310** has balanced inputs and outputs, and because there is no input ground connection, it is very unlikely that any connection problem will be experienced, *provided the wiring instruction in* ***sections 9 & 10*** *have been correctly followed.* If the system has a very loud hum and buzzing, we recommend that you check the input signal leads have their cable shields properly grounded at the source end (that is at the output socket of the unit that is connected to the **FDS-310**s input). If the hum is moderate and slightly 'raspy', we recommend that you check the incoming AC supply is greater than 90V RMS. Hum can also be induced by radiation from large power transformers (***See section 8***).

!!! CAUTION - Important Notes !!!
SERVICE SECTION

22.0 Service Section

22.1 2-Channel Sub-Woofer Operation

• ***Refer to section 11.1***, first 3 bulleted points:

For 'LOW', read 'Sub-Bass' Output.
For 'HIGH', read 'Mainly full range signal, for further splitting'.

• Before setting the crossover point, disconnect the mains power, remove the lid of the unit, and locate the slide switches SW2 and SW3 marked 'divide 10 FREQ X 1' (***See Figure 22.1***). If sub-woofer operation is required on both channels, set both switches to 'divide by 10', otherwise:

SW2 activates Channel 1
SW3 activates Channel 2.

Replace the lid and reconnect the power. The red LED marked 'divide by 10' below the 'CROSSOVER FREQUENCY' knob confirms that the indicated frequency is now *divided* by 10. Example: At the knobs fully counter-clockwise (7 o'clock) position, now read 18Hz (instead of 180Hz).

To disable the 'divide by 10' option, disconnect the mains power, remove the lid, and return the slide switch(es) SW2 and SW3 to the 'x 1' position. Then replace the lid and reinstate the power.

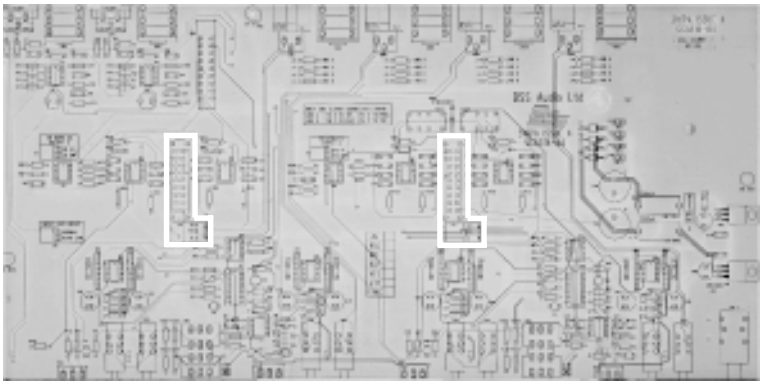


Fig 22.1 Locating the FREQ switches

22.2 Mono-Low/ Linking switch

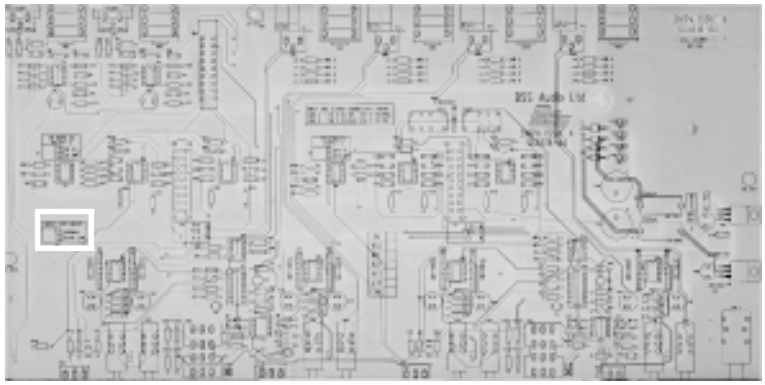
This section refers to section 12 in regard to activating the sub-woofers 'MONO' mode:

• Disconnect the mains power and remove the top cover plate.
• Locate the 3-pin programming plug on the left side of the main PCB, marked 'MONO LOW/LINKING' (***See Figure 22.2***).
• The jumper is factory fitted in the 'NORMAL' position. Remove it, and replace it firmly so that it bridges the 'MONO LOW' position. Now replace the cover plate, and reconnect the mains power.

!!! WARNING - Refer all servicing to qualified service personnel !!!
Risk of electric shock if the unit is opened.
BSS Audio accepts no responsibility for injury subsequent to opening of the unit.

!!! CAUTION - Important Notes !!!
SERVICE SECTION

Fig 22.2 Locating the MONO LOW/LINKING switch



22.3 Activating Equalisation

To activate the equalisation:

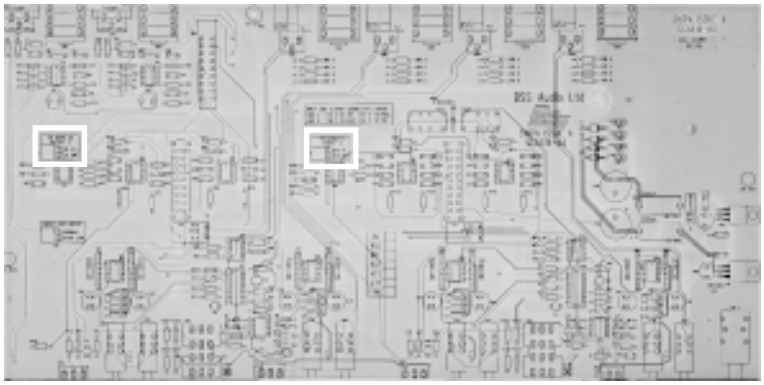
• Disconnect the mains power and remove the top cover plate.

• Locate the 3-pin programming plug on the left side of the main PCB, marked 'CD HORN EQ - OUTPUT 2', and 'CD HORN EQ - OUTPUT 4' in the centre of the PCB. ***Refer to the table in section 14*** to decide which jumper(s) will be changed, according to the present operating mode, and your requirements.

• The jumper is factory fitted in the 'EQ OUT' position. Slide it out and replace it firmly, so that it bridges the 'EQ IN' position.

• Now replace the cover plate and reconnect the mains power.

Fig 22.3 Locating the CD HORN EQ switches



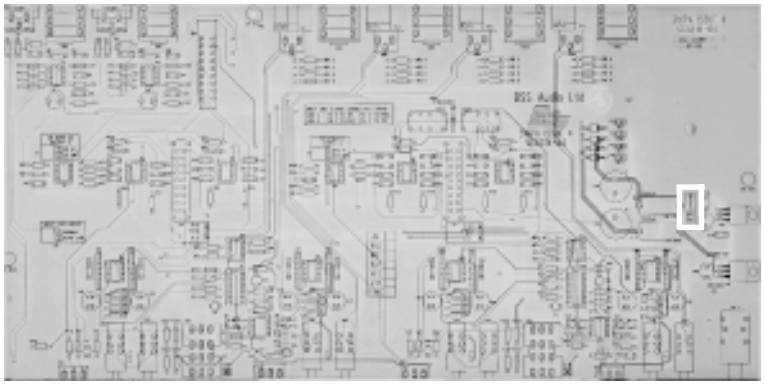
!!! WARNING - Refer all servicing to qualified service personnel !!!
Risk of electric shock if the unit is opened.
BSS Audio accepts no responsibility for injury subsequent to opening of the unit.

!!! CAUTION - Important Notes !!!
SERVICE SECTION

22.4 Eliminating Hum

• Disconnect the power and remove the top cover plate.
• Locate the green wire bolted to the chassis on the right side of the toroidal transformer. Check the wire connects to the PCB terminal marked 'CHASSIS' (***See figure 22.4***).
• Remove the tag from the chassis bolt, or alternatively unsolder its other end from the circuit board. *Either way, do not leave the wire hanging loose; fold it over and sleeve for continued safety.*

Fig 22.4 Locating the CHASSIS point



22.5 Polarity Switching

• Disconnect the power and remove the top cover plate.
• Locate the 1 ohm resistor links behind the phone plug sockets. These are factory set to position 'A'.
• To reverse the polarity, remove the underside cover-plate, de-solder the links and replace in position 'B'. The importance of ensuring that all the drivers in a stack, array or cluster are 'in phase' (meaning they all 'push and pull' in synchronisation) is well known, although mistakes can occur. Sometimes, the driver polarity is marked incorrectly on a rogue unit. Most drive unit manufacturers specify the '+' terminal for the cone moving outward, but a few hold the opposite convention. If some of the drivers operating *within* a specific frequency range in one stack, array or cluster are wired 'out of phase' with the remainder, the sound output will be partially cancelled. POLARITY switching at the crossover cannot correct this situation.

If the drivers operating in one frequency range are wired 'out of phase' with the other frequency band(s), the response at the crossover will exhibit an audible irregularity, either as a peak or a dip. Use the POLARITY switches to test this. Depress and release each in turn if you suspect that one frequency band is wired 'out of phase'. If switching doesn't improve the sound, and the dip or peak is appreciable, the cause is undoubtedly acoustic, to do with the drive-unit spacing and path lengths.

!!! WARNING - Refer all servicing to qualified service personnel !!!
Risk of electric shock if the unit is opened.
BSS Audio accepts no responsibility for injury subsequent to opening of the unit.

23.0 Glossary

Active Active electronic circuits are those which are capable of voltage and power gain by using transistors and integrated circuits.

Amplitude Refers to the voltage level or intensity of a signal, and is usually measured in voltage or decibels.

Balanced A three wire connection in which two of the wires carry the signal information, and the third acts as a shield tied to chassis ground. The two signal lines are of opposite polarity at any given moment in time, and are of equal potential with respect to ground. Balanced connections are used to improve hum and noise rejection in system interconnections.

Bi-Amped Jargon for an active 2-way crossover system.

Crossover Point Jargon for 'Crossover Frequency'

dB A unit for expressing the ratio between two signal levels for comparison purposes. On its own it has no absolute level meaning. Rather, it is a logarithmic ratio used to express the *differences* between two amounts or levels. Positive numbers indicate an increase, and negative ones a decrease. Some useful ratios are:

+3dB	=	Double Power
+6dB	=	x 2 Voltage or x 4 Power
+10dB	=	x 3 Voltage or x 10 Power
+20dB	=	x 10 Voltage or x 110 Power.

dBm The addition of 'm' after dB indicates an absolute scaling for the dB ratio. Instead of a ratio, the dB becomes a measure of power. 0dBm = a power level of 1 milliwatt into a load of 600 ohms. It is also loosely used to describe signal voltage in 600 ohm circuits.

dBu or **dBv** The addition of 'u' or 'v' after dB indicates an absolute scaling for the dB ratio. 0dBu (or 0dBv) = 778mV or 0.778 Volts, and it has no regard for power or impedance. This term is widely used for expressing signal voltages in modern audio equipment with high input impedances and low output impedances.

dBV The same scale as for dBu as above, except that 0dBV = 1.0 Volts.

Distortion Any modification of a signal which produces new frequency components originally present. Harmonic distortion refers to added frequencies that are overtones to the fundamental frequency. Intermodulation distortion refers to added frequencies that are sum and difference values derived from the beating together of two frequencies.

Glossary

Equalisation Modification of the frequency response of an audio system, regardless of level, for corrective or enhancement purposes.

Frequency The repetition of a waveform. The unit of frequency is Hz, and 1 cycle per second is equal to 1Hz. The audio band is generally restricted to frequencies of 20Hz to 20,000Hz (20kHz).

Frequency Response Equipment's relative gain compared to frequency. Generally expressed as +/- a certain number of dBs from 20Hz to 20kHz.

Headroom The amount, in dBs, above the normal operating level that can be used before serious distortion commences.

Impedance The AC equivalent of resistance, measured in ohms. It indicates the amount of drive required for an input, or the drive capability of an output, at a given signal level.

Level The amplitude of a signal, measured in Volts or Decibels.

Line Level Generally indicates a signal whose level is between -10 and +10dBu or -14 to +6 dBV. Mic level refers to levels around -40dBu.

Octave A logarithmic unit for expressing frequency ratios. Positive values indicate an increase and negative ones a decrease. One octave 'up' the scale is equivalent to a doubling in frequency. One octave 'down' is equivalent to a halving of frequency.

Polarity Reversal An instantaneous change in signal polarity, equivalent to a phase shift of 180 degrees. The same as polarity *inversion*.

Phase Reversal Loosely used to describe polarity reversal.

Transient A sudden burst of energy in an audio signal which only lasts for a small period of time relative to the rest of the signal. The level of these transients can often reach 10 times (+20dB) or so above the normal operating level of the audio equipment, and may cause distortion if headroom is inadequate.

Tri-Amped Jargon for an active 3-way crossover system.

Unity Gain Where output level is equal to input signal level.

24.0 Specifications

Input Impedance:	Balanced bridging; 12k ohms
Max. Input Level:	+20dBm/dBu/dBv
Through Gain:	Input to any output with level control set at 0dB: 0dB Fully adjustable from - to +6dB.
Input CMRR:	(Common Mode Rejection Ratio) <-50dB at 120Hz <-50dB at 10kHz
Max. Output Level:	Balanced Mode: +26dBv/dBu 15.5v rms Unbalanced Mode: +20dBv/dBu 7.75 v rms
Min. Load Impedance:	Driven at the MOL, balanced or unbalanced output mode 600 ohms
Output Impedance:	100 ohms
Frequency Response:	Excluding input filtration, outputs summed with controls set to 0.0dB: Between 20Hz and 20kHz +0.5dB In the midband +0.2dB
Crossover Filtration:	24dB/OCT (Fourth order) Linkwitz-Riley
Tuneable 2-way:	LOW-HIGH range: 180Hz to 2000Hz (2kHz) *Frequency range is divisible by 10 with internal switching* - see sections **SUB-WOOFER**
Tuneable 3-way:	LOW-MID range: 180Hz to 2000Hz (2kHz) MID-HIGH range: 800Hz to 9000Hz (9kHz)
Input Filtration:	18dB/OCT ultrasonic -3dB at 30Hz 6dB/OCT subsonic -3dB at 15Hz
THD Harmonic Distortion:	Including residual noise: <0.03% THD up to MOL Typically 0.01% at +6dBv/dBu output
Signal-to-noise ratio (SNR):	Controls set at unity (0dB) inputs terminated with 600 ohms Unweighted: <-85dB, 22Hz to 22kHz
Power requirements:	Less than 30 watts at 95 to 125v AC 50/60Hz
Operating temperature:	5 °C (41 °F) to 55 °C (132 °F)
Mounting requirements:	(Ht x W x D) 44.5mm x 483mm x 216mm 1U/1¾" x 19" x 8.5"
Nett Weight:	3.5kg/8lb
Gross Weight:	(Including carton) 4kg/9lb

25.0 Warranty Information

This unit is warranted by BSS Audio to the original end user purchaser against defects in workmanship and the materials used in its manufacture for a period of one year from the date of shipment to the end user.

Faults arising from misuse, unauthorised modifications or accidents are not covered under this warranty. No other warranty is expressed or implied.

If the unit is faulty it should be sent, in its original packaging, to the supplier or your local authorised BSS Audio dealer with shipping prepaid.

You should include a statement listing the faults found. The unit's serial number must be quoted in all correspondence relating to a claim.

IMPORTANT We recommend that you record your purchase information here for future reference.

Dealer Name:

Dealer Address:

Post/Zip Code:

Dealer Phone No.:

Dealer Contact Name:

Invoice/Receipt No.:

Date of Purchase:

Unit Serial Number:

In keeping with our policy of continued improvement, BSS Audio reserves the right to alter specifications without prior notice.

The **FDS-310** was designed and developed by BSS Audio, Hertfordshire, England.

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World Wide Web address: http://www.bss.co.uk

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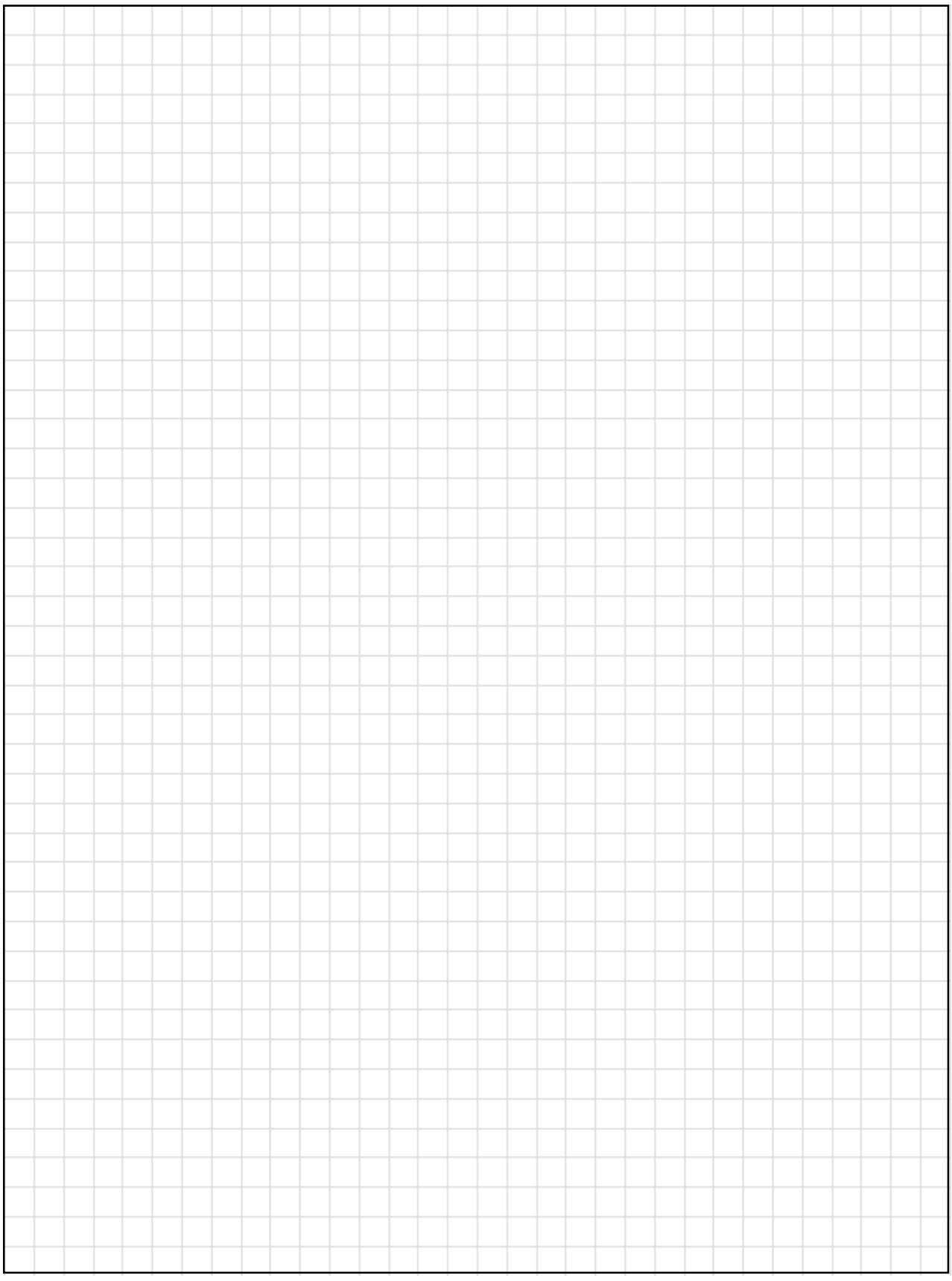
User Notes



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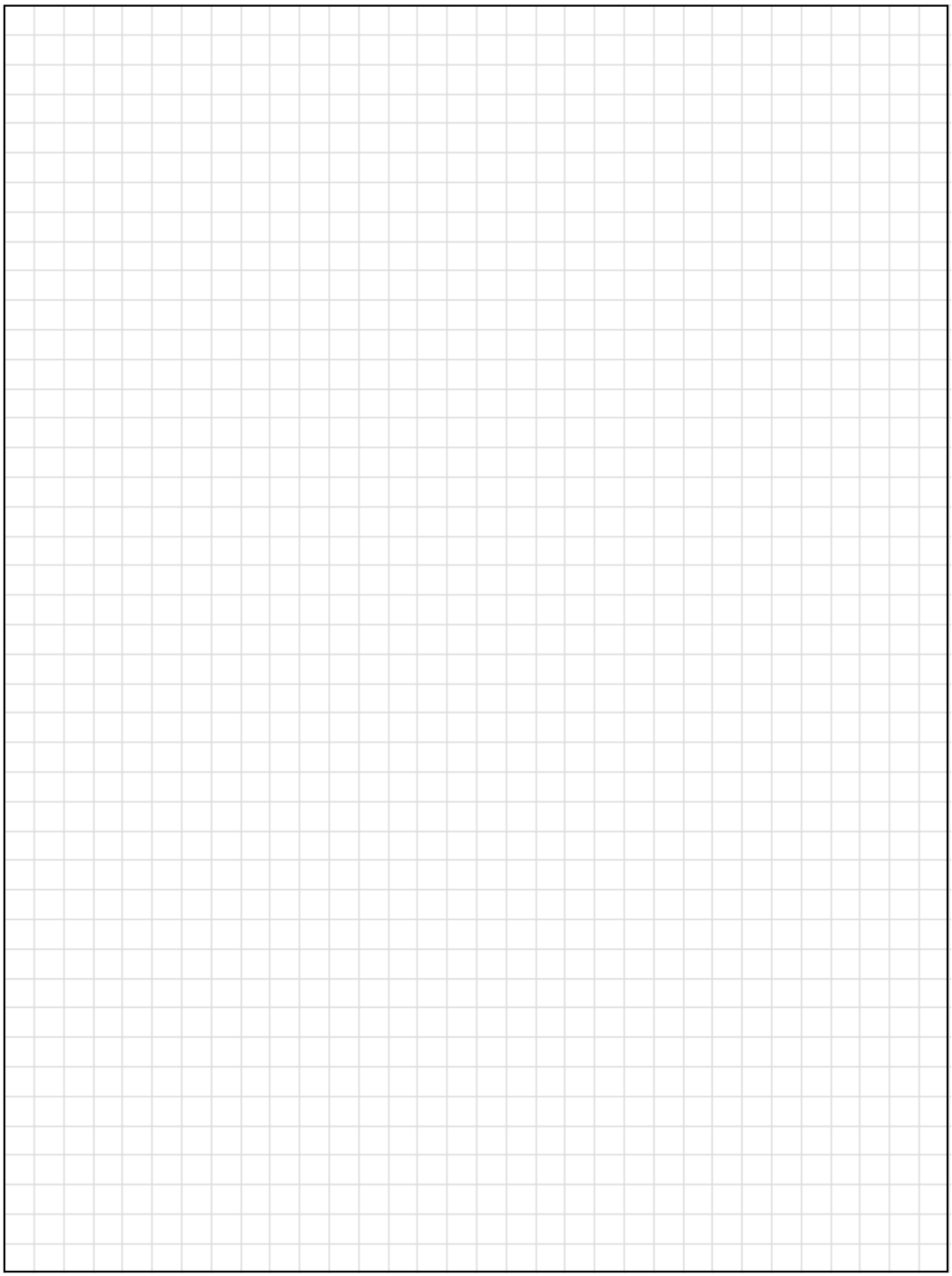

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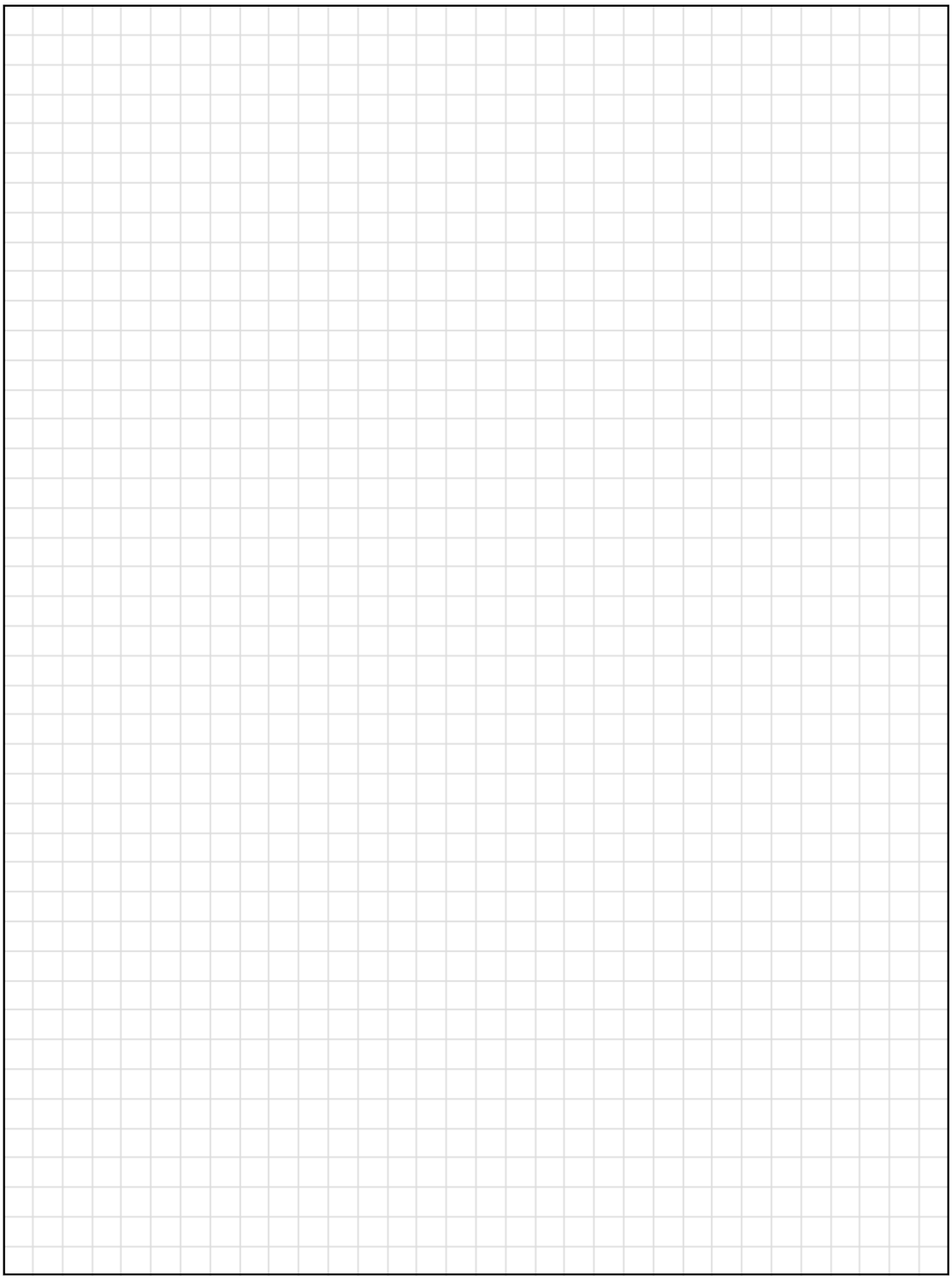

User Notes