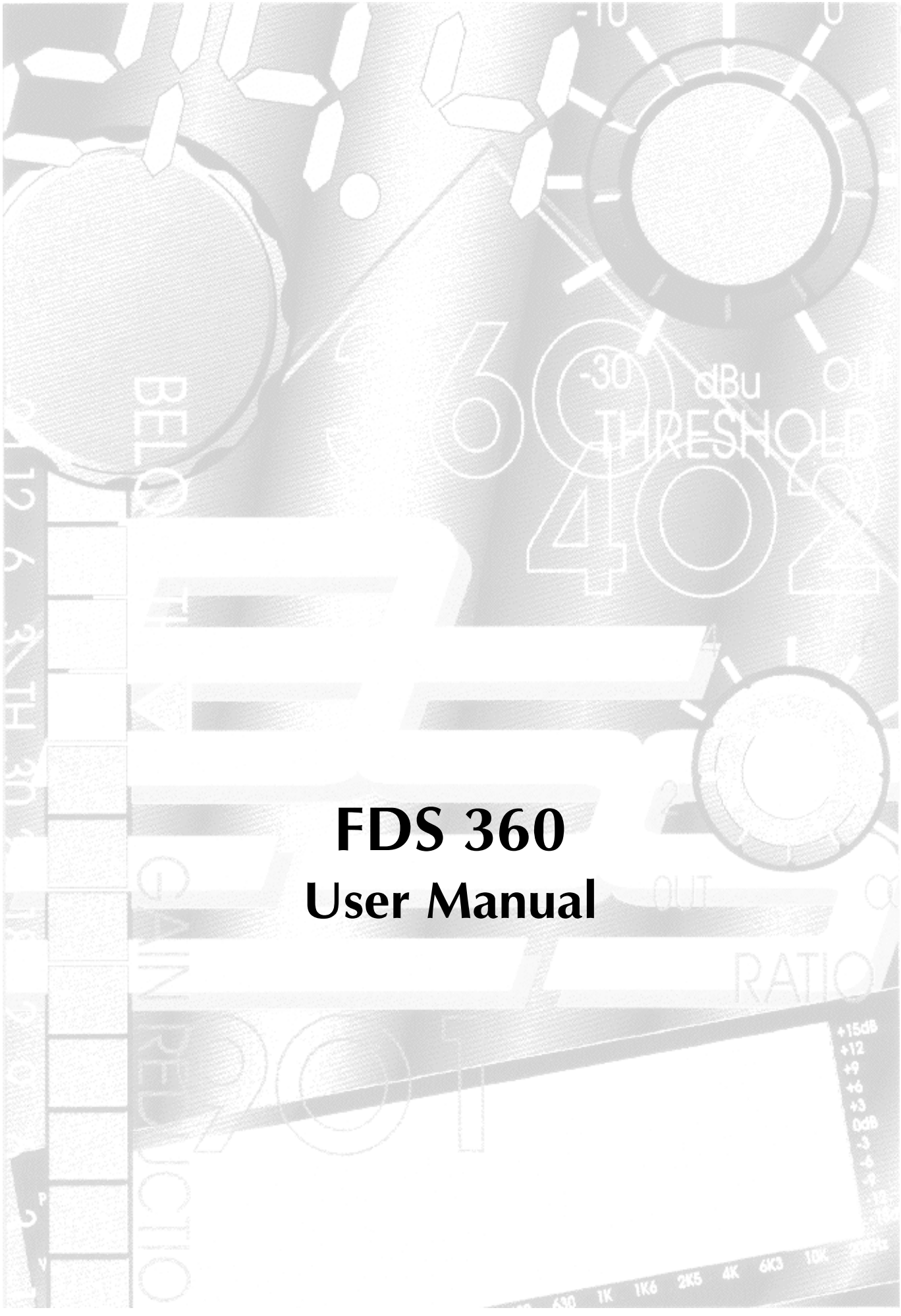


FDS 360

User Manual

V3.0 JMK 14 October 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 consultants alike get to grips with the **FDS-360** 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-360** 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 level) 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 setup

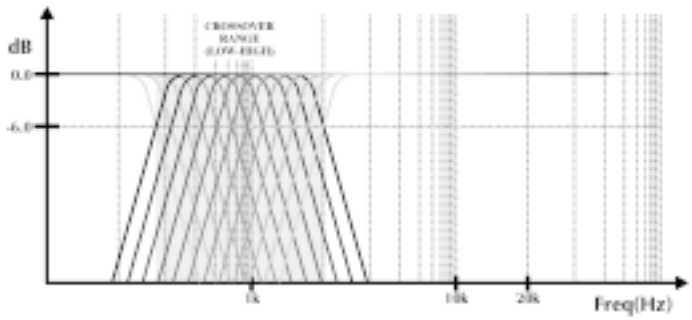
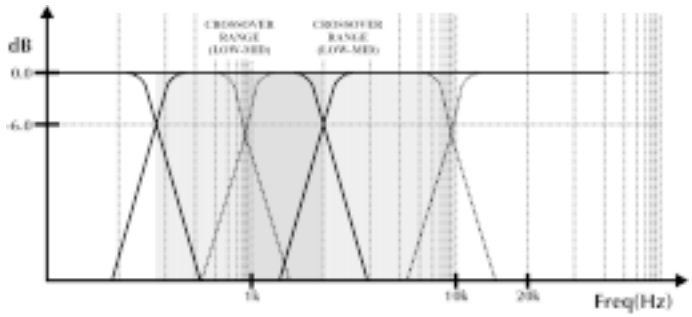


Fig 1.2 Mono 3-way Crossover setup

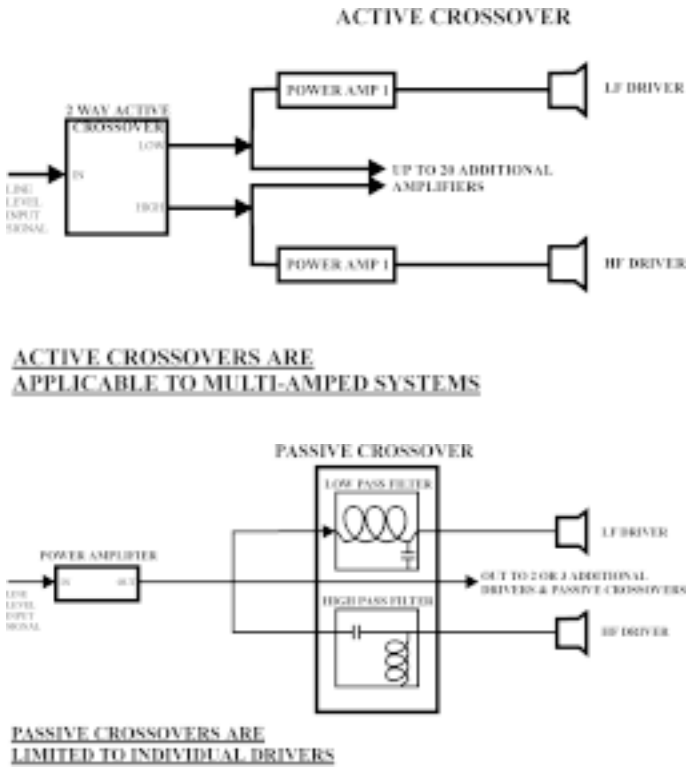


2.0 The difference between Active and Passive Crossovers

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



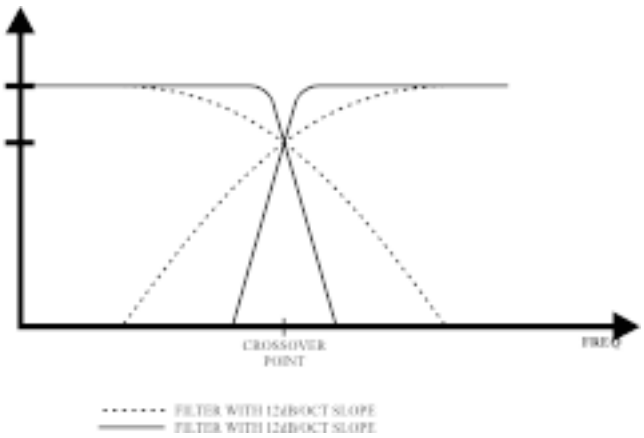
• Crossover frequencies can be more readily altered to suit different driver-horn combinations.
• The level balance between the 2 or 3 frequency bands (brought on by differences in driver and amplifier sensitivity) can be readily trimmed.
• Inside an active crossover unit, line-driving, signal summing, 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-360** 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 are 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



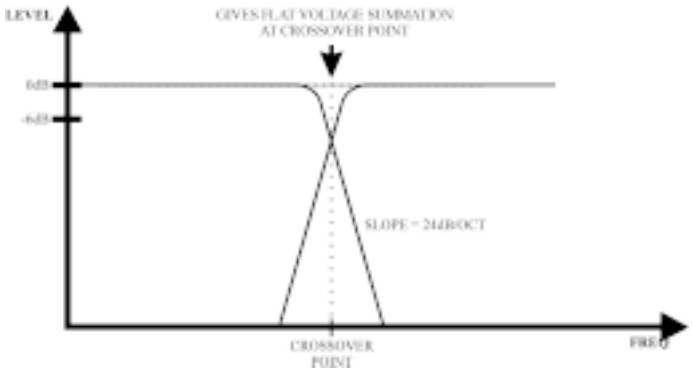
• If one frequency range is driven into clip, drive-units and horns in other frequency ranges are protected from damage, and distortion is kept to a minimum.
• Direct connection of drive-units to the power amplifier cuts out loss of damping factor, normally inevitable thanks to the appreciable resistance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

Amplifiers benefit too from the use of active crossovers. Because 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.

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



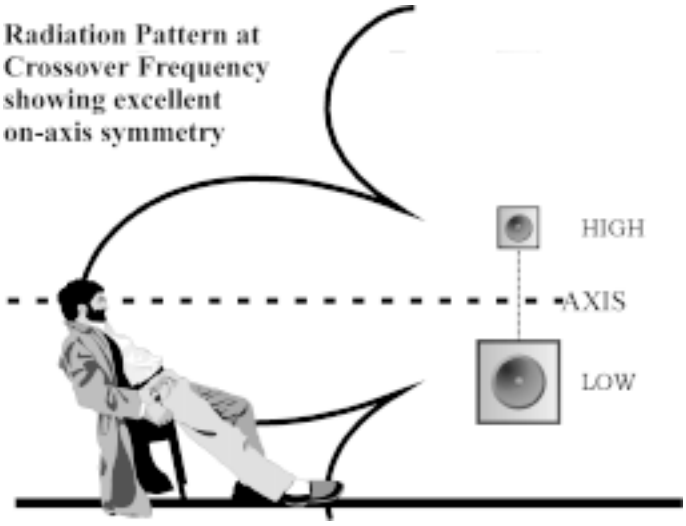
Zero Phase difference at crossover: The phase difference between drivers operating in adjacent frequency bands is close to zero degrees at the crossover frequency.

'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; this 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 cogent 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-360** is an electronic crossover system, and incorporates all the latest technology and facilities that are required for todays high powered loudspeaker systems. This frequency dividing system (**FDS**) is substantially more than a basic crossover, combining a high degree of sophistication which enables accurate control of loudspeaker power, dispersion and acoustical summation around the critical crossover region.

The **FDS-360** features the following:

- Stereo two-way mode, or switchable three/four way mono mode.
- Separate frequency band limiters matched to the precise band of frequencies controlled.
- Separate polarity switching for each band.
- LED signal level monitoring.
- Band insertion points for interfacing external equalisation and time delay units.
- Band-edge phase adjustment allowing 360 degrees of control.
- Crossover filter programming via plug-in frequency cards allowing any frequency, choice of 12/18/24dB/OCT slopes and filter responses to be specified. 24dB/OCT Linkwitz-Riley responses are supplied as standard.
- Internal equalisation option.

Every **FDS-360** is manufactured to the highest professional standards with a robust steel case, high quality circuit boards and 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-360** is subject to stringent quality control procedures throughout the manufacturing process. Components are tested against demanding acceptance criteria. Every 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 26***.

Getting to know the *FDS-360*

Fig 6.1 Front Panel

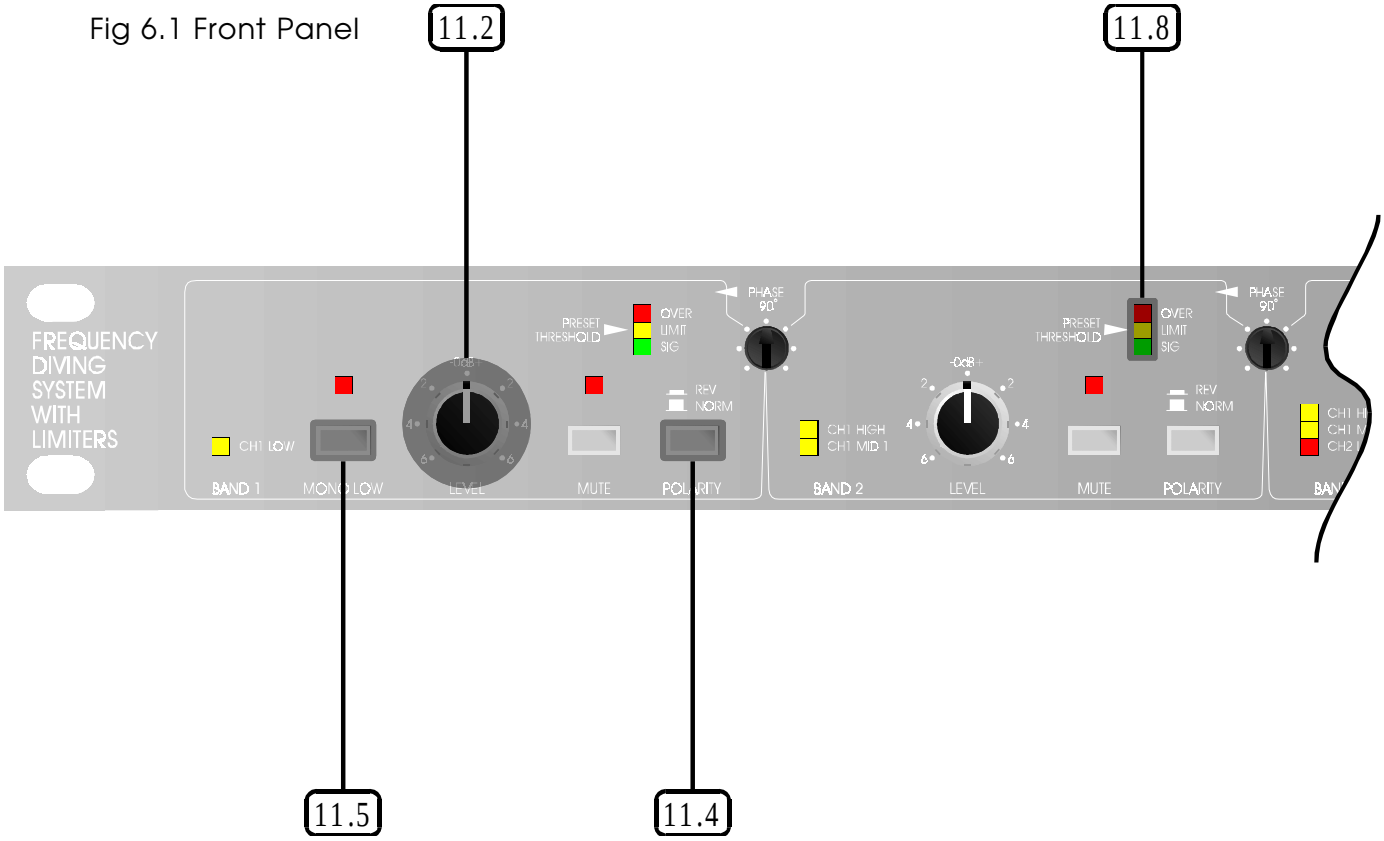
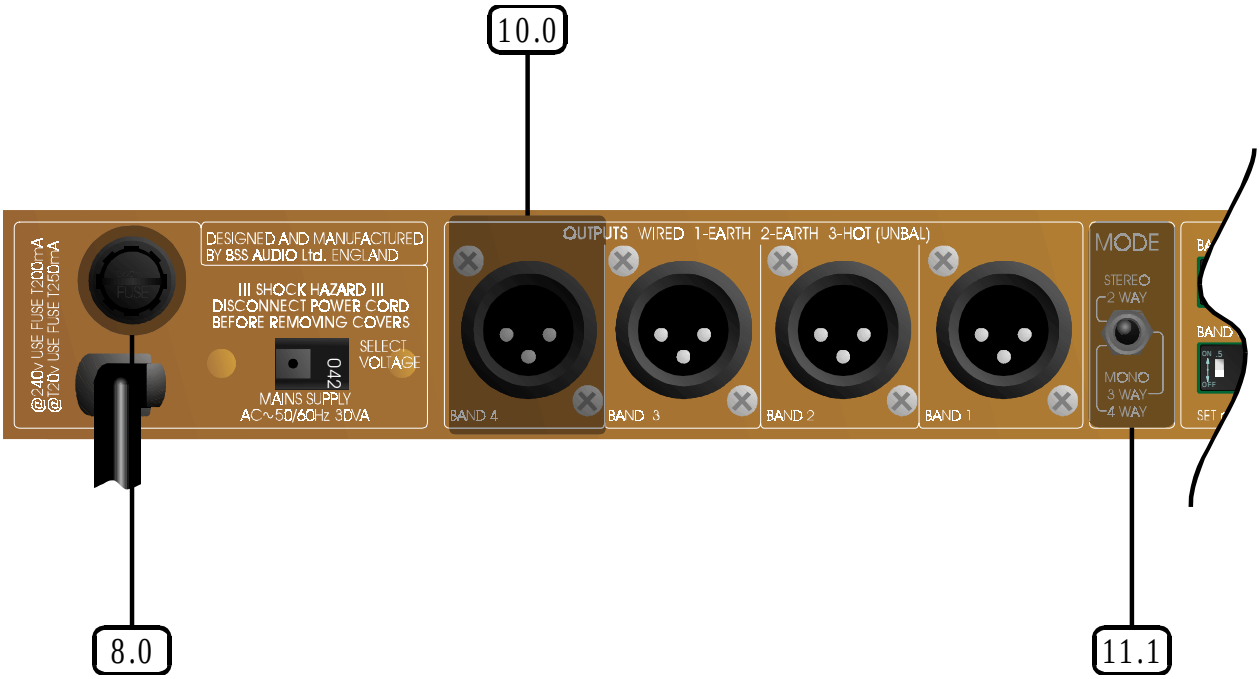
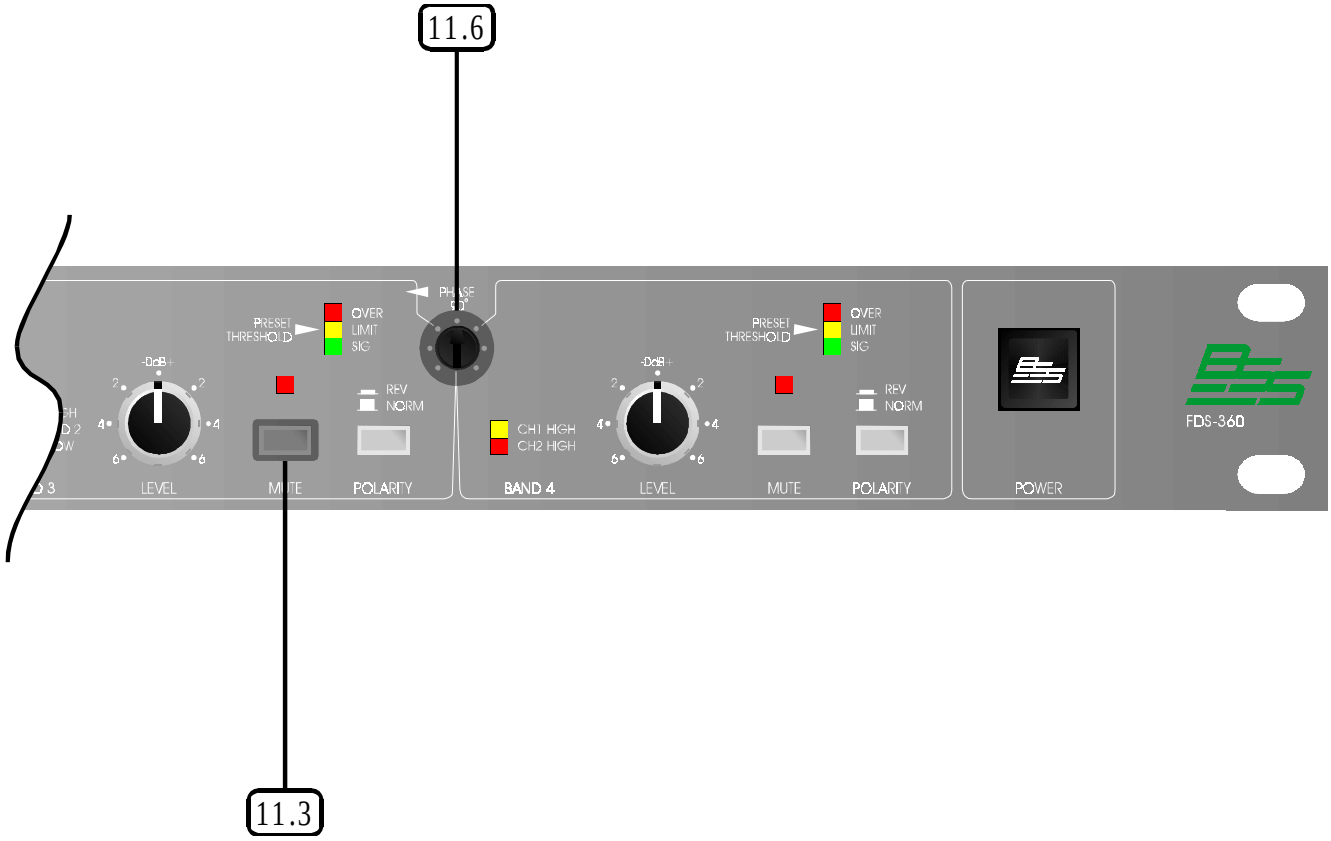
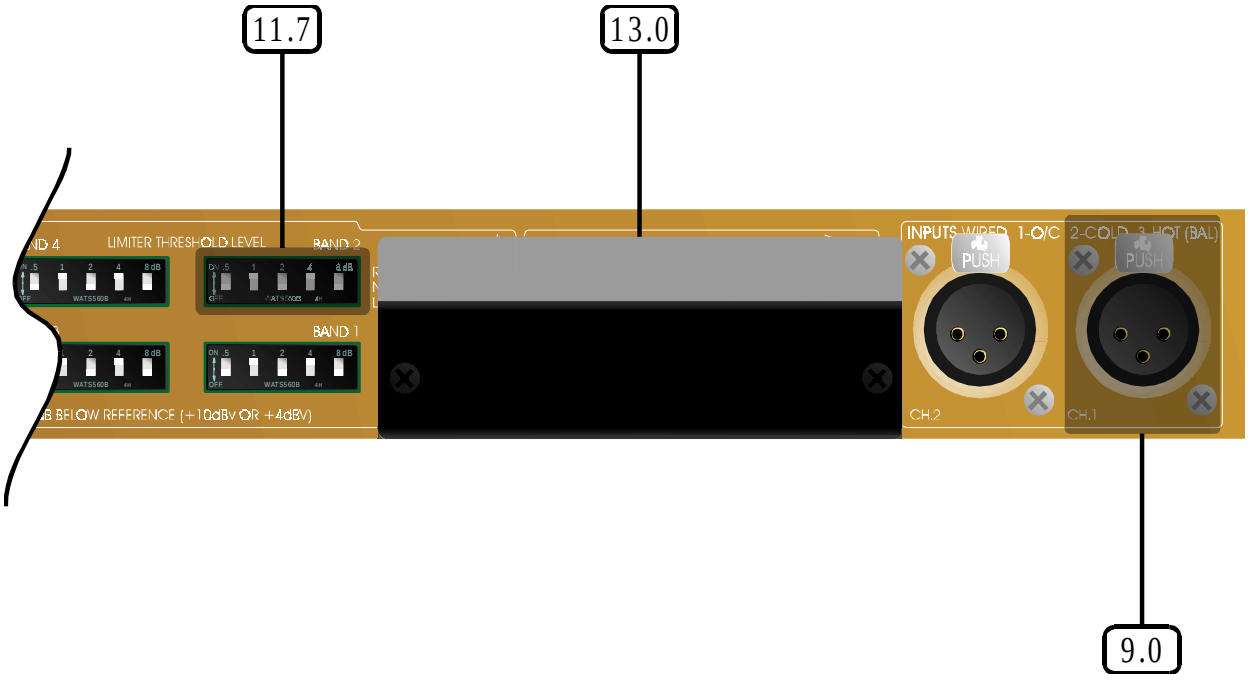


Fig 6.2 Rear Panel







All numbers in bubbles refer to Section numbers.

7.0 Mechanical Installation

A vertical rack space of 1U (1¾" / 10½mm) deep is required. Ventilation gaps are unnecessary (***See Figure 7.1***).

If the **FDS-360** 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.

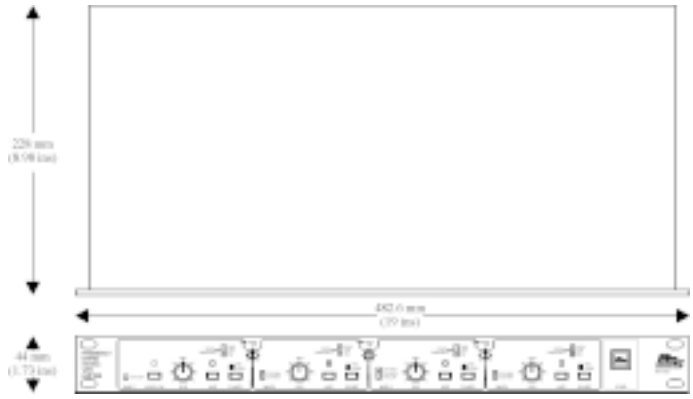
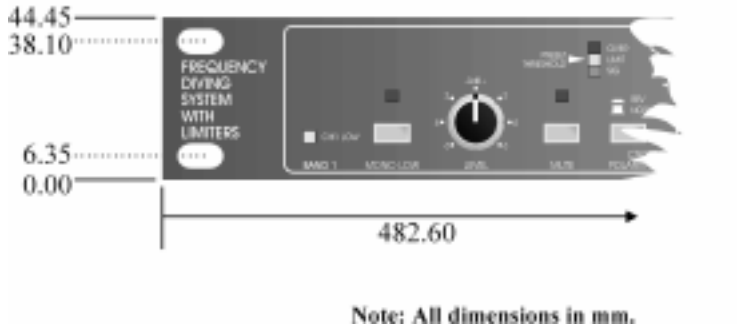


Fig 7.2 Rack dimensions.



Note: All dimensions in mm.

8.0 Mains Power Connection

Voltage: The **FDS-360** operates on supply voltages between 95 and 125V AC. It must not be plugged into 220, 230 and 240V AC outlets. If the unit is accidentally connected to an AC supply giving in excess of 132V AC, ***refer to section 23***, (***See Figure 8.1***).

Frequency: Both 60Hz and 50Hz are acceptable.

Fig 8.1 Mains fuse on rear panel.



Grounding: The **FDS-360** 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 cables ground ('earth') wire is properly terminated - it is important for personal safety, as well as for proper control over the system grounding. If the electronic 0V has to be separated from the chassis and mains power earth, ***refer to section 23***.

Connections: The AC power cable has a moulded 3-pin utility plug attached to the free end to facilitate the correct and proper connections.

AC Power Fusing: The incoming line power passes through a 200mA (for 240V only) anti-surge ('T') fuse, accessible from the rear panel (The fuse is rated at 250mA for 120V). If the fuse blows without good reason, ***refer to section 23***. Always replace with an identical 20mm x 5mm T rated fuse for continued protection from equipment damage and fire. **Also see *section 22*** for information on replacing blown transient suppressors (if applicable).

Power ON: Before turning on the power, it is worth checking that the three frequency cards are installed correctly. Loosen the captive screw securing the small cover plate on the lid of the unit, and inspect the cards. The slope and frequency information is recorded on each of these cards, and it must be ensured that all cards are fitted, regardless of whether they are required. ***Refer to sections 12 & 18*** for more information concerning these cards.

The **FDS-360** outputs are instantaneously muted at power OFF. At switch on, a delay prevents turn-off thumps propagating through the sound system.

9.0 Input Connections

9.1 XLR Plugs.

The two input signals are 10k ohm active balanced on a standard 3 pin 'female' XLR which will accept levels up to +20dBv. The wiring convention is as follows: (***See Figure 9.1a***):

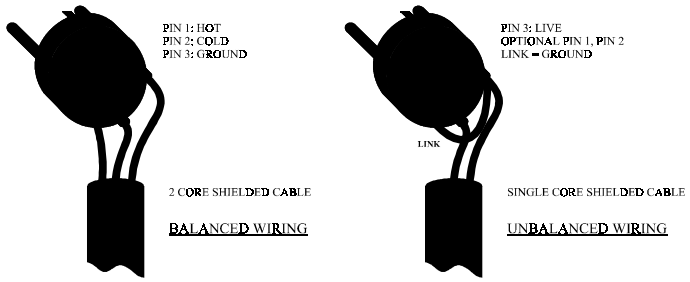
Pin 1: No connection (the shield of the drain wire can be terminated here if desired).
Pin 2: Signal '-', out of phase or 'COLD'.
Pin 3: Signal '+', in phase or 'HOT'.

For unbalanced sources (***See figure 9.1b***):

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.

Fig 9.1 XLR Plug Wiring



10.0 Output Connections

10.1 XLR Plugs

The four signal outputs are DC blocked low impedance unbalanced from a standard 3 pin male XLR and are designed to drive up to +20dBv into 600 ohms or greater. The wiring convention is as follows:

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.

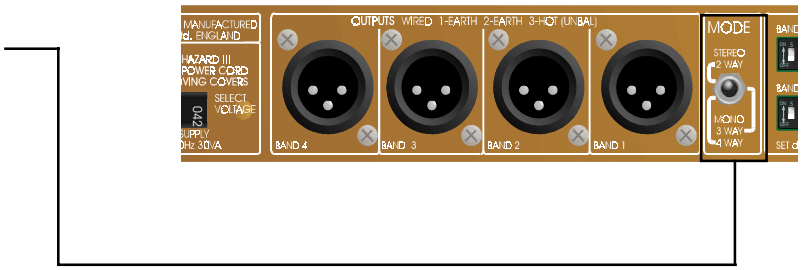
Unbalanced transmission is not recommended for connections to distant equipment, but is generally acceptable for local connections within the rack, or to an adjacent rack.

Output Connections

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.

11.0 Controls

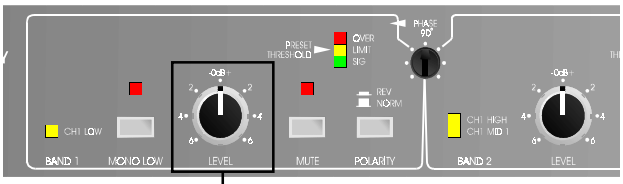
11.1 Mode Switch



The mode switch is located at the rear of the unit and sets the internal architecture for either the stereo 2-way, the mono 3-way, or mono 4-way mode. In the mono modes, the channel 1 input connector is used. ***Refer to section 14*** for other possibilities.

This selector switch also operates the front panel 'band' LEDs, to give a visual indication of the function of each of the four frequency bands.

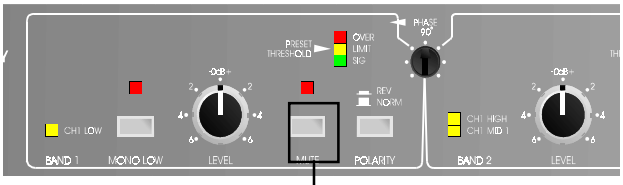
11.2 Level Control



The four front panel controls adjust the level of the program in each of the frequency bands, and is set to give a precise restricted range of ±6dB. In their fully anticlockwise position they do not reduce the level to zero.

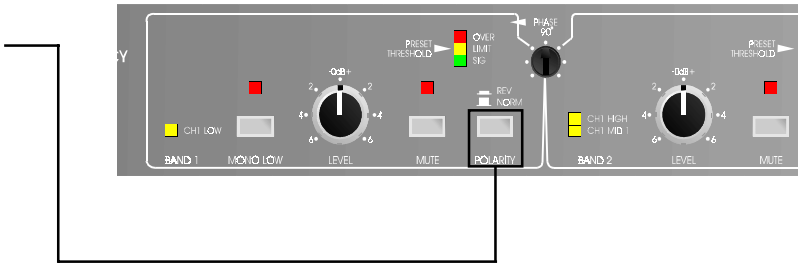
These controls are designed to allow the operator to carefully balance the respective bands in relation to each other, and do not interfere with the crossover networks, or the limiter threshold settings.

11.3 Mute Switch



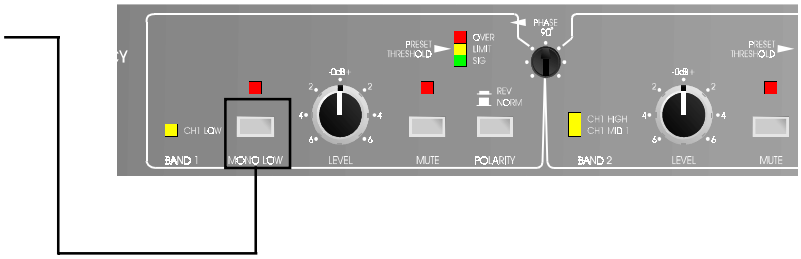
These four controls have a momentary action and allow the operator to mute each band individually. Pressing once will activate the mute function, and pressing again will de-mute. In addition, to protect the following speaker system from DC power thumps, logic circuits ensure that all band outputs are automatically muted when power is first switched on, or if a DC fault occurs internally to the unit. This will be noted when first powering up, as the four mute LEDs will remain on. ***Refer to section 13.2*** for further details.

11.4 Polarity Switch



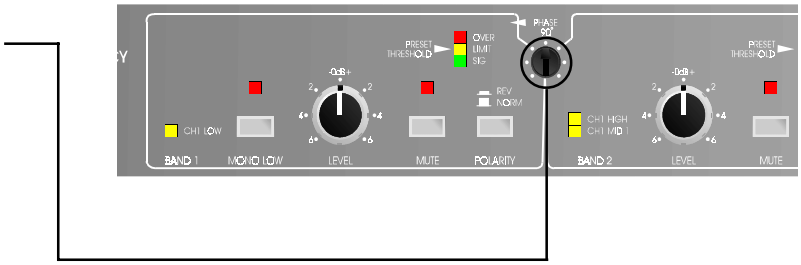
These four latching switched allow 180 degree phase reversal of the signal output for each band individually. ***Refer to section 16*** for more information.

11.5 Mono Low Switch



When operating the **FDS-360** in the stereo 2-way mode, this switch will sum together the signal information in bands 1 and 3 so that the outputs of these bands are equal, regardless of input stereo image. This gives a mono low signal feed which is often desirable for low frequency information. ***Refer to section 14.3*** for more information regarding mono low linking.

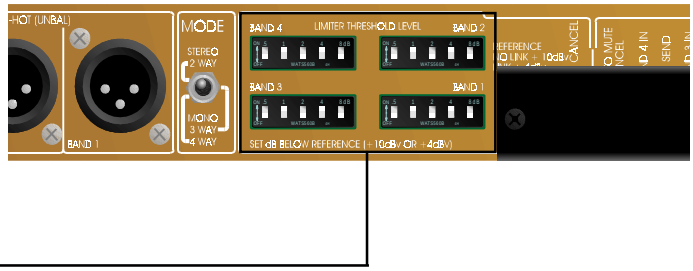
11.6 Phase Control



These three controls will adjust the relative phase between adjacent band outputs at the crossover region. The phase circuitry is programmed by the frequency cards to give precise control regardless of the crossover frequency. When these controls are used in conjunction with the polarity switch the operator has a full 360 degree of adjustment. ***Refer to section 16*** for further information.

Controls

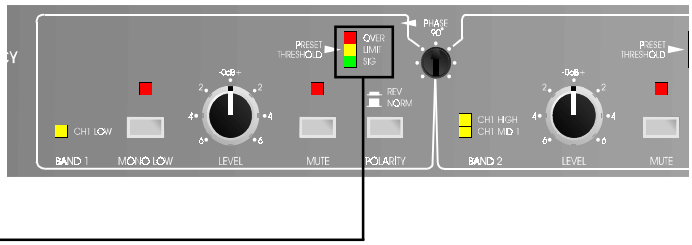
11.7 Limiter Threshold Switch



These four switch blocks on the rear panel allow the individual band limiter thresholds to be set. With all switches in the 'out' position, the threshold will be either +10dBv or +4dBv depending on the barrier strip link.

Binary addition of the switches will then subtract from this reference to give a specific threshold adjustable in 0.5dB steps. (The centre switch position should not be used and is provided for manufacturing reasons only). ***Refer to section 13.1 & 15*** for further information.

11.8 Signal LEDs



Each band has associated with it three LEDs which monitor the signal level. The lower green LED gives an indication that signal is present at a level -15dB below the limiter threshold setting. The middle orange LED indicates that the signal has reached the limiter threshold setting, and the upper red LED indicates 6dB of limiting.

12.0 Frequency Cards

The frequency programming cards for the **FDS-360** are located underneath the small panel on the top cover of the unit. Access to them is obtained by loosening the captive screw and then removing the cover. Each frequency card contains the components required for one low pass filter, one high pass filter, the limiter dynamics setting and phase control setting. The relevant frequency, slope and response type is recorded on a label attached to the respective card.

When fitting the frequency cards take care that they are correctly orientated and positioned in their edge connectors, and that the foam underneath the metal cover is locating properly on the edge of the cards to provide correct support.

Card Location for Four Way System

The card located in position FC1 is for the first break point, that in position FC2 is for the second break point, and that in position FC3 is for the third break point.

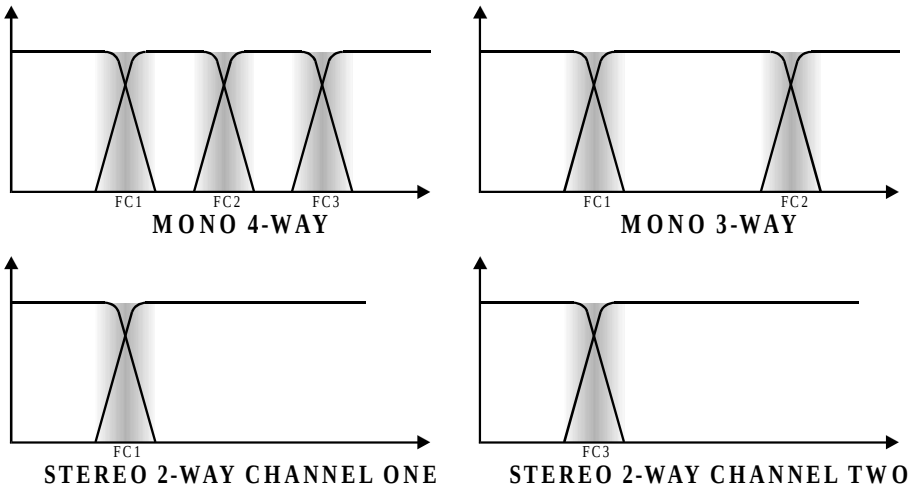
Card Location for Three Way System

The card located in position FC1 is for the first break point, and that in position FC2 is for the second break point. The card in position FC3 will not be used, so its value is not important. However, a card MUST be fitted to prevent damage to the unit.

Card Location for Stereo Two Way System

The card located in position FC1 is for channel 1, and that in position FC3 is for channel 2. The card in position FC2 is not used so its value is not important. A card MUST be fitted in order to prevent damage to the unit.

Refer to section 11 for information on component values for various frequencies. All standard cards supplied are of the Linkwitz-Riley response type. Please refer to your dealer who can supply you with cards for other filter types, as well as frequencies not shown in the tables.



13.0 Rear Barrier Strip

The barrier strip located on the rear of the **FDS-360** provides for a number of facilities specific to the BSS **FDS-360**, to give the operator greater flexibility.

13.1 Limiter Cancel

By adding a wire link between the two marked terminals all four limiters can be cancelled and taken out of circuit. Simultaneously the four red LEDs marked 'over' on the front panel will illuminate, regardless of the level of the input signal, to give a warning to the operator that the limiters have been cancelled.

13.2 Auto Mute Cancel

As mentioned in section 11.1, 'Mode Switch', when the unit is switched on all four mute circuits will operate to protect the following equipment from potentially dangerous DC thumps. To commence using the **FDS-360** the mutes will then have to be operated via the respective mute switches. In certain fixed installations where access to the **FDS-360** is not possible by the operator, it will be necessary to activate the auto-mute cancel facility by adding a wire link between the two marked terminals. Once activated, the **FDS-360** will still power-up in the mute mode, thus maintaining protection, but after approximately 20 seconds will automatically un-mute itself to allow full operation to commence.

13.3 Limiter Threshold Reference

As mentioned in section 11.7, 'Limiter Threshold Switch', the limiter threshold reference is +10dBv. Should a threshold below -5dBv be required, adding a wire link between the two marked terminals will reduce the reference to +4dBv, thus allowing a lower threshold point of -11dBv. This operates on all four limiters together. However, the adjustable range of 15.5dB down from the reference level allows sufficient adjustment for each individual limiter for correct speaker protection. ***Refer to section 15*** for further information.

13.4 Band Insertion Points

The barrier strip provides 'send' and 'return' points for each of the four bands individually. This allows the operator to connect external equipment such as equalisers and digital time delays into the particular frequency band required. The send or input to the external equipment or return to the **FDS-360** is taken to the appropriate BAND IN terminal. The factory provided wire link should obviously be removed. Both the inputs and outputs from the barrier strip are unbalanced and work at line level with a headroom of +20dBv.

14.0 Modes of Operation

The **FDS-360** can be configured as either a stereo 2-way, or mono three/four-way electronic crossover. Further possibilities within this framework can be utilised to allow more flexibility.

14.1 Mono Three Way with Extra Full Range Buffered Output

For applications where only a three way system is used, the fourth way or band will not be directly used. This can be configured to operate as a full range (or some form of high pass function) output, with level control, LED indicators and limiter. This buffered output can be used to drive an auxiliary sound source such as back stage area, bar area or other full range system. To utilise this function, a special frequency card is required in position FC3 which bypasses the normal high pass filter sections. ***Refer to section 18*** for more information on this bypass card.

14.2 Operating a Sub-Woofer system from an Effects Send

When operating in the mono three/four-way mode, the input connector and circuitry for channel two is not utilised. Where a speaker system is configured as a three way with sub-woofer, using band one is derived from the CHN 2 input section, allowing the operator to drive the sub-woofers from an independent signal send (possibly an effects send) rather than from the main stereo left/right sends. To implement this mode of operation the factory fitted wire link on the barrier strip between CHN 1 SEND and BAND 1 IN should be removed, and replaced by linking CHN 2 SEND and BAND 1 IN. The same wire link can be used, and inspection will show that the link is just rotated around the BAND 1 IN position.

As standard, the **FDS-360** has a subsonic filter set for 30Hz, and is some applications when driving sub-woofer speakers it can be advantageous to change this down to 15Hz to allow more low frequency energy to pass. This can be implemented internally, ***refer to section 17*** for further information.

It will be apparent that this feature of using the CHN 2 input as auxiliary input is not specific to BAND 1, and can be easily connected to any of the bands IN terminals. For example, when using the option as in section 12.0 previously, the band four section can be driven from this auxiliary input to provide complete and independent control regardless of the main left and right stereo feeds.

14.3 Mono Low between separate units

As mentioned in section 11.5, 'Mono Low Switch', when operating in the stereo 2-way mode, the two LOW output sections can be summed together to provide a mono signal feed for the low frequency speakers. This facility can also be used when using two **FDS-360** units in a stereo three or four way speaker system. A flexible wire lead should be connected to join together the MONO LOW TIE terminals of the barrier strip of each **FDS-360**. The two mono low switches on the front panels must also be operated. This allows the two units to be permanently tied whilst allowing the mono option to be selected by the front panel switches as required.

15.0 Limiter Adjustment

The **FDS-360** is provided with separate limiters, each of which are carefully designed to provide the maximum possible protection to the speaker system by dynamically controlling the maximum power made available to the power amplifier, and hence the loudspeakers. The frequency card has components that optimise its response to suit the frequencies that are being controlled.

The limiter threshold adjustment switches are located on the rear of the **FDS-360** and comprise four identical switch blocks each with five switches calibrated as : 0.5dB, 1dB, 2dB, 4dB and 8dB. These switches act as attenuators and are active (ON) when in the fully UP position. This attenuation is reference to +10dBv or +4dBv depending on the linking of the rear mounter barrier strip. When shipped from the factory the linking will be for a threshold of +10dBv reference. The setting of individual threshold levels is then achieved by selecting the appropriate switches in a binary addition manner to give the correct number of dBs of attenuation down from the fixed reference level. ***Figure 15.1*** shows this operation.

The limiters on the **FDS-360** can be used in two manners:

- To control the average power below the maximum that the power amplifiers are capable of providing. This will protect speaker units that have a lower power rating than that of the amplifier.

- To allow the maximum power amplifier output to be applied to the speaker units whilst controlling the transient peaks. This avoids heavy amplifier distortion, and 'square waves' being applied causing heavy audible distortion and eventual speaker failure.

Adjustment for A

Set all limiter adjustment switches to their OUT position. Operate the sound system up to the acoustic level that is considered safe, or is required, and then add in the limiter threshold switches to the required amount until the limiter starts to take control. This can be observed by monitoring the middle LED on the signal level meter. Further increase of input signal level will then not cause any further increase in output level.

Adjustment for B

Obtain the input sensitivity for the power amplifier by referring to its specification and then set the limiter threshold switches to give a threshold of 1dB BELOW this level. Since all power amplifiers' dynamic power output are a function of their specific design and the mains voltage present at the time, some adjustment from this setting might be required. The ability to adjust threshold in 0.5dB increments gives ample scope for accurate setting. The table in ***Figure 15.1*** lists some of the common signal levels in Volts and dBv as an example of typical switch settings.

Fig 15.1 Limiter Threshold Settings

RMS Volts	dBv	Switch Settings					4dBv Link
		0.5	1	2	4	8	
2.47	+10						
1.95	+8			■			
1.56	+6				■		
1.24	+4			■	■		
0.98	+2					■	
0.78	0			■		■	
0.62	-2				■	■	
0.49	-4			■	■	■	
0.39	-6			■		■	■
0.31	-8				■	■	■
0.25	-10			■	■	■	■
0.21	-11.5	■	■	■	■	■	■

The 1 and 0.5dB switch positions should be used to set for intermediate settings. The grey box indicates that the switch is ON. A blank box indicates that the switch is OFF. The '+4dBv Link' refers to the strap on the barrier strip.

16.0 Phase Adjustment

One of the characteristics of the Linkwitz-Riley filter response is that at the 'corner' frequency between two adjacent bands the phase of the signal from each band is the same. i.e. the two output signals are in phase. (Some small departure from this occurs in band-pass outputs due to residual effects from the opposite 'corner' frequencies).

In order to assist in obtaining accurate acoustical summation of the signals from adjacent speaker units in a loudspeaker system, it is desirable to be able to adjust the phase of the signal from one frequency band to that from the next frequency band to properly allow for any phase errors that occur in the actual loudspeakers and cabinets themselves. The three 'phase' controls on the **FDS-360** are provided for this purpose.

It will be noticed that a small arrow associated with the graphics around this phase control indicates which frequency band is being moved 'with' reference to the other adjacent band, and that band four having no such control operates as the starting reference.

In operation, phase alignment should commence at the highest frequency band being used, and all other bands then adjusted in sequence down from this band. Owing to residual effects as mentioned above, if after initial adjustment some further re-adjustment is done on any band, then the lower bands will need re-adjusting to compensate.

The polarity switch associated with each band can also be used to provide further control range. If having rotated the phase control fully clockwise, phase alignment is not achieved, then the polarity switch can be operated. Returning the phase control to zero will then give the previous setting, allowing a further 180 degrees of control. It should be remembered that this phase adjustment is designed to assist in obtaining correct phase alignment around the crossover frequencies of the speaker system, and is not the equivalent of inserting digital delays into the frequency band. Should this be required, then you should ***refer to section 13.0*** of the manual.

To assist in setting up the phase controls, a number of methods can be tried:

- Using pink noise and a spectrum analyser will provide a pictorial view of the acoustical energy around the crossover regions, and operation of the phase controls should be made to give the flattest response.

- Careful listening test to the speaker system whilst operating the phase controls will provide another method of alignment.

- Applying a sinewave signal at a frequency equal to each crossover point in turn, through the speaker system will allow operation of the phase control to achieve a minimum speaker level. i.e. a cancellation. Pressing the polarity switch will then invert one of the outputs to achieve a true summation.

17.0 System Diagrams and Descriptions

17.1 Full unit

The input section of the **FDS-360** contains the input signal de-balancing, subsonic and ultrasonic filtering. From here the signal is fed into four parallel paths for filtering and limiting. These four paths are essentially similar, apart from the number and types of filters required. The input for channel 2 is fed via the mode switch.

The gain reduction circuitry for the limiters is located after the level controls and before the main crossover filters, and is of the feedback type. The main crossover filters consists of two series second order filter blocks configured to achieve the Linkwitz-Riley response. By utilising separate order filters in this manner, it is possible to have 12, 18 or 24dB/OCT responses with the low and high pass filters having either the same or differing cutoff frequencies. This flexibility is achieved by suitable programming of the plug-in frequency cards. The DC control voltage for the limiter circuits is derived from a point between the two series filter sections which avoids the frequency-shift effect when limiting occurs. The dynamic time constants are set by capacitor C10 on the frequency card. The phase control linearity is set by capacitor C9 on the frequency card. The final output stages driving the MUTE relays utilise discrete output transistors to ensure adequate current drive into long lengths of signal cable. The MUTE relays are controlled by the front panel mute switch, the power-up auto mute routine, the auto mute cancel facility, and the circuitry which monitors the power supply circuits. If for any reason the internal power supplies fail, all mute relays operate to protect the output from any DC output levels. ***See next page*** for a full system block diagram.

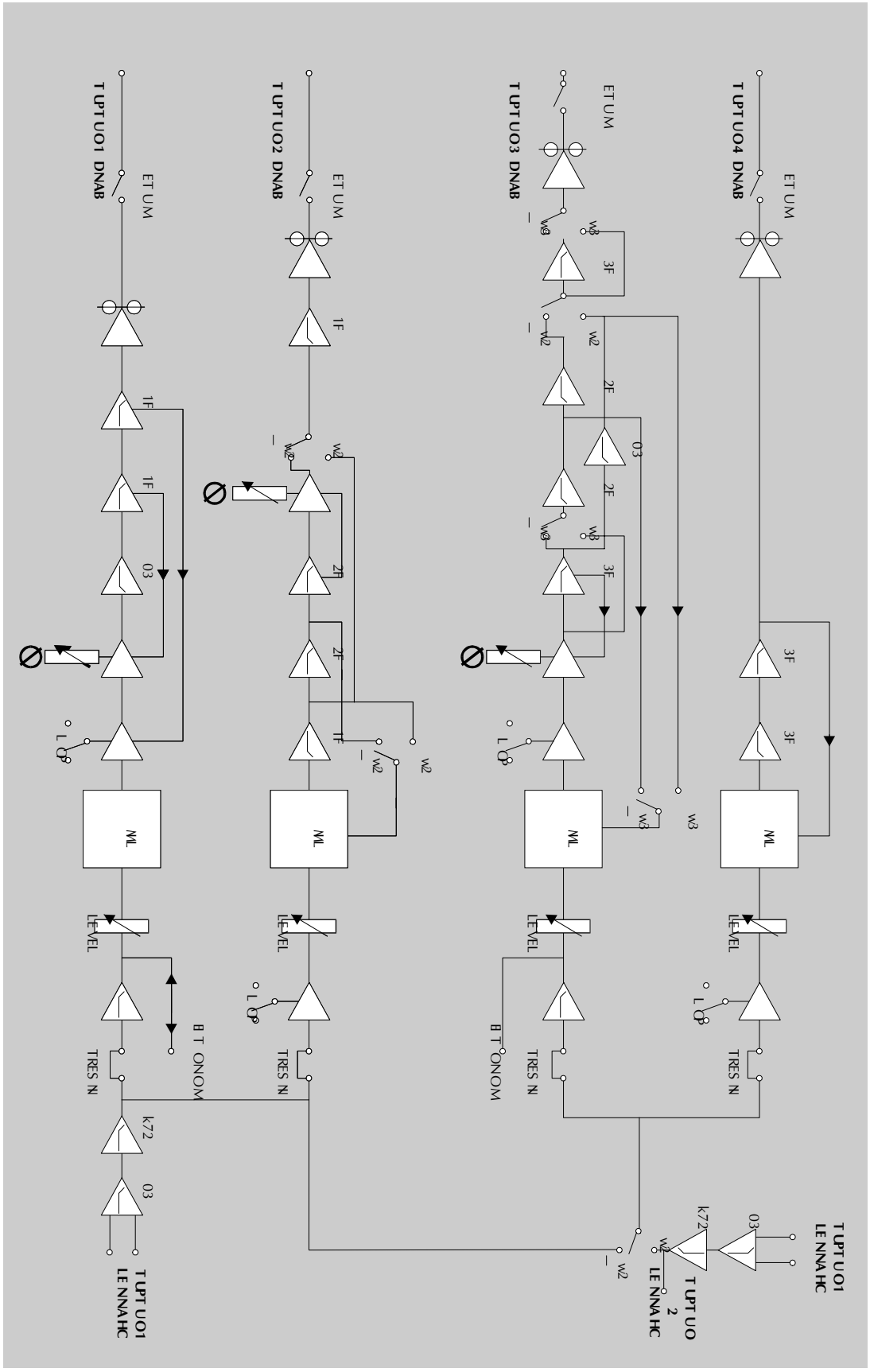
17.2 15Hz Subsonic Filter Change

As mentioned in section 14.0, the cutoff frequency of the subsonic input filter is set as standard at 30Hz. For sub-woofer speaker systems, it may be desirable to change this down to 15Hz. Should this be required, the following table details the extra capacitors that should be fitted into the appropriately marked space on the main circuit board of the unit.

Channel 1: C2, C4, C24A, C23A, C27A as 220nF 5% C28A as 470nF 5%

Channel 2: C14, C15, C34A, C35A, C36A as 220nF 5% C73A as 470nF 5%

System Block Diagram



18.0 Filters and Frequency Tables

18.1 Standard Filters

The standard filter provided for the **FDS-360** is of the Linkwitz-Riley response based on two second order Butterworth circuits in series. The response is a 24dB/OCT slope with a 'corner' frequency where the output of the filter if 6dB down from its pass band level. The use of these filter realisations has been well documented and provides the best possible phase and amplitude response for driving large speaker systems.

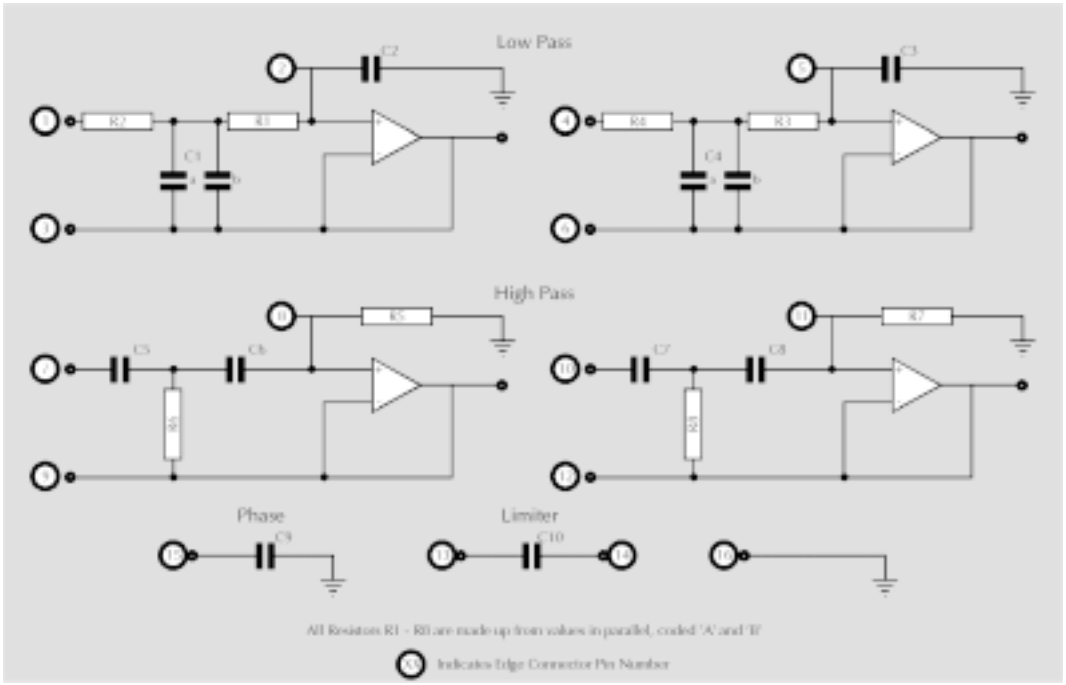
Table 17.1 lists the component values for various frequencies and should be used in conjunction with the drawing for the **FDS-360F** frequency card (***See Figure 18.3***). Blank cards, or ready made cards can be provided by any BSS dealer.

All resistors should be ¼W metal film 2% tolerance or better. Capacitors should be 5% tolerance or better. ***Figure 18.1*** shows how these components relate to the separate filter blocks to assist in making mixed frequency cards that might be needed for speaker systems that require gaps or overlaps in the amplitude response of the filters. Other filter responses can also be realised using these frequency cards, and your dealer will be able to supply these to order.

18.2 Full Range Frequency Card

Should the fourth band output be required to work as a full range buffered output (***See section 14.1***), a full range frequency card is required to be inserted into FC3 position. This card removes all filtering associated with the third frequency point. The limiter setting capacitor C10 should be chosen to suit the lowest frequency in the band, which would normally be 30Hz. ***Figure 18.4*** shows the frequency card modified for this result.

Fig 18.1 Frequency and Component Function



Filters and Frequency Tables

Fig 18.2 Component Values for Frequency Cards type FDS-360/1

FDS-360 FREQUENCY CARD COMPONENT SELECTION - 24dB/Octave

Freq.	R1	R1	R5	R5	C1	C10	C9
50	43k	47k	82k	100k	100nF	330nF	150nF
60	36k	39k	75k	75k	100nF	330nF	150nF
63	33k	39k	47k	150k	100nF	330nF	150nF
70	16k	-	39k	180k	100nF	330nF	150nF
80	15k	220k	39k	100k	100nF	220nF	100nF
100	18k	30k	24k	330k	100nF	220nF	100nF
110	12k	68k	39k	43k	100nF	150nF	68nF
125	18k	18k	18k	-	100nF	150nF	68nF
150	7k5	-	15k	-	100nF	150nF	68nF
160	8k2	47k	15k	220k	100nF	150nF	68nF
180	6k2	-	13k	330k	100nF	150nF	68nF
200	18k	330k	39k	270k	33nF	150nF	68nF
220	18k	100k	100k	47k	33nF	100nF	47nF
250	15k	150k	27k	-	33nF	100nF	47nF
280	13k	180k	43k	56k	33nF	100nF	47nF
300	15k	47k	27k	150k	33nF	100nF	47nF
350	15k	27k	39k	39k	33nF	100nF	47nF
400	10k	56k	18k	330k	33nF	100nF	47nF
500	6k8	-	15k	150k	33nF	47nF	22nF
600	6k2	68k	15k	47k	33nF	47nF	22nF
800	39k	22k	39k	100k	10nF	47nF	22nF
1k0	12k	180k	47k	43k	10nF	33nF	15nF
1k2	10k	150k	27k	62k	10nF	33nF	15nF
1k3	10k	68k	18k	470k	10nF	33nF	15nF
1k5	7k5	-	15k	-	10nF	22nF	10nF
1k6	8k2	47k	22k	39k	10nF	22nF	10nF
2k0	8k2	18k	12k	180k	10nF	22nF	10nF
2k5	18k	56k	27k	-	3n3F	15nF	4n7F
3k0	15k	47k	24k	470k	3n3F	15nF	4n7F
3k5	10k	330k	24k	100k	3n3F	15nF	4n7F
3k7	39k	12k	27k	56k	3n3F	15nF	4n7F
4k0	10k	56k	39k	30k	3n3F	15nF	4n7F
4k5	8k2	100k	18k	100k	3n3F	10nF	3n3F
5k0	6k8	-	18k	56k	3n3F	10nF	3n3F
5k5	6k2	-	13k	270k	3n3F	10nF	3n3F
6k0	6k2	68k	15k	47k	3n3F	10nF	3n3F

FDS-360 FREQUENCY CARD COMPONENT SELECTION - 24dB/Octave

See Notes at bottom for full component ID.

Freq.	R1A	R1B	R5A	R5B	C1A	C10	C9
6k3	27k	6k8	27k	18k	3n3F	10nF	3n3F
6k5	22k	6k8	12k	82k	3n3F	10nF	3n3F
7k0	39k	5k6	13k	39k	3n3F	10nF	3n3F
7k5	10k	8k2	18k	18k	3n3F	6n8F	2n2F
8k0	10k	7k5	10k	62k	3n3F	6n8F	2n2F
8k5	4k7	27k	8k2	330k	3n3F	6n8F	2n2F
9k0	3k9	120k	8k2	100k	3n3F	6n8F	2n2F
9k5	15k	56k	82k	33k	1n0F	6n8F	2n2F
10k0	15k	47k	43k	47k	1n0F	6n8F	2n2F
12k0	12k	43k	27k	62k	1n0F	6n8F	2n2F
15k0	7k5	-	15k	-	1n0F	6n8F	2n2F
18k0	6k2	-	15k	82k	1n0F	6n8F	1n0F
20k0	5k6	-	13k	82k	1n0F	6n8F	1n0F

R1A	=	R1A, R2A, R3A, R4A, R6A, R8A
R1B	=	R1B, R2B, R3B, R4B, R6B, R8B
R5A	=	R5A, R7A
R5B	=	R5B, R7B
C1A	=	C1A, C1B, C2, C3, C4A, C4B, C5, C6, C7, C8
C9	=	C9
C10	=	C10

Fig 18.3 FDS-360F Component Overlay

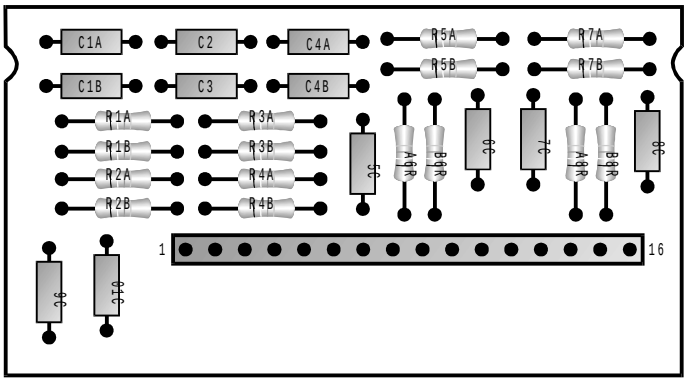
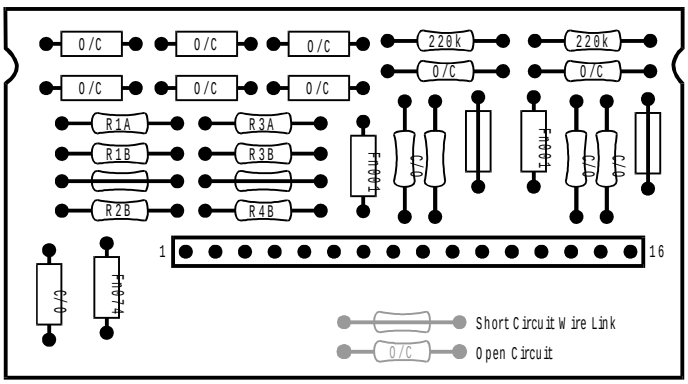


Fig 18.4 FDS-360F Full Range Overlay



19.0 BSS Supported Options

19.1 Output Balancing

The **FDS-360** has unbalanced output as standard. Should output balancing be required, then the BSS **AR204** line balancing unit should be used. This unit provides four input/output circuits, each isolated by a transformer. It utilises a custom designed high quality toroidal transformer carefully developed to accommodate high line level signals down to 15Hz. The maximum load should not exceed 600 ohms. The size and weight of the transformers does not permit them to be included as part of the case structure of the **FDS-360**, so provision has been made for the **AR204** to be either rack mounted or a 1U front panel (which has the capacity to mount 2 x **AR204**), or to be individually mounted inside the racking system of the installation. Connections between this and the **FDS-360** are standard 3 pin XLR leads.

19.2 Security Cover

In installations where fully tamper proof security is required, the FDS-360-SC security cover system can be fitted. This recesses and covers the front panel of the **FDS-360** behind a blank steel panel, such that no access is gained to any of the front panel controls. Fitting instructions for this are provided with each kit.

20.0 FDS-360 Equalisation Options

20.1 Introduction

In certain areas of application, it is necessary to have within a loudspeaker system some form of fixed equalisation to enable a particular type of sound to be reproduced. This can be to overcome problems of room resonances or individual loudspeaker frequency responses. This fixed equalisation is generally provided by an external graphic equaliser or parametric equaliser connected into the main program signal chain prior to the crossover input. Although this system works well, it is expensive to tie up a dedicated equaliser which is set once during installation of the sound system, and then locked away so that no other operator can gain access to it. In some instances it can also be difficult to obtain the correct degree of equalisation for a loudspeaker drive unit when the adjustment required is close to its crossover frequency, as the effects will also be mirrored by the adjacent loudspeaker drive unit.

20.2 FDS-360D Installation

Carefully inspect your equalisation board for any transient damage and check that you have the two support pillars and mounting screws provided. Follow the procedure shown by steps 1-5 below:

1 Remove the frequency card access plate, and top and bottom cover plates from the **FDS-360**.

2 Fit the two support pillars onto the main circuit board using the screws and washers provided. Replace the bottom cover.

3 Carefully cut and remove the four resistors located in position Link 1-4 on the main circuit board and adjacent to the 14-way connector socket, SKT 1. (Do not unsolder these components as their leads are used as through connections).

4 Mount the equalisation board onto the support pillars and secure the screws and washers provided. Carefully fold the ribbon connection cable and plug into SKT 1.

5 Refit the top cover and frequency card access cover plate.

Installation of the equalisation card is now complete.

20.3 Circuit Description

The **FDS-360D** contains four identical blocks of circuitry coded as FLTR 1, 2 , 3 and 4. One such block is shown below (***See figure 20.1***).

This filter block contains section A, a 1st order low pass filter, and section B, a fully parametric equaliser. These two sections can be used to configure any form of cut or boost Bell response or LF/HF shelving response, as indicated in ***Figure 20.2*** overleaf.

As it is unlikely that all four bands of the system will require equalisation, spare sections can be used in series to increase the complexity for a particular band. Reference to the attached full circuit diagram and the component overlay of ***Figure 20.3*** will show the various interconnection methods designed to interface these filter blocks into the correct crossover frequency band.

Equalisation Options

Fig 20.1 Schematic for one filter block

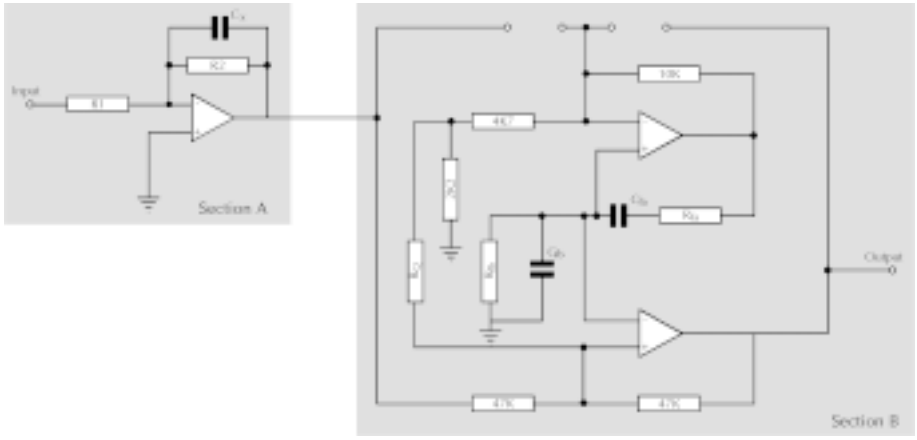


Fig 20.2 Bell Response curve for filter block

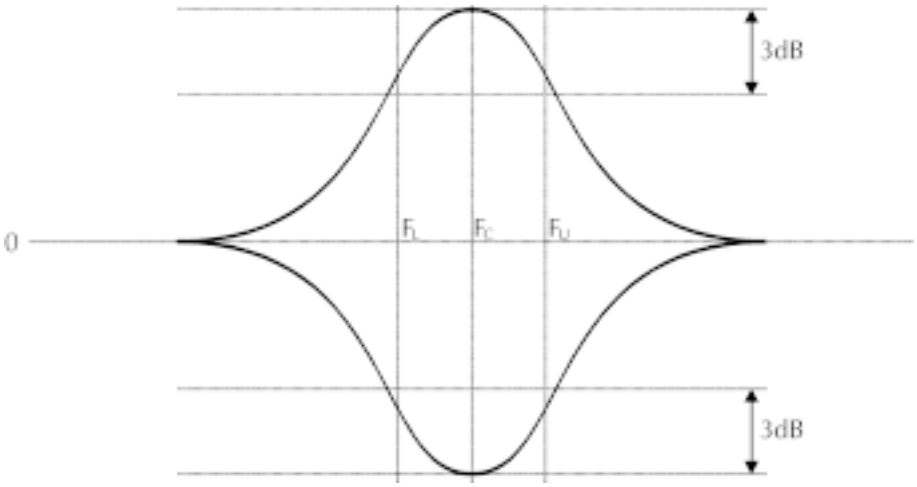
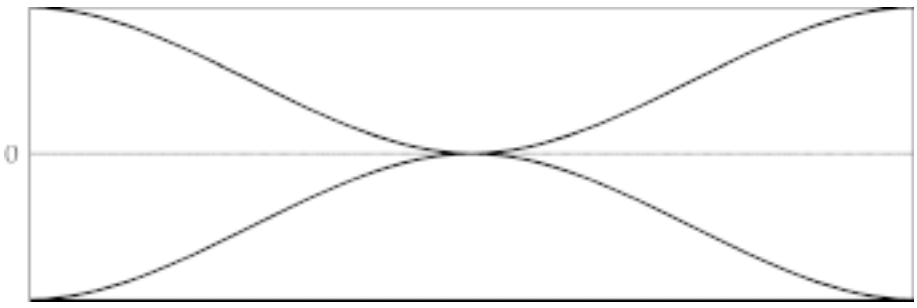


Fig 20.3 HF/LF Response curve for filter block



20.4 Filter Design

Reference should be made to ***Figure 20.1***.

Section A: First Order Low Pass Filter.

This can be used in conjunction with that of section B, and an example plot is shown in ***Figure 20.4***.

The equation for the -3dB frequency point of this circuit is:

F = 1/(6.28 x R2 x Cx), where R is in ohms,
C is in Farads,
F is in Hz.

Note should be taken that R2 is factory fitter as 10k ohms. Inspection of the circuit will show that it is also possible to change the gain of the filter block at this point. The actual gain in dB is:

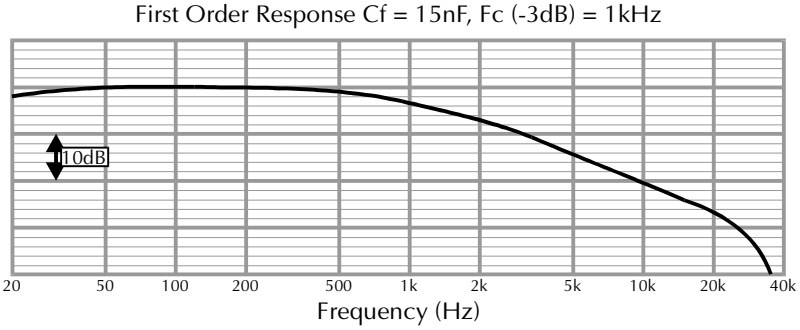
G(dB) = 20 x log(R2/R1)

It should also be noted that both R2 and R1 are factory fitted as 10k ohms, and should the value of R2 be changed, this must be accounted for in the calculation of Cx.

Design limits for both R1 and R2 are in the range of 2k to 100k ohms. There is no restriction on the value of Cx, apart from physical space on the circuit board.

Equalisation Options

Fig 20.4 First Order Sample Response



Section B: Parametric Equaliser Filter.

This is a fully adjustable bell shape equaliser for which control is given over:

- Centre frequency
- Q, or the sharpness of the Bell shape
- The amount in dB of the boost or cut.

A sample response of this equaliser is shown in ***Figure 20.5***:

1. Centre Frequency:

This is set by four components; Rfa, Rfb, Cfa and Cfb, and is given by the following equation:

$$Fc = 1/[6.28\ (R^{*}fa/b\ .\ C^{*}fa/b)],$$ where R is in ohms, C is in Farads, F is in Hz.

For symmetrical and normal responses note that Rfa = Rfb and Cfa = Cfb, and the equation reduces to:

$$Fc = 1/(6.28 \times Rf \times Cf)$$

Such that for Rfa = Rfb = 10k and Cfa = Cfb = 16nF than Fc = 1kHz.

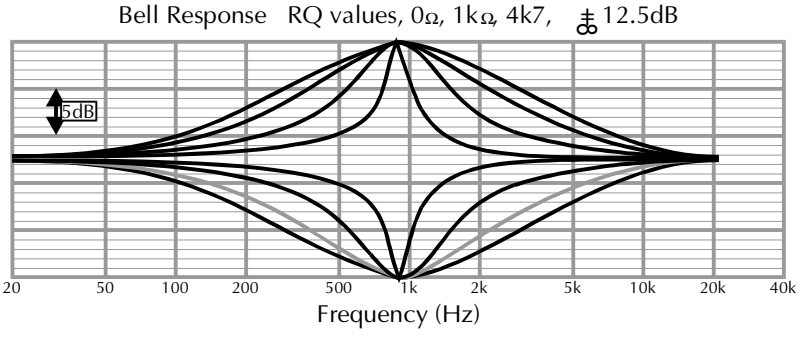
Design limits for Rf should be within the range 2k to 100k ohms. There are no limits for Cf apart from physical space on the circuit board.

2. Q and dB Boost/Cut:

Both of the parameters Q and dB are set by a single resistor, Rq and RdB respectively. To some extent they are interactive and it is therefore easiest to obtain their values from a set of graphs (***See figure 20.10 and 20.11***). These allow for ranges of Q from 0.2 to 3.0 and for a range of boost/cut of up to 16dB.

For further information on deciding on the values of these filter variables, ***refer to section 20.5***.

Fig 20.5 Parametric Equaliser Sample Response



20.5 Application Notes

100Hz Notch to reduce mains related interference

The design specification for this would be:

Fc = 100Hz
Q = Maximum possible
dB cut= Maximum possible

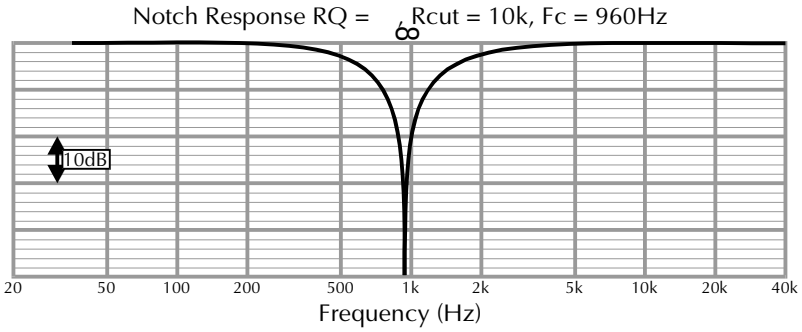
Using the Fc equation given earlier, and selecting Cf = 220nF gives a value for Rf = 7.23k ohms.

Using the graph for Rq will indicate that for a maximum value for Q, the value of Rq should be also be a maximum. In this circuit we can allow Rq to be infinite, so the design value for Rq would be open circuit, and no resistor would be fitted in this position.

Using the graph for RdB will indicate that a minimum value for RdB is required for a maximum value for boost/cut. In this circuit we can set a minimum value for this of 10k ohms. (Ensure this resistor is fitted in the 'cut' of 'C' position on the circuit board).

Notch depths of up to 50dB can be achieved, however this depends on the close matching of the frequency determining components. An example of this notch circuit is shown below in ***Figure 20.6***.

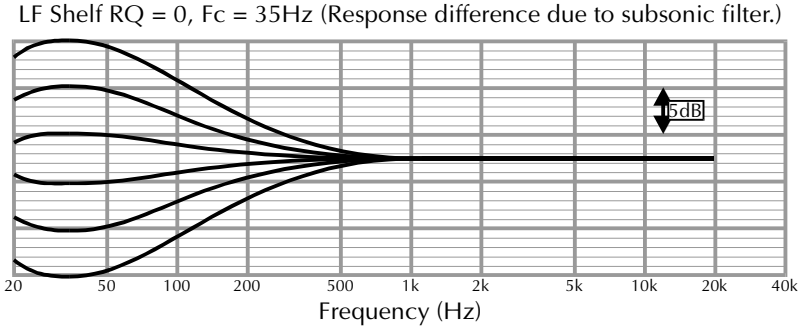
Fig 20.6 Sample Notch Response Curve



Shelving Filter:

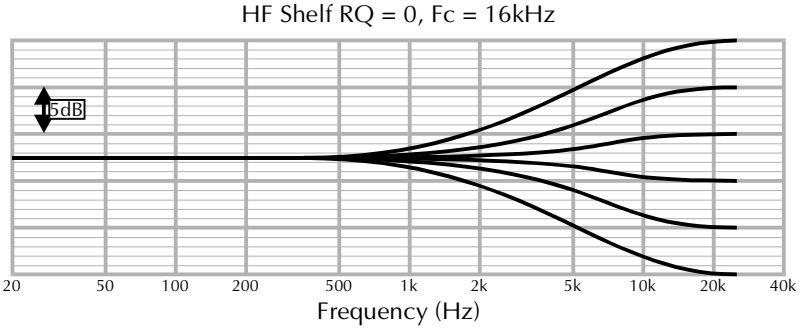
Utilising the parametric section and selecting a very low Q value will achieve a standard shelving type response filter of their boost or cut. Selecting a low Fc (such as 30Hz) will give a bass shelving response, and selecting a high Fc (such as 20kHz) will give a treble shelving response. An example of these shelving curves is given below in ***Figure 20.7***.

Fig 20.7 Sample LF Shelving Response Curves



Equalisation Options

Fig 20.8 Sample HF Shelving Response Curves



20.6 Application of the FDS-360D to a system

A target response should be arrived at by either inspection from a set of frequency response curves, or by adjustment of an external equaliser connected into the system. For simplicity, only one frequency band of the crossover has been considered.

Take a plot of the unmodified frequency response of the **FDS-360** and on the same sheet of graph paper plot the target response. A third plot is then drawn, which is the difference, in dBs, between the two curves and this 'correction' curve is the desired response of the **FDS-360** equalisation section. From this correction curve, the amount of dB boost or cut and the centre frequency, Fc, are easily obtained by inspection. The required Q value can either be obtained by calculation or estimated by comparison with the sample curves provided with this manual.

The equation of Q of a Bell response curve is:

$$Q = Fc/(Fu - Fl),$$

where Fu and Fl are the frequencies at which the amplitude response is 3dB down from the value at Fc.

Fig 20.9 Design Curves for Rq.

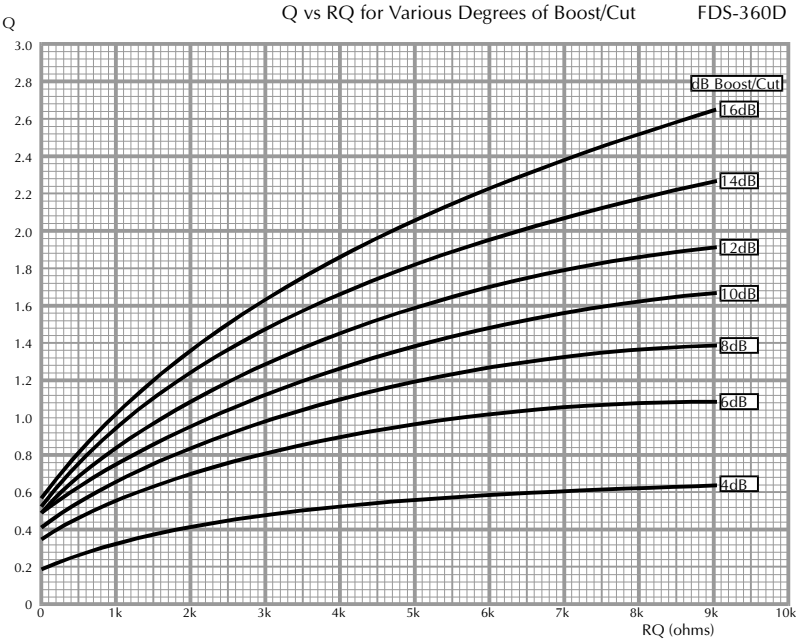
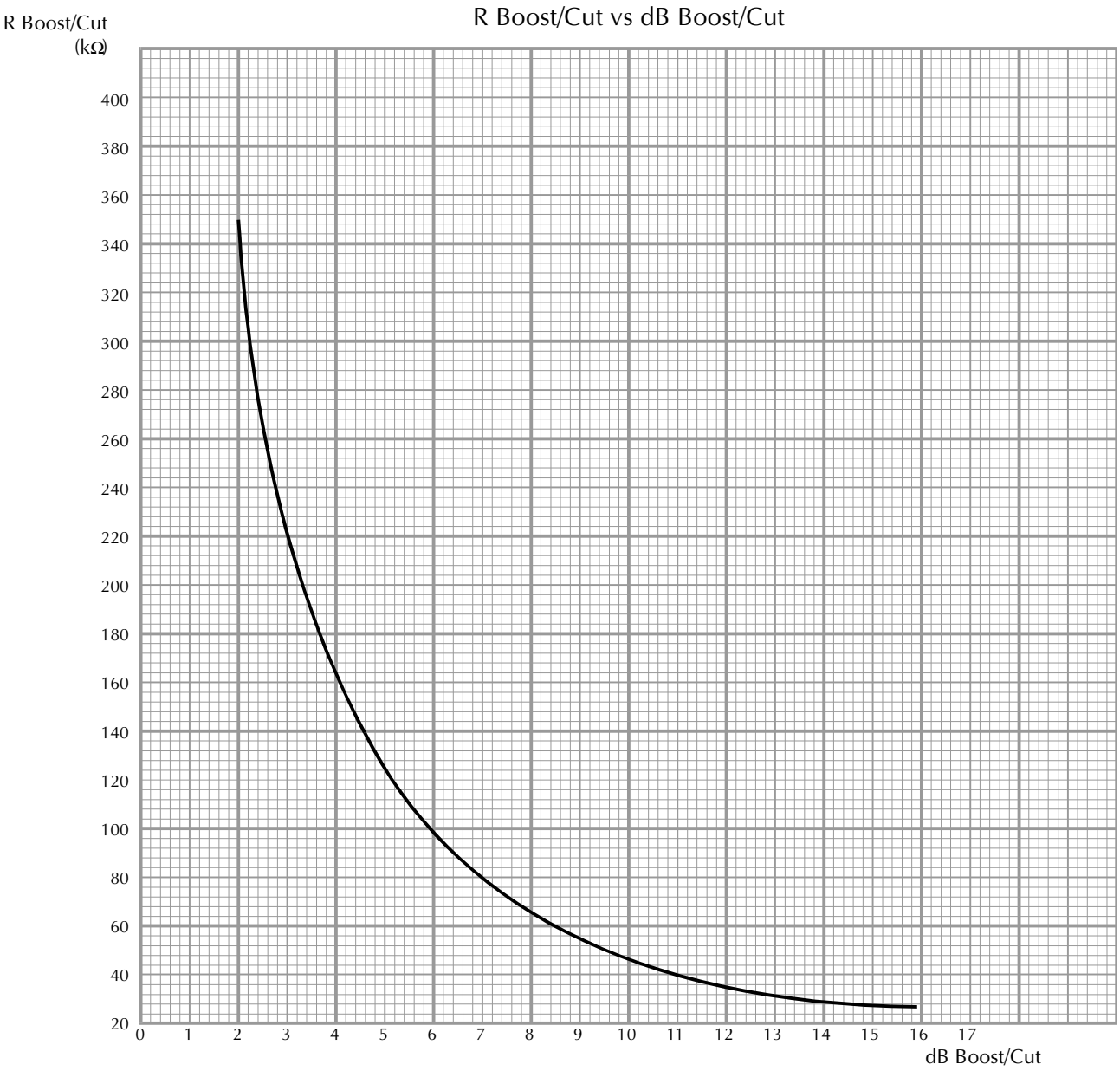
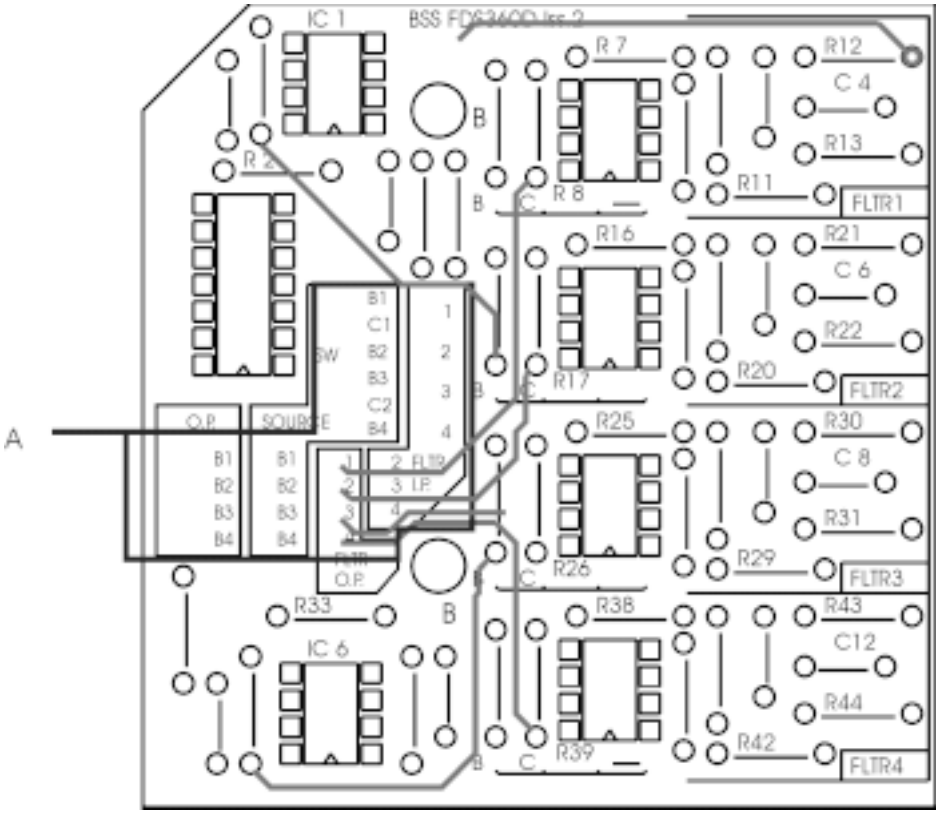


Fig 20.10 Design Curves for RdB



FDS 360 D-Card

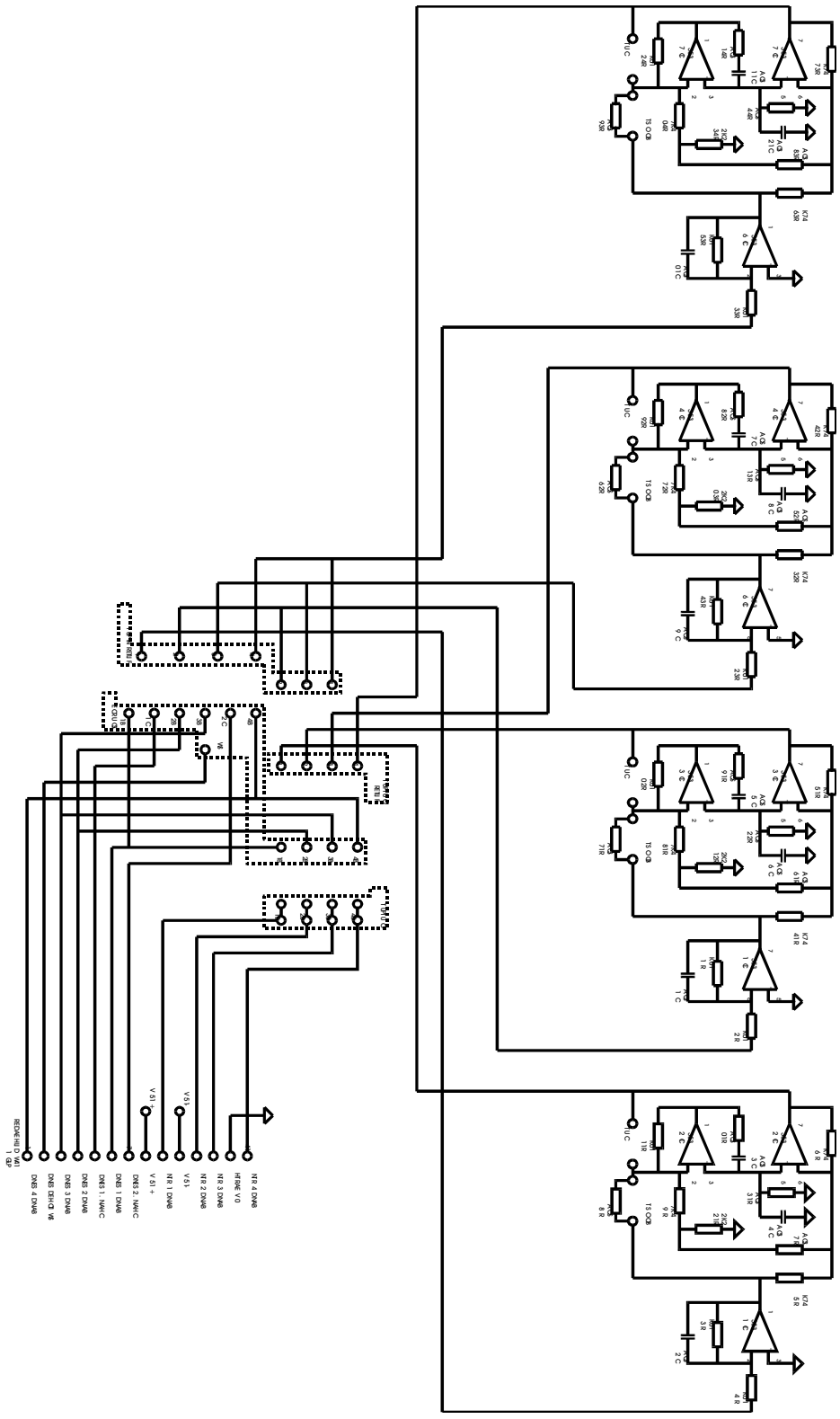


Connection of the filter blocks into the FDS360 frequency bands is arranged by the wire link strapping between the various connection areas:

Filter I.P : Are the inputs to the filter blocks.
Filter O.P : Are the outputs of the filter blocks.
O.P : Are the band insert returns, and are connected to the Filter O.P.
SOURCE : Are the band insert sends, and are connected to the Filter I.P

Note that the main CHN1 and CHN2 input signals are also provided, as is the switched send.
Reference to the FDS360 block diagram in ***section 20.3*** will help clarify the exact position of these signal feeds and insertion points.

Fig 20.12 FDS360 EQ 'D' card Schematic



FDS 360 E-Card

20.7 FDS-360 E Installation

The 360E board filters 3 and 4 are shelf type filters which can be configured as High or Low pass cut or boost. Filters 1 and 2 remain the same as the parametric EQ filters on the 360D board (***See section 20.4*** for further details).

The design idea for filters 3 and 4 is to provide gentle slopes which will enhance or cut low or high frequencies. To obtain these results only 1 resistor value is needed, and the frequency is changed using different capacitor values, typically between 4.7n and 22n.

For high pass cut/boost, X1 + X3 is a resistor and X2 + X4 is a capacitor.

For low-pass cut/boost, X1 + X3 is a capacitor and X2 +X4 is a resistor.

If the 4.7K resistor is changed, there may be some interaction between boost resistors R23 + R34 to R28 + R39 (***See figure 20.13*** for boost resistor values). If this occurs, the values of R23 + R34 to R28 + R39 will have to be changes accordingly.

On the PCB there are 6 positions for the boost resistors, set to give 1dB to 6dB of boost. The resistor values which can be used with these are shown below.

Fig 20.13 Boost resistor values

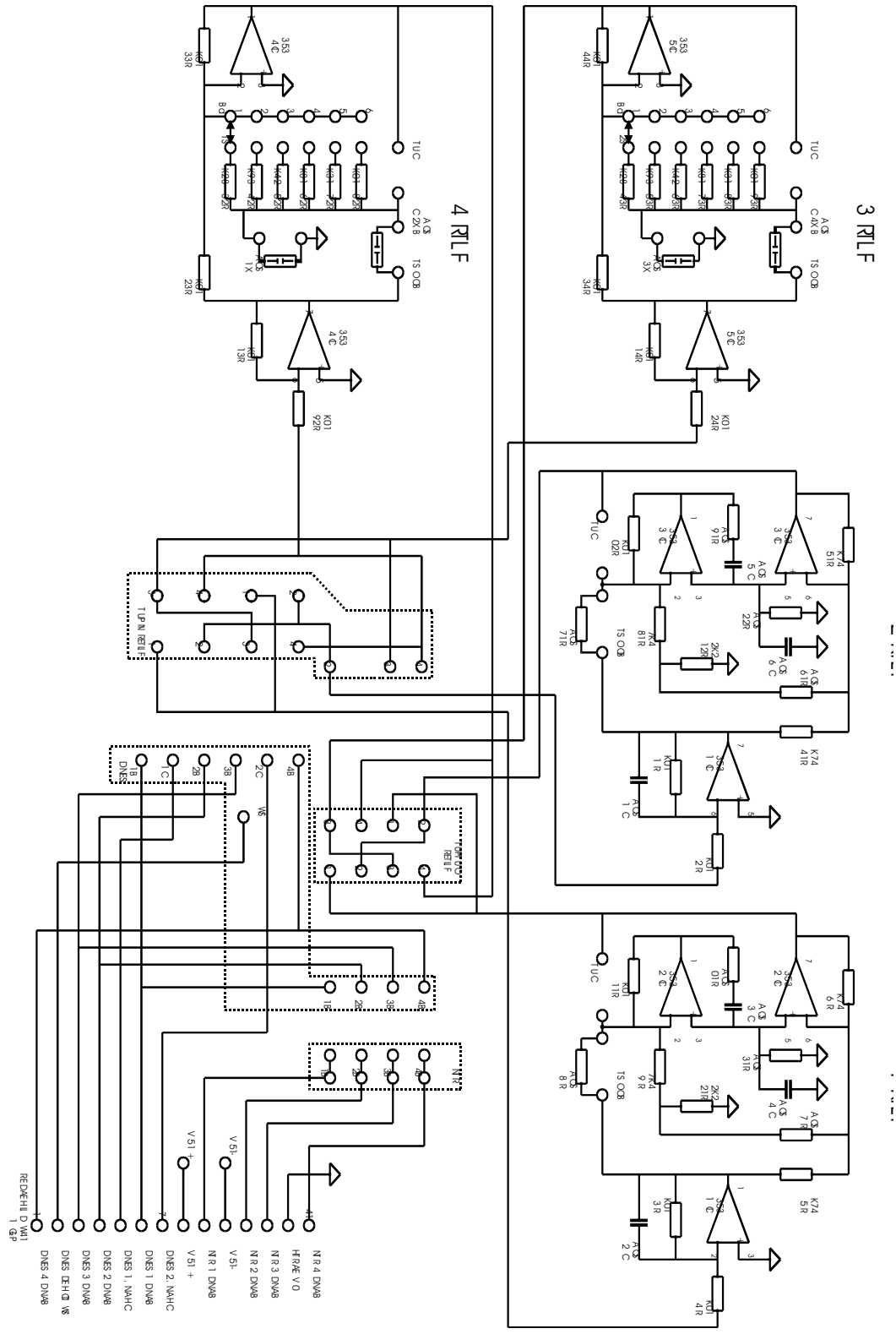
R23 + R34 = 82K
R24 + R35 = 39K
R25 + R36 = 24K
R26 + R37 = 18K
R27 + R38 = 13K
R28 + R39 = 10K

BSS currently use a software package called Analyser III to produce the results for the EQ boards. If you want to check this out, it can be obtained from a company called Number One Systems, at the following address:

Number One Systems
Somersham Road
St. Ives
Huntingdon
Cambridgeshire
PE17 4WR
England

Tel : +44 480 61778
Fax : +44 480 494 042

Fig 20.14 FDS-360 EQ 'E'
Card Schematic

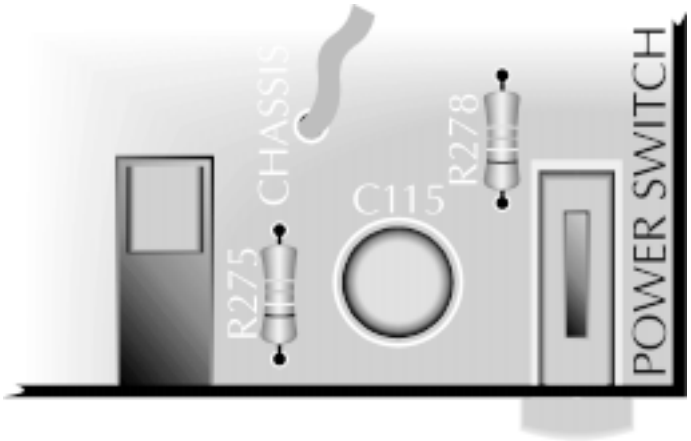


Chassis Earth Link
Transient Suppressor Replacement

21.0 Electronic/Chassis Earth Link

In some installations it may be necessary to separate the electronic 0V from the chassis and mains power earth to help in avoiding earth loops around the unbalanced output connections. Should this become necessary, it is easily achieved by removing a wire link inside the **FDS-360**. ***Figure 21.1*** shows the location of this wire link.

Fig 21.1 Wire Link Location



22.0 Transient Suppressor Replacement

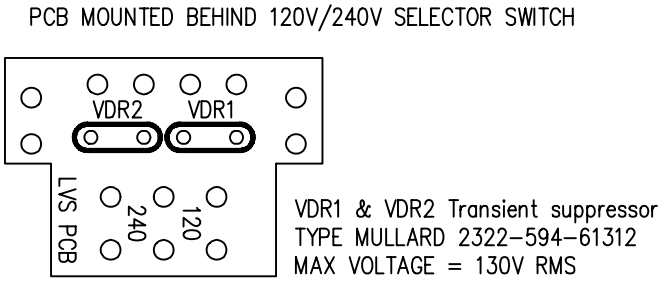
The primary of the mains transformer within the **FDS-360** is protected against high voltage spike interference by two voltage dependent resistors. These provide a short circuit to voltage peaks in excess of their maximum rating.

Should the **FDS-360** be inadvertently connected to 3 phase line/line voltages, or to 240V when selected to 120V, or any other incorrect voltage, these suppressors are likely to fail in a protective short circuit mode. This will be demonstrated by repeated mains fuse failure when powering up the unit.

Even in this case of extreme overvoltage, the **FDS-360** is protected against failure, and the simple removal of these suppressors will allow the unit to be used again. However, it is important that they are replaced as soon as possible to ensure continued protection.

Figure 22.1 indicates the location and specification for the suppressors.

Fig 22.1 Suppressor location



23.0 Troubleshooting

Problem: **No output**

Solution: Is the MUTE switch depressed?
Is the mains power on? (***See section 8.0***)
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 9.0 & 10.0***).
Are the power amplifiers switched on?

Problem: **Excessive Hum, Intermittent sound**

Solution: First check the connections on your input and output plugs (***See sections 9.0 & 10.0***). Unshielded cables, improperly wired connectors and damaged cables are the most common cause of sound system hums and buzzes. Then ***refer to sections 8.0***.

Problem: **Blown fuse**

Solution: The mains supply fuse is unlikely to blow without an electronic fault being present (***See section 8.0***). 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.

24.0 Glossary

Active Active electronic circuits are those which are capable of voltage and power gain by using transistors and integrated circuits. Passive circuits are those which use only capacitors, resistors, transformers, etc.

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

Attack Time The amount of time taken for the compressor or limiter to start gain reduction once the input signal has exceeded the threshold level. This is usually measured in micro or milliseconds (millionths or thousandths of a second).

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.

Breathing A term used to describe the fluctuations of background noise resulting from the compressor action.

Compressor An electronic circuit which reduces its input to output gain as the input signal increases above a predetermined threshold level.

dB A unit for expressing the ration between two signal levels for comparison purposes. On its own it has no absolute level meaning. Rather, it is a logarithmic ration 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 100 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 voltage. 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 0 dBv) = 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 before, except that 0dBV = 1.0 Volts.

Distortion Any modification of a signal which produces new frequency components not presents in the original. 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.

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

Gain Reduction The amount, in dBs, by which a compressor/limiters output has been reduced in level with respect to its uncompressed level.

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

Impedance The AC equivalent of resistance and 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.

Limiter Similar to a compressor but harder acting, and generally used as a protection device for audio systems.

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 double the frequency. One octave 'down' is equivalent to half the frequency.

Ratio The relationship between change in input level and resulting change in output as a consequence of compressing or limiting.

Release Time The time required for a compressor or limiter to restore its gain to normal, after the input signal has fallen below threshold.

Threshold The pre-settable level above which a compressor or limiter will commence to gain reduce.

Glossary

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 a transient can often reach 10 times or so the normal operating level of the audio equipment, and may cause distortion.

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

25.0 Specifications

Gain: 0dB standard. Optional +10dB to order.

Noise: 85dBm 20Hz to 20kHz unweighted.

Distortion: <0.5% THD up to +20dBm output, limiter cancelled.

Typically 0.0005% THD +6dBm output.

Filters: 24dB/OCT Linkwitz-Riley as standard.

Options include any 12, 18, 24dB/OCT filter type with user specified frequencies preset by plug-cards.

Phase: Continually adjustable 0-180 degree at band corner frequency. Additional 180 degree using the polarity switch.

Inputs: 10k ohm electronically balanced.

Input Filter: 24dB/OCT 30Hz subsonic. Optional 15Hz. 18dB/OCT 26kHz ultrasonic.

Outputs: Unbalanced 50 milli-ohm current limited source to drive 600 ohm load. Maximum level +20dBm.

Limiter: Separate for each band with attack and release times scaled to suit. Limit ratio >20:1. Threshold range adjustable in 0.5dM steps from +10dBv to -11dBv.

Indicators: Three LEDs to indicate presence of signal, onset of limiting and over-limiting.

Insertion Points: Channel sends: Output impedance 100 ohm to drive 10k ohm load to +20dBv. Channel returns: Input impedance 10k ohm. Maximum level +20dBv unbalanced.

Mains Supply: Switched 120V or 240V +10%-20% at 50-60Hz.
Power supply is designed with extended low-voltage tolerance to meet show requirements.

Size: 482mm x 44mm x 228mm
19" x 1¾" x 9".

Weight: 4.5kg packed.

26.0 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-360** was designed and developed by BSS Audio, Hertfordshire, England.

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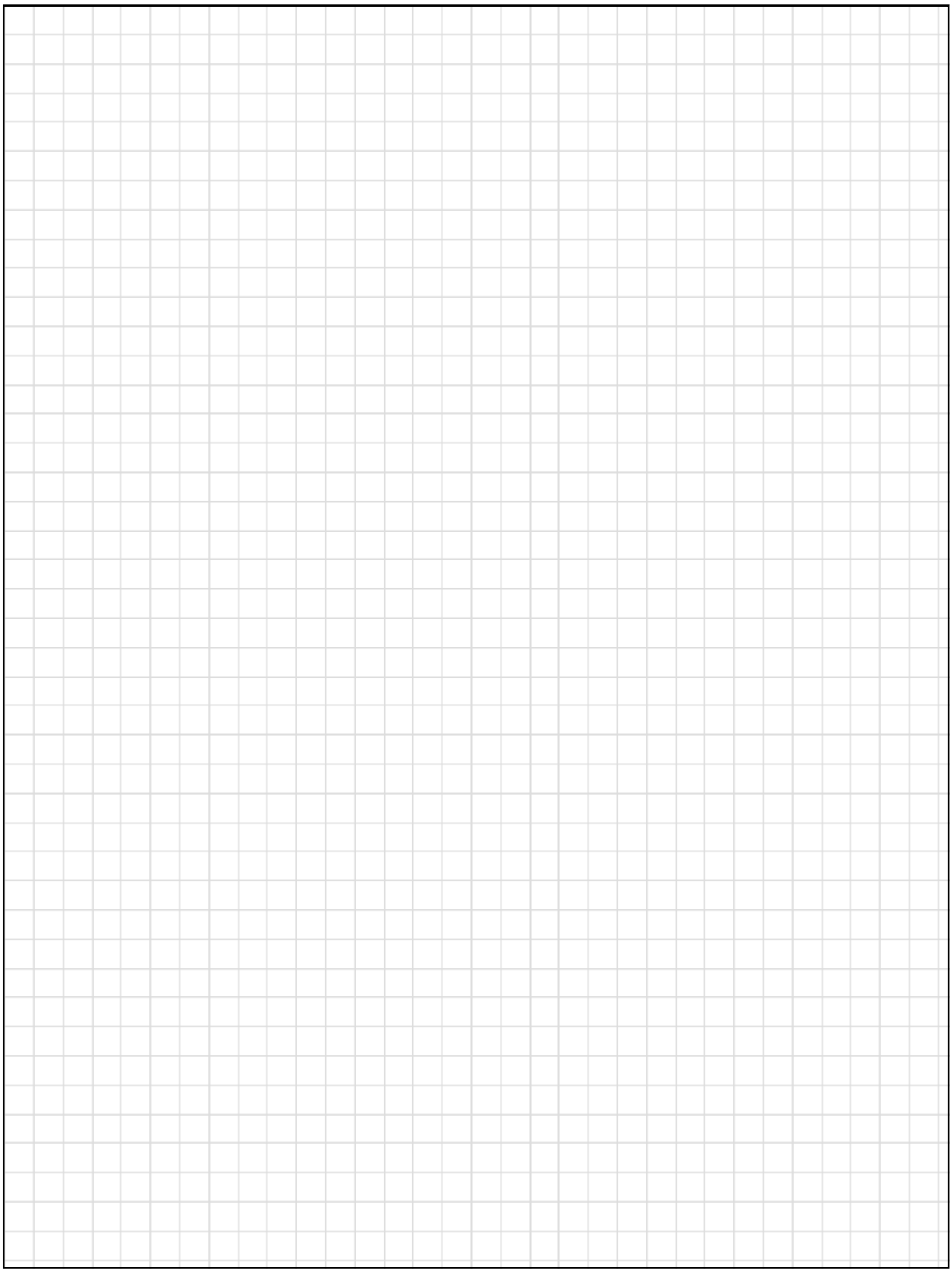
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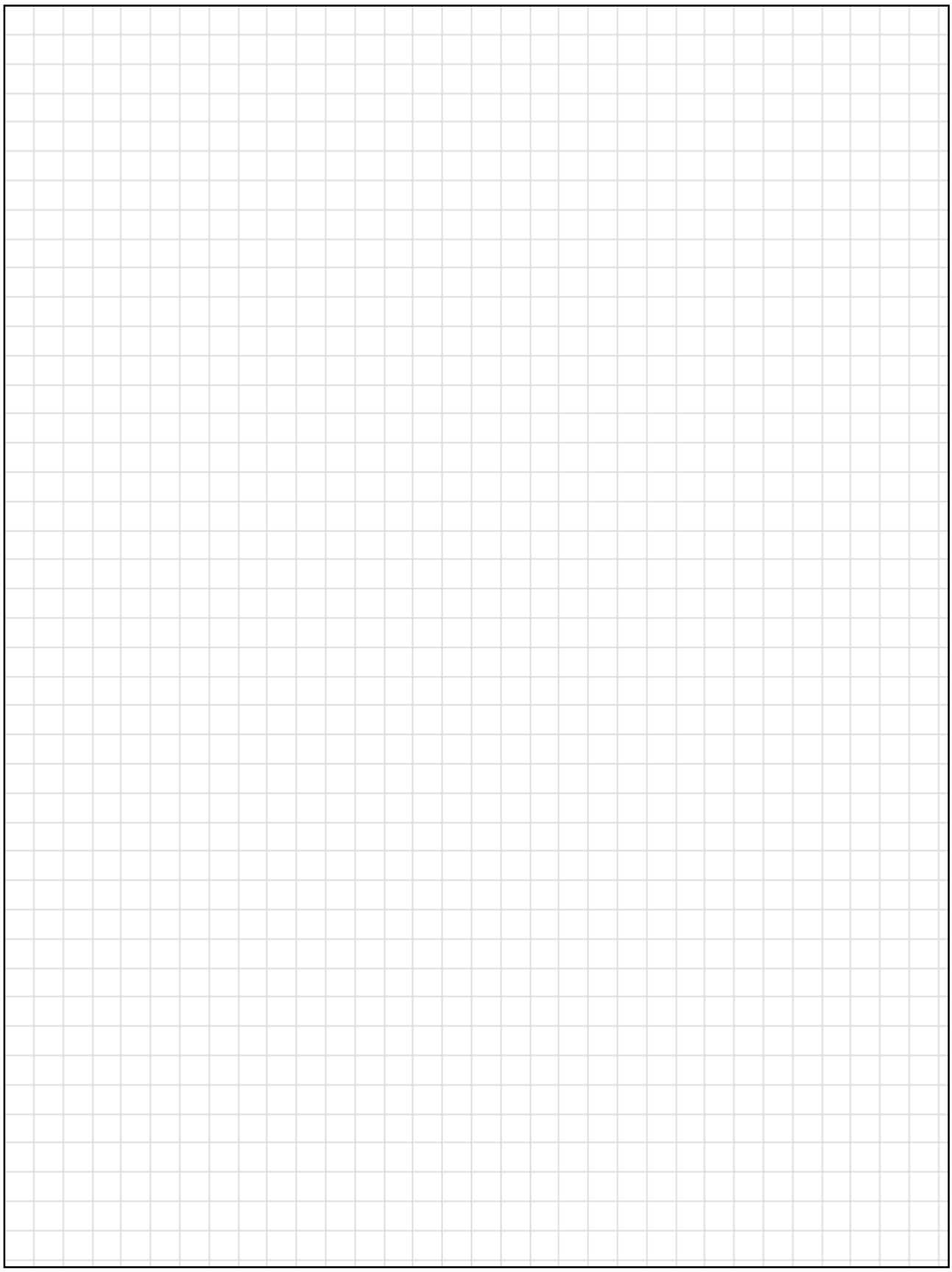
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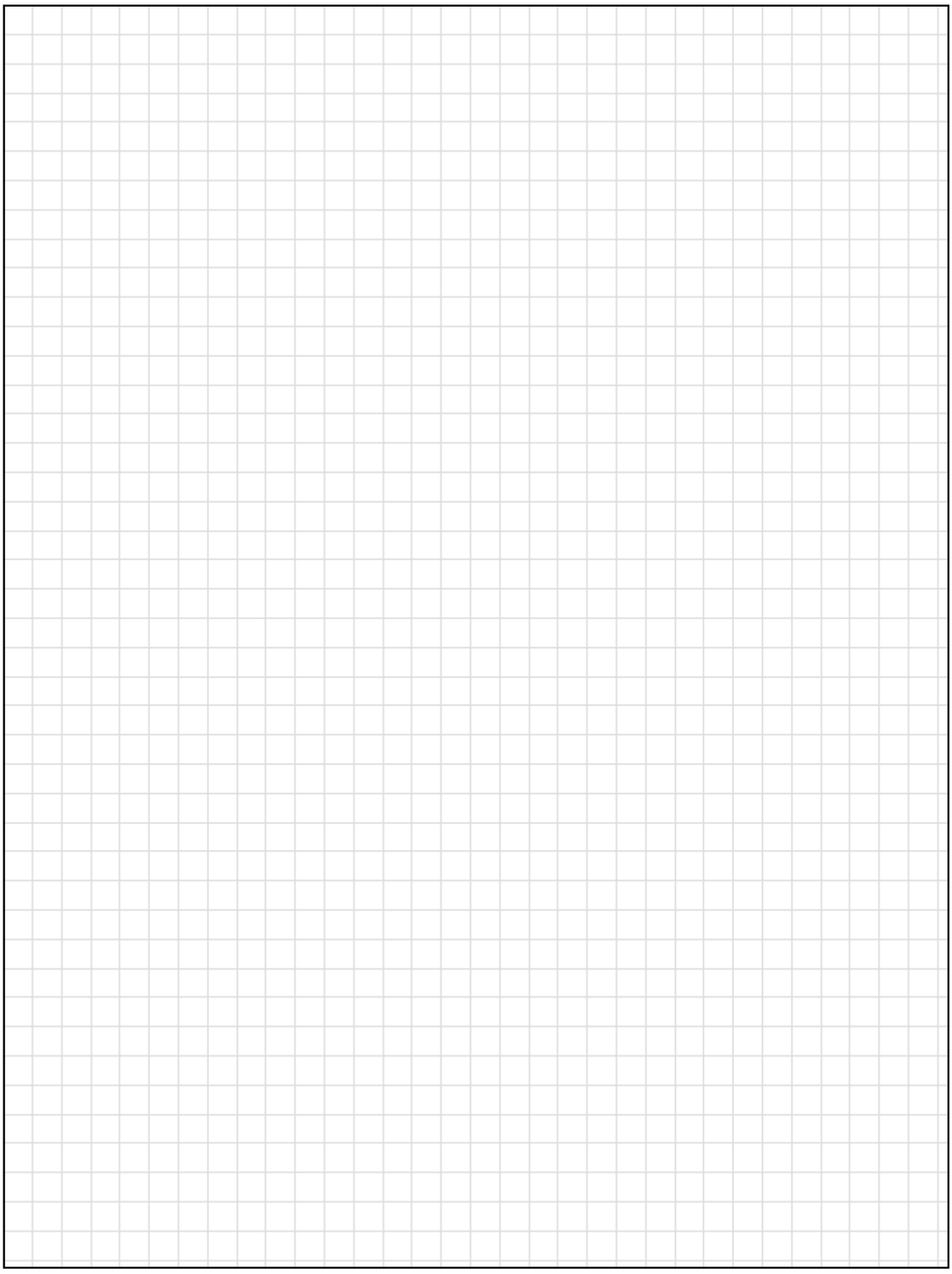
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User Notes



User Notes





User Notes

