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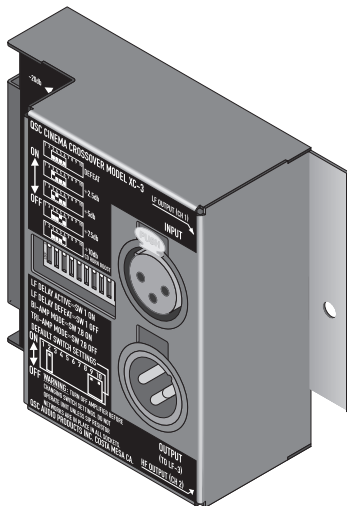
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Cinema Accessories

for DCA Series amplifiers

USER MANUAL



- ▼ **XC-3** *Two-way crossover with delay*
- ▼ **LF-3** *Low-frequency filter with delay*
- ▼ **SF-3** *Subwoofer filter*



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Rev. A

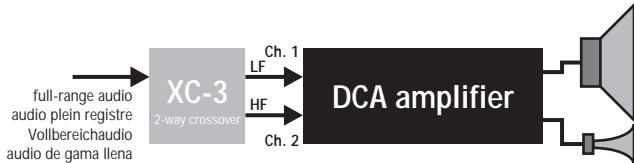
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CINEMA ACCESSORIES FOR DCA AMPLIFIERS

I. Introduction

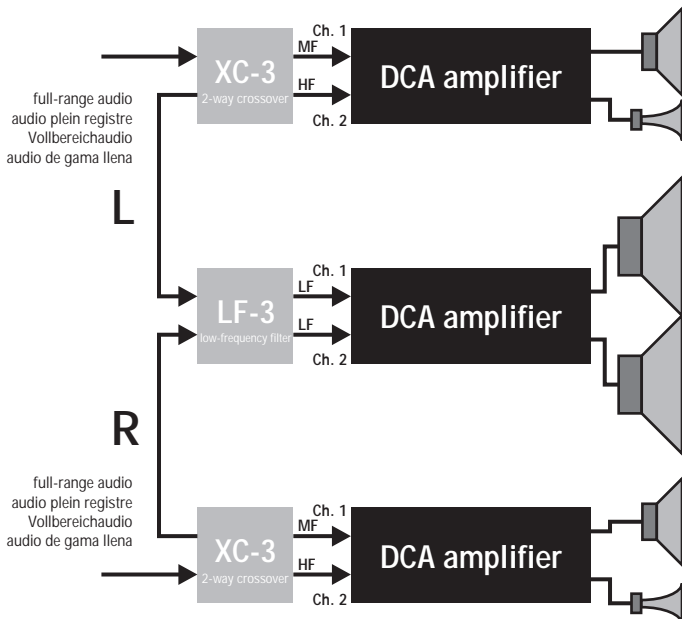
This manual covers setup and operation of cinema crossover accessories for QSC DCA Digital Cinema Amplifiers. These accessories comprise three models: the XC-3 crossover, the LF-3 low frequency filter, and the SF-3 subwoofer filter. Together with DCA amplifiers, they allow you to assemble any type of cinema sound system, mono or multi-channel.



Using the XC-3 in a simple two-way system. In many speaker systems, a passive mid/high combination will handle the higher frequencies, creating essentially a three-way system.

Each accessory mounts directly to the back of the amplifier, from which it also draws its power. It has its own input and, if necessary, output connectors. A male HD-15 connector conveys the audio signals into the amp through its DataPort.

Frequency and delay parameters are user adjustable by inserting selected 8-pin SIP resistor networks (included with each unit) into sockets on the underside of the accessory. A DIP switch permits selection of functions such as delay and high-frequency boost.

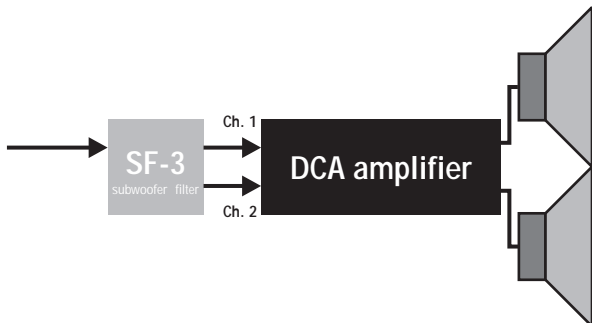


Using the XC-3 and LF-3 in a stereo three-way system

II. Description of Functions

XC-3 This accessory is a two-way crossover, with the low frequency band fed to channel 1 of the amplifier and the high frequencies to channel 2. An all-pass filter on the low frequency band delays the audio signal, permitting time alignment of a cone driver with a high-frequency horn. A selectable high-frequency boost circuit provides several increments of compensation for screen loss or constant-directivity horn equalization. A HF trim control provides 0 to 20 dB of attenuation for matching levels between frequency bands.

The XC-3 can be used by itself with one amplifier for a 2-way system (shown top left), or with the LF-3 and an additional amplifier for 3-way systems, as shown at left. The XC-3 has a pass-through output in parallel with the input for distributing the audio signal to the LF-3. The filter circuitry uses a 4th-order Linkwitz-Riley alignment with 24 dB/octave slopes.



Using the SF-3 with a discrete subwoofer channel

LF-3 Used in a system with the XC-3, the LF-3 performs the low-frequency crossover functions in a 3-way system as shown at left. Unlike the XC-3, though, it is a device with two discrete channels; one LF-3 with an amplifier will support two other amplifiers with two XC-3 accessories, as shown. The 4th-order Linkwitz-Riley low-pass filters have 24 dB/octave slopes.

Each channel also has an all-pass filter providing delay for time alignment. Frequency and delay parameters for both channels are set individually, although in all but a few applications they would be set the same.

Each channel also has a trim control providing 0 to 20 dB of attenuation to facilitate matching levels among the various frequency bands.

SF-3 This subwoofer filter accessory has two summed inputs and a bandpass filter that defines the frequency range of the subwoofer program. The frequencies of the 2nd-order high-pass and 4th-order Linkwitz-Riley low-pass filters are both user-defined. The high-pass filter also has a switchable low-frequency boost feature: switched on, it provides a 6 dB bump at the selected high-pass frequency, useful for extending the low-end response of some speaker systems; off, the response is a flat Butterworth curve that is 3 dB down at the selected frequency. The output is parallel, feeding the same signal into both channels of the amplifier. The SF-3 has no delay function. A level trim control provides 0 to 20 dB of attenuation.

The SF-3 can be used to derive subwoofer-range program from full-range audio, or it can be used with a discrete subwoofer channel in cinema sound systems.

III. Configuring the accessories

Configure each accessory before you mount it to the amplifier. If an accessory is already mounted to an amplifier, always turn the amp off before changing switch settings or input or output connections, or detaching the accessory.

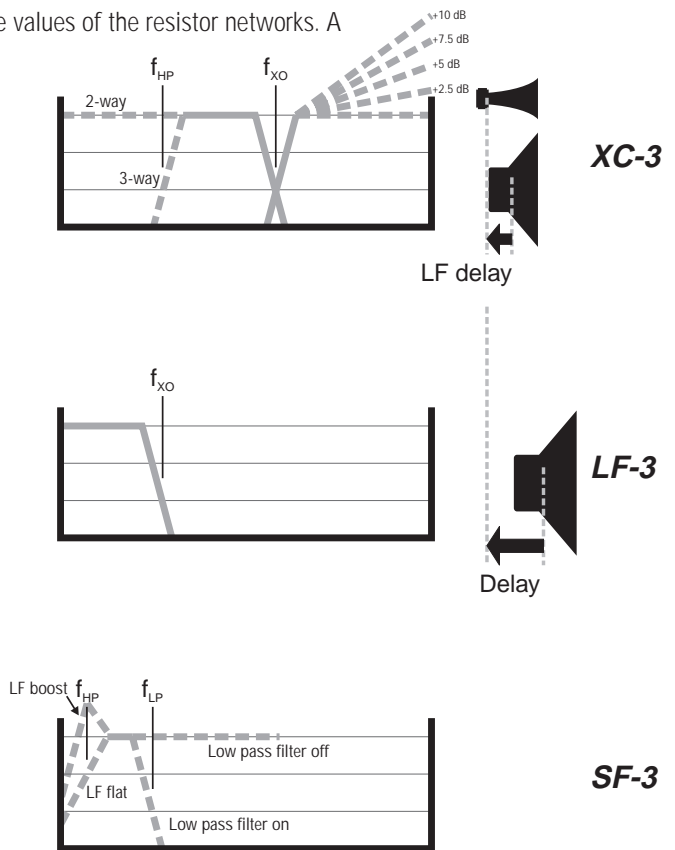
Use the tables on the following pages to determine the correct resistance for the desired frequency and delay settings. A

flowchart for each model will assist you in setting the various parameters, and the chassis label on each accessory also details the correct DIP switch settings. An appendix in the back of this manual lists manufacturer-recommended crossover frequency and delay settings for various popular cinema speaker systems.

The purpose of the delay functions in the XC-3 and LF-3 is to correct for time misalignments between different types of speaker driver in the overlap region between adjacent frequency bands. These time misalignments occur when the acoustical source points of the drivers for the adjacent frequency bands are physically at different distances from the listener(s). A delay compensation of 1 millisecond represents approximately 1.13 ft (13.5 in), or 34.4 cm.

NOTE: Even if you don't use a particular filter or delay feature on an accessory, put an unused SIP resistor network of any value into its socket to ensure circuit stability when it is powered up.

The SIP resistor networks have no polarity and therefore do not need to be inserted in a certain direction. Make sure all eight pins are inserted properly into the sockets holes, and then gently but firmly press the network into the socket until it is fully seated. If a SIP resistor network is difficult to remove with your fingers, use a small screwdriver, prying gently first at one end of the SIP and then the other, until it is loose.



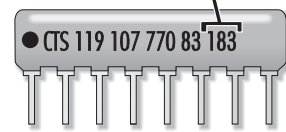
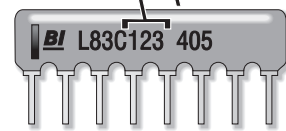
Configurable functions of the three accessory models

Crossover freq. (f_{x0})	SIP resistor value	Delay (ms)	SIP resistor value
80 Hz	68K	1.8	27K
150 Hz	39K	1.4	22K
200 Hz	27K	1.3	20K
250 Hz	22K	1.2	18K
300 Hz	20K	1	15K
350 Hz	18K	0.8	12K
400 Hz	15K	0.7	10K
500 Hz	12K	0.6	8.2K
600 Hz	10K	0.5	6.8K
650 Hz	8.2K	0.4	5.6K
800 Hz	6.8K	0.3	4.7K
1 kHz	5.6K		
1.2 kHz	4.7K		
1.5 kHz	3.9K		

Use these tables with the XC-3 and LF-3 to determine the correct resistor values for the crossover frequencies and delays you need. The shaded values are for the LF-3 and the high-pass frequency (f_{HP}) of the XC-3.



Use only these three digits to determine resistance code. Disregard the other numerals and letters.



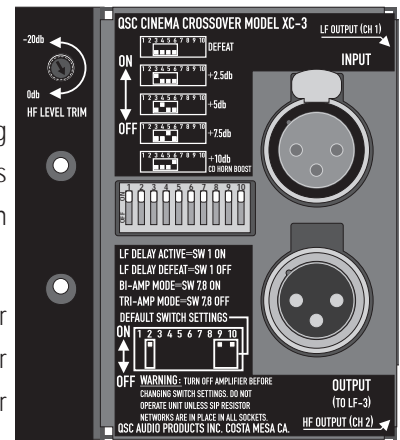
RESISTANCE	CODE
2.7K	272
3.9K	392
4.7K	472
5.6K	562
6.8K	682
8.2K	822
10K	103
12K	123
15K	153
18K	183
20K	203
22K	223
27K	273
33K	333
39K	393
47K	473
56K	563
68K	683

Identifying SIP resistor networks

Setting up the XC-3

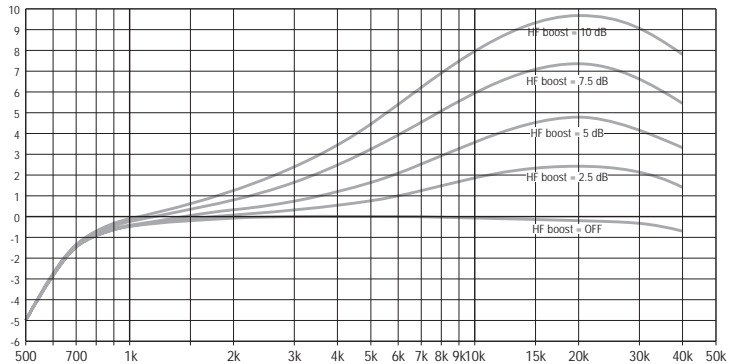
This procedure involves setting the DIP switches, as well as selecting and inserting SIP resistors into the appropriate sockets. Set switches 2, 9, and 10 to ON. The flowchart on the next page takes you through all the steps necessary before mounting the accessory to the amp.

The illustration on the next page shows the locations of the sockets for the SIP resistor networks. The resistor networks have no polarity or directionality and therefore do not need to be inserted in any particular way, as long as each network pin goes into its own hole in the socket.

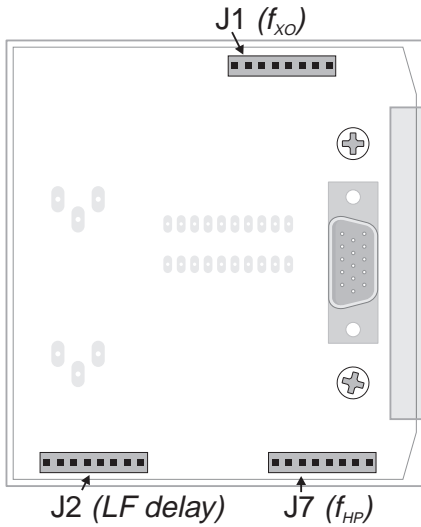


XC-3 controls and switches

Use the tables at the top of this page to select the correct resistor networks for the settings you need. The SIPs supplied with the XC-3 provide a selectable frequency range for f_{x0} of 80 Hz to 1.5 kHz, and delay settings from 0.3 to 1.8 milliseconds, plus *bypass* (no delay); contact QSC's Technical Services department if your application requires different settings.



Effects of high frequency boost on frequency response (crossover frequency = 500 Hz). A boost of +10 dB is most common for compensating for screen loss (attenuation of high frequencies as sound passes through screen perforations) and for constant-directivity horns.



Locations of SIP sockets on the XC-3

When using the XC-3 in a three-way system in conjunction with the LF-3, the lower frequency (f_{HP}) should match the crossover frequency of the LF-3 (f_{XO}). The SIPs supplied with the XC-3 allow a selectable frequency range for f_{HP} of 80 to 500 Hz.

FACTORY SIP SETTINGS

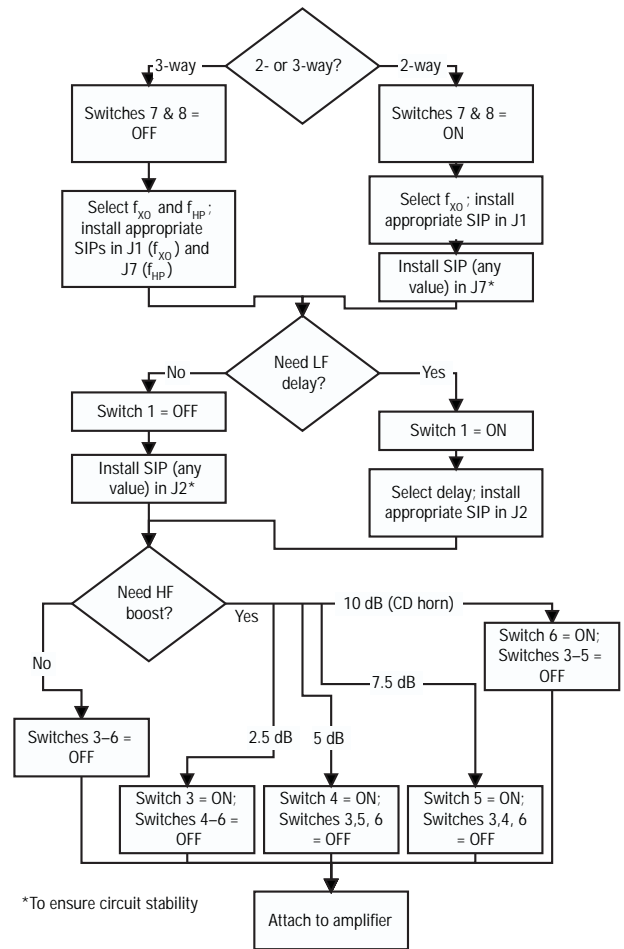
f_{XO}	500 Hz (12K SIP resistor in J1)
LF delay	1.8 ms (27K SIP resistor in J2)
f_{HP}	80 Hz (68K SIP resistor in J7)

FACTORY SWITCH SETTINGS

- Bi-amp mode (switches 7 & 8 = ON)
- LF delay active (switch 1 = ON)
- HF boost defeated (switches 3 through 6 = OFF)
- Switches 2, 9, & 10 = ON

RECOMMENDED AMPLIFIER SETTINGS WITH THE XC-3

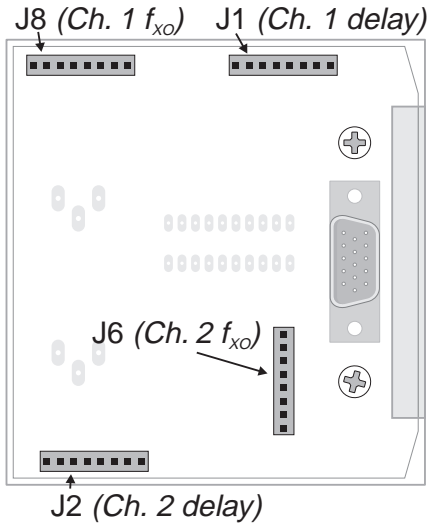
- Clip limiters ON, both channels
- Stereo mode
- High-pass filter ON, both channels
- High-pass frequency 30 or 50 Hz, both channels



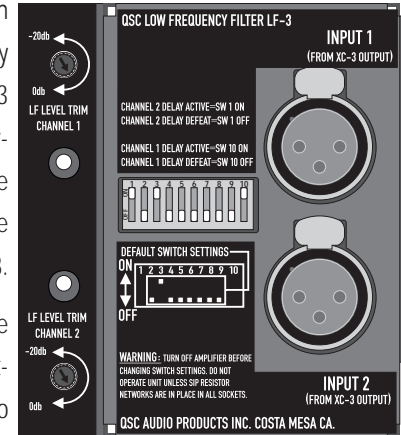
Setup flowchart for the XC-3

Setting up the LF-3

This procedure involves setting the DIP switches, as well as selecting and inserting SIP resistors into the appropriate sockets. Set switches 2 and 4 through 9 to OFF, and switch 3 to ON. The flowchart below takes you through all the steps necessary before mounting the accessory to the amp.



Locations of SIP sockets on the LF-3



LF-3 controls and switches

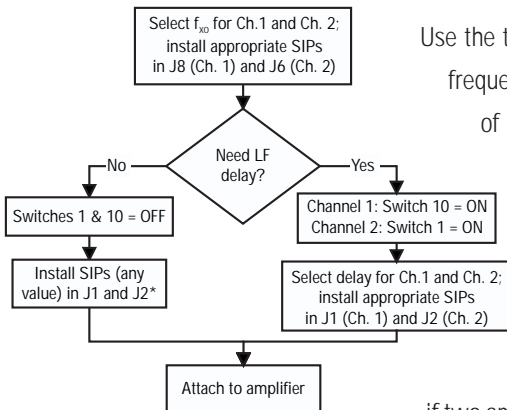
The LF-3 is typically used in a system in conjunction with the XC-3 crossover. For example, a stereo three-way system will require three DCA amplifiers, two XC-3 cinema crossover accessories, and one LF-3 low-frequency cinema accessory, as shown on page 2. The typical input signal is full-range audio taken from the male XLR connector labeled "OUTPUT (TO LF-3)" on the XC-3.

The illustration to the left shows the locations of the sockets for the SIP resistor networks. The resistor networks have no polarity or directionality and therefore do not need to be inserted in any particular way, as long as each network pin goes into its own hole in the socket.

Use the tables at the top of page 5 to select the correct resistor networks for the crossover frequency (f_{xo}) and delay settings you need. The SIPs supplied with the LF-3 provide a range of frequency selections from 80 Hz to 500 Hz, and delay settings from 0.3 to 1.8 milliseconds plus bypass (no delay); contact QSC's Technical Services department if your application requires different settings.

When using the LF-3 in a three-way system in conjunction with the XC-3, the crossover frequency of the LF-3 (f_{xo}) should match the lower high-pass frequency (f_{hp}) of the XC-3.

In most circumstances, the LF-3 would be used with an amplifier in stereo mode. But if two amp channels are needed for one low frequency signal, you can use the Channel 1 input of the LF-3 and parallel the inputs of the amplifier (using the amp's DIP switches).



*To ensure circuit stability

Setup flowchart for the LF-3

FACTORY SIP SETTINGS

f_{xo}	350 Hz, both channels (18K SIP resistor in J6 & J8)
Delay	1.4 ms, both channels (22K SIP resistor in J1 & J2)

FACTORY SWITCH SETTINGS

Delay active, both channels (switches 1 & 10 = ON)
 Switches 2 and 4 through 9 = OFF; switch 3 = ON

RECOMMENDED AMPLIFIER SETTINGS WITH THE LF-3

- Clip limiters ON (both channels)
- Stereo mode; parallel mode in applications requiring dual LF amp channels with one source
- High-pass filter ON (both channels)
- High-pass frequency 30 or 50 Hz, depending on speaker (both channels)

Setting up the SF-3

This procedure involves setting the DIP switches, as well as selecting and inserting SIP resistors into the appropriate sockets. First, set switches 1 through 6 and 10 to OFF. The flowchart on the opposite page takes you through all the steps necessary before mounting the accessory to the amp.

The bottom right illustration details the locations of the two SIP sockets used on the SF-3. The resistor networks have no polarity and therefore do not need to be inserted in any particular way, as long as each pin goes into its own hole in the socket.

The mono subwoofer program can be derived from summing and filtering stereo or mono full-range audio, or it can come from a discrete mono subwoofer channel, such as in a 5.1, 6.1, or 7.1 cinema surround system. If the subwoofer program is to be derived, use the SF-3's low-pass filter to set the high end of the subwoofer passband. If the subwoofer program source is a discrete channel, as in most cinema systems, we recommend that you bypass the low-pass filter.

The SF-3's two inputs are summed together, so you can use one or both, depending on your system needs. The outputs to the two amplifier channels are monaural and in parallel, unlike the XC-3 and LF-3. Thus, SF-3 is the only DCA accessory that can be used with the amplifier in bridged mono mode, when necessary.

Use the table at right to select the correct resistor networks for the SF-3's filter frequency settings. An identification chart for SIP resistor networks is on page 5. The SIPs supplied with the LF-3 provide a selection of three low-pass frequencies: 80, 150, and 250 Hz; and six high-pass frequencies from 20 to 50 Hz. Use the speaker manufacturer's recommended filter settings.

The low-frequency boost switch selects the Q of the high-pass filter: 0.707 for flat (Butterworth), or 2 for "boost," which adds a 6 dB peak at the filter's selected frequency. Some speakers require this boost to extend the low-frequency response.

FACTORY SIP SETTINGS

f_{HP} 30 Hz (27K SIP resistor in J2)

f_{LP} 250 Hz (22K SIP resistor in J1 & J2)

FACTORY SWITCH SETTINGS

Low-pass filter OFF—"cinema" setting (switches 7 & 8 = ON)

LF flat (switch 9 = OFF)

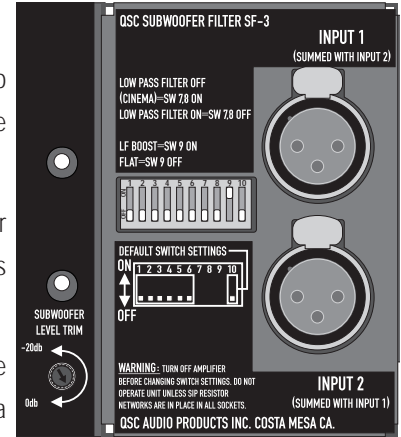
Switches 1 through 6 and 10 = OFF

RECOMMENDED AMPLIFIER SETTINGS WITH THE SF-3

Clip limiters ON (both channels)

Stereo or bridged mono mode, as the application dictates

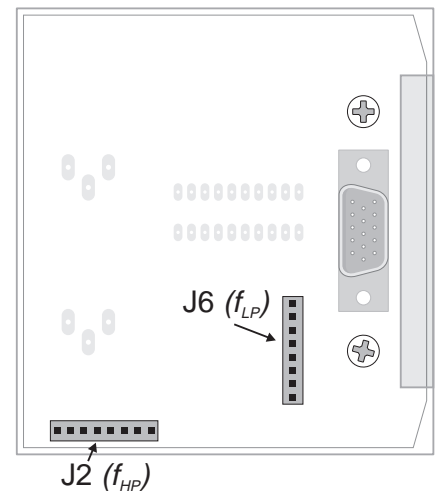
High-pass filter OFF (both channels)



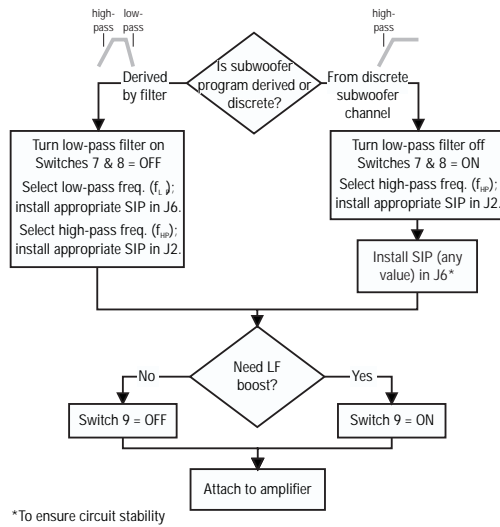
SF-3 controls and switches

Low-pass freq. (f_{LP})	SIP resistor value
80 Hz	68K
150 Hz	39K
250 Hz	22K
High-pass freq. (f_{HP})	SIP resistor value
20 Hz	47K
25 Hz	33K
30 Hz	27K
35 Hz	20K
40 Hz	15K
50 Hz	10K

Use this table to determine the correct resistor values for the SF-3 filter frequencies.



Locations of SIP sockets on the SF-3

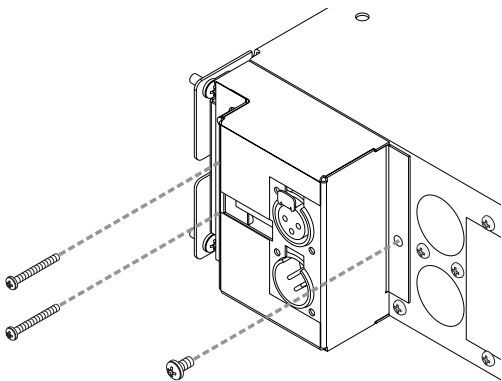


Setup flowchart for the SF-3

IV. Mounting the accessories

An accessory may be mounted with the amplifier either in or out of the rack, even if the amp is installed with rear rack ears.

1. Turn off the amplifier before installing the accessory.
2. Make sure the SIP resistor networks are installed properly and no SIP sockets are empty.
3. Line up the HD-15 connector on the accessory with the amplifier's DataPort, then press the accessory onto the back of the amplifier so that the HD-15 connector inserts into the DataPort.
4. Use the three screws supplied to secure the accessory to the amplifier chassis, as shown at left. Two long screws go into the holes near the DataPort, while the short screw goes through the hole in the tab on the right edge of the accessory. Do not overtighten the screws.
5. Attach the input and output cables to the appropriate connectors on the accessory. Use the amplifier's normal output connectors for attaching speaker and monitor cabling.

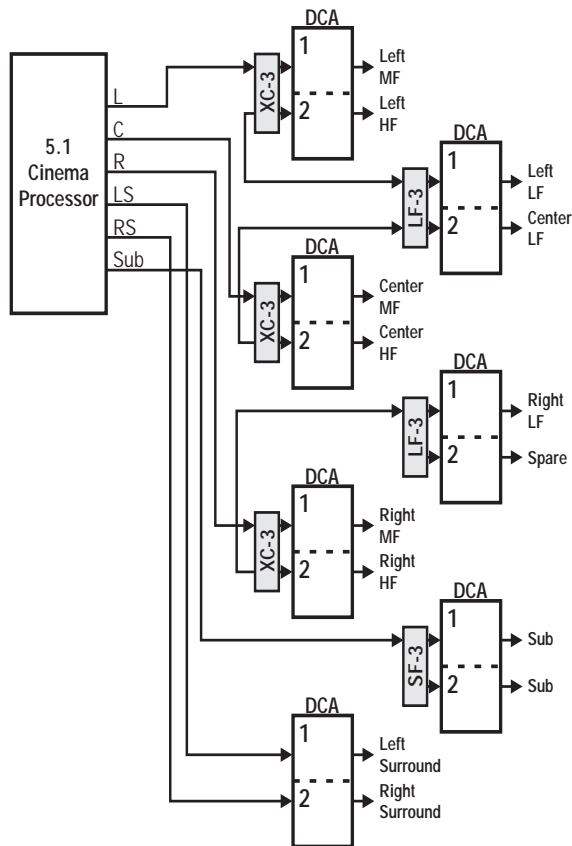


V. Setting up the DCA accessories in the cinema sound system

Setting up the DCA accessories in the B chain of the cinema sound system primarily involves setting the trim levels on the XC-3, LF-3, and SF-3. This requires the pink noise source in the cinema processor and a real-time acoustical spectrum analyzer.

1. Set up the analyzer microphone in the center of the cinema audience seating area or in another recommended location.
2. Set the gain controls wide open for all the DCA amplifiers, and check the HF boost settings on the XC-3 accessories.
3. Apply a pink noise test signal from the cinema processor to the left channel XC-3 input. Watch the frequency response on the analyzer and use the HF trim control on the XC-3 and the LF trim on the LF-3 to balance the levels of their frequency bands to that of the the mid-frequency band, within specifications. If the shape of the HF response is not correct, use a boost setting that better corrects the deficiency; turn the amplifiers off before changing the switch settings.
4. Repeat this process for the center and right screen channels and any surround channels that are bi- or tri-amped.
5. Follow the processor instructions for setting sound pressure level outputs of all the channels, including the subwoofer.

If you are unable to obtain a satisfactory frequency response or SPL on a channel, carefully check the wiring and connections. Some likely causes are reversed speaker polarity on one or more drivers; loose or broken wiring or connections; or blown or damaged speaker drivers.



A typical 5.1 surround system with DCA amplifiers and accessories

APPENDIX

Crossover and delay settings for popular cinema loudspeaker systems

Consult your speaker documentation. Some data has not yet been determined. Also, the high-frequency horn of some of the systems listed have multiple mounting positions, so the desired delay settings will depend on the positioning chosen. Check the QSC website (<http://www.qscaudio.com>) for information updates.

Brand	Model	Crossover frequency (Hz)	Delay (ms)
JBL	4675C	500	1.8
	4670D	800	0.7
	3678	1K	0
Electro-Voice	TS9040D-LX	500	1.8
	TS550D-LX	500	1.8
	TS550DMT-LX	500	1.8
	TS940D	500	
	TS992-LX	1.2K	0
	TS993-C	400	0
	Variplex-B	350	LF: 1.4
	Variplex	350 & 1.5K	LF: 1.4
Klipsch	KPT-940.L	500	1.2
	KPT-904.M	800	0.3
EAW	CB2591	500	
	CB2592	500	
	CB259	500	
	CB152	1200	
	CB153	350	
	CB523	300	
	MC 4973	300 & 1.8K	
	MC 4973B	300	
	MC 4953	300 & 1.8K	
	MC 4953B	300	
	Martin Audio	Screen 4	650

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