SHURE   SHURE

SHURE

SHURE

BYPASS
DFR FILTERS

SIGNAL CLIP

1   2   3

SCENES

PRESS
TO LOCK

HOLD TO
CLEAR

DFR FILTERS

DATA   POWER

DFR11EQ

DIGITAL EQ + FEEDBACK REDUCER

DSP•20 BIT•48 KHz
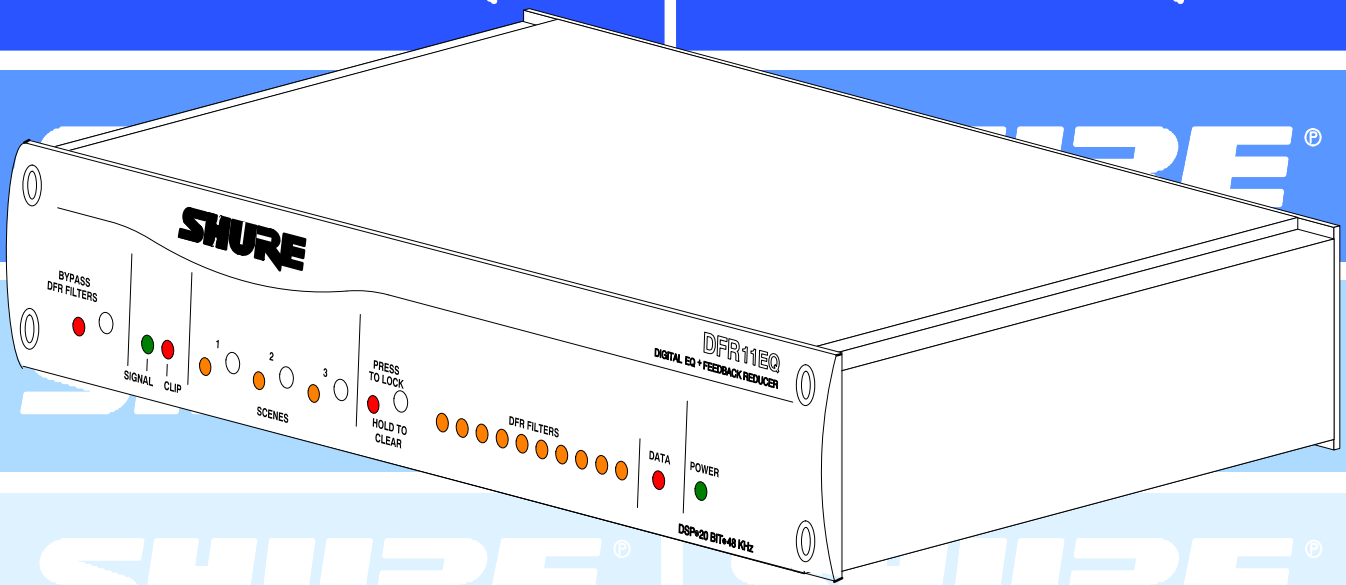
DFR11EQ Version 5
Digital Equalizer with Feedback Reducer, Limiter and Delay

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WHAT'S NEW IN DFR11EQ VERSION 5

The DFR11EQ Version 5 offers several new and improved features, including:

Faster Feedback Filters – When feedback is detected, the DFR11EQ's faster reaction time in placing filters provides an even greater level of protection against unwanted feedback.

Selection of Onboard Scenes using DFR Front Panel – Up to three saved scenes can be accessed through the scene buttons on the front panel. A total of 10 scenes may be saved onboard and accessed when using the software interface. See *Saving and Selecting Scenes*.

Limiter – The DFR11EQ Version 5's new limiter provides a higher level of speaker and system protection by limiting the level to which the signal level can rise. See *Limiter*.

Increased Delay Capabilities – DFR11EQ Version 5 now features up to 1.3 seconds of digital delay, increased from Version 4's 100 ms of delay. See *Delay*.

One-Touch Filter Conversion in the DFR - When the Digital Feedback Reducer creates filters to combat feedback, they are adaptive notch filters. The new TO PEQ button on the DFR control window converts these filters to parametric filters. See *Feedback Reducer Controls*.

Quick Switch-Over Between Graphic and Parametric Equalization – Previously, the DFR11EQ would download the new equalizer each time the equalization mode was switched. Now they are stored on board, making the switch-over almost instantaneous.

Improved Windows Interface - Separate control windows for the Digital Feedback Reducer, the Graphic or Parametric Equalizer, the Limiter and the Delay give the DFR11EQ Version 5 a cleaner, less-congested look with greater ease-of-use.

Advanced Networking Features – DFR11EQ Version 5 offers special advanced features, including Global Scene Control and Remote Modem Access.

OTHER SYSTEM FEATURES

The DFR11EQ Version 5 also features these upgrades originally introduced in Version 4:

Switchable Graphic or Parametric Equalization: The equalizer may be set to work as a graphic equalizer or as a parametric equalizer. This flexibility can help meet your needs as different situations arise. Use the graphic equalizer to equalize overall room sound; or use the parametric equalizer to control the major feedback frequencies covered by the feedback filters, so you can free up all the feedback filters to act as dynamic filters for stray feedback.

Editable Digital Feedback Filters: You can edit the frequency, depth and width of individual feedback filters, to give added control.

Digital Delay: The delay can improve the audio quality of a large sound system with widely spaced speakers. The audio signal to the remote loudspeaker is delayed until it is in alignment with the sound waves coming from other loudspeakers in front. Phase cancellation and sound localization problems are minimized. See *Delay*.

Scenes: Any number of scenes can be stored in separate files. A field (for entering descriptions of scenes) appears in the Recall Scene function, so you can find the desired scene before loading.

Hold Mode Automatically Restores the Basic Feedback Filter Setup: When in Hold mode, a DFR11EQ may change dynamic filters or deepen fixed filters, but the original settings will be restored the next time you power up the unit. This is useful for storing the best filter settings for a given system.

Reverse the Output Signal Polarity: If there is a piece of equipment in the sound system which inverts the polarity of the audio signal, the DFR11EQ can reverse and correct the signal polarity. See *Reversing the Signal Polarity*.

DFR11EQ Setting Printouts: With this option, you can print out a hardcopy which shows all of the settings for a selected DFR11EQ, to document a sound installation. See Printing DFR11EQ Settings.

Input and Output Level Meters and Output Control: The input and output meters let you see the effect of the signal processing on the audio signal. You can check these meters to see if the equalized output sound levels are getting too low compared to the unaffected input levels. You can use the output control to raise the output level to an acceptable level. The frequency response curve graph will adjust with the output level slider, showing you the current operating level. See *IN/OUT Meters and Output Control*.

Undo: This makes it possible to undo the most recent filter deletion.

Response Graph Snapshots: When you take a snapshot, the computer stores the frequency response curve. As you make changes in the filters or equalization, you can show the snapshot to see the difference between the old response and the new. See *Snapshots*.

INTRODUCTION
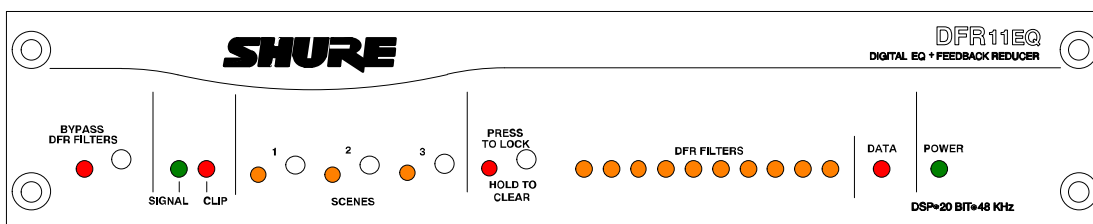
The Shure Model DFR11EQ Version 5 is a single channel signal processor that combines an equalizer, feedback reducer, limiter and delay in a single, half-rack enclosure. The DFR11EQ is designed to be placed in a sound reinforcement signal path to allow equalization of the overall sound system response and automatically detect and control acoustical feedback. The DFR11EQ is designed for installed sound reinforcement applications, such as theaters, conference rooms, meeting halls or houses of worship. The DFR11EQ Version 5 is also an effective setup tool for controlling major feedback modes in live music applications.

The equalizer of the DFR11EQ can be set to act as a 30–band graphic or a 10–band parametric equalizer. The 1/3-octave graphic equalizer can boost up to 6 dB or cut 12 dB for each band. The parametric equalizer offers adjustable frequency, up to 6 dB of boost or 18 dB of cut, and up to a two octave bandwidth.

The feedback reducer of the DFR11EQ Version 5 automatically inserts narrow notch filters at detected feedback frequencies. These notch filters stop a sound system from feeding back, but are narrow enough so their effect on audio quality is minimized. The feedback detection algorithm constantly searches for feedback, with or without the presence of program audio.

Hardware Features

- Crystal* 20-bit A/D and D/A converters (Analog-to-Digital, Digital-to-Analog) allows 104 dB of dynamic range.
- 48 kHz sampling rate provides flat response to 20 kHz.
- Onboard Scenes can be selected via front panel buttons.
- $^1/_2$ rack space chassis allows rack mounting of one or two units in a single rack space with no sagging or bending.
- Shure Link Interface allows multiple Shure Link devices to be controlled with a single computer.
- There are no internal batteries. Settings and DSP program are stored in internal EEPROM.
- Electronically balanced input features combination $^1/_4$-in. and XLR connector and can be used with balanced or unbalanced outputs.
- Independently driven, cross-coupled, balanced $^1/_4$-in. and XLR outputs can be used with balanced or unbalanced inputs, without signal loss.
- Input and output levels are +4 dBu/–10 dBV DIP-switch-selectable.
- 88 MHz Motorola* DSP56009 processor engine features full 24-bit internal processing.
- RS-232 interface allows external computer control and firmware updates.
- Internal linear power supply is switchable between 120 and 230 Vac, eliminating the need for a cumbersome external power supply.
- Solid state bypass eliminates unreliable mechanical relays.

Software Features

- Adaptive Notch Filter algorithm (patent pending) automatically detects feedback and deploys up to 10 narrow band notch filters.
- A tamper-proof equalizer can be switched between 30-band graphic or 10-band parametric equalizer.
- The graphic equalizer is a constant-Q, 30-band, $^1/_3$-octave graphic equalizer. It can boost up to 6 dB or cut 12 dB for each band.
- The parametric equalizer offers 10 filters with adjustable frequency, up to 6 dB of boost or 18 dB of cut, and up to a two octave bandwidth.
- Up to 1.3 seconds of Digital Delay.
- Front and back panels both feature lockout control.
- The Response Curve Viewer displays frequency response of the feedback reducer, equalizer, or both.
- 10 scenes can be stored on board. Multiple scenes can be stored to floppy or hard disk.
- The Limiter provides added protection to external speakers and amplifiers.

DFR11EQ VERSION 5 HARDWARE

Overview

Front Panel
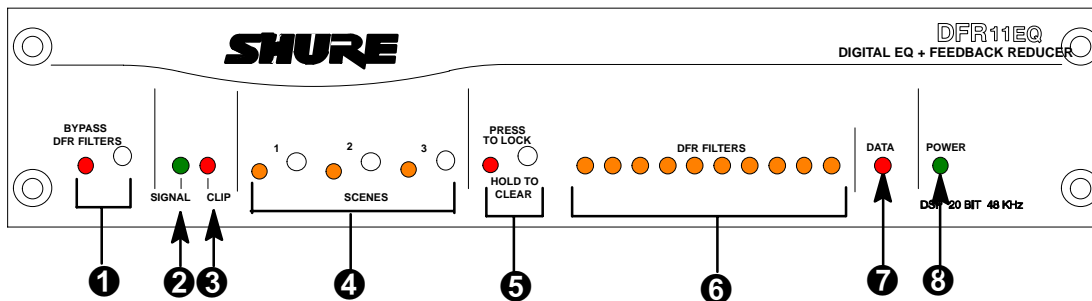
❶ **BYPASS DFR FILTERS Button and LED.** Press this button to suspend feedback reducer operation and remove feedback filters from the audio path. The bypass does not affect the equalizer, delay or limiter. When the LED illuminates, the feedback reducer is bypassed.

❷ **SIGNAL LED.** Illuminates when input signal is present. Intensity varies with input signal level.

❸ **CLIP LED.** Illuminates when the input signal is within 6 dB of clipping.

❹ **SCENE Selection Buttons and LEDs.** Press one of these three buttons to select a pre-set scene. When a scene is selected, the corresponding LED will light.

❺ **LOCK/CLEAR Filters Button and LED.** Press and release this button to lock the filters you have set. Hold down the button for three seconds, and the filters will clear. The LED indicates that the filters are locked.

❻ **DFR FILTER LEDs (10).** Indicate when individual feedback filters are active. When a filter changes or is added, the LED flashes, then stays on.

❼ **DATA LED.** Flashes in unison with the feedback filter LEDs when the detector is deploying a new feedback filter or changing an existing one, and also blinks whenever the unit is communicating with a connected computer.

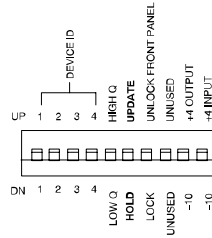❽ **POWER LED.** LED illuminates when unit is attached to a power supply.

Back Panel
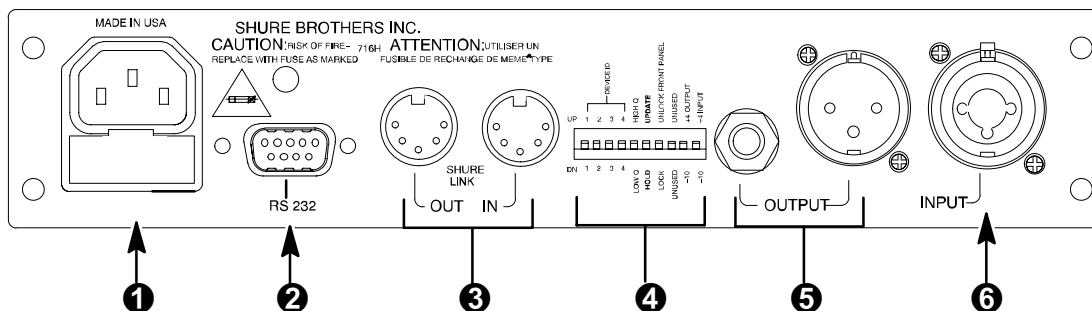
❶ **Power Connector with Integral Fuse.** Connects to AC power. The fuse is located in the drawer below the connector.

❷ **9-Pin RS-232 Port.** Connects the unit to a computer. For use with DFR11EQ software and for DSP firmware upgrades. (Compatible with AMX and Crestron systems.

❸ **Shure Link Interface.** Allows linking of up to 16 Shure Link devices (DFR11EQs, DP11EQs, and UA888s), which may be accessed by computer.

❹ **DIP Switches.** Switches 1 through 4 are used to select the device ID. Switches 5 through 10 change other available options. See *DIP Switches*.

❺ **Output Connector—$^1/_4$-Inch & XLR.** Active, cross-coupled, balanced outputs can be used with balanced or unbalanced inputs. Can be switched between +4 dBu/–10 dBV line-level operation by DIP switch. $^1/_4$-Inch and XLR are driven independently and either can be balanced or unbalanced without affecting the other.

❻ **Input Connector—Combined XLR and $^1/_4$-Inch.** Active balanced input can be used with balanced or unbalanced outputs. It can be switched between +4 dBu/–10 dBV line-level operation by DIP switch.

DIP Switches

The DIP switches located on the rear panel are used for adapting the unit to the sound system requirements. Switches 1 through 4 select the device ID number. Switches 5 through 10 change other available options (see the table below).


DIP SWITCH	FUNCTION	POSITION	
		UP	**DOWN**
1–4	**Device ID**	see below	see below
5*	**Feedback Filter Bandwidth Select** Determines the Q of the feedback filter.	High Q 1/10-octave Feedback Filters remain narrow as they deepen.	Low Q 1/10-octave Feedback Filters widen as they deepen
6*	**Feedback Filter Memory Mode**	Update Stores changed feedback filter settings on power down	Hold Discards changed feedback filter settings on power down, but holds original settings
7*	**Front Panel Lockout** Disables the front panel controls, protects current settings from tampering.	Unlock Front panel buttons operational	Lock Front panel buttons inactive
8	unused	—	—
9	**Output Sensitivity**	+4 dBu	−10 dBV
10	**Input Sensitivity**	+4 dBu	−10 dBV

* DIP switches 5, 6, and 7 may be over-ridden in the Hardware Options window of the DFR11EQ software. See *Hardware Options* for details.

Shure Link Device ID

When your DFR11EQ is linked to other Shure Link devices, each one must be assigned a unique Device ID, 0 through 15*. DIP switches 1 through 4 on the rear panel are used to set the Device ID. To change the Device ID, align the switches according to the illustrations below. The unit comes factory preset to Device ID 15.
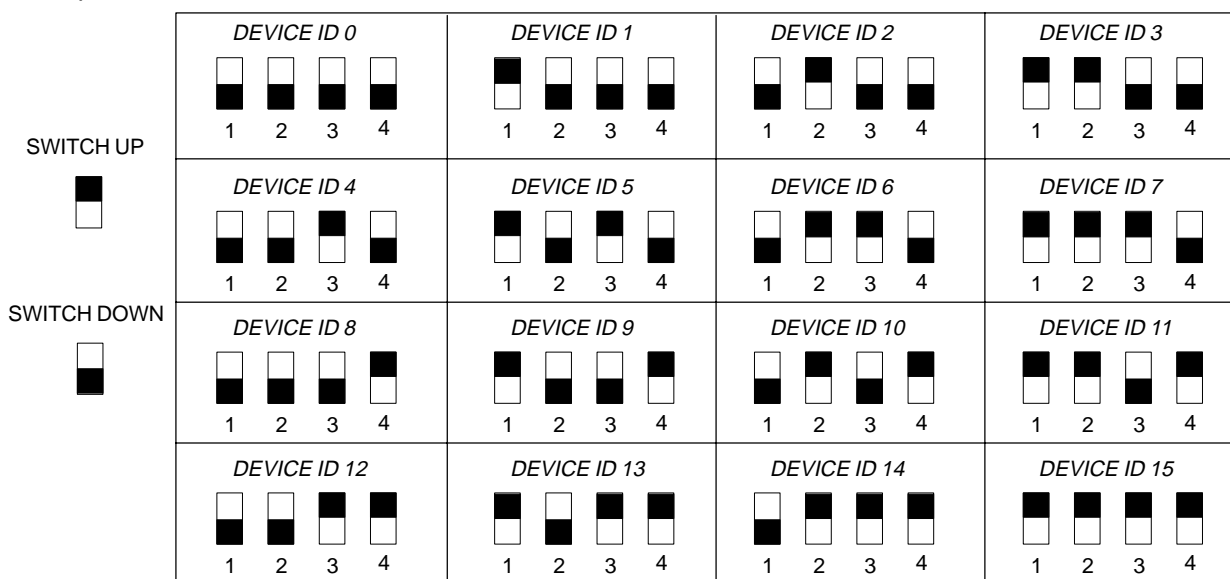
*UA888s may use Device IDs 0 through 3 only.

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DIP Switch/Hardware Options - Definitions

High Q Filters vs. Low Q Filters

The DFR11EQ offers two selections for the shape of the $^1/_{10}$-octave notch filters: the High Q filter (default) and the Low Q filter. A **High Q filter**'s width stays very narrow as the filter depth is increased. This attenuates the minimum amount of signal possible to ensure system stability, while maintaining excellent sound quality. This setting is appropriate for most applications.

The **Low Q filter** setting maintains the filter's shape as it is deepened, so the width of the filter effectively widens as the depth increases. Using this setting attenuates the signal more, producing a greater system stability than the High Q setting, but with slightly diminished sound quality. This setting is appropriate for systems such as a speech-only PA where stability is an absolute must, but the sound quality can be compromised a bit.

The DFR11EQ High Q/Low Q setting may be switched at either DIP switch number 5 (see *DIP Switch* section) or in the software's Hardware Options window (see *Hardware Options* section).
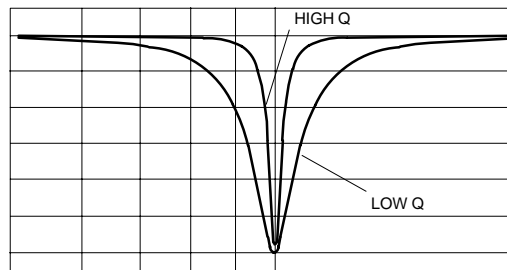
Front Panel Locking

The front panel of the DFR11EQ can be locked at either DIP Switch 6 (see *DIP switch* section) or through the software's Hardware Options window (see *Hardware Options* section). This prevents tampering after the audio signal has been processed to meet the room's requirements. In the Hardware Options window, there is also an option to lock only the DFR controls. This allows users to switch between scenes while maintaining protection of the filters within the scenes.

Hold/Update

The Hold/Update option is accessible using either DIP switch 6 (see *DIP switch* section) or the Hardware Options window (see *Hardware Options* section). They operate in the following ways:

UPDATE position: When the HOLD/UPDATE DIP switch is in the UPDATE position (default), or the UPDATE option is selected in the Hardware Options window, the DFR11EQ saves the feedback filters every time the unit is powered off. When the DFR11EQ is powered on again, the feedback filters will be at exactly the same settings as when the unit was powered down.

HOLD position: When the HOLD/UPDATE DIP switch is in the HOLD position, or the HOLD option is selected in the Hardware Options window, the DFR11EQ immediately saves the feedback filters at the current settings. When the DFR11EQ is powered off, any changes made to the feedback filters after the switch was set will be forgotten. When powered on again, the feedback filter settings will be exactly the same as when the HOLD/UPDATE DIP switch was changed to the HOLD position. This feature is useful for storing the best filter settings for a sound system.

Fixed and Dynamic Notch Filters

The DFR11EQ can control the notch filters as either *dynamic* or *fixed.* Only the depth of a **fixed filter** may change after it is created. The position of a **dynamic filter** may change if there is a need detected for a new filter, such as when a hand-held microphone moves to a "hot spot" (a spot on stage prone to feedback).

The DFR11EQ's10 notch filters are factory preset as 5 fixed and 5 dynamic filters. The first filters to be set are fixed, then the remaining filters are set as dynamic. After all 10 notch filters are set and a new feedback frequency is detected, the DFR11EQ will remove the oldest set dynamic filter and re-deploy it at the new feedback frequency. The fixed filters remain unchanged. However, if feedback occurs at the same frequency as an existing dynamic or fixed filter, the existing filter will deepen.

An example of a system that would benefit from more fixed filters and fewer dynamic filters is one that has fixed microphone and loudspeaker locations. In this type of system, the most dominant frequencies of feedback are defined by the room dimensions and the microphone and loudspeaker placement, and will not change appreciably. However, feedback can still occur, for instance, when someone's hand or head approaches a microphone. A good setting for this type of system would be 7 fixed filters for the non-changing feedback frequencies, and 3 dynamic filters to catch the feedback frequencies caused by the talker.

On the other hand, more dynamic than fixed filters would be appropriate in a system that has several non-stationary wireless microphones. Eight or even all 10 filters could be set to dynamic in this type of system to obtain maximum feedback protection. As every application is different, some experimentation is recommended to get the best results from a given sound system.

The ratio of fixed to dynamic filters can only be changed in the Hardware Options window. See the *Hardware Options* section for details.


DFR11EQ Theory

Feedback: Cause and Reduction

When acoustical feedback occurs in a sound system, it is because the gain of the system is too high. Since no sound system (microphones, loudspeakers, room acoustics, etc.) has an absolutely flat frequency response, feedback will occur at specific frequencies before others; these are the frequencies with the most gain. **The operating principal of the DFR11EQ feedback reduction feature is to lower the gain of these specific frequencies**; then the system can operate with more overall gain before it feeds back, without a perceptible difference in tonal quality.

At the heart of the DFR11EQ's microprocessor is a very powerful algorithm that can accurately and quickly discriminate between feedback and non-feedback sounds (such as speech and music). When this algorithm detects feedback, it smoothly inserts a –3 dB, $1/10$-octave filter into the audio path to reduce the gain at the frequency which is feeding back. This filter is called a **notch filter** due to the narrow section of frequency it affects. If the feedback does not stop, the filter depth is increased in 3 dB increments (to –18 dB) until the feedback stops.
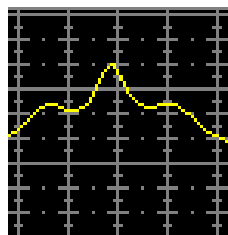
Frequency with excessive gain
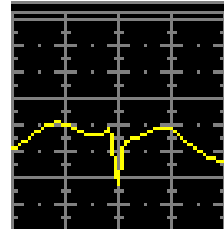
Frequency after notch filter has been added

The illustrations below demonstrate how the DFR11EQ works in a sound system. The system on the left shows a **feedback loop**, where the microphone picks up sound from the loudspeaker and sends it back into the sound system. The system on the right shows how an installed DFR11EQ reduces the gain on the worst case frequencies.
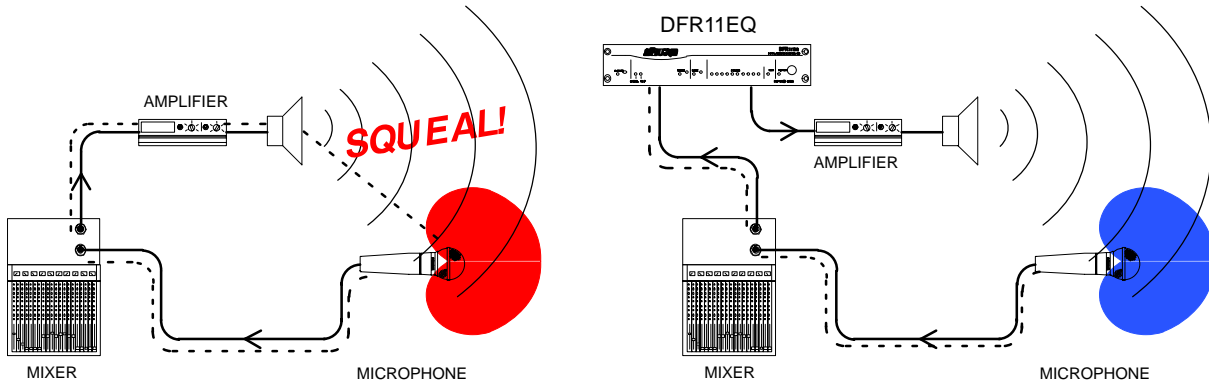
After the DFR11EQ stops the feedback at the dominant frequency, the sound system may start feeding back at the next dominant frequency. In this case, the DFR11EQ inserts another notch filter into the audio path at the new frequency. The DFR11EQ can insert a total of 10 notch filters to reduce feedback.

DFR11EQ Limitations

The DFR11EQ (or any other notch filter system) cannot entirely eliminate feedback in a sound system, it can only help to reduce it. In a typical system, a point of diminishing returns is reached after 4 to 8 notch filters are set. This is because generally there are only a few dominant frequency response peaks above the response of the entire system (figure 4A). The DFR11EQ works very well controlling these peaks. The user can expect a 6 to 9 dB improvement of gain-before-feedback in a typical system. However, if the system has too much overall gain, then all of the frequencies have too much gain; instead of trying to notch out all of the frequencies, better results will be obtained by lowering the gain of the system (Figure 4B). If the system still has insufficient gain, then other changes must be made to the sound system such as different microphone or loudspeaker placement.
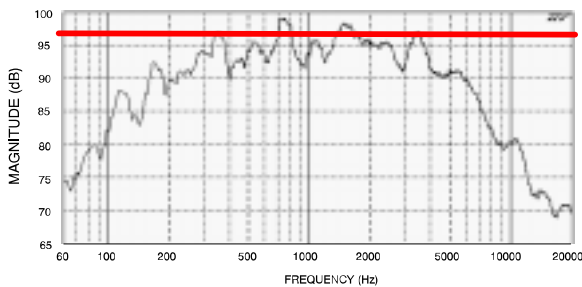
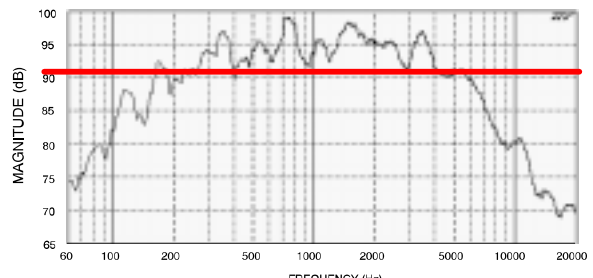

Figure 4A

Use notch filters to lower peaks

Figure 4B

Lower overall gain of system

——— Feedback Threshold

FREQUENCY RESPONSE OF AN UNEQUALIZED SOUND SYSTEM

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Setup for Feedback Control

The DFR11EQ hardware is designed to work in conjunction with the supplied software and a personal computer to offer a wide range of digital sound processing options, including feedback reduction, equalization, delay and limiting. However, the DFR11EQ may be used very effectively as a stand-alone feedback reducer without the benefit of the software or a computer.

There are two basic ways in which to set-up the DFR11EQ as a stand alone feedback reducer: the "Ring Out" method and the "Insurance Policy" method. Each is valid for different situations.

The **"Ring Out" method** is a preemptive measure in which the system gain is raised beyond the normal setting to deliberately make the system feed back. The DFR11EQ will then set the proper filters. The system gain is then reduced slightly, and the system is stable and useable. This set-up method is primarily used for systems which are operated near the feedback point and need an extra margin of stability.

For the **"Insurance Policy" method,** the DFR11EQ is simply installed in the sound system, but filters are not set prior to use. The DFR11EQ adds extra insurance against feedback: the system is not expected to feed back, but if it does, the DFR11EQ is there to catch it. This method is used for systems which already have sufficient gain-before-feedback, but need protection from occasional feedback occurrences due to non-stationary microphones or user-adjustable gain controls.

Setup

1. Connect the DFR11EQ in the desired signal path location. See *Audio Connections.*
2. Set the input and output level DIP switches to the appropriate settings for the sensitivities of the connected equipment.

   > **WARNING:** Other equipment may potentially be damaged after the DFR11EQ is powered down if the DFR11EQ input is set to +4 and the output is set to –10. It is recommended that you avoid using this setting.

3. Set the system gain to minimum, and power up all of the equipment.
4. Slowly raise the gain of the system, and set the gain of each microphone to achieve the desired level.
5. The red CLIP LED should illuminate only on the highest signal peaks. If it illuminates more frequently, check to see that the input level switch is set properly. If it is, lower the level of the signal going into the DFR11EQ.
6. At this point it is highly recommended to equalize the sound system with the DFR11EQ's built–in equalizer (see *Equalizer*) or an external equalizer. The DFR11EQ's feedback reducer is more effective on a well–equalized sound system.

Ringing Out the System ("Ring Out" method only)

1. If necessary, clear any notch filters in the DFR11EQ by pressing and holding the CLEAR button. Turn off the BYPASS and LOCK LEDs if they are not already off.
2. Slowly raise the gain of the signal going through the DFR11EQ. When feedback occurs, the DFR11EQ will insert a filter deep enough to stop the feedback.
3. Repeat step 2 until all fixed filters are set. (There are 5 fixed filters, unless changed by the user via the computer interface.)
4. Lower the gain by 3 to 6 dB to stabilize the sound system.

To store filter settings in the HOLD memory

1. Set the Hold/Update DIP switch to the Update position.
2. Ring out the room until all fixed filters are set.
3. Set the Hold/Update DIP switch to the Hold position.
4. During the performance, the DFR11EQ will change dynamic filters and deepen fixed ones.
5. After the performance, turn the power off and back on; the DFR filters are restored to the state they were in before the performance.

Audio Connections

The DFR11EQ should be placed where an equalizer would be in a signal path.

The following four diagrams show typical connections. Because of its utility and flexibility, the DFR11EQ can be connected in a large variety of different setups to benefit a sound system.

> **NOTE**: All cables must be shielded. See Appendix B. for descriptions of all cable and connection wiring.

Between the Mixer Main Output and the Power Amplifier

The DFR11EQ is most commonly placed between the main output of a mixer and the input of a power amplifier. At the main output, the unit will affect all input channels. This setup is ideal for using the DFR11EQ as an equalizer and as a feedback reducer.
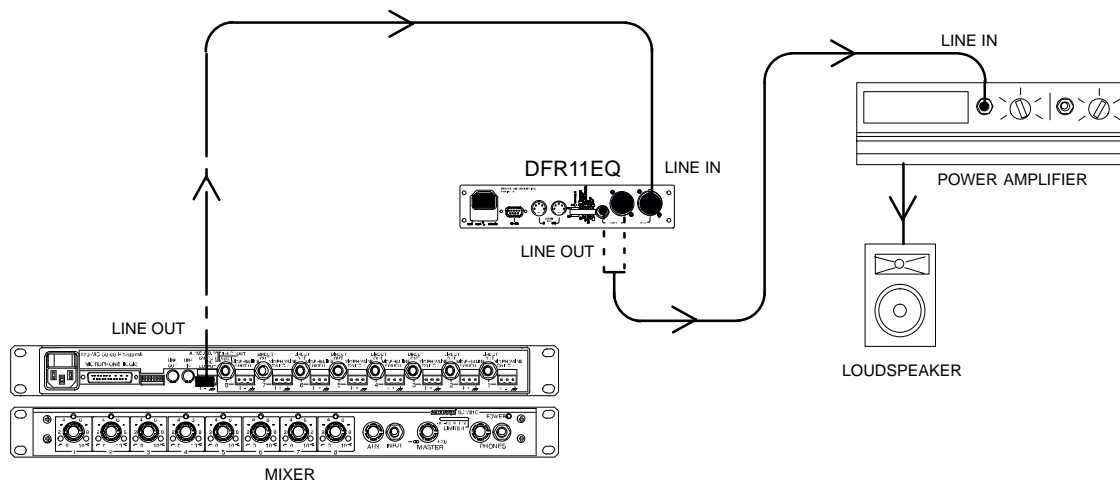
At a Subgroup Insert

When using a multiple bus mixer, the DFR11EQ can be connected to a single subgroup insert. The unit will affect only the channels associated with that subgroup: the other channels will remain unaffected.
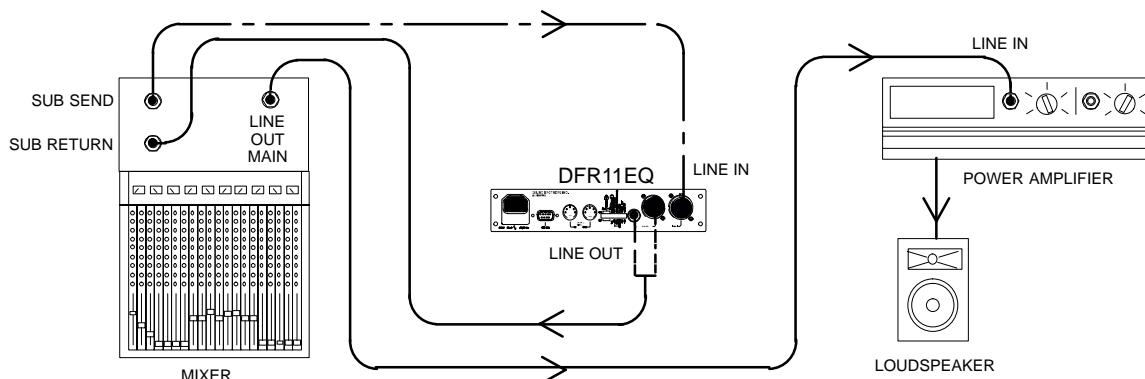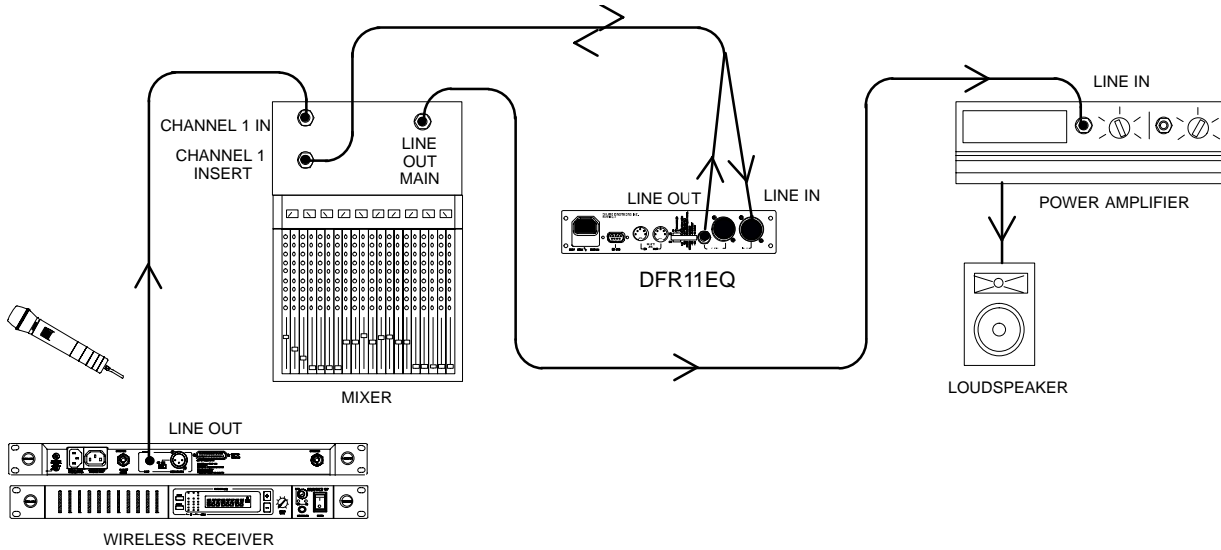
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Inserted in an Input Channel

If only a single microphone is creating feedback problems, the DFR11EQ can be inserted on that channel alone. This is especially useful for wireless microphones, because the constant movement of a performer may bring the microphone too close to the sound reinforcement loudspeakers.

CHANNEL 1 IN
CHANNEL 1 INSERT
LINE OUT MAIN
LINE OUT
LINE IN
LINE IN
POWER AMPLIFIER
DFR11EQ
MIXER
LOUDSPEAKER
LINE OUT
WIRELESS RECEIVER

Inserted Between Mixer and Monitor

Since monitor loudspeakers and microphones are usually in close proximity, the DFR11EQ can be connected to stabilize a monitor system. Place a DFR11EQ on the mixer output which goes to the monitor loudspeaker. For multiple monitor mixes, a DFR11EQ should be placed at the output of each monitor send.
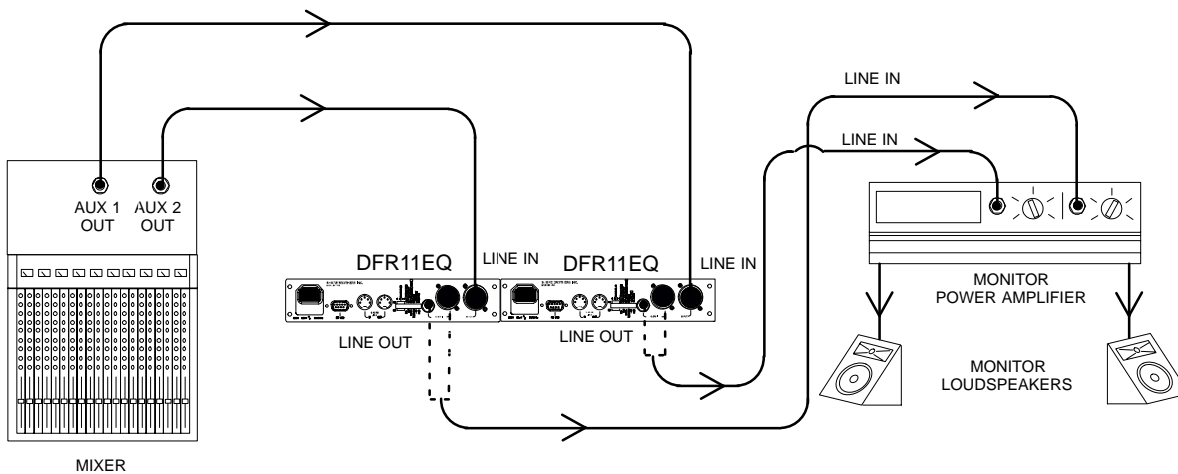
AUX 1 OUT
AUX 2 OUT
DFR11EQ
LINE IN
DFR11EQ
LINE IN
LINE IN
LINE IN
MONITOR POWER AMPLIFIER
LINE OUT
LINE OUT
MONITOR LOUDSPEAKERS
MIXER

VERSION 5 SOFTWARE

Introduction

This section describes the Version 5 Windows-based computer interface software which allows you to utilize the full features of the Shure DFR11EQ. By connecting the DFR11EQ to your computer, you can access the built-in digital equalizer, which can be configured in one of two ways: as a 30-band, $^1/_3$-octave, constant-Q, graphic equalizer, or as a 10-band parametric equalizer. The computer interface also allows access to additional DFR control features to customize the operating characteristics of the feedback filters. After the signal has been equalized and feedback filters have been created, the resulting response curve can be displayed in the frequency response graph as either a feedback filter response, EQ response, or both combined. There is also a limiter to protect against potentially damaging increases in the output signal, and a digital delay which can add up to 1.3 seconds of delay from input to output.

Minimum Computer Requirements

The following are the minimum requirements to install and run the DFR11EQ Version 5 software.

- One 486DX 50 MHz IBM*-compatible computer (math coprocessor required)
- 2 MB hard drive space
- 4 MB RAM
- CD–ROM drive
- Windows version 3.1x, 95, 98 or NT
- 1 available RS-232 serial (COM) port
- One RS-232 cable (9-pin to 9-pin or 9-pin to 25-pin)

Connecting the DFR11EQ to a Computer via the RS-232 (COM) Port

TO COMPUTER
RS-232 CONNECTOR

TO DFR11EQ RS-232
CONNECTOR (9-PIN MALE)
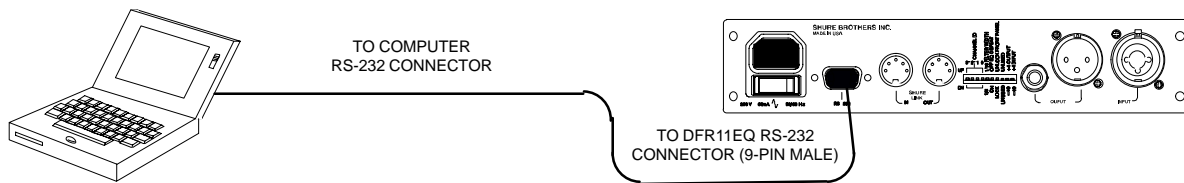
1. Examine the computer's RS-232 (COM) port to determine whether it is a 9-pin or 25-pin port. You will need either a 9-pin to 9-pin or a 9-pin to 25-pin RS-232 cable. For RS-232 cable diagrams, see *Appendix B: Cables.*
2. Connect a 9-pin plug (male) of the cable to the RS-232 port of the DFR11EQ.
3. Connect the other end of the cable to the RS-232 port of the computer.

Software Installation

1. Insert the supplied CD-ROM into the CD-ROM drive of your computer. (After initial installation, the CD-ROM is not necessary to run the software.)
2. The installation menu will appear. If you are using Windows 95 or greater or Windows NT4 or greater, select DFR11EQ software by clicking on it. You will then be led through the installation process. If you are using Windows 3.1X, go to File/Run and run d:\SETUP16.EXE
3. Shure Setup will suggest a destination on your hard disk for the DFR11EQ files and will check the computer hardware to ensure that a coprocessor is present. It will also prompt you for your name and organizational information.

   NOTE: Remember to register your software by filling out and mailing the enclosed registration card, or online via the Shure World Wide Web site ("http://www.shure.com"). This will ensure that you receive information about software updates with additional features as they become available.

The Shure DFR11EQ Installation Menu

The installation menu allows the user access to the DFR11EQ software and the DFR11EQ User Guide. The User Guide is in PDF format, with a separate PDF file for each language. The User Guide can be used online or printed out, in whole or in sections.

Configuring the Computer Serial Port

1. Launch the DFR11EQ software.
2. Click on *Communications* in the main menu bar.
3. Click on the *COM port* option of the drop-down menu.
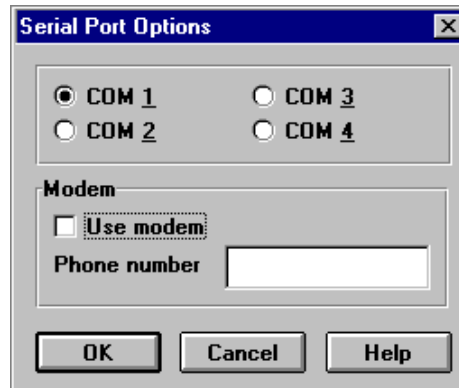
4. In the *Serial Port Options* window, select an available COM port on the computer.
5. Click on the **OK** button.

    NOTE: The COM port selection is saved in the DFR11EQ file, and will not need to be selected again unless you need to change the hardware configuration.

Accessing the DFR11EQ Version 5 Via Modem

A new feature on the DFR11EQ Version 5 is the ability to remotely access installed units via a modem.

To connect a unit or a network of units to allow remote modem access, follow these instructions:

1. Connect the serial port of a 28.8 bps modem to a DFR11EQ using a null modem adaptor.
2. Set up the modem for "Auto Answer", "Auto Disconnect" and "Force Connection at 19200" (see your modem's instructions).

Once the unit is connected to a configured modem, it can be accessed by a remote computer connected to a modem and running the version 5 software:

1. Select Use Modem in the Serial Port Options window
2. Enter the appropriate phone number in the Phone Number field and click on **OK**.

    NOTE: For further information on connecting your DFR11EQ unit to a modem, please contact the Shure applications department at 847/866–2200.

Accessing the Connected DFR11EQs

To bring the networked DFR11EQs online, click on the **CONNECT** button of the Main Control panel. Or, select the *Connect* option of the *Communications* drop-down menu of the main menu bar. The program searches for each unit connected in the network, reading the Shure Link Device ID of each unit.

Overview

CURRENT DEVICE ID   UNIT NAME   SCENE NAME   STATUS
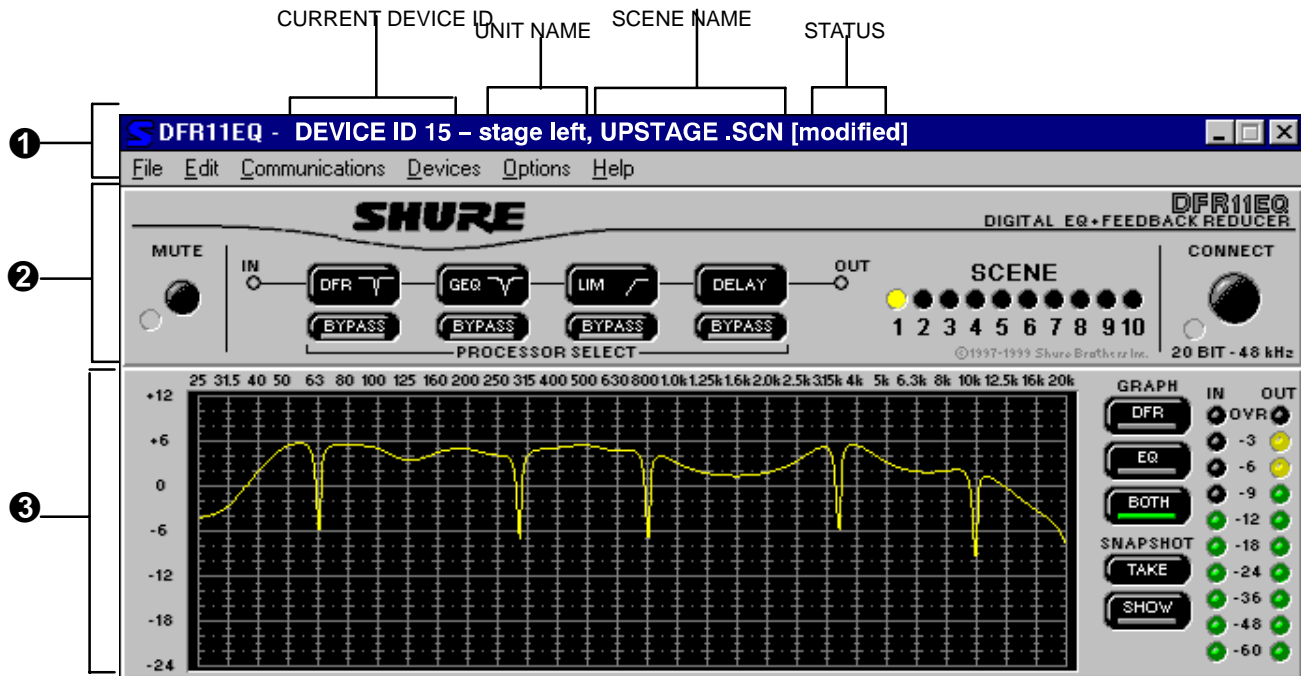
❶ **Title Bar and Main Menu Bar.** When your computer is connected to a DFR11EQ unit, the Title Bar provides the following information:

- **Device ID** is the numerical ID of the connected unit, as determined by dip switches 1–4 on the back of the DFR unit.
- **Unit Name** is the user-selected name of the connected unit (see *Naming a DFR11EQ*)
- **Scene Name** is the user selected name of selected scene (see *Saving and Selecting Scenes.*)
- **Status** displays **(modified)** when a change has been made to a scene until that scene has been saved.

   Through the Main Menu Bar, you can configure the computer connection to the DFR11EQ and access other windows for configuring the DFR11EQ, such as changing equalizer types and saving scenes.

❷ **Main Control Panel.** In the Main Control Panel, the Processor Select Controls Buttons provide access to control panels for four sound processing options:

- **Digital Feedback Reduction (DFR):** Clicking on the **DFR** button will activate the DFR control panel. Clicking on the **DFR Bypass** button suspends the feedback reducer operation and removes its filters from the audio path.
- **Graphic or Parametric Equalization (GEQ or PEQ):** This button activates either the Graphic Equalizer (**GEQ**) or Parametric Equalizer (**PEQ**) control panel. To change the equalizer mode, chose "Equalization..." under OPTIONS on the Main Menu Bar (see *Setting Up the Graphic Equalizer*). Clicking on the EQ **BYPASS** button will remove the equalizer from the audio path and return the audio signal to a flat setting.
- **Limiter (LIM):** Clicking on the **LIM** button activates the Limiter control panel. Clicking on the limiter **BYPASS** button will remove the limiter from the audio path. When the output signal level reaches the threshold setting of the limiter, the symbol on the right side of the **LIM** button illuminates yellow.
- **Delay:** Clicking on the **DELAY** button activates the Delay control panel. Clicking on the delay **BYPASS** button removes the delay from the audio path.

 All four control panels may be viewed simultaneously. If a Bypass button is active, the red light bar at the bottom of the button is illuminated. Other controls accessed through the Main Control panel are:

- **Mute:** This mutes the audio signal of the DFR11EQ. The LED will illuminate and no sound will pass through the system.
- **Scene:** An illuminated LED indicates which scene is selected. Clicking on a different LED will change scene.
- **Connect:** Clicking the **CONNECT** button brings the DFR11EQ plugged in to the computer online, along with any other Shure Link networked devices. When the LED illuminates green, the connected units are online. When the LED is off, the units are operating without the computer interface and the software is running off–line.

❸ **Frequency Response Graph.**   The Frequency Response Graph allows you to accurately display the frequency response of the feedback filters (**DFR**), the equalizer (**EQ**), or the combined response (**BOTH**). The snapshot feature stores the present response curve, allowing you to use this as a reference point as you make changes. This module also contains the IN and OUT meters, which show the input and output signal levels.

USING THE FREQUENCY RESPONSE GRAPH

This section describes how to use the Frequency Response Graph, which displays a response curve showing the effect of the DFR11EQ on the audio signal.

NOTE: See the Output Controls section for details on the functions of the IN/OUT meter on the right side of the Frequency Response Graph display.

Response Curves

DFR Response Curves

Clicking on the **DFR** button displays the feedback filter frequency response curve on the graph. This curve shows the response of all deployed feedback filters. Here you can see the frequency, depth, and Q of each filter.
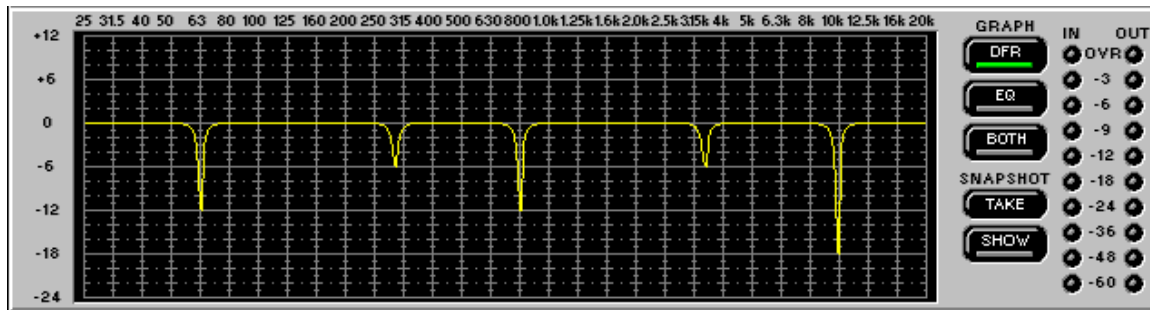
EQ Response Curves

Clicking on the **EQ** button displays the equalizer frequency response curve on the graph. Use this curve as an aid in setting up the equalizer and output level control.
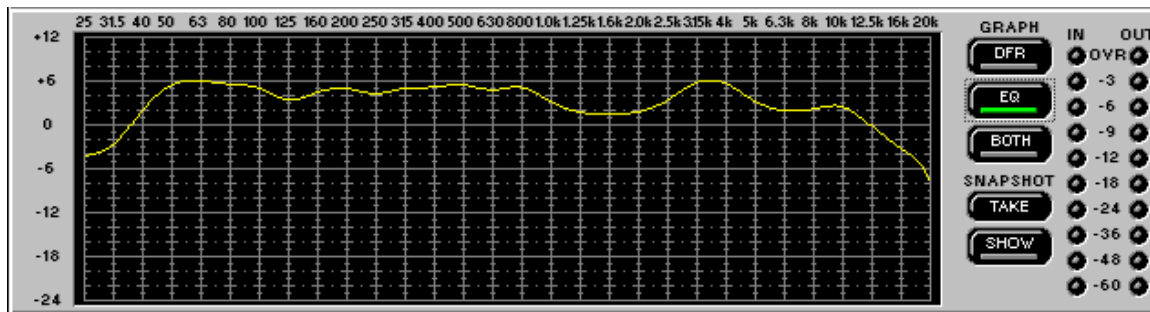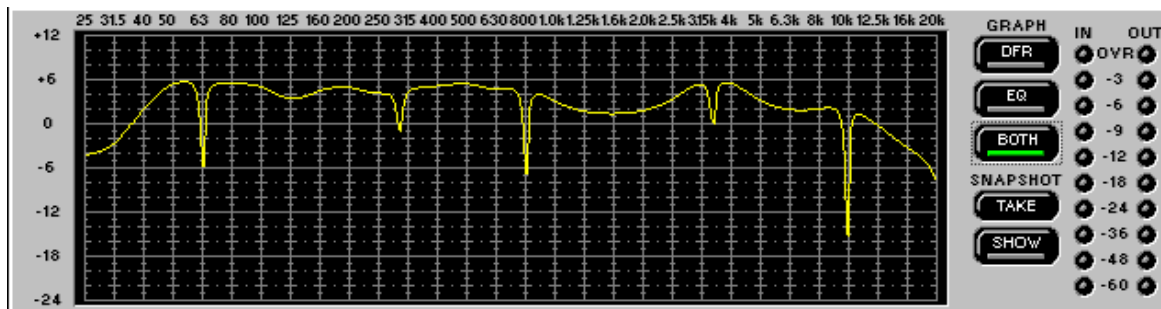
Both

Clicking on the **BOTH** button displays a single response curve which combines the EQ response curve and the DFR response curve, giving the user a graphic representation of how the equalized sound is affected by the feedback filters.
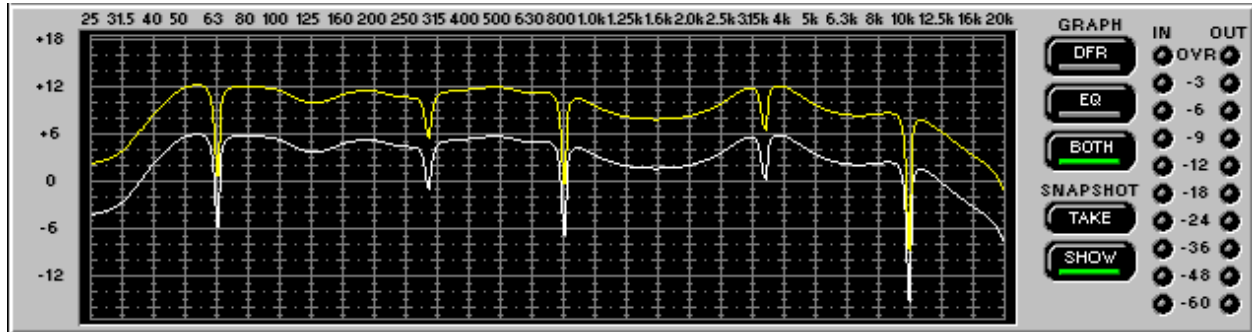
Hide Frequency Response Graph

If you have finished working on the Frequency Response Graph and need to free some space on the the Windows desktop, you can hide the graph.

1. Click on *Options* in the main menu bar.
2. Select *Hide Response Graph...*

Snapshots

One of the features of the DFR11EQ Version 5 software is the ability to take snapshots of a frequency response curve. A snapshot allows you to view a tracing of the original response curve while making changes. This is an effective setup tool. In the illustration above, the upper curve is the frequency response of the current settings, while the lower curve is the snapshot.

In order to use a snapshot:

1. Click on the **TAKE** button.
2. Click on the **SHOW** button.
3. Make changes to the filter or equalizer settings.

   NOTE: If there have been no changes to the curve since the snapshot was originally taken, the snapshot of the curve is directly under the current curve because they are still exactly the same. Once you make changes, the current curve will change and you will be able to see the snapshot underneath.

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EQUALIZER

The Equalizer module of the DFR11EQ Version 5 software can be set to work as a parametric equalizer or as a graphic equalizer, according to your needs. There is an Equalizer Options window (under Options on the Main Menu Bar) for you to set the equalizer type.

Graphic Equalizer
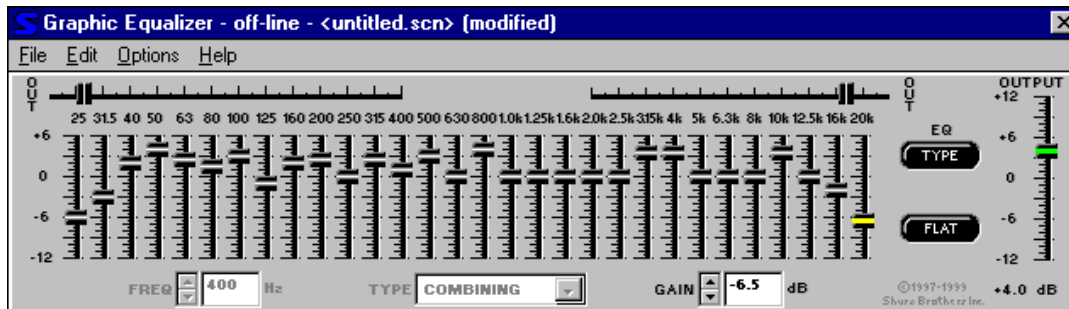
In Graphic Equalizer mode, the software allows the DFR11EQ to act as a constant-Q, 30-band, $1/_3$-octave graphic equalizer with up to 6 dB of boost and 12 dB of cut per band. Additional high and low frequency cut filters with a 12 dB/octave rolloff are included for setting the bandwidth limit of the sound system.

> **NOTE**: See the *Output Controls* section for details on the functions of the OUTPUT control located on the right side of the Equalizer Control window.
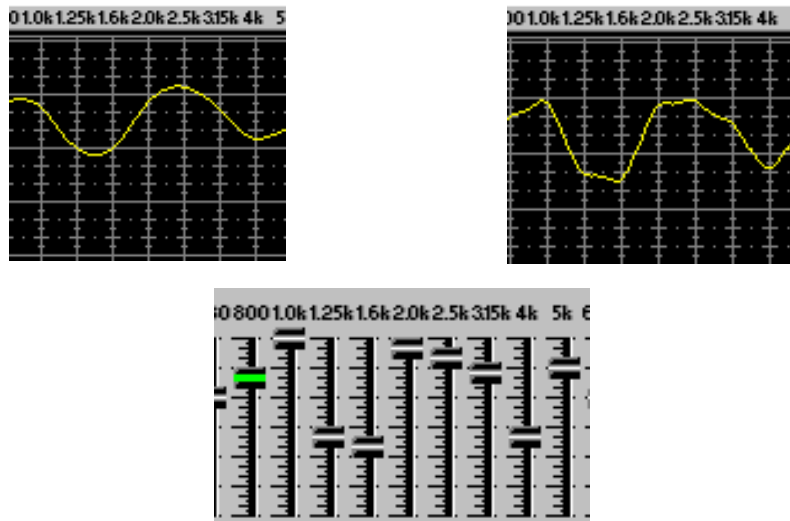
Setting up the Graphic Equalizer

1. Click on *Options* in the main menu bar.
2. Click on *Equalizer...*
3. In the *Equalizer Options* window, click on the **Graphic Equalizer** button.
4. Click on the **OK** button.

This operation may also be performed by using the **EQ Type** button on the Equalizer Control Window.

> **NOTE**: In the Equalizer Options window, there are also three buttons for Version 3 Software, Version 4 Software and Version 5 Software. In the off–line mode, all three of these are selectable, to allow the user to edit scenes using the appropriate software. In the on-line mode, the appropriate software is identified. If Version 3 software is detected, the user may upgrade to Version 4 software by selecting the Version 4 button.

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Combining vs. True $^1/_3$-Octave Equalization

Combining (default)... When the graphic equalizer is setup for combining equalization, the band filters are combined so that the response curve is smoothed out, creating a more even gradation of equalization. In the illustrations above, each showing the same section of an equalizer and the response graph, the one on the left is set to Combining mode. The peaks and troughs on the response graph are smoothed out.

True 1/3 octave... When the graphic equalizer is set up for true 1/3-octave equalization, the band filters act more independently from each other, as shown in the example on the right above. The illustration on the right has the same slider settings as the one on the left, but is set in True 1/3 Octave mode, so the peaks and troughs in the resulting response curve are more prominent.

Adjusting Bands
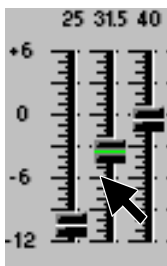
The DFR11EQ graphic equalizer looks and functions just like a conventional graphic equalizer. Each slider controls a $^1/_3$-octave band centered around the frequency indicated above each slider. When a slider is selected, the center of the slider turns green. To move the slider, use the mouse to drag the slider to the desired level, or click the slider at the desired depth. You can also use the ↑ and ↓ keys on the computer keyboard to move the sliders.

Low-Frequency Roll-Off
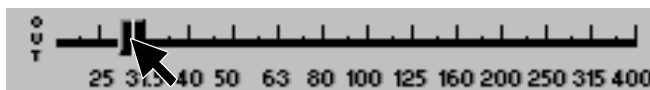
The *Low frequency roll-off* slider determines the corner frequency of the highpass filter. To adjust the Low frequency roll-off, drag the slider to the desired frequency. You can also use the ← and → keys on the computer keyboard to move this slider. When this slider is selected, the SLOPE field appears on the bottom of the control panel. This field shows the amount of rolloff in dB per Octave.

High-Frequency Roll-Off
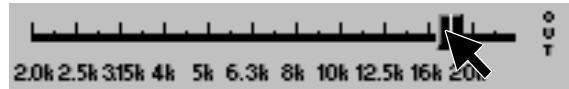
The high frequency roll-off slider determines the corner frequency of the lowpass filter. To adjust the high frequency roll-off, drag the slider to the desired frequency. You can also use the ← and → keys on the computer keyboard to move this slider. When this slider is selected, the SLOPE field appears on the bottom of the control panel. This field allows the user to select the amount of rolloff in dB per Octave.

Graphic Equalizer Fields and Buttons

FREQ. — This field displays the frequency center of the selected filter. The ↑ and ↓ buttons are inactive for graphic equalizer sliders, but are active for the high- and low-frequency sliders.

TYPE — The Type field displays the type of equalizer filter: combining or true $1/3$-octave.

GAIN — The GAIN field displays the amount of cut or boost in dB applied to the selected filter. Use the ↑ and ↓ buttons or type a value in the field to adjust the gain or cut of the filter.

SLOPE – (Not shown) When the High or Low Frequency Rolloff sliders are used, the TYPE field becomes the SLOPE field, which indicates the amount of rolloff in dB per octave.

Flat Button

The **Flat** button resets all the equalizer filters sliders back to the 0 dB position and it resets the high- and low-frequency rolloff sliders to OUT. To reset individual filters, click on the filter using the right mouse button. The Flat button can be undone by selecting the *UNDO* option from the *EDIT* option in the menu bar.

Parametric Equalizer
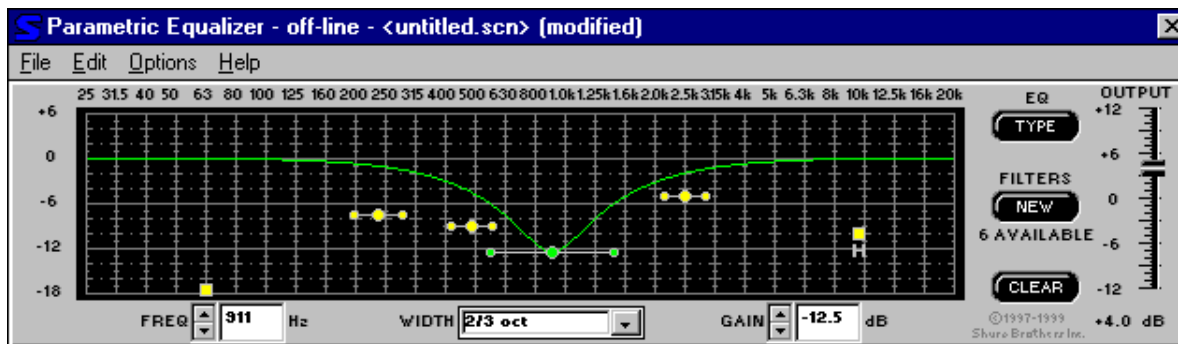
The equalizer of the DFR11EQ can be set to work as a 10-band parametric equalizer. Each filter has adjustable frequency, gain, and width. In addition, there are high- and low-frequency rolloff/shelf filters. Parametric filters are represented as dots, while the high- and low-frequency filters are represented as squares. When a filter is selected, the control representing that filter changes color to indicate that it has been selected, and the PEQ graph shows the response of the selected filter. Parametric filters can be edited using cut, copy, and paste.

Setting up the Parametric Equalizer

1. Click on *Options* in the main menu bar.
2. Click on *Equalizer...*
3. In the *Equalizer Options* window, click on the **Parametric Equalizer** button.
4. Click on the **OK** button.

This operation may also be performed by using the **EQ Type** button on the Equalizer Control Window.

NOTE: In the Equalizer Options window, there are also three buttons for Version 3 Software, Version 4 Software and Version 5 Software. In the off–line mode, all three of these are selectable, to allow the user to edit scenes using the appropriate software. In the on-line mode, the appropriate software is identified. If Version 3 software is detected, the user may upgrade to Version 4 software by selecting the Version 4 button.

Parametric Equalizer Fields and Buttons

FREQ. — This field displays the center frequency of the selected filter. Click on the ↑ and ↓ buttons to adjust the frequency of the filter, or type the desired frequency in the field.

WIDTH — The WIDTH field displays the width of the selected filter. Clicking on the ↓ button will reveal a drop-down menu with the available options. Select one of these to change the width, or type in the desired width. If a shelving filter is selected, the field changes to TYPE and identifies SHELF as the option. Once the high or low filter cuts more than –18 dB, the filter becomes a rolloff filter, so the name of this field changes to SLOPE and displays the slope of the filter. The slope of the rolloff filter is adjustable from –6 to –24 dB/octave.

GAIN — The GAIN field displays the amount of cut or boost in dB applied to the selected filter. Clicking on the ↑ and ↓ buttons will adjust the boost or cut in gain of the filter. With the high and low shelving filters, the response will shelve at the level of the gain of the filter.

Adjusting Parametric Filters
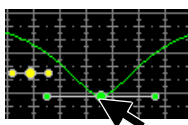
To adjust a parametric filter, simply point and click on the filter. It will change colors to show that it is selected. Then, drag the filter to the desired frequency and level. A parametric filter can be used to cut or boost over a desired bandwidth. Notice that each filter dot also has wings with two smaller dots. Drag these to adjust the Q, or width, of the filter to affect a smaller or larger bandwidth. The Q can also be adjusted from the WIDTH field: click on the ↓ button to reveal the drop-down menu which contains all the most common bandwidth options. The parametric filters can overlap. However, too many overlapping filters may cause the EQ to distort at certain frequencies or gain values.

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NEW Button

`[ NEW ]` Click on the **NEW** button to generate a new parametric filter. Each new parametric filter initially appears at 1 KHz, 0 dB, 2/3-octave. The number of remaining filters is displayed below the **NEW** button.

Clear Button

`[CLEAR]` Click on the **CLEAR** button to clear the filters. A dialog box will come up prompting you to clear one filter, all filters, or the entire block. Click on the **CLEAR ONE** to clear only the currently selected filter, the **CLEAR ALL FILTERS** button to clear all filters, or **CLEAR ALL FILTERS AND GAIN** to clear all filters plus the Output Gain control. Then click on the **OK** button. The Clear function is active even if **LOCK** filters is active.

High- and Low-Frequency Roll-Off/Shelf Filters

Like the graphic equalizer, the parametric equalizer offers both high- and low-frequency filters. These are the filter squares labelled "H" and "L" — that is, respectively, High and Low. When the parametric equalizer is first set, the high- and low-frequency roll-off filters are set for a flat response. In order to change either filter, drag the square. The software will not permit the high- and low-frequency shelf/rolloff filters to cross.

Shelf — The Shelf filters can be adjusted from +6 dB to –18 dB in 0.5 dB increments. Shelving is extremely useful for boosting flat frequency response, tempering very sibilant vocal microphones, or enhancing the sound of off-axis lavalier microphones. The illustration below shows how shelving filters can be used to boost or cut certain frequencies in a sound system.
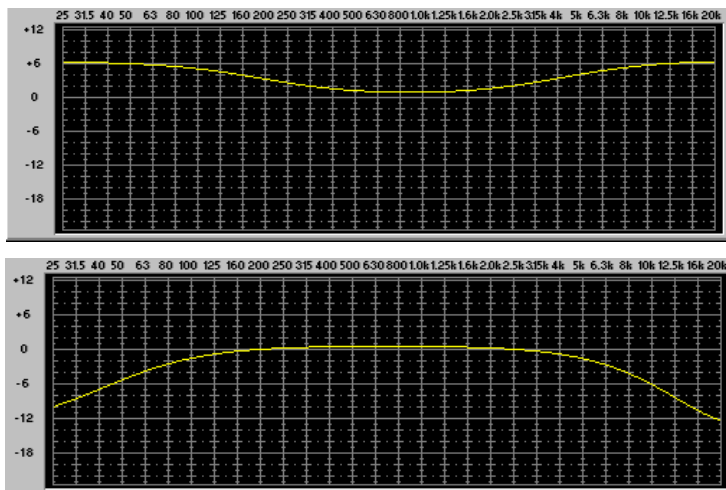
Rolloff — There is an additional step below –18 dB which sets the gain of the shelf to cut. When the filters reach cut, they change from shelf filters to rolloff filters. When in rolloff mode, the GAIN field turns into the SLOPE field, and clicking on the $\uparrow$ and $\downarrow$ buttons will adjust the slope of the rolloff. The slope can be adjusted from 6 dB/octave to 24 dB/octave in 6 dB/octave steps. Please note that these slopes are nominal values, so slopes at high frequencies will be more steep than those at low frequencies. Rolloff filters are ideally used for attenuating the audio signal where extraneous noise, excessive proximity effect, or other unwanted noise is present. The illustration below shows a response curve with high- and low-frequency rolloff filters.

22
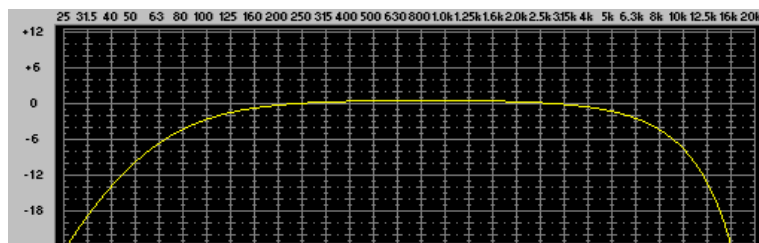
Cutting, Copying, and Pasting Parametric Filters

Cutting a Selected Parametric Filter

1. Click on the desired parametric filter.
2. Click on *Edit* in the menu bar.
3. Click on *Cut.*

Copying a Selected Parametric Filter

1. Click on the desired parametric filter.
2. Click on *Edit* in the menu bar.
3. Click on *Copy.*

Pasting a Selected Parametric Filter

1. Cut or Copy the desired parametric filter.
2. Go to the unit and scene where you would like to place the filter.
3. Click on *Edit* in the menu bar.
4. Click on *Paste.*

FEEDBACK REDUCER

The feedback reducer section allows you to add new feedback filters or edit the frequency, depth or type of existing ones. To access the DFR control window, click on the DFR button on the Main Control Panel.

Feedback Reducer Controls

Lock Filters Button

Click on the **LOCK** button to lock the filters at their current values. The light bar illuminates red when the lock is active. The DFR11EQ will not set any new filters or change the depth of any existing feedback filters. This is identical to the **LOCK** button and LED on the front panel of the DFR11EQ.

Clear Filters Button

Click on the **CLEAR** button to clear feedback filters. A dialog box will come up prompting you to clear one filter, all filters, or the entire block. Click on the **CLEAR ONE** to clear only the currently selected filter, the **CLEAR ALL** button to clear all filters and the Output gain control. Then click on the **OK** button. The Clear function is active even if **LOCK** filters is active.

Feedback Filters Buttons, LEDs, and Related Fields

On the Feedback Filter display, there are 10 LEDs representing each of the 10 feedback filters. The LEDs illuminate from left to right, with the LEDs on the left representing the fixed filters. In order to view the settings of a specific filter, click on the filter's LED. The arrow will identify the selected LED. When a filter is selected, the current settings of that filter will appear in the FREQ., DEPTH, and TYPE fields. You can click on a filter to select it, then edit that filter directly by clicking on the arrow buttons beside the FREQ., DEPTH, and TYPE fields:

FREQ. — This field displays the frequency center of the selected filter. Click on the ↑ and ↓ buttons to adjust the frequency of the filter, or type the desired frequency in the field.

DEPTH — This field displays the depth of cut for the selected the filter. Click on the ↑ and ↓ buttons to adjust the depth in 0.5 dB increments, or type the desired depth in the field.

TYPE — This field displays the Q, or width, setting of the selected filter. The type of each filter can be selected individually using this field. Click on the ↓ button beside the field to reveal the two options: Low Q and High Q. Select one of these options.

To PEQ Button

When filters are created in the Digital Feedback Reducer, they are created as adaptive notch filters. When you click on the TO PEQ button, a dialog box will be launched which will allow you to convert one or all of these filters to parametric filters. Once an adaptive notch filter has been converted to a parametric filter, it cannot be converted back to a adaptive notch filter. **NOTE**: This feature only converts adaptive notch filters to parametric filters if there are enough unused parametric filters.

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Hardware Options Window

The *Hardware Options* window contains options for controlling DIP switches 5, 6 and 7 on the DFR11EQ hardware and setting fixed and dynamic filters. To access the *Hardware Options* window:

1. Click on *Options* in the main menu bar.
2. Select *Hardware Options* on the drop-down menu.

DIP Switch 5, 6, 7 Override and Disable

Clicking on the *DIP Switches 5, 6, 7 Override and Disable* box disables the Filter Bandwidth, Front Panel Lock/Unlock, and Hold/Update DIP switches on the hardware, to prevent tampering. Once the DIP Switches Override and Disable is activated, an X will appear in the box and the High Q/Low Q selection, Front Panel Lock/Unlock, and DFR Filter Update/Hold options will be controllable only from the computer. The DIP switch override does not affect the input and output level or Device ID DIP switches.

Setting High Q or Low Q Filters

The High Q and Low Q option is the same as the Filter Bandwidth DIP switch option controlled by DIP Switch 5 on the back of the unit. For definitions of High Q and Low Q, see *DIP Switch/Hardware Options*.

Front Panel Lock/Unlock/DFR Control Lock

Like the Front Panel Lock/Unlock DIP switch option controlled by DIP Switch 7 on the back panel, this option allows the front panel controls to be locked, in order to protect the unit from tampering. In addition, it provides a third option, DFR Control Lock, that protects the filters created by the Digital Feedback Reducer but allows scenes to be changed on the front panel.

Hold/Update DFR Filters

The Hold/Update DFR Filter option is the same as the Hold/Update DIP switch option controlled by DIP Switch 6 on the back panel. See *Hold/Update* under *DIP Switch/Hardware Options*.

Setting Fixed and Dynamic Filters

DFR11EQ feedback filters are set in one of two modes: *Fixed* or *Dynamic.* For definitions of these two modes, see *DFR11EQ Theory*. The DFR11EQ comes factory preset with 5 fixed and 5 dynamic filters.

To change the ratio of Fixed to Dynamic filters, in the *Hardware Options* window:

1. Place the cursor in the *Number of Fixed DFR Filters* field by using the mouse.
2. Type in the desired number of fixed filters. The remaining filters automatically become dynamic.
3. Click on the **OK** button to accept the changes.

DELAY
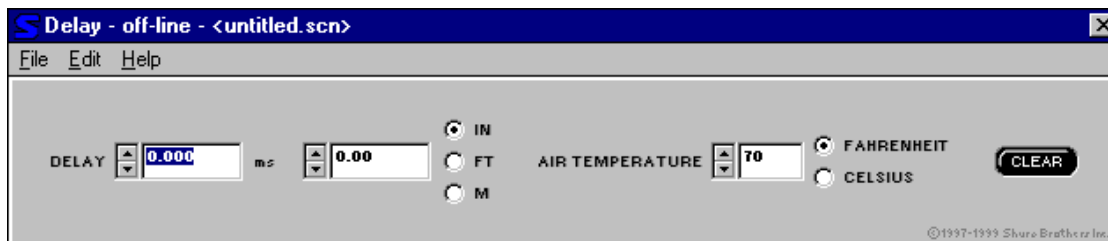
The DELAY section allows the user to add a delay to the outgoing signal, either as a function of time (milliseconds) or as a function of distance (inches, feet or meters). The Delay section includes the following controls:

- **Time Delay:** This field allows you to change the amount of delay in milliseconds (ms). The signal can be delayed up to 1300 ms (1.3 seconds).

- **Distance Delay:** This field allows you to change the amount of delay in distance (inches, feet or meters). The distance represents the how far the sound would travel in the time it is delayed. This is useful in systems where there are remote speakers away from the main speakers.

- **Air Temperature:** This field is used in conjunction with the Distance Delay. Since air temperature affects the rate at which sound travels, this field must be set at the correct room temperature (in either Fahrenheit or Celsius) for the Distance Delay field to be accurate.

- **Clear:** This button clears the delay from the outgoing signal.

Setting Delay by Time

1. Place a DFR11EQ in the audio path between the mixer and the remote speaker. Using the computer interface, call up the Delay control panel by clicking on the DELAY button in the main control section.
2. To set delay by time, use the arrow controls or type a value in the Time Field on the left side of the control panel. It is not necessary to adjust the air temperature field to set delay by time.

Setting Delay by Distance

To set delay by distance, follow these instructions:

1. Place a DFR11EQ in the audio path between the mixer and the remote speaker. Using the computer interface, call up the Delay control panel by clicking on the DELAY button in the main control section.
2. In the Distance Delay Field, select inches, feet, or meters by clicking on the radio button by the desired unit.
3. Measure the distance from the main loudspeaker to the remote loudspeaker.
4. Click on the arrow buttons next to the Distance field, or type a value in the box, to raise or lower the distance.
5. Measure the air temperature.
6. Under the *Air temperature* field, click on the Celsius or Fahrenheit dot to select the desired type.
7. In the *Air temperature* box, click on the ↑ and ↓ buttons to lower or raise the temperature. Set this box to the temperature in the room. The default is 70°F, a typical room temperature.

Using Delay in Common Applications

Using Delay To Correct Phase Cancellation Problems

Problem: Phase cancellation can occur when two loudspeakers are near each other but not aligned. The two speakers can be seen in the illustration below. The waves represent the sound coming from each. The sound waves coming from the main and remote loudspeakers are out of phase. Because they are out of phase, the sounds interfere with each other, degrading audio quality. The illustration below shows how sound waves cross, causing phase cancellations.

LOUDSPEAKER
A

AMPLIFIER

MIXER

AMPLIFIER
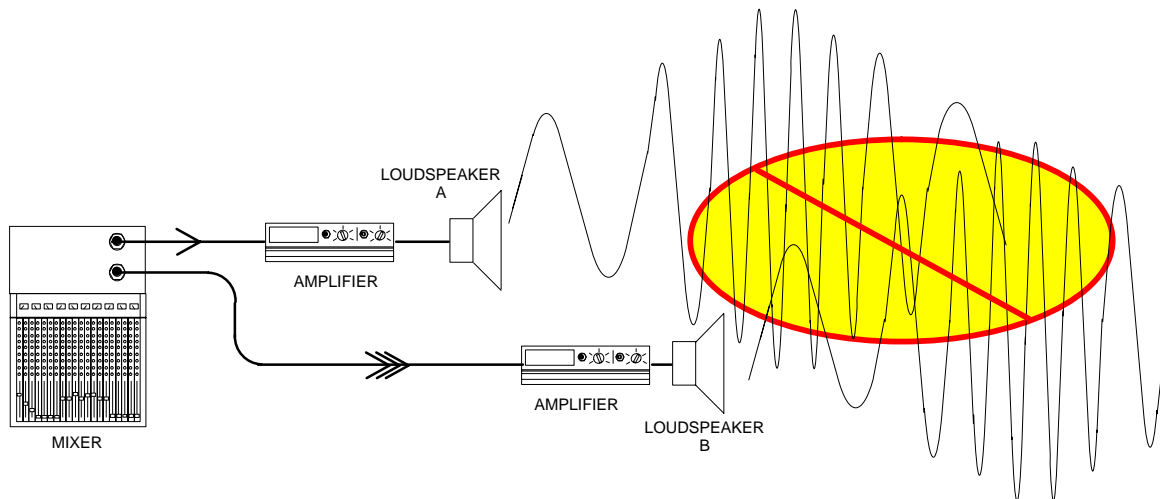
LOUDSPEAKER
B

Solution: The DFR11EQ Delay can be used to delay the signal to loudspeaker B just long enough so that it is aligned and in phase with the sound from the loudspeaker A. When in phase, the waves reinforce each other to maintain audio quality. The following illustration shows how the DFR11EQ delay works in a sound system.

LOUDSPEAKER
A

AMPLIFIER

MIXER

DFR11EQ
WITH DELAY

AMPLIFIER
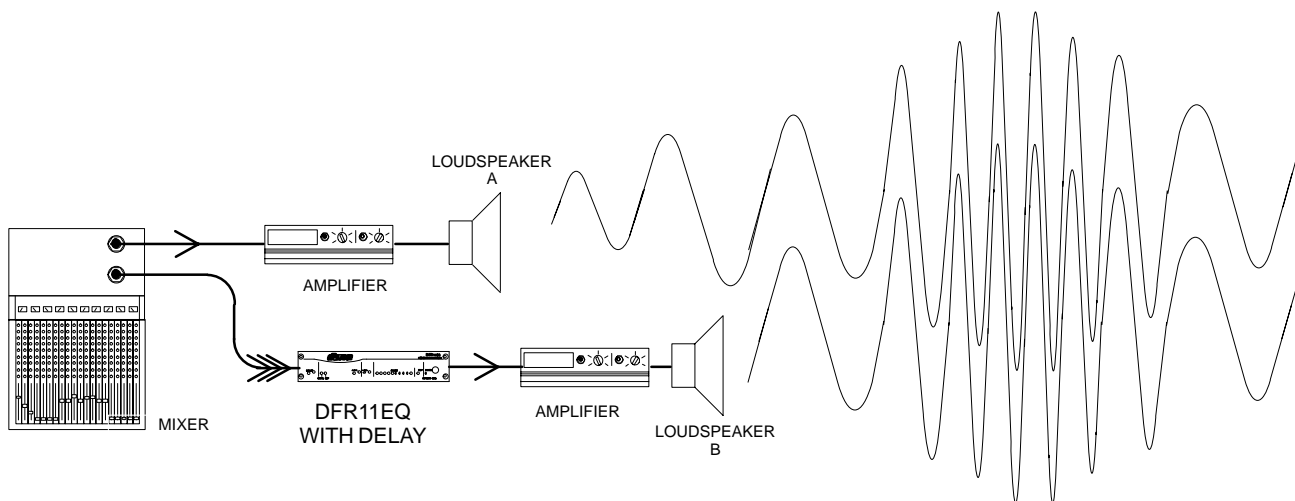
LOUDSPEAKER
B

Using Delay to Correct Time Alignment Problems

Problem: Some larger sound systems may utilize loudspeaker fill systems. One loudspeaker may not be enough for a large hall because of power limitations. A fill loudspeaker may be placed farther in front of the main speaker to augment the sound from the main loudspeaker. This may cause the sound from the fill loudspeaker to arrive at the listener earlier than that from the main loudspeaker. To the audience, it will seem like the sound is coming from the wrong place when the sound from the fill loudspeaker arrives first.
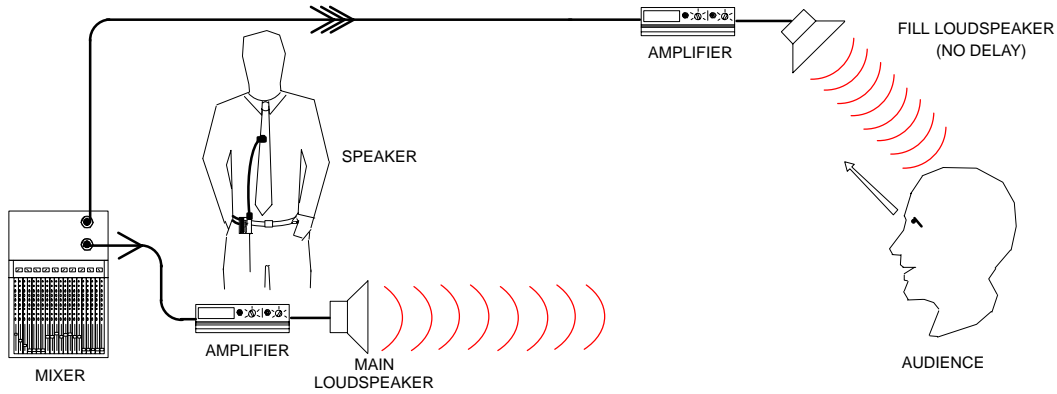
Solution: The delay in the DFR11EQ can be used to solve this problem. Place a DFR11EQ in the audio path to the amplifier of the fill loudspeaker, then set it to the proper amount of delay by following the *Setting Delay by Distance* instructions. If the proper amount of delay is used, the sound from both loudspeakers will arrive at the audience at the same time. Now, the audience will perceive the sound coming from the correct place.

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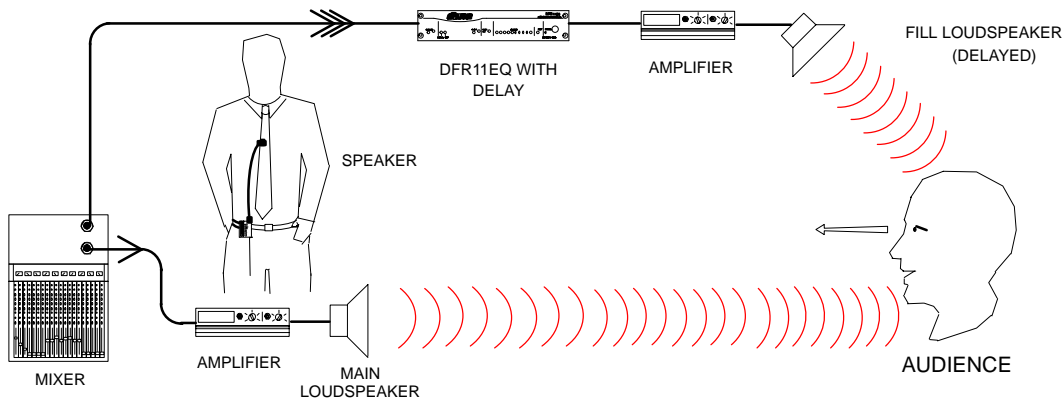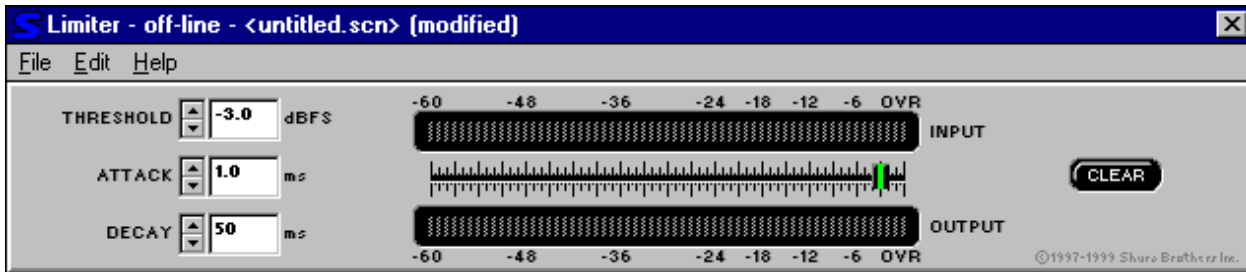
LIMITER

A limiter acts as a ceiling, preventing drastic rises in the dynamic level of an audio signal. Limiting prevents the output level from exceeding the threshold setting, although occasional short peaks may still pass through the system. A limiter is often used to protect against sudden bursts which could potentially damage loudspeakers or other equipment. When the Limiter is active and is reducing the output signal level, the symbol on the right side of the Limiter button on the Main Control Panel illuminates red.

For the Limiter, the parameters and controls function as follows:

THRESHOLD: The threshold sets the dynamic level above which the processing begins. To adjust the threshold, either type the desired level into the THRESHOLD field, click on the ↑ and ↓ buttons of the THRESHOLD field, or click on the desired location on the threshold slider graph.

ATTACK: The attack controls the amount of time before the gain is reduced after an input signal rises above the threshold. Slowing down the attack may create a smoother transition when the limiter is activated, while speeding up the attack adds greater protection from peaks. To adjust the attack, type the desired amount of time into the ATTACK field, or click on the ↑ and ↓ buttons of the ATTACK field.

DECAY: The decay controls the amount of time before the gain is returned to unity once the input level is lower than the threshold. Slowing down the decay may create a smoother transition when the limiter is deactivated. To adjust the decay, type the desired amount of time into the DECAY field, or click on the ↑ and ↓ buttons of the DECAY field.

INPUT METER: Graphically shows the level of the signal before limiter is applied.

OUTPUT METER: Graphically shows the level of the signal after limiter is applied.

THRESHOLD SLIDER: Like the THRESHOLD field, this sets the dynamic level above which the processing begins. Adjusting the Threshold Slider will alter the numerical value in the THRESHOLD Field.

CLEAR: Removes all limiting from the audio signal path, by resetting all the parameters to their defaults.

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OUTPUT CONTROLS

IN/OUT Level Meters

Main Panel

Equalizer Control Window

OUTPUTControl
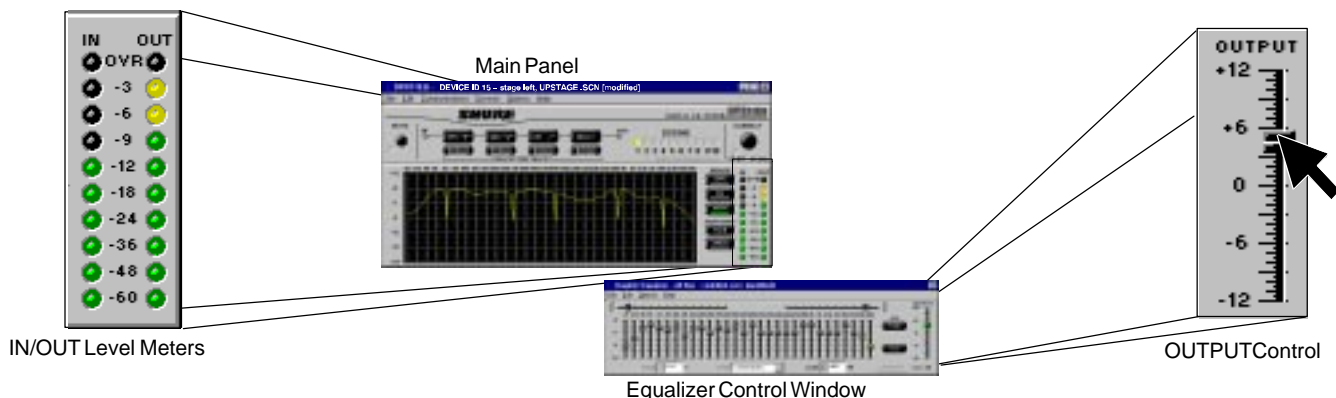
IN/OUT Level Meters

The IN and OUT level meters are located next to the response graph. They display the levels of the input and output in dBu, dBFS or dBV. When the levels go into the red, the unit is near clipping. This is a useful tool for observing gain loss due to equalization settings. To compensate, you can use the OUTPUT slider located on the Equalizer Control window.

To activate the IN/OUT level meters:

1. Click on *Options* in the main menu bar.

2. Click on *Meters* option. A window will appear which will allow you to choose whether the level meter will be calibrated in dBu, dBFS or dBV. Click on the appropriate mode and click OK.

3. When the *Display Level Meters* option is active, a check will appear next to the *Display Level Meters* in the Meter Options dialog.

4. The IN/OUT meters may also be activated by clicking on the inactive, grayed-out meter.

    NOTE: While the IN/OUT level meters are running, the DATA indicator on the DFR11EQ unit will continually flicker. This is normal operation while the IN/OUT meters are active.

OUTPUT Control

The OUTPUT control slider is located on the right side of the Equalizer Control window, in both the Graphic and Parametric mode. Raising or lowering this slider will raise or lower the gain of the output. As the output level is adjusted, the Response Curve Viewer will adjust accordingly, moving the current response curve to the new level on the graph. If you take a snapshot before adjusting the output level, the snapshot will remain at the original output level. The IN/OUT meter will also adjust if it is active.

To adjust the output gain, drag the OUTPUT slider, or click on the appropriate value on the slider. The output slider may be used to adjust the output level if the sound processing has lowered the gain of the signal to an unacceptable level.

Reversing the Output Signal Polarity

This option is designed for sound systems where there is a component which inverts the polarity of the signal, bringing it out of phase with the rest of the equipment. Inverted polarity can cause phase cancellations in the audio. Using this option of the DFR11EQ software, you can digitally invert the audio signal in order to compensate. This will save the time and expense spent in wiring customized cables. When the polarity is reversed, OUTPUT POLARITY REVERSED appears on the main window.

To use the DFR11EQ as an audio signal polarity inverter:

1. Click on *Options* in the main menu bar.

2. Click on *Reverse Output Polarity.* A check will appear next to this option to indicate that it is active.

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SAVING AND SELECTING SCENES

Once a DFR11EQ has been set up with a desired combination of settings, these settings can be saved as a **Scene**. Ten scenes can be saved in internal memory (Onboard), while any number can be saved to disk. Scenes are useful for reducing setup time when multiple units require similar settings. Scenes are also useful for multi-purpose sound systems, or events which require changing settings "on the fly".

To Save a Scene Onboard

To save a scene to one of the ten onboard positions, follow these steps:

1. In the Main Control Panel, chose a Scene position (1 – 10) by clicking on the appropriate Scene LED. It will illuminate yellow. (**NOTE**: Scenes 1 through 3 are accessible via the front panel; scenes 4 through 10 may only be accessed via the software.)
2. Create the scene by adjusting the DFR, EQ, delay and limiter settings.
3. The current settings are saved when another scene is selected or the unit is powered down.
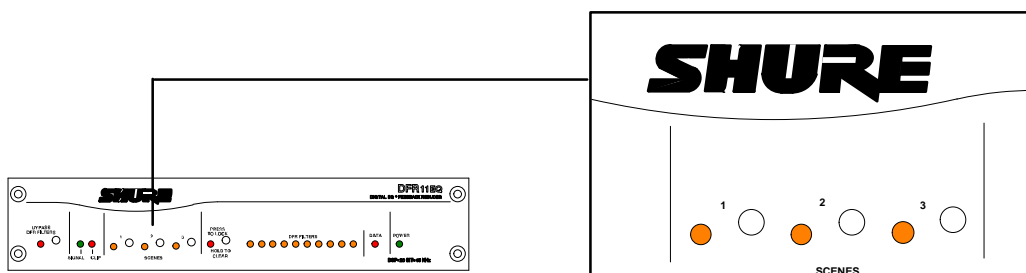
Scene Selection Using Front Panel Controls

In previous versions of the DFR11EQ, scenes could only be changed using the software interface, meaning that a computer was needed to execute this function. With the DFR11EQ Version 5, the user can select one of three saved scenes via the front panel of the DFR11EQ Version 5 hardware. This allows the user to select the three scenes most commonly used and save them so they are easily accessible through one–touch buttons. Scene buttons 1, 2 and 3 on the front panel correspond to Scene LEDs 1, 2 and 3 on the Main Control Panel.

1. Press button 1, 2 or 3 for appropriate scene. When scene is selected, the LED will glow.
2. If no LEDs are glowing in the scene selection section of the hardware's front panel, one of the additional saved scenes has been selected using the software interface.

NOTE: The three Scene buttons on the front panel are preset to provide a flat response until specific scenes are created by the user.

To Save a Scene to Disk

Scenes are saved with the extension .SCN. To save a scene:

1. Click on *File* in the main menu bar.
2. Select the *Save Scene*... option of the drop-down menu.
3. In the *Description* field, type a description of the scene.
4. In the *File Name* field, type the name of the scene.
5. Click on the **OK** button.

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To Recall a Scene from Disk

Once a scene has been saved, the Windows software can be used to reload that scene from disk and recall it to a DFR11EQ. To recall a scene:

1. Click on *File* in the main menu bar.
2. Select *Recall Scene...*
3. On the *Scene* window, select the desired scene.
4. Click on the **OK** button.

Copying and Pasting Scenes
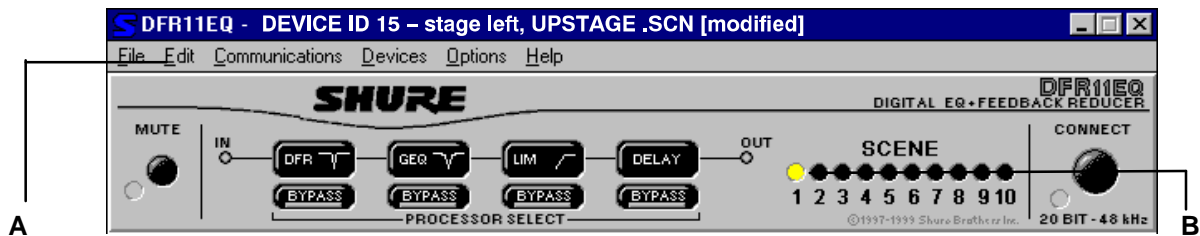
It may be desirable to move an existing scene so that it is accessible via the front panel. To do this, follow these steps:

1. Select the desired scene, either from another onboard scene position or from a disk.
2. Under *Edit* (A) in the Main Menu Bar, select *Copy Scene.*
3. Select the new location for the scene by clicking on the appropriate Scene LED (B) in the Main Control Panel.
4. Under *Edit* (A) in the Main Menu Bar, chose *Paste Scene*. **NOTE**: This will replace the existing scene with the copied scene. If you wish to save the existing scene, copy and paste it into another scene position or save it to disk before pasting in the new scene.

Backup Device and Restore Device

All ten scenes may be saved to a backup file, and then restored later. To backup a set of scenes, follow these steps:

1. In the main menu, click on *File*.
2. Under *File*, click on *Backup Device*.
3. A window will appear which will allow you to name and describe the scene set. Type in the desired information and click **OK**.

The DFR11EQ will then go through each of the ten current scenes and save them, a process which may take up to two minutes. You may save multiple scene sets to your hard drive or a disk.

To restore a set of scenes which is in a back up file, follow these steps

1. In the main menu, click on *File*.
2. Under *File*, click on *Restore Device*.
3. A window will appear which lists all back up files. Select the appropriate file and click **OK**.

The DFR11EQ will then restore each scene to the settings saved in the back up file. This process may take up to two minutes.

Table of Contents

SHURE LINK NETWORKS

Shure Link Connections

A total of 16 Shure Link devices can be linked together and controlled from a single computer. Each unit comes supplied with one 5-pin DIN cable for linking.
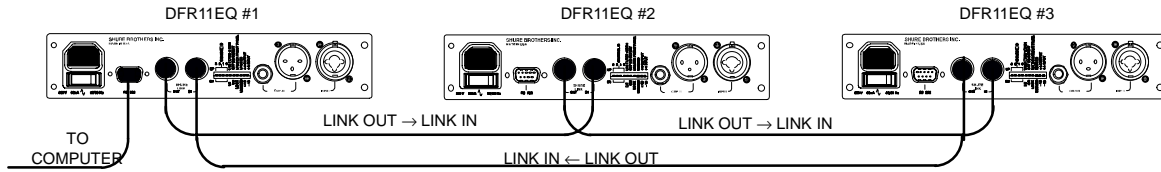
1. Assign each unit a Device ID (0 through 15) via the DIP switches on the rear panel (see *Shure Link Device ID*). UA888s can only be assigned IDs 0 through 3.

   NOTE: All units must have unique Device ID's. The software will not allow adjustments to be made to a Device ID which has multiple Shure LInk devices, because those units may be configured differently.

2. Using the supplied 5-pin DIN cable, connect the Shure Link OUT of the first unit (the one connected directly to the computer) to the Shure Link IN of the second unit. Repeat this connection for each unit to be networked. **The last unit in the chain should be connected from its Shure Link OUT to the Shure Link IN of the first unit.** This creates the loop necessary for all of the networked units to communicate with the computer.

   NOTE: Although a standard MIDI cable can be used to link units, Shure Link is not MIDI compatible.

Shure Link Options

Shure Link Device Menu

The *Device* menu displays the following information:

❶ **Device ID.** This column lists all the Device ID's that are active in the network. The Device ID is assigned through the DIP switches. See *Shure Link Device ID.* This column also indicates when there are multiple units.

❷ **Unit Name.** See *Naming a DFR11EQ.*

❸ **Scene.** This column lists the name of the scene that is active in the device and the status of that scene if it has been modified. Once a modified scene has been saved to disk, the modified status changes.

❹ **Configuration.** This column lists the signal processing modules active in that scene. The modules are listed as follows:

> DFR11EQ ver. 5
> DFR11EQ ver. 4
> DFR11EQ ver. 3
> DP11EQ
> UA888

If a unit is detected but cannot be identified, the following message will appear:

> DFR MEM ERR

NOTE: If there are multiple Shure Link Devices using the same Device ID, that Device ID will appear grayed out in the menu. Those units will be inaccessible to computer control. The software is designed this way to avoid problems which may occur when multiple units on the same Device ID are performing different functions. To access multiple units, please make sure that each unit has been assigned a different Device ID.

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Shure Link Device Selection

In order to select a Device ID on a Shure Link network:

1. Click on *Device* in the main menu.
2. In the Device menu, click on the desired Device ID.

The Device ID will appear beside the DFR11EQ heading in the title bar at the top of the main window, indicating that the unit with that Device ID will receive computer commands.

> **NOTE**: If you select a DP11EQ or UA888, the DFR11EQ Version 5 software will launch the appropriate software, provided that it is installed on the computer.

Global Scene Option

A new feature on the DFR11EQ is the Global Scene option. This allows scenes to be changed simultaneously on multiple DFR11EQs in a Shure Link network. In order to use this option:

1. Click on *Options* in the main menu.
2. In the Options menu, click on *Global Scene*.

If the *Global Scene* Option is active, scene changes on the unit are made to all other Shure Link devices in the network which have the *Global Scene* option activated. If a device does not have the Global Scene option active, it will not be affected by these changes.

Naming a DFR11EQ

In order to name a DFR11EQ in a network:

1. Click on *Device* in the main menu, then click on *Name Device...* .
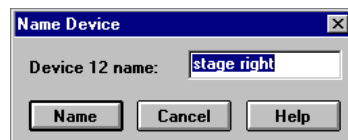
2. In the *Name Device* window, type in the desired name.
3. Click on the OK button. The name will appear in the title bar.

MAINTENANCE
Customizing Graph Colors

The graph colors on the Version 5 software can be customized to fit individual tastes. This can help make the display more visible or aesthetically pleasing. To change the color of an item on the interface:

1. Click on *Options* in the main menu bar.
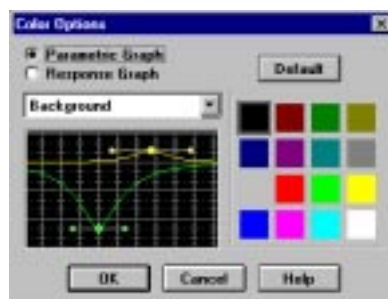
2. Click on *Colors...*
3. In the *Color Options* window, select **Parametric Graph** or **Response Graph.**
4. In the field just below the Parametric Graph/Response Graph buttons, click on the ↓ button.
5. In the drop down menu, select the item you would like to assign a new color. The space below the field will display the selected item.
6. On the colored squares beside the display, select the desired color.
7. Click on the **OK** button.

> **NOTE:** The **Parametric** option of the *Color Options* window will be disabled if the software is configured for graphic equalizer mode.

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Printing DFR11EQ Settings

If you are documenting a sound system, the DFR11EQ offers the option of printing out a hardcopy report showing the settings of a selected unit. To print out a hardcopy of this report:

1. Under *File* in the main menu bar, click on print.

2. Select any of the desired print options available.

3. Click on the button of the **Name:** field to display a drop–down list of available printers, then select a printer. Click on the **OK** button.

DFR11EQ   04/01/99
                                                                            03:30 PM

Device ID   15
Device Name   Main System
Scene Name   MAIN.SCN (modified)

Version
Product Code   Parametric   Microcontroller Code   3.0.1.3
Windows Code   1.73   DSP Boot Code   3.0.0.0
DSP Code   5.0.0.0   Hardware Code   S2423805492

Settings
Bypass   none   Mute   Off
DIP Switch Lockout   Off   Invert   Off

Response Graph

Feedback Filter Settings

Feedback Filters   High Q   Fixed Filters   5
Lock   Off   Dynamic Filters   5

Frequency	Depth	Type	Mode	Frequency	Depth	Type	Mode
545 Hz	–12.0 dB	High Q	Fixed				
5.30 kHz	–9.0 dB	High Q	Fixed				
1000 Hz	–12.0 dB	High Q	Fixed				
80.0 Hz	–9.5 dB	High Q	Fixed				
250 Hz	–12.0 dB	High Q	Fixed				

Paramteric EQ Settings

Output   0.0 dB

Low–Cut/Shelf Fitler   **High–Cut/Shelf Filter**

Frequency	Depth	Slope	Frequency	Depth	Slope
40.3 Hz	–18.0 dB	–6.0 dB/Oct	15.9 kHz	–17.5 dB	–6 dB/Oct

EQ Filters

Frequency	Depth	Bandwidth	Frequency	Depth	Bandwidth
2.61 kHz	–4.0 db	2/3 oct			
10.9 kHz	–4.0 db	2/3 oct			
626 Hz	0.5 dB	0.300 oct			
152 Hz	–4.0 db	0.225 oct			
56.1 Hz	–4.0 db	0.300 oct			

Limiter Settings

Threshold   –6.0 dB   Attack   1.0 ms
                                         Decay   50.0 ms

Delay Settings

Delay   8.875 ms/10.000 ft Temperature   70 Fahrenheit

Exiting the DFR11EQ Application

To Exit

1. Click on *File* in the main menu bar.
2. Select the *Exit* option of the drop-down menu.

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APPENDIX A. SPECIFICATIONS

Frequency Response
20 to 20k Hz $\pm$ 1.0 dB re 1 kHz

Dynamic Range
104 dB minimum, A-weighted, 20 Hz to 20 kHz

Sampling Rate
48 kHz

Digital-to-Analog, Analog-to-Digital Conversion
20 bit resolution

Voltage Gain
-1 dB $\pm$ 1dB (power off)
0 dB $\pm$ 2 dB (equal input and output sensitivities)
12 dB $\pm$ 2 dB (input -10 dBV, output +4 dBu)
-12 dB $\pm$ 2 dB (input +4 dBu, output -10 dBv)

Impedance
Input: 47 kΩ $\pm$ 20% actual
Output: 120 Ω $\pm$ 20% actual

Input Clipping Level
+18 dBu minimum (at +4 dBu setting)
+4 dBV minimum (at -10 dBV setting)

Output Clipping Level
+18 dBu minimum (at +4 dBu setting)
+4 dBV minimum (at -10 dBV setting)

Total Harmonic Distortion
< 0.05% at 1 kHz, +4 dBu, 20 to 20 kHz

LED Signal Indicators
Clip: 6 dB down from input clipping

Propagation Delay from Input to Ouput
1.0 ms, all filters set to Flat (0 ms delay setting)

Polarity
Input to output: non-inverting
XLR: pin 2 positive with respect to pin 3
$^1/_4$-in. TRS: tip positive with respect to ring

Operating Voltage
DFR11EQ: 120 Vac, 50/60 Hz, 75 mA max
DFR11EQJ: 100 Vac, 50/60 Hz, 75 mA max
DFR11EQE: 230 - 240 Vac, 50/60 Hz, 38 mA max

Temperature Range
Operating: $-7°$ to 49° C (20° to 140° F)

Fuse
DFR11EQ:120 Vac. Fuse: 100 mA, 250V time delay
DFR11EQJ: 100 Vac. Fuse: 100 mA, 250V time delay
DFR11EQE: 230 Vac. Fuse: 50 mA, 250 V time delay
In order to change a blown fuse, remove the power cord
and pry open the drawer with a flathead screwdriver.

FUSE

Dimensions
219 mm x 137 mm x 44.5 mm
8 $^5/_8$ in x 5 $^3/_8$ in x 1 $^3/_4$ in

Weight
930 g (2.05 lbs)

FEEDBACK FILTERS

Ten (10) $^1/_{10}$-octave adaptive notch filters from 60 Hz to 20 kHz

Deployed to 1 Hz resolution of feedback frequency

Deployed in depths of 3 dB, 6 dB, 9 dB, 12 dB, and 18 dB (12.5 Low Q in graphic EQ mode) attenuation

Filter shape variable between HI Q and LOW Q (see *High Q vs. Low Q Filters).*

GRAPHIC EQUALIZER

Frequency Bands
30 bands on ISO, $^1/_3$-octave centers

Filter Type
$^1/_3$-octave, constant Q

Maximum Boost
6 dB per band

Maximum Cut
12dB per band, high- and low-pass filters, 12dB/octave nominal

PARAMETRIC EQUALIZER

Frequency Bands
10 bands, variable frequency, variable Q

Boost/Cut Range
+6 dB to -18 dB per band

Q Range
$^1/_{40}$-octave to 2 octave

Shelf/Rolloff Filters
Shelf, +6 to -18 dB per filter
Rolloff, 6dB, 12dB, 18dB, or 24dB per octave nominal

DELAY

Up to 1.3 seconds

LIMITER

Threshold: -60 dBFs to -0.5 dBFs, 0.5 dB resolution
Attack: 1 ms to 200 ms
Decay: 50 ms to 1000 ms
Ratio: ∞ to 1

Audio Connectors
DFR11EQ Audio Input

Connector: (XLR and 1/4-inch combined)	XLR (female)	1/4-inch phone plug (female)
Configuration:	active balanced	active balanced
Actual Impedance:	47 kΩ	47 kΩ
Nominal Input Level:	+4 dBu (+4 input level) −10 dBV (−10 input level)	+4 dBu (+4 input level) −10 dBV (−10 input level)
Maximum Input Level:	+18 dBu (+4 input level) +6 dBV (−10 input level)	+18 dBu (+4 input level) +6 dBV (−10 input level)
Pin Assignments:	Pin 1 = ground Pin 2 = hot Pin 3 = cold	Tip = hot ring = cold sleeve = ground
Voltage / Current/ Phantom Power Protection?	yes	yes

DFR11EQ Audio Output

Connector: (XLR and 1/4-inch separate)	XLR (male)	1/4-inch phone plug (female)
Configuration:	active balanced cross coupled	active balanced cross coupled
Actual Impedance:	120 Ω	120 Ω
Nominal Output Level:	+4 dBu (+4 output level) −10 dBV (−10 output level)	+4 dBu (+4 output level) −10 dBV (−10 output level)
Maximum Output Level:	+18 dBu (+4 output level) +6 dBV (−10 output level)	+18 dBu (+4 output level) +6 dBV (−10 output level)
Pin Assignments:	Pin 1 = ground Pin 2 = hot Pin 3 = cold	Tip = hot ring = cold sleeve = ground
Voltage / Current/ Phantom Power Protection?	yes	yes

CERTIFICATIONS

DFR11EQ (Version 5)

UL Listed and cUL Listed to UL 6500 and CSA E65. Approved under the verification provision of FCC part 15 as a Class B Digital Device.

DFR11EQE (Version 5)

Eligible to bear CE marking. Conforms to European Union Low Voltage Directive 73/23/EEC; VDE GS–Certified to EN 60065. Conforms to European Union EMC Directive 89/336/EEC; Emissions per EN 50081–1 (1992) and Immunity per EN 50082–1 (1992).

NOTE:

*EMC conformance testing is based on the use of supplied and recommended cable types. The use of other cable types may degrade EMC performance.

*Under extremely abnormal conditions of electrical fast transients on the power line, communication may be interrupted between the DFR11EQ and the controlling PC. The unit will not be damaged; normal operation will resume after the CONNECT button or command is used to restore the connection

*This Class B digital apparatus complies with Canadian ICES–003.

FURNISHED ACCESSORIES

Power Cable (DFR11EQ5/DFR11EQJ)* 95A8389
Power Cable (DFR11EQ5E)* 95A8247
Power Cable Clamp* 95A8712
5-pin DIN Shure Link Cable 95A8676
Single Mount Rack Bracket 53A8450
Dual Mount Rack Bracket 53B8442
Straddle Bars 53B8443
DFR11EQ Version 5 Software/User's Guide CD–ROM 95A8830A

*NOTE: The power cord and power cable clamp is supplied assembled. If a replacement power cord is needed, a power cord clamp is also required. If not assembled, the power cord clamp should be clamped as close to the female end of the power cord as possible.

INFORMATION TO USER

Changes or modifications not expressly approved by Shure Brothers Inc. could void your authority to operate this equipment.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.Consult the dealer or an experienced radio/TV technician for help.

APPENDIX B. AUDIO CABLES

The diagrams below provide cabling recommendations for most common cabling situations. The following is a sample of some of the more commonly used cables and applications. Some equipment may have different pinouts than the given examples. Consult the documentation for that equipment. Unless otherwise noted, these cables may be used in the following applications:

- Mixer Line Out to DFR11EQ Input
- DFR11EQ Output to Amplifier Input
- DFR11EQ Output to Mixer Sub Return

- Mixer Send to DFR11EQ Input
- Mixer Sub Send to DFR11EQ Input

NOTE: All cables must be shielded. Except for the Shure Link cable, none of the cables shown are supplied with the DFR11EQ.
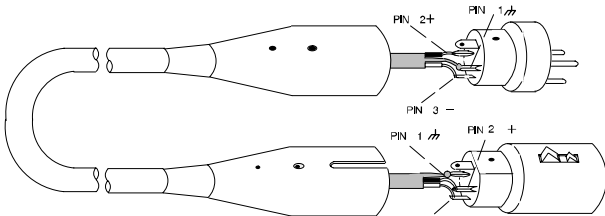
XLR (male) to XLR (female)
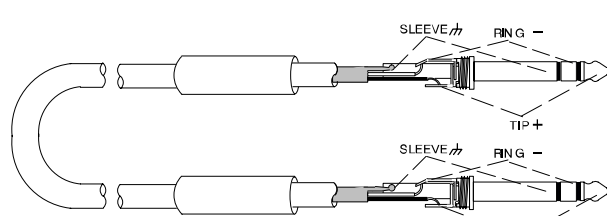
$^1/_4$-in. to $^1/_4$-in. Balanced
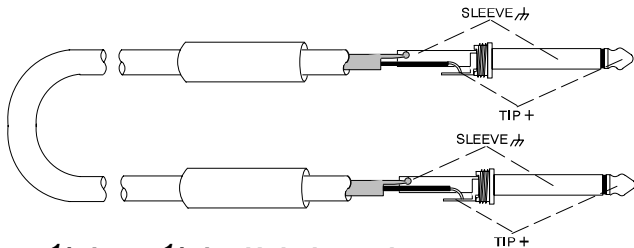
$^1/_4$-in. to $^1/_4$-in. Unbalanced
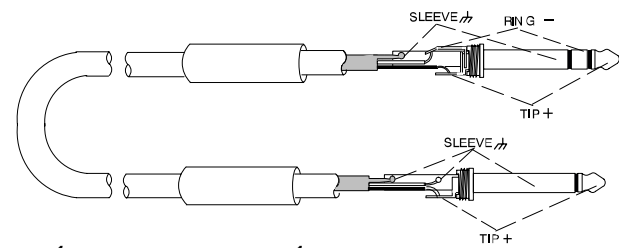
$^1/_4$-in. Balanced to $^1/_4$-in. Unbalanced
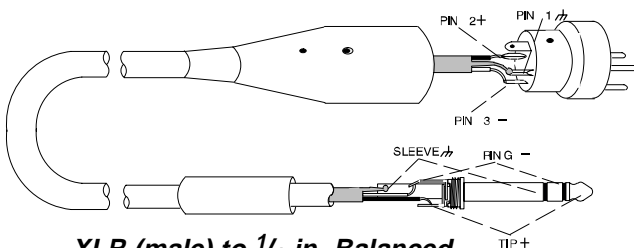
XLR (male) to $^1/_4$-in. Balanced
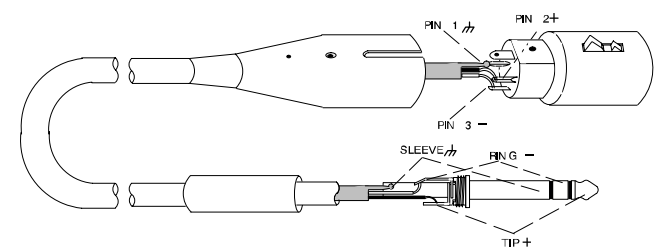
XLR (female) to $^1/_4$-in. Balanced
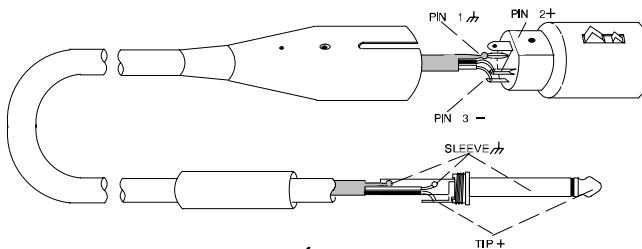
XLR (female) to $^1/_4$-in. Unbalanced
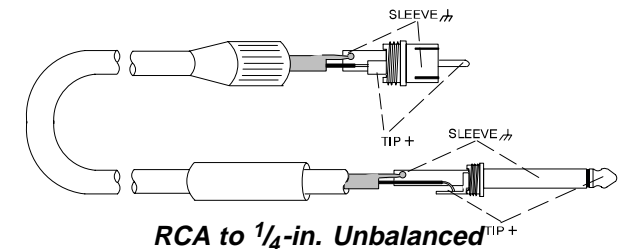
RCA to $^1/_4$-in. Unbalanced

TYPICAL APPLICATION
- DFR11EQ5 Output to Amplifier Input
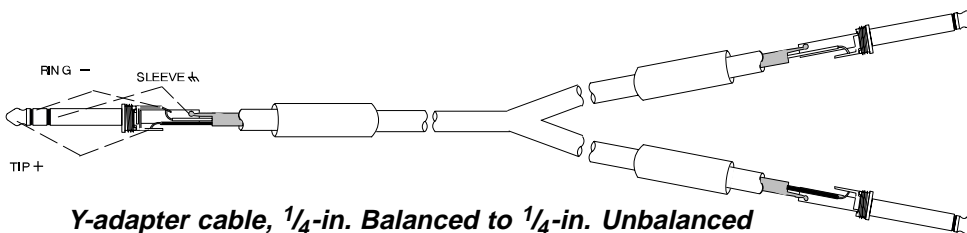
Y-adapter cable, $^1/_4$-in. Balanced to $^1/_4$-in. Unbalanced

TYPICAL APPLICATION
- Mixer Send/Return (Insert) to DFR11EQ Input and Output

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Digital Connectors and Cables

Computer Interface — 9-Pin to 9-Pin RS-232 Cable

9-PIN FEMALE
TO COMPUTER

COMPUTER 9-PIN RS-232
CONNECTOR MALE

9-PIN MALE
TO DFR11EQ

DFR11EQ RS-232
CONNECTOR FEMALE
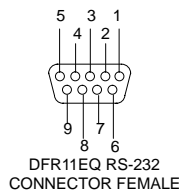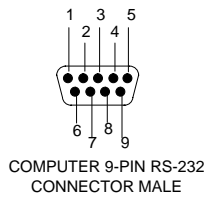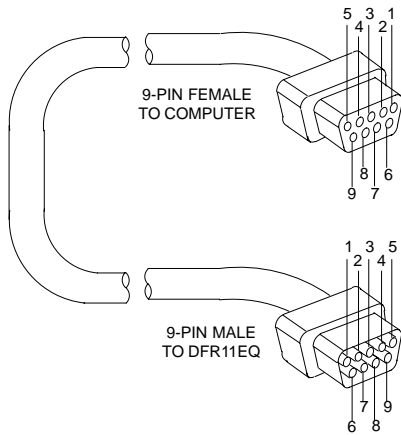
FUNCTION	PIN #
—	1
RX	2
TX	3
DTR	4
GND	5
DSR	6
RTS	7
CTS	8
—	9

Computer Interface — 9-Pin to 25-Pin RS-232 Cable

25-PIN FEMALE
TO COMPUTER

COMPUTER 25-PIN RS-232
CONNECTOR (MALE)

9-PIN MALE
TO DFR11EQ

DFR11EQ RS-232
CONNECTOR FEMALE
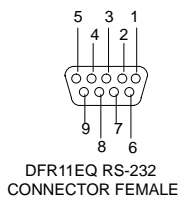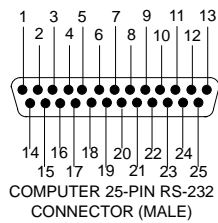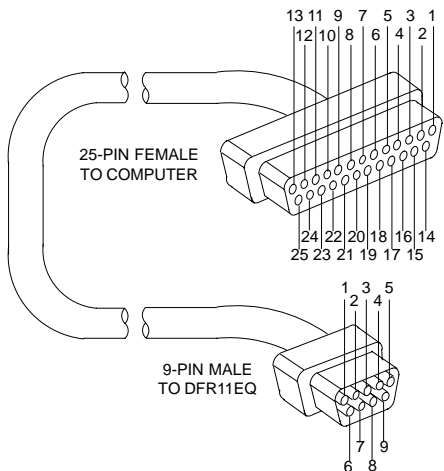
FUNCTION	9-PIN CONNECTOR PIN #	25-PIN CONNECTOR PIN #
—	1	8
RX	2	3
TX	3	2
DTR	4	20
GND	5	7
DSR	6	6
RTS	7	4
CTS	8	5
—	9	22

Shure Link Cable — 5-Pin DIN Cable (MIDI-compatible cable)

SHURE LINK IN

SHURE LINK OUT
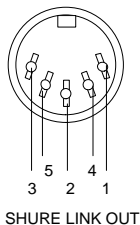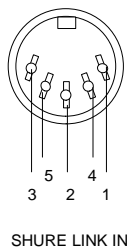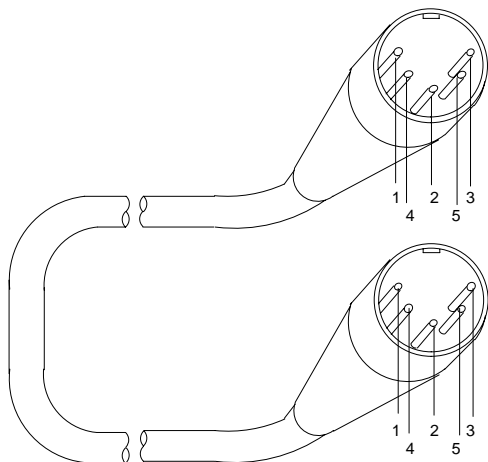
FUNCTION	PIN #
—	1
DATA	4
SHIELD	2
DATA	5
—	3

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APPENDIX C. RACK MOUNTING THE DFR11EQ

The DFR11EQ comes in a $^1/_2$-rack chassis specially designed for sturdiness. The sagging and bending found in most $^1/_2$-rack designs is eliminated — the brackets and straddle bars are designed to ensure that the units will be installed securely.

> **WARNING**: Do not torque the screws too tightly, or the chassis may be damaged.

Single Unit
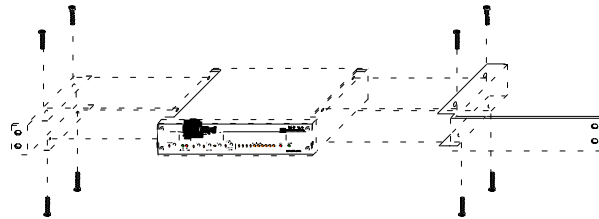
1. Align the supplied rack-mount brackets over the holes.
2. Fasten with the 8 supplied screws.

Dual-Mounted Units
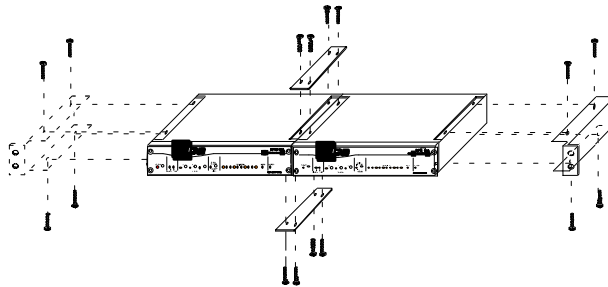
1. Align two units side by side so that the front panels both face the same direction.
2. Place the supplied straddle bars in the recesses on the top and bottom of the units, so that they overlap both. Fasten with the supplied screws.

   NOTE: Be sure to use both straddle bars when installing dual units.
3. Position the rackmount brackets over the holes in the side of the unit. Fasten with the supplied screws.

Mounting in an Equipment Rack

SINGLE MOUNT

DUAL MOUNT

1. Insert the unit(s) into a 19-inch equipment rack.
2. Fasten the unit(s) to the rack using all four of the supplied screws.

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APPENDIX D. KEYBOARD CONTROLS

There are a number of keyboard controls which you can use instead of a mouse.

General Controls

HIGHLIGHT controls from left to right: `Tab`

HIGHLIGHT controls from right to left: `Shift` + `Tab`
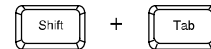
PRESS a selected button: `Space Bar`

SAVE a scene: `Ctrl` + `S`
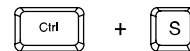
RECALL a scene: `Ctrl` + `R`
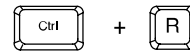
PRINT the settings of the current unit: `Ctrl` + `P`
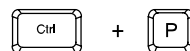
EXIT the processor display: `Alt` + `F4` **or** `Esc`
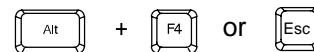
FINE ADJUST a parameter: `↑` **or** `↓`
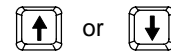
COARSE ADJUST a filter or slider: `Page Up` **or** `Page Down`
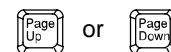
UNDO a clear or flat action: `Ctrl` + `Z`
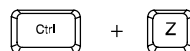
DELETE a highlighted text: `Delete`

COPY highlighted text to the clipboard: `Ctrl` + `C`
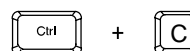
CUT highlighted text to the clipboard: `Ctrl` + `X`
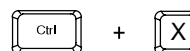
PASTE text from the clipboard: `Ctrl` + `V`
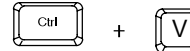
IN/OUT Meters and OUTPUT Slider Controls

RESET the OUTPUT slider: `Space Bar`
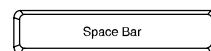
Turn the IN/OUT meters ON and OFF: `Ctrl` + `M`
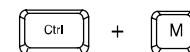
FINE ADJUST the output gain: `↑` **or** `↓`
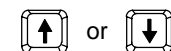
COARSE ADJUST the output gain: `Page Up` **or** `Page Down`
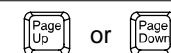
Graphic Equalizer Controls

HIGHLIGHT the sliders from left to right: `←` or `→`
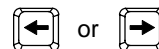
RESET a selected slider: `Space Bar`
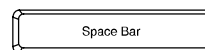
FINE ADJUST the gain of a selected slider: `↑` or `↓`
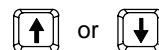
COARSE ADJUST the gain of a selected slider: `Page Up` or `Page Down`
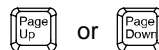
Parametric Equalizer Controls

RESET a selected parametric filter: `Space Bar`

CREATE a new parametric filter: `Insert`
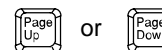
FINE ADJUST the FREQUENCY of a parametric filter: `←` or `→`
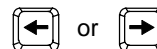
COARSE ADJUST the FREQUENCY of a parametric filter: `Shift` + `←` or `→`

FINE ADJUST the GAIN of a parametric filter: `↑` or `↓`

COARSE ADJUST the GAIN of a parametric filter: `Page Up` or `Page Down`
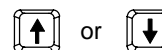
     `Shift` + `↑` or `↓`

ADJUST the WIDTH of a parametric filter: `Ctrl` + `←` or `→`

CUT a parametric filter: `Ctrl` + `X`
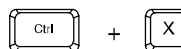
COPY a parametric filter: `Ctrl` + `C`
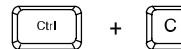
PASTE a parametric filter: `Ctrl` + `V`
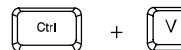
DELETE a parametric filter: `Delete`

Limiter Controls

RESET the threshold: `Space Bar`