SHURE®

DFR22 -- Audio Processor

General Description

The DFR22 Audio Processor with Feedback Reduction is a 2input, 2output digital audio processor. It is designed to equalize sound system response, provide dynamics processing and alignment delay, and automatically detect and control acoustic feedback. A built-in 2 X 2 matrix mixer allows either or both inputs to be routed to either or both outputs, with additional controls for levels and polarity.

The DFR22 is ideal for installed sound reinforcement applications, such as houses of worship, theaters, and meeting facilities. It is also a powerful setup tool in live music applications. Using the DFR22s draganddrop graphical user interface, processors can be placed anywhere in the signal path.

DFR22 Features

- Shure's patented digital feedback reduction algorithm:
  - Now includes stereo DFR processing capability
  - New Auto Clear mode clears dynamic filters after a preset change or power cycle. Dynamic filters can be automatically removed after a specified number of hours.
- Configurable signal path with drag and drop Windows interface. Includes graphic and parametric EQ, up to 10 seconds of delay, compression, limiting, gating, automatic gain control, ducking, and a fully configurable two-way crossover.
- Phoenix and XLR connectors for each input and output
- Compatible with USB to serial port converters
- Front and back panel RS232 ports:
  - 3-pin Phoenix connector on back panel
  - DB9 connector on front panel; requires only TX, RX, and GND to be connected
- Three pre-loaded presets:
  - Preset 1: Two mono 16 filter DFRs
  - Preset 2: A stereo 16 filter DFR
  - Preset 3: A mono 16 filter DFR on each input. Each input is routed to each output.
- Preset selector and indicator for up to 16 presets
- Control input pins for setting up remote preset, volume, and mute controls

Packing List

- Power Cable
- 5-pin DIN ShureLink Cable
- 4 Rackmount Screws with Nylon Washers
- Five 3-Pin Block Connector Terminals (for audio input/output and RS-232 communication)
- One 6-pin Block Connector Terminals (for control inputs)
- One DFR22 Software CD-ROM and Online User Guide

Requirements

Power Requirements

- 100-240 Vac, 50/60 Hz
- 45 W maximum

Computer Requirements

- 20 MB of hard drive space
- CD ROM drive
- RS-232 serial port and cable, or approved USB-to-Serial port adapter*
- VGA monitor with 640 x 480/256 color, or higher resolution
- Mouse or other pointing device
  Processor speed and memory requirements vary, depend-ing on the version of Windows and number of back-ground applica-tions you are running. Operating the DFR22 software simulta-neously with programs such as SIA Smaart or Gold Line TEF requires a faster processor and more RAM. The chart below lists the minimum re-quirements for running the DFR22 software with no other applications--including virus protection, firewall, in-stant messaging, or email--in the background.

Windows Version	Processor Speed	RAM
98, Second Edition	Pentium 166 MHz	48 MB
NT	Pentium 233 MHz	64 MB
ME	Pentium 300 MHz	64 MB
2000 Professional	Pentium 300 MHz	96 MB
XP Professional, Home	Pentium 300 MHz	128 MB

*Most USB-to-serial port adapters work well with the DFR22. To see the latest list of fully approved adapters, visit http://shure.custhelp.com/app/answers/detail/a_id/2951

Software Installation

1. Insert supplied CD into your CD-ROM drive and follow the on-screen instructions.
2. If installation does NOT start automatically, click on the [Start] button on the Windows taskbar and select [Run...] from the pop-up menu.
3. Type [D:/setup], where "D" is your CD-ROM drive letter.
4. Click OK and follow the on-screen instructions.

Using the DFR22 Software

Instructions for the DFR22 software are available in PDF format on the CD-ROM included with the system, or on the Shure web site at www.shure.com.

Register this product by filling out and mailing the enclosed registration card, or register online at the Shure web site (www.shure.com). Registration allows you to receive information about software updates as they become available.
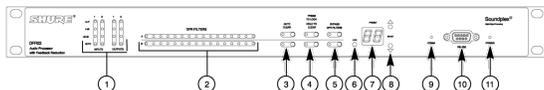
Overview

Front Panel

Figure 1: DFR22 FRONT PANEL

1. **INPUT/OUTPUT Level Meters:**
    *   **CLIP.** Illuminates at 3 dB below clipping level.
    *   **0 VU.** +4 dBu, -10 dBV; software selectable. 0 dB is equal to +4 dBu by default. If the input or output sensitivity is changed to -10dBV using the DFR22 software, 0 dB equals -10 dBV.
    *   **-20 dB.** Illuminates when the signal meets or exceeds the indicated level.
    *   **MUTE.** Illuminates when input or output is muted.
2. **DFR Filter LEDs.** Illuminate when individual feedback filters are active. When a filter changes or is added, an LED flashes, then stays on.
3. **AUTO CLEAR Buttons and LEDs.** Press and release these buttons to configure Auto Clear mode for each channel. Press them again to activate Auto Clear. When an Auto Clear LED illuminates, Auto Clear is active on its corresponding channel.
4. **PRESS TO LOCK/HOLD TO CLEAR Button and LEDs.** Press this button to lock filters at their current values. Holding this button down will reset all feedback filters, even if they are locked. The LED lights to indicate that the lock is active.
5. **BYPASS DFR FILTERS Button and LEDs.** Press these buttons to suspend feedback reducer operation and remove feedback filters from the audio path. When a Bypass LED illuminates, feedback reduction is bypassed on the corresponding channel. Bypass does not affect other processors (such as equalizers, delay, limiters, etc.).

6. **LOAD Button.** Press this button to activate a selected preset.
7. **PRESET Indicator.** Shows the number of the currently active preset. Blinks to show the number of the other presets in the DFR22 when pressing the SELECT buttons.
8. **SELECT Buttons.** Press to scroll through the presets stored in the DFR22.
9. **COMM LED.** Flashes in unison with the feedback filter LEDs when the detector is deploying a new filter or changing an existing one, and also blinks whenever the unit is communicating with a connected computer.
10. **RS232 Port.** Connects the DFR22 to a computer.
11. **POWER LED.** Illuminates when 100-240 VAC power is applied to the DFR22.
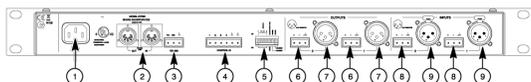
Back Panel

Figure 2: DFR22 REAR PANEL

1. **Power Connector.** Connects to 100-240 VAC power.
2. **Shure Link Interface.** Allows linking of up to 16 Shure Link devices, which may be accessed by a computer.
3. **3-Pin RS-232 Port.** Connects the DFR22 to a computer. For use with DFR22 software and control systems. Refer to the Computer Connections section.
4. **CONTROL IN Pins.** Use control input pins for remote control of preset switching, muting, and gain. Refer to the Control Pin Connections section.
5. **DIP Switches.** Use Switches 1-4 to select a Shure Link Device ID. Use Switch 5 to lock or unlock front panel controls. Refer to the Front Panel Lockout section for information on locking front panel controls.
6. **Output Connectors (Phoenix).** These active, cross-coupled, balanced outputs can be used with balanced or unbalanced inputs. They can be switched between +4 dBu/-10 dBV line-level operation, using the DFR22 software. Refer to the Audio Connections section.
7. **Output Connectors (XLR).** These active, cross-coupled, balanced outputs can be used with balanced or unbalanced in-puts. They can be switched between +4 dBu/-10 dBV line-level operation using the DFR22 software. Refer to the Audio Connections section.
8. **Input Connectors (Phoenix).** These active balanced inputs can be used with balanced or unbalanced outputs. They cannot be used simultaneously with an XLR connector for the same input. They can be switched between +4 dBu/-10 dBV line-level operation using the DFR22 software. Refer to the Audio Connections section.
9. **Input Connectors (XLR).** These active balanced inputs can be used with balanced or unbalanced outputs. They cannot be used simultaneously with a Phoenix connector for the same input. They can be switched between +4 dBu/-10 dBV line-level operation using the DFR22 software. See Audio Connections section for more information.
10. **POWER Switch.**
    Country dependent

Default Presets

The DFR22 comes with three factory-configured presets. Although a computer is required to configure the DFR22's equalizers, dynamics processors, delays, and crossover, you can use the DFR22 "out of the box" as an automatic feedback reducer, without connecting it to a computer.

Preset 1: Provides two independent feedback reducers. The audio signal going to Input 1 is analyzed and filtered by a feedback reducer using up to 16 notch filters, and is then routed to Output 1. Input 2 is analyzed by another feedback reducer and then routed to Output 2. On the front panel, Row A of the DFR Filters and controls is assigned to the feedback reducer on Input 1; Row B is assigned to the feedback reducer on Input 2.

Preset 2: Provides a stereo feedback reducer. Signal going into each input is analyzed independently, but the feedback reducer applies the same notch filters to each channel. As with Preset 1, Row A of the DFR filters and controls on the front panel is assigned to the feedback reducer on Input 1; row B is assigned to the feedback reducer on Input 2. Because the feedback reducers always apply the same filters to both channels, the DFR filter indicators and controls are linked.

Preset 3: Similar to Preset 1, except both inputs are routed to both outputs.

Front Panel Control Functions

Auto Clear

By default, the DFR22 saves all feedback filters during a preset change or power cycle. However, you can configure the device to automatically remove dynamic feedback filters and changes to the depth of fixed feedback filters, according to parameters that you specify.

Each time the DFR22 detects a feedback frequency, it assigns that frequency to one of the filters. By default, the first eight frequencies are assigned to fixed filters, and the second eight are assigned to dynamic filters. Both types of filters can deepen if feedback reoccurs at the same frequency. The frequency of a fixed filter will not change unless you manually clear all of the filters. However, if all filters are in use and an additional feedback frequency is detected, the DFR22 replaces the oldest existing dynamic filter with a new filter at a new frequency.

Establishing the Auto Clear Function. To establish the Auto Clear function, proceed as follows:

The procedure for setting up the Auto Clear function using the front panel controls differs slightly from the procedure in the DFR22 Windows software.

1. Ring out the sound system to set any feedback filters that you want to be a permanent part of the system equalization.
2. Press the Auto Clear button on the DFR22 front panel. The Auto Clear button will blink. Auto Clear will automatically re-designate any engaged filters as fixed and the rest as dynamic. For example, if you have five filters set, Auto Clear will designate those as fixed and will designate the remaining 11 filters as dynamic.
3. The preset indicator will display a flashing [-h]. If you want Auto Clear to work automatically after a certain number of hours, you must use the Preset Select buttons to set the number of hours (1 to 99). Each filter has its own timer, starting from the time it is set or changed. If you leave the preset indicator at [-h], Auto Clear will only work on a preset change or power cycle.
4. Press either the LOAD button or the AUTO CLEAR button again. The AUTO CLEAR LED will glow steadily.
5. When a preset is changed, or if power is turned off and on, the DFR filters will return to the state they were in when Auto Clear was engaged. If a number of hours was specified, each dynamic filter and change to the depth of each fixed filter will be removed that many hours after it is set.

Disengaging the Auto Clear Function. To disengage the Auto Clear function, press the AUTO CLEAR button again. The Auto Clear LED will go out, and the number of fixed filters and dynamic filters will reset to eight of each type.

Holding the clear button down while Auto Clear is engaged will only clear the dynamic filters.

Press to Lock/Hold to Clear

Pressing these buttons locks the filters at their current values. If Auto Clear is not engaged, holding them down for three seconds resets all filters. If Auto Clear is engaged, holding them down only resets dynamic filters. When the PRESS TO LOCK/HOLD TO CLEAR LEDs are illuminated, the Lock function is engaged and no filters can be added or changed. Also, the Auto Clear timer is suspended.

Bypass DFR Filters

Pressing the DFR BYPASS button suspends the feedback reducer operation and bypasses existing feedback filters. It does NOT affect any other processors. When the DFR BYPASS LED illuminates, the feedback reducer is disengaged.

Changing Presets

The Preset Indicator on the front panel displays the number of the active preset. You can scroll through all presets stored in the device by pressing the arrow keys on the preset selector. When you select a preset number, the display blinks. If you press the LOAD button within five seconds, the device will make the selected preset the new Live preset. If you do not press the LOAD button, the preset will not change and the display will return to the original Live preset.

The preset indicator and controls are also used for setting the number of hours after which each dynamic filter is removed when engaging Auto Clear.

Front Panel Lockout

When this DIP switch is in the "Unlock" position, all front panel controls are enabled. When it is in the "Lock" position, all front panel controls are disabled. However, all front panel indicators still function and show the state of each parameter.

You can override this DIP switch using the DFR22 software and individually enable or disable each button on the front panel of the DFR22. Access to the DFR22 via a computer can only be disable by setting the appropriate security level through the DFR22 software.

DFR22 Theory

Feedback Reduction

No sound system (microphones + mixing/signal processing + power amplifiers/loudspeakers + room acoustics) has an absolutely flat frequency response. When the level of a sound system is increased, the frequencies at which peaks occur will be the first to exceed the feedback threshold. The DFR22 attenuates these frequencies, flattening the response of the sound system. The system can then operate at a higher overall level.

The DFR22 includes Shure's patented Adaptive Notch Filter algorithm that can discriminate between feedback and non-feedback sounds. When this algorithm detects feedback, it inserts a shallow, narrow filter into the audio path, reducing gain at the frequency that is feeding back. (See Figure 3.) This filter is called a notch filter, since it affects a narrow section of the audio spectrum. If the feedback does not stop, the filter depth is increased. By default, filters in the DFR22 are deployed as HIGH Q filters. As a High Q filter gets deeper, its Q increases up to a Q of 101 (1/70th of an octave). Using the DFR22 software, you can also set filters to deploy as LOW Q. Low Q filters affect a slightly wider range of frequencies by maintaining a Q of 14.42 (1/10th of an octave) as they deepen. By default, the DFR22 can insert up to 16 notch filters per channel to reduce feedback.

The DFR22's feedback reduction algorithm can be used as a tool during system setup and for peace of mind against unexpected feedback. When setting up a sound system with the DFR22, you can ring out the system by slowly raising the gain while talking into the microphones until the first frequency begins to feed back. The DFR22 will automatically insert a notch filter to attenuate that frequency. Once the system stops feeding back, you can further raise the level and repeat the process for additional frequencies. Typically, you can raise the gain 3-9 dB above the level at which feedback first occurred. You should leave some filters available to catch feedback that might occur later, when the sound system is in use.

Measured Frequency Response with Peak   Measured Frequency Response with Notch F

Figure 3: Effects of Notch Filter on Frequency Response

DFR22 Limitations

The DFR22 (or any other feedback reduction processor) will not let you to increase gain beyond the physical limits of the sound system. In most cases, the point of diminishing returns is reached once 5 to 8 notch filters have been set. This is because there are usually only a few dominant peaks in a system's frequency response (Figure 4A). In most cases, you can expect a 6 to 9 dB improvement in gain-before-feedback. When you are ringing out a system and notice that many frequencies feed back simultaneously, even when you increase the gain slowly, you have reached the point of diminishing returns. If the system still has insufficient gain before feedback at this point, other changes must be made to the sound system, such as changing the placement of the microphones and/or loudspeakers.
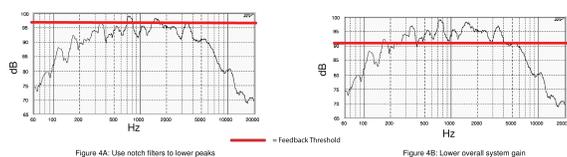

Figure 4A: Use notch filters to lower peaks   ——— = Feedback Threshold   Figure 4B: Lower overall system gain

Figure 4: Frequency Response of an Unequalized Sound System

Rack Mounting The DFR22

Mount the DFR22 in any standard 19-inch audio equipment rack, using the supplied screws. Refer to Figure 5.

Avoid mounting wireless equipment and power amplifiers directly above or below the DFR22. Additional rack mount supports may be necessary for mobile installations.
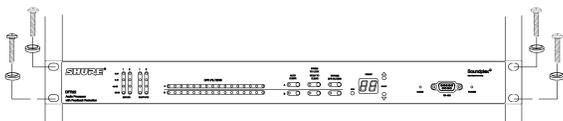

Figure 5: Rack Mounting the DFR22

Power and Initialization

Power Mains Connections

Use the supplied power cable to connect the DFR22 Audio Processor to an active 100-240 Vac power souvce, as shown in Figure 6. The Power LED on the front panel will glow green when power is applied.
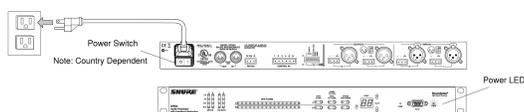

Figure 6: DFR22 Power Connection

Initialization

Once power is applied, the DFR22 Audio Processor takes approximately 5 seconds to initialize. When initialization is complete, the Input/Output LEDs will flash, as shown in Figure 7. The DFR22 is ready to use once the LEDs stop flashing.
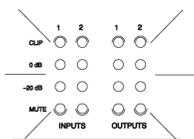

Figure 7: DFR22 Initialization

Audio Connections

Audio will pass from the inputs to the outputs, even if it has not yet been configured through the computer interface.

DO NOT connect equipment to both the Phoenix and XLR connectors of the same input or output at the same time. Doing so could damage the equipment.
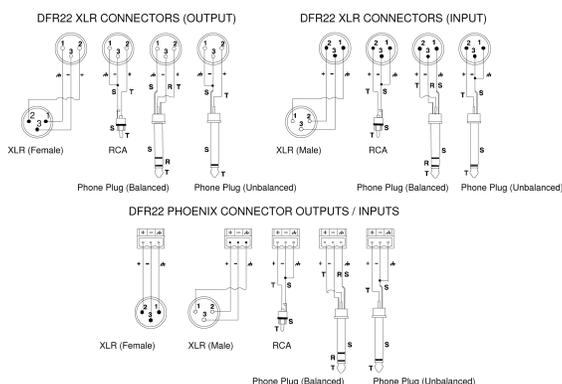
Wiring Connectors

Figure 8: INPUT/OUTPUT CONNECTOR WIRING DIAGRAMS

12 dB and 18 dB Output Pads

Each DFR22 output has a 12 dB pad and an 18 dB pad that can be engaged through the software interface. Use these pads when connecting the DFR22 to lower-level inputs. They cannot be used to prevent clipping at the output stage of the DFR22.

The Output meters indicate the signal level present at the digital-to-analog converters. The 12 and 18 dB pads act upon the signal after the digital-to-analog converters, so the meters do not reflect the pads.

Computer Connections

RS-232 Connections

Connect the COM port on your computer to the 9-pin RS-232 connector on the front panel of the DFR22, shown in Figure 9, using a male-to-female serial cable. Pin outs for a 9-pin RS-232 cable are shown in Figure 10 and listed in Table 1.

One the TX, RX, and GND pins need to be connected in order to communicate with the DFR22.

You can also connect a computer or control system to the 3-PIN RS-232 Phoenix connector on the back panel of the DFR22, as shown in Figure 11.

You CANNOT connect two PCs to the DFR22 at the same time. However, you CAN connect an AMX or Crestron system and a PC to the DFR22 at the same time.
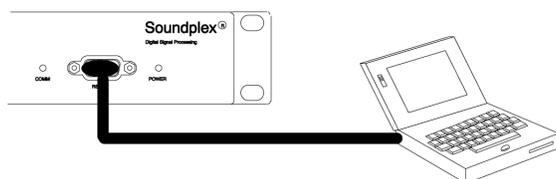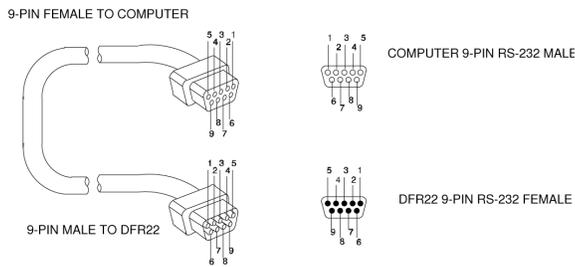

Figure 9: RS-232 Serial Port Connection
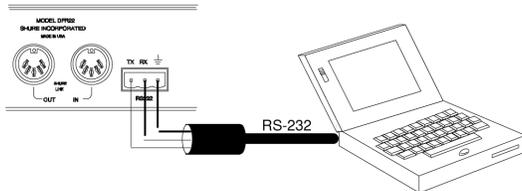
Figure 10: RS-232 Cable Pinouts

Figure 11: Phoenix RS-232 Serial Port Connection

DFR22	COMPUTER	PIN NO.
--	--	1
TX	RX	2
RX	TX	3
--	DTR	4
GND	GND	5
--	DSR	6
--	RTS	7
--	CTS	8
--	--	9

Shure Link Network

Up to 16 Shure Link devices, including the DFR22, DFR11EQ, DP11EQ, P4800, and UA888, can be linked and controlled from one computer. Using 5-pin DIN cables, connect the **Shure Link IN** and **Shure Link OUT** of each device, as shown in Figure 12.

The last device in the chain MUST be connected to the first device (the one connected directly to the computer) to form a loop.
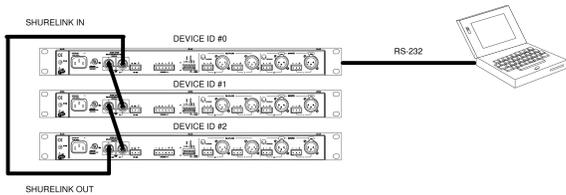
Figure 12: Shurelink Network Connections

DIP Switch Settings for Networked Devices

Assign each Shure Link device a unique Device ID Number, using DIP Switches 1-4, as shown in Figure 13. Refer to Table 2 for Device ID settings.

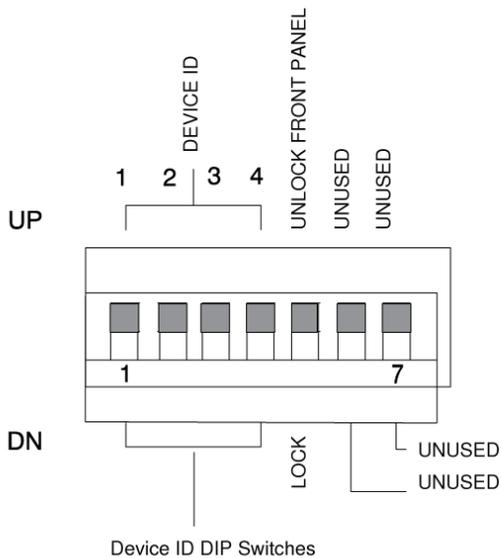**Each Shure Link device MUST have a unique Device ID number.**

Figure 13: DIP Switch Settings for Networked Devices

Device ID Settings

	DIP Switch			
Device ID	1	2	3	4
0	DN	DN	DN	DN
1	UP	DN	DN	DN
2	DN	UP	DN	DN
3	UP	UP	DN	DN
4	DN	DN	UP	DN

Device ID	DIP Switch			
5	UP	DN	UP	DN
6	DN	UP	UP	DN
7	UP	UP	UP	DN

Device ID Settings

	DIP Switch			
Device ID	1	2	3	4
8	DN	DN	DN	UP
9	UP	DN	DN	UP
10	DN	UP	DN	UP
11	UP	UP	DN	UP
12	DN	DN	UP	UP
13	UP	DN	UP	UP
14	DN	UP	UP	UP
15*	UP	UP	UP	UP

*Default setting.

Control Pin Connections

The control pins on the back of the DFR22 connect to switches, potentiometers, and controller hardware. The Control Input pins can be used to change presets, adjust gain, and mute channels.

Use the DFR22 software to configure the control pins so that they match the attached control hardware. You can also use the software to assign minimum and maximum gain values for each control, as well as the gain increment for up/down volume control buttons. Refer to the *Control Pin* section of the Online Help or to the Online User Guide.

Determining Control Pin Allocations

When allocating control pins, you should first determine which pins are to be used for *preset control.* Any remaining pins can then be used to adjust gain or to mute channels. The number of pins needed for preset control depends on the type of control hardware used, as well as the number of presets.

The following methods can be used to allocate control pins:

- **One-to-One:** Use one pin for each preset. starting at Pin 1, and proceeding toward the right. You MUST use consecutive pins, Connect momentary or latching switches.
- **Shure DRS10 Switch:** Use Pin 1 for up to 10 presets.
- **Custom Switch:** Use Pin 1 for up to 10 presets.
- **Binary:** Use the pin numbers listed in Table 3. Connect latching switches.

Table 3. BINARY CONTROL PIN ALLOCATION

Number of Presets	Pin Numbers
2	1
4	1 and 2
8	1-3
16	1-4

Preset Control Connections

Various types of control hardware can be connected to the Control Input pins, as shown in Figure 14. When properly configured, the DFR22 changes to the appropriate preset in response to the switch. Resistor values for custom switches and the Shure DRS10 are listed in Table 4.
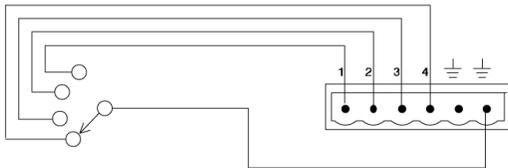
The total resistance of the cable run, from the switch to the DFR22, should be less than 100 Ω. Two-conductor, unshielded cable, such as a Belden 8442, is recommended.

Table 4. CUSTOM SWITCH RESISTOR VALUES

Preset	Resistor Value
1	97 kΩ - ∞ Ω
2	44-60 kΩ
3	26-32 kΩ
4	17-20 kΩ
5	11.3-13.6 kΩ
6	7.8-9.3 kΩ
7	5.2-6.3 kΩ
8	3.3-4.1 kΩ
9	1.9-2.5 kΩ

Preset	Resistor Value
10	0.63-1.1 kΩ

One-to-one Configuration (Each pin represents one preset)

Binary Configuration

Shure DRS10 or Custom Switch Configuration*

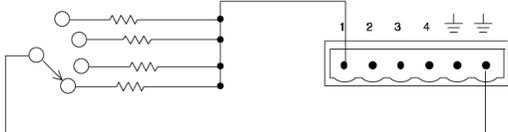Figure 14: WIRING CONTROL INPUT PINS FOR PRESET CONTROL

Mute Control Connections

For mute control, use either a latching switch or a monetary switch. The total resistance of the cable run from the switch to the DFR22 should be less than 100 Ω.

Figure 15 shows an example of how to connect either a latching switch or a monetary switch to the Control Input pins to mute an input or an output.

Switch (momentary or latching)

Ground

Figure 15: MUTE CONTROL PIN CONNECTIONS

Gain Control Connections

For gain control, use either a potentiometer or two momentary switches (one for gain up and one for gain down). If you want to have multiple sets of gain controls acting on the same inputs or outputs, use momentary switches connected in parallel. Figure 16 shows a typical connection between a potentiometer and the Control Input pins. Figure 17 shows a typical connection between two momentary switches and the Control Input pins.

When using a potentiometer, the total resistance of the cable run should be less than 100 Ω.

When using momentary switches, the total resistance of the cable run should be less than 100 Ω.

As supplied, the DFR22 control pins are configured for use with a 10 kΩ audio taper potentiometer. However, you can use the Potentiometer Calibration Wizard in the DFR22 software to configure the DFR22 for use with any 10 kΩ, 20 kΩ, 50 kΩ, or 100 kΩ linear or audio taper potentiometer.
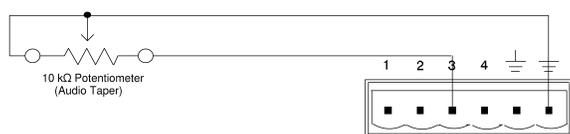

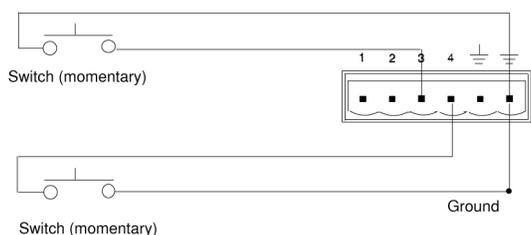Figure 16: GAIN CONTROL PIN CONNECTIONS USING A POTENTIOMETER

Figure 17: GAIN CONTROL PIN CONNECTIONS USING SWITCHES

AMX/Crestron Control Connections

You can connect an AMX or Crestron controller to the back panel RS-232 port, using a Phoenix connector, or to the front panel RS-232 port, using a DB-9 connector. In either case, you only need to connect three wires: send, receive, and ground. See page 8 for the pinout of the RS-232 ports.

To access AMX/Crestron control codes for the DFR22, visit the DFR22 web page at **http://shure.custhelp.com/app/answers/detail/a_id/2951**

Accessories

Furnished Accessories

Line (Power) Cord (SCM800)	95B8389

Line (Power) Cord (SCM810E)	95C8247
5-pin DIN Shure Link Cable	95B8676
Hardware Kit (12 Block Connector Terminals, 3-pin (for audio inputs and outputs) 2 Block Connector Terminals, 10-pin (for control inputs and outputs) 4 Rackmount Screws and Washers)	90AY8100

Optional Accessories

DRS10 Wallplate unit with 10-position rotary switch for preset control