

# Instruction Manual

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## **8920DAC**

AES/EBU TO ANALOG AUDIO CONVERTER

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# *Preface*

## **About This Manual**

This manual describes the features of a specific module of the 8900 Series Modular Products family. As part of this module family, it is subject to Safety and Regulatory Compliance described in the 8900 Series frame and power supply documentation (see the *8900TX/8900TF/8900TFN Frames Instruction Manual*).



# *8920DAC AES/EBU to Analog Audio Converter*

## **Introduction**

The 8920DAC converts digital audio to analog audio and provides true 20-bit performance. Its various modes can modify the outgoing signal to provide channel swapping, channel summing, tones, and phase inversion. When used in an 8900 frame supporting network control, the 8920DAC supports remote mode selection. The module uses 24-bit delta-sigma digital-to-analog converters (DACs) with 128 times over-sampling and noise shaping which offer superior performance with lower idle tones, and excellent sonic performance and resolution.

8920DAC features include:

- Support for 32 kHz, 44.1 kHz, and 48 kHz sampling rates
- Jumper selectable 20-bit or 24-bit DAC mode
- One 75  $\Omega$  loop-through AES-3id/EBU input
- One pair of balanced analog outputs available on terminal block outputs using BNC adapter board
- Input sampling frequency, emphasis, and error LED indicators
- Output range selection from +14 dBu to +24 dBu with jumper selectable maximum level
- Channel level control using an on-board, multi-turn trim potentiometer
- Auto detection of emphasis and engagement of de-emphasis to flatten frequency response
- Module is part of the 8900 family of audio and video modules
- Supports remote control in 8900 networking frames
- Offers remote control lockout using an on-board jumper

## Installation

Installation of the 8920DAC module is a process of:

- Placing the module in the desired frame slot,
- Cabling and terminating signal ports, and
- Configuring the module.

The 8920DAC module can be plugged in and removed from an 8900 Series frame with power on. When power is applied to the module, LED indicators reflect the initialization process (see *Power Up on page 5*).

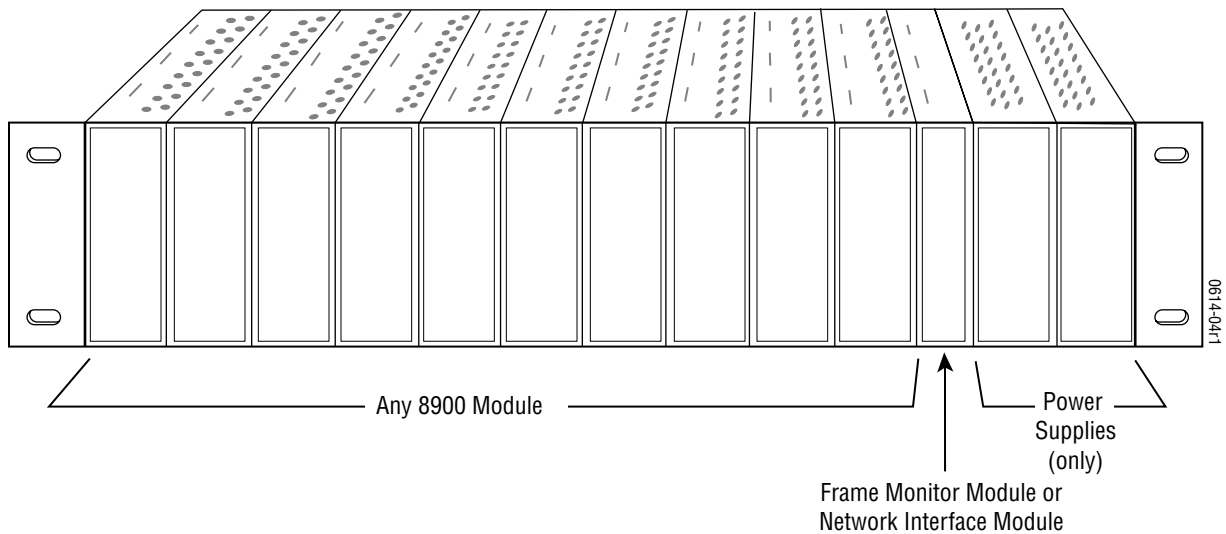
### Module Placement in the 8900 Frame

There are ten cell locations in the frame to accommodate either analog or digital modules. These are the left ten locations. Refer to [Figure 1](#).

The two cells on the right are allocated for the power supplies. For additional information concerning the Power Supply module, refer to the 8900 Power Supply manual.

The third cell from the right is allocated for the Frame Monitor or Network Interface controller modules. These modules provide health monitoring and control options.

Figure 1. 8900 Series Frame





8900 modules are interchangeable within the module cells. There are 10 BNC connectors in each cell's I/O group. The functional assignment of each connector in a group is determined by the module that is placed in that cell. The maximum number of modules an 8900 frame can accept is ten. [Figure 2](#) illustrates the rear connector plate for an 8900 Series frame.

## Frame Capacity

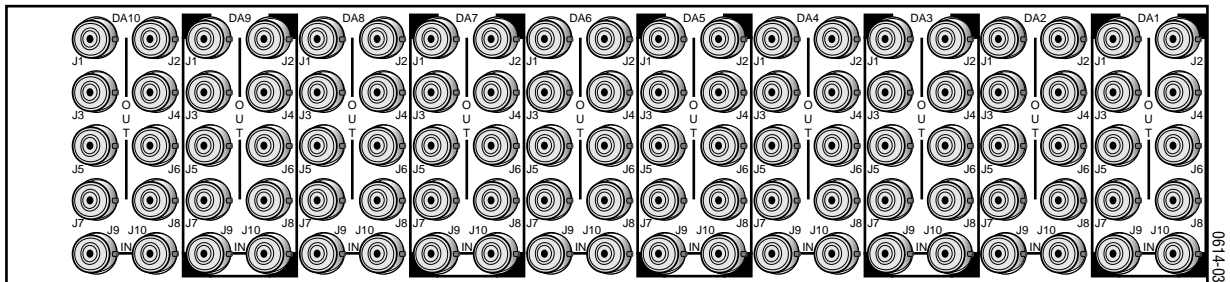
The maximum number of 8900 modules allowed in a frame is determined by frame cooling capacity. [Table 1](#) provides the power capacity, cooling capacity, and maximum module count for the 8920DAC in each frame type.

Table 1. Power, Cooling, and Module Capacity of 8900 Frames

Capacity Calculated	8900T2 Frame	8900T2-F Frame	8900TX Frame	8900TF Frame	8900TFN Frame
Power (W)	60	60	100	100	100
Recommended Module Cooling (W)	30	60	30	90	90
8920DAC Modules	10	10	10	10	10

**Note** Module capacity figures assume no other modules are in the frame. If the maximum number of modules a frame can handle is less than ten, provide as much space between the modules as possible.

Figure 2. 8900 Series Frame Rear Connectors



8900 modules can be inserted and removed while the frame is powered. To install a module in the frame:

1. Insert the module, connector end first, with the component side of the module facing to the right and the ejector tab to the top.
2. Verify that the module connector seats properly against the backplane.
3. Press the ejector tab in to seat the module in place.

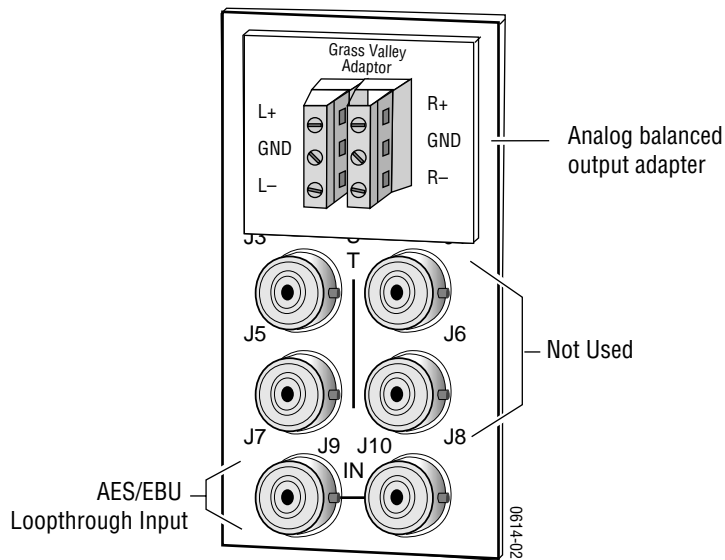
## Cabling

**Note** At the back of this manual are overlay cards that can be placed over the rear connector BNCs to identify the specific 8920DAC connector functions.

### Loop-through Input

Connect an input signal to one of the loop-through input connectors, J9 or J10 (see [Figure 3](#)). The 8920DAC input will accept AES-3id/EBU audio. Terminate the unused connector into 75  $\Omega$  if the signal is not looped to other equipment.

Figure 3. 8920DAC Input/Output Connectors



### Outputs

The 8920DAC provides one stereo analog, differential pair output through the plug-in adapter connected to BNCs J1- J4.

# Power Up

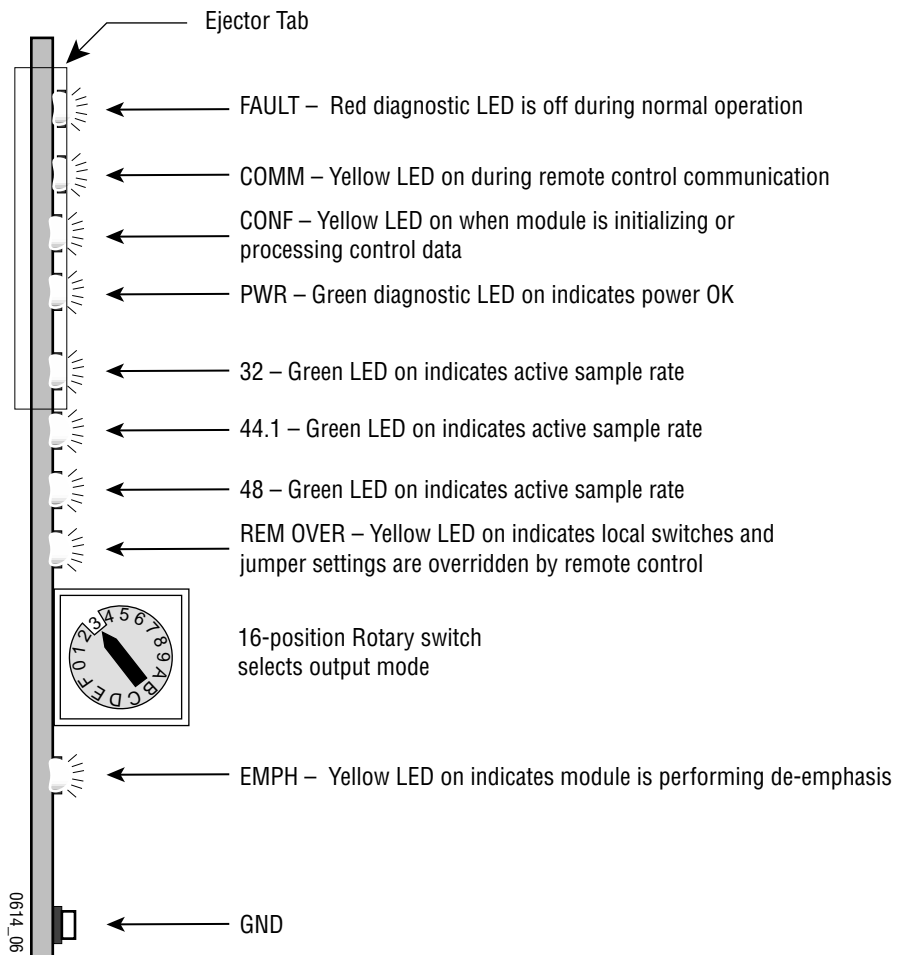
The front LED indicators and configuration switches are illustrated in [Figure 4](#). Upon power-up, the green PWR LED should light and the yellow CONF LED should illuminate for the duration of module initialization.

## Operation Indicator LEDs

With factory default configuration and a valid input signal connected, the green PWR LED should be on and the yellow REM OVER LED should be off. (Refer to [Table 2 on page 6](#) and [Table 3 on page 7](#) to see a complete list of possible operating conditions and the resulting indicator status.)

Audio input presence is indicated by the 32, 44.1, or 48 LED which indicates the corresponding input signal sample rate has been detected. The REM OVER LED indicates that the Function Switch is being overridden by remote control.

Figure 4. LEDs and Configuration Switches



A red FAULT LED indicates an error situation and, when noted with the other indicator LEDs, can indicate a specific problem area. Table 2 describes signal output and LED indications for the various input/reference combinations and user settings.

Table 2. Indicator LEDs and Conditions Indicated

LED	Indication	Condition
<b>Fault (red)</b>	Off	Normal operation
	On continuously	Module has detected internal fault
	Long flash	Configuration problem: FPGA not responding to CPU, Input not present, AES/EBU out of lock
	Short flash	Other AES/EBU error
<b>COMM (yellow)</b>	Off	No activity on frame communication bus
	Long flash	Location Command received by the module from a remote control system
	Short flash	Activity present on the frame communication bus
<b>CONF (yellow)</b>	Off	Module is in normal operating mode
	On continuously	Module is initializing, changing operating modes or updating firmware
<b>PWR (green)</b>	Off	No power to module or module's DC/DC converter failed
	On continuously	Normal operation, module is powered
<b>32 (green)</b>	Off	Sample rate is not near 32 kHz
	On Continuously	Sample rate is 32 kHz $\pm$ 400 ppm
	Flashing	Sample rate is 32 kHz $\pm$ 4%
<b>44.1 (green)</b>	Off	Sample rate is not near 44.1 kHz
	On Continuously	Sample rate is 44.1 kHz $\pm$ 400 ppm
	Flashing	Sample rate is 44.1 kHz $\pm$ 4%
<b>48 (green)</b>	Off	Sample rate is not near 48 kHz
	On Continuously	Sample rate is 48 kHz $\pm$ 400 ppm
	Flashing	Sample rate is 48 kHz $\pm$ 4%
<b>REM OVR (yellow)</b>	Off	Module configuration is by the module's on-board switches and jumpers
	On continuously	Module configuration is by remote control and on-board switch settings are overridden
<b>EMPH (yellow)</b>	Off	Module is not performing de-emphasis
	On continuously	Module is performing de-emphasis

Table 3 provides the possible input and output conditions that result from different inputs and settings.

Table 3. Possible Operating Conditions

<b>Audio Input Condition</b>	<b>Output Condition</b>
Any AES-3id with sample rate between 32 kHz to 48 kHz	Audio will be converted at any sample rate between the minimum and maximum rates. Sample rate LEDs will only light if rate is within 4% of any standard.
Any AES-3id with sample rate between 32 kHz to 48 kHz with Function Switch is set to E (1 kHz Tone)	1 kHz tone with frequency of tone accurate only at 32 kHz, 44.1 kHz or 48 kHz sample rates.
No AES-3id input	No sample rate LEDs will be lit, output will be muted, Fault LED flashing, signal to noise level should be greater than or equal to maximum signal to noise level.
No AES-3id input with Function Switch is set to E (1 kHz Tone)	No tone at output and output will be muted.

## Configuration

The following parameters must be set on the 8920DAC module:

- Control mode – Local/Remote or Local control only (remote lockout),
- Output gain – coarse and fine adjustment,
- 20-bit or 24-bit DAC mode, and
- Output mode – channel swapping, summing, and phase inversion.

The Control Mode, Output Gain and DAC modes must be configured locally using onboard jumpers and switches. Output mode can be set locally with the front rotary switch or can be configured remotely with the network interface.

### Local Onboard Module Configuration

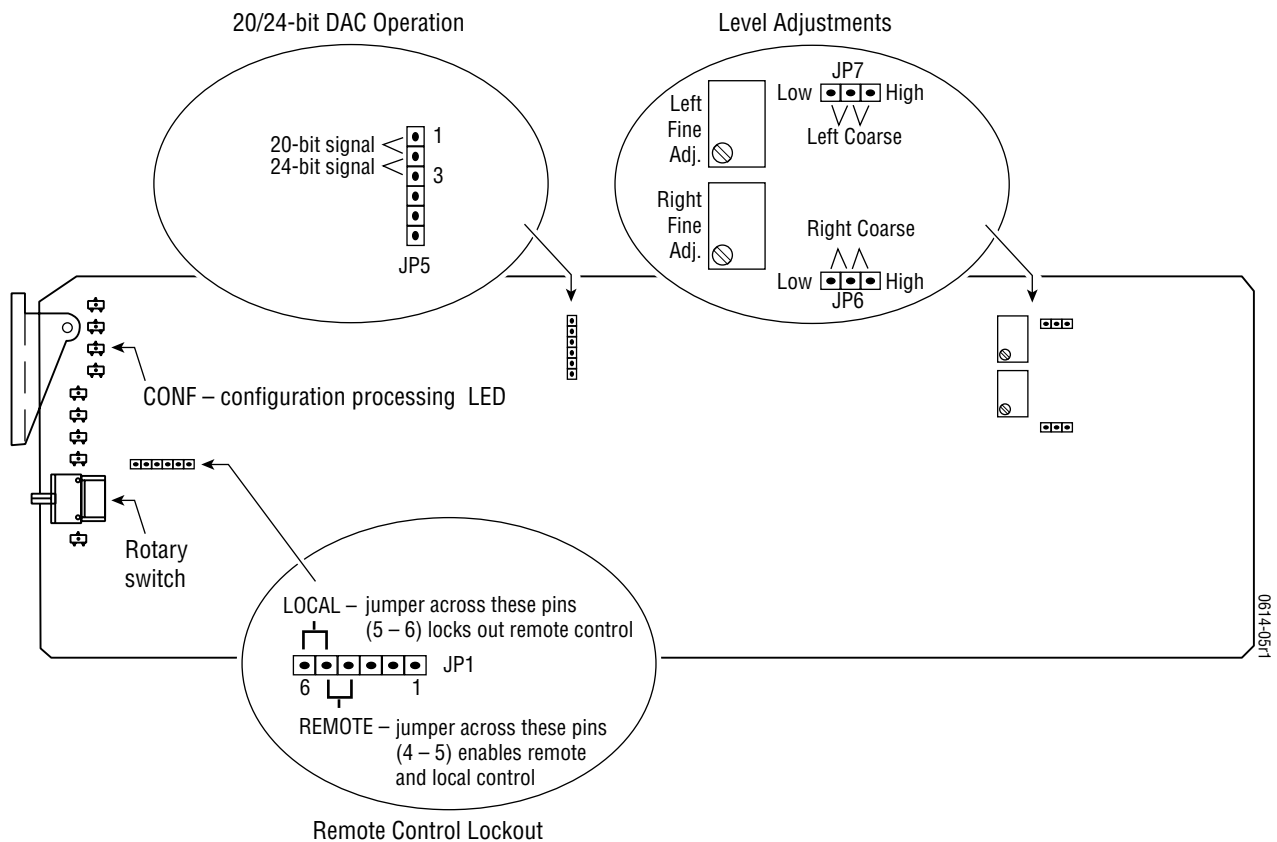
The 8920DAC module must be configured locally to set certain parameters using the on-board components shown in [Figure 5 on page 9](#). The CONF LED indicates status of the configuration process.

These components perform the following:

- Jumper JP1 – sets control mode for Local only or Remote and Local.
- Jumpers JP5 – sets the D-to-A conversion mode to 20- or 24-bits.
- Jumper JP6 and JP7 – set coarse output gain level adjustment for left and right channels.
- Left and Right Fine Adjust Potentiometers – provide fine adjustment of the left and right channel output gain levels.
- Function (rotary) switch – selects a desired output configuration (0 through 9, A through F), although not all positions are used.
- CONF (configuring) LED – when on, indicates the module is initializing or processing configuration information. Whenever the Function Switch is changed, the CONF LED will flash to indicate configuration is being performed.

**Note** Function switch positions 0 and F (Factory defaults) can be used to return the module configuration to the original factory settings.

Figure 5. 8920DAC Module Settings and Adjustments



## Configuring Output Mode

The 8920DAC provides thirteen possible output configurations as shown in Table 4. The module can be configured using the rotary switch shown in Figure 5 or by remote control (see *Input Status/Output Mode on page 13*). To make a configuration setting simply rotate the switch to the desired output configuration. The 16-position rotary switch selects one of 13 possible output modes. Positions B and C are not used and positions 0 and F select the same mode (Factory default).

Table 4. 8920DAC Output Mode Configuration

Switch Position	Mode Description
0	Factory default – No phase inversion, channel swapping or summing
1	Channel swap – Left and Right
2	Both channels phase inverted
3	Left channel phase inverted
4	Right channel phase inverted
5	Right channel to both channel outputs
6	Left channel to both channel outputs

Table 4. 8920DAC Output Mode Configuration

Switch Position	Mode Description
7	Left + Right to both channel outputs (-6dB mono sum)
8	Left - Right to both channel outputs
9	Left + Right to Left channel output and Left- Right to Right channel output
A	Left + Right to both channel outputs and both channels phase inverted
B	Not Used (Digital Silence)
C	Not Used (Digital Silence)
D	Tone 1 to all channels (Digital Silence)
E	Tone 2 to all channels (1 kHz, -20 dBFS)
F	Factory default – No phase inversion, channel swapping or summing

## Level Adjustment

The gain stage of each output channel (right and left) has two means of adjustment—fine and coarse (refer to [Figure 5 on page 9](#)).

The Coarse jumpers (JP6 and JP7) select the range of adjustment either:

- High range—19 to 24 dBu, or
- Low range—14 to 20 dBu.

Fine control within those ranges is set using the multi-turn potentiometers (Left and Right Fine Adj.) providing  $\pm 3$  dBu gain adjustment (do not exceed 24 dBu). This combination gives a maximum range of full-signal settings from +14 dBu to +24 dBu.

## 20/24-bit DAC Operation

Jumper block JP5, pins 1 to 3, determine whether the DAC is in 24-bit or 20-bit mode (see [Figure 5 on page 9](#)). With the jumper across pins 1 and 2, the DAC is in 20-bit mode and will mask the lower four bits of information. With the jumper across pins 2 and 3, the DAC is in full 24-bit mode.

## Remote Control Lockout

When a jumper is placed across pins 5 and 6 of jumper block JP1, module output mode settings are adjustable from the on-board switches only. To have both Local and Remote access, set the jumper across pins 4 and 5 (see [Figure 5 on page 9](#)).



## Remote Configuration and Monitoring

8920DAC monitoring and some module configuration can be performed remotely using the 8900NET interface in 8900TF or TFN frames (see [Figure 6](#)). This section describes the GUI access to the module configuration functions. Refer to the 8900NET Network Interface Module Instruction Manual for information on setting up and operating the 8900 frame network.

For remote access, make sure the jumper block on the module is set for both Local and Remote access ([Figure 5 on page 9](#)).

**Note** The physical appearance of the menu displays shown in this manual represent the use of a particular platform, browser and version of 8900NET module software. They are provided for reference only. Displays will differ depending on the type of platform and browser you are using and the version of the 8900NET software installed in your system.

Figure 6. 8900NET GUI

The screenshot shows the 8900NET GUI interface. At the top is a green header with the Grass Valley Group logo and the text "MODULAR PRODUCTS CONTROL AND MONITORING SIGNAL MANAGEMENT SYSTEM". Below the header is a navigation menu on the left and a main content area on the right.

**Navigation Menu (Left):**

- Frame
  - Status
  - Configuration
- 1 8960ENC
- 2 Media Slot 2
- 3 None
- 4 8960DEC
- 5 8960DEC
- 6 None
- 7 8960DEC
- 8 8960DEC
- 9 Media Slot 9
- 10 8916
- 11 8900NET
- 12 Power Supply 1
- 13 Power Supply 2

**Main Content Area (Right):**

**Frame Status**

8900TFN Module Frame  
 Frame Location : not assigned  
 SMPTE Alarm : **PASS**  
 Temperature State : **PASS**

**Slot Status Bar:**

Module	Empty	Module	Module	Module	Module	Module	Module	Empty	Module	Net Card	Power Supply	Power Supply
--------	-------	--------	--------	--------	--------	--------	--------	-------	--------	----------	--------------	--------------

Front Cover : **No Cover**

**Properties**

Vendor : **Grass Valley Group**  
 Number Of Slots : **10**  
 Frame Hardware Revision : **7**  
 Net Card Software Version : **1.0.1 NAB2000**

The links section lists the frame and its current modules. The selected link's Status page is first displayed and the sub-list of links for the selection is opened. The sub-list allows you to select a particular information page for the selected device.

Content display section displays information for the selected frame or module (frame slot icons are also active links).

The 8900 modules can be addressed by clicking on a specific module icon in the frame status display or on a module name or slot number in the link list on the left.

The 8920DAC will indicate a SMPTE Alarm fault on the Frame Status display for the following alarms:

- Unlocked or missing audio input, or
- Board Failure.

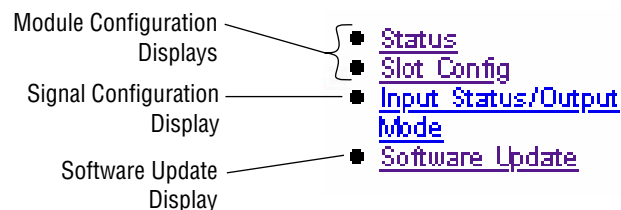
## Module Configuration Displays

The 8900 GUI provides the following links and displays for the 8920DAC module (Figure 7):

- Module Configuration displays showing status and slot configuration information (location and user assigned names),
- Signal Configuration displays, and
- Software Update display.

The Module Configuration displays are the same for all remote controllable 8900 modules. Refer to the 8900NET manual for more information on these displays. Some functions listed may not be supported by a particular module. These will be indicated as not supported.

Figure 7. 8920DAC Display Links



## Software Update Displays

The Software Update display allows you to download new software versions for the module. Refer to the 8900NET manual and the Grass Valley Group website at <http://www.grassvalleygroup.com> for complete details and new software versions.

## Signal Configuration Displays

This section discusses the Signal Configuration Displays available remotely to set and monitor the 8920DAC module parameters. All other module parameters not set remotely must be set locally using the on-board jumpers and switches (see *Local Onboard Module Configuration on page 8*).

- Use  
This  
Link
- [Status](#)
  - [Slot Config](#)
  - [Input Status/Output Mode](#)
  - [Software Update](#)

## Input Status/Output Mode

The Input Status/Output Mode menu display will report the following items under Input Status ([Figure 8](#)):

- Module name – as defined in the main Status menu.
- Frame location – indicates the frame name and slot number.
- 20/24-Bit operation – indicates whether the module is set for 20- or 24-bit operation at jumper J5 on the circuit board. (Refer to *20/24-bit DAC Operation on page 10.*)
- Input Sample Rate – indicates the current sample rate being detected by the module as one of the following: Out of Range, 32K, 32K 4%, 44.1K, 44.1K 4%, 44.056K, 48K or 48K 4%.
- Input Error – indicates any input error conditions present as either Validity, CRC, Parity, Bi-phase, No Lock or No Error.
- De-emphasis Left and Right – indicates whether de-emphasis is being applied to the left and right audio channels.
- Left and Right Ch Data – indicates type of incoming data (audio or non-audio) to the left and right channels.

Under Output Mode, set the desired output for the module from the thirteen selections listed below and shown in the menu display in [Figure 8](#). After making the selection, hit the Apply button to activate it.

- Default – factory default with no phase inversion, channel swapping or summing.
- L/R Swap – swaps left and right channel outputs.
- L/R Invert – both left and right channel outputs phase inverted.
- L Invert – left channel output phase inverted.
- R Invert – right channel output phase inverted.
- R Mono (R to L/R) – right channel to both channel outputs.
- L Mono (L to L/R) – left channel to both channel outputs.
- L plus R to L/R – left plus right to both channel outputs.
- L minus R to L/R – left minus right to both channel outputs.
- L plus R, L minus R – left plus right to left channel output and left minus right to right channel output.
- (L plus R) Inv to L/R – left plus right to both channel outputs with both channel outputs phase inverted.
- Silence – digital silence on both channel outputs.
- 1K@ -20dBFS – tone to both channel outputs.

Figure 8. Input Status/Output Mode Menu Display

**8920dac Input Status/Output Mode**  
 8920DAC Audio D-to-A Converter  
 Frame Location : lab2 , Slot : 3  
 Input Status :  
 20/24 bit operation : 20 bit mode  
 Input Sample Rate : 48K  
 Input Error : No Error  
 De-emphasis Left : On De-emphasis Right : On  
 Left Ch Data : Audio Right Ch Data : Audio  
 Output Mode :

Input sample rate values include:  
 Out of Range  
 32K  
 32K, 4%  
 44.1K  
 44.1K, 4%  
 44.056K  
 48K  
 48K, 4%

Types of input errors include:  
 Validity  
 CRC  
 Parity  
 Bi-phase  
 No Lock

Mode: Selection Current Setting  
 Default Default  
 Apply

- ✓ Default
- L/R Swap
- L/R Invert
- L Invert
- R Invert
- R Mono (R to L/R)
- L Mono (L to L/R)
- L plus R to L/R
- L minus R to L/R
- L plus R, L minus R
- (L plus R)Inv to L/R
- Silence
- 1K@ -20dBFS

# Specifications

Table 5. 8920DAC Specifications

Parameter	Value
<b>Digital Input</b>	
Signal type	AES-3 id-1992, transformer coupled, loop-through
Number of inputs	1 loop-through
Connector type	75 $\Omega$ BNC
Common mode range	+12/-7 V
Differential voltage range	200 mV to 12 V p-p
Sampling rates	32 kHz, 44.1 kHz, 48 kHz
Input return loss	>15 dB (100 kHz to 10 MHz)
Maximum jitter	<200 ps RMS
<b>Outputs</b>	
Number of outputs	1 stereo (two-channel)
Signal type	Balanced analog audio
Signal level for full-code input	+14 to +24 dBu max
Output impedance	50 $\Omega$ single-ended, 100 $\Omega$ differential
Connector type	Terminal block through BNC adapter board
Drive capability	+24 dBu into 10 k $\Omega$
<b>Performance (24 dBu into 10 k<math>\Omega</math> load)</b>	
Signal-to-noise ratio	>107 dB unweighted 22 kHz filter, >110 dB "A" weighted
THD+noise (20-22 kHz)	<0.004%, 22 kHz filter, +24 dBu/10 k $\Omega$ /7.5 nF
Interchannel crosstalk	<-100 dB, 20 Hz to 20 kHz
Intermodulation distortion	<0.006%, CCIF two-tone test, 19 kHz and 20 kHz tones
Frequency response	$\pm$ 0.1 dB, 20 Hz to 20 kHz
DC offset	$\leq$ 1 mV
De-emphasis	50/15 $\mu$ sec, automatic
Delay (input to output)	650 $\mu$ sec
<b>Environmental</b>	
Frame temperature range	0 to 45 degrees C
Operating humidity range	10 to 90% non-condensing
Non-operating temperature	-10 to 70 degrees C
<b>Mechanical</b>	
Frame type	8900 Series
<b>Power Requirements</b>	
Supply voltage	$\pm$ 12 V
Power consumption	< 3 Watts

## Service

The 8920DAC modules make extensive use of surface-mount technology and programmed parts to achieve compact size and adherence to demanding technical specifications. Circuit modules should not be serviced in the field unless directed by Customer Service to do so.

If your module is not operating correctly, proceed as follows:

- Check frame and module power and signal present LEDs.
- Check for presence and quality of input signals.
- Verify that source equipment is operating correctly.
- Check cable connections.

Refer to [Figure 4 on page 5](#) for the location of PWR LED and [Table 2 on page 6](#) for proper LED indications.

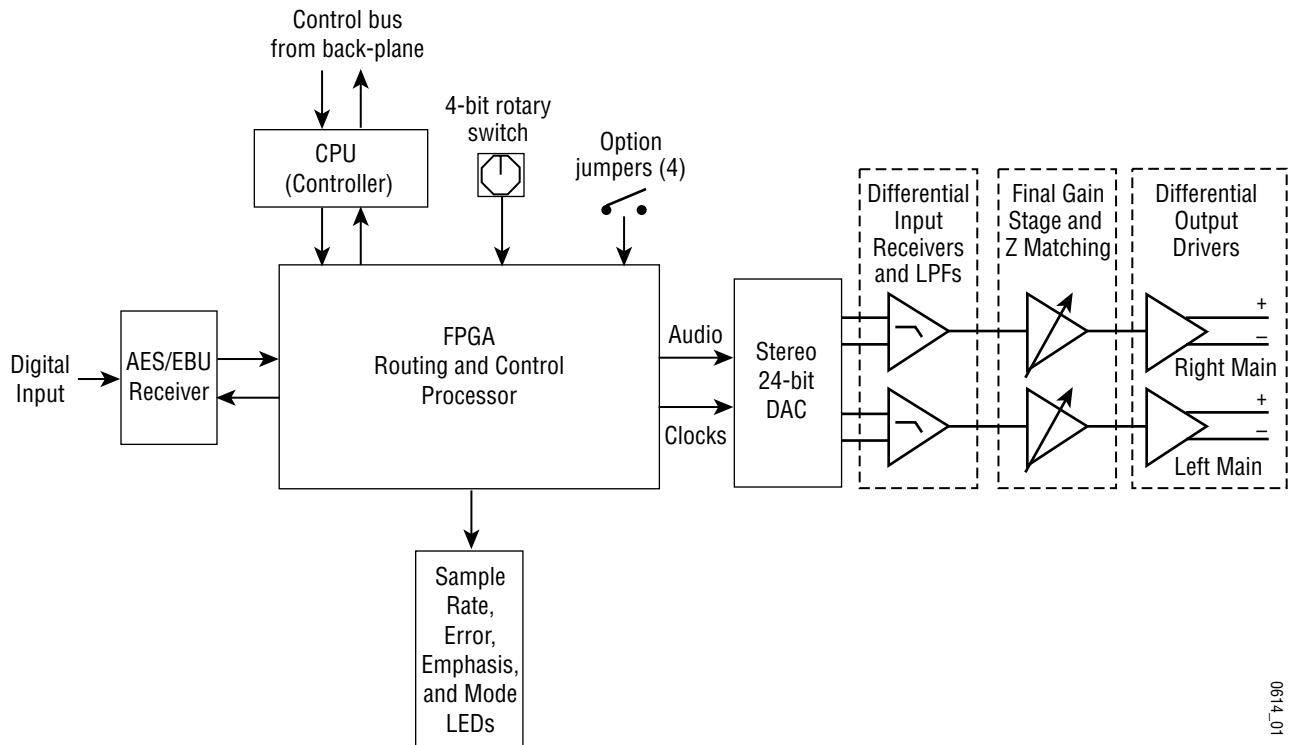
If the module is still not operating correctly, replace it with a known good spare and return the faulty module to a designated Grass Valley repair depot. Call your Grass Valley representative for depot location.

Refer to the [Contacting Grass Valley Group](#) at the front of this document for the Grass Valley Customer Support Information number.

# Functional Description

Refer to the block diagram in [Figure 9](#) while reading the following functional description.

Figure 9. 8920DAC Block Diagram



0614\_01

## Digital Input

AES/EBU audio data is fed into the 8920DAC through an isolation transformer to the receiver. The receiver extracts the audio signal (left/right), as well as clock (bit clock, L/R clock and master clock), sample rate, emphasis and error information. The signal, clock and other decoded information is then passed to a FPGA (field-programmable gate array) for further decoding and routing.

## Control and Routing FPGA

The FPGA receives its programming and control information from the CPU at power up. It also is able to receive mode commands from a four-bit rotary switch. The FPGA receives an digital audio serial stream from the receiver and sends its outputs to the output DAC. The FPGA also performs the following functions:

- Decodes and drives the front panel LEDs,
- Passes clock and audio information to the DAC for analog decoding,
- Enables the appropriate emphasis filter for both channels for the received sample rate on the DAC, and
- Enables a soft mute that ramps up/down in about 20 ms (depending on sample rate).

## CPU (Controller)

The primary purpose of the CPU is to provide remote monitoring capability for the 8920DAC. It receives information about:

- Sample rate,
- Emphasis,
- Error,
- Mode selection, and
- Digital signal present

This information is passed through the frame controller to a remote monitoring location. A removable jumper is provided to allow disabling of remote control.

## Digital/Analog Converter (DAC), Filter, Gain, and Output Stages

The DAC consists of a single, stereo, 24-bit, 128x over-sampling DAC. The outputs of the DACs are differential. They are received by a differential receiver, which also serves as a Low Pass Filter. The signal then passes through to the gain stage.

The output drivers provide precision signal balance and output common mode rejection.



## Regulator

The 8920DAC's power is fed from  $\pm 12\text{V}$  rails of the frame's power supply. Power comes into the module, is fused, and then split into analog and digital paths.

Each stage of the DAC receives its own separate, highly regulated and filtered power source. The following power feeds are produced:

- Digital +5V for micro-controller,
- Digital +3.3V for FPGA, DAC and other digital sections,
- PLL +5V for AES receiver,
- DAC analog +5V
- Analog  $\pm 10\text{V}$  for filter and differential receiver stage, and
- Analog  $\pm 12\text{V}$  for final gain and driver stage.



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