

FR-DAC Flexrack Digital to Analogue Converter Module

V1.00 © ProAVM 2006

1. Introduction

The FR-DAC module converts AES/EBU digital audio to stereo balanced analogue signals at 24-bit resolution and input sample rates of up to 96kHz. The analogue output levels resulting from full scale digital data (0dBFS) may be set anywhere between 0 and +24dBu, with extremely low noise and distortion at all levels.

A fully buffered AES through output replicates the digital input signal, allowing "daisy-chaining" of units without impedance mismatch or signal

degradation. Front panel LEDs indicate the sample rate of the incoming data and an ERROR status output is provided for confidence monitoring of the input data stream.

Up to four function modules, which may be FR-DACs, or others, can be accommodated in 1U in the Flexrack FR-RK1 chassis.

2. Compliance

Please read all of this manual and familiarise yourself with the module and its connections before attempting to use it. To ensure satisfactory operation it is the responsibility of the user to install and operate this equipment correctly and in accordance with the manufacturer's specifications. ProAVM accept no responsibility for damage caused to the FR-DAC, or to user equipment, through incorrect installation or usage of the module.

Do not expose this module to rain or any other sources of water.

Unauthorised adjustment, modification or repair of this equipment may invalidate any warranty and/or safety approvals that apply. In case of query please contact your local distributor, or ProAVM.

3. Unpacking

Unless the FR-DAC module has been supplied as part of a pre-configured system, this package should contain (in addition to this manual):

- 1x FR-DAC module
- 4x module fixing screws (non-countersunk)
- 4x panel fixing screws (countersunk)
- 1 x power supply ribbon cable

If any items are missing or damaged please inform your supplier immediately.

4. General Theory of Operation

The AES/EBU digital audio format transmits two channels of sampled audio data, status/user information and a high-frequency clock signal in a combined data stream over a single balanced pair of wires. At the receiver, the embedded clock signal – which defines the sample rate of the audio data – is recovered and used to decode the audio and status information from the incoming data stream. The audio data can then be converted into the analogue domain.

Because of the high frequencies used, AES/EBU connections must be correctly terminated (with 110 ohms) to avoid degradation of, and hence inability to decode, the data stream. For this reason it is generally not possible to connect an AES/EBU source to more than one AES/EBU receiver simultaneously – multiple terminations substantially reduce the quality of the signal. To allow greater flexibility in installation, the FR-DAC takes the incoming data stream prior to decoding and retransmits it in an identical form which can be fed to another AES/EBU receiver.

The clock signal, which determines the rate at which samples are converted, is recovered from the incoming data stream using a Phase Locked Loop. In this way the converter automatically adapts to any input sample rate within its operating range. Most equipment uses one of a small list of standard sample rates, and front panel LEDs are provided to indicate which (if any) of these is in use. If the input sample rate is outside the operating range, or if there is no input at all, the converter sits idle and the audio outputs are muted. In this situation an ERROR alarm is

raised and the fault condition indicated on the front panel.

With the clock recovered, audio samples can be decoded from the input data stream and fed to the Digital to Analogue converter. The FR-DAC module uses a Burr-Brown multilevel delta-sigma converter to convert the sample data into analogue audio at up to 24 bit resolution. Since the digital data representing each audio sample has a known, fixed number of bits, it also has a finite maximum value. For this reason, digital audio systems have a immovable maximum level which they can convey without distortion, and this is referred to as 0dBFS. Signal-to-noise ratio is optimised when peak signal levels approach 0dBFS as the full resolution of the system is being used.

The analogue domain operates at a far greater variety of levels, so the FRDAC allows the user to select the translation ratio between digital and analogue levels, expressed in terms of the analogue output level generated with the maximum possible digital input level applied. This is implemented as a 4dB/step switched gain amplifier plus an optional +/- 3dB of fine trimming. This approach maximises performance as it is not necessary to bring the audio signal to the front panel for adjustment, and the signal path is correspondingly reduced.

The switched gain amplifier feeds a pair of balanced line drivers capable of delivering full output into loads of 600 ohms or greater.

5. Connections and Indicators

OUTPUTS connector (9 way male D-type)

Pin:	Function:
1	Left audio output +/hot
6	Left audio output screen
2	Left audio output -/cold
7	Right audio output +/hot
3	Right audio output screen
8	Right audio output -/cold
4	ERR status output Emitter
9	ERR status output Collector
5	ERR ground

Outputs are electronically balanced and floating. They may be unbalanced without affecting level by tying the -/cold leg to the corresponding screen pin. Output impedance = 50 ohms

AES/EBU IN connector (3 pin female XLR)

Pin:	Function:
1	Ground (see note)
3	Digital input signal
2	Digital input signal

The input is transformer isolated and terminated with 110 ohms as per AES/EBU specification. Acceptable input sample rate is 32-96kHz. The internal link labelled I/P GND may be removed to disconnect pin 1 of the input connector from DC ground (it remains AC coupled to ground) if desired.

Connections

AES/EBU Input

The AES/EBU input is transformer balanced with an input impedance of 110 ohms. For maximum performance, especially with long cables, connecting leads should utilise screened digital audio cable with the correct impedance characteristics.

AES/EBU Output

The AES/EBU output is transformer balanced with an output impedance of 110 ohms. It carries a fully buffered copy of the AES/EBU input signal; loading on the output does not degrade the input signal or DAC performance. It may therefore be used to chain the same digital audio signal to two or more pieces of equipment while retaining correct cable termination. For maximum performance, especially with long cables, connecting leads should utilise screened digital audio cable with the correct impedance characteristics.

Audio Outputs

The audio outputs are electronically balanced and floating, with an output impedance of 50 ohms. They may be unbalanced without affecting level by tying the -/cold leg to the corresponding screen pin. To achieve specified performance, leads should be of quality screened cable.

ERR Status Output

The ERR output allows monitoring of problems with the digital audio input signal. Conditions under which ERR will be flagged are coding or parity errors in the received data (indicating corruption) or inability of the

AES/EBU OUT connector (3 pin male XLR)

Pin:	Function:
1	Ground
3	Digital output signal
2	Digital output signal

The output is transformer isolated with an output impedance of 110 ohms as per AES/EBU specification. This connector carries a fully buffered copy of the digital input signal and may be used to "daisy chain" units while retaining correct line termination.

Front Panel Indicators

SAMPLE RATE Indicators

These show the sample rate of the incoming digital audio signal and therefore the rate at which the DAC is operating. Rates within $\pm 4\%$ of the labelled frequencies will illuminate the corresponding LED, while rates outside these bands but still within the operating range will illuminate the "??" LED.

ERR Indicator

This LED indicates a problem with the digital audio input signal. Conditions under which ERR will be flagged are coding or parity errors in the received data, indicating corruption, or inability of the digital receiver to lock to the incoming clock signal. This may be caused by the total loss of the input signal or by an input sample rate outside the operating range. The DAC output is muted while ERR is illuminated.

digital receiver to lock to the incoming clock signal. This may be caused by the total loss of the input signal or by an input sample rate outside the operating range. The output appears as a floating opto-transistor, rated at 30V and 5mA. The transistor conducts continuously under normal conditions and stops conducting when an error is detected. For use as an "open collector" output, simply connect the ERR Emitter pin to ERR Ground and take the output signal from ERR Collector.

Setting Up Output Level

The 10 position front panel switch is labelled 0 to 9 and determines the analogue output level delivered when a digital input level of 0dBFS (i.e. full-scale, maximum digital signal level) is applied.

Switch position 0:	0dBFS gives 0dBu on the analogue outputs
Switch position 1:	0dBFS gives +4dBu on the analogue outputs
Switch position 2:	0dBFS gives +8dBu on the analogue outputs
Switch position 3:	0dBFS gives +12dBu on the analogue outputs
Switch position 4:	0dBFS gives +16dBu on the analogue outputs.
Switch position 5:	0dBFS gives +20dBu on the analogue outputs
Switch position 6:	0dBFS gives +24dBu on the analogue outputs
Switch positions 7-9:	Reserved

Two internal trimmers provide an additional $\pm 3\text{dB}$ of gain to allow precise setting/matching of output levels – they are labelled L and R for the left and right channel trimmers respectively. The factory default setting for these trimmers is 0dB of gain.

6. Specifications

(Unless specified, input = 24 bit, 48kHz @ 0dBFS; output = 1kHz @ +12dBu; measurement bandwidth = 20kHz)

Digital input	Balanced, transformer isolated, AES/EBU format
Digital input impedance	110ohms
Digital input sensitivity	200mVp-p
Digital input sample rate	32 to 96kHz, determined by input datastream
Conversion resolution	16 to 24 bits, determined by input datastream
Converter type	Multi-level delta-sigma
Digital output	Balanced, transformer isolated, AES/EBU format
Digital output impedance	110ohms
Digital output level	2.5Vp-p nominal (terminated)
Analogue outputs	Electronically balanced
Analogue output impedance	50ohms
Minimum load impedance	600ohms
Output level range	0 to +24dBu output for 0dBFS input
Level range adjustment	Externally in 4dB (± 0.2) steps, internal $\pm 3\text{dB}$ trim
THD+Noise	-97dB (RMS, input = 48kHz, 20kHz bandwidth)
THD+Noise	-94dB (RMS, input = 96kHz, 40kHz bandwidth)
Signal to noise ratio	101dB (RMS, input = 48kHz, 20kHz bandwidth)

Signal to noise ratio	99dB (RMS, input = 96kHz, 40kHz bandwidth)
Inter-channel crosstalk	-100dB
AF response	+0dB, -0.3dB (20Hz-20kHz)
ERROR output	Floating opto-transistor, max. ratings 30V 5mA
Power supply	Supplied by Flexrack chassis, FR-RK1 <6VA total
Size	210 x 88 x 44mm

7. How to Contact ProAVM

For all enquiries write to:-

ProAVM
61 Station Road
Irthlingborough
Northants
NN9 5QE
United Kingdom

Or telephone 01933 650 700 within the UK, +44 1933 650 700 from outside the UK.

Or fax 01933 650 726 within the UK, +44 1933 650 726 from outside the UK.

Or email sales@proavm.com for sales enquiries or technical.support@proavm.com for technical support.

Alternatively visit our web site: <http://www.proavm.com>

8. Declaration of Conformity

Name of Manufacturer: ProAVM
Address of Manufacturer: 61 Station Road
Irthlingborough
Northants
NN9 5QE

Product: FR-DAC Flexrack Digital to Analogue Converter Module

Declaration: The product described above complies with the requirements of the Low Voltage Directive (73/23/EEC) and the protection requirements of the EMC Directive (89/336/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Standards:

EN 60065:1993	Safety requirements for mains operated electronic and related apparatus for household and similar general use
EN 55103-1:1997	Electromagnetic compatibility - Product family standard for audio, video, audiovisual and entertainment lighting control apparatus for professional use (emissions - environmental categories E1 to E5)
EN 55103-2:1997	Electromagnetic compatibility - Product family standard for audio, video, audiovisual and entertainment lighting control apparatus for professional use (immunity - environmental categories E1 to E5)

9. Warranty

This product is shipped with a 5 year return to base warranty. Please return the product to the company that you bought it from.

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