

# Digital Mixing and Routing System

RM4200D

— Manual —



## Part 2

## System Reference

Preliminary Revision: June 24th, 2006

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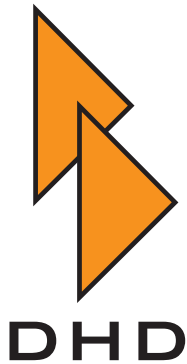
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## II. System Reference Guide

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### About this Manual

This part of the RM4200 manual contains a detailed system description of the RM4200D. You should read this manual if you:

- want to get a detailed overview of the structure of RM4200D and its working principles.
- want to know, *how* certain functions have to be configured and *why* it works this way.
- like to see examples for the configuration of certain functions and understand them.
- are looking for reference information on certain aspects of the RM4200D.

This document was last updated on *June 24th, 2006*.

### Chapter Contents

The following list contains a short overview of the chapter contents:

- *Technical specification.* This chapter contains all important specifications of the RM4200D, including details on power supply, audio modules and CAN bus. There is also a description of the RM4200D's requirements for running it in a computer network. (See „Technical Specifications” on page 3.)
- *Memory Map.* This chapter describes, how the separate “layers” of the operating software of the RM4200D are structured and which purpose they serve. Here, you find details about **Firmware**, **Config** and **Setups**. (See „System Memory Map” on page 44.)
- *Monitoring the System.* This chapter describes, how you can monitor the status of the RM4200D. For this, you can use the functions of the DHD PC software or analyse the system LEDs. (See „Monitoring the System Status” on page 58.)

### Information missing?

You may wonder why there are certain issues missing in the manual. There is a simple reason for that: The texts on those issues have not been published yet. DHD has decided to publish this manual on a step by step basis, depending on how the contents is available.

We choose this procedure to supply revised documentation as quickly as possible, even if the manual as a whole is not finished yet.



**Note:** If you can not find certain information in the manual, please check if you are using the most up-to-date version of it. You find the date of the last revision in the footer of this page and on the title page of the manual. The latest version is available from the DHD homepage at:

*[www.dhd-audio.com](http://www.dhd-audio.com)*

## 1 Technical Specifications

This chapter contains all available specifications of the RM4200D. In addition, you find also information about the CAN bus and the operation of the system within a computer network.

### 1.1 Environmental Conditions

- **Storage Temperature:** -25 ... 85° Celsius



**Caution:** Make sure the RM4200D has the operating temperature before switching it on. Also, the relative humidity must not be exceeded. Above all, *no humidity must condense on or in the device!*

- **Operating temperature:** 5 ... 35° Celsius (depending on mounting conditions)
- **Relative air humidity:** 20 ... 85%, not condensing
- **Ventilation:** The RM4200D is passively cooled by convection. Air flows through the bottom and top of the rack unit (DSP frame).



**Caution:** In a 19"-rack, you need to *leave at least one height unit (NU) above and below the DSP frame empty*, to allow the air flow to cool the device. If there are more devices mounted in the rack that emit heat and/or the DSP frame is equipped with many cards, you may need to leave more space for ventilation. Do not cover the perforated metal plates in bottom and top of the case. Also avoid to operate devices loosing a lot of heat directly next to the DSP frame.

### 1.2 Dimensions and Weight

- **DSP-Frame, fully equipped:** approx. 13,8 kg, dimensions 19", 3, 6 or 9 HE high
- **Fader- and Control Modules, Average Value:** approx. 2,5 kg (Overbridge modules are less heavy respectively), dimensions 160mm x 399mm x 72mm

### 1.3 Mounting Position

The DSP frame must be mounted *always horizontally*, with the base plate underneath and the lid plate on top. Both plates are perforated to allow the air stream for ventilation.

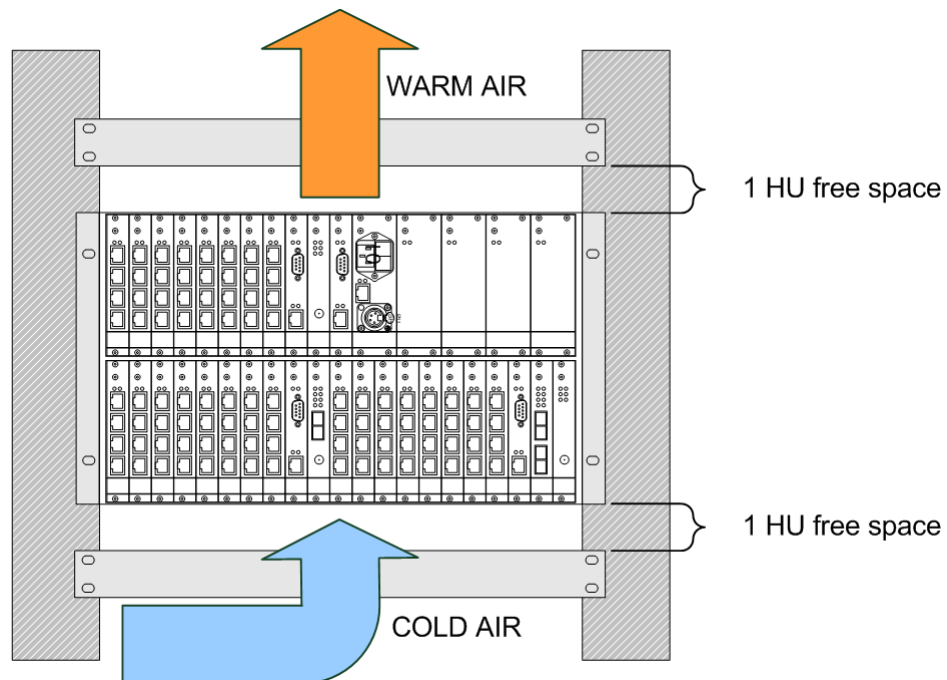


Figure 1–1: The mounting position required for the DSP frame: Above and underneath, leave 1 HU empty for air convection.



**Caution:** *Never mount a DSP frame vertically*, since this will lead to overheating which can damage the electronic parts! Also avoid to cover the airing perforation in base and top, since this blocks ventilation and may cause overheating.

### 1.4 Power Supply

Depending on the application, you can equip the RM4200D with different module combinations. The real power consumption depends on the kind and combination of modules and may vary a lot. Accordingly, there are different combinations of power supply modules possible. In addition, for certain applications, the DSP frame can be equipped with **redundant power supply units**.

The number of necessary power supply units depends on how many modules power must be supplied for. The following tables show the power requirement of the single modules:

**Power Consumption of Control Modules**

Typ	I <sub>max</sub> at 24V in A	P <sub>max</sub> in Watt
RM420-010	0,42	10,1
RM420-011	0,28	6,7
RM420-012	0,59	14,2
RM420-013	0,32	7,7
RM420-013L	0,32	7,7
RM420-014	0,9	21,6
RM420-020	0,4	9,6
RM420-020M	0,5	12,0
RM420-020S	0,4	9,6
RM420-023	0,28	6,7
RM420-025	0,22	5,3
RM420-026	0,2	4,8
RM420-027	0,38	9,1
RM420-028	0,45	10,8
RM420-029	0,45	10,8
RM420-029B	0,45	10,8
RM420-029M	0,55	13,2
RM420-078	0,19	4,6

**Power Consumption of Modules in the DSP frame**

Type	P <sub>max</sub> in Watt
RM420-061	0,7
RM420-062	1,4
RM420-063	2,1
RM420-064	2,1
RM420-850	3
RM420-851	2,6
RM420-848	4,9
RM420-111	0,9
RM420-122	3,5
RM420-222	2,4
RM420-311	1
RM420-422S	3
RM420-421S	1,5
RM420-424S	1



**Tip:** If you would like to know which power supply units you need for a certain configuration, please ask your DHD distributor. In part 5 of this manual, *Installation Guide* you find tables to help you figuring out the correct combinations.

### Types of Power Supply Units and FAQ

There are two voltages in the power supply system of the RM4200D: 5 Volt and 24 Volt. Both voltages are supplied by slide-in power supply units on the right side of the DSP frame. At present, there are two types of power supply modules, “old” and “new” ones. The reason for this update are the improved technical data of the new modules. Current DSP frames are shipped by DHD with the new power supply units, but you can order the old ones as spare parts if required.

Until the change-over, the old power supply units RM420-82 (24V) und RM420-085 (5V) have been used. After that, they have been replaced by the new modules RM420-084 (24V) and RM420-083 (5V) ersetzt. All power supply modules have a power output of 75 Watt.

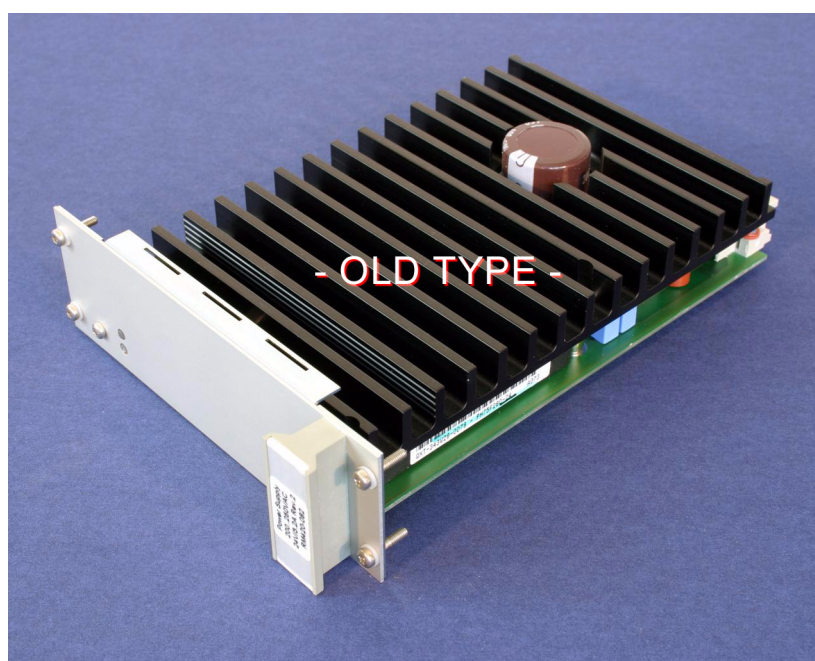


Figure 1–2: “Old” power supply module (RM420-82 and RM420-85). To be recognized from the outside by *two small LEDs*.

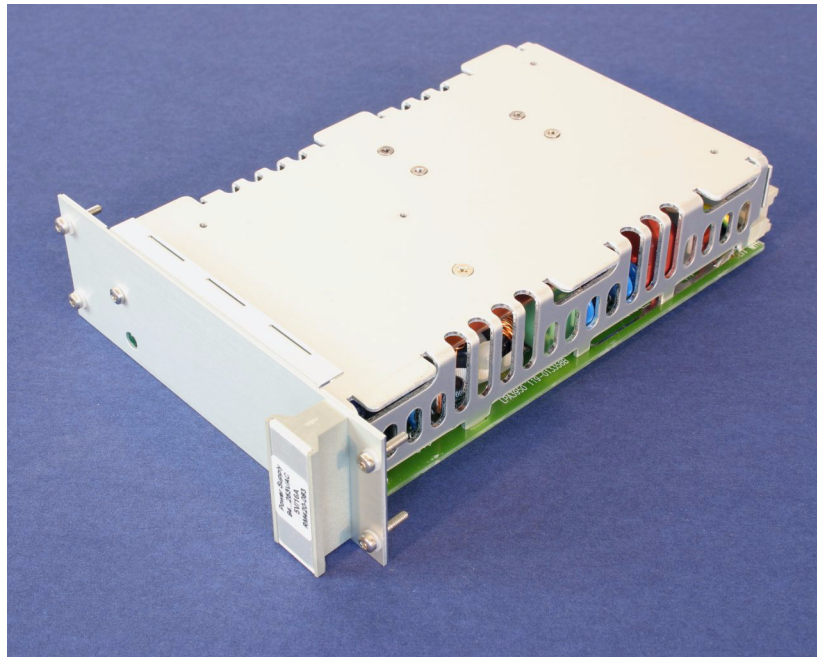


Figure 1–3: “New” power supply module (RM420-84 and RM420-83). From outside to be recognized by *one big LED*.



**Caution:** *Never use both types of power supply modules in one DSP frame!* Although they have the same connectors, the modules have different control signals that are not compatible. Keep this in mind, otherwise you can damage the DSP frame modules!

The following table shows answers to some FAQ concerning power supply units:

Question	Answer
What is the difference between “old” and “new” power supply unit?	<ul style="list-style-type: none"> <li>The “new” power units can be used worldwide, since they can work with input voltages between 94V and 253 V AC.</li> <li>The “old” power supply units can work with input voltages of 200-250V AC only.</li> <li>In addition, the “new” power supply units have a <b>Power Factor Correction (PFC)</b>.</li> </ul>
What does Power Factor Correction (PFC) mean?	In the “old” switching power supply units, the current intake from the AC power line is non-sinusoidal. On rare occasions, this can lead to failures in the AC power line. Power Factor Correction compensates for this effect and is necessary to comply with the EN61000-3-2 standard.
Can “old” and “new” power supply units with <i>the same voltage</i> be used together in a DSP frame?	<b>Caution:</b> No! Do not try this! Although the plugs are mechanically compatible, the control signals are different. If you do not consider this, modules in the DSP frame can be damaged!





Question	Answer
Can “old” and “new” power supply units <i>with different voltages (5V and 24V)</i> be used together in the same DSP frame?	Yes. The power supplies for 5V and 24V are independent from each other. Thus you can use e.g. two “old” power supply modules for 5 V with two “new” modules for 24V together in the same DSP frame. In the same way, you can use “old” modules for 24V with “new” modules for 5 V. Make sure that <i>all modules of one voltage are of the same type!</i>
Why have the “new” modules been introduced at all?	There have been several reasons: <ul style="list-style-type: none"> <li>• Occasional, there were problems acquiring the components for the “old” modules.</li> <li>• The “new” modules can be used worldwide due to the wider range of input voltages.</li> <li>• The “new” modules have Power Factor Correction and comply with the EN61000-3-2 standard.</li> <li>• The “new” modules use energy more efficiently.</li> </ul>

### Specification of the Power Supply Units

The following list contains the most important specifications for the used power supply modules. All values are stated for the “new” modules, the values in brackets refer to the “old” modules.

<b>Input line voltage</b>	115/230V AC, 43...63 Hz
<b>Operating range for input voltage</b>	94...253 V AC (200...250 V AC for “old” modules)
<b>Capacity</b>	75 Watt
<b>Fuses</b>	2x6,3 A delay; fuses are in the DSP frame behind the power supply module.
<b>Compensation of power failure:</b>	$\geq 20$ ms at 230 V AC voltage and full load
<b>24 V supply:</b>	The control modules are protected against wrong connection of 24V voltage.
<b>Protective circuit</b>	<ul style="list-style-type: none"> <li>• Limitation of output current</li> <li>• Limitation of output voltage</li> <li>• Short circuit protection</li> <li>• Limitation of switch-on current</li> <li>• Limitation of switch-on voltage</li> </ul>

### Mounting Regulations for Power Supply Modules to ensure sufficient ventilation

When mounting power units to a DSP frame, you have to make sure that the power supply modules are passively cooled correctly. Therefore, it is necessary to allow air flowing unrestrictedly through *all* used power supply modules.

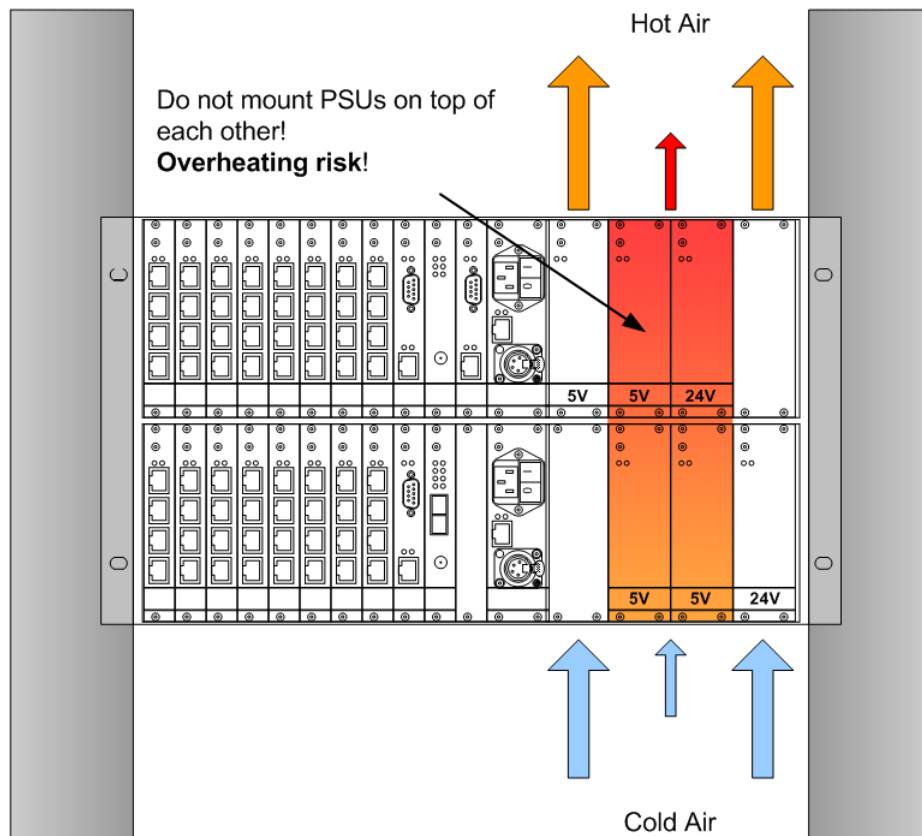




**Caution:** If you are mounting the power supply modules in a way that air convection is blocked, the modules can overheat and do not work correctly any longer. In certain cases, the modules in the DSP frame can even be damaged!

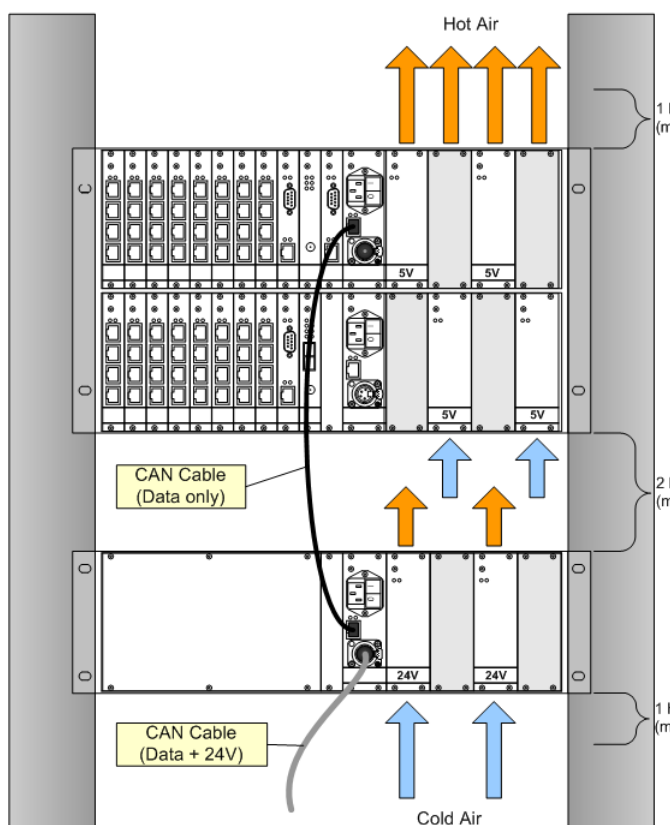
If you have questions concerning the arrangement of power supply modules, please ask your DHD vendor!

The following figure illustrated how heat accumulates if the power modules are not mounted correctly:



**Figure 1–4:** This arrangement of power supply modules causes overheating. Do not use this arrangement!

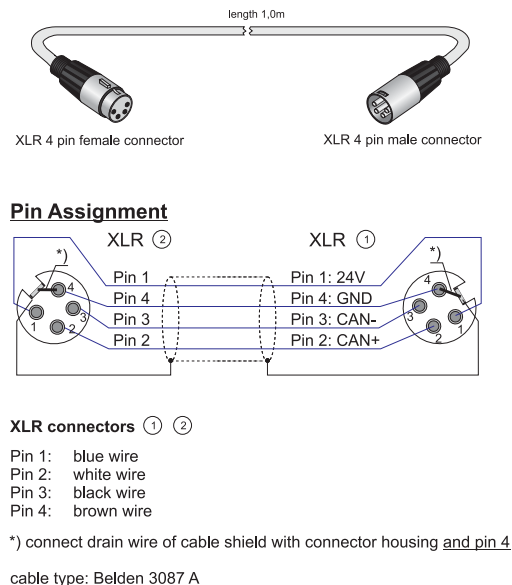
If you need more than one power supply module for the DSP frame (e.g. to supply for several modules or for redundant power supply), make sure the units are operated with sufficient ventilation. In this case, use a second module carrier to mount in the rack additionally. The following figure shows a possible way:



**Figure 1–5:** For several power supply modules use an additional module carrier to ensure convection.

### 1.5 CAN-Bus

The DSP frame is connected to the control modules via the CAN bus. the CAN bus is a serial bus with differential data transfer. For the data transfer, two wires in the cable are needed. In addition, CAN bus cables can also contain two wires for 24V-power supply for the control modules. The CAN bus is daisy-chained from module to module, a 4-pin XLR plug is used as connector.



**Figure 1–6: Pin assignment of the CAN bus cable.**



**Important Note:** The CAN bus within a RM4200D may have a *maximum length of 60 meters*. Also consider that within the DSP frame, the CAN bus has a length of one meter already! If you do not consider these limitations, the communication of the modules within the RM4200D can be severely disturbed.

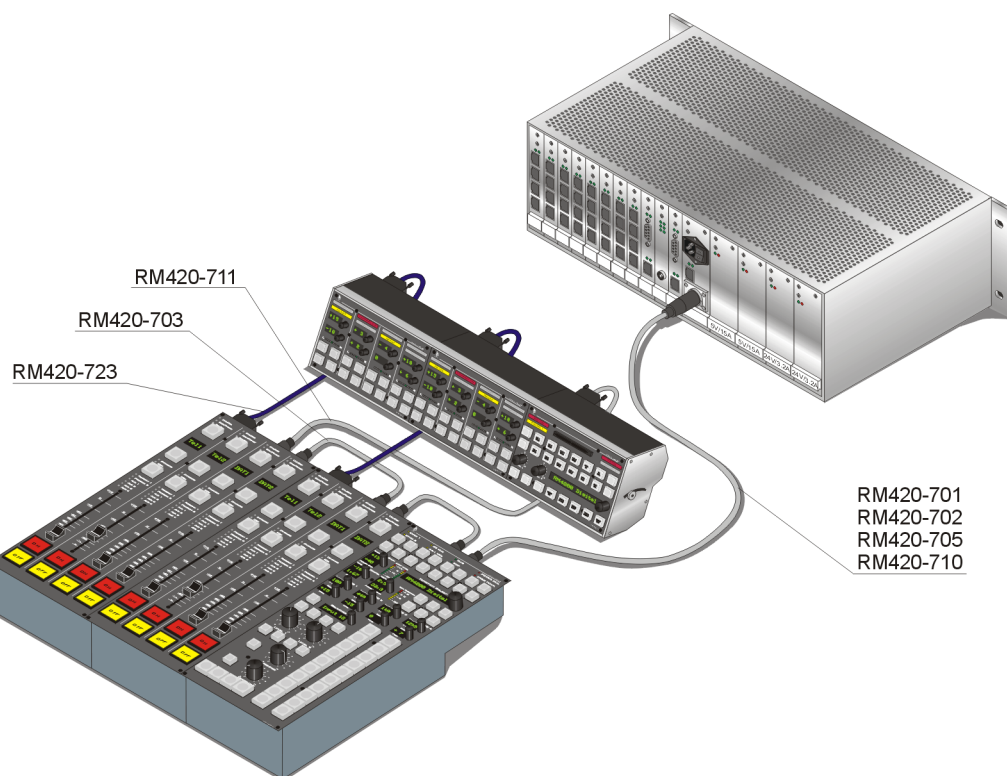
Also, the data lines of the CAN bus must be terminated at both ends to avoid signal reflections. For termination, use a resistor of 90-120 Ohm between the data lines of the CAN bus. Within the DSP frame, the CAN bus is terminated automatically if you use a cable with XLR connector. If the DSP frame is connected to an external power supply unit via a RJ45 port, you have to terminate the bus at the DSP frame using a XLR connector that contains the resistor between the data lines.

As cables for the CAN bus, two BELDEN products can be used:

- The cable *BELDEN 3087A* is used for cable lengths of *under 10 meters*.
- The cable *BELDEN 3086A* is used for cable lengths of *more than 10 meters*. This cable has thicker wires for the power lines to ensure less voltage loss at longer distances.



**Tip:** In contrast to other cable systems (e.g. Ethernet), there is no “standardized” CAN bus cable. DHD has measured the cable types named above and specified them for the RM4200D. You can order these cables in different lengths and with different connectors (XLR and Sub-D) at your DHD vendor. In part 1 of this manual, *System Overview*, you find a parts list with all available cables.

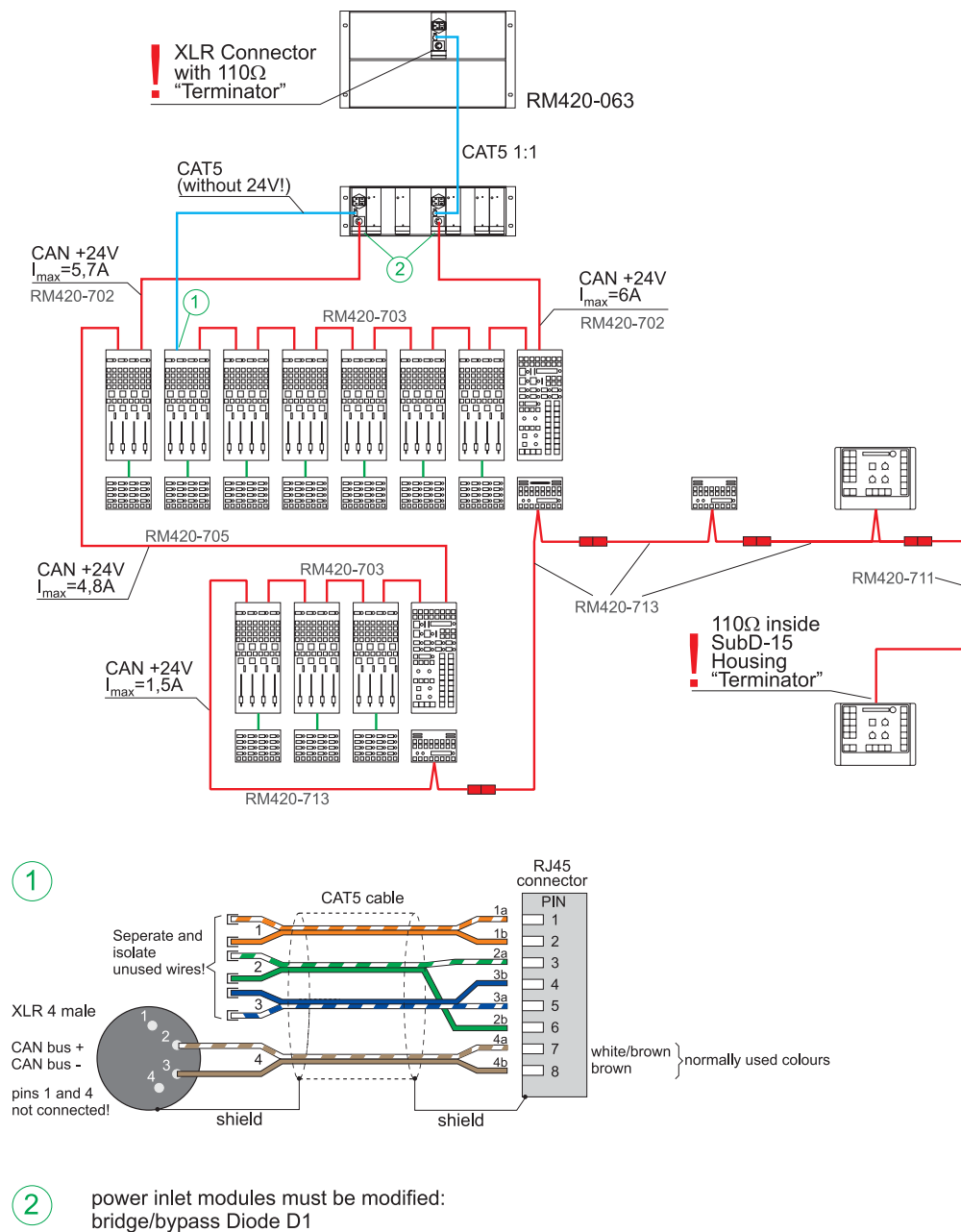


**Figure 1-7:** The connector cables contain data lines and power supply lines for the control modules. The total length of all cables must not exceed 60 meters!



**Note:** Each RM4200D has *one CAN bus only*. This way, it is not possible to operate more than one DSP frame at the same CAN bus. If you want to operate several RM4200D together, you have to couple them via a network connection.

If control modules are offset too far from the DSP frame, an additional power supply unit must be used to supply 24V voltage to the control modules. In this case, DSP frame and power supply carrier are connected via a thin cable which does not have any wires for power. The cable is connected via a RJ45 connector. Also here make sure the overall length of the CAN bus does not exceed 60 meters!



**Figure 1-8: Wiring of a CAN bus in a larger RM4200D.**

Make sure all control modules receive sufficient supply voltage. In larger systems, the supply voltage may be too low at the end of the CAN bus.

You can check this easily by opening the Maintenance window of the **Toolbox4** software and read out the information for the last module in the chain. Values between 21 V and 24V are acceptable. If the voltage is lower, you should add an additional power unit. On this occasion, please ask your DHD vendor.

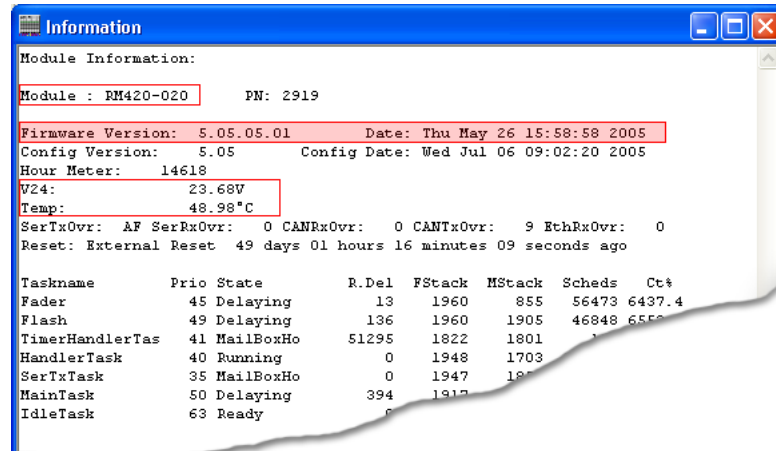


Figure 1–9: The parameter V24 of the module information states the current value of the supply voltage in the module.



**Important Note:** Make sure to ground the control modules properly using the screw threads on the back of the control modules. If there is no proper ground connection, on certain occasions problems with electrostatic discharges may occur!

Electrostatic discharges in the control modules can lead to malfunctions if the modules concerned are not grounded properly. The reason for this is the following:

The control modules are connected to the DSP frame only via the CAN bus cable. If the modules are not grounded properly, the cable is the only connection to the RM4200D ground. Now, if an electrostatic discharge meets the control module, in certain conditions, the charge carriers can not be discharged properly, thus leading to a “Lock-Up” of the module. This effect causes that the module does not react to any operations any more. You have to interrupt the power supply of the module, this way forcing a restart.

## 1.6 Network Interface

The network interface of the RM4200D is a normal Ethernet connector at the DSP frame with a RJ45 connector. The interface is operated using 100 Mbit/s, halfduplex. The appropriate port at a switch must therefore be set to “Auto Sense” or to 100 Mbit/s, semiduplex.



**Note:** Avoid to operate the RM4200D in a 10Mbit/s network. The system is neither specified for this situation, nor tested, and may not work properly!

## 1.7 Requirements for a Computer Network

You can integrate the RM4200D in a normal Ethernet network. For this, you have to observe some details to allow the system to communicate stably and reliably over the network. Please find the necessary detailed information in the next chapter. (See „How To Run RM4200D Systems in a Network” on page 40.)

The following list is a summary of the most important requirements:

- Operate the DHD systems in their own network, physically separate from other networks.
- If a PC is connected to the DHD systems and to other networks, make sure to put two network cards into the PC that are connected with one of the networks respectively.

- The network of the DHD systems *must route UDP broadcast packets*. If this is not the case, there is no communication between different DSP frames possible.
- *There must be no external UDP broadcast traffic in a DHD network*. Otherwise, foreign UDP packets can disturb the operation of a DHD system to a great deal.
- Make sure you operate the operating panel RM420-015 and the Remote Control Software RC420 *never at the same time* in a RM4200D !
- You may operate the operating panel RM420-015 and the DSP Control Software at the same time in a RM42900D, if you use the DSP Control Software with reduced data rate only. To do this, start up the software using the parameter `access4.exe -i 1000`.

### 1.8 I/O-Module



**Important Note:** In addition to the specifications listed here, you find information on the modules and their connections in Part 1 (*List of Modules*) and Part 5 (*Installation Guide*) of this manual.

#### RM420-111 Digital In/Out/GPIO module, 8 channels

- **Reference level digital:** 0 dBFS = full scale modulation
- **Range of frequency for measurement:** 20 Hz...20 kHz
- **Latency (Digital In to Digital Out, with SRC):** typ. 1,5 ms

#### *Digital Inputs*

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<b>Standard:</b>	AES3/EBU + S/PDIF (configurable in software)
<b>Sample rate converter (SRC):</b>	available, can be switched off
<b>Sample frequency range (SRC):</b>	30 kHz ... 100 kHz
<b>Frequency offset (with SRC):</b>	< 0.02 dB
<b>Input impedance:</b>	110 Ohm (AES/EBU), 75Ohm (S/PDIF)
<b>Dynamic range (24 bit):</b>	140dB
<b>THD+N (24 bit with SRC):</b>	< -120 dB (-1 dBFS, at 0dB amplification) < -140 dB (-60 dBFS, at 0dB amplification)
<b>Jitter immunity:</b>	> 40 ns

#### *Digital Outputs*

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<b>Standard:</b>	AES3/EBU, S/PDIF (alternatively)
<b>Output impedance:</b>	110 Ohm (AES/EBU), 75Ohm (S/PDIF)
<b>Dynamic range (24 bit):</b>	144dB
<b>Dither (configurable):</b>	off, 16, 20, 24 Bit
<b>Jitter (internal system synchronization)</b>	< 2 ns (peak)



### *GPI/GPO - Control Inputs and Outputs*

<b>GPI control inputs (optocoupler, DC-insulated):</b>	external input voltage 4V...24V (DC), 4mA
<b>4 GPO switching outputs (DC-insulated):</b>	max. 0.2A / 30V DC / 25V AC

### *Measurement diagram*

The following diagrams were recorded with a *Audio Precision System One* analyzer.

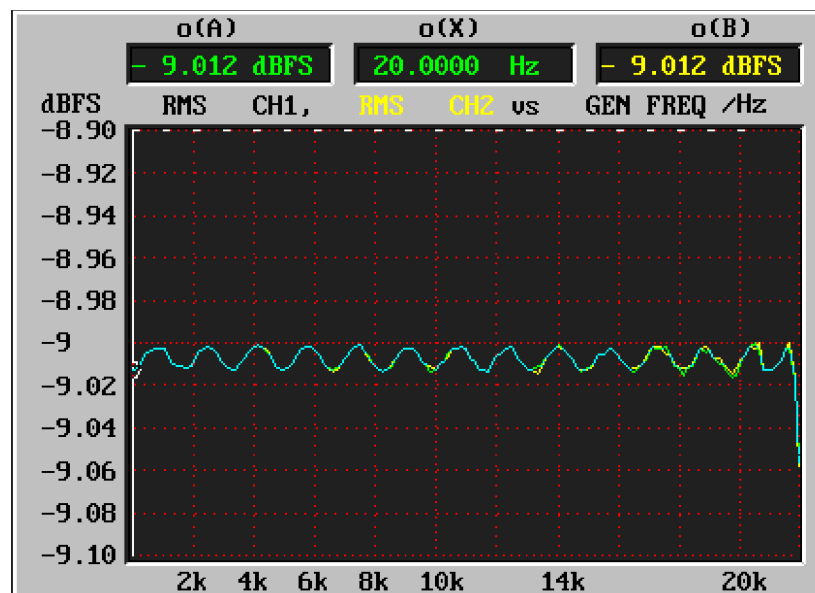


Figure 1-10: Amplitude characteristic Sample Rate Converter,  $f_{\text{sin}} = 48 \text{ kHz}$ ,  $f_s = 48 \text{ kHz}$ .

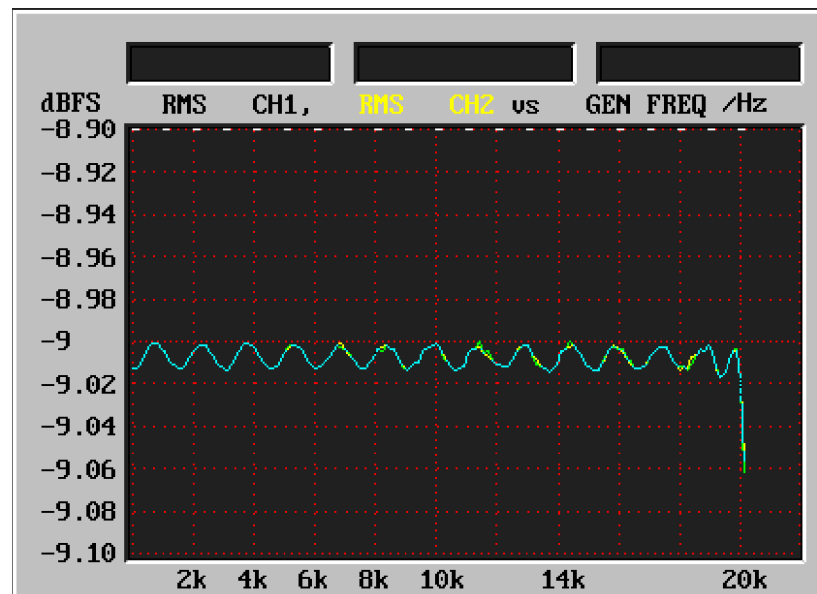


Figure 1-11: Amplitude characteristic Sample Rate Converter,  $f_{\text{sin}} = 44,1 \text{ kHz}$ ,  $f_s = 48 \text{ kHz}$ .

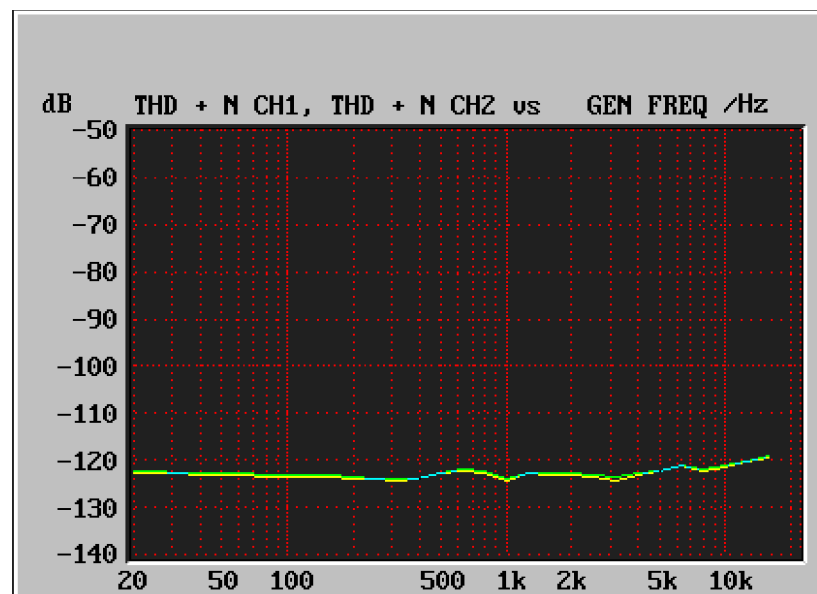


Figure 1-12: Sample Rate Converter total distortions (THD+N) against signal frequency at full scale modulation -1 dB,  $f_{\text{sin}} = 44,1 \text{ kHz}$ ,  $f_s = 48 \text{ kHz}$ .

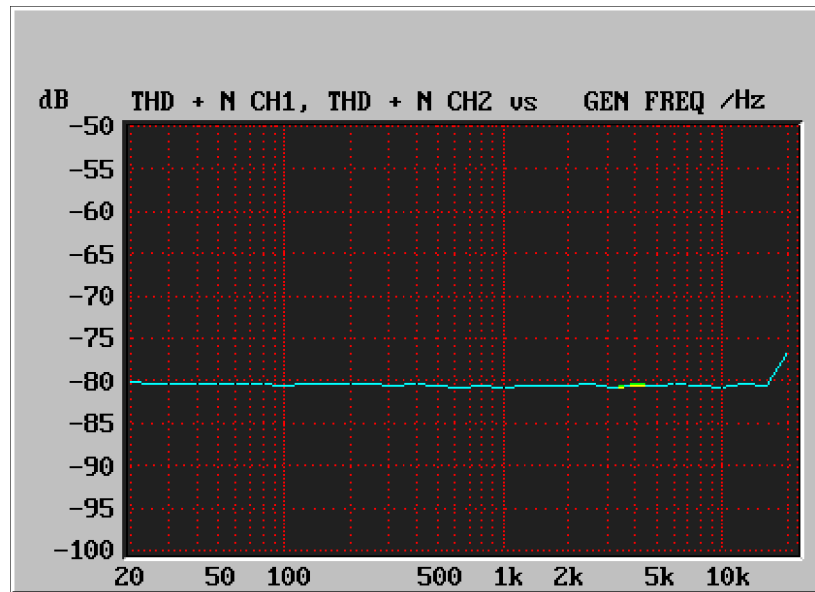


Figure 1-13: Sample Rate Converter total distortions (THD+N) against signal frequency at -60 dB,  $f_{\text{sin}} = 44,1 \text{ kHz}$ ,  $f_s = 48 \text{ kHz}$ .

## RM420-122 Mic/Headphone/GPIO module, 4 channels (up to revision 4)

- **Reference level analog:** 0 dBU = 0.775 V (RMS)
- **Reference level digital:** 0 dBFS = full scale modulation
- **Frequency range for measurements:** 20 Hz...20 kHz
- **Sampling frequency:** 44,1 KHz...48 kHz
- **Latency (Analog In to Analog Out):** typ. 1 ms

### A/D-converter

<b>Maximum input level:</b>	18 dBU (electronically balanced)
<b>Frequency offset:</b>	< 0,5 dB
<b>Amplification analog (in 5dB increments):</b>	0 dB...50 dB
<b>Input impedance:</b>	approx. 8 kOhm
<b>Converter technology:</b>	24 bit, (64 x Oversampling Sigma-Delta)
<b>Dynamic range:</b>	106 dB typical (A-rated)
<b>THD+N:</b>	< -80 dB (-1 dBFS, at 0dB Analog Gain) < -98 dB (-60 dBFS, at 0dB Analog Gain)
<b>Unbalance attenuation:</b>	> 60 dB

## Kapitel 1: Technical Specifications

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<b>Crosstalk:</b>	< -90 dB
<b>Input noise:</b>	< -126 dBu (200 Ohm source impedance, 50dB Analog Gain)

### *D/A-Converter*

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<b>Maximum output level (Headphones unsymmetrical):</b>	15 dBu
<b>Frequency offset:</b>	< 0,3 dB
<b>Output impedance:</b>	ca. 17 Ohm
<b>Load impedance Outputs short-circuit proof:</b>	$\geq 80$ Ohm
<b>Converter technology:</b>	24 bit, (128 x Oversampling Sigma-Delta)
<b>Dynamic range(24 bit):</b>	108 dB typical (A-rated)
<b>THD+N (24 bit with SRC):</b>	< -82 dB (-1 dBFS) < -104 dB (-60 dBFS)
<b>Crosstalk:</b>	< -90 dB
<b>DC voltage offset:</b>	< 10 mV

### *GPI/GPO - Control inputs/outputs*

---

<b>2 analog control inputs (ACI - Analog Control Input):</b>	<ul style="list-style-type: none"> <li>• Connect a linear 10 Ohm potentiometer between control input (at wiper) and ground (left fixed contact).</li> <li>• Alternatively, connect a control voltage of 0...3,3V.</li> <li>• The inputs are not DC-insulated but overvoltage-protected.</li> </ul>
<b>2 GPI-control inputs:</b>	<ul style="list-style-type: none"> <li>• TTL-inputs with internal pull-up-resistor (10 kOhm to 5V).</li> <li>• Switching contact to ground or TTL level (low-active).</li> <li>• Overvoltage protected.</li> </ul>
<b>4 GPO-switching outputs:</b>	<ul style="list-style-type: none"> <li>• electronic relay; DC-insulated</li> <li>• max. 0,2 A / 30 V DC /25 V AC</li> </ul>

## Measurement diagrams RM420-122 A/D-converter

The following diagrams were recorded with an *Audio Precision System One* analyzer.

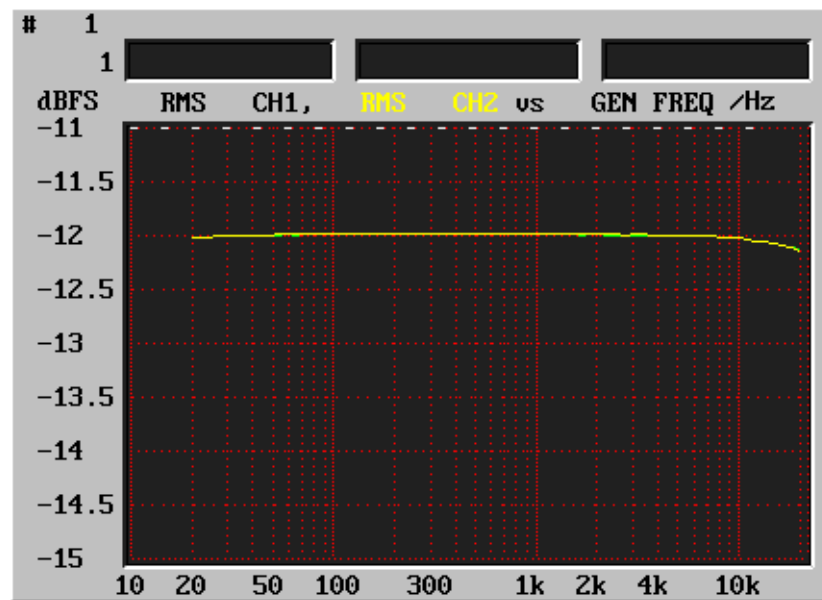


Figure 1-14: RM420-122 A/D-converter: Amplitude frequency response, amplification 0dB.

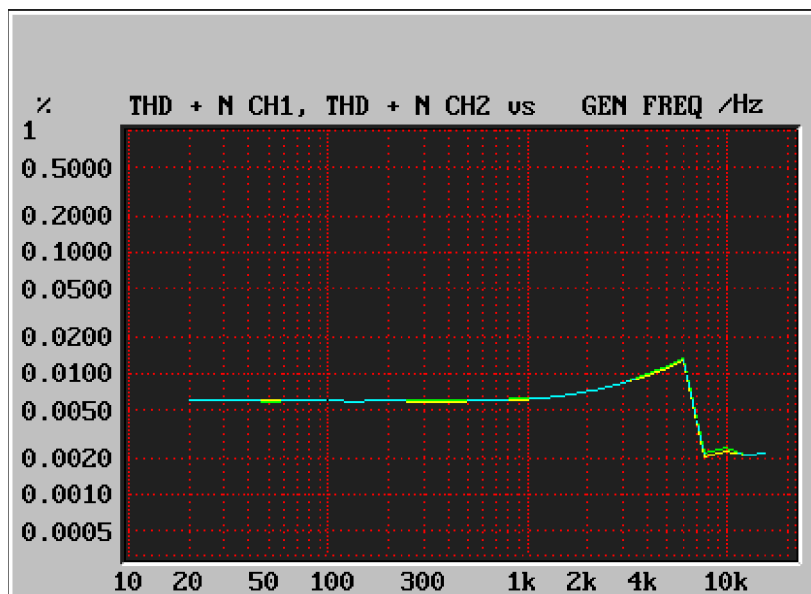


Figure 1-15: RM420-122 A/D-converter: Total distortions (THD+N) against signal frequency at full scale modulation -1 dB, amplification 0 dB.

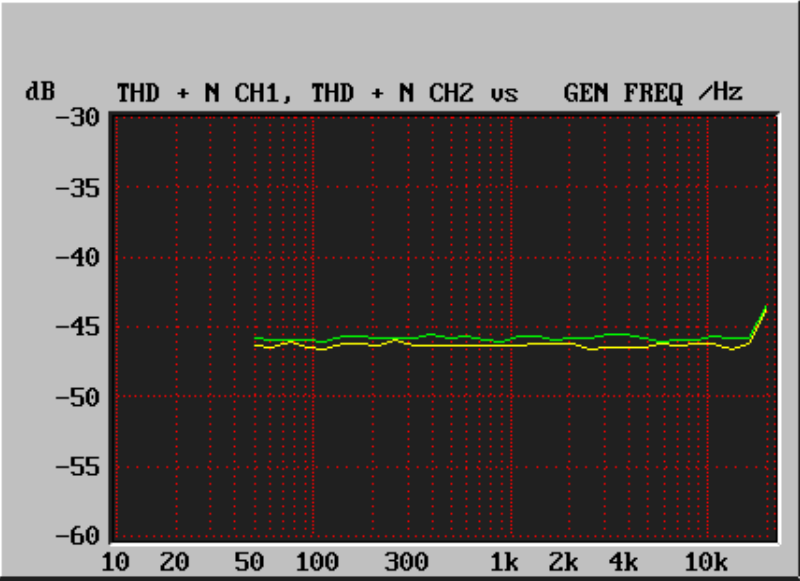


Figure 1-16: RM420-122 A/D-converter: Signal/noise-ratio at -60dB input level (A-rated) against frequency, amplification 0 dB.



Figure 1-17: RM420-122 A/D-converter: Converter linearity at 1kHz, 0...-100 dBFS.

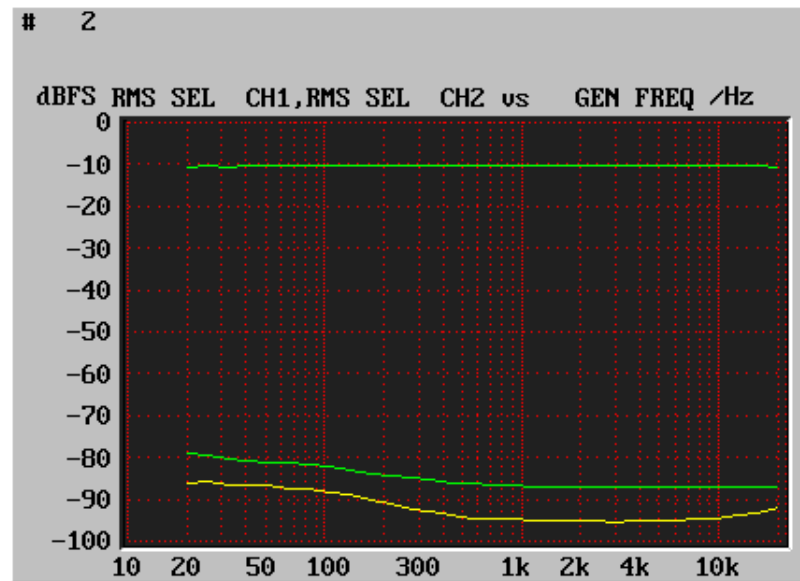


Figure 1-18: RM420-122 A/D-converter: Input unbalance against frequency, amplification +50 dB.

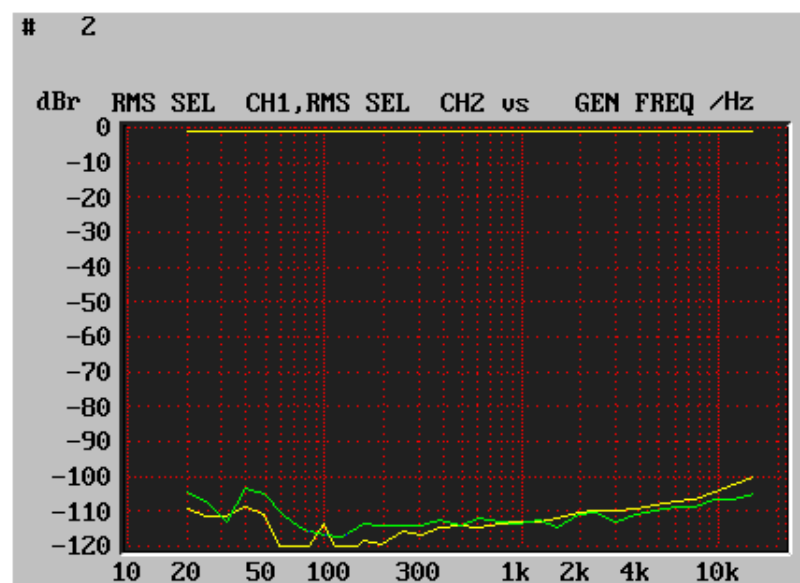


Figure 1-19: RM420-122 A/D-converter: Crosstalk, amplification +50 dB.

*Measurement diagrams RM420-122 D/A-converter*

The following diagrams were recorded using an *Audio Precision System One* analyzer.

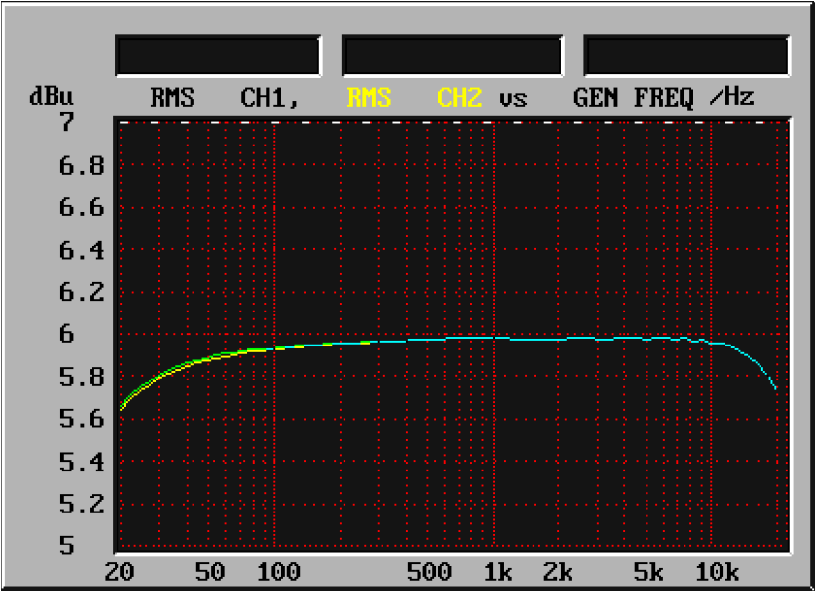


Figure 1-20: RM420-122 D/A-converter: Amplitude frequency response.

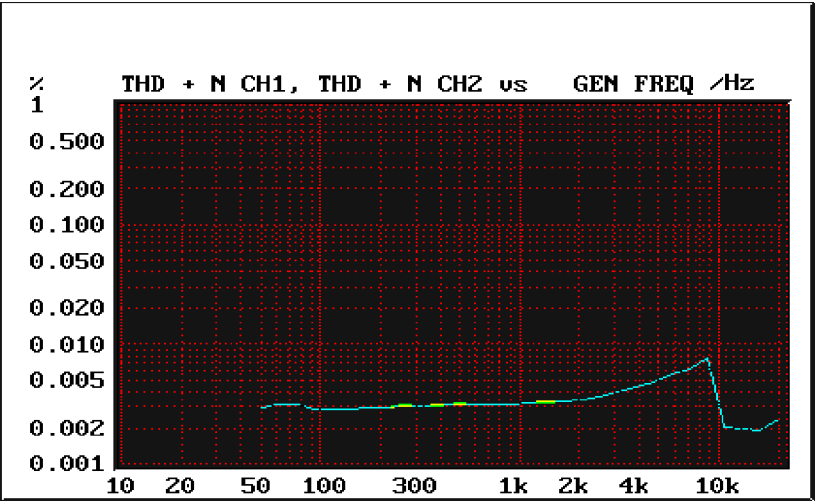


Figure 1-21: RM420-122 D/A-converter: Total distortions (THD+N) against signal frequency at full scale modulation (−1 dBFS).



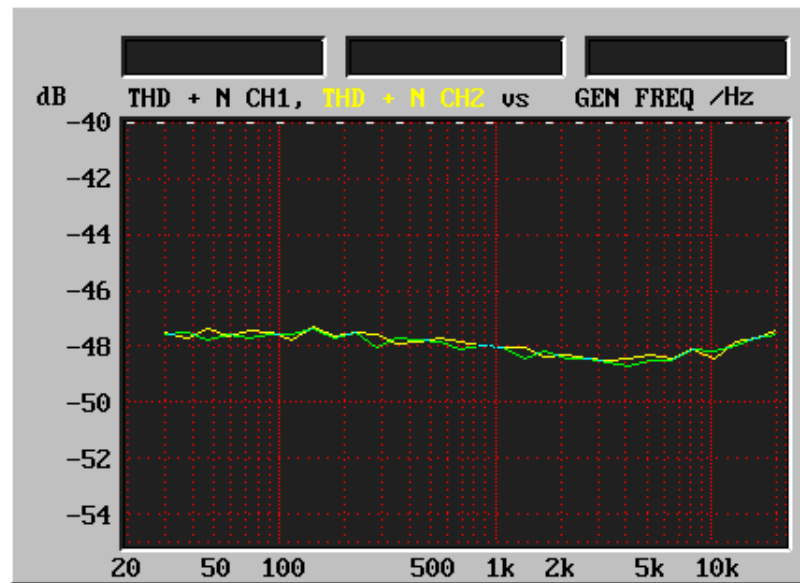


Figure 1-22: RM420-122 D/A-converter: Signal/noise-ratio at -60dBFS, A-rated against frequency.

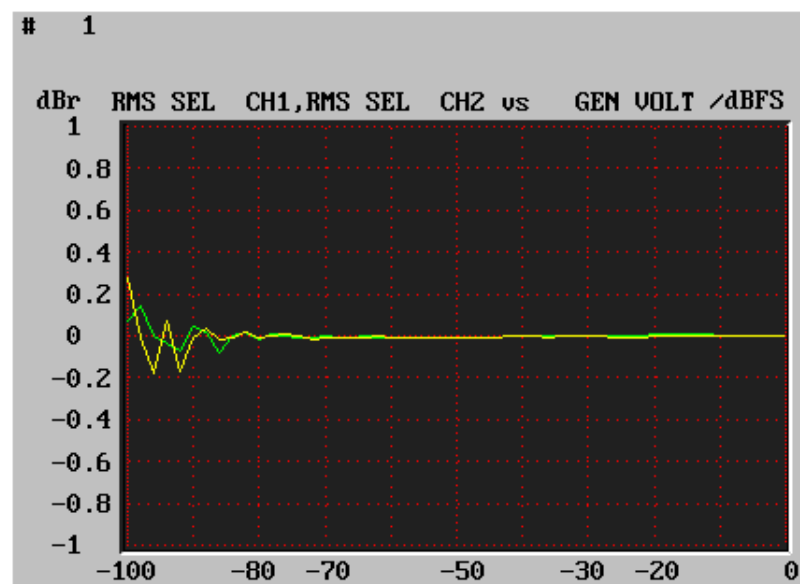


Figure 1-23: RM420-122 D/A-converter: Converter linearity 997 Hz, 0...-100 dBFS.

### RM420-222/223 Analog In/Out/GPIO module, 4 channels

In the course of its history, DHD has developed several revisions of this module. The basic functions of these revisions are similar; but some parameters have better measurement values in later revisions. The differences are marked in the following list.

The module RM420-223 is identical with the module RM420-222, but it has a higher maximum input level.



**Note:** You can exchange modules of different revisions without any problems.

- **Reference level analog:** 0 dB<sub>U</sub> = 0.775 V (RMS)
- **Reference level digital:** 0 dB<sub>FS</sub> = full scale modulation
- **Frequency range for measurements:** 20 Hz...20 kHz
- **Sample frequency:** 44,1 KHz...48 kHz
- **Latency (Analog In to Analog Out):** typ. 1 ms

### *A/D-converter*

<b>Maximum input level:</b>	<ul style="list-style-type: none"> <li>• 18 dB<sub>U</sub> (electronically balanced)</li> <li>• 24 dB<sub>U</sub> (RM420-223, electronically balanced)</li> </ul>
<b>Frequency offset:</b>	< 0,1 dB
<b>Input impedance:</b>	approx. 10 kOhm
<b>Converter technology:</b>	<ul style="list-style-type: none"> <li>• 24 bit, (64 x Oversampling Sigma-Delta) (until Rev. 2)</li> <li>• 24 bit, (128 x Oversampling Sigma-Delta) (since Rev. 2)</li> </ul>
<b>Dynamic range:</b>	<ul style="list-style-type: none"> <li>• 106 dB typical (A-rated) (until Rev. 2)</li> <li>• 111 dB typical (A-rated) (Rev. 3)</li> <li>• 113 dB typical (A-rated) (Rev. 5,6)</li> </ul>
<b>THD+N at -1 dBFS:</b>	- 92 dB
<b>THD+N at -60 dBFS:</b>	<ul style="list-style-type: none"> <li>• -100 dB (until Rev. 2)</li> <li>• -105 dB (Rev. 3)</li> <li>• -110 dB (Rev. 5,6)</li> </ul>
<b>Input unbalance attenuation:</b>	> 60 dB
<b>Crosstalk:</b>	<ul style="list-style-type: none"> <li>• -90 dB</li> <li>• -100 dB (Rev. 3)</li> </ul>

***D/A-converter***


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<b>Maximum output level:</b>	<ul style="list-style-type: none"> <li>• 18 dBU (electronically balanced)</li> <li>• 24 dBU (RM420-223, electronically balanced)</li> </ul>
<b>Divergence in frequency response:</b>	<ul style="list-style-type: none"> <li>• &lt; 0,2 dB (Rev. 2,3)</li> <li>• &lt; 0,15 dB (Rev. 5,6)</li> </ul>
<b>Output impedance:</b>	approx. 25 Ohm
<b>Converter technology:</b>	24 bit, (128 x Oversampling Sigma-Delta)
<b>Dynamic range:</b>	<ul style="list-style-type: none"> <li>• 108 dB typical (A-rated) (Rev. 2)</li> <li>• 112 dB typical (A-rated) (Rev. 3)</li> <li>• 113 dB typical (A-rated) (Rev. 5, 6)</li> </ul>
<b>THD+N at -1 dBFS:</b>	<ul style="list-style-type: none"> <li>• -82 dB (until Rev. 2)</li> <li>• -85 dB (Rev. 3)</li> <li>• -90 dB (Rev. 5,6)</li> </ul>
<b>THD+N at -60 dBFS:</b>	<ul style="list-style-type: none"> <li>• -104 dB (until Rev. 2)</li> <li>• -108 dB (Rev. 3)</li> <li>• -110 dB (Rev. 5,6)</li> </ul>
<b>Unbalance attenuation (impedance):</b>	> 60 dB
<b>Unbalance attenuation (voltage):</b>	> 40 dB
<b>Crosstalk:</b>	< -95 dB
<b>DC voltage offset:</b>	< 10 mV

***GPI/GPO - Control inputs/outputs***


---

<b>2 GPI-control inputs:</b>	<ul style="list-style-type: none"> <li>• Optocoupler, DC-voltage insulated</li> <li>• external 4V...24V (DC) 4mA</li> </ul>
<b>4 GPO-switching outputs:</b>	<ul style="list-style-type: none"> <li>• electronic relay, DC-voltage insulated</li> <li>• max. 0,2 A / 30 V DC /25 V AC</li> </ul>

Measurement diagrams RM420-222 A/D-converter

The following diagrams were recorded using an *Audio Precision System One* analyzer.

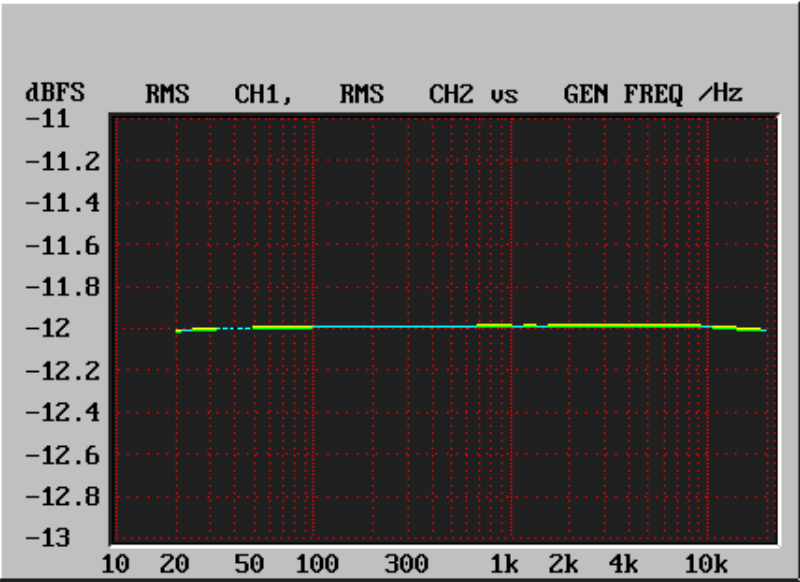


Figure 1-24: RM420-222 A/D-converter: Amplitude frequency response.

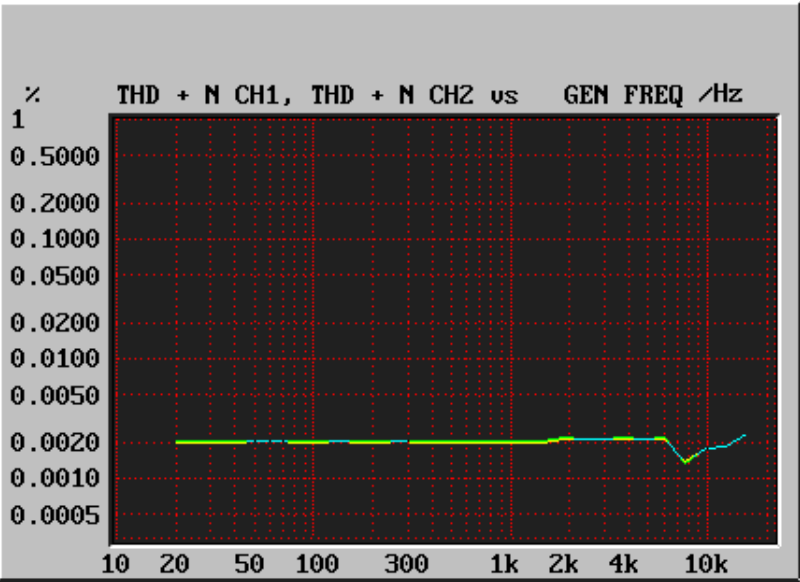


Figure 1-25: RM420-222 A/D-converter: Total distortions (THD+N) against signal frequency at full scale modulation -1 dB.

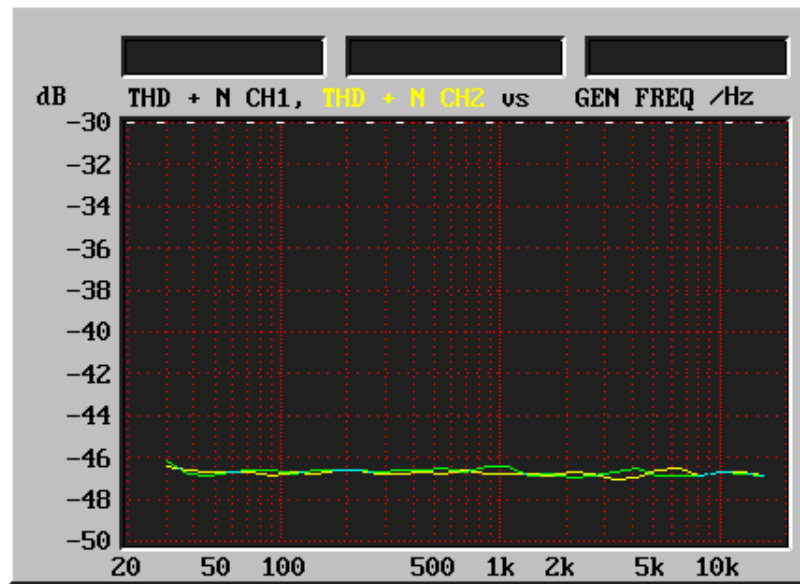


Figure 1-26: RM420-222 A/D-converter: Signal/noise ratio at -60 dBFS, A-rated against frequency.

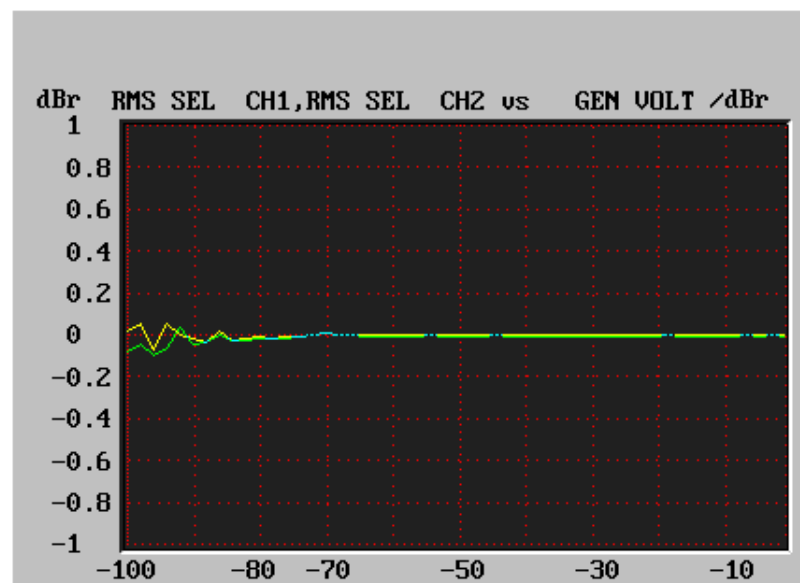


Figure 1-27: RM420-222 A/D-converter: Converter linearity at 1 kHz, 0...-100dbFS.

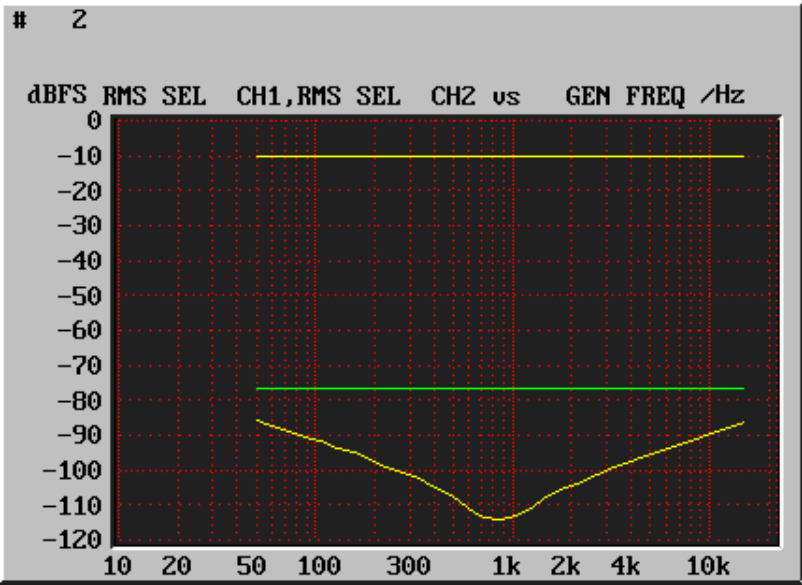


Figure 1-28: RM420-222 A/D-converter: Input unbalance against frequency.

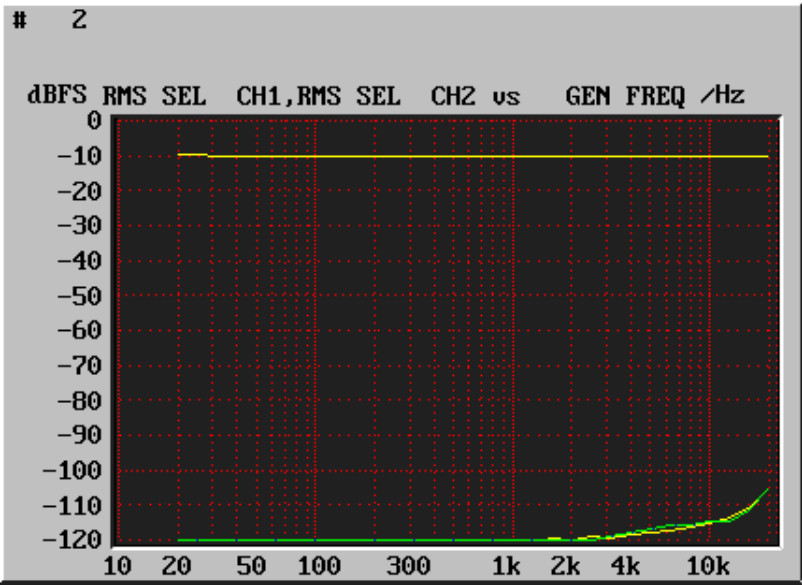


Figure 1-29: RM420-222 A/D-converter: Crosstalk between right and left channel.

## Measurement diagrams RM420-222 D/A-converter

The following diagrams were recorded using an *Audio Precision System One* analyzer.

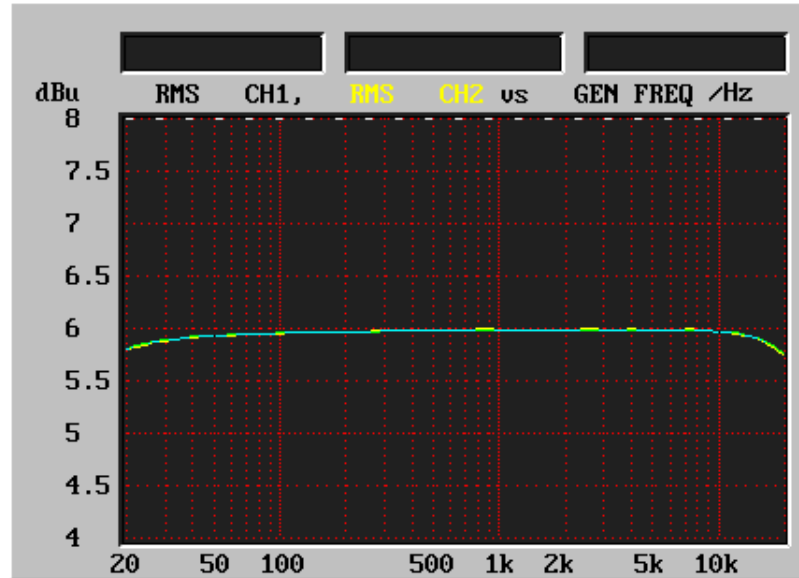


Figure 1-30: RM420-222 D/A-converter: Amplitude frequency response.

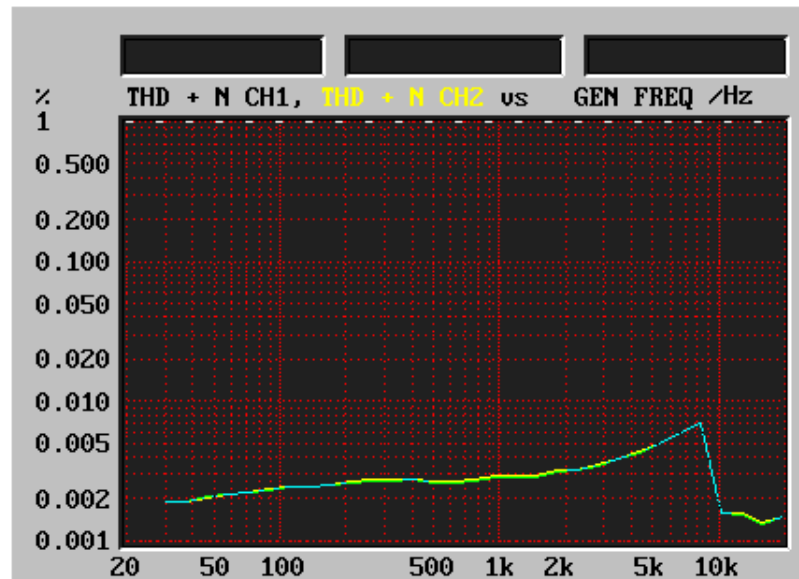


Figure 1-31: RM420-222 D/A-converter: Total distortion (THD+N) against signal frequency at full scale modulation -1 dB.

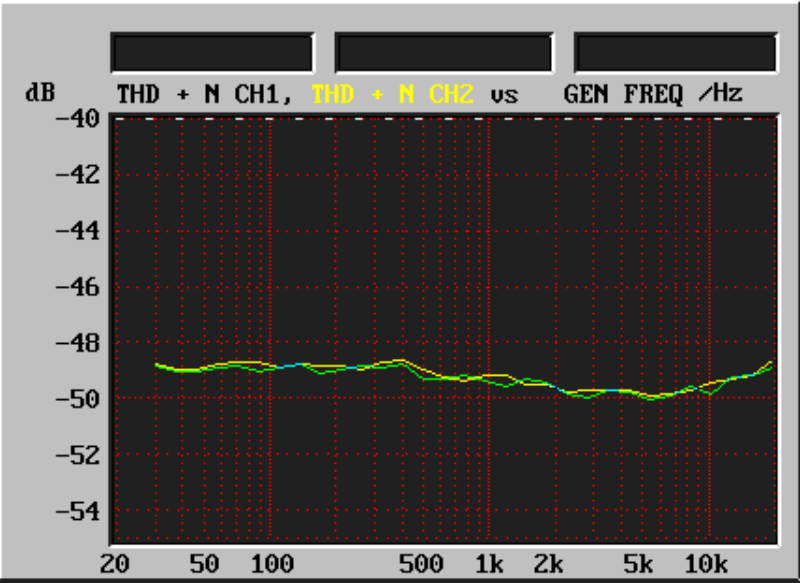


Figure 1-32: RM420-222 D/A-converter: Signal/noise ratio -60 dBFS, A-rated against frequency.

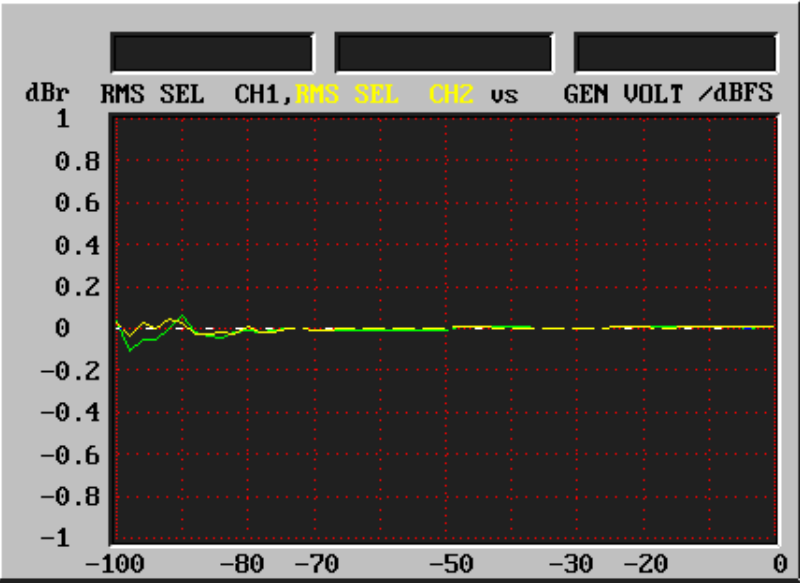


Figure 1-33: RM420-222 D/A-converter: Converter linearity at 1 kHz, 0...-100dbFS.



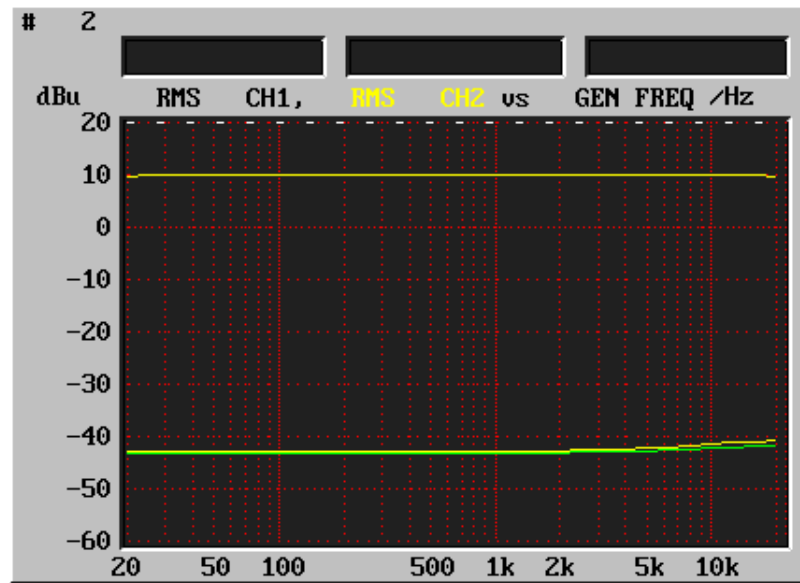


Figure 1-34: RM420-222 D/A-converter: Voltage unbalance (Analog outputs) against frequency.

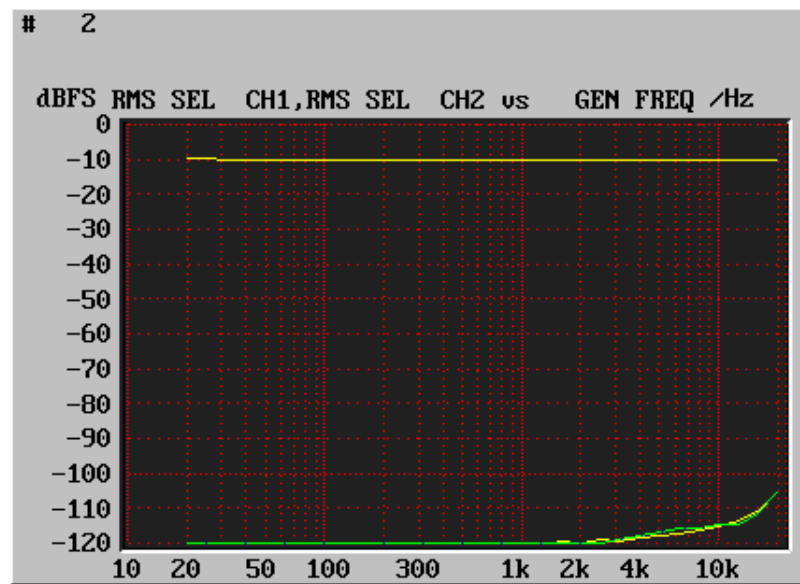


Figure 1-35: RM420-222 D/A-converter: Crosstalk between right and left channel.

*Measurement diagrams RM420-223 A/D-converter*

The following diagrams were recorded using an *Audio Precision System One* analyzer.

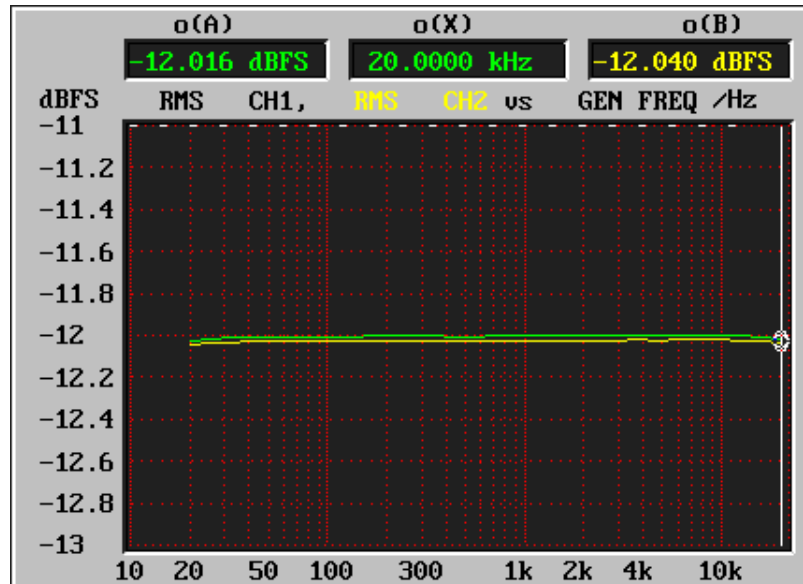


Figure 1-36: RM420-223 A/D-converter: Amplitude frequency response.

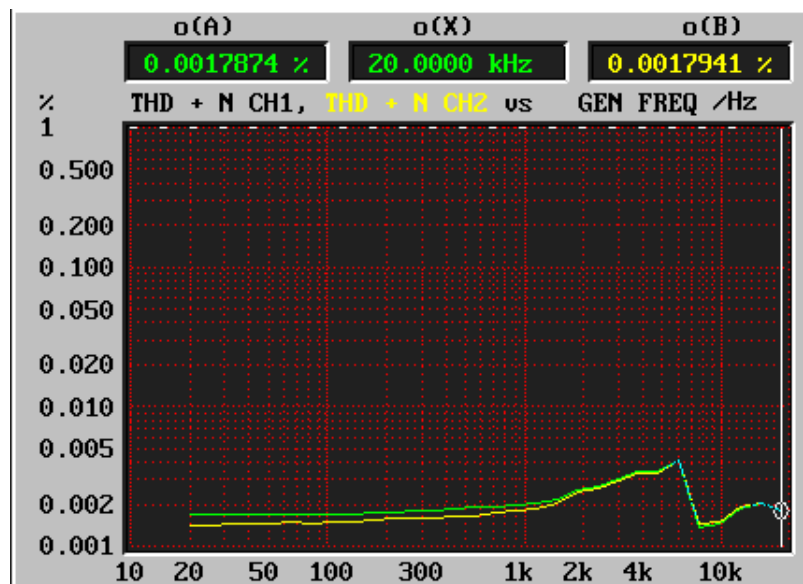


Figure 1-37: RM420-223 A/D-converter: Total distortion (THD+N) against frequency at full scale modulation -1 dB.

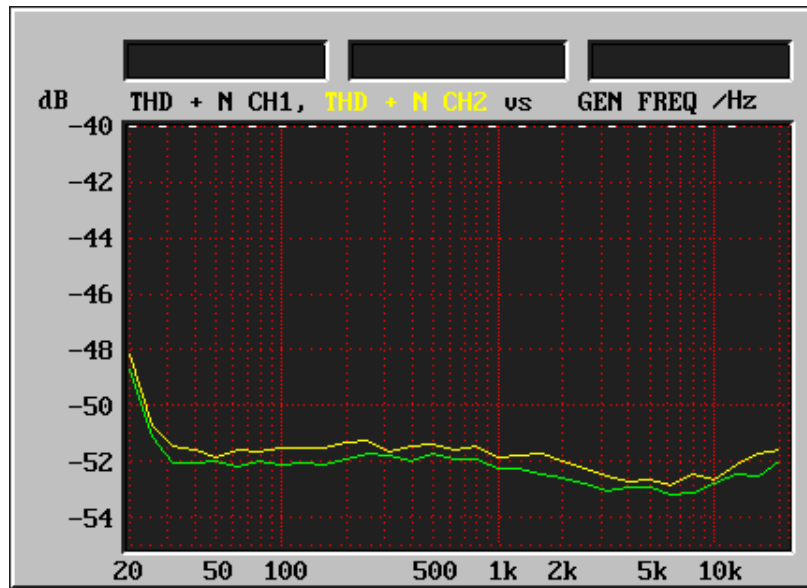


Figure 1-38: RM420-223 A/D-converter: Signal/noise ratio at -60 dBFS, A-rated against frequency.

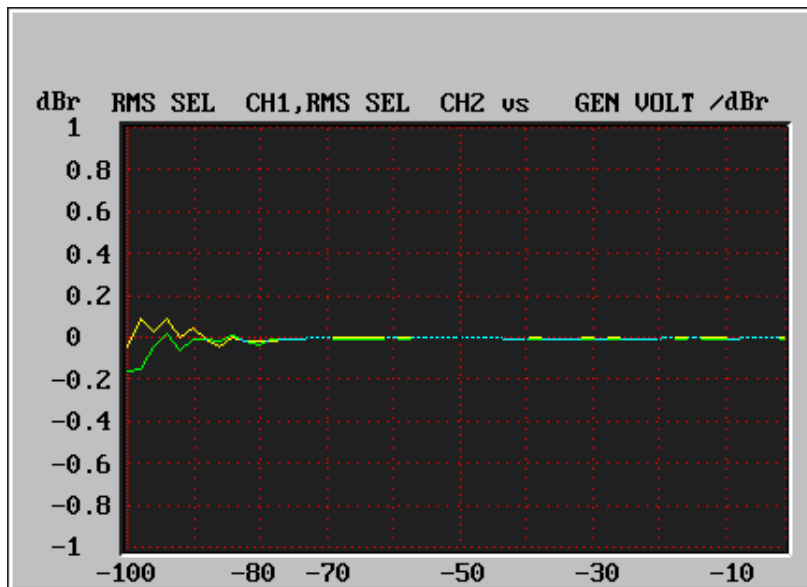


Figure 1-39: RM420-223 A/D-converter: Converter linearity at 1 kHz, 0...-100dBFS.

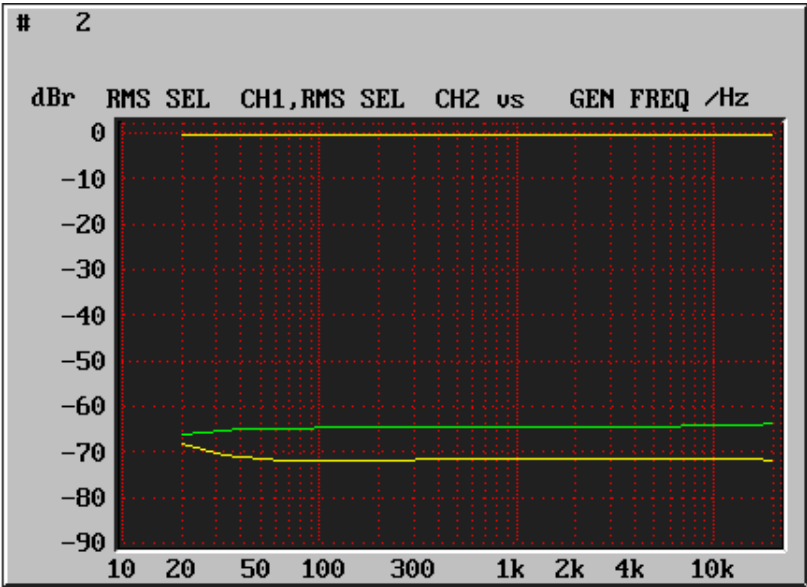


Figure 1-40: RM420-223 A/D-converter: Input unbalance against frequency.

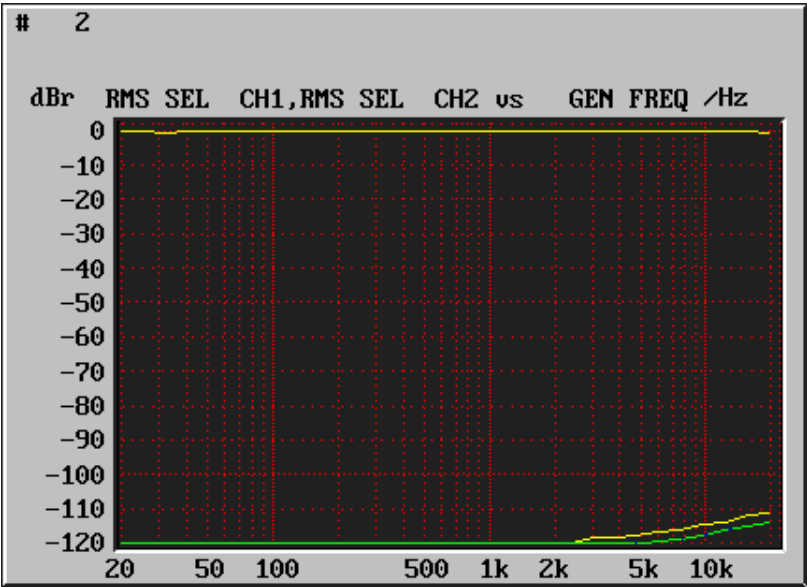


Figure 1-41: RM420-223 A/D-converter: Crosstalk between right and left channel.

## Measurement diagrams RM420-223 D/A-converter

The following diagrams were recorded using an *Audio Precision System One* analyzer.

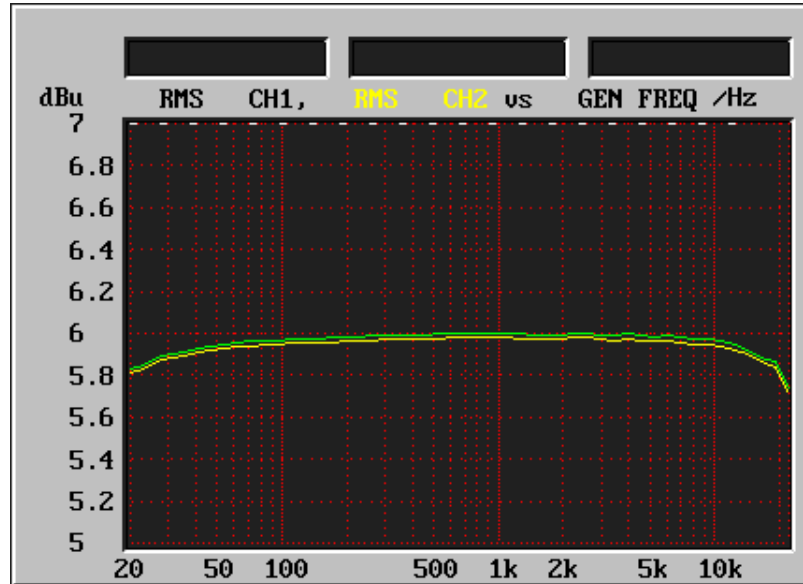


Figure 1-42: RM420-223 D/A-converter: Amplitude frequency response.

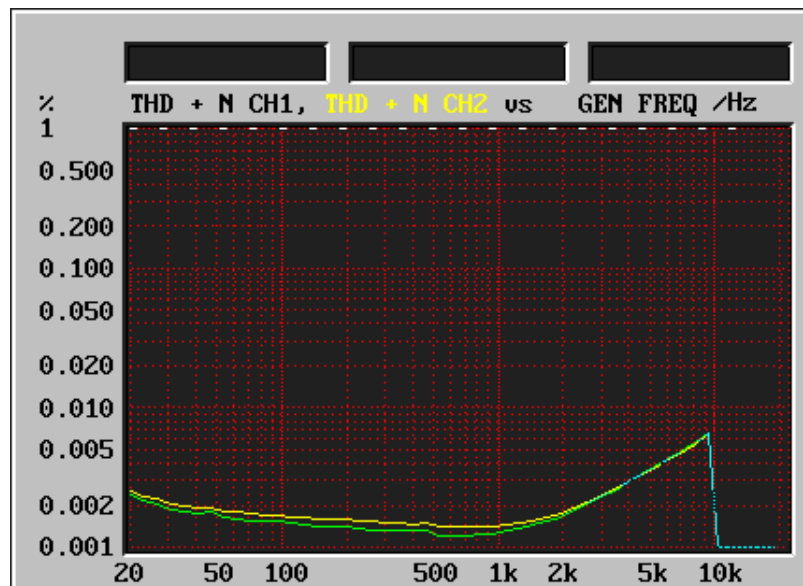


Figure 1-43: RM420-223 D/A-converter: Total distortion (THD+N) against signal frequency at full scale modulation -1 dB.

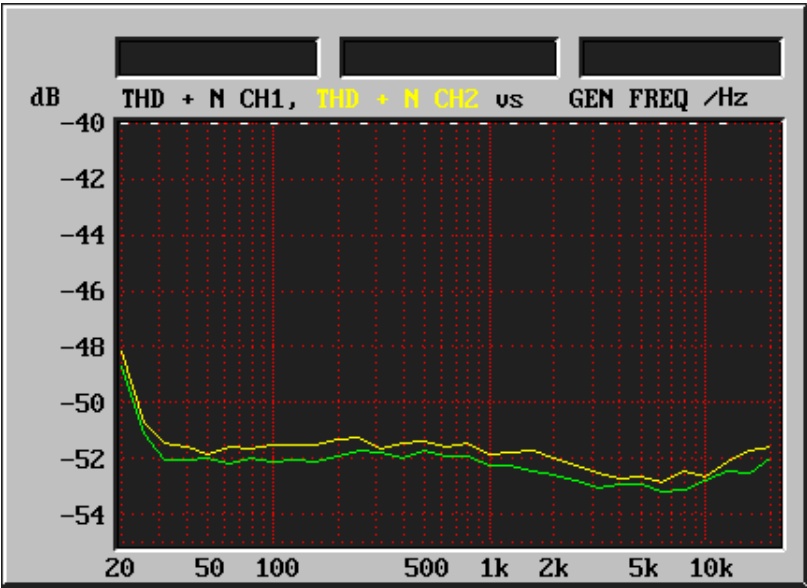


Figure 1-44: RM420-223 D/A-converter: Signal/noise ratio at -60 dBFS, A-rated against frequency.

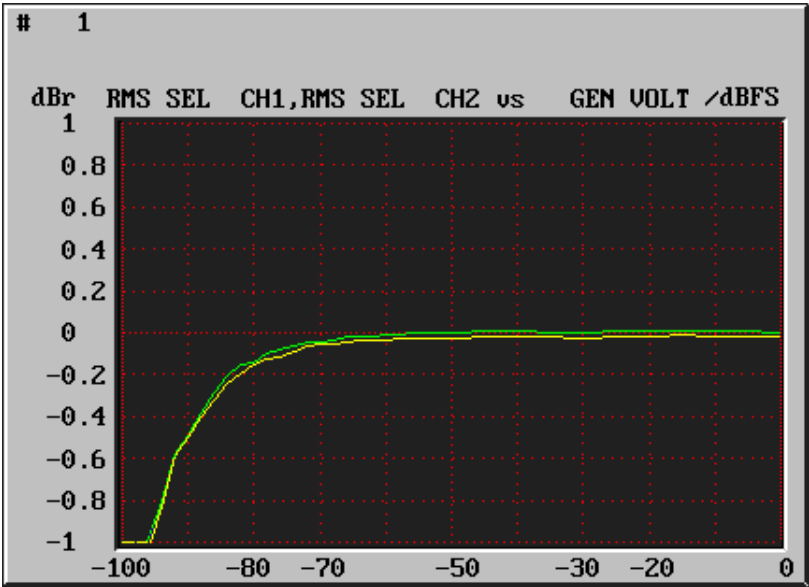


Figure 1-45: RM420-223 D/A-converter: Converter linearity at 1 kHz, 0...-100dbFS.

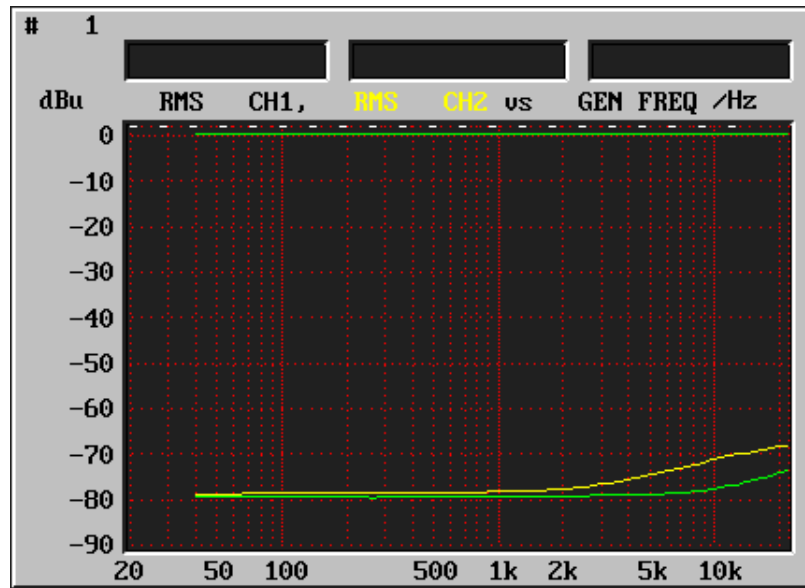


Figure 1-46: RM420-223 D/A-converter: Voltage unbalance (analog outputs) against frequency.

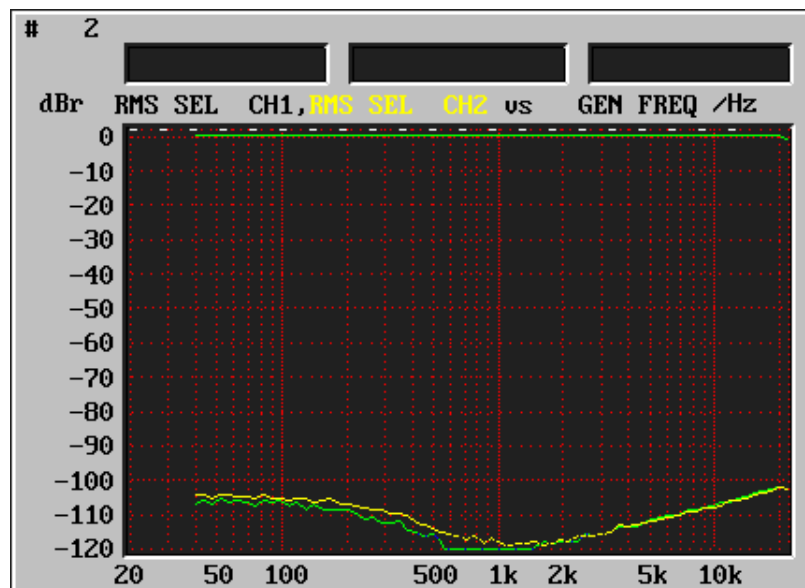


Figure 1-47: RM420-223 D/A-converter: Crosstalk between right and left channel.

## 2 How To Run RM4200D Systems in a Network

### 2.1 Overview

RM4200D systems provide an Ethernet port. This interface – an RJ 45 socket – is located on the Communications & Logic Controller RM420-850. It is a standard Twisted Pair port running on 100 Mbit/s. It complies to the standard 100Base-TX, IEEE 802.3u. Using this port, the RM4200D communicates using the network protocols TCP/IP and UDP.

The Ethernet port is used for two tasks: First, it allows the RM4200D to communicate with one or more Windows PC running DHD application software. Second, several different DSP frames within the same network communicate to each other using Ethernet.



**Important Note:** RM4200D systems need to communicate on a shared network. Especially data packets UDP broadcast traffic needs to flow freely between DSP frames. *If this communication is not reliable, control functions shared between different DSP frames will not work!*

For the Ethernet communication to work properly, several requirements must be met. Please read the following instructions carefully to avoid problems. This is especially true for larger RM4200D installations and complex networks!

### 2.2 Initial Setup

The Ethernet port on the RM420-850 Communications Controller complies to the standard 100Base-TX, IEEE 802.3u. This means, the network connected to it must run at least with a speed of 100 Mbit/s.



**Important Note:** Do not try to connect the RM4200D to a network running on 10 Mbit/s! Even if it looks like this will work, it does in fact not! This operation is neither tested nor recommended by DHD. You should therefore avoid it!

Depending on the firmware version of the RM4200D, the Ethernet port of the RM420-850 Communication Controller operates with different speeds:

Firmware up to Version 5.3.23	Firmware Version 5.3.24 and higher
10/100 Mbit/s	10/100 Mbit/s
Full Duplex	Half Duplex

If you connect other network equipment to the RM4200D, it must be able to handle these specifications. Most current networking hardware does this automatically. However, if you experience connection problems, make sure the requirements are met. This is particularly important if you connect a PC directly to the RM4200D using a crossover Ethernet cable. If you do this, make sure you have set the properties of the network adapter in Windows to the right values. Most network adapters have an “Auto-Detect” option – use this one!



**Important Note:** You can operate several RM4200Ds and Windows-PC running DHD applications within the same network segment. However, you should always use Ethernet switches to connect them to each other. *Do not use older Ethernet hubs or so-called “Switching Hubs”!* Switches provide much better data throughput, because the eliminate collisions between network packets.



If possible, use Ethernet switches that automatically adjust their port speed to the speed of the node connected to a particular port. Also, if you are using VLANs or routers, make sure all devices on a shared network can exchange data on the ports and protocols described in the next section.

### Protocols Used

RM4200D systems use both the protocols TCP/IP and UDP for communication between each other and with DHD application software on Windows PCs. A direct TCP/IP connection is used for data transfer from a RM4200D to a PC or vice versa, e.g. for downloading a configuration or updating the firmware. All optional DHD applications (Access, Route, RC420, Setup Manager) also use direct TCP/IP connections to the RM4200D.

In contrast, UDP is used to transmit control data for the following functions:

- Global Logics.
- Global Potentiometers.
- Global Ressources.
- System messages for display and logging in the Maintenance Window and the DHD Communication Server.

Since the UDP protocol is connectionless, the sending node transmits data onto the network without getting any acknowledge from receiving nodes. Furthermore, the operation system running in the RM4200D does not send UDP packets to certain destination addresses. Instead, it uses *Broadcast addresses* to send its data to all network nodes within the same subnet. All receiving nodes analyse the contents of the received UDP packets and react accordingly, if necessary.



**Important Note:** For the communication to work properly, the network ports *2008, 2009 and 2010* need to be enabled both for *TCP and IP*. Make sure you set up routers, firewalls and security applications on PC accordingly. Also make sure that UDP packets carrying a broadcast address are transmitted correctly. Some up-to-date switches have **Broadcast storm filters** which will block UDP broadcast traffic exceeding a certain limit. Make sure these filters are not affecting the communication of the RM4200D!

### 2.3 Running a RM4200D in a heterogeneous Network

Today, computer networks are used for a great variety of applications. Office printer sharing, access to file servers, streaming of audio and video and also control data for embedded systems (as the RM4200D) runs on the same network infrastructure. Because these networks are so diverse in their use of protocols, they are often called *heterogeneous networks*.

Nodes on such a network are often PCs running Windows, but there can also be printers, networked disk drives or servers running Unix, Linux or any other operation system. All these devices use many different protocols on top of TCP/IP and UDP. For instance, the announcement of services like file sharing or printer services uses UDP broadcasts. For most devices, this works perfectly. However, if an RM4200D is connected to such a mixed network and if the level of UDP traffic becomes too high, this may cause problems for the RM4200D.

Here is why:

Since the RM4200D uses UDP broadcasts for transmitting its control information, each DSP frame on the network must inspect all incoming UDP packets with a broadcast address. This also includes packets from other nodes on the network, for instance Windows PCs

announcing their file sharing services. An RM4200D DSP frame will only react to packets from other DSP frames or DHD software running on Windows PCs. However, it has to inspect any incoming UDP packet, even if it is not sent by a RM4200D system. This inspection uses computing power of the RM420-850 Communications Controller.

Under certain circumstances, a high level of incoming UDP traffic thus can cause data buffers to overflow within the controller. This happens even if the data in the UDP packets is not used, because it was not destined for the RM4200D! In turn, this can cause the controller to delay its main task, which is running the DSP frame. In extreme cases, it may also cause the controller to shut down the Ethernet port completely.



**Important Note:** Therefore, you should avoid running a RM4200D system within a network with too much UDP traffic, since this can cause instability of the Communications Controller.

### Things To Do an Not To Do

To make sure all communication between RM4200D systems and PCs running DHD applications runs smoothly, design your network according to the following rules:

1. Put all RM4200D systems on their own, isolated network. Put all PCs running DHD applications on the same network. Make sure, no “non-DHD traffic” gets on this network.



**Important Note:** Do not run RM4200D systems within an existing office network!

2. Always use *Ethernet-Switches*. Do not use older Ethernet hubs or “Switching Hubs”.
3. Avoid using connections with a speed of 10 Mbit/s. Always use connections with 100 Mbit/s.
4. If you are using a PC, make sure you set its network adapter to “Auto-detect”.
5. UDP broadcasts will only work within the same IP subnet. If different RM4200D systems need to communicate with each other they must have IP addresses within the same subnet.
6. If different RM4200D systems are located within different IP subnets, *they can not exchange data using the UDP protocol*. However, you can still access them from a PC running a DHD application by using their IP address.
7. If you use routers, firewalls etc. make sure network traffic on *ports 2008, 2009 and 2010* is carried both on *TCP and UDP*.

### Connecting to the RM4200D Network

If you need to access the RM4200D systems in their separate network, you need to run DHD application software on one or more PCs connected to this network. Depending on your organisations policies and its IT infrastructure this is sometimes not straightforward.

Therefore, here are some strategies that might work for you:

1. Use a dedicated PC to access the RM4200D systems. Put this PC on the separate network only. If you need to transfer data to and from this PC, use a CD-R or an USB memory stick.
2. Put two network cards in the PC. Connect one to the separate network, the other one to the office network. However, do not turn routing between the two networks on!. Also protect your PC against viruses coming from the office network. While viruses cannot infect DHD systems directly, they can cause heavy network traffic in all networks connected to the infected PC!



**Important Note:** Make sure the PC does not route network traffic between its two network interfaces. On Windows, this feature is called “Internet Sharing”. Turn it *off* using the Network Control Panel in System Preferences.

3. Use a dedicated PC within the separate network. Either put two network cards into this PC or use a router, firewall or VPN solution to connect from the outside to the separate network. Remote control the service PC inside the network with remote control software (PC Anywhere, VNC, Timbuktu etc.)
4. Install a VPN gateway between the separate network and your office network. Set up the VPN in a way that only authorized users and/or authorized PC can connect to the VPN. Either use the VPN clients to control RM4200D systems directly or use them to remote control a service PC inside the RM4200D network.
5. Have no special PC inside the separate network. Use a special service laptop or PC and plug it into the RM4200D network when necessary. Make sure, only authorized users have physical access to the network socket for this PC.



**Important Note:** Make sure you also read Chapter 3.3 – Connecting the Software to the Devices in Part 3 of the RM4200D Documentation (Configuration Manual).

You (or your network administrator) should have the necessary knowledge about all network issues described. If you have any questions, always ask your administrator or read any book on computer networking.

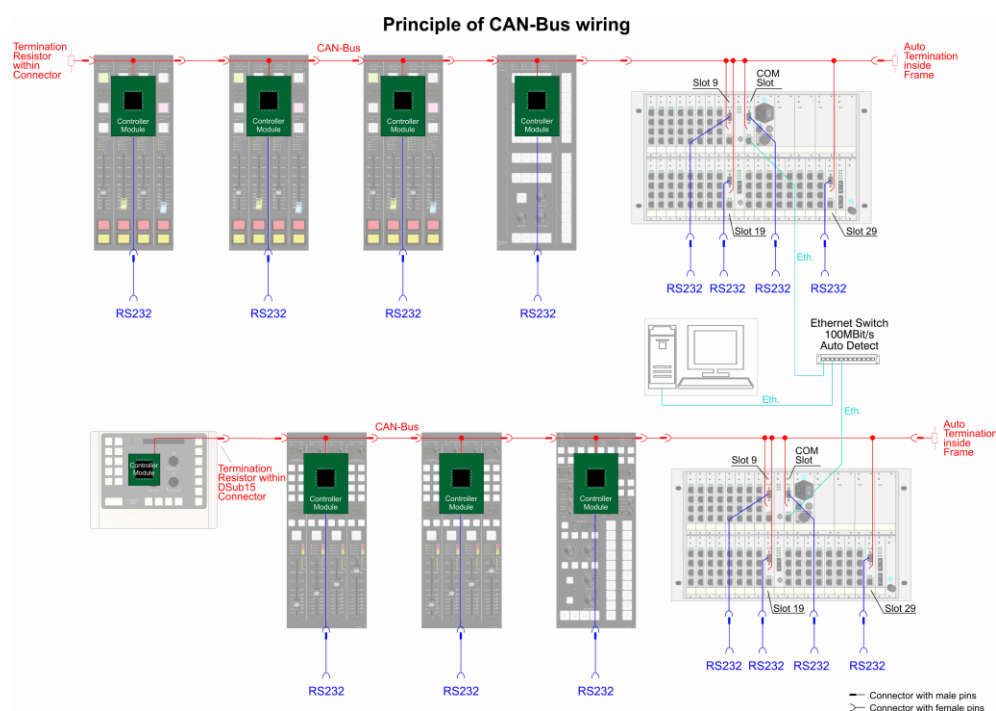
You can also use your favourite Internet search engine or the following links to get more information:

Ethernet:	<a href="http://en.wikipedia.org/wiki/Ethernet">http://en.wikipedia.org/wiki/Ethernet</a>
Internet Protocol - IP:	<a href="http://en.wikipedia.org/wiki/Internet_Protocol">http://en.wikipedia.org/wiki/Internet_Protocol</a>
Subnetz:	<a href="http://en.wikipedia.org/wiki/Subnetwork">http://en.wikipedia.org/wiki/Subnetwork</a>
Transmission Control Protocol - TCP:	<a href="http://en.wikipedia.org/wiki/Transmission_Control_Protocol">http://en.wikipedia.org/wiki/Transmission_Control_Protocol</a>
User Datagramm Protocol - UDP:	<a href="http://en.wikipedia.org/wiki/User_Datagram_Protocol">http://en.wikipedia.org/wiki/User_Datagram_Protocol</a>
Broadcast:	<a href="http://en.wikipedia.org/wiki/Broadcast">http://en.wikipedia.org/wiki/Broadcast</a>

### 3 System Memory Map

#### 3.1 Basics

The RM4200D consists of several modules that are designed for different tasks and depending on the application are used in different combinations. Some of these modules are equipped with a microcontroller to control the functions of the respective module. This way, each module with a microcontroller can work on its own and has its own “intelligence”. However, the complete function of the RM4200D emerges only in cooperation of all modules. They communicate with each others via CAN bus that has to be wired appropriately. The following figure illustrates this:



**Figure 1-48:** This figure illustrates which modules have a microcontroller and how they are interconnected.

As you can see from the figure, all modules with microcontrollers are connected to the CAN-Bus. In addition, each module (except the table-top studio unit RM420-011) have a serial port. All commands transferred via CAN-bus are also available at the serial ports. In addition, the Communications Controller RM420-850 transfers these data also to the Ethernet port.



**Tip:** If you want to use the serial port to connect a PC to a RM4200D, you can connect the PC to *any* serial port. The data traffic is identical at every port. This is sometimes helpful if e.g. a DSP frame is almost out of reach, but the ports of the control modules are easily accessible though.

The following modules have a microcontroller:

- *All control modules (except fader overbridge modules).* All modules making up the user interface of the RM4200D have their own micro controllers. This is true for all but the fader overbridge modules. These modules are “dumb” extensions of the circuit board in the fader module which also controls them. The microcontrollers in the fader modules read the current values of the elements of the user interface (buttons, faders,

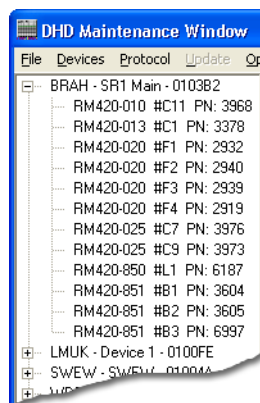
rotary knobs) and transfer them as control signals to the DSP frame. At the same time, they receive commands from the control system and control all display elements respectively – LEDs, alphanumeric displays. In fader modules with motor faders, they also control the motor fader if necessary.

- *DSP Controller RM420-851.* This module is a slot-in card in the DSP frame, it controls an assigned DSP card RM420-848. The DSP controller acts as bridge between audio system and control system and transports the control commands from the CAN bus to the DSP cards. The other way round, it transfers e.g. messages of exceeding levels or correlation problems of stereo signals. Each DSP card in the DSP frame needs an assigned controller, allowing a maximum of three DSP controllers.
- *Communications Controller RM420-850.* This module is a slot-in card in the DSP frame, too. There is only one such controller per DSP frame. It is used to control the DSP frame and also has an Ethernet port. Using this, the DSP frame can communicate via Ethernet with other RM4200D-systems or DHD software on PCs.



**Note:** In the Communications Controller, there is also the memory for the **Setups** as well as the **Parameter RAM** with the current operating parameters of the system. Also, the license codes for the system are stored in here. If you exchange the Communications Controller RM420-850, you may have to transfer this information to the spare part. Please find more information in Part 3 of this manual, *Toolbox 4 Configuration and Reference*.

You can use the **Toolbox4** Software to read out the structure of the modules in a RM4200D. To do this, use the **Maintenance Window** command from the **View** menu. In the tree view on the left, you see all RM4200D devices the software can currently access. Below the entry for each Device, you see all modules that have a microcontroller and can be accessed via the CAN bus.



**Figure 1–49:** A Device consists of several modules. For each module with a microcontroller, the type of the controller, its current ID at the CAN bus and the serial number are displayed.

The microcontroller is the interface between module hardware and the system. In order to be able to fulfill its task, it has to be programmed with the appropriate software. It is the software that carries out the real functions of the RM4200D.

Similar to a desktop PC, the controller software consists of several parts designed for certain tasks. These software parts are located in the memory of the microcontroller and are run as soon as the RM4200D is powered on.

The parts of the software parts directly dependent on each other, together they make up a memory image, the so called Memory Map. The Memory Map consists of five parts:

- *Boot Loader*. This is the basic “startup software”. It is executed by the microcontroller as soon as its operating voltage is switched on or it is resetted. The Boot Loader can not be modified.
- *Firmware*. This is the *operating system* of the modules. It is copied into the flash memory of the microcontroller using the `Toolbox4` software. The firmware contains all necessary functions that make up the RM4200D.
- *Config*. This data describes the system *structure* and the interaction of its components. The Config is created in the `Toolbox4` software and loaded in the RM4200D from there.
- *Setup*. A setup is a “snapshot” of the current condition of the whole system or of some channels.
- *Parameter Memory*. This part of the memory contains the current operating parameters for the RM4200D. It contains e.g. the currents values of the faders, settings for gain, filter and bus assignment of the separate channels.

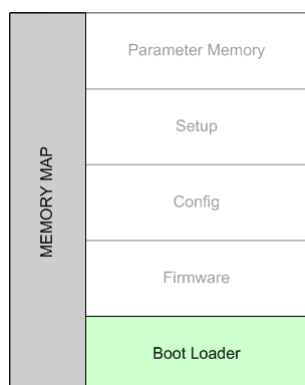


**Note:** All parts of the memory map are stored in the flash memory of the microcontroller. The information is stored also if the system is switched off. The only exception is the Parameter Memory. Its data is stored in a static RAM (SRAM). A large capacitor (“Goldcap”) supplies sufficient support voltage to keep its content for one week.

In the following sections, read more about the parts of the Memory Map.

### 3.2 Boot Loader

After the modules come off the assembly line at the factory, they are equipped with a basic software, the so called **Boot Loader**. This is kind of a “Mini-OS”, supplying the module with some basic functions. The Boot Loader is stored in the “Monitor” segment of the flash memory.



**Figure 1–50:** The Boot Loader is the basic software of the system, it is located on the bottom of the Memory Map.

The Boot Loader contains the following functions:

- Immediately after switching on, the microcontroller identifies itself and the module it is mounted in respectively.
- By use of the Boot Loader, the microcontroller can communicate via the serial port.



- If there is no firmware in the memory of the module yet, the Boot Loader allows the firmware data to be copied via the serial port to the adjacent memory block.
- If there is already a firmware in the memory of the microcontroller, it is started by the Boot Loader. After that, the firmware code is executed; the Boot Loader has done its job.

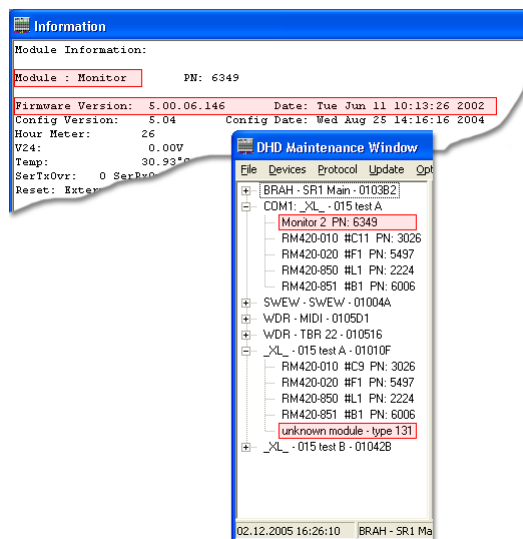
For security reasons, the memory of the Boot Loader can not be accessed by users. After production, the Boot Loader Code is once copied to the memory and kept there forever. This way, it is *always* possible to communicate with a microcontroller via a serial connection. This connection can also be always used to install or update the firmware; even if the data in the memory is faulty or incomplete.

If no valid firmware is available in the next memory block, the startup call for the firmware has failed or booting has been stopped for security reasons, the module remains in the so called **Monitor condition**.



**Important Note:** Do not to mix up the terms *Monitor* with the monitoring of audio signals using a *Monitor bus*. This term comes from the history of computer development and describes the very first, most basic piece of software in a computer system.

You can recognize a module in monitor condition: in the Maintenance Window of the **Toolbox4** software, its ID is replaced by the term **MONITOR** in the tree view. The following figure shows an example for this:



**Figure 1–51:** A module in Monitor condition: The four marked areas illustrate that the Boot Loader is loaded correctly, but there was no firmware started afterwards.

The highlights in the figure show how the condition of a module can be recognized. If only the Boot Loader was loaded, an unknown module is shown in the Device view module tree of the Maintenance Window.

According to the type of connection between PC and DSP frame, the display differs:

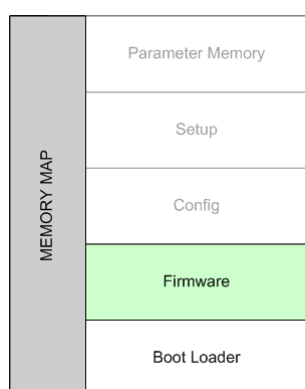
- Ethernet: unknown module
- Serial: Monitor + Prozessor-Seriennummer (PN)

Also, you can have the detailed information of the unknown module displayed. You recognize a module *with Boot Loader but without firmware* by the firmware version 05.00.06.146.

To have the detailed information displayed, highlight the desired module and then press the F11 key. Alternatively, you can also use the **Information** command from the **Device** menu or contextual menu.

### 3.3 Firmware

In the Memory Map, the **Firmware** follows the Boot Loader. This is the actual “Operating System” of the microcontroller, a complex piece of software that is stored in the “Firmware” area of the flash memory.



**Figure 1–52:** The firmware is the operating system of the microcontroller module and vitally necessary for its operation.

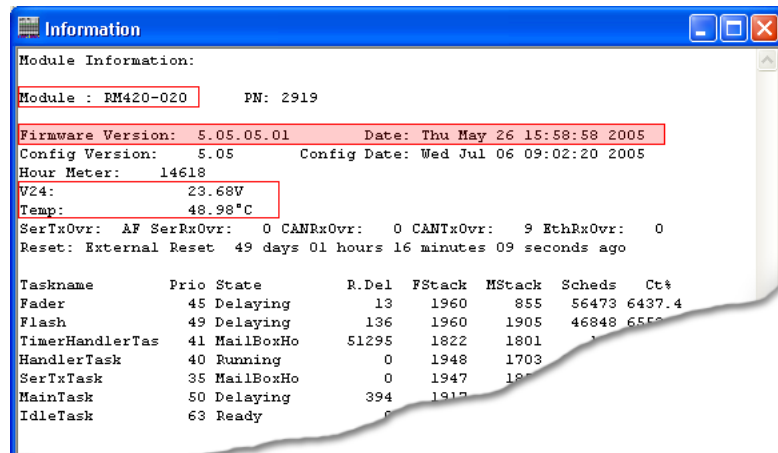
The firmware is loaded after startup of the Boot Loader and after a valid firmware version is recognized in the memory of the microcontroller. This restart happens always after power-cycling the module or after a software reset. (See also „Memory Access at System Reset” on page 55.)

After startup, the firmware checks on which kind of module it is running. This way, it can determine which functions can be executed on this module. It also depends on the configuration, which of the available functions are actually executed on the module. In theory, *all modules of the same version use the same firmware*. According to the kind of module and the configurations used, the functions actually used can vary.



**Note:** If a module has a valid firmware version and if this way successfully loaded by the microcontroller, you can see that in the Maintenance window of the **Toolbox4** software: The corresponding module is displayed with its correct type name in the module tree of the Device.





**Figure 1–53:** If a module has a valid firmware which was loaded correctly by the microcontroller, you can read out detailed module information.

The memory area “Firmware” can be accessed by the RM4200D user, i.e. it can be overwritten. This is necessary if you want to modify the firmware already loaded in the system. This mostly happens if you want to carry out a **firmware update**

The firmware contains information on all available modules and their functions. This is possible since the same type of microcontroller is used on all modules.

To do this, use the Maintenance window of the Toolbox4-Software. In the Update menu, use the command Device Firmware to select a firmware file and transfer it to the RM4200D.



**Important Note:** You must start a firmware update *always* manually. There is no function for automatic firmware updates!

A firmware update becomes necessary, if you want to use a function of the RM4200D that is not yet supported by the firmware currently running in the device. Also, firmware updates correct known software bugs of older versions.

DHD regularly publishes new firmware versions that contain bug fixes or new functions. The firmware is stored in a special file which you can transfer to the modules of RM4200D using the Toolbox4 software. The firmware file can be recognized as follows:

- *File name:* From the filename, you can always tell the version on the contained firmware. Thus, the firmware file belonging to the module information shown above would be called RM4200V05–05–05 .upd, since the version is 05.05.05. (See figure 1–53.)
- *File extension:* A firmware file for a RM4200D has always the extension \* .upd.



**Important Note:** You can obtain notes on modifications and functions of certain firmware versions as well as the current state of development from your DHD dealer or directly from DHD. From there, you can also be provided with firmware updates as files.



**Important Note:** Make sure that *all Modules* of a RM4200D are running with the *same firmware version*. If not, the system can react unpredictably. Different firmware versions in one system can occur, if modules are replaced, which carry a microcontroller with a different firmware version.

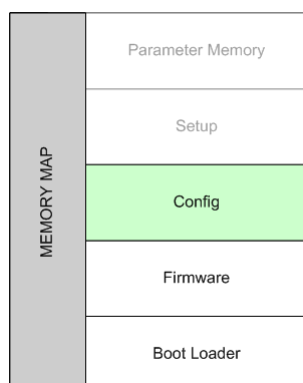
If DHD delivers one or more RM4200D, all modules of this delivery contain the same firmware version. For setting into operation, the most current version or the one recommended by DHD is installed (**Recommended Version**). You find the corresponding firmware file also on the CD enclosed with the RM4200D.



**Tip:** Occasionally, you might use RM4200D modules with initially different firmware versions together. In this case, you *always* have to install a new firmware file to bring all modules up to the same position. It has proven successful to trigger a reset of the Device from the Maintenance window *prior to installing the new firmware*. To do this, use the **Reset** command from the contextual menu of the Device or the appropriate command from the **Device** menu.

### 3.4 Config (Config data)

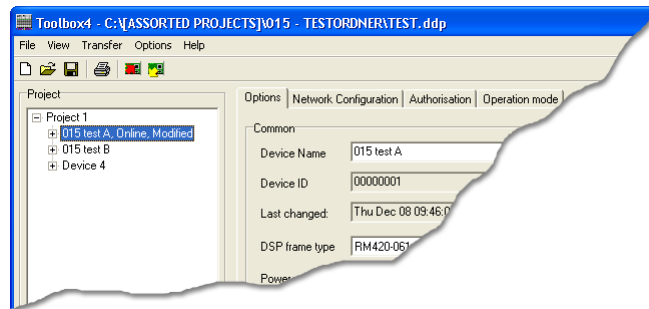
In the next segment of the Memory Map (**Config**), the configurations data is stored. This information describes the “structure” of the RM4200D. As soon as the new firmware is loaded successfully, the configuration data is interpreted next.



**Figure 1–54:** In the Config, the microcontroller learns how the functions of the module are used.

Use the **Toolbox4** software to create or modify the Config. This data structure defines the setup of the RM4200D and determines the cooperation between the components. The functions of the **Toolbox4** software are described in detail in Part 3 of this manual, *Toolbox 4 Configuration and Reference*.

In the **Toolbox4** software, you can manage several Devices as a project. All configuration data is stored in the “Config” memory segment which is located in the flash memory of the microcontroller.



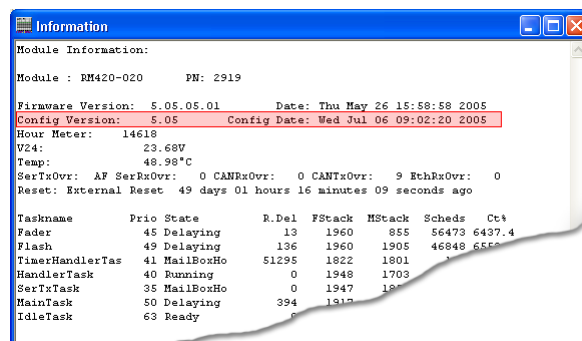
**Figure 1–55:** All configuration data of a Device (marked here) is stored in the Config segment.

With the Toolbox4 software, you as a user can access the *Config* memory segment. Using the commands from the **Transfer** menu, you can overwrite its content (command **Load to Device**) or copy from the Device to the PC (**Load from Device**).



**Note:** At any rate, you have to load the Config data *manually* into the system or copy it from there into the Toolbox4 software respectively. There is no “live update” of the data between PC and RM4200D!

In the Maintenance Window, you can read out information from any module visible on the CAN bus. Using this data you can find out, when the configuration of the module was set up and which version of the Toolbox4 software was used.



**Figure 1–56:** The information under **Config Version** refers to the version of the Toolbox4 software the Config was created with.

In order to make the RM4200D work properly, all modules of the system have to use *exactly identical data for their Config*. Before a microcontroller loads the Config from its own memory segment, it compares it with the Config in the memory of the Communication Controller RM420-850. If both memory segments are identical, it loads the Config from the flash memory of its own module. If not, it copies the data from the Communications Controller first.

Thus, it is ensured automatically that all modules are actually using the same configuration. This is especially important if in an emergency a module has to be exchanged during operation. Then it copies the up-to-date Config from the Communications Controller automatically into its own memory segment.

### 3.5 Setup (Snapshots of the System State)

While the RM4200D is running, the current state of the system is stored in the **Parameter Memory**. Among the stored information are the current bus assignments of signals, the filter settings, the current values of faders and the assignment of available fader channels to the physically available faders. As these parameters change – e.g. the mid frequency of a filter – the corresponding values in the Parameter Memory change as well. (See also „Parameter Memory” on page 53.)

The current state of the Parameter Memory can be “frozen” and saved as a kind of “Snapshot”. This set of data is called **Setup**.

The memory segment “Setup” is not available on all microcontrollers, but only on the Communication Controller RM420-850. All other modules read the necessary information from there. This segment is also located in the flash memory, thus retaining its information also after switching off the device.

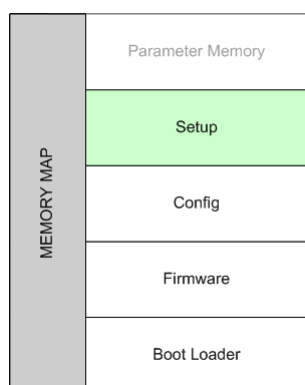


Figure 1–57: Audio parameters are stored in the “Setup” memory segment.

All data of the “Setup” memory segment can be loaded or overwritten during operation.



**Tip:** If you'd like to know exactly, which data are stored in the setups, find out more in chapter 3.6 (“Worth knowing on Setups”) in Part 6 of this manual *Application Software*.

In the Setup memory segment, **Mixer Setups** as well as **Channel Setups** are stored. A Mixer Setup contains data for *all* configured fader channels of a system, whereas in a Channel Setup, only data of *one single* Fader Channel are stored. As a whole, a maximum of 7 Mixer Setups and 250 Channel Setups can be stored.



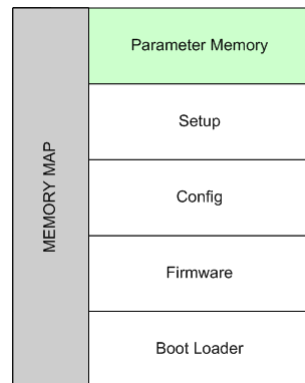
**Note:** Setup 0 or “Default Setup” has a special function: It is loaded on a software reset or if the content of the Parameter Memory is invalid when the DSP frame is switched on. Therefore, you can write Setup 0 *using the Maintenance Window only*, not from the mixer console! (See also „Memory Access at System Reset” on page 55.)

Using the Maintenance Window of the **Toolbox4** software, you can access the Setup memory segment and save or delete setups. You can also define keys on the console, which you can use to store and load setups. Setups can also be stored on chipcards and can be read from them, if a card reader is available in the console.

The most convenient way to setup management is a special software, the **Setup Manager**. This application comes free with every RM4200D. You can also obtain it from your DHD dealer or directly from DHD.

### 3.6 Parameter Memory

The **Parameter Memory** is the last part of the Memory Map. In this memory segment, up-to-date data is stored to control the functions of the RM4200D. Among these are e.g. parameters like filter settings, bus assignments and fader values. The audio system accesses these values permanently to control the signal processing in the DSPs respectively. The control system of the RM4200D writes data into the Parameter Memory, if the user modifies settings at the console or using DHD software on a PC. Therefore, the contents of the Parameter Memory changes permanently, in contrast to the data in the setup that do not change after storing it.



**Figure 1–58:** The Parameter Memory is the last layer in the Memory Map.

For this reason, the memory segment for the parameter Memory is not located in the flash memory, but in the so called SRAM (Static Random Access Memory). This kind of memory loses the data, as soon as it is cut off operating voltage. Therefore, in the RM4200D, the SRAM is supported by a high capacity capacitor (“Goldcap”). This can retain the content of the Parameter Memory for up to one week. Thus, you can interrupt working at the RM4200D, switch it off and continue your work later, without having to save the current state in a Mixer Setup.



**Tip:** When switching it on, the RM4200D measures the voltage at the capacitor to check whether the data is still valid. If the voltage is higher than 2,7 V, the data is correct. If the voltage is lower, the data in the parameter memory is discarded and the Setup 0 is loaded instead. You can read out the voltage at the capacitor, if you use the Maintenance Window of the **Toolbox4** software to have the information of the Communications Controller RM420-850 displayed. The value VRAM displays the current voltage at the goldcap, the value VRAMPOn displays the value when switching on the device. VRAMPOn must be higher than 2,7 V to have the content of the Parameter Memory accepted as valid.

Like the memory segment for Setups, also the Parameter Memory is only available on the Communications Controller RM420-850.

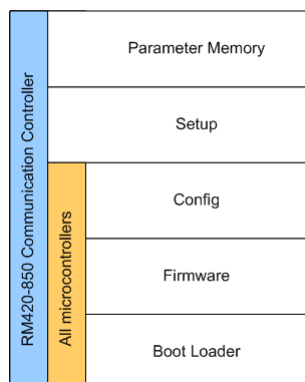


Figure 1–59: The single segments of the Memory Map and their storage locations.

Thus, the following segments of the Memory Map are located *on all microcontrollers*, i.e. also in the Communications Controller RM420-850:

- Boot Loader
- Firmware
- Config

In addition, the following segments are contained on the Communication Controller RM420-850 only:

- Setup
- Parameter Memory



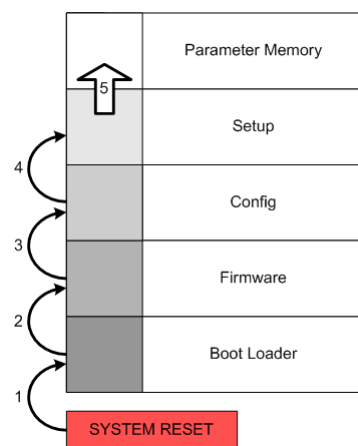
**Important Note:** If you have to replace the Communications Controller RM420-850, make sure to save the Setups stored on it to the PC first. To do this, use the **Setup Manager** software. You can then copy this backup back into the replacement module, thus having the presets available again.

### 3.7 Memory Access at System Reset

The RM4200D can be restarted in two ways: with a **System Reset** or a **System Restart**. The main difference between the two is that at a System Restart, all modules lose their operating voltage and start anew. In contrast, a System Reset restarts a RM4200D, without switching off the operating voltage of the modules.

#### System Reset

At a **System Reset**, the system is restarted while it is already up and running. The single modules are not switched off, the electronic parts keep all operating voltages. The program code of the system software is restarted and the current parameters are reset. Because of this, this event is also called *Software Reset*.



**Figure 1–60:** The loading processes in the memory at System Reset.

You can trigger a System Reset in different ways:

- *In the Maintenance Window of the Toolbox4 software.* Highlight the desired device and press the F12 key. Alternatively, you can also select the **Reset** command from the contextual menu or from the **Device** menu.
- *At the front plate of the DSP Frame.* With a pointed object (e.g. a paper clip), press the reset button.
- *Using a Script.* You can define a script which sends a reset command to the RM4200D. Assign this script to a key, so you can trigger it directly from mixer console.

After a System Reset was triggered, the system is restarted in the following steps (See figure 1–60.):

1. By triggering the System Reset, all modules in the Device are stopped. A Boot Loader is searched for. After it is located, it is started.
2. After a successful start of the Boot Loader, the system checks whether a valid firmware is available in the corresponding memory segment. If so, it is started. If not, the module is stopped in “Monitor” condition.
3. After the firmware loaded successfully, the system checks whether there is the same valid Config on all microcontroller modules. Normally, this should be the case after a System Reset, since the device has been working before. If a module was inserted during operation, it copies the current data from the Communications Controller RM420-850. After thus verification, the Config is loaded.

4. Next, the Communication Controller checks whether a valid Setup 0 is located in the local memory segment “Setup”. If so, it is loaded.
5. By loading Setup 0, its data is copied into the Parameter Memory., All contents is over-written, now the system is ready for operation.

By reading out the module information in the Maintennace Window of the ToolBox4 software, you can find out which kind of reset for the module has been recently carried out and how long it has been working since.

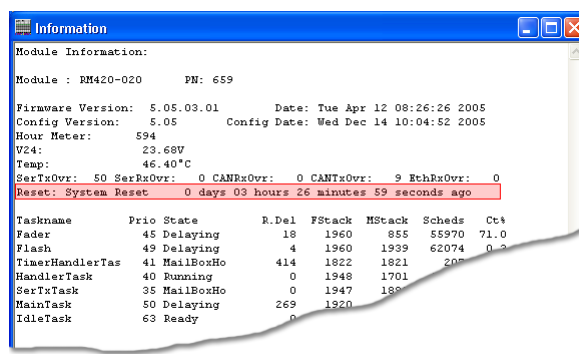


Figure 1–61: This mark illustrates a System Reset at about 3.5 hours ago.

### System Restart

A **System Restart** is carried out when the system is switched off and on again. By switching them all off at the same time using the power switch, of course all modules lose their operating voltage at the same time.

This process is also called **External Reset**, since it does not originate from the system itself but is “externally” forced.

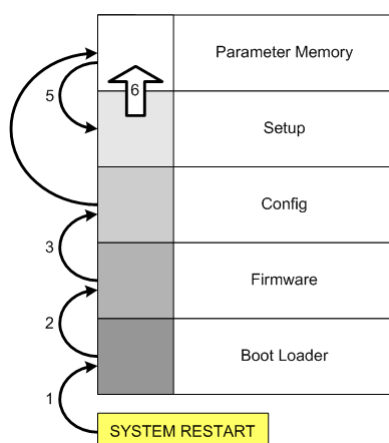


Figure 1–62: The loading processes at System Restart.

An External Reset is either carried out when you switch the device off and on using the power key, or if the line voltage fails for some reason. Hereby, the voltage does not have to beak down completely; a sudden brownout can sometimes not be compensted for by the power supply units.



In both cases it makes sense not to discard the current system settings but to load them again after the restart. The startup process works as follows:

1. The first step after switching on the hardware is a hardware self test which is carried out independently by the modules. If a Boot Loader is available, it is started after that.
2. After successfully starting the Boot Loader, the system checks for a valid firmware in the corresponding memory segment. If so, it is started. If not, the module is in stopped in "Monitor" condition.
3. After loading the firmware successfully, the system checks whether there is the same valid configuration available on all microcontrollers. After a restart, modules that have just been integrated into the system might have to be equipped with the same Config as all the other modules. In this case, the verification and a possible copy process will take a bit longer. After that, the Config is loaded.
4. Next, the Communications Controller RM420-850 checks whether there is valid data in the local memory segment "Parameter Memory". If so, it is loaded. After that, the system is ready for operation and the following steps are not executed.
5. If the data in the Parameter Memory is not valid, the Communications Controller RM420-850 checks whether there is a valid Setup 0 in the memory segment „Setup“. If so, it is loaded.
6. By loading the Setup 0, its data is copied into the Parameter Memory. All contents is overwritten. Now the system is ready for operation.

By reading out the module information, you can check which kind of reset was carried out to a module recently and when this took place.

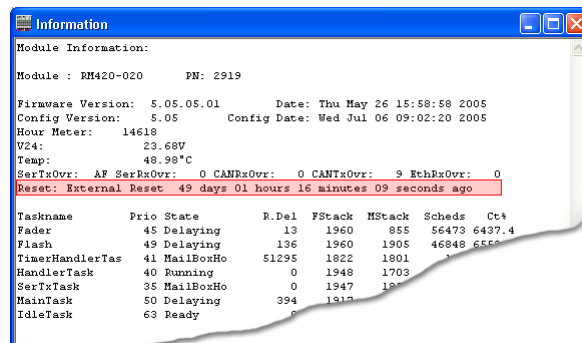


Figure 1–63: This module was switched on for the last time approx. 50 days ago.

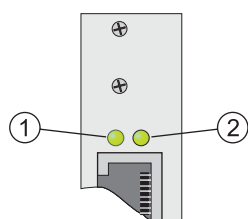
### 4 Monitoring the System Status

#### 4.1 The Meaning of the LEDs

Many modules of the RM4200D have LEDs, which indicate the current module status as well as the status of the whole device. The following information should help you to monitor the system status using the LEDs, also without having to use the DHD software.

##### I/O-Modules (RM420-111, -122, -123, -222, -223, -311)

Each I/O Module has two LEDs with the same function for all modules. The LEDs are located at the upper edge of the module above the RJ45 sockets.

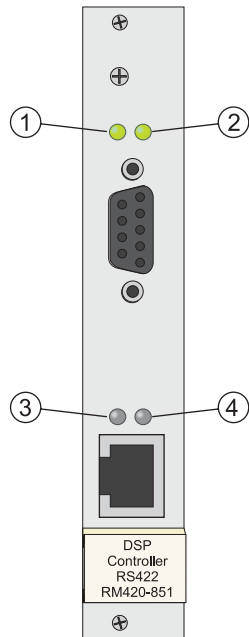


- (1) The left LED indicates whether there is a 5 V operating voltage present at the module. The LED is on constantly, when the module is supplied with the operating voltage and ready for operation.
- (2) The right LED flashes in a quick pulse, as soon as the DSP controller of the backplane (Slot 9, RM420-851) has started successfully and has recognized the corresponding card correctly. The flashing of the right LED of the Modules in the slots 1 - 10 is sequential from left to right. The speed of the sequence depends on the load of the DSP Controller and can vary.

If the right LED flashes slowly, the DSP Controller has not recognized the corresponding module. This happens only if an I/O module has not yet been integrated into the firmware or not been set into operation.

### DSP-Controller RM420-851

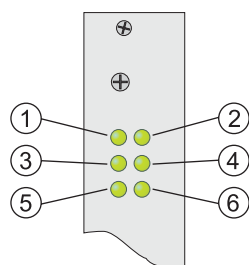
Exactly like the I/O modules, this module has two LEDs at the upper edge of the front plate. In addition, it has two LEDs in the lower part of this plate above the RJ45 socket. These LEDs have no function.



- (1) The left LED indicates whether a 5 V operating voltage is present at the module. The LED is permanently on, if the module is supplied with operating voltage and ready for operation.
- (2) The right LED flashes in a pulse, as soon as the DSP Controller Module is started.
- (3) No function.
- (4) No function.

### DSP Module RM420-848L, M

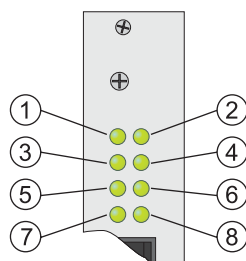
These DSP modules have six LEDs at the upper edge of the front plate.



- (1) The left LED indicates whether a 5 V operating voltage is present at the module. The LED is permanently on, if the module is supplied with operating voltage and ready for operation.
- (2) The right LED flashes in a short sequence, when the DSP controller of the backplane (Slot 9, RM420-851) has started successfully and has recognized the corresponding card. The flashing of the right LED of the modules in the slots 1 to 10 is sequential, so the light seems to run from left to right. The speed of the sequence depends on the load of the DSP controller, it can vary.
- (3) DSP 1 has successfully booted and is ready for operation. The brightness of the LEDs 3 to 5 varies with the load of the corresponding DSPs.
- (4) DSP 2 has booted successfully and is ready for operation.
- (5) DSP 3 has booted successfully and is ready for operation.
- (6) No function.

### DSP Modules RM420-848M with MADI Submodules RM420-421, -422

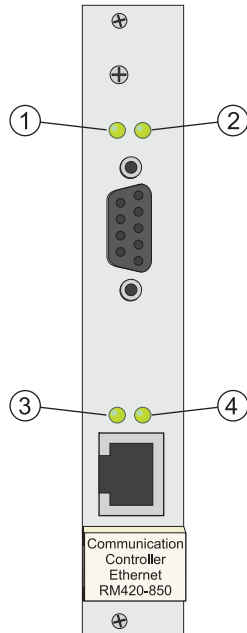
These DSP Modules have eight LEDs at the upper edge of the front plate.



- (1) The left LED indicates whether a 5 V operating voltage is present at the module. The LED is permanently on, if the module is supplied with operating voltage and ready for operation.
- (2) The right LED flashes in a short sequence, when the DSP controller of the backplane (Slot 9, RM420-851) has started successfully and has recognized the corresponding card. The flashing of the right LED of the modules in the slots 1 to 10 is sequential, so the light seems to run from left to right. The speed of the sequence depends on the load of the DSP controller, it can vary.
- (3) DSP 1 has successfully booted and is ready for operation. The brightness of the LEDs 3 to 5 varies with the load of the corresponding DSPs.
- (4) DSP 2 has successfully booted and is ready for operation.
- (5) DSP 3 has successfully booted and is ready for operation.
- (6) No function.
- (7) MADI Port 1 activ.
- (8) MADI Port 2 activ (RM420-422 Dual MADI Submodule only.)

### Communication Controller RM420-850

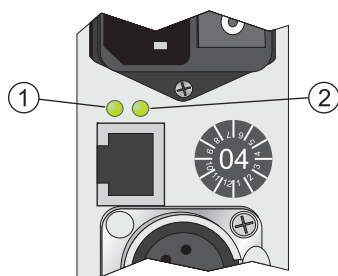
The Communication Controller has four LEDs, two at the upper edge of the front plate and two in the lower part above the RJ45 socket.



- (1) The left LED indicates whether a 5 V operating voltage is present at the module. The LED is permanently on, if the module is supplied with operating voltage and ready for operation.
- (2) The right LED flashes sequentially, when the module starts operating. The flashing of the LED *does not follow* the flashing of the modules in the slots 1 to 10. The flashing frequency depends directly on the load of the controller module and can vary.
- (3) *Network activity:*
  - *Off, but LED 4 is on:* There is a connection open to the network, but no data is transferred.
  - *Flashes:* Data is transferred via the Ethernet port.
  - *Permanently on:* The Ethernet port is very busy, a lot of data is transferred.
- (4) *Network link:*
  - *On:* Link available. The DSP frame is connected to the Ethernet using the RJ45 port.
  - *Off:* No link available. The DSP frame is not connected to the network or there is a problem with the Ethernet cable.

### Power Supply Module RM420-845

The power supply module is available in each DSP frame. It contains a power supply socket and the connector of the CAN bus, a 4-pin XLR socket. The additional RJ45-socket is designed to connect the data line of the CAN bus with an external power supply unit (RM420-081).

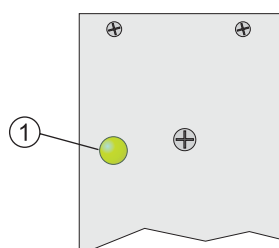


- (1) In normal mode, this LED is off. It is exclusively red, if an external power supply unit (RM420-081) connected to the DSP frame contains at least one defect 24-V power unit RM420-082 (old model!) (the power supply module indicates „DC Fail“). The LED does not indicate if power units of this model are defect in the DSP frame itself.
- (2) This LED is green in normal operation (if an operating voltage of 5V is applied). It indicates that the internal termination of the CAN bus is active in the DSP frame. If you connect an external power unit via the RJ45 socket, the internal termination of the CAN bus is switched off and the LED is off, too. In this case, make sure *that both ends of the CAN bus* are terminated.

### Power Supply Modules RM420-082, -083, -084, -085

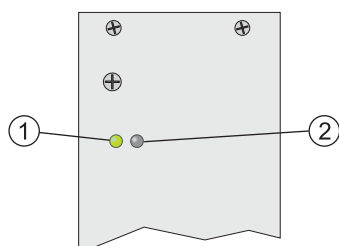
There are two different versions of power supply units for the RM4200D. Currently, the modules RM420-084 (24V) and RM420-083 (5V) are used. Compared with their predecesing models, these modules have only one LED. The old version that is not used any longer was used by the modules RM420-082 (24V) and RM420-085 (5V). These modules are not manufactured any more and are available for exchange only. (See also „Types of Power Supply Units and FAQ” on page 6.)

#### RM420-083, RM420-084 (new modules)



The LED (1) on the front plate is on if the module is supplied with an input voltage (94 – 253VAC) and ready for operation. The LED is off if the module is not supplied with an input voltage or is faulty (DC Fail).

#### RM420-082, RM420-085 (old modules)



- (1) The LED lights green, if the module is supplied with an input voltage (200 – 250VAC) and ready for operation. Despite an attached input voltage the LED is off, if the module is defect and does not supply any output voltage.
- (2) In normal operation, the LED is off. In case of a failure („DC Fail“) the LED is red.



**Note:** On rare occasions, the red LED of this type of power unit is on although there is no failure. This may happen if one of two power units of the same type does not supply any power. This can happen in DSP frames with very few modules. In such cases, the necessary power can sometimes be supplied by one power unit only, the other unit is idle and thus lighting the red LED.

### DSP Frames RM420-064, -063, -062, -061, Front Plate

All DSP frames have several LEDs on their front plate that indicate the current operational status of the RM4200D.



**Important Note:** In the course of its development, the function of different LEDs was modified due to requests by our customers. This way, different firmware revisions can contain different LED functions. In the following sections, the concerned functions are marked respectively. In any case, watch out which firmware version your RM4200D is using! You find the appropriate information in the corresponding sections on the firmware versions.

#### Firmware Version 5.2.16 ... 5.3.26



**Important Note:** The LEDs are controlled by the Communications Controller RM420-850. If this module is not completely initialised when switching on, the LEDs can indicate invalid conditions. In this case, wait some seconds until the display does not change any more. A similar effect can occur if the Communications Controller RM420-850 does not work properly.

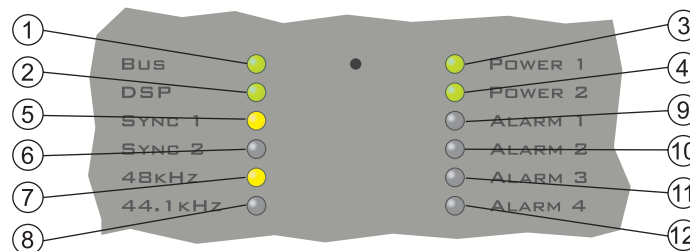


Figure 1-64: The status LEDs on the front plate of the DSP frame.

- (1) *BUS (green)*: The CAN bus is ok.
- (2) *DSP (green)*: All DSP available on the CAN bus work ok.
- (3) *POWER 1 (green)*: The 24 V power supply works ok.
- (4) *POWER 2 (green)*: The 5 V power supply works ok.
- (5) *SYNC 1 (yellow)*: This LED is on if the system is synchronized by the synchronization source 1. You can configure the source in the Config.
- (6) *SYNC 2 (yellow)*: This LED is on if the system is synchronized by the synchronization source 2. You can configure the source in the Config.



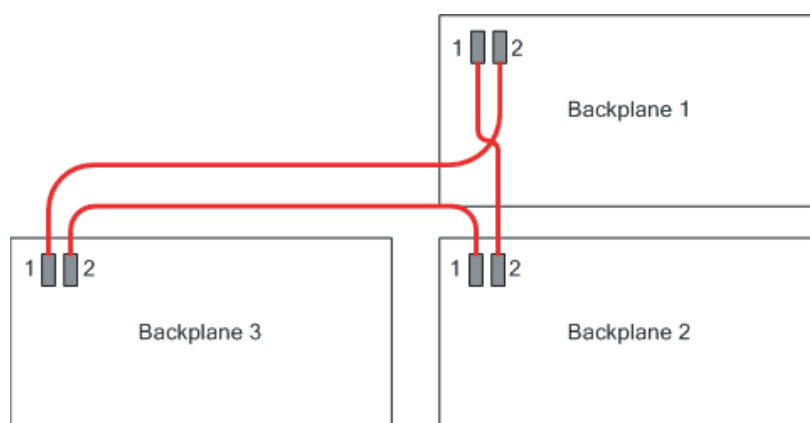
**Note:** The LEDs SYNC 1 and SYNC 2 do never light both at the same time. If both LEDs are off, there is no signal at the configured synchronization sources. In this case, the system is synchronized internally. A change of the synchronization source during operation is marked with the entry „Synchronisation Source now <1 oder 2>“ in the log file.

- (7) *48 kHz (yellow)*: The system is clocked with 48 kHz (measured value, 48 kHz +/- 500 Hz).
- (8) *44.1 kHz (yellow)*: The system is clocked with 44,1 kHz (measured value, 44,1 kHz +/- 500 Hz).



**Note:** The LEDs 48 kHz and 44.1 kHz do never light at the same time. If both LEDs are off, the RM4200D receives a varispeed clock from an external synchronization source which is out of the measurement range named above.

- (9) *ALARM 1 (red)*: No function.
- (10) *ALARM 2 (red)*: Since firmware version 5.3.26 without function. Before, faulty function in at least one DSP.
- (11) *ALARM 3 (red)*: This LED is on if the clock frequency in at least one DSP differs from the target value by more than 20 Hz.
- (12) *ALARM 4 (red)*: This LED is on if an audio link between the two backplanes is interrupted.



**Figure 1–65:** The audio links between the three backplanes of the DSP frame.

The DSP frame consists of several *backplanes*. A backplane is the basic circuit board that carries all modules. On each backplane, there is one DSP module with a DSP controller assigned to it. Each DSP module processes the signals of the I/O modules on the same backplane.

A DSP frame has either one (3 U case) or three backplanes (6 U case). The backplanes are interconnected using serial high speed busses, the so called audio links. The appropriate cables are located behind the front plate of the DSP frame. The connectors of the cables are equipped with clamps to avoid falling off.

The audio links are used to exchange the RM4200D audio signals between different DSP cards. In order to make this work properly, the backplanes must work together synchronized on the same clock. For this purpose, backplane 1 (top) is the master giving the clock. The other backplanes are slaves respectively.

If an “audiolink is interrupted” it means that the correct data exchange on the lines between the DSP cards is jammed due to synchronization problems between the backplanes. In the



logfile of the DHD communication server, messages like “DSP Card <x> Link failed AudioLink <y>” appear.

This error status can have the following reasons:

- The synchronization source is changed and the backplanes have not been synchronized yet.
- At least one of the DSP controllers on the interconnected backplanes does not work at all or is faulty.
- A DSP card has been removed and inserted during operation.

### Firmware Version 5.4.0 ... 5.4.11



**Important Note:** The LEDs are controlled by the Communications Controller RM420-850. If this module is not completely initialised when switching on, the LEDs can indicate invalid conditions. In this case, wait some seconds until the display does not change any more. A similar effect can occur if the Communications Controller RM420-850 does not work properly.

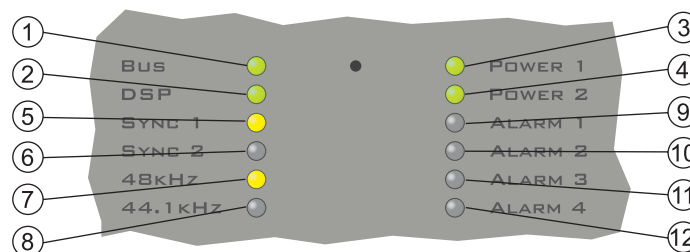


Figure 1–66: The status LEDs on the front plane of the DSP frame.

- (1) *BUS (green)*: The CAN bus works ok.
- (2) *DSP (green)*: All DSPs available on the system work ok.
- (3) *POWER 1 (green)*: The 24 V power supply works ok.
- (4) *POWER 2 (green)*: The 5 V power supply works ok.
- (5) *SYNC 1 (yellow)*: This LED is on if the system is synchronized by the synchronization source 1. You can configure the source in the Config.
- (6) *SYNC 2 (yellow)*: This LED is on if the system is synchronized by the synchronization source 2. You can configure the source in the Config.



**Note:** The LEDs SYNC 1 and SYNC 2 do never light both at the same time. If both LEDs are off, there is no signal at the configured synchronization sources. In this case, the system is synchronized internally. A change of the synchronization source during operation is marked with the entry „Synchronisation Source now <1 oder 2>“ in the log file.

- (7) *48 kHz (yellow)*: The system is clocked with 48 kHz (measured value, 48 kHz +/- 500 Hz).
- (8) *44.1 kHz (yellow)*: The system is clocked with 44,1 kHz (measured value, 44,1 kHz +/- 500 Hz).



**Note:** The LEDs 48 kHz and 44.1 kHz do never light at the same time. If both LEDs are off, the RM4200D receives a varispeed clock from an external synchronization source which is out of the measurement range named above.

- (9) *ALARM 1 (red)*: Nofunction.
- (10) *ALARM 2 (red)*: No function.
- (11) *ALARM 3 (red)*: This LED is on if the clock frequency in at least one DSP differs from the target value by more than 20 Hz.
- (12) *ALARM 4 (red)*: This LED is on if an audio link between two backplanes is interrupted.

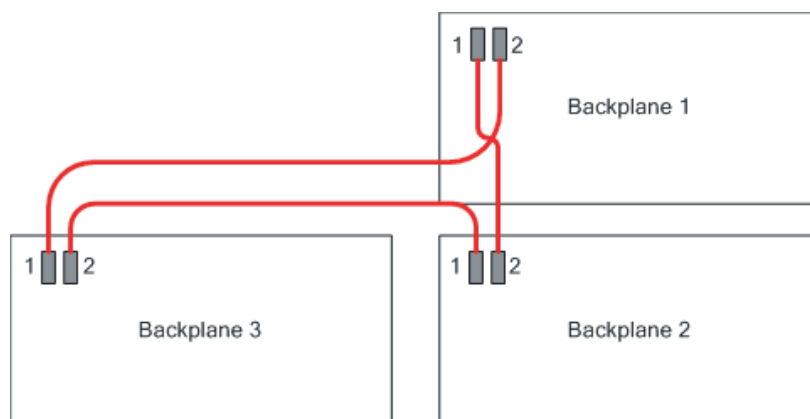


Figure 1–67: The audiolinks between the three backplanes of a DSP frame.

The DSP frame consists of several *backplanes*. A backplane is the basic circuit board that carries all modules. On each backplane, there is one DSP module with a DSP controller assigned to it. Each DSP module processes the signals of the I/O modules on the same backplane.

A DSP frame has either one (3 U case) or three backplanes (6 U case). The backplanes are interconnected using serial high speed busses, the so called audio links. The appropriate cables are located behind the front plate of the DSP frame. The connectors of the cables are equipped with clamps to avoid falling off.

The audio links are used to exchange the RM4200D audio signals between different DSP cards. In order to make this work properly, the backplanes must work together synchronized on the same clock. For this purpose, backplane 1 (top) is the master giving the clock. The other backplanes are slaves respectively.

If an “audiolink is interrupted” it means that the correct data exchange on the lines between the DSP cards is jammed due to synchronization problems between the backplanes. In the

logfile of the DHD communication server, messages like “DSP Card <x> Link failed AudioLink <y>” appear.

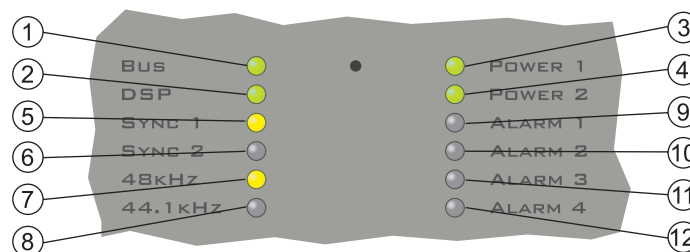
This error status can have the following reasons:

- The synchronization source is changed and the backplanes have not been synchronized yet.
- At least one of the DSP controllers on the interconnected backplanes does not work at all or is faulty.
- A DSP card has been removed and inserted during operation.

*From Firmware Version 5.5.0*



**Important Note:** The LEDs are controlled by the Communications Controller RM420-850. If this module is not completely initialised when switching on, the LEDs can indicate invalid conditions. In this case, wait some seconds until the display does not change any more. A similar effect can occur if the Communications Controller RM420-850 does not work properly.



**Figure 1–68:** The status LEDs on the front plate of the DSP frame.

- (1) *BUS (green)*: The CAN bus works ok.
- (2) *DSP (green)*: All DSPs available in the system work ok.
- (3) *POWER 1 (green)*: The 24 V power supply works ok.
- (4) *POWER 2 (green)*: The 5 V power supply works ok.
- (5) *SYNC 1 (yellow)*: This LED is on if the system is synchronized by the synchronization source 1. You can configure the source in the Config.
- (6) *SYNC 2 (yellow)*: This LED is on if the system is synchronized by the synchronization source 2. You can configure the source in the Config.



**Note:** The LEDs SYNC 1 and SYNC 2 do never light both at the same time. If both LEDs are off, there is no signal at the configured synchronization sources. In this case, the system is synchronized internally. A change of the synchronization source during operation is marked with the entry „Synchronisation Source now <1 oder 2>“ in the log file.

- (7) *48 kHz (yellow)*: The system is clocked with 48 kHz (measured value, 48 kHz +/- 500 Hz).
- (8) *44.1 kHz (yellow)*: The system is clocked with 44,1 kHz (measured value, 44,1 kHz +/- 500 Hz).



**Note:** The LEDs 48 kHz and 44.1 kHz do never light at the same time. If both LEDs are off, the RM4200D receives a varispeed clock from an external synchronization source which is out of the measurment range named above.

- (9) *ALARM 1 (red)*: Power Supply Failed. This LED is on if at least one power supply unit of the DSP frame has failed.
- (10) *ALARM 2 (red)*: External Power Supply Failed. This LED is on if at least one power supply unit in the external power unit RM420-081 has failed. (The external power unit is optional and not with every RM4200D available!)
- (11) *ALARM 3 (red)*: Temperature too high. The control modules of the console have a sensor monitoring the temperature on the microcontroller. If this rises OVER 60 °C, the LED lights up. (Since firmware version 5.5.7, this threshold value has been increased to 65 °C.)
- (12) *ALARM 4 (red)*: Control Module Voltage too low. This LED is on if in at least one module of the console the supply voltage is lower than 20 V DC.



**Important Note:** All alarm messages create entries in the log file accordingly. *This is also true for all messsages displayed using LEDs up to firmware version 5.5.0.)*

### Control Modules RM420-010, -012, -014

The status of the RM4200D is not only indicated at the DSP frame, but also on the central control modules RM420-010, -012 and -014. The LEDs are located at the top edge of the module.



**Note:** Although there are LEDs labelled **ALARM** in the console, they are not used. The reason for this is that some alarm states do only occur very rarely and only for a short time, which is not critical. These conditions are not indicated at the console to not irritate the user.



Figure 1–69: The LEDs in the central control module RM420-010.

The LEDs in the module RM420-010 indicate the following conditions:

<b>LIM 1:</b>	No function.
<b>LIM 2:</b>	No function.
<b>SYNC 1:</b>	This LED is on if the system is synchronized by the synchronization source 1. You can configure the source in the Config.
<b>SYNC 2:</b>	This LED is on if the system is synchronized by the synchronization source 2. You can configure the source in the Config.
<b>48 kHz:</b>	The system is clocked with 48 kHz (measured value, 48 kHz +/- 500 Hz).
<b>44.1 kHz:</b>	The system is clocked with 44,1 kHz (measured value, 44,1 kHz +/- 500 Hz).
<b>State 1:</b>	No function.
<b>BUS:</b>	The CAN bus works ok.
<b>DSP:</b>	All DSPs available in the system work ok.
<b>ALARM1:</b>	No function.
<b>ALARM2:</b>	No function.
<b>ALARM3:</b>	No function.

## Kapitel 4: Monitoring the System Status

The LEDs in the control modules RM4200D 420-012 and -014 indicate the following conditions:

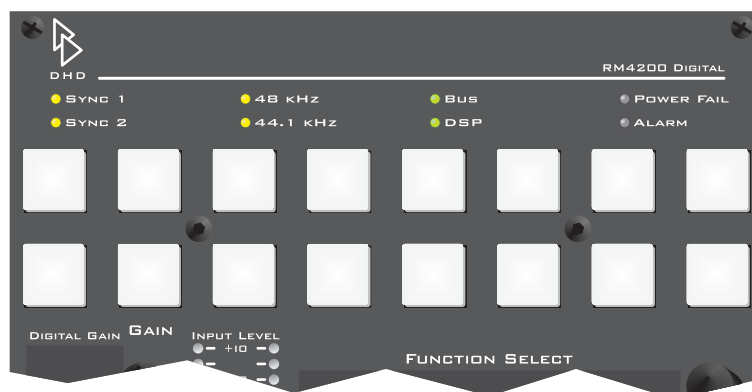


Figure 1–70: The LEDs in the control module RM420-012. The module RM420-014 has identical LEDs.

<b>SYNC 1:</b>	This LED is on if the system is synchronized by the synchronization source 1. You can configure the source in the Config
<b>SYNC 2:</b>	This LED is on if the system is synchronized by the synchronization source 2. You can configure the source in the Config
<b>48 kHz:</b>	The system is clocked with 48 Hz (measured value, 48 kHz +/- 500 Hz).
<b>44.1 kHz:</b>	The system is clocked with 44,1 kHz (measured value, 44,1 kHz +/- 500 Hz).
<b>BUS:</b>	The CAN bus work ok.
<b>DSP:</b>	All DSPs available in the system work ok.
<b>POWER FAIL:</b>	No function.
<b>ALARM:</b>	No function.

### Fader Modules RM420-020, -029

Each fader of a module RM420-20 or RM420-029 has several displays for certain states. The following table shows the details.



*OVERLOAD/ERR: LED in two colors*

<i>Signal type</i>	<i>color</i>	<i>Meaning</i>
analog	green	Signal available, input not overdriven (RM420-020).
	red	Signal available, input overdriven (RM420-020).
	off	No function for RM420-029, since level indicator located next to the fader.
digital	green	Valid signal available (RM420-020).
	red	No valid signal available
	off	Valid signal available (RM420-029).



### *GAIN/PHASE:*

This LED lights yellow if one or more of these conditions are true:

- GAIN not set to 0 dB.
- Analog GAIN not set to 0 dB.
- PHASE is active.
- PHANTOM POWER is active.

### *PAN/BAL:*

This LED lights yellow if one or more of these conditions are true:

- PAN/BAL not in neutral position (0).
- LL is active.
- RR is active.
- MONO is active.
- MONO -3 dB is active.
- MONO -6 dB is active.

### *EQs:*

This LED lights yellow if one or more filters are active (ON):

- EQ is active.
- SUBSONIC is active..
- VAR Low/Hipass is active.

### *DYNAMICS:*

This LED lights yellow if the dynamic processing is active. The following functions make the LED light up:

- COMPRESSOR is active.
- LIMITER is active.
- EXPANDER is active.
- NOISE GATE is active.
- DEESSER is active.
- DEESSER 2 is active.

### *PROGRAM 1:*

The fader signal is switched on program bus 1.

### *PROGRAM 2:*

The fader signal is switched on program bus 2.

### *AUX 1-4:*

The fader signal is switched on Aux Bus 1-4.



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DHD

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DHD Deubner Hoffmann Digital GmbH  
Haferkornstrasse 5  
04129 Leipzig  
— Germany —

Phone: +49 341 5897020  
Fax: +49 341 5897022

For online manuals, support and updates please visit:

[www.dhd-audio.com](http://www.dhd-audio.com)