

# Digital Mixing and Routing System

RM4200D

— Manual —

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## Part 3

### Toolbox4 Configuration and Reference

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## III. Toolbox 4 Configuration Reference

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### About this Book

This part of the RM4200D manual explains the use of the configuration software `Toolbox4`. This program is used for the configuration of all system functions and for adjusting these functions to their specific use. Additionally, the software can be used for special maintenance and service functions of already configured systems (the so called “Maintenance Functions”).

The `Toolbox4` software is used by DHD, its partners and specifically trained service personnel.



**Note:** The `Toolbox4` software is designed *exclusively* for the configuration and maintenance of RM4200D systems by authorized personnel. *It is not required for the daily use of the system and is not to be used by end users.* Access to the program should therefore be regulated via access control mechanisms in operating systems and networks.

The software was developed for use on Windows XP. The use with other Windows operating systems has not been tested and can lead to restrictions (e.g. in graphic display).



**Caution:** The firmware of the RM4200D and the functions of the `Toolbox4` software are closely related to each other. Please make sure that only matching versions of firmware and `Toolbox 4` software are used together. (Find more information on that topic later in chapter 1.)

This book was last changed on March, 27th 2006.

## 1. Overview

A **DSP Frame** is the central component of each RM4200D. It is either used stand-alone (e.g. as a signal router) or connected via CAN-Bus to one or more Control modules. Each RM4200D system contains *one single* DSP frame.

Several RM4200D systems can be operated together. A typical setup would include several studios which are interconnected using a central router. In such an application, the RM4200D in the studios have control Consoles, whereas the router system has no Console. The studio DSP frames are connected to the central router using MADI and Ethernet to exchange audio and control signals.



**Important Note:** Any DSP frame can be connected to *one CAN bus only!* It is therefore not possible to operate more than one DSP frame on the same CAN bus!

### 1.1 Setting up the software

The `Toolbox4` software is a normal Windows program. It does not require any additional DLLs or other files. For installation, copy the program file on to the hard drive of your PC. To remove the program, just delete its program file. Start the software by opening the file `Toolbox4.exe`.

You can use the software without the RM4200D hardware, e.g. to change or check configurations “offline”. However, in most cases the configuration PC is connected to the RM4200D – either using TCP/IP over Ethernet or a direct serial connection.



**Note:** Using Ethernet to connect the `Toolbox4` software to the RM4200D is faster and more convenient, but it requires the correct configuration of the IP addresses. (See “Configuration of IP Addresses” on page 16.)

### 1.2 Devices and Projects

A RM4200D consists of *one* DSP frame or of *one* DSP frame with Control Modules *connected via CAN bus*. In the following, a system like that will be called a **Device**. (Find more details in the volume *System Reference* of this manual.)

Several Devices can be coupled via Ethernet and the **UDP protocol** and are able to exchange **Global Functions** if configured correctly. Global Functions are **Global Logics** and **Global Potentiometers**.



**Note:** Global Logics mean that a RM4200D can control parts of another RM4200D. To enable that, both systems have to be configured appropriately and be able to exchange data via the UDP protocol.

Generally, each Device works independently from all other Devices. If a Device is switched off or disconnected from other Devices, only the exchanged functions stop working.

To make the configuration process easier and secure the assignment of the Devices, the Devices belonging together are managed by the `Toolbox4` software within one **project**. Each project has a **Project ID** which is the same for all Devices in the project. It is saved in all Devices of a project during the upload. When creating a new project, its ID is generated by a random number generator, but it can be changed by hand afterwards.



**Important Note:** If Global Functions are to be exchanged between two or more RM4200, the Project IDs of the Devices must be identical. If this is not the case, the Global Functions do not work.

On the other hand, several RM4200D projects do not influence each other in a network, if they have *different* Project IDs.

Only the Global Logics 1 to 50 can be exchanged via the serial RS232 port of the RM4200D. This communication is compatible to the predecing product RM3200D. Global Potentiometers are not supported by the serial port of the RM4200D.

If several RM4200D are connected with each others, the audio connections they have in common (MADI, Analog, Digital AES3/EBU) can be managed easier using **Device Links**. This works only when the connected Devices are located in the same project. (See “Device Links” on page 46.)

### 1.3 Configuration Data

The configuration software generates a *set of configuration data*, the so called **Config**. This Config contains the whole configuration of a RM4200D that is specific to a customer or an application. Please not that *one Config* contains the information for *one Device*.

A Config is stored on all micro controllers of their Device in the Flash-EEPROM. It is transferred to and from the Device over TCP/IP and Ethernet or over a serial RS232 connection. The corresponding Toolbox4 commands are `Load to Device` and `Load from Device`. Thus, it is possible to read a Config out of a device and edit it in the Toolbox4 software. (See “Transfer Menu” on page 14.)



**Important Note:** Before you can load a Config into a RM4200D, all modules of the Config must be connected to the CAN-Bus. They also must contain the same version of the firmware.

The Toolbox4 software can read out Config data from a RM4200D and write it back. This data can be stored in files as well. If a project consists of several Devices, their Configs are managed in a project file. In the software, this structure is displayed in the project tree on the left. On top of the tree, you find the name of the project, underneath are one or more devices with the assigned device names. (See “The Project Tree” on page 46.)

Besides, you can save the Config of any *single* Device in a **Device Config File**. These files are used to copy Devices Configs from an already existing project into another one. (See also “Extract Device to File” on page 7.)

The file extension of a project file is **.ddp**, the one of a file with just a single Device Config is **.ddf**.



**Note:** Devices that are to exchange Global Logic Functions or Global Potentiometers with each other must have identical project IDs. Although the Project IDs can be set manually in several Device Config files, this is not recommended. In order to avoid errors in the configuration process, you should work with Project Files exclusively.



**Caution:** Device Config files are mainly used to copy already configured Devices from other projects into a new or already existing one. This way, already defined Global Functions can be overwritten by data copied from other projects.

The structure of a Config file is closely related to the firmware of the RM4200D. Therefore, an update of the firmware often requires an update of the Toolbox4 software and vice versa.

Generally, the data structure of the Config tolerates version changes. Config files generated with an older version of the Toolbox4 software can always be opened and modified in a newer version of Toolbox4.

But if a Config file that was generated with a newer version is opened in an older version of Toolbox4, those functions that were edited in the newer version cannot be recognized and modified. An update of the Toolbox4 software is not necessary if the firmware update of RM4200D did only fix errors but did not add any new functions.



**Important Note:** To avoid problems, you should always use matching versions of firmware and the Toolbox4 software. It is especially important to check this when changing individual modules of the RM4200D. The firmware of the modules can be updated using the Toolbox4 software. (See “Maintenance Window” on page 8.)

The matching versions of Toolbox4 and firmware as recommended by DHD can be found in the support area of the DHD website at

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

### 1.4 Example for the Configuration Process

It is a complex process to configure a RM4200D, and there are numerous ways to get it done. Often, there is not set order of the individual steps. Despite this, the following list offers a suggestion for how to configure a “brand new” RM4200D. The list is neither complete nor is it very detailed, but it offers a rough overview of the configuration process:

1. Set the general options for the RM4200D Device. (See “Device Properties” on page 59.)
2. Select the desired slot cards for the DSP frame and assign the labels for audio and control signals. (See “DSP Frame I/O — Configuring the DSP Frame” on page 70.)
3. Place the desired modules in the mounting frame and assign functions to the keys of the Console. (See “Console – Configuring the Console” on page 78.)
4. Configure the Audio System with monitors, internal buses, Fader Channels and so on. (See “Configuring the Audio System” on page 125.)
5. Configure the Logic System to include key functions, GPIOs etc. (See “Configuring the Logic System” on page 186.)
6. Connect the audio signals and logic functions to Output Functions. (See “Output Functions” on page 169.)
7. Route the audio signals on the TDM bus to the outputs of the RM4200D. (See “Output Routing” on page 183.)

## 2. The Program Menus

This section describes the commands and dialogs of the Toolbox4 software.

You can start the program by double-clicking on the file `Toolbox4.exe`. After that, the main program window opens as in the following figure:

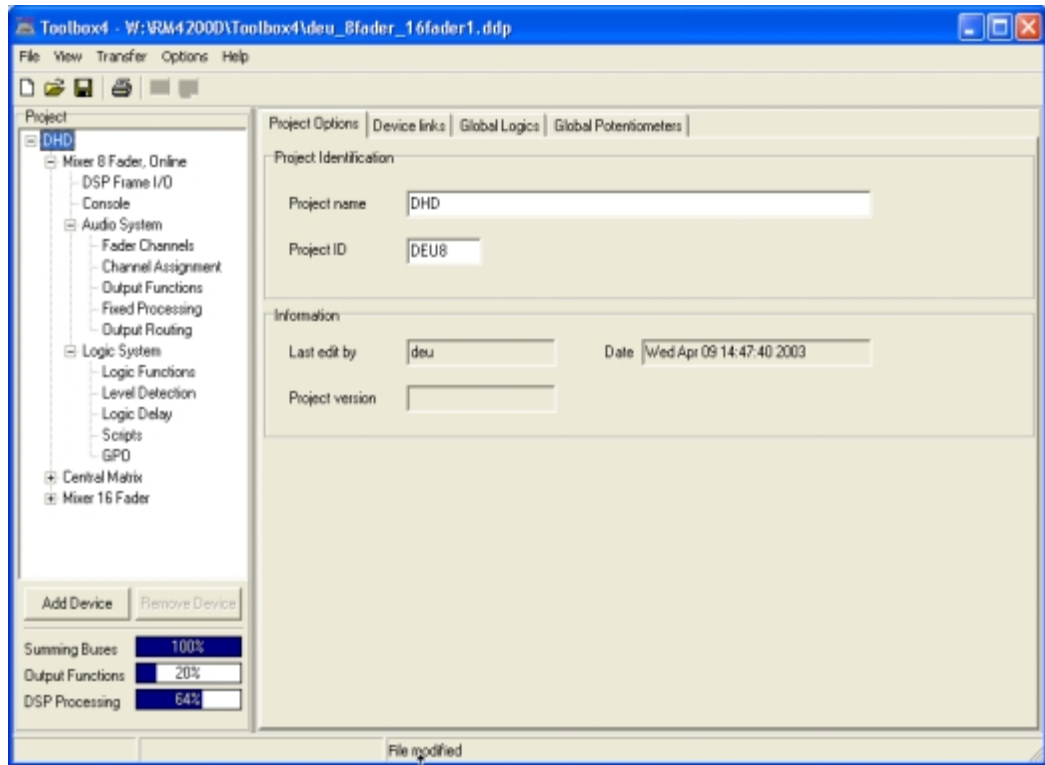


Figure 3–1: Toolbox4 Project Options.

### 2.1 File Menu

#### New Project

This command creates a new project and generates a new project ID using a random number generator. The project is empty and does not contain any devices yet.

You can also execute this command by clicking on the icon



in the tool bar.

Any project file that is already open can be saved before creating a new file.



**Note:** Only one project file can be edited at a time.

#### Open Project File

This command opens a project file.

You can also execute this command by clicking on the icon



in the tool bar. The keyboard shortcut for this command is `Ctrl+O`.

Any project file that is already open can be saved before creating a new file.

### Save Project File

This command saves the open project file.

You can also execute this command by clicking on the icon



in the tool bar. The keyboard shortcut for this command is Ctrl+S.

### Save Copy of Project file as

This command saves a copy of the current project file. In the Save dialog box, the program suggests the name “filename\_copy.ddp”. After saving the copy, the currently open project file “filename.ddp” remains open for further editing.



**Tip:** This command allows to save different intermediate states of a project file as a backup.

### Save Project File as

The current project file is saved either under its previous or under a new file name. In the Save dialog box, the program suggests the previous name “filename.ddp”. After saving, the project file is edited under the new name.

### Replace Device from File

It is possible to save the configuration of individual Devices in a file. (See “Extract Device to File” on page 7.) With the command `Replace Device From File` you can select a Device file (with the extension `.ddf`) and *overwrite* a device in the project with its content.

This function is only available if a Device is selected in the project tree. Otherwise, it is disabled.



**Caution:** The configuration of a Device already available in the project is overwritten with this command – it cannot be undone! Therefore, the program shows a confirmation dialog before you can select a Device file. If you confirm this selection of the file in the Open dialog box, the current configuration of the device is finally replaced! If in doubt, in advance save the old configuration of the Device using the command `Extract Device to File`.

This command allows you to transfer a Device configuration from one project to another. To transfer the data, use the following steps:

1. Save the already existing Device configuration in the relevant project. There, select the desired Device in the project tree and save its configuration in a file using the command `Extract Device to File`.
2. Create an empty Device in the new project. In order to do that, press the button `Add Device` under the project tree or use the contextual menu in the project tree.
3. Select the new Device with the mouse, then select the menu command `Replace Device From File`. Select the file that you created in step 1. Now you have copied the configuration of the Device from a previous in the new project.



**Important Note:** When copying Device configurations, watch out for already defined Global Functions. The values for Global Logic and Global Potentiometers may be overwritten with information from the Device file.

### Extract Device to File

This command saves the configuration of a Device as file with the extension `.ddf`. The name of the file can be selected.

This function is only available if a Device is selected in the Project tree. Otherwise, this menu option is disabled.

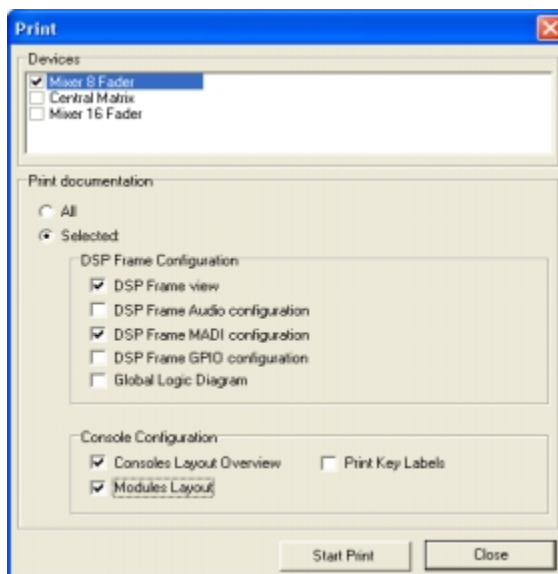
### Print

You can use this command to print Device information on paper.

You can also execute this command by clicking on the icon



in the tool bar.



**Figure 3–2: Toolbox4 Print Dialog.**

In the pane `Devices` you select, which Devices the output will be generated for.

In the pane `Print documentation` you can select, which parts of the documentation are to be printed for the selected Devices.

The option `All` prints the whole documentation for the selected Devices.

Alternatively, with the option `Selected` you can select the following options for printing:

- `DSP Frame view`: View of the DSP frame with all configured cards.
- `DSP Frame Audio configuration`: List of the Audio configuration with assigned labels, slot numbers, connector numbers and further options. In order to keep the list well-structured, there are no MADI modules included.
- `DSP Frame MADI configuration`: List of the MADI configuration with assigned labels, connector numbers and further options. In order to keep the list well-structured, there are only MADI modules included.
- `DSP Frame GPIO configuration`: List of the GPIO configuration with assigned labels, slot numbers and connector numbers.

- **Global Logic Diagram:** Overview of the Global Logic functions created by the Device (Global Logics).
- **Console Layout Overview:** View of the whole Console on one or more sheets, according to the number of assembly frames.
- **Modules Layout:** View of all Control Modules contained in the configuration, each module printed on one sheet.
- **Print Key Labels:** Printout of all key labels contained in the configuration on one or more sheets. For printing, presentation transparencies should be used in a suitable printer. The printed labels can be cut and inserted into the key caps.

### Export DSP Frame I/O as CSV

This command outputs the configuration of a Device as text file. The file is formatted in **CSV format (comma separated value)**. This format can be read by different text processors and spreadsheet programs. Thus it is possible to easily import configuration data for further documentation. The file contains different information of the Device configuration, including labels and numbering of the configured audio channels and GPIOs, defined Fader Channels and a list of the used internal signals.

This command is only available if a Device is selected in the project tree. Otherwise, it is disabled.

### Exit

This command quits the `Toolbox4` application. You are prompted to save the open project file if necessary.

## 2.2 View Menu

### Maintenance Window

Using this command, you open the **Maintenance Window**. In this window, you have direct access to the modules of the RM4200D and you can carry out important adjustment and maintenance measures. There are several functions in this window, they are dealt with in a separate chapter. (See “Maintenance Window — Maintaining the Modules” on page 19.)



**Note:** The functions that can be carried out in the `Maintenance Window` do not affect an open project file. If you want to use the `Toolbox4` software for maintenance functions only, there is no need to open a project file.

The maintenance window can also be opened by pressing F7.

### Audio Sources

This window shows all internal audio signals available for the configuration of the selected Device. The appropriate Device must be selected in the project tree. The name of the current Device is displayed in the title bar of the window. The audio signals are subdivided into groups according to their characteristics.



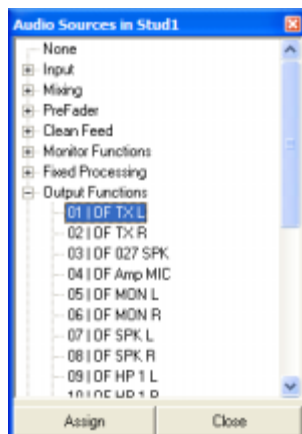


Figure 3–3: Audio Sources Window. You find the name of the current Device in the title bar.



**Note:** For various functions, in the Audio Sources Window you can access signals that are provided by remote Devices. In this case, the name of the appropriate Device is displayed in the title bar of the window. (See also “Global Pool Lines - Using Pool Signals between several Devices” on page 152.)

Please note that this window shows two different types of internal signals that can vary depending on the selected functions:

1. Audio channels available on the internal TDM bus system: Inputs, Mixing (Sums, Groups, Aux buses), Pre Fader (Fader Channels after Input Processing), Clean Feeds, Monitor Functions (PFL only), Fixed Processing, Output Functions.
2. Internal “virtual” audio sources: Monitor Functions (Monitor buses 1 - 6, Rotary Monitor Selector 1 - 10), Routing (Number 1 to 768).

For the inputs of **Output Functions**, you can use all internal virtual audio sources. The internal virtual audio sources can be used for **Output Routing**, too.

As inputs for the other DSP functions, only the audio channels on the internal TDM bus system are available.

If you use the Audio Sources Window when configuring the Output Functions, it will be extended by the entries **Level**, **Potentiometer** and **Phase Reverse**. (See also “Output Functions” on page 169.)

You can also open the window by pressing the F6 key.

### Logic Sources

This window shows all internal logic signals available for the configuration of the selected Device. The appropriate Device must be selected in the Project tree. The name of the current Device will be displayed in the title bar of the window. The logic sources are subdivided into groups according to their characteristics.

If you use the window to select logic sources as inputs for Global Logic Functions, the windows shows the logic sources of *all Devices* in the current project.

You can also open the window by pressing the F5 key.



Figure 3-4: Logic Sources window. The name of the current Device is displayed in the title bar.

### Global Logic Monitor

Global Logic Functions (Global Logics) are used to exchange logic signals between different Devices. This is carried out by **UDP commands** over an Ethernet connection. You can check the signalling between the Devices by using the window Global Logic Monitor.



**Important Note:** For monitoring, the RM4200D hardware must be available in the network. Furthermore, the Toolbox4 PC must be available in the same IP subnet to be able to send and receive UDP commands. Finally, there must be a project file loaded in the Toolbox4 software, the project ID of which is equal to the one of the system to be monitored.

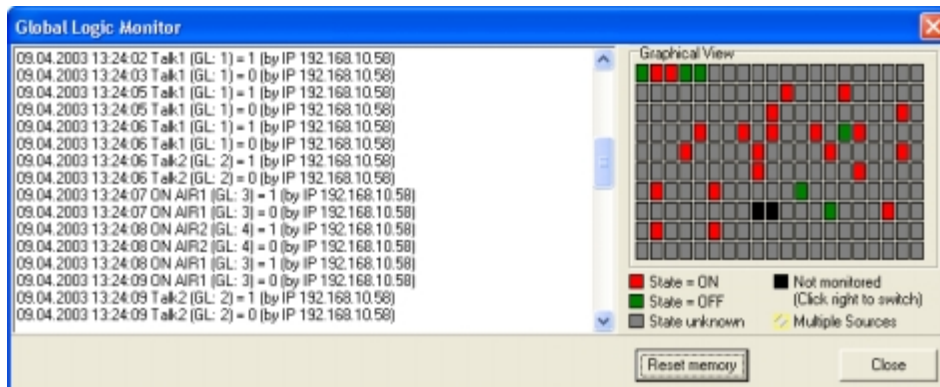


Figure 3-5: Global Logic Monitor window.



**Note:** The functions of the Global Logic Monitor do not influence an open project file. If you only want to use the Global Logic Monitor, you only need to open the project file to select the project ID of the system to be monitored. Alternatively, you can create an empty project and insert its ID manually into the tab Project Options. (See also “Project Options” on page 46.)

The window Global Logic Monitor displays all events both as text and graphics. On the left, you find the events listed with time, name, sent state (logical 1 or 0) and the IP address of the sender. On the right, there are 200 boxes in 10 rows of 20

columns. Each of the boxes displays the logical state of one of the 200 Global Logics available.



**Tip:** Move the cursor over one of the boxes and leave it there for a second. A tooltip displays the number of the underlying Global Logic function.

You can also set the logical states in the graphical display. Click once or twice in the box of the selected function to set the desired value. In return, the box changes its color and the corresponding result is displayed.

The colors of the boxes show the state of the corresponding logic function. They have the following meaning (also refer to the explanation on the display under the graphic):

- Red, `State = ON`: The logic function has the state *logic 1*.
- Green, `State = OFF`: The logic function has the state *logic 0*.
- Grey, `State unknown`: The state of the logic function is temporarily unknown until the appropriate UDP command sets the state of a function. Manually, you can reset all currently displayed states by pressing the button `Reset memory`. In this case, all boxes are grey again.
- Black, `Not monitored`: The display for the selected function is hidden, the corresponding events are not shown in the list. You can use this function if some states change very often and therefore disturb the display. Right-click in the desired box to toggle this filtering.
- Hatched, `Multiple Sources`: If the state of a Global Logic function was set by more than one Device, the corresponding box is displayed hatched.



The state of a Global Logic Function is displayed in grey (`State unknown`), as long as it is unknown. This changes as soon as the appropriate UDP message arrives carrying the state. In every second, the state of one Global Logic Function is transferred to all Devices in the project. This way, 200 seconds after opening the window `Global Logic Monitor`, the states of all Global Logic Functions have been transferred at least once.

### Watches

With this dialog, you can watch the state of certain logic sources within a Device. This is especially helpful for error detection in more complex applications, in which logic functions are e.g. linked to each others.



**Important Note:** You can not watch *all* logic sources that are available in the RM4200D. For technical reasons, certain signals can not be watched. But this should not be your concern – if you add new logic sources to the watches, the possible selection in the `Logic Sources Window` is filtered already. (Further information is provided later in this book.)

If you want to watch logic signals, use the following steps:

1. Make sure the Device to be watched can be reached from the PC via a TCP/IP or serial connection.
2. Load the project file that contains the Device to be watched.
3. In the project tree, select the Device that you want to watch.

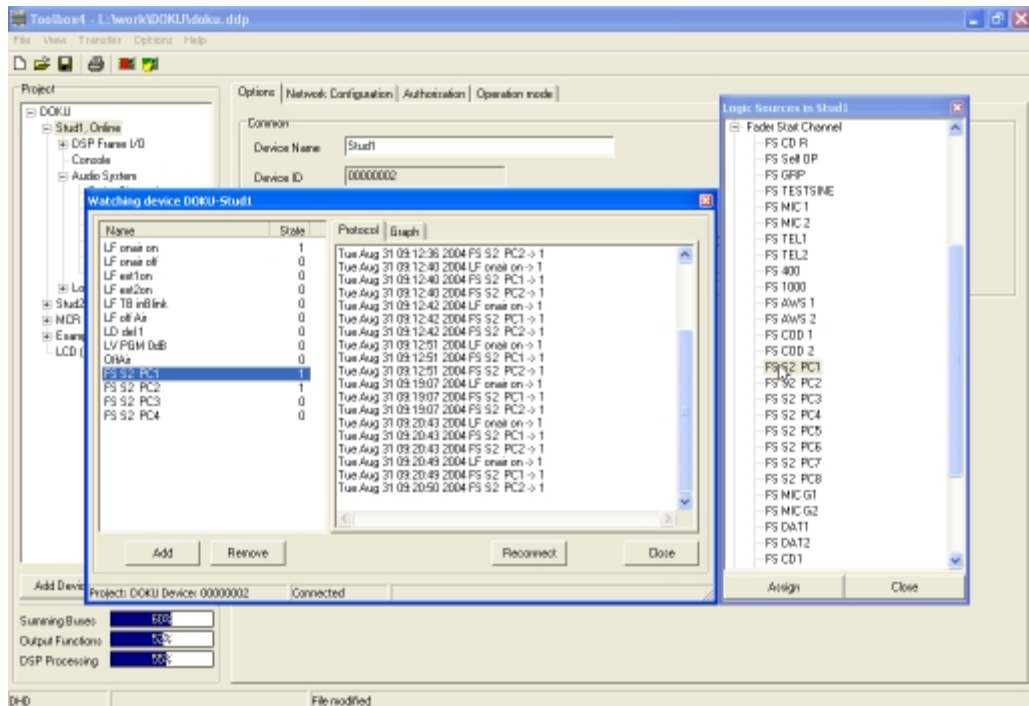
4. Select **Watches** from the **View** menu. The **DHD Connection Dialog** opens. Select the **Device** that you want to watch. Make sure this is *the same Device that is selected in the project tree!* Click on the button **OK**. The window **Watches** opens.



**Important Note:** If you set up a connection to a **Device** different from the one selected in the project tree, you can not select the logic sources in the next step correctly! Make sure the **Device** is exactly the same!

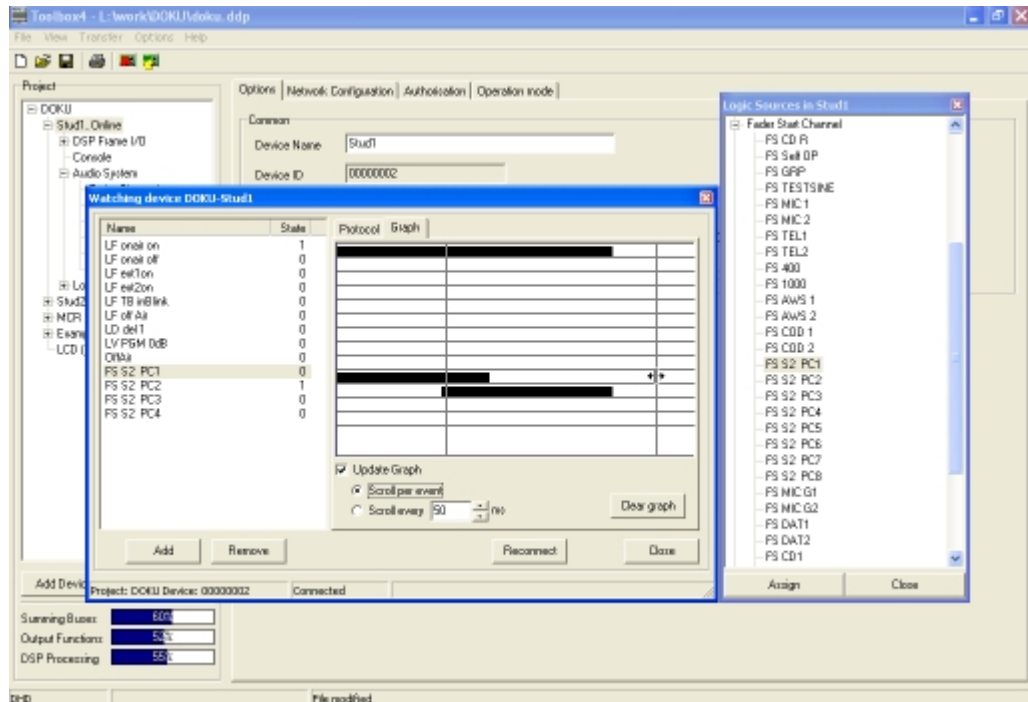
5. In the left part of the **Watches** window, there is a list with the logic sources that you are watching. The names of the logic sources are displayed, as well as their current state. There, “1” means that the logic source is active (or “on”); “0” means “inactive” (or “off”). Click on the button **Add** to add logic sources to the list. Choose the desired logic sources from the **Logic Sources Window**.
6. In the right part of the window, there is a protocol of state changes for the selected logic sources.

State changes can be displayed in two ways: as protocol (tab **Protocol**) or as graph (tab **Graph**). Click on the appropriate tab to choose the desired display.



**Figure 3–6: Watching logic functions, protocol view.**

In the *protocol view*, all state changes for the logic sources you are watching are recorded. The protocol contains date, time and the type of state change. Using the mouse, you can highlight the lines in the protocol, copy them into a text editor and then delete them. To do that, use the context menu in the pane of the protocol view. In the *graph view*, all states of the logic functions are displayed graphically over a certain period of time. This way, you can analyse the processes and dependencies of functions. So, errors in nested logic functions can be detected easier than in the protocol view. Active states (on) are displayed black, inactive states (off) stay transparent.



**Figure 3–7: Watching logic functions, graph view.**

You can use the checkbox `Update Graph` to control the display update. When you activate the checkbox, all state changes are recorded and displayed. If you then deactivate the checkbox, you can analyse the graph without other data disturbing the display. When moving the cursor over the graphs, a movable line is displayed. That way, you can easily check whether two state changes happened at the same time.

You can control when the display of the graph is to be updated:

- `Scroll per event`: As soon as one of the watched logic sources changes, the display is updated by one unit. (One unit is approx. 1 mm wide.)
- `Scroll every <x> ms`: The display is updated at regular time intervals. This is e.g. useful to analyse delayed functions (Logic Delays). Use the entry box or the arrow keys next to it to enter the desired interval. You can define intervals between 20 ms to 10 sec.



**Note:** Please note that for long update intervals, the graph may not be able to display quick changes of logic functions to a full extent if they happen outside the update time.

The buttons in the `Watches` window have the following functions:

- `Add`: Click on this button to add logic functions to the watch list. The `Logic Sources Window` opens to select the desired signals. Each logic source can be selected only once for watching.



**Important Note:** Make sure to always use the button `Add` to open the `Logic Sources Window`. Only this way you can be sure that all displayed logic functions can really be used.

- `Remove`: Click on this button to remove highlighted entries from the watch list.

- **Clear Graph:** This button deletes the graphic display of the logic states.
- **Reconnect:** If the TCP/IP connection to the watched Device has been interrupted, you can restore it using this button.
- **Close:** This button closes the Watches window.

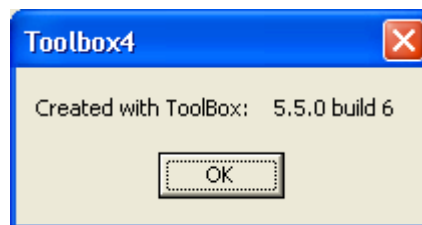
### Fitting Report

The DSP-load of the Device selected in the project tree can be checked with the **Fitting Report**. This command creates and opens a text file describing the DSP-load of the selected Device.

This command is only available if a Device is selected in the project tree; otherwise it is not active. This command can be executed by pressing the key combo Ctrl+R.

### File Info

With the aid of this command you can determine which Toolbox4 version was used for generating the currently opened configuration.



**Figure 3-8:** Display of command File Info

The Toolbox4 version is displayed in the following format: 5.5.0 build 6 (example). Here the information accord to the specifications in the Help - About menu of the Toolbox4 used for the configuration.

The versions of the currently used Toolbox4 and of the opened configuration may differ. Only on saving the configuration, the value is changed.

## 2.3 Transfer Menu

### Connecting the Configuration-PC to a RM4200D

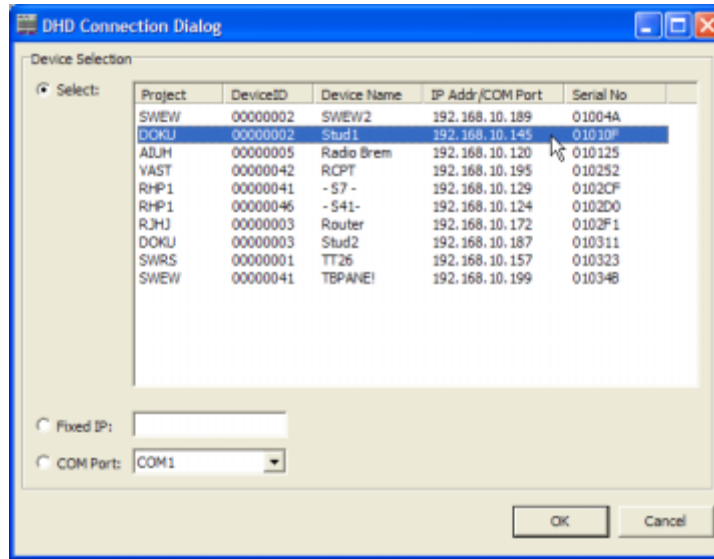
To load a Config from a RM4200D system into the Toolbox4 software or to write it back after changing of the configuration data must be exchanged between the configuration PC and the Devices. This is possible either over an Ethernet connection using TCP/IP or over a serial connection using the RS232 port.



**Tip:** In general, the functions for both ports are identical. The transfer over Ethernet is by far faster and more flexible by using TCP/IP. If you use the serial connection instead, you must connect the configuration PC directly to the RM4200D.

The commands `Load to Device` and `Load from Device` load and save a Config from/to a RM4200D system. In the Toolbox4 software you can select different ways of how the configuration PC can exchange data with the RM4200D.

In any case, first you have to select the desired Device in the project tree and then choose the command for the upload or download. Next, the DHD connection dialog opens. It is identical for both commands:



**Figure 3–9:** The DHD Connection dialog for connecting with the RM4200D Device. Here for upload and displaying the Devices available on the network.

The RM4200D systems use the UDP protocol to announce their availability in the network. This requires that UDP packets can be transferred between the DSP frames and the configuration PC, which can not be guaranteed in every network.



**Note:** If the UDP packets are not transferred between the Toolbox4 software and the Devices, the list of all available RM4200D systems is not displayed in the upper part of the DHD connection dialog. In this case, you need to know exactly which Device uses which IP address. You have to enter the appropriate IP address manually.

If the configuration PC and the RM4200D systems can communicate using the UDP protocol, the list in the upper part of the connection dialog shows all available systems. You can now select the desired system from the list.

Additionally, next to the Device name in the project tree, appears the word *Online*, if the project ID and Device ID of the project file are identical with the data in the Device. If the Config has been changed compared with the one in the Device, additionally the message *Modified* is displayed. These two additional messages are *not* available when connecting via RS232.

These are the options for setting up a connection:

- **Select:** In the upper list, all RM4200D systems in the IP network segment are displayed. This list is automatically generated using UDP broadcast messages that are received from the Devices. For each Device, the corresponding project ID, Device ID, Device Name and IP address are displayed. In the last column, you see the serial number of the Device which is identical with the vendor-specific bytes of the Ethernet MAC address of the Device. You can select the desired Device with a mouse click.
- **Fixed IP:** Here, you can enter the IP address of the Device directly. This may be necessary if no UDP packets can be received because the configuration PC and the RM4200D are connected to different network segments. This option is also helpful for remote maintenance of systems over.

- **COM Port:** Choose this option if you connected the configuration PC over a serial cable to the RM4200D. It does not matter to which module you connect the cable since all modules are connected via the CAN bus, except the Overbridge modules. Depending on the PC configuration, you can choose between the serial ports COM 1 to COM 4.



**Note:** If you use a converter from USB to RS232 for connecting the serial cable, depending on the device, problems or low transfer rates can occur when transferring data. The best option is to test this process before going into the field and if problems occur – especially with laptop computers – use a PC card with a serial port instead.

If you want to connect the configuration PC directly to the RM4200D, you need to use a crossed Ethernet cable. The IP addresses must be configured unambiguously on both sides (no DHCP). The first three bytes of the addresses must be identical, the last byte must differ. For example:

IP address on Toolbox4 PC	192.168.010.057
IP address on RM4200D Device	192.168.010.058
Subnetmask	255.255.255.0

### Configuration of IP Addresses

Each Device needs an unambiguous IP address that is either static or assigned by a DHCP server. You find the appropriate setting for each Device on the tab *Network Configuration*. When you choose the command *Load to Device*, the Device is assigned this new IP address. (See also “Network Configuration” on page 60.)

If the Devices are not permanently connected to an IP network, you should use well documented static IP addresses instead of DHCP. Make sure not to assign an address more than once. Do not operate Devices with DHCP, if there is no DHCP server in the network.



**Important Note:** If you accidentally activate DHCP in the Config or assign a wrong IP address, after uploading the data, the configuration PC might not be able to connect to the RM4200D system via Ethernet any more. In this case, you have to correct the configuration and load it directly into the Device using the serial port.

### Load to Device

This command copies the current Config from the *Toolbox4* software into the selected RM4200D system. First select the Device in the project tree, the Config of which you want to copy. Then choose the command *Load to Device*. In the DHD connection dialog you can select the desired Device. (See figure 3–9.) After confirming the selection, the new Config is transferred. If the name of the Device in the project and the one of the selected Device in the network are not identical, the following warning message is displayed.



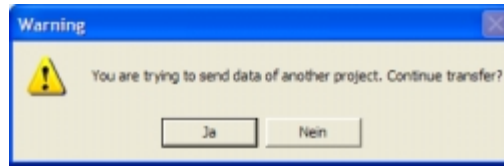


Figure 3–10: Warning message if project IDs in the Toolbox4 software and in the Device do not match when uploading a Config.



**Caution:** Loading a new Config *irrecoverably* overwrites any older Configs available in the Device. Therefore, if in doubt, save the current Config to file before modifying it using the command `Load from device`.

You can also execute the function `Load to Device` by clicking on the icon



in the tool bar.

### Load from Device

This command loads the Config from a RM4200D Device into the Toolbox4 software. If you use one project file for several Devices, remember to select the correct Device in the project tree before using this command. In the DHD connection dialog, you have to select the corresponding RM4200D system, too. (See figure 3–9.)



**Note:** If you want to copy a Config from the Device into the project and if this Device has an entry in the project file already, the Toolbox4 software can help: The Device you have just marked in the project tree is automatically selected in the DHD Connection Dialog. For that, the project IDs and the Device IDs in the software and in the Device must be identical.

Alternatively, you can create an empty project and create an empty Device clicking either on the button `Add Device` or using the contextual menu in the project tree. Then, load the Config from the Device into this empty Device.

You can also mark a Device in a loaded project file and overwrite its Config with the data from a RM4200D system using the command `Load from Device`.



**Caution:** Please remember that the modification caused by the download can not be undone as soon as the project file is saved. Thus, you should always work with copies of the original project files.

This procedure is not applicable if a project consists of several Devices that exchange Global Logic functions, Global Potentiometers or Device Links among each other. In this case, you should base modifications of the Config always on the latest version of the project file, since the central resources named above must be identical for all Devices in the project. But if you load the data for Global functions from other Devices, these might overwrite the settings in the current project file!

Generally, it is always better to save the current Config of a project as project file. As soon as further modifications become necessary, load the project file again and change it accordingly. Next, load the new Config into the corresponding RM4200D systems. With this strategy, the project file is always up to date and at the same time serves as a backup copy for the configuration data.

You can also execute the function `Load from Device` by clicking on the icon



in the tool bar.

### 2.4 Options Menu

You can use the commands in this menu only to set options that modify the usage of the `Toolbox4` software. They do not influence the configuration of the `Devices`.

#### Configuration

##### General

The following options control the performance of the `Toolbox4` software:

- `Number of Backup Levels`: Here you define the number of backup generations.
- `Save automatically`: If this checkbox is checked, the software automatically creates backup copies of the project file. You can set the number of backup files in the field `Number of backup levels` from 1 to 9. As soon as the last file is written, in the next run, the first file is overwritten with the next saved file *thus being lost!* You can adjust the desired interval for the backups in the field `interval` between one and 60 minutes. The generated backup files have the number of the backup in the file extension, for example `1.dd1`. The higher this number is, the older is the file. If you want to use such a file in the `Toolbox4` software again, you have to change the extension back to `.ddp` beforehand.

##### Display

- `Hide sources without name in audio and logic source trees`: This option affects the windows `Audio Sources` and `Logic Sources`. If checked, all sources are hidden, the labels of which have been totally deleted when configuring the `DSP Frame I/O`. (See also “`DSP Frame I/O — Configuring the DSP Frame`” on page 70.)
- `Select next output routing after assign`. Activate this checkbox to work faster when defining the output routing: In this case, the `Toolbox4` software automatically switches to the next output when assigning the audio signals to the outputs – in the list of outputs as well as in the audio signal list in the `Audio Sources Window`. (See also “`Output Routing`” on page 183.)

### 2.5 Help Menu

#### About

Here, the creation date of the software and version of the `Toolbox4` software is displayed, e.g. “`Version 5.3.1 Build 93`”. For service enquiries please always quote this version description completely.

### 3. Maintenance Window — Maintaining the Modules

#### 3.1 Overview

Using the Maintenance Window, you have direct access to the hardware components of the RM4200D. This special window works independently from the different configuration menus and from the project tree of the Toolbox4 software. It contains special functions that are important for setting up a new system and for maintenance tasks.

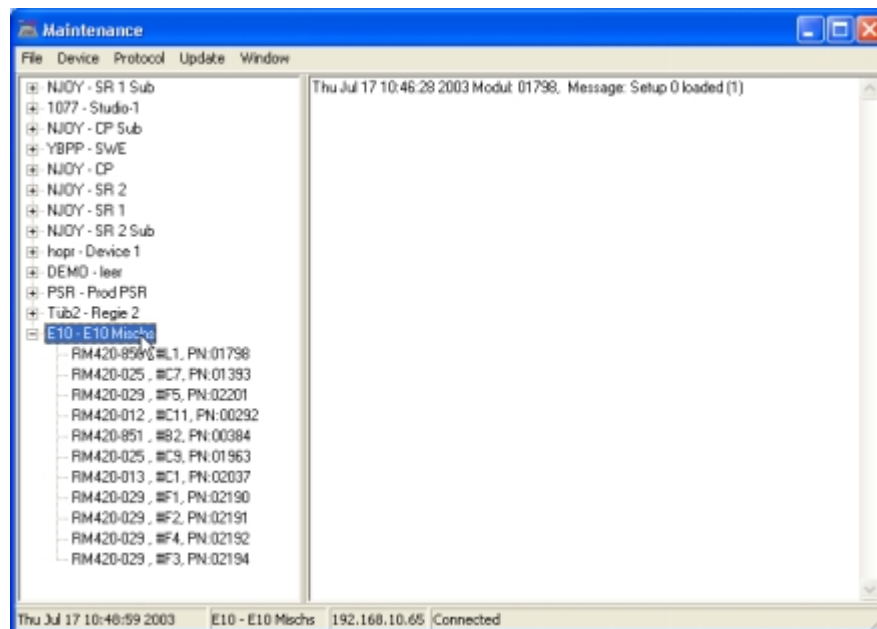


**Tip:** The Maintenance Window works independently from any project files that might be open. Therefore, there is no need to open a project file if you only want to carry out a firmware update, for example. This is especially helpful for on-site-service if no project file is available.

Among others, you can use the Maintenance Window to do the following:

- Update the Device tree.
- Read out information about connected modules.
- Reset individual modules or whole Devices.
- Change module IDs when integrating spare parts.
- Read out and change the license codes.
- Save Mixer Setups.
- Monitor the communication on the CAN bus.

To open the Maintenance Window, select the command `Maintenance Window` from the `View` menu. You can also press the key `F7`.



**Figure 3–11:** The Maintenance Window with all Devices available in the network.

On the left side, the Maintenance Window contains the *Device tree* with all Devices available. On the right, there is the protocol pane. There, according to the selected settings, you can monitor the communication on the CAN bus.

At the bottom of the window, you find information panes with status displays. You can use many functions using both menu commands and keyboard short cuts. Besides, you can bring up the context menu in several places by pressing the right mouse button.

The Device tree displays all RM4200D Devices accessible to the software. This list is generated automatically by UDP messages. However, if building the list does not work correctly, you can manually add missing Devices. This is useful, if the existing network does not transfer UDP packets properly across different network segments or through firewalls. (See “Add device... (Setting up a connection to RM4200D manually)” on page 23.)

In the tree view, you can select the individual Devices and their modules that you want to work on. In the Device tree, the *Project ID* consisting of up to 4 characters is displayed on the left and the first ten characters of the *Device Name* are shown in the middle. On the right, the *serial number of the Device* is shown. This number consists of the DHD-specific bytes from the Ethernet address of the Device. The tree view lists all Devices in alphabetical order.

In contrast to the project tree in the configuration window, the Devices in the Device tree are *not displayed according to a hierarchy!* All available Devices are displayed vertically, although they might be parts of different projects. For each active Device, you can open another branch by clicking on the plus symbol in front of the Project ID. For the given Device, this branch displays all modules that are connected to the CAN bus and ready for operation. *It does not matter whether this module is available in the current Config or not!*

You can also display detailed information about the modules contained in the different backplanes of a DSP frame: Click on the plus sign in front of the DSP Controller module RM420-851. The display will expand to another subsection. In this section, all operational I/O modules contained in the backplane are listed. For each module its slot number, type and serial number are displayed.

Except for the DSP Controller module RM420-85, none of the listed modules is connected to the CAN bus. *Again, it does not matter if the modules are contained within the current Config or not!*



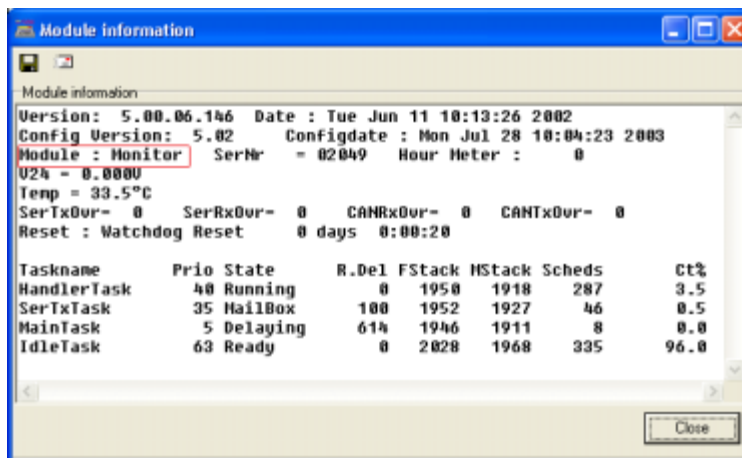
**Caution:** For all RM4200D Devices displayed in the Device tree, certain commands (e.g. F12 = Reset) can be triggered *without* confirmation. Especially in networks with more than one RM4200D, make sure to select the correct system!

### 3.2 Monitor and Unknown Type — Modules without valid Firmware

Under certain conditions, a module shown in the Device tree does not carry the expected label “RM420-xxx”. Instead, “Monitor” or “Unknown type xxx” is displayed. This happens if the software of the module is in a certain mode, the so called **monitor mode**. In this mode, not the normal code is running on the module that otherwise does the signal processing, but a **Boot Loader** that is also called “Monitor”. If the module information can be displayed using the command `Show module information`, you can also see whether the module is in monitor mode. (See figure 3-12.)



**Tip:** In this case, *Monitor* is a special software mode of a module, its name has nothing to do with the term used in audio studio technology to describe monitor speakers or the monitoring of sound signals!



**Figure 3–12: Module information window for a module in Monitor mode.**

The Boot Loader is a kind of “Mini operating system” that always starts immediately after switching on the module or after a reset. It does nothing else than loading the actual operating system (also called **firmware**) of the module from Flash memory into the RAM of the module. Afterwards it starts the software just copied thus setting the module in normal operation. As soon as this was successful, the module signals its name “RM420-xxx” and is displayed this way in the Device tree.

If the Boot Loader was *not* successful copying and starting the operating system, the module remains in Monitor mode. In most cases, the reason for this is an invalid or missing software in the Flash memory of the module. In this case you have to update the firmware of the module. (See “Device Firmware” on page 37.)

### 3.3 Connecting the Software to the Devices

You can connect the PC with the `Toolbox4` software and the RM4200 Devices either using a serial port or via Ethernet and TCP/IP. If possible, you should use Ethernet, since the transfer speed is higher.

In the Device tree, all Devices are displayed that are connected to the PC with the `Toolbox4` software. This includes the Devices that are manually connected via the serial port or by entering the IP address as well as Devices automatically registered by UDP.

The automatic registration works as follows:

Each RM4200D transmits once per second a UDP broadcast message over Ethernet that contains the following data:

- The name of the Device.
- The Device ID.
- The Project ID.
- The date when the current Config was loaded.
- A list of all modules that are connected to the CAN bus and ready for operation.

As soon as these UDP messages reach the `Toolbox4` PC, it processes the data and displays the information in the Device tree. In addition, you can manually add further Devices that can not be registered automatically by UDP. Use the command `Add Device...` from the menu `Device`.



**Important Note:** If the `Toolbox4` PC is connected to a network segment different from the one of the RM4200D Devices, it can happen that the UDP broadcast messages can not be transferred over the border of the segment. In this case, automatic registration does *not* work!

To solve this problem, the transport of UDP messages must be enabled by the network administrator. In most cases, this is carried out for certain Ethernet MAC addresses.

DHD has reserved the MAC address range `00:0A:63:xx:xx:xx` for its products. The last three bytes `xx:xx:xx` of the MAC address are consecutively assigned by DHD to each Communication&Logic Controller RM420-850 during production. Each RM4200D must contain one of these controllers. The MAC address assigned during production can not be changed later on! Therefore, apart from the unique identification for data transfer in the network, it is used for assigning the license codes of RM4200D. (See also “Enter license code” on page 33.)



**Caution:** The MAC address of a RM4200D is permanently assigned to the hardware of the Communication&Logic Controller RM420-850 and can not be changed! Thus, when replacing the module RM420-850, also the MAC address of the RM4200D changes. In this case, you also must order new license codes!



**Important Note:** The `Toolbox4` software was developed for Windows XP, but runs on other Windows versions as well. A known bug in certain versions of Windows NT prevents the reception of UDP broadcast messages. This is the reason why automatic registration does not work, even if the `Toolbox4` PC and the RM4200D are located in the same network segment. In this case you must access the Devices manually via their IP addresses using the command `Add Device...` (See also “Add device... (Setting up a connection to RM4200D manually)” on page 23.)

Please find more detail on the protocols UDP and TCP/IP in the standard literature on computer networks or ask your network administrator.

### Connections using Wide Area Networks

The RM4200D uses the TCP/IP protocol for the communication between DSP frames and the `Toolbox4`-PC. In theory, you could remote control RM4200D systems over Wide Area Network links (WAN), which carry TCP/IP traffic. However, in practice this does not always work properly, because of the following:

- On WAN links, data throughput and latency are often not predictable and can change suddenly. This applies especially, if the connection is made using the “open Internet” instead of a dedicated data line.
- In contrast to a standard PC a RM4200D is a embedded system that also happens to use TCP/IP. However, concerning TCP/IP transmission, it is not as robust and fault tolerant as the PC. This is no problem in local networks, where communication is reliable. However, if the data has to travel over a WAN link, data can get lost under certain circumstances. This loss of data can sometimes have unwanted results.

Therefore you should *not try to remote control RM4200D systems over WAN links!*



**Caution:** Especially, do not try to update the firmware of the RM4200D over a WAN link!

If you really need to remote control a RM4200D use a remote control software like Norton PC Anywhere, Timbuktu Pro or VNC. Use this software to remote control a PC, which is in the same local network as the remote RM4200D.

If you do need to use WAN links, pay attention to the following facts:

- The less additional traffic is on the line the more stable the data connection will be.
- If you have the choice, you should rather use a dedicated data line than the Internet.
- Sometimes it helps to dial up the remote PC directly over ISDN instead of using a WAN link.
- Make sure you mind the usual rules for tunnelling private data traffic over public networks (VPN, access restrictions etc.) Ask your system administrator about it.

### 3.4 File Menu

#### Close

This command closes the Maintenance Window, no data or settings are saved.

### 3.5 Device Menu

#### Add device... (Setting up a connection to RM4200D manually)

With this command you can manually set up the connection to a RM4200D, if it is connected via the serial port or if the automatic registration using UDP does not work.

After using the command `Add Device...`, the `DHD Connection Dialog` opens.

Now you have the following options to set up a connection to a Device:

- `Select`. In the upper part of the dialog, all Devices within the same network segment as the PC running the `Toolbox4` software are listed. This list is automatically build from UDP messages received from the DSP frames on the network. For each Device the following information is displayed: its project ID, its name and its serial number. This number is identical to the DHD-specific bytes of the Ethernet MAC address of the Device. Select the desired Device by clicking on its entry.
- `Fixed IP Address`. Here you can enter the IP address of a Device manually. You may need to do this, if no UDP packets are received by the `Toolbox4-PC`, causing the Device list to be incomplete. You can also use this option if you need to remote access RM4200D systems over wide area connections.



**Important Note:** If the Device is assigned its IP address via DHCP, the address can change depending on the settings. In this case, you have to find out the address currently assigned in a different way, e.g. by a state request to the DHCP server. Therefore, it is easier to work with static IP addresses only. (See also “Configuration of IP Addresses” on page 16.)

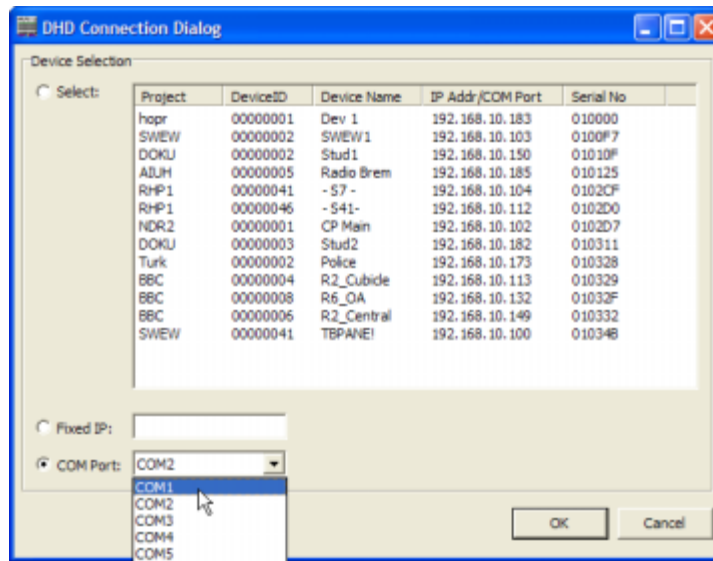


Figure 3–13: DHD Connection Dialog, addressing the Device via a serial port. The list on top shows all Devices available within the same network segment.

- **COM Port.** Select the serial port the Device is connected to. Make sure the port is not already used by other applications or a Toolbox4 software running at the same time! If you close the dialog using the button OK afterwards, the Device is displayed at the selected port in the Device tree. A Device currently connected and switched on is marked by a „+“ in front of the entry COM1 (2...4, respectively). The node can be opened by clicking on it, the branch displays all modules connected to the CAN bus of the Device and ready for operation. (See figure 3–14.)

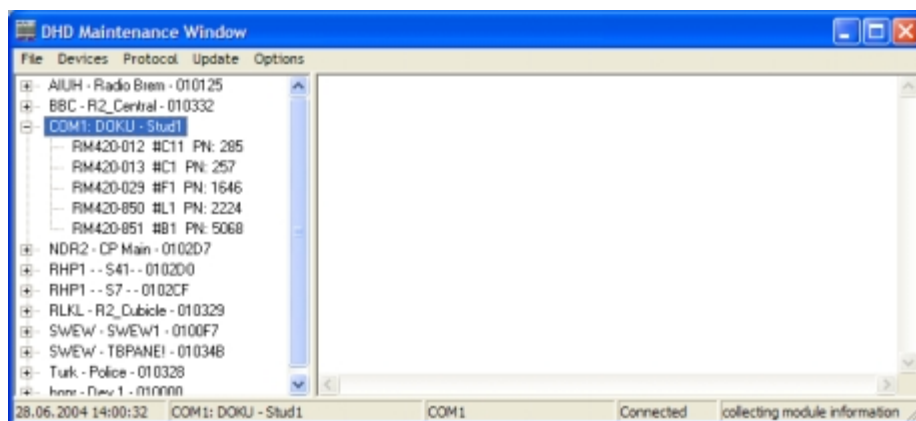


Figure 3–14: Modules in the Device tree, the Device is connected via the serial port COM 1.



**Important Note:** If necessary, you can use USB-RS232-converters. However, because of the great variety of these devices, DHD can not recommend a type. It is possible that such converters do not work at all or do not work with the performance expected. If your PC is not equipped with a serial port (e.g. laptops), you should prefer a slot-in card with a serial port to an USB adapter.



Please note that because of the amount of data, firmware updates can take about 45 minutes when carried out via the serial port. That is why you should always use Ethernet if possible.

### Refresh all devices (Ctrl+F9)

This command updates the information of all Devices displayed in the Device tree. The list of Devices is sorted alphabetically.

### Information (F11)

With this command, you can display the current state of a module. To do this, select the desired module – you may have to click on the node in front of the desired Device first to display all available modules.

Now use the command `Information`, the key F11 or the contextual menu to open the window `Information`. This window displays all available information as text. To save it to an ASCII file, click the button `Save To File`. If the PC is set up accordingly, you can also e-mail this text to DHD. Click the button `Send As Mail` to do so.

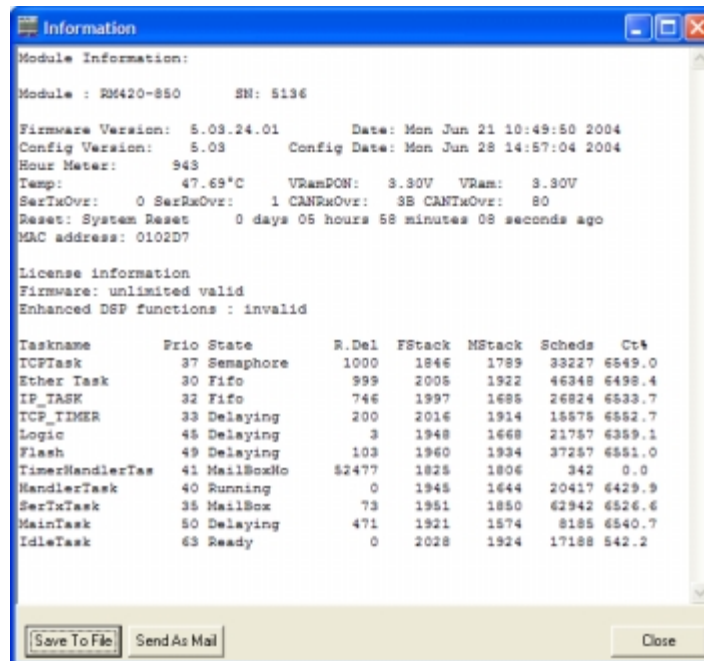


Figure 3–15: Information window for a module. Please note the two buttons in the lower left corner.



**Important Note:** The displayed files are read out from the selected module and displayed, when the command `Show module information` is selected. The display is *not updated automatically* afterwards! Please note also that the displayed values for voltage, temperature and frequency are not as exact as the number of displayed characters might suggest.

The content of the status window can vary depending on the kind of module (see the column Remarks in the following table) and is divided into two panes:

- General information and information on hardware (top).
- Information on software and operating system (bottom).

### General Information and Information on Hardware

The following table contains example values and the corresponding explanations:

Name	Display example	Description	Remark
Version	5.02.14.01	Version of the firmware.	
Date	Mon Jul 21 15:42:37 2003	Date when firmware was created (compiled).	
Config Version	5.02	Version of Toolbox4 software that created the Config.	
Configdate	Thu Jul 24 11:43:34 2003	Date when Config was loaded into the Device.	
Module	RM420-850	Type of module.	
SerNr	1693	DHD serial number.	
Hour Meter	428	Operating hour meter of the module.	
V24	22.829V	Value of the 24V-operating voltage of the Console. <i>max. set value + 5%: 25,2V</i> <i>min. set value - 15%: 20,4V</i>	not for RM420-850 RM420-851
Temp	43.8°C	Temperature on the microcontroller module. Set values for <ul style="list-style-type: none"> <li><i>Console module:</i> between 30°C and 65°C.</li> <li><i>module RM420-850/851:</i> between 30°C and 55°C</li> </ul>	
VRamPON	3.300V	Value of support voltage for the parameter RAM (supported by a goldcap capacitor) when switching on the module: <ul style="list-style-type: none"> <li><i>Set value for valid data:</i> between 2,0 and 3,3V.</li> <li>For a value &lt;2,0V, not the RAM but Setup 0 is used at startup.</li> </ul> After switching off the supply voltage, data is kept for at least 5 days.	nur RM420-850
VRam	3.300V	Current value of support voltage for the parameter RAM (supported by a goldcap capacitor). <i>Set value: 3,3V (+ 5%, - 5%)</i>	nur RM420-850
SerTxOvr	0	Transmit FIFO of the serial port, should be 0 or constant value.	

Name	Display example	Description	Remark
SerRxOvr	0	Receive FIFO of the serial port, should be 0 or constant value.	
CANRxOvr	0	Receive FIFO of the CAN bus, should be 0 or constant value.	
CANTxOvr	0	Transmit FIFO of the CAN bus, should be 0 or constant value.	
Reset	System Reset 112 days 2:02:50	Type of last reset and display of the modules running time since last reset (days, hours, minutes, seconds): <ul style="list-style-type: none"> <li>• <i>System Reset</i>: After reset using Toolbox4, switch on the front panel of the DSP frame or script command.</li> <li>• <i>External Reset</i>: After switching on the power supply.</li> <li>• <i>Watchdog Reset</i>: After restrictions during program run of the microcontroller and automatic restart of the module.</li> </ul>	
SysFreq	48000Hz	Current system sampling rate, note precision of measurements (+ 1Hz, - 1Hz).	only RM420-851
Sync1	48000Hz	Current sampling rate of Sync Source 1, note precision of measurements (+ 1Hz, - 1Hz).	only RM420-851
Sync2	48000Hz	Current sampling rate of Sync Source 2, note precision of measurements (+ 1Hz, - 1Hz).	only RM420-851
AudioLink	5	Number of highspeed audio connections between a maximum of 3 DSP modules RM420-848. The set values depend on the slot and number of installed RM420-851/848 per system: <ul style="list-style-type: none"> <li>• Slot 9/10, 19/20, 29/30: 7, 7, 7</li> <li>• Slot 9/10, 19/20: 3, 5</li> <li>• Slot 9/10: 1</li> </ul>	only RM420-851

Name	Display example	Description	Remark
DSPOK	77	<p>State of the 3 DSPs per module RM420-848 and state of the submodules.</p> <p>Set values for "OK":</p> <ul style="list-style-type: none"> <li>• Without submodule: 77 or 7f.</li> <li>• With submodule: f7 or ff.</li> </ul> <p>Detailed meaning of the bits:</p> <ul style="list-style-type: none"> <li>• Bit7 submodule XILINX booted successfully.</li> <li>• Bit6 DSP2 audio process running.</li> <li>• Bit5 DSP1 audio process running.</li> <li>• Bit4 DSP0 audio process running.</li> <li>• Bit3 DSP XILINX booted successfully. *)</li> <li>• Bit2 DSP2 booted and started.</li> <li>• Bit1 DSP1 booted and started.</li> <li>• Bit0 DSP0 booted and started.</li> </ul> <p>*) errors in some versions of the firmware, set from version 5.2.15</p>	only RM420-851

Name	Display example	Description	Remark
MAC address	01:00:ce	The last 3 bytes of the Ethernet MAC address, complete 48 Bit MAC address of the example: 00:0A:63:01:00:CE	only RM420-850
License information Firmware	unlimited valid	License information for firmware: <ul style="list-style-type: none"> <li>• <i>unlimited valid</i>: Unlimited license code.</li> <li>• <i>valid until...</i>: Time limited license code.</li> <li>• <i>invalid</i>: Invalid license code. An unlimited license code causes random system resets approximately once per hour!</li> </ul> When exchanging the module RM420-850 a new license code may have to be ordered from DHD. (In order to do this, please name the last 3 bytes of the MAC address.)	only RM420-850
Enhanced DSP functions	invalid	License information for the extended DSP functions: <ul style="list-style-type: none"> <li>• <i>unlimited valid</i>: Unlimited license code.</li> <li>• <i>valid until...</i>: Limited license code.</li> <li>• <i>invalid</i>: Invalid license code. An invalid license code causes a bypass of the Enhanced DSP Functions!</li> </ul> When exchanging the module RM420-850 a new license code may have to be ordered from DHD. (In order to do this, please name the last 3 bytes of the MAC address.)	only RM420-850

### **Information on Software and Operating System**

This information gives an overview of the processes running on the real time operating system of the microcontroller. All values are up to date at the moment you are selecting the command `Show module information`. This information is interesting for an advanced diagnosis of the system by a software developer. To avoid overflows in the display of the parameters `Scheds` and `Ct%`, you have to access the display in time periods of less than 34 minutes. This means normally that you should access the display twice shortly after another – the last display is then free of overflows.

The following table shows typical example values for the diagnosis data:

Remark	Taskname	Prio	State	R.Del	FStack	MStack	Scheds	Ct%
all modules	Flash	49	Delaying	90	1960	1934	5	0
all modules	TimerHandlerTas	41	MailBoxHo	28945	1825	1824	5	0
all modules	HandlerTask	40	Running	0	1945	1707	77	1.4
all modules	SerTxTask	35	MailBoxHo	0	1947	1863	26	0
all modules	MainTask	50	Delaying	71	1914	1732	8	0
all modules	IdleTask	63	Ready	0	2028	1934	77	7.2
RM420-850	TCPTask	37	Semaphore	1000	1846	1789	5	0
RM420-850	Ether Task	30	Fifo	0	2006	1928	5	2.9
RM420-850	IP_TASK	32	Fifo	264	1997	1690	74	3.4
RM420-850	TCP_TIMER	33	Delaying	200	2016	1950	33	0
RM420-850	Logic	45	Delaying	9	1927	1690	9	46.5
RM420-851	DSP	45	Delaying	6	1784	1605	8	25.4
RM420-010	MainModule	45	Delaying	1	1949	1670	8	10.6
RM420-011	StudioUnit	45	Delaying	14	1950	1715	8	8.6
RM420-012	Central	45	Ready	0	1940	1671	9	9.7
RM420-013	Overbridge24	45	Delaying	3	1950	1663	5	2.7
RM420-020	Fader	45	Delaying	8	1927	1657	93	5.3
RM420-025	Overbridge40	45	Delaying	8	1951	1793	28	5.9
RM420-026	Overbridge32	45	Delaying	10	1951	1778	14	5.2
RM420-029	Fader029	45	Ready	0	1902	1651	29	9.9

### Get information from all modules (Ctrl+F11)

This command displays the current data of all modules of a Device that are connected to the CAN bus and ready for operation. You have to select a Device in the Device tree first to be able to use this command. A new window `Module information` opens afterwards. The information about the individual modules are separated from each other by stating the Type of module, the module ID and by hyphens. The content corresponds to the information described in the previous section.

To save the output text to an ASCII file, click the button `Save To File`. If the PC is set up accordingly, you can also e-mail it to DHD. Click the button `Send As Mail` to do so.

### Reset (F12)

With this command you can restart the selected Device. It does not matter whether a module of the Device is selected in the Device tree or the name of the Device itself. Alternatively, you can also reset the Device by pressing the F12 key.

In addition, you can reset a whole Device or individual modules by highlighting the desired entries in the Device tree and using the contextual menu.



**Caution:** The reset is carried out immediately without any confirmation. Make sure to select the correct Device or module!



**Important Note:** After a Reset, the setup saved using the command `Save Setup 0` is loaded, *not* the condition before the reset that is saved in the parameter RAM! The data saved there is only loaded after switching off/on, if the value `VRamPON` of the support voltage was higher than 2.0 V when switching on.

### Save Setup 0

With this command, you copy the current content of the parameter RAM of a Device to storage space *Setup 0* in the Flash memory of RM420-850. This way, the settings are kept after switching off the Device and can be used as Default Setup for a reset. In addition, Setup 0 can be loaded like all other setups using the Console.



**Note:** You can save Setup 0 using this command only! *This is not possible using the Console!*

First you have to select the desired Device to trigger the command. Afterwards, a confirmation dialog appears, saying `Save current Parameter settings?`. When confirming with “Yes”, the settings are copied. In addition, on the right in the protocol pane the execution of the command is acknowledged by the module RM420-850:

```
2004-06-28 17:57:40.423 RCV TCP Stud2      Module 5194 Code 0310: Message: Setup 0 saved in RAM
2004-06-28 17:57:41.641 RCV TCP Stud2      Module 5194 Code 0312: Message: Setup stored in Flash
```

The plain text display of these messages is stored in the file “err.err” that has to be available on the PC. If this is not the case, the messages are displayed with their identification numbers:

```
2004-06-28 17:58:11.438 RCV TCP Stud2      Module 5194 Code 0310: Parameter1 0 Parameter2 0
2004-06-28 17:58:12.982 RCV TCP Stud2      Module 5194 Code 0312: Parameter1 0 Parameter2 0
```



**Important Note:** It is important to use the command `Save Setup 0` immediately after each initial setup or change of configuration of the faderchannels of a RM4200D! This is the only way how the system can start with reasonable parameters after a reset, especially for Analog Gain, Phantom voltage, Fader assignment and Bus switching!

### Save Setup 1...6

As with the command `Save Setup 0` you can use this command to copy the content of the parameter RAM to the storage spaces *Setup 1* to *Setup 6* in the Flash memory of the RM420-850. You can pre-load the Setups 1 to 6 with reasonable values. The user of the RM4200 can activate the setups at the Console.

In contrast to Default Setup 0, the setups 1 to 6 can also be saved at the Console. Therefore, use the key function `Save Mixer Setup` in cooperation with rotary selectors. (See also “Load/Save Functions” on page 112.)



**Tip:** When you saved the Default Setup 0 during configuration of a RM4200D, it may be useful to save the same setup also on the spaces *Setup 1* to *Setup 6*. In operation, you can then load this basic setup at the Console, modify it as needed and then save it back to the desired storage space.

To use the command, you first have to select the desired Device. A confirmation dialog appears. When you confirm this dialog, the data is copied and the execution of the command is acknowledged in the protocol pane:

2004-06-28 16:59:36.306 RCV TCP Stud1	Module 2224 Code 0310: Message: Setup 1 saved in RAM
2004-06-28 16:59:37.425 RCV TCP Stud1	Module 2224 Code 0310: Message: Setup 2 saved in RAM
2004-06-28 16:59:37.747 RCV TCP Stud1	Module 2224 Code 0312: Message: Setup stored in Flash
2004-06-28 16:59:38.545 RCV TCP Stud1	Module 2224 Code 0310: Message: Setup 3 saved in RAM
2004-06-28 16:59:39.686 RCV TCP Stud1	Module 2224 Code 0310: Message: Setup 4 saved in RAM
2004-06-28 16:59:40.106 RCV TCP Stud1	Module 2224 Code 0312: Message: Setup stored in Flash
2004-06-28 16:59:40.806 RCV TCP Stud1	Module 2224 Code 0310: Message: Setup 5 saved in RAM
2004-06-28 16:59:41.925 RCV TCP Stud1	Module 2224 Code 0310: Message: Setup 6 saved in RAM
2004-06-28 16:59:42.271 RCV TCP Stud1	Module 2224 Code 0312: Message: Setup stored in Flash

Two setups are saved in one segment of the Flash EPROM, therefore the message Setup stored in Flash is displayed only three times.

If the file "err.err" with the plain text messages does not exist, the identification numbers of the messages are displayed:

2004-06-28 17:06:15.618 RCV TCP Stud1	Module 2224 Code 0310: Parameter1 1 Parameter2 0
2004-06-28 17:06:17.024 RCV TCP Stud1	Module 2224 Code 0310: Parameter1 2 Parameter2 0
2004-06-28 17:06:17.135 RCV TCP Stud1	Module 2224 Code 0312: Parameter1 0 Parameter2 0
2004-06-28 17:06:17.876 RCV TCP Stud1	Module 2224 Code 0310: Parameter1 3 Parameter2 0
2004-06-28 17:06:19.342 RCV TCP Stud1	Module 2224 Code 0310: Parameter1 4 Parameter2 0
2004-06-28 17:06:19.348 RCV TCP Stud1	Module 2224 Code 0312: Parameter1 0 Parameter2 0
2004-06-28 17:06:20.117 RCV TCP Stud1	Module 2224 Code 0310: Parameter1 5 Parameter2 0
2004-06-28 17:06:21.239 RCV TCP Stud1	Module 2224 Code 0310: Parameter1 6 Parameter2 0
2004-06-28 17:06:21.658 RCV TCP Stud1	Module 2224 Code 0312: Parameter1 0 Parameter2 0

### Clear Parameter Memory

With this command, you reset the content of the parameter RAM to its default values, as follows:

- All Gain settings are reset to 0 dB.
- All analog Gain settings are reset to 0 dB.
- All AUX buses are reset to Post Fader.
- All inputs (Fader Channel) are switched onto the buses.
- All EQ frequencies are set to 1000 Hz.
- Phantom voltages are switched off.



**Tip:** If you want to delete mixer Setups, do the following:

1. Delete the current parameters using the menu command `Clear Parameter Memory`.
2. Save Setup 0 using the command `Save Setup 0`.
3. Save Setups 1 to 6 using the command `Save Setup 1..6`.

You have now deleted all custom setups and written default values to their storage space.





**Note:** If you have to manage several RM4200D systems you may find yourself handling setups frequently. In this case, you should use the Setup Manager software. This application comes free with every RM4200D on CD.

### Enter license code

With this command, you can enter the license codes that are vital for the function of the software of the RM4200D. There are license codes for the operation of the software itself and additional codes for enabling the *Enhanced DSP Functions*. The latter enable optional processing functions and must be ordered separately. (See “Fixed Processing – Defining Fixed DSP Functions” on page 178.)

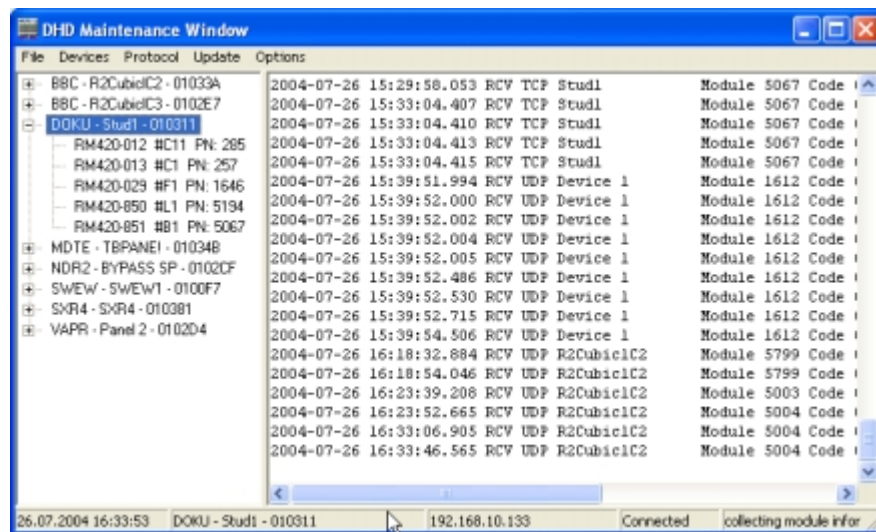


**Note:** An invalid license code allows the operation without restrictions (except Enhanced DSP Processing) of the RM4200D for a duration of 600 hours, which corresponds to 25 days non-stop operation. After that, a "License invalid" message appears in the Rotary Encoder Displays of the Control Modules (RM420-010, RM420-012, RM420-013, ...). Except this message and the Enhanced DSP Processing, operating the system is still possible without restrictions. After 800 hours of operation without a valid license, the system causes a reset about once per hour. The Enhanced DSP functions are inactive when an inactive license code is used, signals are only bypassed in the DSP (bypass mode).

In general, a valid license code that is saved in the Communication&Logic Controller RM420-850 is necessary for operating the RM4200D. Each module RM420-850 has its own license code which is based on the last three bytes of the Ethernet MAC address of the module.

There are two ways to find out the Ethernet MAC address:

First, it is always shown in the project tree of the Maintenance Window. You will find it as the six-digit code to the right of the project ID and the name of the Device.



**Figure 3–16:** The Ethernet MAC address is listed in the project tree next to the project ID and the name of the Device.

Second, the MAC address is also listed in the information window of a module. Just select the desired module in the project tree and choose the command *Information*

from the menu `Devices`. You can also use the function key `F11`. You will find the MAC address in the line labelled `MAC address` on top of the information window.

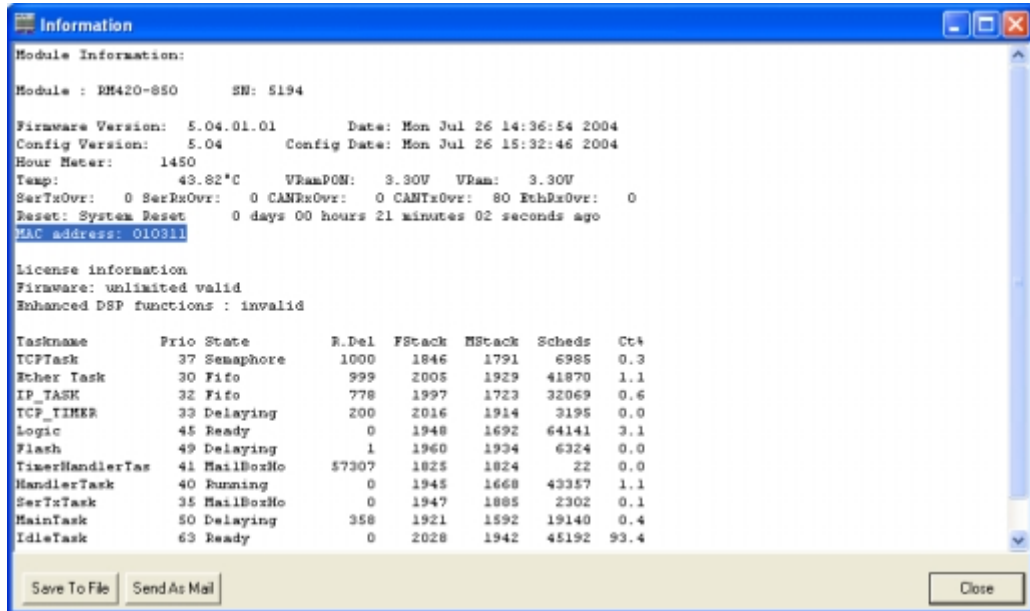


Figure 3–17: Information listing for the RM420-850 module containing the Ethernet MAC address next to the top.



**Important Note:** If you exchange a module RM420-850, you may need a new license code that you can order from DHD. When ordering, please name the last three bytes of the Ethernet MAC address. You can have displayed the address of the module using the command `Show module information` (functional key `F11`), the value is displayed in the line `MAC address` (e.g. `01:00:ce`).

In most cases, RM4200D systems are shipped by DHD with a time limited license code (marked `valid until...`). As soon as the system has fully passed into the property of the customer, DHD sends an e-mail with a permanent license code.

When you received a license code, you should first copy it into the clipboard using the key combination `Ctrl+C`. Now select the desired Device in the Device tree and select the menu command `Enter licensecode`. Then copy the code from the clipboard into the input field using the key combination `Ctrl+V` and confirm by clicking `OK`. The code is transferred into the Device. Check the reception of the code for the module RM420-850 by using the command `Information`. If this is the case, the output for `License information` is now `unlimited valid` or `valid until` with a new date for time-limited license codes respectively.

A wrongly entered license code is ignored!

### Get serial numbers (F3)

With this command, you can output all serial numbers of the modules of a Device connected to a CAN bus including the audio I/O modules and the DSP modules. The numbers are displayed in the protocol pane of the Maintenance Window, additionally, also the software versions active on the separate modules are displayed. To save the output text to an ASCII file, click the button `Save To File`. If the PC is set up accordingly, you can also e-mail it to DHD. Click the button `Send As Mail` to do so. This command is for information only.

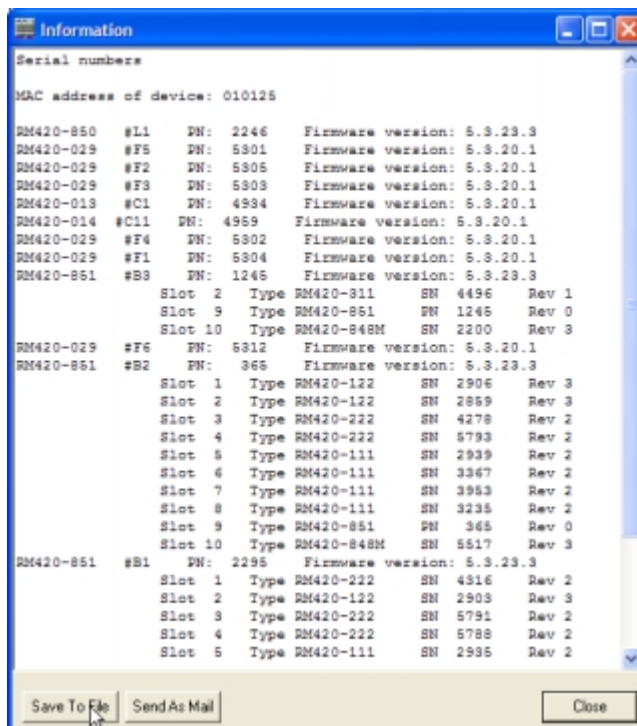


Figure 3–18: Display of the serial numbers of all modules. Note the Ethernet MAC address in the second line from top.

### 3.6 Protocol Menu

In this menu you can adjust the performance of the display in the protocol pane (on the right).

#### Enable CAN Protocol (F4)

If you activate this option, the protocol displays all command that are transferred to the Device on the CAN bus that is currently selected in the Device tree. The meaning of the commands is explained in the volume *The RM4200D CAN Bus Protocol* of this manual.

But also without any knowledge of the protocol, especially for key functions, you can press the corresponding key. The appropriate command is then displayed in the protocol. You can then use it e.g. to manually send it or use it in a script. (See also “Scripts – Controlling Special Functions with Scripts” on page 200.)

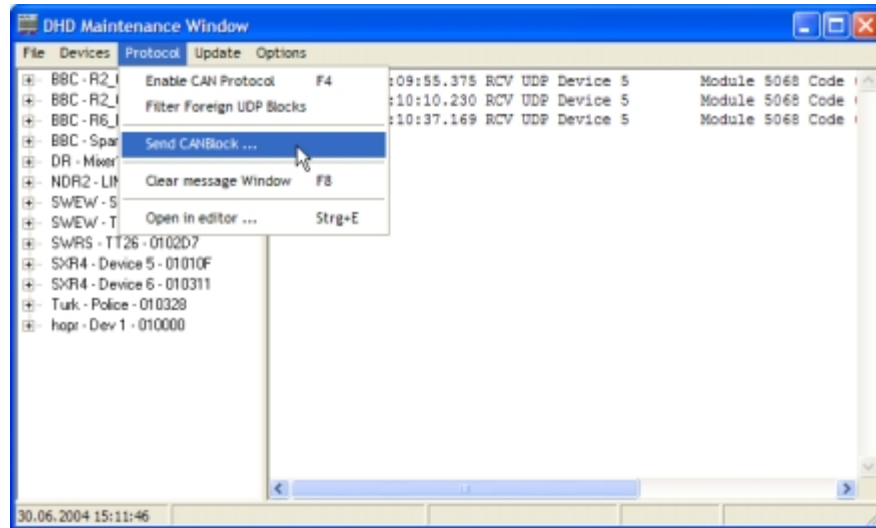


Figure 3–19: Display of the messages on the CAN bus and menu Protocol.

### Filter Foreign UDP Blocks

Use this option, if you want to monitor the UDP traffic of a certain Device *only*. Activate this option, and select the Device to monitor in the device tree. If there is a check mark in front of the menu entry Filter Foreign UDP Blocks, the protocol output is filtered to show the messages from the selected Device only.

### Send CAN Block

Use this dialog to send CAN bus commands to the RM4200D manually.



**Caution:** *Only* use this function, if told so by your DHD dealer or DHD support or if you know exactly what the commands do!

Wrong CAN bus commands – an these include typos in otherwise correct commands – can disrupt the operation of the RM4200D or cause it to stop working at all. If in doubt, ask first before sending CAN bus commands!

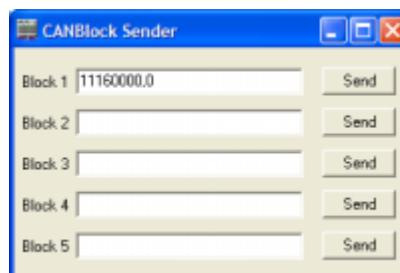


Figure 3–20: The dialog for sending CAN bus commands manually.

You can send CAN bus commands manually using the five input fields of the window. To do this, enter the desired command into a field or copy it from the clipboard using the key shortcut Ctrl+V. If you then click on the corresponding Send button, the command is transmitted directly to the CAN bus of the selected Device and can there be executed by the modules.

The following table contains some examples for CAN bus commands:

CAN bus command code	Meaning
18010000,0	Deletes Firmware of the Device.
181F0000,0	Deletes Config.
18190000,0	Deletes Fader Channel Setups.
181A0000,0	Deletes Mixer Setup 0.
181B0000,0	Deletes Mixer Setups 1 and 2
181C0000,0	Deletes Mixer Setups 3 and 4.
181D0000,0	Deletes Mixer Setups 5 and 6.

### Clear Message Window (F8)

This command deletes the content of the protocol pane.

### Open in Editor (Ctrl+E)

This command transfers the content of the protocol to the Windows editor as plain text.

## 3.7 Update Menu

### Device Firmware

With this command, you transfer a new firmware version into all modules of a RM4200D Device. This process can last several minutes depending on the size of the actual RM4200D system. *You should not press any keys or move any faders while the transfer is running!*



**Tip:** Update the firmware *only if really necessary*. If your RM4200D system runs stable with an older firmware version, there is no reason to update!



**Caution:** Do not try to operate modules with *different firmware versions* within the same RM4200D! This will cause unpredictable behaviour of the system and is strongly discouraged by DHD!

However, this situation can occur, if you change a module for a spare part or if you built a RM4200D from pre-used modules. In these cases, first reset the system from the Maintenance Window and then update the firmware. (See also “Troubleshooting” on page 42.)



**Important Note:** Before you start updating the firmware of your RM4200D, make sure you have read the following information:

- Always make sure that the firmware version and version of the Toolbox4 software match. You can find more details on this topic on the DHD support website at:  
[www.dhd-audio.de](http://www.dhd-audio.de)
- If possible, use Ethernet and TCP/IP to transfer the firmware into the RM4200D. Avoid using a network connection that is already congested with other traffic. If the update over such a network fails, connect the Toolbox4-PC directly to the RM4200D using an Ethernet cross-cable. (See also “Connecting the Software to the Devices” on page 21.)

- If you need to use a serial connection instead of Ethernet, make sure *the cable is not longer than 5 metres!*
- If you have the choice, do not use USB/Serial converters. While some of these adapters may work with your setup, DHD does not recommend using them. Some combinations of USB adapters with certain PC hardware may not work when you try to control a RM4200D with them. If your laptop does not have a serial port, use an extension card with serial ports instead.
- While the update is in progress, do not use any keys or faders on the Console. That way you avoid additional traffic on the CAN bus which could disrupt the transfer of the firmware data.
- Please note, that a firmware update can take up to 25 minutes over Ethernet and up to 45 minutes using a serial connection. If you have to update On Air systems, plan accordingly!
- If the update fails, read the section about troubleshooting below. (See also “Troubleshooting” on page 42.)



**Caution:** Do not attempt a firmware update using a WAN connection between the `Toolbox4-PC` and the RM4200D. Data throughput and latency on such links are sometimes unpredictable and can cause problems during the update. If you need to update remote systems, use a remote control software like Norton PC Anywhere, Timbuktu Pro or VNC. Use this software to remote control a PC within the same local network as the RM4200D. Run the `Toolbox4-Software` on this PC. (See also “Connections using Wide Area Networks” on page 22.)

### Updating the Firmware of Systems *without* Global Functions

If your RM4200D system does *not use* Global Functions, you can update its firmware without using a project file. You can just connect to the systems from the `Toolbox4` software and upload the new firmware.

To update the firmware, do the following:

1. Download the matching versions of the `Toolbox4` software and firmware from the DHD support site. You can recognize firmware files by the extension `.upd`.
2. Replace the existing old version of the `Toolbox4` software on the PC by the new one.
3. Start the new `Toolbox4` software and connect to the Device the firmware of which you want to update. (See also “Connecting the Software to the Devices” on page 21.)
4. Create an empty Device by clicking on the `Add Device` button in the `Toolbox4` software.
5. Download the current Config of the DSP frame into the newly created Device in the `Toolbox4` software.
6. Save this Config as backup on the hard drive.
7. Upload the Config again back onto the Device that you want to update. (This way you have adjusted the internal structures of the Config to the new software version.)

8. Open the Maintenance Window using the command `Maintenance Window` from the `View` menu or press the key `F7`. Make sure the desired Device is selected in the Device tree.
9. Select the command `Device Firmware...` from the `Update` menu. A file dialog appears in which you have to select the firmware file downloaded in step 1.
10. The `Toolbox4` software compares the firmware version in the Device with the firmware version of the file you just selected. The result is shown in a dialog, read it carefully. In this dialog, you can cancel the whole process or carry on.

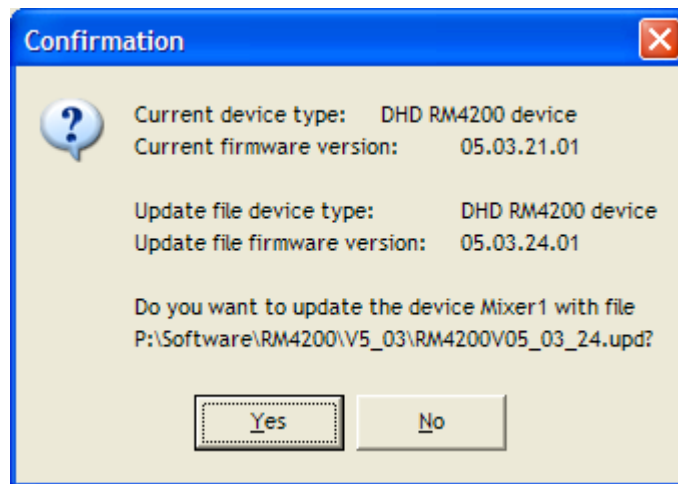


Figure 3-21: Dialog comparing the firmware versions on file and in the Device.

11. Click the button `Cancel` in the confirmation dialog if you want to cancel the update. As soon as you click the `OK` button, the firmware transfer starts and a progress bar is shown. This process can take up to 25 minutes, depending on the size of the RM4200D system. If you use the serial port, the update can take up to 45 minutes. During the upload, click the button `Cancel` in the progress dialog to cancel the update completely.



**Caution:** You should not press any keys or move any faders on the Console while the update is running!

12. After transferring the new firmware successfully, a dialog appears asking you if you want to restart the Device or not. If you refuse, the old firmware runs until the next restart, otherwise the Device is reset and the new firmware is started.
13. You can check the version of the new firmware using the command `Information` from the `Devices` menu.

### Updating the Firmware of Systems *with* Global Functions

If your RM4200D system *does use* Global Functions, you need a project file to update its firmware. (See also “Global Logics” on page 49.)



**Caution:** The relations between all Global Logic Functions are stored in the project file. If you update the firmware *without* a project file, all Global Logic Functions will be lost after the update!

To update the firmware of a RM4200D using Global Logic Functions, do the following:

1. Download the matching versions of the `Toolbox4` software and firmware from the DHD support site. You can recognize firmware files by the extension `.upd`.
2. Replace the existing old version of the `Toolbox4` software on the PC by the new one.
3. Start the new `Toolbox4` software and connect to the Device the firmware of which you want to update. (See also “Connecting the Software to the Devices” on page 21.)
4. Open the project file in the `Toolbox4` software. In the device tree, select the Device you want to update.
5. Download the current Config of the DSP frame into the Device you have just selected in the `Toolbox4` software.
6. Save this Config as backup on the hard drive.
7. Upload the Config again back onto the Device that you want to update. (This way you have adjusted the internal structures of the Config to the new software version.)
8. Open the Maintenance Window using the command `Maintenance Window` from the `View` menu or press the key `F7`. Make sure the desired Device is selected in the Device tree.
9. Now select the command `Device Firmware...` from the `Update` menu. A file dialog appears in which you have to select the firmware file downloaded in step 1.
10. The `Toolbox4` software compares the firmware version in the Device with the firmware version of the file you just selected. The result is shown in a dialog, read it carefully. In this dialog, you can cancel the whole process or carry on.
11. Click the button `Cancel` in the confirmation dialog if you want to cancel the update. As soon as you click the `OK` button, the firmware transfer starts and a progress bar is shown. This process can take up to 25 minutes, depending on the size of the RM4200D system. If you use the serial port, the update can take up to 45 minutes. During the upload, click the button `Cancel` in the progress dialog to cancel the update completely.



**Caution:** You should not press any keys or move any faders on the Console while the update is running!

12. After transferring the new firmware successfully, a dialog appears asking you if you want to restart the Device or not. If you refuse, the old firmware runs until the next restart, otherwise the Device is reset and the new firmware is started.



13. You can check the version of the new firmware using the command `Information from the Devices` menu.

### Updating the Firmware of Single Modules

Usually you update the firmware of all modules in a RM4200D simultaneously. During this process, the firmware data is transmitted over Ethernet and TCP/IP to the DSP frame.

However, sometimes you might want to update just a *single* module, for instance to prepare a replacement part. In this case you do not need a complete RM4200D, you can update this single module using a serial connection instead.

To update the module, do the following:

1. First, find out which firmware version the new module needs. To get this information, read out the firmware version currently running on the RM4200D that will get the new module. (See also “Information (F11)” on page 25.) If necessary, get the matching versions of the firmware and the `Toolbox4` software.
2. Connect the module to a 24 V power supply. All modules get their power from the CAN bus cable. Therefore, you might need to build an adapter for the CAN bus plug. You will find the necessary circuit diagrams in volume 5 of this manual *Part5 – Installation Guide*.
3. Use a serial cable to connect the serial port of the module to the PC running the `Toolbox4` software. Do not use a USB/Serial adapter, but a real serial interface. Remember, which COM port of the PC you connect the cable to.
4. When you have completed the wiring, switch on the 24 V power supply. The displays and LEDs of the module should light up now.
5. Go to the `Toolbox4` software and open the Maintenance Window. In the `DHD Connection Dialog`, use the option `COM port` to connect via the serial cable. Make sure you select the correct COM port.
6. Check the current firmware version in the module. If necessary, update the firmware using the command `Device Firmware...` from the `Update` menu. A file dialog appears, in which you have to select the desired firmware file.
7. The `Toolbox4` software compares the firmware version in the Device with the firmware version of the file you just selected. The result is shown in a dialog, read it carefully. In this dialog, you can cancel the whole process or carry on.
8. Click the button `Cancel` in the confirmation dialog if you want to cancel the update. As soon as you click the `OK` button, the firmware transfer starts and a progress bar is shown. This process can take up to 25 minutes. During the upload, click the button `Cancel` in the progress dialog to cancel the update completely.



**Caution:** You should not press any keys or move any faders on the module while the update is running!

9. After transferring the new firmware successfully, a dialog appears asking you if you want to restart the module or not. If you refuse, the old firmware runs until the next restart, otherwise the module is reset and the new firmware is started.

10. You can check the version of the new firmware using the command `Information from the Devices` menu.

### Troubleshooting

Occasionally, firmware updates may fail. If this happens to you, read the following information and try again:

- Save the current Config to a file. Next, create an empty Config and upload it to the Device. Update the firmware. If this was successful, load the original Config from the file and restore it back to the Device.
- Check, if the data transfer from the PC running the `Toolbox4` software to the RM4200D has to travel on a network with high traffic. If this is the case, connect the PC and the RM4200D directly using a crossed Ethernet cable.
- If the RM4200D consists of modules which originate from several different other RM4200D systems, the modules can have different firmware versions. In this case, first reset the whole Device from the Maintenance Window. Now update the firmware. (See “Maintenance Window” on page 8.)



**Note:** The reset triggered from the Maintenance Window is more “radical” than power-cycling the DSP frame, because Setup 0 is loaded after the reset.

### 3.8 Window Menu

#### Stay on Top

If you choose this option, the Maintenance Window remains floating in the foreground. This is useful for constantly switching between the configuration dialog and the Maintenance Window or for debugging purposes.

### 3.9 Contextual Menu (right mouse button)

Many menu commands can also be triggered using the contextual menu, when the desired Device or module is highlighted in the Device tree. A click on the right mouse button brings up the contextual menu.

In addition to the menu commands already described, in the Device tree you can use the following commands from the contextual menu:

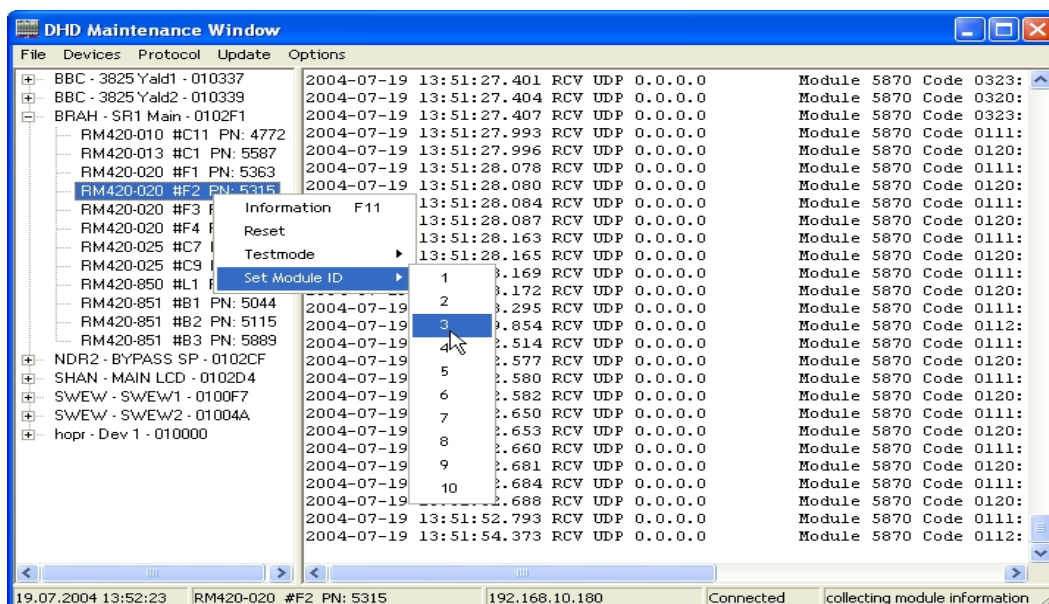
#### Testmode

You can only select this command from the contextual menu, if you have selected a module in the device tree first. During Testmode, all LEDs of the module will be switched on one after another. The lamps inside all keys will light up when the key is pressed and the alphanumeric displays show the current potentiometer values. You can use this function to check all lamps and LEDs as well as to detect which module belongs to which module ID in the device tree.

To activate Testmode, select the desired module in the Device tree and use the command `Testmode` from the contextual menu. In a further submenu you can choose the commands `On` or `Off` to switch Testmode on or off.

#### Set Module ID

If you have selected a module in the Device tree, you can use this command to set its module ID. You can read the current module ID in the tree view behind the name of the corresponding module, it is marked by a “ #” (e.g. “#C1” or “#F3”).



**Figure 3–22: Changing the module ID with the contextual menu.**

To change the ID, first select the desired module in the Device. Now open the contextual menu with a right mouse click and select `Set module ID` and then the desired number from a submenu.



**Important Note:** If by accident you have assigned the same ID to two modules, these two are running “parallel”. This means that all displays and functions are identical on both modules and are running as “mirrors”.



**Tip:** To find out which module in the Console belongs to which ID, use the function `Testmode` described above.

### 3.10 Typical Applications of the Maintenance Window

In the following section, you find a short description of typical tasks for which you have to use the Maintenance Window.

#### Updating the Firmware

First, read out the version of the currently loaded firmware using the command `Information`. Compare it to the current version recommended by DHD. If you really have to update the firmware, follow the steps described above. (See “Device Firmware” on page 37.)

You can use two ways to find out the current firmware version in a Device:

- Select the desired module in the device tree to the left. Use the command `Information` from the `Devices` menu or from the contextual menu. You can also press the F11 key. The dialog `Information` appears, which also lists the current firmware version.
- Select the desired module in the device tree to the left. Use the command `Get information` from all modules from the `Devices` menu or from the contextual menu. You can also use the key combination `Ctrl+F11`. The dialog `Information` appears, which also lists the current firmware version for each module of the Device.

### Saving Mixer Setups

Mixer Setups save the overall state of the RM4200D system. Using the Maintenance Window, you can save a total of 7 setups that can then be loaded into the Console by the user. The setups 1 to 6 can also be changed and saved using the Console. However, Setup 0 is the default setup which is loaded after resetting the system. You can save this setup in the Maintenance Window only; it can be loaded from the Console, but can not be saved from there. (See “Save Setup 0” on page 31.)

If necessary, you can also save the setups 1 to 6 from the Maintenance Window to have a base setup for further adjustments during operation. (See “Save Setup 1...6” on page 31.)

Saving a Setup is confirmed by the following output in the right part of the window:

```
2004-07-21 09:29:20.273 RCV TCP Stud1      Module 5194 Code 0310: Message: Setup 0 saved in RAM
2004-07-21 09:29:21.371 RCV TCP Stud1      Module 5194 Code 0312: Message: Setup stored in Flash
```

### Setup of Replacement Modules

If you replace a module in the Console, you may have to carry out some adjustments in the Maintenance Window. To do that, follow these steps:

1. If necessary, use the command `Testmode` to find out which module ID belongs to the defective module. Write down this module ID. (See “Testmode” on page 42.)
2. Display the data of the module in question using the command `Information`. Save this information as file or write down at least the version number of the firmware of the module. (See “Information (F11)” on page 25.)
3. Change the faulty module. Then identify the new module in the Device tree of the Maintenance Window.
4. Check whether the firmware of the spare part is up-to-date. If not, update the firmware. (See “Device Firmware” on page 37.)
5. Assign the module ID written down in step 1 to the new module. Check the correct assignment using the function `Testmode`.



**Important Note:** You should not use modules with different firmware versions within the same RM4200D! If the spare part has an older firmware version than the other modules, you need to load the already existing firmware file again. But if the module has a newer version – e.g. because it is a newly shipped part – you first have to obtain the matching firmware version and version of the `Toolbox4` software and use them to update the system.

If necessary, you can also replace a newer version of the firmware by an older one. This is for example useful, if you need to integrate a new spare module into a RM4200D running an older firmware version. In this case, you can “downgrade” the new module. If you have any questions about this process, ask your DHD dealer or DHD support!

If you change the module RM420-850, you might have to order new license codes at DHD! (See “Enter license code” on page 33.)



**Tip:** You do not need a complete RM4200D if you just want to upgrade a single module. You can also use a serial connection for the update. This is especially useful in workshop environments or when servicing RM4200D systems in the field. (See also “Updating the Firmware of Single Modules” on page 41.)

### Reading out and Changing the License Code

Use the command `Information` for the module RM420-850 to read out the current license information for the Device. You need a license code for the core operation of the system and maybe also for the Enhanced DSP functions (“Enhanced DSP Functions”). If you want to enter a new license code, use the command `Enter license code`. (See “Enter license code” on page 33.)

### Checking the Communication on the CAN Bus

Using the Maintenance Window you can check whether all modules are correctly registered with the CAN bus. To do this, open the node of the desired Device and check whether all available modules are actually displayed. If this is not the case, the CAN bus cable could be broken, for example.

If you want to check the function of separate keys on the Console, use the command `Enable CAN Protocol` or the F4 key. to monitor the data flow on the CAN bus. Now press keys on the Console. The system then must send the corresponding commands via the CAN bus, which are displayed in the Maintenance window. If this does not happen, there must be an error. (See also “Enable CAN Protocol (F4)” on page 35.)

Apart from that, you can use the CAN bus protocol to record the codes of certain keys for scripts. (See also “Scripts – Controlling Special Functions with Scripts” on page 200.)

## 4. The Project Tree

You find the project tree in the left part of the `Toolbox4` software. One or more Devices are displayed as nodes with their respective names. If you open the node of a particular Device, you can reach different parts of its configuration. (See figure 3–1.)

You can navigate in the project tree by pressing the right mouse button, some functions you can also access by right-clicking for the contextual menu. You can also use the arrow keys on the keyboard for navigation and the buttons in the software for executing the functions.

If you marked the project itself – the top entry in the project tree – you can add a new Device to the project tree, either with the contextual menu or with the button `Add Device`.

If a Device is marked, you can remove it either using the contextual menu or with the button `Remove Device`. In the contextual menu, there is the command `Copy Device` which you can use to copy a Device completely.

### 4.1 Project features

If you mark the topmost entry in the project tree, several tabs are displayed on the right side of the `Toolbox4` window.

#### Project Options

A project is unambiguously identified by the data in the fields `Project name` and `Project ID`. The project name is displayed as topmost entry in the project tree, it has no further function. In contrast, the project ID is transferred to the Devices and important for the communication using the UDP protocol. If several Devices in a network are to exchange Global Functions, they must have the same Project ID.



**Important Note:** If several RM4200D projects are operated in the same network, they all must have different Project IDs!

A project ID consists of 4 ASCII characters forming together a 32 bit address for unambiguous identification. If you create a new project, the project ID is generated anew by a random number generator, but you can edit it afterwards.

The project ID is displayed in the `Maintenance Window` in front of the corresponding Device name as well as in the window for loading a configuration to or from a Device.

You can see in the pane `Information` who has modified the project at which point — in the fields `Last edit by` and `Date`. For the name of the editor, the software enters the current Windows user name. The field `Project version` is for information only, a further function is not implemented yet.

#### Device Links

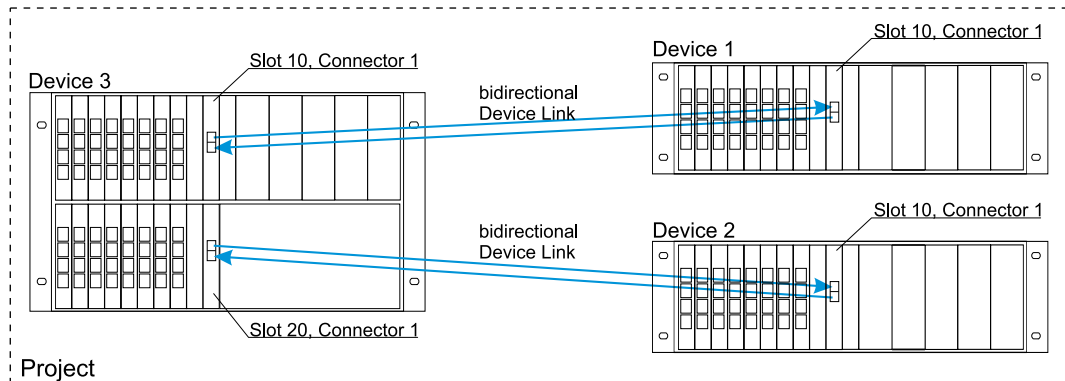
In order to make the configuration of interconnected Devices in a project easier, you can link them to each other using **Device Links**. Then, the labels for the audio channels need only to be entered at one of the Devices – at the output. The corresponding inputs of the other Device receive the same labels automatically. (See “DSP Frame I/O — Configuring the DSP Frame” on page 70.) If the audio modules are interconnected by Device Links, changed labels for the inputs are ignored. Furthermore, the features `Mono/Stereo` and `Headroom` are connected, too.

To be able to use Device Links, at least two Devices must be configured in the project.



**Note:** The configuration of Device Links is only meant to make work easier. Apart from the common editing of labels and features, they have no other functions.

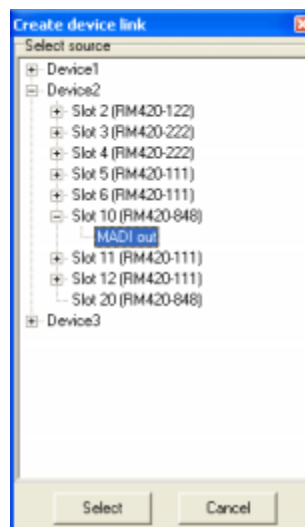
Device Links can be set up for all audio signals available in the RM4200D; MADI, Digital AES3/EBU and analog, too. A Device Link is a connection between a source and a destination, both being defined with the number of a *certain connector in a certain slot* of the DSP Frames. This is especially helpful with MADI connections between Devices. There are mostly used bi-directional as shown in figure 3–23:



**Figure 3–23: Example setup for two bidirectional MADI Device Links.**

Follow these steps for setting up a Device Link:

1. Make sure the desired modules are kept in the configuration and are configured with the appropriate features. (See “DSP Frame I/O — Configuring the DSP Frame” on page 70.)
2. Select the topmost node in the project tree – the project itself. Now choose the tab `Device link` on the right side of the window.
3. Create a new Device using either the command `Add` from the contextual menu or click the button `Add`. In the window appearing, you see the slots and signals available in the project. (See figure 3–24.)



**Figure 3–24: Creating a Device Link, window for selecting the source.**

4. Select the desired signal source by either double clicking or by highlighting it and then pressing the button `Select`. The windows with the signal sources closes, in the next window you see the available destinations for the Device Link. (See figure 3–25.)

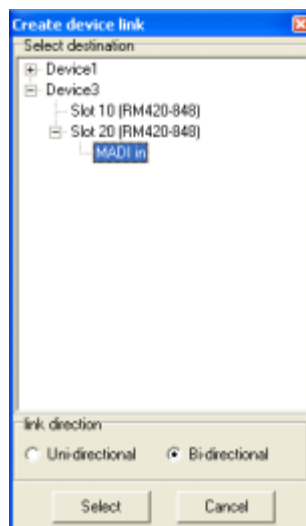


Figure 3–25: Creating a Device Link, window for selecting the destination.

5. Now select the destination of the connection in the same way as you did for the source. For MADI connections, you can also choose the option `Bi-directional` to automatically set up the two paired Device Links. (See figure 3–26.)
6. The connection is set up and displayed in the area `Defined links` in the main window. You see an error message if problems with assignment are occurring.



**Tip:** If you want to change a Device Link later on, you need to delete it first and then set it up again. For deleting, please use either the command `Remove` from the contextual menu or press the button `Remove`.



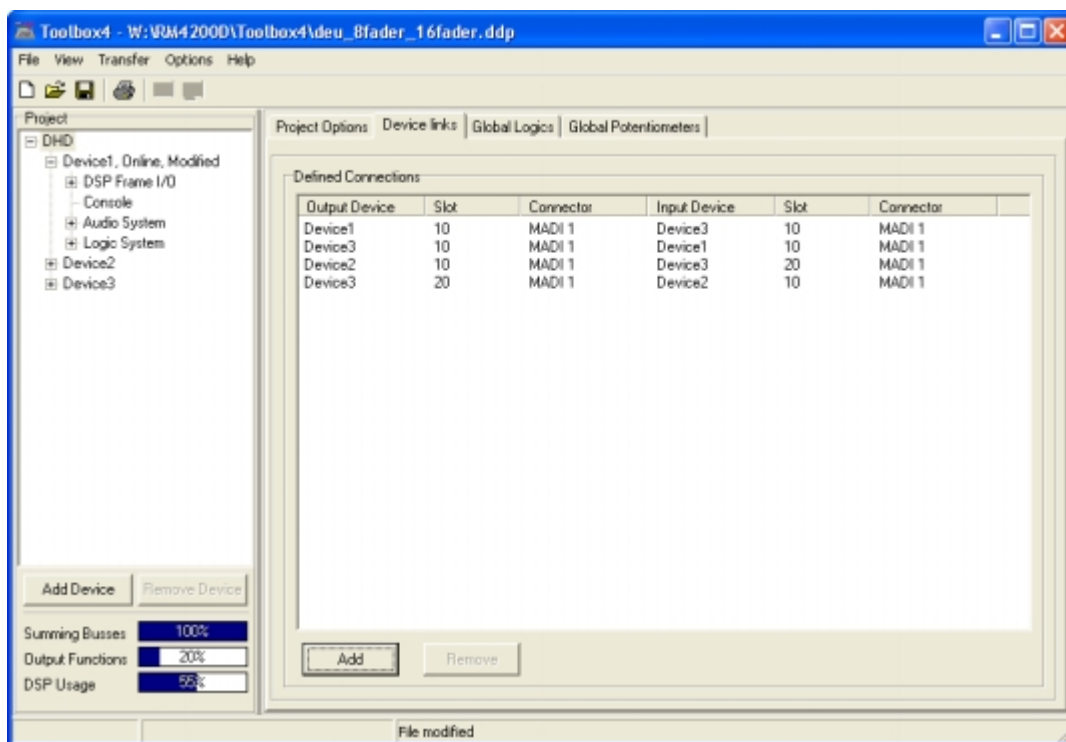


Figure 3–26: Configuration of two bidirectional Device Links between MADI ports.

### Global Logics

If several Devices are coupled with Ethernet, they can exchange Global Logic functions using UDP commands.

These Devices are managed in a project. This makes configuration easier and ensures a correct assignment of the participating Devices. This way, all Devices receive the same project ID.



**Important Note:** The project IDs must be identical in order to make Devices able to exchange Global Logics via UDP.

In a project, you can use up to 200 Global Logic functions, each of which can be feed with *any one* Logic source of the Devices available in the project. All Global Logic functions again are available as Logic sources in each Device of the project.



**Note:** If the RM4200D Devices are coupled over a serial RS232 port, only the Global Logics 1 to 50 can be exchanged. This communication is compatible with the preceding product RM3200D.

To assign a Global Logic function, use the following steps:

1. Mark the topmost node in the project tree – the project itself. Then select the tab Global Logics on the right side of the window.
2. You see a list of all 200 Global Logic functions. Select the desired function and the click on the button Select. Alternatively, you can also double click on the function. Either way, you open the Logic Sources Window. (See figure 3–27.)

3. Select the Logic sources available in the project by clicking on them. Now click on the button **Assign** or double click the selected Logic source. The result is displayed in the line with the selected Global Logic functions in the column **Source**.
4. If necessary, you can now name the Global Logic functions appropriately in the field **Label**.



**Tip:** If the **Logic Sources** Window is open, you can also use **Drag&Drop** to assign the Logic sources to Global Logics.

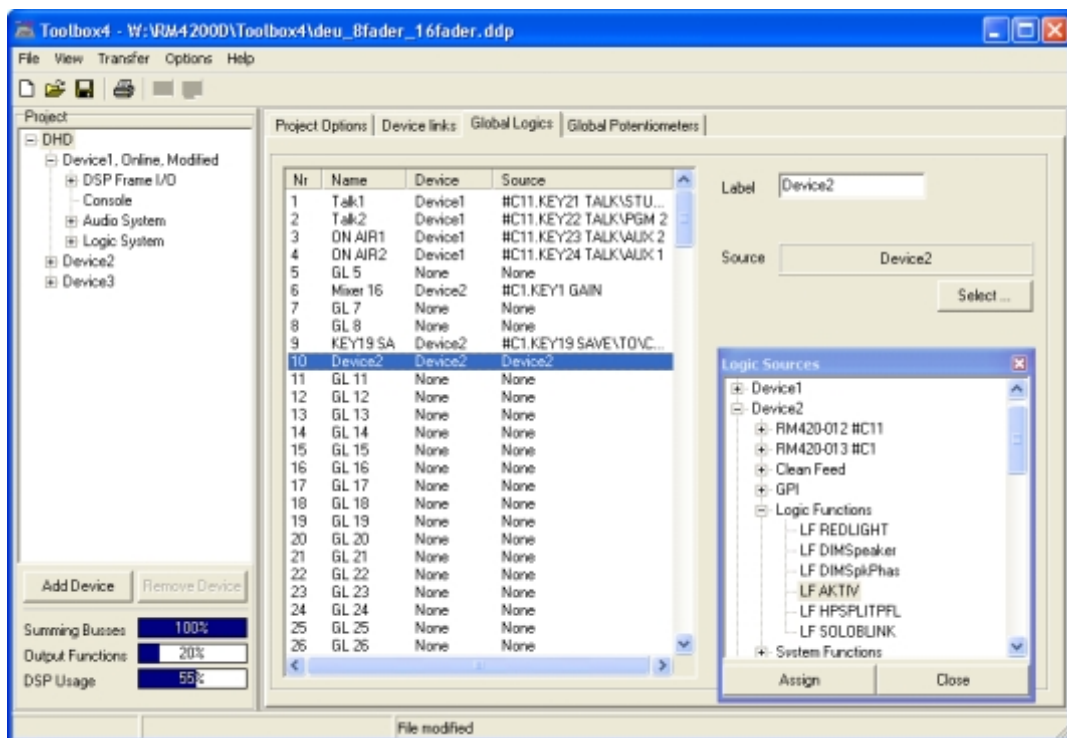


Figure 3–27: Configuration of Global Logic functions.

### Global Potentiometers

If several Devices are coupled with Ethernet, they can exchange Global Potentiometers using UDP commands.

These Devices are managed within a project. This makes configuration easier and ensures a correct assignment of the participating Devices. This way, all receive the same project ID.



**Important Note:** In order to enable Devices to exchange Global Potentiometer values over UDP, their project IDs must be identical.

You can use up to 20 Global Potentiometers in a project. Each of them can be coupled with *one* fader or can be set using scripts. All Global Potentiometers can be used in each Device of the project to influence levels in Output Functions. (See “Output Functions” on page 169.)

A Global Potentiometer is controlled by the corresponding fader. You can define this assignment for the appropriate Device in the submenu **Audio System/Channel**

Assignment. (See “Channel Assignment – Assigning Fader Channels and DSP Processing” on page 165.)

If you have marked the topmost node in the project tree, you can name the Global Potentiometers accordingly in the tab Global Potentiometers.

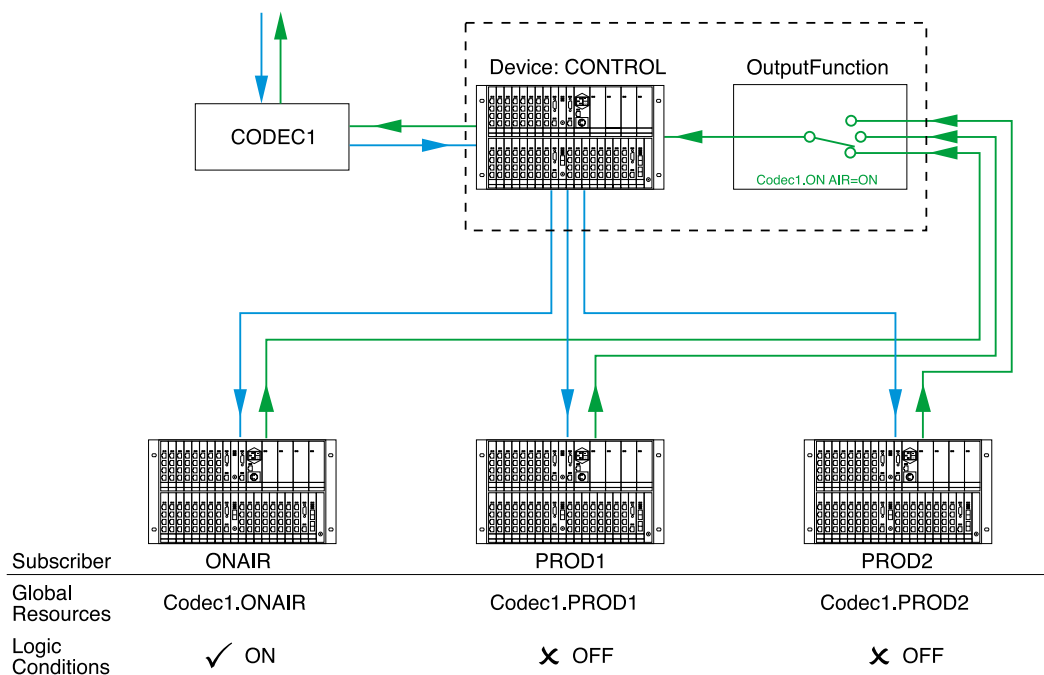


**Note:** Global Potentiometers are not supported by the serial port of RM4200D.

### Global Resources

#### Overview

**Global Resources** are to a certain extent related to Global Logic Functions. They have been developed in order to assign uniquely available audio sources in a studio complex of several RM4200D exclusively to certain users. A typical scenario for this is e.g. a central phone line, the back line of which is feed from two or more studios as selected. But the line can be used by *only one studio at the same time!* The following figure illustrates such a situation. There, the Device “Control” is the **Master**, in which the Global Resource is coordinated. All other Devices are **Subscribers** that access the resource alternately and exclusively.



**Figure 3–28:** Global Resource (CODEC1) with three subscribers. The Device “CONTROL” currently acts as Master, the Device “On AIR” has exclusive access to the Codec.

Global Resources offer the functions necessary to allow the “exclusive ownership” of a resource and the “change of the owner” on request. The functions are based on the following design principles:

1. A Global Resource is offered or “published” by exactly one **Master**. One or more **Subscribers** are defined and can own the resource. You can define up to 20 Global Resources.

2. A resource can either be vacant (not owned by any subscriber) or owned by *exactly one subscriber*. You can determine which state the Global resource should have after switching on the RM4200D or after a reset. It can either be vacant or assigned to a certain subscriber.
3. Master and subscriber are different Devices in the same project. Nevertheless, it is possible to define master and subscriber on the same Device.
4. The master is defined only to determine the Device responsible for the Global Resources management. Apart from that, it has *no special function*.
5. Global Resources are implemented as special logic signals. There is exactly one logic signal for each subscriber of a resource that can be accessed by all Devices in the project. This logic signal is active if the corresponding subscriber owns the resource. At the same time, the logic signals of all other subscribers are inactive. In the `Logic Sources` Window in the pane `Global Resources`, you have access to these signals.
6. Switching between the different subscribers is done using special key functions. These have to be assigned to keys on the Console. Please find more details on that later in the book.
7. Global Resources switch the logic signals only. The audio signal itself is modified using Output Functions or Super Output Functions as usual, controlled by the logic signals of the Global Resources.

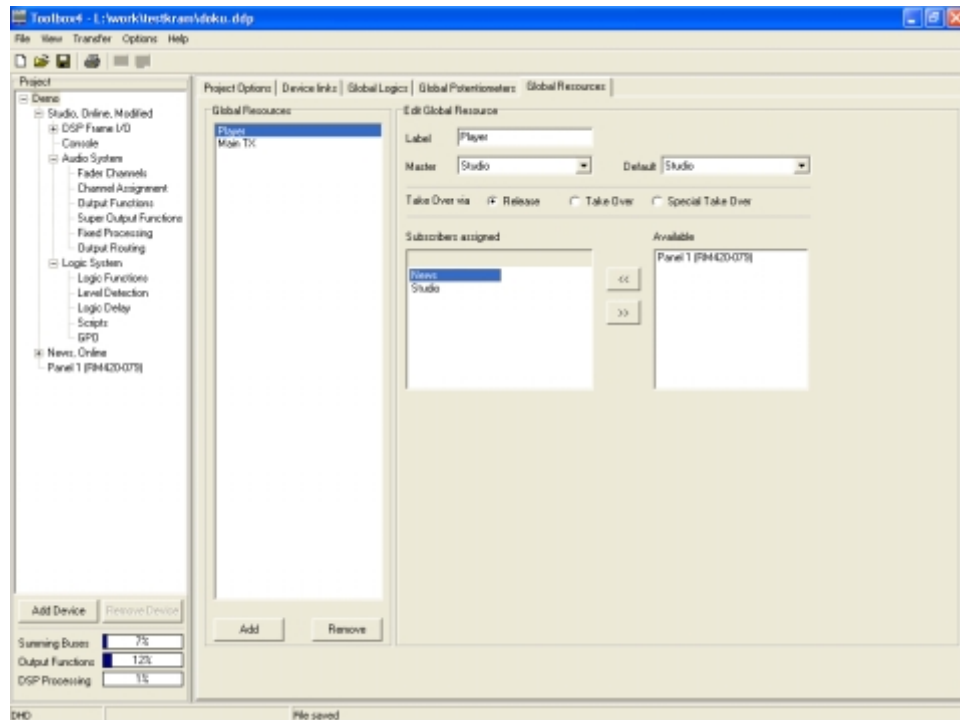
You can define up to 20 Global Resources that are used by all Devices in the same project. For this, the Devices must be coupled via Ethernet, thus being able to exchange messages using UDP!



**Important Note:** Make sure that all Devices have *the same project ID*! If not, no messages can be exchanged using UDP, so the Global Resources do not work.

### Defining Global Resources

In order to define Global Resources, first you have to highlight the uppermost node in the project tree – the project itself - with a mouse click. After that, click on the tab `Global Resources` to open the configuration dialog.



**Figure 3–29: Global Resources Configuration Dialog.**

To define a Global Resource, use the following steps:

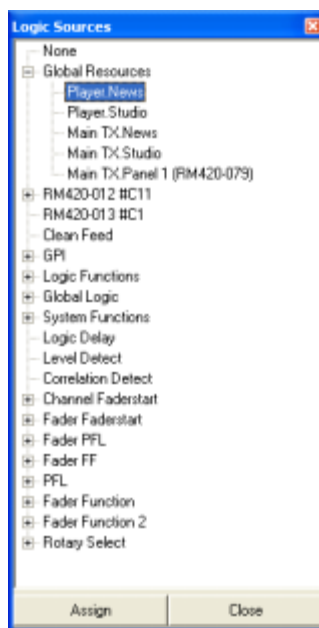
1. Click on the button `Add` to create a new resource. Type a descriptive name in the entry box `Label`.
2. Select the `Device` to manage the Global Resources from the popup menu `Master`. It is not necessary to define a subscriber on this `Device` as well, but you can do it if it seems useful to you.



**Note:** Any `Device` can be defined as `Master`. It is useful, though, to select the `Device` which the resource (e.g. the phone line) is really connected to. This way, you make sure that the line is available if the “`Master`” `Device` is active.

3. Now determine the `Devices` that may access the Global Resource as subscribers. To do that, use the two lists in the bottom area of the dialog. To define a `Device` as subscriber, highlight a `Device` in the pane `Available` and then click on the button `<<` to move it to the list `Subscribers assigned` on the left. To delete a `Device` from the subscribers list, highlight it and then click on the button `>>`.
4. In the `Default` popup menu, define which subscriber owns the Global Resource by default. This is relevant when switching on the `Master Device` or when triggering a reset. The “`Default Subscriber`” is also assigned when a subscriber itself releases the Global Resource without a request from a different subscriber.

- The Global Resource just created is available immediately as a logic function to all Devices in the project. You will find it in the Logic Sources Window under the node Global Resources. It is named <Name of the Global Resource>.<Name of the Subscriber>. There is exactly one logic function for every subscriber assigned. This is always active when the subscriber owns the Global Resource.



**Figure 3–30: Global Resources in the “Logic Sources” Window.**

You can access Global Resources only if you have defined the appropriate keys for a resource request on the Console.



**Important Note:** You have to define a designated key on the Control Module for each Global Resource that you want to access. In addition, there must be keys with the system functions `OK` and `Cancel` defined on the same Console.

To define a key for a Global Resource request, use the following steps:

- Select the node `Console` in the project tree. Click on the tab `Keys` and select a Control Module (RM420-010, RM420-012, RM420-013, RM420-014...).
- In the module view, click on the key you want to use to request the Global Resource. Select the function `Resource Request` from the popup menu `Function`. Two further popup menus appear below.
- In order to select the Global Resource to request the key, use the `Resource` popup menu. Then, select the Device *which the Global Resource will be requested for* from the popup menu `Reserve for`. Each Device can request the Global Resource for itself (entry `Self (default)`) or for other resource subscribers.



**Tip:** For example, it may be useful to request the Global Resource for a different subscriber, if the corresponding key is in the control room from which the lines or phone codecs are assigned to various studios. Assigning the resource to a different Device makes also sense if you are using the control panels with LCD keys.

4. Finally, define the key colors. The ON color is displayed when the Device owns the Global Resource. The OFF color is displayed when the resource is vacant. If the resource is taken by a different subscriber, the key is off.

If a Global Resource is taken by one Device, other authorised subscribers can request the resource. To request or take over resources or to confirm or deny requests, for each Device, the system functions “OK” and “Cancel” must be configured as key functions in a Control Module (RM420-010, RM420-012, RM420-013, RM420 ...).

There are three procedures to take over a Global resource:

1. *Release.* The resource is taken by a Device which is the “Owner”. Another Device requests the resource. The owner can deny or confirm this request. If he confirms it, it releases the resource. The procedure requires that the appropriate keys are pressed on the Consoles of both Devices.
2. *Take Over:* The resource is taken. The request is issued by a different Device. In a second step, the requesting Device confirms the request itself and takes over the resource. Alternatively, the owner can release the resource or deny the request, too.
3. *Special Take Over:* The resource is taken by the owner. It is requested by a different Device. If there is no confirmation from the owner, the requester can enforce the take over. For this, the request key together with the OK key must be pressed for 5 seconds. Alternatively, the owner can release the resource or deny the request, too.

A resource is always handed over in two steps – a request and a confirmation. During this procedure, the colors of the keys involved and the LE displays supply information on the current status of the procedure. It works like this:

1. One Device requests the resource (Request). Therefore, the request key and the OK key must be pressed simultaneously on the Console of the requesting Device.
2. In the second step, the resource is released by the owner (Release) or taken over by the requesting Device (Take Over, Special Take Over).



**Tip:** The best way to understand these procedures is to create a Global Resource for a test and then try out the take over using two Consoles.

### **Example for a resource take over**

The following examples illustrate the different steps and status displays during the assignment of a return line.



**Important Note:** Due to construction constraints, the display options of the LC displays in the Control Modules RM420-010, RM420-012, RM420-013 and RM420-014 and the LCD keys in the modules RM420-027, RM420-078 and

## Part III: Toolbox 4 Configuration Reference

RM420-079 are limited to six digits. To avoid ambiguities, you should assign *six-digit* Device and resource names only.

The following configuration settings are used for the examples:

<b>Resource Name</b>	CODEC		
<b>Default Owner</b>	No Device		
<b>Take Over Mode</b>	Release		
<b>Subscriber Name</b>	Stud1	Stud2	LCD (RM420-079)
<b>Reserve for</b>	Self (default)	Self (default)	Studio 1
<b>Key color ON</b>	Red	Red	-
<b>Key color OFF</b>	Yellow	Yellow	-
<b>Key color "Available"</b>	-	-	-
<b>Key color "Owned"</b>	-	-	-
<b>Key color "Busy"</b>	-	-	-

*Situation 1:* The resource is vacant and taken over by *Stud1*.

	<b>Stud1</b>	<b>Stud2</b>	<b>LCD</b>
Status display	key CODEC = yellow	key CODEC = yellow	key CODEC = green line 1 displays "CODEC"
<i>Request to Resource</i>	Keys CODEC + OK pressed	-	
State display	key CODEC flashes yellow	key CODEC = off	key CODEC flashes green, line 3 displays Rq Device "Stud1"
<i>Check resource state</i>	key CODEC pressed	key CODEC pressed	-
State display	Display (Rq = Request): "CODEC Rq Stud1"	Display (Rq = Request): "CODEC Rq Stud1"	-
<i>Resource take over</i>	keys CODEC + OK pressed	-	-
State display	key CODEC = red	key CODEC = off	key CODEC = red line 2 displays Ow Device "Stud1"
<i>Check resource state</i>	key CODEC pressed	key CODEC pressed	
State display	Display (Ow = Owner): "CODEC Ow Stud1"	Display (Ow = Owner): "CODEC Ow Stud1"	



*Situation 2: The resource is taken by Stud1 and released by Stud1.*

	<b>Stud1</b>	<b>Stud2</b>	<b>LCD</b>
State display	key CODEC = red	key CODEC = off	key CODEC = red line 2 displays Ow Device "Stud1"
<i>Check resource state</i>	key CODEC pressed	key CODEC pressed	-
State display	Display (Ow = Owner): "CODEC Ow Stud1"	Display (Ow = Owner): "CODEC Ow Stud1"	-
<i>Initiate release</i>	keys CODEC + OK pressed	-	-
State display	key CODEC = flas- hes red	key CODEC = off	key CODEC = red line 3 displays "off"
<i>Check resource state</i>	key CODEC pressed	key CODEC pressed	-
State display	Display (Rq = Request): "CODEC Rq Off"	Display (Rq = Request): "CODEC Rq Off"	-
<i>Execute release</i>	keys CODEC + OK pressed	-	-
State display	key CODEC = yel- low	key CODEC = yel- low	key CODEC = green

*Situation 3: The resource Stud1 is taken and requested by Stud2.*

	<b>Stud1</b>	<b>Stud2</b>	<b>LCD</b>
State display	key CODEC = red	key CODEC = off	key CODEC = red line 1 displays "CODEC" line 2 displays Ow Device "Stud1"
<i>Check resource state</i>	key CODEC pressed	key CODEC pressed	-
State display	Display (Ow = Owner): "CODEC Ow Stud1"	Display (Ow = Owner): "CODEC Ow Stud1"	-
<i>Request to resource</i>	-	keys CODEC + OK pressed	-
State display	key CODEC flashes red	key CODEC flashes yellow	key CODEC flashes red, line 3 displays Rq Device "Stud2"
<i>Check resource state</i>	key CODEC pressed	key CODEC pressed	-
State display	Display (Rq = Request): "CODEC Rq Stud2"	Display (Ow = Owner): "CODEC Ow Stud1"	-



<i>Resource hand over</i>	keys CODEC + OKpressed	-	-
State display	key CODEC = off	key CODEC = red	key CODEC = yellow line 2 displays Ow Device "Stud2"
<i>Check resource state</i>	key CODEC pressed	key CODEC pressed	-
State display	Display (Ow = Owner): "CODEC Ow Stud2"	Display (Ow = Owner): "CODEC Ow Stud2"	-

Finally, you have to connect the logic states of the resource with audio signals using an Output Function. (See "Output Functions" on page 169.)

The best option is to create the Output Function within the Device where the signal CODEC1 is physically available. This signal must also be provided to the second Device, e.g. via MADI. The second Device transmits the return signal CODEC2 to the first Device that is connected to CODEC1.

Thus, the Output Function connected to the physical output going to CODEC1 looks like this:

Condition	Source 1	Level 1	Source 2	Level 2
Default	CF CODEC1 (local)	Off	CF CODEC2 (MADI)	Off
CODEC1.Stud1	CF CODEC1 (local)	0 dB	CF CODEC2 (MADI)	Off
CODEC1.Stud2	CF CODEC1 (local)	Off	CF CODEC2 (MADI)	0 dB

### Global Resources in Fader Channels

If necessary, Global Resources can be requested and released also using keys on Fader Modules. To do this, you have to define the keys for the Console and the assigned resource in a Fader Channel. If the Fader Channel is switched to a fader, you can use the request key as follows:

1. Press the defined key in the Fader Channel to request the resource. The key starts flashing. The current owner of the resource can now confirm the request. If you press the key again before receiving a confirmation, the request is interrupted.
2. As soon as the resource is taken over by your Device, the key lights up accordingly.
3. If you press the key again, the resource is released immediately and without a second confirmation.



**Tip:** This mode of operation is useful e.g. if the resources are managed by an engineer or an assistant in the control room and if you want to switch on external lines or phone codecs to a fader quickly, just pressing one key.

To define a key on a Fader Module to request Global Resources, use the following steps:

1. Make sure the Global Resources are defined correctly. (See also "Defining Global Resources" on page 53.)

2. Select to the node `Console` in the project tree and click on the tab `Keys`. Select a `Fader Module` and click on the key you want to use to request a `Global Resource`.
3. Select the entry `Resource` from the `Function` popup menu. Define the key colors for the states `On` and `Off`.
4. In the project tree, switch to the node `Fader Channels` (under `Audio System`). Select a `Fader Channel` from the list `Defined Channels`. This is the channel you want to configure the request key on the `Fader Module` for.
5. To assign the `Global Resource` to the selected `Fader Channel`, use the `Global Resource` popup menu in the pane `General`. Load the `Config` to the `DSP frame`.
6. As soon as the configured `Fader Channel` is switched on a fader, you can request the `Global Resource` using the defined key as described above.

### 4.2 Device Properties

If you select the topmost node of a `Device` in the project tree, the tabs `Options` and `Network Configuration` are displayed in the window on the right. Here you can configure the properties of the selected `Device`.

#### Options

This tab contains general information on the `Device`.

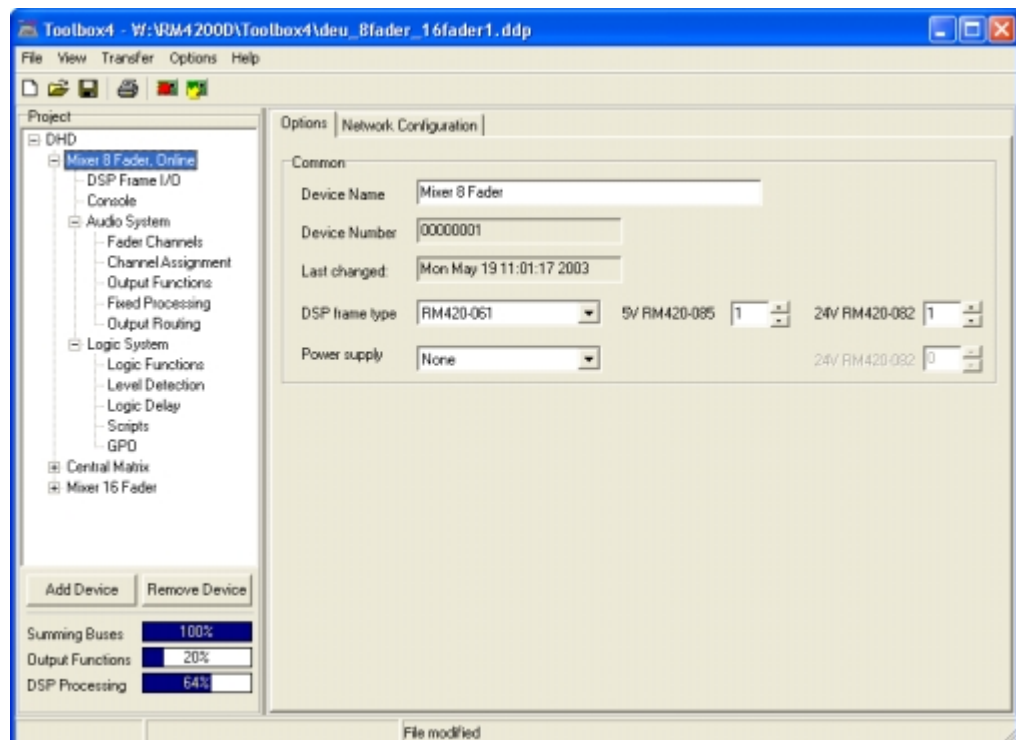


Figure 3–31: Device Options dialog.

You can configure the following options:

- **Label:** This is the name of the Device that you can change if necessary. If a project contains several Devices, they should be named differently. This makes configuration easier since the Device names are used in different lists. The Label can also be displayed in the main display of the modules RM420-010/011/012/013, though being limited to a length of 16 characters only.
- **Device Number:** The serial number of the Device. It can not be changed.
- **Last changed:** Date and time of the last modification of the Device configuration.
- **DSP frame type:** Here you choose the desired DSP frame, either the frame RM420-061 (3 HE) or the frame RM420-063 (6HE). By selecting the DSP frames, the available number of slots (10 or 30 slots) for configuring the I/O modules is defined. Furthermore, in this row, you can define the number of power supply modules RM420-082 and RM420-085 in the DSP frame.
- **Power supply:** If an additional 3 HE module frame is necessary for power supply. here you can select the RM420-081 and also the number of available 24 V power units carried by this frame. The number of necessary power supply units is taken from a table and released by DHD via the confirmation of order.



**Note:** The options for the power unit are for information only. They have no meaning for the configuration of the Device.

### Network Configuration

In this tab, you can configure the IP address of the Device. If you check the checkbox **Automatic via DHCP**, after switching on, the Device tries to receive an IP address from a DHCP server in the network.

If this option is inactive, you can configure a static IP address. Watch the settings in the field **Subnet Mask**, mostly the value 255.255.255.\_\_0 is set.

If available in the current network, you can also define the addresses of the DNS server and the Gateway. Mostly, both values are set to 0.0.0.0.

(See also “Configuration of IP Addresses” on page 16.)

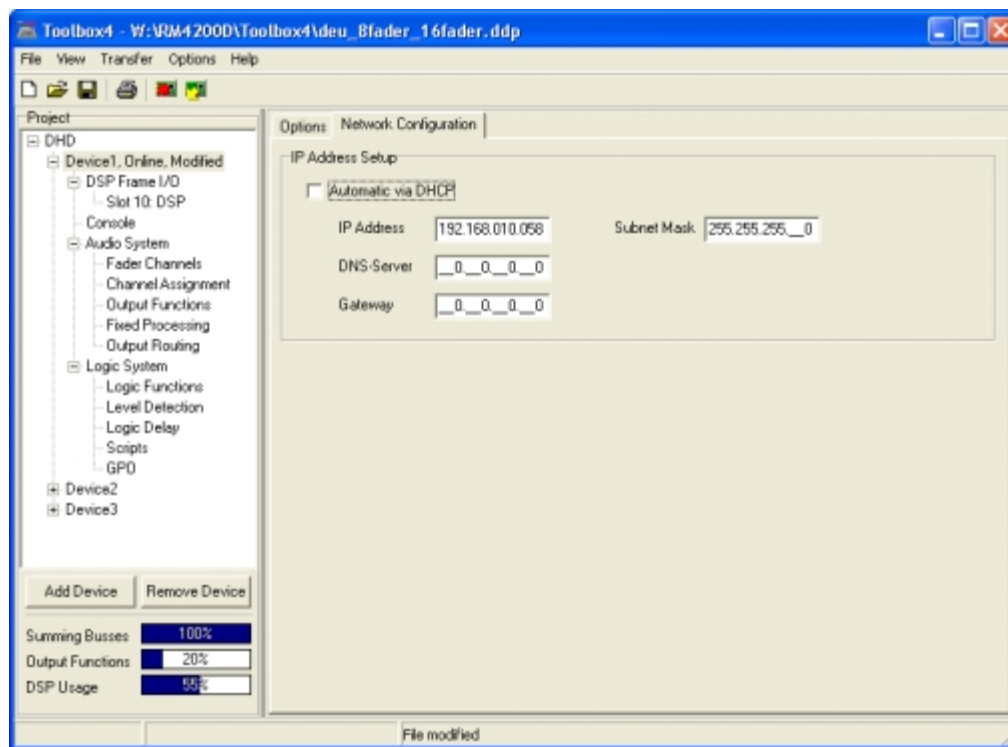


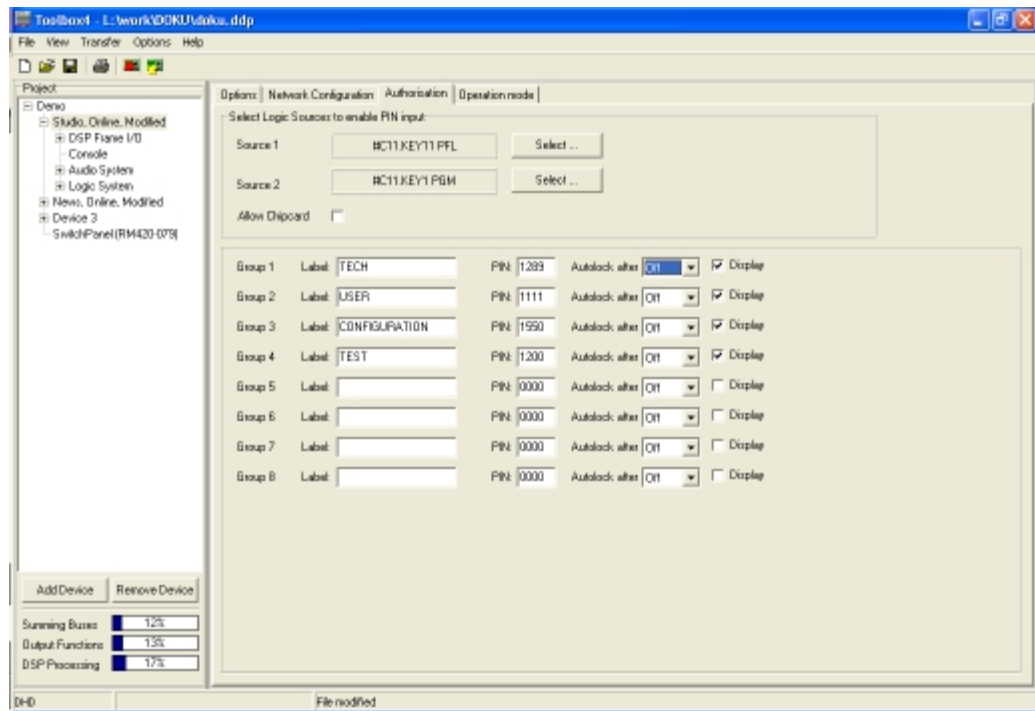
Figure 3–32: Network configuration of a Device.

### Authorisation

If necessary, you can limit the access to certain functions of the RM4200D using this dialog. This is useful, e.g. if certain settings – like DSP processing, Gain or Equalizer – should be editable only by a limited group of users.

Access restrictions work like this:

- The access to certain keys and their assigned functions is restricted. You assign the protected keys when configuring the Console. (See also “Authorisation – Restricting Key Access” on page 83.)
- You can define up to 8 different user groups. Each group can be assigned a name with a maximum length of 16 digits. You can see this name in the display of the modules RM420-010, RM420-012 and RM420-013.
- To log in, first a user has to press two certain keys simultaneously for five seconds. Then, she can enter a four digit PIN using the rotary knob. If the PIN is correct, the user stays “logged in” and has access to the functions that are locked otherwise.
- The user retains access to the special functions until she either logs out or a preset timeout has occurred.



**Figure 3–33: Authorisation, setting up user groups.**

To activate access restrictions, you first have to determine which two logic sources allow the entry of a PIN. *These two logic sources have to be true simultaneously for five seconds to allow the entry of the PIN using the rotary knob. In addition, they have to stay true until the PIN has been entered completely!*

Set the desired logic sources in the lines Source 1 and Source 2. To do this, click on the button Select... respectively and select the logic source from the Logic Sources Window.



**Important Note:** You can select any logic source available in the Config to enable the PIN input mode. It has proved useful, though, to select two keys that are located on the Console. Select the keys in a way that *they can be pressed simultaneously with one hand!* You need the other hand for entering the PIN using the rotary knob.



**Caution:** In any case, make sure to use two “vacant” keys on the Console for this purpose. If you accidentally define a access restricted key for activating the PIN input mode, it will be impossible to use this function.

Now define the different user groups. For this purpose, enter the following data:

- **Label.** This is the name of the group, it may be up to 16 digits long.
- **PIN.** Enter the secret number here. It must have four digits and *may not have any spaces and no leading 0 (zero)*. Make sure that each group has an unique PIN!
- **Autolock after.** Here you can define after what time the used is “logged out”. You can set periods of time between 2 and 30 minutes. If you choose the option OFF, there will be no time limit. Then the user has to press two keys again for 5 seconds simultaneously to log herself out.

- `Display`. Activate this checkbox if the name of the user group logged in should appear in the display of the modules RM420-010, RM420-012 and RM420-013.

Now, in the pane `Console` you can define the keys for which access should be limited. (See also “Authorisation – Restricting Key Access” on page 83.) As soon as you are done, load the modified Config into the Device. The keys on the Console of the Device are now access protected.

If you want to log in the Console as authorised user, use the following steps:

1. Press both keys for activating and hold them for five seconds. After this period of time, the input mode becomes active. The display of the modules RM420-010, RM420-012, RM420-013 and RM420-014 switches to `PIN 0`.
2. Now turn the rotary knob next to the display left and right until the first digit of the PIN is displayed.
3. Now turn the rotary knob into the other direction until the second digit is set correctly.
4. Change direction again and set the third digit, too.
5. Again, change direction and set the fourth digit of the PIN. If this is correct, the output `Success` is temporarily shown in the display. After that, the name of the user group is displayed. If you set a time for the autolock function, the remaining time until automatic logout is displayed instead.
6. Now you have extended access to the Console. Both activation keys do not have to be active any longer.
7. If an autolock time is set, after this period of time, access is terminated automatically. If there is not autolock time configured, hold the activation keys for five seconds to finish the extended access.



**Important Note:** Make sure to change the turning direction for each digit when entering the PIN numbers!

### Operation Mode

In this dialog, you can set various options affecting the operation of the Device currently selected.

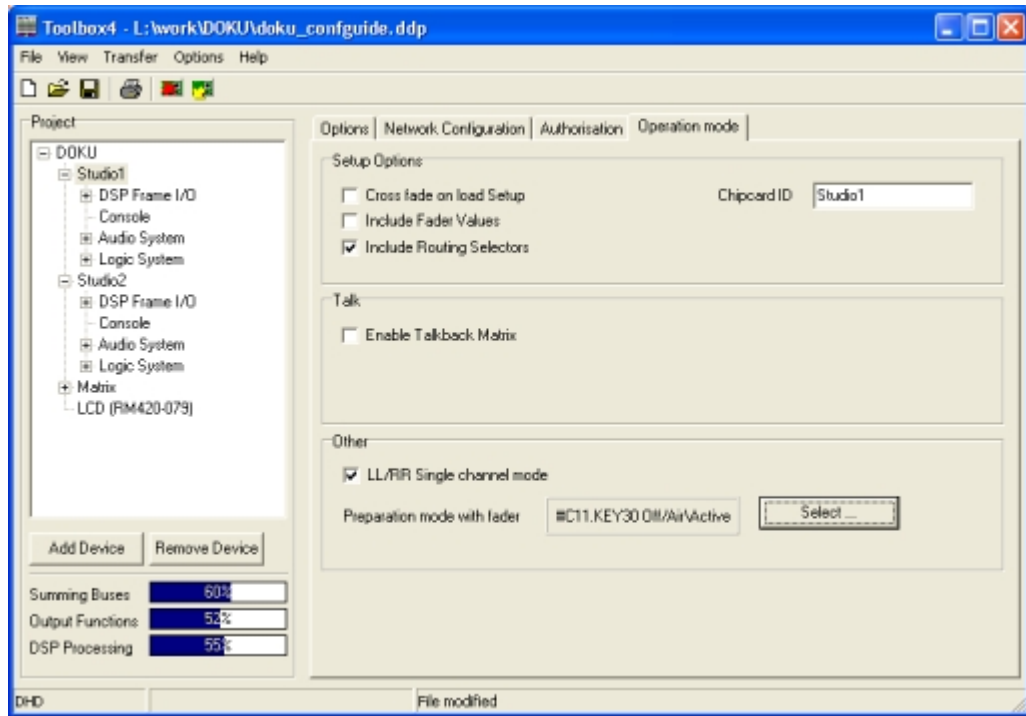


Figure 3–34: Operation mode, setting options for the Device.

#### Setup Options

##### Cross fade on load Setup

If the Console of your RM4200D is equipped with motor faders, here you can activate automatic fading when loading setups. This means that open faders crossfade automatically when loading a new setup.



**Note:** Automatic crossfade works only if the Motor Fader Modules RM420-020M or RM420-029M are used on the Console.



**Important Note:** Automatic crossfades *do not work* if the function `Auto Off` is activated for one of the faders. (See “Fader Channels – Configuring Signal Sources for Faders” on page 159.)

Depending on the state of the faders involved, the RM4200D behaves differently. The various cases are listed in the table below:



Assignment before loading the setup		Assignment after loading the setup		Crossfade
Fader 1	Fader 2	Fader 1	Fader 2	
Channel 1 <i>Open and On</i>	arbitrary <i>Closed and Off</i>	Channel 2 (from setup) <i>Closed and Off</i>	Channel 1 <i>Open and On</i>	The name of channel 1 is temporarily displayed in both fader displays. Then the crossfade is carried out: Fader 1 is opened, fader 2 is closed. Then fader 2 displays the name of channel 2 that was assigned according to the setup.
Channel 1 <i>Open and On</i>	Channel 2 <i>Open and On</i>	Channel 2	Channel 1	Both faders remain unchanged. Assignment of channels is not changed.
Channel 1 <i>Open and On</i>	Channel 2 <i>Open and On</i>	arbitrary	Channel 1, (According to setup, Channel 2 is not switched to pool fader any more)	Both faders remain unchanged. Assignment of channels is not changed.

If three motor faders are involved, an automatic crossfade is carried out as well:

Assignment before loading the setup			Assignment after loading the setup		
Fader 1	Fader 2	Fader 3	Fader 1	Fader 2	Fader 3
Channel 1 <i>Open and On</i>	Channel 2 <i>Open and On</i>	arbitrary <i>Closed and Off</i>	arbitrary <i>Closed and Off</i>	Channel 1 <i>Open and On</i>	Channel 2 <i>Open and On</i>

The crossfade is carried out as follows:

1. Temporarily, the name of channel 2 is displayed in the fader displays of fader 2 and fader 3. Fader 2 is closed, at the same time, fader 3 moves to the current value of fader 2. The crossfade is carried out in a way that it can not be heard.
2. In the display of fader 2 (now closed), the name of channel 1 is displayed.
3. The faders 1 and two are crossfaded. For this, fader 2 moves to the value of fader 1, at the same time fader 1 is closed. The crossfade is carried out in a way that it can not be heard.

### **Include fader values**



**Note:** The function described below is configurable from *version 5.5* (Toolbox4 and Firmware).

This option activates the storing of fader values in setups. The saved values are stored in dB and accord to the setting of the respective fader potentiometer. This applies to the values of all configured faders.



**Important Note:** On the loading of a setup containing fader values, the currently set values are overwritten by the saved values without confirmation. Thus, signals might suddenly be mixed onto busses, producing undesirable mixing results. Therefore we urgently recommend using this option during production only.

### Include Routing Selectors



**Note:** The function described below is configurable from *version 5.5* (Toolbox4 and Firmware).

Before, Routing Selectors (crosspoints) were stored in every setup by default. Consequently, the selection Include Routing Selectors is activated. If you deactivate this function, no future Routing Selectors information will be stored in setups.

### Chipcard ID



**Note:** The function described below is configurable from *version 5.5* (Toolbox4 and Firmware).

With the aid of the Chipcard ID you can realize fixed assignments of setups stored on chip cards to an RM4200D. This inhibits that an RM4200D will process setup data from chip cards that originate from another, differently configured RM4200D.

By default, the Chipcard ID corresponds to the first 10 characters of the Device name, which you can generate in the menu Options. Modifications of the Device name are adopted for the Chipcard ID until you change the entry in the text field Chipcard ID by hand.

It is also possible to manually enter the same Chipcard ID for several Devices. So you can use the setup stored on a chip card on several consoles. We strongly recommend this procedure only for devices with identical configuration.

The Chipcard ID is stored in the RM4200D. When a setup is backed up, the ID is also copied onto the chip card. If a setup is to be loaded from a chip card, both Chipcard IDs are compared. In case they differ, the setup is not loaded, and the display of the RM420-013 shows Invalid Chipcard instead.

For further information about setups, please see part 6 of the Documentation, Application Software Manual - Setup Manager.

### Talk

Activate the checkbox `Enable Talkback Matrix` if you want to operate the selected Device as talkback matrix. Then you can configure the Device as a matrix of x channels and x outputs. The nodes of this matrix can be set by external Devices using the UDP messages. You find an example for this configuration in the volume "Part 2 – System Reference" of this manual.



**Note:** If you activate this option, the selected Device can be used *exclusively* for talkback and routing functions! Please read the corresponding explanations in the volume "Part 2 – System Reference" in this manual.

### **Other**

#### **LL/RR Single Channel mode**

If you activate the checkbox `LL/RR Single Channel mode`, you change the operation mode of the functions `LL` and `RR`. As soon as you activate these functions on the Console, you only hear the left (`LL`) or right (`RR`) channel from the output, respectively the other channel is muted. (See also “ON/OFF Function” on page 93.)

#### **Preparation mode with fader**

The option `Preparation mode with fader` enables you to switch between the conventional functionality of the conference mode and an especially adjusted version of the conference function.

With the `Select` key, you first need to select a logic source, which activates the special conference mode. Ideally this should be a toggling key. In the initial state (key not activated), the conference mode works as it is known. For taking part in the conference, the fader potentiometer must be closed, the respective channel has to be switched on (`Channel ON`), and the key function `CF Prep` in the fader channel must be activated.

If the `Preparation mode with fader` option is activated by the assigned key, only those channels take part in the conference, whose `CF Prep` key function is activated, and which are switched off (`Channel OFF`). Furthermore, in the conference matrix, you can set the volume of a channel via its fader potentiometer.

#### **DSP Power Bargraphs**

There are three bars below the project tree displaying the load of the three main DSP function groups. This display is valid for the Device currently selected in the project tree.

#### **Summing Buses**

Here, the load of the summing buses is displayed. Each DSP module can calculate up to 16 stereo sums, making up a maximum number of 48 stereo sums available for each Device. The system automatically defines the first stereo sum in each configuration as `PFL bus`. Further sums are used as **Program Buses**, **Aux Buses** and **Clean Feeds**. If a DSP module is equipped with a `RM420-422 Dual MADI Module`, twelve routing channels of the `TDM bus system` are used for the `MADI transfer` per module. These twelve channels are taken from the total number of channels normally being available for six stereo sums. Thus, the load of the `Summing Buses` is higher the more `MADI modules` are used.

If the calculated load for the configuration is higher than 100%, the color of the bargraph changes from blue to red. If you try to load a configuration in this condition to a Device, the error message `Operation not allowed` appears:

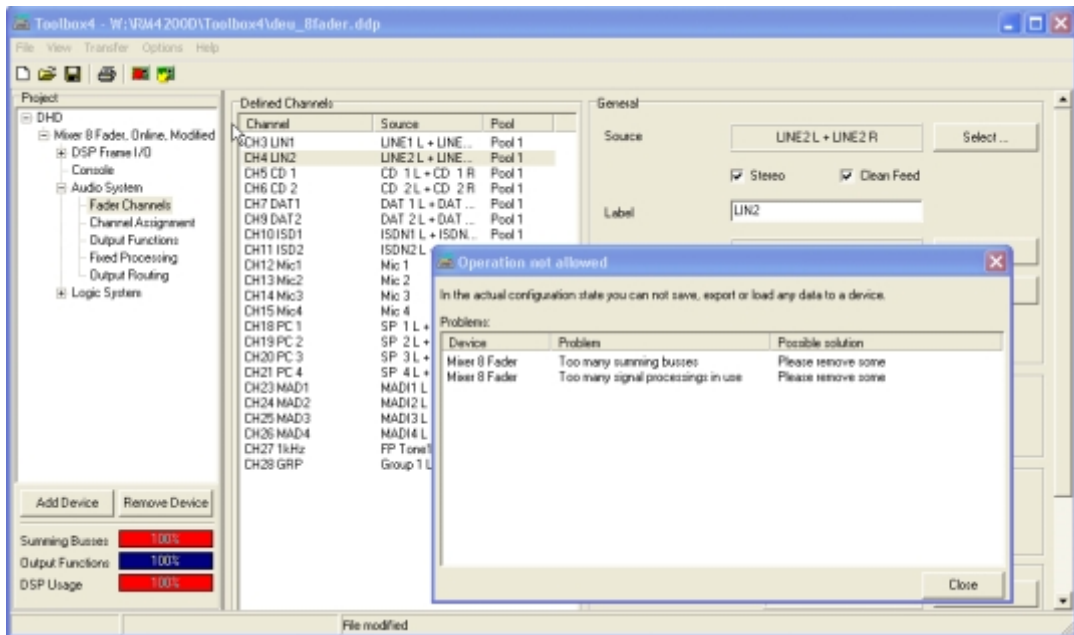


Figure 3–35: Error message “Operation not allowed” when exceeding the maximum DSP load.



**Note:** Summation can be used up to a load of 100% without any restrictions.

**Output Functions**

Here, the load of the DSPs with Output Functions and Super Output Functions is displayed. Each DSP module can calculate up to 40 Output Function and 6 Super Output Functions; thus, a RM4200D system can use up to 120 Output Functions and 18 Super Output Functions.

If a DSP module is equipped with a RM420-422S Dual MADi module, 64 routing channels of the TDM bus system are used for MADi transfer per module. 24 channels from the total number of Output Functions and 2 channels from the total number of Super Output Functions are taken, too. Thus, the load display for the Output Functions is higher the more Dual MADi modules are used.

If the calculated load for the configuration is higher than 100%, the color of the bargraph changes from blue to red.



**Note:** Output functions can be used up to a load of 100% without any restrictions.

### DSP Processing

Here, the load of the available DSP Processings for **Fader Channel Processing** and **Fixed Processing** is displayed. The display is influenced by the following parameters:

- The number of DSP-Processings used.
- The number of DSP cycles needed.
- The size of the Data Memory used in the DSP.
- The size of the Code Memory used in the DSP.
- The number of needed routing channels of the TDM bus system.

The display of these values refers to the DSP modules with their actually mounted DSPs used in the Device. Their load is mainly influenced by the number of Fader Modules, since each Fader Module needs appropriate DSP performance for the Fader Channel Processing and the Fixed Processing. Each DSP function used can modify the load.

A DSP module can calculate a maximum of 24 stereo DSP processings, taking up a total number of 72 stereo DSP processings per RM4200D system.

If a DSP module is equipped with a RM420-422 Dual MADI module, 24 routing channels of the TDM bus system are used for the MADI transfer per module. These 24 channels are taken from the total number of channels normally being available for twelve stereo DSP processings. For this reason, the display DSP Processing changes when MADI modules are used.

If the calculated load for the configuration is higher than 100%, the color of the bargraph changes from blue to red.



**Note:** DSP processings can be used up to a load of 100% without any restrictions. Since the display value is calculated from a total of five parameters, the reason for exceeding the maximum load may not be clear. In this case, use the Fitting Report to get detailed information. (See “Fitting Report” on page 14.)



**Note:** Because of extensions and improvements of the DSP software, the display of the DSP load can vary between different versions of the Toolbox4 software. On rare occasions, configurations set up with an older version of Toolbox4 can cause an excess of the available computing power if edited with a newer version of the program. Normally, the RM4200D has sufficient computing power.



**Important Note:** Always make sure all modules have the correct firmware installed and are configured with the appropriate version of the Toolbox4 software. (See “Configuration Data” on page 3.)

### 5. DSP Frame I/O — Configuring the DSP Frame

#### 5.1 DSP Frame I/O — Configuring the Input and Output Modules

At the beginning of each configuration, you have to configure the I/O modules. You have to define which modules are available in the DSP frame and which features every module should have.

To start the configuration, select the desired Device in the Project tree and click on the node `DSP Frame I/O`. On the right side of the application window, a dialog opens where all options can be configured. (See figure 3-36.)

At present, two different DSP frames are available: RM420-061 with 3U and RM420-063 with 6U. If the topmost node of a Device is selected in the Project tree, you use the tab `Options` to define which frame is used. (See also “Options” on page 59.)

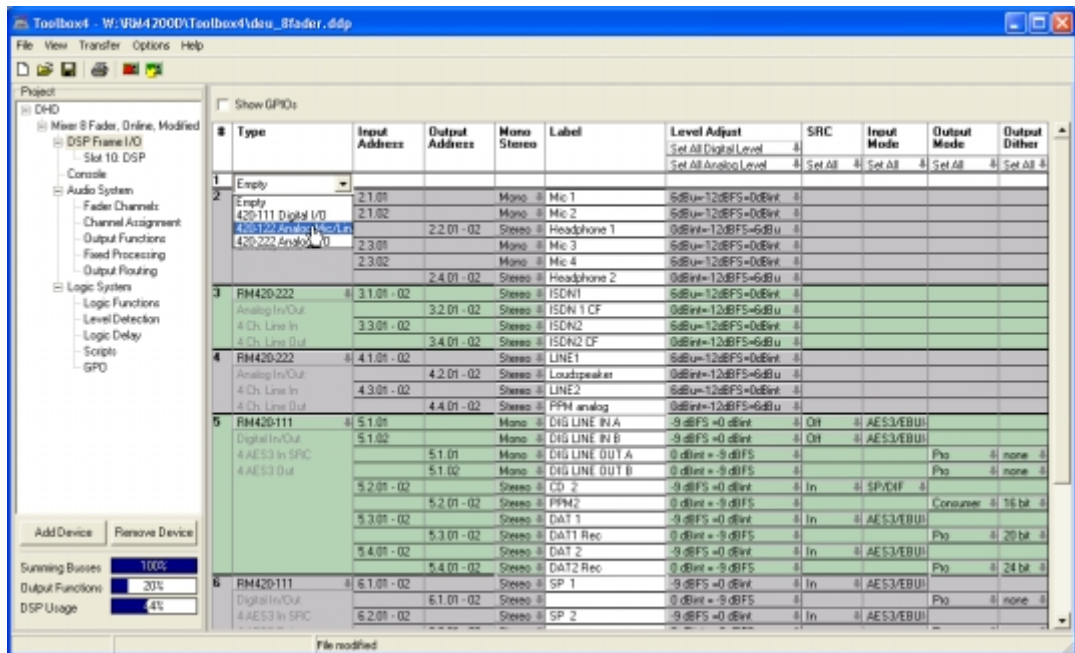
The first column of the configuration dialog displays the slot number. With the mouse, you can select the desired input and output modules for the selected slot using the drop down menus `Type`.

In the drop down menus, only the modules available in the selected slot are displayed. These are the following:

Module	Usable in Slot Number
RM420-111	1-8, 11-18, 21-28
RM420-122	1-8, 11-18, 21-28
RM420-222	1-8, 11-18, 21-28
RM420-223	1-8, 11-18, 21-28
RM420-311	1-8, 11-18, 21-28
RM420-851	9, 19, 29
RM420-848L	10, 20
RM420-848M	10, 20, 30
RM420-848M + RM420-421S	10, 20, 30
RM420-848M + RM420-422S	10, 20, 30
RM420-848M + RM420-424S	10, 20, 30



**Note:** Please consider that the module RM420-850 Communication Controller needs not to be configured since it has to be available in each RM4200D. The DSP Controller RM420-851 is automatically inserted during the configuration of the DSP Module and also displayed, since it is also necessary for operation.



**Figure 3–36: DSP Frame I/O, configuration of the modules in the DSP frame.**

In the columns **Input Address** and **Output Address** the system addresses are displayed that belong to the input and output signals available on the modules. The unified system address is generated for all signal connections based on the same rule, thus being valid for Audio Inputs, Audio Outputs, General Purpose Inputs - GPI, General Purpose Outputs - GPO and Analog Control Inputs - ACI. (See also “Configuring GPIO connectors” on page 76.)

The system address of a signal is generated from the slot number of the module, the number of the connector on the module and the channel number used on that connector. The following table explains this procedure:

Name	Slot Number	Connector Number	Channel Number
Range	1 to 30 (not for the slots 9, 19, 29, where only RM420-851 is possible)	1 to 4 counted from the top	1 to 64 of the channels on the connector
Example	2.	3.	04

In this example, the audio signal with the Input Address 2.3.04 is channel 4 on connector 3 of slot 2.

For the digital modules RM420-111, the audio signals with the output address 5.2.01-02 are the two AES3/EBU channels on the 2nd connector of slot 5.

Audio signals can be combined in pairs for stereo signals using the drop down menu **Mono/Stereo** to make configuration easier. *The first channel with an uneven number is always the left channel.* Except for the Mic/Line Inputs of the module RM420-122, all channels are set to Stereo by default. Also AES3/EBU signals or MAD1 signals can be used mono in the system, since for RM4200D, the kind of the “external” Audio signal (Analog, AES3/EBU, MAD1) does not matter.

In the column `Label`, a name for the respective input or output can be entered in a maximum length of 16 ASCII digits. After inserting a module, the appropriate system address is displayed here. This name appears in the selection lists for the audio signals everywhere in the software. Therefore, you should choose the names in a way that the connected Devices or cables can be clearly identified. You can change labels later without any restrictions. If you delete labels completely, you can suppress them being displayed in the selection lists. You find the respective setting when choosing the command `Configuration...` from the menu `Options` in the tab `Display` and switch on the checkbox `Hide sources without name` in audio and logic source trees.

In the column `Level Adjust` you can set the desired headroom for each channel separately using a drop down menu. The displayed values always refer to the internal reference level of the RM4200D of `0dBint`.



**Important Note:** The default headroom of the digital module is 9 dB or 0 dBint = -9 dBFS respectively. To reach a level of 6 dBu at 0 dBint with this headroom on analog modules, they must be set to 6 dBu = -12 dBFS = 0 dBint. The reason for this are the *fixed analog input and output levels* on the analog modules. These are set to a maximum level of 18 dBu at 0 dBFS (RM420-122, RM420-222).

You can adjust the headroom for all channels in one go, using the drop down menus `Set All Digital Level` and `Set All Analog Level` in the head of the column `Level Adjust`.

For digital modules, the following additional options are available that can be configured individually or using the drop down menus `Set All` in the head of the table:

- `SRC`: Setting for the Sample Rate Converter - SRC. The value `Off` removes the converter from the signal path (Bypass-Mode). If the value is `In`, the converter is active. Signals that are not synchronized to the system sample rate of the Device can be attached to the digital input. The assigned signals can have sample rates between 30 kHz and 100 kHz. The settings of the sample rate converter (`In` or `OFF`) has no influence on the way how the incoming synchronizing signal is processed. (See also “Synchronisation” on page 133.)
- `Input Mode`: This option toggles the terminating resistance of the digital input between 110 Ohm (AES3/EBU, for professional Devices) and 75 Ohm (SPDIF, Consumer Devices).
- `Output Mode`: This option can accept the values `Pro` (default) or `Consumer`. The following parameters are changed:

Mode	Pro (default)	Consumer
Terminating resistance	110 Ohm	75 Ohm
Output voltage	5V	0,5V
Data stream	Professional Bit set	Consumer Bit set



**Note:** Especially for consumer or semiprofessional DAT- or MiniDisc devices, you should activate the option `Consumer` since otherwise they might not synchronize and display e.g. “No Lock”.



- **Output Dither:** If you attach devices with a low resolution of the digital signals to the RM4200D, here you can define how the audio signal is dithered before leaving the digital output. This functions helps to improve the quality of the output signal. You can select the options 16 bit, 20 bit, 24 bit or none (no dithering, default).

### 5.2 MADi Modules – Option on DSP Boards

RM4200D supports the transport of audio signals over **MADI (Multi channel Audio Digital Interface)**. For space reasons, the MADI modules are not designed as normal slot modules but are plugged into the DSP Module RM420-848M as Sub Module. The Delay Submodule RM420-424S is also plugged into the DSP Module. (See also “Delay Submodule RM420-424S” on page 75.)

Each DSP Module RM420-848M has one slot for a submodule. On the Slots 10, 20 and 30 of the DSP Frames, DSP Modules can be operated either with or without plugged submodule.



**Important Note:** Please consider that the “simple function” DSP Modules RM420-848L can only be used on the slots 10 and 20 and can not carry any submodules. Additionally, the “simple function” DSP-Modules RM420-848L and the “full function” modules RM420-848M can not be used together in one DSP frame, since the modules RM420-848L do not have a sufficient number of Routing Channels. Therefore, the `Toolbox4` Software does not allow such a combination at all. A module RM420-848M can be used as a replacement module for a RM420-848L *without changing the configuration*, since it is downwards compatible.

On the slots 10, 20 and 30, DSP Modules and submodules can be combined in the following ways:

Type	Function
RM420-848L	DSP Module, only on Slots 10 and 20
RM420-848M	DSP Module without submodule
RM420-848M + 421	DSP Module with Single MADI Module
RM420-848M + 422	DSP Module with Dual MADI Module
RM420-848M + 422 Redundant	DSP Module with Dual MADI Module, Redundant
RM420-848M + 424	DSP Module with Delay Module

If you have selected the MADI Submodules RM420-421S or RM420-422S in the node DSP Frame I/O, you can configure the following options for each submodule: (See figure 3–37.):

- **Number of Channels:** Here you can define whether a MADI connection is to transport 64 Channels (default) or 56 Channels.
- **Digitalformat:** This option determines in which file format the audio signals are to be transported. You can select the format AES10 MADI (default) or the format 32 Bit Float. AES10 is a fixed point format similar to the AES3/EBU format that does not allow for levels higher than 0dBFS. The 32-Bit floating point format proprietary to DHD does not have these limitations.

- **Level Adjust:** Here you can set the desired headroom for all audio channels of the MADI connection.



**Caution:** Please consider that changing the setting **Level Adjust** overwrites all individual headroom settings for the channels of the MADI connection. Be cautious when using this function and when in doubt, select the values for each channel separately!

If you have selected a MADI submodule, below the node **DSP Frame I/O** a separate branch appears for each submodule. It is labelled **Slot 10: DSP** or similar. Select this entry to configure the submodule. As with other modules, for each MADI channel **Input Address** and **Output Address** are displayed. You can configure the described options **Mono/Stereo**, **Label** and **Level Adjust** in the same way.

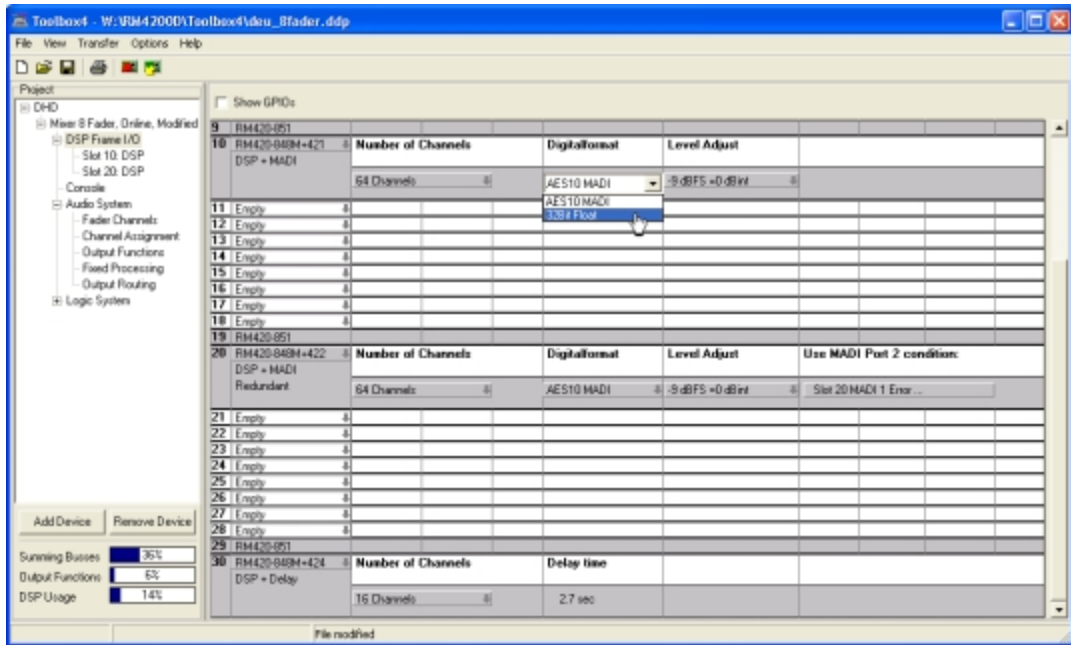
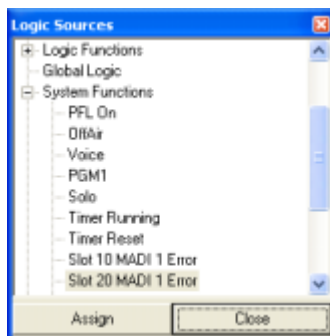


Figure 3–37: DSP Frame I/O, configuration of a DSP module RM420-848M with MADI submodule.

### 5.3 Redundant MADI

The combination of the modules **RM420-848M + 422 Redundant** has a special function: Here, a Dual MADI Module **RM420-422S** is used with two different optical fiber cables attached to it. Each fibre carries the same audio signals. If necessary, one MADI port can switch over to the other MADI port respectively. Any available logic source of the Device can be used to trigger the switch. Typically, the switch would be triggered when an error on the currently active MADI port occurs (see below).



**Figure 3–38: Configuration option RM420-848M+422 Redundant, MADI error as logic source for switching.**

To configure the switching conditions, do the following:

1. Select the node `DSP Frame I/O` and configure the submodule option `RM420-848M+422 Redundant` for the DSP Module.
2. Configure all options as desired. Now click on the button under the headline `Use MADI Port 2 condition`. The `Logic Sources` Window opens. (See figure 3–38.)
3. Select the desired Logic Source for switching. The Logic Sources for errors during the MADI transfers are located under the node `System Functions`.

If you use for example the option on Slot 20, you can define `Slot 20 MADI 1 Error` as Logic Source. In this case, if there is an error in the MADI signal of the first (upper) port, the second port is switched to. Additionally, you could couple the condition `Slot 20 MADI 1 Error` to a key or a GPI in a logic function using an OR-relation. This way, the switch would be triggered by a MADI error OR forced by pressing the key (or toggling the GPI signal).

The switching between the two Input MADI ports with the option `RM420-848M + 422 Redundant` happens directly on the MADI submodule. This means that it reacts like a single MADI Module `RM420-421S` during further configuration. The Output Routing is identical for both ports. As inputs, for the configuration in the system only the inputs of Port 1 are available — whereas in “Failover Mode”, these are the channels of Port 2, of course.

#### 5.4 Delay Submodule RM420-424S

A special case is the Delay Submodule `RM420-424S`, since it does not have any inputs or outputs. If you configure this module, the faders 1 to n can use delay channels automatically. The bigger n is, the shorter will be the available delay time per fader. The following table shows this dependency:

Number of Channels	Fader (always stereo, also when used as mono)	Delay Time (per fader)
2	1	21,8 s
4	1 and 2	10,9 s
8	1 to 4	5,5 s
16	1 to 8	2,7 s
32	1 to 16	1,4 s
64	1 to 32	0,7 s

“Faders” refer to the actual faders of the Console, counted from left to right – not the Fader Channels. If there are more faders used than delay channels available, the upper faders do not have any delay functions. For activating the delay function, only the appropriate keys need to be configured.



**Note:** At present, the delay can not be used as Fixed Processing.

### 5.5 Configuring GPIO connectors

RM4200D allows for connecting external cables for input and output of controlling signals. The control inputs are called **GPI** for “General Purpose Input”, outputs are called **GPO** for “General Purpose Output”. In addition, analog voltage values can be used as input signals, such an input is called **ACI** for “Analog Control Input”.

ACI inputs are used to connect external potentiometers for adjusting levels, e.g. for the volume of headphones. For that, the ACIs are assigned to internal potentiometers and need to be configured into the signal path depending on the desired application via Output Functions. (See also “Output Functions” on page 169.)

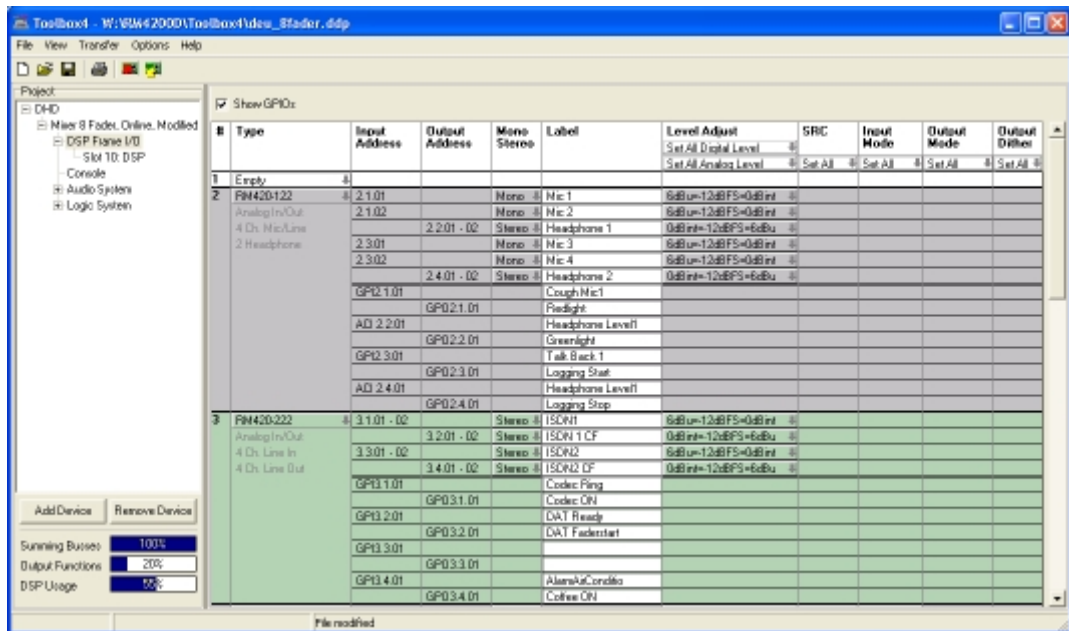


**Note:** The GPIOs are totally independent from the audio signals attached to the same connectors of the modules, unless they are configured to control each other.



**Important Note:** Please note the difference of the GPIs on the module RM420-122 (TTL input with pull up) compared to the modules M420-111 and RM420-222 (optocoupler input) described in detail in the volume *System Reference* in this manual.

The GPIOs available on the Modules RM420-111, RM420-122 and RM420-222 are configured in the same dialog as the inputs and outputs of the audio signals. For that, you need to select the node `DSP Frame I/O` in the project tree and additionally check the checkbox `Show GPIOs` above the table of modules. Only then, the GPIO connectors are displayed for each selected module and also assigned a `Label` in the menu `DSP Frame I/O`. To keep the display of the slot lists in order, the GPIOs available on the selected modules are only shown after switching on the option `Show GPIOs`. (See figure 3–39.)



**Figure 3–39: DSP Frame I/O, configuration of GPIOs.**

The address assignment for the GPIO signals follows the same rules as for audio signals. (See “DSP Frame I/O — Configuring the Input and Output Modules” on page 70.) In the column **Label**, you can assign the signal a descriptive name of 16 ASCII digits maximum. After inserting a module, the labels at first get the corresponding system address, with the digits “GPI”, “GPO” or “ACI” respectively.

The labels should always correspond to the connected devices or function names, to identify the GPIOs in the selection lists easier during further configuration and to keep configuration orderly. Later, labels can be changed without limitations.

If you delete labels completely, you can suppress them being displayed in the selection lists. You find the corresponding setting when choosing the command **Configuration...** from the menu **Options** and switch on the checkbox **Hide sources without name** in audio and logic source trees in the tab **Display**.

## 6. Console – Configuring the Console

For each Device, there is a node **Console** in the project tree. If you select it, you can configure the Console of the Device. In order to do that, you first need to select the modules in the configuration window and then assign their keys to the desired functions and labels.



**Important Note:** The modules RM420-027 (Talkback Panel), RM420-078 (8 LCD Pushbutton Panel) and RM420-079 (16 LCD Pushbutton Panel 1U/19“) are currently supported by the `Toolbox4.5` software. Use this software to configure all available functions. More information about their functionality and interoperability with the RM4200D will be available soon. For the module RM420-018 (Router Control Panel) there is a special configuration software.

When the node `Console` is activated, two tabs appear on the right side of the program window. (See figure 3–40.):

On the tab `Console` you can select the necessary modules and insert them into the chosen mounting frames.

In the tab `Keys` you can assign the keys of the Console the desired functions and attach labels to them.

### 6.1 Configuring the Console Layout

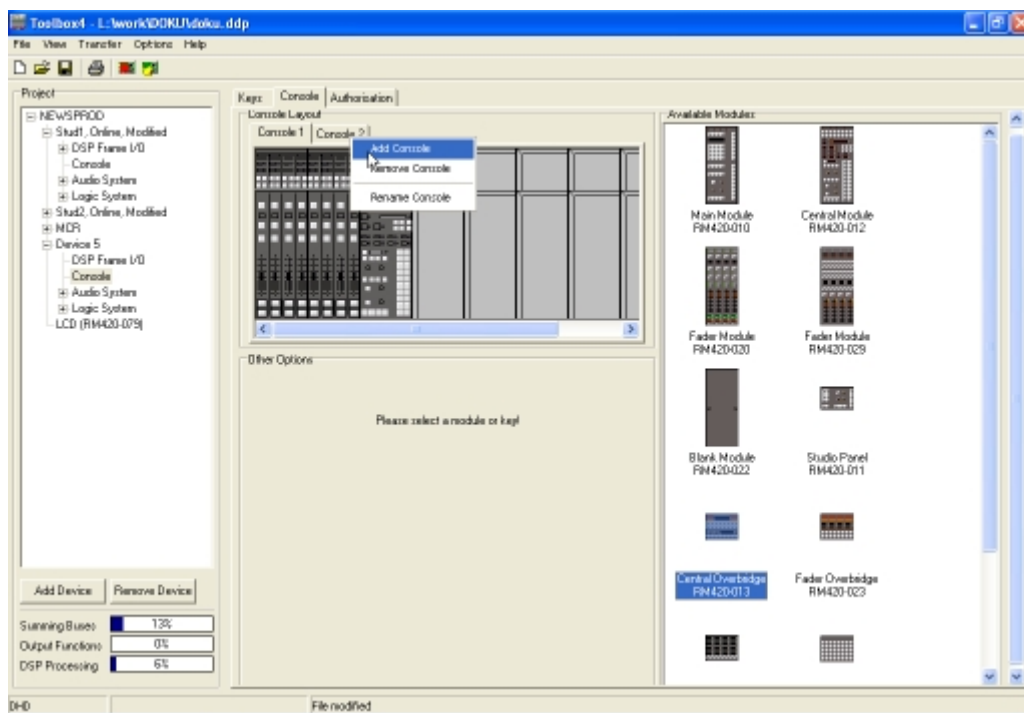
You can configure the Console of RM4200D per Drag and Drop using the mouse. Simply select the module on the right panel of the dialog and drag it to the desired position in the mounting frame.

If you want to insert a further mounting frame, move the cursor over the “tab” on top of the Console pane and select the contextual menu by right-clicking with the mouse. With the command `Add Console` you can now add a new mounting frame. This way, you can create up to six different Consoles. (See figure 3–40.)

With the command `Remove Console` you can remove a mounting frame after confirming your decision. If you want to change the name of the frame, use the command `Rename Console`.



**Note:** The graphic visualisation of the Consoles is only important for printing the views of the mixing desk; otherwise, they just visualise the Console surface for the user of the software. For the configuration itself, the position of the modules in the mounting frame is of no importance at all.



**Figure 3–40: Configuring the Console.**



**Tip:** The smallest mounting frame corresponds to the Profile Frames RM330-031 or the Overbridge Panels RM330-031-O and RM330-031-T. The biggest mounting frame corresponds to the Profile Frames RM420-039 or the Overbridge Panels RM420-039-O and RM420-039-T.

If there are already modules in the mounting frame, you can open a contextual menu by right-clicking on the slots. If you click on an existing module, you can “cut it out” with the command `Cut Module`, and use `Paste Module` to move it to another slot afterwards. If you have already defined functions and labels for the keys of the module, these are transferred to the new slot, too. The command `Copy Module` works similar – it copies the module to the clipboard without removing it from its slot. Using the contextual menu, you can delete modules with the command `Delete Module` or print a view of the modules already arranged with the command `Print Module Layout`. This function is identical with the option `Modules Layout` in the printing dialog of the command `Print` from the `File` menu. (See “Print” on page 7.) When inserting the Module, please watch out for the following special features:

- Fader Overbridge modules can only be used in connection with a Fader Module. You can configure only one Overbridge Module per Fader Module. The Overbridge Modules RM420-023 and RM420-028 can only be configured if you have previously inserted a Fader Module RM420-029 or RM420-020 below. If this is not the case, the message `Fader Overbridge can only be used in combination with fader modules` is displayed.
- The **Studio Panel** RM420-011 is created as desktop device and therefore needs no mounting frame. Thus, you can not “drag” it to the Console already containing other modules. If you do so, the message: `The Studio Panel requires its own console!` appears. You can insert the module into an

empty Console only. If there is none available, you first have to create one before inserting the Studio Panel.

- If you put the empty modules RM420-022 and RM420-022-O into the Console, this is only influencing the printout and the display view of the Console.

When inserting **Fader Modules** of the types RM420-020 or RM420-029, DSP resources for the Input processing are assigned automatically. One stereo processing is necessary for each fader, the bars for the DSP processing change according to the number of inserted Fader Modules. Please consider that here only "empty" DSP processings and the necessary Routing Channels on the bus system are assigned. If you assign actual DSP functions to a Fader Channel, the DSP load increases again.



**Important Note:** If you want to use 24 or more faders, you need to configure at least two DSP modules. But already from 16 faders on, you should use two DSP modules to have sufficient computing power for Input and Fixed Processing. For more than 32 faders, you should use 3 DSP modules accordingly.

### 6.2 Configuring Module Options

In the pane `Other Options` of the dialog, you can define the following features for the Module currently selected in the Console:

- `Access group`: Select here to which Access Group the module belongs. All modules in an Access Group work together for certain functions, e.g. for setting parameters of a Fader Channel from the central Console. There are four Access Groups available.
- `Module ID`: This is the unique identification number of the Module in the RM4200D Device.
- `Invert Fader Scale`: If you activate this checkbox, the fader scale is inverted. To close the fader, you have to move it all the way up. If you move it down towards you, the level increases. For the Fader Module RM420-020 there is a matching front panel available.
- `0dB at Top`: This option allows for Fader Modules to shift the scale by 10dB so the Fader has a gain of 0dB in the uppermost position. Please notice that the labelling of the front cover of the Console *can not display* this shift. It remains unchanged.

The **Module ID** of each module is unique in a RM4200D thus allowing the correct communication of the modules with each other. The configurable Modules of the RM4200D can be separated into the following groups:

Fader Modules	Control Modules - Small, 1 to 32 keys	Control Modules - Large, 33 to 64 keys
IDs #F1 to #F10	IDs #C1 to #C12	IDs #C1 to #C12 (2 IDs each)
RM420-020	RM420-011	RM420-010
RM420-029	RM420-013	RM420-012
+ RM420-023	RM420-026	RM420-025

In a RM4200D Device, up to ten Fader Modules RM420-020 or RM420-029 can be used. These *Fader Modules* are automatically assigned the *Module IDs #F1 to #F10* according to their order from right to left. The Fader Overbridge Modules RM420-023



are simply an extension of the corresponding Fader Module, they automatically receive the same IDs.

The *Control Modules* get assigned a *Module ID* #C1 to #C12 automatically on insert. Modules with more than 32 keys also claim the resources of the following ID.

Thus, in one Device *either* up to 12 small *or* up to six large Control Modules can be used. Combinations are possible as long as the sum of all claimed Module-IDs is not higher than 12. Thus, e.g. three large (six IDs) and six small Modules (six IDs) can be combined.

The address automatically assigned to a Module is displayed in the field `Module ID`.



**Important Note:** The IDs #F1 to #F10 and #C1 to #C12 that are automatically assigned to the modules, *must* be assigned to the “correct” hardware modules when operating the RM4200D. It is the same when mounting a replacement module into an existing system. You can assign the Module IDs using the `Maintenance Window`. (See “Set Module ID” on page 42.)



**Important Note:** In theory, you can configure four different Main Modules RM420-010 within one Device, but it is *not* possible to build four mixers working independently within one RM4200D. Many basic resources and operating functions are designed for the operation of *one* mixer, especially when the bus system and the setup functions are concerned!

By selecting the `Access Group` for a module you define which other modules it will work with. All modules in the same `Access Group` work together, modules in different groups do not. You can choose from a maximum of four different `Access Groups`.

The concept is explained best with an example:

The Fader Modules are configured to `Access Group 1`, the central Control Module RM420-012 as well. If you press now the key with the function `Access` on the Fader Module, you can set the parameters for the selected Fader Channel on the Central Module.

Furthermore, if a central Overbridge Module RM420-013 is configured, in the display of which you want to show a Timer, you should choose a different `Access Group`, but not `Access Group 1`. Otherwise, the display of the Overbridge Module is controlled parallel to the display of the Central Module.

### 6.3 Key Configuration

In the tab `Keys` you can attach the desired functions and labels to the keys of the modules. Furthermore, you can configure the operation mode of the displays in the modules. (See “Special – Configuring Displays in Control Modules” on page 121.)

To configure a module, do the following:

1. Click into the desired module in the corresponding layout view `Console Layout`. The module is highlighted in the mounting frame with a colored frame and displayed in a large view in the `Selected Module` pane.
2. Now click on the desired key or display. Down on the left side appears the `Key Options` or `Special` pane respectively.
3. Type a name for the key in the field `Label`. Later on, this text is printed as label for the key caps.

4. Now go on configuring the keys as wanted, enter the elements under *Key Options*. According to the selected function, there may appear additional parameters for configuration.

For the key configuration, the modules are separated into two groups — *Fader Modules* and *Control Modules*:

Fader Modules	Control Modules
RM420-020	RM420-010
RM420-029	RM420-011
+ RM420-023 (Fader-Overbridge Module)	RM420-012
+ RM420-028 (Fader-Overbridge Module)	RM420-013
	RM420-014
	RM420-025
	RM420-026

The keys of the Fader Modules can be programmed with the functions for the *Fader Modules*, independent from location and design of the keys. (See “Fader Modules and List of Functions” on page 85.)

It is the same for the Control Modules — each key can be programmed with the same functions for Control Modules, independent from location and design of the keys. (See also “Control Modules and List of Functions” on page 99.)

There are differences in the colouring of the keys — according to the type of used components. Certain keys can change colors controlled by the software, others can be configured for one color only using colored key caps. Depending on the key, during configuration you can define which colors a key should have in the states “On” and “Off”.

At present, four different types of keys are used with RM4200D:

Type	Lighting state	Light source	Color options for keys	Color configurable via software	Key surface/ Lifting	Manufacturer/ Name
Default, small	red	LED	clear, matt (no options)	Yes	12mm x 12mm/ 4,5mm	eao Lumitas, 95 series
	yellow	LED				
Default, large	red	LED	clear, matt (no options)	Yes	18mm x 18mm/ 4,5mm	eao Lumitas, 95 series
	yellow	LED				
	green	LED				
Keys under the Fader of RM420-020	red	LED	red, brilliant	No	21mm x 15mm/ 3,5mm	eao Lumitas, 51 series, sunk
	yellow	LED	yellow, brilliant			
	yellow	LED	clear, brilliant			
	green	LED	green, brilliant			
Keys under the Fader of RM420-020 S	red	Lamp	red, matt	No	19mm x 14mm/ 3mm	Micro Switch, 4 A21 series
	yellow	Lamp	yellow, mat			

In addition to the lighting states illustrated in the table, all keys can take on the state “off”.

Please consider that the LED color of the default keys is defined with the Config, depending on the function, it can change color during operation. For this reason, the key caps must be transparent or clear. During the configuration of the default keys, the colors named are the colors of the LEDs, *not* of the colors foils.

This is completely different for the keys below the fader: Here, if you select a color, this is only for information of which LED color and key cap color is to be used for manufacturing the module. These keys can shine only in the color ordered from DHD. During configuration, colors refer to the colors of the key cap, DHD uses the light source according to the table. Other options can not be ordered.

### 6.4 Authorisation – Restricting Key Access

Use the tab *Authorisation* to restrict access to certain keys of the Console to authorised users only. Make sure you have set up user groups *beforehand*, otherwise this will not work. (See “Authorisation” on page 61.)

Click on the tab *Authorisation* to select the keys you want to protect. You will see the modules of the Console in the miniature view. Keys already protected are shown in red, keys freely available are shown in grey. All users can use all grey keys without restriction and without entering a PIN number.

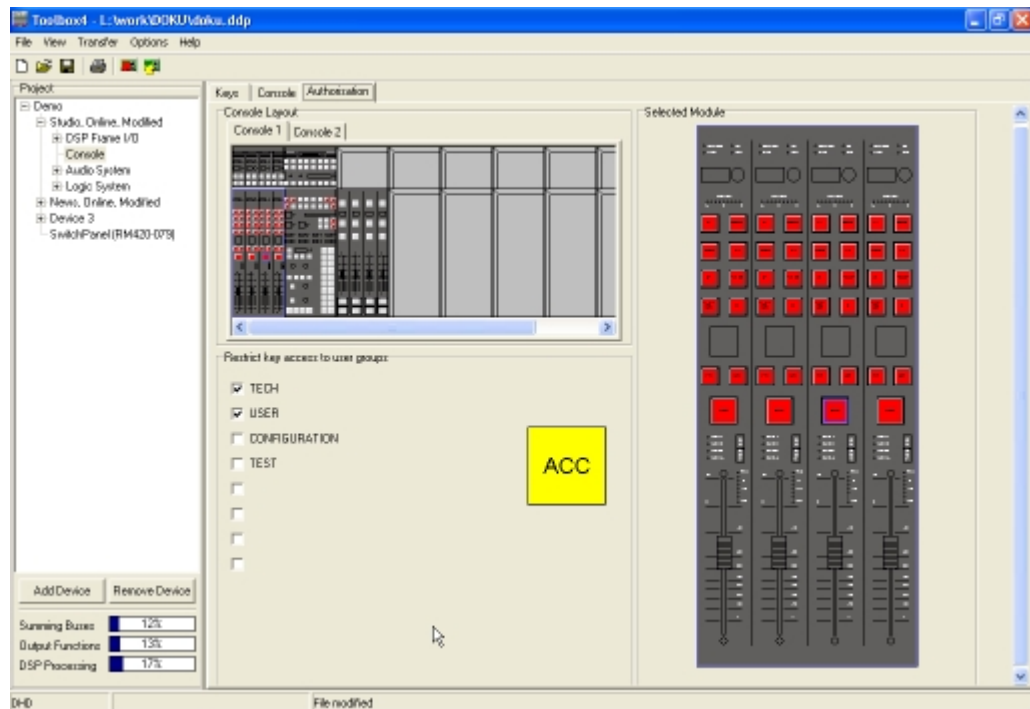


Abbildung 3-41: Console, Authorisation. Selecting the keys with restricted access.



**Important Note:** You can only restrict access to certain keys if you have set up user groups beforehand. Also, the keys you want to protect need to have a label. You assign these labels in the tab `Console`. If one of these two conditions is *not met*, you can not restrict the access to the key!

To restrict key access to certain user groups, do the following:

1. Click the desired module in the tab `Console Layout`. It will be shown at a larger scale in the area `Selected Module` to the right.
2. In this large view, click the key you want to restrict access to. If this key has been assigned a label and if user groups are set up properly, the area `Restrict key access to user groups` shows up bottom left in the dialog. The selected key and its label are displayed there in a larger view. To the left from it the list of all user groups is displayed, each list entry with a checkbox.
3. For each group that will have access to the key, click its checkbox. As soon as at least one checkbox is active, the key will be rendered red in the `Console` view.
4. Repeat steps 2 and 3 for all keys you want to restrict access to.



**Important Note:** If you are using keys on the Console to activate the input mode for the PIN, make sure these keys *are not assigned to a user group*! If you restrict access to these keys, you create a deadlock situation where you can not enter a PIN on the Console!

### 6.5 Fader Modules and List of Functions

The functions described in the following can be configured for the keys of the Fader Modules RM420-020, RM420-029 and the Fader Overbridge Modules RM420-023 and RM420-028.

If you define a function for a key on one Fader Module, this function is valid *uniformly* for all similarly arranged keys of all Fader Modules. If you change the function of one key, the other similarly arranged keys of all Fader Modules change automatically. This coupling can be unlocked for each key of a Fader Module by switching on the checkbox `Independent Key`.

Use this option for *Fixed Fader* with fixed sources only, or in case you wish to place a Fader Module apart from the mail Console, e.g. for a separate editing station.

For configuration of the selected keys, the `Key Options` pane shows the following information and input options:

- `Number`: Each key of the module has a uniform, not changeable number that is displayed here.
- `Label`: Here you can insert the desired key label, all characters available on a keyboard are allowed. A word wrap can be carried out by entering a “\” (back slash). Use the option `Key Labels` in the print dialog of the `Toolbox4` Software to print key labels on a transparency. (See “Print” on page 7.) For default functions, the labels should correspond to the expressions recommended by DHD. DHD reserves the right to permanently print labels on keys that appear in great amounts, e.g. PFL, ON, OFF, TALK, ACC, REC.
- `Color ON` and `Color OFF`: Here you can define independently from the selected key function, which colors the key should shine with according to its operating state. `Color ON` states the color for an active function, `Color OFF` for the inactive one. For the latter, the option `OFF` is mostly used, i.e. the key does not shine at all. If you choose the same color for both conditions, the following message appears: `Warning! Active and inactive function state is using the same color!`

Depending on the selected key type — *Key Default (small)*, *Key Default (large)* or *Key below the Fader*— the options for configuring the ON and OFF colors change as shown in the following figures:

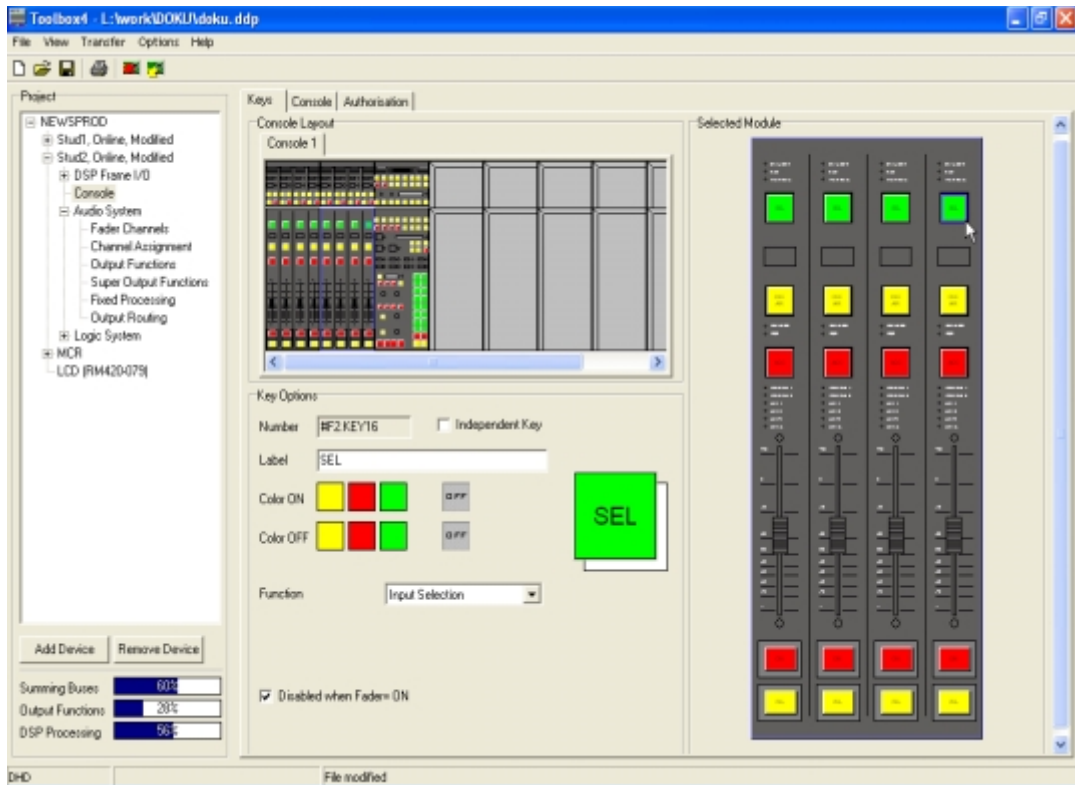


Figure 3–42: Key configuration, Fader Module with default keys (large).

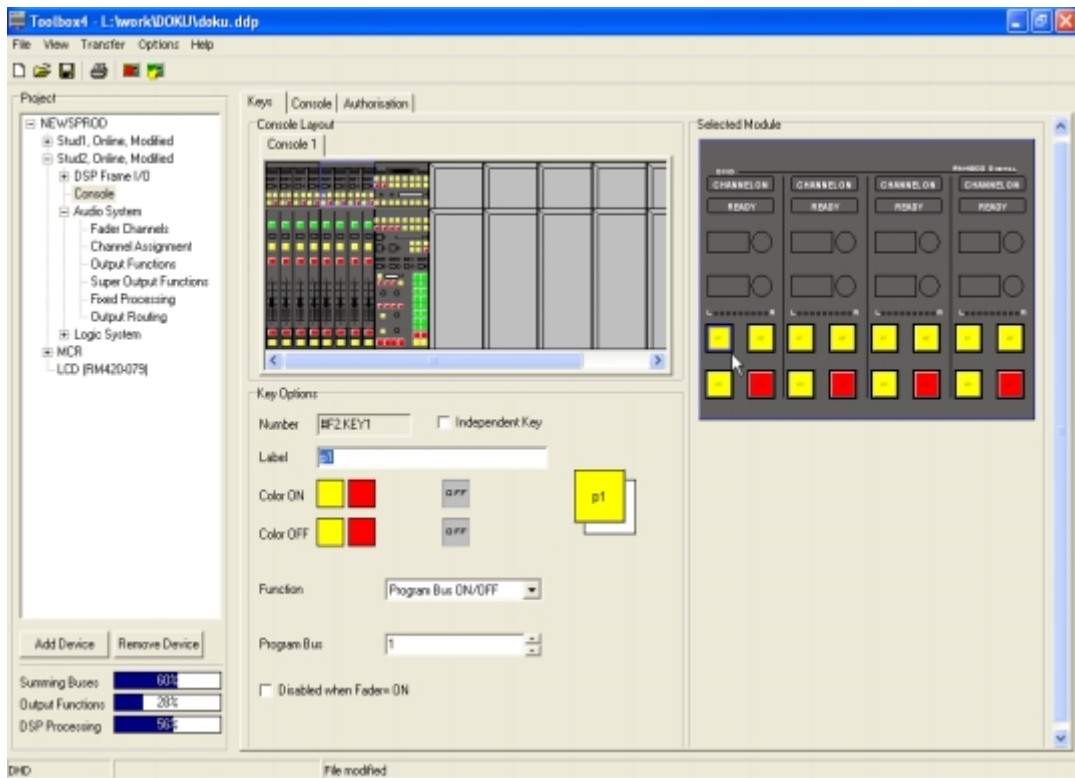
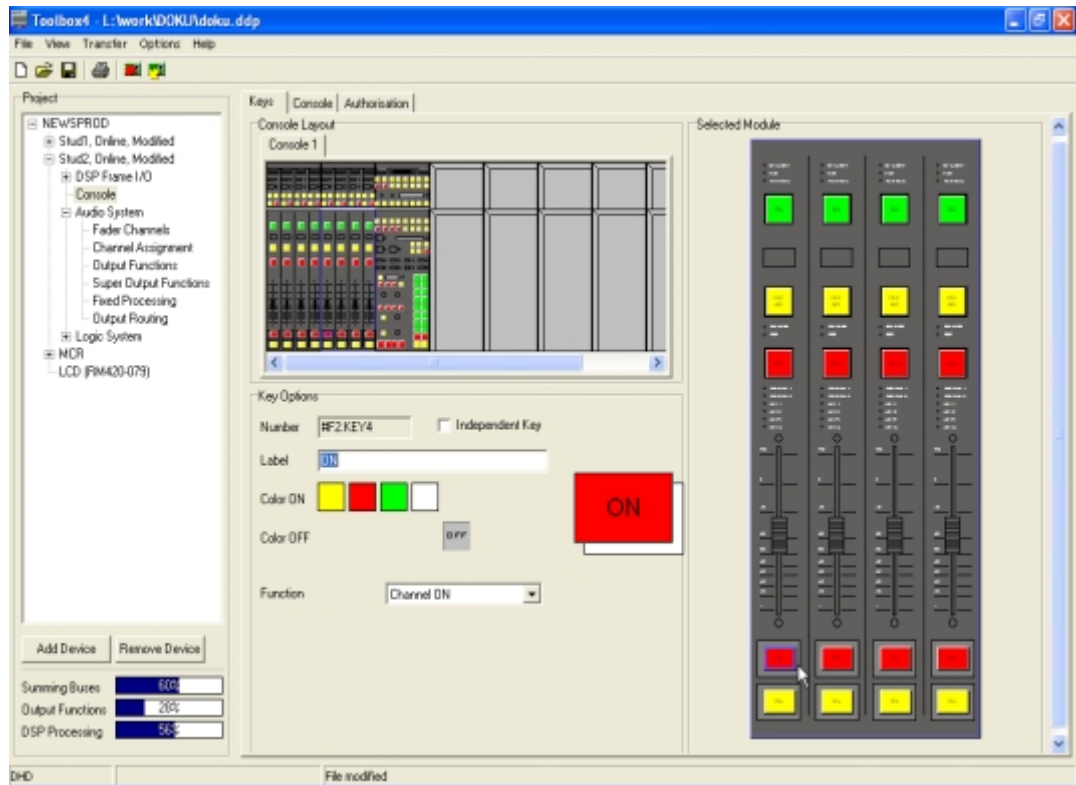


Figure 3–43: Key configuration, Fader Overbridge Module with default keys (small).



**Figure 3–44: Key configuration, Fader Module with keys below the fader.**

In the Pop-up menu **Function** you define which function the selected key should have. Depending on the kind of function, after selecting, there are more options or “Subfunctions” displayed that you can configure much more in detail.

The following table describes the possible options or subfunctions for each functions and briefly explains them:

Name of Function	Option or Sub-function	Options for Selection	Description
no function			<ul style="list-style-type: none"> <li>There is no function.</li> </ul>
Input Selection			<ul style="list-style-type: none"> <li>The input of a fader can be changed using the Main Rotary Encoder in a Control Module of the same Access Group.</li> <li>This operation is only possible with Pool Faders. (See “Input Pools – Properties” on page 133.)</li> </ul>
	Disabled when Fader=ON		<ul style="list-style-type: none"> <li>This operation is locked while the fader is open.</li> </ul>



## Part III: Toolbox 4 Configuration Reference

Name of Function	Option or Sub-function	Options for Selection	Description
Access Gain			<ul style="list-style-type: none"><li>• The Fader is assigned to the Central Control Panel in “Access-Mode”, Digital Gain is activated as first parameter.</li><li>• Digital Gain can be changed with the Main Rotary Encoder of the same Access Group without pressing any further keys; the System Function “Gain” is selected automatically.</li><li>• Useful for the modules RM420-010 and RM420-013.</li><li>• Not useful for the modules RM420-012 and RM420-014, since dedicated Rotary Encoders for Gain are available here.</li></ul>
Access Input Select			<ul style="list-style-type: none"><li>• The fader is assigned to the Central Control Panel in “Access-Mode”, the selection of the Fader Inputs is activated as first parameter.</li><li>• The Input can be changed with the Main Rotary Encoder of the same Access Group without pressing any further keys; the System Function “Input Selection” is selected automatically.</li><li>• When the fader is open, this operation is <i>always locked!</i> (Display “Input locked”)</li><li>• Useful for the modules RM420-012, RM420-010, RM420-014 and RM420-013.</li></ul>
Access PAN/BAL			<ul style="list-style-type: none"><li>• The fader is assigned to the Central Control Panel in “Access-Mode”, Panorama/Balance is activated as first parameter.</li><li>• Panorama and/or Balance can be changed with the Main Rotary Encoder of the same Access Group without pressing any further keys; the System Function “Pan/Bal” is selected automatically.</li></ul>
Channel ON			<ul style="list-style-type: none"><li>• The audio channel is switched on.</li><li>• By default, audio signal and faderstart are activated. In the dialog <code>Audio System/Faderstart</code> further options can be set (On Start, Auto Off and Level). (See “Faderstart” on page 162.)</li></ul>
Channel OFF			<ul style="list-style-type: none"><li>• The channel is switched off.</li><li>• By default, audio signal and faderstart are deactivated. In the dialog <code>Audio System/Faderstart</code> further options can be set (On Start, Auto Off and Level). (See “Faderstart” on page 162.)</li></ul>





Name of Function	Option or Sub-function	Options for Selection	Description
Channel ON/OFF			<ul style="list-style-type: none"> <li>The channel is toggled on and off with the same key.</li> <li>By default, audio signal and faderstart are toggled. In the dialog <code>Audio System/Faderstart</code> further options can be set (On Start, Auto Off and Level). (See “Faderstart” on page 162.)</li> </ul>
Program Bus ON/OFF		Program Bus 1 to 47	<ul style="list-style-type: none"> <li>One fader is switched on to the Program Bus.</li> <li>Using the Program Bus, Groups can be created.</li> <li>In Access Mode, there are further operation options available for switching on a bus.</li> </ul>
	Disabled when Fader=ON		<ul style="list-style-type: none"> <li>Operation locked while the fader is open.</li> </ul>
Off Air			<ul style="list-style-type: none"> <li>Automatic toggling of one channel between Program Bus 1 and Program Bus 2, e.g. for Off Air Recording. After using this function, the signal is switched on to Program Bus 1 or Program Bus 2 only.</li> <li>This function can also be used at open fader.</li> <li>The Clean-Feed signal is created from Pgm 1 or Pgm 2 depending on the current state.</li> </ul>
PFL			<ul style="list-style-type: none"> <li>Pre-listening of the signals <i>before</i> the fader, either summing or alternating.</li> <li>The pre-listening signal is always generated using a separate summing bus and is available as audio source <code>Audio Source/Monitor Functions/PFL L,R</code>.</li> </ul>
	Mix		<ul style="list-style-type: none"> <li>Option summing.</li> </ul>
	PFL Reset		<ul style="list-style-type: none"> <li>Option resets all PFL keys when any other fader is opened.</li> </ul>
	PFL Reset Channel		<ul style="list-style-type: none"> <li>Option resets the PFL key when the corresponding fader is opened.</li> </ul>
	Momentary		<ul style="list-style-type: none"> <li>Key engages. If this checkbox is switched off, the function remains active only as long as the key is pressed. (Non-locking key, default mode) If it is on, the key toggles with each press.</li> </ul>
	Timed Toggle		<ul style="list-style-type: none"> <li>Key engages (press short) or non-locking (press long).</li> </ul>



## Part III: Toolbox 4 Configuration Reference

Name of Function	Option or Sub-function	Options for Selection	Description
Solo		Program Bus 1 to 47	<ul style="list-style-type: none"><li>• Monitoring of the signals <i>after fader</i>, either summing or alternating.</li><li>• The monitor signal is always generated using a separate summing bus and is available as audio source in the <code>Audio Sources</code> Window under <i>Mixing/Busname L, R</i>.</li><li>• The bus must be defined under <code>Audio System/Mixing Functions</code>; the bus number to be set under the <code>Program Bus</code> must correspond to the created bus. (See also “Mixing Functions – Configuring Internal Buses” on page 126.)</li><li>• <i>One</i> internal logic function is created with which the monitor signals can be toggled using <code>Output Functions</code>. You find this <code>Logic Source</code> in the <code>Logic Sources</code> Window under <code>System Functions/Solo</code>.</li><li>• Only <i>one</i> Solo function per Device should be configured!</li></ul>
	Mix		<ul style="list-style-type: none"><li>• Option summing.</li></ul>
	Momentary		<ul style="list-style-type: none"><li>• The function is active as long as the key is <i>pressed and held</i>.</li></ul>
Monitor Bus Control		Monitor Bus 0 to 6	<ul style="list-style-type: none"><li>• Channel related alternating monitor keys; can work independently or in conjunction with a Control Module. The set of monitor keys can be extended with this function e.g. over the faders, and is independent from the PFL function.</li><li>• You can define the sources for the monitor buses under <code>Audio System/Fader Channels/Monitor Bus Source</code>. (See also “Fader Channels – Configuring Signal Sources for Faders” on page 159.) There you can assign any signal, e.g. the corresponding input signal or the Clean Feed signal belonging to the channel path.</li></ul>
Tally			<ul style="list-style-type: none"><li>• The lamp in the key indicates the state “ON”, if the fader is open. The key function itself is unused.</li></ul>
Memo			<ul style="list-style-type: none"><li>• The function is activated on pressing a key and reset by opening the corresponding fader. A reasonable application is the “<i>Next Fader</i>” memory key.</li></ul>

Name of Function	Option or Sub-function	Options for Selection	Description
Talk CF			<ul style="list-style-type: none"> <li>Activates the logic source <i>Logic Source/Clean Feed/CF Talk &lt;name of the input&gt;</i>, if one fader on the Fader Channel is routed with the Clean Feed function activated. (See “Fader Channels – Configuring Signal Sources for Faders” on page 159.)</li> <li>The generated logic source is to be configured as Talk Condition under <i>Audio System/Mixing Functions</i> at the corresponding Clean Feed bus, if the talk function is wanted. (See “Mixing Functions – Configuring Internal Buses” on page 126.)</li> <li>The generated logic source can also be used at any other location in the system.</li> </ul>
	Momentary		<ul style="list-style-type: none"> <li>Key engages. If this checkbox is switched off, the function remains active only as long as the key is pressed. (Non-locking key, default mode) If it is on, the key toggles with each press.</li> </ul>
	Timed Toggle		<ul style="list-style-type: none"> <li>Key engages (press short) or non-locking (press long).</li> </ul>
Output Select CF			<ul style="list-style-type: none"> <li>Activates <i>Output Selector</i> instead of the Clean Feeds as out-going signal if a Fader Channel with activated Clean Feed function is routed on the fader. (See “Fader Channels – Configuring Signal Sources for Faders” on page 159.)</li> <li>This function is only available if an <i>Output Selector Source List</i> was assigned under <i>Audio System/Mixing Functions</i> to the corresponding Clean Feed Bus. (See “Output Selector Source List” on page 131.)</li> <li>In the assigned <i>Output Selector Source List</i>, at least one signal must be defined; if more signals are to be selected, one further operating function for selecting must be configured. Therefore, in a Control Module, create a function <i>Encoder Function/Output Select</i> or <i>System Function/Output Selection</i>.</li> <li>Activates the logic source <i>Logic Source/Clean Feed/CF Output Select &lt;name of input&gt;</i>, if a Fader Channel with activated Clean Feed function is routed on the fader.</li> <li>The generated logic source can also be used at any other location in the system.</li> </ul>



## Part III: Toolbox 4 Configuration Reference

Name of Function	Option or Sub-function	Options for Selection	Description
Preparation CF			<ul style="list-style-type: none"> <li>Switches channel to pre-fader conference (Preparation Mode)</li> <li>Activates the logic source <i>Logic Source/Clean Feed/CF Prep &lt;name of input&gt;</i>, if a Fader Channel with activated Clean Feed function is routed on the fader. (See “Fader Channels – Configuring Signal Sources for Faders” on page 159.)</li> <li>The generated logic source can also be used at any other location in the system.</li> </ul>
	ON-Preparation Reset		<ul style="list-style-type: none"> <li>Function is deactivated automatically when opening the fader, if a Fader Channel with activated Clean Feed function is routed on this fader.</li> <li>Checkbox inactive: After closing the fader, the Clean Feed returns to Preparation Mode. Checkbox active: Function is reset when opening the fader.</li> <li>Color Off is ignored in this function.</li> </ul>
Fader Function			<ul style="list-style-type: none"> <li>Creates universally usable logic source under <i>Logic Source/Fader Function Channel/ FF &lt;name of faderchannel&gt;</i>.</li> <li>Application e.g.: Talk key for Clean Feeds (instead of function Talk as described above), Talk key for headphones assigned to microphones; using Output Functions. Faderstart On/Off at playout devices (using logic functions).</li> </ul>
	Toggle		<ul style="list-style-type: none"> <li>Key engages. If this checkbox is inactive, the function only remains active as long as the key is pressed. (non-locking mode, default)</li> </ul>
	Timed Toggle		<ul style="list-style-type: none"> <li>Key engages (short press) or non-locking (long press).</li> </ul>
Fader Function 2			<ul style="list-style-type: none"> <li>Creates universally usable logic source under <i>Logic Source/Fader Function 2 Channel/ FF2 &lt;name of faderchannel&gt;</i>.</li> <li>Application e.g.: Talk key for Clean Feeds (instead of function Talk as described above), Talk key for headphones assigned to microphones; using Output Functions. Faderstart On/Off at playout devices (using logic functions).</li> </ul>
	Toggle		<ul style="list-style-type: none"> <li>Key engages. If this checkbox is inactive, the function only remains active as long as the key is pressed. (non-locking mode, default)</li> </ul>
	Timed Toggle		<ul style="list-style-type: none"> <li>Key engages (short press) or non-locking (long press).</li> </ul>

Name of Function	Option or Sub-function	Options for Selection	Description
Fader Function Fader			<ul style="list-style-type: none"> <li>Creates universally usable logic source under <i>Logic Source/Fader Function Fader/ FF Fader &lt;number of fader&gt;</i>.</li> <li>Application e.g.: Fader-related switching of audio sources onto alternative PFL busses (Aux, Pre-Fader or Pre-Switched mode)</li> </ul>
	Toggle		<ul style="list-style-type: none"> <li>Key engages. If this checkbox is inactive, the function only remains active as long as the key is pressed. (non-locking mode, default)</li> </ul>
	Timed Toggle		<ul style="list-style-type: none"> <li>Key engages (short press) or non-locking (long press).</li> </ul>
Bypass Input Proc			<ul style="list-style-type: none"> <li>Bypasses Input Processing (EQs, Compressor etc.)</li> </ul>
ON/OFF Function	Subfunction:		<ul style="list-style-type: none"> <li>Functions within a channel are switched on and off directly.</li> </ul>
	Phantom Power		<ul style="list-style-type: none"> <li>48V phantom voltage, only possible for RM420-122.</li> </ul>
	Phase		<ul style="list-style-type: none"> <li>Phase rotation (only right channel in stereo signals).</li> </ul>
	LL		<ul style="list-style-type: none"> <li>Left input signal replaces the right in stereo inputs.</li> </ul>
	RR		<ul style="list-style-type: none"> <li>Right input signal replaces the left in stereo inputs.</li> </ul>
	LR		<ul style="list-style-type: none"> <li>Exchange of input signals in stereo inputs.</li> </ul>
	Mono		<ul style="list-style-type: none"> <li>Mono summation for input signals in stereo inputs.</li> </ul>
	Mono -3dB		<ul style="list-style-type: none"> <li>Mono summation -3dB of the input signals in stereo inputs.</li> </ul>
	Mono -6dB		<ul style="list-style-type: none"> <li>Mono summation -6dB of the input signals in stereo inputs.</li> </ul>
	Program Bus	Program Bus 1 to 47	<ul style="list-style-type: none"> <li>Switching-on of a channel to the Program bus (similar to function Program Bus ON/OFF).</li> <li>You find the available bus numbers under <i>Audio System/Mixing Functions</i>.</li> </ul>
	AUX	AUX Bus 1 to 47	<ul style="list-style-type: none"> <li>Switching-on of a channel to the Aux bus.</li> <li>You find the available bus numbers under <i>Audio System/Mixing Functions</i>.</li> <li>In the display <i>Aux Gain</i>, O overwrites the display of the operation mode A, P or S when in Off state!</li> </ul>
Limiter		<ul style="list-style-type: none"> <li>Limiter is switched on and off (if Limiter is configured).</li> </ul>	




## Part III: Toolbox 4 Configuration Reference

Name of Function	Option or Sub-function	Options for Selection	Description
... ON/OFF Function	Compressor		<ul style="list-style-type: none"> <li>Compressor is switched on and off (if configured).</li> </ul>
	Expander		<ul style="list-style-type: none"> <li>Expander is switched on and off (if configured).</li> </ul>
	EQ		<ul style="list-style-type: none"> <li>Equalizers are switched on and off (No.1 to No.4, if configured).</li> </ul>
	AGC		<ul style="list-style-type: none"> <li>Automatic Gain Control AGC is switched on and off (if configured).</li> </ul>
	SubSonic		<ul style="list-style-type: none"> <li>Subsonic filter is switched on and off (if configured).</li> </ul>
	Deesser		<ul style="list-style-type: none"> <li>Deesser is switched on and off (if configured).</li> </ul>
	Deesser 2		<ul style="list-style-type: none"> <li>Deesser 2 is switched on and off (if configured).</li> </ul>
	Noise Gate		<ul style="list-style-type: none"> <li>Noise gate is switched on and off (if configured).</li> </ul>
	Var.LP/HP		<ul style="list-style-type: none"> <li>Variable High pass /Low pass filter is switched on and off (No. 1 and No. 2, if configured).</li> </ul>
	Delay		<ul style="list-style-type: none"> <li>Delay function is switched on and off (if delay Module RM420-424 is built in and configured).</li> <li>Signal path over RM420-424 remains active also in switched off state (Delay = 0).</li> </ul>
	CF N-Mix		<ul style="list-style-type: none"> <li>Switches the Clean Feed return signal between N-1 (OFF) and N (ON).</li> </ul>
Insert	Switchable Insert Point 1...4	<ul style="list-style-type: none"> <li>Activates the signal path over one of the four Switchable Insert Points.</li> <li>Switching is exclusive, each Switchable Insert Point can be activated <i>for one fader only!</i> (See also "Switchable Inserts" on page 150.)</li> </ul>	
Channel Start			<ul style="list-style-type: none"> <li>Function active: Channel is switched on and fader is in 0dB position. Function inactive: Channels is switched off and fader is in Position -oodB position.</li> <li>Reasonable for motor faders, for normal faders, arrows appear in the display. Then, the faders must be moved manually until they "lock".</li> </ul>

Name of Function	Option or Sub-function	Options for Selection	Description
Encoder Function	Subfunction:	Encoder 1 to 5	<ul style="list-style-type: none"> <li>The rotary encoders in the channel of the modules RM420-023 (Encoder No.1 and 2), RM420-028 (Encoder No.1,2,3,4 and 5) and RM420-029 (Encoder No.3) can be assigned with a locally differing function independently from a central assignment.</li> <li>When deactivating the function, the encoder returns to the function centrally assigned.</li> </ul>
	None	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Sets encoder to the central assignment.</li> </ul>
	Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>Digital Gain</i> to the encoder.</li> </ul>
	Pan/Bal	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>Pan/Bal</i> to the encoder.</li> </ul>
	EQ1 Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ1 Gain</i> to the encoder.</li> <li>The encoder key sets Gain to 0dB.</li> </ul>
	EQ2 Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ2 Gain</i> to the encoder.</li> <li>The encoder key sets Gain to 0dB.</li> </ul>
	EQ3 Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ3 Gain</i> to the encoder.</li> <li>The encoder key sets Gain to 0dB.</li> </ul>
	EQ4 Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ4 Gain</i> to the encoder.</li> <li>The encoder key sets Gain to 0dB.</li> </ul>
	EQ1 Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ1 Freq</i> to the encoder.</li> </ul>
	EQ2 Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ2 Freq</i> to the encoder.</li> </ul>
	EQ3 Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ3 Freq</i> to the encoder.</li> </ul>
	EQ4 Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ4 Freq</i> to the encoder.</li> </ul>
	EQ1 Qual	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ1 Qual</i> to the encoder.</li> </ul>
	EQ2 Qual	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ2 Qual</i> to the encoder.</li> </ul>
	EQ3 Qual	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ3 Qual</i> to the encoder.</li> </ul>
	EQ4 Qual	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ4 Qual</i> to the encoder.</li> </ul>
	Sub Sonic Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>Sub Sonic Freq</i> to the encoder.</li> </ul>
Var.LP/HP	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>Var.LP/HP</i> to the encoder.</li> </ul>	
CF In	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>CF In</i> to the encoder, which can change the input level in to the Clean Feed System with.</li> </ul>	



## Part III: Toolbox 4 Configuration Reference

Name of Function	Option or Sub-function	Options for Selection	Description
.... Encoder Function	CF Out	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>CF Out</i> which can change the output level of the Clean Feed System or of the alternative signal. The level of the assigned audio source Talk Source is changed as well.</li> <li>The function is only available for channels with configured Clean Feed.</li> </ul>
	Input Select	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>Input Select</i> to the encoder.</li> </ul>
	Output Select	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>Output Select</i> to the encoder.</li> <li>The function is only available for channels with configured Clean Feed and activated Output Selector Source List.</li> </ul>
	Timer	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Display of the channel related timer, start at faderstart.</li> <li>Display <i>minute:second</i>.</li> <li>The count down time can be set with the encoder key.</li> </ul>
	Delay	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>Delay</i> to the encoder (if Module RM420-424 is built in and configured).</li> </ul>
	AUX1... 16 Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>AUXn Gain</i> to the encoder.</li> <li>With the encoder key you can switch between the 3 Aux modes <i>Pre Fader</i>, <i>After Fader</i> and <i>Switched Pre Fader</i>. (A, P, S in front of the Gain value in the list.)</li> <li>This menu entry is available for Aux 1 to 16.</li> </ul>
	Stereo Width Control	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Adjusts stereo width from 0 to 2. 0 equals a punctual projection of the signal, 1 is the original width. The increment is 0,05.</li> </ul> <p> <b>Note:</b> All values greater than 1 increase the actual stereo width and are <i>not mono compatible</i> anymore!</p>
Stereo Direction Control	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Direction of source projection. The increment is 1. <ul style="list-style-type: none"> <li>-0 = Center front</li> <li>10R = Right</li> <li>-0 = Center channels swapped</li> <li>10L = Left</li> </ul> </li> </ul>	



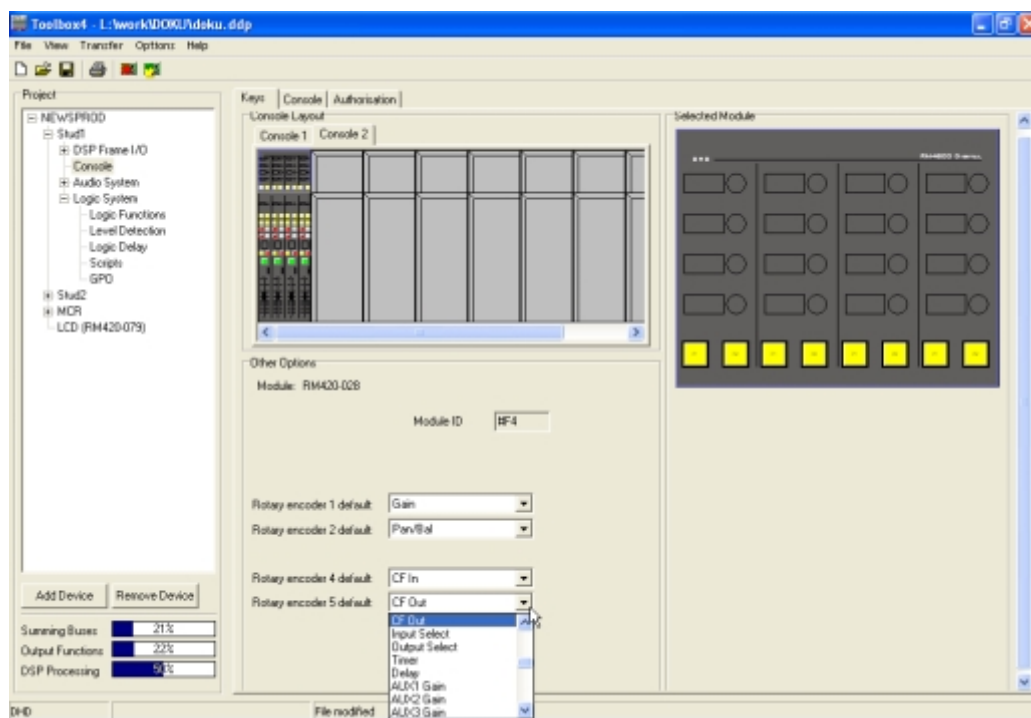


Name of Function	Option or Sub-function	Options for Selection	Description
.... Encoder Function	EQ1..4 Gain/Freq (this menu item occurs for EQ1 to EQ4)	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ1..4 Gain</i> to the encoder.</li> <li>If you press the encoder key, it changes to the function <i>EQ1..4 Freq</i>.</li> </ul>
	EQ1..4 Gain/Freq/Qual (this menu item occurs for EQ1 to EQ4)	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ1..4 Gain</i> to the encoder.</li> <li>If you press the encoder key, it changes to the function <i>EQ1..4 Freq</i>.</li> <li>If you press the encoder key again, it changes to the function <i>EQ1..4 Qual</i>.</li> </ul>
Encoder Function Set	All encoder functions available	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Use this functions to assign <i>several functions to multiple encoders simultaneously</i>.</li> <li>For instance, for an EQ assign the functions <i>GAIN</i>, <i>Freq</i>. and <i>Qual</i>. to multiple encoders. Thus, you have direct access to all parameters.</li> </ul>
	Do Not Change	Encoder 1 to 5	<ul style="list-style-type: none"> <li>The function currently assigned to the encoder is not changed.</li> </ul>
	None	Encoder 1 to 5	<ul style="list-style-type: none"> <li>The encoder display is set to <i>None</i>, it stays blank.</li> </ul>
Cut CF			<ul style="list-style-type: none"> <li>Mutes the Clean Feed signal of the channel. The Talk signal and a possible alternative signal configured with <i>Output Select</i> are not muted.</li> </ul>
Group Logic	Group 1 to 4		<ul style="list-style-type: none"> <li>The fader signal is switched on to the selected group, if this group has been configured. (See also “Group Logic - Join Channels in Groups” on page 144.)</li> </ul>
VCA Fader	VCA 1 to 8		<ul style="list-style-type: none"> <li>The faders potentiometer value is coupled with a VCA fader value. You can use this function to group a number of faders to control them with one single fader. VCA Channels do not sum fader signals into a new, grouped signal.</li> <li>Active VCA selections will be stored in Setups.</li> </ul>
Resource			<ul style="list-style-type: none"> <li>Key for controlling a shared Global Resource. You can use it to request, release and hand over the assigned resource. (See also “Defining Global Resources” on page 53.)</li> <li>The Global Resource needs to be assigned to a Fader Channel. (See also “Global Resources in Fader Channels” on page 58.)</li> <li>The key color <i>ON</i> indicates ownership of the resource.</li> </ul>
Direct Input Select	Fader Channel		<ul style="list-style-type: none"> <li>This function allows to quickly assign another source to a fader. It can be used as A/B switching.</li> </ul>



**Note:** The display functions of the *LEDs* in the channels are statically assigned and *can not* be configured, since they are labelled on the front panel of the Console accordingly!

The Fader Overbridge Modules RM420-029, RM420-023 and RM420-028 have encoder displays and encoder keys. You can use the `Toolbox4` software to assign default functions to the encoder keys. The keys will provide this functions, as long as now other encoder function has been activated.



**Figure 3–45: Assigning the default functions to the encoder keys of a Fader Overbridge Module RM420-028.**

To configure the encoder keys, do the following:

1. In the project tree, click on the node `Console`. Click on any one of the three tabs `Keys`, `Console` or `Authorisation`.
2. In the miniature view of the Console in the middle, click on the desired Overbridge Module. It is displayed in a larger view on the right side of the dialog.
3. Make sure, that *none* of the keys of the module is selected. If you have selected a key by accident, click anywhere between the keys to deselect it.
4. In the lower half of the dialog a popup menu will be shown for each encoder available. Select the desired default function for each encoder key from this menu.

### 6.6 Control Modules and List of Functions

In general, all keys of the Control Modules RM420-010, RM420-011, RM420-013, RM420-014, RM420-025 and RM420-026 can be configured with all functions for *Control Modules*, independent from location and design of the keys.



**Note:** The configurable key functions for *Fader Modules* and *Control Modules* are different!

The flexibility of the RM4200D allows to configure a great variety of functions. Therefore, only a few functions are described here. As additional explanation, you can get files with configuration examples from DHD that you can view in the `Toolbox4 Software`.



**Note:** For many functions, you need to configure the keys in the *Fader Module* as well as in the *Control Module*. These functions are marked with *ACCESS* in the following table. The *Access* key in a *Fader Module*, for example, always cooperates with the functions in a *Control Module*. This works only if both modules are located in the same *Access Group*.

Some functions can only be used with *Control Modules* that have displays of 16 ASCII digits and the corresponding main rotary encoder. These functions are marked with *DISPLAY* in the table. In addition, some functions may need an OK key for confirmation or for reaching lower menu levels. In the table, these are named *OK*. Please also consider the setting *Access Group* of the used modules.



**Important Note:** If a cooperation of several modules is necessary for a function, these must be located in the same *Access Group*. When searching for errors, check the correct assignment of the *Access Groups* to the modules! (See also “Configuring Module Options” on page 80.)

In order to use the following functions, you first need to assign the *System Function* to the corresponding key. Then you can select the desired *Sub Functions* from the following table.



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All functions are *ACCESS* and *DISPLAY* functions. Many have several levels that you reach by pressing the function key again or by pressing the *OK* key in the same module. In the table, these levels are numbered as 1. (main level), 2. (2nd level) etc.:

Name of Sub-function	Options for Selection	Description
Gain		<ol style="list-style-type: none"><li>1. <i>Gain</i> - Digital Gain (-20dB to +20dB in steps of 1dB).</li><li>2. <i>AGain</i> - Analog Gain (0dB to 50dB in steps of 5dB) — only available for RM420-122.</li><li>3. <i>Phasereverse</i> - Phase exchange (ON, OFF) — only right channel for stereo signals.</li><li>4. <i>Phantom</i> - 48V (ON, OFF) — only available for RM420-122.</li><li>5. Function is not reasonable for the modules RM420-012 and RM420-014, since separate rotary encoders and displays for the functions Gain and AGain are available.</li></ol>
Pan/Bal		<ol style="list-style-type: none"><li>1. <i>Pan/Bal</i> - Panorama for mono and Balance for stereo (L10 to R10 in 21 steps).</li><li>2. <i>Channel</i> exchange in the following order: L &gt; L, R &gt; R; L &gt; L, L &gt; R; R &gt; L, R &gt; R; R &gt; L, L &gt; R; mono; mono -3dB; mono -6dB.</li></ol>
Input Selection		<ul style="list-style-type: none"><li>• Selection of the source from the assigned Input Pool of the fader, pool number and name of the source are displayed (<i>Fader Channel Label</i>).</li><li>• Function is only available at a closed fader (Disabled when Fader= On).</li><li>• For faders with fixed source, <i>no Pool</i> is displayed.</li><li>• If you configure a function <i>Access Input Select</i> in the Fader Module, do not need this function (esp. for the modules RM420-012 and RM420-014). The rotary encoder has the function <i>Input Select</i> immediately after pressing the key in the Fader Channel. This function is exited as soon as you press another key with <i>System Function</i> or the <i>Access Key</i> in the Fader Module again.</li></ul>
Output Selection		<ul style="list-style-type: none"><li>• No function, error in some <code>Toolbox4</code> versions. Please use the function <i>CF Out</i>.</li></ul>

Name of Sub-function	Options for Selection	Description
Select Function		<ul style="list-style-type: none"> <li>• Operation of <i>all configured</i> functions in the selected Fader Module by use of rotary encoder and OK key.</li> <li>• Useful for setting functions that are rarely used (e.g. 48V phantom voltage) and to save the corresponding keys.</li> <li>• You <i>can not</i> restrict the choice of the available functions in this menu!</li> <li>• For this function you need to configure an OK key!</li> </ul>
OK		<ul style="list-style-type: none"> <li>• OK key, necessary for switching the menu level or for operating the Load/Save functions.</li> <li>• The function is <i>not</i> general for all modules. It is only valid for the module containing the corresponding functional keys and the associated display.</li> </ul>
Cancel		<ul style="list-style-type: none"> <li>• Cancel key, used for cancelling a pending request. This key is currently used for managing Global Resources only. If you press it simultaneously with a resource request key, a pending request for a resource is cancelled.</li> <li>• The function is <i>not</i> general for all modules. It is only valid for the module containing the corresponding functional keys and the associated display.</li> </ul>
CF In		<ol style="list-style-type: none"> <li>1. <i>CFIn Prep.</i> Switching the channel on to the preparation talk conference (ON/OFF).</li> <li>2. <i>CFIn Gain</i> Input level for the Clean Feed matrix (-15dB to +15dB in steps of 1dB).</li> </ol> <ul style="list-style-type: none"> <li>• This function is available for <i>all</i> sources, not only for Fader Channels with configured Clean Feed.</li> <li>• In earlier firmware versions, instead of <i>CF</i> (Clean Feed) the abbreviation <i>MPX</i> (Multiplex) is displayed.</li> </ul>
CF Out		<ol style="list-style-type: none"> <li>1. <i>CFOut Gain</i> - Output level of the return signal (-15dB to +15dB in steps of 1dB).</li> <li>2. <i>CFOutSelect</i> - Alternative signal (ON/OFF).</li> <li>3. <i>OutSel</i> - Select alternative output from Output Selector Source List.</li> </ol> <ul style="list-style-type: none"> <li>• This function is available <i>only</i> for Fader Channels with Clean Feed.</li> </ul>
Program	Program Bus 1...47	<ul style="list-style-type: none"> <li>• <i>PGM n</i> - switches Program Bus with number n ON/OFF using the rotary encoder.</li> <li>• Function is <i>not</i> locked when fader is open.</li> </ul>

Name of Sub-function	Options for Selection	Description
AUX	AUX Bus 1...47	<ol style="list-style-type: none"> <li>1. <i>AUX n Gain</i> - Set level of channel number n and output it to the Aux Bus (off, -60dB to +15dB in steps of 1dB).</li> <li>2. <i>AUX n Gain</i> - toggles between the 3 Aux modes <i>Pre Fader</i>, <i>Post (After) Fader</i> and <i>Switched Pre Fader</i>.</li> </ol>
Limiter	DSP Device Number 1	<ol style="list-style-type: none"> <li>1. <i>LIM 1</i> - Switches the limiter ON/OFF.</li> <li>2. <i>LIM 1Thr.</i> - Threshold between -20dBint and +20dBint (in steps of 1dB).</li> <li>3. <i>LIM 1Rel.</i> - Decay between 3dB/s and 20dB/s (in steps of 1dB). <ul style="list-style-type: none"> <li>• The attack time can not be configured, it is always set to "fast".</li> </ul> </li> </ol>
Compressor	DSP Device Number 1	<ol style="list-style-type: none"> <li>1. <i>COMP 1</i> - Switches the compressor ON/OFF.</li> <li>2. <i>COMP 1Thr.</i> - Threshold between -50dBint and +10dBint (in steps of 1dB).</li> <li>3. <i>COMP 1Gain</i> - Output Gain between 0dB and +30dB (in steps of 1dB).</li> <li>4. <i>COMP 1Rat.</i> - Ratio between 1.0:1 and 5.0:1 (increment 0.1).</li> <li>5. <i>COMP 1Att.</i> - Attack time between 0.2ms and 50ms (8 values).</li> <li>6. <i>COMP 1Rel.</i> - Decay time between 0.05s and 10s (8 values). <ul style="list-style-type: none"> <li>• The function is not reasonable for the module RM420-012, since separate rotary encoder and displays for the compressor functions are available.</li> </ul> </li> </ol>

Name of Sub-function	Options for Selection	Description
Expander	DSP Device Number 1	<ol style="list-style-type: none"> <li>1. <i>EXP 1</i> - Switches the expander ON/OFF.</li> <li>2. <i>EXP 1Thr.</i> - Threshold between -50dBint and +10dBint (in steps of 1dB).</li> <li>3. <i>EXP 1Gain</i> - Output Gain between 0dB and +30dB (in steps of 1dB).</li> <li>4. <i>EXP 1Rat.</i> - Ratio between 1:1.0 and 1:3.0 (increment 0.1).</li> <li>5. <i>EXP 1Att.</i> - Attack time between 0.05ms and 10ms (8 values).</li> <li>6. <i>EXP 1Rel.</i> - Decay time between 0.2s and 50s (8 values).</li> </ol>
EQ	DSP Device Number 1, 2, 3, 4, according to number of EQs	<ol style="list-style-type: none"> <li>1. <i>EQ nGain</i> - Gain between -15dB and +15dB (in steps of 1dB).</li> <li>2. <i>EQ nFreq</i> - Frequency between 22Hz and 20000Hz (60 fixed values).</li> <li>3. <i>EQ nQual</i> - Quality between 0.3 octaves and 3.0 octaves (in steps of 0.1 octaves) – menu level not available for EQ type <i>Shelving Lo/Hi</i>.</li> <li>4. <i>EQ n</i> - EQ type switchable between Bell, Notch, Hi Shelving and Lo Shelving. <ul style="list-style-type: none"> <li>• You must configure one key per equalizer band (n=1...4), in most cases, all 4 are used.</li> <li>• This function is not reasonable for the modules RM420-012 and RM420-14, since a separate rotary encoder and displays for these functions are available here.</li> <li>• The switching of the EQ type is not noiseless!</li> </ul> </li> </ol>




Name of Sub-function	Options for Selection	Description
AGC	DSP Device Number 1	<ol style="list-style-type: none"><li>1. <i>AGC 1</i> - Switches Automatic Gain Control ON/OFF.</li><li>2. <i>AGC 1Velo</i> - Control rate between 0.3dB/s and 1.5dB/s (increment 0.1).</li><li>3. <i>AGC 1Gain</i> - maximum signal shift between 5dB and 30dB (in steps of 1dB).</li><li>4. <i>AGC 1Level</i> - Nominal output level can be set between -20dBint and 20dBint (in steps of 1dB).</li><li>5. <i>AGC 1Thr.</i> - Freeze threshold of the AGC between -40dBint and -20dBint (in steps of 1dB), at lower levels, the current or latest value is kept respectively.</li></ol>
Sub Sonic	DSP Device Number 1	<ol style="list-style-type: none"><li>1. <i>SubS 1</i> - Switches the Subsonic filter ON/OFF.</li><li>2. <i>SubS 1Freq</i> - Frequency between 32Hz and 200Hz (17 fixed values).<ul style="list-style-type: none"><li>• This subsonic filter is a 3rd class high pass filter (18dB/Octave). For higher filter classes, please use the function <i>Var.LP/HP</i>. (See also “Var.LP/HP” on page 105.)</li></ul></li></ol>
Deesser	DSP Device Number 1	<ol style="list-style-type: none"><li>1. <i>DeEs 1</i> - Switches the Deesser ON/OFF.</li><li>2. <i>DeEs 1Rat.</i> - Ratio between 1.0:1 and 4.0:1 (increment 0.1).</li><li>3. <i>DeEs 1Thr.</i> - Threshold between 1.0 and 1.8 (increment 0.1).</li><li>4. <i>DeEs 1Bandw.</i> - Bandwidth between 0.2 and 0.5 (increment 0.1).</li></ol>
Deesser 2 (light)	DSP Device Number 1	<ol style="list-style-type: none"><li>1. <i>DeEs 1</i>: Switches the Deesser ON/OFF..</li><li>2. <i>DeEs 1 Freq.:</i> Frequency between 1 KHz and 20 kHz (27 pre-defined values).</li><li>3. <i>DeEs 1Thr.:</i> Threshold between -40 and 10 dB (increment 1).</li></ol>



Name of Sub-function	Options for Selection	Description
Noise Gate	DSP Device Number 1	<ol style="list-style-type: none"> <li>1. <i>GATE 1</i> - Switches the Noise Gate ON/OFF.</li> <li>2. <i>GATE 1Thr.</i> - Threshold between -60dBint and -10dBint (in steps of 1dB).</li> <li>3. <i>GATE 1Atn.</i> - Attenuation between 0dB and 30dB (in steps of 1dB).</li> <li>4. <i>GATE 1Rat.</i> - Ratio between 1:1.0 and 1:3.0 (increment 0.1).</li> <li>5. <i>GATE 1Att.</i> - Attack time between 0.2ms and 50ms (8 values).</li> <li>6. <i>GATE 1Rel.</i> - Decay time between 0.05s and 10s (8 values).</li> </ol>
Var.LP/HP	DSP Device Number 1, 2	<ol style="list-style-type: none"> <li>1. <i>FILT n</i> - Switches the Variable High pass/Low pass Filter ON/OFF.</li> <li>2. <i>FILT n</i> - Type of the filter switchable between <i>HighPass</i> and <i>LowPass</i>.</li> <li>3. <i>FILT nFreq</i> - Frequency between 22 Hz and 20000 Hz (60 fixed values).</li> <li>4. <i>FILT nOrder</i> - Filter rate adjustable between 1. Order (6dB/Octave) and 10. Order (60dB/Octave). <ul style="list-style-type: none"> <li>• You need to configure one key (n=1...2) per variable filter.</li> <li>• The switching of type and filter rate is not noiseless!</li> </ul> </li> </ol>



Name of Sub-function	Options for Selection	Description
Delay		<ol style="list-style-type: none"> <li>1. <i>DELAY</i> - Switches Delay ON/OFF.</li> <li>2. <i>DELAY</i> - Delay between 0s and maximum time, increment 10ms. The maximum time depends on the selected number of channels of the RM420-424S in the DSP Frame I/O. (See also "Delay Submodule RM420-424S" on page 75.)</li> </ol> <ul style="list-style-type: none"> <li>• Each full turn of the rotary encoder means a change of 160ms of the delay time.</li> </ul>
Stereo Width Control		<ol style="list-style-type: none"> <li>1. <i>Width1 Width</i>: Adjusts stereo width from 0 to 2. 0 equals a punctual projection of the signal, 1 is the original width. The increment is 0.05, displayed is an increment of 0.1</li> </ol> <p> <b>Note:</b> All values greater than 1 increase the actual stereo width and are <i>not mono compatible</i> anymore!</p> <ol style="list-style-type: none"> <li>2. <i>Width1 Dir</i>: Direction of source projection. The increment is 1. <ul style="list-style-type: none"> <li>-0 = Center front</li> <li>10R = Right</li> <li>-0 = Center channels swapped</li> <li>10L = Left</li> </ul> </li> <li>3. <i>Width1 Character</i>: Stereo system used for recording, XY or MS.</li> </ol>

Some functions can also be operated *in inverse order*. This means that you can *either* first select the desired channel and then the desired function *or* first select the function. In the latter case, the channels linked to the function indicate this link by flashing the corresponding keys. This is especially useful for dynamic processing and routing functions.

Example: First press the key *Access* in a Fader Channel. Now you can switch the buses of the channel in this Control Module on and off using the corresponding key.

In contrast, if there is no *Access* function active in a Fader Channel, you can press and hold a key for assigning a bus in the Control Module. Now, only the *Access* keys of all channels assigned to this bus are flashing. This way, you can realise very quickly which signals are routed to a given bus.

Functions like this are marked *INVERSE* in the following table.



Name of the Function	Option or Sub-function	Options for Selection	Description
no function			<ul style="list-style-type: none"><li>• There is no function.</li></ul>
Monitor Bus		Monitor Bus 1...6	<ul style="list-style-type: none"><li>• Function for creating up to 6 different <i>alternating</i> monitor key sets. Each monitor bus must have at least one and can have an arbitrary number of keys.</li><li>• Monitor keys are assigned to the internal stereo monitor buses <i>Monitor Bus 1L,R</i> to <i>Monitor Bus 6L,R</i>.</li><li>• Monitor buses can be selected in the <i>Audio Sources</i> Window under <i>Monitor Functions/Monitor Bus 1...6L,R</i> as sources for <i>Output Functions</i> or for the <i>Output Routing</i>.</li><li>• Monitor busses can also work with sources from other Devices. (See “Global Pool Lines - Using Pool Signals between several Devices” on page 152.)</li><li>• Monitor buses can not be used as sources for other DSP functions — e.g. <i>Fixed Processing</i>. (For this, you must use an <i>Output Function</i>!)</li><li>• Summation monitoring is <i>not</i> possible with this function, the keys are alternating. Only one source can be switched on at any time.</li><li>• If you press the same key again, the monitor bus switches to the <i>Default Monitor Bus Source</i> selected under <i>Audio System/Monitor Functions</i>. The default setting is <i>Program Bus 1</i>, for Mute select <i>None</i>. (See also “Monitor Functions – Options for Monitoring” on page 125.)</li><li>• You can extend the key set with the <i>Rotary Monitor Selectors 1...6</i> that can be controlled by rotary encoders. Therefore, you need to assign the audio source <i>Monitor Functions/Rotary Monitor Select L,R</i> from the <i>Audio Sources</i> Window to the key.</li><li>• Monitor key sets of a monitor bus can span several modules, e.g. using the modules RM420-012 and RM420-025.</li><li>• Monitor key sets of a monitor bus can also span several modules using a key in each Fader Channel. (Function <i>Monitor Bus Control</i> in <i>Fader Modules</i>), e.g. with the modules RM420-012 and RM420-020.</li></ul>



## Part III: Toolbox 4 Configuration Reference

Name of the Function	Option or Sub-function	Options for Selection	Description
... Monitor Bus		Monitor Bus 0	<ul style="list-style-type: none"><li>• Monitor key sets of a monitor bus can also be operated parallel in several modules, e.g. in the studio using the RM420-011 and parallel in the control room using the RM420-012 (also with <i>Monitor Bus Shift</i>, see below).</li><li>• Monitor buses themselves are <i>no</i> audio channels on the TDM bus system, but are created internally using special routing functions!</li><li>• <i>Special function</i>: Keys with Monitor Bus 0 normally correspond to <i>Monitor Bus 1</i>, but with the key function <i>Monitor Bus Shift</i> they can feed one or more other <i>Monitor buses 2...6</i>.</li><li>• Monitor Bus 1 is not influenced when using the “Shift” function, the selected source remains the same.</li><li>• Monitor Bus shifting is reasonable e.g. to save keys.</li><li>• The LEDs of the keys always show the state of the <i>Monitor Bus</i> that just has been selected using <i>Monitor Bus Shift</i>, or the state of the <i>Monitor Bus 1</i>, if no <i>Monitor Bus Shift</i> key is pressed. It is not possible to use several LED colors for indicating the states of the Monitor buses!</li></ul>
		Left Source	<ul style="list-style-type: none"><li>• Selection of any audio source available on the TDM bus as well as of the corresponding <i>Rotary Monitor Selector</i> for the left channel of a Monitor Bus.</li></ul>
		Right Source	<ul style="list-style-type: none"><li>• Selection of each of the audio sources available on the TDM bus as well as of the corresponding <i>Rotary Monitor Selector</i> for the right channel of a Monitor Bus.</li></ul>
		Global Pool	<ul style="list-style-type: none"><li>• If a Global Pool has been configured and a Global Pool Line has been reserved for the current Monitor bus, you can activate this check box. You can then use audio sources from external devices on this monitor bus. (See “Global Pool Lines - Using Pool Signals between several Devices” on page 152.)</li></ul>
Monitor Bus Shift		Monitor Bus 2...6	<ul style="list-style-type: none"><li>• Monitor keys with <i>Monitor Bus 0</i> normally correspond to <i>Monitor Bus 1</i>, but they can feed one or more other <i>Monitor buses 2...6</i> with the key function <i>Monitor Bus Shift</i>.</li><li>• The operation of the corresponding <i>Rotary Monitor Selectors</i> can also be switched with this function.</li></ul>

Name of the Function	Option or Sub-function	Options for Selection	Description
Potentiometer	<i>DISPLAY</i>	List of available potentiometers	<ul style="list-style-type: none"> <li>• This function activates the operation of potentiometer functions using key and rotary encoder in the Control Module.</li> <li>• In order to use it, <i>in advance</i> you have to select a potentiometer from the list under <i>Audio System/Potentiometer</i> and change its preset name (Pot. x) to make it visible in the selection menu! (See “Potentiometers” on page 138.)</li> <li>• The potentiometers can affect audio signals using Output Functions.</li> <li>• Parallel operation of the same potentiometer is possible.</li> <li>• You can use this function as <i>display</i> for external and pre-defined potentiometer sources. Sources can be: ACI (RM420-122), Global Potentiometers and the electromechanical potentiometers of the Modules RM420-010/011/012/013/014/026.</li> </ul>
		Special case: Balance 1,2	<ul style="list-style-type: none"> <li>• Here, only yellow is reasonably usable as key color for „On“. The red LED is automatically used to indicate a setting different from the neutral position if the function is inactive.</li> <li>• Reasonable for setting the balance of the monitor speakers.</li> <li>• The potentiometer values are calculated using a table and are available for the Output Functions <i>Balance 1L</i> and <i>Balance 1R</i> (or <i>Balance 2L</i> and <i>Balance 2R</i>).</li> </ul>



## Part III: Toolbox 4 Configuration Reference

Name of the Function	Option or Sub-function	Options for Selection	Description
Rotary Monitor Select	DISPLAY	Selector Number 1...10	<ul style="list-style-type: none"><li>• This functions assigns the rotary encoder as control to the selector with the chosen number.</li><li>• So you can extend the monitor key sets created with <i>Monitor Bus 1...6</i> or independently use the selector for monitoring and routing.</li><li>• You have to assign a <i>Source List</i> with audio sources to each <i>Rotary Monitor Selector</i> under <i>Audio System/Monitor Functions/Rotary Monitor Selector</i>. (See “Rotary Monitor Selector” on page 126.)</li><li>• You define the selectable sources of the <i>Source Lists</i> under <i>Audio System/Selector Source Lists</i>. You can use up to 30 different <i>Source Lists</i>. (See “Output Selector Source List” on page 131.)</li><li>• <i>Only</i> for <i>Output Functions</i> can you use the <i>Rotary Monitor Selectors</i> as audio sources. You find them in the <i>Audio Sources Window</i> under <i>Monitor Functions/Rot. Monitor Selector 1...30L,R</i>.</li><li>• <i>Rotary Monitor Selectors</i> can not be used as sources for other DSP functions, e.g. for <i>Fixed Processing</i> or for <i>Output Routing</i>. (For that, you have to use an <i>Output Function</i>!)</li><li>• Monitor buses themselves are <i>no</i> audio channels on the TDM bus system but are created internally using special routing functions!</li><li>• Independent of this key function, the modules RM420-012 and RM420-014 provide a separate display and a rotary encoder <i>Selector</i>. The selector is available for operating the Rotary Monitor Selectors 0 to 30. (See “Special – Configuring Displays in Control Modules” on page 121.)</li></ul>
		Selector Number 1...6	<ul style="list-style-type: none"><li>• The <i>Rotary Monitor Selectors 1...6</i> are available as sources for the <i>Monitor Buses 1...6</i>. They can be assigned to the corresponding Monitor Bus as source of a monitor key in the <i>Audio Sources Window</i> under <i>Monitor Functions/Rotary Monitor Select L,R</i>.</li><li>• If the <i>Monitor Buses 1...6</i> are not used, you can freely use the <i>Rotary Monitor Selectors 1...6</i>, e.g. for routing.</li></ul>



Name of the Function	Option or Sub-function	Options for Selection	Description
... Rotary Monitor Select		<i>Selector Number 0</i>	<ul style="list-style-type: none"> <li>• <i>Special function: Rotary Monitor Selector 0</i></li> <li>• Normally corresponds to <i>Rotary Monitor Selector 1</i>, but can feed one or more other <i>Rotary Monitor Selectors 2...6</i> over the key function <i>Monitor Bus Shift</i>.</li> <li>• The key function <i>Monitor Bus Shift 2...6</i> always influences the <i>Rotary Monitor Selectors 2...6</i>, too.</li> </ul>
User Defined			<ul style="list-style-type: none"> <li>• This function activates the logic source <i>Logic Source/RM420-xxx #m/KEY #n label</i>, if this key is pressed or active (for engaging keys activate checkbox <i>Toggle</i>). <i>#m</i> stands for the number of the module, <i>#n</i> for the number of the key.</li> <li>• You can use the created logic source in many different ways, e.g. for logic functions, Output Functions, Global Logic Functions or controlling of GPOs.</li> <li>• You can define up to three different <i>Lamp Sources</i>. Select the desired row from the table <i>Lamp Source</i> and assign a logic source per double click or Drag &amp; Drop. Each available source in the <i>Logic Sources Window</i> can be assigned. (Mostly, this is the key itself using <i>Logic Source/RM420-xxx #ID/KEY #No label</i>.)</li> <li>• By right-clicking in a row of the table <i>Lamp Source</i> you can change the color of the LED.</li> <li>• You can change the order of the three rows by Drag&amp;Drop using the left mouse key.</li> <li>• The LED with the higher priority shines when its <i>Lamp Source</i> is active; <i>Two colors can not shine at the same time!</i></li> <li>• The LEDs of the keys can be used for displaying system states even without a key function. This is useful for testing GPIs.</li> </ul>
		Toggle	<ul style="list-style-type: none"> <li>• The key engages. If this checkbox is not active, the function remains active only as long as the key is pressed. The key itself should serve as <i>Lamp Source</i> to clearly indicate the state.</li> </ul>
		Timed Toggle	<ul style="list-style-type: none"> <li>• Key is engaging (short press) or alternating (long press). The key itself should serve as <i>Lamp Source</i> to clearly indicate the state.</li> </ul>



## Part III: Toolbox 4 Configuration Reference

Name of the Function	Option or Sub-function	Options for Selection	Description
Load/Save Functions	Subfunction:		<ul style="list-style-type: none"><li>• Key functions for loading and saving the two different setup types – <i>Channel Setup</i> and <i>Mixer Setup</i>.</li><li>• Loading and saving can take some seconds, independent from the amount of data saved in the setup!</li><li>• Please read in the volume <i>System Reference</i> of the manual, which settings and functions are contained in the setups and which are not.</li></ul>
	Load Channel Setup <i>ACCESS</i> <i>DISPLAY OK</i>		<ul style="list-style-type: none"><li>• Loads Input Gain- and Input Processing settings for the channel selected with <i>ACCESS</i>.</li><li>• Setup selection from 0 to 250 (12 steps per turn).</li><li>• Channel Setup 0 is an empty setup (all parameters are 0dB or processing inactive).</li></ul>
	Save Channel Setup <i>ACCESS</i> <i>DISPLAY OK</i>		<ul style="list-style-type: none"><li>• Saves all settings for Input Gain and Input Processing for the channel selected with <i>ACCESS</i>.</li><li>• Selection of the setup from 1 to 250 (12 steps per turn).</li><li>• A write protection for individual setups is not possible!</li></ul>
	Load Channel Setup to ... <i>DISPLAY OK</i>	Fader Number 1...40	<ul style="list-style-type: none"><li>• Loads all Input Gain and Input Processing settings for a defined fader.</li><li>• Selection of the setup from 0 to 250 (12steps per turn).</li><li>• Channel Setup 0 is an empty setup (all parameters 0dB or processing inactive).</li></ul>
	Load Mixer Setup <i>DISPLAY OK</i>		<ul style="list-style-type: none"><li>• Loads Input Gain, Input Processing, Input Routing, summation, Aux and Clean Feed settings of all defined Fader Channels of the mixer.</li><li>• Selection of the setup from 0 to 6.</li><li>• Open faders are not overwritten (their <i>ACCESS</i> keys are flashing), after closing the fader, the setup must be loaded again.</li></ul>






Name of the Function	Option or Sub-function	Options for Selection	Description
... Load/Save Functions	Save Mixer Setup <i>DISPLAY OK</i>		<ul style="list-style-type: none"><li>• Saves Input Gain, Input Processing, Input Routing, Summation, Aux and Clean Feed settings of all defined Fader Channels of a mixer.</li><li>• Setup selection from 1 to 6.</li><li>• A write protection for individual setups is not possible</li><li>• Setup 0 (Default Setup) can only be saved using the Maintenance window of the Toolbox4 software and should be provided with reasonable preferences for the Device. This is especially true for the analog gains of the microphone and the phantom power. (See “Save Setup 0” on page 31.)</li></ul>
	Load Mixer Setup ...	Setup Number 0...6	<ul style="list-style-type: none"><li>• Loads Input Gain, Input Processing, Input Routing, Summation, Aux and Clean Feed settings of all defined Fader Channels of the mixer.</li><li>• The setup is loaded directly while pressing the key for about one second.</li><li>• Open faders are not overwritten (ACCESS keys are flashing), after closing the fader, the setup must be loaded again.</li></ul>
	Load from Chipcard <i>DISPLAY</i>		<ul style="list-style-type: none"><li>• Loads Input Gain, Input Processing, Input Routing, Summation, Aux and Clean Feed settings of all defined Fader Channels of the mixer from the smart card.</li><li>• The setup is loaded directly while pressing the key for about one second.</li><li>• You have to define the key in the module RM420-013 that the card reader is connected to.</li><li>• Open faders are not overwritten (ACCESS keys are flashing), after closing the fader, the setup must be loaded again.</li><li>• Each smart card stores <b>one</b> mixer setup. You can work with one smart card setup on two mixers, only if both mixer are configured identically.</li></ul>



## Part III: Toolbox 4 Configuration Reference

Name of the Function	Option or Sub-function	Options for Selection	Description
... Load/Save Functions	Save to Chipcard <i>DISPLAY</i>		<ul style="list-style-type: none"> <li>Saves Input Gain, Input Processing, Input Routing, Summation, Aux and Clean Feed settings of all defined Fader Channels of the mixer to the smart card.</li> <li>Each smart card stores <b>one</b> mixer setup.</li> <li>Write protection is not possible!</li> <li>You have to define the key in the module RM420-013 that the card reader is connected to.</li> </ul>
Encoder Function	Subfunction:	Encoder 1 to 5	<ul style="list-style-type: none"> <li>The rotary encoders of the modules RM420-023 (Overbridge, Encoder No. 1 - top and No. 2 - bottom), RM420-028 (Overbridge, Encoder No. 1,2,4,5 from top to bottom) and RM420-029 (Fader Module, Encoder No. 3) are assigned the selected subfunctions for all Fader Channels.</li> <li>Independent from the central assignments, the encoders can be assigned locally differing functions for each Fader Channel. This overwrites the central function as long as the local function is active.</li> </ul>
	None	Encoder 1 to 5	<ul style="list-style-type: none"> <li>No function.</li> </ul>
	Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function Digital Gain to the encoder.</li> </ul>
	Pan/Bal	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function Pan/Bal to the encoder.</li> </ul>
	EQ1 Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function EQ1 Gain to the encoder.</li> <li>The encoder key sets Gain to 0dB.</li> </ul>
	EQ2 Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function EQ2 Gain to the encoder.</li> <li>The encoder key sets Gain to 0dB.</li> </ul>
	EQ3 Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function EQ3 Gain to the encoder.</li> <li>The encoder key sets Gain to 0dB.</li> </ul>
	EQ4 Gain	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function EQ4 Gain to the encoder.</li> <li>The encoder key sets Gain to 0dB.</li> </ul>
	EQ1 Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function EQ1 Freq to the encoder.</li> </ul>
	EQ2 Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function EQ2 Freq to the encoder.</li> </ul>
	EQ3 Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function EQ3 Freq to the encoder.</li> </ul>
	EQ4 Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function EQ4 Freq to the encoder.</li> </ul>
	Sub Sonic Freq	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function Sub Sonic Freq to the encoder.</li> </ul>
	Var.LP/HP	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function Var.LP/HP to the encoder.</li> </ul>
CF In	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function CF In to the encoder, that can modify the input level into Clean Feed System.</li> </ul>	

Name of the Function	Option or Sub-function	Options for Selection	Description
... Encoder Function	CF Out	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function CF Out to the encoder that can change the output level of the Clean Feed or of the alternative output. The assigned <i>Talk Source</i> is also influenced.</li> <li>The function is only available for channels with configured Clean Feed.</li> </ul>
	Input Select	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function Input Select to the encoder.</li> <li>The function is only available for channels with configured Clean Feed and activated Output Selector Source List.</li> </ul>
	Timer	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Display of the channel related timer, start at fader start.</li> <li>Display <i>minute:second</i>.</li> <li>The count down time can be set using the encoder key.</li> </ul>
	Delay	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function Delay to the encoder (if module RM420-424 is built in and configured).</li> </ul>
	AUX Select <i>DISPLAY</i>	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Pre-selection of the Aux bus to be adjusted using the main rotary encoder and display (RM420-013).</li> <li>Reasonable if Aux buses &gt;16 are adjusted using the encoder.</li> <li>Function only available in modules with rotary encoder and display, mostly RM420-013.</li> </ul>
	AUX1...16 Gain (this menu entry is available for Aux 1 to 16)	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function AUX#n Gain to the encoder.</li> <li>You can switch with the encoder key between three aux modes: <i>Pre Fader</i>, <i>After Fader</i> and <i>Switched Pre Fader</i> (Display of A, P, S before Gain value).</li> <li>You need to assign a key for each Aux Bus 1...16.</li> <li>For the Aux buses &gt;16 you have to use the function <i>AUX Select</i>.</li> </ul>
	Stereo Width Control	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Adjusts stereo width from 0 to 2. 0 equals a punctual projection of the signal, 1 is the original width. The increment is 0.05.</li> </ul>
			<div style="display: flex; align-items: center;">  <p><b>Note:</b> All values greater than 1 increase the actual stereo width and are <i>not mono compatible</i> anymore!</p> </div>

## Part III: Toolbox 4 Configuration Reference

Name of the Function	Option or Sub-function	Options for Selection	Description
.. Encoder Function	Stereo Direction Control	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Direction of source projection. The increment is 1. <ul style="list-style-type: none"> <li>-0 = Center front</li> <li>10R = Right</li> <li>-0 = Center channels swapped</li> <li>10L = Left</li> </ul> </li> </ul>
	EQ1..4 Gain/Freq (this menu item occurs for EQ1 to EQ4)	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ1..4 Gain</i> to the encoder.</li> <li>If you press the encoder key, it changes to the function <i>EQ1..4 Freq</i>.</li> </ul>
	EQ1..4 Gain/Freq/Qual (this menu item occurs for EQ1 to EQ4)	Encoder 1 to 5	<ul style="list-style-type: none"> <li>Assigns the function <i>EQ1..4 Gain</i> to the encoder.</li> <li>If you press the encoder key, it changes to the function <i>EQ1..4 Freq</i>.</li> <li>If you press the encoder key again, it changes to the function <i>EQ1..4 Qual</i>.</li> </ul>
ON/OFF Function	Subfunction: all <i>INVERS</i>		<ul style="list-style-type: none"> <li>Switching function on/off directly.</li> </ul>
	Phantom Power		<ul style="list-style-type: none"> <li>48V Phantom Power, only possible for RM420-122.</li> </ul>
	Phase		<ul style="list-style-type: none"> <li>Phase inversion (only right channel for stereo signals).</li> </ul>
	LL		<ul style="list-style-type: none"> <li>For stereo signals, the left input signal replaces the right one.</li> </ul>
	RR		<ul style="list-style-type: none"> <li>For stereo signals, the right input signal replaces the left one.</li> </ul>
	LR		<ul style="list-style-type: none"> <li>Side exchange of input signals of stereo inputs.</li> </ul>
	Mono		<ul style="list-style-type: none"> <li>Mono summation of the input signals of stereo inputs.</li> </ul>
	Mono -3dB		<ul style="list-style-type: none"> <li>Mono summation -3 dB of the input signals of stereo inputs.</li> </ul>
	Mono -6dB		<ul style="list-style-type: none"> <li>Mono summation -6 dB of the input signals of stereo inputs.</li> </ul>
	Program Bus	Program Bus 1 to 47	<ul style="list-style-type: none"> <li>Switching onto the Program bus (similar to function Program Bus ON/OFF).</li> <li>Bus number see <i>Audio System/Mixing Functions</i>.</li> <li>The function can <i>not</i> be locked at open fader!</li> </ul>



Name of the Function	Option or Sub-function	Options for Selection	Description
... ON/OFF Function	AUX Bus	AUX Bus 1 to 47	<ul style="list-style-type: none"> <li>Switching onto AUX bus.</li> <li>Bus number see <i>Audio System/Mixing Functions</i>.</li> <li>In the AUX Gain display, O overwrites the available display of mode A, P or S in Off state!</li> <li>The function can <i>not</i> be locked at open fader!</li> </ul>
	Limiter		<ul style="list-style-type: none"> <li>Switching on/off of limiter (if configured).</li> </ul>
	Compressor		<ul style="list-style-type: none"> <li>Switching on/off of compressor (if configured).</li> </ul>
	Expander		<ul style="list-style-type: none"> <li>Switching on/off of expander (if configured).</li> </ul>
	EQ		<ul style="list-style-type: none"> <li>Switching on/off of equalizer (No. 1 to No. 4, if configured).</li> </ul>
	AGC		<ul style="list-style-type: none"> <li>Switching on/off of AGC (if configured).</li> </ul>
	SubSonic		<ul style="list-style-type: none"> <li>Switching on/off of Subsonic filter (if configured).</li> </ul>
	Deesser		<ul style="list-style-type: none"> <li>Switching on/off of Deesser (if configured).</li> </ul>
	Deesser 2		<ul style="list-style-type: none"> <li>Switching on/off of Deesser 2 (if configured).</li> </ul>
	Noise Gate		<ul style="list-style-type: none"> <li>Switching on/off of the Noise Gate (if configured).</li> </ul>
	Var.LP/HP		<ul style="list-style-type: none"> <li>Switching on/off of Variable High pass/Low pass filter.</li> <li>Device Number 1 <i>and</i> 2, if two filters are configured. In this case, <i>both</i> filters are influenced.</li> </ul>
	Delay		<ul style="list-style-type: none"> <li>Assign the function Delay to the encoder (if module RM420-424 is built in and configured).</li> <li>Signal path over RM420-424 remains also in off state (Delay = 0).</li> </ul>
	CF N-Mix		<ul style="list-style-type: none"> <li>Switches the Clean Feed return signal between N-1 (OFF) and N (ON).</li> </ul>
	Off Air		<ul style="list-style-type: none"> <li>Switches the Off Air function on and off.</li> </ul>
Output Select		<ul style="list-style-type: none"> <li>Switches the alternative Clean Feed return signal on and off.</li> <li>The function is only available for channels with associated Clean Feed signals.</li> </ul>	
Insert	Switchable Insert Point 1...4	<ul style="list-style-type: none"> <li>Activates the signal path over one of the four Switchable Insert Points.</li> <li>Switching is exclusive, each Switchable Insert Point can be activated <i>for one fader only!</i> (See also "Switchable Inserts" on page 150.)</li> </ul>	

## Part III: Toolbox 4 Configuration Reference

Name of the Function	Option or Sub-function	Options for Selection	Description
Timer Function	Subfunction: <i>DISPLAY</i>		<ul style="list-style-type: none"> <li>• Display of a timer in a module with display.</li> <li>• The corresponding display in the modules RM420-010/011/012/013/14 must be assigned the correct timer number using <i>Console/Keys/Special</i> (left mouse click on the display). Furthermore, a different <i>Access Group</i> must be assigned to the module, in order not to switch the timer display when pressing an ACCESS key!</li> </ul>
	Timer Start	Timer 1...12	<ul style="list-style-type: none"> <li>• Manual timer start.</li> </ul>
	Timer Stop	Timer 1...12	<ul style="list-style-type: none"> <li>• Manual timer stop.</li> </ul>
	Timer Reset	Timer 1...12	<ul style="list-style-type: none"> <li>• Resets timer to 0.</li> </ul>
	Timer Set	Timer 1...12	<ul style="list-style-type: none"> <li>• Pre-selection of a count down time using a rotary encoder (approx. 2min per turn).</li> <li>• After reaching time 0, the elapsed time since start is displayed!</li> </ul>
Timer Fader	Timer 1...12	<ul style="list-style-type: none"> <li>• Timer can be started with fader start.</li> <li>• Only the fader starts of the Fader Channels work where the option <i>Timer Reset</i> was activated. (See "<i>Fader Channels – Configuring Signal Sources for Faders</i>" on page 159.)</li> </ul>	

Name of the Function	Option or Sub-function	Options for Selection	Description	
Routing	Subfunction:		<ul style="list-style-type: none"> <li>The keys are used for routing signals to the TDM bus to an output or an <i>Output Function</i>.</li> <li>You need to define one key for each source and one for each destination.</li> <li>The routing can be mono and stereo depending on the configuration, but it is uniformly mono or stereo for all keys! Do <i>not</i> used mixed routing of mono and stereo signals!</li> <li>If you press a key of a source, the keys of the routed destinations are flashing.</li> <li>If you press the key of a destination, you can select a new source. The old and the selected sources are flashing, the new source can be taken over with <i>Take</i>. Without the <i>Take</i> function, routing happens immediately.</li> <li>Routing can be carried out over several modules, e.g. one RM420-025 for sources and one RM420-025 for destinations.</li> </ul>	
	Input	Left Source	<ul style="list-style-type: none"> <li>Selection of an arbitrary source for the left channel from the window <code>Audio Sources Window</code>.</li> </ul>	
		Right Source	<ul style="list-style-type: none"> <li>Selection of an arbitrary source for the right channel from the <code>Audio Sources Window</code>.</li> <li>If the routing function is used mono, there will be no selection of a source for the right channel.</li> </ul>	
	Output	Routing Number 1...768		<ul style="list-style-type: none"> <li>For each output key, you must state an unique (!) internal <i>Routing number</i>. This number is available in the <code>Audio Sources Window</code> under <code>Routing/Routing &lt;RoutingNumber&gt; L,R</code> and can be routed to outputs or <code>Output Functions</code>.</li> <li>If the routing function is used mono, there is no selection of the right source.</li> <li>It does not matter which routing number you use for an output key, but you must not assign it twice!</li> <li>The routing number is no channel on the TDM bus so it does not consume any resources.</li> </ul>
			Use Take	<ul style="list-style-type: none"> <li>If you switch on this checkbox, routing is carried out only after pressing the <i>Take</i> key, otherwise immediately. This option can be used for each key separately.</li> </ul>
	Take			<ul style="list-style-type: none"> <li>This key controls the optional <i>Take</i> function for the routing. If used, it has to be configured once per system.</li> </ul>



## Part III: Toolbox 4 Configuration Reference

Name of the Function	Option or Sub-function	Options for Selection	Description
MIDI		MIDI Key 1...40	<ul style="list-style-type: none"><li>• This function outputs key codes for MIDI functions using the Ethernet port.</li><li>• Reasonable for coupling audio workstations with motor faders, if the audio workstations support external MIDI controllers.</li><li>• For this function, you need the separate PC software RM420-554 and a PC MIDI Interface. There is no MIDI interface at the RM4200D itself, a PC with the software is necessary for routing the Ethernet to MIDI.</li></ul>
Talkback System	Talk Source Channel		<ul style="list-style-type: none"><li>• Available only when talk back matrix is activated.</li><li>• List of all talk back sources configured within the matrix. (See also “Talk” on page 66.)</li></ul>
	Talk Destination Aux		<ul style="list-style-type: none"><li>• Available only when talk back matrix is activated.</li><li>• List of all talk back destinations configured within the matrix.</li></ul>
Resource Request	Resource	<Name>	<ul style="list-style-type: none"><li>• List of all resources within in the project the current Device is a subscriber of. (See also “Defining Global Resources” on page 53.)</li><li>• Use this key together with the OK key to manage Global Resources. With these two keys you can request, release and take over resources.</li><li>• Configure the key to use two colours: red for ON and yellow for OFF. Using these two colors the following conditions can be indicated:<ul style="list-style-type: none"><li><i>Off</i>: The resource is owned by another Device.</li><li><i>Yellow, steady</i>: The resource is available.</li><li><i>Yellow, flashing</i>: The resource is owned by another Device. A request is pending, the owner needs to release the resource.</li><li><i>Red, steady</i>: The current Device is the owner of the resource.</li><li><i>Red, flashing</i>: The current Device is the owner of the resource, another Device requests it.</li></ul></li></ul>
	Reserve For	<Subscriber>	<ul style="list-style-type: none"><li>• List of all subscribers configured, for which the resource can be requested and reserved.</li></ul>



### 6.7 Special – Configuring Displays in Control Modules

In the modules RM420-010, RM420-011, RM420-012 and RM420-013 *ASCII displays* with 8 and 16 digits are available. These can be assigned various function in this menu, as well as the LED displays *MIC ON*, *ON AIR*, *PHONE1*, *PHONE2* and the card reader output of the Module RM420-013. You can configure these functions by highlighting the corresponding display with a left mouse click. In the `Toolbox4` software, the selectable areas are marked white.

Name of the Function	Function available in Module Type	Selection options	Description
<i>Select default display text</i>	RM420-010 RM420-011 RM420-012 RM420-013 <i>Selected:</i> 16 digit LED-ASCII display + optical main rotary encoder	RM4200D	<ul style="list-style-type: none"> <li>• Display of the firmware version available in the Device, e.g. “RM4200D V5.01.54”</li> <li>• Default setting, recommended for at least one Module per system.</li> <li>• Overwritten at activation of the <i>ACCESS</i> function in the Fader Channel, if Fader Module and Control Module belongs to the same Access Group. (See also “Configuring Module Options” on page 80.)</li> </ul>
		Device Name	<ul style="list-style-type: none"> <li>• Display of the Device name, max. 16 digits.</li> <li>• Overwritten at activation of the <i>ACCESS</i> function in the Fader Channel, if Fader Module and Control Module belong to the same Access Group.</li> </ul>
		Timer 1...12 (this menu entry is available for the timers 1 to 12)	<ul style="list-style-type: none"> <li>• Display of a timer; max. 12 timers per system possible.</li> <li>• With this function, you can also implement “Slave” displays for timers.</li> <li>• The timer display is overwritten at activation of the <i>ACCESS</i> function in the Fader Channel, if Fader Module and Control Module belong to the same Access Group.</li> </ul>



## Part III: Toolbox 4 Configuration Reference

Name of the Function	Function available in Module Type	Selection options	Description
Default Rotary Monitor Selector	RM420-012 <i>Selected:</i> 8 digit LED-ASCII display + mechanical rotary encoder	<i>Selector Number 1...10</i>	<ul style="list-style-type: none"> <li>• Similar to the key function <i>Rotary Monitor Select</i>, but the configured <i>Rotary Monitor Selector</i> is constantly displayed. (See also “Rotary Monitor Select” on page 110.)</li> <li>• With this, you can extend the monitor key sets generated with <i>Monitor Bus 1...6</i> or use the selector independently for monitoring or routing.</li> <li>• You have to assign a <i>Source List</i> with audio sources to any <i>Rotary Monitor Selector</i> under <i>Audio System/Monitor Functions/Rotary Monitor Selector</i>. (See “Rotary Monitor Selector” on page 126.)</li> <li>• Define the selectable sources of the <i>Source Lists</i> under <i>Audio System/Selector Source Lists</i>. You can use up to 10 different <i>Source Lists</i>. (See “Output Selector Source List” on page 131.)</li> <li>• You can use <i>Rotary Monitor Selectors</i> as audio sources for <i>Output Functions only</i>. You find them in the window <i>Audio Sources Window</i> under <i>Monitor Functions/Rot. Monitor Selector 1...10L,R</i>.</li> <li>• <i>Rotary Monitor Selectors</i> can not be used as sources for other DSP functions, e.g. <i>Fixed Processing</i> or for <i>Output Routing</i>. (For this, you have to use an <i>Output Function!</i>)</li> <li>• Monitor buses themselves are <i>no</i> audio channels on the TDM bus system, but are created internally using special routing functions!</li> </ul>
		<i>Selector Number 1...6</i>	<ul style="list-style-type: none"> <li>• The <i>Rotary Monitor Selectors 1...6</i> are available as source for the <i>Monitor buses 1...6</i> and can be assigned to the corresponding <i>Monitor Bus</i> as source of a monitor key in the <i>Audio Sources Window</i> under <i>Monitor Functions/Rotary Monitor Select L,R</i>.</li> <li>• If the <i>Monitor Buses 1...6</i> are unused, you can freely use the <i>Rotary Monitor Selectors 1...6</i>, e.g. for routing.</li> </ul>
		<i>Selector Number 0</i>	<ul style="list-style-type: none"> <li>• <i>Special function: Rotary Monitor Selector 0</i></li> <li>• Normally, corresponds to <i>Rotary Monitor Selector 1</i>, but can feed one or more other <i>Rotary Monitor Selectors 2...6</i> using the key function <i>Monitor Bus Shift</i>.</li> <li>• The key function <i>Monitor Bus Shift 2...6</i> always influences the <i>Rotary Monitor Selectors 2...6</i>.</li> </ul>



Name of the Function	Function available in Module Type	Selection options	Description
MIC ON Lamp Source	RM420-013 <i>MIC ON</i> <i>red LED</i> <i>display</i>	Logic Source	<ul style="list-style-type: none"> <li>You can select an arbitrary logic source, e.g. a logic function that is coupled to the faderstart of a microphone using OR.</li> <li>The label <i>MIC ON</i> and the red color of the LED can not be changed!</li> </ul>
ON AIR Lamp Source	RM420-013 <i>ON AIR</i> <i>red LED</i> <i>display</i>	Logic Source	<ul style="list-style-type: none"> <li>You can select an arbitrary logic source, e.g. a logic function or a GPI signal for switching the studio "On Air" onto the transmitter line.</li> <li>The label <i>ON AIR</i> and the red color of the LED can not be changed!</li> </ul>
PHONE 1 Lamp Source	RM420-013 <i>PHONE 1</i> <i>yellow LED</i> <i>display</i>	Logic Source	<ul style="list-style-type: none"> <li>You can select an arbitrary logic source, e.g. a logic function or a GPI with call signal or status signal of a telephone hybrid.</li> <li>The label <i>PHONE 1</i> and the yellow color of the LED can not be changed!</li> </ul>
PHONE 2 Lamp Source	RM420-013 <i>PHONE 2</i> <i>yellow LED</i> <i>display</i>	Logic Source	<ul style="list-style-type: none"> <li>You can select an arbitrary logic source, e.g. a logic function or a GPI with call signal or status signal of a telephone hybrid.</li> <li>The label <i>PHONE 2</i> and the yellow color of the LED can not be changed!</li> </ul>
Card Release Source	RM420-013 <i>Chip Card</i> <i>Reader</i>	Logic Source	<ul style="list-style-type: none"> <li>You can select an arbitrary logic source, mostly the key for ejecting the chip card "Eject Card" (for card readers with electromechanical ejection).</li> <li>Production until May, 2003, RM420-013 produced from June 2003 do not have an electromechanical ejection.</li> </ul>

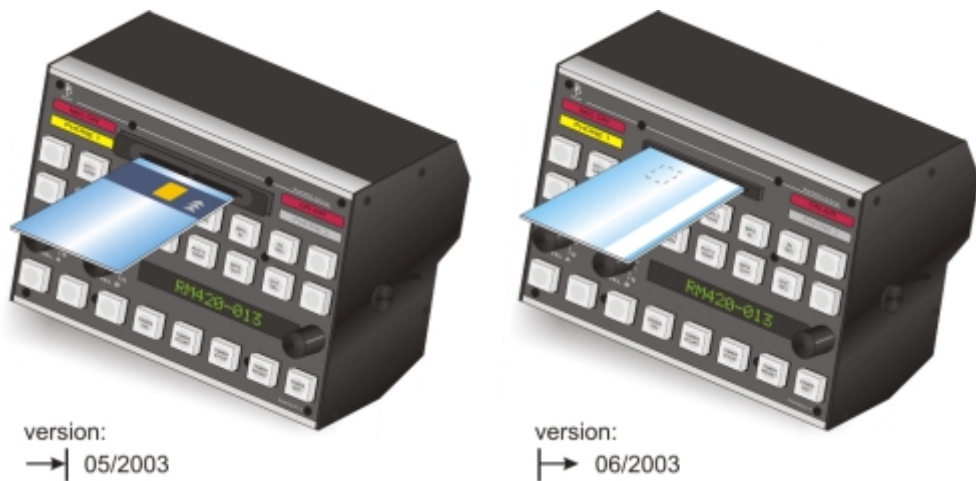


Figure 3-46: Two versions of card readers: With electromechanical eject mechanism, chip on top (left), and with manual removal of the card, chip on bottom (right).

## Part III: Toolbox 4 Configuration Reference

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**Note:** The characters displayable with the LED ASCII digit display available on the RM4200D are defined in the font of the used Osram SLG2016 Displays and can not be changed.

### 7. Configuring the Audio System

In the node *Audio System* of the project tree, you can configure the audio functions of the RM4200D. First, select the node of the desired Device. Now several tabs and further sub-branches are available in the project tree to set up the various options. The options are described in this chapter; you find the general description of the functions in the volume *System Reference* of this manual.

#### 7.1 Monitor Functions – Options for Monitoring

In this tab you define how the monitor system of the RM4200D is performing.

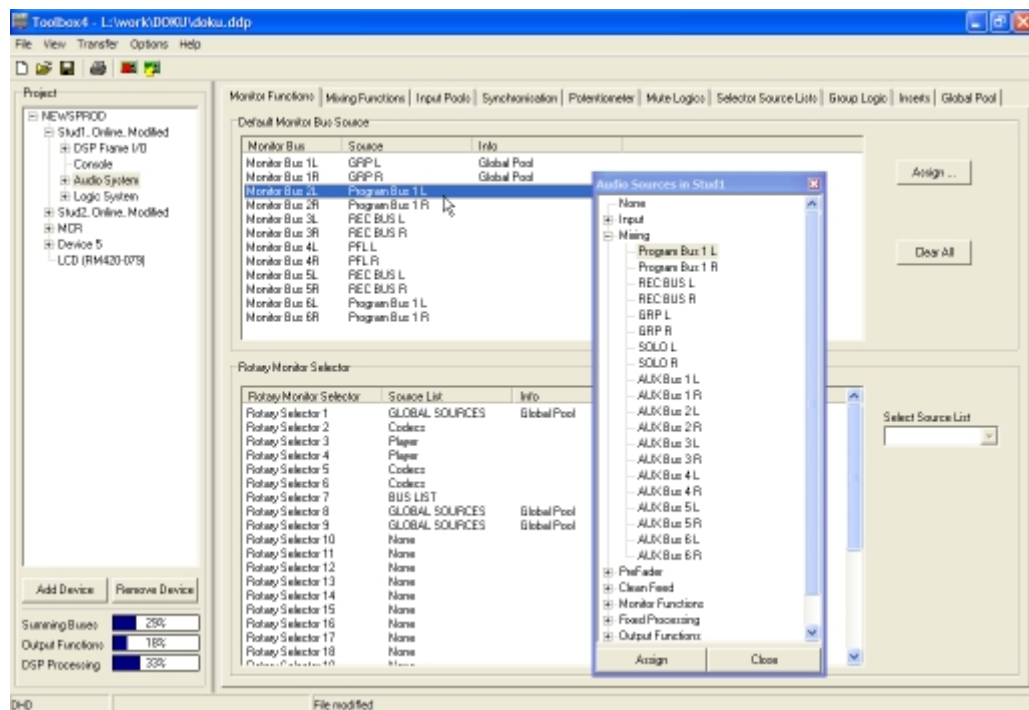


Figure 3–47: Monitor Functions, assigning the audio sources.

#### Default Monitor Bus Source

Here you can configure for the individual monitor buses which audio signal should be used as default source. This source is put on the appropriate bus after switching on the RM4200D or after a reset. It is also active when no monitor key is activated. (If you press an active key again, the assigned source is deactivated and the monitor bus receives the preset signal again.)

For each Monitor Bus 1 . . . 6 you can select the desired signal in the column Source separately. You can use any signal available on the TDM bus. The preset value is *Program Bus 1*; to mute the bus, you have to select *None* as audio source.

In order to assign an audio source, first click on the row with the desired monitor bus. (You can also double click the row to open the *Audio Sources* Window.)

In the *Audio Sources* Window select the desired audio source. Then click the button *Assign*, to assign the source. Alternatively, you can also select the desired source by double clicking or by Drag&Drop.

If there is a Global Pool Line reserved for a monitor bus, there is a label `Global Pool` in the column `Info`. (See also “Global Pool Lines - Using Pool Signals between several Devices” on page 152.)

The button `Clear All` sets all *Default Monitor Bus Sources* to `None` (Mute).



**Note:** If you define a preset source for a monitor bus, but do not assign a key to this source, the signal is switched on “in the background”, no key is shining. To avoid any misunderstanding for the user, you should configure *no* monitor key just for *Audio Source = None!*

### Rotary Monitor Selector

Here you can assign a *Source List* to each *Rotary Monitor Selector* used in the configuration. Up to 10 different lists with a total of 150 entries are available. You can assign the selectable sources of the signal lists under *Audio System/Selector Source Lists*. (See also “Selector Source Lists” on page 143.)

You can distribute the 10 signal lists arbitrarily to the *Rotary Monitor Selectors* and the *Output Selectors* of the *Clean Feed System*. (See also next section, *Mixing Functions*).

To assign the signal list, first mark the desired *Rotary Monitor Selector* and then select the desired list from the drop down menu *Select Source List*.

If there is a Global Pool Line reserved for a Rotary Monitor Selector, there is a label `Global Pool` in the column `Info`. (See also “Global Pool Lines - Using Pool Signals between several Devices” on page 152.)

## 7.2 Mixing Functions – Configuring Internal Buses

In this window you can configure the number of used *summing buses*, *AUX Buses*, the *Talk functions* and special functions of the *Clean Feed System*. Please note that the Clean Feeds also claim *Summing Bus* resources, if they are activated for the *Fader Channels*. (See also “Fader Channels – Configuring Signal Sources for Faders” on page 159.)



**Note:** In general, all summing buses are internally computed in *stereo*, but they can also be computed by mono summation of the left and the right channels. It is *impossible* though to get two mono summing buses out of one stereo summing!

Furthermore, the Dual MADI Modules RM420-422S occupy some channels on the TDM bus system that are normally used for buses. For this reason, the configuration of these modules can influence the bus load. (See also “MADI Modules – Option on DSP Boards” on page 73.)

The following table shows how many buses you can use with the different combinations of DSP Modules with Dual MADI Modules. This number is available for summing buses, AUX buses and Clean Feed buses. In addition, the PFL bus occupies one bus in each combination, no matter if you use it or not. The PFL bus is automatically added to each configuration.

Possible Combination				No. of Buses = PFL-BUs + Available Buses		
Var.	RM420-848L per 16 Buses	RM420-848M per 16 Buses	RM420-848M + RM420-422S per 10 Buses	Number of Buses	PFL Bus	Usable Buses Summing Buses + Aux Buses + Clean Feeds
A	1			16	1	15
B	2			32	1	31
C		1		16	1	15
D		2		32	1	31
E		3		48	1	47
F		0	1	10	1	9
G		0	2	20	1	19
H		1	1	26	1	25
I		0	3	30	1	29
K		1	2	36	1	35
L		2	1	42	1	41



**Important Note:** The number of all configured buses may only be *smaller or equal* to the number of the usable buses as given in the table!

During the configuration process, below the project tree, the load of the summing buses is constantly updated in the bar graph `Summing Buses`.



**Note:** In general, sums can be used up to 100% without any limitation.

If the load goes beyond 100%, the color of the bar changes from blue to red. In this condition, if you try to load the configuration into the Device, the following error message is displayed: `Too many summing buses with the suggestion: Please remove some.`

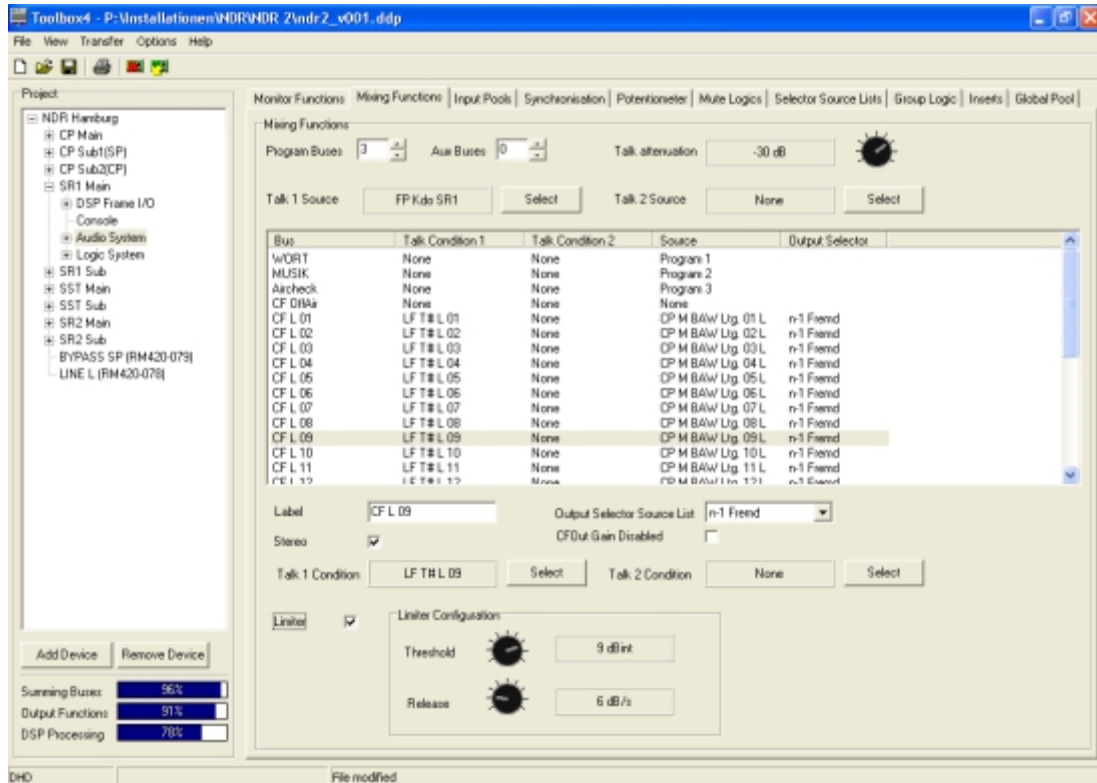


Figure 3–48: Mixing Functions, configuration dialog.

Functions located in the upper part of the tab `Mixing Functions` are general settings and valid for all summing buses, the functions below the list are valid for the summing bus currently selected.



**Note:** In the list with the summing buses *Clean Feeds* are displayed, too. But they are not configured in this tab but in the corresponding *Fader Channel*. (See “Fader Channels – Configuring Signal Sources for Faders” on page 159.)

The column `Source` of the list for summing buses is for information only and illustrates the pre-defined names of the summing buses. For *Clean Feeds* the name of the input signal of the *Fader Channel* is used to which the *Clean Feed* is configured.

In the `Audio Sources Window`, the configured summing buses are available as sources for all DSP functions of the RM4200D. Each summing bus occupies two channels (L,R) on the TDM-Bus. You find the *Program Buses* and *Aux Buses* in the `Audio Sources Window` under `Mixing`, *Clean Feeds* under `Clean Feed`.



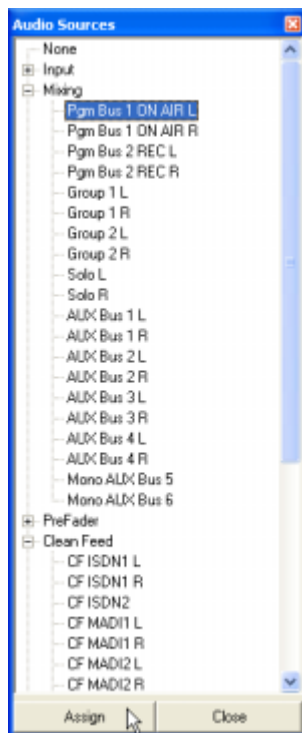


Figure 3–49: Audio Sources Window, summing buses as audio sources.

### Program Buses

Here you can adjust the number of program buses used. It can be configured between 0 and 47. Program buses are always fed *after* the fader; with their help you can create channel groups and implement solo functions.

### Aux Buses

Here you can adjust the number of AUX buses used. It can be configured between 0 and 47.

AUX buses can be used “Pre” or “After” the fader, the AUX Gain per channel can also be adjusted. This is not adjusted in the Toolbox4 software, though, but at the Console of the RM4200D.

### Talk

It is possible to talk into the summing bus using up to two signal paths. You can select these two signals at *Talk 1 Source* and *Talk 2 Source*. Any signal available on the TDM bus can be used as signal source for the Talk function. Mostly it is a microphone signal using a *Fixed Processing* (with compressor and limiter). Both *Talk Sources* are summed with the signal of the summing bus. The latter can be attenuated or switched off using the parameter *Talk Attenuation* between 0dB and Off (mute) in steps of 1dB.

To select the Talk signal source, first mark the desired bus in the list and then click the corresponding button *Select*. The *Audio Sources* Window opens and is active and you can select the desired audio source. You assign the source with the button *Assign*, alternatively you can double click the source or use Drag&Drop.



**Note:** The signals for *Talk Source 1* and *Talk Source 2* are identical for all summing buses, also the attenuation setting *Talk Attenuation*.

## Part III: Toolbox 4 Configuration Reference

For each configured bus, you can assign two logic sources *Talk 1 Condition* and *Talk 2 Condition*, which activate the *Talk* function. By default, the *Talk Condition* is *None* for all buses. If this is not changed, talk into a summing bus is not possible.

To select the logic sources, first mark the desired bus in the list and then click the corresponding button *Select*. The *Logic Sources* Window opens and is active and you can select the desired logic source. You assign a source with the button *Assign*, alternatively you can also double click on the source or use *Drag&Drop*.



**Note:** If this talk function is not flexible enough for your application, you can program more complex talk functions using *Output Functions*. (See also “*Output Functions*” on page 169.)

You can use any logic source available in the system as *Talk Condition*, as illustrated in the following examples:

Logic Source	Application Example
<ul style="list-style-type: none"> <li>• <i>Clean Feed/CF Talk CF&lt;name&gt;</i></li> <li>• Triggered by the key function <i>Talk CF</i> in the Fader Module.</li> </ul>	<ul style="list-style-type: none"> <li>• If a <i>Talk</i> key is defined in the Fader Module that is to talk only into the Clean Feed return signal.</li> <li>• Reasonable when working with many outside lines, codecs and telephones.</li> </ul>
<ul style="list-style-type: none"> <li>• <i>Fader Function/FF &lt;Fader Channel Name&gt;</i></li> <li>• Triggered by the key function <i>Fader Function</i> in the Fader Module.</li> </ul>	<ul style="list-style-type: none"> <li>• If a <i>Fader Function</i> key is defined in the Fader Module that is to talk into the Clean Feed return signal and if a Fader Channel with active Clean Feed is switched to the fader.</li> <li>• For microphones, this key can be used for talking into the corresponding head phone. (Programmed using <i>Output Function</i>.)</li> <li>• For playout devices, this key can be used for remote start and other applications (e.g. routing of the <i>Fader Function</i> to a GPO).</li> </ul>
<ul style="list-style-type: none"> <li>• <i>RM420-0xx/KEY&lt;nr&gt; &lt;name&gt;</i></li> <li>• Triggered by any key of a Control Module.</li> </ul>	<ul style="list-style-type: none"> <li>• Reasonable when working with just a few lines, codecs and telephones.</li> <li>• For talking into program buses and AUX buses.</li> </ul>

Logic Source	Application Example
<ul style="list-style-type: none"> <li><i>Logic Functions/LF</i> &lt;name&gt;</li> </ul>	<ul style="list-style-type: none"> <li>A key of the Control Module is linked to the On Air state of the mixer in a way that talking into the program buses is only possible if the mixer is not On Air.</li> </ul>
<ul style="list-style-type: none"> <li><i>PFL/PFL</i> &lt;Fader Channel name&gt;</li> <li>Triggered by the key function <i>PFL</i> in the fader strip.</li> </ul>	<ul style="list-style-type: none"> <li>If the <i>PFL</i> function is used to talk into the return lines of telephones, outside lines or codecs at the same time without pressing another key.</li> </ul>



**Note:** The key function *Clean Feed Cut* configurable in a Fader Module works *before (pre)* the *Talk* function. This means that talking is also possible with Clean Feed signal switched off.

### Label

In this input field, you can enter a new name for the bus selected in the list or change it. Instead of the pre-defined name, this label is displayed in the `Audio Sources` Window under `Mixing/Busname L, R`. In addition, the name of the bus in the first column of the list changes, too.

### Output Selector Source List

The function *Output Select* offers a flexible opportunity to supply the return circuit of a bus with another signal than the *Clean Feed*. This way, an alternative signal instead of the Clean Feed can be feed in. This feed happens before the functions *Clean Feed Cut* and *Talk*.

You can determine from which signal list the alternative signal for a certain Clean Feed bus should come. To achieve that, first mark the desired bus in the list, then select the desired signal list from the drop down menu `Output Selector Source List`.

In total, there are up to 10 different *Source Lists* in which you can select up to 150 sources. These 10 lists are also used for the *Rotary Monitor Selectors*. You can change the assignment of the signals to the lists under *Audio System/Selector Source Lists*. (See “Selector Source Lists” on page 143.)

In order to use an alternative signal, the following steps are necessary:

1. *Switching between the Clean Feed and alternative signal:* First, configure a key with the function *Output Select* in the Fader Module. This key can switch between the Clean Feed signal and the Output Selector Source List and at any time displays the status of the function to the user. If this key can not be made available in the Fader Module, switching must be carried out with ACCESS and a key *System Function/CF Out* in the Control Module defined in the second level of the function *CFOutSelect*. (See also “CF Out” on page 101.)
2. *Selection of the alternative signal:* Configure an *Encoder Function Output Select*, if a Fader Overbridge RM420-023 or a Fader Module RM420-029 is available. Please note that on the encoder display, only 4 digits are displayed – name the sources of the assigned *Selector Source List* accordingly. If there are no separate encoders available for this function, you can control these using ACCESS and a corresponding key in the Control Module. The key must be assigned to the func-

tion *System Function/CF Out* and then can operate the function *CFOutSelect* in the 3rd menu level. In this case, in a display of a Control Module, up to 8 characters can be displayed. (See also “CF Out” on page 101.)



**Tip:** If the assigned signal list contains only a single signal, the configuration of the 2nd step can be dropped. Then, you can start immediately switching between the Clean Feed and the alternative signal in step 1.

#### Examples:

- With this function, you can switch between an original and its associated Clean Feed signal. To achieve that, you have to define the source *Mixing/Program Bus 1* in the assigned signal list as the alternative signal. This is the „original signal“!
- You can use a reference tone signal. To achieve that, you have to define a *Fixed Processing* with a *Sine* generator and enter it in to the assigned signal list. (See also “Fixed Processing – Defining Fixed DSP Functions” on page 178.)
- You can output the Clean Feed of another Fader Channel. To achieve this, you have to enter this particular channel into the assigned signal list. Of course you can enter the Clean Feed signals of all Fader Channels into the list and let the user pick the desired one.
- If you assign a Clean Feed to a recording device like DAT, Tape or MD, you can carry out an output routing using the corresponding signal list. That way, you could for instance record a source directly while using the RM4200D for a different production task. However, a summing bus is consumed. Alternatively, for this application, the Rotary Monitor Selectors, the PC Routing Software or the routing functions of the keyboard are available.



**Note:** The selection of sources from an Output Selector Source List is *always* carried out with the Main Rotary Control of the Control Module selected with the ACCESS key or with the encoder assigned to the fader strip. Console keys can *not* be used to select sources.

#### Limiter

A simple limiter can be used in each summing bus that does not consume any additional DSP resources. For this function, check the checkbox *Limiter*.

The *Threshold* of a limiter can be adjusted in a range between -30 dBint and +20 dBint, the decay time *Release* between 3 dB/s and 2 dB/s. The attack time can not be adjusted and is always “fast”.

The pre-defined setting of the *Threshold* is +9 dBint, since this level corresponds to 0 dBFS or maximum level for digital outputs with 9 dB headroom. Internal over modulation is limited this way.



**Note:** This limiter is part of the summing bus system and can *not* be adjusted using the DSP Control Software RM420-551 Access. The limiter is not a Fixed processing!

If further limiters are needed (e.g. a transient limiter), you can insert it as separate Fixed Processings after the sums. In this case, you should switch off the simple limiter here. (See also “Fixed Processing – Defining Fixed DSP Functions” on page 178.)

### Stereo

In general, all summing buses are computed *stereo* for internal use, but they also can be used *mono* by mono summation (-3 dB) of the left and right channels. Switch off the checkbox `Stereo` to activate the mono summation. After that, the bus is displayed in the `Audio Sources` Window under the node `Mixing` as entry labelled `Mono <Busname>` only.



**Note:** Clean Feeds are internally created as stereo signals, too. It does not matter whether the source of the Fader Channel of the Clean Feed is mono or stereo.

If in a configuration a bus is to be used *mono and stereo* at the same time, the mono signal must be created using an Output Function.

### 7.3 Input Pools – Properties

In this tab, you can define *Input Pools* and name them. Input Pools are used to alternatively use different sources on faders. To switch between the available signals, the functions *Input Select* or *ACCESS Input Select* are available.

You define the assignment of the sources to the individual Input Pools under *Audio System/Fader Channels*. (See also “Fader Channels – Configuring Signal Sources for Faders” on page 159.)

A pool named `Pool 1` is pre-defined in the dialog. You can create further pools using the button `Add` or delete them with the button `Remove`. A maximum of 15 different pools can be defined.

To change the name of a pool, select it in the list and then change its name in the field `Label`. The name can have a maximum length of up to 7 characters; it is displayed in the display of the Control Modules RM420-010/011/012/013, if *Input Select* or *ACCESS Input Select* was activated in a Fader Module.



**Note:** To be as flexible as possible for fader assignment during operation of the RM4200D, you should configure *only one* Input Pool.

### 7.4 Synchronisation

In this tab, the different synchronisation options for RM4200D are configured.

You can set the `System Sample Rate` to *48 kHz* or *44,1 kHz*.





**Important Note:** Even if the RM4200D works with *external* synchronisation, you must adjust the correct sampling rate here, since otherwise the internal quartz PLL can not lock properly to the external clock.

You can define the two synchronisation sources `Sync Source 1` and `Sync Source 2`. The option configured under `Sync Source 1` is the primary synchronisation source. If this fails, the system automatically switches to the source configured under `Sync Source 2`. If this also fails, the system switches to the internal clock of *48 kHz* or *44,1 kHz*.

## Part III: Toolbox 4 Configuration Reference

The following options are available for synchronisation:

Configuration of the module in Slot 10	Configuration in Slots 1-8	Available Sync Source 1, 2	Function
RM420-848M or RM420-848L or RM420-848M + RM420-424S	At least one Digital I/O Module RM420-111	Internal	Internal synchronisation source 48 kHz or 44,1 kHz.
		AES <Slot.Port:Label>	Synchronisation is generated from the incoming AES data, if the AES signal on this input is valid.
		BNC	TTL wordclock input 48 kHz or 44,1 kHz.
RM420-848M + RM420-421S	At least one Digital I/O Module RM420-111	Internal	Internal synchronisation source 48 kHz or 44,1 kHz.
		AES <Slot.Port:Label>	Synchronisation is generated from the incoming AES data, if the AES signal on this input is valid.
		BNC	TTL wordclock input 48 kHz or 44,1 kHz.
		MultiChannel	The synchronisation is generated from the incoming MADI data stream if a valid MADI signal is attached.
RM420-848M + RM420-422S	At least one Digital I/O Module RM420-111	Internal	Internal Sync source 48 kHz or 44,1 kHz.
		AES <Slot.Port:Label>	Synchronisation is generated from the incoming AES data, if the AES signal on this input is valid.
		BNC	 <b>Important Note:</b> This option can not be used, since the BNC socket is not available for space reasons!
		MultiChannel MADI 1	The synchronisation is generated from the incoming MADI data stream of MADI port 1 (top) if a valid MADI signal is attached.
		MultiChannel MADI 2	The synchronisation is generated from the incoming MADI data stream of MADI port 2 (bottom) if a valid MADI signal is attached.
RM420-848M+R M420-422S <i>Option for redundant MADI (See “Redundant MADI” on page 74.)</i>	At least one Digital I/O Module RM420-111	Internal	Internal Sync source 48 kHz or 44,1 kHz.
		AES <Slot.Port:Label>	Synchronisation is generated from the incoming AES data, if the AES signal on this input is valid.
		BNC	 <b>Important Note:</b> This option can not be used, since the BNC socket is not available for space reasons!
		MultiChannel	The synchronisation is generated from the incoming MADI data stream of MADI port 1 (top) if a valid MADI signal is attached. If the MADI signal on port 1 is invalid, the system switches to port 2 (bottom) automatically if a valid MADI signal is available there.



Note: If you configure a digital input of a RM420-111 module as synchronisation source, it is irrelevant, if this input has its sample rate converter activated or not. (See also “DSP Frame I/O — Configuring the DSP Frame” on page 70.)



**Important Note:** Please consider the following restrictions when connecting the RM4200D to external synchronisation sources:

- In order to make the Quartz PLLs used for external synchronisation work correctly, the external clock signals must work stable in a range of  $\pm 75$  ppm around the selected sampling rates of 48 kHz or 44,1 kHz respectively.
- External synchronisation signals can only be connected to the slots 1 to 10, synchronisation using the slots 11 to 30 is not possible!
- If MADI interfaces are used, the interconnected systems must use the same clock signal!
- If *three modules RM420-422* are used together, they can only be synchronized from MADI, AES3/EBU or internally. This is caused by the fact that on the module RM420-422 (Dual -MADI) there is no space for a BNC socket.

With the checkbox `Slot 10 BNC as Output` the function of the BNC socket on slot 10 is determined. If this option is active, the BNC socket on slot 10 works as TTL wordclock output. This is only possible if none of the two synchronisation sources uses the option `BNC`. In this case, the BNC socket works as an input!

In contrast, the BNC sockets of the slots 20 and 30 are *always* defined as TTL wordclock outputs and can e.g. synchronise local sources. Basically, all TTL wordclock outputs, all AES3/EBU digital outputs and all MADI outputs work with the same system sample frequency, depending on configuration and status of `Sync Source 1` and `Sync Source 2`.

In a DSP frame with several DSP modules, each module uses its own synchronisation. In this case the modules in backplane 2 and 3 synchronise themselves to the module in backplane 1 as “Master”. Under most circumstances, this works without problems and you do not need to worry about it.

However, if the DSP frame uses several backplanes and at least one external synchronisation source *simultaneously*, things are a bit different: On rare occasions and under certain circumstances there can be synchronisation problems, when the synchronisation source is switched.

If you experience such effects, activate the checkbox `Disable VCXO on BP2/3`. This disables the quartz PLL on backplanes 2 and 3, which increases the tolerance for synchronisation. Activate this option, if you need to minimize distortions on the outputs of backplanes 2 and 3 when switching the synchronization source.



**Important Note:** Backplane 1 is always the synchronisation “Master”, backplanes 2 and 3 are “Slaves” and need to synchronize themselves to the Master.

If backplane 1 itself gets its synchronisation from an external source and this source fails, it will switch over to its second synchronisation source, `Sync Source 2`. After that, the backplanes 2 and 3 in turn need to synchronise themselves again, but only *after* the signal on backplane 1 has become stable again. This whole process takes some time.

While backplane 1 is switching its synchronisation source and stabilizing itself again, the audio links between backplane 1 and 2 and backplane 1 and backplane 3 are cut. This happens only for a few milliseconds, until the system has synchronized itself again completely. During this time, distortions may happen on the audio links and the DSP frame may give warning messages about the state of the audio links. Also, D/A converters and AES3/EBU outputs on backplanes 2 and 3 may output distortion noise. The reason for that is the re-synchronisation of the system. The Option `Disable VCXO on BP2/3` shortens the time necessary for this process by setting the PLL to a much shorter adjustment time than usual.

However, you should activate this option only if the DSP frame contains more than one backplane, if it is synchronized from an external signal *and* if you are experiencing problems when switching synchronisation. If this is not the case, do not change anything!

Activate the checkbox `Varispeed`, to synchronize the systems to an external clock with a variable frequency between 40 kHz and 48,2 kHz.



### Configuration Examples

The following table contains some examples for the different synchronisation options:

Sync Source 1	Sync Source 2	Application
Internal	Internal	<ul style="list-style-type: none"> <li>• RM4200D as “Stand-alone” system with internal clock supply.</li> </ul>
BNC	Internal	<ul style="list-style-type: none"> <li>• Synchronisation on incoming TTL wordclock, RM4200D and its digital outputs work synchronously to the external clock.</li> <li>• On failure of the incoming TTL wordclock, the system works with the internal clock source.</li> </ul>
AES <1.1.01:CD>	Internal	<ul style="list-style-type: none"> <li>• Synchronisation on the AES input on Slot 1, Port 1 (here carrying the label “CD”). The RM4200D and its digital outputs work synchronously to the incoming AES signal.</li> <li>• On failure of the incoming AES signal, the system works with the internal clock source.</li> </ul>
MultiChannel	Internal	<ul style="list-style-type: none"> <li>• Synchronisation on incoming MADI-Signal, RM4200D and its digital outputs work synchronously to the incoming MADI signal.</li> <li>• On failure of the incoming MADI signal, the system works with the internal clock source.</li> </ul>
MultiChannel	BNC	<ul style="list-style-type: none"> <li>• Synchronisation on incoming MADI-Signal, RM4200D and its digital outputs work synchronously to the incoming MADI signal.</li> <li>• On failure of the incoming MADI signal, the system works with the incoming TTL wordclock.</li> </ul>
MultiChannel	AES <1.1.01:CD>	<ul style="list-style-type: none"> <li>• Synchronisation on incoming MADI-Signal, RM4200D and its digital outputs work synchronously to the incoming MADI signal.</li> <li>• On failure of the incoming MADI signal, the system works with the AES input signal on Slot1, Port1 (here carrying the label “CD”).</li> </ul>
BNC	MultiChannel	<ul style="list-style-type: none"> <li>• Synchronisation on incoming TTL wordclock, RM4200D and its digital outputs work synchronously to the incoming TTL wordclock.</li> <li>• On failure of the incoming TTL wordclock, the system works with the incoming MADI signal.</li> </ul>

*Example:* Several RM4200D are connected via MADI, synchronisation over MADI:

RM4200D Device	Sync Source 1	Sync Source 2	Description
Central matrix	Internal	Internal	<ul style="list-style-type: none"> <li>Internal system clock of the central matrix is distributed over MADI to the 3 connected mixers, central matrix is Sync Master.</li> <li>Mixers 1 to 3 are Sync Slaves.</li> </ul>
Mixer 1	MultiChannel	Internal	
Mixer 2	MultiChannel	Internal	
Mixer 3	MultiChannel	Internal	

*Example:* Several RM4200D are connected via MADI, synchronisation over MADI, the central matrix is supplied with TTL wordclock from in-house clock using a BNC socket:

RM4200D Device	Sync Source 1	Sync Source 2	Description
Central matrix	BNC	Internal	<ul style="list-style-type: none"> <li>TTL wordclock connected to central matrix over BNC; distributed over MADI to the 3 connected mixers. Central matrix is Sync Master for the clock distribution over MADI.</li> <li>Mixers 1 to 3 are Sync Slaves.</li> </ul>
Mixer 1	MultiChannel	Internal	
Mixer 2	MultiChannel	Internal	
Mixer 3	MultiChannel	Internal	

*Example:* Several RM4200D are connected via MADI. The clock is centrally distributed using TTL wordclock.

RM4200D Device	Sync Source 1	Sync Source 2	Description
Central matrix	BNC	Internal	<ul style="list-style-type: none"> <li>TTL wordclock is connected to the central matrix and to 3 mixers over the central clock distribution.</li> <li>Central matrix and mixers 1 to 3 are Sync Slaves.</li> <li>If the central clock distribution fails, the system is synchronised via MADI. The central matrix becomes Sync Master for Mixers.</li> </ul>
Mixer 1	BNC	MultiChannel	
Mixer 2	BNC	MultiChannel	
Mixer 3	BNC	MultiChannel	

### 7.5 Potentiometers

In order to control levels in the *Output Functions*, up to 122 potentiometer functions can be used in the RM4200D. These potentiometers are used for adjusting the volumes of monitors and headphones, for talk back functions, setting AUX sends and other functions.

The potentiometers can be used in *Output Functions only*; and also only if they are previously configured and named on the tab `Potentiometer`.

A potentiometer is linked to an audio signal and can influence its level. There are different options to control the 122 different potentiometers:

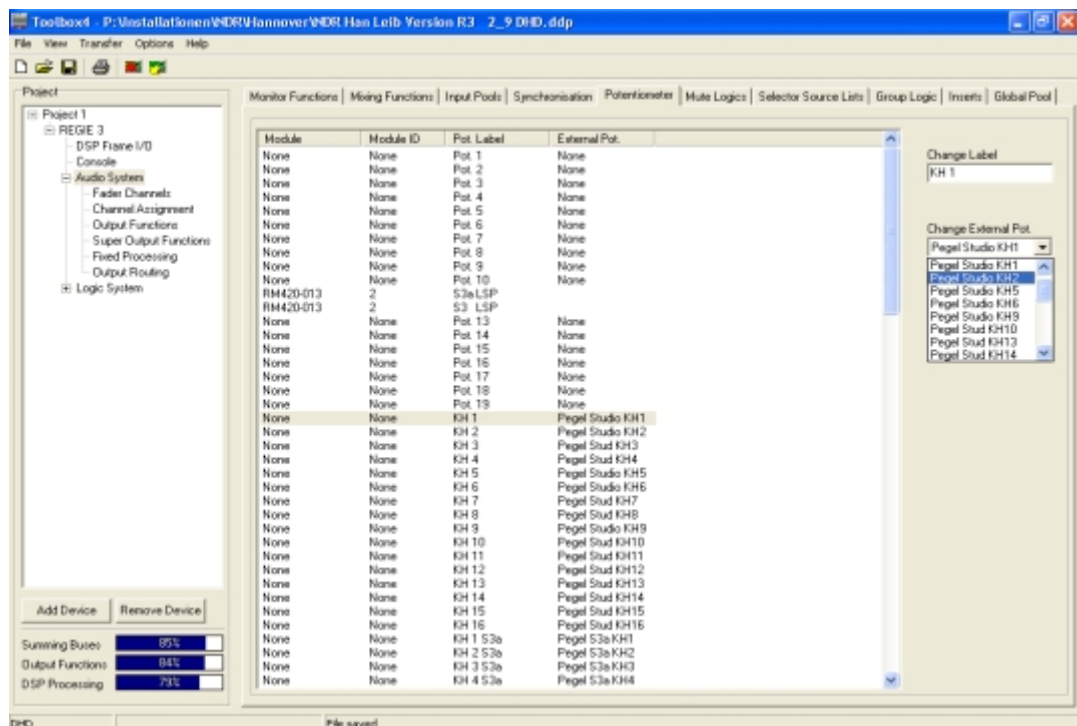
- *Potentiometers of the Control Modules:* These can be labelled with a name different from the pre-defined one, configuration itself is carried out

automatically when inserting the *Control Modules* in a *Device*. (See also “Control Modules and List of Functions” on page 99.)

- *External Potentiometers using Analog Control Inputs (ACI)*: These are configured here and can be labelled different from the pre-defined name. Before that, the GPIs of the modules RM420-122 must be configured. (See also “Configuring GPIO connectors” on page 76.)
- *Potentiometer using key, rotary encoder and display of the Control Module*: These are configured here and *must be labelled different from the pre-defined name, only afterwards* they can be assigned to the key of a Control Module.



**Important Note:** Please comply to the described order of configuration of potentiometers for rotary encoders!



**Figure 3–50: Potentiometer, assigning an Analog Control Input (ACI) to a potentiometer.**

As shown in the figure, each of the 122 available potentiometers is represented by a line in the list, it can be selected by clicking on it.

### Potentiometers of the Control Modules

The Control Modules RM420-010, RM420-011, RM420-012, RM420-013, RM420-026 each have some conventional analog potentiometers. The values of the analog potentiometers are read in by the microcontroller of the Control Module and then digitised. Although the potentiometers have a fixed label on the front cover, they can be used arbitrarily. Control Modules with the module IDs 1 to 12 are possible for each RM4200D Device.

A Control Module can contain up to 10 potentiometers, these are assigned according to the module type as follows:

Control Module	Item number of the potentiometer per Module ID	Potentiometer name pre-labelled on Modules
RM420-010	1	Monitor
	2	Headphone
RM420-011	1	Monitor
	2	Headphone 1
	3	Headphone 2
RM420-012	1	Monitor
	2	Headphone
	3	Level 1
	4	Level 2
RM420-013	1	Level A
	2	Level B
RM420-026	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8



**Important Note:** The potentiometers of the Control Modules RM420-010, RM420-011, RM420-012, RM420-013, RM420-026 can *not* be switched for different functions in a Config, since they are *no* incremental encoders but classical analog potentiometers. Furthermore, the cover foils of the modules can *not* be labels in a customer specific way!

In the column `Module` of the potentiometer list, the type of the Control Module is displayed that supplies the corresponding potentiometer with an input value. If the potentiometer is not controlled by a Control Module, it is marked with the type `None`. The corresponding `Module-ID` is displayed in the 2nd column.

To change the name of the potentiometer, first select its entry in the list and then enter the name in the field `Change Label`. Use a descriptive name to ease the configuration of the *Output Functions*.



**Important Note:** When you insert a Control Module into a Config, it *automatically* occupies 10 successive potentiometers depending on its Module ID. The Control Module with the ID “1” occupies the potentiometers between 1 and 10, the one with the ID “2” the potentiometers between 11 and 20 etc. Names that may have been assigned before and external potentiometers are overwritten if they are located in the corresponding places. This happens even if the corresponding Control Module does not use all ten potentiometers!

Therefore, you should *always first* configure all Control Modules *before* assigning external potentiometers and potentiometers using keys.

At present, the Control Modules use a maximum of 8 (RM420-026) of the 10 possible potentiometers. The unused entries are marked `None` in the list and can be used for the following functions.

### **External Potentiometers using Analog Control Inputs (ACI)**

The modules RM420-122 (Mic/Line/Headphone) contain two inputs each for connecting external analog potentiometers. These potentiometers must be *10kOhm linear*.

The values of the external potentiometers are read in by the microcontroller of the DSP frame and digitised. Reading-in depends on the number of all configured ACIs and is carried out every 20 to 320ms.

To control a potentiometer with ACI, you should first name it under `DSP Frame I/O, Show GPIO` according to its function. The name is pre-defined as follows: `ACI <slot-nr>.<plug-nr>.01`. Thus, the name "ACI 3.2.01" refers to the 2nd plug on slot 3. (See also "Configuring GPIO connectors" on page 76.)

Now mark the desired potentiometer in the list and select `Change External Pot.` from the drop down menu and select the desired ACI.

Then, insert a descriptive name for the new external potentiometer in the field `Change Label` to simplify the configuration of the *Output Functions*.



**Note:** You should put external potentiometers at the unused potentiometer entries marked with `None` between two successive module IDs. When inserting a new Control Module, these will not be overwritten for sure!

### **Potentiometers using Key, Rotary Encoder and Display of the Control Modules**

In the Control Modules RM420-010, RM420-011, RM420-012 and RM420-013 potentiometers can be operated using the Main Rotary Encoder and the corresponding display. Therefore, you have to define a key for each wanted potentiometer function. In addition, the balance setting for monitor loudspeakers is available as a special function. You can use a maximum of two balance functions per RM4200D.

To set up a potentiometer, do the following:

1. Select an entry in the potentiometer list and mark it by a mouse click.



**Note:** You should put potentiometers using keys at the unused potentiometer entries marked with `None` between two successive module IDs. When inserting a new Control Module, these will not be overwritten for sure!

2. Now add a name for this potentiometer in the field `Change Label`. This name *must be different* from the previous default name (e.g. "Pot. 42"), otherwise, you can not assign a key in the next step! Add a descriptive name for the potentiometer to simplify the configuration of the *Output Functions*.
3. Configure a Control Module under *Console/Keys* with the function `Potentiometer`. Select the recently created potentiometer as to be controlled. (See also "Potentiometer" on page 109.)



**Important Note:** You can control potentiometers only then from the main rotary encoder if you have previously changed their pre-defined names. Only potentiometers with a changed name are displayed in the drop down menu for the key combination, all the others not!

### Further Notes on Potentiometers

- After a reset using the reset key at the DSP frame or using the Maintenance Window, the potentiometers 1 to 100 are automatically set to a value of -∞ (off), the potentiometers 111 to 120 are set to 0dB. For adjusting the output levels for buses, AUX sends etc., you should use the potentiometers 111 to 120. This is valid for the potentiometers created using keys and rotary encoders. The analog potentiometers and the ACIs become effective immediately after a reset or after switching on. After approx. 1 second, they overwrite the active reset value.
- After switching on and off, the adjusted potentiometer values are kept, in switched off condition for approx. one week.
- If an ACI is configured but not connected, the corresponding potentiometer is set to 0dB.
- For testing the ACIs, you can also assign the potentiometer parallel to the key function *Potentiometer* of a Control Module. After pressing the key, the read in value of the ACI in dB appears in the display. The analog potentiometers available in the Control Modules can be tested easily as well with this method.

## 7.6 Mute Logics

**Mute Logics** are up to five logic buses for “Muting” of loudspeakers at open faders. They are independent from the logic functions.

In this tab, you can rename the `Mute Logics 1...5` to simplify the configuration process. Mark the desired entry in the list and change the name in the field `Label`.

To configure a Mute Logic, do the following:

1. During configuration of the Fader Channels, select which Mute Logic is to be activated by a certain channel as soon as the fader is opened. All channels with the same active Mute Logic are OR-linked. One channel is enough to activate the function. Usually, mostly microphone inputs are coupled with Mute Logics e.g. to then mute the monitor loudspeakers. You can assign several Mute Logics to each Fader Channel by clicking on the appropriate checkboxes under *Audio System/Fader Channels/Output Mute Functions*. (See “Fader Channels – Configuring Signal Sources for Faders” on page 159.)
2. Determine which Mute Logics shall mute which output signals. You can assign several Mute Logics to each output by clicking on the appropriate checkboxes under *Audio System/Output Routing/Mute Logic*. (See “Output Routing” on page 183.)



**Note:** Mute Logics work totally independent from *Output Functions* and *logic functions*. Neither are they available as *logic sources*.

Mute Logics are easy to configure. In case you need more complex muting functions (e.g. key switchable), you can realise this with logic functions and Output Functions.

If you click on the checkbox `PFL activates Mute Logic` the corresponding Mute Logic is also activated if the PFL function in the assigned Fader Channel is active.

### 7.7 Selector Source Lists

In this tab, you can define the `Selector Source Lists` needed for the functions *Output Selector of Clean Feeds* and for the *Rotary Monitor Selectors*.

In total, up to 10 different signal lists with a total of 150 entries are available. For example, 10 lists with 15 entries each or one list with 150 entries can be configured.

To configure a signal list, do the following:

1. Select an entry from the list `Select Source List`.
2. If necessary, apply a descriptive name to the selected signal list in the field `Source List Label`. These names are displayed during the configuration of the functions *Output Selector* and *Rotary Monitor Selector* for selecting the signal list. They will be displayed in the same order as in this list.
3. In the pane `Sources` in the lower half of the dialog, you can now fill the signal list with audio sources or edit it. Each line represents a stereo signal, you can use any signal available on the TDM bus as source. To add a new source, click on the button `Add`. The `Audio Sources Window` opens and is active. To insert a source above the marked line, use the button `Insert`, to delete a line, click on `Remove`. You can also reach all functions using the context menu in the list view. The functions `Add` and `Insert` can not be executed as soon as the list contains 150 entries or more.
4. Assign the desired audio source to the list entry. Therefore, select the desired audio sources for `Source Left` and `Source Right`. Assign these in the `Audio Sources Window` either with the button `Assign`, by double clicking or `Drag&Drop`. When assigning mono sources, you have to assign the same source to both channels.
5. Enter a name for the list entry in the field `Display Text`. This name may have a maximum length of 8 characters.

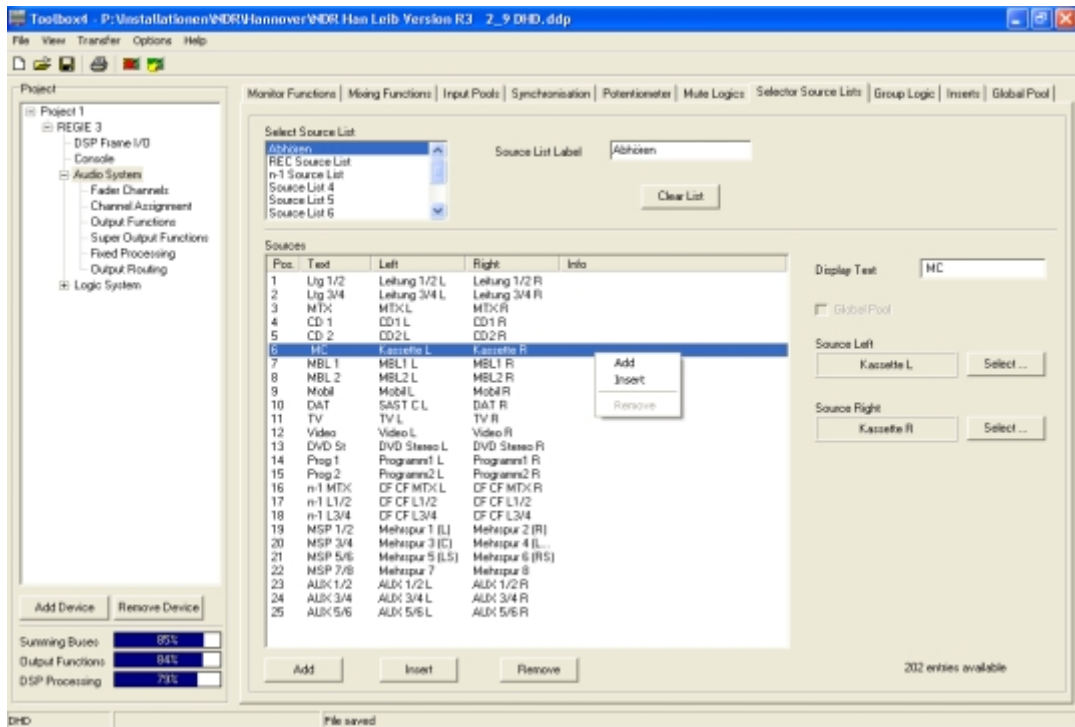


Figure 3–51: Selector Source Lists, configuring signal lists.



**Note:** Please note that the function *Output Select* carried out using the rotary encoder in the Fader Channels can display only 4 digits. 8 characters are only displayed in the display of the Control Modules if *Output Select* is operated via ACCESS.

If you want to change the order of entries you just can do it by Drag&Drop. The button *Clear List* deletes the contents of the selected lists completely!

The last configured positions of the functions *Output Selector* and *Rotary Monitor Selector* are kept after switching the RM4200D on/off, after a reset these are set to Pos. 1 of the list.

### 7.8 Group Logic - Join Channels in Groups



**Important Note:** The group functionality is limited by the system’s architecture and has some deciding disadvantages. It is no longer improved by DHD. For a more comfortable way to group fader signals, please use the **VCA Fader** function instead. To learn more about VCA Faders, proceed to the end of this Group Logic section. (See also “VCA Faders - a flexible alternative.” on page 147.)

You can join the signals of different faders into a group. This group signal in turn is controlled by its own fader, which affects the sum signal of the whole group. You can define up to four groups, associated Clean Feed signals are completely taken into account.





**Tip:** The group function is not used very often. However, if you want to control several microphones together – for instance to record the audience atmosphere at a concert – it is useful.

The creation of groups works like that:

1. For each group you define a separate bus, the **Group Bus**.
2. This bus is assigned as source to a dedicated Fader Channel. This channel becomes the **Group Channel**.
3. Using a key associated to a fader, the signal of this fader is routed off Program Bus 1 and onto the Group Bus.
4. The Group Channel is routed onto a fader. Now you can control the level of the whole group with this single fader.



**Important Note:** Please keep in mind, that putting a signal into a group *always implies* that the signal is removed from Program Bus 1 and routed onto the Group Bus. You should also try to define group functions early in the configuration process. That way you can avoid problems later on when saving Mixer Setups. (Please see below for an explanation.)

To define a group function, do the following:

1. In the project tree, select the node `Audio System` and click on the tab `Mixing Functions`. Create a Program Bus for each group and give it a descriptive name.
2. In the project tree, change to the node `Fader Channels`. Create a new Fader Channel for each group, this will become the Group Channel. Again, give it a descriptive name. Assign the bus signal defined in step 1 as input to the new Fader Channel.
3. Change to the node `Audio System` in the project tree and select the tab `Group Logic`. Use the popup menus to assign the groups to the Fader Channels: For each group, use the popup menu `Group program bus <No.>` to select the bus you have created in step 1. Now, select the associated Group Channel from the popup menu `Group fader channel <No.>`.
4. In the project tree, change to the node `Console`, select the tab `Keys` and click on a Fader Module. Select the key you want to use for switching the fader signal onto a Group Bus. In the popup menu `Function`, select the item `Group Logic`. The pop up menu `Group` appears, select the desired group here. The fader signal will be switched onto this Group Bus when the key is engaged.
5. Download the new Config into the Device.
6. If you want to switch a fader signal onto a group, the Group Bus must be routed to a fader *first*. If this is the case, press the key defined in step 3 on the desired fader strip. Its signal will now be routed onto the Group Bus. Press the key again to remove it from the Group Bus.



**Important Note:** If you switch a signal to a Group Bus, you are effectively removing it from Program Bus 1 at the same time. However, if you did not save any Mixer Setups, all signals are initially routed to all buses. Therefore, if you want the group functions to work properly, you need to assign every defined channel to a fader on the Console once. Follow the instructions of the next steps carefully, otherwise the group functions will not work properly!

7. In the first fader strip, press the Access key. Choose the function `Input Select`. Keep turning the rotary encoder, until every signal in the Input Pool was shown shortly in the LED display. This suffices as assignment, the routing onto the Group Bus happens in the background.
8. In the next fader strip, again press the Access key and choose the function `Input Select`. Turn the rotary encoder one step to the left or right and back again. Now you have prepared the current signal on this fader strip for a potential group function.
9. Repeat step 8 for every fader strip on the Console, until you have initialised all Fader Channels for their group functions.
10. In the `Toolbox4` software, call up the Maintenance Window (key F7). Select the correct Device and store the current state of the Console as Setup 0. Use the command `Save Setup 0` from the menu `Devices`. Select the command `Save Setup 1..6` from the same menu to save the group function for all other Setups, too. Now you can use the routing you have just saved as starting point for all further customisation. Also, this is the reason, why you should save this settings early in the configuration process.



**Important Note:** Please note the following restrictions when using group functions:

- You can *only* route a signal onto a Group Bus when this Group Bus is currently routed onto a fader strip in the Console.
- The group assignment of signals is automatically removed as soon as the Group Bus is “removed” from its fader strip.
- You can not switch a group signal onto its own Group Bus!
- If a Fader Channel is routed to a group, its logic functions will only work, if the fader of the Group Bus is open.
- You *can not* use the group function and the Off Air function *simultaneously*!



**Caution:** If you assigned certain faders to one or more groups, you *can not save this assignment* – neither as Mixer Setup nor as Parameter Setup! Group assignments are “operational only” and therefore can **not** be saved! If you try to save Setups while group assignments are active, these assignments will be cancelled and all signals will be routed back to Program Bus 1. The same happens, if you switch the power of the RM4200D off and on again, the group assignments will be lost. *Therefore, do not store Setups while the RM4200D is On Air!*

### VCA Faders - a flexible alternative.

Due to its restrictions, using the Group Logic is not recommended for some applications. To balance the disadvantages, the VCA Fader function describes a good alternative.

The advantages of VCA Faders are:

- very easy to configure
- switchings to a VCA Fader will be saved in Setups
- the channel's bus routing is not influenced
- more VCA Faders possible than group faders.

Two steps are necessary to create a VCA Fader:

1. *Audio System - Fader channels:* Create a new Fader Channel and assign the desired VCA Fader (1..8) from the `Audio Sources` window.
2. *Console view:* On a fader module, select the key you would like to configure as VCA Switch. Select function `VCA Fader` and choose the correct VCA Fader number.

If you "input select" a VCA fader to the console, its "ACCESS" key starts blinking. This blinking indicates, that the VCA is not active yet. This security mechanism takes care, that no signal is suddenly switched off, which was previously routed to that VCA fader. To activate a newly assigned VCA Fader, press the blinking "ACCESS" key and move the fader potentiometer to 0dB.

### 7.9 Inserts - Patching External Audio Devices into Fader Channels

Use this tab to define insert points or **Inserts** for short. Using inserts, you can patch external processing into the otherwise internal signal path. Inserts are often used for special microphone processing or sound effects.

Typically, the signal path is split before the signal enters the fader strip. The signal is routed to the external device, processed and routed back into the RM4200D. There it is assigned to a fader strip.



**Important Note:** You can define Inserts both for mono and stereo signals. Make sure you are using both options correctly to avoid assigning mono Inserts to stereo signals and the other way round.

The RM4200D provides two different types of Inserts:

- **Fixed Inserts.** These insert points are permanently assigned to a physical *fader strip*. Once defined, the associated signal path is always active, *no matter which Fader Channel signal is currently routed onto the fader strip*. For each fader strip, you can define exactly one Insert.
- **Switchable Inserts.** This type of Insert is similar to a Fixed Insert, with one main difference: Using keys, you can switch it on and off for a given fader strip. Once the Insert is switched on, it will stay active, *no matter which Fader Channel Signal is currently routed to the fader strip*. You can define up to four Switchable Inserts.

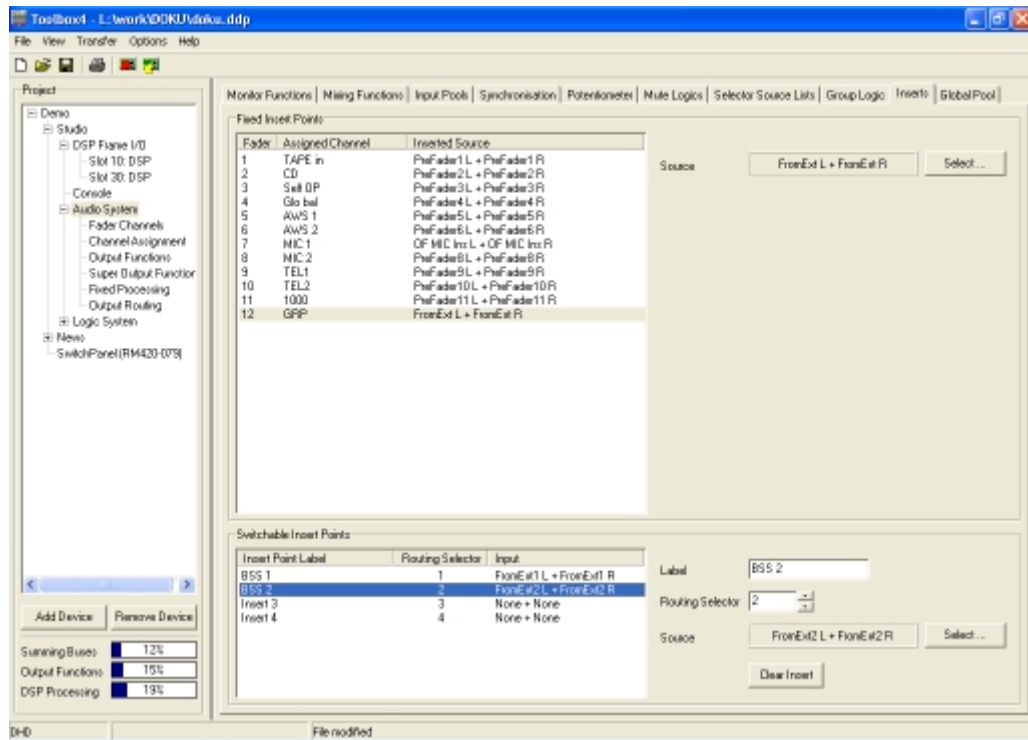


Figure 3-52: Defining Inserts for faders.

### Fixed Inserts

Use the area `Fixed Insert Points` to assign insert points to fader strips. The list shows all available Fader Modules and their associated pre-fader signals in the column `Inserted Source`. The default value for each fader is the pre-fader signal of each fader itself. You can define Fixed Inserts both for stereo and mono signals, the necessary configuration processes are slightly different.



**Important Note:** Fixed Inserts are always associated to certain fader strips. Therefore they are used mostly with audio sources permanently assigned to a fader (“Fixed Fader”) instead of Pool Faders.

### Stereo Insert

To patch an external processing into a stereo signal path, do the following:

1. Connect the input of the external device to an output of the RM4200D. Connect the output of the device to an input of the RM4200D. Remember or write down which in- and outputs of the RM4200D you have used.
2. In the Toolbox4 software, select the node `DSP Frame I/O` of the project tree. Find the input you just connected to the output of the external device. Give a descriptive name to this input, i.e. “FromExt”. You will find the signal in the `Audio Sources Window` under section `Inputs`. Do the same with the output of the RM4200D going to the external device. Give it a name, too, i.e. “ToExt”. (See also “`DSP Frame I/O — Configuring the DSP Frame`” on page 70.)

3. Go to the node `Audio System/Output Routing` in the project tree. Find the output you have just named “ToExt”. As a source for this output, assign the pre-fader signal you want to process. (See also “Output Routing” on page 183.)
4. In the project tree, go to the node `Audio System` and select the tab `Inserts`. Click on the fader you want to associate with an Insert. Click on the button `Select` and choose the return signal “FromExt” from the external device as input for the fader. Now, the pre-fader signal will be routed through the external device before getting into the fader strip.

### **Mono Inserts**

If you want to set up an external processing for a mono signal, do the following:

1. Connect the input (mono) of the external device to an output of the RM4200D. Connect the output of the device to an input of the RM4200D. Remember or write down which in- and outputs of the RM4200D you have used.
2. In the `Toolbox4` software, select the node `DSP Frame I/O` of the project tree. Find the input you just connected to the output of the external device. Give a descriptive name to this input, i.e. “FromExt”. You will find the signal in the `Audio Sources Window` under section `Inputs`. Do the same with the output of the RM4200D going to the external device. Give it a name, too, i.e. “ToExt”. In the column `Mono/Stereo`, make sure you have selected the option `Mono` for each signal. Also, pay attention to the signal pin assignments of the connectors for the RM4200D! (See also “DSP Frame I/O — Configuring the DSP Frame” on page 70.)
3. Change to the node `Audio System/Output Functions` of the project tree. Create a new Output Function, in which you mix left and right channel of the pre-fader signal into a mono signal. This signal is processed by the external device. (See also “Output Functions” on page 169.)
4. In the project tree, change to the node `Audio System/Output Routing`. Find the output you have just named “ToExt” in step 1. As input source for this output, choose the Output Function you have just created. (See also “Output Routing” on page 183.)
5. Create two more Output Functions and name them `<Name>L` and `<Name>R`. As input sources for these functions, use the mono signal “FromExt”, coming back from the external device.



**Important Note:** When you create the Output Functions, the following is essential: The Output Function for the *left stereo channel* must have an *odd number*, the one for the *right stereo channel* must have an *even number*! Also, both Output Functions must follow each other immediately in the list. If you do not comply with these conditions, the signal assignment to the insert points will not work correctly. If necessary, create an additional empty Output Function to get the numbers right.

6. In the project tree, select the node `Audio System` and click the tab `Inserts`. Click on the fader you want to assign an insert to. Click the button `Select` and choose the two Output Functions just defined as input signal for this fader. Now,

the two channels of the pre-fader signal are summed up to one mono signal. This signal is processed by the external device and routed back into the RM4200D. There it is converted back into a stereo signal before it enters the fader strip.



**Note:** You have to use this complicated construction for mono inserts, since input signals for faders *always have to be in stereo*.

### Switchable Inserts

You can define up to four Switchable Inserts. Once defined, you can assign any of them to any fader strip. To do this, you have to define some special keys in the Console first. After that, you just have to press the Access key in the desired fader strip. Now press the defined Insert key in the Console and the insert is assigned to the fader strip. However, you can only assign four Inserts simultaneously at any time!

### Stereo Insert

To configure a Switchable Insert for a stereo signal, do the following:

1. Connect the input of the external device to an output of the RM4200D. Connect the output of the device to an input of the RM4200D. Remember or write down which in- and outputs of the RM4200D you have used.
2. In the Toolbox4 software, select the node `DSP Frame I/O` of the project tree. Find the input you just connected to the output of the external device. Give a descriptive name to this input, i.e. "FromExt". You will find the signal in the `Audio Sources Window` under section `Inputs`. Do the same with the output of the RM4200D going to the external device. Give it a name, too, i.e. "ToExt". (See also "DSP Frame I/O — Configuring the DSP Frame" on page 70.)
3. Select the node `Audio System/Output Routing` in the project tree. Find the output you just named. Assign a free Routing Selector to this output (for example "Routing 1 L/R"). You will find the Routing Selectors in the `Audio Sources Window` in the section `Routing`. Remember or write down the number of the selected Routing Selector. (See also "Output Routing" on page 183.)
4. In the project tree, select the node `Audio System` and click the tab `Inserts`. In the area `Switchable Insert Points` click the Insert you want to configure. Enter a descriptive name for it in the field `Label`.
5. In the field `Routing Selector`, select the Routing Selector you have assigned in step 3. This Routing Selector now works as "Send" output to the external device.
6. In the field `Source`, select the input "FromExt" you have defined in step 1. That way the "Return" signal of the external device is routed back into the signal path.
7. Select the node `Console` in the project tree. Click on the tab `Keys` and select a Fader Module or Control Module. (See also "Console – Configuring the Console" on page 78.)
8. Select a key from the module. In the pop up menu `Function` select the value `ON/OFF Function`. From the pop up menu `Subfunction` choose the value `Insert`. Finally a third pop up menu appears, select the desired Insert from it.

9. Set the colors for the different key states. Upload the new Config into the Device.

Now you can use the Switchable Inserts like this:

First, press the key Access in the desired fader strip. Second, press the Insert key you just defined. The input signal for the fader is now routed through the Insert path. To deactivate the Insert, repeat the procedure.



**Note:** If you configure the Insert key within a fader strip, a single press on this key will activate and deactivate the Insert.

### **Mono Insert**

Switchable Mono Inserts are similar to Fixed Mono Inserts. Like there, Output Functions are used to create the mono signal. Schaltbare Mono-Inserts ähneln den Fixed Inserts mit Monosignalen.

To define a Switchable Mono Insert, do the following:

1. Connect the input (mono) of the external device to an output of the RM4200D. Connect the output of the device to an input of the RM4200D. Remember or write down which in- and outputs of the RM4200D you have used.
2. In the Toolbox4 software, select the node `DSP Frame I/O` of the project tree. Find the input you just connected to the output of the external device. Give a descriptive name to this input, i.e. "FromExt". You will find the signal in the `Audio Sources Window` under section `Inputs`. Do the same with the output of the RM4200D going to the external device. Give it a name, too, i.e. "ToExt". In the column `Mono/Stereo`, make sure you have selected the option `Mono` for each signal. Also, pay attention to the signal pin assignments of the connectors for the RM4200D! (See also "DSP Frame I/O — Configuring the DSP Frame" on page 70.)
3. Change to the node `Audio System/Output Functions` of the project tree. Create a new Output Function, in which you mix left and right channel of a free Routing Selector (for example "Routing 1 L/R") into a mono signal. You will find the Routing Selectors in the `Audio Sources Window` in the section `Routing`. Remember or write down the number of the Routing Selector. (See also "Output Functions" on page 169.)
4. In the project tree, change to the node `Audio System/Output Routing`. Find the output you have just named "ToExt" in step 1. As input source for this output, choose the Output Function you have just created. This signal is processed by the external device. (See also "Output Routing" on page 183.)
5. Create two more Output Functions and name them `<Name>L` and `<Name>R`. As input sources for these functions, use the mono signal "FromExt", coming back from the external device.



**Important Note:** When you create the Output Functions, the following is essential: The Output Function for the *left stereo channel* must have an *odd number*, the one for the *right stereo channel* must have an *even number*! Also, both Output Functions must follow each other immediately in the list. If you do not comply with these conditions, the signal assignment to the insert points will not work correctly. If necessary, create an additional empty Output Function to get the numbers right.

6. In the project tree, select the node `Audio System` and click the tab `Inserts`. In the area `Switchable Insert Points` click the Insert you want to configure. Enter a descriptive name for it in the field `Label`.
7. In the field `Routing Selector`, select the Routing Selector you have assigned in step 3. This Routing Selector now works as “Send” output to the external device.
8. In the field `Source`, select the Output Functions you have created in step 5. That way the “Return” signal of the external device is routed back into the signal path.
9. Select the node `Console` in the project tree. Click on the tab `Keys` and select a Fader Module or Control Module. (See also “Console – Configuring the Console” on page 78.)
10. Select a key from the module. In the pop up menu `Function` select the value `ON/OFF Function`. From the pop up menu `Subfunction` choose the value `Insert`. Finally a third pop up menu appears, select the desired Insert from it.
11. Set the colors for the different key states. Upload the new Config into the Device.

Now you can use the Switchable Inserts like this:

First, press the key `Access` in the desired fader strip. Second, press the Insert key you just defined. The input signal for the fader is now routed through the Insert path. To deactivate the Insert, repeat the procedure.



**Note:** If you configure the Insert key within a fader strip, a single press on this key will activate and deactivate the Insert.

## 7.10 Global Pool Lines - Using Pool Signals between several Devices

### Overview

If you operate several RM4200D within the same project, one device can access audio sources on another Device if necessary. You do not need a separate audio link between the Devices for each source, but you can use up to ten **Global Pool Lines**. Each Global Pool Line you can carry any signal from the remote Device. Which signals are input to the Global Pool Line at the remote Device is *dynamically* controlled by the local Device. Using TCP/IP on the Ethernet, the local Device sends commands to the remote Device, which selects the desired remote signal as input for the Global Pool Line.

Global Pool Lines need Device Links to work. These are physical audio links between two devices and are explained above. The remote device provides the signal to the Device Link, which carries it to the local device. However, the source signal of the remote device is not fixed, but selected dynamically. (See also “Device Links” on page 46.)



You can define up to ten Global Pool Lines. Each of these connections uses one Device Link. Here are some typical applications for such connections:

- Assign external audio signals to Fader Channels. (See “Global Pool Line as Source for a Fader Channel” on page 155.)
- Create monitor busses from external audio sources. (See “Global Pool Lines as Sources for a Monitor Bus” on page 156.)
- Put external audio sources on a Selector Source List. Use this list for a Rotary Monitor Selector. You can then monitor many sources using a Rotary Encoder on the Console. (See “Global Pool Line as Source for a Rotary Monitor Selector” on page 158.)

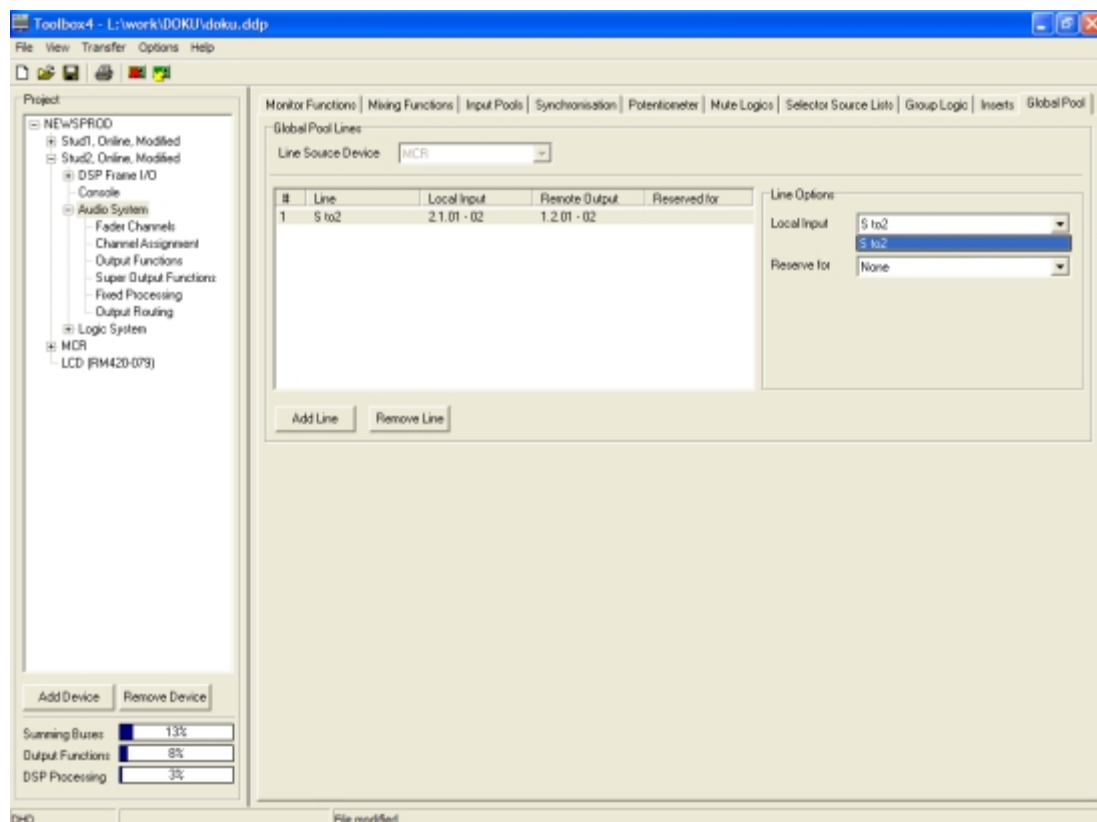


**Important Note:** When using Global Pool Lines, please mind the following restrictions:

- You need to create the necessary Device Links *before* you can define Global Pool Lines. (See also “Device Links” on page 46.)
- For each Device you can define *exactly one other Device* as source for Global Pool Lines. Once you have defined this Device, you can not access the signals of other Devices anymore. However, several Devices can use the same remote Device as source for their respective Global Pool Lines.
- You can use up to ten Global Pool Lines simultaneously. Each line needs its own Device Link. If all lines are in use, you have to release one first, before you can access another signal on the remote Device.
- The Devices must be connected to each other via Ethernet. They need to send and receive TCP/IP messages carrying the control commands for switching sources.

### Creating Global Pool Lines

Before you start, make sure the Device Links between the remote Device and the local RM4200D are set up correctly. The outputs of the remote Device need to be connected to the inputs of the local Device. (See also “Device Links” on page 46.)



**Figure 3–53: Configuring Global Pool Lines.** The local input is being selected (right). To set up Global Pool Lines, do the following:

1. In the project tree, find the desired local Device and select the node `Audio System`. Click on the tab `Global Pool`. In the pop up menu `Line Source Device`, select the remote Device whose inputs you want to access.
2. Click the button `Add Line` to create a new Global Pool Line. As a result, the Device just selected is greyed out. That means, that you can now only get Global Pool Lines *from this Device only*.



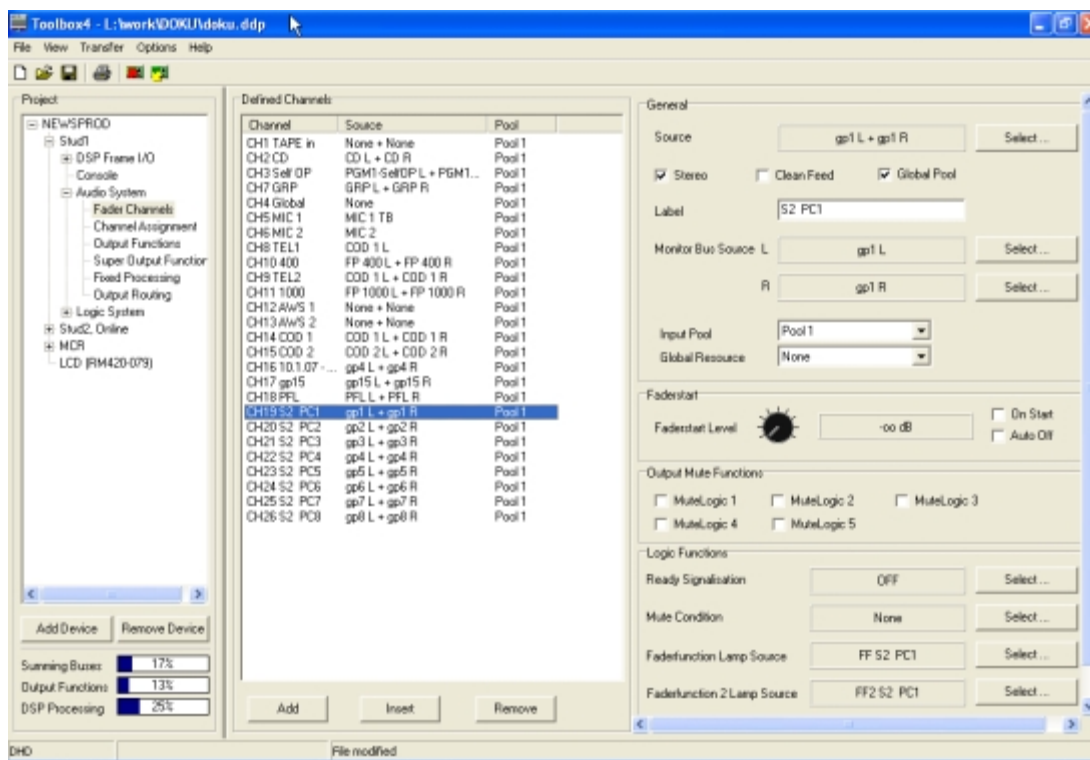
**Tip:** If you decide later on you want another Device as source for the Global Pool Lines, you have to remove all entries from the list first. Only then you can select another Device as signal source.

3. From the right pop up menu `Local Input` select the local input you want to connect to the remote Device via the Device Link.
4. In the pop up menu `Reserve for`, leave the default value `None` unchanged.

- Now the Global Pool Line is defined. Repeat the process for more Global Pool Lines. If necessary, change the values in the area `Line Options`.

### Global Pool Line as Source for a Fader Channel

You can use Global Pool Lines to switch external audio sources onto local faders. For this to work, you need at least one Global Pool Line with no reservation (value `None` in the pop up menu `Reserve for`).



**Figure 3–54: Define a Fader Channel with a Global Pool Lines as source.**

To create a **Global Pool Fader**, do the following:

- In the project tree, change to the node `Audio System / Fader Channels`. Click on the button `Add` to create a new Fader Channel. (See also “Fader Channels – Configuring Signal Sources for Faders” on page 159.)
- In the upper part of the dialog, activate the checkbox `Global Pool`.
- If you now open the `Audio Sources Window`, you can access the audio sources of the remote Device. Select one of them as source for the Fader Channel.
- You can now use the Fader Channel you have just created exactly like any other Fader Channel carrying a local audio input.



**Important Note:** You can create up to 150 Fader Channels which have a signal from a remote Device as input. However, at any one time you can only use ten of these Fader Channels *simultaneously*. This limit is caused by the maximum number of Global Pool Lines, which is ten. If all ten lines are used, you can not use another Global Pool Fader Channel.

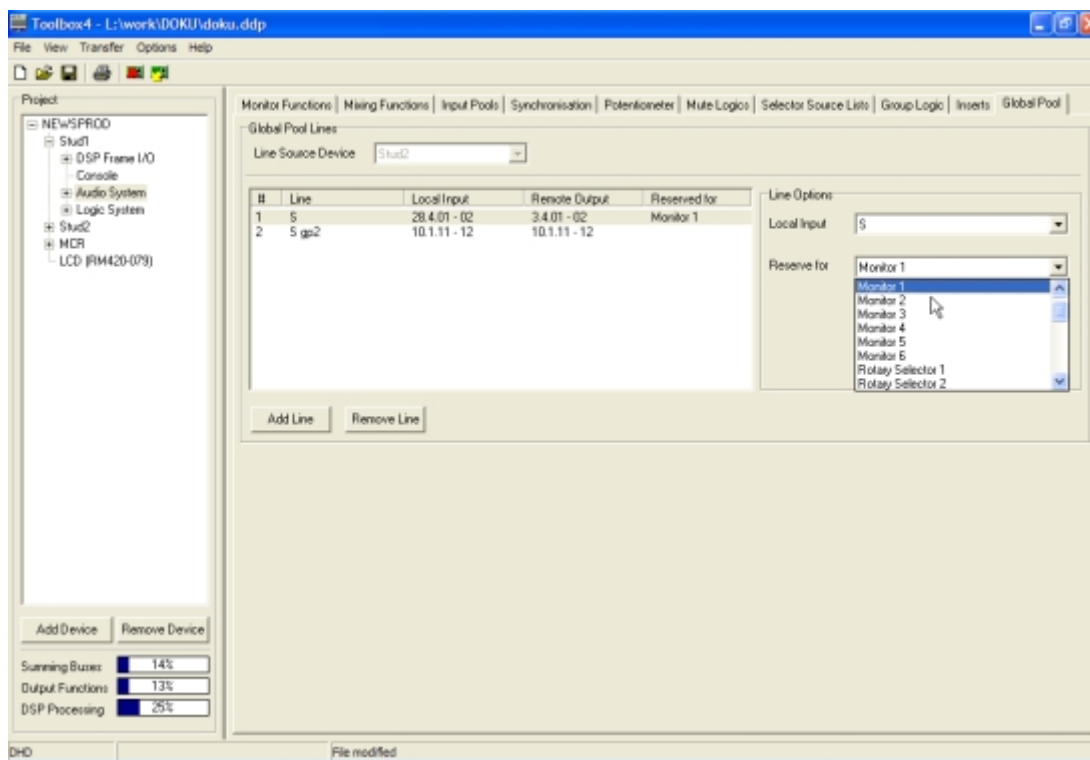
If *all* available Global Pool Lines are used, all other Fader Channels with remote audio signals as source are hidden from the local Fader Pool. You can only access local Fader Channels, until at least one Global Pool Fader Channel is removed from the Console again.

### Global Pool Lines as Sources for a Monitor Bus

If you want to monitor audio inputs of a remote Device you can use Global Pool Lines. However, before you can assign a Global Pool Line as source to a Monitor Bus you have to reserve the Global Pool Line first. Only then you can access the audio sources of the external Device.



**Important Note:** You need to reserve the Global Pool Line for exactly the desired Monitor Bus, otherwise you will not be able to access the audio sources of the remote Device!

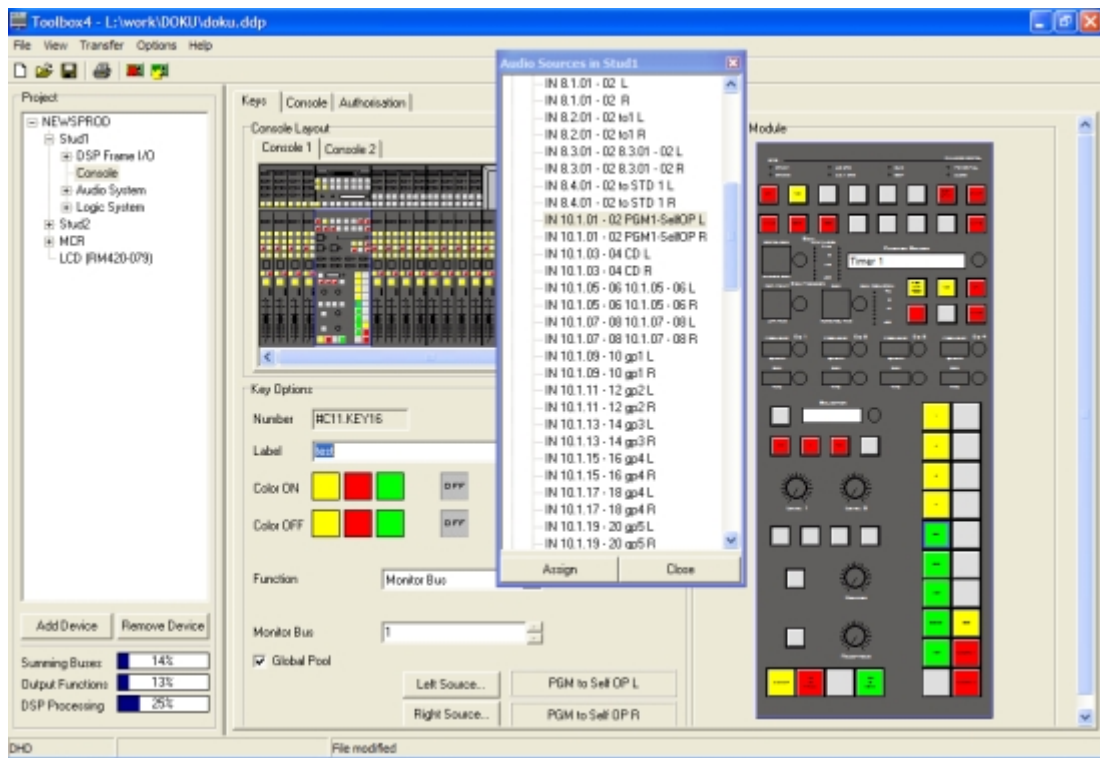


**Figure 3–55: Reserving a Global Pool Line for a Monitor Bus.**

To configure the Monitor Bus, do the following:

1. In the project tree, select the node `Audio System` and click on the tab `Global Pool`. Select the desired Global Pool Line from the list or create a new one. In the pop up menu `Reserve for` select the Monitor Bus you want to use with this Global Pool Line. Remember which Monitor Bus you have selected. In the project tree, change to the dialog `Audio System / Monitor Functions`. If you look at the Monitor Bus you have just assigned a Global Pool Line to, you will see the string `Global Pool` in the column `Info`.
2. In the project tree, go to the node `Console` and click on the tab `Keys`. Select the key you want to use for monitoring in the Control Module.

3. From the pop up menu `Function` select the entry `Monitor Bus`. The pop up menu `Monitor Bus` appears, select the `Monitor Bus` there you used in step 1 to reserve the `Global Pool Line`. The checkbox `Global Pool` will be enabled.
4. Tick the checkbox `Global Pool`. If you open the `Audio Sources Window` now (key F6), you will see the audio signals of the remote device connected to the `Global Pool Line`. The name of the remote Device is shown in the title bar of the `Audio Sources Window`. (See also “Audio Sources” on page 8.)
5. Assign the signals of the remote Device you want to monitor to the fields `Source Left` and `Source Right`. Define label and lamp colors for the key.



**Figure 3–56: Defining a monitor key for signals of a remote Device.**



**Note:** If you configure a monitor key, the checkbox `Global Pool` will be disabled first. It will be enabled automatically if you select a `Monitor Bus` for which a `Global Pool Line` is reserved.

If you change the reservation of a `Global Pool Line` to another `Monitor Bus`, you can not monitor the external signals anymore. Next to the checkbox `Global Pool` the message `Monitor Bus without pool line!` is displayed. However, the assignment of the external audio source to this monitor key is not lost. If you change the reservation of the `Global Pool Line` back, it will work again. That way, you can change the `Monitor Bus` without losing the assignment of all external sources.



**Important Note:** Sometimes you want to re-use a local Monitor Bus for external signals on a Global Pool Line. If you have already defined a key for this Monitor Bus and want to re-use it, too, do the following: First, set the source for the monitoring key to `None`. Second, tick the checkbox `Global Pool`. Now, select the desired audio signal from the external Device.

### Global Pool Line as Source for a Rotary Monitor Selector

Sometimes you want to access a certain number of external audio sources from a Rotary Monitor Selector. As described in the last section, you need to reserve a Global Pool Line for the Rotary Monitor Selector, too.

To setup the Rotary Monitor Selector, do the following:

1. In the project tree, select the node `Audio System` and click on the tab `Global Pool`. Select the desired Global Pool Line or create a new one. In the pop up menu `Reserve for` select one of the Rotary Monitor Selectors. Remember, which selector you have chosen. Change to the dialog `Audio System / Monitor Functions` in the project tree. In the lower half of the dialog find the entry for the Rotary Selector. In the column `Info` the value `Global Pool` will be displayed. (See also “Rotary Monitor Selector” on page 126.)
2. Click on the tab `Selector Source Lists`. Choose a list to contain the external audio sources. In the field `Label`, give it a descriptive name (for example “Global Sources”). (See also “Selector Source Lists” on page 143.)
3. Click the button `Add` to add a new audio source to the list. In the field `Display Text`, give it a descriptive name. This name will be shown on the display of the Console.
4. Tick the checkbox `Global Pool`. In the column `Info` of the list the message `Global Pool` is shown. Now, open the `Audio Sources Window`. You will see the audio signals of the external Device you reserved a Global Pool Line for in step 1. Choose the desired signals for the fields `Source Left` and `Source Right`. If you now read the message `Selector without Pool Line!` in the column `Info`, please ignore it for the moment. It is there, because the Selector Source List has not been assigned to a Rotary Selector yet. It will disappear as soon as this assignment is complete.
5. Click on the tab `Monitor Functions`. In the lower list, select the Rotary Monitor Selector you have reserved a Global Pool Line for in step 1. Now use the pop up menu `Select Source List` to assign the Selector Source List you were working with in steps 2 to 4.
6. Go back to the tab `Selector Source Lists`. Select the list you have just changed again. The warning message in the `Info` column should have disappeared, because the list is now assigned to a Rotary Monitor Selector.
7. Repeat steps 3 and 4 at will, until you have put all desired external sources into the list.



**Tip:** If you want, you can mix local and remote signal source within the same Selector Source List.

As usual, you can assign a Selector Source List with external sources to several Rotary Monitor Selectors. However, make sure *you reserve a Global Pool Line for each Rotary Monitor Selector that will provide external sources!* You can reserve Global Pool Lines for the first 15 of the 30 available Rotary Monitor Selectors.



**Important Note:** You can not use Selector Source Lists containing external sources as *alternative return lines for Clean Feeds!*

Furthermore, lists containing external sources which are linked to a Rotary Monitor Selector via a Global Pool Line can not be used in the dialog **Mixing Functions**. They are not displayed in the pop up menu **Output Selector Source List**. (See also “Mixing Functions – Configuring Internal Buses” on page 126.)

### 7.11 Fader Channels – Configuring Signal Sources for Faders

You reach the dialog **Fader Channels** by navigating in the project tree, as a further sub branch underneath the branch **Audio System**.

Here, the *Fader Channels* are configured that can be switched on to faders. Up to 150 Fader Channels per Device can be configured. Each Fader Channel has an assigned audio source and further features that are configured here, too.



**Note:** To be able to really put an audio source on a “physical” fader, this audio source must be *first* defined as Fader Channel. Then, you can assign the defined Fader Channel in the dialog **Channel Assignment** to the faders themselves.

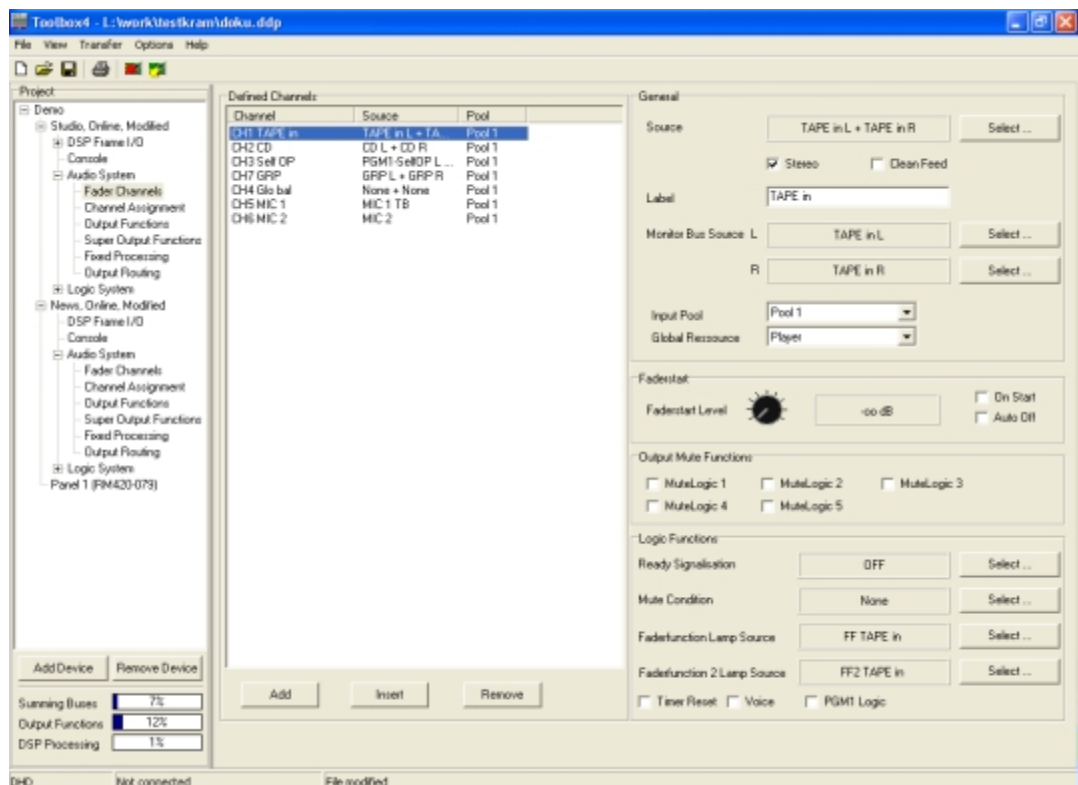


Figure 3–57: Fader Channels, configuring signal sources.

All audio signals available on the TDM bus can be used as sources, mostly input signals are assigned. If you assign a program bus to a Fader Channel, you can create a group. If necessary, a source can be also assigned to several Fader Channels.

In addition, there are 16 MIDI sources as special functions that do not have an audio signal. These are used to remotely control certain editing systems using the fader.

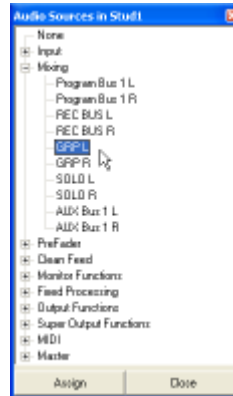


Figure 3–58: Audio Sources Window, selection of a bus signal.

### Defined Channels

In this pane of the dialog you can define new channels and modify existing ones. The list displays the defined channels; in the column *Channel* you find the item number of the Fader Channel and its label. The displayed number of a channel, e.g. CH42 is for information only and has no influence on the further configuration. You need it only if you want to use certain functions in scripts, where the functions refer to Fader Channels. In such a case, this number is used in hex format within the script. (See also “Scripts – Controlling Special Functions with Scripts” on page 200.)

In the column *Source* the assigned audio source is displayed, in the column *Pool* you find the assigned Input Pool. If no pool is assigned to the fader, this column remains empty.

At the same time, the order of the Fader Channels determines the order in which the channels are stored in the assigned Input Pools. If several Input Pools are used, the order follows from up to down separately for each Input Pool. The Fader Channels belonging to an Input Pool do not have to be arranged block wise in the list. If you want to change the order of the list entries you can simply do that by Drag&Drop.


In order to create a new Fader Channel, click on the button *Add*. This automatically opens the *Audio Sources* Window which is then active. Now select the desired audio source and assign it by either double clicking or clicking on the button *Assign*.

With the button *Insert* you can insert a new Fader Channel above a marked list line, with *Remove* you can delete the entry. If a total number of 150 Fader Channels is defined, the functions *Add* and *Insert* cannot be executed any more. The functions *Add*, *Insert* and *Remove* can also be used with the contextual menu inside the list.



### General Options

For a Fader Channel, you can configure the following general options:

Option	Description
<i>Source</i>	The audio signals (mono or stereo) that serve as inputs for the Fader Channel. You can change the audio source of an already existing Fader Channel by double clicking on the marked line in the list or by clicking on the button <i>Select</i> . Drag&Drop from the <i>Audio Sources</i> Window works, too.
<i>Label</i>	Name of the channel. At the <i>first</i> assignment of an input to a new Fader Channel, the first 8 characters of the name of the audio source are automatically kept. This can be changed here later. Please note that for the Fader Module RM420-020 only 4 characters are available in the display, for the RM420-029 8 characters are displayed with a line wrap after 4 digits. Spaces are counted as characters.
<i>Stereo</i>	The channel is mono or stereo. The feature mono or stereo is also automatically taken over from the assigned source; it can be changed later on with the checkbox <i>stereo</i> .   <b>Note:</b> You can define only consecutive channels (beginning with the left channel) as stereo sources.
<i>Clean Feed</i>	This checkbox assigns a corresponding Clean Feed signal to the channel. Please note that a summing bus is consumed as resource and inserted in the list under <i>Audio System/Mixing Functions</i> . (See also “Mixing Functions – Configuring Internal Buses” on page 126.) Clean Feeds in a RM4200D <i>are always assigned to a Fader Channel</i> . If this assignment is unwanted, you can use AUX and Program buses for setting up Clean Feed signals.
<i>Global Pool</i>	When you tick this checkbox and if you have defined a Global Pool Line, you can access the audio sources from the remote Device. The <i>Audio Sources</i> Window will list the sources of the remote Device instead of the local ones. (See also “Global Pool Line as Source for a Fader Channel” on page 155.)
<i>Monitor Bus Source</i>	If in the Fader Module keys are defined with the function <i>Monitor Bus Control</i> , you can configure the signal to be monitored for this function using the buttons <i>L</i> , <i>R Select</i> . As preset, the source of the Fader Channel itself is assigned; but also the Clean Feed belonging to the Fader Channel or any other signal can be chosen. Channel related alternating monitor keys can work independently or in connection with monitor key sets in a Control Module. The monitor key set can e.g. be extended with this function to Fader Modules and is independent from the PFL function. (The function <i>Monitor Bus Source</i> is rarely used.)



Option	Description
<i>Input Pool</i>	Use the pop up menu <i>Input Pool</i> to assign <i>one</i> <i>Input Pool</i> to the selected <i>Fader Channel</i> . In this menu only the <i>Input Pools</i> configured under <i>Audio System/ Input Pools</i> are displayed, also the entry <i>None</i> . Use the latter if you want to lock a <i>Fader Channel</i> to a certain “physical” fader. If you do <i>not</i> want to use the <i>Fader Channel</i> in the pool without deleting it, you have to assign <i>None</i> , too. (See also “ <i>Input Pools – Properties</i> ” on page 133.)
<i>Global Resource</i>	Use this menu to assign a configured <i>Global Resource</i> to the <i>Fader Channel</i> . If you have configured a key with the function <i>Resource</i> in the fader strip, this key will show you the state of the resource. If it shows the key color <i>ON</i> , the local <i>Device</i> owns the resource. You can also use this key to request an already owned resource, to cancel such a request, to release a resource or to take it over. (See also “ <i>Fader Modules and List of Functions</i> ” on page 85.)



### Faderstart

The fader starts can be used as Logic Source for arbitrary functions. In most cases, they are directly routed to the GPOs or control a red light signal using logic functions.



**Note:** If you control a GPO with the fader start, during the configuration of the GPO you have to determine, whether the switching signal should be generated as level change (Level) or impulse (Start/Stop Pulse). (See also “GPOs - General Purpose Outputs” on page 202.)

You can select the following options for the faderstart of the selected channel:

Option	Description
<i>Faderstart Level</i>	Level value from which the fader start is active. -∞ is set as a preset, as the lowest stop. You can adjust the level in a range between -∞ and -10dB in steps of 10dB. The setting refers to the scale of the Fader Module and activates the corresponding Logic Source <i>Faderstart/FS &lt;FaderChanName&gt;</i> when exceeding the set value.
<i>On Start</i>	<p>The logic source <i>Faderstart/FS &lt;FaderChanName&gt;</i> is only activated over the key function <i>Channel On/Off</i> , not when moving the fader.</p> <p style="text-align: center;"> <b>Note:</b> In this case, the corresponding key function <i>must</i> be defined in the Fader Module: either as combined <i>Channel ON/OFF</i> function or as two functions <i>Channel ON</i> and <i>Channel OFF</i>. (See also “Channel ON” on page 88.)</p>
<i>Auto Off</i>	<p>When closing the fader, the channel is switched OFF automatically.</p> <p style="text-align: center;"> <b>Note:</b> In this case, the corresponding key function <i>must</i> be defined in the Fader Module: either as combined <i>Channel ON/OFF</i> function or as two functions <i>Channel ON</i> and <i>Channel OFF</i>. (See also “Channel ON” on page 88.)</p>

### Output Mute Functions


Here you can assign which Mute Logics are activated when opening a fader. In most cases, this assignment is used to mute loudspeakers when opening microphone channels. You can control up to five Mute Logics, to do this, activate the corresponding checkboxes.

You can change the names of the different Mute Logic buses under **Audio System/Mute Logics**. (See “Mute Logics” on page 142.)

The assignment of the corresponding *Mute Logic* to the output signals of the RM4200D is defined under **Audio System/Output Routing**. (See “Output Routing” on page 183.)

### Logic Functions

Here you determine how the selected Fader Channel is coupled with the Logic System of the RM4200D. In detail, you can configure the following options:

Logic Function	Description
<i>Ready Signalisation</i>	<p>The Fader Overbridge Modules RM420-023 and the Fader Modules RM420-029 contain a fixed LED labelled <i>READY</i>. Here you can determine with which Logic Source this display is switched on. The Logic Source is preset to <i>OFF</i>; in this case, the display is switched on at closed fader. If you do not want <i>READY</i> to shine, you have to configure <i>None</i>.</p> <p>For modifications click on the button <i>Select</i>, this opens the <i>Logic Sources Window</i> and activates it. Assign the desired Logic Source with the button <i>Assign</i>, per double click or <i>Drag&amp;Drop</i>.</p> <p><i>Application example:</i> Over GPIs, status signals of playout devices can be displayed. External keys connected using GPIs can display signals triggered by the presenter at the microphone channels.</p>
<i>Mute Condition</i>	<p>Here you can assign which Logic Source can trigger muting of the Fader Channel on activation. <i>None</i> is preset, the channel is not muted.</p> <p>For modifications click on the button <i>Select</i>, this opens the <i>Logic Sources Window</i> and activates it. Assign the desired Logic Source with the button <i>Assign</i>, per double click or <i>Drag&amp;Drop</i>.</p> <p><i>Application example:</i> Over GPIs, external cough keys can be connected.</p> <p> <b>Important Note:</b> A wrongly assigned Logic Source can cause permanent muting of the Fader Channel!</p>
<i>Faderfunction Lamp Source</i>	<p>If in the Fader Module, you assigned a <i>Fader Function</i> to a key, here you can configure, which Logic Source makes the LED of this key light. (See also “Fader Function” on page 92.)</p> <p>The preset Logic Source is the fader function of the selected Fader Channel itself (<i>Fader Function/FF &lt;FaderChName&gt;</i>). In this case, the key is lit when the fader function is active.</p> <p>For modifications click on the button <i>Select</i>, this opens the <i>Logic Sources Window</i> and activates it. Assign the desired Logic Source with the button <i>Assign</i>, per double click or <i>Drag&amp;Drop</i>.</p> <p><i>Application example:</i> As talk key for Clean Feeds, talk key for headphones that are assigned certain microphones (programming over Output Functions), Faderstart On/Off for input Devices (programming over logic functions).</p>
<i>Faderfunction Lamp Source 2</i>	<p>Same function as <i>Fader Function Lamp Source</i>.</p>

Logic Function	Description
<i>Timer Reset</i>	If you assigned <i>Timer Function/Timer Fader</i> to a key in a Control Module, the timers 1...12 can be reset when opening the fader. If you click in this checkbox, the selected Fader Channel triggers the reset. (See also “Timer Function” on page 118.)
<i>Voice</i>	If this checkbox is switched on, the Fader Channel activates the Logic Source <i>System Functions/Voice</i> . <i>Application example:</i> You can assign the Logic Source <i>Voice</i> to a GPO, thus using it as external voice/music identification.
<i>PGM1 Logic</i>	If this checkbox is switched on, the Fader Channel activates the Logic Source <i>System Functions/PGM1</i> , but only if <i>the channel is switched on the program bus 1 at the same time</i> . <i>Application example:</i> The Logic Source <i>PGM1 Logic</i> can be used externally using a GPO as Air Check Record Start – only open faders start recording that are switched on to program bus 1 and configured in this function.

### 7.12 Channel Assignment – Assigning Fader Channels and DSP Processing

Here the Fader Channels defined under *Audio System/Fader Channels* are assigned to the “physical” faders of the configured Fader Modules. Apart from that, in this window you can configure the signal processing for the input signals (Input DSP Processing).

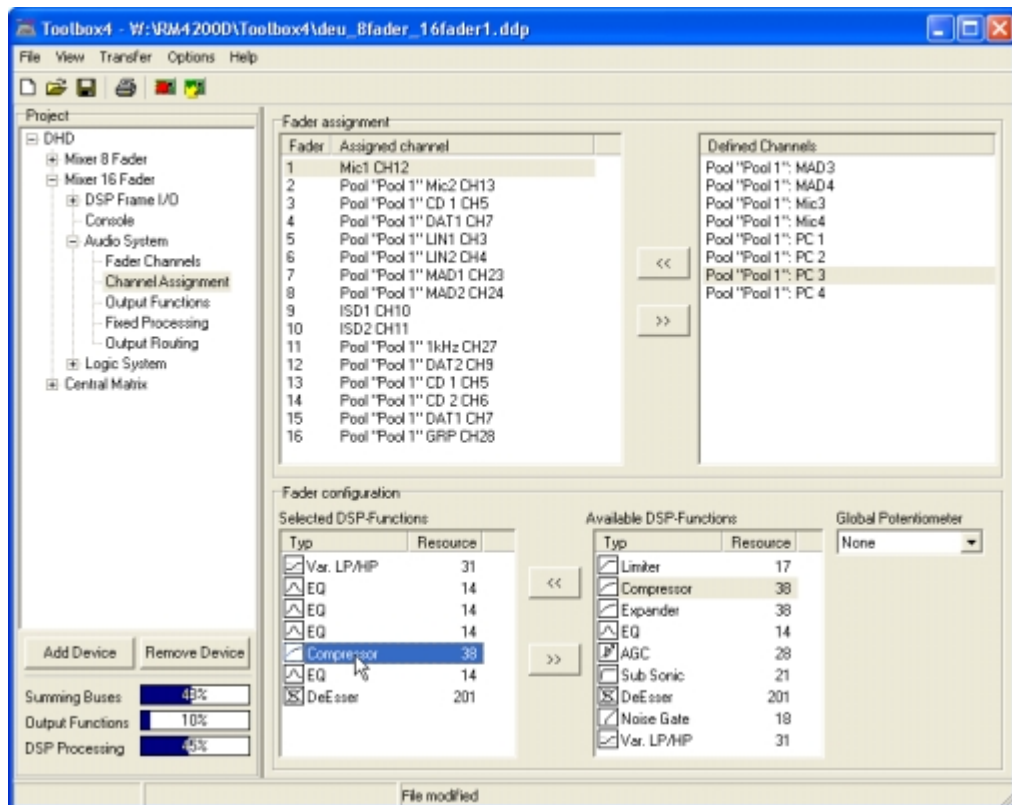


Figure 3–59: Channel Assignment, assigning Fader Channels to faders, setting up Input Processing.

## Fader Assignment

The faders in the Control Modules are numbered from 1 to 40. If the Module IDs are set consecutively from left to right, the fader on the far left of the Console is fader number 1, the one on its right is fader number 2 etc.



**Important Note:** You can change the Module IDs of the Fader Modules in the Maintenance Window. Especially when putting a Device into service and after replacing modules you should check the correct assignment of all Module IDs to avoid problems. If two Fader Modules have the same ID, they are working parallel and show identical channel names in the displays. (See also “Set Module ID” on page 42.)

The pane `Fader Assignment` of the dialog contains two lists: On the left, the physically available faders are displayed, on the right you see the Fader Channels already defined. The number of faders on the left depends on the total number of configured Fader Modules RM420-020 or RM420-029 of which each module contains four faders.

You assign a fader by first marking an entry in the list on the left and then double click on the desired channel on the right. Alternatively, you can also mark the entry in the right list and then use the button `<<` or `Drag&Drop`.

After assignment, the selected channel disappears from the right list, in the left list the next fader is marked automatically. Channels already assigned to faders are overwritten, then they are available in the right list again.

To delete an assignment, mark the corresponding entry in the left list and then use the button `>>`. Alternatively, you can delete an assignment by moving the entry from the left to the right list using `Drag&Drop`.

In the left list, you can also swap the assignment of two faders by moving the entry of the first one to the entry of the second using `Drag&Drop`.

Fader Channels that an Input Pool is assigned to, are marked with the text *Pool <Pool Name>* in front of the fader name. Fader Channels without an assigned Input Pool are not marked in front of the label.



**Important Note:** When working with Input Pools, please consider the following:

- The order of the entries in the left list defines the assignment of the faders after loading the Config into the Device. But you can determine the order of the channels for the function *Input Select* using the rotary encoder under *Audio System/Fader Channels*. (See also “Fader Channels – Configuring Signal Sources for Faders” on page 159.)
- At least one channel per Input Pool must remain in the right list to be able to carry out the function *Input Select* at all.
- You can assign a fader either to *one* Input Pool or statically link it with a Fader Channel that does not belong to the Input Pool. But you can *not operate many different* Input Pools with one fader!

## Fader Configuration

You can define for each fader how its inputs signal is to be processed. This signal processing is called *Input DSP Processing* and is applied before the fader changes the level of the signal. You can configure the corresponding functions in the pane `Fader configuration` in the dialog.

Number, type and order of the DSP functions can be determined for each fader separately – except for the faders that Input Pools are assigned to.



**Important Note:** For Input Pools, the Input Processing is assigned to the pool, not to the individual faders. This means that all faders with the same Input Pool have an identical signal processing for the input signals! That is why you have to configure them only *once*, it is changed for all faders of the same Input Pool automatically and at the same time.


To change the Input Processing of a fader, first select it in the upper left list *Fader assignment*. Then select the desired signal processing from the lower list *Available DSP Functions* on the right. By double clicking, the selected entry is taken over into the left list *Selected DSP-Functions*. Alternatively, you can also use the button << or Drag&Drop.

To remove a signal processing from the left list, double click on the selected entry or move it to the right list using Drag&Drop. You can also first mark it and then use the button >>.



**Note:** The DSP functions are processed in the order of their appearance in the list *Selected DSP Functions* from top to bottom. You can change this order using Drag&Drop.

At present, you can use the following DSP functions for the Input Processing:

Available DSP Functions	Max. Number per Input DSP Processing	Function
Limiter	Device 1	Limiter
Compressor	Device 1	Compressor
Expander	Device 1	Expander
EQ	Device 1; 2; 3; 4	Equalizer per Band, up to 4 different bands possible
AGC	Device 1	Automatic Gain Control
Sub Sonic	Device 1; 2	SubSonic filter (High pass 3rd class)
DeEsser	Device 1	Deesser   <b>Note:</b> Because of the high computing power needed, this is only applicable for single faders!
Deesser2	Device 1	Deesser, with reduced functionality and less resource consumption
Noise Gate	Device 1	Noise Gate
Var. LP/HP	Device 1; 2	Variable Filter, High Pass or Low Pass up to 10th class

The adjustable parameters of the DSP functions are described in the section on the *System Functions* of the Control Modules. (See also “Limiter” on page 102.)

### DSP Fader Channel Example



**Important Note:** The configuration of Input DSP processing requires the sufficient computing power depending on the number of configured faders! Not all combinations are possible, especially when applying the Deesser function. Therefore, during configuration always pay attention to the load display on the left below the project tree.

The computing power is supplied by up to three DSP Modules RM420-848M or up to two modules RM420-848L. You can read the amount of consumed computing power from the bar graph *DSP Processing* below the project tree. When exceeding 100% load, the color of the bar changes from blue to red.

Some examples of the computing power consumption are displayed in the following table, all faders have the same processing:

Number of Faders	DSP Modules	Input DSP Processing (stereo) per Fader	Fixed DSP Processing (stereo)	DSP Processing Load
8	1 x RM420-848L or 1 x RM420-848M	1 x Var.LP/HP 4 x EQ 1 x Compressor 1 x Expander 1 x Limiter	4 x Compressor 1 x Sine Generator	64%
16	1 x RM420-848L or 1 x RM420-848M	1 x Sub Sonic 4 x EQ 1 x Compressor 1 x Limiter	2 x Compressor 1 x Sine Generator	94%
16	2 x RM420-848L or 2 x RM420-848M	1 x Var.LP/HP 1 x Sub Sonic 4 x EQ 1 x Compressor 1 x Expander 1 x Limiter 1 x Noise Gate	4 x Compressor 1 x Sine Generator	79%
24	3 x RM420-848M	1 x Var.LP/HP 1 x Sub Sonic 4 x EQ 1 x Compressor 1 x Expander 1 x Limiter 1 x Noise Gate	4 x Compressor 1 x Sine Generator	77%
32	3 x RM420-848M	1 x Var.LP/HP 4 x EQ 1 x Compressor 1 x Expander 1 x Limiter	4 x Compressor 1 x Sine Generator	78%
40	3 x RM420-848M	1 x Var.LP/HP 4 x EQ 1 x Compressor 1 x Limiter	2 x Compressor 1 x Sine Generator	85%



(ermittelt mit Toolbox4, Version 5.5.0 build 6)

The consumption of computing power is determined by five parameters:

- Number of DSP processings used
- Number of DSP cycles needed
- Size of Data memory used in the DSP
- Size of Code memory used in the DSP
- Number of necessary routing channels of the TDM bus system

These values refer to the number of configured DSP Modules RM420-848 with the DSPs available on them. The load is influenced by the number of Fader Modules, since every module needs resources for the signal processing accordingly. Type and number of DSP functions used influence the load, too.

Every DSP card can compute a maximum number of 24 stereo processings, making up a total maximum number of 72 stereo processings. For the configuration of the Dual MADi Modules RM420-422, 24 of the routing channels of the TDM bus system that are normally used by 12 stereo processings, are used for the transfer of MADi channels. That is why the configuration of these modules causes a change in the DSP load.



**Important Note:** You should pay attention to the following facts in connection with the configuration of DSP functions:

- DSP processings can be used up to 100% without limitation. Since the load display is calculated from a total of five parameters, the reason for exceeding the 100% may not be clearly visible. In this case, you can get details from the Fitting Report. (See also “Fitting Report” on page 14.)
- Because of improvements and extensions of the DSP software the DSP load can vary between the different versions of the `Toolbox4` software. In special situations, configurations created with older versions of the `Toolbox4` can cause the excess of the computing power when editing the projects with a newer software version. Normally, in the RM4200D there is a sufficient amount of computing power available.
- If a firmware update is necessary for the RM4200D. You need to edit the configuration with the corresponding new version of the `Toolbox4` software!

### Global Potentiometer

Several Devices can exchange values for Global Potentiometers via Ethernet and the UDP protocol.

Up to 20 global potentiometers are available in a project. Each of them can be controlled with a fader or can be set using scripts. All Global Potentiometers are available as potentiometer values for controlling levels in Output Functions in any Device of the project.

If you want to control a Global Potentiometer with a selected fader, select it in the drop down menu `Global Potentiometer`.

You find examples for the configurations in the volume *System Reference* of this manual.

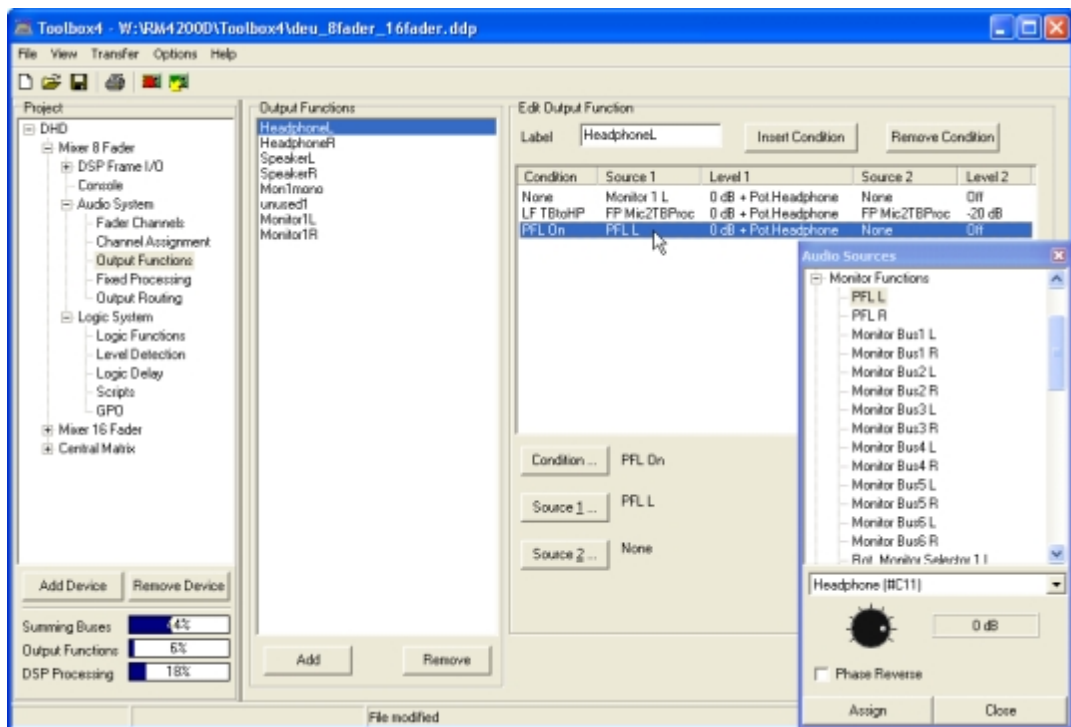
### 7.13 Output Functions

You find the menu `Output Functions` in the project tree as further sub branch below the branch *Audio System*.

Output Functions are universally usable DSP functions for switching, level control, talkback and summation applications. Often, these are used immediately before the audio signal leaves the system, therefore they are called *Output Functions*.

Each *Output Function* has two audio inputs *Source 1* and *Source 2*, that are summed up via two corresponding amplification factors *Level 1* and *Level 2*. The special thing about this is the following: Both the sources of input signals as well as their level values can change according to logic conditions (*Conditions*). The Output Signal of an Output Function itself is also available as an audio source on the TDM bus. This concept allows to implement many different applications in a very flexible way.

In the following figure, you see an example for a configured Output Function in the pane *Edit Output Function*:



**Figure 3–60: Output Functions, selecting audio sources.**

The following signals can be used as input signals (*Source 1* and *2*) for Output Functions:

- Audio channels available on the internal TDM bus: Inputs, Mixing (sums, groups, AUX buses), Pre Fader (Fader Channels after Input Processing), Clean Feeds, Monitor Functions (only PFL), Fixed Processing, Output Functions.
- Internal “virtual” audio sources: Monitor Functions (Monitor Buses 1 - 6, Rotary Monitor Selector 1 - 10), Routing (Number 1 to 768).

You can set the level values (*Level 1* and *2*) from -∞ (off), -100dB to +20dB in steps of 1dB. Furthermore, you can add the value of the potentiometer to this fixed amplification factor. The phase of the signal can be shifted by 180°.

In total, apart from the preset logic condition *None*, an Output Function can have up to 9 further logic conditions. Each of them is displayed as a row in the list to the right and can have assigned different input signals and level values.

The logic condition *None* always stands in the uppermost row and is always active when *none* of the configured conditions below are active.

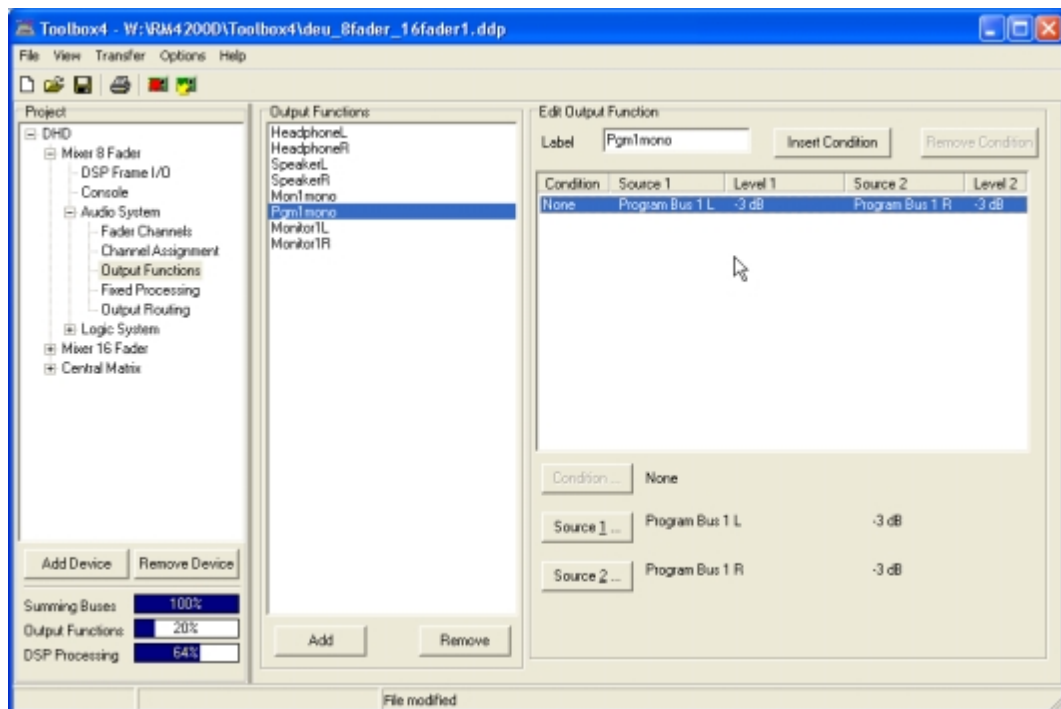
As logic conditions in the column *Condition*, you can use all logic sources available in the *Logic Sources Window*.

The priority of logic conditions decreases from top to bottom, so a condition is only considered if all conditions above it are inactive.

This means for the example in the figure (viewed from bottom to top):

- If the Logic Source *PFL On* is active (at least one PFL key pressed), the third row is carried out – the PFL bus is routed to the output of the Output Function.
- If the *PFL On* and the logic condition *LF TBtoHP* (logic function Talk Back to head phone) are both active at the same time, the second row is carried out – the audio source *FP Mic2TBProc* (Talk Back microphone) is routed via *Source 1* to the output of the Output Function. Using *Source 2* a minimum level of the source *FP Mic2TBProc* of -20dB is mixed in, Talk Back is therefore audible even at closed potentiometer.
- If neither *PFL On* nor the condition *LF TBtoHP* is active, the first row is carried out – *Monitor 1* (monitor selector) is routed to the output of the Output Function.

If no further logic condition is configured, the first line *None* is always active. This variation is often used for mono summation as illustrated in the following figure:



**Figure 3–61: Output Functions, mono summation.**

*Output Functions* are mono on the input and the output sides, that is why for stereo signals they must be programmed separately for the left and the right channels!

To setup a new Output Function, click on the button *Add*; to delete it, click on *Remove* respectively. Both functions can be used over the contextual menu of the list *Output Functions*.



**Note:** In order to use Output Functions as inputs for stereo Fader Channels or for stereo Fixed Processing, there must be an *even number* of Output Functions

## Part III: Toolbox 4 Configuration Reference

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*before* the Output Function in the left channel. For stereo Output Functions used in pairs, the right channel must follow the corresponding left channel.



**Caution:** You should *never delete* Output Functions when changing a configuration. Otherwise the assignment of the following Output Function pairs is disturbed when they are used as stereo inputs for Fader Channels or Fixed Processing! Instead, rename the unused Output Functions, e.g. “unused1” or “rem”. Output functions marked unused this way can be reused later.

### Edit Output Functions

You can configure the features of the Outputs Functions marked in the list `Output Functions` in the pane `Edit Output Functions`.

To configure a newly added Output Function, do the following:

1. Enter a reasonable name for the Output Function in the field `Label`. This name may be up to 10 characters long. Please consider that for a maximum of 120 Output Functions, a suitable name is important for the clarity of the Config.
2. Insert a new condition row; use the button `Insert Condition`. Now mark the row that you want to change. As a result, the three buttons below the list become active.
3. Click on the button `Condition`, to open the `Logic Sources` Window and to activate it. Select the desired Logic Source and assign it with the button `Assign`. Alternatively, you can also move the Logic Source directly to the desired location in the first column of the list by `Drag&Drop`. The first row of the list always contains the condition `None`, which can not be changed.
4. Assign the audio source to the marked row. Therefore, click on the buttons `Source 1` and `Source 2`, to open the `Audio Sources` Window or to activate it. Now select the desired source and adjust the level with the potentiometer in the `Audio Sources` Window. To change the level, click and hold the potentiometer button. If you now move the cursor to the left or the right holding the mouse button at the same time, you can change the level. Alternatively, you can also click on the button, hold the mouse button and change the set value with the following cursor keys:

+ 1dB steps	arrow right or arrow up
- 1dB steps	arrow left or arrow down
Off	Pos 1
+ 20dB	End
+ 10dB steps	PageUp
- 10dB steps	PageDown

5. To shift the phase of the selected audio source by 180 degrees, activate the checkbox `Phase Reverse`.
6. In the `Audio Sources` Window, you also find a drop down menu with potentiometers. Here you can select a potentiometer the level of which will be added to the value already configured. If e.g. you have set the level of the audio source to -3dB and the selected potentiometer is set to -15 dB, the signal will be attenuated by a total of  $-15\text{dB} + (-3\text{dB}) = -18\text{dB}$ . Select the desired potentiometer or use the entry `None`, if you do not want to use a potentiometer.

As potentiometers, the functions described in the section *Potentiometer* are available, furthermore the Global Potentiometers 1 to 20. (See also “Potentiometers” on page 138.)

Global potentiometers can be adjusted by a fader of one of the Devices defined in the project or using a script. (See “Channel Assignment – Assigning Fader Channels and DSP Processing” on page 165.)

Furthermore, there are the following options for the configuration of Output Functions:

- To delete a complete condition row from the Output Function, select it and use the button `Remove Condition`.
- The functions `Insert Condition`, `Select Condition`, `Source 1`, `Source 2` and `Remove Condition` can be carried out for the selected row using the contextual menu.
- You can configure the conditions and the audio sources of the selected row directly by double clicking into the corresponding column.
- You can change the priorities of the conditions by moving the list entries via `Drag&Drop`.

### Number of Output Functions

In each DSP Module RM420-848L and RM420-848M, 40 Output Functions are computed giving a maximum of 120 per Device. Since the Dual MADI Modules RM420-422S occupy several channels on the TDM bus system that are normally used for Output Functions, the configuration of these modules influences the maximum number of Output Functions.

In the following table you find the total number of Output Functions for the different combinations of DSP modules and the Dual MADI module:

Var.	Number of RM420-848L, 40 mono Output Functions each	Number of RM420-848M, 40 mono Output Functions each	Number of RM420-848M + RM420-422S, 16 mono Output Functions each	Number of available Output Functions
A	1			40
B	2			80
C		1		40
D		2		80
E		3		120
F		0	1	16
G		0	2	32
H		1	1	56
I		0	3	48
K		1	2	72
L		2	1	96

The load of the Output Functions is indicated with the `Output Functions` bar graph below the project tree. When exceeding a load of 100%, the bar changes its color from blue to red.

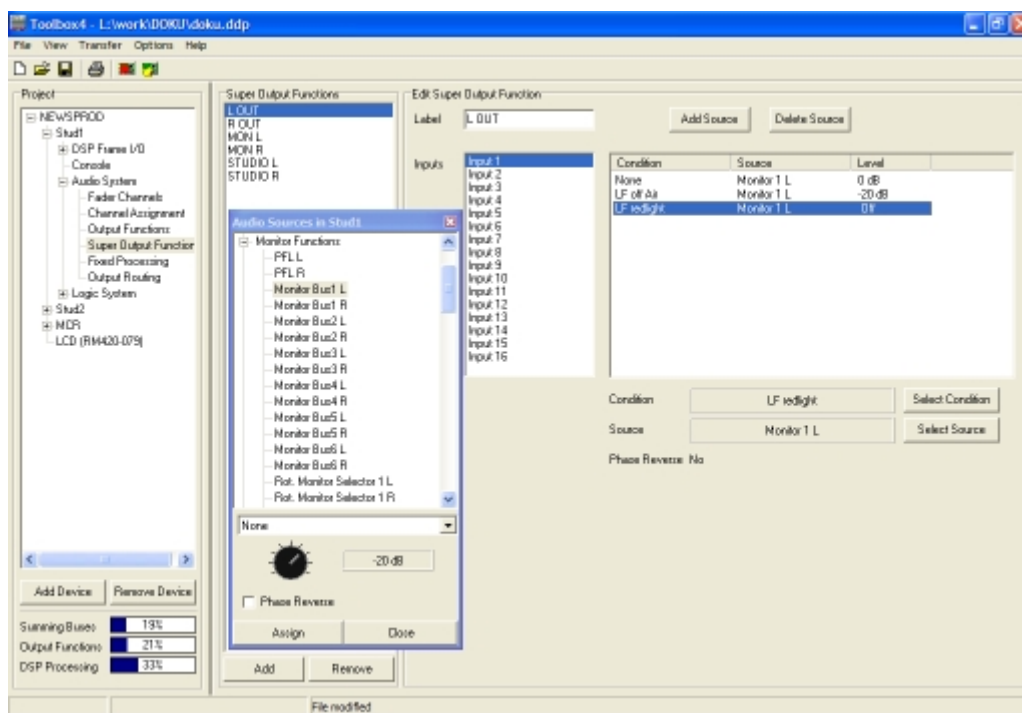
Output functions can be used up to 100% without limitations.

### 7.14 Super Output Functions

You get to the menu `Super Output Functions` navigating in the project tree to a subbranch of `Audio System`.

Super Output Functions are DSP functions universally applicable for switching, level, talkback and summation applications. Often, these functions are used directly in front

of audio outputs of the RM4200D. In general, they work similar to the related Output Functions, where the name “Super Output Function” originates. They are mainly used when several signals are to be coupled at the same time. (See also “Output Functions” on page 169.)



**Figure 3–62: Super Output Functions, assigning an audio source.**

Super Output Functions are able to sum up to 16 input sources (Input 1-16) per function. Each input source is treated equally and can be modified individually depending on logic Conditions. The output signal of a Super Output Function itself is available to the TDM bus as audio source.



**Important Note:** Each DSP Module RM420-848 can supply a maximum of 6 Super Output Functions. This adds up to a total number of 18 possible Output Functions per DSP Frame. Therefore, use the Super Output Functions carefully to avoid complex cascades of Output Functions.

You can use the following signals as input signals (Source):

- Audio channels available on the TDM bus: inputs, mixing (summations, groups, Aux busses), Pre Fader (Fader Channel after Input Processing), Clean Feed (n-1 busses), Monitor Functions (PFL only), Fixed Processing, Output Functions.
- Internal “virtual” audio sources: Monitor Functions (Monitor busses 1 - 6, Rotary Monitor Selector 1 - 10), Routing (number 1 to 768).

You can set the label values (Level) between -∞ (off), -100 dB to +20 dB in increments of 1 dB. Furtheron, to this set amplifier value, the value of a potentiometer can be added and the phase orientation of the signal can be turned by 180°.

Overall, a Super Output Function can have up to 4 further logic functions besides the preset Logic Condition None. Each of them is displayed in the right pane of the dialog as line in the list, it can have assigned different input signals and level values.

The logic condition `None` is always listed in the first line and is always active if *none* of the configured conditions underneath is active (logically true).

You can use all logic sources available in the `Logic Sources` Window as logic conditions in the column `Condition`.

The priority of the logic conditions decreases from top to bottom, therefore a condition is only used if all conditions above are inactive.



**Important Note:** Super Output Functions are mono in their inputs as well as their outputs. For stereo signals, they have to be programmed separately for the left and the right channels!

To create a new Super Output Function, click on the `Add` button at the bottom of the `Super Output Functions` list; to delete a Super Output Function, click on the button `Remove` respectively. You can also access both functions using the context menu in the list `Super Output Functions`.



**Note:** To be able to use Super Output Functions as inputs for Stereo Fader Channel or for Stereo Fixed Processing, there has to be *always a even number* of Output Functions *in front of* the Output Function with the left channel. For Output Functions that are used as paired stereo, the right channel must follow the corresponding left channel.



**Caution:** You should *never delete* Output Functions when modifying a configuration, since otherwise the assignment of the following Function Pairs is disturbed when they are used as stereo inputs for Fader Channels or fixed processing! Assign the unused Output Functions a new name instead, e.g. “unused1” or “rem”. The Output Functions marked as unused this way can be reused later on.

### Edit Super Output Functions

In the dialog `Edit Super Output Functions` you can configure the properties of the Super Output Function highlighted on the left side in the `Super Output Functions` list.

The configure a newly added Super Output Function, do the following:

1. Apply a descriptive name to the Super Output Function, to do this, use the text field `Label`. This name may be up to 10 digits long. Please be aware that for a maximum of 18 available Super Output Functions per Device, the selection of a suitable name can be vital for the clarity of the Config.
2. In the list `Input` highlight the input you want to configure.
3. Insert a new condition line for this new input; to do this, use the button `Insert Source`. Now highlight the line that you want to modify. The two buttons under the list become active.
4. Click on the button `Select Condition` to open or activate the `Logic Sources` Window. Select the desired logic source and assign it using the button `Assign`. Alternatively, you can drag the logic source directly to the desired position in the first column of the list. The first line does always contain the condition `None`, this can not be changed.



5. Assign the Audio Sources for the selected line. To do this, click on the `Select Source`, to open or activate the `Audio Sources` Window. Now select the desired source and use the potentiometer in the `Audio Sources` Window to set the level. To modify the level, click and hold the potentiometer knob. If you now move the cursor with held mouse key to the left and to the right, you can modify the level. Alternatively, you can also click on the knob, hold the mouse key and change the set value using the following cursor keys:

+ 1 dB increments	Arrow right or Arrow up
- 1 dB increments	Arrow left or Arrow down
Off	Pos 1
+ 20 dB	End
+ 10 dB increments	Page Up
- 10 dB increments	Page Down

6. To change the phase orientation of the selected audio source by 180 degrees, activate the `Phase Reverse` checkbox.
7. In the `Audio Sources` Window, there is a popup menu with potentiometers as well. Here you can select a potentiometer, the level value of which becomes effective in addition to the configured value. If e.g. you have set the level of the audio source to -3dB and the selected potentiometer is set to -15 dB, the signal is attenuated by a total of  $-15\text{dB} + (-3\text{dB}) = -18\text{dB}$ . Select the desired potentiometer or use the `None` entry, if you do not want to use any potentiometer.
8. The functions described in the section *Potentiometer* are available as potentiometers, and also for the Global Potentiometers 1 to 20. (See also “Potentiometers” on page 138.)

Global Potentiometers can be set either by a fader of one of the Devices defined in the project or using a script. (See “Channel Assignment – Assigning Fader Channels and DSP Processing” on page 165.)

9. In the list `Inputs` select one or more further inputs and configure them accordingly.

You can also use the following opportunities when configuring the Output Functions:

- Use the button `Remove Source` to remove a whole condition line.
- Using the context menu, the functions `Insert Source`, `Select Condition`, `Select Source`, `Set Level Off` and `Remove Source` can be carried out for the marked line respectively. `Set Level Off` sets the level to -100 dB, i.e. “Off”.
- By double clicking on the corresponding column, you can directly configure the conditions as well as the audio sources for the marked line.
- You can modify the priorities of the conditions by simply dragging an dropping the list entries.

### 7.15 Fixed Processing – Defining Fixed DSP Functions

You find the menu *Fixed Processing* by navigating in the project tree as further sub branch below the branch *Audio System*.

*Fixed Processings* are universally usable, *fixed* DSP functions to e.g. process internal signals with limiters, compressors etc. In addition, you can configure sine generators. You can use any audio signal available on the internal TDM bus as input for a Fixed Processing: Inputs, Mixing (sums, groups, AUX buses), Pre Fader (Fader Channel after Input Processing), Clean Feeds, Monitor Functions (only PFL), Fixed Processing and Output Functions. The output of each Fixed Processing again is available as audio source in the *Audio Sources* Window.

In general, fixed Processings are internally computed in stereo, but they also can be used mono.

The RM4200D contains a lot of useful DSP functions usable from the very beginning; additional special processings require an additional license code that has to be ordered separately.

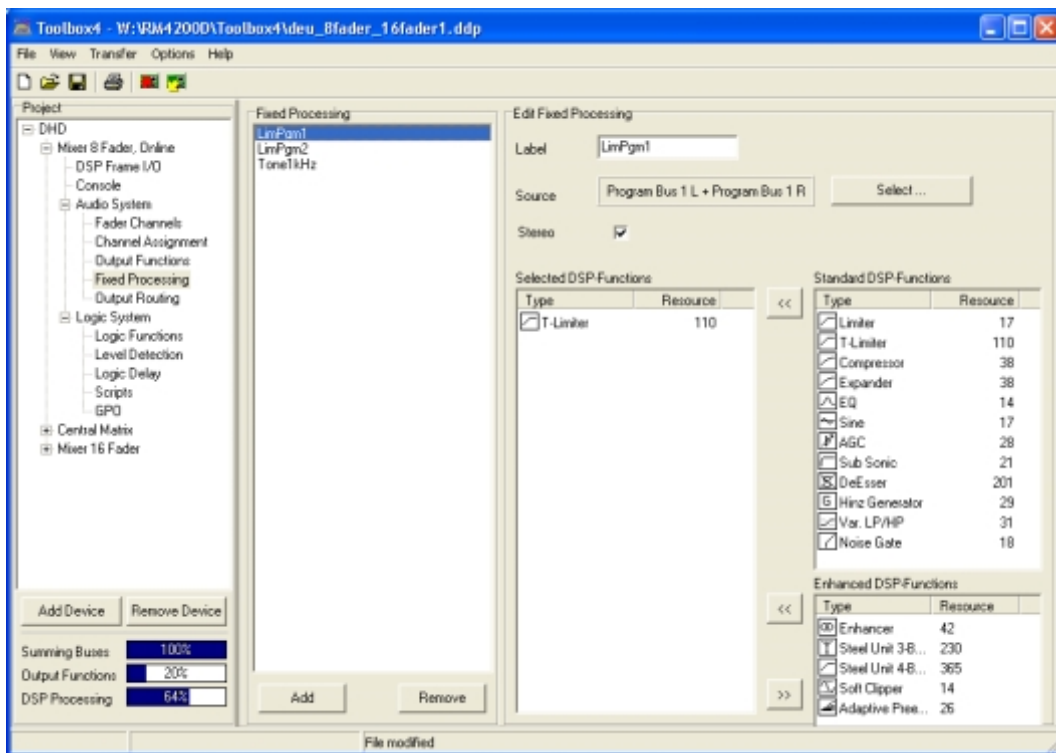







Figure 3–63: Fixed Processing, configuration of a limiter.









**Important Note:** Fixed Processings can *not* be adjusted or controlled with the mixer Console! The adjustment is carried out using Toolbox4 or the DSP Control software RM420-551. Some DSP functions can only be configured with the RM420-551 software.

For the Fixed Processing, the following standard DSP functions are available:

Standard DSP Functions	Max. Number per Fixed Processing	Function
Limiter	Device 1	Limiter
T-Limiter	Device 1	Transient Limiter with 300 $\mu$ s signal delay
Compressor	Device 1	Compressor
Expander	Device 1	Expander
EQ	Device 1; 2; 3; 4	Equalizer per band, up to 4 different bands possible
Sine	Device 1	Sine generator   <b>Note:</b> This is a generator, therefore a possibly routed signal source is ignored by this function.
AGC	Device 1	Automatic Gain Control
Sub Sonic	Device 1; 2	SubSonic filter (High pass 3rd class)
DeEsser	Device 1	Deesser   <b>Note:</b> Only applicable for single DSP processings because of the necessary very high computing power!
DeEsser 2	Device 1	DeEsser   <b>Note:</b> Alternative Deesser with different applicable parameters. Needs less DSP resources.
Hinz Generator	Device 1	Audio signal for traffic tone indication (Germany)   <b>Note:</b> This is a generator, therefore a possibly routed signal source is ignored by this function.
Var. LP/HP	Device 1; 2	Variable filter, high pass or low pass up to 10th class   <b>Note:</b> Parameters can be changed with RM420-551 DSP Control software only!

For special applications like FM processing, you can configure special “Enhanced DSP Functions”. These functions are enabled with a license code per DSP frame. To enter this license code, you use the Maintenance Window. (See “Enter license code” on page 33.)

Enhanced DSP Functions	Max. Number per Fixed Processing	Function
Enhancer	Device 1	Stereo Enhancer for improving the stereo sound   <b>Note:</b> Parameter setup only with RM420-551 DSP Control Software!
Steel Unit 3-Band	Device 1	3-Band Compressor   <b>Note:</b> Parameter setup only with RM420-551 DSP Control Software!
Steel Unit 4-Band	Device 1	4-Band Compressor   <b>Note:</b> Parameter setup only with RM420-551 DSP Control Software!
Soft Clipper	Device 1	Limiter function   <b>Note:</b> Parameter setup only with RM420-551 DSP Control Software!
Adaptive Preemphasis	Device 1	Adaptive Preemphasis (FM transmitter)   <b>Note:</b> Parameter setup only with RM420-551 DSP Control Software!
90° Filter	Device 1	Monosuming without amplifying mid-range frequencies   <b>Note:</b> No parameter setup possible.

In order to use the enhanced functions, you have to order the license code with the item number *RM420-561 DSP Fixed Processing*. For adjustment, you additionally need the *RM420-551 DSP Control Software*, that has to be ordered separately as well if necessary.

To configure a Fixed processing, do the following:

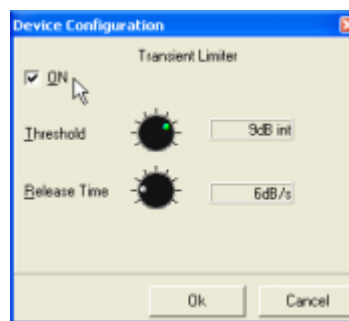
1. Insert a new fixed processing by clicking on the button `Add` below the list `Fixed Processing`. (Alternatively, select a `Fixed Processing` that is already defined to change it.) Now you can configure it in the pane `Edit Fixed Processing`.

2. First, apply a reasonable name to the Fixed Processing by entering it into the field Label. This name can be up to 10 characters long.
3. Select an audio source as input of the processing. To do that, click on the button Select to open the Audio Sources Window and to activate it. Select the desired audio source and assign it with the button Assign. Alternatively, you can also double click on the audio source or assign it using Drag&Drop.



**Note:** If you use generator functions for the Fixed Processing, you do not need an audio source and can use the preset None. If despite of that an audio source is selected, it is ignored!

4. When you activate the checkbox Stereo, the subsequent channel is selected automatically, in most cases the right channel of a stereo signal. Then the Fixed Processing also appears as stereo signal in the Audio Sources Window.
5. Now select the desired DSP functions for the Fixed Processing. Use the two lists Standard DSP Functions and Enhanced DSP Functions. To add a function to the list Selected DSP-Functions, simply double click its entry. Alternatively, you can use drag&drop or first select the desired function and then use the button <<.
6. If necessary, adjust the parameters for the DSP functions. Double click on the corresponding row in the list Selected DSP-Functions and adjust the desired value. The functions that can not be adjusted this way are listed in the table above.



**Figure 3–64:** Fixed Processing, setting the parameters for the Transient Limiter.

Basically, all levels refer to the internal reference level of 0dBint. If e.g. a limiter for digital outputs configured with a headroom of 9dB is to start exactly at a maximum level of 0dBFS, you have to set it to 9dBint.



**Note:** You can assign a maximum of 10 DSP functions to a Fixed Processing.

You have the following further options for configuring a Fixed Processing:

- To remove a Fixed Processing from the list Selected DSP-Functions, first select it and then use the button >>. Alternatively, you can move its entry back to the right list using Drag&Drop.
- The order of the entries in the list Selected DSP Functions (top to bottom) also defines the audio signal path. You can change this order using Drag&Drop.
- To remove a Fixed Processing that is defined already from the left list Fixed Processing use the button Remove below the list.

### Number of DSP Processings

In each DSP Module RM420-848L and RM420-848M 24 stereo DSP Processings are calculated, giving a maximum of 72 per Device. Since the Dual MADI Modules RM420-422S occupy some channels on the TDM bus system that are normally used for DSP processings, the configuration of these modules influences the DSP load.

The available DSP processings are also used for Fixed Processing and for fader Input Processing. During the configuration of the Fader Modules, the corresponding number of DSP processings is automatically occupied.

The following table shows the total number of DSP processings for the different combinations of DSP modules and the Dual MADI Module:

Var.	Number of RM420-848L, 24 stereo DSP Processings each	Number of RM420-848M, 24 stereo DSP Processings each	Number of RM420-848M + RM420-422S, 12 stereo DSP Processings each	Number of available stereo Fixed Processing = DSP Processings - (Minus) Number of Faders
A	1			24 - Number of faders
B	2			48 - Number of faders
C		1		24 - Number of faders
D		2		48 - Number of faders
E		3		72 - Number of faders
F		0	1	12 - Number of faders
G		0	2	24 - Number of faders
H		1	1	36 - Number of faders
I		0	3	36 - Number of faders
K		1	2	48 - Number of faders
L		2	1	60 - Number of faders

The DSP load is displayed by the DSP Processing bargraph below the project tree. Here, the consumption of DSP Processings for Fader Channel Processing and Fixed Processing is indicated. The DSP load is influenced by 5 parameters:

- Number of DSP Processings used
- Number of DSP cycles needed
- Size of Data Memory used in the DSP
- Size of Code Memory used in the DSP
- Number of necessary routing channels of the TDM bus system (see table above).

If the load exceeds 100%, the color of the bar changes from blue to red.



**Important Note:** Please pay attention to the following when configuring DSP functions:

- DSP processings can be used up to 100% without limitation. Since the load display is calculated from a total of five parameters, the reason for exceeding the 100% may not be clearly visible. In this case, you can get details from the Fitting Report. (See also “Fitting Report” on page 14.)
- Because of improvements and extensions of the DSP software the DSP load can vary between the different versions of the `Toolbox4` software. In special situations, configurations created with older versions of the `Toolbox4` can cause the excess of the available computing power when editing the projects with a newer software version. Normally, in the RM4200D there is sufficient computing power available.
- If a firmware update is necessary for the RM4200D, you need to edit the configuration with the corresponding new version of the `Toolbox4` software!

### 7.16 Output Routing

You find the menu `Output Routing` by navigating in the project tree as further sub branch below the branch `Audio System`.

Here, the desired audio channels of the TDM bus are assigned to the I/O-Modules of the RM4200D.

This Output Routing is part of the configuration thus being *fixed*.

If you want to change the routing *flexibly* during operation, other internal functions like routing with keys, scripts or rotary monitor selectors are available. In addition, you can also use the routing software RM420-550.



**Important Note:** Output Routing is carried out independently from the output configuration under `DSP Frame I/O`, generally in *mono*. This means that you have to configure it separately for both channels of a stereo signal. You can configure the output routing independently from the corresponding type of output (analog, digital, MADI) for each output without any limitations.

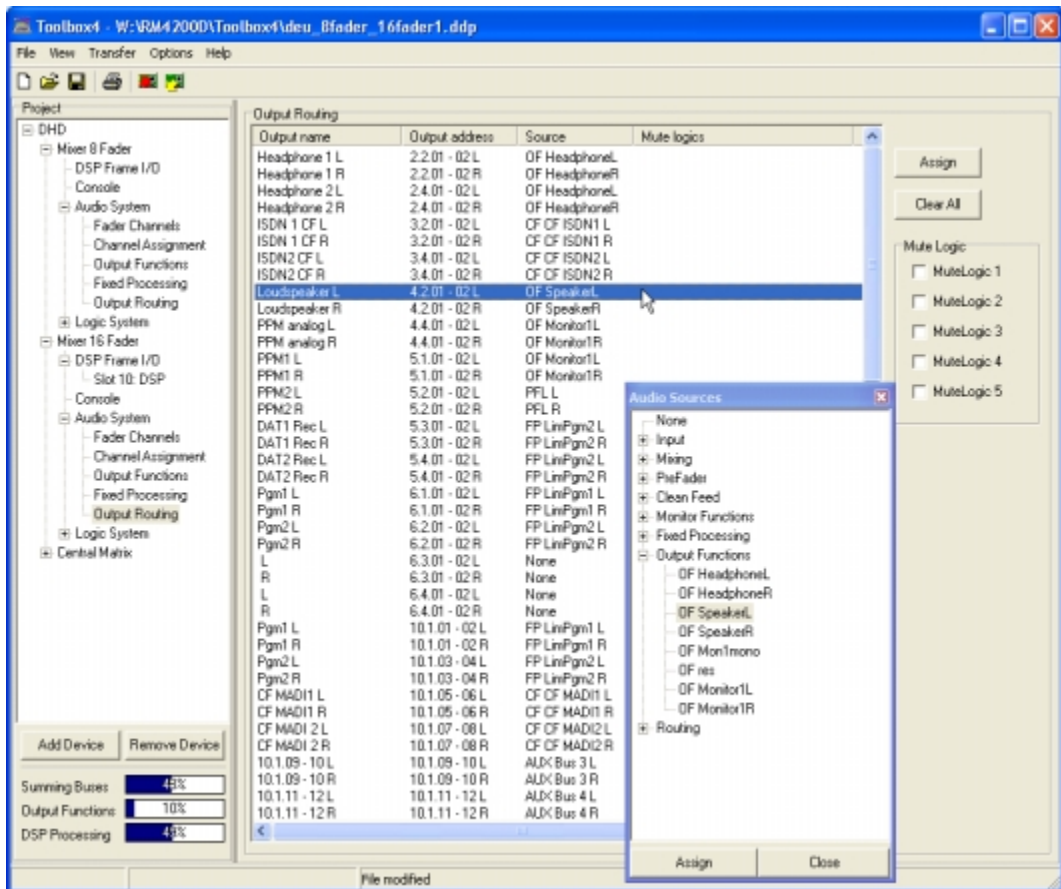


Figure 3–65: Output Routing, assigning the audio source to an output.

The following signals can be routed:

- Audio channels available on the internal TDM bus system: Inputs, Mixing (sums, groups, AUX buses), Pre Fader (Fader Channels after Input Processing), Clean Feeds, Monitor Functions (only PFL), Fixed Processing, Output Functions.
- Internal “virtual” Audio sources: Monitor Functions (Monitor Buses 1 - 6), Routing (Number 1 to 768).

For routing, first select the desired output in the list `Output Routing`. Double click on the entry or use the button `Assign`, to open the `Audio Sources` Window and to activate it.

Now select the desired audio source and assign it with the button `Assign` or by double clicking it. You also can assign an audio source by dragging and dropping it directly on to the entry of the desired output in the list `Output Routing`.

For each output, the following information is displayed in the list `Output Routing`:

- `Output name`: The name entered under `DSP Frame I/O`, for stereo outputs a row for each channel (left and right).
- `Output address`: The address preset by the system after the unified scheme: `<Slot number>. <Plug number>. <Channel number per plug>`.
- `Source`: Routed audio source, None means muting.
- `Mute Logic`: Mute Logics assigned to the output.



### Mute Logic

Here you assign which Mute Logics can mute the selected output. Use the checkboxes in the pane `Mute Logics` to assign the corresponding functions. Under *Fader Channels* you determine which faders activate which Mute Logics. (See also “Output Mute Functions” on page 163.)

In most cases, this function is used for microphones and loudspeakers that are installed in the same room. The loudspeakers are switched off as soon as the microphone faders open.

### CS Routing

This is a special function of the Digital-In/Out Modules RM420-111.



**Important Note:** CS Routing may only be active if a Router Control Panel RM420-018 that is configured accordingly or a Yellowtec Intellimix is connected to this output. Also, the input assigned to the output must be connected to the RM420-018 or the Intellimix *using the same connector!*

These two Devices can control over the Channel Status Bits of the assigned input received by the RM4200D, which audio sources of the TDM bus are routed to the corresponding output. To achieve that, in the AES/EBU data stream, the ASCII fields *Source* and *Destination* of the Channel Status Data are used for transferring the corresponding address.

### Clear All



**Caution:** This button deletes the Output Routing for *all* Outputs, there is no “Undo”!

### 8. Configuring the Logic System

Here you can configure the logic functions of the RM4200D. To do that, open the branch `Logic System` in the project tree; there you find further sub branches for configuration. The separate parts are described in this chapter. Please find additional explanations of the functions in the volume *System Reference* of this manual.

In this chapter (and in the `Toolbox4software`) the following terms are used, some of them have the same meaning:

- Logic 1, true, 1, active.
- Logic 0, false, 0, not active.
- Rising Edge, signal change from 0 to 1.
- Falling Edge, signal change from 1 to 0.

You find all Logic Sources of the RM4200D in the `Logic Sources Window`. If you define new logic functions, these are also displayed in this window, below the node `Logic Functions`. You can use these functions in the same way as you do with the ones preset by the system.

To open the `Logic Sources Window` use the command `Logic Sources` from the `View` menu or press the key `F5`.

You can use all logic functions from the `Logic Sources Window` as input values for the functions described in this section.



**Figure 3–66: Logic Sources Window.**

The following table provides an overview of the different function groups of Logic Sources and their sub entries. You also find detailed descriptions under the functions controlling the different logic sources.

Name of the Function Group	Entries	Description
None		<ul style="list-style-type: none"> <li>• Logic 0 or inactive.</li> </ul>
OFF		<ul style="list-style-type: none"> <li>• Active, if the associated channel is <i>OFF</i>. You can use it to signal the state “Ready” for this channel.</li> <li>• It is only shown if you opened the <code>Logic Sources Window</code> from the dialog <code>Fader Channels</code> and if a defined channel is selected there.</li> </ul>



Name of the Function Group	Entries	Description
Global Resource	<Name of the Global Resource>. <Name of the subscriber>	<ul style="list-style-type: none"> <li>Any Global Resource can be used as logic source, if at least <i>one subscriber</i> is defined for it.</li> </ul>
RM420-0xx # <ID1...ID12>	KEY <1..n> <keylabel>	<ul style="list-style-type: none"> <li>Each key of the Control Modules available in the Config can be used as Logic Source; mostly, the keys are used with the function <i>User Defined</i>.</li> <li>Each configured Control Module appears as separate node with type name and Module ID.</li> </ul>
Clean Feed		<ul style="list-style-type: none"> <li>Logic sources that become active when activating the Clean Feed by pressing a key. The Clean Feeds are configured under <i>Audio System/Fader Channels</i>. (See “Fader Channels – Configuring Signal Sources for Faders” on page 159.)</li> <li>Each configured Clean Feed hat has the following entries with indication of the input name of the Fader Channel:</li> </ul>
	CF Prep. <inputname>	<ul style="list-style-type: none"> <li><i>Preparation Mode</i> (pre talk) activated in this Fader Channel and fader closed.</li> </ul>
	CF Talk <inputname>	<ul style="list-style-type: none"> <li><i>Talk</i> key function activated in this Fader Channel.</li> </ul>
	CF Off Air <inputname>	<ul style="list-style-type: none"> <li><i>Off Air</i> key function activated in this Fader Channel.</li> </ul>
	CF Output Select <inputname>	<ul style="list-style-type: none"> <li><i>Output Select</i> key function activated in this fader. (Alternative signal instead of Clean Feed.)</li> </ul>
GPI	GPI <slot>. <plug.>01 <label>	<ul style="list-style-type: none"> <li>GPI of the module configured under <i>DSP Frame I/O</i>. (See “Configuring GPIO connectors” on page 76.)</li> </ul>
Logic Functions	LF <name>	<ul style="list-style-type: none"> <li>Active when logic function named &lt;name&gt; is active.</li> <li>Each configured logic function has its own entry.</li> </ul>
Global Logic	GL1...200 <name>	<ul style="list-style-type: none"> <li>Active when the corresponding Global Logic is active.</li> <li>Each Global Logic with a name differing from the preset has an entry. (See also “Global Logics” on page 49.)</li> </ul>
System Functions		<ul style="list-style-type: none"> <li>Diverse single functions.</li> </ul>
	PFL On	<ul style="list-style-type: none"> <li>Active when at least one <i>PFL</i> key is pressed.</li> <li>Application e.g. for switching/fading in PFLs in loudspeakers or headphones using Output Functions.</li> </ul>




## Part III: Toolbox 4 Configuration Reference

Name of the Function Group	Entries	Description
...System Functions	Pulse 1	<ul style="list-style-type: none"> <li>Pulse generator, fast, approx. 450ms.</li> <li>Pulse/Pause relation approx. 1:1.</li> <li>Only available as Logic Source for logic functions.</li> <li>Application e.g. for flashing functions.</li> </ul>
	Pulse 2	<ul style="list-style-type: none"> <li>Pulse generator, medium, approx. 900ms.</li> <li>Pulse/Pause relation approx. 1:1.</li> <li>Only available as Logic Source for logic functions.</li> <li>Application e.g. for flashing functions.</li> </ul>
	Pulse 3	<ul style="list-style-type: none"> <li>Pulse generator, slow, approx. 2s.</li> <li>Pulse/Pause relation approx. 1:1.</li> <li>Only available as logic source for logic functions.</li> <li>Application e.g. for flashing functions.</li> </ul>
	Off Air	<ul style="list-style-type: none"> <li>Active when at least one <i>Off Air</i> key is pressed.</li> <li>Application e.g. for starting the Off Air Recordings using a GPO.</li> </ul>
	Voice	<ul style="list-style-type: none"> <li>Active if at least one fader of the Fader Channel is open for which the option <i>Voice</i> is configured.</li> <li>Application e.g. for voice indication in the RDS data stream using a GPO.</li> </ul>
	PGM1	<ul style="list-style-type: none"> <li>Active if at least one fader of a Fader Channel has <i>PGM1 Logic</i> configured, is open and switched on to the <i>Program Bus 1</i>.</li> <li>Application e.g. for starting a recording using a GPO.</li> </ul>
	Solo	<ul style="list-style-type: none"> <li>Active if at least one <i>Solo</i> key is pressed.</li> <li>Application e.g. for switching/fading in of the solo bus in loudspeakers or headphones using Output Functions.</li> </ul>
	Timer Running	<ul style="list-style-type: none"> <li>Active if at least one fader of a Fader Channel is open for which <i>Timer Reset</i> is configured.</li> <li>Application e.g. for controlling external timers using a GPO.</li> </ul>
	Timer Reset	<ul style="list-style-type: none"> <li>Pulses if at least one fader of a Fader Channel is open for the <i>Timer Reset</i> is configured.</li> <li>Application e.g. for controlling external timers using GPO.</li> </ul>
Slot 10,20,30 MADI 1,2 Error	<ul style="list-style-type: none"> <li>Error signal for each configured MADI-Port.</li> <li>Active if no or no valid MADI signal is put on.</li> </ul>	



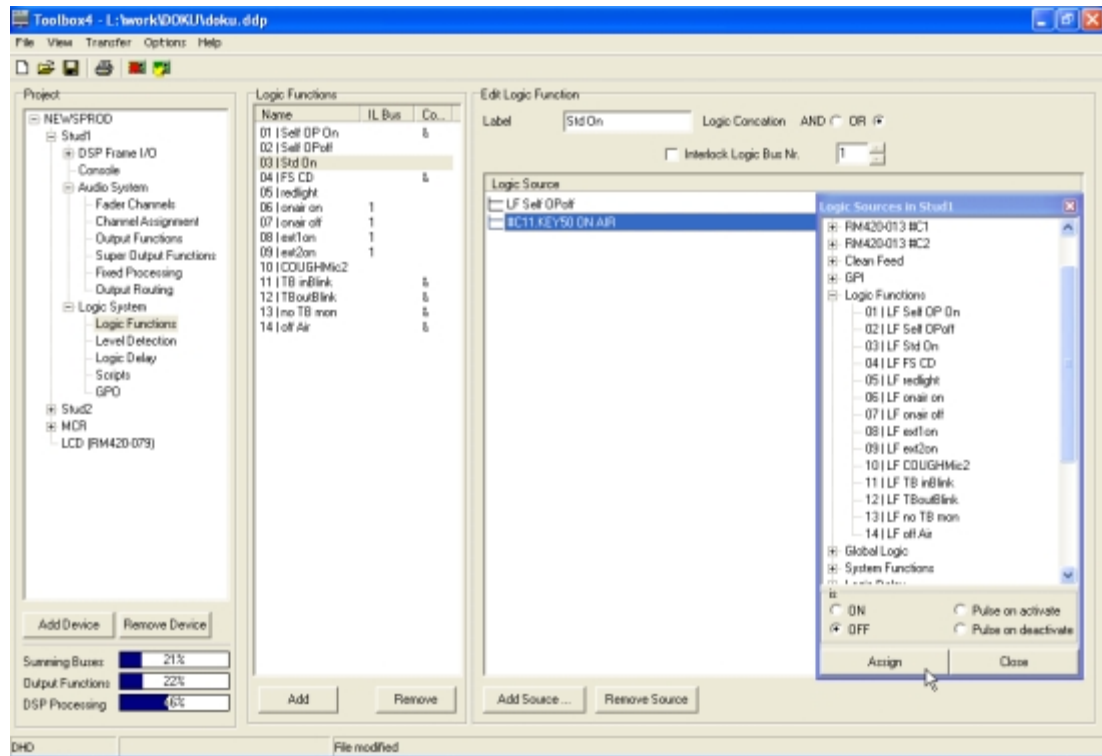
Name of the Function Group	Entries	Description
Logic Delay	LD <name>	<ul style="list-style-type: none"> <li>Active after the end of the preset delay.</li> <li>Each configured <i>Logic Delay</i> has an entry. (See also “Logic Delay” on page 198.)</li> </ul>
Level Detect	LV <name>	<ul style="list-style-type: none"> <li>Active when the level exceeds the preset threshold.</li> <li>Each configured <i>Level Detect</i> has an entry. (See also “Level Detection” on page 196.)</li> </ul>
Correlation Detect	LC <Name>	<ul style="list-style-type: none"> <li>Active, when signal exceeds the set correlation degree (-1 to +1).</li> <li>Each defined <i>Correlation Detect</i> has an entry. You configure the detectors in the dialog Logic System/Level Detection. (See also “Level Detection” on page 196.)</li> </ul>
Fader Start Fader	FS Fader 1...n	<ul style="list-style-type: none"> <li>Active, when the “physical” fader with number 1...n is both <i>open and on</i>.</li> <li>Exception: If the option <i>On Start</i> is active for the currently assigned Fader Channel, you can trigger the fader start with the On/Off key in the fader strip only. (See also “Faderstart” on page 162.)</li> <li>Each configured fader 1...n has an entry (four per Fader Module), no matter which channel is currently assigned to it.</li> </ul>
Faderstart Channel	FS <FaderChanName>	<ul style="list-style-type: none"> <li>Active when the fader of the Fader Channel &lt;FaderChanName&gt; is <i>open and on</i>.</li> <li>Exception: If the option <i>On Start</i> is active for the currently assigned Fader Channel, you can trigger the fader start with the On/Off key in the fader strip only. (See also “Faderstart” on page 162.)</li> <li>Each configured Fader Channel has an entry.</li> </ul>
PFL Fader	PFL Fader 1...n	<ul style="list-style-type: none"> <li>Active if PFL of the “physical” fader with number 1...n is active.</li> <li>Each configured fader 1...n has an entry (four per Fader Module), no matter which channel is currently assigned to it.</li> </ul>
PFL Channel	PFL <FaderChanName>	<ul style="list-style-type: none"> <li>Active if PFL of the Fader Channel &lt;FaderChanName&gt; is active.</li> <li>Each configured Fader Channel has an entry.</li> </ul>
Fader Function Fader	FF Fader 1...n	<ul style="list-style-type: none"> <li>Active if the key function <i>Fader Function</i> of “physical” fader with number 1...n is active. (See also “Fader Function” on page 92.)</li> <li>Each configured fader 1...n has an entry (four per Fader Module), no matter which channel is currently assigned to it.</li> </ul>



Name of the Function Group	Entries	Description
Fader Function Channel	FF <FaderChanName>	<ul style="list-style-type: none"> <li>Active if the key function <i>Fader Function</i> of the Fader Channel &lt;FaderChanName&gt; is active. (See also “Fader Function” on page 92.)</li> <li>Each configured Fader Channel has an entry.</li> </ul> <p> <b>Note:</b> The state of the Fader Function is kept “in the background”, even if the Fader Channel is not switched on to the fader strip any more!</p>
Fader Function 2 Channel	FF2 <FaderChanName>	<ul style="list-style-type: none"> <li>Active if the key function <i>Fader Function 2</i> of the Fader Channel &lt;FaderChanName&gt; is active. (See also “Fader Function” on page 92.)</li> <li>Each configured Fader Channel has an entry.</li> </ul> <p> <b>Note:</b> The state of the Fader Function 2 is kept “in the background”, even if the Fader Channel is not switched on to the fader strip any more!</p>
Rotary Select	RS <SourceListName> Text	<ul style="list-style-type: none"> <li>Active if the corresponding source is selected using one of the <i>Rotary Monitor Selectors 1...10</i>.</li> <li>1 to max. 150 of these logic functions can be used depending on how the signal lists are configured.</li> <li>Application mostly for special talkback functions.</li> </ul> <p> <b>Note:</b> You should assign a signal list for these functions only to one Rotary Monitor Selector at a time, since otherwise the last selection controls the logic function which may cause irritations for the users.</p>

### 8.1 Defining Logic Functions

With RM4200D, you can create up to 150 different logic functions that can use up to 20 Logic Sources. For each logic function, you can link the Logic Sources either by *OR* or *AND*. The list of logic functions illustrates the way each function is linked. If the symbol “&” is displayed in the column *Conc.*, the function is *AND* linked. If the symbol is missing, the function is *OR* linked. To create more complex Boolean functions, you can use already defined logic functions again as Logic Sources for further logic functions.



**Figure 3–67: Logic Functions, configuration dialog.**

*Flip-Flop*-like functions can be set up using *Interlock Logic Buses*. This is a special function that allows all logic functions on the same Interlock Logic Bus to deactivate each other as soon as one of the logic functions becomes active. This way, you can e.g. create alternating key set functions, of which only *one* logic function is active at the same time. Many other applications are possible. You can use up to 100 different Interlock Logic Buses. If a logic function uses an Interlock Logic Bus, its number is displayed in the list of Logic functions in the IL BUS column. (See also “Interlock Logic Bus” on page 193.)

The logic functions are processed every 20 ms in the Communication&Logic Controller RM420-850 and supplied via CAN bus to all other controllers. The order of the processing corresponds to the order in the list (top to bottom) in which the logic functions are contained in the configuration dialog. (See figure 3–67.)







To insert a new logic function into the list Logic Functions, use the button Add. To delete an entry from the list, select it and click on the button Remove. You can choose both functions from the contextual menu inside the list.

After marking the desired function in the list Logic Functions, you can configure it in the right pane of the dialog under Edit Logic Function. The following list describes a configuration example for a new logic function:

1. First enter a descriptive name for the function in the field Label; this may be up to 10 characters long. Please consider that for a maximum of 150 logic functions per Device, this name is important for the clarity of your configuration! The name is displayed in the Logic Sources Window after the short name “LF”.
2. Now click on the button Add Source, to open or activate the Logic Sources Window. Select the desired Logic Source.

## Part III: Toolbox 4 Configuration Reference

- Before assigning the selected Logic Source, first decide how it shall influence the logic function. This feature is displayed in the logic function as icon for each Logic Source. You can define the following features:

ON		<ul style="list-style-type: none"> <li>Logic Source works directly.</li> </ul>
OFF		<ul style="list-style-type: none"> <li>Logic Source is inverted.</li> </ul>
Pulse on activate		<ul style="list-style-type: none"> <li>Rising edge activates the function.</li> </ul> <p> <b>Note:</b> Use only in connection with <i>Interlock Logic Bus!</i></p> <ul style="list-style-type: none"> <li>Example: Key is pressed.</li> </ul>
Pulse on deactivate		<ul style="list-style-type: none"> <li>Falling edge activates the function.</li> </ul> <p> <b>Note:</b> Use only in connection with <i>Interlock Logic Bus!</i></p> <ul style="list-style-type: none"> <li>Example: Key is released.</li> </ul>



**Important Note:** The options *Pulse on activate* and *Pulse on deactivate* may only be used in logic functions with activated *Interlock Logic Bus!*

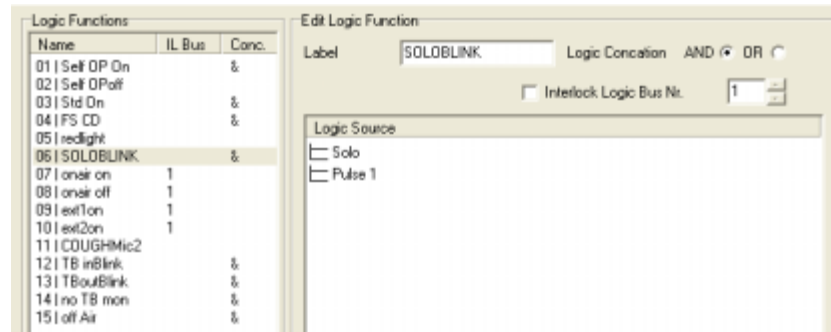
- Now assign the desired Logic Source. Either use the button Add Source or double click the desired source. Alternatively, you can also move a Logic Source into the list using Drag&Drop. If a Logic Source is already marked in the list, it is overwritten. The same happens if you move a Logic Source into an already existing row of the list.
- Choose whether the logic functions are to be linked AND or OR and whether they are to be interconnected with an Interlock Logic Bus. (Find more details on that in the following sections.)

### AND Logic

For the *AND* logic, *all* Logic Sources must be true for the logic function to be true as well. *AND* linked logic functions are marked with a “&” in the Conc. column (Concatenation).

In the following example, the Logic Source *System Functions/Solo* is linked to the Logic Source *System Functions/Pulse1* using an *AND* logic. You can put the created logic function SOLOBLINK on the LED of a *User Defined* key of the control. This starts flashing when at least one *Solo* key is pressed in any Fader Module.





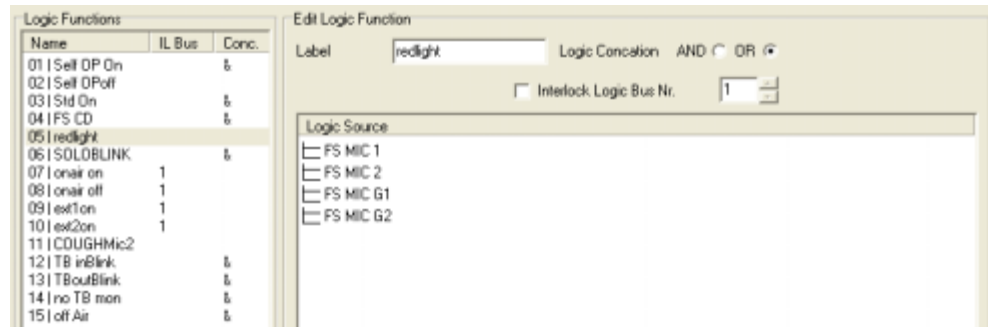
**Figure 3–68: Logic function, example for AND logic.**

You can use the logic source *System Functions/Solo* to switch loudspeakers between the monitor bus and the solo bus using an Output Function. The flashing key indicates that the loudspeaker is not switched on to the monitor bus.

### OR Logic

For the OR logic, at least *one* Logic Source must be true in order for the logic function to be true.

In the following example, the Logic Sources *Fader Start/Mic1...4* are linked with each other by OR.



**Figure 3–69: Logic function, example for OR logic.**

To activate a logic function it is sufficient to open the fader of at least *one* of the microphone channels. This might be a solution to e.g. switch on the red light over a GPO.

### Interlock Logic Bus

This function is used to interlink several alternating logic functions. All logic functions influencing each others must be switched on to the *same* Interlock Logic Bus.

You can use up to 100 different Interlock Logic Buses at the same time, although in this case a logic function can be linked to only *one* Interlock Logic Bus. But it is possible to use several of these logic functions as inputs for further logic functions again that themselves use other Interlock Logic Buses.

The function of an Interlock Logic Bus can be described as follows:

1. If a logic function is linked to an Interlock Logic Bus, at first it reacts normally. It becomes active if its logical conditions become true.

- If a logic function using an **Interlock Logic Bus** becomes *true*, all other logic functions linked to the same **Interlock Logic Bus No.** become *inactive*. Thus, activating *one* logic function on the same Interlock Logic Bus causes the deactivation of *all other* logic functions.

Since the logic functions in the RM4200D are processed successively, a state change of a logic function with activated Interlock Logic Bus can only be triggered reasonably by a rising or falling edge of the triggering Logic Source to be controlled. If you use an already defined logic function as Logic Source, you can also output this result as edge. To achieve that, select the function in the Logic Sources Window and then click on the option *Pulse on activate* or *Pulse on Deactivate*. (See also “Example 4 - Changing state with two keys” on page 195.)



**Note:** The display of the *Interlock Logic Bus No.* under *Edit Logic Function* does not matter when the checkbox *Interlock Logic Bus* is not activated.

### Examples of use

The following examples illustrate the use of Interlock Logic Bus to solve real practical problems.

#### Example 1: Flip Flop Functions

A logic function is set by the rising edge of a GPI, reset by the next rising edge, etc.

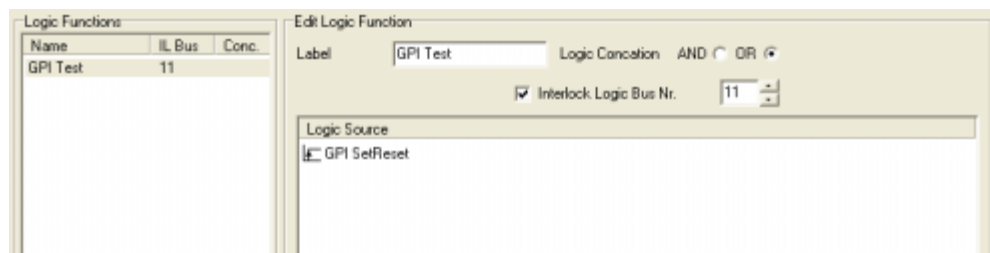


Figure 3–70: Interlock Example 1: Flip Flop.

#### Example 2: Key set, can be switched off

An alternating key set with several keys is created by defining a logic function for each key. All these functions are interconnected with the same Interlock Logic Bus. Each of the logic functions has only the corresponding own key as Logic Source (with the feature “Pulse on activate”).

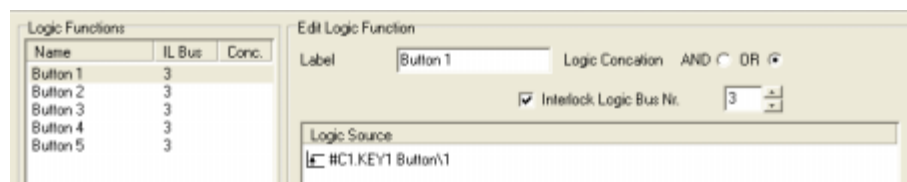


Figure 3–71: Interlock example 2: Key set can be switched off.

When you press a key, its logic function becomes active, the previously active key becomes inactive. When pressing the active key again, it is switched off.

The logic functions control the LEDs of the corresponding keys with the function *User Defined*.

**Example 3: Key set can not be switched off**

This example is similar to the key set from example 2, with one difference: When pressing the currently active key, it is *not* switched off. Only after resetting the system, all logic functions are inactive.



Figure 3-72: Interlock Example 3: Key set can not be switched off.

Each logic function has an own key as Logic Source (Pulse on activate) *AND* additionally, the *own inverted logic function*. This way, the function can only be activated when it is inactive.

The logic functions control the LEDs of the corresponding keys with the function *User Defined*.

**Example 4 - Changing state with two keys**

The following complex example consists of four logic functions. It demonstrates how you can program a key set consisting of two alternating keys. The keys act as follows:

- There are *only* the two states “Key 1 pressed (state A)” and “Key 2 pressed (state B)”; there is *no* state in which both A and B are *inactive*.
- If an active key is pressed again, the state does not change.

The logic function *Aaktiv* is put on the LED of the *User Defined key A* and the logic function *Baktiv* on the LED of the *User Defined Key B*. These two logic functions can e.g. switch audio signals using *Output Functions*.

This arrangement needs an Interlock Logic Bus in one logic functions, e.g. the bus No. 2 in the logic function *Baktiv*. The three other logic functions do not use an Interlock Logic Bus.



Figure 3-73: Interlock Example 4: Change of state with two keys, Logic Function 1.

The logic function *Aaktivier* becomes active if condition B is active and key A is pressed.

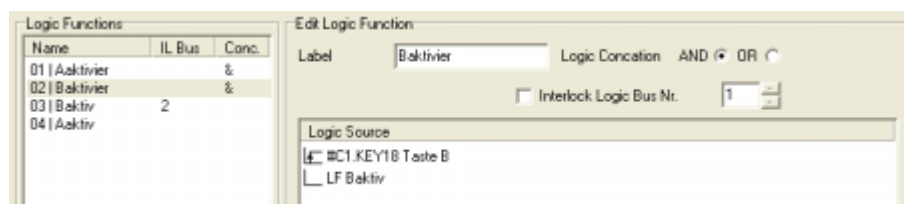
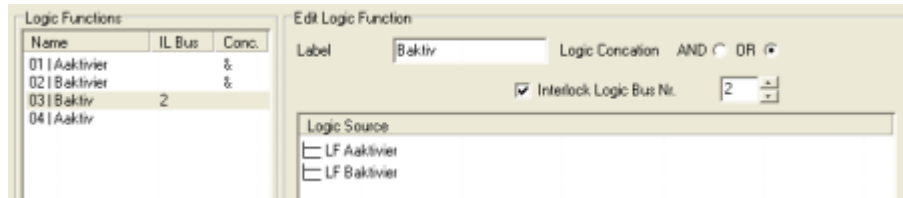


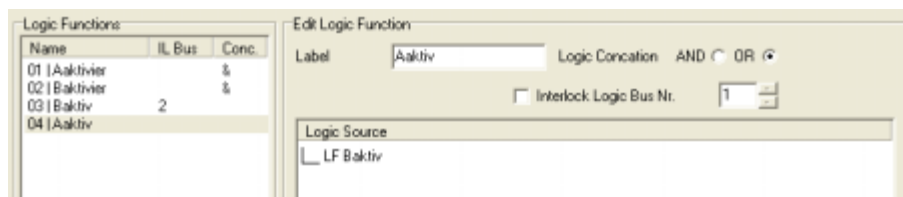
Figure 3-74: Interlock Example 4: Change of state with two keys, Logic Function 2.

*Baktivier* becomes active when condition B is inactive (A is active) and the key B is pressed.



**Figure 3–75: Interlock Example 4: Change of state with two keys, Logic Function 3.** *Baktiv* is assigned to *Interlock Logic Bus 2* and can change its state triggered by *Aaktivier* or *Baktivier*. Which of the two OR linked Logic Sources sets or resets the function, is determined by the logic functions *Aaktivier* or *Baktivier*. In turn, their output is determined by the conditions B and A (= inverted condition B) linked by AND.

*Baktiv* furthermore controls the LED source of key B and the corresponding function to be executed respectively.



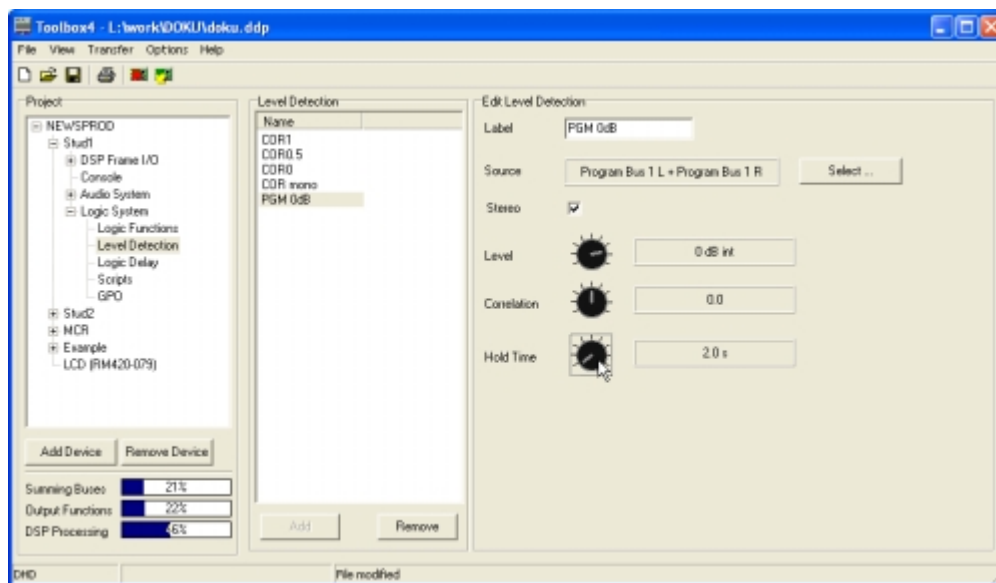
**Figure 3–76: Interlock Example 4: Change of state with two keys, Logic Function 4.** *Aaktiv* is the inversion of the condition *Baktiv*.

*Aaktiv* furthermore controls the LED source of key A or the corresponding function to be executed respectively.

## 8.2 Level Detection

With the Logic System of RM4200D you can monitor the levels and correlation degree of up to five audio signals at the same time. Level Detectors configured accordingly control logic functions that are activated when the level exceeds a preset threshold. These logic functions are available in the Logic Sources Window under *Level Detect/LV <Label>* or *Correlation Detect/LC <Label>*. For each entry in the list Detection, in the Logic Sources Window for Level Detect and Correlation Detect an entry each is added.

The state of the logic function can be output e.g. using a GPO or displayed in the LED of a *User Defined* key on the Control Module.



**Figure 3–77: Level Detect, monitoring of audio levels and correlation degree.**

To insert a new Level and Correlation Detect into the list *Level Detection*, use the button *Add*. In order to delete it, mark the entry and click on the button *Remove*. Both functions are also available in the contextual menu.

After highlighting an entry in the list *Level Detection*, you can configure the Level Detect in the pane *Edit Level Detection* of the dialog:

1. First enter a name for the function in the field *Label*. This may be up to 10 characters long.
2. Now click on the button *Select*, to open or activate the *Audio Sources* Window. Select the audio signal that you want to monitor and assign it as *Source*. To do that, either use the button *Assign*, drag&drop or double click on the desired audio source.
3. When you click on the checkbox *Stereo*, in addition, the subsequent channel is automatically selected for monitoring. In most cases, this is the right channel of a stereo signal.
4. Now adjust the desired threshold using the potentiometer *Level*. You can set it between -40dBint and +10dBint in steps of 1dB.
5. Using the potentiometer *Correlation*, you can set a correlation degree value between -1.0 and 1.0, independent from the set threshold at the *Level* potentiometer. The logic function *Correlation Detect/LC <Label>* becomes active when exceeding this value.
6. With the potentiometer *Hold Time* you can adjust for how long the logic functions *Level Detect/LV <Label>* or *Correlation Detect/LC <Label>* remain active after exceeding the threshold. You can set this hold time between 0,1s and 100s.

To adjust the potentiometers, first click on the desired button. Hold the mouse key down and move the cursor to the left or to the right to change the value. Alternatively, you can also click on a potentiometer button, hold the mouse key and change the value with the following keys:

Level Potentiometer	Correlation Potentiometer	Hold Time Potentiometer	Cursor keys
+ 1dB-steps	+0,1-steps	+ 0,1s-steps	Arrow right or arrow up
- 1dB-steps	-0,1-steps	- 0,1s-steps	Arrow left or arrow down
- 40dBint	-1,0	0,1s	Pos 1
+ 10dBint	+1,0	100s	End
+ 10dB-steps	+1,0-steps	+ 1s-steps	PageUp
- 10dB-steps	-1,0-steps	- 1s-steps	PageDown

The level detectors can be inverted as Logic Sources in logic functions or GPOs to detect an *underrun* of the level. By AND-linking in a logic function with the Logic Source Pulse 1 (or 2, 3), you can also configure flashing functions for exceeding or underrunning of levels.

The correlation degree detectors can be used as Logic Source to detect whether both parts of a stereo signal are equal (1) or at least related (0.1-0.9) . In the negative range, the Logic Source displays faulty stereo signals that are not qualify for mono generation.

### 8.3 Logic Delay

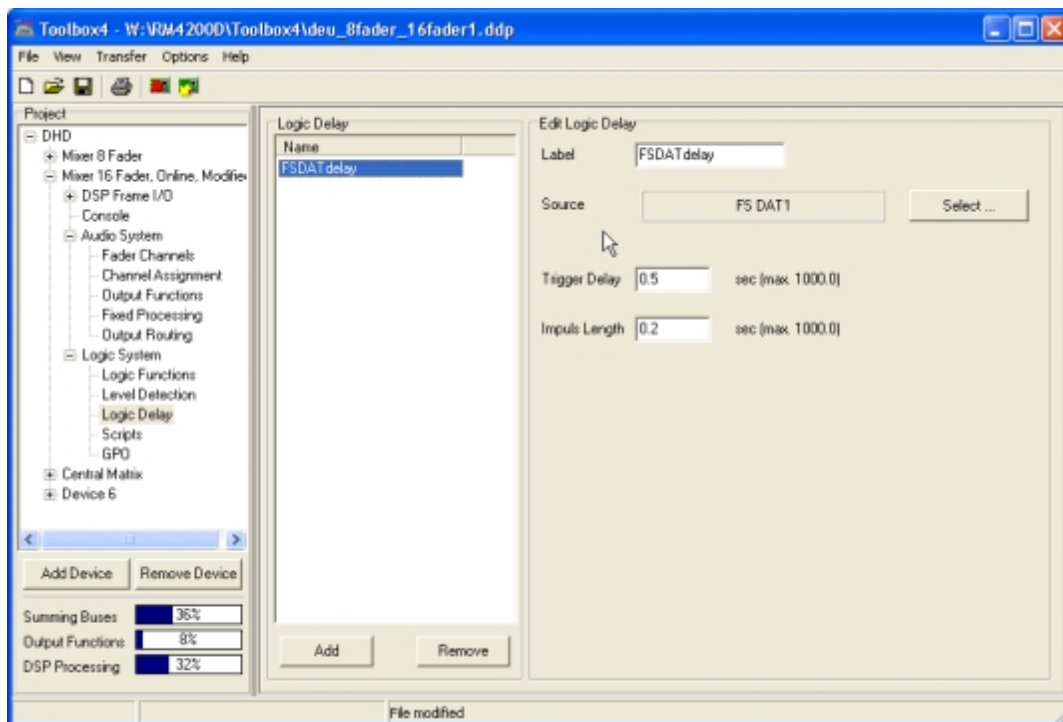
For delaying the output of logic signals, up to 20 *Logic Delays* are available for each Device. These can delay logic signals between 0,1s and 1000s.

The *Logic Delays* are available as logic signals in the Logic Sources Window under *Logic Delay/LD <Label>*.

You can use *Logic Delays* e.g. for delaying fader starts or for extending pulses in general.



**Note:** A *Logic Delay* is started when the selected logic source outputs a rising edge.



**Figure 3–78: Setting up a Logic Delay.**

In the list *Logic Delay*, you can add new entries using the button *Add* or remove available entries with the button *Remove*. Both functions are also available in the contextual menu.

If you have highlighted an entry in the list *Logic Delay*, you can configure it in the pane *Edit Logic Delay*:

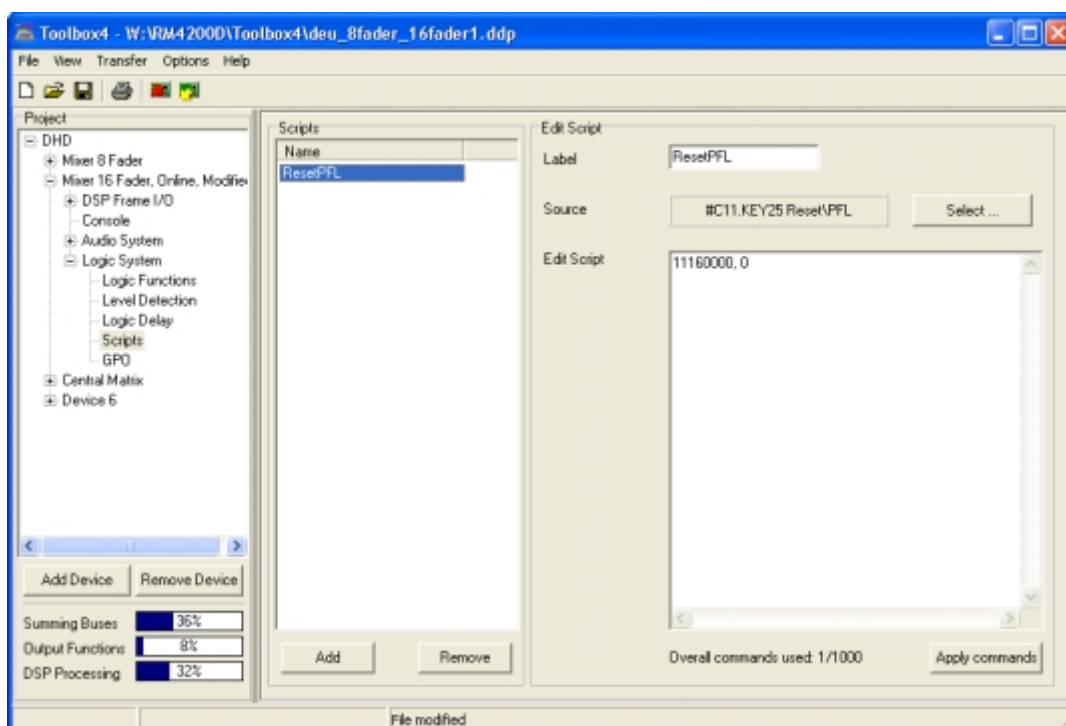
1. First name the function in the field *Label*. The name can be up to 10 characters long.
2. Now click on the button *Select*, to open or activate the *Logic Sources* Window. Select the logic source that you want to delay and assign it as *Source*. This can be done either with the button *Assign*, a double click on the desired logic source or using *Drag&Drop*.
3. Enter the desired delay time in the field *Trigger Delay*. Enter the length of the output pulse in the field *Impulse Length*. You can enter in both fields the desired time using the keyboard with a resolution of 0.1s. The entry is limited to a minimum of 0.1s and a maximum of 1000.0s.

After the rising edge as start condition for the *Logic Delay*, the triggering logic source *Source* is not checked while the function is running. The running time corresponds to the sum of all values of *Trigger Delay* and *Impulse Length*. (Running time = *Trigger Delay* + *Impulse Length*.)

### 8.4 Scripts – Controlling Special Functions with Scripts

By using scripts, you can control the internal functions of the RM4200D directly with commands sent over the CAN bus. This way you can also use functions that can not be directly configured as key functions but are supported by the firmware of the RM4200D. Scripts are started by an assigned logic function as soon as this outputs a rising edge. Then the script sends a preset series of commands to the CAN bus.

You can configure up to 100 scripts with a total number of up to 1000 commands. The scripts are processed from top to bottom. The lines inside a script are processed with a delay of 40ms to avoid system overloads.



**Figure 3–79: Configuring scripts, example “Reset PFL”.**

You find the RM4200D CAN Bus commands in the volume “DHD RM4200D Protocol Description” of this manual. In addition, you can select and copy currently executed commands in the window *Maintenance*. To do that, use the command Show Protocol in the menu Protocol of the window *Maintenance*. (See also “Enable CAN Protocol (F4)” on page 35.)

You can insert scripts in the list *Scripts* by using the button *Add* or remove them with the button *Remove*. Both functions are also available in the contextual menu.

If you have highlighted an entry in the list *Scripts* you can configure the corresponding script in the pane *Edit Script* of the dialog:

1. First name the script in the field *Label*. The name can be up to 10 characters long.
2. Now click on the button *Select*, to open or activate the *Logic Sources* Window. Select the logic source that is to start the script and assign it under *Select Condition*. This can be done either with the button *Assign*, a double click on the desired Logic Source or using *Drag&Drop*.



- Now enter in the pane `Edit Script` a list with the desired commands. Each line may contain only one valid RM4200D CAN bus command.
- Finally, click on the button `Apply commands`, to compile the entered commands into the internal data structures. For larger scripts, this process can last some seconds.



**Important Note:** Before saving the script or leaving the script window using the `Apply commands` button, you have to check whether the entered script is correct. This check is compulsory, since incorrect commands (because of typing errors) can otherwise cause unexpected malfunctions.

### Examples for Scripts

The following example uses an external control signal at a GPI to switch on the faders 1 to 4. This can be used to e.g. switch on the microphones in a studio using an external key.

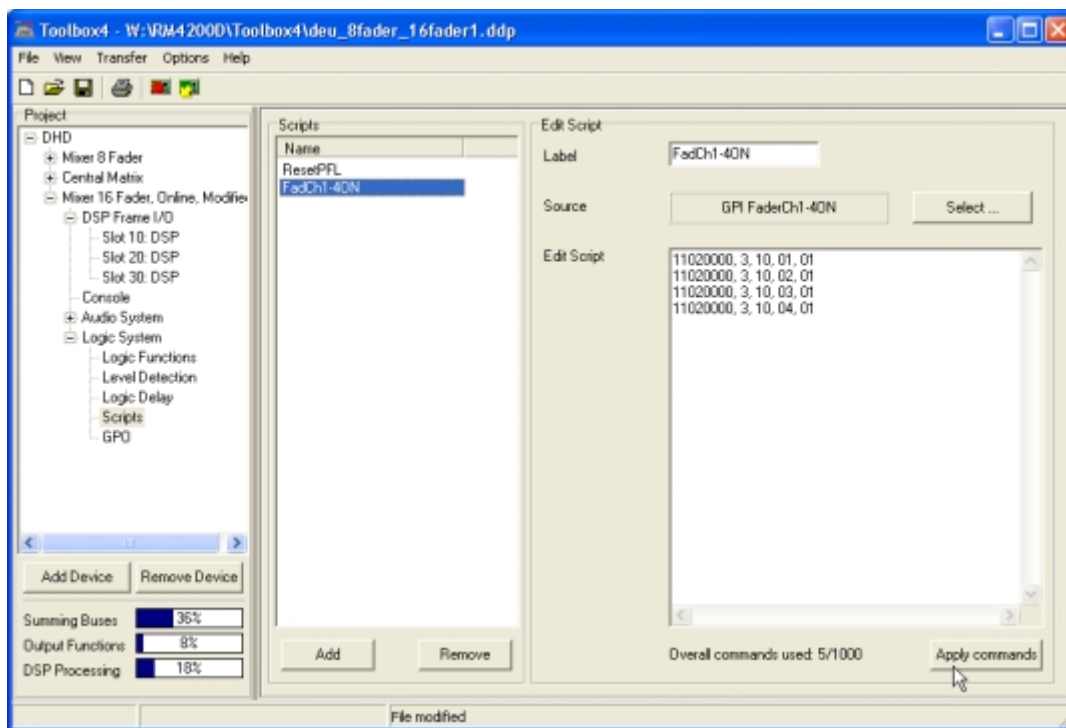


Figure 3–80: Scripts, Example: Switching on Fader Channel 1...4.

The following table contains some further examples for CAN bus commands:

RM4200D CAN Bus command	Function
11160000,0	PFL Reset (for all switched on PFLs)
11020000,3,10,01,01	Fader Channel 1 ON
11020000,3,10,02,01	Fader Channel 2 ON
11020000,3,10,03,01	Fader Channel 3 ON
11020000,3,10,04,01	Fader Channel 4 ON
11020000,3,10,01,00	Fader Channel 1 OFF
11020000,3,10,02,00	Fader Channel 2 OFF

RM4200D CAN Bus command	Function
11020000,3,10,03,00	Fader Channel 3 OFF
11020000,3,10,04,00	Fader Channel 4 OFF
11000000,6,40,02,01,00,40,03	Monitor Bus 1 switched on to Program Bus 1
0103FFFF,0	System-Reset

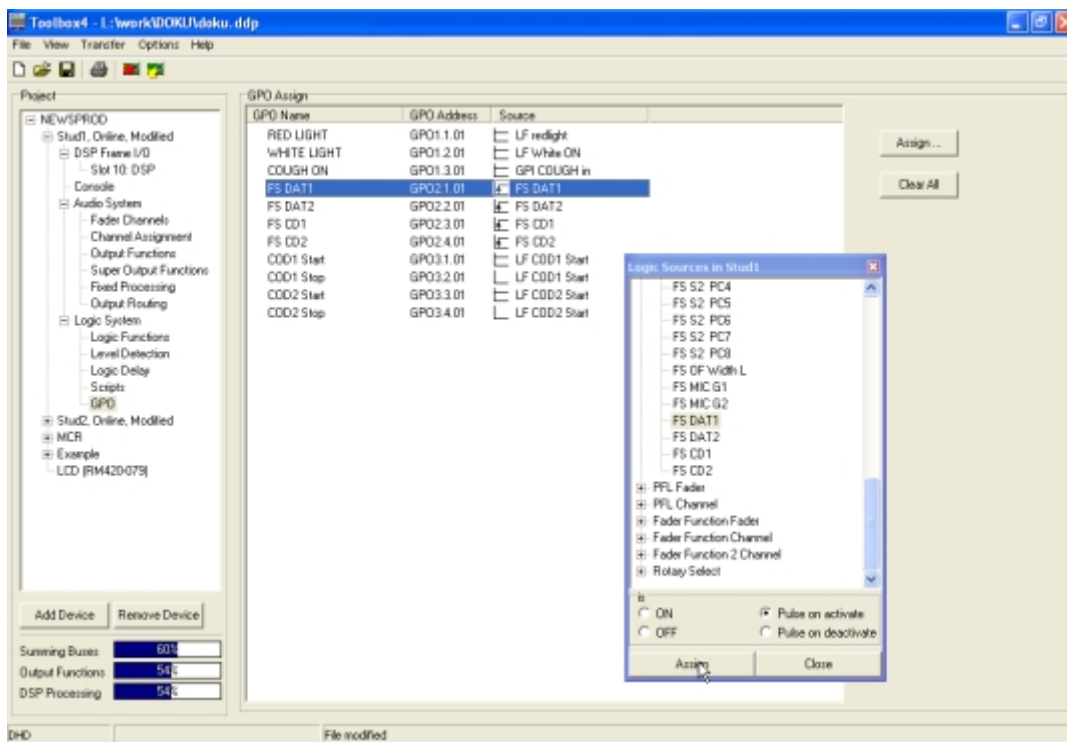
## 8.5 GPOs - General Purpose Outputs

Using GPOs, you can output external control signals from all available Logic Sources. For each GPO, the logic signal can be inverted or output as pulse.

GPOs are available on the plugs of all audio modules, or optionally as separate module. GPOs are totally independent from the audio signals or GPIs that are located on the same connector. GPOs are galvanically isolated.



**Caution:** When connecting external Devices, always pay attention to the specifications for the maximum current and the maximum voltage allowed, to avoid damage and hazards! (Find more information on that in the volume *Part5: Installation Guide* of this manual.)



**Figure 3–81: Assigning General Purpose Outputs (GPO) to Logic Sources.**

In the list GPO Assign all switched outputs are listed that are available to the Device under Audio System/DSP-Frame I/O after inserting the corresponding modules and that are assigned a name there as well. There you can also name the individual GPOs. (See also “Configuring GPIO connectors” on page 76.)







**Important Note:** There might be displayed no or less GPOs displayed in the list GPO Assign than really are available in the system. Only those GPOs are

displayed in the list that you have assigned names under `Audio System/DSP Frame I/O`. All other GPOs are not displayed to keep the list concise.

To assign a GPO to a Logic Source, first highlight the desired entry in the list `GPO Assign`. Then use the button `Assign` to open or activate the `Logic Sources Window`. Alternatively, you can also double click on the corresponding entry in the list. Now select the desired Logic Source and determine how it should work (see following table). To assign it to the GPO, use the button `Assign` in the window `Logic Sources Window` or double click on the Logic Source. You can also move the Logic Source directly to the desired GPO using `Drag&Drop`.

If you want to deactivate an already defined GPO, select the entry `None` as Logic Source (top of the `Logic Sources Window`).

For each Logic Source you have to determine how it shall affect the logic function. Do this using the radio buttons in the `Logic Sources Window` before assigning it to a GPO. The following table lists all available opportunities:

<i>ON</i>		<ul style="list-style-type: none"> <li>Logic Source is applied directly.</li> </ul>
<i>OFF</i>		<ul style="list-style-type: none"> <li>Logic Source is inverted.</li> </ul>
<i>Pulse on activate</i>		<ul style="list-style-type: none"> <li>The rising edge of the Logic Source generates a pulse of 150ms.</li> <li>Application e.g. as start impulse.</li> </ul>
<i>Pulse on deactivate</i>		<ul style="list-style-type: none"> <li>The falling edge of the Logic Source generates a pulse of 150ms.</li> <li>Application e.g. as stop impulse.</li> </ul>

The configured feature is displayed in the list `GPO Assign` for each Logic Source as icon at the beginning of the line.



**Caution:** The button `Clear All` deletes the assignments for *all* GPOs, “Undo” is not possible!



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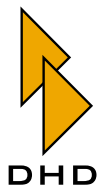
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