User's Guide

RME®
Intelligent Audio Solutions

DIGI96/8 PST

DVD
24 Bit / 96 kHz ✓ *ready*

SyncAlign®   **ZLM**®   **adat**® OPTICAL

PCI Bus Audio Card
2 / 8 Channels Stereo / ADAT® Interface
24 Bit / 96 kHz Digital Audio
32-96 kHz Sample Rate
24 Bit / 96 kHz Analog Audio

Board Rev. 1.0, Hardware version 005

Contents

1. Introduction

Thank you for choosing the RME DIGI96/8 PST. This card is capable of transferring digital and analog audio data directly to a computer from practically any device equipped with a digital audio interface, be it S/PDIF, AES/EBU or ADAT optical. Installation is simple, even for the inexperienced user, thanks to latest Plug & Play technology and full interrupt-sharing. The numerous unique features and well thought-out configuration dialog puts the DIGI96/8 PST at the very top of the range of digital audio interface cards.

Drivers for Windows (95/98, NT, 2000) and MacOS allow a problem-free, comfortable and powerful usage on computer systems with PCI bus technology. Drivers for Unix, Linux and Solaris are also available (see chapter 7.4). With this the DIGI96 series is supported by a variety of Operating Systems like no other digital audio card.

Our Hi-Performance philosophy guarantees full system performance in all possible functions not carried out by the driver (the computer´s CPU) but carried out by the DIGI96 series hardware.

2. Package Contents

Please ensure that all the following parts are included in DIGI96/8 PST's packaging box:

- PCI card DIGI96/8 PST
- Quick Info guide
- RME Driver CD
- Internal cable (2 core)

3. System Requirements

- Windows 95/98/NT/2000, Linux or MacOS
- A free PCI bus slot

Additional system requirements such as CPU, memory etc. depend on the software being used for recording, playing and editing the audio data.

4. Brief Description and Characteristics

- All settings can be changed in real-time, all output options even in playback mode
- Separate record- and playback circuits; complete master mode
- Enhanced Full Duplex: Different sample rates at input and output possible
- Mixed mode: ADAT in - SPDIF out and vice versa
- Automatic and intelligent master/slave clock control
- Unsurpassed Bitclock-PLL (audio synchronization) in ADAT mode
- Optional Word Clock Module (WCM) provides word clock input and output
- Track Marker Support: Supports CD/DAT Start-IDs and read out of CD subcode
- Comes with DIGICheck: the ultimate measurement, analysis and test tool
- ADAT tracks routeable to analog output
- Unique status windows for record and playback, showing mode and sample rate
- Enhanced Zero Latency Monitoring: hardware bypass per track, controlled by Punch-I/O
- AutoSelect searches automatically for an input with valid signal
- SyncAlign guarantees sample aligned and never swapping channels
- Full interrupt-sharing under Windows 95/98 and NT
- Windows driver with Pentium optimization (quad times memory transfer)
- 32 bit memory transfer and fast 128 kB SRAM guarantee very low system load

5. Technical Specifications

5.1 Digital

- Ultra-low jitter SPDIF: < 1 ns in PLL mode (44,1 kHz, optical in)
- Ultra-low jitter ADAT: < 2 ns in PLL mode (44,1 kHz, optical in)
- Input PLL ensures zero dropout, even at more than 40 ns jitter
- Bitclock PLL for trouble-free varispeed in ADAT mode
- High-sensitivity input stage (< 0.2 Vss input level)
- Output voltage Consumer 0.8 V, Professional 1.6 V
- Supported sample rates: 32 / 44.1 / 48 / 64 / 88.2 / 96 kHz and variable (word clock)
- Inputs and outputs ground-free transformer coupled
- Connectors: optical (TOSLINK), coaxial (phono), internal (CD-ROM/Sync-In, Sync-Out)
- Formats: SPDIF, AES/EBU (Consumer/Professional), ADAT optical

5.2 Analog

- Input sensitivity adjustable through jumper +4 dBu / -10 dBV
- Dynamic range input: 105 dB (RMS unweighted, unmuted), 109 dBA
- THD+N input: < -100 dB / < 0.001 %
- Frequency response AD, -0.1 dB: 10 Hz - 20,3 kHz (sf 44.1 kHz)
- Frequency response AD, -0.5 dB: 5 Hz - 44,8 kHz (sf 96 kHz)
- Sample rates record: 32 / 44.1 / 48 / 64 / 88.2 / 96 kHz and variable (word clock)
- Input impedance: 10 kOhm
- Channel separation: > 110 dB

- Analog output fixed +10 / +4 / -2 / -8 dBu @ 0 dBFS
- Dynamic range output: 108 dB (RMS unweighted, unmuted), 112 dBA
- THD+N output: -100 dB / 0.001%
- Frequency response DA, -0.1 dB: 20 Hz - 20.8 kHz (sf 44,1 kHz)
- Frequency response DA, -0.5 dB: 10 Hz - 44 kHz (sf 96 kHz)
- Sample rates playback: 32 / 44.1 / 48 / 64 / 88.2 / 96 kHz and variable (word clock)
- Ouput impedance: 75 Ohm
- Channel separation: > 110 dB

5.3 Transfer Modes: Resolution / Bits per Sample

- 16 bit 2 bytes (stereo 4 bytes) (*)
- 20 bit 3 bytes MSB (stereo 6 bytes)
- 20 bit 4 bytes MSB (stereo 8 bytes) (*)
- 24 bit 3 bytes (stereo 6 bytes)
- 24 bit 4 bytes MSB (stereo 8 bytes) (*)
- 32 bit 4 bytes (stereo 8 bytes) (*)

All the above formats are also available in Multi-Device mode (4 x stereo = 8 channels). The Channel Interleave mode (1 x 8) provides the following resolutions:

- 16 bit 16 bytes (*)
- 24 bit 24 bytes
- 24 bit 32 bytes (*)

* The indicated modes are directly supported by the hardware and therefore work in 32 bit hi-speed transfer mode. The other modes (so called 'packed byte' formats) are queued up to 32 bit data packets by special copy routines in the driver. These routines are written in Assembly, causing no measureable system load. The supported modes with other Operating Systems than Windows 95/98 and NT depend on the OS and/or the corresponding drivers.

6. Hardware Installation

☞ *Important: Switch off the computer and remove the power cable from the power supply before fitting the DIGI96/8 PST. Inserting and removing the card while the computer is in operation will more than likely lead to irreparable damage to the mainboard!*

1. Disconnect the power cord and all other cables from the computer
2. Remove the computer's housing; further information on how to do this can be obtained from your computer´s instruction manual
3. Important: Before removing the DIGI96/8 PST from its protective bag, discharge any static in your body by touching the metal chassis of the PC.
4. Insert DIGI96/8 PST firmly into a free PCI slot, press and fasten the screw.
5. Replace the computer's housing and tighten the screws.
6. Reconnect the power cable and all other cables/connections.

7. Software Installation

7.1 Windows 98

After the hardware has been installed correctly (see 6. Hardware Installation), and the computer has been switched on, Windows will recognize the new hardware component and start its 'Add New Hardware Wizard'. Insert the RME Driver CD into your CD-ROM drive, and follow further instructions which appear on your computer screen.

Windows will install the DIGI96/8 PST driver, and will register the card in the system as a new audio device. The DIGI96/8 PST is now ready for use.

☞ *Unfortunately, in seldom cases, the path to the CD-ROM (i.e. its drive-letter) has to be typed in again during the copy process.*

All cards of the DIGI96 series are quickly and easily configured through the Settings dialog of the DIGI96 driver. The Settings dialog is started in three different ways:

- by clicking on the DIGI icon in the Taskbar's system tray
- by starting the 'Digi96' link from the Desktop
- via 'shortcut key' as defined in the 'Digi96' link (default: Ctrl-Num2)

7.2 Windows NT

As automatic hardware recognition has not been implemented in Windows NT 4.0 the drivers have to be installed 'by hand'.

After the hardware has been installed correctly (see 6. Hardware Installation) and Windows NT has been booted, insert the RME Driver CD into your CD-ROM drive. Register the new device by starting >Control Panel /Multimedia /Devices /Audio Devices /Add<. Change the directory to **\nt** in the CD-ROM. Windows NT will now install the driver. The RME Settings dialog will open automatically.

A click on 'OK' finishes the installation. After a reboot the DIGI symbol will show up in the sy-stray of the taskbar. The DIGITray tool will be loaded automatically each time when booting NT.

A left mouse click on the DIGI symbol starts the 'Settings' dialog. The NT driver supports any combination of up to three RME cards. The driver is installed only once for all cards in the system.

7.3 Windows 2000

After the hardware has been installed correctly (see 6. Hardware Installation), and the computer has been switched on, Windows will recognize the new hardware component and start its 'Hardware Wizard'. Insert the RME Driver CD into your CD-ROM drive, and follow further instructions which appear on your computer screen. The driver files are located in the directory **\win2000** on the RME Driver CD.

Windows will install the DIGI96 driver, and will register the card in the system as a new audio device. The card now ready for use.

Unfortunately, there are rare cases where the CD-ROM path (i.e. its drive-letter) has to be typed in again during the copy process.

All cards of the DIGI96 and Hammerfall series can be easily configured using the RME DIGI Settings dialog. The panel 'Settings' can be opened

- by clicking on the DIGI icon in the Taskbar's system tray
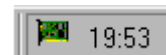
7.4 Linux/Unix

Drivers for Linux, Unix and Solaris are available at 4Front Technology. Information:
http://www.opensound.com

Another source of (free) drivers is the ALSA project:
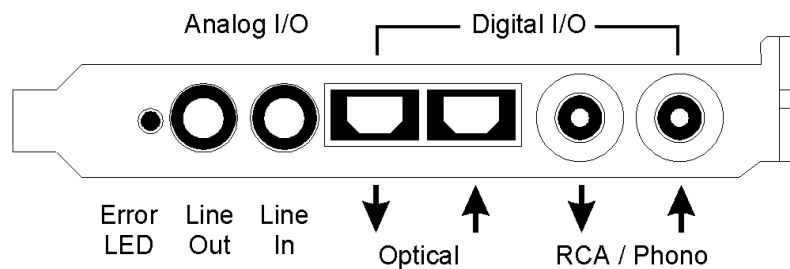http://www.alsa-project.org

8. Operation and Usage

8.1 Connections

The DIGI96/8 PST has 2 external and 1 internal (contact pins on the board) inputs and outputs. The internal digital input can be connected to an internal CD-ROM drive when this is supplied with a digital audio output (advantage: the built in CD-ROM drive is sufficient for digital recording and the need for external cabling does not arise). Or it can be connected with the internal output of another DIGI96 series card (synchronizing multiple cards).

The current input is activated through 'Settings', available by a click on the DIGI symbol in the Taskbar's system tray. The card accepts all commonly used digital sources as well as SPDIF and AES/EBU. Channel status and copy protection are ignored.

To receive signals in AES/EBU format, an adapter cable is required. Pins 2 and 3 of a female XLR plug are connected individually to the two pins of a phono plug. The cable shielding is only connected to pin 1 of the XLR - not to the phono plug. The ground-free design with transformers for digital inputs and outputs offers a trouble-free connection of all devices along with perfect hum rejection.

Note: the red phono socket is the SPDIF output.

All outputs are driven in parallel, therefore carrying identical signals. In the simplest situation, connect 2 devices at the outputs and use the card as a splitter (distribution 1 to 2).

Two ¼" TRS (stereo) jacks are fitted to provide a 2-channel unbalanced analog input and output. The analog output is directly driven from the digital output. A superior 24 bit DAC, followed by a low impedance driver stage, allows the connection of stereo headphones. The settings dialog allows to change the output level from 0 dB down to -78 dB. A special mute circuit reduces noise when switching the computer on and off.

The sensitivity of the analog input can be set per channel to +4 dBu or -10 dBV by jumpers on the board. A sensitivity control by driver or Settings dialog is not available.

The two connectors, ST6 and ST7, provide a connection to the optional Word Clock Module WCM. ST7 is also needed when connecting a AEB4/8-I.

8.2 Playback

DIGI96/8 PAD plays back all wave files in the original wave file's parameters (sample rate, bit resolution, channel numbers), as long as these parameters are supported. Otherwise an error message appears.

In the audio application being used, DIGI96/8 PST must be selected as the output device. This can often be found in the *Options, Preferences* or *Settings* menus under *Playback Device, Audio Devices, Audio* etc. Only a few programs exclusively use Windows' *Preferred Playback Device*. This setting can be changed in >Control Panel /Multimedia /Audio<. We recommend using 24-bit resolution for playback to use the DIGI96 series fullest potential.

The RME Driver CD includes step by step instructions for configuring many popular audio applications. Start setup.htm or setup2.htm (in the **\rmeaudio.web\techinfo** directory).

The screenshot to the right shows a typical configuration dialog as displayed by a (stereo) wave editor. In ADAT mode a playback is done using the currently chosen stereo pair. In SPDIF mode playback always uses channels 1+2.
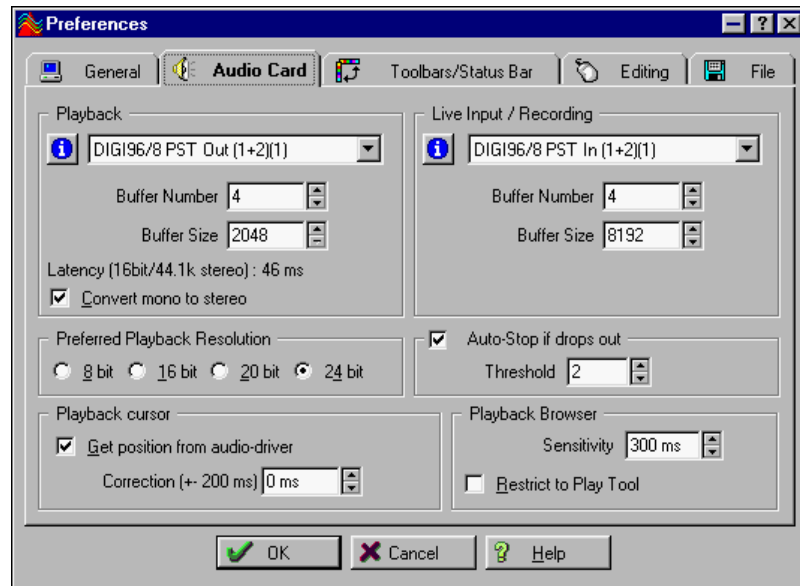
Increasing the number and/or size of audio buffers may prevent the audio signal from breaking up, but also increases latency i.e. output is delayed. For synchronized playback of audio and MIDI, be

Preferences

General | **Audio Card** | Toolbars/Status Bar | Editing | File

Playback
DIGI96/8 PST Out (1+2)(1)
Buffer Number 4
Buffer Size 2048
Latency (16bit/44.1k stereo) : 46 ms
☑ Convert mono to stereo

Live Input / Recording
DIGI96/8 PST In (1+2)(1)
Buffer Number 4
Buffer Size 8192

Preferred Playback Resolution
○ 8 bit ○ 16 bit ○ 20 bit ● 24 bit

☑ Auto-Stop if drops out
Threshold 2

Playback cursor
☑ Get position from audio-driver
Correction (+- 200 ms) 0 ms

Playback Browser
Sensitivity 300 ms
☐ Restrict to Play Tool

✓ OK   ✗ Cancel   ? Help

sure to activate the checkbox 'Get position from audio driver'. Even at higher buffer settings in a mixed Audio/MIDI environment, sync problems will not arise because the DIGI96/8 PST always reports the current play position correctly (even while recording - essential for chase lock synchronization).

8.3 Digital Record

After the DIGI96/8 PST has been set up as the recording device in the software being used at the time, there are a few further points to note. Because the operating system cannot define errors exactly, it may well be that you receive the same error message for very different types of problems.

Unlike analog soundcards which produce empty wave files (or noise) when no input signal is present, digital I/O cards always need a valid input signal to start recording (this includes the correct sample frequency as well).

To take this into account, RME has included three unique features in the DIGI96 series: an error LED for the active digital input in use, a comprehensive I/O signal status display (showing sample frequency, lock and format) in the Settings dialog, and the protective *Check Input* function.

The error LED indicates whether the card gets power and a valid digital input signal. Whenever an error occurs (wrong input, invalid data, signal transmitting device delivers nothing) the LED will light red. As soon as a valid input signal is present the LED will turn off. The display of the sample frequency (see chapter 9, picture Settings) in the Status display offers a similar function. If no sample frequency can be recognized 'Out Of Range' will be shown, in case of an error detection 'No Lock'.

If a 48 kHz signal is fed to the input and the application is set to 44.1 kHz, *Check Input* stops the system from recording. This prevents faulty takes, which often go unnoticed until later on in the production. Such tracks appear to have the wrong playback rate - the audio quality as such is not affected. 'Check Input' may be switched off for vari-speed purposes.

Therefore configuring the software to perform a digital recording is child´s play. After selecting the required input DIGI96/8 PST displays the current sample frequency. This parameter can then be changed in the application's audio attributes (or similar) dialog.

The screenshot to the right shows a typical dialog used for changing basic parameters such as sample frequency and resolution in an audio application.

Any bit resolution can be selected, providing it is supported by both the audio hardware and the software. Even if the input signal is 24 bit, the application can still be set to record at 16-bit resolution. The lower 8 bits (and therefore any signals about 96dB below maximum level) are lost entirely. On the other hand, there is nothing to gain from recording a 16-bit signal at 24-bit resolution - this would only waste precious space on the hard disk.
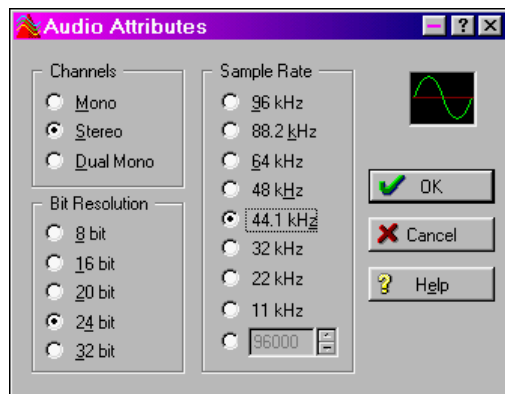
It often makes sense to monitor the input signal or send it directly to the output. The DIGI96 series includes a useful input monitor function, which can be set in the Settings dialog of the DIGI96/8 PST's driver (*Output/Automatic*). Activating Record or Pause in the application causes the input signal to be passed directly to the digital and analog output. However, some applications block monitoring by constantly activating playback, even if the track is empty. This is often required by programs to ensure that timing and punch I/O will work correctly.

Currently two solutions exist which enable real-time monitoring even when playback is active. Our ZLM (Zero Latency Monitoring) technology allows monitoring in Punch I/O mode - with this the card behaves like a tape machine. This method has been implemented in all versions of Samplitude (by SEK'D), and can be activated using the global track option 'Hardware monitoring during Punch'.

The other solution is to use our ASIO 2.0 drivers with a ASIO 2.0 compatible program. When 'ASIO Direct Monitoring' has been switched on, the input signal is routed in real-time to the output whenever record is started. Of course both methods operate on a per-track basis.

8.4 Analog Record

Use the settings dialog to set the active input to 'Analog' and to activate the line inputs (stereo ¼" TRS jack, wiring diagram see appendix). Two jumpers labelled J2/J3 allow you to change the input sensitivity to the most common levels +4 dBu (jumper pulled) and -10 dBV (jumper in place). A full scale level (0 dBFS) requires +19 dBu respectively +2 dBV analog input level. In most cases the factory default -10 dBV proves to be a good choice, because it is highly compatible to many analog devices.

When doing analog recordings we recommend the clock mode AutoSync, which sets both input and output to the same clock. In clock mode Master the output clock will not automatically follow the input's sample rate.

8.5 Record while Play

DIGI96/8 PST allows the playback of audio data during the recording of further audio data, even at different sample frequencies. This feature, known as *Enhanced Full Duplex* or *Record while play*, is a must for multitrack harddisk recording, but it has to be supported by the recording software.

9. Configuring the DIGI96/8 PST

9.1 General

The hardware of the DIGI96 series includes a number of helpful, well thought-of, practical functions and options, which allow you to configure the behaviour of the card to suit many different requirements. Through 'Settings' you will gain access to:

- Input selection
- Output operation
- Output Channel Status
- Synchronization behaviour
- Input and output status display

The display of the current input frequency and format is updated every 0.5 seconds. When choosing an input with a signal including errors or without any input signal the statement 'No Lock' appears, in vari-speed operation or with sample frequencies widely out of tune 'Out of Range' is shown. If the current signal has SPDIF or AES/EBU format then 'Stereo' is displayed, with ADAT format 'ADAT' is shown.

The three states of the output selected through the choice-box 'Output' control the monitoring behaviour of the card.

'Automatic' sets the normal mode where the input signal reaches the output only whilst recording. In this mode, when starting a recording, feedback occurs very often when using digital mixing desks. 'Play only' solves this problem by making sure that the input signal is never passed to the output.

After selecting 'Input', the input signal appears at the output whenever playback is not active. DIGI96/8 PST saves a continual record standby mode and can switch itself to monitoring without active software. As switching between the inputs is carried out in realtime, stepping through the inputs gives a fast check of the incoming signals.

'Check Input' verifies the sample rate of the input signal (see chapter 8.3). 'Disable DS' deactivates the DirectSound support of the DIGI driver (see chapter 12.2).

Any changes made in the Settings dialog are applied immediately - confirmation (e.g. by clicking on OK or exiting the dialog) is not required. However, settings should not be changed during playback or record if it can be avoided, as this can cause unwanted noises. Also, please note that even in 'Stop' mode, several programs keep the recording and playback devices open, which means that any new settings might not be applied immediately. In general, we recommend disabling 'Audio active in background' (assuming this option is available).

Specific information about the right choice of the output's Channel Status (output format Consumer / Professional) can be found in chapter 11.
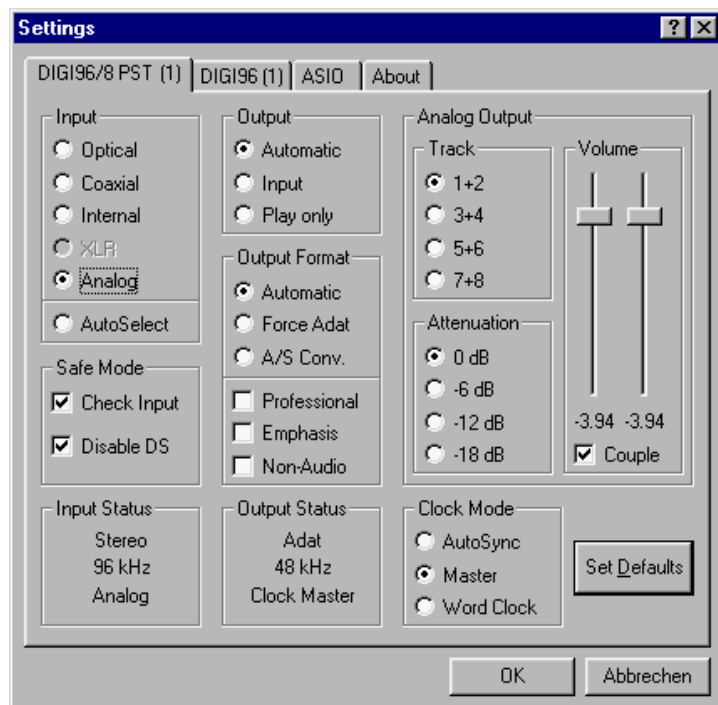
9.2 Analog Output

Whenever the card's output operates in ADAT format the 2-channel analog output will play back one of the four stereo pairs. The desired pair can be selected in the 'Track' field of the Settings dialog.

The analog output level can be set coarse (four 6 dB steps) or fine using the faders in the field 'Volume'. Both methods operate simultaneously and with digital precision. The shown damping values are exactly the ones used. The used technique avoids changes in frequency response and distortion. Only the dynamic range will decrease at higher dampings, as the noise level of the analog output stage remains unchanged.

9.3 Force Adat

The switch 'Force Adat' is a mighty function of the DIGI96/8 series. It forces the digital output into ADAT mode (i.e. 8-channel operation).

When using a 'normal' 2 track program to play or record a stereo file, you're not only able to send the data to any SPDIF device but also to any other ADAT interface! Just activate 'Force Adat' and choose the stereo pair in the device's list box (of the software being used) that corresponds to the channels you want the data being transfered to (for example DIGI96/8 PST (3+4)).

When 'Force Adat' is activated, more than one 2-channel (stereo-) program can access the ADAT interface simultaneously (see chapter 12).

If the software being used requires a continuous ADAT mode, activate the switch 'Force Adat' in the Settings dialog.

☞ *When using ASIO and only one stereo output bus, activated 'Force ADAT' causes the output to operate in ADAT format (see chapter 13).*

When the DIGI is set to pass-through operation (constant monitoring of the input signal by selecting 'Input' mode) it turns into a real-time SPDIF to/from ADAT converter, processed by the hardware without any additional software. Activated 'Force Adat' allows you to use the card as a format converter from SPDIF to ADAT. The stereo signal at the input is copied to all 4 stereo pairs of the output. The switch 'A/S Conv.' forces the card's output into stereo operation. Then the card works as format converter from ADAT to SPDIF. Use the 'Track' buttons to define which one of the 4 stereo input pairs will be routed to the SPDIF output.

☞ *Please note that the NT and 2000 driver have no 'Force Adat' switch. Instead the corresponding mode is activated by using the stereo OR one of the four ADAT wave devices. Therefore the function ADAT from/to SPDIF converter is currently not available.*

9.4 Boot Option ADAT

The jumper JP4, labelled 'Boot ADAT', configures the card's state between power-on of the computer and completed boot of the OS. The card is shipped with the jumper set, thus starting in ADAT mode. This option was introduced because several external devices, especially digital mixing desks like Yamaha's 01V or Spirit's 328 will produce noise when an SPDIF signal is present at their ADAT input.

The other way round will normally not cause any problem, as most SPDIF and AES/EBU input circuits recognize 'wrong' formats and automatically mute the digital audio signal. To start the card in SPDIF mode simply pull off jumper JP4.

9.5 Clock Modes - Synchronization

In the digital world, all devices are either the 'Master' (clock source) or a 'Slave' synchronized to the master. Whenever several devices are linked within a system, there must always be a single master. The DIGI96 series includes a very user-friendly intelligent clock control, which handles the clock switching between master and slave on its own. Click on 'AutoSync' to activate this mode.

In AutoSync mode, the card constantly scans for a valid input signal at the active input. As soon as this matches the current playback sample rate, the card switches from the internal quartz (display 'Clock Master') to the clock generated from the input signal (display 'Clock Slave'). This allows on-the-fly recording, even during playback, without having to synchronize the card to the input signal first. It also allows immediate playback at any sample rate without having to reconfigure the card.

'AutoSync' guarantees a fault-free function of the modes Record, Record while Play and while using more than one card (see chapter 10). In certain cases however, e.g. when the inputs and outputs of a DAT machine are connected directly to the DIGI96/8 PST, AutoSync causes feedback in the digital carrier, so synchronization breaks down. To remedy this, switch the card's clock mode over to 'Master'.

Due to the outstanding clock control and PLL a synchronization of the output signal to the input signal is not only possible at identical sample rates, but also at double/half sample rates.

AutoSync allows multiple cards to be easily synchronized by applying one input signal to all inputs simultaneously (see chapter 10).

Thanks to the described AutoSync technology and a lightning fast PLL the DIGI96 Series is not only capable of handling standard frequencies, but also any sample rate between 25 and 105 kHz. The digital input serves as synchronization source. Please note that at the start of a record or playback a valid sample frequency (32 kHz, 44.1 kHz, 48 kHz, 64 kHz, 88.2 kHz, 96 kHz) has to be fed. When started the sample frequency can be pitched to whatever is needed, DIGI96/8 PST will follow theses changes immediately.

When using the optional Word Clock Module (clock mode 'Word Clock') the word clock input can serve as synchronization source. In vari-speed operation any sample frequency between 25 kHz and 105 kHz is allowed.

Only one device can be master in a digital system! When DIGI96/8 PST operates in clock mode 'Master', all other devices have to be 'Slave'.

More information on these subjects can be found in the HTML document 'sync96.htm', located in the directory **\rmeaudio.web\english\techinfo** on the RME Driver CD, or on our web site.

9.6 Differences under Windows NT / 2000

The NT/2000 driver basically provides the same functions as under Windows 98. But there is one important difference: there is no 'Force Adat' switch. Instead changing between SPDIF (2-channel) and ADAT (8-channel) playback operation is done by using the stereo (DIGI96xx [Slotxx]) or one of the four ADAT wave devices [1+2] to [7+8]. Even if only one of the ADAT devices is used the card immediately switches to ADAT mode. A simultaneous usage of SPDIF device and ADAT devices is not allowed, as the card's operation is restricted to ADAT *or* SPDIF.

10. Using more than one DIGI96/8 PST

The Windows 95/98 and NT driver is able to communicate simultaneously with all the cards registered in the system. The driver marks them with different numbers after the device's name, like 'DIGI96/8 PST In (1)'.

Thanks to our AutoSync technology multiple cards can be synchronized easily by applying one input signal to all inputs simultaneously.

In order to connect more than one DIGI96/8 PST to a digital mixing desk they must all get the same clock(ed input signal). This is easy to achieve: just connect at least one input of each card to one output of the mixing desk.

Example 1: All DIGI's digital inputs are connected to other devices synced to the word clock net.

Activate the corresponding input of each card in its Settings dialog, and activate the mode AutoSync at all cards.

Example 2: Only the outputs of the DIGIs are connected to other devices.

Connect the internal Sync-Out of the master card to the Sync-In (CD-ROM) of the second card, activate its internal input and AutoSync mode. Next connect the third card in the same way, from the second's card Sync-Out to the third's card Sync-In. Configure this card like the second one. The necessary 2-wire cables are the ones supplied with the DIGI cards. Of course this method is also operational with the external connectors, like optical or coaxial, as long as the corresponding input is activated.

A convenient alternative is the test mode of the optional Word Clock Module WCM.

Please note when using more than one card plus the word clock output that only one card can be master!

Example 3: All DIGIs are correctly connected to the Word Clock Module.

Activate the test mode by pushing the test switch, so the red LED lights up. Next activate the mode 'Word Clock' in all card's settings dialogs. Now all cards should show 'Word Clock' in the third line of 'Output Status'.

After activating the test mode all internally connected cards are immediately synchronized, in case clock mode 'Word Clock' was activated in all settings dialogs.

More information on this subject can be found in the HTML document 'sync96.htm', located in the directory **\rmeaudio.web\english\techinfo** on the RME Driver CD, or on our web site.

11. Special Features of the Digital Output

Apart from the audio data itself, digital audio signals in SPDIF or AES/EBU format include a header containing Channel Status information. False Channel Status is a common cause of malfunction. The DIGI96 series ignores the received header and creates a totally new one for the output signal.

☞ *Note that in record or monitor modes, set emphasis bits will disappear. Recordings originally done with emphasis should always be played back with the emphasis bit set!*

This can be done by selecting the 'Emphasis' switch in the Settings dialog. The changes in sound caused by this setting can be monitored in real-time at the analog output jack. At 64, 88.2 and 96 kHz sample rate the analog output does not support De-Emphasis, so no change in sound will be audible.

The DIGI96 series new output header is optimized for largest compatibility with other digital devices:

- 32 kHz, 44.1 kHz, 48 kHz, 64 kHz, 88.2 kHz, 96 kHz, depending on the current sample rate
- Audio use, Non-Audio
- No copyright, copy permitted
- Format Consumer or Professional
- Category General, generation not indicated
- 2-Channel, No Emphasis or 50/15 µs
- Aux bits audio use

☞ *Note that most consumer-orientated equipment (with optical or phono S/PDIF inputs) will only accept signals in 'Consumer' format!*

The status 'Professional' should always be activated when using AES/EBU format (when XLR connectors are used).

The audio bit in the header can be set to 'Non-Audio'. This is necessary when Dolby AC-3 encoded data is sent to external decoders (surround-sound receivers, television sets etc. with AC-3 digital inputs), as these decoders would otherwise not recognize the data as AC-3.

When playing back in multi channel mode (using the optical ADAT interface) the phono connector will be turned off. This prevents sound disturbance by the ADAT signal fed to SPDIF or AES/EBU inputs.

12. Notes on the ADAT Interface

12.1 General

DIGI96/8 PST comes with two different driver methods in one driver. Using channel in-terleave there is only one device, the software in use divides the channels into 8 mono tracks. Because this easy to handle 'Windows native' method is not widely used the DIGI96/8 PST also supports Multi-Device operation. The driver routes the 8 tracks in 4 stereo devices. These 4 stereo devices can be used by nearly any software to record or playback more than 2 channels simultaneously, making DIGI96/8 PST compatible to a wide range of already existing software.

DIGI96/8 PST includes an intelligent hardware controller for ease of use. Whenever mo-re than 2 channels are used, no matter with record, playback or both, the card switches into ADAT mode. Whenever an ADAT signal is present at the optical input the settings dialog of the DIGI96/8 PST indicates 'ADAT 44.1 kHz' or 'ADAT 48 kHz'. If now the output function is set to 'Input' while AutoSync is active the card's output changes to ADAT mode to allow input monitoring of up to 8 channels. The analog output allows you to listen to any of the four stereo pairs. The desired pair can be selected in the 'Track' field of the Settings dialog.

If the software being used requires a continuous ADAT mode activate the switch 'Force Adat' in the Settings dialog.

When using a 'normal' 2 track program to play or record a stereo file, you're not only able to send the data to any SPDIF device but also to any other ADAT interface! Just activate 'Force Adat' and choose the stereo pair in the device's list box (of the software being used) that corre-sponds to the desired channels (for example DIGI96/8 PST (3+4)).

In SPDIF mode it doesn't matter which stereo device is being used. At activated 'Force Adat' it's also possible to use the 4 stereo pairs with different programs. A typical example would be to play back six channels from a harddisk recording program, and simultaneously use a real time synthesizer software on the two remaining channels.

The internal Sync-In and Sync-Out may be used with the included 2-core cable to daisy chain the cards inside the PC (Sync-Out from one card to Sync-In of the next card). To synchronize the cards all except the master (the 'first' card) have to be switched to 'Internal' input. Although this is an interesting possibility (restricted to playback usage, when no AD-converters are available) it will not be used very often. Normally the optical signals are send out synchronized from an external device like a digital mixing desk or ADAT recorders, the cards all set to 'opti-cal input' and 'AutoSync'. So an internal sync is not necessary in this mode.

12.2 Multi Channel Direct Sound

The Windows 95/98 driver of the DIGI96 series supports Direct Sound. Due to compatibility reasons Direct Sound is de-activated by default. To activate the Direct Sound support un-check 'Disable DS' in the Settings dialog.

Additionally the driver offers multi-device Direct Sound. This mode is not officially supported by Windows 95/98, but works perfectly for example with **BPM-Studio**. In this mode DS/ASIO/MME/GSIF can be used simultaneously, as long as different channels are assigned to each driver format. Only the combination ASIO/MME is not supported.

☞ *The multi-device mode for DirectSound requires 'Force ADAT' to be set in the Settings dia-log!*

The DIGI96 series requires identical formats when used in multi-client operation! All programs simultaneously accessing the DIGI MUST use the same sample rate and bit resolution.

13. Operation under ASIO 2.0

13.1 General

As Steinberg is the inventor of ASIO we have chosen Steinberg's Cubase VST as example on how to use and setup our cards in ASIO operation.

Our ASIO driver supports any combination of cards from the DIGI96 series. Important: Multiple cards MUST be synchronized among themselves! This may be done by using the input signal (having a common clock source, for example a digital mixing desk), several synchronized ADATs or the RME Word Clock Module.

Start the ASIO application, go to ASIO/System and choose the device 'ASIO DIGI96 Series'. The button 'ASIO system control' directly starts the Settings dialog of the DIGI96 series (see chapter 9).
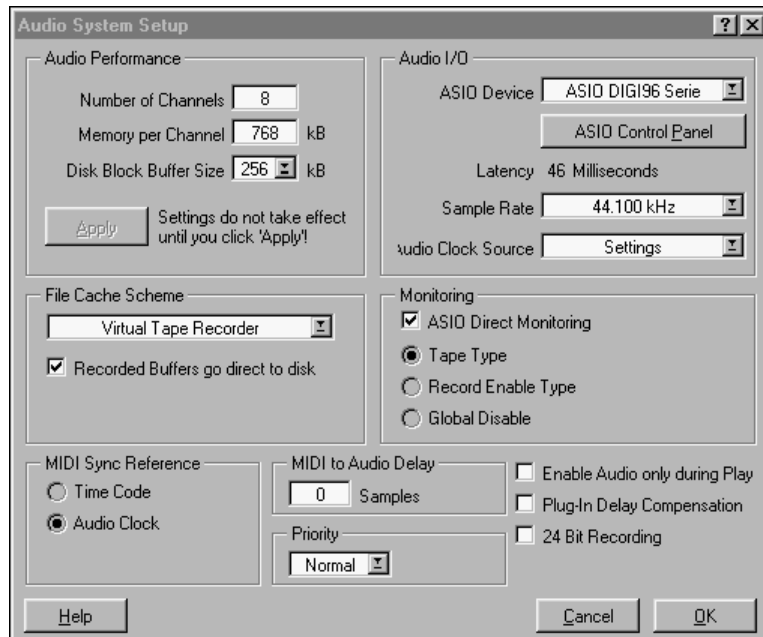
Switching between SPDIF (2 channel) and ADAT (8 channel) is done in the same way as in Windows 98's MME drivers. With this a very easy and convenient method is realized.

Playback: When using more than 2 tracks (Master bus plus at least one other) the card switches into ADAT mode. Simply activate 'Force Adat' in the settings dialog in case the ADAT format is desired when playing back only 2 tracks.

Record: The card automatically recognizes ADAT or SPDIF signals and immediately switches into the corresponding mode. It doesn't matter how many inputs are activated. When more than one input is active and a SPDIF signal is present at the input this (stereo) signal will be routed to input 1+2.

Mixed Mode: Because of the extended ASIO driver concept it is possible to record from a SPDIF source while playing back in ADAT format and vice versa (Mixed Mode). Under certain configurations sync problems might occur, which make it neccessary to use an external word clock for all participating devices.

The Enhanced Zero Latency mode of the DIGI96 series enables the 'ASIO Direct Monitoring' feature of the ASIO 2.0 standard to be used. Please note that in this mode neither routing nor pan are supported so the input signals will only be routed to the same output channel. Other VST mixer settings have no effect.

13.2 Buffer Size - Latency

The Buffer Size value in the RME DIGI Settings dialog determines the latency (in this case the delay) between the audio application and the DIGI96 series as well as general system stability. The higher the value, the more tracks can be recorded and played back simultaneously, and the longer the system takes to react.

In RME DIGI Settings, ASIO, 4 different buffer sizes are available: 6 ms 24 bit, 11 ms 16 bit, 23 ms 24 bit and 46 ms 16 bit.

There is a simple relationship between the resolution of the ASIO host (Cubase etc.) and the driver. If one of both is set to 16 bit the resolution is limited to 16 bit. Bits 17 to 24 will be truncated. So when the driver uses 16 bit and Cubase is set to 24 bit only 16 bit will be transferred to Cubase. When the driver uses 24 bit and Cubase is set to 16 bit, the additional information in bits 17 to 24 will be lost. As the real latency depends on the used sample rate the values are different for different sample rates:

Choice	Buffer size	Resolution	44.1 kHz	48 kHz	88.2 kHz	96 kHz
46 ms/16 bit	2048 s	16 bit	46.4 ms	42.7 ms	23.2 ms	21.3 ms
23 ms/32 bit	1024 s	32 bit	23.2 ms	21.3 ms	11.6 ms	10.7 ms
11 ms/16 bit	512 s	16 bit	11.6 ms	10.7 ms	5.8 ms	5.3 ms
6 ms/32 bit	256 s	32 bit	5.8 ms	5.3 ms	2.9 ms	2.7 ms

Please note that the given latency describes only one way. The complete path through the computer (record plus playback, monitoring) gives double values.

The mode 6 ms often causes crackling and drop outs when used with harddisk based recording, but operates flawlessly when using realtime Synthesizers or pure signal processing (Live Input mode). 11 ms are only recommended in 2 channel operation. Else we STRONGLY recommend to use 46 ms to achieve the highest reliability and security in operation. The 24 bit modes should only be used when really needed, as they not only halve the buffer size (see above), but also produce a higher system load and less reliable system behaviour.

13.3 Known problems

In case the used computer has no sufficient CPU-power and/or sufficient PCI-bus transfer rates, then drop outs, crackling and noise will appear. We also recommend to deactivate all PlugIns to verify that these are not the reason for such effects.

Unfortunately some newer UltraATA66 and UltraATA100 hard disk controller (also Raid controller) seem to violate against the PCI specs. To achieve the highest throughput they hog the PCI bus, even in their default setting. Thus when working with low latencies heavy drop outs (clicks) are heard. Try to solve this problem by changing the default setting of the controller (for example by reducing the 'PCI Bus Utilization').

Another typical source of trouble is wrong synchronization. ASIO does not support asynchronous operation. This means input and output signal must not only have the same sample frequency, but must also be 'in sync' for error-free Full Duplex operation.

As shown in the above table an operation of ASIO at 96 kHz/24 bit will rsult in very small latencies/buffer sizes. This may cause drop outs or clicks on slower computers. Please change to the 'ASIO Multimedia' driver in such a case.

According to our tests single CPU systems running Windows 2000 show lower performance than a standard Windows 98 PC. Especially the graphics operation (screen redraw etc.) results in drop outs at latencies below 46 ms. This problem is not found on dual CPU systems.

14. Operation under GSIF (Gigasampler Interface)

Since driver version 4.93 the Windows 98 driver of the DIGI96 series includes a GSIF interface, providing direct operation with Gigasampler/Studio at up to 8 channels, 96kHz and 24bit.

☞ *In case more than 2 channels shall be used under GSIF, activate 'Force ADAT' in the Settings dialog before starting the software.*

Additionally the driver supports multi-client operation. For example ASIO can use channels 1/2 and Gigasampler (with GSIF) channels 3/4 simultaneously. Unfortunately such an operation is disappointing even with an 800 MHz CPU. Gigasampler/Studio requires a lot of the computers calculation power. An optimum performance is achieved with a stand-alone GSIF PC. Else we recommend not to use the DIGI96 ASIO driver, but the ASIO Multimedia driver. This one can be set to much higher latencies (i.e. 750 ms), thus providing a problem-free simultaneous operation of ASIO and Gigastudio. Gigastudio itself will still work at a very low latency.

☞ *The DIGI96 series requires identical formats when used in multi-client operation! All programs simultaneously accessing the hardware MUST use the same sample rate and bit resolution. Otherwise de-tuned sound or no sound at all will be heared.*

Additional simultaneous operation of GSIF and ASIO requires to use different channels. As Cubase VST always uses tracks 1/2 these tracks must not be activated in Gigastudio/Sampler. The tracks activated under GSIF have to be de-activated in ASIO.

Please note that the ASIO Multimedia driver will use the maximum bit resolution by default. If bit resolution of Gigasampler/Studio and other programs do not match, audio output will be stopped, until the settings match and a reset is initiated ('Reset Devices' or software restart).

15. DIGICheck: Analysis, Test and Measurements using the DIGI96 series

The DIGI96 series from RME is accompanied by a world wide unique software tool: DIGICheck, the incredible utility for test, measure and analysis of the digital audio data stream.

DIGICheck is based on functions of our well-known DAM-1, the **D**igital **A**udio **M**onitor. This device uses a built-in DSP for its calculations. Therefore DIGICheck is not able to realize all the functions of the DAM-1. Additionally the DAM-1 works perfectly in the background while DIGICheck will cause a certain CPU load.

DIGICheck also includes test routines from our research lab and our production site. Thus you are able for the first time to run a detailed function and performance test with your own audio card in your own computer, like it isn't possible with any other test tool.

Although the DIGICheck software is fairly self-explanatory, it still includes a comprehensive online help. A detailed description of all functions and the technical background is also available in HTML format (digich.htm, in the **\techinfo** directory on the RME Drivers CD or from our website). The following is a short summary of the available functions:

- **Level Meter**. High precision 24-bit resolution, 2/8 channels. Application examples: Peak level measurement, RMS level measurement, Over detection, phase correlation measurement, dynamic range and signal-to-noise ratios, RMS to peak difference (loudness), long term peak measurement, input check
- **Channel Status Display**. Shows the channel status information contained in the digital audio data stream. Sample rate measurement
- **Bit Statistics**. Shows the true resolution of audio signals as well as errors and DC offset
- **Performance Test**. Measurement of the PCI-bus data transfer
- **Memory Test**. Tests the on board SRAM and the entire data path in the PC

To install DIGICheck, go to the **\digichck** directory on the RME Drivers CD and run *setup.exe*. Follow the instructions prompted on the screen.

16. Soft- and Hardware Compatibility

The DIGI96 series is fully compatible with PCI-bus version 2.0 and 2.1. The DIGI96 series is continously tested by us to be compatible with all known audio software. As far as we are aware, the DIGI96 Series digital inputs and outputs are fully compatible with all devices with S/PDIF or AES/EBU interfaces.

The NT and 2000 driver support dual processor boards.

The Windows drivers include a special optimization for Pentium Pro/II/III and Celeron (MTRR register). This optimization boosts the data transfer rate up to four times which can be prooved using the supplied program DIGICheck.

More information and frequently asked questions can be found in the HTML document 'faq96e.htm', located in the directory **\rmeaudio.web\english\faq** on the RME Driver CD.

17. Troubleshooting

In case the message box 'New Hardware Component found' does not appear, or the driver can´t be installed under NT:

- Is the Error LED of the DIGI96/8 PST lit when no cable is connected to the optical input? If not, the card is either defect or not sitting properly in the slot.

When the card and the driver have been properly installed but no playback is possible:

- Check that the DIGI96/8 PST appears correctly in the Device Manager. If the device 'DIGI96/8 PST' is marked with a yellow exclamation mark then either an address conflict or an IRQ conflict is present.
- If no yellow exclamation mark is present check the 'Resources' tab.
- Check that the DIGI96/8 PST has been set as 'transmitting device' in the software. Also check the settings under >Settings /Control Panel /Multimedia /Advanced<. Here the DIGI96/8 PST must appear as an audio device when it´s been correctly installed, and can be set as the *Preferred Device* under 'Audio'.

Playback works but recording doesn´t:

- Check that a valid input signal is at hand. In this case the Error LED on the hardware turns off, and the current sample frequency is shown under 'Settings'.
- If you are sure that a valid signal is being sent but the LED is still red, then check the currently selected input in the Settings dialog.
- Check whether the DIGI96/8 PST has been selected as recording device in the audio application.
- Check whether the sample frequency set in the audio application ('Recording properties' or similar) matches the input signal.
- Check that there is no loop cabling present. If so set 'Clock Mode' to 'Master'.

The recording or the playback is disturbed by crackling:

- Increase the quantity and size of the buffers in the software being used.
- Use a different cable (coaxial or optical) to cross-check them for defects.
- Check that there is no loop cabling present. If so set 'Clock Mode' to 'Master'.
- In case of loop cabling with an ADAT we recommend to use the ADAT as master (Int) and the DIGI as slave (AutoSync).
- Increase the buffer size of the hard disk cache (example: from 64 kB to 256 kB).
- Activate Busmaster mode for the hard disks. Windows: Device Manager, double-click on 'Disk drives', then on the required hard disk(s). Select 'DMA' in the Properties dialog.

The computer crashes whenever the DIGI96/8 PST is accessed:

- If your graphics board is an older Matrox Mystique or uses a '968' S3 chip, there could be a memory allocation error. Change the memory area allocated to the DIGI96/8 PST (via Control Panel /System /Device Manager /DIGI968 PST /Properties /Resources /Change Setting) to *below* the area used by the graphics board (e.g. D0000000 - D0FFFFFF). Detailed information on this subject can be found in **\rmeaudio.web\techinfo\install.htm** on the RME Driver CD.

ASIO under Windows 2000 suffers from drop outs at low latencies:

- According to our tests single CPU systems running Windows 2000 show lower performance than a standard Windows 98 PC. Especially the graphics operation (screen redraw etc.) results in drop outs at latencies below 46 ms. This problem is not found on dual CPU systems.

18. Installation problems

More information on installation problems (which fortunately are very seldom, thanks to Plug and Play), can be found in the Tech Info 'Installation problems DIGI32/96 series', located in the directory **\rmeaudio.web\techinfo** on the RME Driver CD**.**

The card's entry is normally found in the Device Manager (>Settings/Control Panel/System<), in the category 'Sound-, Video- and Gamecontroller'. A double click on 'DIGI96/8 PAD' starts the properties dialog. Choosing 'Resources' shows Interrupt and Memory Range.

19. TECH INFO

RME provides more and very detailed information regarding the DIGI96 series on the TECH INFO pages in the web (http://www.rme-audio.com/techinfo/index.htm), and on the RME Driver CD in the directory **\rmeaudio.web\techinfo**. At the time of writing, the following *Tech Info* is available:

Synchronization II (DIGI96 series)
Digital audio synchronization: technical background, problems

Problems with Installation
..and their solutions

List of Driver Updates
Lists all driver updates and the changes in them

TMS (Track Marker Support)
Description of the TMS technology to transfer CD- and DAT information.

Configuration of Samplitude, Cubase and Logic using DIGI32/96 series
Configuration of Cakewalk 7.0 and SAWPlus32 using DIGI32/96 series
Step by step instructions

DIGICheck: Analysis, tests and measurements with the DIGI96 series
A description of DIGICheck, including technical basics.

ADI-1 Inside
Interesting technical description of our 20 bit 2-channel AD/DA converter

ADI-8 PRO Inside
Interesting technical description of our 24 bit 8-channel AD/DA converter

20. Warranty

Each individual DIGI96/8 PST undergoes comprehensive quality control and a complete test in a PC environment at RME before shipping. This may cause very slight signs of wear on the contacts (if the card looks like it was used one time before - it was). The usage of high grade components allows us to offer a full two year warranty. We accept a copy of the sales receipt as valid warranty legitimation.

RME's replacement service within this period is handled by the retailer. If you suspect that your card is faulty, please contact your local retailer. The warranty does not cover damage caused by improper installation or maltreatment - replacement or repair in such cases can only be carried out at the owner's expense.

RME does not accept claims for damages of any kind, especially consequential damage. Liability is limited to the value of the DIGI96/8 PST. The general terms of business drawn up by Synthax OHG apply at all times.

21. Appendix

RME news, driver updates and further product information are available on our website:
http://www.rme-audio.com

If you prefer to read the information off-line, you can load a complete copy of the RME website from the RME Driver CD (in the **\rmeaudio.web** directory) into your browser.

Distributor in Germany:
Synthax, Am Pfanderling 62, D-85778 Haimhausen, Tel.: (49) 08133 / 91810

Manufacturer:
Ingenieurbuero Mueller, Goethestr. 22, D-09648 Mittweida

Trademarks

All trademarks and registered trademarks belong to their respective owners. RME, DIGI96, SyncAlign and ZLM are registered trademarks of RME Intelligent Audio Solutions. SyncCheck is a trademark of RME Intelligent Audio Solutions. Alesis and ADAT are registered trademarks of Alesis Corp. ADAT optical is a trademark of Alesis Corp. Microsoft, Windows, Windows 98/NT/2000 are trademarks of Microsoft Corp. Apple and MacOS are registered trademarks of Apple Computer Inc. Cubase and VST are registered trademarks of Steinberg Soft- und Hardware GmbH. ASIO is a trademark of Steinberg Soft- und Hardware GmbH. emagic and Logic Audio are registered trademarks of emagic Soft- und Hardware GmbH. Pentium is a registered trademark of Intel Corp.
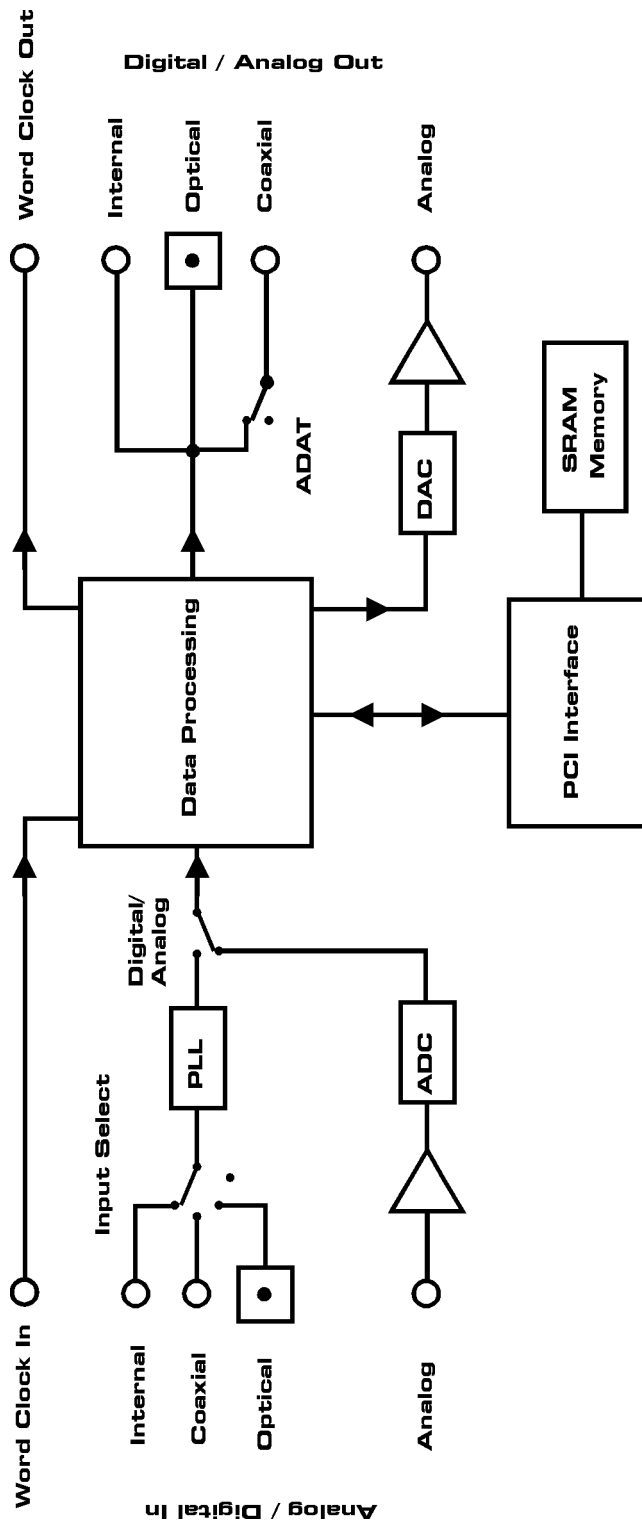
Analog input and output: Pin assignment of the TRS jacks

Analog input and output are accessible through stereo ¼" TRS jacks. This allows a direct connection of headphones at the output. In case the output should operate as line out an adapter TRS plug to RCA phono plugs, or TRS plug to TS plugs is required.

The pin assignment follows international standards. The left channel is connected to the tip, the right channel to the ring of the TRS jack/plug.

Block diagram

The block diagram shows the signal flow of the DIGI96/8 PST. On the output side (top): Word Clock Out, and under "Digital / Analog Out" — Internal, Optical, Coaxial (with ADAT switch) and Analog (through DAC and amplifier). On the input side (bottom): Word Clock In, and under "Analog / Digital In" — Internal, Coaxial, Optical (Input Select via PLL, Digital/Analog) and Analog (through amplifier and ADC). Central blocks: Data Processing, PCI Interface, and SRAM Memory.

CE

This device has been tested and found to comply with the limits of the European Council Directive on the approximation of the laws of the member states relating to electromagnetic compatibility (EMVG) according to EN 55022 class B and EN50082-1.

FCC Compliance Statement

Certified to comply with the limits for a Class B computing device according to subpart J or part 15 of FCC rules. See instructions if interference to radio reception is suspected.

FCC Warning

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This device complies with part 15 of FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference
2. This device must accept any interference received, including interference that may cause undesired operation.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna
• Increase the seperation between the equipment and receiver
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
• Consult the dealer or an experienced radio/TV technician for help.

In order for an installation of this product to maintain compliance with the limits for a Class B device, shielded cables must be used for the connection of any devices external to this product.